

Nemko Test Report No.:

4L0571RUS2

Applicant:

Andrew Corporation
108 Rand Park Drive
Garner, NC 27529

Equipment Under Test:

TFAH 80/85/19

In Accordance With:

FCC Part 24, Subpart E
Broadband PCS Repeaters

Tested By:

Nemko Dallas Inc.
802 N. Kealy
Lewisville, Texas 75057-3136

Authorized By:



Tom Tidwell, Frontline Group Manager

Date:

9/1/04

Total Number of Pages:

43

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Section 1. Summary of Test Results

Manufacturer: Andrew Corporation

Model No.: TFAH 80/85/19

Serial No.: 043003403

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 24, Subpart E.



New Submission



Production Unit



Class II Permissive Change



Pre-Production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE. NONE

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Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	RESULT
RF Power Output	24.232	100W	Complies
Occupied Bandwidth	24.238	Input/Output	Complies
Spurious Emissions at Antenna Terminals	24.238(a)	-13 dBm	Complies
Field Strength of Spurious Emissions	24.238(a)	-13 dBm E.I.R.P.	Complies
Frequency Stability	24.235		NA

Footnotes:

(1) Modulation characteristics were not tested since the E.U.T. processes but does not produce a modulated waveform.

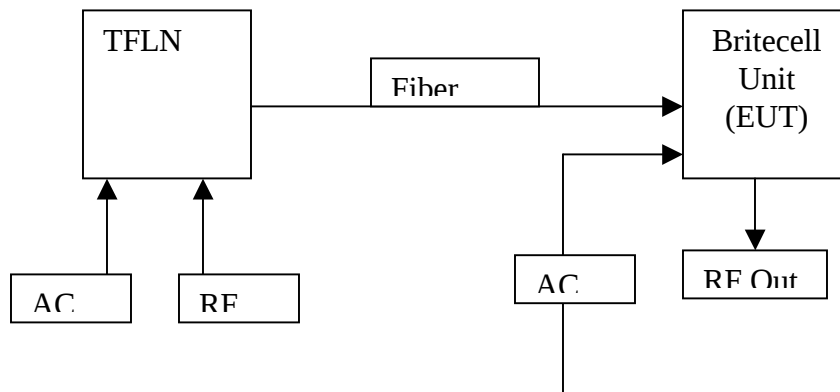
Measurement uncertainty for each test configuration is expressed to 95% probability.

Section 2. General Equipment Specification

Supply Voltage Input:	115 Vac		
Frequency Bands: Downlink:	☒ Block A : 1930 – 1945 MHz ☒ Block D : 1945 – 1950 MHz ☒ Block B : 1950 – 1965 MHz ☒ Block E : 1965 – 1970 MHz ☒ Block F : 1970 – 1975 MHz ☒ Block C : 1975 – 1990 MHz		
Frequency Bands: Uplink:	NA		
Type of Modulation and Designator:	CDMA (F9W) ☒	GSM (G7W) ☒	NADC (DXW) ☒
Output Impedance:	50 ohms		
RF Output (Rated dBm/carrier): DL	Modulation CDMA GSM EDGE TDMA	1 Carrier 31 37 33.5 34.5	2 Carriers 24.5 27 25 25.5
Frequency Translation:	F1-F1 ☒	F1-F2 ☐	N/A ☐
Band Selection:	Software ☐	Duplexer ☐	Fullband ☒

Description of Operation

TFAH 80/58/19 is a fiber based tri-band repeater operating in the 800 MHz SMR, the 800 MHz cellular and the 1900 MHz PCS bands

System Diagram

Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.1046
TESTED BY: David Light	DATE: 8/30/04

Test Results: Complies.**Measurement Data:**

Direction	Modulation Type	Per Channel Power Output (dBm)	Composite Power Output (dBm)
Downlink	CDMA	24.5	27.5
Downlink	GSM	27	30
Downlink	NADC	25	28
Downlink	CDPD	25.5	28.8

Equipment Used: 1036-1065-1604-1629**Measurement Uncertainty:** +/- 1.7 dB**Temperature:** 25 °C**Relative Humidity:** 40 %

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EQUIPMENT: TFAH 80/85/19

FCC PART 24, SUBPART E
BROADBAND PCS REPEATERS
Test Report No.: 4L0571RUS2

Section 4. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.1049
TESTED BY: David Light	DATE: 8/30/04

Test Results: Complies.

Test Data: See attached plot(s).

Test Data – Occupied Bandwidth



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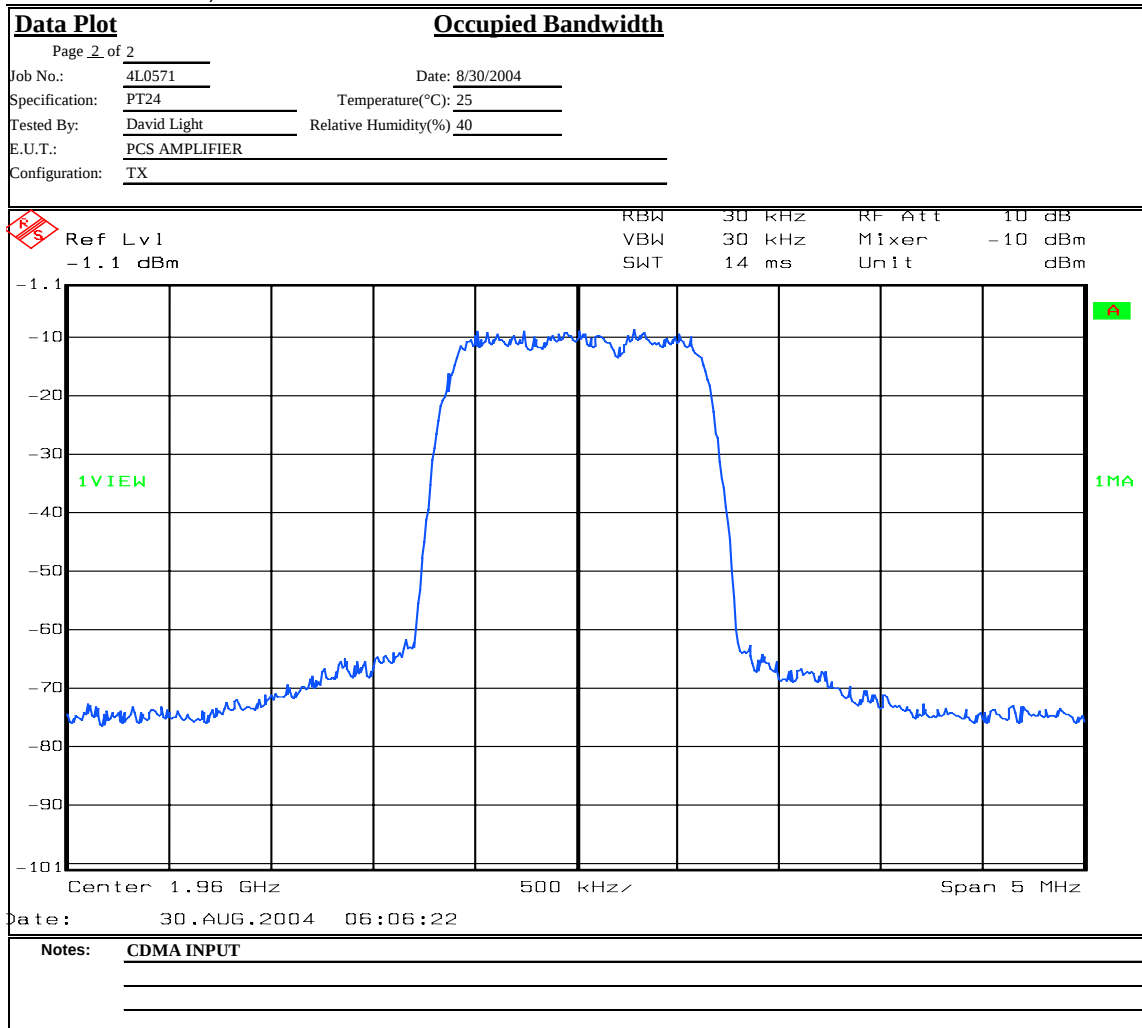
Data Plot		Occupied Bandwidth	
Page 1 of 2		Complete <u>X</u>	
Job No.: 4L0571	Date: 8/30/2004	Preliminary: _____	
Specification: PT24	Temperature(°C): 25		
Tested By: David Light	Relative Humidity(%): 40		
E.U.T.: PCS AMPLIFIER			
Configuration: TX			
Sample Number: 1			
Location: Lab 1	RBW: 30 kHz	Measurement	
Detector Type: Peak	VBW: 30 kHz	Distance: NA m	
Test Equipment Used			
Antenna: _____	Directional Coupler: _____		
Pre-Amp: _____	Cable #1: 1629		
Filter: _____	Cable #2: _____		
Receiver: 1036	Cable #3: _____		
Attenuator #1: 1065	Cable #4: _____		
Attenuator #2: 1604	Mixer: _____		
Additional equipment used: _____			
Measurement Uncertainty: +/-1.7 dB			
Ref Lvl 40 dBm Marker 1 [T1] -2.92 dBm 1.96071643 GHz RBW 30 kHz VBW 30 kHz SWT 14 ms RF Att 20 dB Mixer -10 dBm Unit dBm 31.1 dB Offset 1VIEW 1MA ▼1 [T1] -2.92 dBm ▲1 [T1] 2.73 dB -1.40398798 MHz 1.96071643 GHz Center 1.96 GHz 500 kHz Span 5 MHz			
Date: 30.AUG.2004 08:39:15			
Notes: CDMA OUTPUT MAX POWER 30.7 dBm			

Test Data – Occupied Bandwidth



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EQUIPMENT: TFAH 80/85/19

Test Data – Occupied Bandwidth



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Data Plot

Page 1 of 2

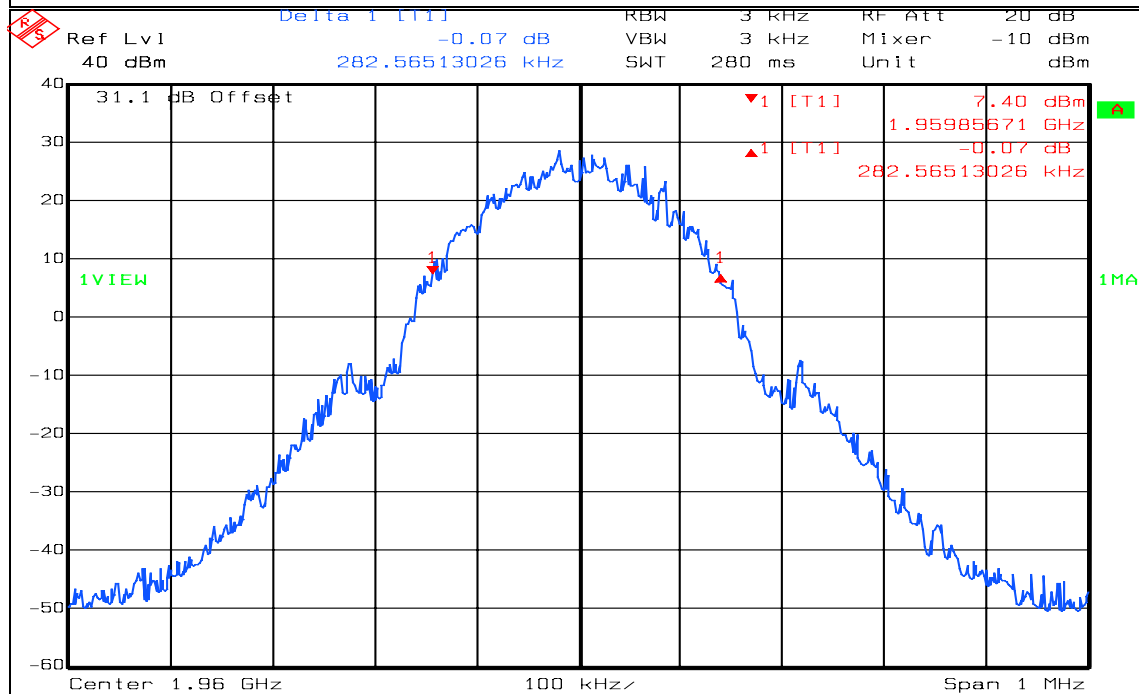
Job No.:	4L0571	Date:	8/30/2004
Specification:	PT24	Temperature(°C):	25
Tested By:	David Light	Relative Humidity(%)	40
E.U.T.:	PCS AMPLIFIER		
Configuration:	TX		
Sample Number:	1		
Location:	Lab 1	RBW:	
Detector Type:	Peak	VBW:	

