3010 Series RF Synthesizer PXI Module

Operating Manual

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About this manual

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

It explains how to set up and configure an Aeroflex 3010 Series RF Synthesizer 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.

Getting Started with afSigGen and *Getting Started with afDigitizer* (supplied on the CD-ROM that accompanies each module (see Associated documentation)) explain how to set up and configure a 3010 Series RF synthesizer with a 3020 Series RF signal generator module or a 3030 Series RF digitizer module. Using the soft front panels and/or dll or COM object supplied, the modules form instruments that provide the functionality and performance of integrated, highly-specified signal generators or digitizers, but with the adaptability to satisfy a diverse range of test or measurement requirements.

Intended audience

Users who need to synthesize signals in the range 1.5 GHz to 3.0 GHz.

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

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 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.
Getting Started with afSigGen	Part no. 46892/678	Setting up and using the signal generator application for 3010 Series and 3020 Series modules.
Getting Started with afDigitizer	Part no. 46892/676	Setting up and using the RF digitizer application for 3010 Series and 3030 Series modules.

Preface

Patent protection

The 3010 Series RF Synthesizer PXI module is protected by the following patents:

GB	2294599
US	5781600
	4609881
EP	0125790

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
dBm	Decibels relative to 1 mW
FPGA	Field Programmable Gate Array
GND	Ground
ISP	In-System Programming
LO	Local Oscillator
PCI	Peripheral Component Interconnect
Pk-Pk	Peak-to-Peak
PXI	PCI eXtensions for Instrumentation
RF	Radio Frequency
RMS	Root Mean Square
SDRAM	Synchronous Dynamic RAM
SFP	Soft Front Panel
SMA	SubMiniature version A (connector)
TTL	Transistor-Transistor Logic
UUT	Unit Under Test
VCO	Voltage-Controlled Oscillator
VXI	VMEbus Extension for Instrumentation

Chapter 1 GENERAL INFORMATION

Introduction

Welcome to the operating manual for the 3010 and 3011 ('3010 Series') RF Synthesizer PXI modules. These high-performance frequency synthesizers:

- cover the frequency range 1.5 GHz to 3.0 GHz with 1 Hz resolution.

- use a single-width 3U module to provide the noise performance and frequency agility of conventional rack instruments.

- can be used as stand-alone frequency synthesizers, or as core synthesizers providing a local oscillator for the 3020 Series digital RF signal generator or the 3030 Series RF digitizer. The 3011 additionally provides a stable common 10 MHz reference to the 3020 and 3030 Series.

Applications

Used with the 3020 Series, the 3010/3011 form an IQ modulated signal source with a potential maximum frequency range of 86 MHz up to 6 GHz and output level range of +5 dBm to −120 dBm.

Used with the 3030 Series, the 3010/3011 form an RF digitizer for input signals in a potential maximum frequency range of 330 MHz to 6 GHz, and up to 33 MHz in bandwidth.

High stability frequency reference

The 3010 is supplied for use with either an internal VCXO frequency standard or an external 10 MHz frequency reference. The 3011 is a high stability variant, fitted with an OCXO.

Software

The 3010/3011 are supplied with a VXIplug&play driver and soft front panel, and a dll and COM object that provide similar functionality to the driver.

PXI Studio, 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. 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

- 3010 or 3011 RF Synthesizer 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

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.

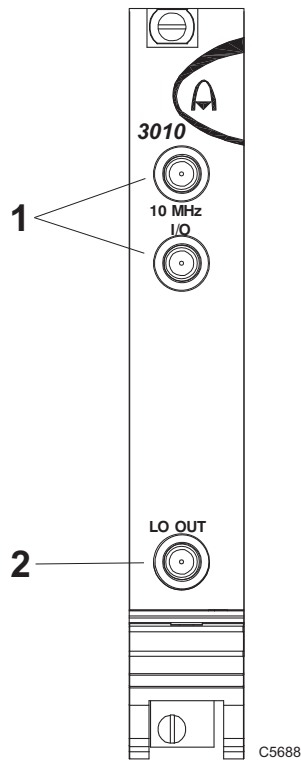Do not use other cleaners, as they can cause damage to the plastic insulators within the connectors.

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

1   10 MHz I/O   Two SMA I/O sockets in parallel.

See *10 MHz I/O sockets*.

Input (3010 and 3011)
Frequency standard input.

Output (3011 only)
Frequency standard output.

2   LO OUT   1.5 to 3 GHz RF output (fixed level, in range −4 to +3 dBm). SMA socket, 50 Ω.

Fig. 3-1 3010 front panel (3011 is similar)

10 MHz I/O sockets

These are two I/O sockets, wired in parallel, which can be used to 'loop through' signals. Both the 3010 and 3011 can accept an external frequency standard input at these sockets. The 3011 can also output a 10 MHz reference from its OCXO on these sockets. The 3010 does not output a 10 MHz signal.

The sockets can be used to link signals between modules and other equipment, in which case their impedance can be set high. If the module is terminating a signal, the sockets' impedance can be set low.

Input (3010 and 3011)

Frequency standard input. SMA socket, high or low (50 Ω) impedance. 0.4 to 4 V pk-pk sine or TTL.

Locking range 10 MHz ±100 Hz.

