

**Nemko Test Report:** 4L0698RUS1Rev2

**Applicant:** Sirit Corporation  
1321 Valwood Parkway  
Carrollton, TX 75006

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

**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

<b>Type(s) of Modulation:</b>	<b>F3E (Voice)</b>	<b>F1D</b>	<b>F2D</b>	<b>D7W (QAM)</b>	<b>Other A1D</b>
	<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<sup>o</sup>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



Nemko Dallas, Inc.

Dallas Headquarters:

802 N. Kealy

Lewisville, TX 75057

Tel: (972) 436-9600

Fax: (972) 436-2667

Data Plot		Occupied Bandwidth			
Page 1 of 4					
Job No.:	4L0698	Date:	12/6/2004	Complete	<input checked="" type="checkbox"/>
Specification:	Pt 90	Temperature(°C):	22	Preliminary:	<input type="checkbox"/>
Tested By:	David Light	Relative Humidity(%):	45		
E.U.T.:	916 MHz Transmitter				
Configuration:	Tx				
Sample Number:	1				
Location:	Lab 1	RBW:	Refer to plots		
Detector Type:	Peak	VBW:	Refer to plots		
<b>Test Equipment Used</b>					
Antenna:	Directional Coupler:				
Pre-Amp:	Cable #1: 1628				
Filter:	Cable #2:				
Receiver:	Cable #3:				
Attenuator #1	Cable #4:				
Attenuator #2:	Mixer:				
Additional equipment used:					
Measurement Uncertainty:	+/-1.7 dB				
Ref Lvl 40 dBm Delta 1 [T1] -0.85 dB 1.98396794 MHz RBW 100 kHz VBW 100 kHz SWT 5 ms Unit dBm					
29.8 dB Offset ▼1 [T1] 7.67 dBm 915.39328657 MHz ▲1 [T1] -0.85 dB 1.98396794 MHz					
Center 916.25 MHz 1.5 MHz Span 15 MHz 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
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TESTED BY: David Light	DATE: 12/6/04
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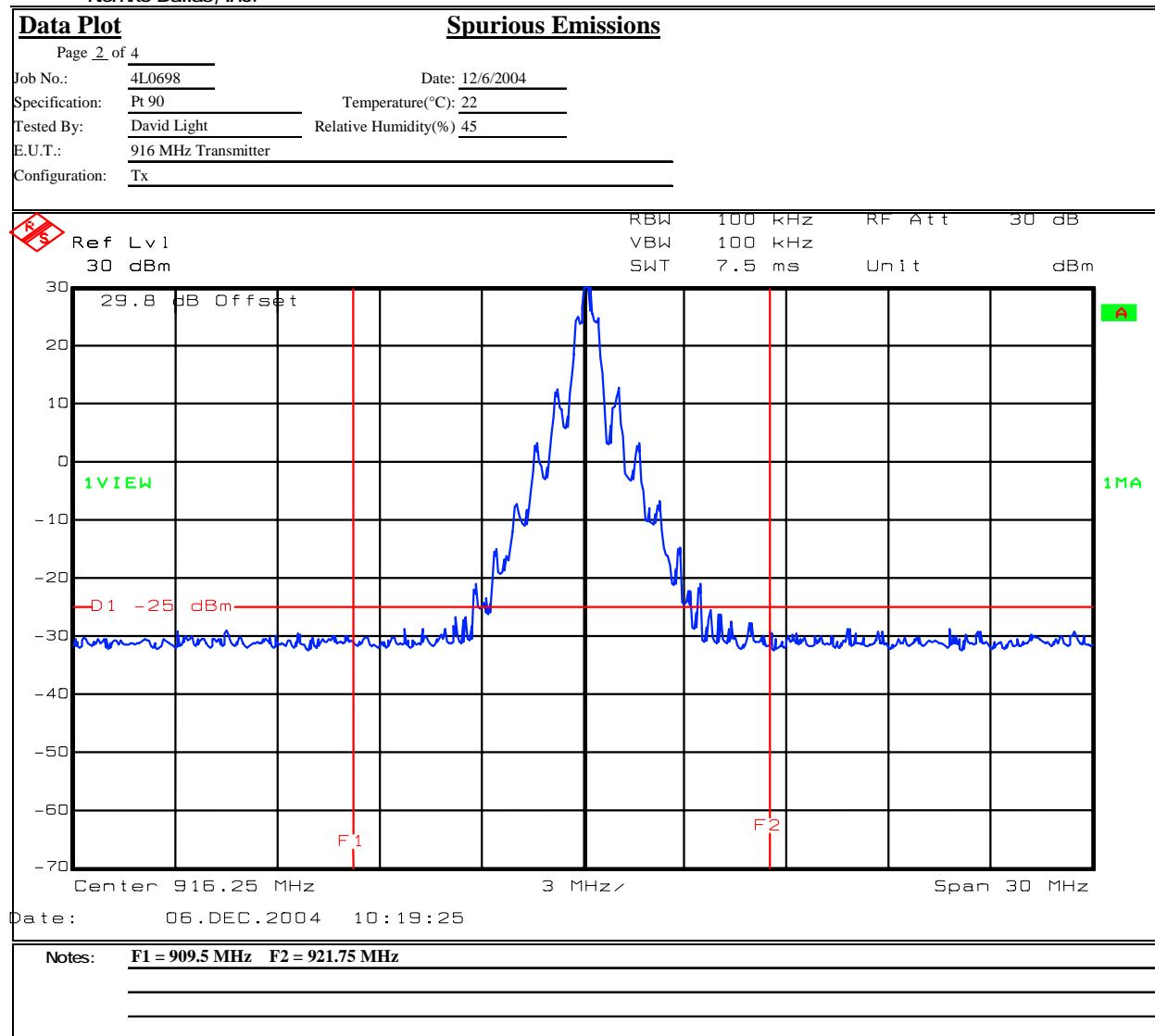
**Test Results:** Complies.

