TEST REPORT

In support of the Application for Grant of Equipment Authorization of the WTFA
For use in the Nokia MetroSite Edge 800 Base Station to FCC part 22

FCC ID: L7KWTFA-01

Report No RO610411A1 January 2003

TÜV PRODUCT SERVICE

BABT

TUV Product Service Ltd, Segensworth Road, Titchfield
Fareham, Hampshire, United Kingdom, PO15 5RH
Tel: +44(0)1329 443459, Fax: +44(0)1329 443331
www.tuvps.co.uk

Equipment:	Metrosite Edge Base Station using the WTFA
FCC ID:	L7KWTFA-01
Specification:	47 CFR 2 & 47 CFR 22
Applicant and Manufacturer:	Nokia UK Limited Stanhope Road Camberley Surrey GU13 3BW
Manufacturer's Representative:	Mr Andrew Parry
APPROVED BY	**M JENKINS** Wireless Group Leader
DATED	**11th December 2002**
Start of Test:	22nd October 2002
Completion of Test:	7th November 2002

This report is intended to replace original report RO610411A that contained typographical errors and required further clarifications.

DISTRIBUTION	Nokia UK Limited	Copy 1
	TÜV Product Service	Copy 2
		Copy No

ENGINEERING STATEMENT

I ATTEST: the measurements shown in this report were made in accordance with the procedures indicated, and that the emissions from this equipment were found to be within the applicable limits. I assume full responsibility for the accuracy and completeness of these measurements. On the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 2, Part 15 and Part 22 of the FCC Rules under normal use and maintenance.

S C Hartley Test Engineer	Ryan Henley Test Engineer	A R Hubbard Test Engineer

CONTENTS: -

For copyright details see Page 99 of 99

Introduction

The information contained within this report is intended to show verification of compliance of the Nokia Base Transmitter Station, Metrosite GSM 800 base station with WTFA, to the requirements of 47 CFR 2 and 47 CFR 22.

Test Location

All testing was conducted at the premises of BABT, Segensworth Road, Fareham, Hants, PO15 5RH. Testing at BABT was carried out by BABT Personnel, S C Hartley, Ryan Henley, A R Hubbard, Test Engineers. Radiated Emissions measurements were performed in a 3 metre semi-anechoic screened room. A complete room description is on file with the FCC Laboratory Division, Registration Number: 90987.

Test Equipment and Ancillaries Used For Test

No	Instrument/Ancillary	Type	Manufacturer	Serial No.	Cal Due
1	Spectrum Analyser	FSEM	Rohde and Schwarz	827156/006	28/12/02
2	20 dB Attenuator	46-20-34	Weinschel	AT9195	17/09/03
3	10 dB Attenuator	47-10-34	Weinschel	BC2506	13/09/03
4	Notch Filter	STNF-500/1000-N/N	K&L	15	TU
5	800 MHz low pass filter	9752	Minicircuits	9752	25/07/03
6	1.5GHz high pass filter	MH-1500-755	Baden Anthony ASS	811014-01	24/08/03
7	Cable	2M-N-N	Reynolds Industries	-	TU
8	Cable	1M-N-N	Reynolds Industries	-	TU
9	Power Supply	11AP10090	Wayne Kerr	189647	TU
10	Variac(3)	-	RS components	-	TU
11	DVM	70 III	Fluke	7230985	04/01/03
12	Climatic Chamber	-	Climatec	-	12/01/03
13	Communications Analyser	CMU300	Rohde and Schwarz	100038	
14	Power Supply	6269B	Hewlett Packard	2323A-10766	TU
15	EMI Receiver	8542E	Hewlett Packard	3617A00165/00154	11/12/2002
16	Bilog Antenna	CBL6143	Schaffner	—	11/04/2003
17	Turntable Controller	HD 050	H-D	050/396	TU
18	Antenna Mast	1051-2	Emco	9101-1570	TU
19	Antenna Mast Controller	2090	Emco	—	TU
20	Screened Room	EAC54300	Siemens	—	TU
21	Low Noise Amplifier (1 – 8GHz	AMF-3D-001080-13P	Miteq	—	TU
22	Low Noise Amplifier (8 – 18GHz)	AMF-4E-080180-15-10P	Miteq	492562	TU
23	Low Noise Amplifier (18 – 26.5GHz)	AMT-26177-33	Avantek	6669	TU
24	Spectrum Analyser	E4407B	Agilent	US41442853	11/02/2003
25	Horn Antenna (1 – 18GHz)	3115	Emco	97015079	29/06/2003
26	Horn Antenna (18 - 26.5GHz)	2024-20	Flann	164	TU
27	Microwave to co-axial Adaptor	20093SF40	Flann	595	TU
28	Signal Generator	8672A	Hewlett Packard	2016A01097	21/12/2002
29	Signal Generator	2031	Marconi	119530066	20/08/2003
30	Transient Limiter	11947A	Hewlett Packard	3107A01649	07-05-2003
31	LISN	ESH2-Z5	Rohde & Schwarz	879675-022	15/04/2003

Note(s)

1) All items are calibrated annually, except where labelled T/U (Traceability Unscheduled). These items are calibrated within the test configurations using calibrated equipment.
2) Throughout the test report the test equipment used for each test is referenced using the number indicated in the table above (1 to 31).
3) The Variable Auto Transformer, (Variac), was used to adjust the supply voltage to 110V AC at a frequency of 60Hz.

Description of Equipment Under Test Configuration

The BTS can be configured as either 850 or 1900 or a combination of both. Both 850 and 1900 TRX's support both GMSK and 8PSK modulation. The cabinet can house a maximum of four TRX's. The testing was performed on the TRX RF output connector. The unit can be configured with three alternative power supply options: 110V AC, 24V DC or 48V DC. Testing was completed on the 1900 TRX's using 24V DC power supply option, and the 850MHz TRX's using the 110V AC power supply option. This ensured testing had been completed on both AC and DC supplies, with limited testing carried out on the 48V DC supply.

Note: For 1900MHz test results, TUV PS report RG610411B refers.

Test Rationale

Output Power

All 3 power supplies were tested with both modulation schemes at maximum and minimum power.

Occupied Bandwidth & Modulation Characteristics

110V AC supply only. The power supply option was deemed to have no effect on these test parameters. Maximum and minimum power levels and both modulation schemes were tested.

Block Edge Measurements

110V AC supply only. The power supply option was deemed to have no effect on the block edge measurement. Testing the Frequency Error at Voltage Variation would indicate any error due to supply voltage, which would cause the fundamental to fall outside the block edge. Both modulation schemes were tested. Maximum power only was tested. If the equipment meets the block edge requirements at maximum power, it will meet the requirements at minimum power. The occupied bandwidth shows that minimum power does not effect the shape of the fundamental, only the amplitude.

Conducted Spurious Emissions

110V AC supply on all three channels, maximum and minimum power and both modulation schemes. To demonstrate that the 48V DC and 24V DC Supplies were compliant, these were tested on middle channel at maximum power.

Radiated Spurious Emissions

30MHz to 1000MHz

Configuration 1a. 24V DC supply. GSM 1900 8PSK Modulation Middle channel, GSM 1900 GMSK Modulation Top channel, GSM 800 8PSK Modulation Middle channel and GSM 800 GMSK Modulation Bottom channel. PAPST Fan. EUT positioned horizontally.

Configuration 1b. 24V DC supply. GSM 1900 8PSK Modulation Middle channel, GSM 1900 GMSK Modulation Top channel, GSM 800 8PSK Modulation Middle channel and GSM 800 GMSK Modulation Bottom channel. PAPST Fan. EUT positioned vertically.

Configuration 2. 48V DC supply. GSM 1900 GMSK Modulation Middle channel, GSM 1900 8PSK Modulation Bottom channel, GSM 800 GMSK Modulation Middle channel and GSM 800 8PSK Modulation Top channel. Japan Servo Fan. EUT positioned vertically.

Configuration 3. 110V AC supply. GSM 1900 GMSK Modulation Bottom channel, GSM 1900 8PSK Modulation Middle channel, GSM 800 GMSK Modulation Top channel and GSM 800 8PSK Modulation Middle channel. Japan Servo Fan. EUT positioned vertically.

Radiated Spurious Emissions - Continued

1GHz to 9GHz

Configuration 4. 24V DC supply. GSM 800 8PSK Modulation Top, Middle, Bottom, GSM 1900 8PSK Modulation Top. Japan Servo fan. EUT positioned vertically. The 1900 GSM Transceiver was used to fully populate the BTS as only 3 800 GSM Transceivers were available.

Frequency Tolerance

24V DC supply only. Both GMSK and 8PSK modulation.

Frequency Tolerance with Voltage Variation

110V AC, 24V DC, 48V DC. Both GMSK and 8PSK modulation. Due to the nature of the test, all three power supply variations were tested. This also ensures that the frequency tolerance remains acceptable to ensure the TRX remains within the block edge.

Line Conducted Emissions

Configuration 5a. 110V AC. GSM 800 8PSK Modulation Top, Middle, Bottom, GSM 1900 8PSK Modulation Top. Japan Servo fan. EUT positioned vertically. The 1900 GSM Transceiver was used to fully populate the BTS as only 3 800 GSM Transceivers were available.

Configuration 5b. 110V AC. GSM 800 GMSK Modulation Top, Middle, Bottom, GSM 1900 GMSK Modulation Top. Japan Servo fan. EUT positioned vertically. The 1900 GSM Transceiver was used to fully populate the BTS as only 3 800 GSM Transceivers were available.

Channel Configuration

The EUT has been tested on bottom, middle and top channels, based on the complete PCS1900 operating band. However, in accordance with Part 22.905, the bottom and top channels are blocked from use. For the Block Edge testing, the tested channels have been changed to demonstrate compliance with the standard. This is reflected in the user guide for the EUT. To cover bottom, middle and top channels for each block and each test case would involve a huge amount of testing. Thus, to provide a practical representative set of results, the EUT was tested at bottom, middle and top of the entire PCS1900 band to demonstrate compliance with the standard.

The equipment under test is made up of the following component parts.

Module	Vendor	Kit Number	Serial Number
Cabinet		058187A….405	B020900045
Transceivers			
WTFA		468654A….X22	L1024047075
WTFA		468654A….X22	L1024047077
WTFA		468654A….X22	L1024047082
WTFA		468654A….X22	L1024047072
Power Supplies			
48V DC PSU		40071 193 200/2	00200
24V DC PSU	Delta Electronics	DPSN-480-AB-3A Rev: S1	OFCO 221
110V AC PSU	ASCOM	40071 193 100/D	00203
Digital Boards			
FXC E1 T1 (Transmission Card)		467611A….103 VXTB	L1013368629
VIFA Card		467208A….103 VIFA	4H021000567

Table 1

List of Performed Measurements using the configuration in Table 1

i)	Radiated Spurious Emissions	47 CFR 2.1053, 22.917(e)
ii)	RF Output Power	47 CFR 2.1046, 22.913(a)
iii)	Modulation Characteristics	47 CFR 2.1047(d)
iv)	Occupied Bandwidth	47 CFR 2.1049, 22.917
v)	Spurious Emissions at Antenna Terminals	47 CFR 2.1051, 22.905
vi)	Spurious Emissions	47 CFR 2.1051, 22,917(e)
vii)	Frequency Stability – Temperature Variations	47 CFR 2.1055, 22.355
viii)	Frequency Stability – Voltage Variations	47 CFR 2.1055, 22.355
ix)	AC Conducted Spurious Emissions	47 CFR 15.207(a)

Test Case: Radiated Spurious Emissions

Test Date: 1st November to 7th November 2002

Rule Parts: 2.1053, 22.917(e)

Measurement Method

The EUT was set up in each of the configurations listed on pages 5 and 6 in turn.

A preliminary profile of the Radiated Electric Field Emissions was obtained by operating the Equipment Under Test (EUT) on a remotely controlled turntable within a semi-anechoic chamber; measurements were taken at a 3m distance. Measurements of emissions from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations. The profiling produced a list of the worst case emissions together with the EUT azimuth and antenna polarisation.

Using the information from the preliminary profiling of the EUT, a search was made in the frequency range 30MHz to 9GHz. The list of worst case emissions was then confirmed or updated. Emission levels were maximised by adjusting the antenna height, antenna polarisation and turntable azimuth. Emissions levels were then formally measured. The details of the worst case emissions were then recorded in the Job Log Book. Details of the worst case emissions are presented in Tables 2 to 6. Plots 1 to 8 are taken from the receiver in max hold while the EUT was rotated through 360 degrees.

Radiated Electric Field Emissions measurements were made using a Hewlett Packard 8542E EMI Receiver in the frequency range 30MHz to 1000MHz and an Agilent E4407B Spectrum Analyser in the frequency range 1GHz to 9GHz. Measurements in the range 30MHz to 1000MHz were made using a Peak Detector in a 120kHz bandwidth and measurements above 1GHz were made using a Peak Detector in a 1MHz bandwidth.

Determination of Spurious Emissions Limit

As the EUT does not have an integral antenna the field strength of the carrier has been calculated assuming that the power is to be fed to a half-wave tuned dipole as per 2.1053(a).

$$E_{(V/m)} = \frac{\sqrt{30 \times G_i \times P_o}}{d}$$

where G_I is the antenna gain relative to isotropic
P_o is the power out of the transceiver in W
d is the distance in metres

therefore at 3m the field strength using the lowest transceiver output power would be:

$$E_{(V/m)} = \frac{\sqrt{30 \times 1.64 \times 4.385}}{3} = 4.9V/m = 133.8dB\mu V/m$$

As per 22.917(e) the spurious emissions must be attenuated by 43 + 10log(P_o) this gives:

43 + 10log(4.385) = 49.4dB

therefore the limit at 3m measurement distance is:

133.8 – 49.4 = 84.4dBµV/m

Test Case: Radiated Emissions (continued)

Configuration: 1a

Alternative Open Area Test Site Results: The levels of the 6 highest emissions measured in accordance with the specification are presented in Table 2 below: -

Emission Frequency	Antenna		Turntable Azimuth	Level at 3m	Cable Loss	Antenna Factor	Field Strength at 3m	Specification Limit
	Polarity	Height						
MHz	H/V	cm	degree	dBµV	dB	dB	dBµV/m	dBµV/m
115.6	H	290	0	27.8	1.3	12.1	41.2	84.4
120.3	H	290	0	26.0	1.4	12.3	39.7	84.4
169.0	H	135	0	25.5	1.7	10.0	37.2	84.4
299.0	H	101	15	22.0	2.3	13.7	38.0	84.4
676.0	V	102	159	20.4	2.8	18.9	42.1	84.4
728.0	V	140	205	17.8	4.0	19.8	41.6	84.4

Table 2

The margin between the specification requirements and all other emissions was 47dB or more below the specification limit.

ABBREVIATIONS FOR ABOVE TABLE

H Horizontal Polarisation V Vertical Polarisation

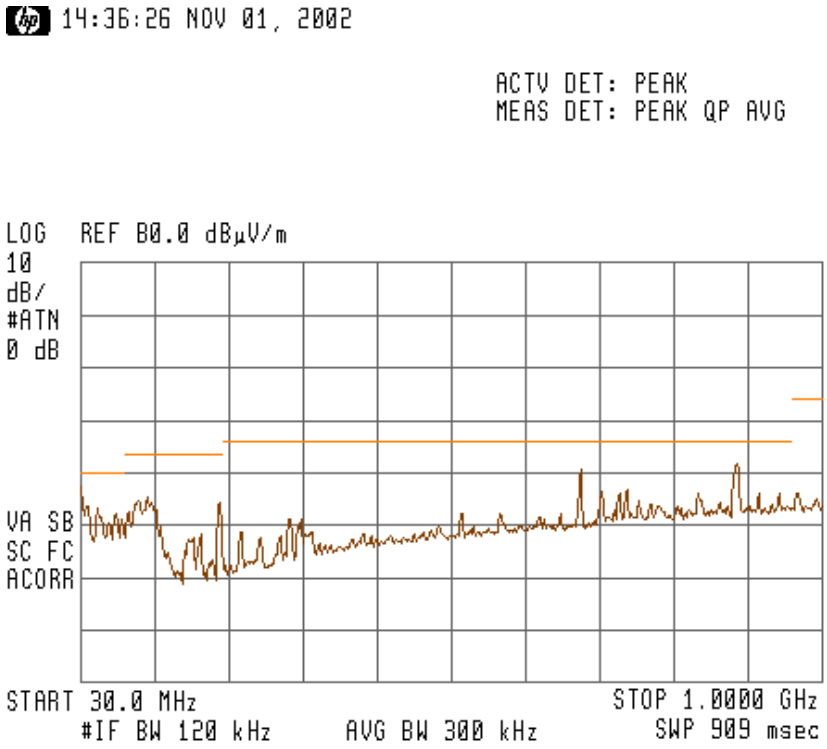
Procedure Test Performed in accordance with ANSI C63.4.

Test Equipment Used:

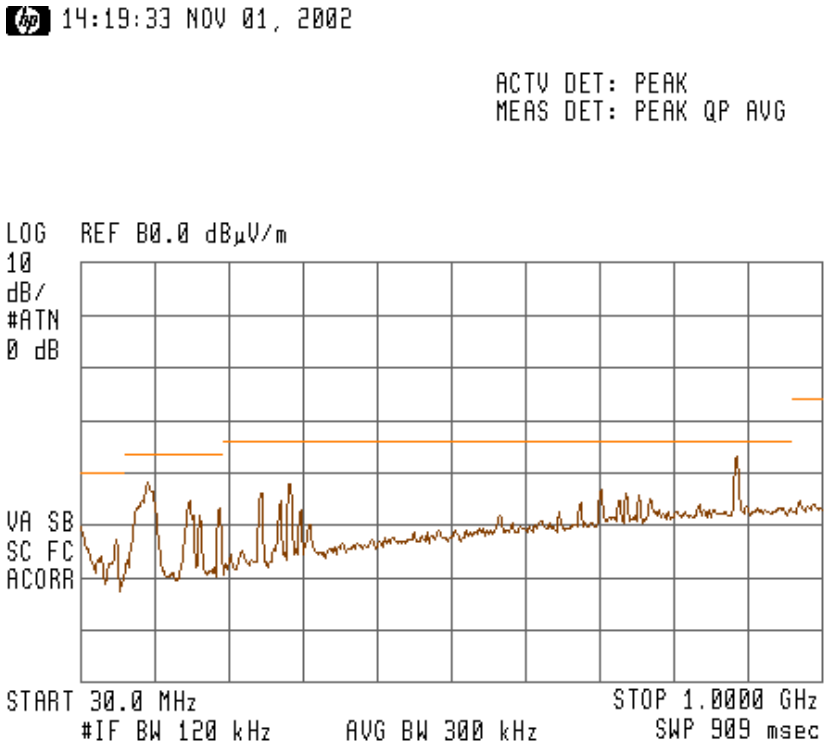
15, 16, 17, 18, 19, 20

Test Case: Radiated Emissions (continued)

Configuration: 1a



Plot 1 Vertical polarisation



Plot 2 Horizontal polarisation

Test Case: Radiated Emissions (continued)

Configuration: 1b

Alternative Open Area Test Site Results: The levels of the 6 highest emissions measured in accordance with the specification are presented in Table 3 below: -

Emission Frequency	Antenna		Turntable Azimuth	Level at 3m	Cable Loss	Antenna Factor	Field Strength at 3m	Specification Limit
	Polarity	Height						
MHz	H/V	cm	degree	dBµV	dB	dB	dBµV/m	dBµV/m
31.47	V	100	172	18.3	0.7	21.8	40.8	84.4
108.90	V	100	202	27.4	1.3	11.7	40.4	84.4
676.00	H	315	241	16.9	3.8	18.9	39.6	84.4
704.54	V	128	172	17.3	3.9	19.2	40.4	84.4
737.30	H	126	315	19.8	4.0	19.8	43.6	84.4
780.00	H	110	235	20.3	4.1	20.1	44.5	84.4

Table 3

The margin between the specification requirements and all other emissions was 45dB or more below the specification limit.

ABBREVIATIONS FOR ABOVE TABLE

H Horizontal Polarisation V Vertical Polarisation

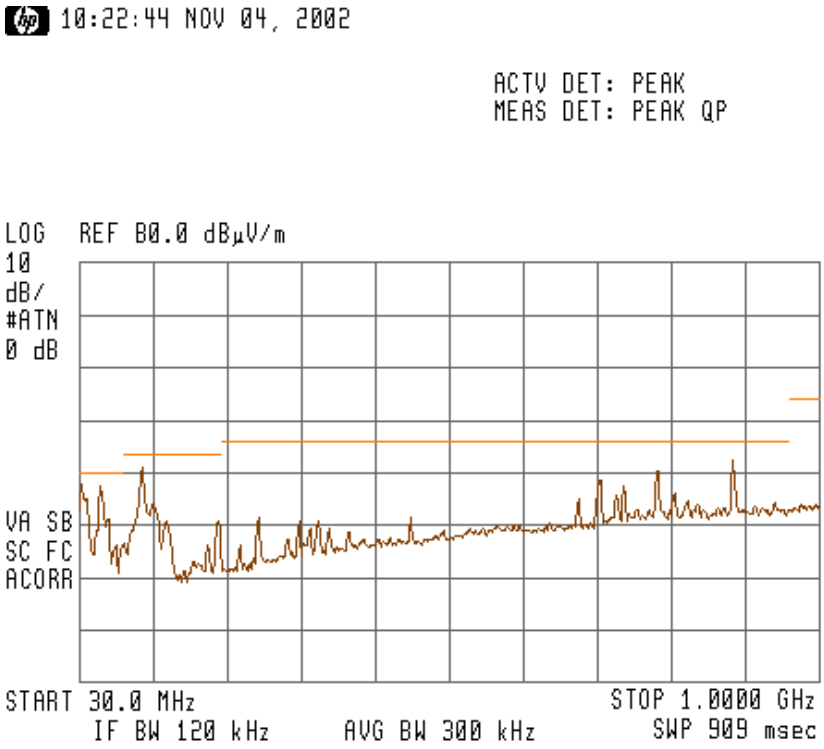
Procedure Test Performed in accordance with ANSI C63.4.

Test Equipment Used:

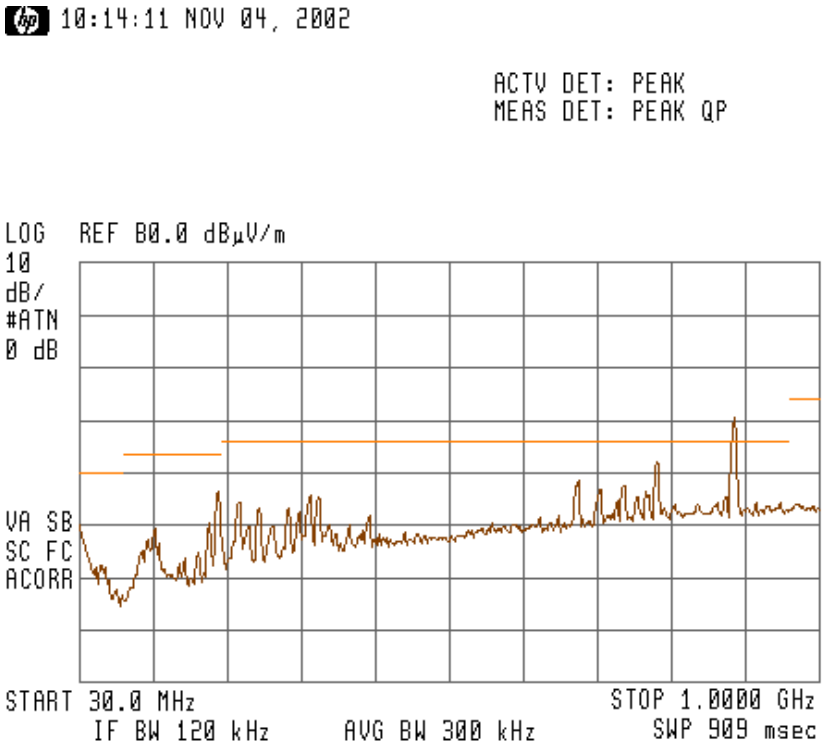
15, 16, 17, 18, 19, 20

Test Case: Radiated Emissions (continued)

Configuration: 1b



Plot 3 Vertical polarisation



Plot 4 Horizontal polarisation

Test Case: Radiated Emissions (continued)

Configuration: 2

Alternative Open Area Test Site Results: The levels of the 6 highest emissions measured in accordance with the specification are presented in Table 4 below: -

Emission Frequency	Antenna		Turntable Azimuth	Level at 3m	Cable Loss	Antenna Factor	Field Strength at 3m	Specification Limit
	Polarity	Height						
MHz	H/V	cm	degree	dBµV	dB	dB	dBµV/m	dBµV/m
63.55	V	103	194	31.1	1.0	8.0	40.1	84.4
676.00	H	101	234	20.3	3.8	18.9	43.0	84.4
704.50	V	125	195	17.9	3.9	19.2	41.0	84.4
737.30	V	119	186	18.7	4.0	19.8	42.5	84.4
832.00	H	136	227	17.0	4.3	20.4	41.7	84.4
858.00	H	123	250	15.5	4.3	20.4	40.2	84.4

Table 4

The margin between the specification requirements and all other emissions was 44dB or more below the specification limit.

ABBREVIATIONS FOR ABOVE TABLE

H Horizontal Polarisation V Vertical Polarisation

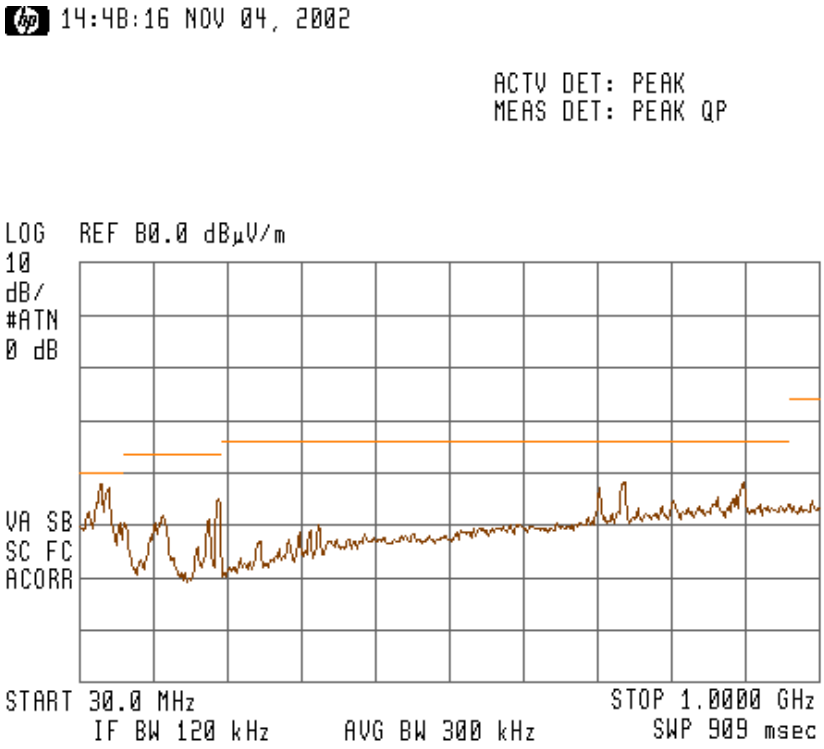
Procedure Test Performed in accordance with ANSI C63.4.

