

Nemko Test Report: 1L0269RUS2

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

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

FCC ID:

In Accordance With: **FCC Part 90, Subpart I**
Base Station Transmitter

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

Authorized By:



Tom Tidwell, Wireless Group Manager

Date: 7/16/01

Total Number of Pages: 31

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Section 1. Summary of Test Results

Manufacturer: Grayson Wireless

Model No.: GMWT 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 90, Subpart I.



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: 100351-0

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Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	MEAS.	RESULT
RF Power Output	90.205	500 W	<500 W	Complies
Audio Frequency Response	TIA EIA-603.3.2.6	N/A	N/A	N/A
Audio Low-Pass Filter Response	TIA EIA-603.3.2.6	N/A	N/A	N/A
Modulation Limiting	TIA EIA-603.3.2.6	N/A	N/A	N/A
Occupied Bandwidth	90.210	Plots	Plots	Complies
Spurious Emissions at Antenna Terminals	90.210	Plots	Plots	Complies
Field Strength of Spurious Emissions	90.210	-13 dBm	< -13 dBm	Complies
Frequency Stability	90.213	1 ppm	< 1 ppm	Complies
Transient Frequency Behavior	90.214		Plots	Complies

Footnotes For N/A's:

- (1) Since the E.U.T. does not contain modulation circuitry modulation testing was not performed.

Section 2. General Equipment Specification

Transmitter

Supply Voltage Input: 115 VAC / 13 VDC

Frequency Range: 851.01 –868.98 MHz

Tunable Bands: Single Channel

20 dB Passband:

Type(s) of Modulation:	F3E (Voice)	F1D	F2D	D7W (QAM)	Other (CW)
	☐	☐	☐	☐	☒

Output Impedance: 50 ohms

RF Power Output (rated):	Single:	20 Watts
	Composite:	N/A

Channel Spacing(s): 30 kHz

Operator Selection of Operating Frequency: Manual

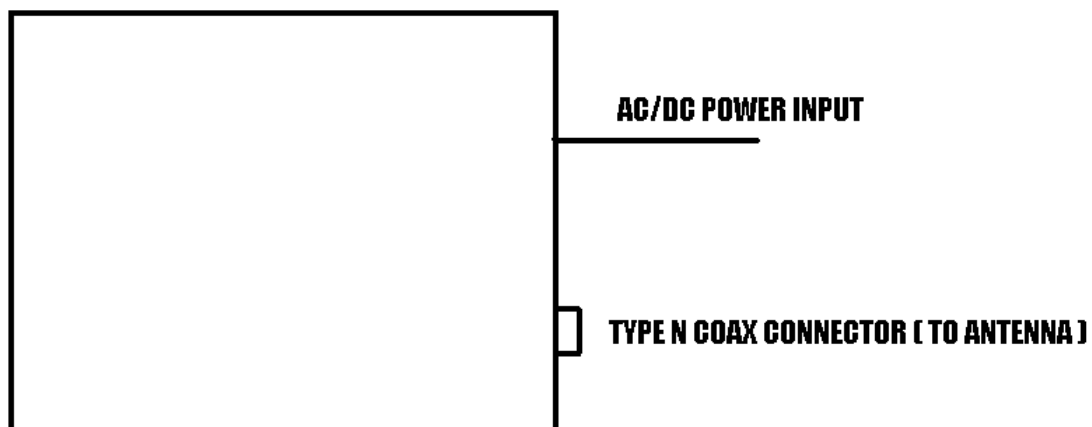
The device operates over the frequency band of 824.01 to 894.98 MHz. Cellular band will be approved for Part 22 operation. Manufacturer prohibits operation in the unlicensed band from 849 to 851 MHz through the use of firmware.

Power Output Adjustment Capability: Manual

Theory of Operation

The GWMT 0802 is a self-contained CW transmitter operating in the SMR band.

System Diagram



Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.985
TESTED BY: David Light	DATE: 6/8/2001

Test Results: Complies.

Measurement Data:

Frequency (MHz)	Supply Voltage	Measured Power (dBm)	Rated Power (dBm)	Measured/Rated (dB)
859.98	115 VAC	42.7	43.0	0.99/1
859.98	98 VAC	42.7	43.0	0.99/1
859.98	132 VAC	42.7	43.0	0.99/1
859.98	13 VDC	42.7	43.0	0.99/1
859.98	11 VDC	Ceased Operation	43.0	N/A
859.98	15 VDC	42.6	43.0	0.99/1

Equipment Used: 1604-1065-1046-1036

Section 4. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.989
TESTED BY: David Light	DATE:5/4/2001

Test Results: Complies.

Test Data: See attached graph(s).

