LMR Master™

Land Mobile Radio Modulation Analyzer and Signal Analyzer, Vector Network Analyzer, Spectrum Analyzer

S412E
500 kHz to 1.6 GHz

Introduction

The S412E is Anritsu's second generation solution for installing and maintaining public safety systems. Built on Anritsu's ninth generation handheld platform, the S412E combines a high performance receiver / spectrum analyzer with the world's most advanced handheld vector network analyzer plus a powerful vector signal generator with internally adjustable power from 0 dBm to -120 dBm.

Spectrum Analyzer Highlights

- Measurements: Occupied Bandwidth, Channel Power, ACPR, C/I, Coverage Mapping
- Interference Analyzer: Spectrogram, Signal Strength, RSSI, Mapping
- Optional 6 GHz Frequency Coverage
- Dynamic Range: > 95 dB in 10 Hz RBW
- DANL: -152 dBm in 10 Hz RBW
- Phase Noise: -100 dBc/Hz max @ 10 kHz offset at 1 GHz
- Frequency Accuracy: < ± 50 ppb with GPS On

VNA Analyzer Highlights

- Broadband coverage of 500 kHz to 1.6 GHz
- 1-path, 2-port Vector Network Analyzer (VNA) w/ quad trace display
- Optional 6 GHz Frequency Coverage
- Intuitive Graphical User Interface (GUI) with convenient Touch Screen
- VNA-quality error correction for directivity and source match
- Outstanding calibration stability, up to 16 hours
- Arbitrary data points up to 4001
- IF Bandwidth selections of 10 Hz to 100 kHz
- 100 dB transmission dynamic range
- 850 µs/data point sweep speed

Land Mobile Radio Signal Analyzer Highlights

- FM modulation with CTCSS, DCS, and DTMF patterns
- Support for ITCR Positive Train Control systems
- 500 kHz to 1.6 GHz frequency coverage
- Internal signal generator control from 0 dBm to -120 dBm
- 2.0 dB signal generator accuracy (Typical)
- P25, NXDN, and DMR2 BER test patterns including 1011 Hz, 1031 Hz, and O.153
- Simultaneous analysis and generation of LMR signals
- Independent control of both receive/transmit frequencies and test patterns

Capabilities and Functional Highlights

- 3 hour battery operation time
- Touch screen keyboard
- Analog FM and Digital LMR Analyzer
- High Accuracy Power Meter
- On-Screen LMR Coverage Mapping (Outdoor and Indoor)
- Channel Scanner
- GPS tagging of saved traces
- USB Data Transfer
- < 5 minute warm-up time
- 8.4 inches daylight viewable color LCD

LMR Master™ S412E featuring 8.4 in. Daylight Viewable Touchscreen
Compact Size: 273 mm x 199 mm x 91 mm, (10.7 in x 7.8 in x 3.6 in), Lightweight: 3.6 kg, (7.9 lbs)

LMR Master™ S412E Specifications

Spectrum Analyzer

Measurements

Smart Measurements	Field Strength (uses antenna calibration tables to measure dBm/m² or dBmV/m)
	Occupied Bandwidth (measures 99% to 1% power channel of a signal)
	Channel Power (measures the total power in a specified bandwidth)
	ACPR (adjacent channel power ratio)
	AM/FM/SSB Audio Demodulation (wide/narrow FM, AM, upper/lower SSB)
	C/I (carrier-to-interference ratio)
	Emission Mask
	Coverage Mapping (requires option 0431)

Setup Parameters

Frequency	Center/Start/Stop, Span, Frequency Step, Signal Standard, Channel #, Channel Increment
Amplitude	Reference Level (RL), Scale, Attenuation Auto/Level, RL Offset, Pre-Amp On/Off, Detection
Span	Span, Span Up/Down (1-2-5), Full Span, Zero Span, Last Span
Bandwidth	RBW, Auto RBW, VBW, Auto VBW, RBW/VBW, Span/RBW
File	Save, Recall, Delete, Directory Management
Save/Recall	Setups, Measurements, Limit Lines, Screen Shots Jpeg (save only), Save-on-Event
Save-on-Event	Crossing Limit Line, Sweep Complete, Save-then-Stop, Clear All
Delete	Selected File, All Measurements, All Mode Files, All Content
Directory Management	Sort Method (Name/Type/Date), Ascend/Descend, Internal/USB, Copy, Format USB
Application Options	Bias-Tee (On/Off), Impedance (50 Ω, 75 Ω, Other)

Sweep Functions

Sweep	Single/Continuous, Manual Trigger, Reset, Detection, Minimum Sweep Time, Trigger Type
Detection	Peak, RMS, Negative, Sample, Quasi-peak
Triggers	Free Run, External, Video, Change Position, Manual

Trace Functions

Traces	Up to three Traces (A, B, C), View/Blank, Write/Hold, Trace A/B/C Operations
Trace A Operations	Normal, Max Hold, Min Hold, Average, # of Averages, (always the live trace)
Trace B Operations	A→B, B←→C, Max Hold, Min Hold
Trace C Operations	A→C, B←→C, Max Hold, Min Hold, A − B→C, B − A→C, Relative Reference (dB), Scale

Marker Functions

Markers	Markers 1-6 each with a Delta Marker, or Marker 1 Reference with Six Delta Markers, Marker Table (On/Off), All Markers Off
Marker Types	Style (Fixed/Tracking), Noise Marker, Frequency Counter Marker Marker Auto-Position Peak Search, Next Peak (Right/Left), Peak Threshold %, Set Marker to Channel, Marker Frequency to Center, Delta Marker to Span, Marker to Reference Level
Marker Table	1-6 markers frequency and amplitude plus delta markers frequency offset and amplitude

Limit Line Functions

Limit Lines	Upper/Lower, On/Off, Edit, Move, Envelope, Advanced, Limit Alarm, Default Limit
Limit Line Edit	Frequency, Amplitude, Add Point, Add Vertical, Delete Point, Next Point Left/Right
Limit Line Move	To Current Center Frequency, By dB or Hz, To Marker 1, Offset from Marker 1
Limit Line Envelope	Create Envelope, Update Amplitude, Points (41 max), Offset, Shape Square/Slope
Limit Line Advanced	Type (Absolute/Relative), Mirror, Save/Recall

LMR Master™ S412E Specifications

Spectrum Analyzer (continued)

Frequency

Frequency Range	100 kHz to 1.6 GHz, (6 GHz with Option 6)
Tuning Resolution	1 Hz
Frequency Reference Aging	± 1.0 ppm/year
Accuracy	± 1.5 ppm (25 °C ± 25 °C) + aging (< ± 50 ppb + aging with GPS on)
Frequency Span	10 Hz to 1.6 GHz including zero span (10 Hz to 6 GHz with Option 6)
Sweep Time	100 ms, 10 µs to 600 seconds in zero span
Sweep Time Accuracy	± 2% in zero span

Bandwidth

Resolution Bandwidth (RBW)	10 Hz to 3 MHz in 1–3 sequence ± 10% (1 MHz max in zero-span) (−3 dB bandwidth)
Video Bandwidth (VBW)	1 Hz to 3 MHz in 1–3 sequence (−3 dB bandwidth) (auto or manually selectable)
RBW with Quasi-Peak Detection	200 Hz, 9 KHz, 120 kHz (−6 dB bandwidth)
VBW with Quasi-Peak Detection	VBW with Quasi-Peak Detection

Spectral Purity

SSB Phase Noise @ 1 GHz	−100 dBc/Hz, −110 dBc/Hz typical @ 10 kHz offset −105 dBc/Hz, −112 dBc/Hz typical @ 100 kHz offset −115 dBc/Hz, −121 dBc/Hz typical @ 1 MHz offset

Amplitude Ranges

Dynamic Range	> 95 dB (2.4 GHz), 2/3 (TOI-DANL) in 10 Hz RBW
Measurement Range	DANL to +26 dBm
Maximum Continuous Input	+33 dBm
Display Range	1 to 15 dB/div in 1 dB steps, ten divisions displayed
Reference Level Range	−120 dBm to +30 dBm
Attenuator Resolution	0 to 55 dB, 5.0 dB steps
Amplitude Units	Log Scale Modes: dBm, dBV, dBmv, dBµV Linear Scale Modes: nV, µV, mV, V, kV, nW, µW, mW, W, kW

Amplitude Accuracy (single sine wave input < Ref level, and > DANL, auto attenuation)

−10 °C to 50 °C after 30 minute warm-up	Typical: ± 0.5 dB, 100 kHz to 6 GHz Maximum: ± 1.3 dB, 100 kHz to 6 GHz

Displayed Average Noise Level (DANL)

Displayed Average Noise Level (DANL)	Preamp Off (Reference level −20 dBm)		Preamp On (Reference level −50 dBm)	
(RBW Normalized to 1 Hz, 0 dB attenuation)	Maximum	Typical	Maximum	Typical
10 MHz to 2.4 GHz	−141 dBm	−146 dBm	−157 dBm	−162 dBm
> 2.4 GHz to 4 GHz	−137 dBm	−141 dBm	−154 dBm	−159 dBm
> 4 GHz to 5 GHz	−134 dBm	−138 dBm	−150 dBm	−155 dBm
> 5 GHz to 6 GHz	−126 dBm	−131 dBm	−143 dBm	−150 dBm
(RBW = 10 Hz, 0 dB attenuation)				
10 MHz to 2.4 GHz	−131 dBm	−136 dBm	−147 dBm	−152 dBm
> 2.4 GHz to 4 GHz	−127 dBm	−131 dBm	−144 dBm	−149 dBm
> 4 GHz to 5 GHz	−124 dBm	−128 dBm	−140 dBm	−145 dBm
> 5 GHz to 6 GHz	−116 dBm	−121 dBm	−133 dBm	−140 dBm

