

Nemko Test Report: 4L0698RUS1Rev2

Applicant: Sirit Corporation
1321 Valwood Parkway
Carrollton, TX 75006

**Equipment Under Test:
(E.U.T.)** S2301-013

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, Frontline Group Manager

Date: 1/19/2004

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Section 1. Summary of Test Results

Manufacturer: Sirit

Model No.: S2301-013

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. NONE
See " Summary of Test Data".

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Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	RESULT
RF Power Output	90.205	300 Watts ERP	Complies
Audio Frequency Response	TIA EIA-603.3.2.6	N/A	N/A
Audio Low-Pass Filter Response	TIA EIA-603.3.2.6	N/A	N/A
Modulation Limiting	TIA EIA-603.3.2.6	N/A	N/A
Occupied Bandwidth	90.210	Plots	Complies
Spurious Emissions at Antenna Terminals	90.210	Plots	Complies
Field Strength of Spurious Emissions	90.210	-25 dBm	Complies
Frequency Stability	90.213	NA	NA
Transient Frequency Behavior	90.214	N/A	N/A

Footnotes For N/A's:

- (1) Since the E.U.T. does not contain modulation circuitry modulation testing was not performed.
- (2) Since the E.U.T. is not a keyed carrier system, Transient Frequency Behavior was not performed.
- (3) The radio does not support audio modulation.
- (4) Fixed non-multilateration transmitters with an authorized bandwidth that is more than 40 kHz from the band edge are not subject to frequency stability restrictions. The device however was measured to show compliance to Part 2 requirements.

Section 2. General Equipment Specification

Transmitter

Supply Voltage Input:	120 Vac										
Frequency Range:	916 MHz nominal										
Tunable Bands:	Single channel										
Type(s) of Modulation:	<table><tbody><tr><td>F3E (Voice)</td><td>F1D</td><td>F2D</td><td>D7W (QAM)</td><td>Other A1D</td></tr><tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input checked="" type="checkbox"/></td></tr></tbody></table>	F3E (Voice)	F1D	F2D	D7W (QAM)	Other A1D	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
F3E (Voice)	F1D	F2D	D7W (QAM)	Other A1D							
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>							
Output Impedance:	50 ohms										
RF Power Output (rated):	Single: 4 Watts Peak conducted										
Channel Spacing(s):	NA										
Operator Selection of Operating Frequency:	None										
Power Output Adjustment Capability:	None										

Operational Description

The **S2301-013** is a 4 watt Amplitude Shift Keyed transmitter and homodyne receiver operating in the 902 to 928 MHz band. . In the downlink mode, filtered Manchester coded data shifts the transmitter between two power levels differing by more than 25 dB at a 300 kbps signaling rate. In the uplink mode, the RF Transceiver transmits an unmodulated carrier at approximately 916.25 MHz and the toll tag amplitude modulates the reflected signal with one of two frequencies, 600 kHz or 1200 kHz, to encode the uplink binary data. The RF Transceiver homodyne receiver downconverts the 600 kHz and 1200 kHz modulation tones to baseband and filters and removes amplitude variation from the FSK signal.

Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.985
TESTED BY: David Light	DATE: 12/6/04

Test Results: Complies.

Measurement Data:

Frequency (MHz)	Measured Power (dBm)	Measured Power (Watts)
916.25	35.7	3.72

Test Equipment Used: 1036 -1064-1604-1628

Test Conditions:

Temperature 22°C

Relative Humidity 45%

Section 4. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.989
TESTED BY: David Light	DATE: 12/6/04

Test Results: Complies.

Test Data: See attached graph(s).

Test Data – 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 4

Job No.: 4L0698

Specification: Pt 90

Tested By: David Light

E.U.T.:	916 MHz Transmitter
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Configuration:	Tx
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Sample Number: _____

Location:	Lab
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Detector Type:	<div></div>
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Date: 12/6/2004

Temperature(°C): 22

Relative Humidity(%)	45
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RBW: Refer to plots

VBW: Refer to plots

Complete X

Preliminary: _____

Occupied Bandwidth

Test Equipment Used

Antenna: _____

Pre-Amp: _____

Filter:

Receiver: 1036

Attenuator #1	1064
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Attenuator #2:	1604
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Additional equipment used:

