Model 9140A-PCA Probe Card Adapter

Instructions

9140A-PCA-901-01 Rev. B / December 2017
Model 9140A-PCA
Probe Card Adapter
Instructions

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Document number: 9140A-901-01 Rev. B / December 2017
The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with nonhazardous voltages, there are situations where hazardous conditions may be present.

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

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

The types of product users are:

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

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

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

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

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

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

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

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

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

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

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

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

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.
For safety, instruments and accessories must be used in accordance with the operating instructions. If the instruments or accessories are used in a manner not specified in the operating instructions, the protection provided by the equipment may be impaired.

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

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

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

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

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

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

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

The ⚠ symbol indicates a connection terminal to the equipment frame.

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

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

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

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

Instrumentation and accessories shall not be connected to humans.

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

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

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

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

Safety precaution revision as of June 2017.
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Introduction

The 9140A-PCA is an interface specifically designed to connect a Keithley parametric test system to a device under test (DUT) while maintaining system specifications. It provides greater accuracy of parametric tests in applications that require a wide range of measurements, including high-voltage up to 3 kV while maintaining low-level measurement performance. The high-capacity, low-leakage 9140A-PCA Probe Card Adapter allows you to make high-voltage measurements in multi-pin, fully automated production test applications.

Figure 1: Probe card and adapter

NOTE
Refer to the manufacturer documentation for your prober for information about connecting hardware to it. Refer to the documentation provided with your Keithley parametric test system for information about connections to the system.
Features

Key features of the 9140A-PCA Probe Card Adapter include:

- Vacuum lock allows quick exchange of probe cards with accurate and repeatable alignment
- System supports 12 high-voltage pins at up to 3 kV and 36 low-voltage pins at up to 200 kV
- High-voltage pins use orange triaxial cables; low-voltage pins use black triaxial cables
- Optional hinged interface mechanism for easy probe card changes
- Easily connects device under test (DUT) cables to a probe card
- Motherboard accepts 48 DUT cables; probe card contains 48 fully guarded measure and sense lines
- Maintains test system specifications to the probe tip
- Preserves full Kelvin connections to the probe tip
- Reduces capacitance with extended guards
- DUT cables can be routed vertically or horizontally to the motherboard, supporting many different probers
- Extends low-current capabilities of the Keithley Parametric Test system

Safety symbols and terms

Refer to Safety precautions (on page 1-1) for important information about safety symbols and all precautions that must be taken when using the probe card adapter.

⚠️ WARNING

Hazardous voltages may be present on the probe card adapter, even after you disengage the interlock. Cables can retain charges after the interlock is disengaged, exposing you to live voltages that, if contacted, may cause personal injury or death. Reset the test equipment to put the probe card adapter in a safe state before touching the prober cables or any connected cables.

Never attempt to touch or change a probe card when tests are running. You must be absolutely certain that all tests have stopped before making contact with anything in the vicinity of the probe card adapter. Also, never run tests without a probe card installed.

Related documentation

The following related customer documentation is included with the Keithley Parametric Test System:

- **Administrative Guide** (part number S540-924-01): This guide provides information about Keithley Parametric Test Systems, including available configurations, site preparation and installation, equipment startup, connection diagrams, and maintenance.
- **Diagnostic and Verification Manual** (part number S540-906-01): This manual describes how to use the diagnostic and verification software suite that is part of your Keithley Parametric Test System.
Unpacking and inspection

The following topics provide information about your shipment.

Inspection for damage

**CAUTION**

Do not touch high-impedance areas of the probe card assembly or the probe card. Touching a high-impedance area will cause leakage and problems when performing low-current measurements. Excessive leakage will cause the probe card adapter to fail system tests.

Carefully unpack your 9140A-PCA Probe Card Adapter from its original shipping carton and inspect the card for any obvious signs of physical damage. Report any such damage to the shipping agent immediately. Save the original packing carton for possible future shipment.

Shipment contents

The following items are included with every 9140A-PCA order:

- 9140A-PCA Probe Card Adapter
- Model 9139A-VUA vacuum control box
- Unpopulated (blank) probe card (this probe card is used for diagnostics and is installed in the probe card adapter)
- A shorted probe card for system verification
- 6 m (15 ft) of 0.64 cm (1/4-in.) vacuum hose
- A 174-7047-XX\(^1\) safety interlock cable

Packing for shipment

Should it become necessary to return the 9140A-PCA for repair, carefully pack it in its original packing carton (or equivalent) with a return authorization (RA) number before shipping.

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\(^1\) Where XX represents the revision; the highest number is the most recent revision.
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Probe card adapter overview

Probe card adapter standard components

The 9140A-PCA probe card adapter consists of the following components; see the drawing following this list for details.

