

Figure 3.2.8.2-1 Test Mode submenu

3.2.8.3 DMR Test Mode with MOTOTRBO™

The R8000 DMR Test Package option / DMR Test Mode allows testing of radios compliant with the ETSI Digital Mobile Radio (DMR) Tier 2 conventional (non-trunked) radio transmission protocol. DMR radios use a digital transmission format employing 4-Level Frequency Shift Keying (4FSK) modulation with a channel access method of Time Division Multiple Access (TDMA) technology. Pressing the DMR soft key initiates the DMR test mode. On the R8000 main display a DMR soft key replaces the Standard mode's Audio Zone soft key – see Figure 3.2.8.3-1. In addition, the Audio Zone area on the main screen is replaced with DMR specific content, and a Constellation display is automatically selected in Meter Zone as a convenience.

The manufacturer's Radio Service Software (RSS), Motorola MOTOTRBO™ Radio Tuner software, is required to perform some tests in DMR mode because certain measurements (BER) require placing the radio in a special test mode. The Tuner software places the radio in specific test modes, while the role of the R8000 service monitor is to transmit and receive test patterns compliant to the DMR physical layer. Tests that don't require RSS include slot Power, Frequency Error, FSK Error, Magnitude Error,

and a Constellation display. Averaging can be applied to some measurements in the System Settings. Figure 3.2.8.3.1-1 shows the R8000 main screen after choosing the DMR Test Mode in Monitor mode.