Measurement Uncertainty: ± 1.7 dB

Directional Coupler: _____

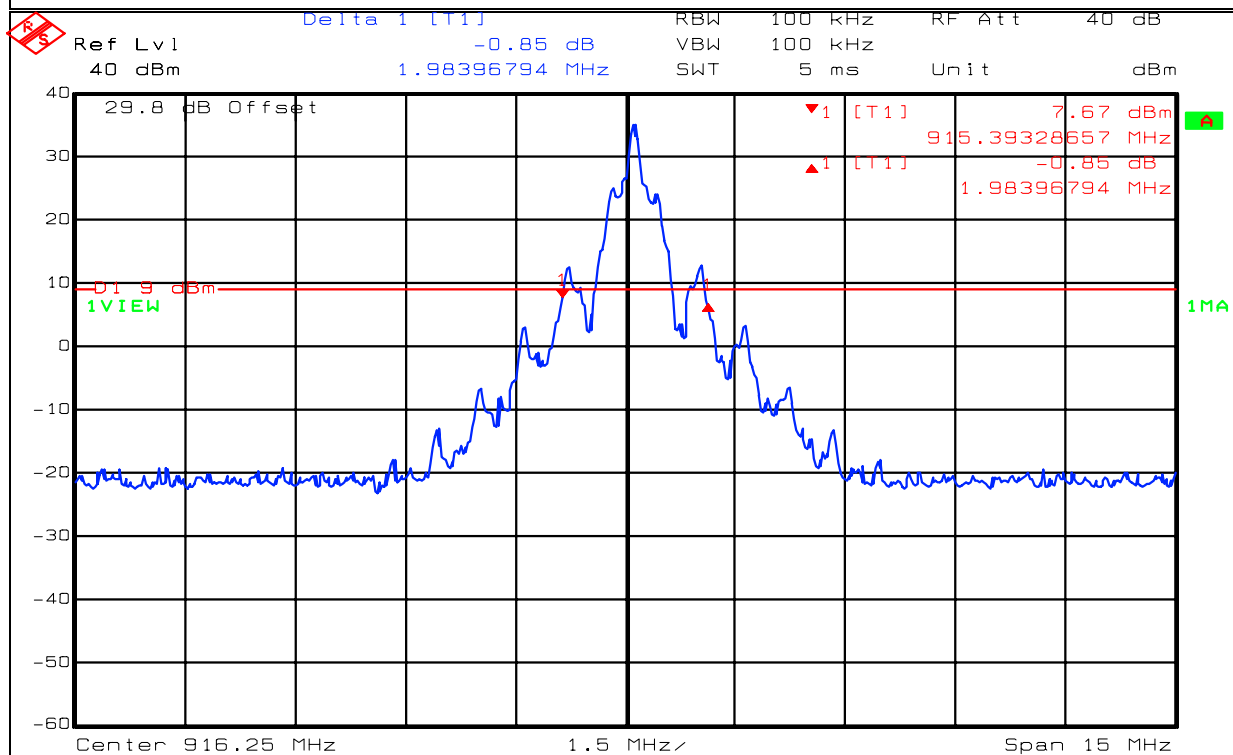
Cable #1:	1628
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Cable #2: _____

Cable #3:

Cable #4:

Mixer: _____



Date: 06.DEC.2004 10:16:39

Notes: 26 dB BW = 2 MHz

Section 5. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.991
TESTED BY: David Light	DATE: 12/6/04

Test Results:

Complies.

Test Data:

See attached graph(s).

