

- Key Features -

- Wide Frequency Coverage
- Calibrated Power Output
- USB COM Interface
- Industry Standard SCPI Commands
- OLED Display and Control Buttons
- Very Cost Effective
- Incredibly Compact
- Conveniently USB Powered
- Models up to 40GHz
- Harmonic Filtering
- Phase Control
- Native Frequency Sweeping
- Optional Ethernet

DS Instruments

SG Series

PORTABLE WIDEBAND SIGNAL GENERATORS



SG6000 - A wideband RF Signal Generator

The SG Series of signal generators from DS Instruments enables users to generate high quality RF/Microwave signals quickly and easily. An OLED display and interface buttons allow frequency selection, attenuator control, and RF output ON/Off without need for a host PC. The RF output covers 25 to 6000MHz, or to 13GHz, or to 22GHz depending on model. The produced waveform is fully synthesized using modern fractional N synthesis. This synthesized source has its own internal precision 10MHz TCXO oscillator and can accept an external reference signal if needed.

Power output level can be controlled via internal step and variable attenuators. Each unit has their output power individually calibrated to a typical accuracy of $\pm 1.0\text{dB}$.

Ease of Use

SG6000 signal generators can be controlled from the front panel interface or by the USB port and a host PC. The user simply connects a PC to the SG6000, and with provided software all settings and functions can be remotely operated in real time.

Signal Generator USB Operation

With the SG6000 connected to the PC via USB port, industry standard SCPI commands are used to fully control the instrument. The USB port is configured on the host PC as a virtual COM port. This feature allows users to control the signal generator for automated test applications from many different operating systems and scripting languages and environments.



SG Series Models Compared

	SG4400L	SG6000L		SG6000X (Dual Channel)	SG6000F	SG12000L	SG22000L	SG30000L	SG40000L
Min Frequency (MHz)	35	25		25	25	25	60	100	25000
Max Frequency (GHz)	4.4	6.0		6.0	6.0	12.0	22.5	30	40
10MHz Reference Input	X	X		X	X	X	X	X	X
Trigger Input Port					X	X	X	X	
RFO Dynamic Range (dB)	40	40		40	40	40	30	30	30
Harmonic Filtering	X	X			X	X		X	X
Standard Ethernet				X	X	X	X	X	X
Min Calibrated Output (dBm)	-22	-22		-20	-25	-25	-5	-15	-10
Max Calibrated Output (dBm)	15	14		14	14	14	14	15	13
Low Phase Noise						X	X	X	X

Note: SG6000PRO has a separate extended datasheet for the SG PRO series models

SG6000

Product Photos



SG6000L / 4400
(Ultra-Compact)



SG6000F
(Harmonic filtered -
PureSine)



SG12000L
(13GHz)



SG22000L
(22GHz)

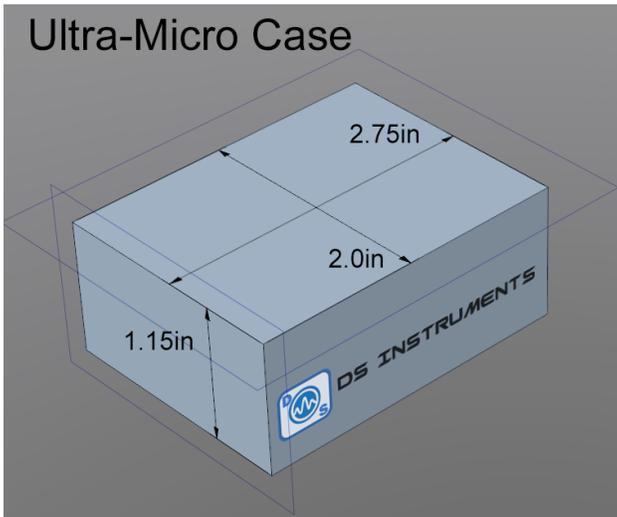


SG6000X
(Dual Channel)

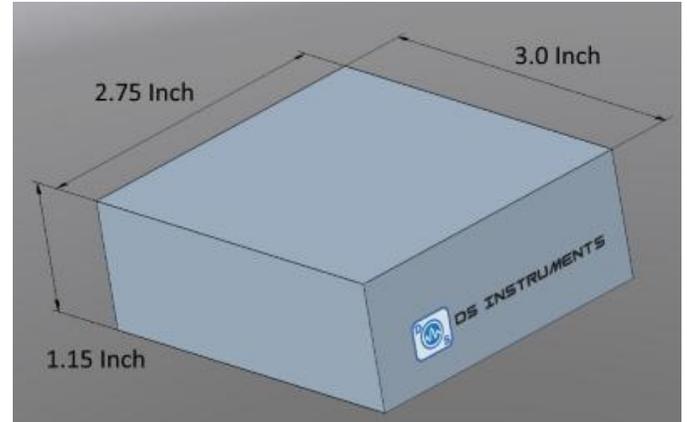


SG6000

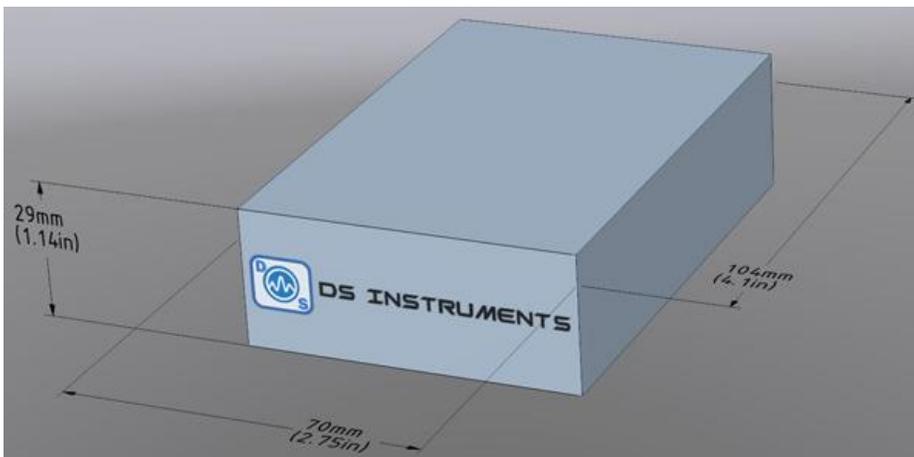
Case Dimensions & Front / Rear Panel Features



