Nemko Test Report:	3L0023RUS1Rev2
Applicant:	Nokia Mobile Phones, Inc. 6021 Connection Drive Irving, Texas 75039
Equipment Under Test: **(E.U.T.)**	Model 2220 (Mexican Build)
In Accordance With:	**FCC Parts 2 and 22** 800 MHz Cellular Subscriber Units
Tested By:	Nemko Dallas Inc. 802 N. Kealy Lewisville, TX 75057-3136
Authorized By:	 Tom Tidwell, Frontline Manager
Date:	5/5/03
Total Number of Pages:	32

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Section 1. Summary of Test Results

Manufacturer: Nokia

Model No.: Model 2220

Serial No.: ESN: 07201962409
ESN: 07201962410

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".

TESTED BY: ____David Light_____ DATE: _March 19 2003_

Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	RESULT
RF Power Output	2.1046	7W ERP	Complies
Spurious Emissions at Antenna Terminals	2.1051	-13 dBm	Complies
Field Strength of Spurious Emissions	2.1053	82.3 dBμV/m	Complies
Frequency Stability	2.1055	2.5 ppm	Complies

Footnotes:

.

Section 2. General Equipment Specification

Frequency Range, MHz:	824.04 to 848.97
Tunable Bands:	824.04 to 848.97 Not selectable by user
Necessary Bandwidth:	30 kHz
Type of Modulation and Designator:	40K0F1D, 40K0F8W, and 30K0DXW
Output Impedance:	50 ohms
RF Power Output (rated):	528.4 mW (TDMA) 290.4 mW (AMPS)
Duty Cycle:	Continuous
Channel Spacing:	30 kHz
Operator Selection of Frequency:	Software Controlled
Power Output Adjustment Capability:	Software Controlled

Operational Description

This device is a wireless dual mode phone that operates in the cellular band.

System Diagram

Refer to separate EXHIBITS

Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 22.913
TESTED BY: Tom Tidwell	DATE: 4/11/03

Test Results: Complies.

Measurement Data:

Conducted Data -

Frequency (MHz)	Mode	Conducted Power (dBm)	Conducted Power (mW)
824.04	AMPS	24.63	290.4
836.52	AMPS	24.63	290.4
848.97	AMPS	24.29	268.5
824.04	TDMA	27.23	528.4
836.52	TDMA	27.13	516.4
848.97	TDMA	26.74	472.1

Agilent power meter E4418B s/n GB40206972 Cal'd 9/19/02 Due 9/19/03
Agilent power sensor 8482H s/n 3318A05855 Cal'd 12/19/02 Due 12/19/03

Test Data - ERP

Nemko Dallas, Inc.

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

ERP Substitution Method

Page 1 of 1

Complete X
Preliminary

Job No.: 3L0023R
Specification: Parts 2 & 22
Tested By: David Light
E.U.T.: Dual mode cellular phone
Configuration: Upright
Sample No: 2
Location: A-OATS
Detector Type: Peak

Date: 3/19/03
Temperature(°C): 20
Relative Humidity(%) 40
RBW: 100 kHz
VBW: 100 kHz
Measurement Distance: 3 m

Test Equipment Used

Antenna: 1304, 1404
Pre-Amp:
Filter:
Receiver: 1036
Attenuator #1
Attenuator #2:
Additional equipment used: 1304, 1053, 406, 1056
Measurement Uncertainty: +/-1.7 dB

Directional Coupler:
Cable #1: 1983
Cable #2:
Cable #3:
Cable #4:
Mixer:

Frequency (MHz)	Meter Reading (dBm)	Correction Factor (dB)	Substitution Input [dBm]	Pre-Amp Gain (dB)	Substitution Antenna Gain (dBd)		ERP (dBm)	ERP (mW)	Polarity	Comments
824.04	-11.5	38.4	26.9	0			26.9	493.1738	V	TDMA
824.04	-22.9	39.1	16.2	0			16.2	41.9759	H	TDMA
836.52	-10.9	37.6	26.7	0			26.7	466.6594	V	TDMA
836.52	-21.7	38.2	16.5	0			16.5	44.5656	H	TDMA
848.97	-11.2	37.6	26.4	0			26.4	431.5191	V	TDMA
848.97	-20.3	40.3	20.0	0			20.0	98.8553	H	TDMA
824.04	-15.1	38.4	23.3	0			23.3	215.2782	V	AMPS
824.04	-28.0	39.1	11.1	0			11.1	12.9718	H	AMPS
836.52	-15.0	37.6	22.6	0			22.6	181.5516	V	AMPS
836.52	-24.6	38.2	13.6	0			13.6	22.8560	H	AMPS
848.97	-14.9	37.6	22.7	0			22.7	184.0772	V	AMPS
848.97	-24.7	40.3	15.6	0			15.6	35.8922	H	AMPS

Notes: **Tested on three orthagonal axis'. Upright was worst case.**

Test Setup Photo

Section 4. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions At Antenna Terminals	PARA. NO.: 2.1051
TESTED BY: Eldon Berry	DATE: 1/30/2003

Test Results: Complies.

Measurement Data:

Test Plots – Spurious Emissions at Antenna Terminals

Nemko Dallas, Inc.

