FCC CFR47 PART 15 SUBPART C CERTIFICATION

TEST REPORT

FOR

BLUETOOTH TEST AND CALIBRATION DEVICE

MODEL: ACCURA °C 200

FCC ID: QTA482-22-0800

REPORT NUMBER: 02U1637-1

ISSUE DATE: JANUARY 8, 2003

Prepared for
SENSARRAY CORPORATION
47451 FREMONT BLVD.
FREMONT, CA 94538
USA

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1. TEST RESULT CERTIFICATION

COMPANY NAME: SENSARRAY CORPORATION
47451 FREMONT BLVD.
FREMONT, CA 94538

EUT DESCRIPTION: BLUETOOTH TEST AND CALIBRATION DEVICE

MODEL NAME: ACCURA °C 200

DATE TESTED: DECEMBER 14, 2002 / DECEMBER 16-19, 2002

TYPE OF EQUIPMENT	2.4 – 2.4835 GHz, INTENTIONAL RADIATOR
MEASUREMENT PROCEDURE	ANSI 63.4 / 1992, TIA/EIA 603
PROCEDURE	CERTIFICATION
FCC RULE	CFR 47 PART 15, SUBPART C

Compliance Certification Services, Inc. tested the above equipment for compliance with the requirements set forth in CFR 47, PART 15, Subpart C. The equipment in the configuration described in this report, shows the measured emission levels emanating from the equipment do not exceed the specified limit.

Note: This document reports conditions under which testing was conducted and results of tests performed. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document.

Approved & Released For CCS By:

MIKE HECKROTTE
CHIEF ENGINEER
COMPLIANCE CERTIFICATION SERVICES

Tested By:

FRANK IBRAHIM
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

2. EUT DESCRIPTION

The ISIS (Intelligent Sensor Input System) is a data acquisition unit for SensArray's embedded temperature sensor silicon wafers, which are used for process characterization and control in the semiconductor manufacturing industry, it operates on the 2400 – 2483.5 MHz band. This unit provides a power output of +4.4 dBm (2.75 mW) and includes a ceramic patch antenna with a 2 dBi gain.

3. TEST METHODOLOGY

Conducted and radiated testing were performed according to the procedures documented on chapter 13 of ANSI C63.4 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, and 15.407.

4. FACILITIES AND ACCREDITATION

4.1. FACILITIES AND EQUIPMENT

The open area test sites and conducted measurement facilities used to collect the radiated data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

Receiving equipment (i.e., receiver, analyzer, quasi-peak adapter, pre-selector) and LISNs conform to CISPR specifications for "Radio Interference Measuring Apparatus and Measurement Methods," Publication 16.

4.2. LABORATORY ACCREDITATIONS AND LISTINGS

The test facilities used to perform radiated and conducted emissions tests are accredited by National Voluntary Laboratory Accreditation Program for the specific scope of accreditation under Lab Code: 200065-0 to perform Electromagnetic Interference tests according to FCC PART 15 AND CISPR 22 requirements. No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government. In addition, the test facilities are listed with Federal Communications Commission (reference no: 31040/SIT (1300B3) and 31040/SIT (1300F2)).

4.3. TABLE OF ACCREDITATIONS AND LISTINGS

Country	Agency	Scope of Accreditation	Logo
USA	NVLAP*	FCC Part 15, CISPR 22, AS/NZS 3548,IEC 61000-4-2, IEC 61000-4-3, IEC 61000-4-4, IEC 61000-4-5, IEC 61000-4-6, IEC 61000-4-8, IEC 61000-4-11, CNS 13438	NVLAP 200065-0
USA	FCC	3/10 meter Open Area Test Sites to perform FCC Part 15/18 measurements	FC 1300
Japan	VCCI	CISPR 22 Two OATS and one conducted Site	VCCI R-1014, R-619, C-640
Norway	NEMKO	EN50081-1, EN50081-2, EN50082-1, EN50082-2, IEC61000-6-1, IEC61000-6-2, EN50083-2, EN50091-2, EN50130-4, EN55011, EN55013, EN55014-1, EN55104, EN55015, EN61547, EN55022, EN55024, EN61000-3-2, EN61000-3-3, EN60945, EN61326-1	N ELA 117
Norway	NEMKO	EN60601-1-2 and IEC 60601-1-2, the Collateral Standards for Electro-Medical Products. MDD, 93/42/EEC, AIMD 90/385/EEC	N ELA-171
Taiwan	BSMI	CNS 13438	SL2-IN-E-1012
Canada	Industry Canada	RSS210 Low Power Transmitter and Receiver	Canada IC2324 A,B,C, and F

* No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government.

5. CALIBRATION AND UNCERTAINTY

5.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

5.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Radiated Emission	
30MHz – 200 MHz	+/- 3.3dB
200MHz – 1000MHz	+4.5/-2.9dB
1000MHz – 2000MHz	+4.6/-2.2dB
Power Line Conducted Emission	
150kHz – 30MHz	+/-2.9

Any results falling within the above values are deemed to be marginal.

