

Series 2800 RF Vector Signal Analyzer

Quick Start Guide

2800S-903-01 Rev. A / September 2007

WARRANTY

Keithley Instruments, Inc. warrants this product to be free from defects in material and workmanship for a period of three (3) years from date of shipment.

Keithley Instruments, Inc. warrants the following items for 90 days from the date of shipment: probes, cables, software, rechargeable batteries, diskettes, and documentation.

During the warranty period, Keithley Instruments, will, at its option, either repair or replace any product that proves to be defective.

To exercise this warranty, write or call your local Keithley Instruments representative, or contact Keithley Instruments headquarters in Cleveland, Ohio. You will be given prompt assistance and return instructions. Send the product, transportation prepaid, to the indicated service facility. Repairs will be made and the product returned, transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days.

LIMITATION OF WARRANTY

This warranty does not apply to defects resulting from product modification without Keithley's express written consent, or misuse of any product or part. This warranty also does not apply to fuses, software, non-rechargeable batteries, damage from battery leakage, or problems arising from normal wear or failure to follow instructions.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE. THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES.

NEITHER KEITHLEY INSTRUMENTS, INC. NOR ANY OF ITS EMPLOYEES SHALL BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OF ITS INSTRUMENTS AND SOFTWARE EVEN IF KEITHLEY INSTRUMENTS, INC., HAS BEEN ADVISED IN ADVANCE OF THE POSSIBILITY OF SUCH DAMAGES. SUCH EXCLUDED DAMAGES SHALL INCLUDE, BUT ARE NOT LIMITED TO: COSTS OF REMOVAL AND INSTALLATION, LOSSES SUSTAINED AS THE RESULT OF INJURY TO ANY PERSON, OR DAMAGE TO PROPERTY.



A GREATER MEASURE OF CONFIDENCE

Keithley Instruments, Inc.

Corporate Headquarters • 28775 Aurora Road • Cleveland, Ohio 44139
440-248-0400 • Fax: 440-248-6168 • 1-888-KEITHLEY (1-888-534-8453) • www.keithley.com

Series 2800 Vector Signal Analyzer

Quick Start Guide

©2007, Keithley Instruments, Inc.
All rights reserved.
Cleveland, Ohio, U.S.A.
2800S-903-01 Rev. A / September 2007

Manual Print History

The print history shown below lists the printing dates of all revisions and addenda created for this manual. The revision level letter increases alphabetically as the manual undergoes subsequent updates. Addenda, which are released between revisions, contain important change information that the user should incorporate immediately into the manual. Addenda are numbered sequentially. When a new revision is created, all addenda associated with the previous revision of the manual are incorporated into the new revision of the manual. Each new revision includes a revised copy of this print history page.

Document Number: 2800S-903-01 Rev. A / September 2007

All Keithley Instruments product names are trademarks or registered trademarks of Keithley Instruments, Inc.

Other brand names are trademarks or registered trademarks of their respective holders.

The following safety precautions should be observed before using this product and any associated instrumentation. Although some instruments and accessories would normally be used with non-hazardous voltages, there are situations where hazardous conditions may be present.

This product is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read and follow all installation, operation, and maintenance information carefully before using the product. Refer to the user documentation for complete product specifications.

If the product is used in a manner not specified, the protection provided by the product warranty may be impaired.

The types of product users are:

Responsible body is the individual or group responsible for the use and maintenance of equipment, for ensuring that the equipment is operated within its specifications and operating limits, and for ensuring that operators are adequately trained.

Operators use the product for its intended function. They must be trained in electrical safety procedures and proper use of the instrument. They must be protected from electric shock and contact with hazardous live circuits.

Maintenance personnel perform routine procedures on the product to keep it operating properly, for example, setting the line voltage or replacing consumable materials. Maintenance procedures are described in the user documentation. The procedures explicitly state if the operator may perform them. Otherwise, they should be performed only by service personnel.

Service personnel are trained to work on live circuits, perform safe installations, and repair products. Only properly trained service personnel may perform installation and service procedures.

Keithley Instruments products are designed for use with electrical signals that are rated Measurement Category I and Measurement Category II, as described in the International Electrotechnical Commission (IEC) Standard IEC 60664. Most measurement, control, and data I/O signals are Measurement Category I and must not be directly connected to mains voltage or to voltage sources with high transient over-voltages. Measurement Category II connections require protection for high transient over-voltages often associated with local AC mains connections. Assume all measurement, control, and data I/O connections are for connection to Category I sources unless otherwise marked or described in the user documentation.

Exercise extreme caution when a shock hazard is present. Lethal voltage may be present on cable connector jacks or test fixtures. The American National Standards Institute (ANSI) states that a shock hazard exists when voltage levels greater than 30V RMS, 42.4V peak, or 60VDC are present. A good safety practice is to expect that hazardous voltage is present in any unknown circuit before measuring.

Operators of this product must be protected from electric shock at all times. The responsible body must ensure that operators are prevented access and/or insulated from every connection point. In some cases, connections must be exposed to potential human contact. Product operators in these circumstances must be trained to protect themselves from the risk of electric shock. If the circuit is capable of operating at or above 1000V, no conductive part of the circuit may be exposed.

Do not connect switching cards directly to unlimited power circuits. They are intended to be used with impedance-limited sources. NEVER connect switching cards directly to AC mains. When connecting sources to switching cards, install protective devices to limit fault current and voltage to the card.

Before operating an instrument, ensure that the line cord is connected to a properly-grounded power receptacle. Inspect the connecting cables, test leads, and jumpers for possible wear, cracks, or breaks before each use.

When installing equipment where access to the main power cord is restricted, such as rack mounting, a separate main input power disconnect device must be provided in close proximity to the equipment and within easy reach of the operator.

For maximum safety, do not touch the product, test cables, or any other instruments while power is applied to the circuit under test. ALWAYS remove power from the entire test system and discharge any capacitors before: connecting or disconnecting cables or jumpers, installing or removing switching cards, or making internal changes, such as installing or removing jumpers.

Do not touch any object that could provide a current path to the common side of the circuit under test or power line (earth) ground. Always make measurements with dry hands while standing on a dry, insulated surface capable of withstanding the voltage being measured.


The instrument and accessories must be used in accordance with its specifications and operating instructions, or the safety of the equipment may be impaired.


Do not exceed the maximum signal levels of the instruments and accessories, as defined in the specifications and operating information, and as shown on the instrument or test fixture panels, or switching card.


When fuses are used in a product, replace with the same type and rating for continued protection against fire hazard.

Chassis connections must only be used as shield connections for measuring circuits, NOT as safety earth ground connections.

If you are using a test fixture, keep the lid closed while power is applied to the device under test. Safe operation requires the use of a lid interlock.


If a  screw is present, connect it to safety earth ground using the wire recommended in the user documentation.

