

# FREEDOM

## Communications System Analyzer

### R8100



DATA SHEET

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## Operating/Display Modes

AM/FM Duplex Monitor and Generator  
 Audio Synthesizer  
 Tracking Generator (Opt.)  
 Dual Display (Opt.)  
 Cable Fault Locator (Opt.)  
 Spectrum Analyzer  
 Frequency Counter  
 Frequency Error Meter  
 Digital Voltmeter  
 Power Meter  
 Oscilloscope  
 Signal Strength Meter  
 SINAD/Distortion Meter



## General

### Displayed Average Noise:

Level (DANL):	-140dBm (50 Ohm input termination)
Dynamic Range:	80dB
Input Related Spurious:	-60dBc max
Residual Spurious (non-input related):	-70dBm

### Power

DC Power Requirements:	15-16VDC @ 8.0A max
AC Adapter Specs:	100-240VAC, 2.5A max, 50-60Hz
Battery Power:	Internal Battery
Battery Operation:	1.5 hour typical easily swappable for extended operation

### MECHANICAL/ENVIRONMENTAL

Weight:	13.75 lbs including internal battery (6.24kg)
Dimensions:	9.4" (23.9cm) H, 12.7" (32.3cm) W, 7.5" (19.1cm) D
Operating Altitude:	Up to 15,000 ft (4572 m)
Humidity:	80% maximum relative humidity
Operating Temperature:	-20° to 50°C with external DC; 0° to 50°C using supplied AC adapter
Storage Temperature:	Without battery: -30° to +80°C; With battery: -20° to +50°C
Battery Charging Temperature:	0° to +45°C
Shock and Vibration Rating:	MIL-PRF-28800F, Class 3

### WARRANTY

Standard Warranty:	Two years
Three Year Service Plan:	Optional
Five Year Service Plan:	Optional

## Generator (Receiver Test)

Port Protection Limit	5W for 30 seconds
Frequency Range:	1MHz to 1GHz (250kHz to 1GHz typical); Optional to 3GHz
Extended Frequency Range (Optional):	1MHz to 3GHz (250kHz to 3GHz typical)
Frequency Resolution:	1Hz

### OUTPUT LEVEL GENERATE PORT

Range FM:	+5dBm to -95dBm below 2GHz; -5dBm to -95dBm above 2GHz
Range AM:	-1dBm to -95dBm below 2GHz; -11dBm to -95dBm above 2GHz
Resolution:	0.1dB
Accuracy:	±2dB

### OUTPUT LEVEL RF I/O PORT

Range FM:	-30dBm to -130dBm below 2GHz; -40dBm to -130dBm above 2GHz
Range AM:	-36dBm to -130dBm below 2GHz; -46dBm to -130dBm above 2GHz
Resolution:	0.1dB
Accuracy:	±1dB to 1GHz ; ±2dB > 1GHz

### SPECTRAL PURITY

Harmonic Spurious:	-20dBc max
Non-Harmonic Spurious:	-35dBc max; <-30dBc at mixing product frequencies (3227MHz - Carrier)
Residual FM:	4Hz, 300Hz to 3kHz (<1GHz); 5Hz, 300Hz to 3 kHz (> 1GHz)
Residual AM:	1.0% max, 300Hz to 3kHz
SSB Phase Noise (20 kHz Offset):	-95dBc/Hz max below 1GHz (15° to 35°C); -93dBc/Hz max all frequencies (0° to 50°C)

### FM MODULATION

Deviation Range:	0 to 75kHz
Deviation Resolution:	1 Hz
Deviation Accuracy:	5% of setting
RF Output Frequency Range:	0 to 40 kHz
Modulation Output Frequency Range :	0 to 20kHz
RF Output Modulation Bandwidth:	DC to 100 kHz
Modulation Output Bandwidth:	5 Hz to 20kHz
IF Bandwidth:	> 200 kHz
Pre-emphasis:	750 μs (selectable)

### AM MODULATION

Deviation Range:	0 to 90% (AM Depth)
Deviation Resolution:	1%
Deviation Accuracy:	5% of setting
RF Output Modulation Frequency Range:	0 to 40 kHz
Modulation Output Frequency Range:	0 to 20 kHz
RF Output Bandwidth:	DC to 100 kHz
Modulation Output Bandwidth:	5 Hz to 20kHz
IF Bandwidth:	> 200 kHz

### SSB-AM (USB or LSB) Modulation

AM Depth Range:	0 to 90%
Depth Resolution:	1%
Modulation Bandwidth:	300Hz to 20kHz

## Receiver (Transmitter Test)

Frequency Range:	250kHz – 1GHz (3GHz optional)
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### SENSITIVITY

Narrowband FM:	2.0uV for 10dB EIA SINAD
Wideband FM:	10uV for 10dB EIA SINAD
AM:	10uV for 10dB EIA SINAD

## RF I/O PORT

VSWR:	< 1.2 to 2GHz, ~ 1.5 to 3GHz
Max Power:	50W for 5 minutes 150W for 30 seconds (30 sec. on, 5 min. off)
Absolute Max Power:	150W
Alarm:	Internal temperature alarm