Test Equipment Used:

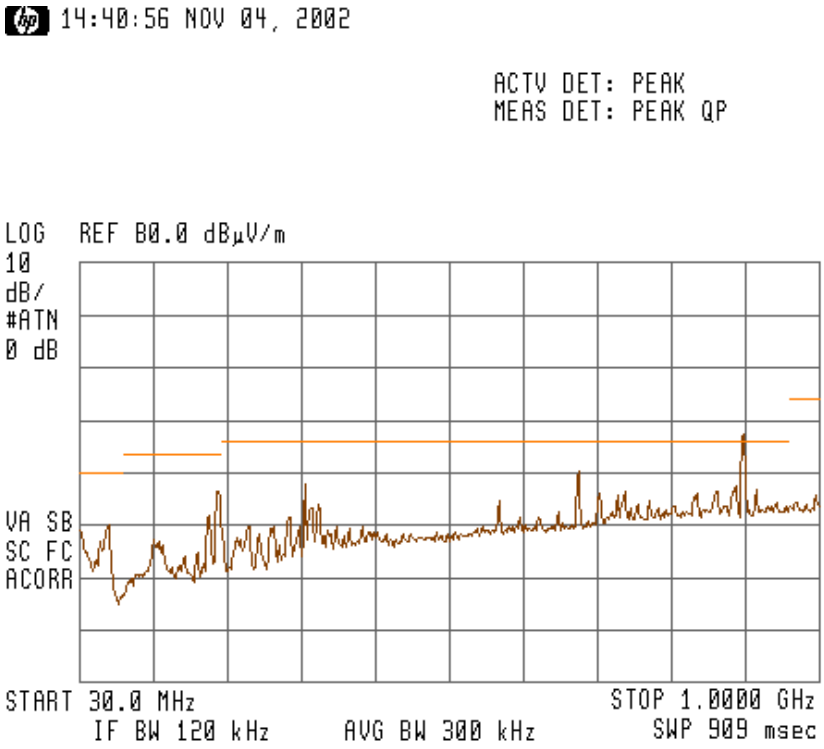
15, 16, 17, 18, 19, 20

Test Case: Radiated Emissions (continued)

Configuration: 2



Plot 5 Vertical polarisation



Plot 6 Horizontal polarisation

Test Case: Radiated Emissions (continued)

Configuration: 3

Alternative Open Area Test Site Results: The levels of the 6 highest emissions measured in accordance with the specification are presented in Table 5 below: -

Emission Frequency	Antenna		Turntable Azimuth	Level at 3m	Cable Loss	Antenna Factor	Field Strength at 3m	Specification Limit
	Polarity	Height						
MHz	H/V	cm	degree	dBµV	dB	dB	dBµV/m	dBµV/m
208.00	H	100	314	24.4	1.9	10.7	37.0	84.4
327.70	H	103	171	20.6	2.4	14.4	37.4	84.4
676.00	H	100	16	13.8	3.8	18.9	36.5	84.4
737.30	V	120	210	19.4	4.0	19.8	43.2	84.4
802.85	V	114	169	13.2	4.2	20.3	37.7	84.4
884.00	H	106	162	13.9	4.4	20.4	38.7	84.4

Table 5

The margin between the specification requirements and all other emissions was 48dB or more below the specification limit.

ABBREVIATIONS FOR ABOVE TABLE

H Horizontal Polarisation V Vertical Polarisation

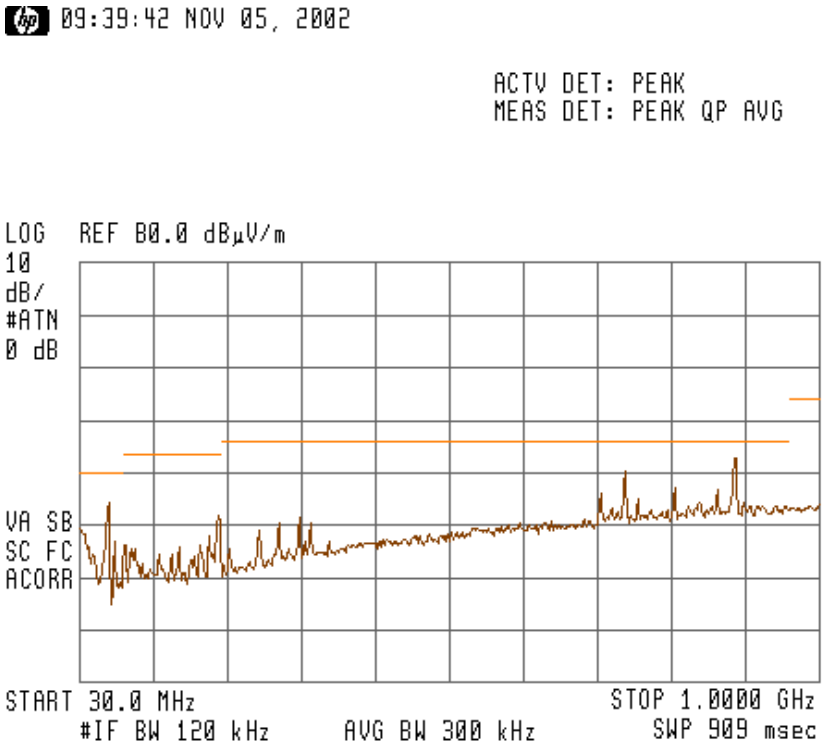
Procedure Test Performed in accordance with ANSI C63.4.

Test Equipment Used:

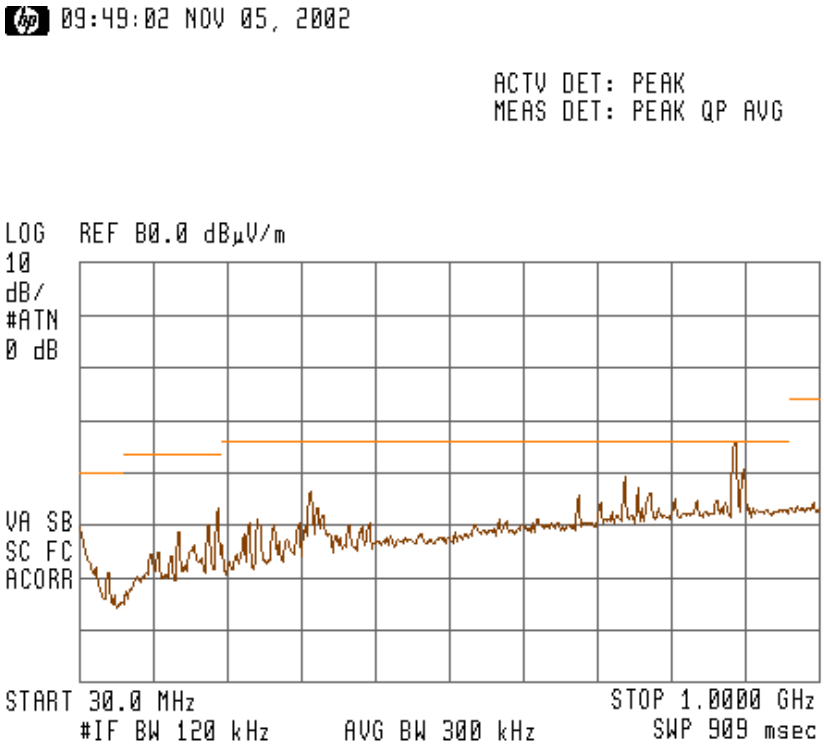
15, 16, 17, 18, 19, 20

Test Case: Radiated Emissions (continued)

Configuration: 3



Plot 7 Vertical polarisation



Plot 8 Horizontal polarisation

Test Case: Radiated Emissions (continued)

Configuration: 4

Alternative Open Area Test Site Results: The levels of the 5 highest emissions measured in accordance with the specification are presented in Table 6 below: -

Emission Frequency	Antenna		Turntable Azimuth	Level at 3m	Cable Loss	Antenna Factor	Field Strength at 3m	Specification Limit
	Polarity	Height						
MHz	H/V	cm	degree	dBµV	dB	dB	dBµV/m	dBµV/m
1763.56	H	204	121	52.04	-33.55	26.97	45.46	84.40
1768.05	H	208	113	52.55	-33.58	26.99	45.96	84.40
1820.02	H	122	150	48.4	-33.71	27.22	41.91	84.40
1872.00	H	192	139	49.68	-33.73	27.45	43.40	84.40
2704.01	H	106	204	44.78	-33.84	29.68	40.62	84.40

Table 6

The margin between the specification requirements and all other emissions was 36dB or more below the specification limit.

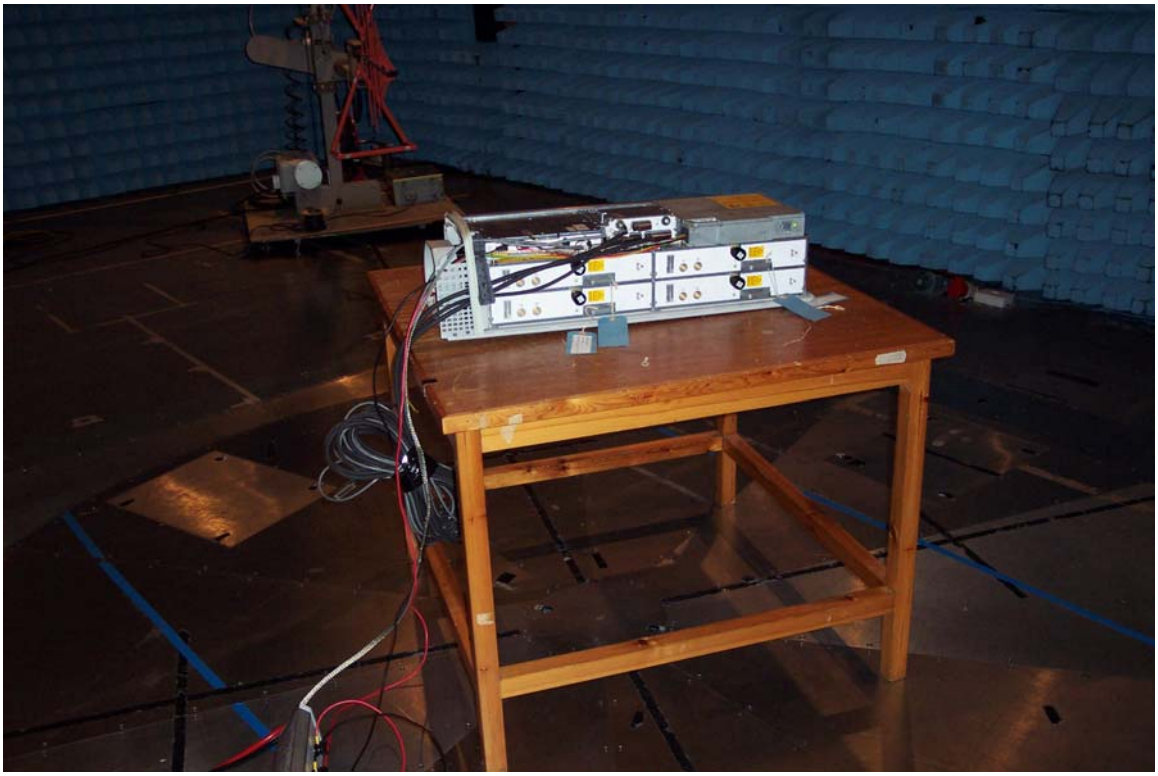
ABBREVIATIONS FOR ABOVE TABLE

H Horizontal Polarisation V Vertical Polarisation

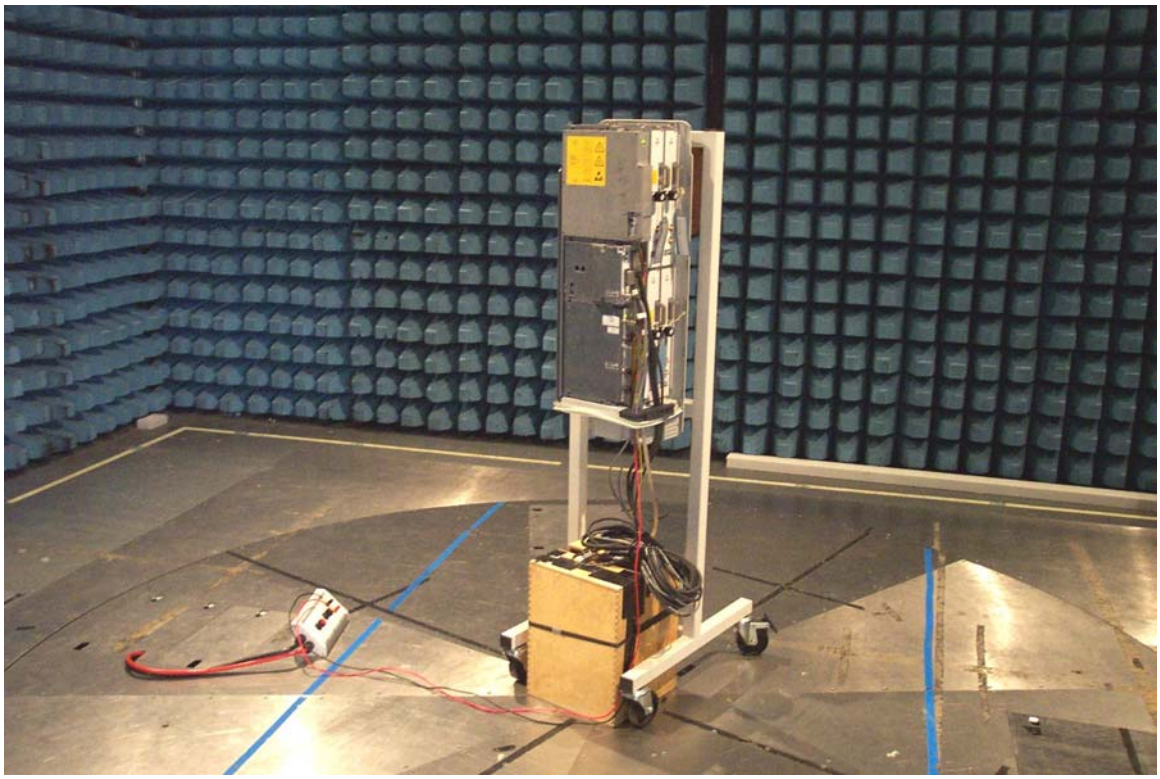
Procedure Test Performed in accordance with ANSI C63.4.

Test Equipment Used:

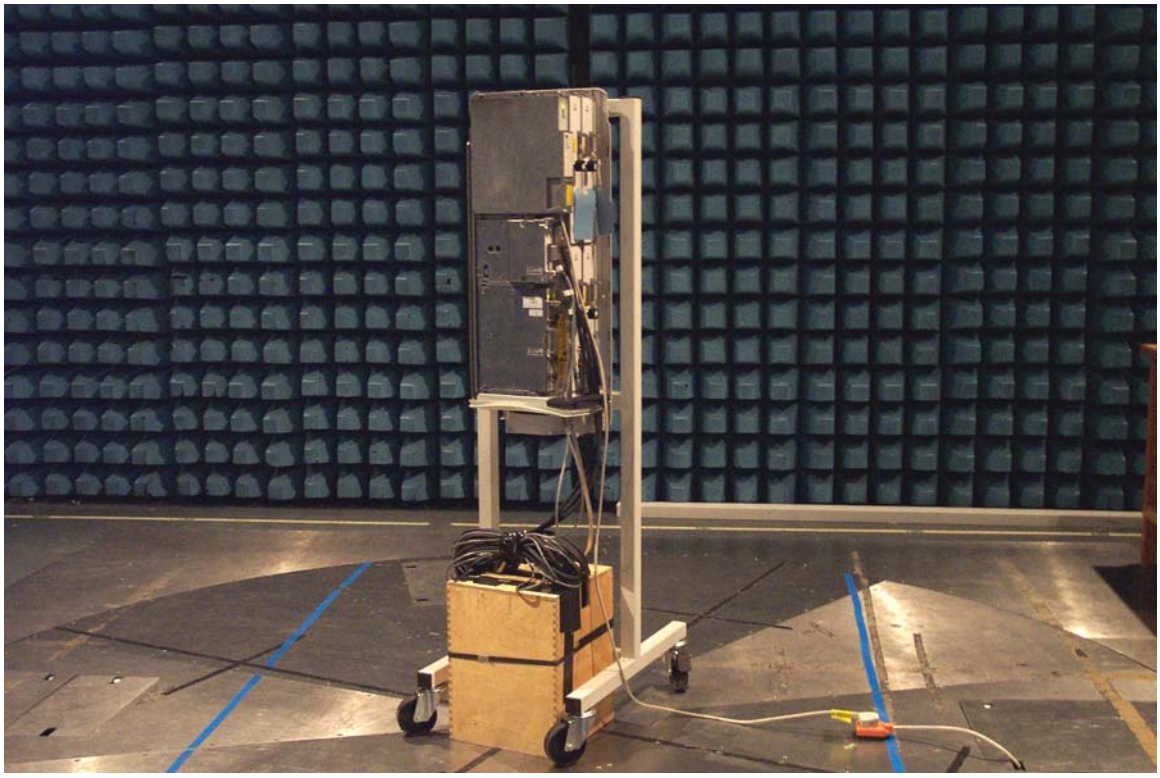
17, 18, 19, 20, 21, 22, 24, 25, 28, 29



Photograph No 1 – Radiated Emissions – Configuration 1a



Photograph No 2 – Radiated Emissions – Configurations 1b, 2 and 4



Photograph No 3 – Radiated Emissions – Configuration 3

Test Case: RF Output Power

Test Date: 24th October 2002

Rule Parts: 2.1046, 22.913(a)

Measurement Method

Using a spectrum analyser and attenuator(s), the output power of the EUT was measured at the antenna terminals. The EUT supports both GMSK and 8PSK modulation schemes. The carrier power was measured with GMSK and 8PSK modulation with all time slots active.

The spectrum analyser RBW and VBW were set to 1MHz and the path loss measured and entered as a reference level offset.

Results

110V AC Supply

Maximum Power - GMSK

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (W)
869.2	16.20	20.6	36.80	4.79
881.4	16.38	20.6	36.98	4.99
893.8	15.91	20.5	36.41	4.38

110V AC Supply

Minimum Power - GMSK

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (mW)
869.2	-14.12	20.6	6.48	4.45
881.4	-13.93	20.6	6.67	4.65
893.8	-14.48	20.5	6.02	4.00

Limit	<500W or <+57dBm

Remarks

EUT complies with CFR 47 2.1046 and 22.913(a). The EUT does not exceed 500W or +57dBm at the measured frequencies.

Test Equipment Used:

1, 2, 7, 9, 10, 11

110V AC Supply

Maximum Power – 8PSK

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (W)
869.2	17.55	20.6	38.15	6.53
881.4	17.70	20.6	38.30	6.76
893.8	17.13	20.5	37.63	5.79

110V AC Supply

Minimum Power – 8PSK

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (W)
869.2	0.38	20.6	20.98	0.13
881.4	0.59	20.6	21.19	0.13
893.8	0.05	20.5	20.55	0.11

Limit	<500W or <+57dBm

Remarks

EUT complies with CFR 47 2.1046 and 22.913(a). The EUT does not exceed 500W or +57dBm at the measured frequencies.

Test Equipment Used:

1, 2, 7, 9, 10, 11

24V DC Supply

Maximum Power – GMSK

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (W)
869.2	16.21	20.6	36.81	4.80
881.4	16.38	20.6	36.98	4.99
893.8	15.91	20.5	36.41	4.38

24V DC Supply

Minimum Power – GMSK

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (mW)
869.2	-14.03	20.6	6.57	4.54
881.4	-14.02	20.6	6.58	4.55
893.8	-14.57	20.5	5.93	3.92

Limit	<500W or <+57dBm

Remarks

EUT complies with CFR 47 2.1046 and 22.913(a). The EUT does not exceed 500W or +57dBm at the measured frequencies.

Test Equipment Used:

1, 2, 7, 9, 10, 11

24V DC Supply

Maximum Power – 8PSK

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (W)
869.2	17.51	20.6	38.11	6.47
881.4	17.75	20.6	38.35	6.84
893.8	17.16	20.5	37.66	5.83

24V DC Supply

Minimum Power – 8PSK

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (W)
869.2	0.39	20.6	20.99	0.13
881.4	0.57	20.6	21.17	0.13
893.8	0.04	20.5	20.54	0.11

Limit	<500W or <+57dBm

Remarks

EUT complies with CFR 47 2.1046 and 22.913(a). The EUT does not exceed 500W or +57dBm at the measured frequencies.

Test Equipment Used:

1, 2, 7, 9, 10, 11

48V DC Supply

Maximum Power – GMSK

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (W)
869.2	16.21	20.6	36.81	4.80
881.4	16.38	20.6	36.98	4.99
893.8	15.91	20.5	36.41	4.38

48V DC Supply

Minimum Power – GMSK

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (mW)
869.2	-14.07	20.6	6.53	4.50
881.4	-13.83	20.6	6.77	4.75
893.8	-14.39	20.5	6.11	4.08

Limit	<500W or <+57dBm

Remarks

EUT complies with CFR 47 2.1046 and 22.913(a). The EUT does not exceed 500W or +57dBm at the measured frequencies.

Test Equipment Used:

1, 2, 7, 9, 10, 11

48V DC Supply

Maximum Power – 8PSK

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (W)
869.2	17.51	20.6	38.11	6.47
881.4	17.70	20.6	38.30	6.76
893.8	17.15	20.5	37.65	5.82

48V DC Supply

Minimum Power – 8PSK

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (W)
869.2	0.41	20.6	21.01	0.13
881.4	0.60	20.6	21.20	0.13
893.8	0.09	20.5	20.59	0.11

Limit	<500W or <+57dBm

Remarks

EUT complies with CFR 47 2.1046 and 22.913(a). The EUT does not exceed 500W or +57dBm at the measured frequencies.

Test Equipment Used:

1, 2, 7, 9, 10, 11

Test Case: Modulation Characteristics

Test Date: 25th October 2002

Rule Parts: 2.1047(d)

Description Of Modulation Technique

The modulation scheme used in GSM is called Gaussian Minimum Shift Keying (GMSK). GMSK facilitates the use of narrow bandwidth and allows for both coherent and non coherent detection capabilities. It is a scheme in which the transitions from One to Zero or Zero to One do not occur quickly, but over a period of time. If pulses are transmitted quickly harmonics are transmitted. The power spectrum for a square wave is rich in harmonics, and the power within the side lobes is wasted, and can be a cause of potential interference.

A method to reduce the harmonics is to round off the edges of the pulses thus lowering the spectral components of the signal. In GSM this is done by using a Gaussian pre-filter which typically has a bandwidth of 81.25kHz. The output from the Gaussian filter then phase modulates the carrier. As there are no dramatic phase transitions of the carrier this gives a constant envelope and low spectral component output from the transmitter.

The spectral efficiency is calculated by

bit rate / Channel bandwidth = 270.83333 kbit/s / 200 kHz = 1.354 bit/s/Hz.

The bandwidth product BT = Bandwidth x bit duration = 81.25 kHz x 3.6923 micros = 0.3

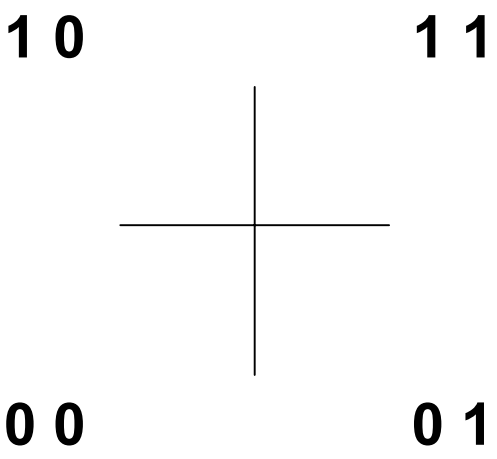
GMSK and 8PSK OVERVIEW

The modulation schemes used for the Metrosite EDGE are GMSK and 8PSK. The 8PSK modulation scheme is EDGE (Enhanced Date Rates for GSM Evolution).

A brief overview of how GMSK and 8PSK works is shown below.

GMSK (Gaussian Minimum Shift Keying)

The fundamental principal behind GMSK is Phase shift keying. This splits a data stream into a series of 2-digit phase shifts, using the following phase shifts to represent data pairs.



Therefore for the BIT sequence 0 0 1 1 1 0 0 1 The corresponding phase shift will be used

BIT SEQUENCE	0 0	1 1	1 0	01
PHASE	225º	45º	135º	315º

This is called QPSK (Quadratic Phase Shift Keying)

However

There is a problem with QPSK: transition from e.g. 00 to 11 gives phase shift of 180° (π radians). This has the effect of inverting the carrier waveform and this can lead to detection errors at the receiver.

Solution: restrict phase changes to ± 90°

1. Split bitstream into 2 streams e.g.

	0 0		1 1		0 1		1 0	
I Stream	0		1		0		1	
Q stream		0		1		1		0

2. Modulate each stream with PSK (1 = 90° or π/2, 0 = -90° or - π/2 phase shift)

I Stream	0		1		0		1	
	-π/2		-π/2		-π/2		π/2	
Q stream		0		1		1		0
		-π/2		π/2		π/2		-π/2

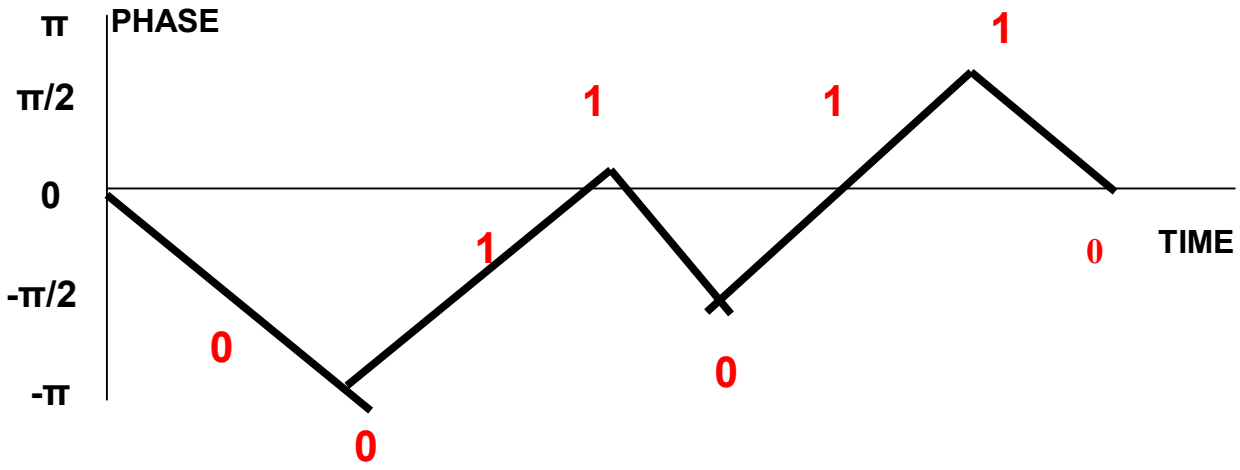
3. Combine (add) the two PSK signals:

Combined Phase	-π/2	-π	-π/2	0	-π/2	0	π/2	0

Result: offset - QPSK, phase change is restricted to ± π/2 radians:

It would be preferable to have "gradual" changes in place between each pair of bits (Continuous-phase modulation). Replacing each “rectangular” shaped pulse (for 1 or 0) with a sinusoidal pulse can do this:

Result: Minimum Shift Keying (MSK):



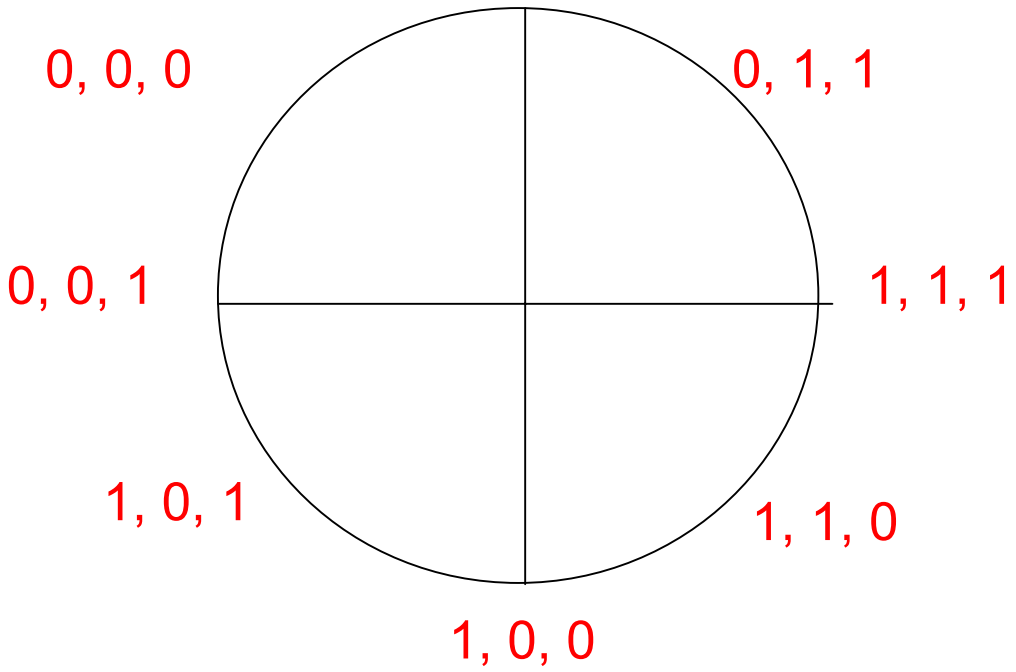
Gaussian Minimum Shift Keying

MSK has high sidebands relative to the main lobes in the frequency domain - this can lead to interference with adjacent signals.

If the rectangular pulses corresponding to the bitstream are filtering using a Gaussian-shaped impulse response filter, we get Gaussian MSK (GMSK) - this has low sidelobes compared to MSK.

8-SK (8-Phase Shift Keying)

8PSK uses the same basic principle of phase shift modulation. The only difference being the increased number of vectors.



Once the digital bit sequence has been generated the same process as GMSK is used to generate the modulated signal.

