

Keysight 34931A-34933A Matrix Modules

Notices

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Manual Part Number

34980-90031

Edition

Edition 4, Aug 2022

Printed in:

Printed in Malaysia

Published by:

Keysight Technologies
Bayan Lepas Free Industrial Zone,
11900 Penang, Malaysia

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Safety Information

CAUTION















A CAUTION notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in damage to the product or loss of important data. Do not proceed beyond a CAUTION notice until the indicated conditions are fully understood and met.

WARNING

A WARNING notice denotes a hazard. It calls attention to an operating procedure, practice, or the like that, if not correctly performed or adhered to, could result in personal injury or death. Do not proceed beyond a WARNING notice until the indicated conditions are fully understood and met.

Safety Symbols

The following symbols or markings that may be on or with the instrument and in the documentation indicate precautions which must be taken to maintain safe operation of the instrument.

	Alternating current (AC)		Caution, risk of electric shock
	Frame or chassis (ground) terminal		Caution, risk of danger (refer to this manual for specific Warning or Caution information)
	Standby supply. Unit is not completely disconnected from ac mains when switch is off		Direct current (DC)
	Off (mains supply)		On (mains supply)
	Three phase alternating current		Presence of a laser device
	Protective earth (ground) terminal		Equipment protected throughout by double insulation or reinforced insulation
	Caution, hot surface		Product is sensitive to electrostatic discharge

Additional Safety Notices

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings or instructions elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Keysight Technologies assumes no liability of the customer's failure to comply with the requirements.

WARNING

Refer to the 34980A User's Guide before using the equipment. The 34980A User's Guide contains additional important information about the modules.

WARNING

GENERAL

If this product is not used as specified in the operating instructions, the protection provided by the equipment could be impaired. This product must be used in a normal condition (in which all means for protection are intact) only. Any external connections must be made prior to applying power.

CAUTION

This instrument has auto-ranging line voltage input. Be sure the supply voltage is within the specified range and voltage fluctuations do not to exceed 10 percent of the nominal supply voltage.

NOTE

Pollution Degree 1: No pollution or only dry, non-conductive pollution occurs. The pollution has no influence (on insulation).

Pollution Degree 2: Normally only non-conductive pollution occurs. Occasionally, a temporary conductivity (leakage current between isolated conductors) caused by condensation can be expected.

WARNING**GROUND THE INSTRUMENT**

This is a Safety Protection Class I Product (provided with a protective earthing ground incorporated in the power cord). The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. Any interruption of the protective conductor inside or outside of the product is likely to make the product dangerous. Intentional interruption is prohibited. The mains wiring and connectors shall be compatible with the connector used in the premise electrical system. Inadequate earth grounding can damage the instrument. Always use the three-prong AC power cord supplied with the instrument.

Connect the AC power cord as follow:

- Ensure that the power cord is not damaged.
 - Install the signal generator so that one of the following items is readily identifiable and easily reached by the operator: AC power cord, alternative switch or circuit breaker.
 - Insert the mains plug into a socket outlet provided with a protective earth grounding.
-

WARNING

Do not use the instrument if it is damaged. Before you use the instrument inspect all connections. Pay particular attention to the insulation surrounding connectors and / or cable assembly insulation. NEVER use a cable showing any signs of damage. Faulty cables can cause electrical shock and /or fire hazards and could lead to personal injury or death.

WARNING

Safety of any system incorporating the equipment is the responsibility of the assembler of the system.

WARNING

The detachable power cord is the instrument disconnecting device. It disconnects the mains circuits from the mains supply before other parts of the instrument. The front panel switch is only a standby switch and is not a LINE switch (disconnecting device). The instrument power cord does not disconnect or de-energize external circuits connected to the analog bus, terminal blocks or modules.

WARNING

Keysight Customers utilizing the Open Platform Test Systems are classified as follows and require the user to have the appropriate skillset:

Operator: Interacts with the test system in a production environment, selection of test sequences, defining variables, running tests (test results, test statistics, control of marking devices)

Supervisor: Includes access to maintenance functions and utility sequences (control of hardline system functions, access to test area)

Developer: Full access

WARNING

Dangerous voltage levels capable of causing death, may be present on a channel. Use extreme caution when handling and testing and adjusting this instrument. Any voltages greater than 30 Vrms, 42.4 Vpeak and 60 Vdc are considered hazardous (IEC 61010-1).

WARNING

The maximum common mode input to any one system component within the system installation is not to exceed the maximum stated ratings.

WARNING

When interconnecting system components, the overall system maximum allowable input rating of the system would default to the lowest rating of any one system component.

WARNING

Removal of the instrument's cover is to be conducted by qualified personnel only. Only qualified, trained personnel who are aware of the hazards involved should remove instrument covers. Prevent operators from accessing any external circuits, test fixtures, cables or wherever hazardous voltages may be present. Failure to recognize and observe normal safety precautions could result in personal injury or death.

WARNING

Under certain conditions, dangerous voltage levels capable of causing injury or death may remain even after external circuits have been disconnected. To avoid electrical shock, remove the main power cord from the 34980A and ensure all connections to the DUT, including field wiring to the instrument and the analog bus (if present) are deenergized and all circuits are discharged before coming in contact with the system. Ensure no hazardous voltages remain on any accessible before handling any part of the instrument and test setup, making connections to the system, removing covers or cleaning the instrument.

WARNING

High Energy Sources: The Analog Buses are designed to handle inputs up to their rated currents or their rated powers, whichever is less. Under certain fault conditions, high energy sources could provide substantially more current or power than the instrument can handle. It is important to provide external current limiting, such as fuses if the inputs are connected to high-energy sources. The overcurrent protection is to be rated for the maximum available short circuit current of the hazardous sources. Ensure that the current limiting devices / snubber circuits are appropriate for the signal being tested. Failure to do so may result in hazardous conditions such as fire or shock and could lead to personal injury or death. Refer to [34980A Current Limiting Graphs](#) for the current limiting graphs of 34890A.

WARNING

Do not connect the Analog Buses directly to a mains power outlet. If it is necessary to measure a mains voltage or any circuit where a large inductive load may be switched, you must add signal conditioning elements to reduce the potential transients before they reach the Analog Buses. Refer to User's Guide for the maximum rated transients for each external source.

WARNING

When working with dangerous voltage levels, intentionally closing of multiple bus and channel relays could cause a potentially lethal hazard on external connections. Use extreme caution when handling and testing and adjusting this instrument. 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

No operator serviceable parts inside. Do not install substitute parts or perform any unauthorized modifications to the instrument. Return the instrument to Keysight for service and repair to ensure the safety features are maintained in operational condition. Instruments that appear damaged or defective should be made inoperative and secured against unintended operation.

WARNING

To prevent electrical shock, disconnect the instrument from mains and external circuits before cleaning. Use a dry cloth or one slightly dampened with water (or 70% Isopropyl Alcohol) to clean the external case parts. Do not attempt to clean internally. Allow any moisture to evaporate prior to energizing the instrument.

WARNING

This product is designed for use in INSTALLATION CATEGORY II and POLLUTION DEGREE 1 and 2 (See module specifications for ratings for each Pollution Degree environment).

WARNING

The AC Voltage source (outlet) must be in proper working order and provide a secure electrical connection. Do not use the outlet if the power cord makes a loose connection or if the power cord plug does not match the outlet. Do not use the outlet if it is damaged or if the voltage is outside the required range.

WARNING

ENVIRONMENTAL HEALTH & SAFETY: When any channel is connected to a hazardous voltage source, the instrument and the device under test should be supervised, following local EHS practices to restrict access.









Environmental Conditions

Keysight 34980A is designed for indoor use in an installation category II and low condensation environment. Table below shows the general environmental conditions for this instrument. Refer to the product data sheet at <https://literature.cdn.keysight.com/litweb/pdf/5989-1437EN.pdf> for more information on the instrument general specifications.

General specifications	Requirement
Temperature	Operating condition: 0°C to 55°C Storage condition: -40°C to 70°C
Humidity	Maximum Relative Humidity (non-condensing): 80% RH up to 40°C, decreases linearly to 37% RH at 55°C ^[a]
Altitude	Up to 2,000 m
Pollution degree	1 or 2

[a] From 40°C to 55°C, the maximum % Relative Humidity follows the line of constant dew point.

Regulatory Markings

	<p>The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives.</p>		
	<p>The UK conformity mark is a UK government owned mark. Products showing this mark comply with all applicable UK regulations.</p>		
<p>CAN ICES/NMB-001(A)</p>	<p>This indicates that this ISM device complies with the Canadian ICES-001. Interference-Causing Equipment Standard for industrial, scientific and medical (ISM) equipment. Matériel industriel, scientifique et médical (ISM)</p>	<p>ISM 1-A</p>	
	<p>The CE mark is a registered trademark of the European Community. This CE mark shows that the product complies with all the relevant European Legal Directives.</p> <p>ICES/NMB-001 indicates that this ISM device complies with the Canadian ICES-001.</p> <p>Cet appareil ISM est conforme à la norme NMB-001 du Canada.</p> <p>ISM GRP.1 Class A indicates that this is an Industrial Scientific and Medical Group 1 Class A product.</p>		
	<p>This symbol is a South Korean Class A EMC Declaration. This is a Class A instrument suitable for professional use and in electromagnetic environment outside of the home.</p>		



This symbol indicates the time period during which no hazardous or toxic substance elements are expected to leak or deteriorate during normal use. Forty years is the expected useful life of the product.



This instrument complies with the WEEE Directive (2002/96/EC) marking requirement. This affixed product label indicates that you must not discard this electrical or electronic product in domestic household waste.



Universal recycling symbol.

IP x y

This mark indicates product has been designed to meet the requirements of "IP x y", where "x" is the solid particle protection and "y" is the liquid ingress protection.

Waste Electrical and Electronic Equipment (WEEE) Directive 2002/96/EC

The crossed out wheeled bin symbol indicates that separate collection for waste electric and electronic equipment (WEEE) is required, as obligated by the EU DIRECTIVE and other National legislation.

Please refer to [keysight.com/go/takeback](https://www.keysight.com/go/takeback) to understand your Trade in options with Keysight in addition to product takeback instructions.