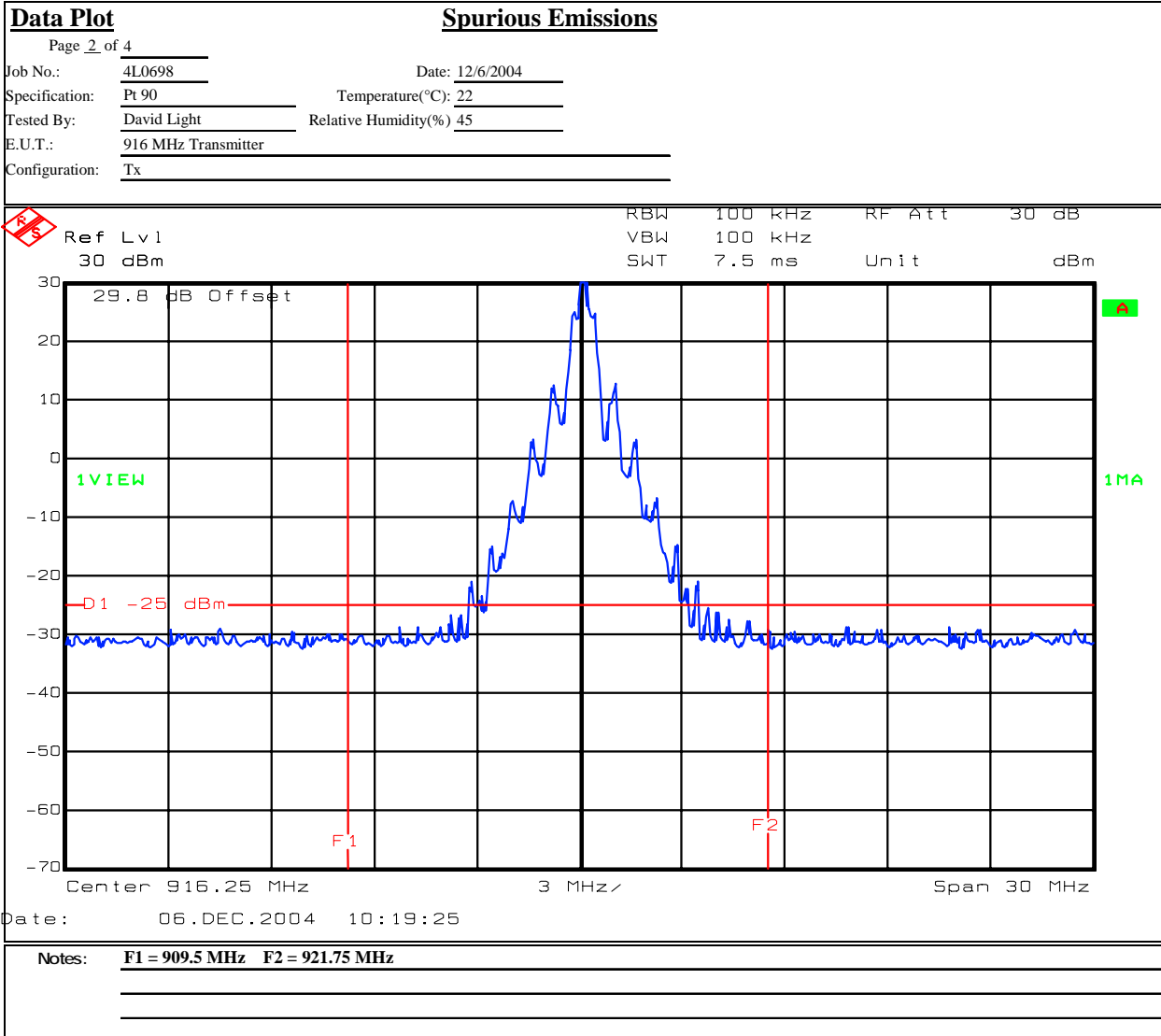
Test Data – Spurious Emissions at Antenna Terminals



