

# LMR Master™

## Spectrum, Coverage, Cable, Antenna, Filter, P25 / NXDN Modulation Analyzer, CW / P25 / NXDN Signal Generator

### 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 worlds most advanced hand held vector network analyzer plus a CW / P25 / NXDN 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:  $\pm 50$  ppb with GPS On

#### VNA Analyzer Highlights

- Broadband coverage of 500 kHz to 1.6 GHz
- 1-path, 2-port Vector Network Analyzer (VNA)
- 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
- User-defined overlays for viewing multiple S-Parameters
- Arbitrary data points up to 4001
- IF Bandwidth selections of 10 Hz to 100 kHz
- 100 dB dynamic range to 1.6 GHz
- 850  $\mu$ s/data point sweep speed

#### CW / P25 / NXDN Signal Generator Highlights

- 2 MHz to 1.6 GHz frequency coverage
- Internal Power control from 0 dBm to -120 dBm
- 2.0 dB power Accuracy (Typical)
- Eight P25 and NXDN BER test patterns including 1011 Hz and O.153
- Simultaneous analysis and generation of P25 / NXDN test signals
- Independent control of analysis and generation frequencies and test patterns

#### Capabilities and Functional Highlights

- 3 hour battery operation time
- Touchscreen keyboard
- AM / FM / PM Analyzer
- High Accuracy Power Meter
- On-Screen Coverage Mapping
- Channel Scanner
- GPS tagging of saved traces
- USB Data Transfer
- < 5 minute warm-up time
- 8.4 in. daylight viewable color LCD



LMR Master™ S412E featuring 8.4" Daylight Viewable Touchscreen  
Compact Size: 273 mm x 199 mm x 91 mm, (10.7 x 7.8 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)<br>Occupied Bandwidth (measures 99% to 1% power channel of a signal)<br>Channel Power (measures the total power in a specified bandwidth)<br>ACPR (adjacent channel power ratio)<br>AM/FM/SSB Demodulation (wide/narrow FM, upper/lower SSB), (audio out only)<br>C/I (carrier-to-interference ratio)<br>Emission Mask<br>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 $\Omega$ , 75 $\Omega$ , 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<br>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 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<br>–105 dBc/Hz, –112 dBc/Hz typical @ 100 kHz offset<br>–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                                    | +35 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<br>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<br>Maximum: ± 1.3 dB, 100 kHz to 6 GHz                                                                                                                                                              |                                        |
| Displayed Average Noise Level (DANL)                                                  |                       | Preamp Off<br>(Reference level –20 dBm)                     |                                                                                                                                                                                                                                         | Preamp On<br>(Reference level –50 dBm) |
| (RBW Normalized to 1 Hz, 0 dB attenuation)                                            |                       | Maximum                                                     | Typical                                                                                                                                                                                                                                 | Maximum                                |
|                                                                                       | 10 MHz to 2.4 GHz     | –141 dBm                                                    | –146 dBm                                                                                                                                                                                                                                | –157 dBm                               |
|                                                                                       | > 2.4 GHz to 4 GHz    | –137 dBm                                                    | –141 dBm                                                                                                                                                                                                                                | –154 dBm                               |
|                                                                                       | > 4 GHz to 5 GHz      | –134 dBm                                                    | –138 dBm                                                                                                                                                                                                                                | –150 dBm                               |
|                                                                                       | > 5 GHz to 6 GHz      | –126 dBm                                                    | –131 dBm                                                                                                                                                                                                                                | –143 dBm                               |
| (RBW = 10 Hz, 0 dB attenuation)                                                       |                       |                                                             |                                                                                                                                                                                                                                         |                                        |
|                                                                                       | 10 MHz to 2.4 GHz     | –131 dBm                                                    | –136 dBm                                                                                                                                                                                                                                | –147 dBm                               |
|                                                                                       | > 2.4 GHz to 4 GHz    | –127 dBm                                                    | –131 dBm                                                                                                                                                                                                                                | –144 dBm                               |
|                                                                                       | > 4 GHz to 5 GHz      | –124 dBm                                                    | –128 dBm                                                                                                                                                                                                                                | –140 dBm                               |
|                                                                                       | > 5 GHz to 6 GHz      | –116 dBm                                                    | –121 dBm                                                                                                                                                                                                                                | –133 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<br><–68 dBc @ F1-280 MHz with F1 Input<br><–70 dBc @ F1 + 190.5 MHz with F1 Input<br><–52 dBc @ 7349-2F2 MHz, with F2 Input, where F2 < 2424.5 MHz<br><–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](http://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 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 (GHz) | High Port Power (dB) | Low Port Power (dBm) |
|-----------------------|----------------------|----------------------|
| 500 kHz to ≤ 3 GHz    | +3                   | −25 dBm              |
| 3 GHz to ≤ 6 GHz      | 0                    | −25 dBm              |

### Transmission Dynamic Range

The transmission dynamic range (the difference between test port power and noise floor) using 100 Hz IF Bandwidth and High Port Power is shown in the following table.

