

**Nemko Test Report:** 3L0216RUS1

**Applicant:** Electronic Systems Technology  
415 N. Quay St. Suit 4  
Kennewick, WA 99336

**Equipment Under Test:  
(E.U.T.)** 192CHP  
Narrow Band Packet Burst Wireless Modem

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

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

**Authorized By:**



Tom Tidwell, Frontline Manager

**Date:** 9/3/03

**Total Number of Pages:** 43

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EQUIPMENT: 190CHP

PROJECT NO.: 3L0216R

**Section 1. Summary of Test Results**

Manufacturer: Electronic Systems Technology

Model No.: 192CHP

Serial No.: CHP 12040

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.

- |                                     |                            |                                     |                     |
|-------------------------------------|----------------------------|-------------------------------------|---------------------|
| <input checked="" type="checkbox"/> | New Submission             | <input type="checkbox"/>            | Production Unit     |
| <input type="checkbox"/>            | Class II Permissive Change | <input checked="" type="checkbox"/> | 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: Eldon Berry DATE: August 28, 2003

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**Summary Of Test Data**

<b>NAME OF TEST</b>	<b>PARA. NO.</b>	<b>SPEC.</b>	<b>MEAS.</b>	<b>RESULT</b>
RF Power Output	90.205		10W/30W	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	2.5kHz/ 3.5 kHz	Complies
Occupied Bandwidth	90.210	Mask C or D	Plots	Complies
Spurious Emissions at Antenna Terminals	90.210	Mask C or D	Plots	Complies
Field Strength of Spurious Emissions	90.210	Mask C or D	Table	Complies
Frequency Stability	90.213	5 ppm	1.74 ppm	Complies
Transient Frequency Behavior	90.214	Plot	Plots	Complies

**Footnotes:**

The EUT does not provide for voice modulation.

## Section 2. General Equipment Specification

### Transmitter

Supply Voltage Input:	13 Vdc nominal				
Frequency Range:	450-470 MHz				
Tunable Bands:	One				
Necessary Bandwidth:	16.6 kHz or 9.8 kHz				
Type(s) of Modulation:	<b>F3E (Voice)</b>	<b>F1D</b>	<b>F2D</b>	<b>D7W (QAM)</b>	<b>Other</b>
	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Data Rate(s)	9,600 bps or 19,000 bps				
Internal/External Data Source:	External				
Emission Designator:	9K8F2D (9,600 bps) or 16K6F2D (19,200 bps)				
Output Impedance:	50 ohm				
RF Power Output (rated):	10, 20, 30 W				
Channel Spacing(s):	12.5 or 25 kHz				
Operator Selection of Operating Frequency:	<b>U.S.A.</b>	Selectable by user.			
	<b>Canada</b>	Set at factory			
Power Output Adjustment Capability:	Pre-programmed.				

### **Theory of Operation**

The EUT is a wireless data transceiver that operates in the 450 – 470 MHz band. Modulation level is 4 level FSK. The radio can generate a data rate of 9,600 bps in a 12.5 kHz channel or 19,200 bps in a 25 kHz channel.

### **Modulation Description and Necessary Bandwidth**

9K8F2D

Necessary Bandwidth:

$$\begin{aligned} B_n &= 2M + 2d \\ M &= 2,400 \text{ Hz} \\ D &= 2,500 \text{ Hz} \\ B_n &= 9.8 \text{ kHz} \end{aligned}$$

16K6F2D

Necessary Bandwidth:

$$\begin{aligned} B_n &= M + 2d \\ M &= 4,800 \text{ Hz} \\ D &= 3,500 \text{ Hz} \\ B_n &= 16.6 \text{ kHz} \end{aligned}$$

EQUIPMENT: **190CHP**

PROJECT NO.: **3L0216R**

### Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.985
TESTED BY: Eldon Berry	DATE: 25Aug03

**Measurement Results:** Complies.

#### Measurement Data:

**RF Power Output (Conducted)**

Job No.: **3L0216R** Date: **8/25/2003**  
 Specification: **FCC part 90** Temperature(°C): **22**  
 Tested By: Eldon Berry Humidity(%): **50**  
 E.U.T.: **192CHP**  
 Configuration: **Test software control**  
 Detector: Peak

**Test Equipment Used:**

Power Meter: \_\_\_\_\_ Directional Coupler: **1054**  
 Power Sensor: \_\_\_\_\_ Cable #1: **1629**  
 Load: \_\_\_\_\_ Cable #2: \_\_\_\_\_  
 Spectrum Analyzer: **1036** Cable #3: \_\_\_\_\_  
 Attenuator #1 **1064** Cable #4: \_\_\_\_\_  
 Attenuator #2: \_\_\_\_\_ Cable #5: \_\_\_\_\_  
 Attenuator #3: \_\_\_\_\_ Cable #6: \_\_\_\_\_  
 Attenuator #4: \_\_\_\_\_ Power Splitter: \_\_\_\_\_

Measurement Uncertainty: **+/- 1.6 dB**

Frequency MHz	Power Watts	Modulation Type	Output Power (dBm)	Output Power (mW)	Rated Power (dBm)
460	10	9K8F1D	39.9	9772.37	40.00
460	10	16K6F1D	39.9	9772.37	40.00
460	30	9K8F1D	44.8	30199.52	44.78
460	30	16K6F1D	44.8	30199.52	44.78

**Section 4. Modulation Characteristics**

The equipment does not provide for voice modulation.

Maximum Frequency Deviation with Data:

Channel Width (kHz)	Data Rate (bps)	Deviation (kHz)
12.5	9,600	2.5
25	19,200	3.5



EQUIPMENT: 190CHP

PROJECT NO.: 3L0216R

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**Section 5. Occupied Bandwidth**

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.989
TESTED BY: Eldon Berry	DATE: 25Aug03

**Measurement Results:** Complies.

**Measurement Data:** See attached data

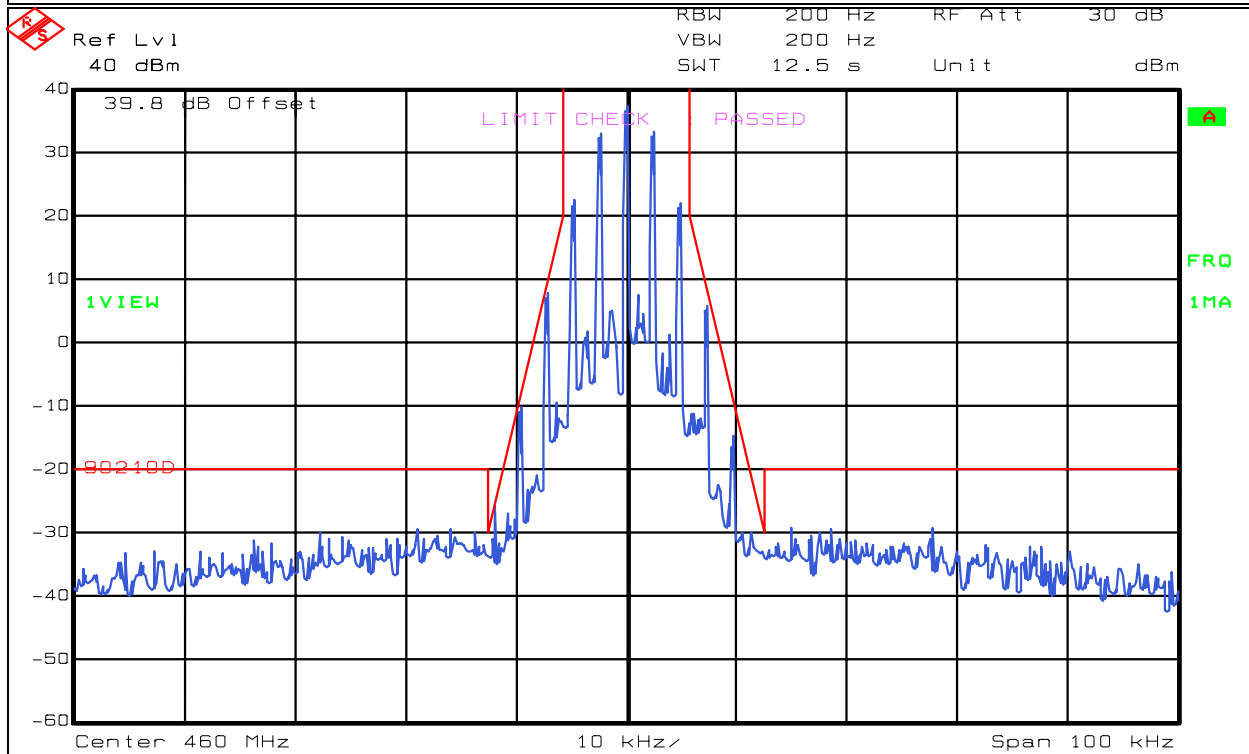
**Occupied Bandwidth Plot**



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

Nemko USA, Inc.