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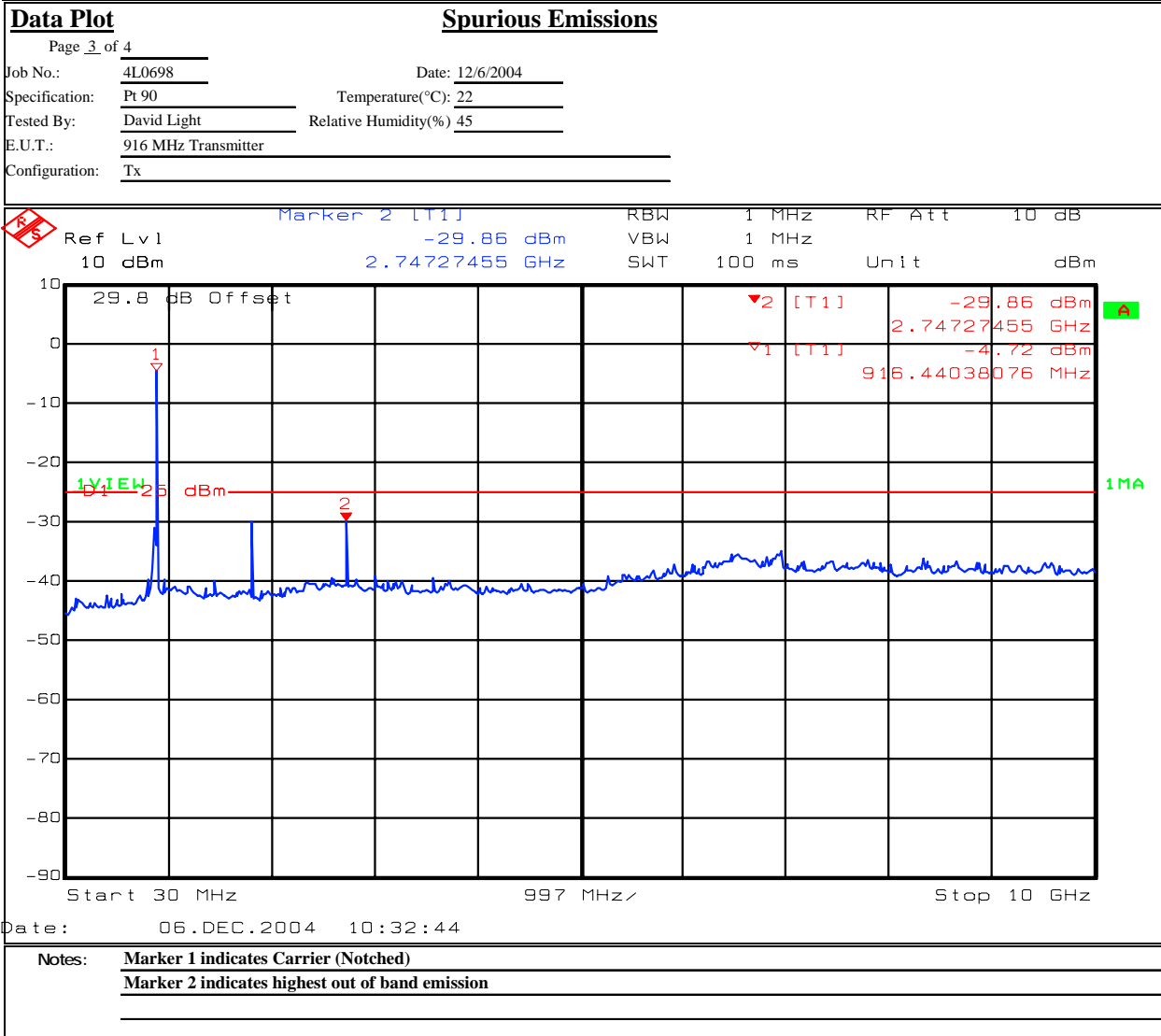
Test Data – Spurious Emissions at Antenna Terminals



