SEL-DTA-1

Display/Transducer Adapter

Instruction Manual

20080530

SCHWEITZER ENGINEERING LABORATORIES, INC.

PMDTA-01

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Section 1
Introduction

Overview

The SEL-DTA Display/Transducer Adapter offers a simple and economical on-line interface to the SEL family of digital relays.

The features of the SEL-DTA include:

- Two-line, 40-column, high-contrast liquid crystal display supplies relay information
- Displays new faults as they occur as a visual alert
- Maintains history of 30 short relay events
- Furnishes visual alert of relay status warnings and failures
- Displays relay status on demand
- Isolated RESET input resets fault location transducers and contact outputs
- Output relay contact for alarm
- Output relay contact acknowledges RESET input
- Five output relay contacts identify fault type
- Eight programmable analog transducer channels proportional to transmission line voltages, currents, power, or fault distance
- Automatic self-testing ensures continuous reliable operation
- EIA-232 communications
- Draws dc power from an SEL-type relay
- Compact 1.75" cabinet allows simple installation in standard 19" relay rack

General Information

The SEL-DTA serves as an extension of the SEL family of digital relays. New faults are automatically captured, stored in a 30-event fault history, and displayed, effectively eliminating the need for a separate automatic message output device. The SEL-DTA also provides access to metering and relay status information. A set of eight voltage outputs and eight current outputs present fault and meter data to monitor and control equipment.

NOTE: PORT 1 of the SEL-DTA is not intended for communication with the target relay.

The SEL-DTA provides three communications ports. **PORT 1** of the SEL-DTA may be used for changing the analog output scaling and other SEL-DTA settings, while **PORT 2** of the SEL-DTA links to the relay for communications and dc power. **PORT 2A** of the SEL-DTA is similar to **PORT 2** when **PORT 2** is only used to power the SEL-DTA. Such a configuration is desirable when the SEL-DTA is mounted further than 7 feet from the target relay and thus requires use of the SEL-PSM Power Supply Module.

Specifications

Display Functions

Three primary sets of display data:	Faults (including fault location, metering, and target relay self-test status

Line-by-line scrolling of fault and status data

Automatic continuous updating of meter data

Standard Meter:	updates approximately every five seconds
Fast Meter:	updates approximately every one-half second

30-event fault history

Self-Testing

Stall timer monitors processor

Setting checks

RAM, ROM, and Display tests

Power Supply (Drawn from relay or SEL-PSM Power Supply Module)

+5 V:	1075 mA maximum 500 mA nominal
+12 V:	405 mA maximum 150 mA nominal
–12 V:	160 mA maximum 120 mA nominal

Routine Dielectric Strength

Contact inputs and relay outputs: 3000 Vdc for 10 seconds

Interference Tests

Contact inputs and relay outputs:	IEEE C37-90 SWC test (type tested) IEC 255-6 interference test (type tested)

Impulse

IEC 255-50.5 joule 5000 volt test (type tested)

RFI Tests

Type-tested in field from a 1/4-wave antenna driven by 20 watts at 150 MHz and 450 MHz, randomly keyed on and off at a distance of one meter from unit.

Dimensions

1.75" x 19" x 13". Mounts in standard 19" relay rack.

Weight

Unit weight:	5.6 lbs.
Shipping weight:	11 lbs., including two manuals

Operating Temperature

–20° to +55°C

Burn-In Temperature

60°C for 48 hours

Transducer Channels

Current and voltage channels are simultaneously available for each of the eight channels. Channels assigned to metering functions automatically update regardless of display mode.

Current Outputs

Option 1:	–1 to +1 mA range
Option 5:	–5 to +5 mA range

9.3 V load compliance

±0.2% accuracy at full scale

>2.25 megohms output impedance

Voltage Outputs

–5 to +5 V range

±0.2% accuracy at full scale

10 mA maximum load current

Control Input Voltage

48 V:	20–60 Vdc
125 V:	60–200 Vdc
250 V:	200–280 Vdc

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Section 2
Initial Checkout

Introduction

The initial checkout of the SEL-DTA should familiarize you with the instrument and ensure that all functions are operational.

Equipment Required

The following equipment is necessary for initial checkout of the SEL-DTA:

- Computer terminal with EIA-232 serial communications interface
- Cable configured for interconnection of SEL-DTA and terminal
- Cable configured for interconnection of SEL-DTA and SEL relay
- Meter capable of measuring currents in the range –5 to +5 mA, and voltages in the range –5 to +5 V
- An SEL digital relay
- Source of three-phase voltages and at least two currents

Checkout Procedure

The checkout procedure uses several SEL-DTA commands. *Section 4: Commands and Serial Communications* provides a full explanation of all commands. However, the following information should allow you to complete the checkout without referring to the detailed descriptions. These descriptions assume familiarity with the target SEL relay; the reader is referred to relay documentation for information regarding relay operations and configurations.

In this manual, commands to type appear in bold/uppercase: **OTTER**. Keys to press appear in bold/brackets: **<Enter>**.

SEL-DTA output appears in the following format:

```
DATE:  01/01/90    Time:  01:01:32
OFFSET  IP = 0 mV
```

Step 1. Inspect the instrument for physical damage such as dents or rattles.

Step 2. Connect a computer terminal to **PORT 1** on the rear panel of the SEL-DTA. Be sure your terminal configuration is compatible. *Section 3: Functional Description* and *Section 4: Commands and Serial Communications* provide additional information on port configurations. *Section 5: Installation* includes information on baud rate selection.

Step 3. With the SEL-DTA disconnected from the relay, turn on the target relay and set the relay Level 1 and Level 2 passwords to OTTER and TAIL, respectively.

Step 4. Turn the target relay off. Connect the target relay autoport to **PORT 2** on the rear panel of the SEL-DTA. Make sure the relay autoport baud rate setting is 2400.

Step 5. Turn on the relay power. The relay enables in its usual manner, and the terminal displays the following message:

```
SEL-DTA Display/Transducer Adapter                Date: 1/1/91    Time: 01:01:01

SEL-DTA
=
```

The SEL-DTA display shows:

```
PLEASE WAIT: ACCESSING RELAY
```

When the SEL-DTA gains access to the relay, it replaces the previous message with the following:

```
SEL-DTA
RELAY ID STRING
```

Failure to access the relay within a couple of minutes indicates a failure in the communications channel between the relay and the SEL-DTA. *Troubleshooting on page 6.3* addresses this and other operational failures; consult this subsection if the relay/SEL-DTA system did not power up properly.

The = prompt preceding the cursor on the terminal indicates that communications with the SEL-DTA are at Level 0, the lowest of the three access levels. The only command accepted at this level is **ACCESS**, which opens communications to Access Level 1.

Step 6. Enter the command **ACCESS <Enter>**. At the password prompt, enter the factory-set password **OTTER <Enter>**. The => prompt appears, indicating that you have established communications at Access Level 1.

Step 7. Press the **{CLEAR}** switch on the front panel. The display turns black while the switch is asserted and shows the following message when the switch is released.

```
SEL-DTA
RELAY ID STRING
```

Step 8. Press the **{STATUS}** switch on the front panel. The display shows:

```
PLEASE WAIT
```

for up to 60 seconds while it retrieves status information from the relay. The first two lines of acquired status data appear on the display:

```
DATE:  01/01/90    Time:  01:01:32
OFFSET  IP = 0 mV
```

Use the **{SCROLL}** switches to view all lines of status data. Holding a **{SCROLL}** switch in automatically repeats the control.

If the SEL-DTA is unable to retrieve the information before the 60-second timeout, the following message appears on the display (date timeout):

```
PLEASE WAIT: ACCESSING RELAY
```

This indicates a communications failure between the relay and the SEL-DTA. Refer to *Troubleshooting on page 6.3* for suggested actions.

Step 9. Assert the **{METER}** switch on the front panel. The display shows:

```
PLEASE WAIT
```

for up to 60 seconds while the SEL-DTA retrieves meter data from the relay.

Since the test source has not yet been connected to the relay, displayed data resembles the following:

```
MET IA=1       B=2       C=0
     P=0.00    Q=0.00
```

The timeout response is identical to that of the **{STATUS}** switch; refer to *Troubleshooting on page 6.3* if a data timeout occurs.

Step 10. Assert the **{FAULTS}** switch. Since no faults have yet been reported to the SEL-DTA by the relay, the instrument displays the following message:

```
       FAULT HISTORY EMPTY
 P=0.00       Q=0.00
```

When the switch is released, the display reverts to its original status.

Step 11. The SEL-DTA is shipped with demonstration settings; inspect these with the **SHOWSET** command. Type **SHOWSET <Enter>** to display the settings.

```
=>SHOWSET <Enter>
ID   =SEL-DTA Display/Transducer Adapter
TIME1=0
LOCK =300.0     RESET=120
MINW = 10.0     MAXW =100.0
QUA1 =VAB       MIN1 =-250      MAX1 =500.0
QUA2 =IA        MIN2 =0.0       MAX2 =1200.0
QUA3 =IB        MIN3 =0.0       MAX3 =1200.0
QUA4 =IC        MIN4 =0.0       MAX4 =1200.0
QUA5 =P         MIN5 =0.0       MAX5 = 200.0
QUA6 =P         MIN6 =0.0       MAX6 =200.0
QUA7 =Q         MIN7 = 200.0    MAX7 =200.0
QUA8 =FL        MIN8 =0.0       MAX8 =100.0
```

The **SHOWSET** command description includes a detailed explanation of SEL-DTA settings. Briefly, the first line shows the SEL-DTA identification string; the second shows the timeout for PORT 1. The third line shows the contact and analog output fault lockout period and automatic reset timeout, while the fourth indicates the fault window settings. The remaining lines contain measured quantity and scaling information for the eight analog output channels.

Step 12. Turn the relay power off and connect a source of three-phase voltage and currents to the relay inputs. Set up a typical set of test currents and voltages at the test source outputs.

Step 13. Turn the relay power back on.

Step 14. Assert the **{METER}** switch and verify correspondence of displayed data and test quantities. Using an ammeter and voltmeter, make sure the currents and voltages delivered to the analog outputs agree with displayed data. Refer to the analog interface subsection of *Section 3: Functional Description* for pin configuration information and output quantity equations.

