

Nemko Test Report: 1L0269RUS1

Applicant: Grayson Wireless
140 Vista Center Drive
Forest, Virginia 24551

**Equipment Under Test:
(E.U.T.)** GWMT 0820

FCC ID:

In Accordance With: **FCC Part 22, Subpart H**
800 MHz Base Stations

Tested By: Nemko Dallas Inc.
802 N. Kealy
Lewisville, TX
75057-3136

Authorized By:

A handwritten signature in black ink, appearing to read "Tom Tidwell".

Tom Tidwell, RF Group Manager

Date: 7/16/01

Total Number of Pages: 33

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Section 1. Summary of Test Results

Manufacturer: Grayson Wireless

Model No.: GWMT 0820

Serial No.: None

General: **All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 22, Subpart H.



New Submission



Production Unit



Class II Permissive Change



Pre-Production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.

See " Summary of Test Data".



NVLAP LAB CODE: 100426-0

TESTED BY: _____ DATE: _____

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Summary Of Test Data

NAME OF TEST	PARA . NO.	SPEC.	MEAS.	RESULT
RF Power Output	2.1046	500 W ERP	< 500 W	Complies
Audio Frequency Response	2.1047	6dB/Octave	N/A	N/A
Audio Low Pass Filter Response	2.1047	Graph	N/A	N/A
Modulation Limiting	2.1047	Graph	N/A	N/A
Occupied Bandwidth (Voice & SAT)	2.1049	Mask	N/A	N/A
Occupies Bandwidth (WB Data & SAT)	2.1049	Mask	N/A	N/A
Occupied Bandwidth (ST)	2.1049	Mask	N/A	N/A
Occupied Bandwidth (SAT)	2.1049	Mask	N/A	N/A
Occupied Bandwidth (Digital Modulation))	2.1049	Not Specified	N/A	N/A
Occupied Bandwidth (CW)	2.1049	Not Specified	Plot	Complies
Spurious Emissions at Antenna Terminals	2.1051	-13 dBm	< -13 dBm	Complies
Field Strength of Spurious Emissions	2.1053	82.3 dB μ V/m	< -13 dBm	Complies
Frequency Stability	2.1055	2.5 ppm	< 2.5 ppm	Complies

Footnotes:

The device transmits CW carriers only.

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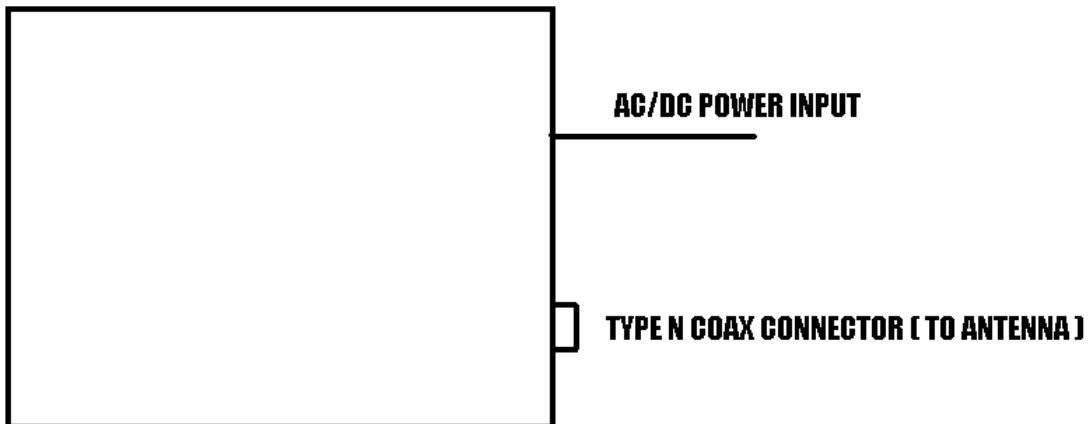
Section 2. General Equipment Specification

Frequency Range:	824.01 – 848.97 MHz 869.01 - 893.7 MHz
Tunable Bands:	824.01 – 848.97 MHz 869.01 - 893.7 MHz
Necessary Bandwidth:	CW
Type of Modulation and Designator:	NON
Output Impedance:	50 ohms
RF Power Output (rated):	20 Watts
Duty Cycle:	Continuous
Channel Spacing:	30 kHz
Operator Selection of Frequency:	Manually Controlled By Operator The device operates over the frequency band of 824.01 to 894.98 MHz. SMR band will be approved for Part 90 operation. Manufacturer prohibits use of the unlicensed band from 849 to 851 MHz with firmware.
Power Output Adjustment Capability:	Manually Controlled By Operator

Operational Description

The GWMT 0820 is a self-contained CW transmitter operating in the cellular band.

System Diagram



Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.1046
TESTED BY: David Light	DATE: 05/31/2001

Test Results: Complies.

Measurement Data:

Frequency (MHz)	Supply Voltage	Output Power (dBm)	Rated Power (dBm)	Measured / Rated (dBm)
836.52	115 VAC (Nominal)	42.5	43	0.99/1
881.52	115 VAC (Nominal)	42.7	43	0.99/1
836.52	98 VAC	42.4	43	0.99/1
881.52	98VAC	42.6	43	0.99/1
836.52	132 VAC	42.4	43	0.99/1
881.52	132 VAC	42.6	43	0.99/1
836.52	13 VDC	42.5	43	0.99/1
881.52	13 VDC	42.6	43	0.99/1
836.52	11 VDC	Stopped Operation	43	N/A
881.52	11 VDC	Stopped Operation	43	N/A
836.52	15 VDC	42.5	43	0.99/1
881.52	15 VDC	42.6	43	0.99/1

Equipment Used: 1604-1065-1046-1036

Measurement Uncertainty: 1.7 dB

Temperature: 22 °C

Relative Humidity: 50 %

NAME OF TEST: Occupied Bandwidth (CW)	PARA. NO.: 2.1047
TESTED BY: David Light	DATE: 5/31/2001

Test Results: Complies.

