Technical Measurements and Records in Support of FCC Type Certification under 47CFR Part 90 and 47CFR Part 74 for a Microwave Video and Audio Transmitter

Manufactured and Submitted by:

Pacific Microwave Research, Inc.
1485 Poinsettia Avenue, Suite #111
Vista, CA 92081
Tel: 760-295-5416
www.pmicrowave.com

FRN # 0006-0883-48

Grantee Code – P5S

Product Model # - DT-200S

Point of Contact:

Administrative

Mr. Christopher M. Durso
President, PMR

Technical

Mr. A. David Dirdo
Chief Technical Officer, PMR

September 14, 2006

Pacific Microwave Research, Inc. (PMR) is a California Corporation engaged in the design and manufacture of wireless transmission and reception equipment for the transport of video and audio signals using frequency bands above 1900 MHz. One such design, the DT-200S, is a compact microwave transmitter capable of operation in bands over the range of 1900 – 2700 MHz. This transmitter is designed to transmit standard NTSC or PAL video signals along with two audio and one data signal over a short range to a compatible receiver. Applications include: law enforcement surveillance, remote video telemetry, and broadcast EFP and ENG. All designs are the intellectual property of Pacific Microwave Research, Inc.

The PMR DT-200S has been tested per §2.907 and §2.947 for conformance with the rules under 47CFR Part 90 and 47CFR Part 74. A data sheet for this product is contained in the Appendix as well as a copy of the standard transmitter test data record that accompanies each unit manufactured. The testing for this submission was conducted at PMR's design and manufacturing facility located at 1485 Poinsettia Avenue, Suite 111, Vista, CA, by Mr. A. David Dirdo, Chief Technical Officer, PMR. The testing was witnessed and results verified by Mr. Christopher M. Durso, President, PMR. All tests were carried out with calibrated laboratory grade electronic test equipment using industry accepted procedures and techniques. The principles conducting the tests have collectively over 30 years in rf, microwave, and related fields. The results of those tests are contained in this submittal.

A block diagram and photograph of the test set-up is contained in this submission to help the evaluator understand the test conditions. No modifications to the EUT (DT-200S) were required during the testing regime to insure compliance with any of the rule sections cited. The tests and results reported in this document were conducted on September 10, 2006 by the undersigned.

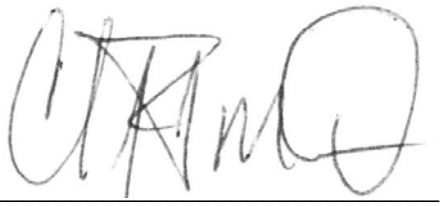
Test Conductor:

I attest to the accuracy of the data contained in this submission.

Mr. A. David Dirdo
Chief Technical Officer, PMR

Verified by:

I attest to the accuracy of the data contained in this submission.



Mr. Christopher M. Durso
President, PMR

Exhibit pursuant to 47CFR 90.205 – Power and antenna height limits

The Pacific Microwave Research DT-200S transmitter is rated at 0.1W (+20 dBm) output power over the operating voltage and frequency range. At no time will the transmitter exceed the maximum power output of 5W (+37 dBm) as required by §90.205(n) or 12W (+41 dBm) as required by §74.636. The data tabulated below in Table 1 (for operation in Part 90) was compiled by PMR using the EUT DT-200S transmitter and the measurement equipment shown in the block diagram test set-up on page 8. The transmitter was terminated into the 50 Ω input of the power meter (§2.1046(a)). The test was run over the full range of specified input voltage (§2.1055(d)). Table 2 shows the data tabulated for operation in Part 74 under the same operating conditions.

Input Voltage Vdc	Frequency of Operation MHz	RF Power Output dBm
10.5	2459.0	+21
12.0	2459.0	+21
14.0	2459.0	+21
18.0	2459.0	+21
24.0	2459.0	+21
32.0	2459.0	+21

Table 1. Frequency & Power Output vs. Input Voltage (Part 90)

Input Voltage Vdc	Frequency of Operation MHz	RF Power Output dBm
10.5	2079.5	+21
12.0	2079.5	+21
14.0	2079.5	+21
18.0	2079.5	+21
24.0	2079.5	+21
32.0	2079.5	+21

Table 2. Frequency & Power Output vs. Input Voltage (Part 74)

Exhibit pursuant to 47CFR 90.207 & 47CFR 74.462 – Types of Emissions

The Pacific Microwave Research DT-200S transmitter is designed to transmit one NTSC (EIA 250C) or PAL compatible television signal along with two audio and one data channel utilizing coded orthogonal frequency division multiplex modulation (COFDM). COFDM is a multi-carrier digital modulation scheme. The emission designator of this complex modulation is **8M6D7W** as per §2.201.

Exhibit pursuant to 47CFR 90.209 – Bandwidth Limitations

The occupied bandwidth per §2.202 of the Pacific Microwave Research DT-200S transmitter 7.86 MHz. The digitally modulated transmission consists of 1705 orthogonal carriers spaced 4.4 kHz apart. A spectrograph of the modulated waveform is shown below in FIGURE 1 for operation in Part 90. FIGURE 2 shows the modulated waveform in Part 74. (occupied bandwidth spectral measurement represents in-band energy -20 dBc from peak)

