VECTOR NETWORK MEASUREMENT SYSTEMS (VNMS)

Ethernet / GPIB

MS4622A/B/D, MS4623A/B/D, MS4624A/B/D

10 MHz to 3 GHz **10 MHz to 6 GHz** **10 MHz to 9 GHz**

Innovative Manufacturing Solutions for Measuring S-Parameters, NF, P_{1dB}, IMD, and 3 and 4-Port Devices

Anritsu's family of RF Vector Network Measurement Systems include the MS462XA, MS462XB, and the new MS462xD. Code named Scorpion™, the MS462XX line is much more capable than traditional VNAs. With Scorpion's all new measurement options of vector error-corrected Noise Figure, Intermodulation Distortion, Fourth Measurement Port, and Harmonics, they create a total test solution. When you add the standard benefits of outstanding dynamic range and blazing fast measurement speed, you have a truly innovative solution for a manufacturing test environment!

Key Benefits

- See the true performance of all your passive and active components including antennas, isolators, filters, duplexers, couplers, SAW filters, baluns, amplifiers, mixers, and multi-port components
- With a single connection perform S-parameter, Harmonics, Time Domain, Compression, Intermodulation Distortion (IMD), Noise Figure (NF), and Frequency Translated Group Delay for accurate and thorough device characterization
- Optimized for your manufacturing process with features like 2 & 4 port AutoCal™ modules which simplify calibrations, sequences for automating repetitive keystrokes, enhanced markers simplify data collection, and external SCSI interface for massive storage
- Measurement speeds of 150 µsec/point and dynamic range of 125 dB

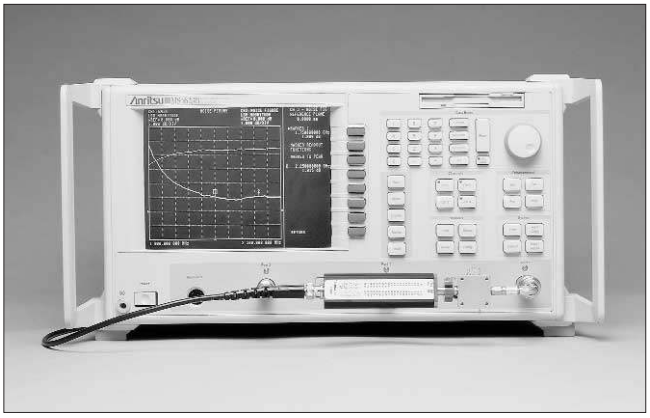
Scorpion's AutoCal™ feature also provides the capability to achieve fast, accurate, and highly repeatable calibrations without the need for an external controller. By using AutoCal™ standard connector types or test port cable converters, you can calibrate directly using Type N, K, 3.5 mm, or SMA connectors. Planned upgrades include adapter characterization with the ability to calibrate using 7/16 or TNC type connectors.

- **4-Port Balance/Differential Measurements**

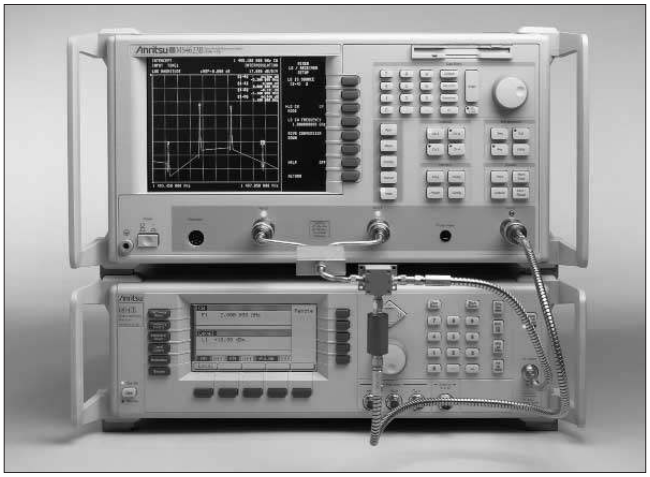
The MS462xD series of Vector Network Measurement Systems (VNMS) allow you to characterize devices like SAW filters and integrated circuits using powerful features like mixed-mode S-parameters, embedding/de-embedding, and arbitrary impedance. De-embedding utilities provide compensation techniques for typical test fixture environments to further enhance the measurement accuracy, while integrated embedding utilities, consisting of an extensive library of circuit primitives, increases time-to-market and yield when simulating the final matched behavior of components. The Scorpion's arbitrary impedance transformations also accurately handle non-50 Ω measurement scenarios typically associated with balanced devices, making the VNMS well suited for applications requiring ripple, insertion loss and amplitude imbalance measurements on the order of 0.1 dB.

