TEST REPORT

In support of the Application for Grant of Equipment Authorization of the ip. access NBT141G PCS 1900 Base Station

FCC ID: QGGM180TVX July 2002

TÜV PRODUCT SERVICE

B A B T

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Equipment:	NBT141G PCS 1900 Base Station
Serial Number:	00009743
FCC ID:	QGGM180TVX
Specification:	47 CFR 2 & 47 CFR 24
Applicant:	ip. access Melbourn Science Park Cambridge Road Melbourn Royston SG8 6EE
Manufacturer:	ip. access Melbourn Science Park Cambridge Road Melbourn Royston SG8 6EE
Manufacturer's Representative:	Mr Nick Johnson
Approved by:	**M JENKINS** Wireless Group Leader
Dated:	18th July 2002
Start of Test:	
Completion of Test:	

Report Distribution:	ip. access	Mr N Johnson	Copy No. 1
	BABT		Copy No. 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 24 of the FCC Rules under normal use and maintenance.

Simon Bennett
Test Manager

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Introduction

The information contained within this report is intended to show verification of compliance of the ip. access PCS 1900 Base Transmitter Station, NBT141G, to the requirements of 47 CFR 2 and 47 CFR 24.

Location Of Testing

All testing was conducted at the premises of BABT, Segensworth Road, Fareham, Hampshire, PO15 5RH. Radiated Emissions measurements were performed on a 3 metre open area test site (OATS). A complete site description is on file with the FCC Laboratory Division, Registration Number: 90987. See Annex A.

Test Equipment and Ancillaries Used For Test

No	Instrument/Ancillary	Type	Manufacturer	Serial No.	Cal Due
1	Power Supply	6644A	Agilent	MY40000284	T/U
2	RMS Multimeter	79III	Fluke	74970620	27/11/02
3	Spectrum Analyser	FSEM	Rohde & Schwarz	827285/006	28/12/02
4	Signal Generator	ESG-4000A	Hewlett Packard	GB37040125	12/1/03
5	Signal Generator	SWM 02	Rohde & Schwarz	894631/014	3/9/02
6	Signal Generator	2031	Marconi	119628/075	23/2/02
7	Attenuator	46-20-34	Weinschel	AT9195	11/7/02
8	High Pass Filter	F-100-4000-5-R	Sematron UK Ltd	0012	T/U
9	Attenuator	BN745353	Spinner GMBH	D59939	23/8/02
10	Network Analyser	8510A	Hewlett Packard	2607A01624	25/8/02
11	S Parameter Test Set	8514A	Hewlett Packard	2615A01567	25/8/02
12	Signal Generator	8340	Hewlett Packard	2349A00286	23/8/02
13	Environmental Chamber	VM04/100	Heraeus Vötsch	40608	17/5/02
14	Frequency Counter	53181A	Hewlett Packard	KR9120300	27/6/02
15	Spectrum Analyser	8568B	Hewlett Packard	184	01 Mar 03
16	Quasi-Peak Adaptor	85650A	Hewlett Packard	1302	01 Mar 03
17	RF Preselector	85685A	Hewlett Packard	1370	01 Mar 03
18	Biconical Antenna	94455-1	Ailtech	422	16 Nov 02
19	Log Periodic Antenna	AT1000	Amplifier Research	829	05 Dec 02
20	Turntable & Controller	1060	Emco	1322	TU
21	Antenna Mast & Controller	1050	Emco	1321	TU
22	Computer	310	Hewlett Packard	—	TU
23	Printer	Think Jet	Hewlett Packard	—	TU
24	Low Noise Amplifier (8-18GHz)	AMF-4E-080180-15-10P	Miteq	2430	TU
25	Low Noise Amplifier (18-26.5GHz)	AMT26177-33	Avantek	2072	TU
26	Spectrum Analyser	8562A	Hewlett Packard	2141	15 Apr 02
27	Horn	3115	Emco	2397	26 Jun 02
28	Horn	2024/20	Flann Microwave	1396	TU

No	Instrument/Ancillary	Type	Manufacturer	Serial No.	Cal Due
29	Microwave Coaxial Adaptor	20093SF40	Flann Microwave	S/N 595	TU
30	Signal Generator	2031	Marconi	1979	14 Sep 02
31	Signal Generator	8672A	Hewlett Packard	411	22 Dec 02
32	Signal Generator	8673B	Hewlett Packard	953	15 May 03
33	Transient Limiter	11947A	Hewlett Packard	122	09 Aug 02
34	Three Phase LISN	ESH2-Z5	Rohde & Schwarz	2380	09 Aug 02

Note(s)

1) All items are calibrated annually , except where labelled T/U (Tracebility 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 14).

Description of Equipment Under Test Configuration

The Pico Cell was configured in a test mode to simulate worst case operating conditions. As the unit is self contained, there are no plug in options as with a normal BTS. Thus, there are no external hardware options such as duplexors, combiners etc. For conducted tests, the supplied antenna was disconnected to allow for direct connection to the transmitter output port. The supplied antenna is not replaceable by the user under normal conditions. It's connection is only accessible by opening the EUT. Under Radiated conditions, the supplied antenna was connected to the RF port. The EUT was connected to a PC to allow control of the unit to set the power levels and channel frequencies, which are described in each of the test clauses. The test modes used were selected to give the worst case results for the applicable test.

List of Performed Measurements

i)	Power Output	47 CFR2.1046, 24.232
ii)	Modulation Characteristics	47 CFR2.1047(d)
iii)	Occupied Bandwidth	47 CFR2.1049(h), 24.238(b)
iv)	Band Edge Measurements	47 CFR24.238(b)
v)	Frequency Stability – Temperature Variations	47 CFR2.1055, 24.235
vi)	Frequency Stability – Voltage Variations	47 CFR2.1055(d)(1)
vii)	Radiated Emissions	47 CFR2.1053, 24.238
viii)	Conducted Emissions	47 CFR2.1051, 24.238(a)

Test Case	:	Radiated Emissions
Test Date	:	6th June 2002
Rule Parts	:	24.238

System Configuration During EMC Testing

The NanoBTS 1900 together with the Power Supply and all associated cabling, was set-up simulating a typical user installation on the Open Field Test Site, then tested in accordance with the specification.

The NanoBTS 1900 was connected via an Ethernet cable to a PC running a BSC program. A voice call was set up between 2 mobile phones registered to the NanoBTS 1900.

During Radiated Emission testing the Power Supply was remotely located in the control room. During Conducted Emission testing the Power Supply was located next to the NanoBTS 1900.

The EUT was functioning correctly during all testing.

Determination of Spurious Emissions Limit

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 Characterisation 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.

The EUT was then transferred to the Open Field Site and placed on a remotely controlled turntable. Using the information from the preliminary profiling of the EUT, a search was made in the frequency range 30MHz to 20GHz. The list of worst case emissions was then confirmed or updated under Open Site conditions. Emission levels were maximised by adjusting the antenna height, antenna polarisation and turntable azimuth. Emissions levels were then formally measured using a Quasi-Peak Detector which met the CISPR requirements. The details of the worst case emissions were then recorded and are presented in Table 1.

The Radiated Electric Field Emissions measurements were made using a Hewlett Packard Spectrum Analyser, Preselector and Quasi-Peak Adaptor in the frequency range 30MHz to 1000MHz and a Hewlett Packard 8562A Spectrum Analyser in the frequency range 1GHz to 20GHz.

The EUT was connected to a 115V 60Hz supply.

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

The level of the carrier was measured as 121.30dBµV/m. The customer declared the transmit power as 0.2W.

Therefore the limit is 121.30 – (43 + 10log(0.2)) = 121.3 – 43 + 7 = 85.30dBµV/m

Test Case : Radiated Emissions (continued)

Test Date : 6th June 2002

Rule Parts : 24.238

Equipment Designation : Intentional Radiator.

The EUT met the requirements of 47 CFR Part 15.238 for Radiated Electric Field Emissions.

The emissions were measured at 3m.

Open Field Site Results : The levels of the 2 highest emissions measured in accordance with the specification are presented in Table 1 below :-

Emission Frequency	Pol	Hgt	Azm	Level at 3m	Cable Loss	Antenna Factor	Field Strength at 3m	Specification Limit
GHz	H/V	cm	deg	dBµV	dB	dB	dBµV/m	dBµV/m
1.970027	H	171	152	92.00	1.5	27.80	121.30	Carrier
9.991208	V	117	228	46.00	-25.34	38.65	59.31	85.30
11.821000	V	132	61	49.83	-23.33	40.04	66.54	85.30

Table 1

The margin between the specification requirements and all other emissions was 25dB or more below the specification limit.

ABBREVIATIONS FOR ABOVE TABLE

H	Horizontal Polarisation	V	Vertical Polarisation
Pol	Polarisation	Hgt	Height
deg	degree	Azm	Azimuth

Procedure Test Performed in accordance with ANSI C63.4.

Performed by S C Hartley, EMC Engineer.
A R Hubbard, EMC Engineer.

PHOTOGRAPHS OF EUT DURING RADIATED EMISSIONS TESTING

Radiated Emissions

Conducted Emissions

Test Case : RF Output Power

Test Date : 27th May 2002

Rule Parts : 2.1046, 24.232

Measurement Method

Using a spectrum analyser and attenuator(s), the output power of the EUT was measured at the antenna terminals. The carrier was modulated by its normal GMSK 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

Maximum Power

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (mW)
1930.2	3.13	20.1	23.23	210.38
1960.0	3.22	20.1	23.32	214.78
1989.8	3.34	20.1	23.44	220.80

Minimum Power

Frequency (MHz)	Output Power (dBm)	Path Loss (dB)	Result (dBm)	Result (mW)
1930.2	-20.25	20.1	-0.15	0.966
1960.0	-20.26	20.1	-0.16	0.964
1989.8	-20.16	20.1	-0.06	0.986

Limit	<100W or <+50dBm

Remarks

EUT complies with CFR 47 2.1046 and 24.232(a). The EUT does not exceed 100W or +50dBm at the measured frequencies.

Test Equipment Used:
1, 2, 3, 4, 7
……..

Test Case	:	Modulation Characteristics
Test Date	:	27th May 2002
Rule Parts	:	2.1047(d)

Description Of Modulation Technique

The system is designed to meet the PCS requirements as defined in the 3GPP specifications: 3GPP TS 05:01, TS 05:02 and TS 05:04 are the most relevant. To summarise the system uses time division multiplexed access (TDMA) to separate eight users on a channel and frequency multiplexing for the up and down links.

There are 299 channels on a 200kHz raster. The frequency band 1850~1910MHz is allocated to the downlink and 1930~1990MHz to the uplink. The duplex frequency is 80MHz and the up and down link is offset in time by three TDMA slots.

The bit rate is 13MHz/48 (≈270.833kHz). There are 1250 bits in a frame that contains the eight slots; one of which is allocated to each user. Therefore each slot is 156.25 bits in length and lasts ≈577μs. To allow control information to be interleaved amongst the user data there is a larger data unit comprising 26 frames called a multiframe. The existence of the multiframe and the associated timing allows extra protection against data corruption by interleaving frames.

The modulation described by TS 05:04 is a differentially encoded scheme where the data are represented by phase shifts of $\pm\pi/2$ over a bit period. The modulation scheme implemented is Gaussian filtered minimum shift keying (GMSK). Minimum shift keying is a special case of frequency shift keying (FSK) with a modulation index of h = 0.5. FSK is a binary modulation scheme with each of the two logical states represented by a different offset from the nominal carrier frequency.

From the well known equation

$$h = 2*Fp*Tb$$

where h is the modulation index, Fp is the peak frequency deviation and Tb is the bit period the peak frequency deviation is shown to be ≈±67.7kHz.

Minimum shift keying has a relatively wide frequency spectrum. To improve spectral efficiency Gaussian filtering is applied to modulation source resulting in a sinusoidal, rather than instantaneous, transition between the two offset frequencies determined by the modulation data and, therefore, a reduced signal bandwidth. The 3dB bandwidth of the Gaussian filter is 81.25kHz.

A complete description of the modulation and filtering is shown on the following page.

Test Case : Modulation Characteristics (Continued)

Test Date : 27th May 2002

Rule Parts : 2.1047(d)

The differentially encoded modulating data values α_i ($\alpha_i \in \{-1,+1\}$) as represented by Dirac pulses excite a linear filter with impulse response at time t defined by:

$$g(t) = h(t) * rect\left(\frac{t}{T}\right)$$

where T is the bit period and the function *rect(x)* is defined by:

$$rect\left(\frac{t}{T}\right) = \frac{1}{T} \qquad for\ |t| < \frac{T}{2}$$

$$rect\left(\frac{t}{T}\right) = 0 \qquad otherwise$$

and * means convolution. *h(t)* is defined by:

$$h(t) = \frac{\exp\left(\frac{-t^2}{2\delta^2 T^2}\right)}{\sqrt{(2\pi)}\ .\ \delta T}$$

where $\delta = \frac{\sqrt{\ln(2)}}{2\pi BT} \qquad and\ BT = 0.3$

where B is the 3 dB bandwidth of the filter with impulse response *h(t)*.

The phase of the modulated signal is:

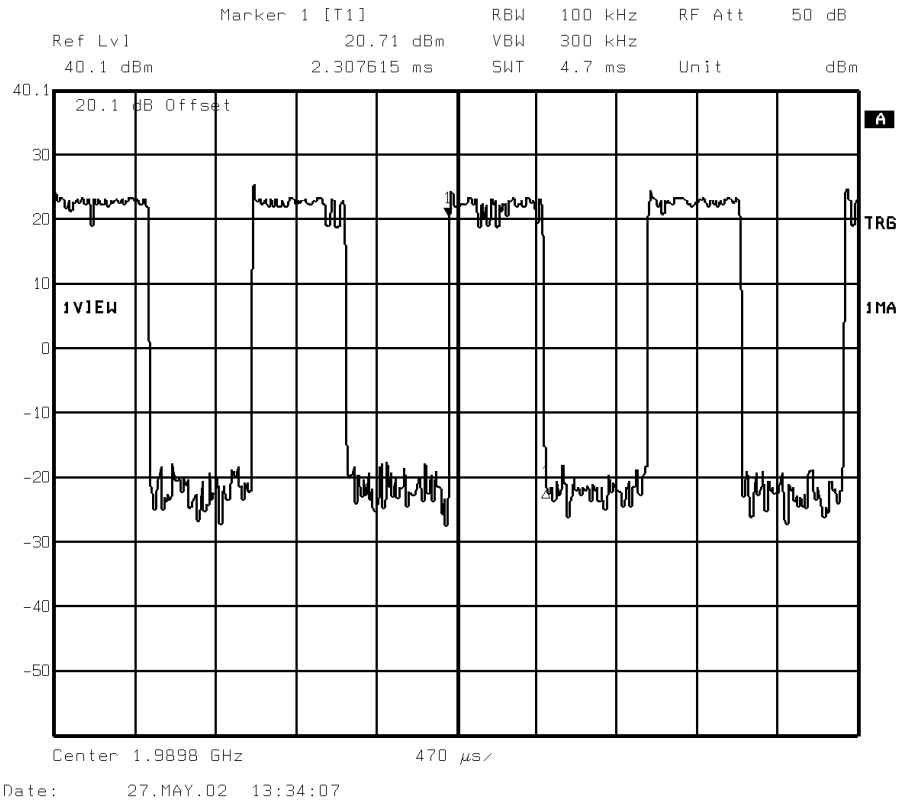
$$\varphi(t') = \sum_i \alpha_i \pi h \int_{-\infty}^{t'-iT} g(u)du$$

where the modulating index *h* is 1/2 (maximum phase change in radians is π/2 per data interval). The time reference *t' = 0* is the start of the slot.

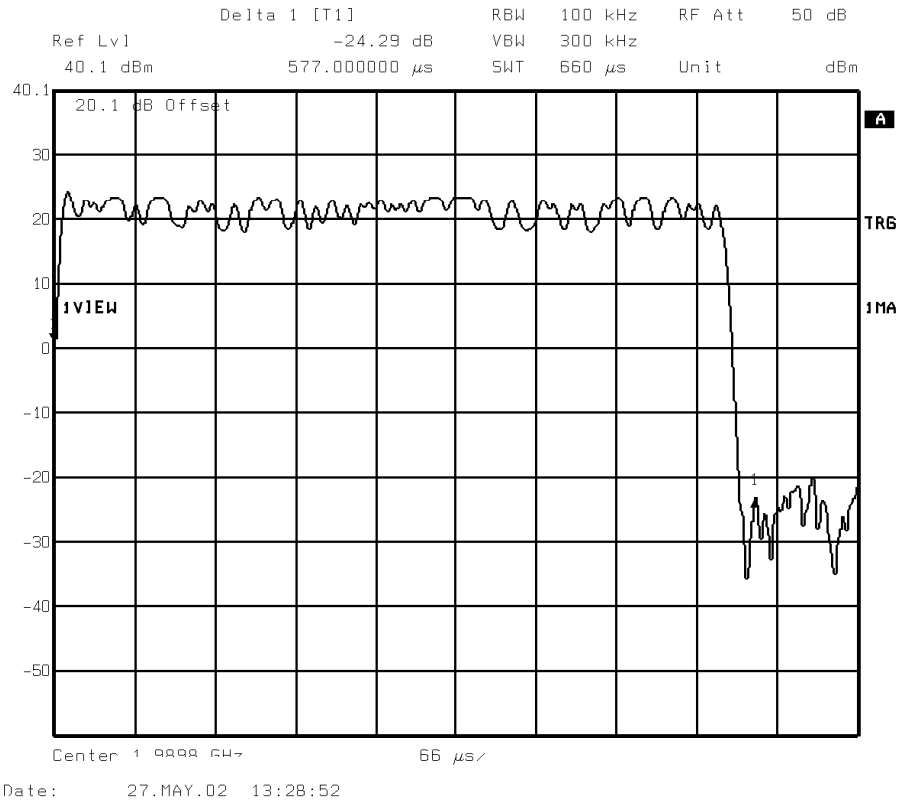
The modulated RF carrier is expressed as:

$$x(t') = \sqrt{\frac{2E_c}{T}}\ .\ \cos(2\pi f_0 t' + \varphi(t') + \varphi_0)$$

where E_c is the energy per modulating bit, f_0 is the centre frequency and φ_0 is a random phase and is constant during one burst



Plot (1)



Plot (2)

Test Equipment Used:
1, 3, 9, 10

……..