- Prober hardware
- Probe card adapter assembly:
  - Appropriate device under test (DUT) cables
  - Strain reliefs and other miscellaneous hardware
  - Motherboard containing interconnect pins for DUT cable connections
  - Pogo pins and retention ring
  - Light shield
  - Prober ring
  - Motherboard support plate
  - Insulation ring (Teflon®)
  - Probe card ring
  - Vacuum connection
- Probe cards (without probe pins)
  - One shorted probe card
  - One blank probe card
## Figure 2: 9140A-PCA probe and adapter components

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Pin arrangement

The 9140A-PCA Probe Card Adapter has 12 high-voltage pins (rated to 3 kV) and 36 low-voltage pins (rated to 200 V). All pins in the 9140A-PCA can accommodate low-current signals.

The pins are organized in groups around the probe card adapter: Four groups of high-voltage pins and four groups of low-voltage pins. See Mechanical specifications (on page 7-1) for information about the pin numbering arrangement.

Spacing around the pins varies depending on the type of pin connection. As shown in the following figure, high-voltage pins have more space between them, which prevents arcing.

Figure 3: 9140A-PCA pin arrangement
NOTE
If you use a probe card that has needles, ensure that the pin distance is adequate for the amount of voltage you are applying. The electrical field around the needle may be amplified if the radius of the needle is smaller than the high-voltage pad pitch distance. The shape of structures on the probe card may be a factor affecting this distance.


Leakage paths, low current, and high-voltage capabilities
The 9140A-PCA Probe Card Adapter makes fast high-voltage and low-current measurements. The short length of the connections between the device under test (DUT) cables and the probe pins reduces capacitive coupling between probe pins. Capacitance is further reduced by the extended guards. This reduced capacitance results in faster rise times.

Short direct connections and extended guard traces (through to the probe blade connections) minimize leakage. The low-leakage materials in the probe card and motherboard also minimize leakage paths.

Because of these factors, the 9140A-PCA has low leakage in both high-voltage and low-current measurement scenarios.

Motherboard characteristics
The motherboard is the interface between the device under test (DUT) cables and the probe card. It accepts 48 DUT cables and is suspended from the prober mounting hardware. Source, measure, guard, and ground (where appropriate) are terminated for each DUT cable on the motherboard.

Source, measure, and guard signals are kept separate for each pin and are carried to the probe card through spring-loaded contacts (pogo pins). Four ground pogo pins connect ground to the probe card. Source and measure lines are guarded on the motherboard using printed circuit board manufacturing techniques.

DUT cables can be routed vertically or horizontally to the motherboard. Vertical routing is used when the DUT cables are routed above the top platform (head plate) of the prober. Horizontal routing is used when the DUT cables are routed under the top platform of the prober.

Probe card configuration
The probe card contains 48 fully guarded measure and sense lines. It contains mounting traces for 48 probe needles. Drilled, plated-through holes are provided for interconnect pins.

An unpopulated (blank) probe card is provided with the probe card adapter assembly. Additional blank probe cards are available through your Keithley sales representative.

NOTE
To reduce pin-to-pin capacitance, use ceramic-blade probes.
Probe needle

Make sure the probe card manufacturer complies with the probe needle specifications required by the 9140A-PCA. Note that ceramic needles are recommended; other types of needles (such as epoxy) may be used if they conform to the dimensions in the following figure.

Figure 4: Probe needle mounting

Light shield

The light shield covers the opening in the center of the probe card adapter. This blocks ambient light and permits testing under lights-out conditions.
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Introduction

WARNING

The installation procedures contained in this manual are intended for use only by qualified service personnel. Do not perform these procedures unless qualified to do so. Failure to observe normal safety precautions could result in personal injury or death.

This section contains information needed to install the 9140A-PCA Probe Card Adapter on your prober. Several topics contain general installation steps. Other topics contain installation steps required for your specific prober. Review the appropriate topics before handling or installing the 9140A-PCA.

Handling precautions

The 9140A-PCA Probe Card Adapter is assembled at the factory to provide the highest quality connections possible between the device under test (DUT) and your system. Use care when handling these parts.

WARNING

Hazardous voltages may be present on the probe card adapter, even after you disengage the interlock. Cables can retain charges after the interlock is disengaged, exposing you to live voltages that, if contacted, may cause personal injury or death. Reset the test equipment to put the probe card adapter in a safe state before touching the prober cables or any connected cables.

Never attempt to touch or change a probe card when tests are running. You must be absolutely certain that all tests have stopped before making contact with anything in the vicinity of the probe card adapter. Also, never run tests without a probe card installed.
CAUTION

Do not touch high-impedance areas of the probe card assembly or the probe card. Touching a high-impedance area will cause leakage and problems when performing low-current measurements. Excessive leakage will cause the probe card adapter to fail system tests. See the following figure for the location of high-impedance areas.

