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:

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FRN # 0006-0883-48

Grantee Code – P5S

Product Model # - AT-100S

Point of Contact:

Administrative

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President, PMR

Technical

Mr. A. David Dirdo
Chief Technical Officer, PMR

August 22, 2002

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 AT-100S, 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 signals 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 AT-100S 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 sheet that accompanies each unit manufactured. The testing for this submission was conducted at PMR's design and manufacturing facility located at 832 Hampton Court, 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 (AT-100S) 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 June 18, 2002 by the undersigned.

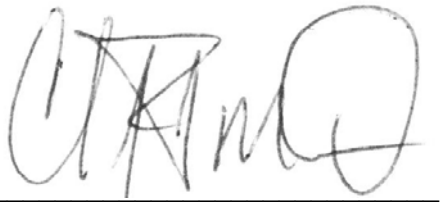
Test Conductor:

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 AT-100 transmitter is rated at 2.0W output power over the operating voltage and frequency range. At no time will the transmitter exceed the maximum power output of 5W as required by §90.205(l) or 12W as required by §74.636. The data tabulated below in Table 1. was compiled by PMR using the EUT AT-100 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 at two different frequencies and three different input voltages (§2.1055(d)).

Input Voltage Vdc	Frequency of Operation MHz	RF Power Output Watts
10.5	2475.56	2.0
12.0	2475.56	2.0
14.0	2475.56	2.0
10.5	2458.58	2.1
12.0	2458.58	2.1
14.0	2458.58	2.1

Table 1. Frequency & Power Output vs. Input Voltage

Exhibit pursuant to 47CFR 90.207 – Types of Emissions

The Pacific Microwave Research AT-100 transmitter is designed to transmit one NTSC (EIA 250C) or PAL compatible television signal utilizing frequency modulation (FM). Additionally, up to two audio channels may be transmitted on independent subcarriers. These audio subcarriers are nominally at 6.2 MHz and 6.8 MHz (subcarrier frequiencies are available from 4.83 MHz through 8.0 MHz) and are injected at -30 dBc. The emission designator of this complex modulation is **16M∅F8W** as per §2.201.

Exhibit pursuant to 47CFR 90.209 – Bandwidth Limitations

The occupied bandwidth per §2.202 of the Pacific Microwave Research AT-100 transmitter when fully modulated transmitter is ~16 MHz with a main carrier peak deviation of ± 4MHz. This can be calculated using Carson's Rule assuming the following:

2M + 2D = Occupied Bandwidth

Where: **M** = subcarrier frequency of 8.0 MHz (highest modulating frequency)
D = subcarrier deviation (± 0.075 MHz)

Then: Occupied Bandwidth = (2 x 8.0) + (2 x 0.075)
or **OB** = 16.0 + 0.15 = **16.15 MHz**

In order to establish compliance with §90.209, the AT-100 is factory calibrated for maximum deviation using the Bessel Null function assuming a nominal video input level of 1 Vp/p. Figure 1. is a spectrograph showing the first carrier null and the main carrier deviation of $\pm$ 4 MHz (§2.1049). The deviation control is factory set and is not user accessible. Likewise, the deviation of the audio subcarriers is set at the factory and not adjustable by the user. Figure 2. depicts the EUT AT-100 modulated with SMPTE bars (§2.1047(d)).

