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3060, 3061, 3065, 3065A (3060 Series)
RF Combiner PXI Modules



User Manual

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About this manual

This manual explains how to set up and configure an Aeroflex 3060, 3061 or 3065 RF combiner PXI module. Where necessary, it refers you to the appropriate installation documents that are supplied with the module.

Please note: this manual applies only when the instrument is used with the supplied software.

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.

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Intended audience

Engineers who require to interface various PXI RF test resources with the item(s) under test.

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.

Associated documentation

The following documentation covers specific aspects of this equipment:

If you want to…	Refer to…
Find information about soft front panels, drivers, application software, data sheets, installation, getting started and user manuals for this and other modules in the 3000 Series	PXI Modules CD-ROM Part no. 46886/028 Supplied with the module
Install modules into a rack, interconnect them, power up and install drivers	3000 Series PXI Modules Common Installation Guide Part no. 46892/663 On the CD-ROM and at www.aeroflex.com/
Set up a populated chassis ready for use	3000 Series PXI Modules Installation Guide for Chassis Part no. 46892/667 On the CD-ROM and at www.aeroflex.com/
Set up and use the universal PXI application for system configuration and operation	PXI Studio User Guide Part no: 46892/809 On the CD-ROM and at www.aeroflex.com/

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.

PXI Express now integrates PCI Express into PXI, providing up to 6 Gbyte/s backplane bandwidth and up to 2 Gbyte/s slot bandwidth. PXI Express maintains backwards compatibility with PXI, providing software compatibility and hardware compatibility with hybrid slots and hybrid systems.

Hybrid slot compatibility

PXI chassis that provide hybrid slots can accept both PXI Express modules and hybrid-compatible PXI modules. Hybrid-compatible PXI modules have a ‘missing’ section of connector (see Fig. 1), which allows them to be inserted into both hybrid slots and standard PXI-1 slots.

Because of the reduced connectivity of Aeroflex hybrid-compatible PXI modules, the PXI parallel local bus LBL[0]–[12] disappears, to be replaced by the serial connection LBL[6], which is typically used to provide list addresses to a 3010 Series RF Synthesizer.

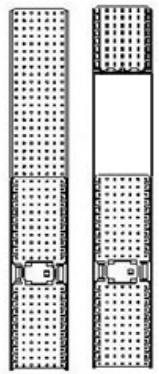


Fig. 1 Standard PXI 1-slot connector (L) and hybrid-compatible PXI connector (R)

This table shows which Aeroflex PXI combiner modules fit only in a standard 1-slot, and which fit in both hybrid-compatible and standard slots:

3060	Standard PXI 1-slot
3061	Hybrid-compatible and standard PXI 1-slot
3065	Standard PXI 1-slot
3065A	Standard PXI 1-slot

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GENERAL INFORMATION

Introduction

This is the user manual for the 3060, 3061 and 3065 RF combiner PXI modules, which are referred to generically in this document as '3060 Series'.

These combiner PXI modules operate over the following frequency ranges:

3060	250 MHz to 2.7 GHz
3061	250 MHz to 2.7 GHz
3065	250 MHz to 6 GHz (usable to 70 MHz)
3065A	250 MHz to 6 GHz (usable to 70 MHz)

and the following peak power level ranges:

	A, B,	C	D	Σ
3060	24 dBm	24 dBm	n/a	27 dBm, 3 V dc
3061	24 dBm	n/a	n/a	30 dBm, 40 V dc 33 dBm, m:s = 1:1 where m = <0.5 ms
3065	24 dBm	24 dBm	24 dBm	27 dBm, 3 V dc 30 dBm, m:s = 1:8 where m = <0.5 ms
3065A	24 dBm	24 dBm	24 dBm	30 dBm, 3 V dc 33 dBm, m:s = 1:8 where m = <0.5 ms

These high-performance modules feature integrated high speed RF switching and a high isolation RF power combiner/splitter in a 3U high single-slot PXI module.

These modules are 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.

3060 Series combiners store their own path loss calibration data, which can be accessed via software calls to the driver.

- Combiners provide a single output from any combination of input ports. Each port is bi-directional, allowing many system configurations. Port D (3065/3065A only) allows for a second output or input channel, or for testing of multifunction mobile telephones that support non-cellular functions.
- Combiners provide direct RF switched connection between input ports to enable automated test system calibration.
- Possible combinations are:

