1.0 General Equipment Information

This device is marketed and manufactured by Microwave Data Systems as the MDS 2710D Data Transceiver and is intended primarily for use in Point-to-Multipoint networks.

1.1 Summary of RF Parameters

Transmitter

Type:	Synthesized, 5.0 kHz steps
Frequency Range:	220 - 222 MHz.
Power Output:	37 dBm maximum (5 Watts)
Crystal frequency:	16 MHz TCXO

Receiver

Type:	Double conversion superheterodyne
Frequency Range:	220 - 222 MHz.
1st Local Oscillator Range:	302.2 - 304.2 MHz.
First Intermediate Frequency:	82.2 MHz.
Second Intermediate Frequency:	455 kHz.
Crystal Frequencies:	16 MHz, 81.745 MHz.

1.2 Construction Details

The MDS 2710D Data Transceiver consists of a transmitter and receiver constructed on a common printed wiring board assembly, sharing many common circuits. The transceiver board is mounted within a die-cast aluminum housing. A die-cast aluminum top cover completes the enclosure assembly, providing a well-shielded enclosure.

Power, interface and antenna connections are made via connectors on the front face of the transceiver package. DC power may be supplied to the transceiver from any suitable DC source capable of supplying 13.8 VDC nominal at a maximum of 2.5 Amperes. The DC power source should be current limited or have a protective fuse or circuit breaker.

2.0 Description of Device Operation

2.1 General Operation

The MDS 2710D Data Transceiver is a narrow band radio designed to operate on 5.0 kHz. channels, meeting the requirements of FCC Part 90 and FCC Part 15 for operation in the 220-222 MHz Band.

2.2 Description of Circuit Functions

The following is a summary of the operation of the MDS 2710D Transceiver. Refer to Figure 1, the block diagram, and to the schematics, to follow the discussion.

2.2.1 Receiver

Receive Front End

Connector J301 on the main PWB board conducts the RF signal from the front panel antenna connector to the antenna switch network. In the receive mode, one port of the antenna switch conducts the receive signal to the input of a bandpass filter.
The output of the filter is amplified by Q401, and then goes to M301, a double-balanced mixer whose local oscillator injection voltage is derived from the VCO U308 through buffer amplifier Q303.

High IF

The 82.2 MHz High IF signal from M301 enters IF amplifier transistor Q301, whose output goes to FL302 a SAW filter which provides part of the IF selectivity of the receiver. The output of FL302 is connected to U302, which contains the Low IF amplifier and other functions.

Low IF

U302 contains several circuit sections: mixer, oscillator, IF amplifier / limiter, quadrature detector and meter drive. The oscillator section of U302 uses crystal Y300 and associated components to set the second oscillator frequency at 81.745 MHz.

The 455 kHz output of the second mixer is fed to a ceramic filter set consisting of FL304 and FL305. This filter set provides the main adjacent channel selectivity of the receiver.

We are further requesting that the Certification be issued for both mobile MO operation and for fixed FX operation. The measurements of frequency stability with temperature and voltage show that the MDS 2710D is well within the required +/- 1.5 ppm stability for mobile equipment in the 220-222 MHz band. The measured worse-case stability is +217 Hz at -30 degrees C. At 222 MHz, this equates to 0.98 ppm.

The requirement for "base" stations given in Part 90 is 0.1 ppm. We justify our request for Certification for fixed "base" operation as follows:

The measurements of frequency stability given in the Test Report include measurements of the modulated spectrum occupancy within the FCC Mask F for each temperature. They clearly show that the signal produced by the MDS 2710D remains within the allotted Mask F under all conditions. This is because we have designed the spectrum occupancy to be 2.8 kHz, well below the allowable 4.0 kHz. This margin assures that the spectrum will always be within the Mask F.

Another way to see this is if we assume worst case allowable "mobile" stability of 1.5 ppm. This equates to 333 Hz at 222 MHz. Our spectrum provides at least a margin of (4.0 kHz - 2.8 kHz) / 2 = 600 Hz on each side of the occupied spectrum before "hitting" the mask. Since our measured stability is better than that required, our margin is also better.

Transmit Power Amplifier

The power amplifier chain of the transmitter section consists of U300 and U304. U300 is a buffer amplifier biased by the + 5v supply. The output of U300 is input to a five watt power amplifier U304.

The RF output of U304 is fed through a directional coupler to the antenna diode switching network and low pass filter.

Antenna Switch

The antenna switch consists of a lumped-element quarter wave section constructed as a 90 degree pi-network on the PCB, and pin diodes. During the transmit mode, diodes CR301 and CR302 are biased on by U305. When the diodes are conducting, CR302 provides a low impedance path for the transmit signal to the antenna port and CR301 shorts out to ground. With CR301 and CR302 on, the network acts as the equivalent of a quarter wave transmission line with no RF current flowing through quarter wave pi-network. With CR302 and CR301 on, RF energy is prevented from appearing at the input of the receiver section.

2.2.4 Processors

Microprocessor / FLASH Memory

The microprocessor U101, controls many of the on-board functions of the transceiver. It runs a predetermined routine that controls all of its pin functions; this routine is stored in FLASH memory, U104. All programmable functions and values are stored by the microprocessor in EEPROM in the microcontroller. This includes operating parameters such frequency, CTS delay time/mode, as well as model and factory serial numbers. The microcontroller uses the 16 MHz system clock as its clock source.

Digital Signal Processor (DSP)

The DSP controls all of the real time modem functions including FIR filtering, converting/writing to D/A, reading from A/D and running the asynchronous RS-232 interface. It runs a predetermined routine that controls all of its pin functions. The routines are downloaded from the microcontroller's FLASH memory when the radio is powered up. All programmable functions and values are stored by the microprocessor in EEPROM in the microcontroller. These are used when the radio is powered up. These include operating parameters such as receive FIR coefficients and application interface baud rate. The DSP uses the 16 MHz system clock as its clock source.