The  symbol on an instrument indicates that the user should refer to the operating instructions located in the user documentation.

The  symbol on an instrument shows that it can source or measure 1000V or more, including the combined effect of normal and common mode voltages. Use standard safety precautions to avoid personal contact with these voltages.

The  symbol on an instrument shows that the surface may be hot. Avoid personal contact to prevent burns.

The  symbol indicates a connection terminal to the equipment frame.

If this  symbol is on a product, it indicates that mercury is present in the display lamp. Please note that the lamp must be properly disposed of according to federal, state, and local laws.

The **WARNING** heading in the user documentation explains dangers that might result in personal injury or death. Always read the associated information very carefully before performing the indicated procedure.

The **CAUTION** heading in the user documentation explains hazards that could damage the instrument. Such damage may invalidate the warranty.

Instrumentation and accessories shall not be connected to humans.

Before performing any maintenance, disconnect the line cord and all test cables.

To maintain protection from electric shock and fire, replacement components in mains circuits - including the power transformer, test leads, and input jacks - must be purchased from Keithley Instruments. Standard fuses with applicable national safety approvals may be used if the rating and type are the same. Other components that are not safety-related may be purchased from other suppliers as long as they are equivalent to the original component (note that selected parts should be purchased only through Keithley Instruments to maintain accuracy and functionality of the product). If you are unsure about the applicability of a replacement component, call a Keithley Instruments office for information.

To clean an instrument, use a damp cloth or mild, water-based cleaner. Clean the exterior of the instrument only. Do not apply cleaner directly to the instrument or allow liquids to enter or spill on the instrument. Products that consist of a circuit board with no case or chassis (e.g., a data acquisition board for installation into a computer) should never require cleaning if handled according to instructions. If the board becomes contaminated and operation is affected, the board should be returned to the factory for proper cleaning/servicing.

Table of Contents

Installing the System	1-1
Introduction.....	1-1
Unpacking and inspecting the system.....	1-1
Inspection for damage.....	1-1
Shipment contents	1-2
Available options for the Series 2800.....	1-2
Repacking for return shipment.....	1-3
Becoming familiar with the instrument	1-3
Specifications	1-8
Locating the instrument in the proper environment.....	1-9
Installing the instrument in a rack.....	1-9
Powering the Series 2800 Vector Signal Analyzer	1-10
Replacing a fuse	1-11
Verifying license options	1-11
Purchasing modulation licenses.....	1-12
Connecting system components.....	1-12
GPIB connections	1-13
LAN (Ethernet) connections	1-13
USB connections	1-13
Configuring the system for remote control or network	1-14
GPIB interface configuration	1-14
LAN (Ethernet) interface configuration	1-15
USB configuration	1-20
Access the Series 2800 from your PC	1-21
Making Measurements	2-1
Frequency domain (two-tone) measurements	2-1
Time domain (GSM) measurements	2-2
Getting Information from Help	3-1
Accessing Help.....	3-1
Help from the front panel.....	3-1
Help from the CD-ROM.....	3-1

Table of Figures

Figure 1: Front panel features..... 1-4

Figure 2: Rear panel features 1-5

Figure 3: User interface features..... 1-7

Installing the System

In this section

Introduction.....	1-1
Unpacking and inspecting the system	1-1
Becoming familiar with the instrument.....	1-3
Specifications	1-8
Locating the instrument in the proper environment	1-8
Installing the instrument in a rack	1-9
Powering the Series 2800 Vector Signal Analyzer	1-10
Verifying license options.....	1-11
Connecting system components	1-12
Configuring the system for remote control or network	1-14

Introduction

If you have any questions after reviewing this information, please contact your local Keithley Instruments representative or call one of our Applications Engineers at 1-888-KEITHLEY (1-888-534-8453) or contact us through our website at www.keithley.com.

Unpacking and inspecting the system

Inspection for damage

After unpacking the Keithley Instruments Series 2800 Vector Signal Analyzer, carefully inspect the unit for any shipping damage. Report any damage to the shipping agent immediately, as such damage is not covered by the warranty (warranty information can be found at the beginning of this manual).

Shipment contents

The following items are included with every Series 2800 Vector Signal Analyzer order:

- Series 2800 Vector Signal Analyzer Product Information CD-ROM (containing software, drivers, and the Series 2800 Help system)
- AC power cord
- Series 2800 Vector Signal Analyzer Quick Start Guide
- Calibration certificate

One of the following models:

- 2810-F Front RF output with bench-top bumpers and handles
- 2810-R Rear RF output with bench-top bumpers and handles
- 2810-FRK Front RF output with Rack-Mount Kit
- 2810-RRK Rear RF output with Rack-Mount Kit
- 2820-F Front RF output with bench-top bumpers and handles
- 2820-R Rear RF output with bench-top bumpers and handles
- 2820-FRK Front RF output with Rack-Mount Kit
- 2820-RRK Rear RF output with Rack-Mount Kit

Available options for the Series 2800

The following items are options than can be ordered for the Model 2810:

- License Option 2810-CDMA-R (cdma2000® and IS-95a reverse link signal analysis personality)
- License Option 2810-GSM (GSM, GPRS, and EDGE signal analysis personality)
- License Option 2810-WCDMA-U (W-CDMA FDD uplink signal analysis personality)
- License Option 2810-WCDMA-D (W-CDMA FDD downlink signal analysis personality)
- RF INSTRUMENTS-RMK Dual Fixed Rack Mounting Kit with flanges
- RF INSTRUMENTS-BENCH-KIT Bench-top Kit with bumpers and handles

The following items are options than can be ordered for the Model 2820:

- Option 004: 400MHz to 4GHz
- Option 006: 400MHz to 6GHz
- License Option 2820-CDMA-R (cdma2000® and IS-95a reverse link signal analysis personality)
- License Option 2820-GSM (GSM, GPRS, and EDGE signal analysis personality)
- License Option 2820-WCDMA-U (W-CDMA FDD uplink signal analysis personality)
- License Option 2820-WCDMA-D (W-CDMA FDD downlink signal analysis personality)
- License Option 2820-80211 (WLAN 802.11a, b, g and j signal analysis)
- RF INSTRUMENTS-RMK Dual Fixed Rack Mounting Kit with flanges
- RF INSTRUMENTS-BENCH-KIT Bench-top Kit with bumpers and handles

Repacking for return shipment

Should it become necessary to return the Series 2800 for repair, carefully pack the entire unit in its original packing carton or the equivalent, and perform the following steps:

- Review the warranty information located at the front of this manual.
- Contact Keithley Instruments to get a Return Material Authorization (RMA). You can contact Keithley Instruments through your local Keithley Instruments representative; by calling the Keithley Instruments factory at 1-888-534-8453 (1-888-KEITHLEY); or through the Keithley Instruments website at www.keithley.com.
- On the shipping label, write ATTENTION REPAIR DEPARTMENT and the RMA number.
- Complete and include the Service Form located at the back of this manual.