Set the module to External reference mode to input a frequency standard.

Output (3011 only)

10 MHz frequency standard output from OCXO. 2 V pk-pk nominal square wave. SMA socket, TTL into 50 Ω.

Soft front panel (af3010_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 afDigitizer or afSigGen dll or COM object.

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 *AF3010_sfp.exe* file; this is in the *C:\VXIPNP\WinNT\af3010* directory on a Windows NT machine, for example. It is also accessible from the Windows Start menu under *Programs\Aeroflex\PXI Module Front Panels\AF3010 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 3-12). 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.
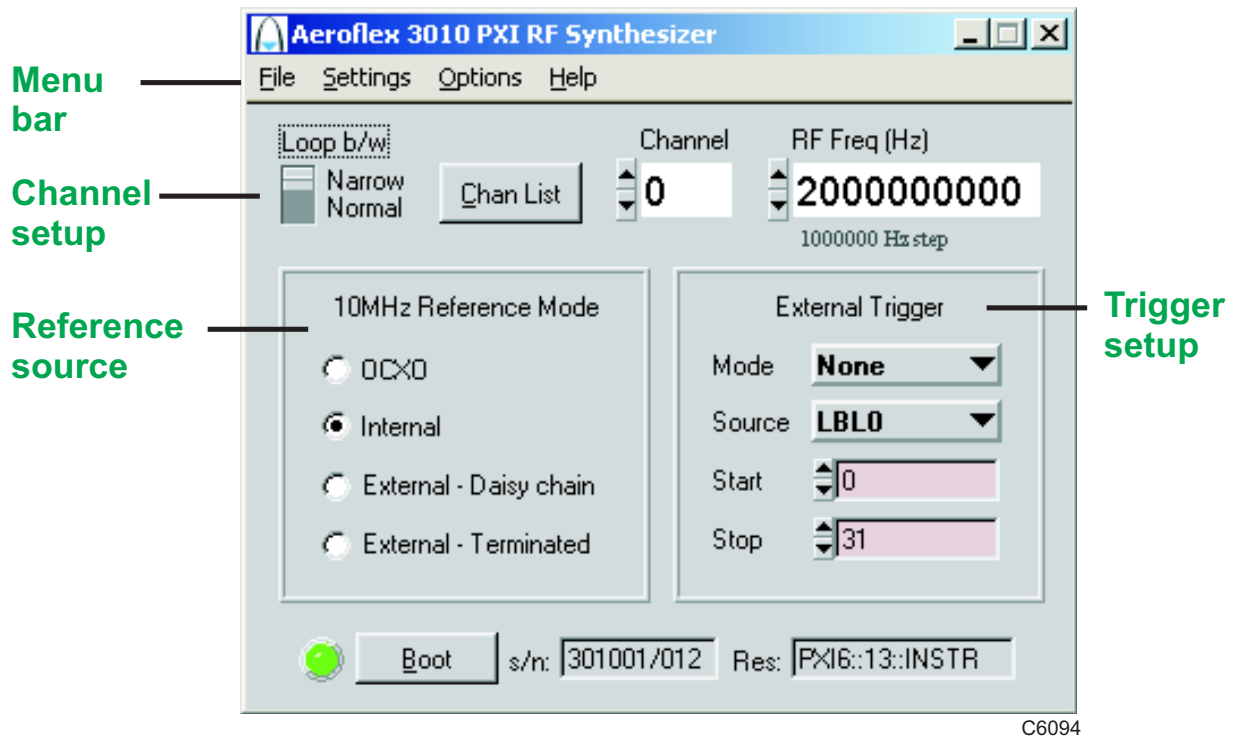
Fig. 3-2 Synthesizer soft front panel

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\af3010\settings, and configurations are saved as *.ini files.

> You can edit settings files as required; for example, you may want to save only a new RF frequency 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 lets you choose the location for your front-panel configuration settings.

Options

Allows you to enable or disable additional instrument options if you have the appropriate password (available from the Sales Desk).

Click **Edit**. Disabled options are shown grayed out. To enable an option, enter the appropriate password. Click **Enable**. The enabled option is shown highlighted in green. Click **OK**.

Help

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

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

<u>B</u>oot

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

Select the 3010 or 3011 you want to boot. Note that the Boot Resource window makes no distinction between 3011 (synthesizer module with OCXO) and 3010 (synthesizer module), showing both as '3010'.

Check the box to use the boot default configuration. Do not change the configuration unless you are advised otherwise.

Click <u>**OK**</u>. 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.

Channel setup

Loop b/w

Click to toggle between Narrow and Normal. Select Narrow loop bandwidth for better phase noise, or Normal for fastest switching speed consistent with good signal quality.

<u>C</u>han List

The Chan List box allows you to select the current channel in non-trigger mode by entering a channel number or by using the up/down arrows.