• Amplifier Measurements
Some of today's most demanding VNA measurements involve the characterization and tuning of multiple port devices such as duplexers, combiners, couplers, etc. In a traditional 2-port VNA, the full characterization and tuning of such devices presents significant challenges in terms of measurement speed, calibration, and the switching of input signals and measurement ports. With the addition of the third measurement port, the simplicity and speed with which these devices can be tested is greatly enhanced. The MS4622B, MS4623, and MS4624B network analyzers not only offer the option of adding a third measurement port, they also offer the industry's first ever second internal source. This second source is completely independent from the main source that switches between ports 1 and 2. By the addition of this second source, the potential now exists for replacing the signal generators and spectrum analyzers currently needed to characterize the non-linear effects that occur when multiple tones are simultaneously present in the pass-band of an active device.

• Vector error-corrected noise figure measurements
The MS4622B, MS4623B, and MS4624B Vector Network Measurement Systems deliver the industry's first ever capability for making vector error-corrected noise figure measurements on active devices in today's hottest market – wireless communications. The Noise Figure options covering the frequency ranges of 50 MHz to 3 GHz and 50 MHz to 6 GHz, give you the functionality for making noise figure measurements much more accurately than has ever before been possible. This option allows for making S-parameter measurements and noise figure measurements with a single test connection. The measurement setup can be configured to make measurements with the noise source set in either an internal or an external mode. In the external mode, the noise source is connected directly to the DUT similar to traditional scalar noise figure measurements. In the internal mode, the noise source is connected to the VNA rear panel and internally routed to port 1. Therefore, when a 12-term calibration is applied concurrently with the noise figure calibration, you can make vector error-corrected noise figure measurements.



• Mixer measurements
Scorpion can also accurately characterize your mixers and other frequency-translating devices (FTDs) for isolation, match, conversion loss, noise figure and frequency translated group delay (FTGD). Without changing cables or instruments, Scorpion can make all these measurements quickly, easily and accurately. Add an external synthesizer and Scorpion can easily orchestrate swept frequency and swept power mixer IMD measurements. You no longer have to buy and integrate five separate instruments to perform these everyday measurements. With the integrated measurement flexibility of Scorpion, you can design and manufacture all of your passive, active, and frequency translating devices using a single instrument.



• AutoCal Automatic Calibrators
One source of potential errors and inaccuracies in any measurement system is its calibration. A great deal of time can be wasted in a busy manufacturing environment trying to verify calibration accuracy, especially when multiple shifts run on several different test stations for the same product line. For this situation, you need a calibration system in place that offers the highest possible degree of assurance that every station on every shift is calibrated for identical results. With the Anritsu AutoCal automatic calibrator, you get just that. Simply connect a serial cable between the AutoCal and the rear panel of the VNA and you're ready to go. If adapters become necessary, AutoCal can handle them with its revolutionary approach to adapter removal. This approach avoids the necessity of multiple calibrations commonly used in adapter removal calibrations. By using the AutoCal adapter characterization process, you can calibrate in a SMA, Type N, 3.5mm, TNC, or 7/16 environment with confidence.