Test Plots – Occupied Bandwidth



Dallas Headquarters:
802 N. Kealy
Lewisville, TX 75057
Tel: (972) 436-9600
Fax: (972) 436-2667

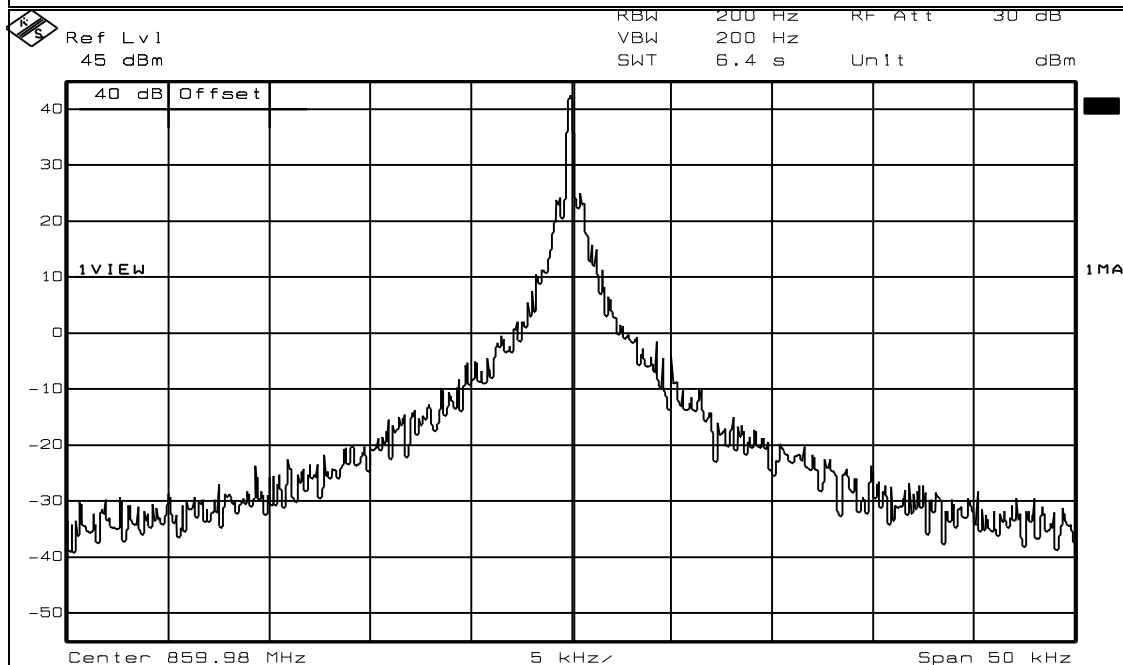
Nemko Dallas, Inc.

Data Plot

Page 1 of 1
Job No.: 1L0269R Date: 6/4/2001 Complete X
Specification: PART 22 Temperature(°C): 22 Preliminary _____
Tested By: David Light Relative Humidity(%) 50
E.U.T.: GWMT 0802
Configuration: TX FULL POWER
Sample Number: S01
Location: Lab 1 RBW: Refer to plots Measurement Distance: N/A m
Detector Type: Peak VBW: Refer to plots

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: 6 JUN 2001 10:29:36

Notes:

Section 5. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.991
TESTED BY: David Light	DATE:6/4/2001

Test Results: Complies.

Test Data: See attached graph(s).

Test Plots – Spurious Emissions at Antenna Terminals



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Fax: (972) 436-2667

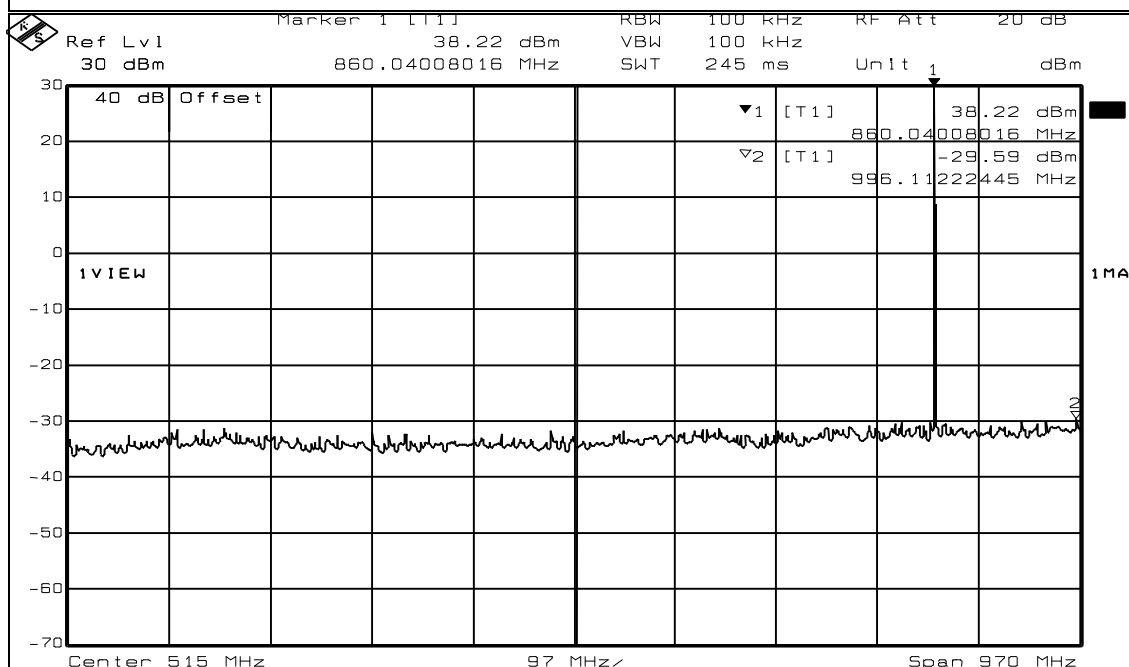
Nemko Dallas, Inc.