Figure 5: 9140A-PCA high-impedance areas

Take these precautions when handling the 9140A-PCA:

- Handle the board only by the edges.
- Use gloves to prevent inadvertent contact with high-impedance areas.
- Avoid bringing the board into contact with sources of contamination.
- Always confirm that fixtures and handling equipment are clean.

General installation considerations

The following topics provide information you should know before installing the 9140A-PCA Probe Card Adapter.

Overview

The mechanical structure of the 9140A-PCA enables installation in a wide variety of probers. It consists of a motherboard suspended from the prober ring (see the figure in Probe card adapter standard components (on page 2-1) for details).

Spacers inserted between the motherboard and prober ring connect the two assemblies. The length of the spacers determines the overall stack height of the probe card assembly. Modification of the motherboard assembly is not required when changing the stack height or when replacing the prober ring. To change the ring insert diameter, replace the prober ring.
Safety

⚠️ WARNING

Failure to make sure that the safety interlock and safety shields and guards are properly installed and arranged as indicated will put personnel in severe danger. Severe personal injury or death due to electric shock or electrocution may result.

For the safety interlock to function properly, the device under test (DUT) interlock sensor must be installed near the DUT connections and the interlock magnet must be installed on the safety shield. It must be set up so that when the magnet is near the switch (interlock closed) the operator cannot touch voltage-carrying conductors. If not properly installed, it will render the interlock inoperative and place personnel at severe risk.

Operator safety from hazardous voltages depends on proper installation. After installation, but before energizing the unit, make sure all prober safety shields are properly in place (refer to the manufacturer of your specific prober for prober safety shield information).

The light shield contains components that allow installation of an interlock switch (such as that provided with a Keithley S540 Parametric Test System), as shown in the following figure.

Figure 6: Probe card adapter light shield

⚠️ WARNING

Do not operate the system until it is properly installed and all prober safety shields are in place. Failure to have the complete system properly installed with all safety shields in place could result in personal injury or death.
Additional probe card adapter safety interlock cable

The Model 174-7047-XX Safety Interlock Cable provides additional protection from electric shock at the Keithley probe card adapter (PCA). The cable attaches to the prober top plate and the PCA so that if you unlatch the top plate of the prober and lift it up to change a probe card or take off the PCA, the interlock is tripped.

Figure 7: Model 174-7047-XX Safety Interlock Cable

![Diagram of Model 174-7047-XX Safety Interlock Cable]

The Model 174-7037-XX cable can be used with customer-supplied PCA solutions.

Figure 8: Model 174-7037-XX interlock cable

![Diagram of Model 174-7037-XX interlock cable]

NOTE

The Model 174-7047-XX cable interfaces with your prober interlock through a relay contact. A shorted prober contact engages the interlock circuit. An open contact interrupts the interlock, turning off hazardous voltage.

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2 Where XX represents the revision; the highest number is the most recent revision.
**9140A-PCA interlock schematic**

The following diagram shows an example interlock configuration.

*Figure 9: 9140A-PCA interlock block diagram*

Stack height

The height from the mounting seat of the prober to the surface of the chuck (stack height) is a basic installation consideration.

*Figure 10: 9140A-PCA stack height*

Stack height must be equal to the stack height of the probe card adapter. The stack height of the Keithley probe card adapter can be 3.378 cm (1.330 in.) or 3.790 cm (1.492 in.) depending on the type of prober and the requirements for cable routing.

Refer to Mechanical specifications (on page 7-1) for detailed mechanical drawings of the 9140A-PCA to determine if your prober is compatible. You may have to install mounting hardware onto the prober to ensure that the prober stack height is the same as the probe card adapter stack height.
Cable routing

Cable routing is an important installation consideration. Device under test (DUT) cables can be routed above or below the top plate of the prober. For cable routing above the top plate, the DUT cables exit vertically from the probe card adapter. For cable routing below the top plate, the DUT cables exit horizontally from the probe card adapter.

The DUT cables are routed under the prober ring of the probe card adapter and may exit from the left, right, or back of the prober. The cable exit you use depends on the type of prober and how the prober is oriented next to the system.

All DUT cables must be the same length. A uniform cable length provides uniform electrical characteristics (capacitance and inductance) of the cables. This is important when performing capacitance measurements or when measuring low-level currents.

See Installation procedure (on page 3-6) for more information about installing DUT cables.

Light shield and microscope clearance

Check the light shield and microscope clearance. Most microscopes are located far enough above the probe card assembly that they do not present clearance problems when the light-shield cover is installed.