Step 15. Set up test quantities corresponding to a forward fault. Shortly after the relay elements respond to the fault condition, the display shows a message in the following format:

```
          NEW FAULT
01 01/02/90 22:33:51.812 1BG 74.54
```

The contents of the second line vary according to test quantities. Faults outside the set fault window are not displayed or maintained in the fault history.

This checkout procedure demonstrates only a few of the SEL-DTA features. Study *Section 3: Functional Description* and *Section 4: Commands and Serial Communications* for a complete understanding of this instrument's capabilities.

Section 3
Functional Description

Introduction

This section describes all SEL-DTA inputs, outputs, display modes, and controls.

Inputs and Outputs

All connections to the SEL-DTA are made on the rear panel. *Appendix B: Mechanical Drawings* includes a rear-panel drawing.

Serial Interfaces

Connectors labeled **PORT 1** and **PORT 2** provide EIA-232 serial communications interfaces. **PORT 1** can be connected to a terminal for changing the SEL-DTA configuration settings, with **PORT 2** connected to the target relay. **PORT 2A** is connected to **PORT 2**, but does not contain the power supply circuitry **PORT 2** provides. The main use of this port is for alternate power supply configurations using the SEL-PSM Power Supply Module.

Display Modes

The front panel switches control display modes and scrolling. The **{SCROLL}** switches repeat if held in the asserted state.

Faults

There are two ways to enter the FAULTS mode.

- Press the front-panel **{FAULTS}** switch
- New faults reported by the relay preempt all other display modes and place the instrument in the FAULTS mode

Pressing the front-panel **{FAULTS}** switch displays the last two validated faults as reported to the SEL-DTA by the relay. Press the **{SCROLL}** switches to view the last 30 validated faults. If no faults have been captured since power up, the instrument displays `FAULT HISTORY EMPTY`.

Display contents are determined by the display window position within the 30-event fault history. *Figure 3.1* illustrates an example fault history, with the window positioned to display the last two faults (as if a user entered the mode recently).

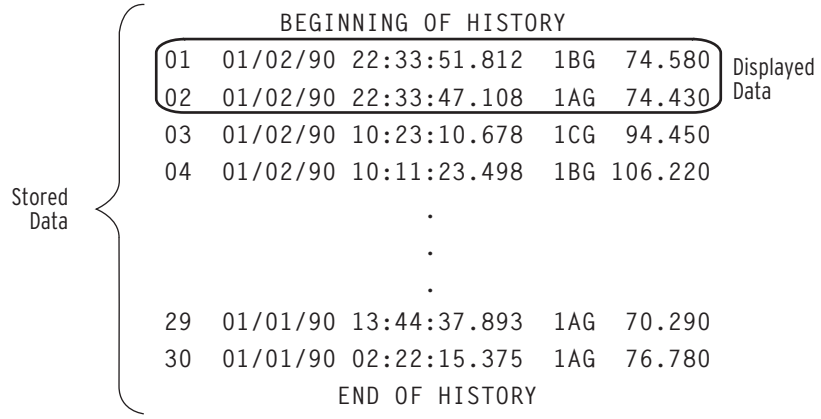

Figure 3.1 FAULTS Mode Initial Window Positioning

Pressing the **{SCROLL DOWN}** switch once changes the display window position as shown in *Figure 3.2*. Any two faults in the 30-event fault history can be viewed using the **{SCROLL UP}** and **{SCROLL DOWN}** switches in this manner.

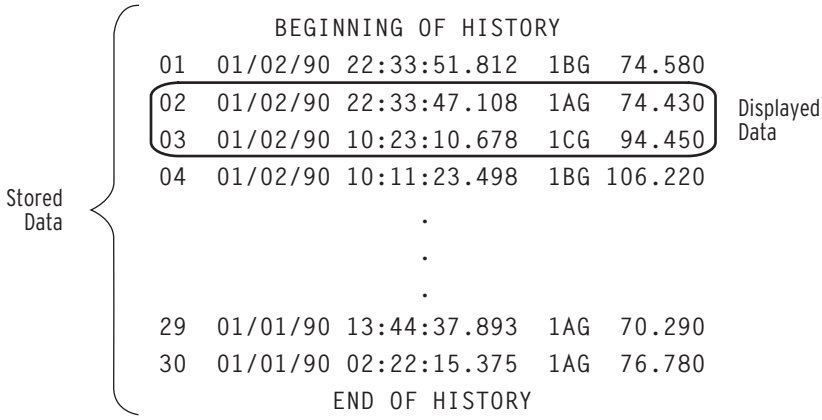

Figure 3.2 FAULTS Mode Display Window After Scroll Down

Faults are numbered sequentially from newest to oldest; the latest fault is assigned the number 1, previous faults are discarded as history length exceeds 30 lines. The assigned number appears in display columns 1–2. Columns 5–12 and 14–25 contain the date and time of the fault, respectively; columns 29–31 show fault type; columns 35–40 indicate fault location.

When the relay sends a fault report to the SEL-DTA, the report is checked against a settable fault location window (see *SET on page 4.7*). If the fault lies within this window, the current display mode is preempted and the SEL-DTA automatically enters the FAULTS mode. The SEL-DTA indicates the receipt of the new fault by adding the line `NEW FAULT` to the top of the fault list in blinking characters, as shown in *Figure 3.3*.

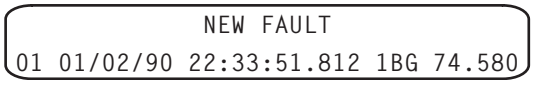

Figure 3.3 New Fault Display

If any transducer outputs are programmed to present the fault location, these channels are updated by the rules outlined in *SET on page 4.7*. The contact outputs reflect fault information as presented in *Contact Outputs on page 3.7*.

Pressing any active front-panel control acknowledges the fault and activates the FAULTS mode functions as previously described. If both new fault(s) and relay status warnings exist and are not acknowledged, the first line is modified as shown in *Figure 3.4*.

```
  New Fault  Relay Status Warning
01 01/02/90 22:33:51.812 1BG 74.580
```

Figure 3.4 New Fault/Relay Status Warning Display

The SEL-DTA remains in the FAULTS mode until another display mode is selected. Also, if all new faults have been acknowledged, the FAULTS mode can be preempted by the status mode via detection of a relay status warning.

METER Commands: Accessing Metering Data or Reset Demand Registers

METER displays meter information, demand and peak-demand information when available, reset demands, or resets peak demand of the selected relay on command (where applicable).

Press **{METER}** to select **METER** commands:

```
METER  (METER to accept, scroll to
       change, other keys to exit)
```

Use the scroll keys to select one of the following:

- METER (instantaneous)
- METER D (demand)
- METER RD (reset demand)
- METER RP (reset peak)

Press **{METER}** again to send the command. Reset functions prompt you for a confirmation. Press scroll up for `YES` to confirm, scroll down for `NO` to reject.

Press **{METER}** again to send the command. Reset functions prompt you for a confirmation. Press scroll up for `YES` to confirm, scroll down for `NO` to reject.

Only the SEL-267/167 and SEL-251/151 families of relays respond to the **METER D**, **METER RD**, and **METER RP** meter functions.

The meter display contains up to eight lines of data, the first two are displayed when the METER mode is activated. View the remaining lines of the meter display by using the **{SCROLL DOWN}** and **{SCROLL UP}** switches. As shown in *Figure 3.5*, this mode uses the following display format:

- **Line 1:** Display line one contains phase current data in rms amps. When Fast Metering is available and enabled, or the SEL-DTA is connected to an SEL-121F Relay, residual current in rms amps is displayed following the phase currents.
- **Line 2:** Display line two contains the real power in MW and reactive power in MVAR. When Fast Metering is available and enabled, three times the negative-sequence current (3I2) in rms amps is displayed preceding the power quantities.
- **Line 3:** Display line three contains phase-to-neutral voltage data in rms kV. When Fast Metering is available and enabled, three times the zero-sequence voltage (3V0) in rms kV is displayed following the phase-to-neutral voltages. If the

SEL-DTA is connected to a SEL-121F Relay, the synchronizing voltage (VS) in rms KV is displayed following the phase-to-neutral voltages.

➤ **Line 4:** Display line four contains phase-to-phase voltage data in rms kV. If Fast Metering is available and enabled, three times the negative-sequence voltage (3V2) in rms kV is displayed following the phase-to-phase voltages.

Additional lines containing demand and peak-demand meter values are available when the SEL-DTA is connected to a relay from the SEL-267/167 or SEL-251/151 families.

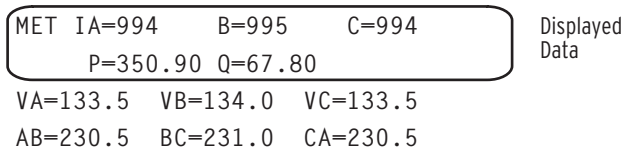

Figure 3.5 Example Meter Display

Analog outputs are shown in *Figure 3.6* (Vout and Iout scaling equations are described in *SET on page 4.7*), where X is any phase, phase-to-phase, or phase-to-neutral quantity; real or reactive power; or fault location. The dedication of transducer channels to meter quantities and the scaled range are user settable parameters.

Example: Given that QUA1 = P, MIN1 = –10000, MAX1 = 20000, and X = 1362

Option 1: VOUT = –1.213 V, IOUT = –0.2425 mA

Option 5: VOUT = –1.213 V, IOUT = –1.2127 mA

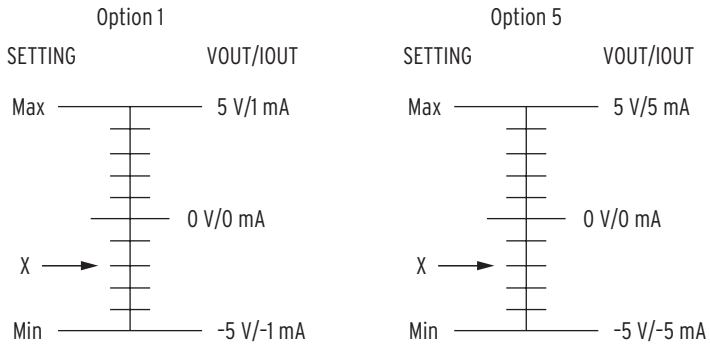

Figure 3.6 Minimum and Maximum Settings Scale Analog Inputs

The SEL-DTA remains in the METER operating mode until a new fault is reported, the mode is manually exited by assertion of the **{CLEAR}** control, or another display mode is activated by assertion of the corresponding control. Additionally, the METER mode can be preempted by the STATUS mode via detection of a relay status warning.

