

Model 7701 Multiplexer Module

Instructions for use with DAQ6510

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Introduction

The 7701 32-Channel High-Speed Differential Multiplexer Module offers 32 channels of 2-pole or 16 channels of 4-pole multiplexer switching. Its 32 channels can be configured for commonside 4-wire ohms measurements. The channels can also be configured as two independent banks of multiplexers. The 7701 is ideal for RTD or thermistor temperature applications.

Figure 1: 7701 32-Channel Differential Multiplexer Module



Item shipped may vary from model pictured here.

The 7701 includes the following features:

- Configurable for 32 channels of differential measurements, with up to 16 channels of 4-pole measurements
- Two female D-shell connectors are standard for secure hook-up and quick teardown
- 150 V, 1 A capacity for voltage channels; 60 W, 125 VA
- Relay closures stored in onboard memory
- Screw terminal jumpers allow user-configurable DMM connections

The 7701 can be used with the DAQ6510 Data Acquisition and Multimeter System.

NOTE

If you are using this switching module with the 2700, 2701, or 2750, please see *Model 7701 User's Guide*, Keithley Instruments document number PA-769.



Connections and wiring

⚠ WARNING

Connection and wiring procedures in this document are intended for use by qualified personnel only, as described by the types of product users in the [Safety precautions](#) (on page 25). 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

Do not connect signals that may exceed the maximum specifications for the 7701. Refer to the specifications provided in the data sheet. Failure to recognize and observe normal safety precautions could result in personal injury or death.

⚠ WARNING

The 7701 can be configured to be connected to the internal DMM of the instrument using the supplied jumpers and the screw terminals. When connected to the internal DMM, all other modules must be derated to 150 VDC or 150 V_{RMS} (212 V_{PEAK}) for AC waveforms. Failure to recognize and observe normal safety precautions could result in personal injury or death.

Screw terminals

The screw terminals of the 7701 are shown in the following figure. Screw terminals are provided to connect the switching module channels to the instrument. User-configurable screw terminals allow the external input to bypass the switching module channels.

Four jumpers are supplied with the 7701 for use with the screw terminals. As shipped, the jumpers are not installed in the 7701, as shown in the following figure. When the jumpers are not installed, all input to the 7701 is electrically isolated from the DMM.

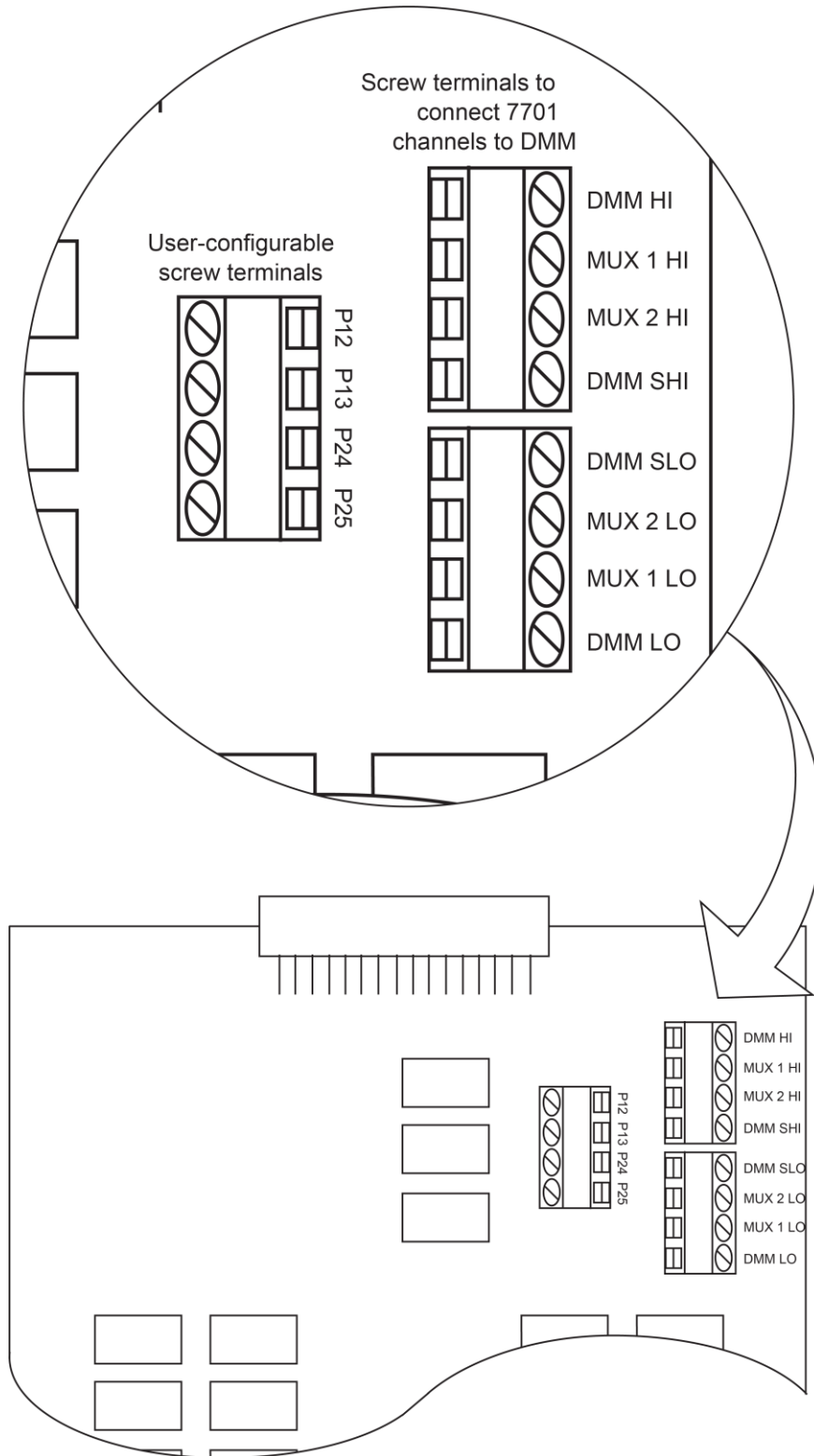
Equipment needed:

- Flat-blade screwdriver
- Cable ties

To make connections to the 7701:

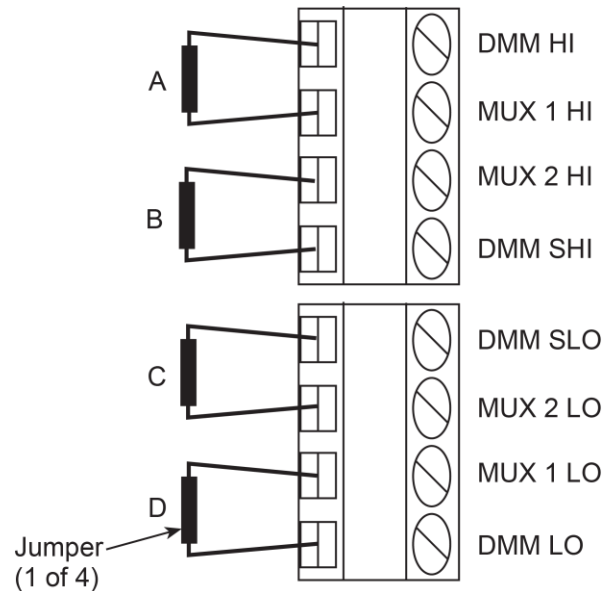
1. Make sure all power is discharged from the 7701 module.
2. Using a screwdriver, turn the access screw to unlock and open the cover.
3. Using the flat-blade screwdriver, loosen the terminal screws and install the wires as needed. The channel designations for the screw terminals are shown in the following figures.