Click on **<u>C</u>han List** to view the channel frequency list (Fig. 3-3). You can set up to 128 channels for hopping, by using the up/down arrows or entering digits.
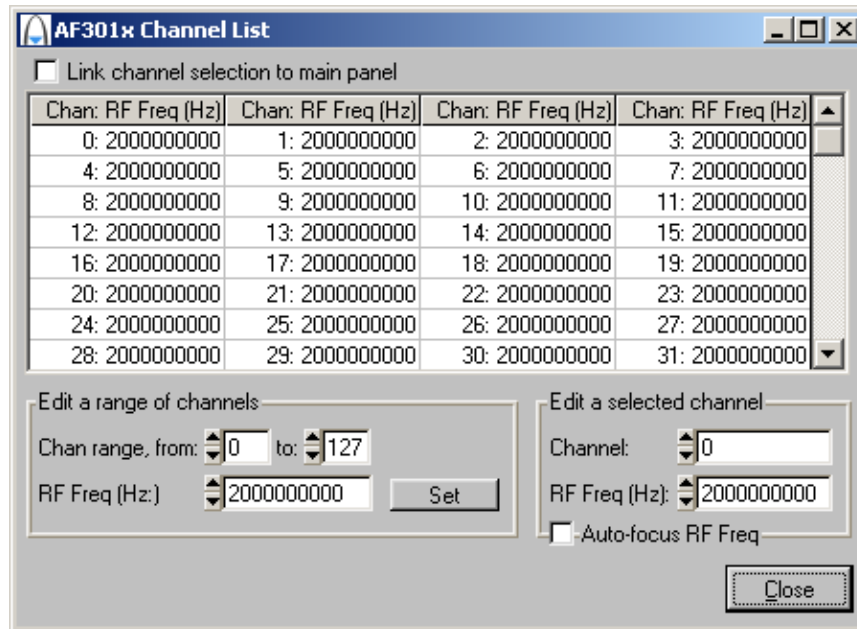

Fig. 3-3 Edit channel settings

The **Edit a range of channels** group lets you apply changes to a set of channels simultaneously, speeding up channel setup.

- Define start and finish values for address numbers in the **Chan range, from:** and **to:** fields.

- Insert values and click **Set** for each field. You are asked to confirm each action. When finished, click <u>**Close**</u> to return to the Channel List screen.

Alternatively, **Edit a selected channel** to change individual entries.

If you check the **Link channel selection to main panel** box, clicking on any channel on this screen makes it become the active channel on the soft front panel.

Check the **Auto-focus RF Freq** box to make the associated RF Freq field active when you click on a channel in the grid.

RF Freq (Hz)

Set the synthesizer frequency for the current channel using the up/down arrows or by entering the frequency in full or scientific (e) notation. If this module is being used with a 3020 Series Signal Generator or 3030 Series Digitizer module, set this value to the required LO frequency.

Step size: double-click on the step value under the frequency field to set up the size of frequency step.

Reference source

10MHz Reference Mode

OCXO

Uses the internal 10 MHz OCXO (3011 only). In this mode, the high-stability reference signal is output to the 10 MHz I/O sockets.

Internal

Uses the internal 10 MHz VCXO (3010 only). There is no output to the 10 MHz I/O sockets.

External – Daisy chain

Sets the 10 MHz I/O sockets to high impedance and applies an externally sourced 10 MHz signal to them. There is no output to the 10 MHz I/O sockets.

External – Terminated

Sets the 10 MHz I/O sockets to 50 Ω and applies an externally sourced 10 MHz signal to them. There is no output to the 10 MHz I/O sockets. Use this mode if this module is the termination for the 10 MHz standard.

Note: *to avoid interference when a 3010 or 3011 is set to Internal/OCXO, remove any external reference from the 10 MHz I/O connector.*

Trigger setup

External Trigger

Used to control channel-hopping.

Mode

None	Not in hopping mode
Advance	Step incrementally through the list of 128 channels. The Start and Stop fields let you set a subset of channels.
Toggle	Toggles between Channel 0 and Channel 1.
Hop	Receives the channel address from the PXI backplane. Provides completely independent hopping.

Source

Defines which lines on the PXI backplane are used for external triggering or addressing. Select from:

PTB	PXI Trigger Bus 0 to 7
LBR	Local Bus Right 0 to 12
LBL	Local Bus Left 0
STAR	Star trigger

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\af3010

Help

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

af3010.doc	3010 function documentation	Text file
af3010.hlp	3010 Visual BASIC function reference	Windows Help file format
af3010_C.hlp	3010 C language function reference	

We recommend that you use the C or Visual Basic formats as these are easier to navigate.
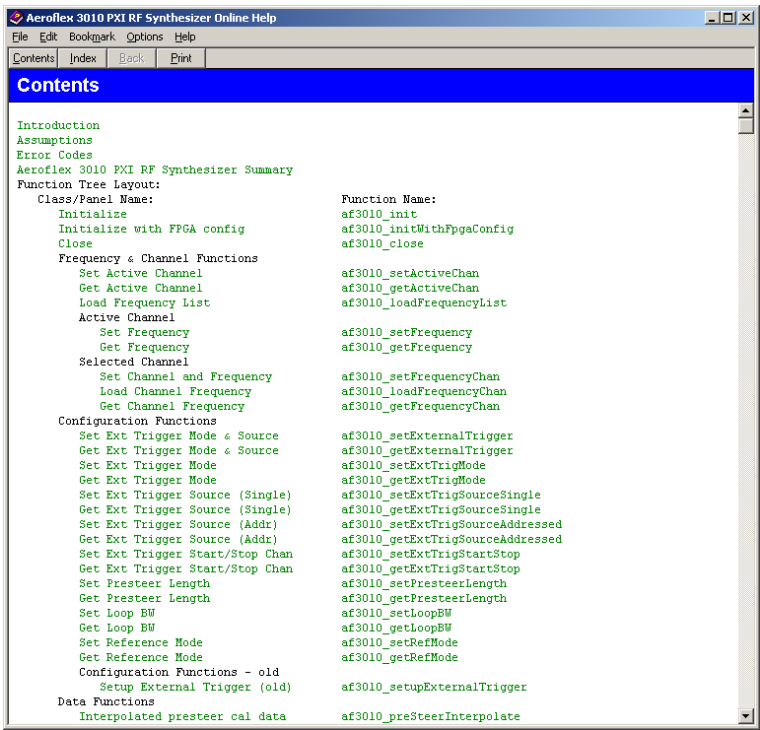
A help file opens at the Contents page:

Fig. 3-4 Online help contents — example

Hyperlinks from here take you to

Introduction

Assumptions

Error codes

Functions listings.

Function 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. An example function is shown below:
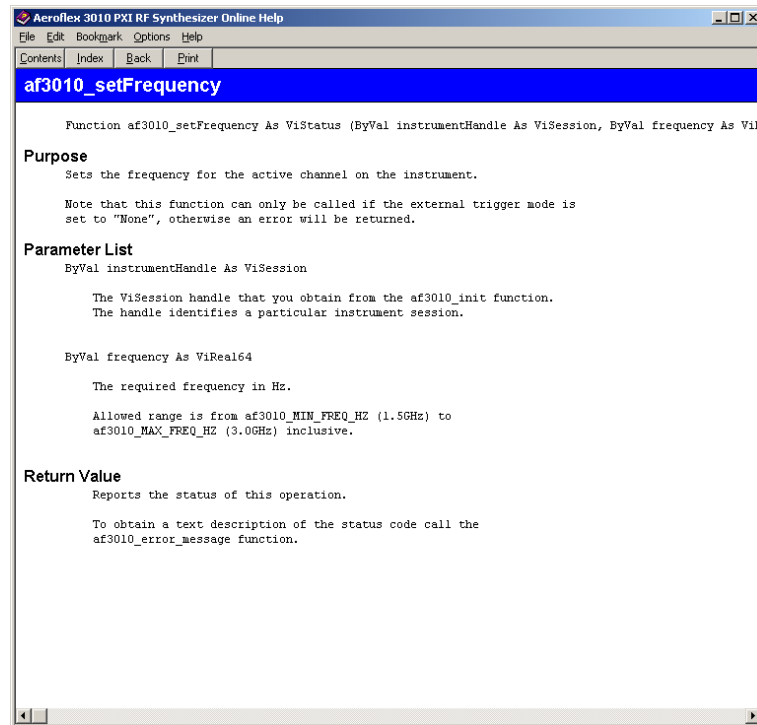

Fig. 3-5 Function listing — example

Chapter 4 BRIEF TECHNICAL DESCRIPTION

Introduction

The Aeroflex 3010 Series (comprising the 3010 and 3011 modules) is a PXI RF synthesizer covering the frequency range 1500 to 3000 MHz, with a fixed nominal output level of 0 dBm. Its primary purpose is to act as an excitation unit for an RF signal generator (Aeroflex 3020 Series), and as a local oscillator for an RF digitizer (Aeroflex 3030 Series).

The 3010 contains a single circuit board containing a PCI interface, power supply conditioning, and the fractional-N based synthesizer circuitry. Connections at the rear of the module are the two PXI connectors (J1 and J2), comprising 32-bit PCI, PXI bus extensions, and power supply. Connections at the front of the module are two 10 MHz reference input/outputs (SMA), and the RF output (SMA). A block schematic for the instrument is shown in Fig. 4-1.

The 3011 is identical to the 3010, with the exception that the 3011 has a high-stability OCXO fitted.

PCI interface

The PCI interface is implemented in an FPGA device, along with all back-end logic associated with the interface. At power-on the PCI FPGA configures automatically from an on-board ISP PROM. The FPGA I/O is powered from 3.3 V, but is compatible with both 3.3 V and 5 V signaling over the PCI backplane.

As well as the PCI configuration space, the device includes a single PCI base address register (BAR) for all communication to and from the module. This provides three serial interfaces to the rest of the module: a configuration link to the FracN device, a read/write link to the FracN device, and a read/write link to an EEPROM containing calibration and all other module-specific data.

Additional connections allow various PXI-extension signals to be routed as external triggers to the module, allowing rapid frequency switching to be controlled from other units in a complete PXI system.

Fractional-N controller

The fractional-N controller is implemented in another FPGA device. Unlike the PCI interface, this device resides inside the RF screening. Consequently only sufficient signaling for configuration and serial control of the fractional-N is passed through the screening from the PCI interface. All module control registers therefore exist in the fractional-N device, allowing control of the fractional-N divider, steering of various module DACs, and other auxiliary control.

The fractional-N divider control is pipelined, and has a modulus offset which is set to allow a 1 Hz settable resolution over the 1500 to 3000 MHz range. As well as directly controlling divider settings from a software driver, a list of frequency settings can be stored in RAM inside the fractional-N controller. These can then either be stepped through using a single external trigger, or directly addressed using a trigger bus, allowing for fast frequency switching.