Spurs

Residual Spurious	< −90 dBm (RF input terminated, 0 dB input attenuation, > 10 MHz)
Input-Related Spurious	< −75 dBc (0 dB attenuation, −30 dBm input, span < 1.7 GHz, carrier offset > 4.5 MHz)
Exceptions, typical	<−70 dBc @ <2.5 GHz, with 2072.5 MHz Input <−68 dBc @ F1-280 MHz with F1 Input <−70 dBc @ F1 + 190.5 MHz with F1 Input <−52 dBc @ 7349-2F2 MHz, with F2 Input, where F2 < 2424.5 MHz <−55 dBc @ 190.5 ± F1/2 MHz, F1 <1 GHz

Third-Order Intercept (TOI)

	Preamp Off (−20 dBm tones 100 kHz apart, 10 dB attenuation)
800 MHz	+16 dBm
2400 MHz	+20 dBm
200-2200 MHz	+25 dBm, typical
> 2.2 GHz to 5.0 GHz	+28 dBm, typical
> 5.0 GHz to 6.0 GHz	+33 dBm, typical

Second Harmonic Distortion

	Preamp Off, 0 dB input attenuation, −30 dBm input
50 MHz	−56 dBc
> 50 MHz to 200 MHz	−60 dBc, typical
> 200 MHz to 3000 MHz	−70 dBc, typical

VSWR

	2:1, typical

LMR Master™ S412E Specifications

Vector Network Analyzer

Definitions

- All specifications and characteristics apply under the following conditions, unless otherwise stated:
- After 15 minutes of warm-up time, where the instrument is left in the ON state.
- Temperature range is 23 °C ± 5 °C.
- All specifications apply when using internal reference.
- All specifications subject to change without notice. Please visit www.anritsu.com for most current datasheet.
- Typical performance is the measured performance of an average unit.
- Recommended calibration cycle is 12 months.

Frequency

Frequency Range: 500 kHz to 1.6 GHz (500 kHz to 6.0 GHz with Option 16)

Frequency Accuracy: 2.5 ppm

Frequency Resolution: 1 Hz

Typical Test Port Power

LMR Master supports selection of either High (default) or Low test port power. Changing power after calibration can degrade the calibrated performance. Typical power by bands is shown in the following table.

Frequency Range	High Port Power	Low Port Power
500 kHz to ≤ 3 GHz	+3 dB	−25 dBm
3 GHz to ≤ 6 GHz	0 dB	−25 dBm

Transmission Dynamic Range

The transmission dynamic range (the difference between test port power and noise floor) using 10 Hz IF Bandwidth and High Port Power is shown in the following table.

| Frequency Range	Dynamic Range
2 MHz to ≤ 4 GHz	100 dB
4 GHz to ≤ 6 GHz	90 dB

Typical Sweep Speed

The typical sweep speed for IF Bandwidth of 100 Hz, 1001 data points, and single display is shown in the following table. The two receiver architecture will simultaneously collect S_{21} and S_{11} (or S_{12} and S_{22}) in a single sweep.

Frequency Range	Typical Sweep Speed
500 kHz to 6 GHz	850 µs / point

Block Diagram

As shown in the following block diagram, the LMR Master has a 2-port, 1-path architecture that automatically measures 2 S-parameters with error-correction precision inherent to VNA operation.
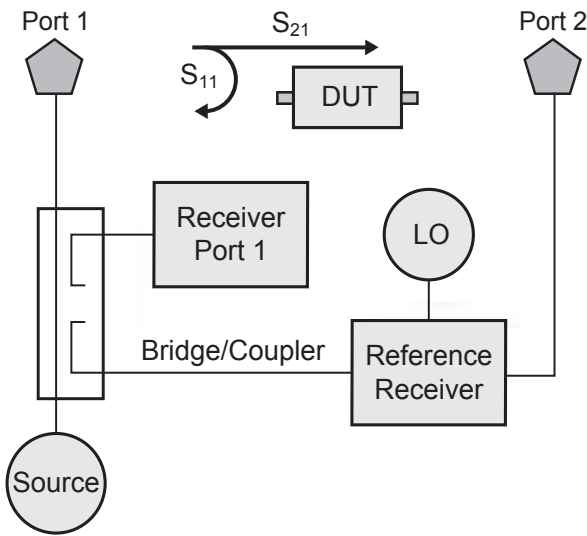
The above illustration is a simplified block diagram of LMR Master's 2-port, 1-path architecture. The magnitude and phase information gained from vector network data enables the LMR Master to make significant error corrections and provide improved field measurements.

LMR Master™ S412E Specifications

Vector Network Analyzer

High Port Power

OSLxx50 Calibration Components (N-Connector)
Corrected System Performance and Uncertainties:

S412E with 1-path, 2-port calibration including
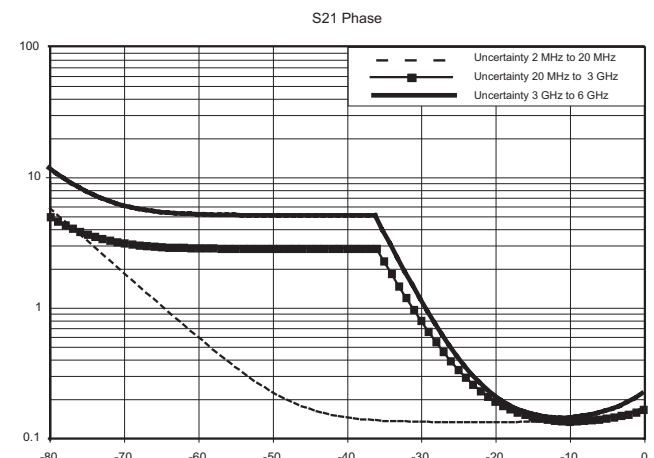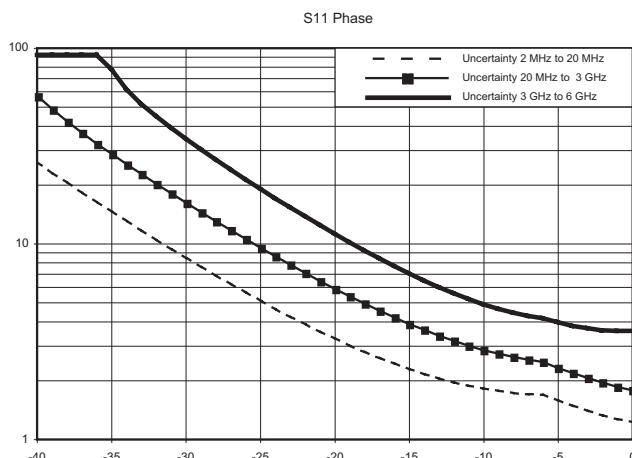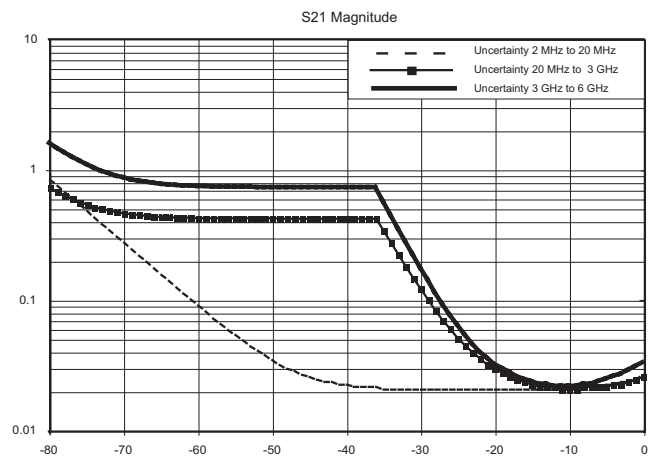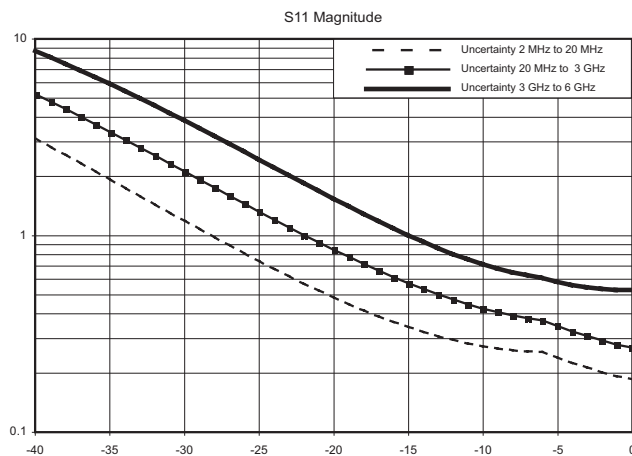isolation using either OSLN50-1 & OSLNF50-1 Calibration Kits

Precision calibration standards come in a convenient
configuration for field work.

Frequency Range	Directivity
≤ 6 GHz	> 42 dB

Frequency Range	Typical High Port Power
≤ 3 GHz	+3 dBm
≤ 6 GHz	0 dBm

Measurement Uncertainties

The following graphs provide measurement uncertainty at 23 ºC ± 5 ºC for the above indicated connector type and calibration. Errors are worse-case contributions of residual directivity, source match, frequency response, network analyzer dynamic range, and connector repeatability. For two-port measurements, transmission tracking, crosstalk, and physical load match termination were added. Isolation calibration and an IF Bandwidth of 10 Hz is used.

LMR Master™ S412E Specifications

Vector Network Analyzer

Low Port Power

OSLxx50 Calibration Components (N-Connectors) Corrected System Performance and Uncertainties:

S412E Model with 1-path, 2-port calibration including isolation using either OSLN50-1 or OSLNF50-1 Calibration Kits.

Precision calibration standards come in a convenient configuration for field work.