Figure 2: 7701 screw terminals



4. Install the four supplied #22 AWG jumpers in the screw terminals as shown in the following figure. Position the jumpers to allow clearance for the top cover. Make sure the jumper wires do not contact each other or other electrical conductors.
 - Jumper A: Connects the HI terminals of the multiplexer 1 channels (1 to 16) to the DMM Input HI.
 - Jumper B: Connects the HI terminals of the multiplexer 2 channels (17 to 32) to the DMM Sense HI.
 - Jumper C: Connects the LO terminals of the multiplexer 2 channels (17 to 32) to the DMM Sense LO.
 - Jumper D: Connects the LO terminals of the multiplexer 1 channels (1 to 16) to the DMM Input LO.

Figure 3: Jumper installation to connect 7701 channels to DMM

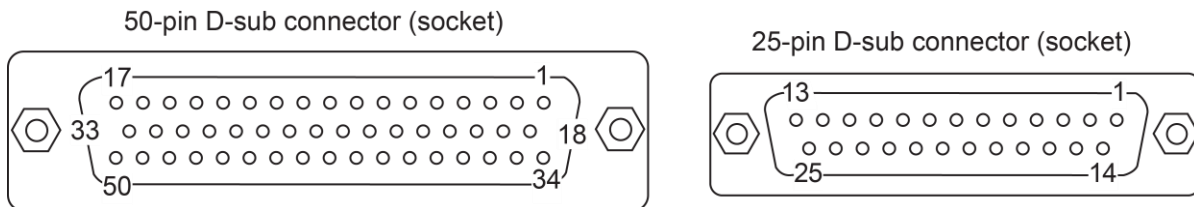


5. Use a flat-blade screwdriver to replace the top cover.

D-sub connectors

The following figure shows the pin numbers for the 7701 rear-panel connectors. The 50-pin D-sub is used to access channels 1 to 24 and Multiplexer 1 terminals. The 25-pin D-sub is used to access channels 25 to 32 and Multiplexer 2 terminals. The user-configurable screw terminals are also accessed at the 25-pin D-sub. Terminal identification for the socket connector pins is provided in the following tables.

Figure 4: 7701 pinouts – rear view



50-pin D-sub connector									
Pin	7701 Terminal	Pin	7701 Terminal	Pin	7701 Terminal	Pin	7701 Terminal	Pin	7701 Terminal
1	Ch 1 Hi	11	Ch 16 Hi	21	Ch 6 Lo	31	Ch 21 Lo	41	Ch 12 Hi
2	Ch 2 Lo	12	Ch 17 Lo	22	Ch 8 Hi	32	Ch 23 Hi	42	Ch 13 Lo
3	Ch 4 Hi	13	Ch 19 Hi	23	Ch 9 Lo	33	Ch 24 Lo	43	Ch 15 Hi
4	Ch 5 Lo	14	Ch 20 Lo	24	Ch 11 Hi	34	Ch 1 Lo	44	Ch 16 Lo
5	Ch 7 Hi	15	Ch 22 Hi	25	Ch 12 Lo	35	Ch 3 Hi	45	Ch 18 Hi
6	Ch 8 Lo	16	Ch 23 Lo	26	Ch 14 Hi	36	Ch 4 Lo	46	Ch 19 Lo
7	Ch 10 Hi	17	MUX 1 Hi	27	Ch 15 Lo	37	Ch 6 Hi	47	Ch 21 Hi
8	Ch 11 Lo	18	Ch 2 Hi	28	Ch 17 Hi	38	Ch 7 Lo	48	Ch 22 Lo
9	Ch 13 Hi	19	Ch 3 Lo	29	Ch 18 Lo	39	Ch 9 Hi	49	Ch 24 Hi
10	Ch 14 Lo	20	Ch 5 Hi	30	Ch 20 Hi	40	Ch 10 Lo	50	MUX 1 Lo

25-pin D-sub connector							
Pin	7701 Terminal	Pin	7701 Terminal	Pin	7701 Terminal	Pin	7701 Terminal
1	Ch 25 Hi	7	Ch 31 Hi	14	Ch 25 Lo	20	Ch 31 Lo
2	Ch 26 Hi	8	Ch 32 Hi	15	Ch 26 Lo	21	Ch 32 Lo
3	Ch 27 Hi	9	MUX 2 Hi	16	Ch 27 Lo	22	MUX 2 Lo
4	Ch 28 Hi	10, 11	Not connected	17	Ch 28 Lo	23	Not connected
5	Ch 29 Hi	12	P12	18	Ch 29 Lo	24	P24
6	Ch 30 Hi	13	P13	19	Ch 30 Lo	25	P25

Wiring

WARNING

You must install a connector cover on an unused D-sub connector. If the connector is left open, an electrical shock hazard may be present. Failure to recognize and observe normal safety precautions could result in personal injury or death.

The 7701 is supplied with one 50-pin IDC ribbon cable connector and one 25-pin IDC ribbon cable connector. These ribbon cable connectors connect to the D-sub connectors of the switching module.

WARNING

When using IDC ribbon cable connections, do not exceed 42 V anywhere in the test system or at the front-panel inputs of the DAQ6510. For higher voltage applications, use larger wire (up to #20 AWG) and solder cup D-sub connectors. Failure to recognize and observe normal safety precautions could result in personal injury or death.

There are two connector kits that have connectors that can be used with the Model 7701:

- **Model 7790 ribbon cable adapter kit:** Contains one DB-50 socket, one DB-50 plug, and one DB-25 ribbon cable plug.
- **Model 7789 50/25-pin solder cup connector kit:** Contains one DB-50 connector and one DB-25 solder cup connector.

IDC ribbon cable connections

Connect an appropriate length of 50-conductor IDC ribbon cable to a 50-pin plug D-sub IDC connector, and connect an appropriate length of 25-conductor IDC ribbon cable to a 25-pin plug D-sub IDC connector. The following table and figure provide terminal identification for the 50-pin ribbon cable connections.

