

KTL Test Report: 9L0022RUS

Applicant: Andrew Corporation
2601 Telecom Parkway
Richardson, Tx.

Equipment Under Test: 2400 Mobile Data Radio

FCC ID: KUWMDL2400MDR

In Accordance With: **FCC Part 15, Subpart C**
Direct Sequence Transmitters 2.4 – 2.4835 GHz

Tested By: KTL Dallas Inc.
802 N Kealy
Lewisville, Tx 75057-3136

Authorized By: 
Tom Tidwell, RF Group Manager

Date: January 4, 2000

Total Number of Pages: 41

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

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EQUIPMENT: 2400 Mobile Data Radio

FCC ID: KUWMDL2400MDR

Section 1. Summary Of Test Results

Manufacturer: Andrew Corporation

Model No.: 2400 Mobile Data Radio

Serial No.: DL

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 15, Subpart C, Paragraph 15.247 for Direct Sequence Spread Spectrum devices.



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

TESTED BY: Ron Gaytan DATE: 8/10/99-10/27/99

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EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Summary Of Test Data:

NAME OF TEST	PARA. NO.	SPEC.	MEAS.	RESULT
Powerline Conducted Emissions	15.207 (a)	48 dB μ V	N/A	N/A
Occupied Bandwidth	15.247 (a)(2)	$\geq$ 500 kHz	12.3246 MHz	Complies
Peak Power Output	15.247 (b)	4 Watts E.I.R.P.	2.383 W E.I.R.P.	Complies
Spurious Emissions (Antenna Conducted)	15.247 (c)	-20 dBc	-20.88 dBm	Complies
Spurious Emissions (Radiated)	15.247 (c)	Table 15.209 (a)	61.8 dBuV/m	Complies
Transmitter Power Density	15.247 (d)	$\leq$ +8 dBm	1.33 dBm	Complies
Processing Gain	15.247 (e)	$\geq$ 10 dB	15.9 dB	Complies

Footnotes: 1. The unit is DC powered. Therefore 15.207(a) is not applicable.**Test Conditions:****Indoor** Temperature: 22°C
Humidity: 36%**Outdoor** Temperature: 28°C
Humidity: 48%

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Section 2. General Equipment Specification**Transmitter:**

Power Input:	18-56 VDC	
Frequency Range:	2467 MHz (Fixed)	
Tunable Bands:	Not Applicable	
6 dB Bandwidth:	13.6347 MHz	
Type of Modulation	GPSK	
Chip Rate:	16.896 Mbps	
Data Rate:	128 Kbps	Radio to radio
	64 Kbps	User equipment to radio
Internal / External Data Source:	External	
Emissions Designator:	13M6F9W	
Output Impedance:	50 ohms	
RF Power Output (Rated):	4 Watts E.I.R.P. maximum (see note below)	
Duty Cycle:	Up to 100 %	
Channel Spacing:	Not Applicable	
Operator Selection of Operating Frequency:	Not Applicable	
Power Output Adjustment Capability:	Computer controlled. Not adjustable above +30 dBm at the antenna port.	

Note: The power output is set by the installer upon installation of the unit. Power is adjusted through software and is not accessible to the user. Instructions are given to the installer to set the output power appropriately for the antenna used for a particular installation.

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Receiver:

Frequency Range:	2417 MHz (Fixed)
Tunable Bands:	Not Applicable
1st IF:	2276.352 MHz
2nd IF:	129.6 MHz
Bandwidth:	12.3246 MHz
Type of Modulation:	GPSK
Operator Selection of Operating Frequency	Not Applicable

NOTE: other oscillators in receiver section are
42.752 MHz
16.896 MHz

KTL Dallas, Inc.

FCC PART 15, SUBPART C
DIRECT SEQUENCE TRANSMITTERS
PROJECT NO.: 9L0022RUS

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Description of Modification:

Not Applicable

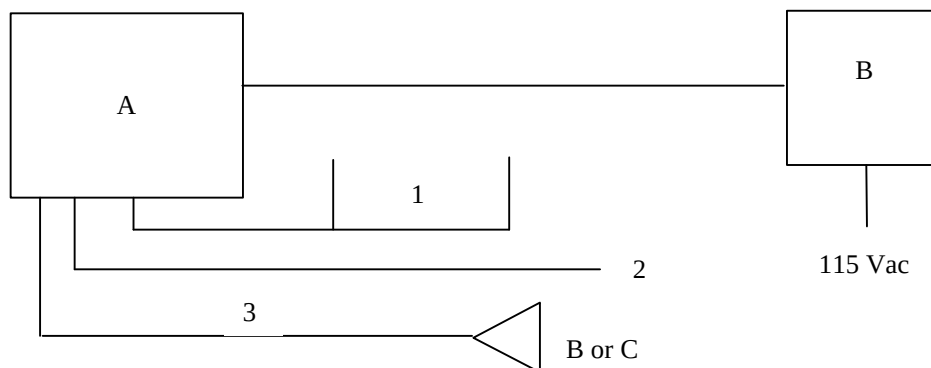
EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Theory of Operation:

The Mobile Data Radio is a full duplex transceiver. The unit receives and transmits data to customer provided equipment through a synchronous interface EIA-530 interface.

This unit is intended to be used with a high gain directional antenna. The output power is set by the installer upon installation and can not be accessed by the user. The installer is instructed to set the power output at the antenna port to an appropriate level for the antenna used in the installation. This guarantees that the maximum power level of 4 W E.I.R.P. is not exceeded.

This transmitter and its antenna are located in areas where access to within 20 cm of the radiator is restricted.

System Diagram: Mobile Setup

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR**Equipment Configuration List (Hardware/Peripherals):**

Item	Generic Description	Manufacturer	Model No.	Serial No.	Rev. No.	FCC ID Status*
(A)	Mobile Data Radio	Andrew Corporation	2400 Mobile Data Radio P/N 385700-1000	DL	A	3
(B)	Mobile Data Radio Power Supply	Topward	6603D	990851	N/A	3
(C)	Transmit Antenna	Antenna Products	ISM PNL P/N 10009-0080-401	005	N/A	3
(D)	50 ohm Load	Sierra Electronic Operation	160B-300	557	N/A	3

* = EUT (Equipment-Under-Test) or part of EUT.

***FCC ID STATUS**

- | | |
|--|---|
| 1. FCC DOC | 2. FCC A/B Verification |
| 3. None – (If performing
FCC testing, contact lab
manager) | 4. Certification (include
FCC ID in parenthesis) |

Inter-Connection Cables:

Item	Cable Type	Manufacturer	Length (m)	Termination**	Shield	Quantity
(1)	Data 1 Cable P/N 385700-1812-001	Andrew Corporation	3.0/3.0	1/6	Yes	1
(2)	Data 2 Cable P/N 385700-1813-001	Andrew Corporation	3.0/3.0	6/6	Yes	1
(3)	RF Output Coax KTL # C22	Unknown	2.5	4	Yes	1
(4)	Power Cord P/N 385700-1810	Andrew Corporation	1.5	1	Yes	1

**** TERMINATION**

- | | |
|---------------------|---------------------|
| 1. Peripheral | 2. Loopback |
| 3. EUT | 4. Resistive |
| 5. Remote Equipment | 6. Other Cable Only |

KTL Dallas, Inc.

FCC PART 15, SUBPART C
DIRECT SEQUENCE TRANSMITTERS
PROJECT NO.: 9L0022RUS

EQUIPMENT: 2400 Mobile Data Radio

FCC ID: KUWMDL2400MDR

Section 3. Powerline Conducted Emissions

NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: 15.207(a)
TESTED BY: Ron Gaytan	DATE: 12/20/99

Test Results: Not Applicable. See attached data.

Measurement Data: See attached data.

KTL Dallas, Inc.

