

GE Industrial Systems

Electromechanical Products Catalog

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GE Protective Relays

Product Catalog

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RELAY TYPE	DESCRIPTION	SECTION
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BFC	Inst. O.C., Harm, Rest.	2
CAP	Power Directional	4
CCP	Power Directional	4
CEB	Phase Offset MHO Distance	3
CEH	Loss of Excitation	9
CEX57	Angle Impedance	9
CEY	Phase MHO Distance	3
CEY	Phase Distance Overcurrent	3
CEYG	Ground MHO Distance	3
CFC	Inst. Overcurrent	4
CFD	Machine Differential	5
CFV	Inst. Overvoltage	10
CFVB	Voltage Balance	10
CFW	Over- and Underpower	4
CHC	Inst. Overcurrent	2
CJC	Phase Directional Overcurrent	4
CJCG	Ground Directional Overcurrent	4
CLPG	Carrier Ground	3
GCXG	Step Ground distance	3
GCX	Phase Reactance Distance	3
GCXY	Phase Reactance, MHO Distance	3
GCY	Phase MHO Distance	3
GGP	Sensitive Power Directional	9
GSY51	Gen. Out of Step	9
HAA	Annunciator Auxiliary	6
HEA	Auxiliary Lockout	6
HFA	Multicontact Auxiliary	6
HFC	Instantaneous Overcurrent	2
HGA	Auxiliary	6
HGA 18	Reclosing	7
HMA	Auxiliary	6
HSA	Auxiliary Lockout	6
IAC	Time Overcurrent	2
IAV	Time Over- Undervoltage	10
IBC	Phase Directional Overcurrent	4
IBCG	Ground Directional Overcurrent	4
IBCVB	Directional Overcurrent, Voltage Rest.	4
ICR	Undervoltage & Phase Seq.	10
ICW	Time Overpower	4
IFC	Time Overcurrent	2
IFCS	Time Overcurrent with Voltage Control	9
IFCV	Time Overcurrent with Voltage Restraint	9
IFD	Transformer Differential	5
IFV	Time Overvoltage	10
IJC	Current Balance	2
IJD	Machine Differential	5
IJF	Frequency	10
IJS	Synchronism Check	8
JBC	Phase Directional Overcurrent	4
JBCG	Ground Directional Overcurrent	4
JBCV	Dir. Overcurrent, Volt Rest.	4
NAA	Auxiliary for Pilot and Distance Relaying	3
NBD	Bus Differential	5
NBV	Voltage Balance	10
NGA	Auxiliary	6
NGV	Instantaneous Voltage	2
NLR	Reclosing	7
PJC	Instantaneous Voltage	10
PJG	Machine Field Ground	9
PJV	Over- Undervoltage	10
PVD	Bus Differential	5
SAM	Static Timing	5
SBC23	Static Breaker Backup, Drawout	2
SBC31	Static 3 Phase Overcurrent	2
SBC53	Static Breaker Backup, Rack Mtd.	2
SBD	Static Bus Differential	5
SCA	Static Dirt. Comparison Blocking Aux.	3
SFF	Static Underfrequency	10
SGC	Static Negative Sequence Overcurrent	9
SLJ	Static Synch. Check	8
SLY	Static Phase Distance	3
SLYG	Static Ground Distance	3
STA	Static Transformer Auxiliary	2
STD	Static Trans. Diff.	5
STV	Static Volts/Hertz	10
TOV	Modular Voltage	10
XCA	Test Probes for “C” Case	11
XLA	Test Plug for “A” Case	11
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TABLE A
Relays and Control Switches Qualified to Meet M&CBD's Interpretation of IEEE 323-1974

Devices

HEA61A
HEA61B
HEA61C
HEA61BA

HFA151A( )F
HFA151A( )H
HFA151B( )F
HFA151B( )H

HFA154B( )F
HFA154B( )H
HFA154E( )F
HFA154E( )H

HFC21B( )A
HFC23C( )A

HGA111A
HGA111A( )F
HGA111J

HMA111A
HMA111B

HSA11A
HSA11B
HSA11C

IAV53L( )A
IAV55C( )A

IFC51AD( )A
IFC51BD( )A
IFC53AD( )A
IFC53BD( )A
IFC66AD( )A
IFC66BD( )A
IFC66KD( )A
IFC77AD( )A
IFC77BD( )A
IFC95AD( )A
IFC95BD( )A
IFCV51BD( )A

IJD52A( )A
IJD53C( )A

IJF51A( )A

NGV11B( )A
NGV13B( )A
NGV18A( )A
NGV21B( )A
NGV29A( )A

PVD21B( )A
PVD21D( )A

SAM11B( )A

SFF31A( )A
SFF31C( )A
SFF31D( )A
SFF32C( )A
SFF201B( )A
SFF202B( )A
SFF204B( )A

SLV11A( )A

STD15D( )A
STD16C( )A

Switches**
SBM Switch
SB-1 Switch
SB-9 Switch
SB-10 Switch

****Notes:**

- SB-1 and SB-9 switch qualification covers standard single switches with a maximum of 32 contacts and SB-10 switches up to 10 stages. Switches with palladium contacts, locking handles and standard pull-to-lock construction are also qualified. SB-9 Tandem switches gear operated with two or three banks are also qualified.
- SBM switch qualification covers standard single switches with a maximum of 20 contacts. Locks, palladium contacts or Tandem arrangements are not available.
- All qualifications cover switches that require removable handles, but does not qualify a part such as a removable handle that must be purchased as a separate part.

TABLE B
Accessories Qualified to Meet IEEE 323-1974

Note: These accessories (Table B) are commercial grade items which will be supplied from warehouse stock. Orders which stipulate 10CFR21 will not be accepted.

EB-25 Terminal Boards
EB-26 Terminal Boards
EB-27 Terminal Boards
ET16/ET17 Indicating Lights
PK-2 Test Block
EB-1 Terminal Boards

List of UL Recognized Devices

GE Protective Relays

The following devices are UL recognized. The letters in the "Ref." columns refer to the UL Product Category Codes and Manufacturer's File Number. These category codes and file numbers locate the recognized devices in the "UL Recognized Component Directory."

RELAYS

Relay Number	Ref.	Relay Number	Ref.	Relay Number	Ref.
CFD12	A	IAV51-55	B	JBC54	B
CFD22		IAV57		JBC77-78	
CFD99		IAV60		JBC99	
CHC11-13		IAV63		JBCG51-54	
CHC15		IAV69		JBCG61	
CHC21		IAV70-74		JBCG63	
CHC99		IAV99		JBCG77-78	
CPD11		IBC51-56		JBCG99	
CPD99		IBC77-78		MDP201*	
DDP		IBC99		NGA15	
DGP*		IBCG51-56		NGA18-19	
HAA11-19		IBCG77-78		NGA99	
HEA61-63		IBCG99		NGV11-13	
HEA99		ICR51		NGV15	
HFA51		ICR53-54		NGV17	
HFA53-54		ICR99		NGV19	
HFA60		ICW51-54		NGV21-23	
HFA65-66		IFC51-62		NGV25-27	
HFA151		IFC66-68		NGV99	
HFA153-154		IFC70		PJC11-15	
HFC21-23		IFC73		PJC18-21	
HGA11		IFC76-81		PJC25	
HGA14-17		IFC85		PJC32	
HGA26		IFC90		PJC99	
HGA33-35		IFC95		PJV11-12	
HGA111		IFC99		PJV14	
HGC11		IFCV51		PJV17-19	
HGC99		IFV51		PJV99	
HMA11		IJC51-53		SAM11	
HMA14		IJC99		SAM13-18	
HMA24-25		IJD51-53		SAM99	
HMA111		IJF51-52		SAM201-207	
HMA124-125		IJF99		SAM299	
IAC51-62		IJS51-52		SBD11	
IAC66-68		INC51		SBD99	
IAC70		INC77		SFC151-154	
IAC73		INC99		SFC177-178	
IAC76-81	B	IRT51		SFF201-202	
IAC85		IRT53		SFF204	
IAC90		IRT99		SFF299	
IAC95		JBC51		THC30	
IAC99				THC99	

Device	Description	Ref.
EB-1, 2, 4, 5	Terminal Board	C
EB-25, 26, 27	Terminal Board	C
ET-5, 6, 16, 17	Indicating Light	A
PK-2	Test Blocks and Plugs	B
SB-1, 9, 10	Switch	A
SBM	Switch	A

Reference Letter	UL Product Category Code	GE File Number
A	NKCR2	E53795(M)
B	NRGU2	E57838(M)
C	XCFR2	E60617

*Planned for 1994 completion

Application Cross Reference

GE Protective Relays

The following cross reference is intended to illustrate GE Relays that approach functional equivalance to the listed counterparts. For specific application guidance, consult the factory.

ABB (W)	GE
AR	SBA
ARS	SBA
BL-1	THC, TMC
CA	IJD52A, IJD53C
CA-16	IFD52B
CA-26	IFD51D
CF-1	IJF51
CM	IJC51E
CO-2	IFC95
CO-4	IAC66S, IAC66T
CO-5	IFC66
CO-6	IFC51
CO-7	IFC51
CO-8	IFC53
CO-9	IFC53A
CO-11	IFC77
COD	IAC59C
COM-5	IFC66K
COM-6	IFC51B
COM-7	IFC51B
COM-8	IFC53B
COM-11	IFC77B
COQ	SGC21
COV-5	IFCV
COV-6	IFCV
COV-7	IFCV
COV-8	IFCS
COV-8	IFCV
COV-9	IFCV
COV-11	IFCV
CP	ICR53
CR	IBC53M
CR-6	IBC51M
CR-7	IBC51M
CR-8	IBC53M
CR-9	IBC53
CR-11	IBC77M
CRC-6	IBCG51M
CRC-7	IBCG51M
CRC-8	IBCG51M
CRC-9	IBCG53M
CRC-11	IBCG77M
CRD-6	IBCG51M
CRD-7	IBCG51M
CRD-8	IBCG53M
CRD-9	IBCG53M
CRD-11	IBCG77M
CRN-1	ICW51, GGP53
CRP-6	IBCG51M
CRP-7	IBCG51M
CRP-8	IBCG53M-Y1A
CRP-9	IBCG53M
CRP-11	IBCG77M
CT	IRT
CV-1	IAV54F
CV-2	IAV54F,IAV55C
CV-5	IFV51A
CV-5	IAV52B
CV-6	IAV70A
CV-7	IAV53K
CV-8	IFV51D, IFV51K
CV-21	IAV74A
CV-22	IAV74A
CV-24	IFV71,IAV72

ABB (W)	GE
CV-25	IFV71B
CV-26	IAV73A,IAV73B
CV-27	IAV73A,IAV73B
CVD	IAV69B
CVE	IJS52A,IJS51A
CVE-1	IJS52
CVE-2	IJS52E,F,G
CVQ	NBV11+IAV54
CW	ICW51B
CWD	ICW52A,ICW53A
DGF	PJG12B
DRC-1	SLR12A
DT-3	IRT51F
H-3	CAP15A
HCB	SPD
HRU	BFC11A
HU	STD15
HU-1	BDD16B
HU-4	STD17C
HV-4	STD17C
IRC-6	JBCG51M, MLCG
IRC-7	JBCG51M, MLCG
IRC-8	JBCG53M, MLCG
IRC-9	JBCG53M, MLCG
IRC-11	JBCG77M, MLCG
IRD-6	JBCG51M, MLCG
IRD-7	JBCG51M, MLCG
IRD-8	JBCG51M, MLCG
IRD-9	JBCG53M, MLCG
IRD-11	JBCG77M, MLCG
IRD-61	JBCG51M, MLCG
IRD-71	JBCG51M, MLCG
IRD-81	JBCG51M, MLCG
IRD-91	JBCG53M, MLCG
IRP-6	JBCG51M, MLCG
IRP-7	JBCG51M, MLCG
IRP-8	JBCG53M, MLCG
IRP-9	JBCG53M, MLCG
IRP-11	JBCG77M, MLCG
IRV-6	JBC51M
IRV-7	JBC51M
IRV-8	JBC53M
IRV-9	JBC53M
IRV-11	JBC77M
ITH	HFC21B,HFC23C
JM	HAA
KA	SCA
KA-4	SCA52A
KA-16	IFD52B
KAB	PVD21
KC-2	CHC12A
KC-4	CHC21A
KD-10	CEY51A
KD-11	CEB52A
KDTG	CEYG51A
KDXG	GCXG51,GCXG53A
KF	SFF201
KH	CFW11E
KLF	CEH51A
KLF-1	CEH
KO-1	CHC11
KO-3	CHC21
KRC	CJCG16M
KRD	CJCG16M

ABB (W)	GE
KRD-4	CLPG12C, MLPG
KRD-5	CLPG12C, MLPG
KRP	CJCG16M
KRT	NAA15+SAM14
KRT-1	NAA15+SAM14
KRV	CJC15E
KS	CEB51A
KST	GSY51A
KV-1	CFV16
LC-1	PVD21 W/ CT'S
LC-2	PVD21 W/ CT'S
LCB	DLS
LDAR	DLP,PLS,TLS
MDAR	DLP
MG-6	HFA 51A,71A
MG-6	HFA 54H,74H
PM-1	SPA
PM-2	SPA11
PM-3	SPA12
PMA	SPA
PMG-13	SPA
POQ	SGC
RC	NLR
RCD	NLR21
S1	SBC223
SA-1	CFD22A
SBFU	SBC53
SC	PJC
SC-1	PJC
SC-11T	SFC177B
SC-7T	SFC151B
SC-8T	SFC153B
SC-9T	SFC153B
SCO	SFC
SD-2	CEY52,CEB52
SDB	CEX57
SDF-1	SFF201
SDG	SLYG81A,SLYG82A
SG	HGA
SG-2	HGA11N
SGR-1	HGA18
SGR-12	NSR21G
SGR-51	NSR21E
SGR-52	NSR21G
SKD	SLY
SOQ	SGC21B
SP	SLY
STU-12	NAA
SV	NGV13B,PJV11A
SV-1	PJV11A
SVF	HGA14BH
TD-2	SAM202
TD-4	SAM204
TD-5	SAM201,SAM205
TD-50	SAM205
TD-52	SAM203
TD-53	SAM201, SAM202
TG-1	HGA-17
TR	HGA
TR-1	HAA15A
TRB	102L218G8
TT	NAA
WL	HEA

Application Cross Reference

GE Protective Relays

ABB (BBC)	GE
DPU	DDP
ITE-25S	IJS51
ITE-25V	IJS52D,IJS52E
ITE-27	IAV
ITE-27B	PJV
ITE-27H	NGV,SLV
ITE-27S	PJV
ITE-32	CAP,CCP
ITE-32&50	CJC
ITE-32&51	IBC,JBC
ITE-32D&50	CJCG
ITE-32D&51	IBCG,JBCG
ITE-32Q&50	CNP
ITE-32R	ICW
ITE-40	CEH
ITE-46D	IJC
ITE-46Q	SGC
ITE-47	ICR
ITE-47H	CFV
ITE-49	TMC
ITE-49T	IRT
ITE-50	PJC
ITE-50R+50D	BFC
ITE-51	IAC66M

ABB (BBC)	GE
ITE-51E	IAC77,IFC77
ITE-51I	IAC51,IFC51
ITE-51IM	IAC66A,IAC66B
ITE-51S	IAC55
ITE-51Y	IAC53,IFC53
ITE-51+50D	IAC66K,IAC66T
ITE-59	IAV
ITE-59F	STV
ITE-59G	IAV51D,IAV51K
ITE-59H	NGV,PJV
ITE-59N	NGV,PJV
ITE-60	CFVB
ITE-60Q	NBV+SAM
ITE-62L	SAM
ITE-62T	SAM
ITE-64F	PJG
ITE-79M	ACR
ITE-79M	MLR,SLR
ITE-79S	HGA18,NSR
ITE-81	IJF,SFF
ITE-87B	PVD,SBD
ITE-87M	CFD
ITE-87T	BDD,STD

BE	GE
BE1-24	STV
BE1-25	IJS,SLJ
BE1-27	CFV,IAV,IFV,NGV,ICR
BE1-27/59	IAV
BE1-32	CAP,CCP,CFW,GGP,ICW
BE1-40Q	CEH
BE1-46N	IJC,SGC
BE1-47N	ICR,NBV
BE1-49	IRT
BE1-50	CHC,HFC,PJC,SBC
BE1-50BF	CHC,SBC
BE1-51	IAC,IFC,SFC,MDP
BE1-51/27C	IFCS
BE1-51/27R	IFCV
BE1-59	CFV,IAV,IFV,NGV,PJV
BE1-59N	CFV,IAV,IFV,NGV,PJV
BE1-60	CFVB,NBV
BE1-67	IBC,IBCG,JBC,JBCG
BE1-79M	NLR,SLR
BE1-79S	HGA18,NSR
BE1-81	IJF,SFF
BE1-87G	CFD,IJD
BE1-87T	BDD,STD,IJD

GEC/A	GE
LFCB	DLS
LFDC	PLS,TLS
LFZP (OPTIMHO)	DLP,TLS,TYS3
SHNB (MICROMHO)	DLP,PLS,TYS3
SHPM (QUADRAMHO)	DLP,TYS3

SEL	GE
SEL-68	OST
SEL-121	DLP
SEL-121C	DLP
SEL-121D	DLP
SEL-121F	DLP

SEL	GE
SEL-121G	DLP
SEL-151	DDP
SEL-167	DLP
SEL-BFR	SBC
SEL-PG10	DLP

KEY: ABB (BBC) = ABB (formerly Brown Boveri)
ABB (W) = ABB (formerly Westinghouse)
BE = Basler Electric
GEC/A = General Electric Co. of England/Alsthom
SEL = Schweitzer Engrg. Labs

Specifying Directions

GE Protective Relays

HOW TO SPECIFY

(See earlier page this section for Nuclear 1E list)
(See earlier page this section for U/L Listed Devices)

A. SWITCHES

Refer to Section 13 under "Ordering Directions."

B. ACCESSORIES

Specify complete catalog number of accessory device per tables in Section 13 and 12.

C. COMPONENT RELAYS

Complete model number of relay, if known (refer to Section 2 through 11) should be specified to save time in scheduling shipments.

Where model number cannot be specified, the following is required:

1. Specific Ratings and Calibration

(a) Specify application or type relay, such as IFC51 or IBC53.

(b) Current and/or voltage rating.

(c) Frequency in Hertz if alternating current.

(d) Rating of instantaneous unit, if unit required.

(e) Dc control voltage.

(f) For distance relays, ohms reach and/or offset.

(g) For Type GES synchronizing, breaker closing time.

2. Requirements and Mounting Details

(a) Some relays, particularly auxiliary relays, have several different type mounting alternatives to select from. See applicable relay catalog page and specify "Panel Thickness." If panel thickness is not specified, hardware suitable for up to 1/4 inch panel mounting will be supplied.

(b) Special requirements for individual relays should be carefully noted on the order. Also, note any unusual current or voltage calibration and/or settings.

3. Special Requests for new relays or accessories (new ratings, new wiring configurations, new designs, etc.) should contain complete information. Factory will establish price and shipment and inform customer and district. Orders for special requests will not proceed until acceptance of price by customer.

4. Requests for special tests or documentation will be reviewed by Meter and Control Department.

5. A Certificate of Conformance for selected items is available at an extra charge, but such special requirements must be noted on the original factory order.

6. Proof of delivery requests may result in an extra charge.

7. Refer to earlier page this section for Nuclear Station Class 1E Applications.

D. PROTECTIVE RELAY SYSTEMS

Complete model number from appropriate "Selection Guides" in Section 3 should be provided when available.

If the complete model number is not available please specify:

1. Protection System Type (e.g. DLP)
2. All necessary ratings and features using the appropriate Selection Guide for reference
3. Any requirements for test accessories or spare modules
4. Number of I/Bs required
5. Any special tests.

E. COMMUNICATION SYSTEMS AND EQUIPMENT

Complete model numbers from appropriate "Ordering Nomenclature" Tables in Sections 14 and 15 should be supplied when possible.

If the complete model numbers is not available, please specify:

1. Communication System Type (e.g. Keyed Carrier Type CS28A or FSK Power Line Carrier CS61C) or equipment type (e.g. Wide-Band Line Tuner CL03A).

2. Ratings and Features Required, using the appropriate "Ordering Nomenclature" and/or Tables in Section 14 or 15 e.g. for CS28A determine Bandwidth, Battery Voltage, Transmit Power, Frequency, etc.

3. Any requirements for test accessories or spare modules.

4. Number of I/Bs required.

5. Any special tests.

F. RENEWAL PARTS

Provide complete renewal part catalog number (from appropriate Renewal Parts Publication — See list in Section 17) when possible.

If the complete catalog number cannot be found in the parts bulletin, provide a complete description of the part plus the COMPLETE CATALOG NUMBER and description of the device which contains the desired part.

Standard hardware, such as screws, nuts, bolts, washers, etc. and cover glass to component relays, which can be purchased locally in the open market, are not listed and should be obtained locally.

Data subject to change without notice

SECTION: 2

Overcurrent Relays

HFC	Instantaneous Overcurrent	1
IAC	Time Overcurrent	3
IFC	Time Overcurrent	13
PJC	Instantaneous Overcurrent	17
BFC	Instantaneous Overcurrent	21
CHC	Instantaneous Overcurrent	23
IJC	Current Balance	26
SBC	Static Breaker Backup	28
STA	Static Transformer Auxiliary Relay	34

Direct Trip Instantaneous Overcurrent Function

DESCRIPTION

The Type HFC relays consist of one or more hinged armature instantaneous overcurrent units. Each unit has two electrically separate contacts, and is assembled in a single end draw-out Type C1 case. The units have a high-seismic rating, and include a target which is latched and raised into view when the unit operates. The targets are manually reset by a button on the front of the relay cover.

APPLICATION

The Type HFC relays find general application where a direct trip instantaneous overcurrent function is required. Typical applications are on transmission lines where it is desired to supplement existing distance relays, or pilot schemes with instantaneous overcurrent relays set to detect severe close-in faults.

The Type HFC21B can be applied with a doughnut-type CT encircling the three phase conductors (ground sensor scheme) to provide sensitive ground fault protection.

The Type HFC23C relay can be used to provide differential protection of a motor usually by means of one self-balanced primary current.

DESIGN CHARACTERISTICS

The HFC relay consists of a molded case, cover, support structure assembly and a connection plug to make the electrical connections. When the connection plug is withdrawn, the trip circuits are opened first and then the CT circuits are shorted. The window provides visual confirmation of CT shorting.

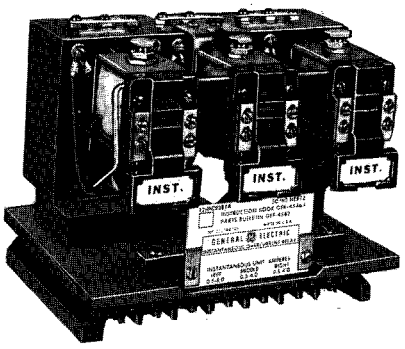
RATINGS

The HFC relays are designed for operation in an ambient air temperature from −20 C to +55 C. The contacts will carry 30 amperes trip current.

BURDENS

The instantaneous units have a tapped coil for operation on either of two ranges (H or L). Selection of the high or low range is determined by the position of the link.

Burdens are listed below.



(Photo 8043212)

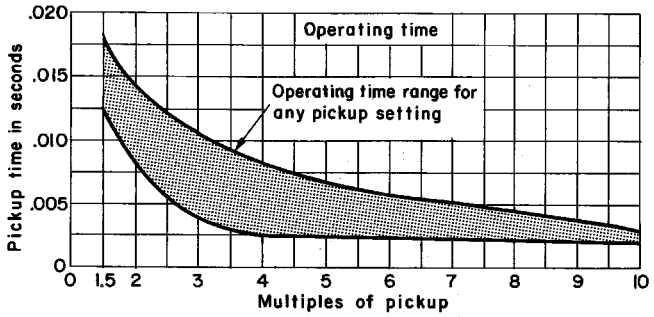
Fig. 1. HFC23C relay (out of case)

CHARACTERISTICS

The instantaneous units have either a 25 to 1 or 8 to 1 range with a tapped coil. There are high and low ranges selected by means of links located on the top of the support structure. The time current curve for the instantaneous unit is shown below.

Hi-seismic Inst. Unit (Amps)	Hz	Link Position	Range (Amps)	Min. Pickup (Amps)	Continuous Rating (Amps)	One-Second Rating (Amps)①	Burdens at Min. Pickup (Ohms)			Burdens In Ohms (Z) Times Pickup		
							R	X	Z	3	10	20
0.5-4	60	L	0.5-2	0.5	0.75	94	10.63	9.77	14.44	9.81	8.56	7.80
		H	2-4	2	1.5		5.13	3.49	6.21	4.66	4.26	4.18
2-50		L	2-10	2	3.7	130	0.750	0.650	0.992	0.634	0.480	0.457
		H	10-50	10	7.5		0.070	0.024	0.074	0.072	0.071	0.070
0.5-4	50	L	0.5-2	0.5	0.75	94	8.86	8.14	12.03	8.18	7.13	6.50
		H	2-4	2	1.5		4.28	2.91	5.18	3.88	3.55	3.48
2-50		L	2-10	2	3.7	130	0.625	0.542	0.827	0.528	0.400	0.380
		H	10-50	10	7.5		0.058	0.020	0.062	0.060	0.059	0.058

① Higher currents may be applied for shorter periods of time in accordance with the formula: $I = \sqrt{K/T}$



(Dwg. 0208A8695)

Fig. 2. Time-current characteristics of the Hi-Seismic instantaneous unit

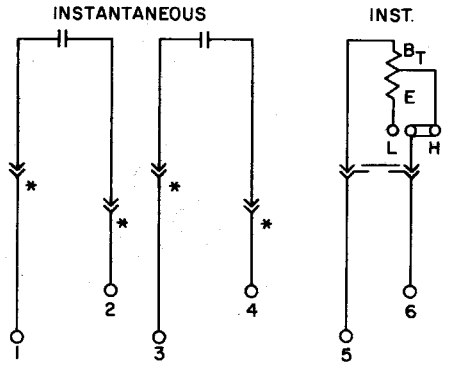
SELECTION GUIDE

Current Range (Amps) Min	Current Range (Amps) Max	Freq. (Hz)	Number of Units	Model Number	Case Size	Approx wt in lb (kg) Net	Approx wt in lb (kg) Ship
0.5 2.0	4.0 50	50/60	1	12HFC21B1A B2A	C1	6 (2.7)	8 (3.6)
0.5 2.0	4.0 50		2	12HFC22B1A B2A	C1	7 (3.2)	9 (4.0)
0.5 2.0	4.0 50		3	12HFC23C1A C2A	C1	8 (3.6)	10 (4.5)

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

CONNECTION DIAGRAMS



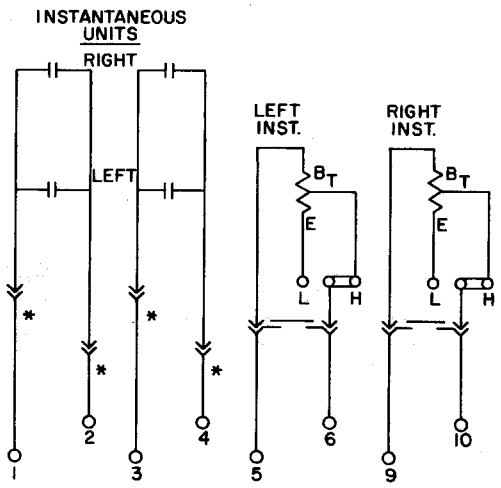
INST. SETTING

SET LINK TO "H" FOR HIGH RANGE AND TO "L" FOR LOW RANGE. LINK SHOWN IN HIGH RANGE POSITION.

* = SHORT FINGERS

(0269A3074-0)

Fig. 3. Type HFC21B Internal Connections Diagram

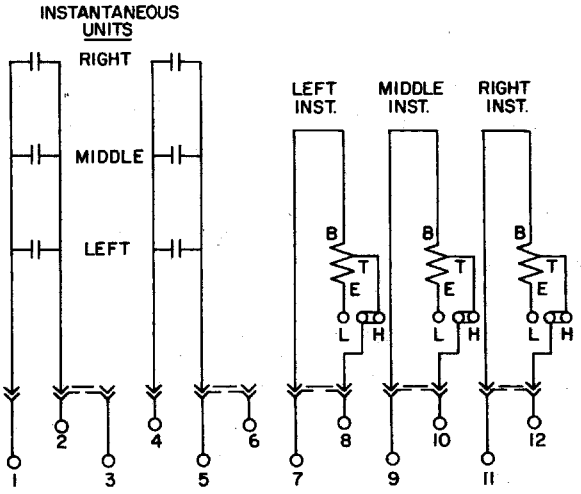


INST. SETTINGS

SET LINK TO "H" FOR HIGH RANGE AND TO "L" FOR LOW RANGE. LINK SHOWN IN HIGH RANGE POSITION.

(0275A1900-0)

Fig. 4. Type HFC22B Internal Connections Diagram

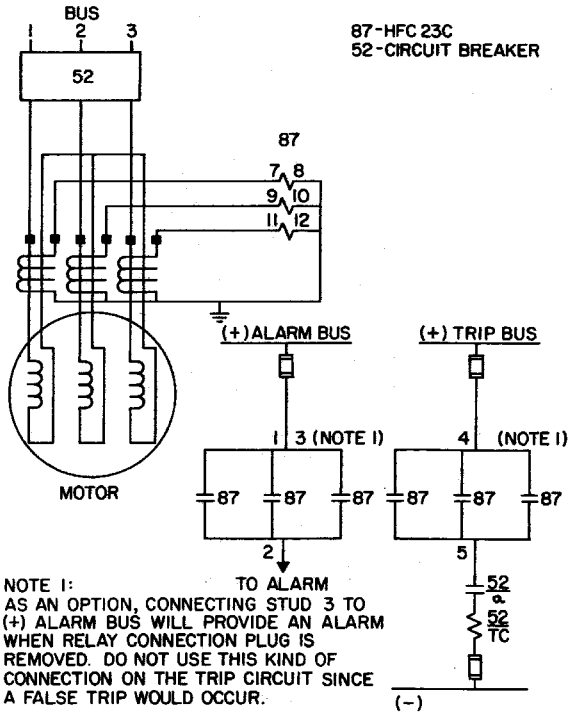


INST. SETTINGS

SET LINK TO "H" FOR HIGH RANGE AND TO "L" FOR LOW RANGE. LINK SHOWN IN HIGH RANGE POSITION.

(0285A6295-0)

Fig. 5. Internal Connections for Relay Type HFC23C



NOTE 1:
AS AN OPTION, CONNECTING STUD 3 TO (+) ALARM BUS WILL PROVIDE AN ALARM WHEN RELAY CONNECTION PLUG IS REMOVED. DO NOT USE THIS KIND OF CONNECTION ON THE TRIP CIRCUIT SINCE A FALSE TRIP WOULD OCCUR.

(0285A7123-0)

Fig. 6. External Connections for Type HFC23C, Self Balancing Primary Current Differential Scheme for Motor Protection

For Time-overcurrent Protection of Ac Circuits and Apparatus

INTRODUCTION

The listing of IAC Models, on pages 11 through 15 is organized by time/current characteristics into seven tables.

To find a known model number:

1. See **WHERE TO FIND IAC MODELS** on this page to determine correct table and page.

2. Turn to that table for sequential listing of models.

To find a model number for a known application:

1. See APPLICATION, to determine time/current characteristics and/or specific application desired.

2. See **WHERE TO FIND IAC MODELS** to determine correct table and page.

3. Use the rating and comment columns of that table to determine Model Number with desired features.

DESCRIPTION

Type IAC relays are used in the protection of industrial and utility power systems against either phase or ground overcurrent. They are single phase (although some models contain more than one unit), non-directional, current sensitive, ac devices. The basic operating mechanism (the time unit) produces one of several available operating characteristics. The operating time is inversely related to operating current which permits close coordination with other protective devices. It consists of a magnetic core operating coil, an induction disc, damping magnet, and a mechanical target. The IAC relay may also include one or more hinged armature instantaneous overcurrent units, with integral target.

The IAC relay is mounted in a drawout case, permitting front access to the relay for testing and maintenance. Testing can be accomplished, without removing the relay, by using XLA test plugs.

APPLICATION

IAC relays are used for protection of feeders, transmission lines, alternating current machines, transformers and for numerous other applications where a relay is required whose operating time is inversely related to operating current.

WHERE TO FIND IAC MODELS

Models of these designs	Time Current Characteristics	See Table	60 Hz See Page	50 Hz See Page
IAC 51, 52, 60	Inverse Time	1	2-11	2-14
IAC 53, 54, 80	Very Inverse Time	2	2-11	2-14
IAC 77, 78, 90	Extremely Inverse Time	3	2-12	2-14
IAC 55, 56, 68, 85, 95	Inverse, Short Time	4	2-12	2-15
IAC 57	Inverse, Medium Time	5	2-12	2-15
IAC 66	Inverse, Long Time	6	2-13	2-15
IAC 59	Inverse, Over and Under Current	7	2-13	2-15

Available Inverse Time/Current Characteristics

Six inverse time/current operating characteristics are available for the time unit of the IAC (see Figure 2). The three standard time characteristics are as follows:

INVERSE TIME relays, (Table 1), are generally applied where the short-circuit current magnitude is dependent largely upon the system generating capacity at the time of the fault.

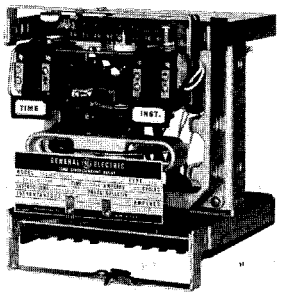
VERY INVERSE TIME relays (Table 2), are best applied on systems where the magnitude of the short circuit current flowing through any given relay is dependent mainly upon the relative location of the fault with respect to the relay and only slightly or not at all upon the system generating capacity.

EXTREMELY INVERSE TIME relays (Table 3), are intended for applications, such as on utility distribution feeders, where sufficient time delay must be provided to allow a re-energized circuit to pick up without unnecessary tripping during the inrush period, and at the same time coordinate properly with power fuses and fuse cutouts.

Three additional time characteristics are available as follows:

INVERSE SHORT TIME (Table 4), relays are used on equipments where tripping must be relatively fast but should not approach the operating time of an instantaneous unit. Protection of power rectifier equipment is an example of such an application.

INVERSE MEDIUM TIME (Table 5), relays are used as generator or transformer neutral relays or as backup protection for feeder ground faults. Also, the inverse medium time relay may be used where a slower relay is required to obtain coordination.



(Photo 8041253)

Fig. 1. IAC53B single-phase overcurrent relay (out of case)

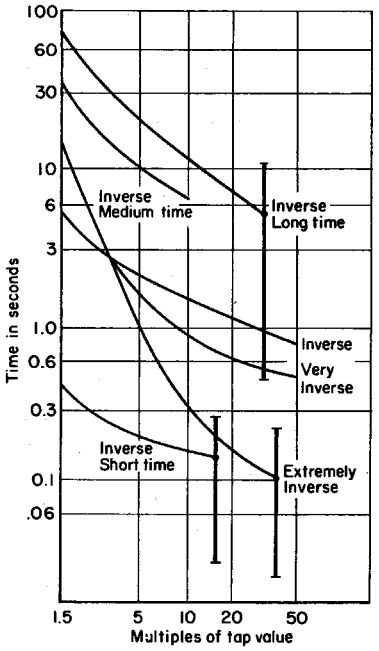


Fig. 2. Typical operating characteristics of 60 Hz Type IAC relays. The No. 5 time-dial setting is shown for each curve, and the range of time adjustment from 0.5 to 10 time-dial settings is shown for the extremely inverse, the inverse short time, and the inverse long time relays.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

Application (Cont'd)

INVERSE LONG TIME (Table 6), relays are designed for applications requiring long time delay. The major area of usefulness is in the protection of motors against overloads under conditions where the customary thermal devices are not applicable.

Instantaneous Unit

Instantaneous units are used to provide tripping with no intentional time delay for currents exceeding a predetermined value. Typically, if the fault current magnitude under maximum generating conditions about triples as a fault is moved toward the relay location from the far end of the line, then an instantaneous unit is desirable.

High dropout instantaneous units are available and are used together with other devices to obtain time-delay tripping. One application is motor protection, where the high dropout unit supervises the time unit for tripping during starting and overload conditions. For special feeder applications the high dropout unit can supervise the time unit to prevent the overtravel from causing undesired tripping and to permit shorter coordination margins.

Specific Applications

MOTOR PROTECTION RELAYS provide overcurrent protection for starting, overload, and fault conditions. The IAC66K relay has an inverse long time characteristic (as described above), which approximates the motor thermal limit, and two instantaneous overcurrent units. The first instantaneous unit is set above the maximum motor starting current and protects for fault conditions only. The second, a special high dropout unit, is customarily used for supervising the time overcurrent unit to permit tripping for stall and heavy overload conditions. Operation of only the time unit indicates a light or moderate overload condition and can be used as an alarm. The IAC66M relay is similar except that the high dropout instantaneous unit is used in conjunction with a 0.1 second time delay telephone relay which blocks operating during initial inrush conditions, allowing the unit to be set more sensitively.

LOAD CENTER PROTECTION The IAC66T relay, which has a static timer unit used with a high dropout instantaneous unit, is designed to protect medium voltage circuits supplying low voltage load centers. This relay coordinates with the short time and long time overcurrent trip characteristics of 600 volt air circuit breakers.

OVER AND UNDERCURRENT RELAYS (Table 7), are for use where an indication of the variation of a current between maximum and minimum limits is required. These relays do not have a time dial. The time characteristics are determined by the contact settings.

TORQUE CONTROLLED RELAYS have wound shading coils connected to terminal studs. Operation of the time-overcurrent unit thus depends on the closing of an external contact across those terminals. The overcurrent relay can be supervised by some external device, such as a directional relay.

FEATURES

Time Overcurrent

Time overcurrent units are available in several ranges to meet current pick-up settings of from 0.1 to 16 amperes. Sensitivity is determined by discrete tap-plug settings, and a time dial gives continuously adjustable time delay over the entire range. IAC model numbers which end in "8..A", such as IAC51B801A, provide an extended range of settings with a ratio of maximum setting to minimum setting of 8:1. Most other IAC relays have a ration of 4:1. The available tap settings are listed below for the common time overcurrent units:

AVAILABLE SETTINGS

Time overcurrent units with 8:1 range of settings:
0.5-4.0 amp unit—0.5, 0.6, 0.7, 0.8, 1, 1.2, 1.5, 2, 2.5, 3, and 4 amp taps
1.5-12 amp unit—1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 10, and 12 amp taps
2-16 amp unit—2, 2.5, 3, 4, 5, 6, 7, 8, 10, 12 and 16 amp taps

Other common IAC time overcurrent units:
0.5- 2.0 amp–0.5, 0.6, 0.8, 1, 1.2, 1.5 and 2 amp
0.6- 1.8 amp–0.6, 0.8, 1.0, 1.0, 1.2, 1.4, 1.6, and 1.8 amp
1.5- 4.5 amp–1.5, 2.0, 2.5, 3.0, 3.5, 4.0, and 4.5 amp
1.5- 6.0 amp–1.5, 2, 2.5, 3, 4, 5, and 6 amp
2.5- 5.0 amp–2.5, 2.8, 3.1, 3.5, 4, 4.5 and 5 amp
2.5- 7.5 amp–2.5, 3.0, 3.5, 4.0, 5.0, 6.0, and 7.5 amp
4.0- 8.0 amp–4, 4.5, 5, 5.6, 6, 6.3, 7.1 and 8 amp
4.0-12.0 amp–4, 5, 6, 7, 8, 10 and 12 amp
4.0-16.0 amp–4, 5, 6, 8, 10, 12 and 16 amp

① Some 4-16 amp units also have 7 amp tap.

Instantaneous Overcurrent

Instantaneous overcurrent units are available in several ranges to meet current settings between 1.0 and 160 amperes. The instantaneous unit in IAC relays with model numbers ending in "8..A" has a maximum setting to minimum setting ratio of 8:1. It uses two separate windings which can be connected either in series (for low range) or in parallel (for high range) with pickup continuously adjustable over each range. The instantaneous unit used in most other IAC relays uses a single winding with a ratio of maximum to minimum setting of 4:1, with pickup continuously adjustable. These instantaneous units drop out at 40 percent or more of setting at minimum setting and 50 percent at maximum setting. High dropout units are also available which drop out at 80 percent or more of setting at minimum setting and 90 percent at maximum setting.

Except as noted in the tables the time-overcurrent unit operating coil is connected in series with the instantaneous unit operating coil if both are present, and each is set independently.

Target and Seal-in

Target and seal-in units, which are included with all time units except as noted in the tables of relay models, are dual rated. 0.2 and 2.0 amp taps are standard; contact factory for form numbers of other ratings available (see ratings table under "Contacts" this page.) The seal-in unit picks up to bypass the contacts of the time unit during trip circuit energization. The 2-amp tap is generally used, except where the relay contacts are used to energize auxiliary relays or other low-current devices.

CONTACTS

Each unit, time or instantaneous, has one or two output contacts (if two contacts per unit, those contacts will have one side common). Contacts of a relay with more than one unit are generally not electrically separate except as noted in the tables. An exception is the high-dropout instantaneous unit, whose contacts are electrically separate from other contacts in the relay.

The current closing rating of the contacts is 30 amperes for voltage not exceeding 250 volts. The current carrying rating of the relay is limited by the tap being used on the target and seal-in units as indicated in the following table:

Ratings of Target Seal-In Units, High Seismic (Hi-G)

	Dual Rated			
	0.2/2.0 Amp		0.6/2.0 Amp	
	0.2	2.0	0.6	2.0
arry 30 Amps for (sec)	0.05	2.2	0.5	3.5
arry 10 Amps for (sec)	.45	20.0	5.0	30
arry continuously (Amp)	.37	2.3	1.2	2.6
linimum Operating (Amp)	.2	2.0	0.6	2.0
linimum Drop-out (Amp)	.05	0.5	.15	0.5
c resistance (Ohms)	8.3	.24	.78	.18
c resistive terrupting rating (Amps)	2.5 Amp @ 125 Vdc			

If the total tripping current exceeds 30 amperes, an auxiliary relay must be used in conjunction with IAC relays.

After tripping occurs ,the tripping circuit of these relays must be opened by an "a" auxiliary switch on the circuit breaker, or by other external automatic means, because the circuit is sealed closed while tripping current is flowing. The contacts will open in 6 cycles (1/10 second) with normal adjustment of "wipe", permitting use of the relay in instantaneous reclosing schemes.

OPERATING COIL RATINGS

Note that relays with both time overcurrent and instantaneous units are limited to the lesser of the respective current ratings, since the operating coils are connected in series.

IAC relays with 8:1 range units

TIME OVERCURRENT UNIT

Tap Setting	IAC51 and 52		IAC53 and 54		IAC77 and 78	
	Taps 0.5-4.0	Taps 2-16	Taps 0.5-4.0	Taps 1.5-12	Taps 0.5-4.0	Taps 1.5-12
	Amperes					
CONTINUOUS-CURRENT RATING						
0.5	1.6		4.0		3.5	
0.6	1.8		4.5		3.7	
0.7	2.0		5.0		4.0	
0.8	2.1		5.5		4.5	
1.0	2.3		6.0		5.0	
1.2	2.7		7.0		5.5	
1.5	3.0		7.5	10	6.0	9.5
2.0	3.5	8	9.0	11.5	7.0	10.5
2.5	4.0	9	10.0	13.0	8.0	11.5
3.0	4.5	10	11.0	14.5	9.0	12.5
4.0	5.0	12	12.0	17.0	10.0	14.0
5.0		14		19.0		15.5
6.0		15		20.0		17.0
7.0		16		20.0		18.0
8.0		17.5		20.0		19.0
10.0		20		20.0		20.0
12.0		20		20.0		20.0
16.0		20				
ONE-SECOND RATING						
All	70 Amps	260 Amps	140 Amps	260 Amps	125 Amps	260 Amps

INSTANTANEOUS UNIT

Instantaneous Unit Range	Connection of Instantaneous Unit—High or Low Range		Continuous Rating	One-second Rating
			Amperes	
0.5-4.0	Low	0.5-2.0	0.75	25
	High	1.0-4.0	1.50	50
2-16	Low	2-8	3.0	130
	High	4-16	6.0	260
10-80	Low	10-40	15.0	400
	High	20-80	25.0	600
20-160	Low	20-80	25.0	600
	High	40-160	25.0	600

Low range refers to coils connected in series.
High Range refers to coils connected in parallel.

IAC relays with 4:1 range units

TIME-OVERCURRENT UNIT

Time Unit Range	One-second Rating	Continuous Rating①②
	Amperes	
4-16 Amp		
IAC51, 52, 53, 54, 77, 78	260	10
1.5-6 Amp		
IAC51, 52	215	5
IAC53, 54	260	5
IAC77, 78	200	6
0.5-2 Amp		
IAC51, 52	70	1.5
IAC53, 54	130	1.5
IAC77, 79	65	3

CASE SIZES AND APPROXIMATE WEIGHTS

IAC Relay Model	Case Size	Net	Shipping
		Weight (Lbs.)	
51N, 66T	S2	12(5.4)	18(8.2)
66M, 80P	M1	18(8.2)	28(12.7)
60T, 80T, 90T	L2	18(8.2)	28(12.7)
All others listed	S1	12(5.4)	18(8.2)

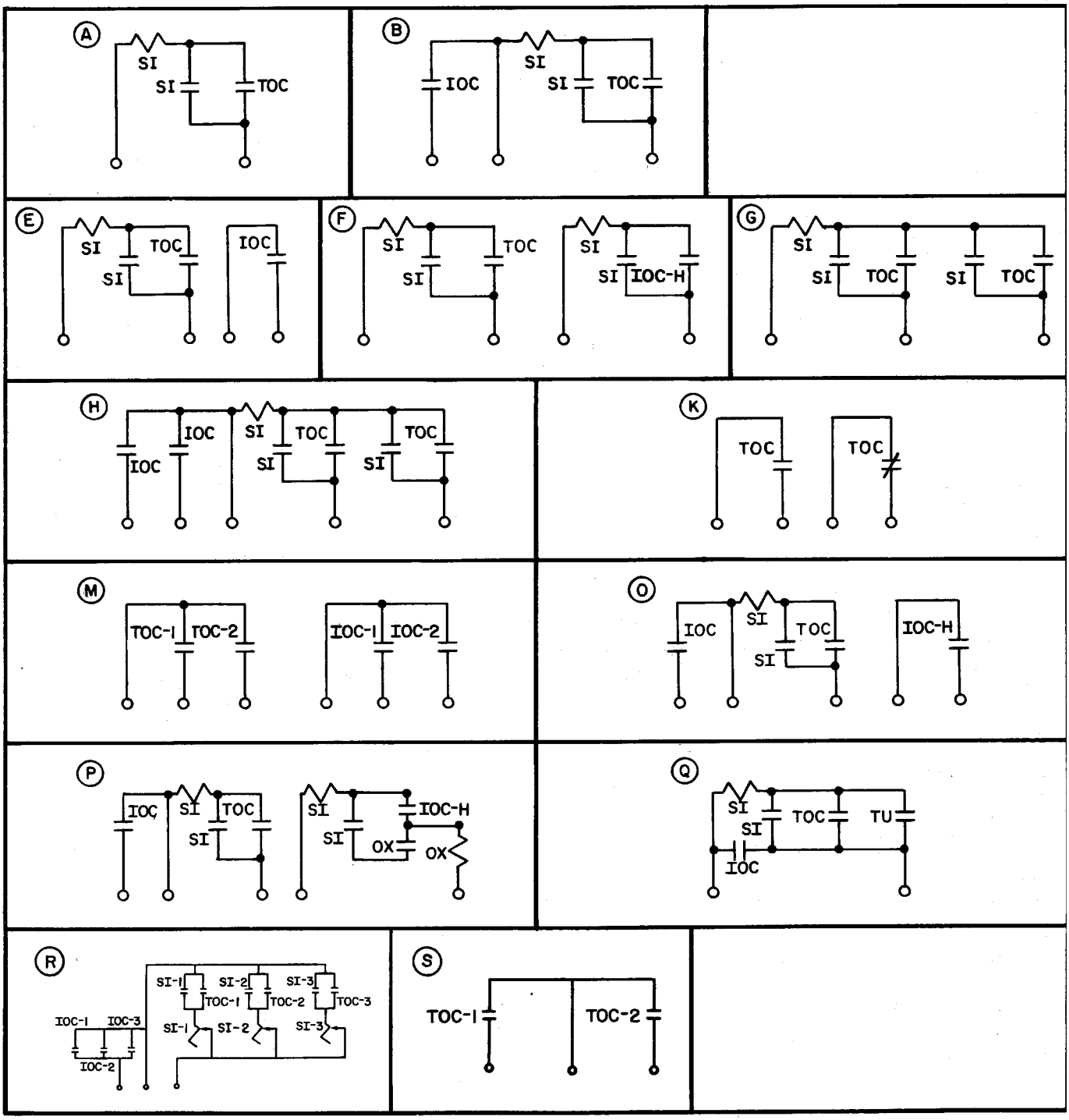
①The continuous rating of the coil circuit applies to all Time Unit taps up to, and including, the value of the rating. For taps above this value, the rating is the same as the tap value.

②Continuous ratings of relays having instantaneous units is the value shown or 1.5 times the minimum setting of the instantaneous units, whichever is the lower of the two values.

SIMPLIFIED OUTPUT CONTACT ARRANGEMENTS

As referenced in tables, pages 2-11 through 2-15.

LEGEND: TOC = Time Overcurrent Unit
IOC = Instantaneous Unit
SI = Seal-in Unit
IOC-H = Instantaneous Unit—Hi-Dropout
OX = Auxiliary Relay
TU = Instantaneous Unit with Timer



60 HERTZ MODELS

Table 1. Inverse Time Characteristic Relays

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC51A801A A802A	0.5-4 2-16	....	1 N.O. See Ⓐ page 2-10	
12IAC51B801A B802A B803A B804A B805A B806A B807A B808A	0.5-4 2-16 0.5-4 2-16 0.5-4 2-16 0.5-4 2-16	0.5-4 0.5-4 2.0-16 2.0-16 10-80 10-80 20-160 20-160	1 N.O. See Ⓑ page 2-10	
12IAC51N 7A N 8A N13A N14A N16A N17A N101A N102A N111A	1.5-6 1.5-6 0.5-2 0.5-2 1.5-6 1.5-6 4-16 4-16 4-16	....	1 N.O. See Ⓐ page 2-10	**Dc Control Volts** 125 250 125 250 24 48 125 250 48 Includes auxiliary relay for bus differential protection and for checking CT secondary circuit.
12IAC51V2A V3A V5A V6A V101A V104A V105A V106A	1.5-6 1.5-6 0.5-2 1.5-6 4-16 4-16 4-16 0.5-2	10-30 4-12 2-6 2-6 10-30 4-12 20-60 10-30	1 N.O. See Ⓕ page 2-10	High dropout instantaneous unit. Two target seal-in units.

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC52A801A A802A	0.5-4 2-16	....	2 N.O. See Ⓖ page 2-10	
12IAC52B801A B802A B803A B804A B805A B806A B807A B808A	0.5-4 2-16 0.5-4 2-16 0.5-4 2-16 0.5-4 2-16	0.5-4 0.5-4 2-16 2-16 10-80 10-80 20-160 20-160	2 N.O. See Ⓗ page 2-10	
12IAC60A12A A15A A111A	1.5-6 0.5-2 4-16	....	1 N.O. See Ⓐ page 2-10	Torque controlled time unit will operate only when an external contact (wired to shading coil) is closed.
12IAC60B11A B13A B15A B16A B20A B21A B112A B114A B115A	1.5-6 1.5-6 1.5-6 0.5-2 1.5-6 2-8 4-16 4-16 4-16	4-16 10-40 2-8 4-16 20-80 10-40 20-80 10-40 4-16	1 N.O. See Ⓑ page 2-10	Similar to IAC60A with instantaneous unit.
12IAC60T1A T2A T3A	2 Units 0.5-4 2-16 0.5-4	2 Units 2-50 2-50 2-50	1 N.O. See Ⓜ page 2-10	**Dc Control Volts** 48/125 48/125 125/250 Has two PJC instantaneous units. No target seal-in units.

Table 2. Very Inverse Time Characteristic Relays

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC53A10A A19A A801A A803A	0.1-0.4 0.15-0.6 0.5-4.0 1.5-12	....	1 N.O. See Ⓐ page 2-10	
12IAC53B32A B34A B38A B50A B54A B76A B78A B801A B803A B805A B807A B809A B810A B811A B812A	0.1-0.4 0.15-0.6 0.1-0.4 0.1-0.4 0.1-0.4 0.1-0.4 0.1-0.4 0.5-4 0.5-4 0.5-4 0.5-4 1.5-12 1.5-12 1.5-12 1.5-12	1-4 10-40 0.5-2 4-16 10-40 2-8 20-80 0.5-4 2-16 10-80 20-160 0.5-4 2-16 10-80 20-160	1 N.O. See Ⓑ page 2-10	
12IAC53M3A M4A M5A M6A M7A M9A M10A M11A	1.5-6 0.5-2 0.5-2 1.5-6 1.5-6 0.5-2 0.5-2 1.5-6	10-30 1-3 2-6 4-12 2-6 4-12 0.5-1.5 0.5-1.5	1 N.O. See Ⓕ page 2-10	High dropout instantaneous unit. Two target seal-in units.
12IAC53M101A M102A M103A	4-16 4-16 4-16	4-12 10-30 20-60	1 N.O. See Ⓕ page 2-10	High dropout instantaneous unit. Two target seal-in units.
12IAC53T801A T802A T803A T804A T805A T806A T807A T808A	0.5-4 0.5-4 0.5-4 0.5-4 1.5-12 1.5-12 1.5-12 1.5-12	0.5-4 2-16 10-80 20-160 0.5-4 2-16 10-80 20-160	1 N.O. See Ⓔ page 2-10	Time unit and instantaneous unit contacts are electrically separate.

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC54A10A A801A A803A	0.1-0.4 0.5-4 1.5-12	....	2 N.O. See Ⓖ page 2-10	
12IAC54B801A B803A B805A B807A B809A B810A B811A B812A B813A	0.5-4 0.5-4 0.5-4 0.5-4 1.5-12 1.5-12 1.5-12 1.5-12 0.1-0.4	0.5-4 2-16 10-80 20-160 0.5-4 2-16 10-80 20-160 4-16	2 N.O. See Ⓗ page 2-10	
12IAC80L1A L2A L3A	4-16 1.5-6 0.5-2	....	1 N.O. See Ⓐ page 2-10	Torque controlled time unit will operate only when an external contact (wired to shading coil) is closed.
12IAC80P1A P2A P3A	2 Unit 4-16 1.5-6 4-16	....	1 N.O. per unit See Ⓢ page 2-10	**Dc Control Volts** 125/250 125/250 48/125 Similar to IAC80L except two units.
12IAC80T1A T2A	2 Units 0.5-4 1.5-12	2 Units 2-50 2-50	1 N.O. per unit See Ⓜ page 2-10	**Dc Control Volts** 48/125 48/125 Has two PJC instantaneous units. No target seal-in units.

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Table 3. Extremely Inverse Time Characteristic Relays

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC77A15A A801A A803A	0.1-0.4 0.5-4 1.5-12	....	1 N.O. See Ⓐ page 2-10	
12IAC77B55A B57A B60A B69A B71A B73A B801A B803A B805A B807A B809A B810A B811A B812A	0.1-0.4 0.1-0.4 0.1-0.4 0.1-0.4 0.1-0.4 0.1-0.4 0.5-4 0.5-4 0.5-4 0.5-4 1.5-12 1.5-12 1.5-12 1.5-12	4-6 0.5-2 2-8 20-80 1-4 10-40 0.5-4 2-16 10-80 20-160 0.5-4 2-16 10-80 20-160	1 N.O. See Ⓑ page 2-10	
12IAC77M3A M4A M5A	4-16 4-16 1.5-6	4-12 10-30 2-6	1 N.O. See Ⓕ page 2-10	High dropout instantaneous unit. Two target seal-in units.

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC78A7A A801A A803A	0.1-0.4 0.5-4 1.5-12	....	2 N.O. See Ⓖ page 2-10	
12IAC78B801A B803A B805A B807A B809A B810A B811A B812A	0.5-4 0.5-4 0.5-4 0.5-4 1.5-12 1.5-12 1.5-12 1.5-12	0.5-4 2-16 10-80 20-160 0.5-4 2-16 10-80 20-160	2 N.O. See Ⓗ page 2-10	
12IAC90B1A B2A	1.5-6 0.5-2	10-40 4-16	1 N.O. See Ⓑ page 2-10	Torque controlled time unit will operate only when an external contact (wired to shading coil) is closed.
12IAC90T1A T2A	2 Units 0.5-4 1.5-12	2 Units 2-50 2-50	1 N.O. per unit See Ⓜ page 2-10	**Dc Control Volts** 48/125 48/125 Has two PJC instantaneous units. No target seal-in units.

Table 4. Inverse, Short Time Characteristic Relays

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC55A2A A3A A101A	1.5-6 0.5-2 4-16	....	1 N.O. See Ⓐ page 2-10	
12IAC55B2A B3A B9A B10A B17A B19A B20A B25A B101A	1.5-6 0.5-2 1.5-6 0.5-2 0.5-2 1.5-6 1.5-6 0.5-2 4-16	10-40 10-40 4-16 4-16 2-8 20-80 2-8 1-4 10-40	1 N.O. See Ⓑ page 2-10	

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC55B104A B115A B121A	4-16 4-16 4-16	20-80 4-16 40-160		
12IAC55F1A F2A F3A F4A F6A F7A	4-16 1.5-6 4-16 1.5-6 0.5-2 1.5-6	4-16 4-16 0.5-2 1.5-6 0.5-2 2-8	1 N.O. See Ⓑ page 2-10	Time unit and instantaneous unit coil leads are brought out to separate studs.
12IAC95F1A	1.5-6	1.5-5	1 N.O. See Ⓔ page 2-10	Moderately short-time characteristic. Low burden.

Table 5. Inverse, Medium Time Characteristic Relays

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC57A2A A3A A101A	1.5-6 0.5-2 4-16	....	1 N.O. See Ⓐ page 2-10	

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC57B2A B3A B10A B13A B101A B104A	1.5-6 0.5-2 1.5-6 1.5-6 4-16 4-16	10-40 10-40 20-80 4-16 10-40 20-80	1 N.O. See Ⓑ page 2-10	

Table 6. Inverse, Long Time Characteristic Relays

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC66A51A A52A A53A	0.6-1.8 1.5-4.5 4-12	....	1 N.O. See Ⓐ page 2-10	
12IAC66B51A B52A B53A B54A B55A B56A B57A	0.6-1.8 1.5-4.5 4-12 0.6-1.8 1.5-4.5 4-12 4-12	2-16 2-16 2-16 10-80 10-80 10-80 20-160	1 N.O. See Ⓑ page 2-10	
12IAC66C51A C52A C53A C54A C55A C56A C57A	0.6-1.8 1.5-4.5 4-12 0.6-1.8 1.5-4.5 4-12 1.5-4.5	2-16 2-16 2-16 10-80 10-80 10-80 0.5-4	1 N.O. See Ⓔ page 2-10	Time unit and instantaneous unit contact leads are brought out separately.

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC66K51A K52A K53A K55A K56A K57A K58A K59A K60A K64A K65A K67A K68A K69A K70A	0.6-1.8 0.6-1.8 0.6-1.8 1.5-4.5 1.5-4.5 1.5-4.5 1.5-4.5 1.5-4.5 1.5-4.5 4-12 4-12 4-12 4-12 4-12 4-12	2-16 2-16 10-80 2-16 2-16 10-80 10-80 10-80 20-160 2-16 10-80 10-80 10-80 10-80 20-160	1 N.O. See Ⓞ page 2-10	**Hi Drop-out Instan-taneous** 1-4 10-40 2-8 2-8 10-40 2-8 4-16 10-40 4-16 10-40 2-8 4-16 10-40 20-80 4-16 Two instantaneous units, one standard and one high dropout.

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Table 6. Inverse, Long Time Characteristic Relays (Con't)

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Hi Drop-out Instan-taneous	Dc Control Voltage	Comments	Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Hi Drop-out Instan-taneous	Dc Control Voltage	Comments
12IAC66M51A	1.5-4.5	2-16	1 N.O. See Ⓟ page 2-10	4-16	48/125/250	Two instantaneous units; One standard, one high drop-out. Two seal-in units. Aux. telephone relay for 0.1 sec time delay pick up of high dropout unit.	12IAC66T51A	1.5-4.5	10-80	page 2-10	7-28	48/110-125/220-250	Two instantaneous units: one standard, one high drop-out. Static time delay on high dropout unit adjustable from 0.05-3.0 seconds, except for IAC66S2A which has 0.03-1 second range.
M52A	1.5-4.5	10-80		2-8			T52A	1.5-4.5	20-160		4-16		
M53A	1.5-4.5	10-80		7-28			T53A	2.5-7.5	10-80		7-28		
M54A	1.5-4.5	10-80		10-40			T54A	2.5-7.5	10-80		10-40		
M55A	1.5-4.5	10-80		20-80			T55A	4-12	10-80		10-40		
M56A	1.5-4.5	20-160		20-80			T56A	4-12	10-80		4-16		
M57A	4-12	2-16		4-16			T57A	4-12	20-160		10-40		
M58A	4-12	10-80		2-8									
M59A	4-12	10-80		7-28									
M60A	4-12	10-80		10-40									
M61A	4-12	10-80		20-80									
M62A	4-12	20-160		20-80									

Table 7. Inverse Time, Over- and Undercurrent Relays

12IAC59C1A	0.5-2	...	1 N.O. & 1 N.C. See Ⓚ page 2-10	No target seal-in unit.	
C2A	1.5-6	...			
C103A	4-16	...			

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Table 1. Inverse Time Characteristic Relays

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC51A804A A805A	0.5-4 2-16	....	1 N.O. See Ⓐ page 2-10	50 Hertz models.
12IAC51B821A B822A B823A B824A B825A B826A B827A B828A	0.5-4 2-16 0.5-4 2-16 0.5-4 2-16 0.5-4 2-16	0.5-4 0.5-4 2-16 2-16 10-80 10-80 20-160 20-160	1 N.O. See Ⓑ page 2-10	50 Hertz models.
12IAC51N9A N10A N18A N103A N104A N119A	1.5-6 1.5-6 0.5-2 4-16 4-16 4-16	....	1 N.O. See Ⓐ page 2-10	**Dc Control Volt** 125 250 125 125 250 48 50 Hertz models. Includes auxiliary relay for bus differential protection and for checking CT secondary circuit.

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC51V102A	4-16	10-30	1 N.O. See Ⓕ page 2-10	50 Hertz model. High dropout instantaneous unit. Two target seal-in units
12IAC52A804A A805A	0.5-4 2-16	....	2 N.O. See Ⓖ page 2-10	50 Hertz models.
12IAC52B821A B822A B823A B824A B825A B826A B827A B828A	0.5-4 2-16 0.5-4 2-16 0.5-4 2-16 0.5-4 2-16	0.5-4 0.5-4 2-16 2-16 10-80 10-80 20-160 20-160	2 N.O. See Ⓗ page 2-10	50 Hertz models.
12IAC60A14A A16A A113A	0.5-2 1.5-6 4-16	....	1 N.O. See Ⓐ page 2-10	50 Hertz models. Torque controlled time unit will operate only when an external contact (wired to shading coil) is closed.
12IAC60B117A B118A B119A	4-16 4-16 4-16	10-40 4-16 20-80	1 N.O. See Ⓑ page 2-10	50 Hertz models. Similar to IAC60A with instantaneous unit.

Table 2. Very Inverse Time Characteristic Relays

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC53A801A 803A	0.5-4 1.5-12	....	1 N.O. See Ⓐ page 2-10	50 Hertz models
12IAC53B61A B801A B803A B805A B807A B809A B810A B811A B812A	0.1-0.4 0.5-4 0.5-4 0.5-4 0.5-4 1.5-12 1.5-12 1.5-12 1.5-12	4-16 0.5-4 2-16 10-80 20-160 0.5-4 2-16 10-80 20-160	1 N.O. See Ⓑ page 2-10	50 Hertz models.
12IAC53T801A T802A T803A T804A T805A T806A T807A T808A	0.5-4 0.5-4 0.5-4 0.5-4 1.5-12 1.5-12 1.5-12 1.5-12	0.5-4 2-16 10-80 20-160 0.5-4 2-16 10-80 20-160	1 N.O. See Ⓔ page 2-10	Time unit and instantaneous unit contacts are electrically separate.

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC54A801A A803A	0.5-4 1.5-12	....	2 N.O. See Ⓖ page 2-10	50 Hertz models
12IAC54B801A B803A B805A B807A B809A B810A B811A B812A B813A	0.5-4 0.5-4 0.5-4 0.5-4 1.5-12 1.5-12 1.5-12 1.5-12 0.1-0.4	0.5-4 2-16 10-80 20-160 0.5-4 2-16 10-80 20-160 4-16	2 N.O. See Ⓗ page 2-10	50 Hertz models
12IAC80L4A	4-16	.....	1 N.O. See Ⓐ page 2-10	50 Hertz model torque controlled time unit will operate only when an external contact (wired to shading coil) is closed.

Table 3. Extremely Inverse Time Characteristic Relays

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC77A804A A805A	0.5-4 1.5-12	....	1 N.O. See Ⓐ page 2-10	50 Hertz models
12IAC77B58A B821A B822A B823A B824A B825A B826A 12IAC77B827A B828A	0.02-0.08 0.5-4 1.5-12 0.5-4 1.5-12 0.5-4 1.5-12 0.5-4 1.5-12	0.04-0.16 0.5-4 0.5-4 2-16 2-16 10-80 10-80 20-160 20-160	1 N.O. See Ⓑ page 2-10	50 Hertz models 50 Hertz models
12IAC77S823A S826A	3 Units 0.5-4 1.5-12	3 Units 2-16 10-80	1 N.O. per unit See Ⓡ page 2-10	50 Hertz models

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC78A804A A805A	0.5-4 1.5-12	....	2 N.O. See Ⓖ page 2-10	50 Hertz models
12IAC78B821A B822A B823A B824A B825A B826A B827A B828A	0.5-4 1.5-12 0.5-4 1.5-12 0.5-4 1.5-12 0.5-4 1.5-12	0.5-4 0.5-4 2-16 2-16 10-80 10-80 20-160 20-160	2 N.O. See Ⓗ page 2-10	50 Hertz models

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Table 4. Inverse, Short Time Characteristic Relays

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC55A5A	1.5-6	.....	1 N.O. See Ⓐ page 2-10	50 Hertz models.
A6A	0.5-2	.....		
A104A	4-16	.....		
12IAC55B6A	1.5-6	10-40	1 N.O. See Ⓑ page 2-10	50 Hertz models.
B7A	0.5-2	10-40		
B14A	0.5-2	4-16		
B22A	0.5-2	2-8		
B105A	4-16	10-40		
B108A	4-16	20-80		
B122A	4-16	4-16		
12IAC55F5A	4-16	4-16	1 N.O. See Ⓑ page 2-10	50 Hertz models. Time unit and instantaneous unit coil leads are brought out to separate studs.
12IAC95F1A	1.5-6	1.5-5	1 N.O. See Ⓔ page 2-10	Moderately short-time characteristic. Low burden.

Table 5. Inverse, Medium Time Characteristic Relays

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC57A6A	0.5-2	.....	1 N.O. See Ⓐ page 2-10	50 Hertz models.
A8A	1.5-6	.....		
A104A	4-16	.....		
12IAC57B6A	1.5-6	10-40	1 N.O. See Ⓑ page 2-10	50 Hertz models.
B7A	0.5-2	10-40		
B11A	1.5-6	20-80		
B105A	4-16	10-40		
B108A	4-16	20-80		

Table 6. Inverse, Long-time Characteristic Relays

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Hi-Dropout Instantaneous	Comments
12IAC66A54A	0.6-1.8	.....	1 N.O. See Ⓐ page 2-10		50 Hertz models.
A55A	1.5-4.5	.....			
A56A	4-12	.....			
12IAC66B58A	0.6-1.8	2-16	1 N.O. See Ⓑ page 2-10		50 Hertz models.
B59A	1.5-4.5	10-80			
B60A	4-12	10-80			
12IAC66C58A	0.6-1.8	2-16	1 N.O. See Ⓔ page 2-10		50 Hertz models. Time unit and instantaneous unit coil leads are brought out to separate studs.
C59A	1.5-4.5	10-80			
C60A	4-12	10-80			
12IAC66K54A	0.6-1.8	10-80	1 N.O. See Ⓞ page 2-10	2-8	50 Hertz models. Two instantaneous units: one standard and one high dropout.
K61A	1.5-4.5	10-80		2-8	
K62A	1.5-4.5	10-80		4-16	
K63A	1.5-4.5	20-160		4-16	
K71A	4-12	10-80		4-16	
K72A	4-12	20-160		4-16	
DC Control Voltage 48/125/250					
12IAC66M63A	1.5-4.5	10-80	1 N.O. See Ⓟ page 2-10	20-80	Two instantaneous units: one standard and one high dropout. Two seal-in units. Aux. telephone relay for 0.1 sec time delay pickup of high dropout.
M64A	1.5-4.5	20-160		20-80	
M65A	4-12	10-80		20-80	
M67A	4-12	20-160		20-80	

Table 7. Inverse Time, Over- and Undercurrent Relays

Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	No. of Contacts Per Unit	Comments
12IAC59C4A	0.5-2	.....	1 N.O. & 1 N.C. See Ⓚ page 2-10	50 Hertz models. No target seal-in unit.
C5A	1.5-6	.....		
C106A	4-16	.....		

SUBSTITUTION LIST FOR IAC RELAYS, arranged in order of Superseded Models (60 Hz only, drawout case mounting)

Previous Model			Superseding IAC 800 Model		
Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)
12IAC51A 2A	1.5-6	.....	12IAC51A801A	.5-4	.....
3A	.5-2	.....	801A	.5-4	.....
101A	4-16	.....	802A	2-16	.....
12IAC51B 2A	1.5-6	10-40	12IAC51B805A	.5-4	10-80
3A	.5-2	10-40	805A	.5-4	10-80
17A	1.5-16	4-16	803A	.5-4	2-16
18A	.5-2	4-16	803A	.5-4	2-16
19A	1.5-6	2-8	803A	.5-4	2-16
22A	.5-2	2-8	803A	.5-4	2-16
23A	1.5-6	40-160	807A	.5-4	20-160
33A	.5-2	1-4	801A	.5-4	.5-4
35A	1.5-6	20-80	805A	.5-4	10-80
37A	1.5-6	1-4	801A	.5-4	.5-4
43A	.5-2	20-80	805A	.5-4	10-80
58A	.5-2	5-2	801A	.5-4	.5-4
65A	1.5-6	5-2	801A	.5-4	.5-4
101A	4-16	10-40	806A	2-16	10-80
104A	4-16	20-80	806A	2-16	10-80
113A	4-16	40-160	808A	2-16	20-160
116A	4-16	4-16	804A	2-16	2-16
149A	4-16	2-8	804A	2-16	2-16
12IAC52A 2A	1.5-6	.....	12IAC52A801A	.5-4	.....
3A	.5-2	.....	801A	.5-4	.....
101A	4-16	.....	802A	2-16	.....
12IAC52B 2A	1.5-6	10-40	12IAC52B805A	.5-4	10-80
3A	.5-2	10-40	805A	.5-4	10-80
14A	1.5-6	4-16	803A	.5-4	2-16
15A	.5-2	4-16	803A	.5-4	2-16
17A	.5-2	2-8	803A	.5-4	2-16
19A	1.5-6	20-80	805A	.5-4	10-80
101A	4-16	10-40	806A	2-16	10-80
104A	4-16	20-80	806A	2-16	10-80
113A	4-16	4-16	804A	2-16	2-16
12IAC53A 2A	1.5-6	.....	12IAC53A803A	1.5-12	.....
3A	.5-2	.....	801A	.5-4	.....
101A	4-16	.....	803A	1.5-12	.....
12IAC53B 2A	1.5-6	10-40	12IAC53B811A	1.5-12	10-80
3A	.5-2	10-40	805A	.5-4	10-80
9A	.5-2	2-8	803A	.5-4	2-16
10A	.5-2	4-16	803A	.5-4	2-16
12A	1.5-6	2-8	810A	1.5-12	2-16
14A	1.5-6	4-16	810A	1.5-12	2-16
21A	1.5-6	7-28	811A	1.5-12	10-80
23A	.5-2	20-80	805A	.5-4	10-80
25A	.5-2	1-4	801A	.5-4	.5-4
26A	1.5-6	20-80	811A	1.5-12	10-80
33A	1.5-6	1-4	809A	1.5-12	.5-4
35A	.5-2	5-2	801A	.5-4	.5-4
52A	1.5-6	40-160	812A	1.5-12	20-160
65A	.5-2	40-160	807A	.5-4	20-160
101A	4-16	10-40	811A	1.5-12	10-80
104A	4-16	20-80	811A	1.5-12	10-80

Previous Model			Superseding IAC 800 Model		
Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)	Model Number	Time Over-Current Unit Range (amps)	Instant. Unit Range (amps)
12IAC53B113A	4-16	4-16	12IAC53B810A	1.5-12	2-16
120A	4-16	7-28	811A	1.5-12	10-80
127A	4-16	40-160	812A	1.5-12	20-160
129A	4-16	2-8	810A	1.5-12	2-16
12IAC54A 2A	1.5-6	.....	12IAC54A803A	1.5-12	.....
3A	.5-2	.....	801A	.5-4	.....
101A	4-16	.....	803A	1.5-12	.....
12IAC54B 2A	1.5-6	10-40	12IAC54B811A	1.5-12	10-80
3A	.5-2	10-40	805A	.5-4	10-80
13A	.5-2	4-16	803A	.5-4	2-16
16A	1.5-6	20-80	811A	1.5-12	10-80
20A	.5-2	2-8	803A	.5-4	2-16
21A	1.5-6	4-16	810A	1.5-12	2-16
23A	1.5-6	2-8	810A	1.5-12	2-16
101A	4-16	10-40	811A	1.5-12	10-80
104A	4-16	20-80	811A	1.5-12	10-80
122A	4-16	4-16	810A	1.5-12	2-16
124A	4-16	40-160	812A	1.5-12	20-160
12IAC77A 11A	4-16	.....	12IAC77A803A	1.5-12	.....
12A	1.5-6	.....	803A	1.5-12	.....
13A	.5-2	.....	801A	.5-4	.....
12IAC77B 31A	4-16	10-40	12IAC77B811A	1.5-12	10-80
32A	1.5-6	10-40	811A	1.5-12	10-80
33A	.5-2	10-40	805A	.5-4	10-80
34A	4-16	20-80	811A	1.5-12	10-80
35A	4-16	4-16	810A	1.5-12	2-16
36A	4-16	40-160	812A	1.5-12	20-160
37A	1.5-6	2-8	810A	1.5-12	2-16
38A	1.5-6	1-4	809A	1.5-12	.5-4
39A	1.5-6	4-16	810A	1.5-12	2-16
40A	.5-2	4-16	803A	.5-4	2-16
45A	.5-2	1-4	801A	.5-4	.5-4
46A	1.5-6	20-80	811A	1.5-12	10-80
47A	.5-2	2-8	803A	.5-4	2-16
49A	.5-2	20-80	805A	.5-4	10-80
50A	.5-2	40-160	807A	.5-4	20-160
51A	4-16	2-8	810A	1.5-12	2-16
56A	1.5-6	40-160	812A	1.5-12	20-160
59A	1.5-6	1.5-6	810A	1.5-12	2-16
12IAC78A 4A	4-16	.....	12IAC78A803A	1.5-12	.....
5A	1.5-6	.....	803A	1.5-12	.....
6A	.5-2	.....	801A	.5-4	.....
12IAC78B 11A	4-16	10-40	12IAC78B811A	1.5-12	10-80
12A	1.5-6	10-40	811A	1.5-12	10-80
13A	.5-2	10-40	805A	.5-4	10-80
14A	4-16	20-80	811A	1.5-12	10-80
15A	4-16	4-16	810A	1.5-12	2-16
16A	1.5-6	4-16	810A	1.5-12	2-16
17A	1.5-6	2-8	810A	1.5-12	2-16
18A	1.5-6	20-80	811A	1.5-12	10-80

For Time-overcurrent Protection of Ac Circuits and Apparatus

INTRODUCTION

Type IFC relays, the newest time-overcurrent relay family, feature smaller size, visible CT shorting, improved testing and extended time and instantaneous current ranges. The IFC is available in 50 and 60 Hertz models with the following time-current characteristics:

- Inverse
- Very Inverse
- Extremely Inverse
- Inverse Long Time
- Inverse Medium Time
- Inverse Short Time

An instantaneous overcurrent unit is optional.

DESCRIPTION

Type IFC relays are used for the protection of industrial and utility power systems against either phase or ground overcurrent. They are single-phase, non-directional, current sensitive ac devices. The basic operating mechanism (the time unit) produces one of several available operating characteristics with operating time inversely related to operating current to permit coordination with other protective devices. It consists of a magnetic-core operating coil, an induction disk, damping magnet, and a mechanical target. The IFC relay may also include a hinged-armature instantaneous overcurrent unit with its own target.

The IFC relay is mounted in a drawout case, permitting front access with the cover off or removal from the case for testing and maintenance. The drawout element consists of a one-piece, molded support structure on which relay subassemblies are mounted. The case—also a one-piece, glass-filled polyester molding — is suitable for either semi-flush or surface mounting. The cover is completely transparent, permitting visual inspection of the relay and determination of CT shorting bar and relay target position.

The time-overcurrent unit has a pickup current range of 0.5-4 amperes or 1-12 amperes. The associated target and seal-in unit is dual rated for 0.2 or 2 amperes, and has high seismic capability.

The instantaneous unit is a hinged-armature relay with high seismic capability. A sliding link selects the upper or lower portion of the 2-50 ampere or 6-150 ampere range of setting adjustment.

APPLICATION

IFC relays are used for protection of feeders, transmission lines, alternating current machines, transformers and for numerous other applications where an operating time inversely related to operating current is required.

Six inverse time/current operating characteristics are available with the IFC (see Figure 2), as follows:

EXTREMELY INVERSE TIME relays (IFC77) are intended for applications, such as on utility distribution feeders, where sufficient time delay must be provided to allow a re-energized circuit to pick up without unnecessary tripping during the inrush period, and at the same time coordinate properly with power fuses and fuse cutouts.

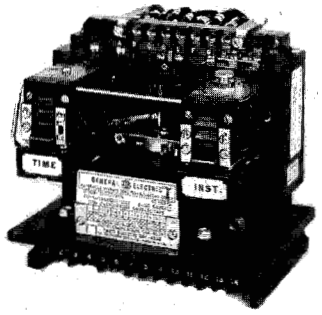
VERY INVERSE TIME relays (IFC53) are best applied on systems where the magnitude of the short circuit current flowing through any given relay is dependent mainly upon the relative location of the fault with respect to the relay and only slightly or not at all upon the system generating capacity.

INVERSE TIME relays (IFC51) are generally applied where the short-circuit current magnitude is dependent largely upon the system generating capacity at the time of the fault.

INVERSE LONG TIME (IFC66) relays are designed for applications requiring long time delay. One major application is in the overcurrent protection of large motors.

MOTOR PROTECTION RELAYS provide overcurrent protection for starting, overload, and fault conditions. The IFC66K relay has an inverse long time characteristic (as described above) which approximates the motor thermal limit, and two instantaneous overcurrent units. The first instantaneous unit is set above the maximum motor starting current and protects for fault conditions only. The second, a special high dropout unit, is customarily used for supervising the time overcurrent unit to permit tripping for stall and heavy overload conditions. Operation of only the time unit indicates a light or moderate overload condition and can be used as an alarm.

INVERSE MEDIUM TIME (IFC57) relays are used as generator or transformer neutral relays or as backup protection for feeder ground faults. Also, the inverse medium time relay may be used where a slower relay is required to obtain coordination.



(Photo 8043267)

Fig. 1. IFC51B overcurrent relay

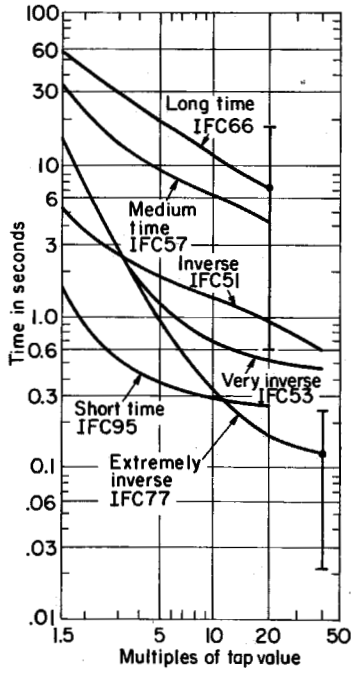


Fig. 2. Typical operating characteristics at 60 Hz Type IFC relays. The No. 5 time-dial setting is shown for each curve, and the range of time adjustment from 0.5 to 10 time-dial settings is shown for the extremely inverse, and the inverse long time relays.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

APPLICATION (Cont'd)

INVERSE SHORT TIME (IFC95) relays are used on equipments where tripping must be relatively fast but should not approach the operating time of an instantaneous unit.

DESIGN FEATURES

SMALLER SIZE—The IFC is smaller in both height and width than the IAC and takes up 25 percent less panel space.

LOWER INVENTORY—Relay selection is simpler and there are fewer models to stock due to the IFC's extended time and instantaneous ranges.

EASIER MAINTENANCE—All live parts are recessed. CT shorting contacts are located at the front and are clearly visible. Case and relay support structure are molded from insulating glass-filled polyester. The IFC is recognized under the Component Program of Underwriters' Laboratories, Inc.

IMPROVED TESTING—The connection feature and test probes make IFC testing easier and more flexible. Time-current characteristics are not changed by removing the relay from its case. See appropriate handbook section for information on test probes and plugs.

RETAINS IAC FEATURES—IFC relays use the simple, reliable induction disk principle in a fully-drawout construction. External terminal connections are identical. Performance characteristics and application criteria are the same.

SEALED CASE—A one-piece, seamless molded case with hooded flange and positive gasket seal provides superior protection in dirty or corrosive environments.

HIGH-SEISMIC CAPABILITY—Seismic Fragility Level exceeds maximum acceleration of 4g ZPA (10g peak) when tested using a biaxial, multi-frequency input.

SELECTION GUIDE — 0.2/2.0 Amp Target and Seal-in

Ratings (Amperes)		Model Number						Case Size	Approx. Wt. in lb (kg)	
Time Unit	Instantaneous Unit	Inverse Time IFC51	Very Inverse Time IFC53	Extremely Inverse Time IFC77	Short Time IFC95	Medium Time IFC57	Long Time IFC66		Net	Ship
60 HERTZ, 1 N.O. Contact										
0.15-1.2	.....	.....	12IFC53A6A	.....						
0.5-4	.....	12IFC51A2A	A2A	12IFC77A2A						
2.5-7.5	.....	.....	.....	.....						
1-12	.....	A1A	A1A	A1A						
0.5-4	2-50	B2A	B2A	B2A						
1-12	2-50	.....	B3A	B3A						
1-12	6-150	B1A	B1A	B1A						
2.5-7.5	6-150	.....	.....	.....						
0.5-4.0	2-8①		12IFC53M1A							
0.5-4.0	4-16①		M2A							
0.5-4.0	10-40①		M3A							
0.5-4.0	20-80①		M4A							
1-12	2-8①		M5A							
1-12	4-16①		M6A							
1-12	10-40①		M7A							
1-12	20-80①		M8A							
50 HERTZ, 1 N.O. Contact										
0.15-1.2	.....	.....	12IFC53A6A	.....						
0.5-4	.....	12IFC51A5A	A2A	12IFC77A2A						
2.5-7.5	.....	.....	.....	.....						
1-12	.....	A4A	A1A	A1A						
0.5-4	2-50	B5A	B2A	B2A						
1-12	2-50	.....	B3A	B3A						
1-12	6-150	B4A	B1A	B1A						
2.5-7.5	6-150	.....	.....	.....				C1	8 (3.6)	14 (6.3)
0.5-4.0	2-8①		12IFC53M1A							
0.5-4.0	4-16①		M2A							
0.5-4.0	10-40①		M3A							
0.5-4.0	20-80①		M4A							
1-12	2-8①		M5A							
1-12	4-16①		M6A							
1-12	10-40①		M7A							
1-12	20-80①		M8A							
60 HERTZ, 2 N.O. Contacts (See Section, Output Contact Arrangement)										
0.5-4	.....	12IFC51AD2A	12IFC53AD2A	12IFC77AD2A	12IFC95AD2A	12IFC57AD2A	.....			
1-12	.....	AD1A	AD1A	AD1A	AD1A	AD1A	.....			
2.5-7.5	.....	.....	.....	.....	.....	.....	12IFC66AD1A			
2.5-7.5	6-150	.....	.....	.....	.....	.....	BD1A			
0.5-4	2-50	BD2A	BD2A	BD2A	BD2A	BD2A	.....			
1-12	2-50	.....	BD3A	BD3A	.....	.....	.....			
1-12	6-150	BD1A	BD1A	BD1A	BD1A	BD1A	.....			
2.5-7.5	6-150						12IFC66CD1A ②			
1.5-6.0	1.5-5.0				12IFC95FD1A					
2.5-7.5	6-150 2-8①	.....	.....	.....	.....	.....	12IFC66KD1A			
50 HERTZ, 2 N.O. Contacts (See Section, Output Contact Arrangement)										
0.5-4	.....	12IFC51AD5A	12IFC53AD2A	12IFC77AD2A	12IFC95AD2A	12IFC57AD2A	.....			
1-12	.....	AD4A	AD1A	AD1A	AD1A	AD1A	.....			
2.5-7.5	.....	.....	.....	.....	.....	.....	12IFC66AD2A			
2.5-7.5	6-150	.....	.....	.....	.....	.....	BD2A			
0.5-4	2-50	BD5A	BD2A	BD2A	BD2A	BD2A	.....			
1-12	2-50	.....	BD3A	BD3A	.....	.....	.....			
1-12	6-150	BD4A	BD1A	BD1A	BD1A	BD1A	.....			
2.5-7.5	6-150						12IFC66CD1A			
1.5-6.0	1.5-5.0				12IFC95FD1A					
2.5-7.5	6-150 2-8①	.....	.....	.....	.....	.....	12IFC66KD2A			

① High-Dropout Instantaneous Unit. ② Wound Shading Coil on TOC Unit.

AVAILABLE SETTINGS

Time-Overcurrent Units:

Range (Amps)	Taps (Amps)
0.15-1.2	0.15, 0.2, 0.25, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 1.0, 1.2
0.5-4.0	0.5, 0.6, 0.7, 0.8, 1.0, 1.2, 1.5, 2.0, 2.5, 3.0, 4.0
1-12	1.0, 1.2, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 10.0, 12.0
1.5-6.0	1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 6.0
2.5-7.5	2.5, 2.8, 3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.5

Instantaneous Units:

Pick-up setting is continuously adjustable over the entire range.

OPERATING COIL RATINGS

Note that relays with both time-overcurrent and instantaneous units are limited to the lesser of the respective current ratings, since the operating coils are connected in series.

TIME-OVERCURRENT UNIT

	IFC51		IFC53			IFC57		IFC66	IFC77		IFC95		
Tap Setting	0.5-4.0 Tap	1-12 Tap	.15-1.2 Tap	0.5-4.0 Tap	1-12 Tap	0.5-4.0 Tap	1-12 Tap	2.5-7.5 Tap	0.5-4.0 Tap	1-12 Tap	0.5-4.0 Tap	1-12 Tap	1.5-6.0 Tap
CONTINUOUS CURRENT RATING - IN AMPERES													
0.15			1.3										
0.2			1.4										
0.25			1.5										
0.3			1.6										
0.4			1.7										
0.5	1.6		1.9	3.8		2.3			2.5		1.2		
0.6	1.8		2.0	4.0		2.5			2.7		1.4		
0.7	2.0		2.1	4.2		2.7			3.0		1.5		
0.8	2.1		2.2	4.4		2.9			3.2		1.6		
1.0	2.3	2.7	2.4	4.7	6.8	3.3	3.9		3.6	5.8	1.9	2.0	
1.2	2.7	4.1	2.5	5.0	7.1	3.6	4.3		4.0	6.4	2.1	2.3	
1.5	3.0	4.6		5.3	7.7	4.1	4.8		4.5	7.2	2.4	2.7	3.0
2.0	3.5	5.3		5.8	8.3	4.7	5.3		5.2	8.4	2.9	3.3	3.5
2.5	4.0	6.0		6.2	8.8	5.3	6.2	5.0	5.9	9.4	3.3	3.9	4.0
2.8								5.3					
3.0	4.5	6.5		6.6	9.4	5.8	6.8	5.5	6.5	10.4	3.7	4.5	4.4
3.5								5.8					
4.0	5.0	7.6		7.1	10.3	6.8	7.8	6.1	7.5	12.1	4.5		5.3
4.5								6.4					
5.0		8.5			11.0		8.8	6.8		13.6		6.6	6.0
5.5								7.0					
6.0		9.3			11.6		9.7	7.3		15.1		7.5	7.0
6.5								7.5					
7.0		10.0			12.4		10.4			16.4		8.4	
7.5								8.0					
8.0		10.8			12.6		11.1			17.6		9.3	
10.0		12.1			13.5		12.4			19.8		10.9	
12.0		13.2			14.4		13.6			21.8		12.5	
ONE-SECOND CURRENT RATING-AMPERES													
All	128	260	60	140	260	128	260	260	84	220	82	164	246

INSTANTANEOUS UNIT

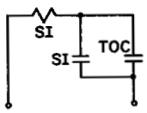
Rating (Amps)	Range Conn. of Unit	Range① (Amps)	Continuous Rating (Amps)	One-Second Rating (Amps)
1.5-5.0	—	1.5-5.0	4.8	130
2-8① (IFC66KD only)	Lower	2-4	3.7	130
	Upper	4-8	4.8	
2-8①	Lower	2-4	1.9	70
	Upper	4-8	3.0	
2-50	Lower	2-10	3.5	130
	Upper	10-50	8.0	
4-16①	Lower	4-8	4.3	140
	Upper	8-16	6.9	
6-150	Lower	6-30	8.0	260
	Upper	30-150	18.0	
10-40①	Lower	10-20	9.0	275
	Upper	20-40	16.2	
20-80①	Lower	20-40	12.6	275
	Upper	40-80	20.0	

① This range is approximate, which means that 6-30 and 30-150 might actually be 6-28 and 28-150. However, there is at least a one-amp overlap between the maximum "Low" setting and the minimum "High" setting.

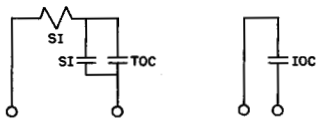
OUTPUT CONTACT ARRANGEMENTS

*Note: The electrical separate second contact associated with the seal-in unit will operate only when the main unit's (time-over-current unit) contact closes and the target seal-in unit draws trip current. Thus, the second contact should be used for alarm purposes only.

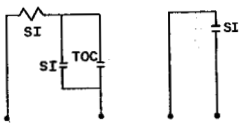
IFC51A, 53A, 77A



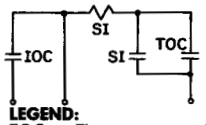
IFC95FD



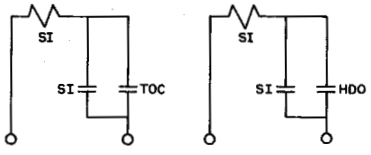
***IFC51AD, 53AD, 57AD, 66AD, 77AD, 95AD**



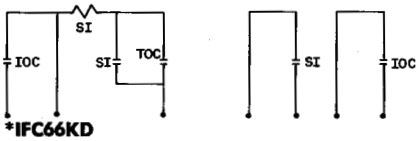
IFC51B, 53B, 77B



IFC53M

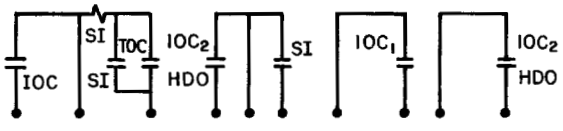


***IFC51BD, 53BD, 57BD, 66BD, 66CD, 77BD, 95BD**



LEGEND:
TOC = Time-overcurrent Unit
IOC = Instantaneous Unit
SI = Seal-in Unit
HDO = High Dropout Instantaneous Unit

***IFC66KD**



SUBSTITUTION TABLE

Time-Current Characteristic	60 Hertz IAC Model			IFC Model Which Supercedes IAC				50 Hertz IAC Model		
	Time Range	Inst. Range	Model Number	60 Hertz Model Number	Time Range	Inst. Range	50 Hertz Model Number	Model Number	Time Range	Inst. Range
	(Amps)				(Amps)				(Amps)	
Inverse	0.5-4 2-16	— —	IAC51A801A A802A	IFC51A2A A1A	0.5-4 1-12	— —	IFC51A5A A4A	IAC51A804A A805A	0.5-4 2-16	— —
Inverse with Instantaneous	0.5-4	0.5-4 2-16 10-80	IAC51B801A B803A B805A	IFC51B2A	0.5-4	2-50	IFC51B5A	IAC51B821A B823A B825A	0.5-4	0.5-4 2-16 10-80
	2-16	2-16 10-80 20-160	IAC51B804A B806A B808A	IFC51B1A	1-12	6-150	IFC51B4A	IAC51B824A B826A B828A	2-16	2-16 10-80 20-160
Very Inverse	0.5-4 1.5-12	— —	IAC53A801A A803A	IFC53A2A A1A	0.5-4 1-12	— —	IFC53A2A A1A	IAC53A801A A803A	0.5-4 1.5-12	— —
Very Inverse with Instantaneous	0.5-4	0.5-4 2-16 10-80	IAC53B801A B803A B805A	IFC53B2A	0.5-4	2-50	IFC53B2A	IAC53B801A B803A B805A	0.5-4	0.5-4 2-16 10-80
	1.5-12	2-16	IAC53B810A	IFC53B3A	1-12	2-50	IFC53B3A	IAC53B810A	1.5-12	2-16
	1.5-12	10-80 20-160	IAC53B811A B812A	IFC53B1A	1-12	6-150	IFC53B1A	IAC53B811A B812A	1.5-12	10-80 20-160
Very Inverse with High Dropout Instantaneous	0.5-2.0 0.5-2.0 1.5-6.0 1.5-6.0 1.5-6.0	2-6① 4-12① 10-30① 4-12① 2-6①	IAC53M5A M9A M3A M6A M7A	IFC53M1A M2A M7A M6A M5A	0.5-4.0 0.5-4.0 1-12 1-12 1-12	2-8 4-16 10-40 4-16 2-8	— — — — —	— — — — —	— — — — —	— — — — —
Extremely Inverse	0.5-4 1.5-12	— —	IAC77A801A A803A	IFC77A2A A1A	0.5-4 1-12	— —	IFC77A2A A1A	IAC77A804A A805A	0.5-4 1.5-12	— —
Extremely Inverse with Instantaneous	0.5-4	0.5-4 2-16 10-80	IAC77B801A B803A B805A	IFC77B2A	0.5-4	2-50	IFC77B2A	IAC77B821A B823A B825A	0.5-4	0.5-4 2-16 10-80
	1.5-12	2-16	IAC77B810A	IFC77B3A	1-12	2-50	IFC77B3A	IAC77B824A	1.5-12	2-16
	1.5-12	10-80 20-160	IAC77B811A B812A	IFC77B1A	1-12	6-150	IFC77B1A	IAC77B826A B828A	1.5-12	10-80 20-160
Medium-time Inverse	0.5-2	—	IAC57A3A	IFC57AD2A	0.5-4	—	IFC57AD2A	IAC57A6A	0.5-2	—
	1.5-6 4-16	— 20-80	IAC57A2A A101A	IFC57AD1A	1-12	—	IFC57AD1A	IAC57A8A A104A	1.5-6 4-16	— —
Medium-time Inverse with Instantaneous	0.5-2	10-40	IAC57B3A	IFC57BD2A	0.5-4	2-50	IFC57BD2A	IAC57B7A	0.5-2	10-40
	1.5-6 1.5-6 1.5-6 4-16 4-16	10-40 20-80 4-16 10-40 20-80	IAC57B2A B10A B13A B101A B104A	IFC57BD1A	1-12	6-150	IFC57BD1A	IAC57B6A B11A B105A B108A	1.5-6 1.5-6 4-16 4-16	10-40 20-80 10-40 20-80
Long-time Inverse	2.5-5 4-8	— —	IAC66A1A A2A	IFC66AD1A	2.5-7.5	—	IFC66AD2A	IAC66A12A A14A	4-8 2.5-5	— —
Long-time Inverse with Instantaneous	2.5-5 4-8 2.5-5 4-8 2.5-5 4-8 2-6	10-40 10-40 20-80 20-80 4-16 40-160 10-40	IAC66B1A B2A B3A B4A B5A B16A B30A	IFC66BD1A	2.5-7.5	6-150	IFC66BD2A	IAC66B7A B8A B9A B10A	2.5-5 4-8 2.5-5 4-8	10-40 10-40 20-80 20-80
Long-time Inverse with Standard and HighDropout Instantaneous	2.5-5 4-8 2.5-5 4-8 2.5-5 4-8 2.5-5 4-8 2.5-5 2-6 2-6	10-40 10-40 20-80 40-160 40-160 20-80 20-80 10-40 4-16 10-40 20-80	IAC66K6A K7A K8A K14A K16A K19A K20A K24A K30A K36A K37A	IFC66KD1A	2.5-7.5	6-150 2-8*	IFC66KD2A	IAC66K1A K2A K4A K10A	2.5-5 2.5-5 4-8 2.5-5	10-40 20-80 40-160 40-160
Short-time Inverse	0.5-2	—	IAC55A3A	IFC95AD2A	0.5-4	—	IFC95AD2A	IAC55A6A	0.5-2	—
	1.5-6 4-16 1.5-6	— — —	IAC55A2A A101A A1A	IFC95BD1A	1-12	—	IFC95BD1A	IAC55A5A A104A	1.5-6 4-16	— —
Short-time Inverse with Instantaneous	0.5-2 0.5-2 0.5-2 1.5-6 0.5-2	10-40 4-16 2-8 2-8 1-4	IAC55B3A B10A B17A B20A B25A	IFC95BD2A	0.5-4	2-50	IFC95BD2A	IAC55B7A B14A B22A	0.5-2	10-40 4-16 2-8
	1.5-6 1.5-6 0.5-2 1.5-6 4-16 4-16 4-16 4-16	10-40 4-16 20-80 20-80 10-40 20-80 4-16 40-160	IAC55B2A B9A B18A B19A B101A B104A B115A B121A	IFC95BD1A	1-12	6-150	IFC95BD1A	IAC55B6A B105A B108A B122A	1.5-6 4-16 4-16 4-16	10-40 10-40 20-80 4-16

① High dropout instantaneous unit.

For Instantaneous Overcurrent or Undercurrent Protection of Ac and Dc Circuits and Machines

APPLICATION

General Service: The Type PJC relay is a high-speed, non-directional current relay that is designed for general service.

Feeder Circuit Overcurrent Protection is a common application for the Type PJC relay where time delay and directional selectivity are not required and where very short tripping times on high-fault currents are desired.

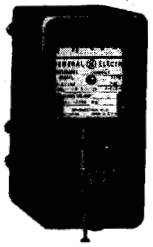
On applications requiring time delay or directional selectivity, the Types IFC or IBC should be used.

DESCRIPTION

(a) The Type PJC is a plunger relay that operates on the principle of electromagnetic attraction. The contacts are opened or closed by an armature which is attracted vertically into a small solenoid.

(b) Generally, the PJC is a single element relay, but these units can be mounted in the drawout case to provide a 2- or 3-unit relay. This grouping of units in a drawout case saves valuable panel space and provides for easy testing and checking. See tabulation, pages 2 and 3 for available combinations.

(c) The basic PJC11, PJC12, PJC14 and PJC15 relays have mechanical targets. The PJC32 line of relays has a somewhat smaller base and thus allows 3 units to be mounted horizontally in the S-1 or S-2 case with the conventional 0.2/2A target seal-in.



(Photo 8007137)

Fig. 1. Type PJC molded case relay.

CONTACT INTERRUPTING RATINGS IN AMPERES

Ac Circuits			Dc Circuits		
Noninductive		Inductive	Noninductive		Inductive
Volts	Amps	Amps	Volts	Amps	Amps
115	5	2	24	5	1.0
230	2	1	48	2	0.5
460	1	0.5	125	1	0.3
...	...	...	250	0.3	0.15

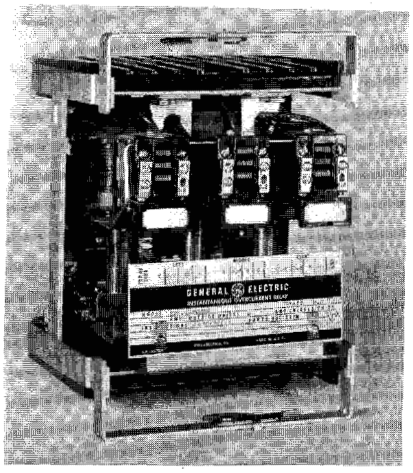
OVERCURRENT RATINGS

Continuous Rating Amperes	Calibration Points			
.06	.02	.032	.05	.08
.12	.04	.064	.1	.16
.2	.05	.08	.125	.2
.225	.075	.12	.188	.3
.3	.1	.16	.25	.4
.6	.2	.32	.5	.8
1	.4	1.6	4	10
1.5	.5	.8	1.25	2
3	1	1.6	2.5	4
5	2	8	20	50
6	2	3.2	5	8
10	4	16	40	100
12	4	6.4	10	16
25	10	16	25	40
25	20	32	50	80
25	40	64	100	160

RELAY CHARACTERISTICS

High-speed Operation: The contact closing time is approximately 1 cycle (60-Hertz bases) at twice the pickup setting.

High Dropout: Contacts reset at approximately 90 to 95 percent of pickup on ac and 70 to 85 percent of pickup on dc when the relay has at least one circuit-closing contact.



(Photo 8040758)

Fig. 2. Type PJC32 relay (removed from case).

Continuous-current Rating: The relay coils are continuously rated as specified on the nameplate for frequencies of 25 to 60 Hertz and dc. Ratings for continuous operation on ac are for the **non picked-up position only.** However, the limitation is mechanical, not thermal, and the relay life expectancy under continuously picked-up conditions is a matter of months.

Self-or Hand-reset: Relays listed in this section have self-resetting contacts and hand-reset targets. Special models that are not listed are available having hand-reset contacts.

Calibration: The standard relays are calibrated at 60 Hertz. For 25 or 50 Hertz and dc applications, this calibration is correct within approximately 10 percent.

Mounting: The molded case relays are surface mounted and have studs for back connection. The drawout case relays can be surface or flush mounted.

CONTACT RATINGS

The current-closing rating of the contacts is 30 amperes. The current-carrying rating is 5 amperes continuously or 30 amperes for 2 seconds.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

TABLE 1—Contact Availability

Relay Models	Number Cont. Per Unit	Contact Types					
		Standard ①	Optional				
PJC11A, 11X, 11Z, 11AV, 11AW, 12A, 12D	2	2 N.O. (Code 20)	2 N.O. (Code 20)	1 N.O. and 1 N.C. (Code 11)	2 N.C. (Code 02)	.....	.....
PJC14C, 14D, 14F	4	2 N.O. and 2N.C. (Code 22)	4 N.O. (Code 40)	3 N.O. and 1 N.C. (Code 31)	2 N.O. and 2 N.C. (Code 22)	1 N.O. and 3 N.C. (Code 13)	4 N.C. (Code 04)
PJC32D, 32E	2	1 N.O. and 1 N.C.	.....	.....	.....	.....	.....
PJC21A, 32C, 32F, 32G, 32H, 32J, 32L	2	2 N.O.	.....	.....	.....	.....	.....
PJC15F	4	4 N.O.	.....	.....	.....	.....	.....

① Unless specified, **standard** contact arrangement will be supplied. To order other than standard contact arrangement, place the contact code behind the model number.

Example: 12PJC11AV3A—Code 11.

N.O. = Normally Open N.C. = Normally Closed

SELECTION GUIDE—Dc, or 25, 50, 60 Hertz Ac

MOLDED CASE RELAYS

Ratings (Amps)			Model Number		Contacts	Approx Wt. in lb (kg)	
Continuous	One Second	Calibration Range	Self-Reset	Hand Reset①		Net	Ship.
.06	2.8	.02-.08	12PJC11A28	.....	2 Contacts (If contact arrangement is not specified, 2 N.O. will be supplied)	2.5 (1.1)	4 (1.8)
.12	5.7	.04-.16	A29	.....			
.2	9.2	.05-.7	A10	.....			
.225	11.4	.075-.3	A30	.....			
.3	18.2	.1-.4	A9	.....			
.6	36.8	.2-.8	A8	12PJC12A10			
1.5	75	.5-2	A1	A1			
3	150	1-4	A2	A2			
6	275	2-8	A3	A3			
12	280	4-16	A4	A4			
25	500	10-40	A5	A5			
40	500	20-80	A6	A6			
40	500	40-160	A7	A7			
1.5	75	.5-2	12PJC14D1	12PJC14F1	4 Contacts (If contact arrangement is not specified, 2 N.O. & 2 N.C. will be supplied)		
3	150	1-4	D2	F2			
6	275	2-8	D3	F3			
12	280	4-16	D4	F4			
25	500	10-40	D5	F5			
40	500	20-80	D6	F6			
40	500	40-160	D7	F7			

DRAWOUT CASE RELAYS

Ratings (Amps)			Model Number		Contacts	Case Size	Approx Wt. in lb (kg)	
Continuous	One Second	Calibration Range	Self-Reset	Hand Reset①			Net	Ship.
ONE UNIT								
.12	5.7	.04-.16	12PJC11AV23A	.....	2 Contacts (If contact arrangement is not specified, 2 N.O. will be supplied)	S1	8 (3.6)	12 (5.4)
.3	18.2	.1-.4	AV10A	.....				
.6	36.8	.2-.8	AV8A	.....				
1.5	75	.5-2	AV1A	12PJC12D1A				
3	150	1-4	AV2A	D2A				
6	275	2-8	AV3A	D3A				
12	275	4-16	AV4A	D4A				
25	275	10-40	AV5A	D5A				
25	275	20-80	AV6A	D6A				
25	275	40-160	AV7A	D7A				
1.5	75	.5-2	12PJC14C1A	.....	4 Contacts (If contact arrangement is not specified, 2 N.O. & 2 N.C. will be supplied)			
3	150	1-4	C2A	.....				
6	275	2-8	C3A	.....				
12	275	4-16	C4A	.....				
25	275	10-40	C5A	.....				
25	275	20-80	C6A	.....				
25	275	40-160	C7A	.....				
TWO UNITS (Both Units Rated Alike)								
1.5	75	.5-2	12PJC11AW11A	.....	2 Contacts (If contact arrangement is not specified, 2 N.O. will be supplied)	S2	10	15
3	150	1-4	AW12A	.....				
6	275	2-8	AW13A	.....				
12	275	4-16	AW14A	.....				
25	275	10-40	AW15A	.....				
25	275	20-80	AW16A	.....				
25	275	40-160	AW17A	.....				

① N.O. Contact may not remain closed when relay is in the latched-up position.

DRAWOUT CASE RELAYS (Cont'd)

Ratings (Amps)			Model Number		Contacts	Case Size	Approx Wt in lb (kg)	
Continuous	One Second	Calibration Range	Self-Reset	Hand Reset			Net	Ship.
THREE UNITS (All Units Rated Alike)								
1 5 10	73.5 375 500	.4-10 2-50 4-100	12PJC11X2A X3A X1A	....	2 Contacts (If contact arrangement is not specified, 2 N.O. will be supplied)	M2	14 (6.4)	20 (9.1)
1.5 3 6 12 25 25 25	75 150 275 275 275 275 275	.5-2 1-4 2-8 4-16 10-40 20-80 40-160	12PJC11Z1A Z2A Z3A Z4A Z5A Z6A Z7A	....		M2	13 (5.9)	19 (8.6)
1.5 3 6 12 25 25 25	75 150 275 275 275 275 275	.5-2 1-4 2-8 4-16 10-40 20-80 40-160	12PJC15F1A F2A F3A F4A F5A F6A F7A	....	4 N.O.	M2	14 (6.4)	20 (9.1)
ONE UNIT - With 0.2/2.0 Amp Target & Seal-in								
1.5 3 6 12 25 25 25	75 150 275 275 275 275 275	.5-2 1-4 2-8 4-16 10-40 20-80 40-160	12PJC21A1A A2A A3A A4A A5A A6A A7A	....	2 N.O.	S1	8 (3.6)	12 (5.4)

THREE UNITS WITH OR WITHOUT 0.2/2.0 AMP TARGET AND SEAL-IN

Model Number	Contacts (Each Unit)		Int. Conn. Diagram (See page 2-24)	Case Size	Approx. Wt. in lb (kg)	
					Net	Ship.
12PJC32C▲A	2 N.O.	3 Target & Seal-ins	Fig. 3	S2	12 (5.4)	18 (8.2)
12PJC32D▲A	1 N.O. & 1 N.C.	3 Target & Seal-in	Fig. 4	S2		
12PJC32E▲A	1 N.O. & 1 N.C.	3 Target Only	Fig. 5	S2		
12PJC32F▲A	2 N.O.	3 Target & Seal-in	Fig. 6	S2		
12PJC32G▲A	2 N.O.	—	Fig. 7	S1		
12PJC32H▲A	2 N.O.	3 Target & Seal-in	Fig. 8	S1		
12PJC32J▲A	2 N.O.	3 Target Only	Fig. 9	S2		
12PJC32L▲A	2 N.O.	2 Targets	Fig. 10	S1		

▲ Complete the model number by selecting the proper number from the table below.

