Maintenance Guide

M9101A, M9102A, M9103A,
M9120A, M9121A, M9122A

Keysight PXI Matrix and Multiplexer Switch Modules

KEYSIGHT
TECHNOLOGIES

Notices

Manual Part Number

M9101-90005

Edition

Third Edition, December 2018
Published in U.S.A.
900 S. Taft Avenue,
Loveland, CO. 80537

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General

Do not use this product in any manner not specified by the manufacturer. The protective features of this product must not be impaired if it is used in a manner specified in the operation instructions.

Before Applying Power

Verify that all safety precautions are taken. Make all connections to the unit before applying power. Note the external markings described under "Safety Symbols".

Ground the Instrument

Keysight chassis' are provided with a grounding-type power plug. The instrument chassis and cover must be connected to an electrical ground to minimize shock hazard. The ground pin must be firmly connected to an electrical ground (safety ground) terminal at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

Do Not Operate in an Explosive Atmosphere

Do not operate the module/chassis in the presence of flammable gases or fumes.

Do Not Operate Near Flammable Liquids

Do not operate the module/chassis in the presence of flammable liquids or near containers of such liquids.

Cleaning

Clean the outside of the Keysight module/chassis with a soft, lint-free, slightly dampened cloth. Do not use detergent or chemical solvents.

Do Not Remove Instrument Cover

Only qualified, service-trained personnel who are aware of the hazards involved should remove instrument covers. Always disconnect the power cable and any external circuits before removing the instrument cover.

Keep away from live circuits

Operating personnel must not remove equipment covers or shields. Procedures involving the removal of covers and shields are for use by service-trained personnel only. Under certain conditions, dangerous voltages may exist even with the equipment switched off. To avoid dangerous electrical shock, DO NOT perform procedures involving cover or shield removal unless you are qualified to do so.

DO NOT operate damaged equipment

Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until safe operation can be verified by service-trained personnel. If necessary, return the product to an Keysight Technologies Sales and Service Office for service and repair to ensure the safety features are maintained.

DO NOT block the primary disconnect

The primary disconnect device is the appliance connector/power cord when a chassis used by itself, but when installed into a rack or system the disconnect may be impaired and must be considered part of the installation.

Do Not Modify the Instrument

Do not install substitute parts or perform any unauthorized modification to the product. Return the product to an Keysight Sales and Service Office to ensure that safety features are maintained.

In Case of Damage

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel

CAUTION

Do NOT block vents and fan exhaust: To ensure adequate cooling and ventilation, leave a gap of at least 50mm (2") around vent holes on both sides of the chassis.

Do NOT operate with empty slots: To ensure proper cooling and avoid damaging equipment, fill each empty slot with an AXIe filler panel module.

Do NOT stack free-standing chassis: Stacked chassis should be rack-mounted.

All modules are grounded through the chassis: During installation, tighten each module's retaining screws to secure the module to the chassis and to make the ground connection.

WARNING

Operator is responsible to maintain safe operating conditions. To ensure safe operating conditions, modules should not be operated beyond the full temperature range specified in the Environmental and physical specification. Exceeding safe operating conditions can result in shorter lifespan, improper module performance and user safety issues. When the modules are in use and operation within the specified full temperature range is not maintained, module surface temperatures may exceed safe handling conditions which can cause discomfort or burns if touched. In the event of a module exceeding the full temperature range, always allow the module to cool before touching or removing modules from the chassis.

WARNING

REMOTE OPERATION

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.

WARNING

To prevent electrical shock, use only wires that are rated for the maximum voltage applied to any channel.

WARNING

When any channel is connected to a hazardous voltage source, all channels in the module should be treated as hazardous.

WARNING

When any channel is connected to a hazardous voltage source, all channel wiring in the module should be rated for the maximum voltage applied.

WARNING

When any channel is connected to a hazardous voltage source, thermocouples attached to any other channel on the module shall have insulation rated for the maximum voltage, or have additional insulation added rated for the maximum voltage and will be isolated from conductive parts using a thermal compound or tape rated for the maximum voltage applied.

WARNING

Do not mount, move or remove any thermocouples when the device under test is connected to a signal source.

WARNING

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.

WARNING

To avoid the possibility of multiple signal sources becoming connected together, we recommend when multiplexing two or more sources they should be connected on separate modules or on separate banks of the same module.

WARNING

BEFORE POWER ON AND OFF

Before powering on the instrument, make sure all signal sources connected to modules are turned off. Turn on signal sources after the instrument is powered on. Turn off signal sources before the instrument is powered off.

Safety Symbols

CAUTION

A CAUTION denotes a hazard. It calls attention to an operating procedure or practice, 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 denotes a hazard. It calls attention to an operating procedure or practice, 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.

Products display the following symbols:


Warning, risk of electric shock


Refer to manual for additional safety information.


Earth Ground.


Chassis Ground.


Alternating Current (AC).


Standby Power. Unit is not completely disconnected from AC mains when switch is in standby.


Antistatic precautions should be taken.

For localized Safety Warnings, Refer to Keysight Safety document (p/n 9320-6792).

The instrument has been tested, investigated and found to comply with the requirements of the Standard(s) for Electrical Measuring & Test Equipment.


ICES/NMB-001
ISM GRP 1-A

Notice for European Community: This product complies with the relevant European legal Directives: EMC Directive (2004/108/EC) and Low Voltage Directive (2006/95/EC).

ISM

This is the symbol for an Industrial, Scientific, and Medical Group 1 Class A product.

The Regulatory Compliance Mark (RCM) mark is a registered trademark. This signifies compliance with the Australia EMC Framework regulations under the terms of the Radio Communication Act of 1992.

ICES/NMB-001

ICES/NMB-001 indicates that this ISM device complies with the Canadian ICES-001.

This symbol represents 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 this product.


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

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

Product Category: With reference to the equipment types in the WEEE directive Annex 1, this product is classified as a “Monitoring and Control instrumentation” product.

Do not dispose in domestic household waste.

To return unwanted products, contact your local Keysight office for more information.

Contents

1 General Information

The Keysight PXI switch modules deliver high-performance switching with fast, easy installation and configuration. The following modules are covered in this Maintenance Guide:

Multiplexer modules

- M9101A Multiplexer: 64-channel, 2-Wire, Reed Relays
- M9102A Multiplexer: 128-channel, 1-Wire, Reed Relays
- M9103A Multiplexer: 99-channel, 2-Wire, Armature Relays

Matrix modules

- M9120A Matrix Switch: 4x32, 2-Wire, Armature Relays
- M9121A Matrix Switch: 4x64, 2-Wire, Reed Relays
- M9122A Matrix Switch: 8x32, 1-Wire, Armature Relays

Keysight also supplies software drivers that allow you to support the modules in all popular PXI chassis' and programming environments. Soft Front Panel software allows you to exercise the channels for test purposes.

NOTE **Keysight AgMSwitch driver version 1.1.x or later or the Keysight LabVIEW G driver version 1.1.x or later is required for programmatic control of these switch modules.**

Related documentation

This Maintenance Guide, and the documentation listed below, are on the Switch Module Software and Product Information CD.

- Help file for the PXI Switch Modules Soft Front Panel
- Help file for the PXI Switch Modules IVI-C/IVI-COM device drivers
- Help file for the PXI Switch Modules LabVIEW G device drivers

Module characteristics

For detailed module characteristics, refer to the module data sheets on the *Switch Module Software and Product Information CD* or check the Keysight web site at: www.keysight.com/find/pxiswitch. Note that the characteristics are typical and not guaranteed specifications.

Safety Considerations

WARNING **SHOCK HAZARD. Only service-trained personnel who are aware of the hazards involved should attempt to remove these modules from the chassis and repair them. Remove all user wiring and connections from the plug- in modules before troubleshooting or verification.**

Electrostatic discharge precautions

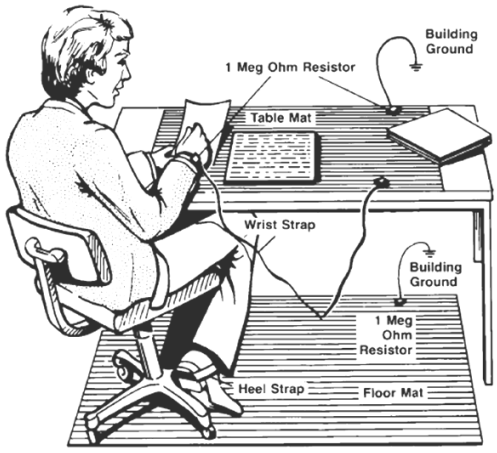
CAUTION

Keysight's PXI Switch Modules are shipped in materials that prevent static electricity damage. The modules should only be removed from the packaging in an anti-static area ensuring that correct anti-static precautions are taken. Store all modules in anti-static envelopes when not in use.

Electrostatic discharge (ESD) can damage or destroy electronic components. All work on electronic assemblies should be performed at a static-safe work station. The following figure shows an example of a static-safe work station using two types of ESD protection. Purchase acceptable ESD accessories from your local supplier.

- Conductive table-mat and wrist-strap combination.
- Conductive floor-mat and heel-strap combination.

Both types, when used together, provide a significant level of ESD protection. Of the two, only the table-mat and wrist-strap combination provides adequate ESD protection when used alone. To ensure user safety, the static-safe accessories must provide at least 1 MΩ of isolation from ground.



Inspect for Damage

Carefully inspect the modules for any damage. Report any shipping damage to the shipping agent immediately, as such damage is not covered by the warranty.

CAUTION **To avoid damage when handling a module; do not touch exposed connector pins.**

Returning a Module for Service

Should it become necessary to return a Keysight PXI switch module for repair or service, follow the steps below:

1. Review the warranty information shipped with your product.
2. Contact Keysight to obtain a return authorization and return address. If you need assistance finding Keysight contact information go to www.keysight.com/find/assist (worldwide contact information for repair and service) or refer to the Technical **Support** information on the product web page at: www.keysight.com/find/pxiswitch.
3. Write the following information on a tag and attach it to the module.
   - Name and address of owner. A Post Office box is not acceptable as a return address.
   - Product model number (for example, M9101A)
   - Product serial number (for example, MYXXXXXXXX). The serial number label is located on the side of the module.
   - A description of failure or service required.
4. Carefully pack the module in its original ESD bag and carton. If the original carton is not available, use bubble wrap or packing peanuts, place the instrument in a sealed container and mark the container “FRAGILE”.
5. On the shipping label, write ATTENTION REPAIR DEPARTMENT and the service order number (if known).

NOTE **If any correspondence is required, refer to the product by serial number and model number.**

Operational Verification of the Modules

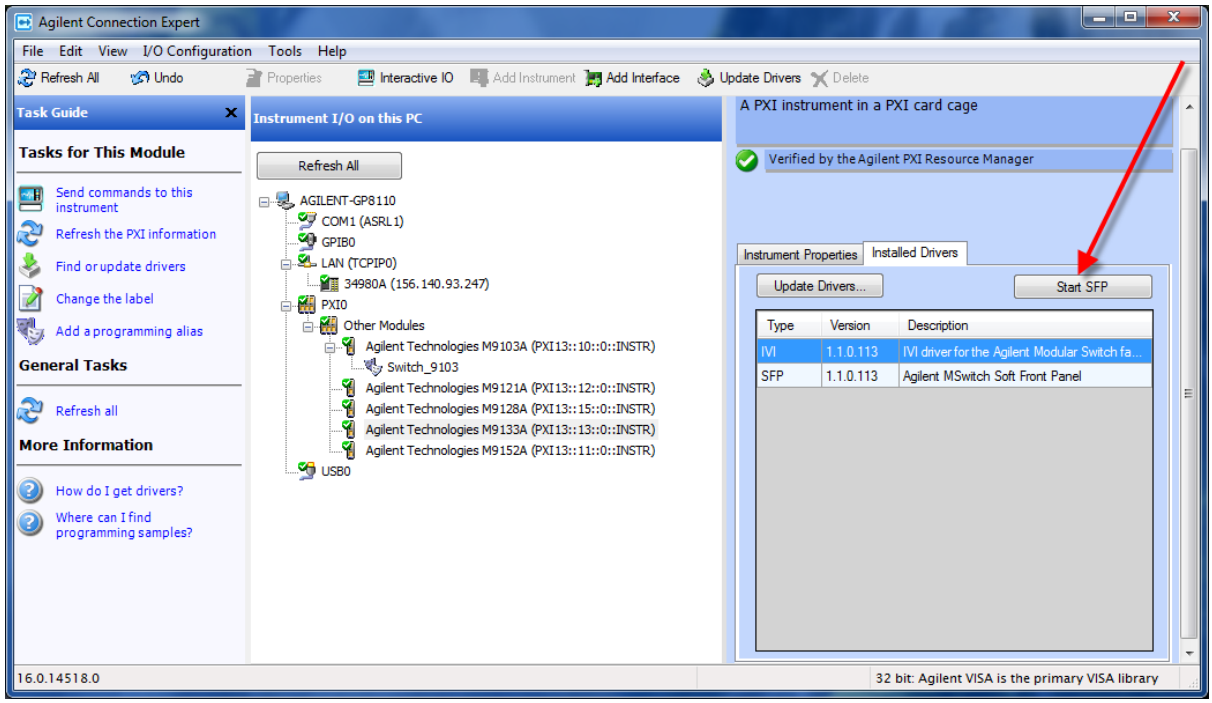
There are no specific programmable operational verification or self test procedures for these modules. However, you can use the Soft Front Panel software to open/close individual channels. This will verify that the module is installed correctly and that the host controller can communicate with the module. If the controller can communicate with one module but not another, the PXIe interface circuitry on the module may be bad.

To control the modules -- that is open and close channel relays -- you must have Keysight IO Libraries Suite installed (version 16.0 or later). IO Libraries Suite is required for the IVI instrument drivers. Use the Keysight Soft Front Panel interface to control the modules. Module drivers and the Soft Front Panel software were provided on the Product and Information CD supplied with the modules. Keysight IO Libraries version 16.0 (or later) must be installed prior to installing and running any other software and prior to powering the chassis. The latest version can be downloaded from: www.keysight.com/find/iosuite.

Run Keysight IO Libraries Connection Expert

- If Keysight Connection Expert is already running on the host controller, click the **Refresh All** button to identify any hardware you have just installed or re-connected.
- If Connection Expert is not already running, run it now to verify your I/O configuration. In the Windows Notification Area, click the IO icon then click Keysight Connection Expert.

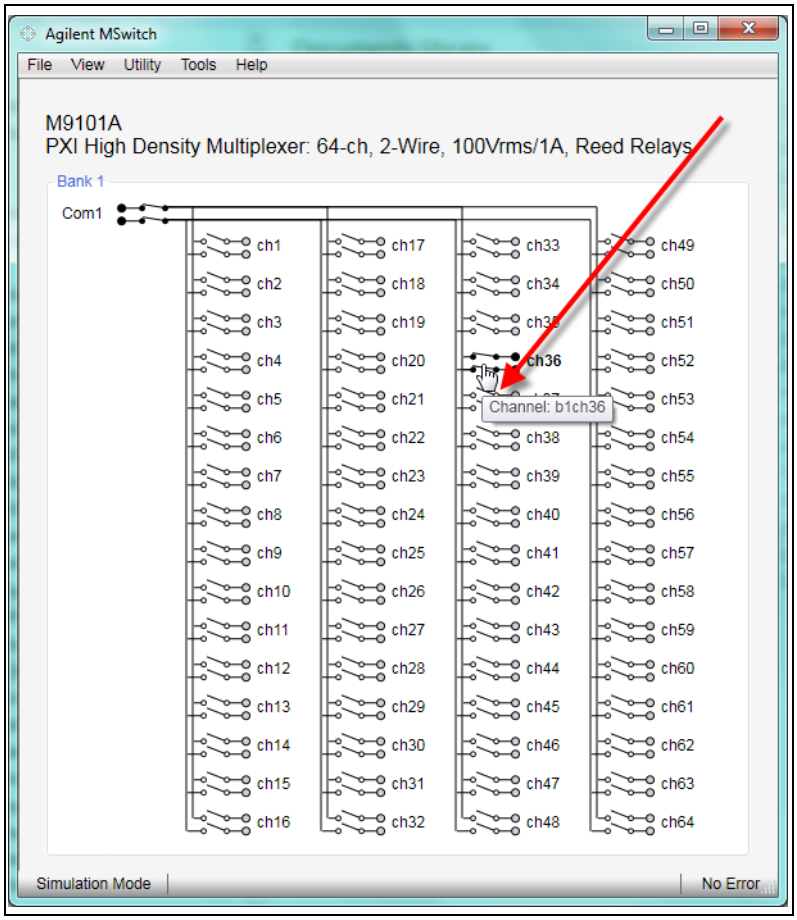
Locate your interfaces and instruments in the Keysight Connection Expert Explorer Pane. The following graphic shows the Connection Expert screen.



Select a module in the center pane (**Instrument I/O on this PC**). The right-hand Pane shows the instrument properties. Select the **`Installed Drivers`** tab then click the **`Start SFP`** button.

Refer to the SFP help file on the *Switch Module Software and Product Information CD* for specific detailed information on the SFP. In the Soft Front Panel interface, when you mouse over a specific channel or matrix crosspoint the cursor changes to the hand cursor, and a popup tool-tip shows the channel number as shown in the following graphic. The following graphic shows an example of the SFP for the M9101A Multiplexer module; it shows channel 36 and the isolation relay closed.

NOTE You can use the Soft Front Panel software to close/open relays (channels) on any of the Keysight PXI switch modules for functional verification testing.



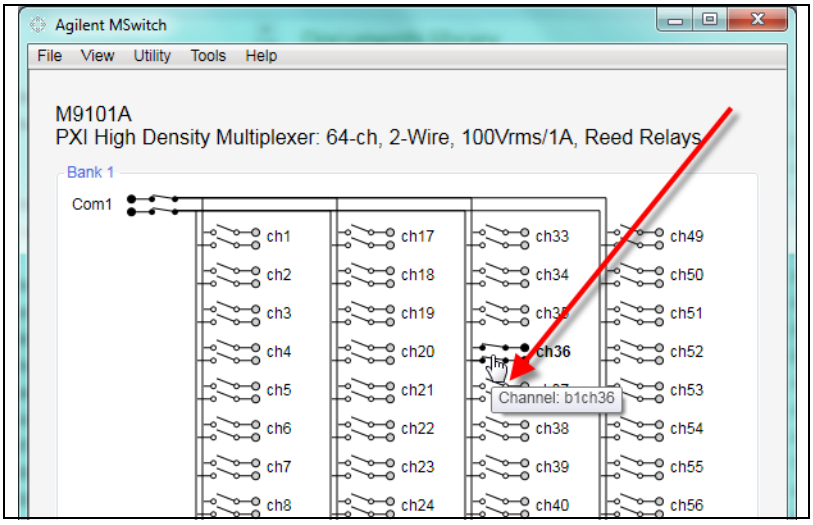
Beginning with SFP Version 1.1.x, if you have another application, either your own program or another instance of the SFP interface, that has initialized the switch module, then the SFP enters it's "monitor" mode. In this mode, you cannot change relay state and the menu buttons are grayed-out. However, as the other application controls the channels, the SFP interface monitors and displays the state of the individual relays. Refer to the SFP help file for additional information.

Identifying channel numbers

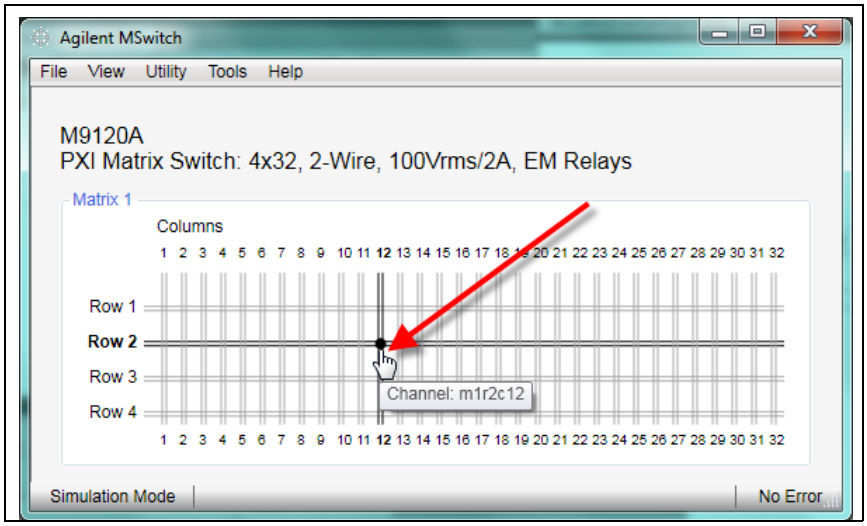
In the Soft Front Panel interface, when you mouse over a specific channel or matrix crosspoint the cursor changes to the hand cursor, and a popup tool-tip shows the Instrument Specific Syntax for the channel number as shown in the following graphics. The Instrument Specific Syntax for channel numbers are used by the IVI and LabVIEW driver open/close commands.

The following graphics show the Soft Front Panel interface and illustrate the channel numbering scheme for multiplexer and matrix modules.

For the multiplexer modules, the Instrument Specific Syntax for channel numbers are in the form: bnchn where bn is the bank number (generally '1') and chn is the channel number. For example, RouteCloseChannel("b1ch36") closes the relay that connects channel 36 to the common. Previously closed channels are automatically opened. See the following graphic:



For the matrix modules, the Instrument Specific Syntax for channel numbers are in the form: m*nrncn* where m indicates a matrix module, r*n* is the row and c*n* is the column. For example, RouteCloseChannel("m1r2c12") closes the relays to connect row 2 to column 12 of matrix 1. See the following graphic of the M9120A with crosspoint R2C12 closed:



Functional Verification Test Procedures

The Functional Verification tests are used to test the module's electrical performance using the typical characteristics supplied in the module's data sheet. For the low frequency multiplexer and matrix modules, the Functional Verification tests consist of measuring each channel's contact path resistance as described the individual chapters. Note that these test only verify that the modules are working, they do not measure any performance specifications.

Recommended test equipment

The following test equipment is required for testing and servicing the PXI switch modules. Essential requirements for each piece of test equipment are described in the Requirements column. Other equipment may be substituted as long as it meets the requirements listed in the Requirements column.

Instrument	Requirements	Recommended Model	Used for PXI Switch Modules
Digital Multimeter	4-wire Ohms	Keysight 34401A, 34410A, 34411A, 3458A, etc.	All modules

In addition, a PXI Chassis and controller are also necessary to control the modules (close/open relays, etc.). A recommended chassis is the M9018A 18-slot PXIe chassis and the M9036A Embedded Controller.

Test conditions

The following setup and environmental conditions are required when testing the modules to ensure the quality of measurements

- Secure all connections to modules.
- Maintain an ambient temperature of 23 °C (± 5 °C).
- Keep relative humidity (RH) below 80%.
- Allow adequate warm up time for the test equipment.
- Plug the PXI chassis all test equipment, and computer (if used) into the same ac power strip to avoid ground loops in the test environment.

You should complete the Functional Verification tests at least once per year. For heavy use or severe operating environments, perform the tests more often.

The person performing the tests must understand how to operate the chassis, the modules using the Keysight Soft Front Panel software, and the specified test equipment. The test procedures do not specify equipment settings for the test equipment except in general terms. It is assumed that a qualified, service-trained technician will select and connect the cables, adapters, and probes required for the tests.

Relay path resistance measurements

Relay module path resistance (relay contact) measurements are appropriate for all relay modules. Measurements are made from the module's front panel terminals, and do not include terminal block or connector resistance. Use 4-wire Ohms measurement techniques and measure directly at the module's front panel terminals where possible. Use shielded twisted pair PTFE insulated cables to reduce settling and noise errors. Keep the input cables as short as possible. Refer to Figure 1.

Note that the characteristics provided on the data sheet are typical and not guaranteed specifications.

WARNING **Do not attempt to measure relay contact resistance directly on the solder terminals on a switch module installed in the PXIe chassis.**

When all relays are "open," a resistance measured on any channel indicates a welded contacts condition and the relay or module must be replaced. There is no specific path resistance or test for this failure.

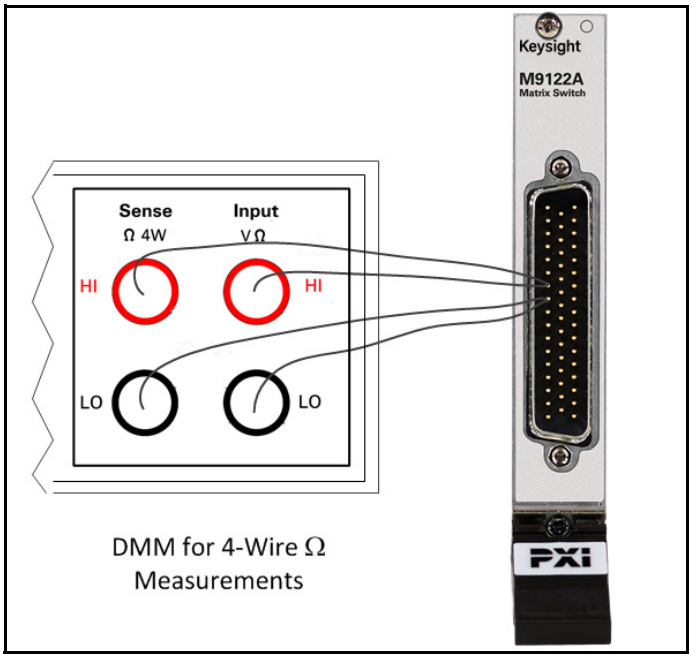


Figure 1 4-Wire Ohms Resistance Measurements

Path resistances

The following table lists the typical path resistances and the approaching Maximum Path Resistance resistance measurements for the low frequency PXI modules.

Relay Module	Initial Path Resistance	Path Resistance*
M9101A	800 mΩ	< 1.50 Ω
M9102A	400 mΩ	< 1.50 Ω
M9103A	470 mΩ	< 1.00 Ω
M9120A	500 mΩ	< 1.40 Ω
M9121A	900 mΩ	< 2.70 Ω
M9122A	250 mΩ	< 1.40 Ω

* If the path resistance exceeds this value, one or more relays in the signal path has a significantly higher contact resistance and may need replacing.

The DC path resistance test is specified for the PXI matrix and multiplexer modules. Measuring dc path resistance provides a simple functional verification of the relays.

Functional Verification Test Record

Each module chapter in this manual has a Functional Test Record. This is a form that you can copy and use to record Functional Verification Test Results for that module. Functional Verification does not verify that the module is within specifications.

Relay Life

Electromechanical relays are subject to normal wear-out. Relay life depends on several factors. The effects of loading and switching frequency are briefly discussed below.

Relay load. In general, higher power switching reduces relay life. In addition, capacitive/inductive loads and high inrush currents (e.g., when turning on a lamp or motor) reduce relay life. Exceeding the specified maximum inputs can cause catastrophic failure.

Switching frequency. Relay contacts heat up when switched. As the switching frequency increases, the contacts have less time to dissipate heat. The resulting increase in contact temperature reduces relay life.

NOTE Switch modules are considered “wear out” items and it is normal for relay performance to degrade over time. Life expectancy and performance depend on the specific application and use model.

End-of-Life Detection

A preventive maintenance routine can prevent problems caused by unexpected relay failure. The end of the life of a relay can be determined using one or more of the three methods described below. The best method (or combination of methods), as well as the failure criteria, depends on the application in which the relay is used.

Contact resistance. As the relay begins to wear out, its contact resistance will increase. When the resistance exceeds a pre-determined value, the relay should be replaced. Note that the characteristics provided on the data sheet are typical and not guaranteed. Refer to “Path resistances” on page 17

Stability of contact resistance. The stability of the contact resistance decreases with age. Using this method, the contact resistance is measured several (5-10) times, and the variance of the measurements is determined. An increase in the variance indicates deteriorating performance.

Number of relay operations. Alternatively, relays can be replaced after a predetermined number of contact closures. However, this method requires knowledge of the applied load and life specifications for the applied load. The Keysight PXI switch modules do not provide a relay closure counter.

Keysight Application Note 1399, Maximizing the Life Span of Your Relays, offers suggestions for selecting the right relays for your application, predicting their longevity and preventing early failures.

Relay replacement strategy

For the matrix and multiplexer relay modules, the replacement strategy depends on the application. If some channels are used more often or at higher loads than the others, the individual relay(s) can be replaced as needed. If all of the channels switch similar loads and switching frequencies, the entire module should be replaced when the relay Maximum Path Resistance approaches. The sensitivity of the application should be weighed against the cost of replacing relays with some useful life remaining.