5.3. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST AND MEASUREMENT EQUIPMENT LIST				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due Date
Spectrum Analyzer	HP	8593EM	3710A00205	6/11/03
Spectrum Analyzer	HP	8568B	2732A03661	11/26/03
Spectrum Display	HP	85662A	2816A16696	11/26/03
Quasi-Peak Detector	HP	85650A	2811A01155	11/26/03
Preamplifier	HP	8447D	2944A06550	8/22/03
Log Periodic Antenna	EMCO	3146	9107-3163	3/30/03
Biconical Antenna	EATON	94455-1	1214	3/30/03
Preamplifier (1 - 26.5GHz)	HP	11	646456	4/26/03
Horn Antenna (1 - 18GHz)	EMCO	3115	6739	1/31/03
Horn Antenna (18 – 26.5GHz)	ARA	MWH 1826/B	1013	1/31/03
High Pass Filter (4.57GHz)	FSY Microwave	FM-4570-9SS	003	N.C.R.
High Freq Amplifier	HP	8449B		
EMI Test Receiver	Rohde & Schwarz	ESHS20	827129/006	4/17/03
LISN	FCC	50/250-25-2	114	4/22/03
LISN	SOLAR	8012-50-R-24-BNC	837990	4/23/03
Line Filter	LINDGREN	LMF-3489	00497	N.C.R

6. SETUP OF EQUIPMENT UNDER TEST

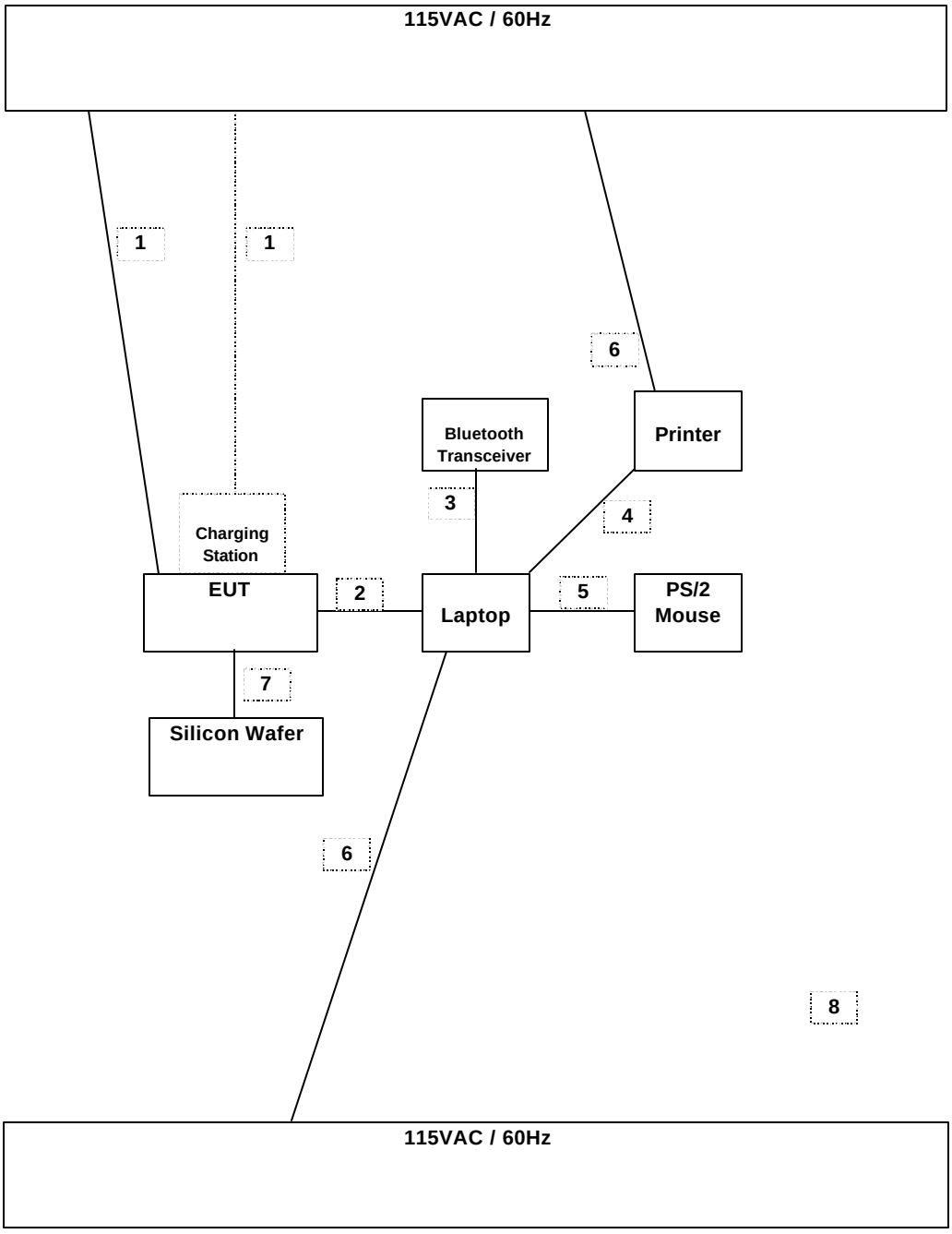
SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Device Type	Manufacturer	Model	Serial Number	FCC ID
Laptop	IBM	2647	99-DKART	N/A
AC Adapter	IBM	02K6756	11S02K6749ZJ1MN32 B82L7	N/A
Silicon Wafer	FLUORWAVE	H93-80	N/A	N/A
Bluetooth Module	TDK	SB2921964	008098440C86	N/A
Charging Station	SENSARRAY	N/A	N/A	N/A
Charging Station Adapter	SENSARRAY	PSA-30U-120	C12300444D7	N/A
PS/2 Mouse	LOGITECH	M-S34	LZB80414947	DZL211029
Printer	HP	2225C	2541S41679	BS46X02225C

I/O CABLES

Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC	2	US115	Unshielded	3 m	Integrated with AC Adapter, Bundled only for LC test
2	Serial	1	RS232	Unshielded	5m	Bundled
3	USB	1	USB	Unshielded	0.3 m	Unbundled
4	Parallel	1	DB25	Shielded	2m	Bundled
5	Mouse	1	Mini DIN	Unshielded	2m	Unbundled
6	AC	1	US115	Unshielded	2m	Unbundled
7	Wafer	1	Ribbon	Unshielded	5cm	Unbundled

SETUP DIAGRAM



7. APPLICABLE RULES

§15.247 (a)- BANDWIDTH

(1) (ii) The maximum 20 dB bandwidth of the hopping channel is 1 MHz.