Calibration Range For Middle Unit (Amps)	Model Number▲ Calibration Range for Left & Right Units (Amps)						
	.5-2	1-4	2-8	4-16	10-40	20-80	40-160
.5-2	23	24	25	26	27	28	29
1-4		34	35	36	37	38	39
2-8			45	46	47	48	49
4-16				56	57	58	59
10-40					67	68	69
20-80						78	79
40-160							89

CONNECTION DIAGRAMS

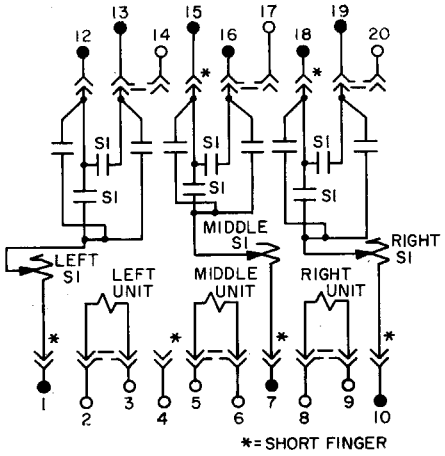


Fig. 3. Internal connections diagram for the PJC32C relay (front view).

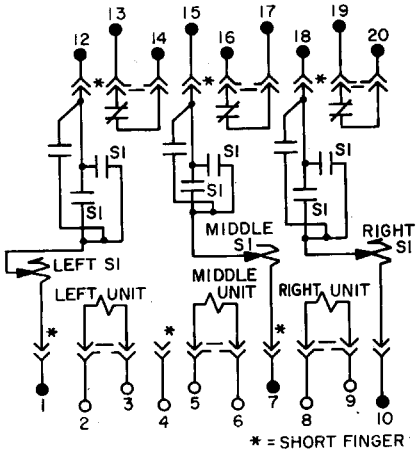


Fig. 4. Internal connections diagram for the PJC32D relay (front view).

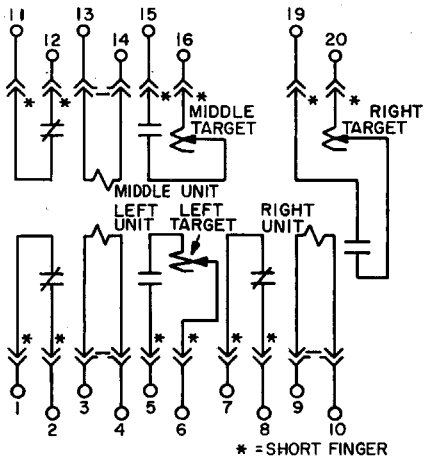


Fig. 5. Internal connections diagram for the PJC32E relay (front view).

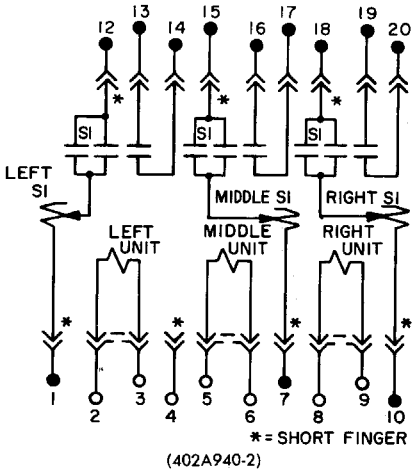


Fig. 6. Internal connections diagram for the PJC32F relay (front view).

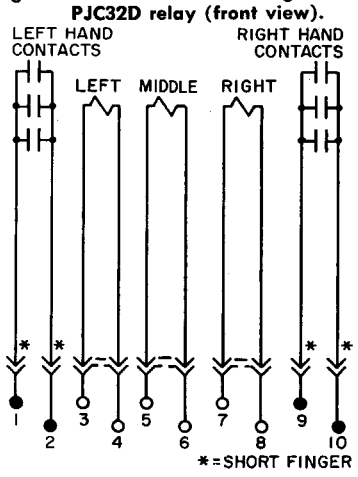


Fig. 7. Internal connections diagram for the PJC32G relay (front view).

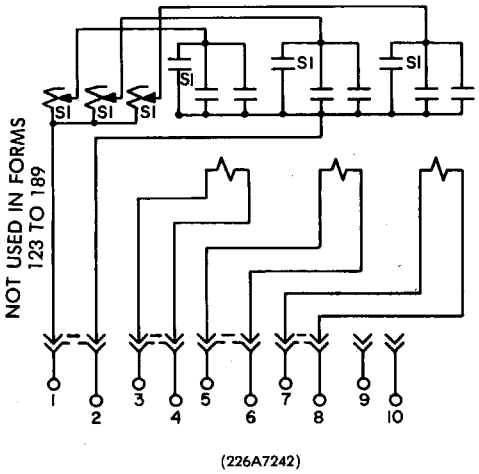


Fig. 8. Internal connections diagram for the PJC32H relay (front view).

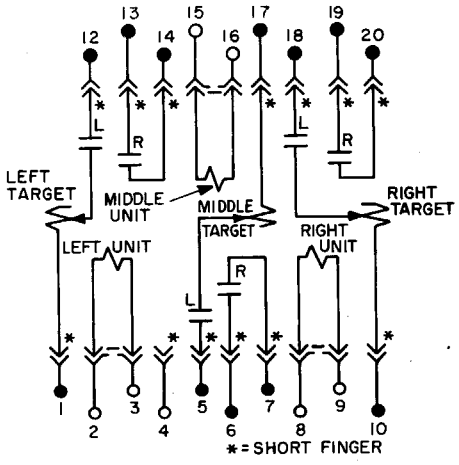


Fig. 9. Internal connections diagram for the PJC32J relay (front view).

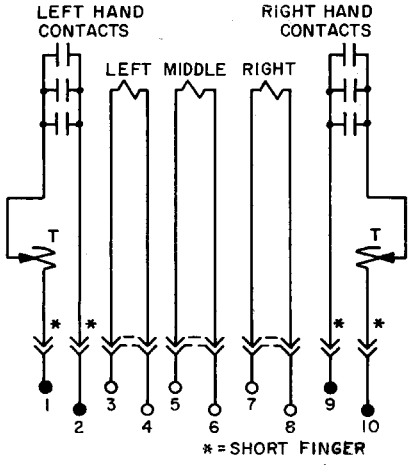


Fig. 10. Internal connections diagram for the PJC32L relay (front view).

DESCRIPTION

The Type BFC relay is an instantaneous-overcurrent relay with harmonic restraint.

The basic instantaneous unit is restrained from operating when the second harmonic component of current is twenty per cent or more of the fundamental component of current. A separate, high-set instantaneous unit of the hinged-armature type operates without harmonic restraint. This unit is factory-set at approximately 26 times the tap value and is designed to assure the relay operates during high-current conditions, when the current transformer may saturate and cause false harmonic restraint of the main unit.

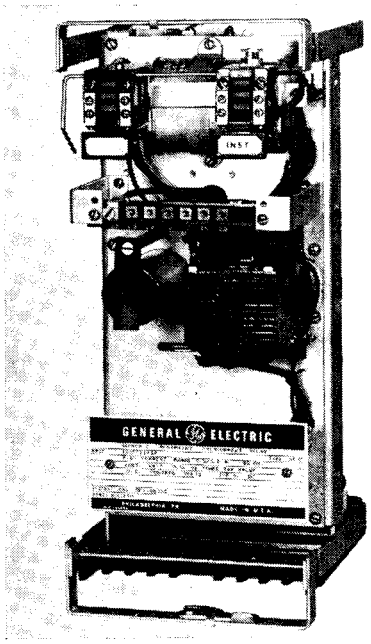
APPLICATION

When applied as a protective relay, the Type BFC relay provides instantaneous protection for faults which exceed the pickup setting. The harmonic restraint feature prevents relay operation when magnetizing inrush currents exist.

The Type BFC relay may be used to supervise ground or phase relays which may operate on inrush current. A typical consideration involves energizing a line which has one or more transformers connected to it. Inrush current to the transformer or transformers may cause the relays to operate at the terminal used to energize the line. The use of a Type BFC relay connected as shown in Fig. 4, page 2-25, will supervise the ground relays to prevent undesired tripping of the line breaker. Phase-relay supervision may be accomplished by using three relays, one in each phase CT lead.

CONTACTS

The auxiliary and instantaneous unit contacts will make and carry 30 amperes for tripping duty for voltages not exceeding 250 volts. If more than one circuit breaker per set of contacts is to be tripped or if the tripping current exceeds 30 amperes, an auxiliary relay must be used. After tripping occurs it is necessary that the tripping circuit of these relays be opened by an auxiliary switch on the circuit breaker or by other automatic means.



(Photo 8035562)

Fig. 1. Type BFC relay in cradle without case.

SELECTION GUIDE

Freq. (Hz)	Cont. Rating (Amps)	Calibration Range① (Amps)	Aux. Rel. Rating (Volts Dc)	Target (Part of Aux. Rel.)	Model Number	Case Size	Approx. Weight lb (kg)	
							Net	Ship
60	5	0.5-2.0	125	Yes	12BFC11A1A	M1	20 (9.0)	30 (13.5)
		4.0-16.0	125		12BFC11A3A			
		0.5-2.0	48		12BFC11A5A			
		4.0-16.0	48		12BFC11A6A			
50		0.5-2.0	125		12BFC11A7A			
		0.5-2.0	250		12BFC11A8A			
		4.0-16.0	125		12BFC11A9A			

① Available Taps—
0.5-2.0 Amps—0.5, 0.6, 0.8, 1.0, 1.2, 1.5, 2.0
4.0-16.0 Amps—4, 5, 6, 7, 8, 10, 12, 16

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

DIAGRAMS

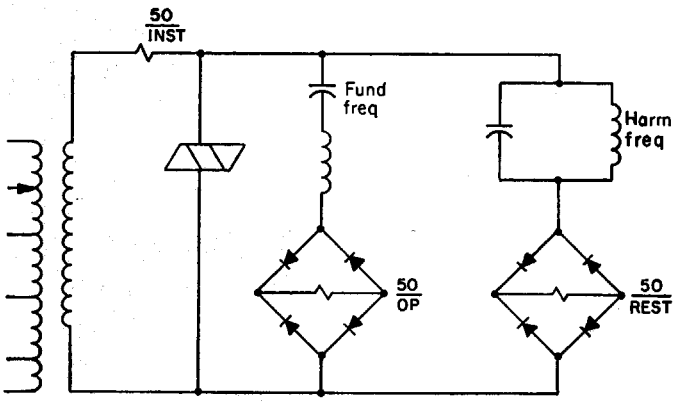


Fig. 2. Operating and restraining circuits of Type BFC relay

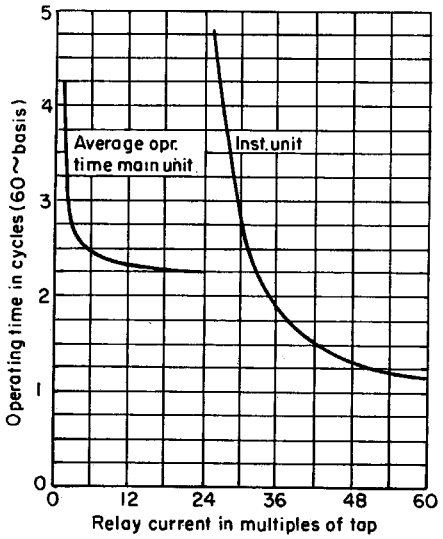


Fig. 3. Operating time characteristic of Type BFC relay (0178A7337)

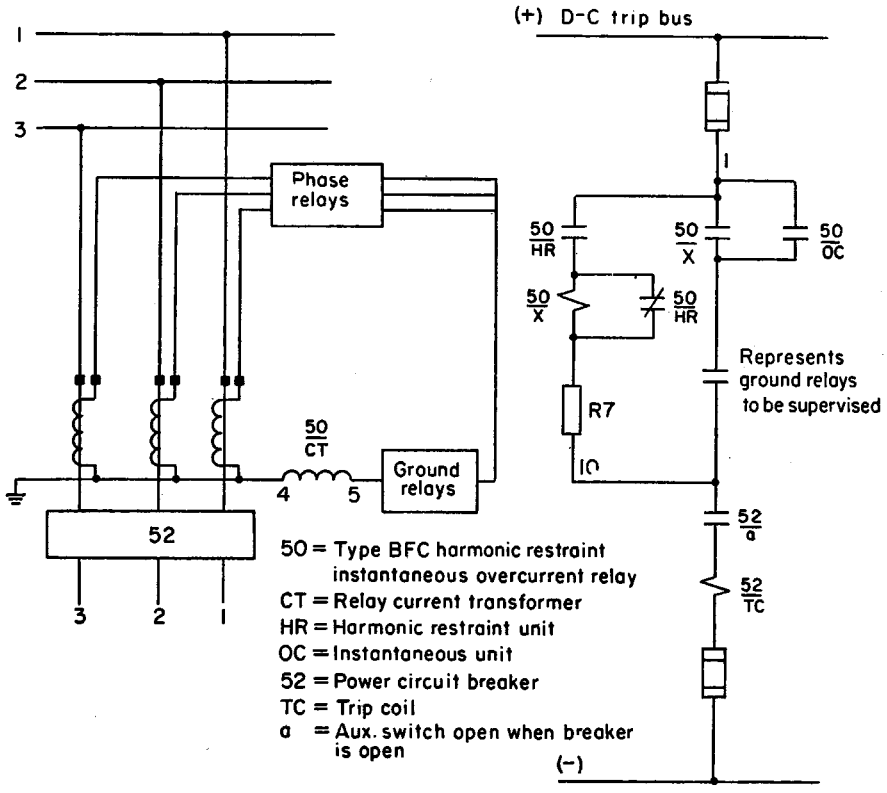


Fig. 4. Typical diagram for Type BFC relay used as a ground-fault detector to supervise ground relays (0178A9087)

DESCRIPTION

The CHC relays are cup-type, high speed, sensitive, overcurrent fault detector relays. These relays may be set to pick up below full load current and operate continuously in the picked-up position. The cup unit circuits are designed to prevent contact welding.

The CHC11A relay is a complete three-phase and ground, multicontact, high speed nondirectional overcurrent relay. The relay consists of an induction cup unit for multiphase faults and a small hinged armature unit for ground faults. Two targets and four electrically separate contacts are available. Three are normally open with a fourth that is field selectable either normally open or closed. An external reactor is supplied with the relay to reduce dropout time of hinged armature unit when applied in breaker failure schemes. Note that use of the reactor will increase pickup of ground fault unit approximately 40 percent.

The CHC15A consists of two cup units. The top unit is used for ground fault detection, with the bottom unit for phase fault detection. Also included in the relay are two targets and four electrically separate contacts; these are normally open with a fourth contact that is field selectable either normally open or closed.

The CHC21A and CHC21C relays consist of an induction cup unit that is responsive to both phase and ground currents, and a telephone type auxiliary relay that provides four or five electrically separate contact circuits. Two of these contact circuits have targets wired in series. The CHC21A auxiliary relay has three normally open contacts and a fourth contact that is field selectable normally open or closed. The CHC21C has an additional normally open contact.

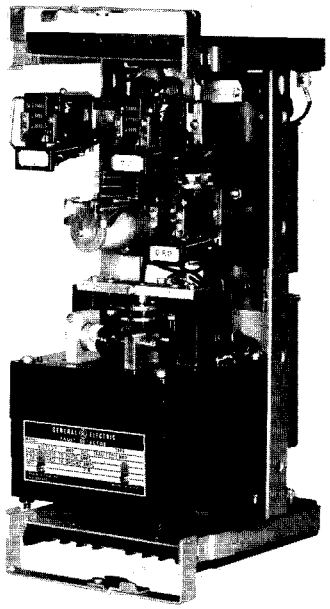
APPLICATION

The CHC11, CHC15, and CHC21 relays may be applied wherever a high-speed fault detector is required. However because it has four or five electrically separate contacts and can be operated continuously in the picked up position, it is particularly well suited for applications as a fault detector in circuit breaker failure schemes. In these schemes, the CHC11, CHC15, and CHC21 relays are used to detect the failed circuit breaker and to select the back up breakers to be tripped in order to isolate the fault.

The CHC12 relay is designed as a current fault detector in conjunction with distance relays to prevent tripping of the circuit breaker or operation of the associated timer because of loss of relay potential supply for reasons other than a system fault. This can occur because of (1) short circuits or open circuits involving the potential supply, (2) from switching (with certain configurations of power circuits) or (3) because of the use of line-side potential supply for the relay. In the latter instance the fault detector protects the associated timer against possible burnout when the breaker is open, and avoids false retripping of the breaker at the instant of reclosure.

RATINGS

The pickup of the cup units and the hinged armature units are continuously adjustable over their entire range.



(Photo 8035502)

Fig. 1. CHC11A fault detector relay (out of case)

The auxiliary telephone relay used in these relays is continuously rated at the nameplate dc voltage for the relay. The contacts can carry three amperes continuously or 30 amperes for two seconds. The current interrupting capabilities are shown in Table I.

The contacts of the cup unit and the hinged armature unit are capable of interrupting the auxiliary telephone unit current.

TABLE I— Auxiliary Telephone Relay Interruping Capabilities

Volts (Dc)	Inductive (Amp)	Non-Inductive (Amp)
48	1.0	3
125	0.5	1.5
250	0.25	1.0

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

GE Protective Relays

SELECTION GUIDE

3 PHASE PROTECTION

Frequency (Hz)	Phase Current (Amps)	Continuous Rating (Amps)	Target and Seal-in (Amps)	Contacts	Model Number	Case Size	Approx. Wt. in Lb. (kg) Net	Ship
60	1-4	5	0.2	1 N.O.	12CHC12A29A	S2	20 (9.1)	25 (11.3)
	1-4		1.0		A25A			
	1-4		2.0		A28A			
	2-8		0.2		A10A			
	2-8		1.0		A2A			
	2-8		2.0		A1A			
	4-16		1.0		A7A			
	10-40		1.0		A12A			
50	2-8		1.0		A13A			

3 PHASE AND GROUND PROTECTION

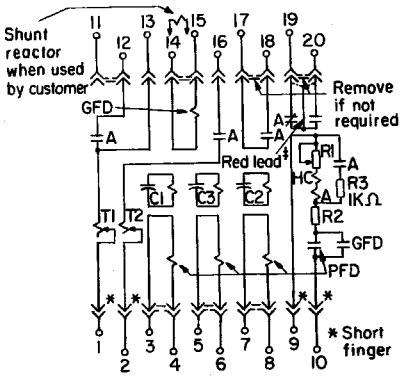
Frequency (Hz)	Phase Current (Amps)	Ground Current (Amps)①	Continuous Rating (Amps) Phase Unit	Ground Unit	Aux. Dc (Volts)	Two Targets (Amps)	Contacts	Model Number	Case Size	Approx. Wt. in Lb. (kg) Net	Ship
60	1-4	0.5-2.0	4		125	0.2/2.0	4 N.O. or 3 N.O. & 1 N.C.	12CHC11A29A	M2	25 (11.3)	31 (14.1)
	1-4	0.5-2.0	4		220			A52A			
	1-4	1-4	4		48			A33A			
	2-8	0.5-2.0	5		48			A25A			
	2-8	0.5-2.0	5		125			A21A			
	2-8	0.5-2.0	5		250			A26A			
	2-8	1-4	5		48			A28A			
	2-8	1-4	5		125			A22A			
	2-8	1-4	5		250			A23A			
	2-8	2-8	5		48			A34A			
	2-8	2-8	5		125			A24A			
	2-8	2-8	5		250			A27A			
	2-8	4-16	5		125			A30A			
	2-8	10-40	5		125			A31A			
	2-8	20-80	5		125			A32A			
	4-16	4-16	5		125			A46A			
	20-80	2-8	5		48			A35A			
50	2-8	0.5-2.0	5		125			A38A			
	2-8	1-4	5		125			A37A			
	2-8	1-4	5		250			A36A			
60	1-4	0.5-2.0	4.0	2.5	125	1.0	4 N.O. or 3 N.O. & 1 N.C.	12CHC15A3A	M2	25 (11.3)	31 (14.1)
	2-8	0.5-2.0	5.0	2.5	48	0.2		A7A			
	2-8	0.5-2.0	5.0	2.5	125	0.2		A2A			
	2-8	0.5-2.0	5.0	2.5	125	1.0		A1A			
	2-8	0.5-2.0	5.0	2.5	250	1.0		A4A			
	2-8	1-4	5.0	5.0	48	1.0		A9A			
	2-8	1-4	5.0	5.0	125	0.2		A8A			
	2-8	1-4	5.0	5.0	125	1.0		A5A			
	4-16	2-8	5.0	5.0	125	1.0		A6A			
	4-16	4-16	5.0	5.0	125	1.0		A10A			

3 PHASE AND GROUND PROTECTION

Frequency (Hz)	Phase Current (Amps)	Ground Current (Amps)①	Continuous Rating (Amps) Phase Unit	Ground Unit	Aux. Dc (Volts)	Two Targets (Amps)	Contacts	Model Number	Case Size	Approx. Wt. in Lb. (kg) Net	Ship
60	2-8	0.5-2.0	10	2.4	48	0.2/2.0	4 N.O. or 3 N.O. & 1 N.C.	12CHC21A3A	M2	22 (10)	27 (12.2)
		0.5-2.0		2.4	110			A6A			
		0.5-2.0		2.4	125			A1A			
		0.5-2.0		2.4	220			A8A			
		0.5-2.0		2.4	250			A4A			
		1-4		4.8	48			A5A			
		1-4		4.8	110			A7A			
		1-4		4.8	125			A2A			
60	2-8	0.5-2.0	10	1	125	0.2/2.0	5 N.O. or 4 N.O. & 1 N.C.	12CHC21C1A	M2	22 (10)	27 (12.2)
		1-4		2	48			C4A			
		1-4		2	125			C2A			
		2-8		4	125			C3A			

① The ground unit is a separate hinged-armature device in the CHC11A and a separate induction cup unit for the CHC15A. The CHC15A. The CHC21A & 21C each use a single induction cup which responds to all phase and ground faults, therefore the phase and ground pickup adjustments are interdependent.

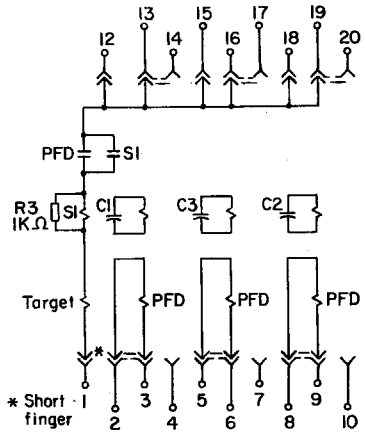
CONNECTION DIAGRAMS



GFD - Hinged arm. unit
PFD - Cup unit
A - Telephone relay
HC - Holding coil
‡ Connect to obtain either normally open or normally closed contact.

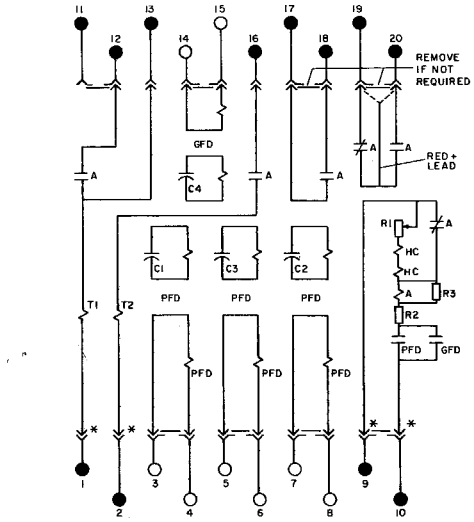
(Dwg. 178A9066)

Fig. 2. Internal connections for CHC11A, front view



(Dwg. 148A3956)

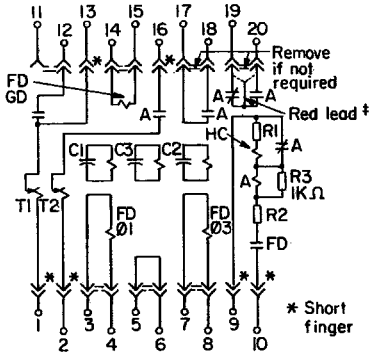
Fig. 3. Internal connections for CHC12A, front view



A = TELEPHONE RELAY
GFD = GROUND FAULT DETECTOR CUP UNIT
PFD = PHASE FAULT DETECTOR CUP UNIT
+ = CONNECT TO OBTAIN EITHER NORMALLY OPEN OR NORMALLY CLOSED CONTACT
* = SHORT FINGER
HC = HOLDING COIL

(Dwg. 1787060)

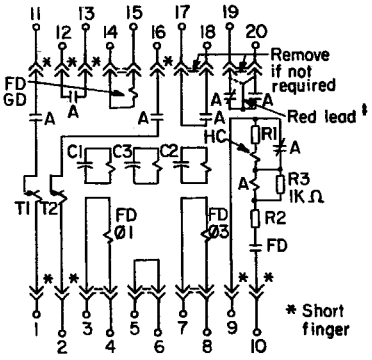
Fig. 5. Internal connections for CHC15A, front view



FD - Cup unit fault detector
A - Telephone relay
HC - Holding coil
‡ Connect to obtain either normally open or normally closed contact.

(Dwg. 227A7097)

Fig. 6. Internal connections for CHC21A, front view



FD - Cup unit fault detector
A - Telephone relay
HC - Holding coil
‡ Connect to obtain either normally open or normally closed contact

(Dwg. 246A2266)

Fig. 7. Internal connections for CHC21C, front view

For Phase-balance Protection of Lines and Machines, For Protection of Exciting Windings of Regulating Transformers

APPLICATION

THREE-PHASE MACHINES

The Type IJC51E relays are used for the protection of lines and of three-phase machines, especially motors and synchronous converters against damage that is caused by phase-unbalancing and single-phase operation.

This protection cannot usually be obtained satisfactorily by voltage relays because in three-phase machine, grounded-neutral, or four-wire circuits the opening of one phase conductor may not appreciably disturb the voltage phase relations or magnitude, especially under light load conditions. The machine, or other connected apparatus, will itself tend to maintain the three-phase voltage intact.

The relay compares the current in each phase with that in each of the other phases. An increase of current in the circuit, irrespective of the magnitude of the current, will not cause the relay to operate, so long as the currents in the phases are not unbalanced by 25 percent or more.

Upon the occurrence of a fault or unbalance in the machine or line which will cause the current in one of the phases to exceed that in the others by 25 percent or more, the torque exerted by the operating coil will be greater than that of the restraining coil, and the relay will function to trip the breaker.

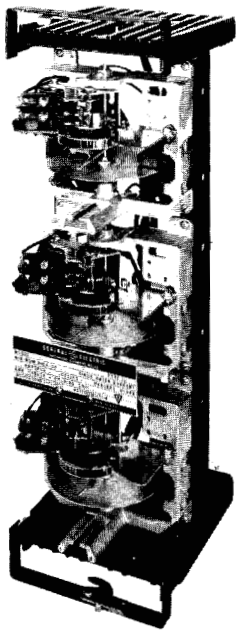
It is recommended practice to protect all polyphase ac machines in unattended installations, and all polyphase motors (with the usual exception of those used for essential power-station auxiliaries) against damage due to single-phase operation.

The IJC51E relay can be classed as a relay which protects against discontinuity of balanced system phase conditions, rather than as a fault-protective relay. When used for protection against single-phase operation of a machine it must have a time setting of such length that it will not trip off its machine on an external single-phase fault. Such a time delay will permit selective tripping by the relays protecting the faulty circuit.

REGULATING TRANSFORMERS (Exciting Winding)

Transformers with load-ratio control equipment (regulating transformers), like all power tranformers, should be provided with differential relays to protect against faults within the transformer. In addition to the differential relays, regulating transformers require IJC current-balance relays to protect against faults that might occur in the exciting winding. Regulating-transformer windings are usually 10 to 12 percent of the kva capacity of the main circuit, and therefore their reactance is such that a fault might occur in the exciting winding which would be several times the full-load current of the regulating unit, but not in excess of the normal load current of the main circuit. Under such conditions the differential relay will not provide sensitive protection to the exciting winding. The IJC52A relay should be used to protect these windings.

Under normal load conditions with maximum buck or boost, the current-transformer secondary current from the main line (series winding) is equal to the secondary current from the exciting winding, thus holding the relay contacts open. Under internal-fault conditions the current in the relay operating coil, which is connected to the exciting-winding current transformers, increases to many times the restraining-coil current from the series curcuit. The relay will operate when the secondary current from the exciting winding becomes 120 percent or more of the secondary current from the series winding, provided this exceeds the 3-ampere minimum pickup of the relay. The IJC52A relay is not affected by external faults because its pickup is automatically raised in proportion to the fault current.



(Photo 8007842)

Fig. 1. Type IJC51E (out of case)

The IJC52B is a single phase version of the IJC52A. It is used where panel layout could be a problem.

CONTACT RATING

The current-closing rating of the contacts is 30 amperes for voltages not exceeding 250 volts. The current-carrying rating is limited by the target (seal-in) and holding coils.

BURDENS—60 Hertz, 5 Amps

IJC51E	1 Amp		5 Amp		10 Amp		20 Amp		40 Amp	
	Z	Pf	Z	Pf	Z	Pf	Z	Pf	Z	Pf
	Operating Coil									
	0.74	0.32	0.62	0.32	0.50	0.279	0.335	0.30	0.225	0.39
	Restraint Coil									
115% Slope	0.99	0.358	0.868	0.325	0.636	0.310	0.40	0.366	0.283	0.5
125% Slope	1.06	0.34	0.928	0.31	0.65	0.30	0.41	0.345	0.29	0.47
135% Slope	1.20	0.33	1.05	0.30	0.716	0.29	0.448	0.345	0.292	0.474
150% Slope	1.46	0.32	1.24	0.29	0.835	0.28	0.54	0.32	0.355	0.46

IJC52A, B	Circuit	Impedance	Power Factor	Volt/Amps
	Operating	0.38	0.38	9.5
	Restraint	0.54	0.34	13.5

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

2

SELECTION GUIDE

Three Phase

Freq. (Hz)	Rating (Amps) Cont.	Rating (Amps) Min. P.U.	Slope (Percent)	Operating Time (Secs.)	Contacts	T. & S.I. Rating (Dc Amps)	Model Number	Case Size	Approx. Wt. lb (kg) Net	Approx. Wt. lb (kg) Ship
For Protection of Ac Rotating Machines and Lines										
Three Phase										
60	5	1.1	120/125/135/150	2.5 3.5	1 N.O. (per phase)	0.2/2.0	12IJC51E2A E3A	L-1	44 (19.8)	55 (24.8)
50				2.5 3.5			E4A E5A			
For Protection of Exciting Windings of Regulating Transformers										
Three Phase										
60	8.7	3	120	....	2 N.O.	0.2/2.0	12IJC52A2A	L-2	44 (19.8)	55 (24.8)
Single Phase										
50	8.7	3	120	....	2 N.O.	0.2/2.0	12IJC52B2A	S-1	12 (5.4)	18 (8.1)

CONNECTION DIAGRAMS

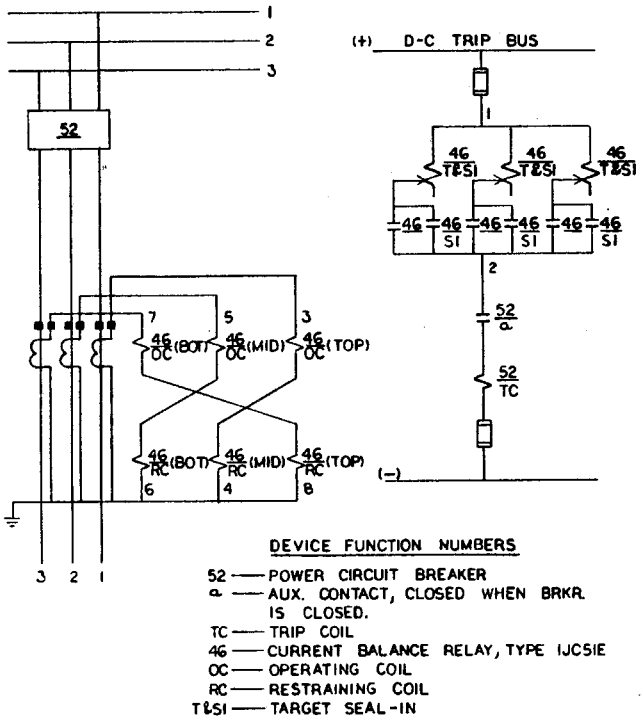


Fig. 2. Typical External Connections for Type IJC51E

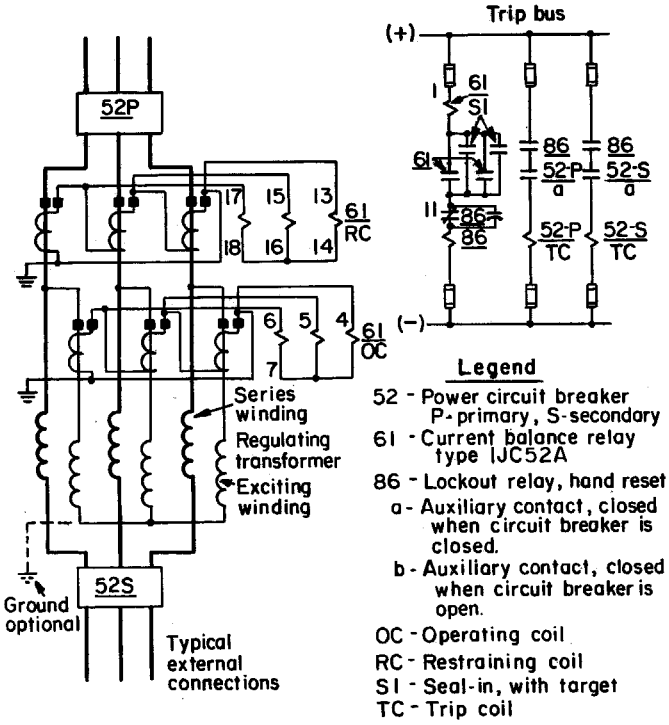


Fig. 3. Typical External Connections for the Type IJC52A Relay

SBC

Static Breaker Backup Relays

GE Protective Relays

INTRODUCTION

The Type SBC is the general designation of a family of static breaker backup relays that provide phase and ground backup protection if the primary circuit breaker fails to clear a system fault. Each relay includes phase and ground current detectors, timers, power supply, necessary logic and surge suppression. These relays are packaged in either a drawout case or an enclosed metal case with hinged front cover suitable for mounting on a 19-inch rack or panel. See Figure 1.

APPLICATION

The Type SBC static breaker backup relays are applied on a "per breaker" basis - that is, one SBC relay for each breaker in any given bus arrangement. In such an application, the current inputs to a particular SBC relay must be from the CT's that measure the current in the protected breaker. The trip outputs from the SBC relay must initiate the tripping (either directly or via transferred tripping) of all breakers which might supply fault current to the failed breaker.

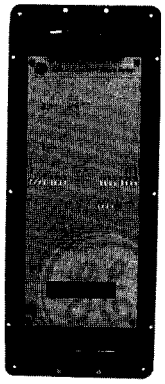
GENERAL DESCRIPTION AND OPERATION

Type SBC200 and SBC53 relays have three phase current inputs (I_A,I_B,I_C). SBC200 models with a rated CT current of 5 amps have a pickup range of 1-8.5 amps and a ground ($3I_0$) input with pick up adjustment of 0.5-4.25 amps. The SBC53 has a phase pickup of 1-10 amps and a ground ($3I_0$) input with a pick up adjustment of 0.5-5.0 amps. They also contain an instantaneous trip output contact, timer(s) and a variety of breaker failure trip (BFT) output contacts.

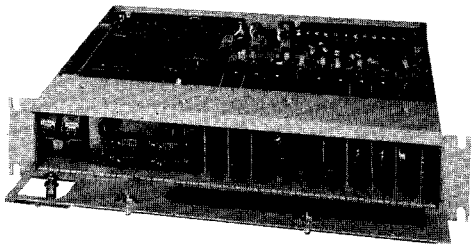
The SBC breaker backup function begins when the primary relays associated with the protected breaker close their contacts (BFI, 62X, 62Y). Closure of one of these contacts energizes the internal power supply of the SBC. These contacts will close when the primary relays see a fault, and will remain closed until the fault is removed by successful breaker operation. With the power supply energized and any one of the four current detectors (I_A, I_B, I_C, $3I_0$) picked up, the instantaneous trip contact(s) (IT) will close. This contact(s) is normally connected to initiate a "retrip" through an alternate trip circuit of the protected breaker.

When the IT contact(s) close, timer A/O is also energized. This timer has a pickup (A) time of 10-1590 milliseconds. If the protected breaker clears the fault, the current detectors will drop out and the A/O timer will reset. If the breaker fails to clear the fault, the A/O timer will reach its time setting and close the BFT contacts. These BFT contacts are used to trip the backup breakers.

This description generally applies to the SBC223A and SBC53A relays. Additional features are provided in the SBC223B&C and in the SBC53B&C relays as described below.



(Photo 8919525)



(Photo 8043336)

Fig. 1. Type SBC200 and SBC53 relays

DRAWOUT CASE CONSTRUCTION

SBC223A - Includes one timer (A/O) and an instantaneous trip (IT) that can function as a re-trip of the original circuit breaker or as a seal-in. The timer is started by contact initiation (BFI) and is reset when either the contact initiation is removed or the current detector resets. Two N.O. BFT contacts with targets (T_1 and T_3), one BFT contact without target, and one instantaneous IT N.O. contact with target (T_2) are provided. See Figure 3.

SBC223B - Similar to SBC223A but with an added contact converter input. The contact converter and the current detector are used to supervise the timer in either the ***AND*** or ***OR*** mode. A movable link selects the mode. In the ***AND*** mode, the timer will reset only if both the current detector and the contact converter reset. In the ***OR*** mode, the timer will reset if either the current detector or the contact converter reset.

SBC223C - Similar to the SBC223B except with two timers (A/O and B/O). The A/O timer is energized by an output from the current detector. The B/O timer is energized by an output from the contact converter or by the contact converter ***AND*** the current detector. The option is determined by a movable link. With two timers, two different tripping times are possible depending on the input conditions. Two "BFT" contacts with targets (T_1 and T_3), one "BFT" contact without target and one instantaneous "IT" contact with target (T_2) are provided. See Figure 5.

SBC231 - Includes three non-directional instantaneous overcurrent functions. The relay is intended for applications requiring an instantaneous ac overcurrent detector with fast pickup, fast reset, minimum overreach, or continued operation in the picked-up mode. The SBC231 can be used to block operation of an under-rated interrupter where fault current exceeds the interrupter's capability or to trip another breaker to reduce the fault current level prior to operation of the under-rated interrupter. The SBC231 can also be used in breaker failure schemes and as a high speed overcurrent detector in pilot and distance relaying schemes. Pickup time of the SBC231 is ½ cycle at 1.5 times pickup level and drop out time is ¾ cycle with minimum fill-in time.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

ENCLOSED METAL CASE CONSTRUCTION

(For 19-inch Rack Mounting)

SBC53A – Includes one timer (A/O) and an instantaneous trip (IT) that can function as a re-trip of the original circuit breaker or other function. The A/O timer is started by contact initiation (BFI) and is reset when either the contact initiation is removed or the current detector resets. This relay has six N.O. electrically separate "BFI" contacts, two targets, T_1 and T_2 and three N.O. isolated instantaneous "IT" contacts. See Figure 7.

SBC53B – Similar to SBC53A but with an added contact converter input (AND - OR logic). The contact converter and the current detector are used to supervise the A/O timer in either the ***AND*** or ***OR*** mode.

SBC53C – Similar to SBC53B but with two timers. A/O and B/O. If the power has been activated, the A/O timer is energized by an output from the level detector and it is usually set for a relatively long time. The B/O timer is energized by an output from ***AND*** - ***OR*** logic and it is generally set for short times. With the link in the IN position, the ***AND*** - ***OR*** logic will produce an output whenever there is an output from the level detector and the contact converter. With the link in the OUT position, the ***AND*** - ***OR*** logic will produce an output whenever the contact converter produces an output. The purpose of two timers is to provide for two different tripping times depending on the input conditions.

The A/O and B/O timers are normally OR'd together to drive the six BFT contacts. If desired, a link on the A/O timer card can be moved to the "OUT" position. Then each timer (A/O and B/O) will independently drive three BFT contacts. See Figure 8.

FEATURES

1. Added security is provided since the SBC relay is not connected to dc control until a fault occurs and the power supply is energized by contact initiation.

2. Each relay has its own regulated power supply with a low voltage cut-off of approximately 60 percent and, thus, the relay will not operate from accidental grounding.

3. The current detector has an LED to indicate pickup, for ease in calibration and testing.

4. Fast reset current detectors, which may be adjusted to less than 5 milliseconds.

5. The SBC200 relays have three "BFT" contact outputs (two with targets) and one or two "IT" instantaneous trip contacts. The SBC53 relays have six electronically separate "BFT" contact outouts, two with targets, and three "IT" instantaneous trip contacts.

6. Surge suppression on all ac and dc input circuits. All relays will pass the ANSI-IEEE SWC test and the GE Fast Transient and RFI test.

RATINGS

CURRENT–A) Nominal 5-amperes at 60 Hertz with continuous capability of 10-amperes.
B) One second amperes–210.

DC POWER SUPPLY–Single rated, 48, 125-, or 250-vdc

Ambient Temperatures

These relays have been designed for continuous operation between –20C and +55C per ANSI standard C37.90. In addition, these relays will oprate within published characteristics, and not malfunction nor be damaged if operated in an ambient up to +65C.

BFT CONTACT RATINGS

3-amp continuous, 30-amp for tripping duty.

BURDEN

(maximum) for 10-amp at 60 Hertz

Phase Pickup Setting	Burden (Va)
1-2	2.3
2-4	1.5
4-10	1.3
3Io Pickup Setting	
0.5-1	4.5
1-2	2.3
2-50	1.6

CURRENT DETECTOR FOR SBC200/53

DROPOUT LEVEL–95 percent of pickup.

DROPOUT TIME–Adjustable from less than 5-ms to 10-ms when current reduced to 90 percent of pickup.

SBC Substitution List

Static Breaker Backup Relays

GE Protective Relays

DESCRIPTION

The following cross reference guide lists the replacement model numbers of the SBC200 series of Breaker Backup relays that can be substituted for earlier design relays. Refer to the appropriate notes for design differences.

SBC MODEL #	REPLACEMENT #	NOTES	SBC MODEL #	REPLACEMENT #	NOTES
12SBC23A01D	SBC223A01A	1, 2, 3, 6	12SBC99AC04D	NONE	4, 6
12SBC23A02D	SBC223A01A	1, 2, 3, 6	12SBC99AD01D	NONE	5, 6
12SBC23A03D	SBC223A01A	1, 2, 3, 6	12SBC99AD02D	NONE	5, 6
12SBC23A04D	SBC223A03A	1, 2, 3, 6	12SBC99AE01D	SBC223B01A	1, 2, 3, 6
12SBC23A05D	SBC223A03A	1, 2, 3, 6	12SBC99AE02D	SBC223B01A	1, 2, 3,6
12SBC23A01D	SBC223A01A	1, 2, 3, 6	12SBC99AF01D	SBC223A02A	1, 8
12SBC23A02D	SBC223B01A	1, 2, 3, 6	12SBC99AG01D	SBC223B02A	1, 8
12SBC23A03D	SBC223B01A	1, 2, 3, 6	12SBC99AH01D	SBC221B01A	1, 2, 7
12SBC23A04D	SBC223B03A	1, 2, 3, 6	12SBC99AJ01D	NONE	1, 2, 3, 6, 10
12SBC23A05D	SBC223B03A	1, 2, 3, 6	12SBC99AK01D	SBC223B01A	1, 2, 3, 6
12SBC23A01D	SBC223C01A	1, 2, 3, 6	12SBC99AK02D	SBC223B01A	1, 2, 3, 6
12SBC23A02D	SBC223C01A	1, 2, 3, 6	12SBC99AL01D	NONE	13
12SBC23A03D	SBC223C01A	1, 2, 3, 6	12SBC99AL02D	NONE	13
12SBC23A04D	SBC223C03A	1, 2, 3, 6	12SBC99AL03D	NONE	13
12SBC23A05D	SBC223C03A	1, 2, 3, 6	12SBC99AL04D	NONE	13
12SBC99AA01	OBSOLETE		12SBC31A01D	SBC231A01A	2, 3, 6, 11
12SBC99AB01D	SBC221A01A	1, 2, 7	12SBC31A02D	SBC231A01A	2, 3, 6, 11
12SBC99AB02D	SBC221A03A	1, 2, 7	12SBC31A03D	SBC231A01A	2, 3, 6, 11
12SBC99AB03D	SBC221A01A	1, 2, 7	12SBC31A04D	NONE	6, 11, 12
12SBC99AB04D	SBC221A03A	1, 2, 7	12SBC31A05D	NONE	6, 11, 12
12SBC99AC01D	NONE	4, 6	12SBC31A06D	NONE	6, 11, 12
12SBC99AC02D	NONE	4, 6	12SBC31A07D	SBC231A01A	2, 3, 6, 11
12SBC99AC03D	NONE	4, 6	12SBC31A08D	SBC231A01A	2, 3, 6, 11

1. The timer range in the old SBC was 50-500 milliseconds, the new timer range is 10-1590 milliseconds in 10 millisecond steps.
2. The phase pickup range in the old SBC was 1-10 amps, the new SBC has a phase pickup range of 1-8.5 amps in .5 amp steps.
3. The residual pickup range in the old SBC was .5-5 amps, the new SBC has a residual pickup range of .5-4.25 amps in .25 amp steps.
4. There is no exact replacement for this model. However, the SBC223C is similar; the only difference is that the SBC223C has the BFT1 and BFT2 outputs tied together and the SBC223C has an IT output. Also, the SBC223C has additional logic for more flexibility.
5. There is no exact replacement for this model. However, the SBC221A and the SBC223A are similar. The SBC221A has single pole tripping but does not have a residual current input. The SBC223A has a residual current input but doesn't have single pole tripping. Both SBC models have an IT output; the SBC99AD does not.
6. This model is also available in a 1 amp 50 Hz version with a phase pickup of .2-1.7 amps in .1 amp steps and a residual pickup of .1-.85 amps in .05 amp steps. It's model # would be SBCXXXX02A.
7. This model is also available in a 1 amp 50 Hz version with a phase pickup of .2-1.7 amps in .1 amp steps. It's model # would be SBCXXXX02A.
8. This is a 1 amp 50 Hz relay. The phase pickup range in the old SBC was .2-2 amps and the residual pickup range was .1-1 amps. The new SBC has a phase pickup range of .2-1.7 amps in .1 amp steps and a residual pickup range of .1-.85 amps in .05 amp steps.
9. This is a 1 amp 50 Hz relay. The phase pickup range in the old SBC was .2-2 amps. The new SBC has a phase pickup range of .2-1.7 amps in .1 amp steps.
10. The old SBC had an adjustable fill-in timer. Its range was 13 to 21 milliseconds. The new SBC has a fixed fill-in timer of 3 milliseconds giving it a faster dropout time.
11. The old SBC and the new SBC perform the same functions, however, the two relays are not stud-for-stud replacements.
12. The phase and residual pickup range in the old SBC was 8-80 amps. The SBC231A has a phase pickup range of 1-8.5 amps in .5 amp steps and a residual pickup range of .5-4.25 amps in .25 amp steps.
13. This special has no direct replacement. The SBC221B has almost equivalent logic except an AND gate is used in place of an OR gate. To create this model with the new SBCs a modification to the logic board of the SBC221B is needed.

SELECTION GUIDE

Drawout Case - 3ϕ + Ground

1 POLE OR 3 POLE	FREQ. (HZ)	RATED CT CURRENT (Amps)	CONTIN. CURRENT (Amps)	DC VOLTAGE	PHASE PICKUP (Amps)	RESIDUAL CURRENT($3I_0$) (Amps)	BFT CONTACTS	INST. TRIP CONTACTS	# TARGETS @ 0.15 AMP PICKUP	FUNCTIONAL BLOCK DIAGRAM	A/O TIMER 10-1590 MS	B/O TIMER 10-1590 MS	MODEL NUMBER	CASE SIZE	APPROX WT IN LB(KG) NET	APPROX WT IN LB(KG) SHIP
SBC221A--1 Pole, One Timer(A/O), plus Contact Converters(CC) for Phase Selection, with BFT and Instantaneous Trip(IT)																
1 POLE	60	5	10	38-280	1 - 8.5 (0.5A Steps)	----------	3 N.O.	1 N.O.	3	FIGURE 1	YES	NO	SBC221A1A	M2	22 (10)	27 (12.3)
1 POLE	50	1	2	38-280	0.2 -1.7 (0.1A Steps)	----------	3 N.O.	1 N.O.	3	FIGURE 1	YES	NO	SBC221A2A	M2	22 (10)	27 (12.3)
1 POLE	50	5	10	38-280	1 - 8.5 (0.5A Steps)	----------	3 N.O.	1 N.O.	3	FIGURE 1	YES	NO	SBC221A3A	M2	22 (10)	27 (12.3)
SBC221B--1 Pole, Two Timers(A/O, B/O), plus Contact Converters(CC) for Phase Selection and Logic, with BFT and Instantaneous Trip(IT)																
1 POLE	60	5	10	38-280	1 - 8.5 (0.5A Steps)	----------	3 N.O.	1 N.O.	3	FIGURE 2	YES	YES	SBC221B1A	M2	22 (10)	27 (12.3)
1 POLE	50	1	2	38-280	0.2 -1.7 (0.1A Steps)	----------	3 N.O.	1 N.O.	3	FIGURE 2	YES	YES	SBC221B2A	M2	22 (10)	27 (12.3)
1 POLE	50	5	10	38-280	1 - 8.5 (0.5A Steps)	----------	3 N.O.	1 N.O.	3	FIGURE 2	YES	YES	SBC221B3A	M2	22 (10)	27 (12.3)
SBC223A--3 Pole, One Timer(A/O), with BFT and 3 scheme Instantaneous Trip(IT)																
3 POLE	60	5	10	38-280	1 - 8.5 (0.5A Steps)	0.5 - 4.25 (0.25A Steps)	3 N.O.	1 N.O.	3	FIGURE 3	YES	NO	SBC223A1A	M2	22 (10)	27 (12.3)
3 POLE	50	1	2	38-280	0.2 - 1.7 (0.1A Steps)	0.1 - 0.85 (0.05A Steps)	3 N.O.	1 N.O.	3	FIGURE 3	YES	NO	SBC223A2A	M2	22 (10)	27 (12.3)
3 POLE	50	5	10	38-280	1 - 8.5 (0.5A Steps)	0.5 - 4.25 (0.25A Steps)	3 N.O.	1 N.O.	3	FIGURE 3	YES	NO	SBC223A3A	M2	22 (10)	27 (12.3)
SBC223B--3 Pole, One Timer(A/O), plus Contact Converter Logic with BFT and 3 scheme Instantaneous Trip(IT)																
3 POLE	60	5	10	38-280	1 - 8.5 (0.5A Steps)	0.5 - 4.25 (0.25A Steps)	3 N.O.	1 N.O.	3	FIGURE 4	YES	NO	SBC223B1A	M2	22 (10)	27 (12.3)
3 POLE	50	1	2	38-280	0.2 - 1.7 (0.1A Steps)	0.1 - 0.85 (0.05A Steps)	3 N.O.	1 N.O.	3	FIGURE 4	YES	NO	SBC223B2A	M2	22 (10)	27 (12.3)
3 POLE	50	5	10	38-280	1 - 8.5 (0.5A Steps)	0.5 - 4.25 (0.25A Steps)	3 N.O.	1 N.O.	3	FIGURE 4	YES	NO	SBC223B3A	M2	22 (10)	27 (12.3)
SBC223C--3 Pole, Two Timers(A/O, B/O), plus Contact Converter Logic with BFT and 3 scheme Instantaneous Trip(IT)																
3 POLE	60	5	10	38-280	1 - 8.5 (0.5A Steps)	0.5 - 4.25 (0.25A Steps)	3 N.O.	1 N.O.	3	FIGURE 5	YES	YES	SBC223C1A	M2	22 (10)	27 (12.3)
3 POLE	50	1	2	38-280	0.2 - 1.7 (0.1A Steps)	0.1 - 0.85 (0.05A Steps)	3 N.O.	1 N.O.	3	FIGURE 5	YES	YES	SBC223C2A	M2	22 (10)	27 (12.3)
3 POLE	50	5	10	38-280	1 - 8.5 (0.5A Steps)	0.5 - 4.25 (0.25A Steps)	3 N.O.	1 N.O.	3	FIGURE 5	YES	YES	SBC223C3A	M2	22 (10)	27 (12.3)
SBC231A--Three Instantaneous Overcurrent Functions																
1 POLE OR 3 POLE	FREQ. (HZ)	RATED CT CURRENT (Amps)	CONTIN. CURRENT (Amps)	DC VOLTAGE	PHASE PICKUP (Amps)	RESIDUAL CURRENT($3I_0$) (Amps)	OUTPUT CONTACTS	# TARGETS @ 0.15 AMP PICKUP	FUNCTIONAL BLOCK DIAGRAM				MODEL NUMBER	CASE SIZE	APPROX WT IN LB(KG) NET	APPROX WT IN LB(KG) SHIP
3 POLE	60	5	10	38-280	1 - 8.5 (0.5A Steps)	0.5 - 4.25 (0.25A Steps)	5 N.O. 1 N.O. or N.C.	2	FIGURE 6				SBC231A1A	M2	22 (10)	27 (12.3)
3 POLE	50	1	2	38-280	0.2 - 1.7 (0.1A Steps)	0.1 - 0.85 (0.05A Steps)	5 N.O. 1 N.O. or N.C.	2	FIGURE 6				SBC231A2A	M2	22 (10)	27 (12.3)
3 POLE	50	5	10	38-280	1 - 8.5 (0.5A Steps)	0.5 - 4.25 (0.25A Steps)	5 N.O. 1 N.O. or N.C.	2	FIGURE 6				SBC231A3A	M2	22 (10)	27 (12.3)

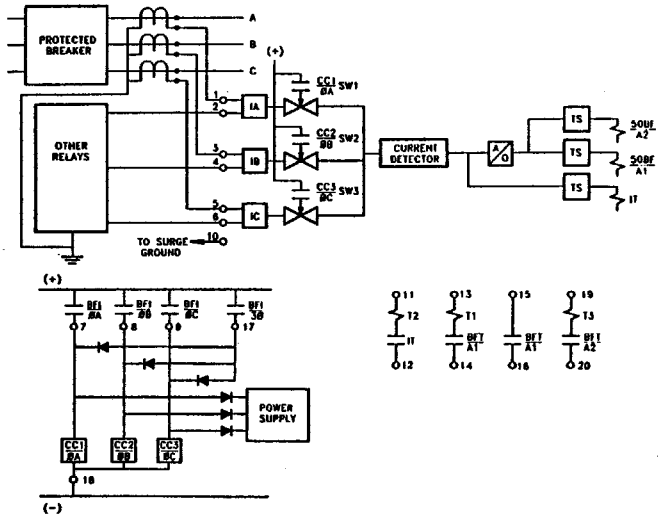


Figure 1
SBC221A Functional Block Diagram

(DWG. 0286A4833)

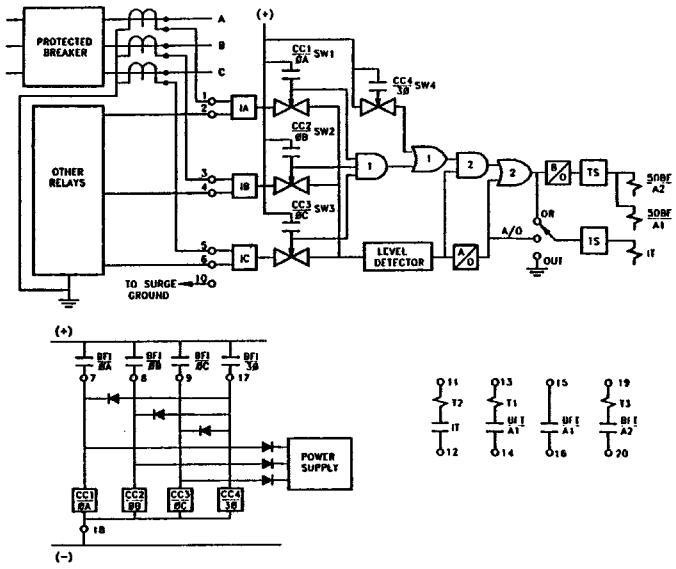


Figure 2
SBC221B Functional Block Diagram

(DWG. 0286A4834)

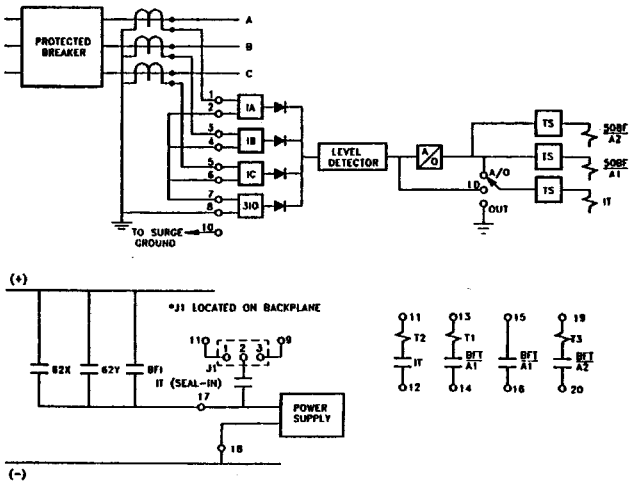


Figure 3
SBC223A Functional Block Diagram

(DWG. 0286A4835)

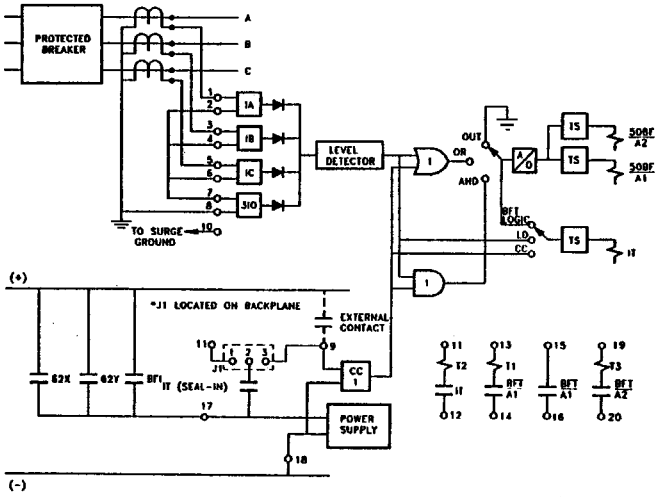


Figure 4
SBC223B Functional Block Diagram

(DWG. 0286A4836)

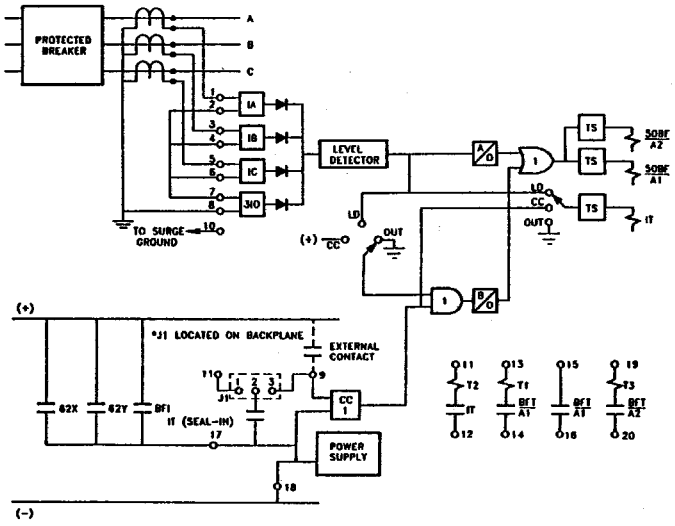


Figure 5
SBC223C Functional Block Diagram

(DWG. 0286A4837)

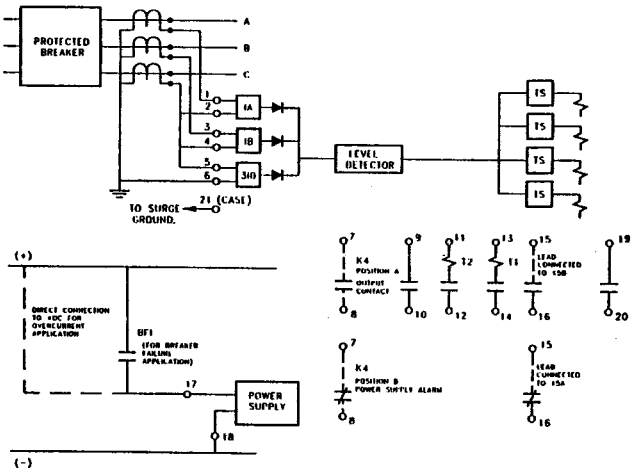


Figure 6
SBC231A Functional Block Diagram

(DWG. 0286A4839)

19 Inch Rack - 3ϕ + Ground

Ac Rating	Phase Range (Amps)	Target T1 and T2 (Amps)	BFT Contacts	Gr. ($3I_0$) Range (Amps)	Inst. Trip Contacts	Contact Conv.	A Timer 50-500 Ms	B Timer 50-500 Ms	Dc Control (Volts)	Model Number	Rack Units	Approx Wt in Lb (Kg) Net	Ship
SBC53A—One Timer (A/O) with BFT and Inst. Trip													
60 Hz 10 Amp.	1-10	1.0	6 N.O.	0.5-5	3 N.O.	—	Yes	—	48 125 250	12SBC53A3 A1 A2	2	22 (9.9)	30 (13.6)
50 Hz 10 Amp	1-10	1.0	6 N.O.	0.5-5	3 N.O.	—	Yes	—	125	12SBC53A4	2	22	30
SBC53B—One Timer (A/O) Plus Contact Converter (CC) with BFT and Inst. Trip													
60 Hz 10 Amp.	1-10	1.0	6 N.O.	0.5-5	3 N.O.	1	Yes	—	48 125 250	12SBC53B3 B1 B2	2	22 (9.9)	30 (13.6)
50 Hz 10 Amp	1-10	1.0	6 N.O.	0.5-5	3 N.O.	1	Yes	—	125	12SBC53B4	2	22	30
SBC53C—Two Timers (A/O, B/O) Plus Contact Converter (CC) with BFT and Inst. Trip													
60 Hz 10 Amp.	1-10	1.0	6 N.O.	0.5-5	3 N.O.	1	Yes	Yes	48 125 250	12SBC53C3 C1 C2	2	22 (9.9)	30 (13.6)
50 Hz 10 Amp	1-10	1.0	6 N.O.	0.5-5	3 N.O.	1	Yes	Yes	125	12SBC53C4	2	22	30

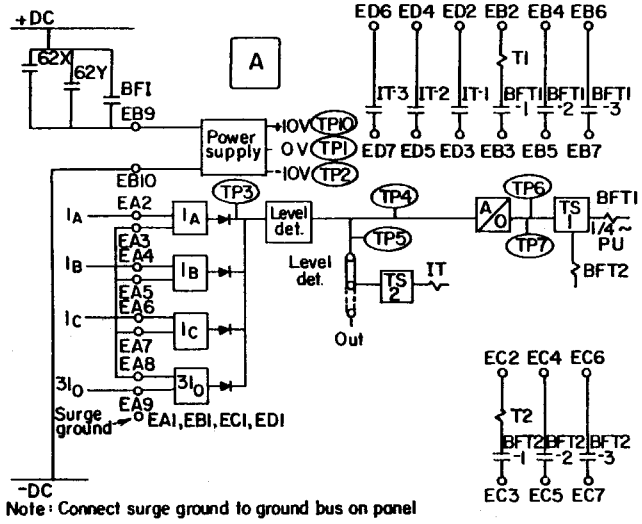


Fig. 7. Typical external conn. and logic for SBC53A

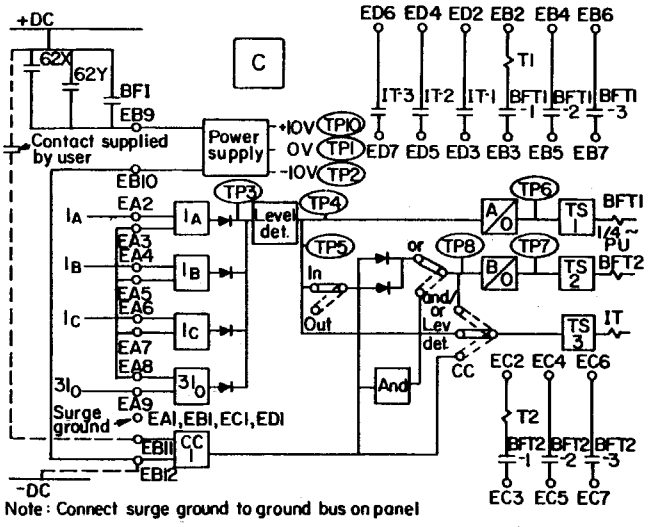


Fig. 8. Typical external conn. and logic for SBC53C

STA

Static Transformer Auxiliary Relay

GE Protective Relays

INTRODUCTION

The STA Static Transformer Auxiliary relay derived from the proven design of the SBC breaker failure relay, provides trip supervision for Sudden Pressure Relays found in Power Transformers. Three-Phase power transformers have always been susceptible to false tripping from a Sudden Pressure Relay (SPR) for high magnitude through-fault currents. These currents will cause the windings to vibrate, setting up pressure waves in the transformer. The pressure waves can cause a SPR to operate. False operation of a SPR can cause a costly outage of the transformer due to operational procedures in place to protect the investment of the transformer and preclude a hasty re-energization. As a result, many utilities have elected to use the SPR to provide an alarm only; losing protection of the transformer from the Sudden Pressure Relay.

APPLICATION

The STA Static Transformer Auxiliary Relay is a way to restore the functionality of the SPR by adding overcurrent supervision to the trip circuit of the SPR. For high magnitude faults, the overcurrent supervision circuit will block the operation of the SPR. However, for low or intermediate magnitude faults the overcurrent supervision will not operate, allowing the SPR to trip. Should a high magnitude fault occur in the transformer it is acceptable for the overcurrent supervision to operate since other means of protection such as an overcurrent relay or a differential relay will have sufficient current to detect and operate to clear the fault.

GENERAL DESCRIPTION

The STA201A relay contains the following basic components and features:

1. A fast-reset current level detector with two independently adjustable pickup settings for phase and ground currents.
2. A/O timer adjustable from 10 - 1590 msecs for dropout control.
3. B/O timer adjustable from 10 - 1590 msecs for supervision timer control.
4. Three electrically separate contact output circuits. Two of these circuits have an electromechanical series target.
5. One output circuit that is used as a power supply alarm output.
6. A regulated power supply with undervoltage cutoff.
7. Surge suppression of all AC and DC input circuits.



Fig. 1. STA Static Transformer Auxiliary Relay

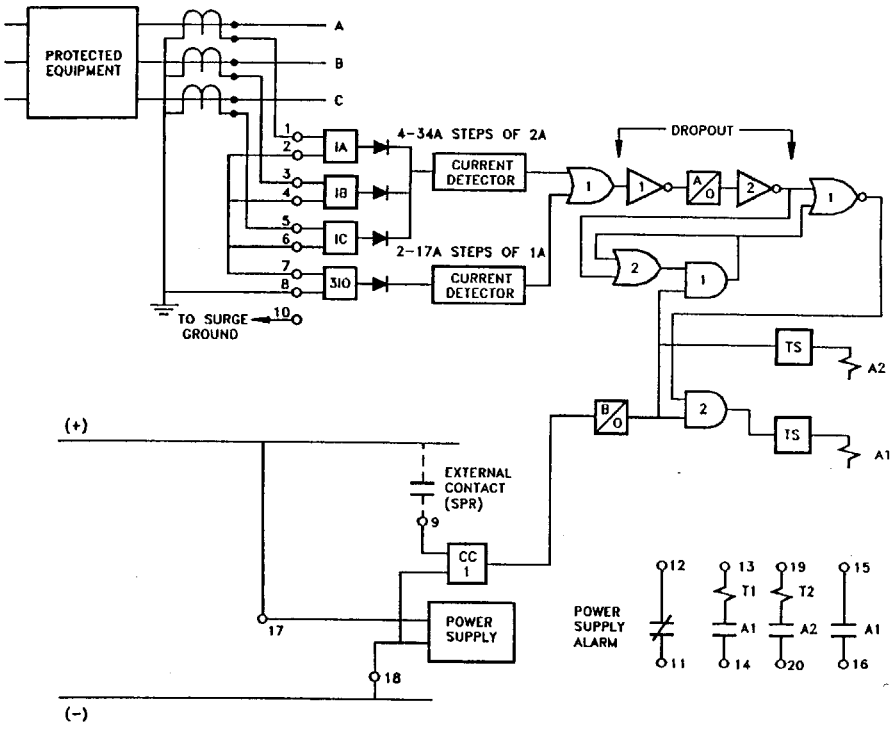


Fig. 2. STA Functional Block Diagram

SELECTION GUIDE---Drawout Case - 3ϕ + Ground

1 POLE OR 3 POLE	FREQ. (HZ)	RATED CT CURRENT (Amps)	CONTIN. CURRENT (Amps)	DC VOLTAGE	PHASE PICKUP (Amps)	GROUND CURRENT PICKUP(Amps)	OUTPUT CONTACTS	POWER SUPPLY CONTACTS	# TARGETS @ 0.15 AMP PICKUP	FUNCTIONAL BLOCK DIAGRAM	A/O TIMER 10-1590 MS	B/O TIMER 10-1590 MS	MODEL NUMBER	CASE SIZE	APPROX WT IN LB(KG) NET	APPROX WT IN LB(KG) SHIP
3 POLE	60	5	10	38-280	4 - 34 (2A STEPS)	2 - 17 (1A STEPS)	3 N.O.	1 N.C.	2	FIGURE 1	YES	YES	STA201A1A	M2	22 (10)	27 (12.3)

SECTION: 3

Pilot and Distance Relays

SCA51A, SCA52A Directional Comparison Blocking Auxiliaries 1

NAA15 Ground Distance Auxiliaries 3

NAA19 Out-of-step Auxiliaries 4

NAA27 Transferred Trip Auxiliaries 5

NAA30A Manual Synch Auxiliaries 7

GCX, GCY, GCXY, GCXG, Phase Packaged Directional-distance 8

CEB Offset MHO-Zone and Phase Packaged Directional-distance 12

CEY, CEYG Zone Packaged Reactance and MHO Directional-distance 14

CLPG Dual-polarized Directional Overcurrent Carrier Ground 15

SLY, SLYG Static Zone Packaged MHO Distance..... 18

SCA51A, SCA52A

Directional Comparison Blocking Auxiliaries

GE Protective Relays

DESCRIPTION

The Type SCA is a solid state carrier auxiliary relay designed for use in directional comparison carrier blocking relay schemes. It functions as the interface between the carrier pilot channel and the distance relays which control the carrier and trip the line terminals. The SCA relays include a variety of functions which are described as follows:

RX - Carrier Receiver Auxiliary.
This unit is driven by the carrier receiver via either a 180 milliamp nominal output or by a high speed reed relay contact. An optical isolation interface is used between the carrier channel and the RX unit.

TTZ - Tripping Coordination Delay Timer.
This unit provides the necessary timing to coordinate the blocking of tripping for faults external to the protected line.

RI - Reclosing Initiating.
This unit initiates circuit breaker reclosing.

A - Tripping Auxiliary.
This unit provides the contact capability to carry 30 amperes for circuit breaker tripping duty.

TB - Transient Blocking.
This unit provides a transient blocking function to improve security against a relay misoperation during a fault current reversal.

MX - Phase Relay Auxiliary.
This unit is energized by the operation of the phase MT to stop carrier blocking.

GX - Ground Relay Auxiliary.
This unit is energized by the operation of the ground relay functions to stop carrier blocking.

Front Panel Controls

— Control Voltage Switch
Three Position: 48V, 110/125V, 220/250V.

— RX Input Switch
Four Position: 300 ma, 48V, 110/125V, 220/250V.

— TTZ Delay Pickup Adjustment
Continuously adjustable 3 to 40 ms; calibration points at 3, 10, 20, 30, 40 ms.

Operating Specifications

— All voltage operated units will pick up at 80% of nominal dc voltage rating determined by the Control Voltage Switch position.

— RX unit on the 300 ma position will pick up at 100 ma receiver current minimum and can remain continuously energized and picked up at 300 ma current.

Timing Specifications

RX - For directional comparison carrier blocking; 1-2 ms pickup, 5 ms dropout, (select RX card jumpers). For other applications can be independently set for 1-2 ms or 5 ms pickup or dropout.

TTZ - Pickup adjustable over range of 3 to 40 ms, dropout is less than 5 ms.

RI - Pickup 1 cycle, dropout 6 to 10 cycles.

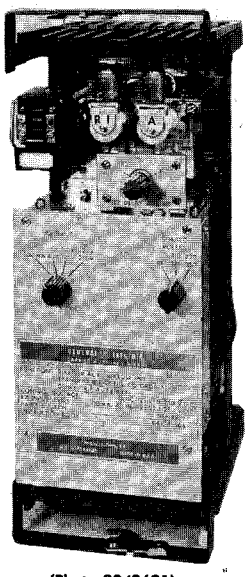
A - Pickup 4 ms, dropout 2 to 3 cycles.

GX, MX, TB - 1 to 3 ms pickup and dropout.

Unit Contact Ratings

RX, TTZ, TB, MX, GX, reed relays:
50 watts resistive maximum load, 300 volts dc maximum voltage, 3 amps dc make and carry current. Contacts for external use are surge protected.

RI, A; telephone relays:
3 amps, carry continuously; 30 amps, make and carry for breaker tripping. Standard telephone relay contact interrupting rating, contact gap 15 mils.



(Photo 8043691)

Fig. 1. Type SCA51A Carrier Auxiliary Relay

APPLICATION

There are two basic models of the SCA relay:

SCA51A - for use with the static component relays - SLY8A, SLYG81A. This model contains the functions RX, TTZ, RI, A and TB.

SCA52A - for use with electromechanical relays. This model contains the functions RX, TTZ, RI, A, MX and GX.

The SCA carrier receiver function RX is directly compatible with the GE Type CS28A carrier receiver. This receiver provides a 180 milliamp nominal output (approximately 300 ma maximum). As an optional alternative the CS28A carrier can be provided with a high speed contact as the interface. In addition, the RX circuit also provides a separate optical isolation interface. The SCA relay can also be used with other carrier channels or with microwave equipment through the use of a contact interface between the receiver and the RX circuit. The TTZ timer, with its wide adjustment range, will provide adequate coordination time delay as required by other channel operating speeds.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

SELECTION GUIDE—SCA Carrier Auxiliary Relays

Device	Control Volts dc	Units Included	Target Seal-in, Amp	Type Carrier	Interface	Model Number	Case Size	Approximate Wt lb (Kg) Net	Approximate Wt lb (Kg) Ship
TYPE SCA51A—Use with static component relays; SLY81A, SLYG81A.									
85	48, 110/125, 220/250	RX, TTZ RI, A, TB	0.6/2	CS28A	Direct from carrier receiver or contact	12SCA51A11A	M-2	25(11.3)	31(14.1)
				Other	Contact only				
TYPE SCA52A—Use with electromechanical relays; CEY52, CEYG51A, CLPG12C									
85	48, 110/125, 220/250	RX, TTZ, RI A, MX, GX	0.6/2	CS28A	Direct from carrier receiver or contact	12SCA52A11A	M-2	25(11.3)	31(14.1)
				Other	Contact only				

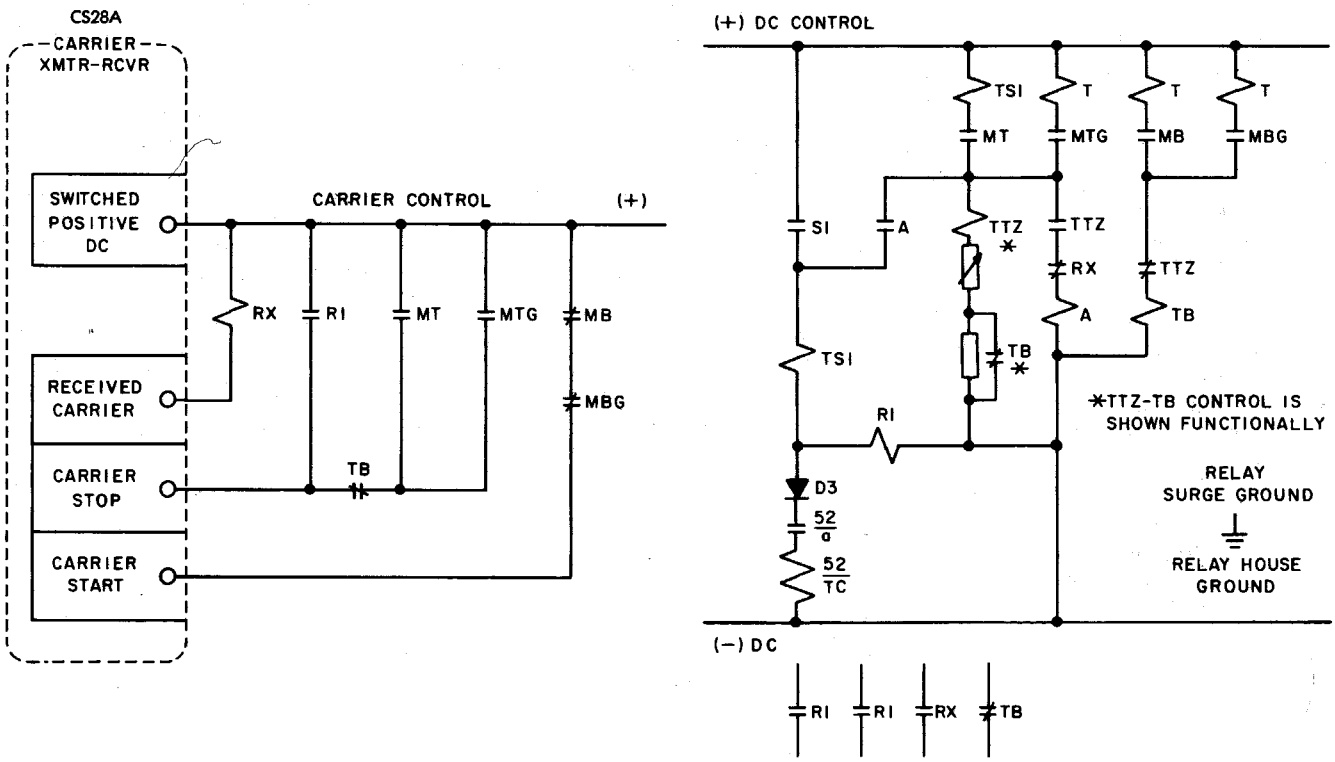


Fig. 2. Simplified external connections SCA51A used with static component relays.

DESCRIPTION

The Type NAA relay is the general designation of a large family of special purpose auxiliary relays. Most NAA relays have two or more telephone type auxiliaries mounted in the regular drawout case. In some specific types an overcurrent function may also be included.

APPLICATION

Ground Distance Relay Auxiliaries

NAA15E—For Ground Step Distance scheme with GCXG51 and GCXG53 phase packaged relays. In this application the three auxiliary units and plunger type overcurrent unit are interlocked with the mho units of the GCXG relays to permit 1st and 2nd zone tripping for single-phase-to-ground faults only.

NAA15H—For use with Ground Distance scheme with CEYG51 and 53 and torque controlled overcurrent relays such as the Type IAC80 and CFC17A.

BURDENS—Typical for NAA15E

The ac burden of the instantaneous unit is shown in Table 1 for the available current ranges. The values in Table 1 are with the armature set for minimum pickup and in the dropped-out position.

Table 1

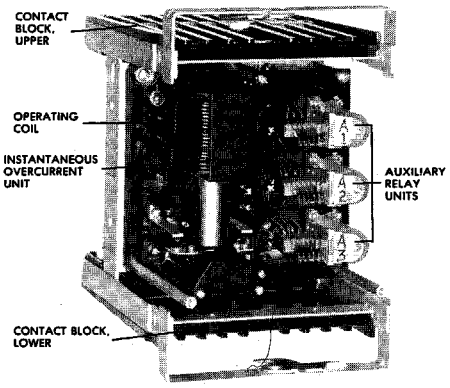
Burden Data at 60 Hz Instantaneous OC Unit

Rated Amps	Cal Range	At 5 Amp		At Min PU	
		Watts	VA	Watts	VA
6	2-8	3.6	11.5	0.6	1.7
3	1-4	12.7	41	0.6	1.7
1.5	0.5-2	55	165	0.6	1.7

RATINGS

The relays can be furnished with instantaneous overcurrent units having ac ratings and calibration ranges as shown in Selection Guide. The overcurrent units are suitable for operation on either 50 or 60 hertz, but are ***not*** rated for ***continuous*** operation in the ***picked-up position.***

The contacts of the auxiliary A units and the instantaneous overcurrent unit will make and carry momentarily 30 amperes dc at control voltages of 250 volts or less. These contacts will carry 3 amperes continuously and have an interrupting rating as shown in Table 2.



(Photo 8035575)

Fig. 1. Typical Type NAA15E ground distance auxiliary

Table 2

Interrupting Ratings A Unit Contacts

Volts Dc	Current Amps	
	Inductive①	Non-Inductive
48	1.0	3.0
125	0.5	1.5
250	0.25	0.75
Volts Ac		
115	0.75	2.0
230	0.5	1.0

① Average trip coil.

SELECTION GUIDE

Type NAA15—Ground Distance Auxiliaries—50/60 Hertz

Volts Dc	Inst OC Amp Range	Rated Amps	Mechanical Target	OC Unit② Contacts	Model Number	Case Size	Approx Wt Lb (Kg)	
							Net	Ship
Type NAA15E—For Use With Phase Packaging Type GCXG								
48/125/250	2-8	6	None	2 NO	12NAA15E5A	S-2	14(6.4)	18(8.2)
48/125/250	1.4	3	None	2 NO	12NAA15E6A			
48/125/250	0.5-2	1.5	None	2 NO	12NAA15E7A			
24/48/125	1-4	3	None	2 NO	12NAA15E8A			
48/110/220	0.5-2	1.5	None	2 NO	12NAA15E9A			
Type NAA15H—For Use With CEYG51-53 and IAC80 With CFC17A								
48	2-8	6	None	1 NO	12NAA15H2A	S-2	14(6.4)	18(8.2)
125	2-8	6	None	1 NO	12NAA15H1A			

② Auxiliary unit contacts are wired to relay studs as required.

REFERENCES:

Dimensions .....Section 16
How to Order .....Section 1
Instruction Books .....Section 17
Target and Contact Data.....Section 16
Relay Standards .....Section 16

NAA19

Out-of-Step Auxiliaries

GE Protective Relays

DESCRIPTION

The Type NAA19B is an auxiliary relay for use with an angle impedance relay type such as CEX57E for tripping on system out-of-step conditions. This relay contains a number of telephone type auxiliary units plus a type PJC instantaneous overcurrent unit and one target seal-in unit all mounted in an M-1 case.

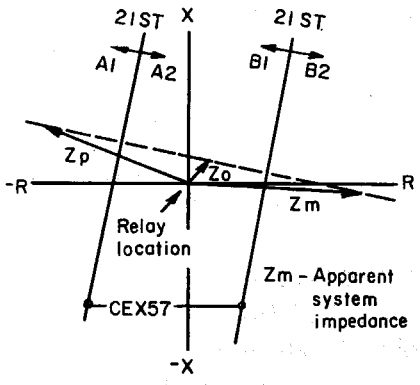
APPLICATION—Section B

In general the NAA19B is applied in conjunction with the CEX57E to detect system out of step conditions and to initiate tripping of the proper local and/or remote breakers in order to separate the system. It is important to note that these relays should be applied at those locations where system studies indicate that an out of step condition can be detected. However, the breaker(s) that should be tripped, to properly separate the system, with generation balancing load, may be remotely located. If this is the case some sort of transferred or remote tripping scheme will be required in addition to the CEX57E and NAA19B relays.

In this scheme, the relays detect the out of step condition by the sequential operation of the angle impedance units in the CEX57E relay as the apparent impedance sweeps across the R-X diagram in the manner outlined in Fig. 1. From Fig. 1 it is apparent that the angle impedance characteristics extend, almost without practical limit, in both the "forward" and "reverse" directions.

During light load conditions on the system, it is possible, due to reactive power transfer, that the apparent (load) impedance as seen by the CEX relay will plot in the vicinity of the CEX characteristics rather than near the R axis as in the case of appreciable real power flow. With slight variations in this load it is possible for the apparent impedance to vary in such a manner as to wander across the angle impedance characteristics at a point quite remote from the origin in the R-X diagram. This would appear as an out of step condition to the CEX-NAA combination except for the instantaneous overcurrent unit which supervises the scheme.

The overcurrent unit in the NAA19B relay is a plunger type PJC and is not intended for operation in the continuously picked up position. Thus, the overcurrent unit should be set for a pick-up of at least 15 percent above the maximum full load current. This will automatically prevent any false operation during light load conditions.



(Dwg. 6556547)

Fig. 1. Typical Characteristic CEX57 with NAA19B for Out-of-Step Tripping

RATINGS

The NAA19B relays covered by this section are available with dc control voltages as indicated in the Selection Guide. The telephone type relay contacts will make and carry 30 amperes momentarily at 250 volts dc or less and have interrupting ratings as indicated in Table A.

TABLE A

Interrupting ratings X units contacts

Volts	Interrupt Amps	
	Inductive①	Non-Inductive
125-dc	0.5	1.5
250-dc	0.25	0.75
115-60 Hz	0.75	2.0
230-60 Hz	0.5	1.0

① Inductance of Average Trip Coil.

SELECTION GUIDE

Type NAA19B—Out-of-step Auxiliaries—50/60 Hertz

Volts Dc	Instantaneous Overcurrent② Amp Range	Rated Amps	Target Seal-In Amps	X1, X2, X4, X5 Time DO Milliseconds	Model Number	Case Size	Approx Wt. Lb (Kg)	
							Net	Ship
48 125 250	2-8	6	0.2/2	200	12NAA19B8A 12NAA19B5A 12NAA19B10A	M-1	21(9.6)	26(11.8)
125 250	4-16	12			12NAA19B2A 12NAA19B4A			
110 220	2-8	6			12NAA19B7A 12NAA19B9A			
110 220	4-16	12			12NAA19B3A 12NAA19B6A			

② The PJC inst. overcurrent unit is not designed to be operated continuously in the picked up position.
NOTE—For Information on the type CEX57 Relay, see Section 10.

APPLICATION

Transferred Tripping Auxiliaries

NAA27AA — For dual channel transformer differential equipment transferred tripping with audio tones or frequency shift carrier, with automatic throw-over to single channel. The relay includes three telephone type units for the functions of X1, X2 and TX and a target/seal-in unit.

NAA27AC—For use in permissive overreaching line protection schemes with single channel audio tone equipment or frequency shift carrier. Included in the relay are three telephone type units for the functions of BX, RI and TTZ and a target. TTZ pick-up time must be specified.

NAA27AD—Intended for use in permissive underreaching line protection schemes with single channel audio tone equipment or frequency shift carrier. Included in the relay are two telephone type units for the functions of BX and RI and a target.

NAA27H—For use in direct and permissive transmission line underreaching schemes with Type 51 channel. This auxiliary includes three telephone type relay units for the functions of GX, TX, and RI and a target/seal-in unit.

NAA27K—Intended for use in direct and permissive transmission line scheme when multi-terminal lines are involved. This relay is required in addition to the other necessary transferred trip auxiliaries and includes two telephone type units for the functions of GX and TX.

GENERAL AND ORDERING

For permissive overreaching schemes the TTZ unit is connected in series with the trip contact (T) of the receiver and introduces a slight coordinating delay into the scheme. This TTZ unit is picked up by the local overreaching phase or ground relays which key the local transmitter. The time delay pickup setting of TTZ should be set for approximately 3-4 milliseconds longer than the release time of the channel being used.

This setting may be specified on the requisition and will be set in final test at the factory.

NAA27L—Intended for use in direct and permissive schemes where Type 51 frequency shift carrier is used as the channel. This relay includes four telephone type units for the functions of GX, TX, RI and TTY, and a target/seal-in unit. The GX, TX and RI units are identical to the corresponding units in the NAA27H relay. TTY is a high speed keying relay for the type 51 carrier channel.

NAA27M —A special purpose auxiliary relay for use at the receiving end terminal in transformer differential transferred tripping schemes with a Type 51 carrier or an audio tone channel. This relay includes two telephone type units for the functions of GX and TX and a target/seal-in unit.

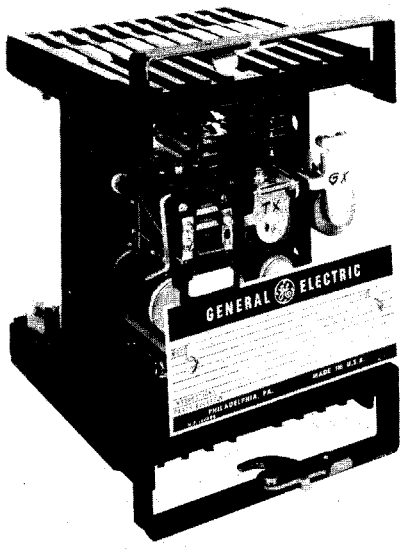
NAA27N—For use in permissive overreaching schemes in conjunction with line relays and other auxiliary devices. Use with Type 51 carrier or audio tone channel. The NAA27N includes the functions of BX, TTY and TTZ. If the circuit to be protected cannot have a power reversal on clearing an external fault, the TTZ function is not needed and studs 1 and 2 should be jumpered together. TTZ pickup time must be specified.

NAA27S—For use in permissive overreaching line schemes where single channel tone equipment with receiver logic module is used. This relay includes three telephone type auxiliary units for the functions of BX, RI and TTZ. Otherwise, similar to the NAA27N. TTZ pick-up time must be specified.

NAA27Y—For use with tone equipment that includes the receiver logic module. The functions included are CX1, CX2 and TX and a target/seal-in unit. One NAA27Y relay is required at each terminal in the scheme.

RATINGS

The telephone relay contacts will make and carry 3 amp continuously or 30 amp dc for tripping duty at control voltages of 250V dc or less. Some of the Type NAA27 relays such as NAA27AA, NAA27AC and NAA27AD have tripping diodes. For such applications these diodes will carry 10 amp continuously or 30 amp for tripping duty and will withstand a maximum of 600V in the reverse direction. The blocking diodes generally have a rating of 600V in the reverse direction and will carry 1 amp in the forward direction.



(Photo 8043136)

Fig. 1. NAA27M auxiliary relay

The interrupting rating of the telephone relay contacts such as "RI" and "BX" are listed in Table 1, below.

Table 1

Type NAA27 Interrupting Ratings

Ac Volts	Amperes	
	Inductive①	Non-Inductive
115	0.75	2.0
230	0.5	1.5
Dc Volts		
48	1.0	3.0
125	0.5	1.5
250	0.25	1.0

① Average trip coil.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

SELECTION GUIDE—Transferred Tripping Auxiliaries

Device No.	Control Volts dc	Functions Included	Target Seal-in Amp	TTZ TD Pickup Milliseconds	Model Number	Case Size	Approx Wt Lb(Kg) Net	Approx Wt Lb(Kg) Ship
TYPE NAA27AA—Dual Channel Direct With Audio Tones or Frequency Shift Carrier								
94	48 125	X1, X2, TX, TSI X1, X2, TX, TSI	0.6/2.0	—	12NAA27AA2A 12NAA27AA1A	S-2	14(6.4)	18(8.2)
TYPE NAA27AC—Permissive Overreaching and Single Channel Audio Tones or Frequency Shift Carrier								
94	48 125 250	BX,RI, TTZ	(Target Only) 0.6/2.0	11-21 11-21 11-21	12NAA27AC3A 12NAA27AC1A 12NAA27AC2A	M-2	21(9.6)	27(12.2)
TYPE NAA27AD—Permissive Underreaching and Single Channel Audio Tones or Frequency Shift Carrier								
94	48 125 250	BX, RI	(Target only) 0.6/2.0	—	12NAA27AD2A 12NAA27AD1A 12NAA27AD3A	M-2	20(9.1)	26(11.8)
TYPE NAA27H—Direct and Permissive Schemes With Type 51								
94	48 125 250 125	GX, TX RI TSI	0.6/2.0 0.6/2.0 0.6/2.0 0.2/2.0	— — — —	12NAA27H17A 12NAA27H16A 12NAA27H15A 12NAA27H19A	S-2	13(5.9)	17(7.7)
TYPE NAA27K—Multi Terminal Auxiliary								
94	48 125 250	GX,TX	— — —	— — —	12NAA27K17A 12NAA27K16A 12NAA27K15A	S-1	12(5.4)	16(7.3)
TYPE NAA27L—Direct Underreaching Auxiliary With Type 51 Channel								
94	48 125 250	GX,TX RI,TTY TSI	0.6/2.0	— — —	12NAA27L30A 12NAA27L29A 12NAA27L28A	S-2	14(6.4)	18(8.2)
TYPE NAA27M—Transformer Differential Auxiliary With Type 51 Channel								
94	48 125 250 125	GX,TX TSI	0.6/2.0 0.6/2.0 0.6/2.0 0.2/2.0	— — — —	12NAA27M17A 12NAA27M16A 12NAA27M15A 12NAA27M18A	S-2	13(5.9)	17(7.7)
TYPE NAA27N—Permissive Overreaching With Type 51 or Audio Tones								
94	48 125 250 48 125 250	BX TTY TTZ	— — — — — —	12-25 12-25 12-25 20-40① 20-40 20-40	12NAA27N33A 12NAA27N32A 12NAA27N31A 12NAA27N36A 12NAA27N35A 12NAA27N34A	S-2	13(5.9)	17(7.7)
TYPE NAA27S—Permissive Overreaching With Audio Tones—When Receiver Logic Module Is Used								
94	125	BX,RI TTZ	(Target only) 0.6/2.0	11-21	12NAA27S1A	S-2	13(5.9)	17(7.7)
TYPE NAA27Y—Dual Channel Direct With Audio Tones—When Receiver Logic Module Is Used								
94	125	CX1,CX2 TX,TSI	0.6/2.0	—	12NAA27Y1A	S-2	14(6.4)	18(8.2)

①For Type 51 carrier channel.

NAA30A Auxiliary

For Relay Supervision of Manual Synchronizing

GE Protective Relays

APPLICATION

Auxiliary For Relay Supervision of Manual Synchronizing

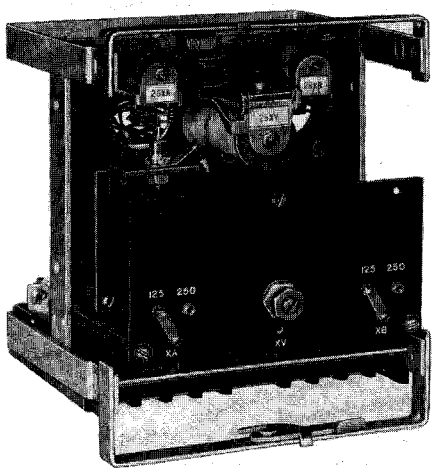
NAA30A—Intended for use with GXS11B synchronizing relay to provide supervision of manual synchronizing. Included in the NAA30A are three telephone type auxiliary units. This combination will allow the operator to synchronize only if permission is received from the GXS11B indicating the bus and machine voltage have not passed the in-phase condition and the machine is running faster (slower by reconnection) than the system. The three auxiliaries included in the NAA30A are—25XA, 25XB and 25XV. Figure 2 illustrates the typical external ac connections for the scheme.

RATINGS

The two auxiliary circuits, 25XA and 25XB, are continuously rated at 125 or 250 volts dc. The voltage selection is made with two links (one per unit) located and clearly identified on the front of the relay. The voltage auxiliary, 25XV, is energized from an input transformer (T1) designed to carry 240 volts continuously. Transformer (T1) is connected in the machine and bus PT circuits, each of which are rated 120V. However, since it is the vector difference of these voltages that is applied to (T1), the transformer must be rated for 240V which occurs when the two voltages are 180 degrees apart.

The 25XV input transformer T1, primary winding has a tap which can be connected for a phase to neutral potential transformer connection by reversing the leads on studs 5 and 5A.

The telephone relay contacts will make and carry 30 amperes momentaruly and can carry 3 amperes continuously. The interrupting capabilities for each contact is listed in Table 1.



(Photo No. 8041547)

Fig. 1. Type NAA30A Auxiliary Relay

INTERRUPTING RATINGS

Table 1

Volts Dc	Interrupt Amps	
	Inductive①	Non-Inductive
125	0.5	1.5
250	0.25	0.75

① Average trip coil.

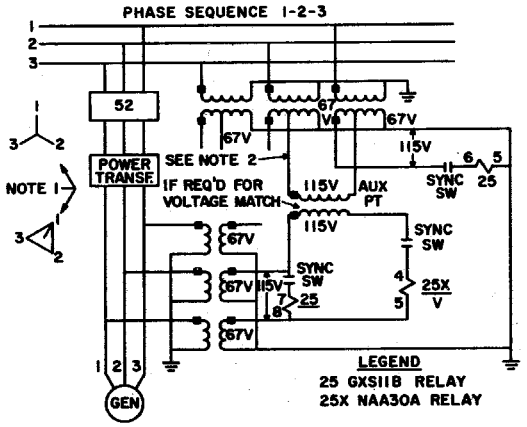
SELECTION GUIDE

Type NAA30A—120 V Ac Auxiliary For GXS11B Manual Synchronizing

Frequency HZ	Control Volts dc	Functions Included	② Dropout Range-25XV Volts	Model Number	Case Size	Approx Wt lb/(Kg) Net	Ship
60	125/250	25X, 25XB, 25XV	30-70	12NAA30A1A	S-1	14(6.4)	18(8.2)
50	110/220			12NAA30A3A			
50	125/250			12NAA30A2A			

② Unless specified otherwise factory setting is 62 volts.

NOTE:
See Section 9 for Type GXS relays.



(0246A3380 SH. 1-0)

Fig. 2. Typical External Ac Connections for NAA30A and GXS11B to Supervise the Operator When Synchronizing a Generator onto a System, Zero Degree Cut-off.

REFERENCES:

Dimensions .....Section 16
How to Order .....Section 1
Instruction Books .....Section 17
Target and Contact Data.....Section 16
Relay Standards.....Section 16

GCX, GCY, GCXY and GCXG

Phase Packaged Directional-distance Relays

GE Protective Relays

For Two, Three, and Four Zone Directional-distance Protection of Transmission Lines

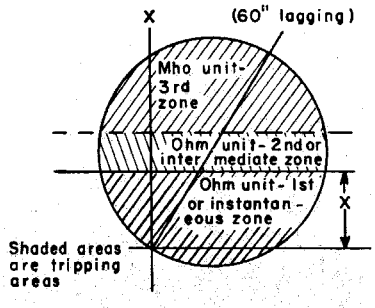


Fig. 1. Typical steady state operating characteristics. Type GCX51A relay

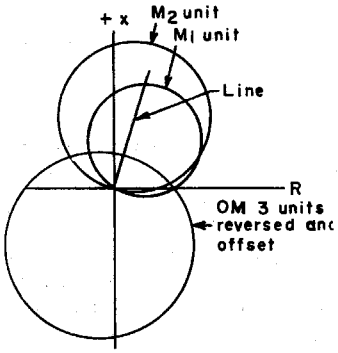


Fig. 2. Typical steady state operating characteristics Type GCY51A relay

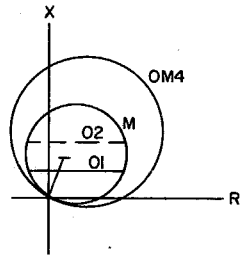


Fig. 3. Typical steady state operating characteristics. Type GCXY51 (OM4 shown without offset)

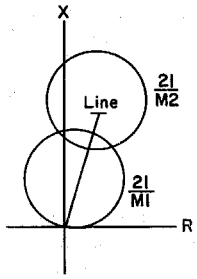


Fig. 4. Typical steady state operating characteristics. Type GCY51F

DESCRIPTION

GCX51 is the type designation for a family of single phase, three-zone phase packaged relays. The first- and second-zone distance measurements are made by a unit having a reactance or ohm type characteristic and the third zone has a directional mho characteristic. See Fig. 1 for R-X diagram.

GCY51 is the type designation for a family of single phase two-zone and three-zone mho phase distance relays for transmission line protection. See Fig. 2 for R-X diagram.

A ***GCY51F*** is a single phase mho relay with two zones of protection. The M1 and M2 units have a 75° angle of maximum torque and M1 has provision for 0.5 ohm offset phase to neutral. The M2 unit has provision for a forward offset of 0-4 ohms phase to neutral, thus giving a conventional two-zone relay or a distinctive "figure eight" characteristic as required. See Fig. 4 for R-X diagram.

The ***GCXY51*** is a single phase, four-zone phase distance relay with two zones of reactance characteristics. A third zone is provided by a unit having a directional mho characteristics, and a fourth zone is provided by a unit with an offset (optional) mho characteristic. See Fig. 3 for R-X diagram.

Typical Terminal Packages—60 Hz

3—GCX51M1A	1-4 Ohm Range
1—SAM	48/110/125/220/250V DC

3—GCY51A1A	0.75-30 Ohm Range
1—SAM	48/110/125/220/250V DC

3—GCY51F1A	0.75-30 Ohm Range
1—SAM	48/110/125/220/250V DC

3—GCXY51A12D	0.1-4 Ohm Range
1—SAM	48/110/125/220/250V DC

APPLICATION—Phase Faults

Directional-distance relaying equipments provide high-speed protection for important transmission lines, and should be considered whenever other relaying is inadequate. The current level is seldom a factor in the time co-ordination of distance relaying. Therefore, changes in generating capacity or in the configuration of the system will not affect distance relaying and complicated short-circuit studies are unnecessary for their application. The length and the loading of a line determine the specific type of distance relay to be applied.

Short and Medium Lines are best protected by the Type GCX distance relay which operate on the reactance principle. Such relays are particularly applicable to short lines, where arc resistance can appreciably affect distance measurement by other means. Relay accuracy and insensitivity to transients permit instantaneous tripping over a maximum percentage of the protected line.

Long Lines are best protected by the Type GCY relay (popularly called the mho relay) because of its greater freedom from the adverse effect of tripping on power swings or loss of synchronism between generating stations.

For lines subject to power swings that are severe enough to affect even the mho-type relays, supplementary means are available to prevent improper operation during the system oscillations.

The GCY51A has 3 mho type units and provides three-zone time distance protection. The OM3 unit can be set in the forward or reversed direction and can be offset for either.

Three-Zone Operation: The Types GCX or GCY (phase-fault) relays in conjunction with a timing relay provide instantaneous operating time for up to 90 percent of the protected line section; a short time for the end zone (remaining 10 percent) and near end of the next section; and a longer time (backup) for faults on more distant sections.

The ***GCY51F*** has two Mho units, M1 and M2. With zero offset for the M2 unit, the relay provides regular two-zone protection. With the M2 unit offset in the forward direction, the relay can provide a very desirable "figure eight" characteristic with two-zone protection for long lines that may carry heavy loads. The M1 unit may be used to provide instantaneous tripping for a portion of the protected line and the M2 unit used with a timer to provide time delay backup tripping for the balance of the line and a portion of the next line section. The trip contacts of both units may be connected in parallel to provide the overreaching characteristic needed for directional comparison or transferred tripping pilot relaying schemes.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

APPLICATION—Phase Faults

The ***GCXY51*** phase distance relay is similar to the GCY51A except it has four zones of protection. Zone one is provided by a reactance unit, O1, under the supervision of the directional mho unit M. The second zone reactance characteristic, O2 is provided by the auxiliary unit OX which is picked up by the timer which extends the reach of the reactance unit. Zone three is provided by the mho unit M by a contact of the timer. The M units can also provide the carrier stop function by carrier auxiliary units. Initiation of carrier is by means of the normally closed contacts of OM, which would be connected to operate for faults in the reverse direction with offset. Thus, this relay is well suited for application in a step distance scheme or with directional comparison carrier.

GROUND FAULT PROTECTION

The three-zone ***GCXG51A*** relay is intended to provide step distance ***ground*** protection for transmission and distribution circuits. This relay is similar to the GCX51 phase relay except it provides first- and second-zone protection for single phase to ground faults plus third-zone protection for single phase to ground and double phase to ground faults. Also, the relay can provide instantaneous protection for up to 80 percent of the protected line section and a short time delay for the remaining 20 percent.

The ***GCXG53A*** ground distance relay is similar to the GCXG51 except for use on ***longer transmission lines.*** Significant differences:

a. The mho unit has an additional current circuit to provide zero sequence current compensation.
b. The mho unit uses median voltage polarization.
c. The mho unit is provided with an adjustment to vary the angle of maximum torque over the range of 60 to 75 degrees lag.

CONTACT RATING

The contacts of these relays will close and carry momentarily 30 amperes DC. However, the circuit breaker trip circuit must be opened by an auxiliary switch contact or other suitable means since the relay contacts have no interrupting rating.

BURDEN DATA

Maximum Potential Burdens (Total Relay)

Relay	Watts	Vo.	
GCX51A, B,H	30	31	At 60 Hz 120V 5 Amp and 100% tap
GCX51M, N, R	27	30	
GCY51A	41.8	42.2	
GCY5F	—	—	
GCXY51A	42.3	45.8	
GCXG51A	25.7	38.9	
GCXG53A	—	—	

For current burdens and potential burdens other than 100 percent tap. See instruction book for details.

Typical Ground Terminal Package for Normal and Short Lines

3-GCXG51A-A
1-SAM
1-NAA15E
1-0367A0266G1 Aux. transf.

Typical Ground Terminal Package for Long Lines

3-GCXG53A-A
1-SAM
1-NAA15E
1-0367A0266G1 Aux.
1-0367A0266G2 transf.