Data Plot

Page 1 of 2
Job No.: 1L0269R Date: 6/6/2001 Complete X
Specification: PART 22 Temperature(°C): 22 Preliminary _____
Tested By: David Light Relative Humidity(%) 50
E.U.T.: GWMT 0820
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: 1060 Cable #2: 1081
Receiver: 1036 Cable #3: _____
Attenuator #1: 1065 Cable #4: _____
Attenuator #2: 1604 Mixer: _____
Additional equipment used: _____
Measurement Uncertainty: +/-3.6 dB



Date: 6.JUN.2001 9:42:52

Notes: MARKER 1 INDICATES CARRIER
MARKER 2 INDICATES HIGHEST EMISSION (Noise Floor)

Test Plots – Spurious Emissions at Antenna Terminals



Dallas Headquarters:

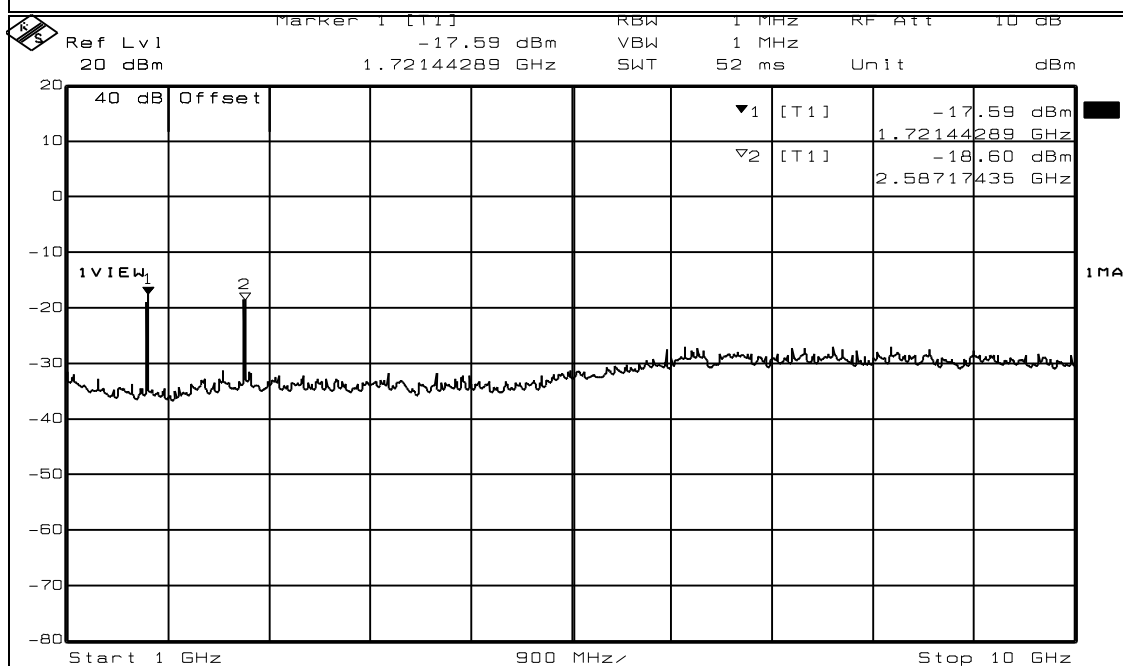
802 N. Kealy
Lewisville, TX 75057
Tel: (972) 436-9600
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Nemko Dallas, Inc.

Data Plot

Page 2 of 2

Job No.: 1L0269R Date: 6/6/2001
Specification: PART 22 Temperature(°C): 22
Tested By: David Light Relative Humidity(%) 50
E.U.T.: GWMT 0820
Configuration: TX FULL POWER



Date: 6 JUN. 2001 9:44:29

Notes:

Section 6. Field Strength of Spurious Emissions

NAME OF TEST: Field Strength of Spurious Emissions	PARA. NO.: 2.993
TESTED BY: David Light	DATE:6/12/2001

Test Results: Complies.

Test Data: See attached table.

Note: See page A5 for applicable limit.