SG4400L, SG6000L

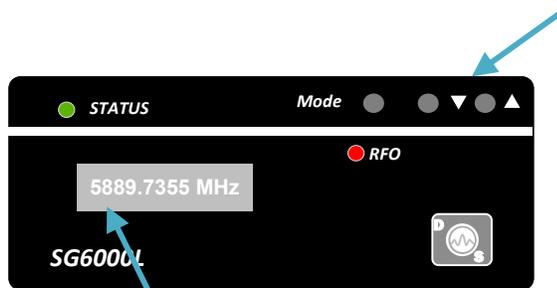


SG6000F, SG6000X, SG12000L



SG22000L

Control Buttons



OLED Display



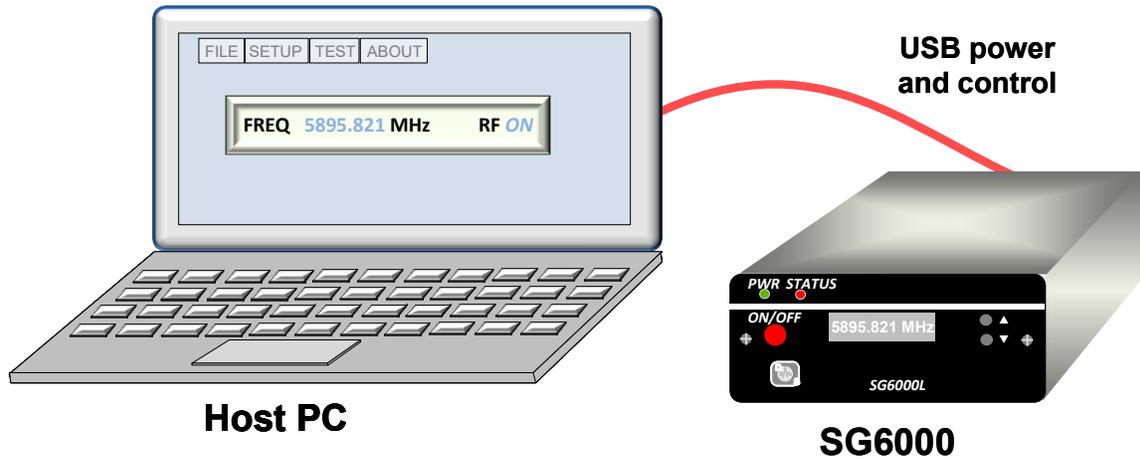
SG output Signal (SMA)

Reference In/Out (MCX)

USB Interface to PC and DC Power Input

SG6000

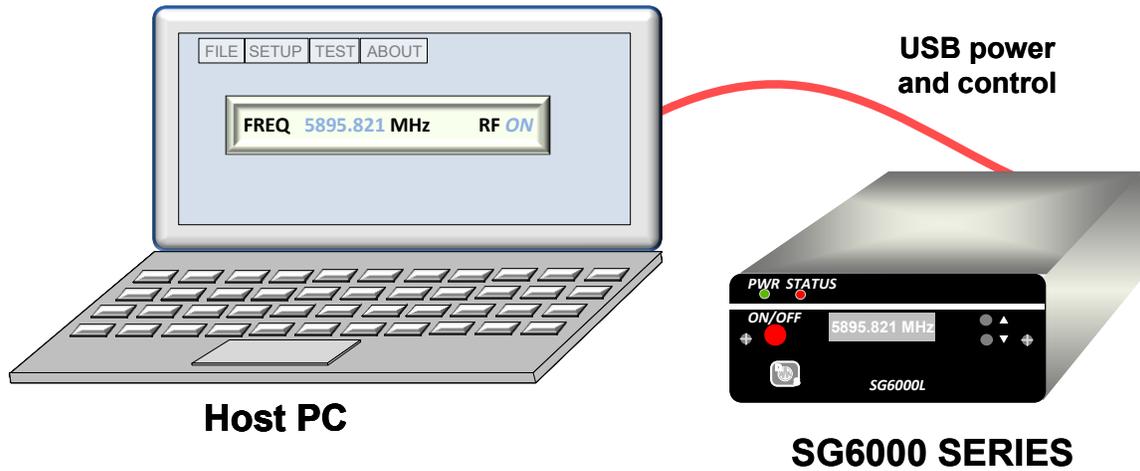
Windows GUI for remote Operation



The screenshot shows the 'Signal Generator Control Pro - DS Instruments' software interface. The window title is 'Signal Generator Control Pro - DS Instruments'. The interface includes a device image of an SG30000, a 'Device Information' section showing 'SG40000PRO, Rev:5, Sn:2654, Fv:7.36, Cal:' and '5.06 VDC' at '19 °C', and a 'Device Configuration' section with a 'Search' field set to 'COM79' and a 'Connect' button. The 'RFO Control (100 - 41000MHz)' section features a frequency control with a value of '40000.000000' and a step of '1.0' MHz, an RF Power control set to '10.00' dBm, and an RF Power Vernier control set to '0'. The 'Phase Control' section has a 'Phase Shift Mode' checkbox and a phase value of '0'. At the bottom, there is a USB icon, an 'RF OFF' button, a 'High Band' indicator, an 'RF ON' button, a 'Sweeping Info' link, and a 'Help! V6.30' button with a logo.

SG6000

Windows GUI for remote Operation - Sweeping



RF Sweeper PRO - DS Instruments



V5.16
[Help!](#)
[Support](#)

Device Configuration

Search

SG30000L - Rev 3 - SER:100 - V6.73

Reference:

Voltage: Temp:

RF Power: dBm

System Sweep Mode

SCAN Mode LIST Mode

Sweep Settings

Type: Direction:

Points: Dwell (mS):

Start (MHz): Stop (MHz):

Step Size: Run Time:

List Mode Controls

Frequency Load List (CSV): loaded frequencies

Device Updated! 1300000000 Device Updated! 1300000000 Device Updated! 1300000000 Device Updated!

SG6000

Calibration and Stability

Power Calibration Explanation

DS Instruments signal generators are each calibrated at the factory to have accurate power output levels across the device bandwidth. When the VERNIER setting is at the default of ZERO, the device is operating in calibrated mode with no adjustment to the power setting shown.

If the fine power tune slider is moved in the control software, or the Vernier setting is changed from the front panel, the output is more (positive), or less (negative), than the dBm value shown. We now consider the device to be operating in uncalibrated mode. This mode will be indicated by the power level box changing colors in the control software.

Say you are at +10dBm, and need more power, slide the Vernier bar to the right. This is called uncalibrated mode because there is no feedback from the amplifiers to let the device know the exact power level at the current frequency. You would need a power meter to know the actual output in uncalibrated mode.

Typically this is used to get more than the max calibrated level, or to fine tune between digital attenuator steps. It can also be used to get a lower power than the minimum calibrated level by about 10dB.

Uncalibrated mode can usually achieve 3-5dB more power than the max level stated, depending on frequency.

The Vernier power resolution is typically around 0.05dB.

Frequency Stability Calculation

DS Instruments signal generators all include an internal temperature-compensated reference frequency source. This is typically a crystal oscillator. The stability of this low-frequency oscillator directly determines the stability of the final microwave output frequency.

The main synthesizer phase locks a low-noise high-frequency oscillator to the reference clock. As the output frequency goes up, the error in absolute frequency output also goes up.

