NEW
October, 2007

MIMO

MIMO RF Signal Analysis and Generation Test Systems and Software

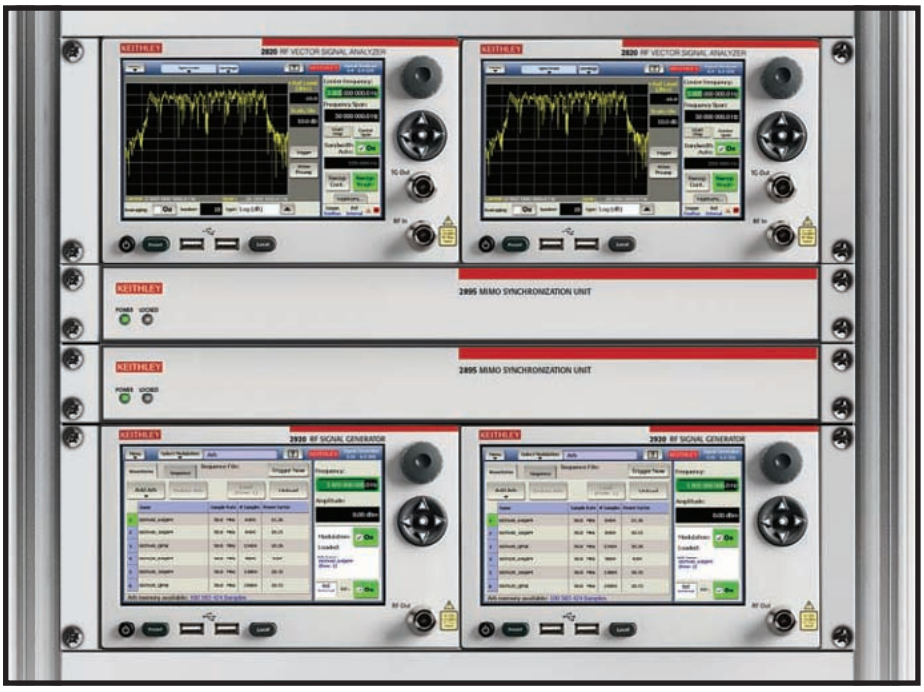
Excellent Performance

- 40MHz bandwidth
- High performance platforms, 2820 SISO EVM -40dB (40MHz BW, 5.8GHz - characteristic)
- +1ns signal sampler synchronization
- <1ns peak-to-peak signal sampler jitter
- <1° peak-to-peak RF-carrier phase jitter

Flexible

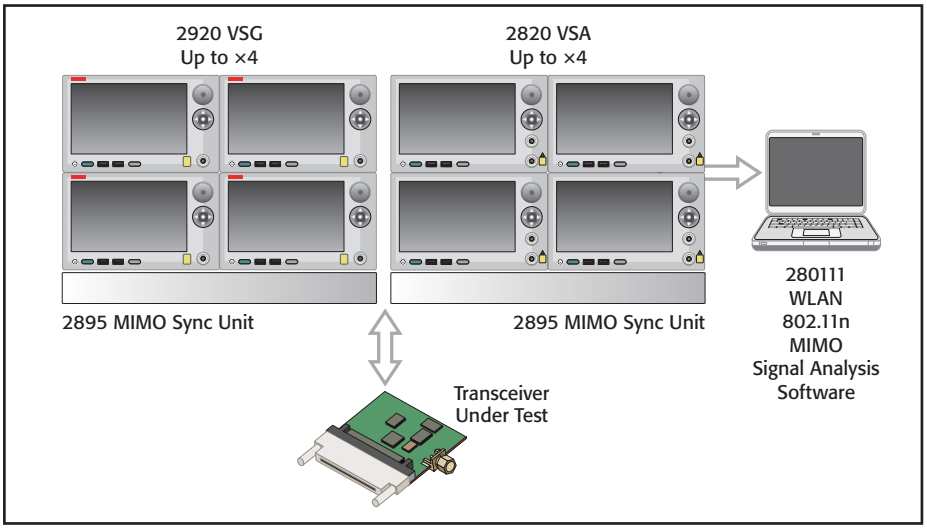
- Two-, three-, or four-channel configurations
- Uses standard MIMO-ready VSA and VSG instruments
- Dual-purpose instruments — use in a MIMO system or as standalone
- Powerful MIMO signal analysis software package option
- Ideal for 802.11n WLAN and 802.16e WiMAX wave 2

LXI



The System 2800-MIMO RF Signal Analyzer and System 2900-MIMO RF Signal Generator are high-performance MIMO test systems designed to meet the requirements of 802.11n WiFi and 802.16e WiMAX multi-input, multi-output communications standards. The systems can be configured into two, three, or four channels with 40MHz signal bandwidth using Model 2820 RF Vector Signal Analyzer and Model 2920 RF Vector Signal Generator instruments. These instruments are MIMO-ready with the hardware connections and firmware built into every instrument.