Measurement Data: See attached graph.

Equipment Used: 1604-1065-1046-1036

Measurement Uncertainty: 1.7 dB

Temperature: 22 °C

Relative Humidity: 50 %

Test Plots – Occupied Bandwidth (CW)



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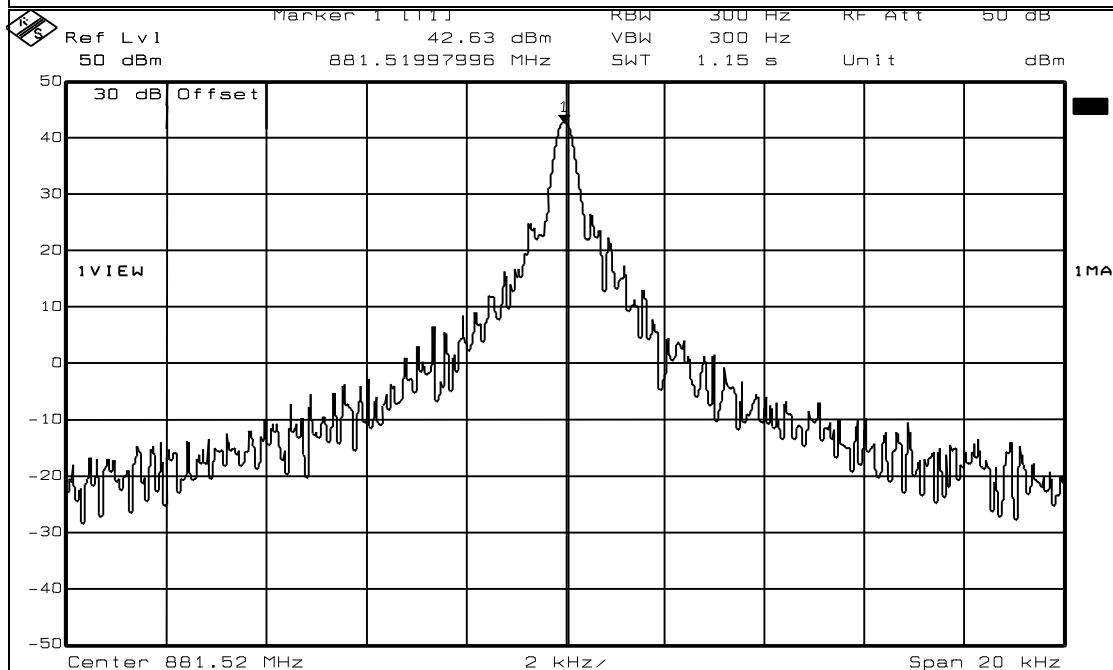
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Data Plot

Page 1 of 2
Job No.: 1L0269R Date: 5/31/01 Complete X
Specification: PART 22 Temperature(°C): 22 Preliminary _____
Tested By: David Light Relative Humidity(%) 50
E.U.T.: GMWT 0802
Configuration: TX FULL POWER
Sample Number: _____
Location: Lab 1 RBW: Refer to plots Measurement
Detector Type: Peak VBW: Refer to plots Distance: N/A m

Test Equipment Used

Antenna: _____ Directional Coupler: _____
Pre-Amp: _____ Cable #1: 1046
Filter: _____ Cable #2: _____
Receiver: 1036 Cable #3: _____
Attenuator #1: 1065 Cable #4: _____
Attenuator #2: 1604 Mixer: _____
Additional equipment used: _____
Measurement Uncertainty: +/-3.6 dB



Date: 31.MAY.2001 14:55:44

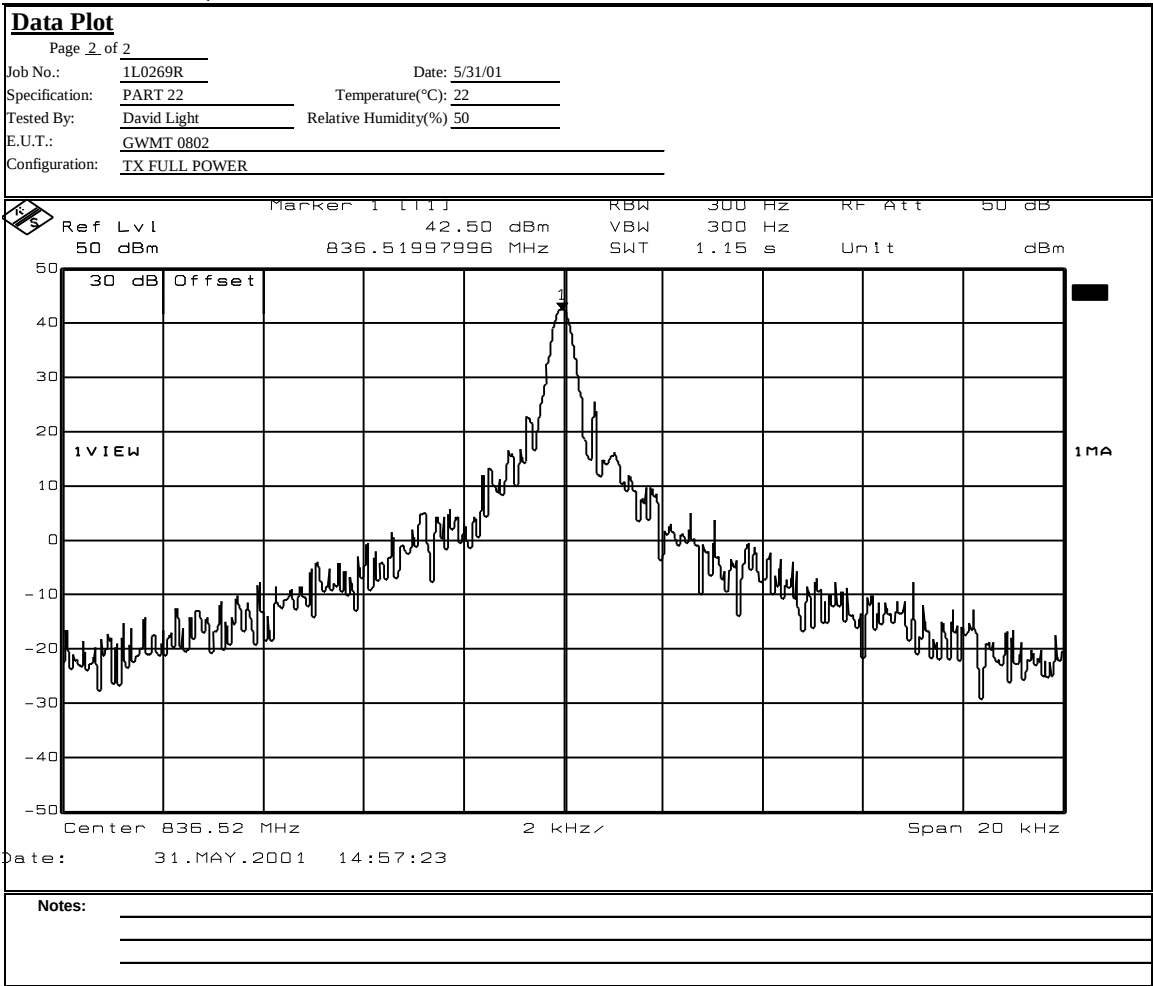
Notes:

