

Nemko Test Report: 1L0025RUS1

Applicant: Andrew Corporation

Equipment Under Test: InCell Fiber Optic Distributed Antenna System
Model: SMR Repeater

FCC ID: KUWINCELLSMR

In Accordance With: **FCC Part 90, Subpart I**
Private Land Mobile Repeater

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

Authorized By:



Tom Tidwell, Wireless Group Manager

Date: February, 2001

Total Number of Pages: 34

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EQUIPMENT: InCell SMR Repeater

PROJECT NO.: 1L0025RUS1

Section 1. Summary of Test Results

Manufacturer: Andrew Corporation

Model No.: Incell SMR Repeater

Serial No.:

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

A	M	P
---	---	---

Equipment Code

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

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EQUIPMENT: InCell SMR Repeater

PROJECT NO.: 1L0025RUS1

Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	MEAS.	RESULT
RF Power Output	90.205		19.7 dBm	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	N/A	N/A	N/A
Transient Frequency Behavior	90.214	N/A	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.

EQUIPMENT: InCell SMR Repeater

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Section 2. General Equipment Specification

Transmitter

Supply Voltage Input:	CDU	120 VAC via power mains			
	RAU	24 Vdc via CDU			
Frequency Range:	851-869 MHz				
Tunable Bands:	851-869 MHz				
Type(s) of Modulation:	F3E (Voice)	F1D	F2D	D7W (QAM)	D7W (IDEN)
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Gain:	15 dB				
Maximum Input:	0 dBm				
Output Impedance:	50 Ohms				
RF Power Output (rated):	Voice:	+14 dBm (.024 W)			
	iDEN:	+20 dBm (.100 W)			
Operator Selection of Operating Frequency:	Not selectable				
Power Output Adjustment Capability:	Not adjustable by user				
Frequency Translation:	F1-F1	F1-F2	N/A		
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
Band Selection:	Software	Duplexer Change	Fullband Coverage		
	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>		

Modifications Made During Testing

None

System Description

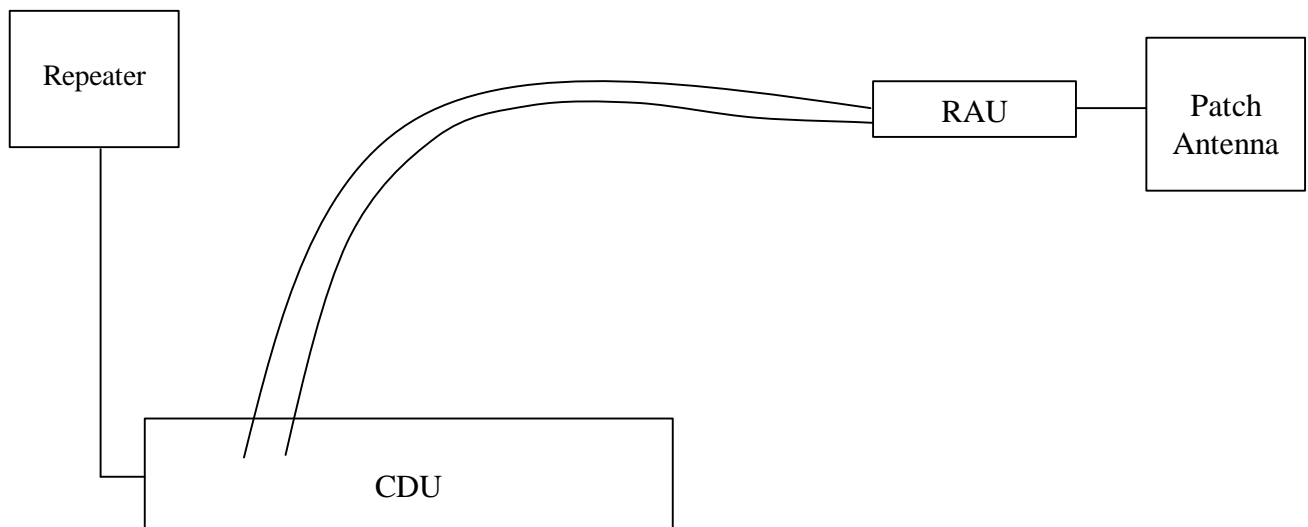
The EUT is a SMR band repeater system that uses fiber optic to distribute modulated rf signals from a base station or repeater to locations throughout a building. The system operates with a direct connection in the uplink direction.

The system is made up of two components:

- 1) CDU (Central Distribution Unit) - This unit is typically located in a wiring closet. Each CDU can interface to six RAU (Remote Antenna Units). The CDU collects and distributes voice and data signals through fiber cable pairs. The CDU connects to the output of a repeater unit. The Uplink direction is a directly wired connection and cannot connect directly to an antenna. The transmit signals from the repeater are converted from rf to optical and distributed via the fiber cables to a RAU.
- 2) RAU (Remote Antenna Unit) - This unit converts the signal received from the CDU back to rf and transmits the rf to subscriber units within its coverage range. Conversely it receives the rf signals transmitted by the subscriber units, converts the rf to an optical signal and sends it to the CDU via fiber.

The overall rf gain of the system in the downlink direction is nominally 15 dB.

System Diagram



EQUIPMENT: InCell SMR Repeater

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Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.985
TESTED BY: David LightTom Tidwell & Debbie Jensen	DATE: 15 Feb 2001

Test Results: Complies.

Measurement Data:

IDEN Modulation

Frequency (MHz)	Measured Power (dBm)
852	11.0
860	13.3
868	13.8

Voice Modulation

Frequency (MHz)	Measured Power (dBm)
852	19.2
860	19.7
868	19.6

EQUIPMENT: InCell SMR Repeater

PROJECT NO.: 1L0025RUS1

Section 4. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.989
TESTED BY: David LightTom Tidwell & Debbie Jensen	DATE:15 Feb 2001

Test Results: Complies.

Test Data: See attached graph(s).

EQUIPMENT: InCell SMR Repeater

PROJECT NO.: 1L0025RUS1

Test Data - Occupied Bandwidth



Dallas Headquarters:
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Tel: (972) 436-9600
Fax: (972) 436-2667

Nemko Dallas, Inc.

