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.
832 Hampton Court
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Tel: 760-631-6885
www.pmicrowave.com

FRN # 0006-0883-48

Grantee Code – P5S

Product Model # - AT-100S

Point of Contact:

Administrative

Mr. Christopher M. Durso
President, PMR

Technical

Mr. A. David Dirdo
Chief Technical Officer, PMR

August 09, 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.

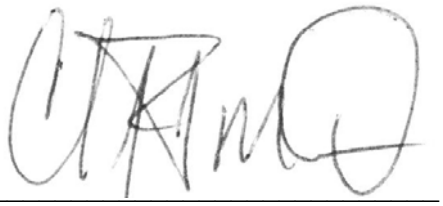
Test Conductor:

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 test was run at two different frequencies and three different input voltages.

Input Voltage Vdc	Frequency of Operation MHz	RF Power Output Watts
10.5	2475	2.0
12.0	2475	2.0
14.0	2475	2.0
10.5	2458	2.1
12.0	2458	2.1
14.0	2458	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 $\pm$ 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 ($\pm$ 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. 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.

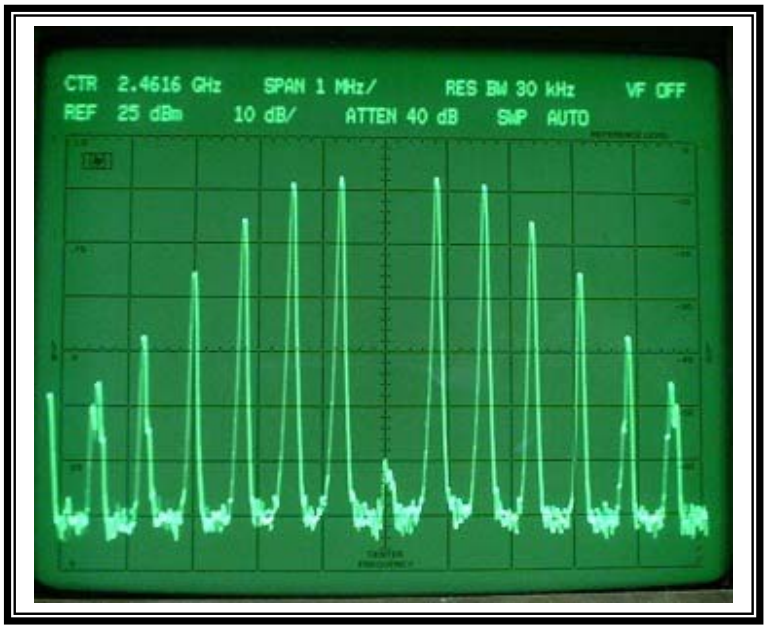


Fig 1. AT-100 Spectrograph of First Carrier Null

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 between the power amplifier output stage and the antenna terminal. 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 (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.

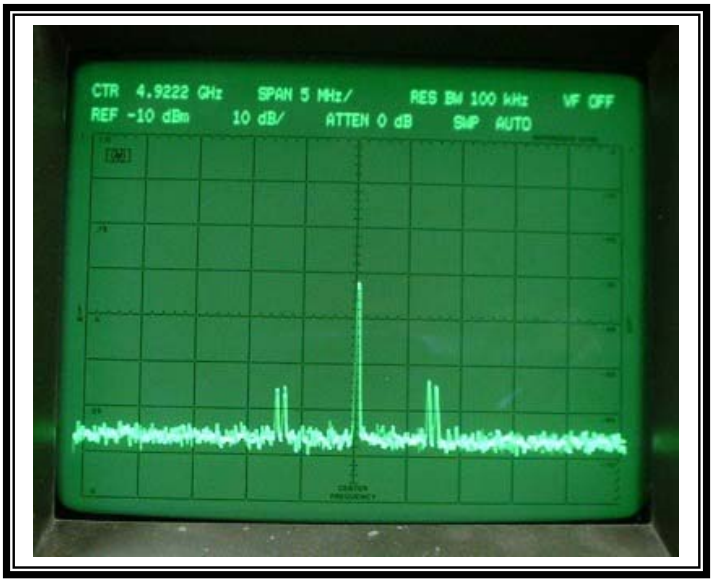


Fig. 3 AT-100 2nd Harmonic Emission –62 dBc

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. 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%. 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. 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. No spurious or harmonic emissions were detectable from the EUT during this test. The noise floor of the spectrum analyzer is –75 dBm.