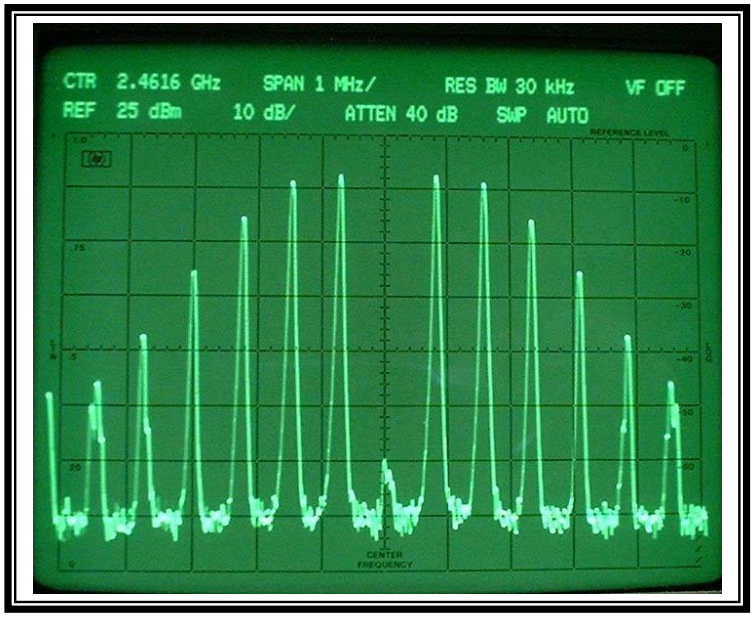


Fig 1. AT-100 Spectrograph of First Carrier Null

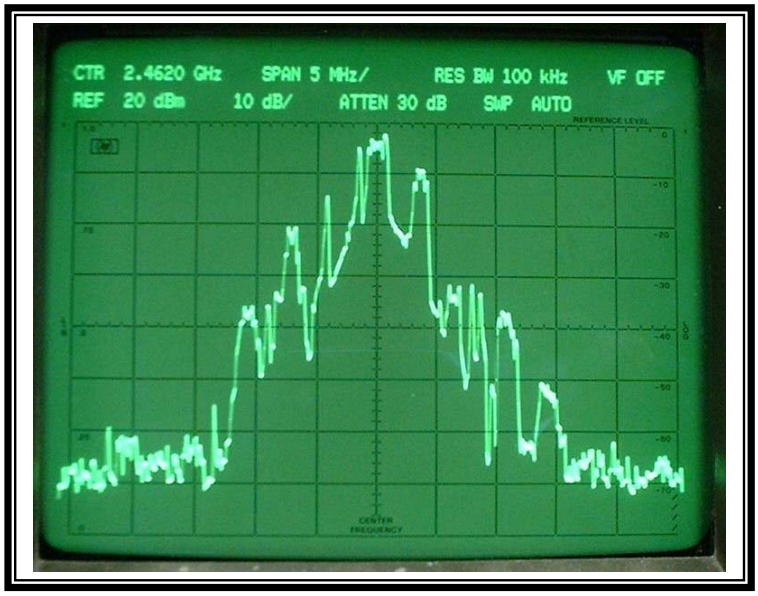


Fig 2. AT-100 Spectrograph of Complex Modulation

Exhibit pursuant to 47CFR 90.210 – Emission Masks

The Pacific Microwave AT-100 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 (LPF 3300) between the power amplifier output stage and the antenna terminal (§2.1033(c)(10). An internal unsaturated ferro-magnetic isolator (ISO1) 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 (16M∅F8W**)** and is not applicable in this case. With respect to §90.210(c)(2) and §74.637, emissions removed from the unmodulated fundamental by 45 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. 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 AT-100 transmitter measured +20 dBm on the spectrum analyzer before the notch filter was inserted in circuit. The level of the second harmonic is measured at –42 dBm on the analyzer placing the second harmonic at –62 dBc with respect to the unmodulated 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 3 shows the unmodulated main and subcarriers of the EUT AT-100 at the second harmonic frequency.

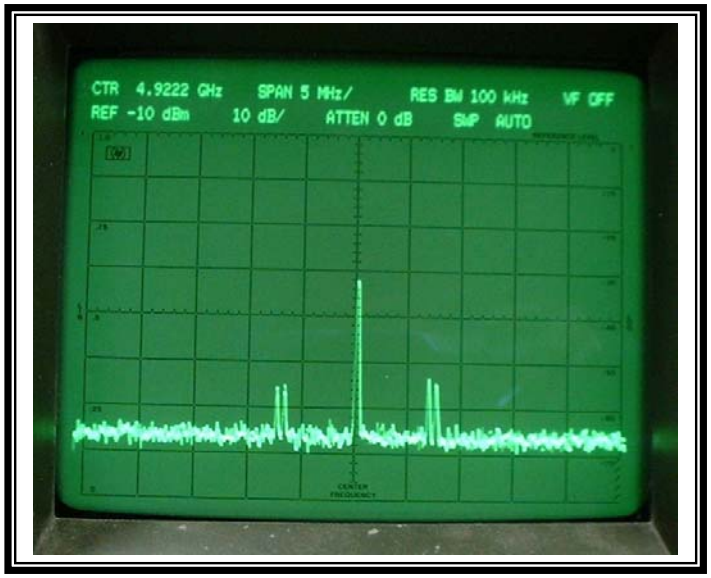


Fig. 3 AT-100 2nd Harmonic Emission –62 dBc

Exhibit pursuant to 47CFR 90.213 – Frequency Stability

The Pacific Microwave EUT AT-100 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 AT-100 is determined by Y1, the reference crystal in the Phase Lock Loop circuit. Crystal Y1 is an 8 MHz crystal with an inherent stability of ±0.002% (§2.1033(c)(10)). Assuming room temperature operation at +20 °C, the data in Table 2 shows a change in operating frequency of only 20 kHz (0.0008%) with a decrease in temperature of –25 °C, and a change in operating frequency of only 20 kHz (0.0008%) with an increase in temperature of +50 °C. This temperature range represents Pacific Microwave's specified operating range for the AT-100 transmitter.