Data Plot		Occupied Bandwidth	
Page 1 of 4		Complete <u> X </u>	
Job No.:	1L0025R	Date:	02/15/01
Specification:	PART 90	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%):	50
E.U.T.:	INCELL SMR REPEATER		
Configuration:	TX FULL POWER		
Sample No.:	S02		
Location:	Lab 1	RBW:	REFER TO PLOTS
Detector Type:	Peak	VBW:	REFER TO PLOTS
Test Equipment Used			
Antenna:	_____	Directional Coupler:	_____
Pre-Amp:	_____	Cable #1:	1082
Filter:	_____	Cable #2:	_____
Receiver:	1036	Cable #3:	_____
Attenuator #1:	1475	Cable #4:	_____
Attenuator #2:	_____	Mixer:	_____
Additional equipment used:	_____		
Measurement Uncert:	+/-3.6 dB		
Ref Lvl 30.7 dBm		RBW 2 kHz VBW 2 kHz SWT 100 ms	RF Att 20 dB Mixer -10 dBm Unit dBm
Center 860 MHz 16 kHz/ Span 160 kHz			
Date: 15.FEB.2001 10:36:02			
Notes: OUTPUT SIGNAL - iDEN			

EQUIPMENT: InCell SMR Repeater

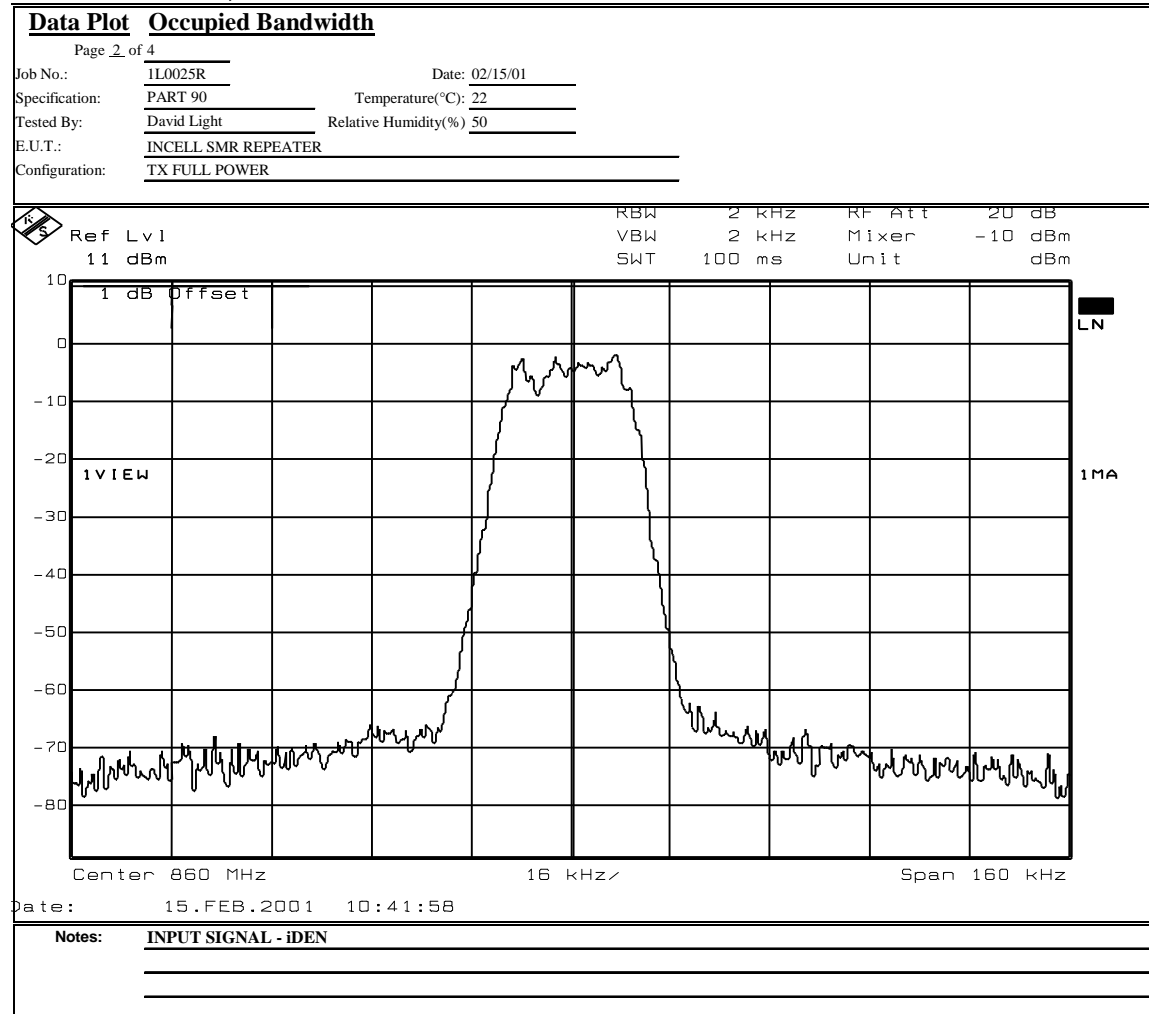
PROJECT NO.: 1L0025RUS1

Test Data - Occupied Bandwidth



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EQUIPMENT: InCell SMR Repeater

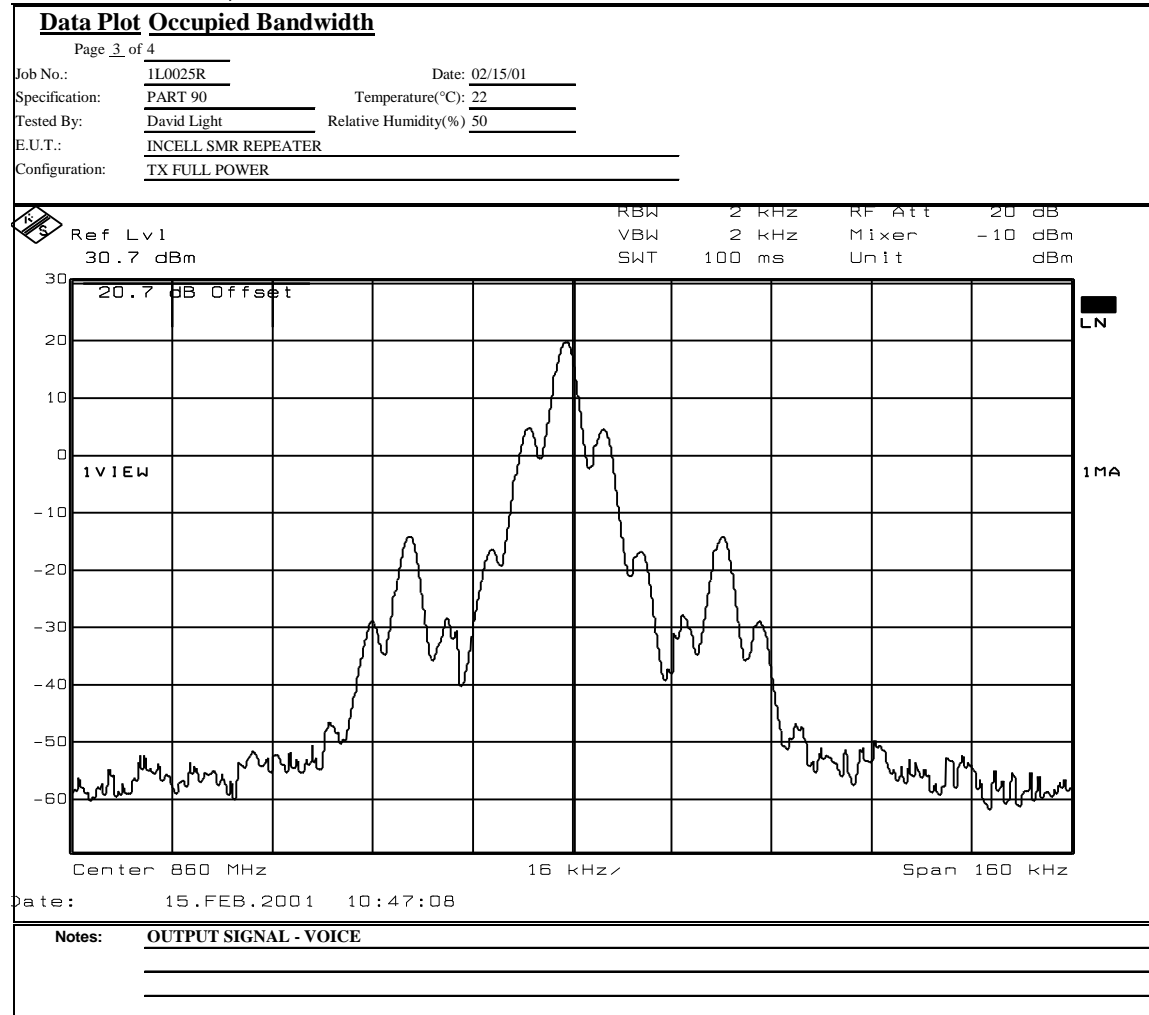
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Test Data - Occupied Bandwidth