3060

Combined output

A, B, C to SUM

Switched connection

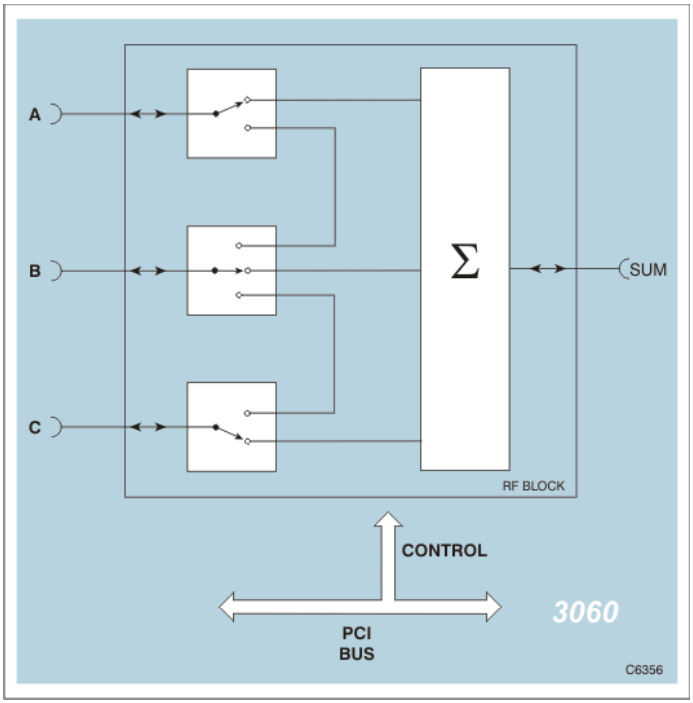
A to B

C to B

Switched and combined

A to B and C to SUM

C to B and A to SUM



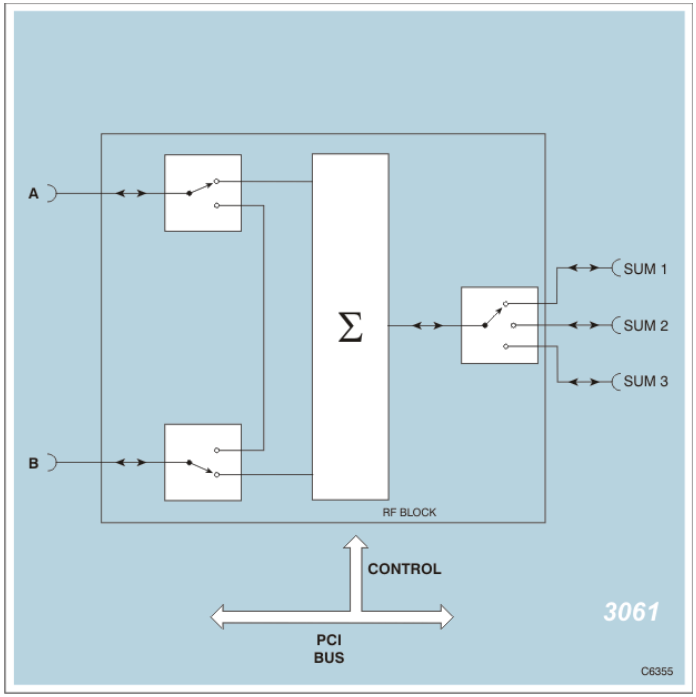
3061

Combined output

A, B to SUM 1, 2 or 3

Switched connection

A to B



3065

Combined output

A, B, C to SUM

Switched connection

A to B and C to D

A to D and C to B

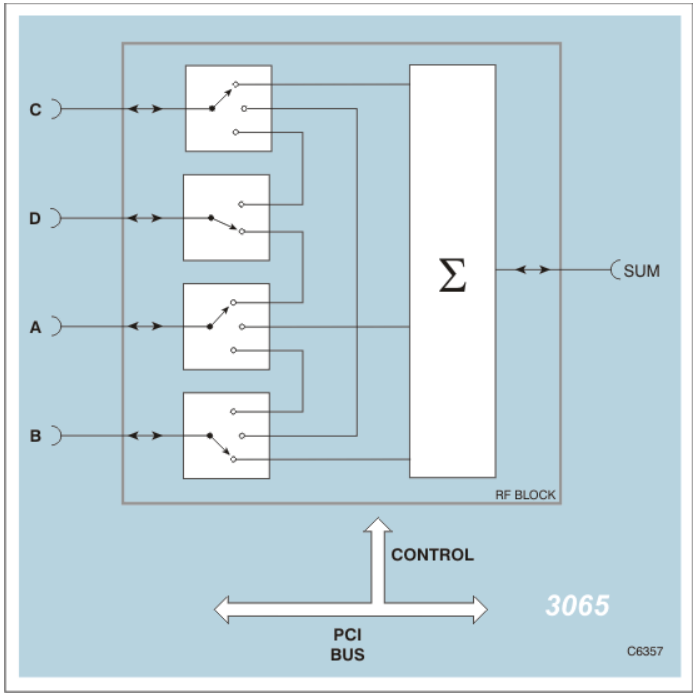
Switched and combined

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



3065A

Combined output

A, B to SUM

Switched connection

A to B and C to D

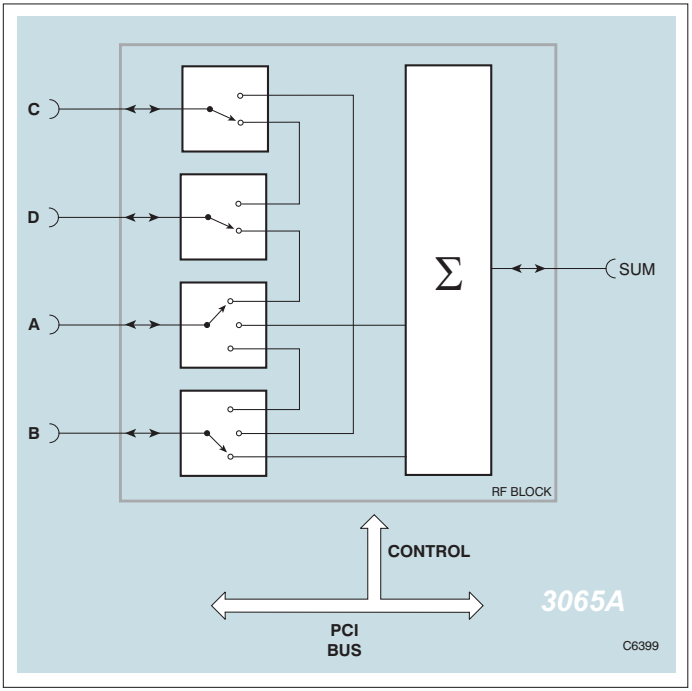
A to D and C to B

Switched and combined

C to B and A to SUM

C to D and A, B to SUM

A to D and B to SUM



Applications

3060 Series combiners 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 (3065/3065A only) allows a second RF source to be routed to the unit under test. The 3061 combiner allows up to three devices (or three interfaces on a single device) to be connected to the summing port, thereby reducing handling and test time.