Data Plot		Occupied Bandwidth		Complete <u>  X  </u>	
Page <u>  1  </u> of <u>  4  </u>				Preliminary: <u>          </u>	
Job No.:	<u>  3L0216R  </u>	Date:	<u>  8/25/2003  </u>		
Specification:	<u>  FCC Part 90.210  </u>	Temperature(°C):	<u>  21  </u>		
Tested By:	<u>  Eldon Berry  </u>	Relative Humidity(%):	<u>  50  </u>		
E.U.T.:	<u>  192CHP  </u>				
Configuration:	<u>  Controlled by test software.  </u>				
Sample Number:	<u>  S01  </u>				
Location:	<u>  Lab 4  </u>	RBW:	<u>  Refer to plots  </u>	Measurement	<u>          </u> m
Detector Type:	<u>  Peak  </u>	VBW:	<u>  Refer to plots  </u>	Distance:	<u>          </u> m
<b>Test Equipment Used</b>					
Antenna:	<u>          </u>	Directional Coupler:	<u>  1054  </u>		
Pre-Amp:	<u>          </u>	Cable #1:	<u>  1629  </u>		
Filter:	<u>          </u>	Cable #2:	<u>          </u>		
Receiver:	<u>  1036  </u>	Cable #3:	<u>  0  </u>		
Attenuator #1:	<u>  1064  </u>	Cable #4:	<u>          </u>		
Attenuator #2:	<u>          </u>	Mixer:	<u>          </u>		
Additional equipment used:	<u>                                  </u>				
Measurement Uncertainty:	<u>  +/-1.7 dB  </u>				



Date: 25.AUG.2003 15:25:48

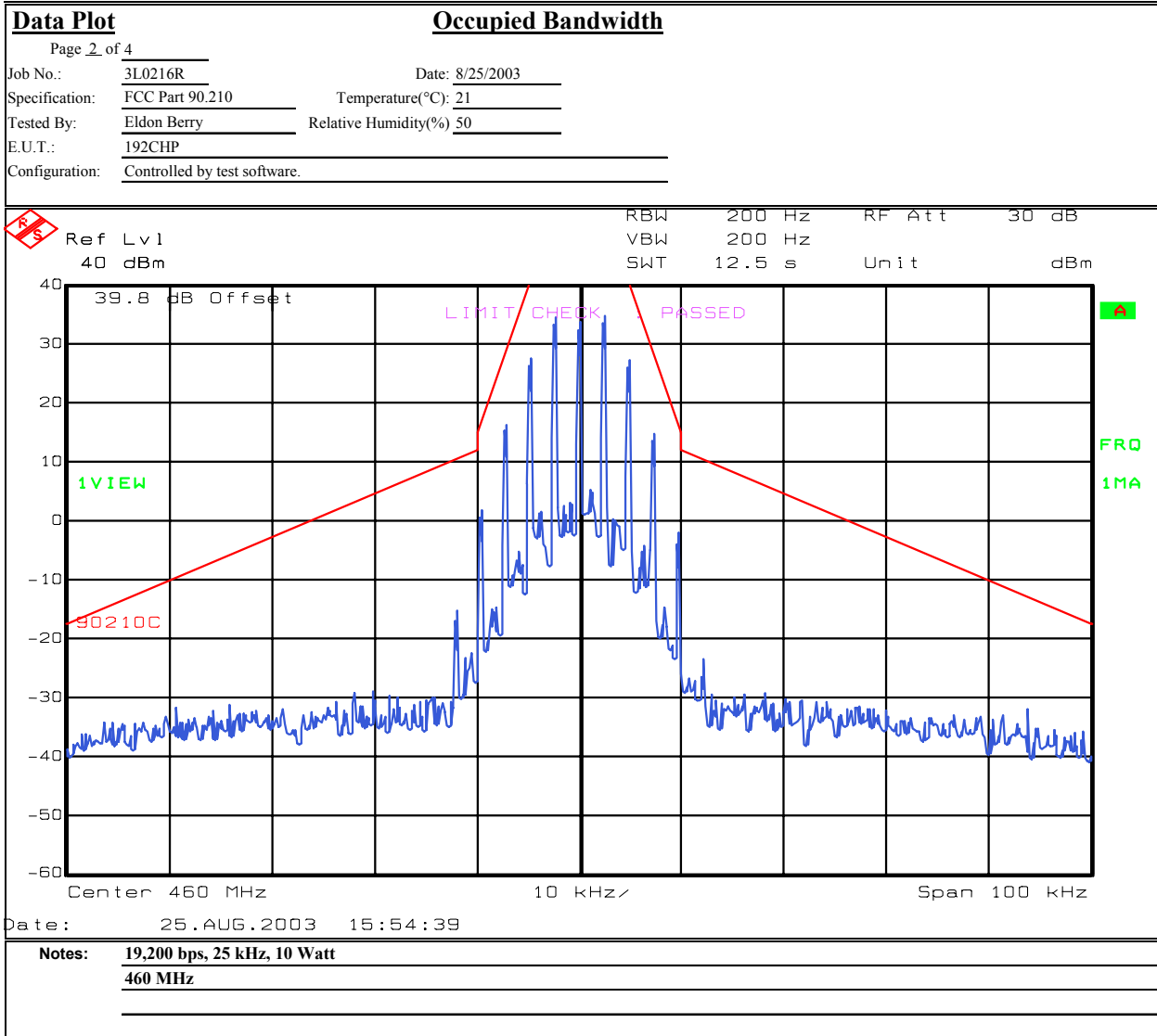
Notes:   9,600 bps, 12.5 kHz, 10 Watt    
  460 MHz

Occupied Bandwidth Plot – cont.



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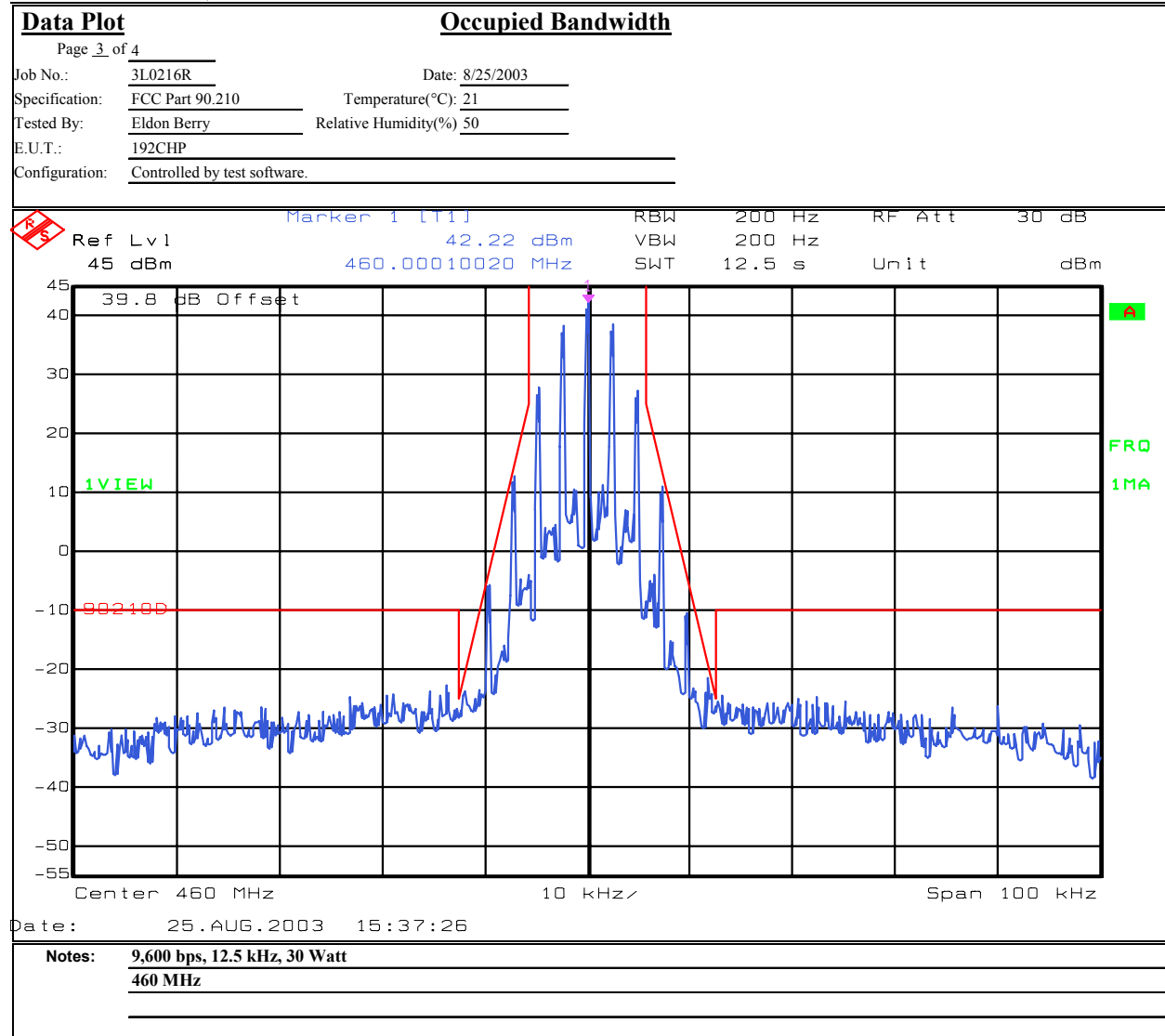
Occupied Bandwidth Plot – cont.



