

Keysight P940xA/C Solid State PIN Diode Switches

Operating and
Service Manual

Notices

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

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

Environmental Conditions

The table below shows the general environmental requirements for this instrument.

Environmental condition	Requirement
Temperature	Operating condition: – –55 °C to +95 °C Storage condition: – –65 °C to +125 °C Cycling condition: – –65 °C to +150 °C, 10 cycles at 20 °C per minute, 20 minutes dwell time per MIL-STD-883F, Method 1010.8, Condition C (modified)
Humidity	Operating condition: – 50% to 95% RH at 40 °C, one 24 hour cycle, repeat five times Storage condition: – <90% RH at 65 °C, one day
Shock	Half sine, smoothed: – 1000 G at 0.5 ms, 3 shock pulses per orientation, 18 total smoothed per MIL-STD-883F, Method 2002.4, Condition B (modified)
Vibration	Broadband: – 50 to 2000 Hz, 7.0 G rms, 15 minutes, per MIL-STD-883F, Method 2026-1 (modified)
Altitude	Storage condition: – <15300 meters (50000 feet)
ESD immunity	Direct discharge: – 2.5 kV per IEC 61000-4-2 Air discharge: – 3.5 kV per IEC 61000-4-2

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

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

Product category

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

The affixed product label is as shown below.



Do not dispose in domestic household waste.

To return this unwanted instrument, contact your nearest Keysight Service Center, or visit <http://about.keysight.com/en/companyinfo/environment/takeback.shtml> for more information.

Sales and Technical Support

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

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

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1 Introduction

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This chapter provides an overview or general information of Keysight solid state PIN diode switches.

Product Overview

The Keysight P940xA/C consists of 8/18 GHz SP2T/4T solid state switches which are developed based on PIN diode technology. These solid state PIN diode switches offer superior performance in terms of isolation, insertion loss, and return loss throughout broadband frequency range.

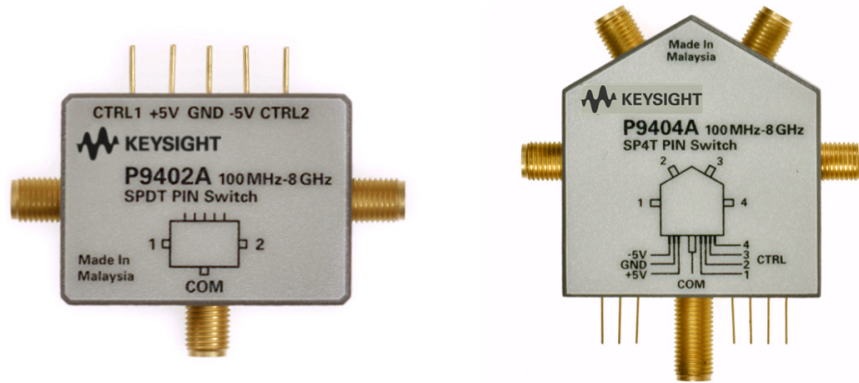


Figure 1-1 Keysight P9402A (left) and P9404A (right) solid state PIN diode switches

Table 1-1 List of solid state PIN diode switches

Keysight model number	Frequency range	Connector type
P9402A	100 MHz to 8 GHz	SMA (f)
P9402C	100 MHz to 18 GHz	SMA (f)
P9404A	100 MHz to 8 GHz	SMA (f)
P9404C	100 MHz to 18 GHz	SMA (f)

Keysight P940xA/C solid state PIN diode switches are particularly designed to match high-speed RF and microwave switching applications in instrumentation, radar, and communication test systems. The P940xA/C switches have a SPDT and SP4T PIN diode individual control switch IC and discrete shunt pin diodes on the RF path which enhances the isolation between ports. Ultra fast switching speed of <450 ns assures fast, reliable, and accurate switching that meets today's high speed switching applications.