Pressing **{METER}** once toggles display updating, showing the present meter values until the button is pressed again. Pressing **{METER}** an even number of times freezes the meter display. A frozen meter display is identified by a : following the meter quantity label as shown *Figure 3.7*. Press **{METER}** again to release the display. The analog output channels are continuously updated regardless of display mode.

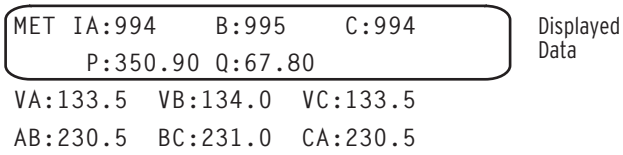

Figure 3.7 Example Frozen Meter Display

Standard Meter

The instrument updates the display with new data approximately every five seconds.

Fast Meter

NOTE: Contact the factory to verify Fast Meter capability in an SEL relay.

The following SEL-DTA firmware revisions have Fast Meter capability:

Firmware Revision code 300 and greater (Rev. 5 Main Board)

Firmware Revision code 201 and greater (Rev. 3 and 4 Main Board)

Firmware Revision code 110 and greater (Rev. 1 and 2 Main Board)

The SEL-DTA is capable of updating and displaying meter quantities every one-half second. The instrument automatically attempts the Fast Meter function when initially connected to an SEL relay. If Port 2 of the SEL relay has not been upgraded to respond to the Fast Meter command, the SEL-DTA defaults to the standard meter function. The enhanced Fast Meter capability allows for fast confirmation of voltage and current quantities during substation switching operations.

The Fast Meter capability is possible because the SEL-DTA performs meter calculations instead of the relay. The SEL-DTA performs these meter calculations using a three-sample average and updates selected outputs every one-half second. Because of the three-sample average, a transition from zero to full scale requires three Fast Meter updates, or 1.5 seconds.

If the SEL-DTA has defaulted to the standard meter function, it automatically attempts the Fast Meter function every 10 minutes.

The Fast Meter function can be user initiated. An SEL-DTA **SET** command followed by a `YES` response, with or without a settings change, triggers a Fast Meter command attempt.

You can visually confirm the SEL-DTA Fast Meter function by observing the meter display updating time.

Status

There are two ways to enter the STATUS mode.

- Press the front-panel **{STATUS}** control
- A relay status warning forces the SEL-DTA into STATUS mode

When the **{STATUS}** control is pressed, the SEL-DTA checks the status of the relay and displays the received status message (see *Figure 3.8*). The **{SCROLL}** controls can be used to view any two lines of the message.

```
DATE:  01/04/90    Time:  08:50:30
OFFSET  IP = 0 mV
```

Figure 3.8 Relay Status Message

Upon automatic receipt of a relay status warning, the SEL-DTA enters the STATUS mode. The display shows `RELAY STATUS WARNING` in blinking characters above the message (see *Figure 3.9*). Pressing any operative front-panel control acknowledges the condition, after which the STATUS mode functions as previously defined.

```
        Relay Status Warning
DATE: 01/04/90      TIME: 08:50:30
```

Figure 3.9 Relay Status Warning Message

The SEL-DTA automatically exits the STATUS mode when it receives a fault report; press **{CLEAR}**, **{METER}**, or **{FAULTS}** to exit manually.

Standby

Press the front-panel **{CLEAR}** switch to enter the STANDBY mode; the following display message indicates STANDBY:

```
SEL-DTA
RELAY ID STRING
```

The SEL-DTA remains in this mode until one of the following occurs:

- An active display mode is selected by pressing an operative front-panel switch
- The SEL-DTA receives a relay status message
- The relay reports a fault to the SEL-DTA

In this mode, only the **{FAULTS}**, **{METER}**, **{STATUS}**, and **{CLEAR}** switches are operative.

The **{CLEAR}** switch function depends on the current SEL-DTA mode. In any mode other than STANDBY, pressing **{CLEAR}** changes the mode to STANDBY. If the SEL-DTA is already in STANDBY mode, the following operations occur:

1. The display module is tested for proper operation; if this test fails, an automatic SEL-DTA status message is sent to SEL-DTA serial PORT 1.
2. With CLEAR asserted, all elements of the display are actuated, allowing visual verification of proper display operation.
3. Upon release, the display clears and the SEL-DTA returns to STANDBY mode.

Rear-Panel Connections and Configurations

Communications Ports

The SEL-DTA provides three communications ports. **PORT 1** can be used for changing the analog output scaling and other SEL-DTA settings, **PORT 2** links to the relay for communications and dc power. **PORT 2A** connects to the serial communications circuitry provided for **PORT 2**, but is not tied to the power supplies. *Section 5: Installation* discusses connection alternatives between the SEL-DTA, relay, and optional terminal.

Transducer Outputs

The SEL-DTA is equipped with eight programmable transducer channels. Each of these is available from the rear panel in voltage (–5 to +5 V) and current (–1 to +1 mA or –5 to +5 mA) form. The instrument also provides a separate return to ground for each channel. These signals are presented at the rear panel through a female 25-pin "D" connector.

For systems requiring screw terminal connections, an optional adapter board is available, which breaks a female 25-pin "D" connector out into screw terminals.

Signals assignments are shown in *Table 3.1*.

Table 3.1 Signals Assignments

Signal Description	Pin Number
Voltage output 1	13
Ground 1	25
Current output 1	12
Voltage output 2	11
Ground 2	24
Current output 2	10
Voltage output 3	9
Ground 3	23
Current output 3	8
Voltage output 4	7
Ground 4	22
Current output 4	6
Voltage output 5	5
Ground 5	21
Current output 5	4
Voltage output 6	3
Ground 6	20
Current output 6	2
Voltage output 7	1
Ground 7	19
Current output 7	14
Voltage output 8	15
Ground 8	18
Current output 8	16

Each output channel is independently programmable with output quantity (Vab, Ia, Fault Location, etc.) and range.

Contact Outputs

The rear panel has six relay contact outputs (A1–A6). These outputs indicate fault conditions and acknowledge reset commands. An additional relay contact indicates self-test failure or other alarm conditions. All contact outputs are dedicated and not programmable.

Contact assignments and signal descriptions are shown in *Table 3.2*:

Table 3.2 Contact Assignments and Descriptions (Sheet 1 of 2)

Relay Contact	Terminal Block Positions	Standard Contact Arrangement[a]	Signal	Description
A1	5,6	a	A	The current fault involves Phase A
A2	7,8	a	B	The current fault involves Phase B
A3	9,10	a	C	The current fault involves Phase C
A4	11,12	a	G	The current fault involves ground

Table 3.2 Contact Assignments and Descriptions (Sheet 2 of 2)

Relay Contact	Terminal Block Positions	Standard Contact Arrangement[a]	Signal	Description
A5	13,14	a	FAULT	A fault has occurred
A6	15,16	a	RST ACK	All fault-related analog and contact outputs are reset
ALARM	17,18	b	ALARM	An alarm condition exists

[a] Shown in the de-energized state. You can order these contacts from the factory with either an a or b configuration.

Relay contacts A1–A5 reflect new fault information. A1–A4 indicate the involved phases; A5 indicates that at least one phase is involved. A1–A5 deassert in response to either of two conditions:

1. Assertion of the RESET isolator input clears A1–A5 immediately and asserts the RST ACK output. The RST ACK signal is valuable for interfacing to RTUs and other instruments requiring verification of proper device operation.
2. If, after a settable interval (RESET), the instrument detects no RESET input assertion, A1–A5 reset automatically.

A settable time interval (LOCK) controls update of contact outputs A1–A5 and any analog outputs dedicated to fault location. During LOCK cycles after a fault, outputs are not affected by subsequent faults. This feature can be used to avoid replacing accurate fault information with less accurate data (this may occur during reclosing operations).

The RST ACK output is tied to the RESET isolator input. When RESET is asserted, RST ACK asserts until a fault occurs.

Isolator Inputs

The SEL-DTA has two programmable isolator inputs for control of transducer and contact output data from a remote system.

ISO1, the RESET input, clears any analog channels set to indicate fault location and contact outputs A1–A5. After the output quantities are cleared, the RST ACK contact output (A6) is closed and remains closed for as long as RESET is asserted. This input is rising-edge sensitive. ISO2 is reserved for future applications and should not be connected.

Self-Tests

The SEL-DTA runs an assortment of self-tests to ensure reliable operation. This section describes each test and the steps taken if a test fails. The instrument generates a report after any change in self-test status. All self-tests are run on power-up and after use of the setting procedure. During normal operation, all self-tests except the display test run every few minutes.

Random-Access Memory

The instrument periodically checks random-access memory (RAM). If a byte cannot be written to and read from, the SEL-DTA declares a RAM failure. It transmits a STATUS message with the socket designation of the affected RAM IC to serial PORT 1. There is no warning state for this test.

Read-Only Memory

The SEL-DTA checks read-only memory (ROM) by computing a checksum. If the computed value does not agree with the stored value, the instrument declares a ROM failure and transmits the STATUS message to serial PORT 1. There is no warning state for this test.

Settings

Two images of the system settings are stored in nonvolatile memory. The SEL-DTA compares them after initial commissioning and periodically thereafter. If the images ever disagree, the setting test fails and the instrument transmits a STATUS message to serial PORT 1. There is no warning state for this test.

Display

The display module is tested when the instrument is powered up, and as described in the STANDBY display mode description. If a display module failure is detected, the SEL-DTA sends an automatic status message to serial PORT 1.

Setting Procedure

Settings for the SEL-DTA are entered with the **SET** command via serial interface PORT 1. Settings are stored in nonvolatile memory, so the instrument retains them when the power is off.