§15.247 (a)- HOPPING FREQUENCY SEPERATION

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Specification limit: >740 kHz (20 dB bandwidth)

§15.247 (a)- NUMBER OF HOPPING CHANNELS

(1) (ii) Frequency hopping systems operating in the 2400 – 2483.5 MHz and the 5725 – 5850 MHz band shall use at least 75 hopping frequencies.

§15.247 (a)- TIME OF OCCUPANCY

(a) (1) (ii) The average time of occupancy on any frequency shall not be greater than 0.4 seconds within 30 second period.

§15.247 (b)- POWER OUTPUT

The maximum peak output power of the intentional radiator shall not exceed the following:

(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels: 1 watt.

(4) Except as shown in paragraphs (b)(3) (i), (ii) and (iii) of this section, if transmitting antennas of directional gain greater than 6 dBi are used the peak output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1) or (b)(2) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Specification Limit: Antenna Gain = 2 dBi, therefore the limit is 30 dBm

§15.247 (b)- RADIO FREQUENCY EXPOSURE

(5) Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines. See §1.1307(b)(1) of this chapter.

§15.247 (c)- SPURIOUS EMISSIONS

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions that fall in the restricted bands, as defined in§15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

§15.247 (d)- PEAK POWER SPECTRAL DENSITY

(d) For direct sequence systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

(f) The direct sequence operating of the hybrid system, with the frequency hopping operation turned off, shall comply with the power density requirements of paragraph (d) of this section.

§15.205- RESTRICTED BANDS OF OPERATIONS

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])
13.36 - 13.41			

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.
[2] Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.207- CONDUCTED LIMITS

Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

NEW LIMITS

Frequency Range (MHz)	Quasi-Peak Limit (dBuV)	Average Limit (dBuV)
0.15 – 0.5	66 to 56 *	56 to 46 *
0.5 - 5	56	46
5 - 30	60	50

* Decreases with the logarithm of the frequency.

§15.209- RADIATED EMISSION LIMITS

(a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

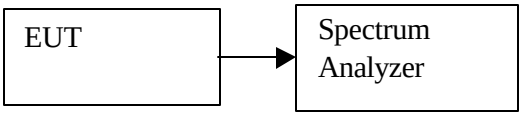
(b) In the emission table above, the tighter limit applies at the band edges.

Frequency Range (MHz)	Field Strength (uV/m at 3 m)	Field Strength (dBuV/m at 3 m)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

8. TEST SETUP, PROCEDURE AND RESULT

8.1. 20 dB BANDWIDTH

TEST SETUP



TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to (1-3) % of the measured BW, and peak detection is used. The 20 dB bandwidth is defined as the total spectrum over which the power is higher than the peak power minus 20 dB.

