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## Introduction

This guide contains information on S46T relay installation and system configuration that is necessary after installing new relays. To install a relay, refer to [Relay kits](#) (on page 1) for a description of the kits and follow the applicable installation instructions.

## Relay kits

### WARNING

Connection and wiring procedures in this document are intended for use by qualified personnel only. Do not perform these procedures unless qualified to do so. Failure to recognize and observe normal safety precautions could result in personal injury or death.

### WARNING

Use only the parts specified in the following table when servicing equipment. Use of improper parts may expose the operator to hazardous voltages that could result in personal injury or death.

Relay kit model number (Description)	Relay location	Kit parts summary (Quantity)	Keithley part number	Installation reference
S46T-SPDT-KIT (18 GHz SPDT)	1 to 8	SPDT unterminated relay (1) SPDT spacer (1) Connecting cable (1)	S40-0154 S40-SE05-307 SYS46-311C	<a href="#">SPDT relay 1 - 8 installation</a> (on page 3)
S46T-SP4T-KIT (18 GHz SP4T)	A to D	4-40 x 3/16 PPHSEM screws (2) 4-40 x 3/8 PFH screws (4) SP4T relay (1) Ribbon cable (1) Mounting plate (1)	4-40 x 3/16 PPHSEM 4-40 x 3/8 PFH RL-282-2 CA-286-1 S40-N410-312	<a href="#">Relay A - D installation</a> (on page 6)
S46T-SP6T-KIT (18 GHz SP6T)	A to D	4-40 x 3/16 PPHSEM screws (2) 4-40 x 3/8 PFH screws (4) SP6T unterminated relay (1) Ribbon cable (1) Mounting plate (1)	4-40 x 3/16 PPHSEM 4-40 x 3/8 PFH RL-282-1 CA-286-1 S40-N410-312	<a href="#">Relay A - D installation</a> (on page 6)
S46T-SPDT-KIT-26 (26.5 GHz SPDT)	1 to 8	SPDT unterminated relay (1) SPDT spacer (1) Connecting cable (1)	RL-308 S40-SE05-307 SYS46-311C	<a href="#">SPDT relay 1 - 8 installation</a> (on page 3)



