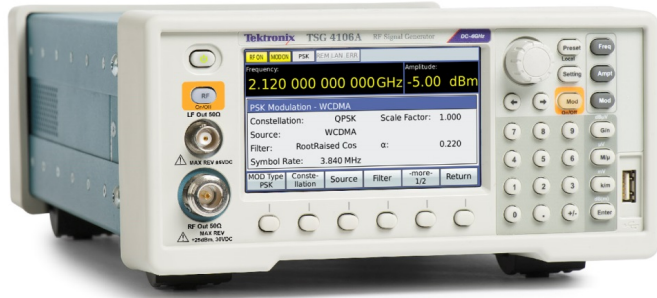


# RF Vector Signal Generators

## TSG4100A Series



The TSG4100A Series RF Vector Signal Generator offers mid-range performance and up to 200 MHz modulation bandwidth at an entry-level RF signal generator price. They use a new technique to provide spurious free outputs with low phase noise (-113 dBc/Hz at 20 kHz offset from 1 GHz carrier) and extraordinary frequency resolution (1  $\mu$ Hz at any frequency). The TSG4100A Series comes standard with analog modulation. Convenient, in-field software upgrades allow for easy transition from analog to more advanced vector and digital modulation capabilities, providing the most flexible configuration and best CAPEX protection. These instruments complement other leading mid-range RF test solutions from Tektronix, such as the USB-based RSA306 Spectrum Analyzer and MDO4000B and MDO3000 Mixed Domain Oscilloscopes.

The TSG4100A Series instruments use an ovenized SC-cut oscillator (TSG410xA-M00 or E1 models) time-base, providing a 100 X improvement in stability (and a 100 X reduction in the in-close phase noise) compared to instruments that use a TCXO time-base.

### Key features

- Analog and vector/digital signal generation capabilities
- Dual baseband ARB generators
- Analog modulation standard
- Soft key upgrade to vector/digital modulation at very low cost
- Digital modulation applications for GSM, EDGE, W-CDMA, APCO-25, DECT, NADC, PDC, and TETRA
- USB, GPIB, RS-232, and LAN interfaces
- 12 pounds (5.6 kg)
- 2U high and half standard rack width

### Key performance specifications

- True DC to 2 GHz, 4 GHz or 6 GHz to support both analog and vector/digital signal generation
- Typical  $\leq \pm 0.30$  dB amplitude accuracy (0 dBm CW signal at 22 °C) from 10 MHz to 6 GHz
- I/Q modulation inputs (400 MHz RF bandwidth)
- ASK, FSK, MSK, PSK, QAM, VSB, and custom I/Q

### Analog modulation

The Tektronix TSG4100A Series RF Vector Signal Generators offer a wide variety of modulation capabilities. Modes include amplitude modulation (AM), frequency modulation (FM), phase modulation ( $\Phi$ M), and pulse modulation. There is an internal modulation source as well as an external modulation input. The internal modulation source produces sine, ramp, saw, square, and noise waveforms. An external modulation signal may be applied to the rear panel modulation input. The internal modulation generator is available as an output on the rear panel.

### Vector modulation

The TSG4100A Series builds on this performance by adding full support for vector signal modulation on RF carriers between 400 MHz and 6.0 GHz. It features a dual arbitrary waveform generator operating at 125 MHz for baseband signal generation. The generator has built-in support for the most common vector modulation schemes: ASK, QPSK, DQPSK,  $\pi/4$  DQPSK, 8PSK, FSK, CPM, QAM (4 to 256), 8VSB, and 16VSB. It also includes built-in support for all the standard pulse shaping filters used in digital communications: raised cosine, root-raised cosine, Gaussian, rectangular, triangular, and more. Lastly, it provides direct support for the controlled injection of additive white Gaussian noise (AWGN) into the signal path.

## Internal baseband generators

Using a novel architecture for I/Q modulation, the TSG4100A Series provides quick, user-friendly waveform generation. The baseband generator supports the playback of pure digital data. It automatically maps digital symbols into a selected I/Q constellation at symbol rates of up to 6 MHz and passes the result through the selected pulse shaping filter to generate a final waveform updated in real time at 125 MHz. This baseband signal is then modulated onto an RF carrier using standard IQ modulation techniques.

Digital communications protocols (GSM, GSM EDGE, W-CDMA, APCO-25, DECT, NADC, PDC, and TETRA) quickly configure the signal generator to the correct modulation type, symbol data rates, TDMA duty cycles, and digital waveform filters. The preset protocols also configure the rear-panel TDMA, START of FRAME, and SYMBOL CLOCK digital outputs. The baseband generators can be configured for these protocols without the use of external computers or third party software.

The I/Q waveforms are computed in real time. Symbols are mapped to constellations, digitally filtered, and up-sampled to 125 Msps to drive the I/Q modulator via dual 14-bit DACs. The symbols can be a fixed pattern, PRBS data from an internal source, or come from a downloaded user list of up to 16 Mbits.

The constellation mapping can be modified by the user. Digital filters include raised cosine, root raised cosine, Gaussian, rectangular, linear, sinc, and user-defined FIR.

## External IQ modulation

The rear-panel BNC I/Q modulation inputs and outputs enable arbitrary vector modulation via an external source. The external signal path supports maximally 400 MHz of RF bandwidth with a full scale range of  $\pm 0.5$  V and a 50  $\Omega$  input impedance.

## Power vs. frequency

All TSG4100A Series models have cascaded stages of amplifiers and digital attenuators to drive the RF output. Five stages can provide up to +25 dB of gain to -130 dB of attenuation in 156 digitally controlled steps. During factory calibration, the output power is measured at 32 frequencies per octave for each of the 156 attenuator steps to populate a memory matrix with about 40,000 elements. When set to a particular frequency and power, the instrument interpolates between these matrix elements to determine the best attenuator setting. An analog attenuator is used to provide 0.01 dB resolution between matrix elements and to compensate for residual thermal effects.

## OCXO time-base

These instruments offer an oven-controlled crystal oscillator (OCXO) time-base. The time-base uses a third-overtone stress-compensated 10 MHz resonator in a thermostatically controlled oven. The time-base provides very low phase noise and very low aging.

## Easy remote communications

Remote operation is supported with RS-232, LAN, and GPIB interfaces. All instrument functions can be controlled and read over any of the interfaces. Up to nine instrument configurations can be saved in non-volatile memory.

# Specifications

All specifications apply to all models unless noted otherwise.