NOTE Relays that wear out normally or fail due to misuse should not be considered defective and are not covered by the product's warranty.

Post-repair safety checks

After making repairs to the modules, inspect them for any signs of abnormal internally generated heat such as discolored printed circuit boards or components, damaged insulation, or evidence of arcing. Determine and correct the cause of the condition. Then perform the verification test as described for each module to verify that the modules is functional.

Replacement Relays

Keysight PXI Switch Module	Keysight Part Number for Replacement Relay	
M9101A Mux. 64-ch, 2-wire Reed Relays	0490-2921	Relay-dry reed 2A 5vdc-coil 1A 100VAC 375 Ω through-hole
M9102A Mux. 128-ch, 1-wire Reed Relays	0490-2921	Relay-dry reed 2A 5VDC-coil 1A 100VAC 375 Ω through-hole
M9103A Mux. 99-ch, 2-wire Armature Relays	0490-2919	Relay 2C 5VDC-coil 220VDC 500 Ω through-hole
M9120A Matrix 4x32 2-wire Armature Relays	0490-2919	Relay 2C 5VDC-coil 220VDC 500 Ω through-hole
M9121A Matrix 4x64, 2-wire Reed Relays	0490-2965	Relay 5VDC-coil 200VDC 250 Ω through-hole
M9122A Matrix 8x32 1-wire Armature Relays	0490-2919	Relay 2C 5VDC-coil 220VDC 500 Ω through-hole

Module Accessories

Module	Accessory Part Number	Description
M9101A M9102A M9103A	Y1182A	PXI connector block: 200-pin, shielded, male
	Y1189A	PXI connector cable: 200-pin, male-to-female, 1 meter
	Y1190A	PXI connector cable: 200-pin, male-to-female, 2 meter
M9120A	Y1181A	PXI connector block: 78-pin, shielded, female, DSub
	Y1187A	PXI connector cable: 78-pin, male-to-female, 1 meter
	Y1188A	PXI connector cable: 78-pin, male-to-female, 2 meter
M9121A	Y1182A	PXI connector block: 200-pin, shielded, male
	Y1189A	PXI connector cable: 200-pin, male-to-female, 1 meter
	Y1190A	PXI connector cable: 200-pin, male-to-female, 2 meter
M9122A	Y1180A	PXI connector block: 50-pin, shielded, female, DSub
	Y1185A	PXI connector cable: 50-pin, male-to-female, 1 meter
	Y1186A	PXI connector cable: 50-pin, male-to-female, 2 meter

2 M9101A Multiplexer, 64 channel, 2-wire Reed Relays

Introduction

Keysight's M9101A high density multiplexer module operates as a conventional multiplexer module with break-before-make action. Relays on this module are Ruthenium sputtered reed relays. Front panel connections are through a high density 200 pin Low Force Helix (LFH) connector. See Figure 2 on page 23.

Isolation relays (RL65 and RL66) connect the 64 individual channel relays to the module Hi and Low COMmon. This allows for minimum capacitive loading and leakage currents in large multiplexer systems. See the schematic, Figure 4 on page 26.

NOTE **There is no user-discernible difference between the M9101A module and the M9102A module. The difference is in the FPGA programming. In the M9101A module, relay RL67 is loaded but never used (see schematic and board layout, Figure 4 and Figure 5 respectively.**

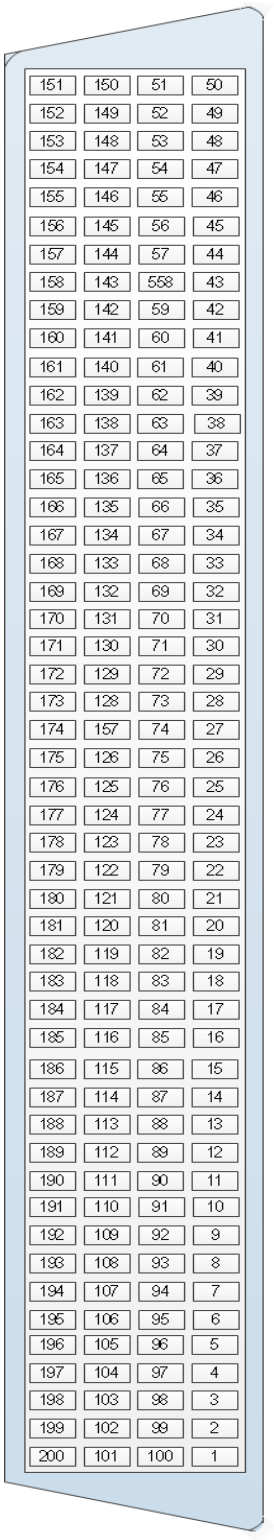
Default switch path

At power on or reset, all relays on the module are open.

Replacement Relays

One spare channel relay (RL68) is loaded on the M9101A PC board. Refer to Figure 5. To use this relay, you must desolder it from the PC board and solder it in place of a defective channel relay. Additional channel or isolation relays may be ordered from Keysight using part number 0490-2921.

CAUTION **To maintain typical switching characteristics (refer to the module data sheet) and user safety, use only Keysight-specified relays. Do not substitute relays unless directed by Keysight support.**



Pin No.	Channel	Pin No.	Channel	Pin No.	Channel	Pin No.	Channel
151	Ch 4 H	150	Ch 3 H	51	Ch 2 H	50	Ch 1 H
152	Ch 4 L	149	Ch 3 L	52	Ch 2 L	49	Ch 1 L
153	Ch 8 H	148	Ch 7 H	53	Ch 6 H	48	Ch 5 H
154	Ch 8 L	147	Ch 7 L	54	Ch 6 L	47	Ch 5 L
155	Ch 12 H	146	Ch 11 H	55	Ch 10 H	46	Ch 9 H
156	Ch 12 L	145	Ch 11 L	56	Ch 10 L	45	Ch 9 L
157	Ch 16 H	144	Ch 15 H	57	Ch 14 H	44	Ch 13 H
158	Ch 16 L	143	Ch 15 L	58	Ch 14 H	43	Ch 13 L
159	Ch 20 H	142	Ch 19 H	59	Ch 18 H	42	Ch 17 H
160	Ch 20 L	141	Ch 19 L	60	Ch 18 L	41	Ch 17 L
161	Ch 24 H	140	Ch 23 H	61	Ch 22 H	40	Ch 21 H
162	Ch 24 L	139	Ch 23 L	62	Ch 22 L	39	Ch 21 L
163	Ch 28 H	138	Ch 27 H	63	Ch 26 H	38	Ch 25 H
164	Ch 28 L	137	Ch 27 L	64	Ch 26 L	37	Ch 25 L
165	Ch 32 H	136	Ch 31 H	65	Ch 30 H	36	Ch 29 H
166	Ch 32 L	135	Ch 31 L	66	Ch 30 L	35	Ch 29 L
167	Ch 36 H	134	Ch 35 H	67	Ch 34 H	34	Ch 33 H
168	Ch 36 L	133	Ch 35 L	68	Ch 34 L	33	Ch 33 L
169	Ch 40 H	132	Ch 39 H	69	Ch 38 H	32	Ch 37 H
170	Ch 40 L	131	Ch 39 L	70	Ch 38 L	31	Ch 37 L
171	Ch 44 H	130	Ch 43 H	71	Ch 42 H	30	Ch 41 H
172	Ch 44 L	129	Ch 43 L	72	Ch 42 L	29	Ch 41 L
173	Ch 48 H	128	Ch 47 H	73	Ch 46 H	28	Ch 45 H
174	Ch 48 L	127	Ch 47 L	74	Ch 46 L	27	Ch 45 L
175	Ch 52 H	126	Ch 51 H	75	Ch 50 H	26	Ch 49 H
176	Ch 52 L	125	Ch 51 L	76	Ch 50 L	25	Ch 49 L
177	Ch 56 H	124	Ch 55 H	77	Ch 54 H	24	Ch 53 H
178	Ch 56 L	123	Ch 55 L	78	Ch 54 L	23	Ch 53 L
179	Ch 60 H	122	Ch 59 H	79	Ch 58 H	22	Ch 57 H
180	Ch 60 L	121	Ch 59 L	80	Ch 58 L	21	Ch57 L
181	Ch 64 H	120	Ch 63 H	81	Ch 62 H	20	Ch 61 H
182	Ch 64 L	119	Ch 63 L	82	Ch 62 L	19	Ch 61 L
183		118	--	83	--	18	--
184	--	117	--	84	--	17	--
185	--	116	--	85	--	16	--
186	--	115	--	86	--	15	--
187	--	114	--	87	--	14	--
188	--	113	--	88	--	13	--
189	--	112	--	89	--	12	--
190	--	111	--	90	--	11	--
191	--	110	--	91	--	10	--
192	--	109	--	92	--	9	--
193	--	108	--	93	--	8	--
194	--	107	--	94	--	7	--
195	--	106	--	95	--	6	--
196	--	105	--	96	--	5	--
197	--	104	--	97	--	4	--
198	--	103	--	98	--	3	--
199	COM H	102	--	99	--	2	--
200	COM L	101	--	100	--	1	--

Figure 2 M9101A Connector and Pinout
(viewed from the front panel, "--" indicates pins not used)

Troubleshooting and Functional Verification Testing

To troubleshoot and verify the relays on the module, perform a closed channel resistance test on each channel. This procedure does not provide performance or specification verification.

CAUTION **Remove all user wiring and connections from the plug-in modules before troubleshooting or verification.**

When all relays are "open," a resistance measured on any channel path indicates a welded contacts condition and the relay or module must be replaced. There is no specific path resistance or test for this failure.

The path resistance characteristic assumes that the individual channel connections on the module front panel are shorted and the DMM is connected to the COMmon terminals. See Figure 3.

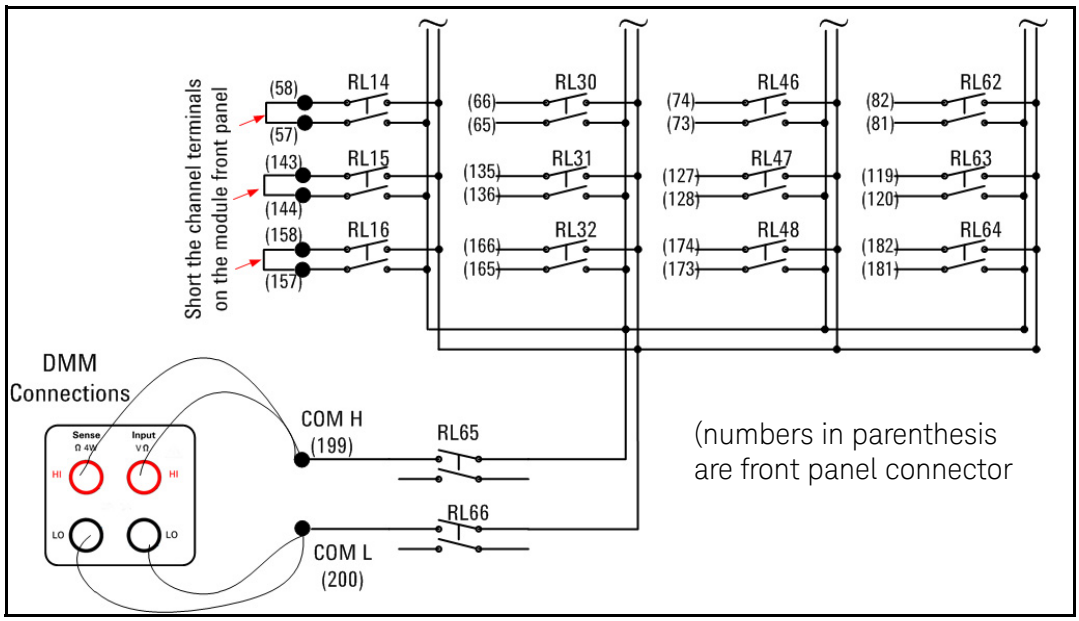


Figure 3 M9101A Contact Resistance Test

Note that this path includes four relay contacts -- the two channel relay contacts (Hi and Lo) and one contact on relays RL65 and RL66. The typical initial path resistance is approximately 800 mΩ.

Alternately, you can measure the contact resistance COM Hi to the channel Hi terminals and then from the COM Lo to the channel Lo terminals. In this case, the contact resistance should be approximately one-half of the total.

M9101A Functional Verification Test Record - Closed Channel Resistance

Channel No.	Path Resistance*	Measured Value	Channel No.	Path Resistance*	Measured Value
1	< 1.50 Ω		33	< 1.50 Ω	
2	< 1.50 Ω		34	< 1.50 Ω	
3	< 1.50 Ω		35	< 1.50 Ω	
4	< 1.50 Ω		36	< 1.50 Ω	
5	< 1.50 Ω		37	< 1.50 Ω	
6	< 1.50 Ω		38	< 1.50 Ω	
7	< 1.50 Ω		39	< 1.50 Ω	
8	< 1.50 Ω		40	< 1.50 Ω	
9	< 1.50 Ω		41	< 1.50 Ω	
10	< 1.50 Ω		42	< 1.50 Ω	
11	< 1.50 Ω		43	< 1.50 Ω	
12	< 1.50 Ω		44	< 1.50 Ω	
13	< 1.50 Ω		45	< 1.50 Ω	
14	< 1.50 Ω		46	< 1.50 Ω	
15	< 1.50 Ω		47	< 1.50 Ω	
16	< 1.50 Ω		48	< 1.50 Ω	
17	< 1.50 Ω		49	< 1.50 Ω	
18	< 1.50 Ω		50	< 1.50 Ω	
19	< 1.50 Ω		51	< 1.50 Ω	
20	< 1.50 Ω		52	< 1.50 Ω	
21	< 1.50 Ω		53	< 1.50 Ω	
22	< 1.50 Ω		54	< 1.50 Ω	
23	< 1.50 Ω		55	< 1.50 Ω	
24	< 1.50 Ω		56	< 1.50 Ω	
25	< 1.50 Ω		57	< 1.50 Ω	
26	< 1.50 Ω		58	< 1.50 Ω	
27	< 1.50 Ω		59	< 1.50 Ω	
28	< 1.50 Ω		60	< 1.50 Ω	
29	< 1.50 Ω		61	< 1.50 Ω	
30	< 1.50 Ω		62	< 1.50 Ω	
31	< 1.50 Ω		63	< 1.50 Ω	
32	< 1.50 Ω		64	< 1.50 Ω	

* Functional test limit

M9101A Schematic

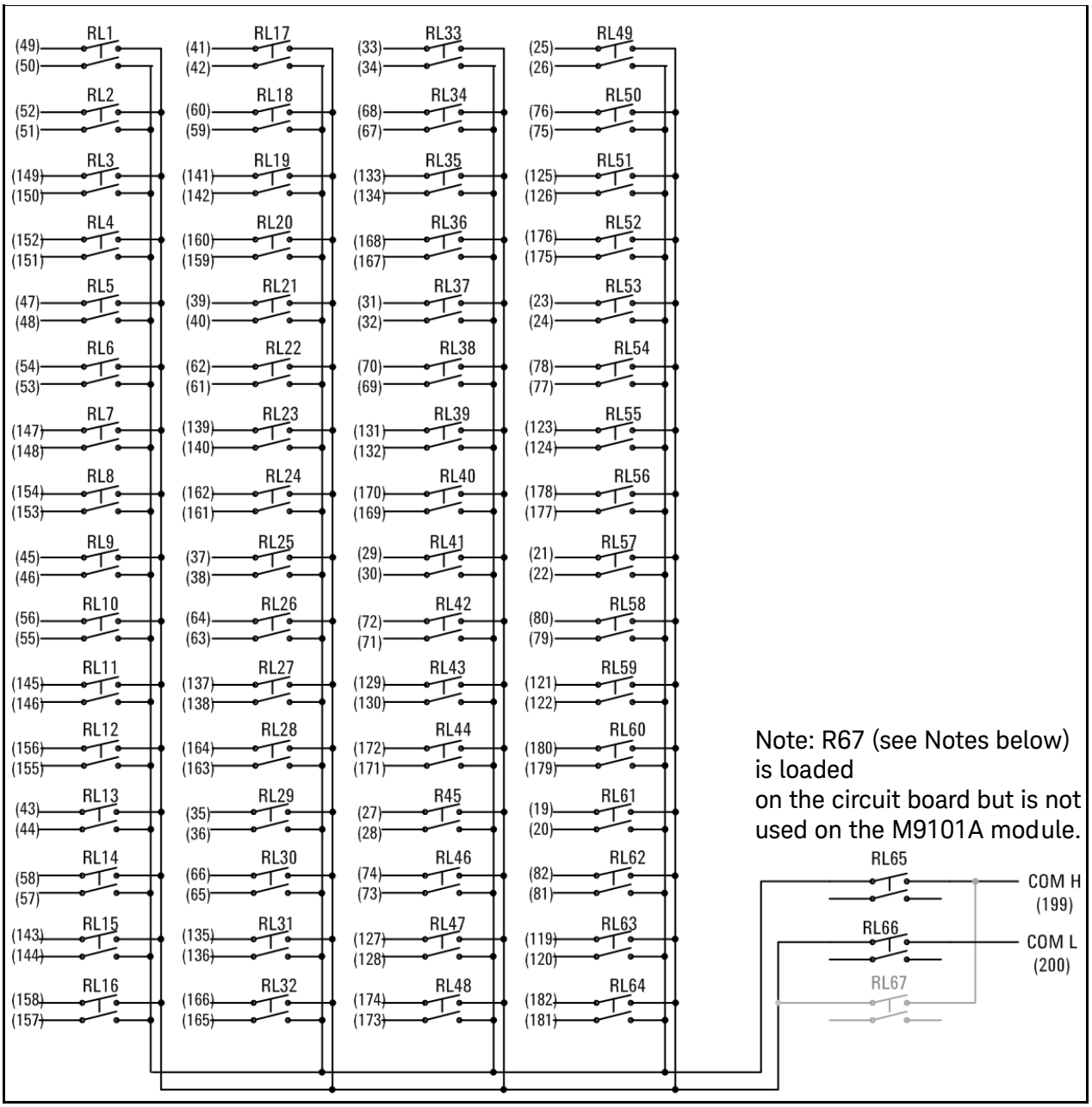


Figure 4 M9101A Schematic

Notes:

- Numbers in parenthesis are front panel connector pin numbers.
- RL67 is loaded on the PC board but is not used on the M9101A module. See note on page 22.
- Channel relay numbers (RL1 - RL64) correspond to the channel numbers.

M9101A PC Board Layout

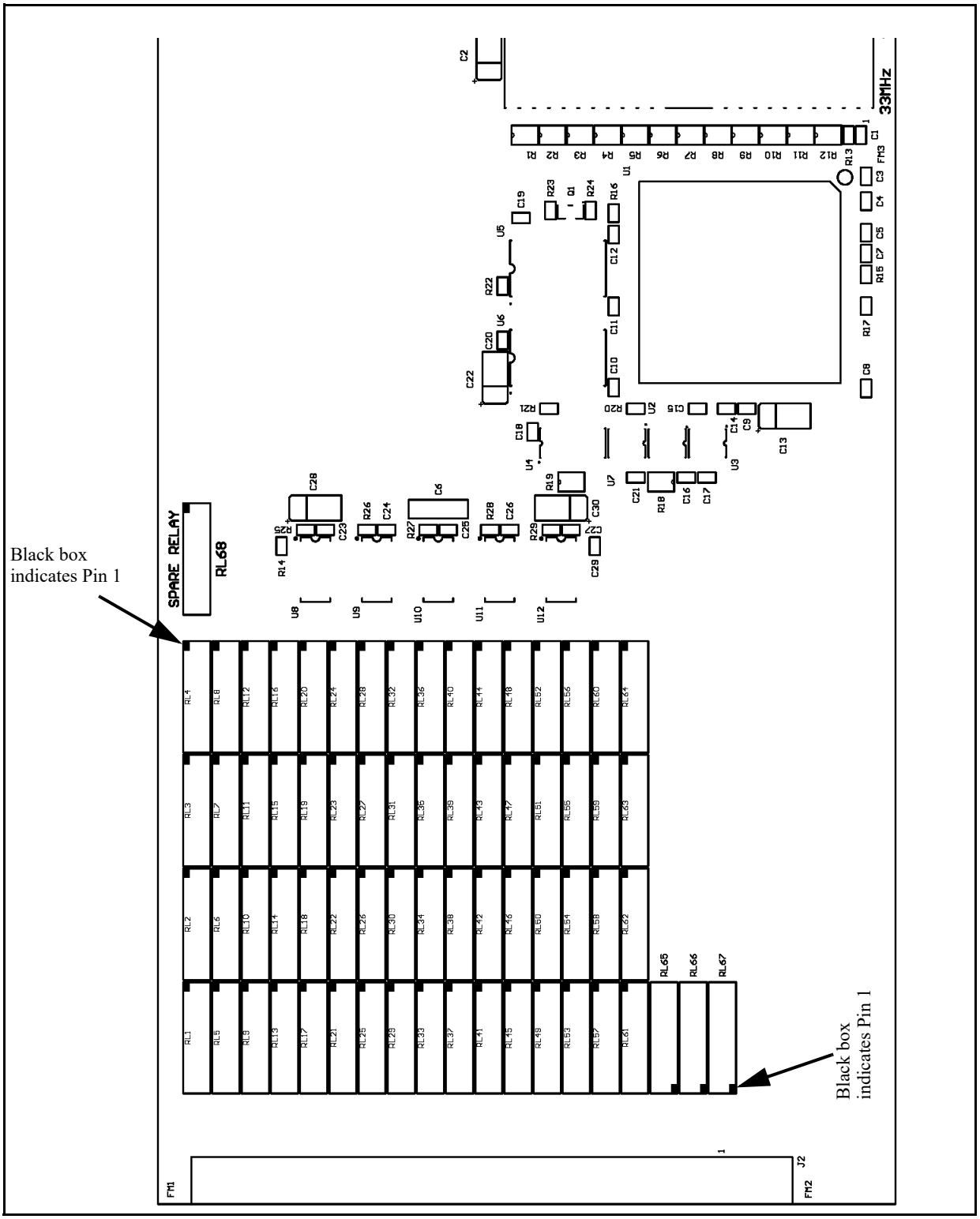


Figure 5 M9101A PC Board Relay Layout

Figure 6 shows the back side (solder side of the M9101A) and also shows the relay contact connections (the center two terminals are for the relay coil drive). Note that relays RL65, RL66, and RL67 are reversed.

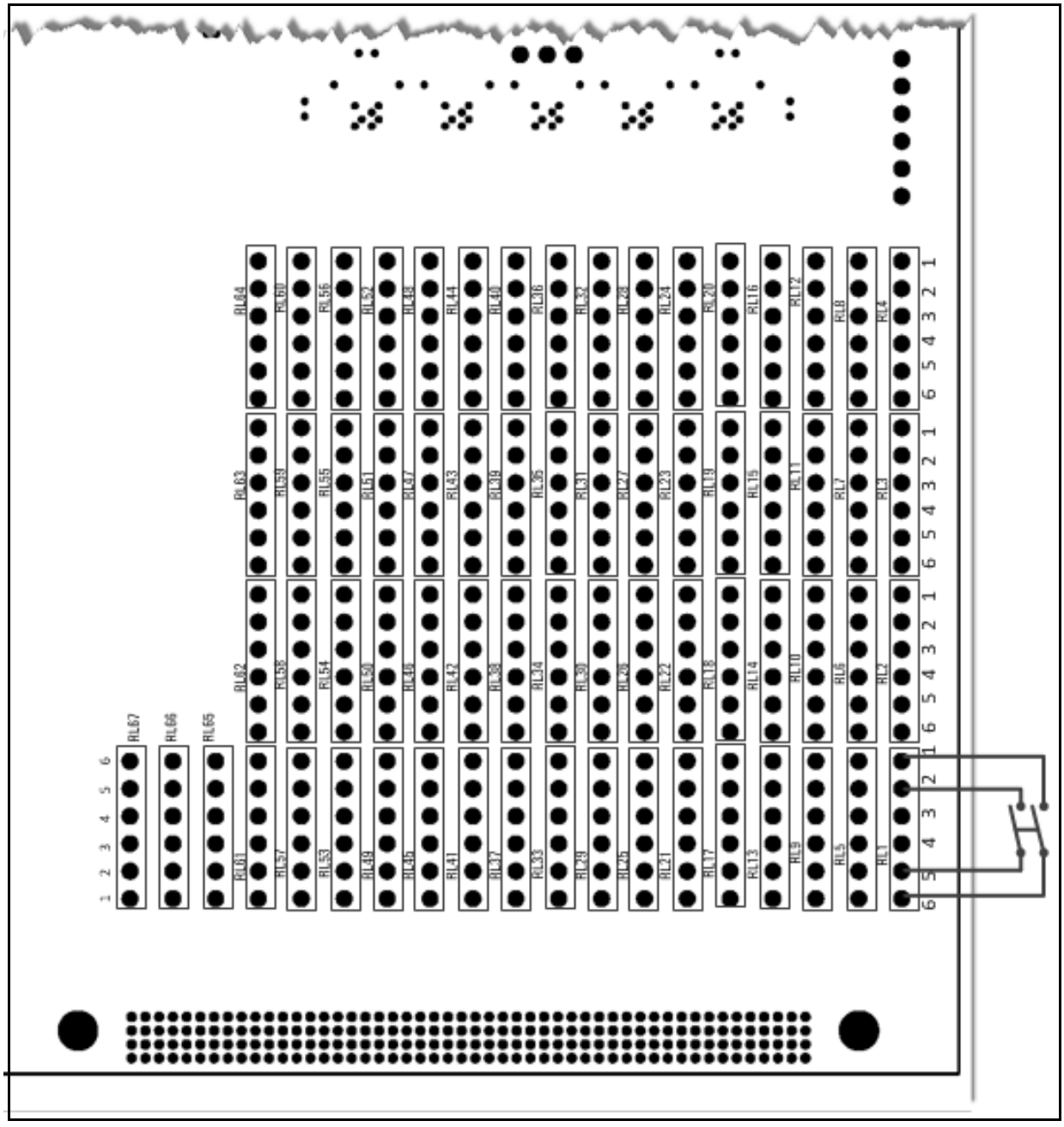


Figure 6 Back side (solder side) of M9101A showing relay contacts

3 M9102A Multiplexer, 128 channel, 1-wire Reed Relays

Introduction

Keysight's M9102A high density multiplexer module operates as a conventional multiplexer module with break-before-make action. Relays on this module are Ruthenium sputtered reed relays. Front panel connections are through a high density 200 pin Low Force Helix (LFH) connector. See Figure 7 on page 31.

Isolation relays (RL65 and RL67) connect the 64 channel relays to the module's COMmon. This allows for minimum capacitive loading and leakage currents in large multiplexer systems. Refer to the schematic Figure 9 on page 36.

NOTE **There is no user-discernable difference between the M9101A module and the M9102A module. The difference is in the FPGA programming. In the M9102A module, relay RL66 is loaded but never used (see schematic and board layout, Figure 9 and Figure 10 respectively.**

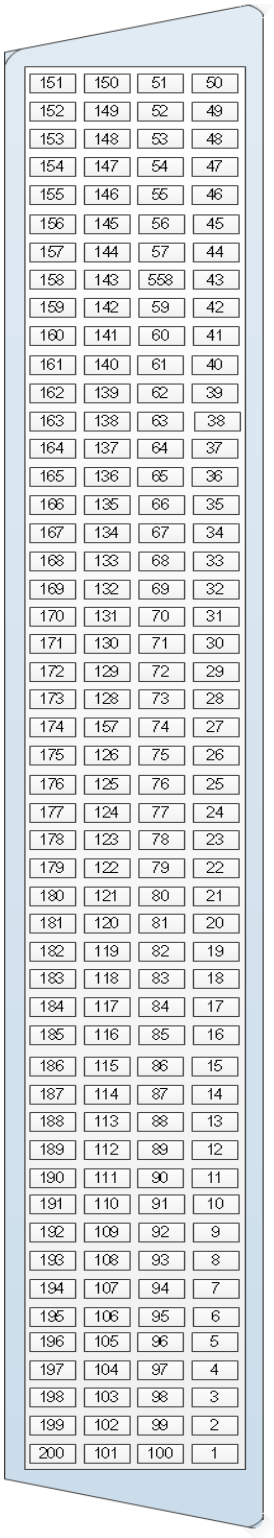
Default switch path

At power on or reset, all relays on the module are open.

Replacement Relays

One spare channel relay (RL68) is loaded on the M9102A PC board. Refer to Figure 10. To use this relay, you must desolder it from the PC board and solder it in place of a defective channel relay. Additional channel or isolation relays may be ordered from Keysight using part number 0490-2921.