Test Case	:	Occupied Bandwidth
Test Date	:	27th May 2002
Rule Parts	:	2.1049, 24.238(b)

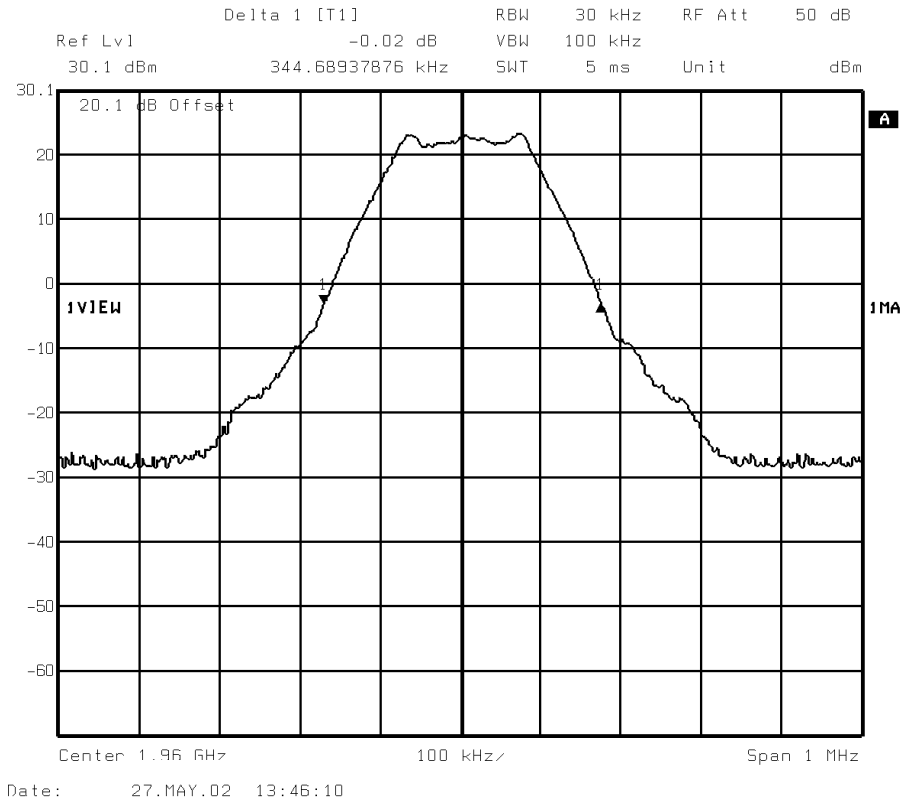
Measurement Method

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

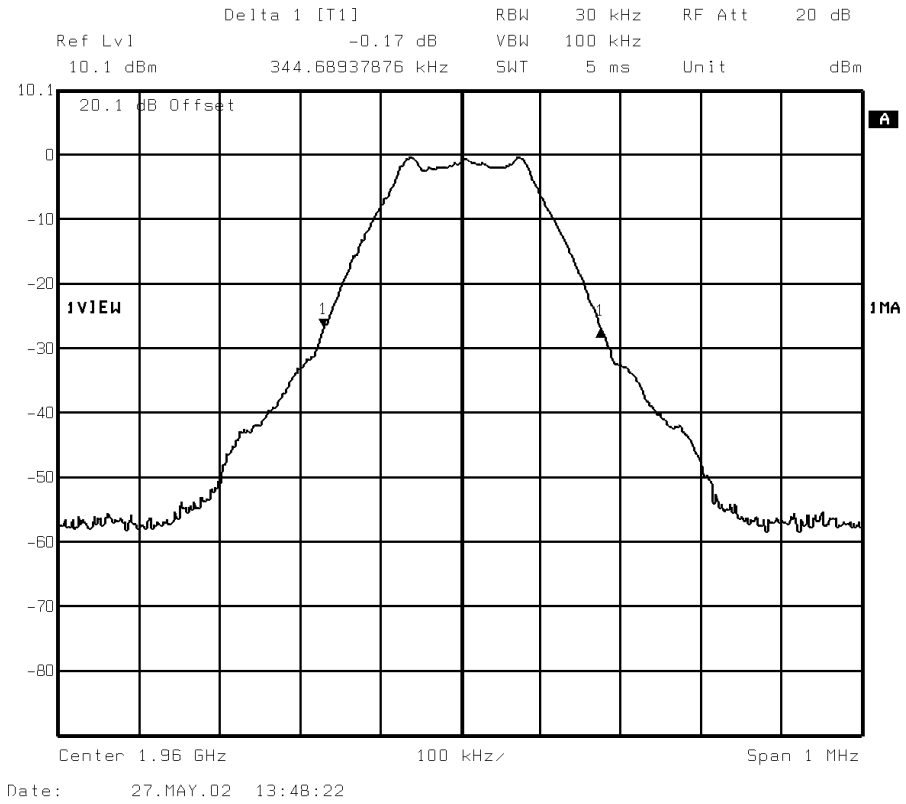
Occupied Bandwidth As Defined By The –26dBc Points

Maximum Power



Test Equipment Used:
1, 3, 9, 10
……..

Minimum Power



Test Equipment Used:
1, 2, 3, 4, 7
……

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

Test Date : 27th May 2002

Rule Parts : 2.1049, 24.238(b)

Measurement Method

In accordance with Part 24.238, at least 1% of the 26dB bandwidth was used for the resolution and video bandwidths up to 1MHz away from the Block Edge. At greater than 1MHz away from block edge, the resolution and video bandwidths were increased to 1MHz.

The reference power and path losses of all channels used for testing in each frequency block were measured. It was found that there was no variation in the path losses of 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.

Frequency Block (MHz)	Lower Block Edge Test Channels/Frequencies	Upper Block Edge Test Channels/Frequencies
A (1930 – 1945)	Channel : 512 Frequency : 1930.2MHz	Channel : 585 Frequency : 1944.8MHz
B (1950 – 1965)	Channel : 612 Frequency : 1950.2MHz	Channel : 685 Frequency : 1964.8MHz
C (1975 – 1990)	Channel : 737 Frequency : 1975.2MHz	Channel : 810 Frequency : 1989.8MHz
D (1945 – 1950)	Channel : 587 Frequency : 1945.2MHz	Channel : 610 Frequency : 1949.8MHz
E (1965 – 1970)	Channel : 687 Frequency : 1965.2MHz	Channel : 710 Frequency : 1969.8MHz
F (1970 – 1975)	Channel : 711 Frequency : 1970.2MHz	Channel : 735 Frequency : 1974.8MHz

Remarks

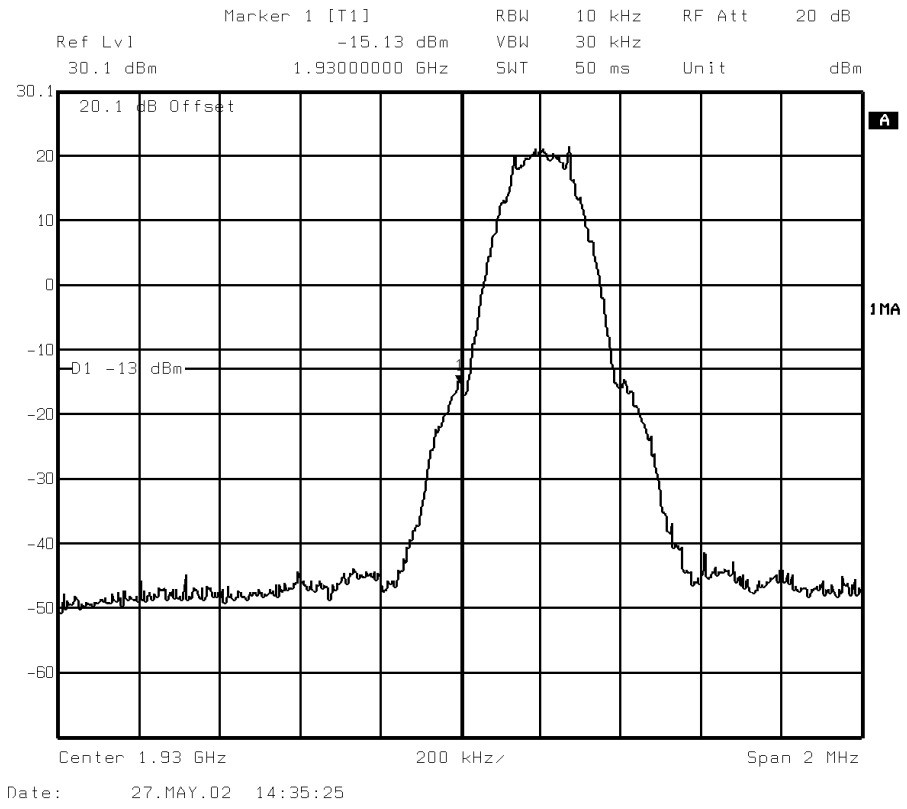
The EUT was tested at one channel in from the edge of the Frequency Blocks with the EUT transmitting on full power with modulation.

The measurement plots are shown on the following pages.

Test Case	:	Spurious Emissions At Antenna Terminals (+/-1MHz)
Test Date	:	27th May 2002
Rule Parts	:	2.1049, 24.238(b)

Block Edge Measurement With EUT Transmitting on Full Power On Channel 512, (1930.2MHz)

Block A
1930 – 1945MHz



Remarks

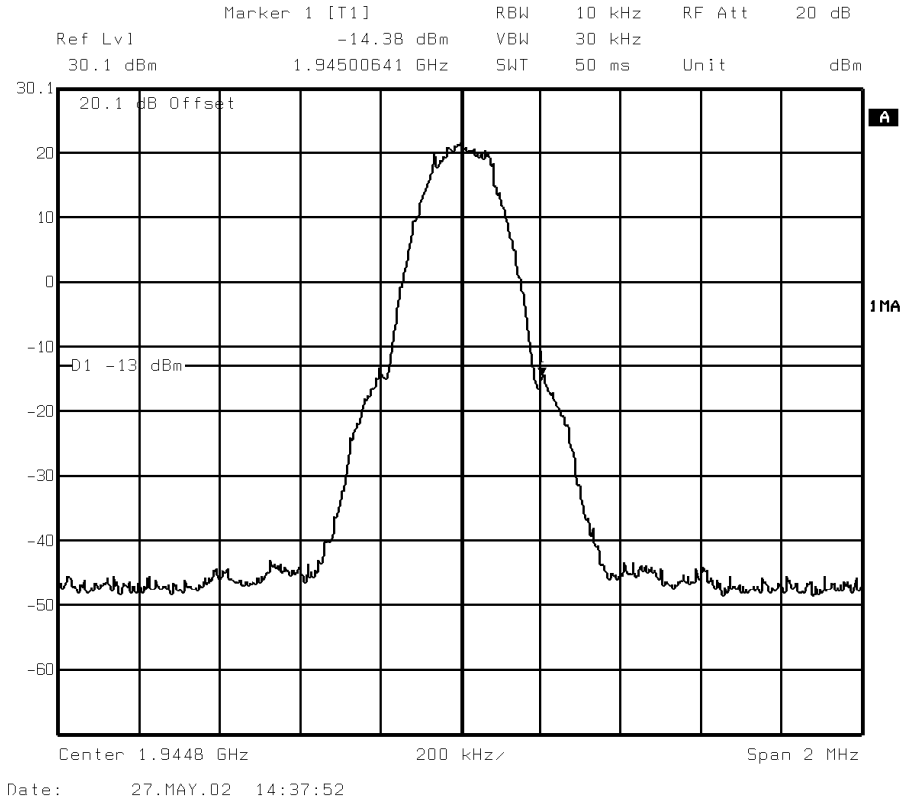
All emissions are below –13dBm up to 1MHz away from the block edge.

Test Equipment Used:
1, 2, 3, 4, 7
……..

Test Case	:	Spurious Emissions At Antenna Terminals (+/-1MHz)
Test Date	:	27th May 2002
Rule Parts	:	2.1049, 24.238(b)

Block Edge Measurement With EUT Transmitting on Full Power On Channel 585, (1944.8MHz)

Block A
1930 – 1945MHz



Remarks

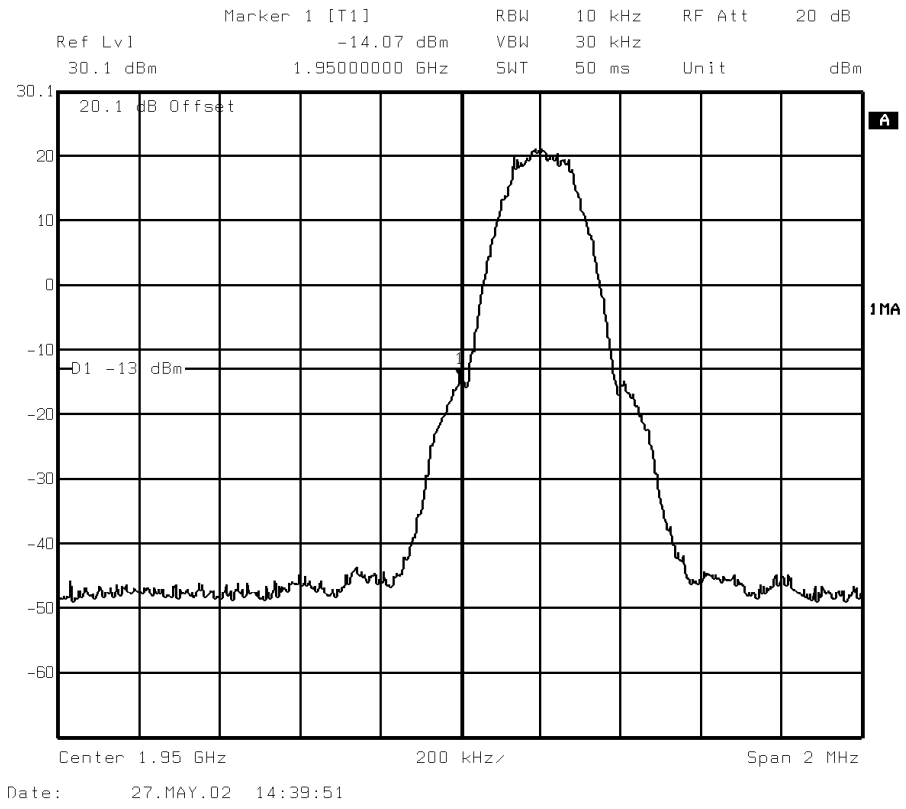
All emissions are below –13dBm up to 1MHz away from the block edge.

Test Equipment Used:
1, 2, 3, 4, 7
……..

Test Case	:	Spurious Emissions At Antenna Terminals (+/-1MHz)
Test Date	:	27th May 2002
Rule Parts	:	2.1049, 24.238(b)

Block Edge Measurement With EUT Transmitting on Full Power On Channel 612, (1950.2MHz)

Block B
1950 – 1965MHz



Remarks

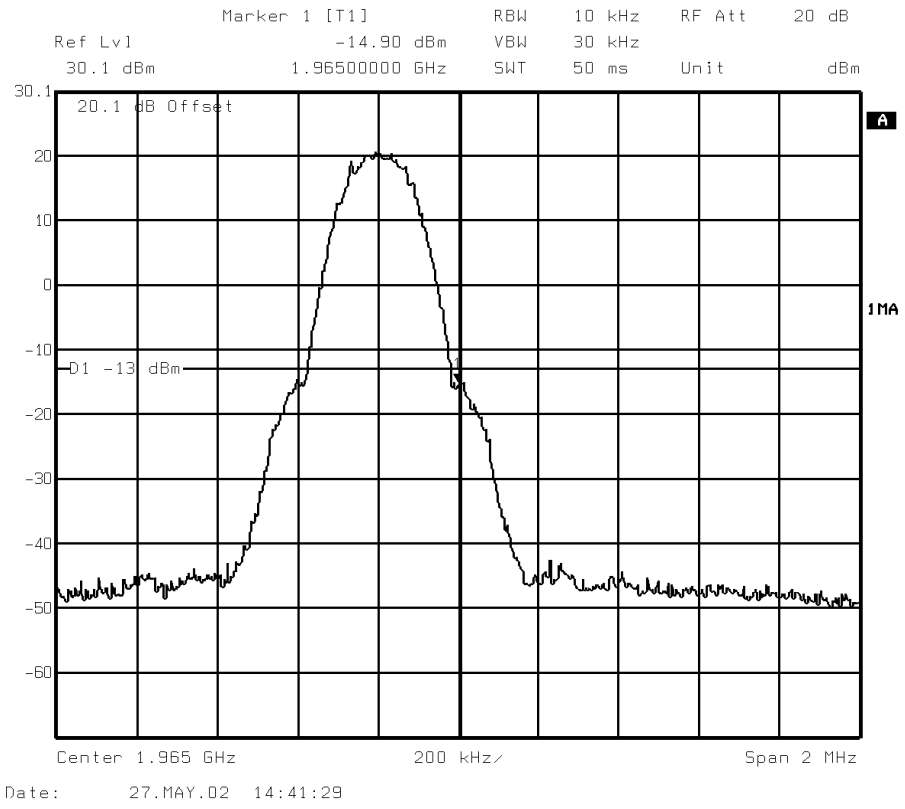
All emissions are below –13dBm up to 1MHz away from the block edge.

Test Equipment Used:
1, 2, 3, 4, 7
……

Test Case	:	Spurious Emissions At Antenna Terminals (+/-1MHz)
Test Date	:	27th May 2002
Rule Parts	:	2.1049, 24.238(b)

Block Edge Measurement With EUT Transmitting on Full Power On Channel 685, (1964.8MHz)

Block B
1950 – 1965MHz



Remarks

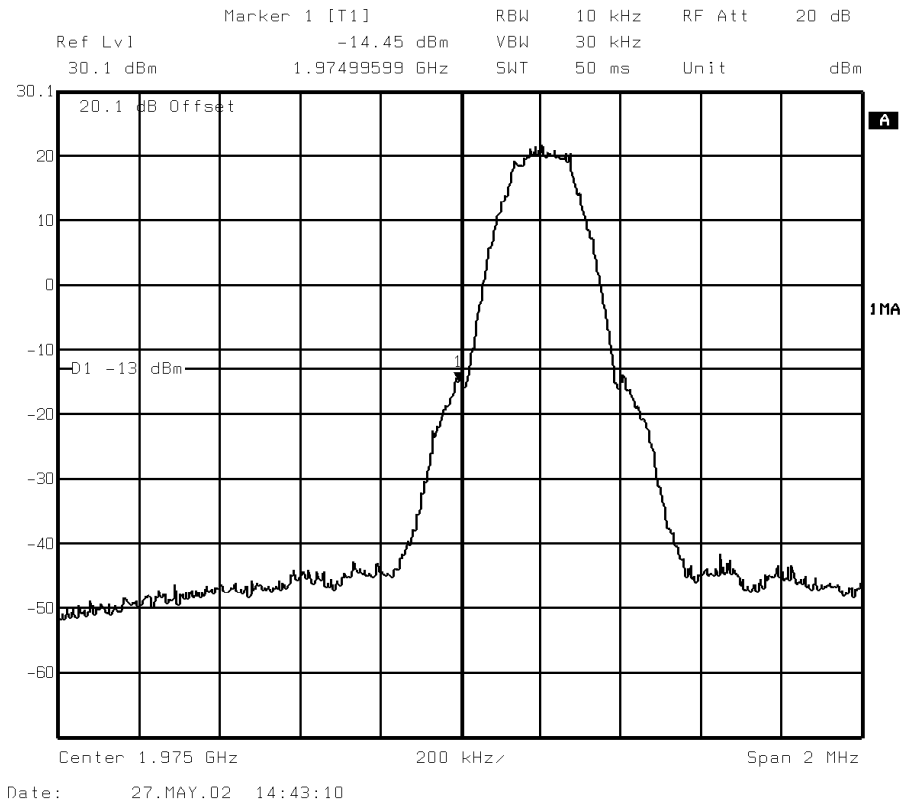
All emissions are below –13dBm up to 1MHz away from the block edge.

Test Equipment Used:
1, 2, 3, 4, 7
……

Test Case	:	Spurious Emissions At Antenna Terminals (+/-1MHz)
Test Date	:	27th May 2002
Rule Parts	:	2.1049, 24.238(b)

Block Edge Measurement With EUT Transmitting on Full Power On Channel 737, (1975.2MHz)

Block C
1975 – 1990MHz



Remarks

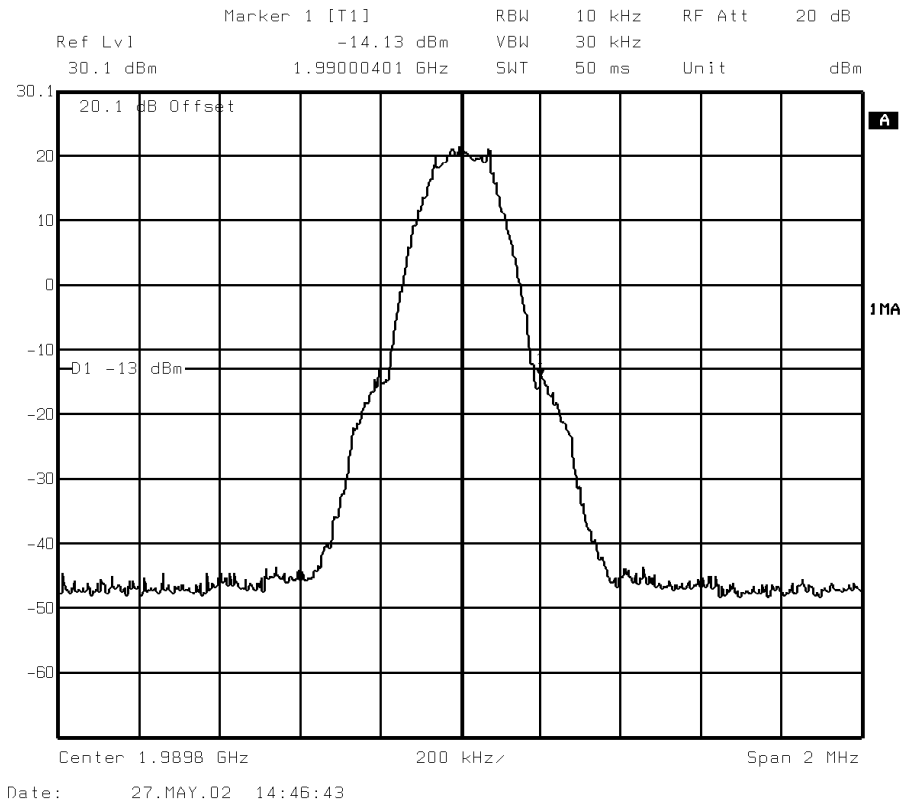
All emissions are below –13dBm up to 1MHz away from the block edge.