The MIMO systems can be initially configured as a 2×2 system then upgraded at a later date to three or four channels by adding standard Model 2820 or Model 2920 instruments. Moreover, the instruments need not be dedicated to a MIMO system. They can be configured for use either in a MIMO



The System-2800 and System-2900 can be configured into high-performance two-, three-, or four-channel systems to test WiFi, WiMAX, and other MIMO devices and equipment.

APPLICATIONS

- Technology research
- Product development and production test of:
  - Wireless equipment
  - Modules & sub-assemblies
  - RFIC devices

1.888.KEITHLEY (U.S. only)

www.keithley.com

KEITHLEY

A GREATER MEASURE OF CONFIDENCE

Signal analysis and generation for RF communications testing

RF/MICROWAVE

MIMO

Ordering Information

System 2800-MIMO:

2820-006 RF Vector Signal Analyzer (2, 3, or 4 units)

2895 MIMO Synchronization Unit

System 2900-MIMO:

2920-006 RF Vector Signal Generator (2, 3, or 4 units)

2920-ARB-40 Arbitrary Waveform Generator, 40MHz bandwidth *or*

2920-ARB-80 Arbitrary Waveform Generator, 80MHz bandwidth

2895 MIMO Synchronization Unit

Optional Hardware

2895-RK Rack-mount kit

Refer to Models 2820 and 2920 datasheets for more complete configuration and option information.

Optional Software & Licenses

280111
WLAN 810.11n MIMO Signal Analysis Software

2820-80211
WLAN 802.11a-b-g-j-n SISO Signal Analysis Personality

2920-80211-PC
SignalMeister™ License for 802.11a-b-g-j WLAN

2920-80211-N-PC
SignalMeister License for 802.11n SISO & MIMO WLAN

80216-D-PC
SignalMeister License for 802.16d-2004 WiMAX

80216-E-PC
SignalMeister License for 802.16e-2005 mobile-WiMAX

Accessories Supplied

AC power cable; RF, clock, and synchronization cables to connect up to four Model 2820 or 2920 units; and Quick Start Guide.

MIMO RF Signal Analysis and Generation Test Systems and Software

system or as stand-alone SISO (single-input, single-output) instruments by selecting the configuration in firmware and changing a few rear-panel cables.

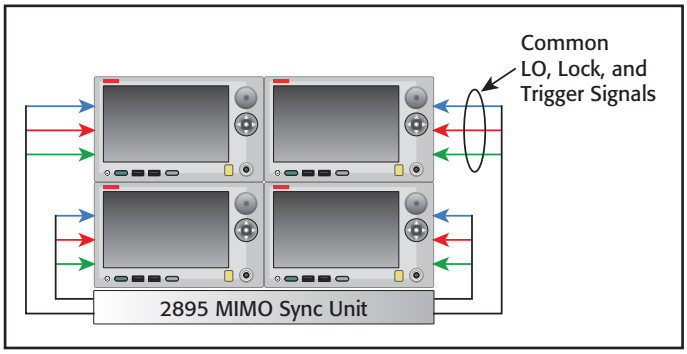
The Model 2895 MIMO Synchronization Unit provides synchronized signals to the system instruments. This gives the system a highly precise and stable alignment between up to four signal analyzers or signal generators.

The Model 280111 WLAN 802.11n MIMO Signal Analysis Software is the industry-leading PC-based tool. This fast and powerful software has an extensive measurement suite for analyzing up to 16 signals of an 802.11n WLAN device with 4x4 MIMO channels.

Precise and Stable Synchronization

The MIMO systems were designed to have a stable RF carrier and a precise signal sampler alignment between all instruments in the system. The Model 2895 MIMO Synchronization Unit distributes a common LO (local oscillator), common clock, and precise trigger to all the signal analyzers or generators connected in the system. This high alignment enables the system to make accurate and repeatable measurements of OFDM (orthogonal frequency-division multiplexing) MIMO signals.

