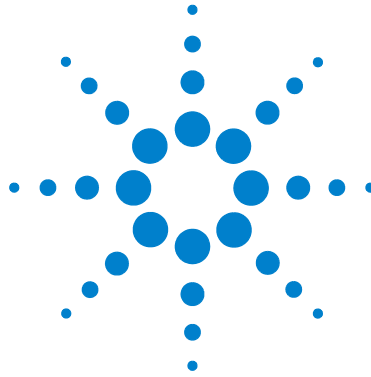




# **Agilent P940xA/C Solid State PIN Diode Switches**

## **Operating and Service Manual**



**Agilent Technologies**

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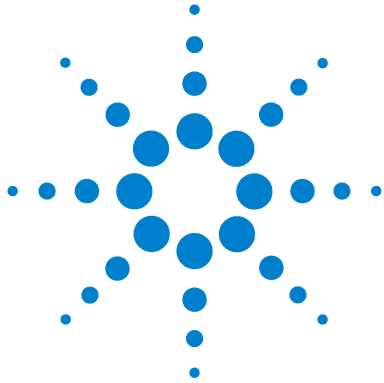
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| France                    | 0825 010 700                                                                       |
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# Contents

|          |                                                               |           |
|----------|---------------------------------------------------------------|-----------|
| <b>1</b> | <b>Introduction</b>                                           | <b>7</b>  |
|          | Product Overview                                              | 8         |
|          | Features                                                      | 9         |
|          | Circuit Logic                                                 | 10        |
|          | Specifications                                                | 12        |
| <b>2</b> | <b>Environmental Specifications &amp; Physical Dimensions</b> | <b>15</b> |
|          | Environmental Specifications                                  | 16        |
|          | Physical Dimensions                                           | 17        |
|          | P9402A/C Dimensions                                           | 17        |
|          | P9404A/C Dimensions                                           | 18        |
| <b>3</b> | <b>Operating Guides</b>                                       | <b>19</b> |
|          | Installation                                                  | 20        |
|          | Initial Inspection                                            | 20        |
|          | Operating Instruction                                         | 21        |
|          | Operator's Check                                              | 21        |
|          | Performance Tests                                             | 23        |
|          | Service Instructions                                          | 23        |





# 1

## Introduction

Product Overview 8

“Features”

Circuit Logic 10

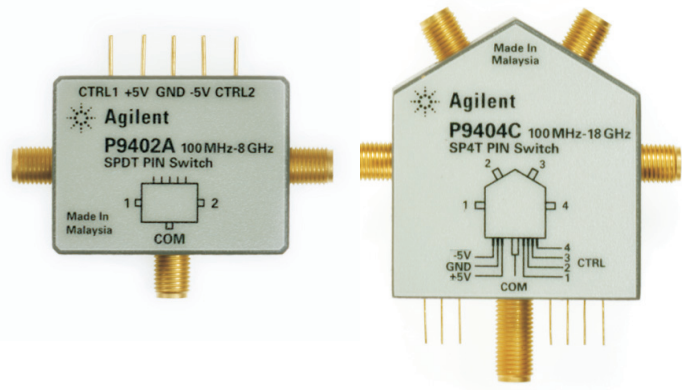
Specifications 12

This chapter provides an overview or general information of Agilent solid state PIN diode switches and specifications for four models of switches available.



# Product Overview

Agilent P940xA/C consist 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** Agilent P9402A (left) and P9404C (right) Solid State PIN Diode Switches