Test Equipment Used:
1, 2, 3, 4, 7
……

Test Case	:	Spurious Emissions At Antenna Terminals (+/-1MHz)
Test Date	:	27th May 2002
Rule Parts	:	2.1049, 24.238(b)

Block Edge Measurement With EUT Transmitting on Full Power On Channel 810, (1989.8MHz)

Block C
1975 – 1990MHz



Remarks

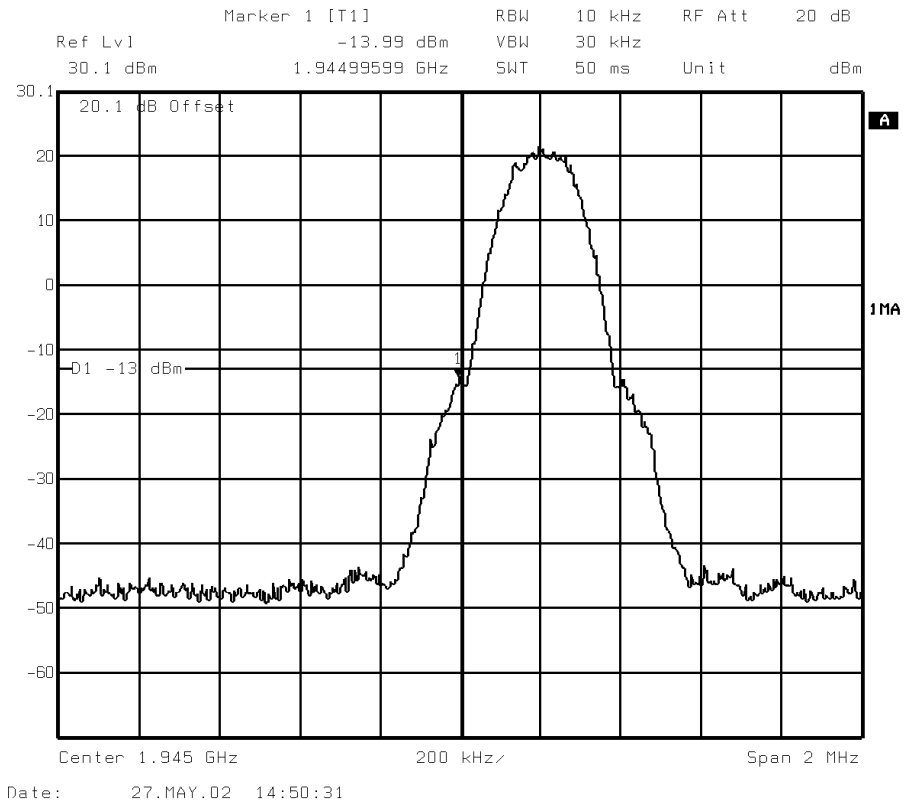
All emissions are below –13dBm up to 1MHz away from the block edge.

Test Equipment Used:
1, 2, 3, 4, 7
……

Test Case	:	Spurious Emissions At Antenna Terminals (+/-1MHz)
Test Date	:	27th May 2002
Rule Parts	:	2.1049, 24.238(b)

Block Edge Measurement With EUT Transmitting on Full Power On Channel 587, (1945.2MHz)

Block D
1945 – 1950MHz



Remarks

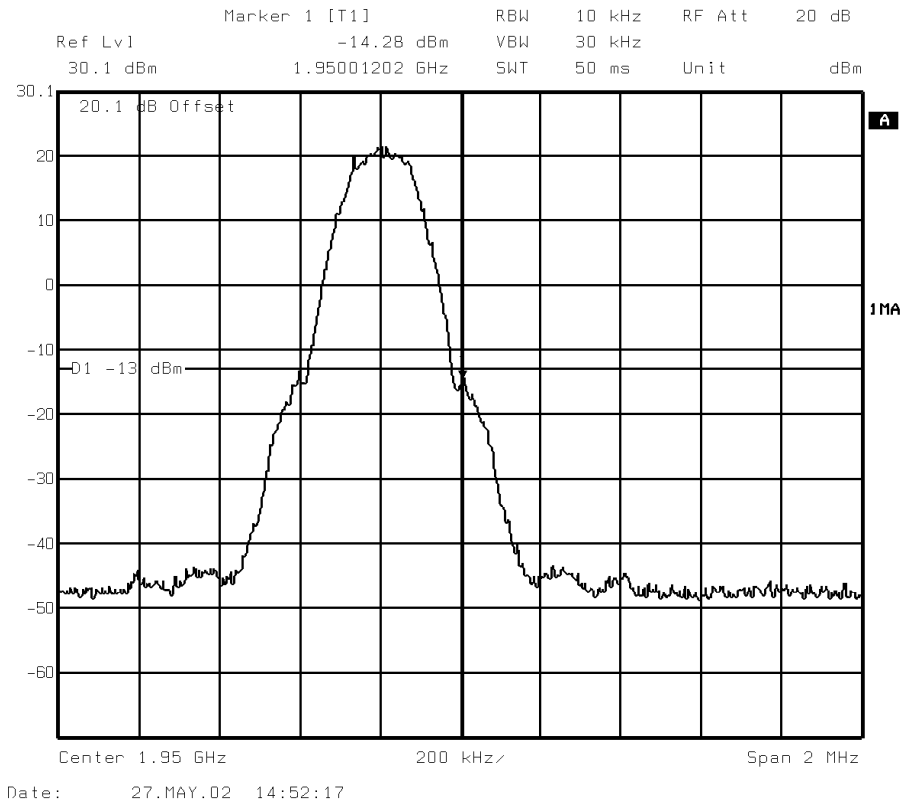
All emissions are below –13dBm up to 1MHz away from the block edge.

Test Equipment Used:
1, 2, 3, 4, 7
……

Test Case	:	Spurious Emissions At Antenna Terminals (+/-1MHz)
Test Date	:	27th May 2002
Rule Parts	:	2.1049, 24.238(b)

Block Edge Measurement With EUT Transmitting on Full Power On Channel 610, (1949.8MHz)

Block D
1945 – 1950MHz



Remarks

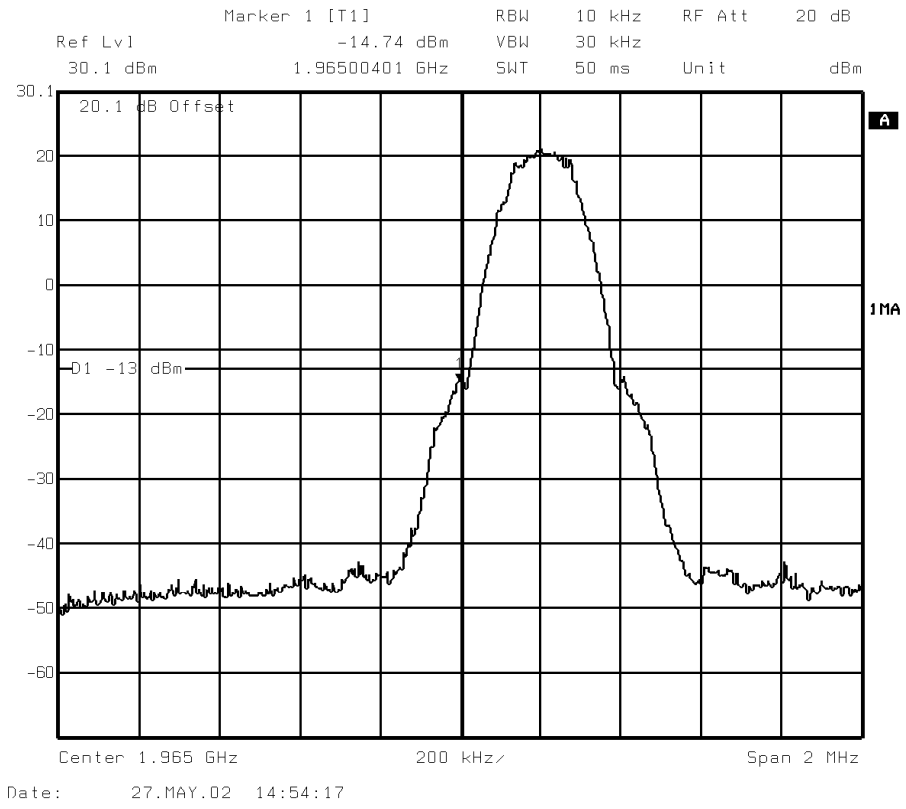
All emissions are below –13dBm up to 1MHz away from the block edge.

Test Equipment Used:
1, 2, 3, 4, 7
……

Test Case	:	Spurious Emissions At Antenna Terminals (+/-1MHz)
Test Date	:	27th May 2002
Rule Parts	:	2.1049, 24.238(b)

Block Edge Measurement With EUT Transmitting on Full Power On Channel 687, (1965.2MHz)

Block E
1965 – 1970MHz



Remarks

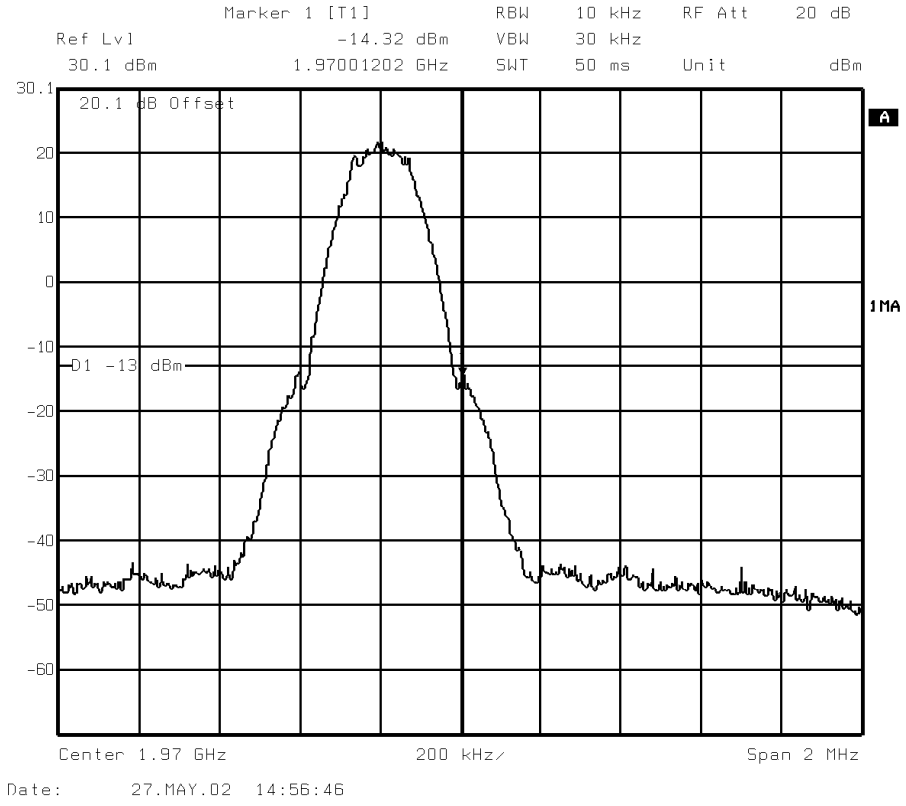
All emissions are below –13dBm up to 1MHz away from the block edge.

Test Equipment Used:
1, 2, 3, 4, 7
……

Test Case	:	Spurious Emissions At Antenna Terminals (+/-1MHz)
Test Date	:	27th May 2002
Rule Parts	:	2.1049, 24.238(b)

Block Edge Measurement With EUT Transmitting on Full Power On Channel 710, (1969.8MHz)

Block E
1965 – 1970MHz



Remarks

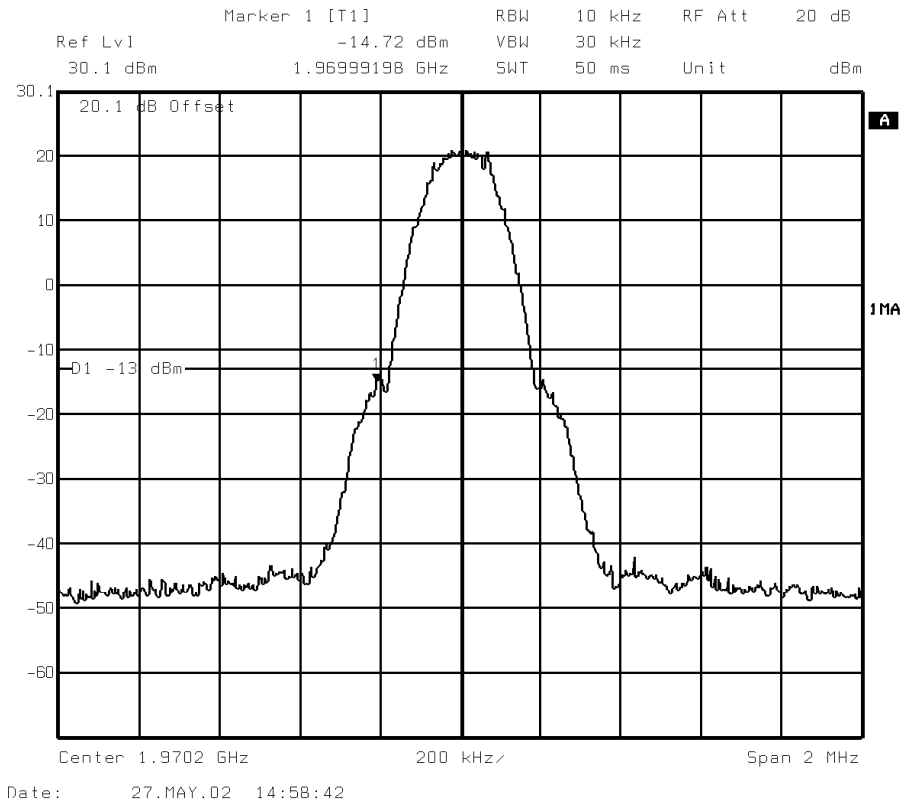
All emissions are below –13dBm up to 1MHz away from the block edge.

Test Equipment Used:
1, 2, 3, 4, 7
……

Test Case	:	Spurious Emissions At Antenna Terminals (+/-1MHz)
Test Date	:	27th May 2002
Rule Parts	:	2.1049, 24.238(b)

Block Edge Measurement With EUT Transmitting on Full Power On Channel 712, (1970.2MHz)

Block F
1970 – 1975MHz



Remarks

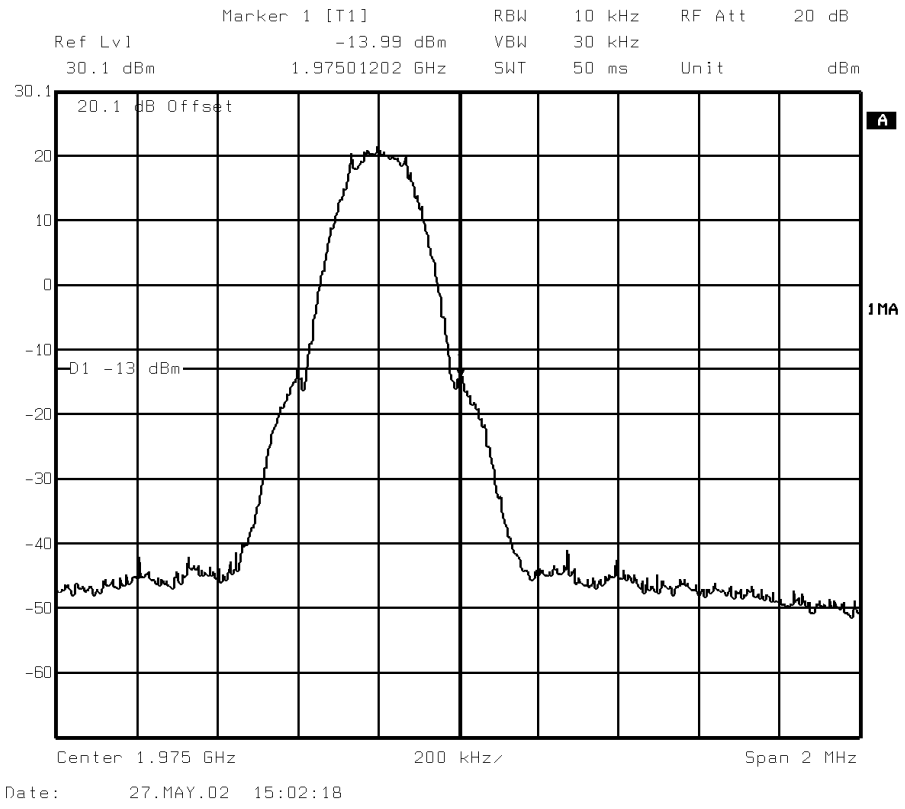
All emissions are below –13dBm up to 1MHz away from the block edge.

Test Equipment Used:
1, 2, 3, 4, 7
……

Test Case	:	Spurious Emissions At Antenna Terminals (+/-1MHz)
Test Date	:	27th May 2002
Rule Parts	:	2.1049, 24.238(b)

Block Edge Measurement With EUT Transmitting on Full Power On Channel 735, (1974.8MHz)

Block F
1970 – 1975MHz



Remarks

All emissions are below –13dBm up to 1MHz away from the block edge.

Test Equipment Used:
1, 2, 3, 4, 7
……

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

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 20 GHz. 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. The resolution and video bandwidths were set to 1MHz in accordance with Part 24.238. The spectrum analyser detector was set to Max Hold.

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 were detected within 20 dB of the –13dBm limit.

Remarks

The EUT passed the requirements laid out in 24.238.

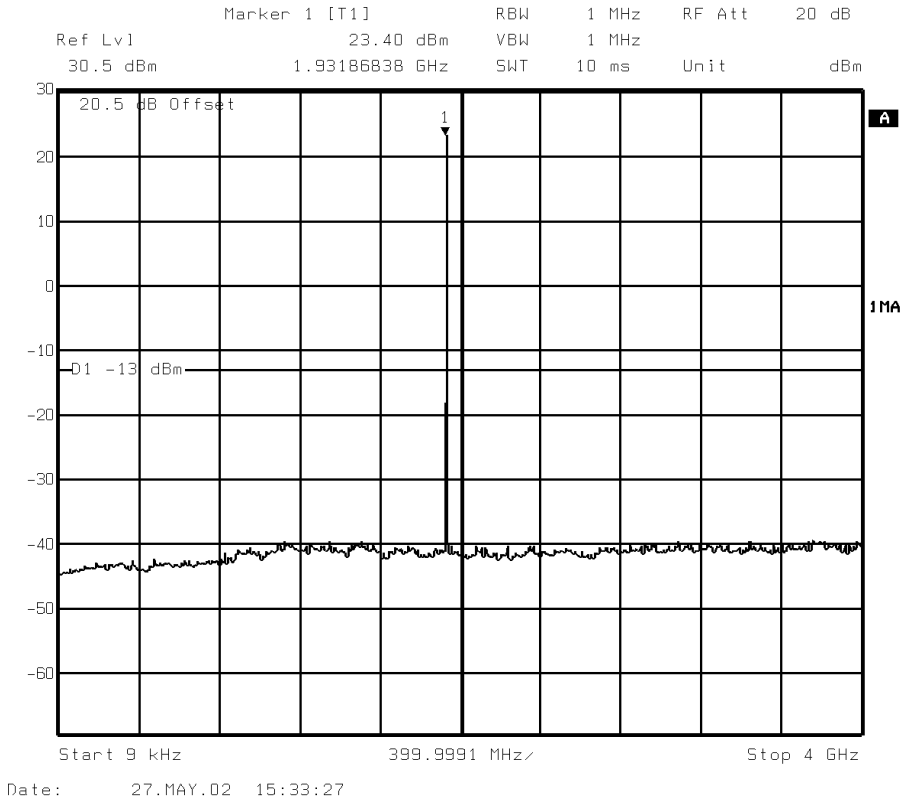
The plots on the following pages show the frequency spectrum from 9kHz to 20GHz of the EUT.