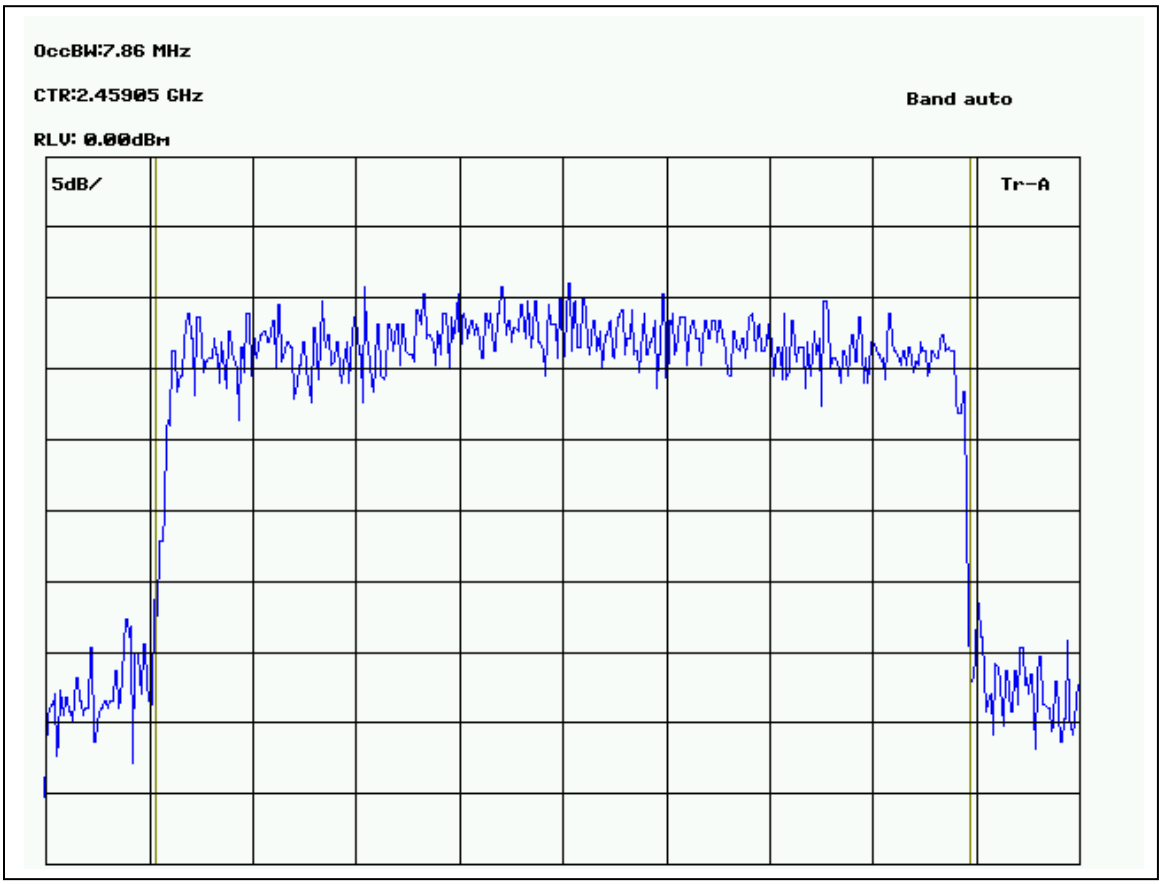


Fig 1. DT-200S Spectrograph of Occupied Bandwidth (Part 90)
(V=5dB/div H=1 MHz/div)

