3065 RF Combiner PXI Module

Operating Manual

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About this manual

This manual applies to instruments with software issues of 2.0 and higher.

This manual explains how to set up and configure an Aeroflex 3065 RF combiner PXI module. Where necessary, it refers you to the appropriate installation documents that are supplied with the module.

This manual provides information about how to configure the module as a stand-alone device. However, one of the advantages of Aeroflex 3000 Series PXI modules is their ability to form versatile test instruments, when used with other such modules and running 3000 Series application software.

Intended audience

Users who need to provide a single combined output from any combination of three input ports, or direct RF switched connection between ports.

This manual is intended for first-time users, to provide familiarity with basic operation. Programming is not covered in this document but is documented fully in the help files that accompany the drivers and associated software on the CD-ROM.

Driver version

This PXI RF module is designed to be used with the latest software driver version supplied on the Aeroflex 3000 Series PXI Modules CD-ROM part no. 46886/028. Operation with earlier versions of driver software may not be supported.

Structure

Chapter 1 General information

Chapter 2 Installation

Chapter 3 Operation

Chapter 4 Brief technical description

Chapter 5 Acceptance testing

Associated documentation

The following documentation covers specific aspects of this equipment:

PXI Modules CD-ROM	Part no. 46886/028	Compilation containing soft front panels, drivers, application software, data sheets, getting started and operating manuals for this and other modules in the 3000 Series.
3000 Series PXI Modules Common Installation Guide	Part no. 46882/663	Detailed information on installing modules into a chassis, external connections, powering up and installing drivers. Multilingual safety precautions.
3000 Series PXI Modules Installation Guide for Chassis	Part no. 46882/667	Explains how to set up a populated chassis ready for use.
PXI Studio User Guide	Part no: 46892/809	Setting up and using the universal PXI application for system configuration and operation.

Preface

The PXI concept

VXI and GPIB systems meet the specific needs of instrumentation users but are often too large and expensive for mainstream applications. PC-based instrumentation may cost less but cannot meet the environmental and operational requirements of many systems.

PXI (PCI Extensions for Instrumentation) is based on CompactPCI, itself based on the PCI standard. PCI was designed for desktop machines but CompactPCI was designed for industrial applications, and features a rugged Eurocard format with easy insertion and removal. PXI adds to the CompactPCI specification by defining system-level specifications for timing, synchronization, cooling, environmental testing, and software. While PXI extends CompactPCI, it also maintains complete interoperability so that you can use any CompactPCI-compliant product in a PXI system and vice versa. PXI also makes use of Windows software, VXI timing and triggering, and VXIplug&play instrument drivers to provide powerful and affordable systems.

Abbreviations/acronyms

dB	Decibels
dBc	Decibels relative to the carrier level
dBm	Decibels relative to 1 mW
GND	Ground
MSA	Microwave Scalar Analzer
PCI	Peripheral Component Interconnect
Pk-Pk	Peak-to-Peak
PXI	PCI eXtensions for Instrumentation
RF	Radio Frequency
RMS	Root Mean Square
SFP	Soft Front Panel
SMA	SubMiniature version A (connector)
UUT	Unit Under Test
VSWR	Voltage Standing-Wave Ratio
VXI	VMEbus Extension for Instrumentation

Chapter 1 GENERAL INFORMATION

Introduction

Welcome to the operating manual for the 3065 RF combiner PXI module. This high-performance RF conditioning module features integrated high speed RF switching and a high isolation RF power combiner/splitter and covers the frequency range 250 MHz to 6.0 GHz (usable down to 70 MHz) in a 3U high single-slot PXI module.

This module is intended for use in RF test systems with the 3020 Series digital RF signal generator and 3030 Series RF digitizer. Together, these modules enable compact, high performance modular RF test systems to be developed.

- The combiner provides a single output from any combination of three input ports A, B and C. Each port is bi-directional, allowing many system configurations. Port D allows for a second output or input channel, or for testing of multifunction mobile telephones that support non-cellular functions.
- It also provides direct RF switched connection between ports A and B, and B and C, to enable automated test system calibration.
- Possible combinations are:

Combined output

A,B,C to SUM

Switched Connection

A to B and C to D

A to D and C to B

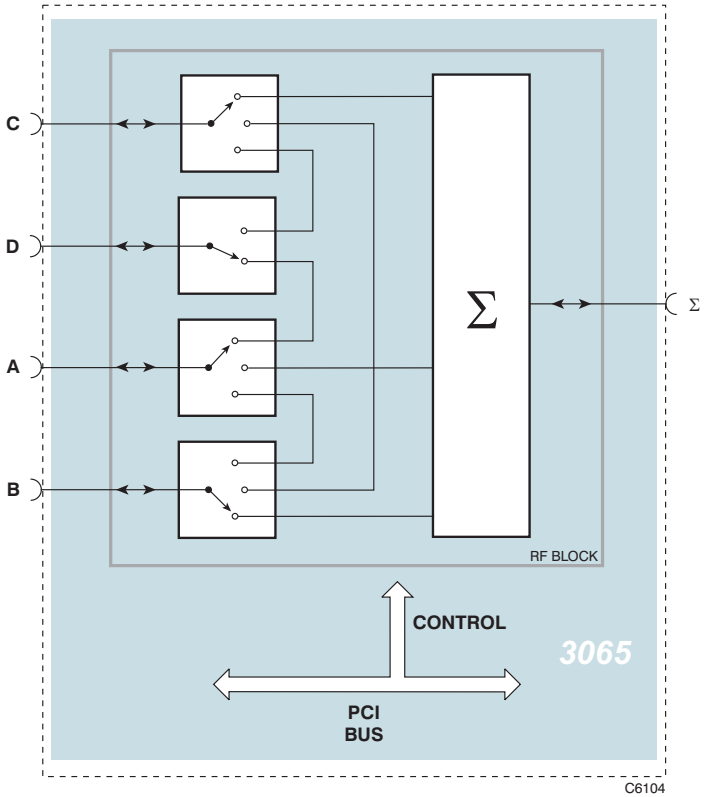
Switched and combined

A to B and C to SUM

C to B and A to SUM

C to D and A,B to SUM

A to D and C,B to SUM



The 3065 stores its own path loss calibration data, which can be accessed via software calls to the driver.

Applications

The 3065 can be used in radio test applications such as transceiver testing, where the combined port Σ acts as a single port duplex connection, one or two RF sources provide TX stimulus inputs, and an RF signal analysis instrument connected to the third port measures the DUT's TX parameters. For testing cellular phones with additional functions such as FM radio or DVB, port D allows a second RF source to be routed to the unit under test.

Software

The 3065 is supplied with a VXI PNP driver and soft front panel, and a COM object and a C interface DLL that provide similar functionality to the driver.

PXI Studio, also supplied with the module, configures your PXI modules as logical instruments using an intuitive and powerful graphical interface. Currently, PXI Studio provides comprehensive signal generator, digitizer and spectrum analyzer applications and further development will provide analysis plugins to suit any modulation scheme.

RF Investigator, also supplied with the module, is an application that provides combined operation of all Aeroflex 3000 Series modules from a single user interface, especially useful for acceptance testing.

Deliverable items

- 3065 RF Combiner PXI module
- PXI Modules CD-ROM part no. 46886/028, containing soft front panels, drivers, application software, data sheets, getting started and operating manuals for this and other modules in the 3000 Series
- *3000 Series PXI Modules Common Installation Guide*, part no. 46882/663
- *3000 Series PXI Modules Installation Guide for Chassis*, part no. 46882/667
- SMA connector cable, part no. 43139/590, 3 off
- 50 ohm termination SMA, part no. 82532, 2 off

Cleaning

Before commencing any cleaning, switch off the chassis and disconnect it from the supply. You can wipe the front panel of the module using a soft cloth moistened in water, taking care not to wet the connectors. Do not use aerosol or liquid solvent cleaners.