CAUTION **To maintain typical switching characteristics (refer to the module data sheet) and user safety, use only Keysight-specified relays. Do not substitute relays unless directed by Keysight support.**



Pin No.	Channel	Pin No.	Channel	Pin No.	Channel	Pin No.	Channel
151	Ch 7	150	Ch 5	51	Ch 3	50	Ch 1
152	Ch 8	149	Ch 6	52	Ch 4	49	Ch 2
153	Ch 15	148	Ch 13	53	Ch 11	48	Ch 9
154	Ch 16	147	Ch 14	54	Ch 12	47	Ch 10
155	Ch 23	146	Ch 21	55	Ch 19	46	Ch 17
156	Ch 24	145	Ch 22	56	Ch 20	45	Ch 18
157	Ch 31	144	Ch 29	57	Ch 27	44	Ch 25
158	Ch 32	143	Ch 30	58	Ch 28	43	Ch 26
159	Ch 39	142	Ch 37	59	Ch 35	42	Ch 33
160	Ch 40	141	Ch 38	60	Ch 36	41	Ch 34
161	Ch 47	140	Ch 45	61	Ch 43	40	Ch 41
162	Ch 48	139	Ch 46	62	Ch 44	39	Ch 42
163	Ch 55	138	Ch 53	63	Ch 51	38	Ch 49
164	Ch 56	137	Ch 54	64	Ch 52	37	Ch 50
165	Ch 63	136	Ch 61	65	Ch 59	36	Ch 57
166	Ch 64	135	Ch 62	66	Ch 60	35	Ch 58
167	Ch 71	134	Ch 69	67	Ch 67	34	Ch 65
168	Ch 72	133	Ch 70	68	Ch 68	33	Ch 66
169	Ch 79	132	Ch 77	69	Ch 75	32	Ch 73
170	Ch 80	131	Ch 78	70	Ch 76	31	Ch 74
171	Ch 87	130	Ch 85	71	Ch 83	30	Ch 81
172	Ch 88	129	Ch 86	72	Ch 84	29	Ch 82
173	Ch 95	128	Ch 93	73	Ch 91	28	Ch 89
174	Ch 96	127	Ch 94	74	Ch 92	27	Ch 90
175	Ch 103	126	Ch 101	75	Ch 99	26	Ch 97
176	Ch 104	125	Ch 102	76	Ch 100	25	Ch 98
177	Ch 111	124	Ch 109	77	Ch 107	24	Ch 105
178	Ch 112	123	Ch 110	78	Ch 108	23	Ch 106
179	Ch 119	122	Ch 117	79	Ch 115	22	Ch 113
180	Ch 120	121	Ch 118	80	Ch 116	21	Ch 114
181	Ch 127	120	Ch 125	81	Ch 123	20	Ch 121
182	Ch 128	119	Ch 126	82	Ch 124	19	Ch 122
183	--	118	--	83	--	18	--
184	--	117	--	84	--	17	--
185	--	116	--	85	--	16	--
186	--	115	--	86	--	15	--
187	--	114	--	87	--	14	--
188	--	113	--	88	--	13	--
189	--	112	--	89	--	12	--
190	--	111	--	90	--	11	--
191	--	110	--	91	--	10	--
192	--	109	--	92	--	9	--
193	--	108	--	93	--	8	--
194	--	107	--	94	--	7	--
195	--	106	--	95	--	6	--
196	--	105	--	96	--	5	--
197	--	104	--	97	--	4	--
198	--	103	--	98	--	3	--
199	COMmon	102	--	99	--	2	--
200	--	101	--	100	--	1	--

Figure 7 M9102A Connector and Pinout
(viewed from the front panel, "--" indicates pins not used)

Troubleshooting and Functional Verification Testing

To troubleshoot and verify the relays on the module, perform a closed channel resistance test on each channel. This procedure does not provide performance or specification verification.

CAUTION **Remove all user wiring and connections from the plug- in modules before troubleshooting or verification.**

When all relays are “open,” a resistance measured on any channel path indicates a welded contacts condition and the relay or module must be replaced. There is no specific path resistance or test for this failure.

The internal path resistance characteristic assumes that the individual channel connection on the module front panel to the COMmon terminal. See Figure 8.

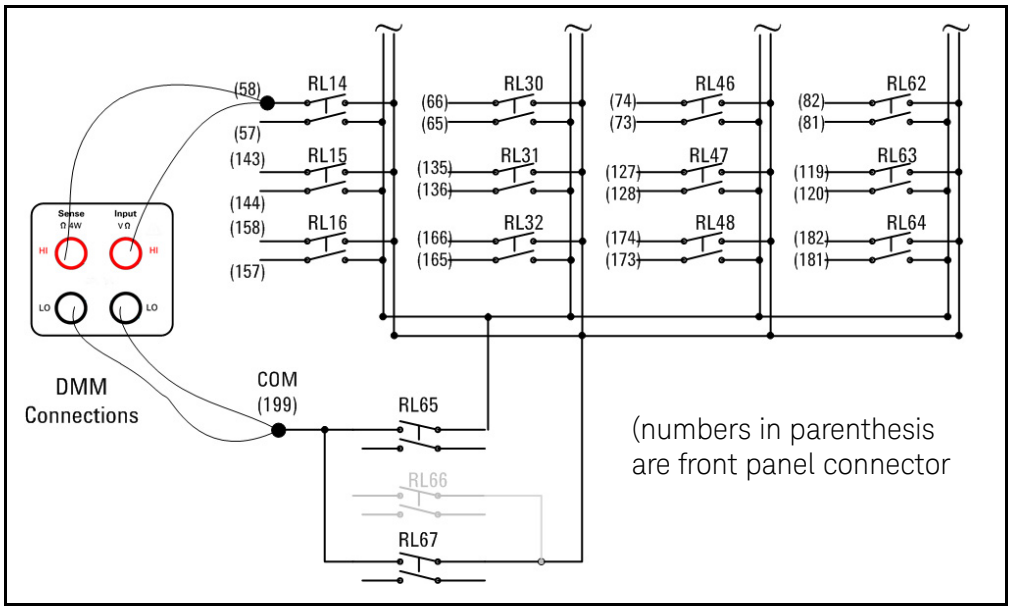


Figure 8 M9102A Contact Resistance Test

Note that this includes two relay contacts -- one channel relay contact and one contact on relays RL65 or RL67. Also, each relay represents two different channels; relay RL14, for example, is used for channels 27 and 28. The typical initial path resistance is approximately 400 mΩ.

Channel to Relay Numbers

Channel Numbers	Relay	Channel Numbers	Relay	Channel Numbers	Relay	Channel Numbers	Relay
1, 2	RL1	33, 34	RL17	65, 66	RL33	97, 98	RL49
3,4	RL2	35, 36	RL18	67, 68	RL34	99, 100	RL50
5,6	RL3	37, 38	RL19	69, 70	RL35	101, 102	RL51
7, 8	RL4	39, 40	RL20	71, 72	RL36	103, 104	RL52
9,10	RL5	41, 42	RL21	73, 74	RL37	105, 106	RL53
11, 12	RL6	43, 44	RL22	75, 76	RL38	107, 108	RL54
13, 14	RL7	45, 46	RL23	77, 78	RL39	109, 110	RL55
15, 16	RL8	47, 48	RL24	79, 80	RL40	111, 112	RL56
17, 18	RL9	49, 50	RL25	81, 82	RL41	113, 114	RL57
19, 20	RL10	51, 52	RL26	83, 84	RL42	115, 116	RL58
21, 22	RL11	53, 54	RL27	85, 86	RL43	117, 118	RL59
23, 24	RL12	55, 56	RL28	87, 88	RL44	119, 120	RL60
25, 26	RL13	57, 58	RL29	89, 90	RL45	121, 122	RL61
27, 28	RL14	59, 60	RL30	91, 92	RL46	123, 124	RL62
29, 30	RL15	61, 62	RL31	93, 94	RL47	125, 126	RL63
31, 32	RL16	63, 64	RL32	95, 96	RL48	127, 128	RL64

M9102A Functional Verification Test Record - Closed Channel Resistance

Channel No.	Path Resistance*	Measured Value	Channel No.	Path Resistance*	Measured Value
1	< 1.50 Ω		65	< 1.50 Ω	
2	< 1.50 Ω		66	< 1.50 Ω	
3	< 1.50 Ω		67	< 1.50 Ω	
4	< 1.50 Ω		68	< 1.50 Ω	
5	< 1.50 Ω		69	< 1.50 Ω	
6	< 1.50 Ω		70	< 1.50 Ω	
7	< 1.50 Ω		71	< 1.50 Ω	
8	< 1.50 Ω		72	< 1.50 Ω	
9	< 1.50 Ω		73	< 1.50 Ω	
10	< 1.50 Ω		74	< 1.50 Ω	
11	< 1.50 Ω		75	< 1.50 Ω	
12	< 1.50 Ω		76	< 1.50 Ω	
13	< 1.50 Ω		77	< 1.50 Ω	
14	< 1.50 Ω		78	< 1.50 Ω	
15	< 1.50 Ω		79	< 1.50 Ω	
16	< 1.50 Ω		80	< 1.50 Ω	
17	< 1.50 Ω		81	< 1.50 Ω	
18	< 1.50 Ω		82	< 1.50 Ω	
19	< 1.50 Ω		83	< 1.50 Ω	
20	< 1.50 Ω		84	< 1.50 Ω	
21	< 1.50 Ω		85	< 1.50 Ω	
22	< 1.50 Ω		86	< 1.50 Ω	
23	< 1.50 Ω		87	< 1.50 Ω	
24	< 1.50 Ω		88	< 1.50 Ω	
25	< 1.50 Ω		89	< 1.50 Ω	
26	< 1.50 Ω		90	< 1.50 Ω	
27	< 1.50 Ω		91	< 1.50 Ω	
28	< 1.50 Ω		92	< 1.50 Ω	
29	< 1.50 Ω		93	< 1.50 Ω	
30	< 1.50 Ω		94	< 1.50 Ω	
31	< 1.50 Ω		95	< 1.50 Ω	
32	< 1.50 Ω		96	< 1.50 Ω	
33	< 1.50 Ω		97	< 1.50 Ω	
34	< 1.50 Ω		98	< 1.50 Ω	
35	< 1.50 Ω		99	< 1.50 Ω	
36	< 1.50 Ω		100	< 1.50 Ω	
37	< 1.50 Ω		101	< 1.50 Ω	
38	< 1.50 Ω		102	< 1.50 Ω	
39	< 1.50 Ω		103	< 1.50 Ω	
40	< 1.50 Ω		104	< 1.50 Ω	
41	< 1.50 Ω		105	< 1.50 Ω	
42	< 1.50 Ω		106	< 1.50 Ω	
43	< 1.50 Ω		107	< 1.50 Ω	
44	< 1.50 Ω		108	< 1.50 Ω	
45	< 1.50 Ω		109	< 1.50 Ω	
46	< 1.50 Ω		110	< 1.50 Ω	
47	< 1.50 Ω		111	< 1.50 Ω	

Channel No.	Path Resistance*	Measured Value	Channel No.	Path Resistance*	Measured Value
48	< 1.50 Ω		112	< 1.50 Ω	
49	< 1.50 Ω		113	< 1.50 Ω	
50	< 1.50 Ω		114	< 1.50 Ω	
51	< 1.50 Ω		115	< 1.50 Ω	
52	< 1.50 Ω		116	< 1.50 Ω	
53	< 1.50 Ω		117	< 1.50 Ω	
54	< 1.50 Ω		118	< 1.50 Ω	
55	< 1.50 Ω		119	< 1.50 Ω	
56	< 1.50 Ω		120	< 1.50 Ω	
57	< 1.50 Ω		121	< 1.50 Ω	
58	< 1.50 Ω		122	< 1.50 Ω	
59	< 1.50 Ω		123	< 1.50 Ω	
60	< 1.50 Ω		124	< 1.50 Ω	
61	< 1.50 Ω		125	< 1.50 Ω	
62	< 1.50 Ω		126	< 1.50 Ω	
63	< 1.50 Ω		127	< 1.50 Ω	
64	< 1.50 Ω		128	< 1.50 Ω	

* Functional test limit

M9102A Schematic

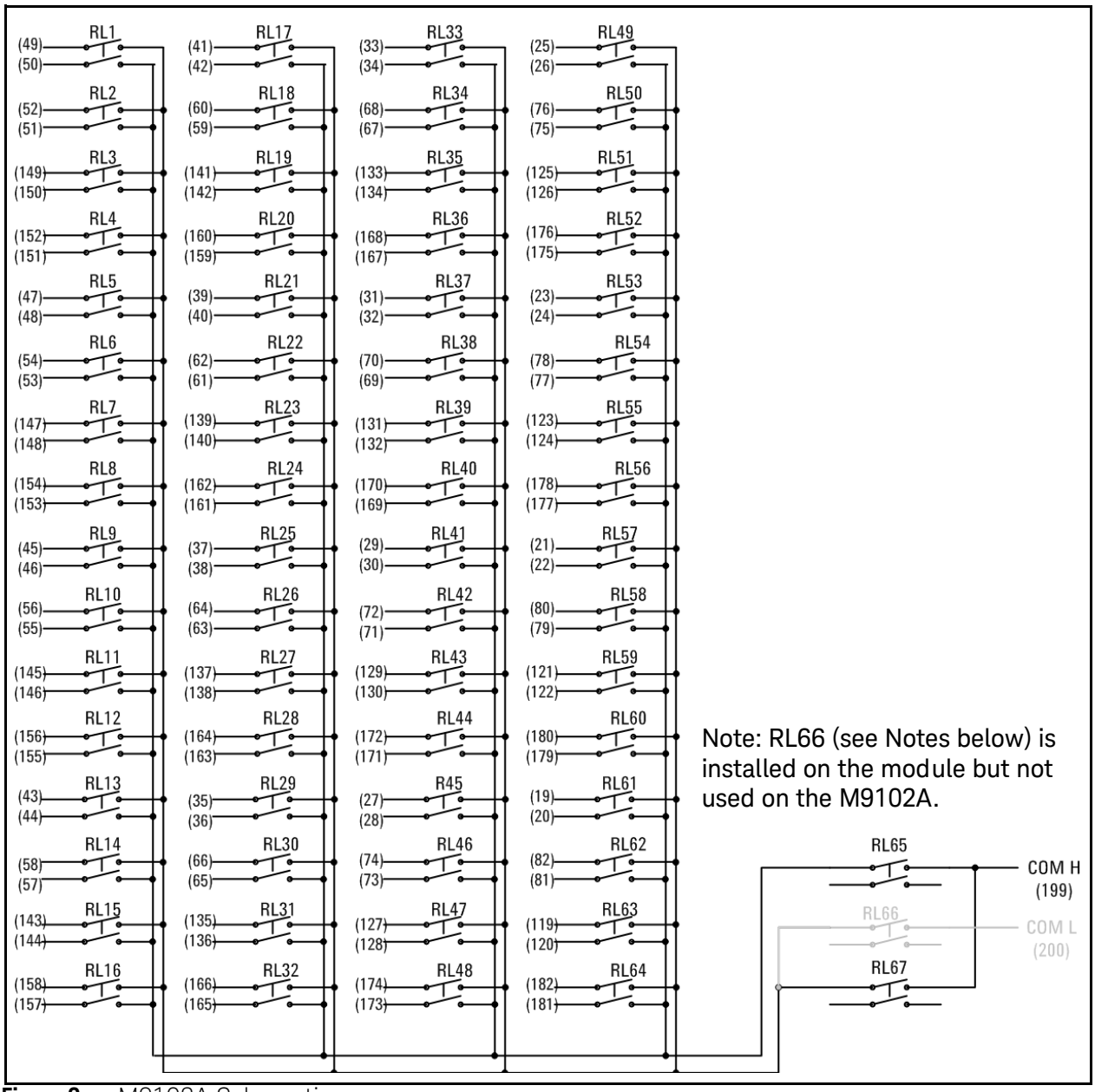


Figure 9 M9102A Schematic

Notes:

- Numbers in parenthesis are front panel connector pin numbers.
- RL66 is loaded on the PC board but is not used on the M9102A module. See note on page 30.
- See "Channel to Relay Numbers" on page 33 for the relationship between relay numbers (RLxx) and channel numbers

M9102A PC Board Layout

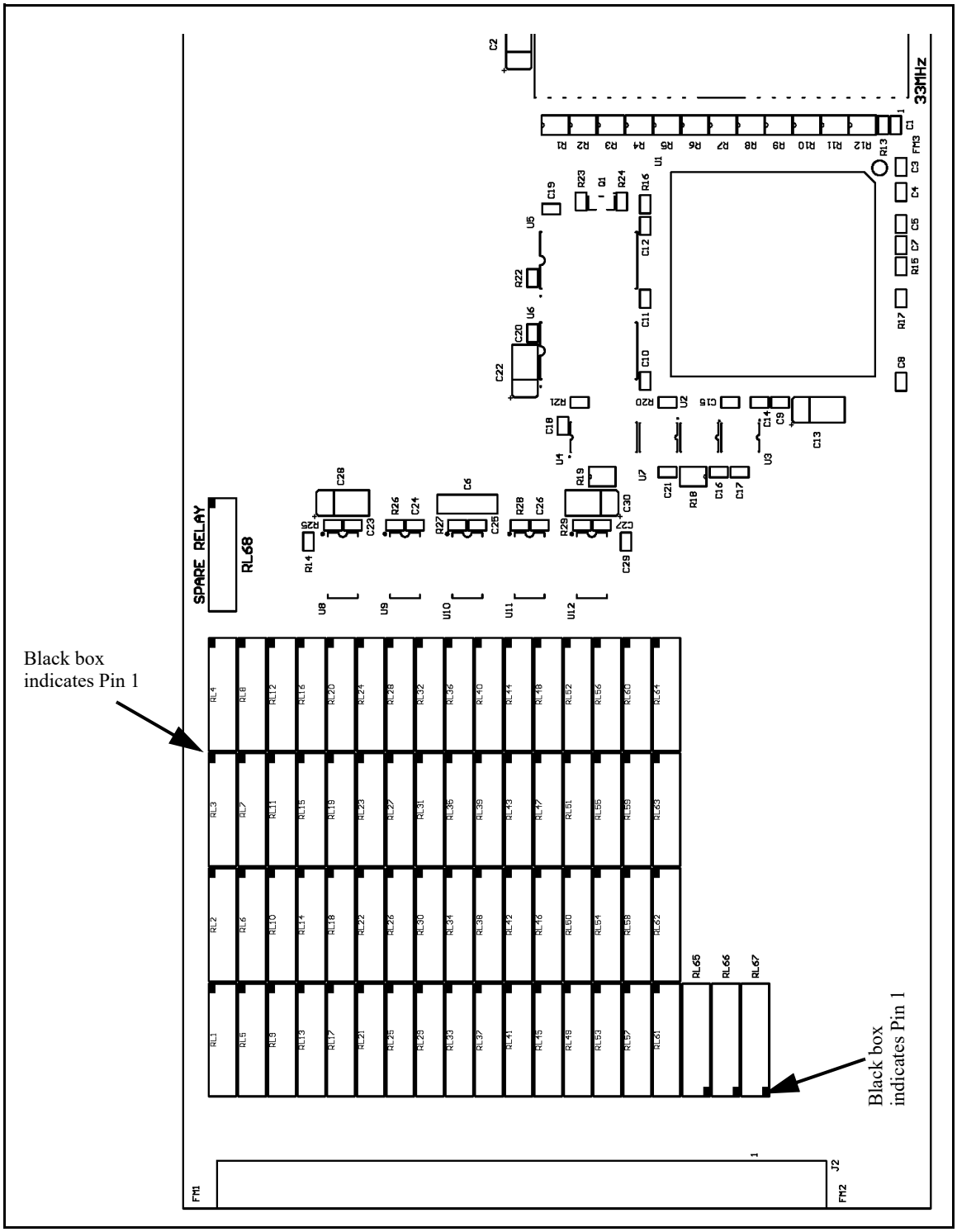


Figure 10 M9102A PC Board Relay Layout

Figure 11 shows the back side (solder side of the M9102A) and also shows the relay contact connections (the center two terminals are for the relay coil drive). Note that relays RL65, RL66, and RL67 are reversed.

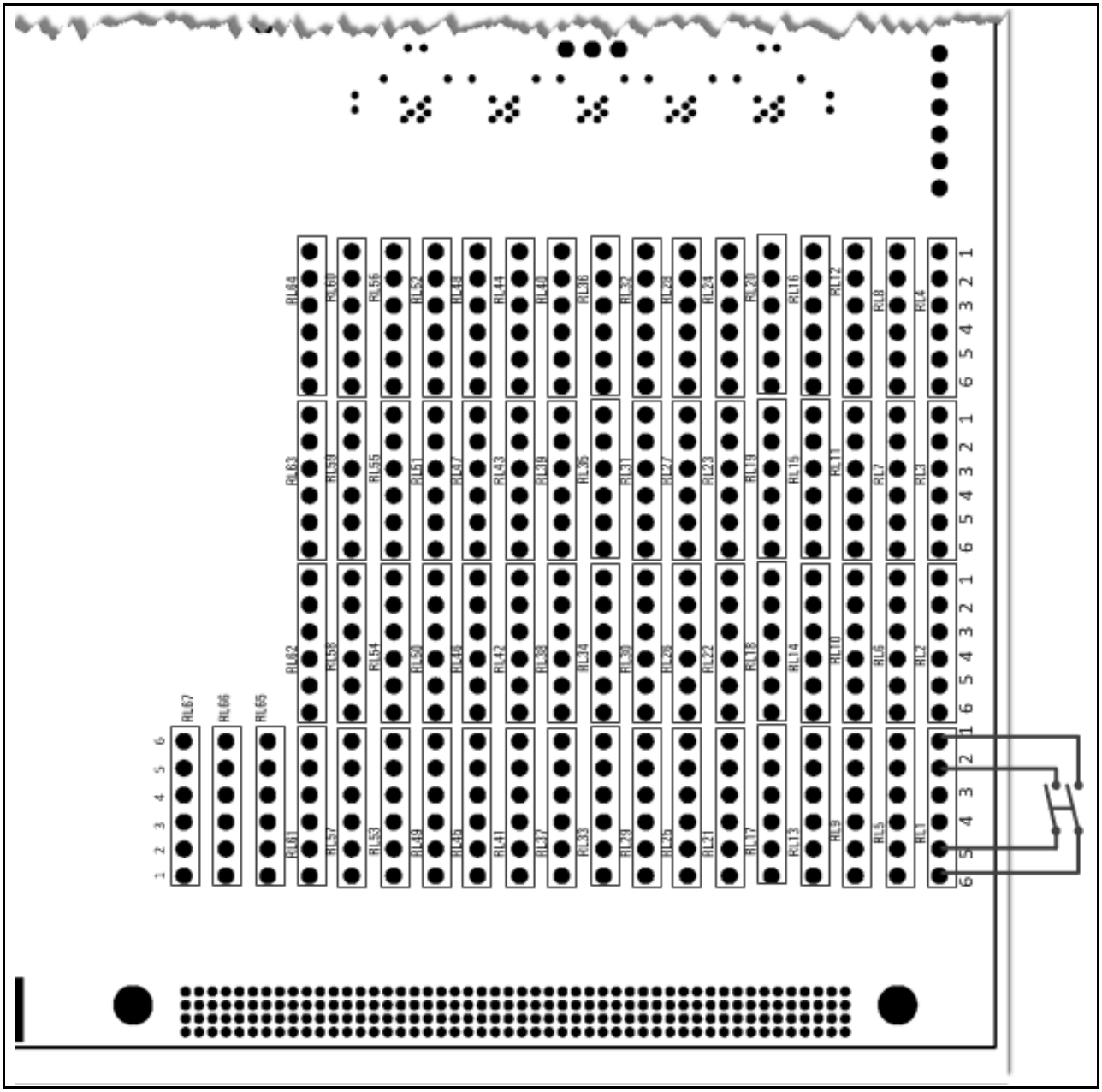


Figure 11 Back side (solder side) of M9102A showing relay contacts

4 M9103A Multiplexer, 99 channel, 2-wire Armature Relays

Introduction

Keysight's M9103A high density multiplexer module operates as a conventional multiplexer module with break-before-make action. This module uses armature relays. Relays on this module are Ruthenium sputtered reed relays. Front panel connections are through a high density 200 pin Low Force Helix (LFH) connector. See Figure 12 on page 41.

Isolation relays (RL100 and RL101) connect the 99 individual channels to the module's COMmon Hi and Low. Refer to the schematic Figure 14 on page 45. This allows for minimum capacitive loading and leakage currents in large multiplexer systems.

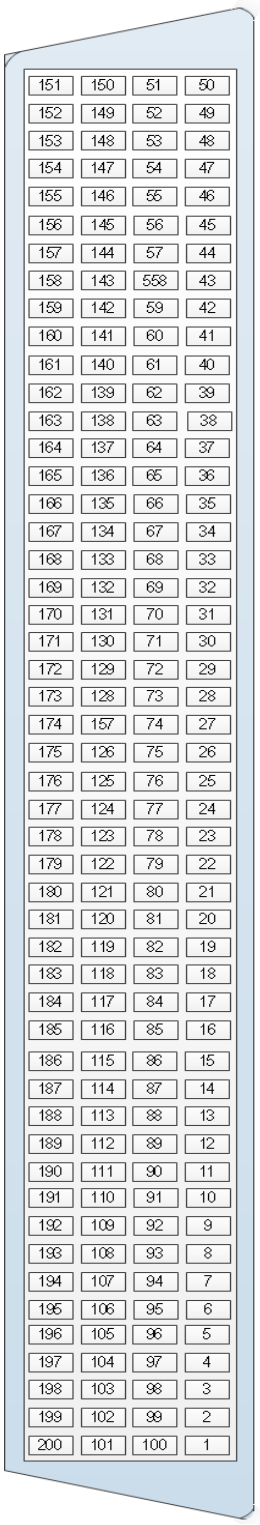
Default switch path

The isolation and all channel relays are open.

Replacement Relays

One spare channel relay (RL103) is loaded on the M9103A PC board. Refer to Figure 15. To use this relay, you must desolder it from the PC board and solder it in place of a defective channel relay. Additional channel or isolation relays may be ordered from Keysight using part number 0490-2919.