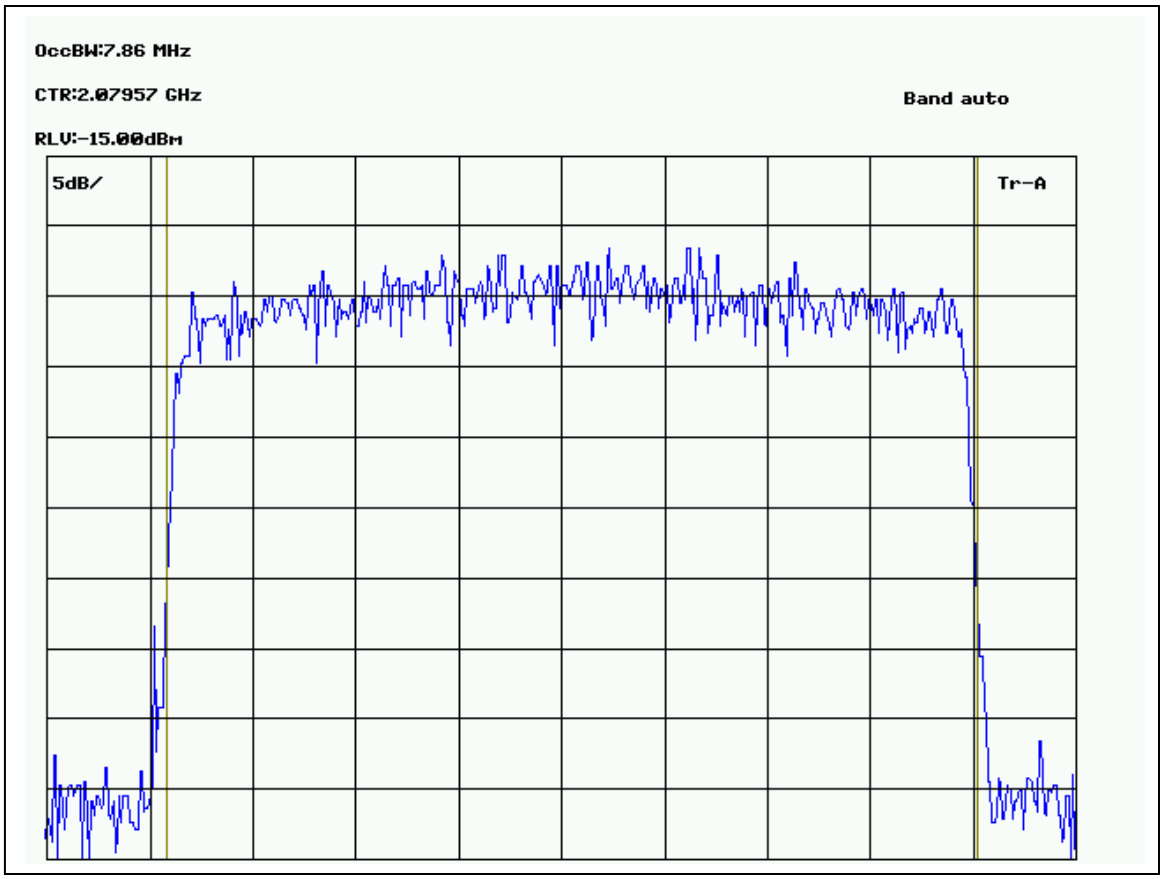


Fig 2. DT-200S Spectrograph of Occupied Bandwidth (Part 74)
(V=5dB/div H=1 MHz/div)

Exhibit pursuant to 47CFR 90.210 – Emission Masks

The Pacific Microwave DT-200S complies with the requirements of the emission mask as stated in §90.210(c) and §74.637. Harmonic supression of the transmitter is accomplished using an integral low pass filter between the power amplifier output stage and the antenna terminal (§2.1033(c)(10). An internal unsaturated ferro-magnetic isolator provides additional suppression of out-of-band energy.

The requirement contained in §90.210(c)(1) is within the modulation bandwidth of the authorized emission (8M6D7W**)** and is not applicable in this case. With respect to §90.210(c)(2) and §74.637, emissions removed from the fundamental by 20 MHz (250% bandwidth) were measured greater than –68 dBc in compliance with the requirement (29 log 45^2 / 11 dB or 65.6 dBc) for such suppression.

Figure 3 shows the spectral mask with the DT-200S operating in Part 90. Figure 4 shows the spectral mask with the DT-200S operating in Part 74.

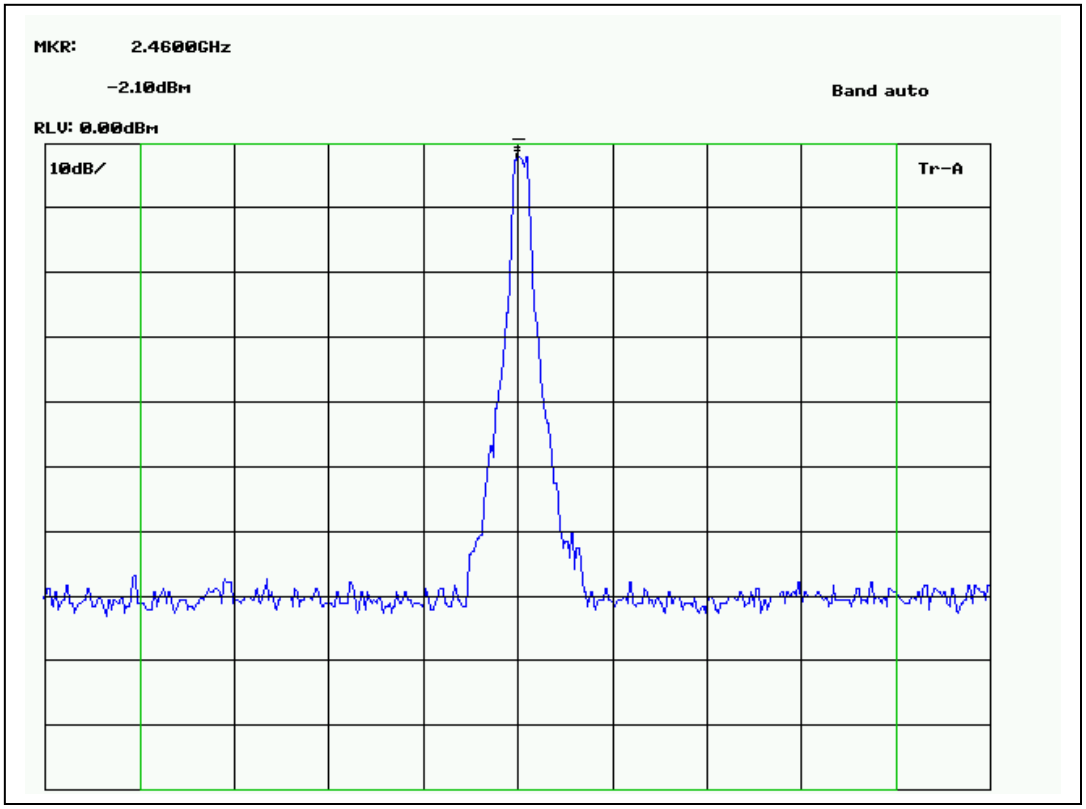


Fig 3. DT-200S Spectrograph of Spectral Purity (Part 90)
(V=10dB/div H=50 MHz/div)