Terminal identification for 50-conductor IDC ribbon cable and 7701 DB-50 connector

Ribbon Cable*:		7701	DB-50	Ribbon Cable*:		7701	DB-50
Conductor	Color	Terminal	Pin #	Conductor	Color	Terminal	Pin #
1	Brown	Ch 1 Hi	1	26	Blue	Ch 13 Lo	42
2	Red	Ch 1 Lo	34	27	Violet	Ch 14 Hi	26
3	Orange	Ch 2 Hi	18	28	Gray	Ch 14 Lo	10
4	Yellow	Ch 2 Lo	2	29	White	Ch 15 Hi	43
5	Green	Ch 3 Hi	35	30	Black	Ch 15 Lo	27
6	Blue	Ch 3 Lo	19	31	Brown	Ch 16 Hi	11
7	Violet	Ch 4 Hi	3	32	Red	Ch 16 Lo	44
8	Gray	Ch 4 Lo	36	33	Orange	Ch 17 Hi	28
9	White	Ch 5 Hi	20	34	Yellow	Ch 17 Lo	12
10	Black	Ch 5 Lo	4	35	Green	Ch 18 Hi	45
11	Brown	Ch 6 Hi	37	36	Blue	Ch 18 Lo	29
12	Red	Ch 6 Lo	21	37	Violet	Ch 19 Hi	13
13	Orange	Ch 7 Hi	5	38	Gray	Ch 19 Lo	46
14	Yellow	Ch 7 Lo	38	39	White	Ch 20 Hi	30
15	Green	Ch 8 Hi	22	40	Black	Ch 20 Lo	14
16	Blue	Ch 8 Lo	6	41	Brown	Ch 21 Hi	47
17	Violet	Ch 9 Hi	39	42	Red	Ch 21 Lo	31
18	Gray	Ch 9 Lo	23	43	Orange	Ch 22 Hi	15
19	White	Ch 10 Hi	7	44	Yellow	Ch 22 Lo	48
20	Black	Ch 10 Lo	40	45	Green	Ch 23 Hi	32
21	Brown	Ch 11 Hi	24	46	Blue	Ch 23 Lo	16
22	Red	Ch 11 Lo	8	47	Violet	Ch 24 Hi	49
23	Orange	Ch 12 Hi	41	48	Gray	Ch 24 Lo	33
24	Yellow	Ch 12 Lo	25	49	White	MUX 1 Hi	17
25	Green	Ch 13 Hi	9	50	Black	MUX 1 Lo	50

* 50-conductor IDC ribbon cable is available from Keithley Instruments. Reference part #15020. You need a 50-conductor flat ribbon cable with 26 AWG wire on 0.050-inch centers rated at 50 V or greater.

The following table and figure provide terminal identification for the 25-pin ribbon cable connections.

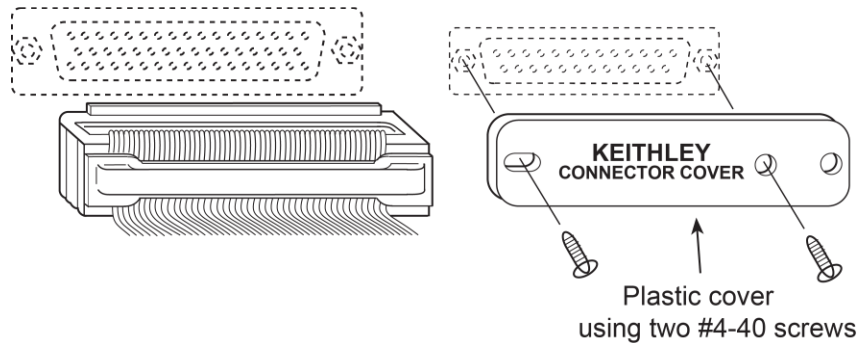
Terminal identification for 25-conductor IDC ribbon cable and 7701 DB-25 connector

Ribbon Cable*:		7701	DB-25	Ribbon Cable*:		7701	DB-25
Conductor	Color	Terminal	Pin #	Conductor	Color	Terminal	Pin #
1	Brown	Ch 25 Hi	1	14	Yellow	Ch 31 Lo	20
2	Red	Ch 25 Lo	14	15	Green	Ch 32 Hi	8
3	Orange	Ch 26 Hi	2	16	Blue	Ch 32 Lo	21
4	Yellow	Ch 26 Lo	15	17	Violet	MUX 2 Hi	9
5	Green	Ch 27 Hi	3	18	Gray	MUX 2 Lo	22
6	Blue	Ch 27 Lo	16	19	White	Not connected	10
7	Violet	Ch 28 Hi	4	20	Black	Not connected	23
8	Gray	Ch 28 Lo	17	21	Brown	Not connected	11
9	White	Ch 29 Hi	5	22	Red	P24	24
10	Black	Ch 29 Lo	18	23	Orange	P12	12
11	Brown	Ch 30 Hi	6	24	Yellow	P25	25
12	Red	Ch 30 Lo	19	25	Green	P13	13
13	Orange	Ch 31 Hi	7				

* 25-conductor IDC ribbon cable is available from Keithley Instruments. Reference part #15025. You need a 25-conductor flat ribbon cable with 28 AWG wire on 0.050-inch centers at 50 V or greater.

The connectors of the prepared ribbon cable assemblies mate to the 50- and 25-pin D-sub connectors of the 7701. If a D-sub connector is unused, make sure the connector cover installed. See the following figure.

Figure 5: Connecting ribbon cable assembly



7789 Solder Cup Adapter Kit cable connections

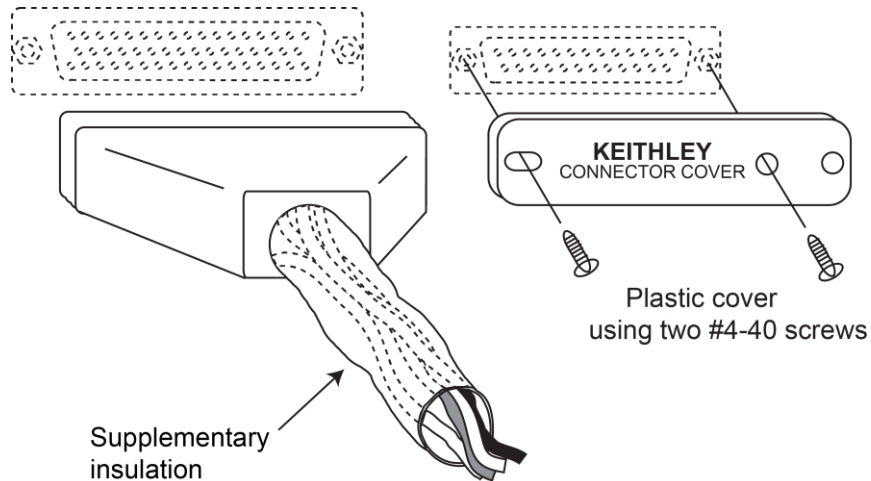
Make all connections to D-sub plug solder cup connectors using the correct wire size up to 20 AWG. Terminal identification for the 50-pin D-sub connector and the 25-pin D-sub connector is provided in the tables in [IDC ribbon cable connections](#) (on page 7). Add supplementary insulation around the harness for voltages above 42 V_{PEAK}, as shown in the following figure.

If a D-sub connector is unused, make sure the connector cover is installed as shown in the following figure.