Frequency Range	Directivity
≤ 6 GHz	> 42 dB dB

Frequency Range	Typical Low Port Power
≤ 3 GHz	-25 dBm
≤ 6 GHz	-25 dBm

Measurement Uncertainties

The following graphs provide measurement uncertainty at 23 ºC ± 5 ºC for the above indicated connector type and calibration. Errors are worse-case contributions of residual directivity, source match, frequency response, network analyzer dynamic range, and connector repeatability. For two-port measurements, transmission tracking, crosstalk, and physical load match termination were added. Isolation calibration and an IF Bandwidth of 10 Hz are used.
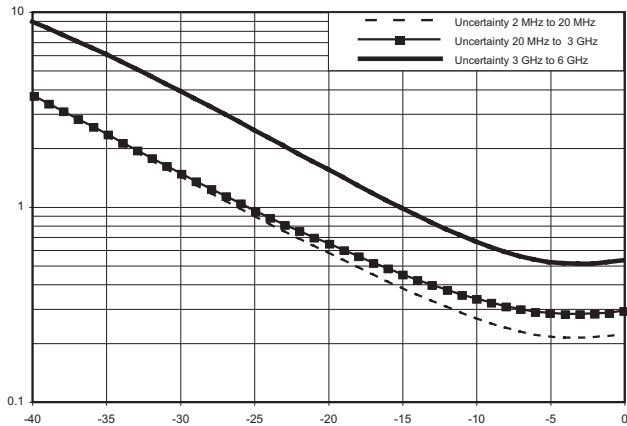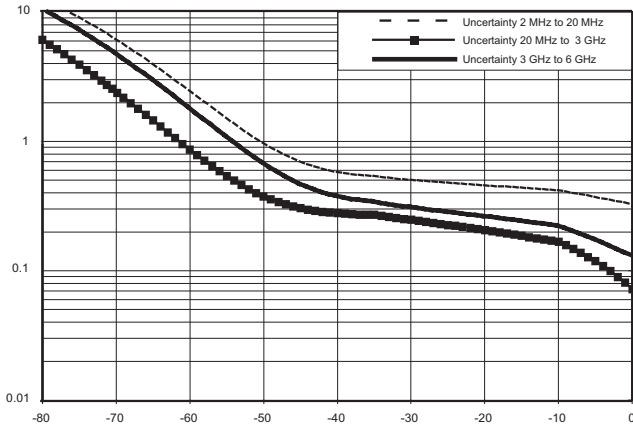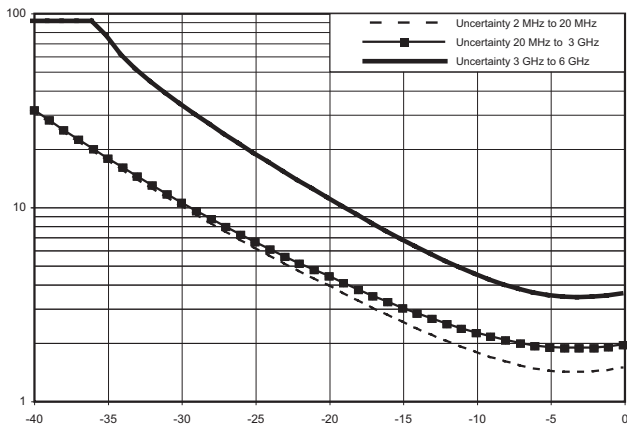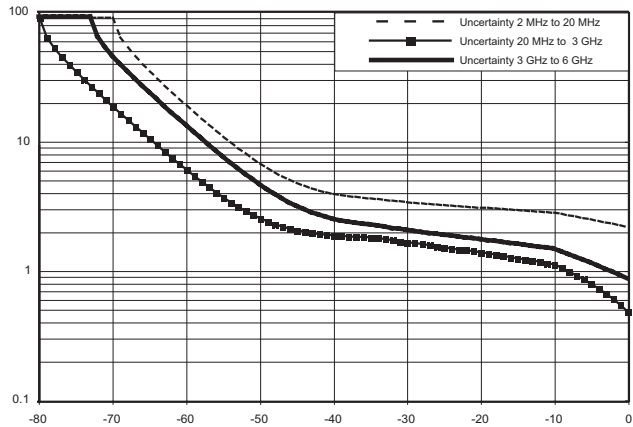
LMR Master™ S412E Specifications

VNA Performance Capabilities

Bias Tee (Option 0010)

For tower mounted amplifier tests, the S412E with optional internal bias tees can supply both DC and RF signals on the center conductor of the cable during measurements. For frequency sweeps in excess of 2 MHz, the LMR Master can supply internal voltage control from +12 to +32 V in 0.1 V steps up to 450 mA. Bias is available on VNA Port 2 and the SPA Input (RF In).

Frequency Range	2 MHz to 4/6 GHz at VNA Port 2
Internal Voltage/Current	+12 V to +32 V at 450 mA. Steady state
Internal Resolution	0.1 V
Bias Tee Selections	Internal, Off
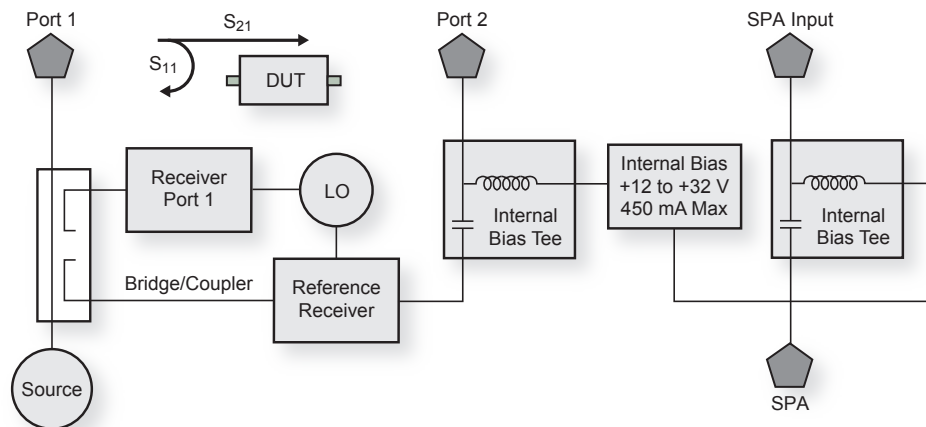
The Compact LMR Master offers optional integrated bias tee for supplying DC plus RF to the DUT as shown in this simplified block diagram.

Vector Voltmeter (Option 0015)

A phased array system relies on phase matched cables for nominal performance. For this class of application, the LMR Master offers this special software mode to simplify phase matching cables at a single frequency. The similarity between the popular vector voltmeter and this software mode ensures minimal training is required to phase match cables. Operation is as simple as configuring the display for absolute or relative measurements. The easy-to-read large fonts show either reflection or transmission measurements using impedance, magnitude, or VSWR readouts. For instrument landing system (ILS) or VHF Omni-directional Range (VOR) applications, a table view improves operator efficiency when phase matching up to twelve cables.

The S412E solution is superior because the signal source is included internally, precluding the need for an external signal generator.

CW Frequency Range	2 MHz to 6 GHz
Measurement Display	CW, Table (Twelve Entries, Plus Reference)
Measurement Types	Return Loss, Insertion
Measurement Format	dB/VSWR/Impedance

Distance Domain (Option 0501)

Distance-to-Fault Analysis is a powerful field test tool to analyze cables for faults, including minor discontinuities that may occur due to a loose connection, corrosion, or other aging effects. By using Frequency Domain Reflectometry (FDR), the Compact VNA Master exploits a user-specified band of full power operational frequencies (instead of DC pulses from TDR approaches) to more precisely identify discontinuities. The Compact VNA Master converts S-parameters from frequency domain into distance domain on the horizontal display axis, using a mathematical computation called Inverse Fourier Transform. Connect a reflection at the opposite end of the cable and the discontinuities appear versus distance to reveal any potential maintenance issues. When access to both ends of the cable is convenient, a similar distance domain analysis is available on transmission measurements.

Option 0501 Distance Domain will improve your productivity with displays of the cable in terms of discontinuities versus distance. This readout can then be compared against previous measurements (from stored data) to determine whether any degradations have occurred since installation

(or the last maintenance activity). More importantly, you will know precisely where to go to fix the problem and minimize or prevent downtime of the system.

Option 0501 Distance Domain also supports field measurements for optical fiber diagnostics. Anritsu Model ODTF-1 test module works directly with RF techniques and converts optical DTF signals to display on the VNA Master.

Maximum Distance (4001 data points, 1.6 GHz span)	374.9 m (1,229.9 ft)
Maximum Distance (4001 data points, 6.0 GHz span)	99.9 m (327.75 ft)
Minimum Distance Resolution (1.6 GHz span)	18.7 cm (7.36 in)
Minimum Distance Resolution (6.0 GHz span)	4.99 cm (1.97 in)
Measurement Display	Return Loss, VSWR
Measurement Format	dB, VSWR

LMR Master™ S412E Specifications

NBFM Analyzer and Coverage Mapping

Measurements	
NBFM Analyzer	**NBFM Coverage** **(requires Option 0031 GPS and a suitable GPS antenna)**
Carrier Power Carrier Frequency Frequency Error FM Deviation Modulation Rate SINAD Quieting THD Occupied Bandwidth (% Int Pwr or > dBc method) Decoded CTCSS/DCS/DTMF	RSSI SINAD Outdoor measured values are overlayed on a geo-tagged map and exportable to both KML and CSV text (requires option 0031 GPS and a suitable GPS antenna) Indoor measured values are referenced by creating touchscreen points on a floorplan.