Software

A 3060 Series combiner 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[1]. PXI Studio provides comprehensive signal generator, digitizer and spectrum analyzer applications, and optional analysis plug-ins to suit specific communications systems.

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.

[1] PXI Studio does not currently support 3061.

Deliverable items

- 3060 Series RF Signal Generator PXI module
- PXI Modules CD-ROM (part no. 46886/028), containing soft front panels, drivers, application software, data sheets, installation guides, safety instructions, getting started and user manuals for this and other modules in the 3000 Series
- *3000 Series PXI Modules Safety Instructions*: printed item, part no. 46882/882
- SMA connector cable: part no. 43139/738; 1 off for 3060/3065/3065A only
- SMA connector cable: part no. 43139/739; 2 off for 3060/3061/3065/3065A
- 50 ohm termination SMA, part no. 23448/726, 1 off for 3060/3065/3065A only
- SMA connector saver: part no. 46885/224, 1 off for 3060/3065/3065A, 3 off for 3061.

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

Specifications

For the latest specifications, see the data sheet included on the CD-ROM (part no. 46886/028) or go to the Aeroflex website.

All 3060 Series specifications are defined when used in conjunction with the driver software supplied with the module.

Warm-up time

Allow at least twenty minutes for a module to warm up and meet its specifications fully after booting.

Calibration and servicing

The recommended calibration interval is 24 months.

There are no user-serviceable parts in these modules. If any attention is needed, return the module to your Aeroflex agent.

INSTALLATION

WARNING

Initial visual inspection

Refer to the *3000 Series Common Installation Guide* part no. 46892/663 on the PXI Modules CD-ROM, part no. 46886/028.

CAUTION

Handling precautions

Refer to the *3000 Series Common Installation Guide* part no. 46892/663 on the PXI Modules CD-ROM, part no. 46886/028.

Hardware installation

WARNING

Before installing the module into the chassis, check inside the chassis:

(a) that no foreign conductive bodies are present between pins on the backplane connectors

(b) that no pins on the backplane connectors are bent or damaged.

Installing the module into the PXI chassis

Refer to the *3000 Series Common Installation Guide* part no. 46892/663 and *Installation Guide for Chassis* part no. 46882/697 on the PXI Modules CD-ROM, part no. 46886/028.

These guides provide information such as specific precautions to take, positioning and fitting the modules, making connections for the LO and the 10 MHz reference signal, installing hardware drivers, and so on.

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.

CAUTION

Overtightening will cause damage!

Do not allow center pins to rotate!

Do not allow the center pins of connectors to rotate when you connect and remove cables.

Use a connector saver!

Use a connector saver (part no. 46885/224, supplied):

(a) on any connector where the cable is routinely connected and disconnected

(b) when the connector on the cable, or the cable end of the connector saver, has not been gauged.

Torque to 1 Nm the end of the connector saver that connects to the module, and torque to 0.56 Nm the end that connects to the cable.

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.