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

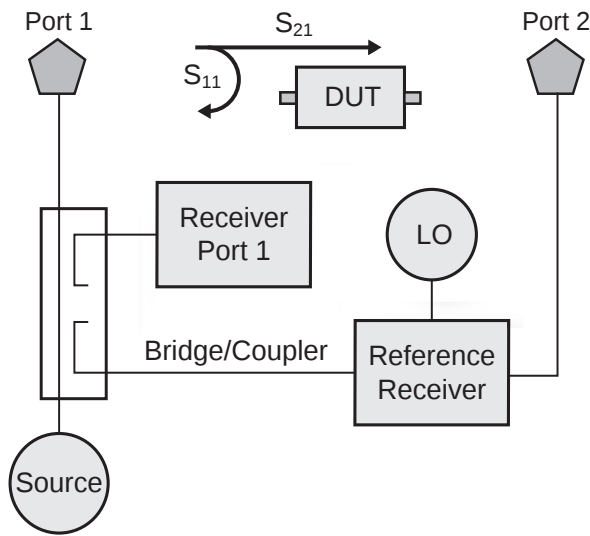
### Typical Sweep Speed

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 (GHz) | Typical Sweep Speed (μs / point) |
|-----------------------|----------------------------------|
| 500 kHz to 6 GHz      | 850                              |

### 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



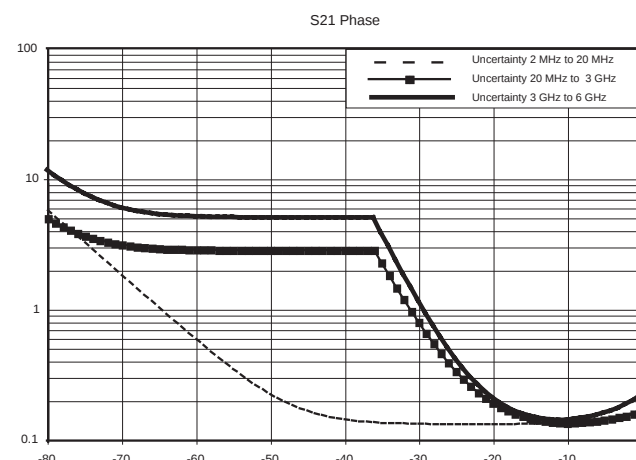
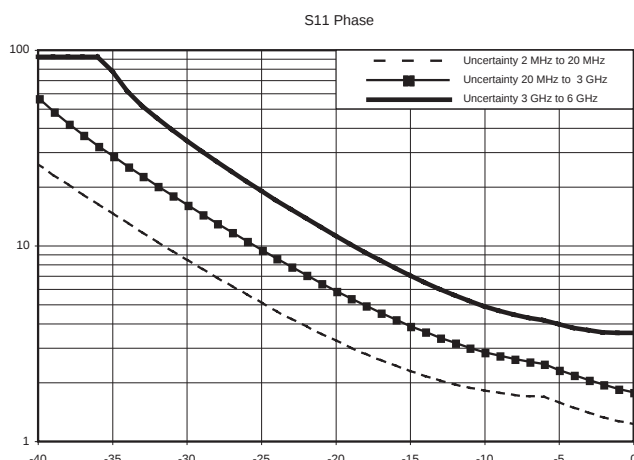
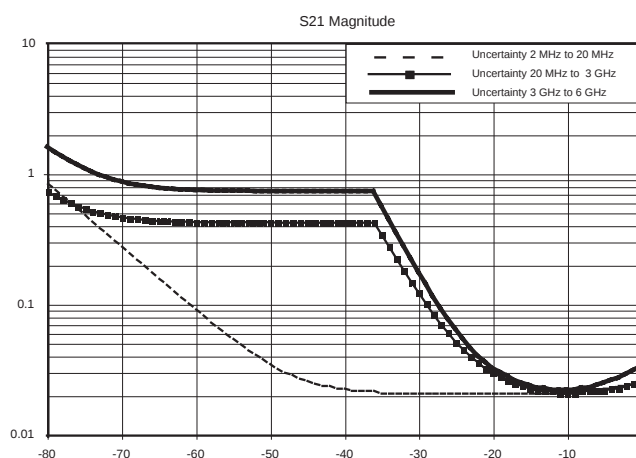
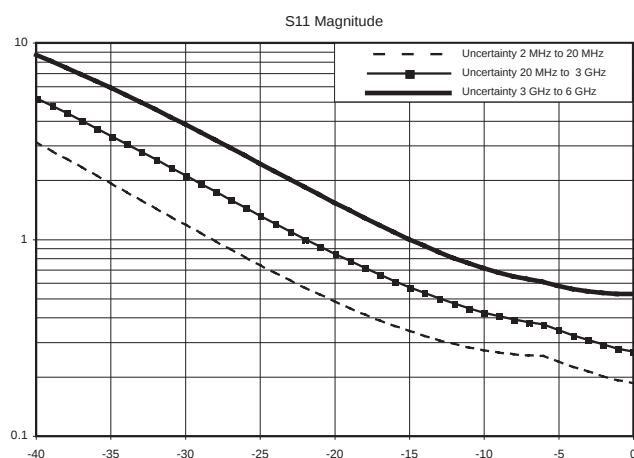
Precision calibration standards come in a convenient  
configuration for field work.

| Frequency Range<br>(GHz) | Directivity<br>(dB) |
|--------------------------|---------------------|
| $\leq 6$                 | $> 42$              |

| Frequency Range<br>(GHz) | Typical High Port<br>Power<br>(dBm) |
|--------------------------|-------------------------------------|
| $\leq 3$                 | +3                                  |
| $\leq 6$                 | 0                                   |

### Measurement Uncertainties

The following graphs provide measurement uncertainty at  $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$  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.