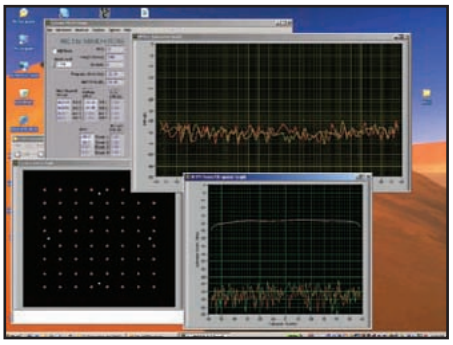
The RF carrier's phase of all instruments in each system is synchronized with one another without limitations of using a phase-locked loop. The RF carrier phases have less than one degree peak-to-peak phase jitter between any two instruments. Additionally, the signal samplers of the MIMO system instruments are precisely aligned. The system has a maximum sample time difference of 1nsec and peak-to-peak sampler jitter of less than 1nsec between any two instruments.



Precise and stable synchronization is achieved by providing common LO, common clock, and precise trigger signals to all of the signal analyzer or signal generator instruments.

Signal Analysis Software

The Model 280111 WLAN 802.11n MIMO Signal Analysis Software is used for multi-channel signal analysis of 802.11n MIMO signals. It can analyze up to four OFDM channels with up to 16 signals. The software's GUI is fast and easy to configure and has a SCPI command set to interface into test systems. It streams data from up to four Model 2820 instruments into the PC, analyzes all of the received signals, and displays the results. It automatically detects the 802.11n modulation coding scheme (MCS). Its extensive measurement set includes SISO measurements such as Error Vector Magnitude (EVM) and Frequency Error and MIMO measurements such as Channel Response and Cross Power (i.e., Transmitter Isolation).



The Model 280111 WLAN 802.11n MIMO Signal Analyzer Software is a fast and powerful PC-based tool with an extensive measurement suite used to characterize communications systems utilizing MIMO technologies.

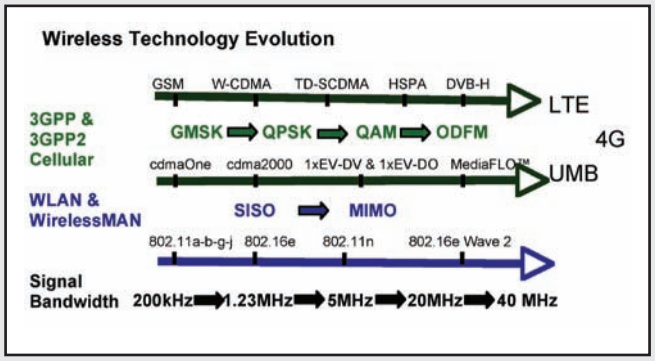
MIMO RF Signal Analysis and Generation Test Systems and Software

Wireless Technology Evolution

The demand for wireless communications continues to increase. Mobility and cost are the main reasons. Wireless is the lowest-cost access for many services, including voice in third-world and developing countries. The number of new users and new services continues to increase. Wireless communication traffic is migrating from mostly voice to mostly data, and many new services require faster data rates.

With limited frequency spectrum, digital wireless technology has progressed rapidly over the past two decades to address these market demands. More spectrally-efficient modulation types and digital coding schemes are being utilized. These have increased signal bandwidths from 200kHz in the early 1990s to 40MHz today. New transmission methods are being deployed to further increase data rates, such as MIMO.

Keithley has the next-generation RF test instruments designed to meet the challenges faced by designers and manufacturers of today's wireless technologies and business conditions. They have the bandwidth to test today's wireless devices and are suitable for most future technologies. They have the flexibility to test multiple signals and can be used in test configurations for both SISO and MIMO testing. Additionally, they address the business requirements with the measurement accuracy needed to ensure high product quality and production yields and high test speed and low equipment cost needed to reduce test cost.



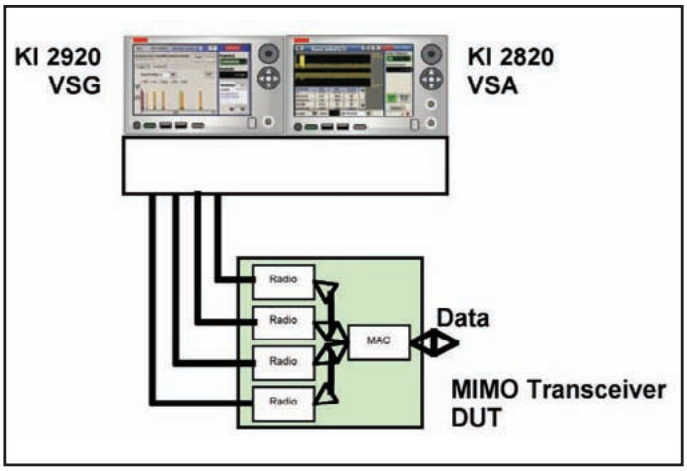
The Models 2820 and 2920 have been designed to test wireless devices today and in the future that use OFDM, MIMO, and other technologies with signals up to 40MHz bandwidth.