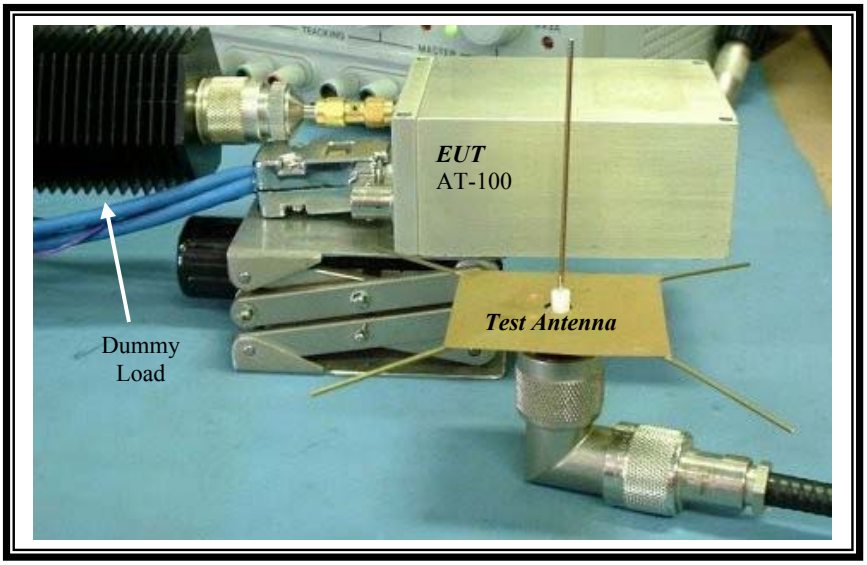


Fig 4. Test Set-up for Spurious Radiation Measurements

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

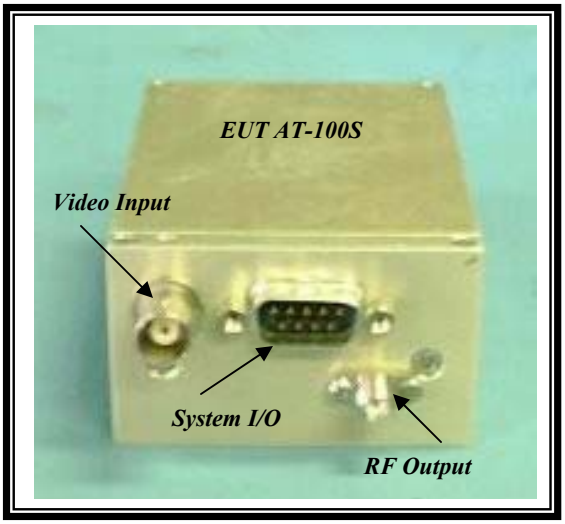


Fig 7. AT-100S Front Panel

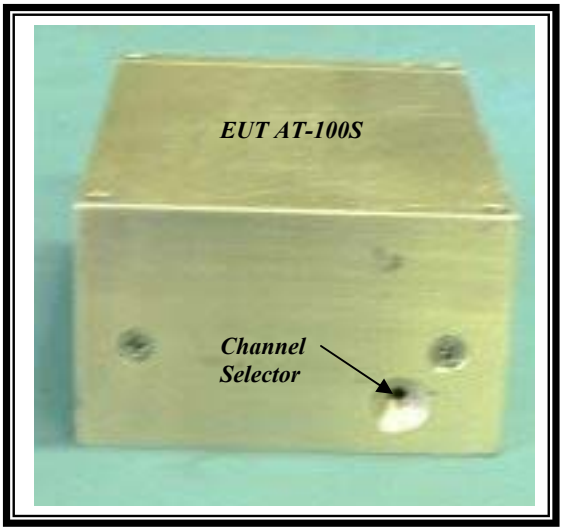


Fig 8. AT-100S Rear Panel

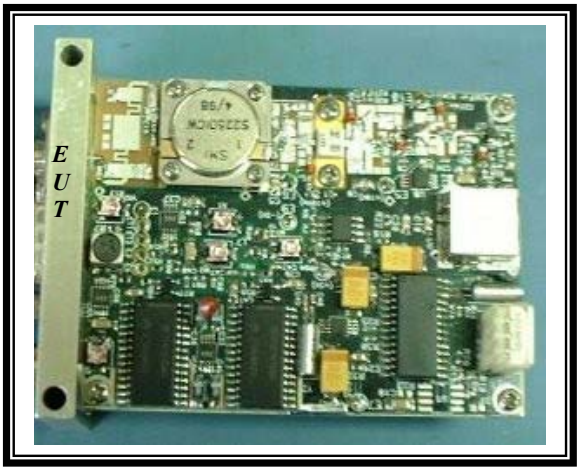


Fig 9. AT-100S RF Board

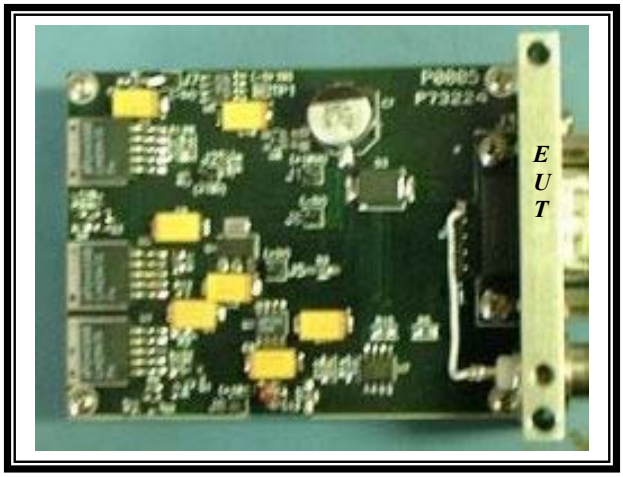
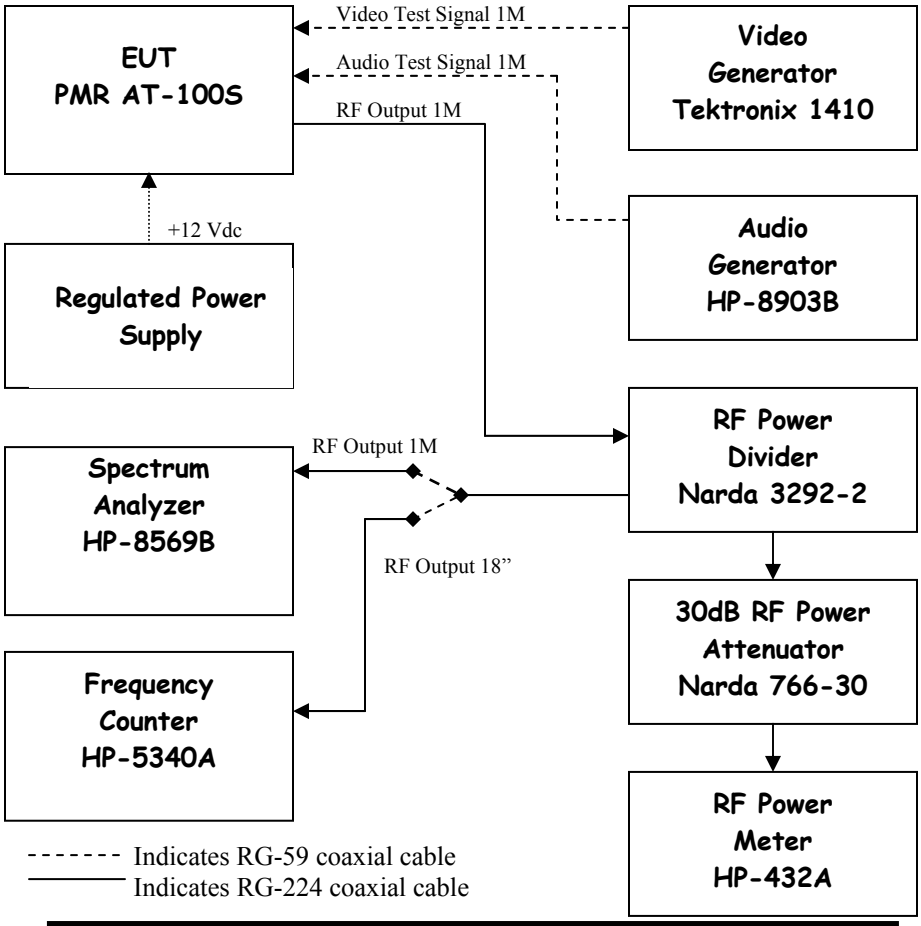