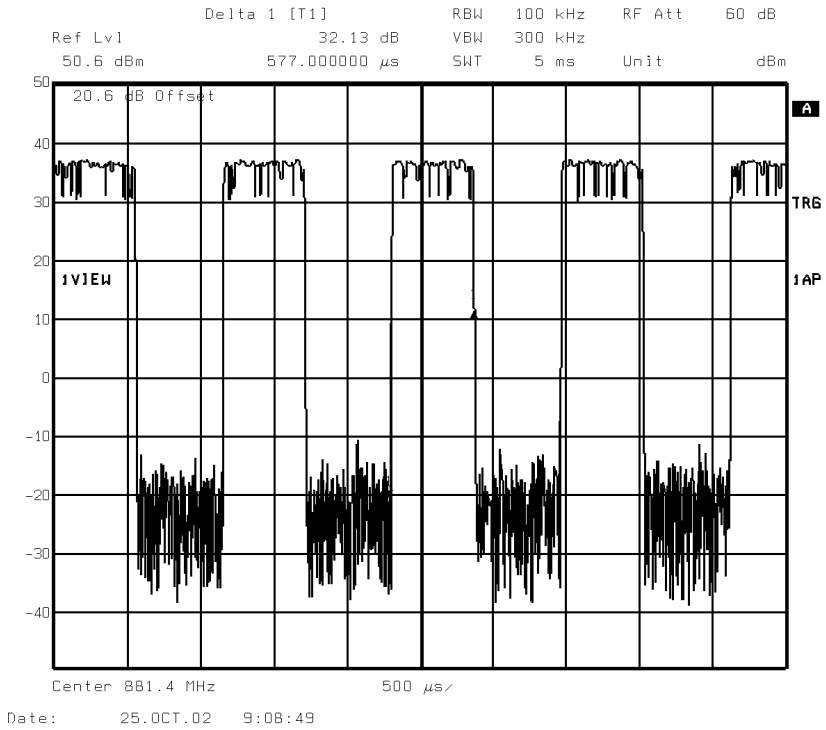
Four plots are shown on the following pages showing the EUT transmitting with the display in the time domain:

1) EUT transmitting with GMSK modulation showing alternate time slots.

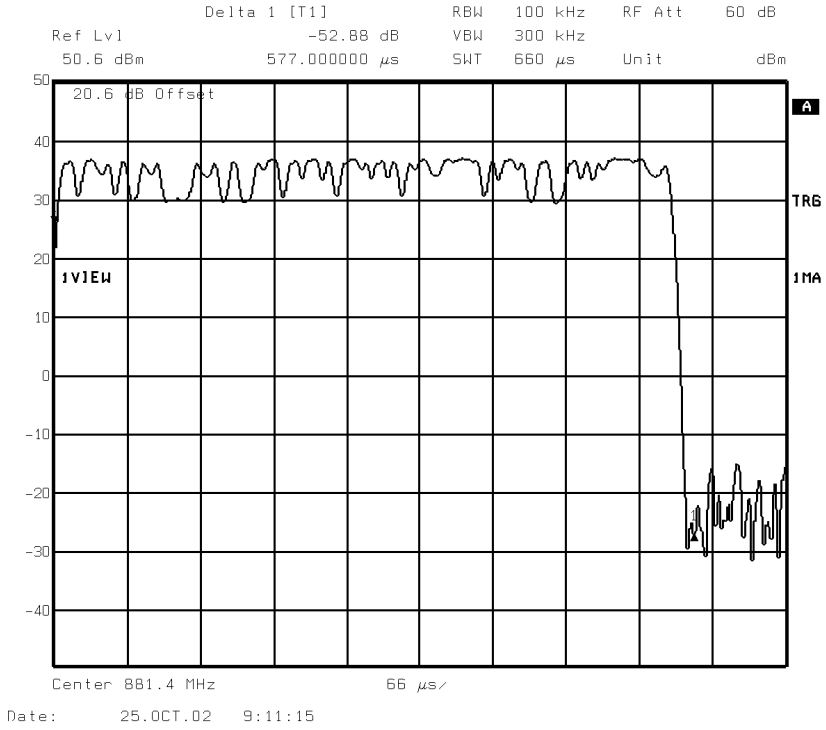
2) EUT transmitting with GMSK modulation showing one time slot.

3) EUT transmitting with 8PSK modulation showing alternate time slots.

4) EUT transmitting with 8PSK modulation showing one time slot.



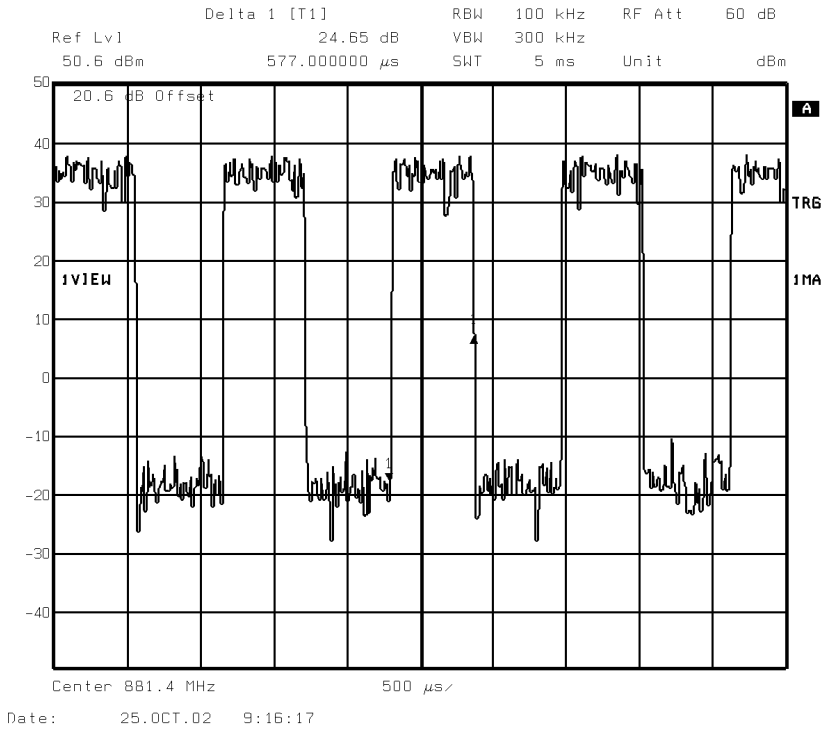
Plot (1)



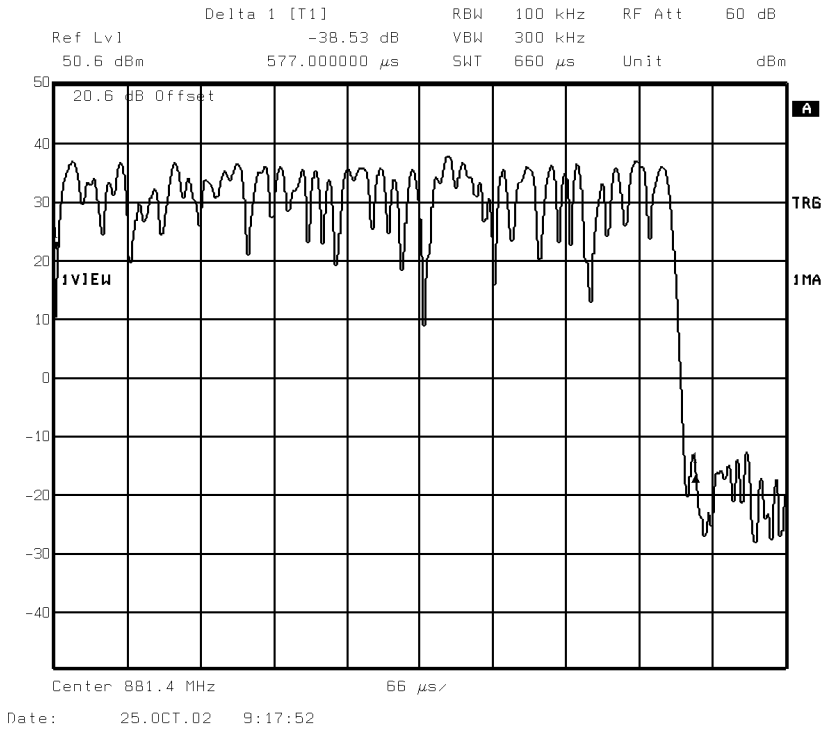
Plot (2)

Test Equipment Used:

1, 2, 7, 10



Plot (3)



Plot (4)

Test Equipment Used:

1, 2, 7, 10

Test Case: Occupied Bandwidth

Test Date: 24th - 25th October 2002

Rule Parts: 2.1049, 22.917

Measurement Method

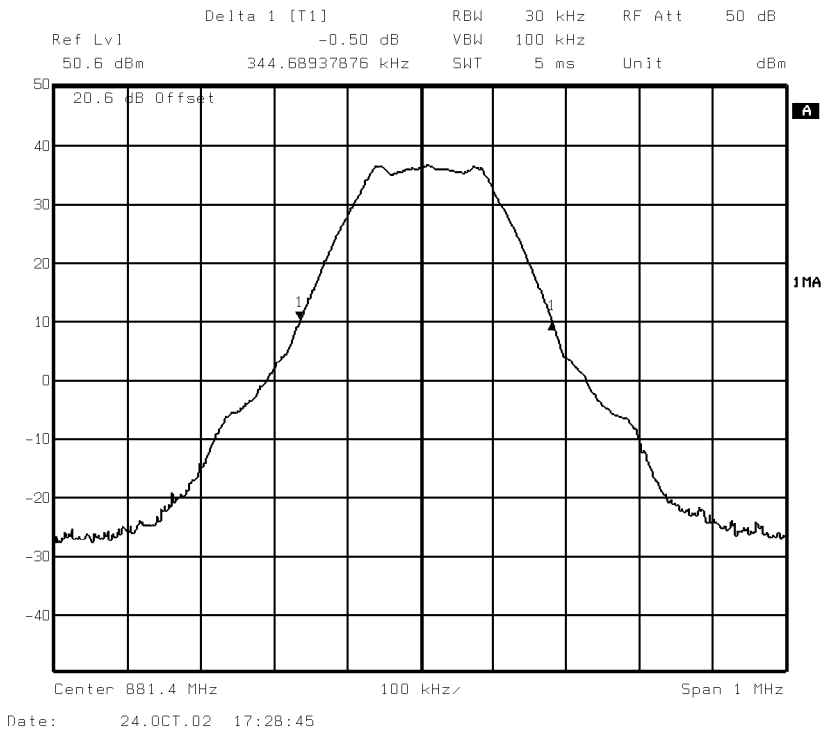
The EUT was transmitted at maximum power, modulated with all timeslots active. Using a resolution bandwidth of 30 kHz and a video bandwidth of 100 kHz, the –26dBc points were established and the emission bandwidth determined.

The requirements in 22.917 specify an emission mask that equipment must meet. However, the mask specified was designed with a system channel spacing of 40kHz. The system channel spacing for GSM is 200kHz. Thus, the mask is considered to be not applicable to this system.

The plot below shows the resultant display from the Spectrum Analyser.

Occupied Bandwidth As Defined By The –26dBc Points

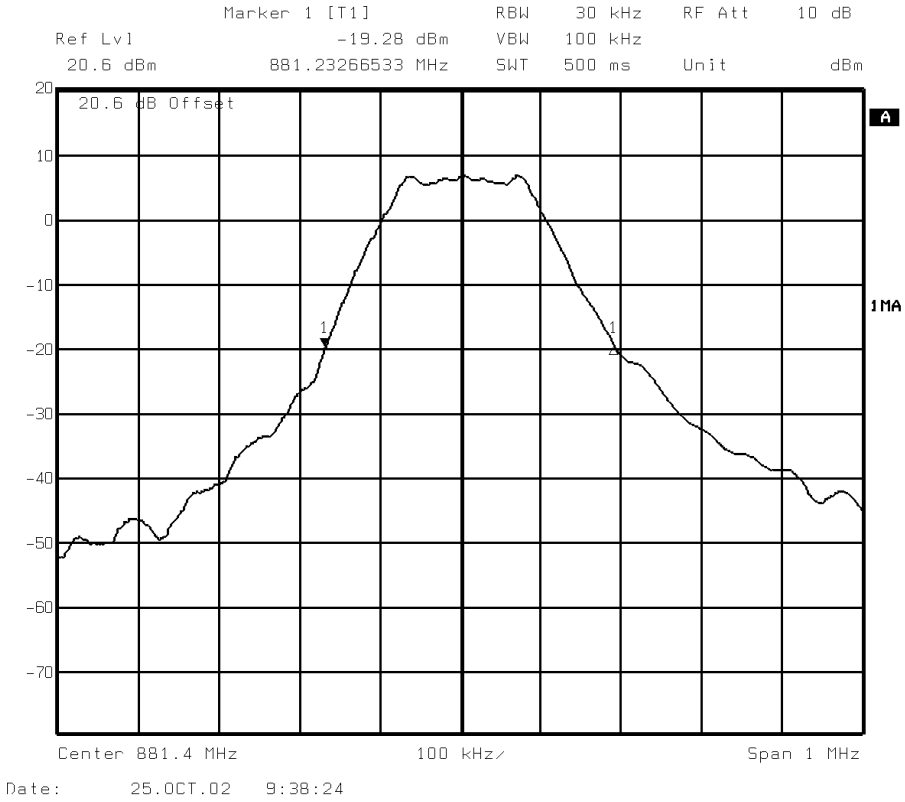
Maximum Power - GMSK



Test Equipment Used:

1, 2, 7, 10

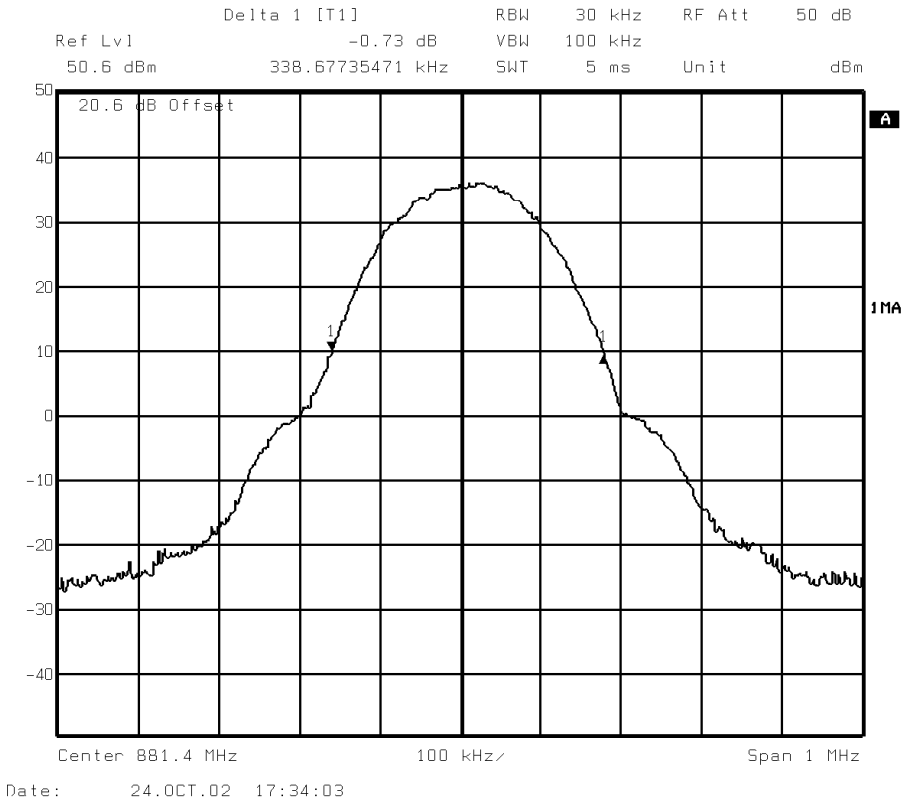
Minimum Power - GMSK



Test Equipment Used:

1, 2, 7, 10

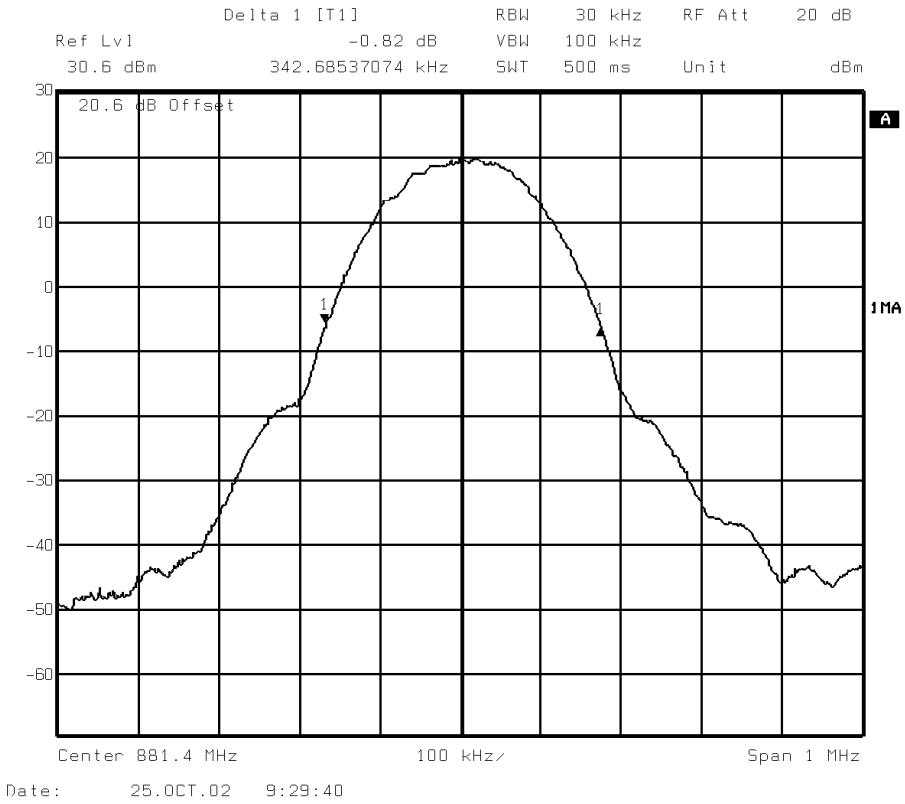
Maximum Power – 8PSK



Test Equipment Used:

1, 2, 7, 10

Minimum Power – 8PSK



Test Equipment Used:

1, 2, 7, 10

Test Case: Spurious Emissions At Antenna Terminals (+/-1MHz)

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.905

Measurement Method

In accordance with 22.917(e), any emissions outside of the block edges shall be attenuated by at least 43 + 10 log(P). The measurements are shown to ±1MHz from the block edges. The plots shown under the Spurious Emissions section covers the required range of 9kHz to 9GHz.

The reference power and path losses of all channels used for testing in each frequency block were measured. It was found that there was <0.5dB variation in all channels, thus the worst case reference level offset was used throughout. Having entered the reference level offset, the limit line was displayed, showing the –13dBm, (43+10logP), limit.

Below are the Frequency Blocks the EUT was tested against along with the tested channels.

Communication Channel Pair Blocks

Frequency Block (MHz)	Lower Block Edge Test Channels/Frequencies	Upper Block Edge Test Channels/Frequencies
A (869.040 – 879.990)	Channel : 129 Frequency : 869.40MHz	Channel : 180 Frequency : 879.60MHz
A (890.010 – 891.480)	Channel : 234 Frequency : 890.40MHz	Channel : 238 Frequency : 891.20MHz
B (880.020 – 889.980)	Channel : 184 Frequency : 880.40MHz	Channel : 230 Frequency : 889.60MHz
B (891.510 – 893.970)	Channel : 241 Frequency : 891.80MHz	Channel : 250 Frequency : 893.60MHz

Control Channel Pair Blocks

The control channel blocks fall within the blocks listed above and therefore not measured. The control channel blocks do not increase the available frequency usage.

Remarks

The channels shown in the table above are the minimum and maximum channels that can be used in each block to maintain compliance. Channels used outside of those stated in the table exceed the specification limits, thus they cannot be used.

The channels outside of those shown in the table above were not tested at lower power levels to determine a level at which compliance would be achieved. Therefore, to maintain compliance, only the channels shown in the table above shall be used.

The measurement plots are shown on the following pages.

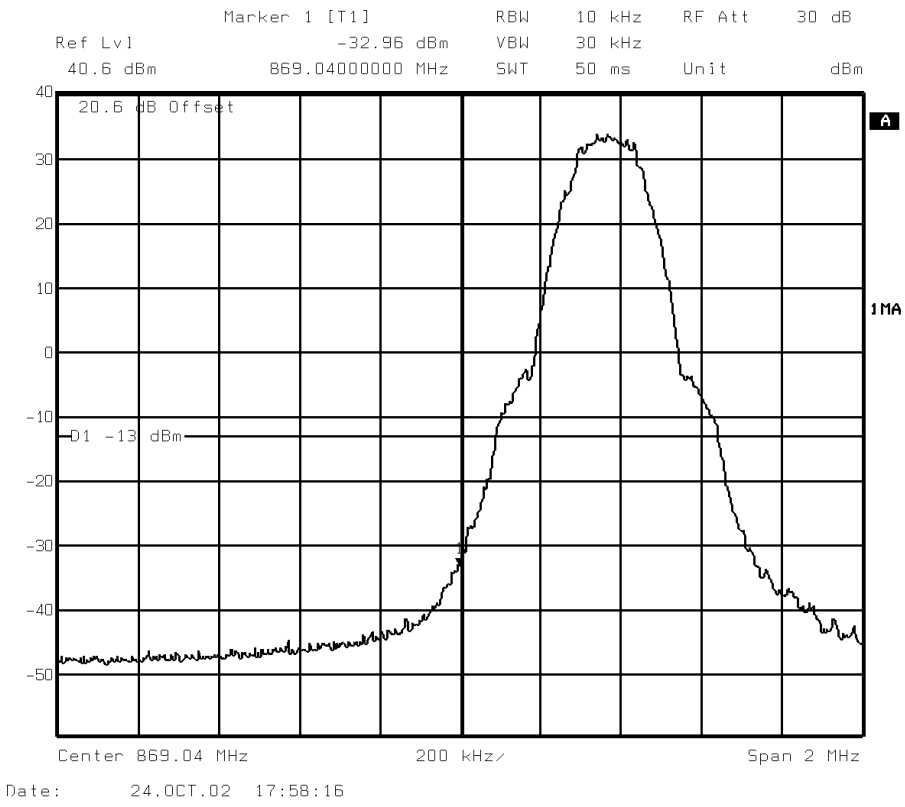
Test Case: Spurious Emissions At Antenna Terminals (+/-1MHz)

Test Date: 24th October 2002

Rule Parts: 2.1049, 22.905

Block Edge Measurement With EUT Transmitting on Full Power On Channel 129, (869.40MHz)
GMSK Modulation

Block A
869.040 – 879.990MHz



Test Equipment Used:

1, 2, 7, 10

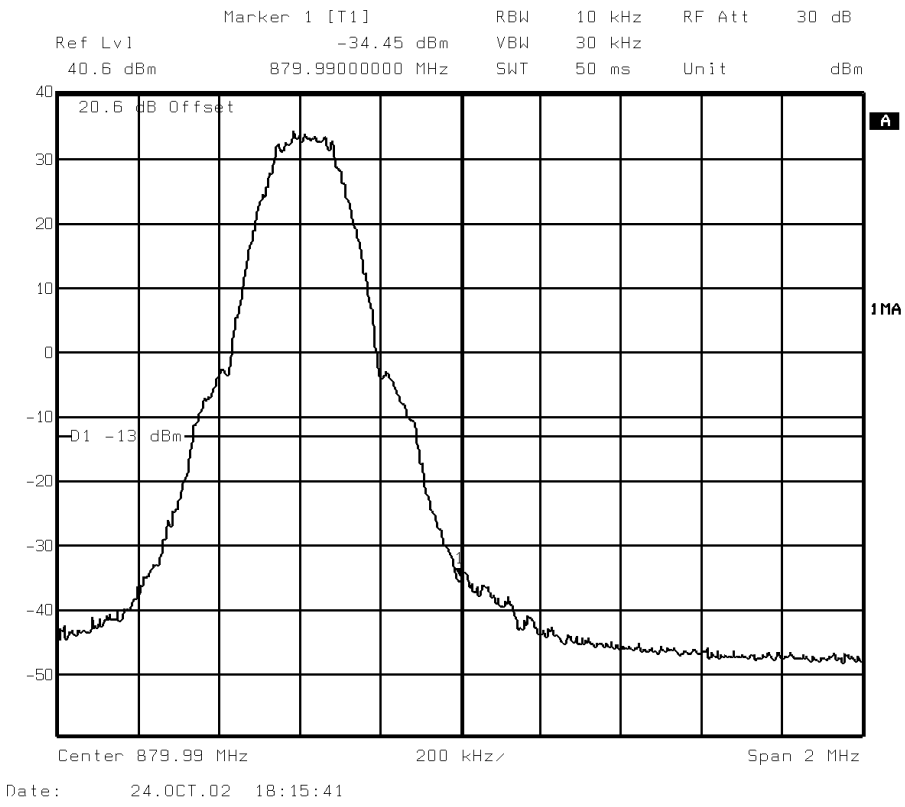
Test Case: Spurious Emissions At Antenna Terminals (+/-1MHz)

Test Date: 24th October 2002

Rule Parts: 2.1049, 22.905

Block Edge Measurement With EUT Transmitting on Full Power On Channel 180, (879.60MHz)
GMSK Modulation

Block A
869.040 – 879.990MHz



Test Equipment Used:

1, 2, 7, 10

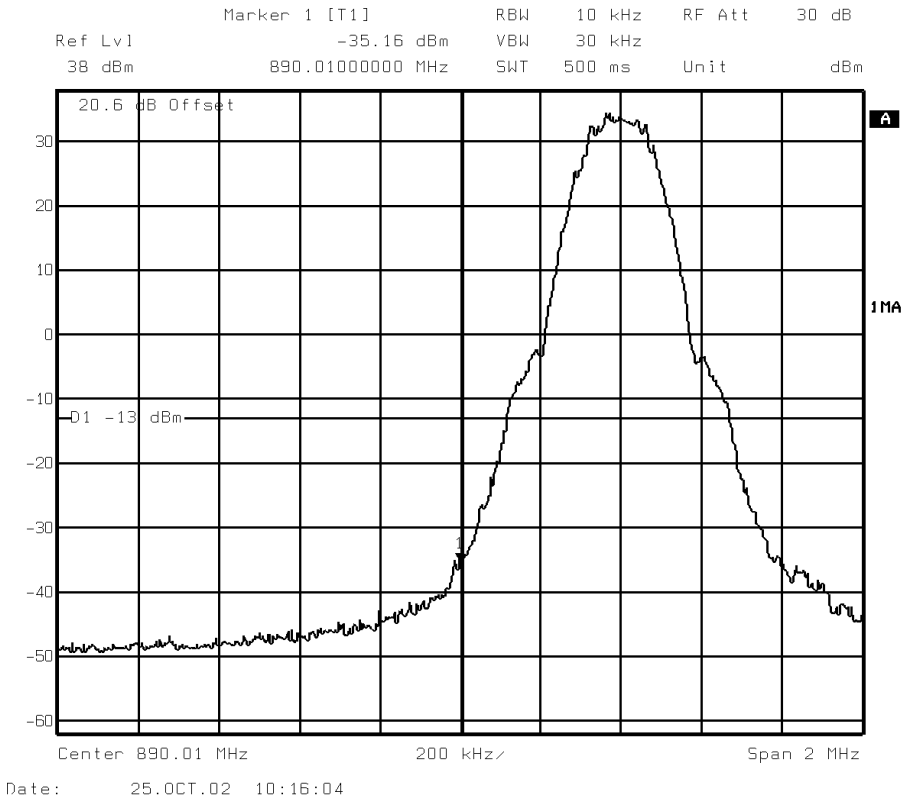
Test Case: Spurious Emissions At Antenna Terminals (+/-1MHz)

Test Date: 25th October 2002

Rule Parts: 2.1049, 22.905

Block Edge Measurement With EUT Transmitting on Full Power On Channel 234, (890.4MHz)
GMSK Modulation

Block A
890.010 – 891.480MHz



Test Equipment Used:

1, 2, 7, 10

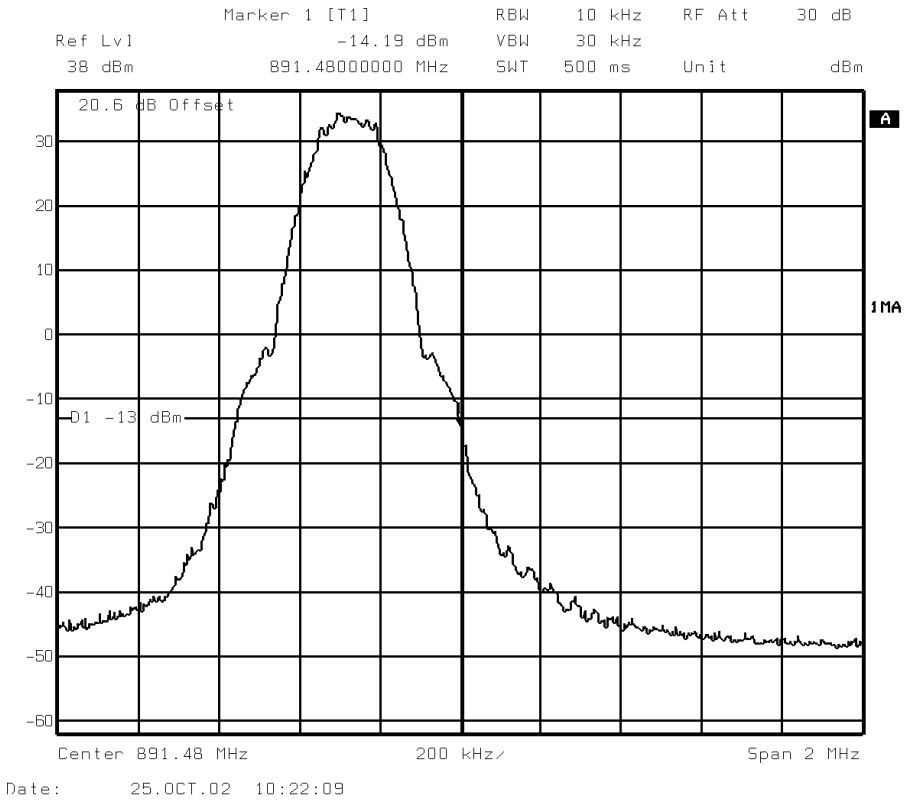
Test Case: Spurious Emissions At Antenna Terminals (+/-1MHz)

Test Date: 25th October 2002

Rule Parts: 2.1049, 22.905

Block Edge Measurement With EUT Transmitting on Full Power On Channel 238, (891.2MHz)
GMSK Modulation

Block A
890.010 – 891.480MHz



Test Equipment Used:

1, 2, 7, 10

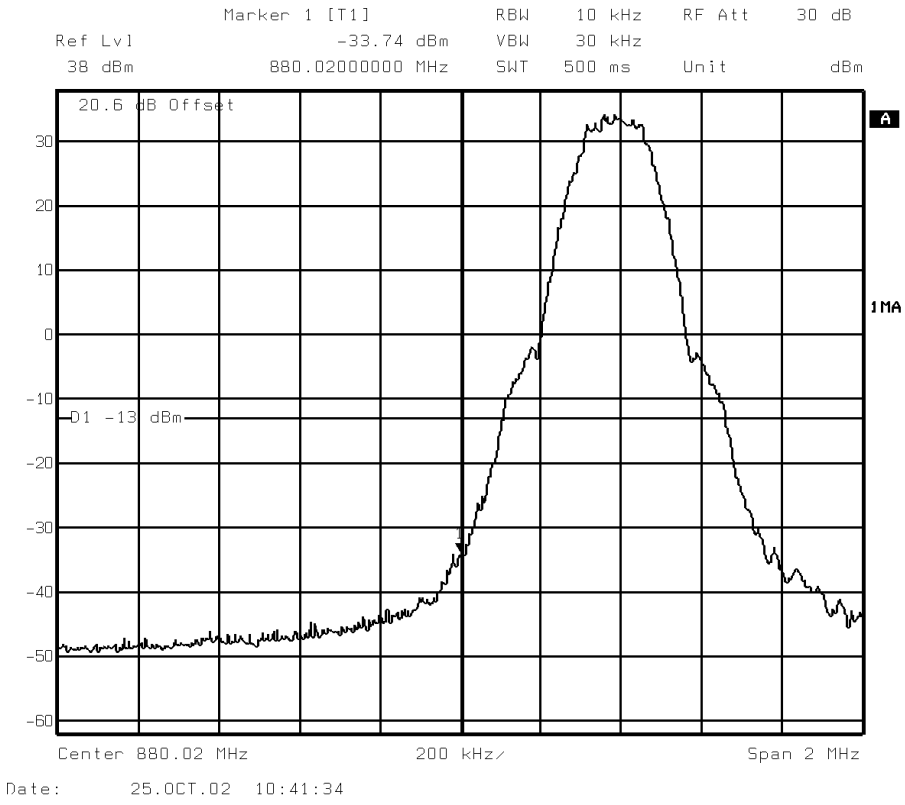
Test Case: Spurious Emissions At Antenna Terminals (+/-1MHz)

Test Date: 25th October 2002

Rule Parts: 2.1049, 22.905

Block Edge Measurement With EUT Transmitting on Full Power On Channel 184, (880.4MHz)
GMSK Modulation

Block B
880.020 – 889.980MHz



Test Equipment Used:

1, 2, 7, 10

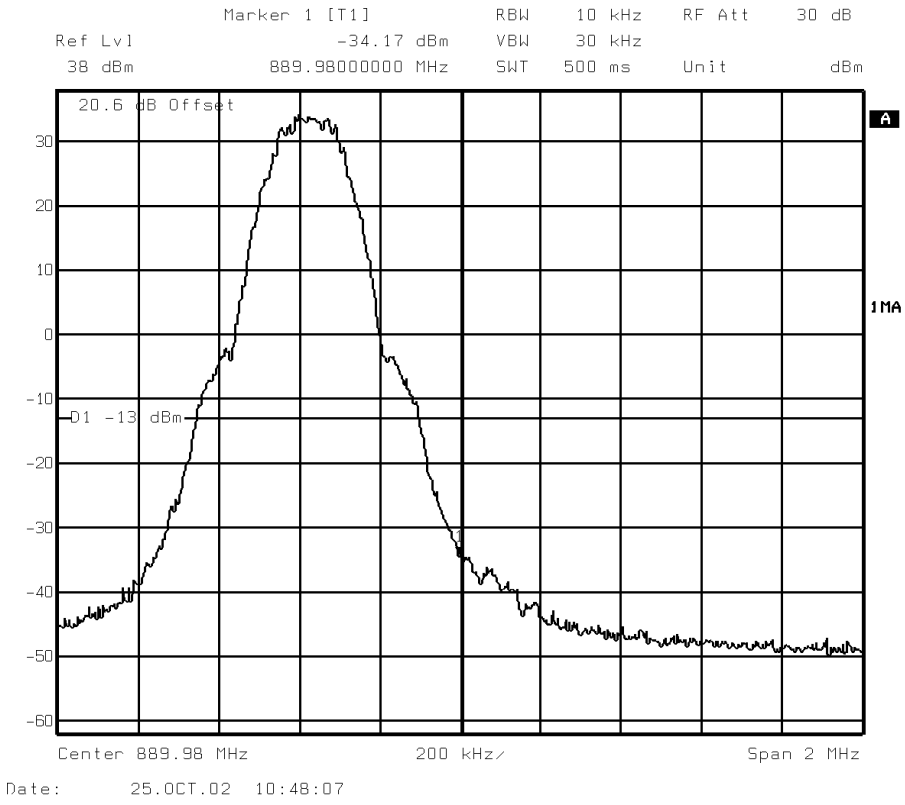
Test Case: Spurious Emissions At Antenna Terminals (+/-1MHz)

Test Date: 25th October 2002

Rule Parts: 2.1049, 22.905

Block Edge Measurement With EUT Transmitting on Full Power On Channel 230, (889.6MHz)
GMSK Modulation

Block B
880.020 – 889.980MHz



Test Equipment Used:

1, 2, 7, 10

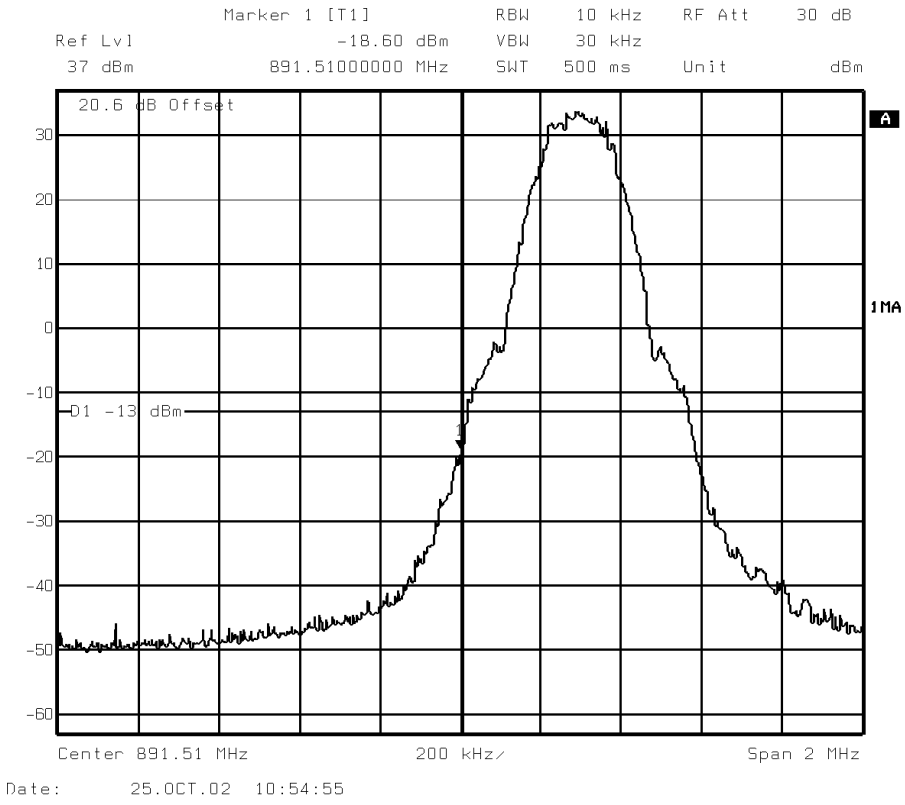
Test Case: Spurious Emissions At Antenna Terminals (+/-1MHz)

Test Date: 25th October 2002

Rule Parts: 2.1049, 22.905

Block Edge Measurement With EUT Transmitting on Full Power On Channel 241, (891.8MHz)
GMSK Modulation

Block B
891.510 – 893.970MHz



Test Equipment Used:

1, 2, 7, 10

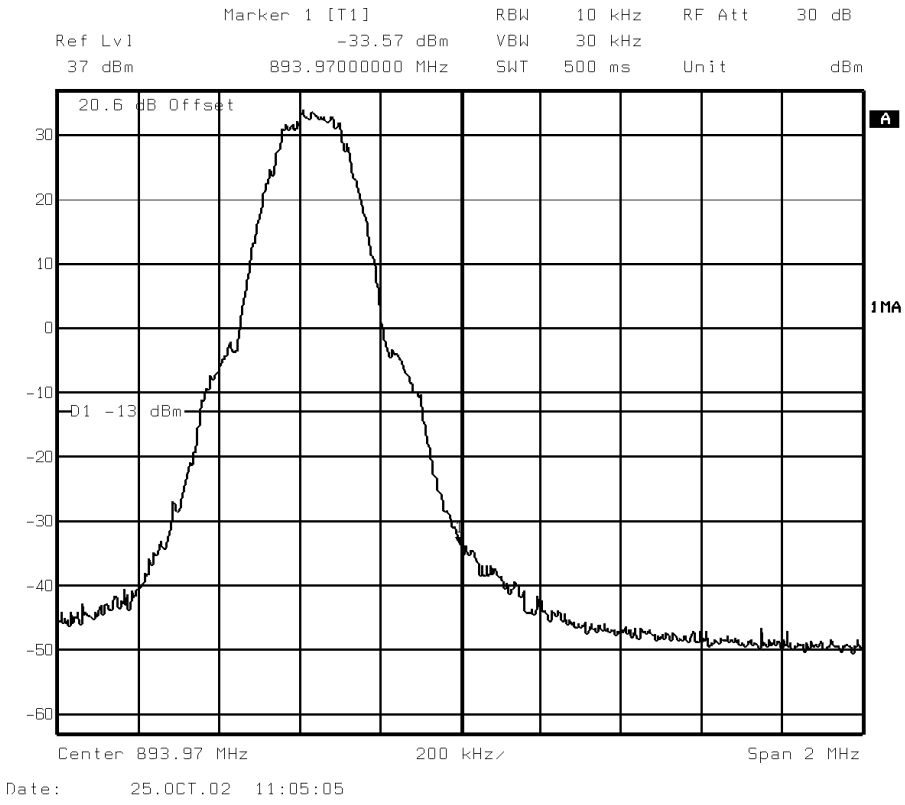
Test Case: Spurious Emissions At Antenna Terminals (+/-1MHz)

Test Date: 25th October 2002

Rule Parts: 2.1049, 22.905

Block Edge Measurement With EUT Transmitting on Full Power On Channel 250, (893.60MHz)
GMSK Modulation

Block B
891.510 – 893.970MHz



Test Equipment Used:

1, 2, 7, 10

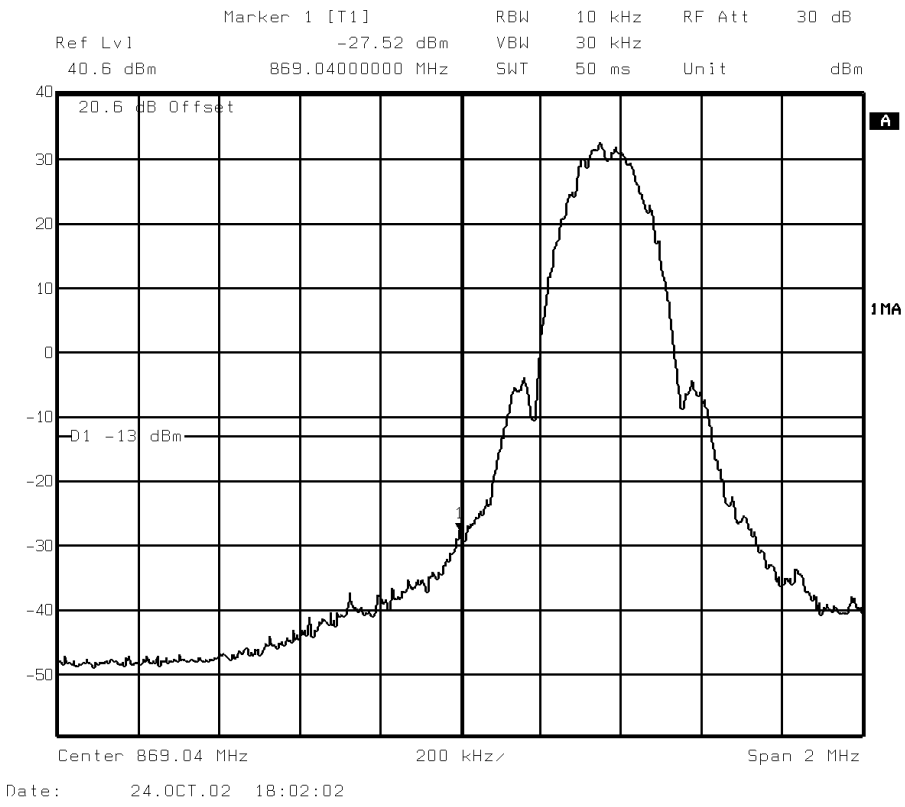
Test Case: Spurious Emissions At Antenna Terminals (+/-1MHz)

Test Date: 24th October 2002

Rule Parts: 2.1049, 22.905

Block Edge Measurement With EUT Transmitting on Full Power On Channel 129, (869.40MHz)
8PSK Modulation

Block A
869.040 – 879.990MHz



Test Equipment Used:

1, 2, 7, 10

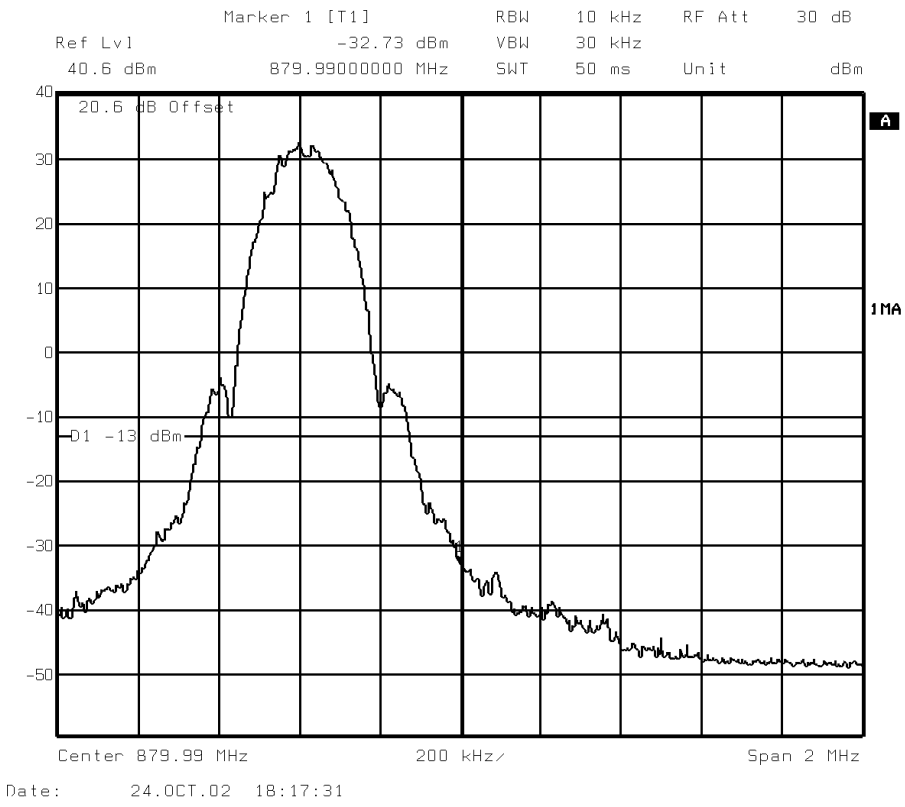
Test Case: Spurious Emissions At Antenna Terminals (+/-1MHz)

Test Date: 24th October 2002

Rule Parts: 2.1049, 22.905

Block Edge Measurement With EUT Transmitting on Full Power On Channel 180, (879.60MHz)
8PSK Modulation

Block A
869.040 – 879.990MHz



Test Equipment Used:

1, 2, 7, 10

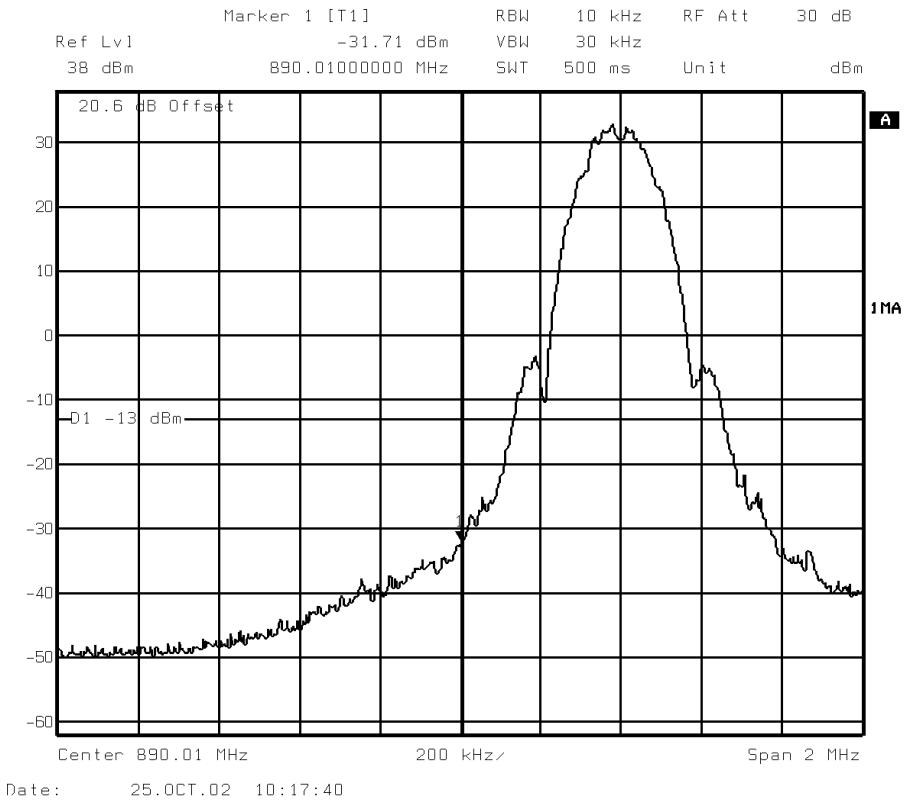
Test Case: Spurious Emissions At Antenna Terminals (+/-1MHz)

Test Date: 25th October 2002

Rule Parts: 2.1049, 22.905

Block Edge Measurement With EUT Transmitting on Full Power On Channel 234, (890.4MHz)
8PSK Modulation

Block A
890.010 – 891.480MHz



Test Equipment Used:

1, 2, 7, 10

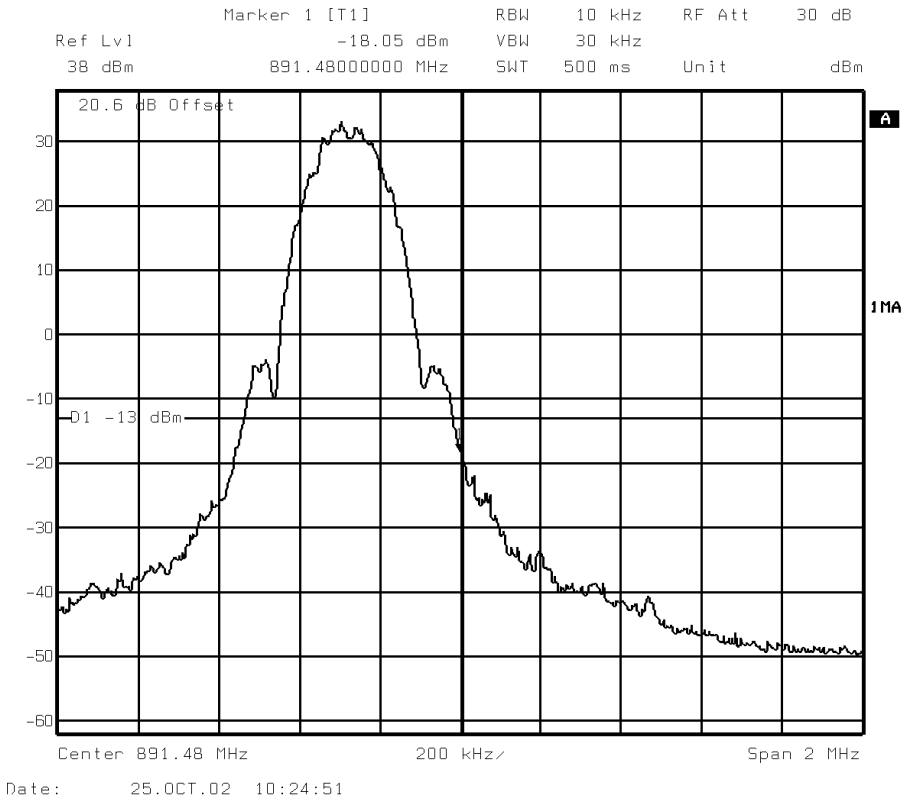
Test Case: Spurious Emissions At Antenna Terminals (+/-1MHz)

Test Date: 25th October 2002

Rule Parts: 2.1049, 22.905

Block Edge Measurement With EUT Transmitting on Full Power On Channel 238, (891.2MHz)
8PSK Modulation

Block A
890.010 – 891.480MHz



Test Equipment Used:

1, 2, 7, 10

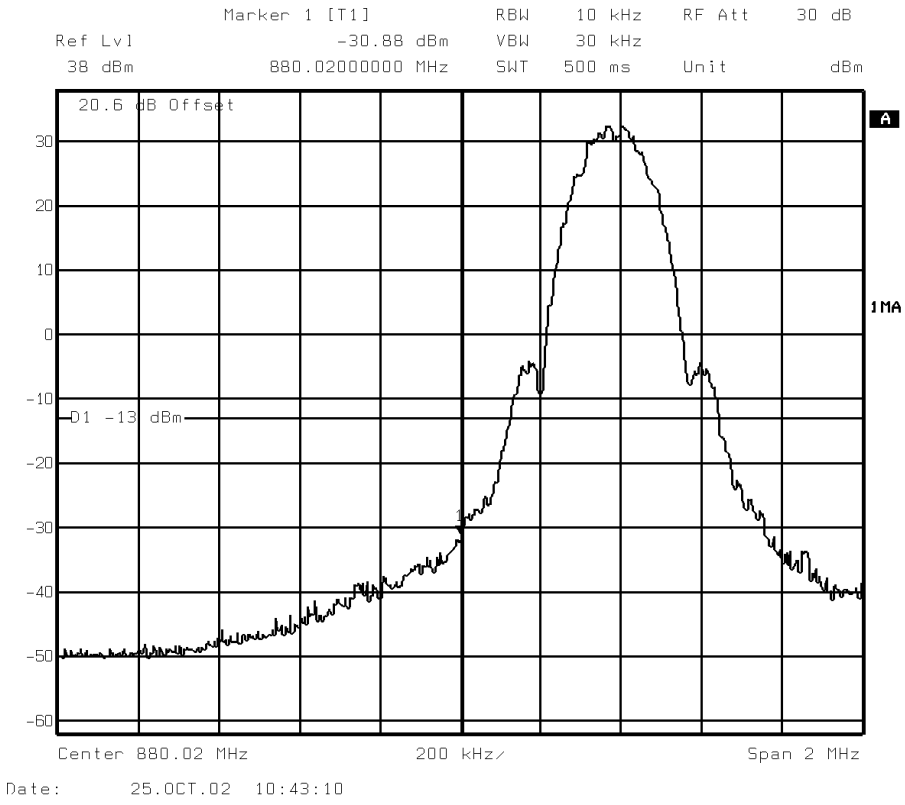
Test Case: Spurious Emissions At Antenna Terminals (+/-1MHz)

Test Date: 25th October 2002

Rule Parts: 2.1049, 22.905

Block Edge Measurement With EUT Transmitting on Full Power On Channel 184, (880.4MHz)
8PSK Modulation

Block B
880.020 – 889.980MHz



Test Equipment Used:

1, 2, 7, 10

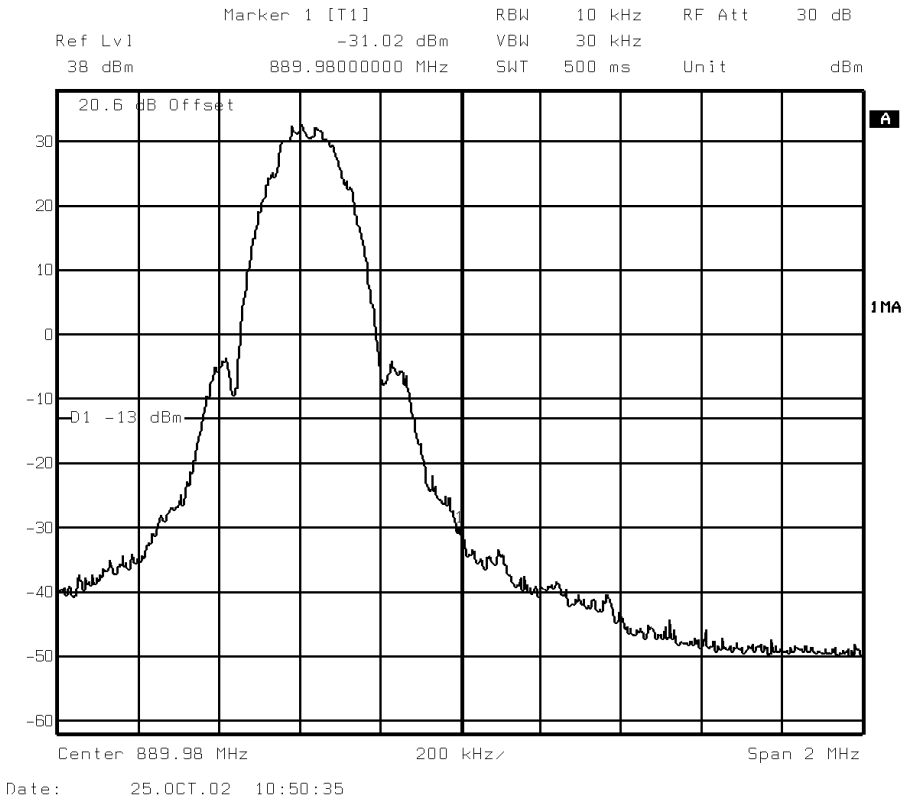
Test Case: Spurious Emissions At Antenna Terminals (+/-1MHz)

Test Date: 25th October 2002

Rule Parts: 2.1049, 22.905

Block Edge Measurement With EUT Transmitting on Full Power On Channel 230, (889.6MHz)
8PSK Modulation