Sales and Technical Support

To contact Keysight for sales and technical support, refer to the support links on the following Keysight websites:

- www.keysight.com/find/34980a
(product-specific information and support, software and documentation updates)
- www.keysight.com/find/assist
(worldwide contact information for repair and service)

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Matrix Modules

This User's Guide covers the following three plug-in modules for the Keysight 34980A Multifunction Switch/Measure Unit:

34931A	Dual 4x8 armature matrix
34932A	Dual 4x16 armature matrix
34933A	Dual/Quad 4x8 reed matrix

The 34931A has two (dual) matrices of latching armature switches. Each matrix is organized in a 4-row by 8-column configuration.

The 34932A has two (dual) matrices of latching armature switches. Each matrix is organized in a 4-row by 16-column configuration.

The 34933A has non-latching reed switches, which you can configure for:

- differential (2-wire) mode, which has two (dual) matrices. Each matrix is organized in a 4-row by 8-column configuration.
- single-ended (1-wire) mode, which has four (quad) matrices. Each matrix is organized in a 4-row by 8-column configuration.

These matrix switch modules offer a convenient way for you to connect multiple instruments to multiple points on your device under test. For a lower cost and better specification alternative, you can connect both matrix and multiplexer (MUX) modules.

Operating Considerations

Connection to Voltage Sources

WARNING

Modules 34931A, 34932A, 34933A:

It is possible to connect more than one power source at the same time with a matrix. Ensure that dangerous or unwanted conditions are not created by these connections. Failure to recognize or observe normal safety precautions could result in equipment damage and may result in hazardous conditions such as fire or shock and could lead to personal injury or death.

NOTE

Safety Interlock The Analog Buses of the 34980A are capable of carrying 300V signals. The matrix modules have a hardware *Safety Interlock* feature that automatically opens the Analog Bus relays when the associated interlock pins on the D-sub connectors (faceplate) lose continuity. This prevents signals on the Analog Buses from being present on the D-sub connector pins. Optional terminal blocks available from Keysight automatically provide continuity for these interlock pins. If cables are used, you must provide continuity for the interlock pins in your DUT assembly. See the pinout information later in this manual for the location of interlock pins on each module.

The matrix modules have Analog Bus relays on Bank 2 only. Therefore, the interlock pins are present on only the Bank 2 D-sub connectors.

Normally, if you attempt to connect to the Analog Buses without a terminal block or cable connected, an error is generated. The `SYSTEM:ABUS:INTERlock:SIMulate` command allows you to temporarily disable errors generated by the Safety Interlock feature and enables the simulation mode. Although Safety Interlock errors are suppressed in this mode, the actual Analog Bus relays affected by the Safety Interlock are disabled as long as no terminal block or cable is connected to the module.

Electrical Considerations

See the *Introduction to the Plug In Modules* chapter of the 34980A Mainframe User's Guide for detailed environmental operating conditions for the 34980A

mainframe and its installed modules. That guidance sets maximum per channel current and power ratings at rated voltage for pollution degree 1 (dry) and pollution degree 2 (possible condensation) conditions, for each of the matrix modules.

SCPI Programming Examples for the Matrix Modules

The programming examples below provide you with SCPI command examples to use for actions specific to the matrix switch modules.

The slot and channel addressing scheme used in these examples follow the general form sccc where s is the mainframe slot number (1 through 8) and ccc is the three-digit channel number. Channel numbers for the matrix modules are derived as follows:

Two-wire mode: The channel numbers for the 34931A, 34932A, and the 34933A (2-wire mode) are derived from the crosspoint or intersection of rows and columns, columns having two digits. See the example below.

Displayed Channel	Means This...
5304	A 34931A, 34932A, 34933A (2-wire mode) matrix module is in slot 5, crosspoint is row 3, column 4. It might be easy to remember this channel configuration as “srcc” (s lot, r ow, c olumn, c olumn)

One-wire mode: The channel numbers for the 34933A (in 1-wire mode) are derived from a specific matrix number and the crosspoint or intersection of rows and columns on that matrix. See the example below.

Displayed Channel	Means This...
2437	A 34933A matrix module in 1-wire mode is in slot 2, matrix of interest is 4, crosspoint is row 3, column 7. It might be easy to remember this channel configuration as “smrc” (s lot, m atrix, r ow, c olumn)

For information on specific configurations, refer to the simplified schematics for the matrix modules on [page 28](#), [page 36](#), [page 44](#) and [page 51](#).

For complete information on the SCPI commands used to program the 34980A, refer to the *Keysight 34980A Programmer's Reference* which can be downloaded from www.keysight.com/find/34980A.

Opening and Closing Channels

Example: Closing and opening matrix channels (34931A, 34932A, and 34933A in two-wire mode) The following commands close and open channels 311 and 312 through 315 of a 34932A matrix module in 2-wire mode. This module is in slot 3. The channel number represents the matrix crosspoint of a row (one digit) and a column (two digits). For example, channel 311 represents crosspoint at row 3 and column 11 on a 34932A module.

```
ROUTe:CLOSe (@3311,3312:3315)
ROUTe:OPEN (@3311,3312:3315)
```

Example: Closing and opening matrix channels (34933A in one-wire mode) The following commands close and open channels 311 and 312 through 315 of the 34933A module in 1-wire mode. The module is in slot 4. The channel number represents the matrix and the matrix crosspoint of a row (one digit) and a column (one digit). For example, channel 311 represents the crosspoint on matrix 3 at row 1, column 1 on a 34933A module in 1-wire mode.

```
ROUTe:CLOSe (@4311,4312:4315)
ROUTe:OPEN (@4311,4312:4315)
```

NOTE

Although the previous two examples show the same channel numbers, the channels are derived differently as determined by a module's configuration mode. See [page 20](#) for channel number derivation.

Example: Closing and opening Analog Bus relays The following command connects the Analog Buses to Matrix 2 for a module (in 2-wire mode) in slot 3.

```
ROUTe:CLOSe (@3921,3922,3923,3924)
ROUTe:OPEN (@3921,3922,3923,3924)
```

NOTE

For matrix modules in 2-wire mode, only Matrix 2 connects to the the Analog Buses. For the 34933A in 1-wire mode, only Matrix 3 and Matrix 4 connect to the Analog Buses.

The Analog Bus relays (numbered s921, s922, s923, etc.) on the matrix modules are ignored if they are included in a range of channels. An error will be generated if an Analog Bus relay is specified as the first or last channel in a range of channels. For example, the following command closes all valid channels between channel 304 and channel 615 (slot 2). In addition, this command closes Analog Bus relay 911 on the module in slot 1 (Bank 1). Note that although the specified range of channels includes the other Analog Bus relays, they are ignored and are not closed by this command.

```
ROUTe:CLOSE (@2304:2615,1911)
```

Example: Querying channels for open or close state The following command returns a 1 (true) or 0 (false) state of channel 204 for a module in slot 3.

```
ROUTe:CLOSE (@3204)
ROUTe:CLOSE? (@3204) !Returns a 1
ROUTe:OPEN? (@3204) !Returns a 0
```

Configuring a Module

Example: Configuring the 34933A module for 2-wire or 1-wire mode The following command configures a matrix module in slot 4 for 1-wire measurements. Because you can configure only the 34933A (and the 34923A and 34925A MUX modules) for either 2-wire or 1-wire mode, an error is generated if you send this command to a slot that does not contain one of those three modules. If you are using terminal blocks with the 34933A module, be sure to use the corresponding 2-wire or 1-wire terminal block.

```
SYSTem:MODUle:WIRE:MODE WIRE1,4
```

NOTE

When using a command to configure the system, the new configuration does not take effect until you cycle power on the 34980A.

Example: Querying the system for module Identify The following command returns the identity of the module installed in slot 7.

```
SYSTem:CTYPE? 7
```

NOTE

For the 34933A matrix module, the query response may include a suffix to indicate a 1-wire configuration. For example, the response for the 34933A will be either "34933A" (differential mode) or "34933A-1W" (single-ended mode).

Reading Cycle Count and Resetting Modules to Power-On State

Example: Reading the cycle count for a relay The following command returns the cycle count on channels 304 and 308 for a matrix module in slot 3.

`DIAGnostic:RELAy:CYCLes? (@3304,3308)`

Example: Resetting module(s) to power-on state The following command resets a module in slot 4 to its power-on state.

`SYSTem:CPON 4`

Linking Multiple Matrix Modules

You can link multiple matrix modules to form a larger matrix. The drawings on [page 25](#) show examples of two-module connections through rows and columns.

Wiring Multiple 34931A or 34932A Modules

With a 34931A you can combine two matrices to form 8x8 (connecting columns) or 4x16 (connecting rows) configurations. Using two 34932A matrices on a 34932A module, you can create 16x8 (connecting columns) or 4x32 (connecting rows) configurations.

You can connect rows in separate modules using external wiring. Or, using Bank 2 matrices, you can connect through the mainframe Analog Buses. For a clear idea of how matrices are arranged and their connections to the Analog Buses, see the simplified schematics on [page 28](#) (34931A) and [page 36](#) (34932A).