NOTE: The Service Form requires the serial number of the Series 2800. The serial number label is located on the rear panel of the instrument. The serial number can also be read from the instrument front panel interface by selecting Menu > Help > About Keithley Series 2800.

Becoming familiar with the instrument

WARNING: *The safe procedure to power-up the Series 2800 is provided in “Powering the Series 2800 Vector Signal Analyzer.” Do not turn on the Series 2800 until you have reviewed that information. Also, please review the Safety Precautions information at the beginning of this manual.*

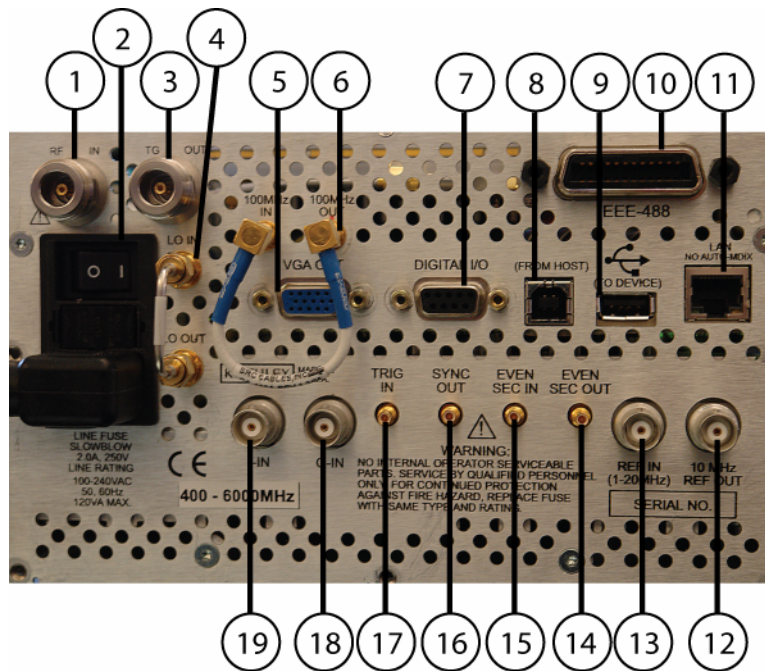
Figure 1: Front panel features



1. Display/touch screen displays the state of the instrument, allows input of settings, and is the primary mechanism for entering data.
2. Rotary knob changes the value of the selected numeric parameter.
3. Puck/arrow keys change the value of the selected numeric parameters incrementally, or in a user-defined step.
4. Puck center button brings up the on-screen numeric entry keypad.
5. TG output connector is a tracking generator output that provides a frequency sweep of fixed amplitude. This output can be cabled through a device under test (filter) for testing. When used in calibration, its output is internally switched to RF In.
6. RF In connector receives the RF signal from an RF signal source for instruments that have a front Type-N RF input (Models 2810-F and 2810-FRK). This input accepts signals in one of the following ranges, depending on the instrument model:
 - Model 2810: 400MHz to 2.5GHz
 - Model 2820 option 004: 400MHz to 4GHz
 - Model 2820 option 006: 400MHz to 6GHz
7. Local button switches the instrument to front panel control after remote use.
8. USB port connects to USB devices: mouse, keyboard, or USB flash drives.

9. USB port connects to USB devices: mouse, keyboard, or USB flash drives.
10. Preset button sets the instrument to a state of initialized default settings.
11. Power button switches the instrument power on and off.

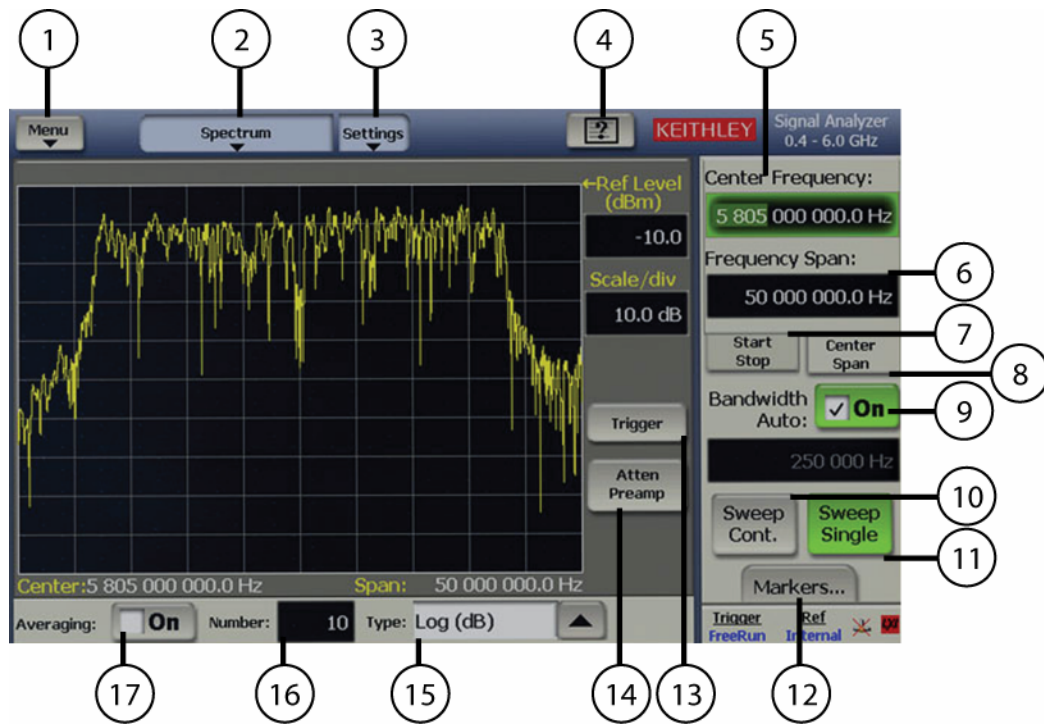
Figure 2: Rear panel features



1. RF IN receives the RF signal from instruments that have a rear Type-N RF output (Models 2810-R and 2810-RRK). This input accepts signals in one of the following ranges, depending on the instrument model:
 - Model 2810: 400MHz to 2.5GHz
 - Model 2820 option 004: 400MHz to 4GHz
 - Model 2820 option 006: 400MHz to 6GHz.
2. Power inlet/switch, fuse module connects the instrument to AC power.
3. TG output connector is a tracking generator output (for Models 2810-R and 2810-RRK) that provides a frequency sweep of fixed amplitude. This output can be cabled through a DUT (filter) for testing. When used in calibration, its output is internally switched to RF In.