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

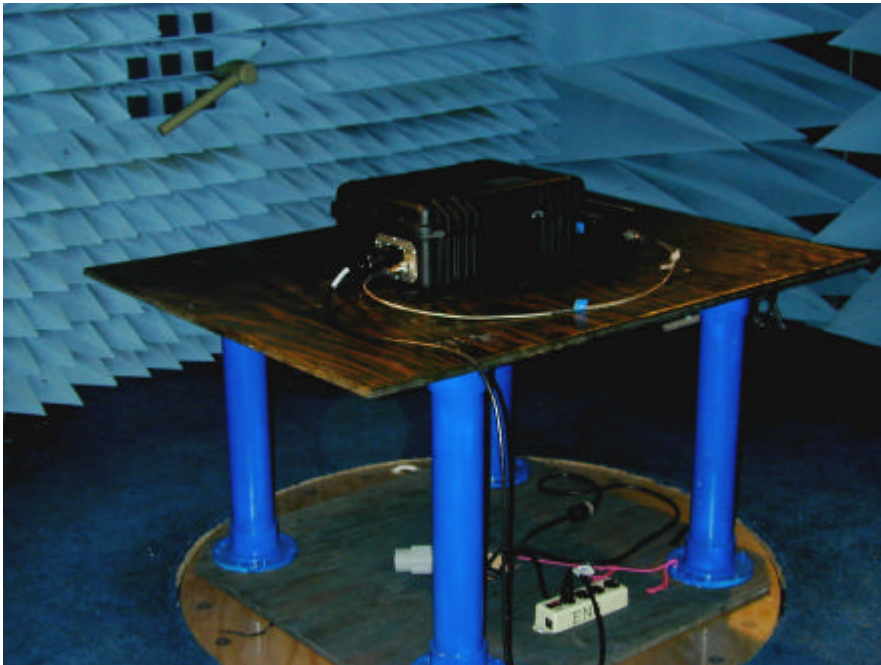
Notes: SCANNED SPECTRUM TO THE 10TH HARMONIC OF CARRIER FREQUENCY

Photographs of Test Setup

FRONT VIEW



REAR VIEW



Section 7. Frequency Stability

NAME OF TEST: Frequency Stability	PARA. NO.: 2.995
TESTED BY: David Light	DATE: 06/01/2001

Test Results: Complies.

Measurement Data: See attached tables.

Test Data – Frequency Stability



Dallas Headquarters:

802 N. Kealy
Lewisville, TX 75057
Tel: (972) 436-9600
Fax: (972) 436-2667

Frequency Stability

Client: GRAYSON WIRELESS

W.O.# 1L0269R

EUT: GMWT 0820

S/N: NONE

Date: 6/1/01

Tech: 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 8 - Transient Frequency Behaviour

NAME OF TEST: Transient Frequency Behaviour	PARA. NO.: 90.214
TESTED BY: David Light	DATE: 06/12/2001

Test Results: Complies.