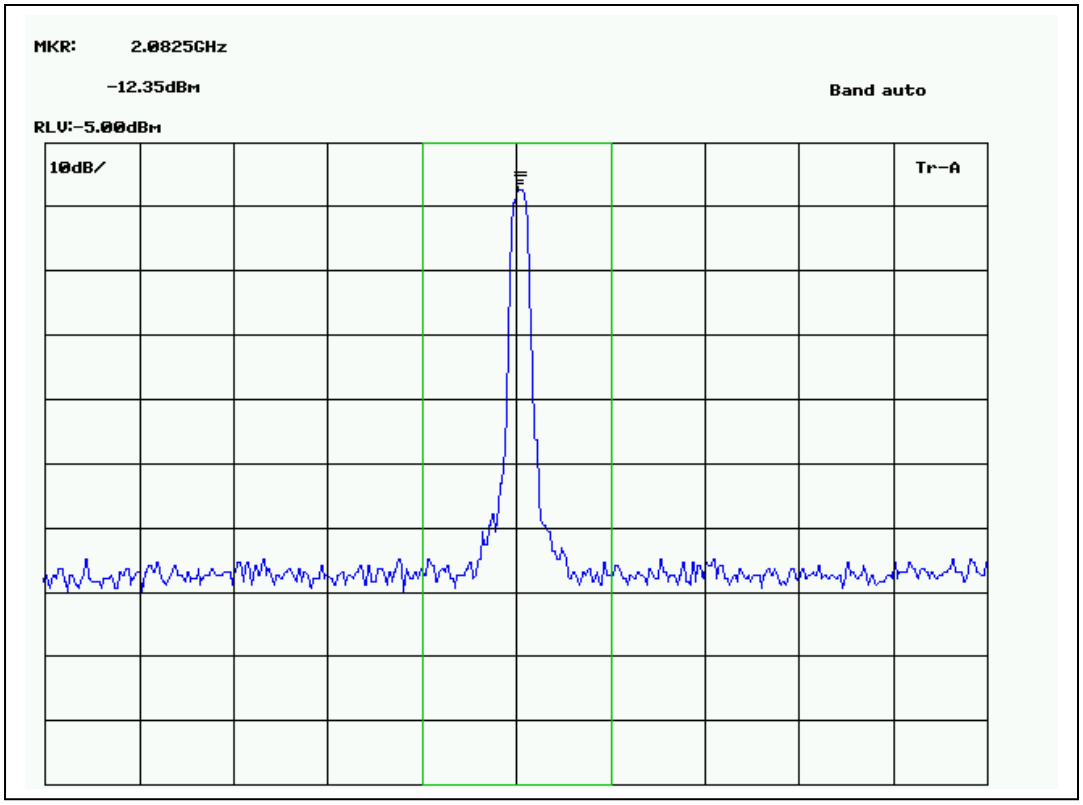


Fig 4. DT-200S Spectrograph of Spectral Purity (Part 74)
(V=10dB/div H=50 MHz/div)

With respect to §90.210(c)(3) and §74.637, the measurement was made using a notch filter at the fundamental to prevent analyzer overload. The level of the EUT DT-200S transmitter measured +21 dBm on the spectrum analyzer before the notch filter was inserted in circuit. The level of the second harmonic is measured at –68 dBm on the analyzer placing the second harmonic at –89 dBc with respect to the fundamental carrier. The suppression of the second harmonic exceeds –46 dBc (43 + 10 log (2)) in compliance with §90.210(c)(3) and §74.637. Figure 5 shows the output of the EUT DT-200S at the second harmonic frequency when operating under Part 90 (4919 MHz). Figure 6 shows the output of the EUT DT-200S at the second harmonic frequency when operating under Part 74 (4162 MHz).

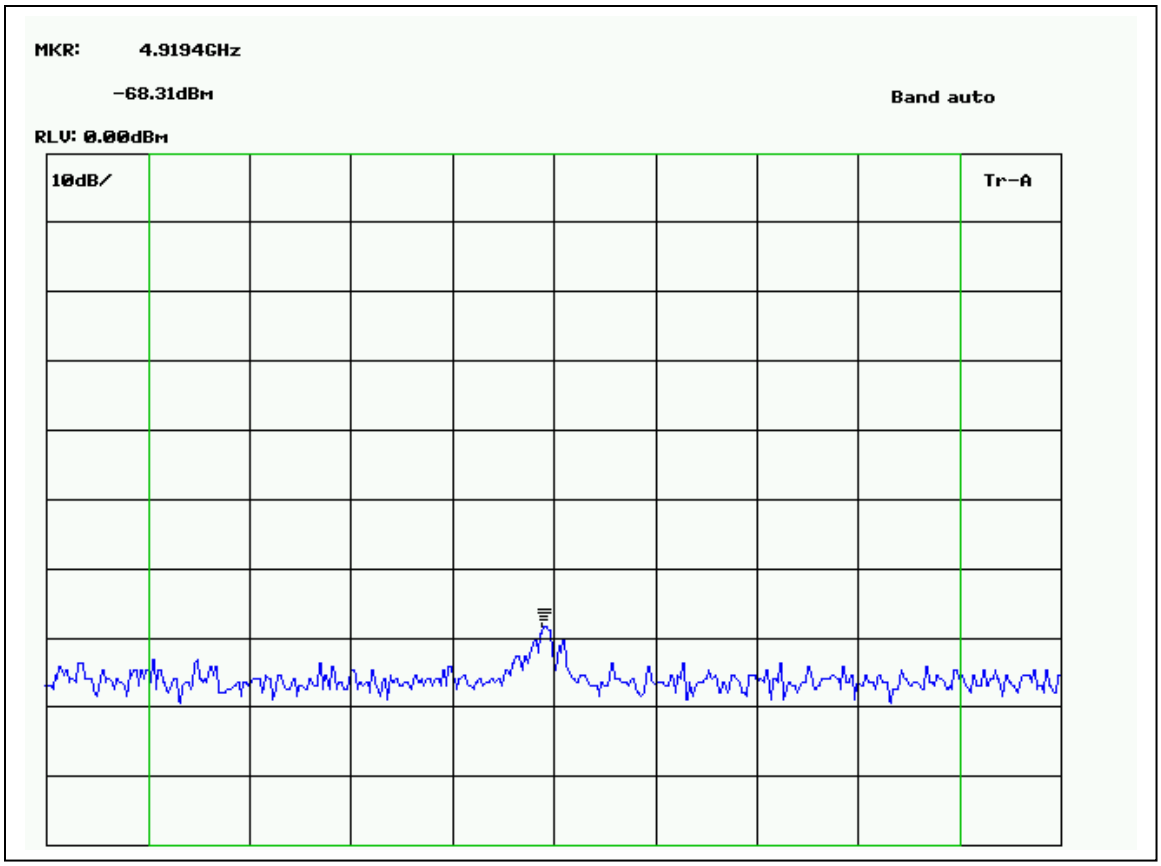


Fig. 5 DT-200 2nd Harmonic Emission –89 dBc (Part 90)
(V=10dB/div H=50 MHz/div)