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Section 6. Field Strength of Spurious Emissions

NAME OF TEST: Field Strength of Spurious Emissions	PARA. NO.: 2.993
TESTED BY: David Light	DATE: 12/6/04

Test Results: Complies.

Test Data: See attached table.

Note: See page A5 for applicable limit.

Test Data - Radiated Emissions



Dallas Headquarters:

802 N. Kealy

Lewisville, TX 75057

Tel: (972) 436-9600

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ERP Substitution Method

Page 1 of 1

Complete X

Job No.: 4L0698

Date: 12/6/04

Preliminary

Specification: PT 90

Temperature(°C): 22

Tested By: David Light

Relative Humidity(%) 45

E.U.T.: 916 MHz TRANSMITTER

Configuration: TX

Sample No: 1

Location: AC 3

RBW: 100 kHz

Measurement

Detector Type: Peak

VBW: 100 kHz

Distance: 3 m

Test Equipment Used

Antenna: 1304

Directional Coupler:

Pre-Amp: 1016

Cable #1: 1484

Filter: 1481

Cable #2: 1485

Receiver: 1036

Cable #3:

Attenuator #1

Cable #4:

Attenuator #2:

Mixer:

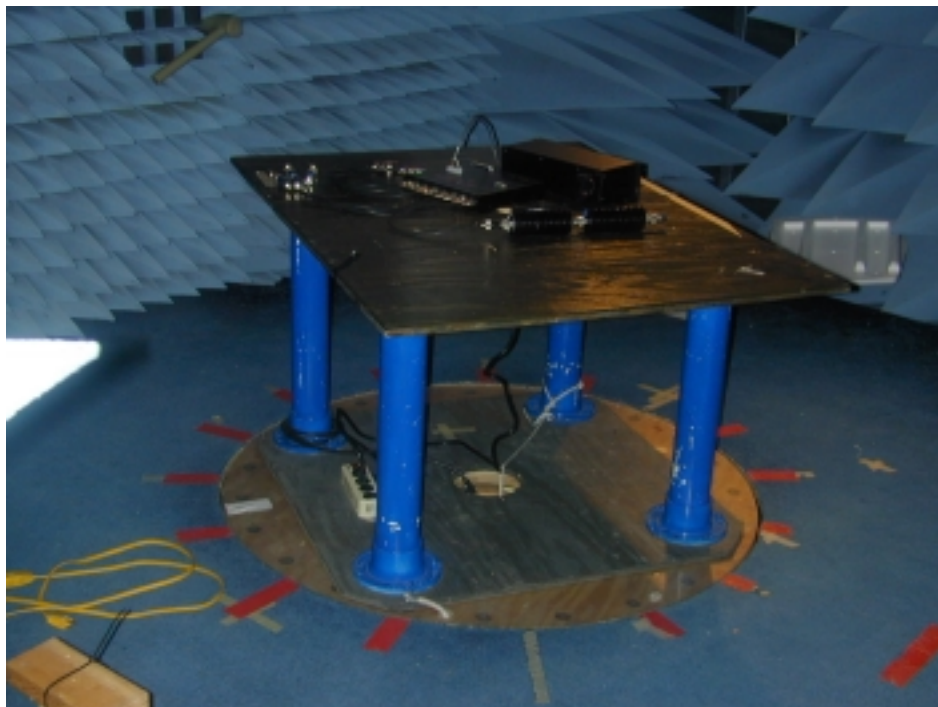
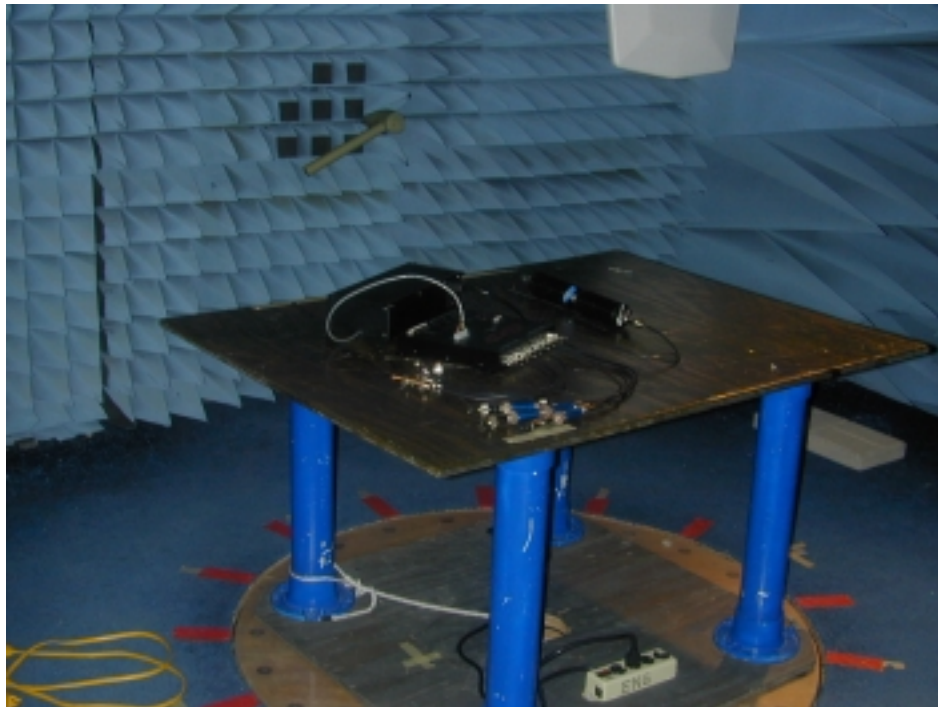
Additional equipment used:

Measurement Uncertainty: +/-1.7 dB

Frequency (MHz)	Meter Reading (dBm)	Correction Factor (dB)		Pre-Amp Gain (dB)	Substitution Antenna Gain (dBd)		ERP (dBm)	ERP (mW)	Polarity	Comments
1832.5	-42.5	29.9		31.8	6.9		-37.6	0.0002	V	
2748.75	-44.1	35.6		32.7	8.0		-33.2	0.0005	V	
3665	-41.1	40.4		32.7	8.0		-25.4	0.0029	V	
4581.25	-56.7	41.2		31.5	9.2		-37.8	0.0002	V	
5497.5	-64.3	40.6		31.9	9.1		-46.5	0.0000	V	
7330	-66.1	39.4		32.2	9.4		-49.5	0.0000	V	
1832.5	-48.6	32.7		31.8	6.9		-40.8	0.0001	H	
2748.75	-53.7	34.6		32.7	8.0		-43.8	0.0000	H	
3665	-45.1	34.3		32.7	8.0		-35.5	0.0003	H	
4581.25	-64.6	35.5		31.5	9.2		-51.4	0.0000	H	
5497.5	-69.1	36.3		31.9	9.1		-55.6	0.0000	H	
7330	-71.1	38.7		32.2	9.4		-55.2	0.0000	H	

Notes: Searched the spectrum to the 10th harmonic of the carrier

Photographs of Test Setup



Section 7. Frequency Stability

NAME OF TEST: Frequency Stability	PARA. NO.: 2.995
TESTED BY: David Light	DATE: 12/8/04

Test Results: Complies.

Measurement Data: See attached tables.

Test Data – Frequency Stability



Nemko Dallas, Inc.