4. For future use.
5. VGA OUT connects the instrument display to an external monitor.
6. For future use.
7. Digital I/O outputs four programmable TTL signals.
8. USB (from host) connects to a USB port on a computer. The computer can then remotely control the instrument
9. USB (to device) connects to a USB device such as a mouse, keyboard, or flash drive.
10. GPIB connects to the GPIB control bus for remote operation.
11. LAN connects to an Ethernet network for remote operation.
12. REF OUT provides a frequency reference to synchronize other instruments (10MHz).
13. REF IN synchronizes the internal frequency reference to an external frequency reference (programmable from 1MHz to 20MHz in 10Hz increments).
14. EVEN SEC OUT provides an even-second clock to synchronize other instruments.
15. EVEN SEC IN synchronizes the internal frequency reference to an even-second clock.
16. SYNC OUT provides a signal for synchronizing events. It is often used in conjunction with the trigger input signal to notify another device that the requested event has been performed.
17. TRIG IN accepts a trigger from an external device to initiate an event in the Series 2800.
18. Q-IN accepts an external signal to directly drive the Q-input of the I/Q modulator.
19. I-IN accepts an external signal to directly drive the I-input of the I/Q modulator.

Figure 3: User interface features



1. Menu displays a drop-down menu that allows you to choose from File, Global Settings, Utilities, and Help.
2. Spectrum displays a drop-down menu that allows you to choose from the various modulation formats.
3. Settings displays a drop-down menu that allows you to choose from a group of settings associated with the setup and modification of the measurement.
4. Help activates the context-sensitive Help system.
5. Center Frequency shows the center frequency setting. Select to edit the value.
6. Frequency Span shows the frequency span. Select to edit the value.
7. Start Stop displays a field to enter a start frequency and a field to enter a stop frequency.
8. Center Span is a default setting that displays the center frequency field and the frequency span field.
9. Bandwidth sets the bandwidth of the channel that you specified for the channel parameter.
10. Sweep Cont. is a default setting to continuously sweep the span that you have specified.
11. Sweep Single takes one sweep of the span that you have specified.

12. Markers opens a dialog screen to enable you to set up to four markers.
13. Trigger opens a dialog screen to enable you to control triggering.
14. Atten Pre opens a dialog screen to enable you to insert an attenuator or preamplifier to optimize the signal level into the mixer section of the Series 2800.
15. Type specifies what data type is used in the measurement.
16. Number specifies how many measurements to take into consideration for the averaging calculation of the measurement results.
17. Averaging is a function that minimizes the effects of noise by averaging the results of multiple measurements. This control switches on averaging, if the check box is selected.

Specifications

Complete specifications for the Series 2800 Vector Signal Analyzer are included on the Product Information CD that came with your instrument. Please check the Keithley Instruments website at www.keithley.com for the latest updates to the specifications.

Locating the instrument in the proper environment

Locate the Series 2800 such that it will operate within the following ambient temperature and humidity limits (refer to the instrument specifications for the complete set of environmental limits):

- Temperature: 0°C to +50°C (+23°C is optimal)
- Relative humidity: 5% to 70% relative humidity (RH), non-condensing (-25°C to +65°C)

NOTE: Accuracy specifications are based on operation at 23°C \pm 5°C and between 5% and 70% RH. Refer to the product specifications for derating factors outside these ranges. Air-conditioned environments are highly recommended.

CAUTION: To avoid overheating, operate the unit only in an area with proper ventilation. Allow at least eight inches of clearance at the back of the instrument to assure sufficient airflow, and adhere to the following:

Operate the unit in a clean, dust-free environment.

Keep the rear exhaust vent free of any obstructions. Even partial blockage may impair proper cooling. Also keep at least one vent at the front of the instrument free of obstruction.

Allow at least 1U (1.75 inch) of space at the top and bottom of the instrument.

Make sure there is adequate airflow around at least one side of the instrument. Adequate air flow ensures that air temperatures around the instrument remain within specified limits under all operating conditions.

To ensure proper cooling in rack environments with only convection cooling, position the hottest equipment at the top of the rack. Place precision equipment, such as the Series 2800, as low as possible in the rack, where temperatures are the coolest. Add spacer panels below the unit to help ensure adequate airflow.

Installing the instrument in a rack

If you have a Keithley Instruments RF Instruments-RMK Dual Fixed Rack-Mounting Kit with flanges, refer to the document that accompanied the kit for installation instructions. Perform the rack-mounting kit installation now.

Powering the Series 2800 Vector Signal Analyzer

The Series 2800 operates within the following ranges:

- Line voltage of 100VAC to 240VAC
- Frequency of 50Hz or 60Hz

Connect and power the Series 2800 as follows:

- 1 Ensure that the operating voltage in your area is compatible with the Series 2800.
- 2 Operate the Series 2800 from a dedicated power source to avoid possible problems caused by electrical transients or line voltage fluctuations.

CAUTION: Operating the instrument on an incorrect line voltage may cause damage, possibly voiding the warranty.

- 3 Before plugging in the power cord, ensure that the rear panel power switch is OFF (O).
- 4 Connect the female end of the supplied power cord to the AC receptacle on the rear panel.

WARNING: *Use only the supplied, grounded line cord (or the equivalent) to assure proper safety grounding.*

- 5 Connect the other end of the supplied line cord to a grounded AC line power receptacle.

WARNING: *The power cord supplied with the unit contains a separate ground for use with grounded outlets. When proper connections are made, the instrument chassis is connected to power line ground through the ground wire in the power cord. Failure to use a grounded outlet may result in personal injury or death due to electric shock.*

- 6 Switch the rear panel power switch to the ON (I) position. The front panel power button displays an amber illumination.
- 7 Switch the instrument on by pressing the front panel power button. The power button now displays a green illumination. The Series 2800 performs a series of self-tests. If it detects a failure, the unit displays an error message.

NOTE: If you notice that the power button is not illuminated or the Series 2800 seems completely unresponsive after three minutes, you may need to change the fuse. In this case, refer to "Replacing a fuse." If a problem develops, return the Series 2800 to Keithley Instruments, Inc. for repair. Refer to "Repacking for return shipment" located earlier in this section for more information on returning the Series 2800 to the factory.

- 8 When the Series 2800 passes the self tests, it automatically boots the system software and displays the start-up screen.
- 9 Warm-up the instrument. The Series 2800 can be used immediately after being switched ON. However, to achieve specified performance, warm-up the instrument for at least 30 minutes.

Replacing a fuse

If the line fuse needs to be replaced, perform the following steps:

WARNING: *Verify that the instrument is disconnected from the AC line and other equipment before changing line fuse.*

- 1 Using a small flat-blade screwdriver, push the retaining clip toward the center of the module to release the fuse holder assembly.
- 2 Pull the fuse holder out of the power module.
- 3 Remove the blown fuse and replace it with a similar 2.0 Amp, 250 VAC, 5x20 mm slow-blow fuse.