**Test Data:** See attached graph(s).

## Test Data – Spurious Emissions at Antenna Terminals



Nemko Dallas, Inc.

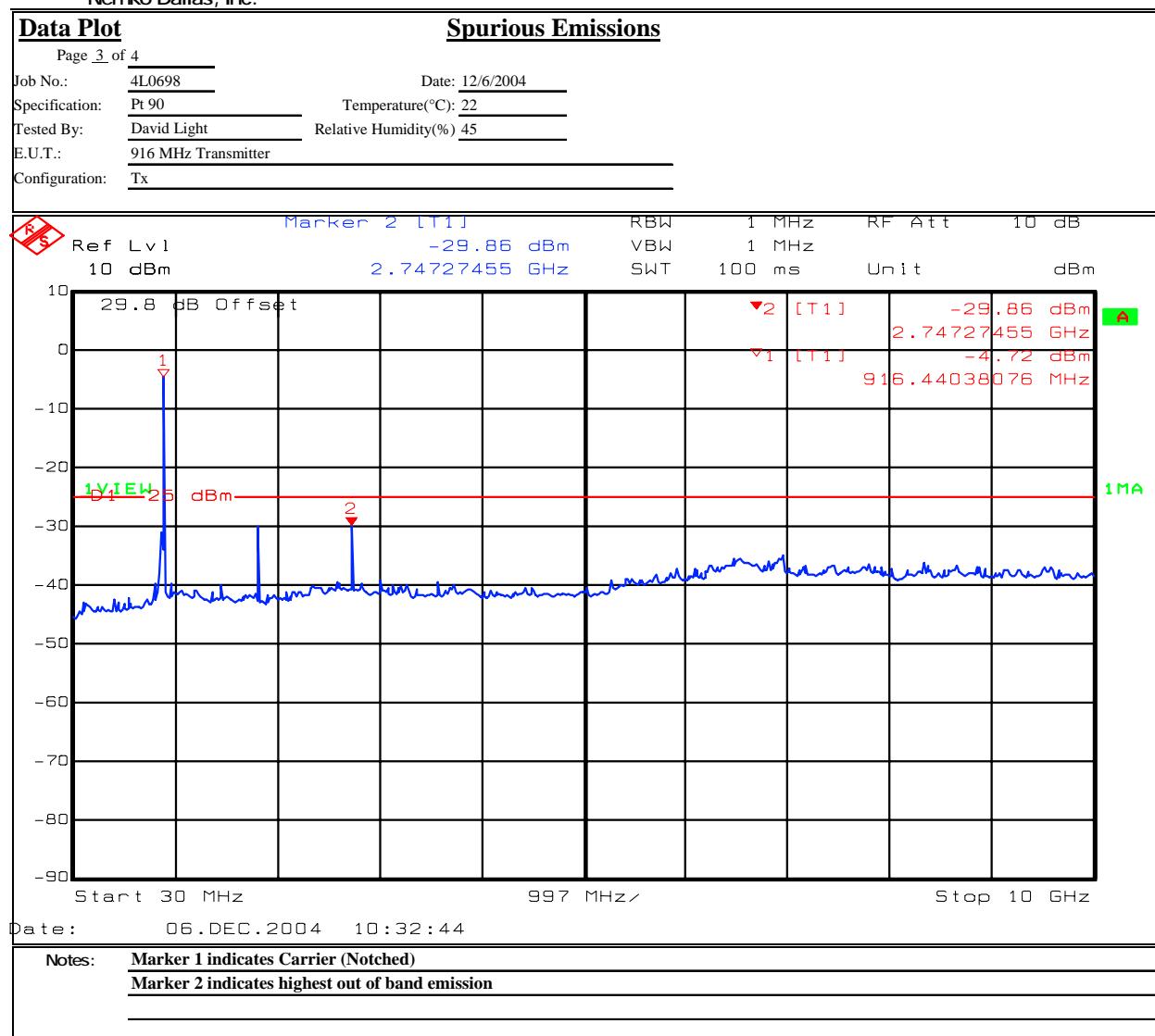
Dallas Headquarters:  
802 N. KealyLewisville, TX 75057  
Tel: (972) 436-9600  
Fax: (972) 436-2667