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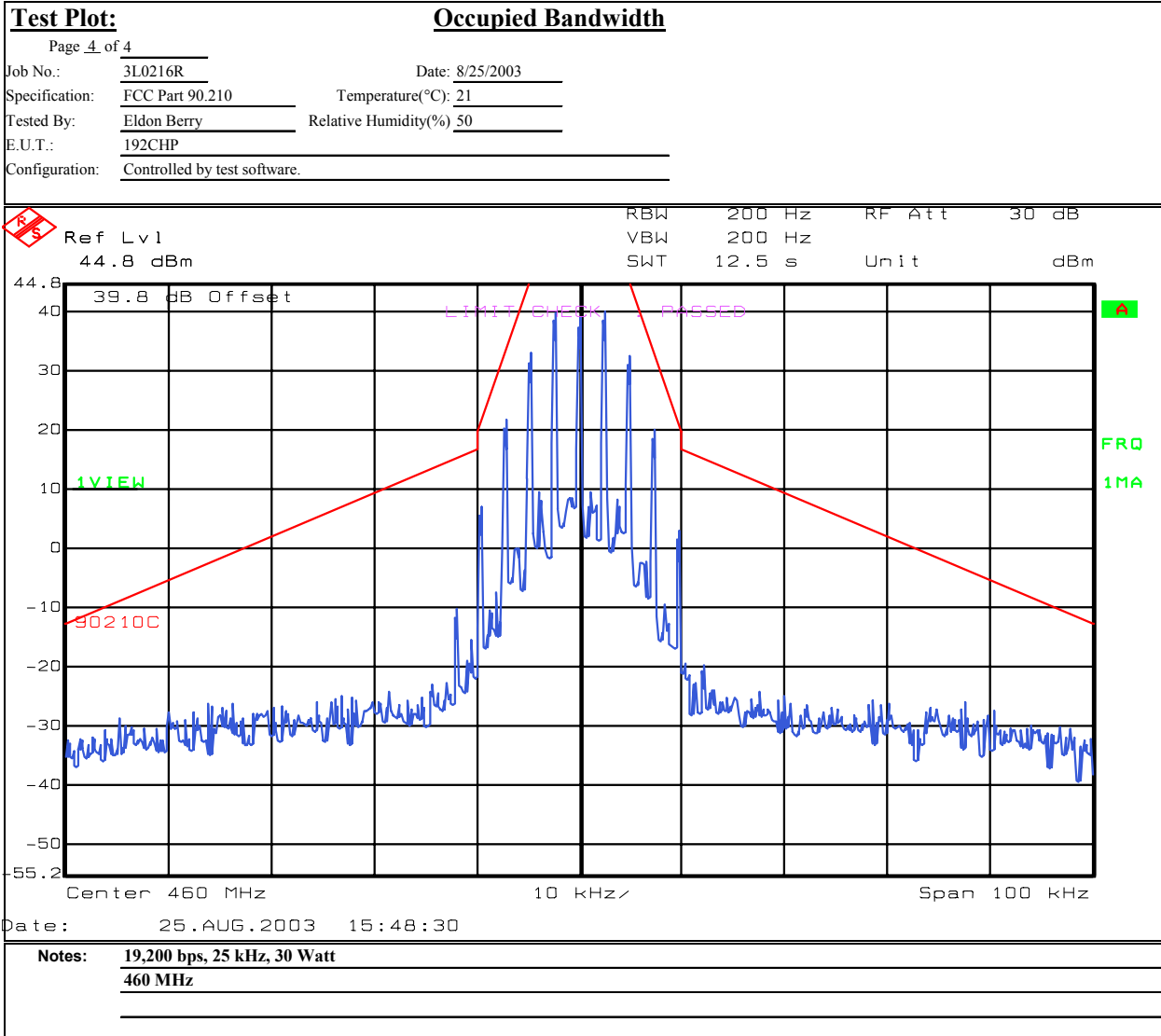


Occupied Bandwidth Plot – cont.



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EQUIPMENT: 190CHP

PROJECT NO.: 3L0216R

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**Section 6. Spurious Emissions at Antenna Terminals**

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.991
TESTED BY: Eldon Berry	DATE: 26Aug03

**Measurement Results:** Complies.

**Measurement Data:** See attached data

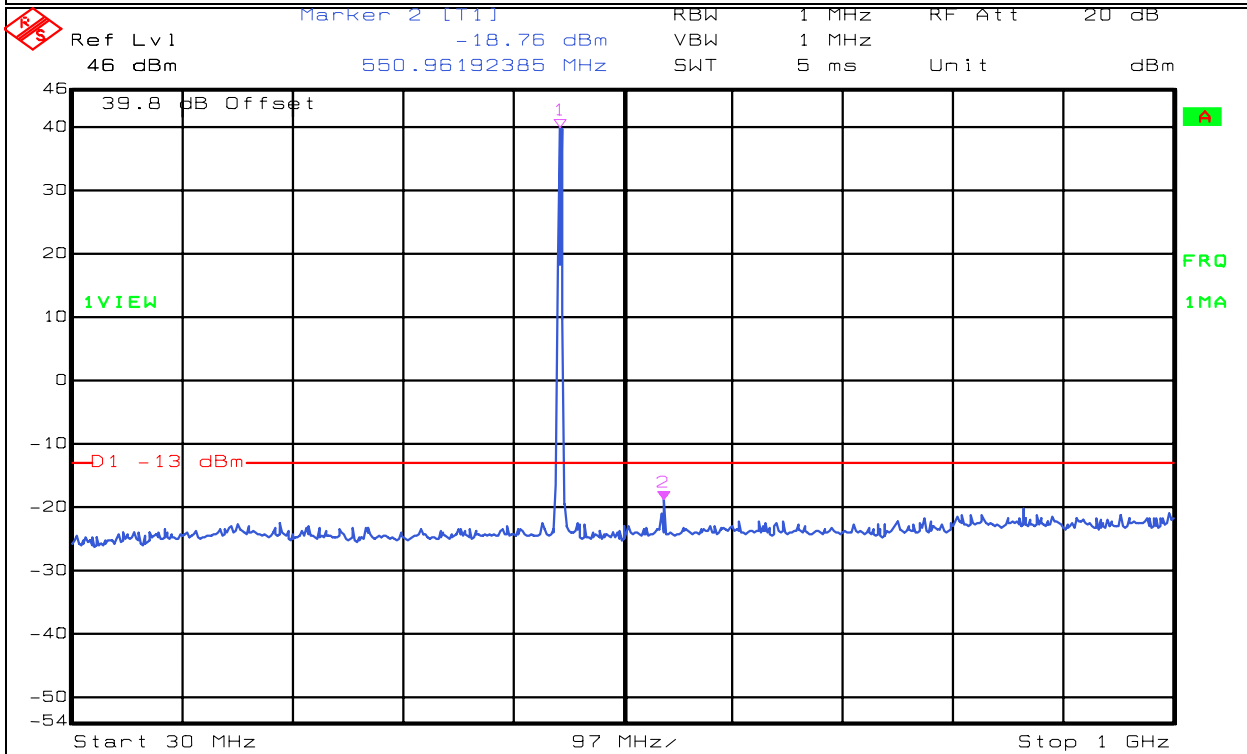
Spurious Emissions at Antenna Terminals



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Data Plot		Spurious Emissions at Antenna Terminals	
Page 1 of 8		Complete	<u>X</u>
Job No.: 3L0216R	Date: 8/26/2003	Preliminary:	_____
Specification: FCC Part 90	Temperature(°C): 21		
Tested By: Eldon Berry	Relative Humidity(%): 46		
E.U.T.: 192CHP			
Configuration: Controlled by test software.			
Sample Number: S01			
Location: Lab 4	RBW: Refer to plots	Measurement	
Detector Type: Peak	VBW: Refer to plots	Distance:	_____ m
<b>Test Equipment Used</b>			
Antenna: _____	Directional Coupler: 1054		
Pre-Amp: _____	Cable #1: 1629		
Filter: _____	Cable #2: _____		
Receiver: 1036	Cable #3: 0		
Attenuator #1: 1064	Cable #4: _____		
Attenuator #2: _____	Mixer: _____		
Additional equipment used: _____			
Measurement Uncertainty: +/-1.7 dB			