CAUTION: For continued protection against fire or instrument damage, only replace fuses with the type and rating listed. If the instrument repeatedly blows fuses, return the unit to Keithley Instruments.

Verifying license options

The Series 2800 Vector Signal Analyzer requires a license file to access the modulation waveforms in the source. To view the current licenses, select Menu > Utilities > Licensing.

You can purchase the following licenses for your Model 2810 instrument:

- License Option 2810-CDMA-R (cdma2000® and IS-95a reverse link signal analysis personality)
- License Option 2810-GSM (GSM, GPRS, and EDGE signal analysis personality)
- License Option 2810-WCDMA-U (W-CDMA FDD uplink signal analysis personality)
- License Option 2810-WCDMA-D (W-CDMA FDD downlink signal analysis personality)

You can purchase the following licenses for your Model 2820 instrument:

- License Option 2820-CDMA-R (cdma2000® and IS-95a reverse link signal analysis personality)
- License Option 2820-GSM (GSM, GPRS, and EDGE signal analysis personality)
- License Option 2820-WCDMA-U (W-CDMA FDD uplink signal analysis personality)
- License Option 2820-WCDMA-D (W-CDMA FDD downlink signal analysis personality)
- License Option 2820-80211 (WLAN 802.11a, b, g and j signal analysis)

Purchasing modulation licenses

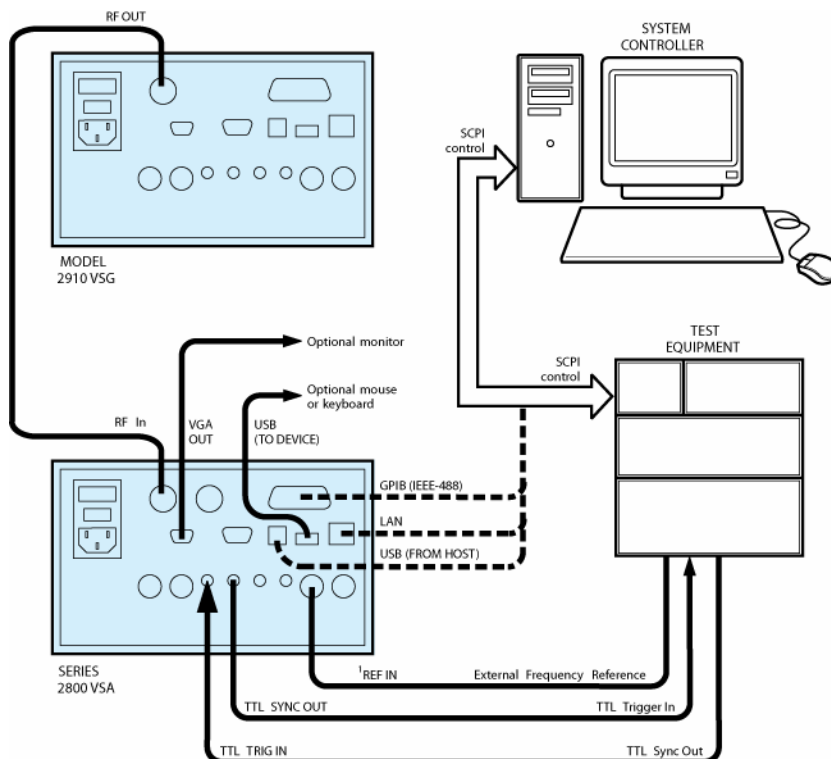
You can purchase modulation license files when you order your instrument or at any time after you have received your instrument.

Contact your Keithley Instruments sales representative or use one of the following numbers/addresses to purchase a license or receive a replacement license certificate.

- Toll-free (North America only): 1-888-KEITHLEY (1-888-534-8453)
- Phone: 440-248-0400
- Email: info@keithley.com (mailto:info@keithley.com)
- Website: www.keithley.com

Connecting system components

NOTE: This is a typical installation, with the Series 2800 connected to the system controller. This arrangement facilitates making screen captures of the VSA display. The rear panel SCPI control connectors are the same on both instruments. Thus, either or both of the instruments could be directly connected to the system controller for remote control. Connection by LAN enables use of the LXI web interface for licensing operations and other features.



1. REF IN can accept an input frequency reference of 1-20MHz.

GPIB connections

- Connect a GPIB bus cable equipped with standard IEEE-488 connectors to the instrument back panel **IEEE-488** connector.
- Connect many instruments to one instrument, using parallel connections that stack the connectors.

NOTE: To prevent physical damage, do not stack more than three connectors on any one unit.

Two screws are located on each connector to ensure that connections remain secure. Present standards call for metric threads, which are identified with dark-colored screws. Earlier versions have different screws, which are silver-colored. Do not use these silver-colored types of screws on the instrument; it is designed for metric threads.

To minimize interference caused by electromagnetic radiation, use only shielded IEEE-488 cables. Available shielded cables from Keithley Instruments are Models 7007-1 and 7007-2.

LAN (Ethernet) connections

- Connect the Series 2800 back panel **LAN** connector to an existing site network through a router, switch, or hub. Use a standard patch cable for this connection.

or

- Connect the Series 2800 back panel **LAN** connector directly to a computer. You must use a crossover cable for this connection to ensure that the computer transmit connections are input to the Series 2800 receive connections, and the other way around (Model CA-180-3A crossover cable is available for ordering from Keithley Instruments).

NOTE: The Ethernet crossover cable can be up to 100 meters in length.

USB connections

- Connect a computer controller to the Series 2800 back panel **USB (FROM HOST)** connector.
- Connect all other USB devices to the Series 2800 back panel **USB (TO DEVICE)** connector or to the two USB connectors on the front panel.

Configuring the system for remote control or network

After adding supported external instruments as described in the previous section, “Connecting system components” (external GPIB instruments, LAN (Ethernet) network, and computers), you must properly configure the system so that the Series 2800 can operate correctly in one of the following system configurations:

- GPIB interface configuration
- LAN (Ethernet) interface configuration
- USB interface configuration

GPIB interface configuration

To avoid communication conflicts over the bus, each device in a GPIB system must have a unique primary address. If you want to verify the GPIB address or change it, perform the following steps:

- 1 Select Menu > Utilities > GPIB Address.
- 2 Use the front panel knob to change the GPIB address, if necessary.
- 3 Select Close.

NOTE: You may also want to install the Keithley Instruments IVI-COM/IVI-C Driver for the Series 2800 Vector Signal Analyzer. This instrument driver provides access to the functionality of the Series 2800 through a COM server or C API, which also complies with the IVI specifications. This driver works in any development environment that supports COM programming, including Microsoft® Visual Basic, Microsoft Visual C++, Microsoft .NET, Agilent VEE Pro, National Instruments LabView, National Instruments LabWindows, and others. The IVI-COM driver can be installed from the Keithley Instruments website at www.keithley.com.