## Frequency

<b>BNC output, all models</b>	DC to 62.5 MHz
<b>N-type outputs</b>	
<b>TSG4102A</b>	950 kHz to 2.0 GHz
<b>TSG4104A</b>	950 kHz to 4.0 GHz
<b>TSG4106A</b>	950 kHz to 6.0 GHz
<b>Frequency resolution</b>	1 $\mu$ Hz at any frequency
<b>Switching speed</b>	<8 ms (to within 1 ppm)
<b>Frequency error</b>	$<(10^{-18} + \text{time-base error}) \times f_c$
<b>Frequency stability</b>	$1 \times 10^{-11}$ (1 s Allan variance)

## Front panel BNC output

<b>Frequency range</b>	DC to 62.5 MHz
<b>Amplitude</b>	1.00 $V_{\text{RMS}}$ to 0.001 $V_{\text{RMS}}$ (-47 dBm to +14.96 dBm)
<b>Offset</b>	$\pm 1.5$ VDC
<b>Offset resolution</b>	5 mV
<b>Maximum excursion</b>	1.817 V (amplitude + offset)
<b>Amplitude resolution</b>	<1 %
<b>Amplitude accuracy</b>	$\pm 0.7$ dB
<b>Harmonics, typical</b>	$<-40$ dBc
<b>Spurious, typical</b>	$<-65$ dBc
<b>Output coupling</b>	DC, 50 $\Omega$ $\pm 2\%$
<b>Impedance</b>	50 $\Omega$
<b>Reverse protection</b>	$\pm 5$ VDC
<b>VSWR, typical</b>	< 1.6 :1

# TSG4100A Series RF Vector Signal Generator

## Front panel N-type output

### Power output

TSG4102A	+16.5 dBm to -110 dBm
TSG4104A	+16.5 dBm to -110 dBm (<3 GHz)
TSG4106A	+16.5 dBm to -110 dBm (<4 GHz)
	+10 dBm to -110 dBm (4-6 GHz)

### Voltage output

TSG4102A	1.5 V <sub>RMS</sub> to 0.7 V <sub>RMS</sub>
TSG4104A	1.5 V <sub>RMS</sub> to 0.7 μV <sub>RMS</sub> (<3 GHz)
TSG4106A	1.5 V <sub>RMS</sub> to 0.7 μV <sub>RMS</sub> (<4 GHz)

Amplitude resolution 0.01 dBm

### Amplitude accuracy

CW, 50 Ω load (dB, typical)	CW, 18 °C to 28 °C	>10 dBm	10 to -30 dBm	-30 to -60 dBm	-60 to -100 dBm	<-100 dBm
	10 MHz to 0.1 GHz	±0.2	±0.25	±0.35	±0.45	±0.6
	0.1 GHz to 2 GHz	±0.15	±0.15	±0.25	±0.35	±0.6
	2 GHz to 4 GHz	±0.3	±0.2	±0.35	±0.6	±0.8
	4 GHz to 6 GHz	NA	±0.3	±0.4	±0.75	±1.25

CW, 50 Ω load (dB, max)	Level range:	+5 to -30 dBm (max)		+5 to -30 dBm (typical)
	Temperature:	18 °C to 28 °C	5 °C to 40 °C	5 °C to 40 °C
	10 MHz to 0.1 GHz	±0.6	±1.0	±0.7
	0.1 GHz to 2 GHz	±0.6	±1.0	±0.6
	2 GHz to 4 GHz	±0.6	±1.0	±0.7
	4 GHz to 6 GHz	±1	±1.5	±0.9

Impedance 50 Ω

Output coupling AC, 50 Ω

VSWR, typical  
 <1.5 (2 MHz to 2 GHz)  
 <1.8 (2 GHz to 6 GHz)

Reverse protection 30 VDC, +25 dBm

IQ modulation output level accuracy  
 Output amplitude is -5 dBm.

Temperature:	18 °C to 28 °C		5 °C to 40 °C
Fc:	Typical (dB)	Max (dB)	Typical (dB)
<2 GHz	±0.1	±0.4	±0.4
2 GHz to 4 GHz	±0.2	±0.6	±0.4
4 GHz to 6 GHz	±0.4	±0.8	±0.7

## Spectral purity of the RF output

Subharmonics	None
Harmonics, maximum	Output level <0 dBm, 1 GHz CW signal
TSG4102A and TSG4104A	< -38 dBc
TSG4106A	< -30 dBc
Harmonics, typical (output level < 0 dBm)	< -35 dBc, CW, Fc < 2 GHz
Spurious (typical)	Output level -10 dBm, CW
< -68 dBc	>10 kHz from carrier in 950 kHz to 1 GHz
< -60 dBc	>10 kHz from carrier in 1 GHz to 2 GHz
< -55 dBc	>10 kHz from carrier in 2 GHz to 4 GHz
< -55 dBc	>10 kHz from carrier in 4 GHz to 6 GHz

Residual FM, typical	1 Hz rms (300 Hz to 3 kHz bandwidth)
----------------------	--------------------------------------

Residual AM, typical	0.006 % rms (300 Hz to 3 kHz bandwidth)
----------------------	---

SSB phase noise	Output level is +5 dBm at 18 °C to 28 °C.
-----------------	---

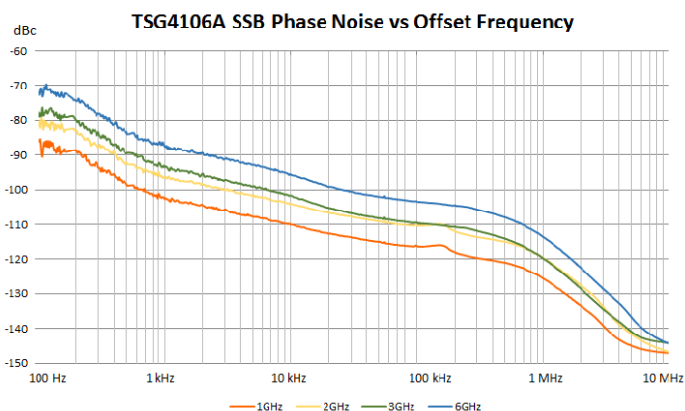
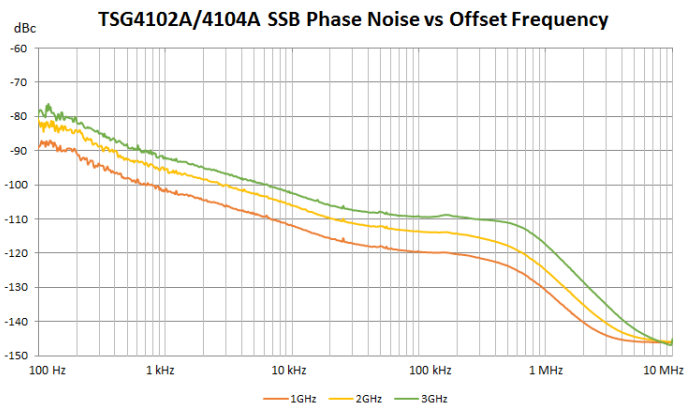
Carrier	Offset from carrier, typical (dBc/Hz)			
	1 kHz	10 kHz	20 kHz	1 MHz
1 GHz	-102	-110	-113	-124
2 GHz	-96	-104	-107	-118
3 GHz	-93	-102	-105	-120
6 GHz	-87	-96	-99	-114