Production Test Systems

Production testing of MIMO devices usually calibrates and tests the characteristics of each individual radio using a SISO test system. This reduces test system cost, though can increase total test time. Each radio is tested sequentially with the other radios in an inactive state.

The Model 2820 RF Vector Signal Analyzer and Model 2920 RF Vector Signal Generator are used with a multiplexer switch to connect to each of the DUT radio transceivers. The multiplexer may have the capability to connect and test more than one DUT in the test fixture, provide signal conditioning elements, or both.

MIMO measurements are not commonly made on every device produced. An example is crosstalk between the radios, which requires testing with all the radios in an active state. These characteristics are assumed to be set by design. MIMO measurements are made on production samples to ensure production process constancy.



The Models 2820 and 2920 are used in a SISO configuration with a switch multiplexer to test the individual transceiver radios of MIMO devices in production applications.

Test Instrumentation

The Model 2820 RF Vector Signal Analyzer and Model 2920 RF Vector Signal Generator are mid-performance test instruments designed for R&D and production testing of modern RF communications equipment and devices. They are built on a next-generation instrument platform that uses state-of-the-art RF and DSP (digital signal processing) technology. This gives them the capability to measure and generate RF signals rapidly without compromising accuracy and repeatability.

The DSP-based Software-Defined Radio architecture is both fast and flexible. Measurement of multiple signal types with up to 40MHz bandwidth is possible with one instrument pair that share a common architecture platform. These innovative technologies allow the instruments to fit into a small package and have a price point that makes them the logical choice for many test applications.

The Models 2820 and 2920 are MIMO-ready and have the hardware and software required to configure them into a MIMO test system. They can be easily reconfigured as stand-alone test instruments or into a MIMO

The Models 2820 and 2920 feature DSP-based Software-Defined Radio architecture to make accurate, high-speed measurements for R&D and production test applications.

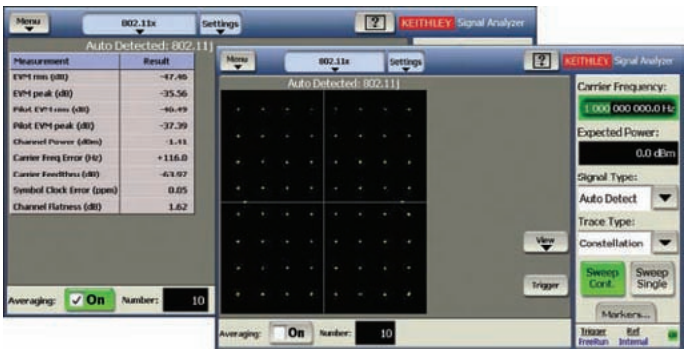
MIMO RF Signal Analysis and Generation Test Systems and Software

system. This flexibility is useful for those who do not want to dedicate a large investment to a MIMO system yet want the capability to do so when necessary.

The Model 2820 RF Vector Signal Analyzer with the optional Model 2820-80211 WLAN 802.11 Signal Analysis Personality can make measurements on all 802.11a, b, g, j, or n SISO signals. The personality can automatically detect the modulation type. It has several measurement displays, including constellation, EVM per channel, EVM per symbol, CCDF, and more. A full set of signal measurements are made in 17 to 50 msec, depending on the signal type.

The Model 2920 has arbitrary waveform generator (ARB) options with 100 Mega-samples of waveform memory and up to 80MHz bandwidth to generate WLAN, WiMAX, and virtually any other test signal required. Many different signal waveforms can be simultaneously resident in the Model 2920's ARB memory. Switching between any two waveforms takes less than 3msec using a SCPI command and is nearly instant using the ARB Sequence mode. Frequency switching time is 1.3msec when using the List mode or ARB Sequence mode and 3msec using a SCPI command. This results in ultra-fast test times of RF devices requiring multiple test frequencies, multiple test signals, or both.

Refer to the Models 2820 and 2920 datasheets for more detailed product information.



The Model 2820-80211 WLAN Signal Analysis Personality option has a full set of measurement capability for high-speed testing of wireless devices using 802.11a, b, g, j, & n signals.