## 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



Nemko Dallas, Inc.

## Dallas Headquarters:

802 N. Keay

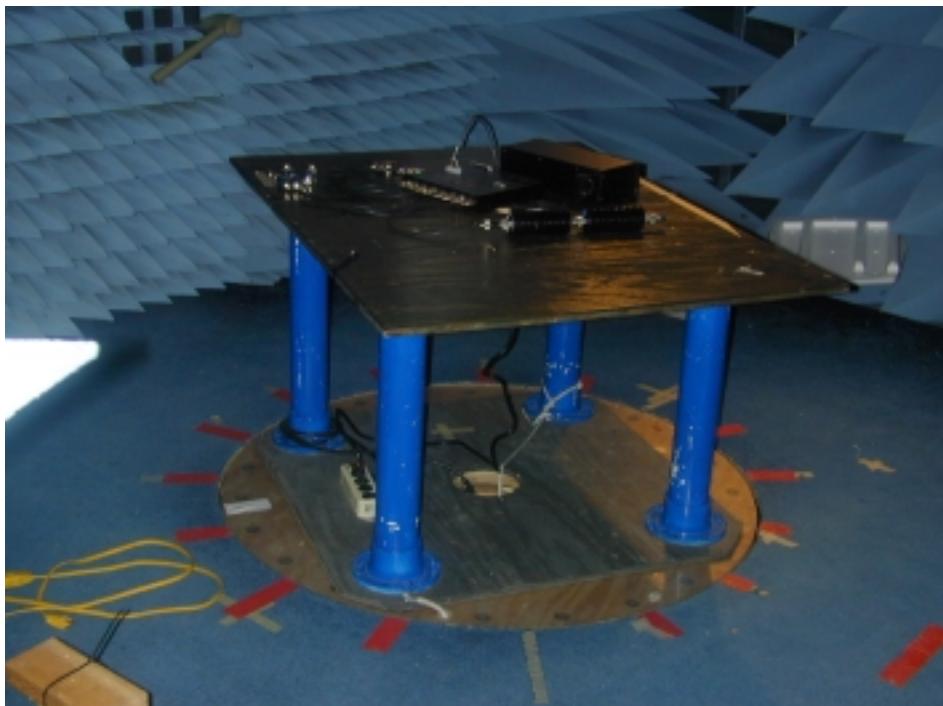
Lewisville, TX 75057

Tel: (972) 436-9600

Fax: (972) 436-2667

ERP Substitution Method										
Page <u>1</u> of <u>1</u>										
Job No.:	4L0698		Date:	12/6/04		Complete <input checked="" type="checkbox"/> Preliminary <input type="checkbox"/>				
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: <u>3</u> m				
<b>Test Equipment Used</b>										
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: <u>+/-1.7 dB</u>										
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: <u>Searched the spectrum to the 10th harmonic of the carrier</u>										

**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**

Nemko Dallas, Inc.

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Frequency Stability

Page <u>1</u> of <u>1</u>	
Job No.:	4L0698
Specification:	Pt90
Tested By:	David Light
E.U.T.:	S2301-013
Configuration:	Tx
Sample Number:	1
<u>Test Equipment Used</u>	
Antenna:	Chamber 283
Pre-Amp:	Cable #1:
Filter:	Cable #2:
Receiver:	Thermometer 619
Attenuator #1	1036
Attenuator #2:	1064
Measurement Uncertainty:	$1 \times 10^{-7}$ ppm
Standard Test Frequency <u>916.356400</u> 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	Strom PR90-010-072	N/A	08/26/04	08/26/05
1485	Cable 2.0-18.0 Ghz	Strom PR90-010-216	N/A	08/02/04	08/02/05
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSK30	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.

**Nemko Dallas**

*EQUIPMENT:S2301-013*

FCC PART 90, SUBPART I  
Fixed Transmitter  
PROJECT NO.:**4L0698RUS1Rev2**

## **ANNEX A - TEST METHODOLOGIES**

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

**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**

**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  $-20 \text{ dBm}$  ( $1 \times 10^{-5}$  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  $\leq 1 \text{ GHz}$ :

$G = 1.64$  (Dipole Gain)

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

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

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

For emissions  $> 1 \text{ GHz}$ :

$G = 1$  (Isotropic Gain)