Block B
880.020 – 889.980MHz



Test Equipment Used:

1, 2, 7, 10

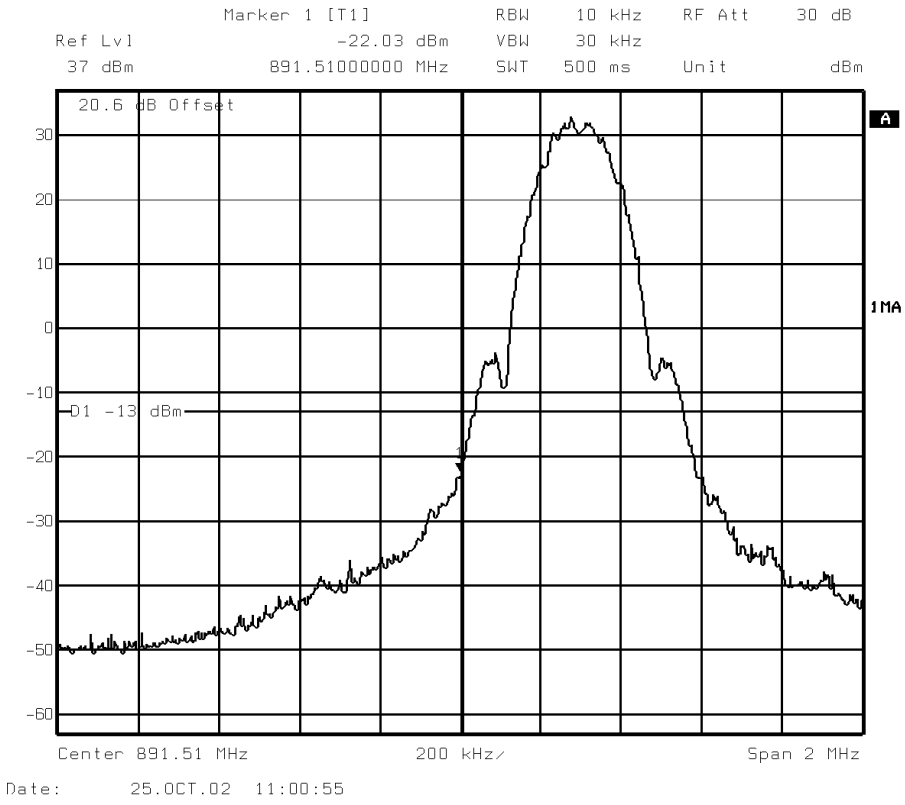
Test Case: Spurious Emissions At Antenna Terminals (+/-1MHz)

Test Date: 25th October 2002

Rule Parts: 2.1049, 22.905

Block Edge Measurement With EUT Transmitting on Full Power On Channel 241, (891.8MHz)
8PSK Modulation

Block B
891.510 – 893.970MHz



Test Equipment Used:

1, 2, 7, 10

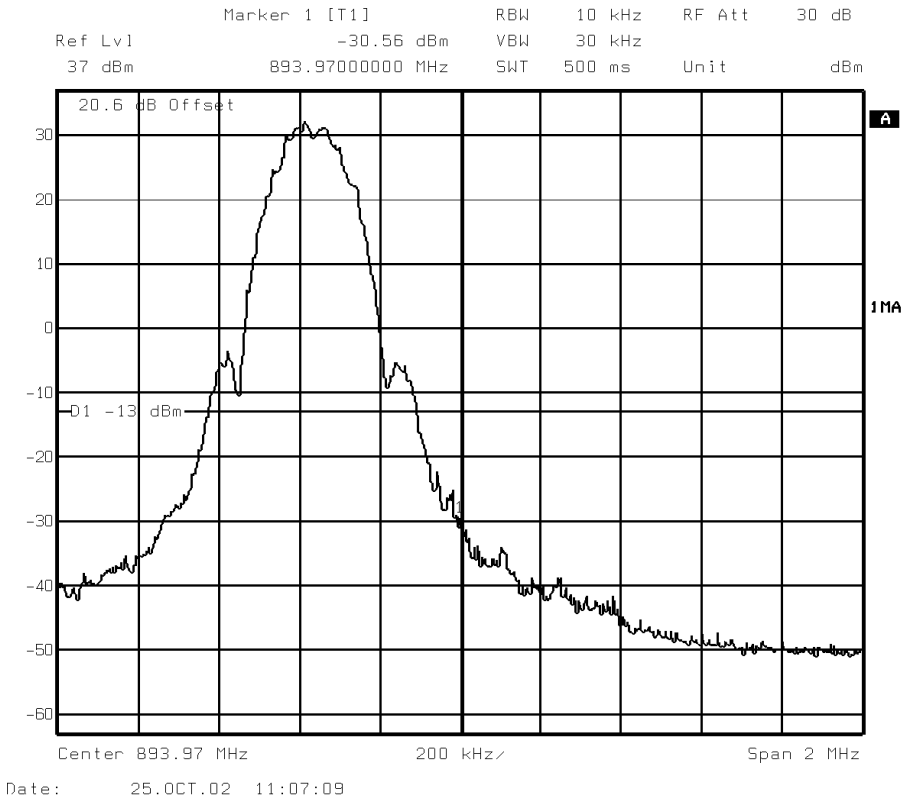
Test Case: Spurious Emissions At Antenna Terminals (+/-1MHz)

Test Date: 25th October 2002

Rule Parts: 2.1049, 22.905

Block Edge Measurement With EUT Transmitting on Full Power On Channel 250, (893.60MHz)
8PSK Modulation

Block B
891.510 – 893.970MHz



Test Equipment Used:

1, 2, 7, 10

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Measurement Method

In accordance with Part 2.1051, the spurious emissions from the antenna terminal were measured. The transmitter output power was attenuated using a combination of filters and attenuators and the frequency spectrum investigated from 9kHz to 9GHz. The EUT was set to transmit on full power with all timeslots active and minimum power with all timeslots active. The EUT was tested on Bottom, Middle and Top channels for both power levels and both modulation schemes. The resolution and video bandwidths were set to 30kHz in accordance with Part 22.917(h). The spectrum analyser detector was set to Max Hold.

From 9kHz to 1.4GHz, an attenuator and a notch filter were used. For measuring the range 1.4GHz to 9GHz, an attenuator and high pass filter were used. This was to reduce saturation effects in the spectrum analyser.

Complete testing was carried out on the EUT with 110V AC Supply on both GMSK and 8PSK modulation schemes and both power levels. Additional testing was performed on 48V DC and 24V DC on middle channel, maximum power.

The maximum path loss across the measurement band was used as the reference level offset to ensure worst case.

In addition, measurements were made up to the 10th harmonic of the fundamental.

Summary Of Results

No emissions within 20dB of the limit – 9kHz to 9GHz

Remarks

The EUT passed the requirements laid out in 22.917(e).

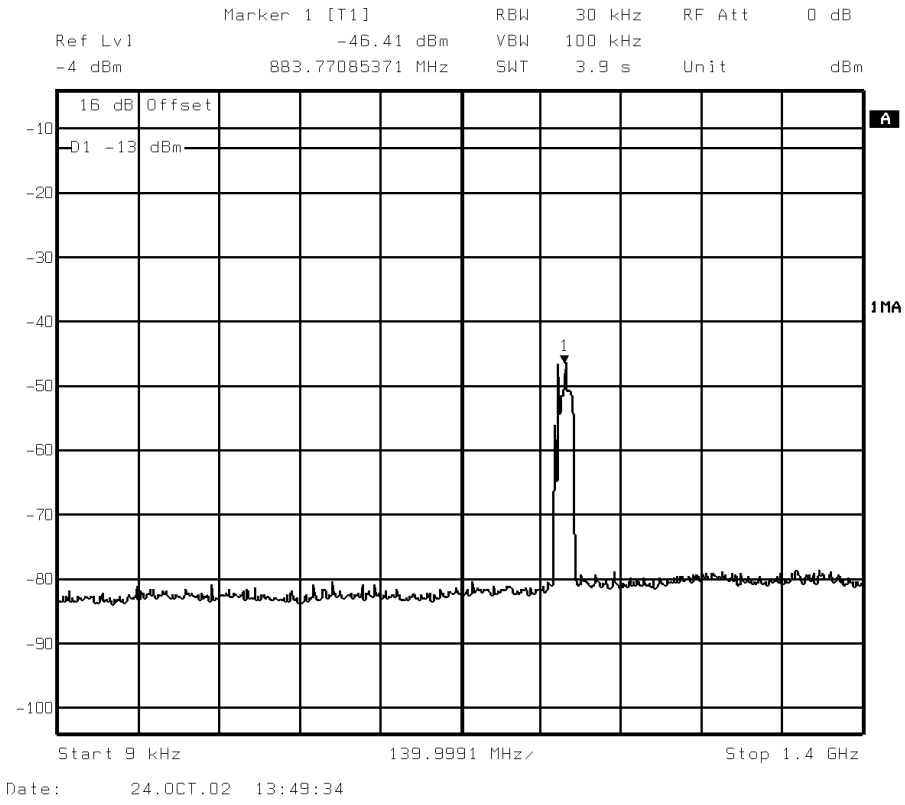
The plots on the following pages show the frequency spectrum from 9kHz to 9GHz of the EUT.

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (9kHz – 1.4GHz)
Channel 128, (869.2MHz) – Maximum Power - GMSK
110V AC Supply



Test Equipment Used:

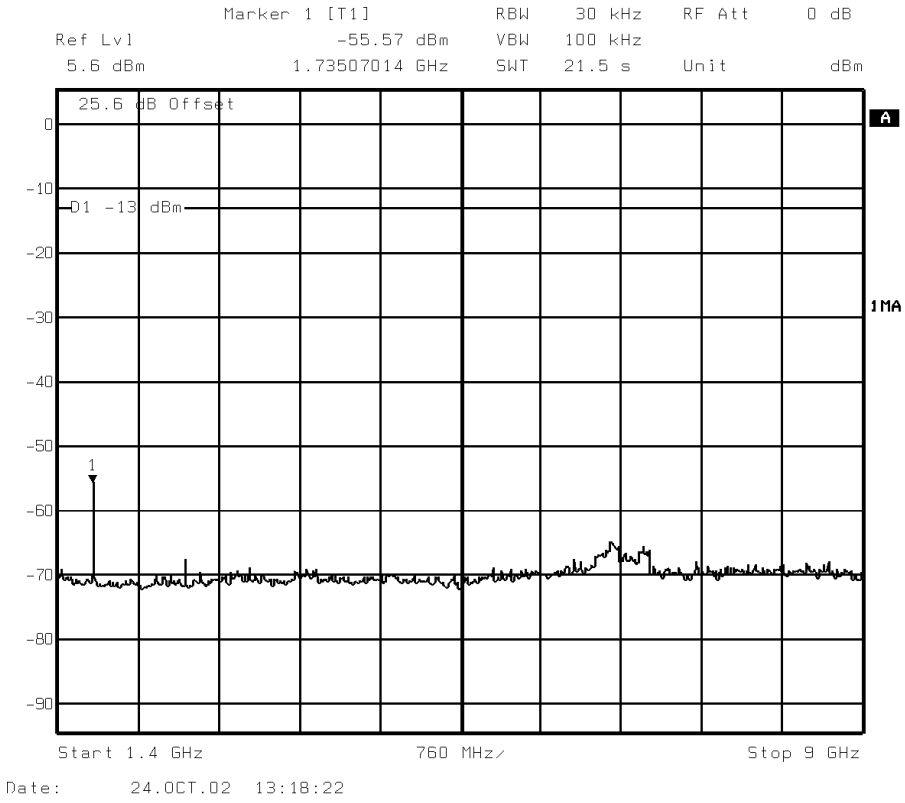
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (1.4GHz – 9.0GHz)
Channel 128, (869.2MHz) – Maximum Power - GMSK
110V AC Supply



Test Equipment Used:

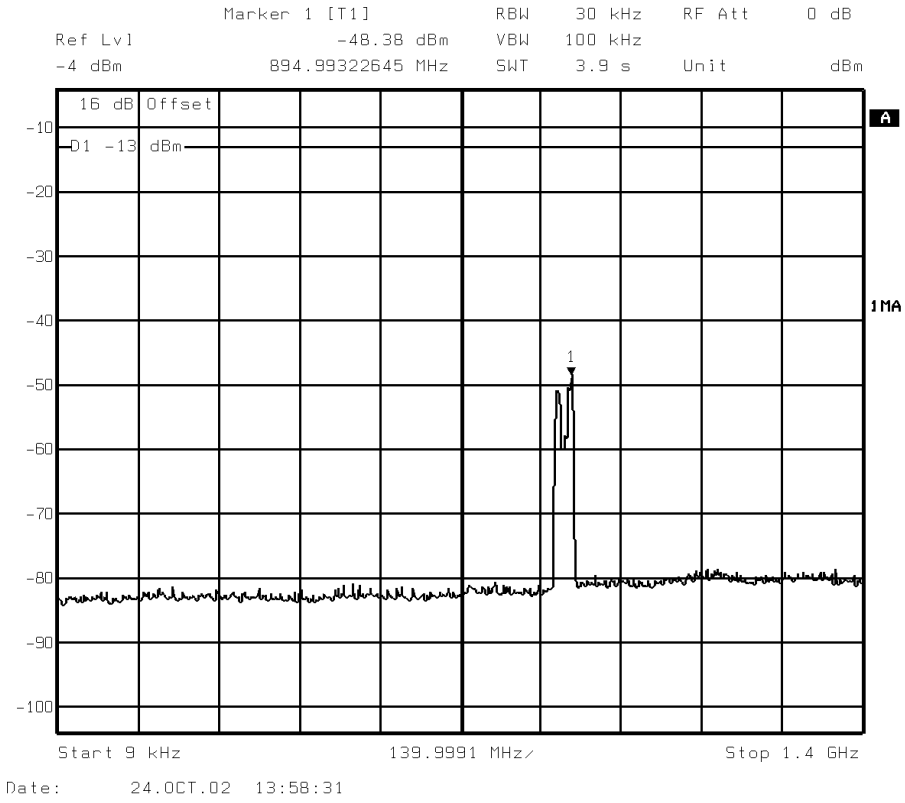
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (9kHz – 1.4GHz)
Channel 189, (881.4MHz) – Maximum Power - GMSK
110V AC Supply



Test Equipment Used:

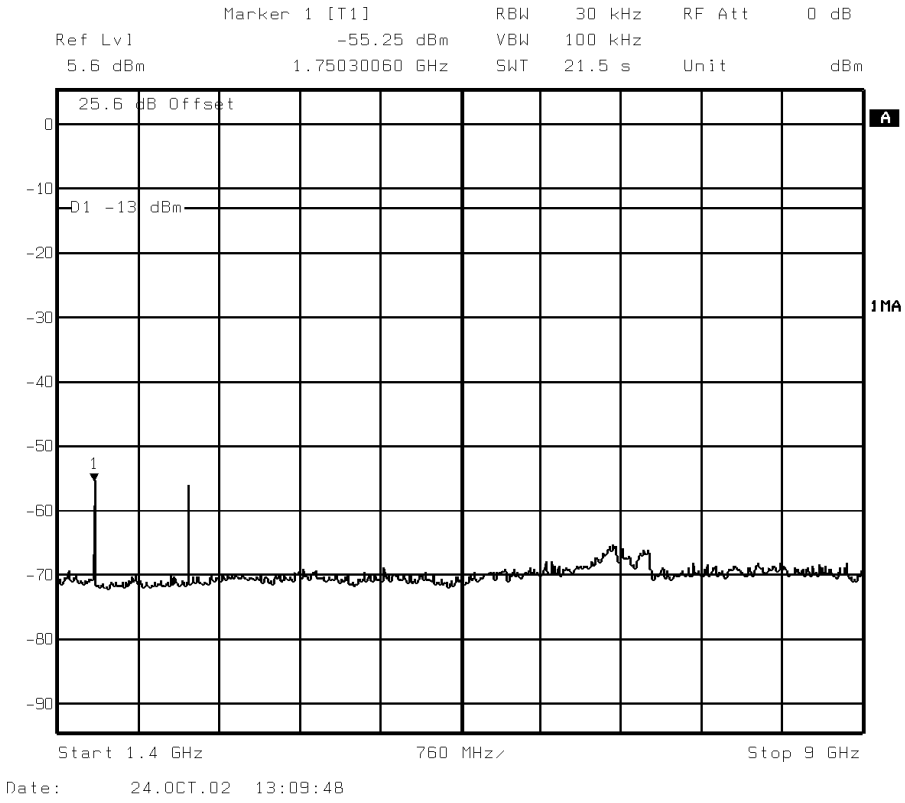
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (1.4GHz – 9.0GHz)
Channel 189, (881.4MHz) – Maximum Power - GMSK
110V AC Supply



Test Equipment Used:

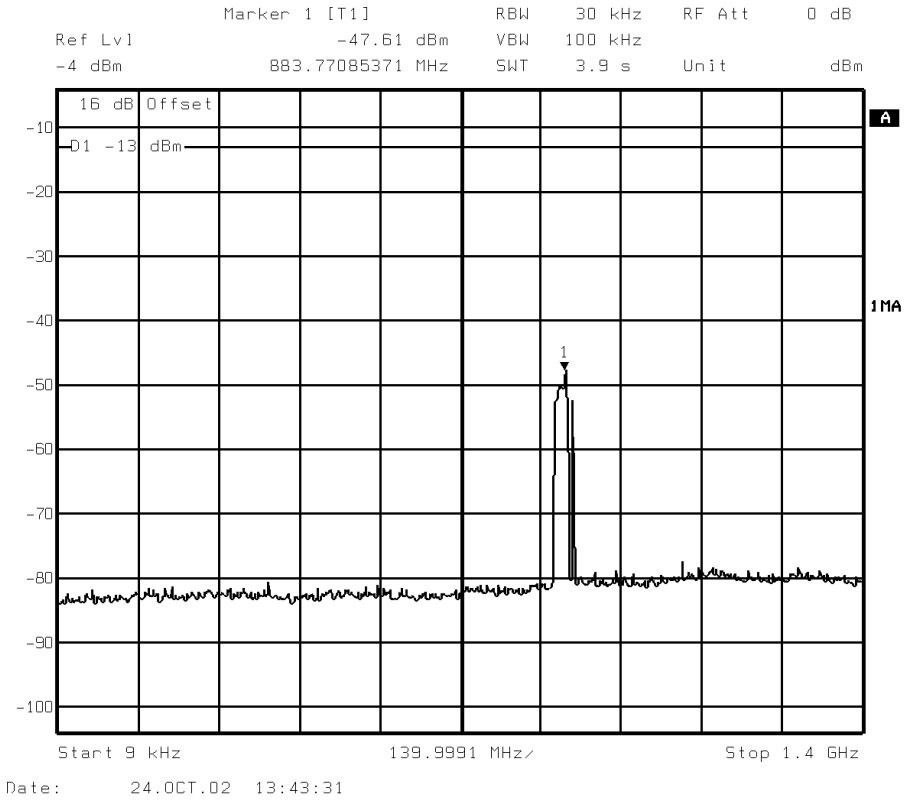
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (9kHz – 1.4GHz)
Channel 251, (893.8MHz) – Maximum Power - GMSK
110V AC Supply



Test Equipment Used:

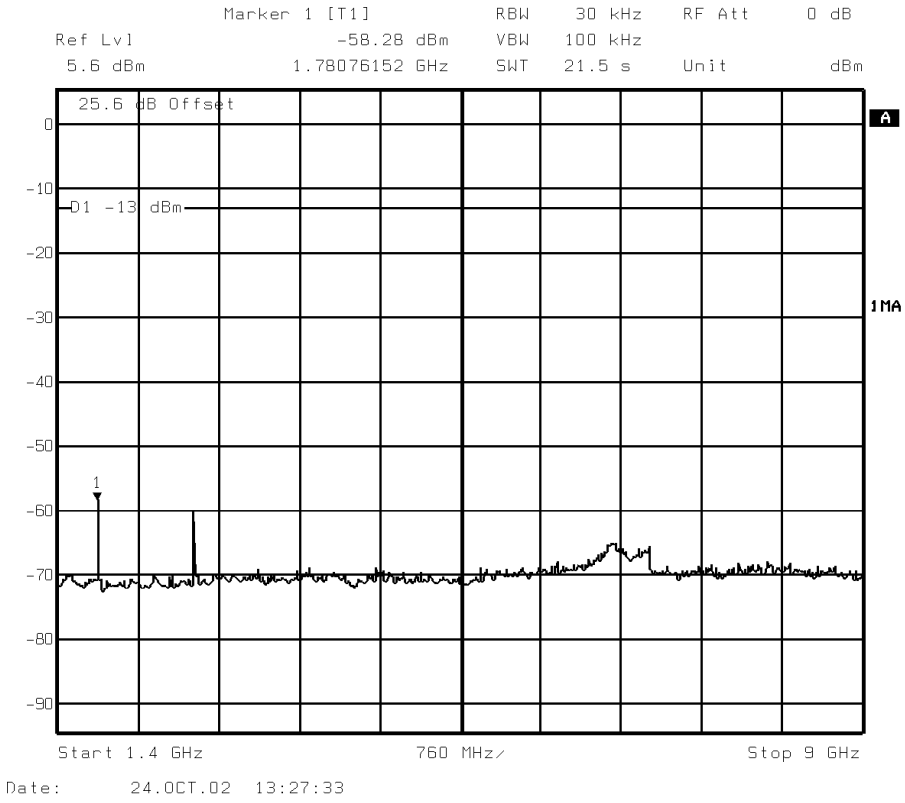
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (1.4GHz – 9.0GHz)
Channel 251, (893.8MHz) – Maximum Power - GMSK
110V AC Supply



Test Equipment Used:

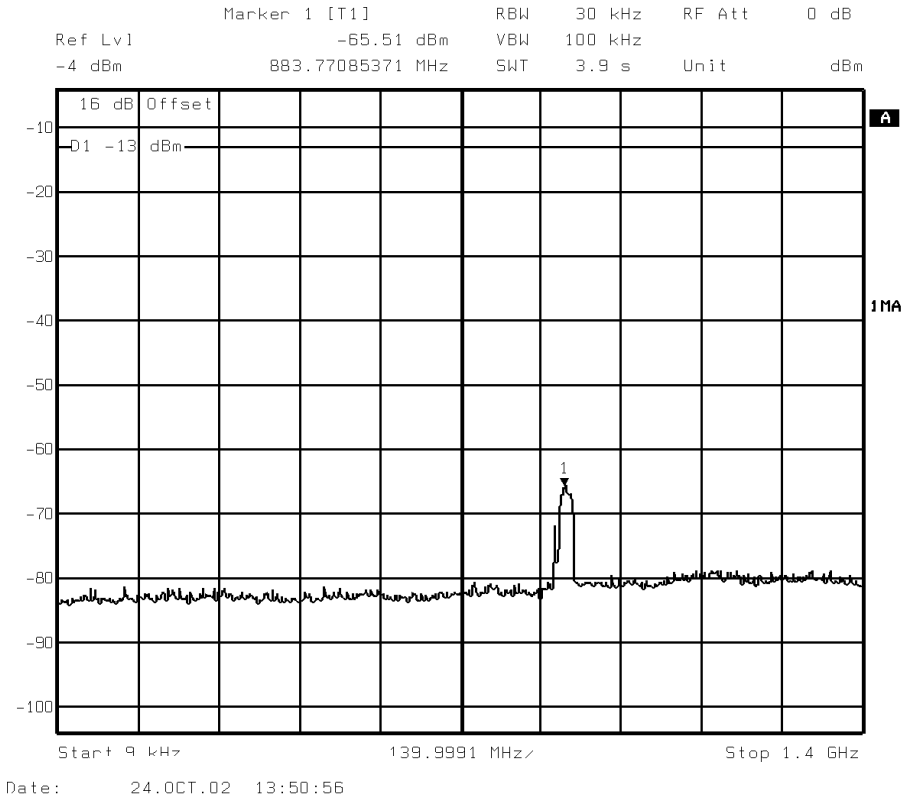
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (9kHz – 1.4GHz)
Channel 128, (869.2MHz) – Minimum Power - GMSK
110V AC Supply



Test Equipment Used:

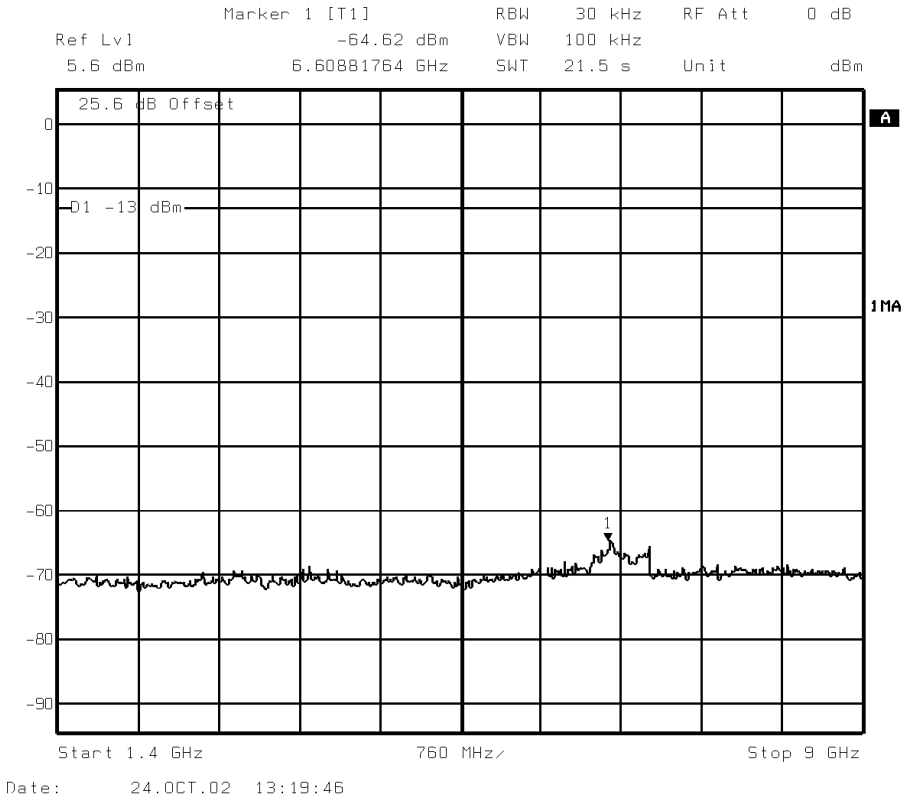
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (1.4GHz – 9.0GHz)
Channel 128, (869.2MHz) – Minimum Power - GMSK
110V AC Supply



Test Equipment Used:

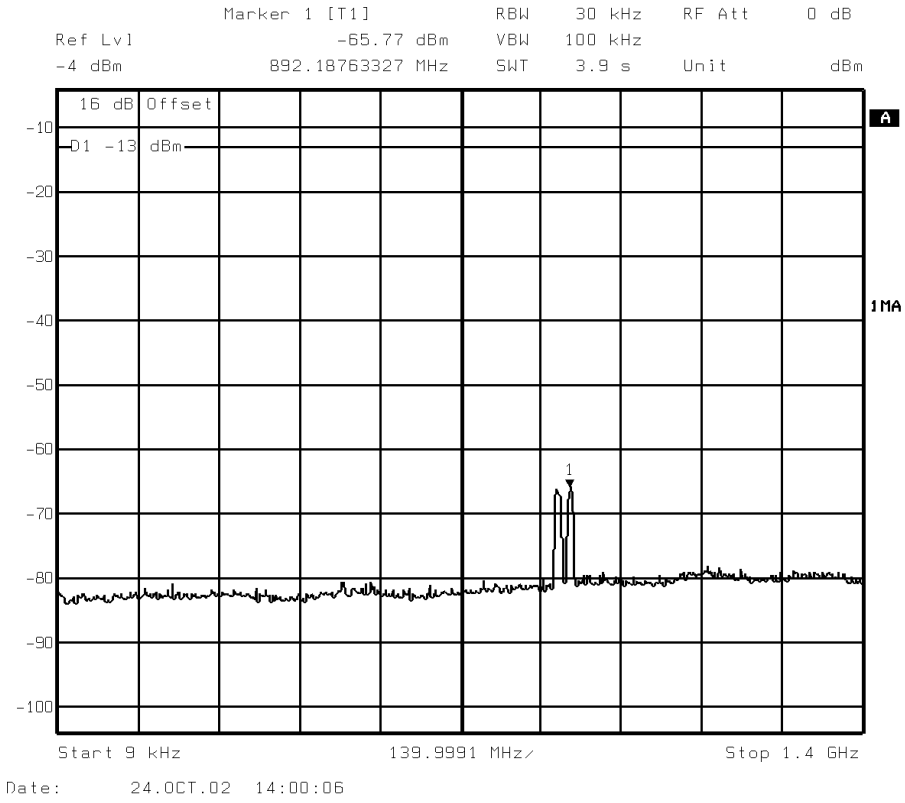
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (9kHz – 1.4GHz)
Channel 189, (881.4MHz) – Minimum Power - GMSK
110V AC Supply