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

Data Plot — **Spurious Emissions at Antenna Terminals**

Page 1 of 6

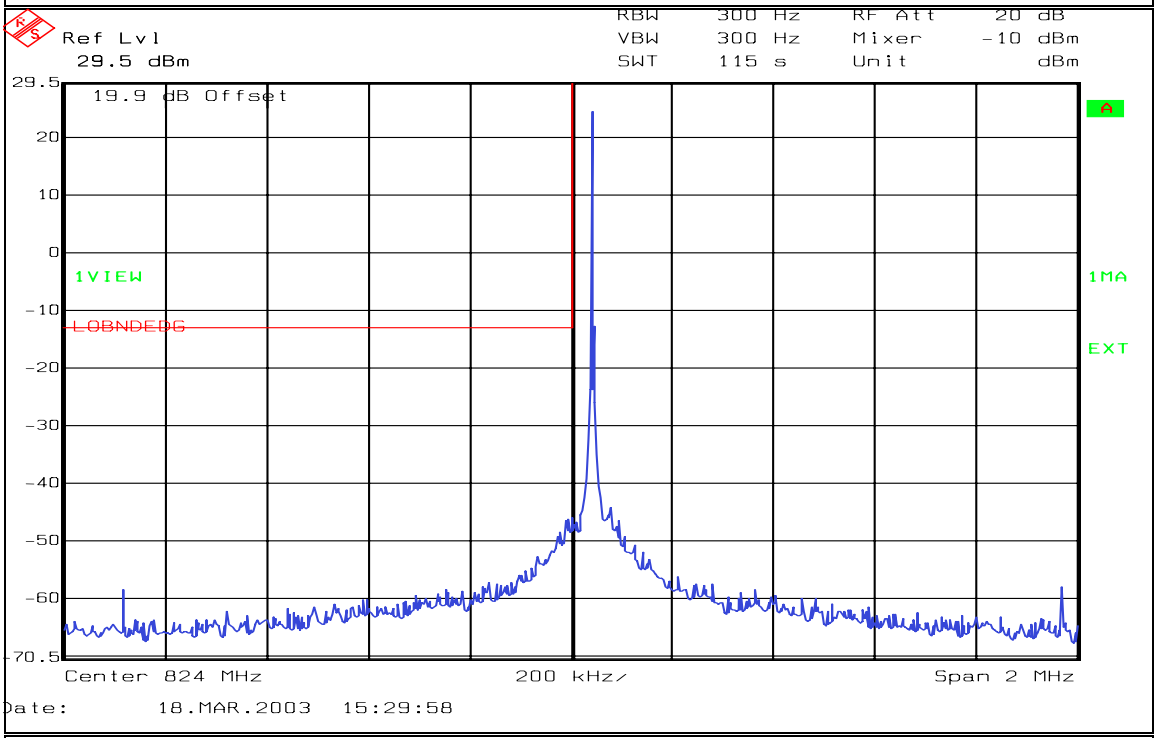
Job No.:	3L0023R	Date:	3/18/2003	Complete	X
Specification:	Pts 2 & 22	Temperature(°C):	22	Preliminary:	
Tested By:	David Light	Relative Humidity(%)	45		
E.U.T.:	Dual mode cellular phone (Mexican Build)				
Configuration:	Tx full power				
Sample Number:	1				
Location:	Lab 1	RBW:	Refer to plots	Measurement	
Detector Type:	Peak	VBW:	Refer to plots	Distance:	NA m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	1628
Filter:		Cable #2:	
Receiver:	1036	Cable #3:	
Attenuator #1		Cable #4:	
Attenuator #2:	1478	Mixer:	

Additional equipment used:

Measurement Uncertainty: +/-1.7 dB



Notes: **LOW BAND EDGE AMPS - TX @ 824.04 MHz**

Test Plots – Spurious Emissions at Antenna Terminals

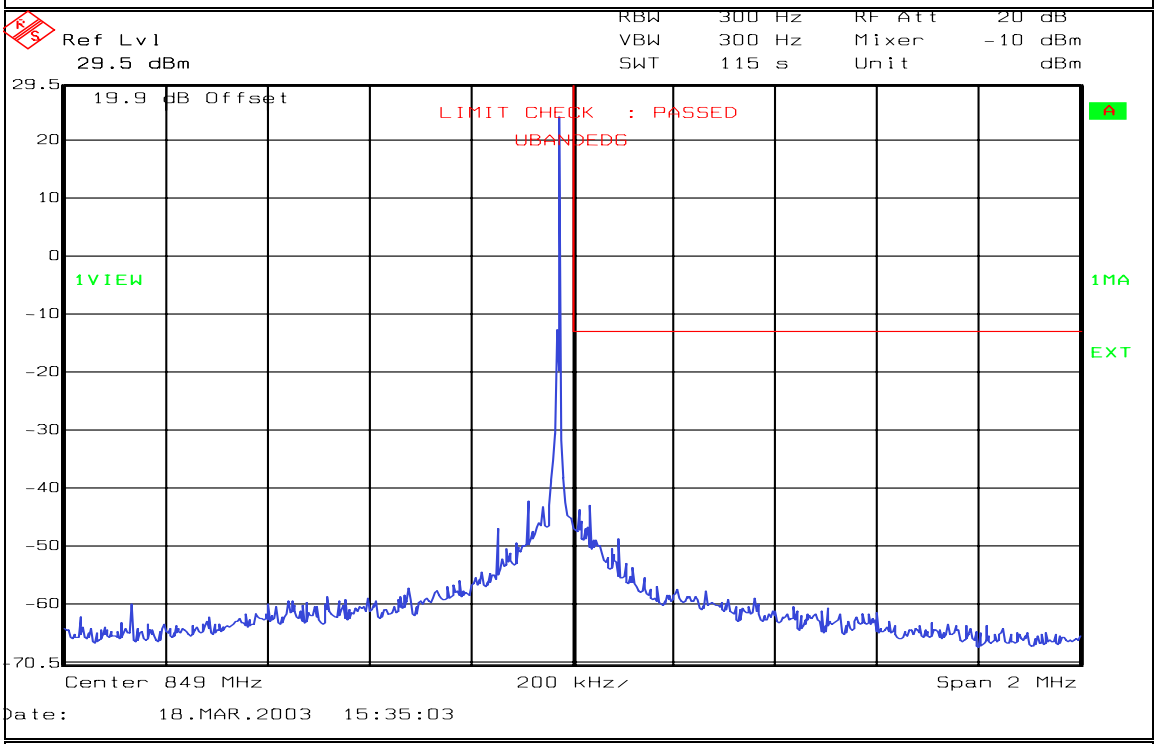
Nemko Dallas, Inc.