Features

- Reduce test system setup costs with the ultra long switching life
- Dramatically increase throughput with ultra fast switching speed of <450 ns
- Minimize cross-talk with exceptionally high port-to-port isolation of >80 dB
- Optimize your system dynamic range with low insertion loss switches of 2.5 dB at 4 GHz, SP4T

Circuit Logic

Keysight P940xA/C switches have the integrated TTL/CMOS driver which is configured in such a way that when CTRL Logic 1 is turn ON by applying logic '0' while the rest of the CTRL Logics are turn OFF by applying logic '1' which will be terminated to 50 Ohm. CTRL Logic 1 will control connection from RFCOM to RF1. This also apply to all the CTRL Logics such as CTRL Logic 2, CTRL Logic 3 and CTRL Logic 4. For application of isolation from all ports, logic '1' is applied to all CTRL Logics. **Figure 1-2** and **Figure 1-3** illustrate the configuration for 2-port and 4-port switches.

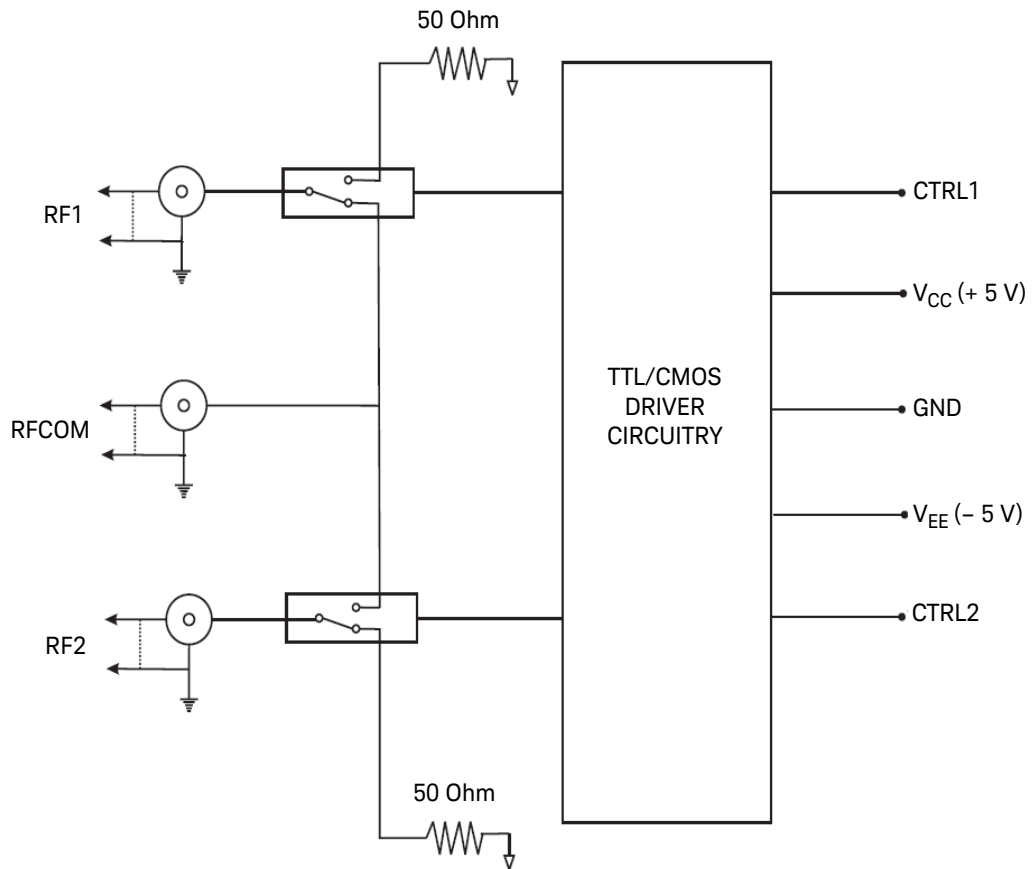


Figure 1-2 Block diagram on the operation of P9402A/C switches

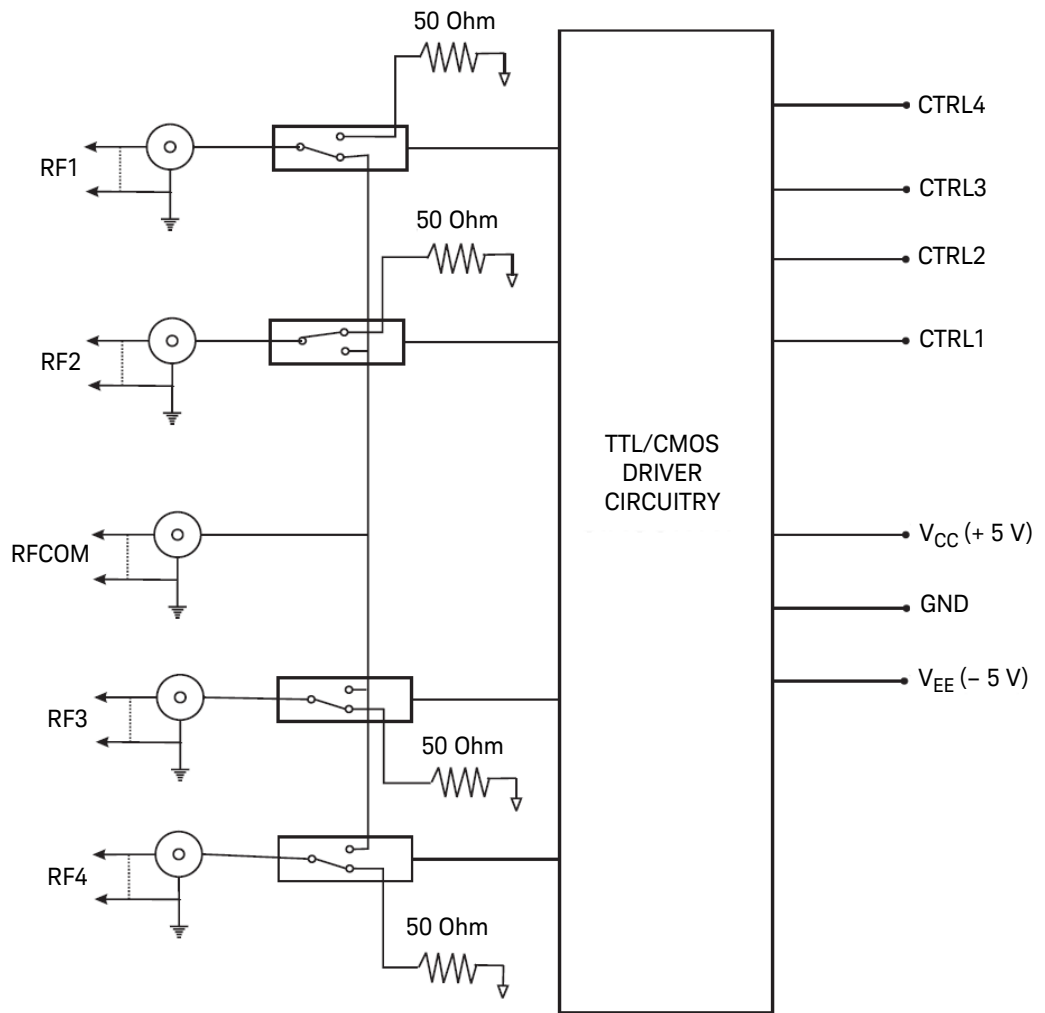


Figure 1-3 Block diagram on the operation of P9404A/C switches

Table 1-2 Switch operation logic