ACCESSORIES AVAILABLE

2910-DCBLOCK	External RF-DC block module
2910-ADAPTER-KIT	Cable and Adapter Accessory Kit

Modes of Operation

SYSTEM 2800: Multi-input system with up to four Model 2820 RF Vector Signal Analyzers.

SYSTEM 2900: Multi-output system with up to four Model 2920 RF Vector Signal Generators.

Note: All items are specifications unless otherwise noted.

System 2800 Multi-Input System Specifications

WAVEFORM SAMPLER ALIGNMENT: <±2ns.

WAVEFORM SAMPLER JITTER: ≤1ns.

RELATIVE PHASE JITTER OF SLAVE RELATIVE TO MASTER: <±1 degree.

System 2900 Multi-Output System Specifications

WAVEFORM ARB ALIGNMENT: <±1ns.

WAVEFORM ARB JITTER: ≤1ns.

RELATIVE PHASE JITTER OF SLAVE RELATIVE TO MASTER: <±1 degree.

OFF POWER BETWEEN BURSTS: >0dBm: <–90dBc. **<0dBm:** <90dBm.

BURST RISE/FALL TIMES (10–90%):

RF Carrier: From 400MHz to ≤ 3GHz: <200ns (preliminary).
From 3GHz to ≤6GHz: <TBD (preliminary).

2895 Inputs and Outputs

INTERNAL FREQUENCY REFERENCE OUTPUT

AGING RATE: ≤1 ppm per year.

TEMPERATURE STABILITY: ≤0.2ppm [1].

IMPEDANCE: 50Ω (characteristic), AC coupled, BNC connector.

REF OUTPUT SIGNAL: 10MHz, +5dBm ±3dB (characteristic).

EXTERNAL FREQUENCY REFERENCE INPUT

FREQUENCY LOCK RANGE: 10MHz ±10Hz (1ppm).

AMPLITUDE LOCK RANGE: Input power range: 0 to +15dBm [2].

IMPEDANCE: 50Ω (characteristic), BNC connector.

MIMO SYSTEM INTERCONNECTIONS

LO IN: Connects to the Master 2820 or 2920 LO output, SMA.

LO OUT 1 THROUGH 4: Provides distributed LO power to the Slave 2820s or 2920s and back to the Master 2820 or 2920, SMA.

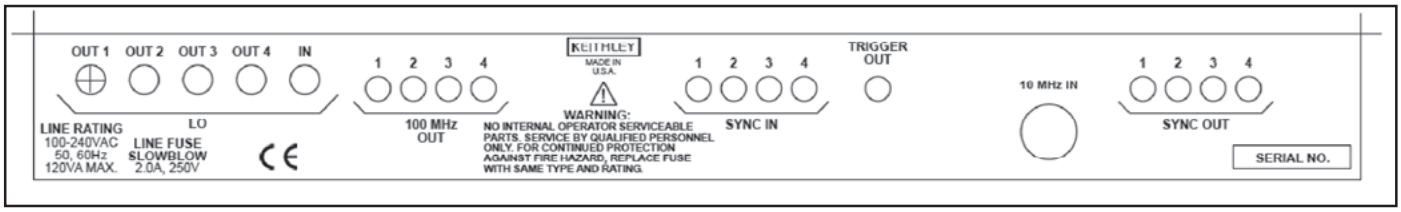
100Hz OUT 1 THROUGH 4: Provides 100MHz Clock outputs to the Master and Slave 2820/2920s, SMB(m).

SYNC IN 1 THROUGH 4: Inputs from 2820 or 2920 Sync Outputs. **Input Level:** 3.3V CMOS, SMB(m).

SYNC OUT 1 THROUGH 4: Provides SYNC signals to 2820 or 2920. **Output Level:** 3.3V CMOS, SMB(m).

NOTES

1. Total variation from 0° to 50°C ambient temperature range.
2. For optimum phase noise performance, 0dBm ≤ Pin ≤ +10dBm.



Model 2895 rear panel. The unit comes with all connectors and cables to configure up to four Model 2820 RF Vector Signal Analyzers or Model 2920 RF Vector Signal Generators.

MIMO RF Signal Analysis and Generation Test Systems and Software

GENERAL SPECIFICATIONS

POWER: 100VAC to 240VAC, 50–60Hz (automatically detected), 40VA max.

CE EMC COMPLIANCE: EU Directive 89/336/EEC; EN 61326-1.

CE SAFETY COMPLIANCE: CE; EU Directive 73/23/EEC, EN 61010-1.