FCC PART 15, SUBPART C
DIRECT SEQUENCE TRANSMITTERS
PROJECT NO.: 9L0022RUS

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Section 4. Occupied Bandwidth

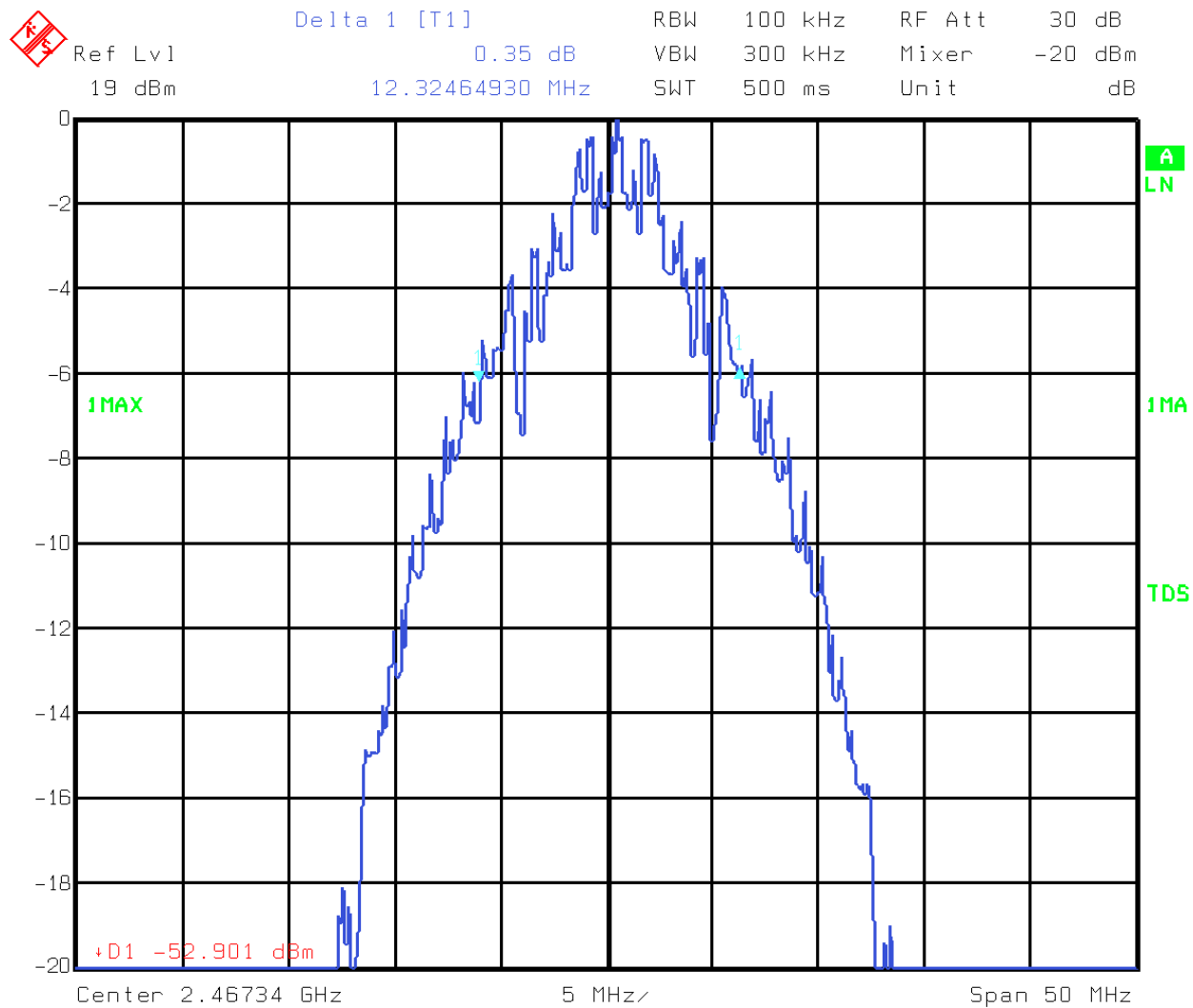
NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(2)
TESTED BY: Ron Gaytan	DATE: 8/12/99

Test Results: Complies. The 6 dB bandwidth is 12.3246 MHz.

Measurement Data: See attached graph.

NOTE: The rf power output level was set to +30 dBm for this test. Measurement of rf power was made using a peak power meter.

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR



Title: Occupied Bandwidth
Date: 12.AUG.1999 14:02:22

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Section 5. Peak Power Output

NAME OF TEST: Peak Power Output	PARA. NO.: 15.247 (b)
TESTED BY: Ron Gaytan	DATE: 8/10/99

Test Results:

Complies. The maximum available peak power output power at the antenna terminals is 1.0 watts. When using a gain antenna, the installer is instructed to set the power output at the antenna terminals appropriately. For this testing a 12 dBi gain antenna was used; thus the power output at the rf output port was set to +24 dBm. The resulting field strength was measured at a distance of 3m and the E.I.R.P. was calculated. The resulting E.I.R.P. was 2.383 W.

Measurement Data:

Detachable antenna? ☒ Yes ☐ No

If yes, state the type of non-standard connector used at the antenna port: Type N female connector. The equipment is professionally installed in a specific application. The equipment is marketed to select users only.

Directional Gain of Antenna: 12 dBi or 15.8 Numeric.
Measured Peak Power Output at input to antenna: +24 dBm.
Measured FS: 129.0 dBμV/m @ 3m or 2.8 V/m @ 3m.
E.I.R.P. calculated from measured field strength: 2.383 W

The power output was measured with a peak power meter. The output level was set via software to + 24 dBm. The field strength of the transmitted signal was measured with the rf power output set to + 24 dBm and the 12 dBi gain panel antenna attached. This data is presented in the following table.

Peak Power Output (Field Strength):

Complete X Preliminary Page 1 of 1

Client: Andrew Corporation Test #: ERP-1 W.O.#: 9L0022R

EUT: 2400 Mobile Transceiver S/N: None Photo ID: 9L0022R

Technician: Ron Gaytan Specification: CFR 47 Part 15.247 Lab: ANC1 Date: 8/13/99

Equipment Used: G2626-G2200-CF31-G2034

Configuration: Tx @ 24 dBm with 12 dBi ISM Panel Antenna

Bandwidth: 1 MHz Video Bandwidth: 1 MHz Antenna Distance 3 m Detector:

Climatic Conditions: EUT Power: X 115 V.A.C. X 60 Hz X Peak
 Temperature: 23 C 208 V.A.C. 50 Hz Average
 Relative Humidity: 38 % 230 V.A.C.
 Atmospheric Pressure: 998 mbar Other 1 Phase 3 Phase

[illegible]

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Section 6. Spurious Emissions (Antenna Conducted)

NAME OF TEST: Spurious Emissions (Antenna Conducted)	PARA. NO.: 15.247(c)
TESTED BY: Ron Gaytan	DATE: 8/12/99, 10/26/99