Fig 10. AT-100S Power Supply

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



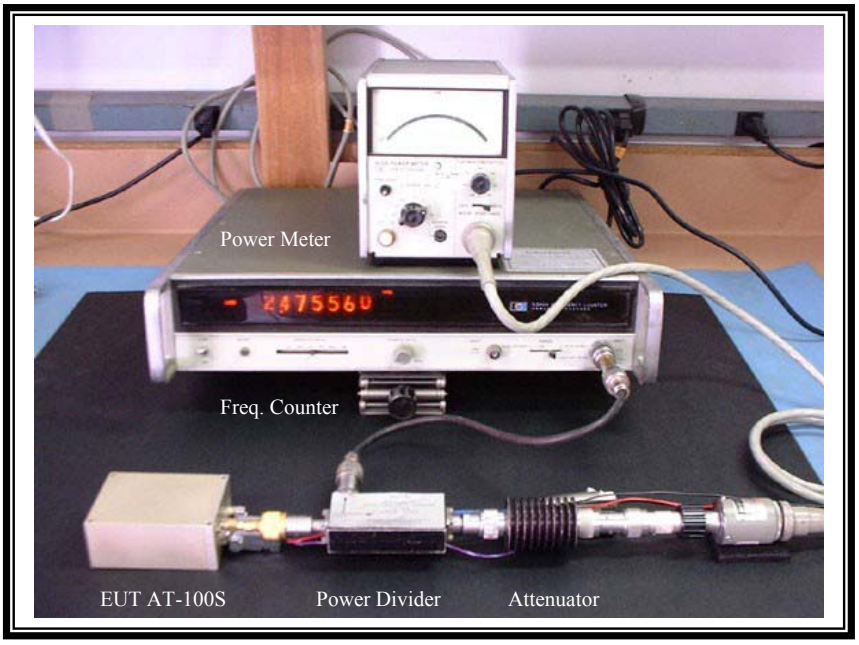


Fig 11. AT-100 Bench Test Set-Up for Certification Testing

Description of Test Set-up

The test set-up used for compliance testing of the EUT AT-100S utilizes the complement of electronic 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.

APPENDIX

PMR AT-100S Schematic Diagrams

PMR AT-100 Series Data Sheet

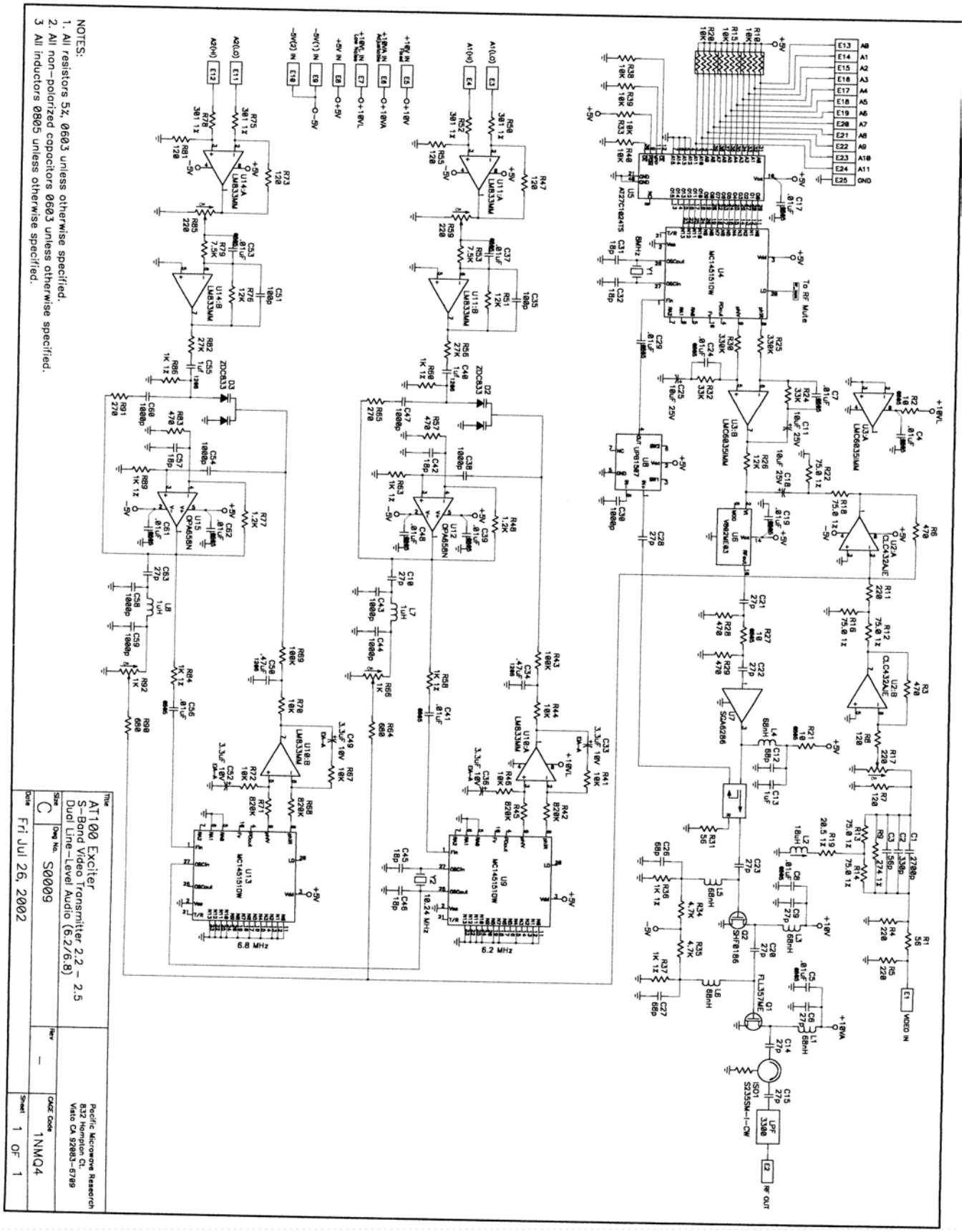
PMR AT-100 Series Transmitter Test Data Sheet