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EQUIPMENT: InCell SMR Repeater

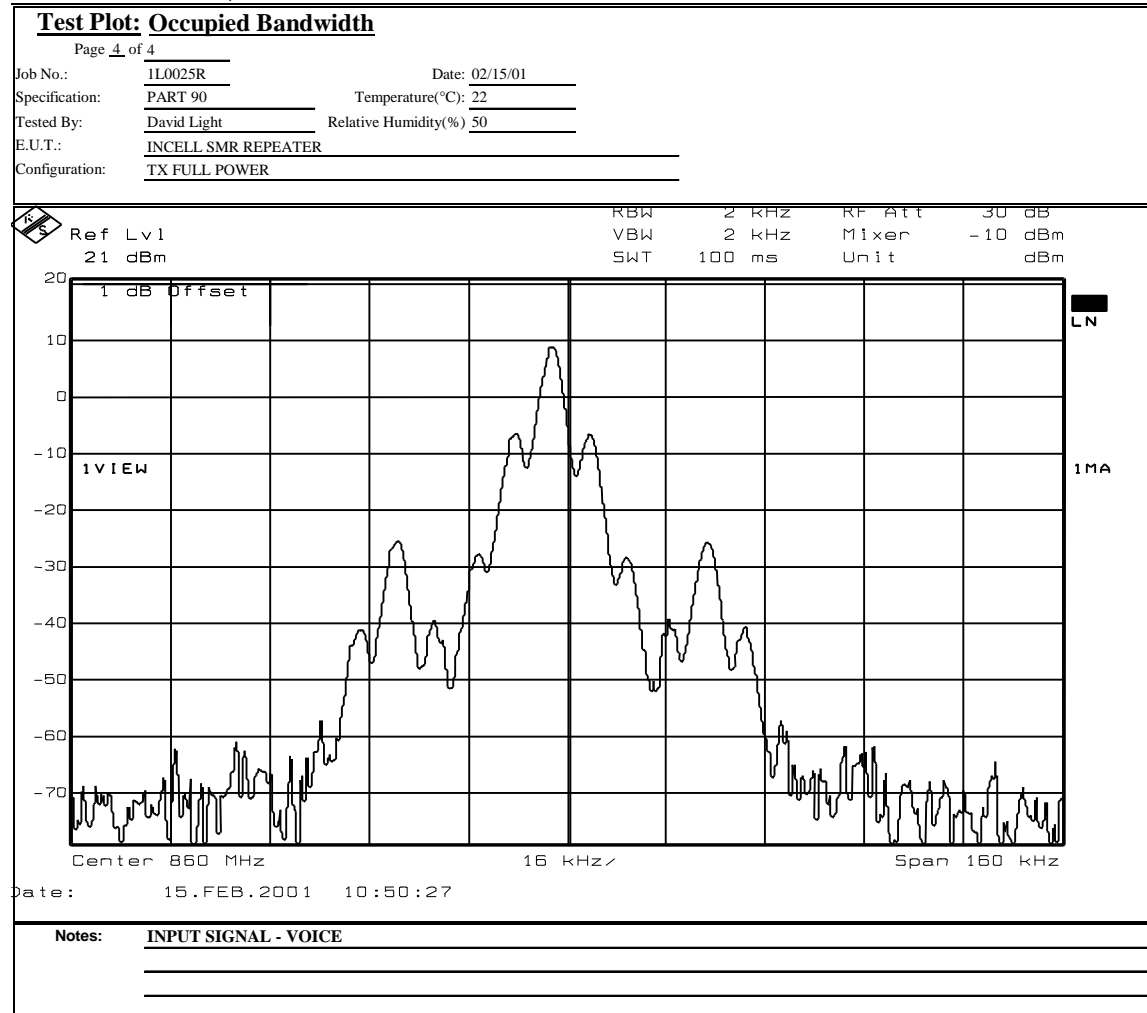
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Test Data - Occupied Bandwidth



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EQUIPMENT: InCell SMR Repeater

PROJECT NO.: 1L0025RUS1

Section 5. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.991
TESTED BY: David LightTom Tidwell & Debbie Jensen	DATE: 15 Feb 2001

Test Results: Complies.

Test Data: See attached graph(s).

EQUIPMENT: InCell SMR Repeater

PROJECT NO.: 1L0025RUS1

Test Data - Spurious Emissions at Antenna Terminals



Nemko Dallas, Inc.