OPERATION

Front-panel connectors

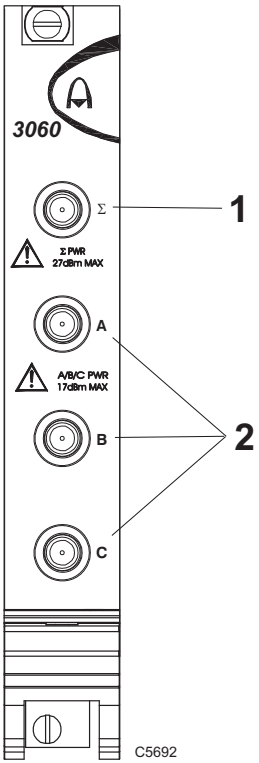


Fig. 2 3060 front panel

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

CAUTION

Maximum safe powers

Σ port: +27 dBm, 3 V dc continuous

A, B, C ports: +24 dBm

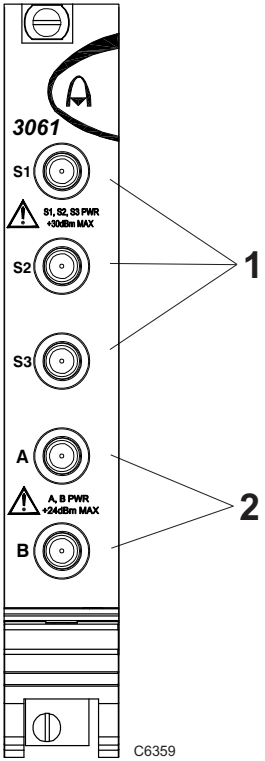


Fig. 3 3061 front panel

1	S1, S2, S3	Switched combined outputs. SMA socket, 50 Ω.
2	A, B	Individual inputs. SMA socket, 50 Ω.

CAUTION

Maximum safe powers

S1, S2, S3 ports: +30 dBm, 40 V dc continuous

+33 dBm mark:space 1:1 where mark <0.5 ms

A, B ports: +24 dBm

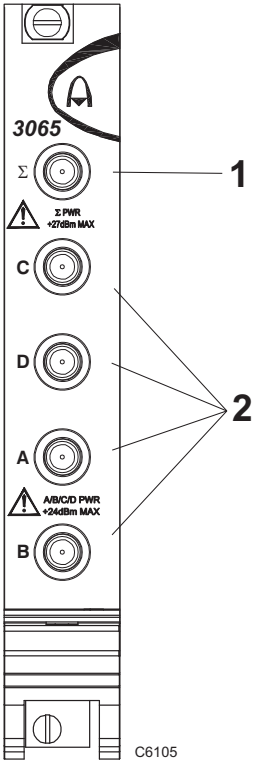


Fig. 4 3065 front panel

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 continuous

+30 dBm mark:space 1:8 where mark <0.5 ms

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

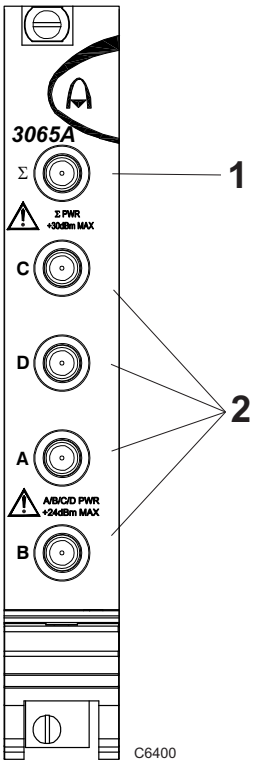


Fig. 5 3065A front panel

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: +30 dBm, 3 V dc continuous

+33 dBm mark:space 1:8 where mark <0.5 ms

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 afCombiner DLL, the afcomCombiner COM object, the .net assembly (*afcombinerDotNet.dll*) or PXI Studio

Installation

The soft front panel is installed during the driver installation process (refer to the *3000 Series PXI Modules Common Installation Guide*, part no. 46892/663, on the PXI Modules CD-ROM).

Access the soft front panel from the Windows Start menu under *Programs\Aeroflex\PXI Module Front Panels\AF3060 Soft Front Panel*. Or open the *af3060_sfp.ex*e file, which if you did not change the default location, is located with the VISA software. The soft front panel, similar to that in Fig. 6, 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. This user 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.

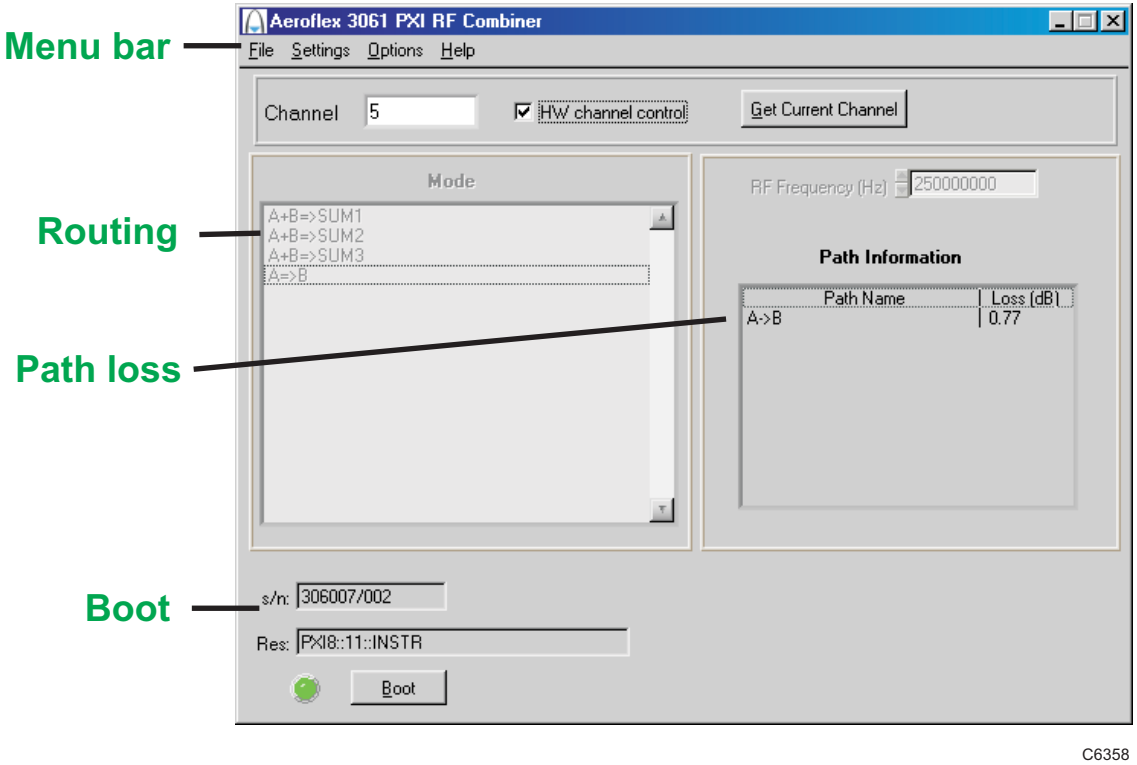


Fig. 6 3061 combiner soft front panel (other 3060 Series panels are similar)

Menu bar

File

Click Exit on the menu bar to close the application.