SET on page 4.7 explains setting entry.

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Section 4
Commands and Serial Communications

Introduction

The SEL-DTA is set via serial communications interface **PORT 1**, which is connected to a computer terminal and/or modem. Communications serve the following purposes:

- The SEL-DTA receives display and transducer configurations
- The SEL-DTA responds by message to changes in system self-test status
- The SEL-DTA responds to commands for setting the clock and requests for instrument status information

Two access levels through the communications ports protect against unauthorized access via passwords.

In this manual, commands to type appear in bold/uppercase: **OTTER**. Keys to press appear in bold/brackets: **<Enter>**.

SEL-DTA output appears in the following format:

```
DATE:  01/01/90    Time:  01:01:32
OFFSET  IP = 0 mV
```

Serial Port Connections and Configurations

There are three serial port connectors on the SEL-DTA rear panel. Connectors are marked **PORT 1**, **PORT 2**, and **PORT 2A**. The ports adhere to EIA-232 data communications standards.

PORT 1 is intended for local communications via a CRT, printing terminal, or other device. *Section 5: Installation* includes cable diagrams for several devices.

In a local arrangement (SEL-DTA and relay mounted in close proximity), **PORT 2** of the SEL-DTA should be connected to the relay automatic message port. Since this cable satisfies all power requirements for the SEL-DTA, cable length must be minimized. *Section 5: Installation* lists maximum lengths for this cable. **PORT 2A** is not used in this configuration; leave it unconnected.

In a remote arrangement, **PORT 2A** is connected to the remote relay. The SEL-DTA draws its power from a locally mounted SEL-PSM Power Supply Module. *Section 5: Installation* also describes this configuration in detail.

The port baud rates are set with jumpers accessed by removing the top cover. Available rates are 300, 600, 1200, 2400, 4800, and 9600. SEL-DTA baud rates must match those set for the relay.

The serial data format is:

8 data bits 2 stop bits	(SEL-DTA Firmware Revisions: 100–400)
or	
1 stop bit No parity	(SEL-DTA Firmware Revisions: 500–800)

This format cannot be altered.

Port pin assignments and signal definitions appear below.

Table 4.1 Port 1 Pin Assignments

Pin	Name	Description
1	TXD	Transmit data output
2	–12V	–12 volt output
3	RTS	The SEL-DTA asserts this line under normal conditions. When its received-data buffer is full, the line deasserts until the buffer has room to receive more data. Connected devices should monitor RTS (usually with their CTS input) and stop transmitting characters whenever the line deasserts. If transmission continues, data may be lost.
4	+12V	+12 volt output
5	RXD	Receive data input
6,8	GND	Ground for ground wires and shields
7	CTS	The SEL-DTA monitors CTS and transmits characters only when CTS is asserted
9	+5V	+5 volt output

Table 4.2 Port 2 Pin Assignments

Pin	Name	Description
1	TXD	Transmit data output
2	–12V	–12 volt output
3	RTS	The SEL-DTA asserts this line under normal conditions. When its received-data buffer is full, the line deasserts until the buffer has room to receive more data. Connected devices should monitor RTS (usually with their CTS input) and stop transmitting characters whenever the line deasserts. If transmission continues, data may be lost.
4	+12V	+12 volt output
5	RXD	Receive data input
6,8	GND	Ground for ground, ground wires, and shields
7	CTS	The SEL-DTA monitors CTS and transmits characters only when CTS is asserted
9	+5V	+5 volt output

Table 4.3 Port 2A Pin Assignments

Pin	Name	Description
1	TXD	Transmit data output
2	N/C	Not connected
3	RTS	Direct from PORT 2 RTS
4	N/C	Not connected
5	RXD	Direct from PORT 2 RXD
6,8	GND	Ground for ground wires and shields
7	CTS	Direct from PORT 2 CTS
9	N/C	Not connected

Communications Protocol

The communications protocol consists of hardware and software attributes. Hardware protocol includes the control line functions described above. The following software protocol is designed for manual and automatic communications.

1. All commands received by the SEL-DTA must be of the form:

   <command><Enter> or **<command><CRLF>**

   Thus, a command transmitted to the SEL-DTA should consist of the command followed by a carriage return or carriage return and line feed. You may truncate commands to the first three characters. Upper and lower case characters may be used without distinction, except in passwords.

NOTE: The **<Enter>** key on most key boards is configured to send the ASCII character 13 (^M) for a carriage return. Press the **<Enter>** key after commands, which should send the proper ASCII code.

2. The SEL-DTA transmits all messages in the following format:

   <STX><MESSAGE LINE 1><CRLF>

   <MESSAGE LINE 2><CRLF>

   .
   .
   .

   <LAST MESSAGE LINE><CRLF><PROMPT><ETX>

   Each message begins with the start-of-transmission character (ASCII 02) and ends with the end-of-transmission character (ASCII 03). Each line of the message ends with a carriage return and line feed.

3. The SEL-DTA indicates the volume of data in its received-data buffer through an XON/XOFF protocol.

   When the buffer drops below 1/4 full, the SEL-DTA transmits XON (ASCII hex 11) and asserts the RTS output.

   The SEL-DTA transmits XOFF (ASCII hex 13) when the buffer fills over 3/4 full. It deasserts the RTS output when the buffer is 95 percent full. Transmission sources should monitor for the XOFF character so they do not overwrite the input buffer. Transmission should terminate at the end of the message

in progress when the transmission source receives XOFF and may resume when the SEL-DTA sends XON.

4. An XON/XOFF procedure can be used to control the SEL-DTA during data transmission. When the instrument receives XOFF during transmission, it pauses until it receives an XON. If there is no message in progress when the SEL-DTA receives XOFF, it blocks transmission of any message presented to its buffer. Messages are accepted after XON is received.

   The CAN character (ASCII hex 18) cancels a pending transmission. This is useful in terminating an unwanted transmission.

5. Control characters can be sent from most keyboards with the following keystrokes:
   - XON: **<Ctrl+Q>** (hold down the Control key and press Q)
   - XOFF: **<Ctrl+S>** (hold down the Control key and press S)
   - CAN: **<Ctrl+X>** (hold down the Control key and press X)

Command Characteristics

When the power is first turned on, the SEL-DTA is in Access Level 0 and honors only the **ACCESS** command. It responds `Invalid command` or `Invalid access level to any other entry`.

All commands except those that affect settings are available in Access Level 1. Setting changes require Level 2 access.

Startup

Immediately after power is applied, the instrument transmits the following message to communications **PORT 1**:

```
SEL-DTA Display/Transducer Adapter   Date: 1/1/91    Time: 01:01:01

SEL-DTA
=
```

Command Format

Commands consist of three or more characters; only the first three characters of any command are required. You may use upper or lower case characters without distinction, except in passwords.

Items in square brackets [...] are optional.

Separate arguments from the command by spaces, commas, semicolons, colons, or slashes.

You may enter commands any time after receiving an appropriate prompt.

Command Descriptions

Access Level 0

Access

ACCESS allows you to enter Access Level 1 from the Level 0 prompt (=). After you type **ACCESS <Enter>**, a prompt for the Level 1 password appears. Enter the password and press **<Enter>**. The first password is set to **OTTER** at the factory; use the Level 2 command **PASSWORD** to change passwords.

The following display indicates successful access:

```
=ACCESS <Enter>
Password: ? @@@@@@

SEL-DTA Display/Transducer Adapter    Date: 1/1/91    Time:  01:02:30

Level 1

=>
```

The => prompt indicates Access Level 1.

Access Level 1

2ACCESS

2ACCESS allows you to enter Access Level 2 from Level 1. After you type **2ACCESS <Enter>**, a prompt for the Level 2 password appears. Enter the second password and press **<Enter>**. The second password is set to **TAIL** at the factory; use the Level 2 command **PASSWORD** to change passwords.

The following display indicates successful access:

```
=>2ACCESS <Enter>
Password: ? @@@@@@

SEL-DTA Display/Transducer Adapter     Date: 1/1/91     Time: 01:02:40

Level 2

=>>
```

The =>> prompt indicates Access Level 2; you may enter any command at this prompt.

DATE [mm/dd/yy]

DATE displays the date stored by the internal calendar/clock. Type **DATE <Enter>** to read the date; type **DATE mm/dd/yy <Enter>** to enter a new date. Since the clock is synchronized with the relay clock approximately every five seconds, changing the date with this command is ineffective if the SEL-DTA is normally connected to a relay. This feature allows the SEL-DTA to benefit from the IRIG-B timecode used by the target relay.

When the power is first turned on, the date is 1/1/91.

QUIT

QUIT command execution returns control to Access Level 0 from Level 1 or 2 and displays the instrument I.D., date, and time. Use this command when you finish communicating with the SEL-DTA to prevent unauthorized access. Note that control may return to Access Level 0 automatically after a settable interval of no activity (see TIME1 setting under *SET on page 4.7*).

SHOWSET

Enter **SHOWSET** to inspect the SEL-DTA settings. The display shows the current settings. You cannot modify settings with this command; setting entry is accomplished with the **SET** command in Access Level 2.

SHOWSET output example:

```
ID   =SEL-DTA Display/Transducer Adapter
TIME1=0
LOCK =300.0    RESET=120
MINW = 10.0    MAXW =100.0
QUA1 =VAB      MIN1 =-250     MAX1 =500.0
QUA2 =IA       MIN2 =0.0      MAX2 =1200.0
QUA3 =IB       MIN3 =0.0      MAX3 =1200.0
QUA4 =IC       MIN4 =0.0      MAX4 =1200.0
QUA5 =P        MIN5 =0.0      MAX5 = 200.0
QUA6 =P        MIN6 =0.0      MAX6 =200.0
QUA7 =Q        MIN7 = 200.0   MAX7 =200.0
QUA8 =FL       MIN8 =0.0      MAX8 =100.0
```

The **SET** command description includes a detailed explanation of the SEL-DTA settings.

STATUS

SEL-DTA self-test status can be examined with the **STATUS** command. The instrument also automatically executes the **STATUS** command whenever a self-test indicates a warning or failure condition. The instrument sends output to communications PORT 1.