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S46T-SP4T-KIT-26 (26.5 GHz SP4T)	A to D	4-40 x 3/8 PFH screws (4) SP4T unterminated relay (1) Mounting plate (1) Ribbon cable (1)	4-40 x 3/8 PFH RL-312 S40-N410-312 S46-U100-350A	<a href="#">Relay A - D installation</a> (on page 6)
S46T-SP6T-KIT-26 (26.5 GHz SP6T)	A to D	4-40 x 3/8 PFH screws (4) SP6T unterminated relay (1) Mounting plate (1) Ribbon cable (1)	4-40 x 3/8 PFH RL-309 S40-N410-312 S46-U100-350A	<a href="#">Relay A - D installation</a> (on page 6)
S46T-SPDT-KIT-T (18 GHz SPDT)	1 to 8	SPDT terminated relay (1) Connecting cable (1)	S40-0172 SYS46-311C	<a href="#">SPDT relay 1 - 8 installation</a> (on page 3)
S46T-SPDT-KIT-26T (26.5 GHz SPDT)	1 to 8	SPDT terminated relay (1) Connecting cable (1)	RL-292-1 SYS46-311C	<a href="#">SPDT relay 1 - 8 installation</a> (on page 3)
S46T-SP4T-KIT-T (18 GHz SP4T)	A to D	4-40 x 3/16 PPHSEM screws (2) SP4T terminated relay (1) Ribbon cable (1)	4-40 x 3/16 PPHSEM RL-317 S40-SV11-350	<a href="#">Relay A - D installation</a> (on page 6)
S46T-SP6T-KIT-T (18 GHz SP6T)	A to D	4-40 x 3/16 PPHSEM screws (2) SP6T terminated relay (1) Ribbon cable (1)	4-40 x 3/16 PPHSEM RL-318 S40-SV11-350	<a href="#">Relay A - D installation</a> (on page 6)
S46T-SP4T-KIT-26T (26.5 GHz SP4T)	A to D	4-40 x 3/16 PPHSEM screws (2) SP4T terminated relay (1) Ribbon cable (1)	4-40 x 3/16 PPHSEM RL-310 S40-SV11-350	<a href="#">Relay A - D installation</a> (on page 6)
S46T-SP6T-KIT-26T (26.5 GHz SP6T)	A to D	4-40 x 3/16 PPHSEM screws (2) SP6T terminated relay (1) Ribbon cable (1)	4-40 x 3/16 PPHSEM RL-290-1 S40-SV11-350	<a href="#">Relay A - D installation</a> (on page 6)
S46T-XFER-KIT (18 GHz XFER)	A to D	M3 x 5 PPH screws (4) XFER unterminated relay (1) XFER mounting plate (1) Ribbon cable (1)	M3 x 5 PPH RL-304 S40-N410-311 S46-U100-350A	<a href="#">Relay A - D installation</a> (on page 6)
S46T-XFER-KIT-26 (26.5 GHz XFER)	A to D	M3 x 5 PPH screws (4) XFER unterminated relay (1) XFER mounting plate (1) Ribbon cable (1)	M3 x 5 PPH RL-308 S40-N410-311 S46-U100-350A	<a href="#">Relay A - D installation</a> (on page 6)
S46T-MSPDT-KIT (18 GHz SPDT)	A to D	4-40 x 1-1/2 PPH screws (2) SPDT unterminated relay (2) Mounting plate (1) Relay spacer (1) Ribbon cable (1)	4-40 x 1-1/2 PPH S40-0154 S40-N410-309 S40-N410-313 S46-U100-350A	<a href="#">Relay A - D installation</a> (on page 6)
S46T-MSPDT-KIT-26 (26.5 GHz SPDT)	A to D	4-40 x 1-1/2 PPH screws (2) SPDT unterminated relay (2) Mounting plate (1) Relay spacer (1) Ribbon cable (1)	4-40 x 1-1/2 PPH RL-308 S40-N410-309 S40-N410-313 S46-U100-350A	<a href="#">Relay A - D installation</a> (on page 6)

## Installation

### **⚠ WARNING**

Turn off the power and disconnect the line cord before installing the new relays. Failure to turn off the power and disconnect the line cord before installing the relays may result in personal injury or death due to electric shock.

Before installing the relays, remove the screws that secure the S46 top cover, and remove the cover.

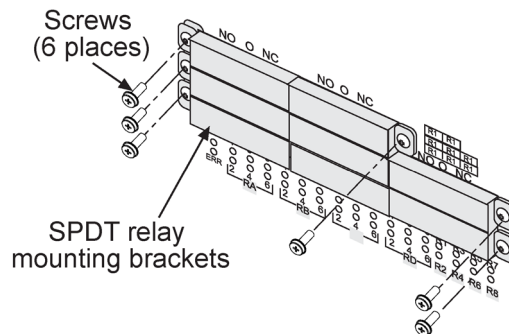
To find the applicable installation procedure for your specific kit, refer to the [Relay kits](#) (on page 1) section.

## SPDT relay 1 through 8 installation

### *To install the SPDT relays 1 through 8*

1. Reference the following figure and remove the six screws that secure the SPDT relay mounting brackets to the S46T chassis.
2. Remove the SPDT assembly from the front panel.