Specifications

Test port characteristics

Standard connector type	N female					
Optional connector types	3.5 mm female, 3.5 mm male, GPC-7, N male					
Measurement port characteristics	Connector	Configuration	Frequency (MHz)	Directivity (dB)	Source match (dB)	Load match (dB)
	3.5 mm (MS4600/11S) (MS4600/11SF)	Ports 1 and 2 MS462xB MS462xD	10 to 1000 1000 to 3000 3000 to 6000 6000 to 9000	>46 >44 >38 >37	>44 >41 >39 >36	>46 >44 >38 >37
		Ports 3 and 4 MS462xB/Opt3x MS462xD	10 to 1000 1000 to 3000 3000 to 6000 6000 to 9000	>44 >42 >37 >36	>42 >40 >37 >35	>44 >42 >37 >36
	N-Type Standard N(F) (MS4600/11NM)	Ports 1 and 2 MS462xB MS462xD	10 to 1000 1000 to 3000 3000 to 6000 6000 to 9000	>46 >44 >38 >37	>44 >41 >39 >36	>46 >44 >38 >37
		Ports 3 and 4 MS462xB/Opt3x MS462xD	10 to 1000 1000 to 3000 3000 to 6000 6000 to 9000	>44 >42 >37 >36	>42 >40 >37 >35	>44 >42 >37 >36
	GPC-7 (MS4600/11A)	Ports 1 and 2 MS462xB MS462xD	10 to 1000 1000 to 3000 3000 to 6000 6000 to 9000	>46 >44 >38 >37	>44 >41 >39 >36	>46 >44 >38 >37
		Ports 3 and 4 MS462xB/Opt3x MS462xD	10 to 1000 1000 to 3000 3000 to 6000 6000 to 9000	>44 >42 >37 >36	>42 >40 >37 >35	>44 >42 >37 >36

Source specifications

Frequency range	MS4622A/B/D, 10 MHz to 3 GHz MS4623A/B/D, 10 MHz to 6 GHz MS4624A/B/D, 10 MHz to 9 GHz	
Frequency resolution	1Hz	
Frequency stability (with internal time base) – aging	<5x10 / year	
Temperature	<5x10 over +15°C to +50°C	
Power output range	MS4622A Transmission/Reflection Test Set MS4622B Active Reversing Test Set MS4622B (Opt 3) w/ 2nd Source, 3rd Test Port & S/A. MS4622B (Opt 4) w/ Noise Figure MS4622B (Opt 6) w/ 3rd Test Port MS4622D Balanced/Differential 4-Port	+10 to –85 dBm +10 to –85 dBm +10 to –85 dBm +7 to –85 dBm +10 to –85 dBm +10 to –85 dBm
	MS4623A Transmission/Reflection Test Set MS4623B Active Reversing Test Set MS4623B (Opt 3) w/ 2nd Source, 3rd Test Port & S/A MS4623B (Opt 4) w/ Noise Figure (3 GHz only) MS4623B (Opt 6) w/ 3rd Test Port MS4623D Balanced/Differential 4-Port	+10 to –85 dBm +7 to –85 dBm +7 to –85 dBm +5 to –85 dBm +7 to –85 dBm +7 to –85 dBm
	MS4624A Transmission/Reflection Test Set MS4624B Active Reversing Test Set MS4624B (Opt 3) w/ 2nd Source, 3rd Test Port & S/A MS4624B (Opt 6) w/ 3rd Test Port MS4624D Balanced/Differential 4-Port	+10 to –85 dBm +7 to –85 dBm +7 to –85 dBm +7 to –85 dBm +7 to –85 dBm
Power control range	≥ 20 dB. The minimum absolute level for power sweep is –15 dBm while the maximum power output for a unit is +10 dBm.	
Source power level	The source power (dBm) may be set from the front panel menu or via GPIB. Port 1 power level is settable from +10 dBm (on the simpler test sets, ranging to +5 dBm on the most complex) to –15 dBm with 0.01 dB resolution. In addition, the Port 1 (& Port 3) power may be attenuated in 10 dB steps using the internal 70 dB step attenuator. Port 3 step attenuator is not available in D models. Port 1 step attenuator is optional in A models.	
Power level accuracy	±1 dB to 6 GHz, ±1.5 dB to 9 GHz (no flat power calibration applied; full-band frequency sweep at –15 dBm, 0 dBm, and maximum rated power).	
Level test port power	The power at all sweep frequencies is leveled to within ±1 dB. Only port 1 and port 3 (if installed) can be externally leveled.	
Harmonics and spurious	<–30 dBc at maximum rated power (MS4622x and MS4623x) <–25 dBc at maximum rated power (MS4624x)	
Sweep type	Linear, CW, Marker, or N-Discrete point sweep	
Power sweep range	20 dB (minimum)	
Source #2 (optional) – Frequency range	10 MHz to 3 GHz (6 GHz or 9 GHz)	
Source #2 (optional) – Frequency resolution	1 Hz	
Source #2 (optional) – Power level accuracy	±1 dB to 6 GHz, ±1.5 dB to 9 GHz (no flat power calibration applied; full-band frequency sweep at –15 dBm, 0 dBm, and maximum rated power).	
Source #2 (optional) – Harmonics and spurious	<–30 dBc at maximum rated power (MS4622x and MS4623x) <–25 dBc at maximum rated power (MS4624x)	
Source #2 (optional) – Sweep type	Linear, CW, Marker, or N-Discrete point sweep	
Source #2 (optional) – Power sweep range	20 dB (minimum)	