Settings

Load and Save on the menu bar 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 the same as for the VISA software (refer to the *3000 Series PXI Modules Common Installation Guide* for details), and settings are saved as *.ini* files.

> You can edit, copy and paste settings files as required; for example, you may want to save only a new routing setup without changing other parameters. 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 on the menu bar lets you choose the locations for your front-panel configuration settings.

Options

There are currently no options available.

Help

Instrument Information on the menu bar 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 on the menu bar 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 3060 Series module you want to boot. Click OK. While you select the boot resource, the indicator is amber. Once the module has initialized, the indicator changes to green within 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.

Mode

This displays all the available routings between the inputs and output(s) for the combiner. The available routings differ, depending on whether the combiner is a 3060, 3061, 3065 or 3065A.

Double-click to select a routing mode.

Remaining ports are routed as shown. All ports are bi-directional.

Path Information

This displays the loss, in dB, of the selected combiner path at the frequency entered in the RF Frequency (Hz) field. For example, A => B (dB) displays the dB loss between the A and B ports at the specified frequency.

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

Channel, HW channel control, Get Current Channel

These controls are available to 3061 combiners only; they are grayed-out for other combiners. They provide channel-by-channel hardware programming of the routing mode, with the option of enabling channel selection via the routing matrix.

Channel

You can allocate any routing mode to any channel number by entering a number in the Channel field, and double-clicking on the associated interconnection in the Mode field. Program as many channels as required.

Stepping manually through the channels by entering different numbers changes the mode accordingly.

HW channel control

Tick this box to cause the 3061 to take its channel number from the list address via the routing matrix, allowing the hardware to control both list addresses and combiner switching.

Route LA_SER to whichever source is providing the list addresses. The 3061 supports serial addressing only.

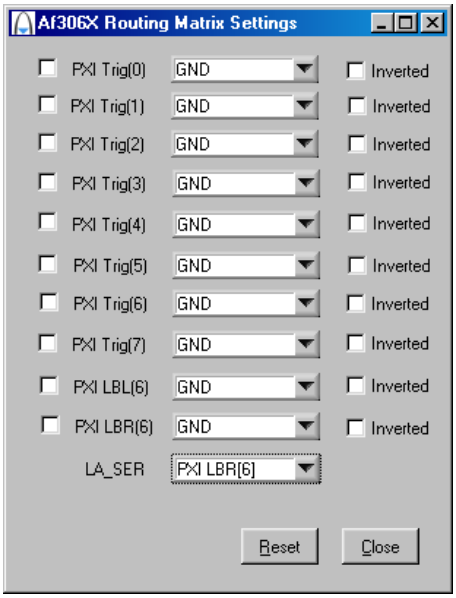


Fig. 7 3061 routing matrix

Get current channel

Displays the channel currently being requested by the list mode hardware.

Switching schemes

Here are some examples of how you can use a 3060 Series module and other PXI components to provide efficient and economical test setups. We have written an application note (number 46891/985) that contains much useful information about using 3060 Series modules in different applications common to RF device testing: download it from the Aeroflex website.

Basic configuration

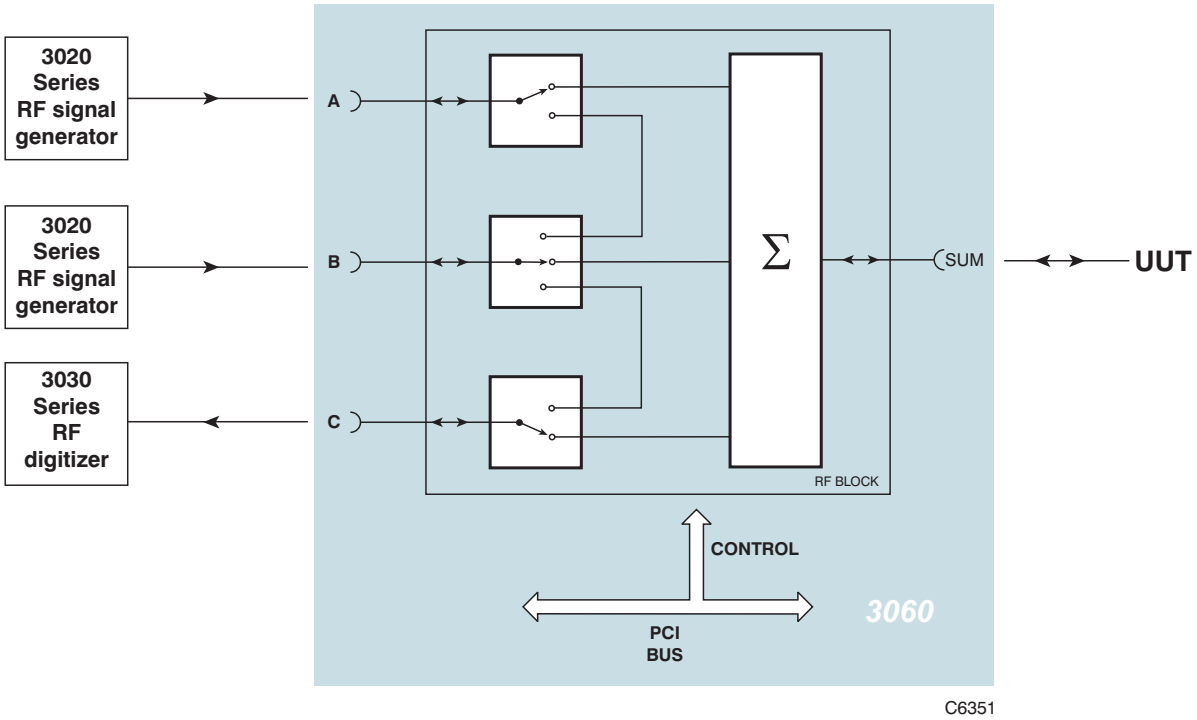


Fig. 8 Transceiver test (3060)