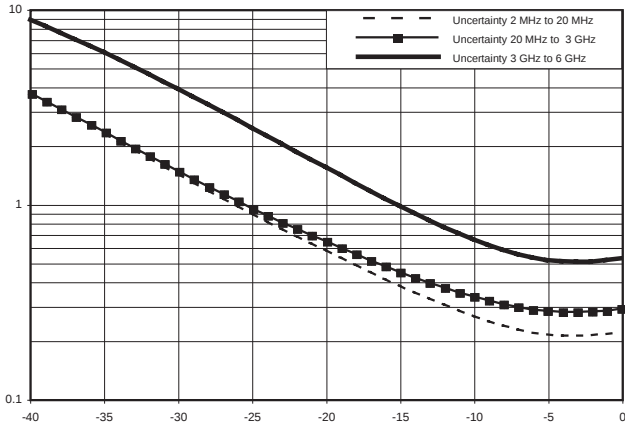
| Frequency Range (GHz) | Directivity (dB) |
|-----------------------|------------------|
| ≤ 6                   | > 42             |

| Frequency Range (GHz) | Typical Low Port Power (dBm) |
|-----------------------|------------------------------|
| ≤ 3                   | +25                          |
| ≤ 6                   | -25                          |

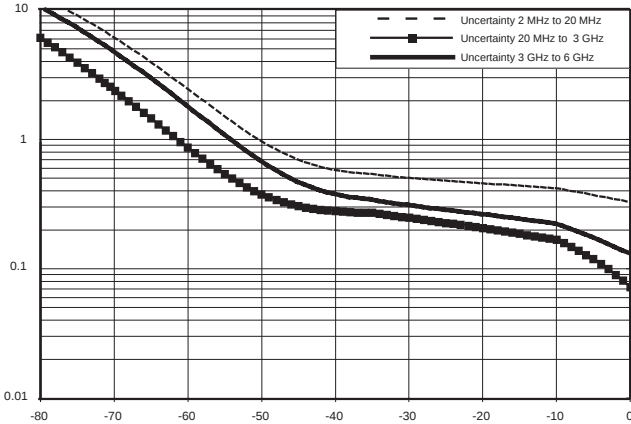
### Measurement Uncertainties

The following graphs provide measurement uncertainty at 23 °C ± 5 °C 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.