CAUTION **To maintain typical switching characteristics (refer to the module data sheet) and user safety, use only Keysight-specified relays. Do not substitute relays unless directed by Keysight support.**



Pin No.	Channel	Pin No.	Channel	Pin No.	Channel	Pin No.	Channel
151	Ch 4 H	150	Ch 3 H	51	Ch 2 H	50	Ch 1 H
152	Ch 4 L	149	Ch 3 L	52	Ch 2 L	49	Ch 1 L
153	Ch 8 H	148	Ch 7 H	53	Ch 6 H	48	Ch 5 H
154	Ch 8 L	147	Ch 7 L	54	Ch 6 L	47	Ch 5 L
155	Ch 12 H	146	Ch 11 H	55	Ch 10 H	46	Ch 9 H
156	Ch 12 L	145	Ch 11 L	56	Ch 10 L	45	Ch 9 L
157	Ch 16 H	144	Ch 15 H	57	Ch 14 H	44	Ch 13 H
158	Ch 16 L	143	Ch 15 L	58	Ch 14 L	43	Ch 13 L
159	Ch 20 H	142	Ch 19 H	59	Ch 18 H	42	Ch 17 H
160	Ch 20 L	141	Ch 19 L	60	Ch 18 L	41	Ch 17 L
161	Ch 24 H	140	Ch 23 H	61	Ch 22 H	40	Ch 21 H
162	Ch 24 L	139	Ch 23 L	62	Ch 22 L	39	Ch 21 L
163	Ch 28 H	138	Ch 27 H	63	Ch 26 H	38	Ch 25 H
164	Ch 28 L	137	Ch 27 L	64	Ch 26 L	37	Ch 25 L
165	Ch 32 H	136	Ch 31 H	65	Ch 30 H	36	Ch 29 H
166	Ch 32 L	135	Ch 31 H	66	Ch 30 L	35	Ch 29 L
167	Ch 36 H	134	Ch 35 H	67	Ch 34 H	34	Ch 33 H
168	Ch 36 L	133	Ch 35 L	68	Ch 34 L	33	Ch 33 L
169	Ch 40 H	132	Ch 39 H	69	Ch 38 H	32	Ch 37 H
170	Ch 40 L	131	Ch 39 L	70	Ch 38 L	31	Ch 37 L
171	Ch 44 H	130	Ch 43 H	71	Ch 42 H	30	Ch 41 H
172	Ch 44 L	129	Ch 43 L	72	Ch 42 L	29	Ch 41 L
173	Ch 48 H	128	Ch 47 H	73	Ch 46 H	28	Ch 45 H
174	Ch 48 L	127	Ch 47 L	74	Ch 46 L	27	Ch 45 L
175	Ch 52 H	126	Ch 51 H	75	Ch 50 H	26	Ch 49 H
176	Ch 52 L	125	Ch 51 L	76	Ch 50 L	25	Ch 49 L
177	Ch 56 H	124	Ch 55 H	77	Ch 54 H	24	Ch 53 H
178	Ch 56 L	123	Ch 55 L	78	Ch 54 L	23	Ch 53 L
179	Ch 60 H	122	Ch 59 H	79	Ch 58 H	22	Ch 57 H
180	Ch 60 L	121	Ch 59 L	80	Ch 58 L	21	Ch 57 L
181	Ch 64 H	120	Ch 63 H	81	Ch 62 H	20	Ch 61 H
182	Ch 64 L	119	Ch 63 L	82	Ch 62 L	19	Ch 61 L
183	Ch 68 H	118	Ch 67 H	83	Ch 66 H	18	Ch 65 H
184	Ch 68 L	117	Ch 67 L	84	Ch 66 L	17	Ch 65 L
185	Ch 72 H	116	Ch 71 H	85	Ch 70 H	16	Ch 69 H
186	Ch 72 L	115	Ch 71 L	86	Ch 70 L	15	Ch 69 L
187	Ch 76 H	114	Ch 75 H	87	Ch 74 H	14	Ch 73 H
188	Ch 76 L	113	Ch 75 L	88	Ch 74 L	13	Ch 73 L
189	Ch 80 H	112	Ch 79 H	89	Ch 78 H	12	Ch 77 H
190	Ch 80 L	111	Ch 79 L	90	Ch 78 L	11	Ch 77 L
191	Ch 84 H	110	Ch 83 H	91	Ch 82 H	10	Ch 81 H
192	Ch 84 L	109	Ch 83 L	92	Ch 82 L	9	Ch 81 L
193	Ch 88 H	108	Ch 87 H	93	Ch 86 H	8	Ch 85 H
194	Ch 88 L	107	Ch 87 L	94	Ch 86 L	7	Ch 85 L
195	Ch 92 H	106	Ch 91 H	95	Ch 90 H	6	Ch 89 H
196	Ch 92 L	105	Ch 91 L	96	Ch 90 L	5	Ch 89 L
197	Ch 96 H	104	Ch 95 H	97	Ch 94 H	4	Ch 93 H
198	Ch 96 L	103	Ch 95 L	98	Ch 94 L	3	Ch 93 L
199	COM H	102	Ch 99 H	99	Ch 98 H	2	Ch 97 H
200	COM L	101	Ch 99 L	100	CH 98 L	1	Ch 97 L

Figure 12 M9103A Connector and Pinout (viewed from the front panel)

Troubleshooting and Functional Verification Testing

To troubleshoot and verify the relays on the module, perform a closed channel resistance test on each channel. This procedure does not provide performance or specification verification.

CAUTION **Remove all user wiring and connections from the plug-in modules before troubleshooting or verification.**

When all relays are "open," a resistance measured on any channel path indicates a welded contacts condition and the relay or module must be replaced. There is no specific path resistance or test for this failure.

The path resistance characteristic assumes that the individual channel connections on the module front panel are shorted and the DMM is connected to the COMmon terminals. See Figure 13.

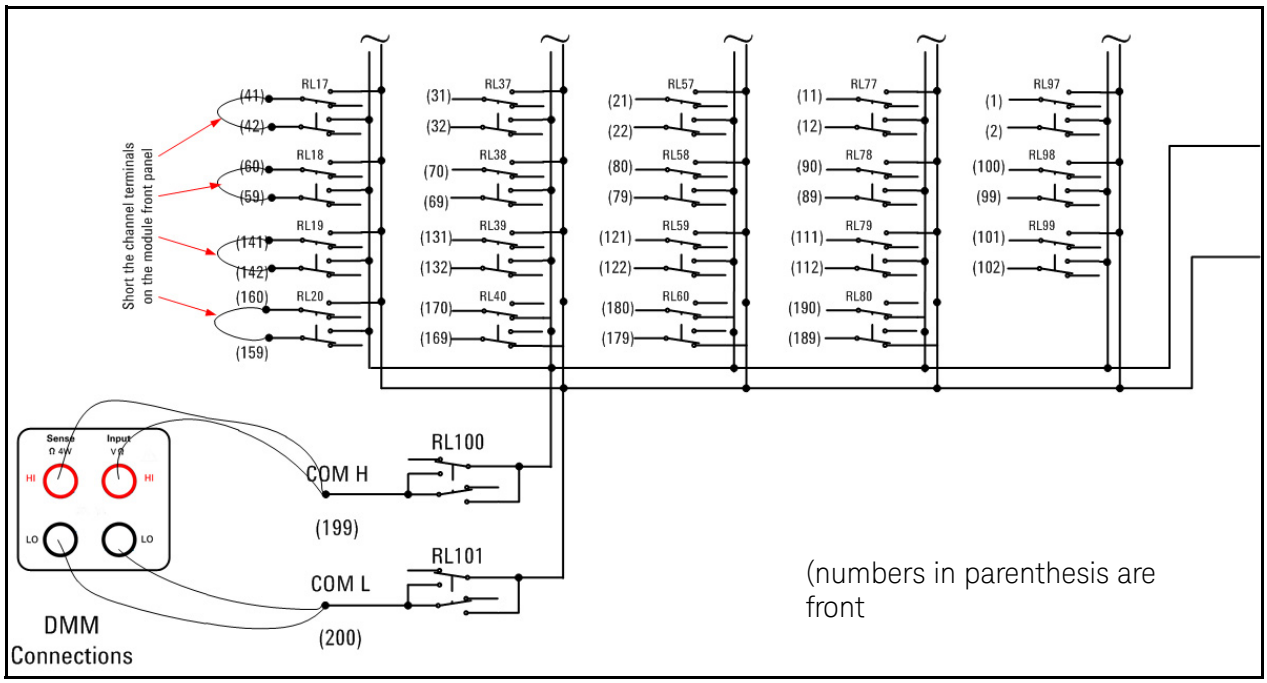


Figure 13 M9103A Contact Resistance Test

Note that this includes four relay contacts -- the two channel relay contacts (Hi and Lo) and one contact on relays RL100 and RL101. The typical initial path resistance is approximately 470 mΩ.. Alternately, you can measure the contact resistance COM Hi to the channel Hi terminals and then from the COM Lo to the channel Lo terminals. In this case, the contact resistance should be approximately one-half of the total path resistance.

M9103A Functional Verification Test Record - Closed Channel Resistance

Channel No.	Path Resistance*	Measured Value	Channel No.	Path Resistance*	Measured Value
1	< 1.0 Ω		51	< 1.0 Ω	
2	< 1.0 Ω		52	< 1.0 Ω	
3	< 1.0 Ω		53	< 1.0 Ω	
4	< 1.0 Ω		54	< 1.0 Ω	
5	< 1.0 Ω		55	< 1.0 Ω	
6	< 1.0 Ω		56	< 1.0 Ω	
7	< 1.0 Ω		57	< 1.0 Ω	
8	< 1.0 Ω		58	< 1.0 Ω	
9	< 1.0 Ω		59	< 1.0 Ω	
10	< 1.0 Ω		60	< 1.0 Ω	
11	< 1.0 Ω		61	< 1.0 Ω	
12	< 1.0 Ω		62	< 1.0 Ω	
13	< 1.0 Ω		63	< 1.0 Ω	
14	< 1.0 Ω		64	< 1.0 Ω	
15	< 1.0 Ω		65	< 1.0 Ω	
16	< 1.0 Ω		66	< 1.0 Ω	
17	< 1.0 Ω		67	< 1.0 Ω	
18	< 1.0 Ω		68	< 1.0 Ω	
19	< 1.0 Ω		69	< 1.0 Ω	
20	< 1.0 Ω		70	< 1.0 Ω	
21	< 1.0 Ω		71	< 1.0 Ω	
22	< 1.0 Ω		72	< 1.0 Ω	
23	< 1.0 Ω		73	< 1.0 Ω	
24	< 1.0 Ω		74	< 1.0 Ω	
25	< 1.0 Ω		75	< 1.0 Ω	
26	< 1.0 Ω		76	< 1.0 Ω	
27	< 1.0 Ω		77	< 1.0 Ω	
28	< 1.0 Ω		78	< 1.0 Ω	
29	< 1.0 Ω		79	< 1.0 Ω	
30	< 1.0 Ω		80	< 1.0 Ω	
31	< 1.0 Ω		81	< 1.0 Ω	
32	< 1.0 Ω		82	< 1.0 Ω	
33	< 1.0 Ω		83	< 1.0 Ω	
34	< 1.0 Ω		84	< 1.0 Ω	
35	< 1.0 Ω		85	< 1.0 Ω	
36	< 1.0 Ω		86	< 1.0 Ω	
37	< 1.0 Ω		87	< 1.0 Ω	
38	< 1.0 Ω		88	< 1.0 Ω	
39	< 1.0 Ω		89	< 1.0 Ω	
40	< 1.0 Ω		90	< 1.0 Ω	
41	< 1.0 Ω		91	< 1.0 Ω	
42	< 1.0 Ω		92	< 1.0 Ω	
43	< 1.0 Ω		93	< 1.0 Ω	
44	< 1.0 Ω		94	< 1.0 Ω	

Channel No.	Path Resistance*	Measured Value	Channel No.	Path Resistance*	Measured Value
45	< 1.0 Ω		95	< 1.0 Ω	
46	< 1.0 Ω		96	< 1.0 Ω	
47	< 1.0 Ω		97	< 1.0 Ω	
48	< 1.0 Ω		98	< 1.0 Ω	
49	< 1.0 Ω		99	< 1.0 Ω	
50	< 1.0 Ω				

* Functional test limit

M9103A Schematic

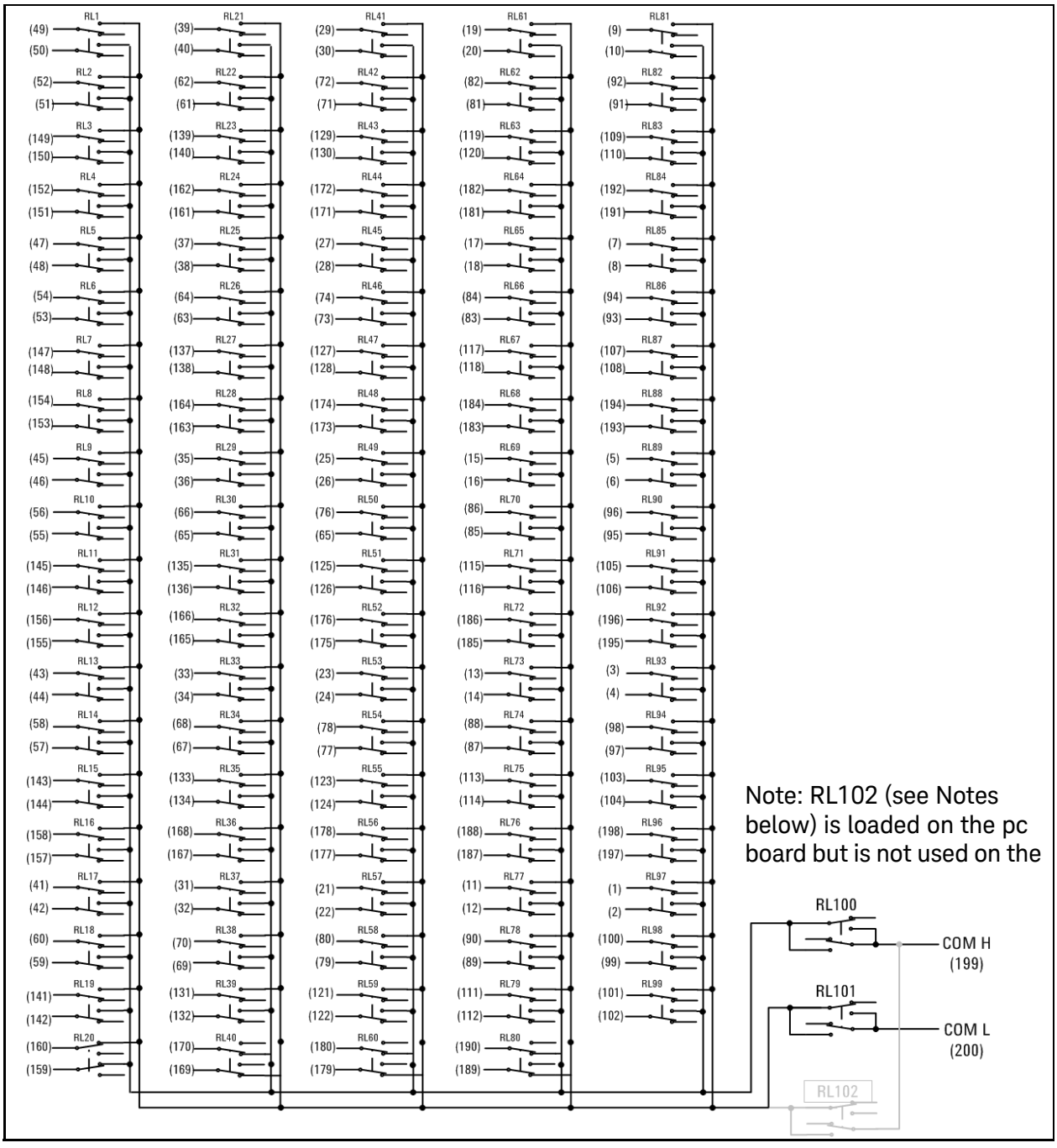


Figure 14 M9103A Schematic

Notes:

- Numbers in parenthesis are front panel connector pin numbers.
- RL102 is loaded on the PC board but is not used on the M9103A module.
- Channel relay numbers (RL1 – RL99) correspond to channel numbers.

M9103A PC Board Layout

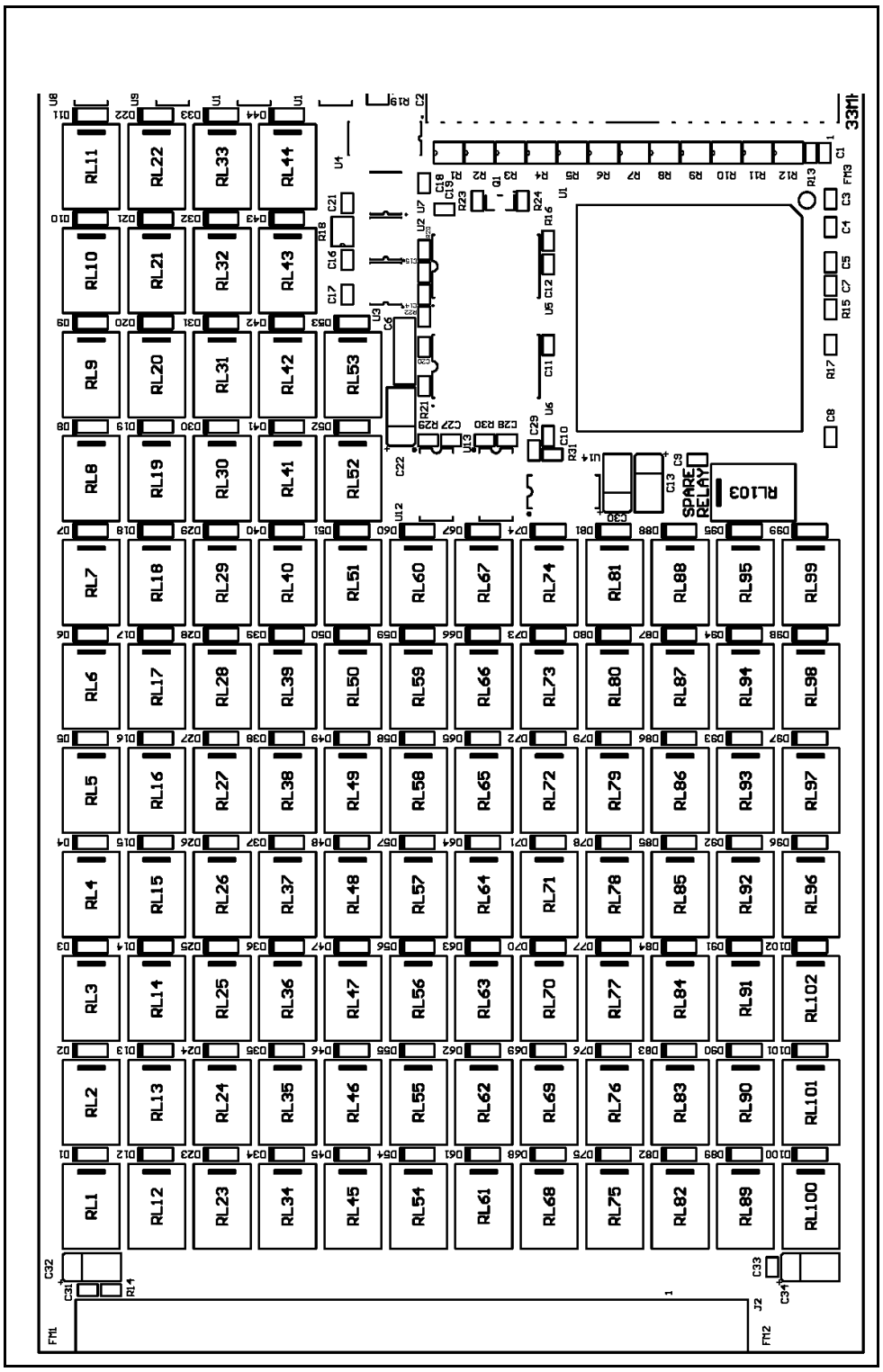


Figure 15 M9103A PC Board Relay Layout

Figure 16 shows the backside (solder side of the M9103A) and also shows the relay contact connections.

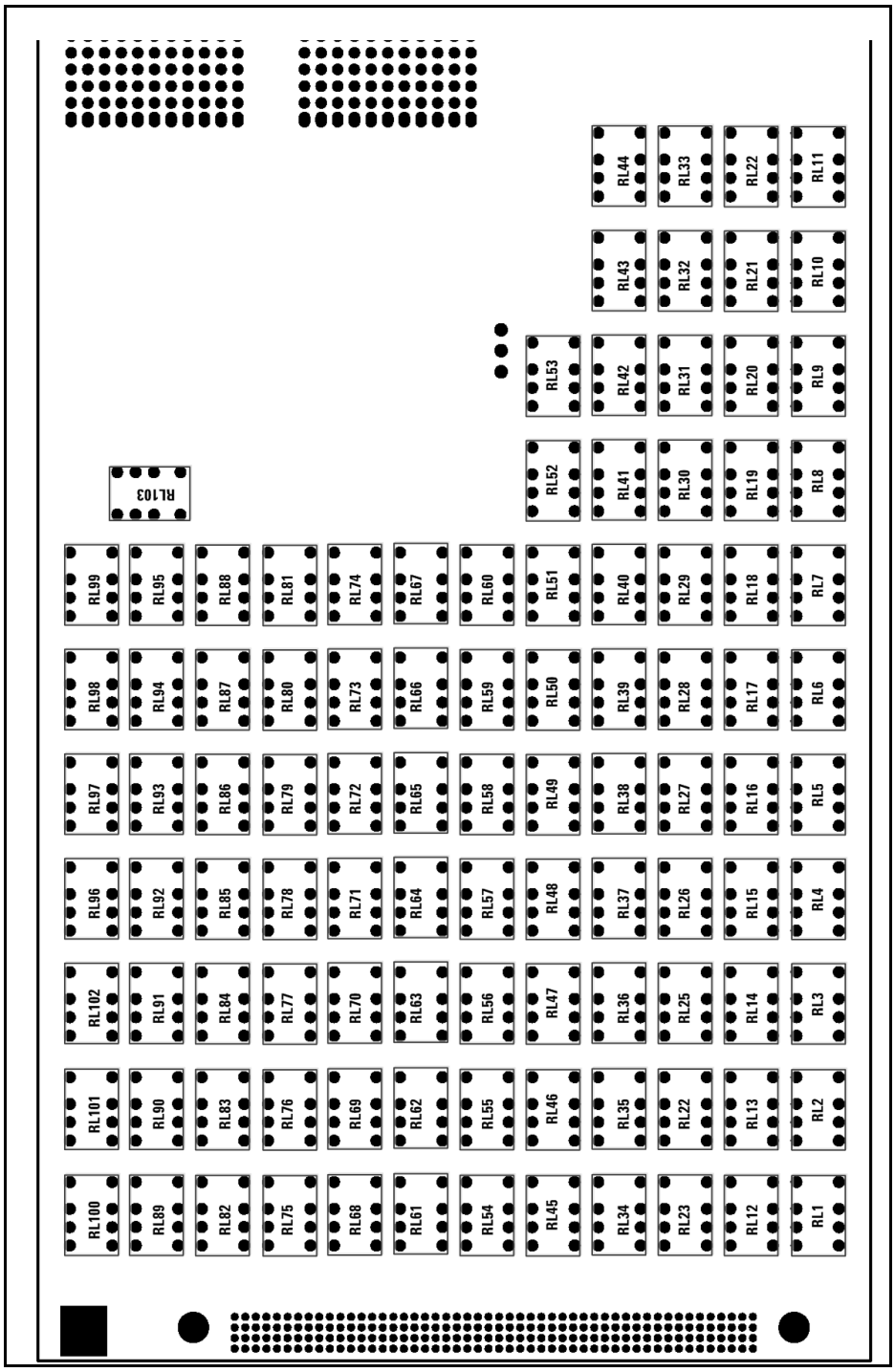


Figure 16 Back side (solder side) of M9103A showing relay contacts

5 M9120A Matrix Switch, 4x32, 2-wire Armature Relays

Introduction

Each M9120A Matrix Switch module is constructed as four separate matrices; each matrix is 32x1 for a total of 128 two pole armature relays. The schematics (Figure 19 and Figure 20) are drawn as four separate matrices (one matrix for each row).

This module is designed to switch medium voltage/power signals in test applications where reed relays do not have sufficient rating. It is suitable for telecoms applications where send and return signals need to be switched simultaneously.

The front panel connector is a 78 pin D style connector. See Figure 17 on page 49

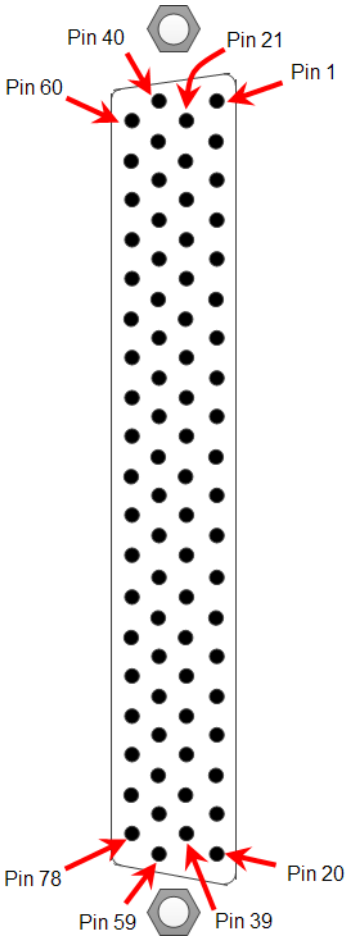
Default switch path

All cross point relays are open.

Replacement relays

One spare channel relay (RL131) is loaded on the M9120A PC board. Refer to Figure 21. To use this relay, you must desolder it from the PC board and solder it in place of a defective channel relay. Additional channel relays may be ordered from Keysight using part number 0490-2919.

CAUTION **To maintain typical switching characteristics (refer to the module data sheet) and user safety, use only Keysight-specified relays. Do not substitute relays unless directed by Keysight support.**



(viewed from the front panel)

Pin No.	Signal	Pin No.	Signal	Pin No.	Signal	Pin No.	Signal
60	Col 1 H	40	Col 1 L	21	Col 2 H	1	Col 2 L
61	Col 3 H	41	Col 3 L	22	Col 4 H	2	Col 4 L
62	Col 5 H	42	Col 5 L	23	Col 6 H	3	Col 6 L
63	Col 7 H	43	Col 7 L	24	Col 8 H	4	Col 8 L
64	Col 9 H	44	Col 9 L	25	Col 10 H	5	Col 10 L
65	Col 11 H	45	Col 11 L	26	Col 12 H	6	Col 12 L
66	Col 13 H	46	Col 13 L	27	Col 14 H	7	Col 14 L
67	Col 15 H	47	Col 15 L	28	Col 16 H	8	Col 16 L
68	Col 17 H	48	Col 17 L	29	Col 18 H	9	Col 18 L
69	Col 19 H	49	Col 19 L	30	Col 20 H	10	Col 20 L
70	Col 21 H	50	Col 21 L	31	Col 22 H	11	Col 22 L
71	Col 23 H	51	Col 23 L	32	Col 24 H	12	Col 24 L
72	Col 25 H	52	Col 25 L	33	Col 26 H	13	Col 26 L
73	Col 27 H	53	Col 27 L	34	Col 28 H	14	Col 28 L
74	Col 29 H	54	Col 29 L	35	Col 30 H	15	Col 30 L
75	Col 31 H	55	Col 31 L	36	Col 32 H	16	Col 32 L
76	--	56	--	37	--	17	--
77	Row 1 H	57	--	38	Row 2 H	18	--
78	Row 3 H	58	Row 1 L	39	Row 4 H	19	Row 2 L
		59	Row 3 L			20	Row 4 L

Figure 17 M9120A Connector and Pinout

Troubleshooting and Functional Verification Testing

To troubleshoot and verify the 128 cross point relays on the module, perform a closed channel resistance test on each row/column cross point. This procedure does not provide performance or specification verification.Each M9120A Matrix Switch module is constructed as four separate matrices; each matrix is 32x1 for a total of 128 two pole relays. The schematics (Figure 19 and Figure 20) are drawn as four separate matrices. Thus:

- to connect Column 1 to Row 1, relay RL1 closes (Figure 19, top schematic)
- to connect Column 1 to Row 2, relay RL2 closes (Figure 19, bottom schematic)
- to connect Column 1 to Row 3, relay RL3 closes (Figure 20, top schematic)
- to connect Column 1 to Row 4, relay RL4 closes (Figure 20, bottom schematic), etc.

Therefore, the first step in troubleshooting is to determine which row/column is defective. Then, by referencing the schematics, you can determine which relay is defective.

CAUTION **Remove all user wiring and connections from the plug-in modules before troubleshooting or verification.**

When all relays are “open,” a resistance measured on any channel path indicates a welded contacts condition and the relay or module must be replaced. There is no specific path resistance or test for this failure.

The differential internal path resistance characteristic assumes that the individual Column connections on the module front panel are shorted and the DMM is connected to the Row terminals. See Figure 18.

After testing Row 1 to each column, move the DMM to Row 2 and test the columns, then Row three to all columns, and finally Row 4 to all columns.

NOTE **Relays 129 and 130 on the PC board, are used for internal Keysight testing only.**

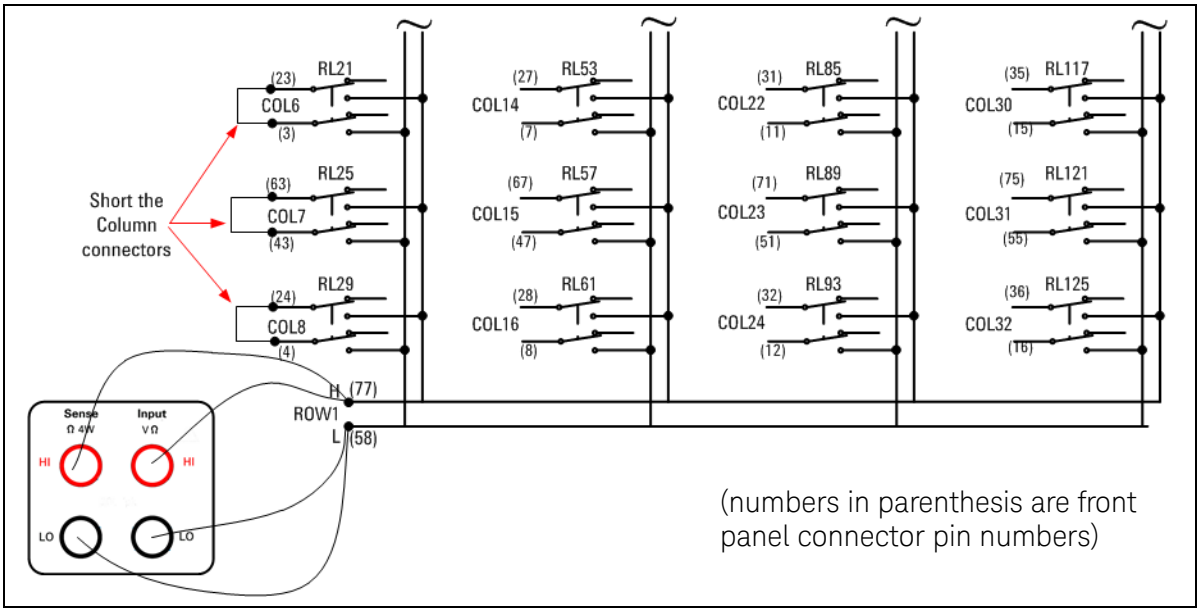


Figure 18 M9120A Contact Resistance Test

Note that this includes two relay contacts -- the two cross point channel relay contacts (Hi and Lo). The typical initial path resistance is approximately 500 mΩ.. Alternately, you can measure the contact resistance Row Hi to the Column Hi terminals and then from the Row Lo to the Column Lo terminals. In this case, the contact resistance should be approximately half the full path resistance.