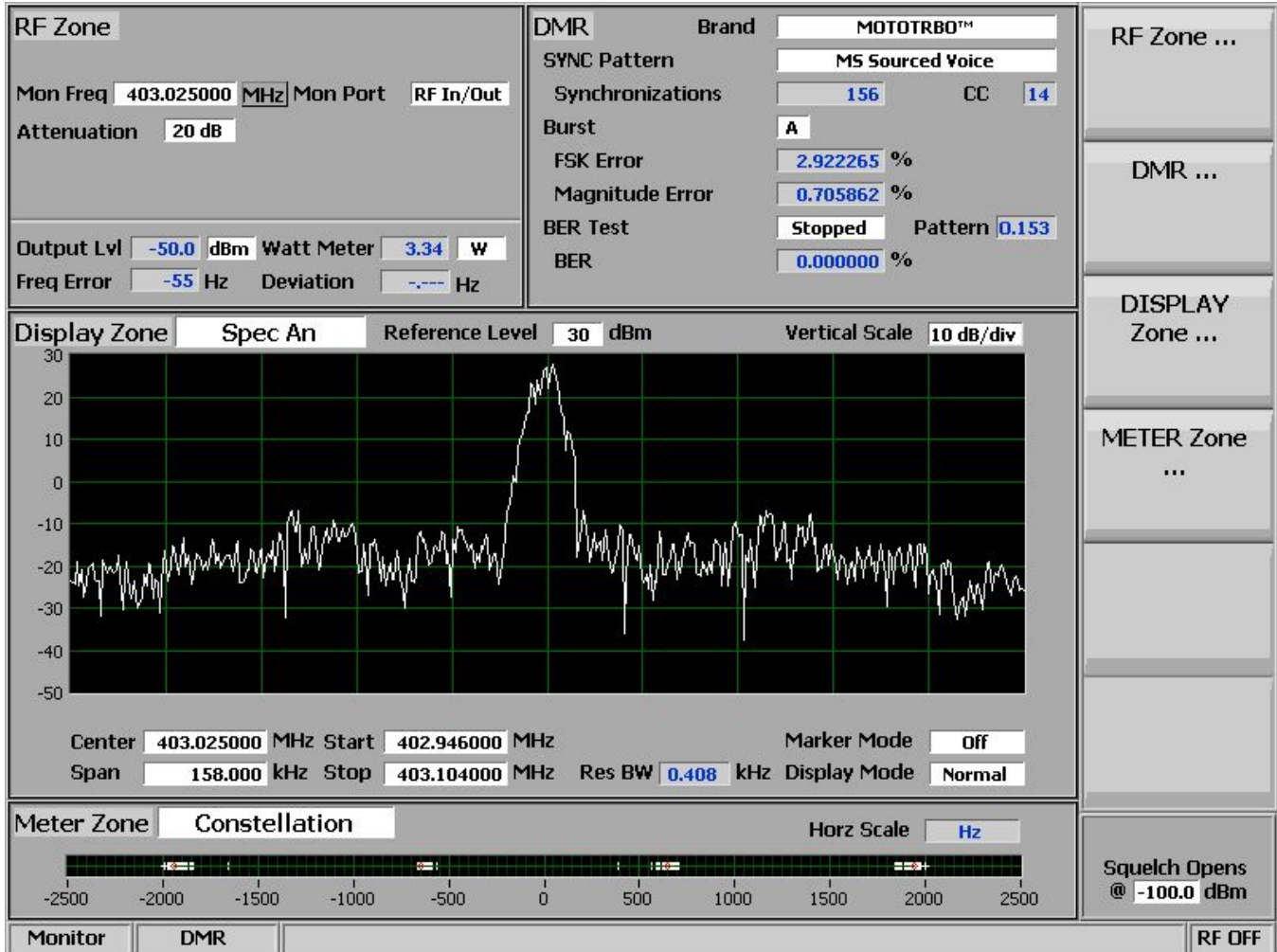


Figure 3.2.8.3-1 Main screen in Monitor mode after selecting DMR Test Mode

3.2.8.3.1 DMR transmitter tests

These tests are performed with the R8000 in Monitor mode – see Figure 3.2.8.3.1-1. During radio transmission the R8000 continuously measures the quality of the radio's transmitted 4FSK signal over the 132 symbols (264 bits) that comprise an entire DMR TDMA burst. Although the service monitor synchronizes to the first burst, it can measure the quality of any of the 6 bursts transmitted by the radio.