Verify remote control over GPIB

If you want to verify communication between a computer and the Series 2800 instrument over the GPIB, install the KI RFI Communicator application (included on the Series 2800 Vector Signal Analyzer Product Information CD-ROM) that allows you to test SCPI communication of your instrument. Perform the following steps:

- 1 Ensure you have a GPIB cable connected between the instrument back panel IEEE-488 connector and the computer GPIB board connector.
- 2 Insert the Series 2800 Vector Signal Analyzer Product Information CD-ROM into the computer drive.
- 3 After the CD-ROM launches, click Applications Info > KI RFI Communicator to download the application installation program.
- 4 Click the downloaded setup.exe file to install the application on your computer.

- 5 On your computer desktop, click the KI RFI Communicator icon to start the application.
- 6 In the KI RFI Communicator home screen, click Setup Interface.
- 7 In the Configure VISA Interface dialog box, select the GPIB tab.
- 8 Set the values for the following GPIB settings:
 - GPIB board # (leave this set to zero, unless you have more than one GPIB interface board in your computer)
 - GPIB primary address
- 9 Click OK.
- 10 Click Send Command to send the command *IDN? that is shown in the Command: box.
- 11 You will see the instrument identification information in the Response: field.
- 12 Continue sending any other SCPI commands of interest.

Refer to the Series 2800 Help (either in the instrument or on the Product Information CD-ROM) for a complete list of compatible SCPI commands.

LAN (Ethernet) interface configuration

It is necessary to assign an IP address to the Series 2800. The IP address is a persistent state, and is not affected by an instrument preset or a power cycle. Ensure that you have connected the equipment as instructed in "Connecting system components" before proceeding with the LAN configuration.

The appropriate procedure depends on the Series 2800 connection configuration. Refer to the procedure that applies to your system configuration:

- Existing site network configuration
- or
- Direct connection configuration

NOTE: Ensure that the instrument is connected to the LAN using a CAT 5e or better patch cable before performing this procedure.

You may also want to install the Keithley Instruments IVI-COM/IVI-C Driver for the Series 2800. This instrument driver provides access to the functionality of the Series 2800 through a COM server or C API, which also complies with the IVI specifications. This driver works in any development environment that supports COM programming, including Microsoft® Visual Basic®, Microsoft® Visual C++, Microsoft® .NET, Agilent VEE Pro, National Instruments LabView, National Instruments LabWindows, and others. The IVI-COM driver can be installed from the Keithley Instruments website at www.keithley.com.

Existing site network configuration

Contact your I.T. administrator to determine the preferred method of assigning IP addresses. Refer to the procedure that applies to your system:

- Static IP address assignment
- DHCP address assignment

Static IP address assignment in an existing site network

Perform the following steps to assign a static IP address for an instrument in an existing site network:

- 1 From the Series 2800, select Menu > Utilities > Ethernet Settings.
- 2 Select the IP Address tab.
- 3 Enter an IP address:
 - a) Select Specify an IP address.
 - b) Select the IP Address field or the keyboard button next to it.
 - c) Repeatedly select the ← (backspace) button to clear the current IP address.
 - d) Select the desired IP address and then select Enter.
- 4 Enter a subnet mask:
 - a) Select the Subnet Mask field or the keyboard button next to it.
 - b) Repeatedly select the ← (backspace) button to clear the current subnet mask.
 - c) Select the desired subnet mask and then select Enter.
- 5 Set the following values per your I.T. administrator's recommendations (you can leave the values blank if there are no recommendations):
 - Default gateway
 - Primary DNS
 - Primary WINS
- 6 Select the Apply button.
- 7 Select Close to close the dialog.

NOTE: Ensure that the combination of Series 2800 IP address and subnet mask is within the range of directly addressable IP addresses of the computer.

For example:

Computer IP address: 192.168.1.50
Computer subnet mask: 255.255.255.0
Series 2800 IP address: 192.168.1.51
Series 2800 subnet mask: 255.255.255.0

DHCP address assignment in an existing site network

If a DHCP server is on the LAN, you can choose to have a DHCP automatically assign an IP address:

- 1 From the Series 2800, select Menu > Utilities > Ethernet Settings.
- 2 Select the IP Address tab.
- 3 Select Obtain an IP address via DHCP.
- 4 Select the Apply button.

This configures the signal generator as a DHCP client. In DHCP mode, the signal generator requests a new IP address from the DHCP server. The assigned address appears in the IP Address field.

- 5 Select Close to close the dialog box.

Direct connection configuration

Assigning a static IP address is the preferred method of assigning an IP address for a configuration that has the Series 2800 directly connected to the computer. Optionally, you can use the DHCP method, which results in a Link Local Address (LLA) being assigned to the Series 2800. Refer to the procedure that applies to your system:

- Static IP address assignment
- DHCP address assignment

Static IP address assignment on a direct connection

Perform the following steps to assign a static IP address for an instrument that has a direct connection to a computer:

- 1 From the Series 2800, select Menu > Utilities > Ethernet Settings.
- 2 Select the IP Address tab.
- 3 Enter an IP address:
 - a) Select Specify an IP address.
 - b) Select the IP Address field or the keyboard button next to it.
 - c) Repeatedly select the ← (backspace) button to clear the current IP address.
 - d) Select the desired IP address and then select Enter.
- 4 Enter a subnet mask:
 - a) Select the Subnet Mask field or the keyboard button next to it.
 - b) Repeatedly select the ← (backspace) button to clear the current subnet mask.
 - c) Select the desired subnet mask and then select Enter.

- 5 Set the following values per your I.T. administrator's recommendations (you can leave the values blank if there are no recommendations):
 - Default gateway
 - Primary DNS
 - Primary WINS
- 6 Select the Apply button.
- 7 Select Close to close the dialog box.

NOTE: Ensure that the combination of Series 2800 IP address and subnet mask is within the range of directly addressable IP addresses of the computer.

For example:

Computer IP address: 192.168.1.50
Computer subnet mask: 255.255.255.0
Series 2800 IP address: 192.168.1.51
Series 2800 subnet mask: 255.255.255.0

DHCP address assignment on a direct connection

Optionally, you can use the DHCP method to assign an IP address. Since there is no DHCP server in a configuration that directly connects the Series 2800 to a computer, the instrument will timeout and then automatically assign itself a Link Local Address (LLA). This process takes 60-90 seconds.

- 1 From the Series 2800, select Menu > Utilities > Ethernet Settings.
- 2 Select the IP Address tab.
- 3 Select Obtain an IP address via DHCP.
- 4 Select the Apply button. This attempts to configure the signal generator as a DHCP client.
- 5 Select Close to close the dialog box.
- 6 When the LAN error indicator disappears (60-90 seconds), select Menu > Utilities > Ethernet Settings. The LLA that was automatically assigned appears in the IP Address field.
- 7 Select Close to close the dialog box.