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

Data Plot — **Spurious Emissions at Antenna Terminals**

Page 2 of 6

Job No.:	3L0023R	Date:	3/18/2003
Specification:	Pts 2 & 22	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	45
E.U.T.:	Dual mode cellular phone (Mexican Build)		
Configuration:	Tx full power		



Notes: UPPER BAND EDGE - AMPS
TX @ 8 848.97 MHz

Test Plots – Spurious Emissions at Antenna Terminals

Nemko Dallas, Inc.

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

Data Plot — **Spurious Emissions at Antenna Terminals**

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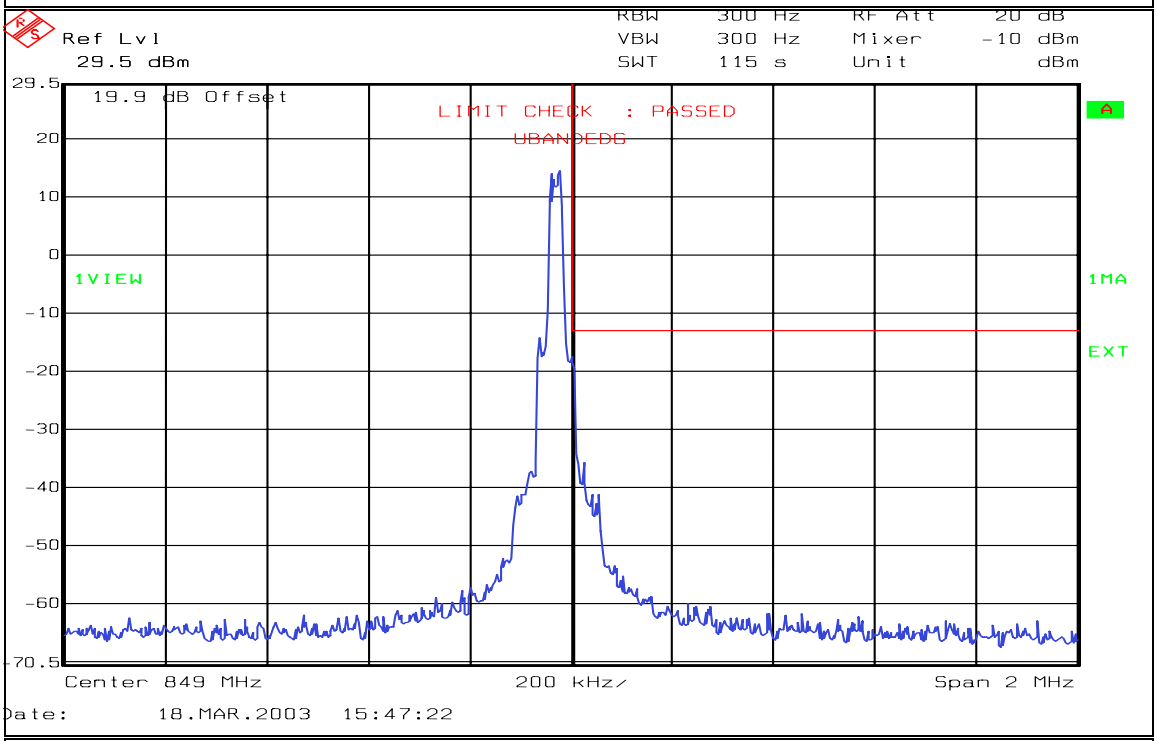
Job No.:	3L0023R	Date:	3/18/2003
Specification:	Pts 2 & 22	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	45
E.U.T.:	Dual mode cellular phone (Mexican Build)		
Configuration:	Tx full power		



Notes: UPPER BAND EDGE - TDMA
TX @ 848.97 MHz

Test Plots – Spurious Emissions at Antenna Terminals

Nemko Dallas, Inc.