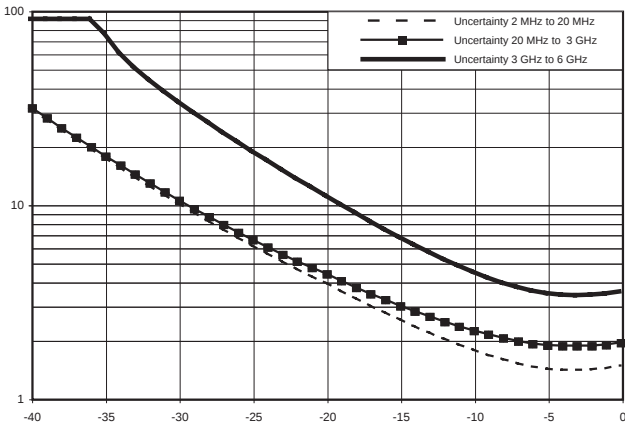
S11 Magnitude



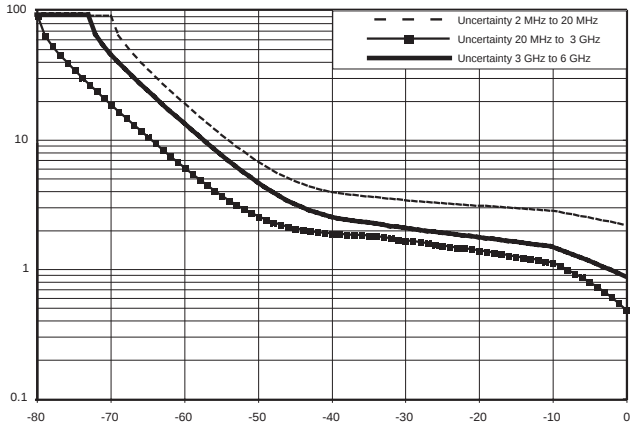
S21 Magnitude



S11 Phase



S21 Phase



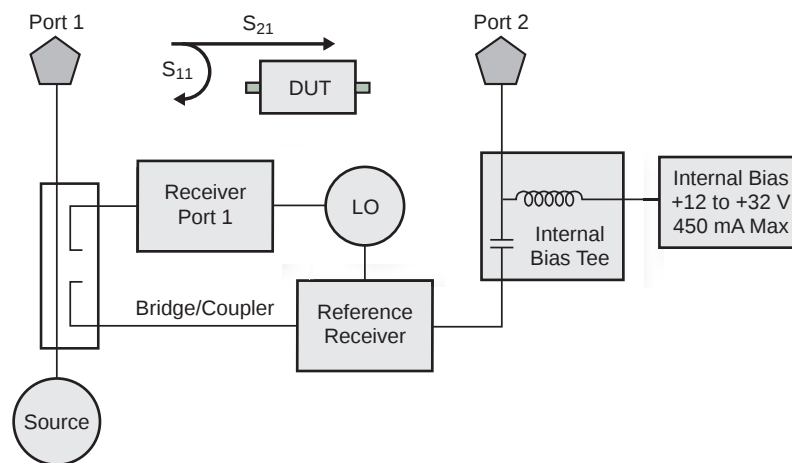
# LMR Master™ S412E Specifications

## 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 can be directed to VNA Port 2.

|                                 |                                      |
|---------------------------------|--------------------------------------|
| <b>Frequency Range</b>          | 2 MHz to 4/6 GHz at VNA Port 2       |
| <b>Internal Voltage/Current</b> | +12V to +32V at 450 ma. Steady state |
| <b>Internal Resolution</b>      | 0.1V                                 |
| <b>Bias Tee Selections</b>      | 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.

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

## LMR Master™ S412E Specifications



### Interference Analyzer (Option 0025)

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

### GPS Receiver Option (Option 0031) (Antenna sold separately, P/N 2000-1528-R)

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



### Coverage Mapping (Options 0431)

#### Measurements

#### Indoor Mapping

RSSI  
ACPR

#### Outdoor Mapping

RSSI  
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  | $\pm$ 10 Hz + Time base error                                                      |
| Measurement Range   | -110 dBm to +26 dBm                                                                |
| Application Options | Bias-Tee (On/Off), Impedance (50 $\Omega$ , 75 $\Omega$ , 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 (S412E), 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                                | MA24106A                                 | MA24108/18/26A                                                                           |
|-----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|------------------------------------------|------------------------------------------------------------------------------------------|
| Description                             | High Accuracy RF Power Sensor                                                                                                                                                                                                                                                                                                                                                                                                                            | Inline High Power Sensor                | High Accuracy RF Power Sensor            | Microwave USB Power Sensor                                                               |
| Frequency Range                         | 50 MHz to 6 GHz                                                                                                                                                                                                                                                                                                                                                                                                                                          | 600 MHz to 4 GHz                        | 50 MHz to 6 GHz                          | 10 MHz to 8 GHz (MA24108A)<br>10 MHz to 18 GHz (MA24118A)<br>10 MHz to 26 GHz (MA24126A) |
| Connector                               | Type N(m), 50 Ω                                                                                                                                                                                                                                                                                                                                                                                                                                          | Type N(m), 50 Ω                         | Type N(m), 50 Ω                          | Type N(m), 50 Ω (MA24108/18A)<br>Type K(m), 50 Ω (MA24126A)                              |
| Dynamic Range                           | -30 dBm to +20 dBm<br>(.001 mW to 100 mW)                                                                                                                                                                                                                                                                                                                                                                                                                | +3 dBm to +51.76 dBm<br>(2 mW to 150 W) | -40 dBm to +23 dBm<br>(0.1 μW to 200 mW) | -40 dBm to +20 dBm<br>(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 <sup>1</sup>                                                                                                                                                                                                                                                                                                                                                                                                                                    | ±0.17 dB <sup>2</sup>                   | ±0.16 dB <sup>1</sup>                    | ±0.18 dB <sup>3</sup>                                                                    |
| Datasheet (for complete specifications) | 11410-00414                                                                                                                                                                                                                                                                                                                                                                                                                                              | 11410-00483                             | 11410-00424                              | 11410-00504                                                                              |
| Notes:                                  | 1) Total RSS measurement uncertainty (0 °C to 50 °C) for power measurements of a CW signal greater than -20 dBm with zero mismatch errors.<br>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.<br>3) Expanded uncertainty with K=2 for power measurements of a CW signal greater than -20 dBm with zero mismatch errors. |                                         |                                          |                                                                                          |