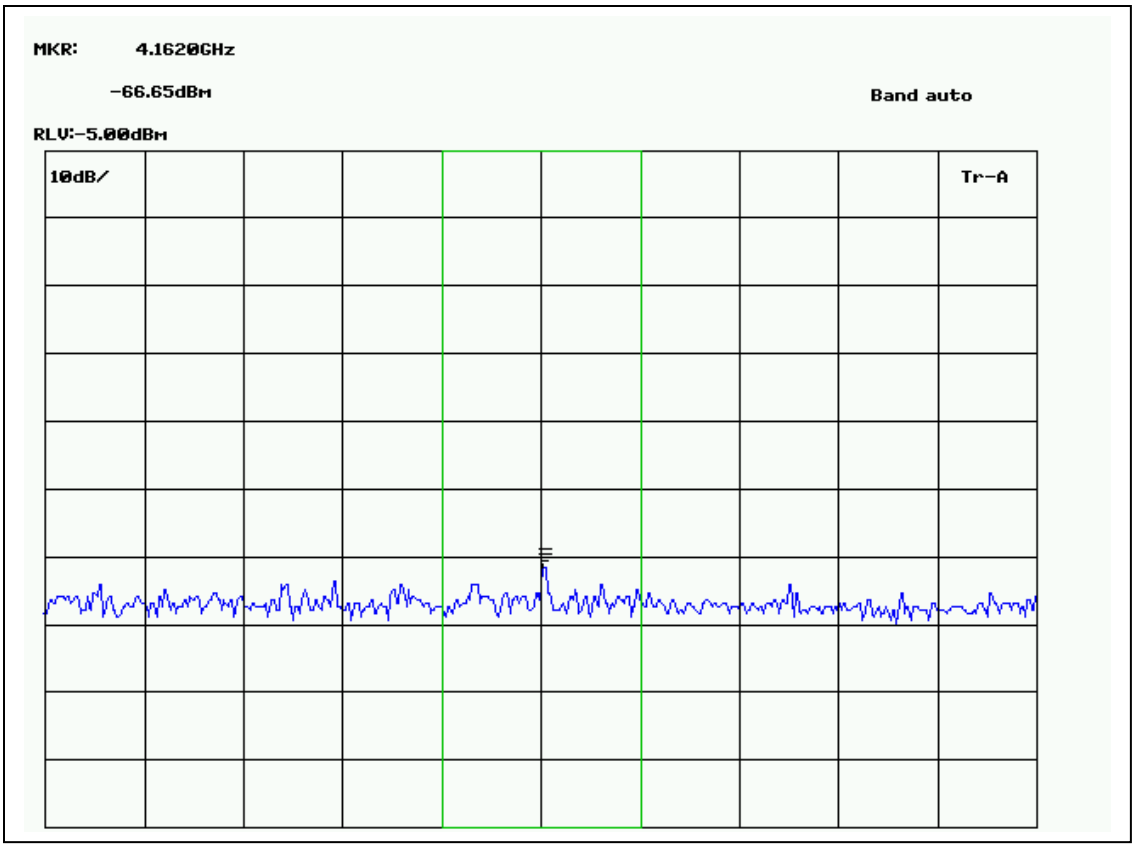


Fig. 6 DT-200 2nd Harmonic Emission –89 dBc (Part 74)
(V=10dB/div H=50 MHz/div)

Exhibit pursuant to 47CFR 90.213 – Frequency Stability

The Pacific Microwave EUT DT-200S transmitter was tested at full output power over a wide temperature range to determine its frequency stability (§2.1055(a)). The results are summarized in Table 2. The frequency stability of the DT-200S is determined by a clock oscillator with a reference frequency of 16 MHz and an inherent stability of ±0.00025% (§2.1033(c)(10)). Assuming room temperature operation at +20 °C, the data in Table 2 shows a change in operating frequency of only 4 kHz (0.00002%) with a decrease in temperature of –25 °C, and a change in operating frequency of only 5 kHz (0.00002%) with an increase in temperature of +50 °C. This temperature range represents Pacific Microwave's specified operating range for the DT-200S transmitter.

The operating frequency or frequencies of the DT-200S are determined at the time of manufacture and are programmed into the PLL systhesizer by PMR technicians to conform with the customer's license parameters. The frequencies are selected by a ten position rotary switch operated by the user. For units operating under Part 74, the frequencies are limited to the bands of 1990 – 2110 MHz, and 2450 – 2483.5 MHz pursuant to §74.602. For units operating under Part 90, the frequencies are limited to the

band of 2450 – 2500 MHz pursuant to §90.20. The frequency of operation cannot be modified in the field to operate outside the licensed band.

If a failure were to occur in the PLL circuitry that controls the operating frequency of the unit, the PLL UNLOCK pin is connected to the voltage regulator that supplies power to the final amplifier in such a manner as to inhibit rf transmission from the unit under such a condition.

Table 3 shows test results for the DT-200S operating in Part 90. Table shows test results for the DT-200S operating in Part 74.