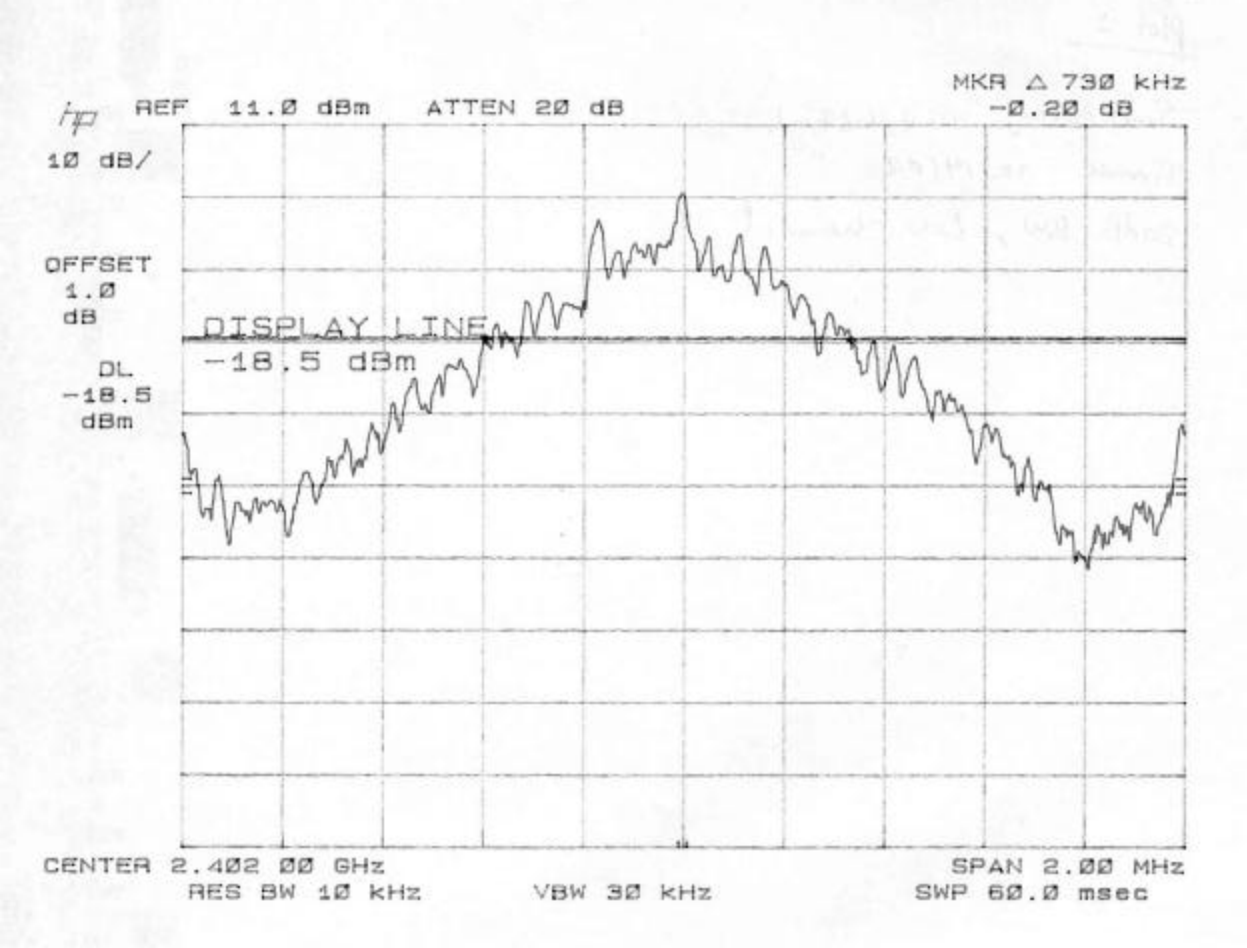
RESULTS

No non-compliance noted:

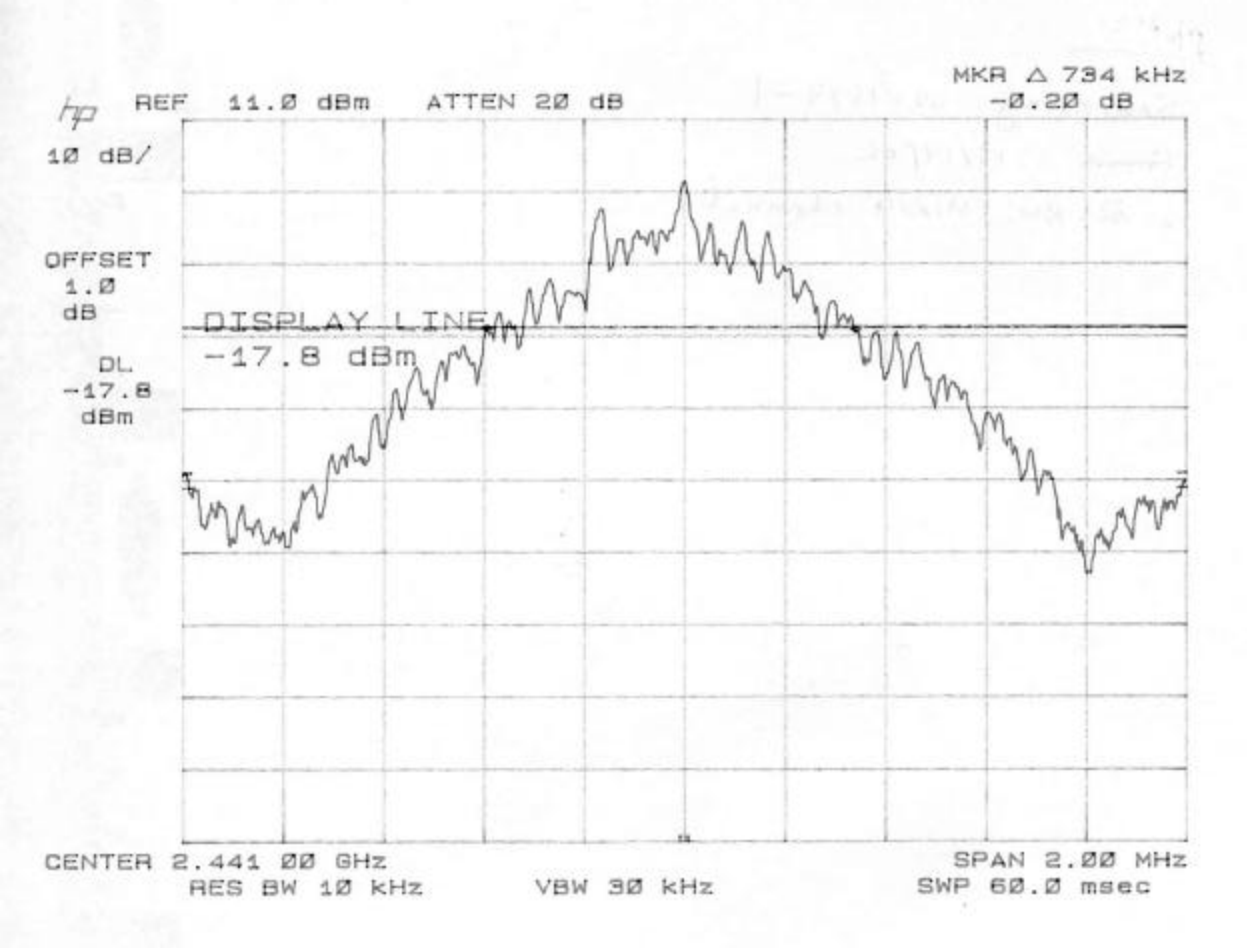
Channel	Frequency (MHz)	B (kHz)	Limit (kHz)	Margin (kHz)
Low	2402	730	1000	-270
Middle	2441	734	1000	-266
High	2480	732	1000	-268

Refer to plots below.