## ANTENNA PORT

Maximum Power:	0dBm
Alarm:	+10dBm

## IF FILTERS:

6.25kHz, 12.5kHz, 25kHz, 50kHz, 100kHz, 200kHz

## FREQUENCY ERROR MEASUREMENT

Type of Display:	Autoranging
Resolution:	1Hz

## FM DEVIATION MEASUREMENT

Demodulation Range:	Up to $\pm 75$ kHz
Accuracy:	$\pm 5\%$ plus residual FM
Frequency Response:	Selectable per the following: Low Pass Filters: 300Hz, 3kHz, 20kHz High Pass Filters: 1Hz, 300Hz, 3kHz

## DEMODO HARWARE CHARACTERISTICS

Demodulation Output Level:	6.25kHz B/W: 2.56V / 1kHz 12.5kHz B/W: 1.28V / 1kHz 25kHz B/W: 0.64V / 1kHz 50kHz B/W: 0.32V / 1kHz 100kHz B/W: 1.6V / 10kHz 200kHz B/W: 0.8V / 10kHz
Demodulation Output Amplitude Flatness:	$\pm 0.2$ dB (300Hz to 3kHz), 1dB point @ 20kHz
Demodulation Output Impedance:	100 ohms nominal

## AUDIO WEIGHTING FILTERS

Filters: none, C-message, CCITT	none, C-message, CCITT
De-emphasis (selectable):	750s

## AM MODULATION MEASUREMENTS

Demodulation Range:	0 to 100%
Accuracy:	$\pm 5\%$ for levels below 80%
Frequency Response:	Selectable per the following: Low Pass Filters: 300Hz, 3kHz, 20kHz High Pass Filters: 1Hz, 300Hz, 3kHz
Demodulation Output Level:	0.8V peak per 10% AM Modulation
Demodulation Output Amplitude Flatness:	$\pm 0.2$ dB (300Hz to 3kHz), 1dB point @ 20kHz
Output Impedance:	100 ohms nominal
SSB Sideband Suppression:	>70 dB

## RECEIVE SIGNAL STRENGTH LEVEL METER

Frequency Range:	1MHz to 1GHz (250kHz to 1GHz typical); Optional to 3GHz
Accuracy:	$\pm 2$ dB
Sensitivity:	-120dBm (Antenna Port; Preamplifier on; 6.25kHz IF B/W)

## BROADBAND POWER METER (RF In/Out Port)

Frequency Range:	1MHz to 1GHz (250kHz to 1GHz typical); Optional to 3GHz
Measurement Range:	0.1W to 150W
Input Impedance:	50 Ohms
Accuracy:	$\pm 10\%$ (2 KHz - 1GHz); $\pm 10\%$ (1GHz - 3GHz <2.5W)
Protection:	Over temperature alarms

## FREQUENCY COUNTER

Frequency Range:	5Hz to 100kHz
Period Counter Range:	5Hz to 20kHz
Input Level:	0.1V rms min

## SINAD METER

Accuracy:	$\pm 1$ dB @ 12dB SINAD
Input Level:	0.1V rms min
Frequency Range:	300 Hz to 10kHz
Reading Range:	0 to >60 dB
Resolution:	0.01dB

## DISTORTION METER

Reading Range:	0.00% to 100%
Distortion Accuracy:	The greater of: $\pm 0.5\%$ of distortion or $\pm 10\%$ of reading
Input Level:	0.1V rms min
Frequency Range:	300Hz to 10kHz
Resolution:	0.01%

## OPTIONAL MODES

DMR (MOTOTRBO™), dPMR, NDXN (Conventional and Type-C Trunking), P25 Phase 1 (Conventional and Trunking), P25 Phase 2, PTC (ITCR), PTC(ACSES), TETRA DMO, TETRA TMO, TETRA Base Station Monitoring, TETRA Base Station T1

# Spectrum Analyzer

## SWEEP

Frequency Range:	1MHz to 1GHz (250kHz to 1GHz typical); Optional to 3GHz
Frequency Resolution:	1Hz
Span Accuracy:	5%
Update Rate:	~10 times per second (depending on span)

## AMPLITUDE

Level Accuracy:	$\pm 2$ dB
Scales (dB/div):	10 (1,2, & 5 w/ESA option)
Log Linearity Accuracy:	<0.1dB
Reference Level Resolution:	1dB
Reference Level Range:	+60 to -70dB
T/R Port Dynamic Range:	80dB
Typical Noise Floor Performance:	-140dBm
SSB Phase Noise (20 kHz Offset):	-95dBc/Hz max below 1GHz (15° to 35° C) -93dBc/Hz max all frequencies (0° to 50° C)
Resolution Bandwidth	Auto Selected
Harmonic Spurious (Antenna Port, No Attenuation):	-20dBc max
Non-Harmonic Spurious (Antenna Porta, No Attenuation):	-60dBc max
Residual Spurious (Input Terminated):	-70dBm
Markers:	Delta, Absolute, and Frequency
Modes:	Standard, Average, Freeze, Max Hold, and Peak Hold