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Receiver specs	Average noise level	–100 dBm in 10 Hz IF Bandwidth (< 3 GHz); Typically > –110 dBm in narrowband sweep –90 dBm in 10 Hz IF Bandwidth (> 3 GHz); Typically > –100 dBm in narrowband sweep
	Maximum input level	+27 dBm, +20 dBm noise figure mode
	Damage level	> +30 dBm, > +23 dBm noise figure mode
	Measurement speed summary	Measurement times are measured using a single trace (S_{21}) display and one average. The measurement speeds for the communications band are measured in a 25 MHz band from 824 – 849 MHz. The typical measurement times displayed are as follows:

Data points	IF bandwidth (Hz)	10 MHz to 3 GHz (ms)	10 MHz to 6 GHz (ms)	10 MHz to 9 GHz (ms)	Communications band (ms)
51	30 kHz 10 kHz 3 kHz 1 kHz 300 Hz	16 21 32 66 187	18 23 35 69 189	31 3 5 46 76 203	11 16 27 61 184
101	30 kHz 10 kHz 3 kHz 1 kHz 300 Hz	26 35 57 126 366	28 38 60 129 370	40 48 71 138 380	20 28 50 120 368
201	30 kHz 10 kHz 3 kHz 1 kHz 300 Hz	44 61 106 242 716	48 65 110 246 720	64 81 126 262 740	37 52 98 234 712
401	30 kHz 10 kHz 3 kHz 1 kHz 300 Hz	80 114 206 480 1424	87 121 212 484 1432	110 146 236 508 1448	70 104 196 468 1408
801	30 kHz 10 kHz 3 kHz 1 kHz 300 Hz	150 218 400 952 2820	161 230 412 960 2840	202 270 456 1000 2900	130 198 380 928 2800

Measurement capabilities	Parameters	S , S , S , S , S , S , S , S , S , S , S , S , S , S , S , S , Harmonics, Noise Figure, Intermodulation Distortion (IMD), and user-defined combinations of a , a , a , a , b , b , b and b . Mixed-Mode terms, too.
	Measurement frequency range	Frequency range of measurement can be narrowed within the calibration range without recalibration. CW mode permits single frequency measurements, also without recalibration. In addition, the system accepts N discrete frequency points where 2 <N <1601.
	Domains	Frequency Domain, CW Draw, and optional High Speed Time (Distance) Domain
	Formats	Log Magnitude, Phase, Log Magnitude & Phase, Smith Chart (Impedance), Smith Chart (Admittance), Linear Polar, Log Polar, Group Delay, Linear Magnitude, Linear Magnitude and Phase, Real, Imaginary, Real & Imaginary, SWR, and Power
	Data points	1601 maximum. Number of data points can be switched to a value of 801, 401, 201, 101, 51, 15, or 3 points without recalibration (if 1601 points were used in the calibration). In addition, the system accepts an arbitrary set of N discrete data points where 2 ≤N ≤1601. CW mode permits selection of a single data point without recalibration.
	Reference delay	Can be entered in time or in distance (when the dielectric constant is entered). Automatic reference delay feature adds the correct electrical length compensation at the push of a button. Software compensation for the electrical length difference between reference and test is always accurate and stable since measurement frequencies are always synthesized. In addition, the system compensates reference phase delay for dispersive transmission media such as microstrip.
	Alternate sweep	Allows the ability to decouple channel 1 and 2 from channel 3 and 4 for the following parameters: correction type, start and stop frequencies, number of data points, markers, sweep time, averaging, smoothing, and IF bandwidth.
	Markers	Twelve independent markers can be used to read out simultaneous measurement data. In alternate sweep mode there are sets of markers for each frequency sweep. In delta reference marker mode, any one marker can be selected as the reference for the other eleven. Markers can be directed automatically to the minimum or maximum of a data trace.
	Enhanced markers	Marker search for a level or bandwidth, displaying an active marker for each channel, and discrete or continuous (interpolated) markers. Identifies the X dB bandwidth of amplifiers, filters, and other frequency sensitive devices.
	Marker sweep	Sweeps upward in frequency between any two markers. Recalibration is not required during the marker sweep.
	Limit lines	Either single or segmented limit lines can be displayed. Two limit lines are available for each trace.
	Single limit readouts	Interpolation algorithm determines the exact intersection frequencies of data traces and limit lines.
	Segmented limit lines	A total of 20 segments (10 upper and 10 lower) can be generated per data trace. Complete segmented traces can be offset in both frequency and amplitude.
	Test limits	Both single and segmented limits can be used for PASS/FAIL testing. PASS or FAIL status is indicated on the display after each sweep. In addition, PASS/FAIL status is output through the rear panel I/O connector as selectable TTL levels (PASS=0V, FAIL=+5V, or PASS=+5V, FAIL=0V).
	Tune mode	Tune Mode optimizes sweep speed in tuning applications by updating forward S-parameters more frequently than reverse ones. This mode lets users select the ratio of forward sweeps to reverse sweeps after a full 12-term calibration. The ratio of forward sweeps to reverse sweeps can be set anywhere between 1:1 to 10,000:1.
	Power sweep measurements	Both Swept Power Gain Compression and Swept Frequency Gain Compression modes are available.
	Sequencing	Seven measurement sequences can be created, stored, edited, and run from the front panel. Sequences can include front-panel functions as well as user-definable control statements. Sequences can be run from either the unit front panel, via GPIB, or from an AT-style keyboard plugged into the front panel.
	Harmonic measurement	Measurement/display of fundamental, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, & 9th harmonic

