SCHWEITZER ENGINEERING LABORATORIES, INC.
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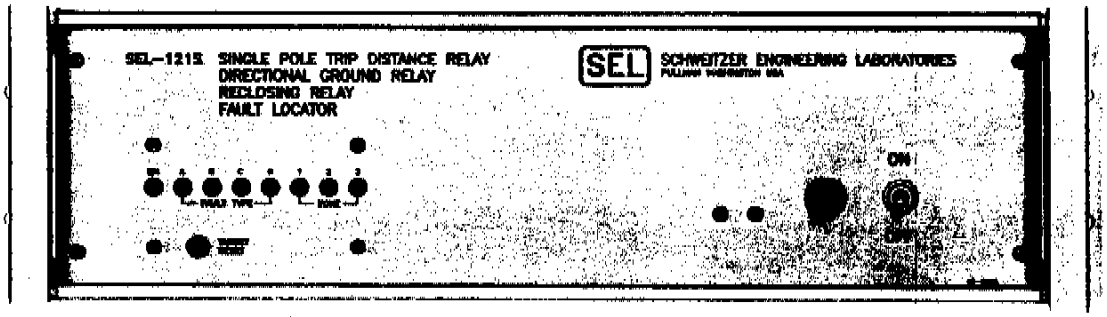
SEL-121S

SINGLE POLE TRIP DISTANCE RELAY
GROUND DIRECTIONAL OVERCURRENT RELAY
GROUND TIME OVERCURRENT RELAY
RECLOSING RELAY
FAULT LOCATOR

DATA SHEET



- THREE ZONES OF TIME STEP PHASE AND GROUND DISTANCE PROTECTION
- SINGLE POLE TRIP OUTPUTS
- RESIDUAL OVERCURRENT AND TIME OVERCURRENT ELEMENTS
- NEGATIVE-SEQUENCE DIRECTIONAL ELEMENT
- SINGLE SHOT RECLOSER
- LOSS-OF-POTENTIAL LOGIC
- PROGRAMMABLE LOGIC SUPPORTING WIDE RANGE OF APPLICATIONS
- FAULT LOCATING • EVENT REPORTING • METERING
- AUTOMATIC SELF TESTING • RS-232-C COMMUNICATIONS (TWO PORTS)
- HORIZONTAL AND VERTICAL MOUNTING CONFIGURATIONS AVAILABLE

GENERAL DESCRIPTION

The SEL-121S relay provides three zones of phase and ground distance protection. Single pole tripping is permitted when either the Zone 1 ground distance element asserts or the Zone 3 ground distance element asserts and the PT input is asserted. Three pole trips are initiated for all other fault types. Ground directional overcurrent and inverse-time overcurrent elements provide backup protection for high-resistance ground faults. Like the SEL-121G relay, the SEL-121S relay uses the very popular programmable-mask logic for unsurpassed application flexibility.

The distance relay elements are memory-polarized with positive-sequence voltage to obtain expanded mho characteristics. The unique memory scheme provides polarization for at least six cycles.

Overcurrent supervision, loss-of-potential detection, high-set overcurrent elements, and other features increase the versatility of the SEL-121S relay.

A single shot recloser provides for fault type selectable automatic line restoration.

The SEL-121S Relay Function Block Diagram illustrates the basic configuration of the protective capabilities.

The SEL-121S relay generates an eleven cycle event report following each fault. Each report includes voltage, current, and sequence-of-events information for relay elements, inputs, and outputs. The relay saves the twelve most recent event reports; each can be retrieved remotely or locally through the serial communication ports.

A metering function permits interrogation of the SEL-121S relay to obtain voltage, current, real power, and reactive power readings. This function also includes per-phase measurements of voltage and current.

The CLOSE, TRIPA, TRIPB, TRIPC, A1, and ALARM output contacts may be specified as either an "a" or "b" type contact. The TRIP outputs are always an "a" type contact.

The SEL-121S relay is compatible with the SEL-PRTU Protective Relay Terminal Unit, the SEL-DTA Display/Transducer Adapter, and the SEL-PROFILE Transmission Line Fault Analysis Program.

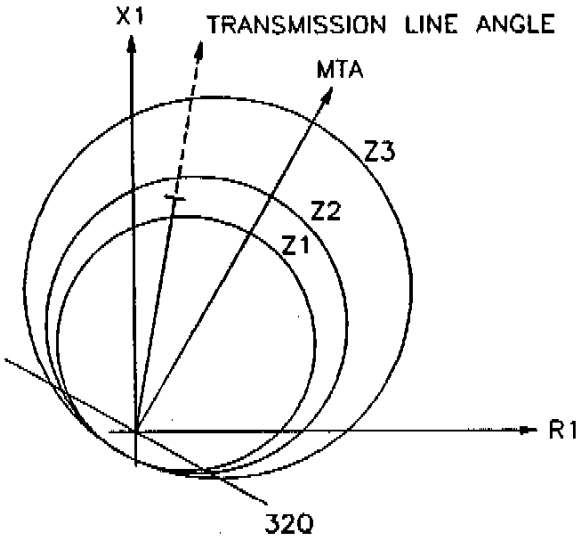
APPLICATIONS

Single Pole Tripping

The SEL-121S relay provides single pole tripping capabilities for single-line-to-ground faults. Two-phase faults, three-phase faults, and ground time-overcurrent trips result in a three pole trip. A possible scheme might be to unconditionally single pole trip for Zone 1 single-line-to-ground faults and single pole trip for single-line-to-ground faults in Zone 3 upon assertion of the permissive trip input. Since residual current will flow during the open pole period following a single pole trip, the Pole Open (PO) feature can be used to disable the 67N and 51N ground elements for a settable time period following a single pole trip.

The mho elements are forward reaching and are supervised by the negative sequence directional (32Q) element. The diameter of the mho circle at the maximum torque angle (MTA) for Zones 1, 2, and 3 can be found by the following formula:

DIAMETER = [SET REACH] / [COS (T.L. ANGLE - MTA)]



Example Mho circles

Time-Step Relaying

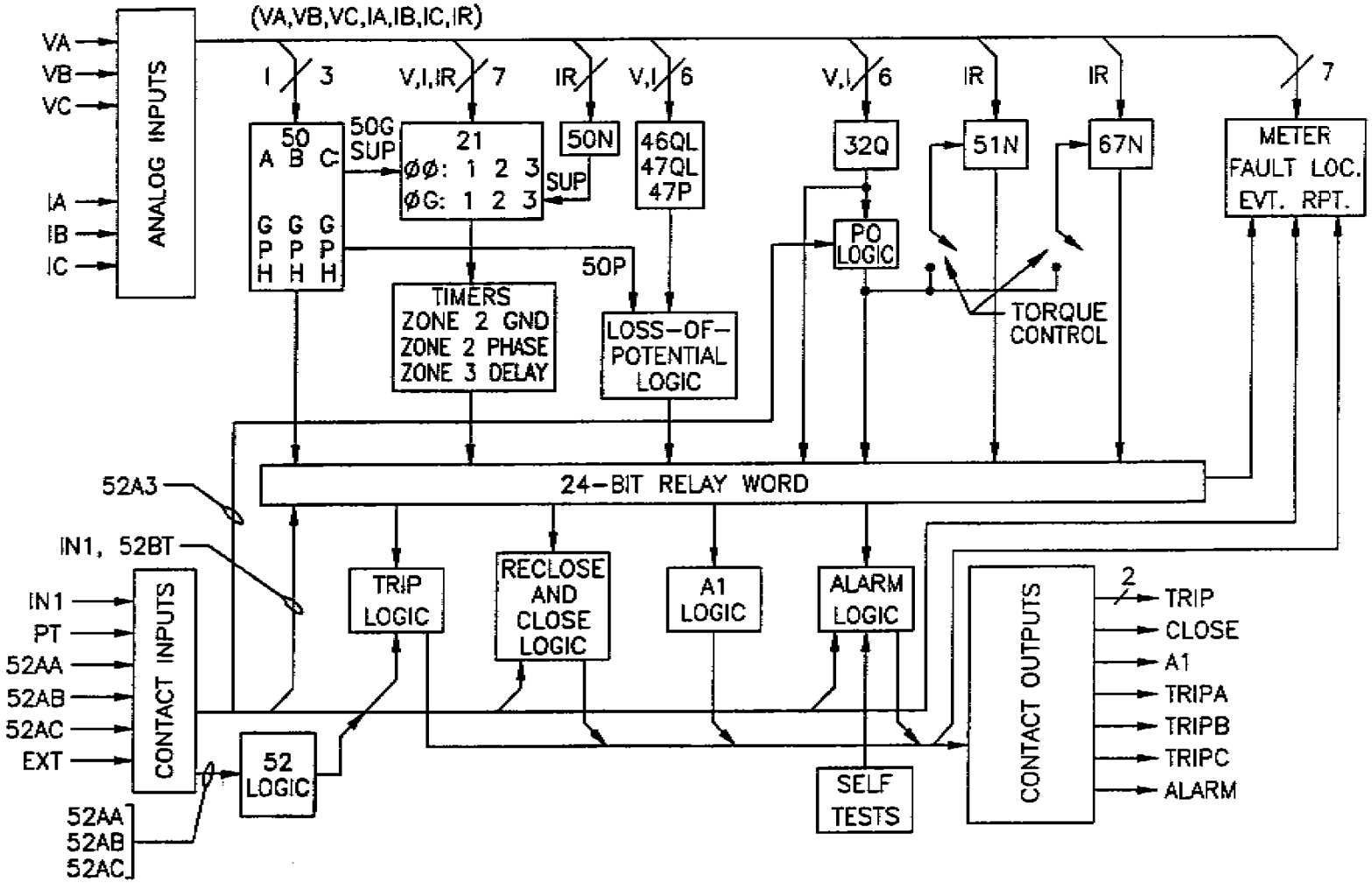
The SEL-121S relay provides three zones of time-step protection with separate timers for phase and ground faults in Zone 2 and a common timer for both phase and ground faults in Zone 3. In such applications, the SEL-121S relay is the only instrument needed for primary relaying. The exhaustive self testing and communications features reduce dependence on local and remote backup schemes.

Schemes Involving Communications

The SEL-121S relay supports direct tripping, permissive underreaching transfer tripping, and permissive overreaching transfer tripping.

In permissive transfer tripping schemes, Zone 1 is set underreaching and Zone 3 may be used to qualify the received permissive signal.

Evaluating scheme performance is made easy by reviewing the event report which shows the voltages, currents, relay elements, inputs, and outputs.



SEL-121S RELAY FUNCTION BLOCK DIAGRAM

DWG. NO. A7-0526
DATE: 05-22-89
REV. 08-07-89

Backup Relaying

Where adequate high-speed primary protection already exists, the SEL-121S relay can be applied as backup. Its programmability and remote-access capabilities allow the relay settings to be changed remotely for virtually any contingency.

Its application also adds event reporting and fault locating.