Putting into storage

If you put the module into storage, ensure that the following conditions are not exceeded:

Temperature range:	–20 to +70°C (–4 to +158°F)
Humidity:	5 to 93%, non-condensing

Chapter 2 INSTALLATION

WARNING

Initial visual inspection

Refer to the 3000 Series Common Installation Guide 46882/663.

CAUTION

Handling precautions

Refer to the 3000 Series Common Installation Guide 46882/663.

Hardware installation

Installing the module into the PXI chassis

Refer to the 3000 Series Common Installation Guide 46882/663 and Installation Guide for Chassis 46882/667.

Connector care and maintenance

How to connect and torque an SMA connector

1 First, ensure that the mating halves of the connector are correctly aligned.

2 Next, engage the threads of the nut and tighten it by hand, ensuring that the mating halves do not move relative to each other.

3 Then use a torque spanner to tighten the connector, in order to ensure consistent matching and to avoid mechanical stress.

Torque settings for connectors are:

0.56 Nm test torque (development use, semi-permanent installations)

1 Nm final torque (permanent installations)

Never use pliers to tighten connectors.

Maintenance

SMA

Clean connectors regularly, using a cotton bud dipped in isopropyl alcohol. Wipe within the connector cavity, then use a dry cotton bud to finish off. Check for any deposits.

Do not use other cleaners, as they can cause damage to the plastic insulators within the connectors.

Cap unused connectors.

PCI

Protect PCI connector pins by keeping modules in their original packing when not fitted in the rack.

Chapter 3 OPERATION

Front-panel connectors

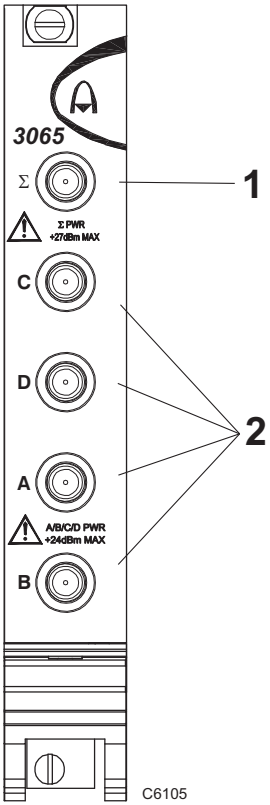


Fig. 3-1 3065 front panel

1	Σ	Combined output. SMA socket, 50 Ω.
2	A, B, C, D	Individual inputs/outputs. SMA socket, 50 Ω.

CAUTION

Maximum safe powers

Σ port: **+27 dBm**, 3 V dc

A, B, C, D ports: **+24 dBm**

Soft front panel (af3060_sfp)

The soft front panel provides a graphical interface for operating the module. It is intended for testing and diagnosing, for demonstration and training, and for basic operation of the module. It represents most of the functions available in the instrument driver. It is not however a comprehensive application suitable for measurements: for this, use the appropriate driver, COM object or C interface DLL, supplied with the modules that form the test system.

Installation

The soft front panel is installed during the driver installation process (refer to the *3000 Series PXI Modules Common Installation Guide*, part no. 46882/663).

Open the *AF3060_sfp.exe* file; this is in the *C:\VXIPNP|WinNT\af3060* directory on a Windows NT machine, for example. It is also accessible from the Windows Start menu under *Programs\Aeroflex\PXI Module Front Panels\AF3060 Front Panel*. The soft front panel, similar to that in Fig. 3-2, is displayed.

Detailed help information

Soft front panel controls are all available as driver export functions unless noted otherwise, and are documented in the help files (page 3-10). This operating manual provides an overview of the facilities that the module provides and summarizes its operation; however, refer to the help files for detailed descriptions of functions, together with their parameter lists and return values.

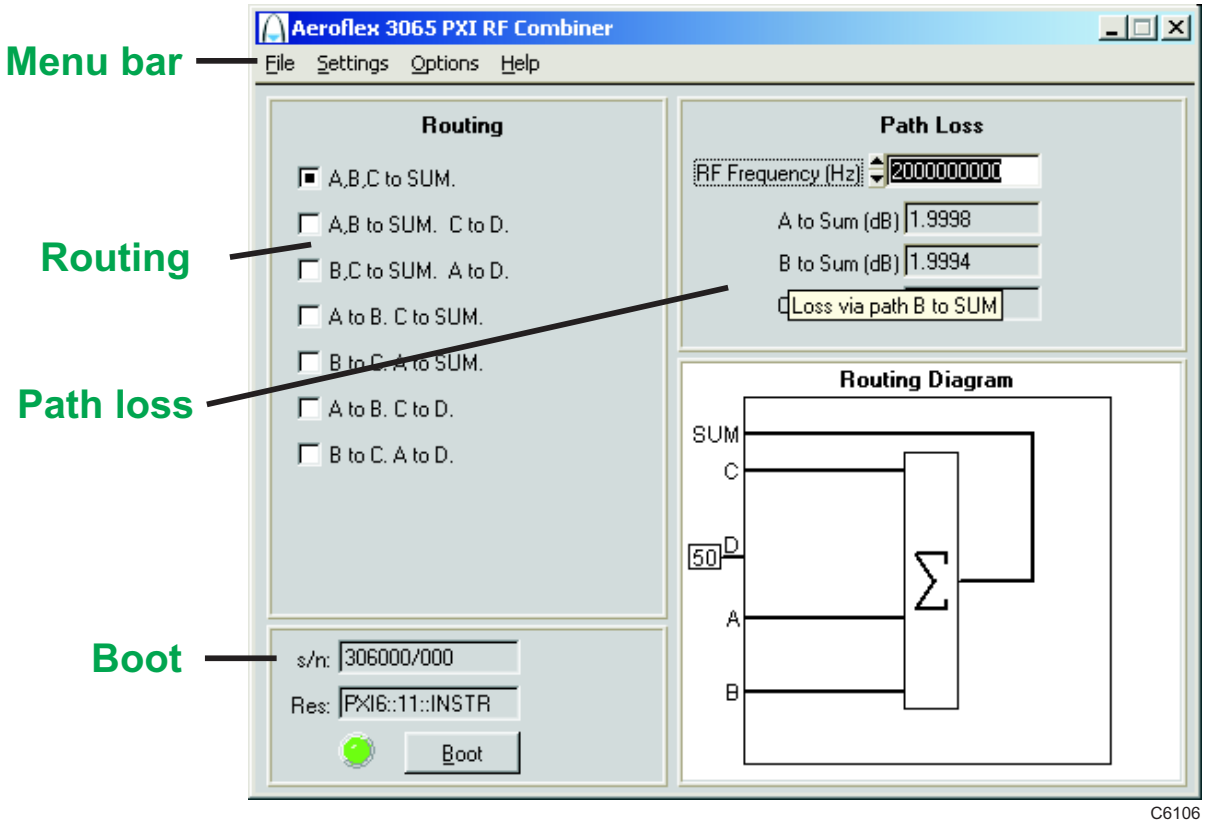


Fig. 3-2 Combiner soft front panel

Soft front panel controls

Menu bar

File

Click **Exit** to close the application.