Case Temp °C	Frequency of Operation MHz	RF Power Output dBm
-30	2458.994	+22.5
-20	2458.994	+22.5
-10	2458.995	+22.0
-5	2458.997	+22.0
0	2458.999	+22.0
10	2459.000	+21.5
20	2459.001	+21.0
30	2459.001	+21.0
40	2459.002	+21.0
50	2459.004	+20.5
60	2459.005	+19.5
70	2459.006	+19.0

Table 3. Frequency & Power Output vs. Case Temperature (Part 90)

Case Temp °C	Frequency of Operation MHz	RF Power Output dBm
-30	2078.494	+22.7
-20	2078.495	+22.6
-10	2078.496	+22.2
-5	2078.497	+22.0
0	2078.498	+22.0
10	2079.500	+21.5
20	2079.500	+21.5
30	2079.501	+21.0
40	2079.501	+21.0
50	2079.503	+21.0
60	2079.504	+20.5
70	2079.505	+20.0

Table 4. Frequency & Power Output vs. Case Temperature (Part 74)

Exhibit pursuant to 47CFR 2.1053 – Field Strength of Spurious Radiation

The Pacific Microwave EUT DT-200S transmitter was tested while operating at full power output into a 50Ω, 10W, microwave power load as shown in Figure 4 (§2.1051 and §2.1053). The purpose of this test was to determine if excessive cabinet radiation is emitted from the EUT DT-200S during normal operation. The DT-200S is housed in an aluminum enclosure to provide the highest possible mechanical and electrical integrity. The test was conducted using the spectrum analyzer as a detector with a λ/4 wavelength antenna connected to the analyzer through an 18" piece of RG-223 coaxial feedline. The antenna length was adjusted for resonance at each harmonic frequency above the fundamental up to the 10th harmonic. The detector antenna was placed in the near field of the transmitter and the analyzer was tuned from the fundamental to the 10th harmonic (§2.1057(a)(2)). No spurious or harmonic emissions were detectable from the EUT during this test. The noise floor of the spectrum analyzer is –90 dBm. Figure 7 shows the test set-up used for testing in both Part 90 and Part 74.

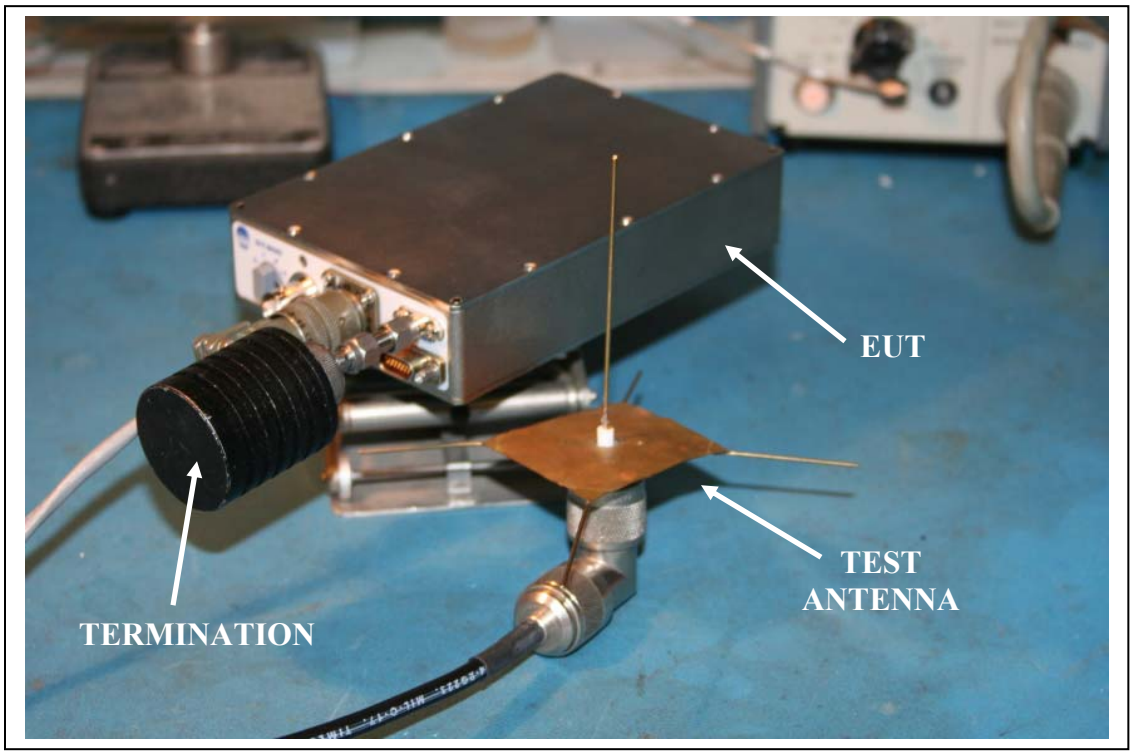


Fig 7. Test Set-up for Spurious Radiation Measurements

Exhibit pursuant to 47CFR 2.925 – Identification of Equipment

Following issuance of the Certification of the PMR DT-200S, each unit will be affixed with an identification label per §2.926 containing the equipment model number, description, part number, serial number, and FCC Identifier as shown in Figure 8.