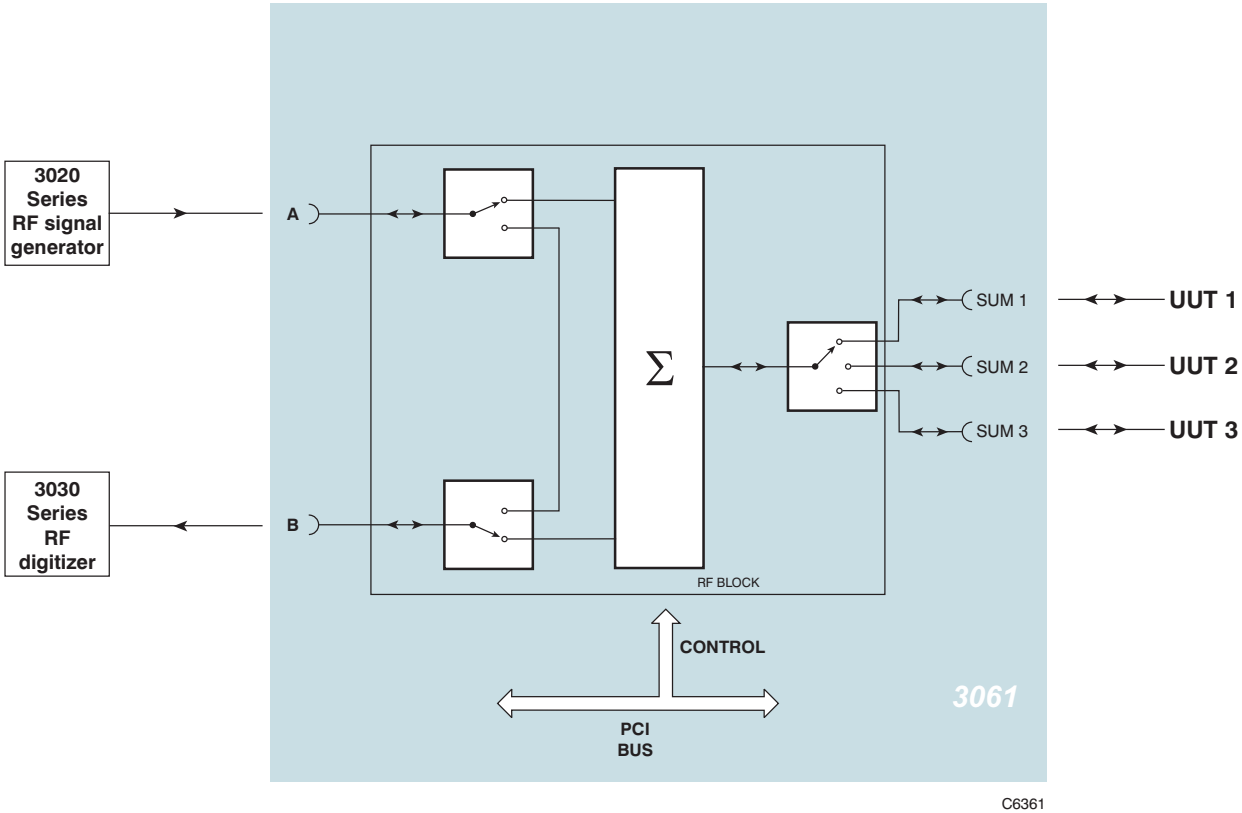


Fig. 9 Transceiver test (3061)