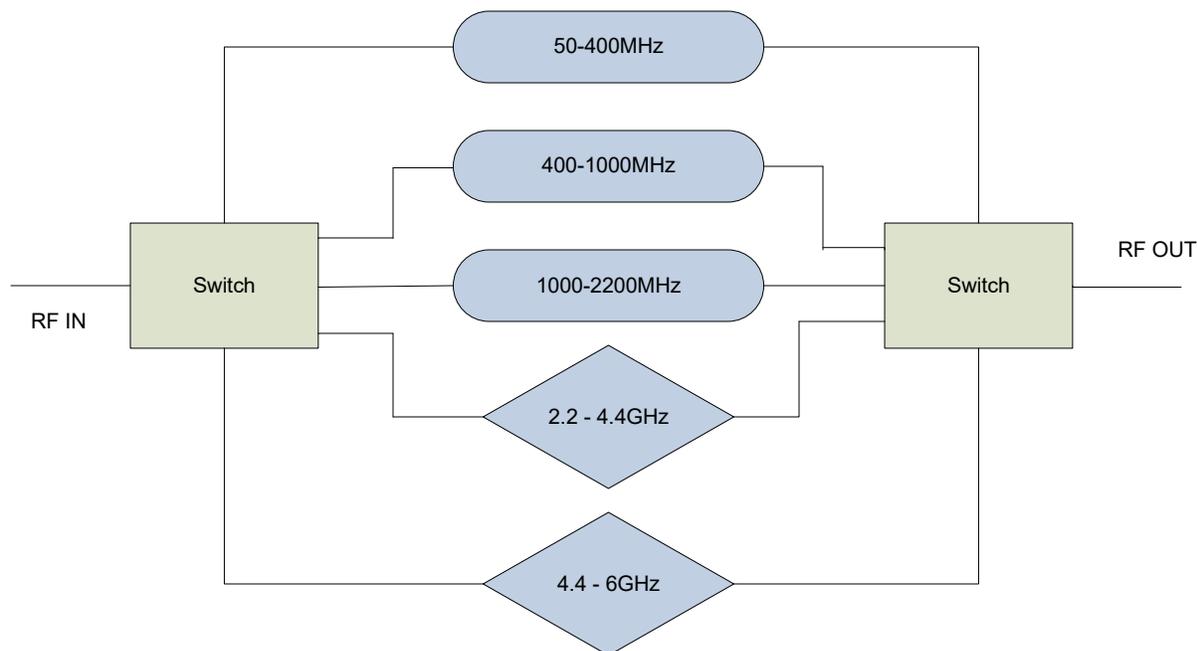
The reference source stability is given in terms of Parts Per Million or PPM. For example the SG6000L has a 10MHz reference rated at ± 2.5 PPM. Using an online PPM to Hz calculator or maths we can determine that at an output of 100MHz the output stability will be ± 250 Hz, and at 1GHz the stability will be ± 2.5 KHz.

SG6000F

Harmonics

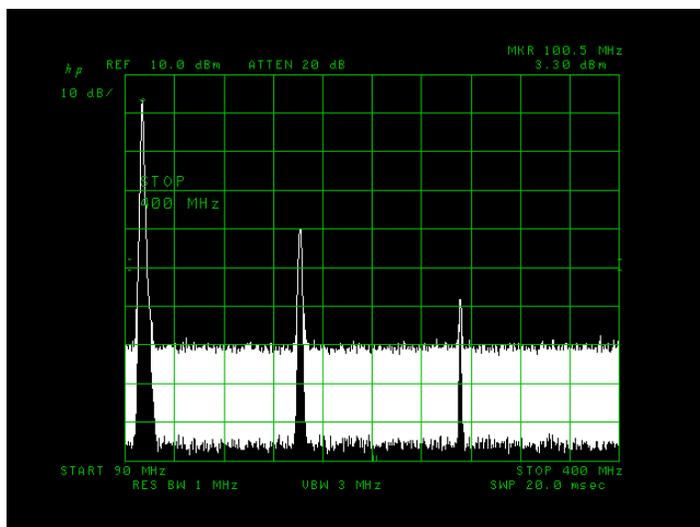
The **SG6000F** focuses on filtering the harmonics inherent to PLL based synthesizers as best as possible. The SG6000F utilizes a filter matrix made up of 3 multi-octave tunable low frequency filters and two fixed high-frequency low-pass filters.

DS Instruments Internal Low-Pass Filter Matrix – SG6000F

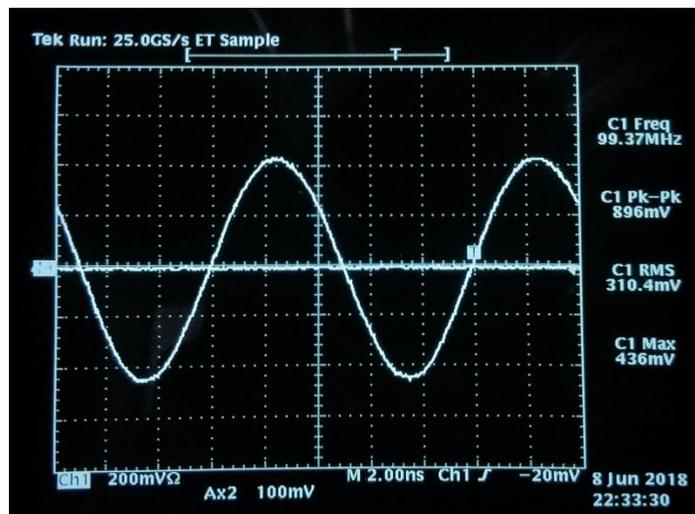


Harmonics are more plentiful at low frequencies (<500MHz) in wideband systems, causing more pronounced distortion. The SG6000 filtering is typically able to reduce the second harmonic to -30dBc, and the third harmonic to under -40dBc. Unfiltered synthesizers can have harmonics as high as -10dBc extending well beyond the 9th.

Low Harmonic Content



Low Distortion!



SG6000

SCPI Serial Command List

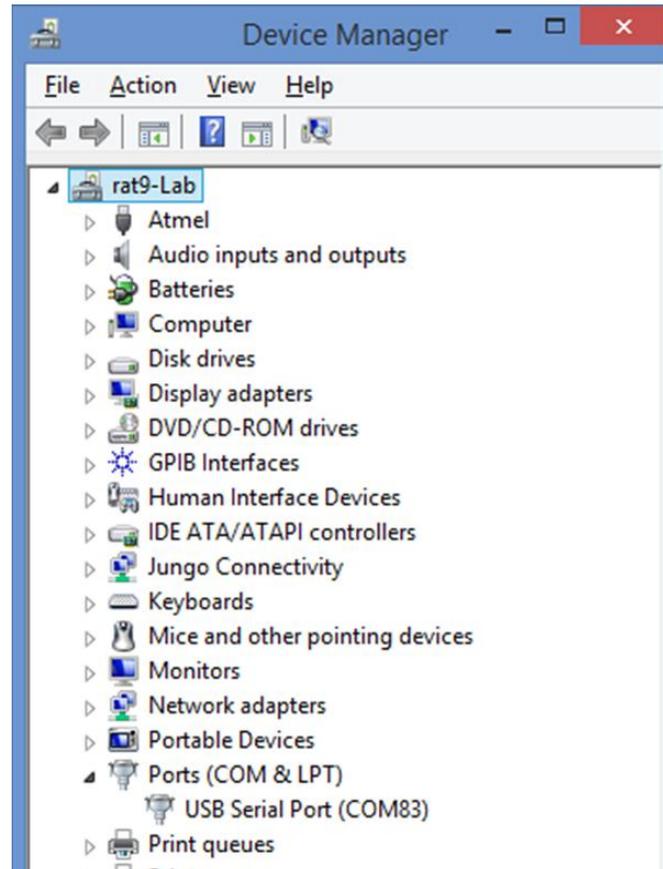
Command	Example 1	Example 2	Description
FREQ:CW	FREQ:CW 400MHZ	FREQ:CW 3.33GHZ	Set output Frequency
FREQ:CW?			Return current Frequency
OUTP:STAT	OUTP:STAT ON	OUTP:STAT OFF	Turn on or off the RF output
OUTP:STAT?			Return if output is enabled
POWER	9	-12.5	Set output power in dBm
POWER?			Return current output power
VERNIER	VERNIER 3	VERNIER -22	Fine tune the output power (no units)
VERNIER?			Return vernier setting
*IDN?			Return the SCPI identification string
*PING?			returns "PONG!" if device is responding
SYST:ERR?			Returns any pending error codes
*CLS			Clears any error codes
SYST:DBG?			Returns last debug status message
*RST			Reset unit now
*INTREF?			Is the internal reference enabled?
*EXTREF?			Is an external reference signal detected?
*INTERNALREF 1			Set reference to internal
*INTERNALREF 0			Set reference to external
*INTERNALREF A			Autodetect 10MHz reference at power up
*DISPLAY	*DISPLAY OFF	*DISPLAY ON	Power on or off the display
*BUZZER	*BUZZER ON	*BUZZER OFF	Mute the buzzer
*SAVESTATE			Save frequency & attenuation as boot defaults
*SYSVOLTS?			Return internal USB voltage
*UNITNAME	*UNITNAME Bob	*UNITNAME DEV-34	Set a unique name in flash memory
*UNITNAME?			Return this device's name
SWE:MODE	SWE:MODE SCAN		Enters sweep mode & arms external sweep trigger
FREQ:START	FREQ:START 1GHZ	FREQ:START 99MHZ	Sweep start frequency
FREQ:STOP	FREQ:STOP 2GHZ	FREQ:STOP 999MHZ	Sweep stop frequency
LIST:DIR	LIST:DIR UP	LIST:DIR DOWN	Sweep direction
SWE:POINTS	SWE:POINTS 10	SWE:POINTS 900	Sweep point count
SWE:DWELL	SWE:DWELL 25	SWE:DWELL 1000	Sweep dwell time in milliseconds
INIT:CONT	INIT:CONT 0	INIT:CONT 1	Sweep continuous mode or single
INIT:IMM			Trigger the sweep now
ABORT			Stop the sweep now
SWE:ACTIVE?			Is the device sweeping now
TRIG:STEP			Mode where trigger command only advances 1 step
TRIG:SWEEP			Trigger command will execute entire sweep (default)
LPMODE	LPMODE ON	LPMODE OFF	Low power mode reduces RF output by ~4-7dB