Some microscopes may protrude into the probe ring assembly to the area below the shield plate. This presents clearance problems. If the microscope is mounted on a pivoted arm, move the microscope aside and then install the light shield.

Installation procedure

⚠️ WARNING

An installed probe card may contain lethal voltages when a test is in operation. Reset the test equipment to place the probe card adapter (PCA) in a safe state. Failure to reset the test equipment may cause injury or death due to electrical shock.

To install the 9140A-PCA Probe Card Adapter:

- **NOTE**
  - You must supply all connections and hardware associated with vacuum hosing, in addition to the vacuum source.

1. Unpack and inspect 9140A-PCA (see Handling precautions (on page 3-1) for special handling information).
2. Remove all power from the parametric test system.
3. Install the probe card adapter in your prober, following instructions provided with the prober. The hardware supplied with your probe card adapter assembly varies depending on the type of prober you have.

   See Mechanical specifications (on page 7-1) for detailed mechanical drawings of the 9140A-PCA to determine if your prober is compatible. If you need assistance with your specific prober configuration, contact your sales representative.
4. Route 1.9 cm (3/4 in.) outside diameter vacuum hose (provided) to the probe card adapter, away from any moving parts of the prober. Make sure the hose remains clear of any pinch points that could cut off or restrict flow through the vacuum hose.

5. Install the 9140A-PCA to a vacuum control box hose. Route a section of vacuum hose from the PCA through the "TO PCA" grommet on the vacuum control box.

6. Connect the vacuum control box end of the hose to valve PF-1 (see the following figure) and the other end of the hose to the PCA.
Figure 11: Vacuum control box

4x40x5/16 PPH (4 places)

1/4" O.D. tubing (TX-40-1)

Vacuum hose routing

To vacuum source

Vacuum control box

Vent (open)

Cable tie

Vacuum control box

Check valve (PF-5)

Vacuum in grommet (GR-46)

Vacuum control box (9139A-345)

Tie mount (CC-47)

Tie wrap (CC-38-3)

Anti-rotation bracket valve handle (9139A-348)

Washer (WA-102-1)

Vent grommet (GR-46)

Vent

Vacuum supply

To PCA grommet (GR-46)

To PCA (TX-40-1)
7. Install the vacuum supply hose. Route the vacuum supply hose from the vacuum source through the "VACUUM IN" grommet on the vacuum control box.

8. Connect the vacuum control box end of the hose to check valve PF-5 (see the previous figure). Make sure the vacuum supply is at least 50.80 cm (20 in.) Hg.

9. Vent the vacuum control box to atmosphere (no connection required).

10. Connect the PCA safety interlock cable to the prober top plate and the PCA.
11. Connect the device under test (DUT) cables between the probe card assembly and the matrix pin cards of the parametric test system.

**NOTE**

Route the cables to avoid sources of electromagnetic fields, vibration, or any other mechanical disturbance.

12. Confirm that moving parts of the prober do not contact the cables.

Information about the location of connections within your system is in the configuration drawings for your system. The user's manuals for the system contain additional information, if required.

To install the probe card:
1. Turn the vacuum control box valve to the load/operate position.
2. Line up probe card pin 1 with the pin 1 indicator on the retainer cap (see the following figure).

   **Figure 12: Probe card and probe card retainer**

   ![Probe card and probe card retainer diagram]

3. Insert the probe card into probe card retainer cap.

   **NOTE**

   Two alignment pins and holes are provided along the perimeter of the probe card. These holes and pins allow proper orientation of the probe card during installation.

4. Align pin 1 of the probe card with pin 1 of the motherboard. Use the alignment marking on the edge of the probe card retainer cap and match to the same markings of the motherboard support ring.

   Attach the retainer cap to the motherboard ring. Make sure latches secure the probe ring (retainer cap will click into place).

5. Do a probe card continuity test using the system diagnostics tool to check Kelvin connections from the system matrix to the probe card adapter.
Probe card removal procedure

**WARNING**
Removing an installed probe card may expose you to lethal voltages when a test is in operation. Reset the test equipment to place the probe card adapter (PCA) in a safe state. Failure to reset the test equipment may cause injury or death due to electrical shock.

Never attempt to touch or change a probe card when tests are running. You must be absolutely certain that all tests have stopped before making contact with anything in the vicinity of the probe card adapter. Also, never run tests without a probe card installed.

*To remove the probe card:*
1. Turn the vacuum control box valve to the unload position.
2. Release the probe card retainer cap latches.
3. Carefully remove the probe card and retainer cap from probe card adapter.

Performance verification

A matrix test is run as part of system diagnostics and requires a blank (unpopulated) probe card. Run a matrix test after the probe card adapter installation to check for leakage, open connections, or shorted connections. Do not run a matrix test after installing each probe card.