PMR AT-100 Series Tune-up Procedure

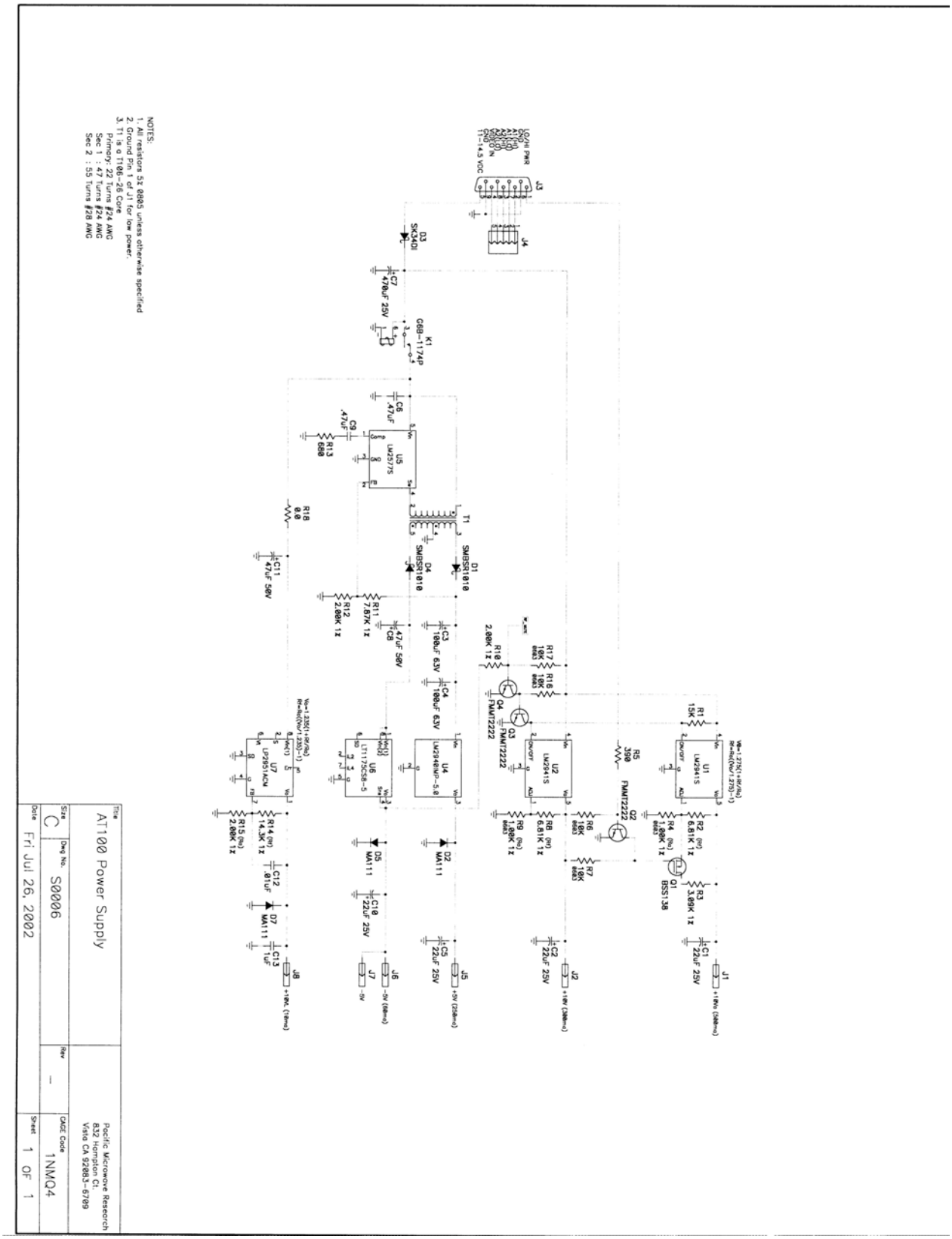
PMR AT-100S Bill of Materials

PMR AT-100 Users Manual

PMR AT-100S Schematic Diagrams



AT-100S Transmitter Video/Audio/RF Schematic



AT-100S Transmitter Power Supply Schematic

PMR AT-100 Series Data Sheet

AT Series Microwave Video and Audio Transmitter

Pacific Microwave Research, Inc.

www.pmicrowave.com

- High Performance Microwave Video Transmitter
- Up to Two Audio Channels Available
- High/Low Power Selection
- L, S, and C – Band Models
- Multi-Channel Selection or 1 MHz Steps
- Ferrite Isolator Output
- NTSC or PAL Standard
- Rugged Packaging

AT Series Microwave Video and Audio Transmitter

The AT Series from Pacific Microwave Research brings a new level of performance and reliability to video and audio transmission. Available in L, S, and C – Bands, the AT-100 provides a minimum of 3W of power into any load. A low power selection is available for applications were power consumption is critical or link margin is sufficient. Packaged in a rugged aluminum housing, the single-board electronics construction lends the AT Series to applications where severe environmental conditions are the norm. Frequency selection is controlled by a sixteen-position selector switch or by an optional BCD code plug for remote control in 1 MHz steps. A comprehensive front panel 9-pin connector provides quick and easy integration into any system without expensive specialized connectors. Two balanced audio subcarriers may be factory selected to any frequency between 5.5 to 7.5 MHz and configured for either microphone or line level. Video and audio pre-emphasis may be set to either the NTSC or PAL standard. The AT Series transmitter is well suited for applications in surveillance, law enforcement, military UAV and RPV, remote broadcast, video production, and airborne data/telemetry.

Pacific Microwave Research, Inc.
832 Hampton Court, Vista, CA 92083
Tel: (760) 631-6885 www.pmicrowave.com

AT Series Microwave Video and Audio Transmitter

Technical Specifications

Electrical:

- Frequency Range
  - AT 100L – 1.7 to 1.9 GHz
  - AT 100S – 2.2 to 2.5 GHz
  - AT 100C1 – 3.2 to 3.5 GHz
  - AT 100C2 – 4.4 to 5.0 GHz
- Ferrite Isolator Output Protection
- VSWR – Infinite (open or short)
- Modulation – True FM
- Modulation Sense – Positive
- Frequency Stability – ±0.002%
- Emphasis – NTSC or PAL
- Spurious/Harmonic Output – > -65 dBc
- Analog or Digital Input filtering options
- Video Input Impedance – 75 Ω unbalanced
- Video Input Response – 10 Hz to 4.5 MHz
- Video Input Sensitivity – 8 MHz/Volt
- Audio – any two between 5.5 to 7.5 MHz
  - Phase Lock Loop
  - 20 Hz to 20 kHz ±1.5 dB
    - 600 Ω Balanced Input
    - Microphone or Line Level
- Power Output
  - High Power – 3.0 W nominal
  - Low Power – 0.3 W nominal

Environmental:

- Operating temperature: -10 to +65 °C
- Relative Humidity: 0 to 95%, non-condensing

Mechanical:

- 9-pin full function I/O connector
- Dimensions – 1.5 H x 2.5 W x 3.5 L inches
- Video Input – BNC female
- Housing – milled aluminum
- Weight – 6.0 oz.
- RF Output – SMA female

Options:

VID-1	NTSC format
VID-2	CCIR format
FRQ-0	Fixed Frequency Single Channel
FRQ-X	X number of channels (16 max.)
FRQ-BCD	Frequency Selection via BCD
SUB-1	Any frequency between 5.5 to 7.5 MHz (mic or line level)
SUB-2	Any frequency between 5.5 to 7.5 MHz (mic or line level)

Accessories:

Antennas: A complete line of antennas for a variety of applications is available.