Test Plots – Occupied Bandwidth (CW)



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Section 4. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions At Antenna Terminals	PARA. NO.: 2.1051
TESTED BY: David Light	DATE:05/31/2001

Test Results: Complies.

Measurement Data: See attached graph.

Equipment Used: 1604-1065-1046-1036-1060-1081

Measurement Uncertainty: 1.7 dB

Temperature: 22 °C

Relative Humidity: 50 %

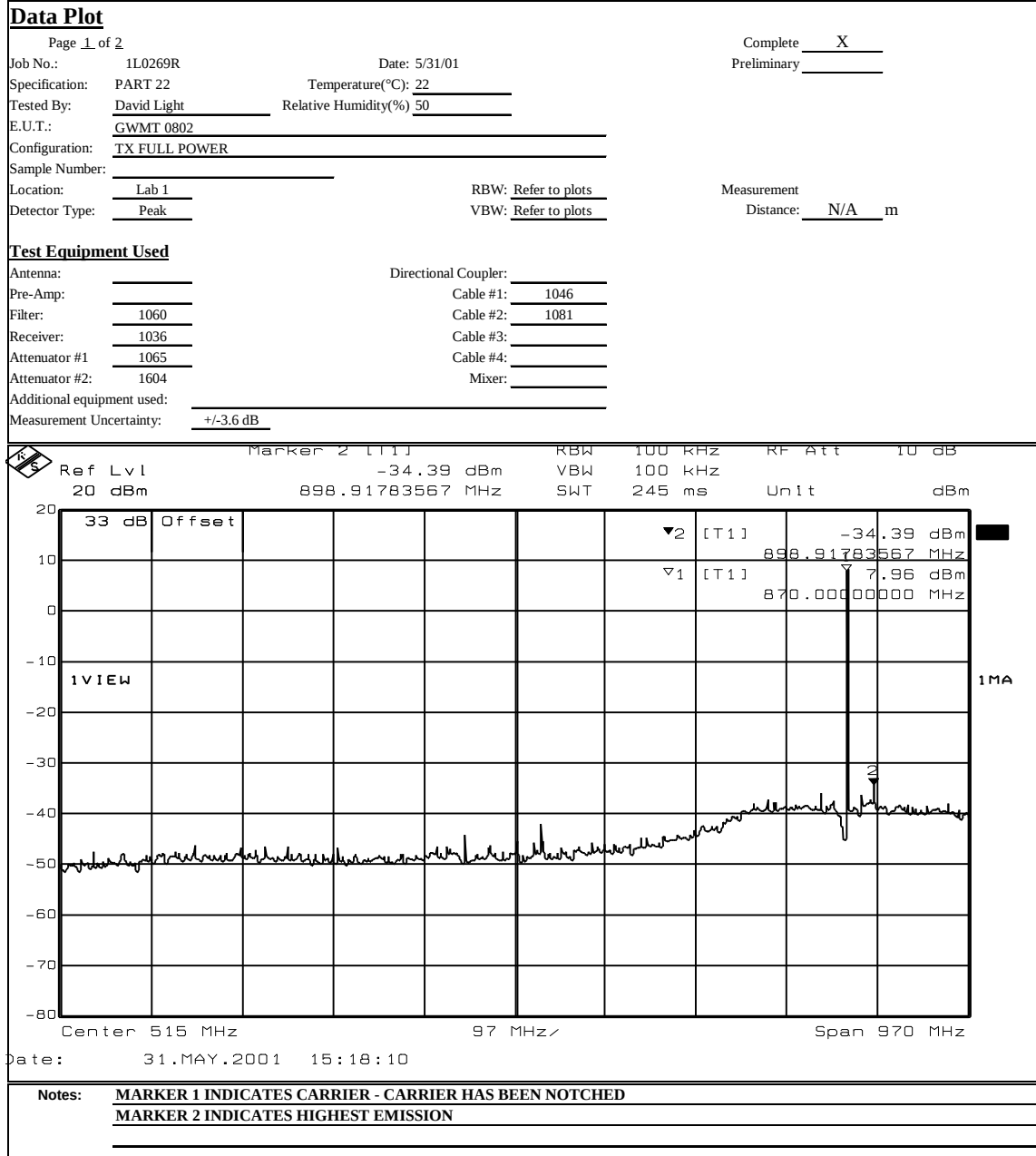
Test Plots – Spurious Emissions at Antenna Terminals