Settings

Load and **Save** allow you to load and save soft front panel configurations from and to your preferred locations. If you did not change the default location when installing the software, it is *C:\VXIPNP\WinNT\af3060\settings*, and settings are saved as *.ini* files.

> You can edit settings files as required. Edit the saved *.ini* file using a text editor (for example, Notepad) to remove unwanted parameters. Ensure only that you do not delete the General (VendorID, DeviceID) and Version (Major/Minor) parameters. Save the changed file. When the settings file is next loaded, the configuration of the soft front panel changes to match the parameters remaining in the settings file.

Directories lets you choose the locations for your front-panel configuration settings.

Options

There are currently no options available on the 3065.

Help

Instrument Information provides the module's PXI resource code and serial number, revision numbers for driver and PCI, its last calibration date, and associated file information and module build information.

About provides the version and date of the soft front panel.

Boot

Click **Boot** to initialize the module and view the Boot Resource window. Resources available for initializing are shown in blue.

Select the 3065. Click **OK**. While you select the boot resource, the indicator is amber. Once the module has initialized, the indicator changes to green in a few seconds.

If no calibration data is available, the driver returns a caution. If this happens, return the module for calibration.

s/n:

After the module initializes, this field displays its serial number.

Res:

After the module initializes, this field displays its VISA resource string.

Routing

Check the appropriate 'to SUM' box to provide a single combined output at Σ from some or all of the inputs A, B and C. Remaining ports are routed as shown. All ports are bi-directional.

Check one of the last two boxes to provide direct RF connections between input ports whilst isolating the combined output.

The routing diagram changes to show the interconnections of the selected switching scheme.

Path Loss

Displays the losses, in dB, of various combiner paths at the frequency entered in the RF Frequency (Hz) field. For example, A to Sum (dB) displays the dB loss between the A and Σ ports at the specified frequency.

Loss values are temperature-compensated to maintain the accuracy of the factory calibrations.

Switching schemes

Here are some examples of how you can use the 3065 and other PXI components to provide efficient and economical test setups.

Basic configuration

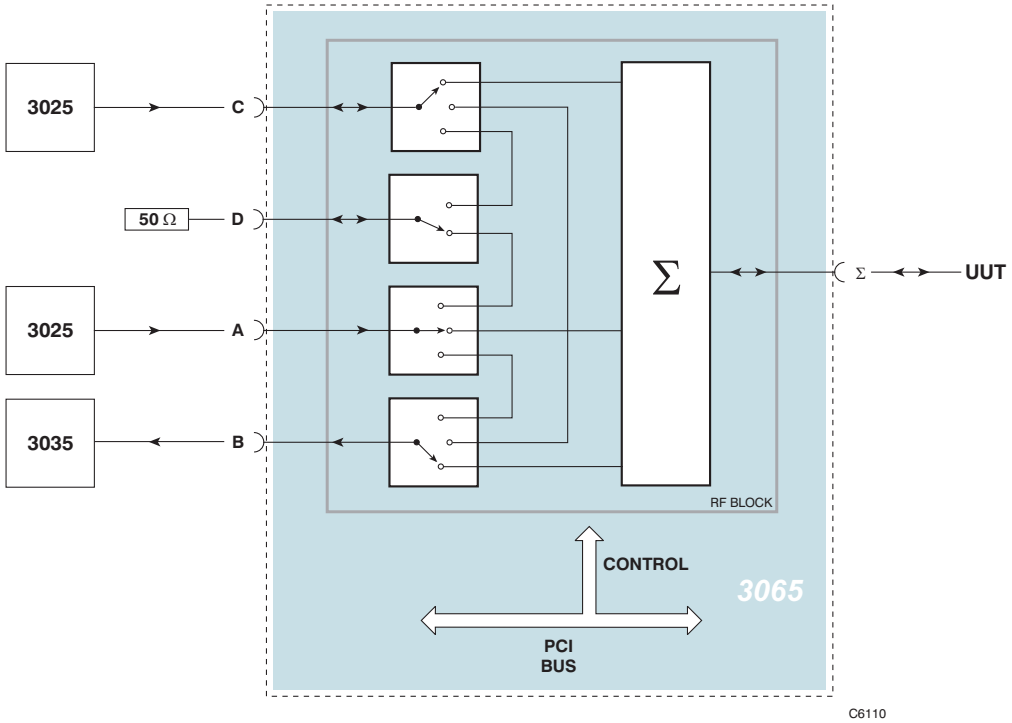


Fig. 3-3 Transceiver test

This configuration connects one or two signal sources and a digital analyzer to the unit under test (UUT) for amplifier or mixer intermodulation testing.

Testing two devices

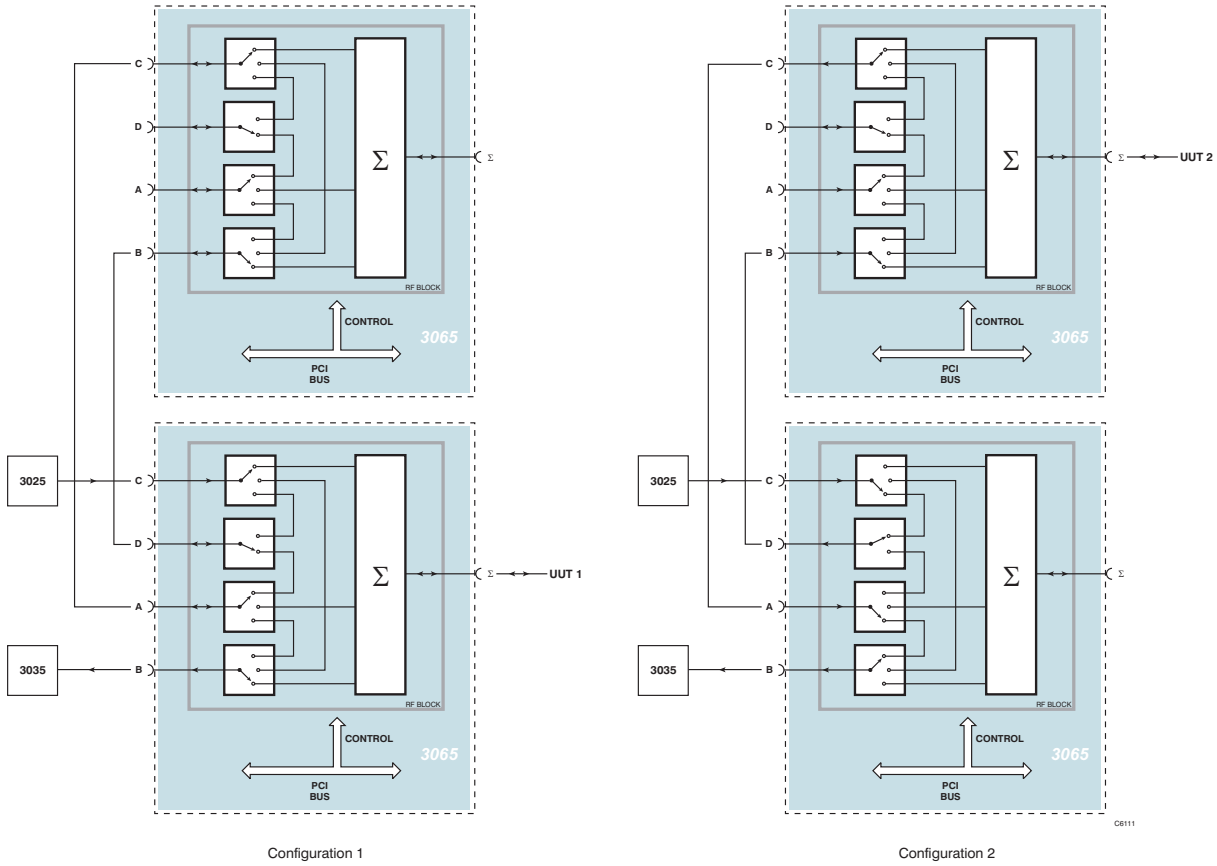


Fig. 3-4 Dual transceiver test

These two configurations let you use a single signal source and digital analyzer to test two devices.