**Figure 1: SPDT relay mounting bracket**

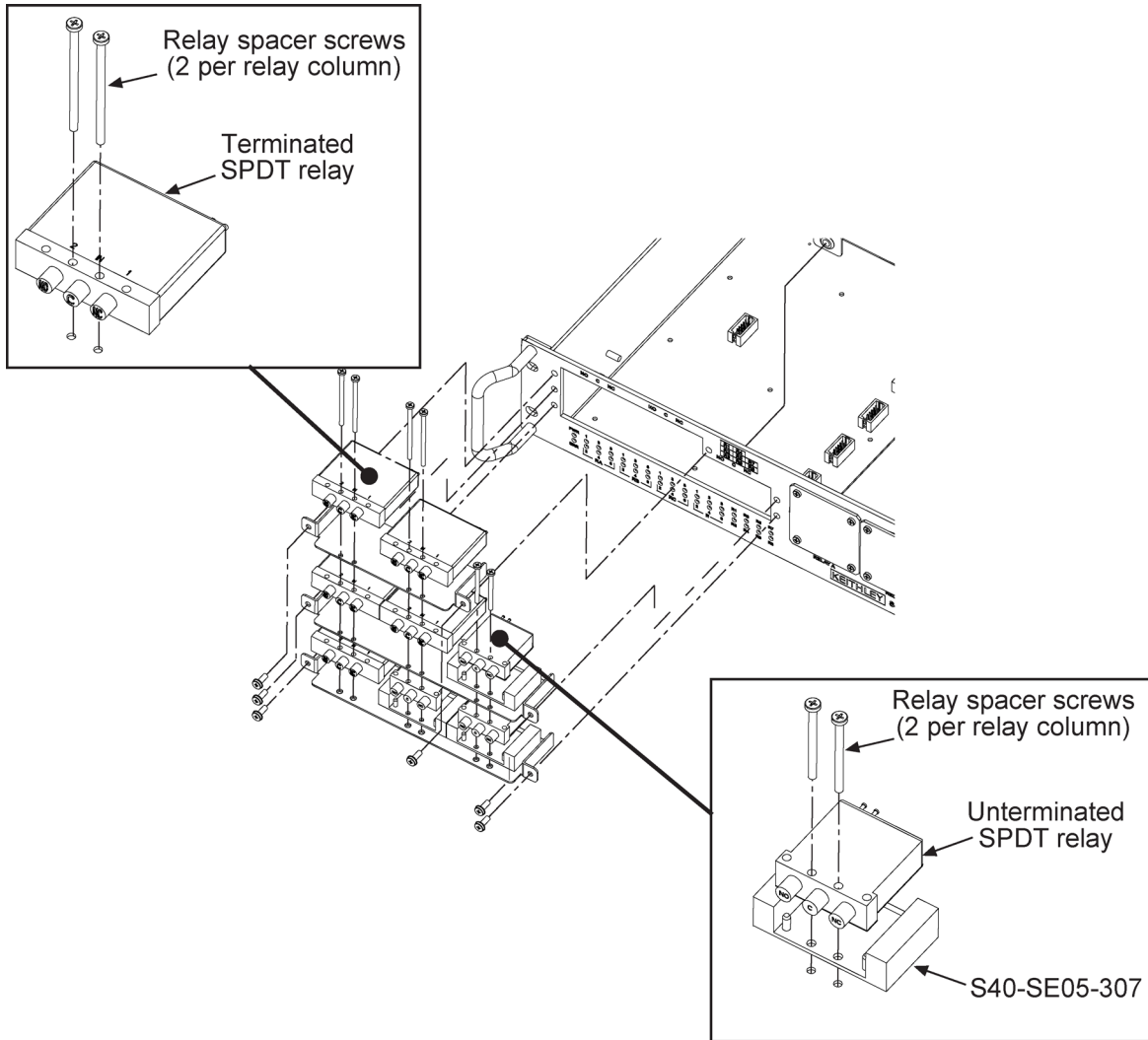


3. Reference the following figure and remove the two screws holding the relay spacers in the relay column containing the desired relay installation location.
4. Loosen the remaining four SPDT screws to facilitate second and third row installation.
5. For terminated relays, replace the spacer in the desired location with the relay. Refer to the inset in the following figure and locate the Terminated SPDT relay installation.  
For unterminated relays, replace the spacer in the desired location with the relay and an S40-SE05-307 spacer. Refer to the inset in the following figure and locate the Unterminated SPDT relay installation.