# LMR Master™ S412E Specifications



## 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<br>(Option 0521)                                                                                                                  |                                                                                                                         | P25 Talk-Out Coverage<br>(Option 0522)                        |
| Received Power<br>Frequency Error<br>Modulation Fidelity<br>NAC (hex)<br>Symbol Rate Error<br>BER (1011 Hz, O.153, Voice, and Control Channel) |                                                                                                                         | BER<br>RSSI<br>Modulation Fidelity                            |
| Graphs                                                                                                                                         |                                                                                                                         |                                                               |
| P25 Analyzer<br>(Option 0521)                                                                                                                  |                                                                                                                         | P25 Talk-Out Coverage<br>(Option 0522)                        |
| Constellation<br>Linear Constellation<br>Spectrum (25 kHz span)<br>Histogram<br>Eye Diagram<br>Summary Display                                 |                                                                                                                         | RSSI vs. Time<br>BER vs. Time<br>Modulation Fidelity vs. Time |
| Setup Parameters                                                                                                                               |                                                                                                                         |                                                               |
| Frequency                                                                                                                                      | Center Frequency                                                                                                        |                                                               |
| Amplitude                                                                                                                                      | Reference level, Scale, Ext Attenuation, Auto Range, Adjust Range                                                       |                                                               |
| Setup                                                                                                                                          | Modulation Type (C4FM, CQPSK), 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                                       |                                                               |
| Symbol Span                                                                                                                                    | 2, 3, 4, 5                                                                                                              |                                                               |
| P25 Coverage (Option 522)                                                                                                                      | USB Memory File Format .p25, .kml, both<br>Log data on / off<br>Display, RSSI vs. Time, BER vs. Time, Mod Fid. vs. Time |                                                               |
| 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)                                                                                                                     |                                                                                                                         |                                                               |
| RSSI, BER, Mod Fid vs. Time                                                                                                                    |                                                                                                                         |                                                               |
| 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                                  |                                                               |
| 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



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

### Measurements

| NXDN Analyzer<br>(Option 0531)                                                                                                              | NXDN Talk-Out Coverage<br>(Option 0532) |
|---------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|
| Received Power<br>Frequency Error<br>Modulation Fidelity<br>RAN (hex)<br>Symbol Rate Error<br>BER (Tone, O.153, Voice, and Control Channel) | BER<br>RSSI<br>Modulation Fidelity      |

### Graphs

| NXDN Analyzer<br>(Option 0531)                                                                                 | NXDN Talk-Out Coverage<br>(Option 0532)                       |
|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Constellation<br>Linear Constellation<br>Spectrum (25 kHz span)<br>Histogram<br>Eye Diagram<br>Summary Display | RSSI vs. Time<br>BER vs. Time<br>Modulation Fidelity vs. Time |

### 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),<br>BER pattern (Tone, 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                                        |
| Symbol Span                 | 2, 3, 4, 5                                                                                                               |
| NXDN Coverage (Option 0532) | USB Memory File Format .nxdn, .kml, both<br>Log data on / off<br>Display, RSSI vs. Time, BER vs. Time, Mod Fid. vs. Time |

### 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)

RSSI, BER, Mod Fid vs. Time

## 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      | Tone, O.153 (v. 52), High Dev, Low Dev, UDCH Pattern 10, CAC, 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                                                           |
| Mod Fidelity         | 1.25% max                                                                    |
| Frequency Accuracy   | Same as Spectrum Analyzer                                                    |