CTRL logic	RFCOM to RF ^[a]
0	Low loss
1	Isolated

[a] RF refers to RF1, RF2, RF3, and RF4.

2 Specifications

Specifications	18
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This chapter provides the specifications of the P940xA/C solid state PIN diode switches.

Specifications

Specifications refer to the performance standards or limits against which the solid state PIN diode switches are tested.

Typical characteristics are included for additional information only and they are not specifications. These are denoted as “typical”, “nominal”, or “approximate” and are printed in italics.

Table 2-1 P9402A/C specifications

Specification	P9402A	P9402C
Frequency range	100 MHz to 8 GHz	100 MHz to 18 GHz
Insertion loss	<2.5 dB (100 MHz to 4 GHz) <3.2 dB (4 GHz to 8 GHz)	<3.5 dB (100 MHz to 8 GHz) <4.0 dB (8 GHz to 18 GHz)
Isolation	80 dB	80 dB
Return loss (ON and common port)	>15 dB	>10 dB
Return loss (OFF port)	>15 dB	>10 dB
<i>Switching speed rise/fall^[a]</i>	<i>380 ns (typical)</i>	<i>380 ns (typical)</i>
Video leakage	N/A	N/A
<i>Characteristic impedance</i>	<i>50 Ω (nominal)</i>	<i>50 Ω (nominal)</i>
Connectors	SMA (f)	SMA (f)