The operating frequency or frequencies of the AT-100 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[1]. The frequencies are selected by a sixteen position rotary switch operated by the user. For units operating under Part 90, the frequencies are limited to the band of 2450 – 2500 MHz pursuant to §90.20. For units operating under Part 74, the frequencies are limited to the band of 1990 – 2110 MHz pursuant to §74.602. The frequency of operation cannot be modified to operate outside the licensed band in the field.

If a failure were to occur in the PLL circuitry that controls the operating frequency of the unit, the PLL UNLOCK indicator 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.

Case Temp °C	Frequency of Operation MHz	RF Power Output Watts
-30	2458.60	2.1
-20	2458.60	2.1
-10	2458.60	2.1
-5	2458.60	2.1
0	2458.60	2.1
10	2458.59	2.0
20	2458.58	2.0
30	2458.58	2.0
40	2458.58	2.0
50	2458.58	2.0
60	2458.59	1.9
70	2458.60	1.8

Table 2. Frequency & Power Output vs. Case Temperature

[1] A special version of the AT-100 is available to military and government users only operating on NTIA frequencies to allow the user to select the operating frequency in 1 MHz steps.

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

The Pacific Microwave EUT AT-100 transmitter was tested while operating at full power output into a 50Ω, 25W, 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 AT-100 during normal operation. The AT-100 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 superflex 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 –75 dBm.

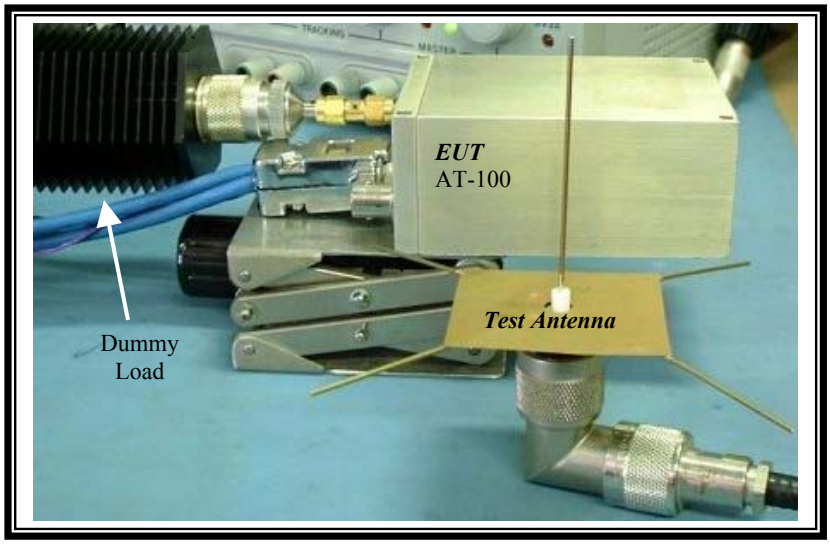


Fig 4. Test Set-up for Spurious Radiation Measurements

Exhibit pursuant to 47CFR 2.925 – Identification of Equipment

Following issuance of the Certification of the PMR AT-100, 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 5.

Pacific Microwave Research, Inc.

Model: AT-100S
Description: Microwave Transmitter
Part Number: AT-100S-N-16-34
S/N: ATS-XXXXX
FCC ID: P5S-AT100S