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Display capabilities	Display channels		Four, each of which can display any S-parameter or user-defined parameter in any format with up to two traces per channel for a maximum of eight traces simultaneously. Each channel is also capable of displaying harmonics, noise figure, intermodulation distortion, or time domain trace. A single channel, two channels (1 and 3, or 2 and 4), or all four channels can be displayed simultaneously. Channels 1 and 3, or channels 2 and 4, can be overlaid for rectilinear graph types.
	Trace overlay		Displays two data traces on the active channel's graticule simultaneously. The overlaid trace is displayed in yellow and the primary trace is displayed in red.
	Trace memory		A separate memory for each channel can be used to store measurement data for later display or subtraction, addition, multiplication or division with current measurement data.
	Blank frequency information		Blanking function removes all references to displayed frequencies on the LCD. Frequency blanking can only be restored through a system reset or GPIB command.
Measurement enhancements	Data averaging		Averaging of 1 to 4096 averages can be selected. The data averaging function is performed at each data point during the frequency sweep. Averaging can be toggled on or off via the front panel; a front-panel LED indicates that the data averaging function is enabled.
	IF bandwidth		Soft Key selection of IF bandwidth (30 kHz, 10 kHz, 3 kHz, 1 kHz, 300 Hz, 100 Hz, 30 Hz, 10 Hz)
	Trace smoothing		Computes an average over a percentage range of the data trace. The percentage of trace to be smoothed can be selected from 0 to 20% of trace.
	Group delay characteristics	Group delay	Group delay is measured by computing the phase change in degrees across a frequency step by applying the formula: $Tg = \frac{-1/360\ d(phase)}{d(frequency)}$
		Aperture	Defined as the frequency span over which the phase change is computed at a given frequency point. The aperture can be changed without recalibration. The minimum aperture is the frequency range divided by the number of points in calibration and can be increased to 20% of the frequency range without recalibration. The frequency width of the aperture and the percent of the frequency range are displayed automatically.
		Range	The maximum delay range is limited to measuring no more than ±180° of phase change within the aperture set by the number of frequency points. A frequency step size of 100 kHz corresponds to 10 microseconds.
		Measurement repeatability (sweep to sweep)	For continuous measurement of a through connection, RSS fluctuations due to phase and FM noise are: $\frac{1.41\ \{(Phase\ Noise)\text{^}2 + (Tg \times Residual\ FM\ Noise)\text{^}2\}\text{^}.5}{360\ (Aperture\ in\ Hz)}$
		Accuracy	Error in $Tg = \frac{Error\ in\ phase}{360} + \frac{(Tg \times Aperature\ Freq.\ Error\ (Hz)}{Aperture}$
		Frequency Translating Group Delay (FTGD)	Allows the measurement of group delay of mixers and other translating devices by analyzing the phase shift experienced by a modulated signal (generated internally). The above Group Delay equation applies, except that the phase change is measured across the modulating bandwidth of the test signal instead of across frequency points. The aperture is fixed at about 900 kHz and the range is limited to about 1 µs. The use of angle modulation keeps the measurement relatively immune from compression and other non-linearities.
	LRL/LRM calibration capability		The LRL calibration technique uses the characteristic impedance of a length of transmission line as the calibration standard. A full LRL calibration consists merely of two transmission line measurements, a high reflection measurement, and an isolation measurement. The LRM calibration technique is a variation of the LRL technique that utilizes a precision termination rather that a second length of transmission line. A third optional standard, either Line or Match may be measured in order to extend the frequency range of the calibration. This extended calibration is achieved by mathematically concatenating either two LRL, two LRM, or one LRL and one LRM calibration(s). Using these techniques, full 12-term error correction can be performed on the MS462XX VNA.
	Dispersion compensation		Selectable as Coaxial (non-dispersive), Waveguide, or Microstrip (dispersive)
	Reference plane		Selectable as Middle of line 1 or Ends of line 1
	Corrected impedance		Determined by Calibration Standards
	AutoCal®		The Scorpion™ family incorporates internal control of the 3658X-series AutoCal modules.
	FlexibleCal™		Optimize throughput by performing only the sweeps required to characterize multi-port devices. Also enables convenient switching between 2, 3 and 4 port calibration without recalibration.
Hard copy	Printer		Scorpion™ supports the HP 2225C InkJet, HP QuietJet, HP DeskJet, HP LaserJet II, III, IV, & V Series, and Epson compatible printers with parallel (Centronics) interfaces. They are also compatible with the ANRITSU "VNA Capture" program (outputs bitmap file over GPIB) and provide bitmap output over front panel to disk.
	GPIB plotters		Scorpion™ supports the HP Models 7440A, 7470A, and 7475A and Tektronix Model HC100 plotters.
Storage	Internal memory		Ten front panel states (setup/calibration) can be stored and recalled from nonvolatile memory locations. The current front panel setup is automatically stored in nonvolatile memory at instrument powerdown. When power is applied, the instrument returns to its last front-panel setup. The system will be able to exchange two stored calibrations in <0.5 s.
	Internal nonvolatile memory		Used to store and recall measurement and calibration data and front panel setups. All files are MS-DOS compatible.
	Internal floppy disk drive		A 3.5 inch diskette drive with 1.44 Mb formatted capacity is used to load measurement programs and to store and recall measurement and calibration data and front panel setups.
	Measurement data		102.8 kb per 1601 point S-parameter data file
	Calibration data		187.3 kb per 1601 point S-parameter data file (12-term cal plus setup)
	Trace memory file		12.8 kb per 1601 point channel
GPIB	GPIB interfaces		2 ports
	System GPIB (IEEE-488.2)		Connects to an external controller for use in remote programming of the network analyzer. Address can be set from the front panel and can range from 1 to 30.
	Dedicated GPIB		Connects to external peripherals for network analyzer controlled operations (e.g., GPIB plotters, frequency counters, frequency synthesizers, and power meters).