SPECIFICATIONS

Relay Functions

Expanded mho characteristics for all faults
- Three phase-to-phase zones with overcurrent supervision
- Three phase-to-ground zones with overcurrent supervision
- Infinite-impulse-response filter provides a minimum of six cycles of memory polarization for all mho elements.
- Phase and residual overcurrent supervision of ground mho elements
- Phase overcurrent supervision of phase mho elements
- High-set phase overcurrent elements

Two residual overcurrent elements for ground faults
- One time-delayed element, with nondirectional or forward directional supervision
- Inverse-time overcurrent element with selectable curve shapes

Negative-sequence directional element for directional supervision

Loss-of-potential logic

Single-shot recloser

Relay Elements

Phase Overcurrent Elements (secondary values)
- 50AG, 50BG, 50CG (supervise ground mho elements)
  - Pickup: 0.5A to 25 times 51NP, but less than 40A, ± 0.1A ± 2% of setting
- 50AP, 50BP, 50CP (supervise phase mho elements)
- 50AH, 50BH, 50CH (high-set elements)
  - Pickup: 0.5A to 40A, ± 0.1 A ± 2% of setting
  - Transient Overreach: 5% of set pickup

Phase and Ground Distance Elements (secondary values)

Zone 3 ground mho distance	21AG3, 21BG3, 21CG3
Zone 3 phase mho distance	21AB3, 21BC3, 21CA3
Zone 2 ground mho distance	21AG2, 21BG2, 21CG2
Zone 2 phase mho distance	21AB2, 21BC2, 21CA2
Zone 1 ground mho distance	21AG1, 21BG1, 21CG1
Zone 1 phase mho distance	21AB1, 21BC1, 21CA1

Minimum Sensitivity: 0.5A

Maximum Torque Angle: 47 - 90 degrees in one-degree steps

Operating Time: 10 - 45 ms (22 ms typical)

Residual current compensation for ground mhos: $0.25 < |K| < 6$

Zone 1, 2, 3 reach: 0.125 to 64 ohms, where
Zone 1 < Zone 2 < Zone 3

Steady-state Error:
5% of set reach ± 0.01 ohm at angle of maximum torque for V > 5V and I > 2A
10% of set reach ± 0.01 ohm at angle of maximum torque for 5 > V > 1V or 0.5 < I < 2A

Transient Overreach:
5% of set reach, plus steady-state error

Positive-Sequence Voltage Memory Polarization:
All mho elements are memory-polarized by an infinite-impulse response filter with a four-cycle time constant, yielding polarization for at least six cycles.

Ground Overcurrent Elements (secondary values)
51N residual time overcurrent element:
Selectable curve shape (4 families of curves)
Time dial: 0.50 to 15.00 in 0.01 steps
Pickup: 0.5A to 8A, ± 0.05A ± 3% of setting
Timing: ± 4% and ± 1 cycle for residual current magnitude between 2 and 20 multiples of pickup
May be directionally controlled (51NTC setting)

67N residual overcurrent element:
Pickup: 0.5A to 25 times 51N pickup
Time delay: 0-8000 cycles in 0.25 cycle increments
Transient overreach: 5% of set pickup
May be directionally controlled (67NTC setting)
50N residual overcurrent element:
Pickup: 0.5A to 25 times 51N pickup, but less than 40A
Transient Overreach: 5% of set pickup
Nondirectional element--supervises ground mho elements

Negative-Sequence Directional Element (32Q)
Angle: same as mho element maximum torque angle (MTA) setting
Sensitivity: less than 0.32 VA of V2*I2, at MTA
This element direction-controls residual overcurrent elements and adds directional security to the distance relay elements for all unbalanced faults.

Sequence-Component Elements
Negative-sequence overvoltage element (47QL)
Pickup: 14 volts of V2
Negative-sequence overcurrent element (46QL)
Pickup: 0.083 amps of I2
Positive-sequence overvoltage element (47P)
Pickup: 14 volts of V1

Fault Location	Fault location is computed from event reports stored following each fault. The algorithm compensates for prefault current to improve accuracy for high-resistance faults during periods of substantial load flow.
Fault Reporting	The SEL-121S relay retains a data record for each of the 12 most recent faults. This record includes the date, time, current, voltage, relay element, input contact, and output contact information. The report may also be triggered by command or contact closure. When tripping occurs after the end of the event report, a second report is triggered at tripping.
Self Testing	Analog ac channel offset errors Stall timer monitors processor Power supply voltage checks Setting checks RAM, ROM, and A/D converter tests
Rated Input Voltage	60-75 volts/phase secondary, three-phase, four-wire connection (VA, VB, VC, VN)
Rated Input Current	5 amps per phase nominal 15 amps per phase continuous 500 amps for one second thermal rating
Output Contact Ratings	30 amps make per IEEE C37-90 para 6.6.2 6 amps carry continuously MOV protection provided
Logic Input Ratings	48 Vdc: 25 - 60 Vdc 125 Vdc: 60 - 200 Vdc 250 Vdc: 200 - 280 Vdc Current = 6 mA at nominal voltage
Power Supply	48 Volt: 30 - 60 Vdc; 12 watts 125 Volt: 85 - 200 Vac or Vdc; 12 watts 250 Volt: 85 - 280 Vdc or 85 - 200 Vac; 12 watts
Dielectric Strength	Routine tested: V, I inputs: 2500 Vac for 10 seconds Other: 3000 Vdc for 10 seconds (excludes RS-232-C)
Interference Tests	IEEE C37-90 SWC test (type tested) IEC 255-6 interference test (type tested)

Impulse Tests	IEC 255-5, 0.5 joule, 5000 volt test (type tested)
RFI Tests	Type-tested in field from a ¼-wave antenna driven by 20 watts at 150 MHz and 450 MHz, randomly keyed on and off, at a distance of 1 meter from relay.
Dimensions	5¼" x 19" x 13". Mounts in EIA 19" rack, or panel cutout.
Unit Weight	21 pounds
Shipping Weight	32 pounds, including two instruction manuals
Operating Temp.	-20 deg C to +55 deg C
Burn-in Temp.	Each SEL-121S relay is burned in at 60 deg C for 100 hours.

LOGIC DESCRIPTION

The SEL-121S logic consists of relay elements, timers, and combinations of conditions. Many of these are recorded in a Relay Word, which forms the heart of the programmable mask logic of this relay. Elements and other quantities available in the Relay Word are indicated in boldface type in this section of the data sheet.

Since so many binary variables are involved, we define the functioning using Boolean logic equations.

Relay Elements

Single-phase overcurrent relays	50AG 50BG 50CG	(50NG setting)
	50AP 50BP 50CP	(50P setting)
High-set single-phase overcurrent relays	50AH 50BH 50CH	(50H setting)
Zone 3 ground mho distance	21AG3, 21BG3, 21CG3	(Z3% setting)
Zone 3 phase mho distance	21AB3, 21BC3, 21CA3	
Zone 2 ground mho distance	21AG2, 21BG2, 21CG2	(Z2% setting)
Zone 2 phase mho distance	21AB2, 21BC2, 21CA2	
Zone 1 ground mho distance	21AG1, 21BG1, 21CG1	(Z1% setting)
Zone 1 phase mho distance	21AB1, 21BC1, 21CA1	

Impulse Tests	IEC 255-5, 0.5 joule, 5000 volt test (type tested)
RFI Tests	Type-tested in field from a ¼-wave antenna driven by 20 watts at 150 MHz and 450 MHz, randomly keyed on and off, at a distance of 1 meter from relay.
Dimensions	5¼" x 19" x 13". Mounts in EIA 19" rack, or panel cutout.
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Since so many binary variables are involved, we define the functioning using Boolean logic equations.

Relay Elements

Single-phase overcurrent relays	**50AG 50BG 50CG**	**(50NG** setting)
	50AP 50BP 50CP	**(50P** setting)
High-set single-phase overcurrent relays	**50AH 50BH 50CH**	**(50H** setting)
Zone 3 ground mho distance	21AG3, 21BG3, 21CG3	(Z3% setting)
Zone 3 phase mho distance	21AB3, 21BC3, 21CA3	
Zone 2 ground mho distance	21AG2, 21BG2, 21CG2	(Z2% setting)
Zone 2 phase mho distance	21AB2, 21BC2, 21CA2	
Zone 1 ground mho distance	21AG1, 21BG1, 21CG1	(Z1% setting)
Zone 1 phase mho distance	21AB1, 21BC1, 21CA1	

Residual time-overcurrent pickup	**51NP**	
Residual time-overcurrent trip	**51NT**	(**51NP**, 51NTD, 51NC, 51NTC settings)
Residual overcurrent pickup	**67NP**	
Residual overcurrent trip	**67NT**	(**67NP**, 67ND setting)
Residual inst overcurrent	**50N**	(**50NG** setting)
Negative-sequence directional	**32Q**	Forward direction
Negative-sequence overvoltage	**47QL**	V2 > 14V loss-of-potential logic
Negative-sequence overcurrent	**46QL**	I2 > 0.083A loss-of-potential logic
Positive-sequence overvoltage	**47P**	V1 > 14V loss-of-potential logic

Contact Inputs

Programmable input	**IN1**	For dir. trip or other user rqmts.
Permissive trip	**PT**	For perm. transfer trip. schemes
Circuit breaker monitor - A phase	**52AA**	
Circuit breaker monitor - B phase	**52AB**	
Circuit breaker monitor - C phase	**52AC**	
External trigger for event report	**EXT**	

Contact Outputs

Circuit breaker trip	**TRIP**	2 Outputs
Circuit breaker close	**CLOSE**	
Programmable output	**A1**	Includes TDPU/TDDO timer
Trip A pole	**TRIPA**	
Trip B pole	**TRIPB**	
Trip C pole	**TRIPC**	
System alarm	**ALARM**	Alarms for self tests, LOP, setting changes, second-level access, and 3 unsuccessful Level 1 attempts.

Logic Settings and Timers

Reclosing relay open interval	79OI	0-8000 cycles; 0 disables
Reclosing relay reset timer	79RS	60-8000 cycles
Zone 2 delay for phase faults	Z2DP	3-2000 cycles
Zone 2 delay for ground faults	Z2DG	3-2000 cycles
Zone 3 delay	Z3D	3-2000 cycles
Ground overcurrent delay	67ND	0-8000 cycles
Pole open disable delay	POD	0-8000 cycles
Zone 2 phase fault timer timeout	Z2PTMR	(Set by Z2DP)
Zone 2 ground fault timer timeout	Z2GTMR	(Set by Z2DG)
Zone 3 fault timer timeout	Z3TMR	(Set by Z3D)
Ground overcurrent timer timeout	67NTMR	(Set by 67ND)
Pole open disable timeout	PODTMR	(Set by POD)
Direction (torque) control of 51N	51NTC	
Direction (torque) control of 67N	67NTC	
Switch onto fault time delay	**52BT**	0.5-10000 cycles
Loss-of-potential enable	LOPE	
Loss-of-potential ALARM enable	LOPA	
A1 contact output timer timeout	A1T	0-8000 cycles A1TP pickup delay 0-8000 cycles A1TD dropout delay

INTERMEDIATE LOGIC

The logic equations developed below represent combinations of the relay elements and other conditions. In the following equations the "*" indicates logical "and," while the "+" indicates logical "or."