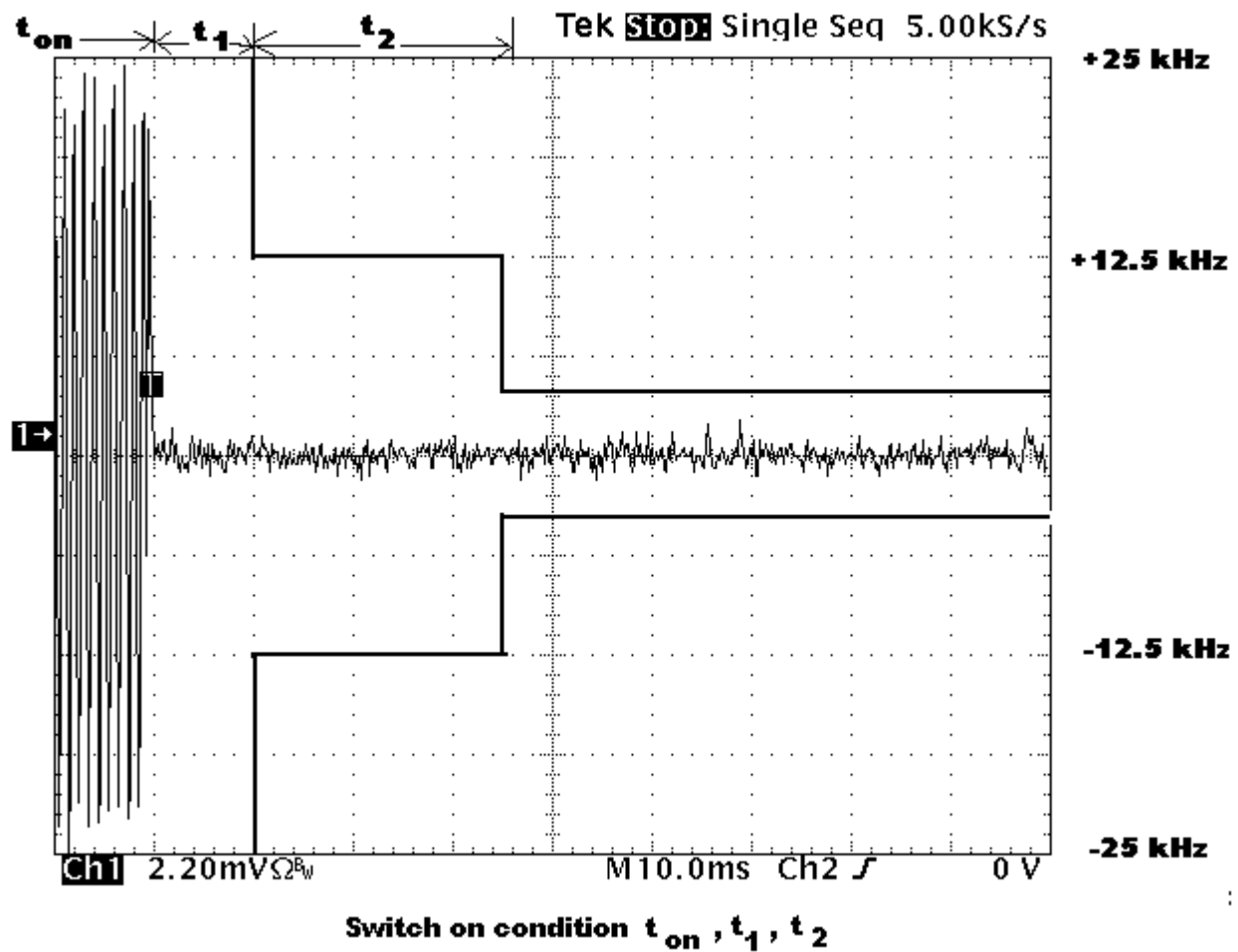
Measurement Data: See attached plots

Time Intervals	Frequency Ranges (MHz)		
	30 to 300	300 to 500	500 to 1000
t ₁	5.0 ms	10.0 ms	20.0 ms
t ₂	20.0 ms	25.0 ms	50.0 ms
t ₃	5.0 ms	10.0 ms	10.0 ms

Test Equipment Used:	1043-1082-1081-1054-1089-1463-1065-1064-1046-1083-1573-1051-1341
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Test Plots – Transient Frequency Behaviour

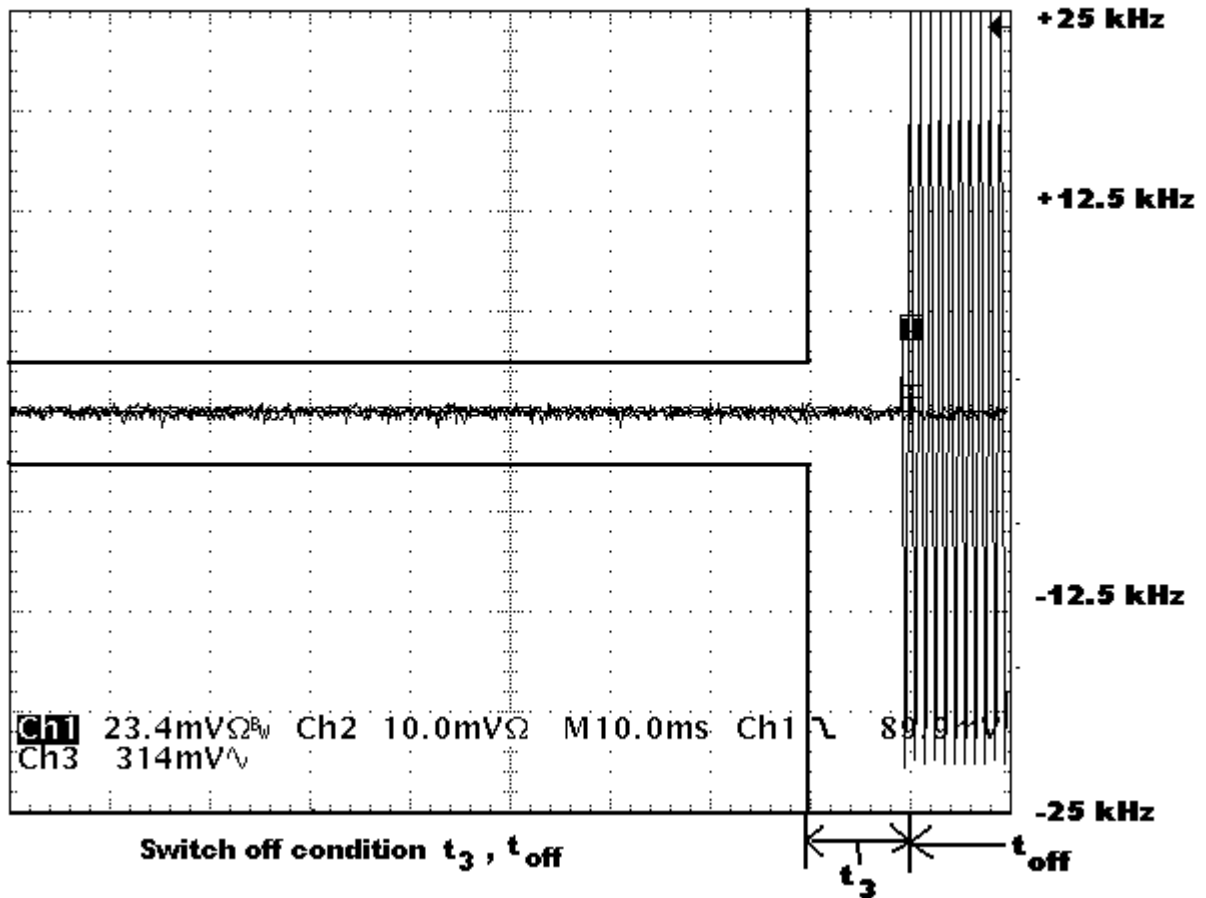
Switch ON condition



Test Plots – Transient Frequency Behaviour

Switch OFF condition

Tek **Stop**: Single Seq 5.00kS/s



Section 9.