Test Equipment Used:

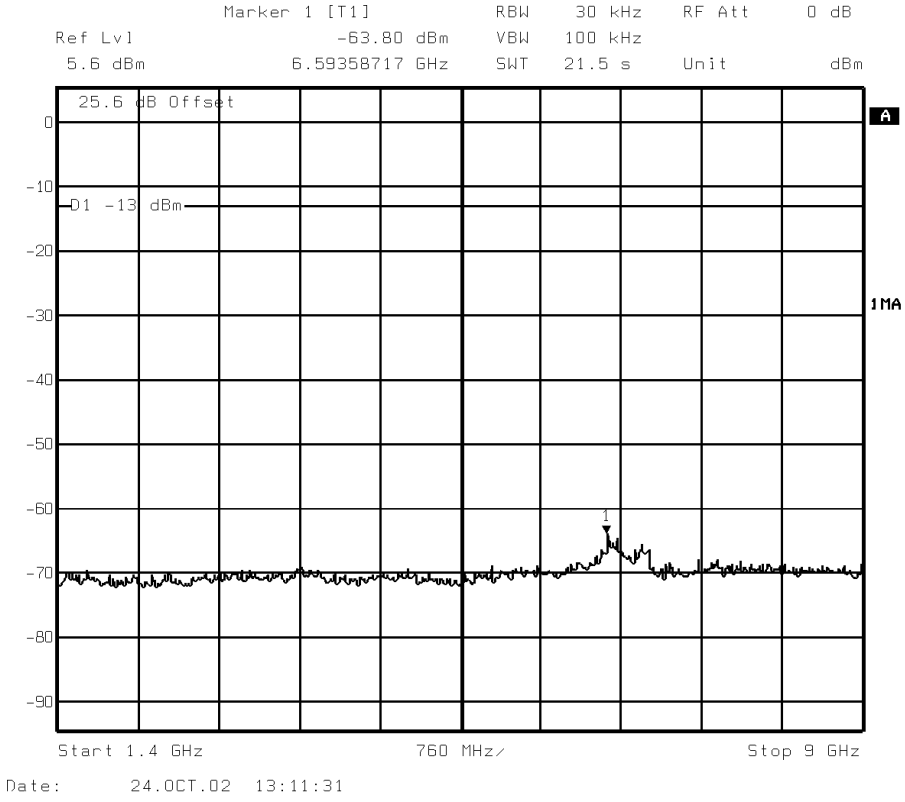
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (1.4GHz – 9.0GHz)
Channel 189, (881.4MHz) – Minimum Power - GMSK
110V AC Supply



Test Equipment Used:

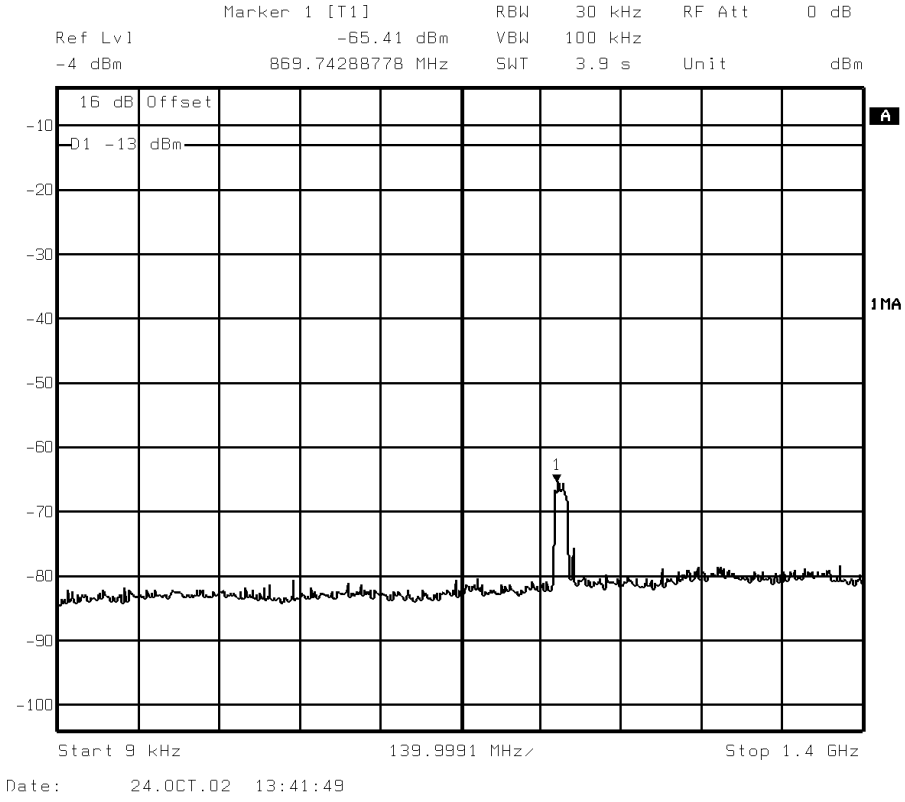
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (9kHz – 1.4GHz)
Channel 251, (893.8MHz) – Minimum Power - GMSK
110V AC Supply



Test Equipment Used:

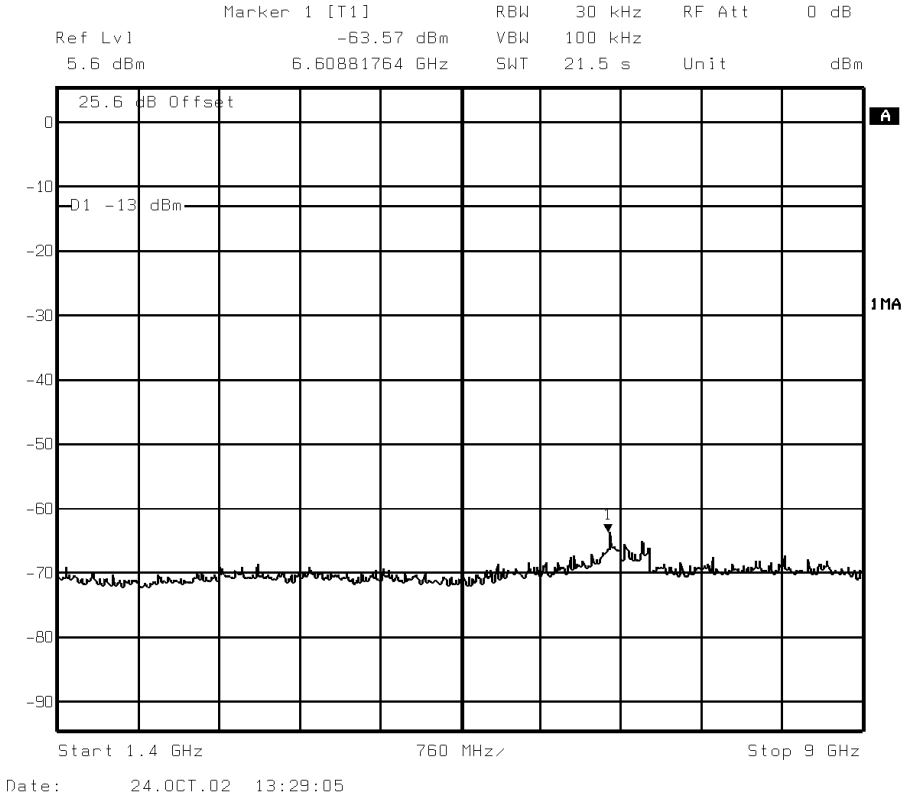
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (1.4GHz – 9.0GHz)
Channel 251, (893.8MHz) – Minimum Power - GMSK
110V AC Supply



Test Equipment Used:

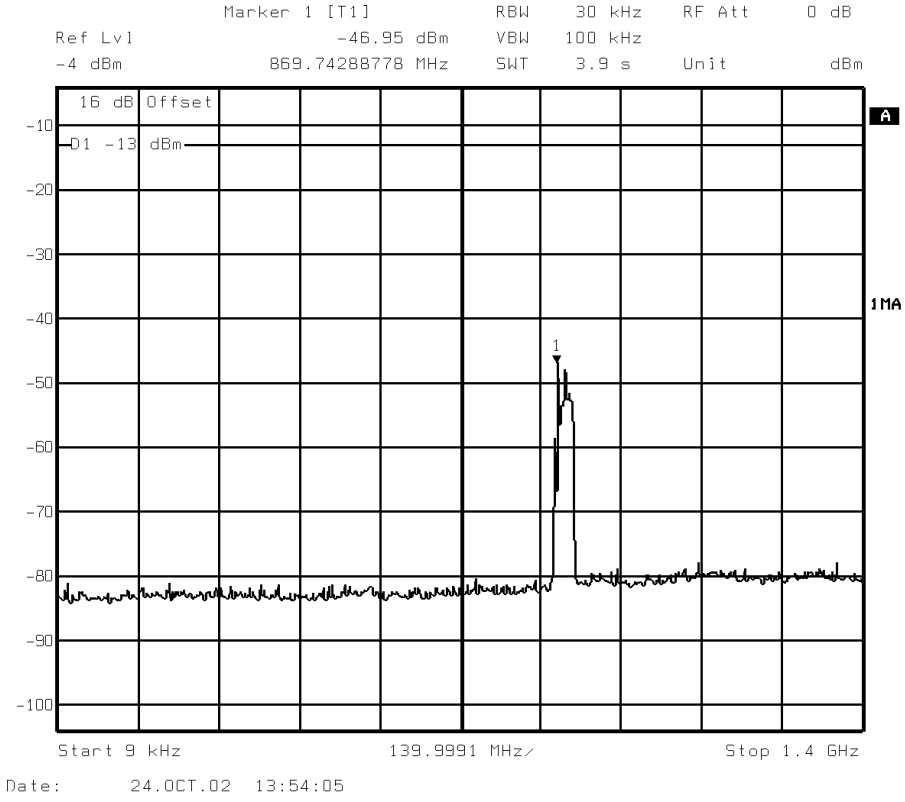
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (9kHz – 1.4GHz)
Channel 128, (869.2MHz) – Maximum Power – 8PSK
110V AC Supply



Test Equipment Used:

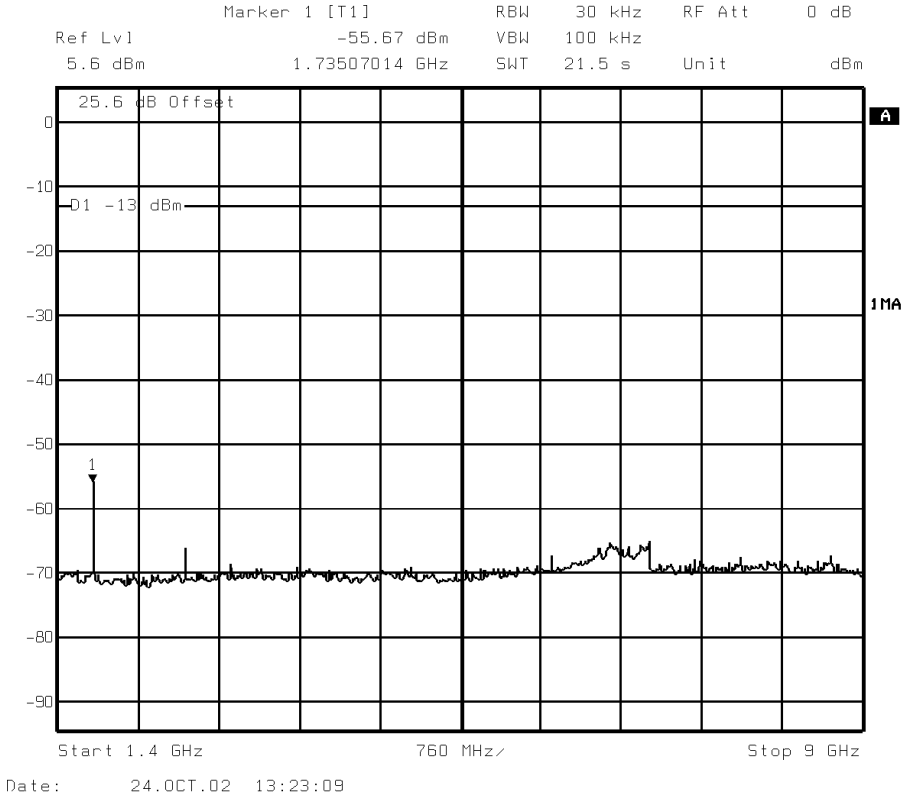
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (1.4GHz – 9.0GHz)
Channel 128, (869.2MHz) – Maximum Power – 8PSK
110V AC Supply



Test Equipment Used:

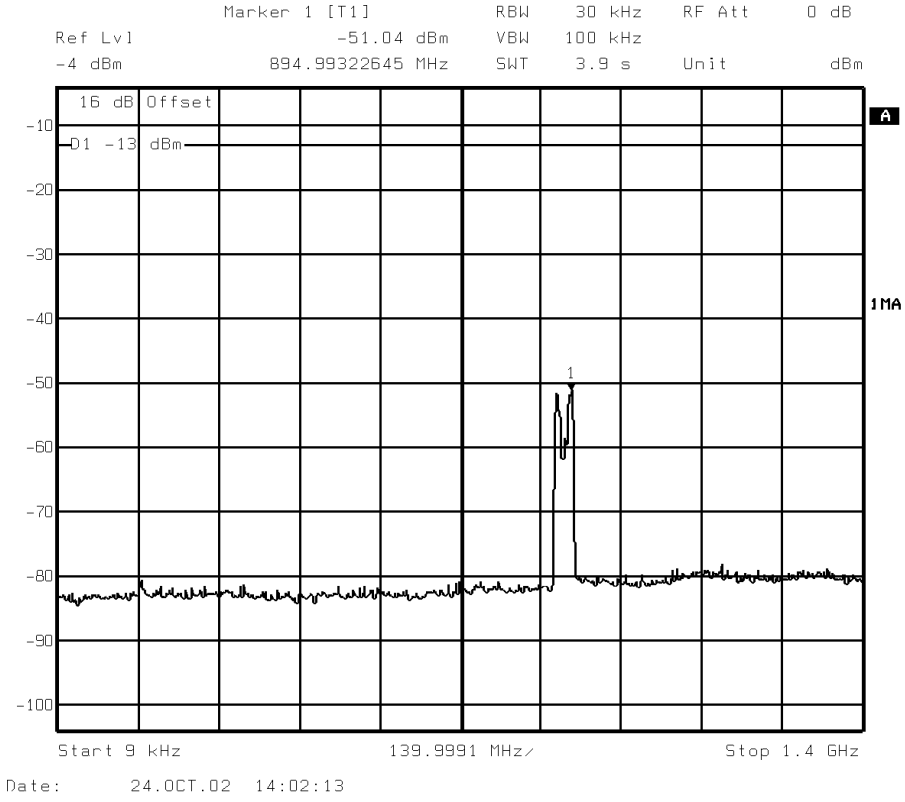
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (9kHz – 1.4GHz)
Channel 189, (881.4MHz) – Maximum Power – 8PSK
110V AC Supply



Test Equipment Used:

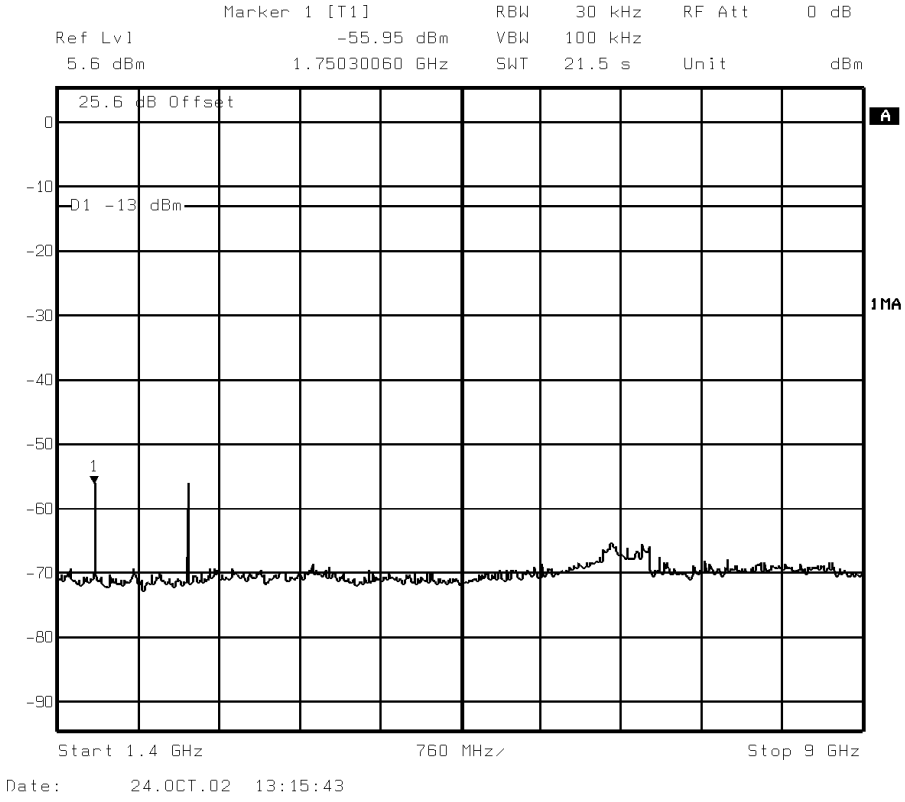
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (1.4GHz – 9.0GHz)
Channel 189, (881.4MHz) – Maximum Power – 8PSK
110V AC Supply



Test Equipment Used:

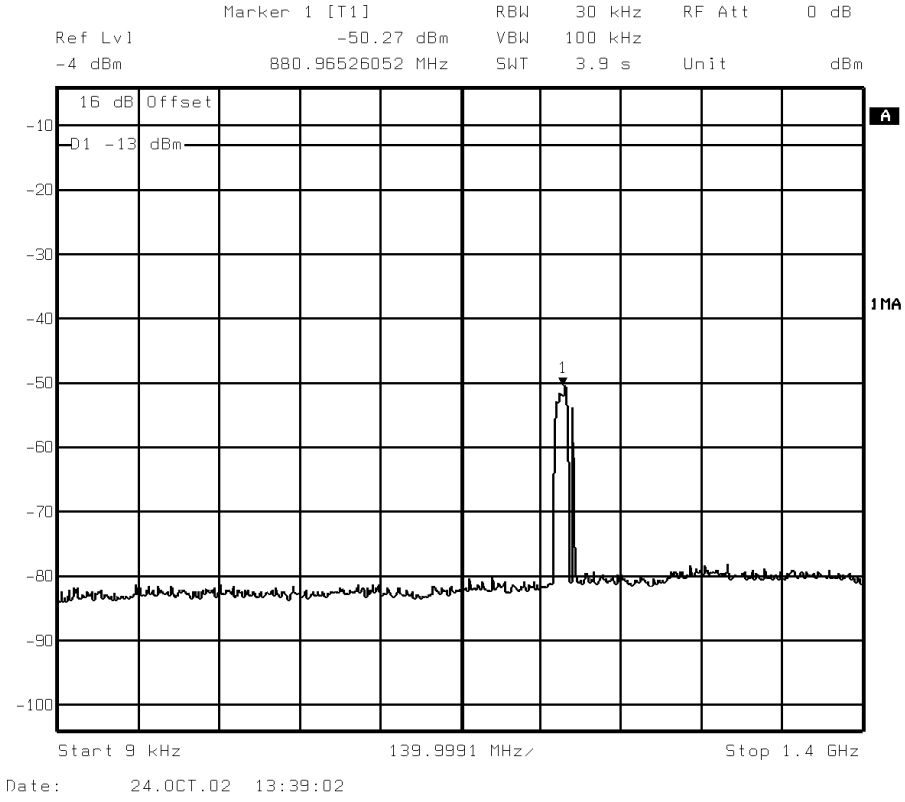
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (9kHz – 1.4GHz)
Channel 251, (893.8MHz) – Maximum Power – 8PSK
110V AC Supply



Test Equipment Used:

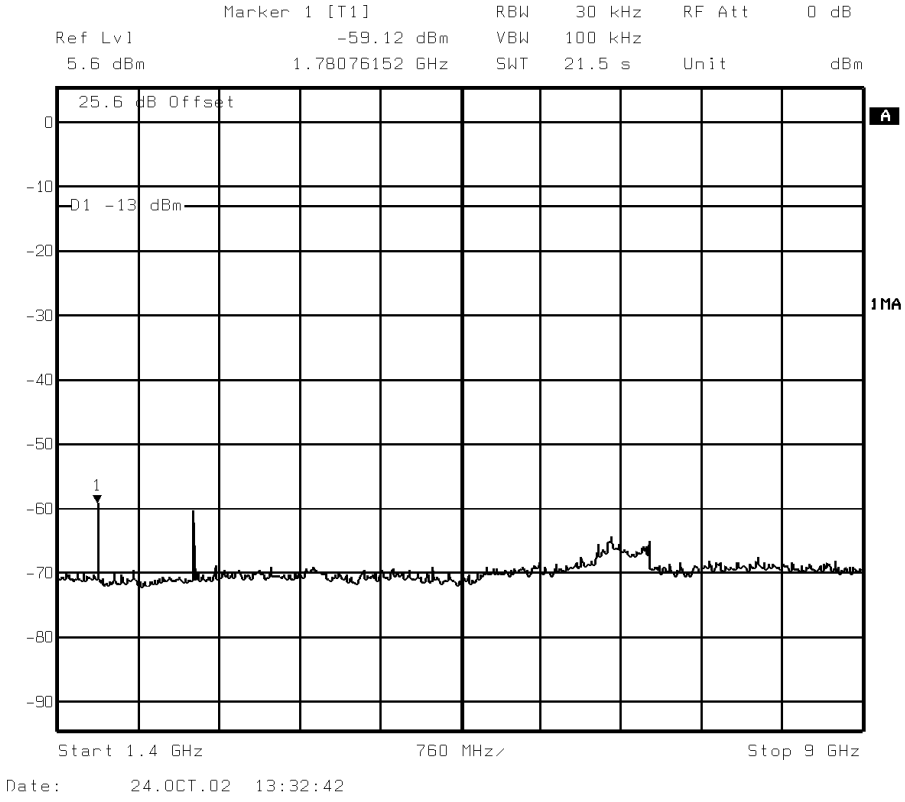
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (1.4GHz – 9.0GHz)
Channel 251, (893.8MHz) – Maximum Power – 8PSK
110V AC Supply



Test Equipment Used:

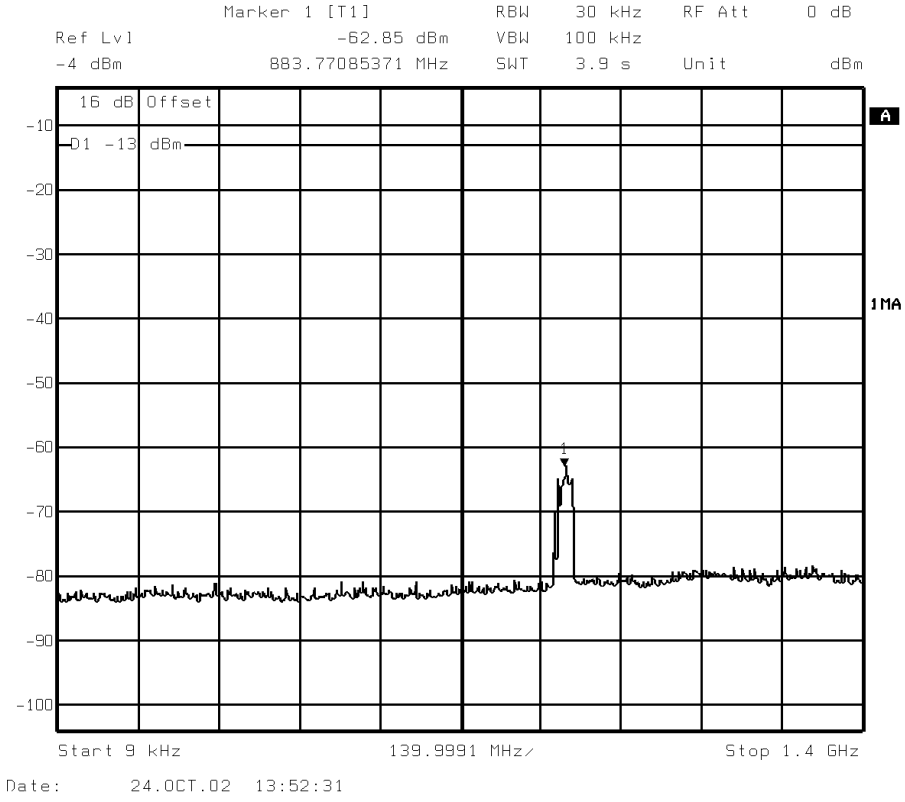
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (9kHz – 1.4GHz)
Channel 128, (869.2MHz) – Minimum Power – 8PSK
110V AC Supply



Test Equipment Used:

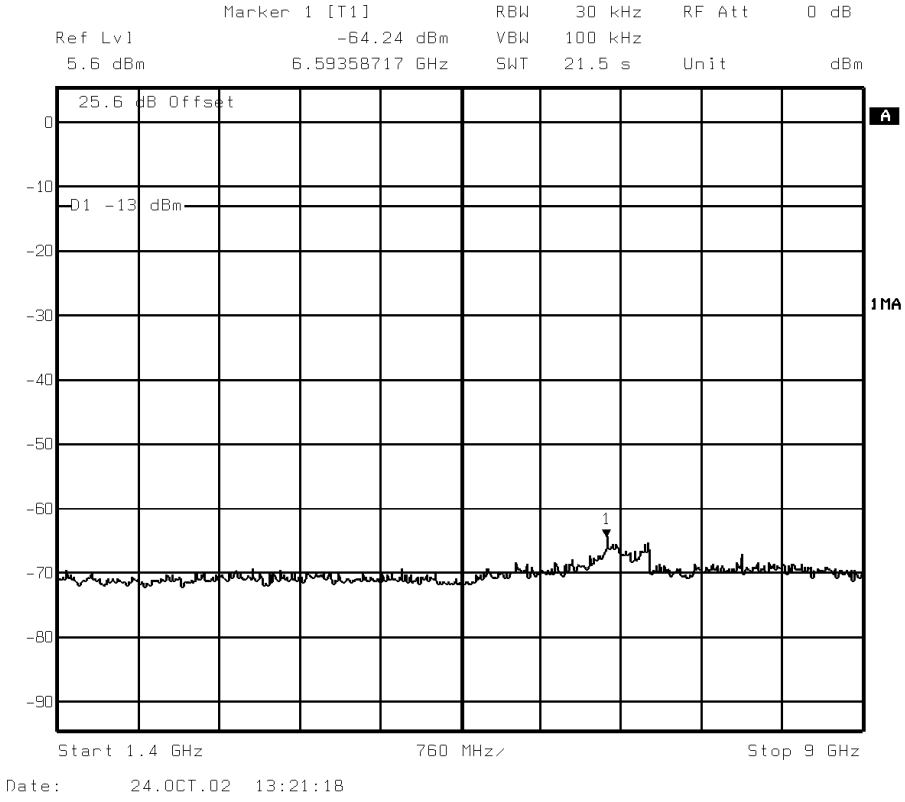
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (1.4GHz – 9.0GHz)
Channel 128, (869.2MHz) – Minimum Power – 8PSK
110V AC Supply



Test Equipment Used:

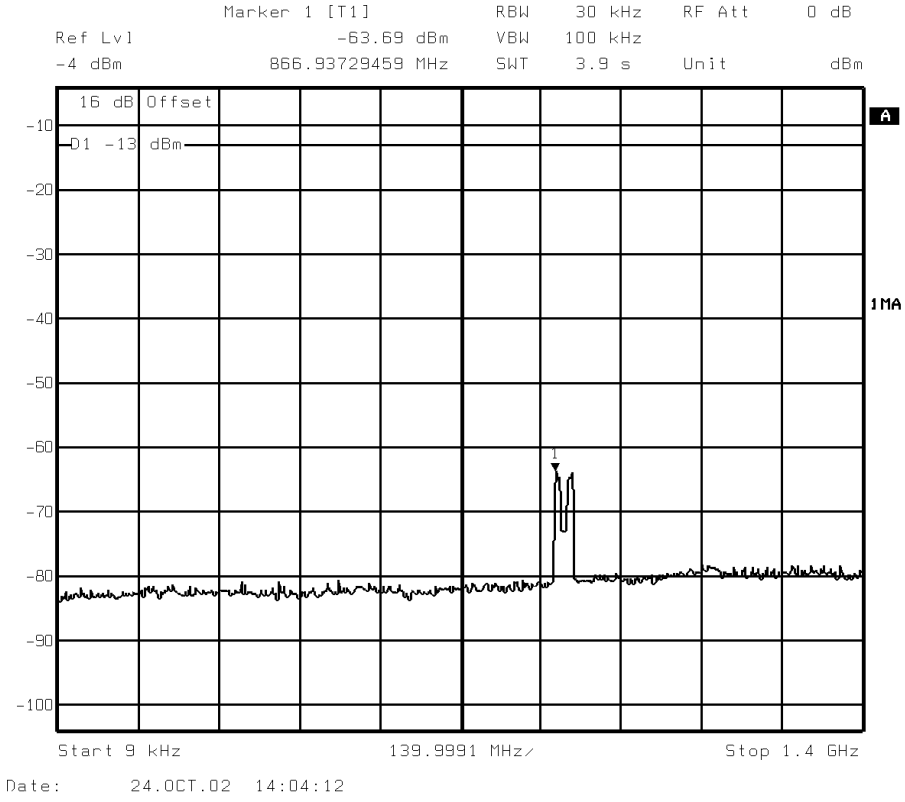
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (9kHz – 1.4GHz)
Channel 189, (881.4MHz) – Minimum Power – 8PSK
110V AC Supply



Test Equipment Used:

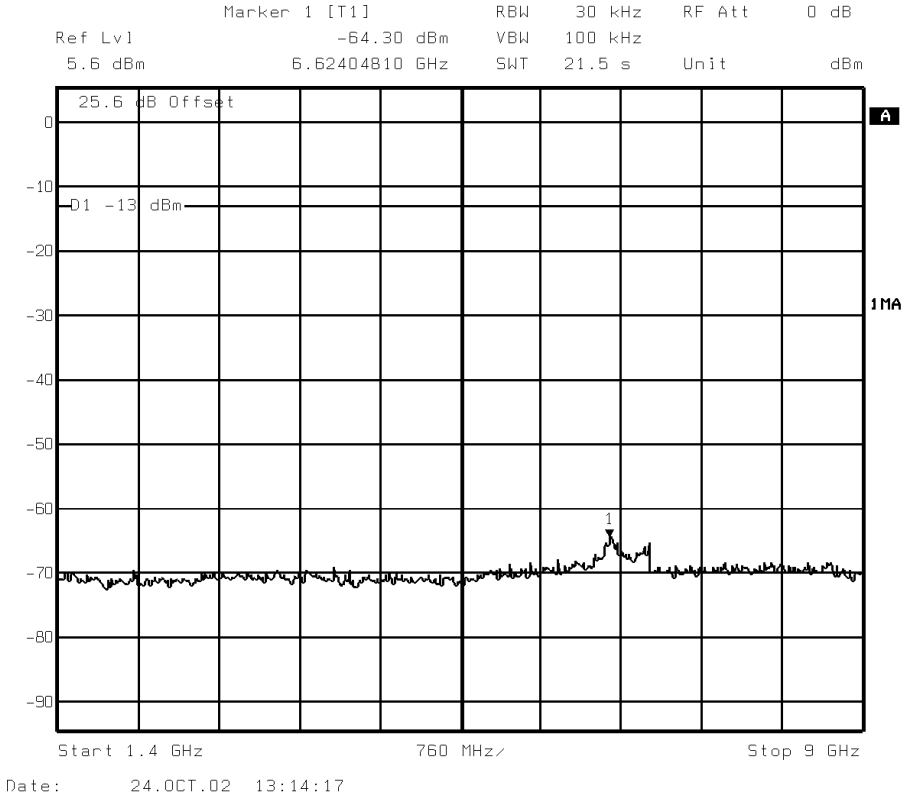
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (1.4GHz – 9.0GHz)
Channel 189, (881.4MHz) – Minimum Power – 8PSK
110V AC Supply



Test Equipment Used:

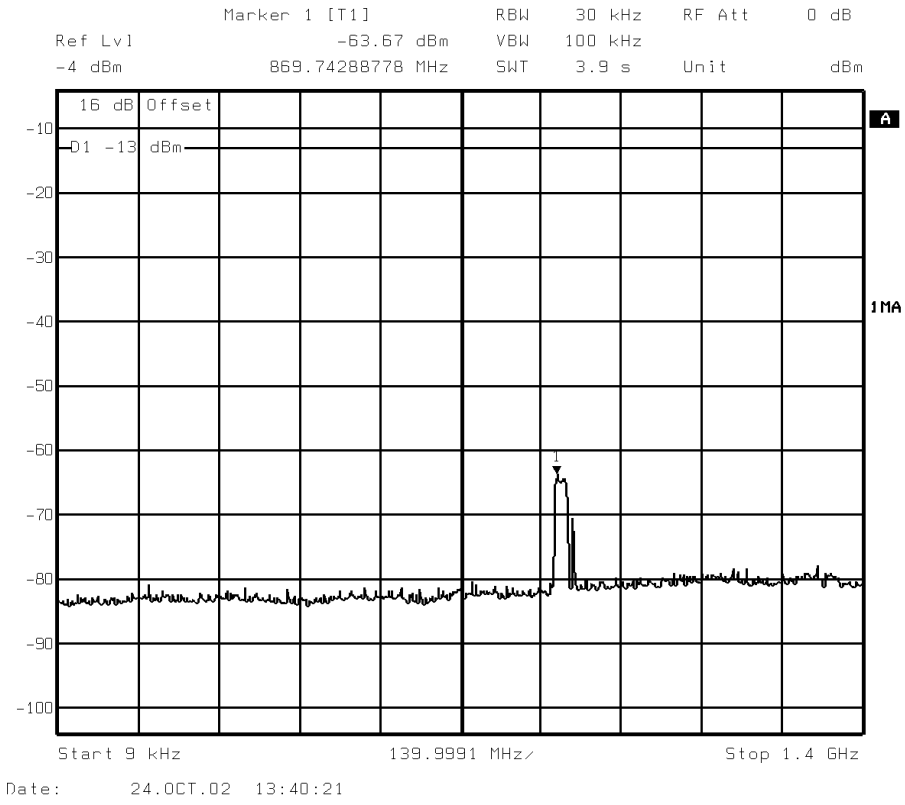
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (9kHz – 1.4GHz)
Channel 251, (893.8MHz) – Minimum Power – 8PSK
110V AC Supply



Test Equipment Used:

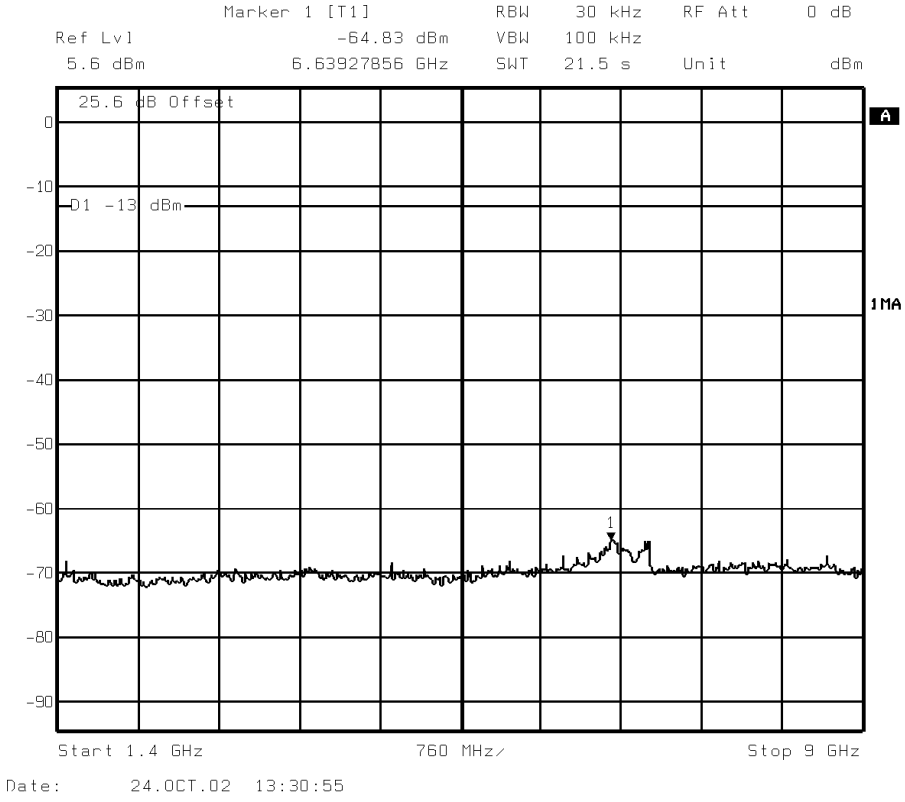
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (1.4GHz – 9.0GHz)
Channel 251, (893.8MHz) – Minimum Power – 8PSK
110V AC Supply



Test Equipment Used:

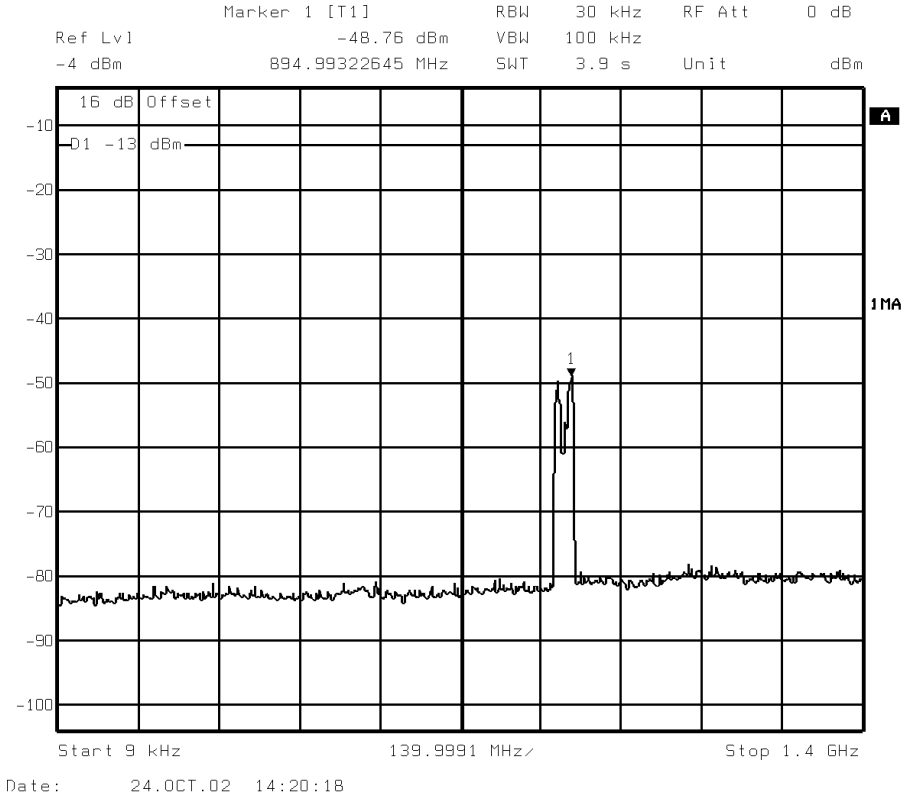
1, 2, 4, 7, 10, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (9kHz – 1.4GHz)
Channel 189, (881.4MHz) – Max Power – GMSK
48V DC Supply



Test Equipment Used:

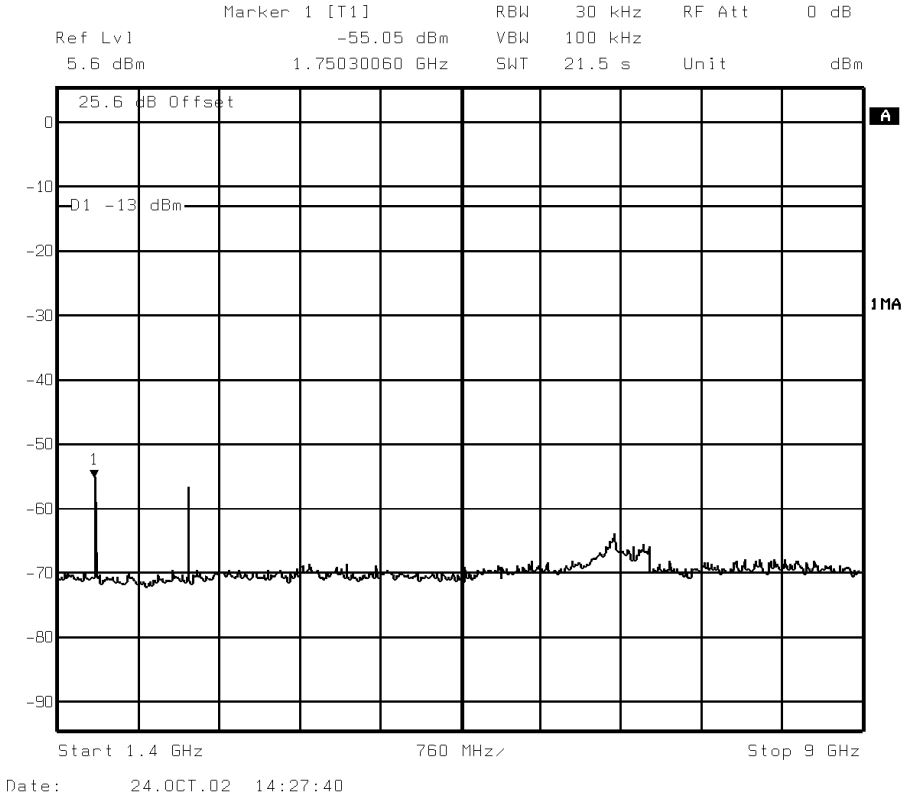
1, 2, 4, 7, 9, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (1.4GHz – 9.0GHz)
Channel 189, (881.4MHz) – Max Power – GMSK
48V DC Supply



Test Equipment Used:

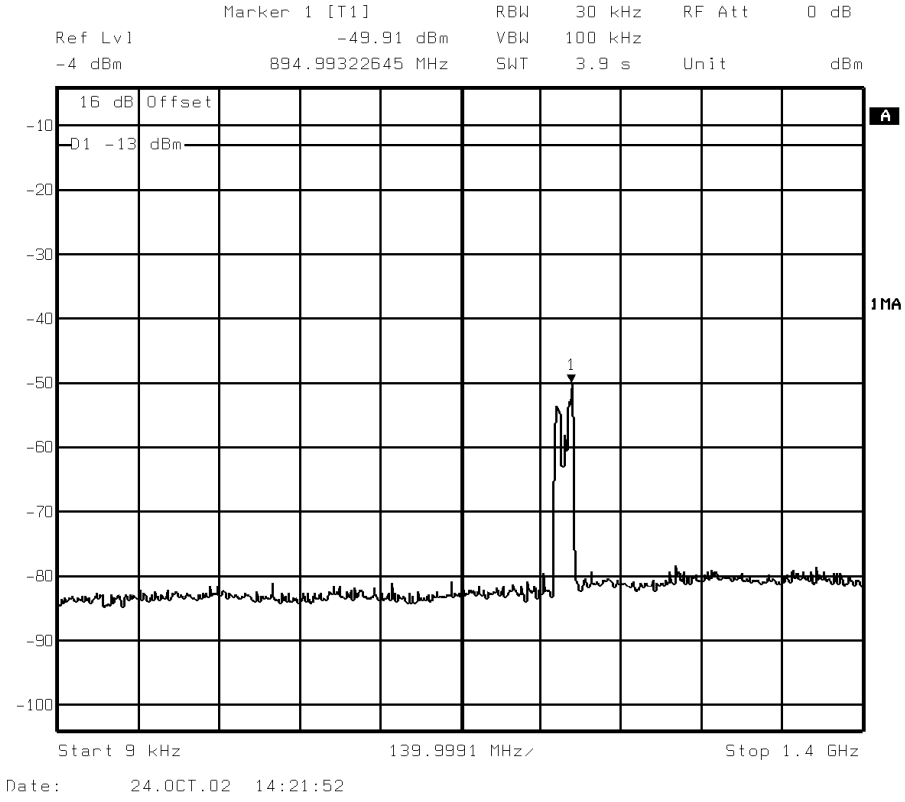
1, 2, 4, 7, 9, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (9kHz – 1.4GHz)
Channel 189, (881.4MHz) – Max Power – 8PSK
48V DC Supply



Test Equipment Used:

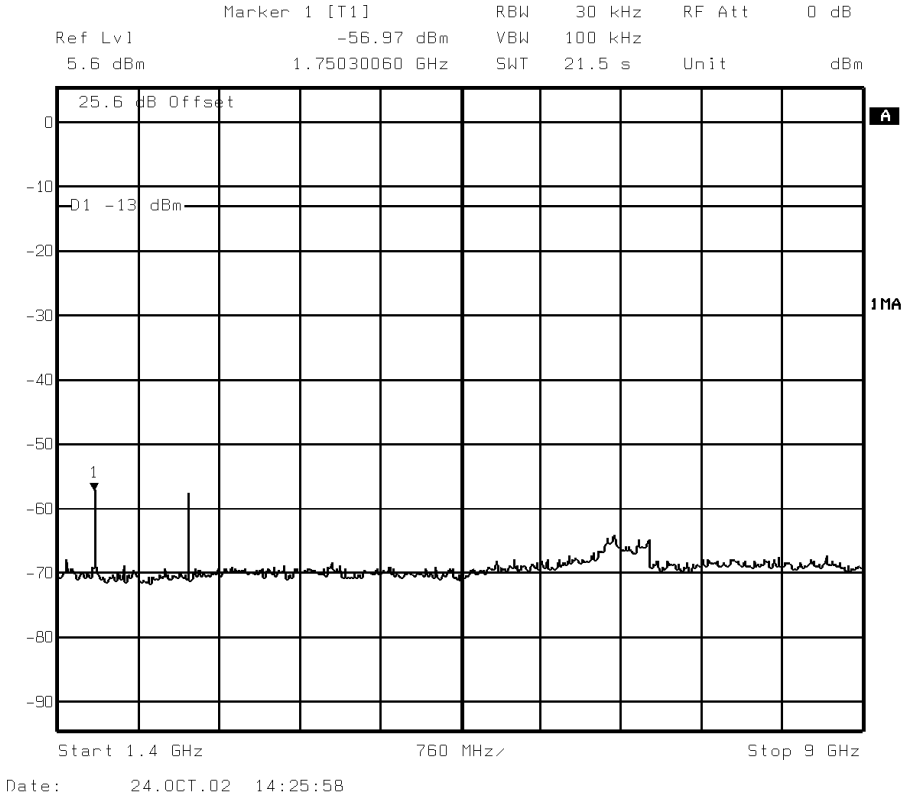
1, 2, 4, 7, 9, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (1.4GHz – 9.0GHz)
Channel 189, (881.4MHz) – Max Power – 8PSK
48V DC Supply



Test Equipment Used:

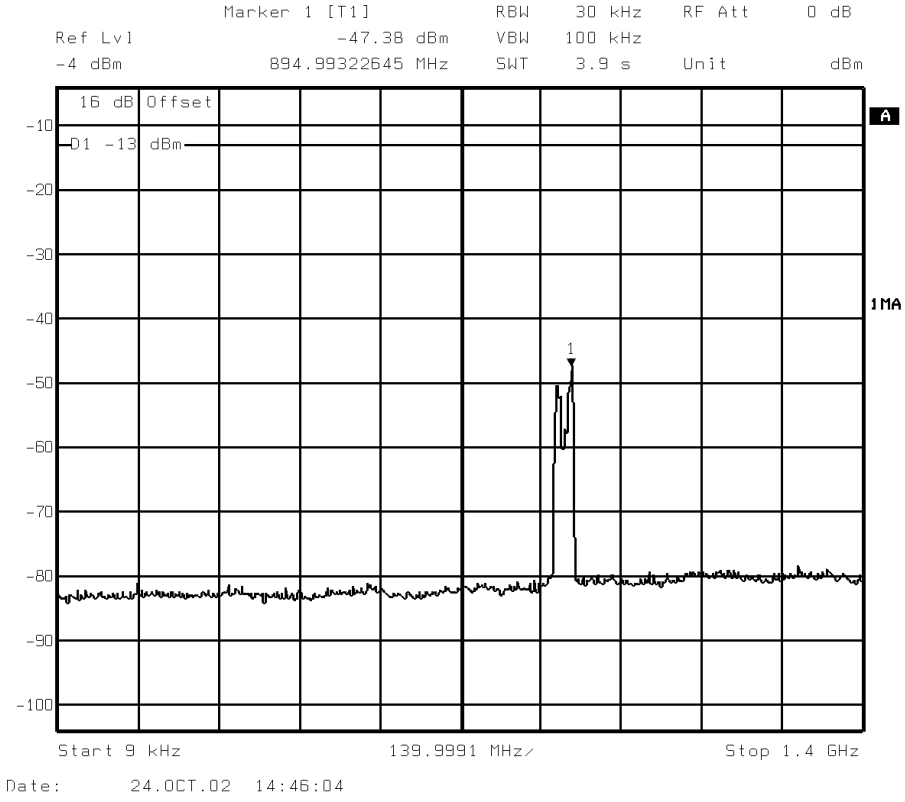
1, 2, 4, 7, 9, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (9kHz – 1.4GHz)
Channel 189, (881.4MHz) – Max Power – GMSK
24V DC Supply



Test Equipment Used:

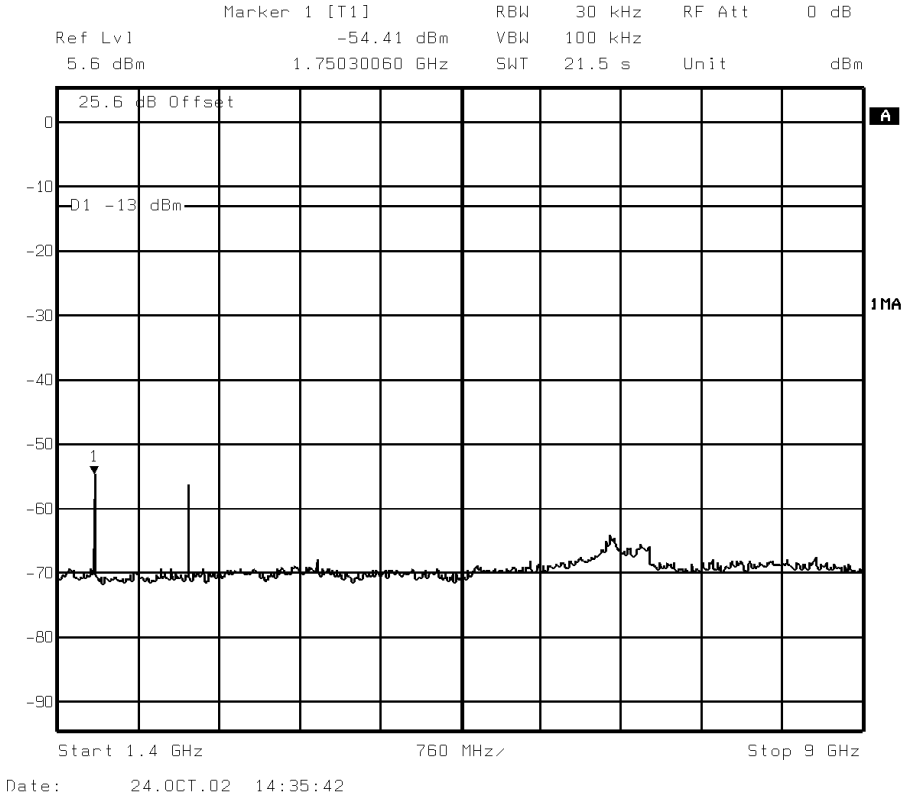
1, 2, 4, 7, 9, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (1.4GHz – 9.0GHz)
Channel 189, (881.4MHz) – Max Power – GMSK
24V DC Supply



Test Equipment Used:

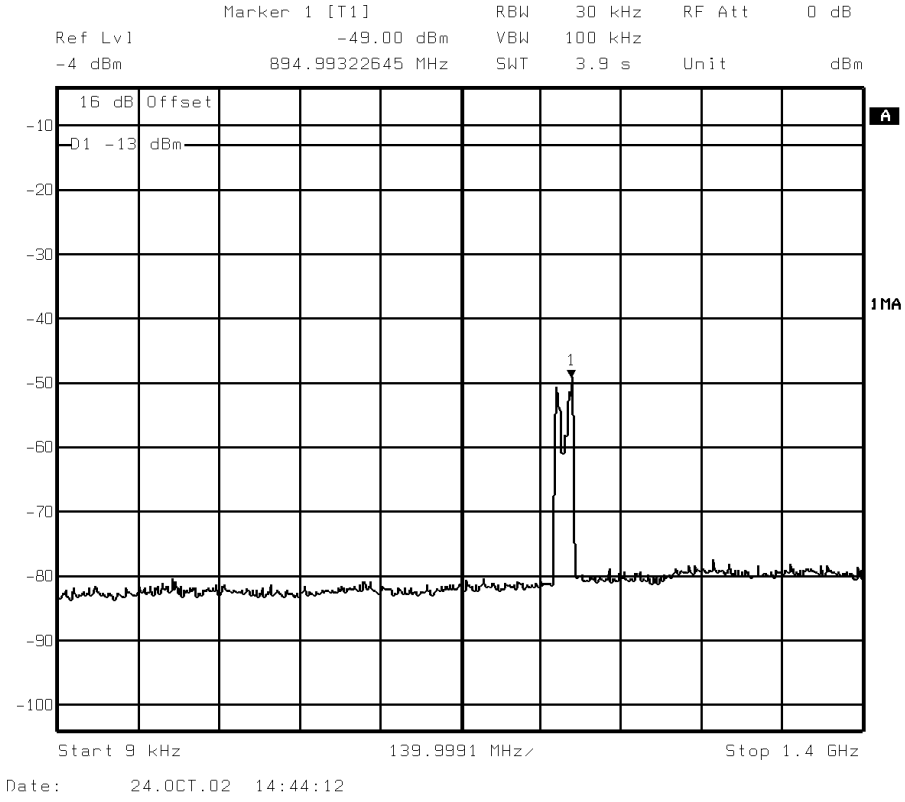
1, 2, 4, 7, 9, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (9kHz – 1.4GHz)
Channel 189, (881.4MHz) – Max Power – 8PSK
24V DC Supply



Test Equipment Used:

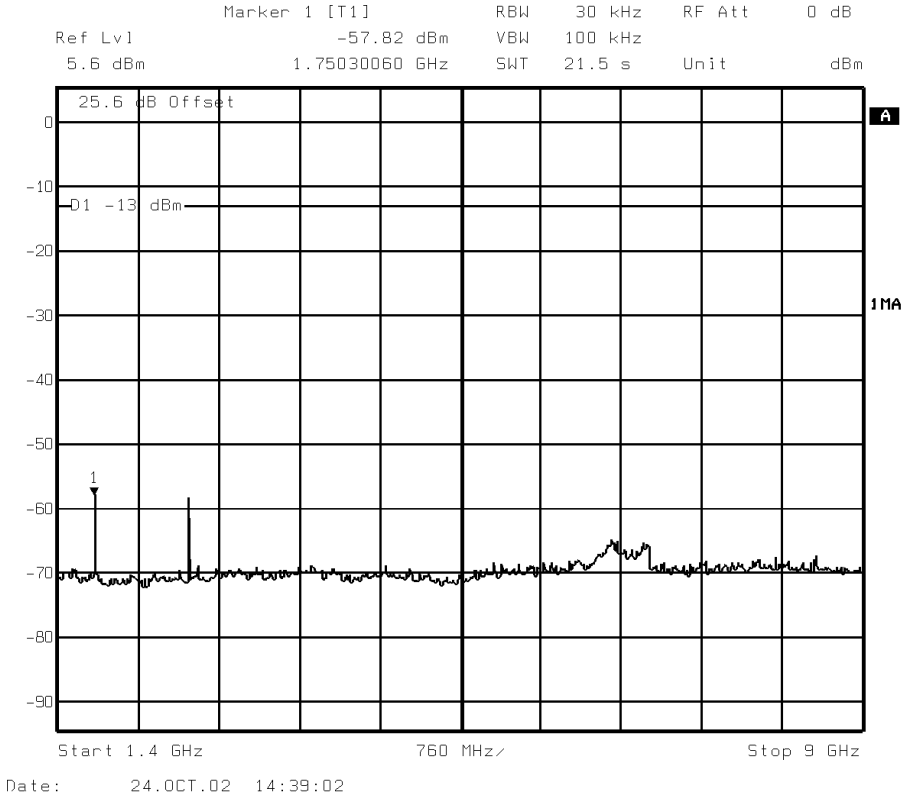
1, 2, 4, 7, 9, 11

Test Case: Spurious Emissions

Test Date: 24th October 2002

Rule Parts: 2.1051, 22.917(e)

Spurious Emissions (1.4GHz – 9.0GHz)
Channel 189, (881.4MHz) – Max Power – 8PSK
24V DC Supply



Test Equipment Used:

1, 2, 4, 7, 9, 11

Test Case: Frequency Stability Under Temperature Variations

Test Date: 25th October 2002

Rule Parts: 2.1055, 22.355

Measurement Method

The EUT was set to transmit on maximum power with all timeslots active. A Digital Communications Analyser, (CMU300), was used to measure the frequency error. The average result was taken over 100 bursts. The temperature was adjusted between –30ºC and +50ºC in 10º steps as per 2.1055.
Results

110V AC Supply - GMSK Modulation

Temperature Interval (ºC)	Test Frequency (MHz)	Deviation (Hz)	Limit (kHz)
-30	881.4	+7	±1.322
-20	881.4	+8	±1.322
-10	881.4	-9	±1.322
0	881.4	-8	±1.322
+10	881.4	-7	±1.322
+20	881.4	-9	±1.322
+30	881.4	+13	±1.322
+40	881.4	+11	±1.322
+50	881.4	+7	±1.322

110V AC Supply - 8PSK Modulation

Temperature Interval (ºC)	Test Frequency (MHz)	Deviation (Hz)	Limit (kHz)
-30	881.4	+8	±1.322
-20	881.4	+8	±1.322
-10	881.4	+16	±1.322
0	881.4	-9	±1.322
+10	881.4	-9	±1.322
+20	881.4	-11	±1.322
+30	881.4	+12	±1.322
+40	881.4	+11	±1.322
+50	881.4	+6	±1.322

Remarks

EUT complies with CFR 47 Part 22.355. The frequency stability of the EUT is sufficient to keep it within the authorised frequency blocks at any temperature interval across the measured range.