SSB phase noise at 1 GHz carrier, maximum (output level +5 dBm, 5 °C to 40 °C)

1 kHz offset	-95 dBc/Hz
10 kHz offset	-106 dBc/Hz
20 kHz offset	-107 dBc/Hz
1 MHz offset	-120 dBc/Hz
2 GHz offset	-118 dBc/Hz
>3 GHz offset	-120 dBc/Hz

# TSG4100A Series RF Vector Signal Generator

## Spectral purity of the RF output



## Phase setting (front panel outputs)

Maximum phase step	$\pm 360^\circ$
Phase resolution	0.01° (DC to 100 MHz) 0.1° (100 MHz to 1 GHz) 1.0° (1 GHz to 6 GHz)

## OCXO time-base (Option M00 or Option E1)

Oscillator type	Oven-controlled, 3rd OT, SC-cut crystal
Initial accuracy at calibration (20 minute warm-up, at 18 °C to 28 °C)	$< \pm 0.02$ ppm
Temperature drift (0 °C to 40 °C)	$< \pm 0.003$ ppm
Aging	$< \pm 0.05$ ppm/year

**VCXO time base (Option M01)**

Initial accuracy at calibration (20 minute warm-up, at 18 °C to 28 °C)	<±0.5 ppm
--	-----------

Temperature drift (0 °C to 40 °C)	<±5.0 ppm
-----------------------------------	-----------

Aging	<±3.0 ppm/year
-------	----------------

**Time-base input**

Frequency	10 MHz, ±2 ppm
-----------	----------------

Amplitude	0.5 V <sub>P,P</sub> to 4 V <sub>P,P</sub> (-2 dBm to +16 dBm)
-----------	--

Input impedance	50 Ω, AC coupled
-----------------	------------------

**Time-base output**

Frequency	10 MHz, sine
-----------	--------------

Source	50 Ω, DC transformer coupled
--------	------------------------------

Amplitude	>7.5 dBm
-----------	----------

**Internal modulation source**

Waveforms	Sine, ramp, saw, square, pulse, noise
-----------	---------------------------------------

Sine THD	-74 dBc (typical at 20 kHz)
----------	-----------------------------

Ramp linearity	<0.05 % (1 kHz)
----------------	-----------------

**Rate**

TSG4102A and TSG4104A	1 μHz to 500 kHz: < 62.5 MHz CF
-----------------------	---------------------------------

	1 μHz to 50 kHz: ≥62.5 MHz
--	----------------------------

TSG4106A	1 μHz to 500 kHz: < 93.75 MHz CF
----------	----------------------------------

	1 μHz to 50 kHz: ≥93.75 MHz
--	-----------------------------

Rate resolution	1 μHz
-----------------	-------

Rate error	1:2 <sup>31</sup> + time-base error
------------	-------------------------------------

Noise function	White Gaussian noise (rms = dev / 5)
----------------	--------------------------------------

Noise bandwidth	1 μHz < ENBW < 50 kHz
-----------------	-----------------------

Pulse generator period	1 μs to 10 s
------------------------	--------------

Pulse generator width	100 ns to 9999.9999 ms
-----------------------	------------------------

Pulse timing resolution	5 ns
-------------------------	------

Pulse noise function	Length 2 <sup>N</sup> -1 PRBS 5 ≤ N ≤ 32, bit period 100 nS to 10 S
----------------------	---

# TSG4100A Series RF Vector Signal Generator

## Analog modulation output

Connector type	BNC (rear panel)
Impedance	50 $\Omega$
Function	AM, FM, $\Phi$ M, Pulse
Scale factor	$\pm 1$ V for $\pm$ full deviation
Pulse/Blank	Low = 0 V Hi = 3.3 V

## External analog modulation input

Connector type	BNC (rear panel)
Impedance	100 k $\Omega$
Function	AM, FM, $\Phi$ M, Pulse
Scale factor	$\pm 1$ V for $\pm$ full deviation
Pulse/Blank	Low = 0 V Hi = 3.3 V
Input coupling	DC or 4 Hz High-pass
Pulse Threshold	+1 VDC
Input Offset	< 500 $\mu$ V

## Amplitude modulation

Range	0 to 100% (decreases above +7 dBm)
Resolution	0.1%
Modulation source	Internal or external
Modulation distortion, typical	
BNC output	<1 % ( $f_c < 62.5$ MHz, $f_m = 1$ kHz)
N-type output	<3 % ( $f_c > 62.5$ MHz, $f_m = 1$ kHz)
Modulation bandwidth (external)	>100 kHz



## Frequency modulation

**Minimum frequency deviation** 0.01 Hz

**Maximum frequency deviation**

**TSG4102A and TSG4104A**

Smaller of  $f_c$  and 64 MHz –  $f_c$ . In 0 to 62.5 MHz

Frequency range	Maximum deviation
62.5 MHz < $f_c$ ≤ 126.5625 MHz	1 MHz
126.5625 MHz < $f_c$ ≤ 253.1250 MHz	2 MHz
253.1250 MHz < $f_c$ ≤ 506.25 MHz	4 MHz
506.25 MHz < $f_c$ ≤ 1.0125 GHz	8 MHz
1.0125 GHz < $f_c$ ≤ 2.0 GHz	16 MHz
2.025 GHz < $f_c$ ≤ 4.0 GHz (TSG4104A)	32 MHz

**TSG4106A**

Smaller of  $f_c$  and 96 MHz –  $f_c$ . In 0 to 93.75 MHz

Frequency range	Maximum deviation
93.75 MHz < $f_c$ ≤ 189.84375 MHz	1 MHz
189.84375 MHz < $f_c$ ≤ 379.6875 MHz	2 MHz
379.6875 MHz < $f_c$ ≤ 759.375 MHz	4 MHz
759.375 MHz < $f_c$ ≤ 1.51875 GHz	8 MHz
1.51875 GHz < $f_c$ ≤ 3.0375 GHz	16 MHz
3.0375 GHz < $f_c$ ≤ 6.0 GHz	32 MHz

**Deviation resolution** 0.1 Hz

**Deviation accuracy, typical**

**TSG4102A and TSG4104A**

< 0.1% of selected deviation + 5 Hz ( $f_c$  < 62.5 MHz)

< 2% of selected deviation + 20 Hz ( $f_c$  > 62.5 MHz)

**TSG4106A**

< 0.1% of selected deviation + 5 Hz ( $f_c$  < 93.75 MHz)

< 2% of selected deviation + 20 Hz ( $f_c$  > 93.75 MHz)