Complete X
Preliminary: _____

Occupied Bandwidth

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	1629
Filter:		Cable #2:	
Receiver:	1036	Cable #3:	
Attenuator #1	1065	Cable #4:	
Attenuator #2:	1604	Mixer:	
Additional equipment used:			
Measurement Uncertainty:	+/-1.7 dB		



Date: 30.AUG.2004 07:13:04

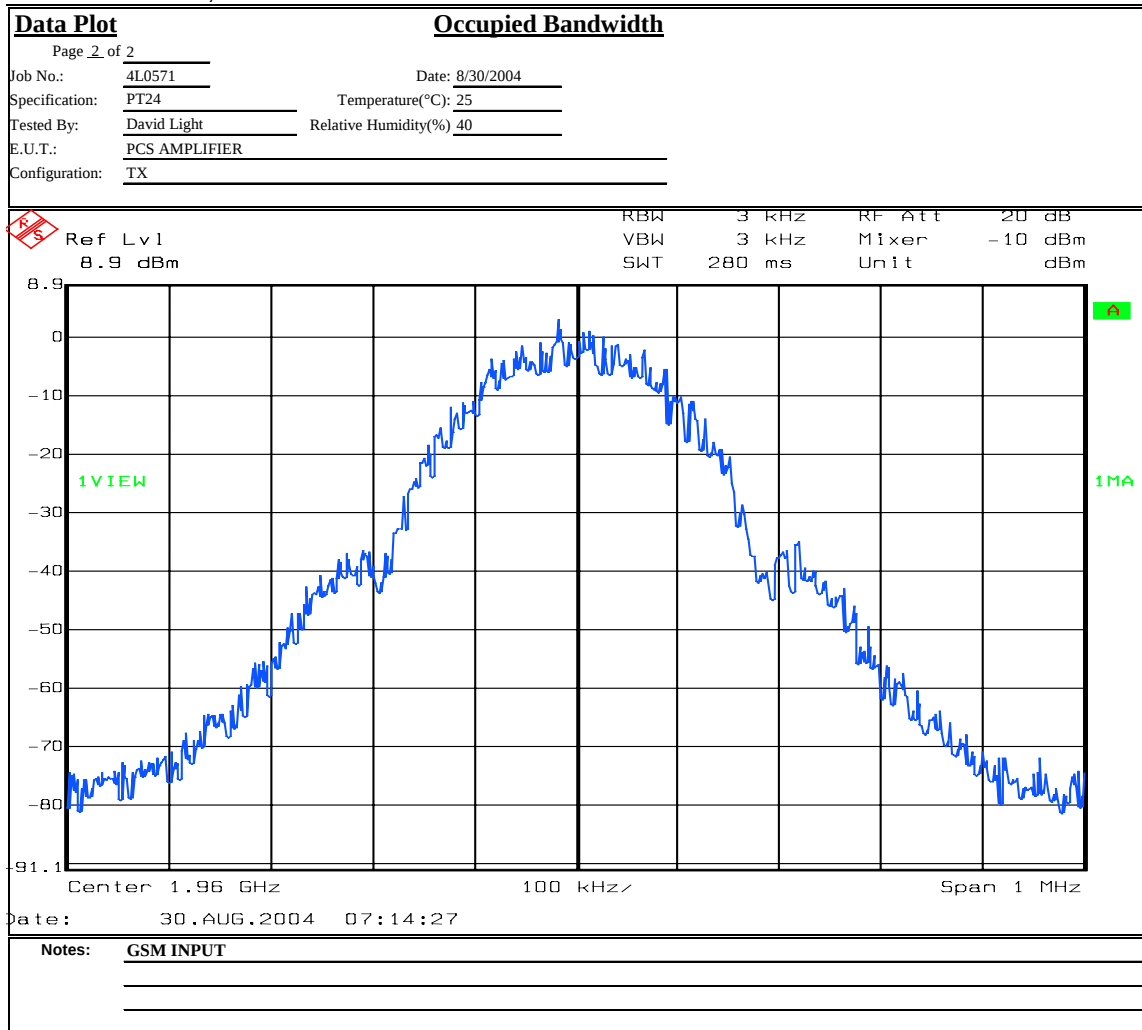
Notes: GSM OUTPUT
MAX POWER 37 dBm

Test Data – Occupied Bandwidth



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Test Data – Occupied Bandwidth



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Data Plot		Occupied Bandwidth	
Page 1 of 2		Complete <u>X</u>	
Job No.: 4L0571	Date: 8/30/2004	Preliminary: _____	
Specification: PT24	Temperature(°C): 25		
Tested By: David Light	Relative Humidity(%): 40		
E.U.T.: PCS AMPLIFIER			
Configuration: TX			
Sample Number: 1			
Location: Lab 1	RBW: 3 kHz	Measurement	
Detector Type: Peak	VBW: 3 kHz	Distance: NA m	
Test Equipment Used			
Antenna: _____	Directional Coupler: _____		
Pre-Amp: _____	Cable #1: 1629		
Filter: _____	Cable #2: _____		
Receiver: 1036	Cable #3: _____		
Attenuator #1: 1065	Cable #4: _____		
Attenuator #2: 1604	Mixer: _____		
Additional equipment used: _____			
Measurement Uncertainty: +/-1.7 dB			
Ref Lvl 40 dBm Marker 1 [T1] -3.71 dBm 1.96014128 GHz RBW 3 kHz VBW 3 kHz SWT 280 ms RF Att 20 dB Mixer -10 dBm Unit dBm Center 1.96 GHz 100 kHz Span 1 MHz			
Date: 30.AUG.2004 07:35:32			
Notes: EDGE OUTPUT MAX POWER 33.5 dBm			

Test Data – Occupied Bandwidth



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Data Plot		Occupied Bandwidth	
Page 1 of 2		Complete ☒ Preliminary ☐	
Job No.: 4L0571	Date: 8/30/2004		
Specification: PT24	Temperature(°C): 25		
Tested By: David Light	Relative Humidity(%): 40		
E.U.T.: PCS AMPLIFIER			
Configuration: TX			
Sample Number: 1			
Location: Lab 1	RBW: 3 kHz	Measurement	
Detector Type: Peak	VBW: 3 kHz	Distance: NA m	
Test Equipment Used			
Antenna:	Directional Coupler:		
Pre-Amp:	Cable #1: 1629		
Filter:	Cable #2:		
Receiver: 1036	Cable #3:		
Attenuator #1: 1065	Cable #4:		
Attenuator #2: 1604	Mixer:		
Additional equipment used:			
Measurement Uncertainty: +/-1.7 dB			
Ref Lvl 40 dBm Marker 1 [T1] -3.71 dBm 1.96014128 GHz RBW 3 kHz VBW 3 kHz SWT 280 ms RF Att 20 dB Mixer -10 dBm Unit dBm Center 1.96 GHz 100 kHz Span 1 MHz			

Date: 30.AUG.2004 07:35:32

Notes: EDGE OUTPUT
MAX POWER 33.5 dBm

Test Data – Occupied Bandwidth



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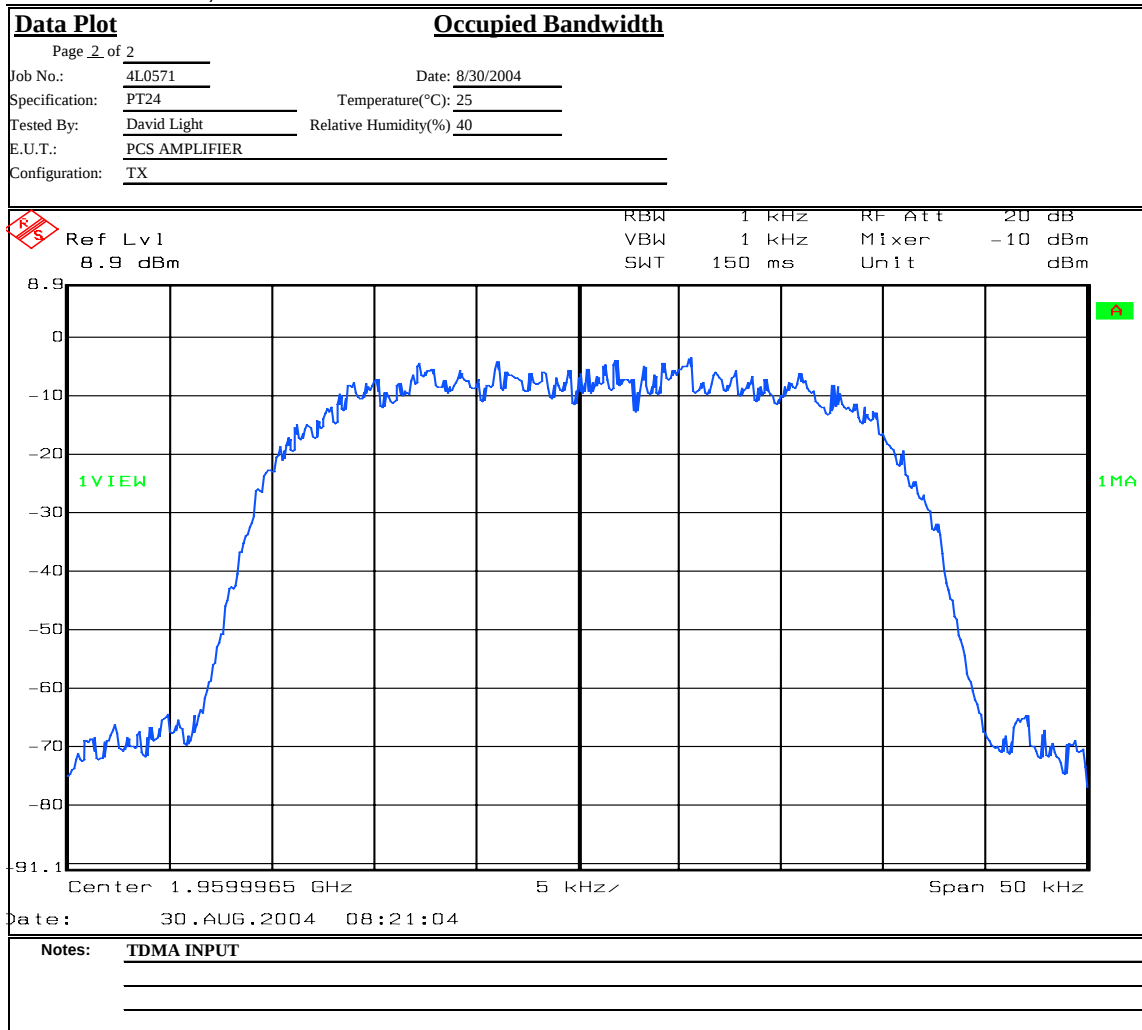
Data Plot		Occupied Bandwidth	
Page 1 of 2		Complete <u>X</u>	
Job No.: 4L0571	Date: 8/30/2004	Preliminary: _____	
Specification: PT24	Temperature(°C): 25		
Tested By: David Light	Relative Humidity(%): 40		
E.U.T.: PCS AMPLIFIER			
Configuration: TX			
Sample Number: 1			
Location: Lab 1	RBW: 1 kHz	Measurement	
Detector Type: Peak	VBW: 1 kHz	Distance: NA m	
Test Equipment Used			
Antenna: _____	Directional Coupler: _____		
Pre-Amp: _____	Cable #1: 1629		
Filter: _____	Cable #2: _____		
Receiver: 1036	Cable #3: _____		
Attenuator #1: 1065	Cable #4: _____		
Attenuator #2: 1604	Mixer: _____		
Additional equipment used: _____			
Measurement Uncertainty: +/-1.7 dB			
Ref Lvl 40 dBm Marker 1 [T1] 0.72 dBm 1.96001348 GHz RBW 1 kHz VBW 1 kHz SWT 150 ms RF Att 20 dB Mixer -10 dBm Unit dBm Center 1.9599965 GHz 5 kHz Span 50 kHz			
Date: 30.AUG.2004 08:19:34			
Notes: TDMA OUTPUT MAX POWER 34.5 dBm			