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

Test Plot: **Spurious Emissions at Antenna Terminals**

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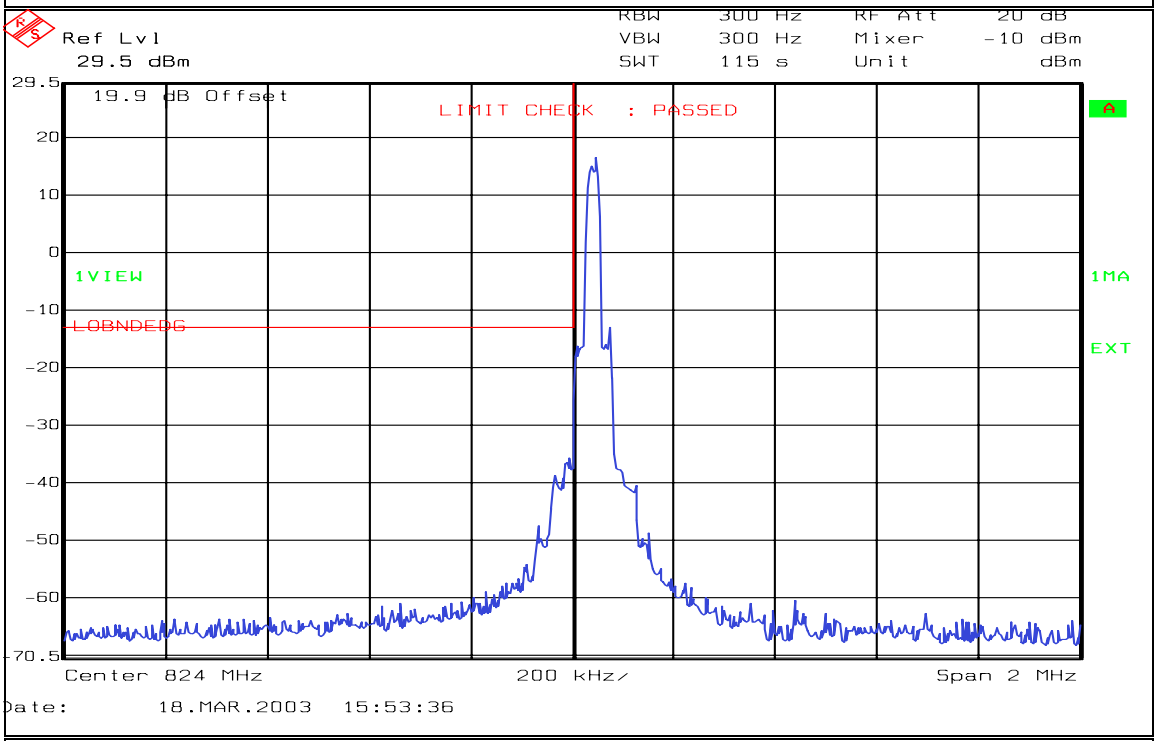
Job No.: 3L0023R Date: 3/18/2003
Specification: Pts 2 & 22 Temperature(°C): 22
Tested By: David Light Relative Humidity(%) 45
E.U.T.: Dual mode cellular phone (Mexican Build)
Configuration: Tx full power



Notes: LOWER BAND EDGE - TDMA
TX @ 824.04 MHz

Test Plots – Spurious Emissions at Antenna Terminals

Nemko Dallas, Inc.

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

Test Plot: **Spurious Emissions at Antenna Terminals**

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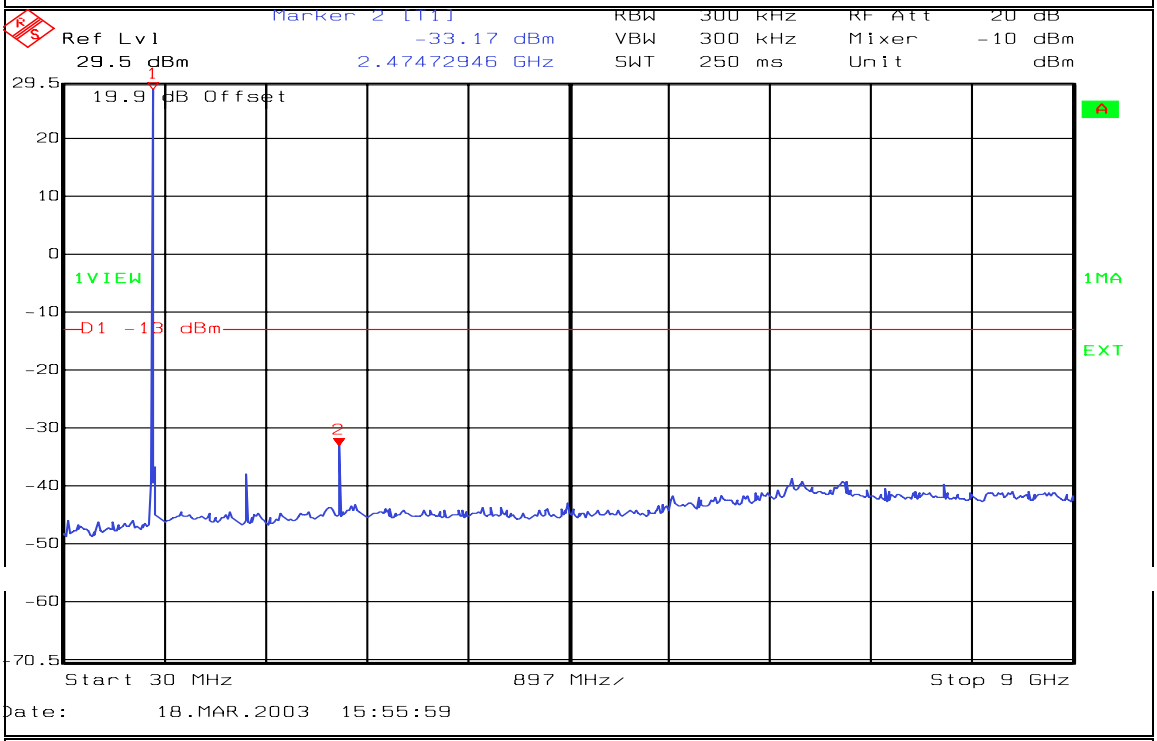
Job No.:	3L0023R	Date:	3/18/2003
Specification:	Pts 2 & 22	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	45
E.U.T.:	Dual mode cellular phone (Mexican Build)		
Configuration:	Tx full power		



Notes:
SPURIOUS EMISSIONS AT ANTENNA TERMINAL - TDMA
MARKER 1 INDICATES CARRIER - MARKER 2 INDICATES HIGHEST EMISSION
SEARCHED SPECTRUM TO 10TH HARMONIC OF CARRIER

Test Plots – Spurious Emissions at Antenna Terminals

Nemko Dallas, Inc.