Test Equipment Used:
1, 3, 5, 6, 7, 8, 9, 10
……

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (9kHz – 4GHz)

Channel 512, (1930.2MHz) – Maximum Power

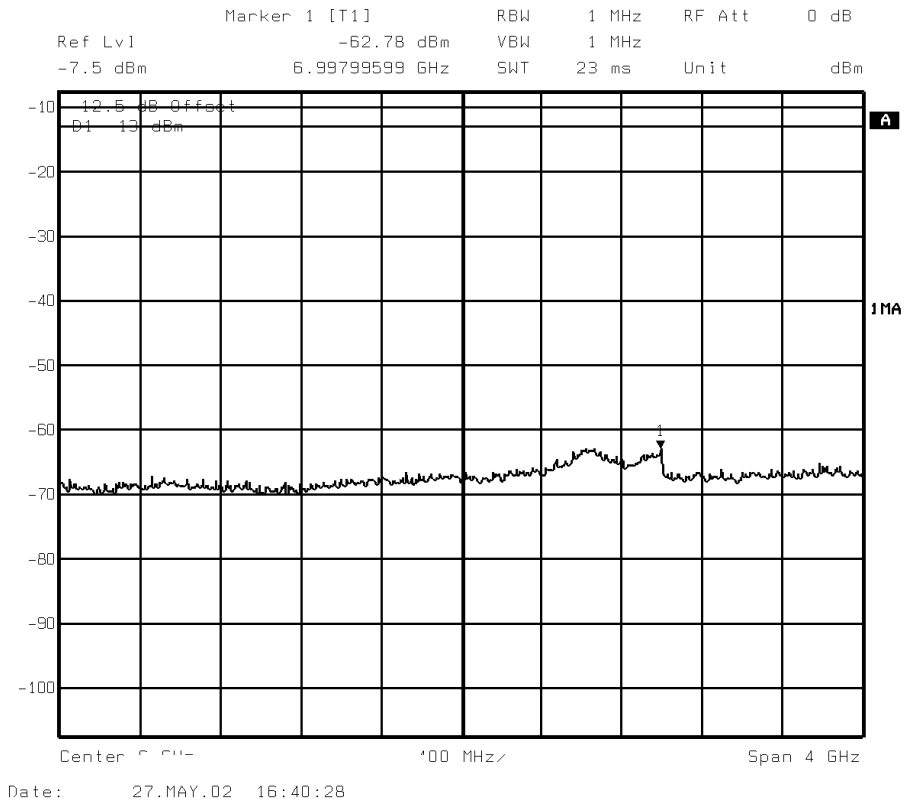


Test Equipment Used:
1, 2, 3, 4, 7
……..

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (4GHz – 8GHz)

Channel 512, (1930.2MHz) – Maximum Power



Test Equipment Used:

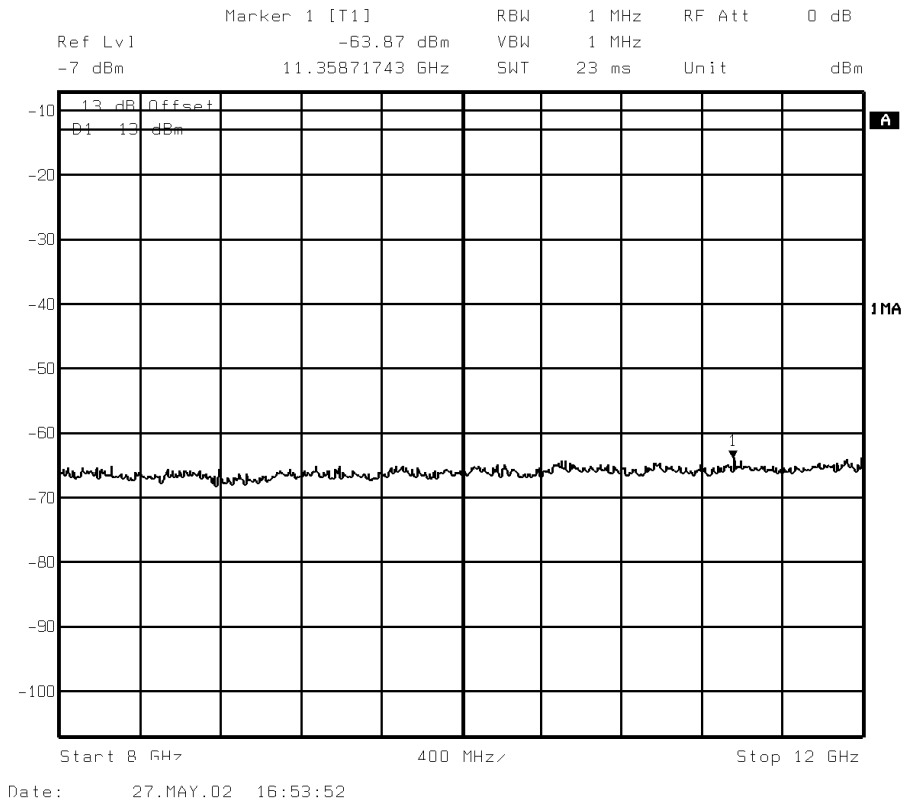
1, 2, 3, 5, 8, 9, 10, 11, 12

……

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (8GHz – 12GHz)

Channel 512, (1930.2MHz) – Maximum Power



Test Equipment Used:

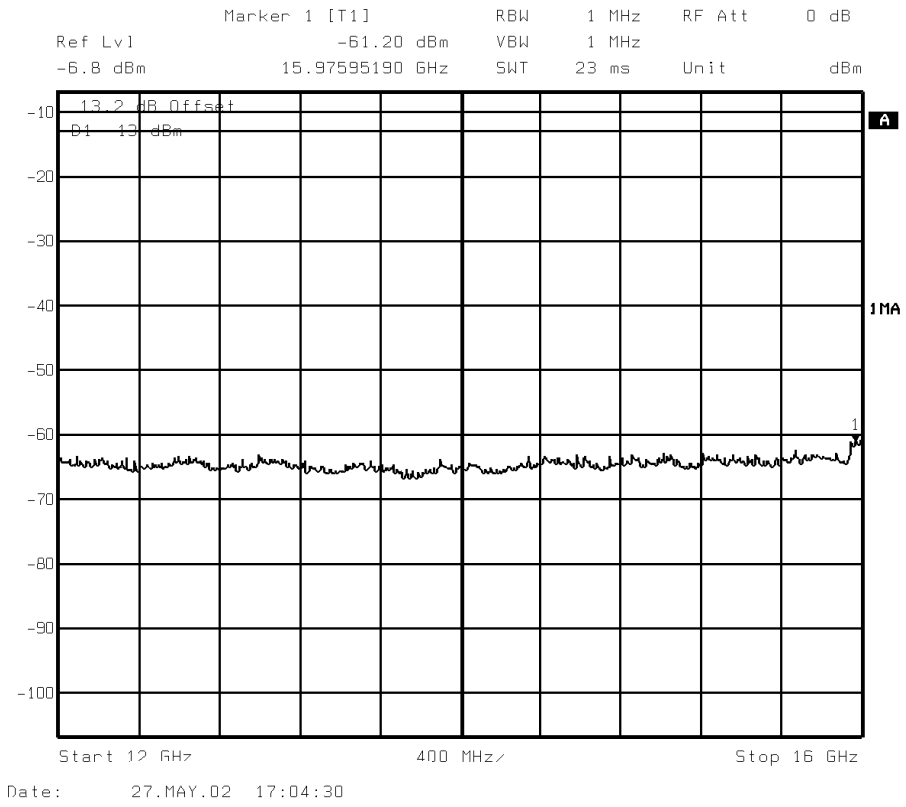
1, 2, 3, 5, 8, 9, 10, 11, 12

……

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (12GHz – 16GHz)

Channel 512, (1930.2MHz) – Maximum Power



Test Equipment Used:

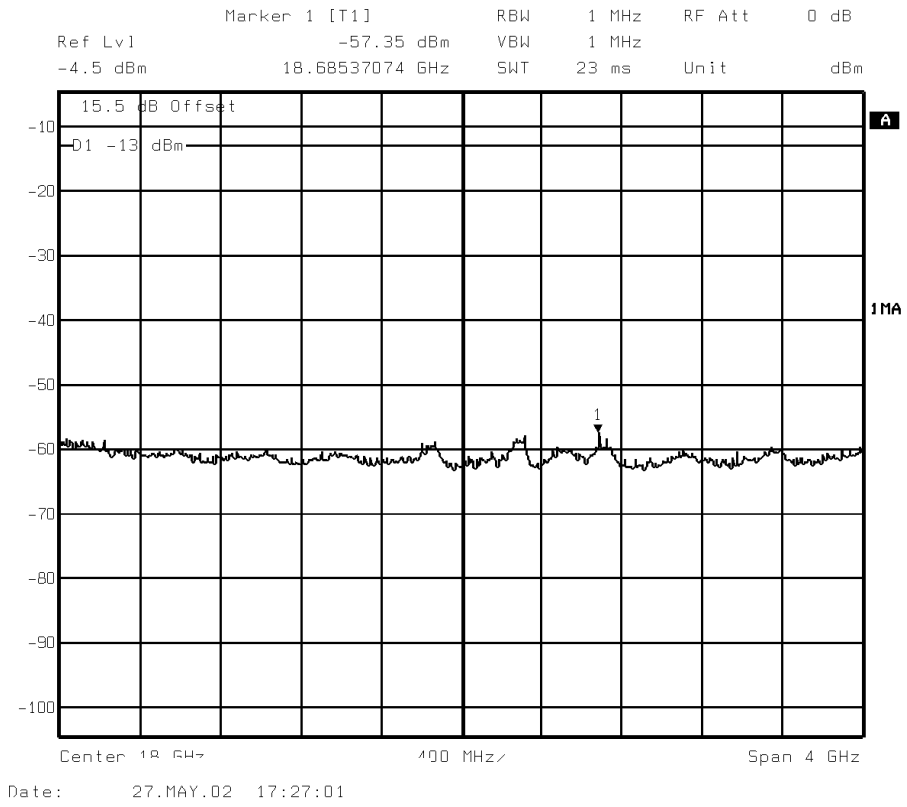
1, 2, 3, 5, 8, 9, 10, 11, 12

……

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (16GHz – 20GHz)

Channel 512, (1930.2MHz) – Maximum Power



Test Equipment Used:

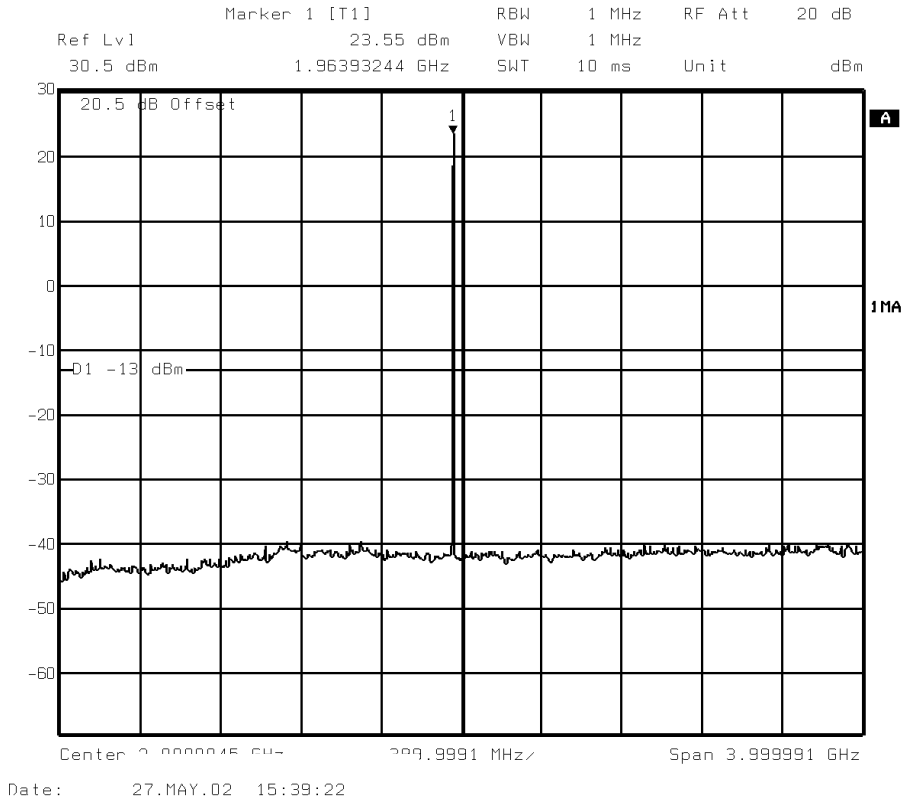
1, 2, 3, 5, 8, 9, 10, 11, 12

……..

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (9kHz – 4GHz)

Channel 661, (1960.0MHz) – Maximum Power



Test Equipment Used:

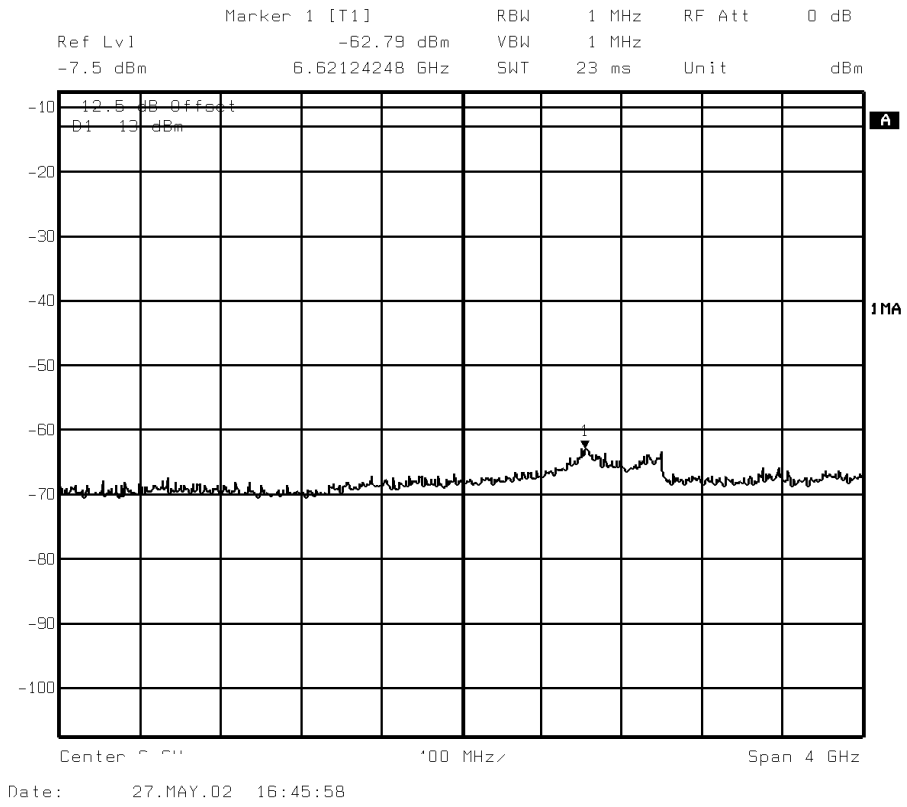
1, 2, 3, 4, 7

……

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (4GHz – 8GHz)

Channel 661, (1960.0MHz) – Maximum Power



Test Equipment Used:

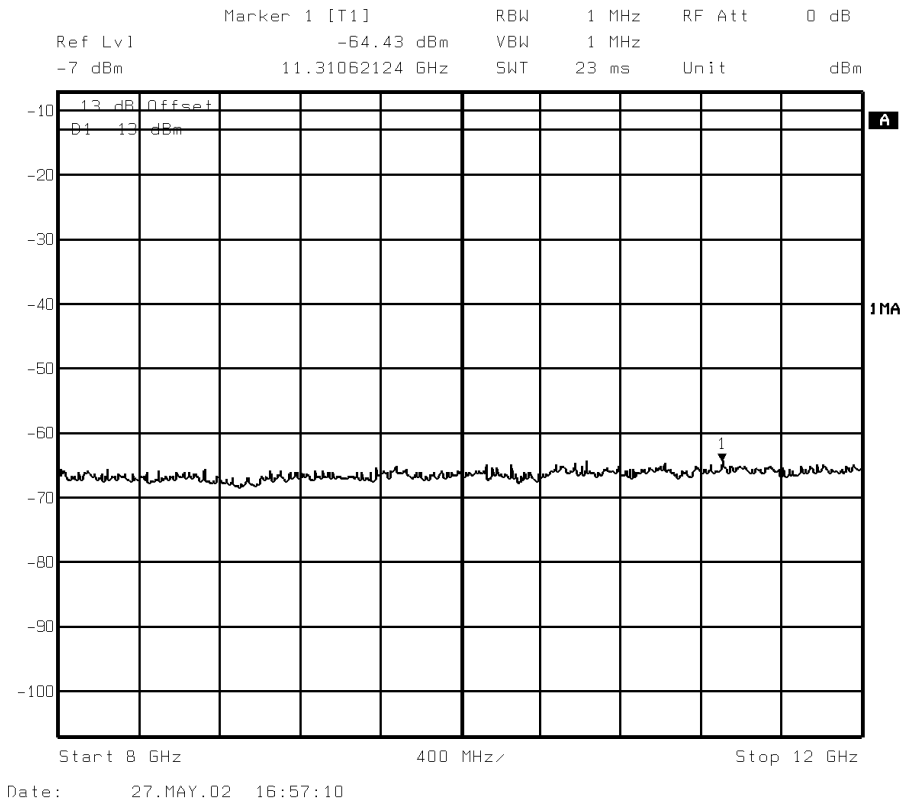
1, 2, 3, 5, 8, 9, 10, 11, 12

……..

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (8GHz – 12GHz)

Channel 661, (1960.0MHz) – Maximum Power



Test Equipment Used:

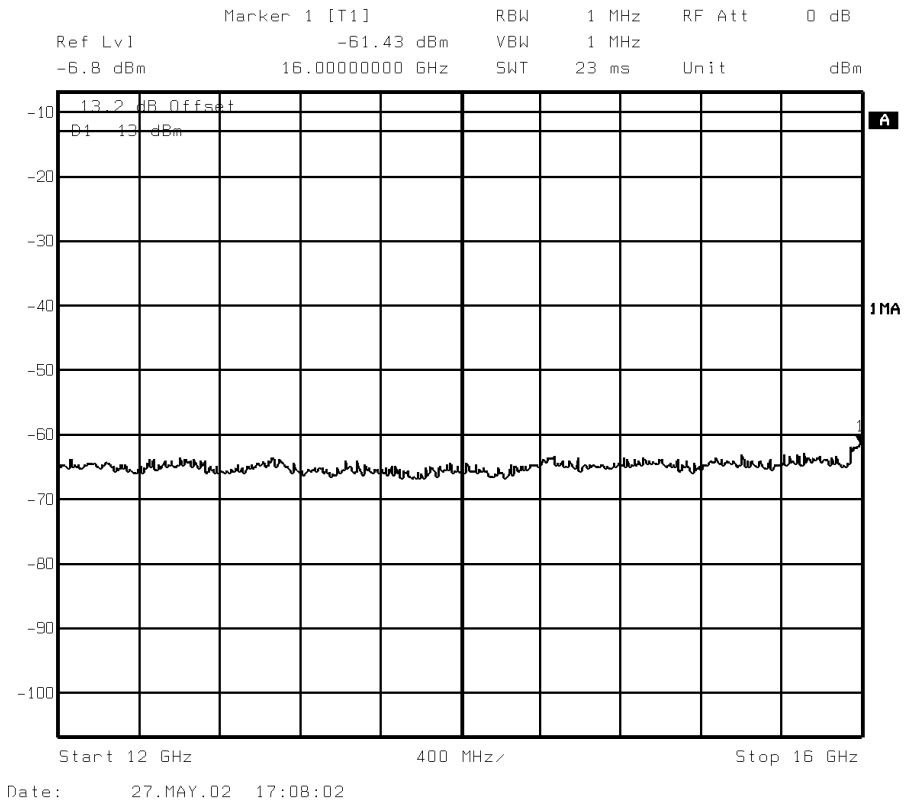
1, 2, 3, 5, 8, 9, 10, 11, 12

……..