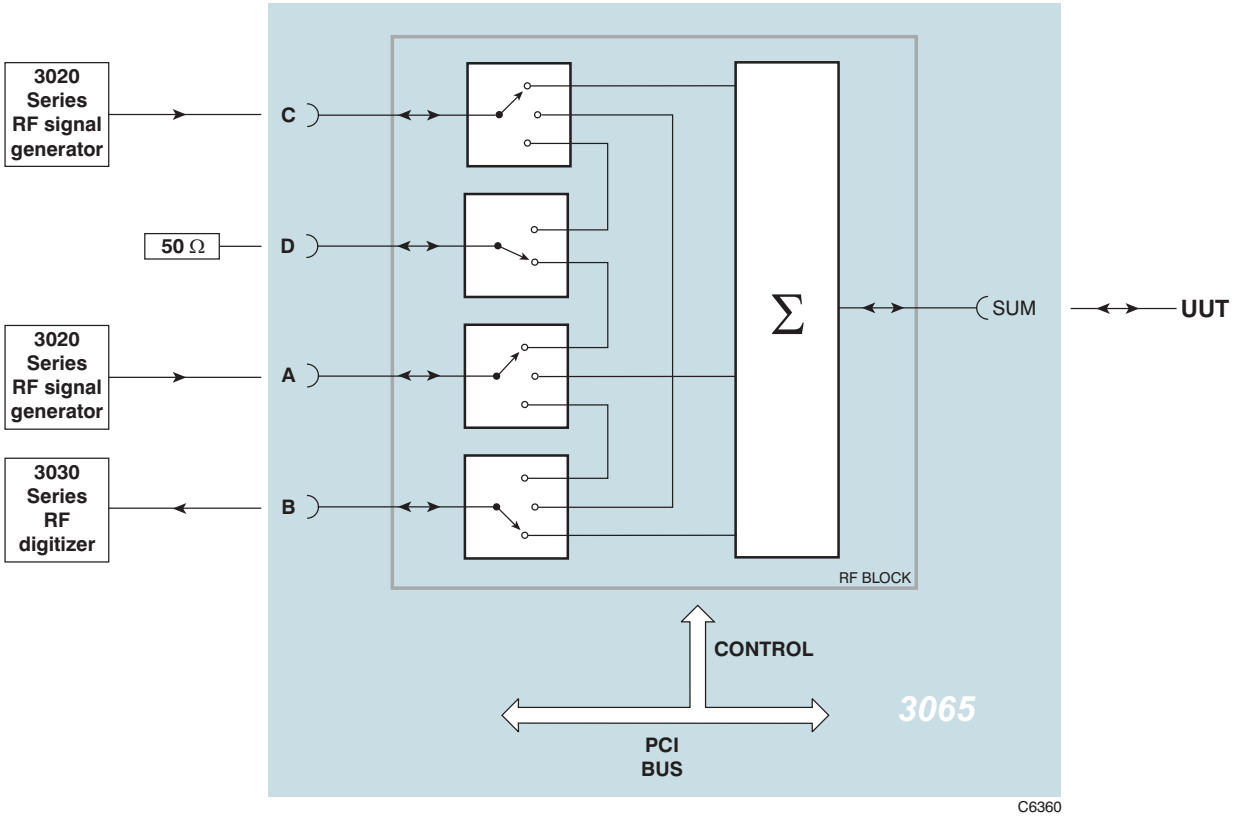


Fig. 10 Transceiver test (3065)

These two configurations connect one or two signal sources and a digital analyzer to the unit(s) under test (UUT) for amplifier or mixer intermodulation testing.

Testing with additional non-cellular function

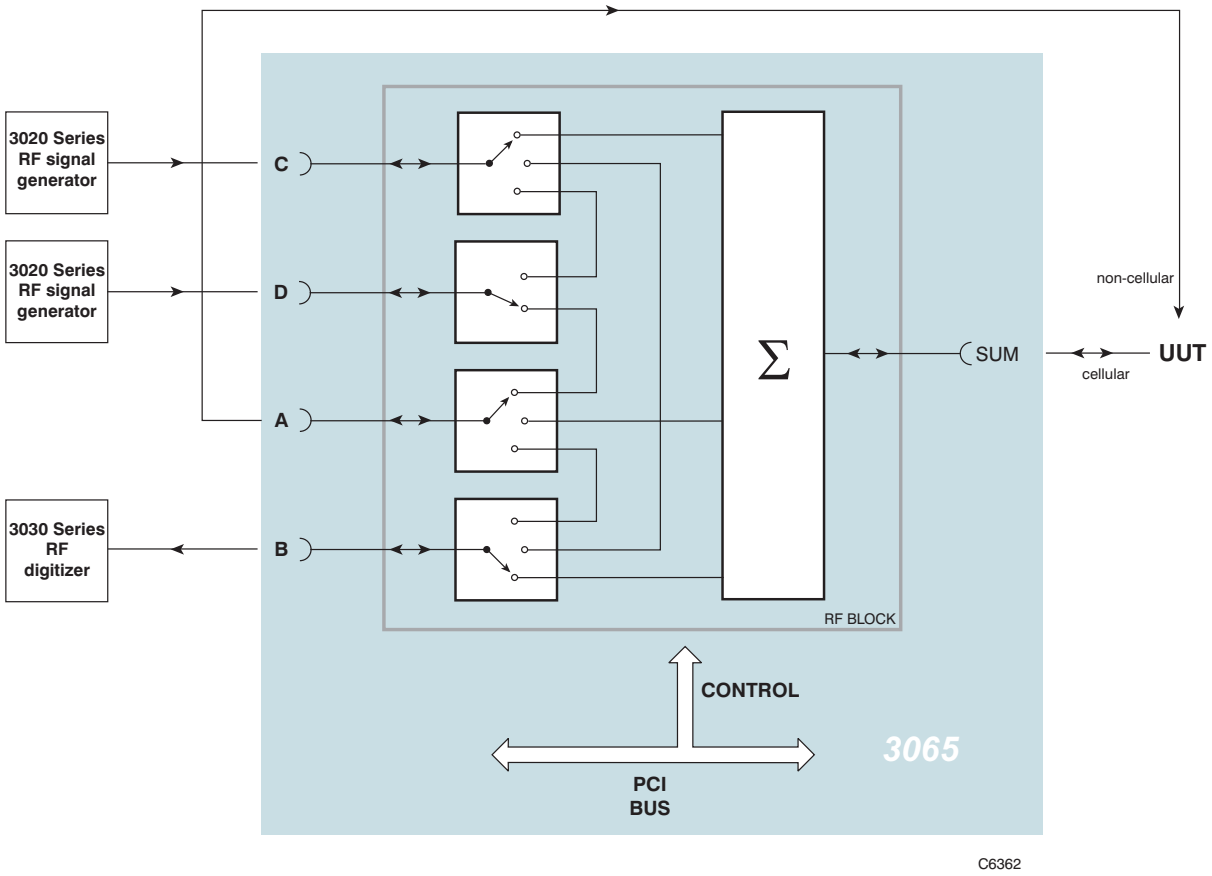


Fig. 11 Cellular and non-cellular transceiver test

This configuration lets you feed both cellular and non-cellular (for example, GPS 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. If you did not change the default location, this is typically the same as for the VISA software.