Test Equipment Used:

7, 11, 12, 13, 14

Test Case: Frequency Stability Under Voltage Variations

Test Date: 25th October 2002

Rule Parts: 2.1055, 22.355

Measurement Method

The EUT was set to transmit on maximum power with all timeslots active. A Digital Communications Analyser, (CMU300), was used to measure the frequency error. The average result was taken over 100 bursts.

Results

110V AC Supply

The mains voltage was adjusted between 85 and 115% of the nominal declared operating voltage as specified by the manufacturer using a variac in conjunction with a DVM.

Supply Variation (%)	AC Voltage (V)	Test Frequency (GHz)	Deviation (Hz)		Deviation Limit (kHz)
			GMSK	8PSK	
85	93.5	881.4	+8	+10	±1.322
0	110	881.4	+8	+9	±1.322
115	126.5	881.4	+8	+10	±1.322

24V DC Supply

The supply voltage was adjusted between 85 and 115% of the nominal declared operating voltage as specified by the manufacturer using a power supply in conjunction with a DVM.

Supply Variation (%)	DC Voltage (V)	Test Frequency (GHz)	Deviation (Hz)		Deviation Limit (kHz)
			GMSK	8PSK	
85	20.4	881.4	+8	+9	±1.322
0	24.0	881.4	+7	+9	±1.322
115	27.6	881.4	+8	+7	±1.322

48V DC Supply

The supply voltage was adjusted between 85 and 115% of the nominal declared operating voltage as specified by the manufacturer using a power supply in conjunction with a DVM.

Supply Variation (%)	DC Voltage (V)	Test Frequency (GHz)	Deviation (Hz)		Deviation Limit (kHz)
			GMSK	8PSK	
85	40.8	881.4	+8	+8	±1.322
0	48.0	881.4	+8	+8	±1.322
115	55.2	881.4	+8	+8	±1.322

Remarks

EUT complies with CFR 47 Part 22.355. The EUT does not exceed ±1.322kHz at the measured frequency either at nominal or voltage variation.

Test Equipment Used:

7, 9, 10, 11, 13

Test Case: AC Conducted Spurious Emissions

Test Date: 7th November 2002

Rule Parts: 15.207(a)

Measurement Method

The EUT was set up in each of the configurations listed on page 6 in turn.

All Conducted Emission Measurements were undertaken within a shielded enclosure. Emissions were measured on the Live and Neutral Lines.

Emissions were then formally measured using both Quasi-Peak and Average Detectors which met the CISPR requirements. The details of the worst case emissions were then recorded and are presented in Table 7, Table 8, Table 9 and Table 10. Plots 9 to 16 are taken from the receiver in max hold.

The Conducted Emission measurements were made using a Hewlett Packard 8542E EMI Receiver.

The test was performed in accordance with ANSI C63.4.

Test Case: AC Conducted Spurious Emissions (Continued)

Configuration: 5a. Live Line

The EUT met the requirements of 47 CFR 15.207(a) [AC Power Port] Conducted Disturbance test for the Live Line.

Conducted Disturbances Live Line: A search was made in the frequency range 150kHz to 30MHz. The levels of the 6 highest emissions were measured in accordance with the specification and are presented in Table 7 below: -

Emission Frequency	Quasi-Peak Level	Average Level	Quasi-Peak Limit	Average Limit	Pass / Fail
MHz	dBµV	dBµV	dBµV	dBµV	
0.150	55.9	52.9	66.0	56.0	Pass
0.162	40.5	65.4	36.5	55.4	Pass
0.204	48.4	63.4	43.5	53.4	Pass
0.745	28.3	56.0	25.7	46.0	Pass
0.895	28.6	26.1	56.0	46.0	Pass
3.007	31.2	27.3	56.0	46.0	Pass

Table 7

The margin between the specification requirements and all other emissions was 27dB or more below the specified Quasi-Peak limit and 21dB or more below the specified Average limit, when measured with a Quasi-Peak detector.

Procedure Test performed in accordance with ANSI C63.4.

Test Equipment Used:

15, 20, 30, 31

Test Case: AC Conducted Spurious Emissions (Continued)

Configuration: 5a. Neutral Line

The EUT met the requirements of 47 CFR 15.207(a) [AC Power Port] Conducted Disturbance test for the Neutral Line.

Conducted Disturbances Neutral Line: A search was made in the frequency range 150kHz to 30MHz. The levels of the 6 highest emissions were measured in accordance with the specification and are presented in Table 8 below: -

Emission Frequency	Quasi-Peak Level	Average Level	Quasi-Peak Limit	Average Limit	Pass / Fail
MHz	dBµV	dBµV	dBµV	dBµV	
0.150	54.1	52.3	66.0	56.0	Pass
0.164	38.1	35.5	65.3	55.3	Pass
0.204	48.4	43.5	63.4	53.4	Pass
0.427	27.5	25.4	57.3	47.3	Pass
2.647	29.7	27.7	56.0	46.0	Pass
3.005	29.9	25.2	56.0	46.0	Pass

Table 8

The margin between the specification requirements and all other emissions was 30dB or more below the specified Quasi-Peak limit and 23dB or more below the specified Average limit, when measured with a Quasi-Peak detector.

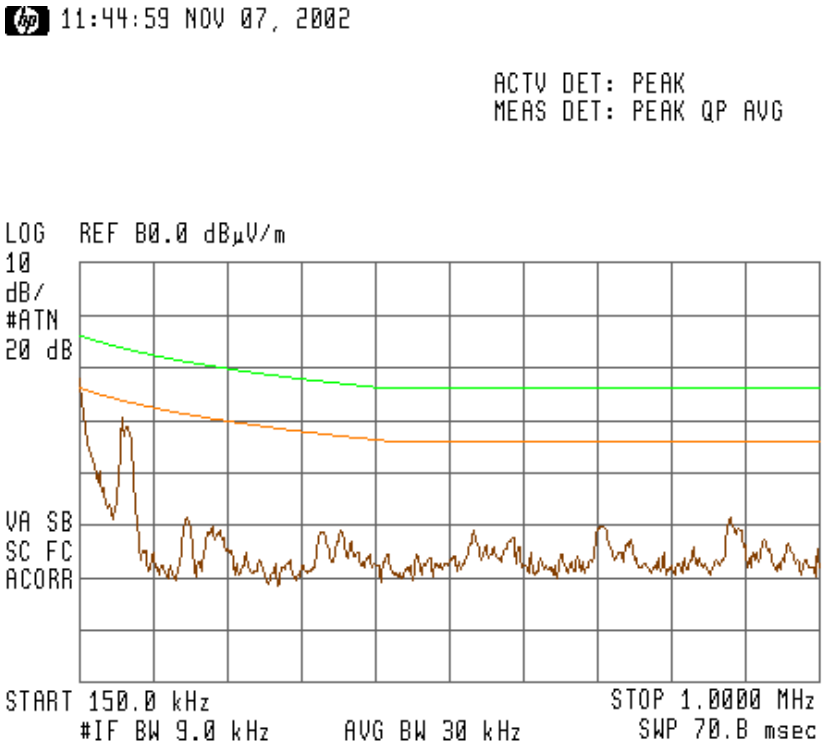
Procedure Test performed in accordance with ANSI C63.4.

Test Equipment Used:

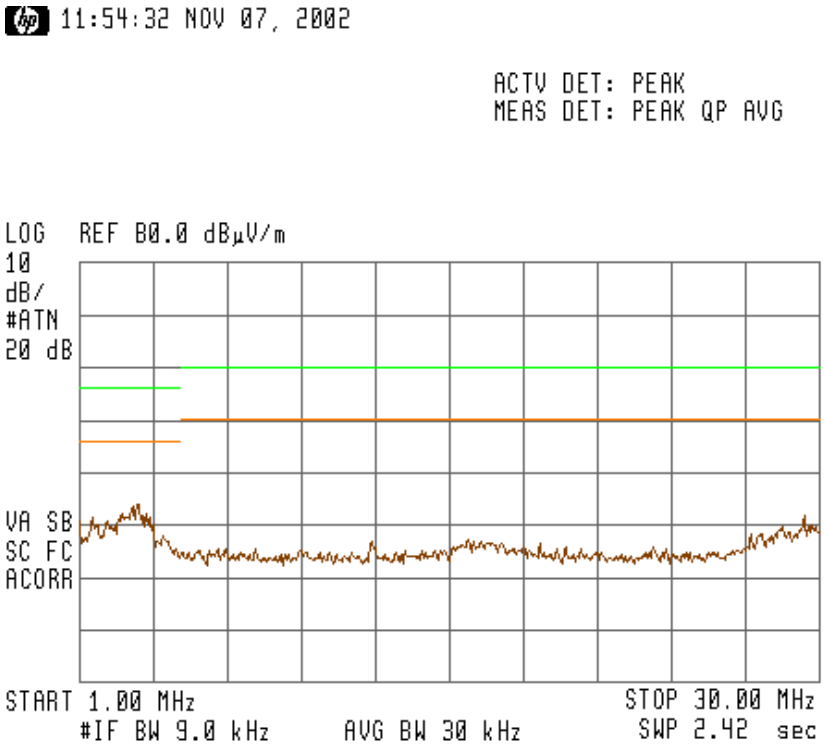
15, 20, 30, 31

Test Case: AC Conducted Spurious Emissions (Continued)

Configuration: 5a. Live Line



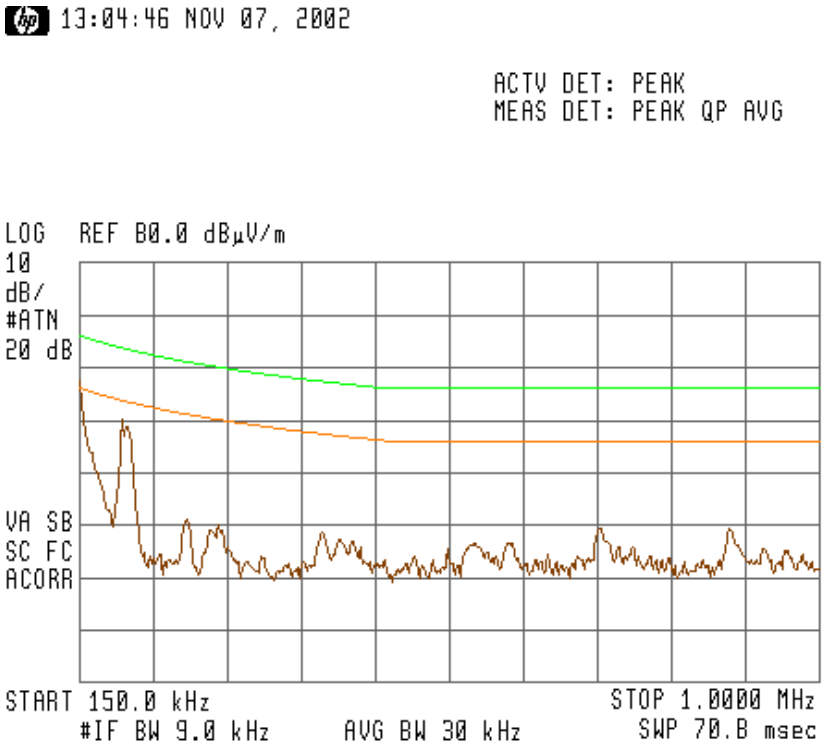
Plot 9 Live Line



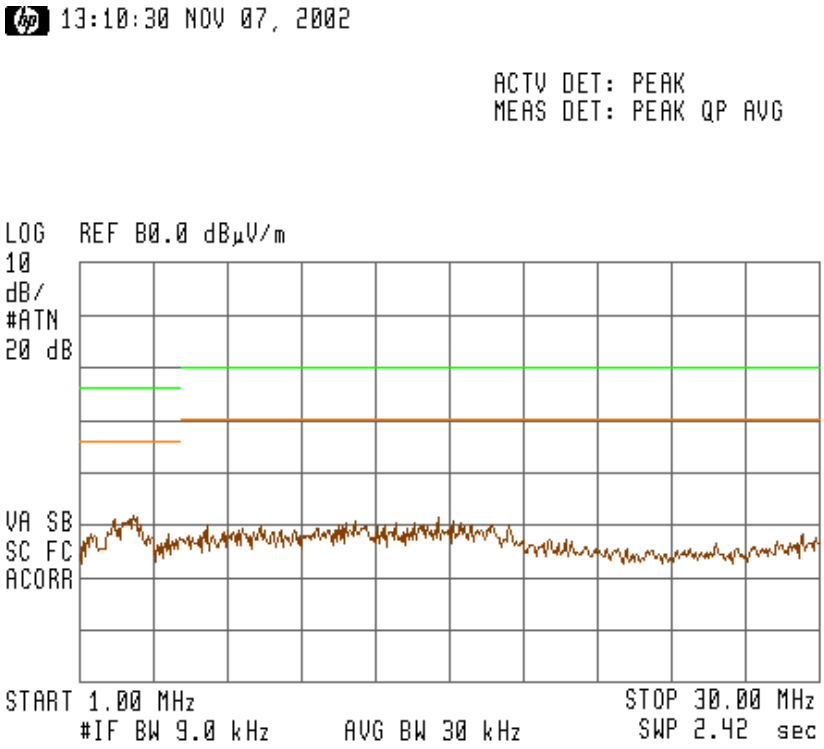
Plot 10 Live Line

Test Case: AC Conducted Spurious Emissions (Continued)

Configuration: 5a. Neutral Line



Plot 11 Neutral Line



Plot 12 Neutral Line

Test Case: AC Conducted Spurious Emissions (Continued)

Configuration: 5b. Live Line

The EUT met the requirements of 47 CFR 15.207(a) [AC Power Port] Conducted Disturbance test for the Live Line.

Conducted Disturbances Live Line: A search was made in the frequency range 150kHz to 30MHz. The levels of the 6 highest emissions were measured in accordance with the specification and are presented in Table 9 below: -

Emission Frequency	Quasi-Peak Level	Average Level	Quasi-Peak Limit	Average Limit	Pass / Fail
MHz	dBµV	dBµV	dBµV	dBµV	
0.150	54.0	52.2	66.0	56.0	Pass
0.158	32.8	38.3	65.6	55.6	Pass
0.204	48.5	43.5	63.4	53.4	Pass
0.894	29.1	26.8	56.0	46.0	Pass
2.858	30.9	27.2	56.0	46.0	Pass
3.308	29.9	26.2	56.0	46.0	Pass

Table 9

The margin between the specification requirements and all other emissions was 27dB or more below the specified Quasi-Peak limit and 20dB or more below the specified Average limit, when measured with a Quasi-Peak detector.

Procedure Test performed in accordance with ANSI C63.4.

Test Equipment Used:

15, 20, 30, 31

Test Case: AC Conducted Spurious Emissions (Continued)

Configuration: 5b. Neutral Line

The EUT met the requirements of 47 CFR 15.207(a) [AC Power Port] Conducted Disturbance test for the Neutral Line.

Conducted Disturbances Neutral Line: A search was made in the frequency range 150kHz to 30MHz. The levels of the 6 highest emissions were measured in accordance with the specification and are presented in Table 10 below: -

Emission Frequency	Quasi-Peak Level	Average Level	Quasi-Peak Limit	Average Limit	Pass / Fail
MHz	dBµV	dBµV	dBµV	dBµV	
0.150	54.3	52.4	66.0	56.0	Pass
0.160	38.4	36.5	65.5	55.5	Pass
0.205	48.4	43.3	63.4	53.4	Pass
1.339	28.4	26.3	56.0	46.0	Pass
2.857	30.5	27.1	56.0	46.0	Pass
3.007	31.0	27.7	56.0	46.0	Pass

Table 10

The margin between the specification requirements and all other emissions was 28dB or more below the specified Quasi-Peak limit and 21dB or more below the specified Average limit, when measured with a Quasi-Peak detector.

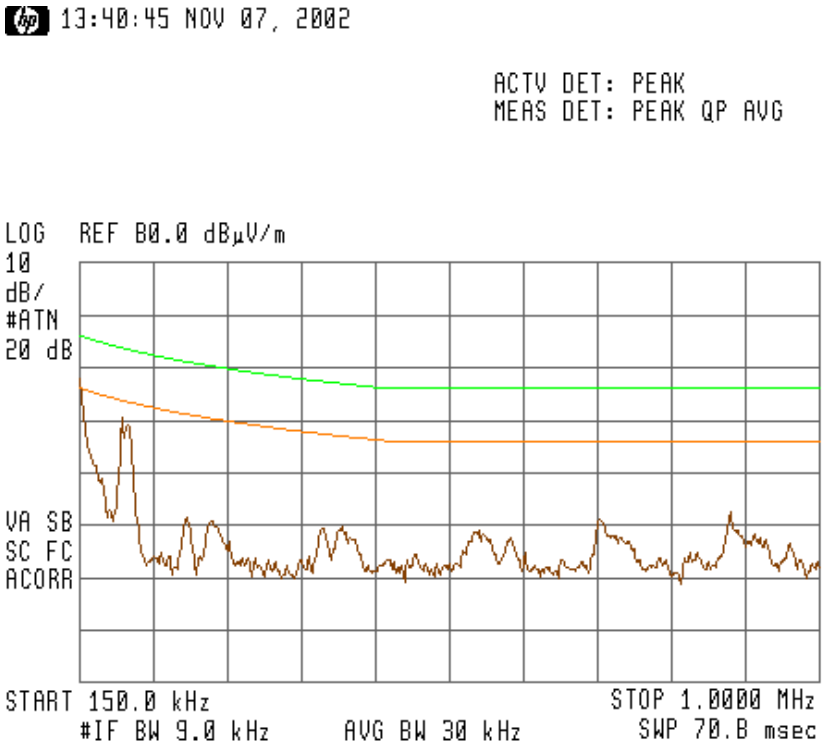
Procedure Test performed in accordance with ANSI C63.4.

Test Equipment Used:

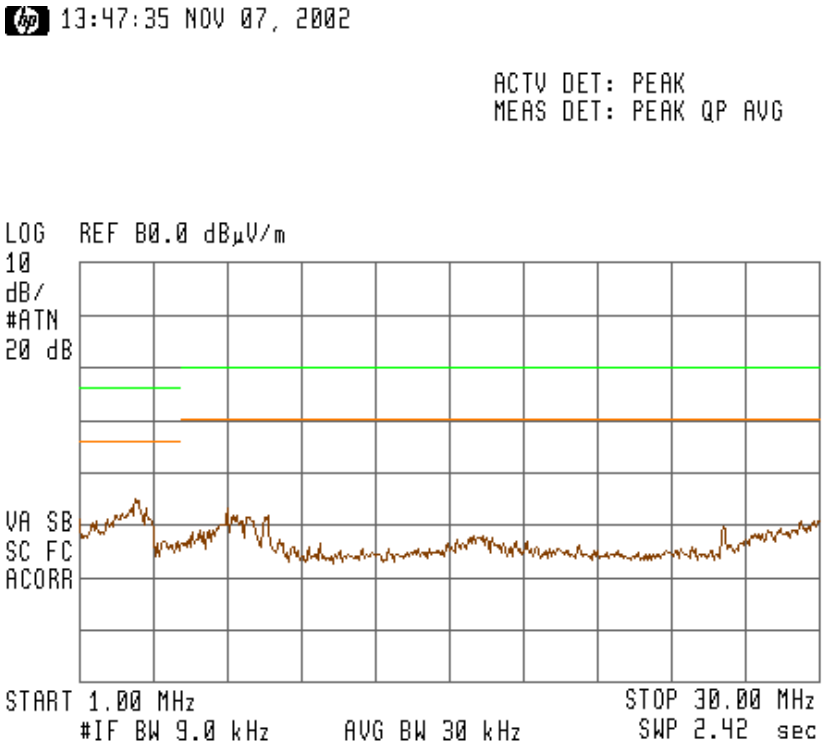
15, 20, 30, 31

Test Case: AC Conducted Spurious Emissions (Continued)

Configuration: 5b. Live Line



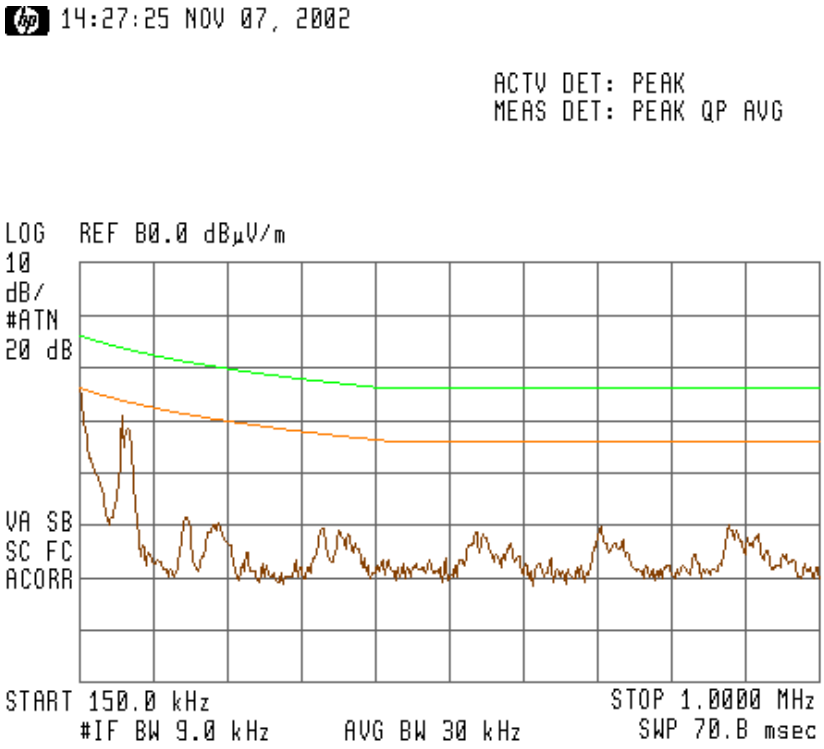
Plot 13 Live Line



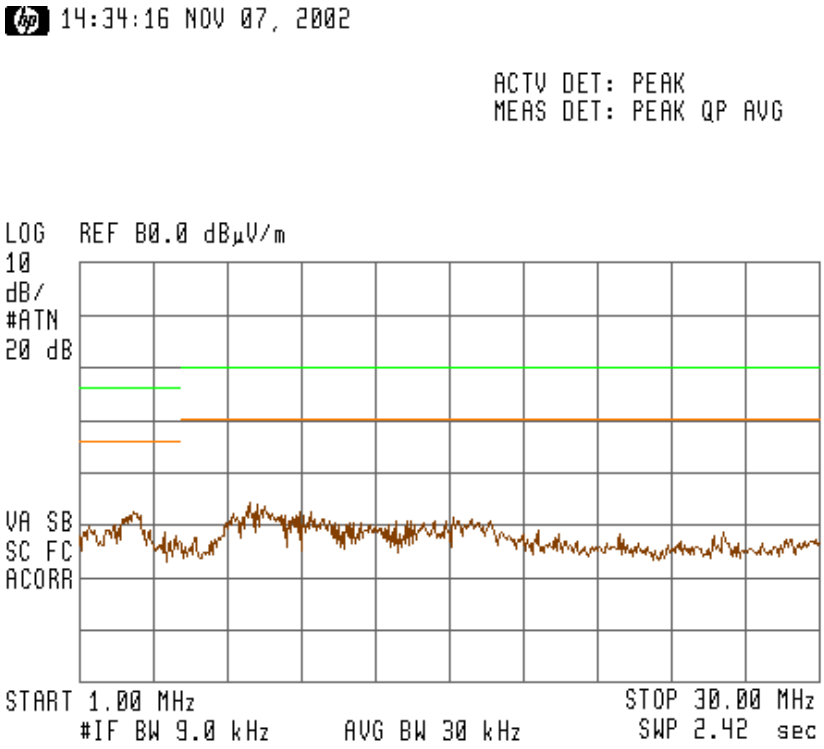
Plot 14 Live Line

Test Case: AC Conducted Spurious Emissions (Continued)

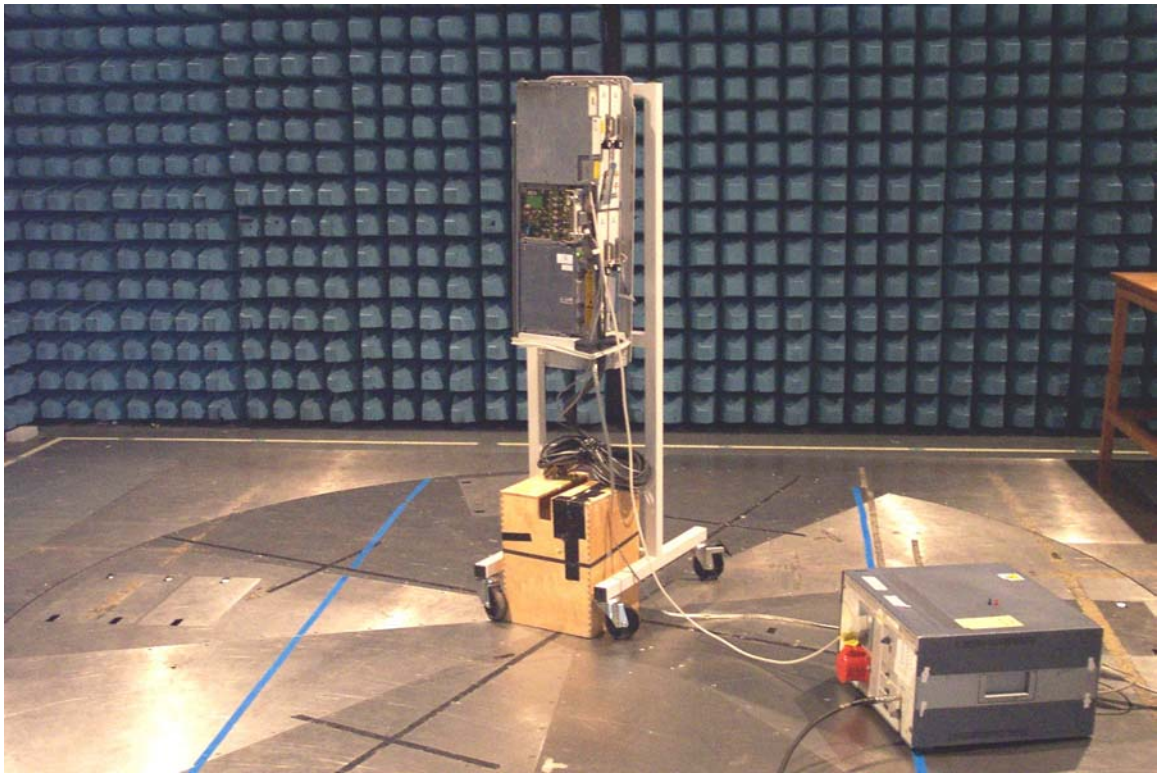
Configuration: 5b. Neutral Line



Plot 15 Neutral Line



Plot 16 Neutral Line



Photograph No 4 – Conducted Emissions – Configurations 5a and 5b

0141
Group

This report relates only to the actual item/items tested.

UKAS Accreditations do not cover opinions and interpretations and any expressed herein are outside the scope of any UKAS Accreditation.

Results of tests not yet included in our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).