**Modulation source** Internal or external

**Modulation distortion, typical** < -60 dB ( $f_c=100$  MHz,  $f_m=1$  KHz,  $f_d= 3$  KHz)

**External FM carrier offset, typical** < ±0.001 X FM deviation

**Modulation bandwidth, typical**

**TSG4102A and TSG4104A**

500 kHz ( $f_c$  < 62.5 MHz)

100 kHz ( $f_c$  > 62.5 MHz)

**TSG4106A**

500 kHz ( $f_c$  < 93.75 MHz)

100 kHz ( $f_c$  > 93.75 MHz)

# TSG4100A Series RF Vector Signal Generator

## Phase modulation

<b>Deviation</b>	0° to 360°
<b>Deviation resolution, typical</b>	0.01° (DC to 100 MHz) 0.1° (100 MHz to 1 GHz) 1° (1 GHz and above)
<b>Deviation accuracy, typical</b>	
<b>TSG4102A and TSG4104A</b>	2% (fc < 62.5 MHz) 3% (fc > 62.5 MHz)
<b>TSG4106A</b>	2% (fc < 93.75 MHz) 3% (fc > 93.75 MHz)
<b>Modulation source</b>	Internal or external
<b>Modulation distortion, typical</b>	< -60 dB (fc = 100 MHz, fm = 1 kHz, $\Phi D = 50^\circ$ )
<b>Modulation bandwidth, typical</b>	
<b>TSG4102A and TSG4104A</b>	500 kHz (fc < 62.5 MHz) 100 kHz (fc > 62.5 MHz)
<b>TSG4106A</b>	500 kHz (fc < 93.75 MHz) 100 kHz (fc > 93.75 MHz)

## Pulse modulation

<b>Pulse mode</b>	Logic High turns RF output ON
<b>On-Off ratio, typical</b>	
<b>BNC output</b>	> 70 dB
<b>Type-N output</b>	> 57 dB (fc < 1.0 GHz) > 40 dB (1.0 GHz ≤ fc < 4.0 GHz) > 35 dB (4.0 GHz ≤ fc < 6.0 GHz)
<b>Pulse feed-through, typical</b>	10% of carrier for 20 ns at turn on
<b>Turn On-Off delay</b>	60 ns
<b>RF Rise-Fall time, typical</b>	20 ns
<b>Modulation source</b>	Internal or external pulse

## Interface connectors

USB	USB 2.0, host
Ethernet (LAN)	10/100 Base-T.TCP/IP and DHCP default
GPIB	IEEE488.2
RS-232	4800 to 115,200 baud, RTS/CTS flow

## External I/Q modulation (Option EIQ)

Carrier frequency range	400 MHz to 2.0 GHz (TSG4102A)
	400 MHz to 4.0 GHz (TSG4104A)
	400 MHz to 6.0 GHz (TSG4106A)
I/Q inputs (rear panel)	50 $\Omega$ , $\pm 0.5$ V
I/Q full scale input	$(I^2 + Q^2)^{1/2} = 0.5$ V
Modulation bandwidth	max 400 MHz RF bandwidth
I or Q input offset	<500 $\mu$ V
Carrier suppression	> -45 dBc for $f_c \leq 3$ GHz
	> -40 dBc for $3 \text{ GHz} < f_c \leq 5$ GHz
	> -35 dBc for $f_c > 5$ GHz
I and Q baseband modulation bandwidth (3 dB from $f_c$ )	> 200 MHz ( $f_c < 2.5$ GHz, RF BW >400 MHz)
	> 150 MHz ( $f_c > 2.5$ GHz, RF BW >300 MHz)

## Dual baseband generator (Option VM00)

Channels	2 (I and Q)
DAC data format	Dual 14-bit at 125 MS/s
Reconstruction filter	10 MHz, 3rd order Bessel LPF
Arbitrary symbol memory	Up to 16 Mbits
Symbol rate	1 Hz to 6 MHz (1 $\mu$ Hz resolution)
Symbol length	1 to 9 bits (maps to constellation)
Symbol mapping	Default or user-defined constellation
Symbol source (User-defined symbols, built-in PRBS generator, or settable pattern generator)	
PRBS length	$2n - 1$ ( $5 < n < 32$ ; 31 to about $4.3 \times 10^9$ symbols)
Pattern generator	16 bits

# TSG4100A Series RF Vector Signal Generator

## Dual baseband generator (Option VM00)

### Digital filtering

Filter type	Raised Cosine, Root Raised Cosine, Gaussian, Rectangular, Linear, Sinc, linearized Gaussian, C4FM, customized FIR
Filter length	24 symbols

---

### Noise impairments

Additive noise	White, Gaussian
Level	-70 dBc to -10 dBc

---

## Basic vector modulation formats (Option VM00)

### Formats by bit

Constellation	1-bit	2-bit	3-bit	4-bit	5-bit	6-bit	8-bit
ASK	2ASK	4ASK	8ASK	16ASK			
FSK	BFSK	4FSK	8FSK	16FSK			
PSK	BPSK	QPSK	8PSK	16PSK			
QAM	n/a	4QAM	n/a	16QAM	32QAM	64QAM	256QAM
CPM	BCPM	4CPM	8CPM	16CPM			
VSB	n/a	n/a	8VSB	16VSB			

---

### Others

OQPSK, DQPSK,  $\pi/4$ DQPSK,  $3\pi/8$  PSK

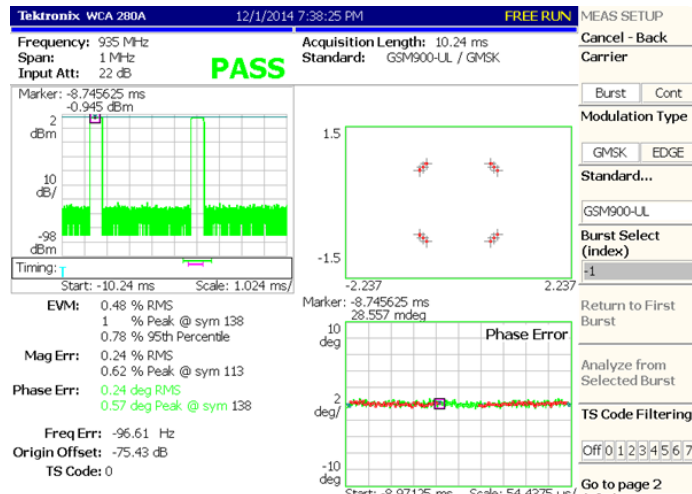
---

Digital modulation applications (typical)