Pacific Microwave Research, Inc.
832 Hampton Court, Vista, CA 92083
Tel: (760) 631-6885 www.pmicrowave.com

PMR AT-100 Series Transmitter Test Data Sheet

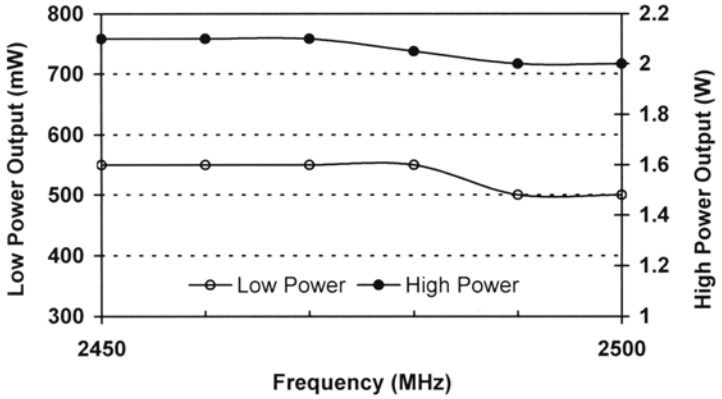
Pacific Microwave Research, Inc.
832 Hampton Ct.
Vista, CA 92083

Date	June 18, 2002
Customer	PMR
P.O. #	Internal

TEST DATA RECORD

Unit Type: Video Transmitter, 2 W
Model #: AT100
Part #: 100270
Serial #: FCC EUT

Freq. Range: 2.4-2.5 GHz
Channels/Steps: 1 MHz steps
Input Voltage Range: 11 – 14.5 Vdc
FCC Identifier: n/a



Test Parameters	
Input Voltage	+12 Vdc
Ambient Temp.	25 °C
Input Signal	1.0 V_{p-p}

Max. Current (High): 1.2 A

Max. Current (Low): 0.7 A

VSWR Max: Infinite

Subcarriers	Aud. #1	Aud. #2
Frequency (MHz)	6.2	6.8
Response (kHz) ± 1 dB	16	16
Deviation (± kHz)	75	75
Input Signal (Vp-p)	6	6
Pre-Emphasis (µS)	75	75
Balanced Impedance (Ω)	600	600

Unit Characteristics	
Input Impedance	75 Ω
Output Impedance	50 Ω
Pre-Emphasis	525 Line
Connectors	
Modulation Input	BNC Female
RF Output	SMA Female
Power – I/0	9 pin D-Sub Male
Frequency Select	Not Installed

Notes:
DB-9 Pin 1 Ground = Low Power
DB-9 Pin 1 Open = High Power

Audio 1 Input = Line Level
Audio 2 Input = Line Level

Power Connector J3 Pinout	
1 = Low Pwr Select	6 = Ground
2 = Audio 1 Hi	7 = Audio 1 Lo
3 = Audio 2 Hi	8 = Audio 2 Lo
4 = Aux Video In	9 = Ground
5 = +12 Vdc In	Use DB9-F

Tech/Date: _____

Eng./Date: _____

Q.C./Date: _____

Frequency Select Connector Pinout – N/A		
1 = 1	6 = 20	11 = 400
2 = 2	7 = 40	12 = n.c.
3 = 4	8 = 80	13 = n.c
4 = 8	9 = 100	14 = n.c.
5 = 10	10 = 200	15 = Ground

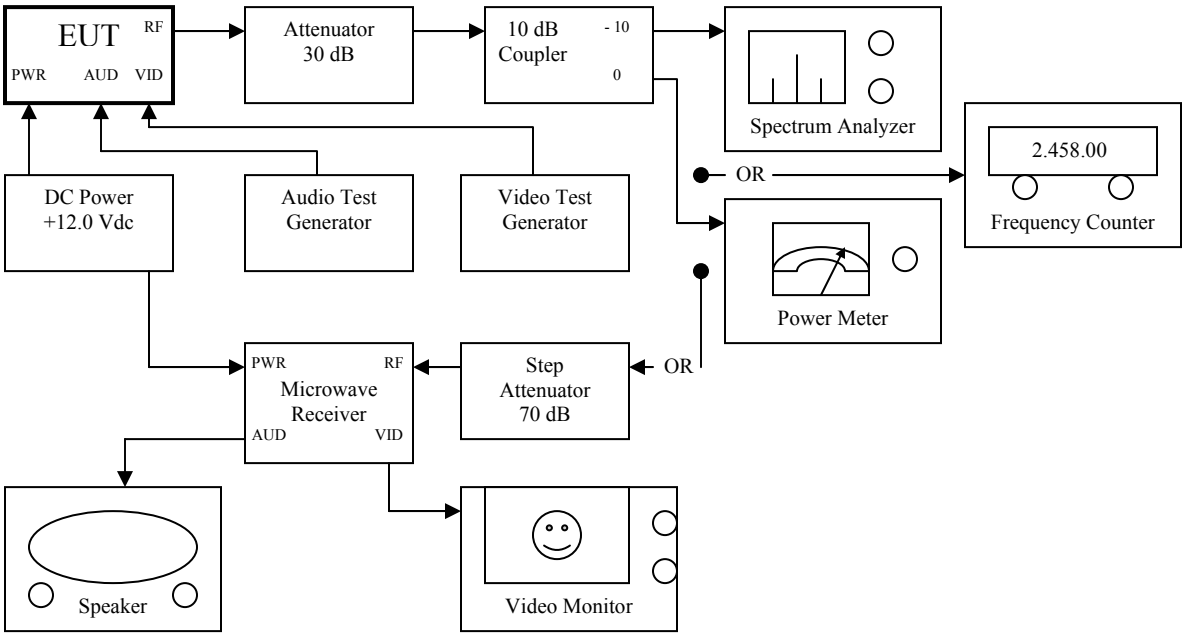
PMR AT-100 Series Tune-up Procedure

Pacific Microwave Research, Inc.
832 Hampton Court
Vista, CA 92083
760.631.6885

Test Date: _____
Test Technician: _____
Test Status: _____ **Pass** _____ **Fail**
Order Number: _____

Transmitter Tune-up Test Procedure
For AT-100 Series

Bench Set-up Block Diagram



Test Procedure

☐ **1.0** Set-up EUT in accordance with block diagram above.

2.0 Transmitter Tune-up

☐ **2.1** Turn on power supply and note indications on power meter and spectrum analyzer. Carrier should be "locked" on frequency (CH1) and output power should be around 2.0 W. If carrier is not "locked" the unit must be returned to an assembly technician for re-work.

☐ **2.2** Current draw should be around 1.1 A for 2.0 W output power.

☐ **2.3** Note the power output level (CH1) and enter it into the test data sheet.

☐ **2.4** Switch to low power mode (CH1) and measure the power output level. Enter this level into the test data sheet.