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Data Plot		Intermodulation Characteristics																									
Page 1 of 2		Complete <u> X </u>																									
Job No.:	1L0025R	Date:	02/15/01																								
Specification:	PART 90	Temperature(°C):	22																								
Tested By:	David Light	Relative Humidity(%):	50																								
E.U.T.:	INCELL SMR REPEATER																										
Configuration:	TX 3 SIGNALS FULL POWER																										
Sample No.:	S02																										
Location:	Lab 1	RBW:	30 kHz																								
Detector Type:	Peak	VBW:	30 kHz																								
Test Equipment Used																											
Antenna:	_____	Directional Coupler:	_____																								
Pre-Amp:	_____	Cable #1:	1082																								
Filter:	_____	Cable #2:	_____																								
Receiver:	1036	Cable #3:	_____																								
Attenuator #1:	1475	Cable #4:	_____																								
Attenuator #2:	_____	Mixer:	_____																								
Additional equipment used: _____																											
Measurement Uncertainty: <u> +/-3.6 dB </u>																											
<table border="1"> <tr> <td>Ref Lvl</td> <td>40.7 dBm</td> <td>Marker 1 [T1]</td> <td>850.84168337 MHz</td> <td>RBW</td> <td>30 kHz</td> <td>RF Att</td> <td>30 dB</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>VBW</td> <td>30 kHz</td> <td>Mixer</td> <td>-10 dBm</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>SWT</td> <td>56 ms</td> <td>Unit</td> <td>dBm</td> </tr> </table>				Ref Lvl	40.7 dBm	Marker 1 [T1]	850.84168337 MHz	RBW	30 kHz	RF Att	30 dB					VBW	30 kHz	Mixer	-10 dBm					SWT	56 ms	Unit	dBm
Ref Lvl	40.7 dBm	Marker 1 [T1]	850.84168337 MHz	RBW	30 kHz	RF Att	30 dB																				
				VBW	30 kHz	Mixer	-10 dBm																				
				SWT	56 ms	Unit	dBm																				
Date: 15.FEB.2001 11:25:24																											
Notes: MARKER 1 INDICATES OUT OF BAND INTERMODULATION MARKER 2 INDICATES INBAND INTERMODULATION iDEN Modulation																											

EQUIPMENT: InCell SMR Repeater

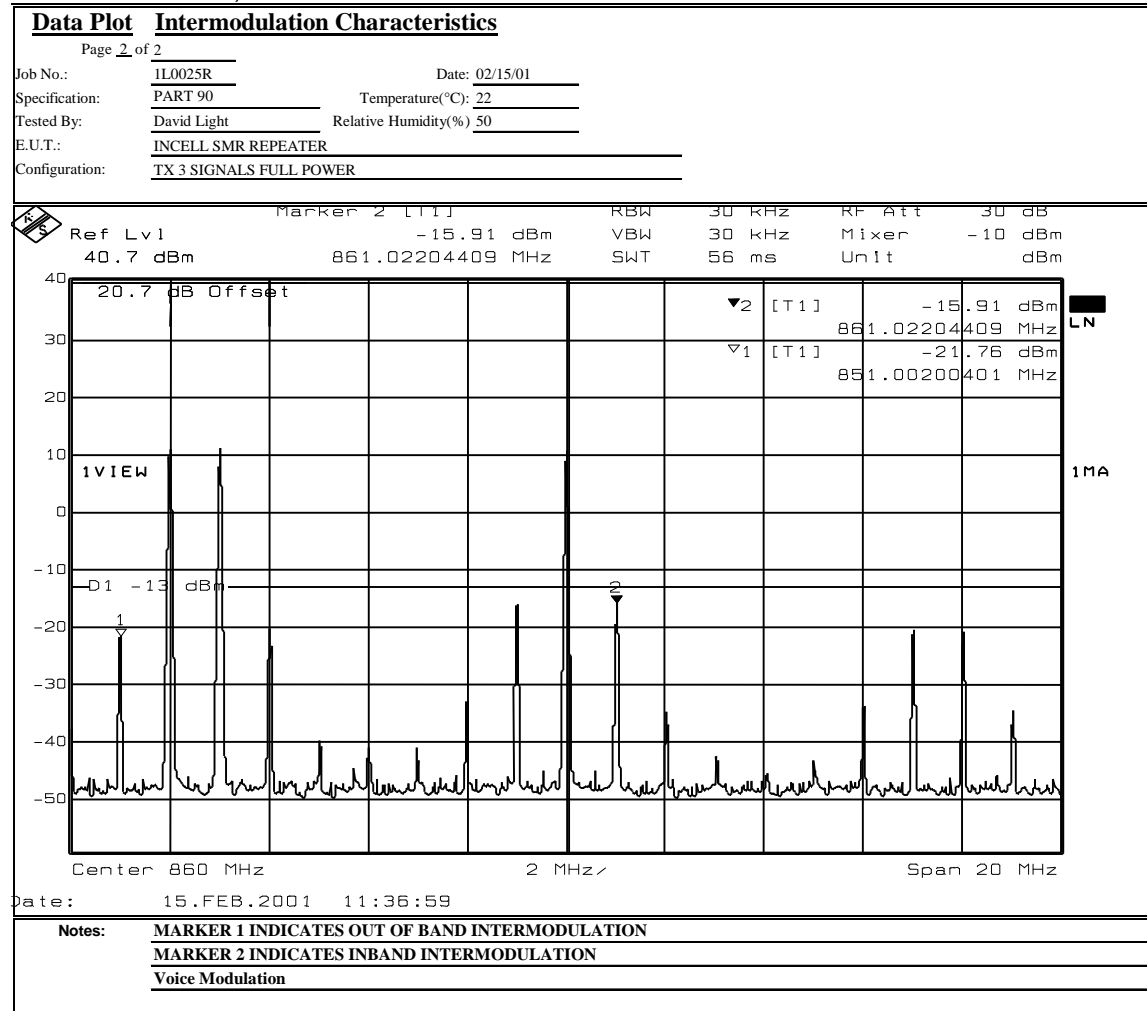
PROJECT NO.: 1L0025RUS1

Test Data - Spurious Emissions at Antenna Terminals



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EQUIPMENT: InCell SMR Repeater