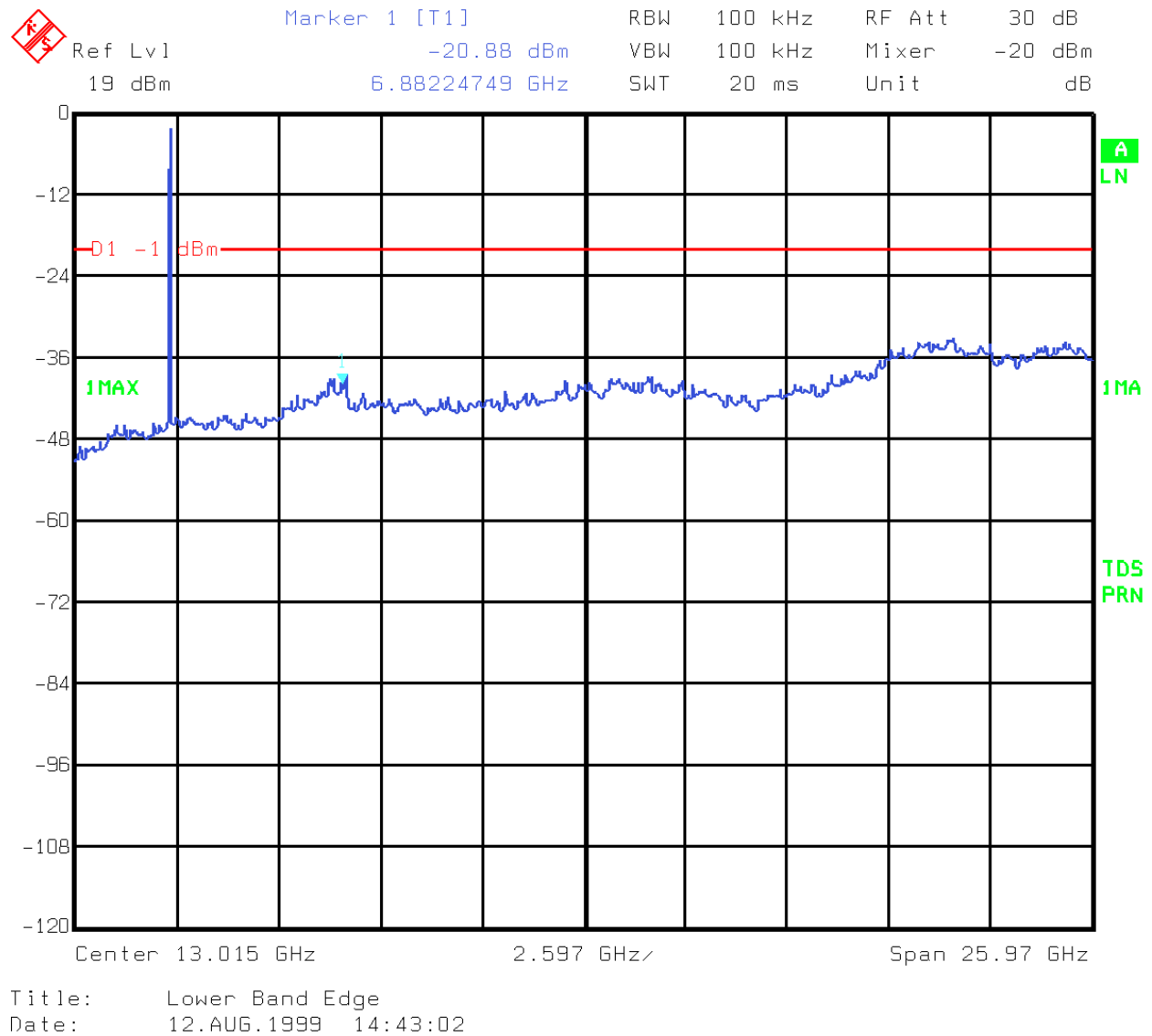
Test Results: Complies. The worst-case emission level is -10 dBm at 2.4835 GHz. This is 20 dB below the specification limit ($+30\text{dBm} - 20\text{ dB} = +10\text{dBm}$).

Measurement Data: See attached graphs.

NOTE: The rf power output level was set to $+30$ dBm for this test. Measurement of rf power was made using a peak power meter.

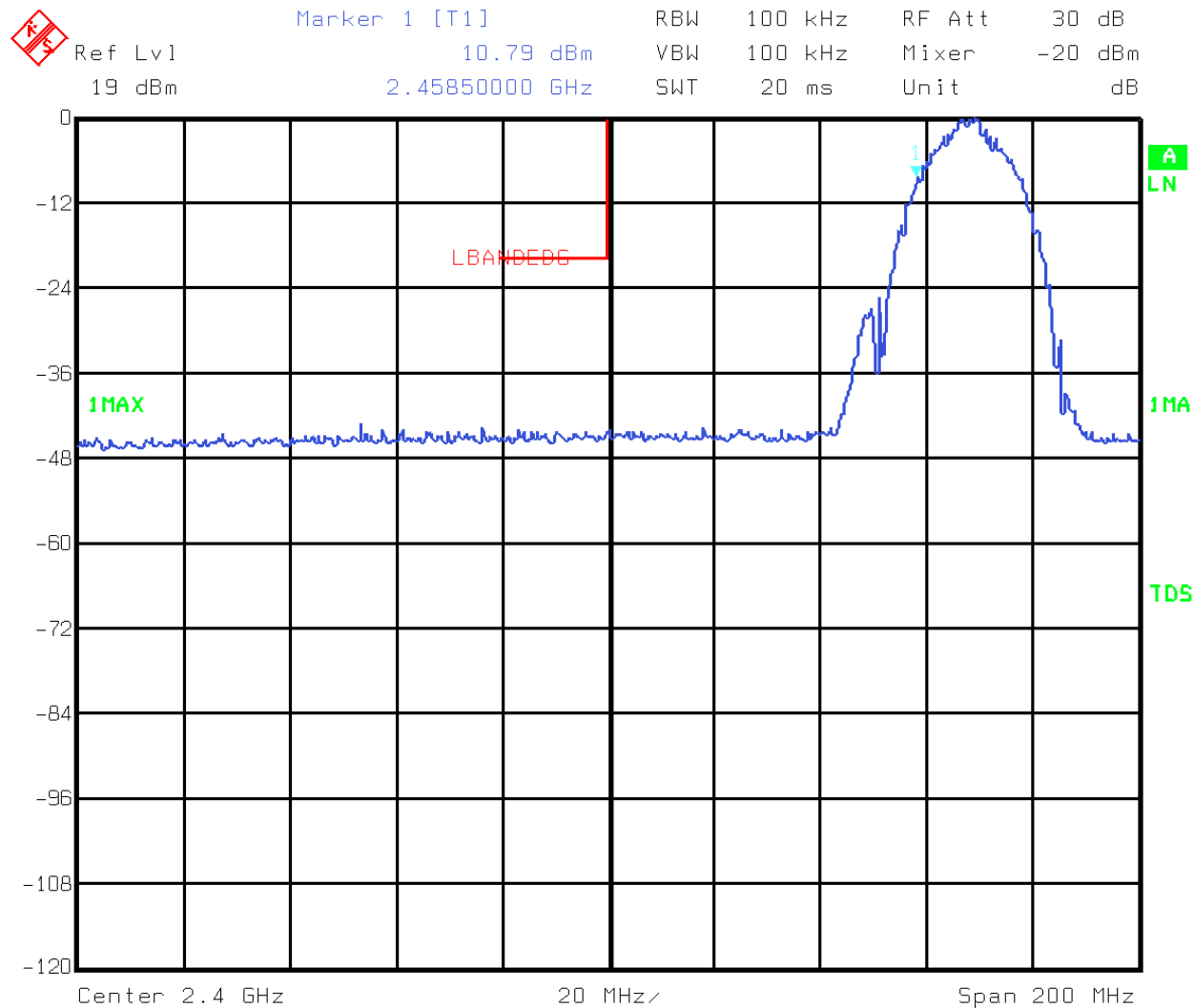
EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Antenna Port Spurious Emissions:



EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

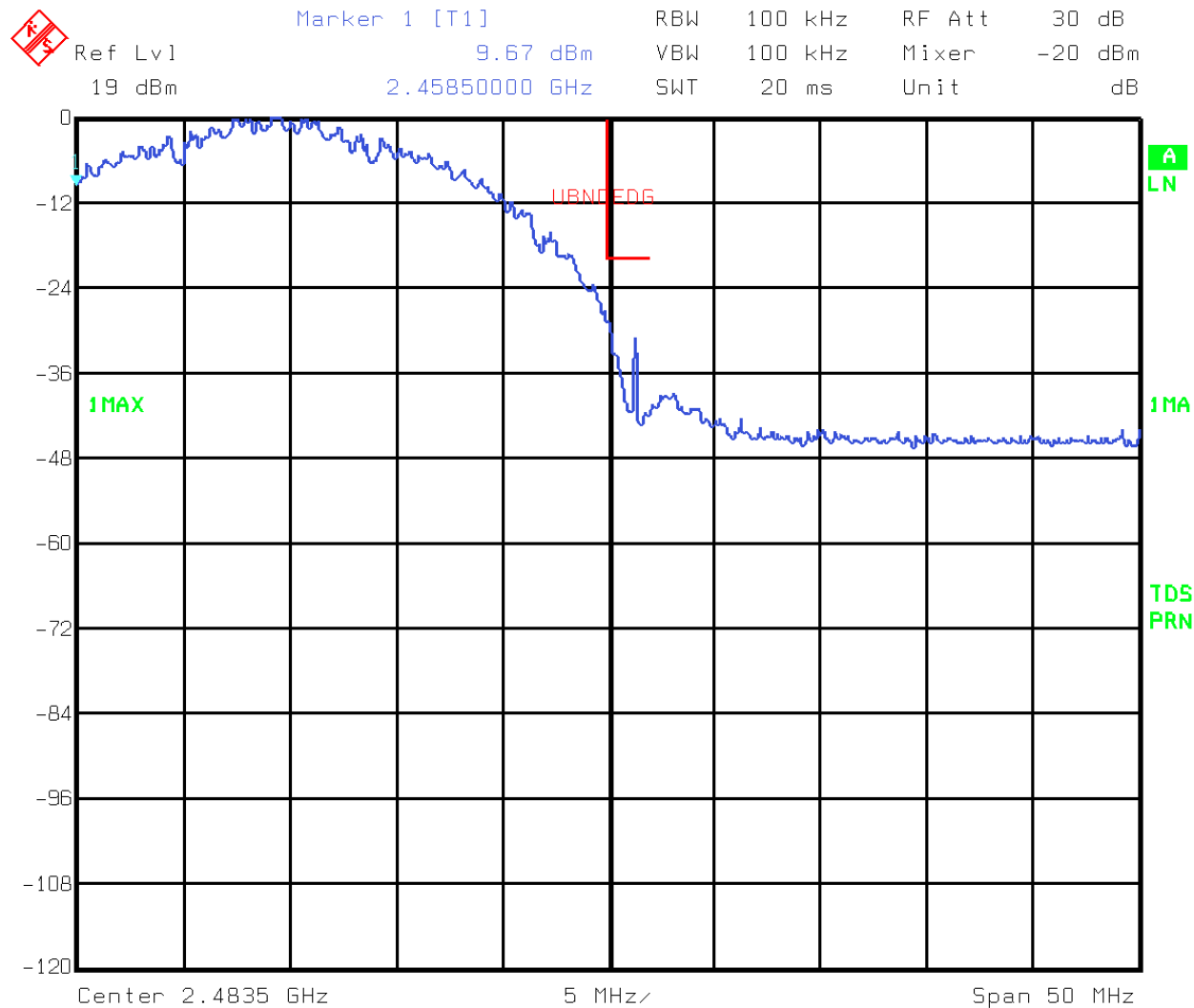
Lower Band Edge:



Title: Lower Band Edge
Date: 12.AUG.1999 14:39:53

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Upper Band Edge:



Title: Upper Band Edge
Date: 12.AUG.1999 14:35:25

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Section 7. Spurious Emissions (Radiated)

NAME OF TEST: Spurious Emissions (Radiated)	PARA. NO.: 15.247(c)
TESTED BY: Ron Gaytan	DATE: 8/17/99, 10/26-27/99

Test Results: Complies. The worst-case noise floor emission level is 61.3 dB μ V/m @ 3m at 4.935 GHz. This is 4.2 dB Below the specification limit.

Measurement Data: See attached graphs.

NOTE: RF power output was set to +24 dBm when measurement was made using the 12 dBi gain antenna. When measuring with the leaky coax feeder the power output was set to +30 dBm (maximum transmit power). Power was set using a peak power meter.

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Test Data - Radiated Emissions (PEAK/AVERAGE):

Microwave Radiated Emissions Data								
Complete ☐		Preliminary ☒		Page <u>1</u> of <u>2</u>				
Client: <u>Andrew Corporation</u>				Test #: <u>MW-2</u>		W.O.#: <u>9L0022R</u>		
EUT: <u>2400 Mobile Transceiver</u>				S/N: <u>None</u>		Photo ID: <u>9L022R MW-2</u>		
Technician: <u>Ron Gaytan</u>		Specification: <u>CFR 47 Part 15.247</u>		Lab: <u>ANC1</u>		Date: <u>8/12/99</u>		
Equipment Used: <u>G2626-CF31-G2200-G2034-934-677-G2235</u>								
Configuration: <u>Tx Mode</u>								
Bandwidth: <u>1 MHz</u>		Video Bandwidth: <u>1 MHz</u>		Antenna Distance <u>3</u> m		Detector:		
Climatic Conditions:		EUT Power: ☒ 115 V.A.C.		☒ 60 Hz		☒ Peak		
Temperature: <u>23</u> C		☐ 208 V.A.C.		☐ 50 Hz		☐ Average		
Relative Humidity: <u>42</u> %		☐ 230 V.A.C.						
Atmospheric Pressure: <u>998</u> mbar		☐ Other		☒ 1 Phase		☐ 3 Phase		

Freq. (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	RF Gain (dB)	Corrected Reading (dBuV/m)	Spec. Limit (dBuV/m)	Pol.	Comments:
2.468	63.3	28.4	3.1	31.8	63	N/A	V	Fundamental Freq.
2.276	54.1	28.2	3.0	31.9	53.4	54	V	Refer to Average Det.
2.276	52.1	28.2	3.0	31.9	51.4	54	V	Average Detector
4.935	47.2	33.2	4.6	29.5	55.5	54	V	Refer to Average Det.
4.935	41.5	33.2	4.6	29.5	49.8	54	V	Average Detector
7.401	37.6	36.1	5.8	34.2	45.3	109	V	Avg. Det. Noise Floor
9.869	38.1	37.6	6.9	33.3	49.3	109	V	Avg. Det. Noise Floor
12.336	37.3	39	8.0	32.8	51.5	54	V	Avg. Det. Noise Floor
								KTL # 677
12.336	5	39	8.0	32.8	19.2	54	V	Avg. Det. Noise Floor
14.803	39.3	42.0	8.7	30.7	59.3	109	V	Avg. Det. Noise Floor
17.27	39.3	44.2	9.6	31.3	61.8	109	V	Avg. Det. Noise Floor
2.468	54.5	28.4	3.1	31.8	54.2	N/A	H	Fundamental Freq.
2.276	51.9	28.2	3.0	31.9	51.2	54	H	Refer to Average Det.
2.276	49.5	28.2	3.0	31.9	48.8	54	H	Average Detector
4.935	44.3	33.2	4.6	29.5	52.6	54	H	Refer to Average Det.
4.935	37.4	33.2	4.6	29.5	45.7	54	H	Average Detector
7.401	37.6	36.1	5.8	34.2	45.3	109	H	Avg. Det. Noise Floor
9.869	38.1	37.6	6.9	33.3	49.3	109	H	Avg. Det. Noise Floor

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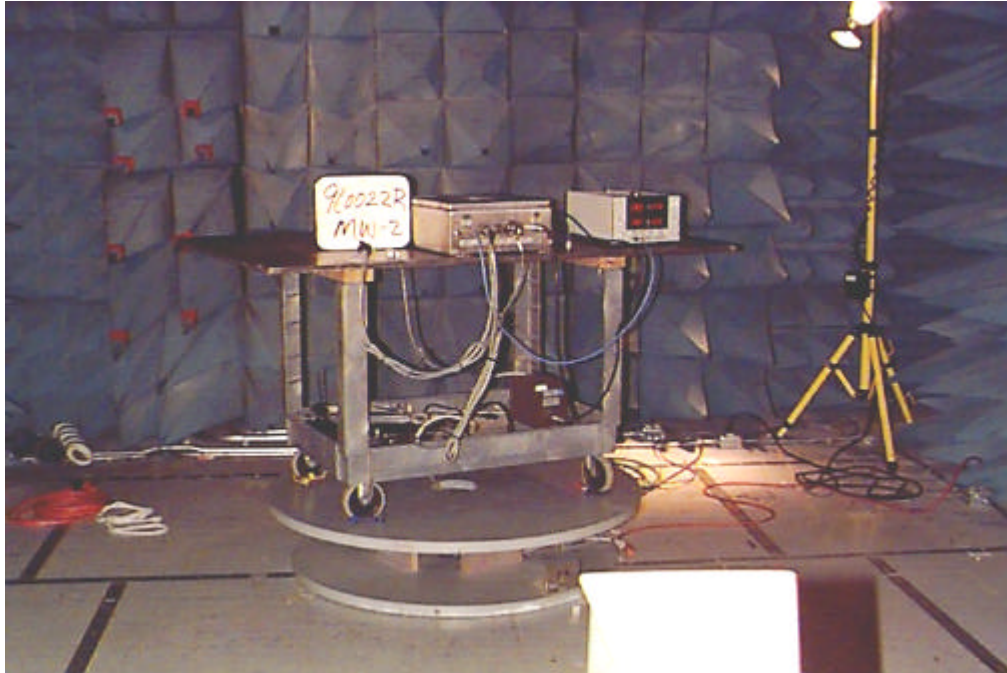
Test Data - Radiated Emissions (PEAK/AVERAGE) (Continued):