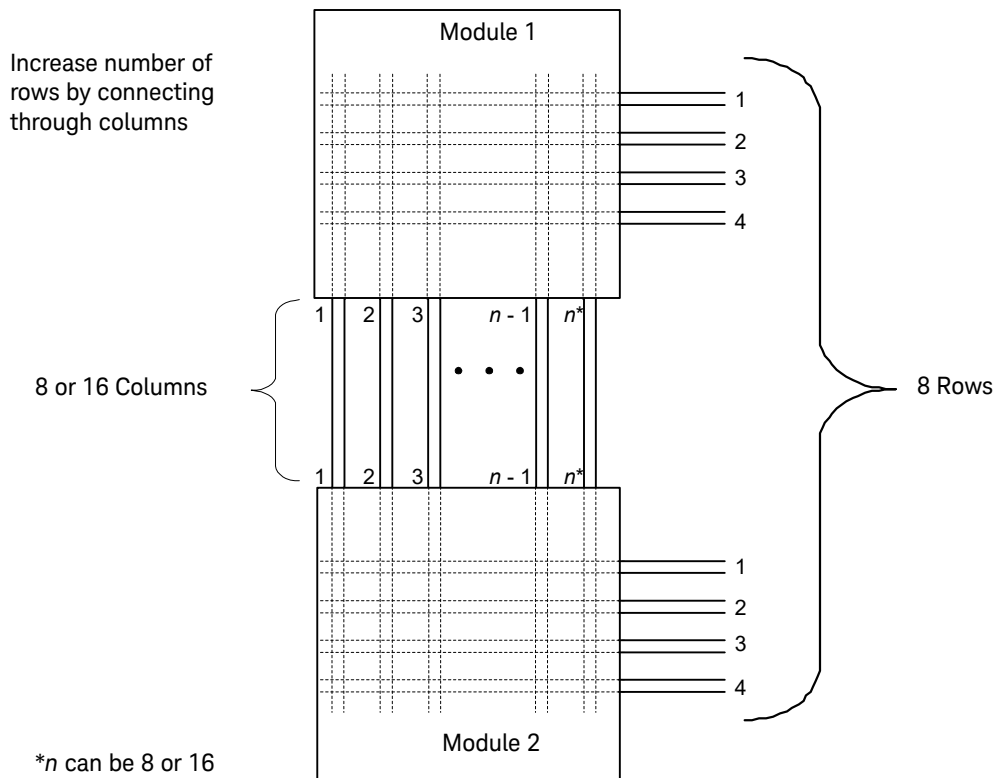
You must use external wiring whenever you connect:

- Rows in Matrix 1 of separate modules
- Rows in Matrix 1 to rows in Matrix 2 on the same or separate modules
- Columns of two matrices on the same or separate modules

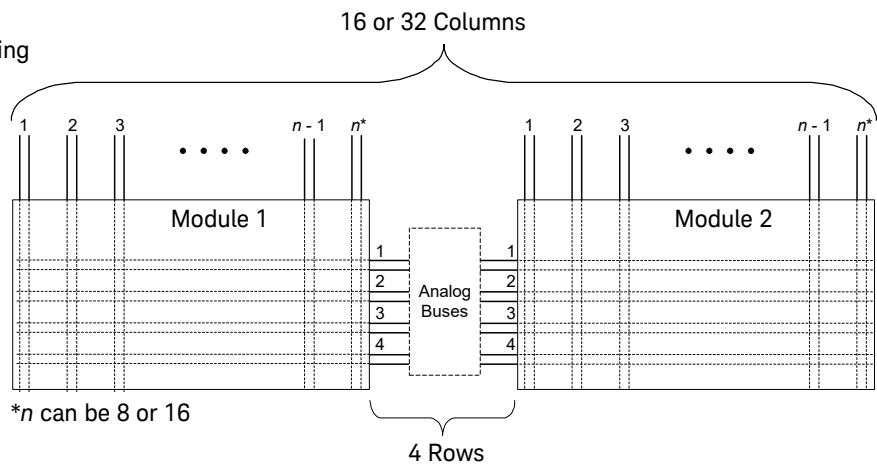
You can expand upon these two-module configurations and add up to eight modules to design your own large matrices. From a programming standpoint, each matrix module operates as an independent module regardless of the external connections. When linking modules, the channel numbering scheme remains the same as for single modules.

Wiring Multiple 34933A Modules

You can connect matrices on the 34933A module in a similar fashion to the 34931A. However, the presence of in-rush resistors on the Analog Buses and columns require additional consideration, and you must take care when linking multiple 34933A matrix modules. See the simplified schematics on [page 44](#) and [page 51](#).



Increase number of columns by connecting through rows



34931A Dual 4x8 Armature Matrix

The 34931A dual 4x8 armature matrix contains two matrices, each with 32 2-wire crosspoint latching armature relays organized in a 4-row by 8-column configuration. Every row and column are made up of two wires each, a high (H) and a low (L). Each crosspoint relay has a unique channel number representing the row and column that intersects to create the crosspoint. For example, channel 304 represent the crosspoint connection between row 3 and column 4 (all columns consisting of two digits; in this case the digits are 04). See the simplified schematic on [page 28](#).

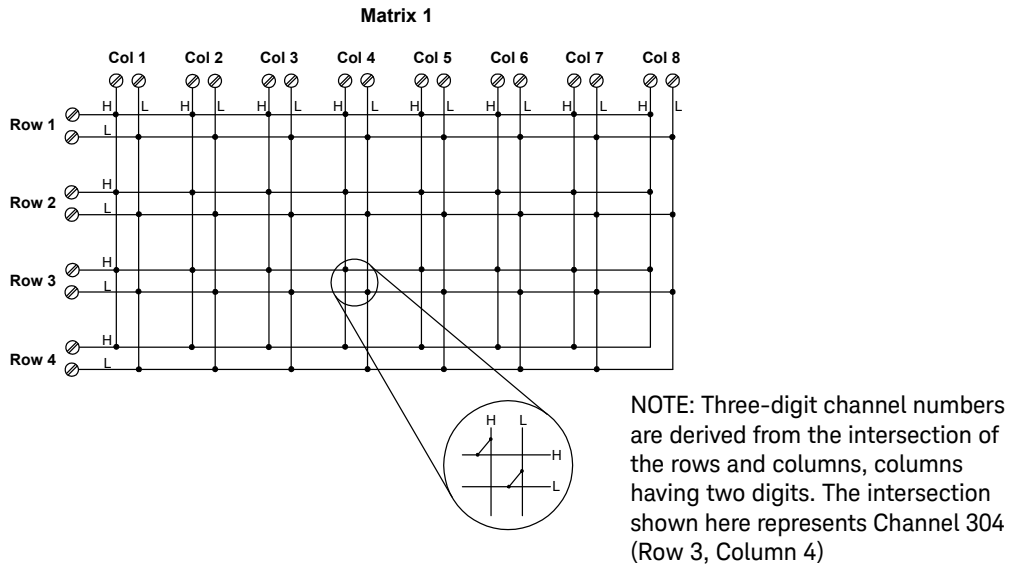
You can connect any combination of inputs and outputs at the same time. However, only Matrix 2 in this module connects to the Analog Buses. By closing channels 921 and 922 you can connect rows 5 and 6 respectively to the internal DMM of the 34980A mainframe for voltage and resistance measurements. You can connect multiple matrix modules externally and/or through the Analog Buses for applications that require large matrices. For information on linking multiple matrices, refer to [page 24](#) of this manual.

NOTE

When the DMM is scanning, it controls ABus1 and ABus2 relays, which are on Matrix 2. Therefore, consider this behavior when you are connecting matrices.

When the power is off, matrix relays maintain state, and Analog Bus relays open.

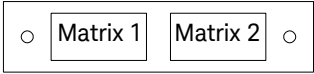
34931A Simplified Schematic



NOTE: Matrix 1 and Matrix 2 are electrically separate from one another.

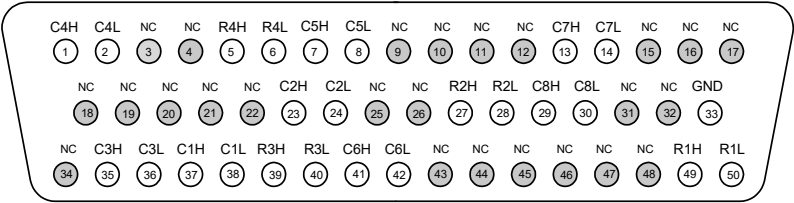
NOTE:
 Matrix Relays: Armature latching
 Analog Bus Relays: Armature non-latching

34931A D-Sub Connectors



For orientation, the D-sub connector end of the module is facing you.

Matrix 1

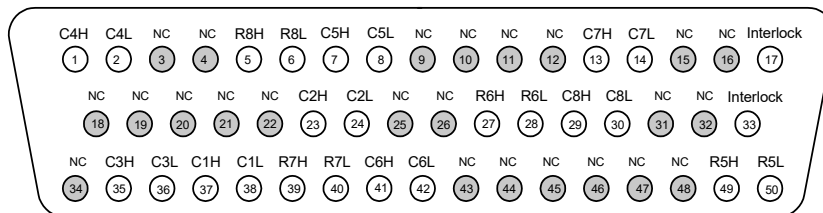


NOTE: In this diagram and the table below, R represents “row,” and C represents “column.”

50-Pin D-Sub Male Connector

Description	Pin	Description	Pin	Description	Pin
R1H	49	C2H	23	C7H	13
R1L	50	C2L	24	C7L	14
R2H	27	C3H	35	C8H	29
R2L	28	C3L	36	C8L	30
R3H	39	C4H	1	GND	33
R3L	40	C4L	2	No Connect pins: 3-4, 9-12, 15-22, 25-26, 31-32, 34, and 43-48.	
R4H	5	C5H	7		
R4L	6	C5L	8		
C1H	37	C6H	41		
C1L	38	C6L	42		

Matrix 2



NOTE: In this diagram and the table below, R represents “row,” and C represents “column.”

50-Pin D-Sub
Male Connector

Description	Pin	Description	Pin	Description	Pin
R5H	49	C2H	23	C7H	13
R5L	50	C2L	24	C7L	14
R6H	27	C3H	35	C8H	29
R6L	28	C3L	36	C8L	30
R7H	39	C4H	1	Interlock	17
R7L	40	C4L	2	Interlock	33
R8H	5	C5H	7	No Connect pins: 3-4, 9-12, 15-16. 18-22, 25-26, 31-32, 34, 43-48	
R8L	6	C5L	8		
C1H	37	C6H	41		
C1L	38	C6L	42		

WARNING

As a safety feature, interlock pins (17 and 33) must be shorted to enable the Analog Bus relays, which are on Matrix 2, to close. The optional 34931T terminal block shorts these pins for you. This feature protects inadvertent routing of high voltages from the Analog Buses to the D-sub connector of the module.

34931T Terminal Block

This terminal block with screw-type connections is labeled with the model number and the abbreviated module name. In addition, space is available on the label for you to write the slot number.