Interference Analyzer (Option 0025)

Measurements	Spectrum
	Field Strength
	Occupied Bandwidth
	Channel Power
	Adjacent Channel Power (ACPR)
	AM/FM/SSB Demodulation (Wide/Narrow FM, Upper/Lower SSB), (audio out only)
	Carrier-to-Interference ratio (C/I)
	Spectrogram (Collect data up to one week)
	Signal Strength (Gives visual and aural indication of signal strength)
	Received Signal Strength Indicator (RSSI) (collect data up to one week)
	Gives visual and aural indication of signal strength
	Signal ID (up to 12 signals)
	Center Frequency
	Bandwidth
	Signal Type (FM, GSM, W-CDMA, CDMA, Wi-Fi)
	Closest Channel Number
	Number of Carriers
	Signal-to-Nose Ratio (SNR) > 10 dB
	Interference Mapping
	Triangulate location of interference with on display maps
Application Options	Bias-Tee (On/Off), Impedance (50 Ω, 75 Ω, Other)

LMR Master™ S412E Specifications

GPS Receiver Option (Option 0031) (Antenna sold separately)

Setup	On/Off, Antenna Voltage 3.3/5.0 V, GPS Info
GPS Time/Location Indicator	Time, Latitude, Longitude and Altitude on display
	Time, Latitude, Longitude and Altitude with trace storage
High Frequency Accuracy	Spectrum Analyzer, Interference Analyzer, CW Signal Analyzers
when GPS Antenna is connected	< ± 50 ppb with GPS On, 3 minutes after satellite lock in selected mode
Connector	SMA, Female

Coverage Mapping (Options 0431)

Measurements	
Indoor Mapping	**Outdoor Mapping**
RSSI	RSSI
ACPR	ACPR

Setup Parameters

Frequency	Center/Start/Stop, Span, Freq Step, Signal Standard, Channel #, Channel Increment
Amplitude	Reference Level (RL), Scale, Attenuation Auto/Level, RL Offset, Pre-Amp On/Off, Detection
Span	Span, Span Up/Down (1-2-5), Full Span, Zero Span, Last Span
BW	RBW, Auto RBW, VBW, Auto VBW, RBW/VBW, Span/VBW
Measurement Setup	ACPR, RSSI
Point Distance / Time Setup	Repeat Type Time Distance
Save Points Map	Save KML, JPEG, Tab Delimited
Recall Points Map	Recall Map, Recall KML Points only, Recall KML Points with Map, Recall Default Grid

Channel Scanner (Option 0027)

Number of Channels	1 to 20 Channels
Measurements	Graph/Table, Max Hold (On/5 sec/Off), Freq/Channel, Current/Max, Single/Dual Color
Scanner	Scan Channels, Scan Frequencies, Scan Customer List, Scan Script Master™
Amplitude	Reference Level, Scale
Custom Scan	Signal Standard, Channel, # of Channels, Channel Step Size, Custom Scan
Frequency Accuracy	± 10 Hz + Time base error
Measurement Range	−110 dBm to +26 dBm
Application Options	Bias-Tee (On/Off), Impedance (50 Ω, 75 Ω, Other)

LMR Master™ S412E Specifications

Power Meter

Frequency	Center/Start/Stop, Span, Frequency Step, Signal Standard, Channel #, Full Band
Amplitude	Maximum, Minimum, Offset, Relative On/Off, Units, Auto Scale
Average	Acquisition Fast/Med/Slow, # of Running Averages
Limits	Limit On/Off, Limit Upper/Lower
Frequency Range	10 MHz to 1.6 GHz (Standard), 10 MHz to 6 GHz (Option 6)
Span	1 kHz to 100 MHz
Display Range	-140 dBm to +30 dBm, ≤ 40 dB span
Measurement Range	-120 dBm to +26 dBm
Offset Range	0 dB to +100 dB
VSWR	2:1 typical
Maximum Power	+35 dBm without attenuator
Accuracy	Same as Spectrum Analyzer
Application Options	Impedance (50 Ω, 75 Ω, Other)

High Accuracy Power Meter (Option 0019) (Requires external USB Power Sensor(s))

Amplitude	Maximum, Minimum, Offset, Relative On/Off, Units, Auto Scale
Average	# of Running Averages, Max Hold
Zero/Cal	Zero On/Off, Cal Factor (Center Frequency, Signal Standard)
Limits	Limit On/Off, Limit Upper/Lower

Power Sensor Model	**PSN50**	**MA24104A/05A**	**MA24106A**	**MA24108/18/26A**
Description	High Accuracy RF Power Sensor	Inline High/Peak Power Sensor	High Accuracy RF Power Sensor	Microwave USB Power Sensor
Frequency Range	50 MHz to 6 GHz	600 MHz to 4 GHz (**MA24104A**) 350 MHz to 4 GHz (**MA24105A**)	50 MHz to 6 GHz	10 MHz to 8 GHz (**MA24108A**) 10 MHz to 18 GHz (**MA24118A**) 10 MHz to 26 GHz (**MA24126A**)
Connector	Type N(m), 50 Ω	Type N(m), 50 Ω (**MA24104A**) Type N(f), 50 Ω (**MA24105A**)	Type N(m), 50 Ω	Type N(m), 50 Ω (**MA24108/18A**) Type K(m), 50 Ω (**MA24126A**)
Dynamic Range	-30 dBm to +20 dBm (.001 mW to 100 mW)	+3 dBm to +51.76 dBm (2 mW to 150 W)	-40 dBm to +23 dBm (0.1 µW to 200 mW)	-40 dBm to +20 dBm (0.1 µW to 100 mW)
VBW	100 Hz	100 Hz	100 Hz	50 kHz
Measurand	True-RMS	True-RMS	True-RMS	True-RMS, Slot Power, Burst Average Power
Measurement Uncertainty	±0.16 dB[1]	±0.17 dB[2]	±0.16 dB[1]	±0.18 dB[3]
Datasheet (for complete specifications)	11410-00414	11410-00483 (**MA24104A**) 11410-00621 (**MA24105A**)	11410-00424	11410-00504

Notes:
1) Total RSS measurement uncertainty (0 ºC to 50 ºC) for power measurements of a CW signal greater than -20 dBm with zero mismatch errors.
2) Expanded uncertainty with K=2 for power measurements of a CW signal greater than +20 dBm with a matched load. Measurement results referenced to the input side of the sensor.
3) Expanded uncertainty with K=2 for power measurements of a CW signal greater than -20 dBm with zero mismatch errors.

CW Signal Generator

Setup Parameters

Generator	On/Off
Tx Output Level	-120 dBm to 0 dBm
Tx Pattern	CW

RF Characteristics

Power Level Accuracy	2.0 dB (CW Pattern, temperature range 15 °C to 35 °C, -120 to 0 dBm) Typical
Frequency Range	500 kHz to 1.6 GHz
Frequency Accuracy	Same as Spectrum Analyzer

LMR Master™ S412E Specifications

P25 Analyzer and P25 Talk-Out Coverage (Options 0521, 0522)

Measurements

P25 Analyzer (Option 0521)	P25 Talk-Out Coverage (Option 0522 , requires Option 0031 GPS)
Received Power Frequency Error Modulation Fidelity NAC (hex) Symbol Rate Error BER (1011 Hz, O.153, Voice, and Control Channel) Symbol Deviation	BER RSSI Modulation Fidelity

Graphs

P25 Analyzer (Option 0521)	P25 Talk-Out Coverage (Option 0522 , requires Option 0031 GPS)
Constellation Linear Constellation Spectrum [Spans (kHz) = 25,50,100,500,1000,5000] Histogram Eye Diagram Summary Display	Outdoor measured values are overlayed on a geo-tagged map and exportable to both KML and CSV text (Requires option 0031 GPS and a suitable GPS antenna) Indoor measured values are referenced by creating touchscreen points on a floorplan

Setup Parameters

Frequency	Center Frequency
Amplitude	Reference level, Scale, Ext Attenuation, Auto Range, Adjust Range
Setup	Modulation Type (C4FM for P25 Phase 1, CQPSK for LSM) BER pattern (1011 Hz, O.153, Voice, Control Channel)
Measurement	P25 Analyzer, P25 Coverage
P25 Analyzer	Active Graph, Maximize Active Trace, Graph Type, Symbol Span
Graph Type	Constellation, Linear Constellation, Spectrogram, Histogram, Eye Diagram, Summary
Eye Diagram Symbol Span	2, 3, 4, 5
P25 Coverage (Option 0522, requires Option 0031 GPS)	USB Memory File Format .p25, .kml, both Log data on / off Measured values are overlayed on a geo-tagged map and exportable to both KML and CSV text

RF Measurements (Option 0521) (temperature range 15 °C to 35 °C)

Received Power dBm	± 1.25 dB, ± 0.5 dB typical
Frequency Error Hz	± 10 Hz + Frequency Reference
Modulation Fidelity %	
BER/MER %	
Symbol Deviation Hz	
Network Access Code Hex	
Symbol Rate Error MHz	

Measurements (Option 0522)

	Measured values are overlayed on a geo-tagged map and exportable to both KML and CSV text

Signal Generator

Setup Parameters

Generator	On/Off
Tx Output Level	-120 dBm to 0 dBm
Tx Pattern	1011 Hz, 1011 Hz Cal, Intfr, Silence, Busy, Idle, High Dev, Low Dev, O.153 (v. 52), CW, AM and FM

RF Characteristics

Power Level Accuracy	2.0 dB (CW Pattern, temperature range 15 °C to 35 °C, -120 to 0 dBm) Typical
Frequency Range	500 kHz to 1.6 GHz
Mod Fidelity	1.25 % max, 0.75 typical
Frequency Accuracy	Same as Spectrum Analyzer

LMR Master™ S412E Specifications

DMR2 Analyzer and DMR2 Talk-Out Coverage (Options 0591, 0592)