Date: 26.AUG.2003 10:13:51

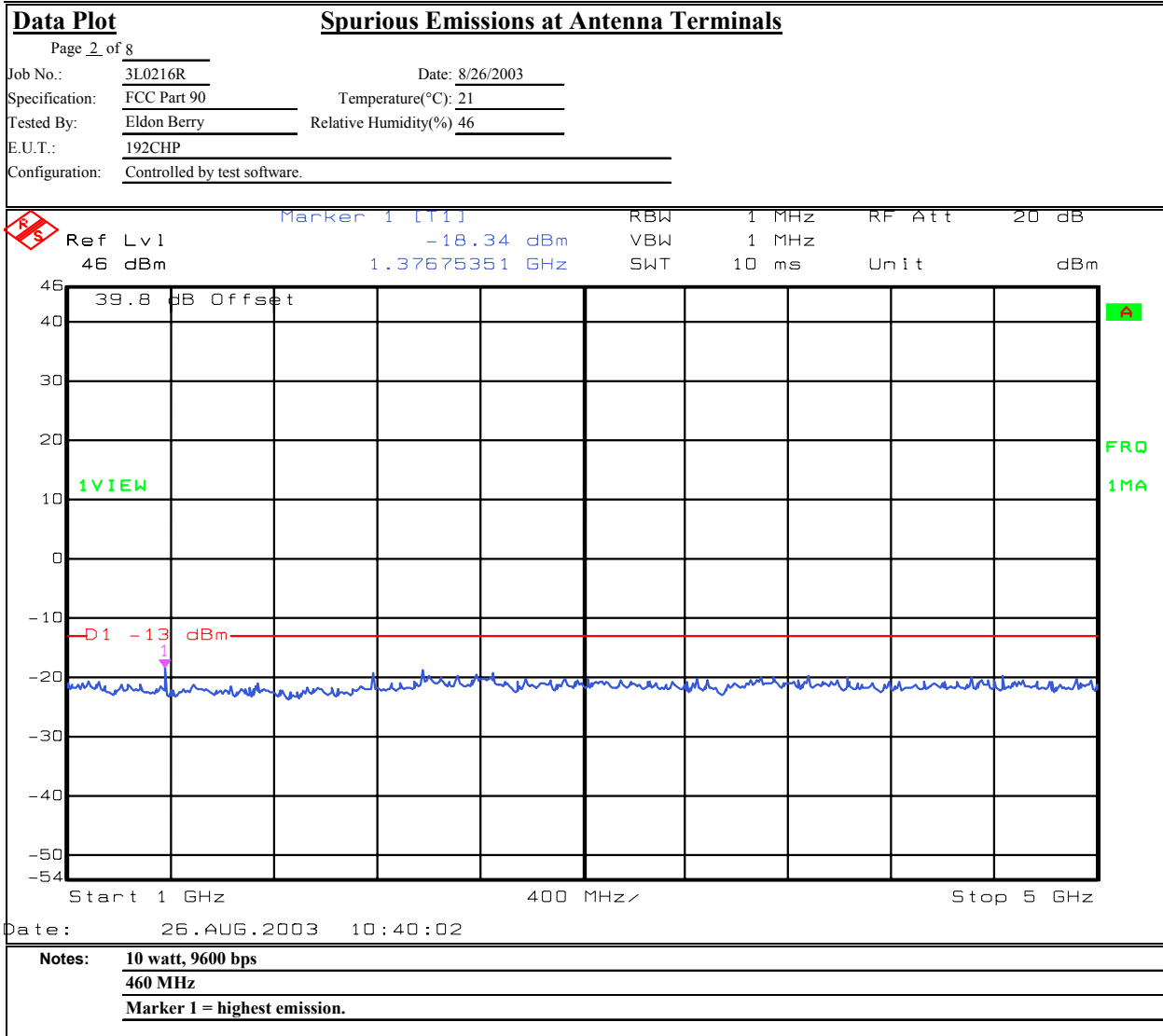
Notes: 10 watt, 9600 bps  
460 MHz  
Marker 1 = carrier, marker 2 = highest emission.

Spurious Emissions at Antenna Terminals – cont.



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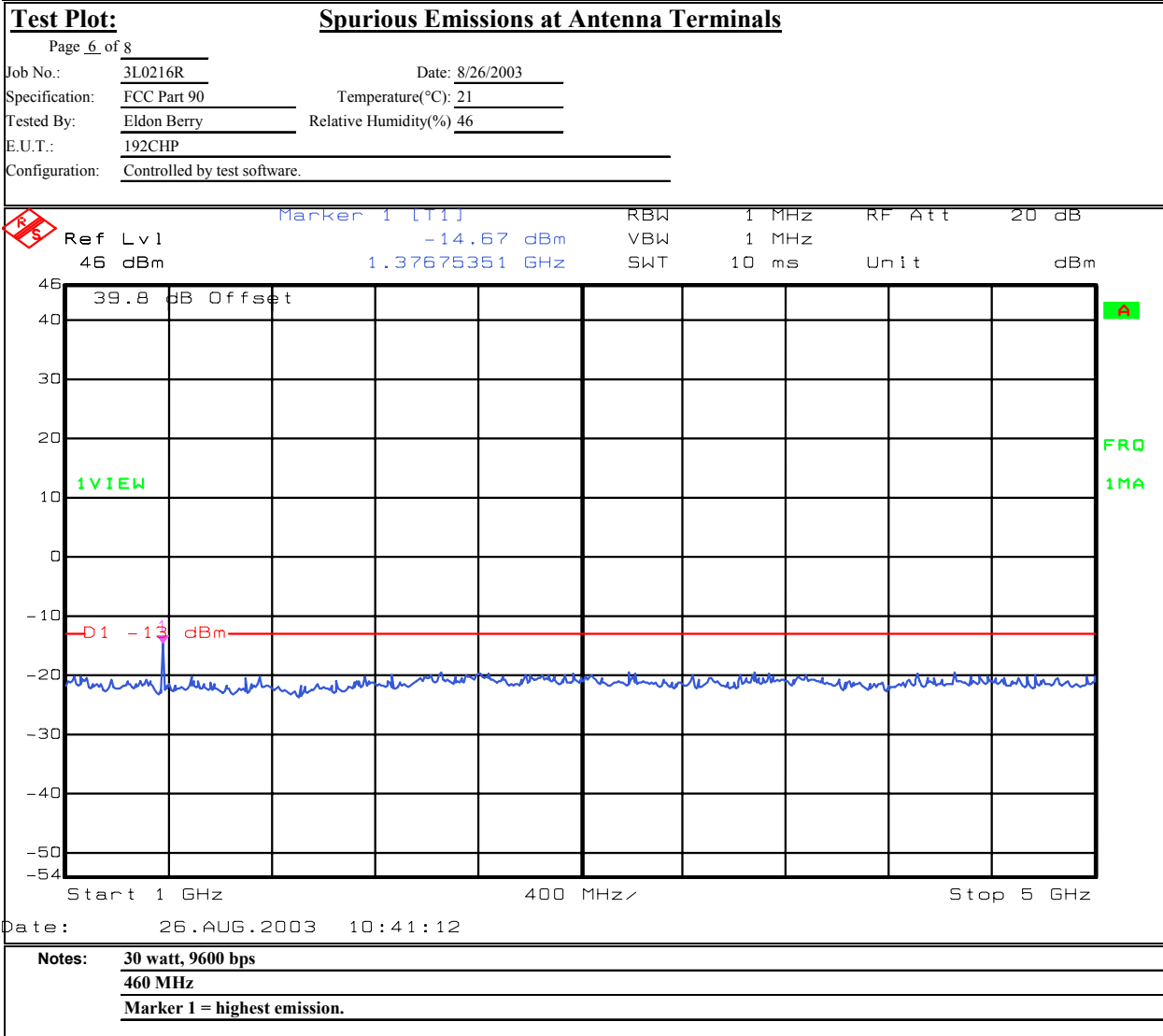


Spurious Emissions at Antenna Terminals – cont.



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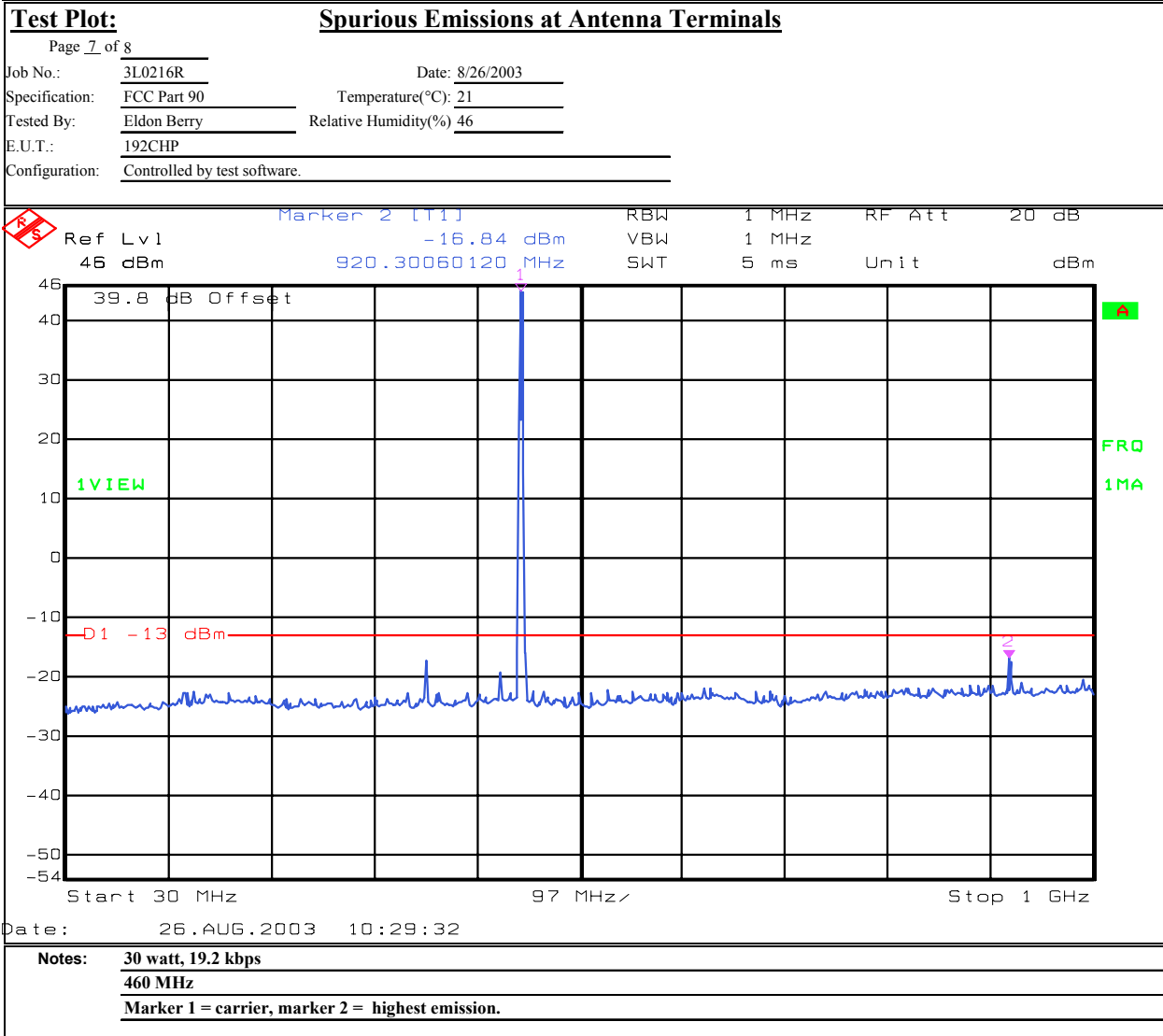