Circuit-Breaker Contact Logic

52A3	= 52AA * 52AB * 52AC	
52B3	= NOT(52AA) * NOT(52AB) * NOT(52AC)	
52BT	= NOT(52A3)	Delayed by **52BT** time setting at pickup and dropout
PO	= NOT(52A3) * NOT(PODTMR)	Pole open (used to supervise forward mhos and to disable 67N and 51N during pole open interval but not longer than POD)
3PT	= TA * TB * TC	3 Pole Trip (used to detect a 3 pole trip condition)

Loss-of-Potential Logic

Set **LOP** = 47QL * NOT(46QL)
+ NOT(47P) * NOT(50P) (Must be valid for three cycles to set)

Clear **LOP** = NOT(47QL) * (47P + NOT(52A3))

(The different set and clear conditions ensure **LOP** stays latched during subsequent faults, but **LOP** is cleared when balanced voltages return.)

Overcurrent Conditions

50G	= 50AG + 50BG + 50CG	Sensitive phase overcurrent condition
50NG	= 50N + 50G	Sensitive ground or phase overcurrent condition
50P	= 50AP + 50BP + 50CP	Phase overcurrent condition
3P50	= 50AP * 50BP * 50CP	Three-phase overcurrent condition
50H	= 50AH + 50BH + 50CH	High-level phase overcurrent condition
67NP	= 67N pickup * NOT(PO)	
67NT	= **67NP** * (32Q + (LOP * LOPE) + NOT(67NTC)) * 67NTMR	Directionally supervised residual overcurrent element (disabled when any pole open)
51NP	= 51N pickup * (32Q + (LOP * LOPE) + NOT(51NTC)) * NOT(PO)	Directionally supervised residual time-overcurrent element (disabled when any pole open)

Distance Relay Logic

3P21	= (21AB3*21BC3*21CA3) * 3P50	Three-phase fault condition
FDS	= 3P21 + 32Q + TRIP output asserted (inst. p.u./¼ cyc. d.o.) + PO	Forward-direction supervision

Z3P = (21AB3*50AP*50BP + 21BC3*50BP*50CP + 21CA3*50CP*50AP) * FDS * NOT(LOP * LOPE)
Z3G = (21AG3*50AG + 21BG3*50BG + 21CG3*50CG) * 50N * FDS * NOT(LOP * LOPE)

Z2P = (21AB2*50AP*50BP + 21BC2*50BP*50CP + 21CA2*50CP*50AP) * FDS * NOT(LOP * LOPE)
Z2G = (21AG2*50AG + 21BG2*50BG + 21CG2*50CG) * 50N * FDS * NOT(LOP * LOPE)

Z1P = (21AB1*50AP*50BP + 21BC1*50BP*50CP + 21CA1*50CP*50AP) * FDS * NOT(LOP * LOPE)
Z1G = (21AG1*50AG + 21BG1*50BG + 21CG1*50CG) * 50N * FDS * NOT(LOP * LOPE)

Z2PT	= Z2P * Z2PTMR	Zone 2 phase timeout
Z2GT	= Z2G * Z2GTMR	Zone 2 ground timeout
Z3T	= (**Z3P** + **Z3G**) * Z3TMR	Zone 3 timeout

Z3AG = 21AG3 * 50AG * 50N * **FDS** * NOT(**LOP** * LOPE)
Z3BG = 21BG3 * 50BG * 50N * **FDS** * NOT(**LOP** * LOPE)
Z3CG = 21CG3 * 50CG * 50N * **FDS** * NOT(**LOP** * LOPE)

RELAY WORD

Relay elements and intermediate logic results used in the SEL-121S relay are represented in a 24-bit Relay Word. You may select bits in this word to control outputs. The selected bits are stored in masks for each function. The bits in each mask are programmed using the LOGIC command.

RELAY WORD

Z1P	**Z1G**	**Z2PT**	**Z2GT**	**Z3P**	**Z3G**	**Z3T**	**50H**
67NP	**67NT**	**51NP**	**51NT**	**50NG**	**5OP**	**50G**	**32Q**
FDS	**3P21**	**LOP**	**52BT**	**IN1**	**PO**	**3PT**	*

The Relay Word Bit Summary Table explains the meaning of each bit in the Relay Word. The "*" in the Relay Word indicates that the bit position is not used.

RELAY WORD BIT SUMMARY TABLE

Z1P Zone 1 phase fault, instantaneous output (set by Z1%)
Z1G Zone 1 ground fault, instantaneous output (set by Z1%)
Z2PT Zone 2 phase fault, time delayed (set by Z2% and Z2DP)
Z2GT Zone 2 ground fault, time delayed (set by Z2% and Z2DG)
Z3P Zone 3 phase fault, instantaneous (set by Z3%)
Z3G Zone 3 ground fault, instantaneous (set by Z3%)
Z3T Zone 3 phase or ground fault, time delayed (set by Z3% and Z3D)
50H High-set phase overcurrent condition (set by **50H**)

67NP Residual overcurrent pickup (set by **67NP**)
67NT Residual overcurrent time delayed trip (set by **67NP**, 67ND, 67NTC)
51NP Pickup of residual time-overcurrent (set by **51NP**)
51NT Timeout of residual time-overcurrent (set by **51NP**, 51NTD, 51NC, and 51NTC)
50NG Sensitive residual or phase overcurrent condition (set by **50NG**)
50P Phase overcurrent condition (set by **50P**)
50G Sensitive phase overcurrent condition (set by **50NG**)
32Q Negative-sequence directional element

FDS Forward-direction supervision
3P21 Three-phase fault condition detected by phase distance relays
LOP Loss-of-potential condition
52BT Inverted 52A3 input delayed by **52BT** setting
IN1 Logic input 1 (use for direct trip, reclose cancel, etc.)
PO Pole open condition
3PT 3 pole trip condition

The use of the Relay Word and programmable masks MTU, MPT, MTO, MR1, MRC, and MA1 provides the user great flexibility in applying the SEL-121S relay, without rewiring panels or changing jumpers on circuit boards.

OUTPUT EQUATIONS

The logic for controlling the TRIP and A1 output relays is programmable for flexibility and testing. The logic is programmed by setting masks for various conditions, which are applied to the Relay Word.

Let R = Relay Word

MTU = mask for trip (unconditional)
MPT = mask for trip (with permissive trip input asserted)
MTO = mask for trip (with breaker open)
MA1 = mask for programmable output A1 control

then:

The programmable output, A1, is given as follows:

A1 = R * MA1 * A1T (Includes A1TP, A1TD settable pickup/dropout delays)

The three pole trip output, TRIP, is programmable by the masks MTU, MPT, and MTO as follows:

TRIP = R * MTU
+ R * MPT * PT
+ R * MTO * 52BT
+ TRIP (OPEN) Command

close TRIP contact = TRIP
open TRIP contact = NOT(TRIP) * [NOT(52A3) + TARGET RESET button pushed] * (60 ms minimum TRIP)

The single pole trip outputs, TRIPA, TRIPB, and TRIPC are not individually programmable by the mask logic. However, they are indirectly dependent on the masks because the three pole trip output, TRIP, must pick up for the single pole trip outputs to operate. The following logic equations control the single pole trip outputs:

TA = TRIP * [NOT(Z3BG + Z3CG) + **Z1P + Z2PT + Z2GT + Z3T + 52BT**]
+ TRIP (OPEN) Command

TB = TRIP * [NOT(Z3AG + Z3CG) + **Z1P + Z2PT + Z2GT + Z3T + 52BT**]
+ TRIP (OPEN) Command

TC = TRIP * [NOT(Z3AG + Z3BG) + **Z1P + Z2PT + Z2GT + Z3T + 52BT**]
+ TRIP (OPEN) Command

A single pole trip output asserts only if the other two single pole trip outputs are not asserted.

close TRIPA contact = TA + (TB * TC)
open TRIPA contact = NOT[TA + (TB * TC)] * [NOT(52AA) + TARGET RESET button pushed] * (60ms minimum TRIPA)

close TRIPB contact = TB + (TA * TC)
open TRIPB contact = NOT[TB + (TA * TC)] * [NOT(52AB) + TARGET RESET button pushed] * (60ms minimum TRIPB)

close TRIPC contact = TC + (TA * TB)
open TRIPC contact = NOT[TC + (TA * TB)] * [NOT(52AC) + TARGET RESET button pushed] * (60ms minimum TRIPC)

The CLOSE output contact will close and open as follows:

close CLOSE contact = (79OI expired + CLOSE command) * NOT(52A3) * NOT(TRIP)
open CLOSE contact = NOT(CLOSE) + 79RS expired

The "*" symbol indicates logical "and", and the "+" indicates logical "or".

RECLOSING RELAY

The reclosing relay provides automatic reclosing for selectable fault types. The open interval and the reset timer are individually programmable.

To provide flexibility in applying the SEL-121S relay to various reclosing schemes, selecting conditions for reclose initiation and cancellation is similar to programming the output relays:

RI = R * MRI MRI selects reclose initiate conditions from the Relay Word
RC = R * MRC MRC selects reclose cancel conditions from the Relay Word

where MRI is the mask for reclose initiation, and MRC is the mask for reclose cancellation.

The open interval does not begin until the TRIP output deasserts. Since the TRIP output never asserts for less than 60 ms, the open interval may start several milliseconds after the fault has actually cleared and the breaker opened.

When the CLOSE output is asserted by the reclosing relay, it remains closed until either the 52A3 element asserts (indicating that the breaker has closed three-pole) or until the **79RS** reset interval expires.

The CLOSE output can also be used to trigger external reclosers.

FAULT TYPE SELECTION

The Fault Type Selection Logic uses the information obtained from the mho elements to determine the correct fault type. The Fault Type Selection Logic initially examines which mho elements (AB, BC, CA, A, B, C) are picked up. This information is often sufficient to determine fault type. If additional information is required, a compensated-torque check is performed, and the maximum torque element determines fault type. This method provides accurate fault type selection for all fault types and loading configurations.

SETTING PROCEDURE

Use the SET and LOGIC commands to enter the settings for the SEL-121S relay via either of the serial interface ports. The settings are stored in nonvolatile memory, so they are retained when the power is off.