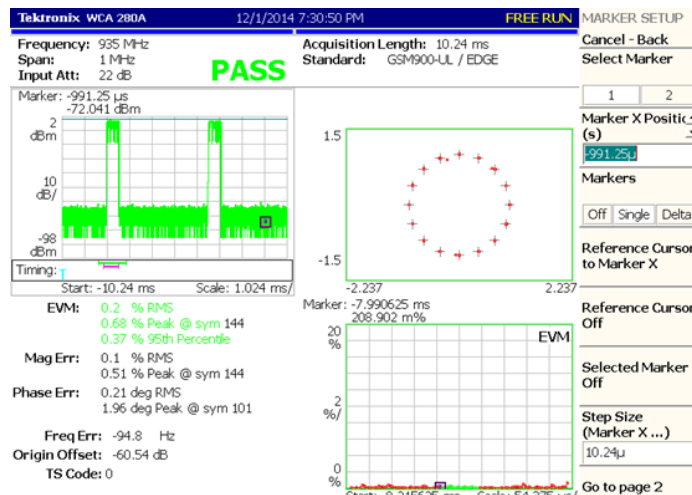
Digital modulation applications options

Option	Application
VM01	GSM
VM02	GSM-EDGE
VM03	W-CDMA
VM04	APCO-25 Phase 1
VM05	DECT
VM06	NADC
VM07	PDC
VM08	TETRA
VM10	Audio clip (analog AM and FM)

Option VM01 GSM, (GMSK, 270.833 kS/s, 935 MHz, 0 dBm), RMS EVM: 0.6%

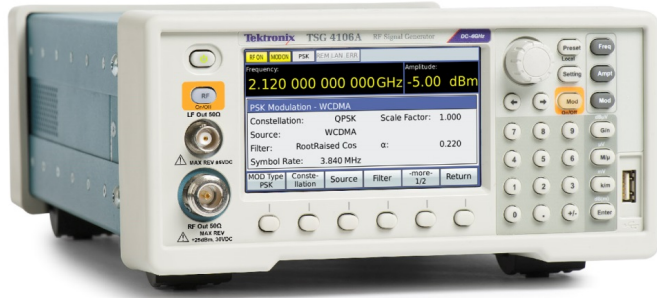


Option VM02 GSM-EDGE, (3π/8 8PSK, 270.833 kS/s, 935 MHz, 0 dBm), RMS EVM: 0.30%



# RF Vector Signal Generators

## TSG4100A Series



The TSG4100A Series RF Vector Signal Generator offers mid-range performance and up to 200 MHz modulation bandwidth at an entry-level RF signal generator price. They use a new technique to provide spurious free outputs with low phase noise (-113 dBc/Hz at 20 kHz offset from 1 GHz carrier) and extraordinary frequency resolution (1  $\mu$ Hz at any frequency). The TSG4100A Series comes standard with analog modulation. Convenient, in-field software upgrades allow for easy transition from analog to more advanced vector and digital modulation capabilities, providing the most flexible configuration and best CAPEX protection. These instruments complement other leading mid-range RF test solutions from Tektronix, such as the USB-based RSA306 Spectrum Analyzer and MDO4000B and MDO3000 Mixed Domain Oscilloscopes.

The TSG4100A Series instruments use an ovenized SC-cut oscillator (TSG410xA-M00 or E1 models) time-base, providing a 100 X improvement in stability (and a 100 X reduction in the in-close phase noise) compared to instruments that use a TCXO time-base.

### Key features

- Analog and vector/digital signal generation capabilities
- Dual baseband ARB generators
- Analog modulation standard
- Soft key upgrade to vector/digital modulation at very low cost
- Digital modulation applications for GSM, EDGE, W-CDMA, APCO-25, DECT, NADC, PDC, and TETRA
- USB, GPIB, RS-232, and LAN interfaces
- 12 pounds (5.6 kg)
- 2U high and half standard rack width

### Key performance specifications

- True DC to 2 GHz, 4 GHz or 6 GHz to support both analog and vector/digital signal generation
- Typical  $\leq \pm 0.30$  dB amplitude accuracy (0 dBm CW signal at 22  $^{\circ}$ C) from 10 MHz to 6 GHz
- I/Q modulation inputs (400 MHz RF bandwidth)
- ASK, FSK, MSK, PSK, QAM, VSB, and custom I/Q

### Analog modulation

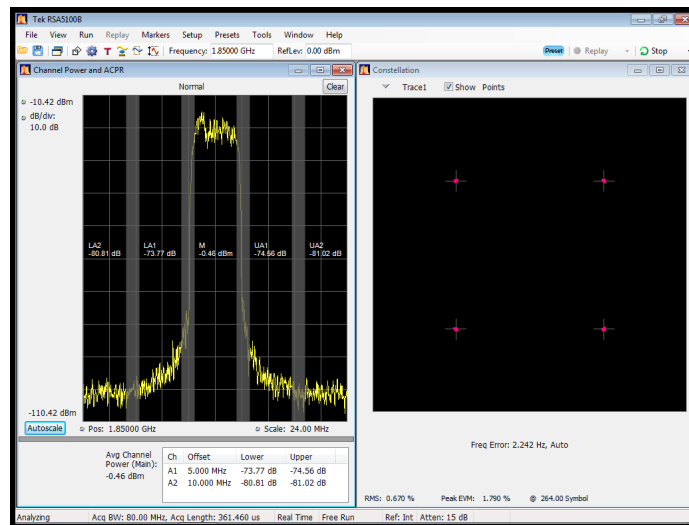
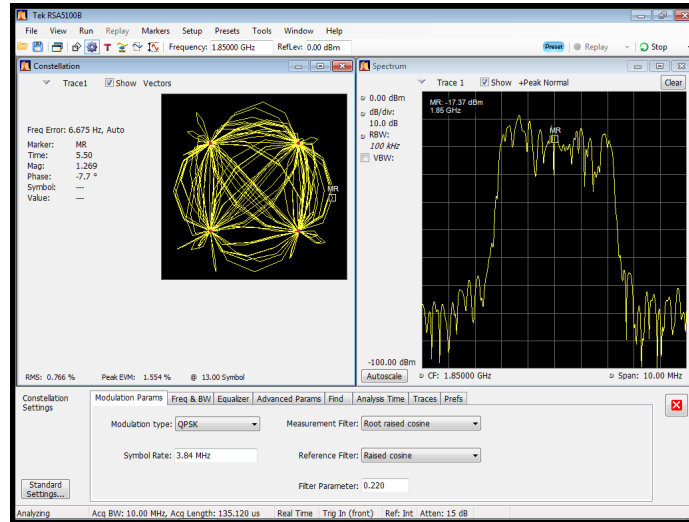
The Tektronix TSG4100A Series RF Vector Signal Generators offer a wide variety of modulation capabilities. Modes include amplitude modulation (AM), frequency modulation (FM), phase modulation ( $\Phi$ M), and pulse modulation. There is an internal modulation source as well as an external modulation input. The internal modulation source produces sine, ramp, saw, square, and noise waveforms. An external modulation signal may be applied to the rear panel modulation input. The internal modulation generator is available as an output on the rear panel.