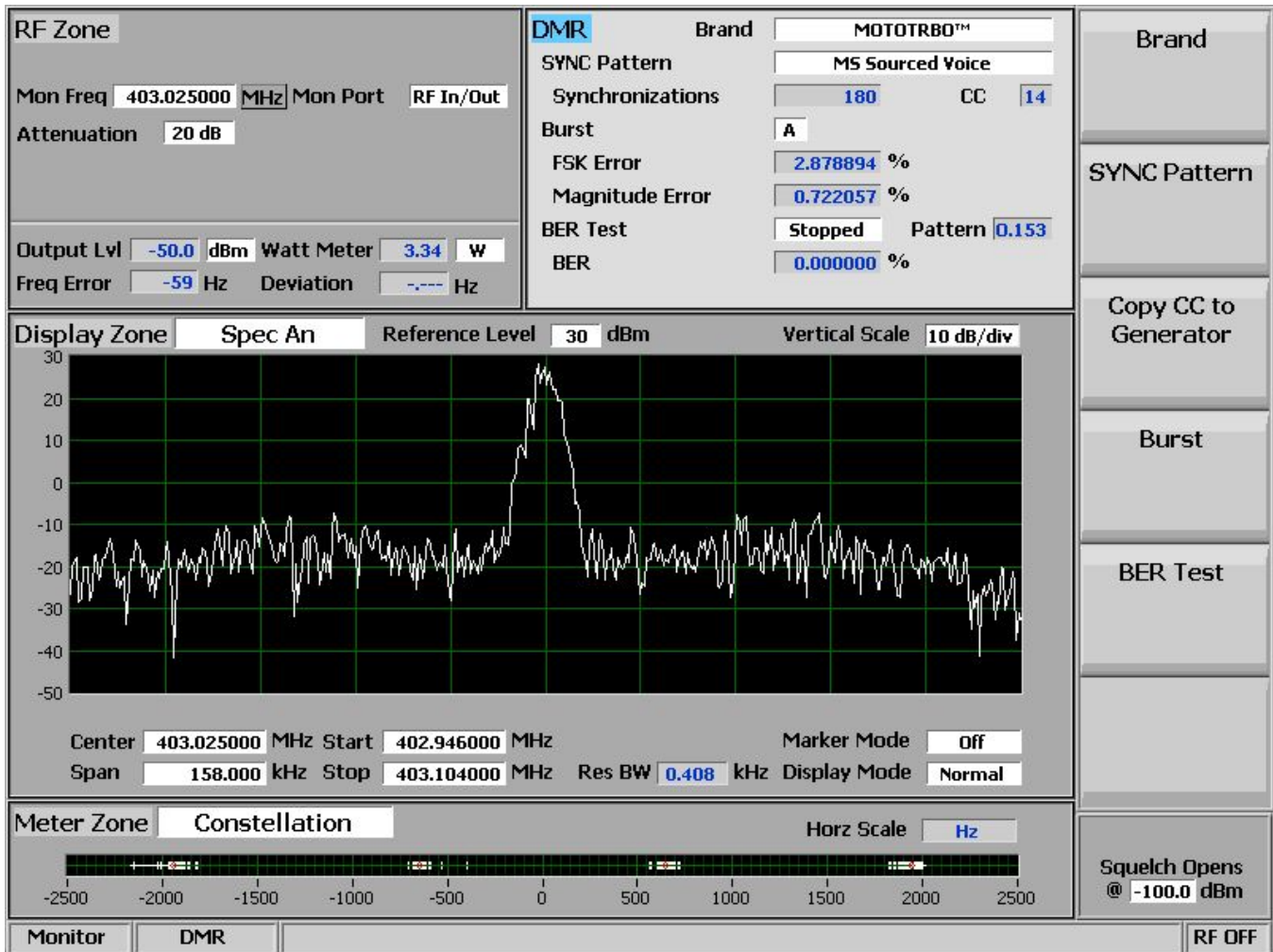


Figure 3.2.8.3.1-1 Submenu after pressing DMR soft key in Monitor mode

Input Lvl (RF Zone display)

Input Lvl displays the amount of power in the specified Burst of the synchronized TDMA slot of the received signal.

Note: When the RF input power on the RF In/Out port is above +20 dBm (100 mW), the R8000 utilizes a broadband power detector for the measurement. The “Input Lvl” field in the RF Zone changes to “Watt Meter” to indicate this measurement mode. For best accuracy disable the Pre-amplifier in Monitor Mode, and set the Gen Port in Generate Mode to RF In/Out.

Note: A DMR TDMA transmission alternates between a used and unused time slot so the RF Zone field will switch between the two. An unused slot has no power, so the display will flash between Input Lvl and Watt Meter. In this condition the Input Lvl reading should be used since null slots can cause the Watt Meter indication to read 3 dB less than the power in the used slots.

The R8000 NXDN™ Test Package option / NXDN™ Test Mode allows testing of radios compliant with the NXDN™ radio transmission protocol. NXDN™ radios use a digital transmission format employing 4-Level Frequency Shift Keying (4FSK) modulation in an RF spectrum managed by Frequency Division Multiple Access (FDMA) technology. The R8000 NXDN™ mode provides a grouping of test functions compliant with the Conformance Test section of the NXDN™ Common Air Interface (CAI) standard. These include Symbol Deviation, Modulation Fidelity, Bit Error Rate (BER) test patterns, Frequency Error, and Power. In addition there is an Eye Diagram with graphical representation of the NXDN™ signal, and a Voice Loopback function that enables the Voice Loop feature (U.S. patent 5703479) for audio verification of the radio’s end-to-end operation.

The manufacturer’s Radio Service Software (RSS) is required to perform some tests in NXDN™ mode because certain measurements (BER) require placing the radio in a special test mode. Tests that don’t require RSS include Power, Frequency Error, Symbol Deviation, Modulation Fidelity. Averaging can be applied to some measurements by the System Settings. The Eye Diagram and Voice Loopback also provide qualitative indication of the radio’s performance. Figure 3.2.8.6-1 shows the R8000 main screen after choosing the NXDN™ Test Mode in Monitor mode.