Fig 5. Metallic Equipment ID label affixed to AT-100 transmitter

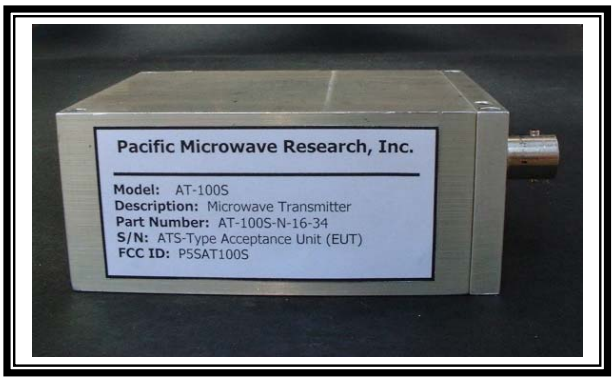


Fig 6. AT-100S with FCC ID Label

Exhibit Showing Interior and Exterior of EUT AT-100S

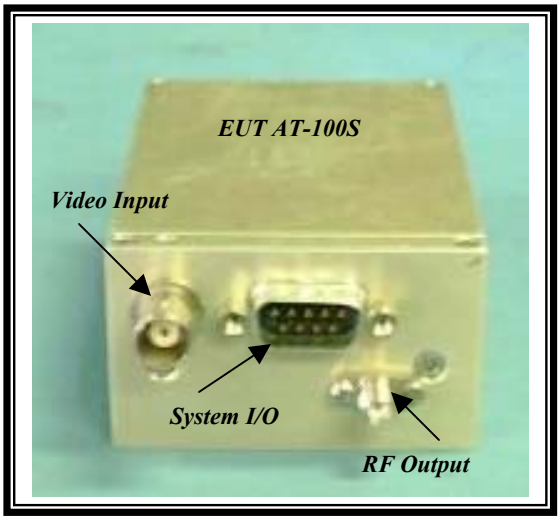


Fig 7. AT-100S Front Panel

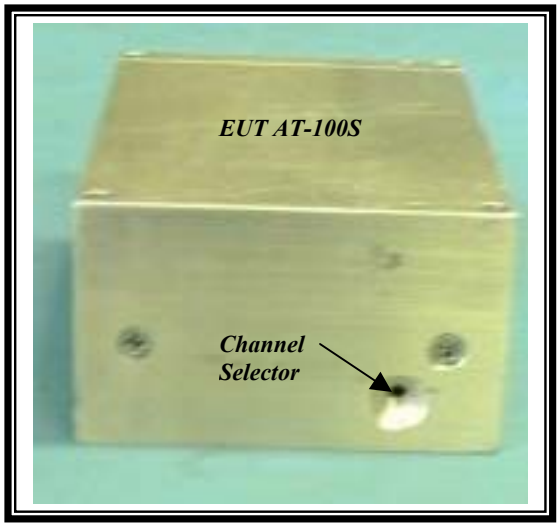


Fig 8. AT-100S Rear Panel

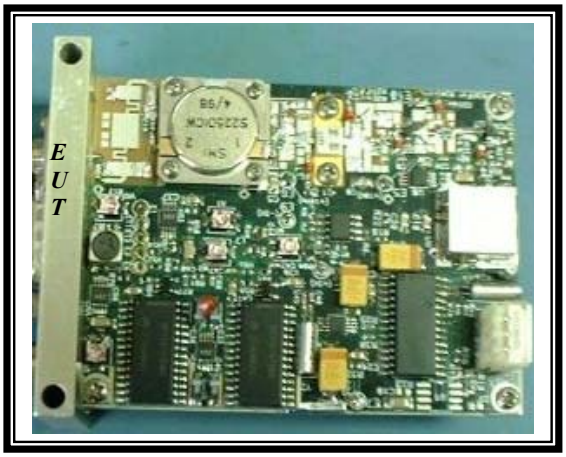


Fig 9. AT-100S RF Board

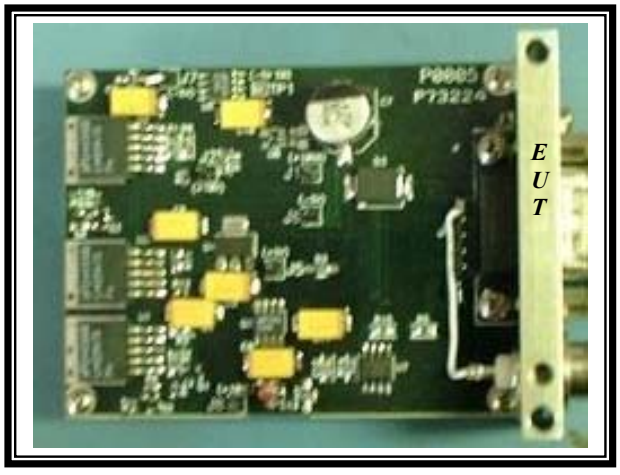
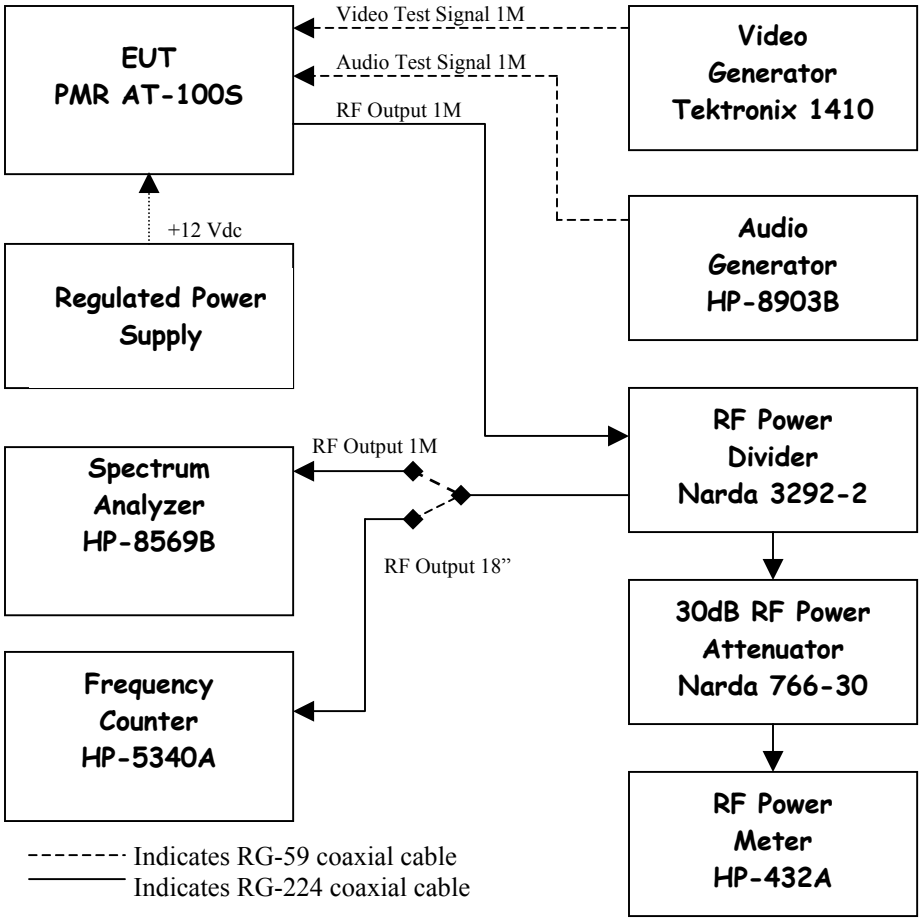


Fig 10. AT-100S Power Supply

Block Diagram of PMR AT-100 Test Set-Up for FCC Certification Testing



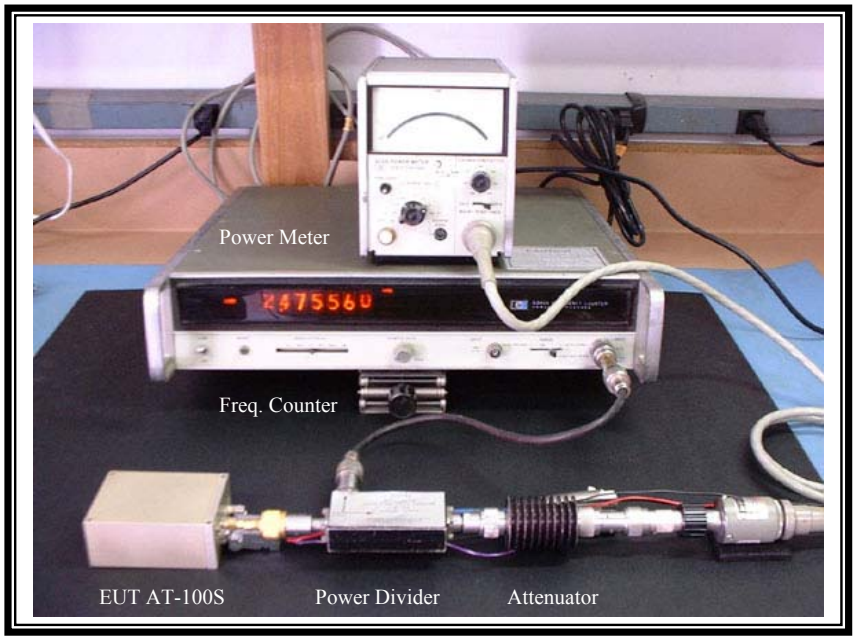


Fig 11. AT-100 Bench Test Set-Up for Certification Testing

Description of Test Set-up

The test set-up used for compliance testing of the EUT AT-100S 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 DB-9M connector. Modulation 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 only 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 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. This difference must be factored into any measurements made downstream. An additional power attenuator is inserted between one of the power divider ports and the test equipment to provide another 30 dB of signal loss. Again, this intentional loss 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.