Power supplies

Adjacent to the backplane connector is a voltage converter. This boosts the 5 V rail from the rack to about 6 V. It also boosts the +12 V rail to about 40 V for use in the VCO and VTF tuning circuits. The converter is based on a transformer rather than an inductor, minimizing magnetic radiation. At the rear inside the screening are two linear voltage regulators. One of these regulates the 6 V from the converter to 5 V, and the other regulates raw 5 V to 4 V for use by the RF and frequency reference circuits.

Synthesizer

This comprises a 1.5 to 3 GHz fractional-N synthesizer with 1 Hz resolution. It also contains comprehensive frequency reference facilities.

The VCO operates from 500 to 667 MHz. The third, fourth and fifth harmonics of this are used to generate the output frequency. A charge-storage diode multiplier generates harmonics, and a chain of voltage-tuned filter stages selects the desired harmonic. The filter stages incorporate limiting, the last of these doubling as an RF level detector. The output is split and buffered to provide the main output and the feedback for synthesis. The feedback path drives the programmable divider via a divide-by-two prescaler.

The 10 MHz reference is input at the reference I/O sockets or in the case of 3011 from the OCXO when selected, in which case the sockets become outputs. The signal drives a self-aligning crystal filter to enhance phase noise. This filter produces 180 degrees of phase shift when in tune. Its output is tested against a phase-shifted replica of the input using an XOR gate as a phase detector. The error is integrated and adjusts the tuning voltage to the filter. In the absence of either an OCXO or an external reference the filter can be run as an oscillator to provide a simple stand-alone frequency reference, in which case the self-aligning is disabled and the tuning is controlled directly by the reference DACs.

The divider output and the conditioned reference drive the inputs of the main phase-frequency detector. The output is low if the divider frequency is lower than the reference frequency and high if it is higher. When the frequencies are the same the output is a rectangular wave at 10 MHz. The mark-to-space ratio then varies with the relative phase of the signals and is a square-wave when fully locked. This signal is converted to a current that is filtered and then integrated in the loop filter. Loop gain is trimmed by switching the value of bias resistors in the voltage-to-current converter. Low loop bandwidth is selected by switching in extra shunt components in the loop filter.

The main VCO is differentially tuned. The loop filter voltage is applied to the negative input and a pre-steer voltage is applied to the positive input. The pre-steer voltage is set such that the loop filter voltage is 2.5 V $\pm$ 0.5 V. A second steer voltage is applied to the voltage-tuned filter. Both voltages are derived from 8-bit DACs and amplified to cover the range 0 to 30 V. Gating allows fast switching but suppresses DAC and amplifier noise under normal operation.

Several readbacks are provided for calibration and diagnostic purposes. The crystal filter loop has low and high indicators to check the validity of an external reference. The loop filter has three readbacks. Two monitor the voltage continuously and read back if the voltage is out of limits. The third is used in calibration to set the voltage to 2.5 V, and is normally disabled to prevent the possibility of interference from spurious toggling. A fourth comparator is used in conjunction with the RF limiter/detector and the reference DACs to enable peaking of the VTF during calibration. Again, this comparator is normally disabled.
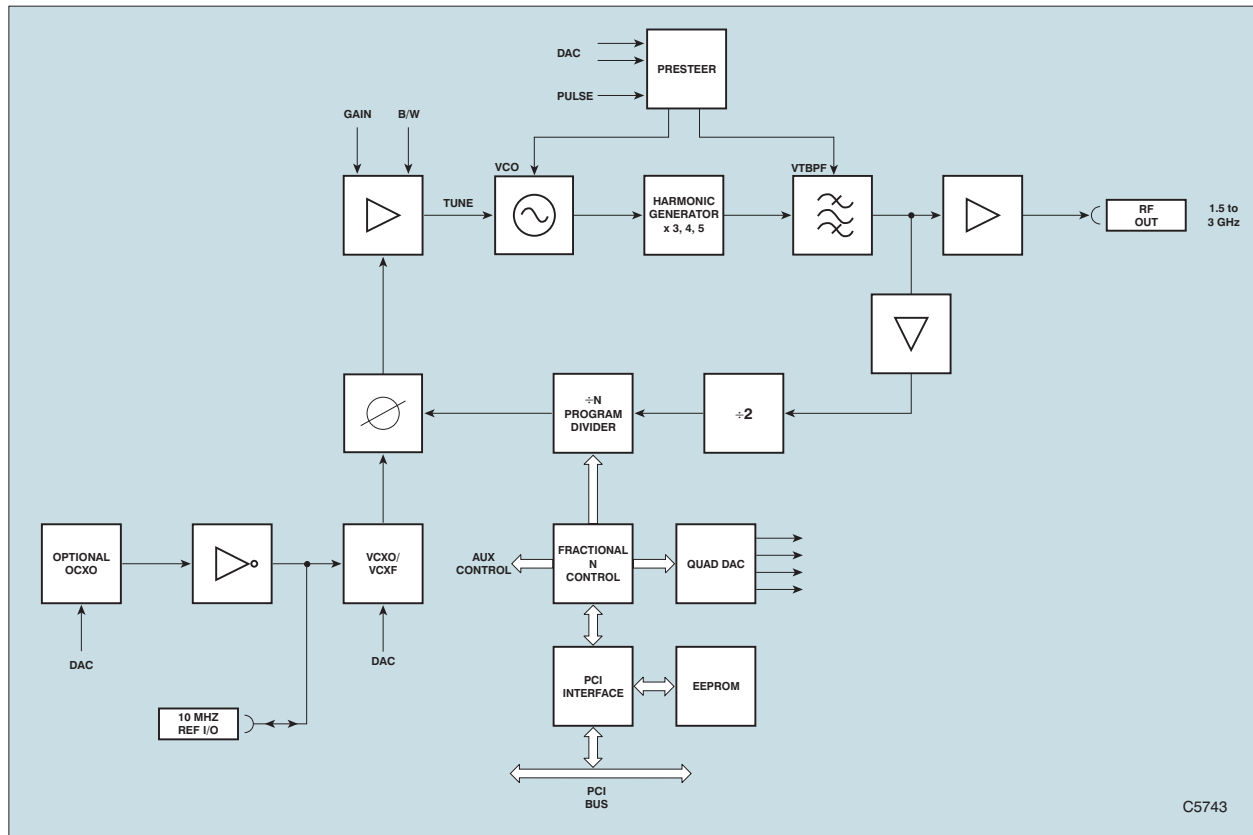
Fig. 4-1 Block schematic diagram