**Table 1** List of Solid State PIN Diode Switches

| Agilent 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)        |

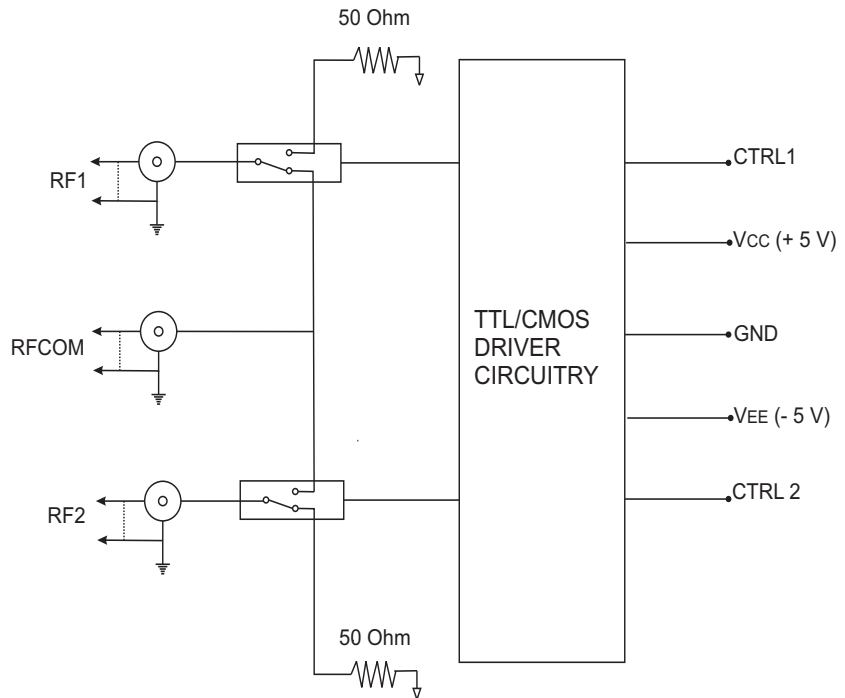
Agilent P940xA/C solid state PIN diode switches are particularly designed to match high- speed RF and microwave switching applications in instrumentation, radar, communication test systems. The P940xA/C switches have a SPDT and SP4T PIN diode individual control switch IC and discrete shunt pin diodes 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

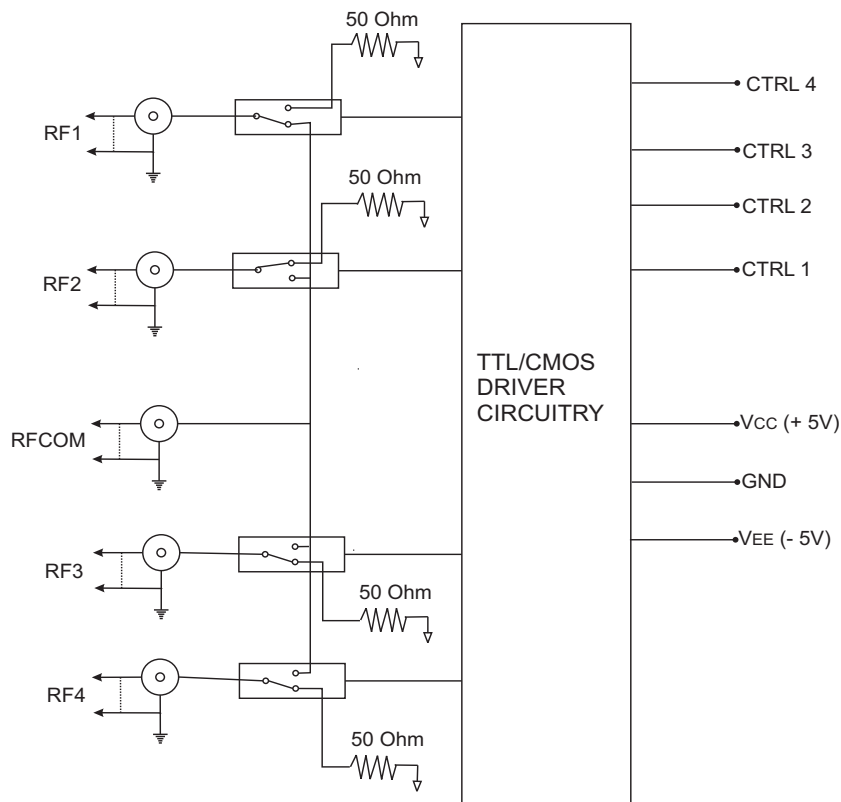
- Reduce test system set up costs with the ultra long switching life
- Dramatically increase throughput with ultra fast switching speed of < 450 ns
- Minimize cross- talk with exceptionally high port- to- port isolation of > 80 dB
- Optimize your system dynamic range with low insertion loss switches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

## Circuit Logic

Agilent 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 2 and Figure 3 are the illustration of configuration for 2- port and 4- port switches.