STATUS report format:

```
SEL-DTA Display/Transducer Adapter     Date: 1/1/91      Time: 01:10:23

SELF TESTS

RAM   ROM   SET   DISPLAY
OK    OK    OK    OK
```

The status of four tests is reported in the last two rows of the report. If a RAM, ROM, or settings (EEPROM) test fails, the IC socket number of the defective part is indicated. A display failure is indicated in the last column.

TIME [hh:mm:ss]

To read the internal clock, type **TIME <Enter>**. To set the clock, type **TIME** followed by the desired setting. Separate the hours, minutes, and seconds with colons, semicolons, spaces, or slashes. To set the clock to 23:30:00, enter:

TIME 23 30 00 <Enter> or **TIME 23:30:00 <Enter>**, etc.

A quartz crystal oscillator provides the time base for the internal clock.

Since the SEL-DTA clock synchronizes with the relay clock approximately every five seconds, changing the time with this command is ineffective if the SEL-DTA is normally connected to a relay. This feature allows the SEL-DTA to benefit from the IRIG-B timecode used by the relay.

Access Level 2

While all commands are available from Access Level 2, the following commands are available only from Access Level 2. Remember, any attempt to enter Access Level 2 pulses the **ALARM** relay closed for one second.

PASSWORD (1 or 2) [password]

To inspect the passwords, enter **PASSWORD <Enter>**.

To change the password for Access Level 1 to BIKE enter:

```
PASSWORD 1 BIKE <Enter>
```

The SEL-DTA sets the password, pulses the **ALARM** relay closed, and transmits the response:

```
Set
```

NOTE: After entering new passwords, type **PASSWORD <Enter>** to inspect them. Make sure they are what you intended and record the new passwords. SEL-DTA passwords must match passwords set for the relay.

Passwords can be any length up to six numbers, letters, or any other printable characters except delimiters (space, comma, semicolon, colon, slash). Upper- and lower-case letters are treated as different characters. Examples of valid, distinct passwords include:

- OTTER
- otter
- Ot3456
- +TAIL+
- !@#$%^
- 123456
- 12345.
- 12345

If the passwords are lost, turn off the SEL-DTA and remove the cover. Disconnect the display cable from the display module and turn the unit back on. This disables password protection, allowing you to execute the **PASSWORD** command and display the current passwords.

SET

The setting procedure requires you to answer prompting messages with new data or press **<Enter>** to indicate no change. When you have entered all data, the SEL-DTA displays the new settings and issues a prompt requesting approval to enable them. After you approve new settings, the SEL-DTA triggers the output reset, clearing the contact outputs and any analog outputs dedicated to fault location.

Error messages indicate when new entries are out of range or of the wrong type.

An example **SET** command display appears at the end of this section; settable parameters are defined as follows.

TIME1 controls the timeout interval of communications PORT 1.

LOCK specifies the time after a fault during which analog and contact output changes are suppressed for outputs dedicated to fault location. If, for example, a fault was immediately followed by two reclose faults within three seconds, only the first fault would affect the analog and contact outputs (using the example LOCK setting of 300 cycles).

RESET specifies the length of time after a fault before the analog and contact outputs automatically reset. The example setting requires the SEL-DTA to wait for two minutes before resetting the outputs. 0 specifies no automatic reset.

Settings MINW and MAXW specify the fault location window. Faults with locations outside this window are ignored by the SEL-DTA. Using the example settings, a fault with a location of 75.34 miles would be captured, stored, displayed, and presented at the contact and analog outputs. A reverse fault with a location of –34.45 miles would not be processed by the SEL-DTA; no outputs would be affected.

Settings QUA1–QUA8 control the type of data appearing at the transducer outputs. Available quantities are shown below:

Currents	IA, IB, IC, IAB, IBC, ICA, 3I2, IR
Voltages	VA, VB, VC, VAB, VBC, VCA, 3V2, 3V0, (SEL 221F/121F) VS
Single-Phase Power	PA, PB, PC (real), Available only with Fast Meter QA, QB, QC (reactive), Available only with Fast Meter
Three-Phase Power	P (real), Q (reactive)
Demand and peak-demand values are only available from the SEL-267/167 and SEL 251/151 families of relays.	
Demand	DA, DB, DC, DR, D3I2, DP, DQ
Peak Demand	PDA, PDB, PDC, PDR, PD3I2, PDP, PDQ
Fault Location	FL

In the example setting, QUA1 is set to "VAB," indicating that Transducer Channel 1 reflects the voltage measured from Phase A to Phase B.

Settings MIN1–MIN8 and MAX1–MAX8 reflect the measured quantities corresponding to –5 V (–1 mA or –5 mA) and 5 V (1 mA or 5 mA), respectively. Values within the set range for a channel are scaled according to *Equation 4.1* through *Equation 4.3*.

–5 V Option 1 or 5:

$$\text{Vout} = \frac{(\text{Measured Quantity} - \text{Min}) \bullet 10\ \text{V}}{\text{Max} - \text{Min}} \qquad \textbf{Equation 4.1}$$

–1 mA Option 1:

$$\text{Iout} = \frac{(\text{Measured Quantity} - \text{Min}) \bullet 2\ \text{mA}}{\text{Max} - \text{Min}} \qquad \textbf{Equation 4.2}$$

–5 mA Option 5:

$$\text{Iout} = \frac{(\text{Measured Quantity} - \text{Min}) \bullet 10\ \text{mA}}{\text{Max} - \text{Min}} \qquad \textbf{Equation 4.3}$$

Using the example settings and a measured value VAB of 231.2 kV, the output quantities for Analog Channel 1 (with Option 1) would be:

–5 V Option 1 or 5:

$$\begin{aligned} \text{Vout} &= \frac{(231.2 - (-250.0)) \bullet 10\ \text{V}}{500.0 - (-250.0)} \\ &= 1.416\ \text{V} \end{aligned}$$

Equation 4.4

–1 mA Option 1:

$$\begin{aligned} \text{Iout} &= \frac{(231.2 - (-250.0)) \bullet 2\ \text{mA}}{500.0 - (-250.0)} \\ &= 283.2\ \text{V} \end{aligned}$$

Equation 4.5

NOTE: To represent quantities having both positive and negative values (i.e., VARs and Watts) such that negative values give negative analog outputs and positive values give positive analog outputs, MIN and MAX must be symmetrical around ground (i.e., MIN = –500 mW and MAX = +500 mW).

SET command display:

```
=>>SET <Enter>

SET clears events, CTRL X cancels.
ID: SEL-DTA Display/Transducer Adapter
 ?

TIME1:  PORT 1 timeout (min)  = 0      ?
LOCK:   Output lockout (cyc)  = 300.0  ?
RESET:  Output timeout (sec)  = 120    ?
MINW:   Min Fault Window      = -10.0  ?
MAXW:   Max Fault Window      = 100.0  ?
QUA1:   Measured quantity     = VAB    ?
MIN1:   Min Range             = -250.0 ?
MAX1:   Max Range             = 500.0  ?
QUA2:   Measured quantity     = IA     ?
MIN2:   Min Range             = 0.0    ?
MAX2:   Max Range             = 1200.0 ?
QUA3:   Measured quantity     = IB     ?
MIN3:   Min Range             = 0.0    ?
MAX3:   Max Range             = 1200.0 ?
QUA4:   Measured quantity     = IC     ?
MIN4:   Min Range             = 0.0    ?
MAX4:   Max Range             = 1200.0 ?
QUA5:   Measured quantity     = P      ?
MIN5:   Min Range             = 0.0    ?
MAX5:   Max Range             = -200.0 ?
QUA6:   Measured quantity     = P      ?
MIN6:   Min Range             = 0.0    ?
MAX6:   Max Range             = 200.0  ?
QUA7:   Measured quantity     = Q      ?
MIN7:   Min Range             = -200.0 ?
MAX7:   Max Range             = 200.0  ?
QUA8:   Measured quantity     = FL     ?
MIN8:   Min Range             = 0.0    ?
MAX8:   Max Range             = 100.0  ?

New settings:

ID   =SEL-DTA Display/Transducer Adapter
TIME1=0
LOCK =300.0                    RESET=120
MINW = 10.0                    MAXW =100.0
QUA1 =VAB      MIN1 =-250.0    MAX1 =500.0
QUA2 =IA       MIN2 =0.0       MAX2 =1200.0
QUA3 =IB       MIN3 =0.0       MAX3 =1200.0
QUA4 =IC       MIN4 =0.0       MAX4 =1200.0
QUA5 =P        MIN5 =0.0       MAX5 = 200.0
QUA6 =P        MIN6 =0.0       MAX6 =200.0
QUA7 =Q        MIN7 = 200.0    MAX7 =200.0
QUA8 =FL       MIN8 =0.0       MAX8 =100.0

OK (Y/N) ? Y <Enter>
```

Table 4.4 Settings Ranges

Setting	Permissible Range <lower,upper;step>
TIME1	<0,30;1>
LOCK	<0,8000;0.25>
RESET	<0,600;1>
MINW	<–100000,100000>
MAXW	<–100000,100000>
QUA1	<IA,FL>
MIN1	<–100000,100000>
MAX1	<–100000,100000>
QUA2	<IA,FL>
MIN2	<–100000,100000>
MAX2	<–100000,100000>
QUA3	<IA,FL>
MIN3	<–100000,100000>
MAX3	<–100000,100000>
QUA4	<IA,FL>
MIN4	<–100000,100000>
MAX4	<–100000,100000>
QUA5	<IA,FL>
MIN5	<–100000,100000>
MAX5	<–100000,100000>
QUA6	<IA,FL>
MIN6	<–100000,100000>
MAX6	<–100000,100000>
QUA7	<IA,FL>
MIN7	<–100000,100000>
MAX7	<–100000,100000>
QUA8	<IA,FL>
MIN8	<–100000,100000>
MAX8	<–100000,100000>

Section 5
Installation

Mounting

The SEL-DTA is designed for mounting by its front vertical flanges in a 19" vertical relay rack. It may also be mounted semi-flush in a switchboard panel. Use four #10 screws for mounting. *Appendix B: Mechanical Drawings* includes front- and rear-panel drawings.