Test Data – Occupied Bandwidth



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Section 5. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.1051
TESTED BY: David Light	DATE: 8/30/04

Test Results: Complies.

Test Data: See attached plot(s).

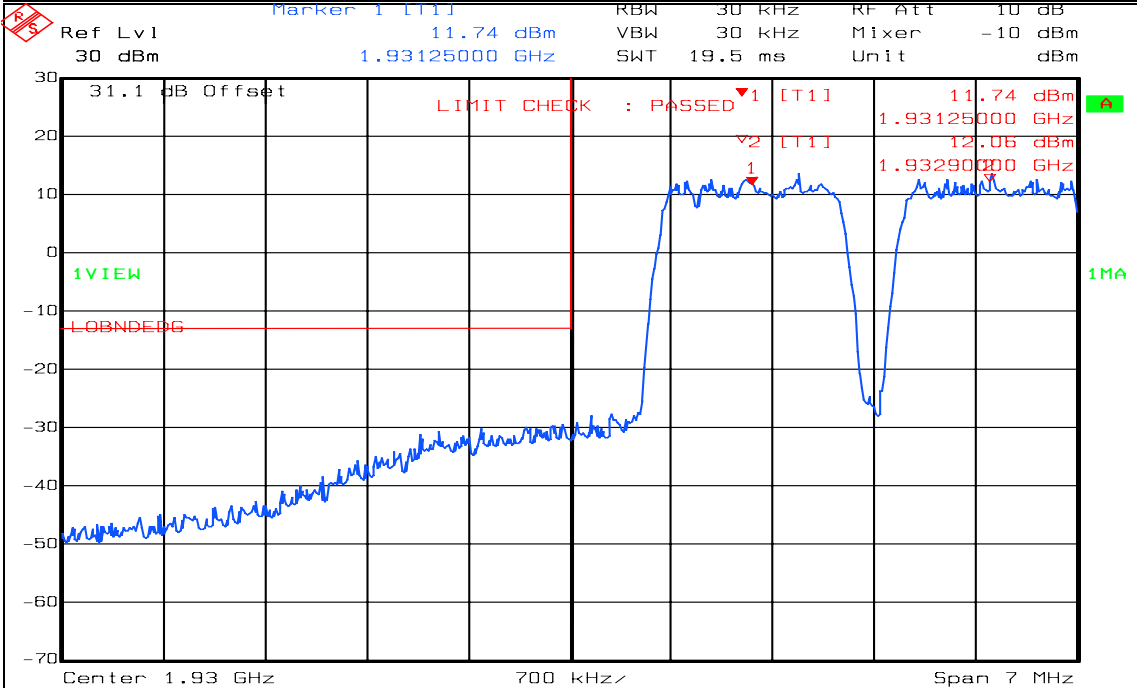
Test Data – Spurious Emissions at Antenna Terminals



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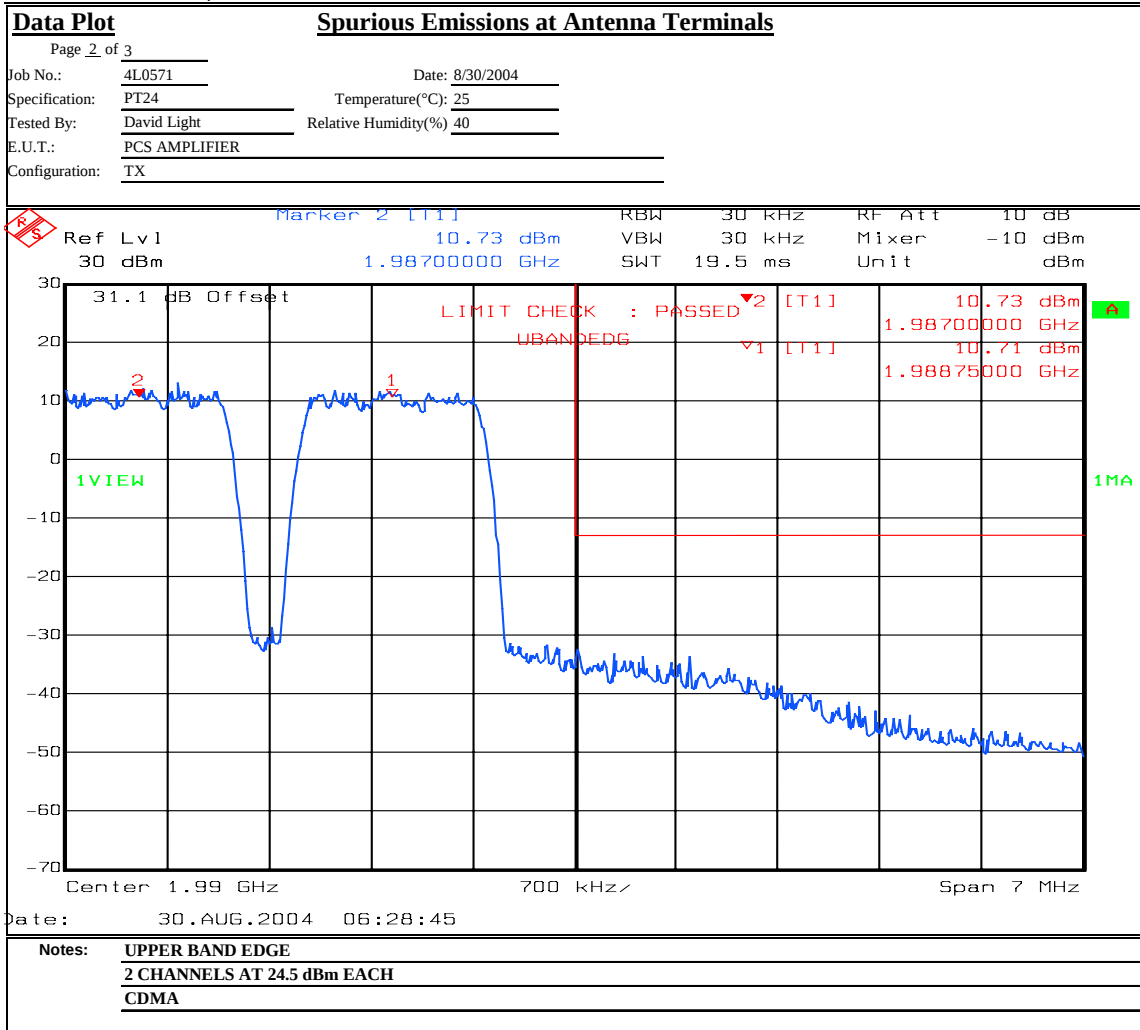
Data Plot		Spurious Emissions at Antenna Terminals	
Page 1 of 3		Complete <u>X</u>	
Job No.: 4L0571	Date: 8/30/2004	Preliminary: _____	
Specification: PT24	Temperature(°C): 25		
Tested By: David Light	Relative Humidity(%): 40		
E.U.T.: PCS AMPLIFIER			
Configuration: TX			
Sample Number: 1			
Location: 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: 1629		
Filter: _____	Cable #2: _____		
Receiver: 1036	Cable #3: _____		
Attenuator #1: 1065	Cable #4: _____		
Attenuator #2: 1604	Mixer: _____		
Additional equipment used: _____			
Measurement Uncertainty: +/-1.7 dB			
			