**Figure 2** Block Diagram on the Operation of P9402A/C Switches



**Figure 3** Block diagram on the Operation of P9404A/C Switches

**Table 2** Switch Operation Logic

| CTRL Logic | RFCOM to RF |
|------------|-------------|
| 0          | Low Loss    |
| 1          | Isolated    |

\* RF refers to RF1, RF2, RF3, and RF4.

# 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 3** P9402A/C Solid State PIN Diode Switches

| Agilent Model Number           | P9402A                                                   | P9402C                                                    |
|--------------------------------|----------------------------------------------------------|-----------------------------------------------------------|
| Frequency Range                | 100 MHz to 8 GHz                                         | 100 MHz to 18 GHz                                         |
| Insertion Loss                 | < 2.5 dB (100 MHz to 4 GHz)<br>< 3.2 dB (4 GHz to 8 GHz) | < 3.5 dB (100 MHz to 8 GHz)<br>< 4.0 dB (8 GHz to 18 GHz) |
| Isolation                      | 80 dB                                                    | 80 dB                                                     |
| Return Loss (ON & Common Port) | > 15 dB                                                  | > 10 dB                                                   |
| Return Loss (OFF Port)         | > 15 dB                                                  | > 10 dB                                                   |
| Switching speed rise/fall*     | 380 ns (typical)                                         | 380 ns (typical)                                          |
| Video Leakage                  | N/A                                                      | N/A                                                       |
| Characteristic Impedance       | 50 $\Omega$ (nominal)                                    | 50 $\Omega$ (nominal)                                     |
| Connectors                     | SMA (f)                                                  | SMA (f)                                                   |

\* Switching speed is based on 50% TTL to 90% RF

**Table 4** P9404A/C Solid State PIN Diode Switches

| Agilent Model Number           | P9404A                                                   | P9404C                                                    |
|--------------------------------|----------------------------------------------------------|-----------------------------------------------------------|
| Frequency Range                | 100 MHz to 8 GHz                                         | 100 MHz to 18 GHz                                         |
| Insertion Loss                 | < 2.5 dB (100 MHz to 4 GHz)<br>< 3.5 dB (4 GHz to 8 GHz) | < 3.5 dB (100 MHz to 8 GHz)<br>< 4.5 dB (8 GHz to 18 GHz) |
| Isolation                      | 80 dB                                                    | 80 dB                                                     |
| Return Loss (ON & Common Port) | > 15 dB                                                  | > 10 dB                                                   |
| Return Loss (OFF Port)         | > 15 dB                                                  | > 10 dB                                                   |
| Switching speed rise/fall*     | 450 ns (typical)                                         | 450 ns (typical)                                          |
| Video Leakage                  | N/A                                                      | N/A                                                       |
| Characteristic Impedance       | 50 $\Omega$ (nominal)                                    | 50 $\Omega$ (nominal)                                     |
| Connectors                     | SMA (f)                                                  | SMA (f)                                                   |

\* Switching speed is based on 50% TTL to 90% RF

**Table 5** Absolute Maximum Ratings

| Parameters                        | P9402A/C |                 | P9404A/C |                 |
|-----------------------------------|----------|-----------------|----------|-----------------|
|                                   | Min      | Max             | Min      | Max             |
| RF input power (average)          |          | + 23 dBm        |          | + 27 dBm        |
| V <sub>CC</sub> DC Supply Voltage | + 4.5 V  | + 5.5 V         | + 4.5 V  | + 5.5 V         |
| V <sub>EE</sub> DC Supply Voltage | – 5.5 V  | – 4.5 V         | – 5.5 V  | – 4.5 V         |
| CTRL input high voltage           | + 2.4 V  | V <sub>CC</sub> | + 2.4 V  | V <sub>CC</sub> |
| CTRL input low voltage            | – 0.8 V  | + 0.8 V         | – 0.8 V  | + 0.8 V         |





## 2 Environmental Specifications & Physical Dimensions

Environmental Specifications 16

Physical Dimensions 17

“P9402A/C Dimensions”

“P9404A/C Dimensions”

This chapter contains the environmental tests on the P940xA/C that fully comply with Agilent Technologies’ product operating environmental specifications. The physical dimensions are illustrated in the later section.