M9120A Functional Verification Test Record - Closed Channel Resistance

Row/Col Path	Path Resistance*	Measured Value	Row/Col Path	Path Resistance*	Measured Value
Row 1			Row 2		
R1Col1	< 1.40 Ω		R2Col1	< 1.40 Ω	
R1Col2	< 1.40 Ω		R2Col2	< 1.40 Ω	
R1Col3	< 1.40 Ω		R2Col3	< 1.40 Ω	
R1Col4	< 1.40 Ω		R2Col4	< 1.40 Ω	
R1Col5	< 1.40 Ω		R2Col5	< 1.40 Ω	
R1Col6	< 1.40 Ω		R2Col6	< 1.40 Ω	
R1Col7	< 1.40 Ω		R2Col7	< 1.40 Ω	
R1Col8	< 1.40 Ω		R2Col8	< 1.40 Ω	
R1Col9	< 1.40 Ω		R2Col9	< 1.40 Ω	

Row/Col Path	Path Resistance*	Measured Value	Row/Col Path	Path Resistance*	Measured Value
R1Col10	< 1.40 Ω		R2Col10	< 1.40 Ω	
R1Col11	< 1.40 Ω		R2Col11	< 1.40 Ω	
R1Col12	< 1.40 Ω		R2Col12	< 1.40 Ω	
R1Col13	< 1.40 Ω		R2Col13	< 1.40 Ω	
R1Col14	< 1.40 Ω		R2Col14	< 1.40 Ω	
R1Col15	< 1.40 Ω		R2Col15	< 1.40 Ω	
R1Col16	< 1.40 Ω		R2Col16	< 1.40 Ω	
R1Col17	< 1.40 Ω		R2Col17	< 1.40 Ω	
R1Col18	< 1.40 Ω		R2Col18	< 1.40 Ω	
R1Col19	< 1.40 Ω		R2Col19	< 1.40 Ω	
R1Col20	< 1.40 Ω		R2Col20	< 1.40 Ω	
R1Col21	< 1.40 Ω		R2Col21	< 1.40 Ω	
R1Col22	< 1.40 Ω		R2Col22	< 1.40 Ω	
R1Col23	< 1.40 Ω		R2Col23	< 1.40 Ω	
R1Col24	< 1.40 Ω		R2Col24	< 1.40 Ω	
R1Col25	< 1.40 Ω		R2Col25	< 1.40 Ω	
R1Col26	< 1.40 Ω		R2Col26	< 1.40 Ω	
R1Col27	< 1.40 Ω		R2Col27	< 1.40 Ω	
R1Col28	< 1.40 Ω		R2Col28	< 1.40 Ω	
R1Col29	< 1.40 Ω		R2Col29	< 1.40 Ω	
R1Col30	< 1.40 Ω		R2Col30	< 1.40 Ω	
R1Col31	< 1.40 Ω		R2Col31	< 1.40 Ω	
R1Col32	< 1.40 Ω		R2Col32	< 1.40 Ω	

Row 3			Row 4		
R3Col1	< 1.40 Ω		R4Col1	< 1.40 Ω	
R3Col2	< 1.40 Ω		R4Col2	< 1.40 Ω	
R3Col3	< 1.40 Ω		R4Col3	< 1.40 Ω	
R3Col4	< 1.40 Ω		R4Col4	< 1.40 Ω	
R3Col5	< 1.40 Ω		R4Col5	< 1.40 Ω	

Row/Col Path	Path Resistance*	Measured Value	Row/Col Path	Path Resistance*	Measured Value
R3Col6	< 1.40 Ω		R4Col6	< 1.40 Ω	
R3Col7	< 1.40 Ω		R4Col7	< 1.40 Ω	
R3Col8	< 1.40 Ω		R4Col8	< 1.40 Ω	
R3Col9	< 1.40 Ω		R4Col9	< 1.40 Ω	
R3Col10	< 1.40 Ω		R4Col10	< 1.40 Ω	
R3Col11	< 1.40 Ω		R4Col11	< 1.40 Ω	
R3Col12	< 1.40 Ω		R4Col12	< 1.40 Ω	
R3Col13	< 1.40 Ω		R4Col13	< 1.40 Ω	
R3Col14	< 1.40 Ω		R4Col14	< 1.40 Ω	
R3Col15	< 1.40 Ω		R4Col15	< 1.40 Ω	
R3Col16	< 1.40 Ω		R4Col16	< 1.40 Ω	
R3Col17	< 1.40 Ω		R4Col17	< 1.40 Ω	
R3Col18	< 1.40 Ω		R4Col18	< 1.40 Ω	
R3Col19	< 1.40 Ω		R4Col19	< 1.40 Ω	
R3Col20	< 1.40 Ω		R4Col20	< 1.40 Ω	
R3Col21	< 1.40 Ω		R4Col21	< 1.40 Ω	
R3Col22	< 1.40 Ω		R4Col22	< 1.40 Ω	
R3Col23	< 1.40 Ω		R4Col23	< 1.40 Ω	
R3Col24	< 1.40 Ω		R4Col24	< 1.40 Ω	
R3Col25	< 1.40 Ω		R4Col25	< 1.40 Ω	
R3Col26	< 1.40 Ω		R4Col26	< 1.40 Ω	
R3Col27	< 1.40 Ω		R4Col27	< 1.40 Ω	
R3Col28	< 1.40 Ω		R4Col28	< 1.40 Ω	
R3Col29	< 1.40 Ω		R4Col29	< 1.40 Ω	
R3Col30	< 1.40 Ω		R4Col30	< 1.40 Ω	
R3Col31	< 1.40 Ω		R4Col31	< 1.40 Ω	
R3Col32	< 1.40 Ω		R4Col32	< 1.40 Ω	

* Functional test limit

M9120A Schematic

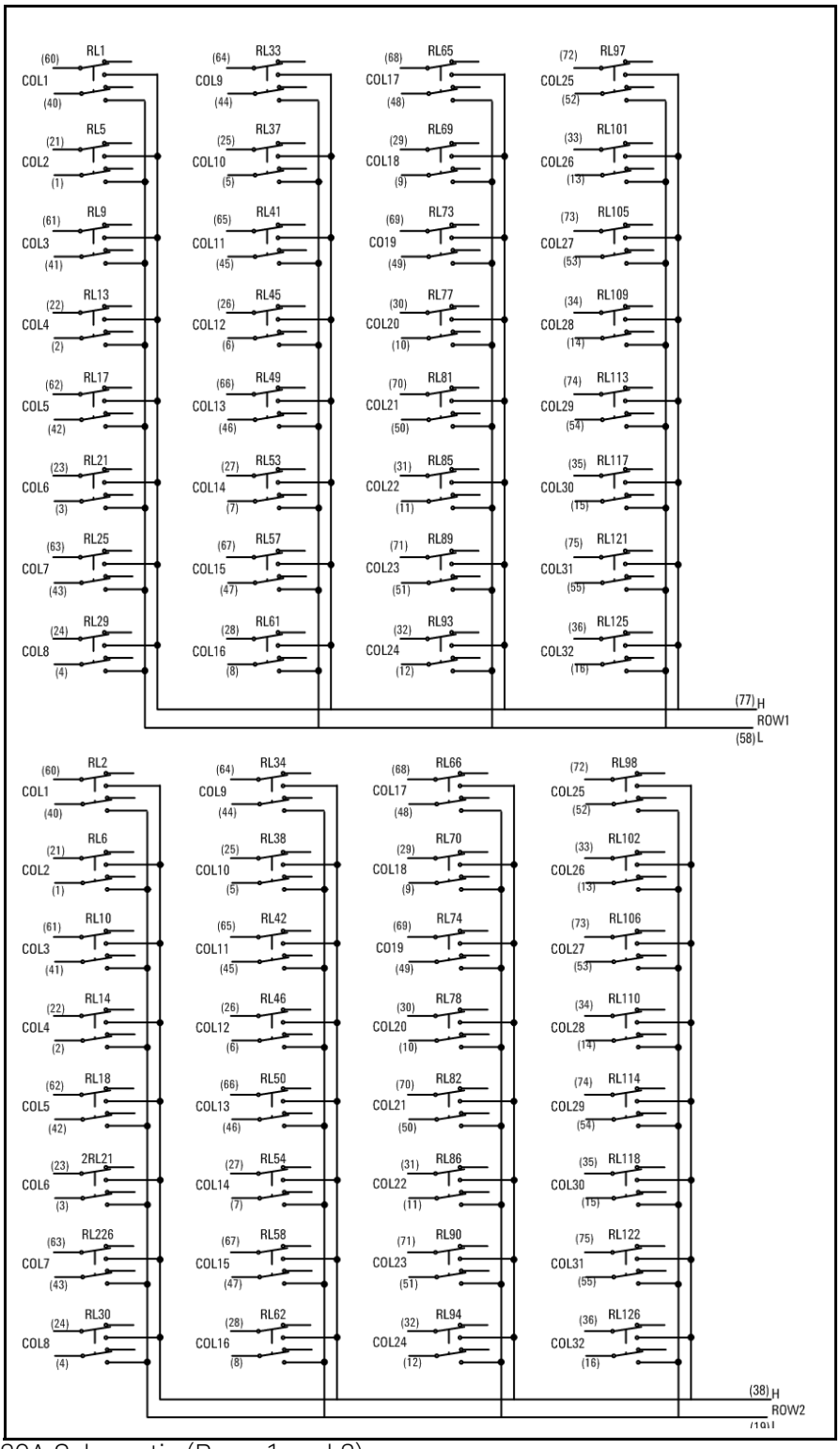


Figure 19 M9120A Schematic (Rows 1 and 2)
numbers in parenthesis are front panel connector pin numbers

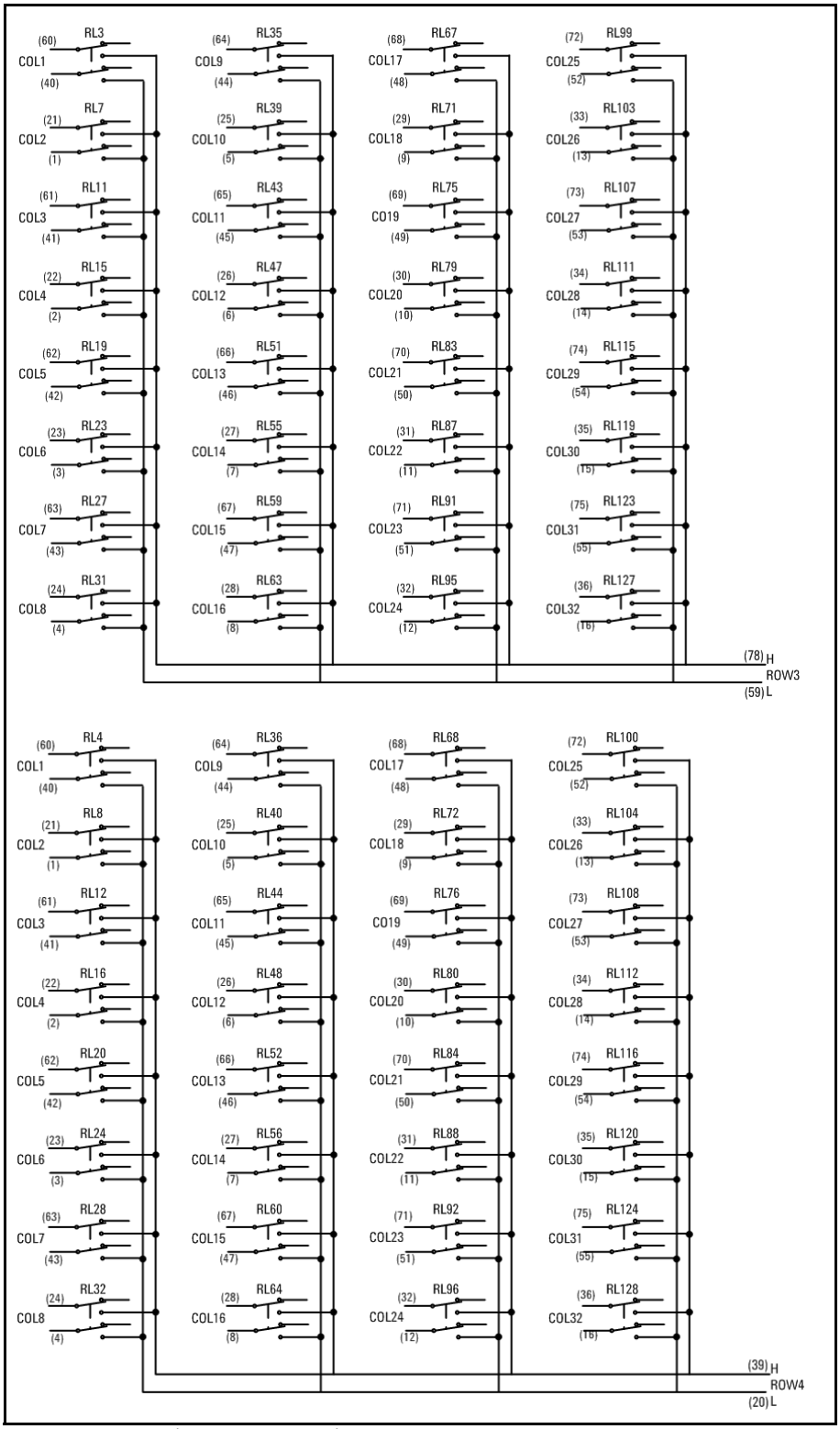


Figure 20 M9120A Schematic (Rows 3 and 4)
numbers in parenthesis are front panel connector pin numbers

M9120A PC Board Layout

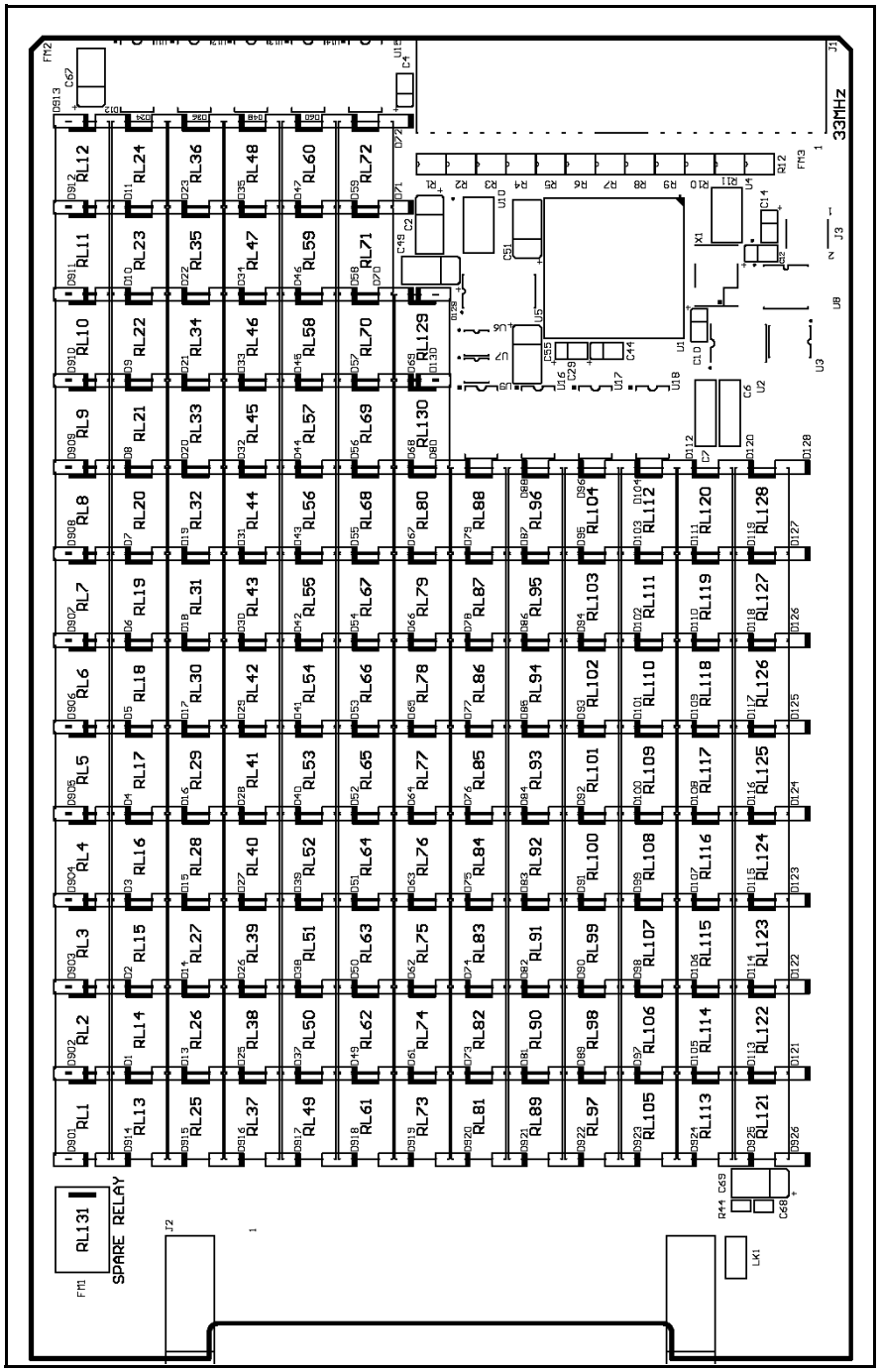


Figure 21 M9120A PC Board Relay Layout

NOTE Relays 129 and 130 on the PC board, are used for internal Keysight testing only.

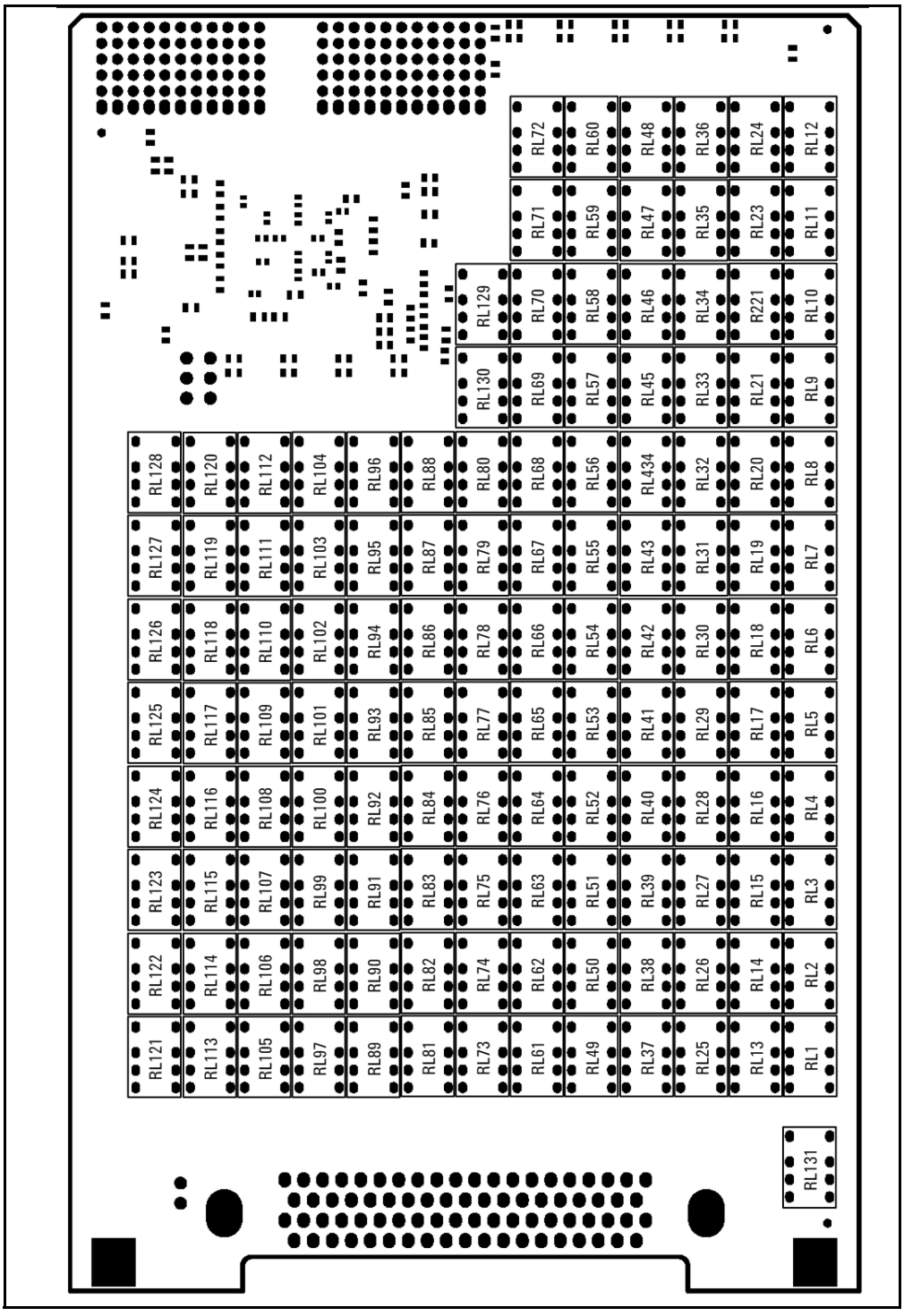


Figure 22 M9120A Backside (solder side) of PC Board showing relay locations

6 M9121A Matrix Switch, 4x64, 2-wire Reed Relays

Introduction

Keysight's M9121A Matrix Switch module is an ultra high density module configured as a 64 column by four row matrix. Each relay is a 2-pole switch.

The 256 relays on this modules are high reliability sputtered Ruthenium reed relays, offering >10^9 operations to provide long life and stable contact resistance. Connections to the modules are through a high density 200 pin Low Force Helix (LFH) connector. See Figure 23.

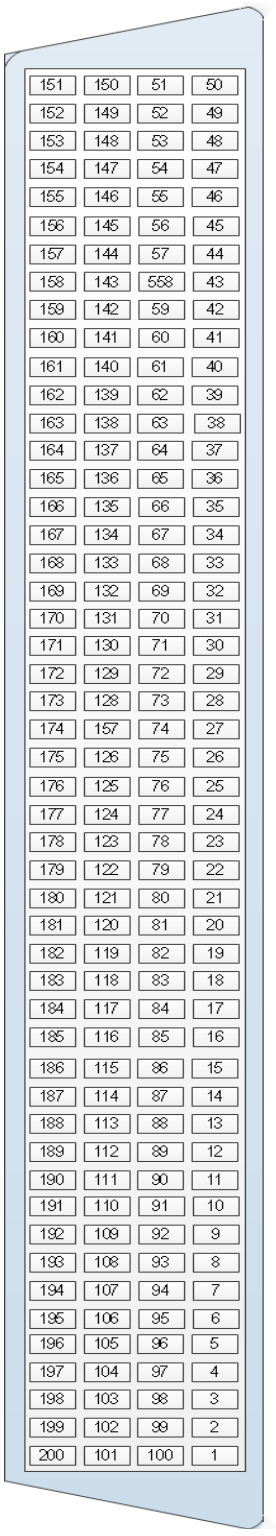
Default switch path

All 256 cross point relays are open.

Replacement relays

One spare channel relay (RL257) is loaded on the M9121A PC board. Refer to Figure 29. To use this relay, you must desolder it from the PC board and solder it in place of a defective channel relay. Additional channel relays may be ordered from Keysight using part number 0490-2965

CAUTION **To maintain typical switching characteristics (refer to the module data sheet) and user safety, use only Keysight-specified relays. Do not substitute relays unless directed by Keysight support.**



Pin No.	Channel	Pin No.	Channel	Pin No.	Channel	Pin No.	Channel
151	Col 1 H	150	Col 2 H	51	Col 3H	50	Col 4 H
152	Col 1 L	149	Col 2 L	52	Col 3 L	49	Col 4 L
153	Col 5 H	148	Col 6 H	53	Col 7 H	48	Col 8 H
154	Col 5 L	147	Col 6 L	54	Col 7 L	47	Col 8 L
155	Col 9 H	146	Col 10 H	55	Col 11 H	46	Col 12 H
156	Col 9 L	145	Col 10 L	56	Col 11 L	45	Col 12 L
157	Col 13 H	144	Col 14 H	57	Col 15 H	44	Col 16 H
158	Col 13 L	143	Col 14 L	58	Col 15 L	43	Col 16 L
159	Col 17 H	142	Col 18 H	59	Col 19 H	42	Col 20 H
160	Col 17 L	141	Col 18 L	60	Col 19 L	41	Col 20 L
161	Col 21 H	140	Col 22 H	61	Col 23 H	40	Col 24 H
162	Col 21 L	139	Col 22 L	62	Col 23 L	39	Col 24 L
163	Col 25 H	138	Col 26 H	63	Col 27 H	38	Col 28 H
164	Col 25 L	137	Col 26 L	64	Col 27 L	37	Col 28 L
165	Col 29 H	136	Col 30 H	65	Col 31 H	36	Col 32 H
166	Col 29 L	135	Col 30 L	66	Col 31 L	35	Col 32 L
167	Col 33 H	134	Col 34 H	67	Col 35 H	34	Col 36 H
168	Col 33 L	133	Col 34 L	68	Col 35 L	33	Col 36 L
169	Col 37 H	132	Col 38 H	69	Col 39 H	32	Col 40 H
170	Col 37 L	131	Col 38 L	70	Col 39 L	31	Col 40 L
171	Col 41 H	130	Col 42 H	71	Col 43 H	30	Col 44 H
172	Col 41 L	129	Col 42 L	72	Col 43 L	29	Col 44 L
173	Col 45 H	128	Col 46 H	73	Ch 47 H	28	Col 48 H
174	Col 45 L	127	Col 46 L	74	Col 47 L	27	Col 48 L
175	Col 49 H	126	Col 50 H	75	Col 51 H	26	Col 52 H
176	Col 49 L	125	Col 50 L	76	Col 51 L	25	Col 52 L
177	Col 53 H	124	Col 54 H	77	Col 55 H	24	Col 56 H
178	Col 53 L	123	Col 54 L	78	Col 55 L	23	Col 56 L
179	Col 57 H	122	Col 58 H	79	Col 59 H	22	Col 60 H
180	Col 57 L	121	Col 58 L	80	Col 59 L	21	Col 60 L
181	Col 61 H	120	Col 62 H	81	Col 63 H	20	Col 64 H
182	Col 61 L	119	Col 62 L	82	Col 63 L	19	Col 64 L
183	--	118	--	83	--	18	--
184	--	117	--	84	--	17	--
185	--	116	--	85	--	16	--
186	--	115	--	86	--	15	--
187	--	114	--	87	--	14	--
188	--	113	--	88	--	13	--
189	--	112	--	89	--	12	--
190	--	111	--	90	--	11	--
191	--	110	--	91	--	10	--
192	--	109	--	92	--	9	--
193	--	108	--	93	--	8	--
194	--	107	--	94	--	7	--
195	--	106	--	95	--	6	--
196	--	105	--	96	--	5	--
197	--	104	--	97	--	4	--
198	Row 1 H	103	Row 2 H	98	Row 3 H	3	Row 4 H
199	Row 1 L	102	Row 2 L	99	Row 3 L	2	Row 4 L
200	--	101	--	100	--	1	--

Figure 23 M9121A Connector and Pinout
(viewed from the front panel, "--" indicates pins not used)

Troubleshooting and Functional Verification Testing

To troubleshoot and verify the 256 cross point relays on the module, perform a closed channel resistance test on each row/column cross point. This procedure does not provide performance or specification verification. Each M9121A Matrix Switch module is constructed as four separate matrices; each matrix is 64x1 for a total of 256 two pole armature relays. The schematics (Figure 25 through Figure 28) are drawn as four separate matrices. Thus:

- to connect Column 1 to Row 1, relay RL1 closes (Figure 25)
- to connect Column 1 to Row 2, relay RL65closes (Figure 26)
- to connect Column 1 to Row 3, relay RL129 closes (Figure 27)
- to connect Column 1 to Row 4, relay RL193 closes (Figure 28), etc.