Date: 30.AUG.2004 06:26:36			
Notes: LOWER BAND EDGE			
2 CHANNELS AT 24.5 dBm EACH			
CDMA			

Test Data – Spurious Emissions at Antenna Terminals



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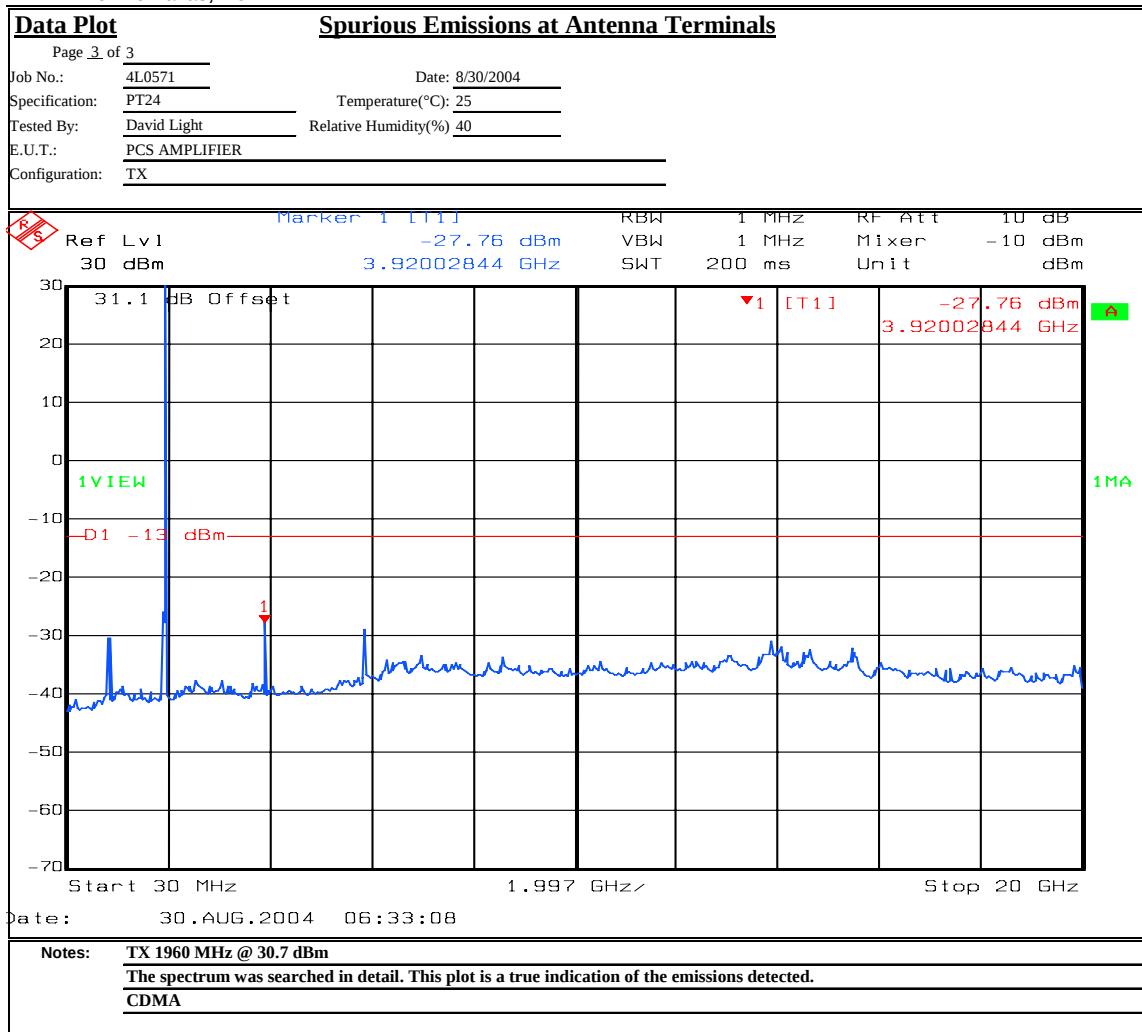


Test Data – Spurious Emissions at Antenna Terminals



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EQUIPMENT: TFAH 80/85/19

Test Data – Spurious Emissions at Antenna Terminals



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Data Plot

Page 1 of 3

Spurious Emissions at Antenna Terminals

Complete X

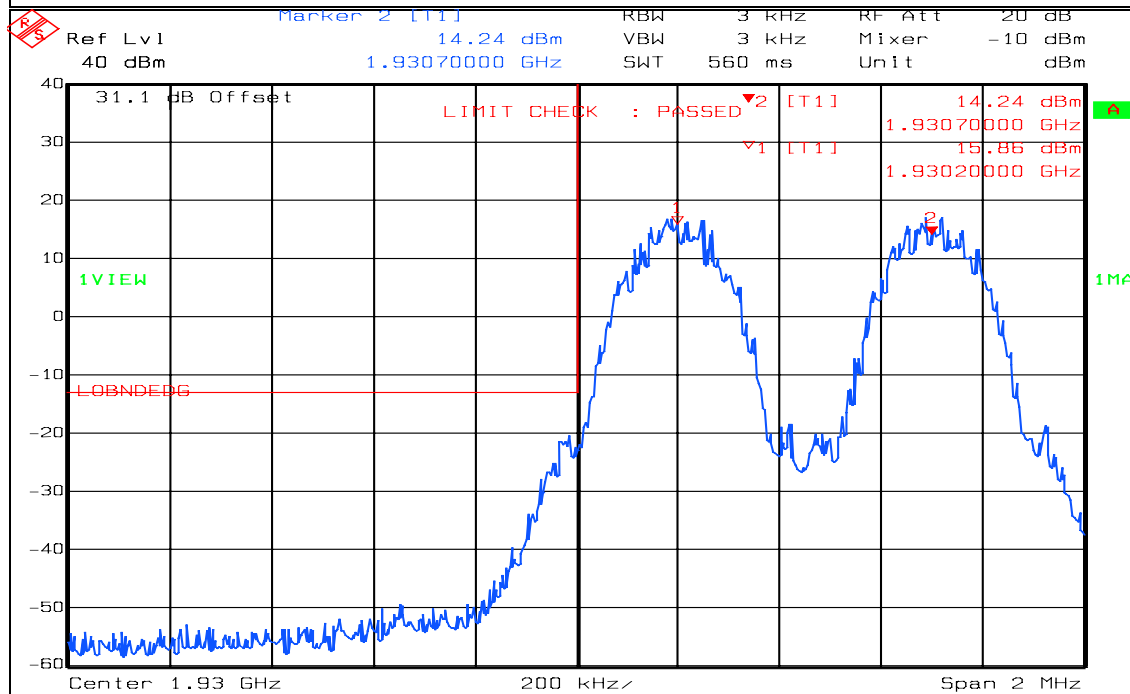
Job No.:	4L0571	Date:	8/30/2004
Specification:	PT24	Temperature(°C):	25
Tested By:	David Light	Relative Humidity(%)	40
E.U.T.:	PCS AMPLIFIER		
Configuration:	TX		
Sample Number:	1		
Location:	Lab 1		RBW:
Detector Type:	Peak		VBW:

Preliminary: _____

Measurement
Distance: NA m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	1629
Filter:		Cable #2:	
Receiver:	1036	Cable #3:	
Attenuator #1	1065	Cable #4:	
Attenuator #2:	1604	Mixer:	
Additional equipment used:			
Measurement Uncertainty:	+/-1.7 dB		



Date: 30.AUG.2004 07:19:43

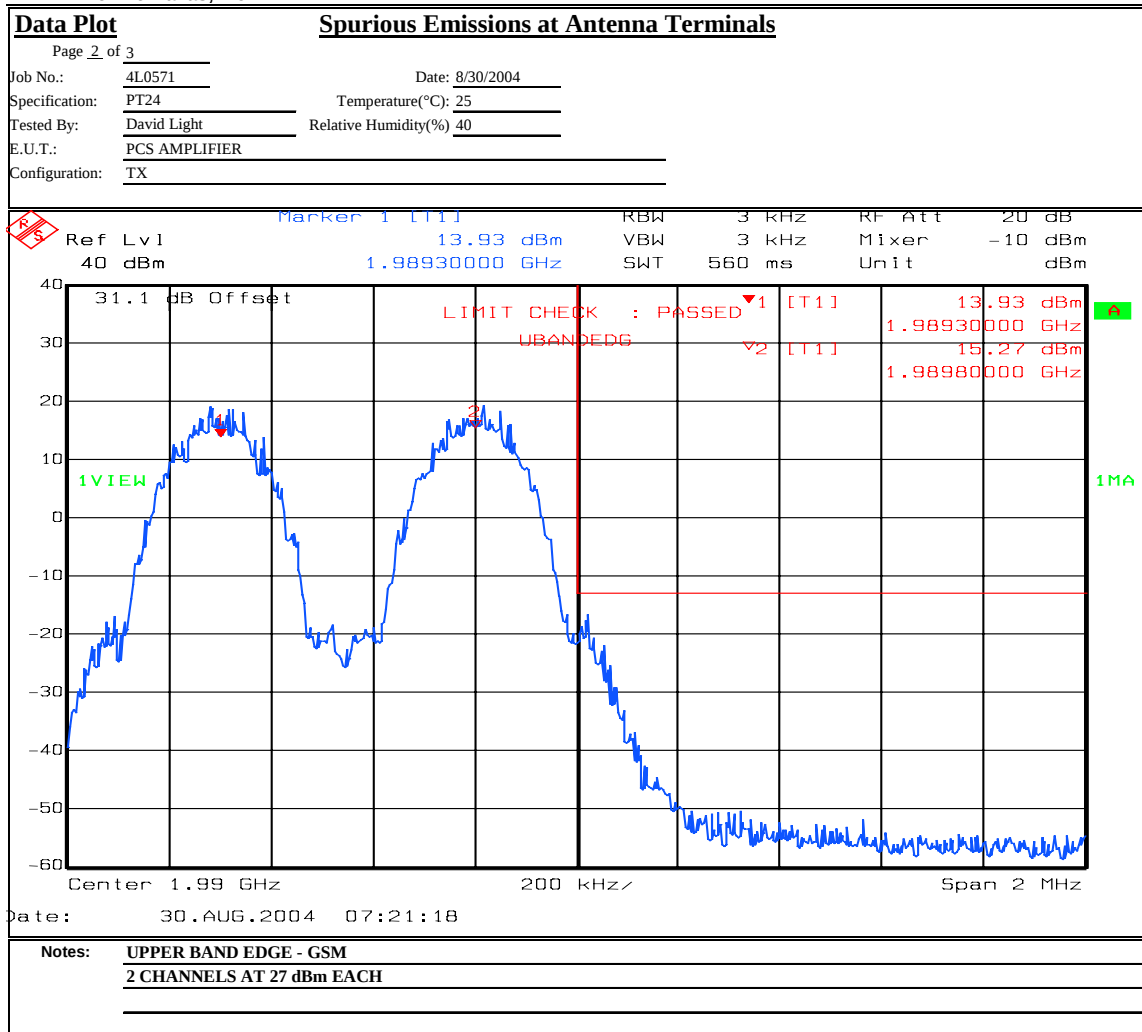
Notes: LOWER BAND EDGE GSM
2 CHANNELS AT 27 dBm EACH