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General	Power requirements	85-240V, 48-63 Hz, 540 VA maximum
	Dimensions	222H x 425W x 450D mm (8.75 x 16.75 x 17.75 in)
	Weight	< 23kg. (52 lb.)
Environmental	Storage temperature range	–40°C to +75°C.
	Operating temperature range	0°C to +50°C (specifications apply at 23°C ±3 °C).
	Relative humidity	5% to 95% at +40°C.
EMC	Meets the emmissions and immunity requirements of	EMC Directive - 89/336/EEC
		EN50081-1:1992
		CISPR-11:1990/EN55011:1991 Group 1 Class A
		EMC Directive - 89/336/EEC per EN61326
		EMMISSIONS Standard EN55011:1991 IEC 61000-3-2 IEC 61000-3-3
		IMMUNITY Standard IEC 1000-4-2:1995/prEN50082-1:1995 - 4kV CD, 8kV AD IEC 1000-4-3:1995/ENV50140:1994 - 3V/m IEC 1000-4-4:1995/prEN50082-1:1995 -500V SL; 1000V PL IEC 1000-4-5:1995/prEN50082-1:1995 - 2kV L-E, 1kV L-L IEC 1000-4-6:1995/ENV50141:1994 IEC 1000-4-8:1995/prEN50082-1:1995 IEC 1000-4-11:1995/prEN50082-1:1995
	Safety	Meets safety requirements of Low Voltage/Safety Standard 72/23/EEC - EN61010-1:1993

Ordering information

Please specify model/order number, name, and quantity when ordering.