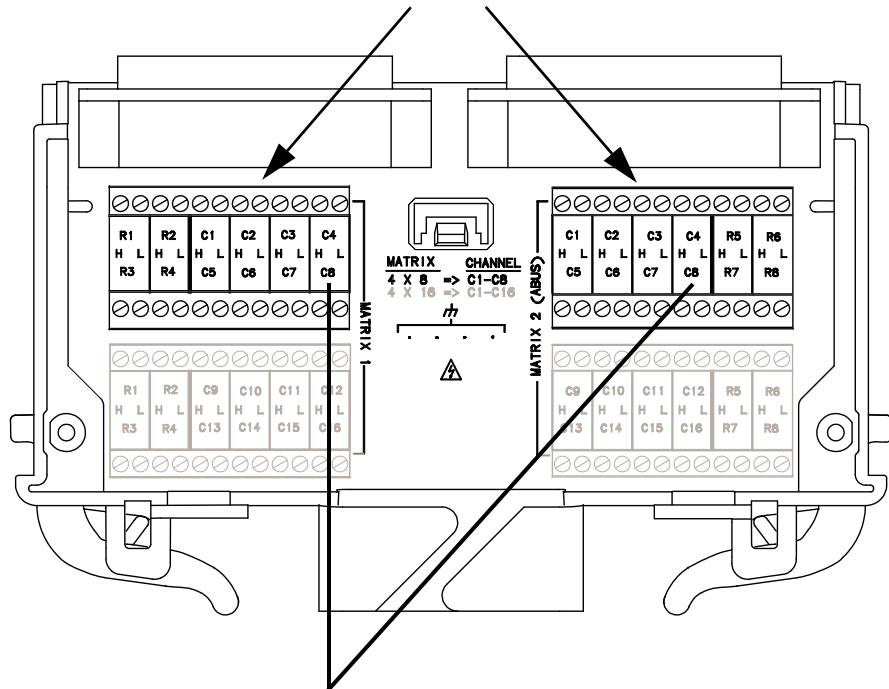
NOTE

All modules that connect to the internal DMM are interlock protected. This means that when an installed module is exposed (no terminal block or cable is connected), the Analog Bus relays, which are on Matrix 2, are open and disconnected from the Analog Buses. See [page 18](#) for further information.

NOTE

On the 34931T terminal block, only two sets of screw terminals are for use with the 34931A module. See the following drawing.

When using the 34931T terminal block, be sure to wire your connections to the two sets of screw terminals closest to the 50-pin D-sub connectors.



Although columns are numbered the same on Matrix 1 and Matrix 2, they are electrically separate from one another (e.g., Col C8).

WARNING

Terminal block wiring: Failure to follow the instructions below could result in equipment damage and may result in hazardous conditions such as fire or shock and could lead to personal injury or death.

Wiring of the terminal block must be performed by qualified persons. A MAXIMUM of 5 mm of conductor insulation is to be removed. All wire strands must be appropriately inserted in the connector housing. The screw connections must be sufficiently secured to prevent accidental loosening.

Never operate the instrument without the terminal block covers securely installed. Use caution to prevent operators from accessing any external circuits, test fixtures, cables or whenever hazardous voltages may be present.

WARNING**External Wiring for Hazardous Voltages:**

To ensure minimum safety insulation when wiring with hazardous voltages, ensure all wiring (both internal and external to the instruments):

- follow (USA) NFPA 79 Table 12.5.1 Conductor Ampacity and 12.5.5(a) Ambient Temperature Correction Factors (or equivalent National Code requirements) when selecting the AWG required.
 - are rated for at least 2 x the maximum applied voltage of the external source or any interconnecting system modules or external connections.
 - flame rated minimum:
 - Wires and cables with overall cross-sectional area of the conductors exceeding 0.5mm^2 meet test of IEC 60332-1-2 (IEC); or
 - Wires and cables with overall cross-sectional area of the conductors of 0.5mm^2 or less, the test of IEC 60332-2-2 (IEC); or
 - FT-1 of CSA C22.2 No. 0.3 (Canada); or
 - VW-1 of UL 1581 (US).
 - temperature rated for the application.
 - classified and suitable to be used external to the enclosure:
 - AWM Class II B or A/B – external/interconnecting wires (single- or multiple-conductor constructions with a jacket) and potentially subject to mechanical abuse (Canada)
 - AWM Style Use – external interconnection of electronic equipment or appliances (US)
-

34932A Dual 4x16 Armature Matrix

The 34932A dual 4x16 armature matrix contains two matrices, each with 64 2-wire crosspoint latching armature relays organized in a 4-row by 16-column configuration. Every row and column are made up of two wires each, a high (H) and a low (L). Each crosspoint relay has a unique channel number representing the row and column that intersect to create the crosspoint. For example, channel 315 represents the crosspoint connection between row 3 and column 15 (all columns consisting of two digits; in this case the digits are 15). See the simplified schematic on [page 36](#).

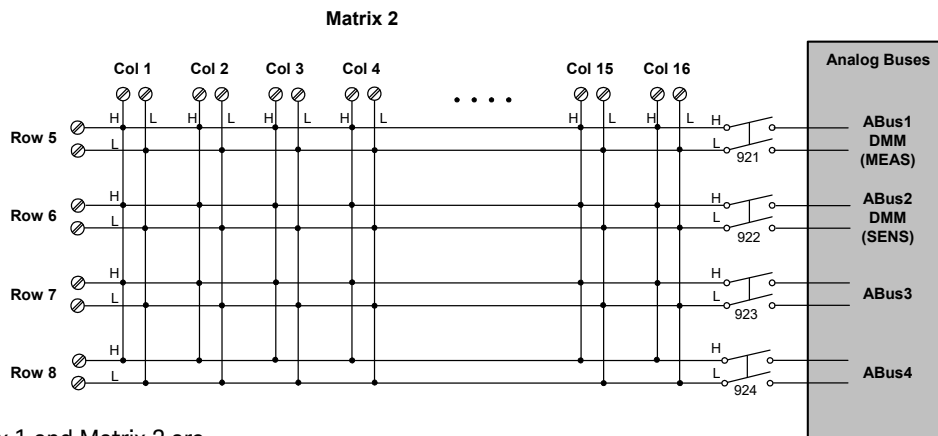
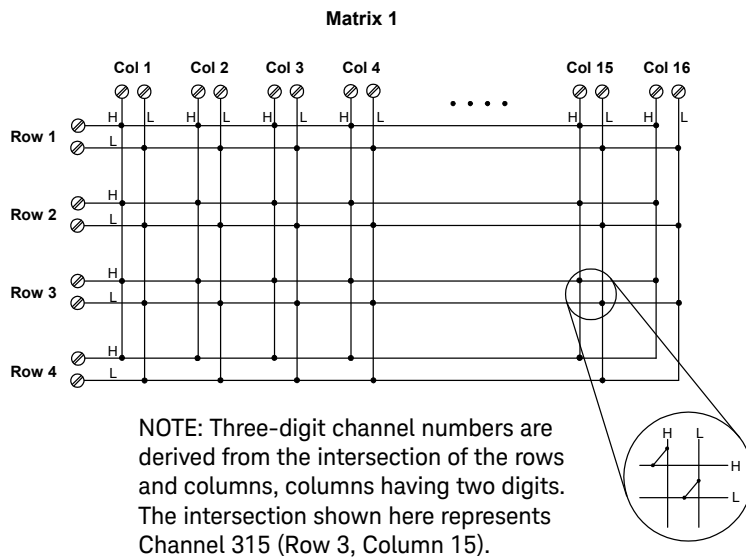
You can connect any combination of inputs and outputs at the same time. However, only Matrix 2 in this module connects to the Analog Buses. By closing channels 921 and 922 you can connect rows 5 and 6 respectively to the internal DMM of the 34980A mainframe for voltage and resistance measurements. You can connect multiple matrix modules externally and/or through the Analog Buses for applications that require large matrices. For information on linking multiple matrix modules, refer to [page 24](#) of this manual.

NOTE

When the DMM is scanning, it controls ABus1 and ABus2 relays, which are on Matrix 2. Therefore, consider this behavior when you are connecting matrices.

When the power is off, matrix relays maintain state, and Analog Bus relays open.

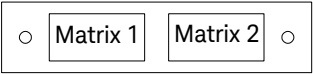
34932A Simplified Schematic



NOTE: Matrix 1 and Matrix 2 are electrically separate from one another.

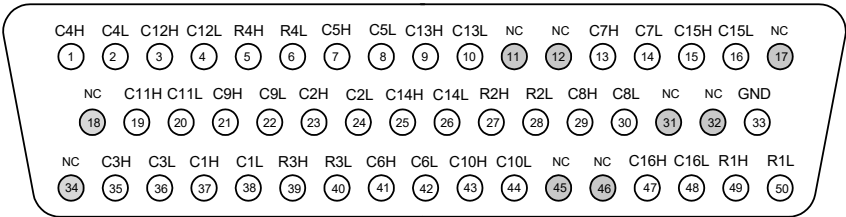
NOTE:
 Matrix Relays: Armature latching
 Analog Bus Relays: Armature non-latching

34932A D-Sub Connectors



For orientation, the D-sub connector end of the module is facing you.

Matrix 1

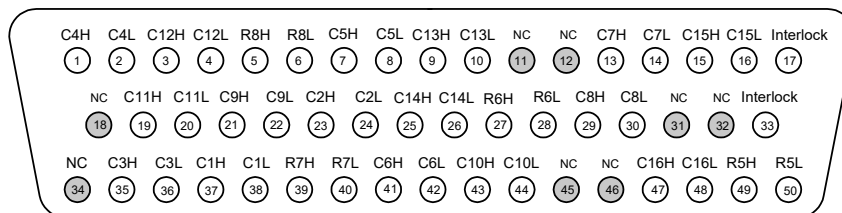


NOTE: In this diagram and the table below, R represents “row,” and C represents “column.”

50-Pin D-Sub Male Connector

Description	Pin	Description	Pin	Description	Pin	Description	Pin	Description	Pin
R1H	49	C2H	23	C7H	13	C12H	3	GND	33
R1L	50	C2L	24	C7L	14	C12L	4	No Connect pins: 11-12, 17-18, 31-32, 34, and 45-46	
R2H	27	C3H	35	C8H	29	C13H	9		
R2L	28	C3L	36	C8L	30	C13L	10		
R3H	39	C4H	1	C9H	21	C14H	25		
R3L	40	C4L	2	C9L	22	C14L	26		
R4H	5	C5H	7	C10H	43	C15H	15		
R4L	6	C5L	8	C10L	44	C15L	16		
C1H	37	C6H	41	C11H	19	C16H	47		
C1L	38	C6L	42	C11L	20	C16L	48		

Matrix 2



NOTE: In this diagram and the table below, R represents “row,” and C represents “column.”