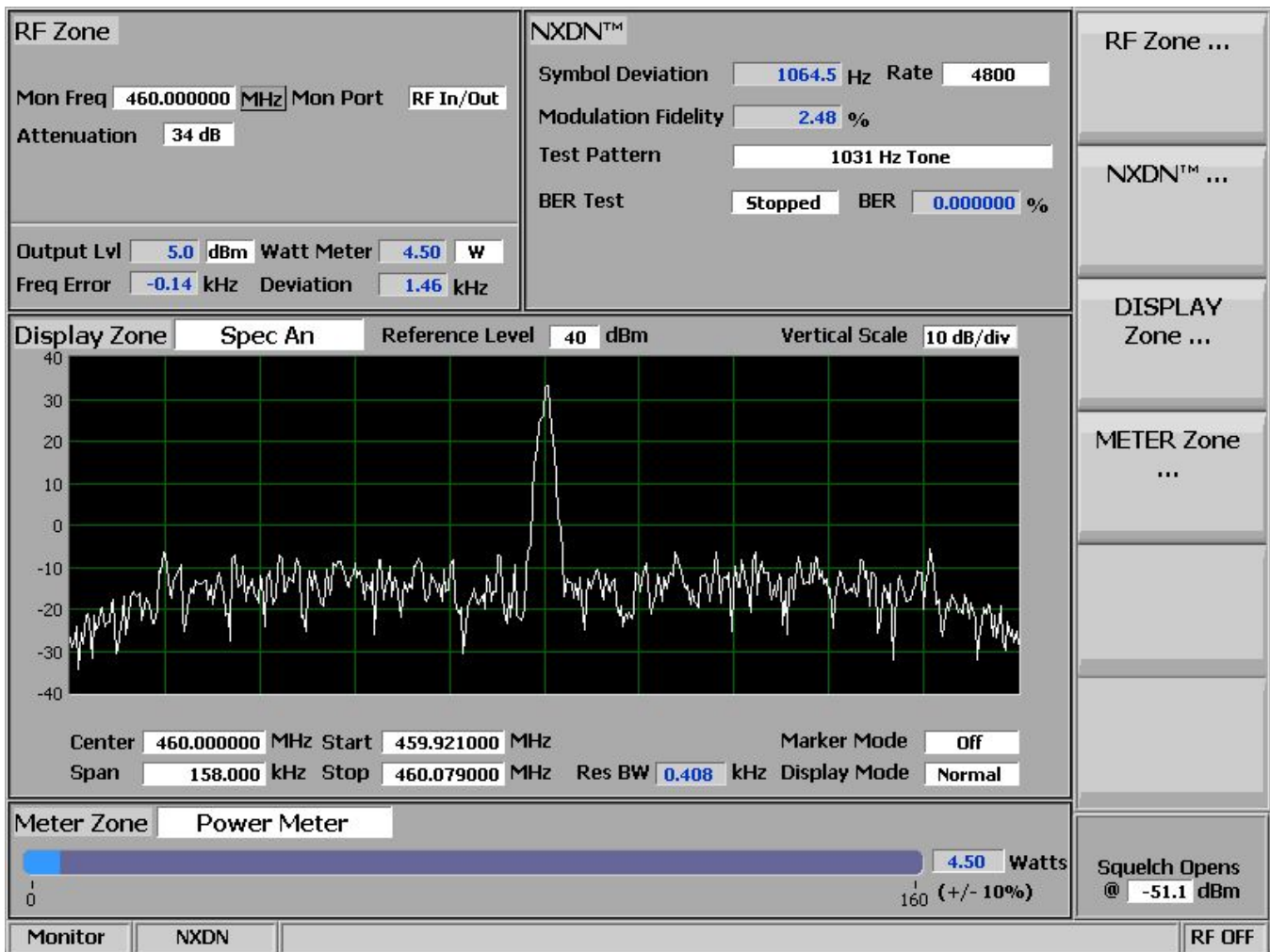


Figure 3.2.8.6-1 Main screen in Monitor mode after selecting NXDN™ Test Mode

3.2.8.6.1 NXDN™ transmitter tests

The entire suite of NXDN™ transmitter tests are available in R8000 Monitor mode after the NXDN™ soft key is pressed – see Figure 3.2.8.6.1-1. During radio transmission the R8000 continuously measures the quality of the transmitted 4FSK signal. Numerical results are displayed as Symbol Deviation and Modulation Fidelity in the NXDN™ zone. When the Eye Diagram is selected in the Display Zone, the R8000 overlays the modulation response over four “target” crossing points for an ideal NXDN™ signal. BER tests require use of the manufacturer’s RSS to place the radio in a special test mode.

Symbol Deviation (NXDN™ Zone display)

NXDN™ radios broadcast voice and data using a 4 level frequency deviation of the carrier to represent symbols containing data bits as shown in the table below. The nominal symbol deviation value for an NXDN™ radio using 4FSK modulation is 1050 Hz in a 6.25kHz channel and 2400 Hz in a 12.5kHz channel. Since the deviation of An NXDN™ 4FSK signal is data dependent, that aspect is factored when measuring overall carrier deviation. The Symbol Deviation field provides the deviation measurement at symbol decision times.

Bits	Symbol	Deviation (6.25kHz)	Deviation (12.5kHz)
01	+3	+1050 Hz	+2400 Hz
00	+1	+350 Hz	+800 Hz
10	-1	-350 Hz	-800 Hz
11	-3	-1050 Hz	-2400 Hz

Modulation Fidelity (NXDN™ Zone display)

Modulation Fidelity (FSK Error) represents how accurately an NXDN™ transmitter reproduces an ideal theoretical modulation. The measurement is performed by comparing the RMS difference between the deviation of the received signal and the ideal 4FSK deviation at the symbol decision points (shown in the previous table).