Dallas Headquarters:

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Tel: (972) 436-9600

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Frequency Stability

Page 1 of 1

Job No.: 4L0698

Date: 12/8/2004

Specification: Pt90

Temperature(°C): 20

Tested By: David Light

Relative Humidity(%) 45

E.U.T.: S2301-013

Configuration: Tx

Sample Number: 1

Test Equipment Used

Antenna: _____

Chamber 283

Pre-Amp: _____

Cable #1: _____

Filter: _____

Cable #2: _____

Receiver: 1036

Thermometer 619

Attenuator #1 1064

Attenuator #2: 1604

Measurement

Uncertainty: 1×10^{-7} ppm

Standard Test Frequency 916.356400 MHz

Temp (°C)	Measured Frequency (MHz)	Rho	Test Voltage	Frequency Error (Hz)	Limit (+/-Hz)	Error (ppm)	Comment
20	916.356400		13.3	0	91635.6	0	
20	916.356400		15.3	0	91635.6	0.0	
20	916.356400		11.3	0	91635.6	0.0	
50	916.318402		13.3	-37998	91635.6	-41.5	
40	916.328589		13.3	-27811	91635.6	-30.3	
30	916.344210		13.3	-12190	91635.6	-13.3	
10	916.359287		13.3	2887	91635.6	3.2	
0	916.360003		13.3	3603	91635.6	3.9	
-10	916.356613		13.3	213	91635.6	0.2	
-20	916.349889		13.3	-6511	91635.6	-7.1	
-30	916.337982		13.3	-18418	91635.6	-20.1	

Notes: Fixed non-multilateration transmitters with an authorized bandwidth that is more than 40 kHz from the band edge are not subject to frequency stability restrictions.

Section 8. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
1628	CABLE, 6 ft	MEGAPHASE TM26 S 1S 5 72	N/A	CBU	CBU
1481	Microwave Highpass Filter	K & L 3DH1-2000/T8000-0/0	4	Cal B4 Use	N/A
1304	HORN ANTENNA	ELECTRO METRICS RGA-60	6151	09/22/03	09/22/05
1484	Cable 2.0-18.0 Ghz	S torm PR90-010-072	N/A	08/26/04	08/26/05
1485	Cable 2.0-18.0 Ghz	S torm PR90-010-216	N/A	08/02/04	08/02/05
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	03/22/04	03/23/06
1064	ATTENUATOR	NARDA 776B -20	NONE	CBU	N/A
1604	ATTENUATOR	NARDA 776B -20	NONE	N/A	N/A
283	Environmental Chamber with controller # 1189006	ENVIROTRONICS SH27 & 2030-22844	129010083	04/22/03	04/21/04
619	THERMOMETER	FLUKE 51	4520028	09/16/04	09/16/05

Note: Temperature was verified using a calibrated thermometer.

ANNEX A - TEST METHODOLOGIES

NAME OF TEST: RF Power Output	PARA. NO.: 2.985
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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

NAME OF TEST: Spurious Emissions at Antenna Terminals	PARA. NO.: 2.991
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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.

NAME OF TEST: Occupied Bandwidth**PARA. NO.: 2.989****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

NAME OF TEST: Field Strength of Spurious**PARA. NO.: 2.993****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)

$R = 3$ m (Measurement Distance)

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

For emissions > 1 GHz:

$G = 1$ (Isotropic Gain)

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

$R = 3$ m (Measurement Distance)