### Vector modulation

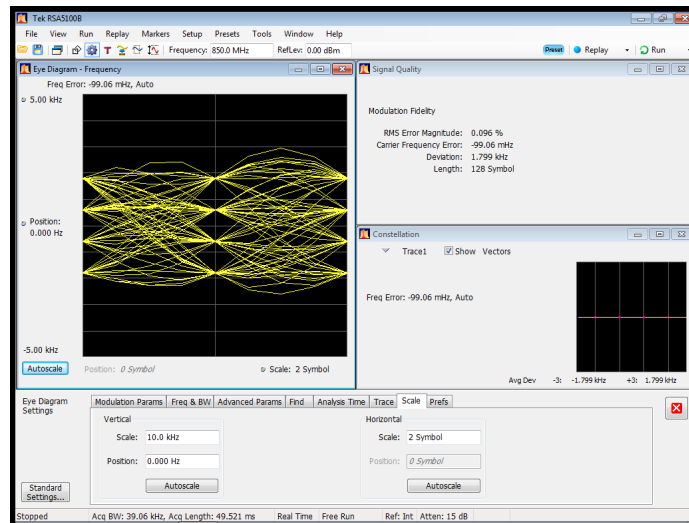
The TSG4100A Series builds on this performance by adding full support for vector signal modulation on RF carriers between 400 MHz and 6.0 GHz. It features a dual arbitrary waveform generator operating at 125 MHz for baseband signal generation. The generator has built-in support for the most common vector modulation schemes: ASK, QPSK, DQPSK,  $\pi/4$  DQPSK, 8PSK, FSK, CPM, QAM (4 to 256), 8VSB, and 16VSB. It also includes built-in support for all the standard pulse shaping filters used in digital communications: raised cosine, root-raised cosine, Gaussian, rectangular, triangular, and more. Lastly, it provides direct support for the controlled injection of additive white Gaussian noise (AWGN) into the signal path.

Digital modulation applications (typical)

Option VM03 W-CDMA (QPSK, 3.840 Mcps, 1.85 GHz, 0 dBm), RMS EVM: 1.7%



Option VM04 APCO-25, (4FSK-C4FM, 4.8 kS/s, 850 MHz, 0 dBm), Freq Err: 0.5%



# TSG4100A Series RF Vector Signal Generator

**ASEAN / Australasia** (65) 6356 3900  
**Belgium** 00800 2255 4835\*  
**Central East Europe and the Baltics** +41 52 675 3777  
**Finland** +41 52 675 3777  
**Hong Kong** 400 820 5835  
**Japan** 81 (3) 6714 3010  
**Middle East, Asia, and North Africa** +41 52 675 3777  
**People's Republic of China** 400 820 5835  
**Republic of Korea** 001 800 8255 2835  
**Spain** 00800 2255 4835\*  
**Taiwan** 886 (2) 2656 6688

**Austria** 00800 2255 4835\*  
**Brazil** +55 (11) 3759 7627  
**Central Europe & Greece** +41 52 675 3777  
**France** 00800 2255 4835\*  
**India** 000 800 650 1835  
**Luxembourg** +41 52 675 3777  
**The Netherlands** 00800 2255 4835\*  
**Poland** +41 52 675 3777  
**Russia & CIS** +7 (495) 6647564  
**Sweden** 00800 2255 4835\*  
**United Kingdom & Ireland** 00800 2255 4835\*

**Balkans, Israel, South Africa and other ISE Countries** +41 52 675 3777  
**Canada** 1 800 833 9200  
**Denmark** +45 80 88 1401  
**Germany** 00800 2255 4835\*  
**Italy** 00800 2255 4835\*  
**Mexico, Central/South America & Caribbean** 52 (55) 56 04 50 90  
**Norway** 800 16098  
**Portugal** 80 08 12370  
**South Africa** +41 52 675 3777  
**Switzerland** 00800 2255 4835\*  
**USA** 1 800 833 9200

\* European toll-free number. If not accessible, call: +41 52 675 3777

**For Further Information.** Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit [www.tektronix.com](http://www.tektronix.com).

Copyright © Tektronix, Inc. All rights reserved. Tektronix products are covered by U.S. and foreign patents, issued and pending. Information in this publication supersedes that in all previously published material. Specification and price change privileges reserved. TEKTRONIX and TEK are registered trademarks of Tektronix, Inc. All other trade names referenced are the service marks, trademarks, or registered trademarks of their respective companies.



03 Mar 2015 77W-60043-0

[www.tektronix.com](http://www.tektronix.com)