[a] Switching speed is based on 50% TTL to 90% RF

Table 2-2 P9404A/C specifications

Specification	P9404A	P9404C
Frequency range	100 MHz to 8 GHz	100 MHz to 18 GHz
Insertion loss	<2.5 dB (100 MHz to 4 GHz) <3.5 dB (4 GHz to 8 GHz)	<3.5 dB (100 MHz to 8 GHz) <4.5 dB (8 GHz to 18 GHz)
Isolation	80 dB	80 dB
Return loss (ON and common port)	>15 dB	>10 dB
Return loss (OFF port)	>15 dB	>10 dB
Switching speed rise/fall ^[a]	450 ns (typical)	450 ns (typical)
Video leakage	N/A	N/A
Characteristic impedance	50 Ω (nominal)	50 Ω (nominal)
Connectors	SMA (f)	SMA (f)

[a] Switching speed is based on 50% TTL to 90% RF

Table 2-3 Absolute maximum ratings

Parameter	P9402A/C		P9404A/C	
	Min	Max	Min	Max
RF input power (average)		+23 dBm		+27 dBm
V _{CC} DC supply voltage	+4.5 V	+5.5 V	+4.5 V	+5.5 V
V _{EE} DC supply voltage	-5.5 V	-4.5 V	-5.5 V	-4.5 V
CTRL input high voltage	+2.4 V	V _{CC}	+2.4 V	V _{CC}
CTRL input low voltage	-0.8 V	+0.8 V	-0.8 V	+0.8 V

Table 2-4 Nominal current drawn

Nominal current drawn for SPDT ^[a]			Nominal current drawn for SP4T ^[b]			Remarks
Conditions	+5 V pin	-5 V pin	Conditions	+5 V pin	-5 V pin	
Port 1 ON	30 mA	25 mA	Port 1 ON	90 mA	30 mA	Either port ON the current drawn at the pin is the same
Port 2 OFF	30 mA	25 mA	Port 2 OFF	90 mA	30 mA	Either port ON the current drawn at the pin is the same
Port 1 OFF	30 mA	25 mA	Port 3 OFF	90 mA	30 mA	Either port ON the current drawn at the pin is the same
Port 2 ON	30 mA	25 mA	Port 4 OFF	90 mA	30 mA	Either port ON the current drawn at the pin is the same
Port 1 and Port 2 OFF	60 mA	0 mA	All Port OFF	120 mA	0 mA	