Measurements

DMR2 Analyzer (Option 0591)	DMR2 Talk-Out Coverage (Option 0592, requires Option 0031 GPS)
Received Power Frequency Error Modulation Fidelity Color Code (hex) RX & TX Timeslot Symbol Rate Error Symbol Deviation BER Mobile Station: 1031 Hz, O.153, Voice, Silence, Idle and Control Channel Base Station: 1031 Hz, 1031 Hz 1% BER, O.153, O.153 1% BER, Silence, TSCC	BER RSSI Modulation Fidelity

Graphs

DMR2 Analyzer (Option 0591)	DMR2 Talk-Out Coverage (Option 0592, requires Option 0031 GPS)
Constellation Linear Constellation Spectrum [Spans(kHz) = 25,50,100,500,1000,5000] Histogram Eye Diagram Summary Display	Outdoor measured values are overlayed on a geo-tagged map and exportable to both KML and CSV text (Requires option 0031 GPS and a suitable GPS antenna) Indoor measured values are referenced by creating touchscreen points on a floorplan

Setup Parameters

Frequency	Center Frequency
Amplitude	Reference level, Scale, Ext Attenuation, Auto Range, Adjust Range
Setup	Modulation Type (Base Station, Mobile Station), BER pattern (1031 Hz, O.153, Voice, Control Channel, Silence, Idle)
Measurement	DMR2 Analyzer, DMR2 Coverage
DMR2 Analyzer	Active Graph, Maximize Active Trace, Graph Type, Symbol Span
Graph Type	Constellation, Linear Constellation, Spectrogram, Histogram, Eye Diagram, Summary
Eye Diagram Symbol Span	2, 3, 4, 5
DMR2 Coverage (Option 0592, requires Option 0031 GPS)	USB Memory File Format .dmr2, .kml, both Log data on / off Measured values are overlayed on a geo-tagged map and exportable to both KML and CSV text

RF Measurements (Option 0591) (temperature range 15 °C to 35 °C)

Received Power dBm	± 1.25 dB, ± 0.5 dB typical
Frequency Error Hz	± 10 Hz + Frequency Reference
Modulation Fidelity %	
BER/MER %	
Symbol Deviation Hz	
Color Code Hex	
Receive Timeslot	
Transmit Timeslot	
Symbol Rate Error mHz	

Measurements (Option 0592)

	Measured values are overlayed on a geo-tagged map and exportable to both KML and CSV text

Signal Generator

Setup Parameters

Generator	On/Off
Tx Output Level	-120 dBm to 0 dBm
Tx Pattern	1031 Hz, O.153 (v. 52), Silence, 1031 Hz with 1% BER, O.153 (v. 52) with 1% BER, TSCC (only available in Base Station Modulation Type), CW, AM and FM

RF Characteristics

Power Level Accuracy	2.0 dB (CW Pattern, temperature range 15 °C to 35 °C, -120 dBm to 0 dBm) Typical
Frequency Range	500 kHz to 1.6 GHz
Mod Fidelity	1.25 % max, 0.75 typical
Frequency Accuracy	Same as Spectrum Analyzer

LMR Master™ S412E Specifications

NXDN Analyzer and NXDN Talk-Out Coverage (Options 0531, 0532)

Measurements

NXDN Analyzer (Option 0531)	NXDN Talk-Out Coverage (Option 0532, requires Option 0031 GPS)
Received Power Frequency Error Modulation Fidelity RAN (hex) Symbol Rate Error BER (1031 Hz, O.153, Voice, and Control Channel) Symbol Deviation	BER RSSI Modulation Fidelity

Graphs

NXDN Analyzer (Option 0531)	NXDN Talk-Out Coverage (Option 0532, requires Option 0031 GPS)
Constellation Linear Constellation Spectrum [Spans (kHz) = 25,50,100,500,1000,5000] Histogram Eye Diagram Summary Display	Outdoor measured values are overlayed on a geo-tagged map and exportable to both KML and CSV text (Requires option 0031 GPS and a suitable GPS antenna) Indoor measured values are referenced by creating touchscreen points on a floorplan

Setup Parameters

Frequency	Center Frequency
Amplitude	Reference level, Scale, Ext Attenuation, Auto Range, Adjust Range
Setup	Modulation Bandwidth (6.25 kHz and 12.5 kHz), BER pattern (1031 Hz, O.153, Voice, Control Channel)
Measurement	NXDN Analyzer, NXDN Coverage
NXDN Analyzer	Active Graph, Maximize Active Trace, Graph Type, Symbol Span
Graph Type	Constellation, Linear Constellation, Spectrogram, Histogram, Eye Diagram, Summary
Eye Diagram Symbol Span	2, 3, 4, 5
NXDN Coverage (Option 0532, requires Option 0031 GPS)	USB Memory File Format .nxdn, .kml, both Log data on / off Measured values are overlayed on a geo-tagged map and exportable to both KML and CSV text

RF Measurements (Option 0531) (temperature range 15 °C to 35 °C)

Received Power dBm	± 1.25 dB, ± 0.5 dB typical
Frequency Error Hz	± 10 Hz + Frequency Reference
Modulation Fidelity %	
BER/MER %	
Symbol Deviation Hz	
Radio Access Number Hex	
Symbol Rate Error mHz	

Measurements (Option 0532, requires Option 0031 GPS)

	Measured values are overlayed on a geo-tagged map and exportable to both KML and CSV text

Signal Generator

Setup Parameters

Mod Bandwidth	6.25 kHz, 12.5 kHz
Generator	On/Off
Tx Output Level	-120 dBm to 0 dBm
Tx Pattern	1031 Hz, O.153 (v. 52), High Dev, Low Dev, UDCH Pattern 10, CAC, CW, AM and FM

RF Characteristics

Power Level Accuracy	2.0 dB (CW Pattern, temperature range 15 °C to 35 °C, -120 to 0 dBm) Typical
Frequency Range	500 kHz to 1.6 GHz
Mod Fidelity	1.25% max
Frequency Accuracy	Same as Spectrum Analyzer

LMR Master™ S412E Specifications

PTC Analyzer and PTC Talk-Out Coverage (Options 0721, 0722)

Measurements

PTC Analyzer (Option 0721)	PTC Talk-Out Coverage (Option 0722, requires Option 0031 GPS)
Received Power Frequency Error 4FSK: BER, Modulation Fidelity, Symbol Deviation, Symbol Rate Error ∏/4 DQPSK: Error Vector Magnitude, BER, IQ Imbalance, Phase Error, Magnitude Error, Symbol Rate Error	BER RSSI Modulation Fidelity

Graphs

PTC Analyzer (Option 0721)	PTC Talk-Out Coverage (Option 0722, requires Option 0031 GPS)
Constellation Linear Constellation Spectrum [Spans(kHz) = 25,50,100,500,1000,5000] Histogram Eye Diagram Summary Display	Measured values are overlayed on a geo-tagged map and exportable to both KML and CSV text (Requires Option 0031 and a suitable GPS antenna)

Setup Parameters

Frequency	Center Frequency
Amplitude	Reference level, Scale, Ext Attenuation, Auto Range, Adjust Range
Setup	Modulation Type (4FSK, DQPSK) Symbol Rate (ksps) (6, 8, 12, 16) TX pattern Preamble + PN9, PN9 Only, CW, AM 1 kHz tone, FM 1 kHz tone
Measurement	PTC Analyzer, PTC Coverage
PTC Analyzer	Active Graph, Maximize Active Trace, Graph Type, Symbol Span
Graph Type	Constellation, Linear Constellation, Spectrogram, Histogram, Eye Diagram, Summary
Eye Diagram Symbol Span	2, 3, 4, 5
PTC Coverage (Option 0532, requires Option 0031 GPS)	USB Memory File Format .mtd, .kml, both Log data on / off Measured values are overlayed on a geo-tagged map and exportable to both KML and CSV text

RF Measurements (Option 0721) (temperature range 15 °C to 35 °C)

Received Power dBm	± 1.25 dB, ± 0.5 dB typical
Frequency Error Hz	± 10 Hz + Frequency Reference
Modulation Fidelity %	
Error Vector Magnitude %	
Phase Error degrees	
Magnitude Error %	
IQ Imbalance dB	
BER %	
Symbol Deviation Hz	
Radio Access Number Hex	
Symbol Rate Error mHz	

Measurements (Option 0722)

	Measured values are overlayed on a geo-tagged map and exportable to both KML and CSV text

Signal Generator

Setup Parameters

Modulation Type (4FSK, ∏/4 DQPSK)	Symbol Rate (ksps) (6, 8, 12, 16)
Generator	On/Off
Tx Output Level	-120 dBm to 0 dBm
Tx Pattern	Preamble + PN9, PN9 Only, CW, AM 1 kHz tone, FM 1 kHz tone

RF Characteristics

Power Level Accuracy	2.0 dB (CW Pattern, temperature range 15 °C to 35 °C, -120 to 0 dBm) Typical
Frequency Range	500 kHz to 1.6 GHz
Mod Fidelity	1.75 % max
Frequency Accuracy	Same as Spectrum Analyzer

AM/FM/PM Signal Analyzers (Option 0509)

Measurements

	RF Spectrum AM/FM/PM	Audio Spectrum (AM)	Audio Spectrum (FM/PM)	Audio Waveform (AM)	Audio Waveform (FM/PM)	Summary (AM)	Summary (FM/PM)
Graphic Display	Power (dBm) vs. Frequency	Depth (%) vs. Modulation Frequency	Deviation (kHz/rad) vs. Modulation Frequency	Depth (%) vs. Time	Deviation (kHz/rad) vs. Time	None	None
Numerical Displays	Carrier Power Carrier Frequency Occupied Bandwidth	AM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	FM/PM Rate RMS Deviation (Pk-Pk)/2 Deviation SINAD* THD* Distortion/Total Vrms*	AM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	FM/PM Rate RMS Depth (Pk-Pk)/2 Depth SINAD* THD* Distortion/Total Vrms*	RMS Depth (AM) Peak + Depth Peak – Depth (Pk-Pk)/2 Depth Carrier Power Carrier Frequency Occupied Bandwidth AM Rate SINAD* THD* Distortion/Total Vrms*	RMS Deviation (FM/PM) Peak + Depth Peak – Depth (Pk-Pk)/2 Depth Carrier Power Carrier Frequency Occupied Bandwidth AM Rate SINAD* THD* Distortion/Total Vrms*