Therefore, the first step in troubleshooting is to determine which row/column is defective. Then, by referencing the schematics, you can determine which relay is defective.

CAUTION **Remove all user wiring and connections from the plug-in modules before troubleshooting or verification.**

When all relays are “open,” a resistance measured on any channel path indicates a welded contacts condition and the relay or module must be replaced. There is no specific path resistance or test for this failure.

The differential internal path resistance characteristic assumes that the individual COLumn connections on the module front panel are shorted and the DMM is connected to each of the ROW terminals. See Figure 24.

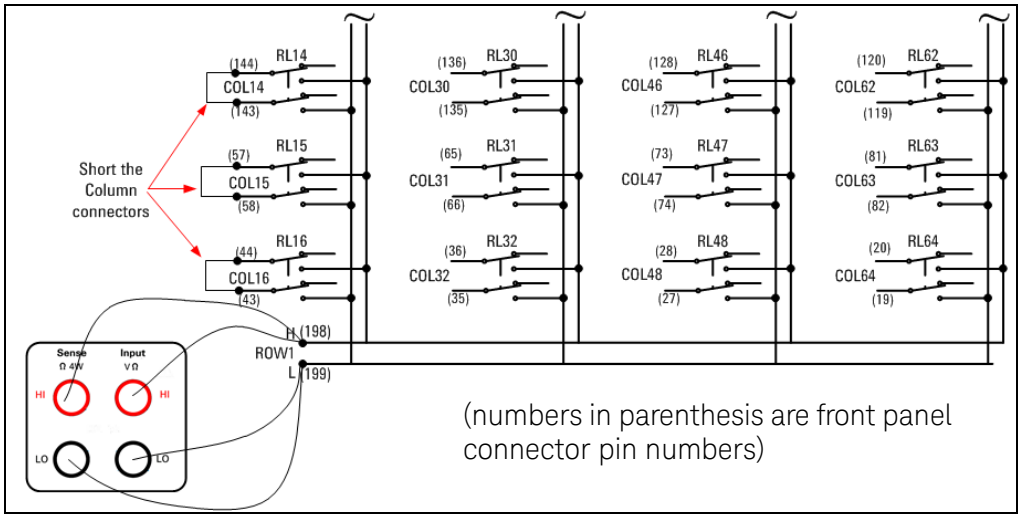


Figure 24 M9121A Contact Resistance Test

Note that this includes two relay contacts -- the two channel relay contacts (Hi and Lo). The typical initial path resistance is approximately 900 mΩ.. Alternately, you can measure the contact resistance COL Hi to the Row Hi terminals and then from the COL Lo to the Row Lo terminals. In this case, the contact resistance should be approximately one-half of the total path resistance.

M9121A Functional Verification Test Record -- Closed Channel Resistance

Row/Col Path	Path Resistance*	Measured Value	Row/Col Path	Path Resistance*	Measured Value
Row 1			Row 2		
R1Col1	< 2.70 Ω		R2Col1	< 2.70 Ω	
R1Col2	< 2.70 Ω		R2Col2	< 2.70 Ω	
R1Col3	< 2.70 Ω		R2Col3	< 2.70 Ω	
R1Col4	< 2.70 Ω		R2Col4	< 2.70 Ω	
R1Col5	< 2.70 Ω		R2Col5	< 2.70 Ω	
R1Col6	< 2.70 Ω		R2Col6	< 2.70 Ω	
R1Col7	< 2.70 Ω		R2Col7	< 2.70 Ω	
R1Col8	< 2.70 Ω		R2Col8	< 2.70 Ω	
R1Col9	< 2.70 Ω		R2Col9	< 2.70 Ω	
R1Col10	< 2.70 Ω		R2Col10	< 2.70 Ω	
R1Col11	< 2.70 Ω		R2Col11	< 2.70 Ω	
R1Col12	< 2.70 Ω		R2Col12	< 2.70 Ω	
R1Col13	< 2.70 Ω		R2Col13	< 2.70 Ω	
R1Col14	< 2.70 Ω		R2Col14	< 2.70 Ω	
R1Col15	< 2.70 Ω		R2Col15	< 2.70 Ω	
R1Col16	< 2.70 Ω		R2Col16	< 2.70 Ω	
R1Col17	< 2.70 Ω		R2Col17	< 2.70 Ω	
R1Col18	< 2.70 Ω		R2Col18	< 2.70 Ω	
R1Col19	< 2.70 Ω		R2Col19	< 2.70 Ω	
R1Col20	< 2.70 Ω		R2Col20	< 2.70 Ω	
R1Col21	< 2.70 Ω		R2Col21	< 2.70 Ω	
R1Col22	< 2.70 Ω		R2Col22	< 2.70 Ω	
R1Col23	< 2.70 Ω		R2Col23	< 2.70 Ω	
R1Col24	< 2.70 Ω		R2Col24	< 2.70 Ω	
R1Col25	< 2.70 Ω		R2Col25	< 2.70 Ω	
R1Col26	< 2.70 Ω		R2Col26	< 2.70 Ω	
R1Col27	< 2.70 Ω		R2Col27	< 2.70 Ω	
R1Col28	< 2.70 Ω		R2Col28	< 2.70 Ω	
R1Col29	< 2.70 Ω		R2Col29	< 2.70 Ω	
R1Col30	< 2.70 Ω		R2Col30	< 2.70 Ω	
R1Col31	< 2.70 Ω		R2Col31	< 2.70 Ω	
R1Col32	< 2.70 Ω		R2Col32	< 2.70 Ω	
R1Col33	< 2.70 Ω		R2Col33	< 2.70 Ω	
R1Col34	< 2.70 Ω		R2Col34	< 2.70 Ω	
R1Col35	< 2.70 Ω		R2Col35	< 2.70 Ω	
R1Col36	< 2.70 Ω		R2Col36	< 2.70 Ω	
R1Col37	< 2.70 Ω		R2Col37	< 2.70 Ω	

Row/Col Path	Path Resistance*	Measured Value	Row/Col Path	Path Resistance*	Measured Value
R1Col38	< 2.70 Ω		R2Col38	< 2.70 Ω	
R1Col39	< 2.70 Ω		R2Col39	< 2.70 Ω	
R1Col40	< 2.70 Ω		R2Col40	< 2.70 Ω	
R1Col41	< 2.70 Ω		R2Col41	< 2.70 Ω	
R1Col42	< 2.70 Ω		R2Col42	< 2.70 Ω	
R1Col43	< 2.70 Ω		R2Col43	< 2.70 Ω	
R1Col44	< 2.70 Ω		R2Col44	< 2.70 Ω	
R1Col45	< 2.70 Ω		R2Col45	< 2.70 Ω	
R1Col46	< 2.70 Ω		R2Col46	< 2.70 Ω	
R1Col47	< 2.70 Ω		R2Col47	< 2.70 Ω	
R1Col48	< 2.70 Ω		R2Col48	< 2.70 Ω	
R1Col49	< 2.70 Ω		R2Col49	< 2.70 Ω	
R1Col50	< 2.70 Ω		R2Col50	< 2.70 Ω	
R1Col51	< 2.70 Ω		R2Col51	< 2.70 Ω	
R1Col52	< 2.70 Ω		R2Col52	< 2.70 Ω	
R1Col53	< 2.70 Ω		R2Col53	< 2.70 Ω	
R1Col54	< 2.70 Ω		R2Col54	< 2.70 Ω	
R1Col55	< 2.70 Ω		R2Col55	< 2.70 Ω	
R1Col56	< 2.70 Ω		R2Col56	< 2.70 Ω	
R1Col57	< 2.70 Ω		R2Col57	< 2.70 Ω	
R1Col58	< 2.70 Ω		R2Col58	< 2.70 Ω	
R1Col59	< 2.70 Ω		R2Col59	< 2.70 Ω	
R1Col60	< 2.70 Ω		R2Col60	< 2.70 Ω	
R1Col61	< 2.70 Ω		R2Col61	< 2.70 Ω	
R1Col62	< 2.70 Ω		R2Col62	< 2.70 Ω	
R1Col63	< 2.70 Ω		R2Col63	< 2.70 Ω	
R1Col164	< 2.70 Ω		R2Col164	< 2.70 Ω	
Row 3			Row 4		
R3Col1	< 2.70 Ω		R4Col1	< 2.70 Ω	
R3Col2	< 2.70 Ω		R4Col2	< 2.70 Ω	
R3Col3	< 2.70 Ω		R4Col3	< 2.70 Ω	
R3Col4	< 2.70 Ω		R4Col4	< 2.70 Ω	
R3Col5	< 2.70 Ω		R4Col5	< 2.70 Ω	
R3Col6	< 2.70 Ω		R4Col6	< 2.70 Ω	
R3Col7	< 2.70 Ω		R4Col7	< 2.70 Ω	
R3Col8	< 2.70 Ω		R4Col8	< 2.70 Ω	
R3Col9	< 2.70 Ω		R4Col9	< 2.70 Ω	
R3Col10	< 2.70 Ω		R4Col10	< 2.70 Ω	
R3Col11	< 2.70 Ω		R4Col11	< 2.70 Ω	
R3Col12	< 2.70 Ω		R4Col12	< 2.70 Ω	
R3Col13	< 2.70 Ω		R4Col13	< 2.70 Ω	
R3Col14	< 2.70 Ω		R4Col14	< 2.70 Ω	
R3Col15	< 2.70 Ω		R4Col15	< 2.70 Ω	
R3Col16	< 2.70 Ω		R4Col16	< 2.70 Ω	
R3Col17	< 2.70 Ω		R4Col17	< 2.70 Ω	
R3Col18	< 2.70 Ω		R4Col18	< 2.70 Ω	
R3Col19	< 2.70 Ω		R4Col19	< 2.70 Ω	
R3Col20	< 2.70 Ω		R4Col20	< 2.70 Ω	
R3Col21	< 2.70 Ω		R4Col21	< 2.70 Ω	
R3Col22	< 2.70 Ω		R4Col22	< 2.70 Ω	

Row/Col Path	Path Resistance*	Measured Value	Row/Col Path	Path Resistance*	Measured Value
R3Col23	< 2.70 Ω		R4Col23	< 2.70 Ω	
R3Col24	< 2.70 Ω		R4Col24	< 2.70 Ω	
R3Col25	< 2.70 Ω		R4Col25	< 2.70 Ω	
R3Col26	< 2.70 Ω		R4Col26	< 2.70 Ω	
R3Col27	< 2.70 Ω		R4Col27	< 2.70 Ω	
R3Col28	< 2.70 Ω		R4Col28	< 2.70 Ω	
R3Col29	< 2.70 Ω		R4Col29	< 2.70 Ω	
R3Col30	< 2.70 Ω		R4Col30	< 2.70 Ω	
R3Col31	< 2.70 Ω		R4Col31	< 2.70 Ω	
R3Col32	< 2.70 Ω		R4Col32	< 2.70 Ω	
R3Col33	< 2.70 Ω		R4Col33	< 2.70 Ω	
R3Col34	< 2.70 Ω		R4Col34	< 2.70 Ω	
R3Col35	< 2.70 Ω		R4Col35	< 2.70 Ω	
R3Col36	< 2.70 Ω		R4Col36	< 2.70 Ω	
R3Col37	< 2.70 Ω		R4Col37	< 2.70 Ω	
R3Col38	< 2.70 Ω		R4Col38	< 2.70 Ω	
R3Col39	< 2.70 Ω		R4Col39	< 2.70 Ω	
R3Col40	< 2.70 Ω		R4Col40	< 2.70 Ω	
R3Col41	< 2.70 Ω		R4Col41	< 2.70 Ω	
R3Col42	< 2.70 Ω		R4Col42	< 2.70 Ω	
R3Col43	< 2.70 Ω		R4Col43	< 2.70 Ω	
R3Col44	< 2.70 Ω		R4Col44	< 2.70 Ω	
R3Col45	< 2.70 Ω		R4Col45	< 2.70 Ω	
R3Col46	< 2.70 Ω		R4Col46	< 2.70 Ω	
R3Col47	< 2.70 Ω		R4Col47	< 2.70 Ω	
R3Col48	< 2.70 Ω		R4Col48	< 2.70 Ω	
R3Col49	< 2.70 Ω		R4Col49	< 2.70 Ω	
R3Col50	< 2.70 Ω		R4Col50	< 2.70 Ω	
R3Col51	< 2.70 Ω		R4Col51	< 2.70 Ω	
R3Col52	< 2.70 Ω		R4Col52	< 2.70 Ω	
R3Col53	< 2.70 Ω		R4Col53	< 2.70 Ω	
R3Col54	< 2.70 Ω		R4Col54	< 2.70 Ω	
R3Col55	< 2.70 Ω		R4Col55	< 2.70 Ω	
R3Col56	< 2.70 Ω		R4Col56	< 2.70 Ω	
R3Col57	< 2.70 Ω		R4Col57	< 2.70 Ω	
R3Col58	< 2.70 Ω		R4Col58	< 2.70 Ω	
R3Col59	< 2.70 Ω		R4Col59	< 2.70 Ω	
R3Col60	< 2.70 Ω		R4Col60	< 2.70 Ω	
R3Col61	< 2.70 Ω		R4Col61	< 2.70 Ω	
R3Col62	< 2.70 Ω		R4Col62	< 2.70 Ω	
R3Col63	< 2.70 Ω		R4Col63	< 2.70 Ω	
R3Col64	< 2.70 Ω		R4Col64	< 2.70 Ω	

* Functional test limit

M9121A Schematic

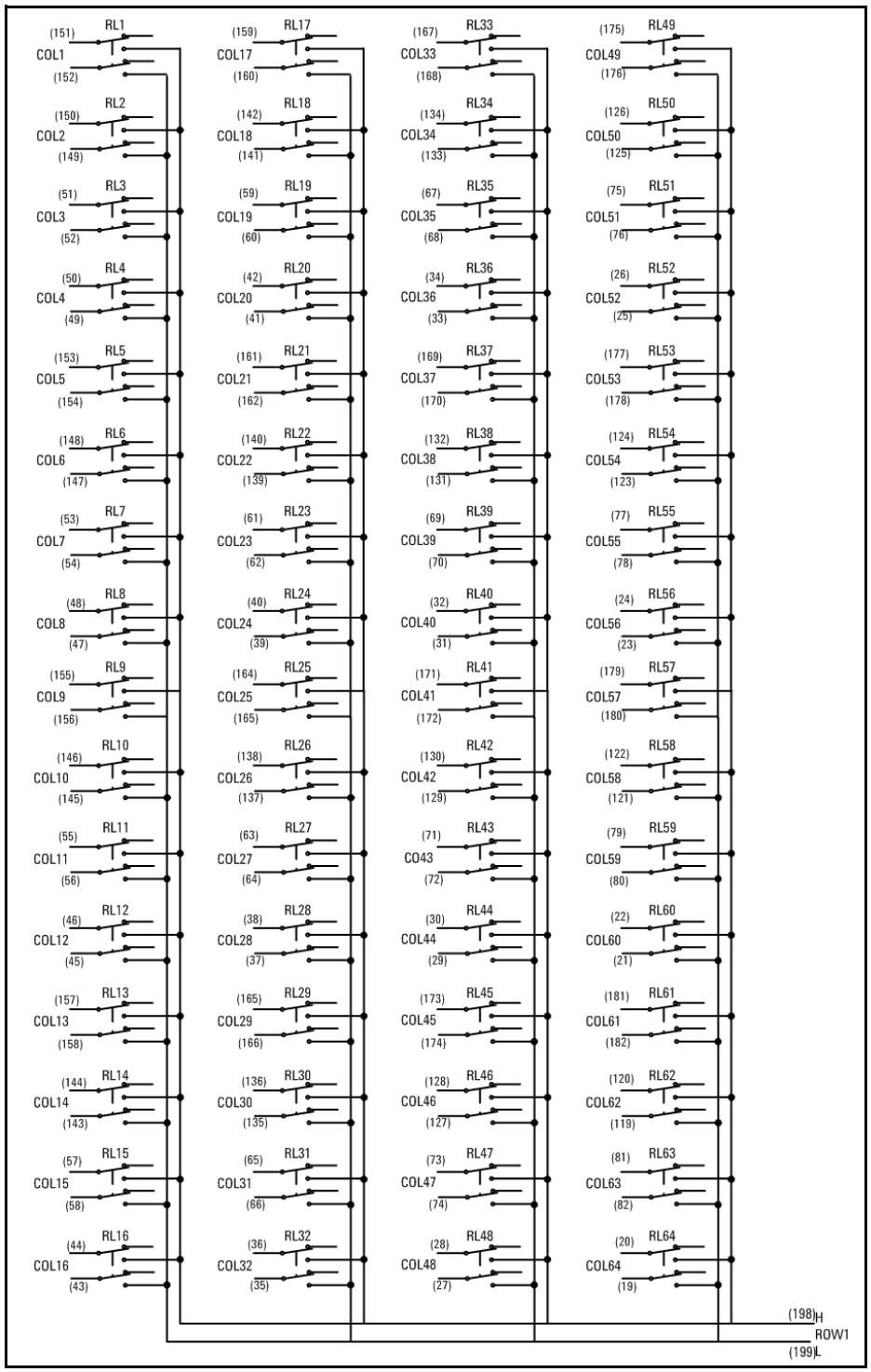


Figure 25 M9121A Schematic (Row 1)
(numbers in parenthesis are front panel connector pin numbers)

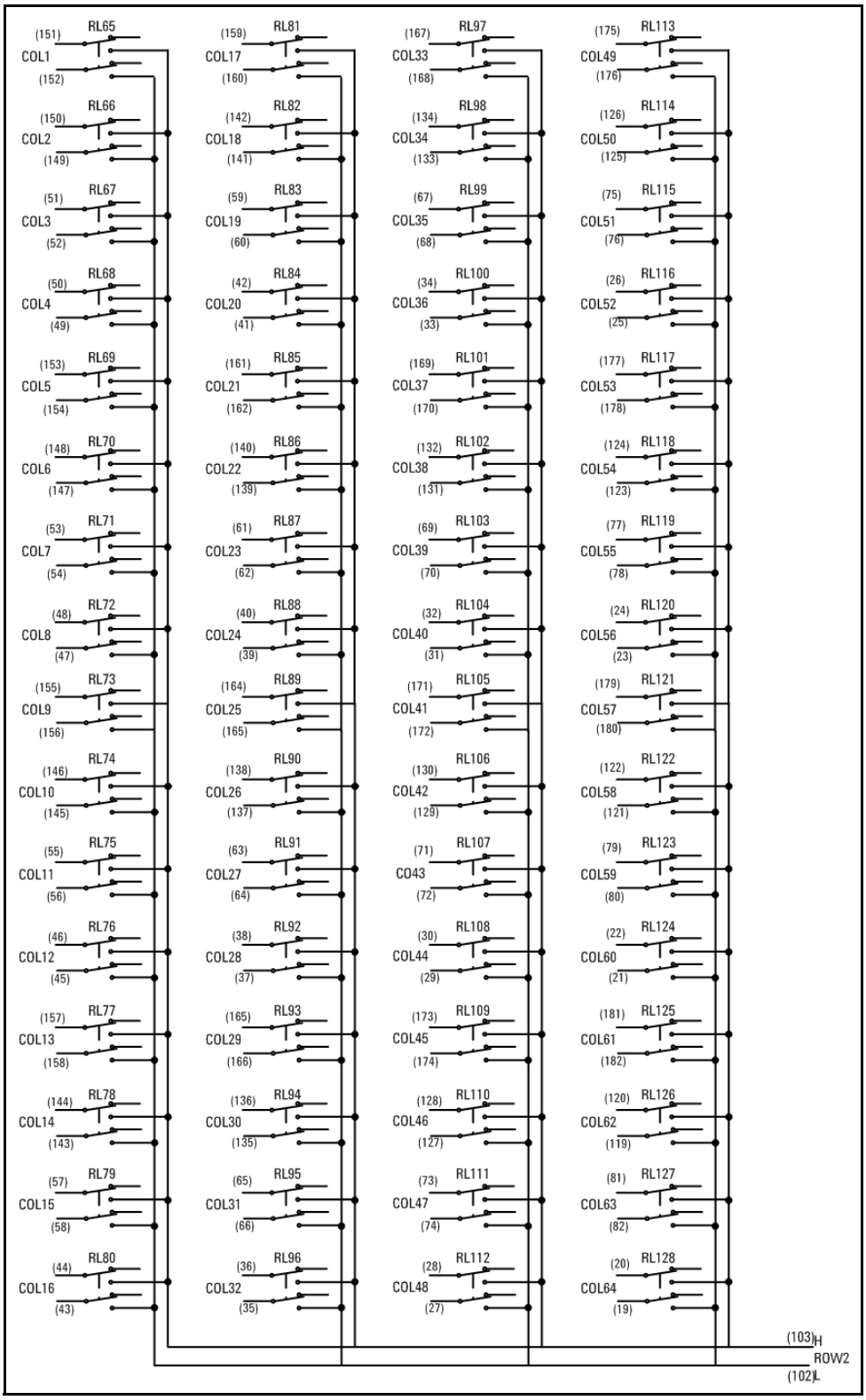


Figure 26 M9121A Schematic (Row 2)
numbers in parenthesis are front panel connector pin numbers

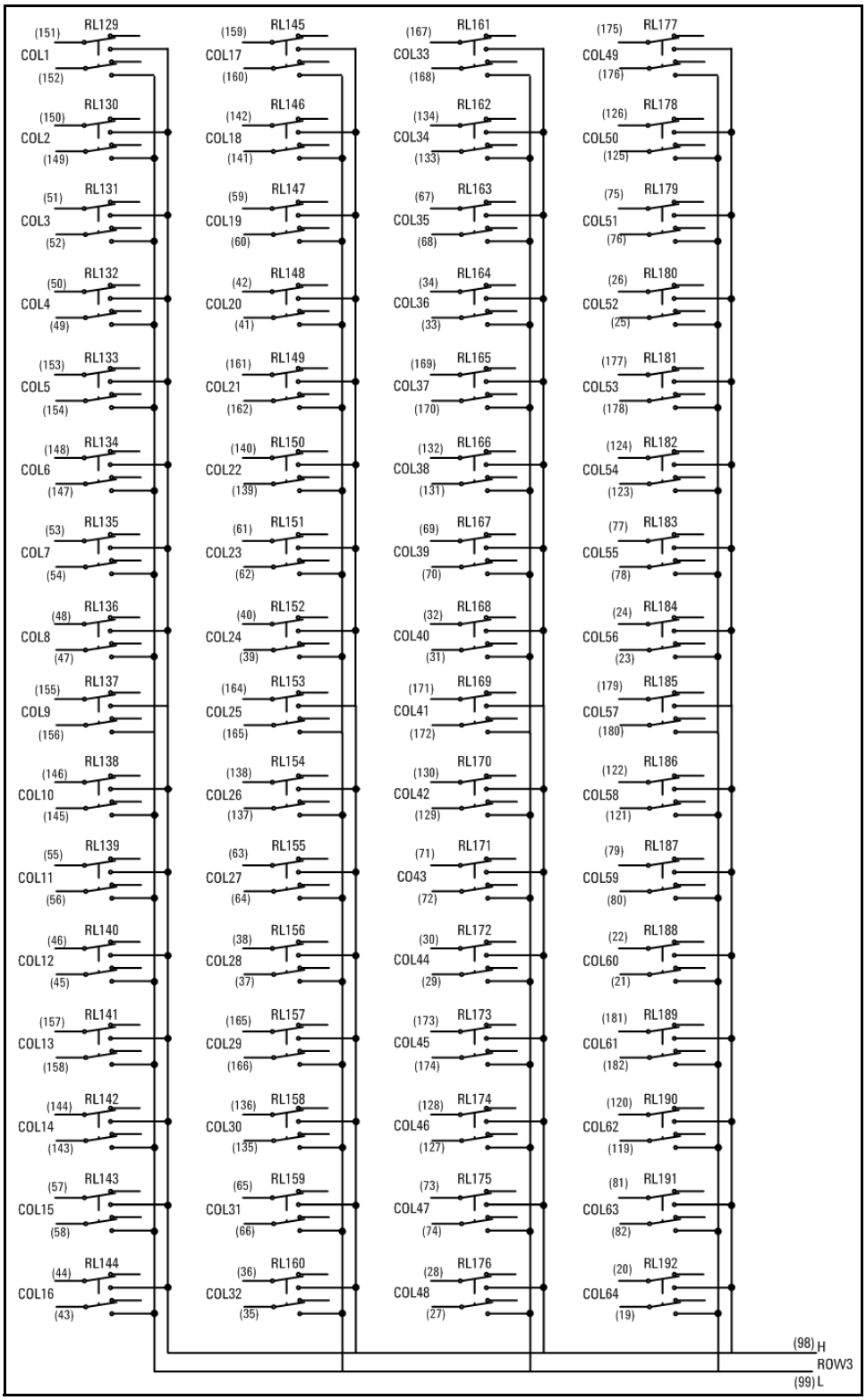


Figure 27 M9121A Schematic (Row 3)
numbers in parenthesis are front panel connector pin numbers

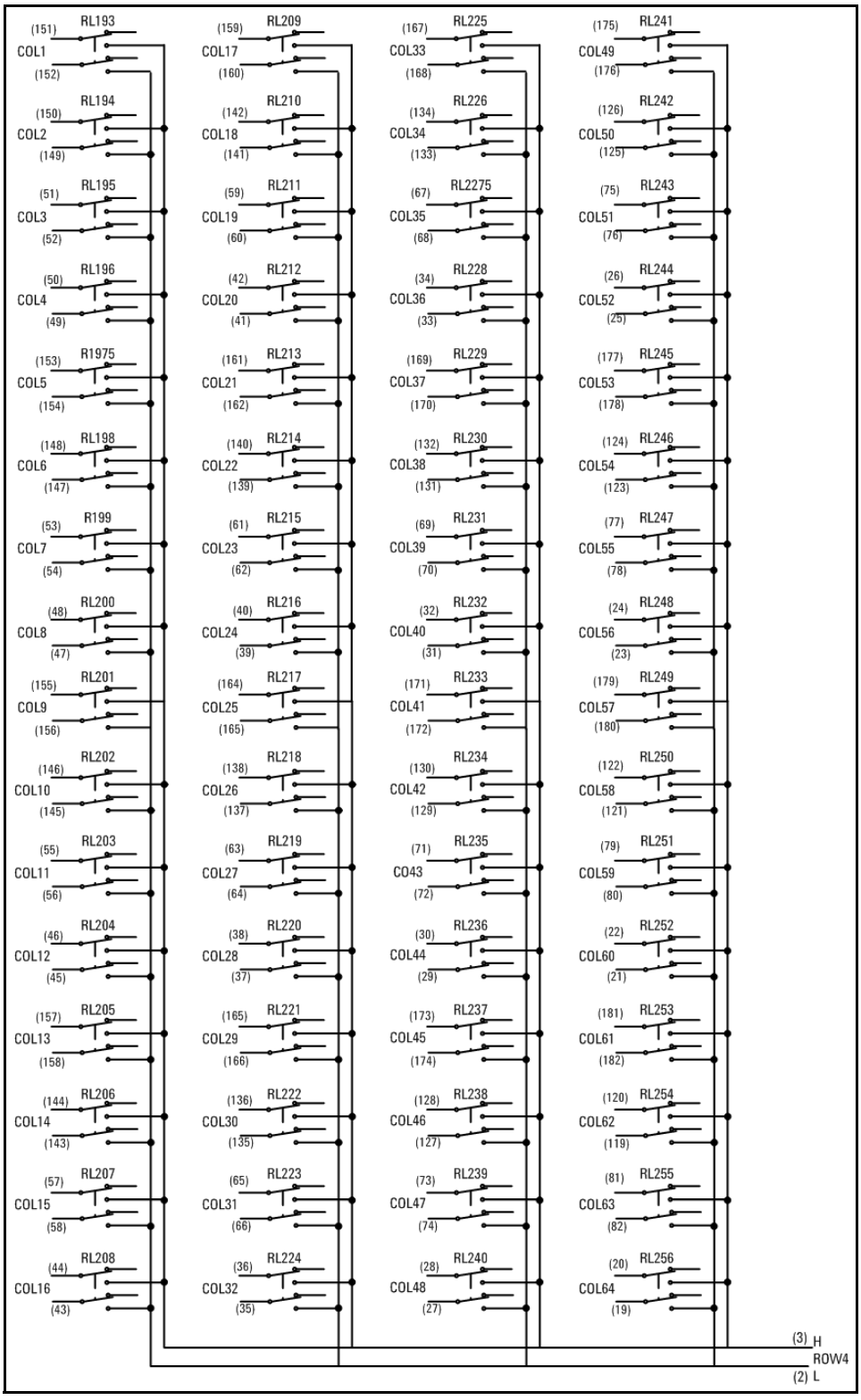


Figure 28 M9121A Schematic (Row 4)
numbers in parenthesis are front panel connector pin numbers