[a] Nominal current drawn on respective CTRL pin when V_{cc} is applied: 12 μ A

[b] Nominal current drawn on respective CTRL pin when V_{cc} is applied: 8 μ A

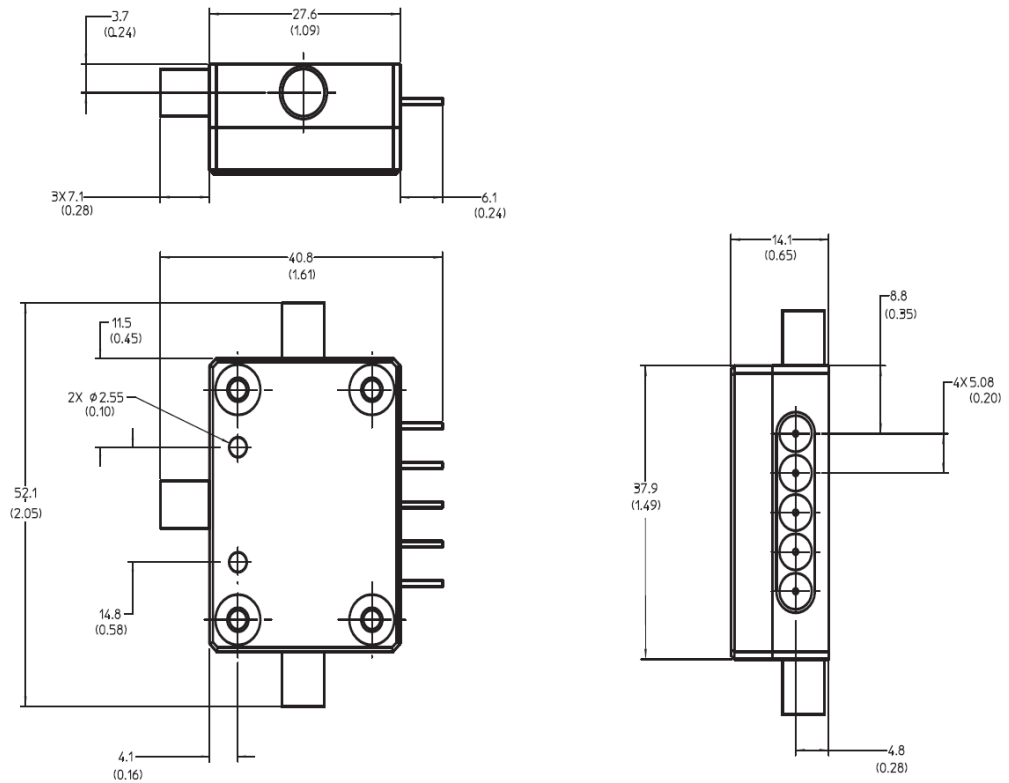
Physical Dimensions

Table 2-5 and Table 2-6 illustrate the physical dimensions of P9402A/C and P9404A/C solid state PIN diode switches.

P9402A/C dimensions

Table 2-5 P9402A/C physical dimensions

Dimensions	Per Figure 2-1
Net weight, kg (lb)	0.05 (0.11)



Dimensions are in millimeters (inches).

Figure 2-1 Dimensions of P9402A/C solid state PIN diode switches

3 Operating Guide

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This chapter describes the installation of the P940xA/C. The operating instruction quick-check procedure is included for verification test prior to usage. Service instructions on the repair and maintenance of the P940xA/C are also included in this chapter.

Installation

Initial inspection

- 1** Inspect the shipping container for damage. If the shipping container or cushioning material is damaged, it should be kept until the contents of the shipment have been checked for completeness and the instrument has been checked both mechanically and electrically.
 - Check for mechanical damage such as scratches or dents.
 - Procedures for checking electrical performance are given under “**Operator’s check**” on page 25 or “**Performance tests**” on page 27.
- 2** If the contents are incomplete, if there is mechanical damage or defect, or if the instrument does not pass the electrical performance test, contact the nearest Keysight Technologies Sales and Service office. Refer to “**Sales and Technical Support**” on page 4 of this manual. Keysight Technologies will arrange for repair or replacement of the damaged or defective equipment. Keep the shipping materials for the carrier’s inspection.
- 3** If you are returning the instrument under warranty or for service, repackaging the instrument requires original shipping containers and materials or their equivalents. Keysight Technologies can provide packaging materials identical to the original materials. Refer to “**Sales and Technical Support**” on page 4 of this manual for the Keysight Technologies nearest to you. Attach a tag indicating the type of service required, return address, model number, and serial number. Mark the container **FRAGILE** to insure careful handling. In any correspondence, refer to the instrument by model number and serial number.

Operating Instructions

Operator's check

The operator's check allows the operator to make a quick check of the switches prior to use or if a failure is suspected.

CAUTION

ESD exceeding the level specified in **“Environmental Conditions”** on page 3 or RF power applied is greater than the maximum specified in **Table 2-3** may cause permanent damage to the device.

Description

The solid state PIN diode switch is connected to a network analyzer configured for the S-parameter measurement. The network analyzer may be set to sweep over the whole or selected frequency range of the solid state PIN diode switch to be verified. The S21 (insertion loss) measurement is the best way to determine if the switch is working properly by applying the appropriate logic to the CTRL pin.