CALIBRATION: 2 years.

ENVIRONMENT (for indoor use only):
18°C to 28°C specified operating, unless otherwise noted.
0°C to 50°C operating survival, non-specified operation.
–25°C to 65°C non-operating (AC power off) storage.
Altitude: 2000 meters above sea level maximum specified operating.
Cooling: Convection, side intake and exhaust.

MECHANICAL VIBRATION AND SHOCK: MIL-PRF-2880 CL3 random vibration, 3 axes.
Sine-Sweep test for resonances, 3 axes.
MIL-STD-810F 516.5 paragraph 4.5.7 procedure VI bench drop.

GENERAL MECHANICAL CHARACTERISTICS:
Height: 44mm (1.75 in.), 1U.
Width: 425mm (16.73 in.), half-rack.
Depth: 559mm (22.0 in.).
Weight: 4.5kg (10.0 lbs.).

WARRANTY: 3 years.

SPECIFICATION NOTES

Specifications describe the instrument's warranted performance. Typical and characteristic values are not warranted but provide additional information regarding performance of the Model 2895 and are provided to assist in a MIMO system configuration with Model 2820 RF Vector Signal Analyzers or Model 2920 RF Vector Signal Generators.

SPECIFICATIONS (warranted performance)

Specification values are performance that is warranted. All units are warranted to meet these performance specifications under the following conditions.

- Ambient operating temperature of 18°C to 28°C, unless otherwise noted.
- After a warm-up time of 30 minutes and self calibration at ambient temperature.

TYPICAL (mean + 3 standard deviations)

Typical values are performance that units will meet under the following conditions.

- Ambient operating temperature of 23°C, unless otherwise noted.
- After a warm-up time of 30 minutes and self calibration at ambient temperature.

This performance is not warranted.

CHARACTERISTIC (mean or expected value)

Characteristic values are nominal performance that units are expected to have under the following conditions.

- Ambient operating temperature of 23°C, unless otherwise noted.
- After a warm-up time of 30 minutes and self calibration at ambient temperature.

This performance is not warranted.

MIMO RF Signal Analysis and Generation Test Systems and Software

KEITHLEY

A GREATER MEASURE OF CONFIDENCE

KEITHLEY INSTRUMENTS, INC. ■ 28775 AURORA ROAD ■ CLEVELAND, OHIO 44139-1891 ■ 440-248-0400 ■ Fax: 440-248-6168 ■ 1-888-KEITHLEY ■ www.keithley.com

BELGIUM
Sint-Pieters-Leeuw
Ph: 02-363 00 40
Fax: 02-363 00 64
www.keithley.nl

CHINA
Beijing
Ph: 8610-82255010
Fax: 8610-82255018
www.keithley.com.cn

FINLAND
Espoo
Ph: 09-88171661
Fax: 09-88171662
www.keithley.com

FRANCE
Saint-Aubin
Ph: 01-64 53 20 20
Fax: 01-60-11-77-26
www.keithley.fr

GERMANY
Germering
Ph: 089-84 93 07-40
Fax: 089-84 93 07-34
www.keithley.de

INDIA
Bangalore
Ph: 080-26771071-73
Fax: 080-26771076
www.keithley.com

ITALY
Milano
Ph: 02-553842.1
Fax: 02-55384228
www.keithley.it

JAPAN
Tokyo
Ph: 81-3-5733-7555
Fax: 81-3-5733-7556
www.keithley.jp

KOREA
Seoul
Ph: 82-2-574-7778
Fax: 82-2-574-7838
www.keithley.co.kr

MALAYSIA
Kuala Lumpur
Ph: 60-3-4041-0899
Fax: 60-3-4042-0899
www.keithley.com

NETHERLANDS
Gorinchem
Ph: 0183-63 53 33
Fax: 0183-63 08 21
www.keithley.nl

SINGAPORE
Singapore
Ph: 65-6747-9077
Fax: 65-6747-2991
www.keithley.com.sg

SWEDEN
Solna
Ph: 08-50 90 46 00
Fax: 08-655 26 10
www.keithley.com

SWITZERLAND
Zürich
Ph: 044-821 94 44
Fax: 41-44-820 30 81
www.keithley.ch

TAIWAN
Hsinchu
Ph: 886-3-572-9077
Fax: 886-3-572-9031
www.keithley.com.tw

UNITED KINGDOM
Theale
Ph: 0118-929 75 00
Fax: 0118-929 75 19
www.keithley.co.uk

 Printed in the U.S.A. No. 2884 Oct. 07