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	3060 Series function documentation	Text file
af3060.hlp	3060 Series Visual BASIC function reference	Windows Help file format
af3060_C.hlp	3060 Series 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:

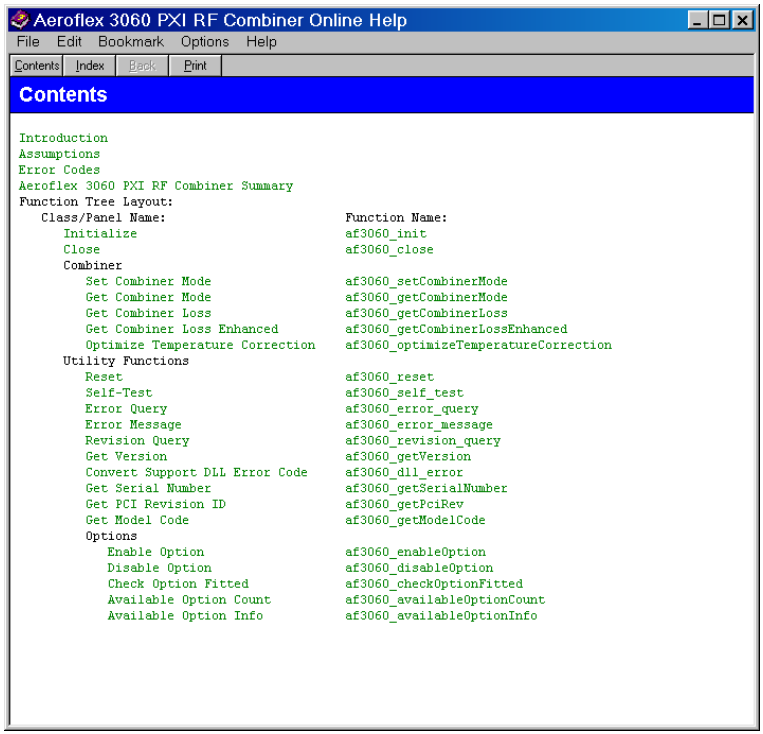


Fig. 12 Online help contents — example

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.

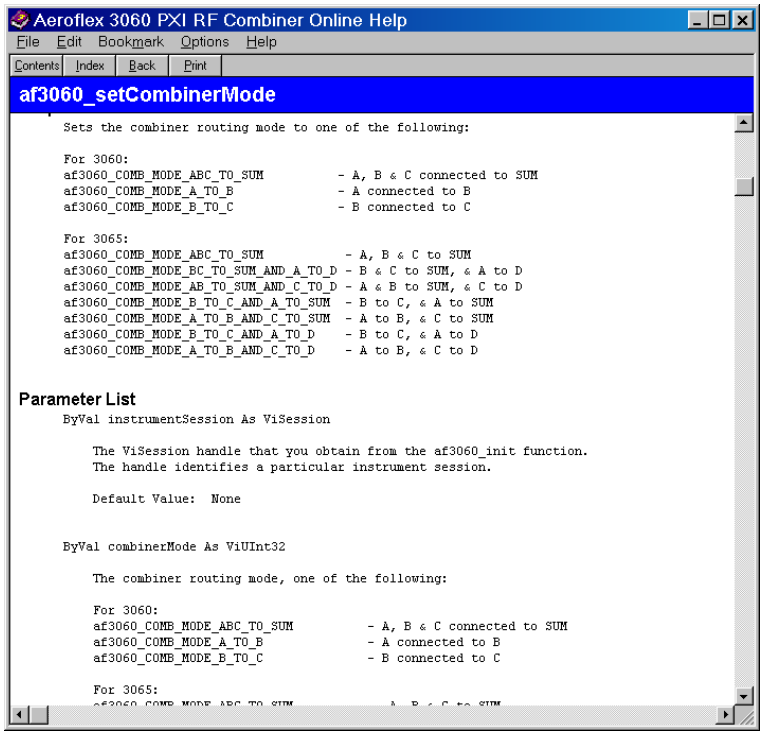


Fig. 13 Function description — example

BRIEF TECHNICAL DESCRIPTION

Introduction

3060 Series modules are high performance RF combiners with integrated high speed RF switching and a high isolation RF power combiner/splitter.

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.

3060 Series modules consist of an RF block and a PCI interface board.

The RF block performs the signal combination and switching between ports. When the combination mode is selected, RF signals pass through their respective combining circuitry, and then to the output port.

When, for example, 'A to B' is selected, switches connect port A to port B and isolate these ports from the combiner circuitry. The match looking into port Σ is maintained. Remaining ports are not affected when 'A to B' mode is selected. 3065 has an additional switched path that enables testing of a separate diversity receive channel without having to make or break physical connections.

3065A is similar to 3065, but the C channel is not connected to port Σ. Compared to the 3065, 3065A has lower loss (providing higher signal generator output level and better system sensitivity) and higher power handling, allowing direct connection to a mobile device with lower risk of damaging the combiner.

3061 has a switched 3-way output on the Σ port.

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

Click here for block schematics for each module type.

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