SET COMMAND EXAMPLE

```
=>>SET

SET clears events. CTRL-X cancels.
Enter date, or RETURN for no change

ID   : Example 230 kV Line
 ?
R1   : (Ohms pri)..... = 13.90    ?
X1   : ..... = 79.96    ?
R0   : ..... = 41.50    ?
X0   : ..... = 248.57   ?
LL   : Line Length (mi)..... = 100.00   ?

CTR  : ..... = 200.00   ?
PTR  : ..... = 2000.00  ?
MTA  : Max Torque Angle (deg) = 80.80    ?

79OI : Open Int (cyc)..... = 40.00    ?
79RS : Reset Int..... = 240.00   ?
A1TP : A1 Pickup Dly (cyc)... = 0.00     ?
A1TD : A1 Dropout Dly (cyc).. = 0.00     ?

Z1%  : Reach (% line)..... = 80.00    ?
Z2%  : ..... = 120.00   ?
Z3%  : ..... = 150.00   ?

Z2DP : Dly-Phase (cyc)..... = 30.00    ?
Z2DG : Dly-Gnd (cyc)..... = 20.00    ?
Z3D  : Dly (cyc)..... = 40.00    ?

50NG : PU (Amps pri)..... = 100.00   ?
50P  : PU..... = 200.00   ?
50H  : PU..... = 3000.00  ?

51NP : PU (Amps pri)..... = 100.00   ?
51NTD: Time Dial..... = 3.00     ?
51NC : Curve (1,2,3,or4)..... = 2        ?
51NTC: Torque Ctrl (Y/N)..... = Y        ?

67NP : PU (Amps pri)..... = 1200.00  ?
67ND : Dly (cyc)..... = 10.00    ?
67NTC: Torque control (Y/N).. = Y        ?

52BT : Dly (cyc)..... = 30.00    ?
POD  : Pole Open Dly (cyc)... = 60.00    ?
LOPE : Loss of Pot (Y/N)..... = Y        ?
LOPA : LOP Alarm (Y/N)..... = Y        ?

TIME1: Port 1 timeout (min).. = 5        ?
TIME2: ..... = 0        ?
AUTO : Auto port (1,2,3)..... = 2        ?
RINGS: (1-30)..... = 3        ?

New settings for: Example 230 kV Line

R1   =13.90    X1   =79.96    R0   =41.50    X0   =248.57   LL   =100.00
CTR  =200.00   PTR  =2000.00  MTA  =80.80
79OI =40.00    79RS =240.00   A1TP =0.00     A1TD =0.00
Z1%  =80.00    Z2%  =120.00   Z3%  =150.00
Z2DP =30.00    Z2DG =20.00    Z3D  =40.00
50NG =100.00   50P  =200.00   50H  =3000.00
51NP =100.00   51NTD=3.00     51NC =2        51NTC=Y
67NP =1200.00  67ND =10.00    67NTC=Y
52BT =30.00    POD  =60.00    LOPE =Y        LOPA =Y
TIME1=5        TIME2=0        AUTO =2        RINGS=3

OK (Y/N) ? Y
Please wait...
Enabled

Example 230 kV Line                    Date: 1/30/90      Time: 09:10:48

=>>
```

LOGIC COMMAND

The Logic command programs a series of masks to control the outputs of the SEL-121S relay. The Logic command is of the form:

Logic <mask>

where <mask> is any of the following:

MTU - mask for trip (unconditional)
MPT - mask for trip (with permissive trip input asserted)
MTO - mask for trip (for breaker open)
MA1 - mask for programmable output A1 control
MRI - mask for reclose initiate conditions
MRC - mask for reclose cancel conditions

The logic programming procedure consists of typing in changes for the mask, or typing <ENTER>, indicating no change. Masks MTU, MPT, MTO, MA1, MRC, and MRI are programmed corresponding to the Relay Word.

The following LOGIC command example shows the setting of the MTU logic mask.

```
=>>LOGIC MTU <ENTER>

1 selects, 0 deselects.

Z1P  Z1G  Z2PT Z2GT Z3P  Z3G  Z3T  50H
 0    0    0    0    0    0    0    0
 ? 11110011 <ENTER>
 1    1    1    1    0    0    1    0
 ? <ENTER>
67NP 67NT 51NP 51NT 50NG 50P  50G  32Q
 0    0    0    0    0    0    0    0
 ? 01010000 <ENTER>
 0    1    0    1    0    0    0    0
 ? <ENTER>
FDS  3P21 LOP  52BT IN1  PO   3PT   *
 0    0    0    0    0    0    0    0
 ? <ENTER>


New MTU :

Z1P  Z1G  Z2PT Z2GT Z3P  Z3G  Z3T  50H
 1    1    1    1    0    0    1    0
67NP 67NT 51NP 51NT 50NG 50P  50G  32Q
 0    1    0    1    0    0    0    0
FDS  3P21 LOP  52BT IN1  PO   3PT   *
 0    0    0    0    0    0    0    0

OK (Y/N) ? Y <ENTER>
Enabled

Example 230 kV Line                                  Date: 1/30/90   Time: 02:12:28

=>>
```

In this example, the mask for unconditional trip MTU selects tripping for Zone 1 faults, timeout of the Zone 2 and 3 phase and ground elements, timeout of the directional overcurrent element (67N), and timeout of the 51N element.

SAMPLE EVENT REPORT

Example 230 kV Line Date: 1/30/90 Time: 09:21:23.004

FID=SEL-121S-R400-V656mp-0900129

Currents (amps)				Voltages (kV)			Relays	Outputs	Inputs
							2255655L 11017000 PGPNNNNP G	ICAITIA PL1PPPL ABC	IP555E NT222X 1 AAAT ABC
IR	IA	IB	IC	VA	VB	VC			
-4	91	113	-211	72.3	62.0	-133.4	..P..P..	.....	..ABC.
-1	-186	170	16	-112.7	118.4	-5.8	..P..P..	.....	..ABC.
4	-91	-113	211	-72.3	-62.0	133.4	..P..P..	.....	..ABC.
0	186	-170	-16	112.7	-118.4	5.8	..P..P..	.....	..ABC.
-3	91	113	-211	72.2	62.0	-133.4	..P..P..	.....	..ABC.
0	-186	170	16	-112.7	118.4	-5.8	..P..P..	.....	..ABC.
0	-91	-113	211	-72.2	-62.0	133.4	..P..P..	.....	..ABC.
3	182	-170	-19	112.7	-118.4	5.8	..P..P..	.....	..ABC.
-1	94	113	-208	72.3	62.0	-133.4	..P..P..	.....	..ABC.
-1	-182	170	19	-112.7	118.4	-5.8	..P..P..	.....	..ABC.
4	-94	-113	208	-72.3	-62.0	133.4	..P..P..	.....	..ABC.
0	186	-170	-16	112.8	-118.4	5.8	..P..P..	.....	..ABC.
-6	91	113	-211	71.4	61.8	-133.6	..P..P..	.....	..ABC.
183	-3	170	16	-107.8	119.8	-4.6	..P..PP.	.....	..ABC.
-271	-365	-113	211	-67.4	-59.2	136.0	..P..PP.	.....	..ABC.
-416	-233	-170	-16	95.6	-124.0	0.5	..PP.PP.	.....	..ABC.
706	796	116	-211	62.9	56.0	-139.2	.3PP.PP.	..1....	..ABC.
470	289	167	16	-87.6	127.3	2.5	.3PP.PP.	..1....	..ABC.
-883	-969	-116	211	-61.4	-54.9	140.2	.1PP.PP.	T.1A...	..ABC.
-478	-299	-167	-16	86.7	-127.7	-2.9	.1PP.PP.	T.1A...	..ABC.
905	991	113	-211	61.2	54.7	-140.4	.1PP.PP.	T.1A...	..ABC.
481	302	170	16	-86.5	127.8	3.0	.1PP.PP.	T.1A...	..ABC.
-907	-994	-113	211	-61.3	-54.7	140.4	.1PP.PP.	T.1A...	..ABC.
-481	-299	-170	-16	86.4	-127.8	-3.0	.1PP.PP.	T.1A...	..ABC.
907	991	113	-211	61.4	54.7	-140.4	.1PP.PP.	T.1A...	..ABC.
479	299	170	16	-86.4	127.8	2.9	.1PP.PP.	T.1A...	..ABC.
-908	-991	-113	211	-61.4	-54.7	140.4	.1PP.PP.	T.1A...	..ABC.
-478	-302	-170	-16	86.4	-127.8	-2.9	.1PP.PP.	T.1A...	...BC.
908	994	116	-208	61.5	54.8	-139.6	.1PP.PP.	T.1A...	...BC.
283	151	85	53	-86.1	126.2	-2.2	.1PP.PP.	T.1A...	...BC.
-644	-692	-41	88	-70.9	-52.1	136.3	.3PP.PP.	T.1A...	...BC.
-21	0	50	-69	92.0	-125.0	14.1	.3PP.PP.	T.1A...	...BC.
233	220	-82	94	84.2	48.1	-132.9	..PP.PP.	T..A...	...BC.
-56	0	-107	41	-99.0	125.3	-21.7	..PP.PP.	T..A...	...BC.
-68	-28	132	-164	-88.7	-46.6	131.8	..G..P..	.....	...BC.
71	0	113	-41	100.0	-125.3	22.7	..G..P..	.....	...BC.
46	3	-138	176	89.3	46.4	-131.6	..G..P..	.....	...BC.
-77	0	-116	41	-100.1	125.3	-22.8	..G..P..	.....	...BC.
-43	0	142	-182	-89.4	-46.3	131.5	..G..P..	.....	...BC.
78	0	116	-38	100.0	-125.4	22.9	..G..P..	.....	...BC.
43	0	-142	182	89.4	46.3	-131.5	..G..P..	.....	...BC.
-78	0	-113	38	-100.0	125.4	-22.9	..G..P..	.....	...BC.
-41	0	138	-182	-89.4	-46.3	131.6	..G..P..	.....	...BC.
77	0	113	-38	100.0	-125.4	22.9	..G..P..	.....	...BC.

Event : 1AG Location : 74.60 mi 6.05 ohms sec
Duration: 4.75 Flt Current: 1035.1

R1 =13.90	X1 =79.96	R0 =41.50	X0 =248.57	LL =100.00			
CTR =200.00	PTR =2000.00	MTA =80.80					
79OI =40.00	79RS =240.00	A1TP =0.00	A1TD =0.00				
Z1% =80.00	Z2% =120.00	Z3% =150.00					
Z2DP =30.00	Z2DG =20.00	Z3D =40.00					
50NG =100.00	50P =200.00	50H =3000.00					
51NP =100.00	51NTD=3.00	51NC =2	51NTC=Y				
67NP =1200.00	67ND =10.00	67NTC=Y					
52BT =30.00	POD =60.00	LOPE =Y	LOPA =Y				
TIME1=5	TIME2=0	AUTO =2	RINGS=3				

Logic settings:

MTU	MPT	MTO	MA1	MRI	MRC
F3	FF	FF	FF	C0	33
50	50	50	50	00	50
00	00	00	00	00	08

EXPLANATION OF EVENT REPORT

```
Example 230 kV Line                              Date: 1/30/90     Time: 09:21:23.004

FID=SEL-121S-R400-V656mp-D900129

            Currents                          Voltages                Relays   Outputs  Inputs
             (amps)                             (kV)

                                                                    2255655L TCATTTA IP555E
                                                                    11017000 PL1PPPL NT222X
    IR      IA      IB      IC      VA      VB      VC  PGPNNNNP      ABC    1 AAAT
                                                            G                    ABC

  -271    -365    -113     211   -67.4   -59.2   136.0  ..P..PP.  .......  ..ABC.
  -416    -233    -170     -16    95.6  -124.0     0.5  ..PP.PP.  .......  ..ABC.

   706     796     116    -211    62.9    56.0  -139.2  .3PP.PP.  ..1....  ..ABC.
   470     289     167      16   -87.6   127.3     2.5  .3PP.PP.  ..1....  ..ABC.
  -883    -969    -116     211   -61.4   -54.9   140.2  .1PP.PP.  T.1A...  ..ABC.
  -478    -299    -167     -16    86.7  -127.7    -2.9  .1PP.PP.  T.1A...  ..ABC.

Event    : 1AG    Location   : 74.60  mi  6.05   ohms sec
Duration: 4.75    Flt Current: 1035.1

R1   =13.90    X1   =79.96    R0   =41.50    X0   =248.57   LL   =100.00
CTR  =200.00   PTR  =2000.00  MTA  =80.80
79OI =40.00    79RS =240.00   A1TP =0.00     A1TD =0.00
Z1%  =80.00    Z2%  =120.00   Z3%  =150.00
Z2DP =30.00    Z2DG =20.00    Z3D  =40.00
50NG =100.00   50P  =200.00   50H  =3000.00
51NP =100.00   51NTD=3.00     51NC =2        51NTC=Y
67NP =1200.00  67ND =10.00    67NTC=Y
52BT =30.00    POD  =60.00    LOPE =Y        LOPA =Y
TIME1=5        TIME2=0        AUTO =2        RINGS=3
```

Currents and voltages are in primary Amps and kV. Rows are 1/4 cycle apart. Time runs down page. Obtain phasor RMS value and angle using any entry as Y-component, and the entry immediately underneath as the X-component. For example, from bottom rows, IAY = -969, IAX = -299. Therefore, IA = 1014 amps RMS primary, at an angle of ATAN(-969/-299) = -107 degrees, with respect to the sampling clock.