Spurious Emissions at Antenna Terminals – cont.



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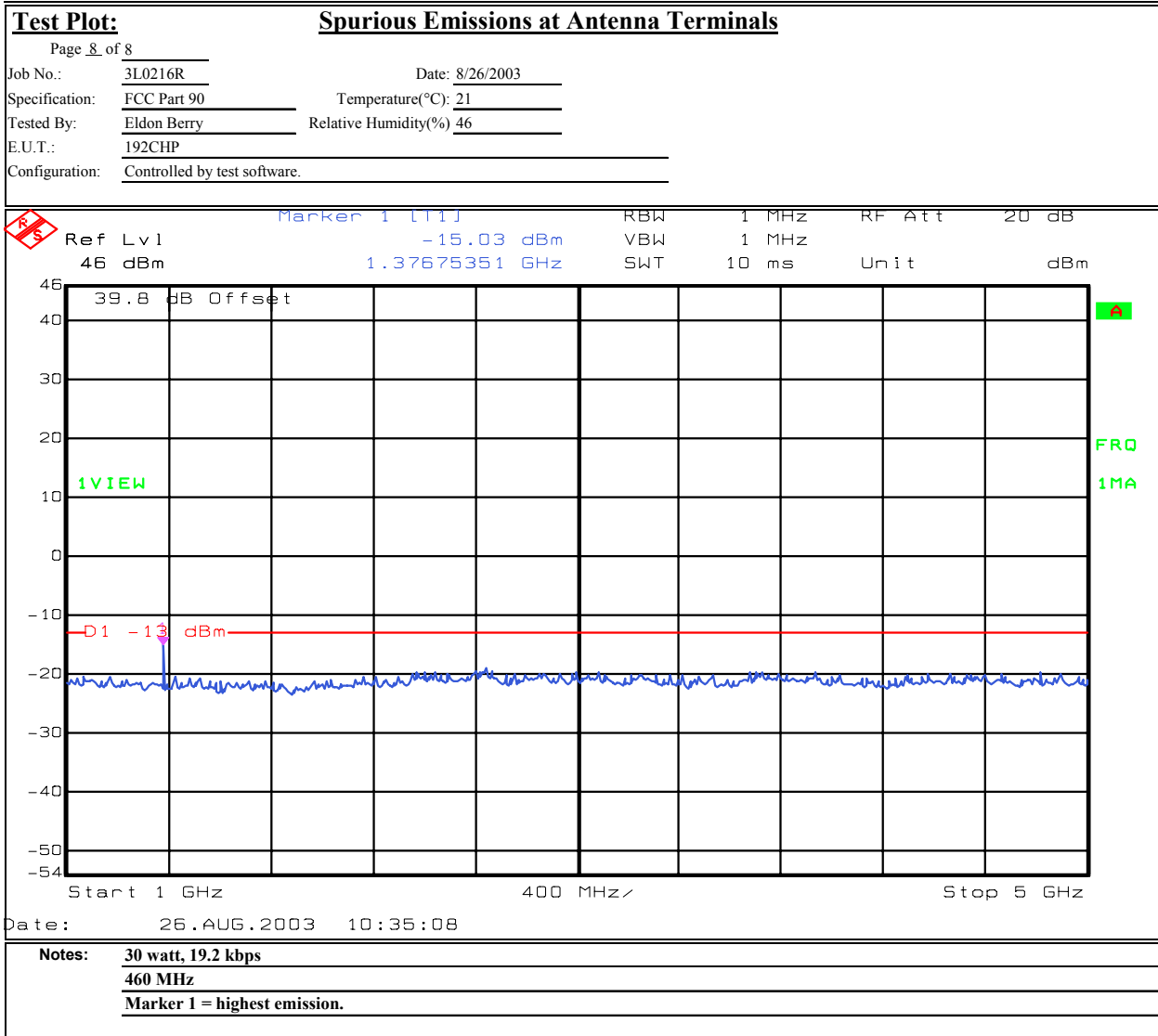
Spurious Emissions at Antenna Terminals – cont.



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*EQUIPMENT:* **190CHP**

PROJECT NO.: **3L0216R**

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**Section 7. Field Strength of Spurious Emissions**

NAME OF TEST: Field Strength of Spurious Emissions	PARA. NO.: 2.993
TESTED BY: Eldon Berry	DATE: 27Aug03

**Measurement Results:** Complies.

**Measurement Data:** See attached data

**Test Data - Radiated Emissions**

<b>ERP Substitution Method</b>											
Page 1 of 1									Complete <u>  X  </u>		
Job No.:	3L0216R		Date:		8/27/03		Preliminary <u>          </u>				
Specification:	Part 90		Temperature(°C):		22						
Tested By:	Eldon Berry		Relative Humidity(%):		48						
E.U.T.:	192CHP										
Configuration:	12.5 kHz BW. EUT controlled by test software										
Sample No.:	1										
Location:	AC 3		RBW:		1 MHz		Measurement				
Detector Type:	Peak		VBW:		1 MHz		Distance:		3 m		
<b>Test Equipment Used</b>											
Antenna:	1304		Directional Coupler:								
Pre-Amp:	1016		Cable #1:		1485						
Filter:			Cable #2:		1484						
Receiver:	1464		Cable #3:								
Attenuator #1			Cable #4:								
Attenuator #2:			Mixer:								
Additional equipment used:	791										
Measurement Uncertainty:	+/-1.7 dB										
Frequency (MHz)	Meter Reading (dBm)	Substitution Level (dBm)		Pre-Amp Gain (dB)	Substitution Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarity	Comments	
										9600 bps	
920	-31.2	-26.0		24.1	5.0	-26.0	-13.0	-12.9667	V		
1380	-34.0	-34.5		32	4.9	-34.5	-13.0	-21.5000	V		
1840	-38.5	-40.5		33	7.3	-40.5	-13.0	-27.5000	V		
2300	-38.6	-37.3		32.9	6.8	-37.3	-13.0	-24.3333	V		
2760	-47.0	-44.6		33.1	8.0	-44.6	-13.0	-31.6000	V		
3220	-56.0	-48.9		32.7	8.0	-48.9	-13.0	-35.8667	V		
3680	-59.8	-49.5		33	8.6	-49.5	-13.0	-36.4667	V		
4140	-53.8	-41.8		33.3	8.2	-41.8	-13.0	-28.7667	V		
4600	-58.8	-48.0		33.2	8.7	-48.0	-13.0	-35.0000	V		
920	-25.6	-18.7		24.1	5.0	-18.7	-13.0	-5.7000	H		
1380	-36.3	-37.6		32	4.9	-37.6	-13.0	-24.6333	H		
1840	-39.0	-39.0		33	7.3	-39.0	-13.0	-26.0000	H		
2300	-46.8	-42.7		32.9	6.8	-42.7	-13.0	-29.7000	H		
2760	-47.0	-44.6		33.1	8.0	-44.6	-13.0	-31.6000	H		
3220	-58.2	-54.6		32.7	8.0	-54.6	-13.0	-41.5667	H		
3680	-60.0	-57.5		33	8.6	-57.5	-13.0	-44.5000	H		
4140	-54.5	-53.0		33.3	8.2	-53.0	-13.0	-39.9667	H		
4600	-57.6	-55.3		33.2	8.7	-55.3	-13.0	-42.3000	H		
<b>Notes: SEARCHED SPECTRUM TO THE 10TH HARMONIC OF CARRIER</b>											



