

# **FREEDOM** Communications System Analyzer **R8000C**



**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):	-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:	$\pm 5\%$ for levels below 80%
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; Preamplicifier 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 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 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 1GHz (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

## 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
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 $\mu$ Sec 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

## 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 (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:	$\pm 1$ V peak reference
Amplitude Flatness:	$\pm 0.2$ dB (300 Hz to 3 kHz), 1 dB point @ 20kHz
Impedance:	600 Ohms
Microphone Input Amplitude Flatness:	$\pm 0.2$ 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 $\pm 1$ LSB
AC Accuracy:	5% full scale $\pm 1$ LSB

## Timebase

Output Frequency:	10 MHz
Stability:	Aging: $\pm 0.1$ ppm / year Temp.: $\pm 0.01$ ppm
Output Level:	Minimum 0 dBm 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 2350 Hz
Accuracy:	±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:	±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:	±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:	±0.1%
Resolution:	0.10%
FREQUENCY ERROR	
Accuracy:	±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

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