20dB Bandwidth, Low Channel



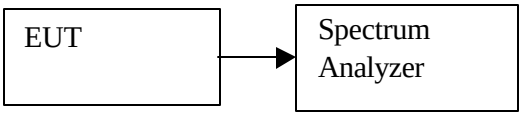
20dB Bandwidth, Middle Channel



20dB Bandwidth, High Channel

8.2. HOPPING FREQUENCY SEPARATION

TEST SETUP



TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The frequency span is set to 10 MHz. The analyzer is set to peak hold, then a pseudo-random hopping sequence of the transmitter is captured. The marker delta function is used to measure the separation between two adjacent hopping channels.

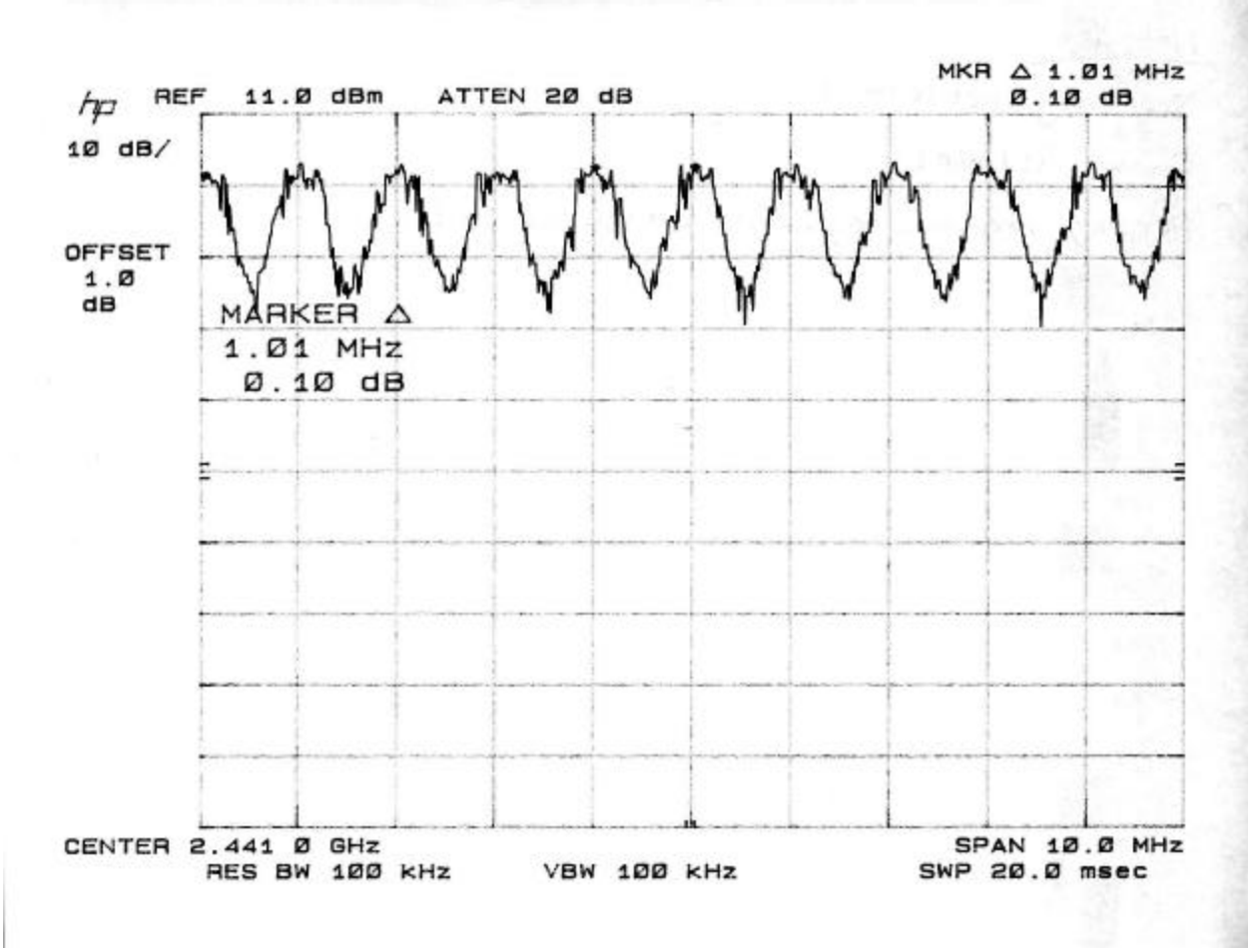
RESULTS

No non-compliance noted:

Hopping Frequency Separation (kHz)	Limit (kHz)	Margin (kHz)
1010	740	-270

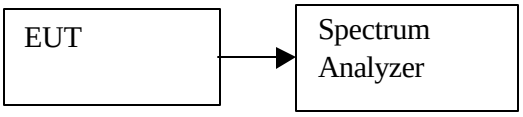
Refer to plot below.

Hopping Frequency Separation-Middle Channel



8.3. NUMBER OF HOPPING CHANNELS

TEST SETUP



TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The span is set to 100 MHz and the resolution bandwidth is set to 1 MHz. The analyzer is set to peak hold, then the complete pseudo-random hopping sequence of the transmitter is captured. Another 2 plots were done where the span was 50 MHz and the resolution bandwidth was set to 300 kHz.