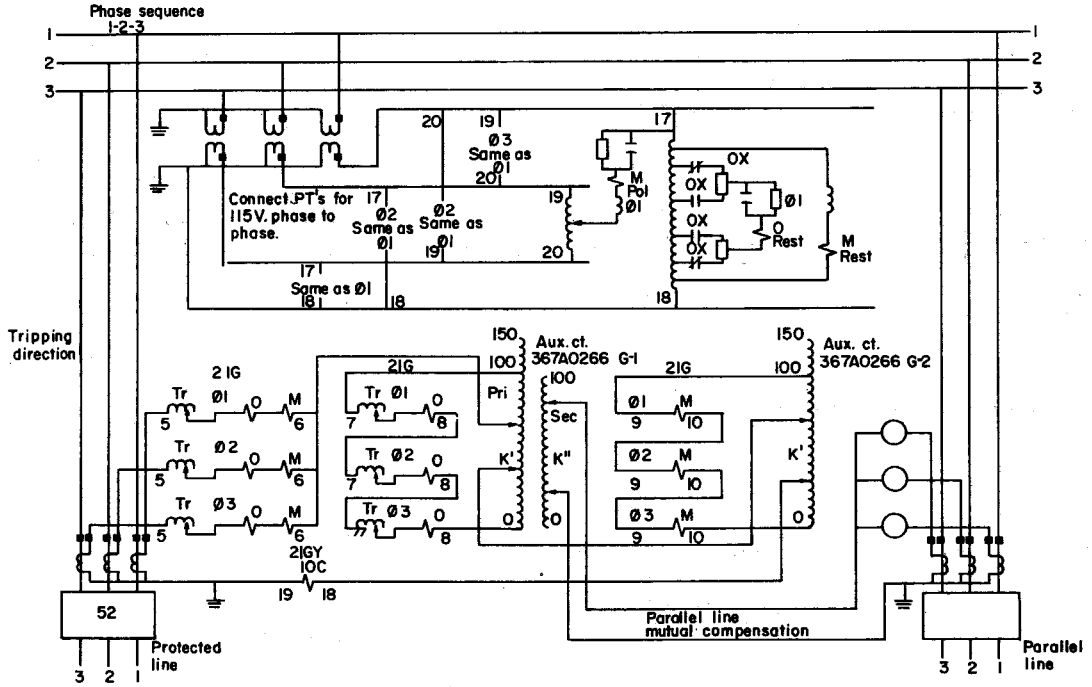
SELECTION GUIDE—3 Zone-phase Reactance

Freq. Hz	Control Volts Dc	Mho Unit Range (Ohms)	Ohm Unit Range (0-N. Ohms)	Target Seal-in (Amps)	O.C. Unit Range (Amps)	Model Number	Case Size	Approx. Wt. in lbs (KG) Net	Ship
STANDARD REACH—GCX51A-Mho Unit Angle of Max. Torque 60°									
60	48/125/205	1-4	.25-10	0.6/2.0	...	12GCX51A23A	L-2	32 (14.5)	38 (17.2)
		2.5-10	.25-10	0.6/2.0	...	12GCX51A12A			
		2.5-10	.25-10	0.2/2.0	...	12GCX51A13A			
		2.5-10	.5-20	0.6/2.0	...	12GCX51A24A			
50	48/125/250	2.5-10	.25-10	0.6/2.0	...	12GCX51A14A			
	48/110/220	2.5-10	.25-10	0.6/2.0	...	12GCX51A20A			
SHORT REACH—GCX51M-Mho Unit Angle of Max. Torque 60°									
60	48/125/250	1-4	.1-4	0.6/2.0	...	12GCX51M1A	L-2	32 (14.5)	38 (17.2)
50	48/125/250	1-4	.1-4	0.2/2.0	...	12GCX51M2A			
	48/125/250			0.6/2.0	...	12GCX51M3A			
	48/110/220			0.6/2.0	...	12GCX51M4A			
	48/110/220			0.2/2.0	...	12GCX51M5A			
STANDARD REACH—GCX51B—Same as GCX51A Except with Inst. O.C. Unit									
60	48/125/250	2.5-10	.25-10	0.6/2.0	4-16	12GCX51B12A	L-2	34 (15.4)	40 (18.1)
				0.6/2.0	2-8	12GCX51B13A			
				0.6/2.0	1-4	12GCX51B14A			
				0.2/2.0	2-8	12GCX51B16A			
50		2.5-10	.25-10	0.6/2.0	2-8	12GCX51B15A			
				0.6/2.0	4-16	12GCX51B20A			
SHORT REACH—GCX51N—Same as GCX51M Except with Inst. O.C. Unit									
60	48/125/250	1-4	.1-4	0.6/2.0	4-16	12GCX51N1A	L-2	34 (15.4)	40 (18.1)
	24/48/125			0.6/2.0	4-16	12GCX51N3A			
	24/48/125			0.6/2.0	10-40	12GCX51N4A			
	48/125/250			0.2/2.0	4-16	12GCX51N6A			
50	48/125/250	1-4	.1-4	0.6/2.0	4-16	12GCX51N2A			
	24/48/125			0.6/2.0	2-8	12GCX51N5A			
STANDARD REACH—GCX51H—Same As GCX51A Except 75° Angle Max. Torque									
60	48/125/250	2.5-10	.25-1	0.6/2.0	...	12GCX51H2A	L-2	34(15.4)	40(18.1)
SHORT REACH—GCX51R—Same as GCXM Except 75° Angle Max. Torque									
60	48/125/250	1-4	.1-4	0.6/2.0	...	12GCX51R1A	L-2	34(15.4)	40(18.1)

SELECTION GUIDE—3 Zone Ground Distance

AC Rating	Control Volts DC	Mho Unit Phase-Neut. Range Ohms	Target Seal-in Amp	Ohm-Unit Phase-Neut. Ohms	Model Number	Required Per Terminal	Case Size	Approx. Wt. Lb (Kg) Net	Ship
TYPE GCXG51—With 60° Max. Torque Angle									
60Hz 120V 5 Amp. and 70V 5 Amp. Rest.	48/125/250	1-30 1-30 2-60 1-30	0.6/2 0.6/2 0.6/2 0.2/2	0.1-4 0.25-10 0.5-20 0.25-10	12GCXG51A11A 12GCXG51A12A 12GCXG51A15A 12GCXG51A13A	3-GCXG 1-SAM 1-NAA15 1-Aux Trans(3)①	L-2	34(15.4)	40(18.1)
	24/48/125 24/48/125	1-30 1-30	0.6/2 0.6/2	0.1-4 0.25-10	12GCXG51A23A 12GCXG51A22A				
50Hz 120V 5 Amp. and 70V 5 Amp. Rest.	48/125/250 48/110/220 48/125/250	1-30 1-30 2-60	0.6/2 0.6/2 0.6/2	0.25-10 0.25-10 0.5-20	12GCXG51A16A 12GCXG51A24A 12GCXG51A21A				
Type GCXG53—3 Zone Ground Distance—Long Lines with 60/75° Max. Torque Angle									
60 Hz 120V 5 Amp. and 70V 5 Amp. Rest.	48/125/250	1-30 1-30 2-60	0.6/2 0.2/2 0.6/2	0.25-10 0.25-10 0.5-20	12GCXG53A3A 12GCXG53A2A 12GCXG53A1A	3-GCXG53 1-SAM14 1-NAA15 2-Aux Transf(4)①	L-2	34(15.4)	40(18.1)
50 Hz 120V 5 Amp. and 70V 5 Amp. Rest.	48/125/250 48/125/250 48/110/220	1-30 1-30 1-30	0.6-2 0.6-2 0.6-2	0.1-4 0.25-10 0.25-10	12GCXG53A5A 12GCXG53A4A 12GCXG53A6A				

① **NOTES:**
(1) For SAM and other timing relays, See Section 6.
(2) For NAA15 auxiliaries. See page 3-13.
(3) **One** auxiliary transformer No. 0367A0266G1 required for each terminal of GCXG51 relays.
(4) For GCXG53 terminal—**one** No. 0367A0266G1 and **one** 0367A0266G2.



(Drawing 0116B9419)

Fig. 5. Typical External Connections Three Type GCXG53A per Terminal

SELECTION GUIDE—4 Zone Phase Distance

60/75° Max. Torque Angle M Unit—75° Max. Torque Angle OM Unit

TYPE GCXY51—1st and 2nd Zone Reactance, 3rd and 4th Mho Distance

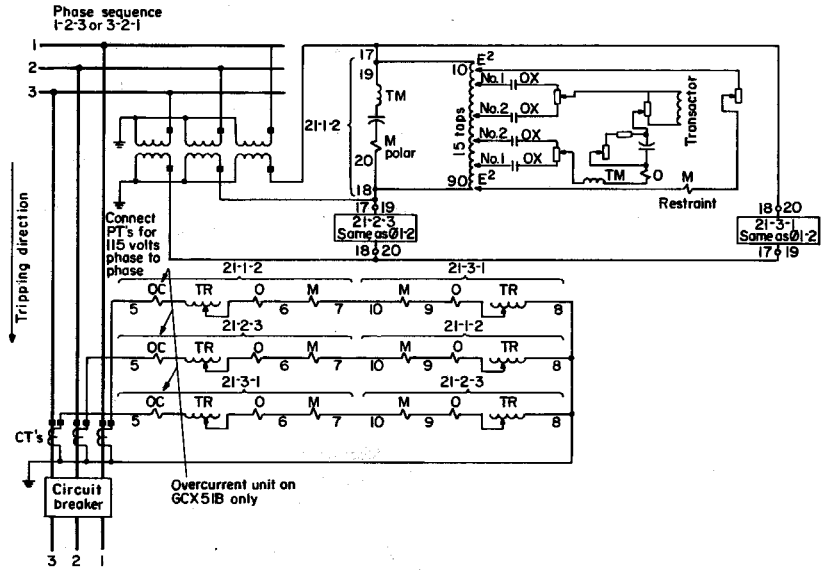
AC Rating	Control Volts DC	Unit Phase-Neut. Ohms	Mho Units Phone-Neut. Ohms M	Mho Units Phone-Neut. Ohms OM	OM Offset Ohms	Target Seal-In Amp.	Model Number	Required Per Terminal	Case Size	Approx Wt(Kg) Net	Approx Wt(Kg) Ship
60Hz											
120V 5 Amp	48/125/250	0.1-4	1-12	3-30	0-0.5	0.6/2	12GCXY51A12D	3-GCXY	L-2D	43(19.5)	50(22.7)
	48/125/250	0.25-10	1-12	3-30	0-0.05	0.6/2	12GCXY51A11D	1-SAM			

3 Zone Phase Mho Distance

AC Rating	Mho Units Phase to Neutral Ohms M1	M2	OM3	OM3 Offset Ohms	Maximum Torque M1 M2	OM3	Target Seal-in Amp.	Model Number	Required Per Terminal	Case Size	Approx Wt Lb(Kg) Net	Ship
TYPE GCY51A												
60Hz												
120V 5 Amp	0.75-30	1-30	3-30	0-0.5	60°	75°	0.6/2	12GCY51A1A	3-GCY 1-SAM	L-2	42(19.1)	49(22.2)
	0.75-30	1-30	3-30	0-0.5	60°	75°	0.2/2	12GCY51A2A A2A				
50Hz												
120V 5 Amp	0.75-30	1-30	3-30	0-0.5	60°	75°	0.6/2	12GCY51A3A		L-2	42(19.1)	49(22.2)
TYPE GCY51D—Similar to GCY51A—Except M2—75° Max. Torque Angle												
					M1	M2 OM3						
60Hz 120V 5Amp	0.75-30	1-30	3-30	0-0.5	60°	75°	0.6/2	12GCY51D1A	3-GCY 1-SAM	L-2	42(19.1)	49(22.2)
TYPE GCY51H—Similar to GCY51A—Except all units 75° Max. Torque Angle												
50Hz 120V 5 Amp	0.75-30	1-30	3-30	0-0.5	75°	75°	0.6/2	12GCY51H3A	3-GCY 1-SAM	L-2	42(19.1)	49(22.2)

TYPE GCY51F—2 Zone Phase Mho or "Figure 8"

AC Rating	Mho Units Phase to Neut. Ohms M1	M2	M1 Offset Ohms	M2 Offset Ohms	Maximum Torque M1	M2	Target Seal-in Amp.	Model Number	Required Per Terminal	Case Size	Approx. Wt Lb(Kg) Net	Ship
60Hz 120V 10 Amp	0.75-30	1-30	0-0.5	0-4	75°	75°	0.6/2	12GCY51F1A	3-GCY 1-SAM	L-2	38(17.2)	44(20)



(Drawing 738180093-5)

Fig. 6. Typical External Connections Three Type GCX51A or 51B per Terminal

CEB

Offset MHO-Zone and Phase Packaged Directional-distance Relays

GE Protective Relays

DESCRIPTION

Type ***CEB*** relays are high-speed, single-zone mho directional distance phase relays with provisions for offsetting the characteristic. The transient overreach characteristic is such that these relays are suitable for 2nd or 3rd zone applications.

APPLICATION

The Type ***CEB51A*** is a single-phase offset mho blocking relay that includes an out-of-step blocking auxiliary (OSB) telephone type relay. This auxiliary has two NO and five NC contacts suitable for out-of-step blocking of either tripping or reclosing.

One relay per terminal is required to provide out-of-step blocking in conjunction with the M2 unit of a Type CEY52 or GCY51 when the OM3 unit is reversed. It is also suitable for two- or three-terminal directional comparison applications that utilize a directional carrier starting relay such as a Type CEB52.

The Type ***CEB51B*** is a single-phase, single-zone relay. Thus, three relays, plus one Type SAM timing relay are required to provide one zone of time delay distance protection against multi-phase faults.

A typical application would include three CEB51B relays with one Type SAM timer for generator backup protection.

The ***CEB52A*** is a three-phase high-speed ***extended (30 to 1) range,*** single-zone, mho distance relay with provisions for offsetting the characteristic a fixed amount. It is suitable for applications as a transmission line carrier starting relay in directional comparison relaying schemes. Also, the CEB52A is suitable as a third-zone distance relay in a straight distance protective scheme using zone packaged relays where carrier may be added in the future.

The CEB52A consists of three single-phase offset mho units in one L-2D case and has one target seal-in for all three phases. It may also be used with a Type SAM timing relay to provide second- or third-zone protection in straight distance schemes.

CONTACT RATINGS

The trip circuit of the relay will close and carry momentarily 30 amperes dc. The breaker trip circuit, however, should always be opened by a circuit breaker auxiliary switch or other suitable means, because the relay contacts cannot interrupt tripping current. If the tripping current should exceed 30 amperes it is recommended that an auxiliary tripping relay be used.

BURDEN DATA

Table 1

Relay Type	Maximum① Current Burden		Maximum① Potential Burden	
	Pf	Va	Pf	Va
CEB52A	0.98	3.86	—	—
Polarizing			0.99	9.2
Restraint			0.57	8
CEB51A	0.7	5	—	—
Polarizing	—	—	0.99	10.3
Restraint	—	—	0.39	7.7
CEB51B	0.7	5	—	—
Polarizing	—	—	0.99	10.3
Restraint	—	—	0.39	7.7

①Maximum Burden imposed on each CT or Pt. at 5 amp 60 Hz and rated voltage and 100 percent restraint tap. For potential Burden calculation other than 100 percent restraint, see instruction book.

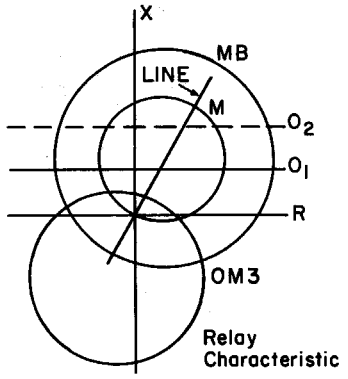
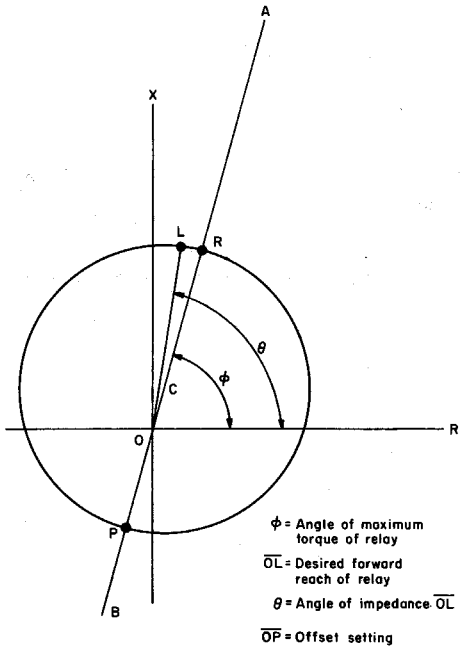


Fig. 1. Typical steady state characteristics for Type GCX51 with starting CEB52A for carrier



(0165A770)

Fig. 2. Typical offset characteristic of Type CEB51B relay

REFERENCES:

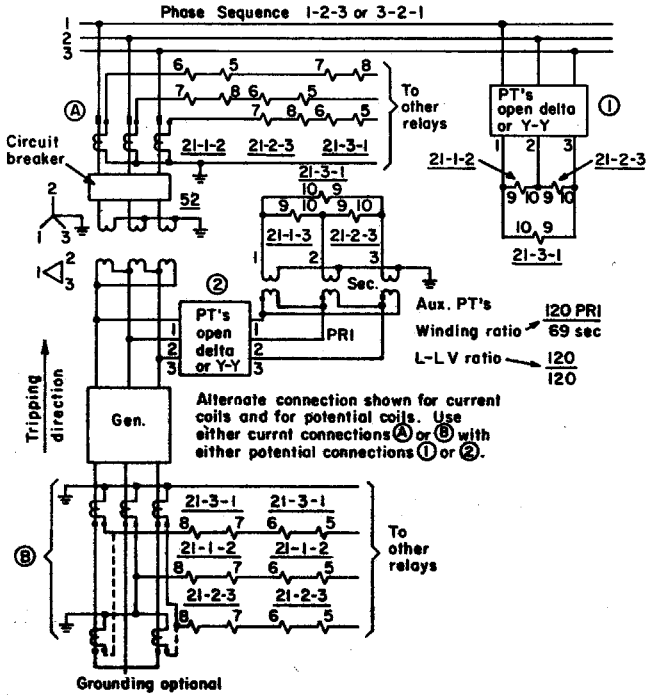
Dimensions .....Section 16
How to Order .....Section 1
Instruction Books .....Section 17
Target and Contact Data.....Section 16
Relay Standards.....Section 16

SELECTION GUIDE

Application	Ac Rating	Dc Control Volts	Number Of Phases	Target Amp	Target Seal-In Amp	Mho Unit Ohms	Max. Torque Angle Range	Max. Torque Angle Factory Setting	Offset Ohms	Model Number	Case Size	Approx Wt Lb(Kg) Net	Approx Wt Lb(Kg) Ship
Type CEB52A—3 Phase Offset Mho—2nd or 3rd Zone Extended Range													
Lines Directional Comparison and Distance	60 Hz 120V 5 Amp	—	3	—	0.6/2	0.5-15	60/75	75°	0/0.25	12CEB52A4D	L-2D	44(20)	51(23.1)
		—	3	—	0.2/2	0.5-15			0/0.25	12CEB52A9D			
		—	3	—	0.6/2	1-30			0/0.5	12CEB52A1D			
		—	3	—	0.2/2	1-30			0/0.5	12CEB52A2D			
		—	3	—	0.6/2	1-30			0/0.2	12CEB52A6D			
		—	3	—	0.6/2	2-60			0/0.5	12CEB52A5D			
		—	3	—	0.6/2	2-60			0/1.0	12CEB52A10D			
	50 Hz 120V	—	3	—	0.2/2	1-30	60/75	75°	0/0.5	12CEB52A3D			
		—	3	—	0.6/2	1-30	60/75	75°	0/0.5	12CEB52A8D			
Type CEB51B—Single Phase Offset Mho—2nd or 3rd Zone													
Generator and Lines	60 Hz 120V 5 Amp	—	1	—	0.2/2	3-30	—	60°	0-4	12CEB51B1A	M-1	25(11.3)	31(14.1)
		—	1	—	0.2/2	3-30	—	75°	0-4	12CEB51B2A			
	50 Hz 120V 5 Amp	—	1	—	0.2/2	3-30	—	75°	0-4	12CEB51B3A			
Type CEB51A—Single Phase Offset Mho With OSB Auxiliary													
Out-of-Step Blocking (OSB)	60 Hz 120V 5 Amp	125/250	1	—	—	3-30	—	60°	0-4	12CEB51A1A	M-2	25(11.3)	31(14.1)
		125/250	1	—	—		—	75°		12CEB51A3A			
		24/48	1	—	—		—	60°		12CEB51A7A			
		24/48	1	—	—		—	75°		12CEB51A6A			
		110/220	1	—	—		—	75°		12CEB51A9A			
	50 Hz 120V 5 Amp	125/250	1	—	—	3-30	—	60°	0-4	12CEB51A2A			
		125/250	1	—	—		—	75°		12CEB51A4A			
		110/220	1	—	—		—	60°		12CEB51A8A			
		110/220	1	—	—		—	75°		12CEB51A5A			

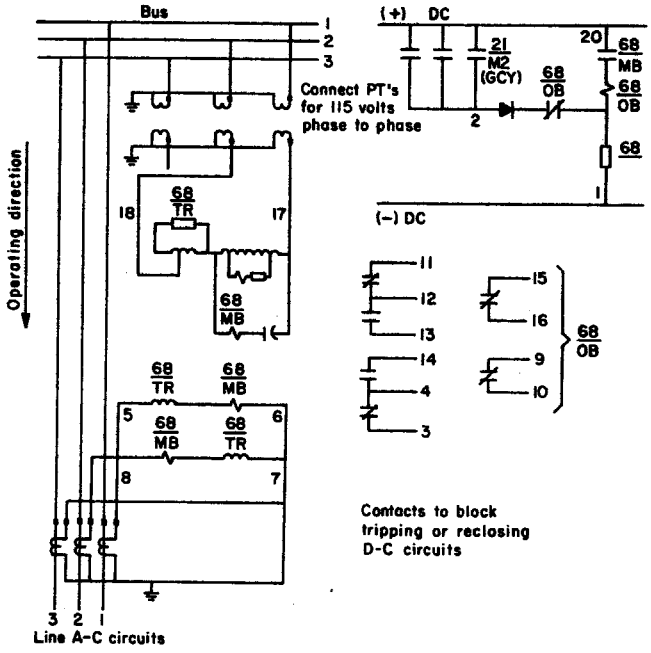
NOTE: For SAM and other timing relays, see Section 6.

CONNECTION DIAGRAMS



(403A118-5)

Fig. 3. Typical external conn. for Type CEB51B for generator back-up protection (3 relays required)



(0208A2405-0)

Fig. 4. Typical external conn. for Type CEB51A relay for out-of-step blocking

PHASE PROTECTION—DESCRIPTION

The ***CEY51A*** and ***CEY52A*** are extended range, three-phase, high-speed, single-zone mho directional-distance relays. These relays include three single-phase units with provision for single phase testing. One target and seal-in unit provides indication of operation for all three distance units and the three-phase contacts are brought out to separate terminal studs.

A ***CEY53A*** is a single phase, extended range, zone-one mho distance relay specifically for shunt reactor protection and includes the normal target seal-in unit.

CEY54A is a three-phase, single-zone, phase mho directional distance relay similar to the ***2nd*** zone ***CEY52A*** except the target seal-in connections are modified and the phase contacts are connected in parallel.

APPLICATION

The type ***CEY51*** relay, because of its low transient overreach and its memory action, is primarily a first-zone tripping relay. As such it is applicable as a high-speed tripping unit in direct and permissive under-reaching transferred tripping schemes. It is also very well suited as a first-zone tripping relay in any scheme and will provide complete one-zone protection for three-phase, phase-to-phase and double phase-to-ground faults.

When applying this relay for the protection of a given circuit, it is generally advantageous to select the highest basic reach tap that will provide the desired reach setting. This will insure the highest possible operating torque level. For 1st zone applications, the relay may be set for as much as 90% of the protected line.

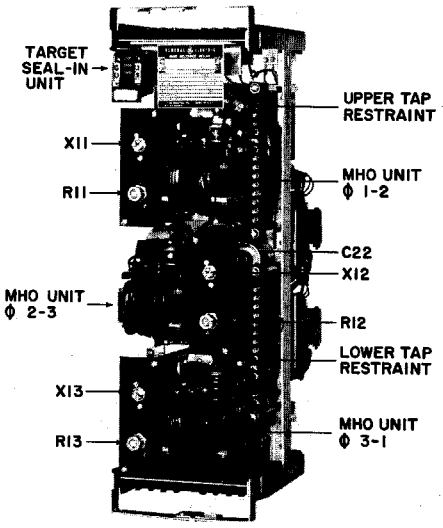
The Type ***CEY52*** and ***CEY54*** because of their high speed and memory action characteristics, find application as a carrier tripping relay in directional comparison schemes, as a permissive and tripping relay in permissive overreaching transferred tripping schemes or as a permissive realy in permissive underreaching transferred tripping schemes. They are also very well suited use as a second-zone relay in any scheme. The transient overreach characteristic of these relays have not been limited to the point where it is suitable for use as a first-zone relay. One CEY52 relay in conjunction with a suitable ***SAM*** relay will provide one zone of time delay protection for three-phase, phase-to-phase and double-phase-to-ground faults.

For shunt reactor protection the ***Type CEY53A*** zone one mho distance relay is available. It provides instantaneous protection against turn-to-turn and single-phase-to-ground faults. The relay is mounted in a single ended size M-1 drawout case and three relays are required for each three-phase reactor application. Refer to instruction book for additional information.

GROUND FAULT PROTECTION

The ***CEYG51A*** is a three-phase, high-speed, single-zone mho type directional distance ground relay. It includes three single phase units with facilities for single phase testing and one target seal-in unit to indicate operation for all three distance units. Also, the ground mho units are provided with separate current circuits for zero sequence current compensation. The mho units are ***quadrature*** voltage polarized and suitable for normal length transmission line protection.

The CEYG53A is a three-phase, high-speed, single-zone mho type directional distance ground relay and the mho units are ***median*** voltage polarized. Otherwise, similar to the ***GEYG51A 2nd*** zone relay.



(8036549)
Typical Type CEY51A
Fig. 1. Mho Distance Relay

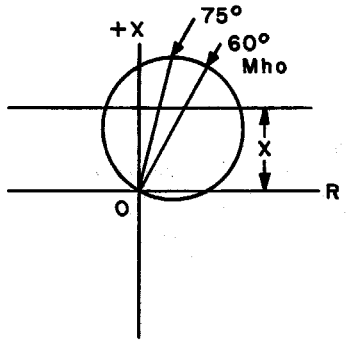


Fig. 2. Typical steady state operating characteristic Type CEY52B

This relay is suitable for longer length transmission lines and is typically applied as the primary ground relay in directional comparison blocking or in permissive overreaching transferred tripping schemes.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

BURDEN DATA

Table 1

Relay Type	②Maximum Current Burden		②Maximum Potential Burden	
	P.F.	Va	P.F.	Va
①CEY51A	0.98	2.5	....	14.3
①CEY52A	0.86	1.25	....	17.9
①CEY54A	0.86	1.25	....	17.9
①CEY52B	0.86	1.25	....	17.0
①CEY53A	0.98	2.5	....	14.3
①CEYG51A	0.86	2.0	....	30.2
①CEYG53A	0.98	4.7	....	22.1
	At 5 Amp 60Hz		On 100% Taps at 60 Hz	

Table 2—TYPICAL ZONE PACKAGED PHASE DISTANCE RELAYS

	Normal or Long Lines
2 Zone	1—CEY51A-D ..... 1st zone 1—CEY52A-D ..... 2nd zone 1—SAM ..... Timer
3 Zone	1—CEY51A-D ..... 1st zone 1—CEY52A-D ..... 2nd zone 1—CEB52A-D ..... 3rd zone 1—SAM ..... Timer

NOTE:
(a) Typical Schematic Diagrams for these and other packages are available on request.
(b) For CEB52 details see pages 3-22 through 3-24.
(c) For SAM details see Section 6.
(d) For NAA15G details see page 3-13.

CONTACT RATINGS

The contacts of these relays will close and carry momentarily 30 amperes dc. However, the circuit breaker trip circuit must be opened by an auxiliary switch contact or other suitable means since the relay contacts have no interrupting rating.

NOTES:
①Potential burdens given are the total of polarizing and restraint circuits.
②For current and potential burdens other than 100% tap see instruction book for details.

SELECTION GUIDE

TYPE CEY51A—3 Phase 1st Zone Phase Mho

Application	AC Rating	Target Seal-in Amp	Mho Unit Range Ohms	Max. Torque Angle		Model Number	Case Size	Approx Wt Lb(Kg)	
				Range	Factory Setting			Net	Ship
1st Zone Line	60Hz 120V 5 Amp	0.6/2	0.375-15	60/75°	60°	12CEY51A3D	L-2D	43(19.5)	50(22.7)
		0.6/2	0.75-30	60/75°	60°	A1D			
		0.6/2	0.75-30	60/75°	75°	A6D			
		0.6/2	1.5-60	60/75°	60°	A9D			
		0.6/2	0.2-8	60/75°	60°	A11D			
		0.2/2	0.375-15	60/75°	60°	A8D			
		0.2/2	0.75-30	60/75°	60°	A2D			
	50Hz 120V 5Amp	0.6/2	0.75-30	60/75°	60°	A10D			
		0.2/2	0.75-30	60/75°	60°	A4D			

Type CEY52A—3 Phase, 2nd or 3rd Zone Phase Mho

2nd or 3rd Zone Line	60Hz 120V 5 Amp	0.6/2	0.5-15	60/75°	60°	12CEY52A4D	L-2D	43(19.5)	50(22.7)
		0.6/2	1-30	60/75°	60°	A1D			
		0.2/2	0.5-15	60/75°	60°	A3D			
		0.2/2	1-30	60/75°	60°	A2D			
	50Hz 120V 5 Amp	0.6/2	1-30	60/75°	60°	A5D			

TYPE CEY54A—3 Phase, 2nd or 3rd Zone Phase Mso—(Parallel Contacts)

2nd Zone Line	60Hz 120V 5 Amp	0.6/2	1-30	60/75°	60°	12CEY54A1D	L-2D	43(19.5)	50(22.7)

Type CEY53A-Single Phase— 1st Zone Phase Mho

Application	AC Rating	Target Seal-in Amp	Mho or Ohm Unit Range Ohms	Max Torque Angle	Model Number	Case Size	Approx Wt Lb(Kg)	
							Net	Ship
Shunt Reactor	60Hz 120V 5 Amp	0.2/2	0.75-30	75°	12CEY53A1A	M-1	25(11.3)	31(14.1)
		0.2/2	1.5-60	75°	A2A			

TYPE CEYG51A—3 Phase, 2nd or 3rd Zone Ground Mho—Quadrature Polarized

Line Ground Distance 2nd or 3rd Zone	60Hz 120V 5 Amp 70V Rest	0.6/2	0.5-15	60°	12CEYG51A5D	L-2D	43(19.5)	50(22.7)
		0.6/2	1-30	60°	A1D			
		0.2/2	1-30	60°	A2D			
	50Hz 120V 5 Amp 70V Rest	0.6/2	1-30	60°	12CEYG51A3D			

TYPE CEYG53A—3 Phase 2nd Zone Ground Mho—Median Polarized

Application	AC Rating	Target Seal-in Amps	Mho Unit Range Ohms	Max Torque Angle		Model Number	Case Size	Approx Wt Lb(Kg)	
				Range	Factory Setting			Net	Ship
Line Ground Distance	60Hz 120V 5 Amp 70V Rest	0.2/2	1-30	60/75°	60°	12CEYG53A2D	L-2D	43(19.5)	50(22.7)
		0.6/2	2-60	60/75°	60°	A1D			

CLPG

Dual Polarized Directional Overcurrent Carrier-ground Relays

GE Protective Relays

DESCRIPTION

The ***CLPG12C*** is a high-speed, zero sequence ground relay designed specifically for use as a ground fault relay in directional comparison relaying schemes. It includes one high-speed zero sequence directional unit ***GD*** which may be polarized from voltage and/or current. Also, it contains two high-speed zero sequence non-directional overcurrent units, ***G1*** and ***G2,*** and one dc operated auxiliary unit, ***GD1X.***

APPLICATION

The ***CLPG12C*** is usually selected for use on grounded neutral systems as the directional comparison ground relay regardless of the type of channel used. This relay, in conjunction with the pilot channel and the CLPG12C relays at the other ends of the protected line section, provides high-speed tripping for all single phase-to-ground faults in the protected line. The relay is suitable for two-terminal and three-terminal lines.

The two non-directional overcurrent units and the operating circuit of the directional unit may be all supplied in series from the neutral connection of the three line current transformers. The polarizing circuit of the directional unit may be supplied from a current transformer in the neutral of a grounded neutral power transformer or from the broken delta secondary connection of three potential transformers whose primary windings are connected in wye, or it may be simultaneously supplied from both sources of polarization.

CLPG12C—Ratings

The ***potential coils*** of the CLPG12C relay are rated 120 volts intermittent and 360 volts for 10 seconds, both values being at rated frequency.

The ***tripping contacts*** of these relays are the normally open contacts of the ***G2*** and ***GD*** units. They will carry 2.5 amperes continuously and will close and carry 30 amperes dc for tripping duty at control voltages of 250V dc or less. The breaker trip coil circuit should, however, always be opened by a circuit breaker auxiliary switch or other suitable means. If the tripping current exceeds 30 amperes an auxiliary tripping relay should be used.

CLPG12C—Burdens

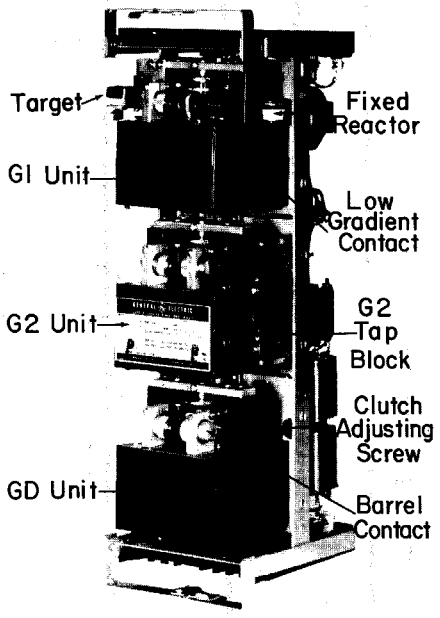
The burdens imposed on the current transformers are listed in the instruction book.

The potential circuit burden calculated at 120 volts, 60 Hz is shown in the following table:

Potential Circuit Burdens

Watts	Vars	Volt Amperes
18	3.18	18.35

The burdens imposed by the 50 Hz relays are approximately 90% of those shown for the comparable 60 Hz relays.



(Photo 8029723)

Fig. 1. CLPG12C Relay (Front View)

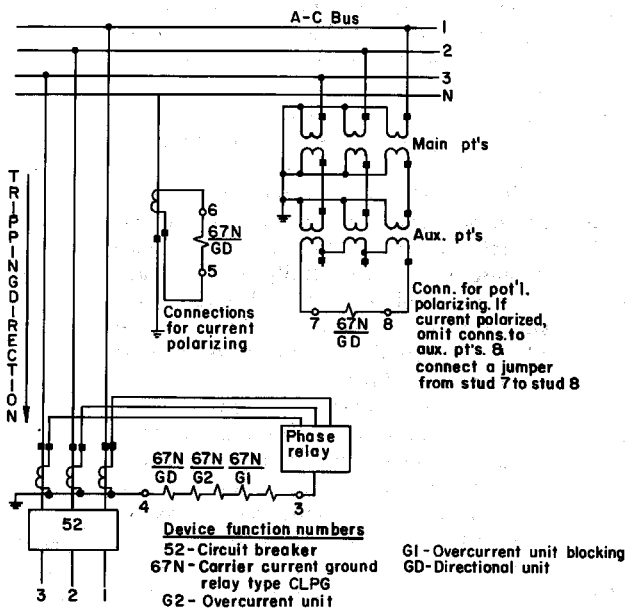
REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

SELECTION GUIDE—Carrier Ground Relay
Type CLPG12C 120v. Intermittent—5 Amp Continuous

Frequency Hz	Control Volts DC	Overcurrent G1 Amp	Overcurrent G2 Amp	Pick-up GD V x I	Target Amp	Seal-in Amp	Model Number	Case Size	Approx Wt Lb(Kg) Net	Approx Wt Lb(Kg) Ship
60	48 125 250	0.4-1.6	0.5-4	3.6-57.6	1	1	12CLPG12C9A C1A C2A	L-2	37(16.8)	44(20)
	48 125 250	0.8-3.2	1-8	3.6-57.6	1	1	C14A C3A C4A			
	48 125	0.4-1.6	0.5-4	3.6-57.6	1 1	0.6/2 0.6/2	C16A C17A			
	125 250	0.4-1.6	0.5-4	3.6-57.6	1 1	0.2/2 0.2/2	C11A C18A			
	125 125 125	0.8-3.2	1-8	3.6-57.6	1 2 0.2	0.2/2 2 0.2/2	C19A C15A C22A			
	125 250 125 125	0.4-1.6	0.5-4	3.6-57.6	0.2 0.2 2 0.6	0.2/2 0.2/2 2 0.6	C20A C21A C23A C13A			
	125 250	0.4-1.6	1-8	3.6-57.6	2 2	0.2/2 0.2/2	C24A C25A			
50	125 250 110 220 220	0.4-1.6	0.5-4	3.6-57.6	1 1 1 1 0.2	1 1 1 1 0.2/2	C5A C6A C12A C10A C26A	L-2	37(16.8)	44(20)
	125 250	0.8-3.2	1-8	3.6-57.6	1	1	C7A C8A			

CONNECTION DIAGRAM



(Dwg 362A544)

Fig. 2. Typical external connections for CLPG12C

SLY81, SLY82, SLY92, SLYG81 and SLYG82

Static Zone Packaged MHO Distance Relays

GE Protective Relays

INTRODUCTION

The SLY81, SLY82, SLY92, SLYG81 and SLYG82 are static distance relays mounted in drawout type cases. They use new measuring techniuqes to provide an increase in fault resistance accommodation, and an improvement in directional integrity.

DESCRIPTION

The type SLY81A, a phase distance relay, provides protection for all multi-phase faults. Relay models are available with the following ohmic reaches: 0.1-4 ohms and 0.75-30 ohms. Each relay has two electrically separate contacts; each contact has its own target. A third contact, with one side connected to battery positive, is also brought out for use with external auxilary functions.

The type SLY81B is similar to the type SLY81A except that it includes an out-of-step blocking function, designated MOB. The MOB function is used to detect an out-of-step condition. An output from MOB operates a normally open contact that can be used to energize an auxiliary relay to block tripping, reclosing, etc., during power swings.

The type SLY82, also a phase distance relay, is the companion to the SLY81 relay. The SLY82 is used primarily to provide the blocking functions in pilot relay schemes applied with a blocking channel. Models are available with a 0.75 to 30 ohm range. Contacts are provided for tripping (one normally open with a series target); for carrier starting, or blocking (one normally closed contact); and for auxiliary functions (one normally open with one side connected to battery positive). The mho functions in the SLY82 can be set with an offset equal to 0.1, 0.2, or 0.3 times the forward reach..

The SLY92A is a phase distance relay that is designed for use where a delta-wye power transformer exists between the relay location and the circuits to be protected by the relay. Typical applications would be backup protection of a generator, or as the carrier start function in a directional comparison blocking scheme. Models are available with an ohmic reach that is adjustable over a range of 0.75 to 30 ohms, and with provisions for offsetting the functions equal to 10, 20 or 30 percent of the set reach. The relay is provided with two separate normally open and one normally closed contact. One of the normally open contacts is provided with a target and seal-in unit. Also included in the relay is an auxiliary potential transformer to compensate for the phase shift introduced by the delta-wye power transformer.

The SLYG81, a ground distance relay, is the counterpart to the SLY81; it is used to provide protection for all single-line-to-ground faults. The contact arrangement in the SLYG81 is basically the same as that in the SLY81, and the same ohmic ranges are available. There is no provision in the SLYG81 to add the MOB function, as it is not required in a ground relay.

The SLYG82 is the ground distance counterpart to the SLY82 phase distance relay. The SLYG82 relay has the same contact arrangement and the same facilities for offset, as the SLY82. Like the SLY82, the SLYG82 is used primarily to provide the blocking functions (for single-line-to-ground faults) in pilot relaying schemes applied with a blocking channel.

APPLICATION

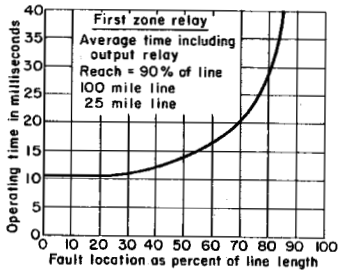
The SLY81 and SLYG81 relays may be used in "stepped distance" relaying schemes to provide any of the zones required, including the first zone. They also can provide the overreaching or underreaching functions required in pilot relaying schemes.

Where blocking functions are required in the pilot relaying scheme, the SLY82 should be used if an SLY81 is used as the overreaching function at the remote terminal, and the SLYG82 should be used if an SLYG81 is used as the overreaching function at the remote terminal.

The SLY92 relay finds application where a delta-wye transformer bank exists between the relay and the circuits to be protected. Because of this, it is ideally suited for application in unit generator schemes to provide backup protection for faults on the adjacent system that are not cleared by first line relays (see Figure 7).

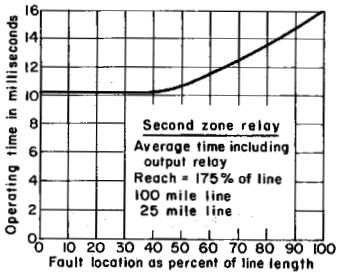
The SLY92 relay may also be used as the blocking function in directional comparison blocking schemes (with interposing delta-wye power transformer). Further details on the application and specific connections can be found in the instruction book.

Because the SLY92 measures the impedance on the remote side of the delta-wye power transformer, a true measurement will only be made if both the current and the voltage circuits are connected to account for the phase shifts introduced through the transformer. The SLY92 relay has included in it an auxiliary phase shifting potential transformer, and the current circuits are designed and connected to measure the correct currents. Typical ac and dc connections for generator backup protection are shown in Figure 8.



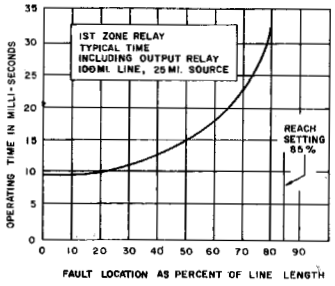
(Dwg. 273A9094)

Fig. 1 Typical operating time for First Zone Phase Relay



(Dwg. 0273A9095-0)

Fig. 2 Typical operating time for Second Zone Phase Relay

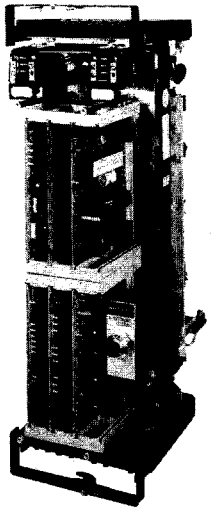


(Dwg. 0257A6180-0)

Fig. 3 Typical operating time for First Zone Ground Relay

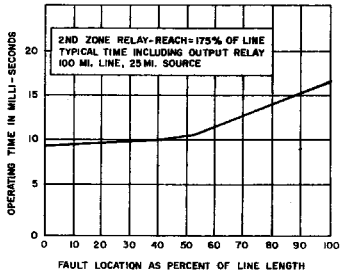
REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16



(Photo 8043198)

Fig. 4 Type SLYG81 Static Ground Distance Relay (out of case and NP removed)



(Dwg. 0257A6180-0)

Fig. 5 Typical operating time for Second Zone Ground Relay

FEATURES

The SLY81, SLY82 and SLY92 phase distance relays utilize a polarizing voltage that is proportional to the faulted phase-pair voltage, plus a portion of the respective positive sequence voltage. This polarization method provides the following benefits for phase-to-phase and phase-to-phase-to-ground faults:

1. Increased arc resistance coverage on a steady-state basis.
2. Ability to produce a continuous output for zero voltage faults.
3. Increased security for reverse faults.

The SLYG81 and SLYG82 relays use a four-input phase angle comparer which offers the following advantages for ground distance applications:

1. Application is simplified for all lines since detailed calculations are greatly reduced.
2. The first and second inputs produce the well-known quadrature polarized unit with a "variable mho" characteristic that increases in size as the source impedance behind the relay is increased, to accommodate increasing fault resistance.
3. Input number 3 is an internally derived compensated zero sequence voltage that restricts the distance measurement to the faulted phase and prevents overreaching on heavy load transfer or on double line to ground faults with high fault resistance.
4. Input number 4 provides zero sequence overcurrent supervision to prevent operation on loss of potential or line de-energizing transients associated with lines that have shunt reactors.
5. The third and fourth inputs also act together as a zero sequence directional unit which provides excellent directional integrity for all faults.

RATINGS

Current:

(a) 5-amp rms nominal at 60 Hz with continuous capability of 10 amp rms.
(b) 250 ampere, one second.

Potential:

69 volts - line to neutral; can withstand 110 percent of this value continuously.

Reach Impedance - See Table 1

SLY81A, SLY81B, SLYG81A Short and Long Reach
SLY82A, SLY92A, SLYG82A - Long Reach only

The relay nameplate includes a setable indicator of base reach tap setting.

Table 1 - Positive Sequence Reach

Reach	Z_{R1} Base Reach Tap in ohms	Z_R Range in ohms
Short	0.1 0.2 0.4	0.1 - 1.0 0.2 - 2.0 0.4 - 4.0
Long	0.75 1.5 3.0	0.75 - 7.5 1.5 - 15 3.0 - 30

Contacts:

All output contacts will make and carry 30 amperes dc for tripping duty. Continuous current ratings are limited by the target coil ratings. See Section 14.

Table 2 - Contact Interrupting Ratings

Voltage	Amperes	
Ac	①Inductive	Non-Inductive
115 230	0.75 0.5	2.0 1.0
Dc		
48 125 250	1.0 0.5 0.25	3.0 1.5 0.75

① Inductive rating with L/R ratio of 0.1 sec.

Ambient Temperature

These relays have been designed for continuous operation between −20C and +55C per ANSI standard C37.90. In addition, these relays will not malfunction for be damaged if operated in an ambient up to +65C.

Battery Drain:

SLY81A, SLY81B, SLY82A, SLY92A, SLYG81A, or SLYG82A

Rated Volts Dc	Condition K2 - Aux	Current Milliamps
125	Standby	80
125	Picked-up	155
48	Standby	200
48	Picked-up	315

BURDENS: SLY81A, SLY81B, SLY82A, SLY92A

The maximum potential burden per phase at 120 volts, 60 Hz is:
0.4 volt amperes
0.2 watts
0.35 vars

The maximum current circuit burden per phase at 5 amperes, 60 Hz is:
Z = 0.028 ∠30° ohms
R = 0.0024 ohms
X = 0.014 ohms

SLYG81A or SLYG82A

The maximum potential burden per phase at 69 volts, 60 Hz is:
0.2 volt amperes
0.17 watts
0.10 vars

The maximum current circuit burden per phase at 5 amperes, 60 Hz is:
Z = 0.03 ∠30° ohms
R = 0.026 ohms
X = 0.015 ohms

POWER SUPPLY

Single rated, 48 or 125V dc with dc to dc converter to provide isolation between the dc control and solid state circuitry for better security. The power supply has a light emitting diode, visible through the relay nameplate, to indicate it is operational.

RELIABILITY

High circuit reliability is provided in the design of these relays by the use of hermetically-sealed silicon semiconductor components which are applied with very conservative derating factors. These components are subjected to a "burn-in" test to reduce infant mortality prior to assembly and installation.

SLY81, SLY82, SLY92, SLYG81 and SLYG82

Static Zone Packaged MHO Distance Relays

GE Protective Relays

SENSITIVITY

The SLY81 is very sensitive. If set at the 3 ohm reach and assuming 15 percent pull-back, minimum operating current for a three-phase fault is 0.21 amps and for a phase-to-phase fault is 0.18 amps. Equivalently for the SLYG81 set the same, the minimum ground fault current is 0.21 amps. For this example the assumption is also made that $I_0 = I_1$ and that $Z_0/Z_1 = 3$.

SEISMIC

These relays have been tested per IEEE Standard C37.98-1978 (formerly IEEE-501). The SLY81, SLY82, SLY92 and SLYG-81 and their normally open contacts have a rating of 5G ZPA. The normally closed contact of the SLY82, SLY92 and the SLYG82 has a rating of 3G ZPA.

SURGE PROTECTION

The relays are designed to meet the surge withstand capability test of ANSI /IEEE C37.90-1978. They also meet the GE "Fast Transient" test and the GE RFI test.

ACCESSORIES

A card puller catalog number 268A9907P1 is available for removing the printed circuit cards from their sockets. It is recommended this tool be used because it will facilitate card removal and help prevent damage to the cards. It should be listed as a separate item on an order. A card extender catalog number 215B8450G1 is available for testing the printed circuit card. It should be listed as a separate item on an order.

SELECTION GUIDE

Application	AC Rating	Freq. (Hz)	Amps	DC Control Volt	Target (Amps-Dc)	Reach L-N Ohms	Positive Sequence Angle	Zero Sequence Angle	Model Number	Case Size	Approx. Wt. lb (kg) Net	Approx. Wt. lb (kg) Ship
TYPE SLY81A—3 Phase, 1st or 2nd Zone Phase Mho Tripping 2-N.O. Tripping Contacts and 1-N.O. Aux. Contact.									**PHASE**			
Line Tripping Phase Distance 1st or 2nd Zone	120	60	5	48	0.6/2.0	0.1-4.0	85°		12SLY81A1D	L2D	30 (13.6)	36 (16.3)
				125		0.1-4.0	85°		A2D			
				48		0.75-30.0	85°		A3D			
				125		0.75-30.0	85°		A4D			
				125		0.1-4.0	65°		A15D			
				125		0.75-30.0	65°		A16D			
				250*		0.1-4.0	65°		A17D			
				250*		0.75-30.0	65°		A18D			
				250*		0.1-4.0	85°		A21D			
									A2D			
			5	48		0.1-4.0			A5D			
				110		0.1-4.0			A6D			
				48		0.75-30.0			A7D			
				110		0.75-30.0			A8D			
			1	48		0.5-20.0			A9D			
	110	50		110	0.6/2.0	0.5-20.0	85°		A10D			
				48		3.75-150.0			A11D			
				110		3.75-150.0			A12D			
			5	125		0.1-4.0			A13D			
				125		0.75-30.0			A14D			
				125		0.1-4.0			A19D			
				250*		0.75-30.0			A20D			
TYPE SLY81B—3 Phase, 2nd Zone Phase Mho Tripping with Out-of-Step Blocking (MOB) 2-N.O. Tripping Contacts and 1-N.O. Aux. Contact									**PHASE**			
Line Tripping with MOB Phase Distance	120	60	5	48	0.6/2.0	0.1-4.0	85°		12SLY81B1D	L2D	30 (13.6)	36 (16.3)
				125		0.1-4.0			B2D			
				48		0.75-30.0			B3D			
				125		0.75-30.0			B4D			
			5	48		0.1-4.0			B5D			
				110		0.1-4.0			B6D			
				48		0.75-30.0			B7D			
				110		0.75-30.0			B8D			
	110	50	1	48	0.6/2.0	0.5-20.0	85°		B9D	L2D	30 (13.6)	36 (16.3)
				110		0.5-20.0			B10D			
				48		3.75-150.0			B11D			
				110		3.75-150.0			B12D			
			5	125		0.1-4.0			B13D			

*Includes an externally mounted pre-regulator.

SLY81, SLY82, SLY92, SLYG81 and SLYG82

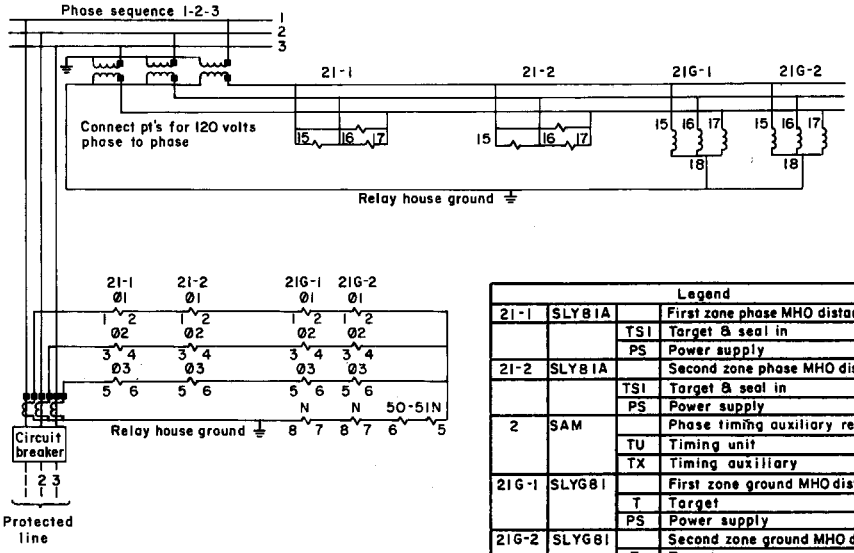
Static Zone Packaged MHO Distance Relays

SELECTION GUIDE

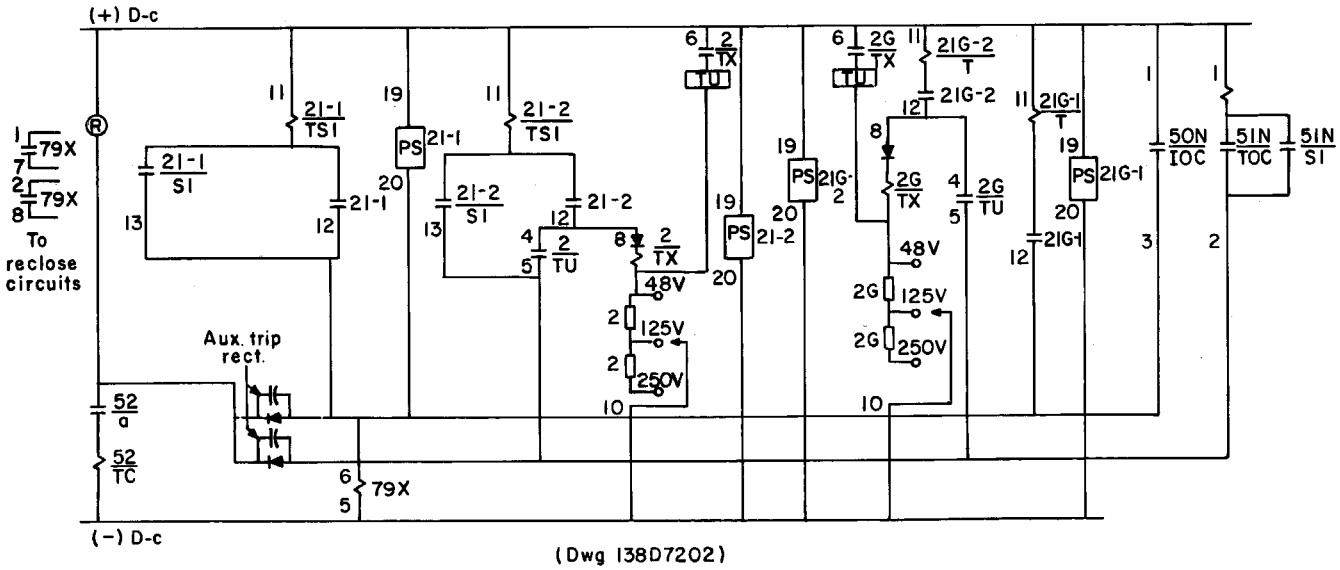
Application	AC Rating	Freq. (Hz)	Amps	DC Control Volt	Target (Amps-Dc)	Reach L-N Ohms	Positive Sequence Angle	Zero Sequence Angle	Model Number	Case Size	Approx. Wt. lb (kg) Net	Ship
TYPE SLY82A—3 Phase, 2nd or 3rd Zone Offset Mho Blocking 1-N.O. Tripping Contact, 1-N.C. Blocking Contact and 1-N.O. Aux. Contact											**PHASE**	
Line Blocking	120	60	5	48	0.6/2.0	0.75-30.0	85°		12SLY82A3D	L2D	30 (13.6)	36 (16.3)
				125		0.75-30.0			A4D			
Ground Distance 2nd or 3rd Zone	110		5	48		0.75-30.0			A7D			
	110		5	110		0.75-30.0			A8D			
	110	50	1	48	0.6/2.0	3.75-150.0	85°		A11D			
	110		1	110		3.75-150.0			A12D			
	120		5	125		0.75-30.0			A15D			
TYPE SLY92A—3 Phase, Generator Backup, Carrier Start, Offset Phase Mho 1-N.O. Tripping Contact, 1-N.C. Blocking Contact and 1-N.O. Aux. Contact											**PHASE**	
Generator Backup, Carrier Start	120	60	5	48	0.6/2.0	0.75-30.0	75°		12SLY92A3D	L2D	30 (13.6)	36 (16.3)
				125					A4D			
				250*					A16D			
	120	50	5	220*	0.6/2.0	0.75-30.0	75°		A15D			
TYPE SLYG81A—3 Phase, 1st or 2nd Zone Ground Mho Tripping 2-N.O. Tripping Contacts and 1-N.O. Aux. Contact.											**GROUND**	
Line Tripping Ground Distance 1st or 2nd Zone	69	60	5	48	0.6/2.0	0.1-4.0	85°	75°	12SLYG81A1D	L2D	30 (13.6)	36 (16.3)
				125		0.1-4.0	85°	75°	A2D			
				48		0.75-30.0	85°	75°	A3D			
				125		0.75-30.0	85°	75°	A4D			
				125	0.2/2.0	0.75-30.0	85°	75°	A5D			
				250*		0.1-4.0	85°	75°	A14D			
				250*		0.75-30.0	85°	75°	A15D			
				125	0.6/2.0	0.1-4.0	65°	55°	A16D			
				125		0.75-30.0	65°	55°	A17D			
				250*		0.1-4.0	65°	55°	A18D			
				250*		0.75-30.0	65°	55°	A19D			
				48		0.1-4.0			A6D			
				110		0.1-4.0			A7D			
				48		0.75-30.0			A8D			
				110		0.75-30.0			A9D			
	63	50	5	48	0.6/2.0	0.5-20.0	85°	75°	A10D			
				110		0.5-20.0			A11D			
				48		3.75-150.0			A12D			
				110		3.75-150.0			A13D			
				125		0.1-4.0			A20D			
TYPE SLYG82A—3 Phase, 2nd or 3rd Zone Offset Ground Mho Blocking 1-N.O. Tripping Contact, 1-N.C. Blocking Contact, and 1-N.O. Aux. Contact											**GROUND**	
Line Blocking Ground Distance 2nd or 3rd Zone	69	60	5	48	0.6/2.0	0.75-30.0	85°	75°	12SLYG82A3D	L2D	30 (13.6)	36 (16.3)
				125					A4D			
	63	50	5	48	0.6/2.0	0.75-30.0	85°	75°	A7D			
			5	110		0.75-30.0			A8D			
			1	48		3.75-150.0			A11D			
			1	110		3.75-150.0			A12D			

*Includes an externally mounted pre-regulator.

CONNECTION DIAGRAMS



Legend			
21-1	SLY81A		First zone phase MHO distance relay
		TSI	Target & seal in
		PS	Power supply
21-2	SLY81A		Second zone phase MHO distance relay
		TSI	Target & seal in
		PS	Power supply
2	SAM		Phase timing auxiliary relay
		TU	Timing unit
		TX	Timing auxiliary
21G-1	SLYG81		First zone ground MHO distance relay
		T	Target
		PS	Power supply
21G-2	SLYG81		Second zone ground MHO distance relay
		T	Target
		PS	Power supply
2G	SAM		Ground timing auxiliary relay
		TU	Timing unit
		TX	Timing auxiliary
50-51N	IFC53B	TOC	Ground time overcurrent
		IOC	Ground inst overcurrent
79X	NGA15AH	RI	Reclose initiation auxiliary



(Dwg. 138D7202)

Fig. 6. Typical External Connection for Two-Zone Phase and Ground Distance Line Protection with Ground Overcurrent Backup.

CONNECTION DIAGRAMS

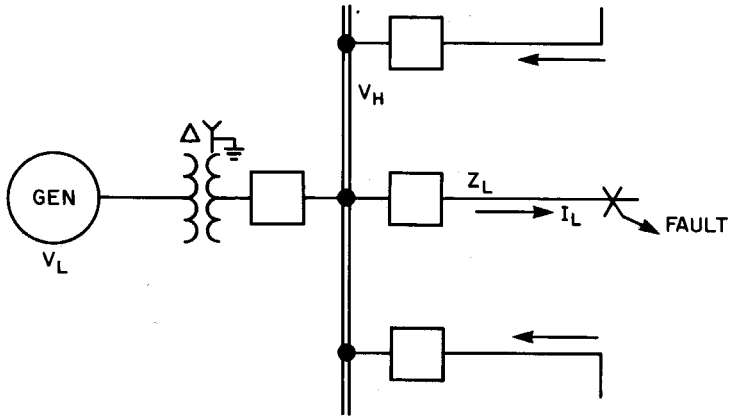
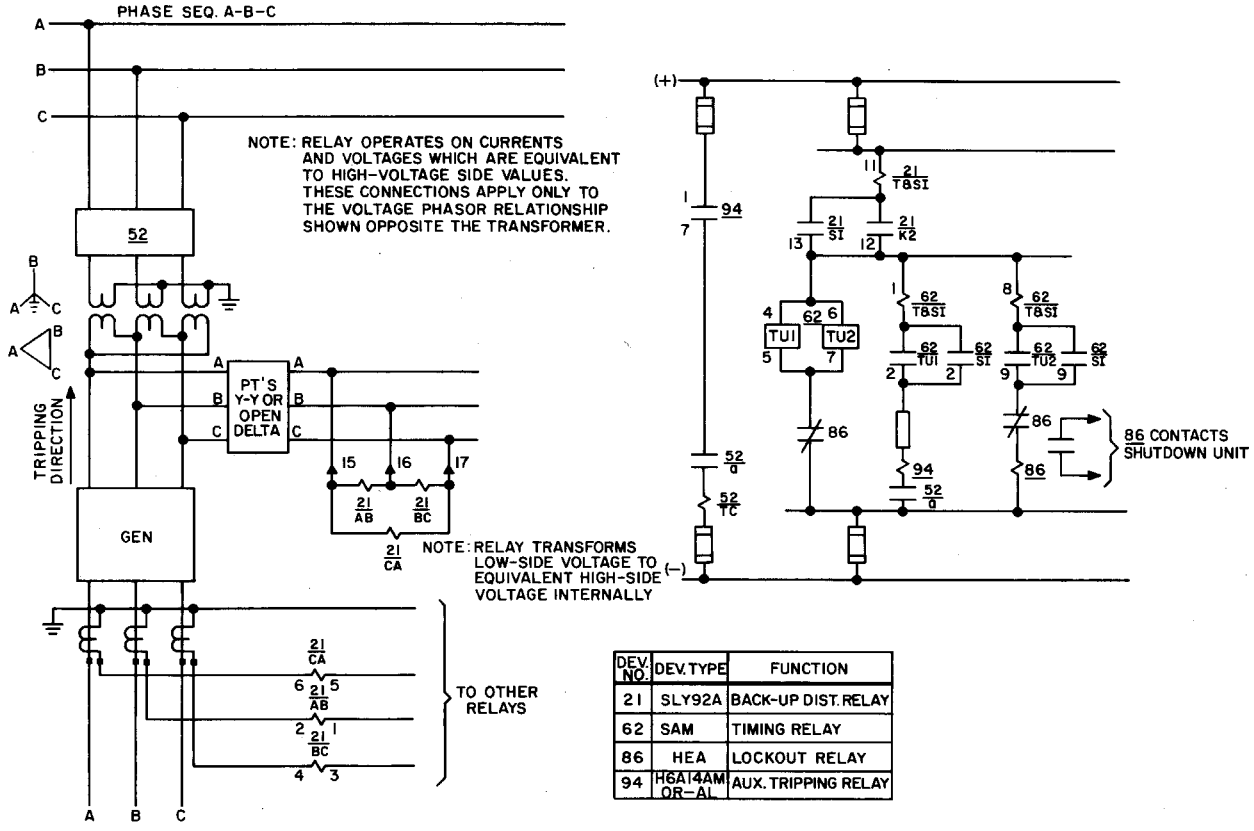


Fig. 7. Typical high voltage bus in generating station.



DEV. NO.	DEV. TYPE	FUNCTION
21	SLY92A	BACK-UP DIST. RELAY
62	SAM	TIMING RELAY
86	HEA	LOCKOUT RELAY
94	H6A I4AM OR-AL	AUX. TRIPPING RELAY

Fig. 8. External connection for SLY92A and SAM relays.

SECTION: 4

Directional Relays

CAP Three Phase Power Directional 1

CCP Sensitive Power Directional 3

CFW Sensitive Over-and Underpower 5

ICW Time-delay Power Directional 7

CJC, CJCG Instantaneous Directional Overcurrent 9

CFC15 Zero Sequence Overcurrent..... 11

IBC, IBCG, IBCV Phase- and Ground-directional Overcurrent 12

JBC, JBCV and JBCG Phase- and Ground-directional Instantaneous Overcurrent.... 14

For Power Directional Protection of Lines, Feeders, and Generators

APPLICATION

Power-directional Protection of Single Lines: The Type CAP15A relay, in conjunction with overcurrent relays, can be used to protect single incoming, outgoing, or tie lines. Normally, the Type IAC60 overcurrent relay is used to provide time-current co-ordination with directional control to prevent false tripping on momentary reversal of power immediately following the clearing of a fault. When the CAP15A is used with the recommended 60-degree connection, the maximum torque on a three-phase fault is developed when the line current lags its unity power-factor postion by 40 degrees. On a phase-to-phase fault, the relay located at the fault develops maximum torque when the resultant of the currents in the faulted phases lags its unity power-factor position by 70 degrees.

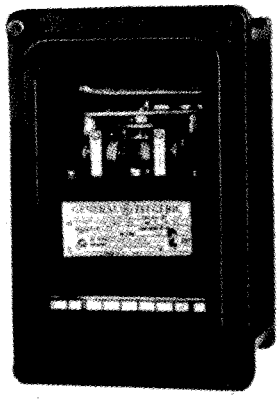
Where the ground fault current in the relay is less than three times the load current, an additional single-phase directional-ground relay is recommended to insure adequate protection against ground faults.

Balanced-power Protection of Two Parallel Lines: The Type CAP15A will provide this protection when connected differentially with overcurrent relays to the current transformer secondaries of both lines. A "through" fault or overload which does not disturb the balance between the lines will not cause the relays to function. When a fault occurs that unbalances the current in the lines, the relays receive the difference between the two currents and the breaker in the faulty line. Other auxiliary relays for co-ordination are also required.

GENERATOR PROTECTION AGAINST MOTORING:

The Type CAP15B relay, in conjunction with a suitable time relay such as the Type IAV, provides sensitive protection against generator motoring. The relay will operate under 0.025 amps at rated voltage and unity power factor. It is suitable for application on unbalanced 3-phase loads.

For compact switchboard use, refer to the Type GGP relay which consists of the Types CAP15B and IAV mounted together in a size M2 drawout case.



(Photo 8008317)

Fig. 1. CAP15 power-directional relay

SELECTION GUIDE—Three-phase; 1 N.O. and 1 N.C. Contact

Freq. (Hz)	VOLTS	Amps	Target Coil Rating (Amps DC)	Right & Left Hold. Coils Rating (Amps DC)	Angle of Max. Torque	Model Number	Case Size	Approx Wt in lb (kg) Net	Approx Wt in lb (kg) Ship
TRANSMISSION LINE PROTECTION									
	115		—	1.0		12CAP15A1A			
	115		—	0.2		A2A			
	115		1.0	1.0		A9A			
	115		0.2	0.2		A10A			
	115		—	—		A13A			
	115		0.05	—		A17A			
60	130	5	—	1.0	40°	A14A			
	130		—	0.2		A15A			
	208		—	1.0		A11A		15	22
	208		—	0.2		A12A	S2	(6.8)	(9.9)
	208		1.0	1.0		A24A			
	230		—	1.0		A7A			
	230		—	0.2		A8A			
	115		—	1.0		A3A			
	115		—	0.2		A4A			
50	115	5	—	—	40°	A16A			
	115		1.0	1.0		A19A			
	115		0.2	0.2		A20A			
MOTORING OF GENERATOR PROTECTION									
	115		—	1.0		12CAP15B1A			
	115		—	0.2		B2A			
	115		1.0	1.0		B15A			
	115		0.2	0.2		B16A			
	115		—	—		B22A			
	208		—	0.2		B20A			
60	208	5	1.0	1.0	0°	B21A			
	208		—	1.0		B23A			
	208		0.2	0.2		B25A		15	22
	230		—	1.0		B5A	S2	(6.8)	(9.9)
	230		—	0.2		B6A			
	230		—	—		B12A			
	230		1.0	1.0		B18A			
	115		—	1.0		A3A			
50	115	5	—	0.2	0°	B4A			
	115		1.0	1.0		B13A			
	115		0.2	0.2		B14A			

TARGET AND HOLDING COIL RATINGS

Function	Amperes, AC or DC	
	0.2 Amp	1.0 Amp
Coil Resistance	7.0Ω D.C.	0.25Ω D.C.
Tripping Duty	5 Amp	30 Amp
Carry Continuously	0.5 Amp	1.25 Amp①

① Determined by the control spring rating.

BURDENS

	Frequency (Hz)	Volt Amps	Watts	Power Factor
Current③	60	0.40	0.20	0.50
	50	0.35	0.20	0.57
Potential②	60	5.30	1.60	0.30
	50	6.20	2.15	0.35

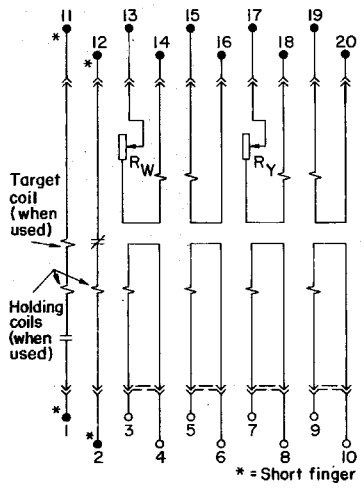
② These burdens are per relay circuit 13-14, 15-16, 17-18 and 19-20).

③ The current burdens shown are with five amperes flowing. With standard connections, one of the three current transformers supplies two current coils in series so that the burden on that transformer will be twice the amount shown. The other two current transformers will each supply one current coil and will have a burden as shown.

REFERENCES:

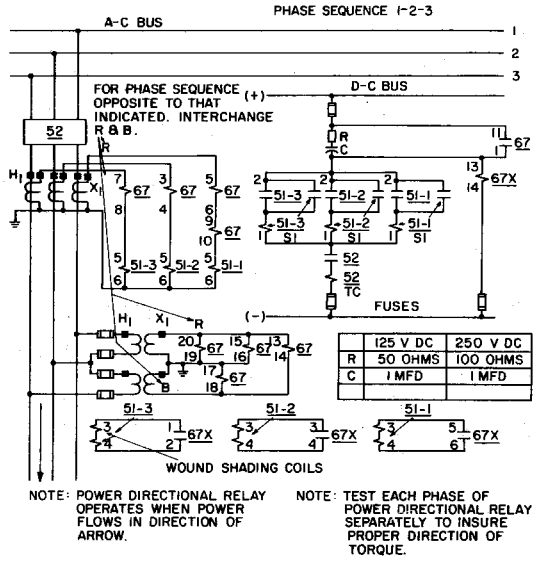
Dimensions ..... Section 16
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Relay Standards ..... Section 16

INTERNAL CONNECTION DIAGRAMS



(Dwg. No. K-6174667)

Fig. 2. CAP15A(-)A relay.



(Dwg. No. 6154168-0)

Fig. 3. Typical external connections of CAP15A for directional overcurrent protection

High-speed Sensitive Three-phase Power Directional Relay for Lines

DESCRIPTION

The CCP is a sensitive, high-speed, power directional relay for three-phase alternating current circuits. The relay is composed of three single-phase induction cylinder units, all mounted on a common shaft. Each of the three units has a 30-degree angle of maximum torque (current leading voltage). When the relay receives line-to-line potentials and phase currents, maximum torque is developed at unity power factor.

The contact assembly consists of two electrically separate contacts, one normally open and one normally closed. There is also a target available which is brought out to separate studs.

APPLICATION

Because of its sensitivity and its real power directional characteristics, the CCP relay finds application where it is required to detect low level reverse power flow. It is generally used in systems where three-phase potentials and currents are available. However, it may also be used if only a single-phase potential is available by connecting the three potential coils in parallel and the three current coils in series. With this arrangement, the paralleled potential circuits should receive potential that lags the current supplied to the series current coils by 30 degrees at unity system power factor.

One of the most common applications of this relay is as a reverse power device to detect ground faults on the delta side of a power transformer bank by actually detecting reverse magnetizing current into the transformer bank. This is illustrated in Figure 1.

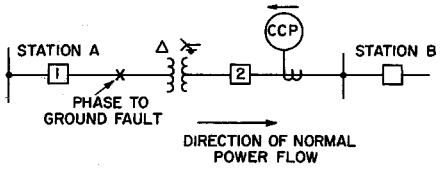
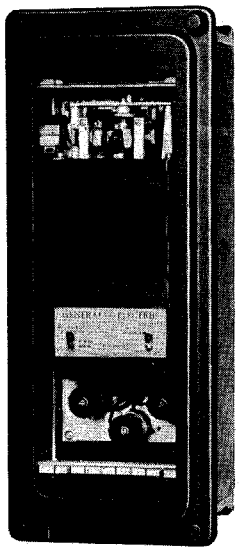


Fig. 1.

If a single-phase-to-ground fault were to occur at the location shown in Figure 1, it would be cleared at Station A by breaker No.1 but not necessarily at Station B by breaker No. 2. However, it is desirable to open breaker No. 2 in order to remove the exciting current taken by the transformer from power sources feeding Station B. This can be accomplished by the CCP13E relay which is generally sensitive enough to operate on the real component of the exciting current (transformer core loss component).

Note that the current transformers at breaker No. 2 must be selected so that their secondary output corresponding to minimum core-loss current exceeds the pickup rating of the relay. On the other hand, the secondary output under maximum load conditions should not exceed the continuous rating of the relay.



(Photo 8010273)
Fig. 2. Type CCP Relay

Since the CCP is a sensitive, high-speed device, it is suggested that it be used in conjunction with a separate time delay relay. This will prevent undesired operation during system disturbances which may momentarily cause the power to be reversed from its normal direction of flow.

SELECTION GUIDE
1-N.O. and 1-N.C. Contact (Electrically Separate)

Voltage	Freq. (Hz)	Current (Amps)	Min. P.U. (Amps)	Max. P.U. (Amps)	Angle Max. Torque Lead	T. & S.I. Rating (Amps)	Model Number	Case Size	Approx. Wt. in Lb. (Kg)	
									Net	Ship
115 208 115 208	60 60 50 50	5	.004	.016	30°	0.2/2.0	12CCP13E1A E3A E2A E4A	M-2	20 (9)	30 (13.5)

TABLE I—BURDENS (Per Phase)

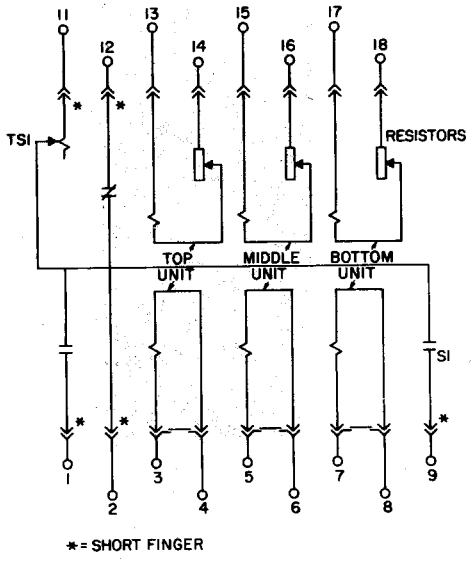
	Voltage	Frequency	R	X	Z	Watts	Vars	VA
Current①	— —	60 50	0.27 0.23	0.62 0.52	0.68 0.57	6.8 5.9	15.6 13.0	17.0 14.3
Potential	115 208 115 208	60 60 50 50	408 1350 413 1370	710 2300 720 2370	815 2640 830 2730	8.1 8.4 8.0 7.9	14.1 14.3 13.9 13.7	16.2 16.4 16.0 15.8

① The current burdens shown are with five amperes flowing and pickup set for minimum.

REFERENCES:

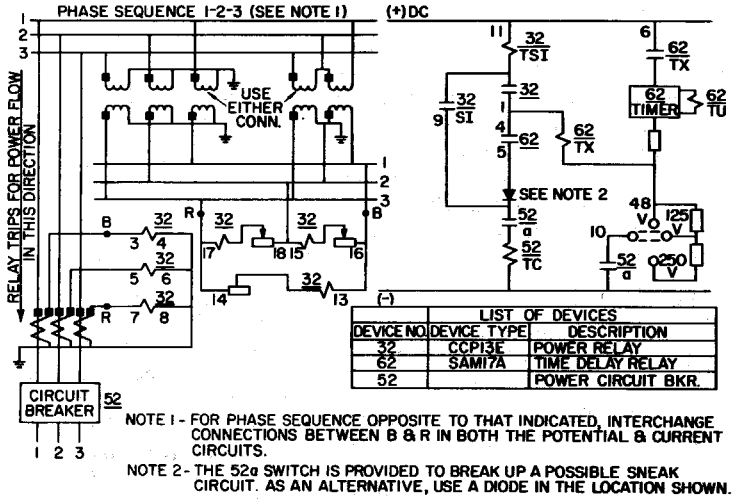
Dimensions .....Section 16
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Target and Contact Data.....Section 16
Relay Standards .....Section 16

INTERNAL CONNECTION DIAGRAMS



(0275A4413-3)

Fig. 3. Internal connection diagram for Type CCP13E relay (front view)



(0275A4413-3)

Fig. 4. Typical external connections of CCP13E relay when used with a time delay relay

CFW

High-speed Overpower and Underpower Relays

For the Control of the Flow of Power in Ac Circuits

APPLICATION

Regulating and Limiting Loads

The Type CFW relay is primarily used as a control device for load-limiting or load-regulating applications on alternating-current circuits.

A typical application employs the CFW, with suitable auxiliary relays, to force the field of a motor as its load varies. See Figure 3.

CALIBRATION RANGE

The normally open (left) contacts are set to close at a value within the calibration range as specified for the particular relay model.

Contact Spread

The travel from contact to contact determines the difference between the overpower and underpower settings. This contact spread is adjustable within the specified ranges.

These calibrations and contact spreads are stated in 3-phase watts, on the basis of balanced 3-phase loads; the CFW is a single phase device, but measures true watts under balanced conditions.

BURDENS

The volt-ampere burdens of relay windings are given in the following tables:

CURRENT CIRCUIT

Freq.	Amps	Volt-Amp	PF
60	5	13.0	0.38
50		11.3	0.40

POTENTIAL CIRCUIT

Freq.	Volts	Volt-Amp	PF	Watts
60	115	15.0	.52	7.7
50		9.3	.50	4.7

SELECTION GUIDE—All have 5-Ampere current coils, 1 N.O. and 1 N.C. contact (electrically separate)

Three Phase Watts (continuous rating)				Model Number		Case Size	Approx. Weight lb (kg)	
Freq (Hz)	Volts	Calibration Range	Contact Spread	1.0 Amp Holding Coil	0.2 Amp Holding Coil		Net	Ship.
60	115	0.800	5-40	12CFW11E23A	12CFW11E24A	S1	20 (9.1)	30 (13.6)
		0-800	10-80	E29A	E34A			
		0-1200	5-40	E37A	——			
		0-1600	10-80	E27A	E28A			
	460	0-3200	20-160	E31A	——			
50	100	0-800	5-40	——	E35A			
	115	0-800	5-40	E21A	E22A			
		0-1600	10-80	——	E33A			

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

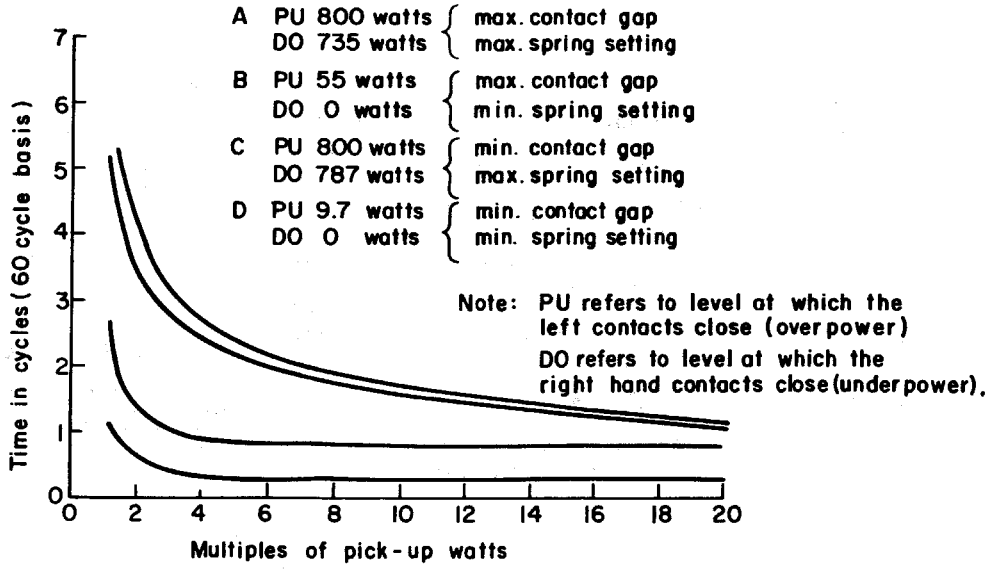


Fig. 2 Time Characteristic Curve For Type CFW11E Relay

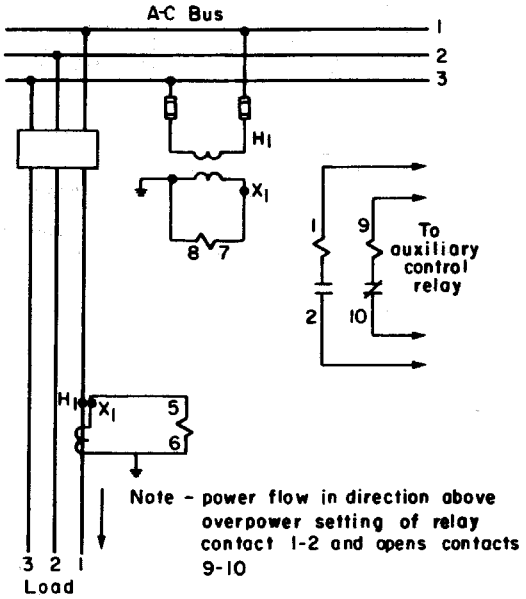


Fig. 3 Typical External Connections For Type CFW11E Relay

For Protection Against Excess Power Flow in a Predetermined Direction. For Anti-motoring Protection of Ac Generators

DESCRIPTION

The ICW relays are single phase, time delay, power directional relays in size S1 drawout cases. Several different types are available, providing underpower as well as overpower detection and giving a choice between line-to-neutral or quadrature (line-to-line) polarizing. For applications on 3-phase systems, only one relay is required in most cases because the power flow is usually the same in all three phases.

APPLICATION

The Type ICW relays are designed for power-directional applications. The operation of these relays depends upon both phase angle and magnitude of the applied current and voltage. They will operate when power flow is of sufficient magnitude and in a specific direction.

The ICW51A functions from line current and quadrature line-to-line voltage, and is calibrated in three-phase watts. It exhibits maximum contact-closing torque when the applied current leads the applied voltage by 90 degrees (unity power factor.)

The ICW51B functions from line current and line-to-neutral voltage, and is calibrated in single-phase watts. It exhibits maximum contact-closing torque when the applied current is in phase with the applied voltage. Because of its operating characteristic, the ICW51B is also recommended for single-phase applications.

The ICW52A provides both overpower and underpower detection in the same relay. With the normal factory setting, the right contact closes when the power flowing is less than 80 percent of the value required to close the left contact.

The ICW53A responds to reactive power (vars) and has both an overpower and an underpower setting (90 percent of overpower). This relay can be used to control the switching of power factor correcting capacitor banks.

Small Generating Stations: The Type ICW-51A and Type ICW51B relays are commonly used to protect against excess power flow from the station into a larger system. The relay will trip the tie breaker if power in excess of a predetermined amount is fed into the large system over a given period of time. The relay will not trip the tie breaker if the local station fails and power is fed to its load from the large system.

Generator Protection Against Motoring

Internal combustion engine-driven
Gas turbine-driven
Water wheel-driven

The ICW51 is recommended for anti-motoring protection for generators rated 200 kw and above and driven by internal combustion engines or gas turbines. This relay may also be used for hydro units if sensitive enough for the particular installation. For internal combustion engine and gas turbine-driven generators, the reverse power losses generally exceed 5 percent of the full-load machine rating.

In general, the most sensitive relay model that has a current coil rating higher than full-load generator current should be used.

Steam Turbine-driven Generators: Low-capacity Units: For units rated from 150 to 1000 kw, the motoring losses generally exceed 2½ percent and may be as high as 5 percent. The standard application for larger units requires a more sensitive relay. However, for these lower rated units the Type ICW is sufficiently sensitive to provide anti-motoring protection.

Reverse Power-Overpower: The ICW can be connected to close its contacts on reverse power or on overpower, but not both.

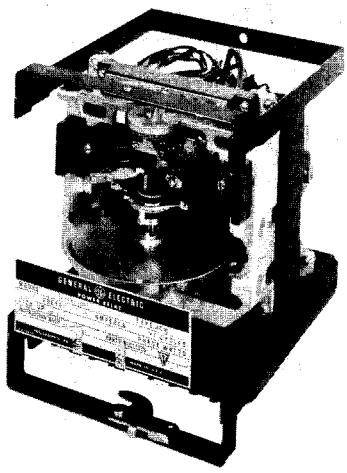
Balanced Load vs Unbalanced Load: When loads are balanced, one single-phase relay can be used as indicated in the Selection Guide. When an unbalanced load is expected, three ICW relays may be used or the Type GGP, three-phase power-directional relay should be considered for complete protection.

Operating Time—ICW51A, 51B or 52B

The number 10 time dial gives approximately 23 seconds at 1.5 times tap setting and 1.0 seconds at 20 times tap setting.

CONTACTS

The main contacts of the relays will carry 2.0 amperes continuously and will close and carry 30 amperes dc momentarily for tripping duty at control voltages of 250 volts dc or less. The breaker trip coil circuit should, however, always be opened by a circuit breaker auxiliary switch or other suitable means. If the tripping current exceeds 30 amperes an auxiliary tripping relay should be used.



(Photo 0042996)

Fig. 1. ICW overpower relay (without case)

On relays which include a combination target and seal-in unit (see Selection Guide) the current-carrying rating of the associated main contact circuit is determined by the tap setting of the seal-in coil as shown in Section 14.

When the main contacts are not bypassed by seal-in unit contacts, as in the ICW52A, they may be required to interrupt the circuit. The interrupting ratings of the main contacts for inductive and noninductive loads are shown in Table A.

TABLE A—MAIN CONTACTS

Volts	Inductive		Noninductive	
	Ac	Dc	Ac	Dc
	Interrupting Rating in Amperes			
125	0.6	0.14	1.5	0.30
250	0.3	0.07	0.75	0.15

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
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SELECTION GUIDE

Frequency Hertz	Volts	Amps	Operating Watts① Calibration Range: Single Phase	Operating Watts① Calibration Range: Three Phase	Model Number	Contacts	Target Seal-in Unit (Amps)	Case Size	Approx Weight Lb (Kg): Net	Approx Weight Lb (Kg): Ship
FOR SINGLE PHASE AND BALANCED LOAD 3 PHASE WATT APPLICATIONS (Using Line-to-Neutral Voltage)										
60	120	5.0	10-40		12ICW51B1A	One Normally Open	0.2/2	S-1	20 (9.1)	25 (11.3)
			25-100		B2A					
			50-200		B3A					
			100-400		B4A					
			200-800		B7A					
		2.5	5-20		B8A					
50	120	5.0	15-60		B5A					
	120		25-100		B6A					
	240		25-100		B9A					
FOR BALANCED LOAD 3 PHASE WATT APPLICATIONS (Using Line-to-Line Voltage)										
60	120	3.5		15-60	12ICW51A1A	One Normally Open	0.2/2	S-1	20 (9.1)	25 (11.3)
		4.0		20-80	A10A					
		5.0		25-100	A2A					
		5.0		50-200	A3A					
		5.0		100-400	A4A					
		5.0		200-800	A5A					
	208	3.5		26-104	A12A					
		5.0		44-175	A13A					
		5.0		50-200	A11A					
		5.0		87-350	A14A					
		5.0		175-700	A15A					
		5.0		350-1400	A16A					
	480	5.0		100-400	A21A					
50	120	2.0		10-40	A19A					
		3.5		15-60	A6A					
		5.0		25-100	A7A					
		5.0		50-200	A9A					
		5.0		200-800	A8A					
	208	5.0		44-175	A24A					
		5.0		50-200	A17A					
		5.0		200-800	A23A					
COMBINATION OVER AND UNDER POWER (Using Line-to-Line Voltage)										
60	120	3.5		15-60	12ICW52A10A	One Normally Open and One Normally Closed	No Target Seal-in	S-1	20 (9.1)	25 (11.3)
		5.0		25-100	A2A					
		5.0		50-200	A3A					
		5.0		100-400	A6A					
		5.0		100-1000	A1A					
	208	5.0		200-800	A5A					
	240	5.0		100-400	A4A					
50	120	5.0		25-100	A8A					
				50-200	A7A					
				100-1000	A9A					
FOR SINGLE PHASE VARS AND BALANCED 3-PHASE (Using Line-to-Line Voltage)										
60	120	5.0	15-150		12ICW53A1A	1 N.O. and 1 N.C.	No Target Seal-in	S-1	20 (9.1)	25 (11.3)
	120		80-400		A2A					
	208		15-150		A5A					
50	120	5.0	15-150		A4A					

① Tap ratings for the various ranges are as follows:

5—20: 5, 6, 8, 10, 12, 16, 20
10—40: 10, 12, 16, 20, 25, 32 and 40 watts.
15—60: 15, 20, 25, 32, 40, 50 and 60 watts.
20—80: 20, 25, 32, 40, 50, 63, 80
25—100: 25, 32, 40, 50, 63, 80 and 100 watts.
26—104: 26, 35, 44, 55, 70, 87 and 104 watts.
44—175: 44, 55, 70, 87, 110, 140 and 175 watts.
50—200: 50, 63, 80, 100, 125, 160 and 200 watts.
87—350: 87, 110, 140, 175, 215, 275 and 350 watts.
100—400: 100, 125, 160, 200, 240, 300 and 400 watts.
100—1000: 100, 133, 200, 330, 470, 670 and 1000 watts.
175—700: 175, 215, 275, 350, 415, 520 and 700 watts.
200—800: 200, 240, 300, 400, 480, 600 and 800 watts.
350—1400: 350, 415, 520, 700, 830, 1000 and 1400 watts.

15—150: 15, 20, 30, 50, 70, 100 and 150 vars
80—400: 80, 100, 120, 150, 200, 300 and 400 vars

DEVICE FUNCTION NUMBERS

32—Power Directional Relay Type ICW
UC—Upper Coil
LC—Lower Coil
SI—Seal-in

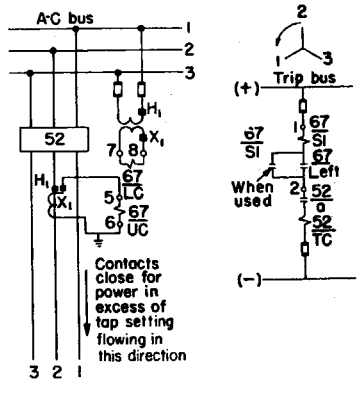


Fig. 2. Typical diagram, ICW51A and ICW52A relays for balanced-load, 3-phase applications using line-to-line voltage

CJC and CJCG

Instantaneous Directional Overcurrent Relays

DESCRIPTION

The CJC is a single phase directional overcurrent relay and the CJCG is a ground directional overcurrent relay both of which are utilized for the protection of feeders and transmission lines. They each consist of an induction-cup instantaneous overcurrent unit (top) and an induction-cup directional unit (bottom).

An M1 or an M2, medium size, drawout case is used to mount each relay. A dual rated target and seal-in unit and one normally open (1 N.O.) contact are provided.

APPLICATION

The CJC and CJCG relays are used for directional multi-phase and phase-to-ground fault protection of feeder and transmission lines. Generally, three single phase CJC relays are used for interphase faults, and a single CJCG relay, residually connected, is used for single phase to ground faults.

The CJCG is a dual polarized relay. It may be polarized by current alone, voltage alone, or by both simultaneously. The simultaneous use of both sets of polarizing coils is advantageous on applications where current and potential polarizing sources are available and there is a possibility that one or the other source may be temporarily lost. The directional unit of the CJC relay must be polarized by potential.

CURRENT CIRCUIT RATINGS

Current Range (Amps)	Unit Connections (Amps)	Continuous Rating (Amps)	One-second Rating (Amps)
0.5-4.0	0.5-2.0 1-4	1.9 2.7	60 120
2-16	2-8 4-16	5.0 6.5	200 260
10-80	10-40 20-80	9.0 15.0	220 260



(Photo 8023487)

Fig. 1. Type CJC directional overcurrent relays

SELECTION GUIDE

Continuous Rating			Instant. Unit Rating (Amps)	Model Number	Case Size	Approx Wt. in Lbs. (kg)	
Amps	Volts	Freq. (Hz)				Net	Ship.
PHASE TYPE CJC—Single Phase - 0.2/2.0 Amp Target and Seal-in Unit							
1.9 5.0	120	60	0.5-4.0 2-16	12CJC15M1A M2A	M-1	25 (11.3)	35 (15.9)
TRANSFER TRIP APPLICATION—0.6/2.0 Amp Target and Seal-in Unit							
1.9 5.0 5.0	120	60	0.5-4 2-16 10-80	12CJCG16M1A M2A M3A	M-2	27 (12.2)	40 (18.1)

BURDENS

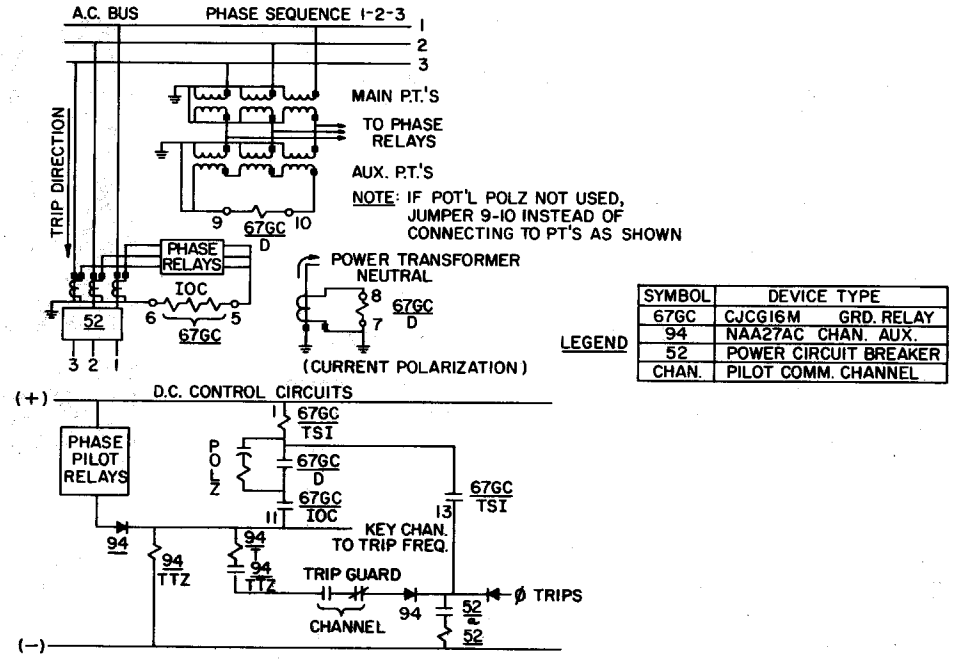
Current Circuit Burdens at 5 Amp, 60 Hertz

Relay Type	Current Range (Amps)	IOC Unit Connections (Amps)	Impedance (Ohms)	Volt-Amperes (I^2Z)	Power Factor
CJC15M	0.5-4.0	0.5-2.0 1-4	10.36 2.59	259.0 64.75	0.39 0.39
	2-16	2-8 4-16	1.07 0.57	26.75 14.27	0.45 0.50
CJCG16M	0.5-4.0	0.5-2.0 1-4	18.54 4.64	464.0 116.0	0.41 0.43
	2-16	2-8 4-16	1.16 0.659	29.0 16.47	0.41 0.437
	10-80	10-40 20-80	0.16 0.040	4.0 1.0	0.496 0.496

REFERENCES:

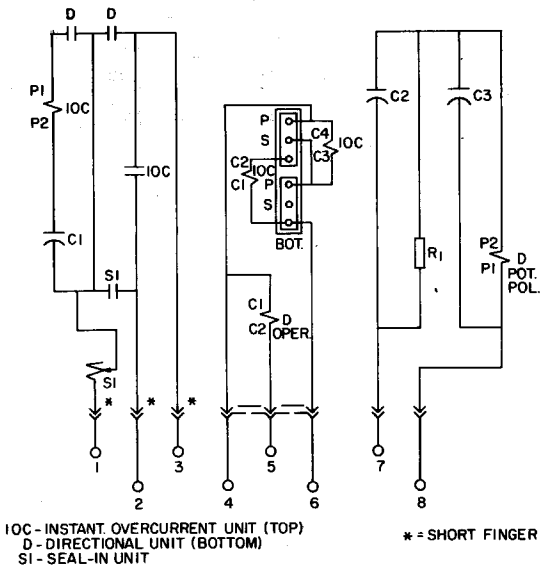
Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

CONNECTION DIAGRAMS



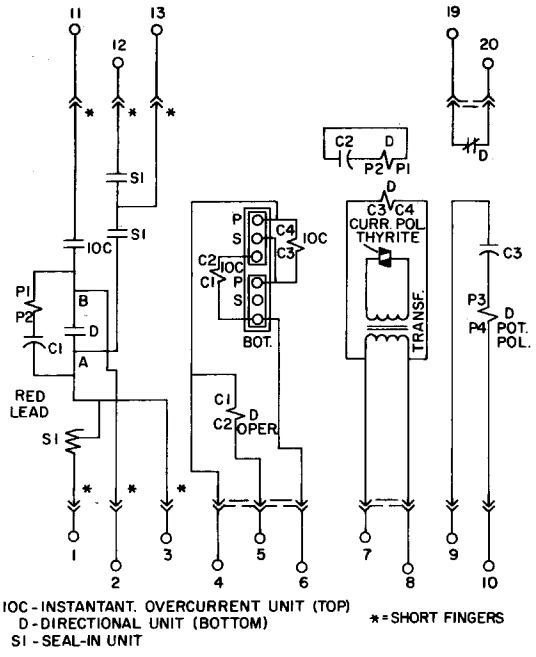
(0257A8393)

Fig. 2. Type CJCG16M Relay— Typical external connections diagram for permissive overreaching transferred tripping of transmission line protection



(0275A4374)

Fig. 3. Internal connections diagram for the Type CJC15M relay



(0275A4344)

Fig. 4. Internal connections diagram for the Type CJCG16M relay

CFC15

Zero-Sequence Overcurrent Relay

GE Protective Relays

DESCRIPTION

The CFC15A is a two unit induction cup instantaneous overcurrent relay in a Type M2 case similar to the CLPG12C relay except that the directional (bottom) unit is omitted. The CFC15A relay contains a low set (upper) unit (G1) for pilot signal starting, a higher set (lower) unit (G2) with series target for trip circuit supervising and an auxiliary unit (GD1X) for prolonging the pilot signal. The G2 has provisions for either series or parellel connections to permit two ranges of pickup for application on 2 terminal or 3 terminal lines respectively.

APPLICATION

The Type CFC15A relay, together with other relays, provides ground-fault protection for two terminal lines and (and some 3 terminal lines) where it is necessary to use a negative-phase-sequence relay rather than a zero-phase-sequence relay for the directional unit. This will be true where zero sequence mutual reactance is such that proper directional response requires the use of a negative phase sequence relay rather than a zero phase sequence relay.

If this relay is to be used as a component of a pilot relay equipment, refer to the instructions for that equipment for choice of settings for the G1 and G2 units.

RATINGS

CFC15A (G1, G2, and CD1X Auxiliary)

The auxiliary telephone relay unit (CD1X) is available in continuous ratings of 125 or 250 volts dc. The current circuits are rated 3 amperes continuous and 140 amperes for one second. The 140 ampere rating is also the maximum permissible current.

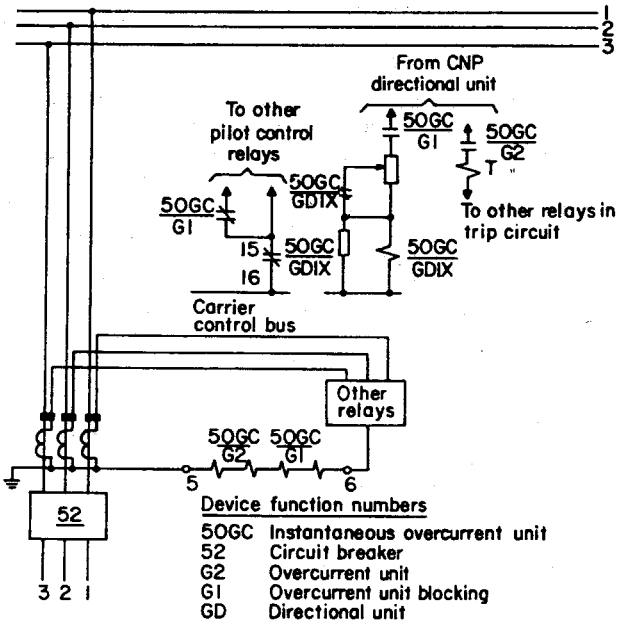
Contact Rating

The contacts of this relay will close and carry momentarily 30 amperes dc for tripping duty at control voltages of 250 volts dc or less. The breaker trip coil circuit should, however, always be opened by a circuit breaker auxiliary switch or other suitable means.

FUNCTIONAL COMPARISON

Standard Zero Sequence Scheme	Function of Relay Units	Negative Sequence Scheme
CLPG—G1 Unit	Carrier Start	CFC—G1 Unit
CLPG—G2 Unit	Carrier Trip	CFC—G2 Unit
CLPG—GD Unit	Directional Carrier	CFC—GD Unit
JBCG—D Unit	Directional Backup	
JBCG—IOC Unit	Instantaneous Backup	
JBCG—TOC Unit	Time Delay Backup	

CONNECTION DIAGRAMS



Dwg. 0165A6009

Fig. 1. Typical External Connections—CFC15A

SELECTION GUIDE

Type CFC—1 N.O. and 1 N.C. Contact Per Unit (G1 and G2)

Rating						Model Number	Case Size	Approx. Wt. in lb (kg)	
Frequency (Hz)	Continuous Amps	Control Volts Dc (GD1X Unit)	G1 Range (Amps)	G2 Range (Amps)	Target Rating (Amps)			Net	Ship.
60	5	48 125 125 250	0.4-1.6	0.5-4.0	1.0 1.0 0.2 1.0	12CFC15A6A A2A A5A A3A	M-2	19 (8.6)	24 (10.9)
50		125			1.0	A4A			

REFERENCES:

Dimensions .....Section 16
How to Order .....Section 1
Instruction Books .....Section 17
Target and Contact Data.....Section 16
Relay Standards .....Section 16

IBC, IBCV and IBCG

Phase- and Ground-directional Overcurrent Relays

GE Protective Relays

For Directional Overcurrent Protection of Feeders and Transmission Lines

APPLICATION

The Type IBC directional overcurrent relays are employed primarily for the protection of feeders and transmission lines in applications where single-phase relays are desired or required.

The Types IBC, IBCV, and IBCG relays consist of two units, an instantaneous power-directional unit (bottom) of the induction-cup type, and a time overcurrent unit (top) of the induction-disk type. The directional-unit contacts control the operation of the overcurrent unit (directional control).

Phase Faults—IBC

The Type IBC relays are frequently applied for phase-fault protection of a single line. Typical external connections of current and potential transformers are shown in Fig. 2. With this connection, the current (at unity-power-factor load) leads the polarizing potential by 90 degrees. Since the directional unit has a 45-degree characteristic, its maximum torque will occur when the fault current (balanced 3-phase fault) lags its unity-power-factor position by 45 degrees.

Phase Fault—IBCV

The Type IBCV relays are used for phase-fault protection when it is necessary to distinguish between fault conditions and overload or power swings. These relays utilize a directional unit similar to the IBC directional unit except voltage restraint is incorporated into the IBCV directional unit design.

When the generation at a given station varies from time to time, it is possible for the maximum load current to exceed the minimum fault current. When a fault occurs with a minimum generation, the restraint torque in the directional unit collapses rapidly as the voltage drops, thus permitting the relay to trip at the lowest value of fault current. On the other hand, the relay is prevented from tripping on heavy-load currents with maximum generation since system voltage is maintained.

Long or overloaded lines, that are operating near the stabilty limit, are subject to severe power swings. These power swings appear to the relay as traveling faults. However, since the voltage is maintained near normal during a power swing, the IBCV relay is less likely to trip than would a relay without voltage restraint.

Ground Faults—IBCG

The IBCG relay is designed for protection against ground faults and is consequently of lower operating current range. The relays used for ground-fault protection usually have a low-range operating coil which is rated either 0.5/4 or 1.5/12 amperes. 2/16 rating is also available.

The directional unit of the Type IBCG is dual-polarized and may be polarized by current alone, voltage alone, or by both simultaneously. This dual polarization is desirable on applications where both current and potential polarizing sources are available and there is a possibilty that one or the other source may be temporarily lost.

General

Inverse Time Characteristic preferred where fault current magnitude depends largely upon system generating capacity at time of fault.

Very-inverse and extremely-inverse Time Characteristics are preferred where fault current magnitude is dependent mainly upon location of fault relative to relay and only slightly upon system generation setup.

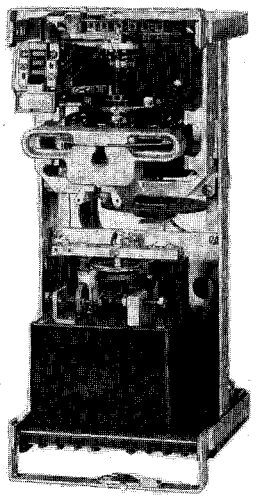
Target seal-in-units are provided for the time and instantaneous overcurrent units and are rated 0.2/2 amperes.

COIL

The short-time and continuous ratings of the operating coil circuits are shown in Table 1.

TABLE 1—Time Overcurrent Unit Taps And Ratings

Tap Range (Amps)	Character.	1-Sec. Rating (Amps)	Cont. Rating (Amps)	
			Min. Tap	Max. Tap
0.5-4.0	Inverse	70	1.6	5.0
	V. Inverse	140	4.0	13
	Ext. Inv.	125	3.5	10
1.5-12	V. Inverse	260	10	30.5
	Ext. Inv.	260	9.5	20
2-16	Inverse	260	8	20



(Photo 8036986)

Fig. 1. Type IBCG relay (out of case, without nameplate)

The current and potential polarizing coils of the dual-polarized ground relay are rated as follows:

Potential polarizing coils—120 volts continuous at rated frequency.

Current polarizing coils—continuous rating of 5 amperes with a one (1) second rating of 160 amp.

TABLE 2—Non-Directional Instantaneous Unit Ratings

Range (Amps)	Connection and Range (Amps)		Contin. Rating (Amps)	1-Sec. Rating (Amps)
6-150	Low (Series)	6-30①	10.2	260
	High (Parallel)	30-150①	19.6	

① This range is approximate, which means that 6-30 and 30-150 might actually be 6-28 and 28-150. However, there is at least a one-amp overlap between the maximum "Low" setting and the minimum "High" setting.

AVAILABLE SETTINGS

Time Overcurrent Units:

0.5-4.0 — 0.5, 0.6, 0.7, 0.8, 1, 1.2, 1.5, 2, 2.5, 3, 4

1.5-1.2 — 1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 10, 12

2-16 — 2, 2.5, 3, 4, 5, 6, 7, 8, 10, 12, 16

CONTACTS

The current-closing rating of the induction unit contacts is 30 amperes for voltages not exceeding 250 volts. Their current-carrying rating is limited by the tap rating of the seal-in unit.

REFERENCES:

Dimensions .....Section 16
How to Order .....Section 1
Instruction Books .....Section 17
Target and Contact Data.....Section 16
Relay Standards.....Section 16

For Directional Overcurrent Protection of Feeders and Transmission Lines

SELECTION GUIDE—0.2/2.0 Amp Target & Seal-in Unit

Freq. (Hz)	Rating (Amps) Time Unit	Non-Dir. Inst. Unit	Dir. P.U.①	Model Number Inverse Time	Very Inverse Time	Ext. Inverse Time	Inverse Time	Very Inverse Time	Ext. Inverse Time	Case Size	Approx. Wt. in Lbs (kg) Net	Ship
IBC, PHASE-TYPE, 120 VOLT				**1 N.O. CONTACT**			**2 N.O. CONTACTS**					
60	1.5-12 2-16		... ...	12IBC51M1A	12IBC53M1A	12IBC77M1A	12IBC52M1A	12IBC54M1A	12IBC78M2A	M-1	22(10)	35(15.9)
	1.5-12 2-16	6-150	... ...	12IBC51M1Y1A	12IBC53M1Y1A	12IBC77M1Y1A	.....	.....	.....		23(10.4)	36(16.3)
50	1.5-12 2-16		... ...	12IBC51M2A	12IBC53M2A	12IBC77M2A	12IBC52M2A	12IBC54M2A	12IBC78M3A		22(10)	35(15.9)
	1.5-12 2-16	6-150	... ...	12IBC51M2Y1A	12IBC53M2Y1A	12IBC77M2Y1A	.....	.....	.....		23(10.4)	36(16.3)
IBCG, GROUND-TYPE, 120 VOLT				**1 N.O. CONTACT**			**2 N.O. CONTACTS**					
60	0.5-4 1.5-12 2-16		... ...	12IBCG51M1A 12IBCG51M2A	12IBCG53M1A 12IBCG53M2A	12IBCG77M1A 12IBCG77M2A	12IBCG52M1A 12IBCG52M2A	12IBCG54M1A 12IBCG54M2A	12IBCG78M1A 12IBCG78M2A		22(10)	35(15.9)
	0.5-4 1.5-12 2-16	6-150	... ...	12IBCG51M1Y1A 12IBCG51M2Y1A	12IBCG53M1Y1A 12IBCG53M2Y1A	.....	.....	.....	.....		23(10.4)	36(16.3)
50	0.5-4 1.5-12 2-16		... ...	12IBCG51M3A 12IBCG51M4A	12IBCG53M3A 12IBCG53M4A	12IBCG77M3A 12IBCG77M4A	12IBCG52M3A 12IBCG52M4A	12IBCG54M3A 12IBCG54M4A	.....		22(10)	35(15.9)
	0.5-4 1.5-12 2-16	6-150	... ...	12IBCG51M3Y1A 12IBCG51M4Y1A	12IBCG53M3Y1A 12IBCG53M4Y1A	.....	.....	.....	.....		23(10.4)	36(16.3)
IBCV, PHASE-TYPE (Dir. Unit with Volt. Restraint), 120 Volt				**1 N.O. CONTACT**			**2 N.O. CONTACTS**					
60	1.5-12 2-16		9	12IBCV51M1A	12IBCV53M1A	12IBCV77M1A	12IBCV52M1A	12IBCV54M1A	12IBCV78M1A		22(10)	35(15.9)
	1.5-12 2-16	6-150		12IBCV51M1Y1A	12IBCV53M1Y1A	.....	.....	.....	.....		23(10.4)	36(16.3)
50	1.5-12 2-16		9	12IBCV51M2A	12IBCV53M2A	12IBCV77M2A	12IBCV52M2A	12IBCV54M2A	12IBCV78M2A		22(10)	35(15.9)
	1.5-12 2-16	6-150		12IBCV51M2Y1A	12IBCV53M2Y1A	.....	.....	.....	.....		23(10.4)	36(16.3)

① At rated voltage.