NOTE: Full SCPI command list and dedicated sweeping command lists are available as independent documents

SG6000

Remote Control Example Code

All of our products can be controlled from any serial-capable programming language or environment. MATLAB, .NET, Linux, python are all popular. We use Visual Studio 2015 and C# for our standard GUI. First determine the port number that your device has installed itself as:



Example Code (C# .NET Framework):

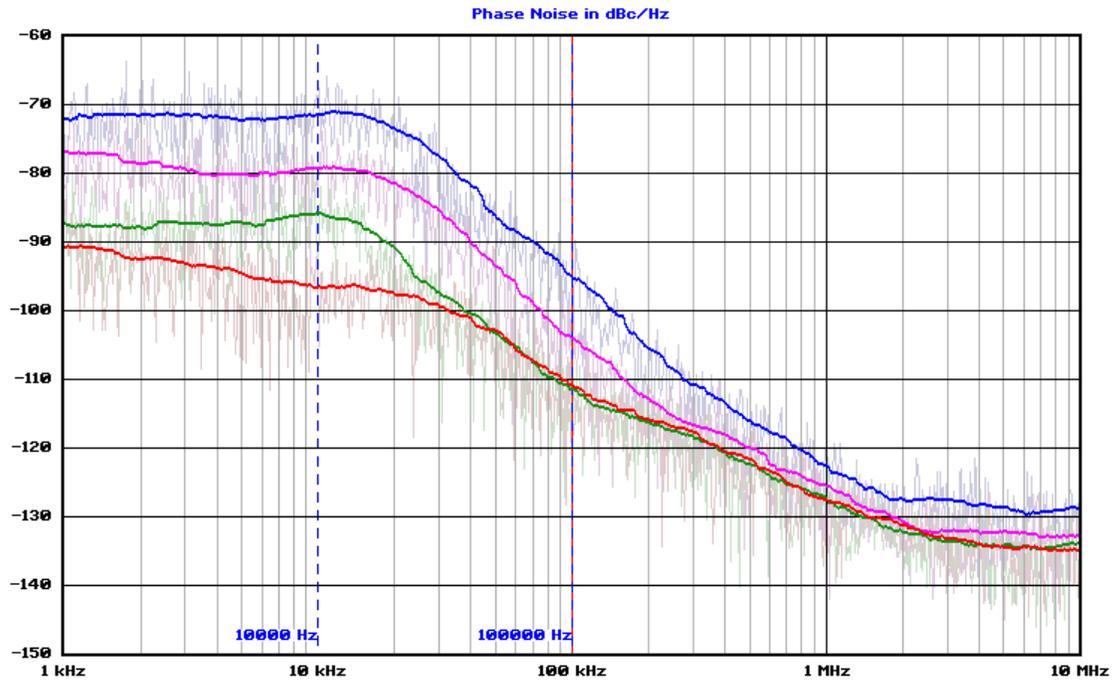
```
using System;
using System.IO.Ports;    // include serial port library

SerialPort myPort = new SerialPort("COM83", 115200, System.IO.Ports.Parity.None, 8, System.IO.Ports.StopBits.One);
myPort.Open();           // open the port we just made
myPort.WriteLine("*IDN?"); // send any command here
myPort.ReadTimeout = 250;

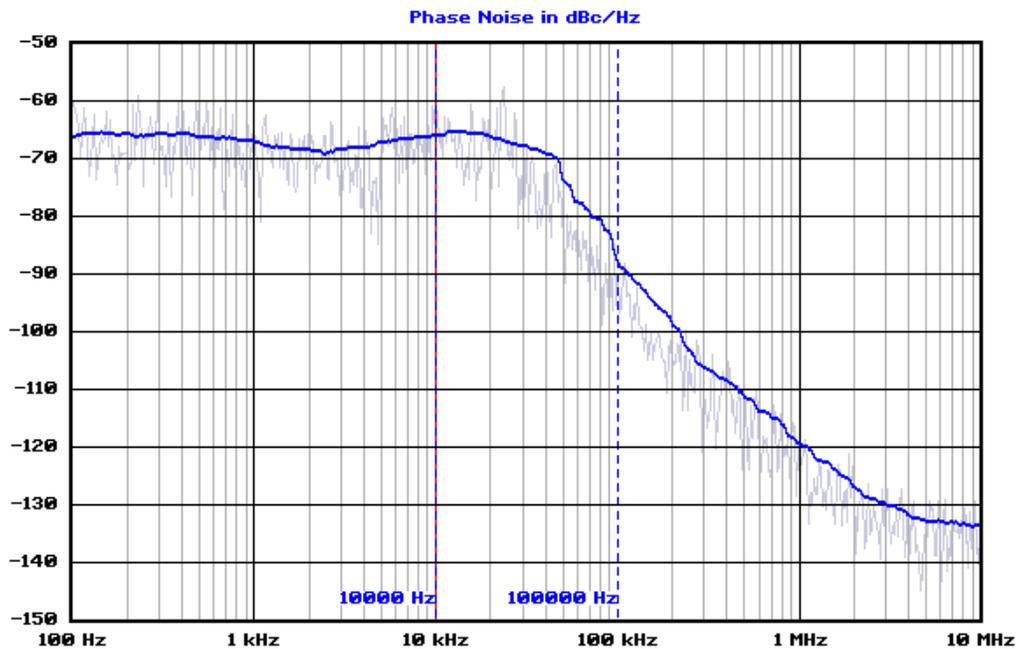
string myResponse = myPort.ReadLine(); // read back the response
System.Threading.Thread.Sleep(30);     // delay before sending the next command
```