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (12GHz – 16GHz)

Channel 661, (1960.0MHz) – Maximum Power



Test Equipment Used:

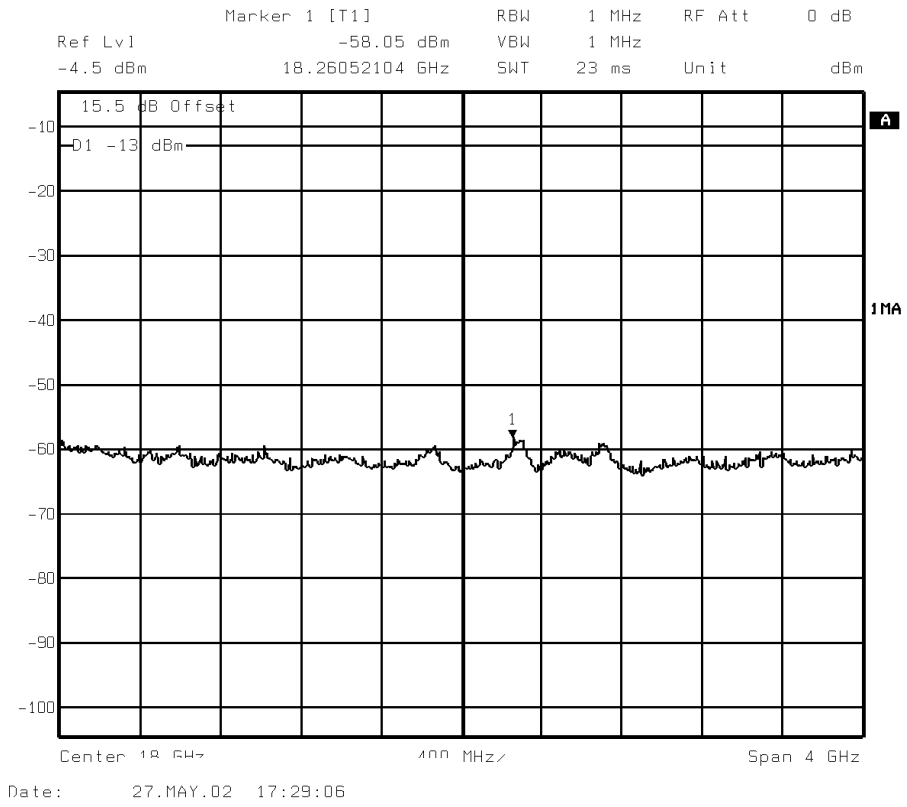
1, 2, 3, 5, 8, 9, 10, 11, 12

……..

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (16GHz – 20GHz)

Channel 661, (1960.0MHz) – Maximum Power



Test Equipment Used:

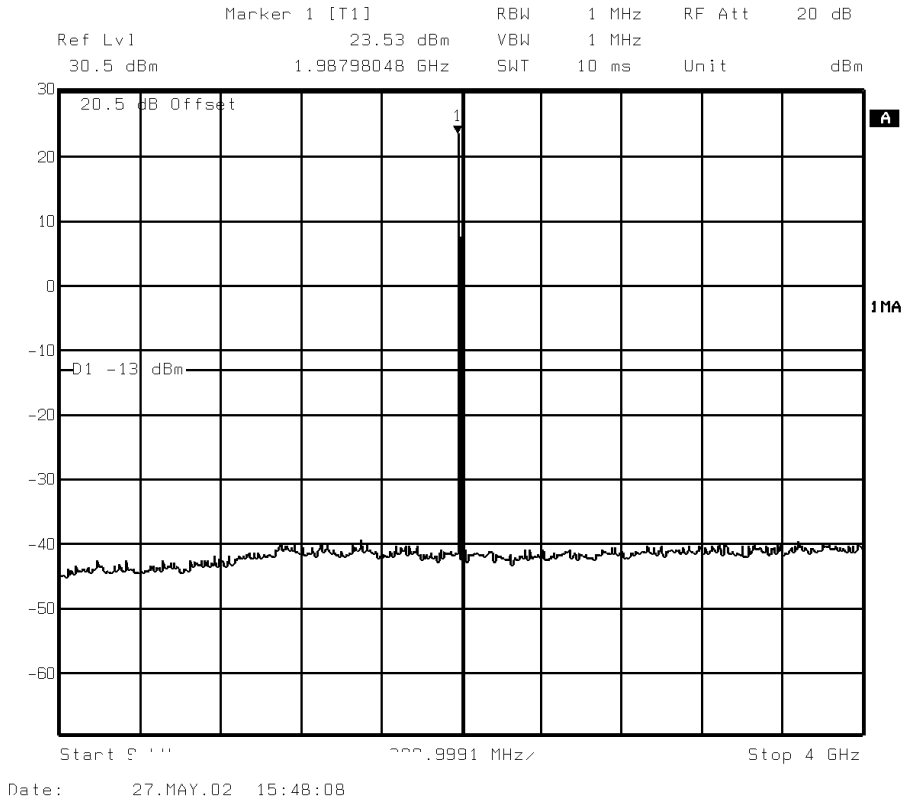
1, 2, 3, 5, 8, 9, 10, 11, 12

……..

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (9kHz – 4GHz)

Channel 810, (1989.8MHz) – Maximum Power



Test Equipment Used:

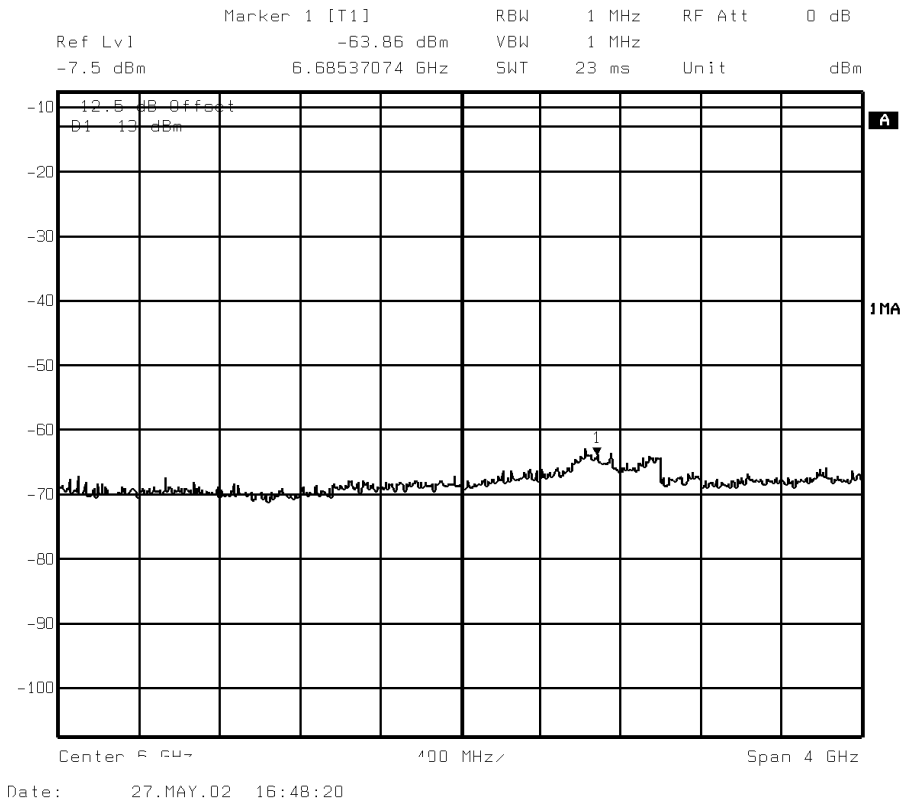
1, 2, 3, 5, 8, 9, 10, 11, 12

……

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (4GHz – 8GHz)

Channel 810, (1989.8MHz) – Maximum Power



Test Equipment Used:

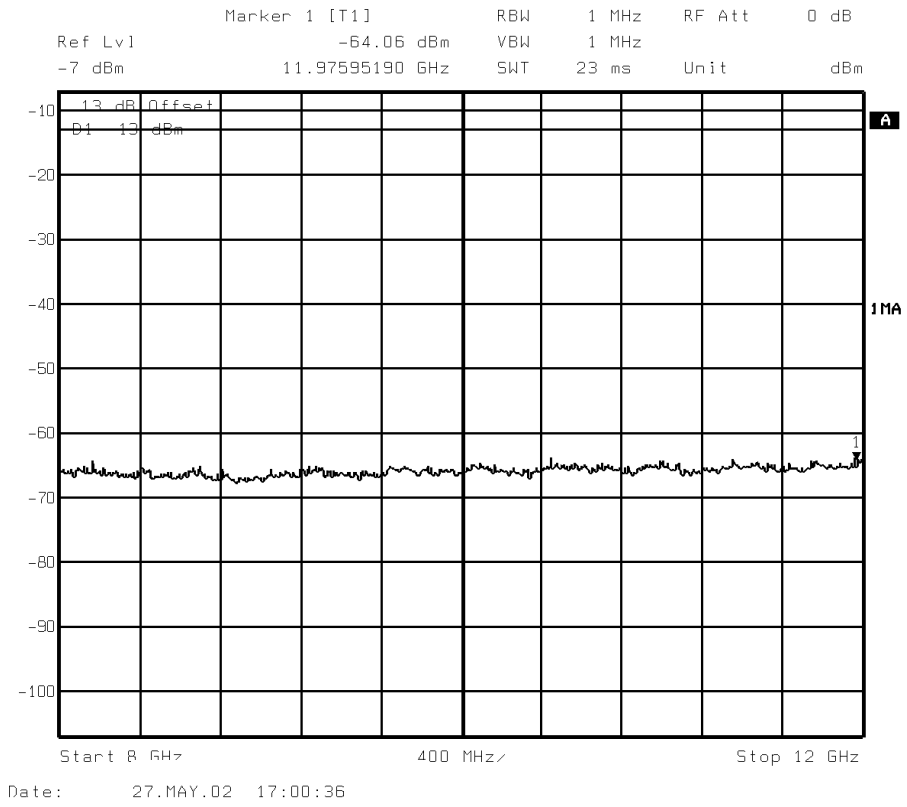
1, 2, 3, 5, 8, 9, 10, 11, 12

……

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (8GHz – 12GHz)

Channel 810, (1989.8MHz) – Maximum Power



Test Equipment Used:

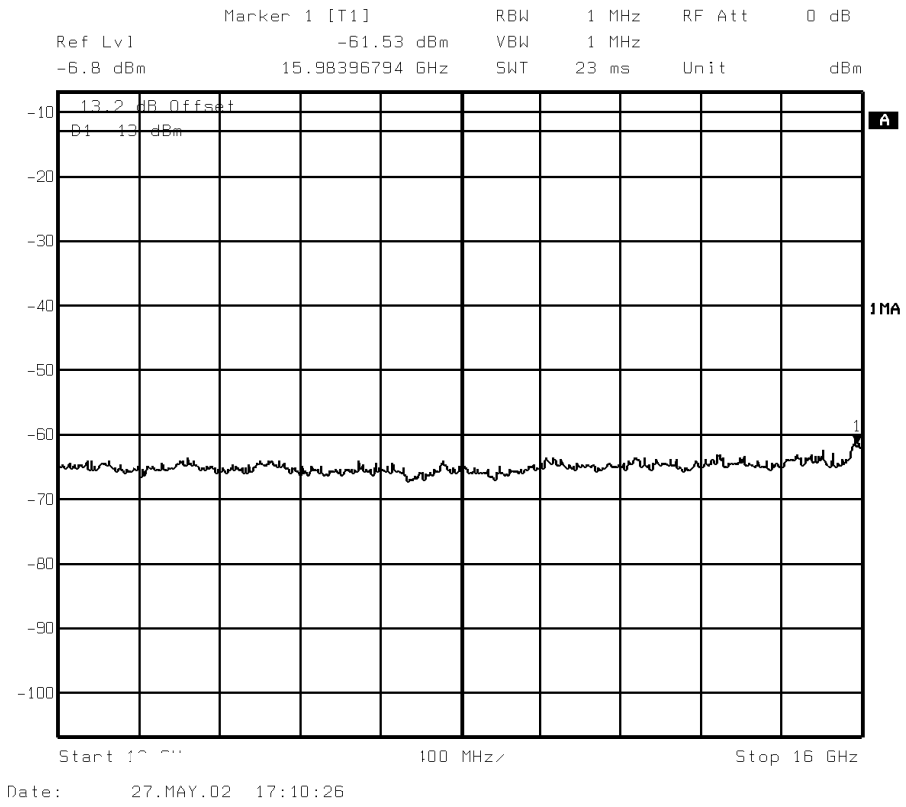
1, 2, 3, 5, 8, 9, 10, 11, 12

……

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (12GHz – 16GHz)

Channel 810, (1989.8MHz) – Maximum Power



Test Equipment Used:

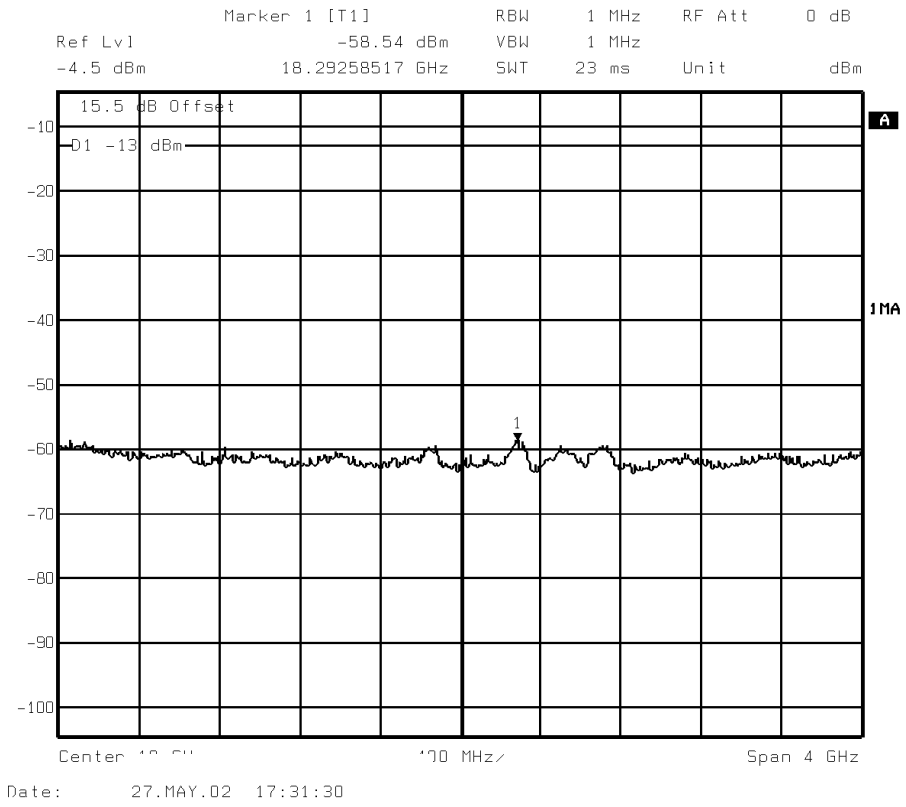
1, 2, 3, 5, 8, 9, 10, 11, 12

……..

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (16GHz – 20GHz)

Channel 810, (1989.8MHz) – Maximum Power



Test Equipment Used:

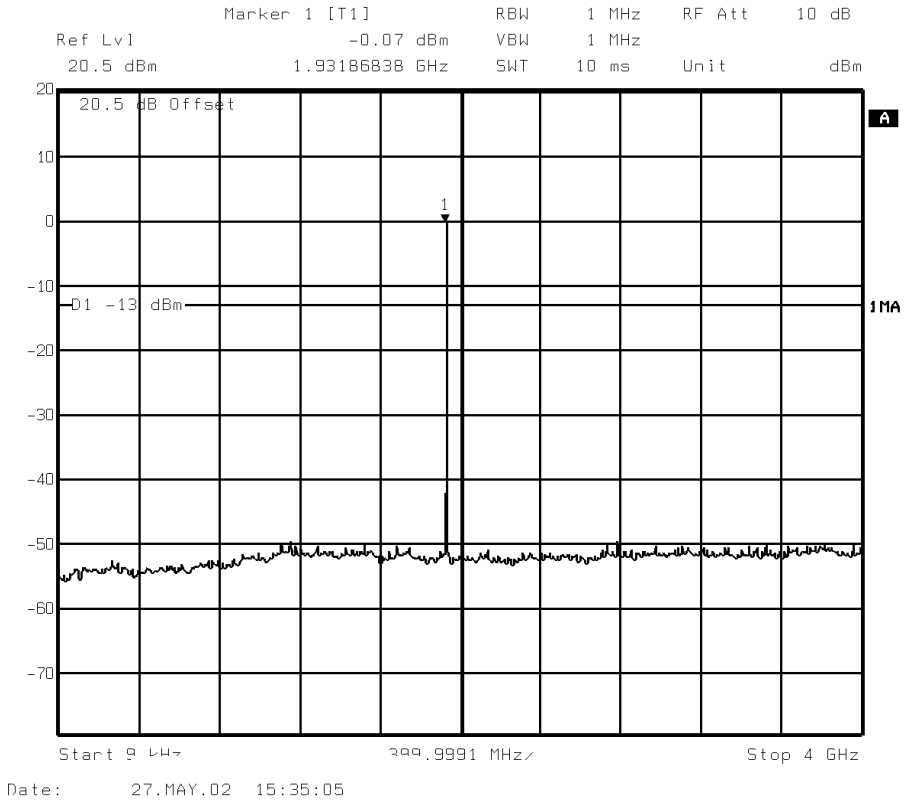
1, 2, 3, 5, 8, 9, 10, 11, 12

……

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (9kHz – 4GHz)

Channel 512, (1930.2MHz) – Minimum Power



Test Equipment Used:

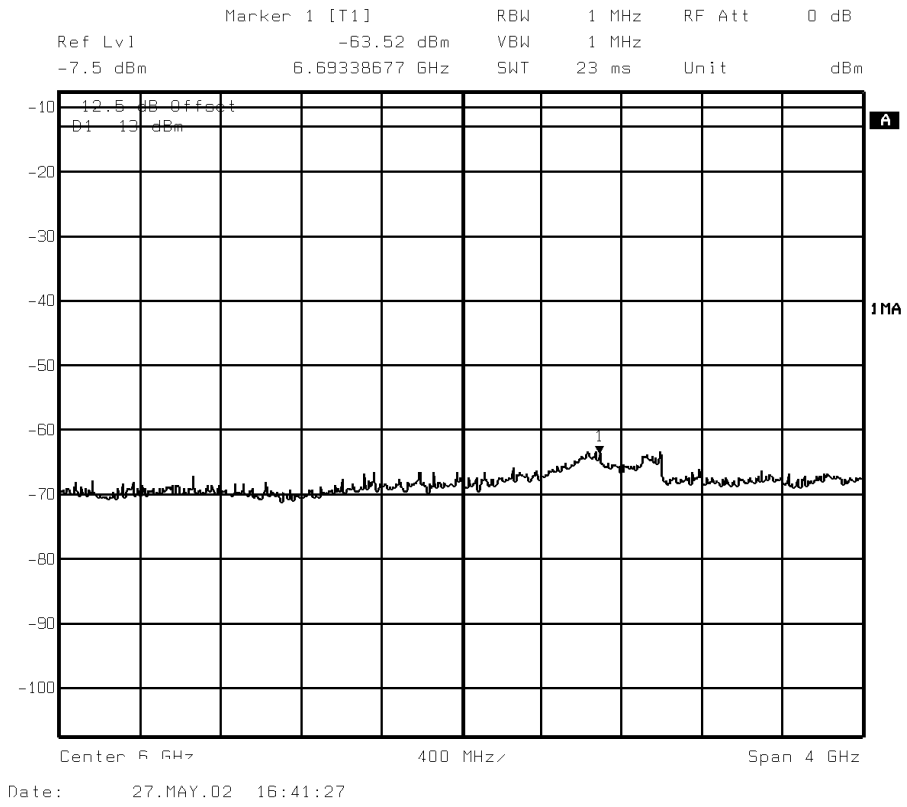
1, 2, 3, 5, 8, 9, 10, 11, 12

……..