CONNECTION DIAGRAM

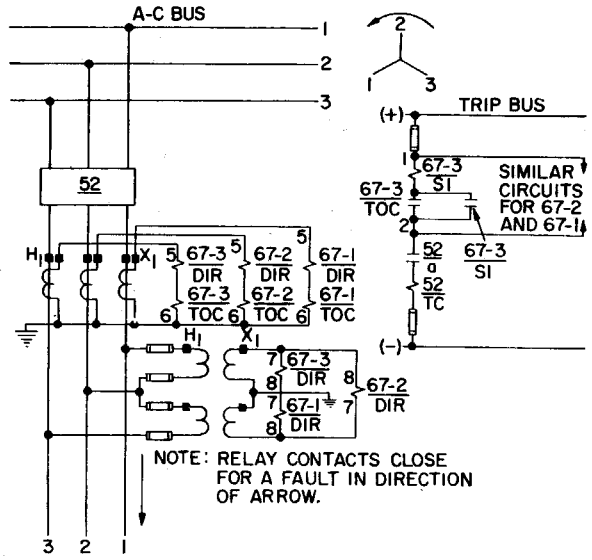


Fig. 2. Typical 90-degree connection of three Type IBC relays used for directional overcurrent protection of a single line.

JBC, JBCV and JBCG

Phase- and Ground-directional Overcurrent
with Directional Instantaneous Relays

GE Protective Relays

For Directional Overcurrent Protection of Feeders and Transmission Lines

APPLICATION

The Types JBC, JBCV, and JBCG relays consist of three units, an instantaneous power-directional unit (bottom) of the induction-cup type, a time overcurrent unit (middle) of the induction-disk type, and an instantaneous-overcurrent unit (top) of the induction-cup type. The directional-unit contacts control the operation of both the instantaneous and the time-overcurrent units (directional control). In this application, the instantaneous unit provides high-speed protection for close-in high-current faults.

Phase Faults—JBC

The Type JBC relays are frequently applied for phase-fault protection of a single line. Typical external connections of current and potential transformers are shown in Figure 2 (see page 2). With this connection, the current (at unity-power-factor load) leads the polarizing potential by 90 degrees. Since the directional unit has a 45 degree characteristic, its maximum torque will occur when the fault current (balanced 3-phase fault) lags its unity-power-factor position by 45 degrees.

Phase Faults—JBCV

The Type JBCV relay is applied for phase-fault protection when it is necessary to distinguish between fault conditions and overload or power swings. The voltage restraint feature of the relay makes this distinction possible. Figure 3 (see page 2) shows the effect of voltage restraint on the impedance characteristic of this relay as compared with that of the Type JBC relay.

When the generation at a given station is apt to vary from time to time, it is possible that the maximum load current may exceed the minimum fault current. When this occurs the Type JBC relay will not distinguish between a heavy load with maximum generation and a fault with minimum generation. This is a typical application for the Type JBCV relay. When a fault occurs with minimum generation, the restraint torque in the directional unit collapses rapidly as the voltage drops, thus permitting the relay to trip at the low value of fault current. On the other hand, the relay is prevented from tripping on heavy-load currents with maximum generation as the directional unit will not pick up due to the system voltage being maintained.

Long or heavily loaded lines, that are operating near the stability limit, are subject to severe power swings. These power swings appear to the relay as traveling faults. Since the voltage is maintained near normal during a power swing, the Type JBCV relay is less likely to trip than would a relay without voltage restraint.

Ground Faults—JBCG

The JBCG relay, with both time and instantaneous units directionally controlled, is designed for protection against ground faults and is therefore of lower operating current range. The relays used for such protection usually have a low-range operating coil which is rated either 0.5-4 or 1.5-12 amperes and 2-16 amperes is also available.

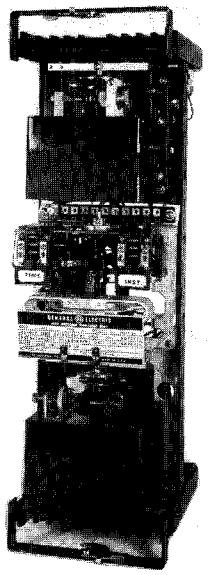
The directional unit of the Type JBCG is dual polarized and may be polarized by current alone, voltage alone, or by both simultaneously. This dual polarization is desirable on applications where both current and potential polarizing sources are available and there is a posibility that one or the other source may be temporarily lost.

General

Inverse Time Characteristic are preferred where fault current magnitude depends largely upon system generating capacity at time of fault.

Very-inverse and Extremely-inverse Time Characteristics are preferred where fault current magnitude is dependent mainly upon location of fault relative to relay and only slightly upon system generation setup.

Target Seal-in-units are provided for the time and instantaneous overcurrent units and are rated 0.2/2.0 amperes, or 0.6/2.0 amperes.



(Photo 8043260)

Fig. 1. Type JBC relay (out of case)

TABLE 1—Directional Instantaneous Unit Ratings

Cal. Range (Amps)	Setting	Pick-up Range (Amps)	1-Sec. Rating (Amps)	Cont. Current Rating (Amps)
2-16	Series Parallel	2-8 4-16	160 320	5 10
10-80	Series Parallel	10-40 20-80	230 460	10 20

TABLE 2—Non-Directional Instantaneous Unit Ratings

Range (Amps)	Connection and Range (Amps)		Contin. Rating (Amps)	1-Sec. Rating (Amps)
6-150	Low (Series) High (Parallel)	6-30① 30-150①	10.2 19.6	260

① This range is approximate, which means that 6-30 and 30-150 might actually be 6-28 and 28-150. However, there is at least a one-amp overlap between the maximum "Low" setting and the minimum "High" setting.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

For Directional Overcurrent Protection of Feeders and Transmission Lines

CONTACTS

The current-closing rating of the induction unit contacts is 30 amperes for voltages not exceeding 250 volts. Their current-carrying rating is limited by the tap rating of the seal-in unit.

TABLE 3—Time Overcurrent Unit Taps and Ratings

Tap Range (Amps)	Characteristics	1-Second Rating (Amps)	Continuous Rating (Amps)	
			Minimum Tap	Maximum Tap
0.5-4	Inverse (51)	70	1.6	5
	V. Inverse (53)	140	4	13
	Ext. Inv. (77)	125	3.5	10
1.5-12	V. Inverse (53)	260	10	30.5
	Ext. Inv. (77)	260	9.5	20
2-16	Inverse (51)	260	8	20

AVAILABLE SETTINGS

Time Overcurrent Units:

0.5-4 —0.5, 0.6, 0.7, 0.8, 1, 1.2, 1.5, 2, 2.5, 3, 4
1.5-12 —1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 10, 12
2-16 —2, 2.5, 3, 4, 5, 6, 7, 8, 10, 12, 16

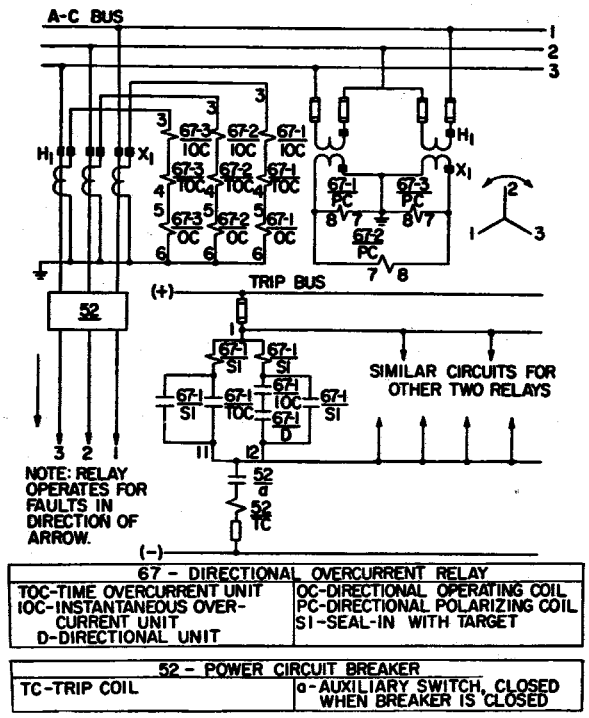


Fig. 2. Typical external connections for three single-phase Type JBC51 relays for directional phase-fault protection of a single line

CONNECTION DIAGRAMS

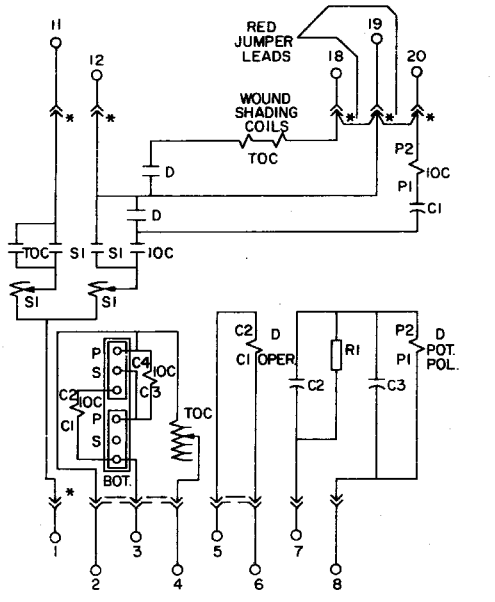


Fig. 3. (0257A6174-0) Internal Connections for JBC51M and JBC53M Relays.

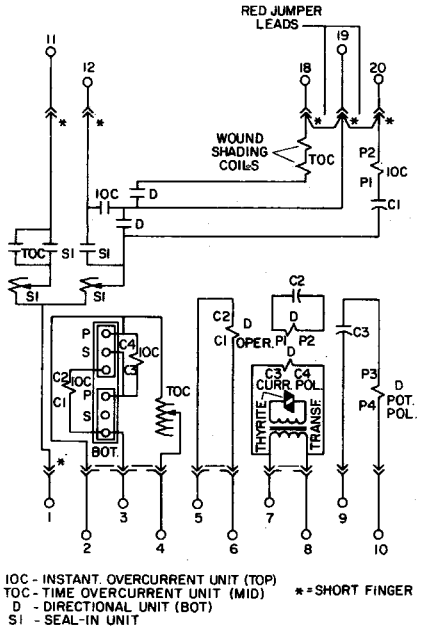


Fig. 4. (0257A6195-0) Internal Connections for JBCG51M and JBCG53M Relays.

JBC, JBCV and JBCG

Phase- and Ground-directional Overcurrent
with Directional Instantaneous Relays

GE Protective Relays

For Directional Overcurrent Protection of Feeders and Transmission Lines

SELECTION GUIDE
Minimum IOC P.U. Greater Than Full Load

Freq (Hz)	Time O.C. Unit (Amps)	Dir. Inst. Unit (Amps)	Non-Dir. Inst. Unit (Amps)	Tripping Contacts	Model Number			Case Size	Approx Wt in lbs (kg)	
					Inverse Time	Very Inverse Time	Extremely Inverse Time		Net	Ship.
JBC, PHASE-TYPE, 120 VOLT, 0.2/2.0-AMP TARGET AND SEAL-IN UNIT										
60	1.5-12 2-16	10-80	... ...	1 N.O.	..... 12JBC51M1A	12JBC53M1A	12JBC77M1A	L2	34 (15.4)	50 (22.7)
	2-16	2-16 10-80	6-150		12JBC51M2Y1A M1Y1A	....	....		35 (15.9)	51 (23.1)
50	1.5-12 2-16	10-80	... ...		..... 12JBC51M2A	12JBC53M2A	12JBC77M2A		34 (15.4)	50 (22.7)
60	2-16	10-80	... ...	2 N.O.	12JBC52M1A	.....	.....	L2	34 (15.4)	50 (22.7)
	1.5-12				.....	12JBC54M1A	12JBC78M1A			
50	2-16	10-80	... ...		12JBC52M2A	.....	.....			
	1.5-12				.....	12JBC54M2A	12JBC78M2A			
JBCG, GROUND-TYPE, 120 VOLT, 0.2/2.0-AMP TARGET AND SEAL-IN UNIT										
60	0.5-4	2-16 10-80	... ...	1 N.O.	12JBCG51M1A M2A	12JBCG53M1A M2A	12JBCG77M1A M2A	L2	35 (15.9)	51 (23.1)
	1.5-12	2-16 10-80	... ...		....	M5A M6A	M5A M6A			
	2-16	2-16 10-80	... ...		M5A M6A	....	....			
	0.5-4	2-16 10-80	6-150	1 N.O.	12JBCG51M1Y1A M2Y1A	12JBCG53M1Y1A M2Y1A	....		36 (16.3)	52 (23.6)
	1.5-12	2-16 10-80			....	M3Y1A M4Y1A	....			
	2-16	10-80			M3Y1A	.....	.....			
50	0.5-4	2-16 10-80	... ...	1 N.O.	12JBCG51M3A M4A	12JBCG53M3A M4A	12JBCG77M3A M4A	L2	35 (15.9)	51 (23.1)
	1.5-12	2-16 10-80	... ...		....	M7A M8A	M7A M8A			
	2-16	2-16 10-80	... ...		M7A M8A	....	....			
60	0.5-4	2-16 10-80	... ...	2 N.O.	12JBCG52M1A M2A	12JBCG54M1A M2A	12JBCG78M1A M2A	L2	35 (15.9)	51 (23.1)
	1.5-12	2-16 10-80	... ...		....	M5A M6A	M5A M6A			
	2-16	2-16 10-80	... ...		M5A M6A	....	....			
50	0.5-4	2-16 10-80	... ...	2 N.O.	12JBCG52M3A M4A	12JBCG54M3A M4A	12JBCG78M3A M4A			
	1.5-12	2-16 10-80	... ...		....	M7A M8A	M7A M8A			
	2-16	2-16 10-80	... ...		M7A M8A	....	....			
JBCG, GROUND-TYPE, 120 VOLT, 0.6/2.0-AMP TARGET AND SEAL-IN UNIT										
60	0.5-4	2-16 10-80	... ...	1 N.O.	....	12JBCG53M9A M10A	....	L2	34 (15.4)	50 (22.7)
	1.5-12	2-16 10-80	... ...		....	M13A M14A	....			
	0.5-4	2-16 10-80	6-150		....	12JBCG53M5Y1A M6Y1A	....		36 (16.3)	52 (23.6)
	1.5-12	2-16 10-80	2-50		....	12JBCG53M9Y1A M10Y1A	....			
	1.5-12	2-16 10-80	6-150		....	M7Y1A M8Y1A	....			
50	0.5-4	2-16 10-80	... ...	1 N.O.	....	12JBCG53M11A M12A	....	L2	34 (15.4)	50 (22.7)
	1.5-12	2-16 10-80	... ...		....	M15A M16A	....			

For Directional Overcurrent Protection of Feeders and Transmission Lines

SELECTION GUIDE (Cont'd)

Phase-type Voltage Restrained

Freq. (Hz)	Time O.C. Unit (Amps)	Dir. Inst. Unit (Amps)	Non-Dir. Inst. Unit (Amps)	Dir. P.U. (Amps) at Rated Volts	Tripping Contacts	Model Number: Inverse Time	Model Number: Very Inverse Time	Model Number: Extremely Inverse Time	Case Size	Approx Wt in lbs (kg): Net	Approx Wt in lbs (kg): Ship.
JBCV, PHASE-TYPE (Dir. Unit with Voltage Restraint), 120 Volt, 0.2/2.0 Target and Seal-in Unit											
60	1.5-12 1.5-12 2-16 2-16	2-16 10-80 2-16 10-80	... ...	9	1 N.O.	.... 12JBCV51M1A M3A	12JBCV53M1A M2A	12JBCV77M1A M2A	L-2	35 (15.9)	51 (23.1)
50	2-16 2-16	2-16 10-80	... ...			12JBCV51M2A M4A	.....	.....			
60	1.5-12	2-16	6-150			.....	12JBCV53M1Y1A	.....		36 (16.3)	52 (23.6)
60	1.5-12 1.5-12 2-16 2-16	2-16 10-80 2-16 10-80	... ...	9	2 N.O.	.... 12JBCV52M1A M3A	12JBCV54M1A M2A	12JBCV78M1A M2A		35 (15.9)	51 (23.1)
50	2-16 2-16	2-16 10-80	... ...			12JBCV52M2A M4A	.....	.....			

Minimum IOC P.U. Less than Full Load

Time O.C. Unit (Amps)	Dir. Inst. Unit (Amps)	Freq. (Hz)	Dc Aux. (Volts)	Tripping Contacts	Model Number: Inverse Time	Model Number: Very Inverse Time	Model Number: Extremely Inverse Time	Case Size	Approx Wt in lbs (kg): Net	Approx Wt in lbs (kg): Ship.
JBC, PHASE-TYPE, 120 VOLT, 0.2/2.0-AMP TARGET AND SEAL-IN UNIT										
1.5-12 2-16	2-16	60	125	1 N.O.	..... 12JBC51P1A	12JBC53P1A	12JBC77P1A	L2	34 (15.4)	50 (22.7)
1.5-12 2-16	2-16	50			..... 12JBC51P2A	12JBC53P2A	12JBC77P2A			
2-16	2-16	60		2 N.O.	12JBC52P1A	.....	.....			
2-16	2-16	50			12JBC52P2A	.....	.....			

TYPE JBCG61 AND JBCG63

Application

These ground directional overcurrent relays are primarily for use in the transferred tripping schemes for highspeed protection of transmission lines. The basic schemes are:

1. Direct underreaching
2. Permissive underreaching
3. Permissive overreaching

The JBCG61 and the JBCG63 relays are similar respectively to the JBCG51 and the JBCG53 relays. However, the JBCG61 and the JBCG63 relays differ in the arrangement of the seal-in unit contacts and in the location of the directional unit contacts. Both contacts of the seal-in unit are connected to separate relay terminals, and the directional unit is arranged so that it can be used independently.

SELECTION GUIDE

120-VOLT, 60-HERTZ (Continuous)—0.6/2.0-AMP TARGET AND SEAL-IN UNIT

Time O.C. Unit (Amps)	Dir Inst. Unit (Amps)	Tripping Contacts	Model Number: Inverse Time	Model Number: Very Inverse Time	Case Size	Approx Wt in lbs (kg): Net	Approx Wt in lbs (kg): Ship.
0.5-4.0 0.5-4.0 1.5-12.0 1.5-12.0 2-16 2-16	2-16 10-80 2-16 10-80 2-16 10-8	1 N.O.	12JBCG61M1A M2A M3A M4A	12JBCG63M1A M2A M3A M4A	L-2	35 (15.9)	52 (23.4)

S E C T I O N : 5

Differential and Timing Relays

BDD Transformer Percentage-differential 1

CFD High Speed Differential..... 3

IFD & IFD Percentage Differential..... 5

PVD Bus Differential voltage 8

SBD Static Bus Differential 10

STD Percentage-differential..... 12

SAM Timing 14

BDD

Percentage-differential Relays
with Harmonic Restraint

GE Protective Relays

For High-speed Phase and Ground Protection of Two- and Three-winding Power Transformers and Autotransformers

DESCRIPTION

The Type BDD relays are for the protection of transformers rated 2000 kva and above and for transformers with windings rated 15 kv or above. However, the importance of the transformer to the system, not its size alone, should be the basis for the decision on this quality of protection.

APPLICATION

The Type BDD differential relays should be used for all applications where high-speed operation and system stability are important. These relays have a percentage slope operating characteristic which prevents operation unless the differential current is greater than a certain percentage of the through current. A tap plug on the front of the relay provides slope percentages of 15, 25, or 40 which is usually adequate even for in-phase tap changing under load. Current transformer errors should not exceed 20 percent at 8 times tap value.

AVAILABILITY

Six different forms of the Type BDD relay are available. Each relay is a single-phase unit with one differential circuit. Three relays are required for three-phase protection. The six different forms are provided with *two, three, four, five, six or seven* through-current restraint circuits for the protection of power transformers with two or more windings or circuits. See Selection Guide, page 6-2.

The Types BDD16B, -17B, -18B, -19B and -20B with three, four, five, six and seven through-current restraint circuits, respectively, also have provision for accommodating one additional circuit connection to the transformer without a through-current restraint in the relay. This application can safely be made only when the additional circuit has no in-feed or is at best a very weak source and needs no through-current restraint.

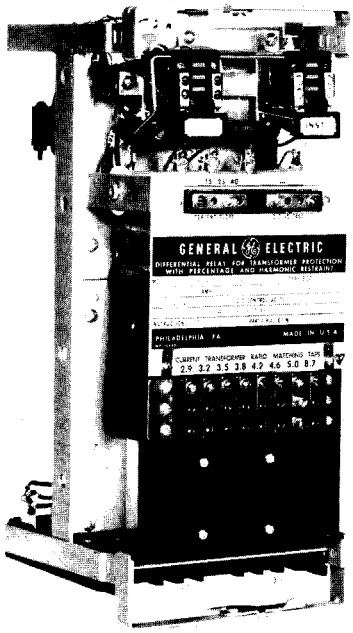
FEATURES

Harmonic-current Restraint prevents incorrect tripping on magnetizing inrush currents and no auxiliary desensitizing equipment is required.

No Auxiliary Current Transformers are needed for normal applications since the relay is provided with tapped internally mounted auxiliary transformer. The *low burden* of this relay minimizes current transformer error. Current transformer ratios should be selected carefully to obtain best protection. Refer to instructions.

Minimum Pickup is proportional to the current tap in use and at zero restraint is approximately 30 per cent of tap value.

Targets—The hinged armature instantaneous unit has a self-contained target indicator —**"INST."** The main operating unit auxiliary includes an indicating target thus giving each phase relay two targets.



(Photo 8036915)

Fig. 1. Type BDD15B, single-pole, percentage-differential relay in cradle without case

CONTACTS

Type BDD15B relay is provided with two sets of open contacts and the Types BDD16B, -17B, -18B, -19B and -20B are provided with one set of open contacts. The current-closing rating of the contacts is 30 amperes for voltages not exceeding 250 volts. If more than one circuit breaker per set of contacts is to be tripped, or if the tripping current exceeds 30 amperes, an auxiliary relay must be used with the Type BDD relay. After tripping occurs, it is necessary that the tripping circuit of these relays be opened by an auxiliary switch on the circuit breaker or by other automatic means. A hand-reset relay is recommended and normally used.

BURDENS

NOTE: Burdens and minimum pickup values are substantially independent of the percent slope settings and are approximately 100 percent power factor. Figures given are burdens imposed on each current transformer at 5.0 amperes.

Relay	Tap Setting Amps	Zero Restraint Pickup③ Amps	Operating Circuit① 60 Hertz Relays② Burden VA	Operating Circuit① 60 Hertz Relays② Imped Ohms	Restraint Circuit 60 Hertz Relays② Burden VA	Restraint Circuit 60 Hertz Relays② Imped Ohms
12BDD15B	2.9	0.87	3.2	0.128	1.3	0.052
16B	3.2	0.96	2.7	0.108	1.2	0.048
17B	3.5	1.05	2.4	0.096	1.1	0.044
18B	3.8	1.14	2.0	0.080	1.0	0.040
19B	4.2	1.26	1.9	0.076	0.9	0.036
20B	4.6	1.38	1.6	0.064	0.8	0.032
	5.0	1.50	1.5	0.060	0.7	0.028
	8.7	2.61	0.7	0.028	0.5	0.020

① Burden of operating coil is zero under normal conditions.
② Burden of 50 Hertz relay is the same or slightly lower.
③ It should be recognized that pickup current flows not only through the differential current transformer but also through one of the primary windings of the through current transformer producing some restraint. However, compared to the operating energy, this quantity of restraint is so small that it may be assumed to be zero.

REFERENCES:

Dimensions .....Section 16
How to Order .....Section 1
Instruction Books .....Section 17
Target and Contact Data.....Section 16
Relay Standards.....Section 16

SELECTION GUIDE—Single-phase (3 Relays Required for 3-phase Protection)
RATINGS—Single-phase 5 Amperes 1.5 amp minimum pick-up① 15/25/40 percent slope.

Ratings		Number of Contacts	Dc Control Volts			Case Size	Approximate Weight in Lb (kg)	
Amperes	Frequency, Hertz		125/250	48/125	24/48		Net	Shipping
			Model Number					
FOR TRANSFORMER PROTECTION REQUIRING 2 RESTRAINTS								
5	60	2 N.O.	12BDD15B11A	12BDD15B16A	12BDD15B13A	M1	22 (10)	34 (15.4)
	50		12BDD15B12A	12BDD15B17A	12BDD15B14A			
FOR TRANSFORMER PROTECTION REQUIRING 3 RESTRAINTS								
5	60	1 N.O.	12BDD16B11A	12BDD16B16A	12BDD16B13A	M1	24 (10.9)	36 (16.3)
	50		12BDD16B12A	12BDD16B18A	12BDD16B14A			
FOR TRANSFORMER PROTECTION REQUIRING 4 RESTRAINTS								
5	60	1 N.O.	12BDD17B1A	12BDD17B3A	.....	L2	26 (11.8)	39 (17.7)
	50		12BDD17B2A	.....	.....			
FOR TRANSFORMER PROTECTION REQUIRING 5 RESTRAINTS								
5	60	1 N.O.	12BDD18B3A	12BDD18B5A	.....	L2	28 (12.7)	42 (19)
	50		12BDD18B1A	12BDD18B6A	.....			
FOR TRANSFORMER PROTECTION REQUIRING 6 RESTRAINTS								
5	60	1 N.O.	12BDD19B1A	12BDD19B2A	.....	L2	28 (12.7)	42 (19)
FOR TRANSFORMER PROTECTION REQUIRING 7 RESTRAINTS								
5	60	1 N.O.	12BDD20B1A	.....	.....	L2	28 (12.7)	42 (19)

① Minimum pickup is 1.5 amperes with tap plugs in the 5-ampere and the 25-per-cent slope positions.

CONNECTION DIAGRAM

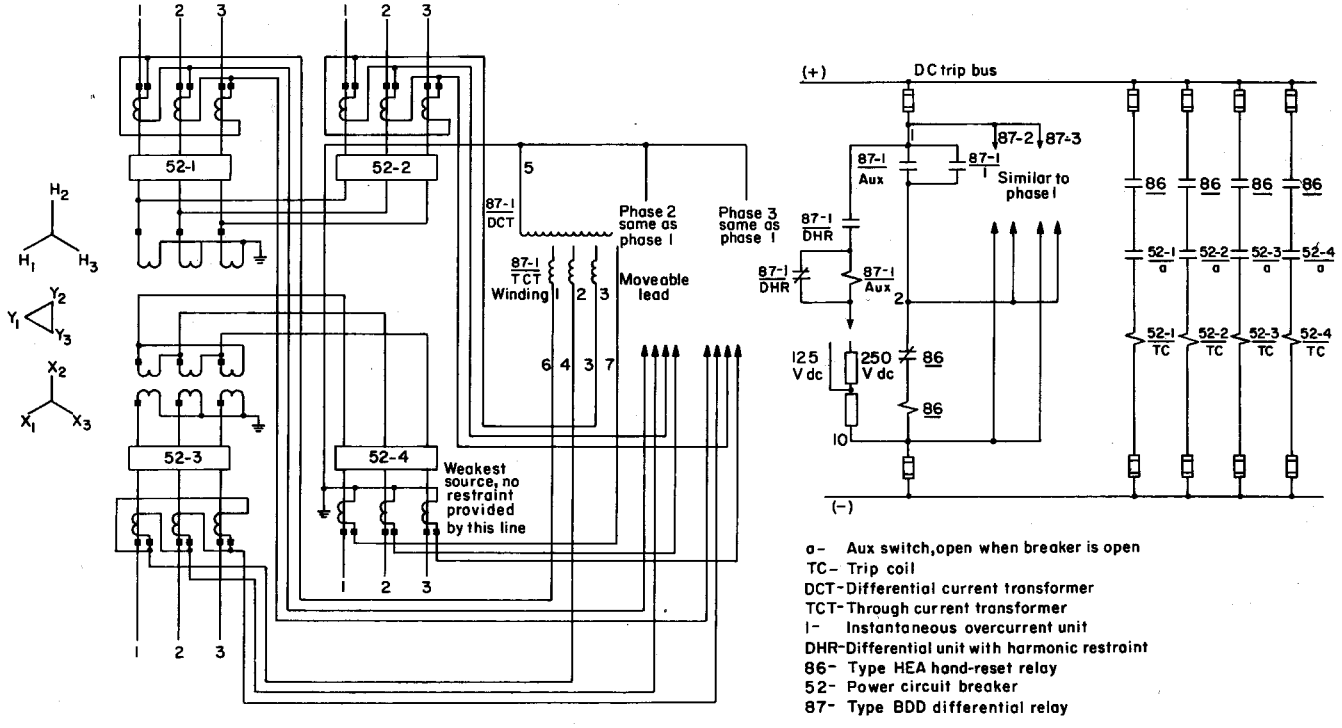


Fig. 2. Typical elementary diagram for Model No. 12BDD16B11 relays for four-circuit transformer protection with three restraints (0264B0499-1)

CFD

High Speed Differential Relays

GE Protective Relays

For Differential Protection of Ac Generators, Frequency Converters, Synchronous Condensers, and Motors

APPLICATION

Type CFD22B high-speed, product-restraint relays are designed to provide percentage-differential relaying protection for the larger and more important machines. They are recommended for *generators* rated 2000 kva and above and for *motors* and *synchronous condensers* rated 3000 hp (or kva) and above.

APPLICATION FACTORS

Where the total R.M.S. symmetrical current that would flow in a differential relay coil is excessive, high voltage may result with sensitive differential relays, and a Thyrite limiter may be required across each phase of the current transformer secondaries. Where taps on the current transformer secondary windings are unused or do not exist, currents below 84 amps are safe without limiters. Where taps are used on the CT secondaries, limiters are not necessary if the current is less than $84 \times \frac{(\text{Active Turns})^2}{(\text{Total Turns})^2}$. Installations not shown to be safe by the approximate rule given above should be referred to the General Office with data on the fault currents, CT ratios, and CT excitation characteristics, to determine whether limiters are actually needed.

The field switch should be tripped automatically at the same time the machine is disconnected from the system. If the neutral of a machine is grounded directly, or through a low impedance, it is advisable to provide a neutral breaker which can be tripped to open the ground-return circuit of the fault current as quickly as possible.

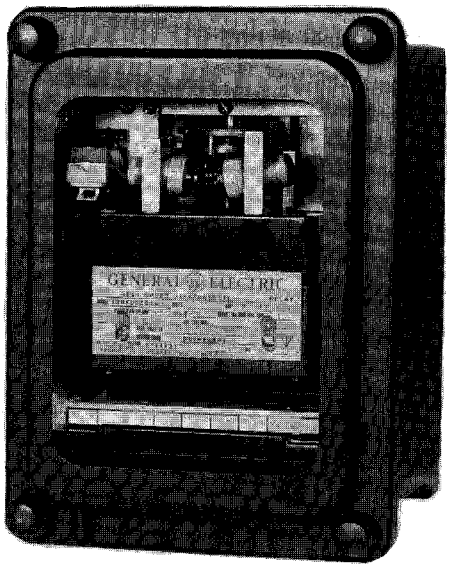
Current transformers must be accurate within 2 per cent to twice normal current. Above twice normal current accuracy is not so important.

Type CFD Relays WILL NOT Function for:

(1) Turn-to-turn faults in the machine windings.
(2) Open circuits in the machine windings.
(3) High currents caused by external overloads or short-circuits.
(4) Line power surges.
(5) Ground between windings and machine frame, if system is ungrounded, unless a second ground occurs in another phase of the system.

Type CFD Relays WILL Function for:

(1) Internal machine faults, except turn-to-turn.
(2) Faults in primary cables within the protected differential zone.
(3) Ground short-circuits in any part of the machine winding, except a portion very close to the neutral, provided there is no neutral impedance to limit ground current to a value below the relay pickup calibration.



(Photo 8007103)

Fig. 1. CFD single-phase differential relay

Product-restraint Principle

The CFD relays function on the product-restraint principle, which gives very little, or zero, restraining torque on single-end-feed internal faults, and an operating torque from the restraint coils on internal faults, with an external source of power.

If a current flows from the neutral side into the generator and another current flows from the generator to the bus, then the restraining coils produce a restraining torque that is proportional to the product of these two currents and the cosine of the angle between them. These are the conditions that will exist during normal operation, during external faults, and during internal faults when the generator continues to supply some current to the bus.

Conversely, if a current flows from the neutral side into the generator and another current flows from the bus into the generator, then the restraining coils produce an operating torque that is proportional to the product of these two currents and the cosine of the angle between them. These are the conditions that will exist during an internal fault when part of the fault current comes from the bus.

Percentage Slope: The relay has a slope which increases very rapidly above approximately twice normal current. This feature eliminates the necessity for close "matching" of the current transformers.

Under normal conditions the two secondary currents should be equal but they may differ due to current transformer errors. The "difference" or "error" current will flow in the operating coil. For currents up to full load of the machine the error current will be less than the 10 per cent "difference" current required to operate the relay. With an external fault the current in the current transformers can be high and the "error" current may be well over 10 per cent. For this reason, the slope of the relay characteristic is made to increase as the current increases.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

SELECTION GUIDE

SINGLE-PHASE (3 required)

Ratings			Contacts Normally Open Per Unit	Target and Holding Coil Amperes	Model No.	Case Size	Approx Wt in Lb	
Cont Rating in Amp	Freq in Hertz	Min P.U. Amp					Net	Ship.
5	60	0.2	2	1	12CFD22B1A	S1	12	18
5	60	0.2	2	0.2	B2A			
5	50	0.2	2	1	B3A			
5	50	0.2	2	0.2	B4A			
THREE-PHASE								
5	60	0.2	2	1	12CFD22A1A	L2	35	45
5	60	0.2	2	0.2	12CFD22A2A			
5	50	0.2	2	1	12CFD22A3A			
5	50	0.2	2	0.2	12CFD22A4A			
VOLTAGE LIMITER FOR LINE CURRENT TRANSFORMER SECONDARY—SINGLE-PHASE								
...	....	...	...	...	6118766G3		1	2

① For voltage limiter dimensions see Section 14.

DIMENSIONS

See Section 14.

CONNECTION DIAGRAM

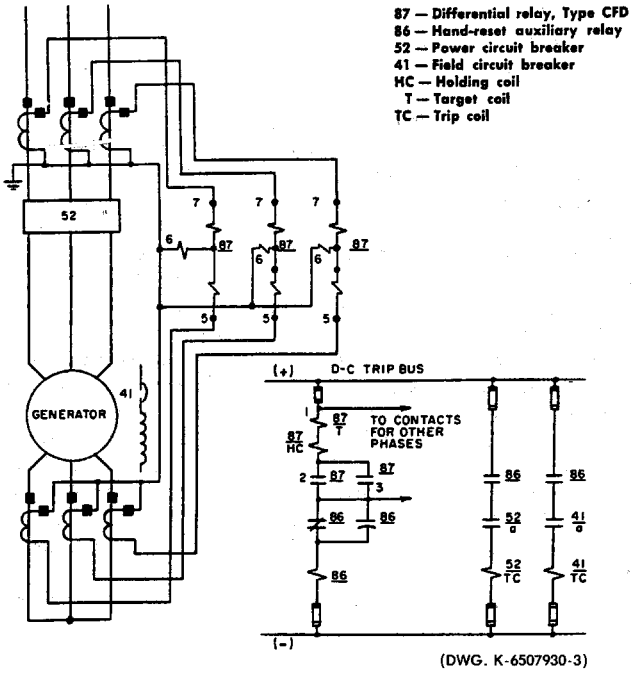


Fig. 2. Typical external connection for single-phase CFD22B relays for protection of a wye-connected generator with six leads brought out

BURDENS

The burdens of the coils in one phase (one induction unit) at 60 Hertz are given below:

Circuit	Continuous rating—Amp	Burden on one CT	
		Power Factor	Volt Amps
Restraining	5	.57	0.9
Operating②	0.5	.81	14.4

② Calculated unsaturated values (VA at 0.5 amp).

The operating circuit burden as a function of differential current is given in the table below. The burden is imposed on one current transformer.

Current-Amperes	Multiple of Min Pickup current	Burden on One CT Impedance—Ohms
0.2	1	58
0.6	3	29
2.0	10	11
4.0	20	6.3
5.0	25	5.4

For the Protection of Ac Rotating Machinery, Power Transformers, and Multi-circuit Buses

APPLICATION

The Types IJD and IFD relays are induction disk units that should be applied as follows:

For Ac Rotating Machines the Type IJD52A is recommended for ratings as indicated in Table 1, page 6-6.

Differential protection is also recommended for smaller machines, under the following conditions:

(1) Machines which operate in parallel on the same bus with differentially protected machines.

(2) Machines, regardless of size, which are important to the operation of the system. The decision governing this application is based on the actual importance of the machine, and the degree of relaying required for the particular application.

For generators rated 2000 kva and above or motors and synchronous condensers rated 3000 hp (or kva) and above, high-speed product-restraint relays, Type CFD are recommended.

NOTE: In order to provide complete percentage-differential protection, it is necessary that both ends of each machine winding be brought out to the terminal board. This construction should be specified when purchasing the machine, since those of lower voltages or lower hp or kva ratings may not ordinarily have this feature.

The IJD52A relays protect against phase-to-phase and phase-to-ground faults within the machine and leads within the differential zone, provided the fault current is above the relay minimum pickup value. They will not protect against open circuits or turn-to-turn faults. If the neutral of the system is not grounded, protection against grounds in the machine winding is provided only upon the occurrence of a second fault in another phase of the system.

5

SELECTION GUIDE—Single-phase 0.2/2-amp Target Seal-in

Frequency (Hz)	Continuous Rating, (Amps)	Tap Range, (Amps)	Minimum Operation Current, (Amps)	Slope Characteristic (Percent)	Contacts	Model No.	Case Size	Approx. Wt-Lb(Kg) Net	Approx. Wt-Lb(Kg) Ship
TYPE IJD52A—FOR PROTECTION OF AC ROTATING MACHINES (3 required)									
60	5	.....	0.1	10	2-N.O.	12IJD52A11A	S1	12(5.4)	15(6.8)
60		.....	0.5	25		A12A			
50		.....	0.1	10		A14A			
50		.....	0.5	10		A17A			
50		.....	0.5	25		A19A			
TYPE IJD52B—FOR PROTECTION OF AC ROTATING MACHINES (1 required)									
60	5	.....	0.1	10	2-N.O. (with one side common)	12IJD52B11A	L-2	28(12.6)	39(17.6)
60		.....	1.0	10		B14A			
60		.....	4.0	50		B15A			
60		.....	0.5	25		B16A			
60		.....	1.0	50		B17A			
60		.....	2.0	50		B18A			
50		.....	0.1	10		B12A			
50		.....	4.0	50		B19A			
TYPE IJD53C—FOR PROTECTION OF 2-WINDING POWER TRANSFORMERS (3 required)									
60	Twice Tap Setting	3.2-8.7	1.28-3.48	25	2-N.O.	12IJD53C11A	S1	12(5.4)	15(6.8)
60				50		C14A			
50				25		C12A			
50		3.2-8.7	1.28-3.48	50		C15A			
50		0.64-1.74	0.26-.70	25		C19A			
TYPE IJD53D—FOR PROTECTION OF 2-WINDING POWER TRANSFORMERS (1 required)									
60	Twice Tap Setting	3.2-8.7	1.28-3.48	25	2-N.O. (with one side common)	12IJD53D11A	L-2	28(12.6)	39(17.6)
60				50		D14A			
50				25		D12A			
50				50		D15A			
TYPE IFD51D—FOR PROTECTION OF WYE-WINDING OF POWER TRANSFORMERS (1 required)									
60	5	0.5-2.0a Inst.①	0.5	12.5-25.0	1-N.O.	12IFD51D1A	M-2	22(10)	32(14.5)
50						D2A			
TYPE IFD52B—FOR PROTECTION OF MULTI-CIRCUIT BUSES (6 required)									
60	5	4-16A Inst.①	0.4-1.4		1-N.O.	12IFD52B1A	M2	23(10.4)	35(15.9)
60		2-8A Inst.①				B4A			
50		2-8A Inst.①				B5A			
VOLTAGE LIMITER FOR LINE CURRENT TRANSFORMER SECONDARY—SINGLE-PHASE									
50/60	.....	.....	.....	.....	.....	M-6118766G3	...	1(.5)	2(.9)

① Range of instantaneous fault detection unit.

② The Type IFD52B relays do not have taps for balancing secondary currents; external current-balancing auxiliary autotransformers are shipped automatically and included in the price of the relay.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

TABLE 1 APPLICATION

Ratings of ac rotating machines for which percentage-differential protection using Type IJD52A relays is recommended

Voltage Range	Generators Kva	Synchronous Condensers and Motors Kva or Hp
5000 and up	0 to 1999	501 to 2999
2200 to 4999	501 to 1999	1500 to 2999
0 to 2199	1000 to 1999	Not Applicable

APPLICATION (cont'd)

Rotating machine current transformers should be selected so that the "difference" current will not exceed 5 per cent of the current that may be encountered during normal or abnormal operation of the machine. This includes all currents up to the maximum fault current which can be delivered by the machine in case of an external fault. This calculation must be based on the actual current-transformer secondary burden including the leads.

In general, it is recommended that current transformers for IJD differential protection be used for no other purpose.

For power transformers, it is recommended that percentage-differential protection be provided for transformers rated 1000 kva and above if circuit breakers are provided for each winding into which power can flow when an internal fault occurs, and for all transformers rated 5000 kva and above even if it requires the purchase of the necessary circuit breakers.

Differential protection is also recommended for transformers rated below 1000 kva that operate in parallel with differentially protected transformers and have circuit breakers for all parallel-connected windings. If a fault occurring in a small parallel-connected transformer is not promptly removed, it may prove just as damaging to service as a similar fault in a large bank.

The IJD53C relay is used for protection of ***two-winding power transformers.*** This relay has tapped operating and restraining coils, making it possible to balance secondary currents from the two sets of current transformers.

Percentage-differential relays are recommended for transformers rated 1000 up to 1999 kva, below 15,000 volts.

For transformers rated 2000 kva and above, any voltage, high-speed differential relays are recommended (see Type BDD, STD).

Above recommendations also apply to power autotransformers having equivalent physical capacities.

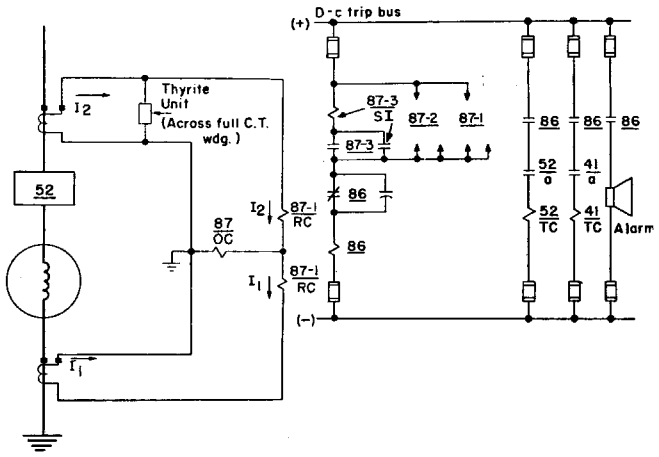


Fig. 2. Typical machine connections

For bus differential protection the IFD52B relay is used for protection of multi-circuit buses. This relay has six restraining coils and can be used with a maximum of six source connections to the bus. Since two restraining coils are wound on one U-magnet, it is necessary to use two relays per phase to prevent faulty operation in case of a through fault. An instantaneous overcurrent unit is included to increase shock resistance.

DESENSITIZING EQUIPMENT (IJD and IFD)

In some instances differential relays will operate on magnetizing inrush currents when the power transformer is first energized. This condition can be overcome by the addition of auxiliary desensitizing equipment. To avoid this problem, the Type STD harmonic restraint relay should be considered.

GENERAL

(a) For most installations a hand reset multi-contact auxiliary relay is required.

(b) Short-circuit duty:

Where short-circuit current available from the bus is sifficient to result in line current transformer secondary current in excess of 50 amperes, a Thyrite® voltage limiter should be connected across the secondary of each line current transformer secondary. Refer to Type CFD, pages 6-3 and 6-4, for additional comments.

BURDENS

Model No.	Coil	Amp	Tap	Freq. (Hz)	Impedance	Z (Ohms)
IJD52A( )	Restraint	5.0	—	60	0.2 + j0.7	0.7
	Restraint	5.0	—	50	0.2 + j0.6	0.6
	Operating	0.6	—	60	19.6 + j69.8	72.5
	Operating	0.6	—	50	19.5 + j58.2	61.4
IJD53C11A C14A	Restraint	5.0	—	60	0.04 + j0.01	0.04
	Operating	3.2	—	60	0.3 + j0.8	0.8
IJD53C12A C15A	Restraint	5.0	—	50	0.04 + j0.01	0.04
	Operating	3.2	—	50	0.2 + j0.7	0.7
IJD53C19A	Restraint	1.0	—	50	1.0 + j0.2	1.0
	Operating	.64	—	50	6.2 + j16.5	17.6
IFD52B-A	**Refer to instruction book**					

INTERNAL CONNECTION DIAGRAMS

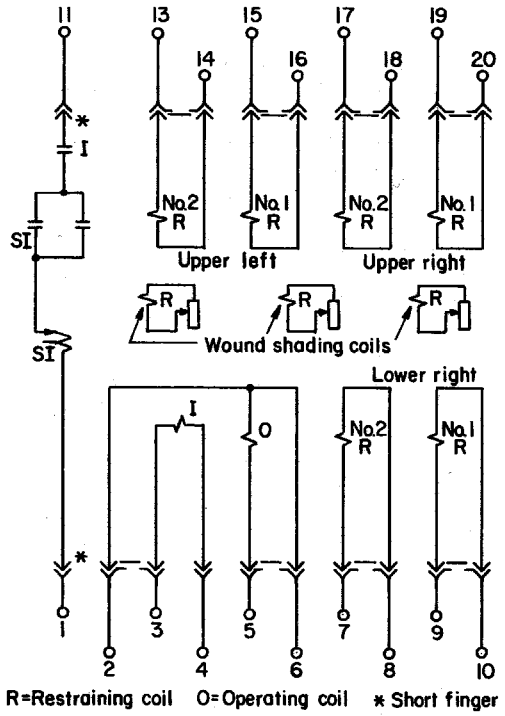


Fig. 3. Internal connections for IFD52B, front view (148A3957)

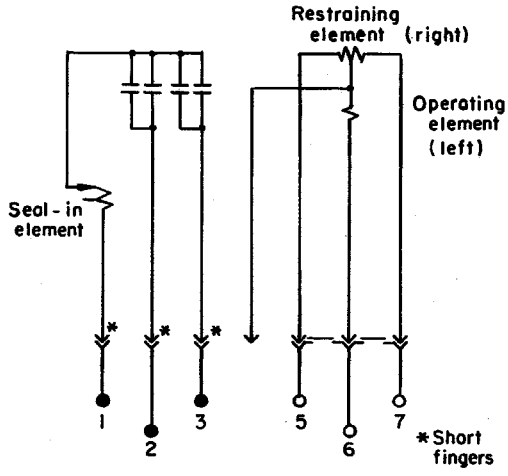


Fig. 4. Internal connections for IJD52A, front view (6209677)

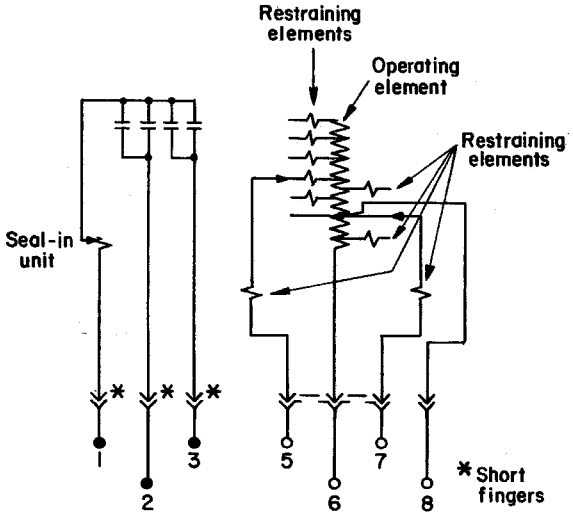


Fig. 5. Internal connections for IJD53C, front view (6556496)

PVD21

High Speed PVD
Bus Differential Voltage Relays

GE Protective Relays

For High-speed Differential Protection of Switchgear.
Used with Standard Bushing-type Current Transformers

INTRODUCTION

The Type PVD21 relay is a single-phase, high-speed, high-impedance, voltage-operated relay designed to provide protection in bus differential schemes. The Type PVD21 utilizes the same operating principle (high impedance voltage) as the earlier PVD models, but provides faster operating speeds and higher seismic capabilities. Typical operating speed is 20 milliseconds at 4X pickup (See Fig. 2). The Type PVD21 is mechanically interchangeable with the earlier PVD models, and provides additional output contacts as shown in Figs. 3 and 4.

DESCRIPTION

The PVD21 relay is available in four models. All models include a high-speed voltage sensing unit (87L) that operates from the voltage provided by the differentially connected CT's during an internal fault. In addition, a high seismic instantaneous overcurrent unit (87H) is included in the PVD21B and 21D models. The overcurrent unit 87H, which has an electrically separate output contact, may be used to supplement the voltage unit 87L, and/or to implement breaker failure protection when used with a suitable timing relay and other auxiliary devices.

The PVD21A and 21B models use a single Thyrite® stack to limit the magnitude of the voltage developed across the relay. For applications where high internal fault currents can be encountered, the PVD21C and 21D models are available. These relays include two Thyrite stacks, and offer the same basic protection, but with a slight decrease in sensitivity. See the PVD21 instruction book for proper selection and application for the PVD21C and D models.

CURRENT TRANSFORMER REQUIREMENTS

The Type PVD21 relays can be applied for bus protection in most cases where CT's having negligible leakage reactance are used. This generally includes any kind of current transformer with a toroidal core if the windings (on the taps used) are completely distributed about the core. It is preferable that all the CT's in the bus differential circuit have the same ratio. When adding to an existing bus, at least one CT in the new breaker should be ordered with the same ratio as the bus differential CT's in the existing breakers. If the differential circuit unavoidably includes different ratio CT's, application of the PVD21 may still be possible, but special attention must be given to protection against overvoltage conditions during internal faults. Refer applications involving different ratio CT's to the local General Electric Company sales office.

RATINGS

The voltage unit 87L has a continuous rating of 150V.

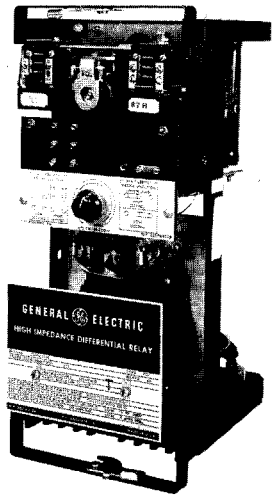
The current unit 87H is a Hi-G, high seismic instantaneous unit with the following ratings for the coil:

87H UNIT (2-50 AMPERE RANGE)

Link Position	Range (Amperes)	Continuous Rating (Amperes)	One Second Rating (Amperes)
Low	2-10	3.7	130
High	10-50	7.5	

The contacts of the 87L unit have a current closing rating of 30 amperes for voltages not exceeding 250 volts. The current carrying rating is limited by the seal-in unit rating (see below). **The target and seal-in unit** is a Hi-G, high seismic unit, dual rated with 0.2 and 2.0 amp (dc) taps, with the following ratings:

Description	Tap Setting	
	0.2 Amperes	2.0 Amperes
DC resistance (ohms)	8.0	0.24
Minimum operating (amp)	0.2	2.0
Carry continuous (amp)	0.3	3
Carry 30 amps for (sec)	0.03	4
Carry 10 amps for (sec)	0.25	30



(Photo 8043266)

Fig. 1. PVD21B relay (out of case)

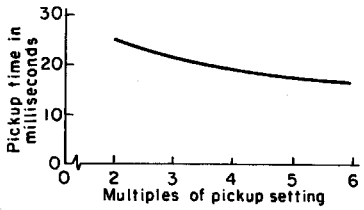


Fig. 2. Typical operating times of the PVD21 relay—87L unit

SELECTION GUIDE—Single-Phase (Three Required)

Continuous Rating (Volts)	Frequency (Hz)	Voltage Unit (87L) Min	Voltage Unit (87L) Max	Current Unit (87H) Min	Current Unit (87H) Max	Thyrite® Stacks	Model Number	Case Size	Approx Wt in Lb (kg) Net	Approx Wt in Lb (kg) Ship
150	60	75V	500V	...	...	1	12PVD21A1A	M-1	20(9)	27(12.2)
	50			...	...		A2A			
	60			2A	50A		12PVD21B1A			
	50			2A	50A		B2A			
	60			...	...	2	12PVD21C1A			
	50			...	...		C2A			
	60			2A	50A		12PVD21D1A			
	50			2A	50A		D2A			
	60			4A	100A	2	12PVD21D3A			

NOTE: All PVD21 relays include a 0.2/2.0 amp T. & SI Unit used in conjunction with the 87L Unit.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

CONNECTION DIAGRAM

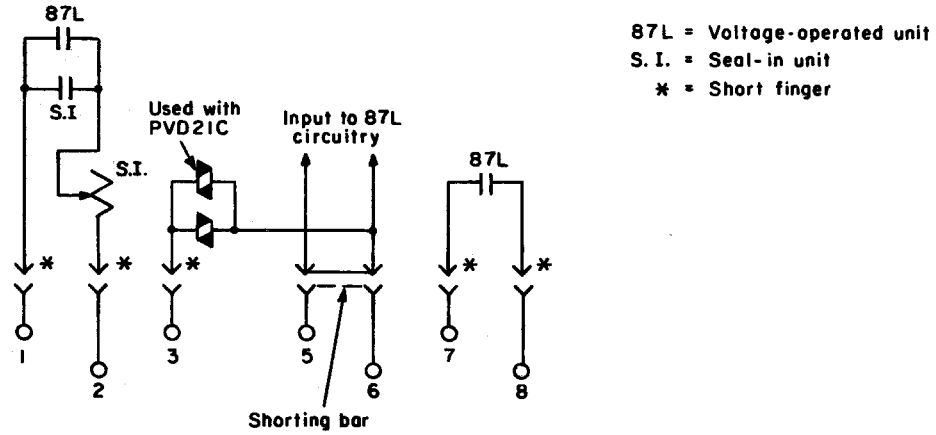


Fig. 3. Simplified internal connection diagram for PVD21A and PVD21C

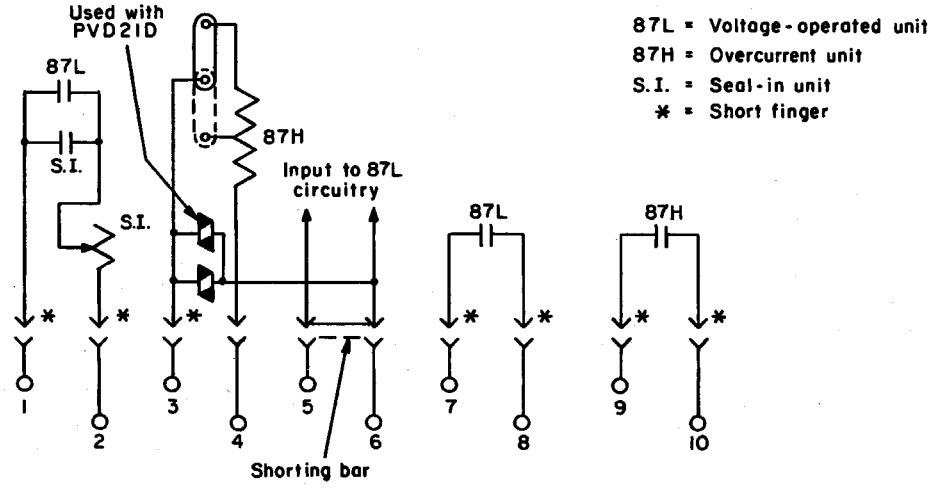


Fig. 4. Simplified internal connection diagram for PVD21B and PVD21D

SBD

Static Bus Differential Relays

GE Protective Relays

For High-speed Differential Protection of Busses and Shunt Reactors

DESCRIPTION

The Type SBD11B is a single-phase, high-speed differential relay. It is specifically designed to provide bus differential protection, but may also be used for differential protection of shunt reactors. A high impedance, voltage measuring circuit with overcurrent supervision is used for fault detection. The utilization of static circuitry eliminates the need for restraint coils or tuned circuits, and results in very short operating times. Output isolation is obtained with a telephone-relay, and a target seal-in unit is provided. A voltage selecting link allows the relay to operate on 48, 125, or 250 volts d-c. The relay is packaged in an S-2 type drawout case and requires no auxiliary CT's.

APPLICATION

The Type SBD11B relay is intended to be applied where sensitive, high-speed differential protection is required; and where severe CT saturation can occur for internal and external faults. The current transformers used with the relay should have fully distributed windings. The SBD can be applied with multi-ratio CT's, provided all CT's are on the same tap (see current transformer requirements).

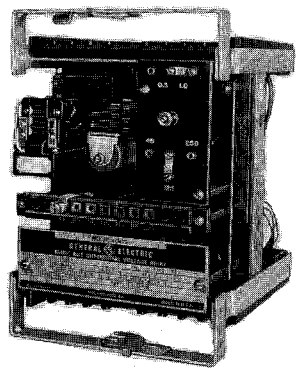
A conventional differential relay circuit is used with the SBD11B relay connected in parallel with all the current transformer secondaries of each phase (see Figure 2). Complete protection for phase and ground faults requires three single-phase SBD11B relays plus one lockout auxiliary relay, Type HEA, having three normally open contacts in addition to those which are required for tripping circuit breakers. The auxiliary contacts short out a portion of the input circuit after a trip has been initiated. This allows the relay to operate as a straight overcurrent function following lockout relay operation and at the same time insures that the short time rating of the relay is not exceeded. Thus, the SBD11B may be used to initiate a breaker failure timer.

The high-impedance, voltage-actuated operating principle is used in the SBD11B relay design. For normal conditions, the differential connection of the CT's results in negligible voltage across the relay. During an internal fault, the unbalance in CT currents produces a voltage above relay pickup, resulting in operation. Severe external faults, even those which result in complete CT saturation, will not produce sufficient voltage across the relay to cause operation. This selectivity is always possible because of the low d-c resistance of the CT winding when saturated and its comparatively high magnetizing impedence.

The SBD relay is set by calculating the required voltage and current taps. The objective is to select the lowest available taps which are secure from misoperation for external faults. This will provide maximum relay sensitivity for internal faults. Needed for this calculation are estimates of the maximum fault current available at the bus, and the resistances of the current transformers and the wiring connecting them to the junction point. The relay instruction book fully describes the recommended procedure to set the relay using this information and provides sample calculations.

Operating time for the SBD relay is typically from 5 to 8 milliseconds. The sensitivity level for internal faults as determined by the voltage tap setting will depend on CT excitation characteristics and the number of circuits involved. Recommended practices to insure maximum relay sensitivity are contained in the instruction book, which should be consulted before applying the relay.

Where lightning arresters are located within the zone protected by the relay, the 12SBD11B2A model should be selected.



(Photo 1228725)

Fig. 1. SBD single-phase relay (out of case)

CURRENT TRANSFORMER REQUIREMENTS

1. While a mixture of multi-ratio current transformers may be used, it is essential that the taps used result in all of the CT's having the same ratio. Where part winding taps are employed, it should be insured that the voltage developed across the full winding due to autotransformer action does not exceed the CT hi-pot rating. Otherwise, no special calculations or equipment are required when mixed ratio CT's are used.
2. All current transformers should have fully distributed windings. The full winding should be used where possible, but tapped windings can be used if they are also distributed, as they are on General Electric bushing CT's. If the CT's do not meet this requirement, the instruction book describes a method to apply the SBD11B provided the leakage reactance is known.
3. The use of dedicated CT's is recommended. The application of other devices in the SBD current transformer circuits will result in less sensitive protection.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

CONTACT RATINGS

Three electrically separate, normally open contacts from the output telephone relay are furnished. One of these contacts is provided with a target and seal-in unit.

The spare normally open contacts will make 30 amperes for tripping duty, and will make and carry 30 amperes continuously. The interrupting ratings are as shown in the table to the right.

Volts	Interrupting Ratings (Amps)	
	①Inductive	Non-inductive
Ac		
115	0.75	2.0
230	0.5	1.0
Dc		
48	1.0	3.0
125	0.5	1.5
250	0.25	0.75

① Inductance with L/R ratio of 0.1 sec.

5

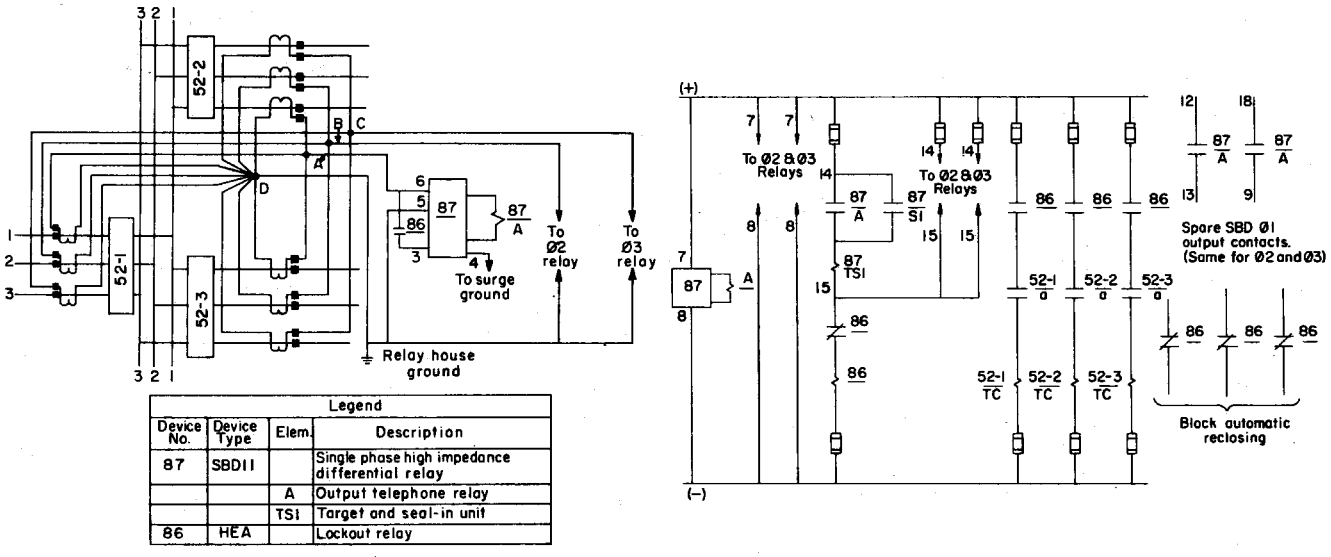
SELECTION GUIDE—Single Phase

Frequency (Hertz)	Voltage Adjustment Range	Current Taps	Target and Seal-in Amps	Dc Control Volts	Model Number	Case Size	Approximate Weight in lb (kg)	
							Net	Shipping
50/60	50-350	0.5/1.0 0.5/2.5	0.2/2.0	48/125/250	12SBD11B1A B2A	S2	14(6.4)	20(9.1)

AC CURRENT RATINGS

Continuous—10A RMS
1 Second—160A RMS (Symmetrical)
5 Cycles—480A RMS (Symmetrical)
2 Cycles—215A RMS (Fully Offset)

CONNECTION DIAGRAMS



Legend			
Device No.	Device Type	Elem.	Description
87	SBD11		Single phase high impedance differential relay
		A	Output telephone relay
		TSI	Target and seal-in unit
86	HEA		Lockout relay

Fig. 2. Typical Elementary Diagram for the SBD11B relays for a three breaker bus (0246A6979, 80)

GE Protective Relays

For High-speed Phase and Ground Protection of Power Transformers and Autotransformers

DESCRIPTION

The STD is a harmonic restrained percentage differential relay specifically designed for transformer fault protection. The STD15 through 23 relays differ from each other only in the number of restraint circuits that they include (see Selection Guide). The STD25 through 29 relays differ from STD15 through 23 relays in that they utilize only second harmonics for the harmonic restraint circuit while the others use all the harmonics. Harmonic restraint is employed to prevent undesired tripping as a result of exciting current inrush to the transformer being protected. Inrush to a transformer usually occurs when the transformer is energized or when a nearby fault is cleared thus suddenly restoring normal voltage to the bank. The second harmonic component is the predominant harmonic transformer inrush current.

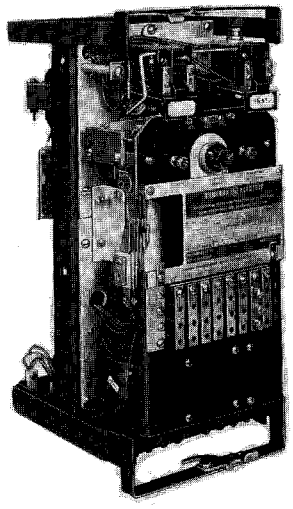
APPLICATION

In general the STD relays are recommended for application wherever it is desired to provide high speed transformer differential protection that is secure against undesired operations on transformer inrush currents. The STD15 through 23 relays produce harmonic restraint from all harmonics and are thus better suited for use throughout the system where the normal harmonic content is insignificant. Specifically, the STD25 through 29 relays are recommended for use on rectifier transformers where relatively high levels of odd harmonics are normally present. Since these relays produce harmonic restraint on second harmonic currents only they will be unaffected by the odd harmonics generated by the load.

For best performance it is recommended that a separate restraint be used for each set of CT's employed. For example, for a two winding transformer, the two restraint STD15 would suffice. For a three winding transformer (with all three windings loaded) the three restraint STD16 should be used. When a transformer is connected to a ring bus, it is very desirable to have a separate restraint for each of the two associated breakers. For example, a two winding transformer connected to a ring bus on the high side and the low side would best be protected with a four restraint STD17.

In general, it is best to use one set of relays for each transformer to be protected. While it is possible to protect two or more transformers (all switched together) with one set of relays, this results in less sensitive protection as well as a lack of indication of the faulted transformer. When two or more transformers are to be switched separately, it is *not* recommended that one set of relays be used to protect all of them. This is so because a transformer suddenly energized tends to take the harmonic components of the inrush current from the parallel banks while the fundamental component comes from the system. With only one set of relays protecting two or more banks the harmonic restraint circuit of the relays will not see the harmonic currents. Thus, no harmonic restraint is produced and an undesired trip of all the transformer banks may result from the fundamental component of the inrush that is seen by the relays as operating current.

The through restraint circuits of all the STD relays are continuously adjustable in the range of 15 thru 40 percent slopes. The slope employed should be selected on the basis of the matching between the CT ratios and the taps on the relay. Each restraint circuit has 8 taps between 2.9 and 8.7 amperes so that on power transformers with fixed taps it is possible to match to within about 5 percent. When protecting load tap changing transformers it will generally not be possible to match taps on the relay to within 5 percent over the complete range of the power transformers. The higher slope settings should be used for these applications.



(Photo 8042539)
Fig. 1. Type STD16C relay (out of case)

BURDENS—All STD Relays

Tap Setting Amps	Zero-Restraint Pickup③ Amps	Operating Circuit① 60 Hz Relays② Burden VA	Operating Circuit① 60 Hz Relays② Imped Ohms	Restraint Circuit 60 Hz Relays② Burden VA	Restraint Circuit 60 Hz Relays② Imped Ohms
2.9	0.87	3.2	0.128	1.3	0.052
3.2	0.96	2.7	0.108	1.2	0.048
3.5	1.05	2.4	0.096	1.1	0.044
3.8	1.14	2.0	0.080	1.0	0.040
4.2	1.26	1.9	0.076	0.9	0.036
4.6	1.38	1.6	0.064	0.8	0.032
5.0	1.50	1.5	0.060	0.7	0.028
8.7	2.61	0.7	0.028	0.5	0.020

① Burden of operating coil is zero under normal conditions.
② Burden of Hertz relay is the same or slightly lower.
③ It should be recognized that pickup current flows not only through differential current transformer but also through one of the primary windings of the through current transformer producing some restraint. however, compared to the operating energy, this quantity of restraint is so small that it may be assumed to be zero.

NOTE: Burdens and minimum pickup values are substantially independent of the percent slope settings and are all approximately 100 percent power factor. Figures given are burdens imposed on each current transformer at 5.0 amperes.

CONTACTS

The Type STD relays are furnished with one normally open contact. The current-closing rating of the contact is 30 amperes for voltages not exceeding 250 volts. After tripping occurs, it is necessary that the tripping circuit of these relays be opened by an auxiliary switch on the circuit breaker or by other automatic means.

If more than one circuit breaker per contact is to be tripped, or if the tripping current exceeds 30 amperes, an auxiliary relay must be used in conjunction with the STD relay. A hand-reset relay such as the HEA is recommended and normally used.

REFERENCES:

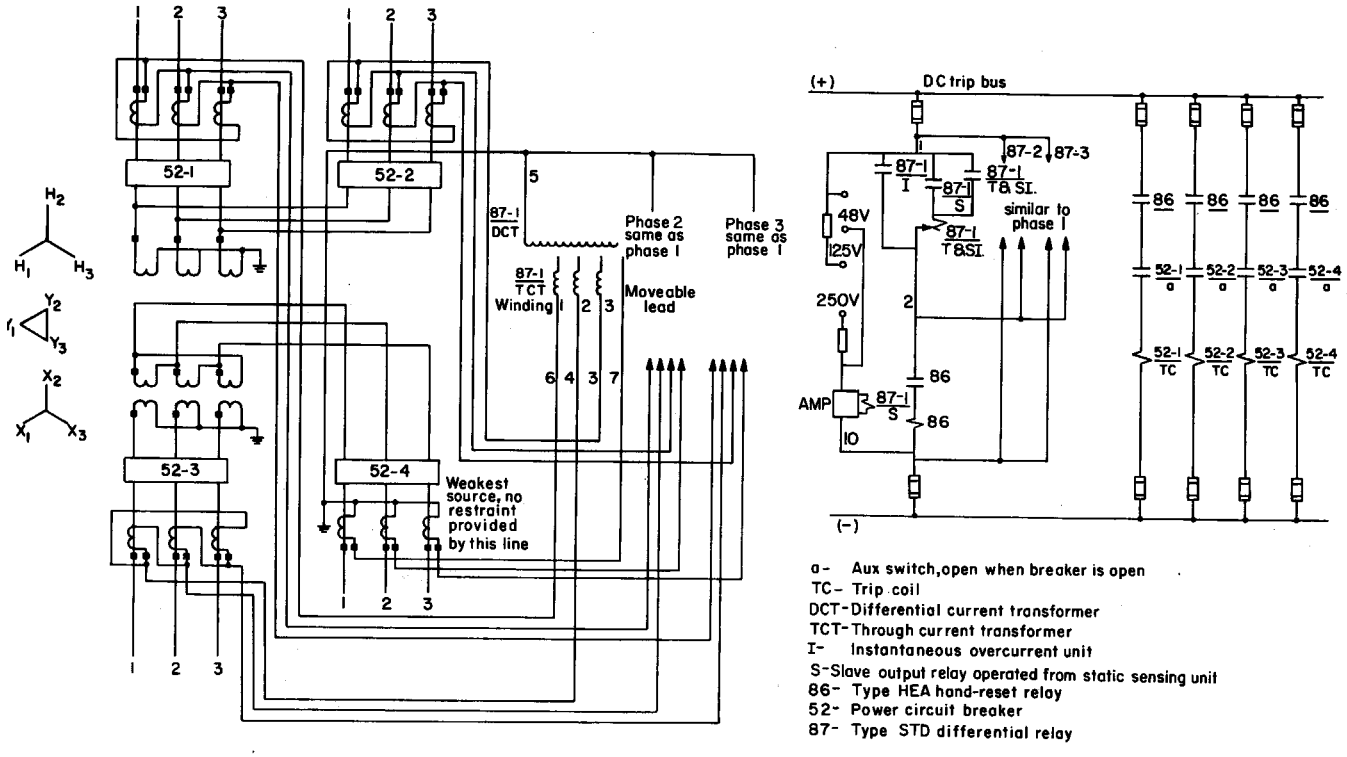
Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

SELECTION GUIDE—Single Phase

No. Rest. Wind.	Amps	Freq. (Hz)	Slope (%)	Dc Control (Volts)	Target & Seal-in (Amps)	Min-P.U. (Amps) ①	Model Number	Cont.	Case Size	Approx Wt in lb (kg) Net	Ship
RESTRAINT ON ALL HARMONICS											
2	5	60	15/25/40	48/125/250	0.2/2.0 0.6/2.0	1.5	12STD15C5A C3A	1 N.O.	M1	24 (10.9)	34 (15.4)
		50			0.2/2.0 0.6/2.0		C6A C4A				
		60			0.2/2.0		12STD15D3A	2 N.O.			
3		60			0.2/2.0 0.6/2.0		12STD16C5A C3A	1 N.O.		27 (12.2)	37 (16.8)
		50		48/110/220	0.2/2.0		C7A				
				48/125/250	0.2/2.0 0.6/2.0		C6A C4A				
4		60 50			0.6/2.0		12STD17C2A C3A		L2	30 (13.6)	43 (19.5)
5		60 50		48/125/250	0.6/2.0		12STD18C2A C3A			32 (14.5)	45 (20.4)
		50		48/110/220			C4A				
8		60		48/125/250	0.6/2.0		12STD21C1A			38 (17.2)	51 (23.1)
RESTRAINT ON 2nd HARMONIC ONLY											
2	5	60	15/25/40	48/125/250	0.6/2.0	1.5	12STD25D2A	1 N.O.	L1	29 (13.1)	42 (19)
3		60			0.6/2.0		12STD26C1A			31 (14)	44 (20)
5		60			0.2/2.0 1.0		12STD28C2D C1D		LD2	37 (16.8)	50 (22.7)
6		60			0.2/2.0 0.6/2.0		12STD29C2D C1D			39 (17.7)	52 (23.6)

① Minimum pickup is 1.5 amperes for the 5 amp tap and 25 percent slope setting.

CONNECTION DIAGRAM



(0128B1982)

Fig. 2. Elementary diagram for the STD-16 relays for four-circuit transformer protection with three restraints.

SAM200
Static
Timing Relays

GE Protective Relays

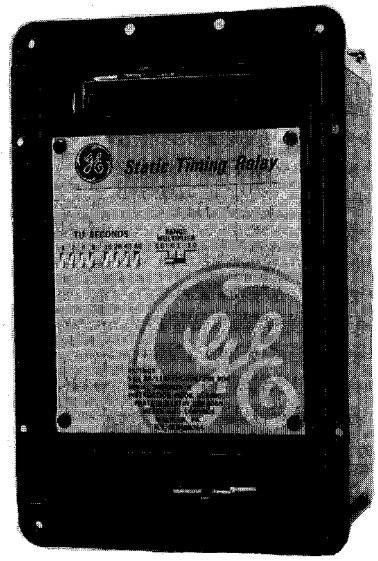
For General Purpose & Distance Relay Timing Functions

DESCRIPTION

The SAM200 series of relays provide highly accurate and repeatable timing functions that produce a contact closure after a selected time delay has expired. The total time delay consists of the set time delay added to the operating time of the associated output relay (typically 2-6 milliseconds).

The time delay settings are made using toggle switches on the front plate of the relay, easily accessible by removing the front cover. Utilizing high reliability solid-state components, the SAM200 relays operate in stage-settable ranges of .01 to 99 seconds, within ± 3 milliseconds of selected setting.

The SAM200 series are designed to supersede the SAM11A-17G relays. (see Selection Table.)



APPLICATION

The SAM200 relays may be applied wherever accurate and repeatable timing functions are required. The basic timing function is the same for all models of the SAM200 family, but each model is different based on the number of timing functions present, the presence or absence of targets, and the contact arrangement. This differentiation makes certain models more suitable for specific applications. Table I lists the models and their recommended applications.

RATINGS/OPERATING CHARACTERISTICS

DC Control Voltage:
- Nominal - 48, 110, 125, 220, 250
- Minimum - 37 volts
- Maximum - 280 volts

Timing Settings:

-Range Multiplier - 0.01
Recommended timing range:
0.03 to 0.99 sec. in 0.01 sec. steps
Repeatability: ± 1.5%

-Range Multiplier - 0.1:
Recommended timing range:
0.10 to 9.90 sec. in 0.10 sec. steps
Repeatability: ± 0.75%

-Range Multiplier - 1.0
Recommended timing range:
1.0 to 99.0 sec. in 1.00 sec. steps

Environmental:

-Operating
- 20° C to +55° C 95% relative humidity (noncondensing)
- Surge: ANSI C37.90 and GE RFI tests IEC 255-4, 255-5

Contact Ratings:
- Make and carry 30 amps for 1 second

TABLE I - SELECTION-APPLICATION GUIDE

MODEL	APPLICATIONS	TIMING FUNCTIONS	TRIP TARGETS*	CASE SIZE	FUNCTIONAL EQUIVALENT
SAM201A1A	General purpose	TU	TA & TB	S1	SAM11B,D,H
SAM202A1A	General purpose.. ..2 zone step distance schemes for zone-packaged distance relays	TU	None	S1	SAM11A,17A, SAM99AA,17D
SAM203A1A	General purpose.. ..3-zone step distance schemes for line protection	TU2 & TU3	TA & TB	S1	SAM13C
SAM204A1A	3-zone step distance schemes for line protection using zone-packaged distance relays	TU2 & TU3	None	S1	SAM16A
SAM205A1A	2-zone step distance schemes for line protection using phase-packaged distance relays	TU	T1 & T2	S1	SAM17C,G
SAM206A1A	3-zone step distance schemes for line protection using phase-packaged distance relays	TU2 & TU3	T1,T2,T3	S1	SAM14A, SAM14B, SAM99F
SAM207A1A	General purpose	TU	None	S2	-----

*Target identification is user selectable

"General purpose" category includes use of appropriate SAM200 relay for timing function associated with local breaker-failure backup schemes.

"Phase-packaged" refers to component distance distance relays where the measuring units for all zones associated with one phase or phase-pair are included in one relay case.

"Zone-packaged" refers to component distance relays where the measuring units of all 3 phases or phase-pairs associated with one zone are included in one relay case. (see Section 14 for case size dimensions.)

TABLE II - BURDENS

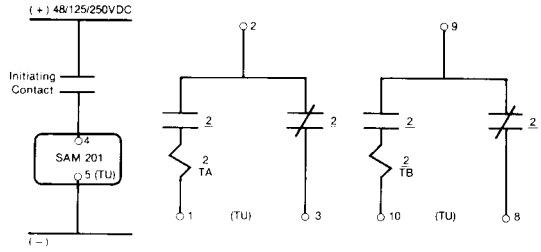
	Power Supply DC Watts		
Model	48	125	250
201, 202, 205	1.1	3.0	6.3
203	2.3	6.3	13.5
204, 206	1.8	4.7	9.9
207	2.4	6.5	13.9

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

External Connections For SAM200 Timing Relays

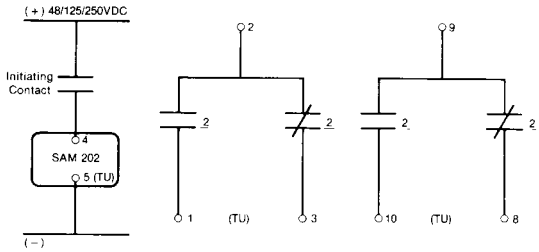
SAM201



LEGEND

2	SAM Timing Relay	TA	Target
TB	Target	TU	Timing Unit

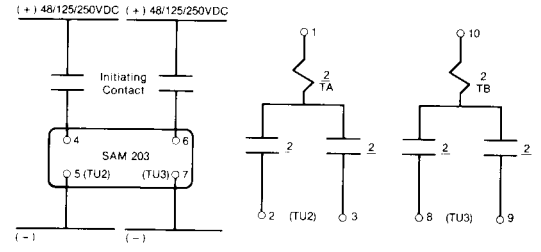
SAM202



LEGEND

2	SAM Timing Relay
TU	Timing Unit

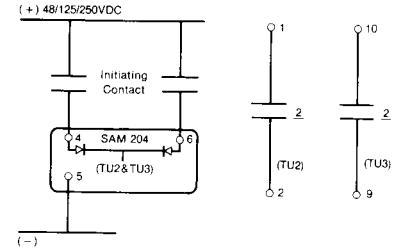
SAM203



LEGEND

2	SAM Timing Relay	TU2	Timing Unit Unit 2
TA	Target	TU3	Timing Unit 3
TB	Target		

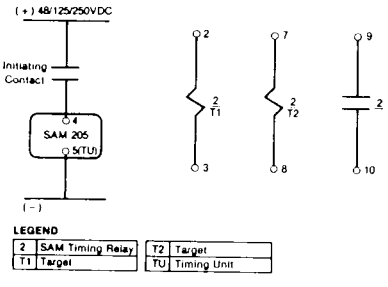
SAM204



LEGEND

2	SAM Timing Relay
TU2	Timing Unit 2
TU3	Timing Unit 3

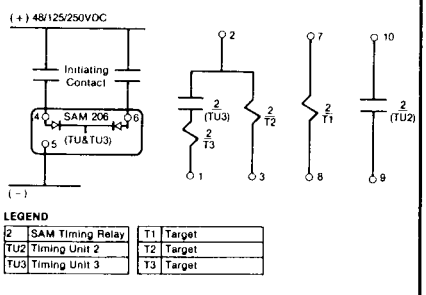
SAM205



LEGEND

2	SAM Timing Relay	T2	Target
T1	Target	TU	Timing Unit

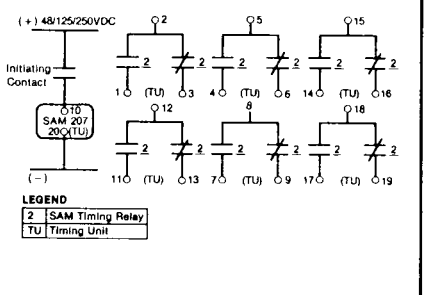
SAM206



LEGEND

2	SAM Timing Relay	T1	Target
TU2	Timing Unit 2	T2	Target
TU3	Timing Unit 3	T3	Target

SAM207



LEGEND

2	SAM Timing Relay
TU	Timing Unit

SECTION: 6

Auxiliary Relays

HAA Auxiliary or Annunciator..... 1

HEA Multicontact Auxiliary..... 3

HFA100 Multicontact Auxiliary 8

HFA Multicontact Auxiliary..... 12

HFA100 Conversion Kit 17

HGA100 Hinged-armature Auxiliary 18

HGA Hinged-armature Auxiliary 20

HGA100 Conversion Kit..... 24

HMA100 Hinged-armature Auxiliary 25

HMA Hinged-armature Auxiliary 27

NGA Auxiliary 29

HSA11 Multicontact Auxiliary 31

For Annunciation and Target Applications

DESCRIPTION

Generally two specific forms of the HAA are available—a current operated unit and a voltage operated unit. Example: HAA15A4 is 0.2/2 amperes dc and the HAA15B5 is a 125-volt dc unit. Also two general case designs are available. The single units such as HAA15 use a molded plastic case with glass window and all others the standard drawout case.

The HAA relays contain a standard target unit which is a small hinged armature type relay with a "U" shaped magnet frame, a fixed pole piece, an armature which operates the normally open contacts and the target, and an operating coil.

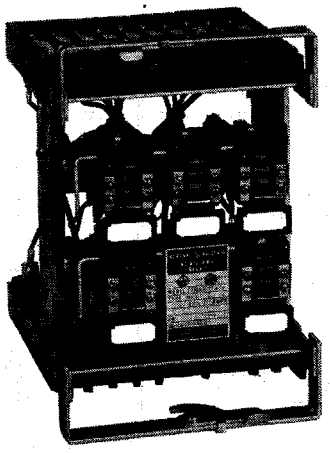
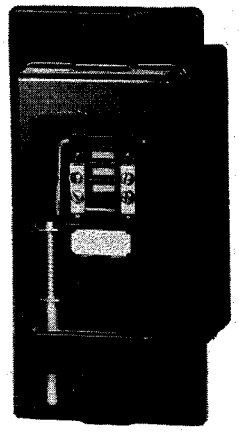


Fig. 1. Type HAA11A relay (removed from case)



(Photo 821917)

Fig. 2. Type HAA15 relay in flush-mounted molded case.

APPLICATION

The HAA auxiliary relay may be used whenever a target is required. Also each unit has at least one set of contacts available for alarm or other similar use. See Selection Guide and Fig. 3 on page 8-2 for contact arrangements.

A typical application would be to obtain a local annunciation of an abnormal condition and to relay the alarm to a central annunciator. With this arrangement the abnormal condition would operate one of the HAA coil circuits dropping the target and causing the associated unit contacts to relay the alarm to the remote annunciator.

The HAA16B, HAA16C, and HAA19A relays are special high speed dc voltage relays with a pickup of 1 cycle or less at rated voltage for use with transformer pressure relays for increased security. The connections of the HAA16B and HAA16C are shown in Figure 4. Its coil is shorted by a normally closed contact of the transformer pressure relay to prevent the HAA relay from operating in case a voltage surge should flash over the normally closed contacts of the pressure relay.

CONTACT RATINGS

The contacts will make and carry 30 amperes momentarily and will carry 6 amperes continuously.

The resistance values, pickup values, and the current carrying ability of the operating coils of all the current-operated HAA relays, may be found in Section 16. The appropriate data for the voltage-operated HAA relays may be found in the tables below.

BURDENS

Since these are dc relays the burdens may be easily calculated. In the case of voltage operated relays the burden in watts may be found by using the following expression:

$$Pdc = \frac{V^2}{R_t} = \text{Burden (watts)}$$

V = voltage rating of relay

R_t = total resistance (coil plus external resistance)

For current operated relays use the following expression:

$Pdc = I^2R_t = \text{Burden (watts)}$

I = Applied Current

VOLTAGE UNITS—Resistances

Model Number	Contin. Dc Rating (Volts)	Maximum Pickup (Dc Volts)	Dropout (Dc Volts)	Coil Resistance (Ohms)	Internal Resistance (Ohms)	External Resistance (Ohms) ①
.....	48	41	4.8	840	...	...
.....	125	106	12.5	5600	...	...
.....	250	212	25.0	5600	5600	...
12HAA16B5 & C5	24	13	2.4	14	75	...
B4 & C4	32	15	3.2	14	100	...
B1 & C1	48	22	4.8	95	350	...
B2 & C2①	125	60	12.5	95	350	650①
B3 & C3①	250	120	25.0	95	350	1650①
12HAA19A2A	48	22	4.8	95	350	...
A1A	125	60	12.5	95	1000	...

① These resistors are supplied automatically with the relay and should not be ordered separately.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

SELECTION GUIDE

Number Units Per Case	Volts Dc	Current Dc (Amps)	Model Number	Contact Configuration	Case Size	Approx Wt in lb (kg) Net	Approx Wt in lb (kg) Ship
1	... ...	0.2/2.0 0.6/2.0	12HAA15A4 A5	E	② (Back Connected)	2(1)	3(1.4)
	48 125 250	....	12HAA15B6 B5 B4	E	② (Back Connected)	2(1)	3(1.4)
	...	0.2/2.0	12HAA15E1	E	② (Front Connected)	2(1)	3(1.4)
	125	.....	12HAA15F1	E	② (Front Connected)	2(1)	3(1.4)
	48 125 250	....	12HAA15H1 H2 H3	F	② (Back Connected)	2(1)	3(1.4)
	24 32 48 125① 250①	....	12HAA16B5* B4* B1* B2* B3*	E	② (Back Connected)	3(1.4)	4(1.8)
	24 32 48 125① 250①	....	12HAA16C5* C4* C1* C2* C3*	E	② (Front Connected)	3(1.4)	4(1.8)
	48 125	....	12HAA19A2A A1A	H	S2	8(3.6)	12(5.4)
3	48 125 250	....	12HAA14B3A B2A B1A	B	S1	6(2.7)	10(4.5)
	...	0.2/2.0	12HAA14C1A	B	S1	6(2.7)	10(4.5)
4	...	0.2/2.0	12HAA12A4A	A	S1	7(3.2)	10(4.5)
	48 125 250	....	12HAA12B2A B1A B3A	A	S1	7(3.2)	10(4.5)
5	... ...	0.2/2.0 0.6/2.0	12HAA11A1A A2A	D	S2	8(3.6)	12(5.4)
	48 125 250	....	12HAA11B3A B2A B1A	D	S2	8(3.6)	12(5.4)
	125	.....	12HAA18A1A	I	S2	8(3.6)	12(5.4)
6	...	0.2/2.0	12HAA13A1A	C	S2	8(3.6)	12(5.4)
	48 125 250	....	12HAA13B3A B1A B2A	C	S2	8(3.6)	12(5.4)
	....	1.0	12HAA13D1A	C	S2	8(3.6)	12(5.4)
	250	.....	12HAA13E1A	G			

① Includes external resistor.

② Molded case similar to HGA case which includes a glass window in the cover. The back connected relay can be ordered for semi-flush mounting by adding "F" to the model number. Example: 12HAA16B2F

*Used as an interposing relay after the transformer sudden pressure relay.

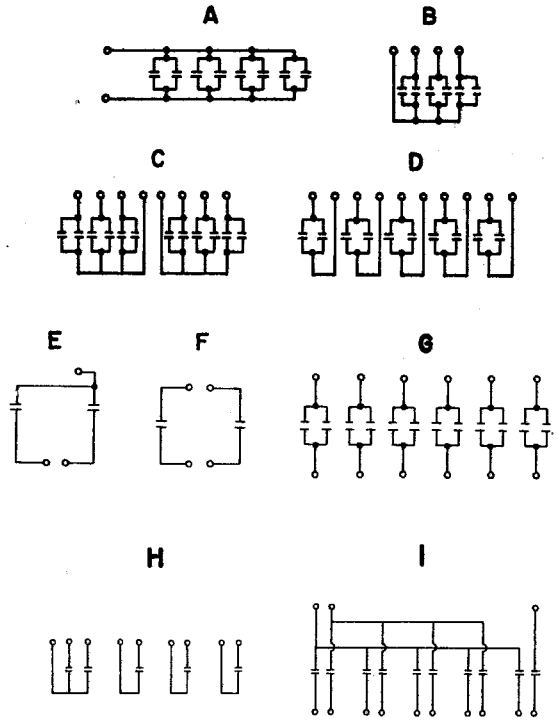


Fig. 3. Contact configurations

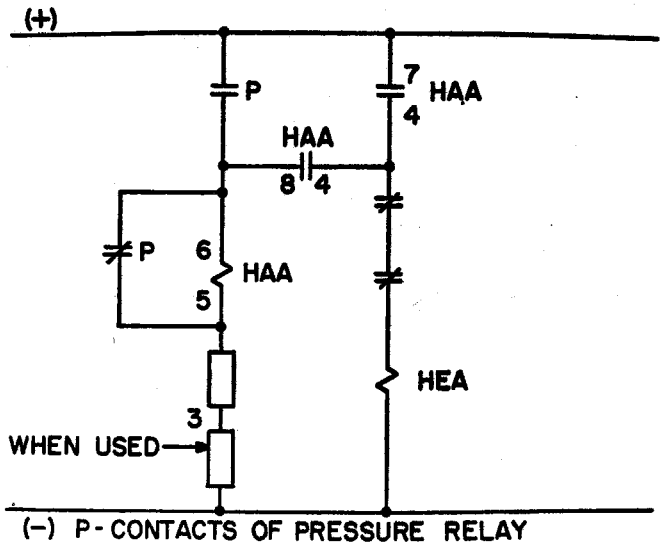


Fig. 4. Schematic for application of HAA16B or HAA16C relay with transformer fault pressure relay

HEA61, HEA62, and HEA63

APPLICATION

The Type HEA high-speed multicontact, auxiliary relays are applicable where it is desired that a number of operations be performed simultaneously from the operation of a single relay.

Typical functions that can be performed by these relays are:

1. Trip the main circuit breaker of a system.
2. Trip station auxiliary breakers.
3. Trip main or auxiliary field breakers.
4. Trip and lock out all breakers on a bus.

Perhaps the most important use of the Type HEA relay is in conjunction with differential relays which protect transformers, rotating apparatus, buses, etc.

CONSTRUCTION

The HEA multicontact, hand-reset auxiliary relays are built with many parts common to the well-known Type SB-1 control and transfer switches.

The mechanical target on the escutcheon plate assembly indicates the position of the relay. The black target indicates the reset position and the orange target, the tripped position. To reset the relay after being tripped, the handle is turned clockwise as indicated by the arrow on the escutcheon plate.

Since basically the HEA relay is similar to the SB-1 switch, it is available with a shaft long enough to allow it to be mounted on panels with a thickness of from 1/8 inch to 2 inches thick, in increments of 1/16 inch.

Like the SB-1 switch, all HEA relays must be ordered for the specific panel thickness, otherwise the relay will be supplied with a shaft long enough to be mounted only on a 1/8 inch panel.

EXAMPLE:

12HEA61A222 for 3/4 inch panel relay number would be 12HEA61A222X12 (3/4 inch = 12/16 = ... X12).

EXAMPLE:

12HEA63F272 for 1 1/2 inch panel relay number would be 12HEA63F272X24 (1 1/2 inch = 24/16 = ... X24).

OPERATION

The operating shaft is held in the reset position by a positive roller latch which is especially constructed to resist shock and vibration. It is released through the action of the operating coil, in attracting a hinged-armature element.

All HEA relays are made so that they should not normally be tripped manually, although it is possible by removing the rear cover and releasing the hinged-armature element.

SPECIAL MOUNTING

Type HEA61A, 61B, 61C, 62C, 63C and 63G relays can be supplied with a bevel-gear drive which allows the relay to be mounted in locations where normally the depth is not sufficient. The relays can be mounted like the standard but the bevel-gear drive changes the direction by 90 degrees of that portion of the relay that is behind the panel. The bevel-gear drive is available to change the direction up, down, left, or right.

To select the proper model number of the special relay, select the number of the standard relay desired (example—12HEA61C230X2). If a right angle drive upward is desired, add the letters "Right-angle Up" to the standard model number. Hence, the model number would be 12HEA61CRU230X2 (for 1/4-in. panel).

CONTACT RATINGS

The current-closing rating of the contacts is 50 amperes for voltages not exceeding 600 volts. The contacts have a current-carrying capacity of 20 amperes continuously or 50 amperes for one minute. The interrupting ability of the contacts varies with the inductance of the circuit. The values (in amperes) given in Table I, for dc inductive circuits, are based on the average trip coil.

BURDENS

The burdens for the Type HEA relays are given in Table II.

TABLE I—CONTACT INTERRUPTING RATINGS

Circuit Volts	Amps Noninductive Circuits Number of Contacts			Amps Inductive Circuit Number of Contacts		
	1	2 in Series	4 in Series	1	2 in Series	4 in Series
24 dc	6.0	30.0	...	4.0	20.00	30.0
48 dc	5.0	25.0	40.0	3.0	15.00	25.0
125 dc	2.5	11.0	25.0	2.0	6.25	9.5
250 dc	0.75	2.0	8.0	0.7	1.75	6.5
600 dc	0.25	0.45	1.35	0.15	0.35	1.25
115 ac	40.00	50.0	...	24.0	50.0	...
230 ac	25.00	50.0	...	12.0	25.0	40.0
460 ac	12.00	25.0	...	5.0	12.0	20.0
550 ac	6.00	12.0	...	4.0	10.0	15.0

TABLE II—BURDEN DATA OF TRIP COIL

Intermittent Rating Volts	Frequency	Coil Resis Ohms at 25 C	Ac Coil Current Amps at (Rated Volts)	Operating Range Volts	Rating of Protective Relay Target Coil Amp	
					Universal Target Seal-in	Separate Target and Seal-in
24	dc	1.2	.....	14-30	2.0	1.0
48	dc	4.5	.....	28-60	2.0	1.0
125	dc	23	.....	70-140	0.2	1.0
250	dc	103	.....	140-280	0.2	0.2
115	50/60 Hz	.....	25	95-125	2.0	.....
230	50/60 Hz	.....	14	190-250	2.0	.....
460	50/60 Hz	.....	7	380-500	2.0	.....

HEA61 Hand Reset

WHERE TO USE

The HEA61 relay is a hand-reset high speed auxiliary relay. When it is used in conjunction with differential relays which are protecting transformers, rotating machines, buses, etc, it is preferred that the auxiliary relay be hand reset to prevent accidental reclosing of breakers when an internal fault has caused the differential relay to operate.

OPERATION

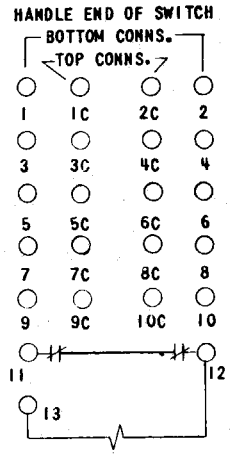
The HEA61 relay is available with 6, 10, or 16 main electrically separate contacts. In addition there are 2 normally closed contacts that are wired for opening the operating coil circuit. See Figure 2.

The time required to trip the relay, from the instant of energization of the coil to the closing of the contacts, is approximately 15 milli-seconds (1 cycle on 60 Hertz basis)—slightly less for opening of the contacts. See Figure 3.



(Photo 8031895)

Fig. 1. 6-contact Type HEA relay (cover removed)



INTERNAL CONNECTIONS

NOTE - CONTACTS 11 & 12 SHOWN IN RESET POSITION.

Fig. 2. Typical HEA61B relay contact arrangement

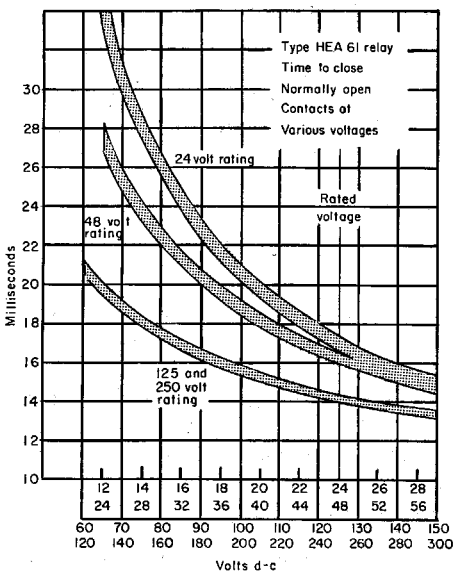


Fig. 3. Typical time-voltage characteristics of Type HEA61 relay

NOTE: When viewed from the handle end of the relay, the odd contacts are on the right-hand side and the even contacts are on the left-hand side starting at the handle end and proceeding to the rear of the relay. Normally, the open contacts are the first contacts (nearest the handle) on the relay, in the reset position.

Example: 12HEA61B233 rated 125-volts dc
3 NO (contact numbers 1, 2, and 3)
7 NC (contact numbers 4, 5, 6, 7, 8, 9, 10)

SELECTION GUIDE

Contact Arrangement Reset (Latched) Position		Model Number							Approx Wt in lb (kg)	
Contact Numbers Norm. Open	Contact Numbers Norm. Closed	24 Volt Dc	48 Volt Dc	125 Volt Dc	220 Volt Dc	250 Volt Dc	115 Volt 50/60 Hz	230 Volt 50/60 Hz	Net	Ship
2 CONTACT (Plus 2 Contacts in Coil Circuit)										
3-4	None	12HEA61M40	12HEA61M30	12HEA61M20	12HEA61M80	12HEA61M10	12HEA61M90	12HEA61M100	3	5
3	4	M41	M31	M21	M81	M11	M91	M101	(1.3)	(2.2)
None	3-4	M42	M32	M22	M82	M12	M92	M102		
6 CONTACT (Plus 2 Contacts in Coil Circuit)										
None	1-6	12HEA61A240	12HEA61A230	12HEA61A220	12HEA61A280	12HEA61A210	12HEA61A290	12HEA61A300		
1	2-6	A241	A231	A221	A281	A211	A291	A301		
1-2	3-6	A242	A232	A222	A282	A212	A292	A302		
1-3	4-6	A243	A233	A223	A283	A213	A293	A303	4	6
1-4	5-6	A244	A234	A224	A284	A214	A294	A304	(1.8)	(2.7)
1-5	6	A245	A235	A225	A285	A215	A295	A305		
1-6	None	A246	A236	A226	A286	A216	A296	A306		

HEA61 Hand Reset

SELECTION GUIDE (Cont'd)

Contact Arrangement Reset (Latched) Position		Model Number							Approx Wt in lb (kg)	
Contact Numbers Norm. Open	Contact Numbers Norm. Closed	24 Volt Dc	48 Volt Dc	125 Volt Dc	220 Volt Dc	250 Volt Dc	115 Volt 50/60 Hz	230 Volt 50/60 Hz	Net	Ship
10 CONTACT (Plus 2 Contacts in Coil Circuit)										
None	1-10	12HEA61B270	12HEA61B250	12HEA61B230	12HEA61B330	12HEA61B210	12HEA61B350	12HEA61B370		
1	2-10	B271	B251	B231	B331	B211	B351	B371		
1-2	3-10	B272	B252	B232	B332	B212	B352	B372		
1-3	4-10	B273	B253	B233	B333	B213	B353	B373		
1-4	5-10	B274	B254	B234	B334	B214	B354	B374		
1-5	6-10	B275	B255	B235	B335	B215	B355	B375	6	8
1-6	7-10	B276	B256	B236	B336	B216	B356	B376	(2.7)	(3.6)
1-7	8-10	B277	B257	B237	B337	B217	B357	B377		
1-8	9-10	B278	B258	B238	B338	B218	B358	B378		
1-9	10	B279	B259	B239	B339	B219	B359	B379		
1-10	None	B280	B260	B240	B340	B220	B360	B380		
14 CONTACTS (Plus 2 Contacts in Coil Circuit)										
None	1-14	12HEA61V70	12HEA61V50	12HEA61V30	.....	12HEA61V10	12HEA61V90	12HEA61V110		
1	2-14	V71	V51	V31	.....	V11	V91	V111		
1-2	3-14	V72	V52	V32	.....	V12	V92	V112		
1-3	4-14	V73	V53	V33	.....	V13	V93	V113		
1-4	5-14	V74	V54	V34	.....	V14	V94	V114		
1-5	6-14	V75	V55	V35	.....	V15	V95	V115	7	9
1-6	7-14	V76	V56	V36	.....	V16	V96	V116	(3.1)	(4)
1-7	8-14	V77	V57	V37	.....	V17	V97	V117		
1-8	9-14	V78	V58	V38	.....	V18	V98	V118		
1-9	10-14	V79	V59	V39	.....	V19	V99	V119		
1-10	11-14	V80	V60	V40	.....	V20	V100	V120		
1-11	12-14	V81	V61	V41	.....	V21	V101	V121		
1-12	13-14	V82	V62	V42	.....	V22	V102	V122		
1-13	14	V83	V63	V43	.....	V23	V103	V123		
1-14	None	V84	V64	V44	.....	V24	V104	V124		
16 CONTACTS (Plus 2 Contacts in Coil Circuit)										
None	1-16	12HEA61C270	12HEA61C250	12HEA61C230	12HEA61C290	12HEA61C210	12HEA61C310	12HEA61C350		
1	2-16	C271	C251	C231	C291	C211	C311	C351		
1-2	3-16	C272	C252	C232	C292	C212	C312	C352		
1-3	4-16	C273	C253	C233	C293	C213	C313	C353		
1-4	5-16	C274	C254	C234	C294	C214	C314	C354		
1-5	6-16	C275	C255	C235	C295	C215	C315	C355		
1-6	7-16	C276	C256	C236	C296	C216	C316	C356		
1-7	8-16	C277	C257	C237	C297	C217	C317	C357		
1-8	9-16	C278	C258	C238	C298	C218	C318	C358	8	10
1-9	10-16	C279	C259	C239	C299	C219	C319	C359	(3.6)	(4.5)
1-10	11-16	C280	C260	C240	C300	C220	C320	C360		
1-11	12-16	C281	C261	C241	C301	C221	C321	C361		
1-12	13-16	C282	C262	C242	C302	C222	C322	C362		
1-13	14-16	C283	C263	C243	C303	C223	C323	C363		
1-14	15-16	C284	C264	C244	C304	C224	C324	C364		
1-15	16	C285	C265	C245	C305	C225	C325	C365		
1-16	None	C286	C266	C246	C306	C226	C326	C366		

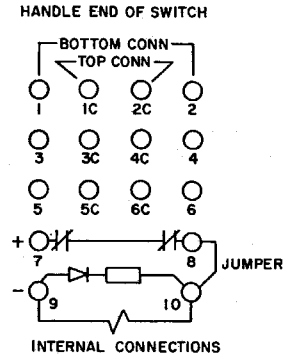
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HEA62 Hand Reset

The HEA62 relay is identical to the HEA61 with the exception that on the HEA62 there is a diode-resister combination inserted across the coil circuit. See Fig. 4. This diode-resistor supresses the surge sometimes caused by the interruption of the coil contacts on a dc circuit.

The diode-resistor combination is mounted on a small board that is mechanically attached beneath the trip coil frame.

Although in most cases this diode-resistor combination is unnecessary, it is offered for those unusual conditions where the user might feel it necessary. The HEA62 is available only in the 62A, 62B, and 62C dc series.



NOTE– CONTACTS 7 & 8 SHOWN IN RESET POSITION.

Fig. 4. Typical HEA62A relay contact arrangement

HEA63 Hand and Electric Reset

WHERE TO USE

APPLICATION

The HEA63 relay is basically a standard HEA61 except it has a rotary solenoid which is used to electrically reset the relay and there are only certain contact sequences available (see Selection Guide). This relay is especially useful where the operator and the HEA63 relay are some distance apart.

OPERATION

The operation of the relay may be understood by referring to Fig. 5. When electrical resetting is desired, a contact or switch is closed which completes the HGA33 relay (which is a part of the overall HEA63 relay and is supplied automatically with the relay) coil circuit through a contact of the HEA relay. This contact is closed in the trip position. Closure of the HGA33 contacts energizes the rotary solenoid which imparts enough rotational force to the HEA shaft through a coupling to cause the HEA to reset and latch. When the HEA resets, the contact which energized the HGA33 coil opens and de-energizes the HGA33 relay. This HGA is of the time delay drop out variety with approximately 0.25 seconds drop out time. The time delay insures that the HEA has fully latched. The contacts of the HGA33 then interrupt the rotary solenoid operating current. The HGA33 contacts have a high interrupting rating which is required because the rotary solenoid current is of a relatively high inductive magnitude.

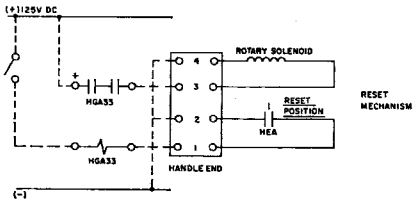
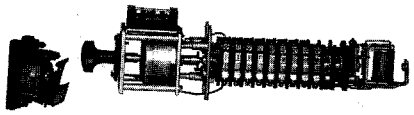


Fig. 5 Typical schematic of HEA63 relay

Rating (Volts)	Rotary Solenoid Coil Current (Amperes)
24	26.8
48	13.5
125	5.5
250	2.8



(Photo 8034092)

Fig. 6. 15-contact Type HEA63 relay with HGA33 (covers removed)

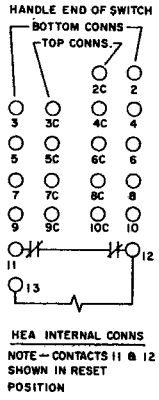


Fig. 7. Typical HEA63B contact arrangement

HEA63 Hand and Electric Reset

SELECTION GUIDE

Contact Arrangement Reset (latched) Position		Model Number								Approx Wt in lb (kg) (Includes HGA)	
		With Front-connected Auxiliary (HGA33A)				With Back-connected Auxiliary (HGA33B)					
Contact Numbers Norm. Open	Contact Numbers Norm. Closed	24 Volts Dc	48 Volts Dc	125 Volts Dc	250 Volts Dc	24 Volts Dc	48 Volts Dc	125 Volts Dc	250 Volts Dc	Net	Shipping
5 CONTACT (Plus 2 Contacts in Trip Circuit and 1 Contact in Reset Circuit)											
None	2-6	12HEA63A241	12HEA63A331	12HEA63A221	12HEA63A211	12HEA63D241	12HEA63D331	12HEA63D221	12HEA63D211		
2	3-6	A242	A332	A222	A212	D242	D332	D222	D212		
2-3	4-6	A243	A333	A223	A213	D243	D333	D223	D213		
2-4	5-6	A244	A334	A224	A214	D244	D334	D224	D214	14 (6.3)	18 (8.2)
2-5	6	A245	A335	A225	A215	D245	D335	D225	D215		
2-6	None	A246	A336	A226	A216	D246	D336	D226	D216		
9 CONTACTS (Plus 2 Contacts in Trip Circuit and 1 Contact in Reset Circuit)											
2	3-10	12HEA63B272	12HEA63B252	12HEA63B232	12HEA63B212	12HEA63F272	12HEA63F252	12HEA63F232	12HEA63F212		
2-3	4-10	B273	B253	B233	B213	F273	F253	F233	F213		
2-4	5-10	B274	B254	B234	B214	F274	F254	F234	F214		
2-5	6-10	B275	B255	B235	B215	F275	F255	F235	F215		
2-6	7-10	B276	B256	B236	B216	F276	F256	F236	F216	15 (6.8)	19 (8.6)
2-7	8-10	B277	B257	B237	B217	F277	F257	F237	F217		
2-8	9-10	B278	B258	B238	B218	F278	F258	F238	F218		
2-9	10	B279	B259	B239	B219	F279	F259	F239	F219		
2-10	None	B280	B260	B240	B220	F280	F260	F240	F220		
15 CONTACTS (Plus 2 Contacts in Trip Circuit and 1 Contact in Reset Circuit)											
2-8	9-16	12HEA63C318	12HEA63C278	12HEA63C238	12HEA63C218	12HEA63G318	12HEA63G278	12HEA63G238	12HEA63G218		
2-9	10-16	C319	C279	C239	C219	G319	G279	G239	G219		
2-10	11-16	C320	C280	C240	C220	G320	G280	G240	G220		
2-11	12-16	C321	C281	C241	C221	G321	G281	G241	G221		
2-12	13-16	C322	C282	C242	C222	G322	G282	G242	G222	16 (7.2)	20 (9)
2-13	14-16	C323	C283	C243	C223	G323	G283	G243	G223		
2-14	15-16	C324	C284	C244	C224	G324	G284	G244	G224		
2-15	16	C325	C285	C245	C225	G325	G285	G245	G225		
2-16	None	C326	C286	C246	C226	G326	G286	G246	G226		

6

HFA100

Multicontact Auxiliary Relays

GE Protective Relays

For Ac and Dc Circuit Applications

DESCRIPTION

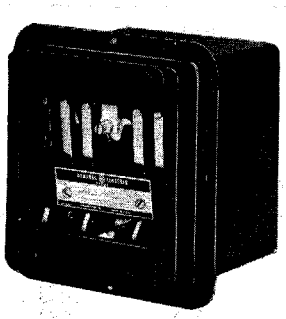
Type HFA Century Series relays are designed for applications where a number of auxiliary functions must be performed simultaneously. The Century Series coil design provides longer operating life than previous designs as a result of changes in the entire coil insulation system.