Power Connections

Power is supplied to the SEL-DTA by the target relay via communications cable connected to **PORT 2**; refer to *Communications Circuits* for cabling recommendations.

Communications Circuits

Connections to the two EIA-232 serial communications ports are made via three nine-pin connectors labeled **PORT 1**, **PORT 2**, and **PORT 2A** on the rear panel. Pins 6 and 8 of these connectors connect directly to frame (chassis) ground.

NOTE: These connections should not be relied upon for safety grounding.

Low-energy, low-voltage MOVs and passive RC filters protect the communications circuits. Minimize communications-circuit difficulties by keeping the length of the EIA-232 cables as short as possible. Cable length should never exceed 100 feet. Use shielded communications cable for lengths greater than ten feet.

In a local arrangement (see *Figure 5.1*), all SEL-DTA power requirements are supplied by the relay via the cable which connects the devices. Therefore, this cable must be kept as short as possible (*Table 5.1* shows maximum cable lengths for various wire gauges). If the SEL-DTA is located at a great distance from the target relay, use the configuration in *Figure 5.1*. In this arrangement, the SEL-DTA is powered from the SEL-PSM (Power Supply Module) via **PORT 2**; it is linked to the relay for data via **PORT 2A**. Since power is not drawn from the relay, cabling to the relay may be quite long. Further extension is possible with a short-haul modem or similar isolating device.

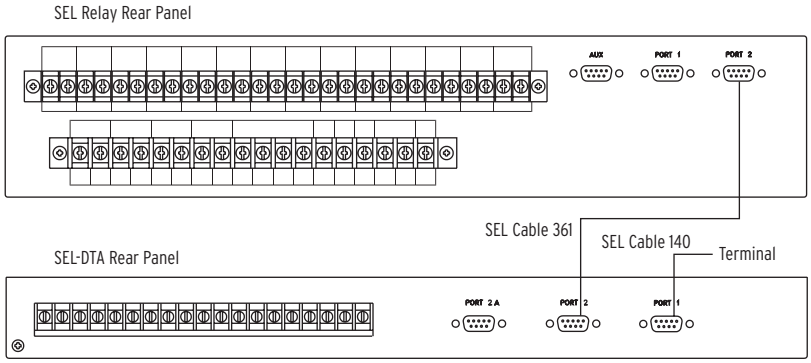

Figure 5.1 SEL-DTA Attached to Local Relay

Table 5.1 Maximum Cable Lengths for Various Wire Gauges (Cable 361)

Wire Size (AWG)	Maximum Cable Length (Feet)
22	7.0
24	4.5

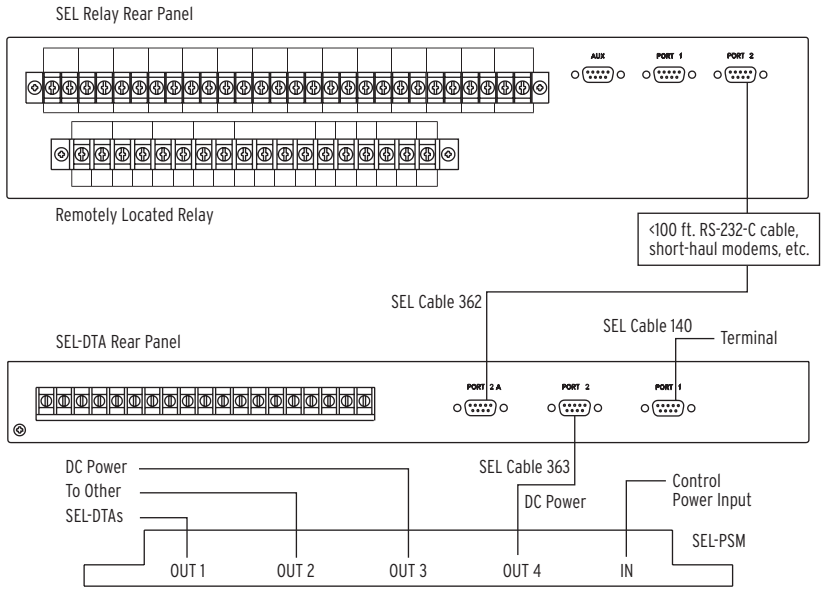

Figure 5.2 SEL-DTA With SEL-PSM Connected to Remote Relay

Jumper Selection

The SEL-DTA jumper tables information in *Appendix B: Mechanical Drawings* provides the location and configuration information for all jumpers. They are easily accessed by removing the top cover.

EIA-232 Jumpers

Jumpers **J105**–**J116** are used to configure the communications channels.

Baud Rate

⚠CAUTION
Do not select two baud rates for the same port. This can damage the baud rate generator.

The baud rate of the **PORT 1** and **PORT 2** communications channels is set with jumpers **J105**–**J116**. Available baud rates are 300, 600, 1200, 2400, 4800, and 9600. Baud rate settings for the SEL-DTA must match those set for the associated relay.

Timebase Configuration

Jumper **J131** allows configuration of the crystal-controlled timebase. It is factory set and should not be changed.

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Section 6

Service and Calibration

Removing Cover

Step 1. Remove power source by disconnecting SEL-DTA and relay.

Step 2. Remove seven screws from top of cabinet.

Step 3. Remove two screws from rear panel.

Step 4. Remove cover by sliding to the rear.

Calibration

Calibration of the instrument consists of trimming the transconductance of the transducer current sources.

Periodic calibration is unnecessary. However, calibration should be considered for the conditions listed below:

- Replacement of any analog components in the system, such as op amps, transducer transistors, or the D/A converter
- Out-of-tolerance transducer output quantities

Equipment Required

- Fluke 8050A DMM or equivalent
- Fluke 8840A DMM or equivalent
- Cable for attaching relay to SEL-DTA

Procedure

Step 1. Use the cable to connect **PORT 2** of the SEL-DTA to the relay.

Step 2. Turn on the system power.

Step 3. Set the SEL-DTA output calibration:

a. Current Offset Adjust

1. Set the SEL-DTA outputs to 0 for each of the outputs and the Fluke 8050A to 200 uA dc range.
2. Connect the COMMON (LO) of the DMM to the SEL-DTA ground. For each current output, connect the DMM current (2A) input to the appropriate SEL-DTA pin (12, 10, 8, 6, 4, 2, 14, 16) and adjust the appropriate current offset pot (R197–R204) as follows:

   Option 1: –0.04 uA to +0.04 uA Range
   –0.004% to +0.004% Error

Option 5: –0.20 uA to +0.20 uA Range
–0.004% to +0.004% Error

b. Voltage Offset Adjust

1. Set the SEL-DTA outputs to 0 for each of the outputs and the Fluke 8840A to the 200 mV dc range.
2. Connect the COMMON (LO) of the DMM to the SEL-DTA ground. For each voltage output, connect the DMM voltage (HI) input to the appropriate SEL-DTA pin (13, 11, 9, 7, 5, 3, 1, 15) and adjust the appropriate voltage offset pot (R189–R196) as follows:

   Either Option: –0.20 mV to +0.20 mV Range
   –0.004% to +0.004% Error

c. Current Gain Adjust

1. Set the SEL-DTA outputs to negative full scale for each output and the Fluke 8840A to the 2 mA dc range for the 1 mA option or to the 20 mA dc range for the 5 mA option.
2. Connect the COMMON (LO) of the DMM to the SEL-DTA ground. For each voltage output, connect the current (2A) input to the appropriate SEL-DTA pin (12, 10, 8, 6, 4, 2, 14, 16) and adjust the appropriate current gain pot (R162–R169) as follows:

   Option 1: 0.9994 mA to 0.9996 mA Range
   –0.01% to +0.01% Error

   Option 5: 4.9971 mA to 4.9981 mA Range
   –0.01% to +0.01% Error

d. Voltage Gain Adjust

1. Set the SEL-DTA outputs to negative full scale for each output and the Fluke 8840A to the 20 V dc range.
2. Connect the COMMON (LO) of the DMM to the SEL-DTA ground. For each voltage output, connect the DMM voltage (HI) input to the appropriate SEL-DTA pin (13, 11, 9, 7, 5, 3, 1, 15) and adjust the appropriate voltage pot (R285–R292) as follows:

   Either Option: 4.9971 V to 4.9981 V Range
   –0.01% to +0.01% Error

Step 4. Replace the instrument cover.

Display Contrast

Adjust the display for optimal readability using the display contrast potentiometer (R186).

Troubleshooting

Inspection Procedure

Complete the following inspection procedure before disturbing the system. After you finish the inspection, proceed to *Table 6.1*.

Step 1. Check to see that power to the target relay is on.

Step 2. Inspect the cabling to the SEL-DTA serial communication ports. Be sure the relay is connected to **PORT 2** and a communications device is connected to **PORT 1**.

Table 6.1 Troubleshooting Table (Sheet 1 of 2)

Issue	Cause
Garbled or nonexistent display data	➤ Power is off ➢ Incorrect cabling from relay to SEL-DTA ➢ Relay power is off ➢ Blown fuse in relay ➢ Relay input power is not present ➤ Loose or disconnected internal ribbon cable to display module ➤ Display contrast incorrectly adjusted ➤ SEL-DTA display module or main board failure
System does not respond to commands	➤ Communications device not connected to system ➤ SEL-DTA or communications device at incorrect baud rate or other communication parameter incompatibility (parity, word length, cabling error, etc.) ➤ System is attempting to transmit information, but cannot due to handshaking conflict. Check communication cabling. ➤ System is in the XOFF state, halting communications. Type **<Ctrl+Q>** to put your system in XON state.
No prompting message issued to terminal upon power-up	➤ Terminal not connected to SEL-DTA **PORT 1** ➤ Wrong baud rate ➤ Improper connection of terminal to system ➤ SEL-DTA main board failure
SEL-DTA fails to gain access to relay	➤ Relay baud rate does not agree with SEL-DTA baud rate ➤ SEL-DTA passwords not identical to relay passwords
System does not display faults	➤ SEL-DTA connected to relay port which is not designated automatic (relay may be equipped with old software which does not support multiple automatic message ports) ➤ Relay baud rate does not agree with SEL-DTA baud rate ➤ Improper connection of SEL-DTA to relay
Terminal displays meaningless characters	➤ Incorrect baud rate setting ➤ Check terminal configuration. See *Section 4: Commands and Serial Communications*.
Self-test failure: ROM	➤ EPROM failure. Replace EPROM.
Self-test failure: RAM	➤ Failure of static RAM IC. Replace RAM.
Self-test failure: SET	➤ EEPROM failure. Replace EEPROM.