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (4GHz – 8GHz)

Channel 512, (1930.2MHz) – Minimum Power



Test Equipment Used:

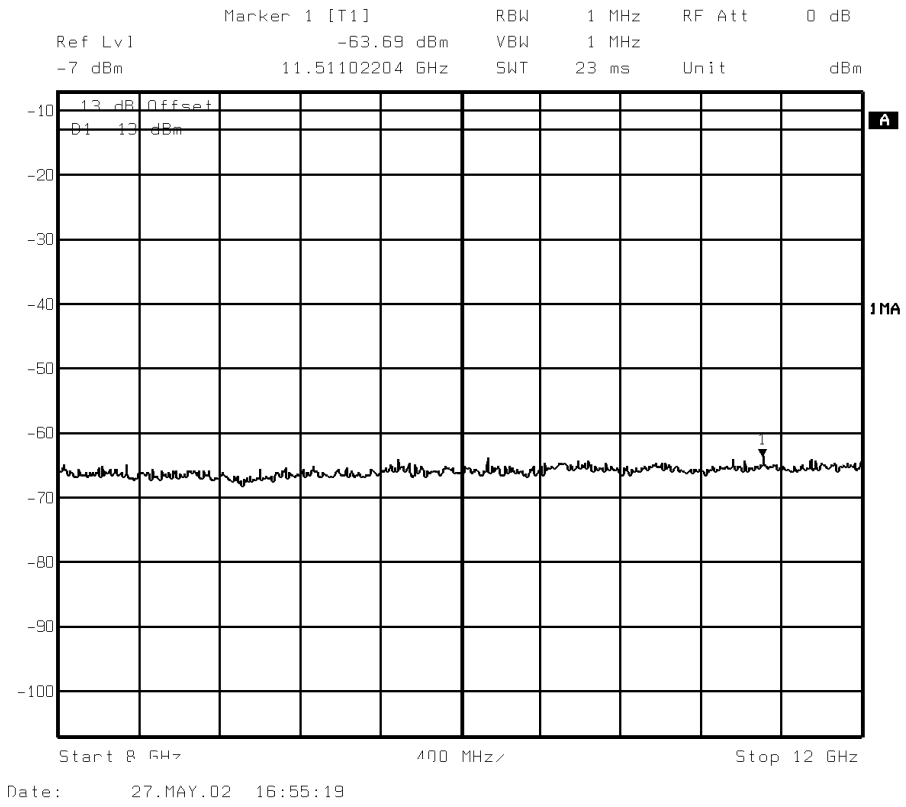
1, 2, 3, 5, 8, 9, 10, 11, 12

……..

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (8GHz – 12GHz)

Channel 512, (1930.2MHz) – Minimum Power



Test Equipment Used:

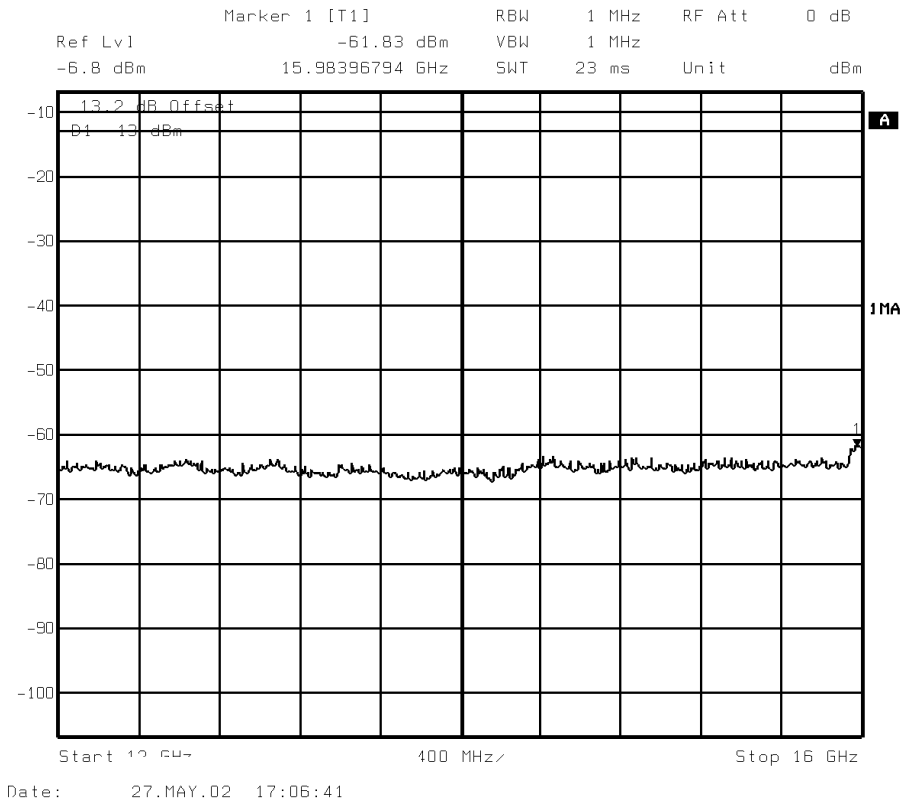
1, 2, 3, 5, 8, 9, 10, 11, 12

……

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (12GHz – 16GHz)

Channel 512, (1930.2MHz) – Minimum Power



Test Equipment Used:

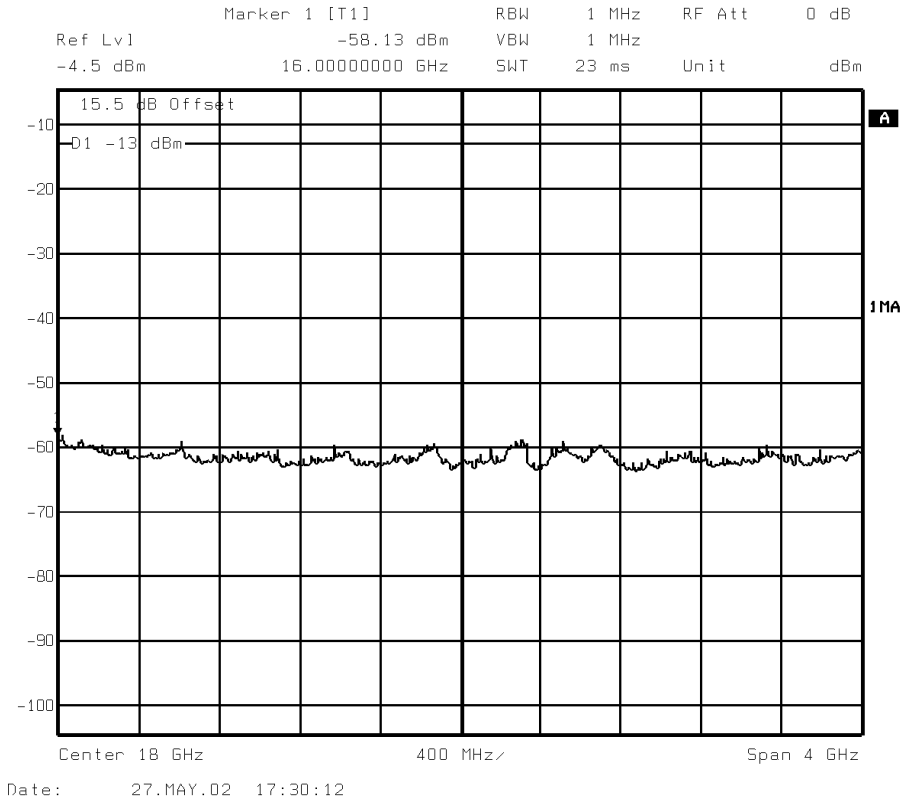
1, 2, 3, 5, 8, 9, 10, 11, 12

……

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (16GHz – 20GHz)

Channel 512, (1930.2MHz) – Minimum Power



Test Equipment Used:

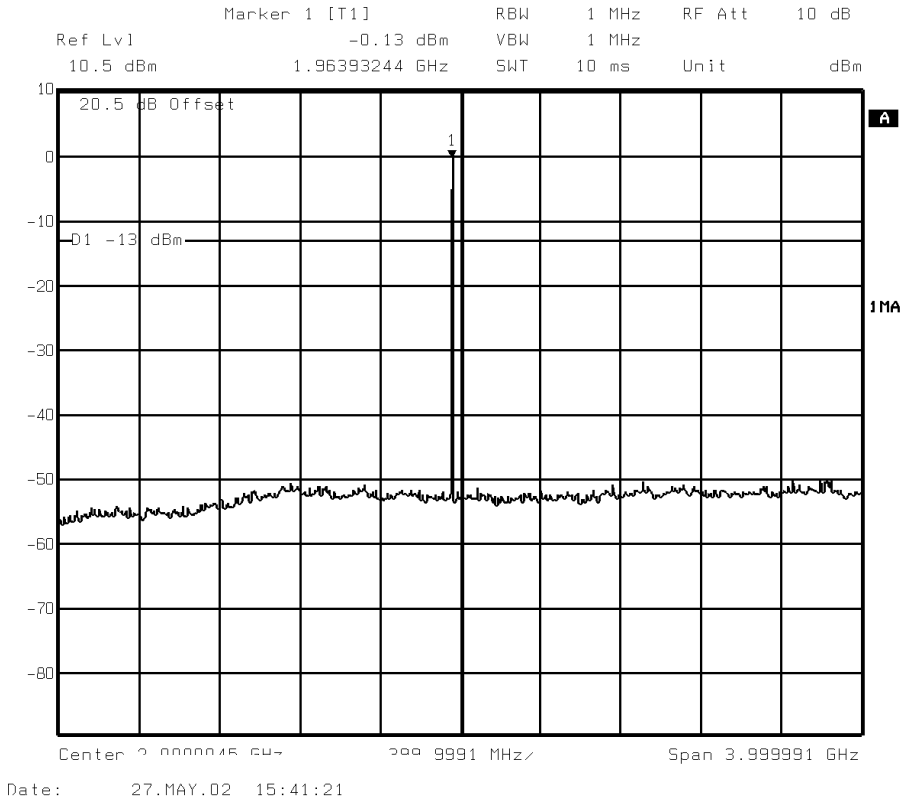
1, 2, 3, 5, 8, 9, 10, 11, 12

……..

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (9kHz – 4GHz)

Channel 661, (1960.0MHz) – Minimum Power



Test Equipment Used:

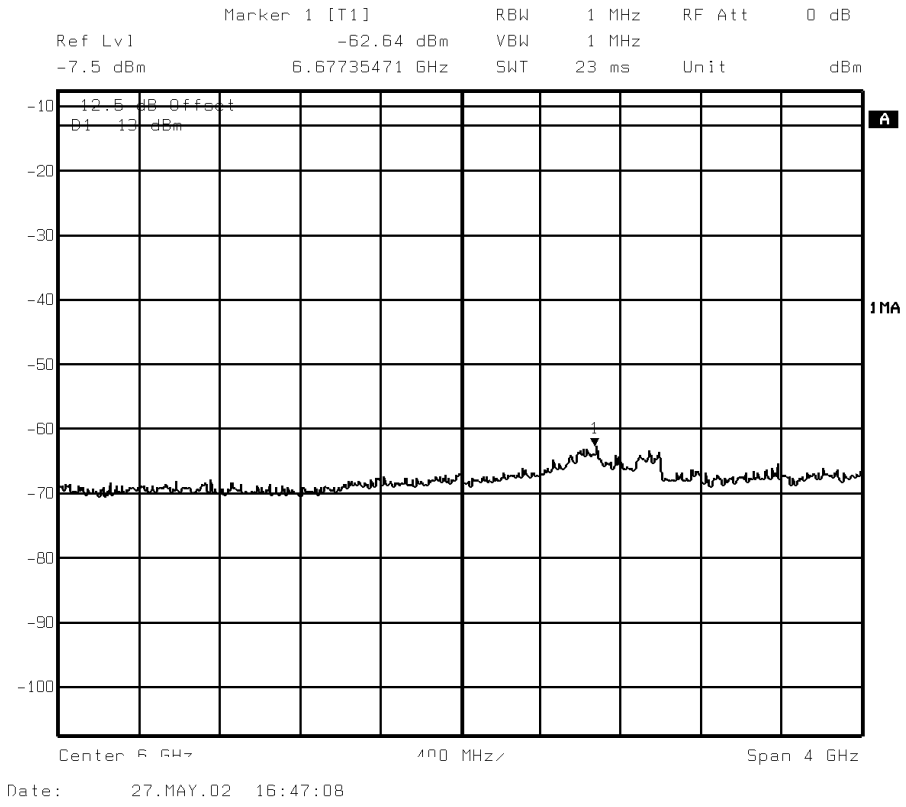
1, 2, 3, 5, 8, 9, 10, 11, 12

……..

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (4GHz – 8GHz)

Channel 661, (1960.0MHz) – Minimum Power



Test Equipment Used:

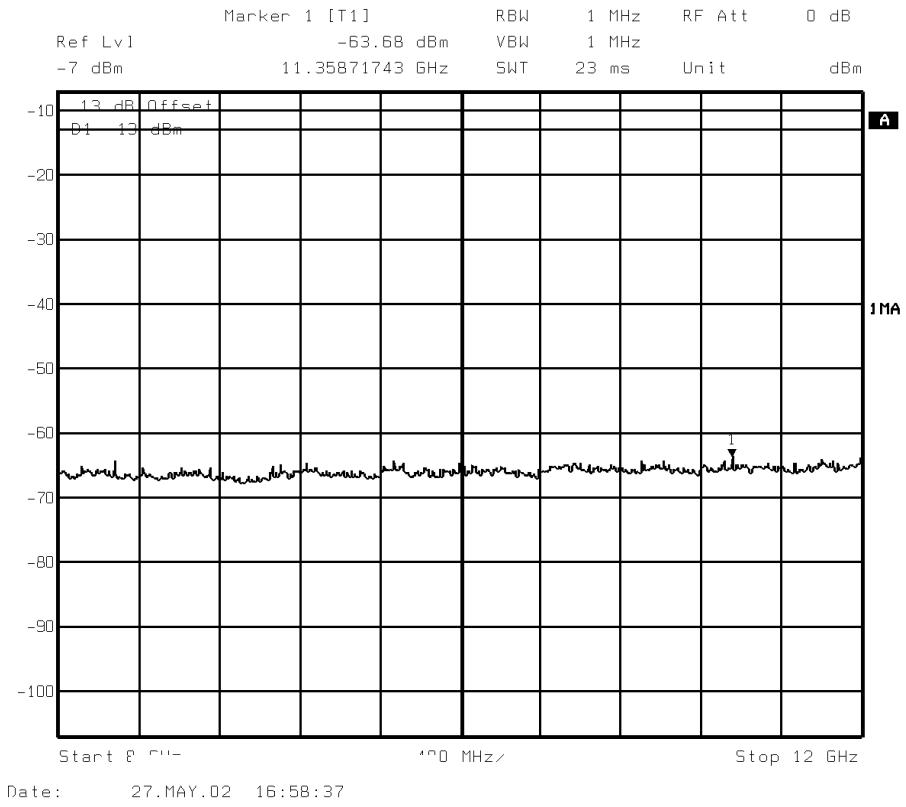
1, 2, 3, 5, 8, 9, 10, 11, 12

……..

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (8GHz – 12GHz)

Channel 661, (1960.0MHz) – Minimum Power



Test Equipment Used:

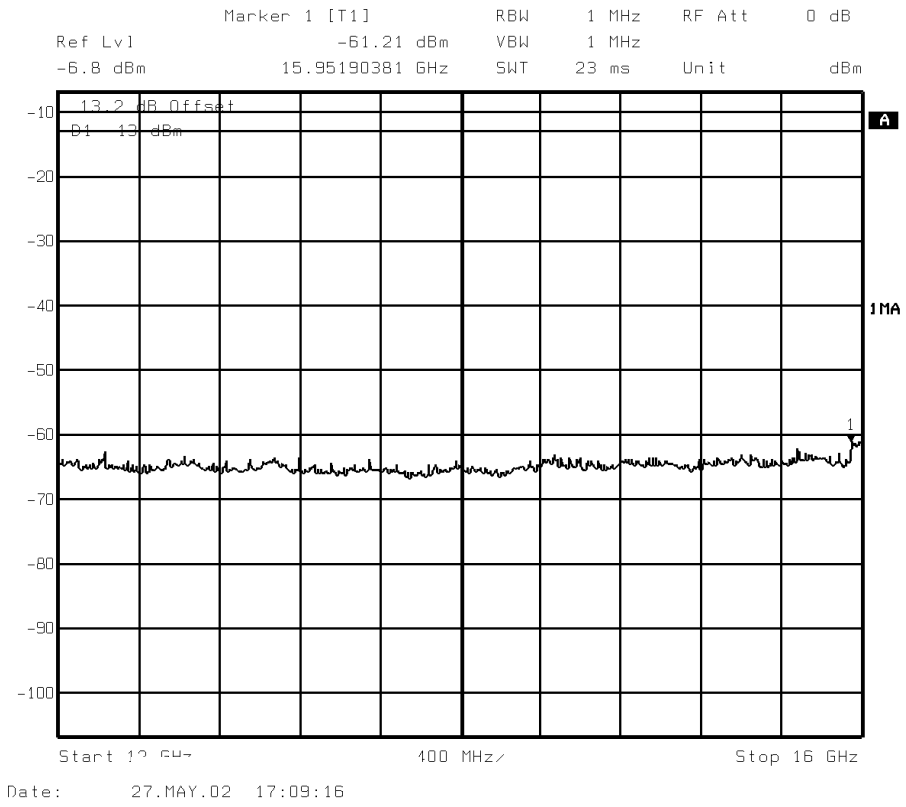
1, 2, 3, 5, 8, 9, 10, 11, 12

……..

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (12GHz – 16GHz)

Channel 661, (1960.0MHz) – Minimum Power



Test Equipment Used:

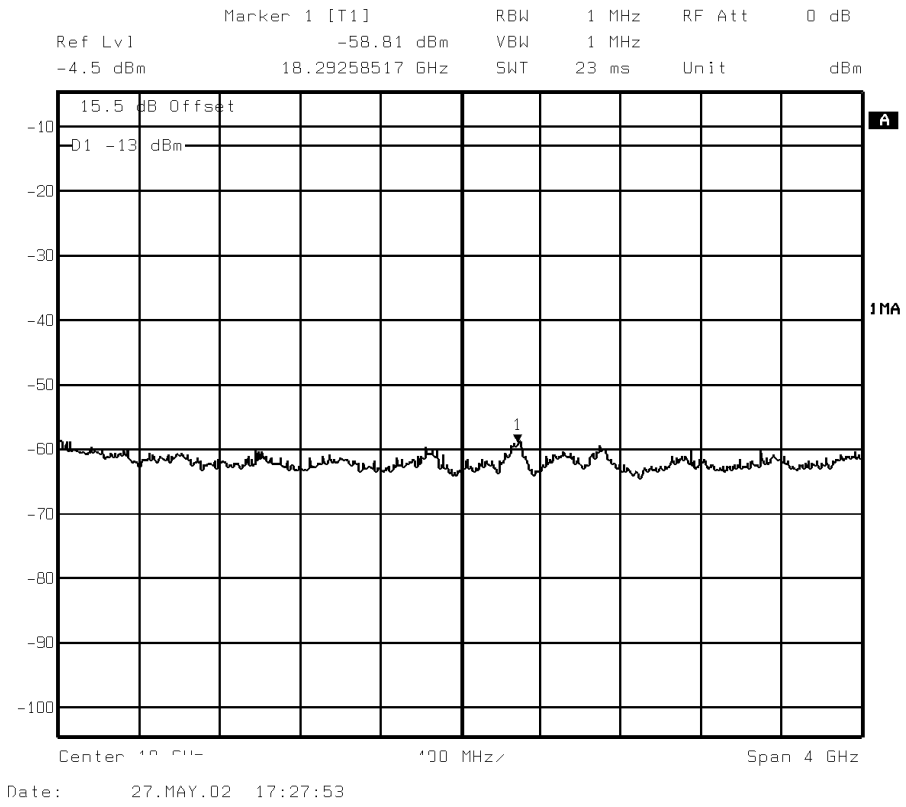
1, 2, 3, 5, 8, 9, 10, 11, 12

……..