**Test Data - Radiated Emissions – cont.**

<b>ERP Substitution Method</b>											
Page 1 of 1									Complete <u>  X  </u>		
Job No.:	3L0216R		Date:		8/27/03		Preliminary <u>          </u>				
Specification:	Part 90		Temperature(°C):		22						
Tested By:	Eldon Berry		Relative Humidity(%):		48						
E.U.T.:	192CHP										
Configuration:	30 watt 25 kHz BW. EUT controlled by test software										
Sample No.:	1										
Location:	AC 3		RBW:		1 MHz		Measurement				
Detector Type:	Peak		VBW:		1 MHz		Distance:		3 m		
<b>Test Equipment Used</b>											
Antenna:	1304		Directional Coupler:								
Pre-Amp:	1016		Cable #1:		1485						
Filter:			Cable #2:		1484						
Receiver:	1464		Cable #3:								
Attenuator #1			Cable #4:								
Attenuator #2:			Mixer:								
Additional equipment used:	791										
Measurement Uncertainty:	+/-1.7 dB										
Frequency (MHz)	Meter Reading (dBm)	Substitution Level (dBm)		Pre-Amp Gain (dB)	Substitution Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Margin (dB)	Polarity	Comments	
										19.2 kbps	
920	-29.6	-24.4		24.1	5.0	-24.4	-13.0	-11.3667	V		
1380	-35.8	-36.3		32	4.9	-36.3	-13.0	-23.3000	V		
1840	-40.3	-42.3		33	7.3	-42.3	-13.0	-29.3000	V		
2300	-39.2	-37.9		32.9	6.8	-37.9	-13.0	-24.9333	V		
2760	-46.2	-43.8		33.1	8.0	-43.8	-13.0	-30.8000	V		
3220	-57.5	-50.4		32.7	8.0	-50.4	-13.0	-37.3667	V		
3680	-64.0	-53.7		33	8.6	-53.7	-13.0	-40.6667	V		
4140	-61.0	-49.0		33.3	8.2	-49.0	-13.0	-35.9667	V		
4600	-60.3	-49.5		33.2	8.7	-49.5	-13.0	-36.5000	V		
920	-26.0	-19.1		24.1	5.0	-19.1	-13.0	-6.1000	H		
1380	-38.3	-39.6		32	4.9	-39.6	-13.0	-26.6333	H		
1840	-39.6	-39.6		33	7.3	-39.6	-13.0	-26.6000	H		
2300	-47.0	-42.9		32.9	6.8	-42.9	-13.0	-29.9000	H		
2760	-57.0	-54.6		33.1	8.0	-54.6	-13.0	-41.6000	H		
3220	-57.0	-53.4		32.7	8.0	-53.4	-13.0	-40.3667	H		
3680	-59.5	-57.0		33	8.6	-57.0	-13.0	-44.0000	H		
4140	-54.5	-53.0		33.3	8.2	-53.0	-13.0	-39.9667	H		
4600	-56.8	-54.5		33.2	8.7	-54.5	-13.0	-41.5000	H		
<b>Notes: SEARCHED SPECTRUM TO THE 10TH HARMONIC OF CARRIER</b>											

**Photographs of Test Setup**



EQUIPMENT: 190CHP

PROJECT NO.: 3L0216R

**Section 8. Frequency Stability**

NAME OF TEST: Frequency Stability	PARA. NO.: 2.995
TESTED BY: Eldon Berry	DATE: 28Aug03

**Measurement Results:** Complies.

**Measurement Data:**

**Measurement Conditions:** Temperature: 23 °C  
Humidity: 62 %

**Measurement Uncertainty:** +/- 10<sup>-7</sup> ppm

Test Equipment: #283, #425, #1990, #1048, #1064, #1054, #1019

Mode 12.5 kHz BW 9600 bps  
Standard Test Frequency: 460 MHz

Temperature	Voltage (Vdc)	Frequency (MHz)	Change* (Hz)	Change (PPM)
50	13	459.999632	-475	1.03
40	13	459.999856	-251	0.55
30	13	460.000340	233	0.51
20	13	460.000107	0	0.00
10	13	460.000726	619	1.35
0	13	460.000750	643	1.40
-10	13	460.000755	648	1.41
-20	13	460.000813	706	1.53
-30	13	460.000887	780	1.70
20	11.05	460.000107	0	0.00
20	14.95	460.000090	-17	0.04

\* Change compared to frequency at 20 degree C.

Mode 25 kHz BW 19,200 bps

EQUIPMENT: 190CHP

PROJECT NO.: 3L0216R

Standard Test Frequency: 460 MHz

Test Equipment: #283, #425, #1990, #1048, #1064, #1054, #1019

Temperature	Voltage (Vdc)	Frequency (MHz)	Change* (Hz)	Change (PPM)
50	13	459.999636	-452	0.98
40	13	459.999856	-232	0.50
30	13	460.000340	252	0.55
20	13	460.000088	0	0.00
10	13	460.000735	647	1.41
0	13	460.000734	646	1.40
-10	13	460.000741	653	1.42
-20	13	460.000806	718	1.56
-30	13	460.000888	800	1.74
20	11.05	460.000088	0	0.00
20	14.95	460.000073	-15	0.03

\* Change compared to frequency at 20 degree C.

EQUIPMENT: 190CHP

PROJECT NO.: 3L0216R

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**Section 9. Transient Frequency Behavior**

NAME OF TEST: Transient Frequency Behaviour	PARA. NO.: 90.214
TESTED BY: Eldon Berry	DATE: 26Aug03

**Measurement Results:** Complies.

**Measurement Data:** See attached plots

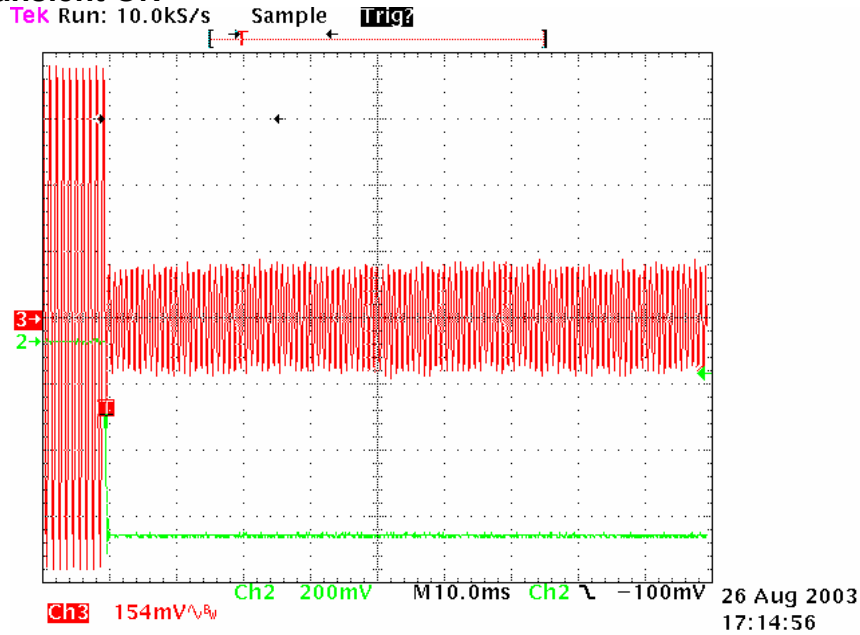
**Measurement Conditions:** Temperature: 23 °C  
Humidity: 60 %

Test Equipment: #892, #1036, #1064, #1629, #1054, #1048, #1990, #425, #1051,  
#1341