# LMR Master™ S412E Specifications



## AM/FM/PM Signal Analyzers (Option 0509)

| Measurements       |                                                             |                                                                                        |                                                                                                      |                                                                                        |                                                                                           |                                                                                                                                                                                               |                                                                                                                                                                                                         |
|--------------------|-------------------------------------------------------------|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                    | RF Spectrum<br>AM/FM/PM                                     | Audio Spectrum<br>(AM)                                                                 | Audio Spectrum<br>(FM/PM)                                                                            | Audio<br>Waveform<br>(AM)                                                              | Audio<br>Waveform<br>(FM/PM)                                                              | Summary<br>(AM)                                                                                                                                                                               | Summary<br>(FM/PM)                                                                                                                                                                                      |
| Graphic Display    | Power (dBm)<br>vs. Frequency                                | Depth (%)<br>vs. Modulation<br>Frequency                                               | Deviation<br>(kHz/rad) vs.<br>Modulation<br>Frequency                                                | Depth (%)<br>vs. Time                                                                  | Deviation<br>(kHz/rad)<br>vs. Time                                                        | None                                                                                                                                                                                          | None                                                                                                                                                                                                    |
| Numerical Displays | Carrier Power<br>Carrier Frequency<br>Occupied<br>Bandwidth | AM Rate<br>RMS Depth<br>(Pk-Pk)/2 Depth<br>SINAD*<br>THD*<br>Distortion/Total<br>Vrms* | FM/PM Rate<br>RMS Deviation<br>(Pk-Pk)/2<br>Deviation<br>SINAD*<br>THD*<br>Distortion/Total<br>Vrms* | AM Rate<br>RMS Depth<br>(Pk-Pk)/2 Depth<br>SINAD*<br>THD*<br>Distortion/Total<br>Vrms* | FM/PM Rate<br>RMS Depth<br>(Pk-Pk)/2 Depth<br>SINAD*<br>THD*<br>Distortion/Total<br>Vrms* | RMS Depth (AM)<br>Peak + Depth<br>Peak – Depth<br>(Pk-Pk)/2 Depth<br>Carrier Power<br>Carrier<br>Frequency<br>Occupied<br>Bandwidth<br>AM Rate<br>SINAD*<br>THD*<br>Distortion/Total<br>Vrms* | RMS Deviation<br>(FM/PM)<br>Peak + Depth<br>Peak – Depth<br>(Pk-Pk)/2 Depth<br>Carrier Power<br>Carrier<br>Frequency<br>Occupied<br>Bandwidth<br>AM Rate<br>SINAD*<br>THD*<br>Distortion/Total<br>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: $\pm 1$ Hz (< 100 Hz), $\pm 2\%$ (> 100 Hz)<br>Depth: $\pm 5\%$ for (Modulation rates 10 Hz to 100 kHz)                              |
| FM             | Modulation Rate: $\pm 1$ Hz (< 100 Hz); $\pm 2\%$ (100 Hz to 100 kHz)<br>Deviation Accuracy: $\pm 5\%$ (100 Hz to 100 kHz)**                          |
| PM             | Modulation Rate: $\pm 1$ Hz (< 100 Hz); $\pm 2\%$ (100 Hz to 100 kHz)<br>Deviation Accuracy: $\pm 5\%$ (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<br>Audio Spectrum: 2 kHz, 5 kHz, 10 kHz, 20 kHz                                                                         |
| RBW/VBW        | 30                                                                                                                                                    |
| Span/RBW       | 100                                                                                                                                                   |
| Sweep time     | 50 $\mu$ s 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<br>(Option 0541)                                                           | Modulation<br>(Option 0542)                                                                                                                                                                                                            | Over-the-Air (OTA)<br>(Option 0546)                                                             | Pass/Fail<br>(User Editable)                                                                                                                                                                                                                                                                                          |
|-------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Channel Spectrum<br>Channel Power<br>Occupied Bandwidth<br>ACLR<br>RF Summary | Constellation<br>Reference Signal Power<br>Sync Signal Power<br>EVM<br>Frequency Error<br>Carrier Frequency<br>Cell ID<br>Sector ID<br>Group ID<br>Control Channel Power<br>RS<br>P-SS<br>S-SS<br>PBCH<br>PCFICH<br>Modulation Summary | Synch Signal Power<br>(Six Strongest)<br>Power<br>Cell ID<br>Sector ID<br>Group ID<br>Dominance | Pass Fail All<br>Pass/Fail RF<br>Pass Fail Demod<br>Measurements<br>Channel Power<br>Occupied Bandwidth<br>ACLR<br>Frequency Error<br>Carrier Frequency<br>Dominance<br>EVM (peak)<br>EVM (rms)<br>RS Power<br>SS Power<br>P-SS Power<br>S-SS Power<br>PBCH Power<br>PCFICH Power<br>Cell ID<br>Group ID<br>Sector ID |

### Setup Parameters

|                             |                                                                                                                                      |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| Frequency                   | E-UTRA bands 1 - 21 (tuneable 10 MHz to 4.0 GHz)<br>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

## General Specifications

All specifications and characteristics apply under the following conditions, unless otherwise stated: 1) After 5 minutes of warm-up time, where the instrument is left in the ON state; 2) All specifications apply when using internal reference; 3) All specifications subject to change without notice; 4) Typical performance is the measured performance of an average unit; 5) Recommended calibration cycle is 12 months.

### Setup Parameters

|                             |                                                                                                                                                                                                     |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| System                      | Status (Temperature, Battery Info, Serial Number, Firmware Version, Options Installed)<br>Self Test, Application Self Test<br>GPS (see Option 0031)                                                 |
| System Options              | Name, Date and Time, Brightness, Volume<br>Language (English, French, German, Spanish, Chinese, Japanese, Korean, Italian, User defined)<br>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 $\Omega$                                                      |
| VNA Port 1 Damage Level                   | 23 dBm, $\pm$ 50 VDC                                                             |
| RF In                                     | Type N, female, 50 $\Omega$                                                      |
| RF In Damage Level                        | +35 dBm peak, $\pm$ 50 VDC, Maximum Continuous Input ( $\geq$ 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                              | 2.5 mm mini-phone plug                                                           |
| External Reference In                     | BNC, female, 50 $\Omega$ , Maximum Input +10 dBm<br>1 MHz, 5 MHz, 10 MHz, 13 MHz |
| External Trigger/Clock Recovery           | BNC, female, 50 $\Omega$ , Maximum Input $\pm$ 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<br>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 °C to 71 °C                          |
| Altitude              | 4600 meters, operating and non-operating |

### ESD

|                    |                              |
|--------------------|------------------------------|
| RF Port Center Pin | Withstands up to $\pm$ 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

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## Master Software Tools (for your PC)

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### Database Management

|                      |                                                                                           |
|----------------------|-------------------------------------------------------------------------------------------|
| Full Trace Retrieval | Retrieve spectrum 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                                                   |

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### 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                                                     |

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### Mapping (GPS Required)

|                        |                   |
|------------------------|-------------------|
| Spectrum Analyzer Mode | MapInfo, MapPoint |
|------------------------|-------------------|