SG6000

(6GHz) Typical Phase Noise



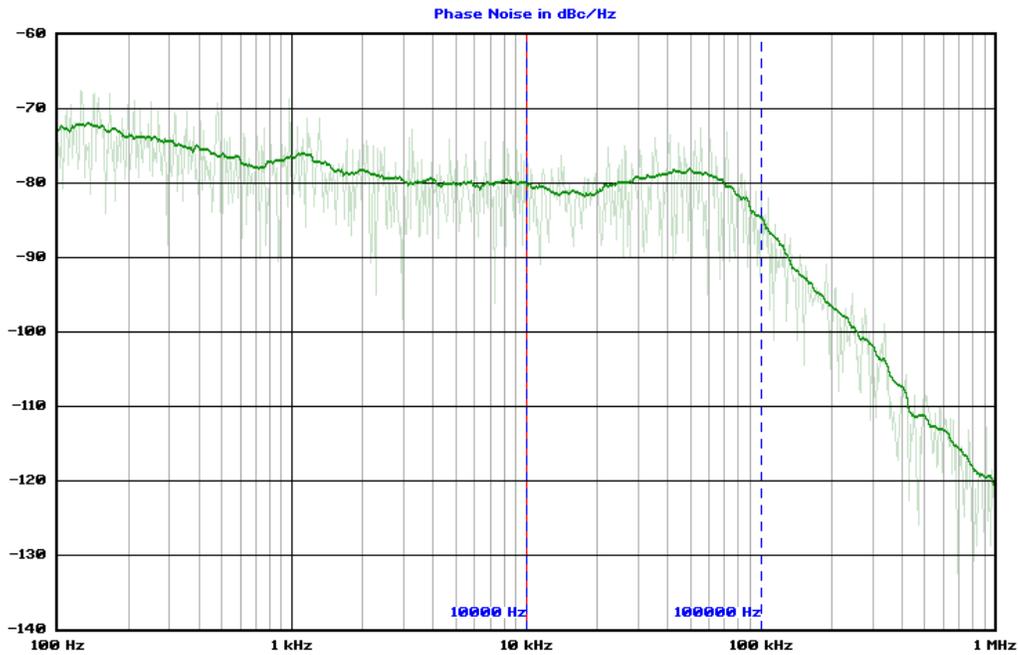
Trace	Carrier Hz	Carrier dBm	dBc/Hz at 100000 Hz	RMS Jitter
SC6000L	6 000 000 000	0.00	-95.2	1.3E-012 s
SC6000L	2 400 000 000	0.00	-104.0	1.3E-012 s
SC6000L	900 000 000	0.00	-111.3	1.2E-012 s
SC6000L	433 000 000	0.00	-110.8	1.3E-012 s



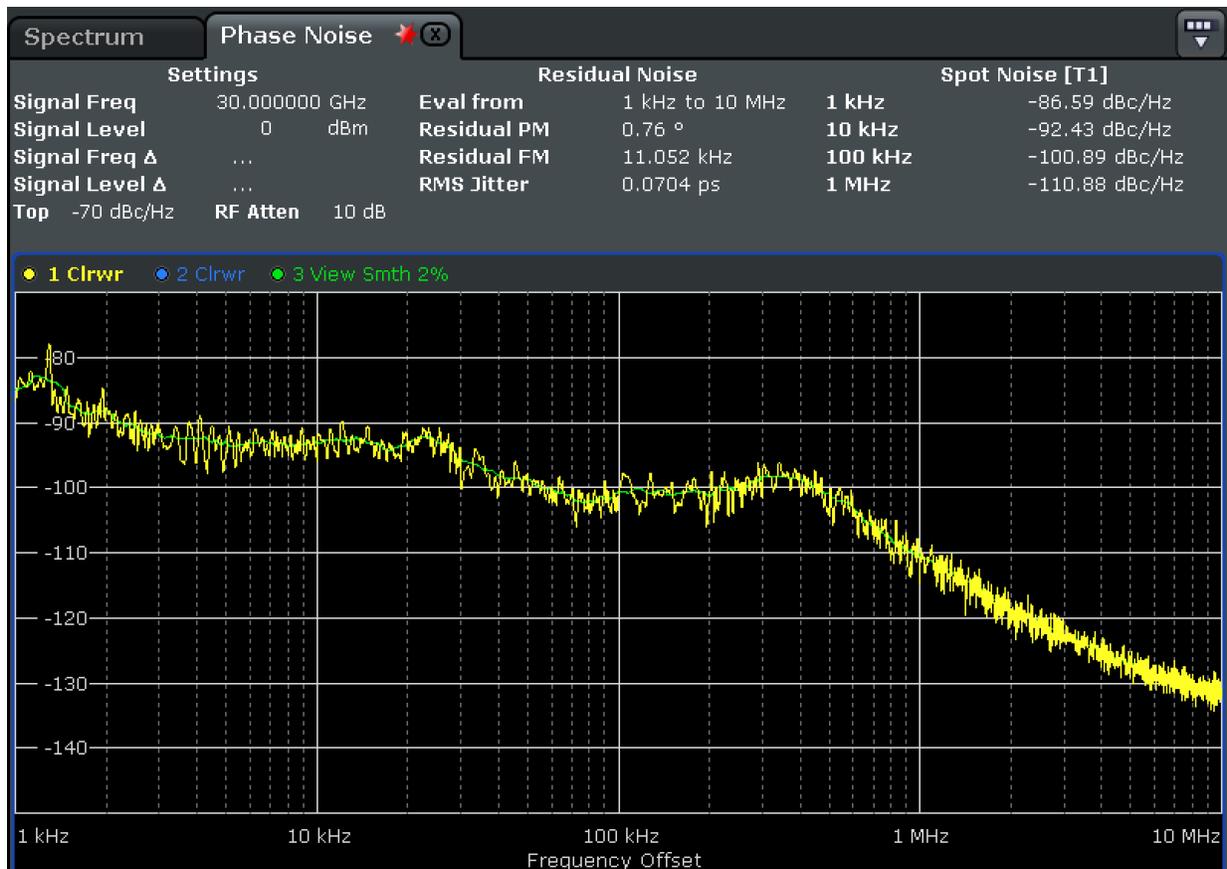
Trace	Carrier Hz	Carrier dBm	dBc/Hz at 10000 Hz	RMS Jitter
SC12000	12 000 000 000	13.00	-65.9	1.7E-012 s