The six electrically separate contact circuits are adaptable for either circuit-opening or circuit-closing applications. If more than six circuits are to be controlled, the coils of two or more relays may be connected in series (dc only) or in parallel.

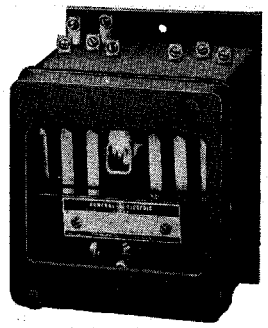
HFA Century Series relays are offered in non-drawout case or drawout case construction.

Non-drawout case HFA relays are available for front connection (suitable for surface mounting only) or back connection (suitable for semi-flush mounting only).

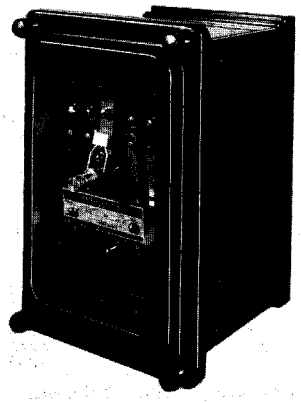
Drawout case HFA relays are back-connected and are suitable for either semi-flush or surface mounting.



(Photo 8025537)
Fig. 1. Semi-flush (back connected) Type HFA151A-F



(Photo 8025781)
Fig. 2. Surface mounting (front connected) Type HFA151A-H



(Photo 1227763)
Fig. 3. Drawout Case Type HFA171A-A

LONG-LIFE COIL DESIGN

Basic design features of HFA Century Series coils are as follows:

Spool—the spool on which this coil is wound is made of high thermal strength, glass-filled polyester to obtain long life at elevated temperatures. This material shows no signs of cracking or brittleness under accelerated life testing.

Wire Insulation—the wire insulation is a polyamide-imide wire coating (180 C rating) which retains insulation integrity and mechanical strength at continuous elevated temperatures and which is also non-hydroscopic and fungus resistant. Tefzel insulation is used where required, such as on leads.

Encapsulation—Polybutadiene solventless impregnant.

Process

The polyamide-imide insulated coils, wound on high-temperature spools, are prebaked to drive off all volatile materials, vacuum-impregnated with the solventless varnish, and then post-baked. The impregnation material is also non-hydroscopic and has temperature expansion coefficients compatible with the spool and with the wire, so that stresses do not develop under temperature cycling.

Nameplates for Century Series relays are green to provide easy visual differentiation from standard life relays.

Accelerated life tests—conducted at elevated temperature and maximum voltage—have established a projected service life of 40 years to 1 percent failure (that is, when 1 percent of all such relays have failed) at 55 C and 110 percent rated voltage.

APPLICATION

Selection of Dc Relays for Tripping Duty Where Operating Coil Circuit is Opened By An Auxiliary Switch: The operating time of the standard HFA relay is approximately 5 cycles (60 Hertz basis). If used on dc for tripping a circuit breaker, the operating time should be reduced to approximately 1 cycle in order that no appreciable time delay will be added to the operating time of the protective relay. This can be accomplished by selecting a relay which has a lower voltage rating than the control circuit. Recommended voltage ratings for one minute tripping duty are listed below.

Supply Voltage (Volts Dc)	Use Relay with Coil Rated: (Volts Dc)	Oper-Coil Current (Amps)	Target Coil Tap Value in Prot. Relay (Amps)	Time to Close N.O. Contacts at Pickup (60 Hz Basis)
24	6	5.3	2.0	Approximately one cycle
32	6	7.1	2.0	
48	12	2.7	2.0	
125	24	1.7	0.2	
250	48	0.9	0.2	

When so applied, the HFA operating coil must be opened by the breaker auxiliary switch, to prevent overheating. The increased current through the HFA operating coil will assure operation of the target on the protective relay.

High-Speed Tripping

Type HFA153K and 173K relays are designed to have a pickup time of no more than ½ cycle (60 Hertz basis). The required coil series resistor is included in the basic model number. All models have one long-wipe normally closed contact for inserting this resistor in the coil circuit once the relay is picked up.

CONTACT RATING

Contacts are electrically separate and easily reversible from normally open to normally closed or vice versa. The current-closing rating of the contacts is 30 amperes. The current-carrying rating is 12 amperes continuously or 30 amperes for 1 minute.

Contact Interrupting Ratings

Volts Dc	1 Contact (Amps)	2 Contacts in Series (Amps)	Volts Ac	1 Contact (Amps)	2 Contacts in Series (Amps)
NON-INDUCTIVE					
6 to 24	15	30	115	30	30
48	8	16	230	20	30
125	3	6	460	8	12
250	1	2	...	...	...
INDUCTIVE					
24	6.0	12	115	20	20
48	3.5	6	230	10	10
125	1.0	1.5	460	5	5
250	0.3	0.35	...	...	...

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

SELECTION GUIDE
Self and Hand Reset—Instantaneous Relays

Rating (Volts)	Dc Resistance (Ohms)	Impedance ①	Operating Time (Cycles)②	Contacts	Self-Reset Model Number③	Hand-Reset Model Number③	Approx Wt in lb (kg) Net	Ship
NON-DRAWOUT MODELS								
DIRECT CURRENT—STANDARD SPEED								
6	5.6				12HFA151A7 F or H	12HFA151B7 F or H		
12	20				A6 F or H	B6 F or H		
24	82				A5 F or H	B5 F or H		
32	145				A13 F or H	B13 F or H		
48	337				A4 F or H	B4 F or H		
			5	Table 1			5(2.3)	7(3.2)
62.5	507				A3 F or H	B3 F or H		
110	1600				A12 F or H	B12 F or H		
125	2040				A2 F or H	B2 F or H		
220	5350				A11 F or H	B11 F or H		
250	7780				A1 F or H	B1 F or H		
ALTERNATING CURRENT, 60 HERTZ								
120	13.5	446	2	Table 1	12HFA151A9 F or H	12HFA151B9 F or H	5(2.3)	7(3.2)
240	55	1810			A8 F or H	B8 F or H		
ALTERNATING CURRENT, 50 HERTZ								
120	20	540	2	Table 1	12HFA151A19 F or H	12HFA151B19 F or H	5(2.3)	7(3.2)
240	82	2160			A18 F or H	B18 F or H		
DRAWOUT MODELS—S2 Size Case								
DIRECT CURRENT—STANDARD SPEED								
6	5.6				12HFA171A7A	12HFA171B7A		
12	20				A6 A	B6 A		
24	82				A5 A	B5 A		
32	145				A13 A	B13 A		
48	337				A4 A	B4 A		
			5	Table 1			12(5.4)	18(8.2)
62.5	507				A3 A	B3 A		
110	1600				A12 A	B12 A		
125	2040				A2 A	B2 A		
220	5350				A11 A	B11 A		
250	7780				A1 A	B1 A		
ALTERNATING CURRENT, 60 HERTZ								
120	13.5	446	2	Table 1	12HFA171A9 A	12HFA171B9 A	12(5.4)	18(8.2)
240	55	1810			A8 A	B8 A		
ALTERNATING CURRENT, 50 HERTZ								
120	20	540	2	Table 1	12HFA171A19 A	12HFA171B19 A	12(5.4)	18(8.2)
240	82	2160			18A	B18 A		

HIGH-SPEED TRIPPING MODELS

Rating (Volts)	Coil Resistance (Ohms)	Resistor Ohms	Operating Time (Cycles)②	Contacts	Model Number	Approx Wt in lb (kg) Net	Ship
NON-DRAWOUT CASE MODELS③							
24	0.8	7.5			12HFA153K5 F or H		
48	2.5	30			K4 F or H		
125	20	200	0.5	Table 2	K2 F or H	6(2.7)	9(4.1)
250	82	800			K1 F or H		
DRAWOUT CASE MODELS - S2 CASE							
24	0.8	18			12HFA173K5 A		
48	2.5	75			K4 A		
125	20	500	0.5	Table 3	K2 A	12(5.4)	18(8.2)
250	82	2000			K1 A		

① Within plus or minus 10 percent.
② 60-Hertz-basis. Time for energizing operating coil to closing of normally open contacts.
③ Specify desired mounting on order. For **semiflush mounting back-connected** add letter "F" to listed model number. For example—12HFA151A2F. If for **surface mounting, front connected,** add letter "H" to listed model number, for example—12HFA151A2H.

SELECTION GUIDE (Cont'd)

Table 1

	Code Number						
	60	51	42	33	24	15	06
Position No.	Contact Arrangement						
1	≒	≒	≒	≒	≒	≒	≠
2	≒	≒	≒	≒	≠	≠	≠
3	≒	≒	≠	≠	≠	≠	≠
4	≒	≠	≠	≠	≠	≠	≠
5	≒	≒	≒	≠	≠	≠	≠
6	≒	≒	≒	≒	≒	≠	≠

≒ = Normally open contact, open when relay is de-energized.

≠ = Normally closed contact, closed when relay is de-energized.

Table 2

	Code Number		
	1	2	3
Position No.	Contact Arrangement		
1	≒	≒	≒
2	≒	≒	≒
3	≠•	≠•	≠•
4	≒	≒	≠
5	≒	≠	≠
6	≒	≒	≒

≒ = Normally open contact, open when relay is de-energized.

≠ = Normally closed contact, closed when relay is de-energized.

≠• = Long-wipe closed contact, closed when relay is de-energized and opens <u>after</u> the standard NC contact. This contact is used to insert the dropping resistor into the coil circuit.

Table 3

	Code No.
	1
Position No.	Contact Arrangement
1	≒
2	≒
3	≒
4	≠•
5	≒
6	≒

≒ = Normally open contact, open when relay is de-energized.

≠• = Long-wipe closed contact, used to insert the dropping resistor into the coil circuits.

NOTE:
If contact code is not specified on the order, ***Code 60 will be furnished.*** Relays stocked in the warehouse are stocked with contact Code 60. Conversion from normally open to normally closed or vice-versa, can be easily accomplished in the field.

ELECTRIC RESET RELAYS

Table A lists the combination of reset and mounting available.

Table B lists the voltage and frequencies of the operating and reset coils.

Table C shows the various contact configurations available.

To obtain a complete catalogue number, select the ***basic number*** from Table A; insert the ***form number*** from Table B; specify the ***contact code*** from Table C.

EXAMPLE:

Electric reset only Front connected Surface mounting	Select 12HFA154E-H from Table A
48V dc operate coil 120V 60 Hz reset coil	Select form number 44 from Table B
3 N.O. and 2 N.C. contacts	Select contact code 42 from Table C

Thus, 12HFA154E44H code 42 is the complete relay number.

Table A
SELECTION OF HFA ELECTRIC RESET MODELS

Type of Reset	Mounting	Contacts	Basic Number①	Weight lb(kg) Net	Ship
Electric and Hand Reset	Back connected semi-flush	Table C	12HFA154B-F	5(2.3)	7(3.2)
	Front connected surface mounted		A154B-H	5(2.3)	7(3.2)
	Back connected drawout case		A174B-A	12(5.4)	18(8.2)
Electric Reset Only	Back connected semi-flush	Table C	12HFA154E-F	5(2.3)	7(3.2)
	Front connected surface mounted		A154E-H	5(2.3)	7(3.2)
	Back connected drawout case		A174E-A	12(5.4)	18(8.2)

① On hand and electric reset Types HFA154B, 174B, 154E and 174E one contact is wired in series with reset coil to provide positive cut-off. Thus **five** contacts are available for external circuits.

Table B
SELECTION GUIDE—FORM NUMBERS

	Voltage and Frequency	Reset Coil Rating 110V Dc	125V Dc	220V Dc	250V Dc	120V 60 Hz	120V 50 Hz
		Form Numbers					
OPERATE COIL RATING	6V Dc	...	27	...	7	47	...
	12V Dc	...	26	...	6	46	...
	24V Dc	...	25	...	5	45	...
	32V Dc	33	...	13	...	...	53
	48V Dc	...	24	...	4	44	...
	62.5V Dc	...	23	...	3	43	...
	110V Dc	32	...	12	...	...	52
	125V Dc	...	22	...	2	42	...
	220V Dc	31	...	11	...	...	51
	250V Dc	...	21	...	1	41	...
	120V 60 Hz	...	29	...	9	49	...
	240V 60 Hz	...	28	...	8	48	...
	120V 50 Hz	39	...	19	...	...	59
	240V 50 Hz	38	...	18	...	...	58

Table C—Contact Arrangement

	Code Number 60	51	42	33	24	15
Position No.	Contact Arrangement					
1	⇌	⇌	⇌	⇌	⇌	⇍
2	⇌	⇌	⇌	⇌	⇍	⇍
3	⇌	⇌	⇍	⇍	⇍	⇍
4	⇌	⇍	⇍	⇍	⇍	⇍
5	⇌	⇌	⇌	⇍	⇍	⇍
6 ③	⇌	⇌	⇌	⇌	⇌	⇌

NOTES:

⇌ = Normally open contact, open when relay is de-energized.

⇍ = Normally closed contact, closed when relay is de-energized.

③This contact is reserved for opening the reset coil circuit to protect the intermittently rated reset coil.

If contact code is not specified on the order, ***Code 60 will be furnished.*** Relays stocked in the warehouse are stocked with contact Code 60. Conversion from normally open to normally closed or vice-versa, can be easily accomplished in the field.

OPERATING CHARACTERISTICS

Model Number	Pickup Voltage in Percent of Rating HOT	COLD	Dropout Voltage in Percent of Rating Ac	Dc	Operating Time at Rated Voltage to Close a N.O. Contact Ac	Dc	Operating Time to Open a N.O. Contact When Voltage Reduced to Zero Ac	Dc
HFA151A, -B HFA171A, -B	80 or Less, Ac or Dc	60 Dc 80 Ac or Higher	30-60	2-10	33 ms or Less	84 ms or Less	14 ms or Less	28 ms or Less
HFA153K HFA173K	8 or Less (Dc Only)	6 or Less (Dc Only)	—	2-10	9 ms or Less for Tripping Duty			9 ms or Less

For Ac and Dc Circuit Applications



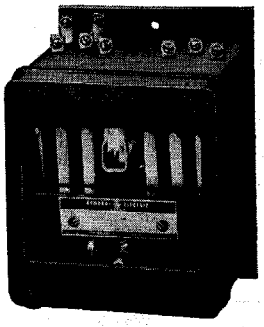
(Photo 8043394)

Fig. 1. Surface mounting (back connected) Type HFA51A



(Photo 8025537)

Fig. 2. Semi-flush (back connected) Type HFA51A-F



(Photo 8025781)

Fig. 3. Surface mounting (front connected) Type HFA51A-H



(Photo 1227763)

Fig. 4. Type HFA Multicontact relay. Drawout

APPLICATION

The type HFA relay is designed for application where a number of auxiliary functions must be performed simultaneously. Six contacts are provided. If more than six circuits are to be controlled, the coils of two or more relays may be connected in series (dc only) or in parallel.

All HFA relays have six electrically separate contact circuits adaptable for either circuit-opening or circuit-closing applications.

The HFA relays are available for front or back connection. The front connected relays are suitable for surface mounting only as shown in Figure 3.

The back connected relays are suitable for either surface mounting or semi-flush mounting: a steel flange is provided for the latter. These are shown in Figures 1 and 2.

The HFA relay is also available in an S2 type draw-out case as shown in Figure 4.

APPLICATION

Selection of Dc Relays for Tripping Duty Where Operating Coil Circuit Is Opened By An Auxiliary Switch.

The operating time of the standard HFA relay is approximately 5 cycles for the dc models (60 Hertz basis). If used on dc for tripping a circuit breaker, the operating time should be reduced to approximately 1 cycle in order that no appreciable time delay will be added to the operating time of the protective relay. This can be accomplished by selecting a relay which has a lower voltage rating than the control circuit. Recommended voltage ratings for one minute tripping duty are listed below.

Supply Voltage (Volts Dc)	Use Relay with Coil Rated: (Volts Dc)	Oper. Coil Current (Amps)	Target Coil Tap Value in Prot. Relay (Amps)	Time to Close N.O. Contacts at Pickup (60 Hz Basis)
24	6	5.3	2.0	Approximately one cycle
32	6	7.1	2.0	
48	12	2.7	2.0	
125	24	1.7	0.2	
250	48	0.9	0.2	

When so applied, the HFA operating coil must be opened by the breaker auxiliary switch to prevent overheating. The increased current through the HFA operating coil will assure operation of the target on the protective relay.

CONTACT RATING

Contacts are electrically separate and easily reversible from normally open to normally closed or vice versa. The current-closing rating of the contacts is 30 amperes. The current-carrying rating is 12 amperes continuously or 30 amperes for 1 minute.

Contact Interrupting Ratings

Volts Dc	1 Contact (Amps)	2 Contacts in Series (Amps)	Volts Ac	1 Contact (Amps)	2 Contacts in Series (Amps)
NON-INDUCTIVE					
6 to 24	15	30	115	30	30
48	8	16	230	20	30
125	3	6	460	8	12
250	1	2	...	...	...
INDUCTIVE					
24	6.0	12	115	20	20
48	3.5	6	230	10	10
125	1.0	1.5	460	5	5
250	0.3	0.35	...	...	...

STANDARD SPEED

The HFA51 and -71 relays are instantaneous, hinged armature, six contact auxiliary relays supplied in either a drawout or non-drawout case for panel mounting.

SELECTION GUIDE—Non-drawout Case

Continuous Rating, Volts	Dc Resistance, (Ohms)① at 25 C	Impedance Ohms 25 C④	Operating Time, Cycles ②	Contacts	Self-reset Model Number③	Hand-reset Model Number③	Approx Wt in lb (kg) Net	Approx Wt in lb (kg) Ship
DIRECT CURRENT								
6	5.2	....	5	Table 4	12HFA51A48	12HFA51B48	5 (2.2)	7 (3.1)
12	21	....			A47	B47		
24	82	....			A46	B46		
32	140	....			A45	B45		
48	336	....			A44	B44		
62.5	510	....			A43	B43		
125	2000	....			A42	B42		
250	8000	....			A41	B41		
ALTERNATING CURRENT, 60 HERTZ								
115	13	415	2	Table 4	12HFA51A49	12HFA51B49	5 (2.2)	7 (3.1)
208	45	1350			A50	B50		
230	52	1650			A51	B51		
460	212	6600			A52	B52		
ALTERNATING CURRENT, 50 HERTZ								
115	20	575	2	Table 4	12HFA51A54	12HFA51B54	5 (2.2)	7 (3.1)
208	52	1880			A86	B86		
230	80	2300			A55	B55		
460	325	9200			A56	B56		

SELECTION GUIDE—Drawout Case

Continuous Rating Voltage and Frequency	Dc Resistance (Ohms)① at 25 C	Impedance (Ohms) at 25 C	Contact	Model Number Self Reset	Model Number Hand Reset	Operating Time (ms)	Case Size	Approx Wt in lb (kg) Net	Approx Wt in lb (kg) Ship
6V Dc	5.2	....	Table 4	12HFA71A48A	12HFA71B48A	84	S2	12 (5.4)	18 (8.1)
12V Dc	21	....		A47A	B47A				
24V Dc	82	....		A46A	B46A				
48V Dc	336	....		A44A	B44A				
125V Dc	2000	....		A42A	B42A				
250V Dc	8000	....		A41A	B41A				
115V 60 Hz	13	415		A49A	B49A	34	S2	12 (5.4)	18 (8.1)
208V 60 Hz	45	1350		A50A	B50A				
230V 60 Hz	52	1650		A51A	B51A				
460V 60 Hz	212	6600		A52A	B52A				
115V 50 Hz	20	575		A54A	B54A	34	S2	12 (5.4)	18 (8.1)
208V 50 Hz	52	1880		A86A	B86A				
230V 50 Hz	80	2300		A55A	B55A				
460V 50 Hz	325	9200		A56A	B56A				

NOTES:

① Within plus or minus ten percent.

② On 60 Hertz basis (time from energizing operating coil to the closing of the normally open contacts).

③ Model numbers shown are for **back connected, surface mounted.**

If back connected, semi-flush mounting is desired, add suffix letter "F". Example: 12HFA51A42F.

If front connected, surface mounting is desired, add suffix letter "H". Example: 12HFA51A42H.

4 Intermittent rating.

Table 4

	Code Number						
	60	51	42	33	24	15	06
Position No.	Contact Arrangement						
1	⫩	⫩	⫩	⫩	⫩	⫩	≠
2	⫩	⫩	⫩	⫩	≠	≠	≠
3	⫩	⫩	≠	≠	≠	≠	≠
4	⫩	≠	≠	≠	≠	≠	≠
5	⫩	⫩	⫩	≠	≠	≠	≠
6	⫩	⫩	⫩	⫩	⫩	≠	≠

NOTES:

⫩ = Normally open contact, open when relay is de-energized.

≠ = Normally closed contact, closed when relay is de-energized.

If contact code is not specified on the order, ***Code 60 will be furnished.*** Relays stocked in the warehouse are stocked with contact Code 60. Conversion from normally open to normally closed or vice-versa, can be easily accomplished in the field.

TIME-DELAY APPLICATIONS

The type HFA65D relays are similar to the HFA51 relays except they have adjustable time-delay dropout.

Although the HFA65D relay has a time delay dropout adjustable from 0.25 seconds to 2.0 seconds, it is normally set for 2 seconds at the factory unless otherwise specified.

The type HFA65E relays have an adjustable time-delay pickup with a fixed time dropout of 0.25 seconds. Pickup is normally set for 0.083 seconds unless otherwise specified.

DIMENSIONS

See Section 14.

HIGH-SPEED TRIPPING

The HFA53K relays are designed to have a pickup time of 9ms (one-half cycle—60 Hertz basis). The required external resistor is included in the basic model number. Since one contact is used for the operating coil transfer circuit, only five contacts are available for external circuits.

The HFA73K is a high-speed tripping relay with a pickup time of not more than 9ms. The required series resistor is built into the relay. Since one contact is used for the operating coil transfer circuit, only five contacts are available for external circuits.

Table 5

	Code Number						
	60	51	42	33	24	15	06
Position No.	Contact Arrangement						
1	≒	≒	≒	≒	≒	≒	≠
2	≒	≒	≒	≒	≠	≠	≠
3	≒	≒	≠	≠	≠	≠	≠
4	≒	≠	≠	≠	≠	≠	≠
5	≒	≒	≒	≠	≠	≠	≠
6	≒	≒	≒	≒	≒	≠	≠

NOTES:

≒ = Normally open contact, open when relay is de-energized.

≠ = Normally closed contact, closed when relay is de-energized.

If contact code is not specified on the order, ***Code 60 will be furnished.*** Relays stocked in the warehouse are stocked with contact Code 60. Conversion from normally open to normally closed or vice-versa, can be easily accomplished in the field.

SELECTION GUIDE

Time-delay Relays with Residual-gap Adjustment

Rating (Volts)	Resistance Ohms 25C ①	Contacts	Adjustable Time-delay Dropout Model No.③	Time Delay Dropout (Seconds)	Adjustable Time-Pick-up Model No.③	Time (Seconds)	Approx Wt in lb (kg) Net	Ship
DIRECT CURRENT—SURFACE MOUNTED MODELS								
12	11.7	Table 5	12HFA65D67	0.25 to 2	12HFA65E67	0.067 to 0.10	7 (3.1)	10 (4.5)
24	48		D66		E66			
32	77		D65		E65			
48	187		D64		E64			
62.5	308		D63		E63			
125	1230		D62		E62			
250	4950		D61		E61			
ALTERNATING CURRENT—25/5000 HERTZ—Necessary Rectifier Included								
120	790	Table 5	12HFA65D84	0.25 to 2	12HFA65E84	0.067 to 0.10	8 (3.6)	12 (5.4)
208	3580		D76		E76			
230	3580		D77		E77			

SELECTION GUIDE—Non-drawout Case

Rating Volts Dc	Coil Resistance Ohms, 25 C①	Resistor Ohms	Operating Time (Cycles) ②	Contacts	Model Number ③	Approx Wt in lb (kg) Net	Ship
48	2	30	0.5	Table 6	12HFA53K95	6(2.7)	9(4)
125	21	200			K91		
250	82	800			K92		
125④	13.5	10	0.5	Table 6	12HFA53K93	6(2.7)	9(4)
250④	13.5	30			K94		

SELECTION GUIDE—Drawout Case

Continuous Rating (Volts Dc)	Dc Coil Resistance Ohms at 25 C	Internal Series Resistance Ohms	Operating Time	Contacts	Model Number	Case Size	Approx Wt in lb (kg) Net	Ship
48	2.9	75	9ms	Table 7	12HFA73K3A	S2	12(5.4)	18(8.1)
125	21.0	500			1A			
250	82.0	2000			2A			

NOTES:

① Within plus or minus ten percent.

② On 60 Hertz basis (time from energizing operating coil to the closing of the normally open contacts).

③ Model numbers shown are for **back connected, surface mounted.**
If **back connected, semi-flush mounting** is desired, add suffix letter "F". Example: 12HFA51A42F.
If **front connected, surface mounting** is desired, add suffix letter "H". Example: 12HFA51A42H.

④ Intermittent rating.

Table 6

	Code Number			
	1	2	3	5
Position No.	Contact Arrangement			
1	≒	≒	≒	≒
2	≒	≒	≒	≠
3	≠•	≠•	≠•	≠•
4	≒	≒	≠	≠
5	≒	≠	≠	≠
6	≒	≒	≒	≒

≠• = Long-wipe closed contact, closed when relay is de-energized and opens after the standard NC contact. This contact is used to insert the dropping resistor into the coil circuit.

Table 7

	Code No. 1
Position No.	Contact Arrangement
1	≒
2	≒
3	≒
4	≠•
5	≒
6	≒

≠• = Long-wipe closed contact, used to insert the dropping resistor into the coil circuits.

ELECTRIC RESET RELAYS

Table D lists the combination of reset and mounting available.

Table E Lists the voltage and frequencies of the operating and reset coils.

Table F and G (below) show the various contact configurations available.

To obtain a complete catalog number, select the **basic number** from Table D; insert the **form number** from Table E; specify the **contact code** from either Table F or Table G.

EXAMPLE:

Electric reset only Front connected Surface mounting Reset coil cutoff contact	Select 12HFA54E-H from Table D
48V dc operate coil 115V 60 Hz reset coil	Select form number 245 from Table E
3 N.O. and 2 N.C. contacts	Select contact code 42 from Table F

Thus, 12HFA54E245H code 42 is the complete relay number.

SELECTION GUIDE

Table D—Basic Number

Type of Reset	Mounting	Basic Number	Contact	Basic Number	Contact	Approx Wt in lb (kg) Net	Ship
Hand and Electric Reset	Back-connected Surface mounting	12HFA54B-	Table F	12HFA54H-	Table G	5 (2.2)	7 (3.1)
	Back-connected Semi-flush mounting	12HFA54B-F		12HFA54H-F			
	Front-connected Surface mounting	12HFA54B-H		12HFA54H-H			
	Back-connected Drawout case	12HFA74B-A		12HFA74H-A		12 (5.4)	18 (8.1)
Hand and Electric Reset with Mechanical Target	Back-connected Surface mounting	12HFA54C-		12HFA54J-		5 (2.2)	7 (3.1)
	Back-connected Semi-flush mounting	12HFA54C-F		12HFA54J-F			
	Front-connected Surface mounting	12HFA54C-H		12HFA54J-H			
Electric Reset Only	Back-connected Surface mounting	12HFA54E-		12HFA54L-			
	Back-connected Semi-flush mounting	12HFA54E-F		12HFA54L-F			
	Front-connected Surface mounting	12HFA54E-H		12HFA54L-H			
	Back-connected Drawout case	12HFA74E-A		12HFA74L-A		12 (5.4)	12 (8.1)

Table E—Form Numbers

	Voltage and Frequency	Reset Coil Rating 48V Dc	125V Dc	250V Dc	115V 60 Hz	230V 60 Hz
		Form Numbers				
Operating Coil Rating	12V Dc	122	182	212	242	272
	24V Dc	123	183	213	243	273
	48V Dc	125	185	215	245	275
	125V Dc	127	187	217	247	277
	250V Dc	128	188	218	248	278
	115V 60 Hz	129	189	219	249	279
	230V 60 Hz	130	190	220	250	280

Table G

	Code Number 60	51	42	33	24	15	06
Position No.	Contact Arrangement						
1	⫩	⫩	⫩	⫩	⫩	⫩	≠
2	⫩	⫩	⫩	⫩	≠	≠	≠
3	⫩	⫩	≠	≠	≠	≠	≠
4	⫩	≠	≠	≠	≠	≠	≠
5	⫩	⫩	⫩	≠	≠	≠	≠
6	⫩	⫩	⫩	⫩	⫩	≠	≠

Table F

	Code Number 60	51	42	33	24	15
Position No.	Contact Arrangement					
1	⫩	⫩	⫩	⫩	⫩	≠
2	⫩	⫩	⫩	⫩	≠	≠
3	⫩	⫩	≠	≠	≠	≠
4	⫩	≠	≠	≠	≠	≠
5	⫩	⫩	⫩	≠	≠	≠
6 ③	⫩	⫩	⫩	⫩	⫩	⫩

③ This contact is reserved for opening the reset coil circuit to protect the intermittently rated reset coil.

NOTE for F and G:

⫩ = Normally open contact, open when relay is de-energized.

≠ = Normally closed contact, closed when relay is de-energized.

If contact code is not specified on the order, ***Code 60 will be furnished.*** Relays stocked in the warehouse are stocked with contact Code 60. Conversion from normally open to normally closed or vice-versa, can be easily accomplished in the field.

OPERATING CHARACTERISTICS

Model Number	Pickup Voltage in Percent of Rating		Dropout Voltage in Percent of Rating		Operating Time at Rated Voltage to Close a N.O. Contact		Operating Time to Open a N.O. Contact When Voltage Reduced from Rated to Zero	
	HOT	COLD	Ac	Dc	Ac	Dc	Ac	Dc
HFA51A, -B HFA54B, -C, -E, -H, -J, -L HFA71A, -B HFA74B, -E, -H, -L	80 or Less, Ac or Dc	60 or Less, Dc	30-60	2-10	33 ms or Less	84 ms or Less	14 ms or Less	28 ms or Less
HFA53K HFA73K	80 or Less (Dc Only)	60 or Less (Dc Only)	—	2-10	9 ms or Less for Tripping Duty			9 ms or Less
HFA65D	①	35-80 Ac 30-60 Dc	①	①			Adjustable 250 to 2000 ms—Fact. Set at 2000 ms	
HFA65E		①			Adjustable 67-100 ms—Fact. Set at 83 ms		250 ms	

① These relays are adjusted to give the proper time delays at rated voltage. Since these adjustments affect the pickup voltage point, it is not possible to accurately predict the pickup voltage.

Conversion Kit

Type HFA to Type HFA100 Century Series Relays

GE Protective Relays

To Retrofit Previous Design HFA Auxiliary Relays

DESCRIPTION

GE Century Series Conversion Kits includes all the parts required to retrofit Type HFA auxiliary relays with the longer life Century Series operating coil. This coil design is the result of a successful program aimed at developing auxiliary relay coils with a four-fold increase in service life.

The conversion kit for Type HFA auxiliary relays consists of the appropriate Century Series coil mounted on a laminated core subassembly, a green nameplate with the corresponding Century Series relay model number and a set of simple instructions for conversion in the field. The coil and core are furnished as a subassembly to make removal and replacement of the shading ring unnecessary.

LONG LIFE COIL DESIGN

The basic design features of HFA Century Series coils are as follows:

Spool—the spool on which this coil is wound is made of high thermal strength, glass-filled polymer to obtain long life at elevated temperatures. This material shows no signs of cracking or brittleness under accelerated life testing.

Wire Insulation—the wire insulation is a polyamide-imide wire coating (180 C rating) which retains insulation integrity and mechanical strength at continuous elevated temperatures and which is also non-hydroscopic and fungus resistant. Tefzel insulation is used where required, such as on leads.

Impregnation—Polybutadiene solventless impregnant.

Process

The polyamide-imide insulated coils, wound on high-temperature spools, are prebaked to drive off all volatile materials, vacuum-pressure impregnated with the solventless varnish, and then post-baked. The impregnation material is also non-hydroscopic and has temperature expansion coefficients compatible with the spool and with the wire, so that stresses do not develop under temperature cycling.

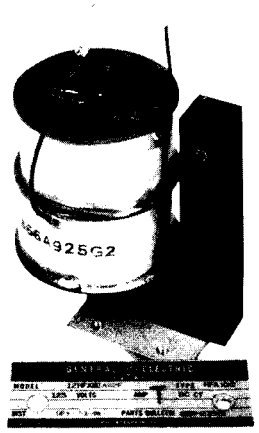
Nameplates for Century Series Conversion Kits are green to provide easy visual differentiation from standard life relays.

Accelerated life tests—conducted at elevated temperature and maximum voltage—have established a projected service life of 40 years to 1 percent failure (that is, when 1 percent of all such relays have failed) at 55 C and 110 percent rated voltage.

APPLICATION

Century Series Conversion Kits make it possible to upgrade the reliability of HFA relays already installed in the field. They offer potential savings in maintenance costs and downtimes—particularly in hot or damp locations, or for continuously energized applications.

Conversion kits are available for HFA relay models and operating coil voltage ratings corresponding to those in the Selection Guide table below.



(Photo 8043156)

Fig. 1.

SELECTION GUIDE—HFA Kits①

Present Relay Models	Coil Rating—Volts			Conversion Kit Catalog Number
	Continuous		Intermittant	
	Dc	Ac	Dc②	
HFA51A, B HFA53K HFA54B, E HFA71A, B HFA73K HFA74B, E	6			0257A9680G8
	12		125	G7
	24		250	G6
	32			G5
	48			G4
	62.5			G3
	110			G20
	125			G2
	220			G21
	250			G1
		120 60 Hz		0257A9680G18
		240 60 Hz		G54
		120 50 Hz		0257A9680G7
		240 50 Hz		G6
			24	0257A9680G59
			48	G25

①Ordering Instructions

The order must include the following:

1. Model number of conversion kit
2. Model number of present relay
3. Coil voltage of present relay

Note: Without the above information, the nameplate included with the kit cannot be properly stamped.

② For fast pickup HFA Models HFA53K(-)F and HFA73K(-)F.

6

HGA100

Hinged-armature Auxiliary Relays

GE Protective Relays

To Perform Auxiliary Functions in Ac and Dc Circuits

DESCRIPTION

Type HGA Century Series auxiliary relays are designed to provide additional contacts, higher contact carrying and interrupting ratings, timing, interlocking, electrical separation, or other auxiliary functions.

The Century Series coil design provides longer operating life than previous designs as a result of changes in the entire coil insulation system.

Where more than two circuits are to be controlled, the coils of two or more relays may be connected either in parallel on ac or in series or parallel on dc to obtain the desired results.

The contact arrangement for each relay (or unit) is double-pole, double-throw (2 normally open, 2 normally closed).

LONG-LIFE COIL DESIGN

Basic design features of HGA Century Series coils are as follows:

Spool—the spool on which the coil is wound is made of high thermal strength, glass-filled polymer to obtain long life at elevated temperatures. This material shows no signs of cracking or brittleness under accelerated life testing.

Wire Insulation—the wire insulation is a polyamide-imide wire coating (180 C rating) which retains insulation integrity and mechanical strength at continuous elevated temperatures and which is also non-hydroscopic and fungus resistant. Tefzel insulation is used where required, such as on leads.

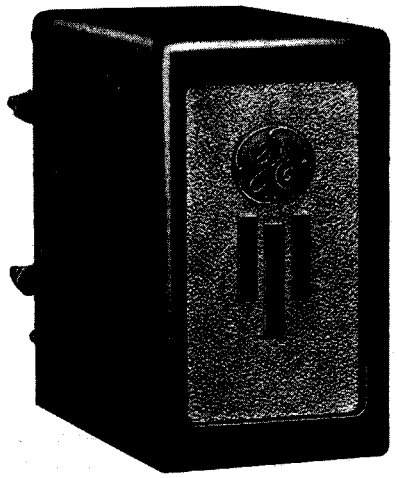
Impregnation—Polybutadiene solventless impregnant.

Process

The polyamide-imide insulated coils, wound on high-temperature spools, are prebaked to drive off all volatile materials, vacuum-pressure impregnated with the solventless varnish, and then post-baked. The impregnation material is also non-hydroscopic and has temperature expansion coefficients compatible with the spool and with the wire, so that stresses do not develop under temperature cycling.

Nameplates for Century Series relays are green to provide for easy visual differentiation from standard life relays.

Accelerated life tests—conducted at elevated temperature and maximum voltage—have established a projected service life of 40 years to 1 percent failure (that is when 1 percent of all such relays have failed) at 55 C and 110 percent rated voltage. Under nominal conditions—that is, at an ambient-temperature averaging 20 C and at 100 percent voltage—that translates to a median life of 100 years (when 50 percent of all such relays could be expected to have failed) even for ac coils continuously energized.



(Photo 851505)

Fig. 1. Type HGA111A back-connected relay with cover

CONTACT RATINGS

The current-closing rating of the contacts is 30 amperes. The current-carrying rating is 12 amperes continuously or 30 amperes for one minute.

The interrupting ratings for the various voltages are as follows:

Contact-circuit Volts		Single Break	Double Break
Ac	Dc		
NONINDUCTIVE CIRCUITS			
...	6-32	15	30
...	48	8	16
...	125	2	3
...	250	0.3	0.4
115	...	30	30
230	...	20	30
INDUCTIVE CIRCUITS			
...	6-32	5	10
...	48	3	6
...	125	1	1.5
...	250	0.25	0.3
115	...	10	20
230	...	6	10

APPLICATION

Standard Pickup: the HGA111 is the standard auxiliary relay which is instantaneous in operation and is used for auxiliary functions where intentional delays of over 1¼ to 3 cycles are not required and where standard pickup values, as listed in the table, are satisfactory.

RELAY CHARACTERISTICS

Voltage or Current Pickup Values. The values listed in the table below apply as indicated:

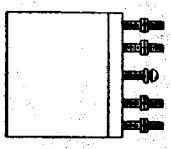
Relay Types	Percentage of Rated Volts or Amperes		
	Pickup Value Ac/Dc Hot Coil	Dropout Value	
		Ac	Dc
HGA111	80%	40 to 50%	2 to 10%

FIELD CONVERSION KIT

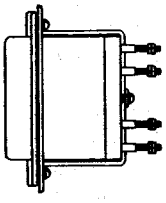
Kits are available with all parts required for retrofitting type HGA relays now in service to achieve increased service life. See page 8-24.

REFERENCES:

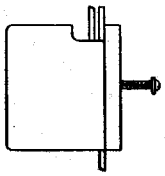
Dimensions ..... Section 16
How to Order ..... Section 1
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Target and Contact Data ..... Section 16
Relay Standards ..... Section 16



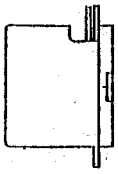
BC surface mounting with cover



BC semi-flush mounting with cover



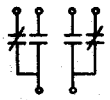
FC surface mounting with cover



FC surface mounting with cover with provisions for front mounting

SELECTION GUIDE

Type HGA 100 Standard Pickup

Coil Rating (Volts)	Dc Res Ohms at 25 C ①	Ac Ohms ②	Contact	Pickup Time (Cycles)	Model Number: Surface Mounted Back Connected with Studs and Solid Cover	Model Number: Semi-flush Mounted Back Connected with Studs and Cover with Glass Window	Model Number: Surface Mounted Front Connected with Solid Cover	Model Number: Surface Mounted Front Connected with Solid Cover and Provision for Front Mounting	Approx Wt in lb (kg) Net	Approx Wt in lb (kg) Ship.
DIRECT CURRENT										
6	11		2 N.O. 2 N.C. 	Approx 2	12HGA111A7	12HGA111A7F	12HGA111J7	12HGA111S7	2(0.9)	3(1.4)
12	41				A6	A6F	J6	S6		
24	160				A5	A5F	J5	S5		
32	270				A13	A13F	J13	S13		
48	585				A4	A4F	J4	S4		
62.5	1029				A3	A3F	J3	S3		
110	3035				A12	A12F	J12	S12		
125	3850				A2	A2F	J2	S2		
250	15320				A1	A1F	J1	S1		
ALTERNATING CURRENT—60 HERTZ										
120	99	915	Same as Dc	Approx 2	12HGA111A9	12HGA111A9F	12HGA111J9	12HGA111S9	2(0.9)	3(1.4)
240	372	3590			A8	A8F	J8	S8		
ALTERNATING CURRENT—50 HERTZ										
120	136	985	Same as Dc	Approx 2	12HGA111A19	12HGA111A19F	12HGA111J19	12HGA111S19	2(0.9)	3(1.4)
240	567	3940			A18	A18F	J18	S18		

① Within plus or minus 10 percent.

② The ac impedence for the standard relay with armature in the dropped position is 1/2 of listed value.

HGA

Hinged-armature Auxiliary Relays

GE Protective Relays

For the Performance of Auxiliary Functions in Ac and Dc Circuits

APPLICATIONS

The Type HGA hinged armature auxiliary relays are designed to provide additional contacts, higher contact carrying and interrupting ratings, timing, interlocking, electrical separation, or other auxiliary functions.

Where more than two circuits are to be controlled, the coils of two or more relays may be connected either in parallel on ac or in series or parallel on dc to obtain the desired results.

GENERAL-PURPOSE RELAYS

Standard Pickup: The HGA11 is the standard auxiliary relay which is instantaneous in operation and is used for auxiliary functions where intentional delays of over 1¼ to 2 cycles are not required and where standard pickup values, as listed in the table, are satisfactory.

The contact arrangement for each relay (or unit) is double-pole, double-throw (2 normally open, 2 normally closed).

Low Pick-up: The HGA14 relay has been designed with a shorter armature gap which is obtained by the setting of an adjustable back contact. This construction allows a lower pickup value than normal and a faster pickup time. Also relays are available for tripping duty and target operation with pickup times of ½ cycle on a 60-cycle basis, and are intermittently rated.

The contact arrangement is one single-pole, double-throw contact and one normally open contact for each relay (or unit). The second normally closed contact is not used with the low pickup setting. This second contact can be used if the wipe is restored to normal and the control spring tension increased thus raising the pickup toward the 80 percent (60 percent dc cold) level which would apply with standard gap relays.

AC UNDERVOLTAGE

Low Dropout. The Type HGA14BH(-)A relay is a three-phase residual voltage relay with low dropout. A primary application is as on automatic throwover schemes where induction motors are the principal load.

TIME-DELAY RELAYS

Fixed-time Dropout. The HGA17 is designed to provide a time-delay dropout of approximately 15 cycles (60-cycle basis). The delay is obtained by momentarily sustaining the magnetic flux at the relay pole face by means of induced currents in a copper ring which acts as a shorted one-turn coil. A small delay in pickup time is also obtained since the induced currents also tend to retard the buildup of the relay magnetic field. Operating times are measured at or from rated voltage or amperes for pickup and dropout times respectively.

Adjustable-time Pickup: The HGA14D has a resistor-capacitor timing circuit with the resistor being adjustable to vary the charging time of the capacitor which is connected across the relay operating coil.

Contact arrangement for the fixed-time dropout (HGA17) is one single-pole, double-throw contact and one normally open contact per relay (or unit).

RELAY CHARACTERISTICS

Voltage or Current Pickup Values. The values listed in the table below apply as indicated for all relays.

Relay	Pickup Classification	Percentage of Rated Volts or Amps			
		Pickup Value		Dropout Value	
		Ac	Dc	Ac	Dc
HGA11	Standard	80%	80%	40-50%	2-10%
HGA14	Low	40%	30%	20-30%	2-10%
HGA17A,B,C	Time	30-40%	20-30%	2-10%	2-10%
HGA17D,H	Time	80% Max.	60% Max.	5-15%	2-10%

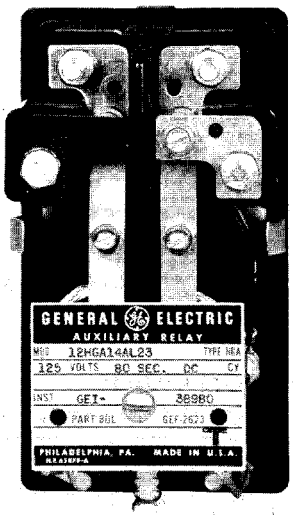
CONTACT RATINGS

Standard Pickup Relays—Type HGA11

The current-closing rating of the contacts is 30 amperes. The current-carrying rating is 12 amperes continuously or 30 amperes for one minute.

Interrupting Ratings of Contacts in Amperes

Contact-circuit Volts		Single Break	Double Break
Ac	Dc		
NONINDUCTIVE CIRCUITS			
...	6-32	15	30
...	48	8	16
...	125	2	3
...	250	0.3	0.4
115	...	30	30
230	...	20	30
INDUCTIVE CIRCUITS			
...	6-32	5	10
...	48	3	6
...	125	1	1.5
...	250	0.25	0.3
115	...	10	20
230	...	6	10



(Photo 8043229)

Fig. 1. Type HGA14AL connected relay with cover

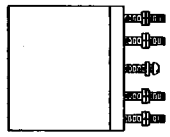
Low Pickup Relays—Types HGA14, HGA17

The current closing ratings of the contacts is 30 amperes. The current carrying rating is 12 amperes continuously or 30 amperes for one minute. The interrupting ratings (noninductive circuits) for the various voltages are as follows:

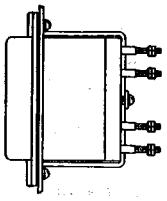
Contact-circuit Volts		Single Break
Ac	Dc	
NONINDUCTIVE CIRCUITS		
...	6-32	10
...	48	5
...	125	0.6
...	250	0.25
115	...	20
230	...	10
INDUCTIVE CIRCUITS		
...	6-32	5
...	48	3
...	125	0.5
...	250	0.2
115	...	10
230	...	5

REFERENCES:

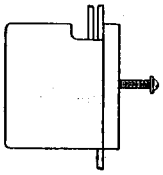
Dimensions ..... Section 16
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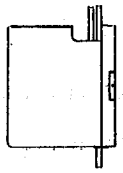
BC surface mounting with cover



BC semi-flush mounting with cover



FC surface mounting with cover



FC surface mounting with cover with provisions for front mounting

6

SELECTION GUIDE—MOLDED CASE RELAYS

Coil Rating (Volts)	Dc Res Ohms at 25 C ①	Ac Ohms ②	Contact	Pickup Time (Cycles)	Model Number: Surface Mounted Back Connected with Studs and Solid Cover③	Model Number: Semi-flush Mounted Back Connected with Studs and Cover with Glass Window	Model Number: Surface Mounted Front Connected with Solid Cover ③	Model Number: Surface Mounted Front Connected with Solid Cover and Provision for Front Mounting	Approx Wt in lb (kg) Net	Approx Wt in lb (kg) Ship.
General-Purpose Relays										
TYPE HGA STANDARD PICKUP										
DIRECT CURRENT										
6	10		2 N.O. 2 N.C.	Approx 2	12HGA11A58	12HGA11A58F	12HGA11J58	12HGA11S58	2 (0.9)	3 (1.4)
12	40				A57	A57F	J57	S57		
24	160				A56	A56F	J56	S56		
32	250				A55	A55F	J55	S55		
48	512				A54	A54F	J54	S54		
62.5	830				A53	A53F	J53	S53		
110	2460				A60	A60F	J60	S60		
125	3650				A52	A52F	J52	S52		
220	9600				A59	A59F	J59	S59		
250	15500				A51	A51F	J51	S51		
ALTERNATING CURRENT—60 HERTZ										
115	90.5	1000	Same as Dc	Approx 2	12HGA11A70	12HGA11A70F	12HGA11J70	12HGA11S70	2 (0.9)	3 (1.4)
230	367	3960			A71	A71F	J71	S71		
ALTERNATING CURRENT—50 HERTZ										
115	98.5	830	Same as Dc	Approx 2	12HGA11A74	12HGA11A74F	12HGA11J74	12HGA11S74	2 (0.9)	3 (1.4)
230	512	4270			A75	A75F	J75	S75		
TYPE HGA LOW PICKUP (40% of Rating for AC or 30% of Rating for DC)										
DIRECT CURRENT										
6	10		2 N.O. 1 N.C.	Approx 1	12HGA14A58	12HGA14A58F	12HGA14AF58	—	2 (0.9)	3 (1.4)
12	40				A57	A57F	AF57	—		
24	160				A56	A56F	AF56	—		
32	250				A55	A55F	AF55	—		
48	512				A54	A54F	AF54	—		
62.5	830				A53	A53F	AF53	—		
110	2460				A60	A60F	AF60	—		
125	3650				A52	A52F	AF52	—		
220	9600				A59	A59F	AF59	—		
250	15500				A51	A51F	AF51	—		
ALTERNATING CURRENT—60 HERTZ										
115	90.5	1000	Same as Dc	Approx 1	12HGA14A70	12HGA14A70F	12HGA14AF70	—	2 (0.9)	3 (1.4)
230	376	3960			A71	A71F	AF71	—		
ALTERNATING CURRENT—50 HERTZ										
115	98.5	830	Same as Dc	Approx 2	12HGA14A74	12HGA14A74F	12HGA14AF74	—	2 (0.9)	3 (1.4)
230	512	4270			A75	A75F	AF75	—		

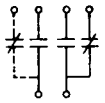
① Within plus or minus 10 percent.

(Continued on page 8-22)

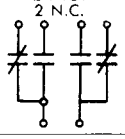
② The ac impedence for the standard gap relays with armature in dropped position is 1/2 of listed value.

③ To obtain glass in cover of HGA relays, add suffix "G" to Model. Example: Model 12HGA11A58G.

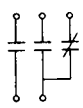
MOLDED CASE RELAYS (Cont'd)

Coil Rating (Volts)	Dc Res Ohms at 25 C ①	Ac Ohms ②	Contact	Pickup Time (Cycles)	Model Number: Surface Back Connected with Cover and Studs③	Model Number: Semi-flush Back Connected with with cover	Model Number: Front Connected with Cover (No Studs)③	Approx Wt in lb (kg): Net	Approx Wt in lb (kg): Ship.
TIME DELAY—Fixed Time (15 Cycles Dropout) (Copper Slugged Coil)									
DIRECT CURRENT									
12	24.5		2 N.O. 1 N.C. 	Approx 2	12HGA17A57	12HGA17A57F	12HGA17C57	2 (0.9)	3 (1.4)
24	98				A56	A56F	C56		
32	153				A55	A55F	C55		
48	375				A54	A54F	C54		
62.5	585				A53	A53F	C53		
110	1700				A70	A70F	C70		
125	2280				A52	A52F	C52		
220	10300				A68	A68F	C68		
250	10300				A51	A51F	C51		
ALTERNATING CURRENT—50/60 HERTZ									
115	1700		Same as Dc	Approx 2	12HGA17A63④	12HGA17A63F④	12HGA17C63④	4 (1.8)	5 (2.3)
230	1700				A64④	A64F④	C64④		

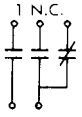
FIXED TIME PICKUP WITH APPROX 15-CYCLE DELAY ON DROPOUT

Coil Rating (Volts)	Dc Res Ohms at 25 C ①	Ac Ohms ②	Pickup Volts	Contact	Pickup Time (Cycles)	Model Number: Surface Back Connected with Cover and Studs③	Model Number: Semi-flush Back Connected with cover	Model Number: Front-Connected with Cover (No Studs)③	Approx Wt in lb (kg): Net	Approx Wt in lb (kg): Ship.
DIRECT CURRENT										
12	24.4		60%	2 N.O. 2 N.C. 	3.5	12HGA17H57	12HGA17H57F	12HGA17D57	2 (0.9)	3 (1.4)
24	98					H56	H56F	D56		
32	153					H55	H55F	D55		
48	375					H54	H54F	D54		
62.5	585					H53	H53F	D53		
110	1700					H70	H70F	D70		
125	2280					H52	H52F	D52		
220	10300					H68	H68F	D68		
250	10300					H51	H51F	D51		
ALTERNATING CURRENT 50/60 HERTZ										
115	1700		80%	Same as Dc	3.5	12HGA17H63④	12HGA17H63F④	12HGA17D63④	4 (1.8)	5 (2.3)
230	1700					H64④	H64F④	D64④		

MOLDED CASE TRIPPING RELAYS—1/2 Cycle or Less (For tripping two breakers)

Volts Dc Intermittent	Pickup Volts	Contact	Back Connected with Cover③: ⑥ For 3—2-amp Targets	⑥ For 3—1-amp Targets	⑥ For 3—0.6-amp Targets	⑥ For 3—0.2-amp Targets	For Carrier GCX or GCY	Approx Wt lb (kg): Net	Approx Wt lb (kg): Ship
24			12HGA14AM5	12HGA14AM10	12HGA14AM15	12HGA14AM20	.....		
32			AM4	AM9	AM14	AM19	.....		
48		2 N.O. 1 N.C.	AM3	AM8	AM13	AM18	12HGA14AM28		
125			AM2	AM7	AM12	AM17	AM26		
250			AM1	AM6	AM11	AM16	AM25		
	80% or Less		Front Connected with Cover③					2 (0.9)	3 (1.4)
24			12HGA14AL5	12HGA14AL10	12HGA14AL15	12HGA14AL20	12HGA14AL29		
32			.....	AL9	.....	AL19	.....		
48			AL3	AL8	AL13	AL18	AL28		
125			AL2	AL7	AL12	AL17	AL26		
250			AL1	AL6	AL11	AL16	AL25		

MOLDED CASE—Adjustable Time Delay on Pickup

Volts Dc	Pickup Volts	Contact	Pickup Time (Cycles)	Back Conn.⑤ with Cover	Approx Wt lb: Net	Approx Wt lb: Ship.
48	15 or Less	2 N.O. 1 N.C. 	2- 4	12HGA14D1		
125	61-67		2- 6	D2		
125	30-35		1- 3	D3	8 (3.6)	12 (5.4)
125	65-70		4-24	D7		
125	65-70		2-12	D6		
250	65-70		1- 6	D4		
250	65-70		1-12	D5		

① Within plus or minus 10 percent.
② The ac impedance for the standard gap relays with armature in dropped position is 1/2 of listed value.
③ To obtain glass in cover of HGA relays add suffix "G" to Model. Example: Model 12HGA17H57G.
④ External rectifier and resistor included as required.
⑤ External capacitor(s) included as required.
⑥ Although the relays are voltage operated, these target currents are shown only as an example to aid in selecting the proper relay.

Note: Any back-connected HGA Relay with molded case can be furnished for semi-flush mounting. Add "F" to regular model number when ordering. Example: **12HGA11A52F.** Cover will have glass windows.

SELECTION GUIDE—Drawout Case Relays

Coil Rating (Volts)	Each Unit: Dc Ohms at 25C①	Each Unit: Ac Impedance	Each Unit: Contact	Pickup Time (Cycles)	Model Number: Standard Pickup	Model Number: Low Pickup	Case Size	Approx Wt in lb (kg): Net	Approx Wt in lb (kg): Ship.
General-Purpose									
SINGLE UNIT—STANDARD OR LOW PICKUP - DC									
6 12 24 48 62.5 125 220 250	10 40 160 512 830 3650 9600 15500		②	HGA11 Approx 2 HGA14 Approx 1	12HGA11R15A R16A R1A R2A R3A R4A R5A	12HGA14AH15A AH1A AH2A AH3A AH4A AH16A AH5A	S1	7 (3.2)	9 (4.1)
ALTERNATING 60 HERTZ									
115 230	90 376		②	Same as Dc	12HGA11R6A R9A	12HGA14AH6A AH9A	S1	7 (3.2)	9 (4.1)
ALTERNATING 50 HERTZ									
115 230	99 512		②	Same as Dc	12HGA11R7A R10A	12HGA14AH7A AH10A	S1	7 (3.2)	9 (4.1)
DOUBLE UNIT—STANDARD OR LOW PICKUP - DC									
6 12 24 48 62.5 125 250	10 40 160 512 830 3650 15500		②	HGA11 Approx 2 HGA14 Approx 1	12HGA11N342A N373A N1A N32A N63A N94A N125A	..... 12HGA14AB342A AB1A AB32A AB63A AB94A AB125A	S2	9 (4.1)	11 (5)
ALTERNATING 60 HERTZ									
115 230	90 376		②	Same as Dc	12HGA11N156A N249A	12HGA14AB156A AB249A	S2	9 (4.1)	11 (5)
ALTERNATING 50 HERTZ									
115 230	99 512		②	Same as Dc	12HGA11N187A N280A	12HGA14AB187A AB280A	S2	9 (4.1)	11 (5)
Time Delay									
SINGLE UNIT—FIXED TIME (15 Cycles Minimum Dropout) (Copper Slugged Coil) - DC									
12 24 32 48 62.5 125 250	25 98 153 375 585 2280 10300		②	2	....	12HGA17J1A J2A J3A J4A J5A J6A J7A	S1	7 (3.2)	9 (4.1)
ALTERNATING 50/60 HERTZ									
115	1700		②	Approx 2	.....	12HGA17J10A	S1	7 (3.2)	9 (4.1)

SINGLE-UNIT SHORT GAP WITH RECTIFIERS

60 Cycles—Low Burden—For Use with Bushing Potential Device

Volts Ac Single-phase and Three-phase	3 Phase Basis Dropout③ (Volts) Min.	3 Phase Basis Dropout③ (Volts) Max.	Burden VA	Contact	Model Number	Case Size	Approx Wt in lb (kg): Net	Approx Wt in lb (kg): Ship.
120 208	18 30	50 90	1.2		12HGA14BH1A 2A	S1	9 (4.1)	12 (5.4)

① Within plus or minus 10 percent.
② HGA11 (standard pickup) double pole, double throw {2 normally open / 2 normally closed} per unit.
HGA14 (low pickup) one single pole, double throw.
HGA17 (time delay) plus one normally open contact per unit.
③ In single phase applications multiply these values by 1.33.

Conversion Kit

Type HGA to Type HGA100 Century Series Relays

GE Protective Relays

To Retrofit Previous Design HGA Auxiliary Relays

DESCRIPTION

GE Century Series Conversion Kits include all the parts required to retrofit Type HGA auxiliary relays with the longer life Century Series operating coil. This coil design is the result of a successful program aimed at developing auxiliary relay coils with a four-fold increase in service life.

The HGA Relay Conversion Kit consists of the appropriate Century Series coil, a green nameplate with the corresponding Century Series HGA model number and a set of simple instructions for conversion in the field.

APPLICATION

Century Series Conversion Kits make it possible to upgrade the reliabilty of HGA relays already installed in the field. They offer potential savings in maintenance costs and downtimes . . . particularly in hot or damp locations, or for continuously energized applications.

Conversion kits are available for HGA relay models and operating coil voltage ratings corresponding to those in the Selection Guide table below.

LONG-LIFE COIL DESIGN

Basic design features of HGA Centurey Series coils are as follows:

Spool—the spool on which the coil is wound is made of high thermal strength, glass-filled polymer to obtain long life at elevated temperatures. This material shows no signs of cracking or brittleness under accelerated life testing.

Wire Insulation—the wire insulation is a polyamide-imide wire coating (180 C rating) which retains insulation integrity and mechanical strength at continuous elevated temperatures and which is also non-hydroscopic and fungus resistant. Tefzel insulation is used where required, such as on leads.

Impregnation—Polybutadiene solventless impregnant.

Process

The polyamide-imide insulated coils, wound on high-temperature spools, are prebaked to drive off all volatile materials, vacuum-pressure impregnated with the solventless varnish, and then post-baked. The impregnation material is also non-hydroscopic and has temperature expansion coefficients compatible with the spool and with the wire, so that stresses do not develop under temperature cycling.

Nameplates for Century Series Conversion Kits are green to provide easy visual differentiation from standard life relays.

Accelerated life tests—conducted at elevated temperature and maximum voltage — have established a projected service life of 40 years to 1 percent failure (that is, when 1 percent of all such relays have failed) at 55 C and 110 percent rated voltage. Under nominal conditions—that is, at an ambient-temperature averaging 20 C and at 100 percent voltage—that translates to a median life of 100 years (when 50 percent of all such relays could be expected to have failed) even for ac coils continuously energized.

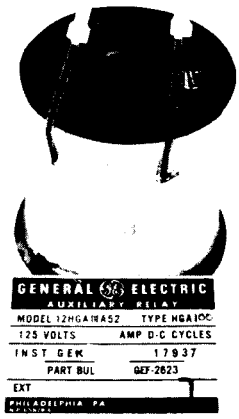


Fig. 1

SELECTION GUIDE—HGA Kits

Present Relay Models	HGA Coil Rating Volts Dc	Ac	Conversion Kit Catalog No.
HGA11A, J	6		0257A9681G15
	12		G13
	24		G10
	32		G9
	48		G7
	62.5		G6
	110		G4
	125		G3
	220		G2
	250		G1
		120-60 Hz	0257A9681G46
		240-60 Hz	G99
		120-50 Hz	0257A9681G101
		240-50 Hz	G100

NOTE: To convert from Ac to Dc or vice-versa requires a different pole piece.

ORDERING INSTRUCTIONS

The order must include the following:

model number of conversion kit
model number of present relay
coil voltage of present relay

Without the above information, the nameplate included with the kit cannot be properly stamped.

HMA100

Hinged-armature Auxiliary Relays

For Ac and Dc Auxiliary Functions

DESCRIPTION

The Type HMA relay is an instantaneous auxiliary device whose contacts are opened and closed by the movement of a hinged armature.

Type HMA Century Series auxiliary relays are designed to provide additional contacts, higher contact carrying and interrupting ratings, timing, interlocking, electrical separation and other auxiliary functions.

The Century Series coil design provides longer operating life than previous designs as a result of changes in the entire coil insulation system.

LONG-LIFE COIL DESIGN

Basic design features of HMA Century Series coils are as follows:

Spool—the spool on which the coil is wound is made of high thermal strength, glass-filled polymer to obtain long life at elevated temperatures. This material shows no signs of cracking or brittleness under accelerated life testing.

Wire Insulation—the wire insulation is a polyamide-imide wire coating (180C rating) which retains insulation integrity and mechanical strength at continuous elevated temperatures and which is also non-hydroscopic and fungus resistant. High temperature insulation is used where required, such as on leads.

Impregnation—Polybutadiene solventless impregnant.

Process

The polyamide-imide insulated coils, wound on high-temperature spools, are pre-baked to drive off all volatile materials, vacuum-pressure-impregnated with the solventless varnish, and then post-baked. The impregnation material is also non-hydroscopic and has temperature expansion coefficients compatible with the spool and with the wire, so that stresses do not develop under temperature cycling.

Nameplates for Century Series relays are green to provide easy visual differentiation from standard life relays.

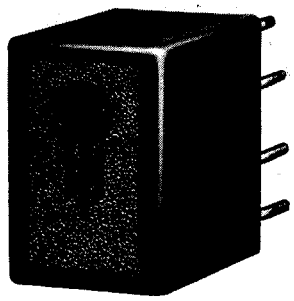
Accelerated life tests—conducted at elevated temperature and maximum voltage—have established a projected service life of 40 years to 1 percent failure (that is, when 1 percent of all such relays have failed) at 55C and 110 percent rated voltage. Under nominal conditions—that is, at an ambient temperature averaging 20C and at 100 percent voltage—that translates to a median life of 100 years (when 50 percent of all such relays could be expected to have failed).

APPLICATION

The HMA111A is a back-connected relay supplied either with or without cover and having a double-pole, double-throw contact arrangement. The HMA111B is similar to the HMA111A except that it is front connected and is available **only without** cover. Relays for dc service are adjusted to pick up at 60 percent of their rating when cold and 80 percent when hot. Relays for ac service are adjusted to pick up at 80 percent of their rating.

FIELD CONVERSION

For conversion of HMA relays in the field, it is recommended that the entire relay be replaced with a Century Series HMA, since this relay is not readily disassembled and reassembled.



(Photo 8011265)

Fig. 1. Type HMA111A back-connected relay with cover

RATINGS

These relays are available with coil ratings for standard voltages up to and including 240 volts 50 or 60 Hertz ac and up to 250 volts dc. The 250-volt relay uses a resistor in series with the coil.

The current-closing rating of the contact is 30 amperes. The current-carrying rating is 12 amperes continuously or 30 amperes for one minute.

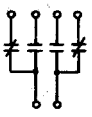
The interrupting ratings for the various voltages are as follows:

Contact Circuit		Noninductive		Inductive	
Volts	Freq. or Hz	Single Break Amp	Double Break Amp	Single Break Amp	Double Break Amp
6-32	Dc	15	30	6	12
48		10	20	3	6
62.5		5	10	1.5	3
110		1.5	3	0.6	1.2
125		1.5	3	0.6	1.2
220		0.3	0.5	0.1	0.3
250		0.3	0.5	0.1	0.3
120	60	20	30	15	15
240		13	25	10	10
120	50	20	30	15	15
240		13	25	10	10

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

SELECTION GUIDE—Approximately 35 Milliseconds Pickup

Coil Rating Volts	Dc Res Ohms at 25 C	Contact	Model Number: Back Connected with Cover and Studs	Model Number: Front Connected without Cover or Studs	Model Number: Flush Back Connected with Glass Covered Studs	Model Number: Surface Back Connected with Glass Covered Studs	Approx Wt in lb(kg): Net	Approx Wt in lb(kg): Ship
DC MODELS								
6	16		12HMA111A7	12HMA111B7	.....	.....		
12	56		A6	B6	.....	.....		
24	225	2 N.O.	A5	B5	12HMA124A5	12HMA125A5		
32	400	2 N.C.	A13	B13	.....	.....		
48	950		A4	B4	A4	A4	1(0.5)	2(0.9)
62.5	1449		A3	B3	.....	.....		
110	4239		A12	B12	.....	.....		
125	5800		A2	B2	A2	A2		
220	950①		A11	B11	.....	.....		
250	950①		A1	B1	.....	.....		
AC MODELS—60 Hertz								
120	345	Same	12HMA111A9	12HMA111B9	12HMA124A9	12HMA125A9	1(0.5)	2(0.9)
240	1410		A8	B8	.....	.....		
AC MODELS—50 Hertz								
120	517	Same	12HMA111A19	12HMA111B19	12HMA124A19	12HMA125A19	1(0.5)	2(0.9)
240	2082		A18	B18	.....	.....		

① Uses 3300 ohm external resistor for 220 volt; 3300 ohm for 250 volt.

BURDENS

The burdens for the dc coils are shown in the Selection Guide. The ac burdens are shown in the following table.

Ac Coils—Century Series

COIL RATING		R_{DC} ±10%	R_{DO} ±10%	X_{DO} ±10%	Z_{DO} ±10%	R_{PU} ±5%	X_{PU} ±5%	Z_{PU} ±5%
VOLTS	HZ							
120	60	345	503	964	1087	1389	1534	2069
240	60	1410	2962	3800	4818	5923	5166	7859
120	50	517	595	1031	1190	1567	1838	2415
240	50	2082	2687	4652	5372	7086	8289	10905

R_{DC}—Dc resistance
R_{DO}—Ac resistance with armature not picked up
X_{DO}—Inductive reactance with armature not picked up
Z_{DO}—Impedance with armature not picked up
R_{PU}—Ac resistance with armature picked up
X_{PU}—Inductive reactance with armature picked up
Z_{PU}—Impedance with armature picked up

For Ac and Dc Auxiliary Functions

DESCRIPTION

The Type HMA relay is a general purpose, hinged armature, self resetting relay. It is housed in a molded TEXTOLITE case for surface mounting, and can be supplied either front or back connected. Back connected models are supplied with a removable front cover, whereas front connected models are supplied without cover or rear studs.

APPLICATION

The HMA relay is a high speed auxiliary relay designed for use with high speed circuit breaker. The pick-up time at rated voltage is approximately 2 cycles (on a 60 Hertz basis). Relays for dc applications are adjusted to pick up at 60 percent of their rating when cold and 80 percent when hot. Relays for ac application are adjusted to pick up at 80 percent of their rating.

The HMA11A is a back connected relay supplied with cover. The HMA11B is similar except it is front connected and is supplied without cover. The HMA24A is similar to the HMA11A except it is made for semi-flush mounting with a glass cover.

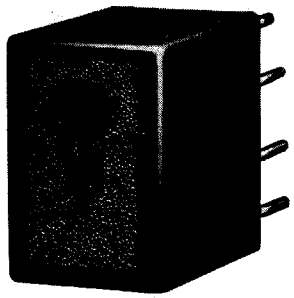
The HMA25A is similar to the HMA24A except it is surface mounted, back connected with glass cover.

RATING

The current closing or momentary rating of the contact is 30 amperes for one minute. The current carrying or steady-state rating is 12 amperes.

The interrupting ratings for the various voltages are as follows:

Contact Circuit		Noninductive		Inductive	
Volts	Freq. or Hz	Single Break Amp	Double Break Amp	Single Break Amp	Double Break Amp
6-32	Dc	15	30	6	12
48		10	20	3	6
62.5		5	10	1.5	3
110		1.5	3	0.6	1.2
125		1.5	3	0.6	1.2
220		0.3	0.5	0.1	0.3
250		0.3	0.5	0.1	0.3
120	60	20	30	15	15
240		13	25	10	10
120	50	20	30	15	15
240		13	25	10	10



(Photo 8011265)

Fig. 1. Type HMA11A back-connected relay with cover

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BURDENS

The burdens for dc coils are shown in the Selection Guide. The ac burdens are shown in the following table.

Ac Coils

COIL RATING		R_{DC} ±10%	R_{DO} ±10%	X_{DO} ±10%	Z_{DO} ±10%	R_{PU} ±5%	X_{PU} ±5%	Z_{PU} ±5%
VOLTS	HZ							
115	60	330	440	864	975	1215	1342	1815
230	60	1300	2580	3310	4180	5160	4500	6900
460	60	5100	7040	13825	15600	19440	21475	29040
115	50	380	503	871	1006	1323	1552	2029
230	50	1500	2010	3480	4025	5300	6200	8120

R_{DC}—Dc Resistance
R_{DO}—Ac resistance with armature not picked up.
X_{DO}—Inductive reactance with armature not picked up
Z_{DO}—Impedance with armature not picked up
R_{PU}—Ac resistance with armature picked up
X_{PU}—Inductive reactance with armature picked up
Z_{PU}—Impedance with armature picked up

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

SELECTION GUIDE—Approximately 35 Milliseconds Pickup

Coil Rating				Model Number				Approx Wt in lb (kg)	
Volts Dc	Volts Ac	Dc Ohms	Contact	Back Connected with Cover	Front Connected without Cover	Semi-flush Mtg. Back Connected with Glass Cover	Surface Mtg. Back Connected with Glass Cover	Net	Ship
DC MODELS									
6	...	15.3	2 N.O.	12HMA11A21	12HMA11B1	12HMA24A4	.....		
12	...	60	2 N.C.	A22	B2	.....	.....		
24	...	230		A23	B3	.....	12HMA25A4		
32	...	440		A24	B4	.....	.....		
48	...	1000		A25	B5	A5	A3	1(0.5)	2(0.9)
62.5	...	1450		A53	B25	.....	.....		
125	...	5660		A26	B6	A2	.....		
250	...	930①		A47	B19	.....	.....		
AC MODELS—60 Hz									
...	115	...		12HMA11A31	12HMA11B11	.....	.....		
...	125	...	Same	A54	B27	12HMA24A1②	12HMA25A1		
...	208	...		A48	.....	.....	.....	1(0.5)	2(0.9)
...	230	...		A32	B12	.....	.....		
AC MODELS—50 Hz									
...	115	...		12HMA11A41	12HMA11B16	.....	.....		
...	125	...	Same	.....	B26	12HMA24A3②	.....	1(0.5)	2(0.9)
...	230	...		A42	B17	.....	.....		

① Uses 3300 ohm external resistor.
② 120 VAC.

DESCRIPTION

The Type NGA15 is the general designation for a family of telephone-type dc auxiliary relays mounted in a small molded case similar to Type HGA relays. These auxiliary relays are available with several different contact arrangements and operating times. All models are continuously rated. Some have a surge limiting diode circuit for the operating coil as noted in the Selection Guide.

APPLICATION

The NGA15U, 15AG and 15AK are general purpose auxiliary relays. They include a diode combination in parallel with the coil circuit to limit the magnitude of the voltage surges that can be developed when the coil circuit is interrupted. Such an arrangement makes these relays suitable for application in control and relaying circuits where blocking rectifiers are used and supplied from the same dc source as the relay.

The NGA15J is a long-time delay relay for pickup and dropout but does not include a surge limiting diode circuit.

The NGA15AA, 15AH and 15AJ relays were specifically designed to initiate automatic reclosing (RI) in a protective relay scheme. These relays are surge limited and may be used in many other applications.

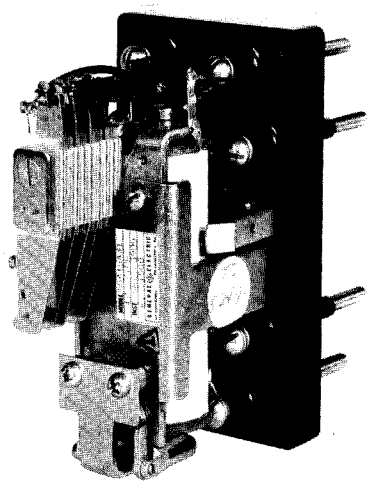
The NGA15Q and 15X are general purpose high-speed auxiliary relays and are not surge limited.

Ratings

The NGA15 relays listed include the necessary resistors for the coil circuits where needed. These resistors are usually mounted inside the relay case. For some of the continuously rated models, an external resistor is required and these models are identified by "①".

VOLTAGE RATING

The NGA relays have been designed and assembled with components to give a pickup of 80 percent or less of rated voltage and to give the required operating times at rated voltage. The operating voltage range is 80 to 112 percent of nominal dc rating.



(Photo 8043227)

Fig. 1. Type NGA15 auxiliary back connected (cover removed)

Contact Rating

The relay contacts will close and carry 30 amperes dc momentarily for tripping duty at control voltages of 250 volts dc or less. These contacts will carry 3 amperes continuously and have an interrupting rating as given in Table 1.

TABLE 1 Interrupting Ratings

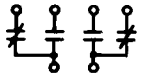
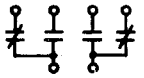
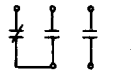
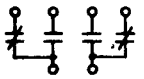
Volts	Amps Inductive①	Amps Non-Inductive
48 v dc	1.0	3.0
125 v dc	0.5	1.5
250 v dc	0.25	0.75
115 v, 60 Hz	0.75	2.0
230 v, 60 Hz	0.5	1.0

① Inductance of average trip coil

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

SELECTION GUIDE

Continuous Dc Rating (Volts)	Pick-up Time (Milliseconds)	Drop-out Time (Milliseconds)	Model Number: Back Conn. Surface Mtd.② with solid cover	Model Number: Front Conn. Surface Mtd. with glass window cover	Contact Arrangement	Case Size	Approx. Wt. Lb (kg): Net	Approx. Wt. Lb (kg): Ship
SURGE LIMITED								
110 125 220 250	8	8	12NGA15U4① U2① U3① U5①	....		Molded ③	3 (1.4)	4 (1.8)
48 125 250	8	8	12NGA15AK3① AK2① AK1①	12NGA15AG2① AG1①				
48 125 220 250	8	32	12NGA15AK6 AK4 AK7 AK5	12NGA15AG4 AG3			2 (0.9)	3 (1.4)
48 125 250	16	116-167	12NGA15AH3 AH1 AH2①	..... 12NGA15AA3 AA4①				
125	16	116-167	12NGA15AJ1①	.....			3 (1.4)	4 (1.8)
75 125 125 125 125 125 250	50 8 28-38 50-55 80-120 90-110 50-55	250 100 220-300 — 60-90 60 —	12NGA15A28 A21 A34 A33 A30 A32	..... 12NGA15L6 ..... L5 .... L7			2 (0.9)	3 (1.4)
NOT SURGE LIMITED								
125 220 250	4	4	12NGA15Q5① Q6① Q4①	12NGA15X2①		Molded ③	3 (1.4)	4 (1.8)
48 125 250	60-70	16	12NGA15J6 J5 J4	....			2 (0.9)	3 (1.4)

① Model number includes external resistor.
② Add suffix "F" for semi-flush mounting with glass window cover.
③ Molded case construction similar to the Type HGA.

APPLICATION

The type HSA high-speed multi-contact, auxiliary relays are applicable where it is desired that a number of operations be performed simultaneously from the operation of a single relay.

Typical functions that can be performed by these relays are:

1. Trip and lock out the main circuit breaker of a system.
2. Trip station auxiliary breakers.
3. Trip main or auxiliary field breakers.
4. Trip and lock out all breakers on a bus.

Perhaps the most important use of the HSA relay is as an auxiliary used in conjunction with differential relays for bus, transformer, line or rotating machine protection.

CONSTRUCTION

The HSA multi-contact, auxiliary relays are built with many parts common to the type SBM control switches.

The mechanical target on the escutcheon plate assembly indicates the position of the relay. The black target indicates the reset position and the orange target, the tripped position. To reset the relay after it has been tripped, the handle is turned clockwise as indicated by the arrow on the escutcheon plate.

Since the HSA relay is similar to the SBM switch, it is available with a shaft long enough to allow it to be mounted on panels with thickness up to ¼ inch.

OPERATION

The HSA11 relay is available with 9, 13 or 19 main electrically separate contacts. In addition, there are 2 normally closed contacts that are wired for opening the operating coil circuit. See Figure 1.

The operating shaft is held in reset position by a positive roller latch which is especially constructed to resist shock and vibration. The latch is released through the action of a plunger device actuated by the relay operating coil. All HSA relays are made so that they should not normally be tripped manually; however, manual tripping can be accomplished through use of an escutcheon knockout (and pre-drilled hole in panel) which provides access to a screwdriver-operated tripping device. The time required to trip the relay, from the instant of energization of the coil to the closing of the contacts, is per HSA Relay Operating Characteristics (Figures 2 & 3), slightly less for opening of contacts.

TARGET DROPPING

Universal targets in series with HSA trip coils increase HSA trip time. A typical increase in trip time for a single 0.2 ampere target and an HSA with a 125 VDC trip coil is 1.3 milliseconds.

Table 1 shows the maximum number and type of universal targets that can be dropped by the current pulse of HSA trip coils.

Table 1 - Target Dropping

HSA Coil Group	Coil Voltage	Number of Parallel Targets Dropped		
		0.2 amp	0.6 amp	2.0 amp
1	48 VDC	6	6	3
2	110 VDC	6	6	2
2	125 VDC	6	6	2
3	220 VDC	6	3	1
3	250 VDC	6	4	1

NOTE: A minimum of two parallel 0.2 ampere targets is recommended to assure tripping of 48 VDC HSA relays.

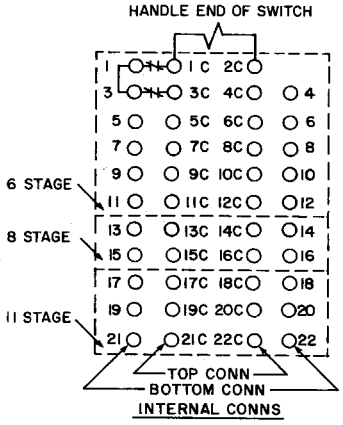


Fig. 1. HSA11 Relay Contacts.

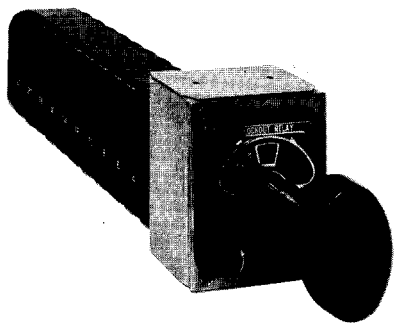


Fig. 4. Type HSA11 Auxiliary Relay

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SEISMIC CAPABILITY

The seismic capability of HSA N.O. (Normally Open) and N.C. (Normally Closed) contacts are given in Table 2.

Table 2 - HSA Seismic Capability

Seismic Capability in g's ZPA			
HSA Reset		HSA Tripped	
N.O.	N.C.	N.O.	N.C.
6.0	4.0	6.0	6.0

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

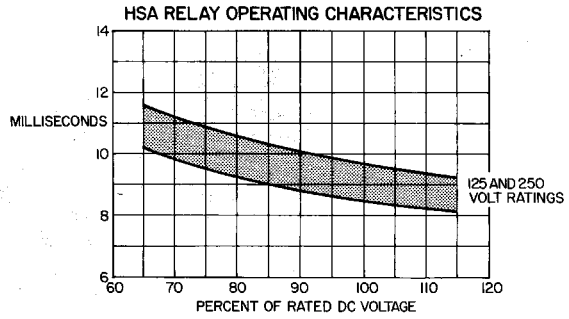


Fig. 2. Operating Characteristics, 8- and 11-stage HSA Relays

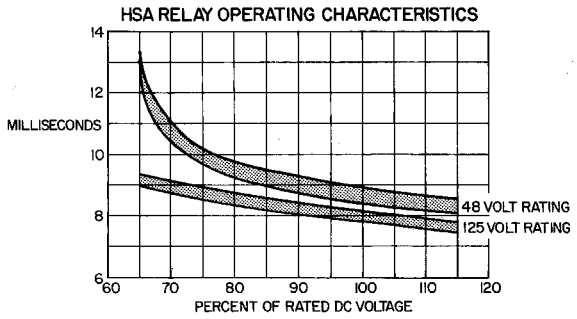


Fig. 3. Operating Characteristics, 6-stage HSA Relays.

SERVICE TEMPERATURE

The HSA will operate over an ambient temperature range of −20°C to +55°C and will not be damaged by storage ambients of −40°C to +65°C.

DIELECTRIC CAPABILITY

HSA relays are rated 600 volts in accordance with the Dielectric Test Section of Relay Standard ANSI/IEEE C37.90-1978.

TRIP COIL RATINGS

The three trip coils available for HSA relays have multiple voltage ratings as shown in Table 3. To obtain maximum tripping speed, the coils are rated for intermittent duty only.

Table 3 - Trip Coil Voltage Ratings

Intermittent Rating (Volts)	Frequency (Hz)	Operating Range (Volts)	Coil Group
48	DC	32- 55	1
110	DC	70-145	2
125	DC	70-145	2
220	DC	140-290	3
250	DC	140-290	3
69	50/60	45- 80	1
110	50/60	70-140	2
120	50/60	70-140	2
220	50/60	140-280	3
240	50/60	140-280	3

CAUTION: Do not hold the reset handle in the reset position if the HSA will not reset. Failure to reset indicates that the trip coil is energized. Holding the reset handle in the reset position with the trip coil energized at rated voltage will cause rapid coil heating and possible insulation damage.

CONTACT RATINGS

The current-closing ratings of the contacts is 30 amperes for voltages not exceeding 600 volts. The contacts have a current carrying capacity of 20 amperes continuously. The interrupting ability of the contacts varies with the inductance of the circuit. The values (in amperes) given in Table 4 for dc inductive circuits, are based on the average trip coil.

BURDENS

The burdens for the type HSA relays are given in Table 5 and Table 6.

Table 4 - Contact Interrupting Ratings

Circuit Volts	Amps Non-inductive		Amps Inductive (L/R-.04)	
	Single Contact	Two in Series	Single Contact	Two in Series
48 DC	10	50	6	30
125 DC	5	22	4	13
250 DC	1.5	4	1.4	3.5
120 AC	50	50	50	50
240 AC	50	50	25	50

Table 5 - DC Burden Data for HSA Relays

Coil Group	Volts	Coil Resistance (ohms at 25°C ± 10%)	DC Inrush Current (amps)
1	48	2.85	17
2	110	11.8	12
2	125	11.8	13
3	220	47.5	5
3	250	47.5	5.5

Table 6 - AC Burdens

		AC Burdens		
Coil Group	Volts	Frequency	Z (ohms)	Voltage Lead Angle
1	69	60	10	30
2	110	60	11	29
2	120	60	11	29
3	220	60	45	28
3	240	60	45	28
1	69	50	10	27
2	110	50	11	24
2	120	50	11	24
3	220	50	45	23
3	240	50	45	23

SELECTION GUIDE

Contact Arrangement Reset (Latched) Position		Model Number			Approx Wt in lb (kg)	
Contact Numbers Norm. Closed	Contact Numbers Norm. Open	48 Volt Dc 69 Volt Ac 50/60 Hz Ac	110/125 Volt Dc 110/120 Volt Ac 50/60 Hz Ac	220/250 Dc 220/240 Ac 50/60 Hz Ac	Net	Ship
9 CONTACT (Plus 2 Contacts in Coil Circuit)						
None	4-12	12HSA11A100	12HSA11A110	12HSA11A120		
4	5-12	A101	A111	A121		
4-5	6-12	A102	A112	A122		
4-6	7-12	A103	A113	A123		
4-7	8-12	A104	A114	A124	3.1	5
4-8	9-12	A105	A115	A125	(1.4)	(2.3)
4-9	10-12	A106	A116	A126		
4-10	11-12	A107	A117	A127		
4-11	12	A108	A118	A128		
4-12	None	A109	A119	A129		
13 CONTACT (Plus 2 Contacts in Coil Circuit)						
None	4-16	12HSA11B200	12HSA11B220	12HSA11B240		
4	5-16	B201	B221	B241		
4-5	6-16	B202	B222	B242		
4-6	7-16	B203	B223	B243		
4-7	8-16	B204	B224	B244		
4-8	9-16	B205	B225	B245		
4-9	10-16	B206	B226	B246	3.5	5.4
4-10	11-16	B207	B227	B247	(1.6)	(2.4)
4-11	12-16	B208	B228	B248		
4-12	13-16	B209	B229	B249		
4-13	14-16	B210	B230	B250		
4-14	15-16	B211	B231	B251		
4-15	16	B212	B232	B252		
4-16	None	B213	B233	B253		
19 CONTACT (Plus 2 Contacts in Coil Circuit)						
None	4-22	12HSA11C300	12HSA11C320	12HSA11C340		
4	5-22	C301	C321	C341		
4-5	6-22	C302	C322	C342		
4-6	7-22	C303	C323	C343		
4-7	8-22	C304	C324	C344		
4-8	9-22	C305	C325	C345		
4-9	10-22	C306	C326	C346		
4-10	11-22	C307	C327	C347		
4-11	12-22	C308	C328	C348		
4-12	13-22	C309	C329	C349	4	6
4-13	14-22	C310	C330	C350	(1.8)	(2.7)
4-14	15-22	C311	C331	C351		
4-15	16-22	C312	C332	C352		
4-16	17-22	C313	C333	C353		
4-17	18-22	C314	C334	C354		
4-18	19-22	C315	C335	C355		
4-19	20-22	C316	C336	C356		
4-20	21-22	C317	C337	C357		
4-21	22	C318	C338	C358		
4-22	None	C319	C339	C359		

S E C T I O N : 7

Reclosing Relays

HGA18 Single-shot Recloser 1

NLR Multi-shot Recloser 3

HGA18

Single-shot Reclosing Relays

GE Protective Relays

DESCRIPTION

The Type HGA18 is a self-resetting, "single-shot" reclosing relay which initiates immediate reclosure of a power circuit breaker. The HGA18 consists of an HGA unit and an R-C circuit mounted in a draw-out case. The HGA unit coil consists of an operating winding and a holding winding which are connected in separate circuits (see Figures 2 and 3). The HGA18 is available in either ac or dc voltage rating. Both versions come equipped with a target in the output contact circuit. The target coil may be bypassed by means of an internal jumper if it is not needed.

APPLICATION

The HGA18 relays are designed for use where a single immediate reclosure of circuit breakers is desired. In the event that the breaker reopens after reclosure within the relay reset time, the relay will cause the breaker to lock-out. However, if the breaker remains closed for at least the relay reset time, the relay will reset and be ready for another reclosing operation. Power to operate the relay is obtained from a fully charged capacitor which is caused to discharge into the relay coil when a "b" switch on the breaker closes or a reclose initiating (RI) contact closes.

The HGA18 is well suited for use where the service does not justify subsequent time reclosures, such as provided by the SLR relay. Typical applications include remote controlled stations, attended stations where the operator's presence is only part time, unattended stations, electrically operated pole-mounted breakers, and outdoor switch houses.

FACTORS IN APPLICATION

There are certain requirements that should be understood in order to take full advantage of immediate reclosing.

(a) Control Switch—An extra contact should be provided on the **control switch** to prevent the HGA18 relay from reclosing the breaker after it has been tripped manually by the control switch.

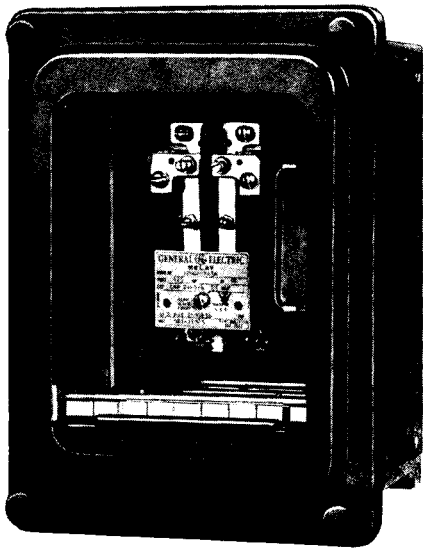
(b) Undervoltage Devices—When such devices are on the system, it is necessary to co-ordinate between the HGA18 reset time and and trip time of the undervoltage device.

(c) Closing Relays—Where the Type HGA18 relays are used, it is essential that the breaker mechanisms have closing relays which insure complete closure of the breaker even though the auxiliary switch on the breaker mechanism opens before closure is complete.

Where trip-free closing relays are used, it is necessary that they reset quickly enough to permit immediate reclosure of the breaker.

(d) Latch-checking Switches—In order to insure successful operations of breakers reclosed by Type HGA18 relays, it is necessary to have a latch-checking switch on all trip-free solenoid mechanisms.

(e) Holding Coil Circuit—This circuit must be complete no later than the instant when the operating coil becomes energized, and must remain complete until reclosure has progressed to the point where it will carry through even if the reclosing relay opens the closing circuit.



(Photo 8007533)

Fig. 1. Type HGA18 reclosing relay

(f) Overcurrent Relays—The protective relays that trip the breaker obviously must open their contacts before the breaker recloses; otherwise the breaker may even trip a second time though the fault has cleared.

(g) Power Circuit Breakers—the derating factors applying to the interrupting rating of breakers should be checked for all applications of the HGA18 relays.

CONTACTS

Current-closing rating of the contacts is 30 amperes for voltages not exceeding 250 volts. The contacts have a current carrying rating of 12 amperes continuously or 30 amperes for one minute.

Interrupting ratings (non-inductive circuits) for various voltages are given in the table below:

	Dc				Ac	
Volts	24	48	125	250	115	230
Amps	3	1.5	0.6	0.25	20	10

SELECTION GUIDE
2 N.O. Contacts

Rated Voltage		Operating Range (Volts)	Reset Time (Secs)	Target Rating (Amps)	Model Number		Case Size	Approx. Wt. In lbs. (kg)	
DC	25-60 Hz ①				Standard	Shock Resistant		Net	Ship
48	.....	39-54	15	1.0	12HGA18M3A②	.....	S-1	8 (3.6)	15 (6.8)
125	.....	100-140		1.0	M4A	12HGA18M2A②			
125	.....	100-140		0.2	.....	M5A			
250	.....	200-281		1.0	.....	M1A			
...	115	92-129		0.2	N1A①	.....	S-2	9 (4.1)	17 (7.7)

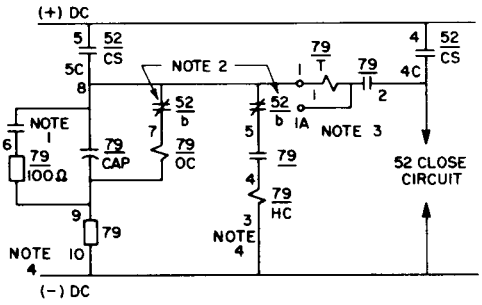
① Ac model includes external rectifier with mounting bracket.
② These models include external capacitors with mounting brackets.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

CLOSING TIME

The time for the closing of the HGA18 contacts is approximately one cycle on a 60-Hertz basis. This includes the total operating time of the HGA18 relay, from the instant the "b" switch closes until the closing impulse is given to the closing relay. The closing time of the various breakers, of course, depends on several factors, such as the type of mechanism and the type and size of the breaker.



52CS - CONTROL SWITCH
79 - HGA18M

OC - OPERATE COIL
HC - HOLDING COIL
T - TARGET
CAP - CAPACITOR

NOTE 1: DISABLING CONTACT, TO BE SUPPLIED BY USER.
NOTE 2: TWO BREAKER b SWITCHES ARE NECESSARY TO AVOID A SNEAK CIRCUIT. WHEN ONLY ONE b SWITCH IS AVAILABLE, SEE DRAWING 0285A6287
NOTE 3: IF TARGET OPERATION IS NOT DESIRED, SHIFT INT. JUMPER FROM 1A TO 1.
NOTE 4: TERMINALS 3 AND 10 MUST BE OF SAME D-C POLARITY.

Fig. 4. Typical external connection of Type HGA18M relay where two 52/b contacts are available

	16SB1B9 SWITCH			
	CLOSE	NOR AFT CLOSE	NCR AFT TRIP	TRIP
1 2 | 1				X
1 2 | 2				X
3 4 | 3		X	X	
3 4 | 4	X			
5 6 | 5	X	X		
5 6 | 6	X	X		

Fig. 5. Contact arrangement of breaker control switch used in typical scheme.

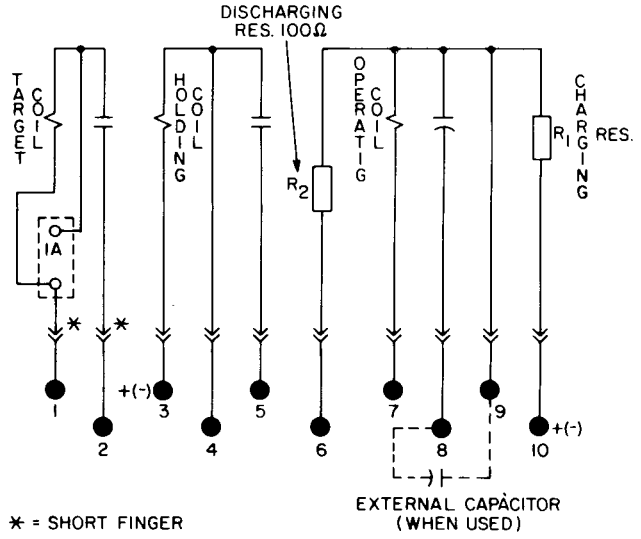


Fig. 2. Internal connection diagram for Type HGA18M relay

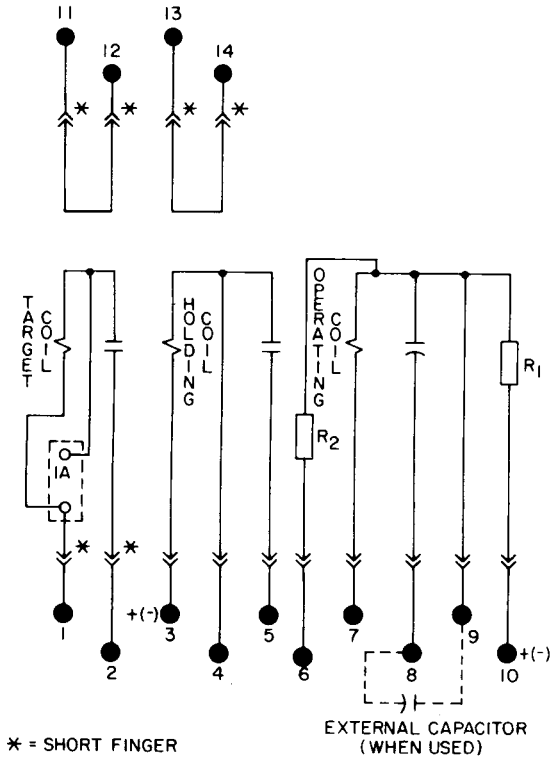


Fig. 3. Internal connection diagram for Type HGA18N relay

DESCRIPTION

The Type NLR21 is a multi-shot reclosing relay designed to automatically reclose a circuit breaker which has been tripped by a protective relay. The relays have improved surge withstand capability compared to earlier models. Included is a dc operated timing circuit with solid-state components which provides an extremely stable timing function, a heavy-duty stepping switch, auxiliary units, time-adjusting rheostat and adjustment cams to select the reclosing intervals.

APPLICATION

The NLR multi-shot reclosing relay is designed for use in two major applications of power systems:

1. Distribution area on radial circuits (all listed NLR21's except NLR21E); and
2. Transmission lines where generation is usually present behind both line terminals (NLR21E).

The NLR21A, and -21B are, respectively, dc and ac operated relays recommended for distribution circuits and provide up to three adjustable reclosures. The initial reclosure may be instantaneous or delayed, followed by up to two delayed reclosures. The NLR21C and -21D are respectively dc and ac operated relays which provide up to four reclosures. The initial reclosure must be instantaneous followed by up to three delayed adjustable reclosures.

The NLR21E relay is recommended for transmission line applications where selective reclosing is usually required. The relay provides an instantaneous initial reclosure, initiated only by an auxiliary relay associated with high-speed primary line protection, and up to three delayed reclosures which will follow any breaker trip by line relays, primary or backup. An auxiliary unit is included which stops the timer when each delayed reclosure position is reached to wait for the synchronism check relay to complete the reclosing circuit.

The NLR21G is intended for applications where it may be desirable to block reclosing and initiate fast lockout of the NLR relay if the breaker is tripped by supervisory, by a differential relay, or by a breaker failure backup scheme. Operation of an included auxiliary unit by means of an external contact will block reclosing and cause the stepping switch to step immediately into the lockout position.

The NLR21U and -21M provide up to three and four reclosures respectively. However, they are rated for dual dc operation at 48 or 125 volts.

The NLR21P and -21T are, respectively, ac and dc relays which can be used when a separate adjustable time delay of four to 24 milliseconds is desired for the initial reclosure.

OPERATION

Reclosing signals are provided at timed intervals by cams of a stepping switch. An adjustable timing circuit normally set to provide a time interval of five seconds, operates the stepping switch one step at the end of each interval. Contacts operated by the adjustable cams provide reclosing signals on any of the first 34 steps. The 35th step is lockout, and the 36th step is reset, which completes the cycle and resets the relay to the starting step. A cam in position zero (which is also step 36) provides an instantaneous reclosure.

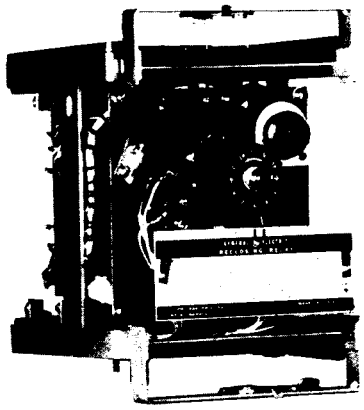
A small rheostat is used to provide step-time interval adjustment of 0.5 to 5 seconds. The total timing cycle, from the start of the timer to reset is thus adjustable up to a maximum of three minutes.

Provisions are included for blocking the instantaneous signal. Also, an auxiliary contact operated by an adjustable cam can be used for additional control functions, such as to block automatic tap changing during the reclosing period. A normally open or normally closed contact is available.

The reset selecting link has three positions:

None, Next Close, and Step 2.

None: Resets one step-time interval after lockout if breaker remains closed.



(Photo 122762)

Fig. 1. NLR21E relay withdrawn from case

Next Close: Resets when the next reclosing signal is reached if the breaker is still closed.

Step 2: Resets two step-time interval after any successful reclosure.

FEATURES

Relays listed in the Selection Guide for distribution circuit application include the following features:

A. Coordination With Branch Fuses

In some systems involving multishot reclosing relays, the main feeder is protected by a circuit breaker and the branch feeders by fuses. This means of sectionalizing a system requires that a fault on a branch be cleared initially by the main breaker tripped by a high-speed relay unit. If the fault persists following immediate reclosure, it must be cleared the second time by the branch feeder fuse. To accomplish this, the contacts of the high-speed protective relay must be blocked following the initial trip-out. The NLR relay can be connected to block instantaneous tripping of the breaker after the initial reclosing thus providing time for the branch fuse to clear the fault, rather than the main breaker.

Instantaneous tripping can be reinstated automatically when the NLR relay locks out.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

B. Selective Reclosing

In certain applications it is desirable to utilize the instantaneous reclosure if the circuit breakers are tripped by an instantaneous relay. However, if the circuit breakers are tripped by a time-delay relay, the NLR will by-pass the instantaneous reclosure and will wait for the first delayed reclosure.

APPLICATION CONSIDERATIONS

a. Latch-checking Switches

In order to insure successful operation of a breaker reclosed by an NLR relay adjusted for immediate initial reclosure, it is necessary to use a latch-checking switch on its solenoid mechanism if it is trip-free. This switch completes the closing circuit only after the mechanism latch is properly reset for the reclosure.

b. Control Switches

An extra contact should be provided on the control switch to prevent the NLR from reclosing the breaker after it has been tripped manually by the control switch. If tripped in this manner, the breaker must be reclosed by the control switch in order to restore the automatic reclosing feature.

c. Undervoltage Devices

In order to obtain the advantage of instantaneous reclosure on utilization devices, the undervoltage devices (or equivalent) in their control should not be instantaneous, but should have a dropout delay of one or two seconds.

d. Protective Relays

The protective relays that trip the circuit breaker must open their contacts before the breaker recloses; otherwise the breaker may retrip immediately even though the fault has cleared.

e. Closing Control Circuits

It is essential that the circuit breaker mechanisms use closing circuits which assure complete closure of the breaker, even though the closing circuit is opened at some point before closure is complete.

f. Interrupting Ratings

The derating factor for the interrupting rating of the power circuit breaker should be checked for the proposed reclosing cycle.

CONTACT RATINGS

The relay contacts will make and carry 30 amperes momentarily and carry 1.0 ampere continuously.

The relay contacts will interrupt the currents given in table below:

Volts	Current Inductive①	Current Non-inductive①
48 v dc	1.0	3.0
125 v dc	0.5	1.5
250 v dc	0.25	0.75
115 v dc	0.75	2.0
230 v ac	0.5	1.0

① Induction of average trip coil.

BURDENS

Volts	Freq.	Res.—Ohms Min.
250	Dc	1500
125	Dc	400
48	Dc	70
240	50/60 Hz	1500
120	50/60 Hz	400

The resistance values given are the relay resistance when the stepping switch coil is energized for about 8 milliseconds when the switch steps. At other times when the timer is running the relay resistance is approximately 10 times the values given above. When the relay is in reset, it has zero burden. Ac burden is at unity power factor.

The NLR will operate in ambient temperatures of −20 C to 60 C with a max. time variation of 6 percent, and down to −40 C with a maximum variation of 10 percent.

SELECTION GUIDE

Rating		Model Number					Case Size	Approx Wt lb (kg)	
Voltage	Freq.	3① Reclosures ②	4① Reclosures ②	4① Recl. with Prov. for synch. check ③	3① Recl. with fast lockout	3① Recl. with sep. del. on initial Recl.③		Net	Ship
32	Dc	12NLR21A4A	.....	.....	.....	.....	S2	14 (6.4)	18 (8.2)
48		.....	.....	12NLR21E3A	12NLR21G2A	.....			
125		.....	.....	E2A	G1A	12NLR21T1A			
250		A1A	12NLR21C1A	E1A	.....	.....			
48/125		U1A	M1A	.....	.....	.....			
120	50/60 Hz	B1A	D1A	.....	.....	P1A			
208		B4A	.....	.....	.....	.....			
240		B2A	D2A	.....	.....	.....			

① Models with three reclosures may have an instantaneous or a delayed instantaneous initial reclosure. Models with four reclosures have fixed instantaneous initial reclosure.

② For application on distribution circuits.

③ For application on transmission circuits.

SECTION: 8

Synchronizing Relays

IJS Synchronism Check..... 1

SLJ Static Synchronism Check..... 3

When the Two Sources are Already Interconnected

DESCRIPTION

The Type IJS is an induction disk synchronism check relay that has two shaded pole U-magnet driving elements acting on opposite sides of a single rotating disk. One operating element drives the disk in the contact closing direction and the other in the restraining or opposite direction. The disk shaft is restrained by a spiral spring, to hold the contacts open when the relay is de-energized. The motion of the disk is retarded by permanent magnets to give a time delay.

APPLICATION

Generally, the Type IJS relay is applicable as a synchronism-check relay to permit closure of a circuit breaker only when two sources connected to it are synchronized elsewhere. It determines that synchronism is being maintained by other interconnections, and then permits closure of the circuit breaker. In such an application, the voltages on either side of an open line breaker may be slightly out of phase with each other because of load flow on the rest of the system. The relay, however, can be calibrated to permit closure of the breaker under these conditions if the voltage and the phase-angle differences are not excessive.

The relay has an adjustable time delay and permits operation only if the phase angle remains less than a definite number of degrees for a selected time. The relay operating torque increases as the phase angle decreases and is a maximum when the two compared voltages are in phase.

On systems where the two sides of a given breaker may or may not be interconnected elsewhere at any given moment when paralleling is desired, the GES or GXS is used for synchronizing when a *finite* frequency difference exists; and the IJS is used at the same location for synchronism check when the frequency difference is negligible or zero due to the existence of an interconnection elsewhere. In this application, the IJS contacts are connected in parallel with those of the GES or GXS.

Forms of the relay are available with a rated calibration range up to 60 degrees. For settings over 20 degrees, consideration should be given to the resulting generator stresses at the instant of closure through existing system impedances, as in any other situation involving out-of-phase closure.

The IJS51A is the basic synchronism-check relay and includes a target seal-in unit. IJS52A is similar to the basic IJS51A but without the target seal-in unit.

DEAD LINE OR BUS

In addition to permitting closure of the breaker when the two sources are in permanent synchronism, it is sometimes desirable to permit closure when either section is de-energized or dead.

The IJS52D includes the normal synchronism check induction element. It also includes two telephone-type instantaneous undervoltage units designated as "B" for bus and "L" for line. Depending on the external connections, the telephone-type instantaneous undervoltage units "27B" and "27L" will permit reclosing of the breaker under a variety of system conditions. See Fig. 2-1 to 2-6, Page 9-2.

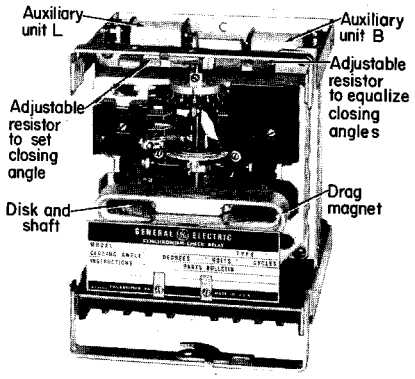
The IJS52E provides a combination of synchronism-check operation, with a time-delay dead-line- live-bus and/or dead-bus-live-line check.

It performs either or both of the voltage checking functions (as selected by external switch contacts) by means of internally mounted instantaneous voltage relays which connect both coils of the IJS unit to the bus or line when the voltage on the opposite side of the controlled breaker is 15 percent or less of rated value. The pickup time of the IJS unit at 0 degrees is thus the closing delay for the dead-line- live-bus and/or the live-line- dead-bus checking functions.

The IJS52E performs the synchronism-check function in the usual manner whenever the voltage on each side of the controlled breaker is at or above 45 percent of rated value. This insures that both of the instantaneous voltage relays will be picked up, and in that position they connect the coil circuits of the IJS unit to the bus and line so that the unit responds to phase relations in the usual way.

The IJS52F is similar to the IJS52D except it includes an additional telephone-type unit, (25X) to provide three N.O. electrically separate contacts.

The IJS52G is similar to the IJS52E except for the addition of a selector switch. This switch has two positions - in the "down" position the relay will function as hot line-dead bus checking scheme. In the "up" position of this switch the relay functions as a hot bus-dead line checking scheme.