**WARNING**
During leakage tests, high voltages are present on the probe card adapter.

**NOTE**
You must install a blank probe card in the probe card assembly to run diagnostics. A blank probe card is supplied with the probe card adapter. You must keep this blank probe card.

The clean surface of the blank probe card provides a known, low-leakage test environment. The unmodified Kelvin connections assure accurate continuity tests.

Handling and storage of the blank probe card is important (see Handling precautions (on page 3-1)).

For accurate leakage tests, follow these precautions:
- Do not populate the blank probe card; it must remain unpopulated.
- Store the blank probe card in a protective container, in a clean, low-humidity environment.
- When installing the blank probe card, handle it by the edges; do not touch the surface of the probe card.

For more information about running system verification and diagnostics, refer to the Diagnostics and Verification manual for your system.
Performance verification using system diagnostics

Using the blank probe card provided with the 9140A-PCA, run the matrix test from the system diagnostics tool on your Keithley parametric test system to verify probe card adapter performance. The system diagnostics tests must pass using the blank probe card before you can run system verification.

When all diagnostics test have passed using the blank probe card, install the shorted probe card that came with your system. You can now run complete system verification using the system diagnostics and verification tool.

For more information about the system diagnostics and verification tool, refer to the Diagnostics and Verification Manual for your system.
Introduction

This section describes how to do maintenance and preserve the high-performance characteristics of the probe card adapter.

A minimum amount of maintenance is required for the motherboard and the device under test (DUT) cables. However, when maintenance is required, it is important to perform maintenance operations correctly. Maintenance tasks such as replacing cables can have a significant effect on the performance of the probe card adapter.

When doing maintenance, lubricate all O-rings using VAC Goop® (from Swagelok®). Make sure to use adequate VAC Goop for lubrication, but do not over-lubricate O-rings.

For maintenance of the probe pins, refer to documentation provided by the manufacturer of the probe pins.

⚠️ WARNING
The system can source high voltages at current levels that can result in personal injury or death. Turn off power to the system before performing any maintenance procedure.

Mechanical disassembly

Disassembly of the probe card adapter is required when replacing device under test (DUT) cables or when motherboard maintenance is required.

NOTE
When reassembling the probe card adapter, use VAC Goop® (from Swagelok®) to coat all O-rings.
An installed probe card may contain lethal voltages when a test is in operation. Reset the test equipment to place the probe card adapter (PCA) in a safe state. Failure to reset the test equipment may cause injury or death due to electrical shock.

Never attempt to touch or change a probe card when tests are running. You must be absolutely certain that all tests have stopped before making contact with anything in the vicinity of the probe card adapter. Also, never run tests without a probe card installed.

### NOTE

If time and space are available, it is possible to disassemble the probe card adapter without disconnecting the DUT cables.

**To disassemble the probe card adapter:**

1. Place the PCA in a safe state by resetting the test equipment.
2. Turn the vacuum control box valve to the unload position.
3. Disconnect the vacuum hose from the probe card adapter.
4. Disconnect the DUT cables from your system.
5. Disconnect the interlock cable from the probe card adapter.
6. Remove the probe card adapter assembly from your prober.
7. Remove the light shield assembly (see [Probe card adapter standard components](#) on page 2-1)).
8. Remove the Allen-head screws that secure the cable strain relief for the cable being replaced or moved.
9. Remove the probe card from the probe card adapter assembly (see [Probe card removal procedure](#) on page 3-10)).

### Moving DUT cable connections

An installed probe card may contain lethal voltages when a test is in operation. Reset the test equipment to place the probe card adapter (PCA) in a safe state. Failure to reset the test equipment may cause injury or death due to electrical shock.

Typically, prober pin 1 is connected to system pin 1, prober pin 2 is connected to system pin 2, and so on. If an application requires different connections, you can connect the prober pins to other system pins.

If you have an S540 parametric test system, each device under test (DUT) cable is independently connected to the matrix. To move a DUT connection, unplug the DUT cable from the matrix.

### NOTE

System pin is defined as a node or crossbar in the matrix of your parametric test system.
Cleaning

Cleaning is important to ensure accurate measurements. The cleaning process removes contamination that causes shunt resistance (leakage) between measurement paths. Contamination can take many forms. Some sources of contamination are:

- Residue remaining after incomplete cleaning
- Residue after using improper or contaminated cleaning fluids
- Residue from fingerprints (see Handling precautions (on page 3-1) for more information)
- Flux from soldering
- Condensation from room conditions that do not meet Keithley specifications

Observe the following precautions when it is necessary to use solder on a circuit board:

- Use lead-free solder, and take care not to spread the solder to other areas on the circuit board.
- Remove the solder from the work area when the repair has been completed. Use pure water and clean foam-tipped swabs or a clean soft brush to remove the solder.
- Once the solder has been removed, swab only the repaired area with methanol, then blow-dry the board with dry nitrogen gas.
- After cleaning, allow the board to dry in a 50 °C (122 °F) low-humidity environment for several hours.