⚠ WARNING

All solder cup wiring must be rated for the maximum voltage in the system. For example, if 150 V is applied to the front terminals of the instrument, all matrix module wiring must be rated for 150 V. Failure to recognize and observe normal safety precautions could result in personal injury or death.

Figure 6: Connecting solder cup cable assembly



Typical connections

The following examples show typical wiring connections for the following types of measurements:

- Two-wire resistance and thermistor
- Four-wire resistance and RTD
- DC or AC voltage

Figure 7: 2-wire resistance and thermistor connections

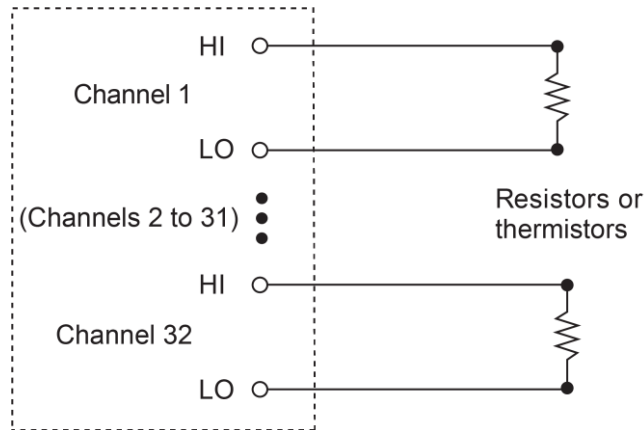


Figure 8: 4-wire resistance and RTD connections

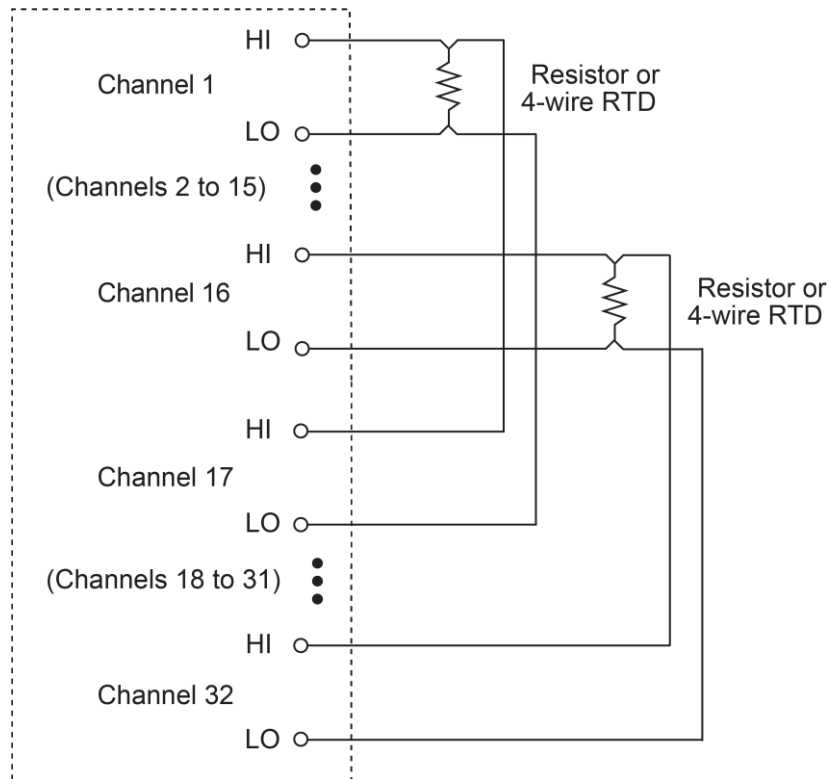
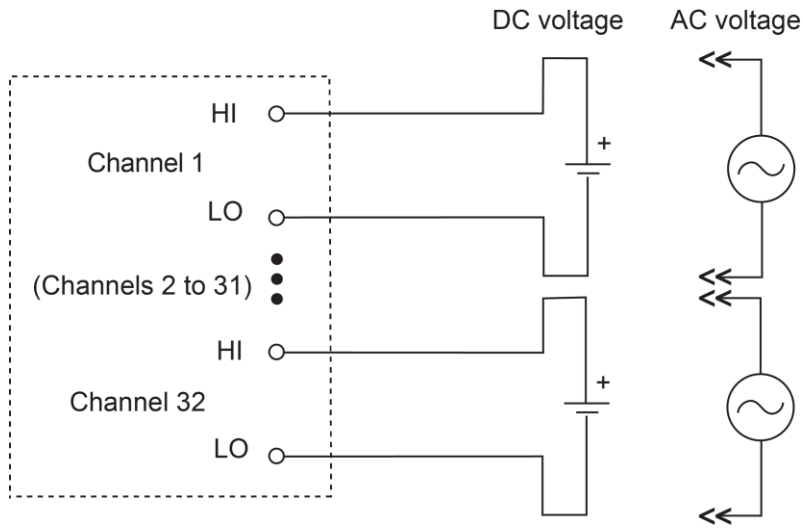


Figure 9: Voltage connections - DC or AC



Connection log

You can use the next table to record your connection information.

Connection log for the 7701

Channel		Color	Description	Description	Color	Channel
MUX 1	H					P12
	L					P13
MUX 2	H					P24
	L					P25
CH1	H				H	CH17
	L				L	
CH2	H				H	CH18
	L				L	
CH3	H				H	CH19
	L				L	
CH4	H				H	CH20
	L				L	
CH5	H				H	CH21
	L				L	
CH6	H				H	CH22
	L				L	
CH7	H				H	CH23
	L				L	
CH8	H				H	CH24
	L				L	
CH9	H				H	CH25
	L				L	
CH10	H				H	CH26
	L				L	
CH11	H				H	CH27
	L				L	
CH12	H				H	CH28
	L				L	
CH13	H				H	CH29
	L				L	
CH14	H				H	CH30
	L				L	
CH15	H				H	CH31
	L				L	
CH16	H				H	CH32
	L				L	

Installation

WARNING

Before operating an instrument with a switching module, verify that the switching module is properly installed and the mounting screws are tightly fastened. If the mounting screws are not properly connected, an electrical shock hazard may be present.

If you are installing two switching modules, it is easier to install one switching module into slot 2 first, then install the second switching module into slot 1.

NOTE

If you have a Keithley Instruments Model 2700, 2701, or 2750 instrument, you can use your existing switching module in the DAQ6510. Follow the instructions in your original equipment documentation to remove the module from the instrument, then use the following instructions to install it in the DAQ6510. You do not need to remove wiring to the module.

NOTE

For inexperienced users, it is recommended that you do not connect a device under test (DUT) and external circuitry to the switching module. This allows you to exercise close and open operations without the dangers associated with live test circuits. You can also set up pseudocards to experiment with switching. Refer to "Pseudocards" in the *Model DAQ6510 Data Acquisition and Multimeter System Reference Manual* for information on setting up pseudocards.