## Oscilloscope

### VERTICAL INPUT

Input Impedance:	1 Meg Ohm / 600 Ohm (Selectable)
Range:	$\pm 70$ VDC, $\pm 33$ Vrms AC / $\pm 24$ VDC, $\pm 15$ Vrms AC
Accuracy:	5% of full scale
Bandwidth:	0 to 50kHz

### HORIZONTAL SWEEP

Range:	20 uSec to 1 Sec / div. (Selectable)
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### TRIGGER SELECTION

Normal, Auto (Free Running), Single Sweep and Freeze

### SPECIAL FUNCTIONS

Markers:	Absolute Voltage, Delta Voltage, Delta Frequency and Delta Period
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## Audio Modulation Synthesizer

Modulation Types:	1 kHz tone, Standard formats (Private Line, Digital Private Line, DPL Invert, Two-Tone Paging, 5/6 Tone Paging, POCSAG, EURO Tones, or User Defined Tone Sequences), Tone-A, Tone B, Tone C (RF Output), DTMF, and external inputs from both a supplied microphone and BNC connector.
Modulation Output Level:	$\pm 8$ V peak ( $\pm 16$ /BW V/kHz FM, $\pm 0.08$ V/% AM)
Amplitude Flatness:	$\pm 0.2$ dB (300Hz to 3kHz), 1dB point @ 20kHz
1 kHz Tone Distortion:	Not to exceed 1% THD
Impedance:	100 Ohms
Modulation Input Level:	$\pm 1$ V peak reference
Amplitude Flatness:	$\pm 0.2$ dB (300Hz to 3kHz), 1dB point @ 20kHz
Impedance:	600 Ohms
Microphone Input Amplitude Flatness:	$\pm 0.2$ dB (300Hz to 3kHz), 1dB point @ 20kHz

## Tracking Generator

Frequency Range:	1MHz to 1GHz (250kHz to 1GHz typical); Optional to 3GHz
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## Digital Voltmeter (DVM)

Input Impedance:	1 Meg Ohm / 600 Ohm (Selectable)
Voltage Range:	1V, 10V, 70V full scale
Frequency Range:	50Hz to 20kHz
DC Accuracy:	1% full scale $\pm 1$ LSB
AC Accuracy:	5% full scale $\pm 1$ LSB

## Timebase

Output Frequency:	10MHz
Stability:	Aging: $\pm 0.1$ ppm / year    Temp.: $\pm 0.01$ ppm
Output Level:	Minimum 0dBm into 50 Ohms
Warm Up:	3 minutes: within $\pm 0.1$ ppm

## Display

### FRONT PANEL DISPLAY

Resolution:	800 x 600
Size:	Size: 8.4" (21.3cm) Full Color LCD

### EXTERNAL DISPLAY

External Display:	VGA
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### REMOTE FRONT PANEL

Remote Front Panel:	Available over Ethernet
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## Supplemental Digital Specifications

### DMR

#### FSK ERROR

Range: 0 to 10%

Accuracy (2% to 10%): <5%

Resolution: 0.01%

#### MAGNITUDE ERROR

Range: 0-5%

Accuracy: <5% of reading

Resolution: 0.01%

#### SYMBOL DEVIATION

Range: 1500 to 2350Hz

Accuracy:  $\pm 10$ Hz

Resolution: .1Hz

#### BER

Range: 0 to 20%

Resolution: 0.00001%

### NXDN

#### FSK ERROR

Range: 0 to 10%

Accuracy (2% to 10%): <5%

Resolution: 0.01%

#### MAGNITUDE ERROR

Range: 0-5%

Accuracy: <5% of reading

Resolution: 0.01%

#### SYMBOL DEVIATION

Range: 840 to 1260Hz (4800bps)  
1920 to 2880Hz (9600bps)

Accuracy:  $\pm 10$ Hz

Resolution: .1Hz

#### BER

Range: 0 to 20%

Resolution: 0.00001%

### dPMR

#### FSK ERROR

Range: 0 to 10%

Accuracy (2% to 10%): <5%

Resolution: 0.01%

#### MAGNITUDE ERROR

Range: 0-5%

Accuracy: <5% of reading

Resolution: 0.01%

#### SYMBOL DEVIATION

Range: 1500 to 2350Hz

Accuracy:  $\pm 10$ Hz

Resolution: .1Hz

#### BER

Range: 0 to 20%

Resolution: 0.00001%

### TETRA

#### EVM (RMS)

Range: 0 to 20%

Accuracy (2% to 10%): <10%

Resolution: 0.10%

#### RESIDUAL CARRIER

Range: 0-10%

Accuracy:  $\pm 0.1$ %

Resolution: 0.10%

#### FREQUENCY ERROR

Accuracy:  $\pm 500$ Hz

Resolution: 1 Hz

### P25 MEASUREMENT MODULATION FIDELITY

Range: 0 to 10%

Resolution: 0.01%

Accuracy: <5.0% of reading  
for 2.0 % and higher

## Remote Interface (Optional Feature)

### REMOTE FRONT PANEL

Available over Ethernet

## FREEDOM

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