(Photo 8038825)

Fig. 1. Typical Type IJS52D Relay (without case)

RATINGS

The operating and restraining coils of the synchronism-check unit are continuously rated. The contact of this unit will make and carry momentarily 30 amperes but it has no interrupting rating. The current-carrying ratings are affected by the selection of the tap on the seal-in coil. See Target Data, Section 16.

For the IJS52D, 52E and 52F the telephone-type voltage relay contacts will make and carry 30 amperes momentarily for normal duty, but the circuit must be opened by a breaker auxiliary switch or other suitable means.

The telephone-type relays have operating coils rated the same as main unit, and are continuously rated.

BURDENS

The maximum burden for the synchronism-check unit is 12 voltamperes, 4 Watts at 60 Hertz. The burden varies with the phase difference of the two voltages with a minimum at zero degrees to a maximum at 180 degrees.

The burden of each telephone-type undervoltage unit is 13 volt amperes and 8 watts at 115 volts 60 Hertz.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

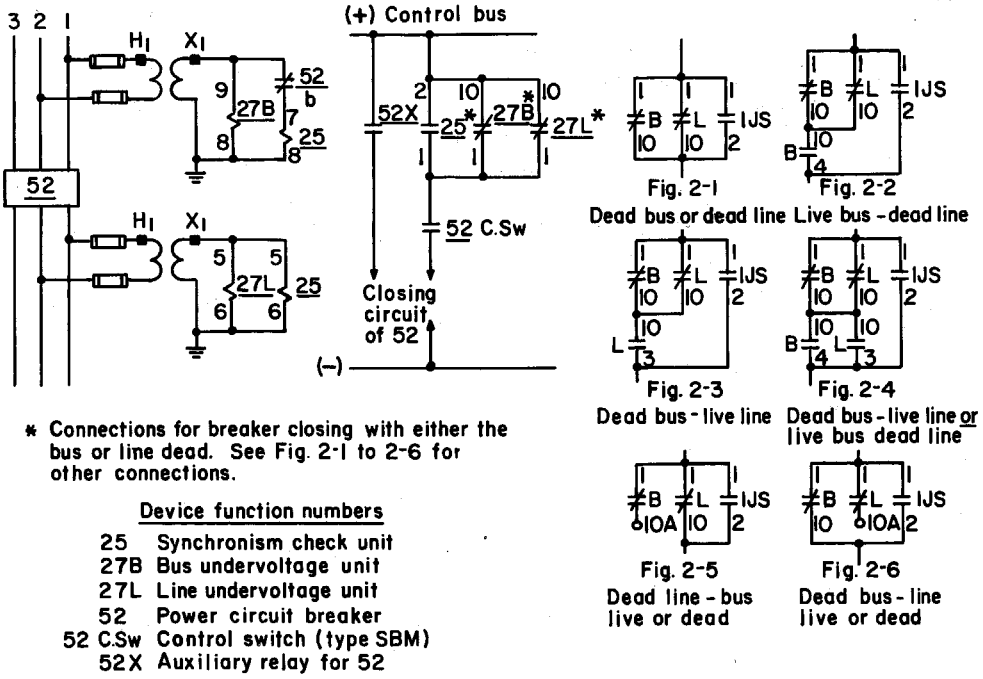
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SELECTION GUIDE

Frequency Hertz	Volts Ac	Closing① Angle at Rated Volts	Target Seal-in Amp	Main Contacts	Model Number	Case Size	Approx Wt Lb (Kg) Net	Approx Wt Lb (Kg) Ship
TYPE IJS51A—Synchronism Check With Seal-in Unit								
60	115	20° 20/60°	0.2/2	1-N.O.	12IJS51A1A 12IJS51A3A	S-1	13 (5.9)	17 (7.8)
50	115	20/60°	0.2/2	1-N.O.	12IJS51A4A			
TYPE IJS52A—Synchronism Check Without Seal-in								
60	115 115 230 115	20° 20/60° 20° 10°	— — — —	1-N.O.	12IJS52A1A 12IJS52A7A 12IJS52A8A 12IJS52A10A	S-1	13 (5.9)	17 (7.8)
50	115	20°	—	1-N.O.	12IJS52A2A			
TYPE IJS52D—Synchronism Check With 2 Instantaneous Undervoltage Units - Bus and Line								
60	115 115 67	20° 20/60° 20/60°	— — —	1-N.O.	12IJS52D1A 12IJS52D3A 12IJS52D6A	S-1	14 (6.3)	18 (8.1)
50	115	20° 20/60°	— —	1-N.O.	12IJS52D2A 12IJS52D4A			
TYPE IJS52E—Synchronism Check With Time Delay Check of Bus and Line								
60	115	20° 20/60°	— —	1-N.O.	12IJS52E1A 12IJS52E3A	S-1	14 (6.3)	18 (8.1)
50	115	20° 20/60°	— —	1-N.O.	12IJS52E2A 12IJS52E4A			
TYPE IJS52G—Similar To IJS52E Except With Selector Toggle Switch								
60 60	115	20° 20/60°	— —	1-N.O.	12IJS52G1A 12IJS52G3A	S-1	14 (6.3)	18 (8.1)
TYPE IJS52F—Similar To IJS52D Except With Added Telephone Auxiliary Relay								
60	115	20°	Auxiliary Volts dc 125	Auxiliary 3-N.O.	12IJS52F1A	M-2	21 (9.6)	27 (12.2)

① For relays with 20/60-degree range, specify closing-angle setting desired, when ordering. If not specified on order, factory setting will be 40°.

CONNECTION DIAGRAM



* Connections for breaker closing with either the bus or line dead. See Fig. 2-1 to 2-6 for other connections.

Device function numbers

25	Synchronism check unit
27B	Bus undervoltage unit
27L	Line undervoltage unit
52	Power circuit breaker
52 C.Sw	Control switch (type SBM)
52X	Auxiliary relay for 52

Fig. 2. Typical elementary diagram of external connections of Type IJS52D relay (Ref. 0264B0496)

INTRODUCTION

The Type SLJ21A is a static synchronism check relay which is designed to permit closing of a breaker only if the angle between the voltages on the line and bus sides of the breaker is less than a set angle for a set period of time. Also included are two voltage measuring circuits to check line and bus voltage conditions. The relay is mounted in a size S2 drawout case.

APPLICATION

The SLJ21A static relay is designed to perform the function of synchronism check before allowing a circuit breaker to be closed. The maximum angle between the parts of a system for which closing will be permitted by the relay is referred to as the closing angle and is adjustable over a range of 10 to 60 degrees.

The relay is a single-phase device that receives single-phase voltage from the same phase on each side of the breaker, or the equivalent in the case where a delta-wye power transformer is interposed between the two sources of voltage. It is the angle between these two voltages that forms the basis of synchronism check. Refer to typical external connections, Figure 2.

The relay is designed to be used primarily in those applications where the parts of the system to be joined are interconnected at other points on the system. Even though in synchronism, there may be an angular difference in the voltages existing on either side of the breaker as a result of load flow throughout the interconnected system. It may be desirable to permit closing of the breaker even though an angular difference exists, provided, of course, the angular difference is not great enough to be detrimental to the system or connected equipment. Each application should be checked on an individual basis to determine the maximum angle for which closing can be permitted. Once this angle has been determined, the relay should be set accordingly. If desired, some time delay may be added to insure that the system is stable and that synchronism really exists.

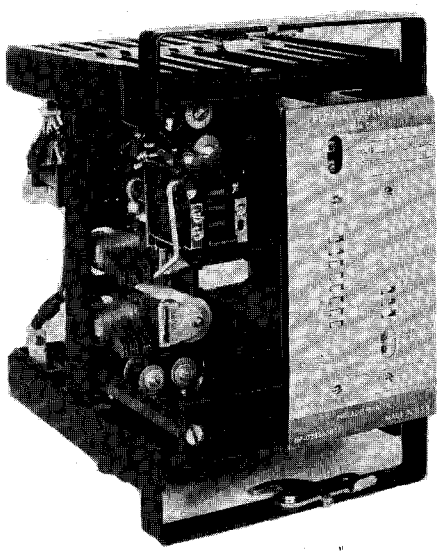
The SLJ21A relay may be used in applications requiring a synchronism check high-speed function for supervision of fast power transfer schemes, for any application requiring fast pickup and dropout, or for any general application where synchronism check is required.

DESCRIPTION

The SLJ21A synchronism check relay uses a block-block type measuring scheme to determine if the angle between the voltages on each side of an open breaker is within a set limit for a set amount of time. This angle is defined as the closing angle and is adjustable by timer TL-1 to permit closure from 10 to 60 electrical degrees. The pick up delay time is provided via timer TL-2 and is adjustable from 20 milliseconds to 20 seconds. The output telephone relay (25) associated with the synchronism check function has a pickup time of approximately 4-6 milliseconds and a dropout time of 16 milliseconds when measured from the moment of coil energization and de-energization, respectively. To these times must be added the respective pickup and dropout times of timers TL-1 and TL-2. Thus, the minimum overall operate time for the synchronism check function is approximately 30 milliseconds, whereas the overall dropout time is approximately 25 milliseconds. The (25) telephone unit is provided with two normally open contacts, one of which has a series-connected target.

Two undervoltage functions, one for monitoring the line voltage and the other for monitoring the bus voltage, operate through common logic and with a common telephone relay (27) to provide various combinations of dead line or dead bus operation. Dropout of each function is separately and continuously adjustable over the range of 10-120 volts.

A contact converter (CC-1) is provided for external control of the synchronism check and/or both voltage functions.



(Photo 8043744)
Fig. 1. Type SLJ21A Relay (out of case)

DEAD-LINE OR DEAD-BUS

In order for the SLJ synchronism check function to provide an output, there must be a voltage present on both sides of the breaker, and the phase angle between these voltages must be within the closing angle setting of the relay. For applications where dead line and/or dead bus operation is required, undervoltage detectors are used to bypass the synchronism check device. These undervoltage devices are included as an integral part of the relay.

REFERENCES:

Dimensions .....Section 16
How to Order .....Section 1
Instruction Books .....Section 17
Target and Contact Data.....Section 16
Relay Standards.....Section 16

RATINGS

Operating Range

The SLJ21A is designed to operate over an ambient temperature range of −20° to +55°C. The phase angle which is set at 25°C and will vary no more than ±2 degrees over a temperature range of 0° to 55°C. An additional −2 degrees variation may occur for temperature between 0° and −20°C. The time-delay timer will vary no more than ±2 percent over the full rated temperature range.

These relays have been designed for continuous operation in ambient temperatures between −20°C and +55°C per ANSI Standard C37.90. In addition, the relay is designed to operate correctly and not malfunction nor be damaged in an ambient temperature up to +65°C.

CONTACT RATINGS

The contacts of the telephone type units will make and carry 30 amperes momentarily and will carry 3 amperes continuously. One contact of the synchronism check unit has a series target coil which (depending on tap setting) may limit the current. The contact interrupting ratings are listed in Table 1.

Seismic

The SLJ21A relay has been tested per IEEE Standard 501-1978. The output contacts have a rating of 6G ZPA.

Surge Protection

The SLJ21A was designed to meet ANSI-C37.90a-1974, IEEE Standard 472-1974 SWC test. It also meets the GE "Fast Transient" test and the GE "RFI" test.

TABLE 1—Telephone Relay Interrupting Ratings

Volts	Interrupt Amps.	
	*Inductive	Non-Inductive
48dc	1.0	3.0
125dc	0.5	1.5
250dc	0.25	0.75
115V-60 Hz	0.75	2.0
230V-60 Hz	0.5	1.0

TABLE 2—Typical Burdens

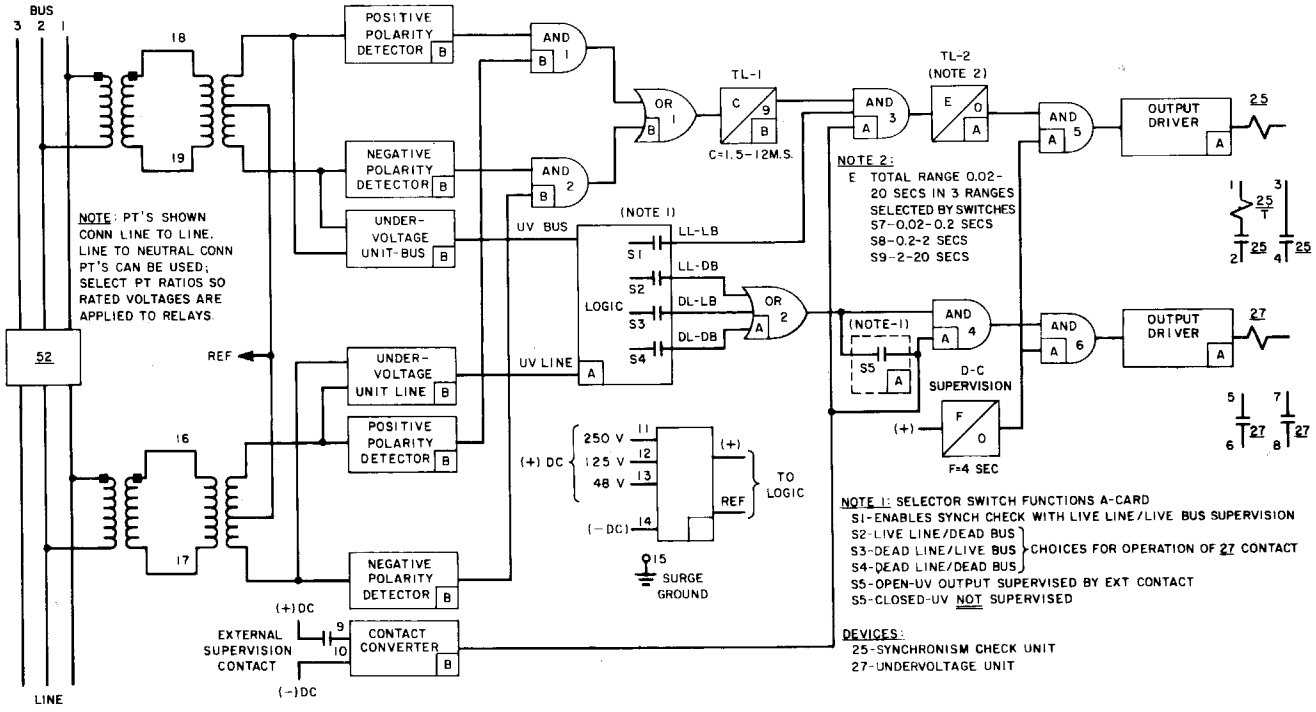
Ac Burden	Watts	Va
Bus Circuit	1.0	1.0
Line Circuit	1.0	1.0

Dc Burden	48V	125V	250V
Watts	5.5	12.5	22

SELECTION GUIDE

Model Number	Frequency Hertz	Volts Ac	Volts Dc	Closing Angle	Target Amps	Operating Time	Case Size	Approx Wt. lb (Kg)	
								Net	Ship
12SLJ21A1A	50/60	120	48 125 250	10° - 60°	0.6/2	20 Milliseconds to 20 Seconds	S2	14 (6.4)	17 (7.7)

CONNECTION DIAGRAM



(Dwg. 0138B7608)

Fig. 2. Typical External Connections & Logic Diagram for SLJ21A

SECTION: 9

Generator Protection Relays

CEH Loss-of-excitation 1

GGP Power Directional (3 phase) 3

CEX57, GSY51 Angle Impendance..... 4

IFCS Time Overcurrent with Voltage Control 6

PJG Machine Field Ground Detector 8

IFCV Time Overcurrent with Voltage Restraint .. 9

SGC Static Negative Sequence Time Overcurrent 11

For High-speed Detection of Loss of Excitation of Synchronous Generators

APPLICATION

The type CEH relays are used for the detection of the loss of excitation of synchronous generators, and to automatically remove the generator from service. Loss of excitation can be damaging to the machine, and/or detrimental to the operation of the system. It is recommended that loss-of-excitation protection be considered for all synchronous generators.

Fig. 3 (see page 10-2) illustrates a unit type generator connected to a power system with an offset mho distance relay at its terminals set as indicated on the R-X diagram. The relay is set with an offset equal to one half the direct axis transient reactance, and a diameter equal to the direct axis synchronous reactance of the generator. Typical impedance loci, as seen by the relay when the excitation is lost as a result of a short circuit across the field windings, are also shown in Fig. 3. Curve A represents loss of excitation from full load conditions. This locus terminates in a region near the negative X axis at a point located approximately at the average of the direct and quadrature axis sub-transient impedances of the generator. In the case of no load, or very light load prior to the loss of excitation, the impedance seen by the relay terminates in an area near the negative X axis as shown by point C. The impedance seen in this case is approximately equal to the average of the direct and quadrature synchronous impedances of the generator. Curve B applies for some moderate condition between full and no load. Thus, the characteristic of Fig. 3 will suffice to detect a loss of excitation from any initial loading. Since a characteristic with settings as illustrated in Fig. 3 is required to detect loss of excitation, it should be ascertained that such an application is secure against undesired operation on stable system swings resulting from system disturbances.

Fig. 4 (see page 10-2) illustrates typical impedance loci as viewed by two offset mho relays located at the generator terminals for different system conditions after a nearby fault is cleared. Two mho characteristics are shown; the larger one with settings as shown in Fig. 3, and the smaller one set with a diameter equal to the impedance of 1.0 per unit on the machine base. Referring to Fig. 3, a loss of excitation will be detected

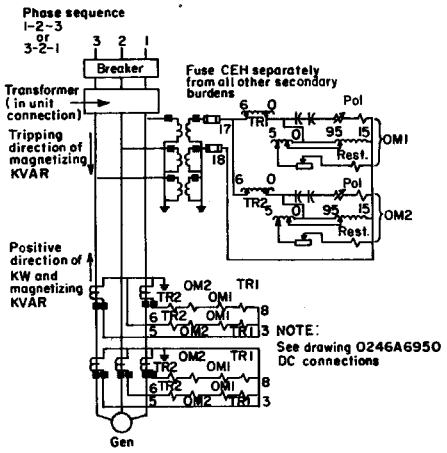
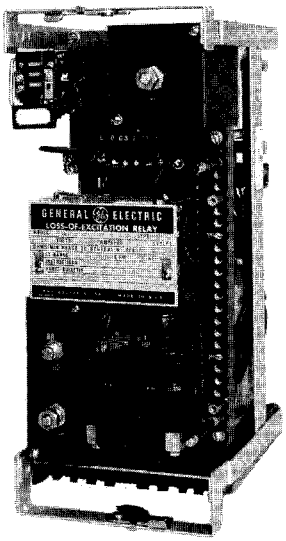


Fig. 1. External ac connections for Type CEH52A relay using wye connected PT's.



(Photo 8041892)

Fig. 2. Type CEH51 relay withdrawn from case.

9

SELECTION GUIDE

Rating			Auxiliary Unit Voltage	Characteristic Circle Diameter (Ohms)①		Offset (Ohms)		T. & S.I. Rat. (Amps)	Time Delay (Secs.)	Model Number	Case Size	Approx Wt in Lbs (Kg)	
Volt	Frequency (Hz)	Current (Amps)		Min	Max	Min	Max					Net	Ship
SINGLE PHASE—1 MHO UNIT													
115	60	5	24/48 48/125 125/250	5	50	0	4	0.2/2.0	....	12CEH51A6A A4A A1A	M-1	24 (10.9)	35 (15.9)
115	50	5	110/220 125/250						....	A5A A3A			
SINGLE PHASE—2 MHO UNITS, 1 STATIC TIMER													
115	60	5	125/250	10	100	0	6	0.2/2.0 0.6/2.0	0.05-3.0	12CEH52A2D A1D	L-2D	34 (15.4)	45 (20.4)

① Phase to neutral secondary basis.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

APPLICATION (Cont'd)

by the mho unit set with the larger characteristic regardless of the load on the generator, whereas the mho unit set with the smaller characteristic will only detect the loss if the generator is operating with a moderate to heavy load.

The dash curve A in Fig. 4 represents the case for conditions of a three-phase short circuit at F, the high side of the unit transformer, occurring when the machine is running at full load and unity power factor L_a. The fault was cleared at the critical switching time, that is, the maximum switching time for which the machine is just stable. When the fault is cleared in nominal relay plus breaker times with the voltage regulator in service, the impedance jumps to point S_a and follows the path of the dash lines back to the region around L_a. This is a stable swing, and the impedance path does not enter either characteristic.

The solid curve B illustrates an extreme case of a similar set of circumstances. In this case:

a. The machine was running under-excited prior to the fault L_b.

b. The fault was not cleared until the critical switching time for the machine in question.

c. Low system impedance.

d. The voltage regulator was out of service.

While the resultant swing was stable and would eventually settle back to the area around L_b, the impedance locus entered the larger relay characteristic. Studies indicate that the duration of its stay in the characteristic is in the order of 0.2 to 0.4 seconds. Thus, if the larger relay characteristic is employed with a time delay set for about 0.5 to 0.6 seconds, undesired tripping will not take place.

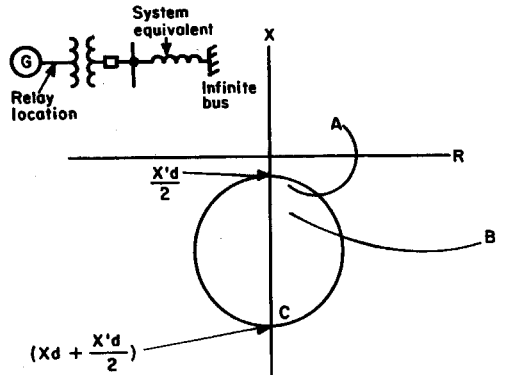
Thus, a mho relay set as in Fig. 3 can detect a loss of excitation for all machine loadings, but it is susceptible to tripping during a stable swing if the conditions of Fig. 4 exist. If two mho functions are used, and set with the diameters shown in Fig. 4, time delay can be incorporated with the larger set function, and incorrect tripping can be avoided. The smaller set function will provide high-speed tripping for a loss of excitation when the machine is carrying moderate to heavy loads. It should be recognized that a bonafide loss of excitation, when the machine is lightly loaded, may be detected only by the mho function set with the larger characteristic. This will result in a delayed trip which may have an adverse effect on the system. This contingency should be evaluated by the user.

Two models of the CEH relay are available for use in loss of excitation detection schemes.

The first model, designated the CEH51A, contains a single mho function. It is designed primarily for use in those applications where the impedance loci will enter the characteristics due only to a loss of excitation; for example, for the conditions shown in Fig. 3.

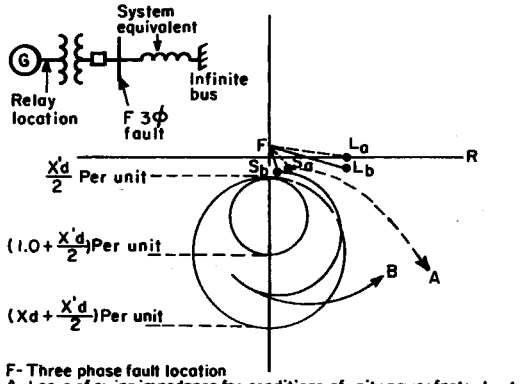
The second model, designated the CEH52A (see Fig. 1, page 11-1), is designed specifically for use in those applications where the impedance loci can enter the required characteristic for other system conditions as well as a bonafide loss of excitation; for example, for the conditions depicted in Fig. 4. This relay contains two independent mho functions and a built in timer that operates in conjunction with one of the mho functions. The mho function without the timer can be set short, as shown in Fig. 4, to provide high-speed tripping for a loss of excitation when the machine is carrying moderate to heavy loads. The second mho function can be set larger as shown in Fig. 4, and through the built in timer provide a delay in tripping so that the machine will ride through any stable swings that may occur. External connections for the CEH52A relay are shown in Fig. 1.

DRAWINGS



A– Short-circuited field at full load
B– Short-circuited field at moderate load
C– Short-circuited field at no load or open-circuited field at no load

Fig. 3. Typical impedance of loci on loss of field excitation.



F– Three phase fault location
A– Locus of swing impedance for conditions of unity power factor load, and/or fast fault clearing, and/or voltage regulator in service (dashed lines)
L_a–Unity power factor 1.0 per unit load impedance.
S_a–Impedance immediately after fault is cleared.
B– Locus of swing impedance for conditions of leading 0.95 power factor load, and fault clearing at critical switching time, and voltage regulator out of service. (solid lines)
L_b–0.95 Leading power factor unit load impedance.
S_b–Impedance immediately after fault is cleared.

Fig. 4. Typical impedance loci for swings resulting from system disturbances.

For Protection of Generators Against Running Light as Synchronous Motors

APPLICATION

Turbine-driven Generators

The usual application of the GGP relay is to prevent motoring of a turbine-driven generator. The real purpose is to protect the turbine not equipped with integral protective means if its steam supply is lost or reduced. Under such a condition the generator will take power from the bus and run light as a synchronous motor, driving the turbine at normal speed. With no steam or insufficient steam present in the turbine, the blades may be damaged by overheating as developed by windage. Under normal operating conditions, such heat is dissipated into the steam.

Unbalanced Systems

The GGP is a 3-phase relay that is suitable for unbalanced loads and is preferred instead of three single-phase relays, giving full power directional protection for all varying conditions. The GGP should be used wherever phase-balancer action, in the presence of unbalanced loads, may cause the failure of single-phase power relays to trip.

Sensitivity

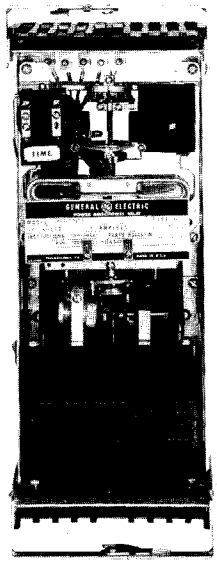
If motoring occurs, resulting in a power reversal (see Selection Guide below for the main unit current setting), the directional unit induction cylinder design of the relay will close contacts at once. These contacts energize the operating coil circuit of the timing unit, which starts to time out. This relay measures true watts, and is practically unaffected by the reactive component. Since the directional unit contacts are brought out to studs, they may also be used to energize an alarm.

Timing

The timing unit can be adjusted to operate in any time from 1.5 to 30 seconds, at which time the contacts close, tripping the generator breaker. If conditions return to normal at any time during the timing cycle, the power-directional unit opens its contacts, thereby de-energizing the timing unit, which resets. Tripping cannot occur unless the power reversal lasts long enough for the timing unit to complete its full travel and close its contacts.

CONTACTS

Electrically separate main and timing contacts, both single-circuit normally open. A 0.2/2-amp target seal-in is available with seal-in contacts connected across the timing (Type IAV) unit contacts. Standard contact ratings for the universal seal-in unit are applicable.



(Photo 841752)

Fig. 1. GGP53C relay (out of case)

BURDENS

Model	Terminals	VA	Watts	PF
CURRENT CIRCUIT—5 AMPS., 60 Hz				
GGP53C	3-4	22.0	6.4	0.29
	5-6	11.0	3.2	0.29
	7-8	11.0	3.2	0.29
POTENTIAL CIRCUIT—120, 60 Hz				
GGP53C	2-12	20.3	7.8	0.38
	13-14	21.4	10.7	0.50
	15-16	21.4	10.7	0.50

SELECTION GUIDE,—3-phase, 5 Amps

Frequency (Hz)	Volts	Target and Seal-in (Amps)	Main Unit Fixed Setting		Timing Unit Adjustment (Seconds)		Model Number	Case Size	Approx Wt in lb (kg)	
			Volts	Amps ①	Min	Max			Net	Ship.
60	120	0.2/2.0	120	0.010	1.5	30	12GGP53C1A	M2	22 (10)	34 (15.4)
50	120						C3A			

① At unit power factor.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

CEX57 and GSY51

Angle Impedance Relays

GE Protective Relays

For Out-of-step Tripping and Blinder Applications — Generators and Transmission Lines

DESCRIPTION

The Type **CEX57** is a family of high-speed induction cup relays with angle impedance characteristics that can be set parallel to the impedance characteristic of a protected line. Generally, these relays are meant to be used with other protective relays in blinder applications to restrict the tripping zone of a scheme or they may be used in applications that require tripping for out-of-step conditions. These are a single-phase relays that includes two ohm units with opposite polarity and may also include an auxiliary telephone type unit.

The Type **GSY51** relay includes a mho distance unit with reverse offset, six auxiliary telephone units and a target-seal in unit all mounted in one drawout case. This relay is intended for use with the **CEX57E** angle impedance relay to provide out-of-step protection for a generator.

APPLICATION

Type **CEX57D** and **CEX57F** relays are intended for use in blinder applications where it is desirable to restrict the tripping zone in transmission line protective schemes. Three **CEX** relays are required per terminal for blinder applications. Tripping will be permitted only when the fault impedance plots within the reach of the mho tripping function and inside both the **CEX57** ohm units. See Fig. 1.

The contacts of the **CEX57D** ohm units are brought out separately and are externally connected in series with the contacts of the corresponding mho tripping function to provide supervision. For the **CEX57F,** the contacts are internally connected in series and are used to operate an auxiliary telephone-type relay. The contacts of this auxiliary are then used to supervise the corresponding mho tripping function.

The out-of-step tripping of transmission lines requires one **CEX57E** and one **NAA19B** relay. The NAA relay includes an overcurrent supervising unit, six auxiliary telephone units and a target-seal in. For further information on this protection scheme, refer to the **NAA19B** in Section 3.

The usual application of the **GSY51A** with associated **CEX57E** is at the terminals of a generator to provide out-of-step protection for the machine. Formerly system and generator impedance characteristics were such that the electrical center during a loss of synchronism condition was located out on the transmission system. Hence, the swing could be detected by line relaying or by out-of-step relaying schemes at selected line terminals. However, with the advent of EHV systems, larger generators and the expansion of transmission systems, generator and step-up transformers impedances have increased in magnitude while system impedances have tended to decrease. As a result, on many systems today, the system impedance center and the electrical center during swings can occur in the generator or in the generator step-up transformer.

Thus, the combination of one **GSY51A** and one **CEX57E** angle impedance relay located at the machine terminals is intended to detect an out-of-step condition when the swing locus passes through the machine or step-up transformer.See Fig. 2.

It is recommended that the **GSY51A** relay be calibrated at the factory for the user's specific application. Field calibration is difficult because of interaction between the various adjustments. The user should specify the relay forward reach in ohms, phase-to-neutral, at 90 degrees lead (into the generator) and the offset reach in ohms, phase-to-neutral, at 270 degrees lead.

OPTIONAL ITEM

A single-phase-to-ground fault that evolves into a double-phase-to-ground condition may appear as an impedance swing to the CEX-GSY scheme. To avoid the possibility of a misoperation under such conditions, a PJC11AV-A instantaneous ground overcurrent relay may be used to supervise the CEX-GSY contact circuit. See Type GSY instruction book for further details.

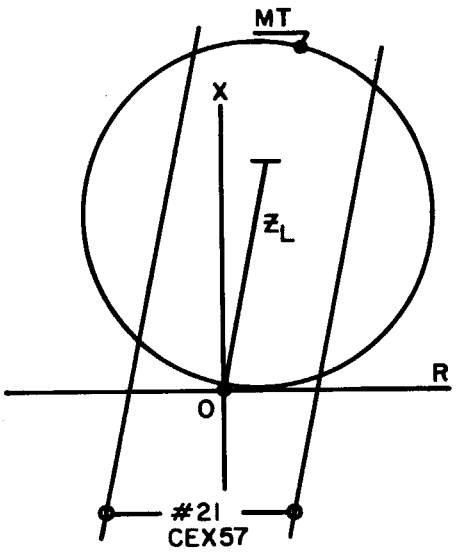


Fig. 1. Typical characteristic CEX57D or CEX57F as a blinder

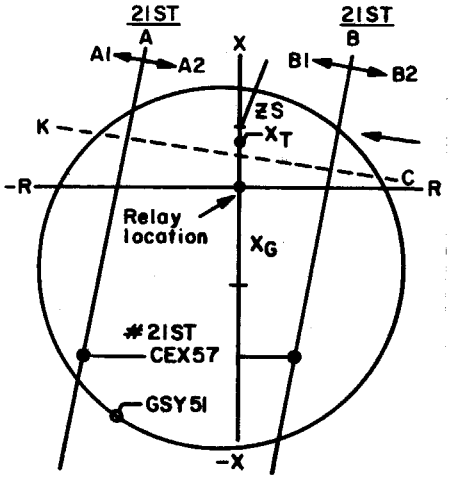


Fig. 2. Typical characteristic CEX57E with GY51A for out-of-step tripping

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

RATINGS

The Type **CEX57** and **GSY51** relays are rated 120-volts, 5-amperes and forms are available for 50 or 60 Hertz applications. The basic minimum ohmic reach taps, phase-to-neutral are:

CEX57—0.5/1.5/3.0 ohms
GSY51—2/4/6 ohms

CONTACTS

The contacts of the CEX57 and GSY51 relays will close and carry momentarily 30 amperes, up to 250V dc. However, the circuit breaker trip circuit must be opened by an auxiliary switch contact or other suitable means since the relay contacts have no interrupting rating.

BURDENS

Relay Type	Frequency Hz	Maximum Current Burden②		Maximum Potential Burden①	
		PF.	VA.	PF.	VA.
CEX57 CEX57	60 50	0.80 0.81	5.13 4.41	0.59 0.69	21.8 20.0
GSY51 ③GSY51	60 ③50	0.93	3.3	0.84	14.87 ....

① Maximum burden is for restraint set at 100%. For other settings see instruction book.
② Burden imposed by each current circuit at 5 amperes and highest basic ohm tap.
③ Burden at 50 Hz will be slightly lower.

SELECTION GUIDE

Blinder Applications—Angle Impedance Units

TYPE CEX57D—(Single-phase—3 Required)—1 NO & 1 NC Contact per Unit, Electrically Separate

AC Rating	DC Control Volts	Ohm Unit Range Ohms	Max Torque Angle	Model Number	Case Size	Approx Wt Lb(Kg)	
						Net	Ship
60 Hz 120V 5 Amp	.....	0.5-30	5-35°	12CEX57D1A	M-2	30(13.6)	36(16.3)
50 Hz 120V 5 Amp	.....	0.5-30	5-35°	12CEX57D2A			

TYPE CEX57F—(Single-phase—3 Required)—Auxiliary Telephone Unit Output of 2 NO Contacts per Relay

60Hz 120V 5 Amp	48/125/250	0.5-30	5-35°	12CEX57F1A	M-2	31(14.1)	37(16.8)
50 Hz 120V 5 Amp	48/125/250	0.5-30	5-35°	12CEX57F2A			

Out-of-Step Tripping Applications

TYPE GSY51A—(One Required)—Use with One CEX57E for Generator Protection

AC Rating	DC Control Volts	Target Seal-In Amp	Mho Unit Range Ohms	Mho Unit Max Torque Angle Lead	Mho Unit Offset①	Offset Max Torque Angle Lead	Model Number②	Case Size	Approx Wt Lb(Kg)	
									Net	Ship
60 Hz 120V 5 Amp	125	0.6/2	2-60	90°	0/4	270°	12GSY51A1A	L-2	33(15)	39(17.7)
50 Hz 120V 5 Amp	125 220	0.6/2 0.6/2	2-60 2-60	90° 90°	0/4 0/4	270° 270°	12GSY51A2A A3A			

① Mho unit has offset steps of 0.5 ohm
② When ordering specify forward reach and offset ohms settings required.

TYPE CEX57E—(One Required) Use with GSY51A Above or Use with NAA19B for Transmission Lines (1 NO & 1 NC Contact per Unit—Common Connection)

AC Rating	DC Control Volts	Ohm Unit Range Ohms	Max Torque Angle	Model Number	Case Size	Approx Wt Lb(Kg)	
						Net	Ship
60 Hz 120V 5 Amp	.....	0.5-3.0	5-35°	12CEX57E1A	M-2	30(13.6)	36(16.3)
50 Hz 120V 5 Amp	.....	0.5-3.0	5-35°	12CEX57E2A			

NOTE: Information on Type NAA19B relay is in Section 3.

IFCS

Time-overcurrent Relays with Voltage Control

GE Protective Relays

DESCRIPTION

The Type IFCS relays include an induction disc time overcurrent unit with wound shading coils controlled by the contact of an undervoltage unit. This overcurrent unit is similiar to the IFC51 (inverse) or the IFC53 (very inverse) except that the shading rings on the U magnet have been replaced with the wound shading coils.

The Type IFCS relays are supplied with two electrically separate contacts. One of these contacts which operates the target seal-in unit is on the induction disc unit and can be used as a trip contact; the second contact of the seal-in unit can be used for alarm or remote indication.

APPLICATION

The Type IFCS relays are designed to provide backup protection at the generator against external phase faults which are not cleared by other protective equipment. An inverse time-overcurrent relay may be used for ground fault protection.

Such back-up protection at the generator is normally provided by either a voltage-controlled inverse time overcurrent relay such as the IFCS, or by a single-step distance relay with definite time delay. The choice between the two forms of back-up relaying depends on the type of relays on the adjacent system with which the back-up relays must be selective. If the adjacent circuits are protected by inverse time overcurrent relaying, then the voltage controlled time-overcurrent relay Type IFCS can be used. Models are available with either inverse or very inverse time characteristics to coordinate with relays of like characteristic on the adjacent system. But if the adjacent circuits are protected by high-speed pilot or step distance relaying, then distance-type relays must be used for the back-up function with the definite time delay provided by an auxiliary timer.

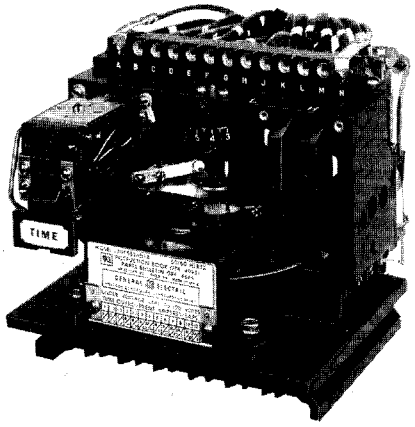
Three single-phase Type IFCS relays are required to provide phase fault back-up protection. The current source for the relays should be current transformers at the neutral ends of the generator windings when such CT's are available. With these connections the relays will, in addition to external fault back-up protection, provide generator fault back-up protection even if the generator breaker is open or there is no other source of generation on the system.

The undervoltage unit in the Type IFCS relay should be supplied with phase-to-phase voltage preferably from the generator potential transformers. The induction disc unit is typically set to pick up on fault currents below maximum load current and is prevented from operating on normal load conditions by the undervoltage unit. It should be recognized that accidental loss of potential to the Type IFCS relay will cause the relay to trip if generator load current in secondary amperes is greater than the pick-up current of the relay. If a second set of potential transformers is available, an additional relay, the Type CFVB voltage balance relay, can be used to prevent false tripping of the IFCS upon accidental loss of its ac voltage source.

The voltage-controlled phase overcurrent relays, and the inverse time overcurrent ground relay if used, should be connected to trip a Type HEA hand reset auxiliary relay that in turn will trip the main and field breakers, and sound an alarm.

AVAILABLE TAPS (Time-overcurrent unit)

1/12 amp—1.0, 1.2, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 10.0, 12.0.



(Photo 8043487)

Fig. 1. Type IFCS relay (removed from case)

Voltage Unit

The burden is at unity power factor and is listed below:

Rated Volts	Maximum Burden Watts
120	4.70

SELECTION GUIDE (0.2/2.0 amp target and seal-in)

Voltage	Frequency Hertz	Undervoltage Calibration Range (Volts)	Time Overcurrent Unit Range (Amps)	Model Number	Case Size	Approx Weight lb (kg)	
						Net	Ship
INVERSE CHARACTERISTIC							
120	60	70-100	1/12	12IFCS51AD1A	C1	8	14
120	50	70-100	1/12	12IFCS51AD2A	C1	8	14
VERY INVERSE CHARACTERISTIC							
120	50/60	70-100	1/12	12IFCS53AD1A	C1	8	14

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

BURDENS
Time-overcurrent Unit

Model	Hz	Range	Min. Tap Amps	Burdens at Min. Pickup Min. Tap (ohms)			Burdens in Ohms (Z) Times Pickup		
				R	J_X	Z	3	10	20
IFCS51	60	1-12	1.0	1.09	4.41	4.55	2.46	1.00	0.77
IFCS53	60			0.35	1.18	1.23	1.21	0.82	0.51
IFCS51	50			0.91	3.68	3.79	1.80	0.83	0.64
IFCS53	50			0.29	0.98	1.03	1.01	0.68	0.43

NOTE: The impedance values given are those for minimum tap, the impedance for other taps at pickup current (tap rating) varies inversely (approximately) as the square of the tap rating. For example, an IFCS53 60 hertz relay has an impedance of 1.23 ohms on the 1.0 ampere tap. The impedance of the 4.0 amp tap is $(1.0/4.0)^2 \times 1.23 = 0.077$ ohms.

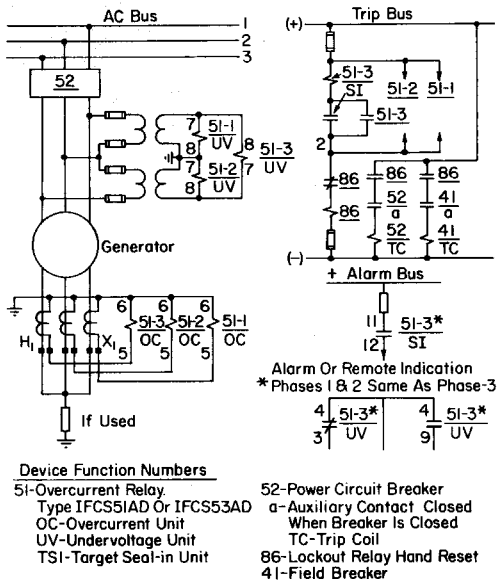


Fig. 3. External connections for relay Type IFCS with generator (275A3812)

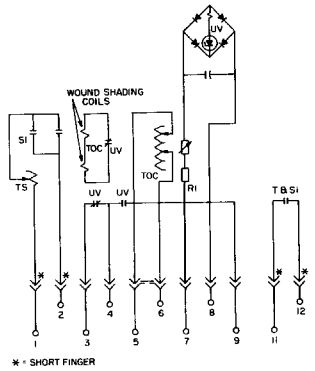


Fig. 5. Internal connection diagram (269A3197) for IFCS relay.

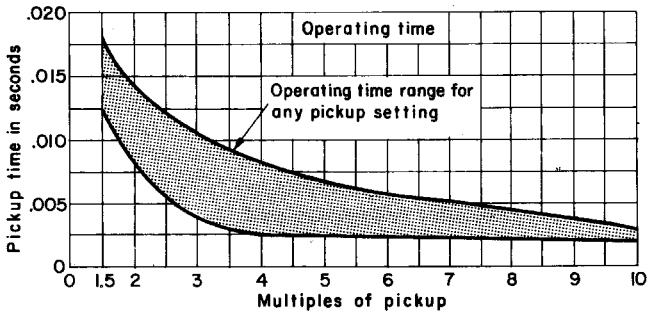


Fig. 2. Time-current curve for instantaneous unit

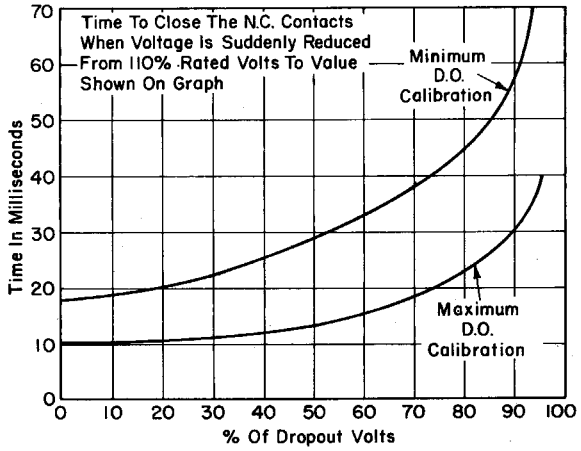


Fig. 4. Operating time curves for the IFCS (165A7560) for voltage unit.

PJG

Machine Field Ground Detector Relay

GE Protective Relays

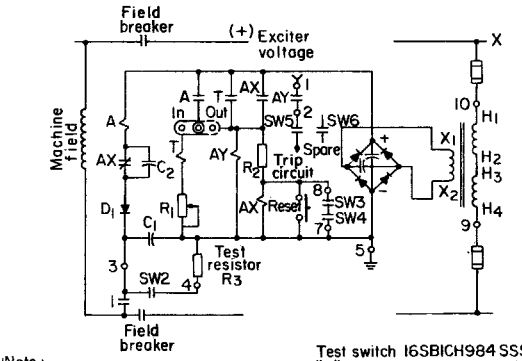
For Detecting Grounds and Preventing Possible Short Circuits

DESCRIPTION

The Type PJG12B relay detects grounds in a normally ungrounded field winding of a synchronous machine. It may be used for machine fields rated 600 volts or less with ceiling excitation up to 750 volts and no more than 1000 volts reverse, or back, excitation. A choice of either instantaneous or time-delayed operation is determined by selection of link position. The PJG12B operates for 120 or 240 volts ac, 50 or 60 Hertz. A filter circuit reduces ripple voltage in the rectifier bridge output to no more than 3 volts peak-to-peak.

The relay is arranged for either hand-reset or electric reset from a separate switch or push button.

The PJG12B consists of a plunger-type instantaneous overcurrent relay (A), a thermal time-delay unit (T), a hinged-armature auxiliary unit (AX), and a voltage operated instantaneous unit (AY) which provides output contacts and target indication. The output contacts (AY) will make and carry 6 amperes continuously and 30 amperes for tripping duty.



Note:
1. Stud numbers refer to PJG12B relay.
2. Transformer primary shown connected for 240 VAC. For 120 VAC, primaries are connected as follows: H1 H3 to 10; H2 H4 to 9
3. This test checks correct relay operation but not the fact that the rotor is properly grounded.

Test switch 16SB1CH984SSS(-)V
"X" denotes contact closed

Contacts Handle end		SW	(FV) Positions Nor	Reset	Test
1	2	1	X		
		2			X
3	4	3		X	
		4		X	
5	6	5	X		
		6		X	X

Fig. 1. Typical connections for Type PJG12B relay



(Photo 8008306)

Fig. 2. Type PJG ground detector relay

APPLICATION

Short circuits in normally-ungrounded fields of synchronous machines can often be prevented by detecting and removing a ground before a second ground results in a short circuit and possible serious damage. The Type PJG12B relay is designed for the detection of such grounds and can be used to sound an alarm or for tripping duty.

To ensure that this protection will function for a ground in the field winding, it is necessary that the rotor iron be grounded without depending on a path through the bearings, since this oil film may withstand the voltage applied by the relay, and thus prevent the relay from operating when required. Grounding means must not be installed where it will bypass the bearing insulation which is provided for prevention of shaft currents.①

The PJG12B may be used for instantaneous or time-delayed operation. The time delay is intended to override transient conditions which may occur when an excitation system is transferred between manual and automatic control. It is also desirable to prevent operation of this relay for grounds that may occur during maintenance on the field metering circuits. For instantaneous operation, the operating time is no more than 100 milliseconds at rated voltage. For time-delay operation, relay operating time is 2.0 ± 0.5 seconds at rated voltage and 25°C ambient temperature.

SENSITIVITY

The ground detector unit will respond to grounds in the negative field lead of up to 500 ohms at 80 percent of rated ac relay voltage.

BURDENS

The maximum burdens of these relays at their rated voltage and frequency are 66 volt-amps for 60 Hertz and 33 volt-amps for 50 Hertz applications.

SELECTION GUIDE

Volts② Ac	Freq Hz.	Machine Field Voltage-Vdc Nominal	Ceiling	Reverse	Model Number③	PJG Models Superseded by PJG12B1A	Case Size	Approx Wt in lb (Kg) Net	Ship
120/240	50/60	600	750	1000	12PJG12B1A	12PJG11B1A, 2A 12PJG11E3A 12PJG11F6A 12PJG11H1A	M1	23 (10.4)	28 (12.7)

① Recommended field grounding practice for a particular machine should be obtained from the machine manufacturer.

② Relay will be connected for 240 volts if requested on the requisition. Otherwise relay will be furnished connected for 120 volts. Voltage may be easily changed from 120 to 240 volts or vice-versa in the field.

③ Does not include test switch. Recommended switch is Model Number 16SB1CH984SSS(-)V.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

DESCRIPTION

The Type IFCV relays are drawout, induction-disc time-overcurrent relays having voltage restraint and inverse time characteristics.

The Type IFCV relays are supplied with two electrically separate contacts. One of these contacts, which operates the target seal-in unit, is on the induction disc unit and can be used as a trip contact; the second contact of the seal-in unit can be used for alarm or remote indication.

WHERE TO USE

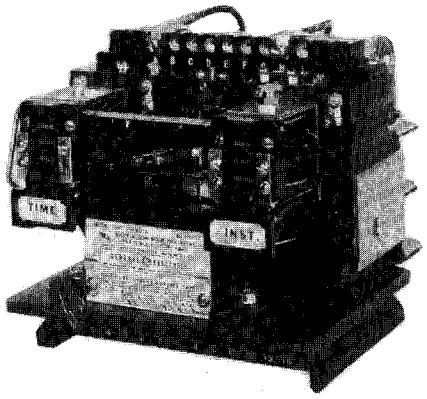
System Fault Backup Protection should be provided at the source of fault current, the generator, to minimize the damage resulting from a short circuit if the primary protective devices should fail to operate. Overcurrent relays with voltage restraint, Type IFCV, are recommended for this application. Three single-phase relays are required for each generator, with potential coils energized from line-to-line potential of the protected line. With full voltage applied to the restraint coil the relay should be set to pick up between 150 and 200 percent of full load on unregulated machines, and between 200 and 250 percent on regulated generators. For best protection the relays should be connected to trip both the armature and field breaker. This can be effected by means of a multicontact auxiliary relay, Type HSA.

Generator Fault Backup Protection. Under certain conditions this relay will provide protection for the generator. It will operate if an internal fault is not cleared by differential relays, provided sufficient current is fed into the fault from other sources.

Voltage Restraint will prevent the relay from operating on heavy loads such as motor-starting currents. With zero restraint voltage the relay will operate at 25 percent of tap value. Therefore, complete loss of restraint potential will usually allow the relay to operate even though machine output is less than full load. High sensitivity is achieved with the voltage restraint feature, and the relay requires less current to operate on faults than on loads or power swings.

Relay Time Characteristics are suitable for obtaining selectivity with feeder circuits which utilize time-overcurrent relays.

Typical internal and external connections are shown on page 2.



(Photo 8043510)

Fig. 1. IFCV51BD Relay removed from case.

BURDENS—Time-overcurrent Unit

POTENTIAL CIRCUIT

Volts	Frequency (Hz)	Watts	VARS	VA
120	50	9.26	14.4	17.1
120	60	9.43	17.3	19.7

CURRENT CIRCUIT

Range	Freq.	Tap	Amp	Imp Ohms	VA	PF
2-16	50	2	5	3.10	77.5	.43
2-16	60	2	5	2.58	64.5	.43

Instantaneous Unit

Hi Seismic Inst. Unit (Amps)	Hz	Line Position	Range (Amps)	Min Pickup (Amps)	Burdens at Min. Pickup (Ohms)			Burdens in Ohms (Z) Times Pickup		
					R	J_X	Z	3	10	20
6-150	60	L	6-30	6	0.110	0.078	0.135	0.095	0.081	0.079
		H	30-150	30	0.022	0.005	0.023	0.022	0.022	0.022
6-150	50	L	6-30	6	0.092	0.065	0.112	0.079	0.068	0.066
		H	30-150	30	0.018	0.004	0.019	0.018	0.018	0.018

SELECTION GUIDE—Single-phase (with 0.2/2.0 Amp T&SI)

Current Operating Range (Amps)			Restraint (Volts)	Model Number		Contacts ①	Case Size	Approx Weight in lb (kg)	
Time Overcurrent Unit		Instantaneous Unit		60 Hertz	50 Hertz			Net	Ship
At Rated Voltage	At Zero Volts								
2-16	0.5-4	—	120	12IFCV51AD1A	12IFCV51AD2A	2-N.O.	C1	8 (3.6)	14 (6.3)
2-16	0.5-4	6-150	120	12IFCV51BD1A	12IFCV51BD2A				

① See description paragraph above.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

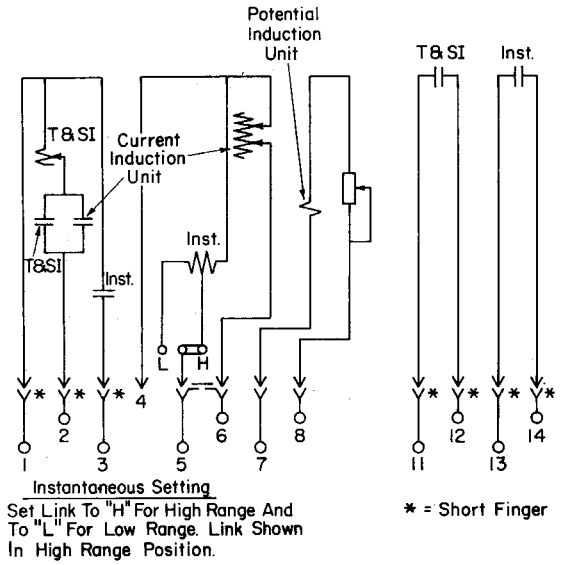


Fig. 2. Internal connections Type IFCV51BD relay (0275A3203)

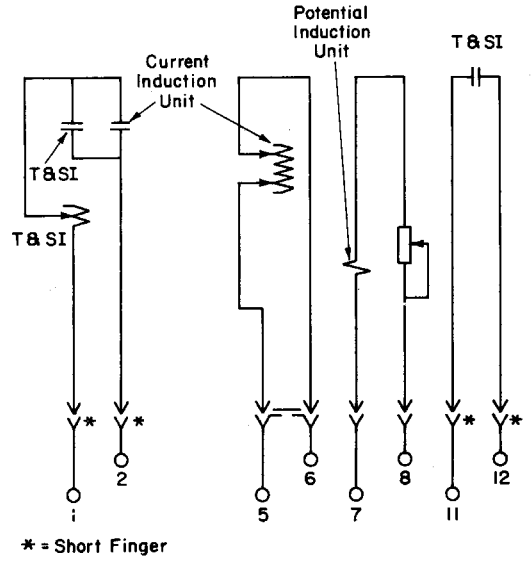


Fig. 3. Internal connections of Type IFCV51AD relay (0273A9599)

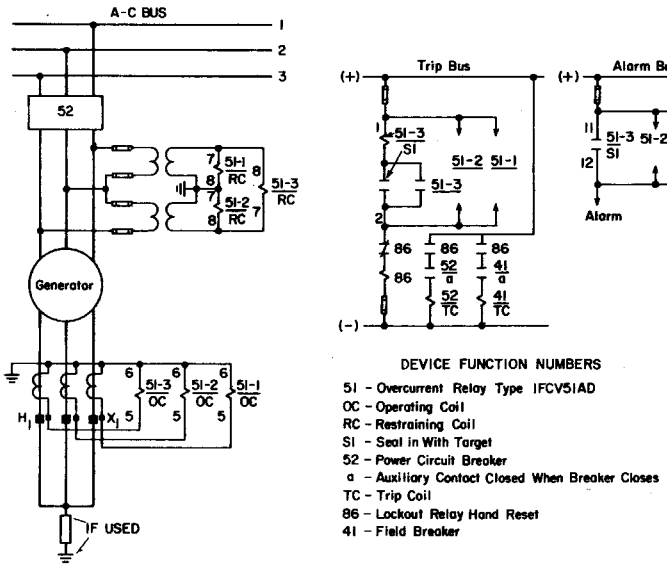


Fig. 4. Typical external connections of IFCV relays for back-up protection against external faults (275A4451) to a generator.

For the Protection of Generators from Unbalanced Phase Currents

DESCRIPTION

The Type SGC relay is a static negative-sequence time overcurrent relay. It is intended primarily for the protection of generators against possible damage from unbalanced currents resulting from prolonged faults or unbalanced load conditions. The SGC features high sensitivity and dial selection of K setting from K=2 to K=40. A reset memory approximates machine cooling following intermittent negative-sequence overcurrent. The SGC comes in a standard M-2 drawout case.

APPLICATION

When a generator is subjected to an unbalanced fault or load, its stator current includes a negative-sequence component (I_2). This current sets up a counter-rotating flux field in the machine which causes double frequency currents to flow in the rotor iron and slot wedges, resulting in local heating. This heating will not be excessive if I_2^2t is less than K, a constant of the machine, where I_2^2t is the integrated product of negative-sequence current squared (I_2^2) and the duration of the fault (t) in seconds. The time characteristic of the trip circuit of the SGC relay is $I_2^2t = K$, with K being continuously adjustable from 2 to 40 (see figure 2, next page). This permits matching the characteristics of the relay with the I_2^2t capability of the machine to be protected.

The Type SGC relay is designed to protect the generator from damage due to abnormal conditions on the system rather than from damage caused by internal faults. The SGC is thus in a sense providing backup protection for system relays. Hence, while it is essential that the time characteristic (value of K) be selected so that the machine will be cleared before suffering damage from an external unbalanced condition, it is also necessary that the relaying schemes responding to system faults be selected so that their correct operation will remove the fault before the SGC operates.

OPERATION

Input Sensing

The SGC has a negative-sequence network which accepts inputs from the three CT phase currents and develops the negative-sequence component (I_2) of the generator current. The output of the network is adjusted by the input tap setting to establish a per unit reference level as close as possible to full load generator current. Taps are provided in 0.2 ampere steps from 3.1 to 4.9 (5 amp relay) and .62 to .98 (1 amp relay) for matching to the CT secondary current corresponding to the rated full load generator current.

Trip Function

The per unit negative-sequence component (I_2) is integrated, with respect to time, to achieve the operating time characteristic of $I_2^2t = K$, where K is continuously adjustable from 2 to 40. The integrator is enabled by a Trip Level Detector which has an adjustable set point of 0.04 to 0.40 per unit of tapsetting. (Corresponding closely to 0.04 to 0.40 of full load generator current). When I_2 exceeds the set point, integration commences and a timer also starts. The timer causes operation after 10-990 seconds, however the unit will not operate in less than 0.2 seconds.

Reset Function

The dropout of the trip-level detector is close to its pickup. Thus if I_2 were to fall below pickup value before the timing cycle were completed, the integrator would stop and a linear ramp resetting of the integrator would commence at the rate of 2.5 seconds for each percent of full time (250 seconds) achieved in the timing cycle at dropout. This approximates machine cooling following intermittent current. If I_2 were to increase again above pickup, the integrator would again be initiated, beginning at whatever value the reset function had reduced it to.

Alarm Function

The alarm circuit is initiated by the per unit negative-sequence component (I_2) with a pickup adjustment range of 0.02 to 0.20 per unit of generator current. An inherent time delay of 3 seconds is provided to eliminate nuisance alarms on transient conditions.

Indication

Visual indication of the Alarm Level Detector is provided by a light-emitting diode (LED). Similarly an LED indicates power supply operation.

Remote Readout

The SGC21A, B, & C relays provide an output point which permits monitoring the negative-sequence current (I_2) level by means of a switchboard instrument supplied with the relay for remote mounting.

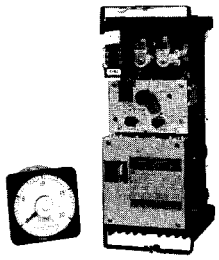


Fig. 1. Type SGC21B Static Negative Sequence Time-overcurrent relay (out of case)

The instrument is a GE Type DB-40 dc microammeter calibrated to indicate I_2 as a percentage of input tap block setting. Full scale is 20 percent.

The connection between the relay terminal and the remote meter should be made with a shielded twisted pair number 18 AWG or larger with the shield grounded at the relay.

Ambient Temperature

−20 C to +65 C.

BURDEN

The ac current burden is less than 0.20 ohms per phase.

Contact Outputs

One normally open contact is provided for the trip function with a target seal-in unit. One normally open contact is provided for the alarm function.

POWER SUPPLY

The SGC relays in this section have a regulated dc power supply and will perform properly over a range of dc control from 80 percent to 110 percent of rated voltage. The dc power supply presents a burden of less than 8 watts untripped or less than 12 watts tripped for 48V or 110/125V dc.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

TRIPPING CONTACT RATING

The tripping contact will make and carry 30 amperes dc for tripping duty at control voltages of 125V dc or less. However, the circuit breaker trip circuit must be opened by an auxiliary switch contact or other suitable means.

CT Secondary Circuits

5 amp relay

Continuous current—10 amp on any or all CT secondaries.

One-second current—250 amp on any or all CT secondaries.

1 amp relay

Continuous current—2 amp on any or all CT secondaries.

One-second current—50 amp on any or all CT secondaries.

Accessory

A card extender (catalog number 184B5645G1) is available for testing the printed circuit cards. It should be listed as a separate item on an order.

Alarm Contact Ratings

The alarm function contact (1 N.O.) will make and carry 3 amperes continuously or 30 amperes for 2 seconds. Interrupting ratings are:

ALARM UNIT CONTACT INTERRUPTING RATINGS

Voltage	Amperes	
	Inductive④	Non-inductive
Ac		
115	0.75	2.0
230	0.5	1.5
Dc		
48	1.0	3.0
125	0.5	1.5

④ The inductive rating is based on the inductance of a coil having an L/R ratio of approximately 3 to 1.

TAP BLOCK SETTING

Taps are available in 0.2 amp steps between 3.1 and 4.9 amperes and cover the normal load current range from 3.0 - 5.0 amperes on 5 amp relays. On the 1 amp relays taps are available in 0.2 amp steps between 0.62 - 0.98 and cover the normal load current from 0.6 - 1.0 ampere.

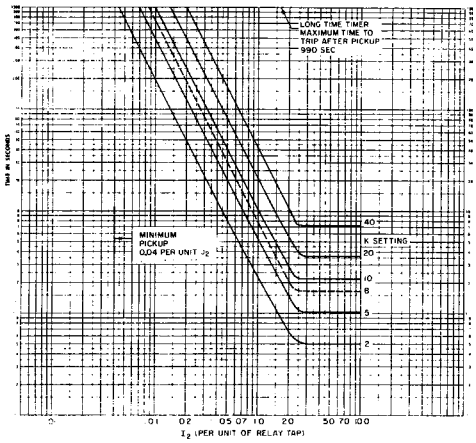


Fig. 2. Type SGC Typical Time-current characteristics—$I_2^2t = K$.

SELECTION GUIDE

1—N.O. Tripping Contact and 1—N.O. Alarm Contact

AC Rating		Power Supply Voltage	Target Seal-in	I_2 Remote①	Minimum I_2 Sensitivity (P.U.)		I_2^2T Range	Model No.	Case Size	Approx Wt lb (kg)	
Hz	(Dc Amps)	(Dc)	(Dc Amps)	Readout	Trip Function	Alarm Function				Net	Shipping
60	5	48/110/125						12SGC21A1A			
50	5	48/110/125	0.2/2.0	NO①	0.04-0.40	0.02-0.20	2-40	12SGC21A2A	M-2	20(9.1)	28 (12.7)
50	1	48/110/125						12SGC21A3A			
60	5	125/250③						12SGC21A4A			
60	5	48/110/125						12SGC21B1A			
50	5	48/110/125	0.2/2.0	YES	0.04-0.40	0.02-0.20	2-40	12SGC21B2A	M-2	24 (10.9)	32 (14.5)
50	5	125/220③						12SGC21B3A			
60	5	125/250③						12SGC21B4A			
60	5	48/110/125						12SGC21C1A			
50	5	48/110/125	0.2/2.0	NO①	0.04-0.40		**2-40**	12SGC21C2A	M-2	20 (9.1)	28 (12.7)
60	5	125/250③						12SGC21C3A			

① Includes remote readout circuitry but no external DB-40 instrument.

② Measured in per unit (P.U.) of tap setting which closely corresponds to full load generator current.

③ Includes an external pre-regulator to allow use of higher voltage.

CONNECTION DIAGRAM

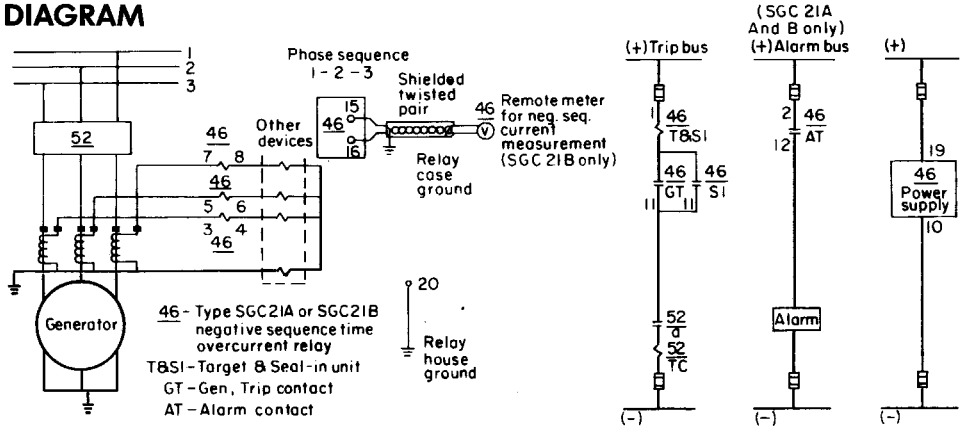


Fig. 3. Typical External Connections For Type SGC Relay.

SECTION: 10

Voltage and Frequency Relays

CFV, CFVB High-speed Voltage Balance 1

IAV Time Delay Voltage 3

ICR Phase-sequence and Undervoltage 7

IFV Time Delay Voltage 9

NBV Voltage Unbalance 12

NGV Voltage 13

PJV Instantaneous Voltage 15

STV Overexcitation 17

SFF Substitution 18

SFF200 Static Digital Frequency 19

IJF Over-and Under-frequency 22

TOV 1000 Modular Voltage 24

TOV 1000C Modular Voltage 28

CFV and CFVB

High Speed Undervoltage and Voltage-balance Relays

GE Protective Relays

APPLICATION

UNDERVOLTAGE PHASE-FAULT DETECTION is provided by the Type CFV12 relay and is used in preference to the Type ICR when high-speed operation is desired. The drop-out on a phase-to-phase fault will be approximately 20 percent lower than the calibrated dropout on a 3-phase fault. Where more accurate fault detection is required, it is recommended that three single-phase Type CFV16A relays be used. They will have the same dropout on single- or three-phase faults.

PHASE SEQUENCE of a three-phase system can be continuously checked by the Type CFV12 relay in addition to providing undervoltage fault detection.

GROUND-FAULT DETECTION is provided by the CFV16B relay using one single-phase relay across the broken-delta corner of a wye-delta transformer.

VOLTAGE-BALANCE RELAYS, type CFVB11B, are used to block other relays or devices that will operate incorrectly when a potential transformer fuse blows. They require two sets of potential transformers that normally receive the same primary voltage during the time when blown-fuse protection is required.

CONTACT RATING

Current Closing — 30 amperes, 250 volts maximum.

Current Carrying Ratings are limited by the different ratings of the target and holding coils. The choice of these ratings depends on the current taken by the tripping circuit. Refer to target and contact data in Section 16.

TARGET AND HOLDING COIL RATINGS — AC OR AMPERES

Rating of Coil	1 amp	0.2 amp
Tripping Duty	30.0	5.0
Carry Continuously	2.0	0.5

The dc resistance of the target coil and the holding coils are 0.25 ohms each for the 1.0-amp target, 7 ohms each for the 0.2-amp target. For the universal target, the resistance is 0.13 ohms for the 2-amp tap and 7 ohms for the 2-amp tap.

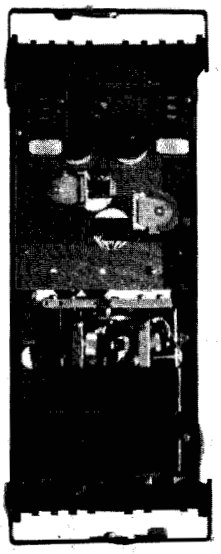


Fig. 1. CFVB11B Relay (out of case)

10

SELECTION GUIDE

Frequency (Hz)	Voltage	Calibration Range (Dropout Volts)	Holding Coil (Amps dc)	Target Coil (Amps dc)	Model Number	Case Size	Approx. Wt. lb. (kg) Net	Approx. Wt. lb. (kg) Ship
SINGLE-PHASE VOLTAGE 1-N.O., 1-N.C.–TARGET AND HOLDING COIL ON N.C. CONTACT-SHORTING BAR ACROSS N.O. CONTACT								
		15-45	1.0	1.0	12CFV16A4A			
		15-45	0.2	0.2	A5A			
		15-45	—	—	A6A			
60	115	30-105	1.0	1.0	A1A		12 (5.4)	18 (8.1)
		30-105	0.2	0.2	A2A	S1		
		30-105	—	—	A3A			
		30-105	—	1.0	A15A			
50	110	30-105	0.2	0.2	A17A			
SINGLE-PHASE VOLTAGE 1-N.O., 1-N.C.–TARGET AND HOLDING COIL ON N.O. CONTACT-SHORTING BAR ACROSS N.C. CONTACT								
		15-45	1.0	1.0	12CFV16B4A			
		15-45	0.2	0.2	B5A			
		15-45	—	—	B6A			
60	115	30-105	1.0	1.0	B1A		12 (5.4)	18 (8.1)
		30-105	0.2	0.2	B2A	S1		
		30-105	—	—	B3A			
THREE-PHASE UNDERVOLTAGE AND PHASE SEQUENCE 1-N.O., 1-N.C. (HOLDING COIL ON BOTH)								
60	115	30-120	1.0	1.0	12CFV12A3A			
		30-120	0.2	0.2	A4A			
							12 (5.4)	18 (8.1)
50	115	30-120	0.2	0.2	A12A	S1		
		30-120	1.0	1.0	A13A			

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

CFV and CFVB

High Speed Undervoltage and Voltage-balance Relays

GE Protective Relays

Frequency (Hz)	Rated Voltage	Calibration Range (Dropout Volts)	Model Number	Aux. Relay Voltage (dc)	Case Size	Approx. Wt. in lb (kg) Net	Ship
THREE-PHASE VOLTAGE BALANCE 2-N.C. AND 1-N.O.							
60	120	50-95% of rated voltage on either source when other source is 100% same.	12CFVB11B1A	125/250	M2	22 (9.9)	34 (15.4)
			B5A	48/125			
			B6A	110/220			
	100		B4A	110/220			
50	120		B2A	125/250			
			B3A	110/220			
			B7A	48/125			

BURDENS

CFV

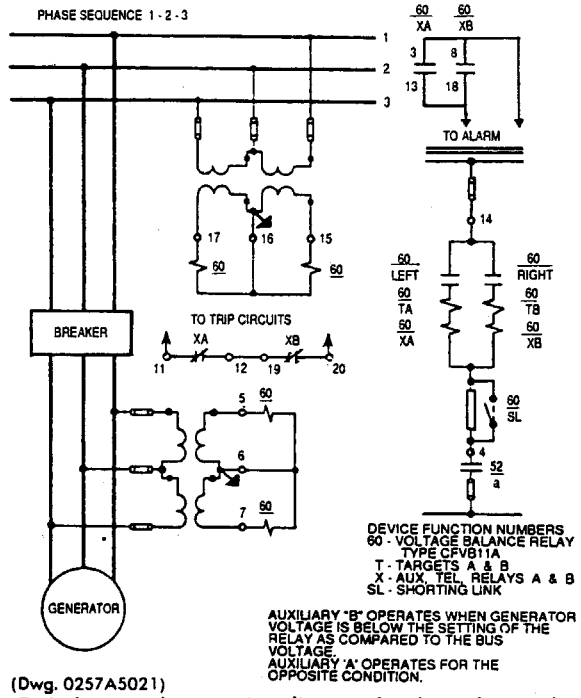
Relay	Volts	Freq.	Dropout	Studs	Watts	Vars.	Volt-Amp.
CFV12A	115	60	6-25	5-6	3.8	3.9	5.4
			6-25	7-8	11.0	12.2	17.0
			30-120	5-6	3.8	3.9	5.4
			30-120	7-8	11.8	12.2	17.0
			40-160	7-8	11.7	12.3	17.0
		50	6-25	5-6	4.3	4.5	6.4
			6-25	7-8	14.2	14.9	20.3
			30-120	5-6	4.3	4.5	6.4
			30-120	7-8	14.2	14.9	20.3
CF16A or CFV16B	115	60	6-20	5-6	14.4	3.2†	14.8
			15-45		12.2	1.6†	14.8
			30-105		12.2	1.6†	14.8
		50	6-20		14.7	3.0†	15.0
			15-45		10.8	2.2†	11.0
			30-105		10.8	2.2†	11.0
	110		30-105		9.0	1.8†	9.2

†Capacitive

CFVB (120 VOLTS)

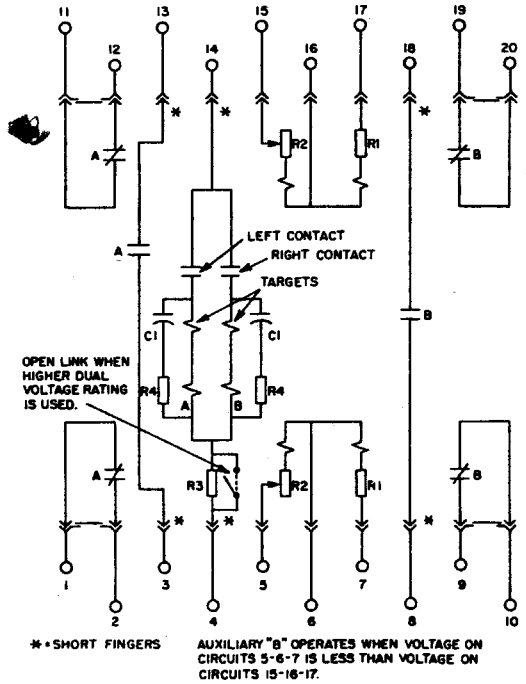
Circuit	Frequency (Cycles)	Impedance (Ohms)	P.F.	V.A.
5-6	60	5075	0.97	2.83
6-7		2240	0.97	6.43
15-16		5075	0.97	2.83
16-17		2240	0.97	6.43
5-6	50	5080	0.97	2.83
6-7		2155	0.97	6.68
15-16		5080	0.97	2.83
16-17		2155	0.97	6.68

CONNECTION DIAGRAMS



(Dwg. 0257A5021)

Fig. 2. Typical external connection diagram for three-phase voltage balance relay, Type CFVB11B, used to indicate when a potential transformer fuse flows.



(Dwg. 0246A6890-0)

Fig. 3. Internal diagram for CFVB11B Relay.

DESCRIPTION

The Type IAV relays are single phase induction disk relays designed to respond, with time delay, to either an increasing or a decreasing voltage, or both. Some models are frequency compensated, and some include an instantaneous unit (hinged armature type). Most models listed in the Selection Guide include a target seal-in unit on all contacts.

The basic mechanism of all models is an induction-disk unit with either a tapped coil or a tapped resistor for setting pickup.

[In the overvoltage models, the relay is calibrated on increasing voltage to close the normally open contact at tap setting. The time dial adjusts the angle through which the disk rotates and, hence, the time delay.]

In the undervoltage models, the relay is calibrated on decreasing voltage to close the normally closed contact at tap setting. The time dial adjusts the angle through which the disk rotates at voltages above tap setting.

In the combined overvoltage and undervoltage models, the relay is calibrated on increasing voltages to close the normally open contacts at tap setting and on decreasing voltages to close the normally closed contacts at various percentages of tap setting.

For the undervoltage and combined undervoltage and overvoltage relays, the two connecting plug S2 case is used to prevent false tripping when the relay is removed or replaced. Either plug completes the coil circuit and thus opens the normally closed contact used with undervoltage operation. Both plugs are needed to complete the contact circuits.

APPLICATION

OVERVOLTAGE RELAYS

Type IAV overvoltage relays are used for protection against simple overvoltage, but other applications are also common. They are applied to ground detection, both on feeders and on ac generators, and they are also used in timed switching arrangements, where their dependability and accuracy make them preferable to purely mechanical timing relays.

For protection against overvoltage in a three-phase system, use the IAV51A relay (Fig. 2). For instantaneous protection as well as time delay, use the IAV71B.

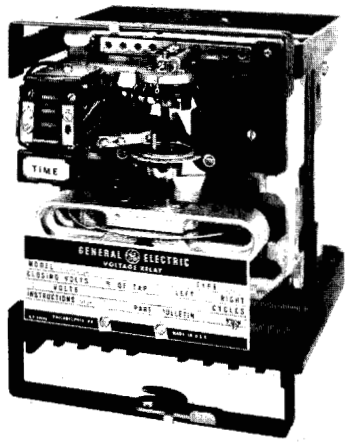
For the detection of grounds on ungrounded three-phase systems, two methods are in general use. One measures the zero sequence potential (Fig. 4), and the other measures the actual voltage between the system neutral and ground (Fig. 6).

For the circuit of Figure 4, use Type IAV51D, a low pickup relay which has its operating circuit tuned to the rated frequency. The potential transformers used in this circuit are connected grounded-Y primary, broken- delta secondary. The primaries should have ratings equal to the line-to-line voltage of the system, and the secondaries can have ratings of either 67 or 115 volts.

Select a relay model with a continuous rating of three times the potential transformer secondary voltage. This is necessary because, when a ground occurs, the zero sequence voltage may be up to three times the normal transformer secondary voltage. Thus, with a potential transformer secondary rated 67 volts, use a 199-volt relay coil. For ground fault protection of ac rotating machines, use a circuit similar to that shown in Figure 6 applying Type IAV51D or IAV51K relays. These are low-pickup relays whose coil circuits are tuned by capacitors to their rated frequencies. The circuits are thus rendered only one-eighth as sensitive to the third harmonic as they are to the rated frequency.

In Figure 6, a distribution transformer is connected between the machine neutral of the generator and ground. Normally there is no voltage on the transformer but during a fault, there is a voltage with a worst-case magnitude equal to the phase-to-ground value.

Greater sensitivity can be obtained by choosing a distribution transformer with higher secondary voltage. In such a case, the relay will not carry the fault voltage continuously, and provision must be made to de-energize the operating coil using an auxiliary relay. The short-time rating for both IAV51D and IAV51K is 360 volts for 10 seconds.



(Photo 8043218)
Fig. 1. Type IAV71A overvoltage relay (out of case)

The IAV51M relay may be used for a definite time delay and the time is adjustable from 3 to 30 seconds by means of a time dial. Operating time is defined as the time to close the contacts with voltage suddenly raised from zero to the rated value.

UNDERVOLTAGE RELAYS

For simple undervoltage protection, select the IAV relay according to the time voltage characteristic required.

In a typical automatic-preferred emergency throwover scheme, the undervoltage contacts of the IAV54E relay are used to trip the circuit breaker in the normal source circuit, and the auxiliary switch (52b) of this normal source breaker permits the voltage closing contacts of an IAV51A relay in the emergency source to close its circuit breaker.

COMBINED UNDERVOLTAGE AND OVERVOLTAGE RELAYS

Types IAV53, IAV69, IAV70, and IAV73 relays are time-delay, over- and undervoltage relays having two contacts, one of which closes on overvoltage and the other on undervoltage.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

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FREQUENCY COMPENSATION

The following Type IAV relays are frequency compensated:

Overvoltage relays—IAV71, IAV72

Undervoltage relays—IAV74A

Undervoltage and Overvoltage relays—IAV73A, IAV73B

These relays have uniform characteristics over a frequency range of 30-90 Hertz. A typical application is on systems supplied by hydro-generators, where the frequency tends to increase when faults occur. Frequency compensation is provided by an R-C circuit across the wound shading coils of the induction disk operating coil and core unit.

CHARACTERISTICS

Type IAV relays will continuously withstand rated voltage on all taps, and tap voltage on all taps above rated voltage. For the minimum and maximum taps shown in the list below, the following intermediate taps are available:

Tap Range	Taps Available
5.4-20	5.4, 7.5, 12.5, 20
10-40	10, 15, 25, 40
16-64	16, 24, 40, 64
28-112	28, 42, 70, 112
55-140	55, 64, 70, 82, 93, 105, 120, 140
110-280	110, 128, 140, 164, 186, 210, 240, 280
220-560	220, 256, 280, 328, 372, 420, 480, 560

The overvoltage relays and the undervoltage relays are provided with time dials for adjustment of time delay.

The combined under- and overvoltage relays are made both with and without time-delay adjustment. Models IAV53, -69, and -73 have time delays which are functions of the setting of the undervoltage contacts. Model IAV70 has a time dial which permits adjustment of time delay independently of the voltage settings.

TRIPPING CIRCUITS AND CONTACT RATINGS

The current carrying rating of the contact circuit is determined by whether the relay has a seal-in unit and by the tap used on the seal-in coil. Without a seal-in unit the relay contacts will close and carry 30 amperes for tripping duty and 2 amperes continuously at control voltages of 250 volts dc or less. Refer to Section 16 for data on target seal-in units.

SELECTION GUIDE—Type IAV

General Description	Rated Volts Ac	Tap Range Volts Min	Tap Range Volts Max	Target Seal-in	Contacts	Model Numbers 60 Hertz	Model Numbers 50 Hertz	Case Size	Approx Wt, lb (kg) Net	Approx Wt, lb (kg) Ship
OVERVOLTAGE (DEVICE No. 59)										
General duty, overvoltage and control switching. Time delay 1 to 10 seconds at 1.6 times tap setting.	115 208 230 460	55 70 110 220	140 140 280 560	0.2/2	1-N.O.	12IAV51A1A A7A A2A A3A	12IAV51A4A A9A A5A A11A	S1	12 (5.4)	15 (6.8)
Same as IAV51A except 2-N.O. Contacts 1-Target Seal-in.	115 199 230	55 70 110	140 140 280	0.2/2 (1)	2-N.O.	12IAV52A1A A7A A2A	12IAV52A4A A9A A5A			
Low Pick-up										
Ground detection on 3-phase systems and on generator stator windings. Time delay 0.75 to 7.5 seconds at 200% of tap setting, or 4 seconds on N.O. 10 TDS.	115① 199① 345①	10 16 28	40 64 112	0.2/2	1-N.O.	12IAV51D2A D1A D9A	12IAV51D5A D4A D10A	S1	12 (5.4)	15 (6.8)
	67①	5.4	20			12IAV51K1A	12IAV51K2A	S1②	13 (5.9)	16 (7.3)
Same as IAV51D or IAV51K except 2 N.O. Contacts	199①	16	64		2-N.O.	12IAV52D1A	.....	S1	12(5.4)	15(6.8)
	67①	5.4	20			12IAV52K1A	12IAV52K2A	S1②	13 (5.9)	16 (7.3)
Timing Applications										
Single circuit closes with time delay. Fixed pickup voltage. Time delay: 3 to 30 seconds at rated volts.	115 208 230		55 100 110	0.2/2	1-N.O.	12IAV51M1A M4A M3A	12IAV51M2A	S1	12 (5.4)	15 (6.8)
Frequency Compensated										
Frequency sensitive applications. Otherwise same as IAV51A compensated 30-90 Hertz	115	55	140	0.2/2	1-N.O.	12IAV71A1A	12IAV71A3A	S1	13 (5.9)	16 (7.3)
Frequency compensated; instantaneous unit added, also frequency compensated; for hydro-generator applications; general duty for ac generator overvoltage protection and voltage regulator backup. 1 to 10 second time delay.	115 230 230	55 110 110	140 280 280			12IAV71B2A③ B5A③ B6A④	12IAV71B3A③			
Similar to IAV71A except 2 N.O. Contacts	115	55	140		2-N.O.	12IAV72A1A	.....			
Similar to IAV72A except includes inst. unit with 1 N.O. Contact	115 230	55 110	140 280			12IAV72B1A③	12IAV72B4A③ B3A③			
Similar to IAV72B except includes inst. Unit with 2-N.O. Contacts	115	55	140			.....	12IAV72C3A③			

① IAV51D, 51K, 52D, and 52K—10 Second Rating at 360 volts.
② Includes external capacitor.
③ Inst. unit adjustable 120-200 volts.
④ Inst. unit adjustable 180-300 volts.

GE Protective Relays

SELECTION GUIDE—Type IAV

General Description	Rated Volts Ac	Tap Range Volts Min	Tap Range Volts Max	Target Seal-in	Contacts	Model Number 60 Hertz	Model Number 50 Hertz	Case Size	Approx Wt, lb (kg) Net	Approx Wt, lb (kg) Ship
UNDERVOLTAGE (Device No. 27)										
5 Sec Time Delay at zero volts if set on No. 10 TD Time Range 1 to 13 sec at 80% of tap.	67	32	80	0.2/2	1 N.C.	12IAV54E14A	.....	S2	12 (5.4)	16 (7.3)
	115	55	140			E1A	12IAV54E4A			
	208	110	280			E13A	.....			
	230	110	280			E2A	E5A			
	460	220	560			E3A	E6A			
30 Sec Time Delay at zero volts if set on No. 10 TD	115	55	140			12IAV54F1A	.....			
	230	110	280			F2A	12IAV54F4A			
	460	220	460			F3A	.....			
75 Sec Time Delay at zero volts on No. 10 TD	115	55	140			12IAV54H1A	.....			
	460	220	560			H2A	.....			
Same as IAV54E except no Seal-in	115	55	140	None		12IAV54J1A	.....			
	230	110	280			J2A	.....			
	460	220	560			J3A	12IAV54J4A			
5 Sec Time Delay same as IAV54E except 2 N.C.	115	55	140	0.2/2	2 N.C.	12IAV55C1A	12IAV55C4A			
	230	110	280			C2A	C5A			
	460	220	560			C3A	C9A			
30 Sec Time Delay	115	55	140			12IAV55F1A	.....			
	230	110	280			F2A	.....			
75 Sec Time Delay	115	55	140			12IAV55H1A	.....			
Frequency Compensated										
5 Sec Time Delay at zero volts on No. 10 TDS. Compensated 30-90 Hz	115	55	140	0.2/2	1 N.C.	12IAV74A1A	.....	S2	13 (5.9)	17 (7.7)
OVER- AND UNDERVOLTAGE (Device No. 27/59)										
General duty; electrically separate contacts with target seal-in unit series with each contact; UV adjustable from 50 to 95% of OV tap setting. Time delay 1.1 sec. at zero volts: 0.4 sec. at 2 x tap. setting.	115	55	140	0.2/2 (2)	1 N.C. 1 N.O.	12IAV53K1A	12IAV53K4A	S2	13 (5.9)	17 (7.7)
	230	110	280			K2A	K5A			
	460	220	560			K3A	K11A			
Automatic control schemes; same as IAV53K except target seal-in units are omitted	115	55	140	None		12IAV53L1A	12IAV53L4A			
	230	110	280			L2A	L5A			
	460	220	560			L3A	.....			
Similar to IAV53K except target seal-in units are omitted. Time delay 0.5 sec. at zero volts.	115	55	140			12IAV53N1A	.....			
	460	220	560			N3A	.....			
General duty; common connection between contacts; OV setting is independent of UV adjustment; UV adjustable from 60 to 95% of OV tap setting; target and seal-in unit in series with each contact.	120	55	140	0.2/2 (2)		12IAV69A1A	12IAV69A3A			
	208	110	280			A4A	.....			
	240	110	280			A2A	.....			
Automatic control schemes; same as IAV69A except target seal-in units are omitted	120	55	140	None		12IAV69B1A	12IAV69B3A			
	240	110	280			B2A				
General duty; common connection between contacts; UV setting fixed at 95% or more of OV tap setting; target seal-in unit in series with each contact; adjustable time delay 30 seconds max. on complete loss of V.	120	55	140	0.2/2 (2)		12IAV70A1A	.....			
	240	110	280			A2A	.....			
Automatic control schemes; same as IAV70A except target seal-in units are omitted	120	55	140	None		12IAV70B1A	12IAV70B3A			
	240	110	280			B2A	.....			
Frequency Compensated										
General duty; same as IAV53K except Frequency Compensated. 30-90 Hz	115	55	140	0.2/2 (2)	1 N.C.	12IAV73A1A	.....	S2	13 (5.9)	17 (7.7)
Automatic control schemes; same as IAV53L except Frequency Compensated. 30-90 Hz				None	1 N.O.	12IAV73B1A	.....			

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DIAGRAMS AND CHARACTERISTICS

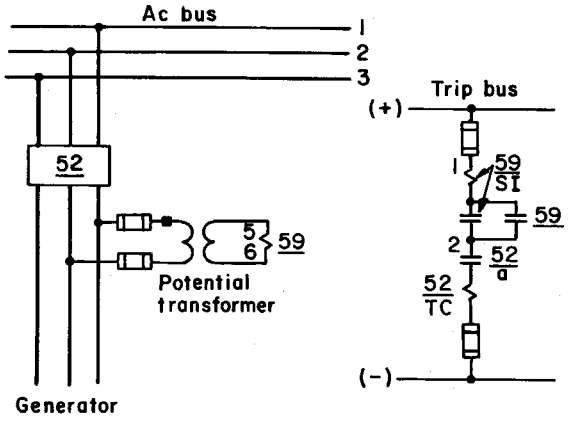


Fig. 2. Typical external for Type IAV51A used for overvoltage protection.

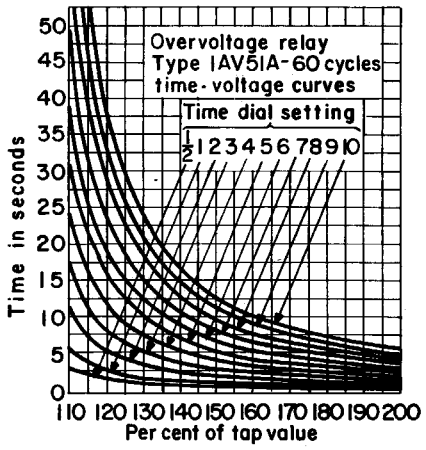


Fig. 3. Typical Time Voltage curve for Types IAV51A, 71 and 72

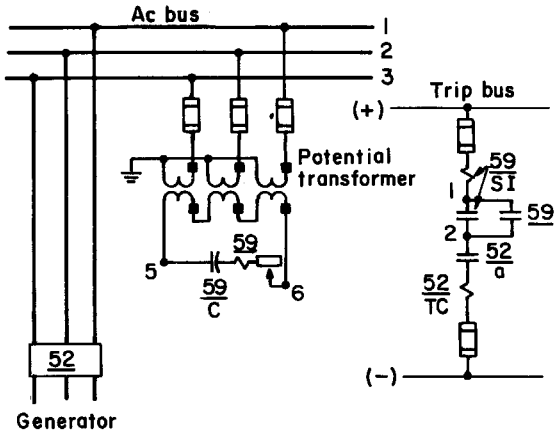


Fig. 4. Typical external for ground fault protection 3ph. Ungrounded system Type IAV51D

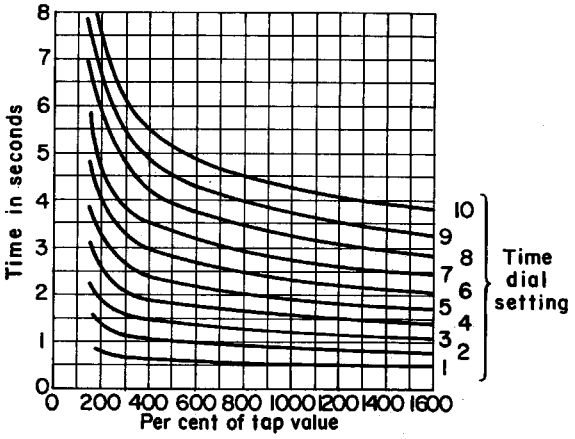


Fig. 5. Typical Time Voltage curve for Types IAV51D and 51K

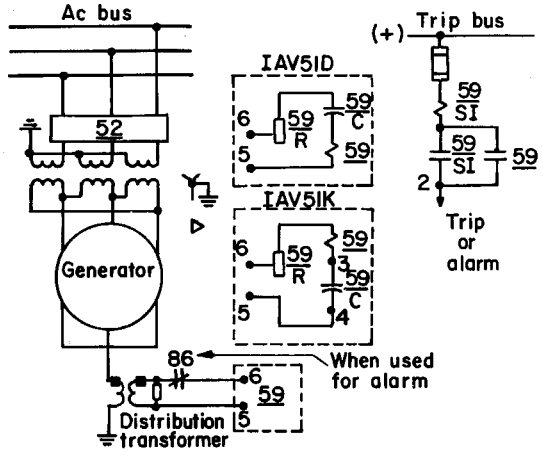


Fig. 6. Typical external for ground fault protection of an ac rotating machine Type IAV51D or 51K

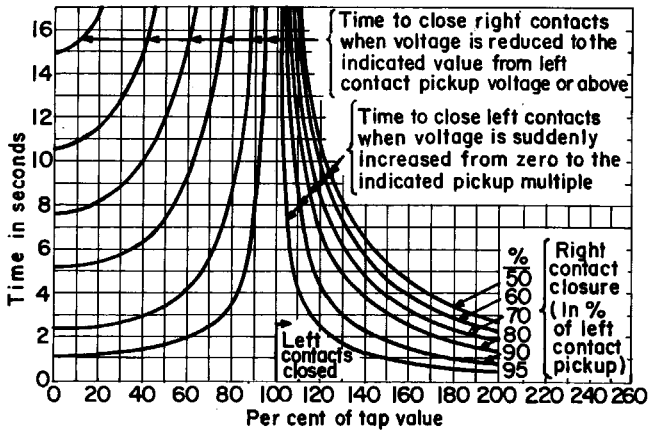


Fig. 7. Typical Time Voltage curve for Types IAV53K, 53L, 73A and 73B

Ac Undervoltage, Open or Reverse Phase Protection

DESCRIPTION

The Type ICR is a three-phase voltage operated induction-disk time delay relay designed to respond to phase sequence, open phase or undervoltage. Each ICR relay includes a basic induction-disk unit and may also include dual rated target seal-in units.

The ICR51A relay has a single circuit closing contact which opens on undervoltage or reversed-phase sequence, and a time dial for selecting the time delay for the contact closing. This relay does not have a target or seal-in unit. When the relay is adjusted to open its contact at 75 percent of rated voltage, the time required to close the contact, with rated voltage applied and a time dial setting of 10, is 10 seconds.

The ICR53 and ICR54 relays have single pole double throw electrically separate contacts. The left contact opens on undervoltage or reverse phase sequence and the right N.C. contact may have a target seal-in unit. Also, forms are available with two target seal-in units or no target seal-in units. These relays do not have a time dial.

In general the ICR53A, 53B and 53C relays will provide a time delay of 1.2 seconds if adjusted for 90 percent pickup and 80 percent dropout when the voltage is suddenly dropped from the rated value to zero.

The ICR53D is similar to the other ICR53 relays except it provides a long time delay of 3 seconds when the applied voltage is suddenly dropped to zero.

For a very short time delay of 0.17 second, the ICR54A and 54B relays are available. Otherwise, they are similar to the ICR53A and ICR53B.

Case Construction

The ICR53A is furnished in a single-end (S1) drawout case.

The Types ICR53 and ICR54 contain a contact that is closed when the relay is deenergized. For this reason, these relays are supplied in double-end (S2) drawout cases. The external connections are such that the relay coils are energized when either the upper or lower connection plug is put in place. The relay will, therefore, have time to open its closed contact before the second connection plug can be put in place. It is necessary to have both plugs in place before the contact circuits are completed. Refer to Figure 3.

APPLICATION

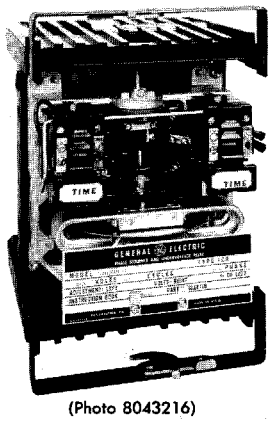
Type ICR relays are used principally for protection of ac machines from undervoltage and, when starting, from open-phase or reverse-phase sequence. They are also recommended for other applications, such as automatic throw-over equipments, where it is desired to check the presence of three-phase voltage for correct phase sequence.

The most extensive application of these relays is in metal-clad switchgear, where they are used to prevent the starting of a machine, if the phase and voltage conditions of the circuit are not correct. They also function to stop the machine, if the voltage across the relay terminals falls below a predetermined value. Usually, these relays will not disconnect a running motor, if one phase of the supply is open-circuited, because the motor will supply three-phase potential to the relay even with one phase disconnected from the source. However, these relays will prevent the starting of the motor when one phase is open, and will also prevent starting in the wrong direction, if the phase sequence is reversed.

Time delay of contact operations may be necessary to prevent shutdown on temporary dips in voltage. Delay may also be necessary to attain proper sequential operation with other devices in the control circuit. Timing is determined by the calibration settings of the right and left contacts for all ICR relays except the ICR51A which has one normally open contact and a time dial adjustment.

OPERATION

For these relays the induction disk is actuated by a wattmetric type operating unit. The voltage coils are located above and below the operating disk. Phase shift is provided in each coil by a series capacitor to produce a split-phase field which develops torque on the induction disk.



(Photo 8043216)

Fig. 1. Type ICR53C—Phase Sequence and Undervoltage Relay (out of case)

BURDENS

The burdens imposed by the two potential circuits at rated voltage and 60 Hertz are as follows:

Volts	Coil Circuit	Watts	Vars①	VA	PF
120	5-6	2.15	4.70	5.20	0.41
120	7-8	0.66	2.30	2.40	0.27
240	5-6	3.55	13.15	13.3	0.26
240	7-8	0.41	6.38	6.40	0.06
480	5-6	2.83	23.8	24.0	0.12
480	7-8	0.45	23.0	23.0	0.02

① Capacitive

CONTACT RATINGS

The current carrying rating of the ICR contact circuit is determined by whether the relay has a seal-in unit and by the tap used on the seal-in coil. Without a seal-in unit the relay contacts will close and carry 30 amperes for tripping duty and 2 amperes continuously at control voltages of 250 volts dc or less. Refer Section 16 for contact data for relays that include target seal-in units.

When the contacts of the induction unit are not bypassed by the seal-in unit contacts, they may try to interrupt the circuit. The interrupting rating of the contacts for noninductive leads are as follows:

Make and Interrupt at:	Ac Amps	Dc Amps
125 volts	1.50	0.30
250 volts	0.75	0.15

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

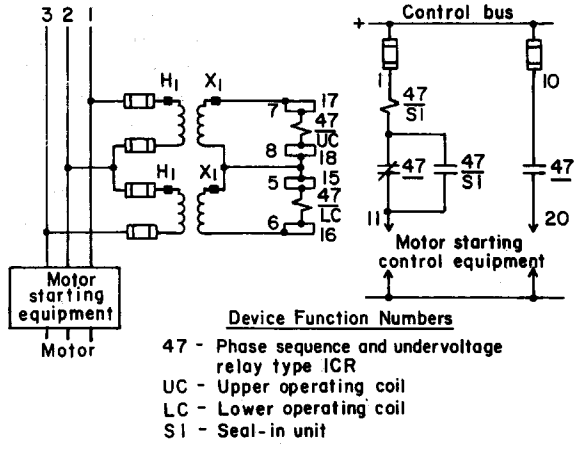
SELECTION GUIDE

Rated Volts Ac	Closing Volts Range ①N.C. Right Contact: Range in % of N.O. Contact	①N.C. Right Contact: Factory Setting Volts	②N.O. Left Contact: Range in % of Rated V.	②N.O. Left Contact: Factory Setting Volts	Target Seal-in Unit 0.2/2 Amp	Model Number: 60 Hertz	Model Number: 50 Hertz	Case Size	Approx Wt Lb (kg): Net	Approx Wt Lb (kg): Ship
Type ICR51A— Adjustable Time - 10 Seconds Max. on No. 10 Time Dial (1-N.O.)										
120	.....	.....	65-95	90	.....	12ICR51A21A	12ICR51A24A	S1	12 (5.4)	16 (7.3)
208	.....	.....		164	.....	A28A	A27A			
240	.....	.....		180	.....	A22A	A25A			
480	.....	.....		360	.....	A23A	A26A			
Type ICR53A— 1.2 Sec. Time Delay on Loss of Voltage. 1 N.O. and 1 N.C.- 1 SI Unit										
					Target SI Unit in N.C. Circuit only					
120	75-90	96	75-100	108	Yes	12ICR53A1A	12ICR53A4A	S2	13 (5.9)	17 (7.7)
208		166		187		A8A	.....			
240		192		216		A2A	A7A			
480		384		432		A3A	.....			
Type ICR53B— 1.2 Sec. Time Delay on Loss of Voltage. 1 N.O. and 1 N.C. - No SI Units										
120	75-90	96	75-100	108	.....	12ICR53B1A	12ICR53B8A	S2	12 (5.4)	16 (7.3)
208		166		187	.....	B6A	.....			
240		192		216	.....	B2A	B4A			
480		384		432	.....	B3A	.....			
Type ICR53C— 1.2 Sec. Time Delay on Loss of Voltage. 1 N.O. and 1 N.C. - 2 TSI Units										
					Target SI Unit in N.C. and N.O. Circuit					
120	75-90	96	75-100	108	Yes	12ICR53C1A	.....	S2	13 (5.9)	17 (7.7)
240		192		216		C3A	.....			
480		384		432		C4A	.....			
Type ICR53D— 3 Sec. Time Delay on Loss of Voltage. 1 N.O. and 1 N.C. - No TSI Units										
120	75-90	96	75-100	108	.....	12ICR53D1A	.....	S2	12 (5.4)	16 (7.3)
208		166		187	.....	D6A	.....			
Type ICR54A— 0.17 Sec. Time Delay on Loss of Voltage. 1 N.O. and 1 N.C. - 1 TSI Unit										
					Target SI Unit in N.C. Circuit only					
120	75-90	96	75-100	108	Yes	12ICR54A1A	12ICR54A7A	S2	13 (5.9)	17 (7.7)
208		166		187		A8A	.....			
240		192		216		A2A	.....			
480		384		432		A3A	A9A			
Type ICR54B— 0.17 Sec. Time Delay on Loss of Voltage. 1 N.O. and 1 N.C. - No TSI Units										
120	75-90	96	75-100	108	.....	12ICR54B1A	.....	S2	12 (5.4)	16 (7.3)
240		192		216	.....	B2A	.....			

① The right contacts are opened when the relay is energized, and will close when the voltage drops to values equal to, or less than, those listed in this column.

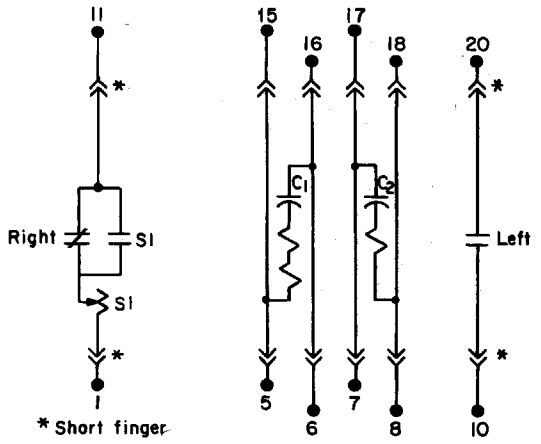
② The left contacts, which are closed when the relay is energized, will open when undervoltage occurs. If single-phase or reverse-phase sequence exists, these contacts will not close when the relay is energized.

CONNECTION DIAGRAMS



(Dwg. 0376A0951-2)

Fig. 2. Typical external connections for the Type ICR53A or ICR54A (Ac machine protection)



(Dwg. 0362A0633-4)

Fig. 3. Typical interanl connections for Type ICR53A or 54A relay

DESCRIPTION

The Type IFV relays are single phase induction disk relays designed to respond, with time delay, to an increasing voltage. Some models are frequency compensated, and some include an instantaneous unit (hinged armature type).

The type IFV relays are supplied with two eletrically separate contacts. One of these contacts which operates the target seal-in unit is on the induction disc unit and can be used as a trip contact; the second contact of the seal-in unit can be used for alarm or remote indication.

APPLICATION
OVERVOLTAGE RELAYS

Type IFV overvoltage relays are used for protection against simple overvoltage, but other applications are also common. They are applied to ground detection, both on feeders and on ac generators, and they are also used in timed switching arrangements, where their dependability and accuracy make them preferable to purely mechanical timing relays.

For protection against overvoltage, use the IFV51AD relay (Fig 2). For instantaneous protection as well as time delay, use the IFV71BD.

For the detection of grounds on ungrounded three-phase systems, two methods are in general use. One measures the zero sequence potential (Fig. 4), and the other measures the actual voltage between the system neutral and ground (Fig. 6.)

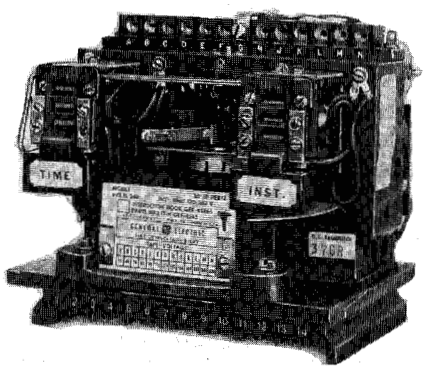
For the circuit of Figure 4, use Type IFV51DD, a low pickup relay which has its operating circuit tuned to the rated frequency. The potential transformers used in this circuit are connected grounded-Y primary, broken-delta secondary. The primaries should have ratings equal to the line-to-line voltage of the system, and the secondaries can have ratings of either 67 or 115 volts.

Select a relay model with a continuous rating of three times the potential transformer secondary voltage. This is necessary because, when a ground occurs, the zero sequence voltage may be up to three times the normal transformer secondary voltage. Thus, with a potential transformer secondary rated 67 volts, use a 199-volt relay coil.

For ground fault protection of ac rotating machines, use a circuit similar to that shown in Figure 6 applying Type IFV51DD or IFV51KD. These are low-pickup relays whose coil circuits are tuned by capacitors to their rated frequencies. The circuits are thus rendered only one-eighth as sensitive to the third harmonic as they are to the rated frequency.

In Figure 6, a distribution transformer is connected between the machine neutral of the generator and ground. Normally there is no voltage on the transformer but during a fault, there is a voltage with a worst-case magnitude equal to the phase-to-ground value.

Greater sensitivity can be obtained by choosing a distribution transformer with higher secondary voltage. In such a case, the relay will not carry the fault voltage continuously, and provision must be made to de-energize the operating coil using an auxiliary relay. The short-time rating for both IFV51DD and IFV51KD is 360 volts for 10 seconds.



(Photo 8043453)
Fig. 1 Type IFV71BD overvoltage relay (out of case)

FREQUENCY COMPENSATION

The following Type IFV relays are frequency compensated overvoltage relays—IFV71AD and IFV71BD.

The frequency compensation range of these relays are 50 to 150 percent of system frequency. A typical application is on systems supplied by hydro-generators, where the frequency tends to increase when faults occur. Frequency compensation is provided by an ac circuit across the wound shading coils of the induction disk operating coil and core unit.

10

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

CHARACTERISTICS

The IFV51DD and IFV51KD relays are single-phase overvoltage relays of induction disk construction that may be used to provide very sensitive protection for overvoltage conditions.

Relay Type	Continuous Rating (Volts)	Pickup Range Continuously Adj. (Volts)
IFV51DD	120 208 360	9.5-42 14.5-65 26.0-115
IFV51KD	69	5.0-22

For the minimum and maximum taps shown in the list below, the following intermediate taps are available for both the IFV51AD1A and IFV71AD1A.

Tap Range		Taps Available	
50 Hz	60 Hz	50Hz	60Hz
50-250	55-280	50, 56, 60, 72, 82, 100, 113, 125, 144, 164, 185, 211, 250	55, 64, 70, 82, 93, 110, 128, 140, 164, 186, 210, 240, 280

TRIPPING CIRCUITS AND CONTACT RATINGS

The current carrying rating of the contact circuit is determined by whether the relay has a seal-in unit and by the tap used on the seal-in coil. Without a seal-in unit the relay contacts will close and carry 30 amperes for tripping duty and 2 amperes continuously at control voltages of 250 volts dc or less. Refer Section 16 for data on target seal-in units.

SELECTION GUIDE—Type IFV

General Description	Rated (Volts)	Pickup Range Volts 50 Hz Min	50 Hz Max	60 Hz Min	60 Hz Max	Target Seal-in (Amps)	Contacts	Model Numbers (50 Hz)	Model Numbers (60 Hz)	Case Size	Approx Wt. lb (kg) Net	Approx Wt. lb (kg) Ship
OVERVOLTAGE (DEVICE No. 59)												
General duty, overvoltage and control switching. Time delay .5 to 11.0 seconds at 1.6 times tap setting.	240	50	250	55	280	0.2/2.0	2 N.O.	12IFV51AD1A		C1	8 (3.6 kg)	14 (6.3 kg)
Low Pick-up												
Ground detection on 3-phase systems and on generator stator windings. Time delay for a frequency of 50 Hz 0.8-9.0 seconds and at 60 Hz 0.9-9.0 seconds at 200% tap setting.	120① 208① 360			9.5 14.5 26.0	42 65 115	0.2/2.0	2 N.O.		12IFV51DD1A 2A 3A	C1	8 (3.6 kg)	14 (6.3 kg)
	120① 208① 360	9.5 14.5 26.0	42 65 115			0.2/2.0	2 N.O.	12IFV51DD4A 5A 6A		C1	8 (3.6 kg)	14 (6.3 kg)
	69①	5	22	5	22	0.2/2.0	2 N.O.	12IFV51KD2A④	12IFV51KD1A④	C1	8 (3.6 kg)	14 (6.3 kg)
Frequency Compensated												
Frequency sensitive applications. Frequency compensation range are 50 to 150 percent of system frequency.	240	55	280	55	280	0.2/2.0	2 N.O.	12IFV71AD1A		C1	8 (3.6 kg)	14 (6.3 kg)
Frequency compensated; instantaneous unit added, also frequency compensated. For hydrogenerator applications; general duty for ac generator overvoltage protection and voltage regulator backup. 0.45 to 11 second time delay.	240	55	280	55	280	0.2/2.0	2 N.O.	12IFV71BD1A③ 2A②		C1	8 (3.6 kg)	14 (6.3 kg)

①IFV51DD, 51KD are 360 volts at a 10 second rating.
②Inst. unit adjustable 180-300 volts.
③Inst. unit adjustable 120-200 volts.
④Includes external capacitor.