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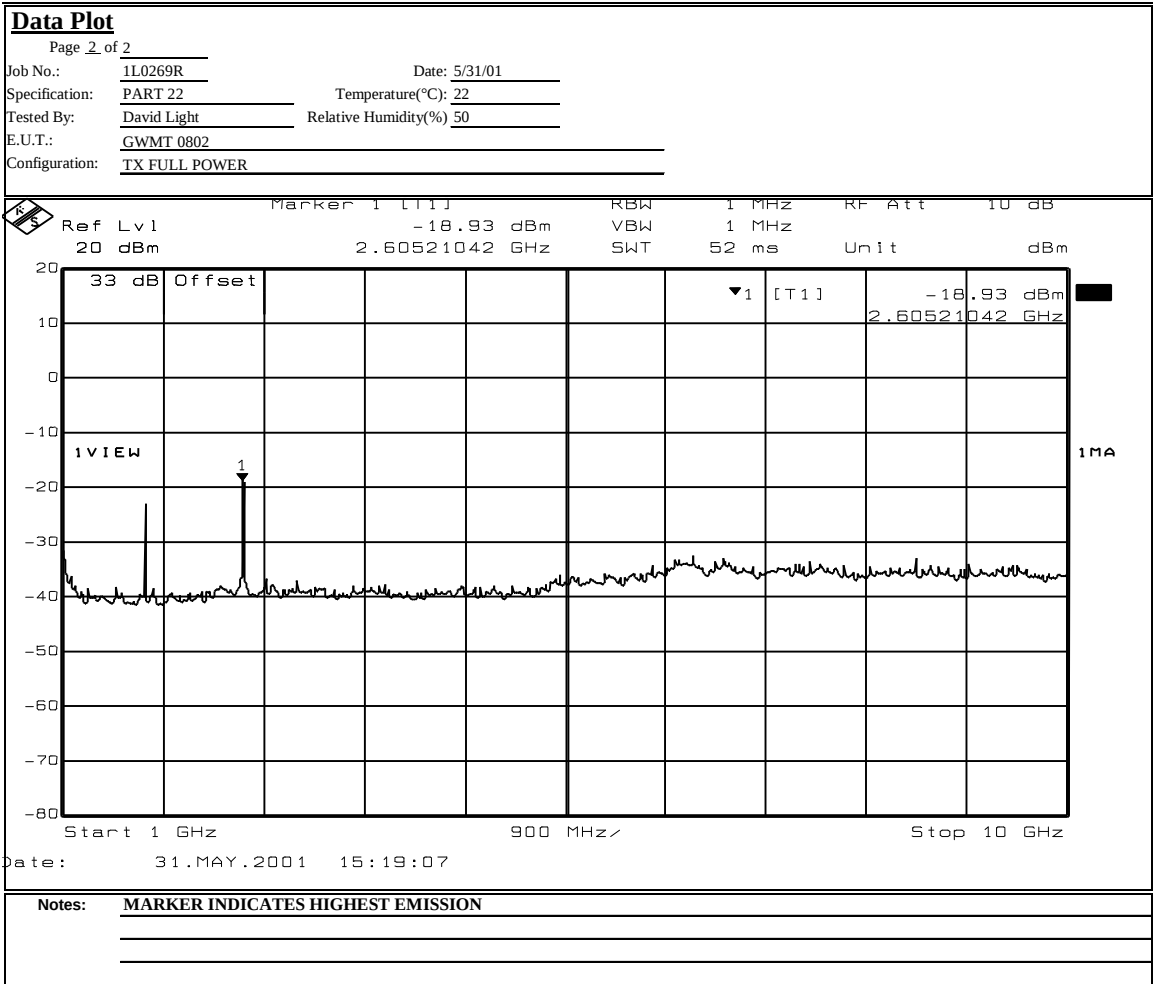


Test Plots – Spurious Emissions at Antenna Terminals



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Section 5. Field Strength of Spurious

NAME OF TEST: Field Strength of Spurious	PARA. NO.: 2.1053
TESTED BY: David Light	DATE: 6/12/2001

Test Results: Complies.

Measurement Data: See attached table.

Equipment Used: 1464-993-1484-1485-1061

Measurement Uncertainty: 1.7 dB

Temperature: 22 °C

Relative Humidity: 50 %

Test Data - Radiated Emissions



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Field Strength of Spurious Emissions

Page 1 of 1
 Job No.: 1L0269R Date: 6/12/01 Complete X
 Specification: Temperature(°C): 22 Preliminary _____
 Tested By: Tom Tidwell Relative Humidity(%) 50
 E.U.T.: GWMT 0820
 Configuration: TRANSMIT FULL POWER
 Sample No: 1
 Location: AC 3 RBW: 300 kHz Measurement
 Detector Type: Peak VBW: 500 kHz Distance: 3 m

Test Equipment Used

Antenna: 993 Directional Coupler: _____
 Pre-Amp: 1016 Cable #1: 1484
 Filter: Cable #2: 1485
 Receiver: 1464 Cable #3: _____
 Attenuator #1: Cable #4: _____
 Attenuator #2: Mixer: _____
 Additional equipment used: _____
 Measurement Uncertainty: +/-3.6 dB

Frequency (MHz)	Meter Reading (dBm)	Correction Factor (dB)		Pre-Amp Gain (dB)	Substitution Antenna Gain (dBd)		ERP (dBm)	ERP (mW)	Polarity	Comments
1704	-55.6	29.9		33.3	6.4		-52.7	0.000005	V	
2556	-64.5	35.6		33.8	8.0		-54.8	0.000003	V	
3408	-69.0	37.1		33.6	8.1		-57.4	0.000002	V	Noise floor
4260	-70.0	42.8		33.5	7.9		-52.8	0.000005	V	Noise floor
8520	-73.0	40.3		34.3	9.9		-57.1	0.000002	V	Noise floor
1704	-57.8	32.7		33.3	6.4		-52.1	0.000006	H	
2556	-66.0	34.6		33.8	8.0		-57.2	0.000002	H	
3408	-69.0	35.8		33.6	8.1		-58.7	0.000001	H	Noise floor
4260	-70.0	35.2		33.5	7.9		-60.4	0.000001	H	Noise floor
8520	-73.0	41.8		34.3	9.9		-55.5	0.000003	H	Noise floor