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

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

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

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

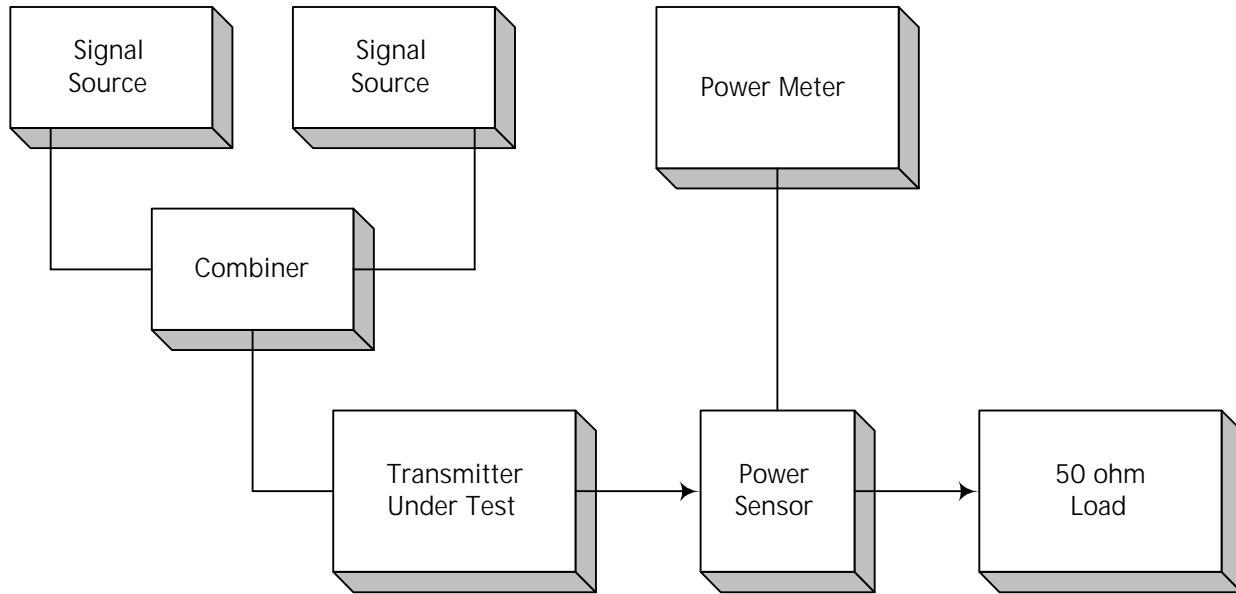
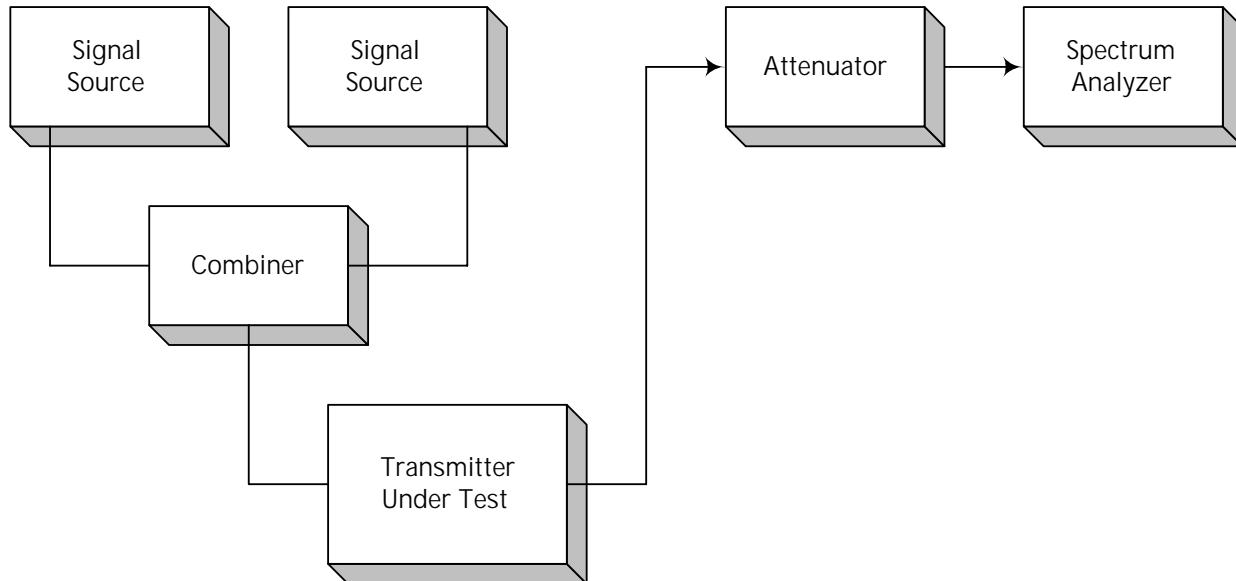
Frequency Band (MHz)	Fixed And Base Stations	Mobile Stations	
		> 2 Watts o/p pwr	< 2 Watts o/p pwr
Below 25	100	100	200
25 - 50	20	20	50
72 - 76	5	-	50
150 - 174	5	5	5
220 - 222	0.1	1.5	1.5
421 - 512	2.5	5	5
806 - 821	1.5	2.5	2.5
821 - 824	1.0	1.5	15
851 - 866	1.5	2.5	2.5
866 - 869	1.0	1.5	1.5
869 -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