Testing three devices

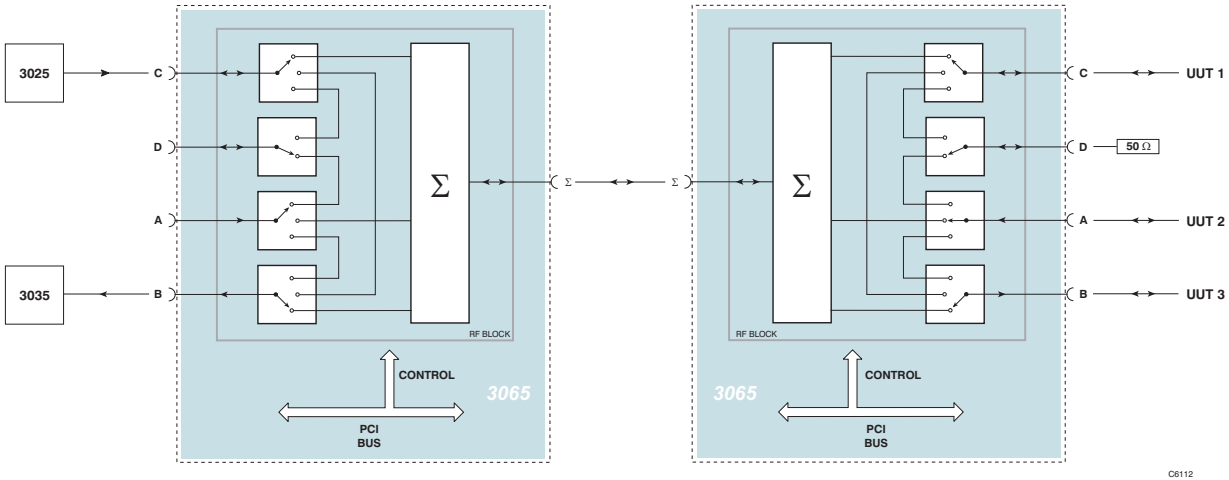


Fig. 3-5 Triple transceiver test

This configuration lets you connect three devices under test to a single signal source and digital analyzer.

Testing with additional non-cellular function

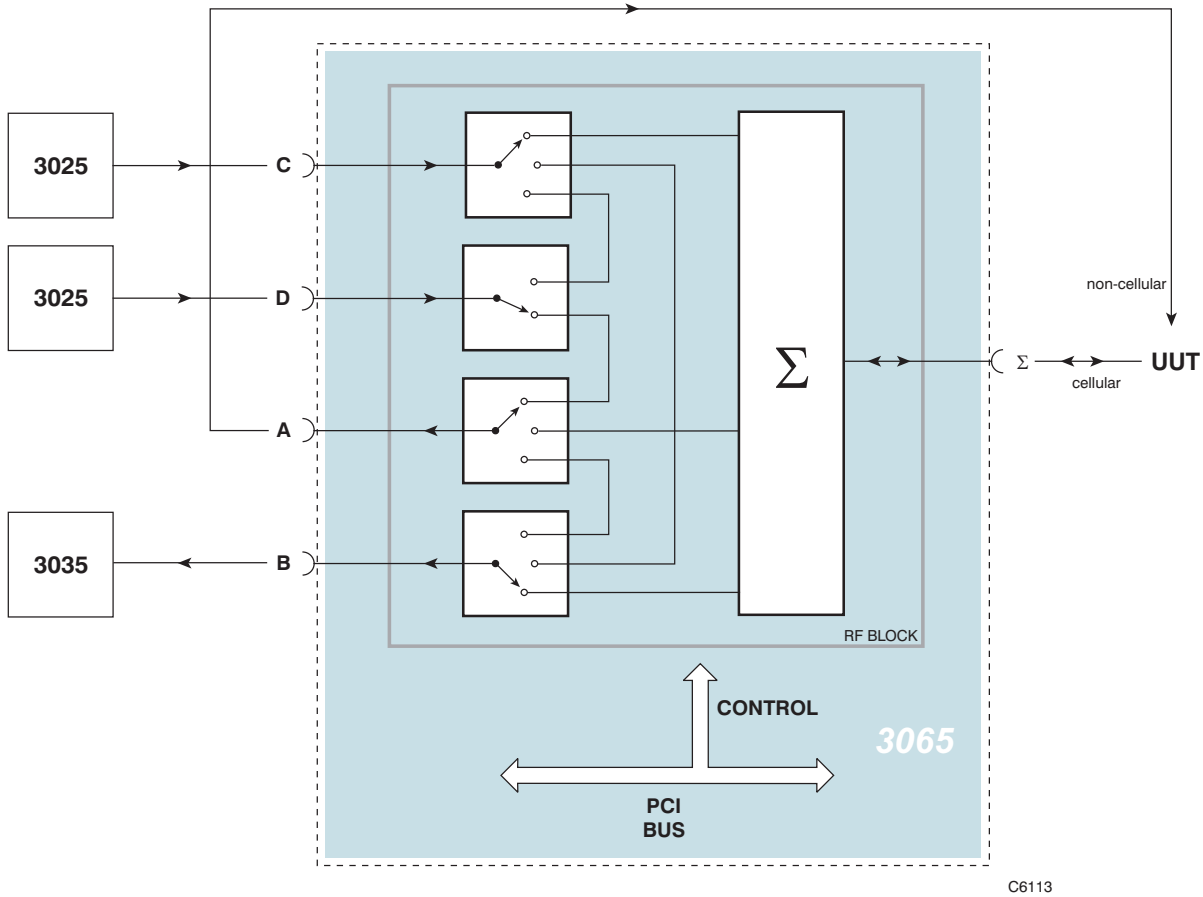


Fig. 3-6 Cellular and non-cellular transceiver test

This configuration lets you feed both cellular and non-cellular (for example, GSP or DVB) signals to the UUT's independent RF connection points, so that parallel testing is possible.

Driver export functions

On-line help and functional documentation for driver export functions are available on the CD-ROM supplied with your module. They are installed onto your computer at the same time as the drivers.

Driver installation folder

Find help and functional documentation in the driver installation folder on your computer. This is typically:

C:\vxipnp\winnt\af3060

Help

Within the driver installation folder are help files that provide descriptions, parameter lists and return values. Help files are provided in three formats:

af3060.doc	3065 function documentation	Text file
af3060.hlp	3065 Visual BASIC function reference	Windows Help file format
af3060_C.hlp	3065 C language function reference	

We recommend that you use the C or Visual Basic formats as these are easier to navigate.