<FID>	Firmware Identification Data
<Relays>	columns show states of internal relay elements ---> Designators 21P : two-phase distance..... : Z1, Z2, Z3 ---> 1,2,3 21G : ground distance..... : Z1, Z2, Z3 ---> 1,2,3 50P : phase overcurrent..... : 50H, 50P, 50G ---> H,P,G 51N : residual time-overcurrent : 51NP, 51NT ---> P,T 67N : inst ground overcurrent.. : 67NP, 67NT ---> P,T 50NG: res/phase overcurrent.... : ---> P 50N : residual overcurrent..... : ---> P LOP : loss-of-potential logic.. : ---> L
<Outputs>	columns show states of output contacts: OFF = "." T=TRIP, C=CLOSE, A1=PROGRAMMABLE, A=TPA, B=TPB, C=TPC, A=ALARM
<Inputs>	columns show states of input contacts: IN1=PROG. INPUT 1, PT=PERMISSIVE TRIP, 52AA=A PHASE POLE, 52AB=B PHASE POLE, 52AC=C PHASE POLE, EXT=EXTERNAL TRIGGER
<Event>	Fault indications are "ZT" where Z indicates zone and T type Z is one of 1=Zone 1, 2=Zone 2, 3=Zone 3, 5=51N, 6=67N H=50H, "?" = indeterminate zone T is one of AG,BG,CG = single-phase, AB,BC,CA = 2-phase ABG,BCG,CAG = two-phase to ground, ABC = 3-phase followed by a "T" if a TRIP triggered the report Other indications are TRIP = triggered by TRIP output and EXT = externally or otherwise triggered
<Location>	Distance to fault in miles. 999999 is indeterminate distance
<ohms sec>	Distance to fault in secondary ohms. 999999 is indeterminate
<Duration>	Fault duration determined from relay element(s) pickup time
<Flt Current>	Max phase current (primary amps) taken near middle of fault
R1,X1,R0,X0	Primary series impedance settings for transmission line
LL	Line length corresponding to specified line impedances
CTR, PTR	Current and potential transformer ratios (XTR:1)
MTA	Maximum Torque angle
79OI, RS	One-shot recloser Open and Reset intervals
A1TP, TD	A1 contact output pickup and dropout delays
Z1%,Z2%,Z3%	Reaches of three- and two-phase mhos, percent of line length (LL)
Z2PD, G, Z3D	Zone 2 timer for phase and ground faults, Zone 3 timer for both phase and ground faults.
50NG, P, H	Residual/Phase, phase and high set overcurrent
51NP, TD, C, TC	GND time-overcurrent Pickup, Time-Dial, Curve, Torque Control
67NP, D, TC	Inst ground overcurrent Pickup, Delay, Torque Control
52BT	52B delay setting (for switch-onto-fault coordination)
POD	Pole Open Delay
LOPE, LOPA	Loss-of-Potential Enable, Alarm
TIME1,2	Communications port timeout intervals (automatic log-off)
AUTO	Port assignment for automatic message transmissions
RINGS	Number of rings to wait before modem answers telephone
<Logic settings>	See LOGIC command for a description of mask settings

SAMPLE COMMAND DISPLAYS

Sample History Command

```
=>>HISTORY
Example 230 kV Line                          Date: 1/30/90       Time: 09:04:05:745

#    DATE         TIME         TYPE  DIST   DUR   CURR
1   1/30/90   09:03:01.092   3AG   100.2  7.25  798
2   1/30/90   09:02:13.041   3AG   74.9   7.00  1016
3   1/30/90   09:00:39.962   1AG   25.3   7.25  2162
4   1/30/90   09:00:13.345   1BC   25.5   7.25  3167
5
6
7
8
9
10
11
12
```

Sample Meter Command

```
=>>METER
Example 230 kV Line                          Date:  1/30/90  Time:  13:27:05

              A        B        C        AB       BC       CA
I (A)       994      995      994      1723     1724     1724
V (kV)   134.4    134.3    134.2    233.1    232.8    232.9

P (MW)      401.12
Q (MVAR)      1.00
```

Sample Self Test Status Report

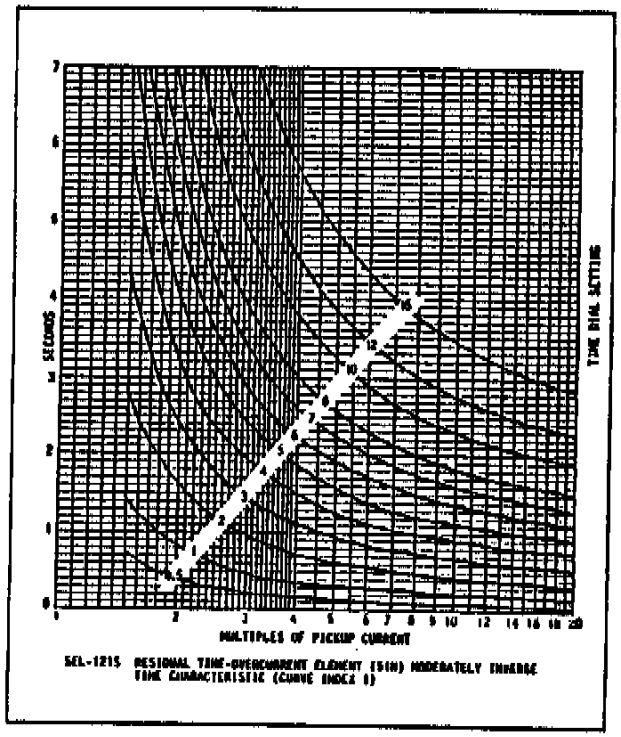
```
=>>STATUS
Example 230 kV Line                          Date: 1/30/90    Time: 01:04:56
SELF-TESTS

W=Warn   F=Fail
      IR   IA   IB   IC   VA   VB   VC
OS    0    0    0    0    0    0    0
PS      4.99      15.14     -14.85
RAM     ROM     A/D      MOF      SET
OK      OK      OK       OK       OK
```

Targets Command

The eight-LED display on the front panel can be programmed to show relay targets (default), Relay Word bits, contact inputs, and contact outputs as shown below. This feature is especially useful for testing individual relay elements.

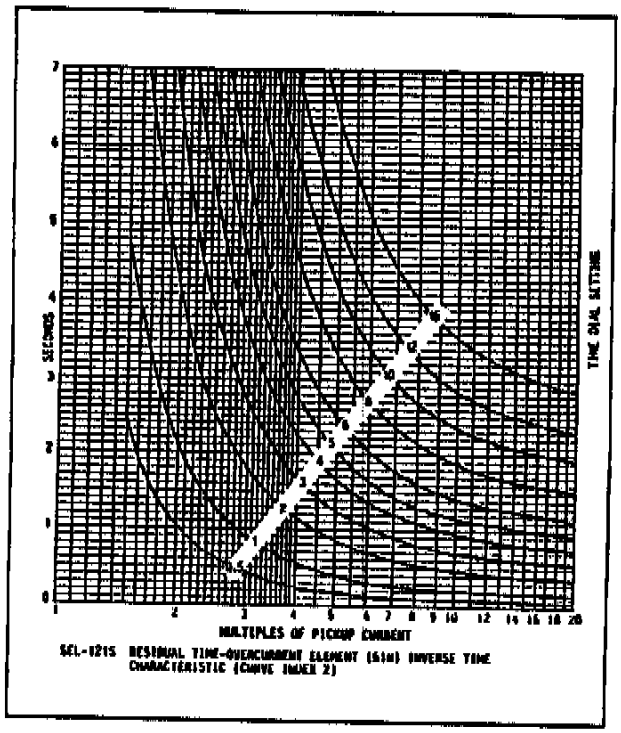
```
=>>TARGETS [N]
LED: 1      2      3_     4      5      6      7      8
N
0    EN     A      B      C      G      Z1     Z2     Z3     RELAY TARGETS
1    Z1P    Z1G    Z2PT   Z2GT   Z3P    Z3G    Z3T    50H    RELAY WORD
2    67NP   67NT   51NP   51NT   50NG   50P    50G    32Q    RELAY WORD
3    FDS    3P21   LOP    52BT   IN1    PO     3PT    *      RELAY WORD
4    50N    Z3CG   Z3BG   Z3AG   RC     RI     52A3   52B3   INTERNAL ELEMENTS
5             EXT    52AC   52AB   52AA   PT     IN1    CONTACT INPUTS
6             TRIP   CLOSE  A1     TRIPA  TRIPB  TRIPC  ALRM   CONTACT OUTPUTS
```

The front panel targets can be reset and cleared remotely or locally using the target command. Type **TARGET R <ENTER>** to reset and clear the targets.