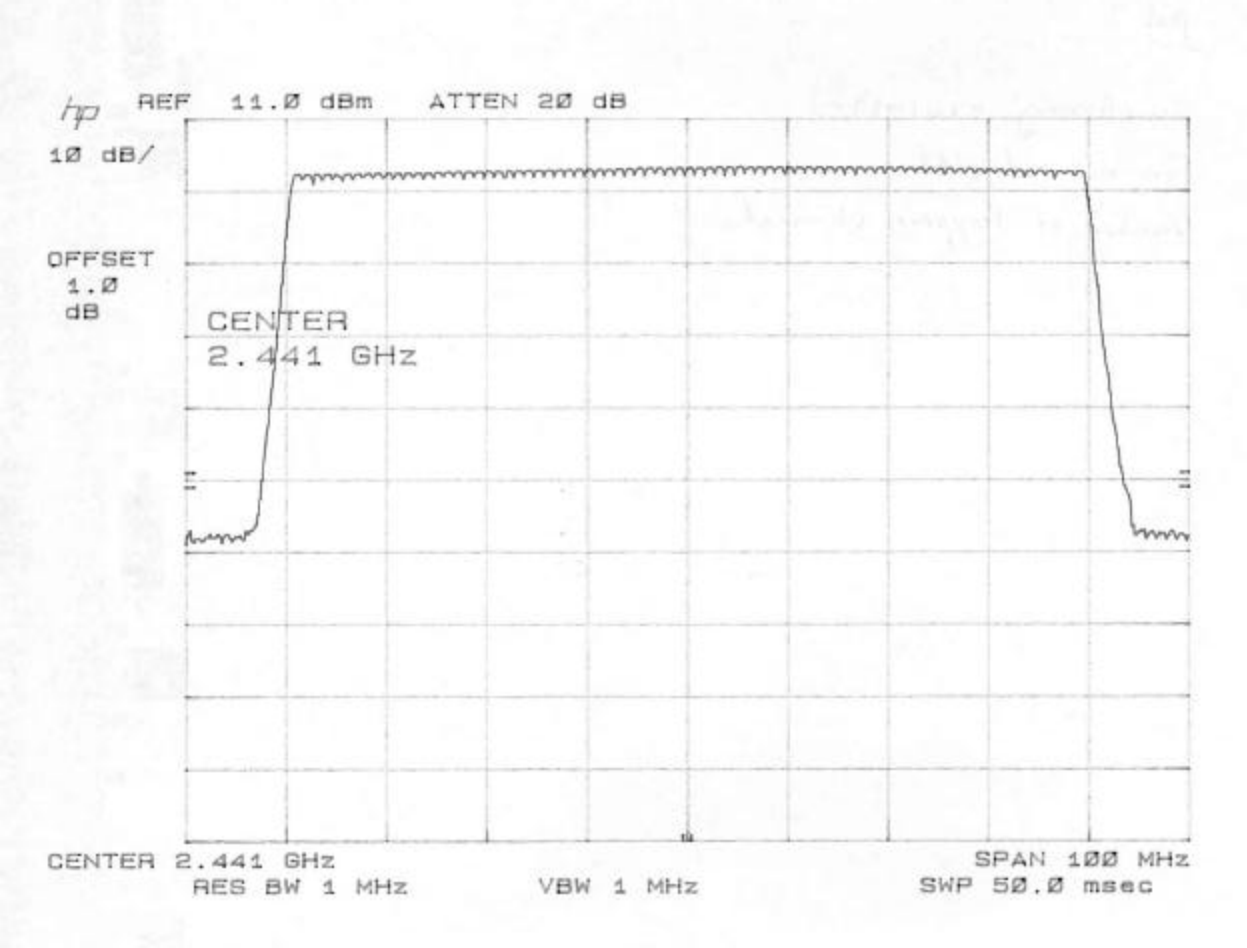
RESULTS

No non-compliance noted:

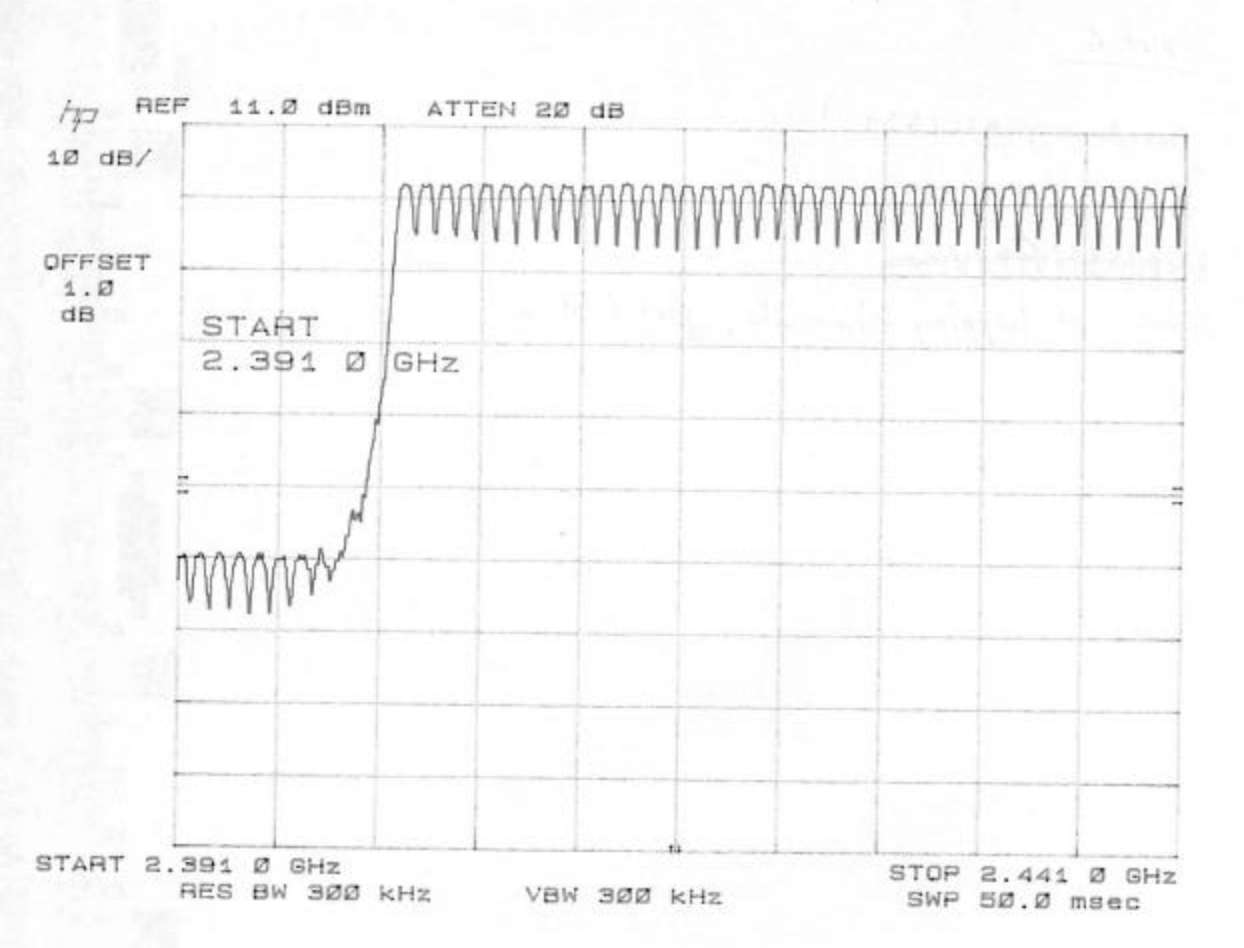
Mode	Number of Hopping Channels	Limit
Data	79	Minimum of 75