[illegible]

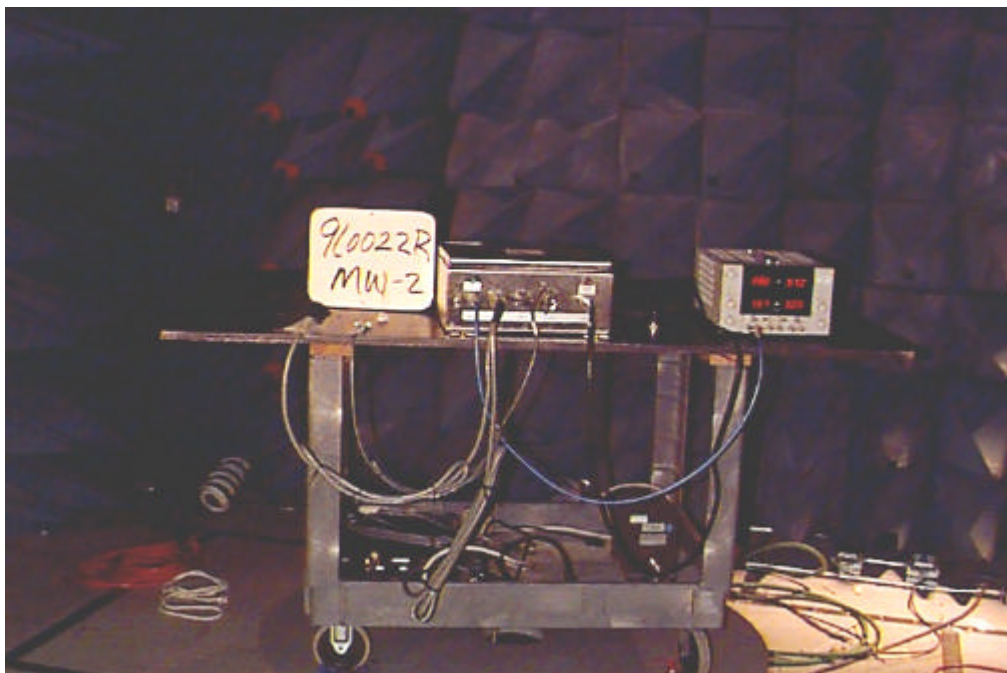
EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Radiated Photographs (Worst Case Configuration):

FRONT VIEW:



FRONT VIEW:



EQUIPMENT: 2400 Mobile Data Radio

FCC ID: KUWMDL2400MDR

Test Data - Microwave Radiated Emissions (MW-2):

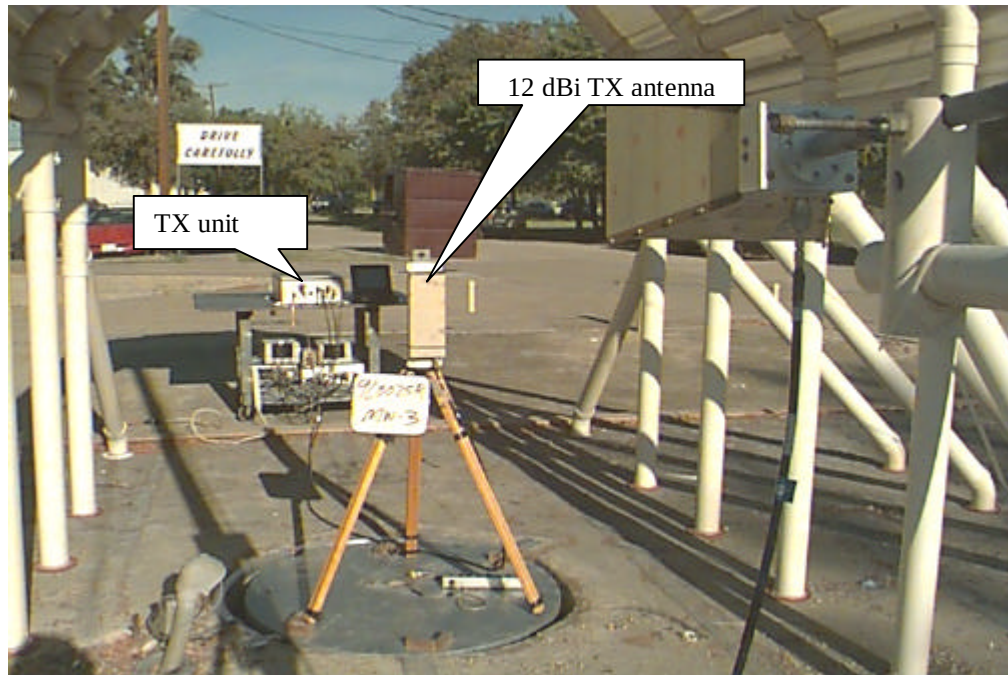
Microwave Radiated Emissions Data									
Complete ☐		Preliminary ☒				Page <u>1</u> of <u>1</u>			
Client: <u>Andrew Corporation</u>					Test #: <u>MW-2</u>		W.O.#: <u>9L0025R</u>		
EUT: <u>385700-4000-001</u>					S/N: <u>None</u>		Photo ID: <u>9L0025R</u>		
Technician: <u>Ron Gaytan</u>					Specification: <u>CFR 47 Part 15.247</u>		Lab: <u>D OATS</u>		Date: <u>10/26/99</u>
Equipment Used: <u>677-G2016-CF31-EM2200</u>									
Configuration: <u>TX MAX POWER</u>									
Bandwidth: <u>1 MHz</u>		Video Bandwidth: <u>1 MHz</u>		Antenna Distance: <u>3</u> m		Detector:			
Climatic Conditions:		EUT Power: ☒ 115 V.A.C.		☒ 60 Hz		☒ Peak			
Temperature: <u>19</u> C		☐ 208 V.A.C.		☐ 50 Hz		☐ Average			
Relative Humidity: <u>42</u> %		☐ 230 V.A.C.							
Atmospheric Pressure: <u>998</u> mbar		☐ Other <u> </u>		☐ 1 Phase		☐ 3 Phase			
Freq. (MHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	RF Gain (dB)	Conver. Factor	Corrected Reading (dBuV/m)	Spec. limit (dBuV/m)	Pol.	Comments:
2.421	51	27.6	3.1	0	0	81.7	N/A	V	
4.805	11.4	34	4.6	0	0	50	54	V	
4.835	19	34	4.6	0	0	57.6	54	V	
4.835	8	34	4.6	0	0	46.6	54	V	Average Det.
7.248	7	37.2	5.7	0	0	49.9	67.7	V	Avg Det. N.F
12.08	4	39.6	8.0	33.5	0	18.1	54	V	Avg Det. N.F
2.421	62	27.6	3.1	0	0	92.7	N/A	H	
4.805	11.4	34	4.6	0	0	50	54	H	
4.835	13	34	4.6	0	0	51.6	54	H	
4.835	2	34	4.6	0	0	40.6	54	H	Average Det.
7.248	7	37.2	5.7	0	0	49.9	67.7	H	Avg Det. N.F
12.08	4	39.6	8.0	33.5	0	18.1	54	H	Avg Det. N.F
									Scanned 1-18 GHz

DATA\COMMON\FORMS\TESTDATASHEETS\MICRORE REV 030597

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Microwave Radiated Emissions Photographs:

FRONT VIEW:



SIDE VIEW:



EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Section 8. Transmitter Power Density