The file opens at the Contents page:

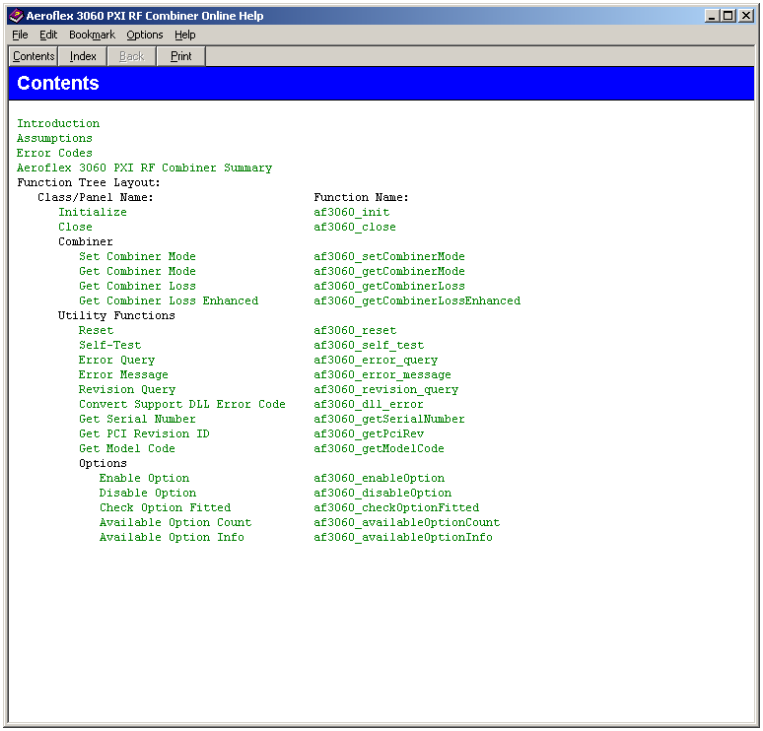


Fig. 3-7 Online help contents — example

Hyperlinks from here take you to

- Introduction
- Assumptions
- Error codes
- Functions listings.

Functions listings

Functions are grouped by type. Click on the hyperlink for details of the function. Each function has a description of its purpose, and may have a list of parameters and return values.

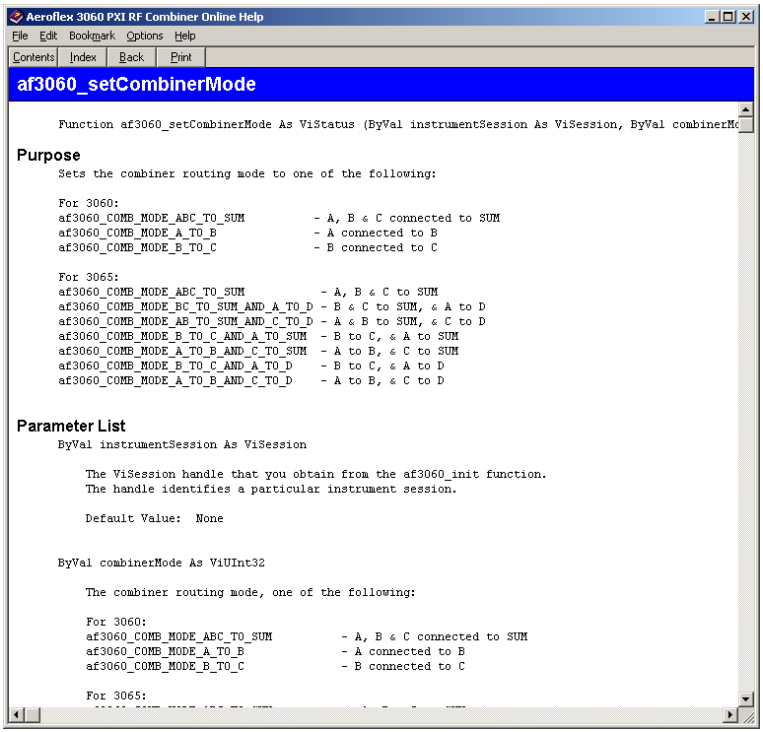


Fig. 3-8 Function description — example

Chapter 4 BRIEF TECHNICAL DESCRIPTION

Introduction

The 3065 is a high performance RF conditioning module with integrated high speed RF switching and a high isolation RF power combiner/splitter. A block schematic for the instrument is shown in Fig. 4-1.

Electronic RF switching is used to ensure that minimal time delays are incurred when performing system calibration, as well as providing high reliability for volume manufacturing.

RF switch control and combiner path calibration information is communicated via the PXI backplane.

The 3065 module consists of an RF block and a PCI interface board; a description of each is given below.

RF block

The RF block performs the signal combination and switching between ports A, B, C and Σ, and between port D and ports A or C. Port switching is implemented using PIN diodes and the combiner is implemented using passive high isolation balun technology.

When the combination mode is selected, forward-biased diodes allow RF signals on ports A, B and C to reach their respective combining circuitry based around two transformer baluns, and then to the output port Σ. A chain of diodes achieves the required port-to-port isolation.

When ‘A to B’ is selected, diode switches connect port A to port B and isolates these ports from the combiner circuitry. The match looking into port Σ is maintained. Port C is not affected when ‘A to B’ mode is selected. A similar process occurs when mode ‘C to B’ is selected.

PCI interface

The PCI interface enables inter-module communication via the PCI bus and provides control and power signals to the 3065. An EEPROM stores module-related calibration data.

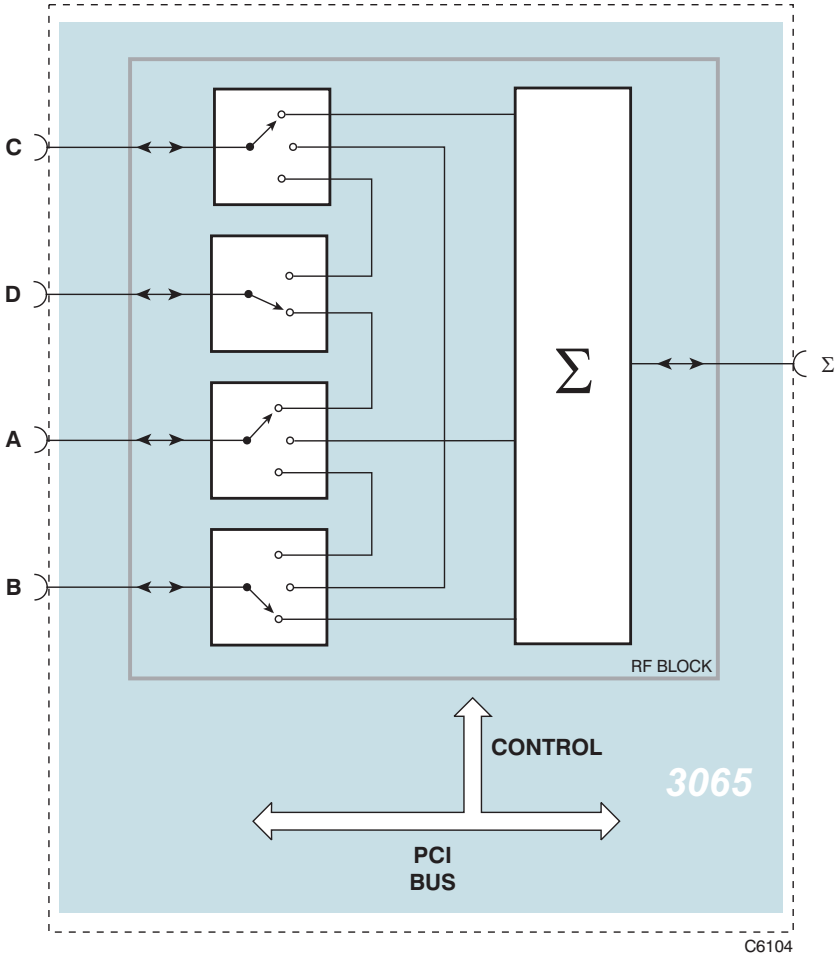


Fig. 4-1 Block schematic diagram

Chapter 5 ACCEPTANCE TESTING

Introduction

The test procedures in this chapter enable you to verify that the 3065 RF Combiner is meeting its specified performance.