Test Data – Spurious Emissions at Antenna Terminals



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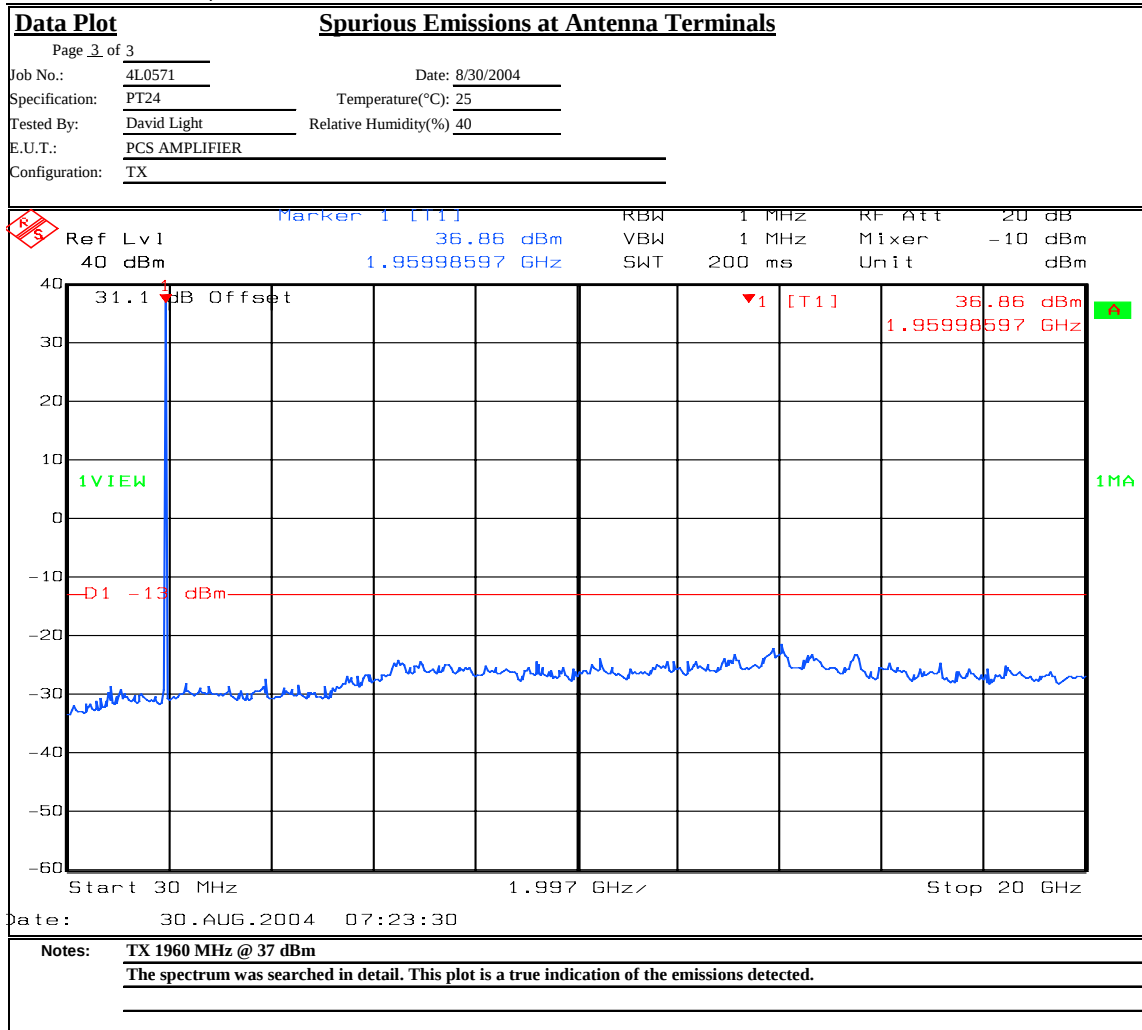
Test Data – Spurious Emissions at Antenna Terminals



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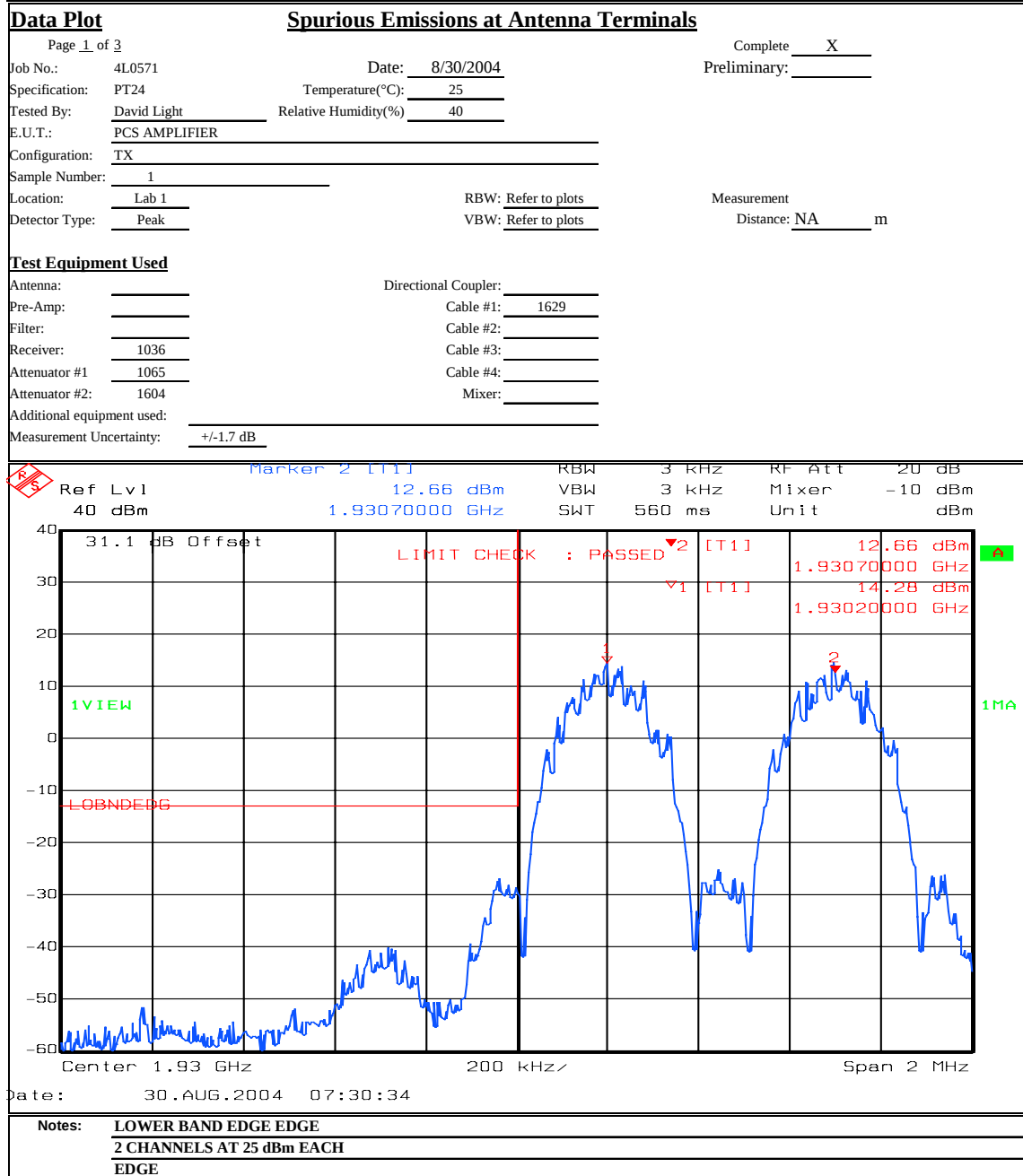


Test Data – Spurious Emissions at Antenna Terminals



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Dallas Headquarters:

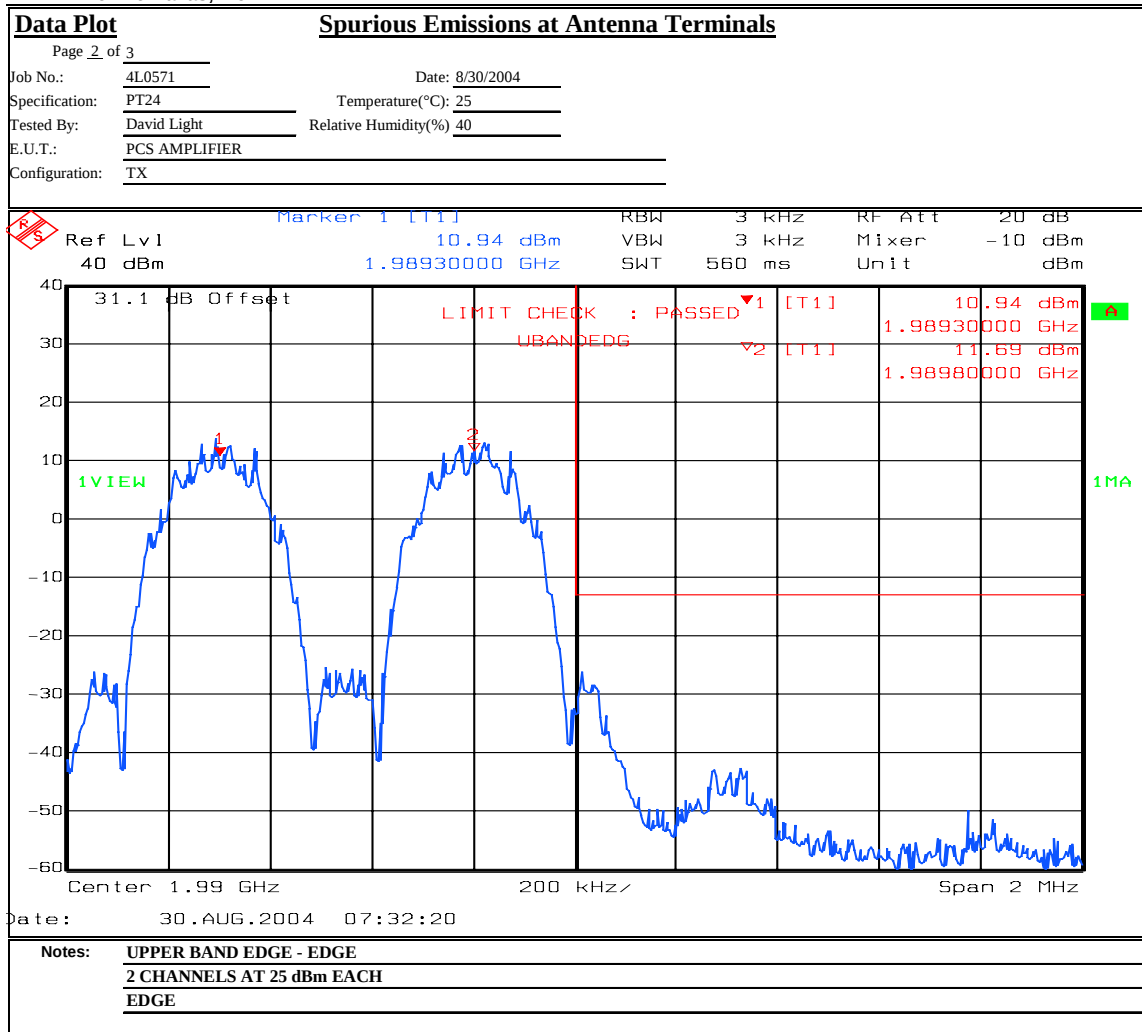
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Test Data – Spurious Emissions at Antenna Terminals