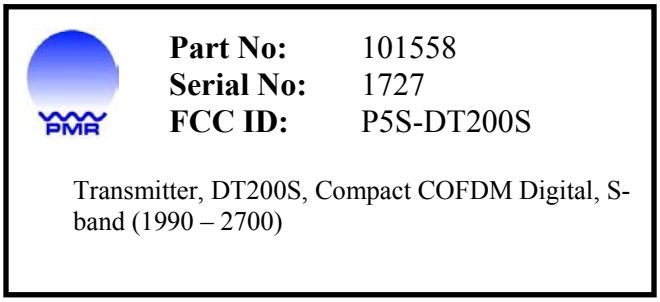


Fig 8. Vinyl Equipment ID label affixed to DT-200S transmitter

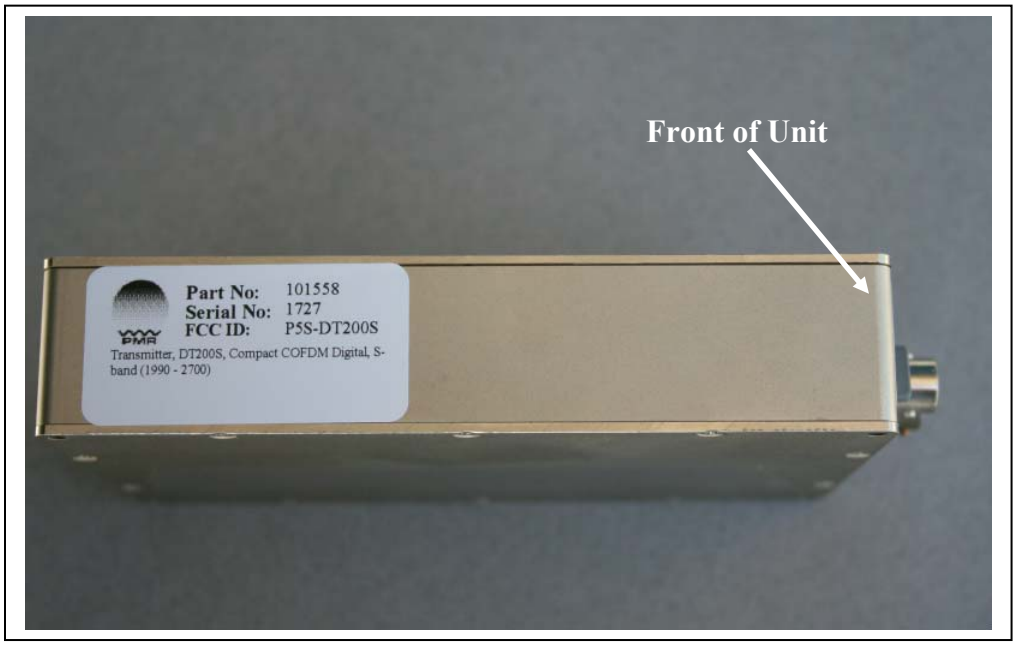


Fig 9. DT-200S with FCC ID Label

Exhibit Showing Exterior and Interior of EUT DT-200SS

Fig 10. DT-200S Front Side

Fig 11. DT-200S Rear Side

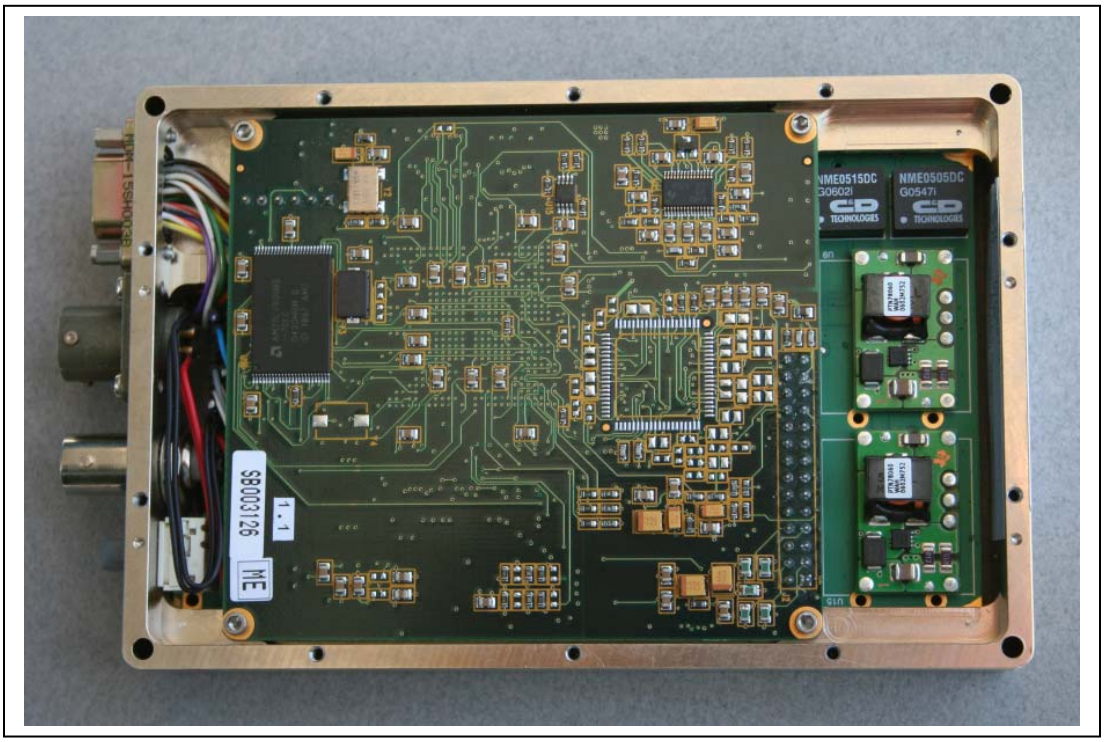
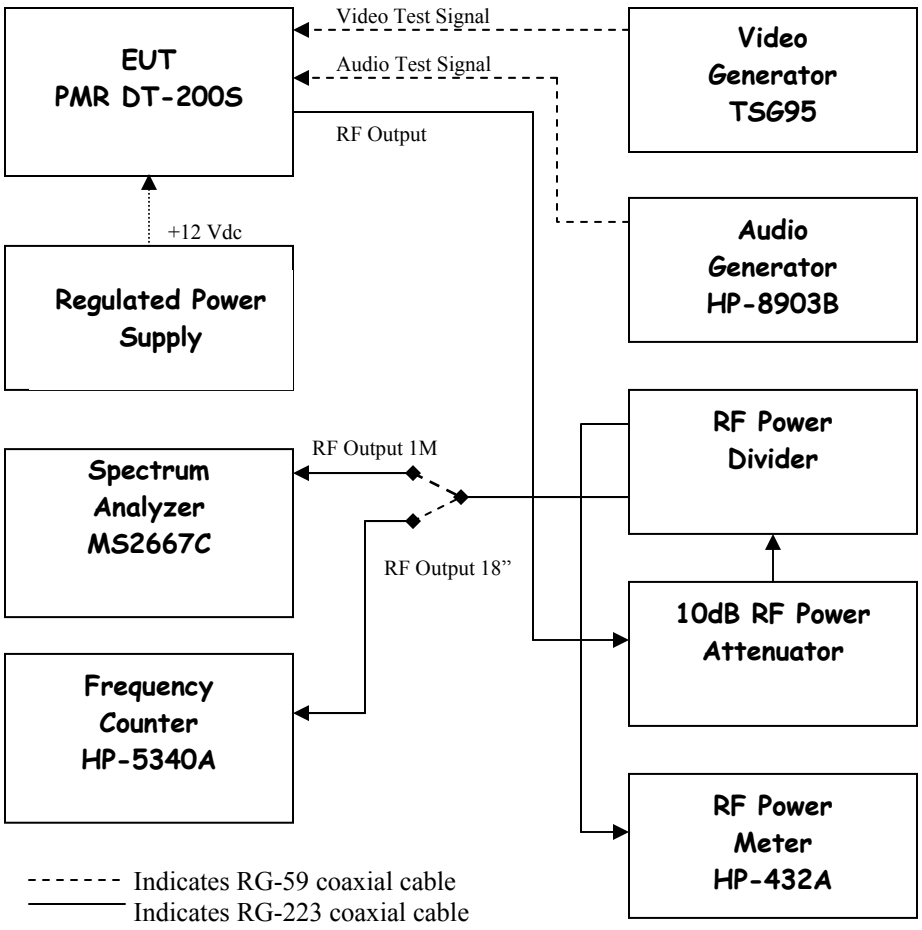