## NOTE

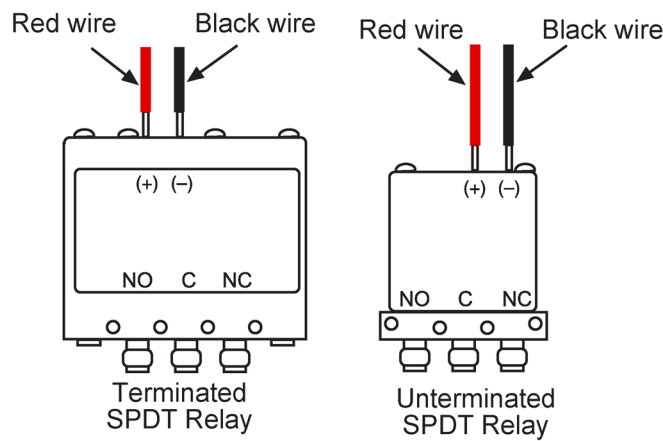
You can install either relay type (terminated or unterminated) in any of the eight available locations. However, you will need to use the shorter relay spacer screws when installing relays on the right side of the instrument column.

**Figure 2: SPDT 1 through 8 relay installation**



6. Install the two screws removed in step 2 in the new relay column.
7. Thread the red and black wires (from the relay) through the PVC Tubing (PVC tubing & TX-52-7 are part of SYS46-311C)(not shown). The TX-52-7 may be cut to a length that will allow the relay assembly to be removed without removing the top cover.
8. Refer to the following figure and solder the two control wires to the terminals of the relay.

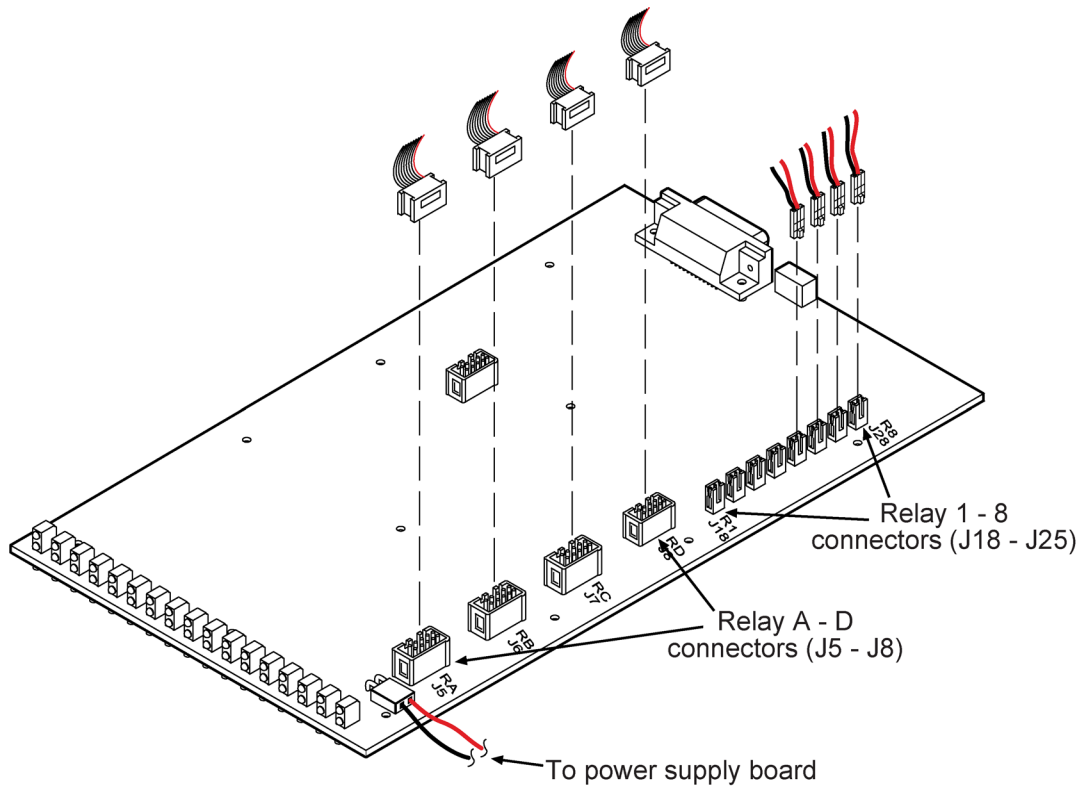
**Figure 3: Connect control wires to the SDPT relay**



9. Install the relay mounting bracket using the screws removed in step 1.
10. Refer to the following table and figure in order to plug the wire connector into the appropriate circuit board connector.
11. Install the top cover and configure the system as indicated in [System configuration](#) (on page 9).