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (16GHz – 20GHz)

Channel 661, (1960.0MHz) – Minimum Power



Test Equipment Used:

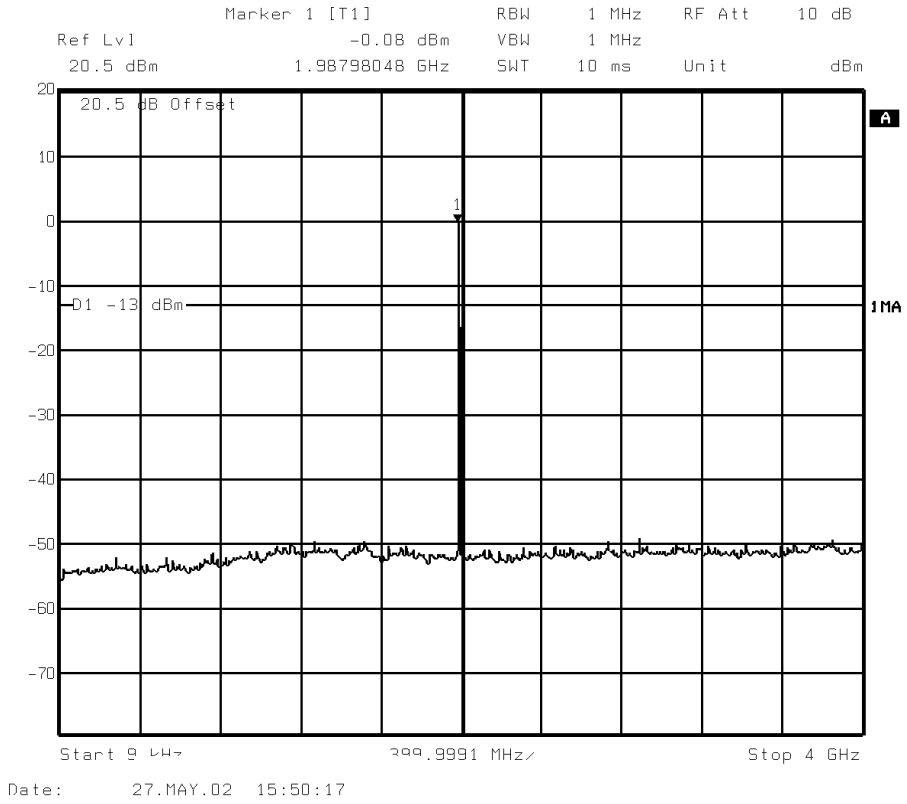
1, 2, 3, 4, 5, 8, 9, 10, 11, 12

……

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (9kHz – 4GHz)

Channel 810, (1989.8MHz) – Minimum Power



Test Equipment Used:

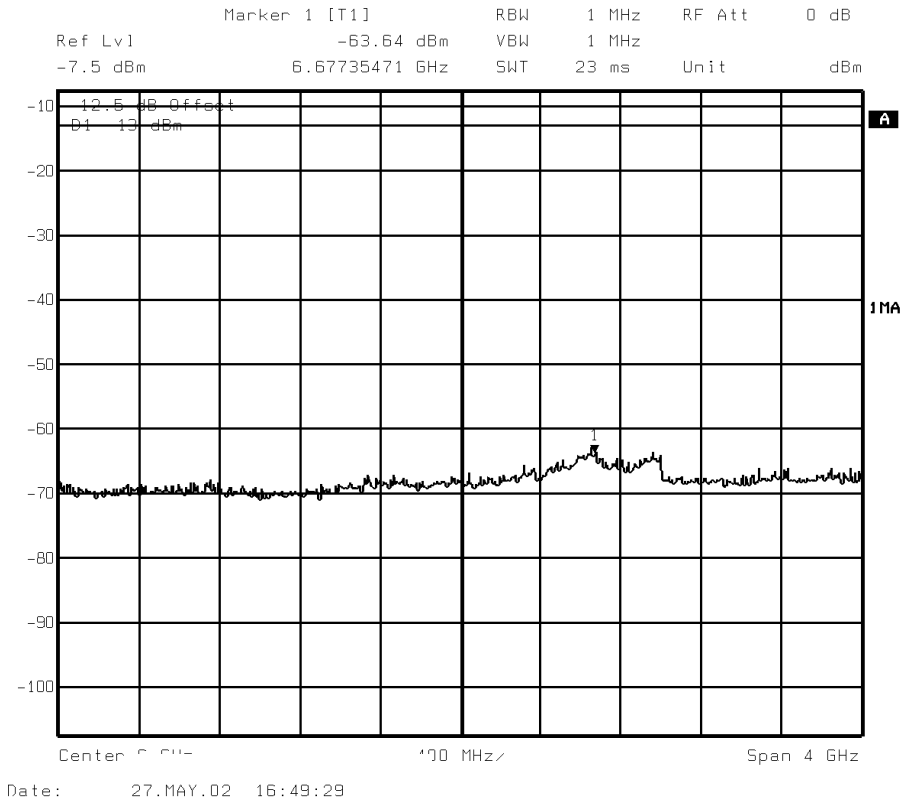
1, 2, 3, 5, 8, 9, 10, 11, 12

……

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (4GHz – 8GHz)

Channel 810, (1989.8MHz) – Minimum Power



Test Equipment Used:

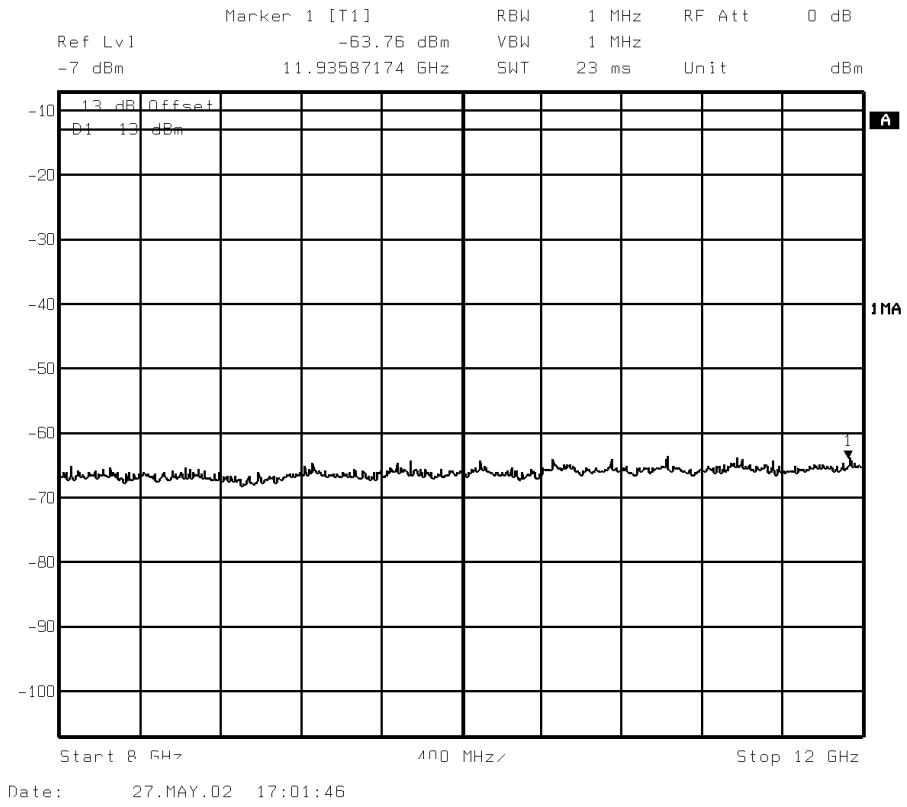
1, 2, 3, 5, 8, 9, 10, 11, 12

……

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (8GHz – 12GHz)

Channel 810, (1989.8MHz) – Minimum Power



Test Equipment Used:

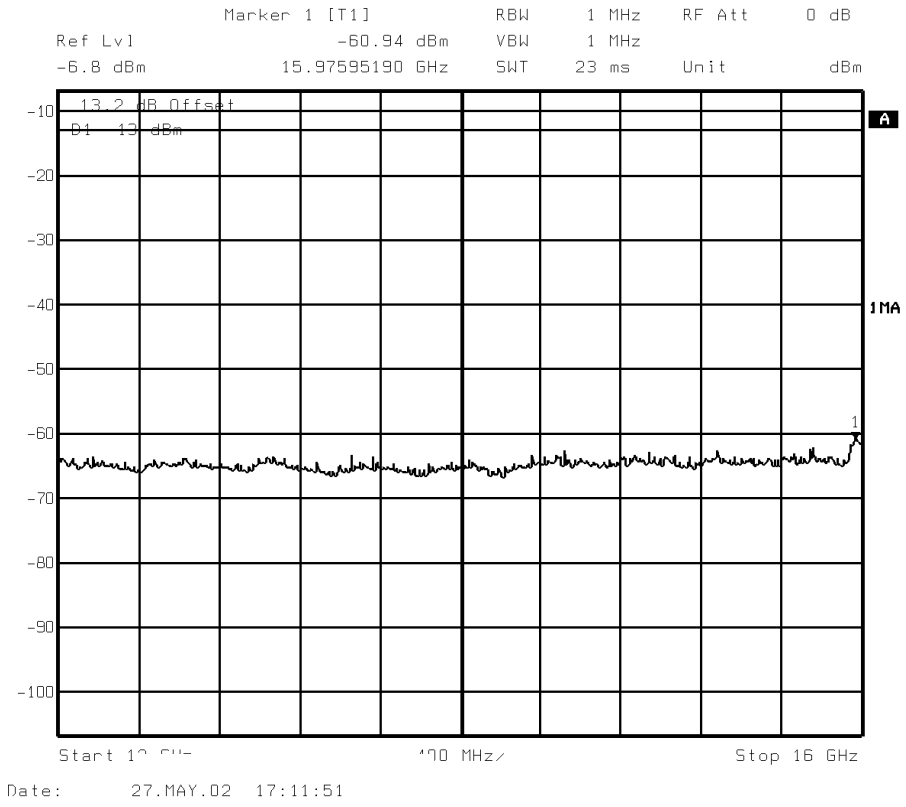
1, 2, 3, 5, 8, 9, 10, 11, 12

……

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (12GHz – 16GHz)

Channel 810, (1989.8MHz) – Minimum Power



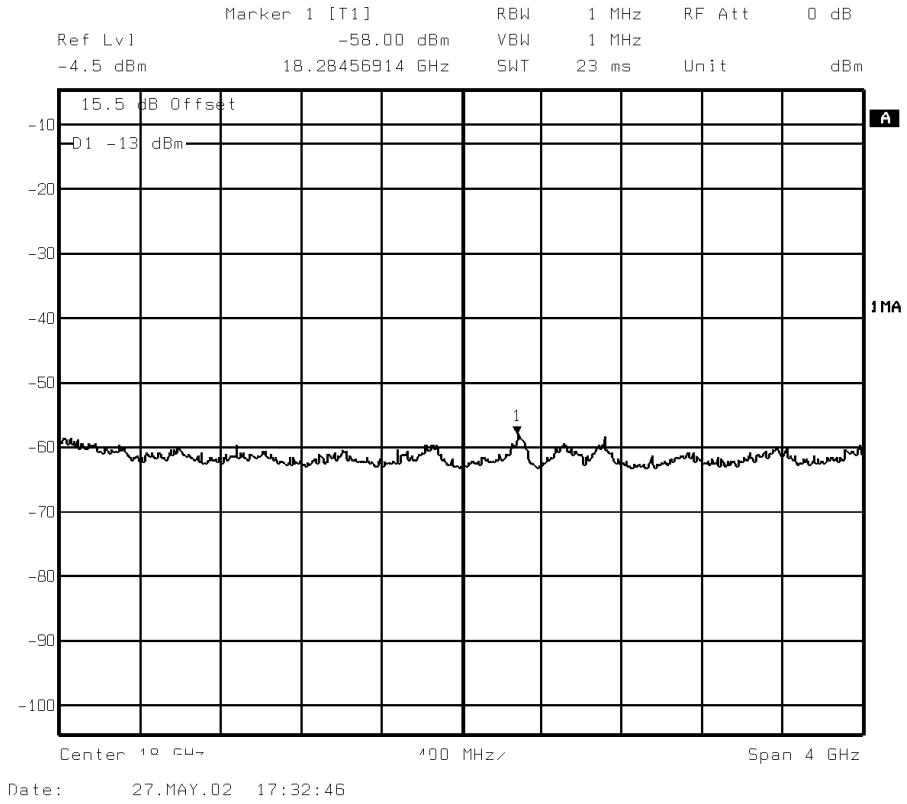
Test Equipment Used:

1, 2, 3, 5, 8, 9, 10, 11, 12

……..

Test Case	:	Spurious Emissions
Test Date	:	27th May 2002
Rule Parts	:	2.1051, 24.238(a)

Spurious Emissions (16GHz – 20GHz)
Channel 810, (1989.8MHz) – Minimum Power



Test Equipment Used:
1, 2, 3, 5, 8, 9, 10, 11, 12
……..

Test Case : Spurious Emissions

Test Date : 28th May 2002

Rule Parts : 2.1051, 24.238(a)

Harmonic Emissions — Channel 512, (1930.2MHz) – Maximum Power

Frequency (GHz)	Raw Result (dBm)	Path Loss (dB)	Corrected Result (dBm)	Limit (dBm)
3.8604	-73.11	20.1	-53.01	-13
5.7906	-78.39	11.8	-66.59	-13
7.7208	-83.62	12.1	-71.52	-13
9.6510	-77.83	12.9	-64.93	-13
11.5812	-78.66	12.0	-66.66	-13
13.5114	-77.39	13.4	-63.99	-13
15.4416	-76.68	12.3	-64.38	-13
17.3718	-76.32	13.4	-62.92	-13
19.3002	-77.50	13.2	-64.30	-13

Harmonic Emissions — Channel 661, (1960.0MHz) – Maximum Power

Frequency (GHz)	Raw Result (dBm)	Path Loss (dB)	Corrected Result (dBm)	Limit (dBm)
3.9200	-68.92	20.4	-48.52	-13
5.8800	-78.56	11.5	-67.06	-13
7.8400	-79.06	12.8	-66.26	-13
9.8000	-79.08	12.1	-66.98	-13
11.7600	-76.78	12.0	-64.78	-13
13.7200	-78.36	11.7	-66.86	-13
15.6800	-75.10	12.7	-62.40	-13
17.6400	-77.98	13.4	-64.58	-13
19.6000	-76.67	13.8	-62.87	-13

Test Case : Spurious Emissions (continued)

Harmonic Emissions Channel 810, (1989.8MHz) – Maximum Power

Frequency (GHz)	Raw Result (dBm)	Path Loss (dB)	Corrected Result (dBm)	Limit (dBm)
3.9796	-68.65	20.0	-48.65	-13
5.9694	-77.91	11.8	-66.11	-13
7.9592	-78.03	13.1	-64.93	-13
9.9949	-78.75	12.3	-66.45	-13
11.9388	-76.77	11.8	-64.97	-13
13.9286	-76.90	12.2	-64.70	-13
15.9184	-76.53	12.2	-64.33	-13
17.9082	-77.04	14.6	-62.44	-13
19.8980	-76.71	14.6	-62.11	-13

Test Equipment Used:
1, 3, 5, 6, 7, 8, 10
……

Test Case : Spurious Emissions

Test Date : 28th May 2002

Rule Parts : 2.1051, 24.238(a)

Harmonic Emissions Channel 512, (1930.2MHz) – Minimum Power

Frequency (GHz)	Raw Result (dBm)	Path Loss (dB)	Corrected Result (dBm)	Limit (dBm)
3.8604	-80.39	20.1	-60.29	-13
5.7906	-78.12	11.8	-66.32	-13
7.7208	-79.40	12.1	-67.30	-13
9.6510	-78.32	12.9	-65.42	-13
11.5812	-78.69	12.0	-66.69	-13
13.5114	-78.00	13.4	-64.60	-13
15.4416	-76.72	12.3	-64.42	-13
17.3718	-75.41	13.4	-62.01	-13
19.3002	-76.93	13.2	-63.73	-13

Harmonic Emissions Channel 661, (1960.0MHz) – Minimum Power

Frequency (GHz)	Raw Result (dBm)	Path Loss (dB)	Corrected Result (dBm)	Limit (dBm)
3.9200	-81.39	20.4	-60.99	-13
5.8800	-88.07	11.5	-76.57	-13
7.8400	-79.47	12.8	-66.67	-13
9.8000	-79.40	12.1	-67.3	-13
11.7600	-87.63	12.7	-74.93	-13
13.7200	-79.09	11.0	-68.09	-13
15.6800	-74.36	12.7	-61.66	-13
17.6400	-77.06	13.4	-63.66	-13
19.6000	-76.46	13.8	-62.66	-13

Test Case : Spurious Emissions (continued)

Harmonic Emissions Channel 810, (1989.8MHz) – Minimum Power

Frequency (GHz)	Raw Result (dBm)	Path Loss (dB)	Corrected Result (dBm)	Limit (dBm)
3.9796	-79.17	20.0	-59.17	-13
5.9694	-79.09	11.8	-67.29	-13
7.9592	-79.63	13.1	-66.53	-13
9.9949	-79.17	12.3	-66.87	-13
11.9388	-78.53	11.8	-66.73	-13
13.9286	-78.81	12.2	-66.61	-13
15.9184	-77.36	12.2	-65.16	-13
17.9082	-77.47	14.6	-62.87	-13
19.8980	-76.78	14.6	-62.18	-13

*Instrumentation Noise Floor

Test Equipment Used:
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
……

Test Case	:	Frequency Stability Under Temperature Variations
Test Date	:	28th May 2002
Rule Parts	:	2.1055, 24.135(a)

Measurement Method

The EUT was set to transmit on maximum power, (unmodulated). A Frequency Counter using an external 10MHz reference, was used to measure the maximum frequency error.

The temperature was adjusted between –30ºC and +50ºC in 10º steps as per 2.1055.

Results

Temperature Interval(ºC)	Test Frequency (GHz)	Deviation (Hz)	Limit (kHz)
-30	1.96	-20	±1.96
-20	1.96	-20	±1.96
-10	1.96	-19	±1.96
0	1.96	-17	±1.96
+10	1.96	-16	±1.96
+20	1.96	-15	±1.96
+30	1.96	-14	±1.96
+40	1.96	-12	±1.96
+50	1.96	-12	±1.96

Limit	±0.0001% or 1ppm

Remarks

EUT complies with CFR 47 Part 24.135(a). The EUT does not exceed ±1.96kHz at the measured frequency at any temperature interval across the measured range.

Test Equipment Used:
1, 2, 13, 14
……

Test Case	:	Frequency Stability Under Voltage Variations
Test Date	:	28th May 2002
Rule Parts	:	24.135(a)

Measurement Method

The EUT was set to transmit on maximum power, (unmodulated). A Frequency Counter using an external 10MHz reference, was used to measure the maximum frequency error.

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

Results

Supply Variation(%)	DC Voltage (V)	Test Frequency (GHz)	Deviation (Hz)	Deviation Limit (kHz)
85	37.4	1.96	-17	±1.96
0	44.0	1.96	-16	±1.96
115	50.6	1.96	-17	±1.96

Limit	±0.0001% or 1ppm

Remarks

EUT complies with CFR 47 Part 24.135(a). The EUT does not exceed ±1.96kHz at the measured frequency either at nominal or voltage variation.

Test Equipment Used:
1, 2, 14
……

Test Case : AC Conducted Line Emissions

Test Date : 1st June 2002

Rule Parts : 15.207

Measurement Method

All Conducted Emission Measurements were undertaken within the Characterisation Chamber. Emissions were measured on the Live and Neutral Lines.