2.5 Disconnect the power meter from the coupler and connect this port to the frequency counter input. Verify proper operational frequencies per the programming chart using the frequency counter.

2.6 Reconnect the power meter and measure the power output in high power and low power modes at each channel. Enter this data into the test data sheet.

2.7 Select the channel with the highest output power level and note the current flow as indicated on the power supply. Enter that value in the test data sheet.

2.8 Switch to low power and select the channel with the highest power output level and note the current flow as indicated on the power supply. Enter that value in the test data sheet.

3.0 Main Carrier Modulation Set-up

3.1 Adjust Spectrum Analyzer for a frequency span of 2 MHz/Div. Adjust amplitude reference level to 0 dB.

3.2 Set the video test generator to output 761 kHz at 162 mV-RMS.

3.3 Carefully adjust video adjustment pot (R17) while observing the spectrum analyzer for first carrier null. Adjust for the best possible null. The deviation is now set for $\pm$ 4 MHz.

3.4 Set the video test generator for SMPTE Bars and observe the modulation on the spectrum analyzer.

4.0 Subcarrier Injection Level Set-up

4.1 Adjust Spectrum Analyzer for a frequency span of 2 MHz/Div. Adjust amplitude reference level to 0 dB.

4.2 Observe the spectrum analyzer and carefully adjust the level of the lowest frequency subcarrier using the audio 1 subcarrier injection level pot (R66) such that the level of the subcarrier is –28 dBc referenced to the main unmodulated carrier.

4.3 Observe the spectrum analyzer and carefully adjust the level of the highest frequency subcarrier using the audio 2 subcarrier injection level pot (R92) such that the level of the subcarrier is –28 dBc referenced to the main unmodulated carrier.

5.0 Subcarrier Modulation Level Set-up

5.1 Set the output frequency of the audio test generator to 400 Hz and the output level to + 9dBm (for line level) or –50 dBm (for mic level).

5.2 Connect the audio signal to the audio 1 input.

5.3 Adjust the Spectrum Analyzer for a frequency span of 50 kHz/Div.

5.4 Observe the deviation of the subcarrier on the spectrum analyzer and adjust audio level pot (R59) for audio 1 such that the deviation is three units wide ($\pm$75 kHz or 150 kHz p/p).

5.5 Observe the deviation of the subcarrier on the spectrum analyzer and adjust audio level pot (R85) for audio 2 such that the deviation is three units wide ($\pm$75 kHz or 150 kHz p/p).

6.0 Performance Verification

6.1 Set the test receiver to the same frequency as the EUT.

- **6.2** Set the video test generator for SMPTE bars.
- **6.3** Set the audio test generator for 1 kHz at -10 dBm.
- **6.4** Adjust step attenuator and observe the video monitor for a good quality image.
- **6.5** Listen to the speaker and sweep both audio channels from 50 Hz to 20 kHz. Verify good quality audio.

7.0 Final Assembly

- **7.1** Place thermal gap pad on the end of the floor assembly.
- **7.2** Assemble transmitter housing using two #6 pan head screws.
- **7.3** Affix FCC ID label.
- **7.4** Complete all entries in Transmitter Test Data Sheet.

PMR AT-100S Bill of Materials

Bill of Materials

100298

AT100 Power Supply

Part Description	PMR Part	No.Quantity	Reference Numbers
Capacitor, .1uF, 50V, X7R, 0805	100513	1	C: 12
Capacitor, 22uF, 25V, EIAD, Tantalum	100160	7	C: 1, 2, 5, 6, 8, 10, 11
Capacitor, 3.3uF, 25V, Dipped Tantalum	100069	1	C: 13
Capacitor, 470uF, 25V, FC, Electrolytic, G case, SMD	100098	1	C: 7
Connector, D-sub receptacle (DB9), 9 pin, Male, Right-angle .318 mount w Boardlocks	100589	1	J: 3
Connector, Header, 36X1, Male, .100 spacing, head .375 tail .250	100082	11	J: 4(5Pins), 1, 2, 5, 6, 7, 8
Diode, Schottky, MA2YD1500L, MINI-2P	100425	1	D: 1
Diode, Schottky, SK34DI, SMD	100005	1	D: 3
Diode, Switching, MA111, S-MINI	100004	3	D: 2, 5, 7
IC, LM2940IMP-5.0, 5V 1A LDO Regulator, SOT-223	100102	1	U: 4
IC, LM2941S, Adjustable 1 Amp LDO Regulator, TO-263	100159	3	U: 1, 2, 5
IC, LP2951ACM, Adjustable LDO regulator, SO-8	100103	1	U: 7
IC, LT1054CS8, Switched Capacitor Voltage Inverter, SO-8	100029	1	U: 3
IC, LT1175CS8-5, -5V LDO Regulator, SO-8	100104	1	U: 6
IC, MAX6509H, Resistor Programmable Temperature Switch	100297	1	U: 8
PCB, P0005A, AT100 Power Supply	100449	1	PCB

Resistor, 1.00K (1K), 0603, 1%	100088	3	R: 4, 9, 12
Resistor, 1.2K, 0603, 5%	100014	1	R: 3
Resistor, 10K, 0603, 5%	100136	4	R: 6, 7, 16, 17
Resistor, 14.3K, 0805, 1%	100129	1	R: 14
Resistor, 15K, 0805, 5%	100019	1	R: 1
Resistor, 2.00K (2K), 0805, 1%	100076	2	R: 10, 15
Resistor, 30.1 ohm, 0805, 1%	100244	1	R: 18
Resistor, 390 ohm, 0805, 5%	100126	1	R: 5
Resistor, 4.75K, 0805, 1%	100243	1	R: 11
Resistor, 5.36K, 0805, 1%	100386	1	R: 8
Resistor, 6.81K, 0805, 1%	100011	1	R: 2
Transistor, MOSFET, BSS138, SOT-23	100105	1	Q: 1
Transistor, Signal, NPN, FMMT2222ATA, SOT-23	100114	3	Q: 2, 3, 4
Capacitor, .47uF, 25V, 1206, X7R	100077	2	C: 34, 50
Capacitor, 10000p (.01uF), 50V, 0805	100086	16	C: 4, 5, 7, 8, 17, 19, 24, 29, 37, 39, 41, 48, 53, 56, 61, 62
Capacitor, 1000p, 50V, X7R, 0603	100084	9	C: 30, 38, 43, 44, 47, 54, 58, 59, 60
Capacitor, 100p, 50V, 0603	100087	2	C: 35, 51
Capacitor, 10uF, 16V, 1210	100415	3	C: 11, 18, 25
Capacitor, 18p, 50V, 0603	100140	6	C: 31, 32, 42, 45, 46, 57