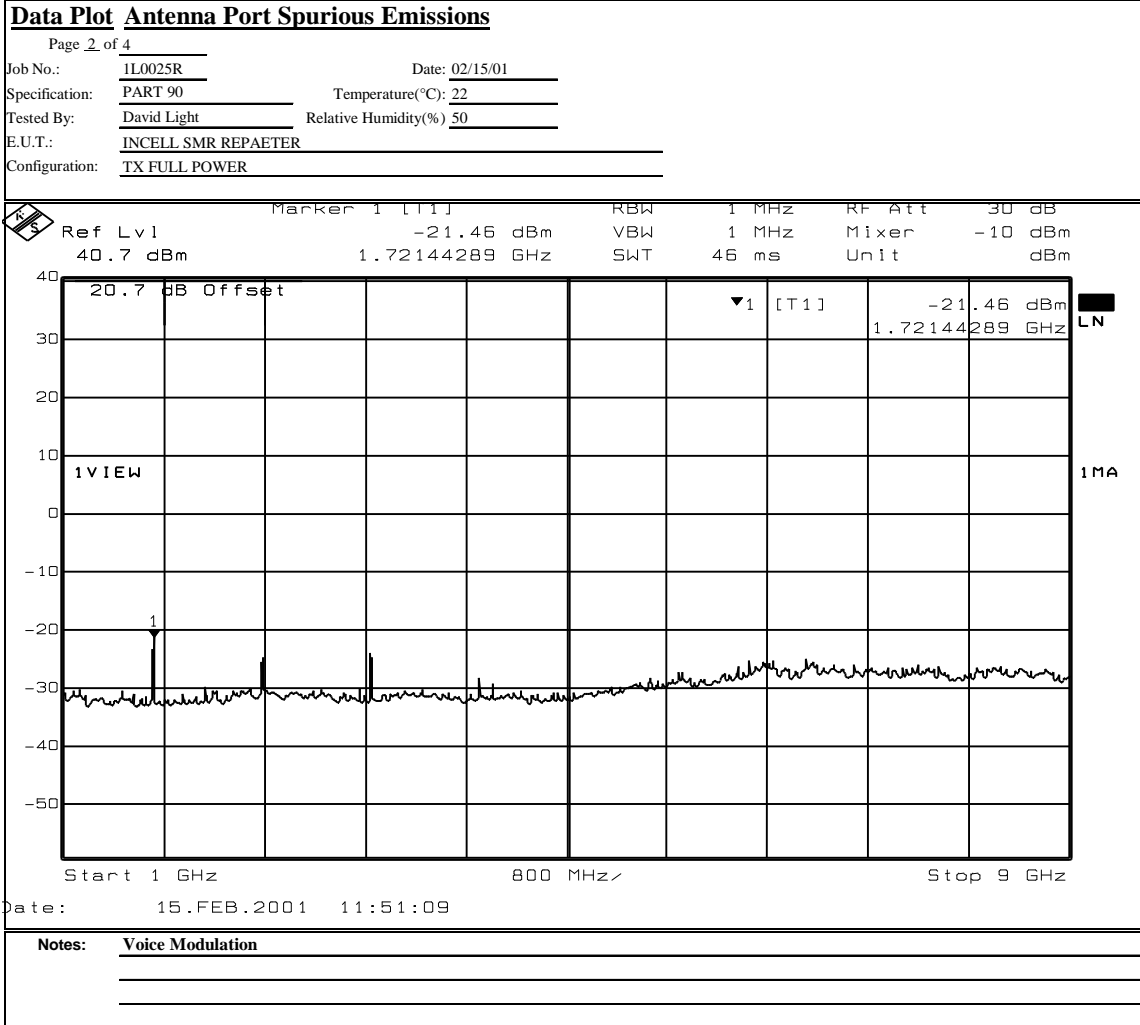
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EQUIPMENT: InCell SMR Repeater

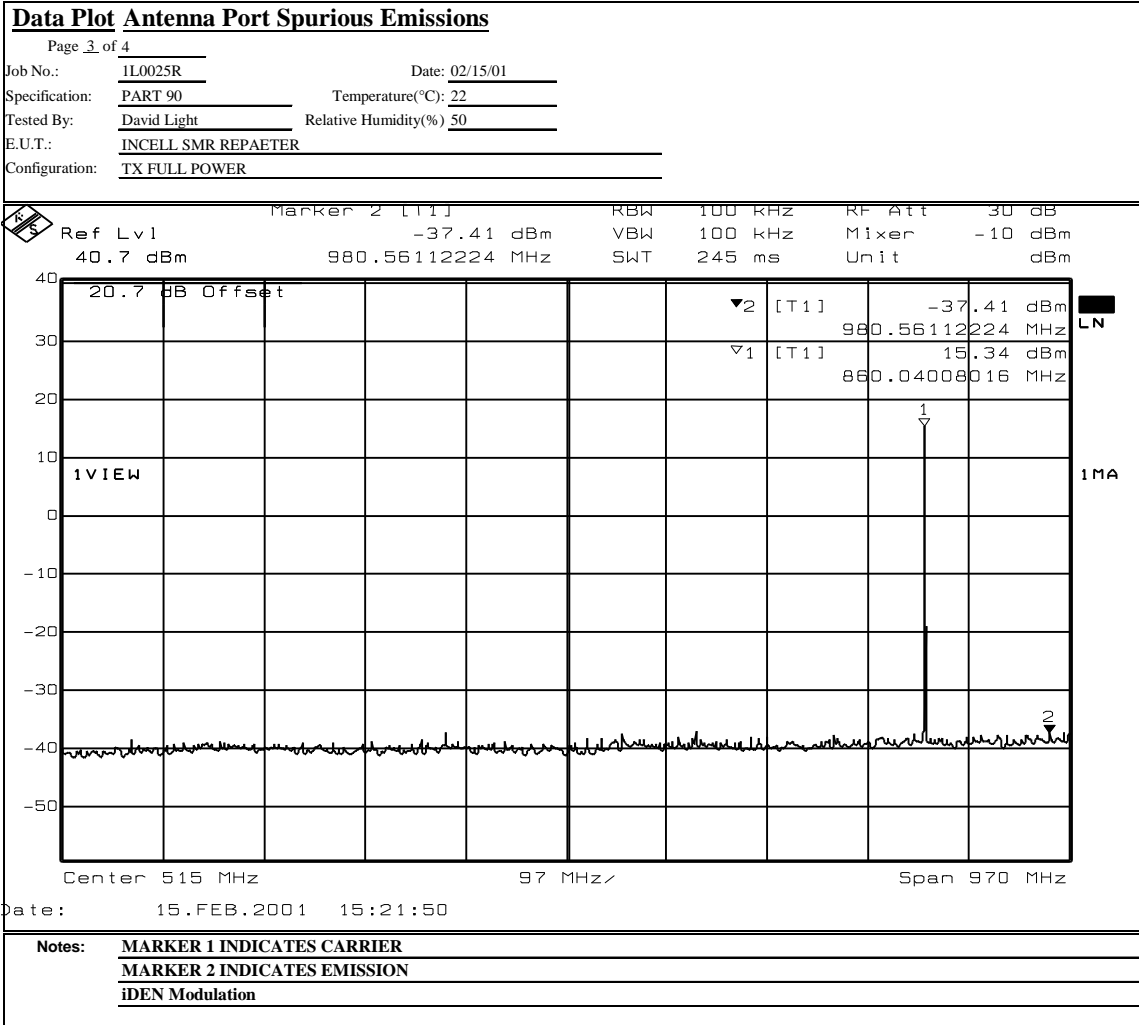
PROJECT NO.: 1L0025RUS1

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Nemko Dallas, Inc.