# Environmental Specifications

Agilent P940xA/C solid state PIN diode switches are designed to fully comply with Agilent Technologies' product operating environmental specifications as shown in [Table 6](#).

**Table 6** P9402A/C & P9404A/C Solid State PIN Diode Switches Environmental Specifications

|                       |                                                                                                                                |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Temperature:          |                                                                                                                                |
| • Operating           | -55° C to +95° C                                                                                                               |
| • Storage             | -65° C to +125° C                                                                                                              |
| • Cycling             | -65° C to +150° C, 10 cycles @ 20° C per minute, 20 minutes dwell time per MIL-STD-883F, Method 1010.8, Condition C (modified) |
| Humidity:             |                                                                                                                                |
| • Operating           | 50% to 95% RH @ 40° C, one 24 hour cycle, repeat 5 times                                                                       |
| • Storage             | <90% RH at 65° C, 1 day                                                                                                        |
| Shock:                |                                                                                                                                |
| • Half sine, smoothed | 1000 G @ 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             | < 15, 300 meters (50,000 feet)                                                                                                 |
| ESD immunity:         |                                                                                                                                |
| • Direct discharge    | 2.5 kV per IEC 61000-4-2                                                                                                       |
| • Air discharge       | 3.5 kV per IEC 61000-4-2                                                                                                       |

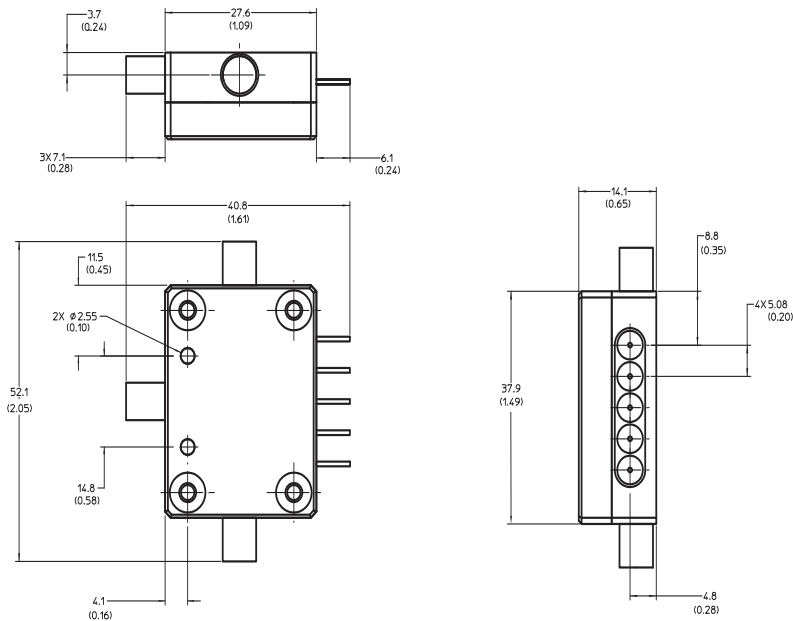
Physical Dimensions

Table 7 and Table 8 illustrate the physical dimensions of P9402A/C and P9404A/C solid state PIN diode switches.

P9402A/C Dimensions

Table 7 P9402A/C Solid State PIN Diode Switches Physical Dimensions

| Dimensions          | Per Figure 4 |
|---------------------|--------------|
| Net weight, kg (lb) | 0.05 (0.11)  |



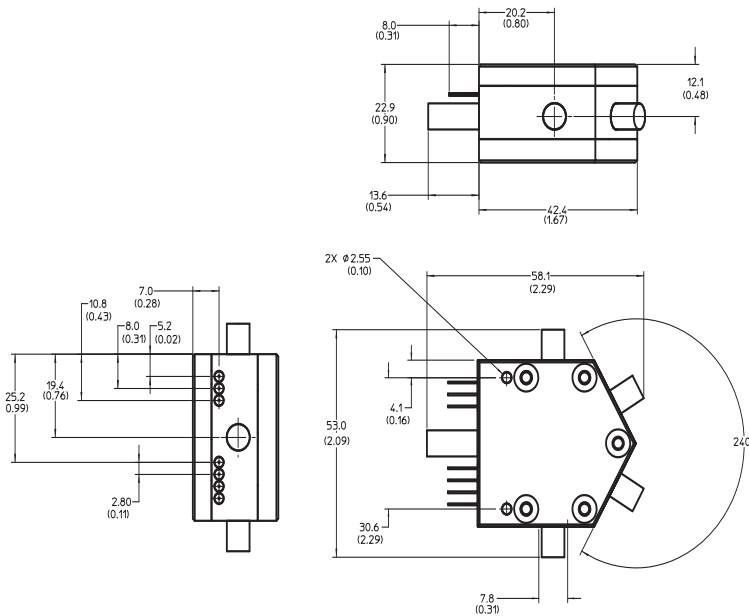
Dimensions are in millimeters (inches).