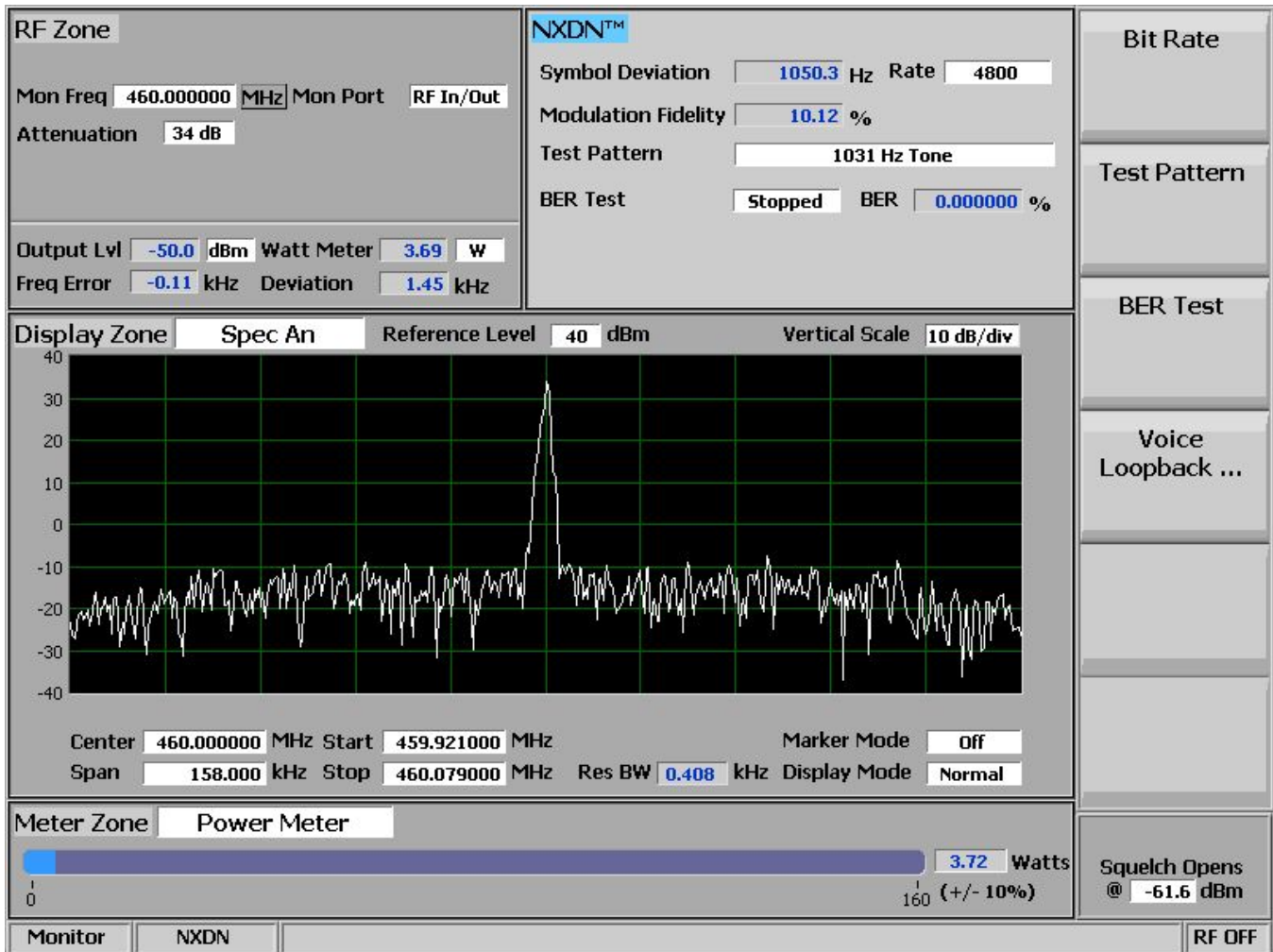


Figure 3.2.8.6.1-1 Submenu after pressing NXDN™ soft key in Monitor mode

Eye Diagram (Display Zone setting)

The Eye Diagram provides a visual display of the received NXDN™ signal and overlays the modulation response over the four “target” crossing points for an ideal NXDN™ signal – see Figure 3.2.8.6.1-2. Navigate to the Display Zone while in NXDN™ mode to select the Eye Diagram for viewing with the other NXDN™ measurements on the main screen. The Eye Diagram can indicate whether a transmitter has significant unbalances or offsets in the modulation circuitry by noting how tightly grouped the waveform is around the crossing points.