50-Pin D-Sub
Male Connector

Description	Pin	Description	Pin	Description	Pin	Description	Pin	Description	Pin
R5H	49	C2H	23	C7H	13	C12H	3	Interlock	17
R5L	50	C2L	24	C7L	14	C12L	4	Interlock	33
R6H	27	C3H	35	C8H	29	C13H	9	No connect pins: 11-12, 18, 31-32, 34, and 45-46.	
R6L	28	C3L	36	C8L	30	C13L	10		
R7H	39	C4H	1	C9H	21	C14H	25		
R7L	40	C4L	2	C9L	22	C14L	26		
R8H	5	C5H	7	C10H	43	C15H	15		
R8L	6	C5L	8	C10L	44	C15L	16		
C1H	37	C6H	41	C11H	19	C16H	47		
C1L	38	C6L	42	C11L	20	C16L	48		

WARNING

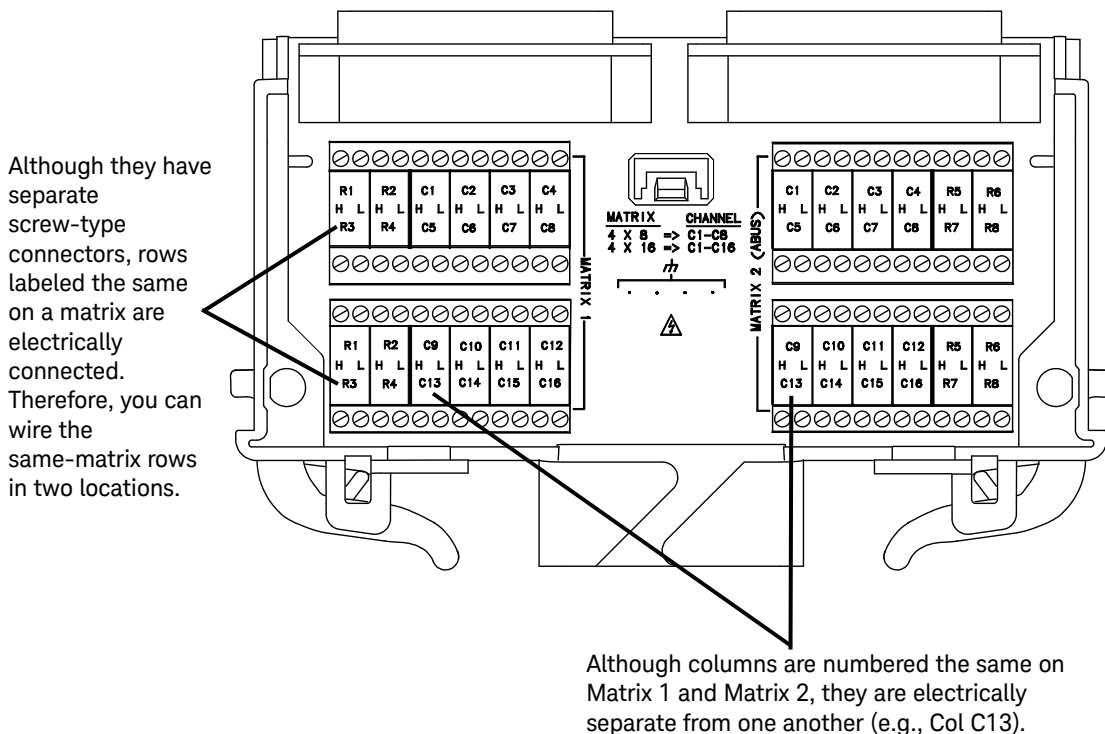
As a safety feature, interlock pins (17 and 33) must be shorted to enable the Analog Bus relays, which are on Matrix 2, to close. The optional 34932T terminal block shorts these pins for you. This feature protects inadvertent routing of high voltages from the Analog Buses to the D-sub connector of the module.

34932T Terminal Block

This terminal block with screw-type connections is labeled with the model number and the abbreviated module name. In addition, space is available on the label for you to write the slot number.

NOTE

All modules that connect to the internal DMM are interlock protected. This means that when an installed module is exposed (no terminal block or cable is connected), the Analog Bus relays, which are on Matrix 2, are open and disconnected from the Analog Buses. See [page 18](#) for further information.



WARNING

Terminal block wiring: Failure to follow the instructions below could result in equipment damage and may result in hazardous conditions such as fire or shock and could lead to personal injury or death.

Wiring of the terminal block must be performed by qualified persons. A MAXIMUM of 5 mm of conductor insulation is to be removed. All wire strands must be appropriately inserted in the connector housing. The screw connections must be sufficiently secured to prevent accidental loosening.

Never operate the instrument without the terminal block covers securely installed. Use caution to prevent operators from accessing any external circuits, test fixtures, cables or whenever hazardous voltages may be present.

WARNING**External Wiring for Hazardous Voltages:**

To ensure minimum safety insulation when wiring with hazardous voltages, ensure all wiring (both internal and external to the instruments):

- follow (USA) NFPA 79 Table 12.5.1 Conductor Ampacity and 12.5.5(a) Ambient Temperature Correction Factors (or equivalent National Code requirements) when selecting the AWG required.
 - are rated for at least 2 x the maximum applied voltage of the external source or any interconnecting system modules or external connections.
 - flame rated minimum:
 - Wires and cables with overall cross-sectional area of the conductors exceeding 0.5mm^2 meet test of IEC 60332-1-2 (IEC); or
 - Wires and cables with overall cross-sectional area of the conductors of 0.5mm^2 or less, the test of IEC 60332-2-2 (IEC); or
 - FT-1 of CSA C22.2 No. 0.3 (Canada); or
 - VW-1 of UL 1581 (US).
 - temperature rated for the application.
 - classified and suitable to be used external to the enclosure:
 - AWM Class II B or A/B – external/interconnecting wires (single- or multiple-conductor constructions with a jacket) and potentially subject to mechanical abuse (Canada)
 - AWM Style Use – external interconnection of electronic equipment or appliances (US)
-

34933A Dual/Quad 4x8 Reed Matrix

Using program commands or the front panel of the 34980A, you can configure the 34933A dual/quad 4x8 reed matrix module for differential (2-wire) mode or single-ended (1-wire) mode.

The 34933A module contains 100 Ω in-rush resistors that are used to protect the reed relays from reactive loads. If you have applications where in-rush resistors interfere with measurements, connections are provided on the terminal blocks for you to bypass the in-rush resistors that are located on the columns. See the simplified schematics on [page 44](#) and [page 51](#). However, if you choose to bypass the in-rush resistors, the life of the reed relays that you bypass may be degraded.

Two-Wire Mode

To physically configure the module for 2-wire mode, use the 34933T-001 terminal block, or a compatible standard or custom cable. If using a standard or custom cable, make sure you connect interlock pins 17 and 33 on the Matrix 2 D-sub connector. Refer to the pinout drawing and table on [page 46](#).

In 2-wire mode, the 34933A module contains two matrices, each with 32 2-wire crosspoint non-latching reed relays organized in a 4-row by 8-column configuration. Every row and column are made up of two wires each, a high (H) and a low (L). Each crosspoint relay has a unique channel number representing the row and column that intersect to create the crosspoint. For example, channel 308 represents the crosspoint connection between row 3 and column 08 (all columns consisting of two digits; in this case the digits are 08). See the simplified schematic on [page 44](#).

You can connect any combination of inputs and outputs at the same time. However, only Matrix 2 in 2-wire mode of this module connects to the Analog Buses. By closing channels 921 and 922 you can connect rows 5 and 6 respectively to the internal DMM of the 34980A mainframe for voltage and resistance measurements.

In 2-wire mode, you can close no more than 20 channels simultaneously due to power dissipation. However, note that Analog Bus relays count half as much as channel relays in that total. For example, with one Analog Bus relay closed, you can close up to a maximum of 19 channel relays. If you try to close more than the allowed number of channels, you will receive an error message.

One-Wire Mode

To physically configure the module in 1-wire mode, use the 34933T-002 terminal block, or a compatible standard or custom cable. If using a standard or custom cable, make sure you connect interlock pins 17 and 33 on the Matrix 2 D-sub connector. Refer to the pinout drawing and table on [page 53](#).

In 1-wire mode, the 34933A module contains four matrices (1 through 4), each with 32 1-wire crosspoint non-latching reed relays organized in a 4-row by 8-column configuration. Every row and column has one wire each. Each crosspoint relay has a unique channel number representing the matrix, and the single-wire row and column that intersect to make the crosspoint. For example, channel 218 represents Matrix 2, row 1 and column 8. See the simplified schematic on [page 51](#).