Replacing pogo pins

**WARNING**

An installed probe card may contain lethal voltages when a test is in operation. Reset the test equipment to place the probe card adapter (PCA) in a safe state. Failure to reset the test equipment may cause injury or death due to electrical shock.

*To replace a pogo pin:*
1. Reset the tester hardware.
2. Remove the probe card from the probe card adapter assembly (see Probe card removal procedure (on page 3-10)).
3. Using a pair of needle-nose pliers, pull the defective pogo pin out of its socket.
The pogo pins are not symmetrical. Damage to the socket may occur if the pogo pins are inserted incorrectly.

4. Locate the rounded end of the replacement pogo pin (see the following figure).

**Figure 13: Orientation of pogo pin and socket**

- Pogo pin (CS-830)
- Socket (CS-831)
- Retainer ring
- Mother board
- Double chisel tip
- Rounded end
- Small end
- Solder pads (on surface of board) this is the probe ring side of the motherboard

5. Insert the rounded end of the pin into the socket. The double-chisel tip, located on the other end of the pogo pin, must protrude out of the socket. This end of pogo pin contacts a pad located on the probe card.

6. Reinstall the probe card.

**Replacing a pogo pin socket**

If a pogo pin breaks off in a socket or if the pin becomes lodged in a socket, the pogo pin socket can be replaced.

**WARNING**

An installed probe card may contain lethal voltages when a test is in operation. Reset the test equipment to place the probe card adapter (PCA) in a safe state. Failure to reset the test equipment may cause injury or death due to electrical shock.

**To replace a socket:**

1. Follow the steps in Mechanical disassembly (on page 4-1) to disassemble the probe card adapter.
2. Locate the defective pogo pin or socket assembly.
3. Locate the pad where the defective socket is soldered to the motherboard. This pad is on the probe-ring side of the motherboard (refer to the figure in Probe card adapter standard components (on page 2-1)).
4. Desolder the socket from the probe-ring side of the motherboard.

**CAUTION**

Do not apply excessive heat when desoldering the socket. Excessive heat can melt the retention ring of the probe card adapter.
5. Push the end of the desoldered socket that protrudes through the motherboard and remove it by pulling on the other side with a pair of needle-nose pliers.
6. Pull the socket out of its hole in the retention ring.
7. Remove residual solder from the hole of the solder pad.
8. Insert the small end of the replacement socket into the hole located in the retention ring (see the figure in Replacing pogo pins (on page 4-3)).
9. Slide the socket into the hole until the bottom of the socket is flush with the surface of the retention ring (pogo pin not installed in the socket).
10. Confirm that the socket is installed properly (see the figure in Replacing pogo pins (on page 4-3)). The small end of the socket protrudes through the hole on the motherboard. The open end of the socket is flush with the surface of the retainer ring.
11. Solder the socket to the pad located on the motherboard.
12. Install a pogo pin in the socket.
13. Clean the flux from the solder connection (see Cleaning (on page 4-3) for more information).
14. Reinstall the probe card.

Replacing the vacuum connection

The vacuum connection of the probe card adapter can be replaced if damaged.

To replace the vacuum connection:
1. Remove the vacuum connection.
2. Make sure all old sealant is removed from threaded holes on probe card adapter.
3. Lightly apply standard pipe sealant to new vacuum connection.
4. Install the new vacuum connection (do not over tighten).
In this section:

Ordering information ................................................................. 5-1
Factory service ........................................................................ 5-1
Parts list .................................................................................. 5-1

Ordering information

To place an order or get information about replacement parts, contact your Keithley representative or see the back cover of this manual for contact information. When ordering parts, be sure to include the following information:

1. Probe card adapter model number: 9140A-PCA
2. Probe card adapter serial number
3. Part description and part number

Factory service

To return the probe card adapter to Keithley Instruments for repair:

1. Obtain a return authorization (RA) number from Keithley.
2. Carefully pack the probe card adapter in the original packing carton or the equivalent.
3. Ship it to the address provided by the customer service representative that provided your RA number.

Parts list

This section contains a list of replaceable parts for the 9140A-PCA.

Blank probe card

For a replacement blank (unpopulated) probe card, order Keithley part number 389-5226-XX3.

3 Where XX represents the revision; the highest number is the most recent revision.
# 9140A-PCA-01 and 9140A-PCA-02 parts list

The following table lists the replaceable parts for the 9140A-PCA-01 and 9140A-PCA-02 probe card adapters.