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

Test Plot: **Spurious Emissions at Antenna Terminals**

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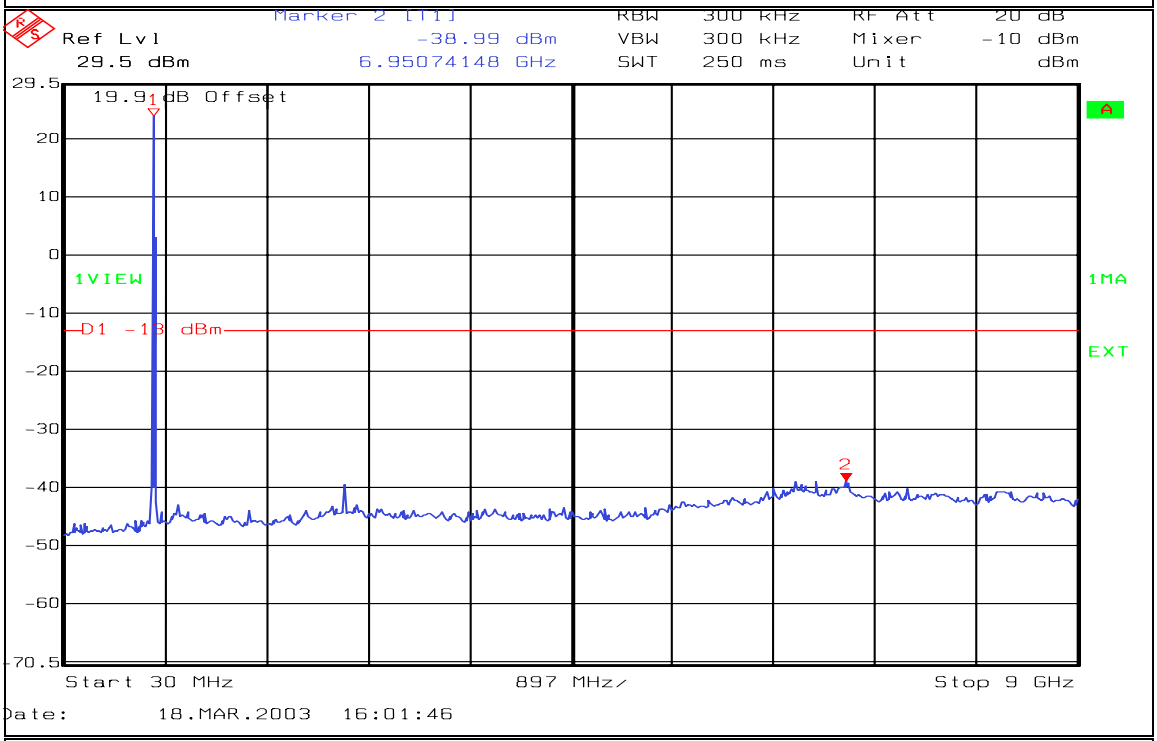
Job No.:	3L0023R	Date:	3/18/2003
Specification:	Pts 2 & 22	Temperature(°C):	22
Tested By:	David Light	Relative Humidity(%)	45
E.U.T.:	Dual mode cellular phone (Mexican Build)		
Configuration:	Tx full power		



Notes:
SPURIOUS EMISSIONS AT ANTENNA TERMINAL - AMPS
MARKER 1 INDICATES CARRIER - MARKER 2 INDICATES HIGHEST EMISSION
SEARCHED SPECTRUM TO 10TH HARMONIC OF CARRIER

Section 5. Field Strength of Spurious

NAME OF TEST: Field Strength of Spurious	PARA. NO.: 2.1053
TESTED BY: David Light	DATE: 3/20/03

Test Results: Complies.

Measurement Data: **See attached table.**

Test Data - Radiated Emissions

Nemko Dallas, Inc.

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

ERP Substitution Method

Page 1 of 1 — Complete X — Preliminary

Job No.: 3L0023R — Date: 3/20/03
Specification: Part 22 — Temperature(°C): 20
Tested By: David Light — Relative Humidity(%) 30
E.U.T.: Model 2220 (Mexican build)
Configuration: Upright (Worst case)
Sample No: 2
Location: AC 1 — RBW: 100 kHz — Measurement Distance: 3 m
Detector Type: Peak — VBW: 100 kHz