SG6000

Phase Noise Plots Continued



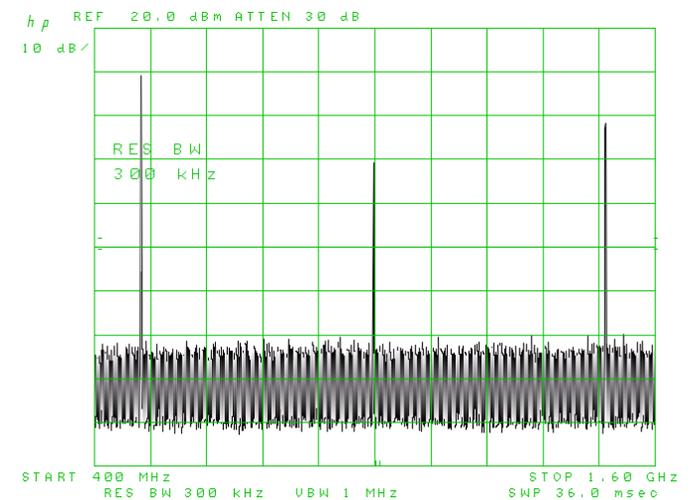
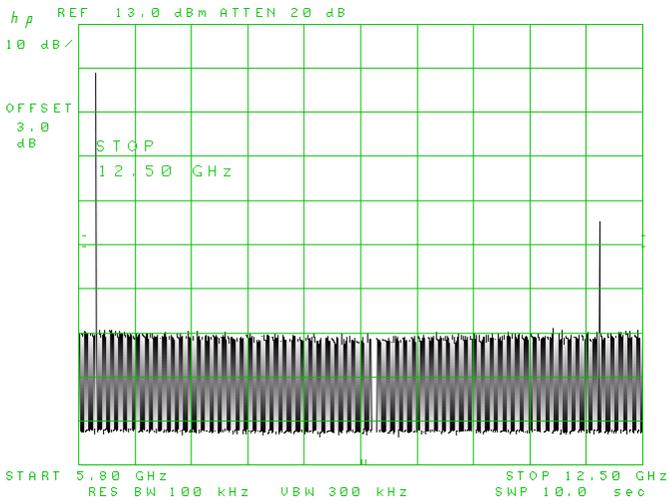
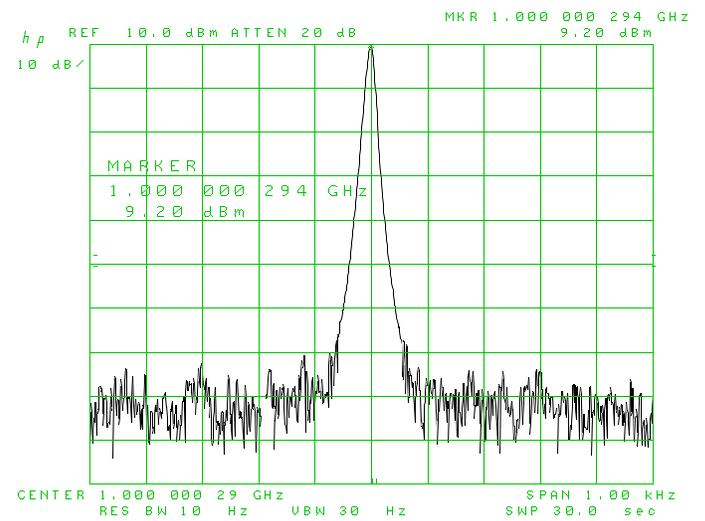
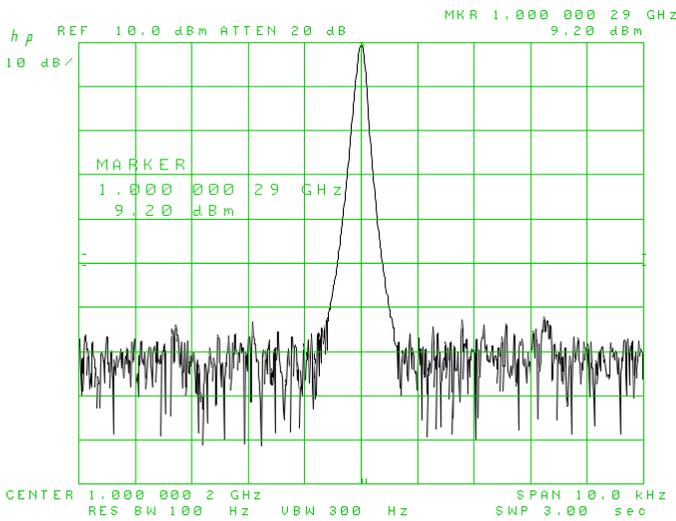
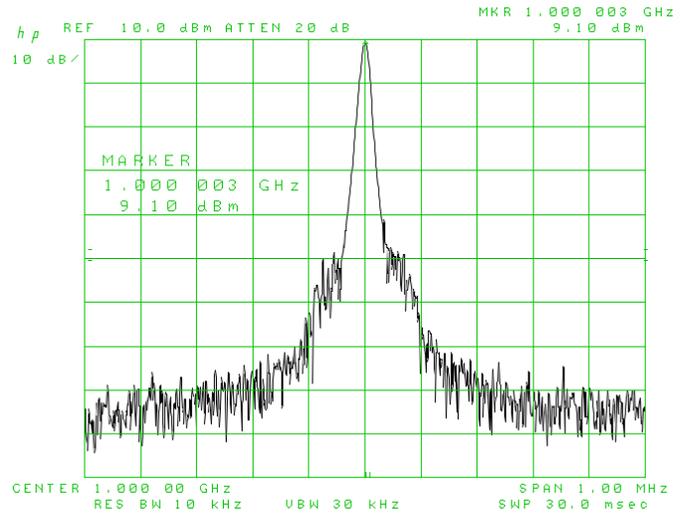
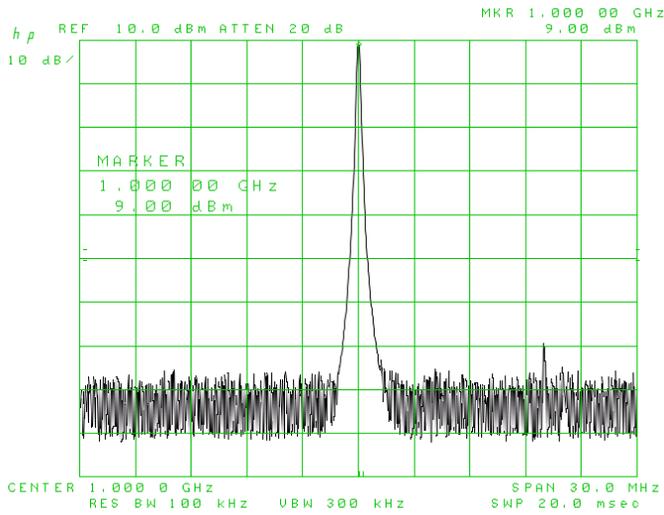
Trace	Carrier Hz	Carrier dBm	dBc/Hz at 10000 Hz	RMS Jitter
SC22000L-R18	18 000 000 000	15.00	-80.3	3.7E-013 s