Abbreviations

Throughout the chapter, the following abbreviations are used:

UUT	Unit Under Test
SFP	Soft Front Panel

Test procedures

Each test procedure shows you how to configure the test equipment and then describes how to perform the test. Tables are provided for recording your results. Measurements should fall within the maximum and minimum limits indicated, provided that you use the recommended test equipment and adhere to the test precautions.

The tests recommend the use of conventional 'rack and stack' test equipment. Other PXI modules may be used as long as they comply with the minimum specification.

Controlling the UUT

Control of the UUT (unit under test) is by the SFP (soft front panel) supplied on the CD–ROM (part no. 46886/028).

Follow the instructions provided in the 3000 Series Common Installation Guide (part no. 46882/663) to ensure that this software is correctly installed.

Each test procedure relies on the module being set to its power–up conditions. To avoid switching the instrument off and back on, reboot the module via the SFP as follows:

- Click on **Boot**.
- Select the appropriate resource from the list.
- Click on **OK**.
- After a few seconds, the indicator turns green to show that the boot sequence has completed successfully.

Note that for clarity, the PXI chassis and controller are not shown in the test equipment setup diagrams.

Recommended test equipment

The test equipment recommended is shown below. Alternative equipment may be used provided it complies with the stated minimum specification. The minimum specification is only an indication of the required performance. With all measurements, you should ensure that the performance of the test equipment has adequate stand–off from the specification of the UUT.

Description	Minimum specification	Example	Test parameters
Signal generator	250 MHz to 6 GHz	Aeroflex 3416	Insertion loss
Power meter and sensor	250 MHz to 6 GHz	Aeroflex 6960B and 6924	Insertion loss
Power splitter	6 GHz	Agilent 11667B	Insertion loss
Spectrum analyzer	6 GHz	Aeroflex 2394	Isolation
Microwave scalar analyzer	250 MHz to 6 GHz	Aeroflex 6822, 6823 or 6824	Return loss
Autotester	250 MHz to 6 GHz	Aeroflex 59999/168	Return loss
50 ohm SMA termination (4 off)	250 MHz to 6 GHz	Aeroflex 82532	All

Test precautions

To ensure minimum errors and uncertainties when making measurements, it is important to observe the following precautions:

- Always use recently calibrated test equipment, with any correction figures taken into account, so as to establish a known traceable limit of performance uncertainty. This uncertainty must be allowed for in determining the accuracy of measurements.
- Ensure any user calibration routines are performed when necessary. On most power meters it is also necessary to perform an auto-zero routine.
- Use the shortest possible connecting leads.
- Allow 20 minutes for the UUT to warm up, plus any extra time for other test equipment being used.

Checking that the UUT powers up correctly

This test ensures that the 3065 powers up in a satisfactory manner and that the internal self-tests do not report any errors. This test assumes that instrument is fitted in a PXI chassis and that the supplied installation software is installed on the host controller.

- Apply power to the PXI chassis.
- Press the supply switch on the PXI chassis.

Wait for the operating system to complete its boot-up sequence.

- Double-click on the af3060_SFP icon.

The 3065 SFP now starts up. After completing its boot-up sequence, the indicator next to the **Boot** button should be red.

- Click on **Boot**.

While the module is booting, the indicator turns amber.

- After a few seconds, the indicator turns green to show that the boot sequence has completed successfully.

Insertion loss and isolation

This test measures the following:

- the loss between ports A, B, C and the combined port
- the loss between ports A and B or B and C or A and D or C and D
- the isolation between ports A and B, A and C, or B and C with the 3065 set to A,B,C to Σ
- The isolation between ports D and Σ
- The isolation between A and D (D routed to C)
- The isolation between B and D (D routed to A)

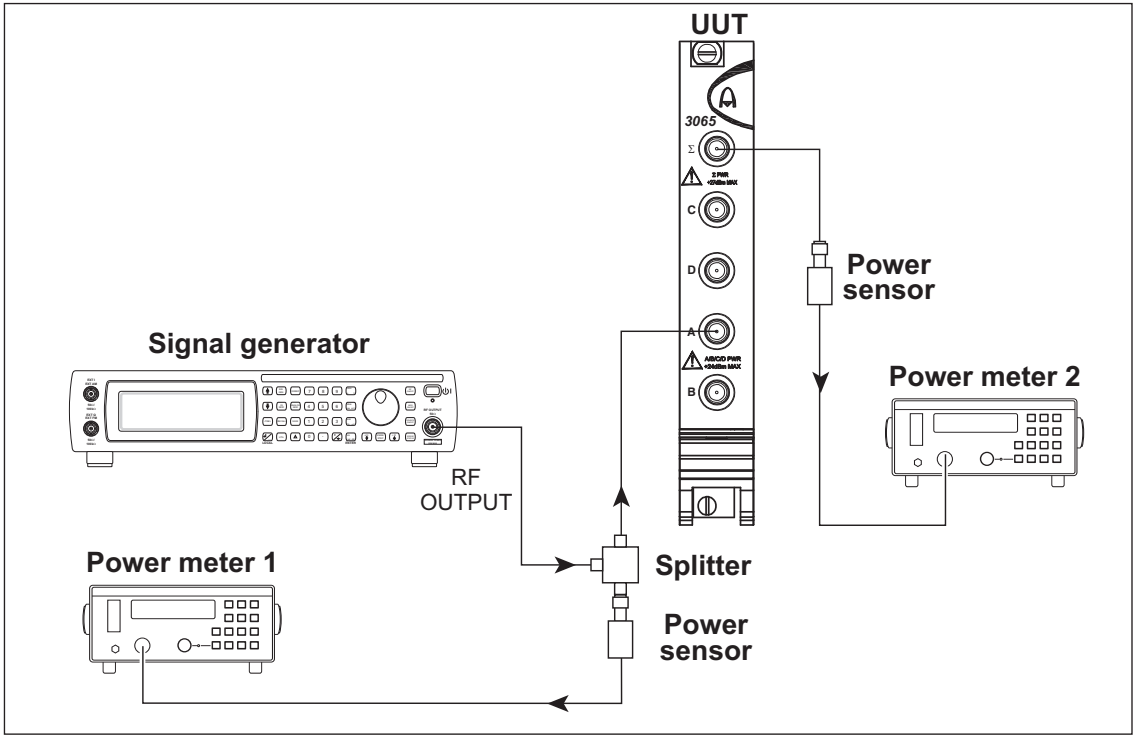


Fig. 5-1 Insertion loss test set-up

Insertion loss

A–Σ

1 Connect the test equipment as shown in Fig. 5-1 and terminate the unused ports with 50 ohm terminations.

2 On the UUT set:

A,B,C to SUM.

3 On the signal generator set:

Carrier Frequency	250 MHz
RF Level	0 dBm

4 Record the difference in the level measured between power meter 1 and power meter 2 in Table 5-1.

5 Repeat (3) and (4) at the remaining frequencies in Table 5-1.

B–Σ

6 Connect the signal generator/splitter/power meter 1 to the UUT B port and terminate the unused ports with 50 ohm terminations.

7 Repeat (3) and (4) at the remaining frequencies in Table 5-1.

C–Σ

8 Connect the signal generator/splitter/power meter 1 to the UUT C port and terminate the unused ports with 50 ohm terminations.