Setup Parameters

Frequency	Center Freq, Span, Freq Step, Signal Standard, Channel, Channel Increment, Set Carrier Freq
Amplitude	Scale, Power Offset, Adjust Range
Setup	Demod Type (AM, FM, PM), IFBW, Auto IFBW
Measurements	RF Spectrum AM/FM/PM, Audio Spectrum (AM/FM/PM), Audio Waveform (AM/FM/PM), Summary (AM/FM/PM), Average
Marker	On/Off, Delta, Peak Search, Marker Freq to Center, Marker to Ref Lvl, Marker Table, All Markers Off

Specifications

AM	Modulation Rate: ± 1 Hz (< 100 Hz), ± 2% (> 100 Hz) Depth: ± 5% for (Modulation rates 10 Hz to 100 kHz)
FM	Modulation Rate: ± 1 Hz (< 100 Hz); ± 2% (100 Hz to 100 kHz) Deviation Accuracy: ± 5% (100 Hz to 100 kHz)**
PM	Modulation Rate: ± 1 Hz (< 100 Hz); ± 2% (100 Hz to 100 kHz) Deviation Accuracy: ± 5% (deviation 0 to 93 Rad, rate 10 Hz to 5 kHz)**
IF Bandwidth	1 kHz to 300 kHz in 1-3 sequence
Frequency Span	RF Spectrum: 10 kHz to 10 MHz Audio Spectrum: 2 kHz, 5 kHz, 10 kHz, 20 kHz
RBW/VBW	30
Span/RBW	100
Sweep Time	50 µs to 50 ms (Audio Waveform)

* Requires Sinewave modulation
** IFBW must be greater than 95% occupied BW

LMR Master™ S412E Specifications

LTE Signal Analyzers (Options 0541, 0542, 0546)

Measurements

RF (Option 0541)	Modulation (Option 0542)	Over-the-Air (OTA) (Option 0546)	Pass/Fail (User Editable)

Channel Spectrum
  Channel Power
  Occupied Bandwidth
ACLR
RF Summary
	Constellation
	  Reference Signal Power
	  Sync Signal Power
	  EVM
	  Frequency Error
	  Carrier Frequency
	  Cell ID
	  Sector ID
	  Group ID
	Control Channel Power
	  RS
	  P-SS
	  S-SS
	  PBCH
	  PCFICH
	  Modulation Summary
		Synch Signal Power
		(Six Strongest)
		  Power
		  Cell ID
		  Sector ID
		  Group ID
		Dominance
			Pass Fail All
			Pass/Fail RF
			Pass Fail Demod
			Measurements
			  Channel Power
			  Occupied Bandwidth
			  ACLR
			  Frequency Error
			  Carrier Frequency
			  Dominance
			  EVM (peak)
			  EVM (rms)
			  RS Power
			  SS Power
			  P-SS Power
			  S-SS Power
			  PBCH Power
			  PCFICH Power
			  Cell ID
			  Group ID
			  Sector ID

Setup Parameters

	Frequency	E-UTRA bands 1 - 21 (tuneable 10 MHz to 4.0 GHz) Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
	Bandwidth	10 MHz
	Span	1.4, 3, 5, 10, 15, 20, 30 MHz
	Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range
	Sweep	Single/Continuous, Trigger Sweep
	Save/Recall	Setup, Measurement, Screen Shot (save only), to Internal/External Memory
	Measurement Summary Screens	Overall Measurements, RF Measurements, Modulation Quality

RF Measurements (Option 0541) (requires Option 0031)

	RF Channel Power Accuracy	± 1.5 dB, ± 1.0 dB typical, (RF input -50 dBm to +10 dBm)

Modulation (Option 0542) (requires Option 0031)

	Frequency Error	± 10 Hz + time base error, 99% confidence level
	Residual EVM (rms)	2.0% typical (E-UTRA Test Model 3.1) (RF Input -50 dBm to +10 dBm)

Over-the-Air (OTA) Measurements (Option 0546) (requires Option 0031)

	Scanner	Six strongest Sync Signals
	Auto Save	Yes
	GPS Tagging and Logging	Yes

LMR Master™ S412E Specifications

IEEE 802.16 Fixed WiMAX Signal Analyzers (Options 0046, 0047)

Measurements

RF (Option 0046)	Demodulation (Option 0047)	Over-the-Air (OTA)	Pass/Fail (User Editable)

Channel Spectrum
  Channel Power
  Occupied Bandwidth
Power vs. Time
  Channel Power
  Preamble Power
  Data Burst Power
  Crest Factor
ACPR
	Constellation
	  RCE (RMS/Peak)
	  EVM (RMS/Peak)
	  Frequency Error
	  Carrier Frequency
	  Base Station ID
	Spectral Flatness
	  Adjacent Subcarrier Flatness
	EVM vs. Subcarrier/Symbol
	  RCE
	  EVM
	  Frequency Error
	  Carrier Frequency
	  Base Station ID
		There are no additional OTA Measurements.
		
		RF Measurements and Demodulation can be made OTA
			Channel Power
			Occupied Bandwidth
			Burst Power
			Preamble Power
			Crest Factor
			Frequency Error
			Carrier Frequency
			EVM
			RCE
			Base Station ID

Setup Parameters

Bandwidth	1.25, 1.50, 2.50, 3.50, 5.00, 5.50, 6.00, 7.00, 10.00 MHz
Cyclic Prefix Ratio (CP)	1/4, 1/8, 1/16, 1/32
Span	5, 10, 15, 20 MHz
Frame Length	2.5, 5.0, 10.0 msec
Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range
Sweep	Single/Continuous, Trigger Sweep
Save/Recall	Setup, Measurement, Screen Shot (save only), to Internal/External Memory
Measurement Summary Screens	Overall Measurements, RF Measurements, Signal Quality Measurements

RF Measurements (Option 0046) (temperature range 15 ºC to 35 ºC)

RF Channel Power Accuracy	± 1.5 dB, ± 1.0 dB typical, (RF input -50 dBm to +20 dBm)

Demodulation (Option 0047) (temperature range 15 ºC to 35 ºC)

Frequency Error	0.07 ppm + time base error, 99% confidence level
Residual EVM (rms)	3% typical, 3.5% maximum (RF Input -50 dBm to +20 dBm)

LMR Master™ S412E Specifications

IEEE 802.16 Mobile WiMAX Signal Analyzers (Options 0066, 0067, 0037)

Measurements

RF (Option 0066)	Demodulation (Option 0067)	Over-the-Air (OTA) (Option 0037)	Pass/Fail (User Editable)
Channel Spectrum	Constellation	Channel Power Monitor	Channel Power
Channel Power	RCE (RMS/Peak)	Preamble Scanner (Six)	Occupied Bandwidth
Occupied Bandwidth	EVM (RMS/Peak)	Preamble	Downlink Bust Power
Power vs. Time	Frequency Error	Relative Power	Uplink Burst Power
Channel Power	CINR	Cell ID	Preamble Power
Preamble Power	Base Station ID	Sector ID	Crest Factor
Downlink Burst Power	Sector ID	PCINR	Frequency Error
Uplink Burst Power	Spectral Flatness	Dominant Preamble	Carrier Frequency
ACPR	Adjacent Subcarrier Flatness	Base Station ID	EVM
	EVM vs. Subcarrier/Symbol		RCE
	RCE (RMS/Peak)		Sector ID
	EVM (RMS/Peak)		
	Frequency Error		
	CINR		
	Base Station ID		
	Sector ID		
	DL-MAP (Tree View)		

Setup Parameters

Zone Type	PUSC
DL-MAP Auto Decoding	Convolutional Coding (CC), Convolutional Turbo Coding (CTC)
Bandwidths	3.50, 5.00, 7.00, 8.75, 10.00 MHz
Cyclic Prefix Ratio (CP)	1/8
Span	5, 10, 20, 30 MHz
Frame Lengths	5, 10 msec
Demodulation	Auto, Manual, FCH
Frequency	Center, Signal Standard, Channel #, Closest Channel, Decrement/Increment Channel
Amplitude	Scale/Division, Power Offset, Auto Range, Adjust Range
Sweep	Single/Continuous, Trigger Sweep
Save/Recall	Setup, Measurement, Screen Shot (save only), to Internal/External Memory
Measurement Summary Screens	Overall Measurements, RF Measurements, Signal Quality Measurements

RF Measurements (Option 0066) (temperature range 15 ºC to 35 ºC)

RF Channel Power Accuracy	± 1.5 dB, ± 1.0 dB typical, (RF input -50 dBm to +20 dBm)

Demodulation (Option 0067) (temperature range 15 ºC to 35 ºC)

Frequency Error	0.02 ppm + time base error, 99% confidence level
Residual EVM (rms)	2.5% typical, 3.0% maximum, (RF Input -50 dBm to +20 dBm)

Over-the-Air (OTA) Measurements (Option 0037)

Channel Power Monitor	Over time (one week), measurement time interval 1 to 60 sec
Preamble Scanner	Six Strongest Preambles
Auto Save	Yes
GPS Logging	Yes