Capacitor, 1uF, 25V, 1206	100085	3	C: 13, 40, 55
Capacitor, 2700p, 50V, X7R, 0603	100133	1	C: 1
Capacitor, 27p, 50V, 0603	100078	11	C: 6, 9, 10, 14, 15, 20, 21, 22, 23, 28, 63
Capacitor, 3.3uF, 10V, EIAA, Tantalum	100151	4	C: 33, 36, 49, 52
Capacitor, 330p, 50V, 0603	100010	1	C: 2
Capacitor, 56p, 50V, 0603	100131	1	C: 3
Capacitor, 68p, 50V, 0603	100132	3	C: 12, 26, 27
Crystal, 10.240 MHz, Cylinder	100068	1	Y: 2
Crystal, 8.000 MHz, Cylinder	100067	1	Y: 1
Diode, Varicap, ZDC833ATA, SOT-23, Dual	100066	2	D: 2, 3
IC, AT27C1024-xxVx, 64K X 16 EPROM, TSOP-40	100161	1	U: 5
IC, CLC432AJE, Dual Monolithic Op Amp, SO-8	100032	1	U: 2
IC, LM833MM, Dual low noise audio OP amp, MSOP-8	100118	3	U: 10, 11, 14
IC, LMC6035IMM, Dual FET Input Op Amp, MSOP-8	100319	1	U: 3
IC, MC145151DW2, Parallel Input PLL Synthesizer, SOG-28	100157	3	U: 4, 9, 13
IC, SGA-6286, 3.5 GHz 12.4dB Gain Block, SOT-86	100164	1	U: 7
IC, UPB1507GV, MMIC Prescale 3GHz, MSOP-8	100119	1	U: 8
IC, V802ME03, VCO 2275-2475 MHz, MINI-14H	100153	1	U: 6
IC,OPA658N, Current-Feedback Op Amp, SOT-23-5	100023	2	U: 12, 15

Inductor, 18uH, Adjustable, 5CCD, SMD	100071	1	L: 2
Inductor, 1uH, 30%, 0805	100130	2	L: 7, 8
Inductor, 68nH, 5Turns #28AWG Magnet wire on .050 Dia.	100303	5	L: 1, 3, 4, 5, 6
PCB, P0007A, AT100 Exciter, 2.3GHz 1MHz Steps	100453	1	NA
Pot, 1K, 1 Turn, 3mm, Top Adjust, SMT, Linear, Sealed	100008	2	R: 66, 92
Pot, 220, 1 Turn, 3mm, Top Adjust, SMT, Linear, Sealed	100009	3	R: 17, 59, 85
Resistor, 1.00K (1K), 0603, 1%	100088	8	R: 36, 37, 58, 60, 63, 84, 86, 89
Resistor, 1.2K, 0603, 5%	100014	2	R: 48, 77
Resistor, 10 ohm, 0805, 5%	100018	3	R: 2, 21, 27
Resistor, 100K, 0603, 5%	100138	2	R: 43, 69
Resistor, 10K, 0603, 5%	100136	10	R: 33, 38, 39, 40, 41, 44, 46, 67, 70, 72
Resistor, 10K, 1/16W, 5%, Array of 4	100001	3	R: 10, 15, 20
Resistor, 120 ohm, 0603, 5%	100124	6	R: 7, 8, 47, 55, 73, 81
Resistor, 12K, 0603, 5%	100016	3	R: 26, 51, 76
Resistor, 20.5 ohm, 0603, 1%	100094	1	R: 19
Resistor, 220 ohm, 0603, 5%	100013	3	R: 4, 5, 11
Resistor, 270 ohm, 0603, 5%	100125	2	R: 65, 91

Resistor, 274 ohm, 0603, 1%	100095	1	R: 9	D1C7
Resistor, 27K, 0603, 5%	100121	2	R: 56, 82	C3C5
Resistor, 301 ohm, 0603, 1%	100090	4	R: 50, 52, 75, 78	C3B5
Resistor, 330K, 0603, 5%	100017	2	R: 25, 30	D1C2
Resistor, 33K, 0603, 5%	100122	2	R: 24, 32	C3E5
Resistor, 4.7K, 0603, 5%	100012	2	R: 34, 35	C3E1
Resistor, 470 ohm, 0603, 5%	100137	6	R: 3, 6, 28, 29, 57, 83	D1B1
Resistor, 56 ohm, 0603, 5%	100123	2	R: 1, 31	D1A1
Resistor, 680 ohm, 0603, 5%	100015	2	R: 64, 90	C3D1
Resistor, 7.5K, 0603, 5%	100000	2	R: 53, 79	A1A1
Resistor, 75 ohm, 0603, 1%	100089	6	R: 12, 13, 14, 16, 18, 22	C3D5
Resistor, 820K, 0603, 5%	100033	4	R: 42, 45, 68, 71	D1D2
Transistor, GaAsFET, SHF-0186K, SOT-86	100165	1	Q: 2	B2C1

PMR AT-100 Users Manual

Pacific Microwave Research, Inc.

AT-100 Series

Microwave Video and Audio Transmitter

USER'S MANUAL

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S/N _____

1.1 Introduction

The AT-100 Series Microwave Video and Audio Transmitter from Pacific Microwave Research is a compact transmitter designed for short-range transmission applications under FCC Part 90 and Part 74. Common uses include law enforcement surveillance and electronic field production. The AT-100 is a compact unit designed for portable and field applications to transmit remote video to a central receive location. The AT-100 is designed to transmit one NTSC (or PAL) video signal plus two high quality video signals. The AT-100 operates from a 12 Vdc power source and is capable of up to 2 Watts of output power. The AT-100 may be equipped with up to 16 channels consistent with parameters listed on the user's FCC station license.

2.0 Operation

The following section describes the proper operating techniques for the AT-100 Series transmitter including power, antenna, video, and audio connections. The AT-100 generates heat during normal operation. The user should give careful consideration to mounting the transmitter in such as way as to insure heat is directed away from the housing. An external heatsink may be desirable in some operational modes.

2.1 Primary Connections

A number of connections must be made in order for the AT-100 to operate properly. These include dc power; transmit antenna, video input, and audio input.

WARNING

Prior to transmitting, the user should determine the proper frequency or channel of operation. Operating on the wrong frequency could cause interference to other licensed users. Part 90 users may coordinate frequencies through nationally recognized frequency coordination bodies or through local law enforcement user groups. Part 74 users should contact their local frequency coordinator or check www.sbe.org for additional information. Always verify a frequency is not in use before transmitting.

2.1.1 DC Power Input

The AT-100 is designed to operate from a nominal +12 Vdc power source. Power is supplied through the front panel DB-9M connector (J3) with +12 Vdc on Pin 5 and Ground on Pin 9. This source should be fused at 2.0 A. The AT-100 will operate over a voltage range of +11 to +14.5 Vdc. Power consumption at the high power setting (2 W) is nominally 1.2 A. Power consumption at the low power setting (0.5 W) is nominally 0.7 A. The input to the AT-100 is internally protected against reverse polarity. The AT-100 transmitter is operating whenever power is applied.