SG6000

Typical Output Power Spectrums

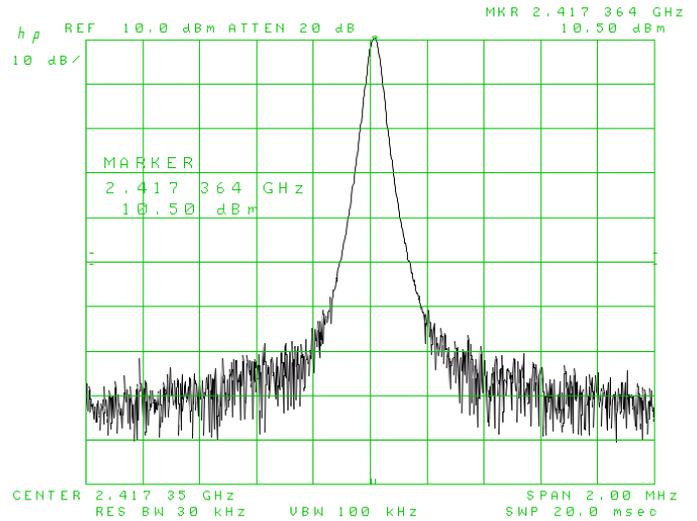
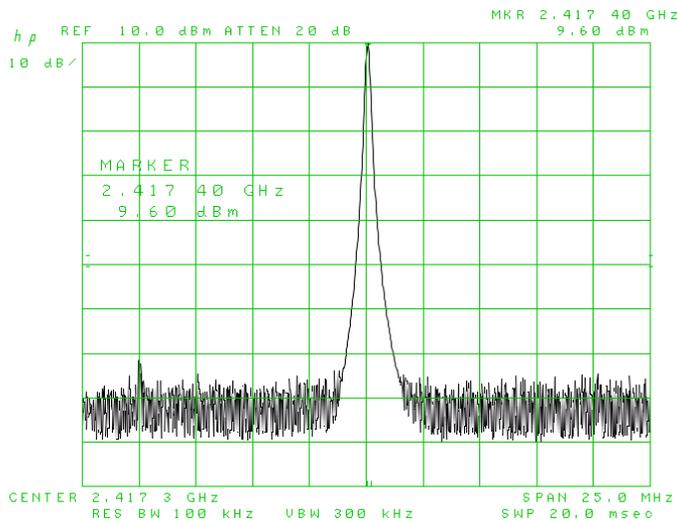
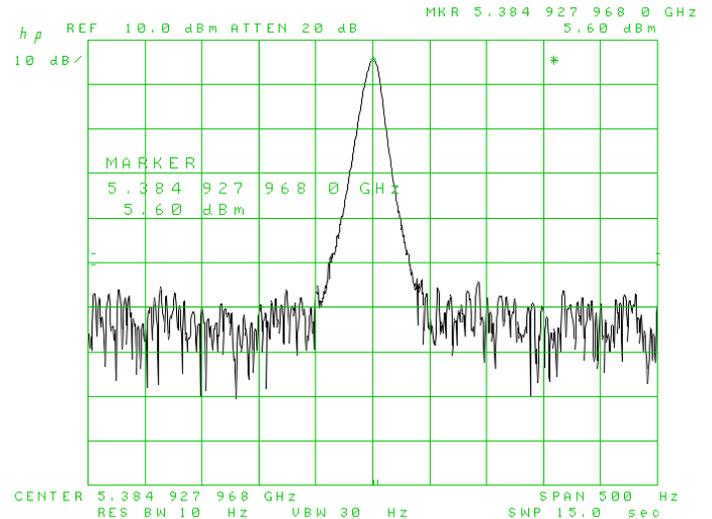
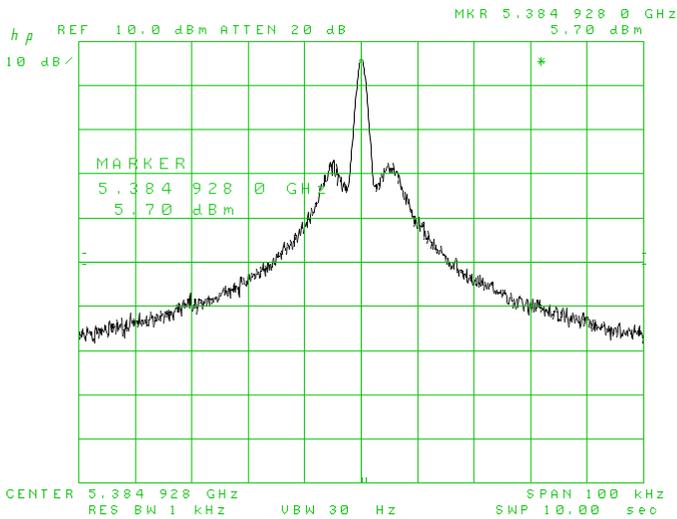
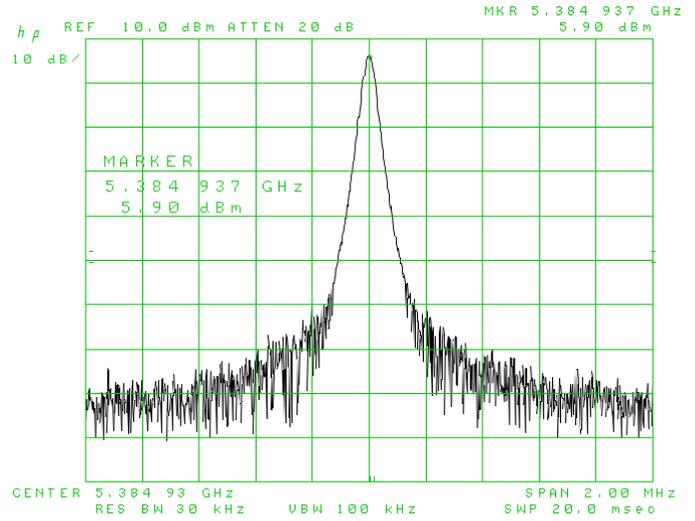
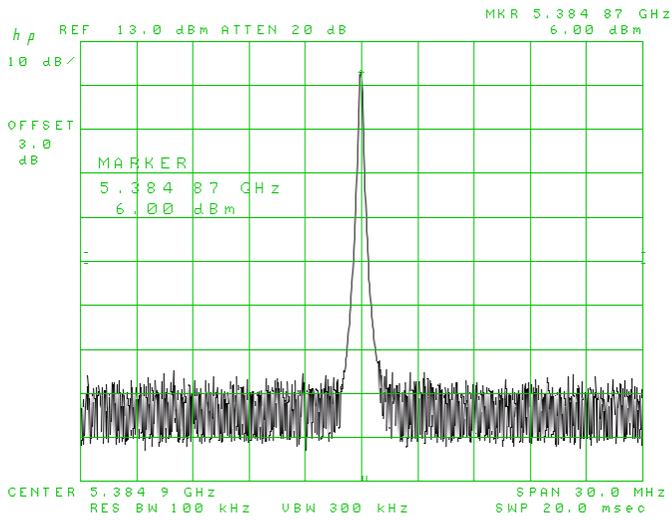
[25 Deg. C, USB Power , internal 10MHz]



SG6000

Typical Output Power Spectrums, Cont.