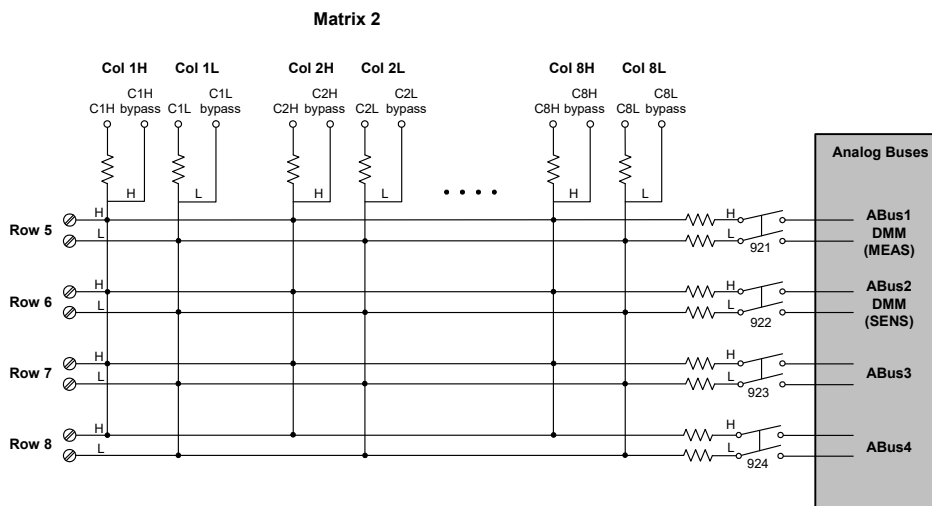
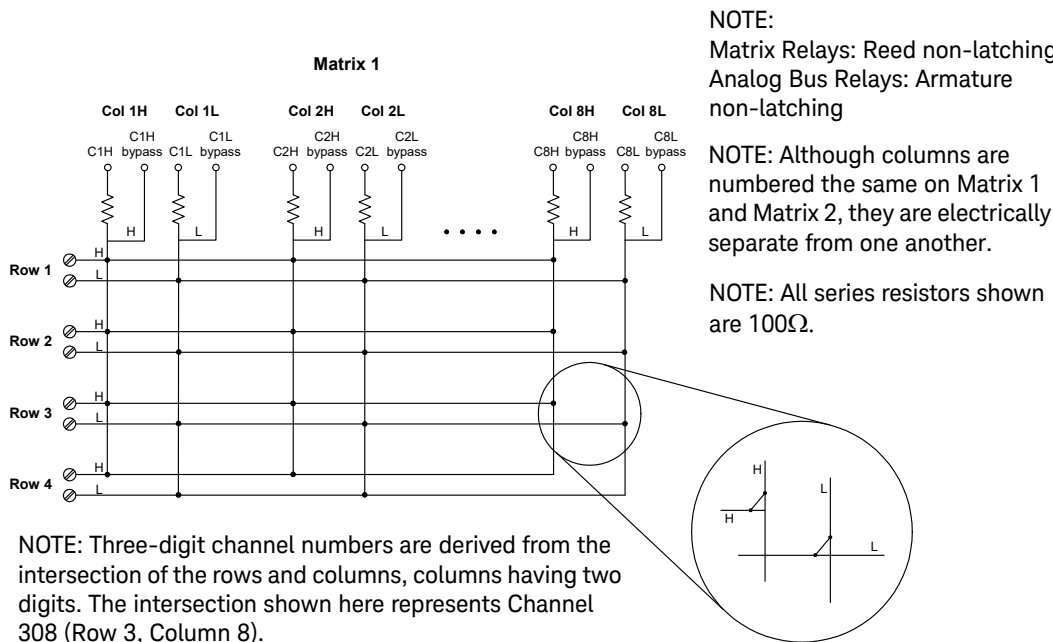
In 1-wire mode, you can close no more than 40 channels simultaneously due to power dissipation. For example, with one Analog Bus relay closed you can close up to a maximum of 39 channel relays. If you try to close more than the allowed number of channels, you will receive an error message.

You can connect any combination of inputs and outputs at the same time. However, only Matrix 3 and Matrix 4 in 1-wire mode of this module connect to the Analog Buses. By closing channels 921 and 922 you can connect rows 1 and rows 2 respectively to the internal DMM of the 34980A mainframe for voltage and resistance measurements.

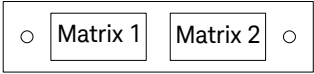
You can connect multiple matrix modules externally and/or through the Analog Buses for applications that require large matrices. For information on linking multiple matrix modules, refer to [page 24](#) of this manual.

When the power is off, matrix relays and Analog Bus relays open.

34933A Simplified Schematic for Two-Wire Mode

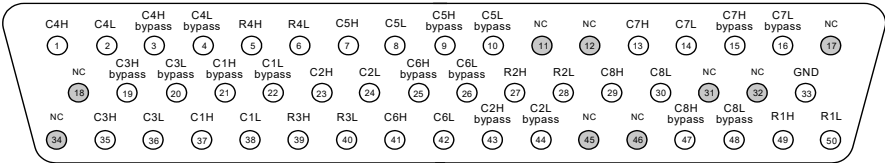


34933A D-Sub Connectors for Two-Wire Mode



For orientation, the D-sub connector end of the module is facing you.

Matrix 1

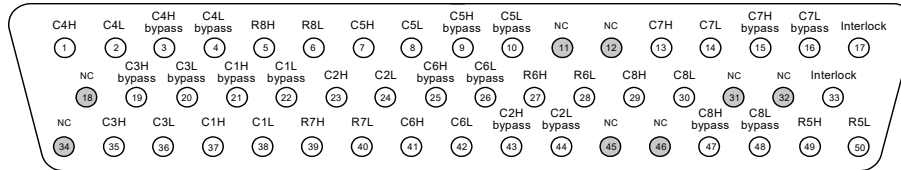


50-Pin D-Sub Male Connector

- NOTE:**
- In this diagram and the table below, R represents “row,” and C represents “column.”
 - Bypass” means to bypass the 100Ω in-rush resistor that protects the reed relays.

Description	Pin	Description	Pin	Description	Pin	Description	Pin	Description	Pin	Description	Pin
R1H	49	C1H	37	C5H	7	C1H bypass	21	C5H bypass	9	GND	33
R1L	50	C1L	38	C5L	8	C1L bypass	22	C5L bypass	10	No Connect pins: 11-12, 17-18, 31-32, 34, and 45-46	
R2H	27	C2H	23	C6H	41	C2H bypass	43	C6H bypass	25		
R2L	28	C2L	24	C6L	42	C2L bypass	44	C6L bypass	26		
R3H	39	C3H	35	C7H	13	C3H bypass	19	C7H bypass	15		
R3L	40	C3L	36	C7L	14	C3L bypass	20	C7L bypass	16		
R4H	5	C4H	1	C8H	29	C4H bypass	3	C8H bypass	47		
R4L	6	C4L	2	C8L	30	C4L bypass	4	C8L bypass	48		

Matrix 2



50-Pin D-Sub Male Connector

NOTE:

- In this diagram and the table below, R represents “row,” and C represents “column.”
- “Bypass” means to bypass the 100Ω in-rush resistor that protects the reed relays.

Description	Pin	Description	Pin	Description	Pin	Description	Pin	Description	Pin
R5H	49	C2H	23	C7H	13	C4H bypass	3	Interlock	17
R5L	50	C2L	24	C7L	14	C4L bypass	4	Interlock	33
R6H	27	C3H	35	C8H	29	C5H bypass	9	No Connect pins: 11-12, 18, 31-32, 34, and 45-46	
R6L	28	C3L	36	C8L	30	C5L bypass	10		
R7H	39	C4H	1	C1H bypass	21	C6H bypass	25		
R7L	40	C4L	2	C1L bypass	22	C6L bypass	26		
R8H	5	C5H	7	C2H bypass	43	C7H bypass	15		
R8L	6	C5L	8	C2L bypass	44	C7L bypass	16		
C1H	37	C6H	41	C3H bypass	19	C8H bypass	47		
C1L	38	C6L	42	C3L bypass	20	C8L bypass	48		

WARNING

As a safety feature, interlock pins (17 and 33) must be shorted to enable the Analog Bus relays, which are on Matrix 2, to close. The optional 34933T-001 (for 2-wire) terminal block shorts these pins for you. This feature protects inadvertent routing of high voltages from the Analog Bus to the D-sub connector of the module.

34933T-001 Terminal Block for Two-Wire Mode

This terminal block with screw-type connections is labeled with the model number and the abbreviated module name. In addition, space is available on the label for you to write the slot number.

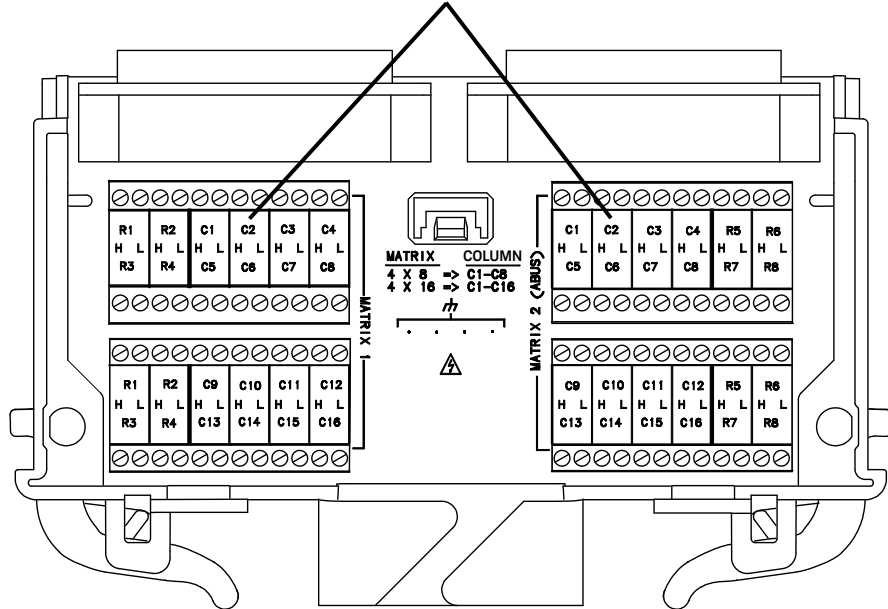
NOTE

All modules that connect to the internal DMM are interlock protected. This means that when an installed module is exposed (no terminal block or cable is connected), the Analog Bus relays, which are on Matrix 2, are open and disconnected from the Analog Buses. See [page 18](#) for further information.

NOTE

If you are using an Keysight terminal block to connect your DUT to this module be sure to use the 34933T-001 terminal block that corresponds to the 2-wire configuration mode. Note that an error will not be generated if you have installed a terminal block that doesn't match the present module configuration.

Although columns are numbered the same on Matrix 1 and Matrix 2, they are electrically separate from one another (e.g., Col C2).



WARNING

Terminal block wiring: Failure to follow the instructions below could result in equipment damage and may result in hazardous conditions such as fire or shock and could lead to personal injury or death.

Wiring of the terminal block must be performed by qualified persons. A MAXIMUM of 5 mm of conductor insulation is to be removed. All wire strands must be appropriately inserted in the connector housing. The screw connections must be sufficiently secured to prevent accidental loosening.

Never operate the instrument without the terminal block covers securely installed. Use caution to prevent operators from accessing any external circuits, test fixtures, cables or whenever hazardous voltages may be present.