Emissions were then formally measured using a Quasi-Peak Detector which meets the CISPR requirements. The details of the worst case emissions were then recorded in the Job Log Book. Details of the worst case emissions for the Live and Neutral Lines are presented in Tables 2 and 3 respectively.

The EUT was connected to a 115V 60Hz supply.

The Conducted Emission measurements were made using a Hewlett Packard Spectrum Analyser, Preselector and Quasi-Peak Adaptor.

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

Conducted Emission (Terminal Voltages) Results

Equipment Designation : Intentional Radiator. Live Line.

The EUT met the requirements of 47 CFR Part 15.207 for Conducted Emissions on the Live Line. However all the emissions in the table below were below the specification limit by a margin less than the measurement uncertainty of the measurement system.

Test Results

Conducted Emissions Live Line : A search was made in the frequency range 450kHz to 30MHz. The levels of the 9 highest emissions were measured in accordance with the specification and are presented in Table 2 below :-

Emission Frequency	Measured Level	Cable Loss	Sensor Factor	Absolute Level		Spec Limit	
MHz	dBµV	dB	dB	dBµV	µV	dBµV	µV
1.504	36.2	0.0	10.3	46.5	211.3	48.0	250.0
2.053	36.3	0.0	10.3	46.6	213.8	48.0	250.0
2.416	36.1	0.0	10.3	46.4	208.9	48.0	250.0
2.556	36.4	0.0	10.3	46.7	216.3	48.0	250.0
2.600	36.6	0.0	10.3	46.9	221.3	48.0	250.0
2.657	35.9	0.0	10.3	46.2	204.2	48.0	250.0
2.784	37.9	0.0	10.3	47.2	229.1	48.0	250.0
2.833	36.1	0.0	10.3	46.4	208.9	48.0	250.0
2.889	36.7	0.0	10.3	47.0	223.9	48.0	250.0

Table 2

The margin between the specification requirements and all other emissions was 2dB or more below the specified limit.

Test Case : AC Conducted Line Emissions (continued)

Test Date : 1st June 2002

Rule Parts : 15.207

Equipment Designation : Intentional Radiator. Neutral Line.

The EUT met the requirements of 47 CFR Part 15.207 for Conducted Emissions on the Neutral Line.

Conducted Emissions Neutral Line : A search was made in the frequency range 450kHz to 30MHz. The levels of the 9 highest emissions were measured in accordance with the specification and are presented in Table 3 below :-

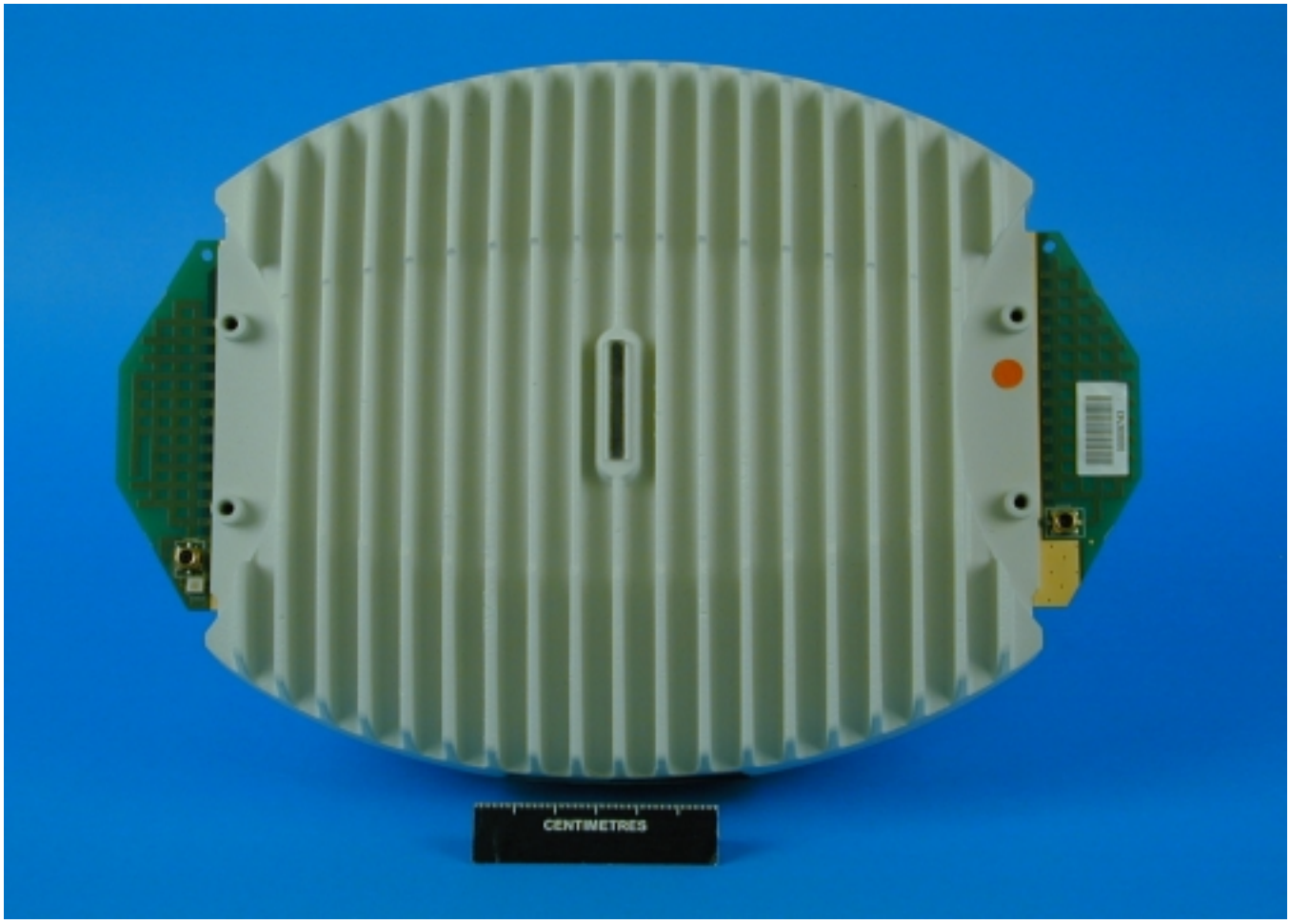
Emission Frequency	Measured Level	Cable Loss	Sensor Factor	Absolute Level		Spec Limit	
MHz	dBµV	dB	dB	dBµV	µV	dBµV	µV
1.346	32.1	0.0	10.3	42.4	131.8	48.0	250.0
1.878	32.1	0.0	10.3	42.4	131.8	48.0	250.0
2.610	33.9	0.0	10.3	44.2	162.2	48.0	250.0
2.791	34.3	0.0	10.3	44.6	169.8	48.0	250.0
2.846	32.7	0.0	10.3	43.0	141.3	48.0	250.0
2.978	33.7	0.0	10.3	44.0	158.5	48.0	250.0
3.029	32.6	0.0	10.3	42.9	139.6	48.0	250.0
3.030	32.9	0.0	10.3	43.2	144.5	48.0	250.0
3.888	33.1	0.0	10.3	43.4	147.9	48.0	250.0

Table 3

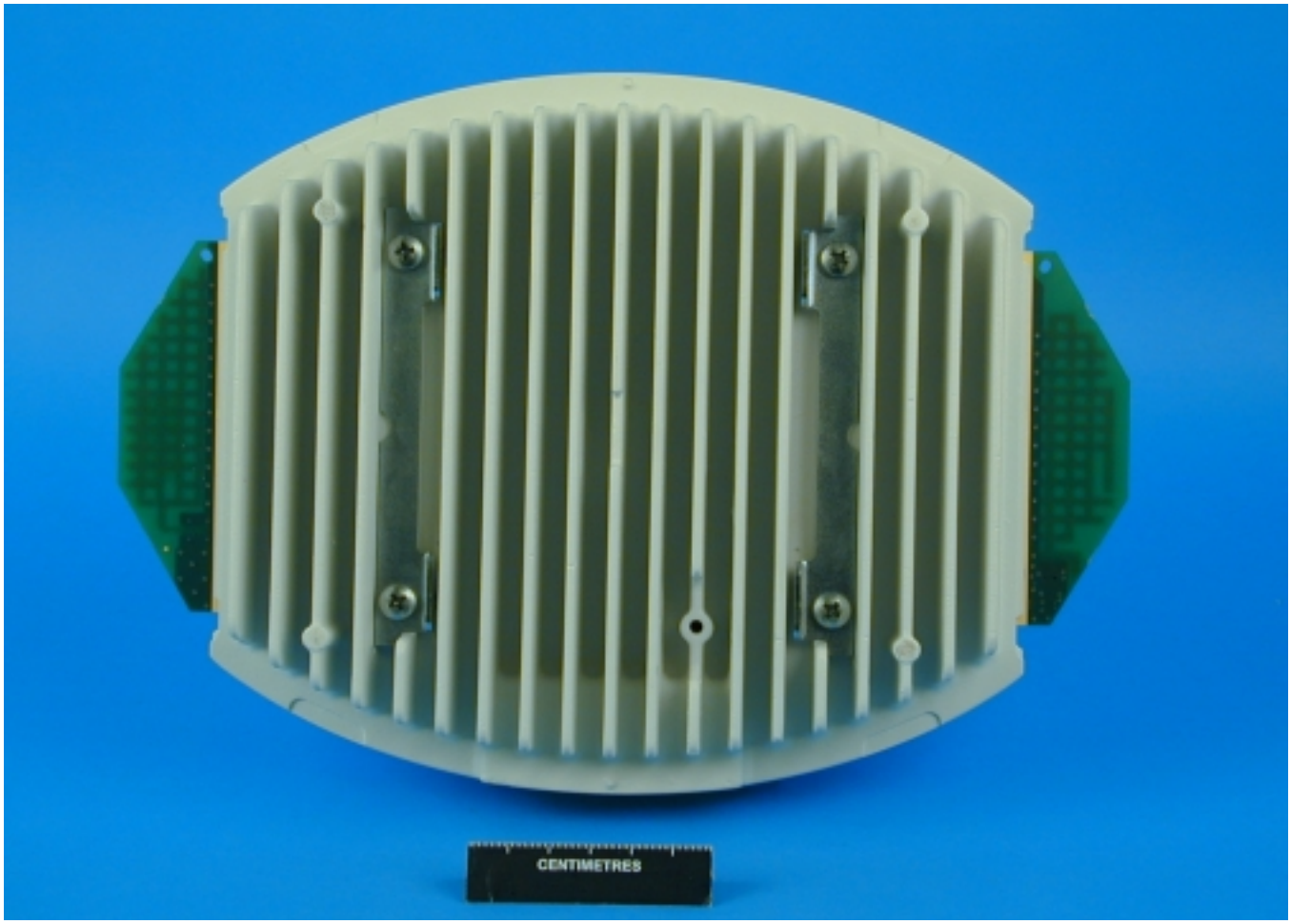
The margin between the specification requirements and all other emissions was 6dB or more below the specified limit.

Procedure Test performed in accordance with ANSI C63.4.

Performed by S C Hartley, EMC Engineer.

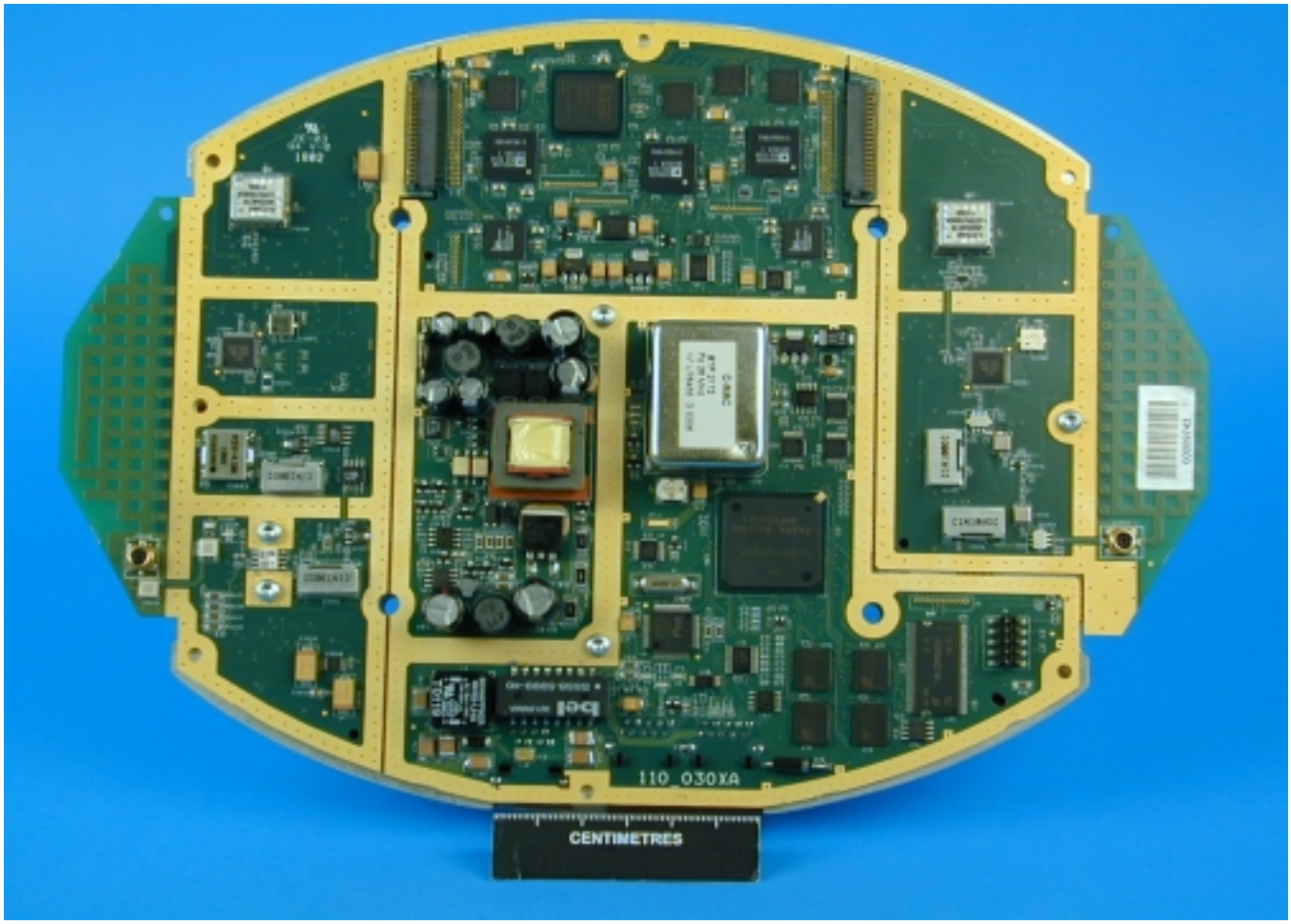


Front View of NBT141G

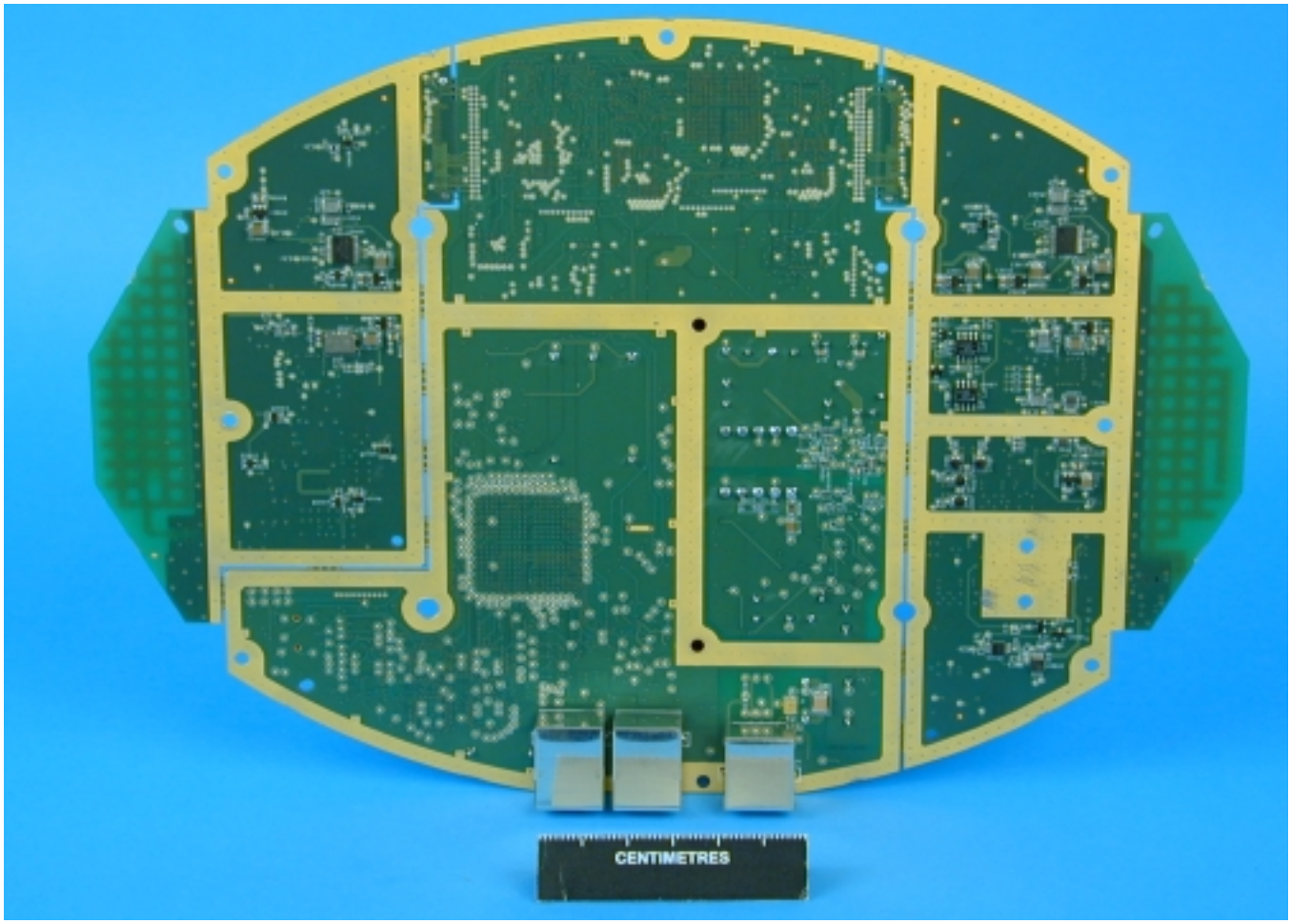


Rear View of NBT141G

Side View of NBT141G



Internal View 1 of NBT141G



Internal View 2 of NBT141G

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Group

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).

Annex A

FCC Measurement Facility Compliance Letter

FCC SITE COMPLIANCE LETTER

FEDERAL COMMUNICATIONS COMMISSION
Laboratory Division
7435 Oakland Mills Road
Columbia, MD. 21046

April 10, 2001

Registration Number: 90987

BABT Product Service
Segensworth Road
Titchfield, Fareham
Hampshire PO15 5RH
United Kingdom
Attention: Jensen Adams

Re: Measurement facility located at Titchfield
3 & 10 meter site
Date of Listing: April 10, 2001

Gentlemen:

Your submission of the description of the subject measurement facility has been reviewed and found to be in compliance with the requirements of Section 2.948 of the FCC Rules. The description has, therefore, been placed on file and the name of your organization added to the Commission's list of facilities whose measurement data will be accepted in conjunction with applications for Certification under Parts 15 or 18 of the Commission's Rules. Please note that this filing must be updated for any changes made to the facility, and at least every three years from the date of listing the data on file must be certified as current.

If requested, the above mentioned facility has been added to our list of those who perform these measurement services for the public on a fee basis. An up-to-date list of such public test facilities is available on the Internet on the FCC Website at WWW.FCC.GOV, E-Filing, OET Equipment Authorization Electronic Filing.

Sincerely,

Thomas W Phillips
Electronics Engineer