<table>
<thead>
<tr>
<th>Description</th>
<th>Keithley part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>.025 pin</td>
<td>CS-835</td>
</tr>
<tr>
<td>4-40 × 1/4 Phillips pan-head screw (strap to standoff)</td>
<td>4-40X1/4PPH</td>
</tr>
<tr>
<td>4-40 × 3/8 socket button head (probe ring to spring contact retainer)</td>
<td>4-40X3/8SOBTNH</td>
</tr>
<tr>
<td>4-40 × 3/4 socket, button head (ring segment mounting)</td>
<td>4-40X3/4SOBTNH</td>
</tr>
<tr>
<td>6-32 × 3/4 Phillips pan-head screw (shield plate mounting)</td>
<td>6-32X3/4PPH</td>
</tr>
<tr>
<td>6-32 × 1-1/4 socket, flat head (motherboard retainer mounting)</td>
<td>6-32X1-1/4SOFHS</td>
</tr>
<tr>
<td>10 AWG PVC green/yellow</td>
<td>SC-99-5</td>
</tr>
<tr>
<td>Cable assembly, interlock switch</td>
<td>174-7037-XX*</td>
</tr>
<tr>
<td>Interlock cable</td>
<td>174-7047-XX*</td>
</tr>
<tr>
<td>Cap, probe card retainer</td>
<td>9139A-327</td>
</tr>
<tr>
<td>Cover, interlock light</td>
<td>5500-339</td>
</tr>
<tr>
<td>Cover light probe ring</td>
<td>9139-312</td>
</tr>
<tr>
<td>Ground ring, 48-channel, 3 kV</td>
<td>878-1428-XX*</td>
</tr>
<tr>
<td>Handle, shield</td>
<td>HH-37</td>
</tr>
<tr>
<td>Insulator, black decal</td>
<td>9139-313-01</td>
</tr>
<tr>
<td>Insulator, black decal</td>
<td>9139-313-02</td>
</tr>
<tr>
<td>Lug</td>
<td>LU-99-6</td>
</tr>
<tr>
<td>Lug</td>
<td>LU-113</td>
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<tr>
<td>Magnet</td>
<td>MA-4</td>
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<tr>
<td>O-ring, thermobonded (use Swagelok® VAC Goop®)</td>
<td>GA-32</td>
</tr>
<tr>
<td>O-ring, thermobonded (use Swagelok VAC Goop)</td>
<td>GA-33</td>
</tr>
<tr>
<td>Pin, crimp barrel, .040</td>
<td>CS-836-1</td>
</tr>
<tr>
<td>Pin, crimp barrel, .060</td>
<td>CS-836-2</td>
</tr>
<tr>
<td>Probe card, 48-channel, 3 kV</td>
<td>878-1539-XX*</td>
</tr>
<tr>
<td>Probe, pogo pin</td>
<td>CS-830</td>
</tr>
<tr>
<td>Probe ring, 48-channel, 3 kV</td>
<td>878-1413-XX*</td>
</tr>
<tr>
<td>Probe ring insert</td>
<td>9139A-325A</td>
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<tr>
<td>Receptacle, pogo pin</td>
<td>CS-831</td>
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<tr>
<td>Retainer, spring contact</td>
<td>9139A-331</td>
</tr>
<tr>
<td>Retainer ring</td>
<td>9139A-326</td>
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<tr>
<td>Shield plate, probe ring</td>
<td>9139-310</td>
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<tr>
<td>Socket, .025</td>
<td>SO-146-1</td>
</tr>
<tr>
<td>Socket, .040</td>
<td>SO-146-2</td>
</tr>
<tr>
<td>Socket, .060</td>
<td>SO-146-3</td>
</tr>
<tr>
<td>Spacer (9140A-PCA-01)</td>
<td>9139A-334-2</td>
</tr>
<tr>
<td>Spacer (9140A-PCA-02)</td>
<td>9139A-334-1</td>
</tr>
<tr>
<td>Standoff, mounting block</td>
<td>386-8064-XX*</td>
</tr>
<tr>
<td>Strap, probe ring shield</td>
<td>9139-314A</td>
</tr>
<tr>
<td>Washer (motherboard to spring contact retainer)</td>
<td>WA-102-2</td>
</tr>
<tr>
<td>Wire guide quadrant LO (strain relief for low-voltage cables)</td>
<td>386-8007-XX*</td>
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<tr>
<td>Wire guide quadrant HI (strain relief for high-voltage cables)</td>
<td>386-8008-XX*</td>
</tr>
</tbody>
</table>

* XX represents the revision; the highest number is the most recent revision.
## Probe card retainer and cam assembly parts list