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
1043	Flexible cable 1m	Astrolab Inc. 32027-2-29094K-1M	0	01/29/01	01/29/02
1082	CABLE 2m	Astrolab 32027-2-29094-72TC	N/A	06/01/01	06/01/02
1081	CABLE 2m	Astrolab 32027-2-29094-72TC	N/A	06/04/01	06/04/02
1054	DUAL DIRECTIONAL COUPLER	NARDA 3020A	34366	Cal Not Req	N/A
1089	COMBINER	MINI-CIRCUITS ZA3PD-1	NONE	CBU	N/A
1463	Color 4 Ch Digitizing Oscilloscope	Tektronix TDS684A	B010460	04/13/01	04/13/02
1064	ATTENUATOR	NARDA 776B-20	NONE	CBU	N/A
1083	Cable 2m	Astrolab 32027-2-29094-72TC	N/A	06/01/01	06/01/02
1573	Zero-Bias Schottky Diode Detector	HEROTEK DZR400KA	222276	CalNotReq	N/A
1051	Radio Communication Analyzer	Rhode & Schwarz CMTA-54	835875/002	03/17/01	03/17/02
1341	COMMUNICATION SERVICE MO	ROHDE & SCHWARZ CMS53	883832/018	CNR	N/A

ANNEX A - TEST METHODOLOGIES

Minimum Standard: Para. No. 90.205(a). The maximum allowable station ERP is dependent upon the stations HAAT and required service area and will be authorized in accordance with Table 1 of 90.205(d).

Method Of Measurement:

Detachable Antenna:

The peak power at antenna terminals is measured using an in-line peak power meter. Power output is measured with the maximum rated input level.

Integral Antenna:

If the antenna is not detachable from the circuit then the Peak Power Output is derived from the peak 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 isotropic 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 an isotropic radiator

Test Method: RBW: 1% of emission bandwidth in the 0 - 1 GHz range.
1 MHz at frequencies above 1 GHz.

VBW: $\Rightarrow$ RBW

The spectrum is searched up to 10 times the fundamental frequency.

Minimum Standard: Para. No. 90.210, see table 1 below for applicable mask.

Table 1

Frequency Band (MHz)	Mask for equipment with Low Pass Filter	Mask for equipment without Low Pass Filter
Below 25	A or B	A or C
25 - 50	B	C
72 - 76	B	C
150 - 174	B, D or E	C, D or E
150 Paging only	B	C
220 - 222	F	F
421 - 512	B, D or E	C, D or E
450 paging only	B	H
806 - 821/ 851 - 866	B	G
821 - 824/ 866 - 869	B	H
896 - 901/ 935 - 940	I	J
902 - 928	K	K
929 - 930	B	G
Above 940	B	C
All other bands	B	C

Minimum Standard: Para. No. 90.210, see table 1 for applicable mask.

Calculation of Field Strength Limit

An example of attenuation requirement of $50 + 10 \log P$ is equivalent to -20 dBm (1×10^{-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)

$$E = \frac{\sqrt{30GP}}{R} = E = \frac{\sqrt{30 \times 1.64 \times 10^{-5}}}{3} = 0.00739 \text{ V / m} = 77.4 \text{ dBmV / m}$$

For emissions > 1 GHz:

$G = 1$ (Isotropic Gain)

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

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

$$E = 77.4 - 20 \log \sqrt{1.64} = 75.2 \text{ dBmV / m@3m}$$

MASK	Spurious Limit	FS Limit Below 1 GHz	FS Limit Above 1 GHz
A,B,C,G,H,I	-13dBm	84.4 dBμV/m@3m	82.2 dBμV/m@3m
D,J	-20dBm	77.4 dBμV/m@3m	75.2 dBμV/m@3m
E,F,K	-25dBm	72.4 dBμV/m@3m	70.2 dBμV/m@3m