LMR Master™ S412E Specifications

General Specifications

Setup Parameters

System	Status (Temperature, Battery Info, Serial Number, Firmware Version, Options Installed)
	Self Test, Application Self Test
	GPS (see Option 0031)
System Options	Name, Date and Time, Brightness, Volume
	Language (English, French, German, Spanish, Chinese, Japanese, Korean, Italian, User defined)
	Reset (Factory Defaults, Master Reset, Update Firmware)
File	Save, Recall, Delete, Directory Management
Save/Recall	Setups, Measurements, Screen Shots Jpeg (save only)
Delete	Selected File, All Measurements, All Mode Files, All Content
Directory Management	Sort Method (Name/Type/Date), Ascend/Descend, Internal/USB, Copy, Format USB
Internal Trace/Setup Memory	2,000 traces, 2,000 Setups
External Trace/Setup Memory	Limited by size of USB Flash drive
Mode Switching	Auto-Stores/Recalls most recently used Setup Parameters in the Mode

Connectors

VNA Port 1, VNA Port 2, RF In, Signal Gen	Type N, female, 50 Ω
VNA Port 1 Damage Level	23 dBm, ± 50 VDC
RF In	Type N, female, 50 Ω
RF In Damage Level	+33 dBm peak, ± 50 VDC, Maximum Continuous Input (≥ 10 dB attenuation)
GPS	SMA(f)
External Power	5.5 mm barrel connector, 12.5 to 15 VDC, < 4.0 Amps
USB Interface (2)	Type A, Connect USB Flash Drive and Power Sensor
USB Interface	5-pin mini-B, Connect to PC for data transfer
Headset Jack	3.5 mm mini-phone plug
External Reference In	BNC, female, 50 Ω, Maximum Input +10 dBm 1 MHz, 5 MHz, 10 MHz, 13 MHz
External Trigger/Clock Recovery	BNC, female, 50 Ω, Maximum Input ± 50 VDC

Display

Type	Resistive Touchscreen
Size	8.4" daylight viewable color LCD
Resolution	800 x 600

Battery

Type	Li-Ion
Battery Operation	3.0 hours, typical

Electromagnetic Compatibility

European Union	CE Mark, EMC Directive 2004/108/EC
	Low Voltage Directive 2006/95/EC
Australia and New Zealand	C-tick N274
Interference	EN 61326-1
Emissions	EN 55011
Immunity	EN 61000-4-2/-4-3/-4-4/-4-5/-4-6/-4-11

Safety

Safety Class	EN 61010-1 Class 1
Product Safety	IEC 60950-1 when used with company supplied Power Supply

Environmental

Operating Temperature	–10 °C to 55 °C
Maximum Humidity	95% RH (non-condensing) at 40 °C
Shock	MIL-PRF-28800F Class 2
Storage	–40 ºC to 71 °C
Altitude	4600 meters, operating and non-operating

ESD

RF Port Center Pin	Withstands up to ± 15 kV

Size and Weight

Size	273 mm x 199 mm x 91 mm (10.7 in x 7.8 in x 3.6 in)
Weight	3.6 kg, (7.9 lbs)

LMR Master™ S412E Specifications

Master Software Tools (for your PC)

Database Management

Full Trace Retrieval	Retrieve spectum analyzer traces from instrument into one PC directory
Trace Catalog	Index all traces into one catalog
Trace Rename Utility	Rename measurement traces
Group Edit	Titles, subtitles, plot scaling, markers and limit lines, simultaneously on similar files
DAT File Converter	Converts HHST files to MST file format and vice-versa

Data Analysis

Trace Math and Smoothing	Compare multiple traces
Data Converter	Convert from/to Return Loss, VSWR, Cable Loss, DTF and also into Smith Charts
Measurement Calculator	Translates into other units

Report Generation

Report Generator	Includes GPS, power level, and calibration status along with measurements
Edit Graph	Change scale, limit lines, and markers
Report Format	Create reports in HTML for PDF format
Export Measurements	Export measurements to *.s2p, *.jpg or *.csv format
Notes	Annotate measurements

Mapping (GPS Required)

Spectrum Analyzer Mode	MapInfo, MapPoint

Folder Spectrogram (Spectrum Monitoring for Interference Analysis and Spectrum Clearing)

Folder Spectrogram – 2D View	Creates a composite file of multiple traces
	Peak Power, Total Power, Peak Frequency, Histogram, Average Power (Max/Min)
	File Filter (Violations over limit lines or deviations from averages)
	Playback
Video Folder Spectrogram – 2D View	Create AVI file to export for management review/reports
Folder Spectrogram – 3D View	Views (Set Threshold, Markers)
	- 3D (Rotate X, Y, Z Axis, Level Scale, Signal ID)
	- 2D View (Frequency or Time Domain, Signal ID)
	- Top Down
	Playback (Frequency and/or Time Domain)

List/Parameter Editors

Traces	Add, delete, and modify limit lines and markers
Antennas, Cables, Signal Standards	Modify instrument's Antenna, Cable, and Signal Standard List
Product Updates	Auto-checks Anritsu website for latest revision firmware
Firmware Upload	Upload new firmware into the instrument
Languages	Add up to two languages and modify non-English language menus
Display	Modify display settings

Script Master™
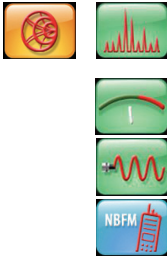
Channel Scanner Mode	Automate scan up to 1200 channels, repeat for sets of 20 channels, repeat all channels
GSM/GPRS/EDGE or W-CDMA/HSPA+ Mode	Automate Signal Analysis testing requirements with annotated how-to pictures

Connectivity

Connections	Connect to PC using USB
Download	Download measurements and live traces to PC for storage and analysis
Upload	Upload measurements from PC to instrument
Firmware Updates	Create USB Flash Drive for firmware update

LMR Master™ S412E Ordering Information

Ordering Information – Options

	S412E	Description
	500 kHz to 1.6 GHz	Vector Network Analyzer
	100 kHz to 1.6 GHz	Spectrum Analyzer
	10 MHz to 1.6 GHz	Power Meter
	500 kHz to 1.6 GHz	CW Signal Generator
	10 MHz to 1.6 GHz	NBFM Analyzer

	Options	
	S412E-0010	High Voltage Variable Bias Tee
	S412E-0501	Distance Domain
	S412E-0031	GPS Receiver (requires suitable GPS antenna)
	S412E-0019	High-Accuracy Power Meter (requires External Power Sensor)
	S412E-0025	Interference Analyzer (Option 0031 recommended)
	S412E-0027	Channel Scanner
	S412E-0006	6 GHz Coverage on Spectrum Analyzer
	S412E-0016	6 GHz Coverage on Vector Network Analyzer
	S412E-0015	Vector Voltmeter
	S412E-0431	Coverage Mapping (requires Option 0031)
	S412E-0509	AM/FM/PM Analyzer
	S412E-0521	P25 Analyzer Measurements
	S412E-0522	P25 Coverage Measurements (requires Options 0031 and 0521)
	S412E-0591	DMR2 Analyzer Measurements
	S412E-0592	DMR2 Coverage Measurements (requires Options 0031 and 0591)
	S412E-0531	NXDN Analyzer Measurements
	S412E-0532	NXDN Coverage Measurements (requires Options 0031 and 0531)
	S412E-0721	PTC Analyzer
	S412E-0722	PTC Coverage Measurements (requires Options 0031 and 0721)
	S412E-0541	LTE RF Measurements (requires Option 0031)
	S412E-0542	LTE Modulation Quality (requires Option 0031)
	S412E-0546	LTE Over-the-Air Measurements (requires Option 0031)
	S412E-0046	IEEE 802.16 Fixed WiMAX RF Measurements (requires Option 0031)
	S412E-0047	IEEE 802.16 Fixed WiMAX Demodulation (requires Option 0031)
	S412E-0066	IEEE 802.16 Mobile WiMAX RF Measurements (requires Option 0031)
	S412E-0067	IEEE 802.16 Mobile WiMAX Demodulation (requires Option 0031)
	S412E-0037	IEEE 802.16 Mobile WiMAX Over-the-Air Measurements (requires Option 0031)
	S412E-0098	Standard Calibration (ANSI 2540-1-1994)
	S412E-0099	Premium Calibration to Z540 plus test data

LMR Master™ S412E Ordering Information

Power Sensors (For complete ordering information see the respective datasheets of each sensor)

Part Number	Description
PSN50	High Accuracy RF Power Sensor, 50 MHz to 6 GHz, +20 dBm
MA24104A	Inline High Power Sensor, 600 MHz to 4 GHz, +51.76 dBm
MA24105A	Inline Peak Power Sensor, 350 MHz to 4 GHz, +51.76 dBm
MA24106A	High Accuracy RF Power Sensor, 50 MHz to 6 GHz, +23 dBm
MA24108A	Microwave USB Power Sensor, 10 MHz to 8 GHz, +20 dBm
MA24118A	Microwave USB Power Sensor, 10 MHz to 18 GHz, +20 dBm
MA24126A	Microwave USB Power Sensor, 10 MHz to 26 GHz, +20 dBm

Manuals (soft copy included on Handheld Document Disc and at www.anritsu.com)

Part Number	Description
10920-00060	Handheld Instruments Documentation Disc
10580-00318	LMR Master User Guide (Hard copy included)
10580-00289	Vector Network Analyzer Measurement Guide

10580-00244	Spectrum Analyzer Measurement Guide
	 - Interference Analyzer, Channel Scanner,
	   Gated Sweep, CW Signal Generator, AM/FM/PM Analyzer,
	   Interference Mapping, Coverage Mapping

10580-00234	3GPP Signal Analyzer Measurement Guide - GSM/EDGE, W-CDMA/HSPA+, TD-SCDMA/HSPA+, LTE, TD-LTE
10580-00243	Land Mobile Radio Measurement Guide
10580-00240	Power Meter Measurement Guide - High Accuracy Power Meter
10580-00319	Programming Manual