Chapter 5 ACCEPTANCE TESTING

Introduction

The test procedures in this chapter enable you to verify that the 3010/3011 RF Synthesizer 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.

Control of the 3010/3011 UUT is via the supplied SFP.

Each test procedure relies on the UUT 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.

For clarity, the PXI rack and controller are not shown in the test equipment set-up 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
Frequency counter	3 GHz	Agilent 53181A	Frequency accuracy
Power meter and sensor	1.5 GHz to 3 GHz	Aeroflex 6960B and 6912	RF level accuracy
Oscilloscope	10 MHz	Tektronix TDS3032	10 MHz reference output
Function generator	10 MHz, 0.4–4 V	Agilent 33250	10 MHz reference input

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 3010 or 3011 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 rack and that the supplied installation software is installed on the host controller.

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

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

- Double-click on the af3010_SFP icon.

The 3010 SFP now starts up. After completing its boot up sequence, the indicator next to the **Boot** button should be red.

- Click on **Boot**.
- If other 3010 or 3011 PXI modules are fitted in the rack, ensure you select the appropriate resource from the list.
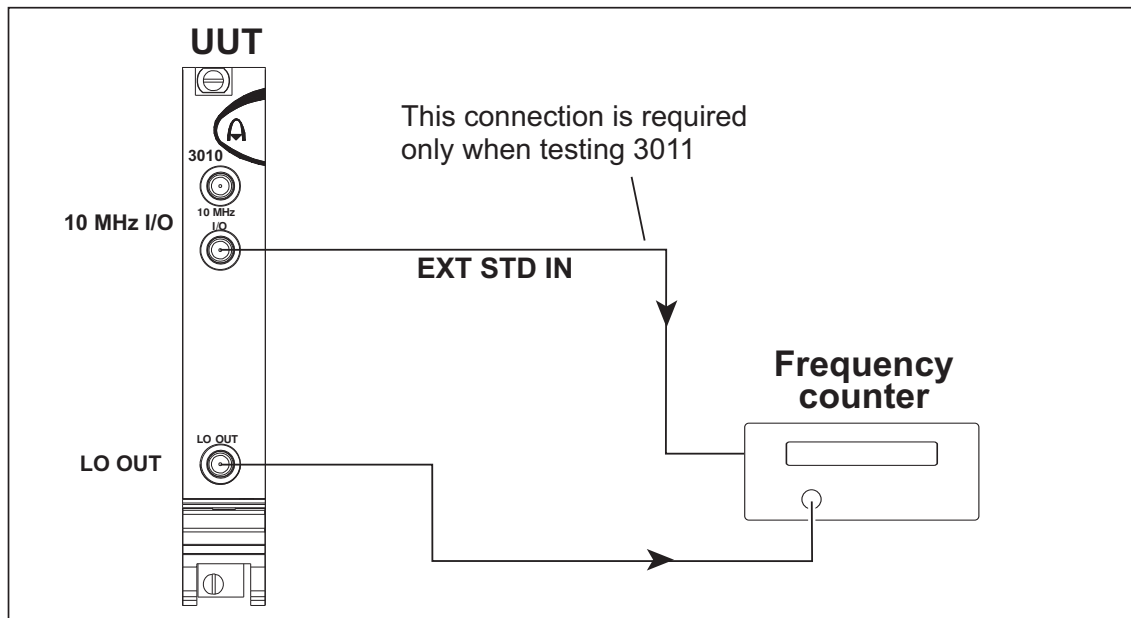- Click on **OK**.

While the 3010 or 3011 is booting, the indicator turns amber.

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

Carrier frequency test

This test checks the module's frequency locking circuitry. It confirms the correct operation of phase locked loops and dividers.

In the case of 3011, the accuracy is determined by the module's internal reference standard. By using the 3011's reference output as the reference frequency for the frequency counter, the test limits are ±1 count.