Figure 4 Dimensions of P9402A/C Solid State PIN Diode Switches

P9404A/C Dimensions

Table 8 P9404A/C Solid State PIN Diode Switches Physical Dimensions

| Dimensions          | Per Figure 5 |
|---------------------|--------------|
| Net weight, kg (lb) | 0.15 (0.33)  |



Dimensions in millimeters (inches).

Figure 5 Dimensions of P9404A/C Solid State PIN Diode Switches



### 3 Operating Guides

|                       |    |
|-----------------------|----|
| Installation          | 20 |
| “Initial Inspection”  |    |
| Operating Instruction | 21 |
| “Operator’s Check”    |    |
| Performance Tests     | 23 |

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” or “Performance Tests”.
- 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 Agilent Technologies Sales and Service office. Refer to the Service and Support information in the front matter of this manual. Agilent 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. Agilent Technologies can provide packaging materials identical to the original materials. Refer to Service and Support information in the front matter of this manual for the Agilent 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 Instruction

## Operator's Check

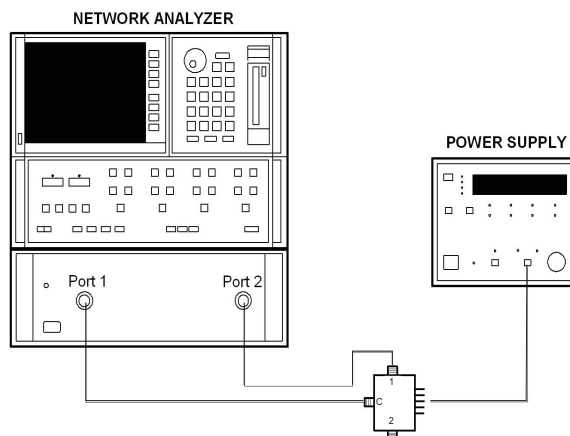
The operator's check is supplied to allow the operator to make quick-check of the switches prior to use or if a failure is suspected.

### CAUTION

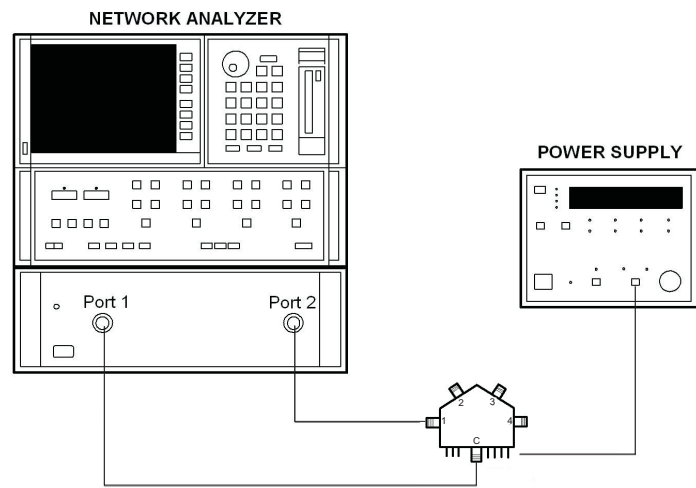
ESD exceeding the level specified in [Table 6](#) or RF power applied is greater than the maximum specified as in [Table 5](#) may cause permanent damage to the device.

### 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 6** Quick-check Configuration for P9402A/C



**Figure 7** 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 3](#) or [Table 4](#).
- 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 3](#) or [Table 4](#).
- 5 Repeat steps 2 to 4 for each respective ports and verify against [Table 3](#) or [Table 4](#).

## 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 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 Microwave Connector Care Quick Reference Card (08510- 90360).