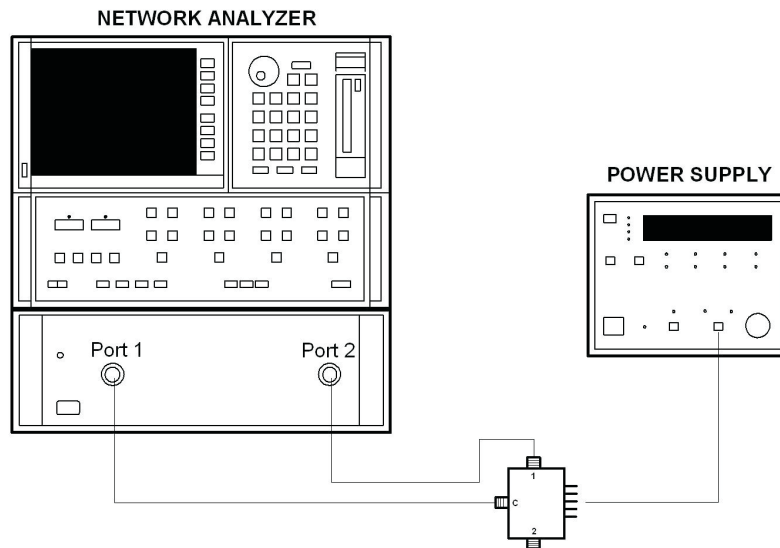


Figure 3-1 Quick-check configuration for P9402A/C

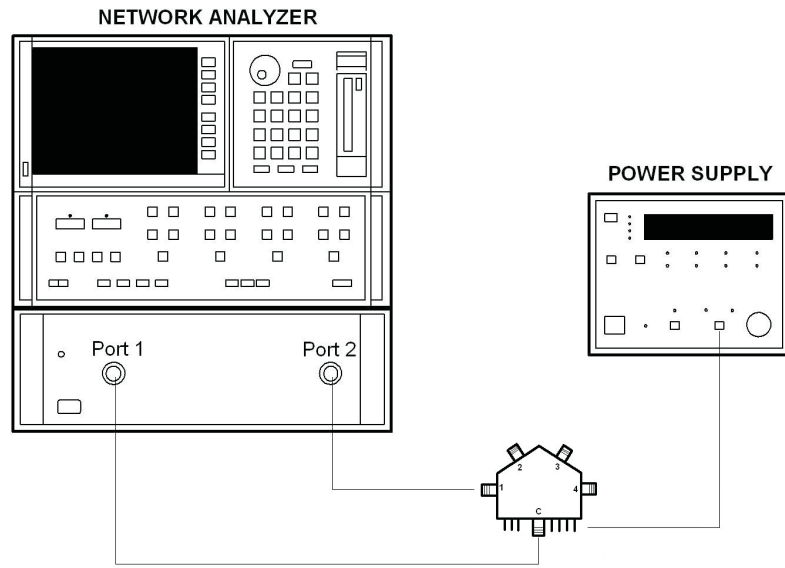


Figure 3-2 Quick-check configuration for P9404A/C

Quick-check procedure

- 1 Calibrate the network analyzer with full 2-port cal using the appropriate electronic/mechanical calibration kit.
- 2 To measure Port 1 of the switch, connect network analyzer's Port 1 to the common port of the switch and network analyzer's Port 2 to Port 1 of the switch respectively.
- 3 Turn ON Port 1 of the switch by applying logic '0' (0 V) to biasing pin CTRL 1 and turn OFF the rest of the ports by applying logic '1' (+5 V) to the respective biasing pin. Measure S11, S21 and S22(ON) and verify against [Table 2-1 on page 18](#) or [Table 2-2 on page 19](#).
- 4 Turn OFF Port 1 of the switch by applying logic '1' (+5 V) to biasing pin CTRL 1. Measure S22(OFF) and verify against [Table 2-1 on page 18](#) or [Table 2-2 on page 19](#).
- 5 Repeat steps 2 to 4 for each respective ports and verify against [Table 2-1 on page 18](#) or [Table 2-2 on page 19](#).

Performance tests

The solid state PIN diode switches can be tested to the accuracy of the specifications with a network analyzer or equivalent equipment of suitable accuracy. If a network analyzer is available, test instrument using the procedure in the analyzer's operating manual.

Service instructions

Adjustment

The P940xA/C solid state PIN diode switches do not have internal adjustments and should not be opened.

Repair

The P940xA/C solid state PIN diode switches are not recommended for repair as most components are not easily removed.

Maintenance

The connectors, particularly the connector faces, must be kept clean. For instruction on connecting and care of your connectors, refer to the *Microwave Connector Care Quick Reference Card (08510-90360)*.

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