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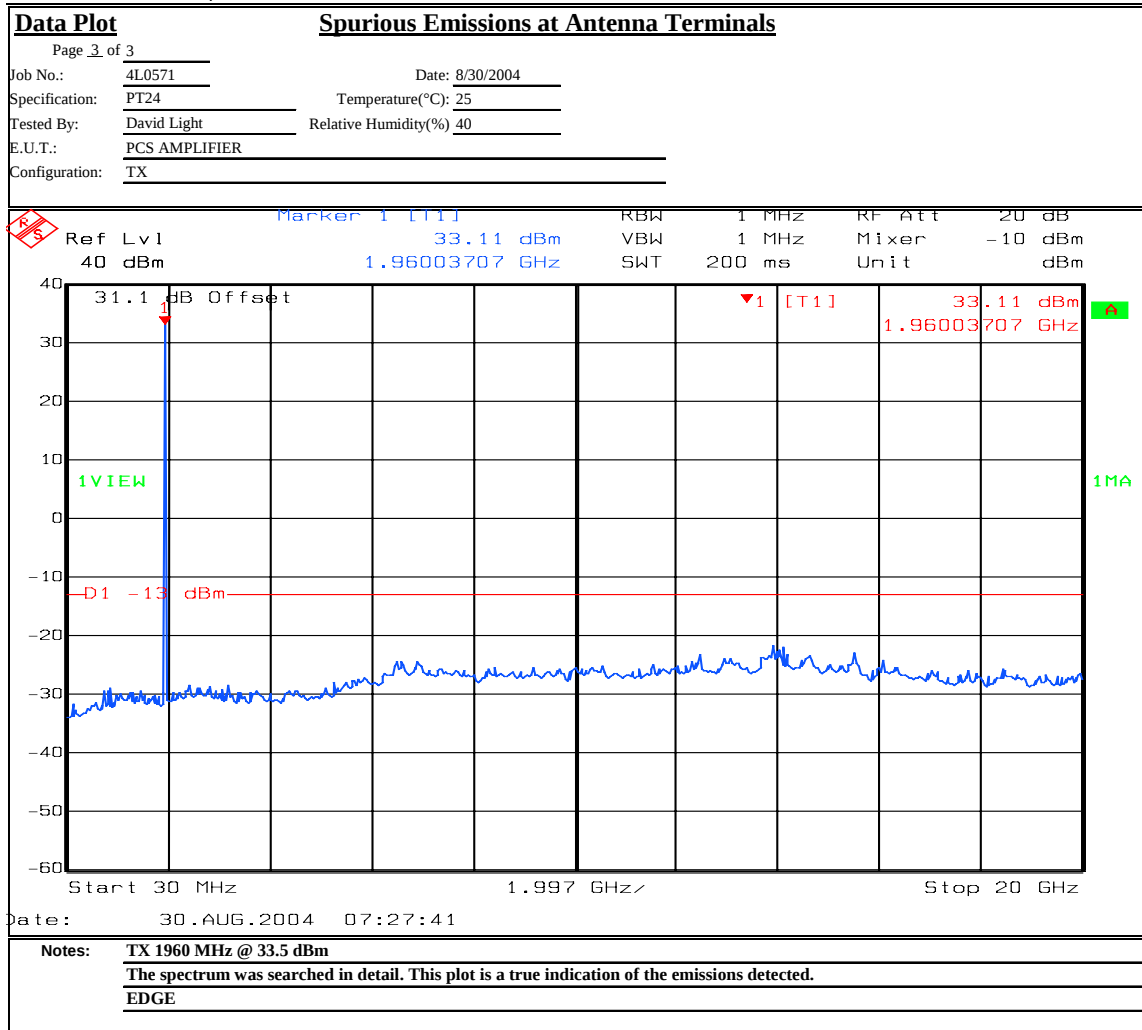
Test Data – Spurious Emissions at Antenna Terminals



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EQUIPMENT: TFAH 80/85/19

Test Data – Spurious Emissions at Antenna Terminals



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Data Plot

Page 1 of 3

Job No.:	4L0571	Date:	8/30/2004
Specification:	PT24	Temperature(°C):	25
Tested By:	David Light	Relative Humidity(%)	40
E.U.T.:	PCS AMPLIFIER		
Configuration:	TX		

Configuration:	TX
----------------	----

Sample Number: 1

Location: Lab 1

Detector Type:	Peak
----------------	------

RBW: Refer to plots

VBW: Refer to plots

Complete X

Preliminary: _____

Measurement

Distance: NA m

Test Equipment Used

Antenna: _____

Pre-Amp: _____

Filter: _____

Receiver: 1036

Attenuator #1	1065
---------------	------

Attenuator #2:	1604
----------------	------

Additional equipment used:

Measurement Uncertainty: ± 1.7 dB

Directional Coupler:

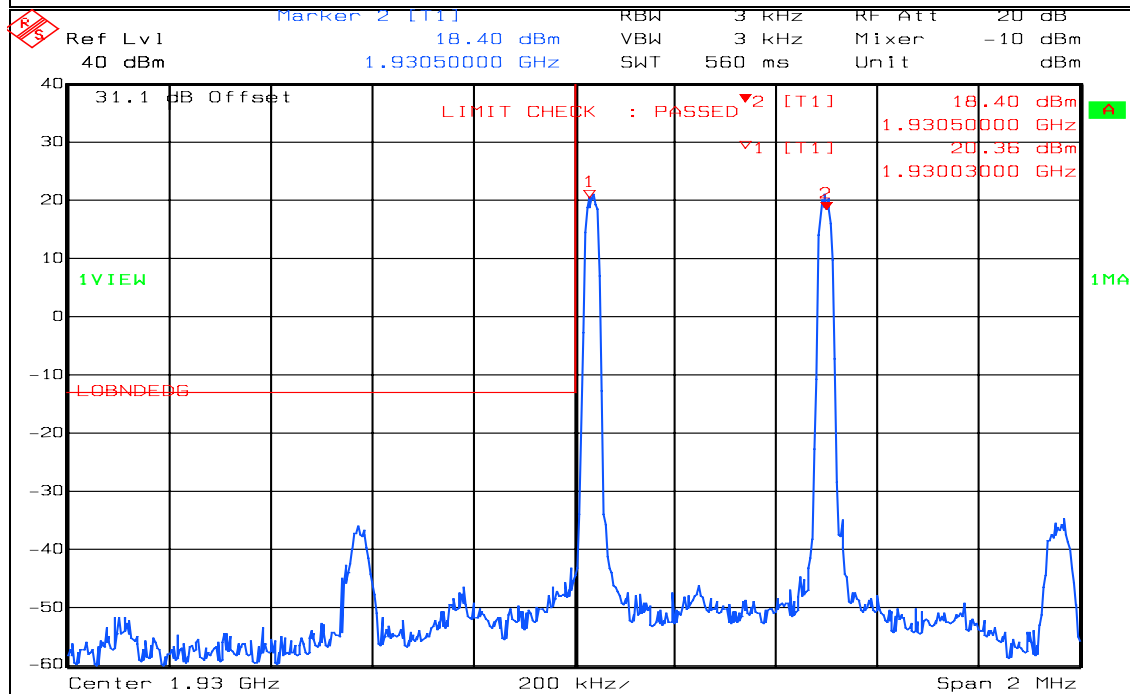
Cable #1: 1629

Cable #2:

Cable #3:

Cable #4:

Mixer: _____



Date: 30.AUG.2004 08:30:35

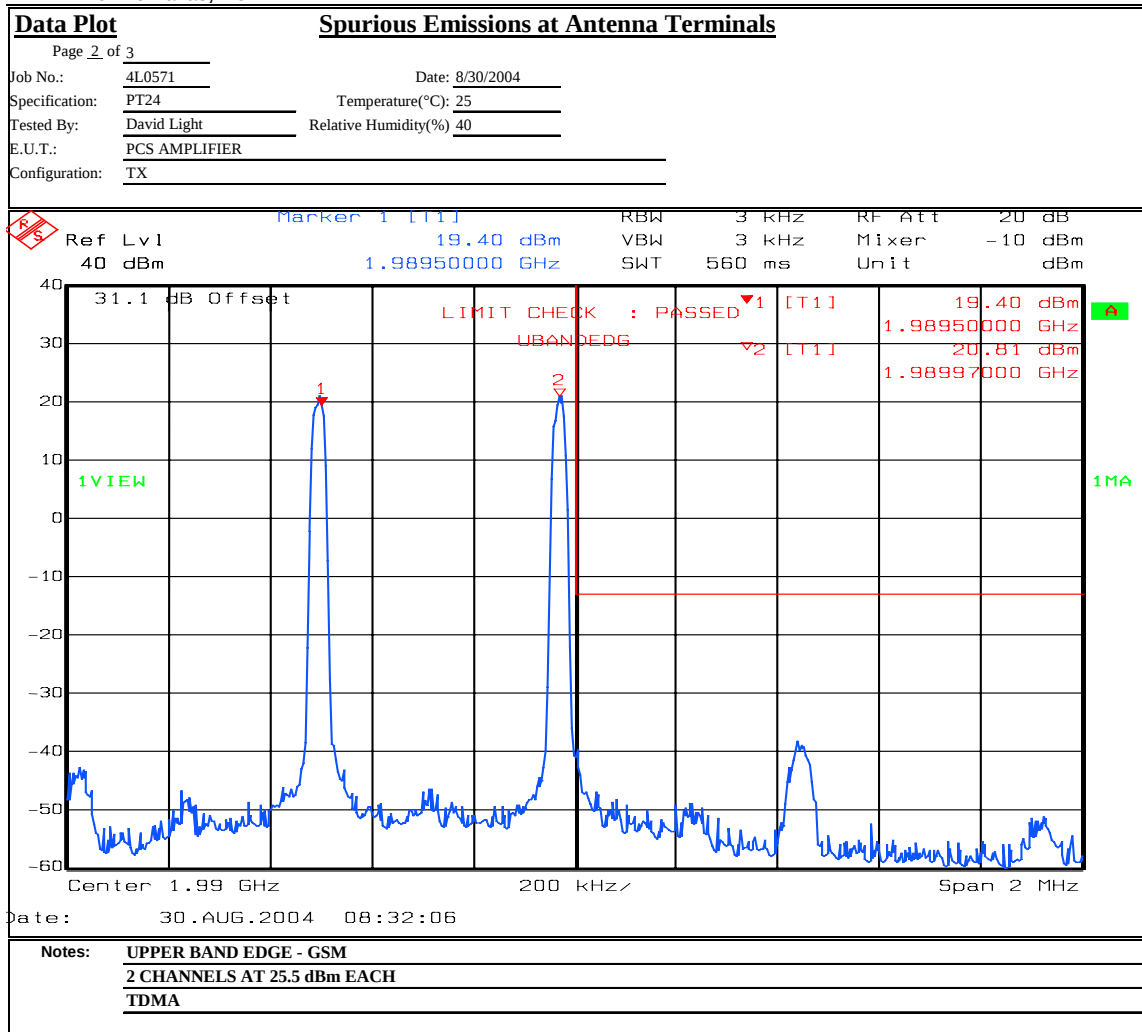
Notes: LOWER BAND EDGE GSM
2 CHANNELS AT 25.5 dBm EACH
TDMA