WARNING

To prevent electric shock that could result in injury or death, never handle a switching module that has power applied to it. Before installing or removing a switching module, make sure the DAQ6510 is turned off and disconnected from line power. If the switching module is connected to a DUT, make sure power is removed from all external circuitry.

WARNING

If a card slot is unused, you must install slot covers to prevent personal contact with high voltage circuits. Failure to install slot covers could result in personal exposure to hazardous voltages, which could cause personal injury or death if contacted.

CAUTION

Before installing or removing a switching module, make sure the DAQ6510 power is turned off and disconnected from line power. Failure to comply may result in incorrect operation and loss of data in the memory.

Required equipment:

- Medium flat-blade screwdriver
- Medium Phillips screwdriver

To install a switching module into the DAQ6510:

1. Turn off the DAQ6510.
2. Disconnect the power cord from the power source.
3. Disconnect the power cord and any other cables that are connected to the rear panel.
4. Position the DAQ6510 so you are facing the rear panel.
5. Use the screwdriver to remove the slot cover screws and the cover plate. Retain the plate and screws for future use.
6. With the top cover of the switching module facing up, slide the switching module into the slot.
7. Press the switching module in firmly to make sure the switching module connector is connected to the DAQ6510 connector.
8. Use the screwdriver to tighten the two mounting screws to secure the switching module to the mainframe. Do not overtighten.
9. Reconnect the power cord and any other cables.

Remove a switching module

NOTE

Before you remove a switching module or begin any testing, make sure that all the relays are open. Since some relays may be latched closed, you must open all the relays before removing the switching module to make connections. Additionally, if you drop your switching module, it is possible for some relays to latch closed.

To open all channel relays, go to the CHANNEL swipe screen. Select **Open All**.

WARNING

To prevent electric shock that could result in injury or death, never handle a switching module that has power applied to it. Before installing or removing a switching module, make sure the DAQ6510 is turned off and disconnected from line power. If the switching module is connected to a DUT, make sure power is removed from all external circuitry.

WARNING

If a card slot is unused, you must install slot covers to prevent personal contact with high voltage circuits. Failure to install slot covers could result in personal exposure to hazardous voltages, which could cause personal injury or death if contacted.

CAUTION

Before installing or removing a switching module, make sure the DAQ6510 power is turned off and disconnected from line power. Failure to comply may result in incorrect operation and loss of data in the memory.

Required equipment:

- Medium flat-blade screwdriver
- Medium Phillips screwdriver

To remove a switching module from the DAQ6510:

1. Turn off the DAQ6510.
2. Disconnect the power cord from the power source.
3. Disconnect the power cord and any other cables that are connected to the rear panel.
4. Position the DAQ6510 so you are facing the rear panel.
5. Use the screwdriver to loosen the mounting screws that secure the switching module to the instrument.
6. Carefully remove the switching module.
7. Install a slot plate or another switching module in the empty slot.
8. Reconnect the power cord and any other cables.

Operation

Refer to the instrument documentation for operating instructions.

This switching module does not support current measurements. If the instrument has the TERMINALS switch set to REAR and you are working with the slot that contains this switching module, the AC, DC, and digitize current functions are not available. You can measure current using the front panel or using another slot that contains a switching module that supports the AC, DC, and digitize current measurements.

If you use remote commands to attempt to measure current when configuring a channel, an error is returned.

Module configuration schematic

The following figure shows a simplified schematic diagram of the 7701 module. The 7701 has input channels that are grouped into two banks of 16 channels (32 channels total). A backplane isolation relay is provided for each bank. The first bank contains channels 1 to 16 while the second bank contains channels 17 to 32. Each input channel of the 32-channel multiplexer module is wired with separate inputs for HI/LO, providing fully isolated inputs.

As shown in the following figure, all 7701 channels are isolated from the DMM of the DAQ6510 by screw terminals. To connect the switching module channels to the DMM, you must install the supplied jumpers, as described in [Screw terminals](#) (on page 2).

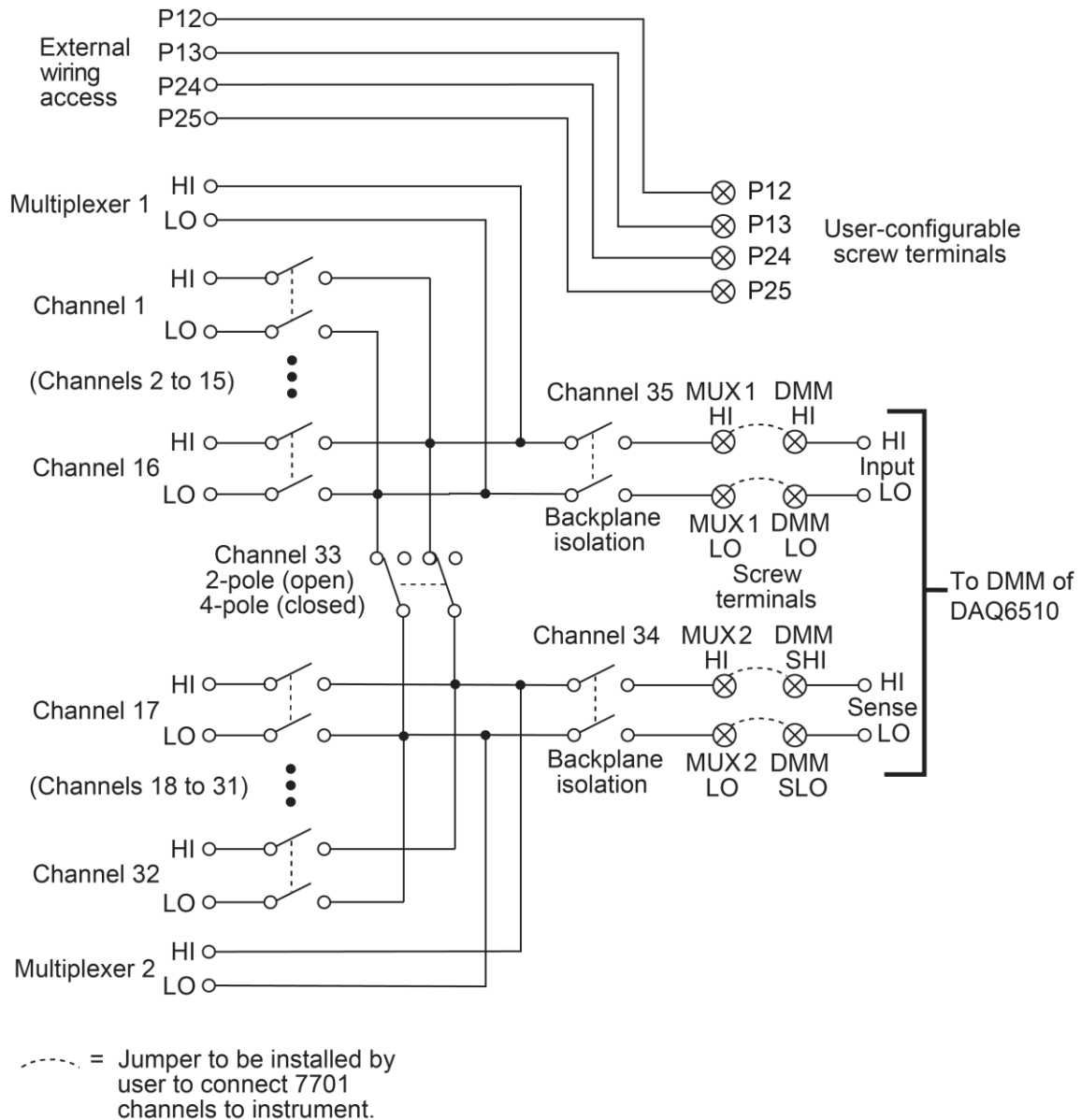
For added flexibility, the 7701 is equipped with four extra screw terminals. These user-configurable screw terminals are hard-wired to the DB-25 socket connector of the switching module. These screw terminals allow you to use an external input to bypass the switching module channels.