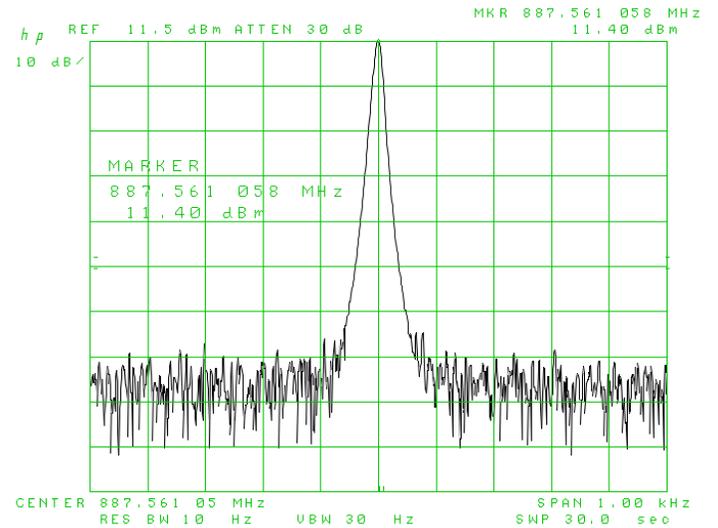
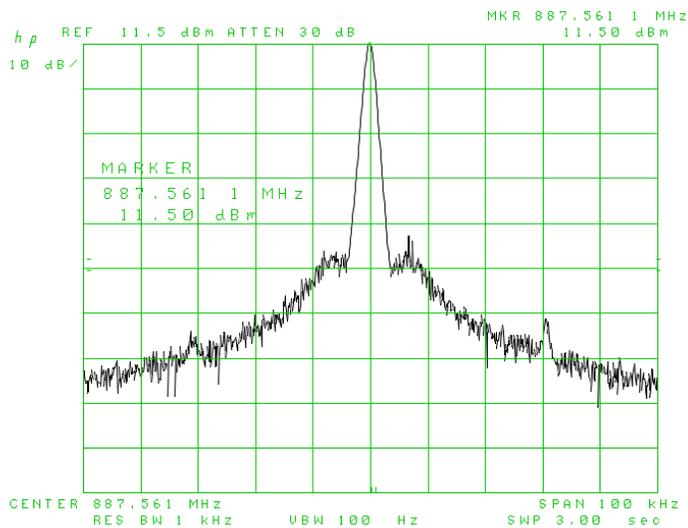
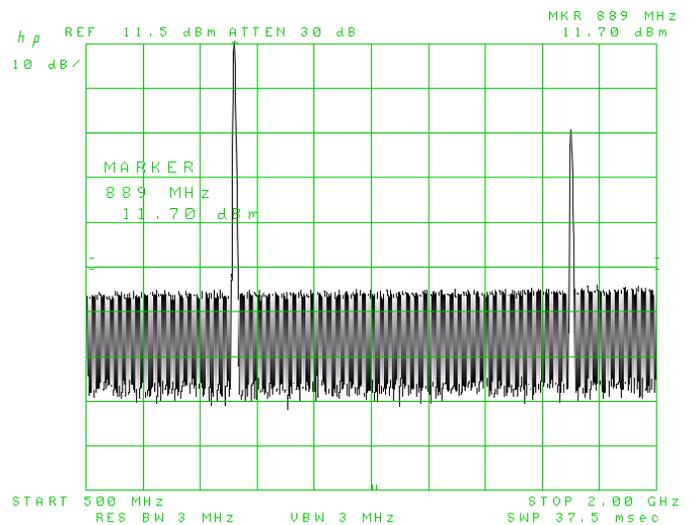
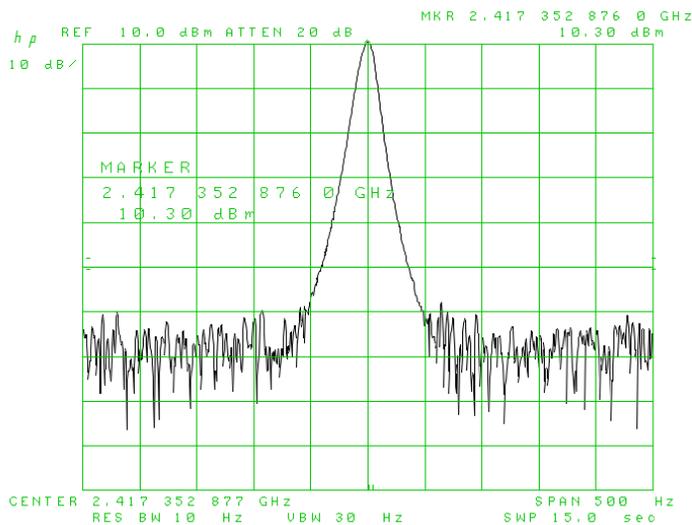
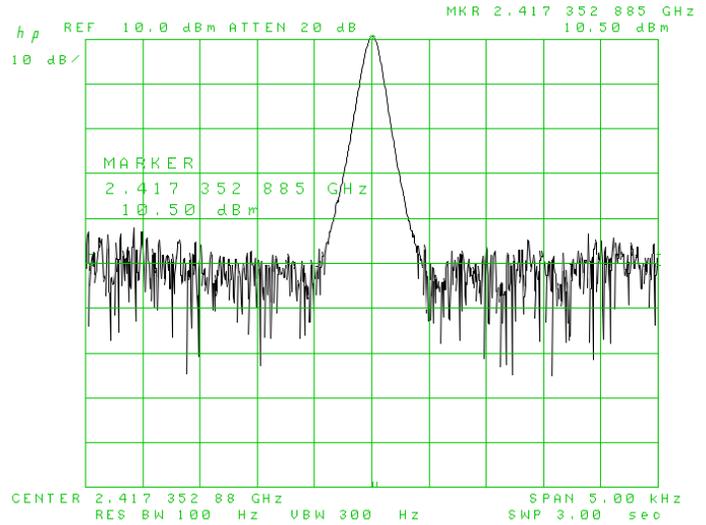
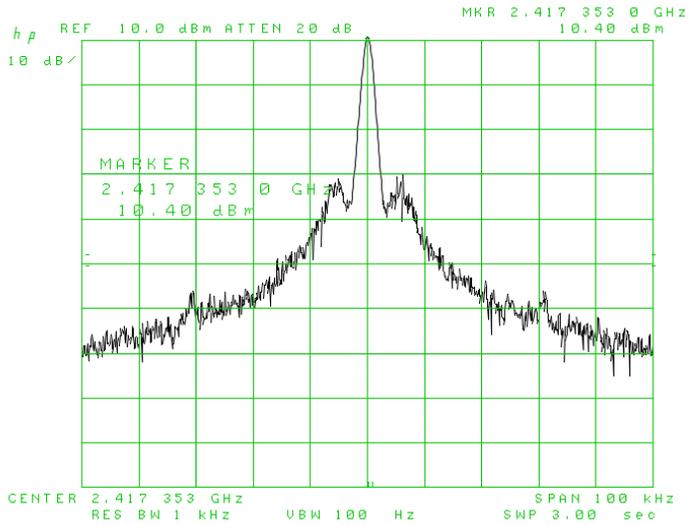
[25 Deg. C, USB Power, internal 10MHz]



SG6000

Typical Output Power Spectrums, Cont.

[25 Deg. C, USB Power, internal 10MHz]



SG6000 Series Pricing

Ordering Information

SG4400L – Standard Version – 35 to 4400MHz

SG4400LE – Standard Version with Ethernet – 35 to 4400MHz

SG6000L – Standard Version – 25 to 6000MHz

SG6000F – Extended Harmonic Filtering – 25 to 6000MHz

SG6000X – Dual Channel – 25 to 6000MHz

SG12000L – 50MHz to 13GHz Output

SG22000L – 60MHz to 22GHz Output

SG30000L – 100M to 30GHz Output

SG40000L – 24GHz to 40GHz Output

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MADE IN



U. S. A.



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SG6000 Series Signal Generators