EQUIPMENT: InCell SMR Repeater

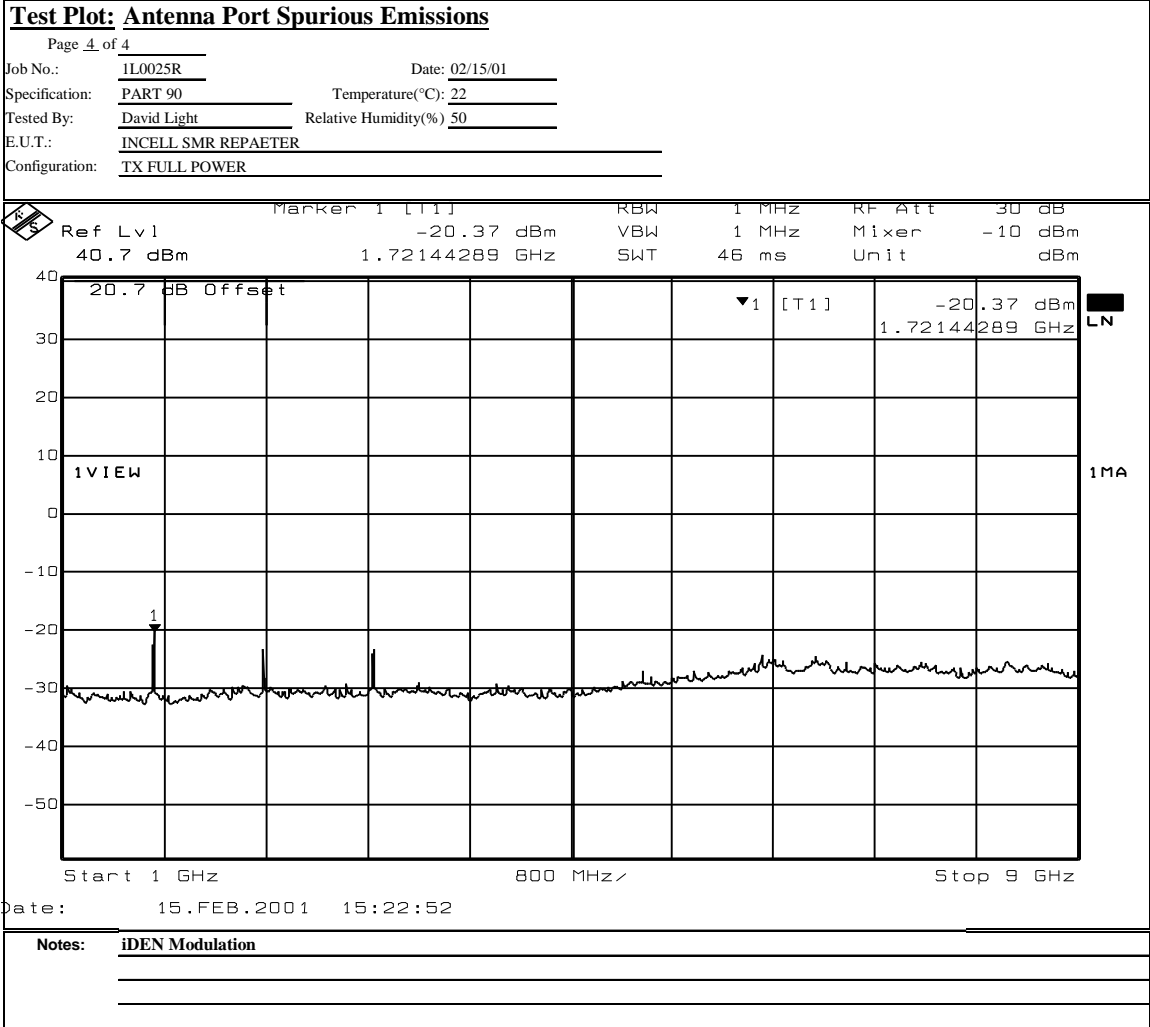
PROJECT NO.: 1L0025RUS1

Test Data - Spurious Emissions at Antenna Terminals



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EQUIPMENT: InCell SMR Repeater

PROJECT NO.: 1L0025RUS1

Section 6. Field Strength of Spurious Emissions

NAME OF TEST: Field Strength of Spurious Emissions	PARA. NO.: 2.993
TESTED BY: David LightTom Tidwell & Debbie Jensen	DATE: 16 Feb 2001

Test Results: Complies.

Test Data: See attached table.

Note: See page A5 for applicable limit.

EQUIPMENT: InCell SMR Repeater

PROJECT NO.: 1L0025RUS1

Test Data - Radiated Emissions



Nemko Dallas, Inc.

Dallas Headquarters:
802 N. Kealy
Lewisville, TX 75057
Tel: (972) 436-9600
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Field Strength of Spurious Emissions

Page 1 of 1 Complete X
Preliminary _____

Job No.: 1L0025R Date: 2/16/01

Specification: PART 90 Temperature(°C): 22

Tested By: David Light Relative Humidity(%) 50

E.U.T.: INCELL SMR REPEATER

Configuration: TX FULL POWER MID BAND

Sample Number: S02

Location: AC 3 RBW: 1 MHz Measurement

Detector Type: Peak VBW: 500 kHz Distance: 3 m

Test Equipment Used

Antenna: _____ 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 Unc +/-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
1720	-46.7	29.9	32.9	6.4	-43.4	0.000046	V	
2580	-53.7	35.6	33.3	8.0	-43.5	0.000045	V	
3440	-54.8	37.1	33.6	8.1	-43.2	0.000048	V	
4300	-61.2	42.8	33.2	7.9	-43.7	0.000043	V	
5160	-62.5	40.6	32.8	9.1	-45.6	0.000027	V	NOISE FLOOR
6020	-63.7	37.9	32.0	9.5	-48.3	0.000015	V	NOISE FLOOR
6880	-66.0	38.3	32.8	10.1	-50.4	0.000009	V	NOISE FLOOR
7740	-65.5	40.4	33.4	9.4	-49.0	0.000012	V	NOISE FLOOR
8600	-63.7	40.3	34.4	9.9	-47.9	0.000016	V	NOISE FLOOR
1720	-47.0	32.7	32.9	6.4	-40.9	0.000082	H	
2580	-55.0	34.6	33.3	8.0	-45.7	0.000027	H	
3440	-59.3	35.8	33.6	8.1	-49.0	0.000013	H	
4300	-63.0	35.2	33.2	7.9	-53.1	0.000005	H	NOISE FLOOR
5160	-62.5	36.3	32.8	9.1	-50.0	0.000010	H	NOISE FLOOR
6020	-63.7	36.6	32.0	9.5	-49.6	0.000011	H	NOISE FLOOR
6880	-66.0	37.8	32.8	10.1	-50.8	0.000008	H	NOISE FLOOR
7740	-65.5	39.8	33.4	9.4	-49.7	0.000011	H	NOISE FLOOR
8600	-63.7	41.8	34.4	9.9	-46.3	0.000023	H	NOISE FLOOR