Verify remote control over LAN

If you want to verify communication between a computer and the Series 2800 instrument over the LAN, install the KI RFI Communicator application (included on the Series 2800 Vector Signal Analyzer Product Information CD-ROM) that allows you to test SCPI communication of your instrument. Perform the following steps:

- 1 Ensure you have a LAN cable connected between the instrument back panel LAN connector and the computer.
- 2 Insert the Series 2800 Vector Signal Analyzer Product Information CD-ROM into the computer drive.
- 3 After the CD-ROM launches, click Applications Info > KI RFI Communicator to download the application installation program.
- 4 Click the downloaded setup.exe file to install the application on your computer.
- 5 On your computer desktop, click the KI RFI Communicator icon to start the application.
- 6 In the KI RFI Communicator home screen, click Setup Interface.
- 7 In the Configure VISA Interface dialog box, select the LAN/TCIP tab.
- 8 Set the values for the following settings, or the values displayed in the Ethernet dialog if DHCP is used:
 - NIC # (leave this set to zero, unless you have more than one NIC card installed in your computer)
 - TCPIP port # = 5025
 - TCPIP address = IP address that you assigned to the Series 2800
- 9 Click OK.
- 10 Click Send Command to send the command *IDN? that is shown in the Command: box.
- 11 You will see the instrument identification information in the Response: field.
- 12 Continue sending any other SCPI commands of interest.

Refer to the Series 2800 Help (either in the instrument or on the Series 2800 Product Information CD-ROM) for a complete list of compatible SCPI commands.

LAN troubleshooting

The Series 2800 Vector Signal Analyzer defaults to an Ethernet setting of “Auto-negotiation On” to detect the speed of the network and set the instrument operation speed to match the network speed. If the auto-negotiation process fails, the operation speed must be set manually.

NOTE: If the instrument speed does not match the network speed, Auto-negotiation On is the recommended setting.

- 1 Select Menu > Utilities > Ethernet Settings.
- 2 Select the Advanced tab.
- 3 Select the appropriate speed:
 - 10 Mbps
 - 100 Mbps
- 4 Select Apply.

- 5 To ensure that both the instrument and the network recognize the speed change, you may need to disconnect and then reconnect the LAN cable.

USB configuration

It is necessary to load a USB driver onto the computer that will be running the remote control program. For convenience, the USB driver can be installed from the Series 2800 Vector Signal Analyzer Product Information CD-ROM. Updates for the USB driver can be downloaded from the Keithley Instruments website at www.keithley.com.

Installing the USB driver from the CD-ROM

Perform the following steps to install the USB driver to your computer:

- 1 Insert the Series 2800 Vector Signal Analyzer Product Information CD-ROM into the disk drive of the computer.
- 2 With the Series 2800 powered on, connect a USB cable between the PC and the USB (FROM HOST) connector on the Series 2800 rear panel.
- 3 Follow the operating system instructions to load the USB driver.

Installing the USB driver from the Keithley Instruments website

Perform the following steps to look for updates of the USB driver to install on your computer:

- 1 With the computer connected to the Internet, insert the Series 2800 Vector Signal Analyzer Product Information CD-ROM into the computer disk drive.
- 2 After the CD-ROM launches, click Online Updates to get to the Keithley Instruments website, <http://www.keithley.com>.
- 3 From the left pane select: RF Spectrum Analysis, Signal Generation and Switching.
- 4 From the SELECT ONE dialog box in the center pane select: Vector Signal Analyzers (Spectrum Analyzers).
- 5 From the VECTOR SIGNAL ANALYZERS list select: any one of the Series 2800 analyzers.
- 6 From the DOWNLOADS menu in the left pane select: software driver.
- 7 Scroll to and select: the USB driver for the Series 2800.
- 8 Download the Series 2800 USB driver from the website
- 9 Click the driver setup file that you just downloaded.

Verify remote control over USB

If you want to verify communication between a computer and the Series 2800 over the USB, install the KI RFI Communicator application that allows you to test SCPI communication of your instrument. Perform the following steps:

- 1 Set up the equipment as shown in "Connecting system components."

- 2 Insert the Series 2800 Vector Signal Analyzer CD-ROM in the computer drive and click Install KI RFI Communicator to download the application installation program.
- 3 Select Run to install the program on your computer.
- 4 Select the KI RFI Communicator Icon that has been placed on the desktop.
- 5 In the KI RFI Communicator home screen, click Setup Interface.
- 6 In the Configure VISA Interface dialog box, select the USB tab and click Find USB Devices. This will display a list of all instruments connected through USB.
- 7 Select the list item that corresponds with the serial number of the instrument that you want to communicate with, and then click OK.
- 8 Click Send Command to send the *IDN? command that is in the Command: box.
- 9 You will see the instrument identification information in the Response: field.
- 10 Continue sending any other SCPI commands of interest.

Refer to the Series 2800 Help (either in the instrument or on the product information CD-ROM) for a complete list of compatible SCPI commands.

Access the Series 2800 from your PC

To access the instrument and control the operation over the LXI Web interface, you must install a Java Runtime Environment (JRE) in the computer that is connected to the instrument. The Series 2800 Vector Signal Analyzer Product Information CD-ROM that accompanied your Keithley Instruments Series 2800 contains a Java Runtime Environment 5.0 Update 7. This JRE contains the Java virtual machine, runtime class libraries, and Java applications launcher that are necessary to run the program that accesses and controls the instrument through the LXI Web interface.

Install the JRE from the CD_ROM:

- 1 Install the CD-ROM into your computer disk drive.
- 2 Download the JRE.

Check online for future updates to the JRE

You can receive free future updates to this JRE by downloading them from the Keithley Instruments website. This JRE is appropriate only if you are operating in a Windows environment.

- 1 Using your internet browser, type in the following URL: <http://www.keithley.com>.
- 2 From the left pane, select RF Spectrum Analysis > Signal Generation and Switching.
- 3 From the SELECT ONE dialog box in the center pane, select: Vector Signal Analyzers (Spectrum Analyzers).
- 4 From the VECTOR SIGNAL ANALYZERS list, select any one of the Series 2800 analyzers.
- 5 From the DOWNLOADS menu in the left pane, select software.

- 6 Scroll to and select: J2SE™ Runtime Environment 5.0 Update 7.
- 7 Download the software from the website.

If you are operating in a Unix, Linus, or Solaris environment

You may download the appropriate JRE from the Sun Microsystems Website:

- 1 Using your internet browser, type in the following URL:
<http://java.sun.com/javase/downloads/index.jsp>.
- 2 Scroll to the Java Runtime Environment (JRE) 5.0 Update 7 and select Download.
- 3 From this page you are able to download the appropriate executable file.

Connect to the instrument

Launch a web browser and use the LAN-connected instrument IP address for the URL (for example, <http://192.40.128.183>).