Table 6.1 Troubleshooting Table (Sheet 2 of 2)

Issue	Cause
Self-test failure: display	➤ Loose or disconnected display module cable ➤ Display module failure
At power-up, display stays darkened	➤ SEL-DTA automatic message port (**PORT 1**) is in the XOFF state. Connect a terminal to **PORT 1** and issue **<Ctrl+Q>** to enter XON state.

Appendix A
Firmware and Manual Versions

Firmware

To find the firmware revision number in your SEL-DTA, use the **VERSION** command. This is a FID string with the Part/Revision number in bold:

FID=**SEL-DTA-R700**-V31-D921109

Table A.1 lists the firmware versions and a description of modifications. The most recent firmware version is listed first.

Table A.1 Firmware Revision History (Sheet 1 of 2)

Firmware Identification (FID) Number	Description of Changes
	➤ Setting error message correction.
SEL-DTA-R120	Two stop bits: Base Product old pwb
SEL-DTA-R211	Two stop bits: Base Product rev 4 pwb
SEL-DTA-R307	Two stop bits: Base Product rev 5 pwb
SEL-DTA-R505	One stop bit: Base Product old pwb
SEL-DTA-R605	One stop bit: Base Product rev 4 pwb
SEL-DTA-R705	One stop bit: Base Product rev 5 pwb
	➤ 2 1/2 element power calculation for delta Fast Meter. ➤ SEL-251 demand and reset demand/peak. ➤ Fast meter single-phase power for analog output. ➤ One minute timeout for freeze meter function.
SEL-DTA-R119	Two stop bits: Base Product old pwb
SEL-DTA-R210	Two stop bits: Base Product rev 4 pwb
SEL-DTA-R306	Two stop bits: Base Product rev 5 pwb
SEL-DTA-R504	One stop bit: Base Product old pwb
SEL-DTA-R604	One stop bit: Base Product rev 4 pwb
SEL-DTA-R704	One stop bit: Base Product rev 5 pwb
	➤ FL analog output reset correction.
SEL-DTA-R118	Two stop bits: Base Product old pwb
SEL-DTA-R209	Two stop bits: Base Product rev 4 pwb
SEL-DTA-R305	Two stop bits: Base Product rev 5 pwb
SEL-DTA-R503	One stop bit: Base Product old pwb
SEL-DTA-R603	One stop bit: Base Product rev 4 pwb
SEL-DTA-R703	One stop bit: Base Product rev 5 pwb

Table A.1 Firmware Revision History (Sheet 2 of 2)

Firmware Identification (FID) Number	Description of Changes
	➤ Added SEL-267/167 Demand Meter support. ➤ Added SEL-251 Delta Version Meter support. ➤ Added SEL-251-1 Versions Meter support. ➤ Added SEL-221F/121F Fault Type 6 support.
SEL-DTA-R117	Two stop bits: Base Product old pwb
SEL-DTA-R208	Two stop bits: Base Product rev 4 pwb
SEL-DTA-R304	Two stop bits: Base Product rev 5 pwb
SEL-DTA-R502	One stop bit: Base Product old pwb
SEL-DTA-R602	One stop bit: Base Product rev 4 pwb
SEL-DTA-R702	One stop bit: Base Product rev 5 pwb
	➤ Added SEL-321 support.
SEL-DTA-R116	Two stop bits: Base Product old pwb
SEL-DTA-R207	Two stop bits: Base Product rev 4 pwb
SEL-DTA-R303	Two stop bits: Base Product rev 5 pwb
SEL-DTA-R501	One stop bit: Base Product old pwb
SEL-DTA-R601	One stop bit: Base Product rev 4 pwb
SEL-DTA-R701	One stop bit: Base Product rev 5 pwb
	➤ Initial version.
SEL-DTA-R115	Two stop bits: Base Product old pwb
SEL-DTA-R206	Two stop bits: Base Product rev 4 pwb
SEL-DTA-R302	Two stop bits: Base Product rev 5 pwb
SEL-DTA-R500	One stop bit: Base Product old pwb
SEL-DTA-R600	One stop bit: Base Product rev 4 pwb
SEL-DTA-R700	One stop bit: Base Product rev 5 pwb

Instruction Manual

The date code at the bottom of each page of this manual reflects the creation or revision date.

Table A.2 lists the instruction manual release dates and a description of modifications. The most recent instruction manual revisions are listed at the top.

Table A.2 Instruction Manual Revision History

Revision Date	Summary of Revisions
20080530	Appendix A ➤ Added Instruction Manual subsection.
Information about previous versions of the SEL-DTA is not available.	

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Appendix B
Mechanical Drawings

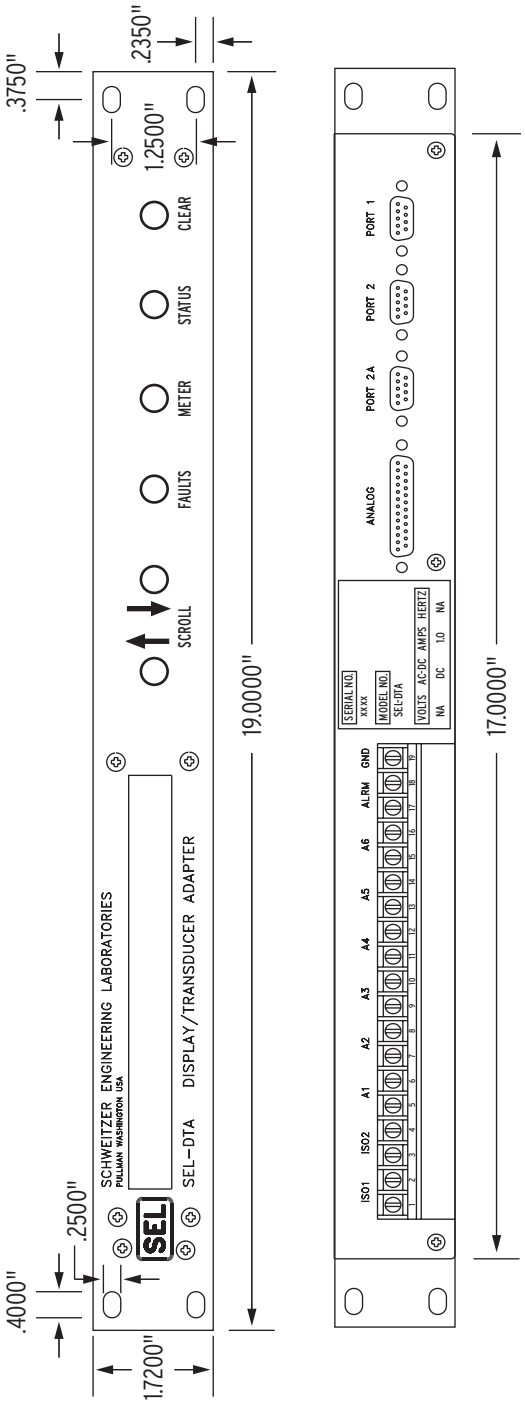
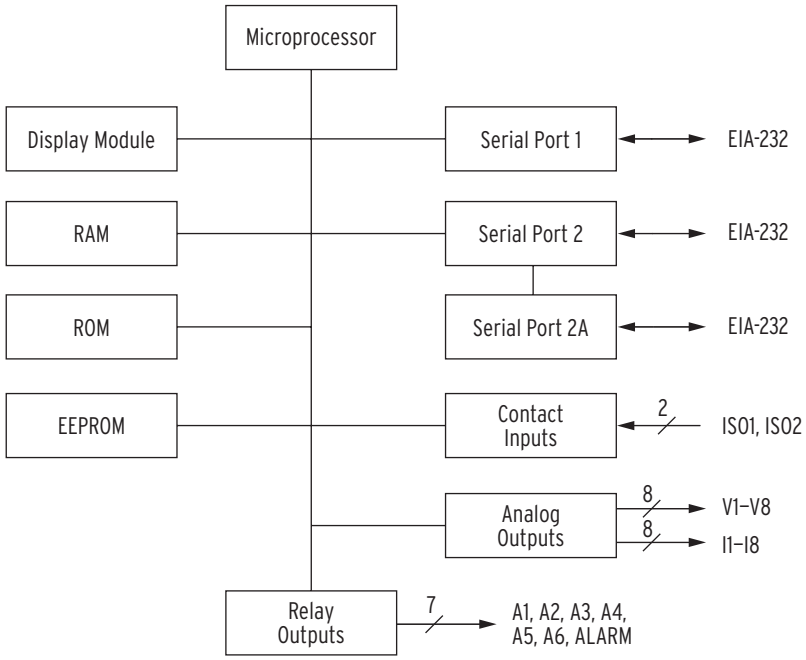
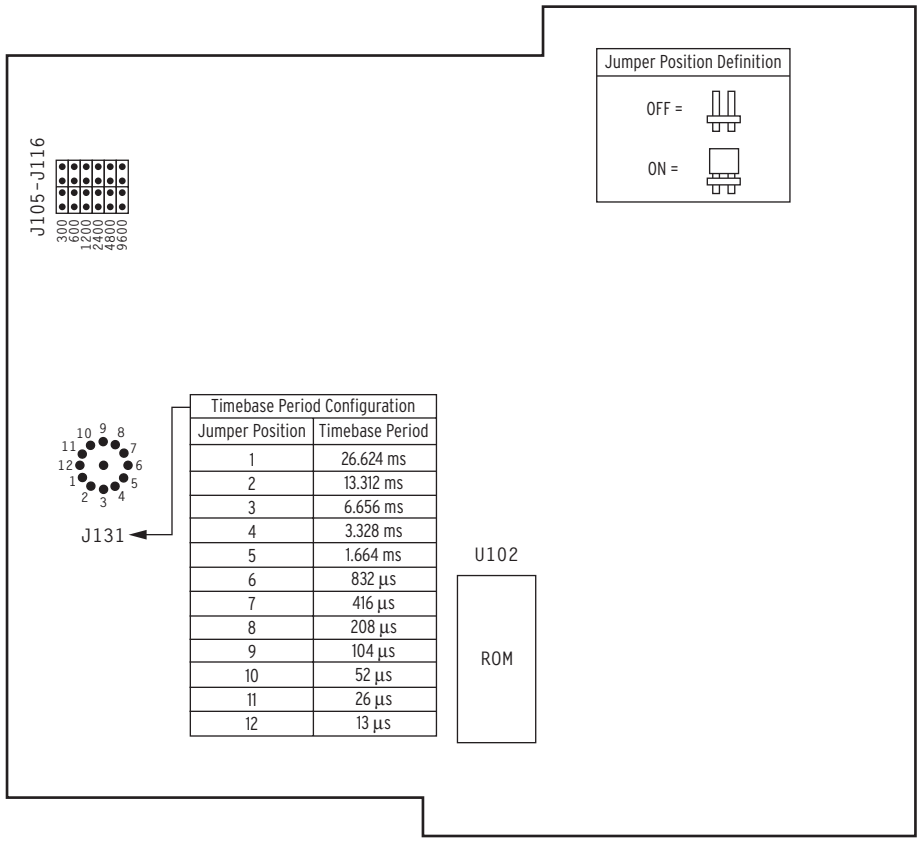