WARNING**External Wiring for Hazardous Voltages:**

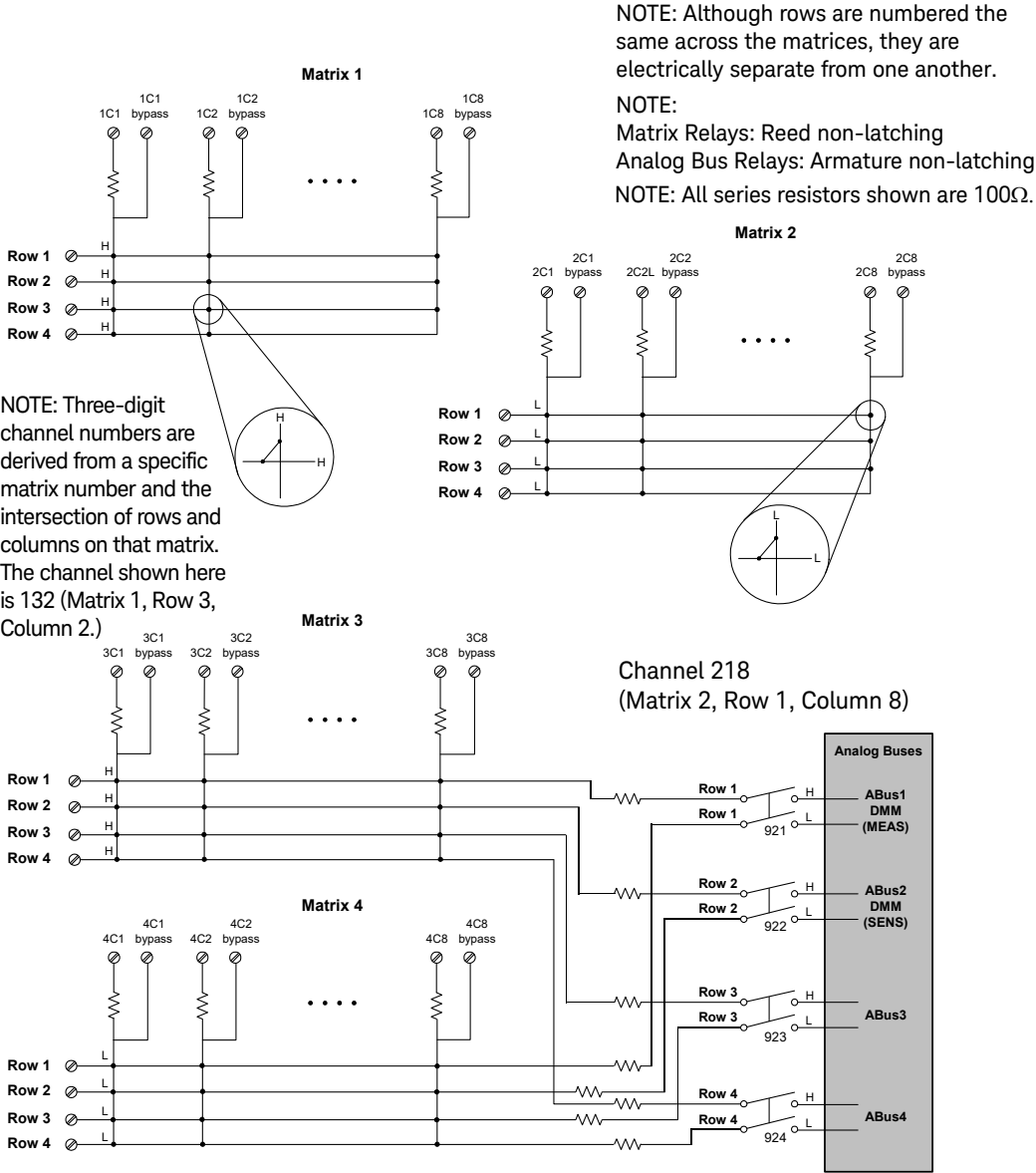
To ensure minimum safety insulation when wiring with hazardous voltages, ensure all wiring (both internal and external to the instruments):

- follow (USA) NFPA 79 Table 12.5.1 Conductor Ampacity and 12.5.5(a) Ambient Temperature Correction Factors (or equivalent National Code requirements) when selecting the AWG required.
- are rated for at least 2 x the maximum applied voltage of the external source or any interconnecting system modules or external connections.
- flame rated minimum:
 - Wires and cables with overall cross-sectional area of the conductors exceeding 0.5mm^2 meet test of IEC 60332-1-2 (IEC); or
 - Wires and cables with overall cross-sectional area of the conductors of 0.5mm^2 or less, the test of IEC 60332-2-2 (IEC); or
 - FT-1 of CSA C22.2 No. 0.3 (Canada); or
 - VW-1 of UL 1581 (US).
- temperature rated for the application.
- classified and suitable to be used external to the enclosure:
 - AWM Class II B or A/B – external/interconnecting wires (single- or multiple-conductor constructions with a jacket) and potentially subject to mechanical abuse (Canada)
 - AWM Style Use – external interconnection of electronic equipment or appliances (US)

When using the 34933T terminal block for 2-wire mode, access is provided to the bypass columns through the columns labeled C9 through C16. Follow this wiring convention shown in the table below for both matrices.

Terminal marked...	Connects to...	Terminal marked...	Connects to...
C9H	C1Hbypass	C13H	C5H bypass
C9L	C1L bypass	C13L	C5L bypass
C10H	C2H bypass	C14H	C6H bypass
C10L	C2L bypass	C14L	C6L bypass
C11H	C3H bypass	C15H	C7H bypass
C11L	C3L bypass	C15L	CC7L bypass
C12H	C4H bypass	C16H	C8H bypass
C12L	C4L bypass	C16L	C8L bypass

34933A Simplified Schematic for One-Wire Mode

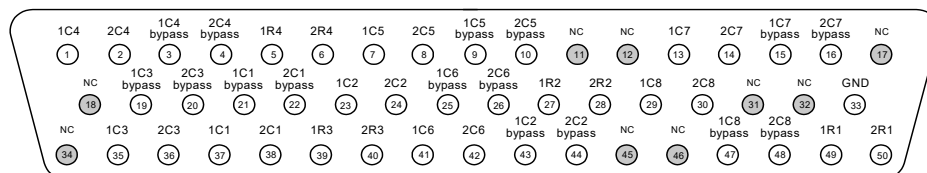


34933A D-Sub Connectors for One-Wire Mode

- Matrices 1 & 2
- Matrices 3 & 4

For orientation, the D-sub connector end of the module is facing you.

Matrices 1 and 2

50-Pin D-Sub
Male Connector

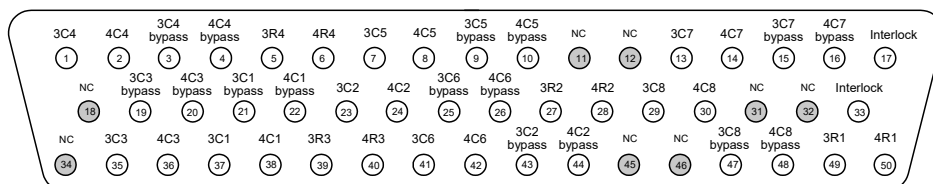
Description	Pin	Description	Pin	Description	Pin	Description	Pin	Description	Pin
1R1	49	1C2	23	1C7	13	1C4 bypass	3	GND	33
1R2	27	2C2	24	2C7	14	2C4 bypass	4	No connect pins: 11-12, 17-18, 31-32, 34, and 45-46	
1R3	39	1C3	35	1C8	29	1C5 bypass	9		
1R4	5	2C3	36	2C8	30	2C5 bypass	10		
2R1	50	1C4	1	1C1 bypass	21	1C6 bypass	25		
2R2	28	2C4	2	2C1 bypass	22	2C6 bypass	26		
2R3	40	1C5	7	1C2 bypass	43	1C7 bypass	15		
2R4	6	2C5	8	2C2 bypass	44	2C7 bypass	16		
1C1	37	1C6	41	1C3 bypass	19	1C8 bypass	47		
2C1	38	2C6	42	2C3 bypass	20	2C8 bypass	48		

NOTE

Conventions for these drawings and tables as they relate to pinout information:

- **2R4** means Matrix **2**, Row **4**.
- **1C5** means Matrix **1**, Column **5**
- **4C2 bypass** means: Matrix **4**, Column **2**, and the connection bypasses the 100Ω in-rush resistor that protects the reed relays

Matrices 3 and 4



50-Pin D-Sub
Male Connector

Description	Pin	Description	Pin	Description	Pin	Description	Pin	Description	Pin
3R1	49	3C2	23	3C7	13	3C4 bypass	3	Interlock	17
3R2	27	4C2	24	4C7	14	4C4 bypass	4	Interlock	33
3R3	39	3C3	35	3C8	29	3C5 bypass	9	No connect pins: 11-12, 18, 31-32, 34, and 45-46	
3R4	5	4C3	36	4C8	30	4C5 bypass	10		
4R1	50	3C4	1	3C1 bypass	21	3C6 bypass	25		
4R2	28	4C4	2	4C1 bypass	22	4C6 bypass	26		
4R3	40	3C5	7	3C2 bypass	43	3C7 bypass	15		
4R4	6	4C5	8	4C2 bypass	44	4C7 bypass	16		
3C1	37	3C6	41	3C3 bypass	19	3C8 bypass	47		
4C1	38	4C6	42	4C3 bypass	20	4C8 bypass	48		

WARNING

As a safety feature, interlock pins (17 and 33) must be shorted to enable the Analog Bus relays, which are on Matrix 2, to close. The optional 34933T-002 (for 1-wire) terminal block shorts these pins for you. This safety feature protects inadvertent routing of high voltages from the Analog Buses to the D-sub connector of the module.