2.1.2 Antenna

The antenna is connected to front panel female SMA connector (J9). Any resonant antenna is suitable for connection. Antenna type and gain should be determined based upon the intended application. The AT-100 is protected against opens or shorts at the antenna terminal by an internal isolator. Only high quality coaxial cable should be used to interconnect the transmitter and antenna. All SMA connectors should be tightened with the appropriate 5/16" wrench using approximately 5 in./lbs of torque. MAXIMUM TORQUE IS 8 IN./LBS. DO NOT OVERTIGHTEN. Thumb tight connections are not suitable for reliable operation!

2.1.3 Video Input

Video is input to the AT-100 through the front panel BNC connector (J10). This unbalanced input accepts a nominal 1 Vp/p video input. The transmitter may be factory configured for the NTSC or PAL standard. An NTSC transmitter must be used with an NTSC receiver. A PAL transmitter must be used with a PAL receiver. Maintenance of proper video levels is important to prevent over-modulation of the transmitter. High video levels could potentially cause interference to adjacent channel users. Low video levels will result in a lack of luminance at the receiver. Proper link performance demands attention to video levels.

2.1.4 Audio Input

Audio is input to the AT-100 through the front panel DB-9M connector (J3). Typically, the AT-100 is configured for two audio subcarrier channels. Each audio subcarrier has a balanced input with a nominal impedance of 600 Ω. The AT-100 may be factory configured for line or microphone level inputs. Line level audio is typically 0 dBm and microphone level is typically –50 dBm. The input for subcarrier number one is on Pin 2 (+) and Pin 7 (-). The input for subcarrier number two is on Pin 3 (+) and Pin 8 (-). Unbalanced audio may be connected to the subcarrier inputs by connecting the high side of the audio source to the (+) terminals and leaving the (-) terminals unconnected.

3.0 Power Output

The AT-100 is capable of operating at two power levels to fit a variety of operational scenarios. The high power setting is defaulted with no connection to Pin 1 of J3. The nominal power output on high power is 2 W. To select low power, Pin 1 of J3 must be connected to ground. This can be accomplished by placing a jumper in the rear of the mating connector (Pin 6), by a remote switch, or by an open collector transistor junction.

4.0 Frequency Selection

Frequency selection of the AT-100 is accomplished by operation of a 16-position rotary switch located on the rear panel. Use a small flat blade screwdriver or "tweaker" tool to operate the switch. Frequencies are programmed into the transmitter in accordance with the users FCC license parameters. Your radio **(S/N _____)** is programmed as indicated in Table 1.

CH	FREQ MHz
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	

Table 1. AT-100 Channel Assignments

PIN	MHz
1	1
2	2
3	4
4	8
5	10
6	20
7	40
8	80
9	100
10	200
11	400
12	N/C
13	N/C
14	N/C
15	N/C

Table 2. Remote Frequency Control

As an option, users of NTIA frequencies my select the frequency of operation of the AT-100 in 1 MHz steps. This is accomplished by connecting a BCD switch to optional connector J11 in accordance with the pin-out shown in Table 2. This option is only available to government users.

5.0 Specifications

ELECTRICAL

- Frequency Range
  - AT 100L – 1.7 to 1.9 GHz
  - AT 100S – 2.2 to 2.5 GHz
  - AT 100C1 – 3.2 to 3.5 GHz
  - AT 100C2 – 4.4 to 5.0 GHz
- Ferrite Isolator Output Protection
- VSWR – Infinite (open or short)
- Modulation – True FM
- Modulation Sense – Positive
- Frequency Stability – +0.002%
- Emphasis – NTSC or PAL
- Spurious/Harmonic Output – > -65 dBc
- Analog or Digital Input filtering options
- Video Input Impedance – 75 Ω unbalanced
- Video Input Response – 10 Hz to 4.5 MHz
- Video Input Sensitivity – 8 MHz/Volt
- Audio – any two between 5.5 to 8.0 MHz
  - Phase Lock Loop
  - 20 Hz to 20 kHz +1.5 dB
  - 600 Ω Balanced Input
  - Microphone or Line Level
- Power Output
  - High Power – 2.0 W nominal
  - Low Power – 0.5 W nominal

MECHANICAL

- 9-pin full function I/O connector
- Housing – milled aluminum
- Dimensions – 1.5 H x 2.5 W x 3.5 L inches
- Weight – 6.0 oz.
- Video Input – BNC female
- RF Output – SMA female

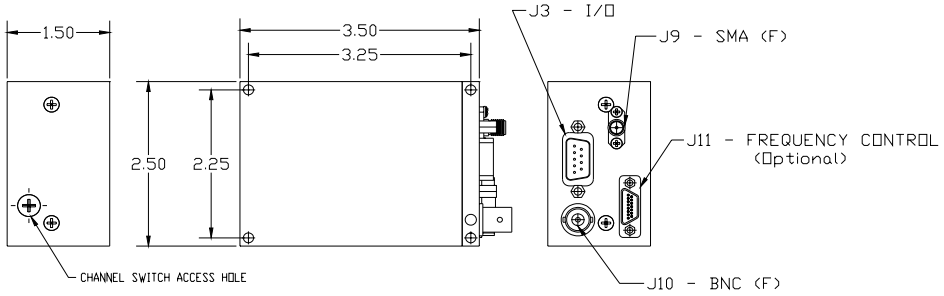
ENVIRONMENTAL

- Operating temperature: -10 to +65 °C
- Relative Humidity: 0 to 95%, non-condensing

ACCESSORIES

- Antennas: A complete line of antennas for a variety of applications is available.
- Weather Resistant Enclosure Transmitter/Heatsink Assembly with Thumbwheel Frequency Control

6.0 Mechanical



7.0 Connector Pin-out

Connector J3 ■ DB-9 Male ■ System I/O
Connector Pinout Data

Pin #	Function
1	Lo/Hi Power – Tie to ground for low power
2	Audio 1 Input (HI)
3	Audio 2 Input (HI)
4	Aux Video Input (parallel with J10 BNC)
5	+11 to +14.5 Vdc – Primary power input
6	Ground
7	Audio 1 Input (LO)
8	Audio 2 Input (LO)
9	Ground

8.0 Repair

There are no user serviceable parts inside the AT-100. Damage to the QC seals on the transmitter voids the warranty. Should your unit require service, contact Pacific Microwave Research, Inc. at 760.631.6885 or www.pmicrowave.com to request an RMA number.

-- End of Submittal --

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