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<th>Description</th>
<th>Keithley part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4-40 × G PFHUC (handle mount)</td>
<td>4-40XGPFHUC</td>
</tr>
<tr>
<td>1</td>
<td>Adapter, right angle</td>
<td>PF-6</td>
</tr>
<tr>
<td>2</td>
<td>Cam, retainer</td>
<td>9139A-328</td>
</tr>
<tr>
<td>1</td>
<td>Cap, probe card retainer</td>
<td>9139A-327</td>
</tr>
<tr>
<td>2</td>
<td>Dowel pin</td>
<td>9139A-335</td>
</tr>
<tr>
<td>2</td>
<td>Dowel pin cam</td>
<td>9139A-336</td>
</tr>
<tr>
<td>1</td>
<td>O-Ring, thermobonded</td>
<td>GA-32</td>
</tr>
<tr>
<td>1</td>
<td>O-Ring, thermobonded</td>
<td>GA-33</td>
</tr>
<tr>
<td>2</td>
<td>Pivot pin cam</td>
<td>9139A-329</td>
</tr>
<tr>
<td>1</td>
<td>Retainer ring</td>
<td>9139A-326</td>
</tr>
<tr>
<td>1</td>
<td>Ring, insulator</td>
<td>9139A-332</td>
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<tr>
<td>2</td>
<td>Torsion spring</td>
<td>9139A-330</td>
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<tr>
<td>2</td>
<td>Truarc ring, #45133-14H</td>
<td>FA-233-2</td>
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## Miscellaneous vacuum control box parts list

<table>
<thead>
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<tbody>
<tr>
<td>4</td>
<td>Nylon tie wrap</td>
<td>CC-38-3</td>
</tr>
<tr>
<td>1</td>
<td>Static shielding bag</td>
<td>PO-13-3</td>
</tr>
<tr>
<td>4</td>
<td>Tie mount</td>
<td>CC-47</td>
</tr>
<tr>
<td>1</td>
<td>Tygon® tubing (order by length)</td>
<td>TX-40-1</td>
</tr>
</tbody>
</table>
In this section:

Glossary................................................................................. 6-1

Glossary

Chuck: The metal platform that holds the wafer during probing.

Ground ring: Printed circuit board that interconnects all pin grounds to triaxial cables.

Head plate (top plate) (ring carrier): The upper surface of the prober that holds the probe card adapter.

Hypertac™ pin: A type of connector pin used where low contact resistance, long life, and low insertion forces are required.

Interconnect pins: Pins located between the probe card end of the device under test (DUT) cable and the motherboard.

Motherboard assembly: The printed circuit board where the DUT cables and pogo pins are soldered.

Motherboard support ring: The metal ring located under the motherboard.

Pogo pins: The spring-loaded contacts that are located between the motherboard and the probe card.

Probe blade: A fine wire or contact assembly that provides the electrical connection between the die on the wafer and the probe card.

Probe card: The printed circuit board where the probe blades are mounted.

Probe card adapter: The complete probe assembly. This includes the motherboard assembly, DUT cables, probe card, and prober-specific hardware. The probe card adapter is mounted to the head plate.

Probe card support ring: The retaining ring for the probe card. This is mounted on the bottom side of the probe card adapter and holds the probe card.

Probe needles: The contacts located between the probe card and the pads on the wafer.

Prober-specific hardware: Any special hardware that is required to install the probe card adapter into a specific prober.

Ring carrier: Supports the motherboard assembly (prober specific). Also see "Head plate."

Stack height (of prober): The distance between the surface the probe ring mounts on and the surface of the chuck.

Stack height (of probe card adapter): The distance between the surface where the probe ring rests against the top plate and the tips of the probe blades.
In this section:

Probe card adapter mechanical drawings .................................. 7-1

Probe card adapter mechanical drawings

You can use the drawings in this section to determine whether your prober is compatible with the 9140A-PCA.

Probe card adapter assembly

Figure 14: Probe card adapter with probe card installed
Probe card adapter width and stack height

Figure 15: Width and height

Stack height

9140A-PCA-01
3.790 cm
(1.492 in.)
or
9140A-PCA-02
3.378 cm
(1.330 in.)

226.06 mm
(8.900 in.)
240.92 mm
(9.485 in.)
247.65 mm
(9.750 in.)
Probe card adapter top view pin arrangement

Figure 16: Pin arrangement

Front of prober
Probe card dimensions

Figure 17: 9140A-PCA 3-KV probe card dimensions

48-channel 3-kV probe card

Outside diameter 152.40 mm (6.00 in.)

Inside diameter 31.75 mm (1.25 in.)

Thickness 2.92 mm (0.115 in.)