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

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

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### 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/HSDPA Mode | Automate Signal Analysis testing requirements with annotated how-to pictures           |

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### 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                           |

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# LMR Master™ S412E Ordering Information

## Ordering Information – Options

|                                                                                    | S412E              | Description                                                 |
|------------------------------------------------------------------------------------|--------------------|-------------------------------------------------------------|
|   | 500 kHz to 1.6 GHz | LMR Master                                                  |
|                                                                                    | Options            |                                                             |
|                                                                                    | S412E-0010         | Bias-Tee                                                    |
|                                                                                    | S412E-0006         | 6 GHz Coverage on Spectrum Analyzer                         |
|                                                                                    | S412E-0016         | 6 GHz Coverage on Vector Network Analyzer                   |
|   | S412E-0015         | Vector Voltmeter                                            |
|   | S412E-0031         | GPS Receiver (requires Antenna P/N 2000-1528-R)             |
|                                                                                    | S412E-0019         | High-Accuracy Power Meter (requires External Power Sensor)  |
|   | S412E-0025         | Interference Analyzer (Option 0031 recommended)             |
|   | S412E-0027         | Channel Scanner                                             |
|   | S412E-0431         | Coverage Mapping (requires Option 0031)                     |
|                                                                                    | S412E-0501         | Distance Domain on Cable Test                               |
|   | S412E-0509         | AM/FM/PM Analyzer                                           |
|   | S412E-0521         | P25 Analyzer Measurements                                   |
|                                                                                    | S412E-0522         | P25 Coverage Measurements (requires Options 0031 and 0521)  |
|   | S412E-0531         | NXDN Analyzer Measurements                                  |
|                                                                                    | S412E-0532         | NXDN Coverage Measurements (requires Options 0031 and 0531) |
|  | 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-0098         | Standard Calibration (ANSI 2540-1-1994)                     |
|                                                                                    | S412E-0099         | Premium Calibration to Z540 plus test data                  |

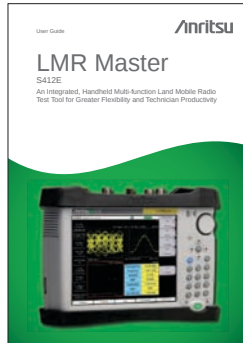
## LMR Master™ S412E Ordering Information

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



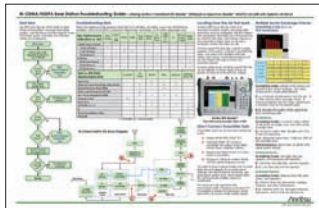
| Part Number | Description                                             |
|-------------|---------------------------------------------------------|
| PSN50       | High Accuracy RF Power Sensor, 50 MHz to 6 GHz, +20 dBm |
| MA24104A    | Inline High Power Sensor, 600 MHz to 4 GHz, +51.76 dBm  |
| MA24106A    | 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](http://www.anritsu.com))



| Part Number | Description                                                                                                                                                                        |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10920-00060 | Handheld Instruments Documentation Disc                                                                                                                                            |
| 10580-00318 | LMR Master User Guide (Hard copy included)                                                                                                                                         |
| 10580-00242 | 2-Port Transmission Measurement for VNA Master<br>- Bias-Tee                                                                                                                       |
| 10580-00231 | Spectrum Analyzer Measurement Guide<br>- Interference Analyzer, Channel Scanner,<br>Gated Sweep, CW Signal Generator, AM/FM/PM Analyzer,<br>Interference Mapping, Coverage Mapping |
| 10580-00234 | 3GPP Signal Analyzer Measurement Guide<br>- GSM/EDGE, W-CDMA/HSDPA, TD-SCDMA/HSDPA, LTE                                                                                            |
| 10580-00243 | P25 and NXDN Measurement Guide                                                                                                                                                     |
| 10580-00240 | Power Meter Measurement Guide<br>- High Accuracy Power Meter                                                                                                                       |
| 10580-00319 | Programming Manual                                                                                                                                                                 |

**Troubleshooting Guides** (soft copy at [www.anritsu.com](http://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)

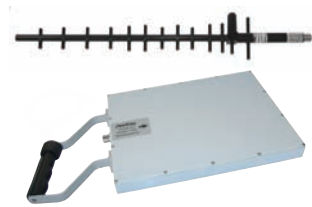


| Part Number | Description                                                                                                                                          |
|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10920-00060 | Handheld Instruments Documentation Disc                                                                                                              |
| 10580-00318 | LMR Master User Guide (includes Bias-Tee, GPS Receiver)                                                                                              |
| 3-68736     | Soft Carrying Case                                                                                                                                   |
| 2300-498    | Master Software Tools (MST) CD Disc                                                                                                                  |
| 633-44      | Rechargeable Li-Ion Battery                                                                                                                          |
| 40-168-R    | AC-DC Adapter                                                                                                                                        |
| 2000-1520-R | USB Flash Drive                                                                                                                                      |
| 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<br>One Year Warranty (Including battery, firmware, and software)<br>Certificate of Calibration and Conformance |