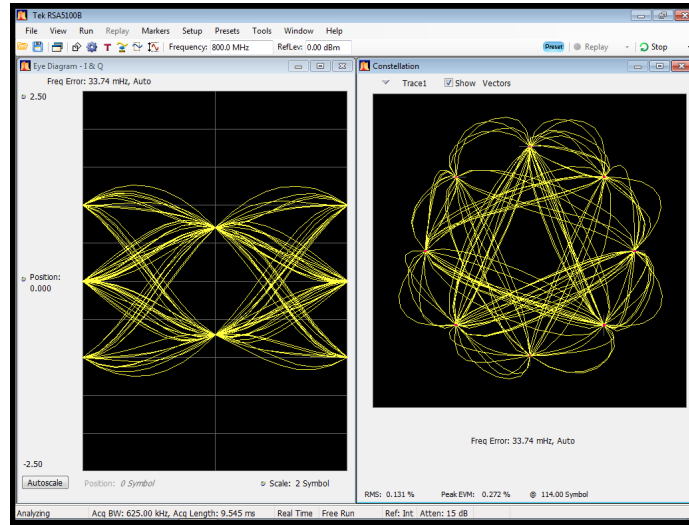
**Tektronix**<sup>®</sup>



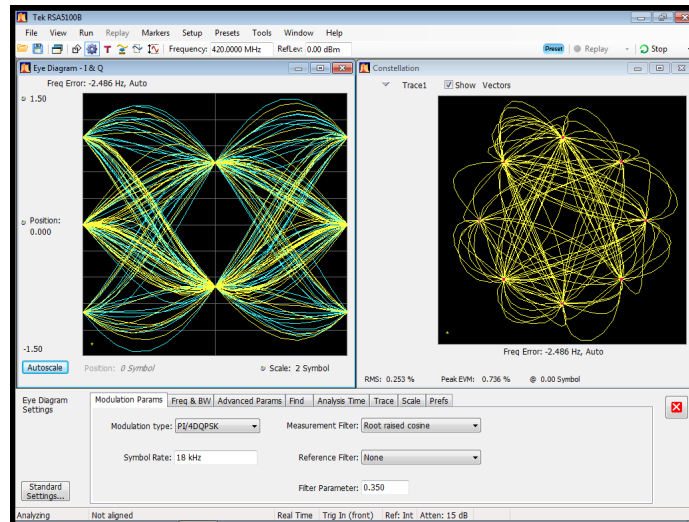


### Digital modulation applications (typical)

Option VM07 PDC, ( $\pi/4$  DQPSK, 21 kS/s, 800 MHz, 0 dBm), RMS EVM: 0.6%

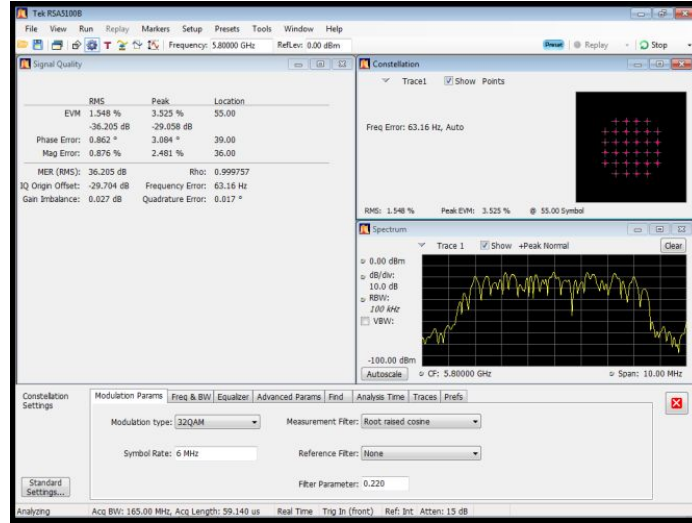


Option VM08 TETRA, ( $\pi/4$  DQPSK, 18 kS/s, 420 MHz, 0 dBm), RMS EVM: 0.7%

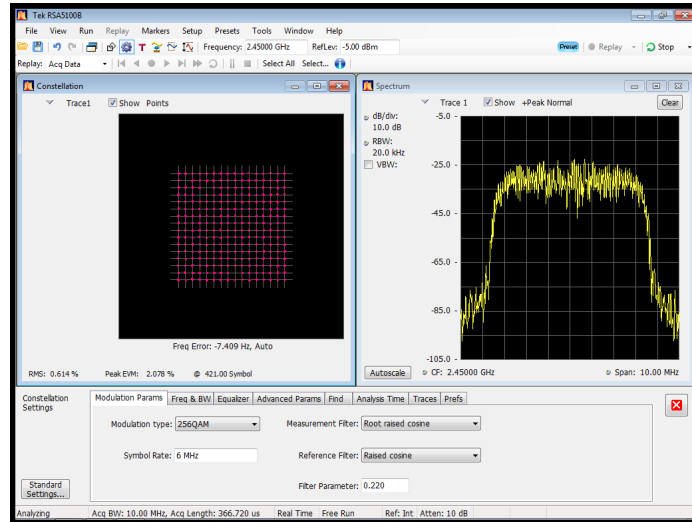


Digital modulation applications (typical)

32QAM, (6 MS/s, 5.8 GHz, Root raised cosine filter, 0 dBm), RMS EVM: 1.6%



256QAM, (6 MS/s, 2.45 GHz, Root raised cosine filter, 0 dBm), RMS EVM: 1.1%



TSG4100A-ATT Option

Nominal impedance	50 Ω
Nominal attenuation	30 dB
Frequency range	DC to 6 GHz
Attenuation deviation	±0.75 dB (DC to 6 GHz)
Maximum VSWR	1.15 (DC to 4 GHz) 1.2 (4 GHz to 6 GHz)
Power rating	5 Watt average power up to 25 °C ambient temperature, linearly derated to 1 Watt at 125 °C ambient temperature.
Weight	0.052 kg

## TSG4100A-ATT Option

Operating temperature	-65 °C to 125 °C
Compliance	2011/65/EU (RoHS) compliant

## Rear-panel markers

Type	Symbol Clock, Data Frame, TDMA, and user-defined
Amplitude	0.5 to 4 V <sub>pp</sub> (-2 dBm to +16 dBm)
Output impedance	50 Ω, AC coupled

## Physical characteristics

<b>Dimensions</b>	
Height	114 mm (4.5 in)
Width	216 mm (8.5 in)
Depth	347 mm (13.7 in)
<b>Weight</b>	
Weight	5.4 kg (12 lbs)

## Operating characteristics

<b>Temperature</b>	
Operating	+5 °C to +40 °C
Non-operating	-20 °C to +60 °C

<b>Humidity</b>	<b>Operating</b>	<b>Non-operating</b>
	5% to 95% relative humidity (%RH) at up to +30 °C	5% to 95% RH (Relative Humidity) at up to +30 °C
	5% to 45% RH above +30 °C up to +40 °C, non-condensing	5% to 45% RH above +30 °C up to +40 °C, non-condensing

<b>Altitude</b>	
Operating	Up to 3,000 m
Non-operating	Up to 12,000 m

<b>Line power</b>	<90 W, 90 to 264 VAC, 47 to 63 Hz with PFC
-------------------	--

<b>Vibration and shock</b>		
<b>Random vibration</b>	<b>Operating</b>	<b>Non-operating</b>
	0.27 GRMS, 5 500 Hz, 10 minutes per axis, 3 axes (30 minutes total for Option M01)	2.28 GRMS, 5 500 Hz, 10 minutes per axis, 3 axes (30 minutes total for Option M01)
	0.22 GRMS, 5 500 Hz, 10 minutes per axis, 3 axes (30 minutes total for Options M00 or E1)	2.13 GRMS, 5 500 Hz, 10 minutes per axis, 3 axes (30 minutes total for Options M00 or E1)
<b>Mechanical shock</b>	<b>Non-operating</b>	
	Half-sine mechanical shocks, 50 g peak amplitude, 11 msec duration, 3 drops in each direction of each axis (18 total for Option M01)	
	Half-sine mechanical shocks, 30 g peak amplitude, 11 msec duration, 3 drops in each direction of each axis (18 total for Options M00 or E1)	

## Regulatory information

### EC Declaration of Conformity - EMC

EMC Directive 2004/108/EC	EN 61326-1
Radiated and Conducted emissions	Class A
Australia/New Zealand	Australia Radio Communications Act 1992
Korea	KCC

---

### Safety

Third Party Certification Standards	UL 61010; CSA C22.2 No. 61010-1
EC Declaration of Conformity - Low Voltage	Low Voltage Directive 2006/95/EC; EN61010-1

### Safety Certification Compliance

Equipment type:	Test and measuring
Safety class:	Class 1 - grounded product
Pollution degree:	2 (as defined in IEC61010-1)
Rated for indoor use only.	

---

## Ordering information

### Models

For each of the basic models, there are three required but exclusive model options that need to be specified at the time of order: M00, M01, and E1. Pricing varies based on chosen option. See the Instrument Options section for details.