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

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

NAME OF TEST: Frequency Stability**PARA. NO.: 2.995**

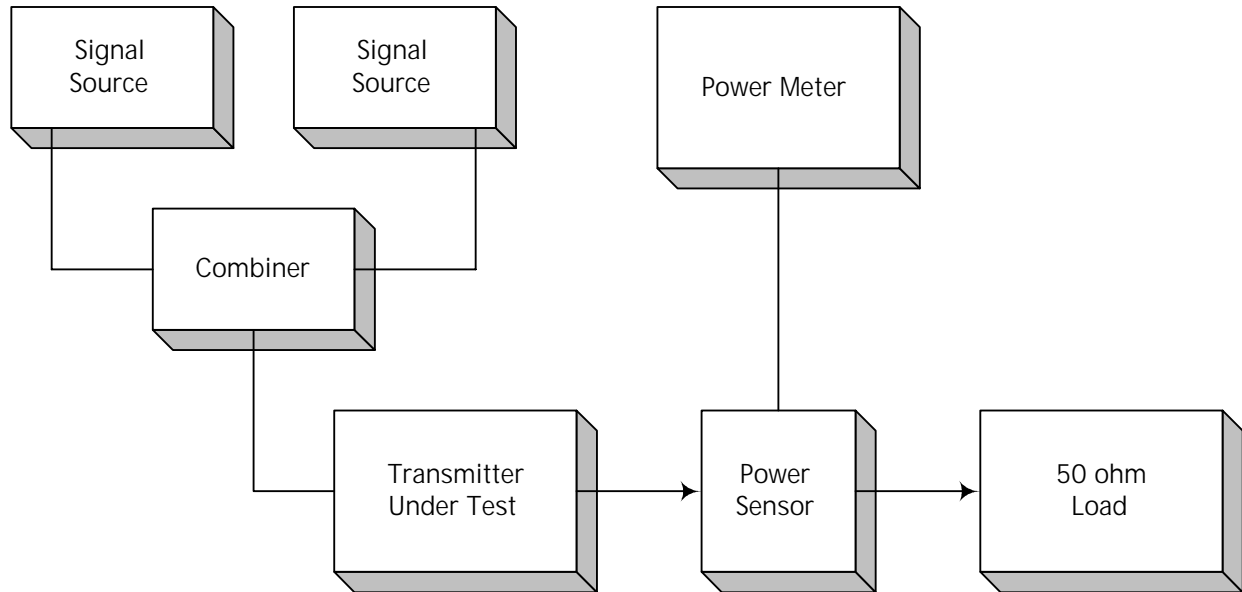
Minimum Standard: Para. No. 990.213. The transmitter carrier frequency shall remain within the assigned frequency below in ppm.

Table 2

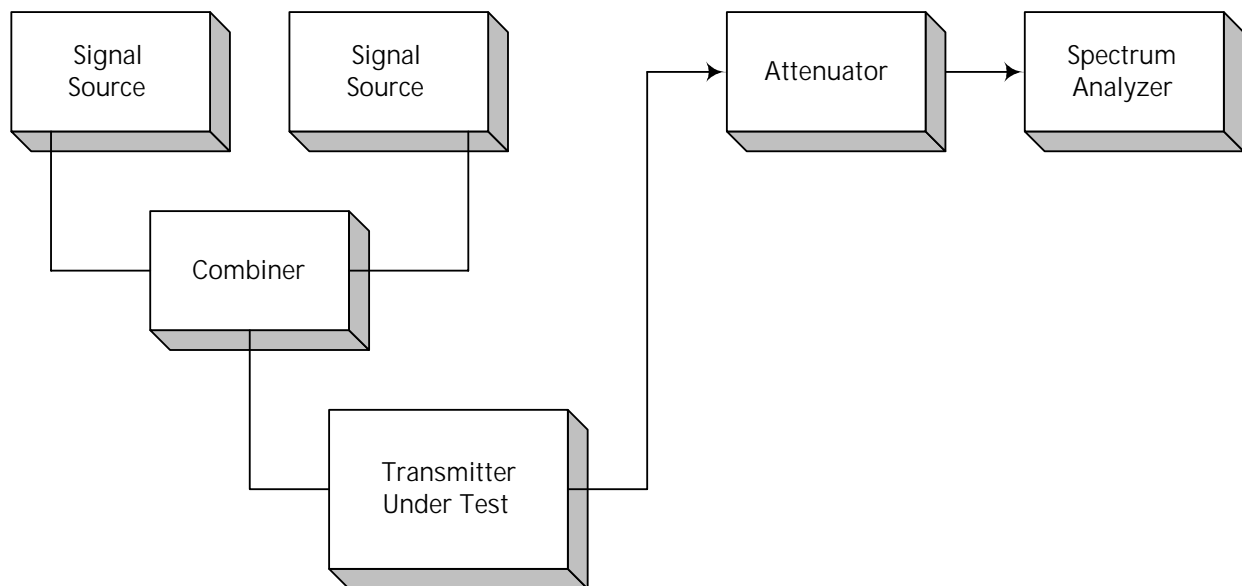
Frequency Band (MHz)	Fixed And Base Stations	Mobile Stations	
		> 2 Watts o/p pwr	< 2 Watts o/p pwr
Below 25	100	100	200
25 - 50	20	20	50
72 - 76	5	-	50
150 - 174	5	5	5
220 - 222	0.1	1.5	1.5
421 - 512	2.5	5	5
806 - 821	1.5	2.5	2.5
821 - 824	1.0	1.5	15
851 - 866	1.5	2.5	2.5
866 - 869	1.0	1.5	1.5
869 - 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