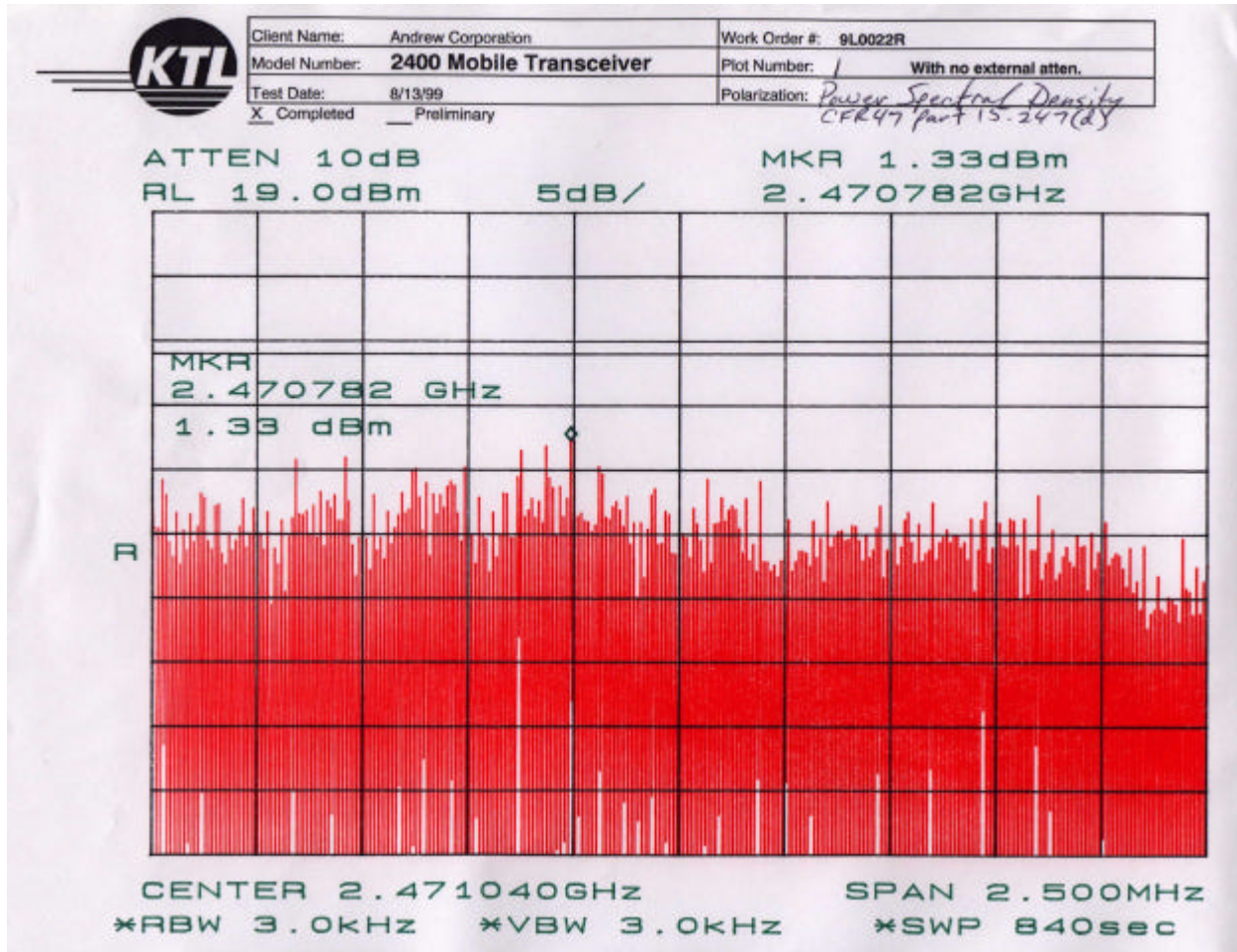
NAME OF TEST: Transmitter Power Density	PARA. NO.: 15.247(d)
TESTED BY: Ron Gaytan	DATE: 8/13/99, 10/26/99

Test Results: Complies.

Measurement Data: See attached graphs.

NOTE: The power output was set to +30 dBm (1 watt) with a peak power meter.

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Power Spectral Density Data:

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Section 9. Processing Gain

NAME OF TEST: Processing Gain	PARA. NO.: 15.247(e)
TESTED BY: Ron Gaytan	DATE: 8/13/99

Test Results: Complies. The processing gain of the system is 15.9 dB.

Measurement Data: See attached data.

The processing gain of the system was demonstrated by measuring the rf signal before de-correlation and after de-correlation and comparing the bandwidth of the two waveforms.

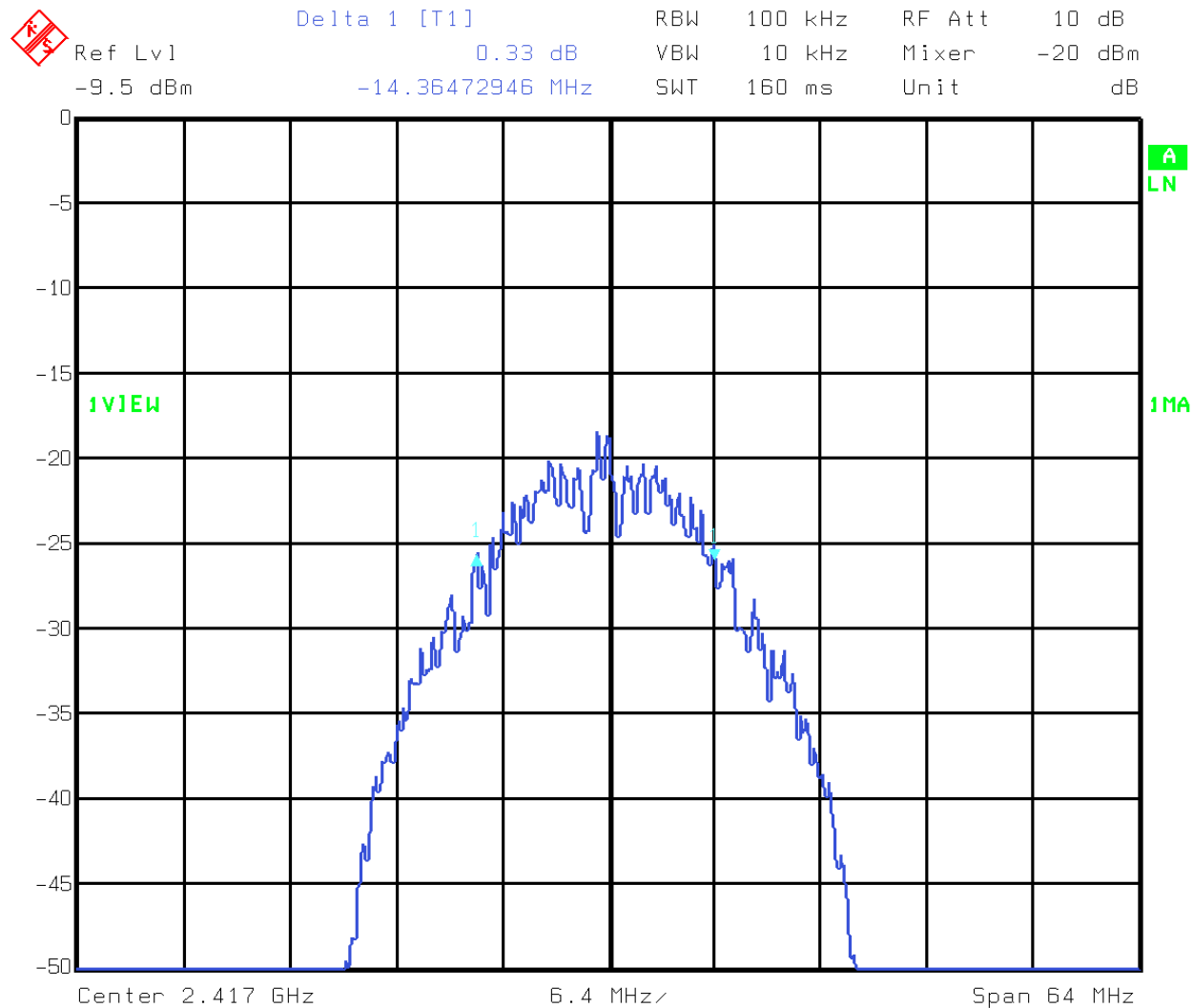
1st graph is the RF output from the base transmitter

2nd graph is plot of the IF spectrum measured at the output of the correlator.