Relay	Connector	Relay	Connector	Relay	Connector
1	J18	5	J22	A	J5
2	J19	6	J23	B	J6
3	J20	7	J24	C	J7
4	J21	8	J25	D	J8

Figure 4: Relay connector locations

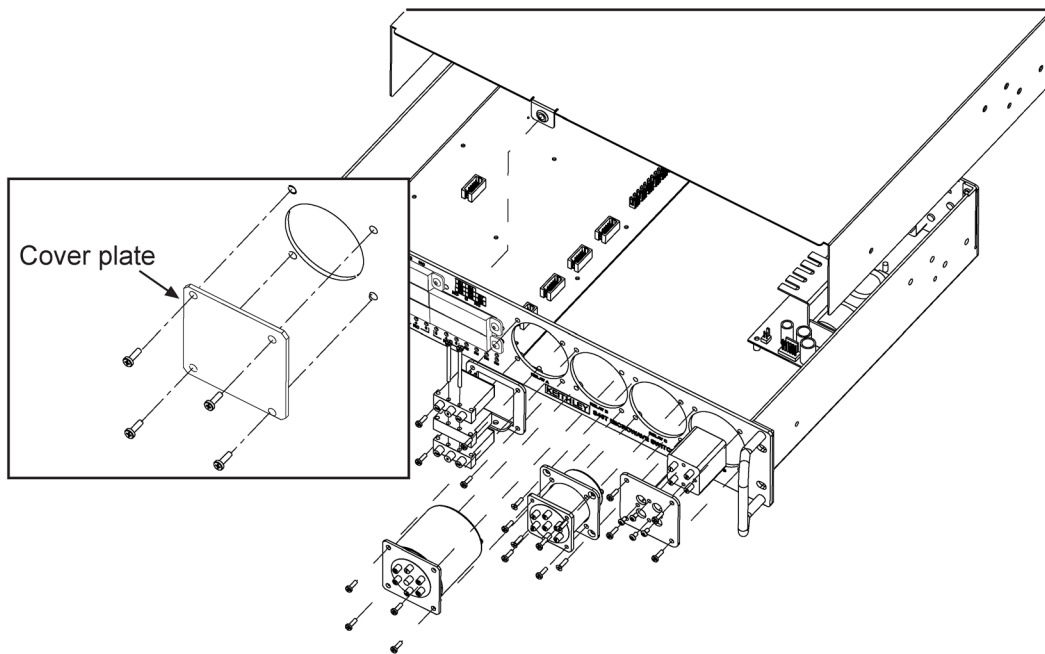


## Relay A through D installation

### *To install A through D relays*

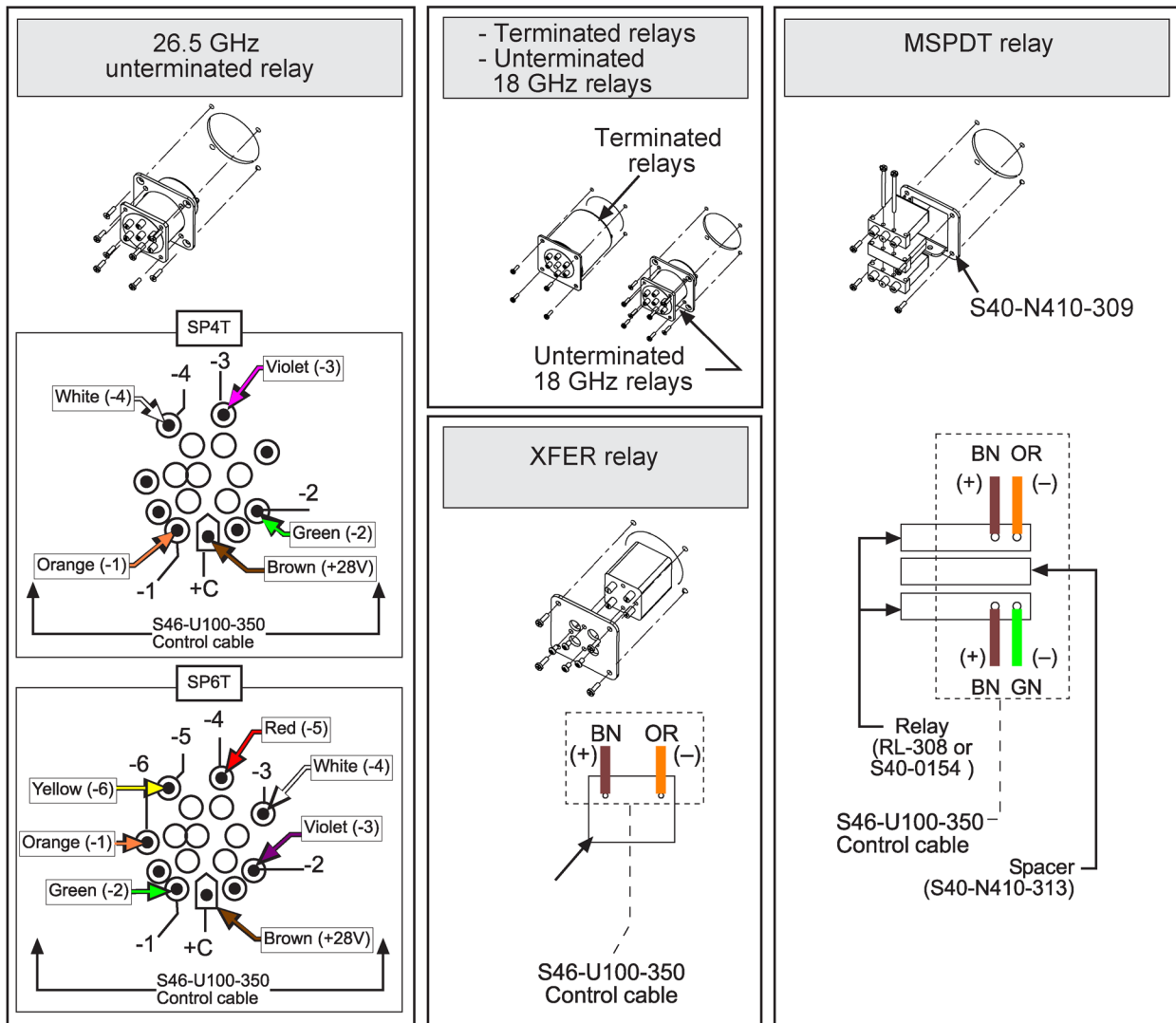
1. Refer to the following figure and remove the four screws securing the cover plate over the mounting hole where the new relay is to be installed.

Figure 5: Relay A through D installation



2. Refer to the following figure to connect and solder the supplied ribbon cable to the following relays: XFER relays (transfer relays); 26.5 GHz unterminated relays; MSPDT relays
3. For the A through D relays, secure the ribbon cable to the relay with the two supplied screws.
4. Using the following figure, install the relay in the mounting hole, and then secure it with the four screws removed in step 1.
5. Plug the ribbon connector into the appropriate circuit board connector (see previous figure).
6. Install the top cover, and then configure the system as covered in (see [System configuration](#) (on page 9)).

Figure 6: Connect control wires A through D relays





## System configuration

After installing the new relays, you must program the S46 for the new relay configuration with the following command:

```
:ROUT:CONF:CPOL <clist>
```

<clist> is defined as follows:

```
clist = (@0 | 3-6, 0 | 3-6, 0 | 3-6, 0 | 1, ... 0 | 1)
Relay: A      B      C      D      1...      8
```

### NOTE

All switch locations must be included in the <clist> whether or not all locations are populated. The numeric value (1 or 3 through 6) indicates the number of throws, while a value of 0 indicates that a location is not populated.