9 Repeat (3) and (4) at the remaining frequencies in Table 5-2.

A–B

10 Connect the signal generator/splitter/power meter 1 to the UUT A port and power meter 2 to the UUT B port and terminate the unused ports with 50 ohm terminations.

11 On the UUT set:

A to B. C to SUM.

12 Repeat (3) and (4) at the frequencies shown in Table 5-3.

B–C

13 Connect the signal generator/splitter/power meter 1 to the UUT B port and power meter 2 to the UUT C port and terminate the unused ports with 50 ohm terminations.

14 On the UUT set:

B to C. A to SUM.

15 Repeat (3) and (4) at the frequencies shown in Table 5-3.

A–D

16 Connect the signal generator/splitter/power meter 1 to the UUT A port and power meter 2 to the UUT D port and terminate the unused ports with 50 ohm terminations.

17 On the UUT set:

B to C. A to D.

18 Repeat (3) and (4) at the frequencies shown in Table 5-4.

C–D

19 Connect the signal generator/splitter/power meter 1 to the UUT C port and power meter 2 to the UUT D port and terminate the unused ports with 50 ohm terminations.

20 On the UUT set:

A to B. C to D.

21 Repeat (3) and (4) at the frequencies shown in Table 5-4.

Table 5-1 Insertion loss results, A–∑, B–∑

Frequency (MHz)	A–∑ result (dB)	B–∑ result (dB)	Limit (dB)
250			<15.5
500			<15.5
750			<15.5
1000			<15.5
1250			<15.5
1500			<15.5
1750			<15.5
2000			<15.5
2250			<15.5
2500			<15.5
2700			<15.5
3000			<17.5
4000			<17.5
5000			<17.5
6000			<17.5

Table 5-2 Insertion loss results, C–∑

Frequency (MHz)	C–∑ result (dB)	Limit (dB)
250		<16
500		<16
750		<16
1000		<16
1250		<16
1500		<16
1750		<16
2000		<16
2250		<16
2500		<16
2700		<16
3000		<16
4000		<16
5000		<16
6000		<16

Table 5-3 Insertion loss A–B, B–C

Frequency (MHz)	A–B result (dB)	B–C result (dB)	Limit (dB)
250			<3
500			<3
750			<3
1000			<3
1250			<3
1500			<3
1750			<3
2000			<3
2250			<3
2500			<3
2700			<3
3000			<5
4000			<5
5000			<5
6000			<5

Table 5-4 Insertion loss A–D, C–D

Frequency (MHz)	A–D result (dB)	C–D result (dB)	Limit (dB)
250			<3
500			<3
750			<3
1000			<3
1250			<3
1500			<3
1750			<3
2000			<3
2250			<3
2500			<3
2700			<3
3000			<5
4000			<5
5000			<5
6000			<5

Isolation

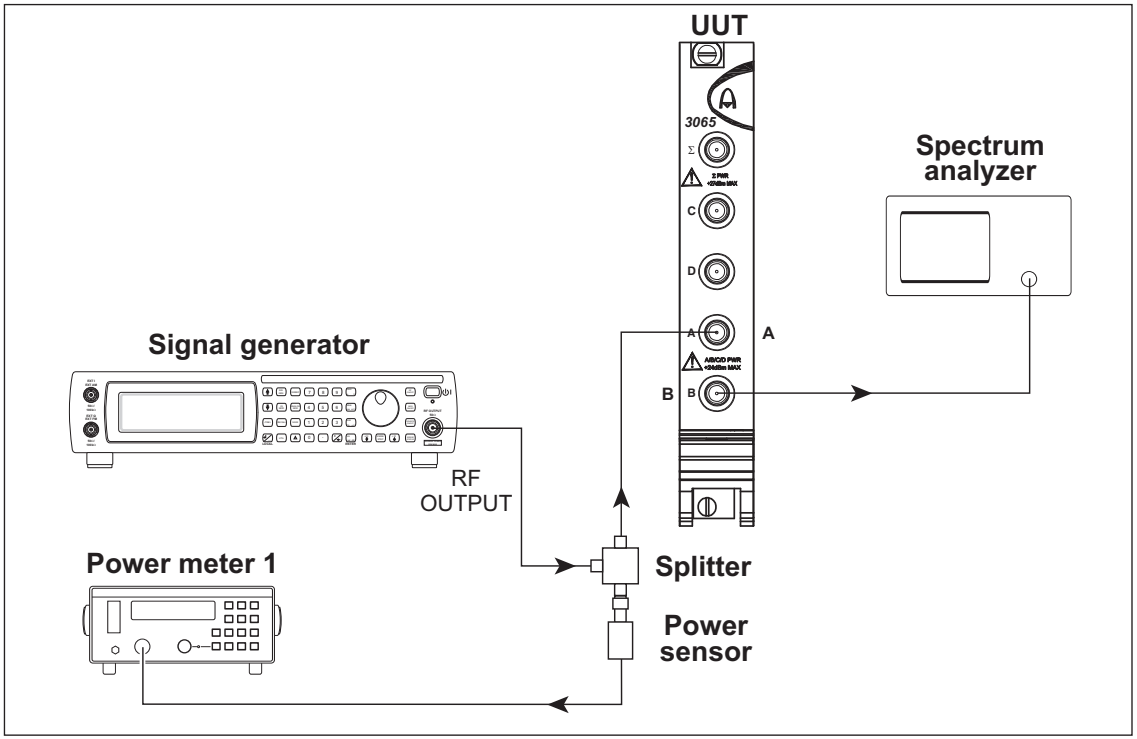


Fig. 5-2 Isolation test setup

A–B

1 Connect the test equipment as shown in Fig. 5-2 and terminate the other ports with 50 ohm terminations.

2 On the UUT set:

A,B,C to SUM.

3 On the signal generator set:

Carrier Frequency	250 MHz
RF Level	0 dBm

4 On the spectrum analyzer set:

Carrier Frequency	250 MHz
Ref Level	0 dBm
Span	100 kHz
Marker	⇒ Peak

5 Record the difference in the level measured between the power meter and the marker on the spectrum analyzer in Table 5-5.

6 Repeat (3) to (5) at the remaining frequencies in Table 5-5.

A–C

7 Connect the spectrum analyzer to the UUT C port and terminate the other ports.

8 Repeat (3) to (5) at the frequencies in Table 5-5.

B–C

9 Connect the signal generator/splitter/power meter to the UUT B port, the spectrum analyzer to the C port, and terminate the other ports.

10 Repeat (3) to (5) at the frequencies in Table 5-6.

B–D

11 Connect the signal generator/splitter/power meter to the UUT B port, the spectrum analyzer to the D port, and terminate the other ports.

12 Repeat (3) to (5) at the frequencies in Table 5-5.

A–D

13 Connect the signal generator/splitter/power meter to the UUT A port, the spectrum analyzer to the D port and terminate the other ports.

14 On the UUT set:

A,B, to SUM. C to D.

15 Repeat (3) to (5) at the frequencies in Table 5-5.

C–D

16 Connect the signal generator/splitter/power meter to the UUT C port, the spectrum analyzer to the D port and terminate the other ports.

17 On the UUT set:

B,C, to SUM. A to D.

18 Repeat (3) to (5) at the frequencies in Table 5-5.

D–Σ

19 Connect the signal generator/splitter/power meter to the UUT D port, the spectrum analyzer to the Σ port and terminate the other ports.