Fig 12. DT-200S Interior Bottom

Fig 13. DT-200S Interior Top

Block Diagram of PMR DT-200S Test Set-Up for FCC Certification Testing



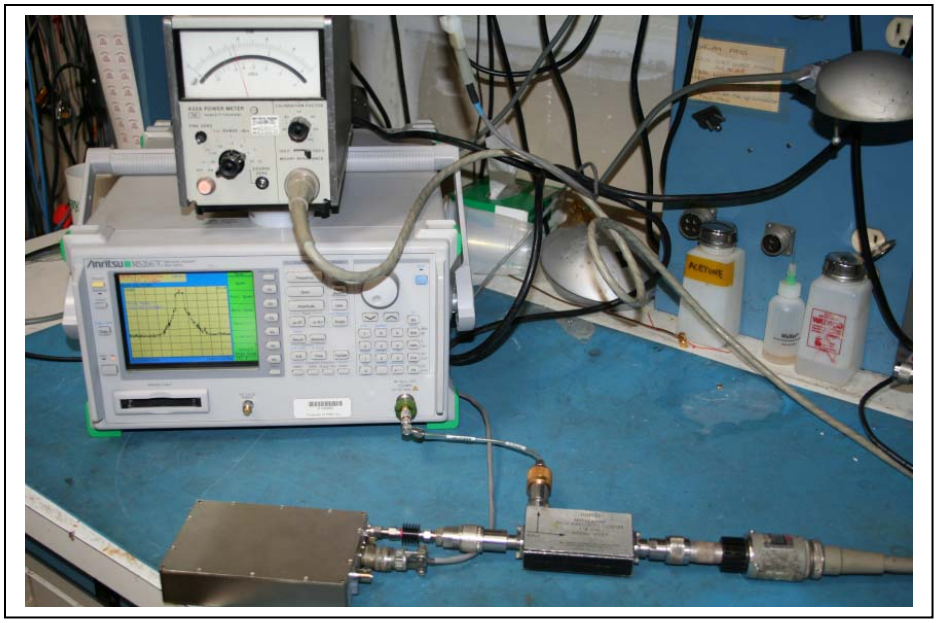


Fig 14. DT-200S Bench Test Set-Up for Certification Testing

Description of Test Set-up

The test set-up used for compliance testing of the EUT DT-200SS utilizes the complement of modern electronic microwave test equipment located at PMR to support design and testing of the company's products. The primary test set-up is as follows (reference the above block diagram):

The EUT power, video, and audio test signals are input through the front panel connectors. Test signals are provided by calibrated test equipment using standard formats and levels in conformance with EIA Specification RS-250C. A primary voltage of +12 Vdc as applied to the EUT during the testing process. The input voltage was varied over the acceptance range for one test to verify transmitter power output over the allowable voltage input range. The rf output of the EUT is connected from the transmitter SMA connector through an attenuator to a microwave power divider. The power divider is used to split the signal for connection to the input of a frequency counter or spectrum analyzer (depending on the measurement desired) as well as directly to an rf power meter. Each port of the power divider represents a reduction in power by -3 dB. The insertion loss of the attenuator and power divider must be factored into any measurements made downstream. High quality microwave connectors and interconnect cabling was used throughout the test set-up and subsequent procedures to minimize system losses and unwanted coupling that could have resulted in erroneous measurements.