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Fig. 5-1 Carrier frequency accuracy test setup

1   Connect the test equipment as shown in Fig. 5-1.

2   On the UUT set:

10MHz Reference Mode	Internal	(3010)
10MHz Reference Mode	OCXO	(3011)
RF Freq (Hz)	1500000000	
	(may be entered as 1.5e9)	

3   Record the frequency measured by the frequency counter against each of the LO frequencies shown in Table 5-1 (3010) or Table 5-2 (3011).

Table 5-1 3010 LO frequency results

Carrier frequency	Minimum (Hz)	Result (Hz)	Maximum (Hz)
1500 MHz	—		—
2000 MHz	—		—
2500 MHz	—		—
3000 MHz	—		—

Table 5-2 3011 LO frequency results

Carrier frequency	Minimum (Hz)	Result (Hz)	Maximum (Hz)
1500 MHz	1 499 999 999		1 501 000 001
2000 MHz	1 999 999 999		2 000 000 001
2500 MHz	2 499 999 999		2 500 000 001
3000 MHz	2 999 999 999		3 000 000 001

RF output level test

The RF output level test ensures correct operation of the signal generator's level control circuitry.
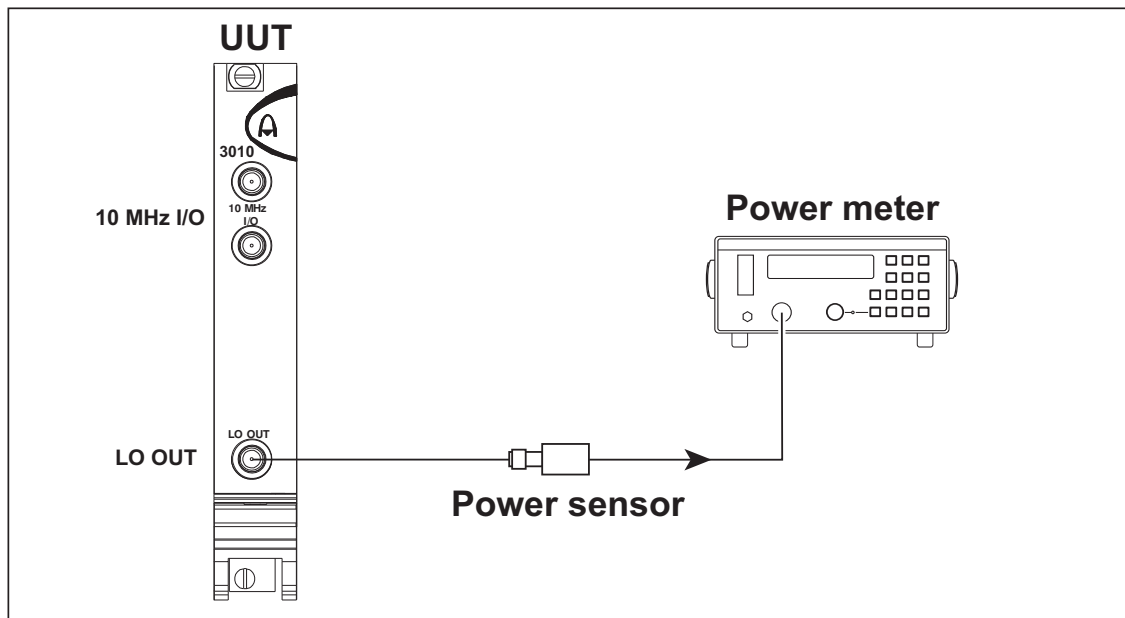
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Fig. 5-2 LO output level test setup

1 Connect the test equipment as shown in Fig. 5-2.

2 On the UUT set:

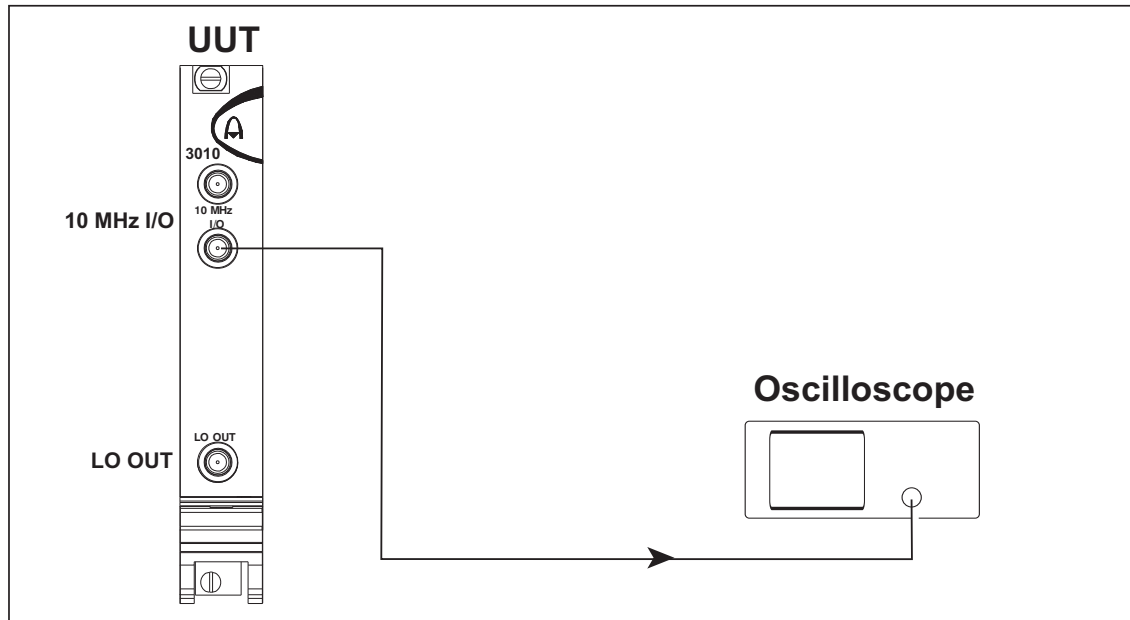|		
10MHz Reference Mode	Internal	(3010)
10MHz Reference Mode	OCXO	(3011)
RF Freq (Hz)	1500000000	
	(may be entered as 1.5e9)	