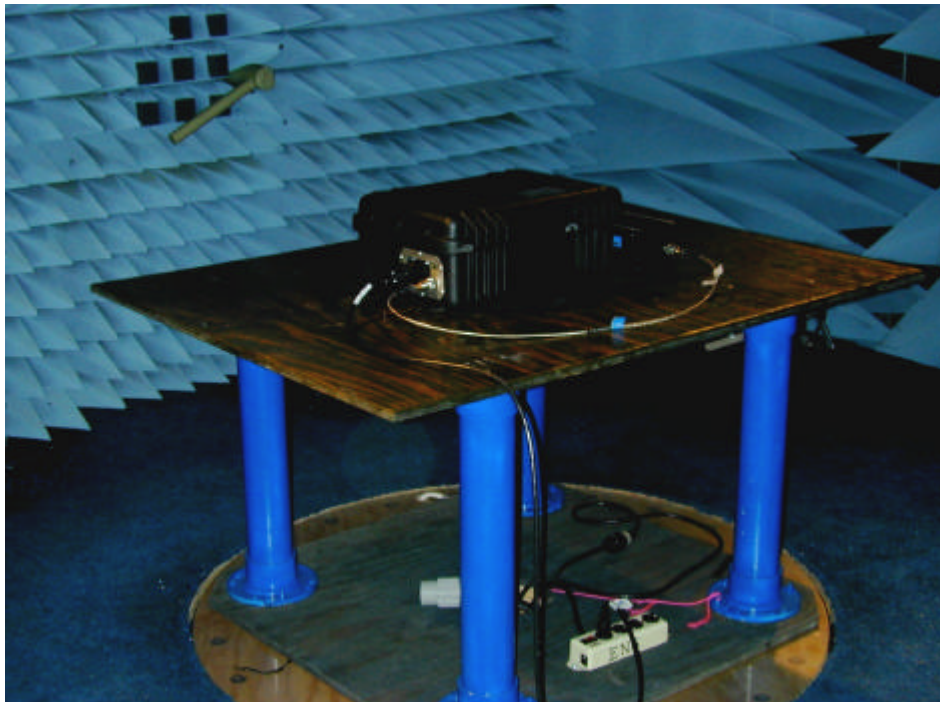
Notes: SCANNED SPECTRUM TO THE 10TH HARMONIC OF CARRIER FREQUENCY

Photographs of Test Setup

FRONT VIEW



REAR VIEW



Section 6. Frequency Stability

NAME OF TEST: Frequency Stability	PARA. NO.: 2.1055
TESTED BY: David Light	DATE: 06/01/2001

Test Results: Complies.

Measurement Data: See attached table.

Standard Test Frequency: 881.52 MHz
Standard Test Voltage 115 VAC
Standard Test Voltage: 13 VDC

Equipment Used: 283-1036

Measurement Uncertainty: 1×10^{-11} ppm

Temperature: 22 °C

Relative Humidity: 50 %

Test Data – Frequency Stability



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Frequency Stability

Client: GRAYSON WIRELESSW.O.# 1L0269REUT: GMWT 0802S/N: NONEDate: 6/1/01Tech: LIGHT

Test Equipment used: 283-1026

Temperature	Voltage	Frequency Error (Hz)
20 °C	115 VAC	-86.000000
20 °C	92 VAC	-90
20 °C	132 VAC	-75
20 °C	13 VDC	+24
20 °C	11 VDC	Stopped Operation
20 °C	15 VDC	-13
10 °C	115 VAC	-223
0 °C	115 VAC	-232
-10 °C	115 VAC	-78
-20 °C	115 VAC	+168
-30 °C	115 VAC	+256
30 °C	115 VAC	-165
40 °C	115 VAC	-380
50 °C	115 VAC	-510

Section 7. Test Equipment List

ASSET	Description	Manufacturer Model Number	Serial Number	Cal. Date	Cal. Due
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	06/14/99	06/14/01
1065	ATTENUATOR	NARDA 776B-10	NONE	CBU	N/A
1604	ATTENUATOR	NARDA 776B-20	NONE	CBU	N/A
1046	Flex cable 1m	Astrolab Inc. 32022-2-29094K-1M	N/A	01/29/01	01/29/02
1060	TUNABLE NOTCH FILTER	K&L 3TNF-500/1000-N/N	162	CBU	N/A
1081	CABLE 2m	Astrolab 32027-2-29094-72TC	N/A	06/04/01	06/04/02
993	Horn antenna	A.H. Systems SAS-200/571	XXX	07/16/99	07/16/01
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	05/30/01	05/30/02
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/02/01	01/02/02
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	05/25/00	05/25/01
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	06/01/01	06/01/02
283	ENVIROMENTAL CHAMBER	ENVIROTRONICS SH27	129010083	05/02/01	05/02/02
1026	FREQUENCY COUNTER	HEWLETT PACKARD 5350B	8232A01493	08/17/00	08/17/01

ANNEX A - TEST DETAILS

NAME OF TEST: RF Power Output**PARA. NO.: 1.1046****Minimum Standard:**

Para. No. 22.913(a). The E.R.P. of mobile transmitter and auxiliary test transmitter must not exceed 7 watts.

EIA is 19B Para. No. 3.2.1.3. The transmitter shall be compiled of 8 distinct power levels.

The output power shown above shall be maintained within the range of +2 dB, -4 dB of nominal dBW value

PL	I	II	III
0	+6	+2	-2
1	+2	+2	-2
2	-2	-2	-2
3	-6	-6	-6
4	-10	-10	-10
5	-14	-14	-14
6	-18	-18	-18
7	-22	-22	-22

Method Of Measurement:Detachable Antenna:

The power at antenna terminals is measured using an in-line power meter.