Test Data – Spurious Emissions at Antenna Terminals



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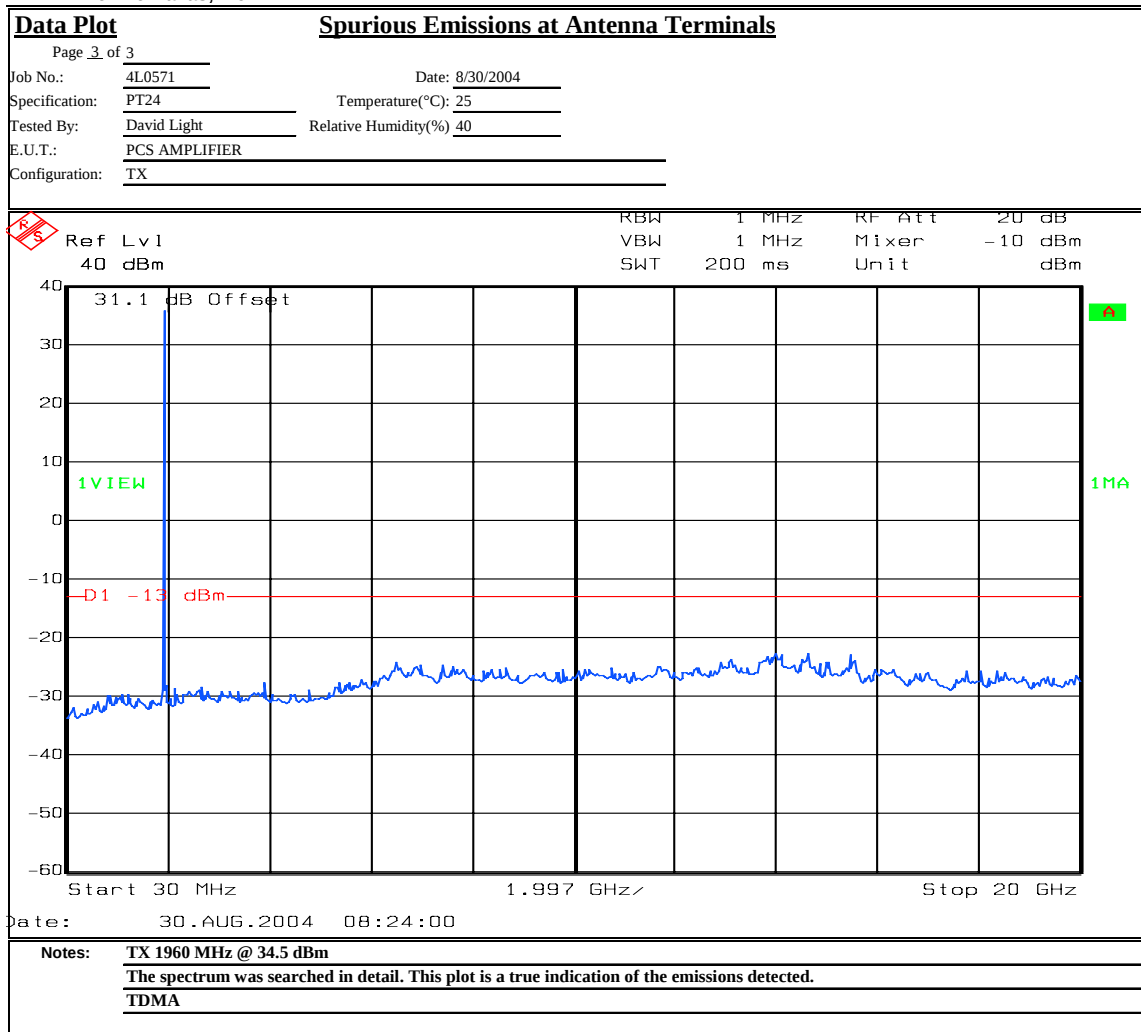


Test Data – Spurious Emissions at Antenna Terminals



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Section 6. Field Strength of Spurious

NAME OF TEST: Field Strength of Spurious Emissions	PARA. NO.: 2.1051
TESTED BY: Brian Boyea	DATE: 8/31/04

Test Results: Complies.

Test Data: See attached table.

Test Data - Radiated Emissions



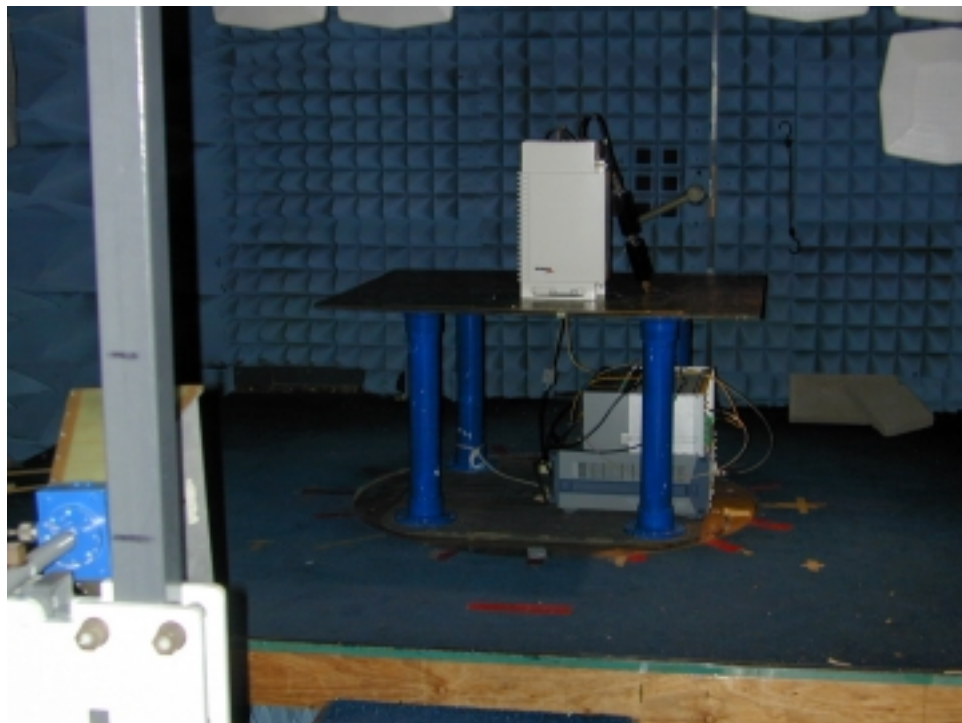
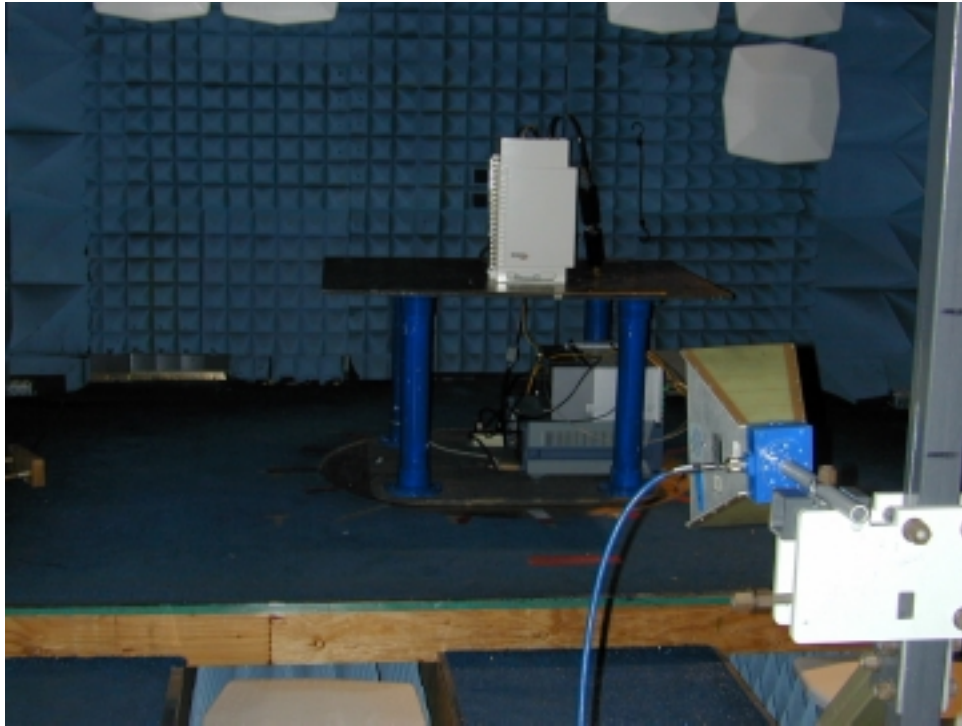
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EIRP Substitution Method										
Page <u>1</u> of						Complete <u>X</u>				
Job No.: 4L0571R		Date: 8/31/04				Preliminary _____				
Specification:		Temperature(°C): 23								
Tested By: Brian Boyea		Relative Humidity(%) 33								
E.U.T.:										
Configuration:										
Sample No:										
Location: AC 3		RBW: 1 MHz		Measurement						
Detector Type: Peak		VBW: 1 MHz		Distance: 3 m						
Test Equipment Used										
Antenna: 1304		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 Uncertainty: +/-3.6 dB										
Frequency (MHz)	Meter Reading (dBm)	Correction Factor (dB)		Pre-Amp Gain (dB)	Substitution Antenna Gain (dBi)	Spec Limit 13 dBm	EIRP (dBm)	EIRP (mW)	Polarity	Comments
3920	-45.7	43.3		33	10.7	13	-24.7	0.003415	V	
5880	-37.3	39.8		32.1	11.4	13	-18.2	0.015252	V	
7840	-50.3	41.8		32.9	11.3	13	-30.1	0.000985	V	
3920	-46.8	35.5		33	10.7	13	-33.6	0.000437	H	
5880	-38.2	37.8		32.1	11.4	13	-21.1	0.007822	H	
7840	-47.2	41.5		32.9	11.3	13	-27.3	0.001862	H	
										1960 MHz Channel
Notes: Searched spectrum to the 10th harmonic. All emissions within 20 dB of the spec limit of -13 dBm were reported.										

Photographs of Test Setup



EQUIPMENT: TFAH 80/85/19

Section 7. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	10/27/03	10/26/04
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	07/30/04	07/31/06
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	08/26/04	08/26/05
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	08/02/04	08/02/05
1304	HORN ANTENNA	ELECTRO METRICS RGA-60	6151	09/22/03	09/22/05
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	03/22/04	03/23/06
1065	ATTENUATOR	NARDA 776B-10	NONE	CBU	N/A
1604	ATTENUATOR	NARDA 776B-20	NONE	N/A	N/A
1629	CABLE, 6 ft	MEGAPHASE 10311 1GVT4	N/A	CBU	N/A

Nemko Dallas

EQUIPMENT: TFAH 80/85/19

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ANNEX A - TEST DETAILS

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

Minimum Standard: Para. No.24.232. Base stations are limited to 1640 watts peak E.I.R.P. with an antenna height up to 300 meters HAAT. In no case may the peak output power of a base station transmitter exceed 100 watts.

Method Of Measurement:Detachable Antenna:

The peak power at antenna terminals is measured using an in-line peak power meter. Power output is measured with the maximum rated input level.

Integral Antenna:

If the antenna is not detachable from the circuit then the Peak Power Output is derived from the peak radiated field strength of the fundamental emission by using the plane wave relation $GP/4\pi R^2 = E^2/120\pi$ and proceeding as follows:

$$P = \frac{E^2 R^2}{30G} = \frac{E^2 3^2}{30G}$$

where,

P = the equivalent isotropic radiated power in watts

E = the maximum measured field strength in V/m

R = the measurement range (3 meters)

G = the numeric gain of the transmit antenna in relation to an isotropic radiator

NAME OF TEST: Occupied Bandwidth**PARA. NO.: 2.1047**

Minimum Standard: Para. No. 24.238(b). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB.

Method Of Measurement:CDMA

Spectrum analyzer settings:

RBW: 30 kHz

VBW: $\geq$ RBW

Span: 5 MHz

Sweep: Auto

Mask: Set markers to -26 dB from peak of CW.

GSM

RBW: 3 kHz

VBW: $\geq$ RBW

Span: 2 MHz

Sweep: Auto

Mask: Set markers to -26 dB from peak of CW.