Although the 7701 relays are the latching type (relays hold their state even after power has been removed), all relay states are set to open a few seconds after either a power cycle or a reset command is issued.

With a 2-wire function selected (such as DCV), channels 1 to 32 can be closed. When one of these channels is closed, channel 35 automatically closes to connect the channel to the DMM Input.

With a normal 4-wire function selected (such as 4-wire resistance), channels 1 to 16 can be closed. These 16 channels are paired to channels 17 to 32 (channel 1 paired to channel 17, channel 2 paired to channel 18, and so on). When one of these system channels is closed, its paired channel and channels 33 and 34 also close to connect the DUT to the DMM.

Figure 10: 7701 simplified schematic



NOTE

The 7701 is rated for low-voltage applications. When connecting the 7701 to the internal DMM using the screw terminals, all other modules in the mainframe must be derated to 150 VDC or 150 V_{RMS} (212 V_{PEAK}) for AC waveforms.

NOTE

Channels 33 to 35 in this schematic refer to designations used for control and are not available channels.

NOTE

Channels 33, 34, and 35 can be individually controlled. For more information, refer to "Multiple channel operation" in the instrument reference manual.

Applications

⚠ WARNING

The following applications use multiple channel operation, where each channel is controlled independently. Multiple channel operation should only be performed by experienced test engineers who recognize the dangers associated with multiple channel closures. Failure to recognize and observe normal safety precautions could result in personal injury or death.

Refer to "Multiple channel operation" in the instrument reference manual for additional information.

Commonside 4-wire resistance measurements

When using 4-wire resistance measurements and normal channel operation, the instrument can test up to 16 DUTs. By using multiple channel operation and the user-configurable screw terminals, the instrument can test up to 32 DUTs using 4-wire resistance. An example of this test system is shown in the figure following the table.

All 32 DUTs are connected to a common metal bus. The bus is connected directly to Input HI and Sense HI of the DMM through the user-configurable screw terminals. The 32 measurement channels can be used to connect the other side of each DUT to Input LO and Sense LO of the DMM.

For this application, control channels 33 and 35 as follows:

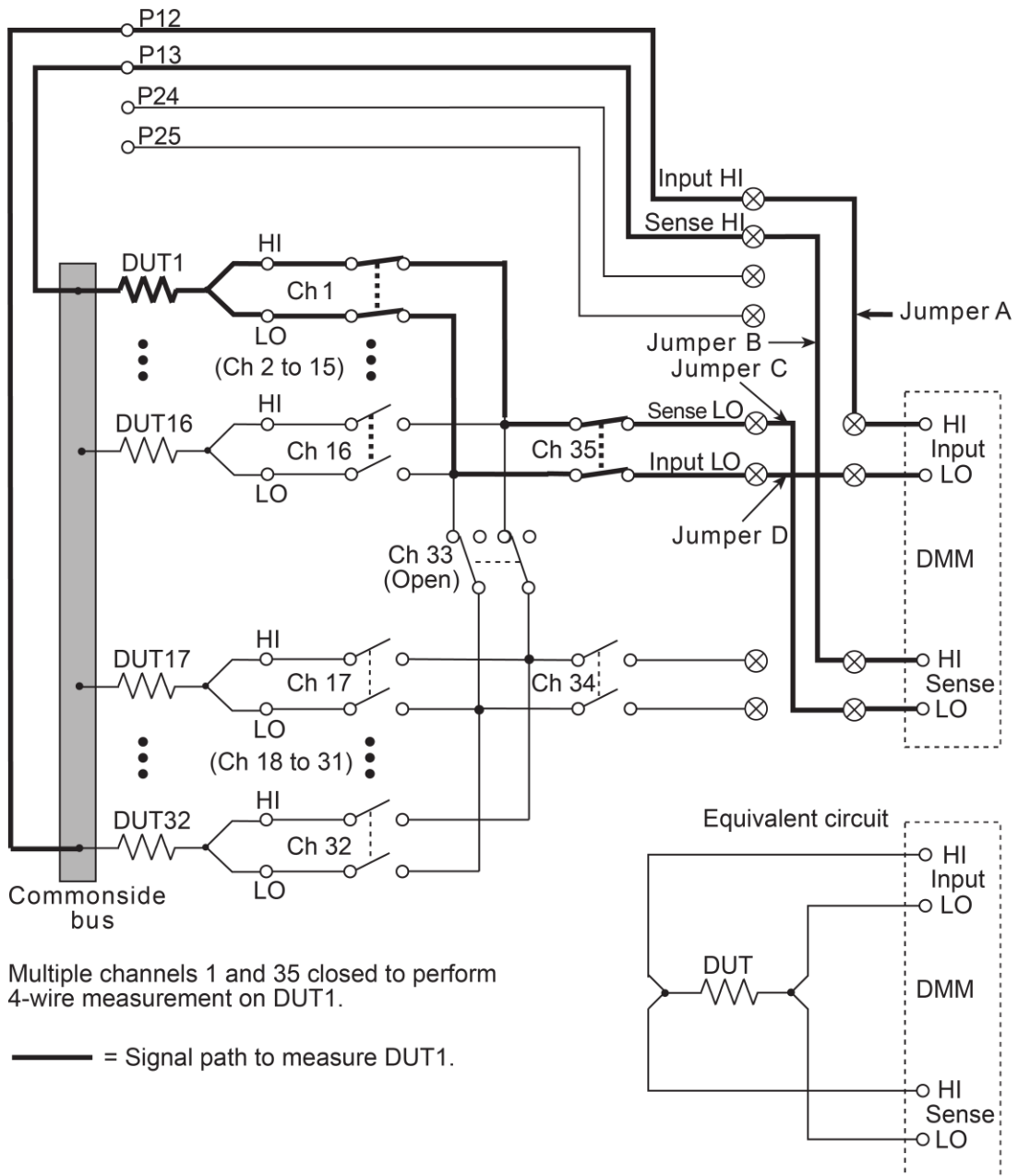
- Opening channel 33 connects Multiplexer 1 (channels 1 to 16) to Multiplexer 2 (channels 17 to 32). Channel 33 must remain open for all DUT tests.
- Closing channel 35 connects a measurement channel (1 to 32) to the DMM Input. Channel 35 must remain closed for all DUT tests.