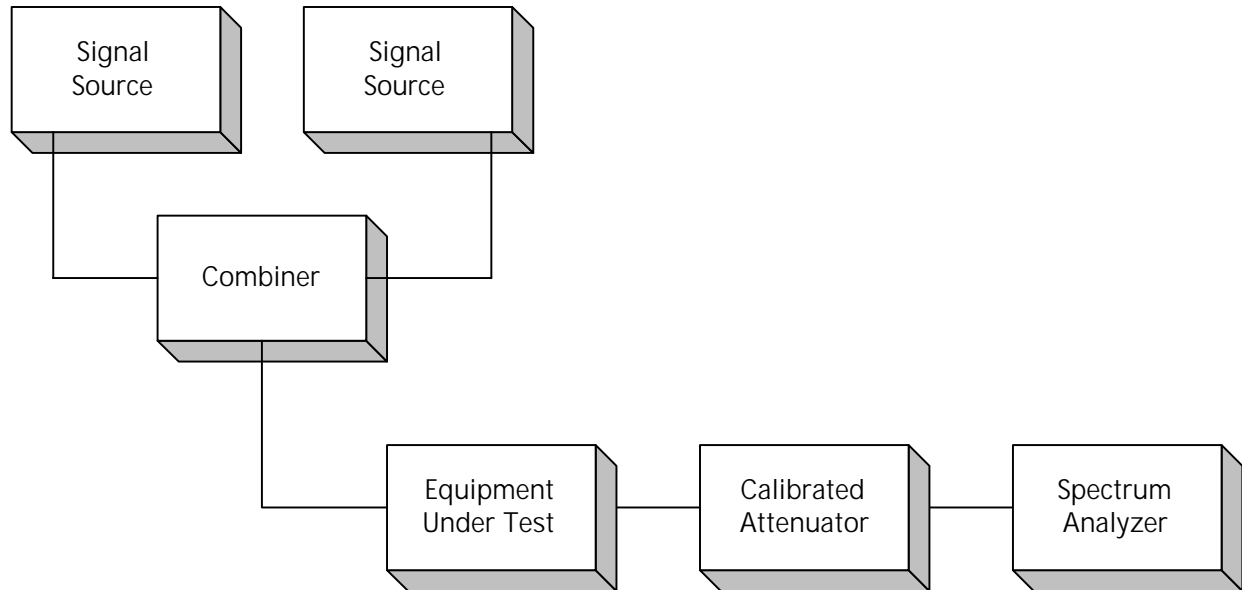
Para. No. 2.985 - R.F. Power Output



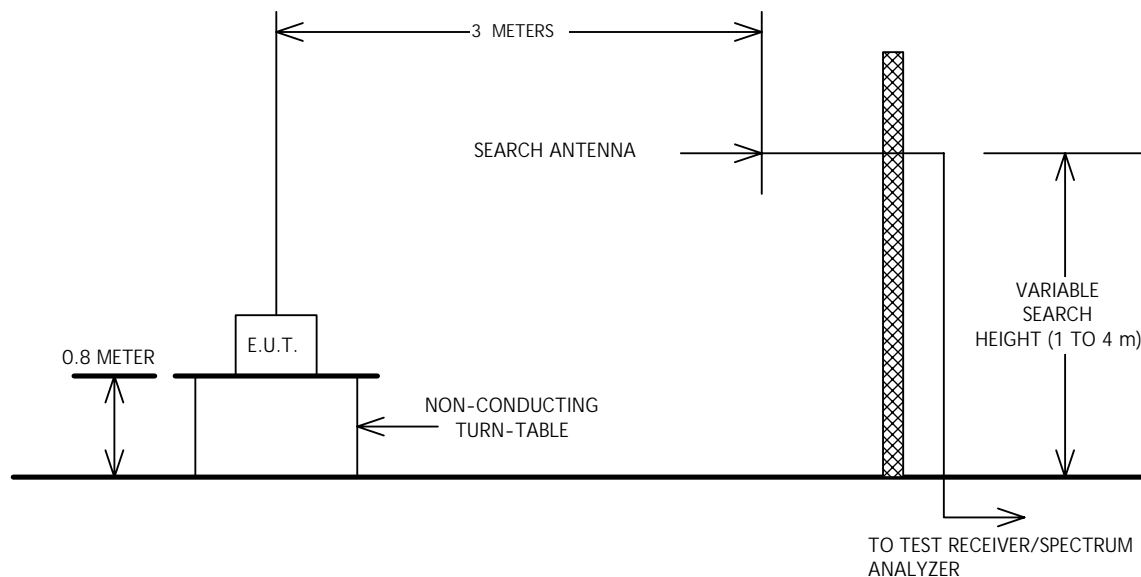
Para. No. 2.989 - Occupied Bandwidth



Para. No. 2.991 - Spurious Emissions at Antenna Terminals



Para. No. 2.993 - Field Strength of Spurious Radiation



Para. No. 2.995 - Frequency Stability