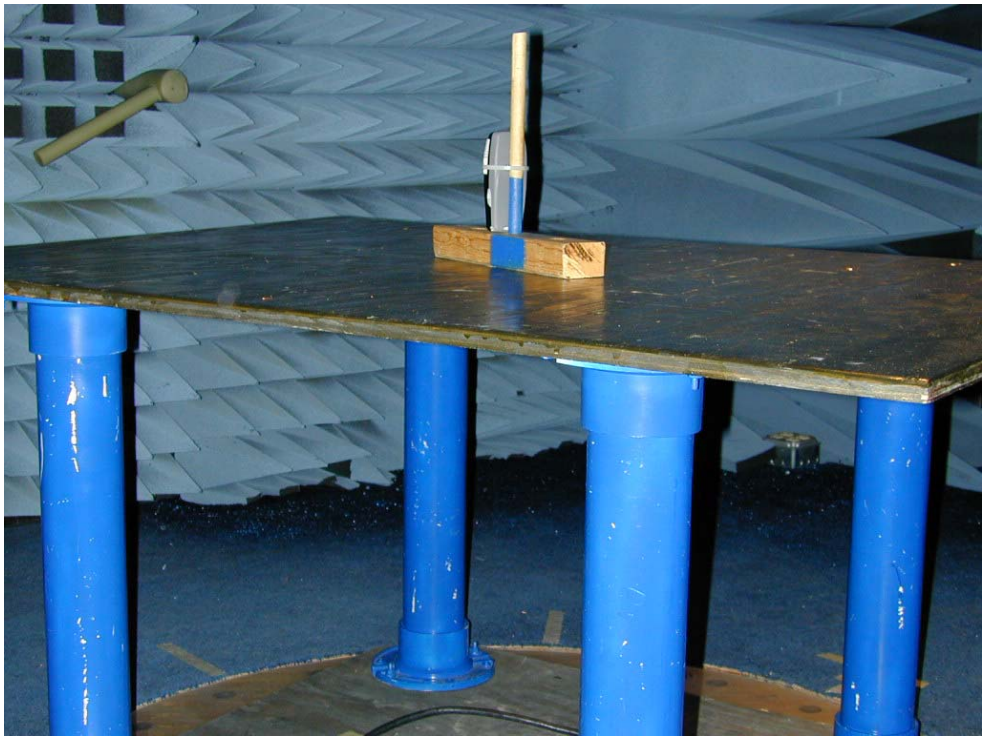
Test Equipment Used

Antenna: 1304 — Directional Coupler:
Pre-Amp: — Cable #1: 1485
Filter: 1481 — Cable #2: 1484
Receiver: 1036 — Cable #3: 1046
Attenuator #1 — Cable #4:
Attenuator #2: — Mixer:
Additional equipment used: 1060
Measurement Uncertainty: +/-1.7 dB

Frequency (MHz)	Meter Reading (dBm)	Correction Factor (dB)		Pre-Amp Gain (dB)	Substitution Antenna Gain (dBd)	Limit (dBm)	ERP (dBm)	ERP (mW)	Polarity	Comments
1673.04	-84.3	31.0		0	7.3	-13	-46.1	0.0000	V	Noise floor
2509.56	-80.8	35.5		0	8.0	-13	-37.4	0.0002	V	
3346.08	-85.0	39.8		0	8.0	-13	-37.2	0.0002	V	Noise floor
4182.60	-86.2	45.3		0	8.2	-13	-32.7	0.0005	V	Noise floor
5019.12	-85.8	41.3		0	8.2	-13	-36.3	0.0002	V	Noise floor
5855.64	-85.5	39.8		0	9.3	-13	-36.4	0.0002	V	Noise floor
6692.16	-83.3	41.3		0	9.4	-13	-32.6	0.0005	V	Noise floor
7528.68	-84.8	41.8		0	9.2	-13	-33.8	0.0004	V	Noise floor
8365.20	-86.3	42.8		0	9.1	-13	-34.4	0.0004	V	Noise floor
1673.04	-84.3	33.0		0	7.3	-13	-44.1	0.0000	H	Noise floor
2509.56	-80.7	35.5		0	8.0	-13	-37.3	0.0002	H	
3346.08	-85.0	36.3		0	8.0	-13	-40.7	0.0001	H	Noise floor
4182.60	-86.2	34.8		0	8.2	-13	-43.2	0.0000	H	Noise floor
5019.12	-85.8	38.3		0	8.2	-13	-39.3	0.0001	H	Noise floor
5855.64	-85.5	37.8		0	9.3	-13	-38.4	0.0001	H	Noise floor
6692.16	-83.3	39.2		0	9.4	-13	-34.8	0.0003	H	Noise floor
7528.68	-84.8	41.5		0	9.2	-13	-34.2	0.0004	H	Noise floor
8365.20	-86.3	42.5		0	9.1	-13	-34.7	0.0003	H	Noise floor

Notes: Searched spectrum to the 10th harmonic of carrier
The device was tested on 3 orthagonal axis'. Upright orientation was determined to be worst case.

Photographs of Test Setup



Section 6. Frequency Stability

NAME OF TEST: Frequency Stability	PARA. NO.: 2.1055
TESTED BY: David Light	DATE: 3/20/03

Test Results: Complies.

Measurement Data: See attached tables.

Equipment Used: Wavetek Cellular Test System Model 3600D s/n 9228038
Cal'd 11/25/02 Due 11/25/03
283-619

Temperature: 22 °C

Relative Humidity: 30 %

Test Data – Frequency Stability

Mode of Operation: AMPS
Channel 384
Standard Test Frequency: 836.52 MHz
Standard Test Voltage: 3.8 Vdc

Temperature (°C)	Voltage (Vdc)	Frequency (MHz)	Change (Hz)	Change (ppm)
50	3.8	836.520247	247	0.295
40	3.8	836.520320	320	0.383
30	3.8	836.520296	296	0.354
20	3.8	836.520268	268	0.320
10	3.8	836.520336	336	0.402
0	3.8	836.520330	330	0.394
-10	3.8	836.520303	303	0.362
-20	3.8	836.520328	328	0.392
-30	3.8	836.520325	325	0.389
20	4.4	836.520240	240	0.287
20	3.1*	836.520241	241	0.288

Mode of Operation TDMA
Channel 384
Standard Test Frequency: 836.52 MHz
Standard Test Voltage: 3.8 Vdc

Temperature (°C)	Voltage (Vdc)	Frequency (MHz)	Change (Hz)	Change (ppm)
50	3.8	836.519999	-1	-0.001
40	3.8	836.519991	-9	-0.011
30	3.8	836.519994	-6	-0.007
20	3.8	836.519995	-5	-0.006
10	3.8	836.520001	1	0.001
0	3.8	836.520004	4	0.005
-10	3.8	836.519996	-4	-0.005
-20	3.8	836.519996	-4	-0.005
-30	3.8	836.520000	0	0.000
20	4.4	836.519994	-6	-0.007
20	3.1*	836.519995	-5	-0.006

*Note – Unit cutoff point.