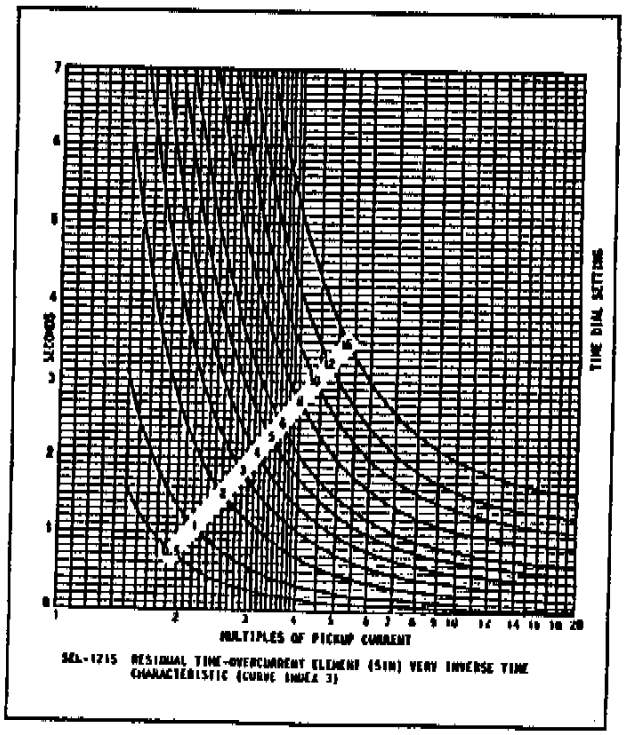
SEL-121S RESIDUAL TIME-OVERCURRENT ELEMENT (51N) MODERATELY INVERSE TIME CHARACTERISTIC (CURVE INDEX 1)

DWG. NO. A7-0576
DATE: 08-06-89



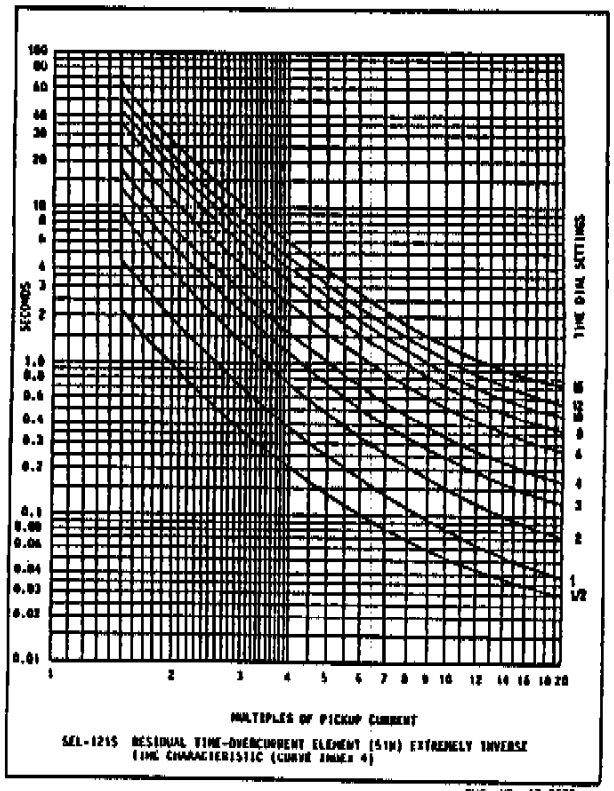
SEL-121S RESIDUAL TIME-OVERCURRENT ELEMENT (51N) INVERSE TIME CHARACTERISTIC (CURVE INDEX 2)

DWG. NO. A7-0577
DATE: 08-06-89



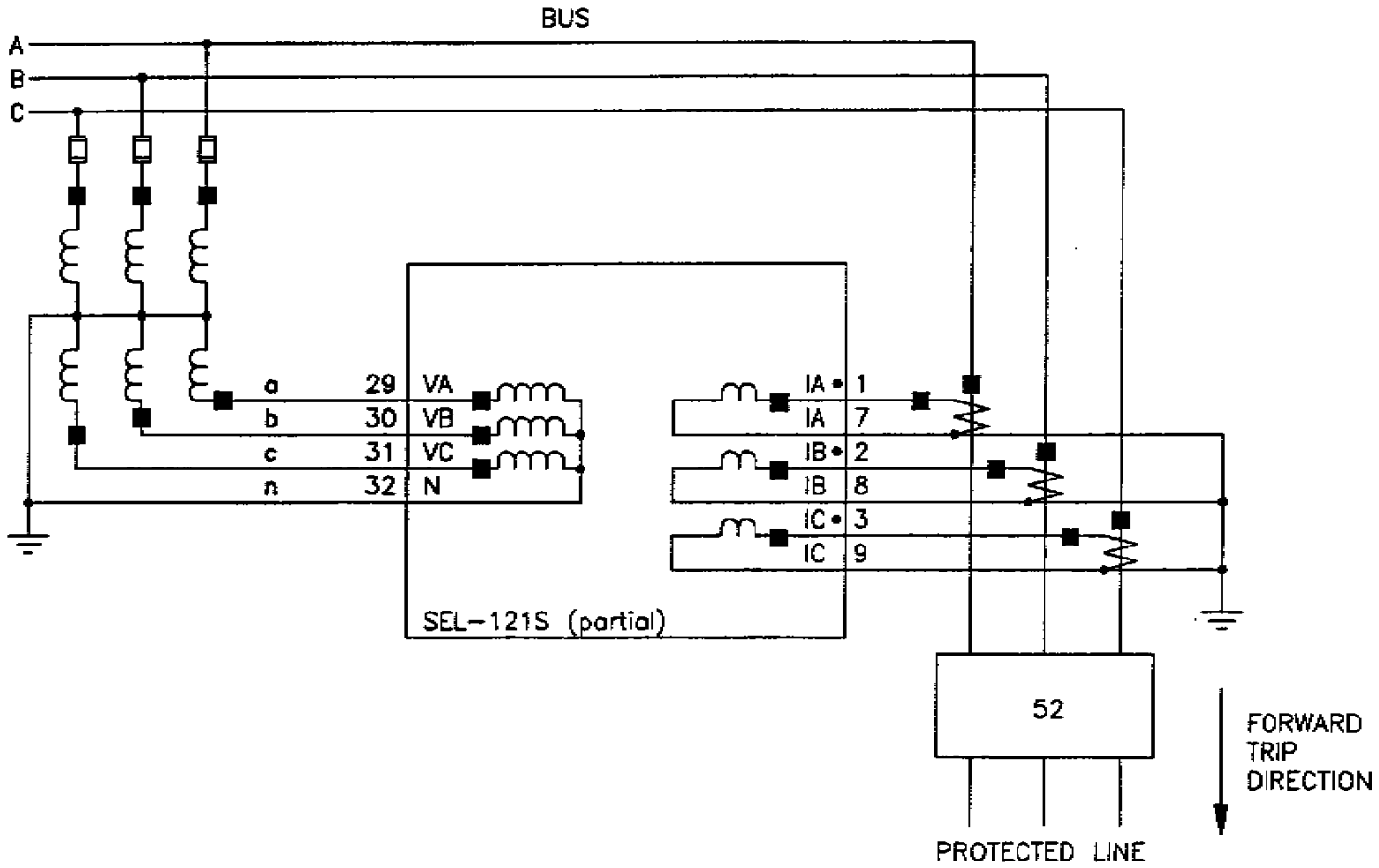
SEL-121S RESIDUAL TIME-OVERCURRENT ELEMENT (51N) VERY INVERSE TIME CHARACTERISTIC (CURVE INDEX 3)

DWG. NO. A7-0578
DATE: 08-06-89



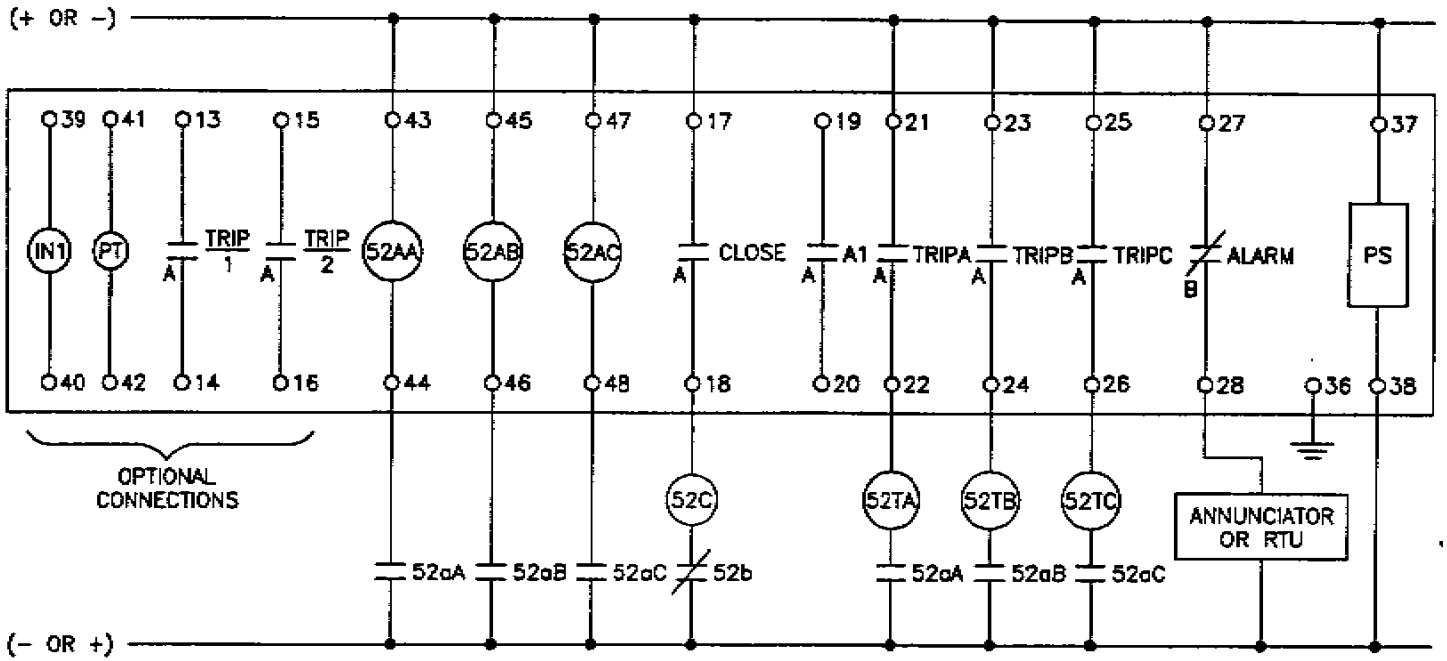
SEL-121S RESIDUAL TIME-OVERCURRENT ELEMENT (51N) EXTREMELY INVERSE TIME CHARACTERISTIC (CURVE INDEX 4)