NADC

RBW: 1 kHz

VBW: $\geq$ RBW

Span: 1 MHz

Sweep: Auto

Mask: Set markers to -26 dB from peak of CW.

NAME OF TEST: Spurious Emission at Antenna Terminals	PARA. NO.: 2.1051
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Minimum Standard: Para. No.24.238(a). On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power by at least $43 + 10 \log (P)$ dB.

Method Of Measurement:

Spectrum analyzer settings:

CDMA

RBW: 1 MHz (> 1 MHz from Band Edge)
RBW: 30 kHz (< 1 MHz from Band Edge)
VBW: $\geq$ RBW
Sweep: Auto
Video Avg: 6 Sweeps

GSM

RBW: 1 MHz (> 1 MHz from Band Edge)
RBW: 3 kHz (< 1 MHz from Band Edge)
VBW: $\geq$ RBW
Sweep: Auto
Video Avg: Disabled

NADC

RBW: 1 MHz (> 1 MHz from Band Edge)
RBW: 3 kHz (< 1 MHz from Band Edge)
VBW: $\geq$ RBW
Sweep: Auto
Video Avg: Disabled

To demonstrate compliance at band edges the frequency of the input signal is set to the lowest and highest assigned channel and the center frequency of the spectrum analyzer is set to the upper and lower edges of the appropriate frequency block.

NAME OF TEST: Field Strength of Spurious Radiation

PARA. NO.: 2.1053

Minimum Standard: Para. No.24.238(a). On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power by at least $43 + 10 \log (P)$ dB.

Test Method:

The maximum field strength of the spurious emission is measured at a distance of 3 meters. The device under test is then replaced with a substitution antenna of known gain with respect to a $\frac{1}{4}$ wave dipole antenna. A calibrated signal source is used to feed the substitution antenna. The rf level to the substitution antenna is adjusted to repeat the previously measured field strength. The rf input level to the substitution antenna is the effective radiated power of the spurious emission after any correction for substitution antenna gain against a $\frac{1}{4}$ wave dipole.

The spectrum was searched up to 20 GHz.

NAME OF TEST: Frequency Stability**PARA. NO.: 2.1055**

Minimum Standard: Para. No. 24.235. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

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.

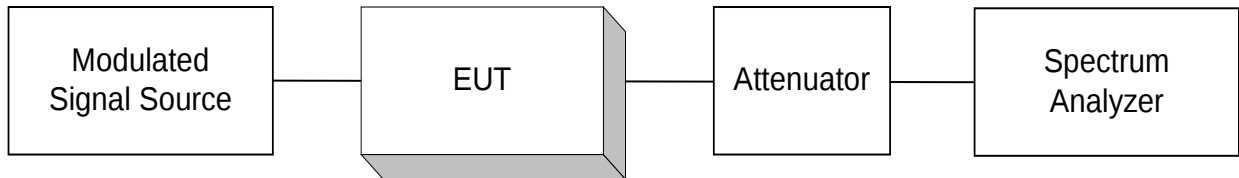
Nemko Dallas

EQUIPMENT: TFAH 80/85/19

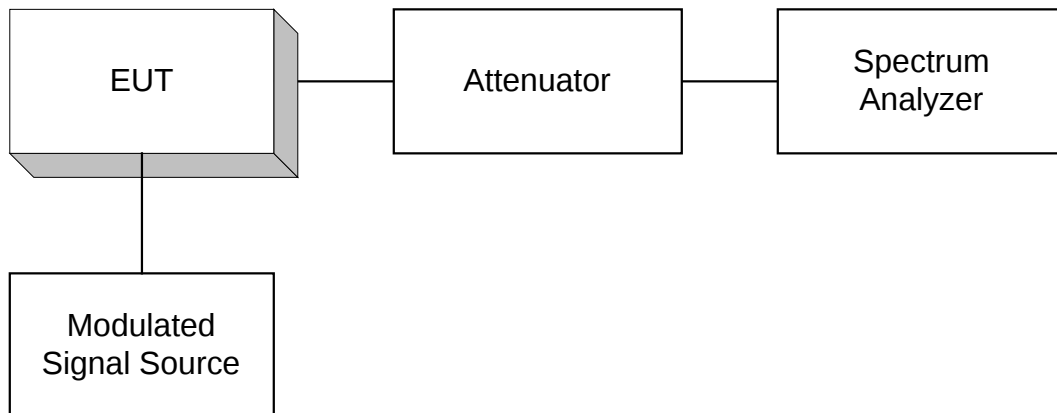
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ANNEX B - TEST DIAGRAMS

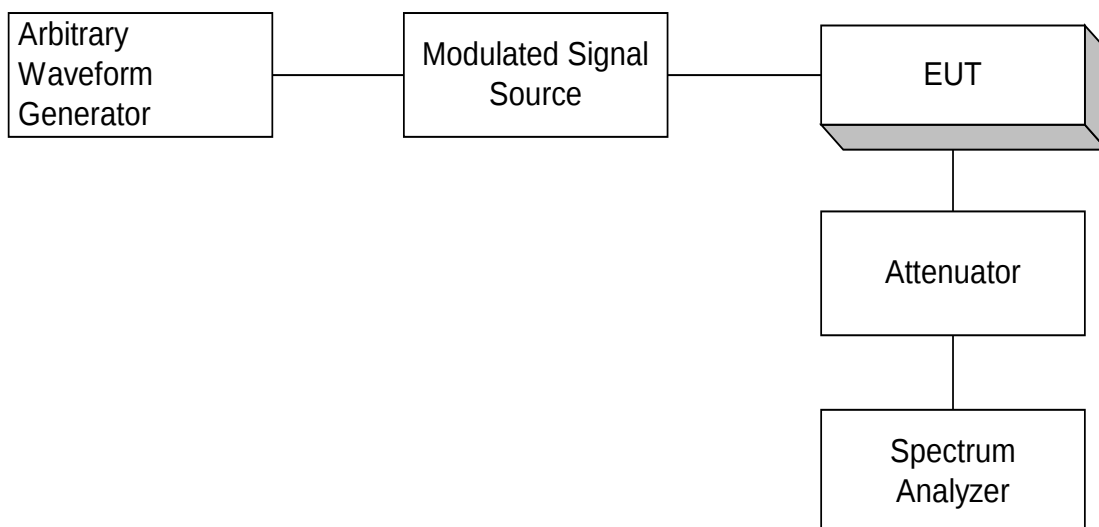
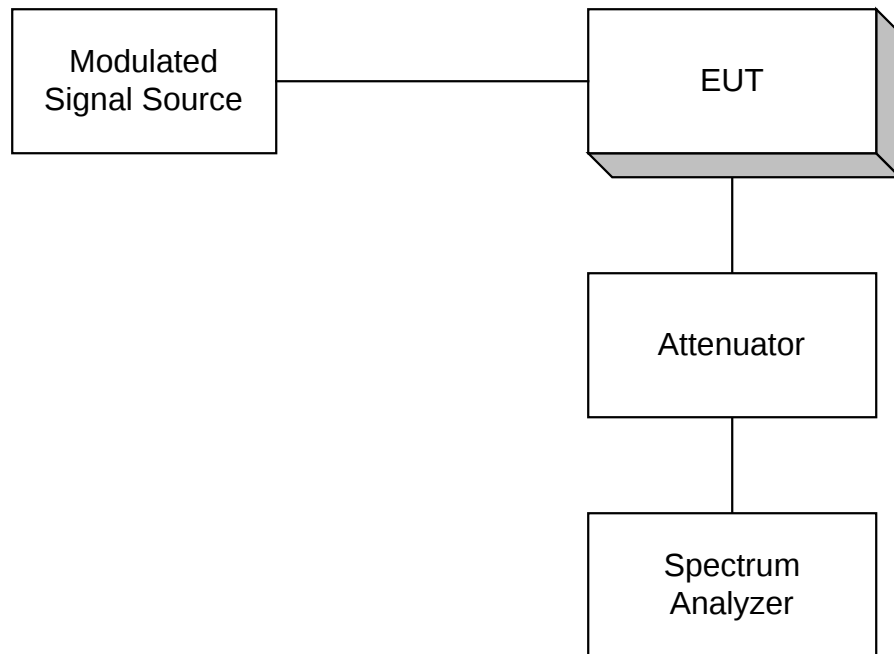
Para. No. 2.985 - R.F. Power Output



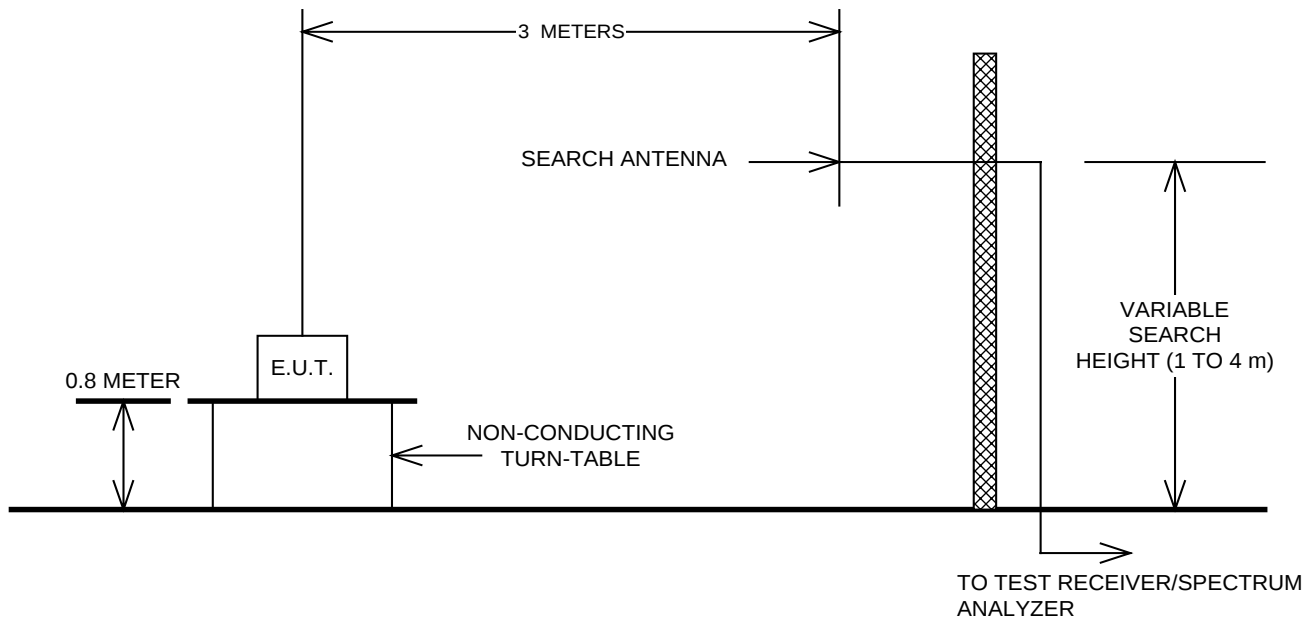
Para. No. 2.989 - Occupied Bandwidth



Para. No. 2.991 Spurious Emissions at Antenna Terminals



Para. No. 2.993 - Field Strength of Spurious Radiation



Para. No. 2.995 - Frequency Stability