Integral Antenna:

If the antenna is not detachable from the circuit then the Power Output is derived from the radiated field strength of the fundamental emission by using the plane wave relation $GP/4\pi R^2 = E^2/120\pi$ and proceeding as follows:

$$P = \frac{E^2 R^2}{30G} = \frac{E^2 3^2}{30G}$$

where,

P = the equivalent radiated power in watts

E = the maximum measured field strength in V/m

R = the measurement range (3 meters)

G = the numeric gain of the transmit antenna in relation to a halfwave dipole antenna

NAME OF TEST: Audio Frequency Response	PARA. NO.: 2.1047
---	--------------------------

Minimum Standard:

Para. No. 15-19-B. From 300 to 3000 Hz the audio frequency response shall not vary more than +1 to -3 dB from a true 6dB octave pre-emphasis characteristic as referred to 1000 Hz level (with the exception of a permissible 6dB per octave roll-off from 2500 to 3000 Hz).

Method Of Measurement:

Operate the transmitter with the compressor disabled, and monitor the output with a frequency deviation meter or standard test receiver without standard 750-microsecond de-emphasis, with expander disabled, and without C-message weighted filter (see 6.6.2). Apply a sine wave audio input to the transmitter external audio input port, vary the modulating frequency from 300 to 3000 Hz and observe the input levels necessary to maintain a constant ± 2.9 kHz system deviation.

NAME OF TEST: Audio Low Pass Filter Response	PARA. NO.: 2.1047
---	--------------------------

Minimum Standard:

Para. No. 22.915 (d). For mobile stations, signals must be attenuated as a function of frequency as follows:

- i. In the frequency ranges 3.0 to 5.9 Hz and 6.1 to 15 kHz, 40 log (f/3) dB.
- ii. In the frequency range 5.9 to 6.1 kHz, 35 dB
- iii. In the frequency range above 15 kHz, 28 dB.

Method Of Measurement:

Adjust the audio input frequency to 1000 Hz and adjust the input level to 20 dB greater than that required to produce ± 8 kHz deviation. Note the output level on the frequency deviation meter or standard test receiver. Using the output level as reference (0dB), vary the modulating frequency from 3000 Hz to 30,000 Hz and observe the change in output while maintaining a constant audio input level.

NAME OF TEST: Modulation Limiting**PARA. NO.: 2.1047****Minimum Standard:** Para. No. 22.915(b)

The levels of the modulating signals must be set to the values specified below and must be maintained within $\pm 10\%$ of these values.

Voice: ± 12 kHzSAT: ± 2 kHzWideband Data: ± 8 kHzST: ± 8 kHz**Method Of Measurement:**

Voice: A 1 kHz audio tone is injected at levels between -45 and +20 dBVrms. The peak deviation is noted. This is repeated with a 300 Hz tone and a 3 kHz tone.

SAT: A SAT tone is generated by the mobile station and the peak deviation is measured.

Wideband Data: Wideband data is generated by the mobile station and the peak deviation is measured.

ST: ST data is generated by the mobile station and the peak deviation is measured.

NAME OF TEST: Occupied Bandwidth (Voice & SAT)	PARA. NO.: 2.1049
---	--------------------------

Minimum Standard: 22.917(b) The mean power of any emission removed from the carrier frequency by a displacement frequency (f_d in kHz) must be attenuated below the mean power of the unmodulated carrier (P) as follows:

- (i) On any frequency removed from the carrier frequency by more than 20 kHz but not more than 45 kHz: at least 26 dB
- (ii) On any frequency removed from the carrier frequency by more than 45 kHz, up to the first multiple of the carrier frequency:

at least 60 dB or $43 + 10 \log (P)$ dB, whichever is the lesser attenuation.

Method Of Measurement:

Spectrum Analyzer Settings:

RBW: 300 Hz

VBW: $\geq$ RBW

Span: 100 kHz

Sweep: Auto

Mask: CELLF3E

Input Signal Characteristics (F3E/F3D):

AF1 frequency: 2.5 kHz

AF1 level: 16 dB above the level sufficient to produce ± 6 kHz deviation with a 1 kHz tone.

SAT: 6000 Hz SAT

SAT level: sufficient to produce ± 2 kHz deviation.

NAME OF TEST: Occupied Bandwidth (WBD & SAT)	PARA. NO.: 2.1049
---	--------------------------

Minimum Standard: 22.917(d) The mean power of any emission removed from the carrier frequency by a displacement frequency (f_d in kHz) must be attenuated below the mean power of the unmodulated carrier (P) as follows:

(1) On any frequency removed from the carrier frequency by more than 20 kHz but not more than 45 kHz:

at least 26 dB

(2) On any frequency removed from the carrier frequency by more than 45 kHz but not more than 90 kHz:

at least 45 dB

(3) On any frequency removed from the carrier frequency by more than 90 kHz, up to the first multiple of the carrier frequency:

at least 60 dB or $43 + 10 \log (P)$ dB, whichever is the lesser attenuation.

Method Of Measurement:

Spectrum Analyzer Settings:

RBW: 300 Hz

VBW: $\geq$ RBW

Span: 200 kHz

Sweep: Auto

Mask: CELLF1D

Input Signal Characteristics:

RF level: Maximum recommended by manufacturer

10 kbps WBD + DAT

ST

NAME OF TEST: Spurious Emission at Antenna Terminals	PARA. NO.: 2.1051
---	--------------------------

Minimum Standard: Para. No. 22.917(b). The mean power of emissions must be attenuated below the mean power of the unmodulated carrier on any frequency twice or more than twice the fundamental emission by at least $43 + 10 \log P$. This is equivalent to -13 dBm absolute power.

Method Of Measurement:

Spectrum Analyzer Settings:

RBW: 30 kHz (AMPS). As required for digital modulations.