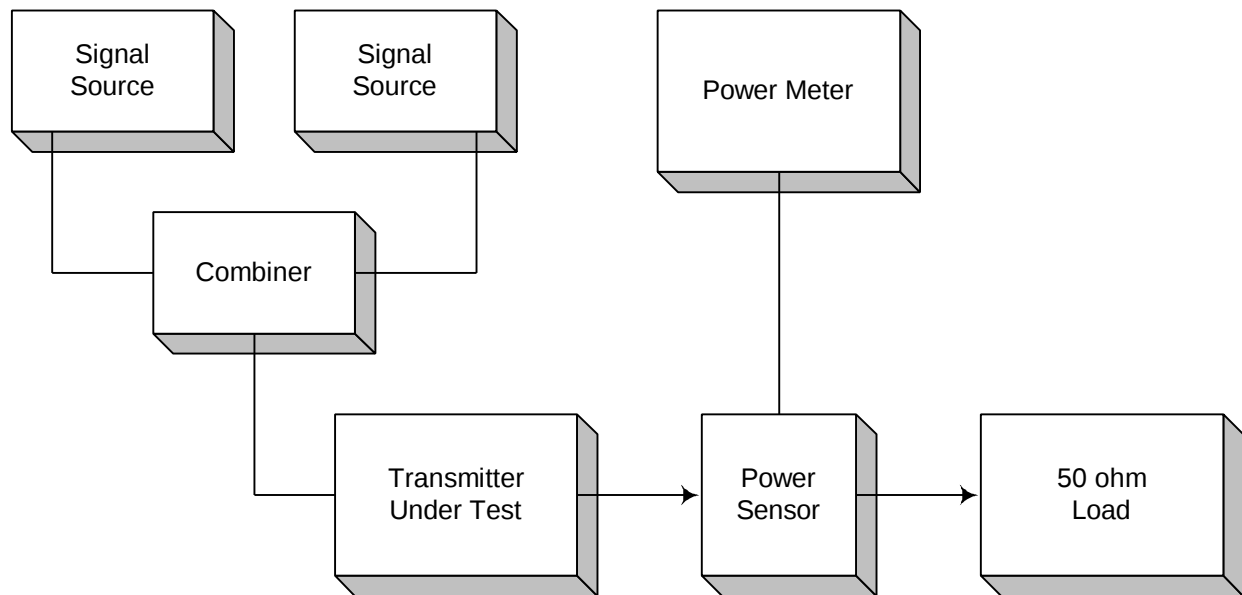
Minimum Standard: Para. No. 990.213. The transmitter carrier frequency shall remain within the assigned frequency below in ppm.

Table 2

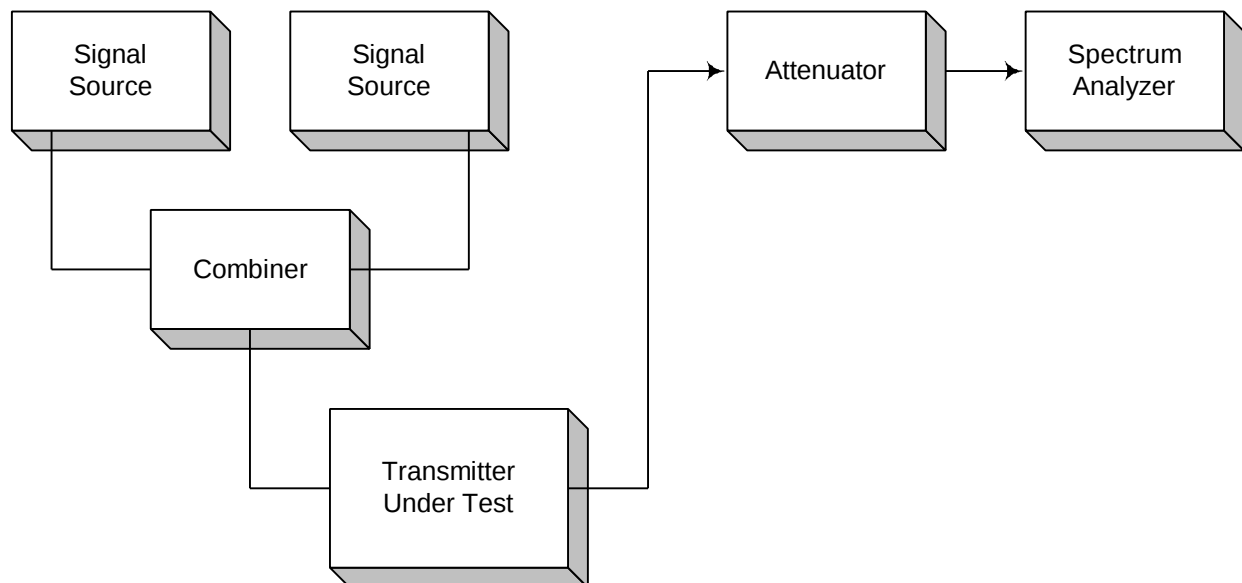
Frequency Band (MHz)	Fixed And Base Stations	Mobile Stations	
		> 2 Watts o/p pwr	< 2 Watts o/p pwr
Below 25	100	100	200
25 - 50	20	20	50
72 - 76	5	-	50
150 - 174	5	5	5
220 - 222	0.1	1.5	1.5
421 - 512	2.5	5	5
806 - 821	1.5	2.5	2.5
821 - 824	1.0	1.5	15
851 - 866	1.5	2.5	2.5
866 - 869	1.0	1.5	1.5
869 - 901	0.1	1.5	1.5
902 - 928	2.5	2.5	2.5
929 - 930	1.5	-	-
935 - 940	0.1	1.5	1.5
1427 - 1435	300	300	300
Above 2450	-	-	-