M9121A PC Board Layout

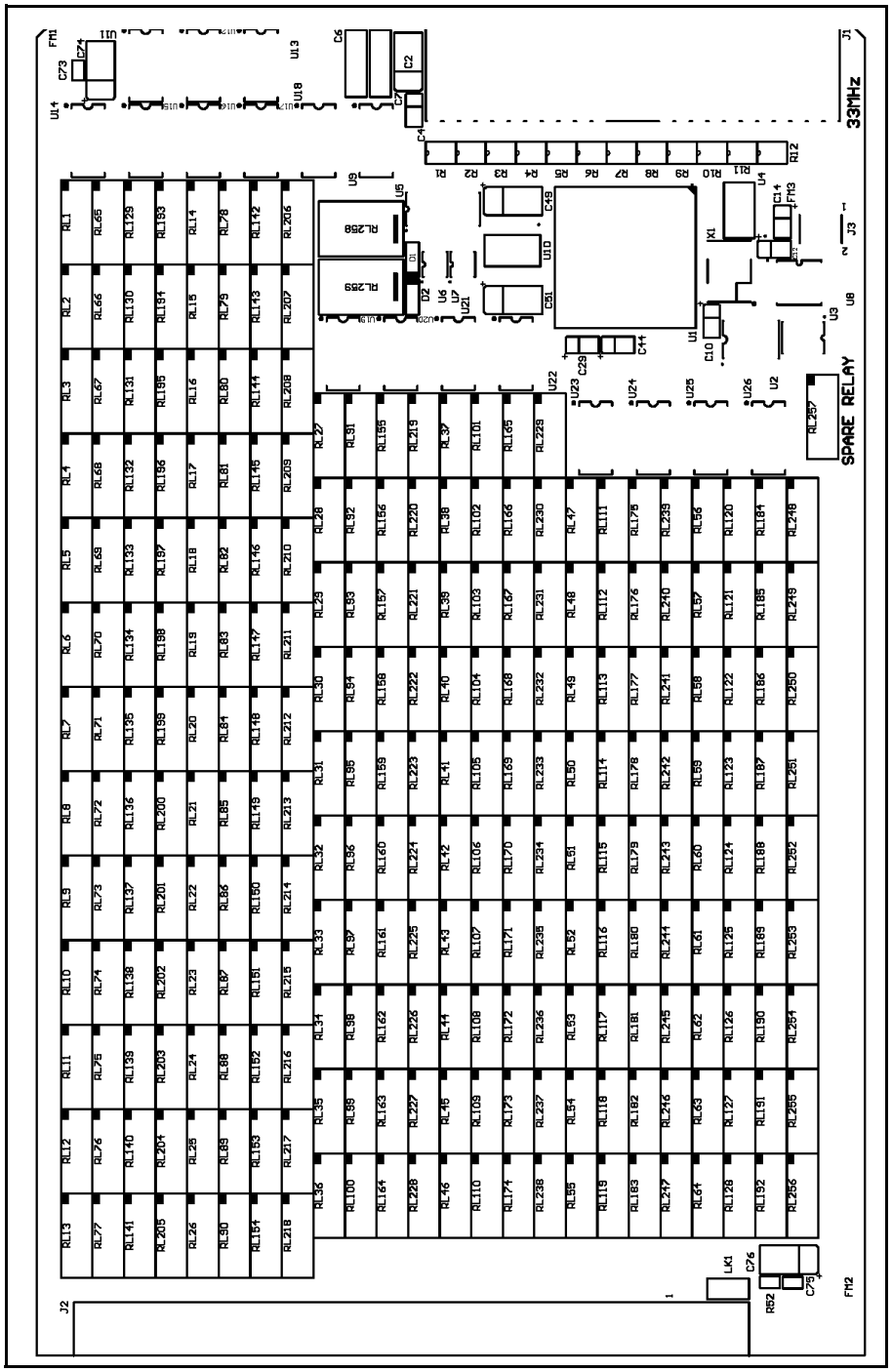


Figure 29 M9121A PC Board Relay Layout

NOTE Relays 258 and 259 on the PC board, are used for internal Keysight testing only.

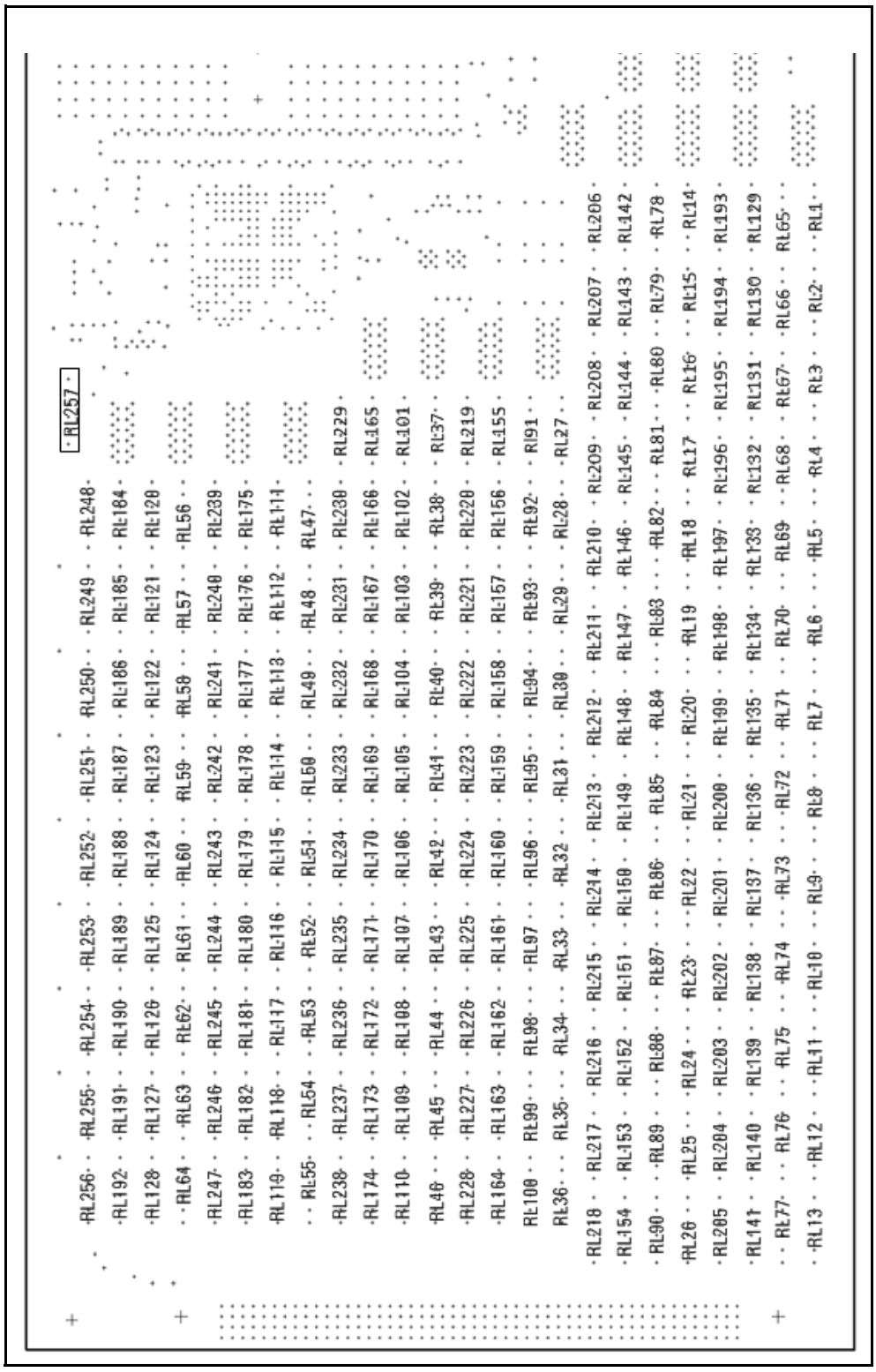


Figure 30 M9121A Backside of PC Board (solder side)

7 M9122A Matrix Switch, 8x32, 1-wire Armature Relays

Introduction

Keysight's M9122A Matrix Switch module is a high density module configured as a 32 column by eight row matrix. Each relay is a single-pole switch.

The 256 cross point relays on this modules are high reliability Palladium-Ruthenium, gold plated, bifurcated armature relays, providing long life and stable contact resistance. Connections to the modules are through a 50-pin connector. See Figure 31 on page 71.

Default switch path

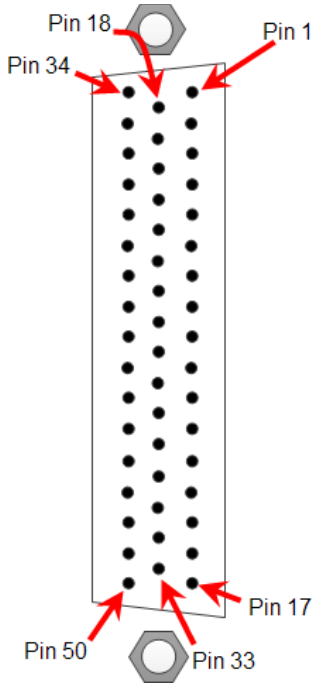
All cross point relays are open.

Replacement Relays

One spare channel relay (RL258) is loaded on the M9122A PC board. Refer to Figure 37. To use this relay, you must desolder it from the PC board and solder it in place of a defective channel relay. Additional channel relays may be ordered from Keysight using part number 0490-2919

CAUTION **To maintain typical switching characteristics (refer to the module data sheet) and user safety, use only Keysight-specified relays. Do not substitute relays unless directed by Keysight support.**

NOTE **Relay 259 on the PC board is used for internal Keysight testing only.**



Pin No.	Signal	Pin No.	Signal	Pin No.	Signal
1	Row 3	18	Row 2	34	Row 1
2	Row 6	19	Row 5	35	Row 4
3	--	20	Row 8	36	Row 7
4	--	21	--	37	--
5	--	22	--	38	--
6	Col 3	23	Col 2	39	Col 1
7	Col 6	24	Col 5	40	Col 4
8	Col 9	25	Col 8	41	Col 7
9	Col 12	26	Col 11	42	Col 10
10	Col15	27	Col 14	43	Col 13
11	Col 18	28	Col 17	44	Col 16
12	Col 21	29	Col 20	45	Col 19
13	Col 24	30	Col 23	46	Col 22
14	Col 27	31	Col 26	47	Col 25
15	Col 30	32	Col 29	48	Col 28
16	--	33	Col 32	49	Col 31
17	--			50	--

(viewed from the front panel) (-- indicates pins not used)

Figure 31 M9122A Connector and Pinout

Troubleshooting and Functional Verification Testing

To troubleshoot and verify the 256 cross point relays on the module, perform a closed channel resistance test on each row/column cross point. This procedure does not provide performance or specification verification.Each M9122A Matrix Switch module is constructed as eight separate matrices; each matrix is 32x1 for a total of 256 relays. The schematics (Figure 33 through Figure 36) are drawn as separate matrices. Thus:

- to connect Column 1 to Row 1, relay RL1 closes (Figure 33, top schematic)
- to connect Column 1 to Row 2, relay RL33 closes (Figure 33, bottom)
- to connect Column 1 to Row 3, relay RL65 closes (Figure 34, top)
- to connect Column 1 to Row 4, relay RL97 closes (Figure 34, bottom), etc.

Therefore, the first step in troubleshooting is to determine which row/column is defective. Then, by referencing the schematics, you can determine which relay is defective.

CAUTION **Remove all user wiring and connections from the plug-in modules before troubleshooting or verification.**

When all relays are “open,” a resistance measured on any channel path indicates a welded contacts condition and the relay or module must be replaced. There is no specific path resistance or test for this failure.

The single ended path resistance characteristic assumes a measurement from each COLumn terminal to a ROW terminal. You will need to measure each column to each row. See Figure 32.

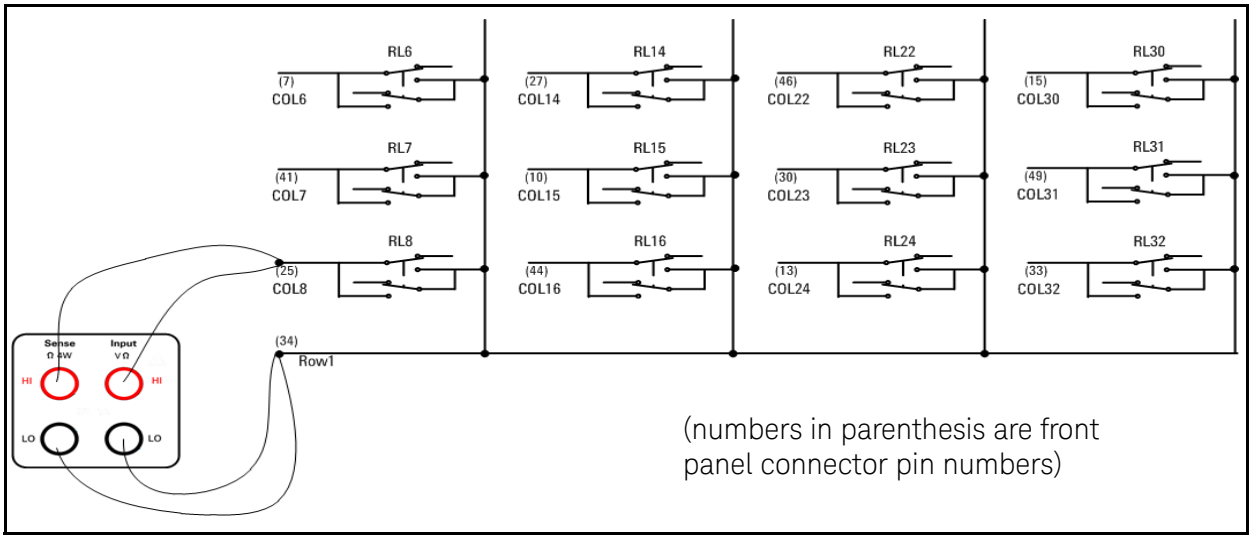


Figure 32 M9122A Contact Resistance Test

Note that this includes two relay contacts. The typical initial path resistance is approximately 250 mΩ..

M9122A Functional Verification Test Record - Closed Channel Resistance

Row/Col Path	Path Resistance*	Measured Value	Row/Col Path	Path Resistance*	Measured Value
Row 1			Row 2		
R1Col1	< 1.40 Ω		R2Col1	< 1.40 Ω	
R1Col2	< 1.40 Ω		R2Col2	< 1.40 Ω	
R1Col3	< 1.40 Ω		R2Col3	< 1.40 Ω	
R1Col4	< 1.40 Ω		R2Col4	< 1.40 Ω	
R1Col5	< 1.40 Ω		R2Col5	< 1.40 Ω	
R1Col6	< 1.40 Ω		R2Col6	< 1.40 Ω	
R1Col7	< 1.40 Ω		R2Col7	< 1.40 Ω	
R1Col8	< 1.40 Ω		R2Col8	< 1.40 Ω	
R1Col9	< 1.40 Ω		R2Col9	< 1.40 Ω	
R1Col10	< 1.40 Ω		R2Col10	< 1.40 Ω	
R1Col11	< 1.40 Ω		R2Col11	< 1.40 Ω	
R1Col12	< 1.40 Ω		R2Col12	< 1.40 Ω	
R1Col13	< 1.40 Ω		R2Col13	< 1.40 Ω	
R1Col14	< 1.40 Ω		R2Col14	< 1.40 Ω	
R1Col15	< 1.40 Ω		R2Col15	< 1.40 Ω	
R1Col16	< 1.40 Ω		R2Col16	< 1.40 Ω	
R1Col17	< 1.40 Ω		R2Col17	< 1.40 Ω	
R1Col18	< 1.40 Ω		R2Col18	< 1.40 Ω	
R1Col19	< 1.40 Ω		R2Col19	< 1.40 Ω	
R1Col20	< 1.40 Ω		R2Col20	< 1.40 Ω	
R1Col21	< 1.40 Ω		R2Col21	< 1.40 Ω	
R1Col22	< 1.40 Ω		R2Col22	< 1.40 Ω	
R1Col23	< 1.40 Ω		R2Col23	< 1.40 Ω	
R1Col24	< 1.40 Ω		R2Col24	< 1.40 Ω	
R1Col25	< 1.40 Ω		R2Col25	< 1.40 Ω	
R1Col26	< 1.40 Ω		R2Col26	< 1.40 Ω	
R1Col27	< 1.40 Ω		R2Col27	< 1.40 Ω	
R1Col28	< 1.40 Ω		R2Col28	< 1.40 Ω	
R1Col29	< 1.40 Ω		R2Col29	< 1.40 Ω	
R1Col30	< 1.40 Ω		R2Col30	< 1.40 Ω	
R1Col31	< 1.40 Ω		R2Col31	< 1.40 Ω	
R1Col32	< 1.40 Ω		R2Col32	< 1.40 Ω	

Row/Col Path	Path Resistance*	Measured Value	Row/Col Path	Path Resistance*	Measured Value
Row 3			Row 4		
R3Col1	< 1.40 Ω		R4Col1	< 1.40 Ω	
R3Col2	< 1.40 Ω		R4Col2	< 1.40 Ω	
R3Col3	< 1.40 Ω		R4Col3	< 1.40 Ω	
R3Col4	< 1.40 Ω		R4Col4	< 1.40 Ω	
R3Col5	< 1.40 Ω		R4Col5	< 1.40 Ω	
R3Col6	< 1.40 Ω		R4Col6	< 1.40 Ω	
R3Col7	< 1.40 Ω		R4Col7	< 1.40 Ω	
R3Col8	< 1.40 Ω		R4Col8	< 1.40 Ω	
R3Col9	< 1.40 Ω		R4Col9	< 1.40 Ω	
R3Col10	< 1.40 Ω		R4Col10	< 1.40 Ω	
R3Col11	< 1.40 Ω		R4Col11	< 1.40 Ω	
R3Col12	< 1.40 Ω		R4Col12	< 1.40 Ω	
R3Col13	< 1.40 Ω		R4Col13	< 1.40 Ω	
R3Col14	< 1.40 Ω		R4Col14	< 1.40 Ω	
R3Col15	< 1.40 Ω		R4Col15	< 1.40 Ω	
R3Col16	< 1.40 Ω		R4Col16	< 1.40 Ω	
R3Col17	< 1.40 Ω		R4Col17	< 1.40 Ω	
R3Col18	< 1.40 Ω		R4Col18	< 1.40 Ω	
R3Col19	< 1.40 Ω		R4Col19	< 1.40 Ω	
R3Col20	< 1.40 Ω		R4Col20	< 1.40 Ω	
R3Col21	< 1.40 Ω		R4Col21	< 1.40 Ω	
R3Col22	< 1.40 Ω		R4Col22	< 1.40 Ω	
R3Col23	< 1.40 Ω		R4Col23	< 1.40 Ω	
R3Col24	< 1.40 Ω		R4Col24	< 1.40 Ω	
R3Col25	< 1.40 Ω		R4Col25	< 1.40 Ω	
R3Col26	< 1.40 Ω		R4Col26	< 1.40 Ω	
R3Col27	< 1.40 Ω		R4Col27	< 1.40 Ω	
R3Col28	< 1.40 Ω		R4Col28	< 1.40 Ω	
R3Col29	< 1.40 Ω		R4Col29	< 1.40 Ω	
R3Col30	< 1.40 Ω		R4Col30	< 1.40 Ω	
R3Col31	< 1.40 Ω		R4Col31	< 1.40 Ω	
R3Col32	< 1.40 Ω		R4Col32	< 1.40 Ω	

Row/Col Path	Path Resistance*	Measured Value	Row/Col Path	Path Resistance*	Measured Value
Row 5			Row 6		
R5Col1	< 1.40 Ω		R6Col1	< 1.40 Ω	
R5Col2	< 1.40 Ω		R6Col2	< 1.40 Ω	
R5Col3	< 1.40 Ω		R6Col3	< 1.40 Ω	
R5Col4	< 1.40 Ω		R6Col4	< 1.40 Ω	
R5Col5	< 1.40 Ω		R6Col5	< 1.40 Ω	
R5Col6	< 1.40 Ω		R6Col6	< 1.40 Ω	
R5Col7	< 1.40 Ω		R6Col7	< 1.40 Ω	
R5Col8	< 1.40 Ω		R6Col8	< 1.40 Ω	
R5Col9	< 1.40 Ω		R6Col9	< 1.40 Ω	
R5Col10	< 1.40 Ω		R6Col10	< 1.40 Ω	
R5Col11	< 1.40 Ω		R6Col11	< 1.40 Ω	
R5Col12	< 1.40 Ω		R6Col12	< 1.40 Ω	
R5Col13	< 1.40 Ω		R6Col13	< 1.40 Ω	
R5Col14	< 1.40 Ω		R6Col14	< 1.40 Ω	
R5Col15	< 1.40 Ω		R6Col15	< 1.40 Ω	
R5Col16	< 1.40 Ω		R6Col16	< 1.40 Ω	
R5Col17	< 1.40 Ω		R6Col17	< 1.40 Ω	
R5Col18	< 1.40 Ω		R6Col18	< 1.40 Ω	
R5Col19	< 1.40 Ω		R6Col19	< 1.40 Ω	
R5Col20	< 1.40 Ω		R6Col20	< 1.40 Ω	
R5Col21	< 1.40 Ω		R6Col21	< 1.40 Ω	
R5Col22	< 1.40 Ω		R6Col22	< 1.40 Ω	
R5Col23	< 1.40 Ω		R6Col23	< 1.40 Ω	
R5Col24	< 1.40 Ω		R6Col24	< 1.40 Ω	
R5Col25	< 1.40 Ω		R6Col25	< 1.40 Ω	
R5Col26	< 1.40 Ω		R6Col26	< 1.40 Ω	
R5Col27	< 1.40 Ω		R6Col27	< 1.40 Ω	
R5Col28	< 1.40 Ω		R6Col28	< 1.40 Ω	
R5Col29	< 1.40 Ω		R6Col29	< 1.40 Ω	
R5Col30	< 1.40 Ω		R6Col30	< 1.40 Ω	
R5Col31	< 1.40 Ω		R6Col31	< 1.40 Ω	
R5Col32	< 1.40 Ω		R6Col32	< 1.40 Ω	

Row/Col Path	Path Resistance*	Measured Value	Row/Col Path	Path Resistance*	Measured Value
Row 7			Row 8		
R7Col1	< 1.40 Ω		R8Col1	< 1.40 Ω	
R7Col2	< 1.40 Ω		R8Col2	< 1.40 Ω	
R7Col3	< 1.40 Ω		R8Col3	< 1.40 Ω	
R7Col4	< 1.40 Ω		R8Col4	< 1.40 Ω	
R7Col5	< 1.40 Ω		R8Col5	< 1.40 Ω	
R7Col6	< 1.40 Ω		R8Col6	< 1.40 Ω	
R7Col7	< 1.40 Ω		R8Col7	< 1.40 Ω	
R7Col8	< 1.40 Ω		R8Col8	< 1.40 Ω	
R7Col9	< 1.40 Ω		R8Col9	< 1.40 Ω	
R7Col10	< 1.40 Ω		R8Col10	< 1.40 Ω	
R7Col11	< 1.40 Ω		R8Col11	< 1.40 Ω	
R7Col12	< 1.40 Ω		R8Col12	< 1.40 Ω	
R7Col13	< 1.40 Ω		R8Col13	< 1.40 Ω	
R7Col14	< 1.40 Ω		R8Col14	< 1.40 Ω	
R7Col15	< 1.40 Ω		R8Col15	< 1.40 Ω	
R7Col16	< 1.40 Ω		R8Col16	< 1.40 Ω	
R7Col17	< 1.40 Ω		R8Col17	< 1.40 Ω	
R7Col18	< 1.40 Ω		R8Col18	< 1.40 Ω	
R7Col19	< 1.40 Ω		R8Col19	< 1.40 Ω	
R7Col20	< 1.40 Ω		R8Col20	< 1.40 Ω	
R7Col21	< 1.40 Ω		R8Col21	< 1.40 Ω	
R7Col22	< 1.40 Ω		R8Col22	< 1.40 Ω	
R7Col23	< 1.40 Ω		R8Col23	< 1.40 Ω	
R7Col24	< 1.40 Ω		R8Col24	< 1.40 Ω	
R7Col25	< 1.40 Ω		R8Col25	< 1.40 Ω	
R7Col26	< 1.40 Ω		R8Col26	< 1.40 Ω	
R7Col27	< 1.40 Ω		R8Col27	< 1.40 Ω	
R7Col28	< 1.40 Ω		R8Col28	< 1.40 Ω	
R7Col29	< 1.40 Ω		R8Col29	< 1.40 Ω	
R7Col30	< 1.40 Ω		R8Col30	< 1.40 Ω	
R7Col31	< 1.40 Ω		R8Col31	< 1.40 Ω	
R7Col32	< 1.40 Ω		R8Col32	< 1.40 Ω	

* Functional test limit

M9122A Schematic

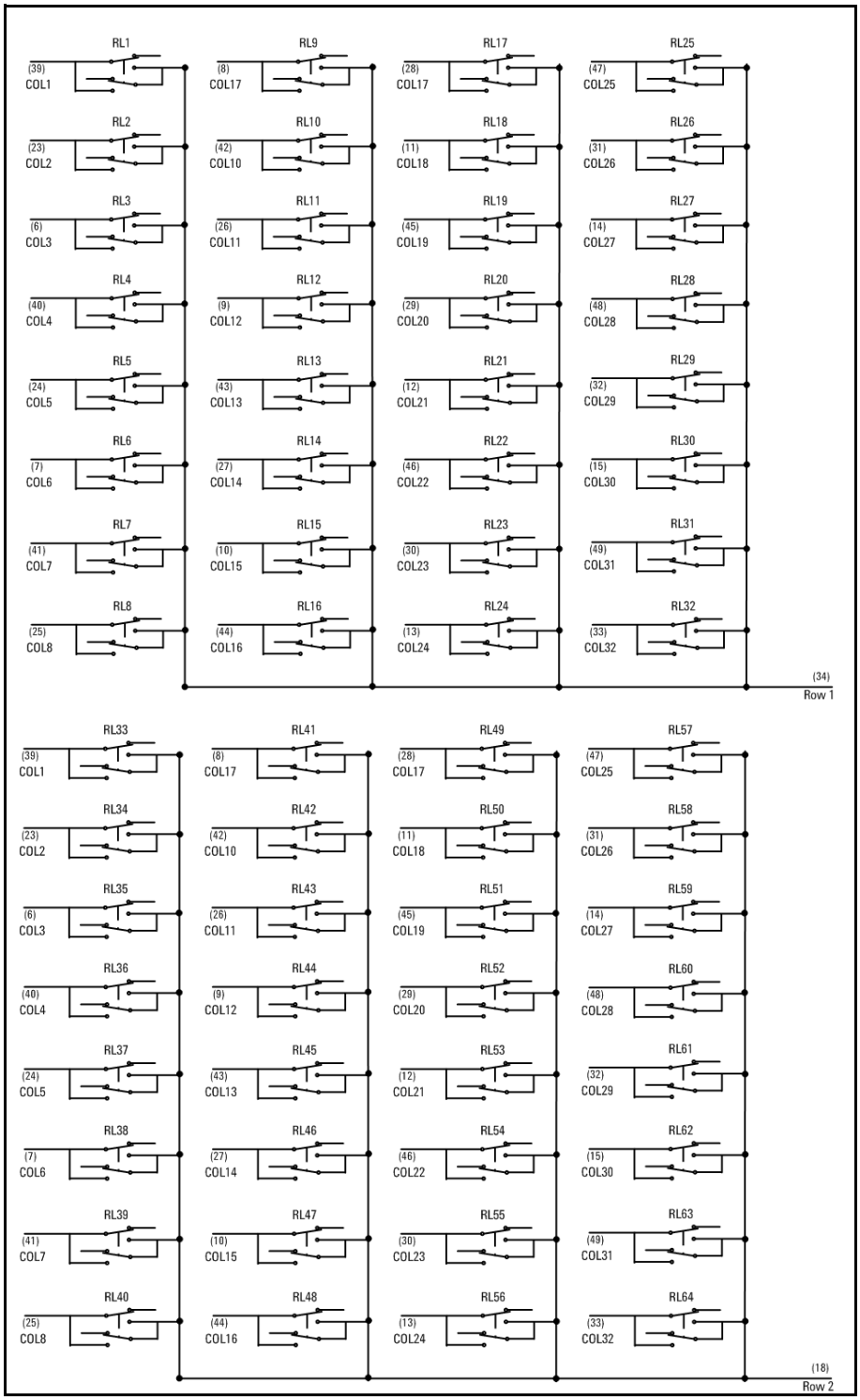


Figure 33 M9122A Schematic (Rows 1 and 2, motherboard)
numbers in parenthesis are front panel connector pin numbers