For example, if RELAY A and RELAY B are SP6T, RELAY 1 and RELAY 2 are SPDTs, and all other locations are not populated, the command syntax would be:

```
:ROUT:CONF:CPOL (@6, 6, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0)
```

S46T-MSPDT-KIT and S46T-XFER-KIT are programmed with a value of 3 (not the number of throws as other relays). The MSPDT top relay uses the first channel assignment for relay's A-D, the second channel controls the lower relay. The XFER relay uses the first channel assignment for relay's A-D.

Terminated SP4T relays are programmed with a value of 6. Ports 2, 3, 5 and 6 control channels are used.

See the S46T Instruction Manual (document number S46-901-01) for detailed programming information.

The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with nonhazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product. Refer to the user documentation for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product warranty may be impaired.

The types of product users are:

**Responsible body** is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

**Operators** use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

**Maintenance personnel** perform routine procedures on the product to keep it operating properly, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the user documentation. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

**Service personnel** are trained to work on live circuits, perform safe installations, and repair products. Only properly trained service personnel may perform installation and service procedures.

Keithley products are designed for use with electrical signals that are measurement, control, and data I/O connections, with low transient overvoltages, and must not be directly connected to mains voltage or to voltage sources with high transient overvoltages. Measurement Category II (as referenced in IEC 60664) connections require protection for high transient overvoltages often associated with local AC mains connections. Certain Keithley measuring instruments may be connected to mains. These instruments will be marked as category II or higher.

Unless explicitly allowed in the specifications, operating manual, and instrument labels, do not connect any instrument to mains.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30 V RMS, 42.4 V peak, or 60 VDC are present. A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000 V, no conductive part of the circuit may be exposed.

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance-limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, ensure that the line cord is connected to a properly-grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.


For safety, instruments and accessories must be used in accordance with the operating instructions. If the instruments or accessories are used in a manner not specified in the operating instructions, the protection provided by the equipment may be impaired.


Do not exceed the maximum signal levels of the instruments and accessories. Maximum signal levels are defined in the specifications and operating information and shown on the instrument panels, test fixture panels, and switching cards.

When fuses are used in a product, replace with the same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as protective earth (safety ground) connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.


If a  screw is present, connect it to protective earth (safety ground) using the wire recommended in the user documentation.

The  symbol on an instrument means caution, risk of hazard. The user must refer to the operating instructions located in the user documentation in all cases where the symbol is marked on the instrument.

The  symbol on an instrument means warning, risk of electric shock. Use standard safety precautions to avoid personal contact with these voltages.


The  symbol on an instrument shows that the surface may be hot. Avoid personal contact to prevent burns.

The  symbol indicates a connection terminal to the equipment frame.

If this  symbol is on a product, it indicates that mercury is present in the display lamp. Please note that the lamp must be properly disposed of according to federal, state, and local laws.

The **WARNING** heading in the user documentation explains hazards that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in the user documentation explains hazards that could damage the instrument. Such damage may invalidate the warranty.

The **CAUTION** heading with the  symbol in the user documentation explains hazards that could result in moderate or minor injury or damage the instrument. Always read the associated information very carefully before performing the indicated procedure. Damage to the instrument may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits — including the power transformer, test leads, and input jacks — must be purchased from Keithley. Standard fuses with applicable national safety approvals may be used if the rating and type are the same. The detachable mains power cord provided with the instrument may only be replaced with a similarly rated power cord. Other components that are not safety-related may be purchased from other suppliers as long as they are equivalent to the original component (note that selected parts should be purchased only through Keithley to maintain accuracy and functionality of the product). If you are unsure about the applicability of a replacement component, call a Keithley office for information.

Unless otherwise noted in product-specific literature, Keithley instruments are designed to operate indoors only, in the following environment: Altitude at or below 2,000 m (6,562 ft); temperature 0 °C to 50 °C (32 °F to 122 °F); and pollution degree 1 or 2.

To clean an instrument, use a cloth dampened with deionized water or mild, water-based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., a data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

Safety precaution revision as of June 2017.