3   Record the output level measured by the power meter against each of the LO frequencies shown in Table 5-3.

Table 5-3 LO output level results

Carrier frequency	Minimum (dBm)	Result (dBm)	Maximum (dBm)
1500 MHz	−4		+3
1625 MHz	−4		+3
1750 MHz	−4		+3
1875 MHz	−4		+3
2000 MHz	−4		+3
2125 MHz	−4		+3
2250 MHz	−4		+3
2375 MHz	−4		+3
2500 MHz	−4		+3
2625 MHz	−4		+3
2750 MHz	−4		+3
2875 MHz	−4		+3
3000 MHz	−4		+3

10 MHz reference output test — 3011 only

This test confirms correct operation of the 10 MHz reference output on the 3011.

Fig. 5-3 10 MHz reference output test setup

1   Connect the test equipment as shown in Fig. 5-3.

2   On the UUT set:

     10MHz Reference Mode   OCXO

3   On the oscilloscope, check that a 2 V pk-pk (nominal) square wave is displayed.

10 MHz reference input test

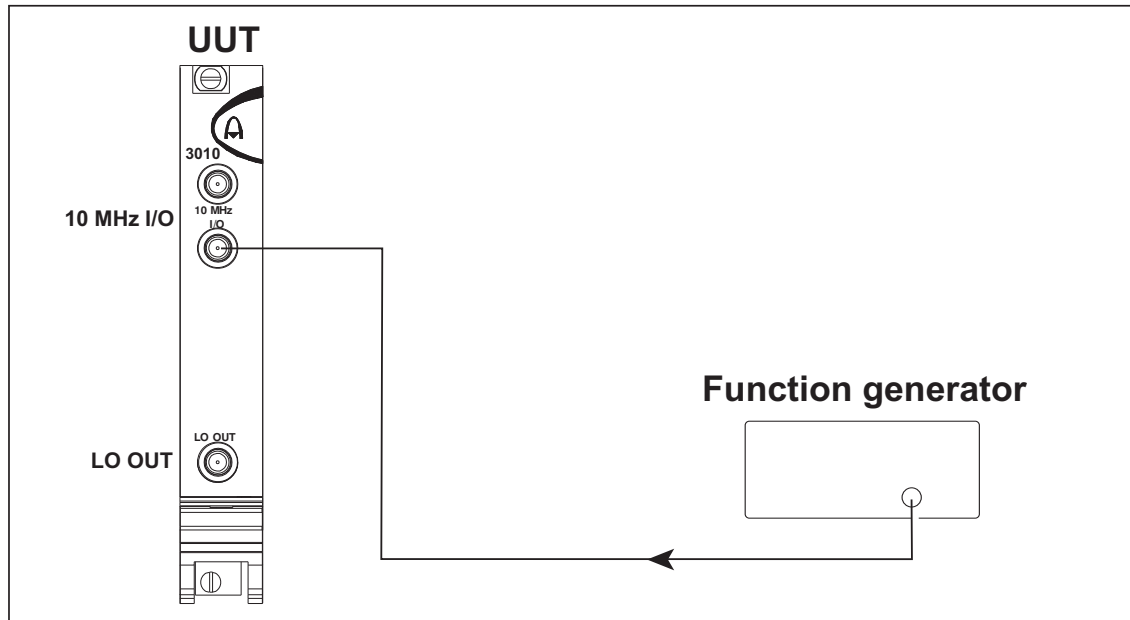This test confirms correct operation of the 10 MHz input.

C5939

Fig. 5-4 10 MHz reference input test setup

1   Connect the test equipment as shown in Fig. 5-4.

2   On the UUT set:

    10MHz Reference Mode   External

3   Set the function generator to 9 999 900 Hz, 0.4 V pk-pk.

4   Check that no error messages are generated by the UUT via the SFP and tick the appropriate box in Table 5-4.

5   Set the function generator to 4 V pk-pk and repeat (4) above.

6   Set the function generator to 10 000 100 Hz and repeat (4) above.

7   Set the function generator to 0.4 V pk-pk and repeat (4) above.

Table 5-4 10 MHz reference frequency input results

Test frequency (Hz)	Test level (V pk-pk)	(✓)
9 999 900	0.4	
9 999 900	4	
10 000 100	4	
10 000 100	0.4	

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