DIAGRAMS AND CHARACTERISTICS

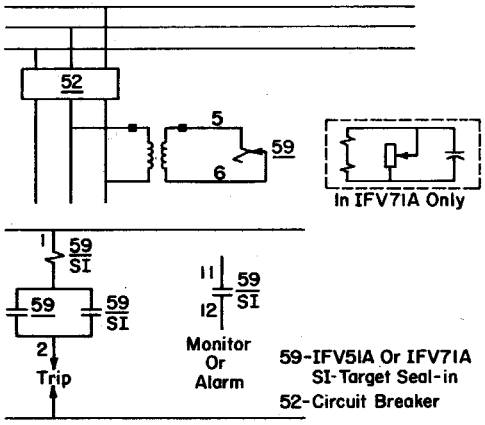


Fig. 2. Typical external for Types IFV51AD and IFV71AD used for overvoltage protection (273A9038)

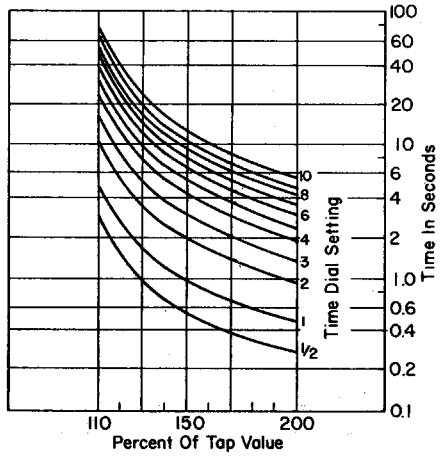


Fig. 3 Typical time voltage curve for Type IFV51AD (0275A2075)

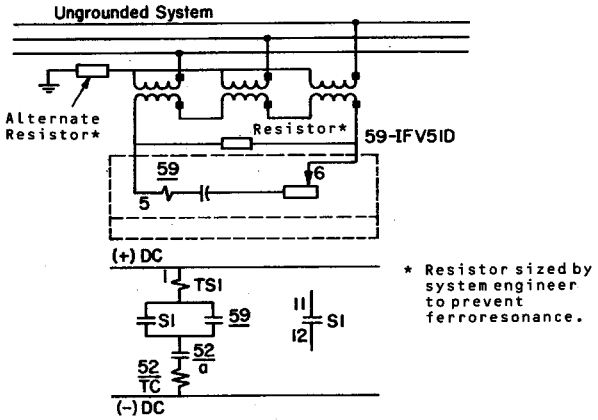


Fig. 4. Typical external for ground fault protection 3ph. Ungrounded system Type IFV51DD (275A2089)

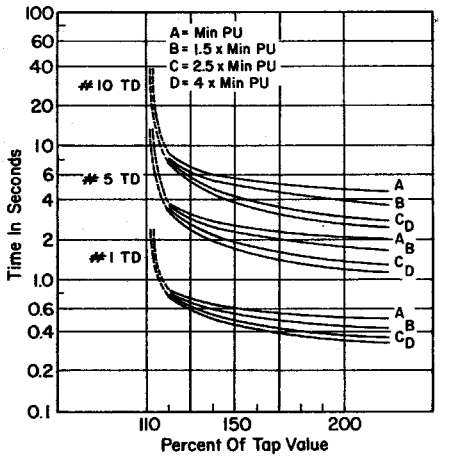


Fig. 5. Typical time voltage curve for Types IFV51KD and IFV51DD (0273A9519)

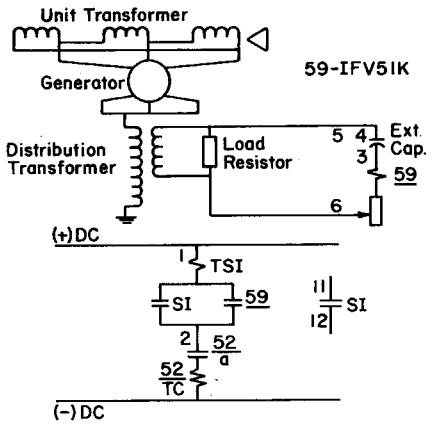


Fig. 6. Typical external for ground fault protection of an ac rotating machine Type IFV51KD (275A2090)

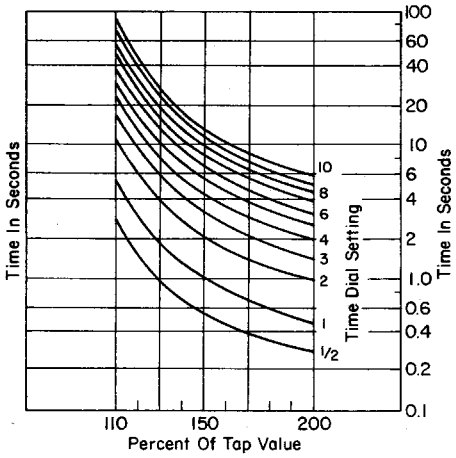


Fig. 7. Typical time voltage curve for Type IFV71 (0275A2074)

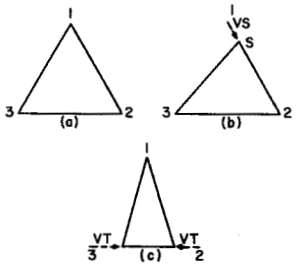
High-speed, sensitive, three-phase voltage unbalance relay

DESCRIPTION

The NBV11A relay is a high speed sensitive three-phase voltage unbalance relay which is capable of detecting a small voltage unbalance in a three-phase system. The NBV11A when applied as a protective device is normally used in conjunction with a time-delay relay. One NBV11A relay and one timing relay are required at each terminal.

APPLICATION

The principal application of the NBV11A relay is to protect three-phase motors from the damage which may be caused by single-phase operation. When one fuse blows in a three-phase supply to a group of motors, these motors will continue to run on single-phase power. At this time the voltage unbalance will be small since the motors will maintain nearly full voltage across the open phase and a sensitive voltage unbalance relay is required to detect the single-phase power so the NBV11A relay is used to trip the supply breaker or to sound an alarm. Since the NBV operates on a percentage of the unbalance in line voltages, it will detect a single-phase condition on light load as well as on heavy load. The NBV is usually connected to a bus and it will effectively protect a group of many motors when the open circuit is between source and the bus. The NBV11A is a high speed relay and a timing relay should be used to prevent false tripping or alarm. When undervoltage tripping is permissible, the scheme using a 27 device should be used. If a reliable source of dc power is available, a dc timing relay such as the SAM may be used. In the above application the relay also provides protection against reverse phase-sequence operation.



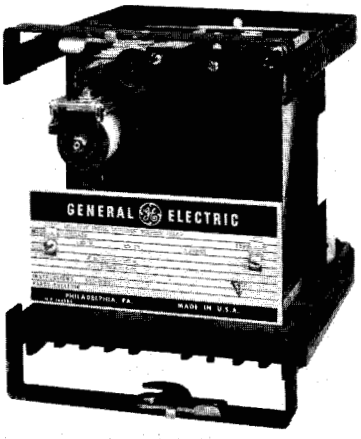
SYSTEM VOLTAGES

(a) Balanced conditions
(b) Unbalanced by shift of one corner
(c) Unbalanced by shifting two corners toward each other along vector between them.

$$V_N = \tfrac{1}{3}(V_{12} + a^2V_{23} + aV_{31})$$

where V_N = Neg. Sequence Component
$a = 1\angle 120^\circ$
$a^2 = 1\angle 240^\circ$

Fig. 1. System voltages under balanced and unbalanced conditions



(Photo 8043190)

Fig. 2. NBV voltage unbalance relay

CONTACT RATINGS

The relay contact ratings are as shown in Table I.

TABLE I

Rating	Continuous Current (Amps)	Interruption Current (Amps)	
		Ind	Non-ind
125 V-DC	1.0	0.3	0.75
250 V-DC	1.0	0.01	0.2
115 V-60 cy	1.0	2.0	4.0
230 V-60 cy	1.0	1.0	2.0

BURDENS

The three-phase burden of the NBV relay does not divide equally among the potential transformers that supply the relay. Thus, Table II illustrates how this burden divides when the relay is supplied from 3 potential transformers that are connected in wye with relay stud 5 connected to PT #1, relay stud 6 to PT #2, and relay stud 7 to PT #3.

Table II gives the burden division when the relay is supplied from two potential transformers connected in open delta. It is recommended that terminal 6 of the relay be connected to the "V" point of the delta-connected potential transformers.

Burdens—Table II

Volts	Frequency (Hz)	Current (MA)			Burden per PT (VA) Wye-connected PTS			Burden per PT (VA) Open Delta PTS	
		I_5	I_6	I_7	PT #1 (Studs 5-6)	PT #2 (Studs 6-7)	PT #3 (Studs 7-5)	PT #1 (Stud 5)	PT #2 (Stud 7)
120	60	77	115	38	5.32	7.97	2.63	9.23	4.56
120	50	40	95	66	2.77	6.57	4.57	4.80	7.82
208	60	38	59	23	3.96	7.07	2.76	7.90	4.78
208	50	32	49	19	3.30	5.90	2.30	6.60	3.98
240	60	80	120	40	2.70	4.00	1.30	4.60	2.28

SELECTION GUIDE

Ratings		Model Number	Pickup (VN)①	Range (V)		Case Size	Approx Wt in lbs (kg)	
Voltage	Frequency (Hz)			VS	VT		Net	Ship.
120	60	12NBV11A1A	5.8-11.5	10-20	5.8-11.5	S1	15(6.8)	22(10)
208		A3A	10-20	17-34	10-20			
240		A4A	11.5-23	20-40	11.5-23			
120	50	A2A	5.8-11.5	10-20	5.8-11.5			
208		A5A	10-20	17-34	10-20			

① See Fig. 1.

NOTE: Harmonic filter—60 Hz, 165A6788G1: 50 Hz, 165A6788G2

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

WHERE TO USE

The Type NGV relay is a high-speed relay designed for calibration on decreasing voltage (drop-out), or increasing voltage (pick-up) and may be continuously energized at rated voltage. The NGV19 is a special relay available for application as a battery monitor.

The NGV is an instantaneous, voltage-operated, hinged-armature telephone type relay. It is available with one, two, or three independent units in one case. These units are designed for direct-current. Where the relays are to be applied to alternating-current, a bridge-type circuit provides full-wave rectification for the coil circuit. See Fig. 2. In both the ac and dc versions, a zener diode in the coil circuit establishes a sharply-defined set point controlled by a rheostat that is mounted on the front of the relay.

Some specific applications for the undervoltage NGV relays are listed below:

1. Instantaneous undervoltage detection for preferred emergency throwover control equipment.
2. Ground fault detection for faulted-phase selection on ungrounded systems.
3. Phase fault detection for disabling telephone or telemetering services at stations with weak backfeed on carrier channels used for relay protection of other terminals.

For Type NGV17A, 17B, 17C, 18A, and 19A, the pick-up voltage is less than 5 percent higher than the dropout voltage. For all other type NGV relays, the pickup voltage is less than 10 percent higher than the dropout voltage. The voltage range from the beginning of the relay action to its completion is approximately 1 percent of the rated voltage. The relay pick-up time is approximately 2 cycles and the drop-out characteristic is shown in Fig. 3.

The ac burden per element is 4 to 5 watts maximum.

The NGV19 relay is a time-delay, dc undervoltage relay with extra high dropout designed specifically to monitor the dc charging supply for a station battery and sound an alarm if this supply fails. The relay contains an instantaneous undervoltage unit connected to the station battery, and an auxiliary time-delay unit connected to the ac battery charging power supply.

This time-delay unit provides a minimum time delay of one-half second after the undervoltage unit operates. It is not senstitive to fluctuations in the ac supply since it will stay held-in down to 25 percent voltage. If the ac supply fails, however, the time-delay unit drops out and sounds the alarm without waiting for the battery voltage to decrease.

CONTACT RATING

Close and carry 30 amperes dc for tripping duty at 250 volts dc or less.

INTERRUPTING RATING

Volts	Amp (Inductive)	Amp (Noninductive)
24 dc	1.0	3.0
48 dc	1.0	3.0
125 dc	0.5	1.5
250 dc	0.25	0.75
69 50/60 Hz	1.0	3.0
120 50/60 Hz	0.75	2.0
208 50/60 Hz	0.5	1.0
240 50/60 Hz	0.5	1.0
277 50/60 Hz	0.4	0.8
480 50/60 Hz	0.25	0.4

NOTE: The inductive rating is based on the inductance of an average trip coil.



(Photo 8043189)

Fig. 1. Type NGV15 undervoltage relay

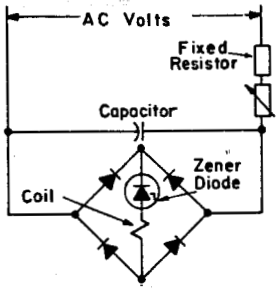


Fig. 2. NGV coil circuit, with diode bridge for ac application

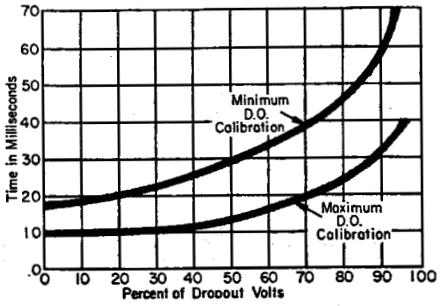


Fig. 3. NGV relay—time to close the N. C. contacts when voltage is suddenly reduced from 110% rated volts to value shown on graph

SELECTION GUIDE—DC

No. Units Per Case	Volts	Calibration Range Dropout Volts	Model Number	Contacts		Model Number	Contacts		Model Number	Contacts		Case Size	Approx Wt in lbs (kg)	
													Net	Ship
1	24 48 125 250	19-27 38-54 100-140 200-280	12NGV17A5 A3 A2 A4	1N.O. and 1N.C.	① Back Conn.	12NGV17B1 12NGV17B2	1N.O. and 2 N.C.	① Back Conn.	12NGV17C3 C1 C2	1N.O. and 1N.C.	Front Conn.	Molded	3(1.4)	5(2.3)
	24 48 125 250	18-24 38-54 100-140 200-280	12NGV18A4A A3A A2A A1A	1N.O. and 1N.C.	S1 Case							S1	10(4.5)	15(6.8)

① The molded case is similar to the HGA11 relay. Add "F" to Model No. for semi-flush mounting Example 12NGV17A2F.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

GE Protective Relays

SELECTION GUIDE—AC

No. Units	Rating Volt	Rating Freq. (Hz)	Contacts (Per Unit)	Calibrated on Dropout① Cal. Range (V)	Dropout W/O Target Model Number	Dropout With Target Model Number	Dropout With Target Tar. Rat. (Amps)	Calibrated on Pickup② Cal. Range (V)	Pickup W/O Target Model Number	Pickup With Target Model Number	Pickup With Target Tar. Rat. (Amps)	Case Size	Approx Wt in lbs (kg) Net	Approx Wt in lbs (kg) Ship.
1	69	60	1 N.O. 1 N.C.	40-58	12NGV15A30	.....	...	.....	.....	.....	...	Molded △	3(1.4)	5(2.3)
	120	50/60		70-100	A21	.....	...	.....	.....	.....	...			
	208			121-173	A22	.....	...	.....	.....	.....	...			
	240			140-200	A23	.....	...	.....	.....	.....	...			
	480			280-400	A11	.....	...	.....	.....	.....	...			
1	69	50/60	2 N.O. 2 N.C.	40-58	.....	12NGV13B24A	2.0	.....	.....	.....	...	S1	10(4.5)	14(6.8)
	69			40-58	12NGV13A14A	B28A	0.2	.....	.....	.....	...			
	120			8-16	A20A	.....	...	.....	.....	.....	...			
	120			35-50	.....	B39A	0.2	.....	.....	.....	...			
	120			35-50	.....	B43A	2.0	.....	.....	.....	...			
	120			70-100	A11A	B25A	0.2	.....	.....	.....	...			
	120			70-100	.....	B21A	2.0	.....	.....	.....	...			
	120			80-120	.....	B30A	0.2	.....	.....	.....	...			
	120			80-120	.....	B29A	2.0	.....	.....	.....	...			
	170			100-140	A15A	.....	...	.....	.....	.....	...			
	208			121-173	A12A	B26A	0.2	.....	.....	.....	...			
	208			121-173	.....	B22A	2.0	.....	.....	.....	...			
	240			140-200	A13A	B27A	0.2	.....	.....	.....	...			
	240			140-200	.....	B23A	2.0	.....	.....	.....	...			
2*	120	50/60	2 N.O. 2 N.C.	70-100	12NGV12A11A	B11A	2.0	.....	.....	.....	...	S2	11(5)	16(7.3)
	120			70-100	.....	12NGV12B15A	0.2	.....	.....	.....	...			
	208			121-173	A12A	.....	...	.....	.....	.....	...			
	240			140-200	A13A	.....	...	.....	.....	.....	...			
3*	69	60	3 N.O. 1 N.C.	40-58	.....	12NGV11B18A	0.2	.....	.....	.....	...	S2	12(5.4)	18(8.2)
	120			70-100	.....	B15A	0.2	80-120	.....	12NGV21B5A	0.2			
	120			70-100	.....	.....	...	80-120	.....	B1A	2.0			
	120			70-100	.....	B11A	2.0	.....	.....	.....	...			
	208			121-173	.....	.....	...	121-173	.....	B9A	0.2			
	69	50/60		40-58	12NGV11A20A	.....	...	.....	.....	.....	...			
	120			70-100	A11A	.....	...	.....	.....	.....	...			
	208			121-173	A12A	.....	...	.....	.....	.....	...			
	240			140-200	A13A	.....	...	.....	.....	.....	...			

* 2-unit and 3-unit relays have two targets.

① In two-unit and three-unit relays, the normally ***open*** contacts are wired out in ***series,*** and the normally ***closed*** are wired out in ***parallel.***

② In these three-unit relays, the normally ***closed*** contacts are wired out in ***series,*** and the normally ***open*** are wired out in ***parallel.***

△ The molded case is similar to HGA11. Add suffix "F" to model number for semi-flush mounting.
Example: 12NGV15A—F.

STATION BATTERY MONITORING

Number of Units per Relay	Volts Dc	Calibration Range Dropout Volts	Ac Supply Voltage Volts	Ac Supply Voltage Hertz	Model Number	Time Delay (sec)	Case Size	Approx Wt in lbs (kg) Net	Approx Wt in lbs (kg) Ship.
1	48	40-54	120	50/60	12NGV19A5A	0.5	S1	10(4.5)	15(6.8)
	125	54-86	120		A8A				
	125	100-140	120		A1A				
	125	100-140	208		A2A				
	125	100-140	240		A3A				
	250	200-280	120		A4A				
	250	200-280	240		A13A				

D.C. BUS GROUND DETECTION

Number of Units per Relay	Volts Dc	Maximum Resistance to Ground to Operate(K ohms)	Contacts Left Unit Minus Bus Ground	Contacts Right Unit Plus Bus Ground	Model Number	Case Size	Approx Wt in lbs (kg) Net	Approx Wt in lbs (kg) Ship
2	250	30	1 N.O.	1 N.O.	12NGV29A1A	S1	10 (4.5)	15 (6.8)
	125	15			A2A			
	48	5			A3A			
	24	1.25			A4A			

For High-speed Overvoltage Protection of Ac and Dc Circuits and Dc Undervoltage Protection

DESCRIPTION

Type PJV relays consist of one or more units mounted in a molded case or in a drawout relay case. The units are plunger type relays with the armature adjustable on the plunger rod to vary the pickup. The movable contacts are fastened directly to the armature assembly on each side of the calibrating tube.

APPLICATION

These relays are high speed, plunger-type voltage relays used where instantaneous operation is required. Different model numbers are available for:

Ac overvoltage
Dc overvoltage
Dc undervoltage

Overvoltage—These relays are calibrated in terms of the voltage required to close the N.O. (normally open) contacts and open the N.C. (normally closed) contacts on increasing voltage when the pickup setting is reached. The target, when available, operates for pickup operations only.

Undervoltage—These relays are calibrated in terms of the dc voltage required to open the N.O. (normally open) contact and close the N.C. (normally closed) contacts on decreasing voltage when the dropout setting is reached. They may be used where instantaneous operation is required because of low-voltage conditions caused by faults, overloading, blowing of fuses, battery failure, or sequential control operations. The target, when available, operates for dropout operation only. For ac undervoltage applications, the NGV relay is recommended.

RELAY CHARACTERISTICS

Pickup Times for ac overvoltage relays are approximately 1 cycle at voltages of 1.5 times the pickup voltage setting.

Reset Times for ac overvoltage relays are less than 2 cycles to close the normally closed contact at voltages of 80 percent or less of pickup voltage.

Continuous Rating: The PJV relay coils are continuously rated as specified on the nameplate and will stand 10 percent overrated voltage continuously without injury to the coil with the plunger set for any position within the calibration range. **Ratings for continuous operation on ac are for the non-picked-up position only.** However, the limitation is mechanical, not thermal, and the relay life expectancy under continuously picked-up conditions is a matter of months. **If the relay application is such that continuous operation in the picked-up position is anticipated, then the type NGV relay should be used.**

For certain molded case PJV11 relays for dc voltage applications, an external resistor is included for series connection with the operating coil to improve the relay performance.

Self Reset: All overvoltage models listed in this section have self-reset contacts.

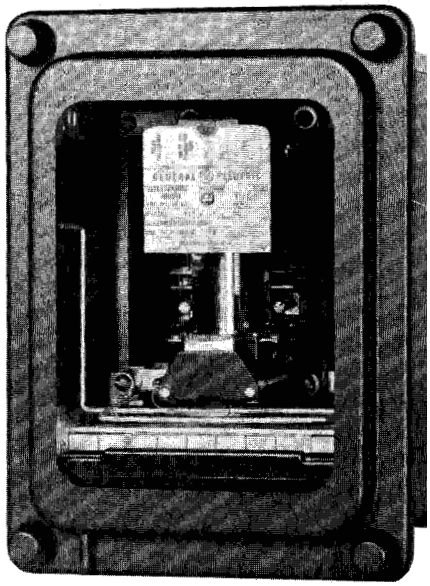
The ac rated models will dropout between 90 and 95 percent of pickup volts while the dc rated models will dropout between 70 and 90 percent of pickup volts.

These standard percentage values are not adjustable and are for contact arrangements of one normally open and one normally closed contact.

When a **dc undervoltage** relay with 95 percent or better is required, the Type PJV17 is applicable. This relay has an auxiliary ac winding in addition to the main dc operating coil and its effect is to increase the percentage. The PJV17 can be used with battery chargers and voltage regulators.

Targets are mechanically operated by the movement of the relay plunger. **Targets** on **overvoltage** relays with a pickup voltage calibration operate when the voltage equals or exceeds the pickup voltage setting.

Targets on **undervoltage** relays with a dropout voltage calibration operate when the voltage is equal to or lower than the dropout setting.



(Photo 8007388)

Fig. 1. PJV11 single-unit relay, drawout construction

Molded and Drawout Case Construction are both available. The molded-case relays are surface mounted and back connected.

RATINGS OF CONTACTS

The current-closing rating of the contacts is 30 amperes. The current-carrying rating is 5 amperes continuously or 30 amperes for two seconds. Interrupting ratings are listed in the following table.

INTERRUPTING RATINGS IN AMP

Ac Noninductive Circuits		Dc Noninductive Circuits	
Volts	Amperes	Volts	Amperes
115	5	24	5
230	2	48	2
460	1	125	1
...	...	250	0.3

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

SELECTION GUIDE—With Mechanical Targets

No. Units	Continuous Rating		Model Number				Contact	Case Size	Approx. Wt. in Lb. (Kg)	
	Volts	Freq. (Hz)	Calibration Range (Volts)	Overvoltage Calibrated in Pickup	Calibration Range (Volts)	Undervoltage Calibrated in Dropout			Net	Ship
1	24	Dc	10-31	12PJV11A12	10-21	12PJV11BB6①	② Code 20, 11, or 02	Molded	2.5 (1.1)	4 (1.8)
	48		20-62	A13	20-42	BB4①				
	62.5		25-80	A43	25-54	BB3①				
	125		50-160	A10	50-109	BB2①				
	250		100-320	A11①	100-218	BB1①				
	67	60	60-93	12PJV11A19	...	.....				
	115		70-160	A1	...	.....				
	230		140-320	A2	...	.....				
	460		280-640	A3	...	.....				
	115	50	70-160	12PJV11A4	...	.....				
	230		140-320	A5	...	.....				
	460		280-640	A6	...	.....				
	24	Dc	10-31	12PJV11AM6A	10-21	12PJV11BA5A		S1	8 (3.6)	12 (5.4)
	48		20-62	AM4A	20-42	BA4A				
	62.5		25-80	AM3A	...	.....				
	125		50-160	AM2A	50-109	BA2A				
	220		88-282	AM7A	...	.....				
	250		100-320	AM1A	100-218	BA1A				
	35	60	15-45	12PJV11AF21A	...	.....				
	67		41-93	AF16A	...	.....				
	115		70-160	AF1A	...	.....				
	230		140-320	AF2A	...	.....				
	460		280-640	AF3A	...	.....				
	115	50		12PJV11AF4A	...	.....				
	230			AF5A	...	.....				
	60			AF6A	...	.....				
2	115	60	70-160	12PJV11AH1A	...	.....		S2	10 (4.5)	15 (6.8)
	230		140-320	AH2A	...	.....				
	460		280-640	AH3A	...	.....				
	115	50	70-160	12PJV11AH4A	...	.....				
	230		140-320	AH5A	...	.....				
	460		280-640	AH6A	...	.....				
3	67	60	41-93	12PJV11AS7A	...	.....		M2	14	19
	115		70-160	AS1A	...	.....				
	230		140-320	AS2A	...	.....				
	460		280-640	AS3A	...	.....				
	115	50	70-160	12PJV11AS4A	...	.....				
	230		140-320	AS5A	...	.....				
	460		280-640	AS6A						

HIGH DROPOUT (95 PERCENT)

No. Units	Continuous Rating		Dropout Calibration (Volts Dc)	Aux. Winding		Model Number	Aux. Winding		Model Number	Aux. Winding		Model Number	Cont.	Case Size	Approx. Wt. in Lb. (Kg)	
	Volts	Freq. (Hz)		Volts	Freq. (Hz)		Volts	Freq. (Hz)		Volts	Freq. (Hz)				Net	Ship
1	12	Dc	6-12.5	115	50/60	12PJV17A27	230	50/60	.....	460	50/60	.....	② Code 11 (Only)	Molded	4 (1.8)	7 (3.2)
	24		9-25			A12			12PJV17A19			.....				
	32		12-33.3			A28			.....			.....				
	48		18-50			A1			A17			.....				
	125		50-130			A2			A15			12PJV17A13				
	250		100-260			A8			A20			.....				
	24	Dc	9-25			12PJV17B5A			12PJV17B3A			.....		S2	10 (4.5)	15 (6.8)
	48		18-50			B1A			.....			.....				
	125		50-130			B2A			B6A			.....				
	250		100-260			B7A			B4A			.....				

① Includes an external resistor.
② Code 20 = 2 N.O. contacts.
Code 11 = 1 N.O. and 1 N.C. contact.
Code 02 = 2 N.C. contacts.
Code 22 = 2 N.O. and 2 N.C. contacts.

For Overexcitation Protection of Transformers and Generators

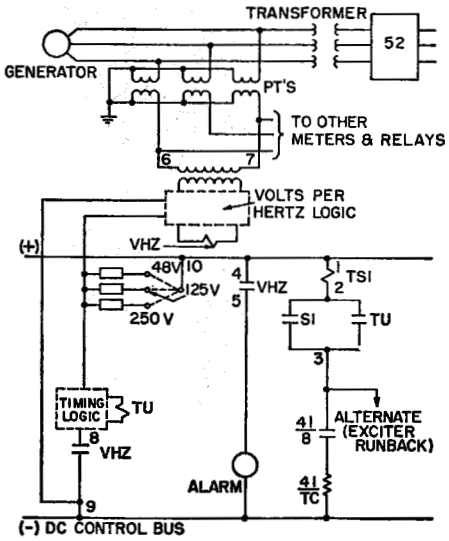


Fig. 1. External connections for the Type STV11A relay

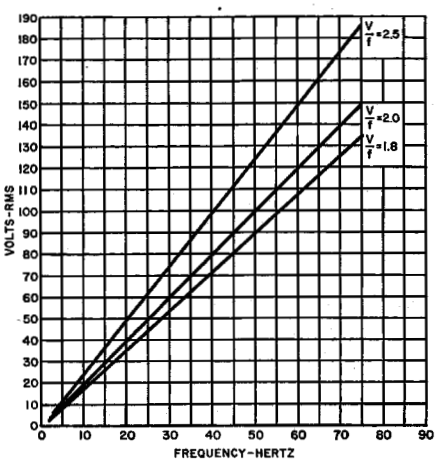
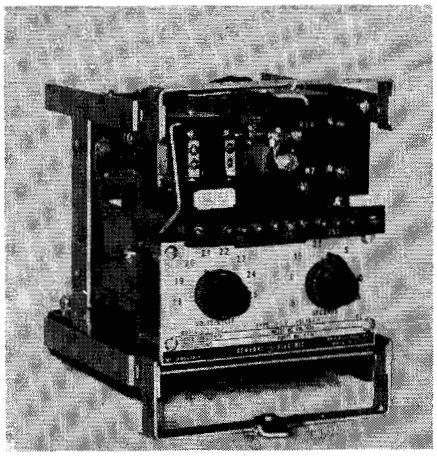


Fig. 2, Pickup volts vs. frequency, Type STV relay (60 Hz models)



(Photo 8037497)

Fig. 3. Type 12STV11A1A relay, front view (out of case)

DESCRIPTION

The Type STV relay is a single-phase static overexcitation relay. It consists of an overexcitation sensing unit which has a linear volts per hertz pickup characteristic (Fig. 2), and a timing unit to provide a definite time before initiating some protective action. A target seal-in unit is also provided to protect the timing unit contacts during tripping duty.

APPLICATION

The Type STV relay is designed specifically for equipment protection in case of overexcitation. Overexcitation of a generator or power transformer may occur during start-up, shutdown, or as a result of remote load rejection. As as result, overheating due to core saturation within a very short time may cause severe damage. This relay, employing a constant volts per hertz pickup, recognizes overexcitation and initiates some appropriate action to protect the equipment.

Although voltage regulators are available with voltage-frequency characteristics desirable for overexcitation control, the STV relay is recommended for alarm and backup protection or primary protection in case of regulator failure.

CONTACT RATINGS

Timing Unit (TU)			Volts/Hz Unit (VHz)			
Target Seal-in Ratings	Current Tripping	Current Continuous	Volts	Hertz	Current Inductive①	Current Non-inductive
0.2/2.0	5.0	0.4	48 125	dc dc	1.0 0.50	3.0 1.5
2.0/and above	30	4.0	250 115 230	dc 60 60	0.25 0.75 0.50	0.75 2.0 1.0

① Inductance of average trip coil.
Note: Current ratings are listed for voltages not in excess of 250 volts dc.

SELECTION GUIDE

Rating		Oper. Range (Hz)	Pickup Adj. Range (V/Hz)	Time Delay (Sec.)	Dc Control (Volts)	Target and Seal-in (Amps Dc)	Model Number	Case Size	Approx. Wt. in Lb (kg)	
Volts	Freq. (Hz)								Net	Ship
120	60	15-72	1.8-2.5	0.5-15.0 2.0-60.0 0.5-15.0 2.0-60.0	48/125/250	0.6/2.0 0.6/2.0 0.2/2.0 0.2/2.0	12STV11A1A A2A A4A A5A	S-1	15 (6.8)	18 (8.2)
120	50	15-72	2.2-2.9	0.5-15.0	48/125/250	0.6/2.0	A3A			
120			2.2-2.9	0.5-15.0	48/110/220	0.2/2.0	A6A			
100			1.8-2.5	0.5-15.0	48/110/220	0.2/2.0	A7A			
110			2.2-2.9	0.5-15.0	48/125/250	0.6/2.0	A8A			
120			2.2-2.9	2.0-60.0	48/125/250	0.6/2.0	A9A			
120			2.2-2.9	2.0-60.0	48/110/220	0.2/2.0	A10A			
120			2.2-2.9	2.0-60.0	48/110/220	0.6/2.0	A11A			
110			1.8-2.5	2.0-60.0	48/125/250	0.2/2.0	A12A			

BURDENS

The ac burden is approximately 0.6 volt-amperes.

Dc Burden

Volts Dc	Watts	
	Timer not Energized	Timer Energized
48	1.10	5.8
125	2.99	16.0
250	6.00	34.5

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

GE Protective Relays

Original Relay Number	Closest* Superseding Relay Number
SFF21A1A	SFF201B1A
SFF21A2A	SFF201B1A
SFF21A3A	SFF201B1A
SFF21A4A	SFF201B1A
SFF21A5A	SFF201B1A
SFF21A6A	SFF201B1A
SFF21A7A	SFF201B1A
SFF21A8A	SFF201B1A
SFF21A9A	None
SFF21A10A	None
SFF21A11A	SFF201B1A
SFF21A12A	SFF201B1A
SFF21A13A	SFF201B1A
SFF21A14A	SFF201B1A
SFF21B–All Forms	None
SFF21H–All Forms	SFF201B1A
SFF22A–All Forms	SFF202B1A
SFF22C1A	SFF202B1A
SFF22E1A	SFF202B1A
SFF22F1A	SFF202B1A
SFF23C–All Forms	SFF201B1A
SFF31A–All Forms	SFF201B1A
SFF31C1A	SFF201B1A
SFF31D1A	SFF201B1A
SFF32A–All Forms	SFF202B1A
SFF32C1A	SFF202B1A
SFF33A1A	SFF201B1A
SFF33C1A	SFF201B1A
SFF201A1A	SFF201B1A
SFF202A1A	SFF202B1A
SFF204A1A	SFF204B1A

***Note:** The new SFF200-series relays are a new design digital relay, by its very design being different than the earlier SFF20-series and the SFF30-series. This difference is not only in the connection points, but in some instances also in the case size.

Static Relay for High-speed Detection of Underfrequency or Overfrequency Conditions

DESCRIPTION

Type SFF200 relays are digital frequency relays designed to operate when the system frequency changes to a predetermined level. They may be set for over-, under-, or restore-frequency operation. Versions are available with one, two, or four frequency points independently settable for function, frequency value, and output delay.

The setting range is 40 to 79.9 Hz in 0.01 Hz steps. Detection of overfrequency or underfrequency levels for 3 cycles will result in an output in 0 to 1.55 seconds delay (0.05 second steps). Detection of system frequency above restore frequency setting for 3 cycles will result in an output prolonged by 0 to 1.55 seconds.

A rate of change feature on the multi-frequency models, when enabled, will produce an output at the higher of two adjacent underfrequency setpoints if the next lower frequency setpoint is reached before the higher setpoint times out.

An Ac undervoltage function will cutoff all outputs whenever the input voltage is less than its setting. The function is adjustable from 35 to 100% of 120 volts (in 5% steps). It will drop out in ½ cycle and pickup in 1 cycle. The SFF200 relays may be powered from either a Dc or Ac control source (37-280 Vdc or 45-132 Vrms 50/60 Hz). However, when the restore frequency mode is used, a restore enable contact input requires Dc control power.

All adjustments are front panel accessible without removing the nameplate. These include: frequency, mode of operation, time delay, undervoltage cutoff, and rate of change "in" or "out" (multi-frequency models only). All above adjustments are per measurement point except undervoltage cutoff.

Indications are provided on the front panel for:

IN SERVICE (green LED) = Control power and Startup Ok (normally on) [1 per relay];

TRIP F (#) (red LED) = Freq (#) output (trip current operated and latched until reset) [1 per setpoint];

TRIP RoC (red LED) = Rate of change caused freq (#) trip current operated and latched until reset [for F1 in SFF202; for F1, F2, F3 in SFF204];

TEST F (#) (amber LED) = Freq (#) detector output (self reset) [1 per setpoint];

TEST TB (amber LED) = Freq (#) output to trip bus (self reset) [1 per setpoint].

APPLICATION

The SFF200 series of frequency relays can be applied wherever an extremely stable device is required for the accurate detection of underfrequency or overfrequency conditions.

Underfrequency

The underfrequency trip feature of the SFF200 relays may be used in load conservation schemes where accuracy and repeatability of frequency measurement is important. If a system disturbance results in loss of generating capacity such that load exceeds generation, system frequency will start to decay and the system may be in danger of collapsing. Underfrequency relays distributed around the system can be used to detect this condition and to disconnect selected system load to compensate for the loss of generation. Such action must be taken promptly and must be of sufficient magnitude to conserve essential load and enable the rest of the system to recover from the underfrequency condition.

Since the SFF200 compares the period of three successive voltage waves with a crystal reference, distortions of this input voltage wave affecting its period may cause incorrect measurement. Longer time delay settings will make this less likely to occur.

It is generally not good practice to supply a relay from a potential source that is connected to one bus section while using that relay to disconnect load on another bus section. For example, a frequency relay connected to a motor bus may see the frequency decaying faster than the voltage and produce a trip output. If the undervoltage cutoff does not coordinate with the underfrequency delay in such a relay, it could inadvertently disconnect load on a separate bus section. When an unattended substation with a large amount of motor load is isolated from the system, a load shedding scheme may see the frequency decaying faster than the voltage due to the motor load and initiate a trip and lockout. The undervoltage cutoff feature coordinated with the underfrequency delay in the SFF200 can be used to prevent such inadvertent operation.

Where an industrial installation is tapped off a power company transmission circuit that utilizes high speed automatic reclosing, an SFF200 relay could be used at the industrial location to prevent motor/generator damage which might result from reclosing to the system out of phase. The relay would detect the drop in frequency while the transmission breaker is open and trip the industrial incoming breaker before reclosing could occur.



Fig. 1. Type SFF200 static digital frequency relay

Rate of Change

This feature will allow load to be shed faster if the frequency decays at a rate faster than was anticipated when the delay timer settings were determined.

Overfrequency

The overfrequency function may be used anywhere that it is desired to detect an overfrequency condition, e.g., to protect a generator against sustained overfrequency beyond rating due to inadvertent load rejection.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

Overfrequency (Cont'd)

Another application is the removal of supplemental protection enabled only during off-line operation of a generator such as applied for protection against accidental energization on turning gear.

Load Restoration

Once the system frequency has recovered after a successful load shedding operation, the restore function in the SFF200 relay (if selected) can be used to initiate the load restoration process. A load restoration program usually incorporates substantial time delay, which must be provided by a timer external to the SFF200 relay. The time delay is related to the time required to add generation and the desire to stagger the reconnection of load allowing the system to stabilize after each step.

SPECIFICATIONS

Dc Control Voltage
37 to 280 Volts

Ac Control Voltage
45 to 132 Vrms 50/60 Hz

Ac Measurement Input
42 to 132 Vrms 50/60 Hz

Settings

Frequency
Setpoint 40.00 to 79.99 Hz on 0.01 Hz steps
Repeatability ±0.002 Hz

Timing
Setpoint 0 to 255 ms in 1 ms steps*
0 to 25.5 sec in 0.1 sec. steps
Repeatability ±3% of setting

Undervoltage
Setpoint 35 to 95% in 5% steps (based on 120 Vrms)
Repeatability ±3% of setting

Rate of change (multi-setpoint models only)
Freq 1 to freq 2: IN or OUT
Freq 2 to freq 3: IN or OUT
Freq 3 to freq 4: IN or OUT

Environmental

(a) Operating
−20 to +55 degrees C, 95% relative humidity (noncondensing) **Note: The unit will not malfunction, nor be damaged, in ambient up to +65C.**

(b) Storage
−40 to +75 degrees C, 95% relative humidity (noncondensing)

(c) Surge
ANSI C37.90 (SWC and Fast Transient)
IEC 255
GE RFI

Contact Ratings
Make and carry = 30 amps for 1 sec

Target Supervision Unit
0.1 amp operate level with less than 0.6 vdc drop at 30 amps

Burden

See Selection Guide below.

ACCESSORIES

A card extender (catalog number 215B8031G1) is available for testing the printed circuit cards. It should be listed as a separate item on an order.

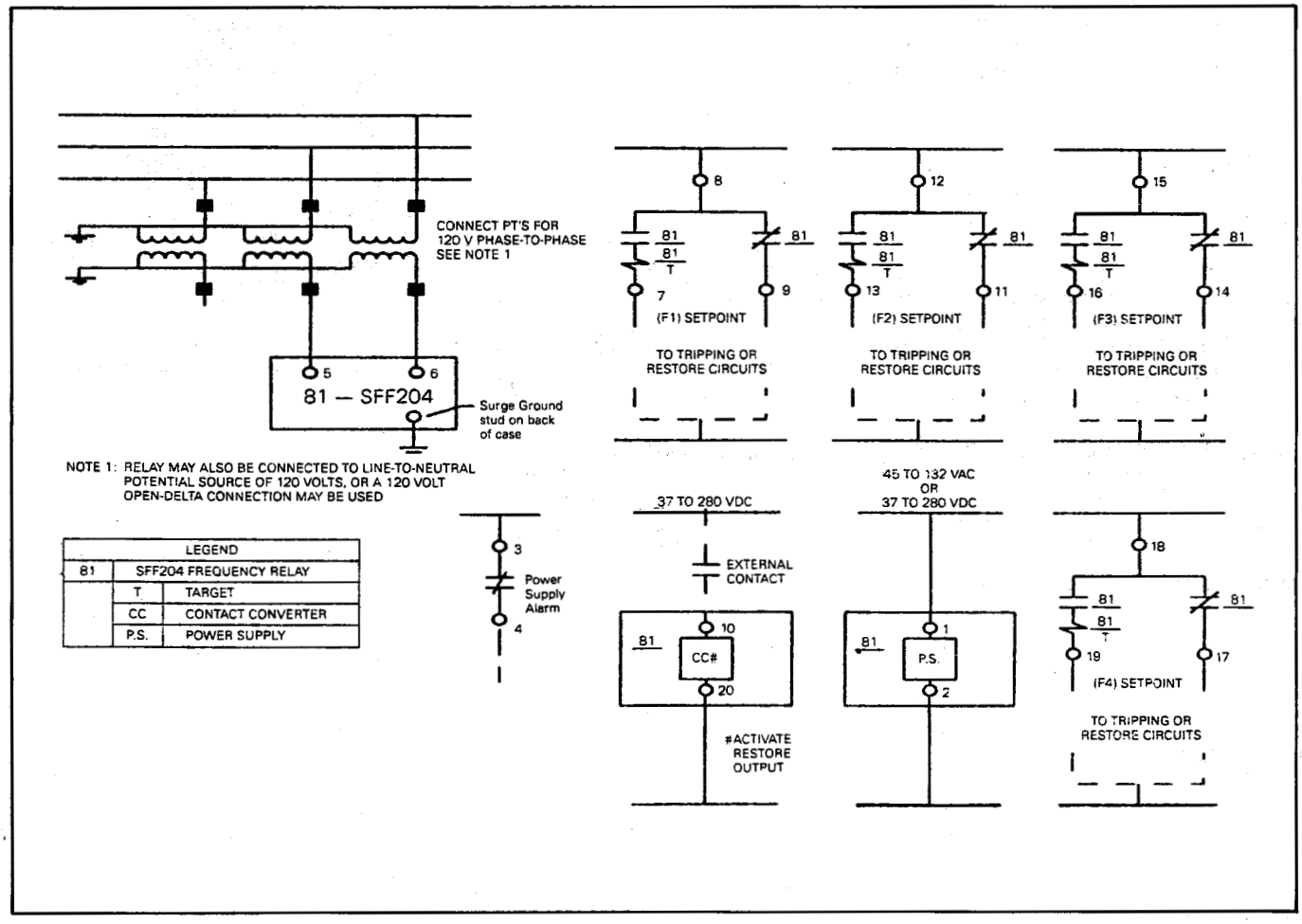
SELECTION GUIDE

Model Number	Case Size	Set Points	Burdens					Weight in Lbs. (Kg)	
			Power Supply				Measurements	Net	Ship
			Dc Watts			Ac VA	Ac VA		
			48 vdc	125 vdc	250 vdc	120 vac	120 vac		
SFF201B1A	S2	1	3.2	3.5	6.3	8.1	1	13 (5.91)	16 (7.25)
SFF202B1A	M2	2	4.9	5.2	8.0	10.6	1	19 (8.64)	23 (10.43)
SFF204B1A	M2	4	8.4	8.7	11.5	15.7	1	20 (9.09)	24 (10.89)

Single phase measurement at 120 v nominal, 48/125/250 vdc or 69/120 Vrms nominal control power (see above specifications for setting ranges and ratings that apply to all models)

*Total time delay is the time-delay setting plus 3 cycles plus the output relay operating time of 6-8 ms.

CONNECTION DIAGRAM



(Dwg. 0285A9666-0)

Fig. 2. External connections for Type SFF204 relay

10

IJF

Overfrequency and Underfrequency Relays

GE Protective Relays

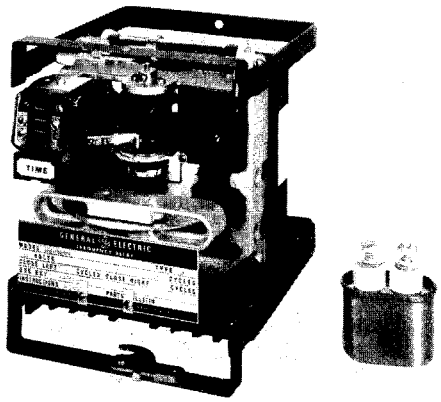
DESCRIPTION

IJF frequency relays are of the induction disk type intended for the protection of apparatus against the effects of overfrequency and/or underfrequency. There is one target seal-in unit on the Type IJF51A, IJF51B, and IJF51C. There are two target seal-in units, one to the left and one to the right of the shaft on the IJF52A.

APPLICATION

These frequency relays are applied where detection of abnormal frequency conditions is required. One of the applications is the protection of synchronous apparatus against overspeed or underspeed conditions caused by loss of load in the case of generators, or loss of power supply in the case of motors and condensers. They can be used to operate protective devices, or to sound an alarm whenever the frequency of the circuit (speed) varies a predetermined amount above or below normal.

The IJF can also be used for load shedding. However, this application is limited to systems where the rate of change of frequency is relatively small, or where the maximum overload on system generation is not excessive. Refer to page 11-21 for the SFF relay for load shedding applications requiring higher speed relays.



(Photo 8042926)

Fig. 1. Type IJF51B frequency relay

BURDENS—60 Hertz

Relay Type	Watts	Power Factor	Volt-Amperes
12IJF51A	8.6	0.99	8.7
12IJF51B	5.7	0.98	5.8
12IJF51C	5.7	0.98	5.8
12IJF52A	9.5	0.89	10.7

SELECTION GUIDE—0.2/2.0 Amp Target and Seal-in

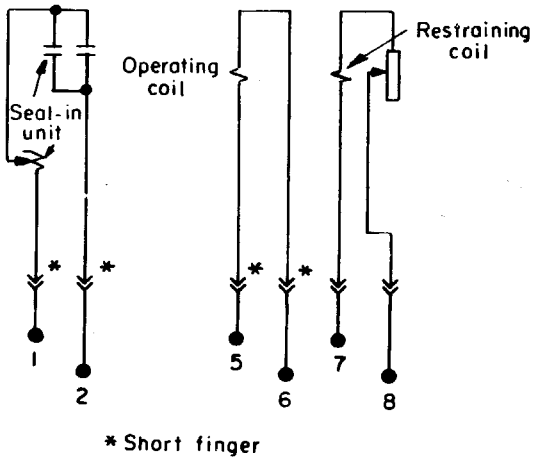
Freq. (Hz)	Volts	Frequency at which Contacts are Adjusted to Close (Hz)②	Frequency Calibration Range (Hz)	Contacts	Frequency Range at which Right Contact Closes Above the Left Contact (Hz)	Model Number ①	Case Size	Approx. Wt in Lb (kg)	
								Net	Shipping
OVERFREQUENCY									
60	115	58	57-60	1 N.O.	...	12IJF51A2A	S1	11 (5)	20 (9)
		60	58-62		...	A7A			
		61	55-65		...	A11A			
		63	61-65		...	A1A			
		70	65-75		...	A4A			
50		47	45-49		...	A5A			
		53	51-55		...	A3A			
UNDERFREQUENCY									
60	115	45	—	1 N.O.	...	12IJF51B1A	S1	11 (5)	20 (9)
		52	48-55		...	B5A			
		55	50-60		...	B8A			
		57	55-59		...	B2A			
50	115	47	45-49		...	B3A			
	220	47	45-49		...	B7A			
UNDERFREQUENCY									
60	115	45	42-47	1 N.C. ③	...	12IJF51C1A	S1	11 (5)	20 (9)
		52	48-55		...	C2A			
		57	55-59		...	C4A			
50	115	45	42-47		...	C3A			
OVER- AND UNDER-FREQUENCY									
60	115	59	55-65	2 N.O. (Left-U.F.) (Right-O.F.)	.75-2.0	12IJF52A4A	S-1	11 (5)	20 (9)
50	115	50	49-51		.8-2.0	A3A			

① Includes external capacitor.
② On IJF52A relay the left (underfrequency) contact is adjustable.
③ This contact is closed at zero volts, but open at rated voltage and frequency above set point.

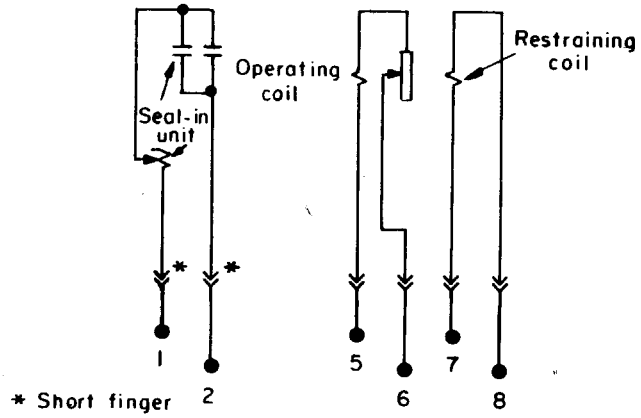
REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

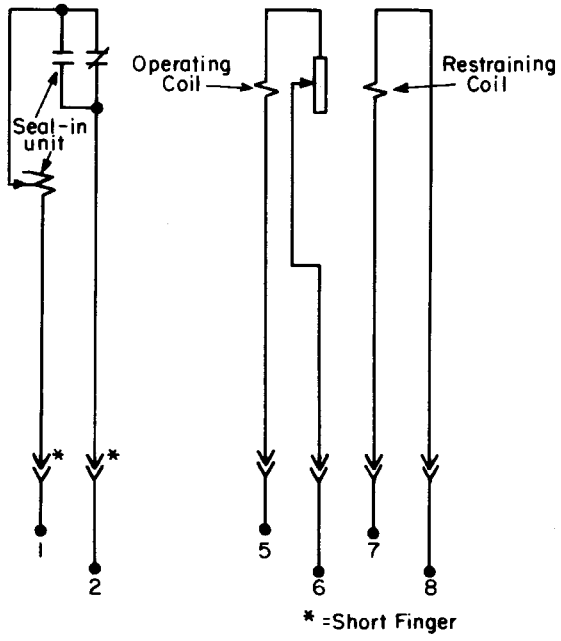
INTERNAL CONNECTION DIAGRAMS



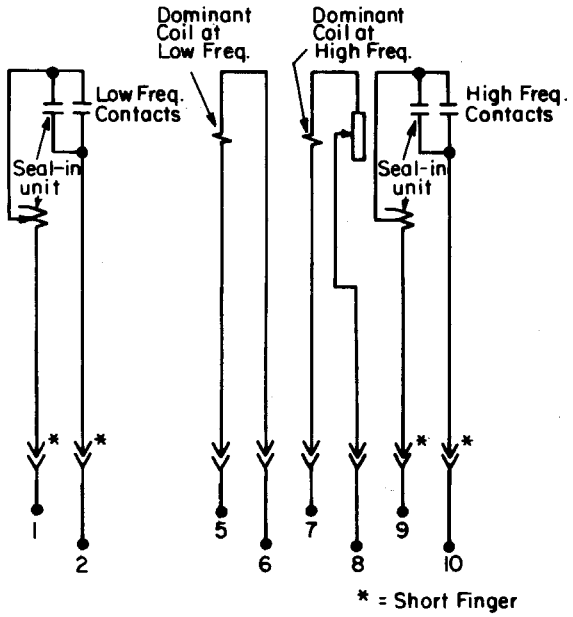
(K-6306813)
Fig. 2. Type IJF51A relay



(K-6306616)
Fig. 3. Type IJF51B relay



(362A558)
Fig. 4. Type IJF51C relay



(K-6400202)
Fig. 5. Type IJF52A relay

TOV Series 1000

Modular Voltage Relay

GE Protective Relays

DESCRIPTION

Type TOV relays are undervoltage and overvoltage relays, single phase, two phase, or three phase, instantaneuous or fixed time, adjustable from 0.1 to 10 seconds.

Adjustments are made from dip switches located on the front of the relay.

The single phase relays include a desensitising filter to the effects of third harmonics, as well as the ability to select between overvoltage and undervoltage operation in the same relay.

TOV relays are solid state, modular relays and are supplied in 1/8 rack size cases, as shown in Figure 4.

APPLICATION

Some of the more common undervoltage applications of the TOV relay are:

1. Instantaneous detection of undervoltage in automatic transfer equipment.
2. As fault detector with distance relays (using communication channels) in the case of lines with weak infeed at one terminal.

Some of the more common overvol tage applications of the TOV relay are:

1. As overvoltage detector for automatic control systems whose functional security depends on voltage.
2. Three phase overvoltage protection with time delays ranging from 100 milliseconds to 10 seconds.
3. Phase to ground fault detection in systems with isolated neutrals and in alternating current rotating machines.

CONSTRUCTION

- Accurate and reliable, with low power consumption.
- Non-Drawout Case.
- LED Indicating Lamps:

  PICK-UP target with manual reset auxiliary power supply voltage
- Fire resistant, shock resistant, sealable plastic cover, with exterior indicator resets.
- Output unit with high seismic rating.
- High reliability components, manufactured using techniques to minimize failures due to infant mortality.

VOLTAGE RANGES

— Adjustable voltage ranges are available as follows:

*20 to 275 Volts AC.
*50 to 305 Volts AC.
* 3 to 65 Volts AC. (Only in single-phase version) in 1 Volt. steps.

— The maximum allowable continuous voltages are:

*400 AC for the 20 to 275 volts and 50 to 305 volts ranges.
*200 V AC for the 3 to 66 volts range.

OPERATING TIMES

There are two operating modes:

1. Instantaneous (25-30 milliseconds).
2. Time delay with two scales:

   a. 0.1-1 seconds in 100 millisecond steps.

   b. 1-10 seconds in 1 second steps.

The same relay can be used in either mode.

APPROXIMATE WEIGHTS

Approximate Net Weight:

5 lbs. (2.3 Kg)

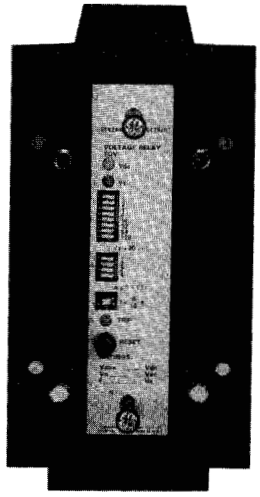


Fig. 1. Relay type TOV

Approximate Shipping Weight:

5.5 lbs. (2.5 Kg)

DIRECT CURRENT AUXILIARY CIRCUIT VOLTAGE

Nominal Voltage (VDC)	Operating Range (VDC)
48	38-60
110	86-132
125	100-150
220	176-264

BURDENS

Depending on the service voltage and the number of auxiliary relays, the DC burden is:

Normal: 45 - 63 mA

Tripped: 63 - 79 mA

The burden of the AC voltage circuits is less than 1 volt-ampere.

REFERENCES:

How to Order ..... Section 1
Instruction Books..... Section 17-9

CONTACT DATA

The basic TOV relay has one auxiliary trip output relay with a form C contact. The contact rating is:

Continuous: 3 Amperes

Make and Carry: 30 Amperes

Break:

180 VA resistive at 125/250 VDC

60 VA inductive at 125/250 VDC

Additionally, another relay is provided with a form C contact. This contact can be used as a signalling relay. The contact rating is:

Continuous: 3 Amps, 250 VDC maximum.
Make and Carry: 5 Amps for 30 seconds, 250 VDC max.
Break: 25 Watts inductive 250 VDC maximum.

TYPE TESTS

The TOV relay complies with the type tests recommended by IEC 255.5, Impulse Withstand and High Frequency Interference. The relay also complies with General Electric standards for Fast Transients.

INSULATION TEST VOLTAGE

Between terminals and ground:
2000 Volts ac for one minute at industrial frequency (50 Hz or 60 Hz).

Between independent terminal groups:
2000 Volts ac for one minute at industrial frequency (50 Hz or 60 Hz).

Between terminals of each one of the output contacts:
1000 Volts ac for one minute at industrial frequency (50 Hz or 60 Hz).

TEMPERATURES RANGES

Effective range: –5 C to + 40 C
Operating range: – 20 C to + 55 C
Storage range: –40 C to + 60 C

RELATIVE HUMIDITY

Up to 95% without condensing.

ACCURACY

Accurate to within +/–5% of Operating Value.

Accurate to within +/–5%, or 30 milliseconds, of operating time.

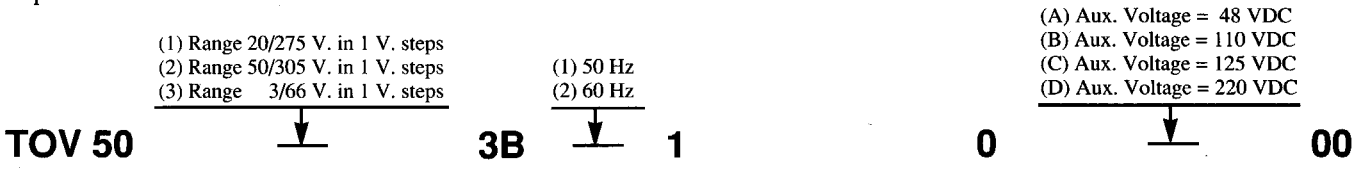
FREQUENCY RANGE

	With filter		Without filter (*)
Nominal frequency	50 Hz	60 Hz	50/60 Hz
Effective range Operating range	48-51 Hz 46-53 Hz	57-63 Hz 56-64 Hz	48/63 Hz 46/64 Hz

(*) Only the three-phase model.

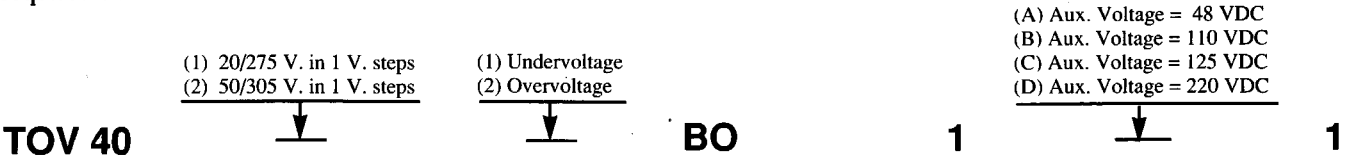
MODEL SELECTION (Single Phase relays)

The information to completely define a relay model follows. Along with the precise model number, please clearly specify the required characteristics.



MODEL SELECTION (Three Phase relays)

The information to completely define a relay model follows. Along with the precise model number, please clearly specify the required characteristics.



Example: Modular overvoltage relay, three phase, 50 - 305 Volts, with auxiliary voltage of 48 VDC. MODEL - TOV4022B010A00.

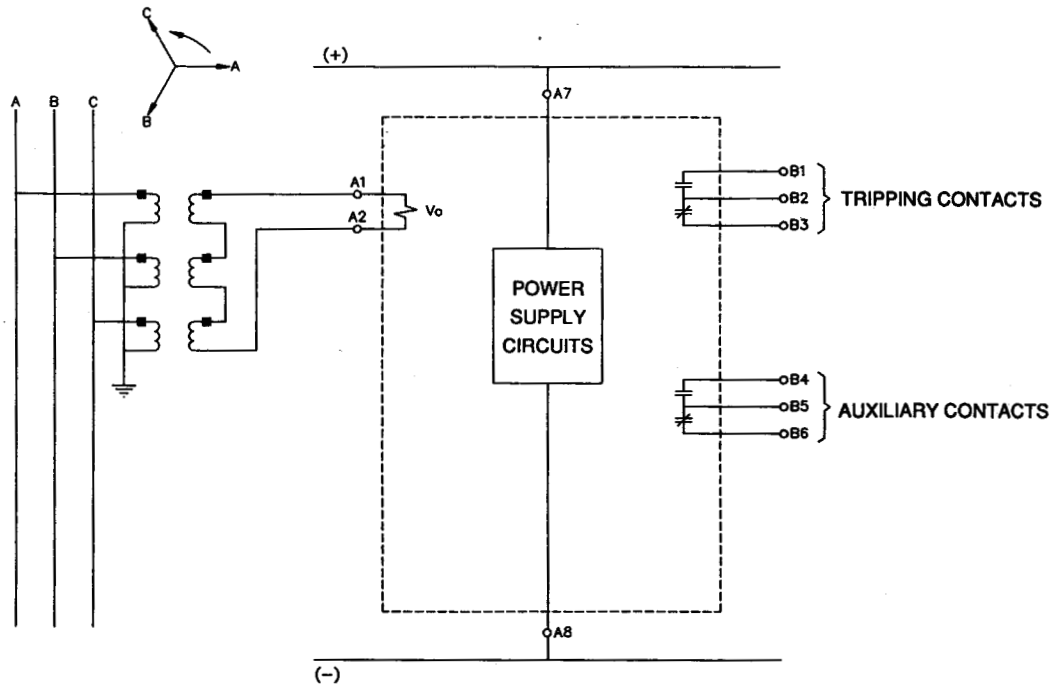


Fig. 2. External connection diagram. Single phase version

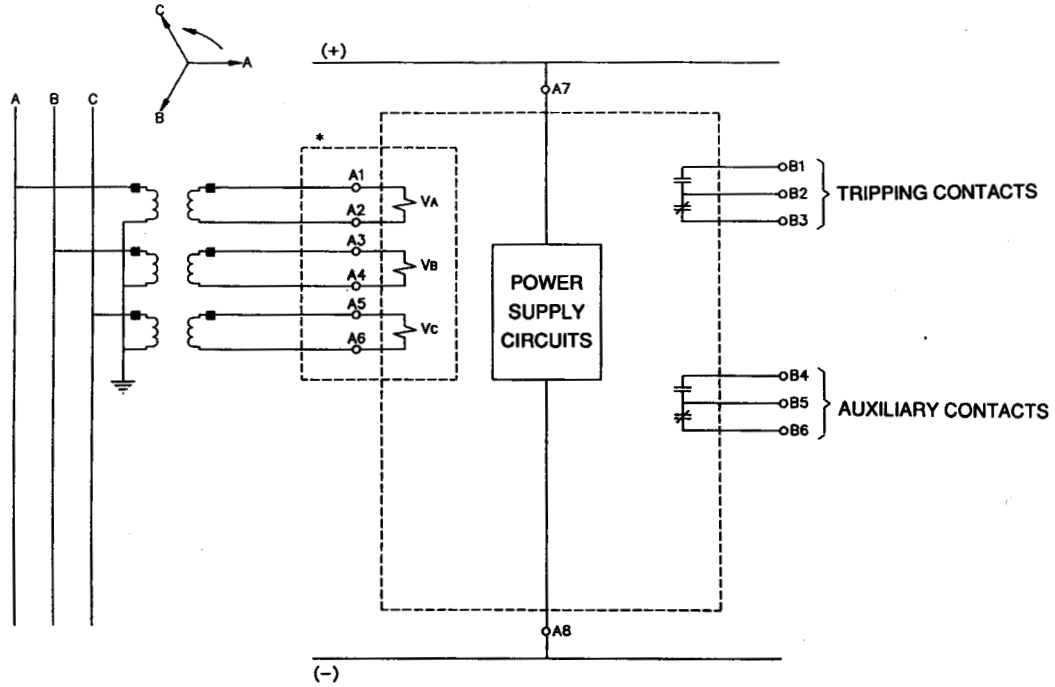
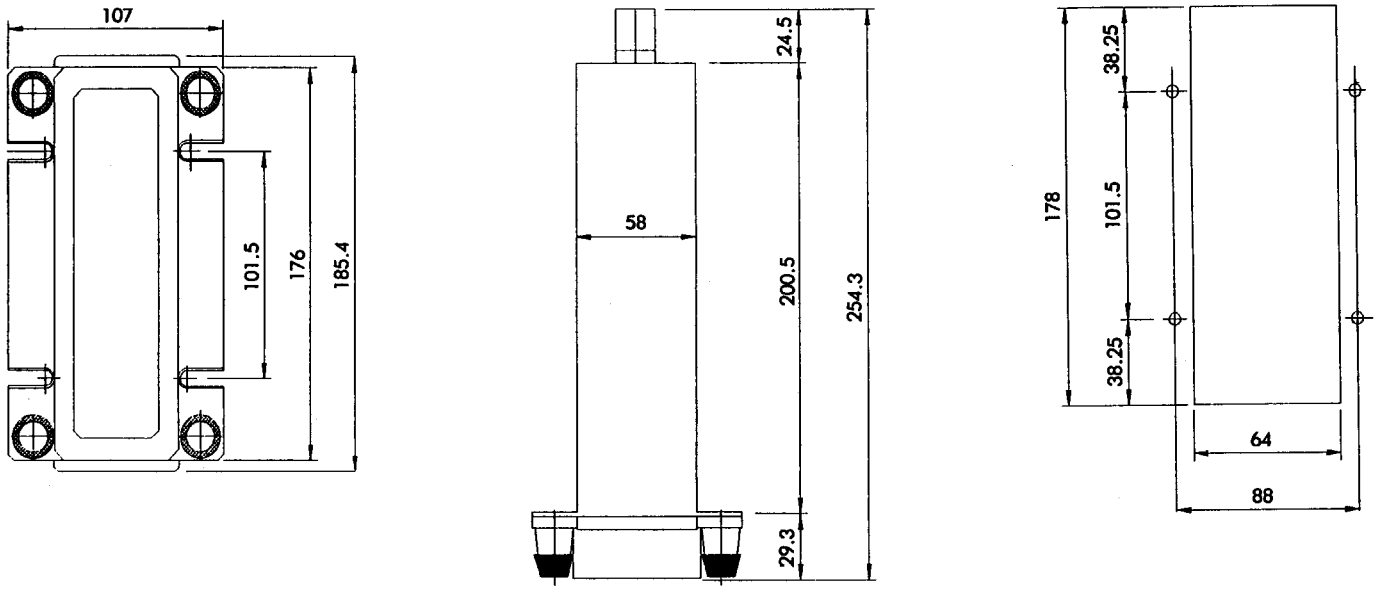


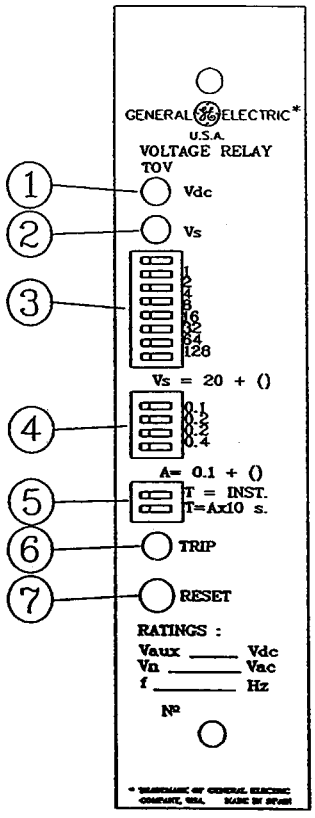
Fig. 3. External connection diagram. Three phase version



(DWG. 226B6086F1)

Fig. 4. TOV Relay Dimensions and Mounting Specifications

DIMENSIONS IN m.m.



1 RELAY IN SERVICE INDICATOR (GREEN LED)
2 RELAY PICK-UP INDICATOR (RED LED)
3 TAP SELECTION
4 TIME SELECTION
5 TIMING MODE
6 TRIP INDICATOR (RED LED)
7 RESET

Fig. 5. Nameplate

TOV Series 1000C

Modular Voltage Relay

GE Protective Relays

DESCRIPTION

Type TOV relays are undervoltage and overvoltage relays, single phase, two phase, or three phase, instantaneous or fixed time, adjustable from 0.1 to 10 seconds.

Adjustments are nade from dip switches located on the front of the relay.

The single phase relays include a desentising filter to the effects of third harmonics, as well as the ability to select between overvoltage and undervoltage operation in the same relay.

TOV relays are solid state, modular relays and are supplied in 1/8 standard 19″ wide rack size cases, as shown in Figure 4.

APPLICATION

Some of the more common undervoltage applications of the TOV relay are:

1 . Instantaneous detection of undervoltage in automatic transfer equipment.

2 . As fault detector with distance relays (using communication channels) in the case of lines with weak infeed at one terminal.

Some of the more common overvoltage applications of the TOV relay are:

1 . As overvoltage detector for autommatic control systems whose functional security depends on voltage.

2 . Three phase overvoltage protection with time delays ranging from 100 milliseconds to 10 seconds.

3 . Phase to ground fault detection in systems with isolated neutrals and in alternating current rotating machines.

CONSTRUCTION

- Accurate and reliable, with low power consumption.
- Non-Drawout Case.
- LED Indicating Lamps:
  PICK-UP target with manual reset auxiliary power supply voltage.
- Fire resistant, shock resistant, sealable plastic cover, with exterior indicator resets.
- Output unit with high seismic, rating.
- High reliability components, manufactured using techniques to minimize failures due to infant mortality.

VOLTAGE RANGES

— Adjustable voltage ranges are available as follows:
  - 20 to 275 Volts ac
  - 50 to 305 Volts ac
  - 3 to 65 Volts ac

(Only in single-phase version) I_n 1 Volt steps.

— The maximum allowable continuous voltages are:
  - 400 ac for the 20 to 275 Volt and 50 to 305 Volt ranges.
  - 200 VAC for the 3 to 66 Volt range.

OPERATING TIMES

There are two operating modes:

1 . Instantaneous (25-30 milliseconds).

2 . Time delay with two scales:
  a. 0.1-1 seconds in 100 millisecond steps.
  b. 1-10 seconds in 1 second steps.

The same relay can be used in either mode, or in both modes.

APPROXIMATE WEIGHTS

Approximate Net Weight:
5 lbs. (2.3 Kg)

Approximate Shipping Weight:
5.5 lbs. (2.5 Kg)

AUXILIARY CIRCUIT VOLTAGE

Nominal Voltage	Operating Range
24-48 Vdc/ac	19-60 Vdc/ac
48-125 Vdc/ac	38-150 Vdc/ac
110-240 Vdc	88-288 Vdc
110-220 Vac	88-264 Vac

BURDENS

Depending on the service voltage and the number of auxiliary relays, the dc burden is:

Normal: 45-63 mA

Tripped: 63-79 mA

The burden of the ac voltage circuits is less than 1 volt-ampere.

CONTACT DATA

The basic TOV relay has one trip output relay and three switched auxiliary output relays, the trip output contact rating is:

Continuous: 3 Amperes

Make and Carry: 30 Amperes

Break:
180 VA resistive at 125/250 Vdc
60 VA inductive at 125/250 Vdc

The three auxiliary output relays contact rating is:

Continuous:
3 Amps, 250 Vdc maximum.

Make and Carry:
5 Amps for 30 seconds. 250 Vdc max.

Break:
25 Watts inductive 250 Vdc maximum.

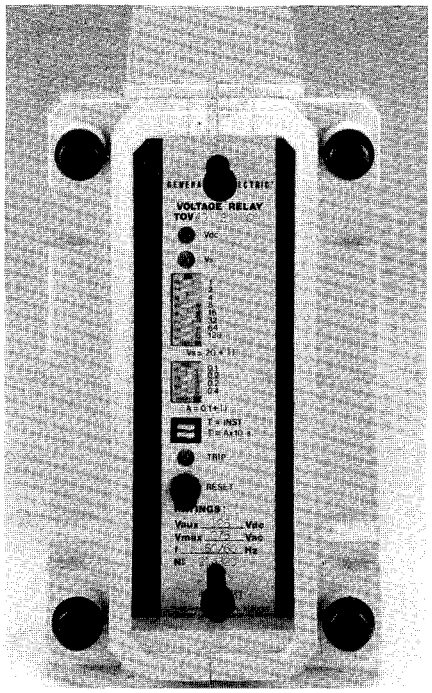


Fig. 1. Relay type TOV

TYPE TESTS

The TOV relay complies with the type tests recommended by IEC 255.5, Impulse Withstand and High Frequency Interference. The relay also complies with GE standards for Fast Transients.

INSULATION TEST VOLTAGE

Between terminals and ground:
2000 Volts are for one minute at industrial frequency (50 Hz-60 Hzx).

Between independent terminal groups:
2000 Volts ac for one minute at industrial frequency (50 Hz-60 Hz).

Between teerminals of each one of the output contacts:
1000 Volts ac for one minute at industrial frequency (50 Hz-60 Hz).

TEMPERATURE RANGES

Effective range: -5 C to +40 C
Operating range: -20 C to +55 C
Storage range: -40 C to +60 C

RELATIVE HUMIDITY

Up to 95% without condensing.

ACCURACY

Accurate to within ±5% of Operating Value.

Accurate to within ±5 %, or 30 milliseconds, of operating time.

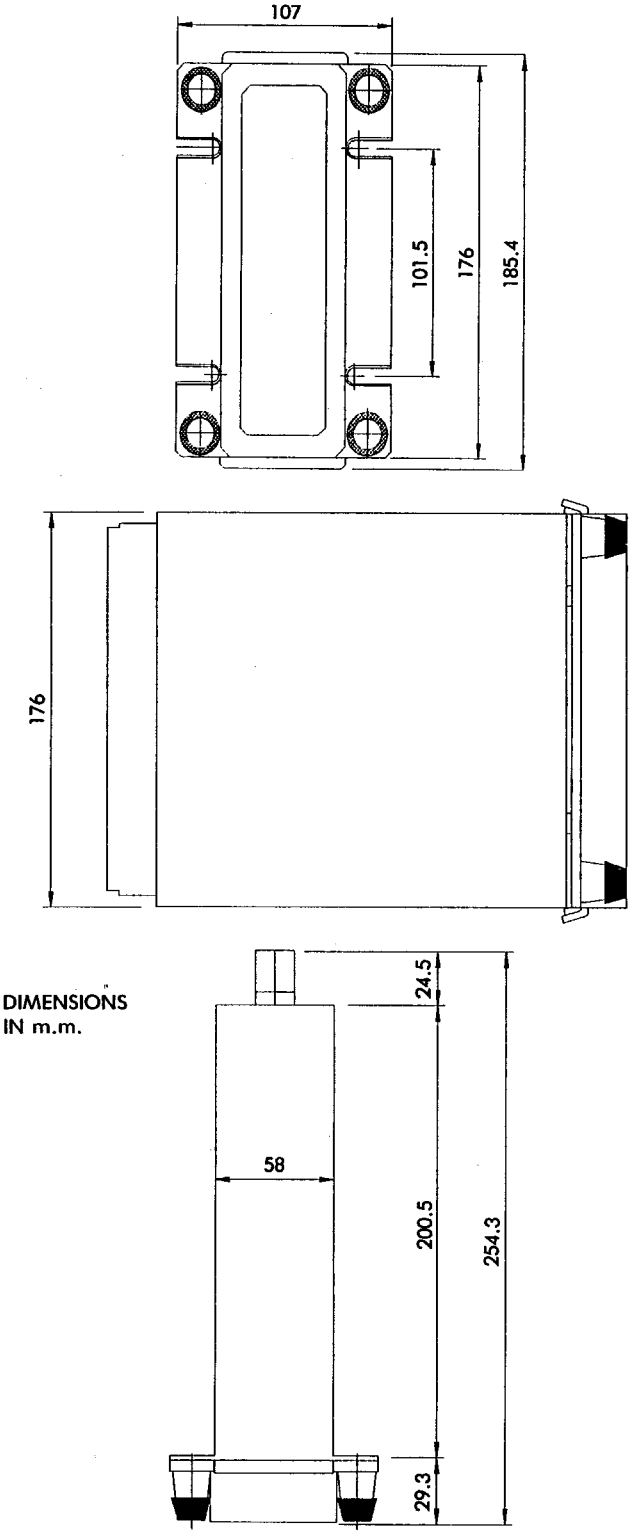
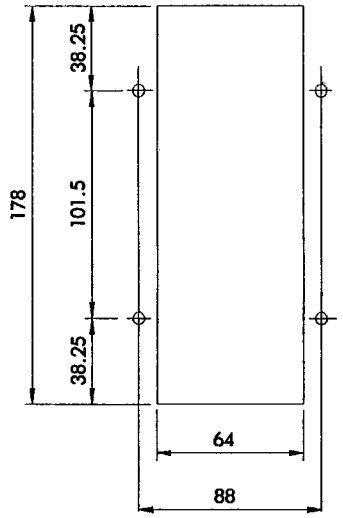
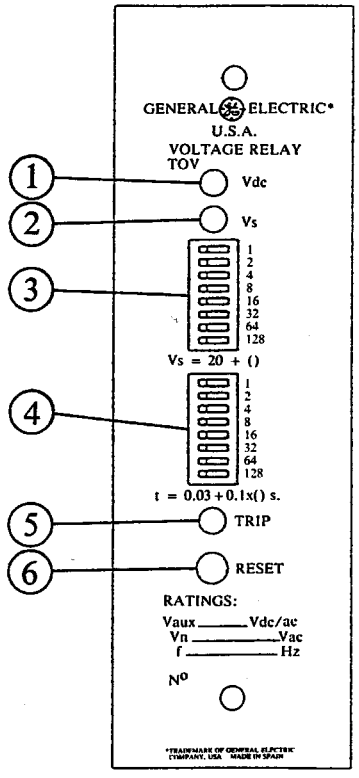


Fig. 4. TOV Relay Dimensions and Mounting Specifications



DIMENSIONS IN MOUNTING



1 RELAY IN SERVICE INDICATOR (GREEN LED)
2 RELAY PICK-UP INDICATOR (RED LED)
3 TAP SELECTION
4 TIME SELECTION
5 TRIP INDICATOR (RED LED)
6 RESET

Fig. 5. Nameplate

FREQUENCY RANGE

	With filter		Without filter (*)
Normal frequency	50 Hz	60 Hz	50/60 Hz
Effective range Operating range	45-51 Hz 46-53 Hz	57-63 Hz 57-63 Hz	48/63 Hz 46/64 Hz

(*)Only the three-phase model.

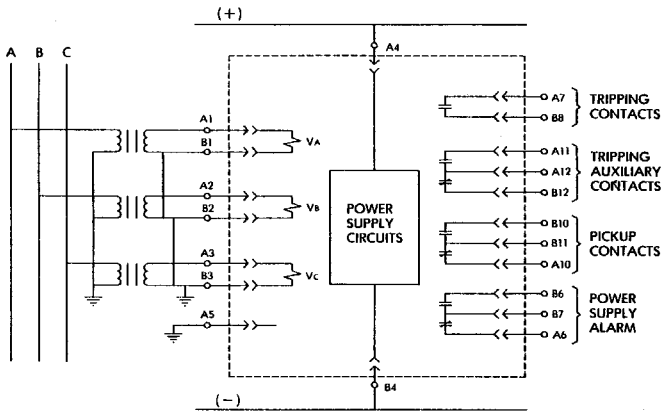
NOMENCLATURE SELECTION GUIDE

TOV Model Numbers Three Phase and Single Phase Models

TOV * 0 * 3 * * * 0 * 0 0 C

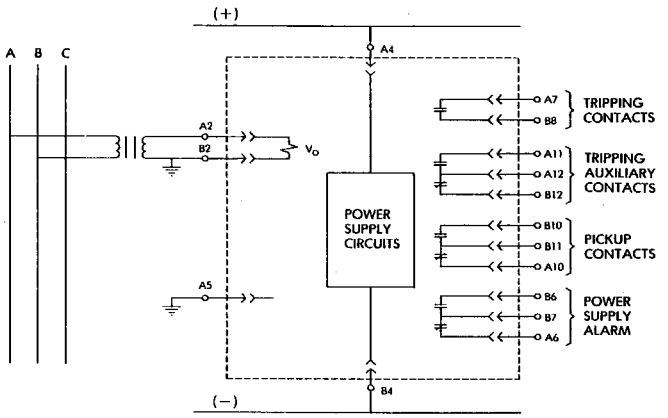
4	Three Phase
5	Single Phase
1	Range: 20/275V in 1V steps
2	Range: 50/315V in 1V steps
3	Range: 3/ 66V in 1V steps
I	Undervoltage, Overvoltage, Single Phase — Three Phase
M	
(B)	
(0)	Three Phase
1	Filter 50 Hz — Single Phase
2	Filter 60 Hz — Single Phase
3	Three Phase
1	Single Phase
F	24/48 VDC/VAC — Auxiliary Voltage
G	48/125 VDC/VAC — Auxiliary Voltage
H	110/240 VDC-110/220 VAC — Auxiliary Voltage

The TOV is available in three models with switched contacts. One live voltage, one started, and one trip auxiliary.



(DWG. 226B6083F2)

Fig. 2. External connection diagram. Single phase version



(DWG. 226B6083F3)

Fig. 3. External connection diagram. Three phase version

SECTION: 11

Test Equipment and Accessories

XCA Test Probe and Plug 1

XLA12A Test Plug 3

XLA13A Test Plug 4

XTM Test Plug, Card Extender and Bracket Kits 5

XRT12A Electro-Mechanical Relay Tool Kit .. 6

Harmonic Restraint Test Rectifier 7

Auxiliary Transformers 9

Tripping and Blocking Rectifiers 11

Test Probes and Plugs for C-case Drawout Relays

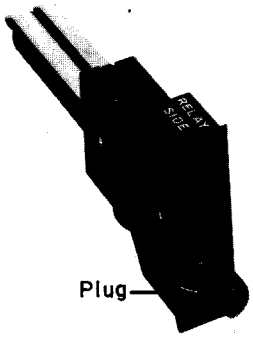
DESCRIPTION AND APPLICATION

Three different XCA test plugs are available to provide an easy means of testing C-case drawout relays without removing them from their cases.

The ***XCA11A1*** is a two-position four-point test probe used in testing C-case relays. It is keyed to the barrier strips in the C-case, and can only be inserted in positions 1-2, 3-4, 5-6, etc. These terminal pairs are used for current transformer connections and trip circuit outputs in C-case relays. It cannot be inserted in positions 2-3, 4-5, etc. It has contact fingers which are electrically separate, top to bottom, and are connected to standard banana-plug receptacles on the face of the probe. This test probe is furnished with an accessory shorting plug Type 0184B5461 (see Figure 1) which may be used to short out CT inputs during relay tests.

The ***XCA11A2*** is a prewired test probe for use in measuring current in the CT circuits connected to a C-case relay. It consists of a Type XCA11A1 test probe to which a jumper and six-foot long (1.8 m) ammeter leads have been added. See Figure 2.

The ***XCA28A1*** is a full-width 14-position 28-point test plug which provides complete flexibilty in testing C-case relays. See Figure 3. It has 28 electrically separate contact fingers connected to 14 concentric binding posts. One side of the test plug is prominently marked "Relay Side" and the other "Case Side". The test plug is keyed so that it can only be inserted in the proper manner. The "Relay Side" contact fingers are connected to the black inner binding posts and engage the relay internal connections. Test leads with either spade lugs or banana jacks may be used with these binding posts. The contact fingers on the "Case Side" are connected to the outer binding posts with red thumb nuts and engage the C-case stud connections. Removable test links are furnished with each test plug for through connection, short circuiting and external wiring. These accessory links are identical to those supplied with the Type XLA test plug. See Figure 4.



(Photo 8043264)

Fig. 1. Type XCA11 test probe with shorting plug 0184B5461

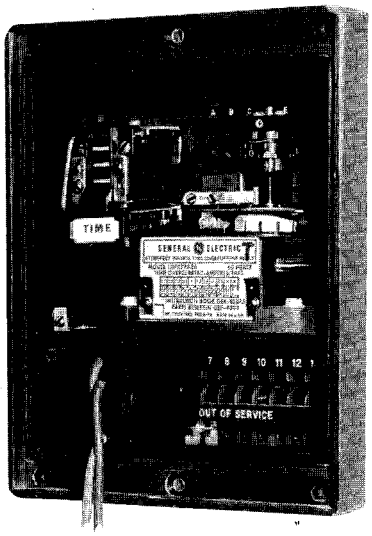


Fig. 2. C-case relay with XCA11A2 ammeter test probe

TEST PROBE SELECTION GUIDE①

Application	Model Number	Number Required	Weight, lb (kg)	
			Net	Shipping
All tests	12XCA28A1	1	2.6 (1.2)	
Measure CT current	12XCA11A2	1	.3 (.14)	.5 (.2)
Test current circuit only	12XCA11A1②	1 and 1 shorting plug	.15 (.06)	.3 (.14)
Test current and output circuits	12XCA11A1②	2-4 depending on relay	.....	.....

① For maximum flexibility in testing, it is recommended that each set of test equipment include one 12XCA28A1 full-width test plug and one 12XCA11A2 ammeter test probe. Alternatively, two 12XCA11A1 two-position test probes, each with 0184B5461 shorting plug and one 12XCA11A2 ammeter test probe should be ordered.

② Model 12XCA11A1 includes one accessory shorting plug 0184B5461.

How to Order ..... Section 1
Instruction Books ..... Section 17

Test Probes and Plugs

CONNECTION DIAGRAM

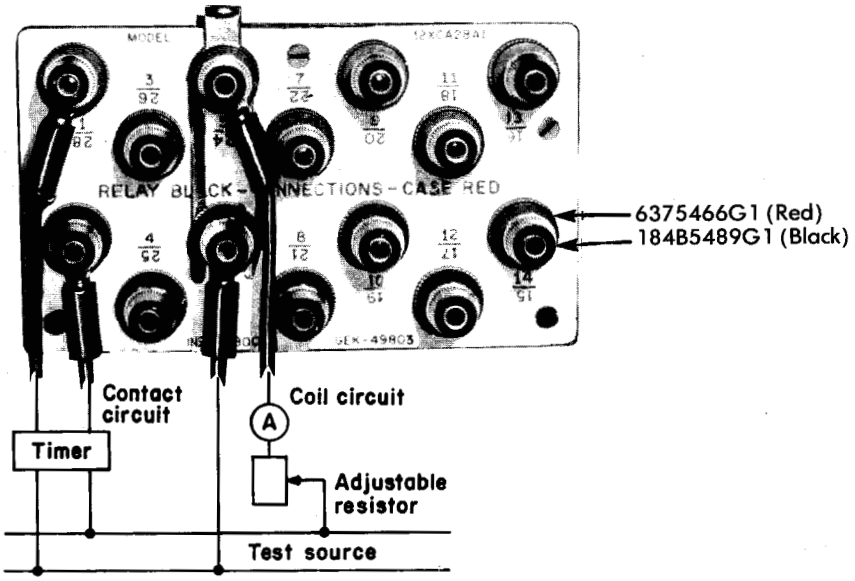


Fig. 3. Typical separate source connections and wiring diagram for testing an IFC overcurrent relay using the XCA28 test plug



Qty 10 Cat. No. 6242939 Through connection link

Qty 5 Cat. No. 6375471 Short-circuiting link

Qty 10 Cat. No. 6242937 Large test clip

Qty 10 Cat. No. 6242938 Small test clip

(Photo 1236857)

Fig. 4. Accessory links are provided with the test plug XCA28 for jumper connections and for connections to terminal studs

Accessory Link Kit 273A9598G1 = (10)-6242939P1 thru-links
(5)-6375471P1 short-circuit links
(10)-6242937P1 test clip
(10)-6242938P1 test clip

Test Plugs for Drawout Relays

APPLICATION

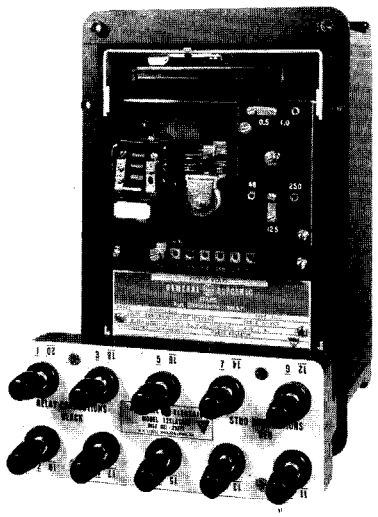
The test plug provides a quick and easy means of testing drawout case relays or meters without removing them from their cases. The test plug is substituted for the regular connecting plug and there is nothing to disconnect. The **XLA12A** enables power to be applied to the relay from either a separate source or the source that feeds the equipment. The **XLA13A** can only be used **when a separate source of power is available.**

To insure low-contact resistance the test plug contact fingers are silver plated.

XLA12A 20-POINT PLUG

The XLA12A test plug consists of a black and red Textolite® molding with twenty electrically separate contact fingers connected to ten concentric binding posts. The ten contact fingers on the black side are connected to the inside binding posts with the black thumb nuts and engage the relay internal connections. The contact fingers on the red side are connected to the outer binding posts with the red thumb nuts and engage the drawout case stud connections. When using the test plug in the bottom of the relay, numbers one to ten, corresponding to the relay studs, appear upright, while numbers eleven to twenty are upside down. It is **impossible,** due to its construction, to insert the plug into the bottom of a relay with numbers one to ten up-side down. By the same token, numbers eleven to twenty will always appear in the upright position when the plug is inserted in the top of a relay.

NOTE: Links and test clips **are provided with each XLA12A** in the quantities shown in Fig. 4.



(Photo 8043221)

Fig. 1. Drawout relay with XLA12A test plug inserted

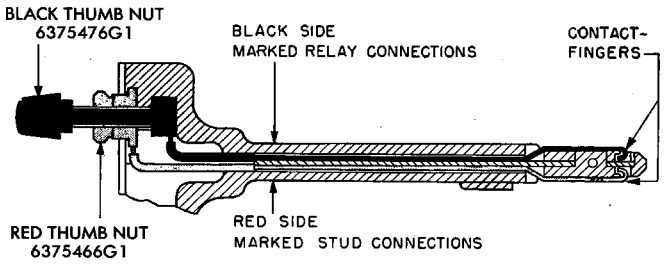
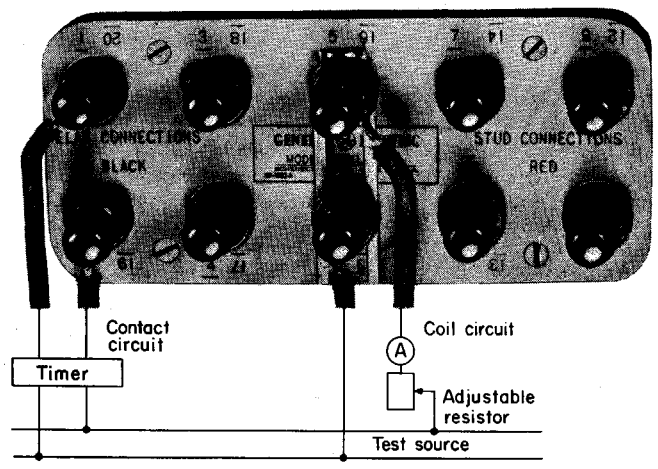


Fig. 2. Sectional view of XLA12A test plug showing internal wiring

SELECTION GUIDE

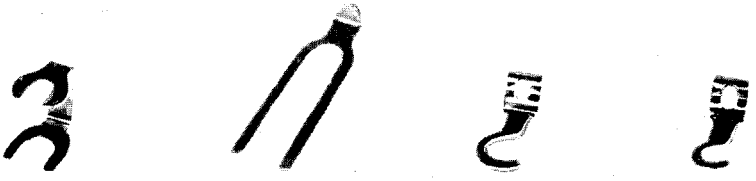
Model No.	Number of Points	Approx Wt in lb (kg)	
		Net	Shipping
12XLA12A1	20	3 (1.4)	6 (2.7)
12XLA13A1	10	2 (0.4)	4 (1.8)



(Photo 8004359)

Fig. 3. Typical separate source connections and wiring diagram for testing an IAC overcurrent relay using the XLA12A test plug

ACCESSORY LINKS



Qty 10 Cat. No. 6242939 Through connection link

Qty 5 Cat. No. 6375471 Short-circuiting link

Qty 10 Cat. No. 6242937 Large test clip

Qty 10 Cat. No. 6242938 Small test clip

(Photo 1236837)

Fig. 4. Accessory links are provided with the test plugs for jumper connections and for connections to terminal studs

Accessory Link Kit 273A9598G1 =(10)-6242939P1 thru-links
(5)-6375471P1 short-circuit links
(10)-6242937P1 test clip
(10)-6249938P1 test clip

How to Order .....Section 1
Instruction Books .....Section 17

Test Plugs and Clip

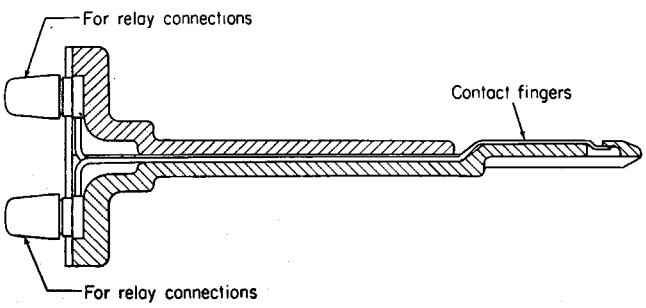
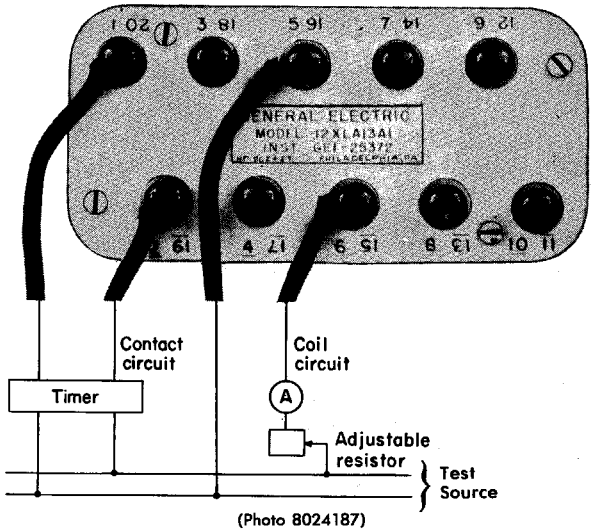


Fig. 5. Sectional view of XLA13A test plug showing internal wiring



(Photo 8024187)

Fig. 6. Typical separate source connections and wiring diagram for testing an IAC overcurrent relay using the XLA13A test plug

XLA13A 10-POINT PLUG

The XLA13A test plug consists of a black Textolite molding with ten electrically separate contacts. Each contact terminates at a separate binding post. See Fig. 6. When the relay connecting plug is withdrawn any current-transformer secondaries will be short-circuited by shorting bars in the case. The insertion of the XLA13A test plug does not disturb the current transformer shorting arrangement. The diagonally staggered binding posts are numbered. Numbers one to ten, corresponding to the relay stud connections, appear upright when using this plug in the bottom of a relay, while number eleven to twenty appear up-side down. Because of its design, the XLA13 test plug **cannot be inserted** into the bottom of a relay with numbers one to ten up-side down. Thus, the contacts of the inserted plug will always be toward the relay.

NOTE: Ten test clips **are provided with each XLA13A** as shown in Fig. 7.

ACCESSORY TEST CLIP

Accessory Link Kit = (10)-6242938P1 test clip
273A9598G2



Qty 10
Cat. No.
6242938
Small
test clip

(Photo 1236837)

Fig. 7. Accessory test clip

For Modular Relays

DESCRIPTION AND APPLICATION

The Type XTM test plug is available for testing modular type relays. The connection plugs can be removed from the modular relay, and the Type XTM test plug can be inserted, as shown on Fig. 3, for current injection testing and input/output access. The modular relays have two connection plugs and require two test plugs, one right-hand test plug and one left-hand test plug (See Fig. 1). Modular relay, Fig. 3, is shown with left-hand test plug inserted. The handle of the test plug may be pulled out and turned to the right for easy access to connection points.

The card extender, listed in Table 2 below, provide versatility for testing plug-in modules in the relay. The module to be tested can be removed from the relay, the card extender inserted in place of the module, then the module can be inserted into the card extender as shown in the example in Fig. 3. This gives complete access to module card for test purposes.

A bracket kit for semi-flush mounting is required when selected equipment, listed in Table 3 below, is being mounted in an existing 17″ deep GE Swing Rack Cabinet. The brackets provide for shelf extention when modular relays are mounted in existing cabinets as mentioned above. Pricing for test plugs, card extenders and bracket kits can be found on Page 9-1 of the GE pricing catalog, GEP-971A.

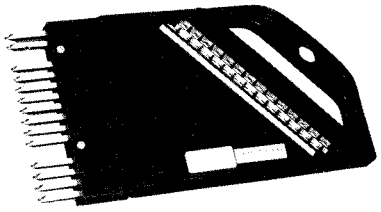


Fig. 1. XTML1 Test Plug (Left hand test plug shown).

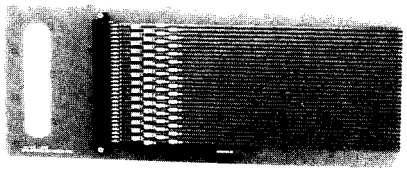


Fig. 2. 0138B7406G1 Card Extender.

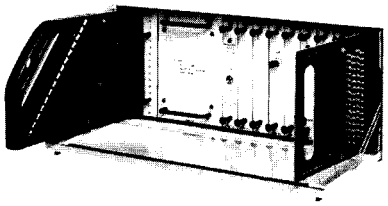


Fig. 3. Test Plug and Card Extender Inserted into relay.

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ORDERING GUIDE

TABLE 1—Test Plugs

Catalog Number	Number Required	Net Equipment
XTM28L1 (Left Hand)	2	DGP
XTM28R1 (Right Hand)	2	
XTM28L1 (Left Hand)	1	All Other Modular Relays
XTM28R1 (Right Hand)	1	

Note: (1) pair test plugs provides 28 test points

TABLE 2—Test Extenders

Catalog Number	Net Equipment	Number Required
138B7406G1	DLS, PLS, TLS, TYS	1
19B230830G1	CS51C	1
19C318404G1	CS51B, 61, 71A	1
19D427767G1	NN & NS40A, TYS CS25/27C, 28A	1
215B8031G1	DDP, SAM200, SFF200	1
215B8450G1	SLY80	1

TABLE 3—Bracket Kits for Semi-Flush Mounting

Catalog Number	Net Equipment	Number Required
19D436725G4	CS51C, DLP, DLS, PLS	1
19D436725G4	TLS, TYS	2
286A3620G1	CS28A, NS40A	1

How to Order .....Section 1
Instruction Books .....Section 17

Electromechanical Relay Tool Kit

Model XRT12A

GE Protective Relays

APPLICATION

Model No. XRT12A covers a set of relay tools contained in a flexable vinyl pouch. The set consists of 18 selected tools, of suitable variety, for the proper maintenance of General Electric relays. Individual tools are described in the table below.

MODEL NO. AND WEIGHTS

Model No.	Approx. Wt. in Lb.	
	Net	Shipping
XRTA12A	1.2	2.0

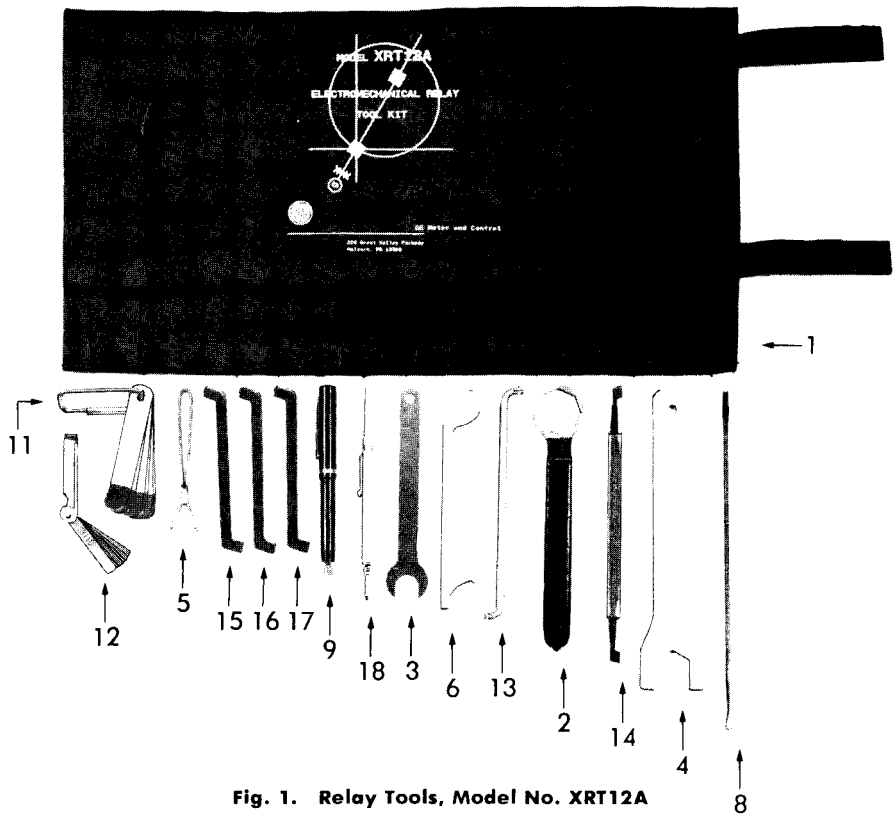


Fig. 1. Relay Tools, Model No. XRT12A

TOOLS CONTAINED IN TOOL SET MODEL NO. XRT12A

PT	Catalog #	Description	Typical Use
1	0286A2026P001	Hvy Gauge Vinyl Pouch	
2	0178A9455P001	Spec. 15/16" Box Wrench	Core adj.-4 pole cup unit
3	0246A7916P001	Spec. 1/2" Open-end Wrench	Clutch adj.-4 pole cup unit
4	0378A0518P004	Spec. 13/16" Open-end Wrench	Core adj.-8 pole cup unit
5	0286A2024P001	Spec. 5/8" Spanner Wrench	Spring adj.-8 pole cup unit
6	0184B5401P001	Spec. Spanner Wrench	Spring adj.-IFC unit
7	0286A2025P001	Contact Leaf Adjuster *(not shown)*	Moving contacts-HFA, HGA
8	0285A5441 P-1	Push/Pull Spring Hook	Extension type springs
9	0285A5442 P-1	Contact Burnisher	Contact cleaning
10	0285A5442 P-25	25 Extra Blades for Burnisher	Contact cleaning
11	0285A5443 P-1	Angle Feeler Gauge Set	Contact gaps-general
12	0285A5444 P-1	Straight Feeler Gauge Set	Contact gaps-general
13	0285A5445 P-1	Contact Leaf Adjuster	Telephone type relay
14	0285A5445 P-2	Contact Leaf Adjuster	Telephone type relay
15	0285A5446 P-1	Armature Adjuster	Telephone type relay
16	0285A5446 P-2	Armature Adjuster	Telephone type relay
17	0285A5446 P-3	Armature Adjuster	Telephone type relay
18	0285A5447 P-1	0.085" wide Pot Adjuster	Trim pots-PC boards

Portable Test Rectifier

For Testing Harmonic Restraint Characteristics

GE Protective Relays

For Relay Types STD, BDD and BFC

DESCRIPTION

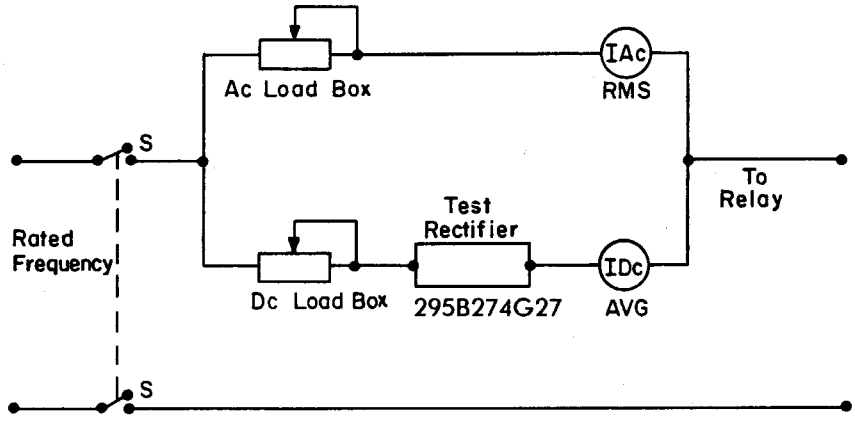
The test rectifier consists of a medium power silicon rectifier mounted on an appropriate heat sink in a small molded case. Connections to the terminals at each end of the case may be made by clamping leads or terminal under the molded thumb nuts, or by clipping the leads directly to the hexagonal portion of the terminal. A half wave rectifier symbol is shown on the nameplate to facilitate proper choice of DC meter connections.

APPLICATION

The test rectifier is a compact, portable piece of test equipment designed for calibration testing of the second harmonic restraint feature of differential or over-current relays.

Magnetizing inrush current in a power transformer contains both second and third harmonics as well as components of higher frequency in addition to the dc and fundamental frequency components. Normally, a relay receives the difference in inrush magnetizing currents for two phases. Usually only one phase has a magnetizing inrush but occasionally two cores have simultaneous inrushes. This is the most severe condition because if these currents are equal, the third harmonic will be largely cancelled due to the 120-degree phase relationship of the two phases.

It is desirable to use a test method which will provide a good match with critical service conditions. Therefore, it is better to set the harmonic restraint adjustment on the relay using test currents containing second harmonic rather than third harmonic.



Second harmonic test connection using test rectifier

Fig. 1.

The test method, Fig. 1 adopted for transformer differential relays involves a test current made up of two parts. One part is a half-wave rectified current I_{DC} and the other is an ac current I_{AC} of the same phase relation.

The test rectifier is designed for second harmonic calibration testing of all Type BDD, HDD and STD transformer differential relays and Type BFC harmonic restraint overcurrent relays. Some of the older transformer differential relays, such as Type HDD, BDD15A, or BDD16A, may originally have been calibrated at the factory with third harmonic current by using a test reactor in the circuit. It is recommended that the second harmonic current and test rectifier method of calibration testing be used for these relays since it will provide a higher degree of accuracy.

For specific information on how to use the test rectifier for testing any of the harmonic restraint relays, refer to the instruction book.

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SELECTION GUIDE 50/60 Hertz①

Ac Input Voltage		Dc Output Amperes	Catalog Number	Approx Weight Pounds (Kg)	
Nominal	Maximum	Maximum		Net	Shipping
115	260	8	295B274G27	0.5(0.23)	1(0.45)

① For rectifier application in dc tripping or control circuits, refer to TRIPPING AND BLOCKING RECTIFIERS.

REFERENCES:

How to Order ..... Section 1
Instruction Books ..... Section 17
Relay Standards ..... Section 16

In the chart there is two pages reserved for the HARMONIC RESTRAINT, but in last years book there is only one page to scan, not two.

Auxiliary Transformers

For Balancing Secondary Currents of Current Transformers

GE Protective Relays

APPLICATION

The auxiliary transformers listed below are used primarily with relays for differential protection of power transformers. The ratio of power transformers is usually such that equal values of secondary current cannot be obtained from current transformers of standard ratio on the high- and low-voltage sides.

Auxiliary transformers should be used with the Types IAC and IFD relays for all such applications. They are not required with relays which have provisions for balancing secondary currents, such as Types IJD and BDD.

SELECTION

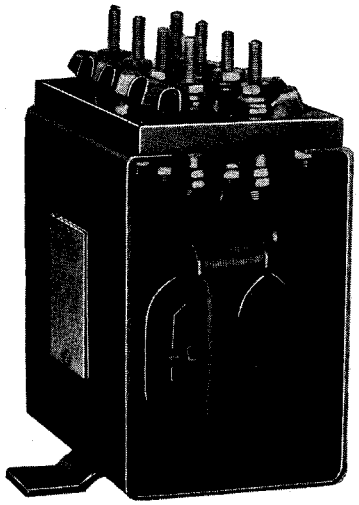
Assume it is designed to provide differential protection for a 13,800/2300-volt, 1000-kVa single-phase power transformer. The normal full-load current on the high and low side is 72 and 435 amperes respectively. This would require current transformers rated 100/5 and 500/5 amperes, which would give secondary currents of 3.6 and 4.35 amperes. The transformer selected should have tap ratings equal or proportional to 3.6 and 4.35 amperes. Refer to the listing below. Taps 5 and 8 of the transformer Cat. No. 3661843G9 are suitable for the application.

NOTE: In a wye-delta bank of power transformers, the current transformers in the leads to the wye-connected winding must be connected in delta. Therefore the ratio of the relay current to the current transformer secondary current for the delta current transformers is 1.73.