ANNEX B - TEST DIAGRAMS

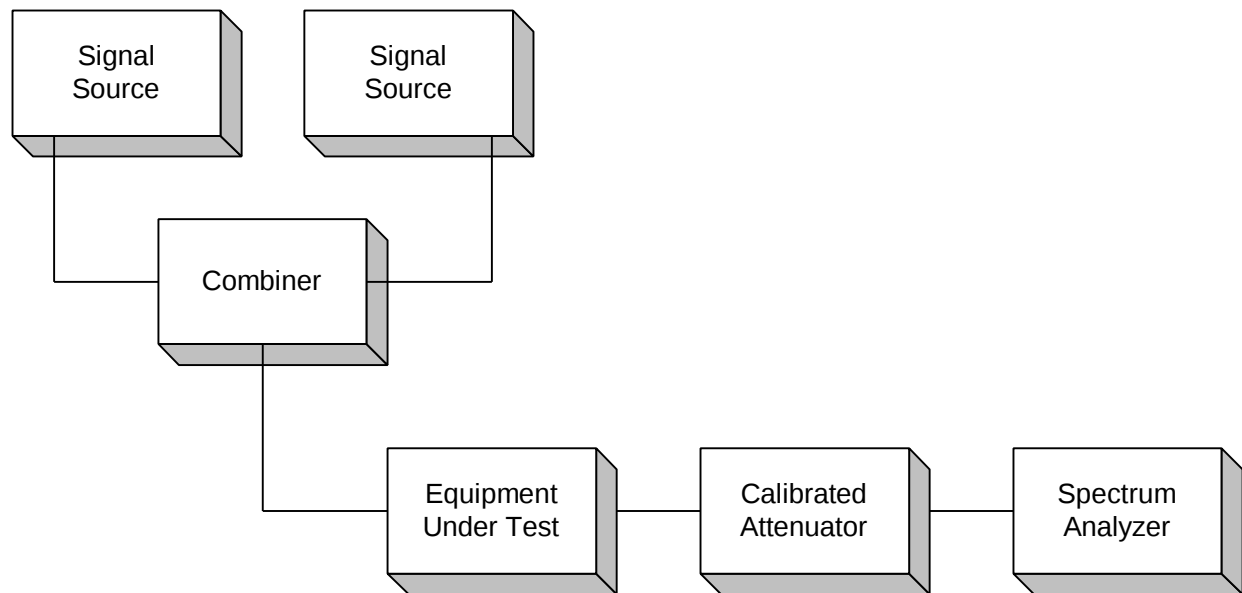
Para. No. 2.985 - R.F. Power Output



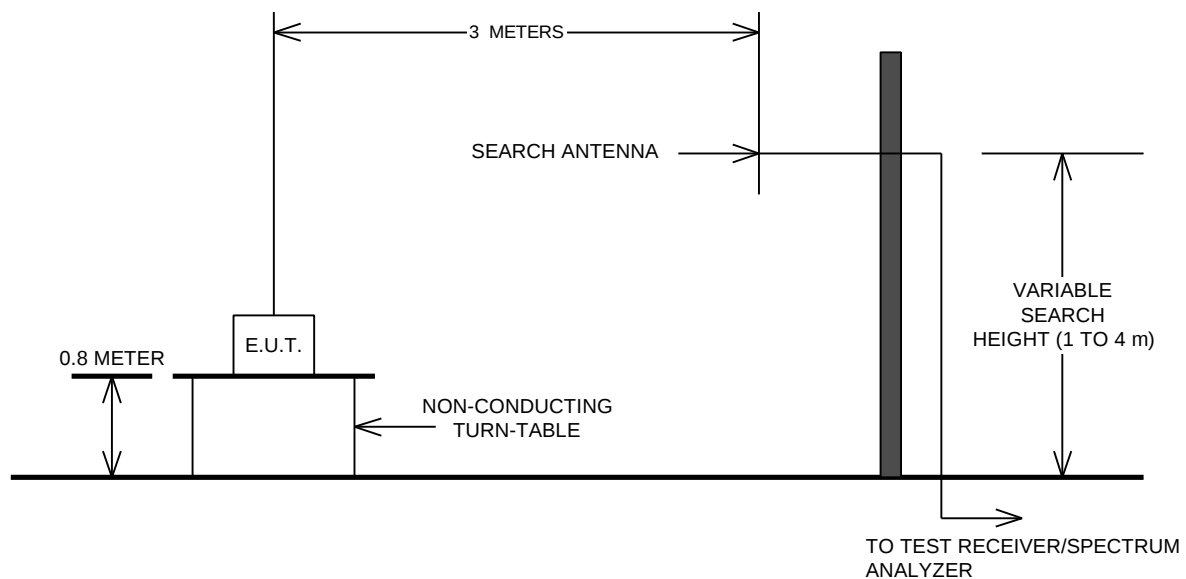
Para. No. 2.989 - Occupied Bandwidth



Para. No. 2.991 - Spurious Emissions at Antenna Terminals



Para. No. 2.993 - Field Strength of Spurious Radiation



Para. No. 2.995 - Frequency Stability