$G_p = 10 \log(BW \text{ before de-correlation} / BW \text{ after de-correlation})$
 $G_p = 10 \log(14.36 / .373)$
 $G_p = 15.85 \text{ dB}$

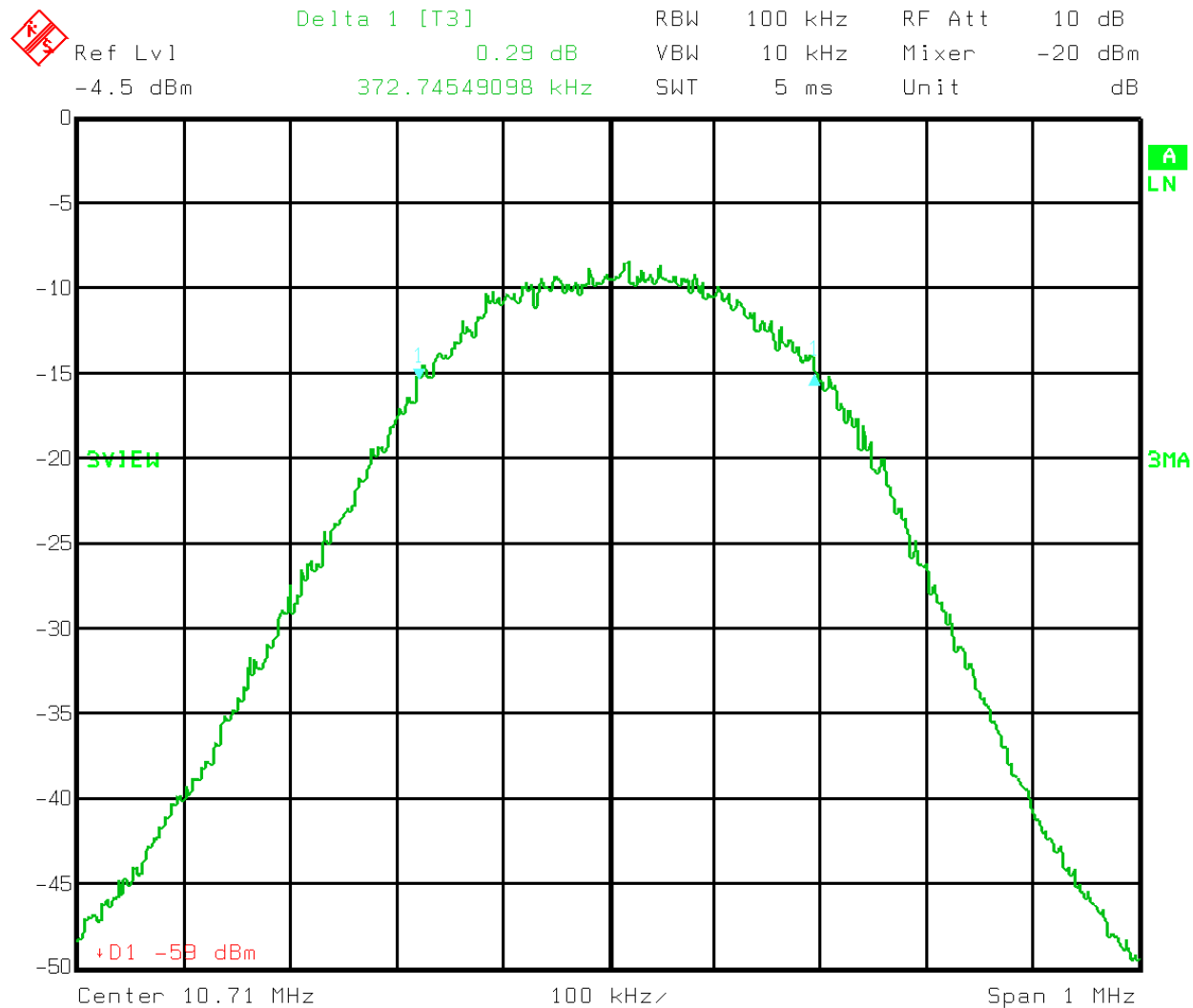
EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Processing Gain Data (Base RF Out):



Title: 6 dB BW of Transmitted Signal (Base RF Out)
Date: 13.AUG.1999 11:13:30

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Processing Gain Data (Mobile IF):

Title: 6 dB BW of De-Correlated Signal (Mobile IF)
Date: 13.AUG.1999 10:59:59

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR**Section 10. Test Equipment List**

<u>KTL ID</u>	<u>Description</u>	<u>Manufacturer Model Number</u>	<u>Serial Number</u>	<u>Calibration Date</u>
CF31	Cable, 7.6m	KTL Semi-Flex, Storm	N/A	01/29/99
677	RECEIVER, 1-18 GHz	ELECTRO METRICS EMC 50	185	08/26/98
934	HORN ANTENNA (18-26.5GHZ)	EMCO 3160-09	9705-1079	08/13/97
G2034	ANTENNA-HORN	ELECTRO METRICS RGA-60	6174	06/28/99
G2200	AMPLIFIER	HEWLETT PACKARD 8449A	2749A00159	06/11/99
G2626	SPECTRUM ANALYZER	HEWLETT PACKARD 8566B	2618A02843	04/21/99
	Anchoic Chamber #1			

Calibration interval on all items is typically 12 months from the calibration date shown. Where relevant, measuring equipment is subjected to in-service checks between testing. Should any measurement equipment be utilized beyond its scheduled calibration date, the measurement equipment is subjected to in-service checks prior to use. TKL shall notify clients promptly, in writing, of identification of defective measuring equipment that casts doubt on the validity of results in this report.

LEGEND:

CNR CALIBRATION NOT REQUIRED
N/A NOT APPLICABLE
CBU CALIBRATED BEFORE USE

KTL Dallas, Inc.

FCC PART 15, SUBPART C
DIRECT SEQUENCE TRANSMITTERS
PROJECT NO.: 9L0022RUS

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

ANNEX A - TEST METHODOLOGIES

KTL Dallas, Inc.

FCC PART 15, SUBPART C
DIRECT SEQUENCE TRANSMITTERS
PROJECT NO.: 9L0022RUS

EQUIPMENT: 2400 Mobile Data Radio

FCC ID: KUWMDL2400MDR

NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: 15.207(a)
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Minimum Standard:

The R.F. that is conducted back onto the AC power line on any frequency within the band 0.45 to 30 MHz shall not exceed 250 μ V (48 dB μ V) across 50 ohms.

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

NAME OF TEST: Occupied Bandwidth

PARA. NO.: 15.247(a)(2)

Minimum Standard: The minimum bandwidth shall be at least 500 kHz.**Method Of Measurement:**

The spectrum analyzer is set as follows:

RBW: 100 kHz

VBW: 100 kHz

Span: >RBW

LOG dB/div.: 2 dB

Sweep: Auto

Number of channels tested:

Tuning Range	Number Of Channels Tested	Channel Location In Band
1 MHz or Less	1	Middle
1 to 10 MHz	2	Top And Bottom
More Than 10 MHz	3	Top, Middle, Bottom

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

NAME OF TEST: Peak Power Output PARA. NO.: 15.247(b)

Minimum Standard: The maximum peak power output shall not exceed 1 watt.
If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400-2483.5 Mhz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Direct Measurement Method For Detachable Antennas:

If the antenna is detachable, a peak power meter is used to measure the power output with the transmitter operating into a 50 ohm load.

Calculation Of EIRP For 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

The RBW of the spectrum analyzer shall be set to a value greater than the measured 6 dB occupied bandwidth of the E.U.T.