DWG. NO. A7-0579
DATE: 08-06-89



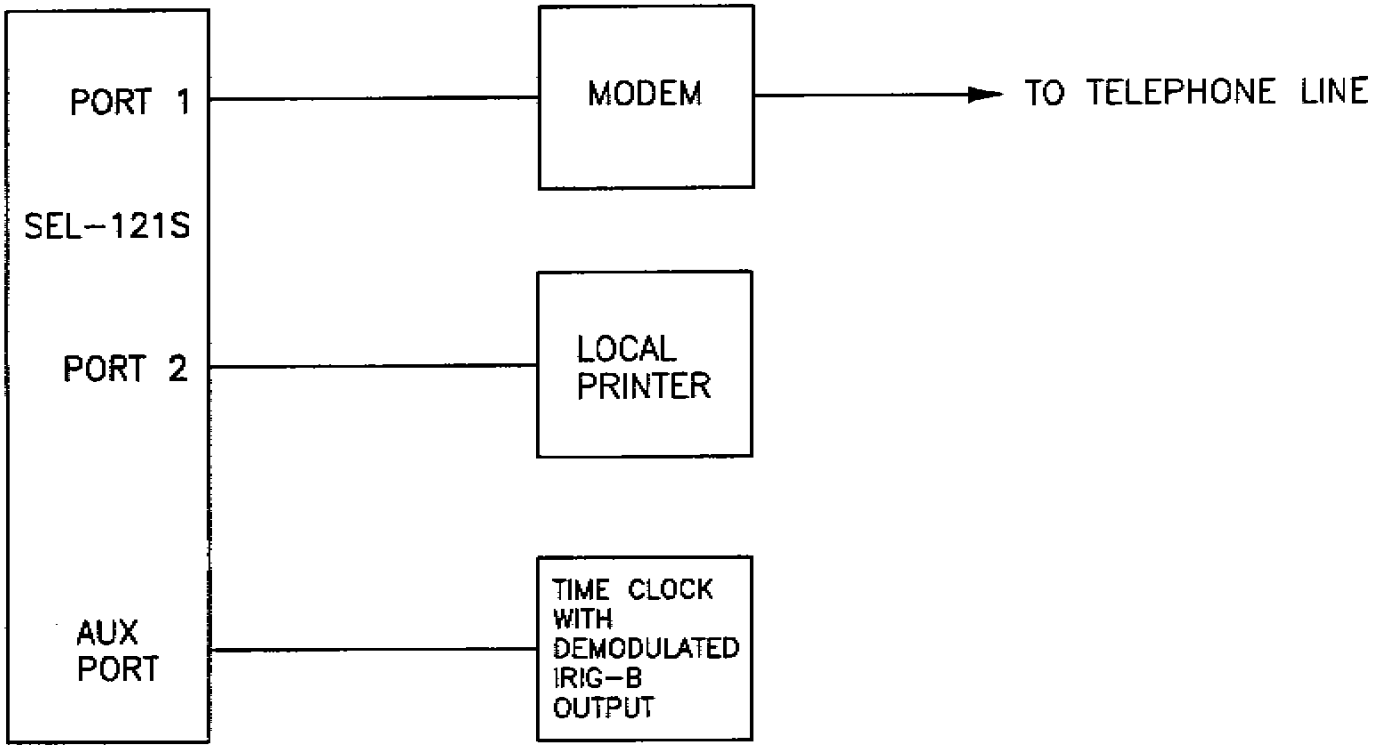
SEL-121S EXTERNAL CURRENT AND VOLTAGE CONNECTIONS

DWG. NO. A7-0531
DATE: 05-22-89



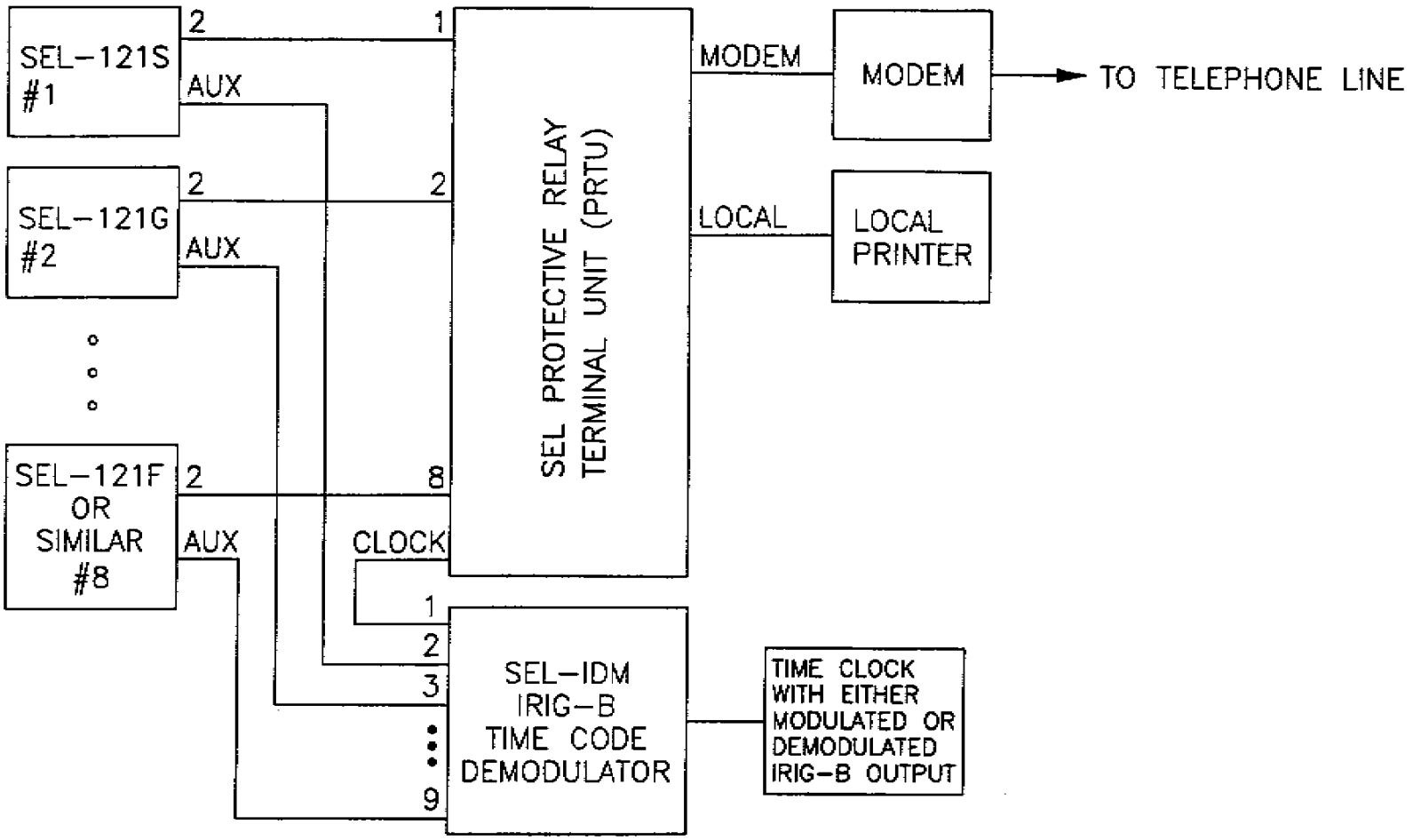
SEL−121S DC EXTERNAL CONNECTION DIAGRAM (TYPICAL SINGLE POLE TRIPPING APPLICATION)

DWG. NO. A7−0525
DATE: 08−04−88



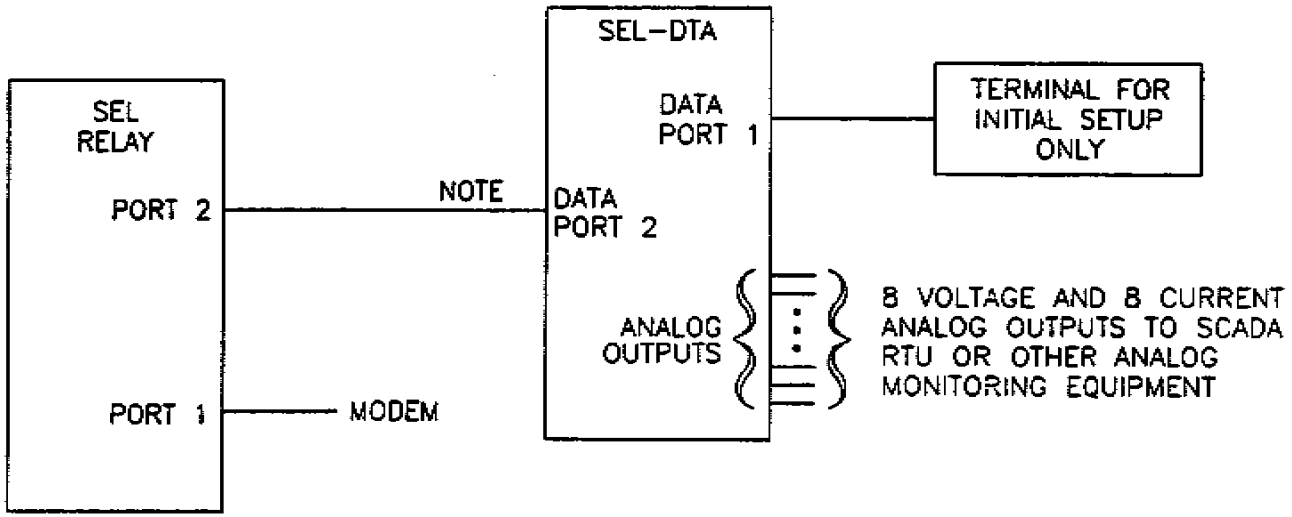
SEL–121S COMMUNICATIONS AND CLOCK CONNECTIONS
ONE UNIT AT ONE LOCATION

DWG. NO. A7–0529
DATE: 05–22–89



SEL–121S COMMUNICATIONS AND CLOCK CONNECTIONS MULTIPLE UNITS AT ONE LOCATION

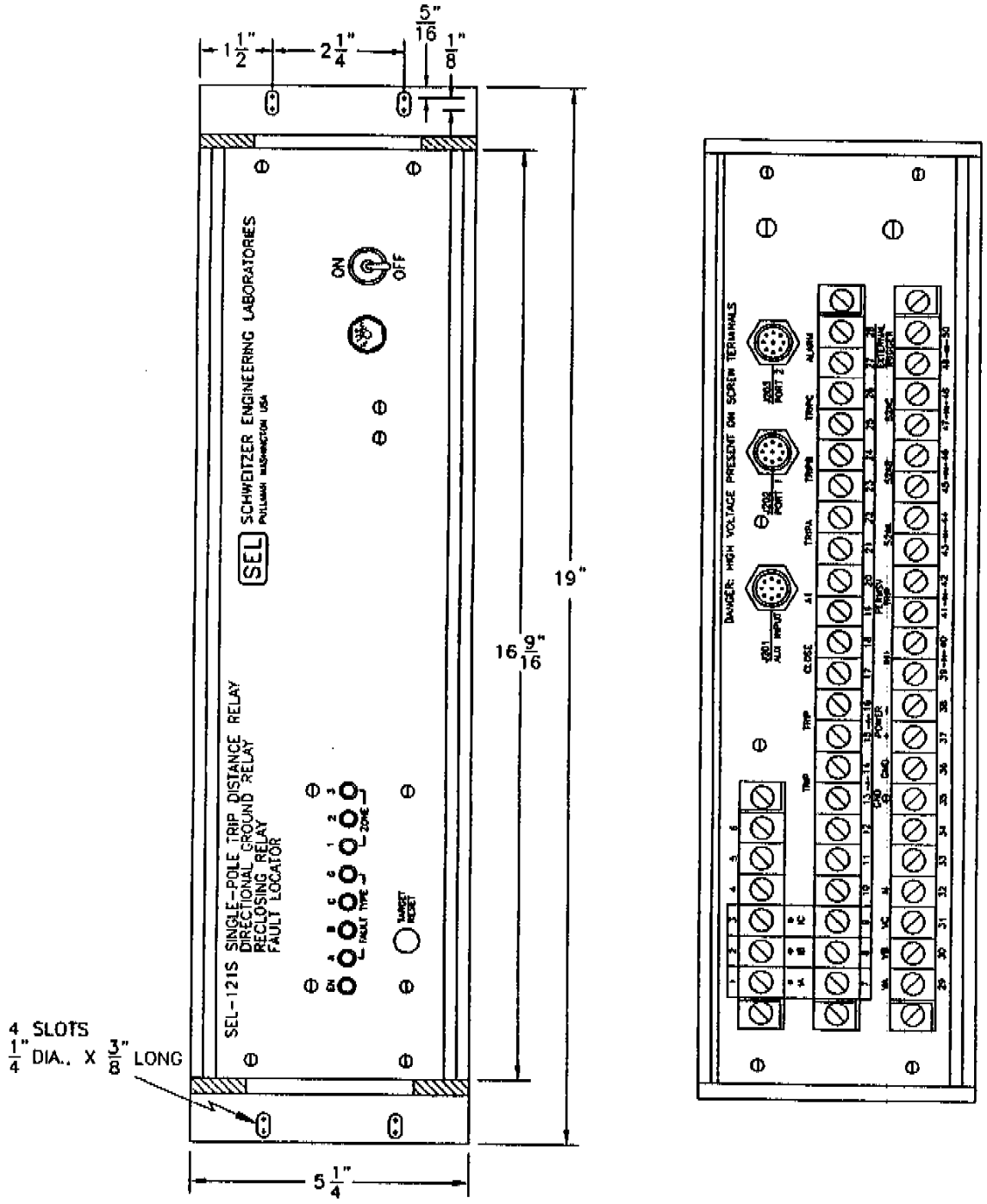
DWG. NO. A7–0530
DATE: 05–22–89
DATE: 08–07–89



