

## *FREEDOM* Communications System Analyzer *R8000C*



DATA SHEET

# Table of Contents

Operating/Display Modes . . . . .	3
General . . . . .	3
Generator (Receiver Test) . . . . .	4
Receiver (Transmitter Test) . . . . .	5
Spectrum Analyzer . . . . .	6
Signal to Noise Ratio (SNR) Meter . . . . .	7
Oscilloscope . . . . .	7
Audio Modulation Synthesizer . . . . .	7
Tracking Generator . . . . .	7
Digital Voltmeter (DVM) . . . . .	7
Timebase . . . . .	7
Display . . . . .	8
Supplemental Digital Specifications . . . . .	8
Remote Interface (Optional Feature) . . . . .	8

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

### Power

DC Power Requirements:	24 VDC @ 5.0 A max
AC Adapter Specs:	100-240 VAC, 2.5 A max, 50-60 Hz
Battery Power:	Optional External Battery
Battery Operation:	1 hour minimum

### MECHANICAL/ENVIRONMENTAL

Weight:	11.7 lbs (5.3kg)
Dimensions:	9.4" (23.9 cm) H, 12.7" (32.3 cm) W, 7.5" (19.1 cm) 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:	-30 ° to +80 °C

### WARRANTY

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

## Generator (Receiver Test)

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

### OUTPUT LEVEL GENERATE PORT

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

### OUTPUT LEVEL RF I/O PORT

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

### SPECTRAL PURITY

Harmonic Spurious:	-20 dBc max
Non-Harmonic Spurious:	-35 dBc max ; <-30 dBc at mixing product frequencies (3227 MHz - Carrier); 10 MHz Harmonics <-124 dBm (RF I/O)
Residual FM:	4 Hz, 300 Hz to 3 kHz (<1 GHz); 5 Hz, 300 Hz to 3 kHz (> 1 GHz)
Residual AM:	1.0% max, 300 Hz to 3 kHz
SSB Phase Noise (20 kHz Offset):	-95 dBc/Hz max below 1 GHz (15 ° to 35 °C); -93 dBc/Hz max all frequencies (0 ° to 50 °C)

### FM MODULATION

Deviation Range:	0 to 75 kHz
Deviation Resolution:	1 Hz
Deviation Accuracy:	5% of setting
RF Output Frequency Range:	0 to 40 kHz
Modulation Output Frequency Range :	0 to 20 kHz
RF Output Modulation Bandwidth:	DC to 100 kHz
Modulation Output Bandwidth:	5 Hz to 20 kHz
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 20 kHz
IF Bandwidth:	> 200 kHz

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

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

## Receiver (Transmitter Test)

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

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

## RF I/O PORT

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

## ANTENNA PORT

Maximum Power:	0 dBm
Alarm:	+10 dBm

## IF FILTERS:

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

## FREQUENCY ERROR MEASUREMENT

Type of Display:	Autoranging
Resolution:	1 Hz

## 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: 300 Hz, 3 kHz, 20 kHz High Pass Filters: 1 Hz, 300 Hz, 3 kHz

## DEMODO HARWARE CHARACTERISTICS

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

## AUDIO WEIGHTING FILTERS

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

## AM MODULATION MEASUREMENTS

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

## RECEIVE SIGNAL STRENGTH LEVEL METER

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

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

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

## FREQUENCY COUNTER

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

## SINAD METER

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

## DISTORTION METER

Reading Range:	0.00% to 100%
Distortion Accuracy:	The greater of: ±0.5% of distortion or ±10% of reading
Input Level:	0.1 V rms min
Frequency Range:	300 Hz to 10 kHz
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:	1 MHz to 1 GHz (250 kHz to 1 GHz typical); Optional to 3 GHz
Frequency Resolution:	1 Hz
Span:	9.751 kHz to 1GHz (3 GHz w/ Option)
Span Accuracy:	5%
Update Rate:	~10 times per second (depending on span)

## AMPLITUDE

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

## Signal to Noise Ratio (SNR) Meter

Range:	0 to 100 dB
Resolution:	0.01 dB
Accuracy:	±1 dB (20 dB to 50 dB)
Signal Frequency:	300 Hz to 10 kHz
Audio Input Level:	0.1 to 30 Vrms
RF Input Level:	>>RF I/O Port: -10 to +50 dBm; >>ANT Port: -50 to 0 dBm

## Oscilloscope

### VERTICAL INPUT

Input Impedance:	1 Meg Ohm / 600 Ohm (Selectable)
Range:	±70 VDC, ±33 Vrms AC / ±24 VDC, ±15 Vrms AC
Vertical Scale:	10 mV to 10 V (1-2-5 sequence), 15 V, 20 V, 25 V
Accuracy:	5% of full scale
Bandwidth:	0 to 50 kHz

### 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:	Single Marker: Absolute Voltage Dual Marker: Delta Voltage, Delta Frequency, 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:	±8 V peak (±16/BW V/kHz FM, ±0.08V/% AM)
Amplitude Flatness:	±0.2 dB (300 Hz to 3 kHz), 1 dB point @ 20 kHz
1 kHz Tone Distortion:	Not to exceed 1% THD
Impedance:	100 Ohms
Modulation Input Level:	±1 V peak reference
Amplitude Flatness:	±0.2 dB (300 Hz to 3 kHz), 1 dB point @ 20kHz
Impedance:	600 Ohms
Microphone Input Amplitude Flatness:	±0.2 dB (300 Hz to 3 kHz), 1 dB point @ 20 kHz

## Tracking Generator

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

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

## Timebase

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

# 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 2350 Hz

Accuracy:  $\pm 10$  Hz

Resolution: .1 Hz

#### 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 1260 Hz (4800bps)  
1920 to 2880 Hz (9600bps)

Accuracy:  $\pm 10$  Hz

Resolution: .1 Hz

#### 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 2350 Hz

Accuracy:  $\pm 10$  Hz

Resolution: .1 Hz

#### 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