VBW: $\geq$ RBW

Start Frequency: 0 MHz

Stop Frequency: 10 GHz

Sweep: Auto

NAME OF TEST: Field Strength of Spurious Radiation**PARA. NO.: 2.1053****Minimum Standard:**

Para. No. 22.917(b). The mean power of emissions must be attenuated below the mean power of the unmodulated carrier on any frequency twice or more than twice the fundamental emission by at least $43 + 10 \log P$. This is equivalent to -13 dBm absolute power.

Calculation Of Field Strength Limit:

An example of attenuation requirement of $43 + 10 \log P$ is equivalent to -13 dBm (5×10^{-5} Watts) at the antenna terminal. We determine the field strength limit by using the plane wave relation.

$$GP/4\pi R^2 = E^2/120\pi$$

For emissions ≤ 1 GHz:

$G = 1.64$ (Dipole Gain)

$P = 10^{-5}$ Watts (Maximum spurious output power)

$R = 3\text{m}$ (Measurement Distance)

$$E = \frac{\sqrt{30GP}}{R}$$

$$E = \frac{\sqrt{30 \times 1.64 \times 5 \times 10^{-5}}}{3} = 0.016533 \text{ V / m} = 84.4 \text{ dBmV / m}$$

For emissions > 1 GHz:

$G = 1$ (Isotropic Gain)

$P = 1 \times 10^{-5}$ Watts (Maximum spurious output power)

$R = 3\text{m}$ (Measurement Distance)

$$E = 84.4 - 20 \log \sqrt{1.64} = 82.3 \text{ dBmV / m@3m}$$

The spectrum is searched to 10 GHz.

NAME OF TEST: Frequency Stability**PARA. NO.: 2.1055****Minimum Standard:**

Para. No. 22.355. The transmitter carrier frequency shall remain within the tolerances given in Table C-1.

Freq. Range (MHz)	Mobile > 3 W	Mobile ≤ 3 W
821 to 896	2.5	2.5

Table C-1

Method Of Measurement:Frequency Stability With Voltage Variation:

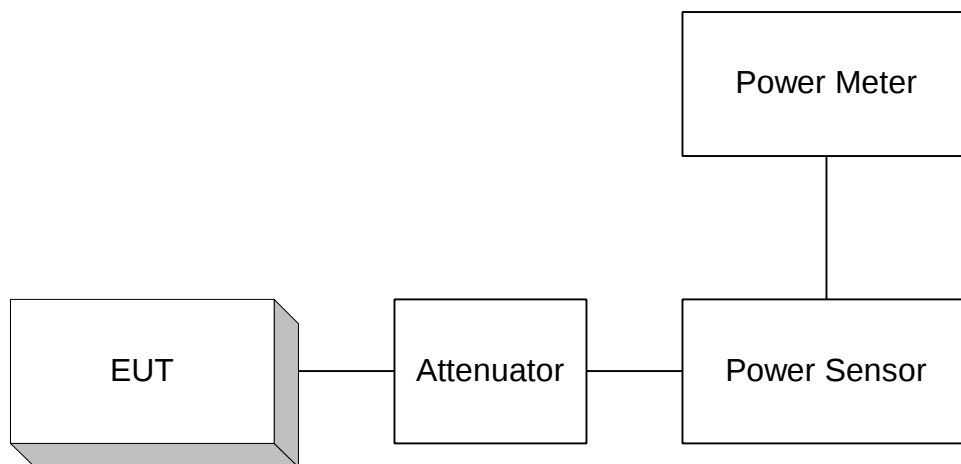
The E.U.T. is placed in an environmental chamber and allowed to stabilize at +20 degrees Celsius for at least 15 minutes. The frequency counter and signal generator are phase locked with the same 10 MHz reference frequency by connecting the 10 MHz ref. out of the counter to the 10 MHz ref, in of the signal generator. With the voltage input to the E.U.T. set to 85% S.T.V., the frequency is measured in 30 second intervals for a period of 5 minutes. This procedure is repeated at 100% S.T.V. and 115% S.T.V.

Frequency Stability With Temperature Variation:

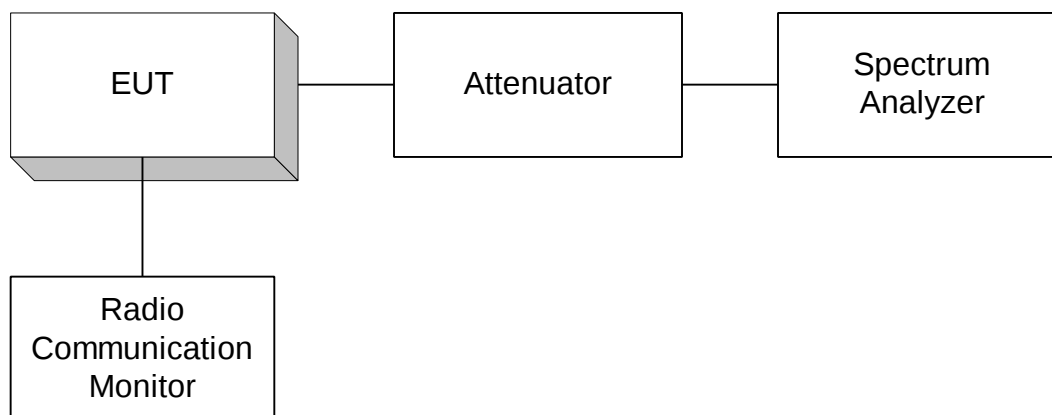
The input voltage to the E.U.T. is set to S.T.V. and the temperature of the environmental chamber is varied in 10 degree steps from -30 degrees C to +50 degrees C. The E.U.T. is allowed to stabilize at each temperature and the frequency is measured in 30 second intervals for a period of 5 minutes.