Troubleshooting Guides (soft copy at www.anritsu.com)
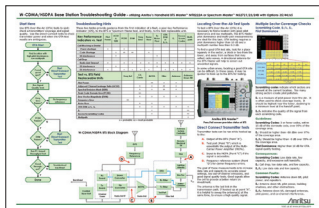
Part Number	Description
11410-00551	Spectrum Analyzers Field Users Guide
11410-00472	Interference Troubleshooting Guide
11410-00566	LTE eNode Testing Troubleshooting Guide

Standard Accessories (included with instrument)

Part Number	Description
10920-00060	Handheld Instruments Documentation Disc
10580-00318	LMR Master User Guide (includes Bias-Tee, GPS Receiver)
2000-1654-R	Soft Carrying Case
2300-498	Master Software Tools (MST) CD Disc
633-44	Rechargeable Li-Ion Battery
40-168-R	AC-DC Adapter
806-141-R	Automotive Cigarette Lighter Adapter
3-2000-1498	USB A/5-pin mini-B Cable, 10 feet/305 cm
11410-00486	LMR Master S412E Technical Data Sheet One Year Warranty (Including battery, firmware, and software) Certificate of Calibration and Conformance

LMR Master™ S412E Ordering Information

Optional Accessories

Calibration Components, 50 Ω

Part Number	Description
OSLN50-1	Precision Open/Short/Load, N(m), 42 dB, 6.0 GHz, 50 Ω
OSLNF50-1	Precision Open/Short/Load, N(f), 42 dB, 6.0 GHz, 50 Ω
22N50	Open/Short, N(m), DC to 18 GHz, 50 Ω
22NF50	Open/Short, N(f), DC to 18 GHz, 50 Ω
SM/PL-1	Precision Load, N(m), 42 dB, 6.0 GHz, 50 Ω
SM/PLNF-1	Precision Load, N(f), 42 dB, 6.0 GHz, 50 Ω

Directional Antennas
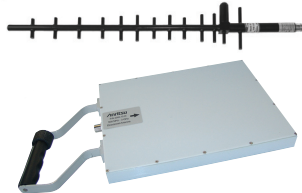
Part Number	Description
2000-1411-R	822 MHz to 900 MHz, N(f), 10 dBd, Yagi
2000-1412-R	885 MHz to 975 MHz, N(f), 10 dBd, Yagi
2000-1413-R	1710 MHz to 1880 MHz, N(f), 10 dBd. Yagi
2000-1414-R	1850 MHz to 1990 MHz, N(f), 9.3 dBd, Yagi
2000-1415-R	2400 MHz to 2500 MHz, N(f), 10 dBd, Yagi
2000-1416-R	1920 MHz to 2170 MHz, N(f), 10 dBd, Yagi
2000-1519-R	500 MHz to 3 GHz, log periodic

Portable Antennas

Part Number	Description
2000-1200-R	806 MHz to 866 MHz, SMA(m), 50 Ω *
2000-1473-R	870 MHz to 960 MHz, SMA(m), 50 Ω *
2000-1035-R	896 MHz to 941 MHz, SMA(m), 50 Ω (1/2 wave) *
2000-1030-R	1710 MHz to 1880 MHz, SMA(m), 50 Ω (1/2 wave) *
2000-1474-R	1710 MHz to 1880 MHz with knuckle elbow (1/2 wave) *
2000-1031-R	1850 MHz to 1990 MHz, SMA(m), 50 Ω (1/2 wave) *
2000-1475-R	1920 MHz to 1980 MHz and 2110 MHz to 2170 MHz, SMA(m), 50 Ω *
2000-1032-R	2400 MHz to 2500 MHz, SMA(m), 50 Ω (1/2 wave) *
2000-1361-R	2400 MHz to 2500 MHz, 5000 MHz to 6000 MHz, SMA(m), 50 Ω *
2000-1636-R	Antenna Kit (Consists of: 2000-1030-R, 2000-1031-R, 2000-1032-R, 2000-1200-R, 2000-1035-R, 2000-1361-R, and carrying pouch)
2000-1487	Telescoping Whip Antenna, BNC **

*   Requires 1091-27-R SMA(f) to N(m) adapter
** Requires 1091-172-R BNC(f) to N(m) adapte

Filters

Part Number	Description
1030-114-R	806 MHz to 869 MHz, N(m) to SMA(f), 50 Ω
1030-109-R	824 MHz to 849 MHz, N(m) to SMA(f), 50 Ω
1030-110-R	880 MHz to 915 MHz, N(m) to SMA(f), 50 Ω
1030-105-R	890 MHz to 915 MHz, N(m) to N(f), 50 Ω
1030-111-R	1850 MHz to 1910 MHz, N(m) to SMA(f), 50 Ω
1030-106-R	1710 MHz to 1790 MHz, N(m) to N(f), 50 Ω
1030-107-R	1910 MHz to 1990 MHz, N(m) to N(f), 50 Ω
1030-112-R	2400 MHz to 2484 MHz, N(m) to SMA(f), 50 Ω
1030-149-R	High Pass, 150 MHz, N(m) to N(f), 50 Ω
1030-150-R	High Pass, 400 MHz, N(m) to N(f), 50 Ω
1030-151-R	High Pass, 700 MHz, N(m) to N(f), 50 Ω
1030-152-R	Low Pass, 200 MHz, N(m) to N(f), 50 Ω
1030-153-R	Low Pass, 550 MHz, N(m) to N(f), 50 Ω
1030-155-R	2500 MHz to 2700 MHz, N(m) to N(f), 50 Ω

Attenuators

Part Number	Description
3-1010-122	20 dB, 5 W, DC to 12.4 GHz, N(m) to N(f)
42N50-20	20 dB, 5 W, DC to 18 GHz, N(m) to N(f)
42N50A-30	30 dB, 50 W, DC to 18 GHz, N(m) to N(f)
3-1010-123	30 dB, 50 W, DC to 8.5 GHz, N(m) to N(f)
1010-127-R	30 dB, 150 W, DC to 3 GHz, N(m) to N(f)
3-1010-124	40 dB, 100 W, DC to 8.5 GHz, N(m) to N(f), Uni-directional
1010-121	40 dB, 100 W, DC to 18 GHz, N(m) to N(f), Uni-directional
1010-128-R	40 dB, 150 W, DC to 3 GHz, N(m) to N(f)

LMR Master™ S412E Ordering Information

Optional Accessories (continued)

Phase-Stable Test Port Cables, Armored w/ Reinforced Grip (recommended for cable & antenna line sweep applications)

Part Number	Description
15RNFN50-1.5-R	1.5 m, DC to 6 GHz, N(m) to N(f), 50 Ω
15RDFN50-1.5-R	1.5 m, DC to 6 GHz, N(m) to 7/16 DIN(f), 50 Ω
15RDN50-1.5-R	1.5 m, DC to 6 GHz, N(m) to 7/16 DIN(m), 50 Ω
15RNFN50-3.0-R	3.0 m, DC to 6 GHz, N(m) to N(f), 50 Ω
15RDFN50-3.0-R	3.0 m, DC to 6 GHz, N(m) to 7/16 DIN(f), 50 Ω
15RDN50-3.0-R	3.0 m, DC to 6 GHz, N(m) to 7/16 DIN(m), 50 Ω

Phase-Stable Test Port Cables, Armored (recommended for use with tightly spaced connectors and other general purpose applications)

Part Number	Description
15NNF50-1.5C	1.5 m, DC to 6 GHz, N(m) to N(f), 50 Ω
15NN50-1.5C	1.5 m, DC to 6 GHz, N(m) to N(m), 50 Ω
15NDF50-1.5C	1.5 m, DC to 6 GHz, N(m) to 7/16 DIN(f), 50 Ω
15ND50-1.5C	1.5 m, DC to 6 GHz, N(m) to 7/16 DIN(m), 50 Ω
15NNF50-3.0C	3.0 m, DC to 6 GHz, N(m) to N(f), 50 Ω
15NN50-3.0C	3.0 m, DC to 6 GHz, N(m) to N(m), 50 Ω

Adapters

Part Number	Description
1091-26-R	SMA(m) to N(m), DC to 18 GHz, 50 Ω
1091-27-R	SMA(f) to N(m), DC to 18 GHz, 50 Ω
1091-80-R	SMA(m) to N(f), DC to 18 GHz, 50 Ω
1091-81-R	SMA(f) to N(f), DC to 18 GHz, 50 Ω
1091-172-R	BNC(f) to N(m), DC to 1.3 GHz, 50 Ω
510-102-R	N(m) to N(m), DC to 11 GHz, 50 Ω, 90° right angle

Precision Adapters

Part Number	Description
34NN50A	Precision Adapter, N(m) to N(m), DC to 18 GHz, 50 Ω
34NFNF50	Precision Adapter, N(f) to N(f), DC to 18 GHz, 50 Ω

Backpack and Transit Case

Part Number	Description
67135	Anritsu Backpack (For Handheld Instrument and PC)
760-243-R	Large Transit Case with Wheels and Handle

Miscellaneous Accessories

Part Number	Description
2000-1528-R	GPS Antenna, SMA(m) with 15 ft cable
2000-1652-R	GPS Antenna, SMA(m) with 1 ft cable
633-44	Extra Rechargeable Li-Ion Battery
2000-1374	External Charger for Li-Ion Battery
2300-532	Map Master CD
2000-1653	Protective Screen Cover (Package of 2)
66864	Rack Mount Kit, Master Platform

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MASTER USERS GROUP

The Master Users Group is an organization dedicated to providing training, technical support, networking opportunities and links to Master product development teams. As a member you will receive the Insite Quarterly Newsletter with user stories, measurement tips, new product news and more.

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