In the figure following the table, channels 1 and 35 are closed to test DUT 1. The tests for the other DUTs are similar except that different measurement channels are closed, as shown in the following table.

Tested Device	Closed Channels	Tested Device	Closed Channels	Tested Device	Closed Channels	Tested Device	Closed Channels
DUT 1	1 and 35	DUT 9	9 and 35	DUT 17	17 and 35	DUT 25	25 and 35
DUT 2	2 and 35	DUT 10	10 and 35	DUT 18	18 and 35	DUT 26	26 and 35
DUT 3	3 and 35	DUT 11	11 and 35	DUT 19	19 and 35	DUT 27	27 and 35
DUT 4	4 and 35	DUT 12	12 and 35	DUT 20	20 and 35	DUT 28	28 and 35
DUT 5	5 and 35	DUT 13	13 and 35	DUT 21	21 and 35	DUT 29	29 and 35
DUT 6	6 and 35	DUT 14	14 and 35	DUT 22	22 and 35	DUT 30	30 and 35
DUT 7	7 and 35	DUT 15	15 and 35	DUT 23	23 and 35	DUT 31	31 and 35
DUT 8	8 and 35	DUT 16	16 and 35	DUT 24	24 and 35	DUT 32	32 and 35

In the figure below, the bold lines show the signal path to test DUT 1.

Figure 11: Commonsense 4-wire test system (multiple-channel operation)



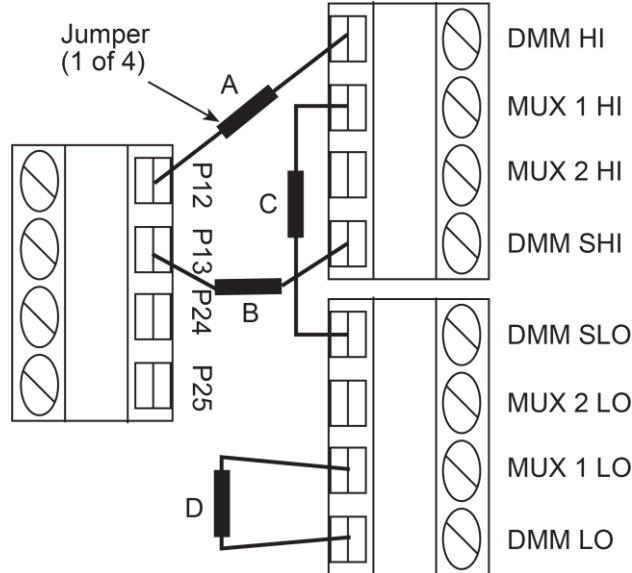
Jumper installation for 4-wire commonside ohms application

Jumper installation for the commonside 4-wire resistance test system is shown in the following figure.

In the following figure:

- Jumper A: Connects the DUT commonside bus (P12) to DMM Input HI.
- Jumper B: Connects the DUT commonside bus (P13) to DMM Sense HI.
- Jumper C: Connects the DUT to DMM Sense LO through the switching channels.
- Jumper D: Connects the DUT to DMM Input LO through the switching channels.

Figure 12: Jumper installation for commonside 4-wire resistance test system



Test setup

On the front panel of the DAQ6510, set TERMINALS to **REAR** for this test.

Test procedure

You must run this application using remote commands with the switching module in slot 1.

The following example shows how to remotely configure for commonside ohms, then sequentially make measurements on DUTs 1 to 32 (as shown in the figure above). Repeat these steps for the channel sequentially for each DUT (2 to 32). The example then demonstrates how to returns the data from the reading buffer and open all channels.

Using SCPI commands

```
ROUTe:OPEN:ALL
SENSe:FUNcTION "FRESistance", (@101:132)
ROUTe:CSOhms (@slot1), ON
ROUTe:CLOSe (@101)
READ?
```

Repeat closing and reading channels for each DUT (channels 102 to 131).

```
ROUTe:CLOSe (@132)
READ?
TRACe:DATA? 1, 32, "defbuffer1"
ROUTe:OPEN:ALL
```

Using TSP commands

```
channel.open("allslots")
channel.setdmm("slot1", dmm.ATTR_MEAS_FUNCTION, dmm.FUNC_4W_RESISTANCE)
channel.setcommonsense("slot1", channel.ON)
channel.close("101")
print(dmm.measure.read())
```

Repeat closing and reading channels for each DUT (channels 102 to 131).

```
channel.close("132")
print(dmm.measure.read())
printbuffer(1, defbuffer1.n, defbuffer1)
channel.open("allslots")
```

Biasing and measuring DUTs (dual multiplexing)

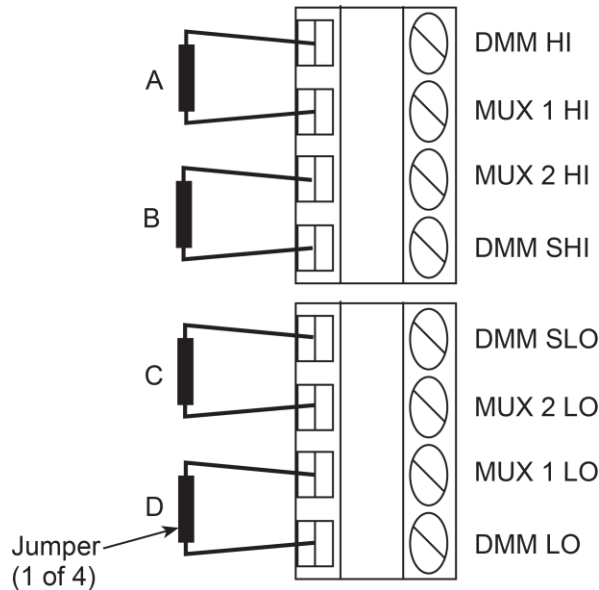
⚠ WARNING

Multiple channel operation is required for the following application. Multiple channel operation should only be performed by experienced test engineers who recognize the dangers associated with multiple channel closures. Failure to recognize and observe normal safety precautions could result in personal injury or death.

This application demonstrates how to use the 7701 as a dual multiplexer to bias and measure 16 DUTs. An external source powers the DUT, while the DMM of the DAQ6510 measures the output of the DUT. To prevent overloading of the external source, each DUT is powered and measured separately.

For this application, the jumpers must be set as shown in the following figure. Refer to [Screw terminals](#) (on page 2) for more information on setting the jumpers.

Figure 13: Jumper installation to connect 7701 channels to DMM



The figure after the table shows the connections for this application. The external source is connected to the Multiplexer 2 terminals of the switching module, and a DUT is connected to channels 1 to 16. Channels 17 to 32 are used to connect external power to each DUT.