NOTE: SEL-DTA DISPLAY/TRANSDUCER ADAPTER (DTA)
DATA AND CONTROL POWER

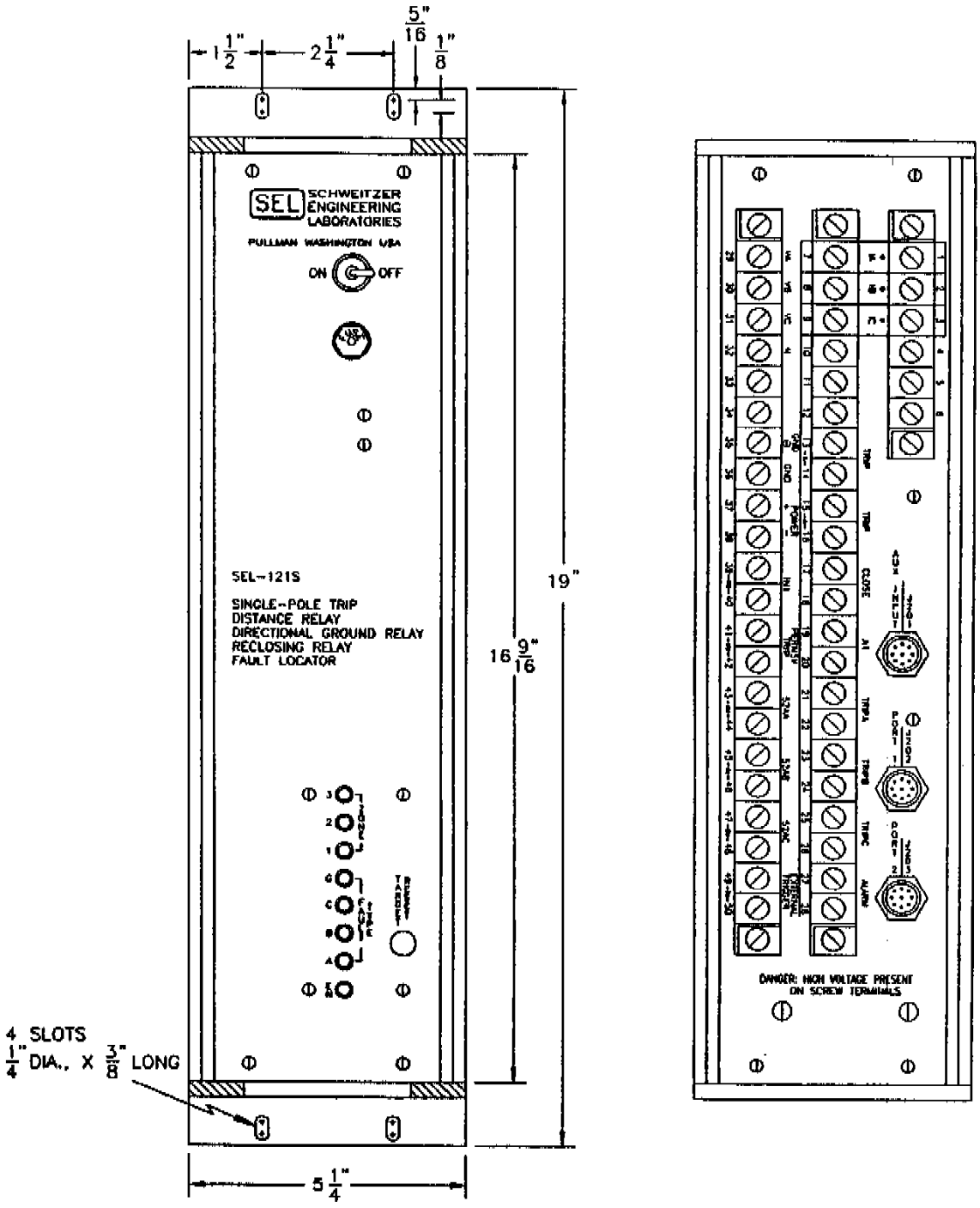
SEL RELAY COMMUNICATIONS DIAGRAM FOR CONNECTION TO THE SEL-DTA

DWG. NO. A7-0413
DATE: 10-07-88



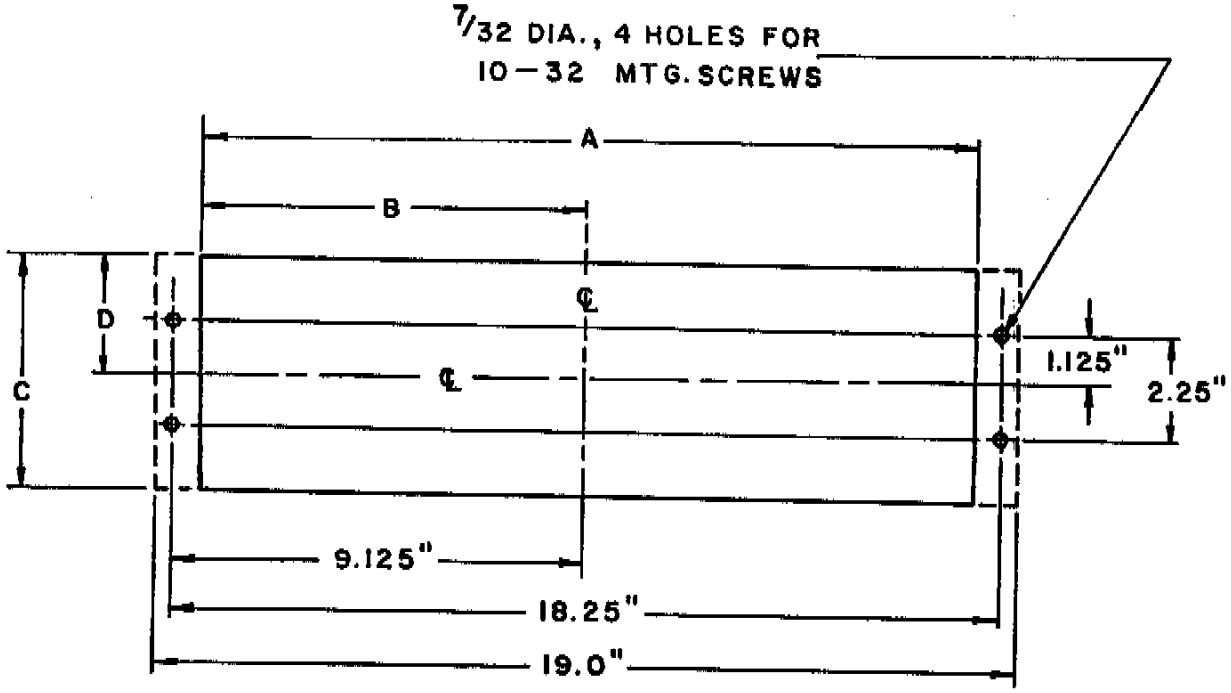
SEL-121S RELAY HORIZONTAL FRONT AND REAR PANEL DRAWINGS

DWG. NO. A7-0527
DATE: 05-22-89
REV: 02-21-90



SEL-121S RELAY VERTICAL FRONT AND REAR PANEL DRAWINGS

DWG. NO. A7-0528
DATE: 05-22-89
REV. 08-07-89



DIMENSION A:
CASE: 17.00"
CUT OUT: 17.25" - 17.875"
17.375" PREFERRED

DIMENSION B:
CASE: 8.5"
CUT OUT: 8.625" - 8.9375"
8.688" PREFERRED

DIMENSION C:
CASE: 5.25"
CUT OUT: 5.35" - 5.45"

DIMENSION D:
CASE: 2.625"
CUT OUT: 2.675" - 2.725"

NOTE: ALL INSTRUMENTS MAY BE MOUNTED HORIZONTALLY (AS SHOWN) OR VERTICALLY.

PANEL CUTOUT AND DRILL PLAN FOR SEMI-FLUSH MOUNTING OF 5.25 INCH HIGH CASE

DWG. NO. A7-0174
DATE 5/11/87 JS
REV. 3/9/88

SEL-121S SINGLE POLE TRIP RELAY/FAULT LOCATOR COMMAND SUMMARY

Level 0

ACCESS Answer password prompt (if password protection enabled) to gain access to Level 1. Three unsuccessful attempts pulses ALARM relay.

Level 1

2ACCESS Answer password prompt (if password protection enabled) to gain access to Level 2. This command always pulses the ALARM relay.

DATE Show or set date. DAT 2/3/89 sets date to Feb. 3, 1989. The month and date settings are overridden when IRIG-B synchronization occurs. Pulses the ALARM relay momentarily when a different year is entered than previously stored year.

EVENT Show event record. EVE 1 shows long form of most recent event.

HISTORY Show DATE, TIME, EVENT TYPE, FAULT LOCATION, DURATION, and CURRENT for the 12 most recent faults.

IRIG Force immediate execution of time-code synchronization task.

METER Show primary current, voltage, real and reactive power. METER runs once. "METER N" runs N times.

QUIT Return to Access Level 0 and reset targets to target 0.

SHOWSET Show the relay and logic settings. This command does not affect the settings. The logic settings are shown in hexadecimal format for each mask.

STATUS Show self test status.

TARGETS Show data and set target lights as follows:

TAR 0: Relay Targets	TAR 1: RELAY WORD ROW #1
TAR 2: RELAY WORD ROW #2	TAR 3: RELAY WORD ROW #3
TAR 4: RELAY WORD ROW #4	TAR 5: Contact Inputs
TAR 6: Contact Outputs	TAR R: Clears targets and returns to TAR 0

Be sure to return to TAR 0 when done, so LEDs display fault targets.

TIME Show or set time. TIM 13/32/00 sets clock to 1:32:00 PM. This setting is overridden when IRIG-B synchronization occurs.

TRIGGER Trigger and save an event record. (Type of event is EXT).

Level 2

CLOSE Close circuit breaker, if allowed by jumper setting.

LOGIC Show or set logic masks MTU, MPT, MTO, MAI, MRI, MRC. ALARM relay closes while new settings are being computed, and event data buffers are cleared.

OPEN Open circuit breaker, if allowed by jumper setting.

PASSWORD Show or set passwords. Pulses the ALARM relay momentarily when new passwords are set.
PAS 1 OTTER sets Level 1 password to OTTER.
PAS 2 TAIL sets Level 2 password to TAIL.

SET Initiate setting procedure. ALARM relay closes while new settings are being computed, and event data buffers are cleared.

Use the following to separate commands and their parameters: space, comma, semicolon, colon, slash.

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SEL/3-90