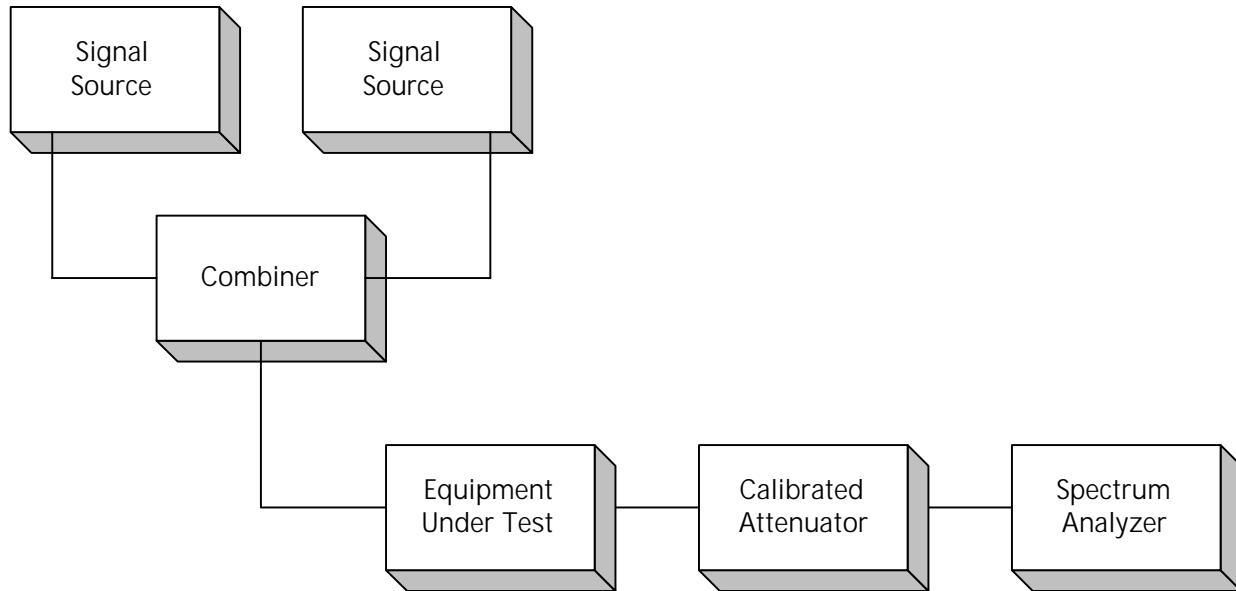
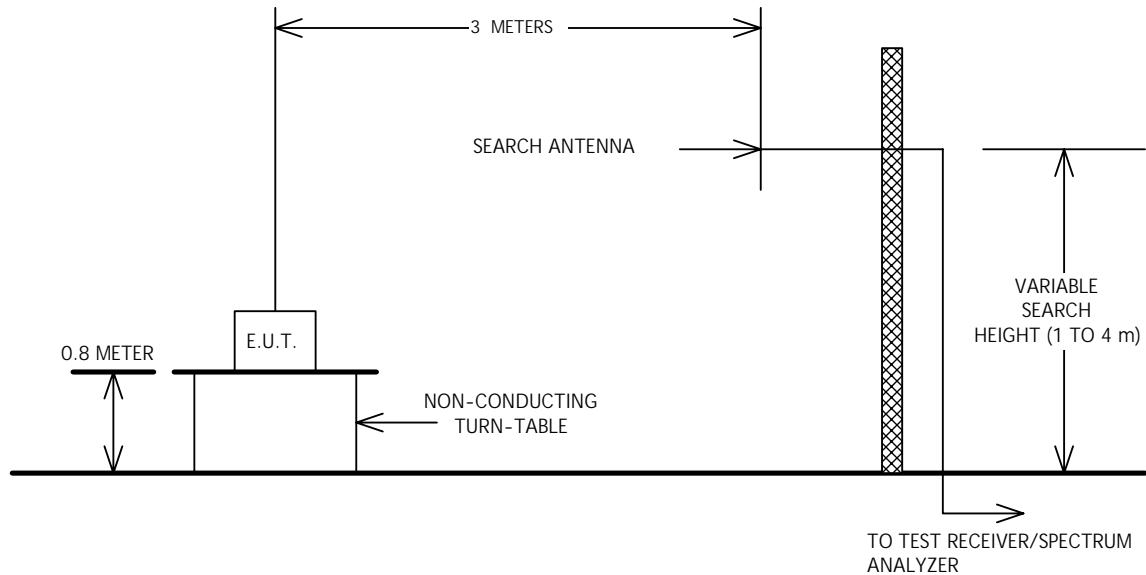
**Nemko Dallas**

*EQUIPMENT:S2301-013*

FCC PART 90, SUBPART I  
Fixed Transmitter  
PROJECT NO.:**4L0698RUS1Rev2**

**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**