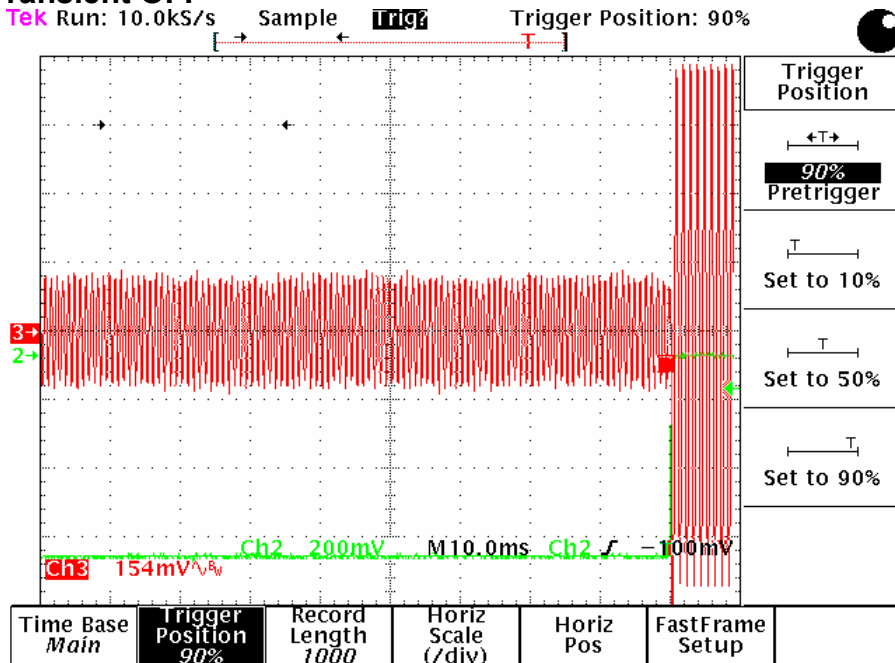
Transient Plots - 12.5 kHz Bandwidth

Vertical scale = 3.125 kHz/div, Horizontal scale = 10 ms/div

9600 bps Transient ON



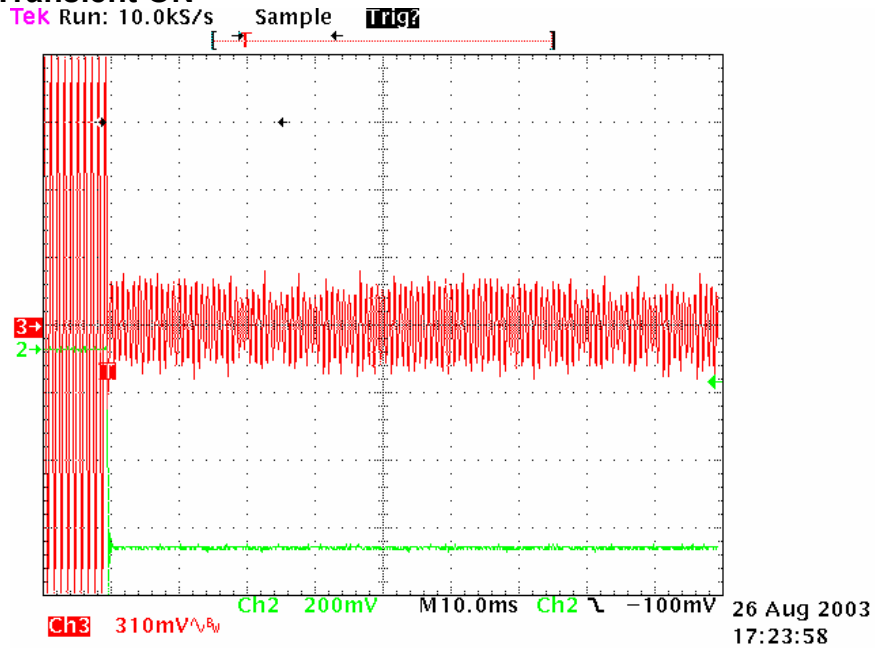
9600 bps Transient OFF



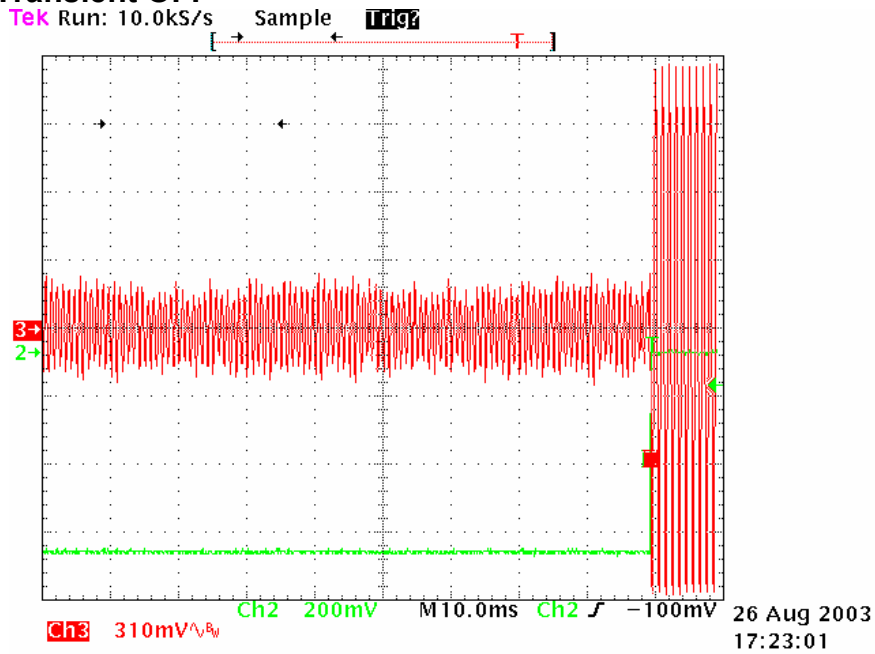
Transient Plots - 25 kHz Bandwidth

Vertical scale = 6.25 kHz/div, Horizontal scale = 10 ms/div

19,200 bps Transient ON



19,200 bps Transient OFF



## Section 10. 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	04/22/03	04/21/04
425	DIGITAL MULTIMETER	FLUKE 45-01	5930073	10/03/02	10/03/03
718	HP SPECTRUM ANALYZER	HEWLETT PACKARD 8591EM	3639A00980	01/06/03	01/06/04
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	08/28/03	08/28/04
1019	CABLE, 9.5m	KTL RG223	N/A	01/02/03	01/02/04
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	12/18/01	12/19/03
1048	50 OHM LOAD	NARDA 27470	254	Cal B4 Use	N/A
1051	Radio Communication Analyzer	Rhode & Schwarz CMTA-54	835875/002	CNR	N/A
1054	DUAL DIRECTIONAL COUPLER	NARDA 3020A	34366	Cal Not Req	N/A
1064	ATTENUATOR	NARDA 776B-20	NONE	CBU	N/A
1341	RADIO COMMUNICATION SERVICE MONITOR	ROHDE & SCHWARZ CMS53	883832/018	CNR	N/A
1463	Color 4 Ch Digitizing Oscilloscope	Tektronix TDS684A	B010460	08/07/03	08/06/04
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	02/11/03	02/11/05
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	07/24/03	07/23/04
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	07/24/03	07/23/04
1629	CABLE, 6 ft	MEGAPHASE 10311 1GVT4	N/A	CBU	N/A
1983	CABLE	KTL Site A OATS	N/A	03/28/03	03/27/04
1990	CABLE, 4.8m	KTL RG214	N/A	04/09/03	04/08/04



## **ANNEX A - TEST METHODOLOGIES**

<b>NAME OF TEST: RF Power Output</b>	<b>PARA. NO.: 2.985</b>
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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

EQUIPMENT: 190CHP

PROJECT NO.: 3L0216R

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**NAME OF TEST: Audio Frequency Response**

**PARA. NO.: 2.987(a)**

**Test Method:** TIA/EIA-603

**Minimum Standard:** TIA/EIA-603, Para. 3.2.6 from 300 Hz to 3000 Hz.  
The

transmitter audio frequency response shall have a nominal 6 dB per octave pre-emphasis characteristic.

**NAME OF TEST: Audio Low-Pass Filter Frequency Response**

**PARA. NO.: 2.987(a)**

**Test Method:** TIA/EIA-603

**Minimum Standard:** TIA/EIA-603

**NAME OF TEST: Modulation Limiting**

**PARA. NO.: 2.987(a)**

**Test Method:** TIA/EIA-603

**Minimum Standard:** TIA/EIA-603

<b>NAME OF TEST: Occupied Bandwidth</b>	<b>PARA. NO.: 2.989</b>
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**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

**Test Method:**

RBW: 1% of emission bandwidth in 0 - 1 GHz range. 1 MHz at frequencies above 1 GHz.

VBW: ⇒ RBW

The spectrum is search up to 10 times the fundamental frequency.

**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 x 10<sup>-5</sup> 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<sup>-5</sup> Watts (Maximum spurious output power)

R = 3m (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 x 10<sup>-5</sup> Watts (Maximum spurious output power)

R = 3m (Measurement Distance)

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

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

**NAME OF TEST: Transient Frequency Behaviour** **PARA. NO.: 2.214**

**Minimum Standard:**

**Transient Frequency Behaviour for Equipment Designed to Operate on 25 kHz Channels**

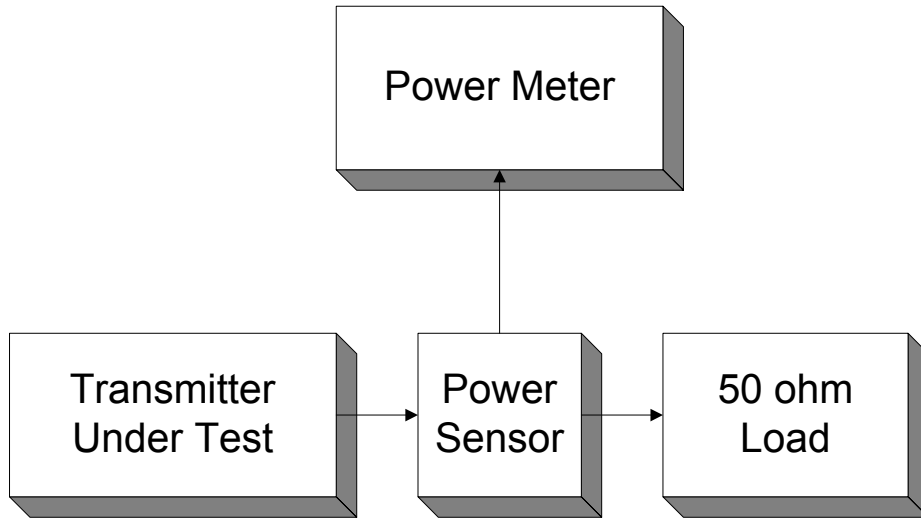
Time intervals <sup>1,2</sup>	Maximum Frequency difference <sup>3</sup> (kHz)	Frequency ranges (MHz) All equipment					
		Base station and portable radios			Mobile Radios		
		150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)	150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)
t <sub>1</sub> <sup>4</sup>	± 25	5.0	10.0	20.0	5.0	10.0	5.0
t <sub>2</sub>	± 12	20.0	25.0	50.0	20.0	25.0	20.0
t <sub>3</sub> <sup>4</sup>	± 25	5.0	10.0	10.0	5.0	10.0	5.0

**Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz & 6.25 kHz Channels**

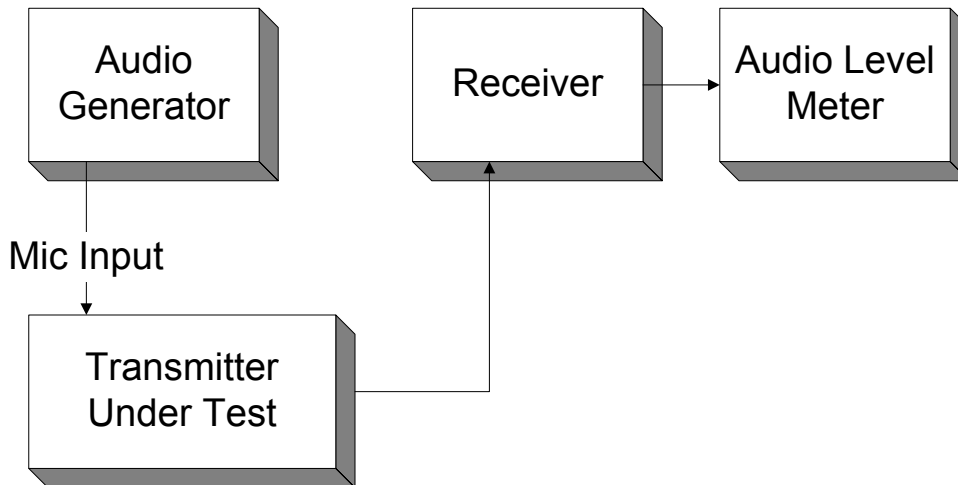
Time intervals <sup>1,2</sup>	Maximum Frequency difference <sup>3</sup> (kHz)	Frequency ranges (MHz) All equipment		
		150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)
t <sub>1</sub> <sup>4</sup>	± 12.5 / ± 6.25	5.0	10.0	20.0
t <sub>2</sub>	± 6.25 / ± 3.125	20.0	25.0	50.0
t <sub>3</sub> <sup>4</sup>	± 12.5 / ± 6.25	5.0	10.0	10.0

## **ANNEX B - TEST DIAGRAMS**

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

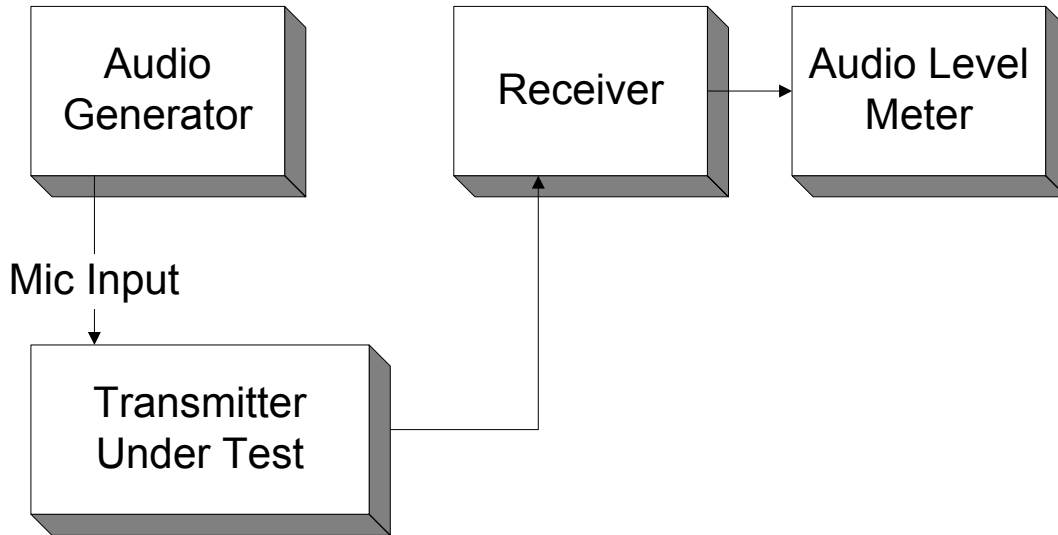


**Para. No. 2.987(a) - Audio Frequency Response**

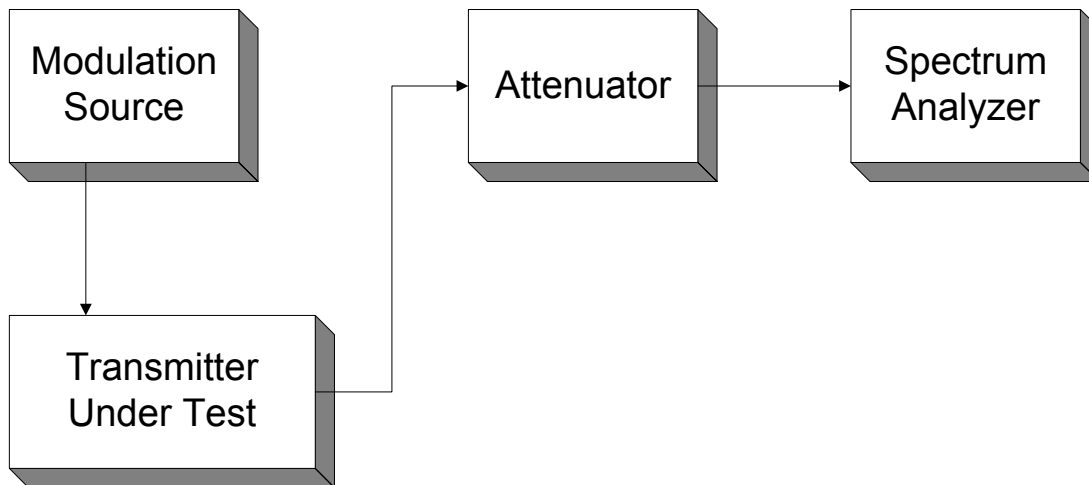




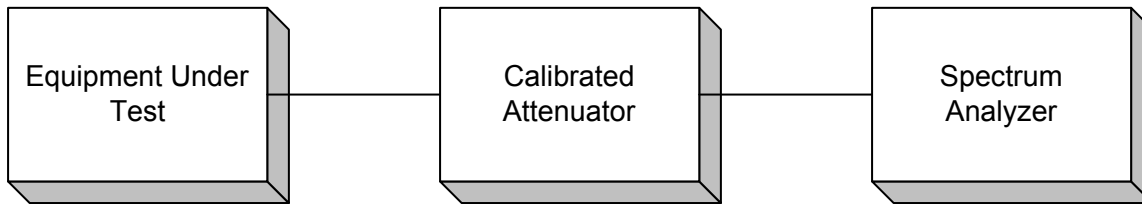
**Para. No. 2.987(b) - Modulation Limiting**



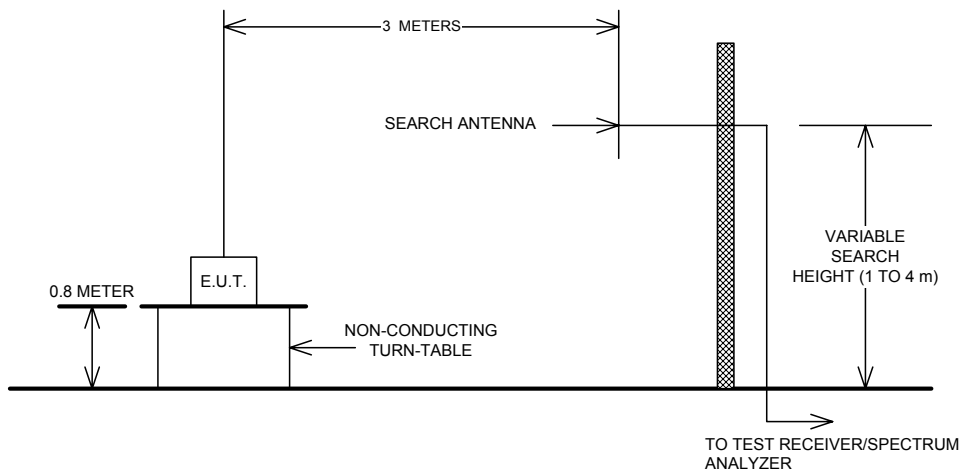
**Para. No. 2.989 - Occupied Bandwidth**



**Para. No. 2.991 - Spurious Emissions at Antenna Terminals**



**Para. No. 2.993 - Field Strength of Spurious Radiation**



**Para. No. 2.995 - Frequency Stability**