Section 7. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
283	Environmental Chamber with controller # 1189006	ENVIROTRONICS SH27 & 2030-22844	129010083	01/10/02	01/10/03
1304	HORN ANTENNA	ELECTRO METRICS RGA-60	6151	07/30/01	07/31/03
1404	Dipole set	EMCO 3121C	9701-1256	06/10/02	06/10/03
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	12/18/01	12/19/03
1983	CABLE	KTL Site A OATS	N/A	08/05/02	08/05/03
1053	SIGNAL GENERATOR	ROHDE & SCHWARZ SMIQ 03	DE22081	08/13/02	08/13/03
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	07/15/02	07/15/03
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	07/15/02	07/15/03
1628	CABLE, 6 ft	MEGAPHASE TM26 S1S5 72	N/A	03/05/03	03/04/04
1478	20db Attenuator DC 18 Ghz	MCL Inc. BW-S20W6	NONE	CBU	N/A
1481	Microwave Highpass Filter	K & L 3DH1-2000/T8000-0/0	4	Cal B4 Use	N/A
1060	TUNABLE NOTCH FILTER	K&L 3TNF-500/1000-N/N	162	CBU	N/A
619	THERMOMETER	FLUKE 51	4520028	02/25/03	02/25/04

Wavetek Cellular Test System Model 3600D s/n 9228038 Cal'd 11/25/02 Due 11/25/03
Agilent power meter E4418B s/n GB40206972 Cal'd 9/19/02 Due 9/19/03
Agilent power sensor 8482H s/n 3318A05855 Cal'd 12/19/02 Due 12/19/03

ANNEX A - TEST DETAILS

NAME OF TEST: RF Power Output **PARA. NO.: 2.1046**

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:

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.

NAME OF TEST: Occupied Bandwidth PARA. NO.: 2.1049

(i) **Minimum Standard:** No in-band emission requirements.

Para. No. 22.917(a). The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

Method Of Measurement:

Spectrum Analyzer Settings on band edges (up to 1 MHz from band edge):

RBW: 1% of 26 dBc bandwidth
VBW: ≥ RBW
Span: 2 MHz
Sweep: Auto

Spectrum Analyzer Settings out-of-band(> 1MHz from band edge):

RBW: 100 kHz or greater
VBW: ≥ RBW
Sweep: Auto

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.

Input Signal Characteristics:
RF level: Maximum recommended by manufacturer
10 kbps WBD + DAT
ST

NAME OF TEST: Spurious Emission at Antenna Terminals **PARA. NO.: 2.1053**

Minimum Standard: Para. No. 22.917(a). The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

Method Of Measurement:

Spectrum Analyzer Settings:
RBW: 100 kHz or greater.
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(a). The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

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.

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

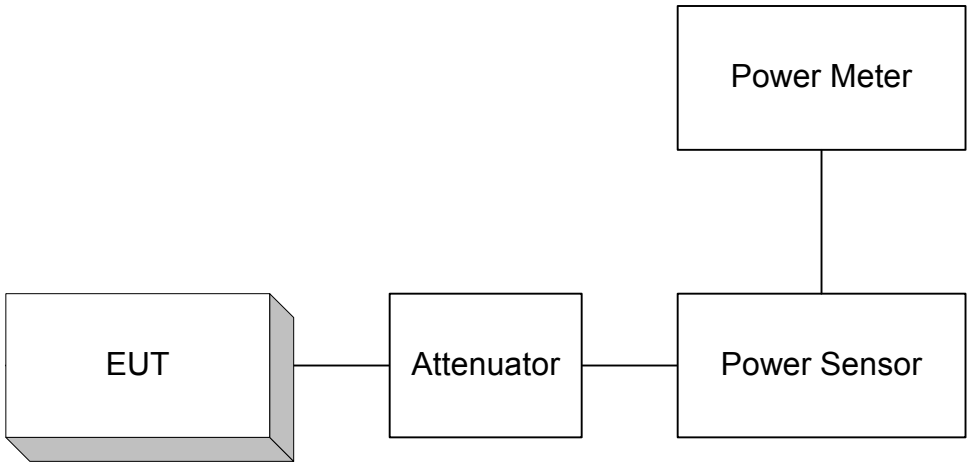
Method Of Measurement:

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.