# LMR Master™ S412E Ordering Information

## Optional Accessories

### 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



|             |                                                                                                                             |
|-------------|-----------------------------------------------------------------------------------------------------------------------------|
| 2000-1200-R | 806 MHz to 866 MHz, SMA(m), 50 $\Omega$                                                                                     |
| 2000-1473-R | 870 MHz to 960 MHz, SMA(m), 50 $\Omega$                                                                                     |
| 2000-1035-R | 896 MHz to 941 MHz, SMA(m), 50 $\Omega$ (1/2 wave)                                                                          |
| 2000-1030-R | 1710 MHz to 1880 MHz, SMA(m), 50 $\Omega$ (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 $\Omega$ (1/2 wave)                                                                        |
| 2000-1475-R | 1920 MHz to 1980 MHz and 2110 MHz to 2170 MHz, SMA(m), 50 $\Omega$                                                          |
| 2000-1032-R | 2400 MHz to 2500 MHz, SMA(m), 50 $\Omega$ (1/2 wave)                                                                        |
| 2000-1361-R | 2400 MHz to 2500 MHz, 5000 MHz to 6000 MHz, SMA(m), 50 $\Omega$                                                             |
| 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) |

### Filters



|            |                                                                      |
|------------|----------------------------------------------------------------------|
| 1030-114-R | 806 MHz to 869 MHz, N(m) to SMA(f), 50 $\Omega$                      |
| 1030-109-R | 824 MHz to 849 MHz, N(m) to SMA(f), 50 $\Omega$                      |
| 1030-110-R | 880 MHz to 915 MHz, N(m) to SMA(f), 50 $\Omega$                      |
| 1030-105-R | 890 MHz to 915 MHz Band, 0.41 dB loss, N(m) to SMA(f), 50 $\Omega$   |
| 1030-111-R | 1850 MHz to 1910 MHz, N(m) to SMA(f), 50 $\Omega$                    |
| 1030-106-R | 1710 MHz to 1790 MHz Band, 0.34 dB loss, N(m) to SMA(f), 50 $\Omega$ |
| 1030-107-R | 1910 MHz to 1990 MHz Band, 0.41 dB loss, N(m) to SMA(f), 50 $\Omega$ |
| 1030-112-R | 2400 MHz to 2484 MHz, N(m) to SMA(f), 50 $\Omega$                    |
| 1030-149-R | High Pass, 150 MHz, N(m) to N(f), 50 $\Omega$                        |
| 1030-150-R | High Pass, 400 MHz, N(m) to N(f), 50 $\Omega$                        |
| 1030-151-R | High Pass, 700 MHz, N(m) to N(f), 50 $\Omega$                        |
| 1030-152-R | Low Pass, 200 MHz, N(m) to N(f), 50 $\Omega$                         |
| 1030-153-R | Low Pass, 550 MHz, N(m) to N(f), 50 $\Omega$                         |
| 1030-155-R | 2500 MHz to 2700 MHz, N(m) to N(f), 50 $\Omega$                      |

### Attenuators



|            |                                                            |
|------------|------------------------------------------------------------|
| 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)                    |

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



|                |                                                      |
|----------------|------------------------------------------------------|
| 15RNFN50-1.5-R | 1.5 m, DC to 6 GHz, N(m) to N(f), 50 $\Omega$        |
| 15RDFN50-1.5-R | 1.5 m, DC to 6 GHz, N(m) to 7/16 DIN(f), 50 $\Omega$ |
| 15RDN50-1.5-R  | 1.5 m, DC to 6 GHz, N(m) to 7/16 DIN(m), 50 $\Omega$ |
| 15RNFN50-3.0-R | 3.0 m, DC to 6 GHz, N(m) to N(f), 50 $\Omega$        |
| 15RDFN50-3.0-R | 3.0 m, DC to 6 GHz, N(m) to 7/16 DIN(f), 50 $\Omega$ |
| 15RDN50-3.0-R  | 3.0 m, DC to 6 GHz, N(m) to 7/16 DIN(m), 50 $\Omega$ |

# LMR Master™ S412E Ordering Information

## Optional Accessories (continued)

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



|              |                                               |
|--------------|-----------------------------------------------|
| 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



|            |                                                          |
|------------|----------------------------------------------------------|
| 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 degrees right angle |

### Precision Adapters



|         |                                                     |
|---------|-----------------------------------------------------|
| 34NN50A | Precision Adapter, N(m) to N(m), DC to 18 GHz, 50 Ω |
| 34NFN50 | Precision Adapter, N(f) to N(f), DC to 18 GHz, 50 Ω |

### Backpack and Transit Case



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

### Miscellaneous Accessories



|             |                                       |
|-------------|---------------------------------------|
| 2000-1528-R | GPS Antenna, SMA(m)                   |
| 2000-1520-R | USB Flash Drive                       |
| 2000-1374   | External Charger for Li-Ion Batteries |
| 2300-532    | Map Master CD                         |









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