Number of channels tested:

Tuning Range	Number Of Channels Tested	Channel Location In Band
1 MHz or Less	1	Middle
1 to 10 MHz	2	Top And Bottom
More Than 10 MHz	3	Top, Middle, Bottom

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

NAME OF TEST: Spurious Emissions at Antenna Terminal PARA. NO.: 15.247(c)

Minimum Standard: In any 100kHz bandwidth outside the 2400-2483.5 MHz bands emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits. Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

Frequency (MHz)	Field Strength (mV/m @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

Method Of Measurement:**Upper Band Edge**

RBW: At least 1% of span/div.
 VBW: >RBW
 Span: As necessary to display any spurious at band edge.
 Sweep: Auto
 Center Frequency: 2483.5 MHz
 Marker: Peak of fundamental emission
 Marker Δ: Peak of highest spurious level above 928 MHz

Lower Band Edge

RBW: At least 1% of span/div.
 VBW: >RBW
 Span: As necessary to display any spurious at band edge.
 Sweep: Auto
 Center Frequency: 2400 MHz
 Marker: Peak of fundamental emission
 Marker Δ: Peak of highest spurious level below 902 MHz

30 MHz - 10th Harmonic Plot

RBW: 100 kHz
 VBW: 300 kHz
 Sweep: Auto
 Display line: -20 dBc

Number of channels tested:

Tuning Range	Number Of Channels Tested	Channel Location In Band
1 MHz or Less	1	Middle
1 to 10 MHz	2	Top And Bottom
More Than 10 MHz	3	Top, Middle, Bottom

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

NAME OF TEST: Radiated Spurious Emissions

PARA. NO.: 15.247(c)

Minimum Standard:

In any 100kHz bandwidth outside the 2400-2483.5 MHz bands emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits. ***Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:***

Frequency (MHz)	Field Strength (mV/m @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

15.205 Restricted Bands

MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.125-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41	1718		

Number of channels tested:

Tuning Range	Number Of Channels Tested	Channel Location In Band
1 MHz or Less	1	Middle
1 to 10 MHz	2	Top And Bottom
More Than 10 MHz	3	Top, Middle, Bottom

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

NAME OF TEST: Transmitter Power Density

PARA. NO.: 15.247(d)

Minimum Standard: The transmitted power density averaged over any 1 second interval shall not be greater than +8 dBm in any 3 kHz bandwidth.

Method Of Measurement: The spectrum analyzer is set as follows:

RBW: 3 kHz

VBW: >3 kHz

Span: => measured 6 dB bandwidth

Sweep: Span(kHz)/3 (i.e. for a span of 1.5 MHz the sweep rate is $1500/3 = 500$ sec.

LOG dB/div.: 2 dB

Note: For devices with spectrum line spacing ≤ 3 kHz, the RBW of the analyzer is reduced until the spectral lines are resolved. The measurement data is normalized to 3 kHz by summing the power of all the individual spectral lines within a 3 kHz band in linear power units.

For Devices With Integral Antenna:

For devices with non-detachable antennas, the received field strength is peaked and the spectrum analyzer is set as above. The peak emission level is then measured and converted to a field strength by adding the appropriate antenna factor and cable loss. This field strength is then converted to an equivalent isotropic radiated power using the same method as described for Peak Power output.

Number of channels tested:

Tuning Range	Number Of Channels Tested	Channel Location In Band
1 MHz or Less	1	Middle
1 to 10 MHz	2	Top And Bottom
More Than 10 MHz	3	Top, Middle, Bottom

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

NAME OF TEST: Processing Gain	PARA. NO.: 15.247(e)
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Minimum Standard: The processing gain shall be at least 10 dB.

Method Of Measurement: The plot was taken of the spectrum of the RF transmitter and compared to a plot of the IF spectrum measured at the output of the correlator.

Calculation Of Processing Gain:

The processing gain was determined by the ratio of the bandwidth correlated waveform to the bandwidth of the de-correlated waveform as follows:

$$G_p = 10 \log(\text{BW before de-correlation} / \text{BW after de-correlation})$$

$$G_p = 10 \log(14.36 / .373)$$

$$G_p = 15.85 \text{ dB}$$

KTL Dallas, Inc.

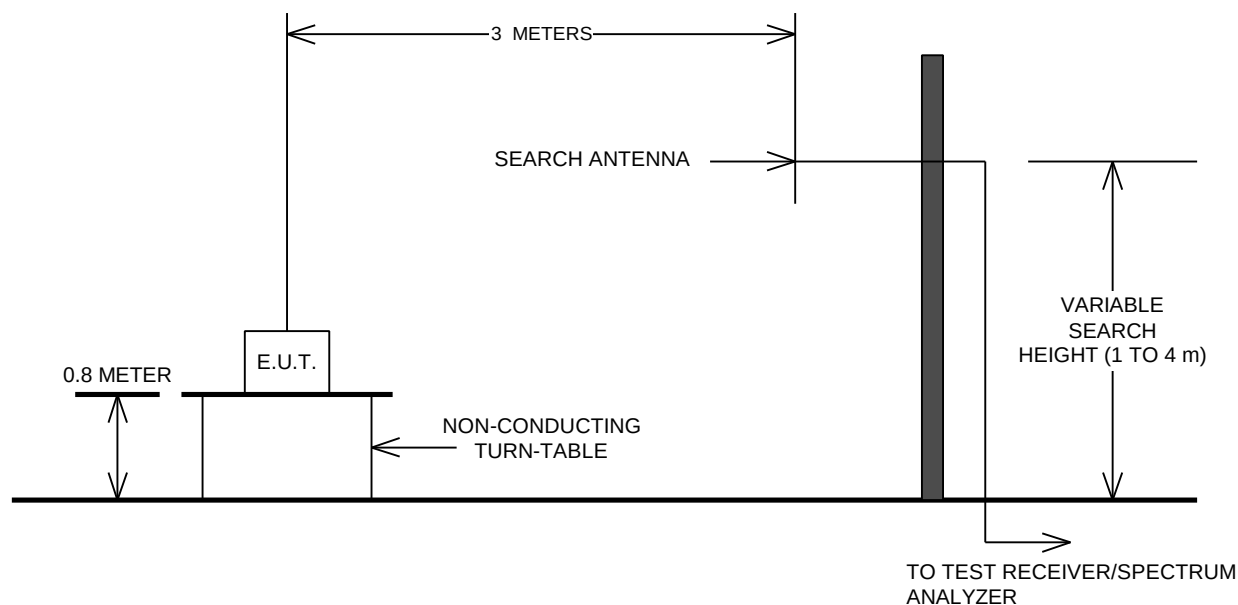
FCC PART 15, SUBPART C
DIRECT SEQUENCE TRANSMITTERS
PROJECT NO.: 9L0022RUS

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

ANNEX B - BLOCK DIAGRAMS

EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Test Site For Radiated Emissions



Below 1 GHz

Peak detector.
RBW = 100 kHz

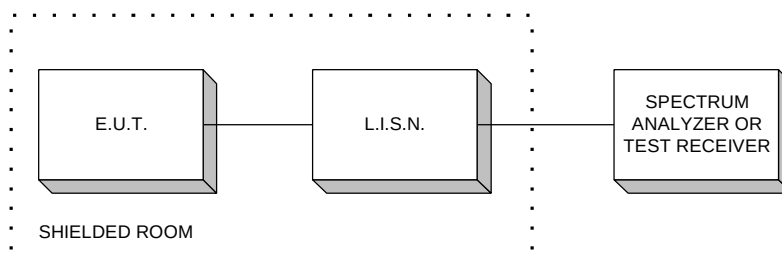
Above 1 GHz For Peak Emission Levels

Peak detector
RBW = 1 MHz
VBW = >RBW

Above 1 GHz For Average Emission Levels

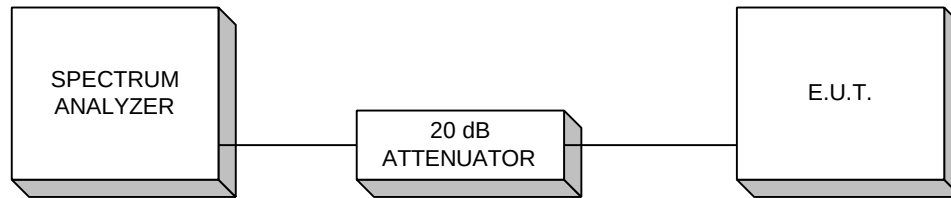
Peak detector
RBW = 1 MHz
VBW = 10 Hz

Conducted Emissions



EQUIPMENT: 2400 Mobile Data Radio
FCC ID: KUWMDL2400MDR

Transmitter Power Density & Peak Power At Antenna Terminals



If the E.U.T. has an integral (non-detachable) antenna, the above test is performed as a radiated measurement and the result is reported as EIRP.

Processing Gain