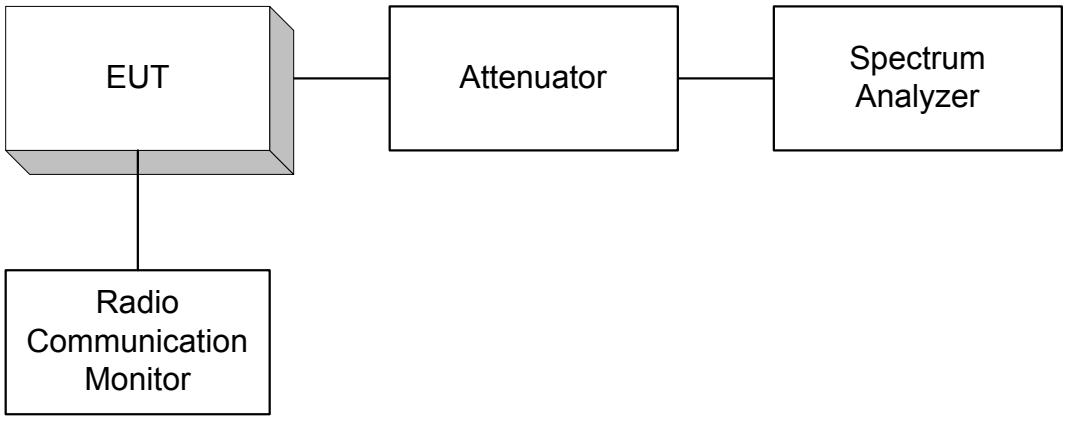
Frequency Stability With Temperature Variation:
The input voltage to the E.U.T. is set to S.T.V. and the temperature of the environmental chamber is varied in 10 degree steps from -30 degrees C to +50 degrees C. The E.U.T. is allowed to stabilize at each temperature and the frequency is measured in 30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

ANNEX B - TEST DIAGRAMS

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

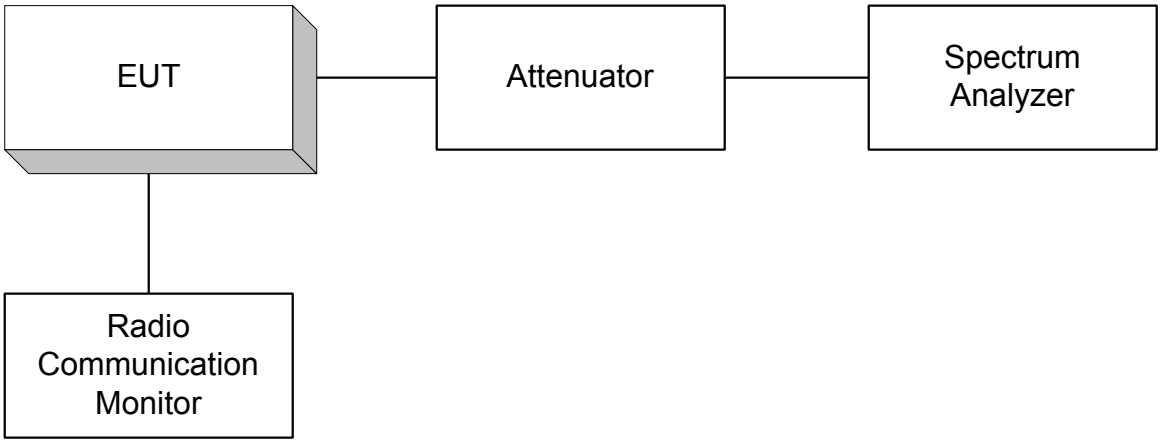


Para. No. 2.1049 - Occupied Bandwidth



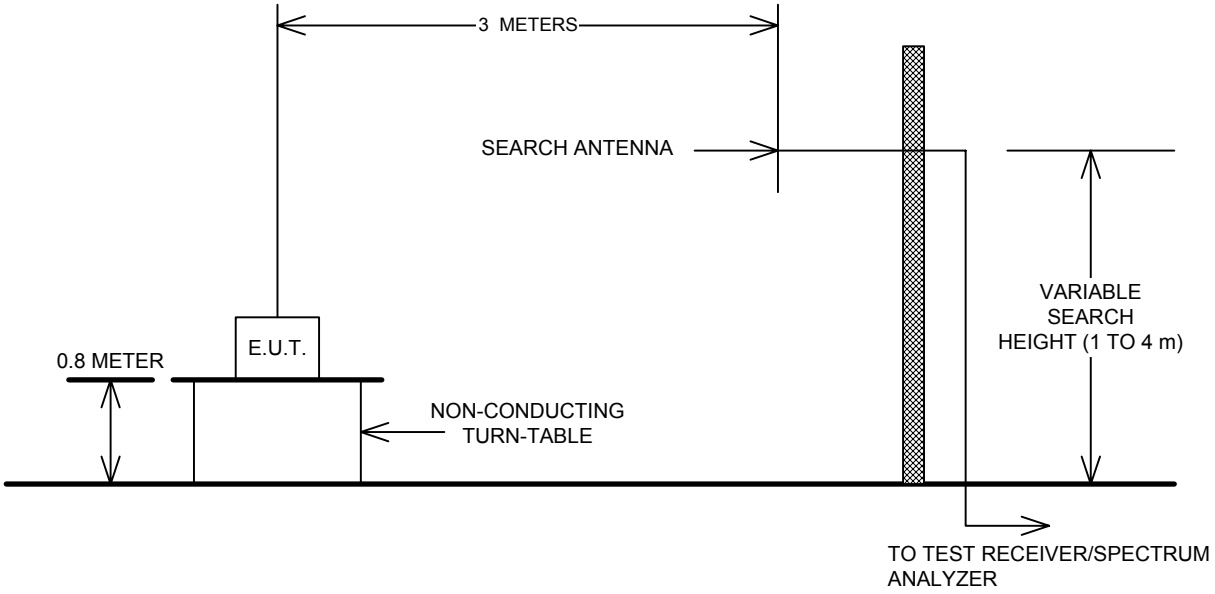
The Radio Communication Monitor is used only to provide modulation input for external modulation.

Para. No. 2.1053 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