Figure B.1 SEL-DTA Horizontal Front and Rear Panel Drawings



RAM = Random-Access Memory
ROM = Read-Only Memory
EEPROM = Electronically-Erasable Programmable ROM

Figure B.2 SEL-DTA Hardware Block Diagram



Timebase Period Configuration	
Jumper Position	Timebase Period
1	26.624 ms
2	13.312 ms
3	6.656 ms
4	3.328 ms
5	1.664 ms
6	832 µs
7	416 µs
8	208 µs
9	104 µs
10	52 µs
11	26 µs
12	13 µs

Figure B.3 SEL-DTA Jumper/ROM Drawing

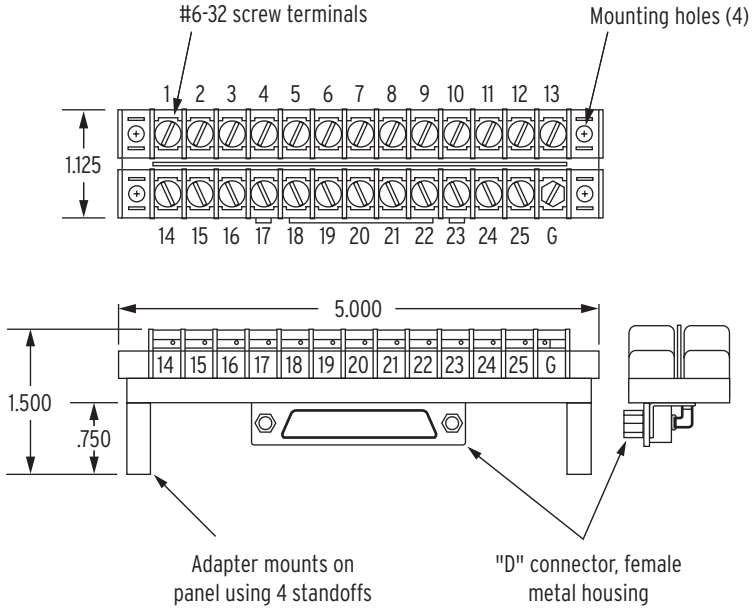


Figure B.4 DB-25 to Terminal Block Adapter

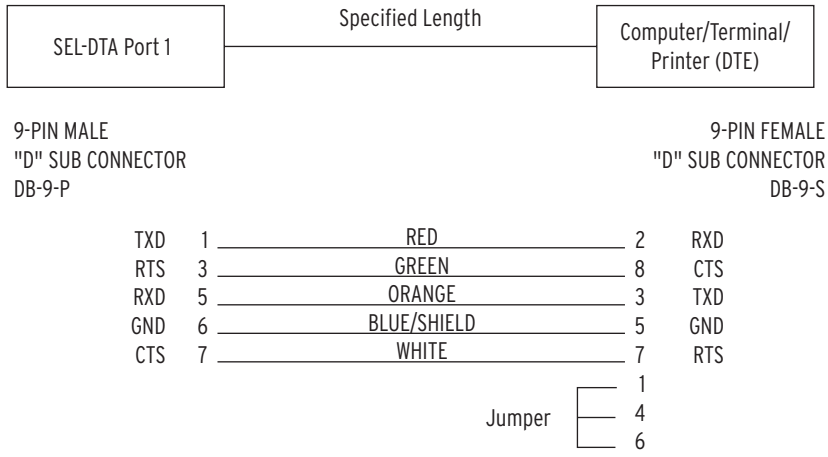


Figure B.5 Cable 143 Wiring Diagram

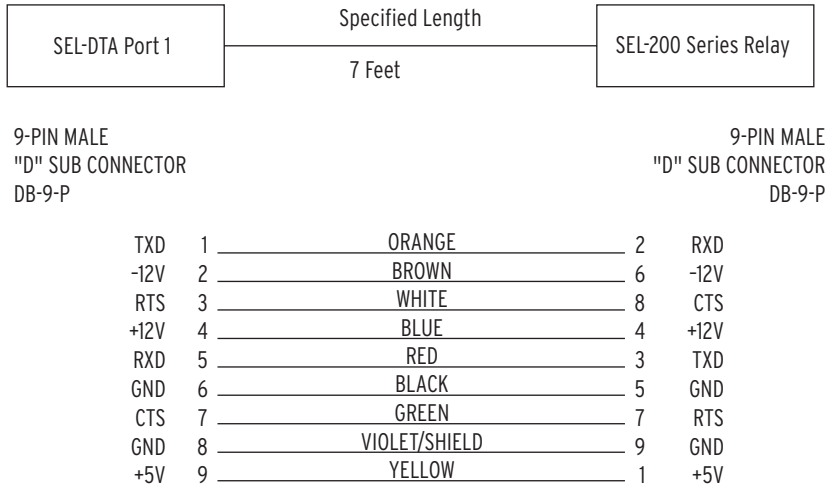


Figure B.6 Cable 261 Wiring Diagram

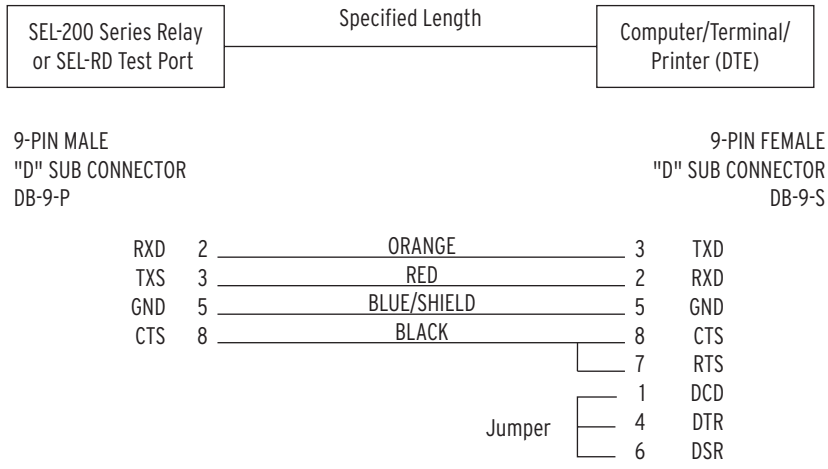


Figure B.7 Cable 234A Wiring Diagram

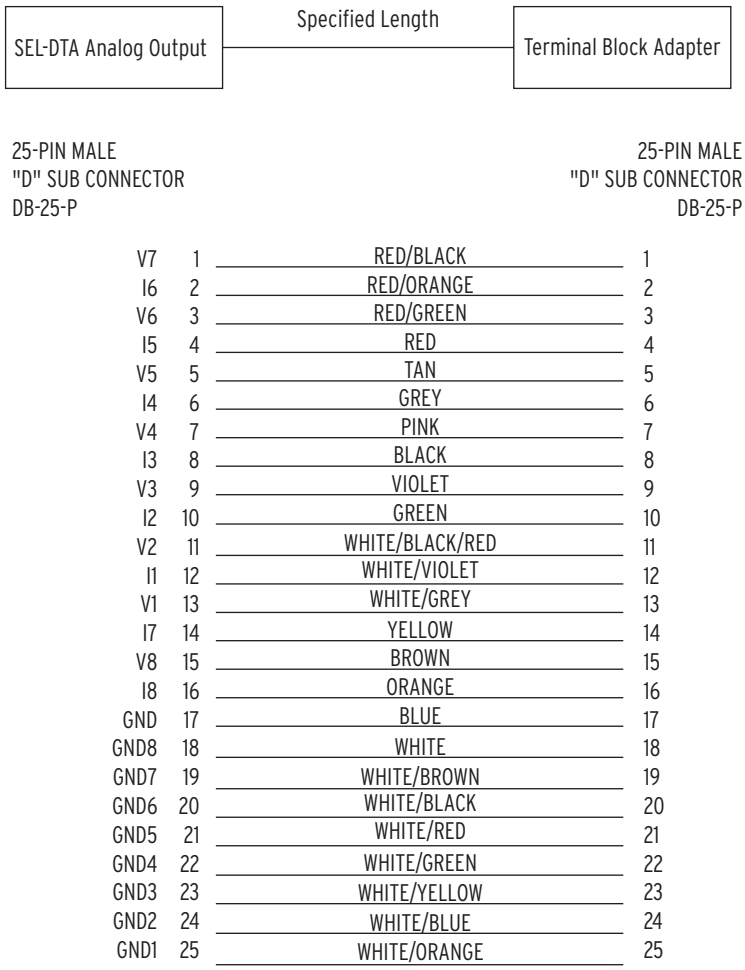


Figure B.8 Cable 701 Wiring Diagram

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