<b>TSG4102A</b>	Analog signal generator with 2 GHz frequency coverage, basic model
<b>TSG4104A</b>	Analog signal generator with 4 GHz frequency coverage, basic model
<b>TSG4106A</b>	Analog signal generator with 6 GHz frequency coverage, basic model

### Standard accessories

Accessory	Description
RF cable	1 meter, N-type to N-type RF cable
Documentation CD	All instrument models ship with a CD containing PDF files of user manuals in all available languages.
Installation and Safety Instructions	All instrument models ship with a printed Installation and Safety Instructions manual (multi-language: English and Russian).
Calibration	Statement of Calibration
Power cord	Country specific (see Power cord options)

### Warranty

Three years

### Instrument options

#### Hardware options (All regions except North America)

Options M00 or M01 must be specified at the time of instrument order.

<b>M00</b>	Instrument with oven-controlled crystal oscillator (OCXO)
<b>M01</b>	Instrument with voltage-controlled crystal oscillator (VCXO)
<b>GPIB</b>	Adds GPIB interface

#### Hardware options (North America only)

Option E1 must be specified at the time of instrument order.

<b>E1</b>	Instrument with oven-controlled crystal oscillator (OCXO) time-base and GPIB interface
-----------	--

#### Hardware options (All regions)

<b>TSG4100A-RM1</b>	Single rack mount kit (can be ordered separately)
<b>TSG4100A-RM2</b>	Dual rack mount kit (can be ordered separately)
<b>TSG4100A-ATT</b>	30 dB, 5 W RF attenuator up to 6 GHz
<b>D1</b>	A list of performance verification test results

## Software options

To upgrade to vector/digital modulation capability and/or add more modulation options after initial purchase, order "TSG4100A-UP + VM xx" instead of "TSG410xA VMxx".

<b>VM00</b>	Basic vector modulation package with internal 6 MHz modulation bandwidth
<b>VM01</b>	GSM modulation (requires Option VM00)
<b>VM02</b>	GSM EDGE modulation (requires Option VM00)
<b>VM03</b>	W-CDMA modulation (requires Option VM00)
<b>VM04</b>	APCO-25 modulation (requires Option VM00)
<b>VM05</b>	DECT modulation (requires Option VM00)
<b>VM06</b>	NADC modulation (requires Option VM00)
<b>VM07</b>	PDC modulation (requires Option VM00)
<b>VM08</b>	TETRA modulation (requires Option VM00)
<b>VM10</b>	Audio Clip (analog AM and FM)
<b>EIQ</b>	External 200 MHz modulation bandwidth (requires Option VM00)

## Power plug options

<b>Opt. A0</b>	North America power plug (115 V, 60 Hz)
<b>Opt. A1</b>	Universal Euro power plug (220 V, 50 Hz)
<b>Opt. A2</b>	United Kingdom power plug (240 V, 50 Hz)
<b>Opt. A3</b>	Australia power plug (240 V, 50 Hz)
<b>Opt. A5</b>	Switzerland power plug (220 V, 50 Hz)
<b>Opt. A6</b>	Japan power plug (100 V, 50/60 Hz)
<b>Opt. A10</b>	China power plug (50 Hz)
<b>Opt. A11</b>	India power plug (50 Hz)
<b>Opt. A12</b>	Brazil power plug (60 Hz)
<b>Opt. A99</b>	No power cord

## Language options

Request the option below if you would like to order a printed version of the English User Manual. (An electronic version of this manual is provided as a PDF on the CD that shipped with your instrument and is also available for download from the Tektronix Web site.)

<b>Opt. L0</b>	English manual
----------------	----------------

## Service options

<b>Opt. C3</b>	Calibration Service 3 Years
<b>Opt. C5</b>	Calibration Service 5 Years
<b>Opt. D1</b>	Calibration Data Report
<b>Opt. D3</b>	Calibration Data Report 3 Years (with Opt. C3)
<b>Opt. D5</b>	Calibration Data Report 5 Years (with Opt. C5)
<b>Opt. R5</b>	Repair Service 5 Years (including warranty)



Tektronix is registered to ISO 9001 and ISO 14001 by SRI Quality System Registrar.



Product(s) complies with IEEE Standard 488.1-1987, RS-232-C, and with Tektronix Standard Codes and Formats.



Product Area Assessed: The planning, design/development and manufacture of electronic Test and Measurement instruments.

# TSG4100A Series RF Vector Signal Generator

**ASEAN / Australasia** (65) 6356 3900  
**Belgium** 00800 2255 4835\*  
**Central East Europe and the Baltics** +41 52 675 3777  
**Finland** +41 52 675 3777  
**Hong Kong** 400 820 5835  
**Japan** 81 (3) 6714 3010  
**Middle East, Asia, and North Africa** +41 52 675 3777  
**People's Republic of China** 400 820 5835  
**Republic of Korea** 001 800 8255 2835  
**Spain** 00800 2255 4835\*  
**Taiwan** 886 (2) 2656 6688

**Austria** 00800 2255 4835\*  
**Brazil** +55 (11) 3759 7627  
**Central Europe & Greece** +41 52 675 3777  
**France** 00800 2255 4835\*  
**India** 000 800 650 1835  
**Luxembourg** +41 52 675 3777  
**The Netherlands** 00800 2255 4835\*  
**Poland** +41 52 675 3777  
**Russia & CIS** +7 (495) 6647564  
**Sweden** 00800 2255 4835\*  
**United Kingdom & Ireland** 00800 2255 4835\*

**Balkans, Israel, South Africa and other ISE Countries** +41 52 675 3777  
**Canada** 1 800 833 9200  
**Denmark** +45 80 88 1401  
**Germany** 00800 2255 4835\*  
**Italy** 00800 2255 4835\*  
**Mexico, Central/South America & Caribbean** 52 (55) 56 04 50 90  
**Norway** 800 16098  
**Portugal** 80 08 12370  
**South Africa** +41 52 675 3777  
**Switzerland** 00800 2255 4835\*  
**USA** 1 800 833 9200

\* European toll-free number. If not accessible, call: +41 52 675 3777

**For Further Information.** Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit [www.tektronix.com](http://www.tektronix.com).

Copyright © Tektronix, Inc. All rights reserved. Tektronix products are covered by U.S. and foreign patents, issued and pending. Information in this publication supersedes that in all previously published material. Specification and price change privileges reserved. TEKTRONIX and TEK are registered trademarks of Tektronix, Inc. All other trade names referenced are the service marks, trademarks, or registered trademarks of their respective companies.



**Tektronix**<sup>®</sup>

 **S J ELECTRONICS**  
POWER • TEST & MEASUREMENT

**0800 583 4455**  
**[www.sjelectronics.co.uk](http://www.sjelectronics.co.uk)**  
**[sales@sjelectronics.co.uk](mailto:sales@sjelectronics.co.uk)**