Notes: **SCANNED TO THE TENTH HARMONIC OF CARRIER**
CHECKED THE AXIS - WORST CASE LYING FLAT

EQUIPMENT: InCell SMR Repeater

PROJECT NO.: 1L0025RUS1

Photographs of Test Setup

FRONT VIEW



REAR VIEW



EQUIPMENT: InCell SMR Repeater

PROJECT NO.: 1L0025RUS1

Section 7. Frequency Stability

NAME OF TEST: Frequency Stability	PARA. NO.: 2.995
TESTED BY: Tom Tidwell & Debbie Jensen	DATE:

Test Results: Complies/Does Not Comply.

Measurement Data: See attached tables.

Not Applicable

EQUIPMENT: InCell SMR Repeater

PROJECT NO.: 1L0025RUS1

Section 8. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	06/14/99 2 Yr Cycle
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/02/01 2 Yr Cycle
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	05/25/00
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	05/25/00
1082	CABLE 2m	Astrolab 32027-2-29094-72TC	N/A	05/23/00
1016	AMPLIFIER	HEWLETT PACKARD 8449A	2749A00159	05/24/00
1475	20db Attenuator DC 18 Ghz	MCL Inc. BW-S20W3	NONE	CBU
993	Horn antenna	A.H. Systems SAS-200/571	XXX	07/16/99 2 Yr Cycle

Annex A - Test Methodologies

EQUIPMENT: InCell SMR Repeater

PROJECT NO.: 1L0025RUS1

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

EQUIPMENT: InCell SMR Repeater

PROJECT NO.: 1L0025RUS1

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.

EQUIPMENT: InCell SMR Repeater

PROJECT NO.: 1L0025RUS1

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

EQUIPMENT: InCell SMR Repeater

PROJECT NO.: 1L0025RUS1

NAME OF TEST: Field Strength of Spurious

PARA. NO.: 2.993

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

Test Method: TIA/EIA-603-1992, Section 2.2.12

The antenna substitution method was used to determine the equivalent radiated power at spurious frequencies. The spurious emissions were measured at a distance of 3 meters. The EUT was then replaced with a reference substitution antenna with a known gain referenced to a dipole. This antenna was fed with a signal at the spurious frequency. The level of the signal was adjusted to repeat the previously measured level. The resulting erp is the signal level fed to the reference antenna corrected for gain referenced to a dipole.

EQUIPMENT: InCell SMR Repeater

PROJECT NO.: 1L0025RUS1

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

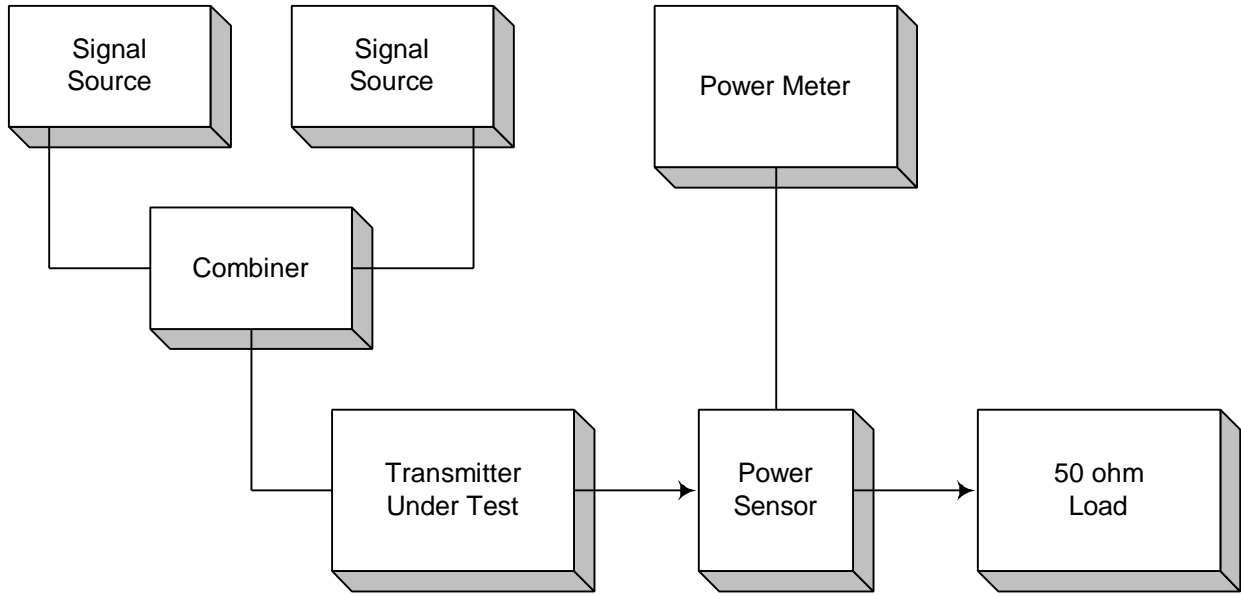
Minimum Standard: Para. No. 990.213. The transmitter carrier frequency shall remain within the assigned frequency below in ppm.