BURDEN

The voltampere burden of these devices will not exceed 15 voltamps at a 60 Hertz input current equal to tap value.

The burden can be calculated from the equivalent circuit diagram shown by Figure 2. When used to step up the current, it must be remembered that the burden of the load increases as the square of the step-up ratio.



(Photo 8007679)

Fig. 1. Auxiliary transformer, Cat. No. 3661843

CHARACTERISTICS

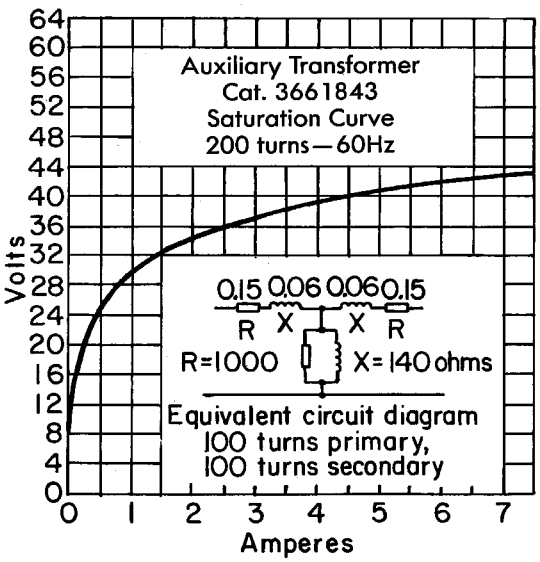


Fig. 2. Saturation curve and equivalent circuit of auxiliary transformers Cat. No. 3661843G1, 2, 4, 6, 11, 12, 13, 15, 16, and 17. For other groups, the currents, voltages, and impedances read or computed from Fig. 2. should be multiplied by the factors in the following table: (Curve No. 6174213)

Auto. Trans Group No.	Amperes	Volts	Impedance
G3	1.25	0.80	0.64
G5	1.25	0.80	0.64
G7	1.25	0.80	0.64
G8	0.94	1.06	1.13
G9	0.94	1.06	1.13
G10	1.25	0.80	0.64
G14	1.15	0.87	0.76

SELECTION GUIDE—All are rated 25-60 Hertz

Tap Ratings—Amperes, 25-60 Hertz								Cat. No.	Approx Wt lb (kg)	
Terminal Tap Number									Net	Ship
1	2	3	4	5	6	7	8			
	8.7	5.0	4.8	4.6	4.4	4.2	4.0	3661843G1		
	5.7	5.0	4.8	4.6	4.4	4.2	4.0	G2		
	8.7	6.0	5.8	5.6	5.4	5.2	5.0	G3		
	7.4	5.0	4.8	4.6	4.4	4.2	4.0	G4	6	7
Start	9.0	8.7	8.3	5.6	5.4	5.2	5.0	G5	(2.7)	(3.2)
	10.4	7.3	5.2	4.9	4.6	4.3	4.0	G6		
	13.0	7.5	7.0	6.5	6.0	5.5	5.0	G7		
	6.65	5.0	4.75	4.5	4.25	4.0	3.75	G8		
	10.5	5.0	4.75	4.5	4.25	4.0	3.75	G9		

Tap Ratings—Amperes, 25-60 Hertz								Cat. No.	Approx Wt lb (kg)	
Terminal Tap Number									Net	Ship
1	2	3	4	5	6	7	8			
	10.5	7.3	7.0	6.7	6.4	6.1	5.0	3661843G10		
	13.8	5.5	5.2	4.9	4.6	4.3	4.0	G11		
	7.55	7.25	7.15	7.0	6.75	5.65	4.0	G12		
	8.4	8.0	7.6	7.2	5.0	4.2	4.0	G13		
Start	8.7	5.6	5.4	5.2	5.0	4.8	4.6	G14	6	7
	7.0	6.7	6.4	6.1	5.8	4.2	4.0	G15	(2.7)	(3.2)
	8.7	6.0	5.5	5.0	4.5	4.0		G16		
	15.1	5.0	4.8	4.6	4.4	4.2	4.0	G17		

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

Auxiliary Transformers

For Balancing Secondary Currents of Current Transformers

GE Protective Relays

DESCRIPTION

Auxiliary current compensating transformers are available for use with ground distance relays to improve the reach measurement.

No. 0367A0266G1 (two windings)
No. 0367A0266G2 (single winding)

APPLICATION

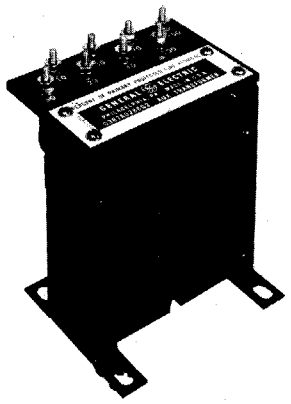
These auxiliary transformers are intended for use with ground distance relays to provide current compensation for the zero sequence self-impedance of the protected line, or for the zero sequence mutual impedance with a parallel line. Transformer 0367A0266G1, a two-winding transformer, is intended for application with reactance-type ground distance relays where it is desired to provide compensation for both the zero-sequence self-impedance and mutual impedance.

Transformer 0367A0266G2, a single-winding transformer, is intended for applications with mho-type directional ground distance relays where compensation for the zero-sequence self-impedance may be necessary but mutual compensation is not recommended. Both transformers are suitable for application on either 50 or 60 Hertz systems.

For more detailed information on the application of these auxiliary transformers refer to the appropriate instruction book of the relay type to be used: CEXG20, CEYG51, GCXG51A or GCXG53A.

CHARACTERISTICS

The excitation curve for the 100-turn winding of either transformer is shown in Figure 2. Internal connections and coil tap connections are shown in Figures 3 and 4.



(Photo 8043223)

Fig. 1. Typical auxiliary compensating Trans. No. 0367A0266G2

SELECTION GUIDE

Ac Rating	Primary Turns	Secondary Turns	Catalog Number	Approx Wt lb (kg) Net	Ship
50/60 Hz	150 150	50 ...	0367A0266G1 G2	7 (3.2) 7.5 (3.4)	8 (3.6) 8.5 (3.9)

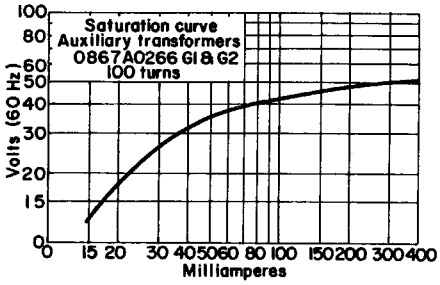


Fig. 2. Typical saturation curve.

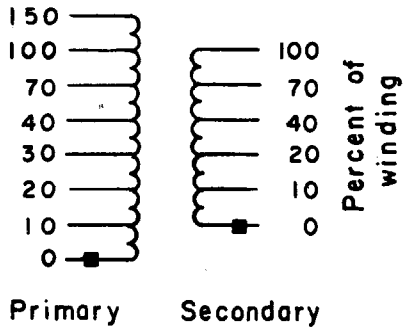


Fig. 3. Typical internal for Cat. No. 0367A0266G1

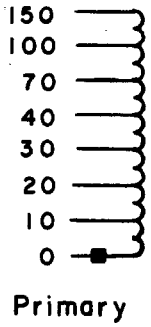


Fig. 4. Typical internal for Cat. No. 0367A0266G2

RATINGS

The one second current rating of these auxiliary transformers is 260 Amperes.

REFERENCES:

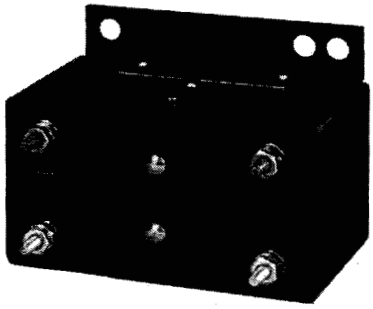
Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

Tripping and Blocking Rectifiers

For DC Control Circuits
Up to 250 Volts DC (Nominal)

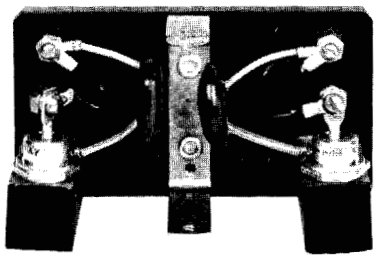
GE Protective Relays

Rectifiers for Tripping Duty or Blocking in Control Circuits in Place of Auxiliary Relays



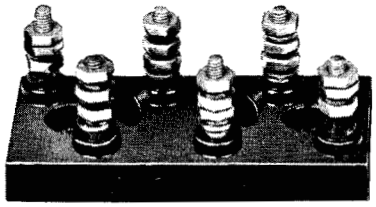
(Photo 8039262)

Fig. 1. Medium current double rectifiers, front view with case and mounting bracket.



(Photo 8043231)

Fig. 2. Medium current double rectifiers, back view, removed from case.



(Photo 8025304)

Fig. 3. Low-current double rectifier board assembly (with cover plate removed).

DESCRIPTION

Medium Current Rectifiers

The **medium-current** rectifiers with necessary "heat sinks" (for heat dissipation) and surge capacitors, are mounted in a molded case with provision for surface mounting or mounting on the back of any GE drawout relay case for switchgear applications. It is available with a single rectifier or with double rectifiers (Fig. 1 and 2). Both sides include mounting plate (Fig. 1).

Low Current Rectifiers

The **low-current** rectifiers are mounted on a simple insulated base to provide ease of mounting and have a protective plate for mechanical protection of the individual rectifiers.

It is available with a single rectifier or with double rectifiers, Fig.3.

No surge protection is included with this unit since application and circumstances will vary considerably. However, if for tripping duty it is suggested that user provide suitable protection.

APPLICATION

These Silicon Junction rectfiers are proven components with no moving parts for isolating or tripping duty in control circuits. They reduce fault clearing time and serve in place of auxiliary relays.

The application of these rectifers may:

1. Reduce tripping time when tripping two breakers from one set of relays. (Auxiliary trip relay requires from ½ to 1 cycle.)
2. Reduced circuit complexity in isolating protective relay trip circuits and transfer trip-keying circuits.
3. Simplify circuitry for many protective relay schemes.

Tripping Duty

A pair of tripping rectifiers provides protective-relay tripping of two circuit breakers in a ring bus, 1½-breaker or double-breaker arrangement while maintaining the necessary separation of the two trip circuits in case of tripping by control switch or by relays of adjacent circuits, (Fig. 4). This is limited to cases where the total trip current of the two breakers is within the relay contact rating, usually 30 amperes.

In cases where circuit breakers require less than 15 amperes for normal trip but more than 15 amperes each for trip-free operation, the rectifier scheme may still be used safely if only one breaker is closed or reclosed for testing a circuit, with the other breaker following after a few seconds.

Blocking

A single rectifier capable of handling trip current at each line terminal, can maintain isolation between the protective relay trip circuit, (Fig. 5), and the transfer-trip-receiver trip circuit in a two-way transfer-trip installation, thus avoiding locking in of both channels for a mid-line fault that actuates the protective relays at both ends.

The low-current rectifiers are used primarily for control circuit applications such as across an auxiliary relay coil to give time-delay dropout.

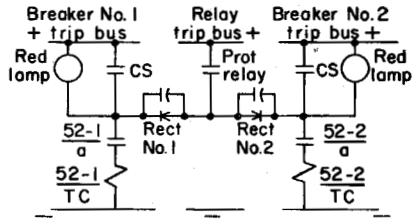


Fig. 4. Tripping rectifiers for double-bus or 1½ breaker scheme

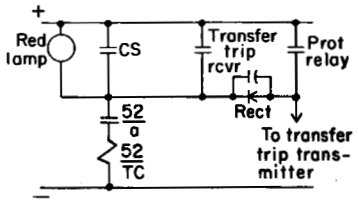


Fig. 5. Tripping rectifier for two-way transfer tripping of a transmission line

Surge Protection

An internally mounted capacitor is connected across each rectifier unit of the **medium-current** rectifier to provide protection for minor surges which may occur in control wiring. **Severe surge** conditions may require corrective measures in the control-circuit design.

REFERENCES:

Dimensions ..... Section 16
How to Order ..... Section 1
Instruction Books ..... Section 17
Target and Contact Data ..... Section 16
Relay Standards ..... Section 16

Tripping and Blocking Rectifiers

For DC Control Circuits
Up to 250 Volts DC (Nominal)

GE Protective Relays

SELECTION GUIDE

Typical Applications	No. Rectifier Circuits	Nominal Station Battery Voltage	Dc Amps Continuous 55C Ambient per Circuit	Dc Amps per Circuit 30-Second Rating	Dc Volts Forward Drop Max.	Dc MA Leakage Max.	PIV	Catalog Number	Approx Weight lb (kg) Net	Approx Weight lb (kg) Shipping
MEDIUM CURRENT RECTIFIERS										
Tripping two breakers	2	24-125	10	30	1.2V at 30 amp	4 MA at 140V	400V	102L218G8	2½(1.13)	3½(1.59)
	2	24-250				4 MA at 280V	600V	G9		
Blocking or relay trip circuits	1	24-125				4 MA at 140V	400V	G11	1½(0.68)	2½(1.13)
	1	24-250				4 MA at 280V	600V	G12		
LOW CURRENT RECTIFIERS										
Control Circuit	2	24-125	0.72	See Fig. 6	1.2V at 0.72 amp	0.3 MA at 140V	400V	295B233G14	½(0.23)	1(0.45)
	2	24-250				0.3 MA at 280V	600V	G15		
Control Circuit	1	24-125				0.3 MA at 140V	400V	G12	⅜(0.17)	¾(0.34)
	1	24-250				0.3 MA at 280V	600V	G13		

SELECTION CONSIDERATIONS

The selection of the proper rectifier unit depends upon the control-circuit voltage, current required, and whether one or two breakers are to be tripped. See Fig. 6 for a curve of trip current plotted against duration in cycles for the low-current units.

Assume an application, such as shown in Fig. 4 using breakers with rated interrupting time of eight cycles and trip current of 6 amperes each at 125 volts. Assume that it is used with an NLR recloser giving one instantaneous and two 15-second reclosures, on a permanent fault.

Total number of trippings 4

Assume trip current duration same as listed interrupting time ..... 8 cycles

Total duration of trip current ..... 32 cycles

From Fig. 6 or table for 125V nominal, 140V max., Cat. No. 102L218 or use 3 units of. . . .Cat. No. 295B233 in parallel

Order either 1 Cat. No. 102L218G8 or 3 Cat. No. 295B233G14 (User to provide suitable surge protection for the Cat. No. 295B233G . . . . units).

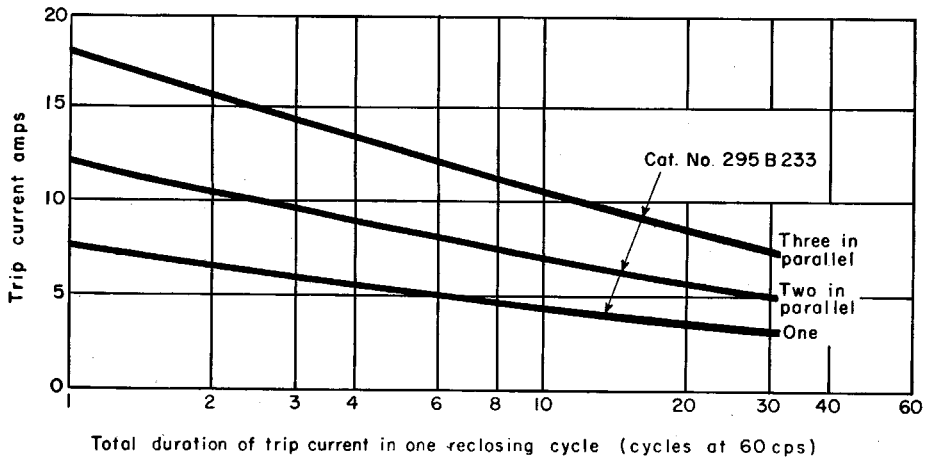


Fig. 6. Short-time rating of silicon rectifier (for each trip circuit)

SECTION: 12

General Information
Dimensions and Data

Dimensions-Component Relays 1

Target and Contact Data 14

Relay and Accessory Standards..... 16

Device Function Numbers..... 19

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Component Relay Nomenclature .....

GE Protective Relays

Dimensions are subject to change and should not be used for construction without approval.

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Case Size C1	4
L1	2
L2	2
L2B	2
L2D	2
L2T	2
M1	2
M2	2
M2D	2
S1	2
S2	2
V1	2
Nondrawout Case	
Case Size: L1E	2
M1E	2
S1E	2
Nondrawout Case	
Relay Type: HAA	7
HEA	5
HFA	6
HGA	7, 8
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HMA	7, 8
NGA	7
NGV	7
PJC	9
PJV	9
SAM	7

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HFA66 Rectifier	9
HGA18H Rectifier	9
HGA18J Rectifier	9
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Accessories	10, 11
Test Equipment	12
Resistors	12
Modular Relays	15, 16, 17

12

GE Protective Relays

Dimensions are subject to change and should not be used for construction without approval.

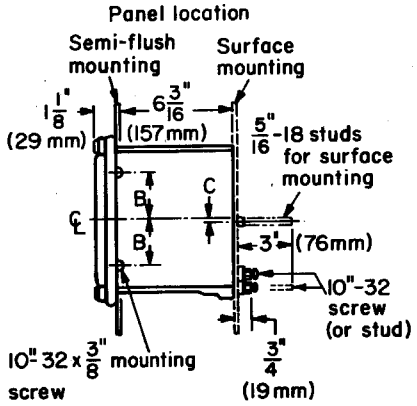


Fig. 8.
Side view,
single-end V1 case

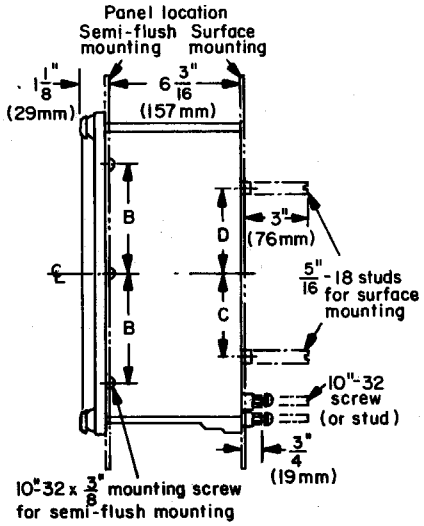


Fig. 9
Side view, L1, M1, and S1
single-end cases

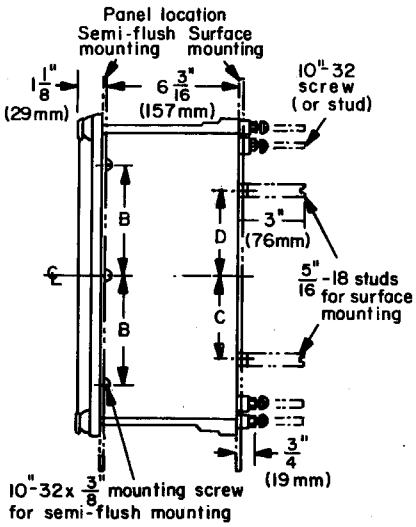


Fig. 10
Side-view, L2, M2, and S2
double-end cases

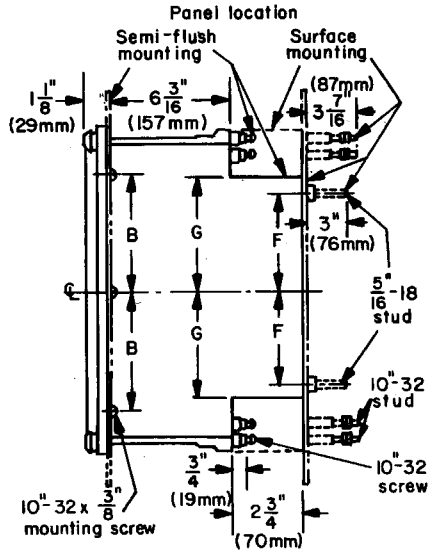


Fig. 11
Side view, L2B, L2D, and M2D deep
cases only

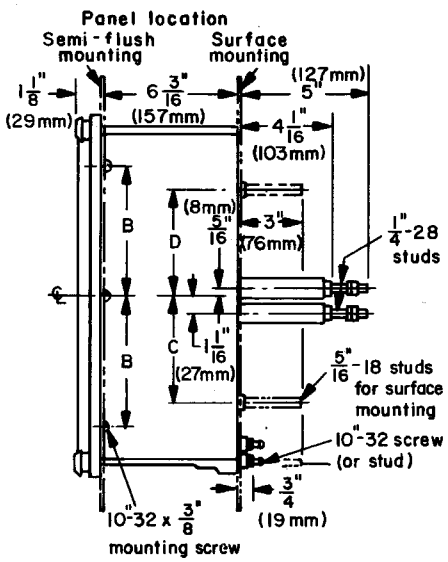


Fig. 12
Side view, L1E, M1E, and S1E
single-end cases (nondrawout)

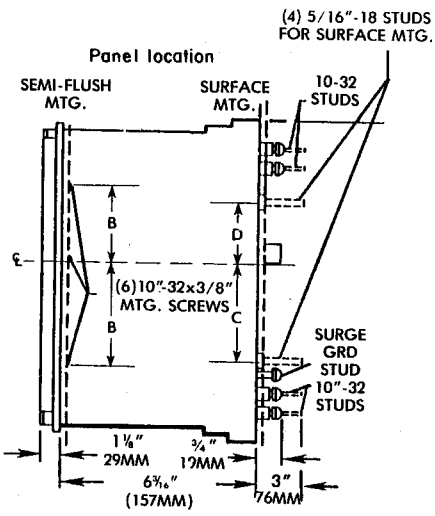


Fig. 13
Side view
double-end L2T case

Dimensions are subject to change and should not be used for construction without approval.

DRAWOUT CASE DIMENSIONS

Size	Figure	Case	Connecting Plugs	DIMENSIONS IN INCHES						
				A	B①	C②	D	E⑤	F	G
V1	8	Very Small	One	7	1 1/8	3/32	....	3 11/32	....	....
S1	9	Small	One	9 1/8	2 3/16	1 5/32	1 27/32	4 13/32	....	....
S1E④	12	Small	One	9 1/8	2 3/16	1 5/32	1 27/32	4 13/32	....	....
S2	10	Small	Two	10 5/16	2 25/32	1 3/4	1 3/4	5	....	....
M1	9	Medium	One	15 1/8	5 3/16	4 5/32	4 5/32	7 13/32	....	....
M1E④	12	Medium	One	15 1/8	5 3/16	4 5/32	4 5/32	7 13/32	....	....
M2	10	Medium	Two	16 5/16	5 25/32	4 3/4	4 3/4	8	....	....
M2D	11	Medium Deep	Two	16 5/16	5 25/32	N/A	N/A	8	4 3/4	5 5/8
L1	9	Large	One	20 5/16	7 25/32	6 3/4	6 3/4	10	....	....
L1E④	12	Large	One	20 5/16	7 25/32	6 3/4	6 3/4	10	....	....
L2	10	Large	Two	20 5/16	7 25/32	6 3/4	6 3/4	10	....	....
L2B③	11	Large Deep	Two	20 5/16	7 25/32	N/A	N/A	10	N/A	7 5/8
L2D	11	Large Deep	Two	20 5/16	7 25/32	N/A	N/A	10	6 3/4	7 5/8
L2T	13	Large	Two	20 5/16	7 25/32	6 3/4	7 25/32	10	N/A	N/A

Size	Figure	Case	Connecting Plugs	DIMENSIONS IN MILLIMETERS						
				A	B①	C②	D	E⑤	F	G
V1	4	Very Small	One	178	29	2	....	85	....	....
S1	5	Small	One	232	56	29	47	112	....	....
S1E④	8	Small	One	232	56	29	47	112	....	....
S2	6	Small	Two	262	71	44	44	127	....	....
M1	5	Medium	One	384	132	106	106	188	....	....
M1E④	8	Medium	One	384	132	106	106	188	....	....
M2	6	Medium	Two	414	147	121	121	203	....	....
M2D	7	Medium Deep	Two	414	147	N/A	N/A	203	121	143
L1	5	Large	One	516	198	171	171	254	....	....
L1E④	8	Large	One	516	198	171	171	254	....	....
L2	6	Large	Two	516	198	171	171	254	....	....
L2B③	7	Large Deep	Two	516	198	N/A	N/A	254	N/A	194
L2D	7	Large Deep	Two	516	198	N/A	N/A	254	171	194
L2T	13	Large	Two	516	198	171	198	254	N/A	N/A

① 4 screws in "V" & "S" 6 in "M" and "L" size cases.
② 2 studs in "V" & "S" 4 in "M" and "L" size cases.
③ Same depth except louvers extending additional 1/4" prevent surface mounting.
④ Size E style case is not completely drawout since bushings on rear of case must first be removed.
⑤ These are maximum dimensions.

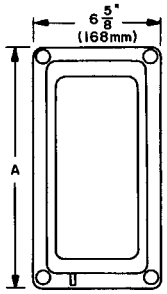
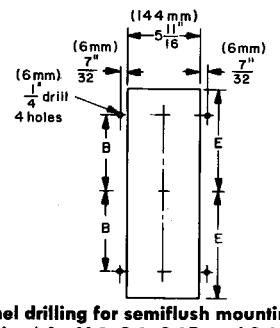
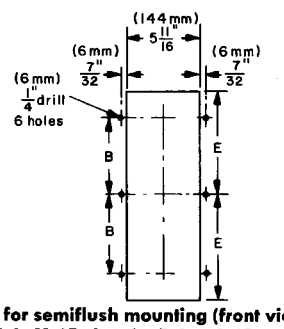


Fig. 14
Front view, all sizes



Panel drilling for semiflush mounting (front view) for V-1, S-1, S-1E, and S-2 cases



Panel drilling for semiflush mounting (front view) for M-1, M-1E, M-2, M-2D, L-1, L-1E, L-2, L-2B and L-2D

Fig. 15. Drawout relays for semiflush mounting

GE Protective Relays

Dimensions are subject to change and should not be used for construction without approval.

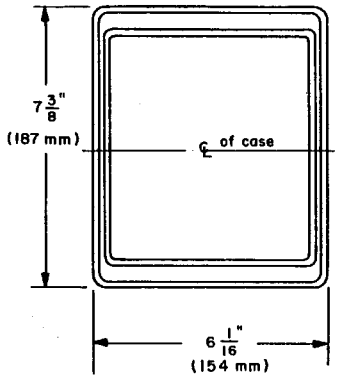


Fig. 1. Type C1 case relay mounting (front view)

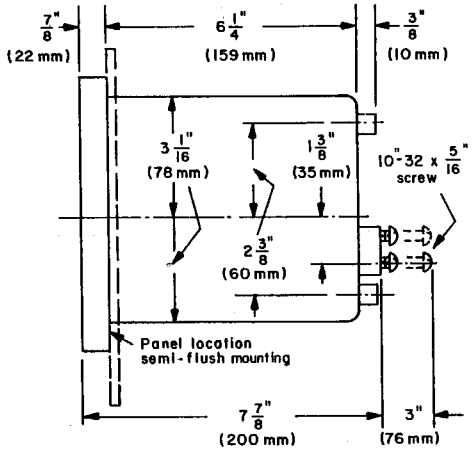


Fig. 2. Type C1 case relay mounting (side view)

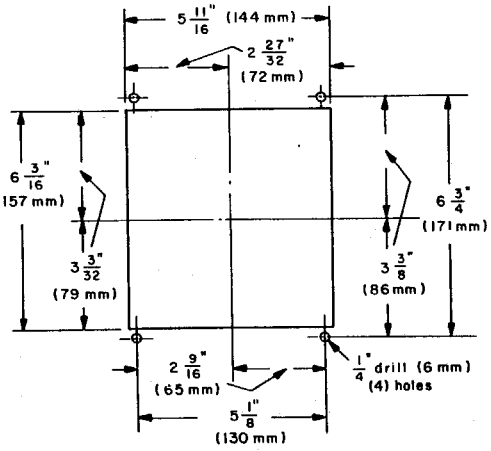


Fig. 3. Panel drilling for semiflush mounting for Type C1 case relays

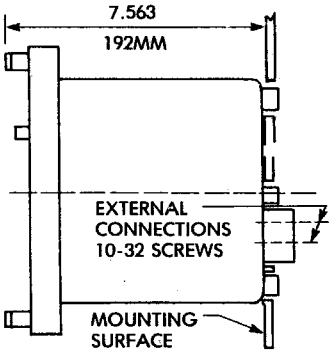


Fig. 4
Type C1 case relays recommended for surface mounting (side view) for panels no larger than 0.188 in. (5mm) thick

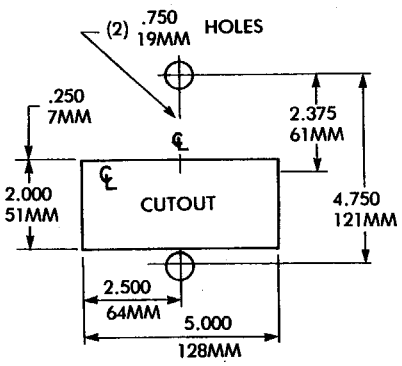


Fig. 5
Panel drilling for surface mounting for Type C1 case relays on panels no larger than 0.188 in. (5mm) thick

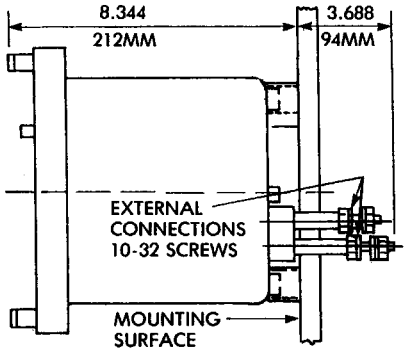


Fig. 6
Types C1 case relays recommended for surface mounting (side view) for panels larger than 0.188 in. (5mm) thick

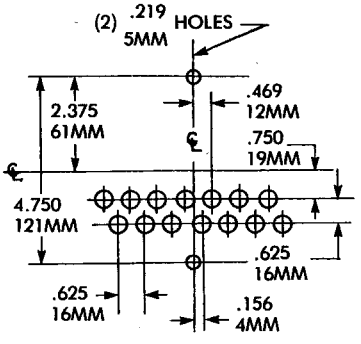


Fig. 7
Panel drilling for surface mounting for Type C1 case relays on panels larger than 0.188 in. (5mm) thick

GE Protective Relays

Dimensions are subject to change and should not be used for construction without approval.

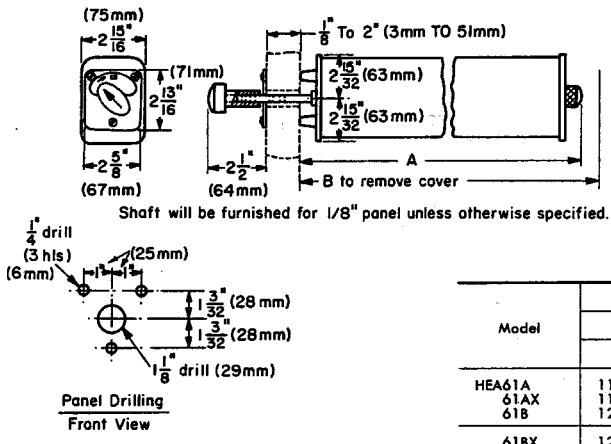
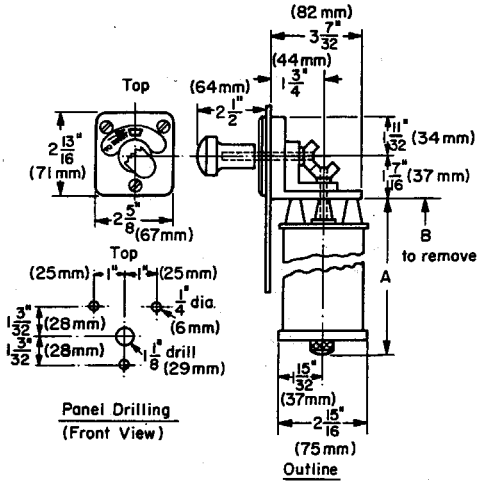


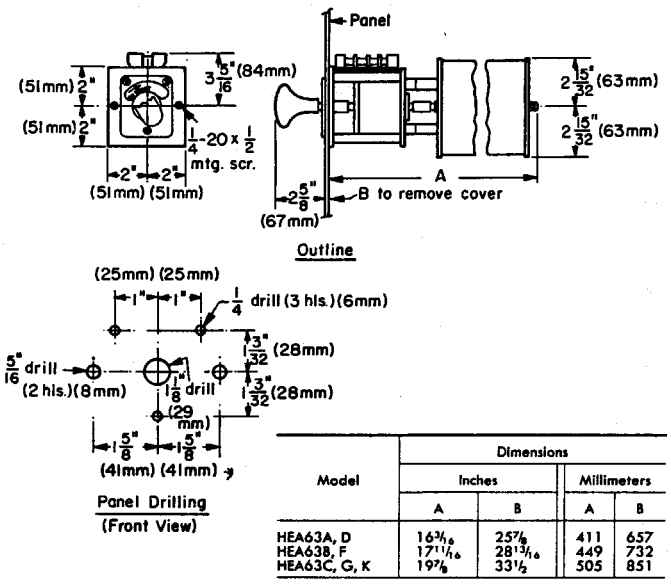
Fig. 16
Type HEA61, HEA62 Relay

Model	Dimensions			
	Inches		Millimeters	
	A	B	A	B
HEA61A	11 5/16	21	287	533
61AX	11 5/16	21	287	533
61B	12 13/16	23 15/16	325	608
61BX	12 13/16	23 15/16	325	608
61C	15 1/16	28 11/16	383	729
61CX	15 1/16	28 11/16	383	729
61D	15	28 5/8	381	727
61E	12 9/16	23 5/16	319	608
61J	11 5/16	21	287	533
61L	11 5/16	21	287	533
61M	9 1/16	15 3/4	230	400
61N	12 9/16	23 15/16	319	608
61S	12 13/16	23 15/16	325	608
61T	15	28 5/8	381	727
61V	14 1/4	27 1/8	362	689
62A	11 5/16	21	287	533
62B	12 13/16	23 15/16	325	608
62C	15	28 5/8	381	727



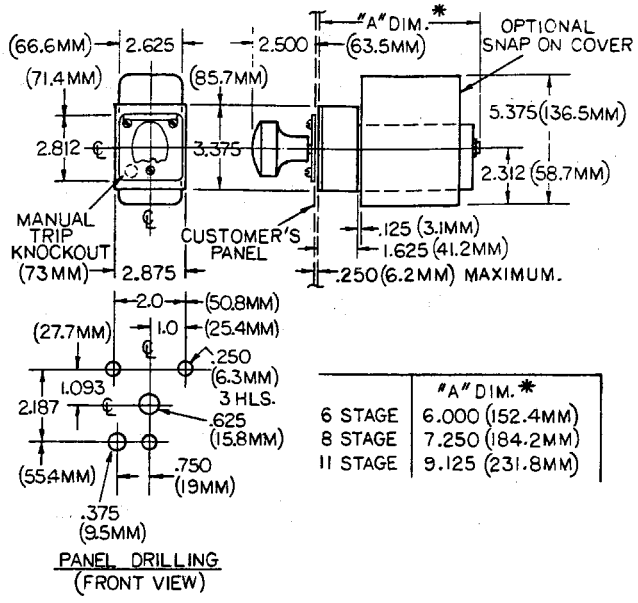
"Top" of Front Plate and Panel Drilling remains as shown whether unit chosen is for angling right, left, up, or down

Fig. 17
Type HEA right angle (down)



Model	Dimensions			
	Inches		Millimeters	
	A	B	A	B
HEA63A, D	16 3/16	25 7/8	411	657
HEA63B, F	17 11/16	28 13/16	449	732
HEA63C, G, K	19 7/8	33 1/2	505	851

Fig. 18
Type HEA63 Relay



	"A" DIM.*
6 STAGE	6.000 (152.4MM)
8 STAGE	7.250 (184.2MM)
11 STAGE	9.125 (231.8MM)

Fig. 19
Type HSA Relay

Dimensions are subject to change and should not be used for construction without approval.

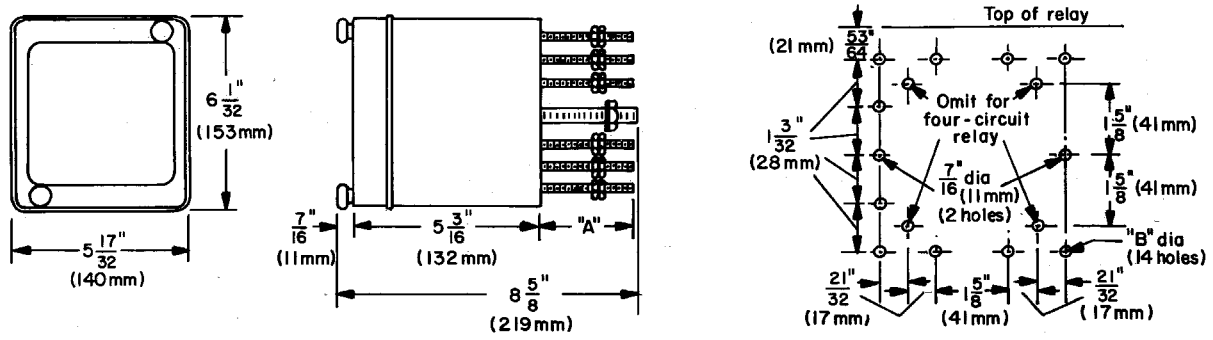


Fig. 20. Back-connected Type HFA Relay for surface mounting

Type of Panel	A	B
Insulating Steel—1/8" or 1/4"	3 1/16" (78mm) 1 9/16" (40mm)	7/16" (11mm) 9/16" (14mm)

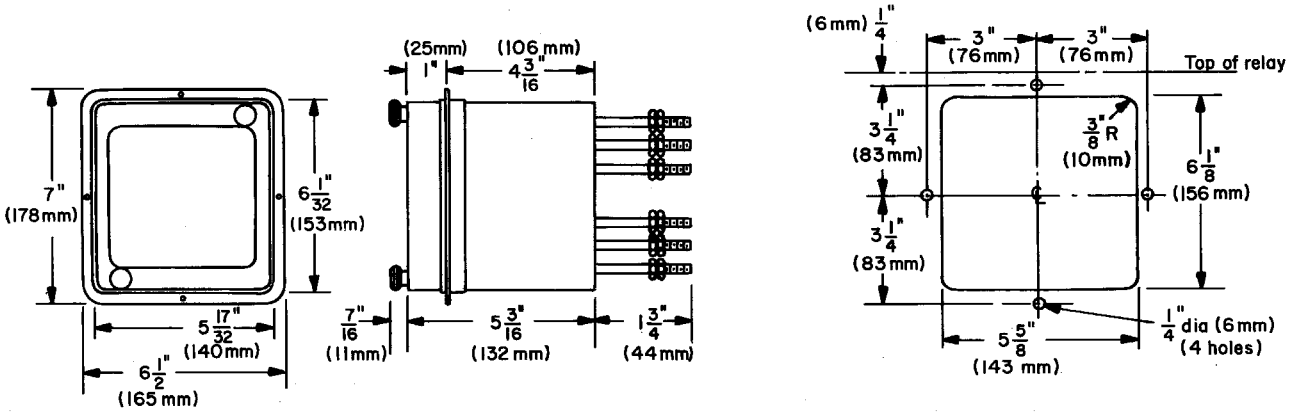


Fig. 21. Back-connected Type HFA Relays for semiflush mounting

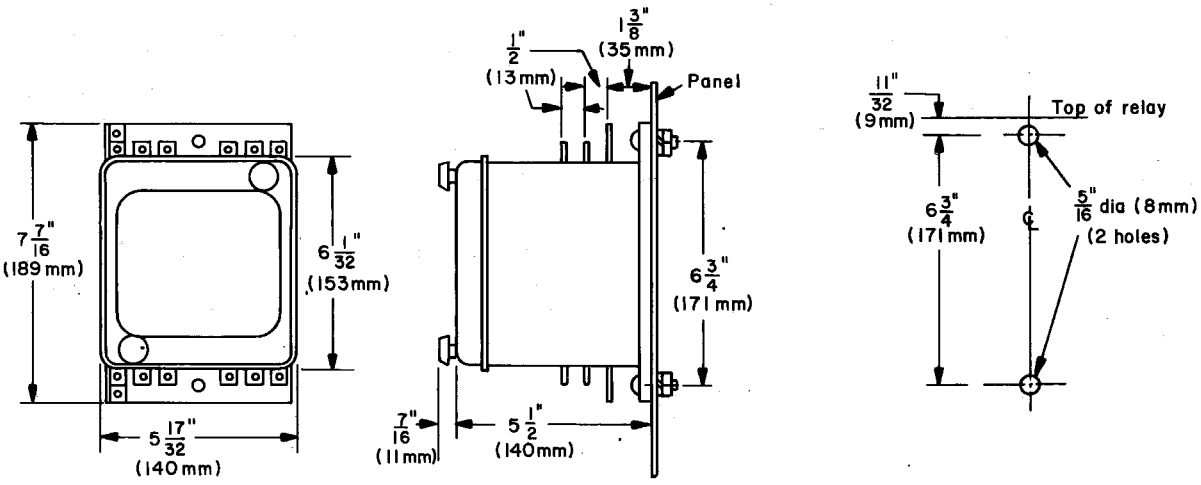
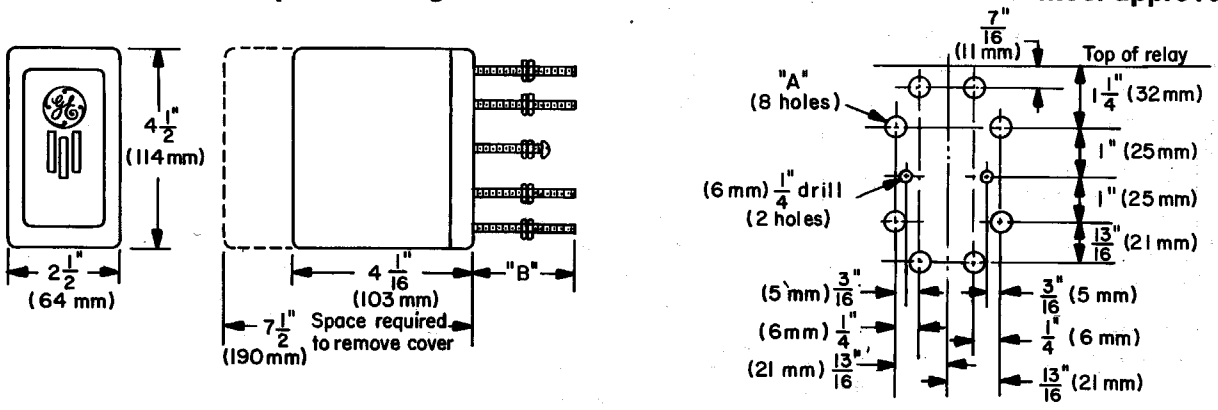


Fig. 22. Front-connected Type HFA Relay for surface mounting

Dimensions are subject to change and should not be used for construction without approval.



Type of Panel	A①	B
Insulating	7/16" (11 mm)	2 13/16" (71 mm)
Steel	9/16" (14 mm)	1 3/8" (35 mm)

① Number of holes varies with relay type.

Fig. 23. Types HAA, HGA, HGC, HMA25A, HMA125A, NGA, NGV, and SAM back-connected Relays for surface mounting

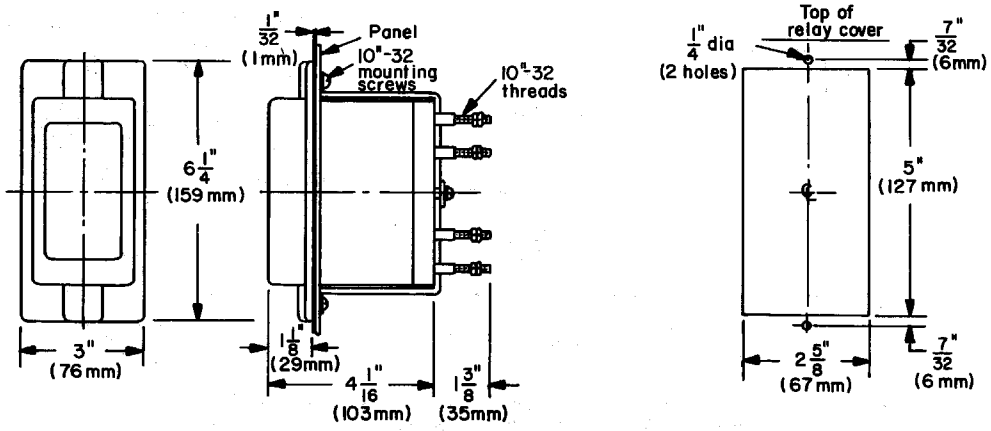


Fig. 24. Types HAA, HGA, HMA24A, HMA124A, NGA, NGV, and SAM back-connected semiflush Relays

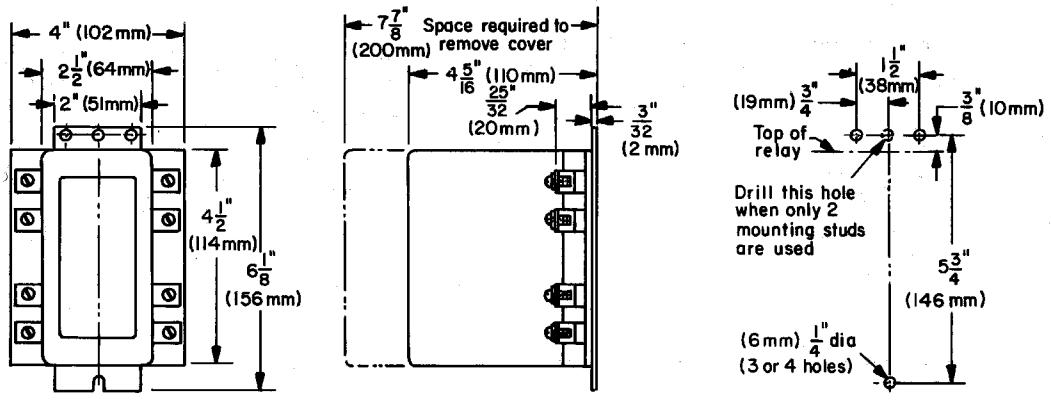


Fig. 25. Types HAA, NGA and NGV front-connected Relays for surface mounting

12

Dimensions are subject to change and should not be used for construction without approval.

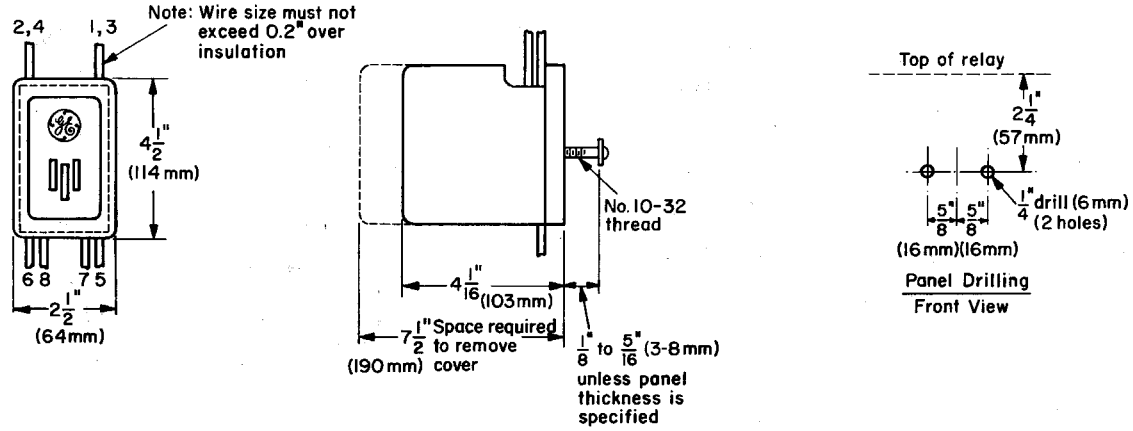


Fig. 26. Types HGA and HGC front-connected Relays for surface rear mounting

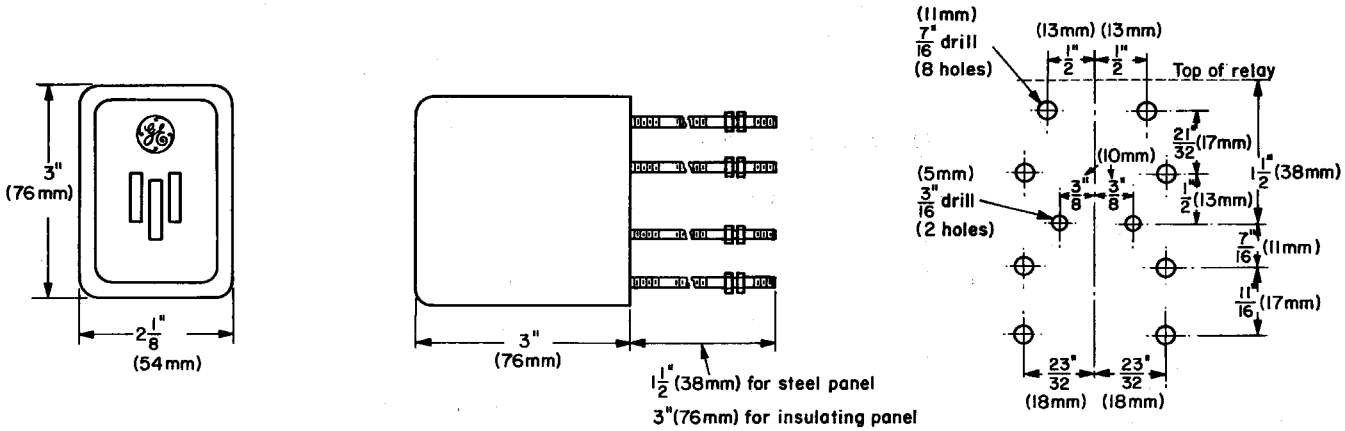


Fig. 27. Type HMA back-connected Relay for surface mounting
(For HMA 25A and HMA 125A see Fig. 23
For HMA 24A and HMA 124A see Fig. 24)

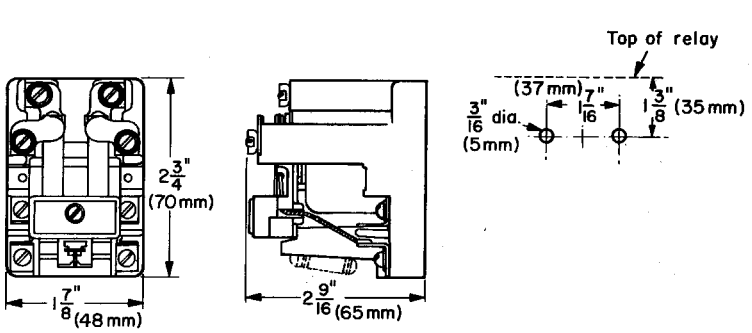


Fig. 28. Type HMA front-connected Relay for surface mounting

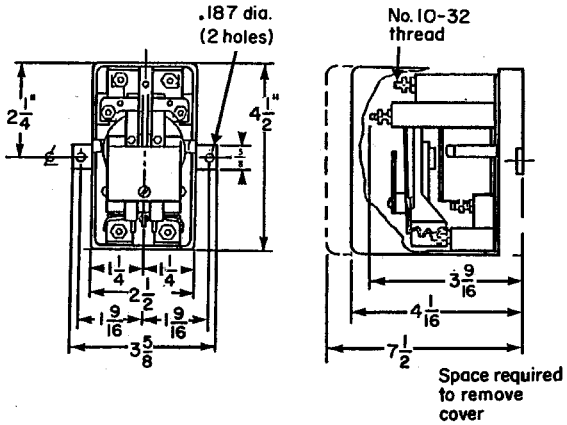
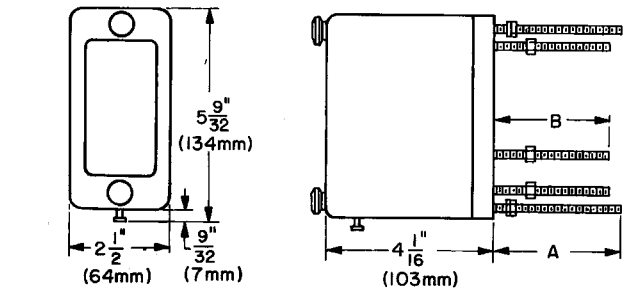
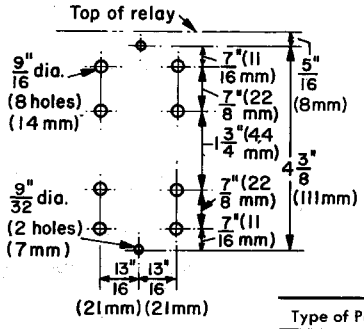


Fig. 28A.
Outline and Panel Drilling Dimensions
for Types HGA11S and HGA111S Relays

Dwg. 0165A7757-2

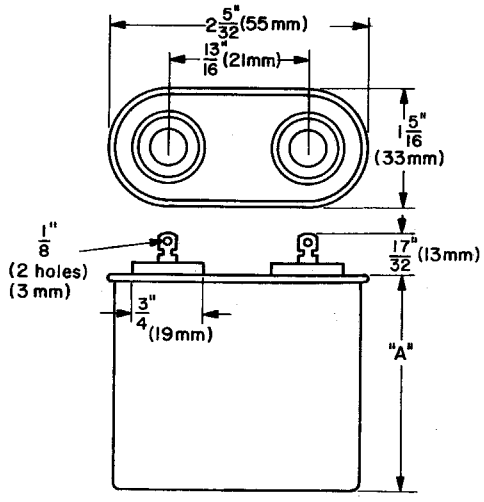
Dimensions are subject to change and should not be used for construction without approval.





Type of Panel	A	B
Insulating	3 1/8" (79mm)	2 7/8" (73mm)
Steel	1 5/8" (41mm)	1 3/8" (35mm)

Fig. 29. Types PJC and PJV Relays



Relay	"A"
IJF51A9A 12A 13A 51B7A 52A2A	2 1/8" (54mm)
All other IJF Relays	1 3/4" (44mm)

Fig. 30. Capacitor furnished with Type IJF Relay (mounting clips not shown)

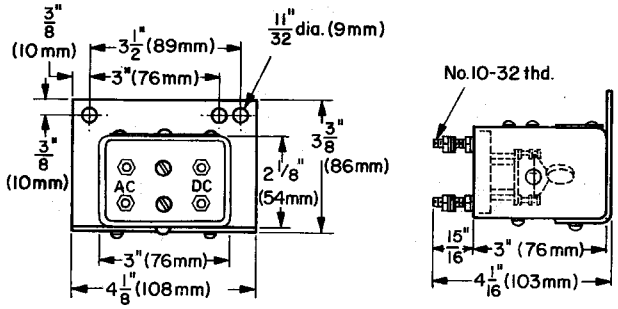


Fig. 31. Rectifier furnished with Type HFA65, HFA66, HFA18H, and H6A18J Relays

12

Dimensions are subject to change and should not be used for construction without approval.

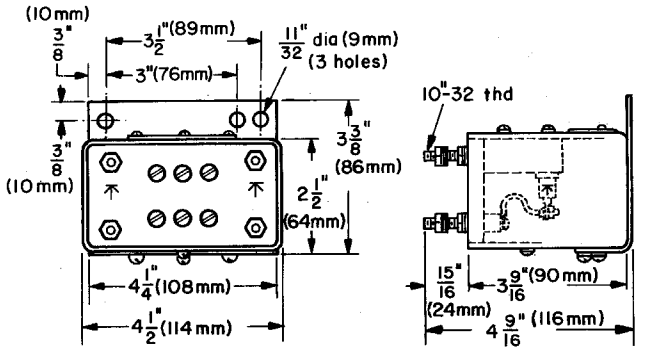


Fig. 32. Trip rectifier Cat. Nos. 102L218G7, G8, G9 (2-unit)

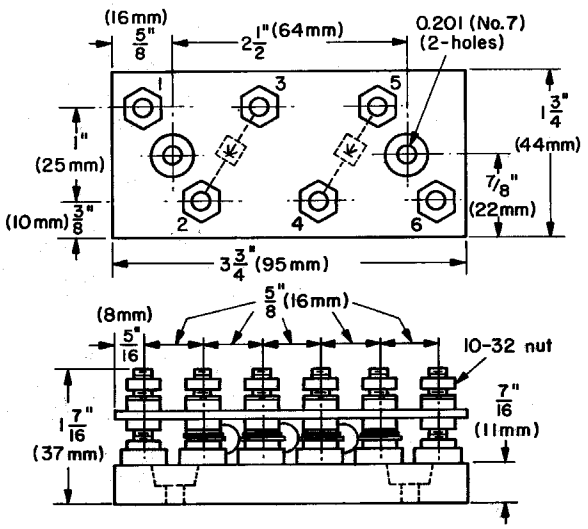


Fig. 33. Rectifier board, Cat. Nos. 295B233G8, G10

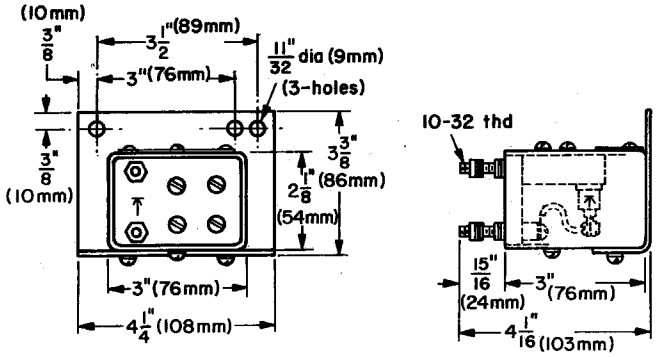


Fig. 34. Trip rectifier Cat. Nos. 102L218G10, G11, G12 (1-unit)

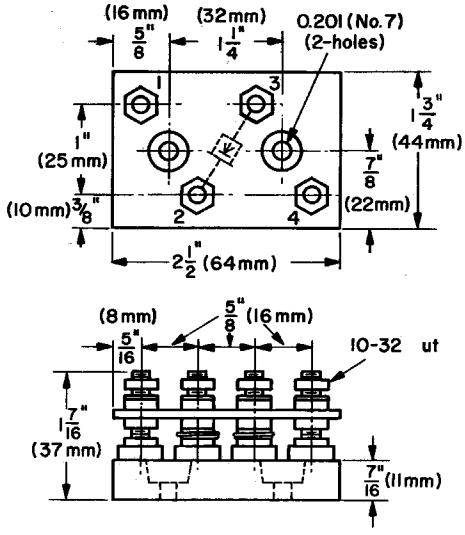


Fig. 35. Rectifier board, Cat. Nos. 295B233G5, G7

Dimensions are subject to change and should not be used for construction without approval.

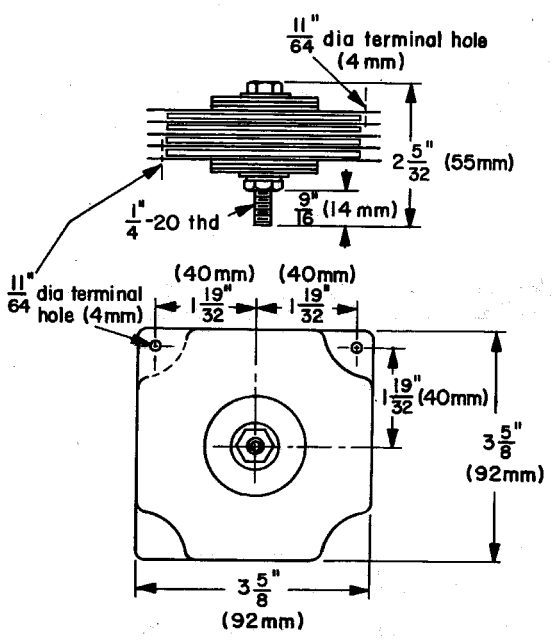


Fig. 36. Voltage limiter for current transformer secondaries Cat. No. 6118766G3

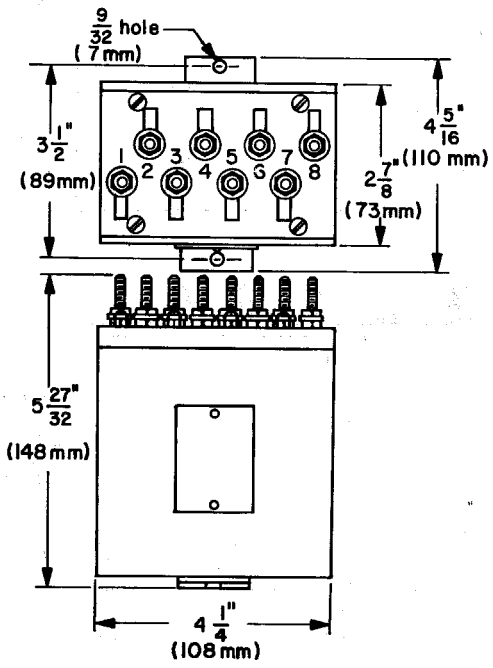


Fig. 37. Dimensions of auxiliary autotransformer Cat. No. 3661843

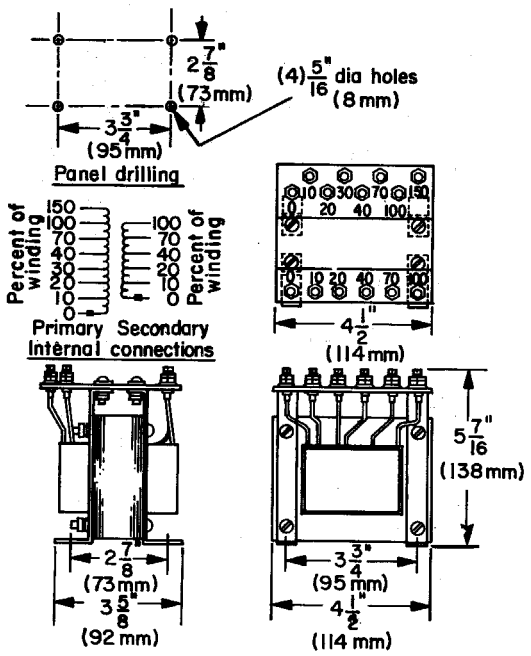


Fig. 38. Auxiliary transformer (for use with type GCXG51A Relays) Cat. No. 367A0266

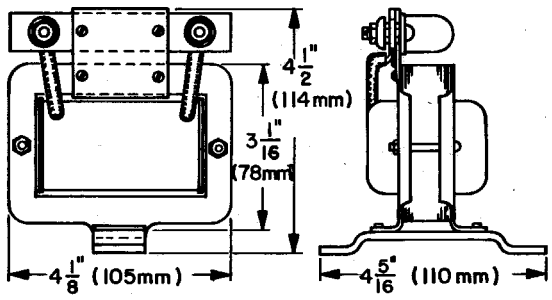


Fig. 39. Dimensions of tripping reactor Model No. 12XBC11A

12

Dimensions are subject to change and should not be used for construction without approval.

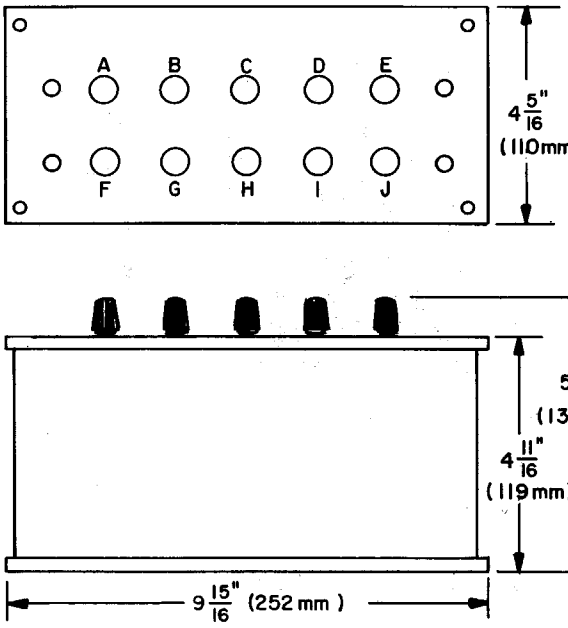


Fig. 40. Test resistor, Cat. No. 6158546

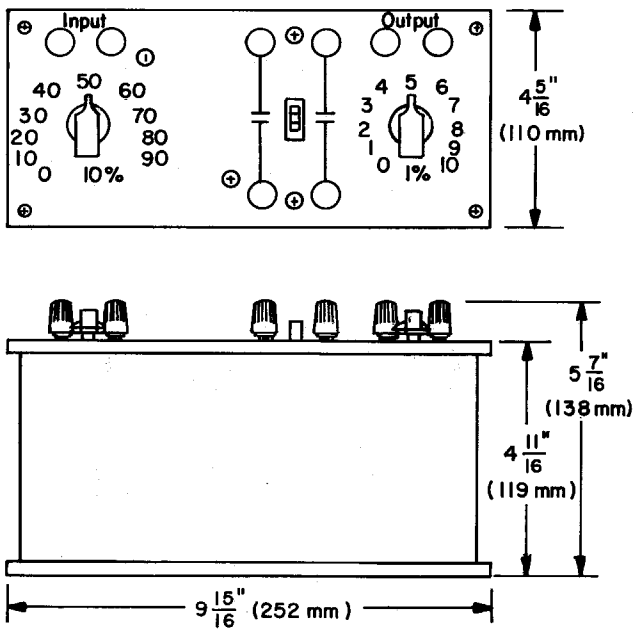


Fig. 41. Test box, Cat. No. 102L201

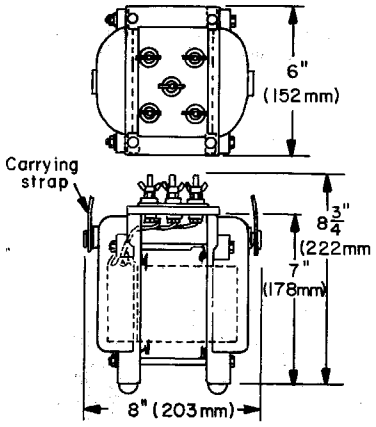


Fig. 42. Test reactor, Cat. No. 6054975G1

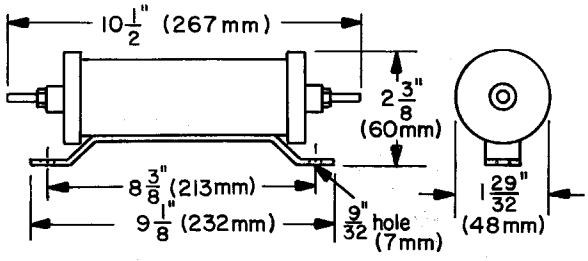


Fig. 43. Single-unit cage resistor

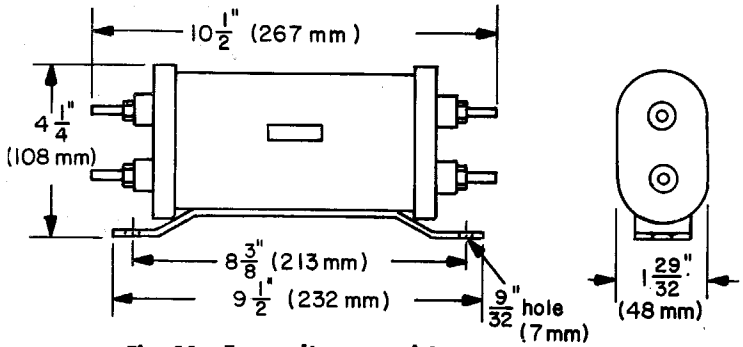


Fig. 44. Two-unit cage resistor

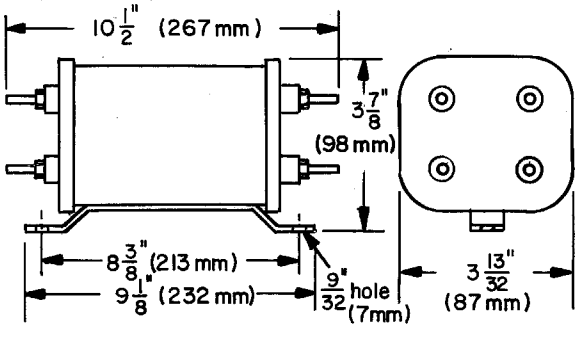
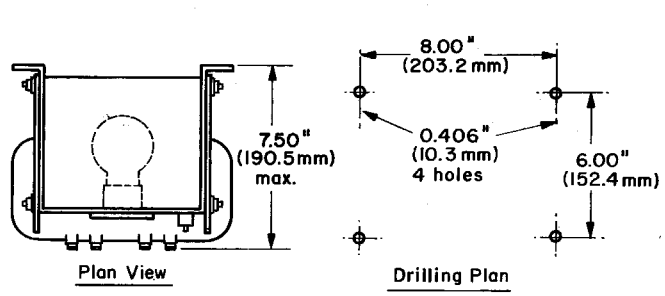


Fig. 45. Three- or four-unit cage resistor

Dimensions are subject to change and should not be used for construction without approval.



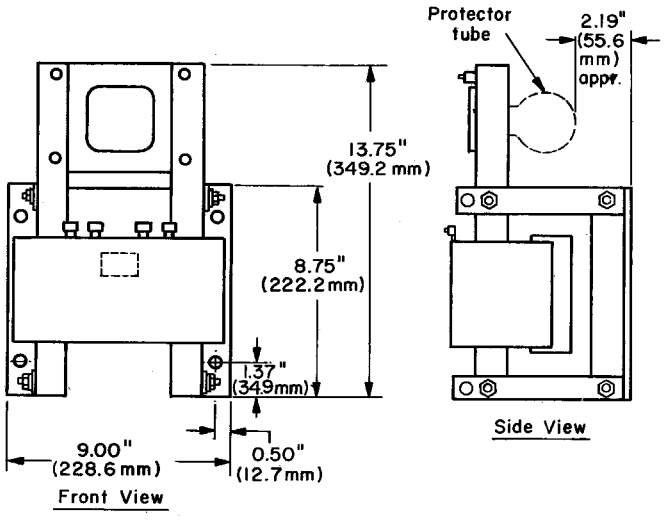
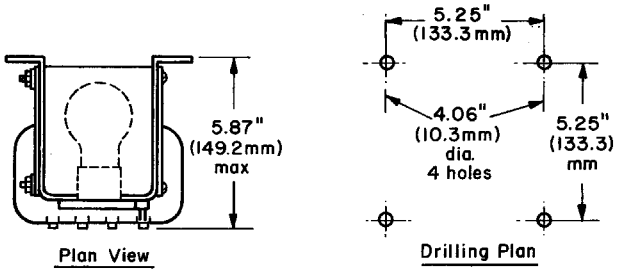


Fig. 46. Neutralizing reactor furnished with SPD, SPA wire pilot systems



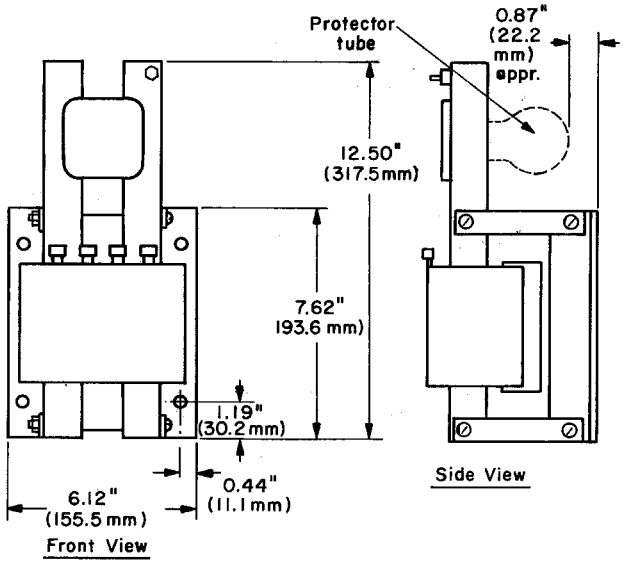


Fig. 47. Mutual drainage reactor furnished with SPD, SPA wire pilot systems

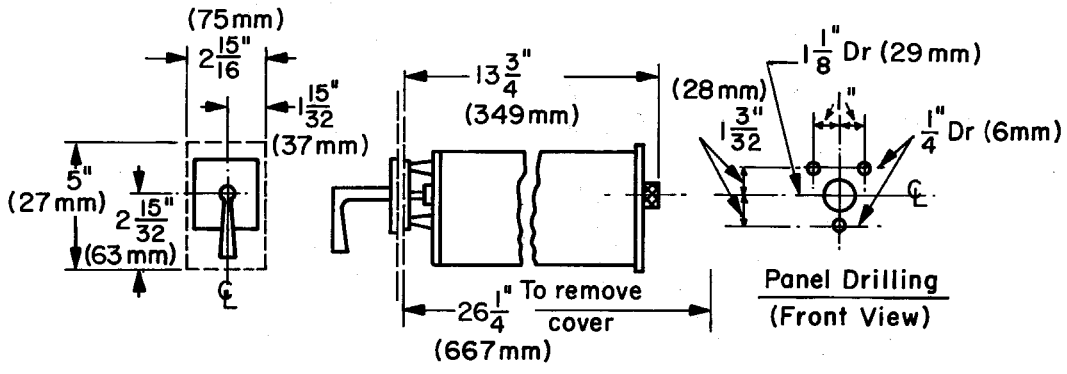


Fig. 48. Meter switch furnished with SPD, SPA wire pilot systems



Fig. 61. Standard 0.2/2 Amp HI-G target Seal-in unit set at 2 Amp Tap

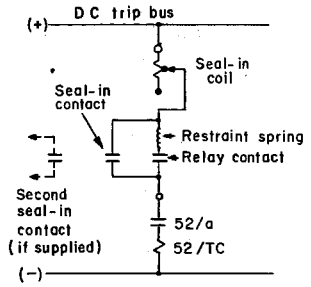


Fig. 62.

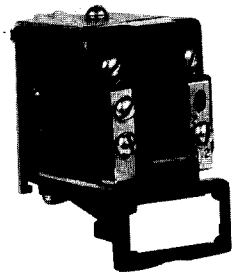


Fig. 63. Standard 0.2/2 Amp target only unit set at 0.2 Amp tap

DESCRIPTION

Target seal-in units are provided in many protective relays. These units provide a visible target to indicate that trip current has flowed. See Figure 61. They also contain seal-in contacts which shunt the flow of trip current away from the restraint spring in a protective relay. When the protective relay operates, its contacts close to initiate the flow of current in the trip circuit. See Figure 62. In induction disc relays, that contact is mounted on the disc shaft and is connected to the trip circuit through the restraint coil spring. That spring has only a short time rating, so the trip current must be shunted away from it to prevent overheating. When the disc contact closes and trip current begins to flow, it flows through the coil of the target seal-in unit. This causes that hinged armature unit to operate and close its seal-in contact, which then shorts out the disc contact and restraint spring. The seal-in contact remains closed until the circuit breaker trips, the 52/a contacts open and the trip circuit is thus interrupted. The operation of the armature of this unit also sets a target flag to indicate that tripping has occurred. The flag remains set (red color showing) until manually reset from the front cover of the relay. On some units, a second electrically separate contact is also supplied.

RATINGS

The rating of target seal-in units is based on the nominal pickup current in amperes. The 2.0 ampere tap, which can carry up to 30 amperes trip current, is normally selected for relays which trip circuit breakers directly. If the tripping is through an auxiliary or lockout relay, a more sensitive tap (such as 0.2 amperes or 0.6 amperes) is used. Depending on the protective relay selected, the target seal-in unit may be dual rated (0.2/2, 0.6/2 or 1/4 amperes) or single rated (0.2, 0.6, 1 or 2 amperes). See Table 7 (16-24) for electrical characteristics.

TARGET UNITS

Target units (without seal-in contacts) are used in protective relays where the seal-in function is not required. This hinged armature unit is operated by the flow of current through its coil. The operation of the armature sets a target flag. The flag remains set (red color showing) until manually reset from the front cover of the relay. Depending on the protective relay selected, the target unit may be dual rated (0.2/2, 0.6/2 or 1/4 amperes - see Figure 63) or single rated (0.2, 1 or 2 amperes - see Figure 64.).

The coils of these target units are identical to those used in the target seal-in units. See Table 7 for electrical characteristics.

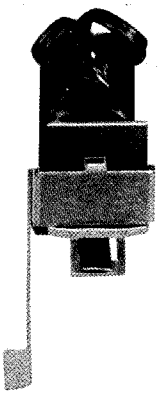


Fig. 64. Single rated 1 Amp target only unit

INSTANTANEOUS UNITS

Instantaneous overcurrent units are provided in many protective relays. These hinged armature units operate without intentional time delay when the current through the unit is above the pickup level. See Figure 65. Operation of the armature causes the contacts to close and raises the built-in target flag to the set position. The flag remains set (red color showing) until manually reset from the front cover of the relay. On some units, a second electrically separate contact is also supplied.

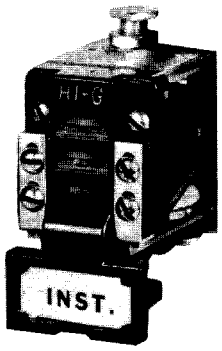


Fig. 65. Standard HI-G instantaneous unit

Contact Ratings of Instantaneous Units

Current closing rating: 30 amp at 250V dc and below
Carry continuously: 5 amp
Interrupting rating,
Dc resistive (amps): 2.5 amp

The ratings of the operating coil (including pickup range, continuous rating and one second rating) appear on the descriptive page for the protective relay in which the instantaneous unit is used.

TABLE 7. RATINGS OF TARGET SEAL-IN UNITS, HIGH SEISMIC (Hi-G)

	Dual Rated			
	0.2/2.0 Amp		0.6/2.0 Amp	
	0.2	2.0	0.6	2.0
Carry 30 Amps for (sec)	0.05	2.2	0.5	3.5
Carry 10 Amps for (sec)	.45	20.0	5.0	30
Carry continuously (Amp)	.37	2.3	1.2	2.6
Minimum Operating (Amp)	.2	2.0	0.6	2.0
Minimum Drop-out (Amp)	.05	0.5	.15	0.5
Dc resitance (Ohms)	8.3	.24	.78	.18
Dc resistive Interrupting rating (Amps)	2.5 Amp @125 Vdc			

TABLE 8. SAM 200 SERIES TARGET RATINGS

Operate Level	Single Rated
	0.15 Amp

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Relay Standards

INTRODUCTION

All General Electric protective relays in this handbook, unless otherwise noted, are designed and manufactured in accordance with the ANSI/IEEE standard C37.90 that applies to protective relays. To better understand the application, design, rating and selection of protective relays, certain parts of the American National Standard (ANSI) and IEEE standard will be summarized for easy reference. This summary should help guide the relay engineer regarding service conditions, standard ratings and other application requirements, but is not intended as a substitute for a reference to the complete standard.

CONTENTS

	Applicable Standard
Usual Service Conditions	ANSI/IEEE C37.90-1989 Standards for Relays and Relay systems
Ratings—Current and Voltage	ANSI/IEEE C37.90-1989
Maximum design for all relays	
Ac and dc auxiliary relays	
Make and carry rating for tripping contacts	
Tripping contacts duty cycle	
Dielectric tests by manufacturer	ANSI/IEEE C37.90-1989
Dielectric tests by user	ANSI/IEEE C37.90-1989
Surge Withstand Capability (SWC)	ANSI/IEEE C37.90.1-1989
Fast Transient Test	ANSI/IEEE C37.90.1-1989
Radio Frequency Interference (RFI)	GE in-house test (IEEE standard under preparation)
Seismic Qualifications - Class IE Equipment for Nuclear Power Generating Stations	IEEE 323-1974. Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations
Seismic testing of protective and auxiliary relays	Formerly IEEE 501, now IEEE C37.98 Seismic Tesing of Relays
Electric Power System Device Function numbers	ANSI C37.2

REFERENCE STANDARD

ANSI/IEEE C37.90 - 1989 "Standards for Relays and Relay Systems."

Scope and Limitations

The standards and references that follow apply primarily to relays and relay systems used to control power switchgear.

What is a Relay?

A relay is "an electrical device designed to respond to input conditions in a prescribed manner, and after specified conditions are met, to cause contact operation or similar abrupt change in associated electric control circuits."

Usual Service Conditions:

Relays must be suitable for operation under the following:

(a) The ambient temperature of the air immediately around the relay case or other enclosure shall be within the limits of −20C to +55C.

(b) The altitude shall not exceed 5000 ft (1500 meters).

Ratings

(a) Standard current and voltage ratings— The standard current and voltage ratings for relays shall be as follows:

Voltage (V)		Current (A)
Ac (rms)	Dc	Ac (rms)
120 240 480	24 48 125 250	1 5

(b) Allowable variation from rated voltage — Protective relays which are designed to be energized continuously with ac voltage shall operate without damage at rated frequency with voltage not more than 10 percent above rated voltage, but not necessarily in accordance with temperature rise limits established for operation at rated voltage.

(c) Maximum design voltage or current— The maximum design voltage or current for all relays, other than voltage-operated auxiliary relays, shall be equal to the rated voltage or current of the relay. This is the highest rms alternating or direct voltage or current at which the relay is designed to be energized continuously without exceeding the allowable temperature rise for the class of insulation (Many GE relays are designed to continuously carry current in excess of the rated current).

For dc auxiliary relays, relay power supply, or auxiliary relay circuits with dc voltage ratings, the maximum design voltage shall be as shown in Table 9.

The maximum design voltage for ac auxiliary relays shall be 110 percent of rated voltage.

(d) Range of operating voltage for auxiliary relays — dc auxiliary relays, which may be continuously energized for indefinite periods, dc power supplies, and auxiliary relay circuits with dc voltage ratings, shall be able to withstand the maximum design voltage without exceeding the allowable temperature rise. These relays shall operate successfully over a range from 80 percent of rated voltage to the maximum design voltage. Ac auxiliary relays shall be able to withstand 110 percent of rated voltage without exceeding the allowable temperature rise. These relays shall operate successfully over a range from 85-110 percent of rated voltage.

Table 9.

Rated Volts	Maximum Design Volts
24	28
48	56
125	140
250	280

(e) Make and Carry Ratings for Tripping Contacts (revised 1978) — a tripping contact is designed for the purpose of energizing a power circuit breaker trip coil.

The contact shall make and carry 30 amperes for at least 2000 operations in a prescribed duty cycle.

Dielectric Tests

General—Dielectric tests between circuits, and dielectric tests between circuits and relay frame, shall be considered as routine tests. Dielectric tests across open contacts shall be considered as design tests. Dietectric tests are not required across contacts with surge-suppression components, nor across solid-state output circuits; when these are used, the Surge Withstand Capability (SWC) test should be substituted for the dielectric test.

Standard Test Voltage — Relays rated 600 volts and below shall withstand for one minute a low-frequency alternating-current voltage test of twice rated voltage plus 1000 volts with a minimum of 1500 volts.

Duration of Test Voltage

The test voltage for all relays shall be applied continuously for a period of 60 seconds.

As an alternate, to be made at the point of manufacture only, it is permissible to test any relay for one second at a value of 20 percent higher than the standard 60 second test voltage.

Dielectric Tests by Users

Dielectric tests, in accordance with the standard, may be made by the user on new relays only, to determine whether specifications are fulfilled. New relays are defined as those which have not been in service and are not more than one year old from date of shipment and have been suitably stored to prevent deterioration.

Additional dielectric tests may be made, using 75 percent of the standard test voltage, at the point of installation to determine the practicality of placing or continuing the device or equipment in service.

Points of Application of Voltage

The test voltage of insulation to ground and between circuits shall be applied successively between each electric circuit and all other electric circuits, and between each electric circuit and the metal frame of the relay. The test voltage across open contacts shall be applied to the relay terminals which connect to the contacts.

Surge Withstand Capability (SWC) Tests

The surge withstand capability (SWC) is a design test for relay systems and, in particular, static relays.

The purpose of this test is to apply to the terminals of the relay system a standardized test wave shape that is representative of surges observed and measured in actual installations. In order to pass this test, relay systems must be able to withstand the applied surge without damage to components and without operating incorrectly.

Surge Withstand Capability (SWC) Wave Shape and Characteristics

The SWC test wave is an oscillatory wave, with a frequency range of 1.0 MHz to 1.5 MHz, voltage range of 2.5 kV to 3.0 kV crest value of the first half cycle peak, and envelope decaying to 50 percent of the crest value of the first peak in not less than 6 μs from the start of the wave. The source impedance of the surge generator used to produce the test wave shall be 150 ohms $\pm$ 5 percent. The test wave to be applied to test specimen at a repetitive rate of not less than 50 tests per second for a period of not less than 2.0 seconds.

NOTE: (1) All voltage and time values refer to the open circuit condition of the surge generator.
(2) Time period and repetition rate have been chosen to cover equipment which is used on 50 Hertz as well as 60 Hertz systems. The SWC test shall be applied to the relay as specified in ANSI C37.90.

FAST TRANSIENT TEST

(Ref: W. C. Kotheimer and L. L. Mankoff, Protection of Relays from Their Electrical Environment - Georgia Tech Relay Conference, 1977)

The Fast Transient test simulates the surges due to the interruption of inductive devices such as auxiliary relay coils, alarm bell coils, solenoids, etc. These surges are localized in effect, being attenuated by a few tens of feet of circuit from the source. Laboratory experiments show, however, that this surge presents a very real hazard to solid state equipment in the circuit close to it, possibly causing false operation or damage to semiconductor devices.

This "fast transient," produced by interrupting the current through an auxiliary relay coil or a breaker trip coil, has rise times in the 5-nanosecond range and power in the tens of kilowatts range. When subjected to such a transient, many semiconductor devices can be degraded such that failure may occur at a later time.

All new relay designs are subjected to this "fast transient" as a design-proof test. It was found that relays which survive the SWC test may fail the "fast transient" test.

(Recommend Guide Form Specification)

"The test shall be the application for two seconds of at least 60 pulses per second at each polarily from a surge generator having a source impedance of about 75 ohms resistance.

"When measured open circuit, the surge generator shall produce pulses having a rise time of 5 nanoseconds or less to a peak value of $\pm$5000 volts. The test voltage shall be applied to the relay as specified in ANSI C37.90 for the SWC test."

RADIO FREQUENCY INTERFERENCE (RFI)

Approximate Frequencies below 550 Mhz used by Electric Utilities in the USA

Freq. Band Mhz	Notes
27	Citizens Band, Class D
37	
47-48	
158-173	
216-220	
220-225	Citizens Band, Class E
450-470	Citizens Band, Class A
470-512	Land Mobile

A study has indicated that the possibility of misoperation of a protective or control device to radiated electromagnetic interference is a function of the following:

1. Field intensity and frequency of radiation.
2. Sensitivity of the affected circuitry to radiation.
3. Coupling efficiency resulting from device construction, lead configuration, etc.

An in-house test to check the security of static relays against false tripping is now used.

(Recommended Guide Form Specification)

"The relay shall not be damaged nor exhibit spurious output when subjected to a radio frequency susceptibility test, over a frequency range of 25 - 500 megahertz with a field strength measured at the front face of the relay, of 7.0 volts per meter. For these tests the relay is energized and connected for normal operation."

STANDARD FOR QUALIFYING CLASS 1E EQUIPMENT FOR NUCLEAR POWER GENERATION STATIONS① IEEE323-1974—A Guide for the Qualification of Class 1E

Class 1E - The safety classification of the electric equipment and systems that are essential to emergency reactor shutdown, or are otherwise essential in preventing significant release of radioactive material to the environment.

Testing - Outline of procedures which can be used to seismically qualify equipment by test.

Proof Testing - To qualify equipment for a particular application.

Fragility Testing - To qualify equipment by determining its ultimate capability.

SEISMIC TESTING OF RELAYS① IEEE C37.98 (Formerly IEEE-501)—

standard to establish procedures for determining the seismic capabilities of protective and auxiliary relays by fragility and testing.

In order to define the conditions for fragility testing of relays, parameters in three separate areas must be specified.

(a) Electrical settings and inputs to the relay.

(b) The change in state deviation in operating characteristics or other change of performance which constitutes failure.

(c) The seismic vibration environment to be imposed during test.

Typical Fragility Test

Tests are conducted with biaxial multi-frequency broadband vibrations applied to the shaker table. The standard response spectrum (SRS) of the vibrational stimulus (See Figure 66) is plotted as a percentage of the Zero Period Acceleration (ZPA). The 1.0 Hz point is 25% of the ZPA, the 4.0 to 16.0 HZ band is 250% of the ZPA and 33.0 HZ and above is equal to the ZPA. The range of maximum amplification of acceleration, 4.0 to 16.0 HZ, has been designed to most realistically match the range of peak acceleration input to the relays by equipments and panels on which they are mounted.

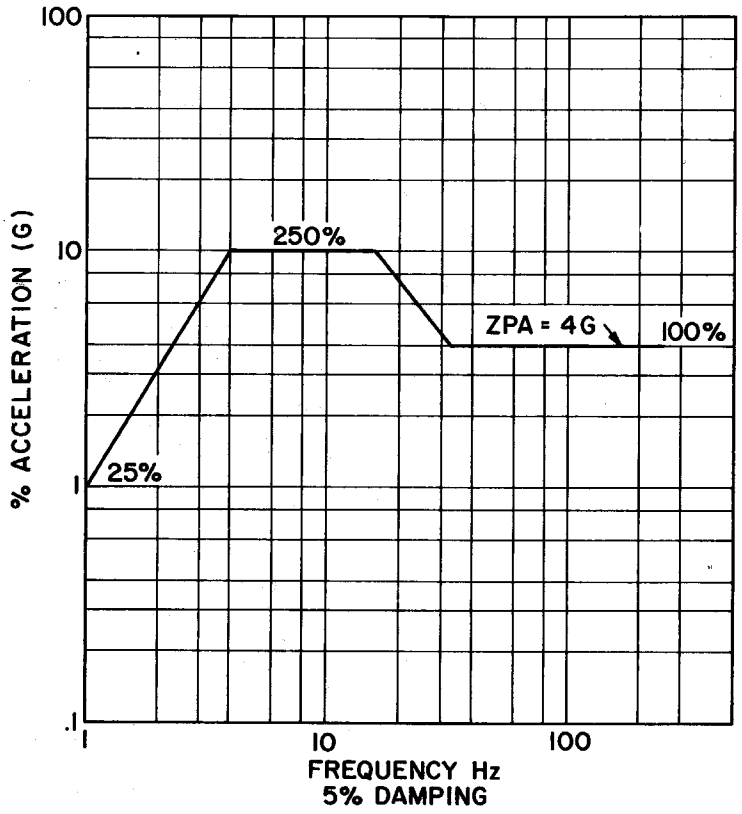


Fig. 66. Multi-frequency broad-band standard response spectrum shape (SRS) for relay with ZPA level of 4 Gs

The stimulus is increased in amplitude until failure occurs (per Item b, above) or the limits of the shaker table are reached. The fragility level of a relay or device is defined as the maximum ZPA level, expressed in Gs, that can be applied without causing failure.

① Relays for Class 1E duty are tested and qualified on a selective basis only. For information on specific relay types contact your local General Electric sales office.

Power System Device Function Numbers

Used in Protective Relaying

GE Protective Relays

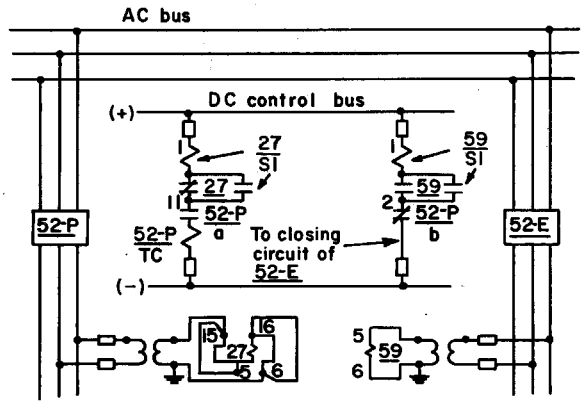
APPLICATION

For electrical substations, generating stations, power utilization and conversion equipment.

Purpose—To quickly identify the function, on drawings or in instruction books, of each device in many types of automatic, semi-automatic and manual switchgear equipment. ANSI Standard C-37.2 includes both protective relay device numbers as well as devices used in automatic control. This industry standard was originally prepared for electromechanical relays but also applies to equipment that has electronic or solid state devices. The device numbers listed below were extracted from ANSI C-37.2 and are those commonly used in protective relaying.

Device Number	Description
2	Time-delay Starting or Closing Relay
8	Control Power Disconnecting Device
15	Speed or Frequency Matching Device
21	Distance Relay
24	Volts per Hertz Relay
25	Synchronizing or Synchronism-Check Device
27	Undervoltage Relay
30	Annunciator Relay
32	Directional Power Relay
37	Undercurrent or Underpower Relay
38	Bearing Protective Device
40	Field Relay
46	Reverse-phase or Phase-balance Current Relay
47	Phase-sequence Voltage Relay
49	Machine or Transformer Thermal Relay
50	Instantaneous Overcurrent or Rate-of-Rise Relay
51	Ac Time Overcurrent Relay
52	Ac Circuit Breaker
59	Overvoltage Relay
60	Voltage or Current Balance Relay
64	Ground Detector Relay
66	Notching or Jogging Device
67	Ac Directional Overcurrent Relay
68	Blocking Relay
69	Permissive Control Device
74	Alarm Relay
76	Dc Overcurrent Relay
78	Phase-Angle Measuring or Out-of-Step Protective Relay
79	Ac Reclosing Relay
81	Frequency Relay
85	Carrier or Pilot-wire Receiver Relay
86	Lockout Relay
87	Differential Protective Relay
94	Tripping or Trip-free Relay

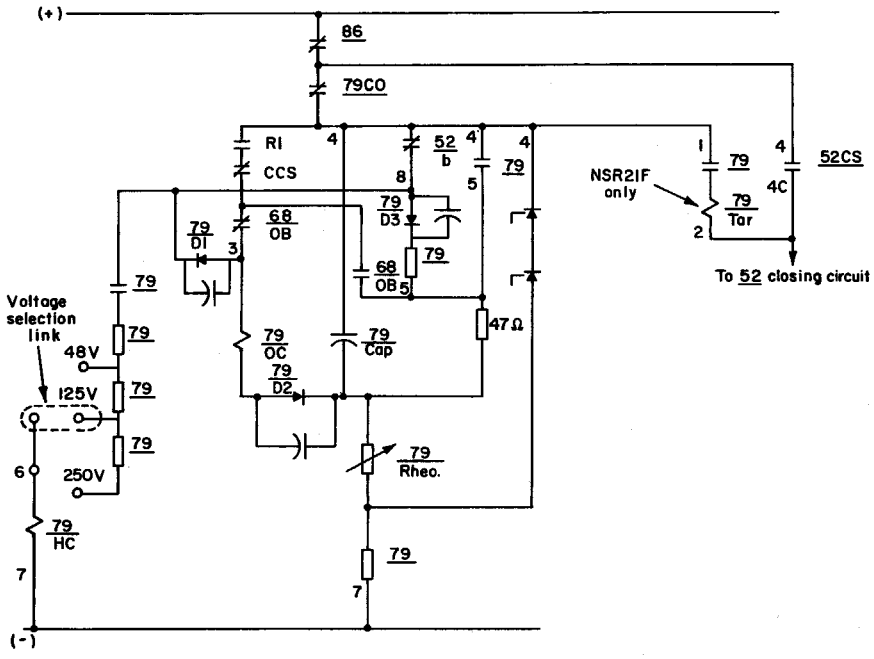
Examples of Device Function Number Use



LEGEND
(Figure 67)

1, 2, etc. –Relay stud numbers
27 –Undervoltage relay, Type IAV
52 –Power circuit breaker
a –Auxiliary switch, closed when circuit breaker is closed
b –Auxiliary switch, closed when circuit breaker is open
59 –Overvoltage relay, Type IAV
E –Emergency circuit
P –Preferred circuit
SI –Seal-in unit, with target
TC –Trip coil

Fig. 67. Typical external connection diagram of Type IAV54E undervoltage relay and IAV51A overvoltage relay applied in an automatic bus transfer scheme (preferred-emergency throwover).



(Dwg. 0257A5095-0)

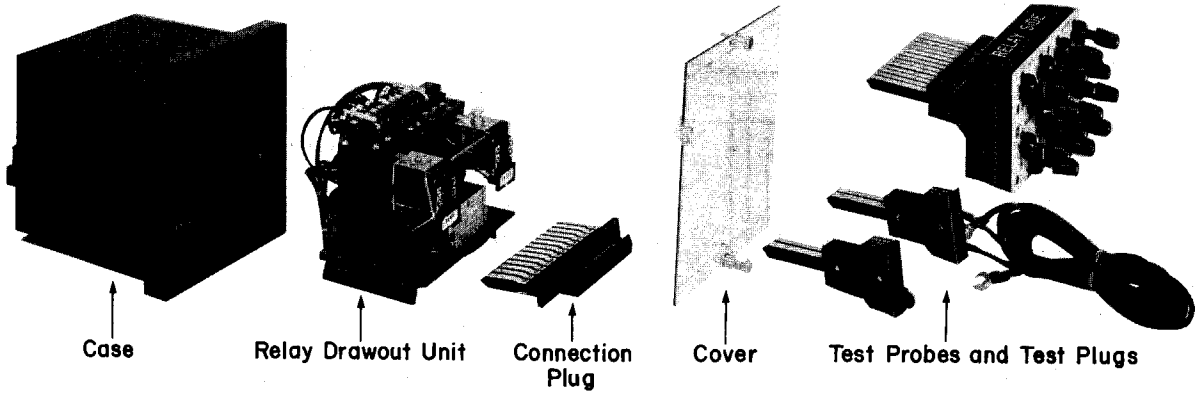
Figure 68. Typical External Connections for the NSR21E and NSR21F Reclosing Relays. (Reclosure Initiated by RI contact)

Legend

Device No.	Type	Description
52C	SB	Control Switch
52		Ac Circuit Breaker
79		Reclosing Relay
86		Lockout Relay (if used)
79C0		Reclosing Cutout Switch
RI		Reclosing Initiating Unit
68/0B		Out-of-Step Blocking Relay
CCS		Channel Cutout Switch

52CS Control Switch Development
X Denotes Contact Closed

Contacts Handle End		Close	Normal After Close	Normal After Trip	Trip
1 ○–○ ○–○ 2	1				X
	2				X
3 ○–○ ○–○ 4	3		X	X	
	4	X			
5 ○–○ ○–○ 6	5	X	X		
	6	X	X		



(Photo 8043254)

Fig. 69. Typical "C" case construction

DESCRIPTION

The one-piece molded dusttight C size drawout relay case is designed to house a relay unit with one connection plug. The relay unit is easily removed for testing and maintenance.

The one-piece molded case will meet or exceed the applicable ANSI and IEEE relay standards. Reference ANSI C37.90 and C37.90a - IEEE 313 and 472.

CONSTRUCTION (See Fig. 69)

Case is a one-piece glass-filled polyester molding suitable for either semi-flush or surface mounting.

A hooded flange prevents accumulated debris from falling into relay as cover is removed. "Out of Service" legend on bottom of connection block is visible only with connection plug removed indicating relay is disconnected. Paper label inside of case and metal nameplate on relay unit identify the relay model number. The dead-front feature renders this construction very safe even when the cover is removed.

Relay Drawout Unit consists of one-piece molded support structure with relay subassemblies mounted to provide easy access for maintenance.

Connection Plug makes positive silver-to-silver contact between fingers on the drawout element and the bottom connection block on the case.

Cover is gasketed and completely transparent, permitting visual inspection of the relay and determination of shorting bar and target position. The target reset button projects from the front of the cover.

Test Probe and Test Plug are used for routine in-case testing. Testing is accomplished by removing the connection plug and inserting the XCA11A2 ammeter probe with, suitable external connections, or the XCA1-1A1 two-position four-point general test probe. Also, the XCA28A1 full-width 14-position 28-point test plug is available to provide complete flexibility in testing the "C" case relay. The XCA11A test probes are keyed to the barrier strips of the case for added security and safety.

OPERATION (See Fig. 70)

The Connection Plug when fully inserted, energizes the relay circuits by electrically connecting contact fingers on the ***Case*** and the ***Drawout Unit***.

As the connection plug is withdrawn, current transformer secondary connections are short-circuited and the relay is de-energized as follows:

1. Plug clears short contact fingers in trip circuit before disconnecting any other circuits. There is no need to first operate a separate trip circuit switch to prevent false tripping.

2. Current circuit fingers on case connection block engage the shorting bar located at lower front of case to short-circuit current transformer secondary connections.

3. Window provides visual confirmation of contact between shorting bar and current circuit contact fingers.

4. Plug clears case contact fingers and then long fingers on removable element to open relay current circuit.

5. Plug is fully withdrawn and relay is completely de-energized.

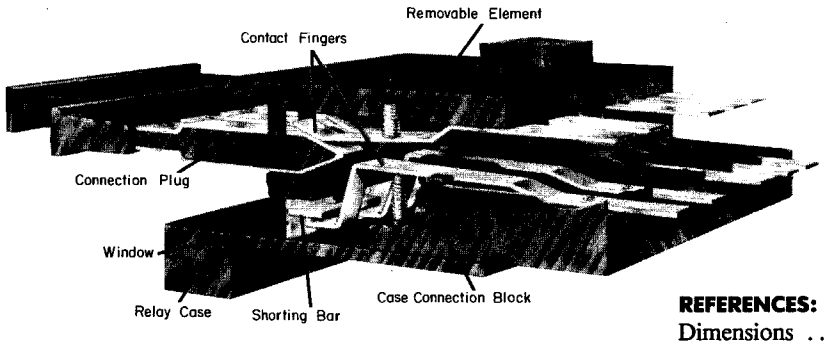


Fig. 70. Drawout Case (C) Connection System

REFERENCES:

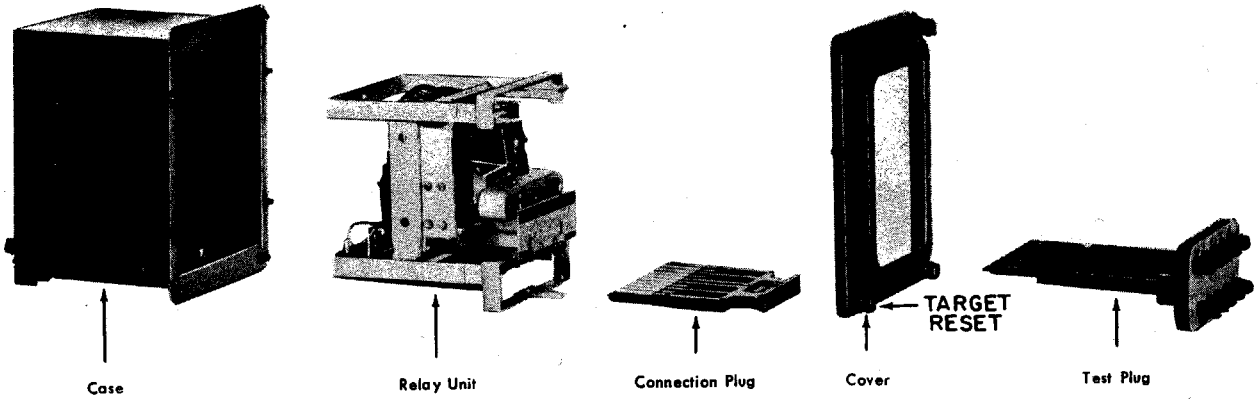
Dimensions ..... Section 16
Relay Standards ..... Section 16

Drawout Relay Cases

Sizes S, M, L or V

GE Protective Relays

CONSTRUCTION



(Photo 8026176)

Fig. 71. Typical Case Construction

DESCRIPTION

The fabricated steel and phenolic, dust proof, drawout relay case is designed to house relay units with one or two connection plugs as required for the specific relay type.

The relay unit is easily removed for testing and maintenance. This fabricated case is available in sizes: very small (V), small (S1, S2), medium (M1, M2) and large (L1, L2). The designation S1E, M1E and L1E indicates added bushings or insulation for some specific applications. The suffix "B", such as L2B, indicates added louvers for ventilation. The suffix "D", such as M2D and L2D, indicates added depth or deep case. The suffix "T", such as L2T, indicates a dedicated surge ground terminal board.

The fabricated case will meet or exceed the applicable ANSI and IEEE relay standards. Reference ANSI C37.90 and C37.90a - IEEE 313 and 472.

CONSTRUCTION (See Fig. 71)

Case is fabricated steel with phenolic end blocks, and is suitable for either semi-flush or surface mounting. Paper label inside of case and metal nameplate on relay unit identify the relay model number. The dead-front feature renders this construction safe even when the cover is removed.

Relay Drawout Unit is securely mounted on a steel cradle which permits easy accessibility for maintenance.

Connection Plug makes positive silver-to-silver contact between the contact fingers on the relay contact block and the case terminal block. Where the relay internal circuits require more than 10 contact fingers, an additional terminal block, contact block, and connecting plug is provided at the top of the relay.

Cover is gasketed steel or phenolic frame with glass insert which permits visual inspection of the relay and determination of target position. The target reset button projects from the bottom of the cover.

Test Plug Routine testing can be accomplished by removing the relay cover and connecting plug and substituting a 10- or 20-point Type XLA test plug with suitable external connections. See Section 13 for Test Plug details.

OPERATION (See Fig. 72)

The Connection Plug when fully inserted, energizes the relay circuits by electrically connecting contact fingers on the ***Case Terminal Block*** and the ***Relay Removable Element***.

As the connection plug is withdrawn, current transformer secondary connections are short-circuited and the relay is de-energized as follows:

1. Connection plug clears short contact fingers in trip circuit before disconnecting any other circuits. There is no need to first operate a separate trip circuit switch to prevent false tripping.

2. Terminal block contact fingers disengage, but current circuit is maintained through auxiliary contact fingers.

3. Current circuit fingers on terminal block engage shorting bar to short-circuit current transformer secondary connections.

4. Plug clears auxiliary contact fingers and removable element contact fingers to open relay current circuit.

5. Plug is fully withdrawn and relay is completely de-energized.

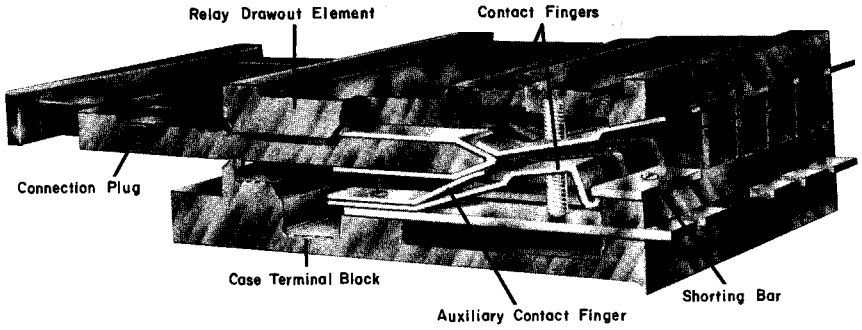


Fig. 72. Drawout Case (S, M, L or V) Connection System

RELAY NOMENCLATURE SYSTEM

INTRODUCTION

The GE protective relay nomenclature system has been developed over a number of years and is used to describe electromechanical, static, and static equipment relays. You will note some open or blank spaces to allow for new product developments.

The first three or four letters included in the model numbers assigned to protective relays convey a general idea of each relay's characteristic features of design and application. There are always three, and sometimes four, of these letters used in the following manner:

Letter	1st Position Operating Principle	2nd Position② Protective Application	3rd Position Primary Function	4th Position add'l. Definition
A	Automatic	Auxiliary	Auxiliary	.....
B	Balance	Bus	Blocking (or Bearing)	Balance or Blocking
C	Cylinder—Induction	Carrier	Current	Current Polarized
D	.....	Direct Current	Differential	.....
E	Electronic	.....	.....	.....
F	.....	Feeder-Time Delay	Frequency	.....
G	Group of Units	Generator	.....	Ground
H	Hinged Armature	Feeder-High Speed	Loss of Excitation	.....
I	Induction Disk	.....	.....	.....
J	Group of Units	.....	Synch. Check	.....
K	.....	.....	Phase Sequence	.....
L	.....	Line-High Speed	Phase Angle	Modified Circle
M	Motor	Machine	Time	.....
N	Non-GE - ①	Network	.....	Negative Sequence
P	Plunger	Pilot Wire	Power Directional	Positive Sequence or Potential Polarized
R	Rotating Armature	.....	Reclosing or Phase Sequencing	.....
S	Static or Solid State	Power Supply	Synchronizing or Selector	Supervised or Controlled
T	Temperature	Transformer	Temperature	.....
U	.....	Ultra-High Speed	.....	.....
V	.....	Vacuum	Voltage	Voltage Restrained
W	.....	.....	Power	.....
X	Miscellaneous	.....	Reactance	.....
Y	.....	.....	Admittance—Mho	.....
Z	.....	.....	Impedance	.....

① Typical example — Telephone Type relay.

② For electro-mechanical relays, 2nd letter designation may be arbitrary.

EXAMPLES:

HFA—Hinged armature Auxiliary
GCX—Group of Units—Reactance Distance
JBCG—Group of Units—Ground Directional Overcurrent
SLY—Static Line Mho
SLYG—Static Line Mho Ground
STD—Static—Differential protection of Transformers

Following the "Type Letters" are "Type Numerals" and "Form Numbers". These are assigned in sequence and have no special significance; they cover major and minor variations in design necessary to adapt the relay to a particular application.

Newer special relays, designed at Customer request, use '99' as "Type Numerals" to distinguish special from standard designs.
Example: 12 IAC '99' AB 001A.