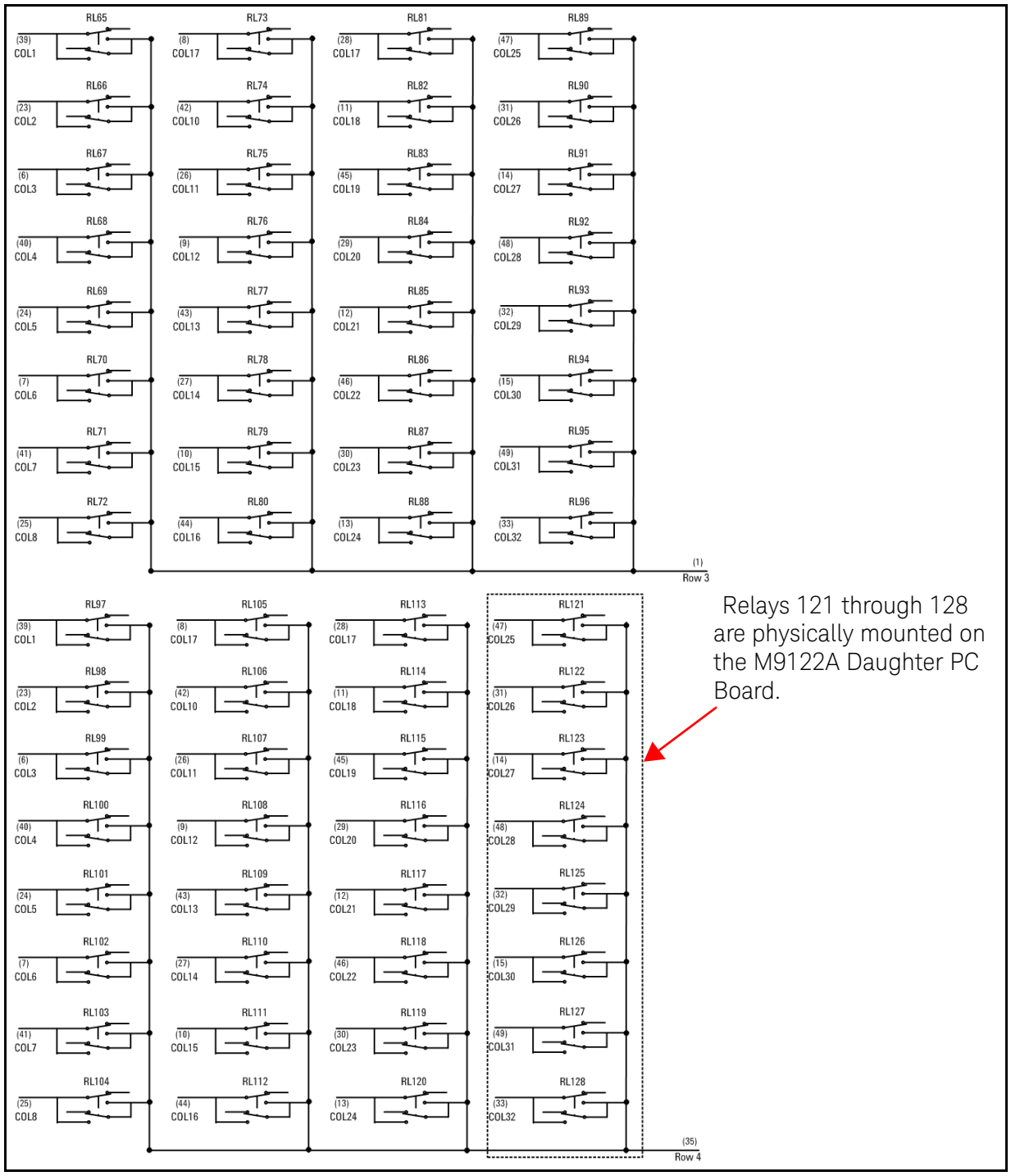


Figure 34 M9122A Schematic (Rows 3 and 4, motherboard and daughter board)
numbers in parenthesis are front panel connector pin numbers

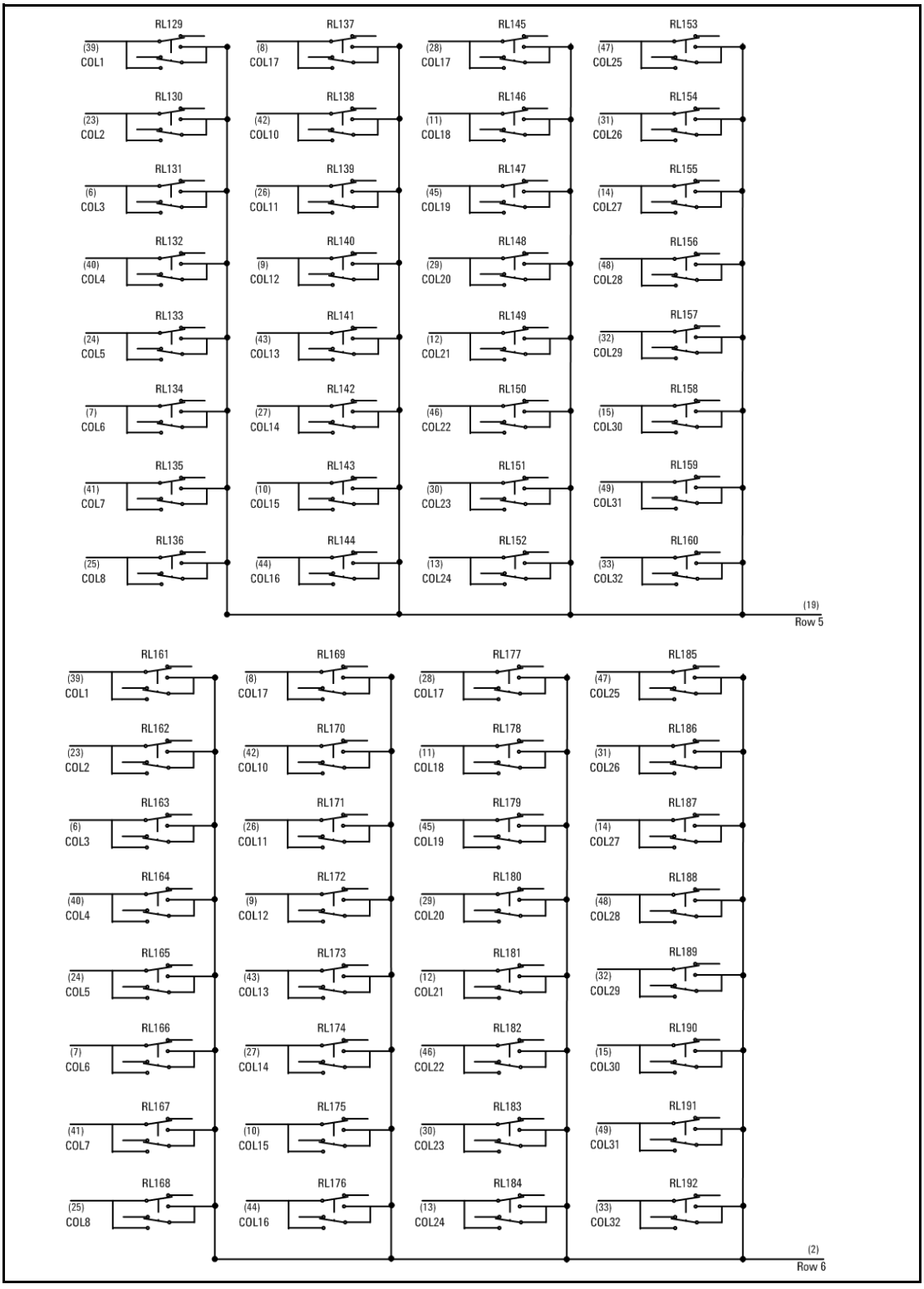


Figure 35 M9122A Schematic (Rows 5 and 6, daughter board)
numbers in parenthesis are front panel connector pin numbers

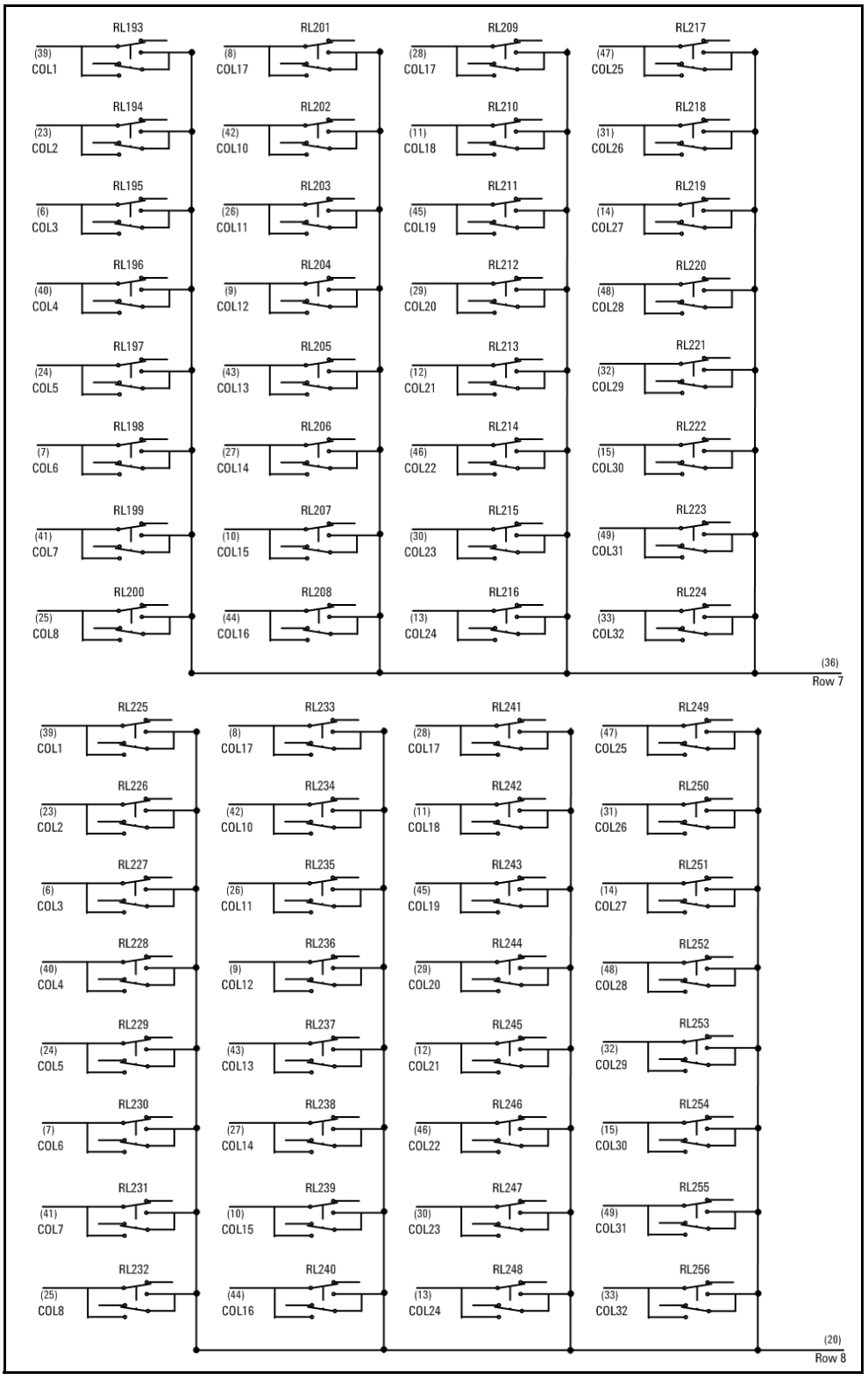


Figure 36 M9122A Schematic (Rows 7 and 8, daughter board)
numbers in parenthesis are front panel connector pin numbers

M9122A PC Board Layout

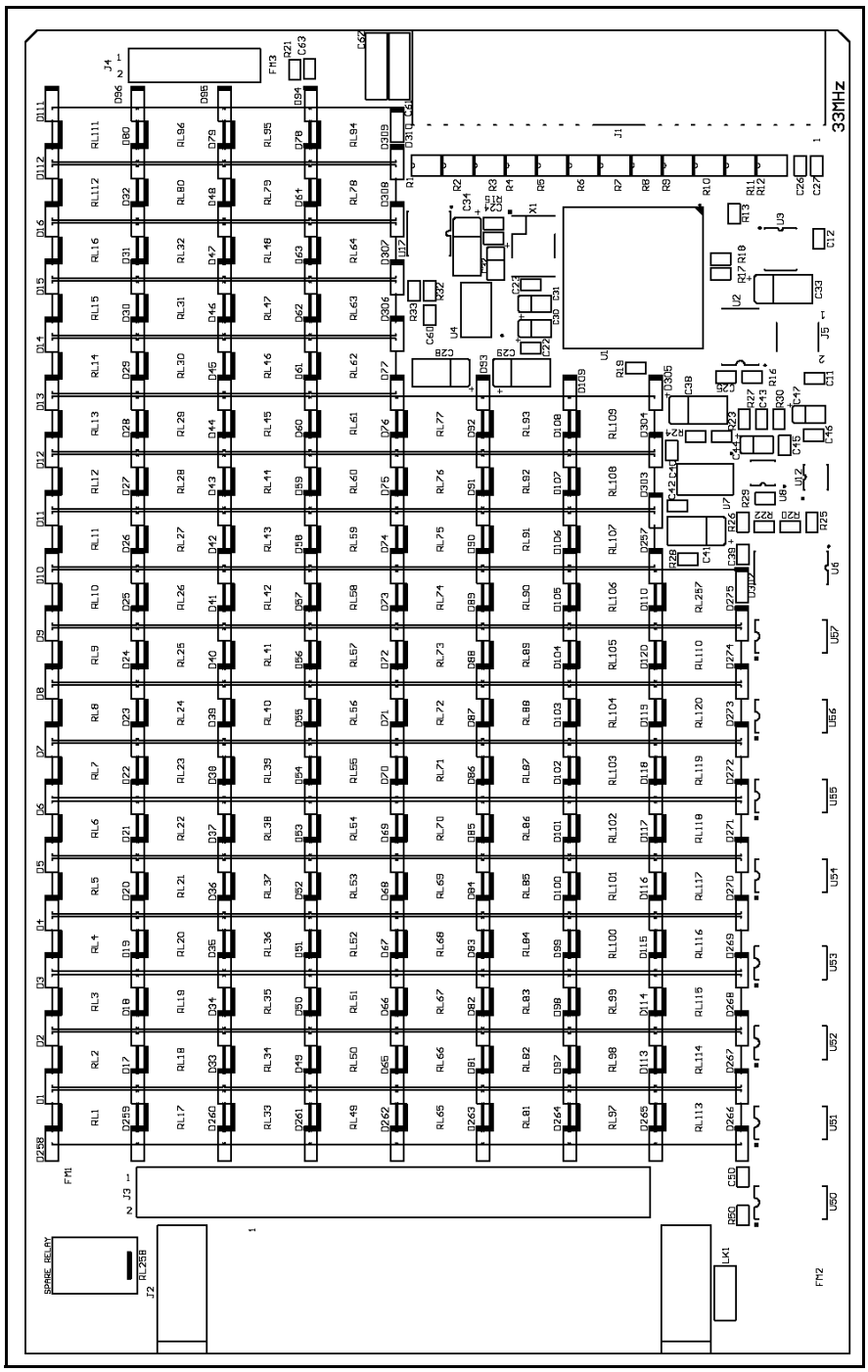


Figure 37 M9122A PC Motherboard Layout

NOTE Relays 258 and 259 on the PC board, are used for internal Keysight testing only.

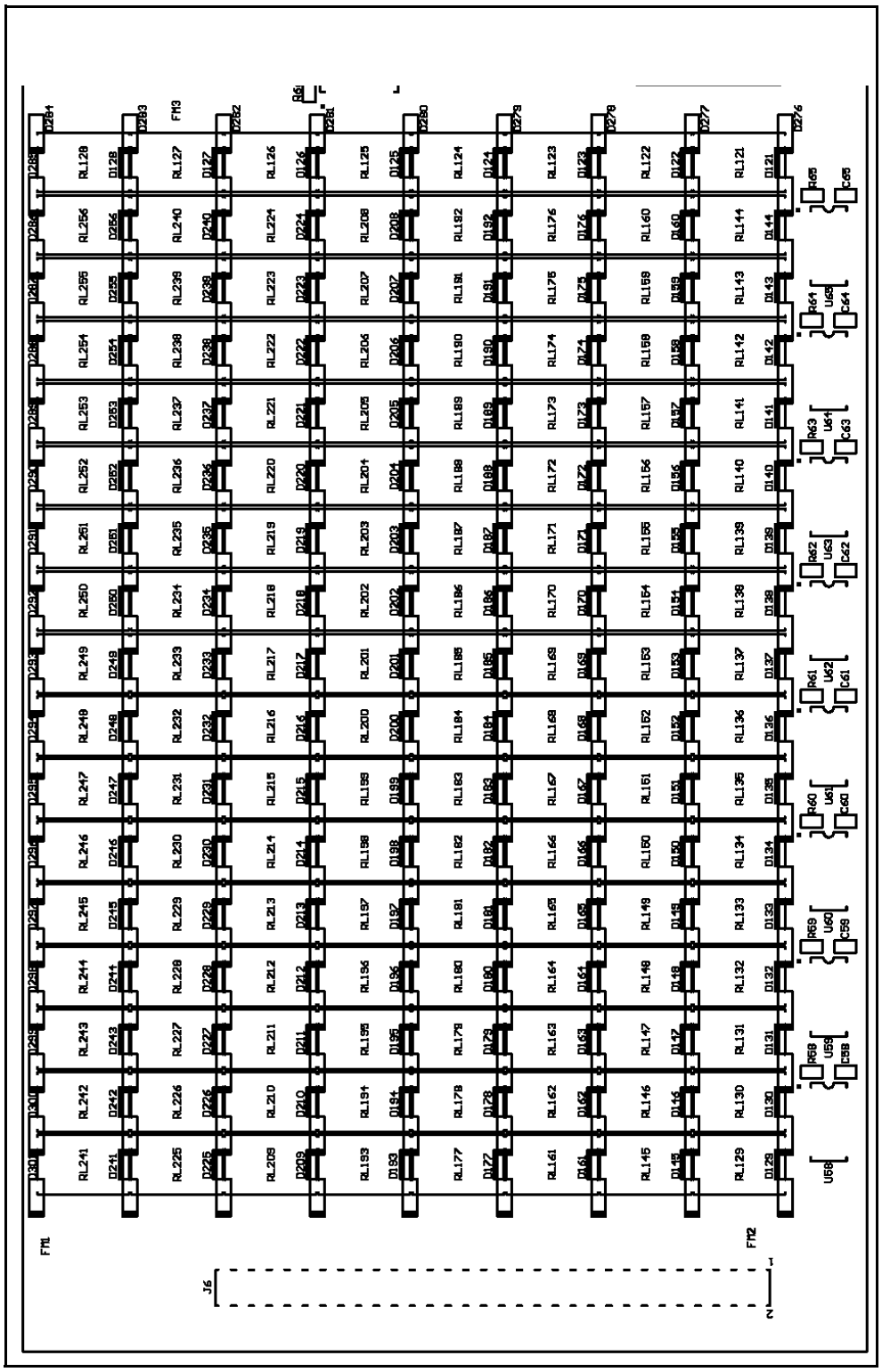


Figure 38 M9122A PC Daughter board Layout

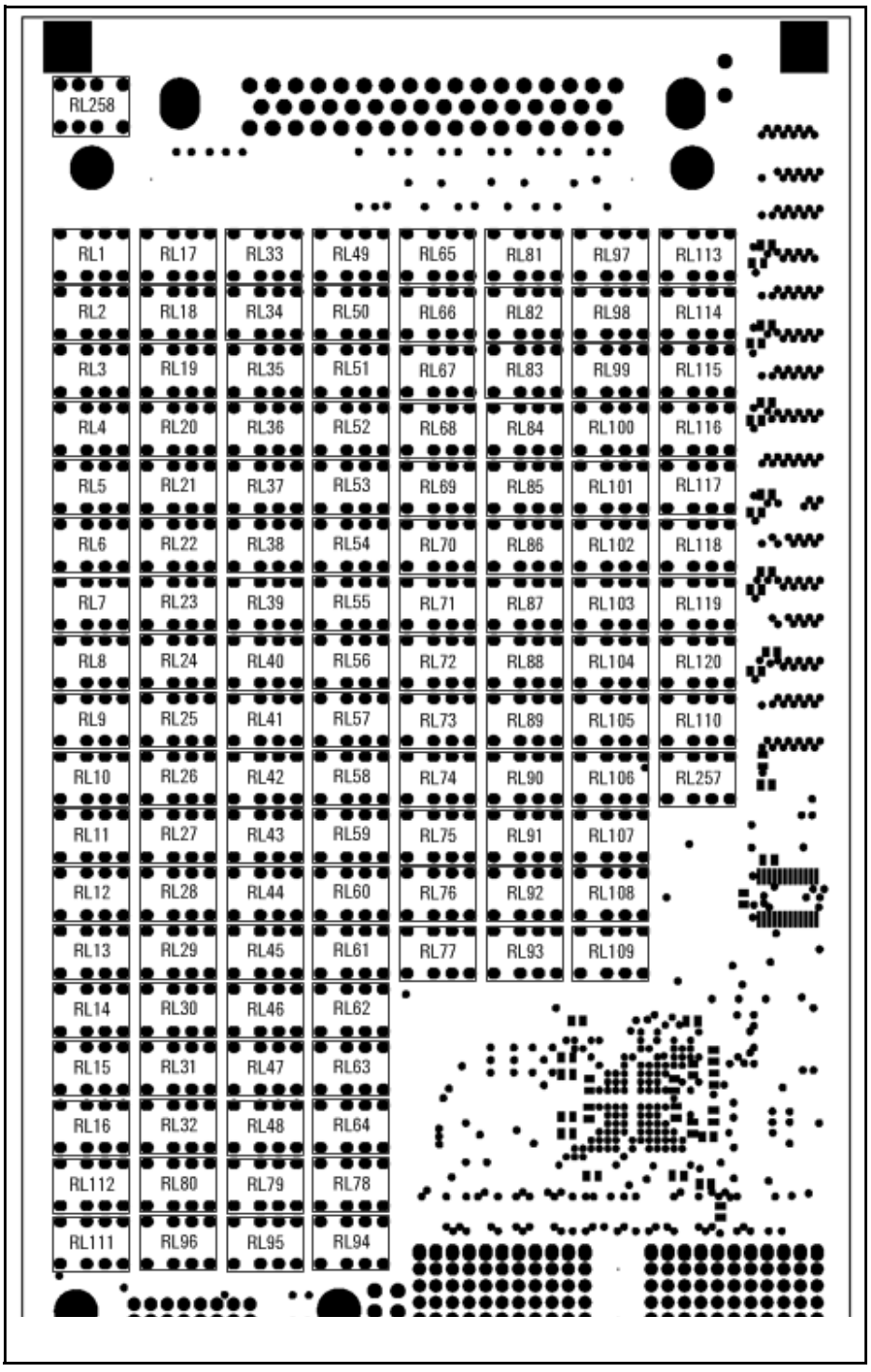


Figure 39 M9122A Backside of PC Motherboard (solder side) showing relay locations

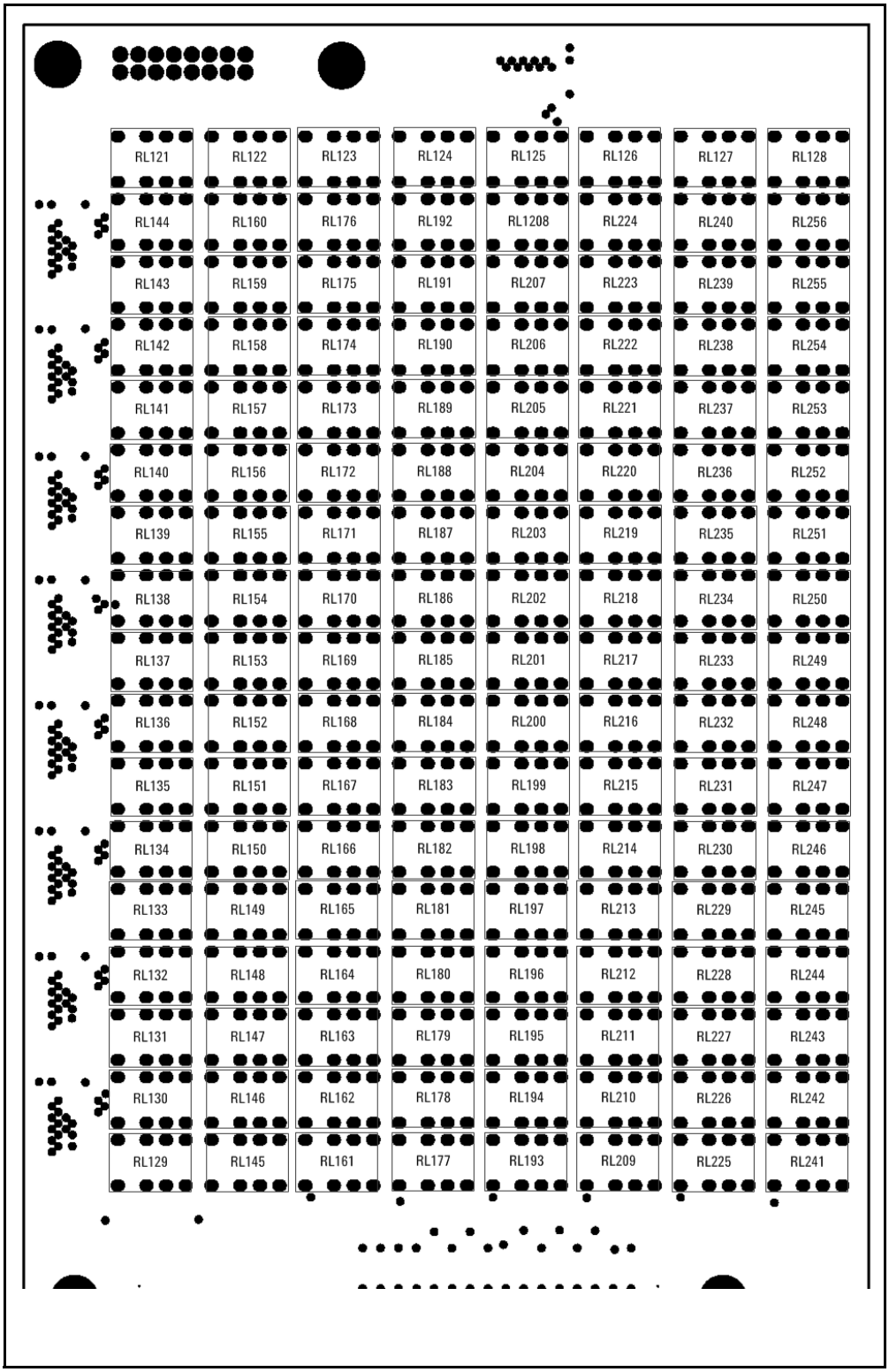


Figure 40 M9122A Backside of PC daughter board (solder side) showing relay locations

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Edition 3, December 2018

M9101-90005

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