If you do not know the instrument IP address, you can find it from the instrument front panel interface by selecting Menu > Utilities > Ethernet Settings.

Making Measurements

In this section

Frequency domain (two-tone) measurements	2-1
Time domain (GSM) measurements	2-2

Frequency domain (two-tone) measurements

The spectrum measurement sets up viewing and measurement of signals within the frequency range of the Keithley Instruments Series 2800 Vector Signal Analyzer. As you view a signal on the Series 2800 measurement spectrum, you can see where it is relative to other signals. This is useful for looking at a signal of interest and seeing where other signals (such as spurs) are in relation to it.

Common signal characteristics of interest are:

- Signal carrier frequency
- Signal amplitude
- Frequency bandwidth occupied by the signal
- Modulation applied to the carrier signal

What follows is a simple procedure to display an RF signal in the frequency domain. The measurement assumes the presence of a dominant continuous signal.

The spectrum is set to maximum to view the signal. A marker is attached to the largest signal. The signal is moved to the center of the screen and the bandwidth adjusts around it for closer examination.

Setting up the test signal

This example procedure shows you how to load and output a two-tone waveform on the Keithley Instruments Model 2910 VSG. Refer to "Connecting system components" for interconnect details.

- 1 Press instrument front panel Preset button.
- 2 Choose Select Modulation. Select Analog > 2 Tone.
- 3 Select Load. Under the green Modulation button, the Model 2910 VSG displays the file name and frequency span.
- 4 Select RF on. Ensure that both Modulation and RF are on.

Measuring the signal

- 1 Choose the measurement personality:
 - a) Select Preset to get to a common starting point.
 - b) From the measurement selection menu, choose Spectrum > General Purpose > Spectrum.
- 2 Set the measurement parameters:
 - a) Double-click the Frequency Span and set to 5KHz.
 - b) Select Settings > Spur Cancellation.

The signal of interest is now in view on the screen.
- 3 Adjust the screen for optimum viewing:
 - a) Apply a marker to the signal of interest.
 - b) Select Markers, and then select Marker 1 On.
 - c) Select Marker to Max.
 - d) Select Marker to Center, then select Close.
 - e) Adjust Frequency Span around the signal.
- 4 Transfer measurement results:
 - a) Select Menu > File > Save Screen....
 - b) Select Look In: and navigate to the storage location.
 - c) Select the keyboard button, type the image title, and select Enter.
 - d) Select Save.
 - e) Select Yes to transfer the measurement results to a file.

Time domain (GSM) measurements

The GSM signal format is based on Time Division Multiple Access (TDMA). TDMA works by dividing the frequency band into individual time slots. Each time slot corresponds with an individual communications channel. In GSM there are eight time slots; a cell phone transmits during one time slot, receives in another, and stays silent for the remaining six time slots. The GSM signal, therefore, appears as a signal burst in the time domain.

The Series 2800 synchronizes and captures the GSM burst and displays it on the front panel screen. From this captured signal, many measurements can be made simultaneously. The results are compared with the settings and what is expected from the GSM Standard.

Setting up the test signal

This example procedure shows you how to load and output a GSM modulation waveform on the Keithley Instruments Model 2910 VSG. Refer to “ Verifying license options” for details; also see "Connecting system components" for interconnect details.

- 1 Press the instrument front panel Preset button.
- 2 Choose Select Modulation. Select Standards > GSM / EDGE.
- 3 Select Waveform File > Open and choose the GSM waveform of interest.
The file for a GSM / EDGE waveform will have an *.csv notation, indicating that it is a comma-separated value format.
- 4 Select Open > Load to apply the waveform to the RF carrier signal. Notice that the waveform filename appears below the Modulation On button.
- 5 Ensure that both the RF On and Modulation On buttons are selected.

Measuring the signal

This example procedure shows you how to view a demodulated GSM waveform in the time domain on the Series 2800:

- 1 Choose the measurement personality:
 - a) Select Preset to return the default settings.
 - b) From the Spectrum pull-down menu, select GSM.
- 2 Set the measurement parameters.
The signal of interest is now visible on the Series 2800 screen at the default settings.
- 3 Press the View button to choose between a view of the graph, table, or graph and table.
- 4 To optimize the measurement, open the Trace Type drop-down menu and select the view that is appropriate to your measurement.
- 5 Transfer measurement results:
 - a) Select Menu > File > Save Screen....
 - b) Select Look In: and navigate to the storage location.
 - c) Select the keyboard button, type the image title, and select Enter.
 - d) Select Save.
 - e) Select Yes to transfer the measurement results to a file.

Getting Information from Help

In this section

Accessing Help.....	3-1
Help from the front panel.....	3-1
Help from the CD-ROM.....	3-1

Accessing Help

You can quickly access information that shows you how to set up and control output signals using the Series 2800 front panel interface and programming commands. You can access the Series 2800 Help from the front panel menu, and from the CD-ROM that was shipped with the instrument.

Help from the front panel

To access the Help from the Series 2800 front panel, select Menu > Help > Help System....

Help from the CD-ROM

To access the System Help from the Series 2800 Vector Signal Analyzer Product Information CD-ROM:

- 1 Insert the CD-ROM into the computer.
- 2 If the computer is not set up to auto-run, double-click the CD drive in Windows Explorer.
- 3 When the CD launches, double-click the Open the Series 2800 Vector Signal Analyzer System Help link.
- 4 Either Open the System Help for immediate use, or Save it as a file on your computer for later recall and use.

This page left blank intentionally .

Model No. _____ Serial No. _____ Date _____

Name and Telephone No. _____

Company _____

List all control settings, describe problem and check boxes that apply to problem. _____

Intermittent Analog output follows display Particular range or function bad; specify _____

IEEE failure Obvious problem on power-up Batteries and fuses are OK

Front panel operational All ranges or functions are bad Checked all cables

Display or output (check one)

Drifts

Unable to zero

Unstable

Will not read applied input

Overload

Calibration only

Certificate of calibration required

Data required

(attach any additional sheets as necessary)

Show a block diagram of your measurement system including all instruments connected (whether power is turned on or not). Also, describe signal source.

Where is the measurement being performed? (factory, controlled laboratory, out-of-doors, etc.)

What power line voltage is used? _____ Ambient temperature? °F _____

Relative humidity? _____ Other? _____

Any additional information. (If special modifications have been made by the user, please describe.)

Be sure to include your name and phone number on this service form.

Specifications are subject to change without notice.
All Keithley trademarks and trade names are the property of Keithley Instruments, Inc.
All other trademarks and trade names are the property of their respective companies.



A G R E A T E R M E A S U R E O F C O N F I D E N C E

Keithley Instruments, Inc.

Corporate Headquarters • 28775 Aurora Road • Cleveland, Ohio 44139 • 440-248-0400 • Fax: 440-248-6168 • 1-888-KEITHLEY • www.keithley.com