34933T-002 Terminal Block for One-Wire Mode

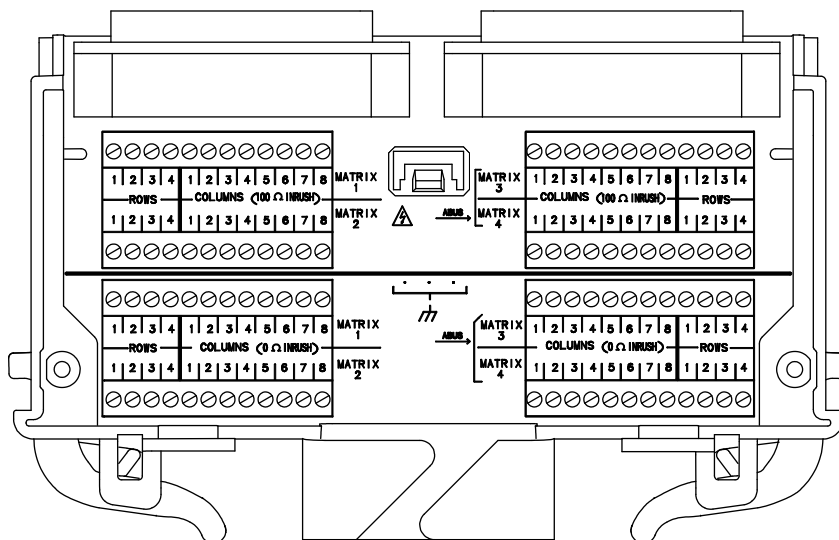
This terminal block with screw-type connections is labeled with the model number and the abbreviated module name. In addition, space is available on the label for you to write the slot number.

NOTE

All modules that connect to the internal DMM are interlock protected. This means that when an installed module is exposed (no terminal block or cable is connected), the Analog Bus relays and current channels are open and disconnected from the Analog Buses. See [page 18](#) for further information.

NOTE

If you are using an Keysight terminal block to connect your DUT to this module be sure to use the 34933T-002 terminal block that corresponds to the 1-wire configuration mode. Note that an error will not be generated if you have installed a terminal block that doesn't match the present module configuration.



NOTE: Analog Bus connections are on Matrix 3 and Matrix 4.

WARNING

Terminal block wiring: Failure to follow the instructions below could result in equipment damage and may result in hazardous conditions such as fire or shock and could lead to personal injury or death.

Wiring of the terminal block must be performed by qualified persons. A MAXIMUM of 5 mm of conductor insulation is to be removed. All wire strands must be appropriately inserted in the connector housing. The screw connections must be sufficiently secured to prevent accidental loosening.

Never operate the instrument without the terminal block covers securely installed. Use caution to prevent operators from accessing any external circuits, test fixtures, cables or whenever hazardous voltages may be present.

WARNING**External Wiring for Hazardous Voltages:**

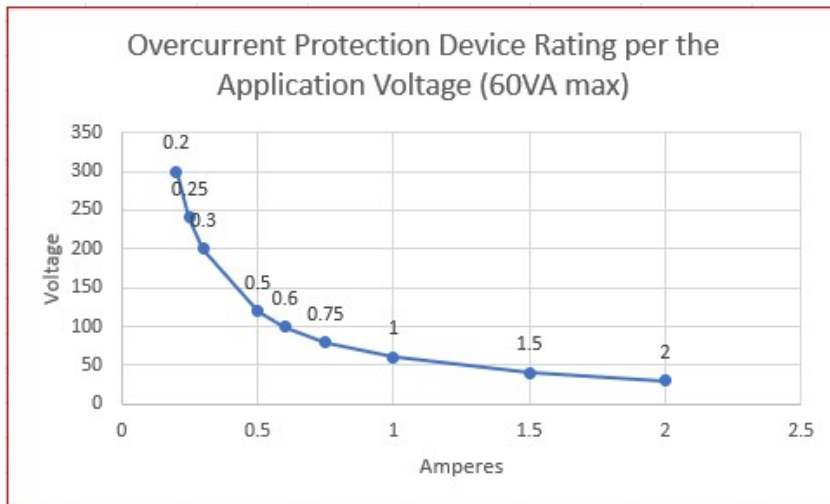
To ensure minimum safety insulation when wiring with hazardous voltages, ensure all wiring (both internal and external to the instruments):

- follow (USA) NFPA 79 Table 12.5.1 Conductor Ampacity and 12.5.5(a) Ambient Temperature Correction Factors (or equivalent National Code requirements) when selecting the AWG required.
 - are rated for at least 2 x the maximum applied voltage of the external source or any interconnecting system modules or external connections.
 - flame rated minimum:
 - Wires and cables with overall cross-sectional area of the conductors exceeding 0.5mm^2 meet test of IEC 60332-1-2 (IEC); or
 - Wires and cables with overall cross-sectional area of the conductors of 0.5mm^2 or less, the test of IEC 60332-2-2 (IEC); or
 - FT-1 of CSA C22.2 No. 0.3 (Canada); or
 - VW-1 of UL 1581 (US).
 - temperature rated for the application.
 - classified and suitable to be used external to the enclosure:
 - AWM Class II B or A/B – external/interconnecting wires (single- or multiple-conductor constructions with a jacket) and potentially subject to mechanical abuse (Canada)
 - AWM Style Use – external interconnection of electronic equipment or appliances (US)
-

34980A Current Limiting Graphs

Modules	Pollution Degree 1	Pollution Degree 2	Transients
Matrix Switch 34931A Terminal Block 34931T	Dual 4x8 matrix, 30MHz $\pm 300\text{Vrms}$ or VDC ¹ 1A (switch) / 2A (carry) 60VA per channel ² Volt-Hertz limit: 10^8 Initial closed channel resistance: $<1.5\ \Omega$ ^{3,4}	Dual 4x8 matrix, 30MHz $\pm 100\text{Vrms}$ or VDC ¹ 1A (switch) / 2A carry 60VA per channel ² Volt-Hertz limit: 10^8 Initial closed channel resistance: $<1.5\ \Omega$ ^{3,4}	1000Vpk
Matrix Switch 34932A Terminal Block 34932T	Dual 4x16 matrix, 30MHz $\pm 300\text{Vrms}$ or VDC ¹ 1A (switch) / 2A (carry) 60VA per channel ² Volt-Hertz limit: 10^8 Initial closed channel resistance: $<1.5\ \Omega$ ^{3,4}	Dual 4x16 matrix, 30MHz $\pm 100\ \text{Vrms}$ or VDC ¹ 1A (switch) / 2A (carry) 60VA per channel ² Volt-Hertz limit: 10^8 Initial closed channel resistance: $<1.5\ \Omega$ ^{3,4}	1000Vpk

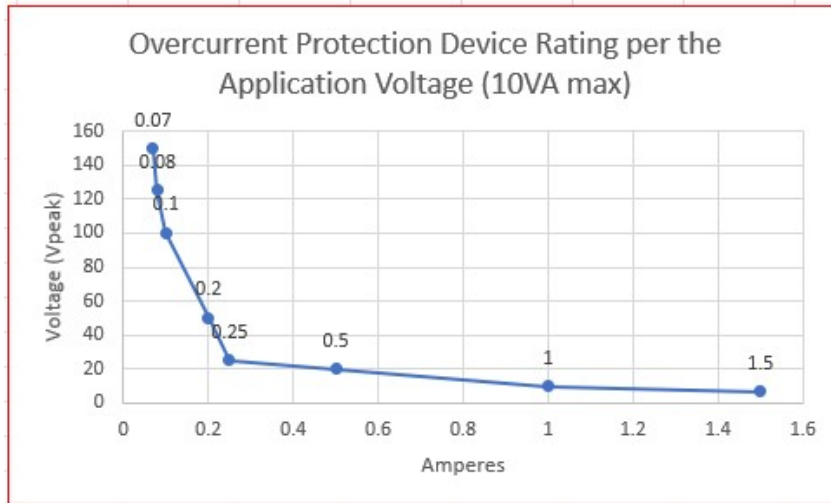
The overcurrent protection devices will be rated, or the snubber circuits will limit the current, according to:



1. DC or AC RMS voltage, channel-to-channel or channel-to-earth.
 2. Limited to 6 W of channel resistance power loss per module.
 3. Into analog bus. System errors are included in the internal DMM measurement accuracy specifications.
 4. Channel resistance is typically $< 1.5 \Omega$ but can go as high as 50Ω when a channel is used in measurement applications with < 10 mA load current. Increased relay channel resistance for measurements with load currents below 10 mA can occur on cards that have been out of service or following relay inactivity for periods of greater than 1 week. Switching relays for 2K cycles prior to use may reduce the variation in channel resistance. Keysight recommends the use of 4-wire Ohms for resistance measurements. For high accuracy voltage measurements, select the DMM input resistance setting of > 10 G ohms to minimize the impact of relay contact resistance.
-

Modules	Pollution Degree 1	Pollution Degree 2	Transients
Matrix Switch 34933A Terminal Block 34933T	Dual/quad 4x8 matrix, 30MHz	Dual/quad 4x8 matrix, 30MHz	750Vpk
	$\pm 150\text{Vpeak}^1$	$\pm 100\text{Vpeak}^1$	
	$0.5\text{A}^2 / 0.05\text{A}^3$ (switch)	$0.5\text{A}^2 / 0.05\text{A}^3$ (switch)	
	$1.5\text{A}^2 / 0.05\text{A}^3$ (carry)	$1.5\text{A}^2 / 0.05\text{A}^3$ (carry)	
	10VA/channel ^{4,5}	10VA/channel ^{4,5}	
	Volt-Hertz limit: 10^8	Volt-Hertz limit: 10^8	
	Initial closed channel resistance ^{2,6} : <1.5 Ω / 200 Ω	Initial closed channel resistance ^{2,6} : <1.5 Ω / 200 Ω	

The overcurrent protection devices will be rated, or the snubber circuits will limit the current, according to:



1. Peak voltage, channel-to-channel or channel-to-earth.
2. With input resistors bypassed. Bypassing resistors will reduce the lifetime of relays. See the rated load relay life characteristics.
3. With input protection resistors: $2 \times 100\ \Omega \pm 5\%$; 0.5W; TC = ± 200 ppm/ $^{\circ}\text{C}$. The series resistance of the 34923/24 limits the use of the 100 Ω range.
4. Power restrictions allow only 20 channels to be closed at one time.
5. Limited to 6 W of channel resistance power loss per module.
6. Into analog bus. System errors are included in the internal DMM measurement accuracy specifications.

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Edition 4, Aug 2022

Printed in Malaysia



34980-90031

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