For this application, channels 33, 34, and 35 are controlled as follows:

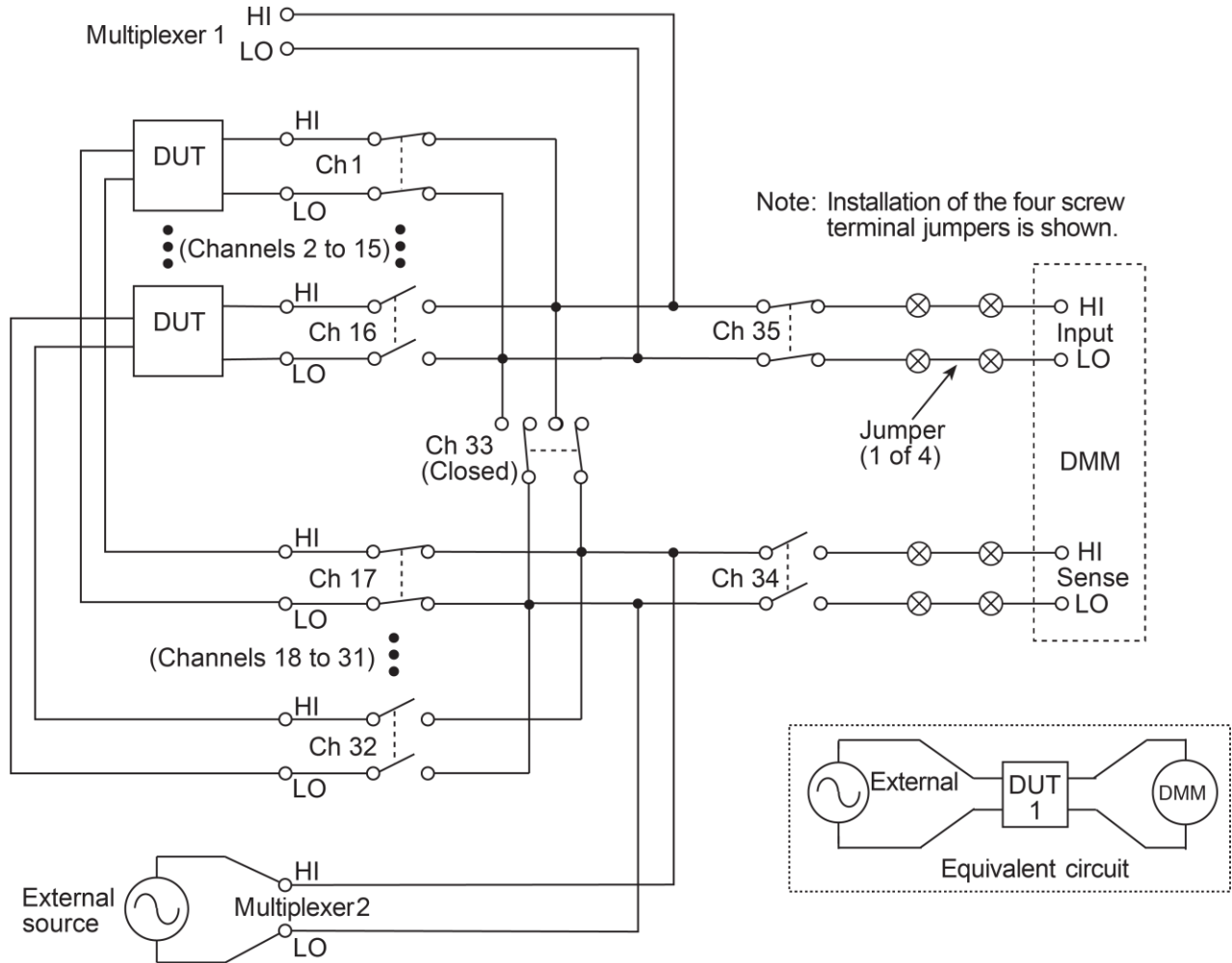
- Closing channel 33 isolates the input measurement channels 1 to 16 (Multiplexer 1) from the external source channels 17 to 20 (Multiplexer 2). It also connects the DUT to the external source. This channel must remain closed while testing a DUT.
- Opening channel 34 isolates the external source from the backplane of the DAQ6510. This channel must remain open while testing a DUT.
- Closing channel 35 connects an input channel (1 to 16) to the DMM. This channel must remain closed while testing a DUT.

Closed channels for each DUT test are listed in the following table.

Tested Device	Closed Channels	Tested Device	Closed Channels
DUT 1	1, 17, 33, and 35	DUT 9	9, 25, 33, and 35
DUT 2	2, 18, 33, and 35	DUT 10	10, 26, 33, and 35
DUT 3	3, 19, 33, and 35	DUT 11	11, 27, 33, and 35
DUT 4	4, 20, 33, and 35	DUT 12	12, 28, 33, and 35
DUT 5	5, 21, 33, and 35	DUT 13	13, 29, 33, and 35
DUT 6	6, 22, 33, and 35	DUT 14	14, 30, 33, and 35
DUT 7	7, 23, 33, and 35	DUT 15	15, 31, 33, and 35
DUT 8	8, 24, 33, and 35	DUT 16	16, 32, 33, and 35

In the following figure, channels 1 and 17 are closed to test DUT 1. The test for the other DUTs is similar except that different source and measure channels are closed.

Figure 14: Biasing and measuring DUT test system



Test setup

On the front panel of the DAQ6510, set TERMINALS to **REAR** for this test.

Test procedure

You must run this application using remote commands with the switching module in slot 1.

In this example, you:

- Open all channels.
- Close channel 133.
- Close channel 135.
- Close channel 101.
- Close channel 117.

Repeat these steps for the channel for sequentially for each DUT as shown in the previous table. After all tests are complete, open all channels.

SCPI commands

```
ROUTE:OPEN:ALL
SENSe:FUNcTION "VOLTage:DC"
ROUTE:MULTiple:CLOSe (@133)
ROUTE:MULTiple:CLOSe (@135)
ROUTE:MULTiple:CLOSe (@101)
ROUTE:MULTiple:CLOSe (@117)
READ?
ROUTE:MULTiple:OPEN (@101, 117)
```

TSP commands

```
channel.open("allslots")
dmm.measure.func = dmm.FUNC_DC_VOLTAGE
-- Close channel 33 to isolate measure channels (1 to 16) from source channels (17 to
32).
channel.multiple.close("133")
--Close channel 35 to connect measure channels (1 to 16) to the DMM Input.
channel.multiple.close("135")
-- Close channel 1 to test DUT1.
channel.multiple.close("101")
--Close channel 17 to connect DUT 1 to the external source.
channel.multiple.close("117")
--Measure DUT1
print(dmm.measure.read())
-- Open channel 1 and 17 to disconnect DUT1 from the DMM.
channel.multiple.open("101,117")
```

Factory service

To return the switching module to Keithley Instruments for repair:

- Call the Repair Department at 1-800-833-9200 or send an email to RMAREQUEST@tektronix.com for a Return Material Authorization (RMA) number.
- Carefully pack the instrument in the original packing carton.
- Write **ATTENTION REPAIR DEPARTMENT** and the RMA number on the shipping label.

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.