Table 2

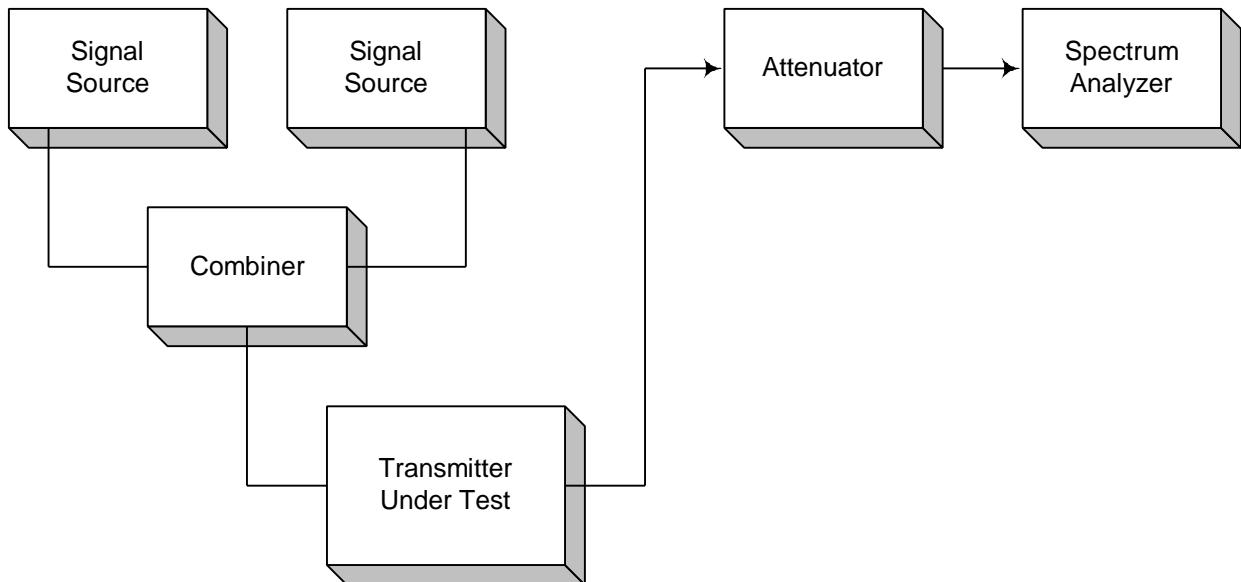
Frequency Band (MHz)	Fixed And Base Stations	Mobile Stations	
		> 2 Watts o/p pwr	< 2 Watts o/p pwr
Below 25	100	100	200
25 - 50	20	20	50
72 - 76	5	-	50
150 - 174	5	5	5
220 - 222	0.1	1.5	1.5
421 - 512	2.5	5	5
806 - 821	1.5	2.5	2.5
821 - 824	1.0	1.5	15
851 - 866	1.5	2.5	2.5
866 - 869	1.0	1.5	1.5
869 -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

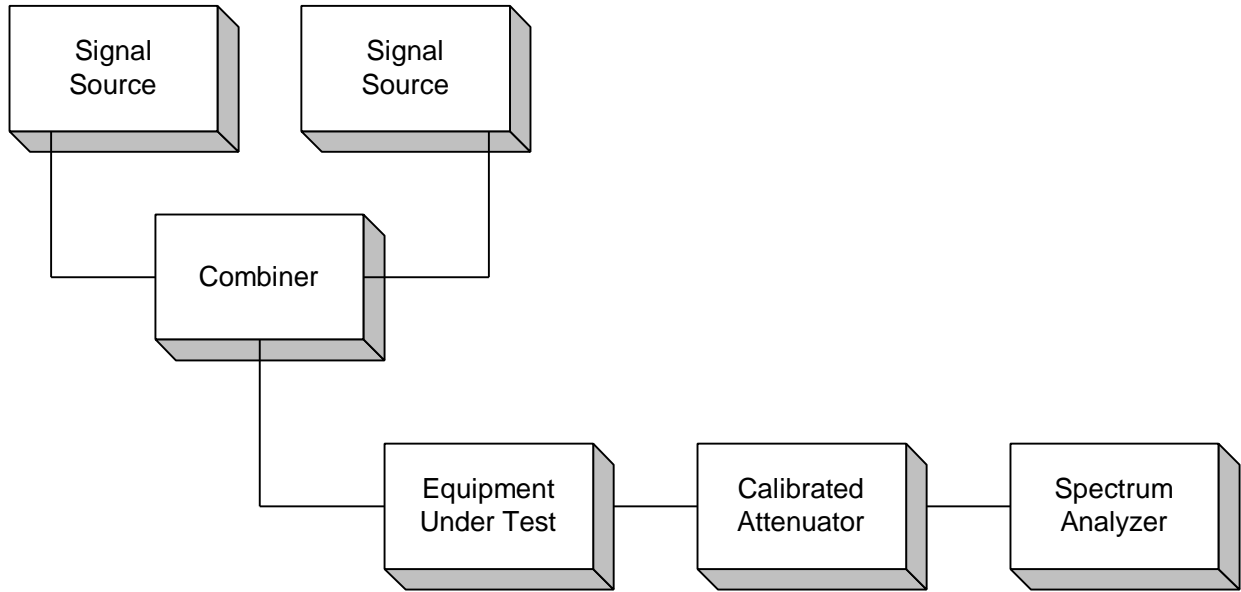
Para. No. 2.985 - R.F. Power Output



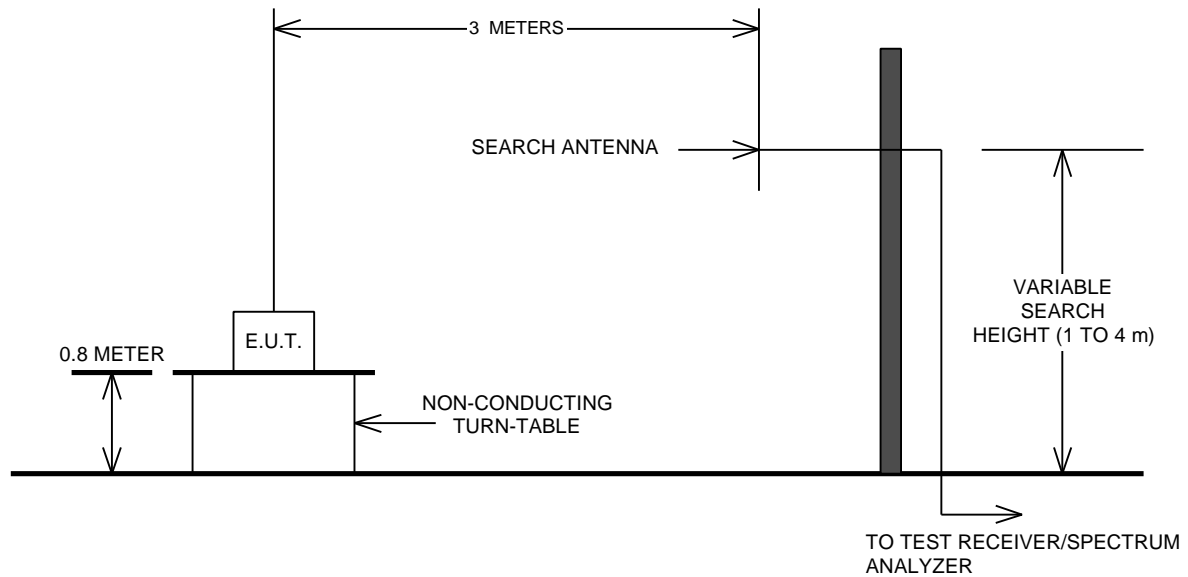
Para. No. 2.989 - Occupied Bandwidth



Para. No. 2.991 - Spurious Emissions at Antenna Terminals



Para. No. 2.993 - Field Strength of Spurious Radiation



EQUIPMENT: InCell SMR Repeater

PROJECT NO.: 1L0025RUS1

Para. No. 2.995 - Frequency Stability