20 Repeat (3) to (5) at the frequencies in Table 5-5.

Table 5-5 Isolation results (all ports except B–C)

Frequency (MHz)	A–B result (dB)	A–C result (dB)	B–D result (dB)	A–D result (dB)	C–D result (dB)	D–SUM result (dB)	Limit (dB)
250							>35
500							>35
750							>35
1000							>35
1250							>35
1500							>35
1750							>35
2000							>35
2250							>35
2500							>35
2700							>35
3000							>35
4000							>35
5000							>35
6000							>35

Table 5-6 Isolation results B–C

Frequency (MHz)	B–C result (dB)	Limit (dB)
250		>35
500		>35
750		>35
1000		>35
1250		>35
1500		>35
1750		>35
2000		>35
2250		>32
2500		>32
2700		>32
3000		>32
4000		>32
5000		>32
6000		>32

Return loss

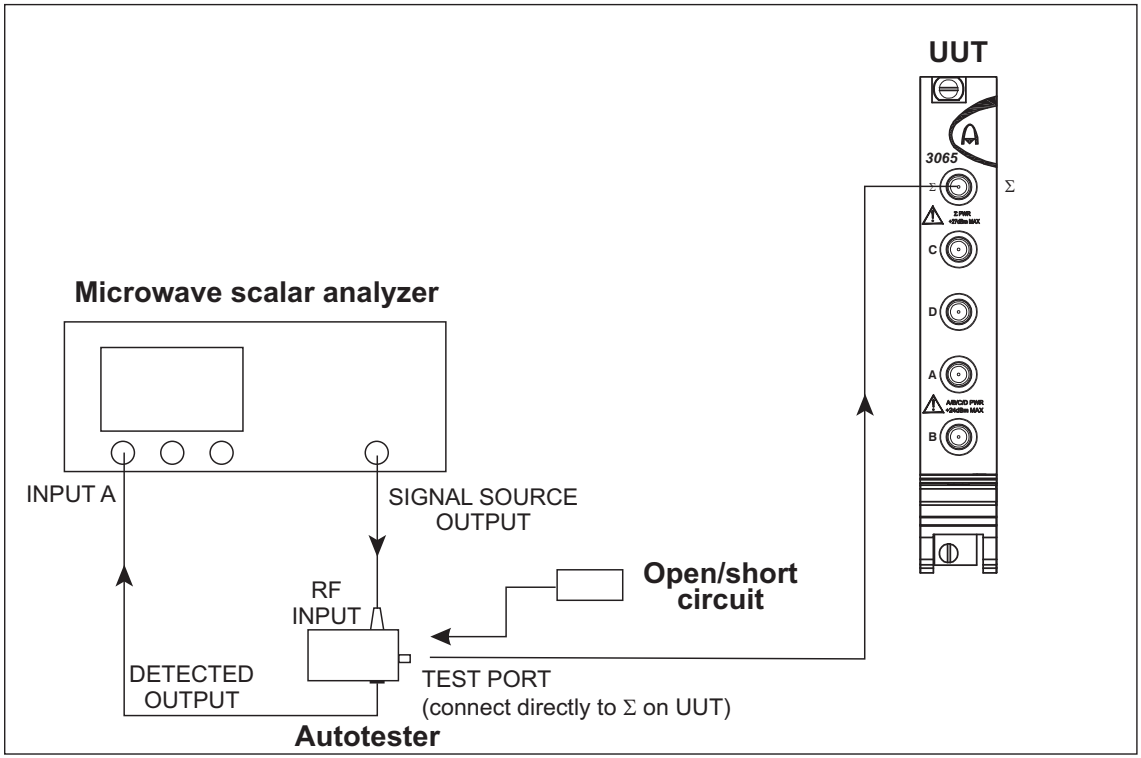


Fig. 5-3 RF input VSWR test setup

A, B, C to Σ

Port Σ

1 Connect the test equipment as shown in Fig. 5-3 and terminate the unused ports with 50 ohm terminations.

2 On the UUT set:

A,B,C to SUM.

3 On the microwave scalar analyzer (MSA) define the source conditions as follows:

[PRESET]
[Full]
[SOURCE]
[Set Start Frequency] 250 [Mu]
[Set Stop Frequency] 6000 [Mu]

4 Calibrate the MSA for VSWR measurements as follows:

[CAL]
[Short AND Open Cal]

5 Connect the short circuit to the test port of the autotester.

6 On the MSA select *[Continue]*

7 Remove the short circuit and connect the open circuit to the test port of the autotester.

8 On the MSA select *[Continue]*

9 Remove the open circuit and connect the test port of the autotester directly to the Σ port on the UUT.

10 On the MSA select:

[FORMAT/SCALING]
[VSWR]

Using the rotary control on the MSA, measure the worst case return loss and record the frequency and value in Table 5-7.

Port A

11 Connect the autotester to the A port, terminate the unused ports with 50 ohm terminations and repeat (10) above using Table 5-8.

Port B

12 Connect the autotester to the B port, terminate the unused ports with 50 ohm terminations and repeat (10) above using Table 5-9.

Port C

13 Connect the autotester to the C port, terminate the unused ports with 50 ohm terminations and repeat (10) above using Table 5-9.

Input switch test

Ports A and B

14 On the UUT set:

A to B. C to D.

15 Connect the autotester to the A port, terminate the B port with a 50 ohm termination and repeat (10) above using Table 5-10.

16 Connect the autotester to the B port, terminate the A port with a 50 ohm termination and repeat (10) above using Table 5-10.

Ports C and D

17 Connect the autotester to the C port, terminate the D port with a 50 ohm termination and repeat (10) above using Table 5-10.

18 Connect the autotester to the D port, terminate the C port with a 50 ohm termination and repeat (10) above using Table 5-10.

Ports B and C

19 On the UUT set:

B to C. A to D.

20 Connect the autotester to the B port, terminate the C port with a 50 ohm termination and repeat (10) above using Table 5-10.

21 Connect the autotester to the C port, terminate the B port with a 50 ohm termination and repeat (10) above using Table 5-10.

Ports A and D

22 Connect the autotester to the A port, terminate the D port with a 50 ohm termination and repeat (10) above using Table 5-10.

23 Connect the autotester to the D port, terminate the A port with a 50 ohm termination and repeat (10) above using Table 5-10.

Table 5-7 Port Σ return loss result

Frequency (MHz)	Σ Result (dB)	Limit (dB)
In range 250 MHz to 2.7 GHz:		>20
In range 2.7 GHz to 5 GHz:		>18
In range 5 GHz to 6 GHz:		>16

Table 5-8 Port A return loss result

Frequency (MHz)	A Result (dB)	Limit (dB)
In range 250 MHz to 6 GHz:		>11 typ 14

Table 5-9 Ports B, C and D return loss result

Frequency (MHz)	B Result (dB)	C Result (dB)	D Result (dB)	Limit (dB)
In range 250 MHz to 2.7 GHz:				>14 typ. 17
In range 2.7 GHz to 6 GHz:				>11 typ. 14

Table 5-10 Ports A & B, C & D, B &C, A & D return loss result

Frequency (MHz)	A to B Result (dB)	B to A Result (dB)	C to D Result (dB)	D to C Result (dB	Limit (dB)
In range 250 MHz to 2.7 GHz:					>14 typ. 17
In range 2.7 GHz to 6 GHz:					>11 typ. 14

Frequency (MHz)	B to C Result (dB)	C to B Result (dB)	A to D Result (dB)	D to A Result (dB	Limit (dB)
In range 250 MHz to 2.7 GHz:					>14 typ. 17
In range 2.7 GHz to 6 GHz:					>11 typ. 14

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