ANNEX B - TEST DIAGRAMS

Para. No. 2.1046 - R.F. Power Output

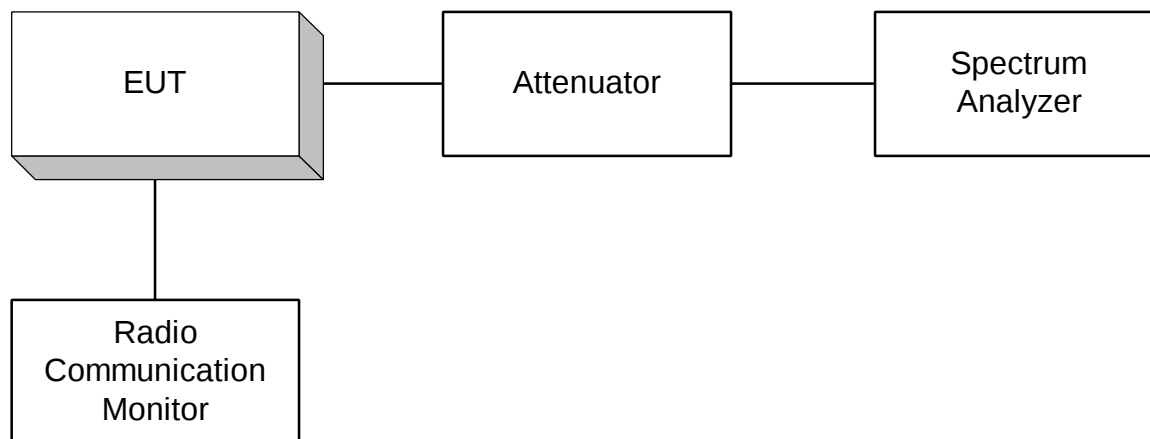


Para. No. 2.1049 - Occupied Bandwidth



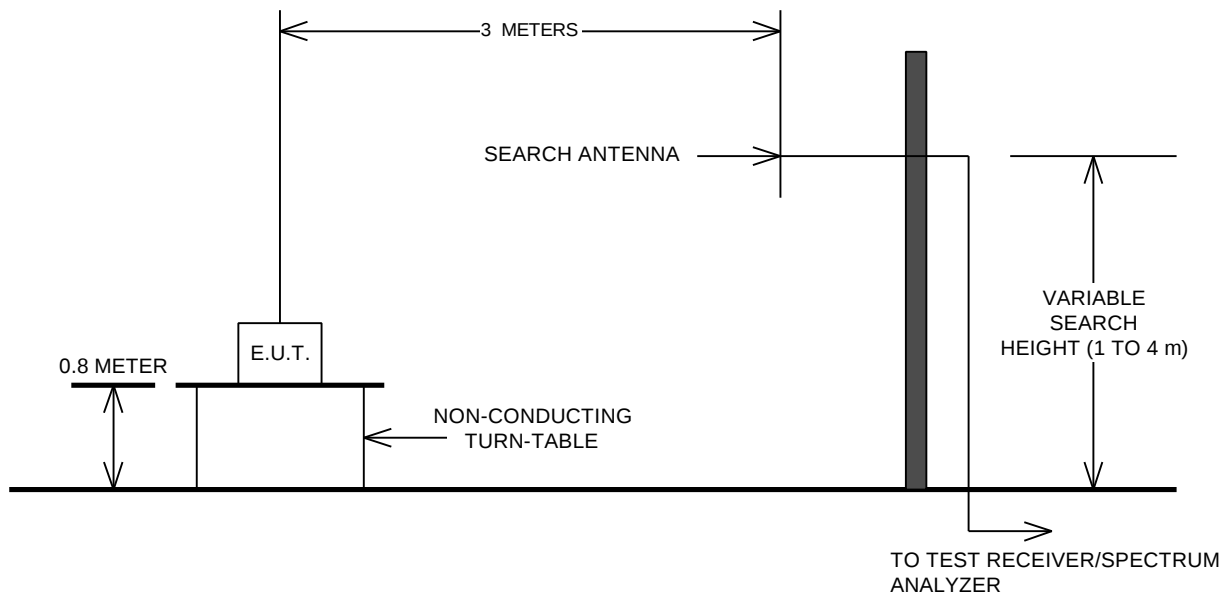
The Radio Communication Monitor is used only to provide modulation input for external modulation.

Para. No. 2.1051 Spurious Emissions at Antenna Terminals

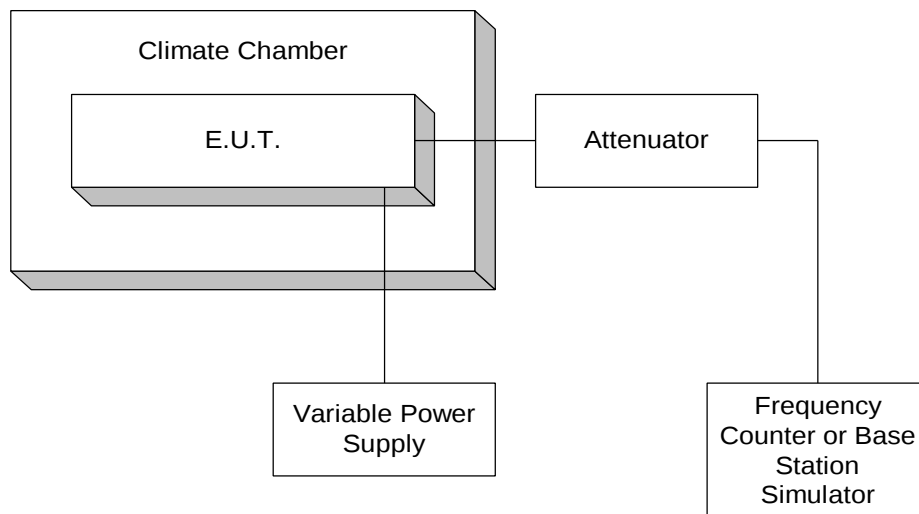


The Radio Communication Monitor is used only to provide modulation input for external modulation.

Para. No. 2.1053 - Field Strength of Spurious Radiation



Para. No. 2.1055 - Frequency Stability



Para. No. 2.1045 – Audio Frequency Response, Audio Low Pass Filter Response And Modulation Limiting