Model/Order No.	Name
	Main frame
MS4622A	10MHz – 3GHz transmission/reflection
MS4622B	10MHz – 3GHz active reversing
MS4622D	10MHz – 3GHz Balanced / Differential 4-Port
MS4623A	10MHz – 6GHz transmission/reflection
MS4623B	10MHz – 6GHz active reversing
MS4623D	10MHz – 6GHz Balanced / Differential 4-Port
MS4624A	10MHz – 9GHz transmission/reflection
MS4624B	10MHz – 9GHz active reversing
MS4624D	10MHz – 9GHz Balanced / Differential 4-Port
	Options
Option 1	Rack mount kit with slides
Option 2	Time domain
Option 3A	Adds to MS4622B a 2nd internal source (3 GHz source) + 3rd port
Option 3B	Adds to MS4623B a 2nd internal source (6 GHz source) + 3rd port
Option 3E	Adds to MS4624B a 2nd internal source (9 GHz source) + 3rd port
Option 4*1	Noise figure 50 MHz to 3 GHz (only for B models)
Option 4B*1	Noise figure 50 MHz to 6 GHz (only for B models)
Option 4F*1	Noise figure 50 MHz to 3 GHz (only for D models)
Option 4G*1	Noise figure 50 MHz to 6 GHz (only for D models)
Option 5	Frequency translation group delay
Option 6*2	3rd test port (B models; for use with external synthesizer)
Option 7	T/R step attenuator (only for A models, standard on B)
Option 8	Harmonic measurement
Option 11*3	Test Port connector
Option 13	Intermodulation distortion
	AutoCal®
36581NNF/2	AutoCal®, Type N, 10 MHz to 9 GHz
36581KKF/2	AutoCal®, Type K, 10 MHz to 9 GHz
36584KF	AutoCal®, 4-Port Type K, 10 MHz to 9 GHz
36584NF	AutoCal®, 4-Port Type N, 10 MHz to 9 GHz

Model/Order No.	Name
	Noise sources
NC346A	5 dB ENR noise source (3.5 mm)
NC346B	15 dB ENR noise source (3.5 mm)
	Calibration kits
3750R	SMA/3.5 mm RF Cal Kit ≤9 GHz
3750R/1	Adds a set of five Phase Equal Insertables (PEIs)
3750R/3	Adds additional 3.5 mm (female) and 3.5 mm (male) terminations required for four port calibrations.
3751R	GPC-7 RF Cal Kit ≤9 GHz
3751R/2	Adds a third GPC-7 termination required for three port calibrations.
3751R/3	Adds two additional GPC-7 terminations required for four port calibrations.
3753R	50 Ω, Type N, RF Cal Kit ≤9 GHz
3753R/1	Adds a set of five Phase Equal Insertables (PEIs)
3753R/3	Adds additional N (female) and N (male) terminations required for four port calibrations.
3753-75R	75 Ω, Type N, RF Cal Kit ≤9 GHz
3753-75R/3	Adds additional N (75 Ω female) and N (75 Ω male) terminations required for four port calibrations.
	Verification kits
3663R	Type N verification kit
3666R	SMA/3.5 mm verification kit
3667R	GPC-7 verification kit
	Accessories
15LL50-0.3A	3.5 mm Male-Male Cable, 30 cm
15LL50-0.6A	3.5 mm Male-Male Cable, 60 cm
15LLF50-0.3A	3.5 mm Male-Female Cable, 30 cm
15LLF50-0.6A	3.5 mm Male-Female Cable, 60 cm
15NN50-0.3B	Type N Male-Male Cable, 30 cm
15NN50-0.6B	Type N Male-Male Cable, 60 cm
15NNF50-0.3B	Type N Male-Female Cable, 30 cm
15NNF50-0.6B	Type N Male-Female Cable, 60 cm

*1: Does not include noise source.
*2: Port 3 is a receiving port only, unless using an external synthesizer.
*3: Standard connector is N-female, no cost option for 3.5 mm (male), 3.5 mm (female), N-male, or GPC-7.