Refer to plots below.

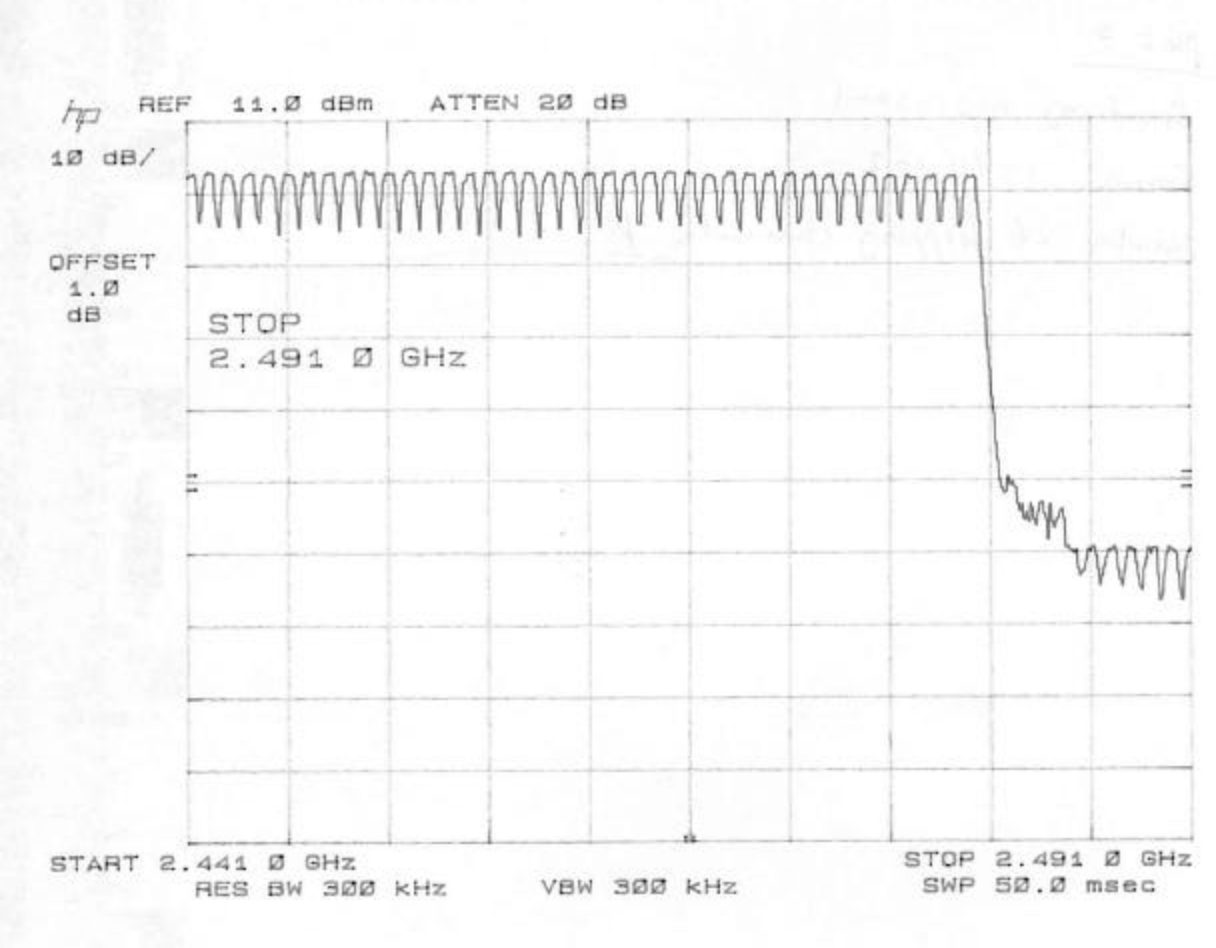
Number of Hopping Channels



Number of Hopping Channels, Plot 1 of 2

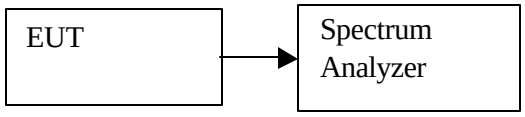


Number of Hopping Channels, Plot 2 of 2



8.4. TIME OF OCCUPANCY

TEST SETUP



TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The transmitter is set to operate in its normal frequency hopping mode. The spectrum analyzer center frequency is set to one of the hopping channels near the center of the operating band and the span is set to zero Hz. The sweep time is set to display one complete pulse. The marker delta function is used to measure the duration of the pulse.

RESULTS

The dwell time of 0.264 s within a 31.6 second period in data mode is independent from the packet type (packet length). The calculation for a 31.6 second period is a follows:
Dwell time = time slot length * hop rate / number of hopping channels * 31.6 s
Example for a DH1 packet (with a maximum length of one time slot)
Dwell time = 413 µs * 1600 1/s / 79 * 31.6 s = 0.264 s (in a 31.6 s period)

For multi-slot packet the hopping is reduced according to the length of the packet.

Example for a DH5 packet (with a maximum length of five time slots)

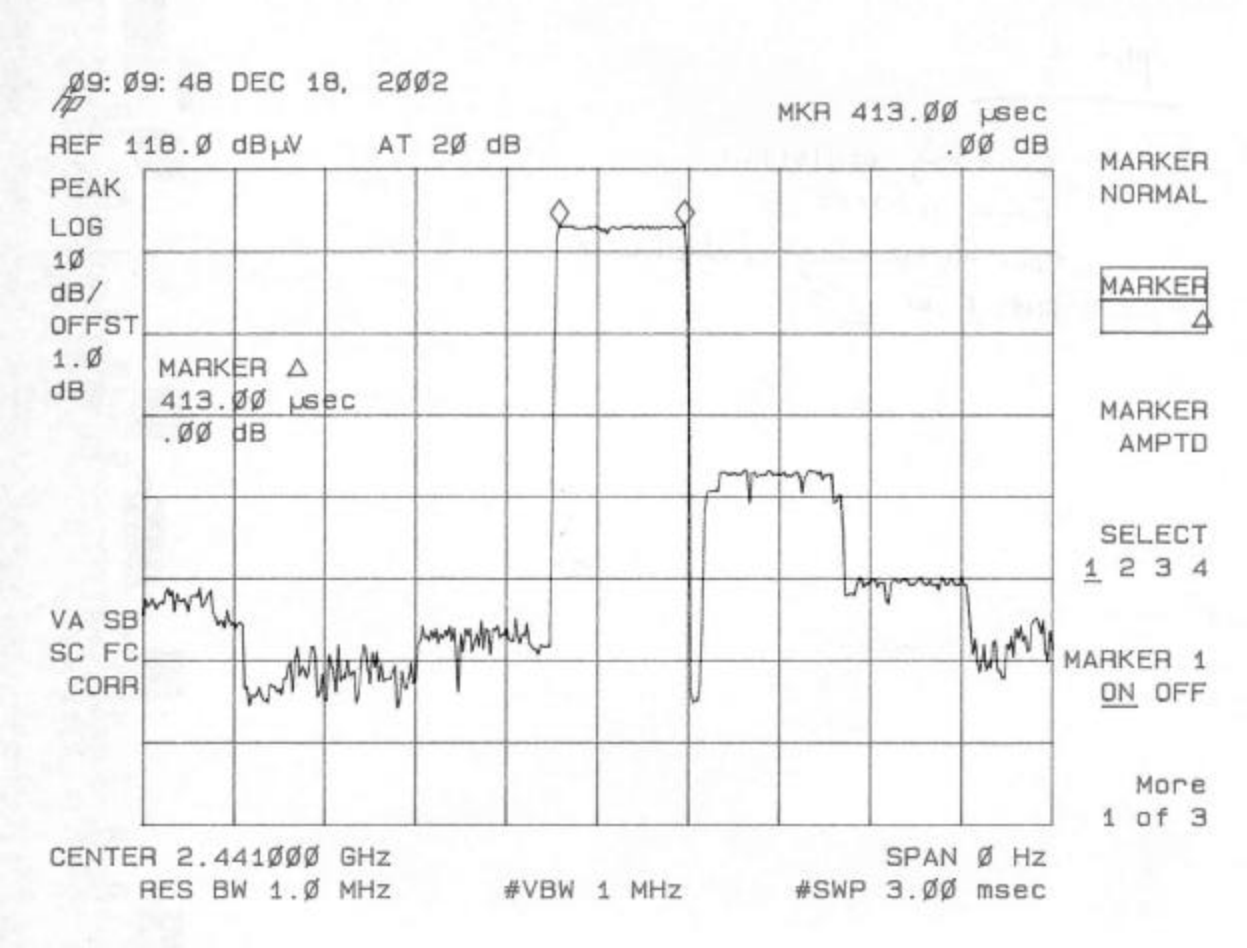
Dwell time = 5 * 413 µs * 1600 * 1/5 *1/s / 79 * 31.6 s = 0.264 s (in a 31.6 s period).

This is according the Bluetooth Core Specification V 1.0B (+ critical errata) for all Bluetooth devices. Therefore, all Bluetooth devices comply with the FCC dwell time requirement in the data mode.

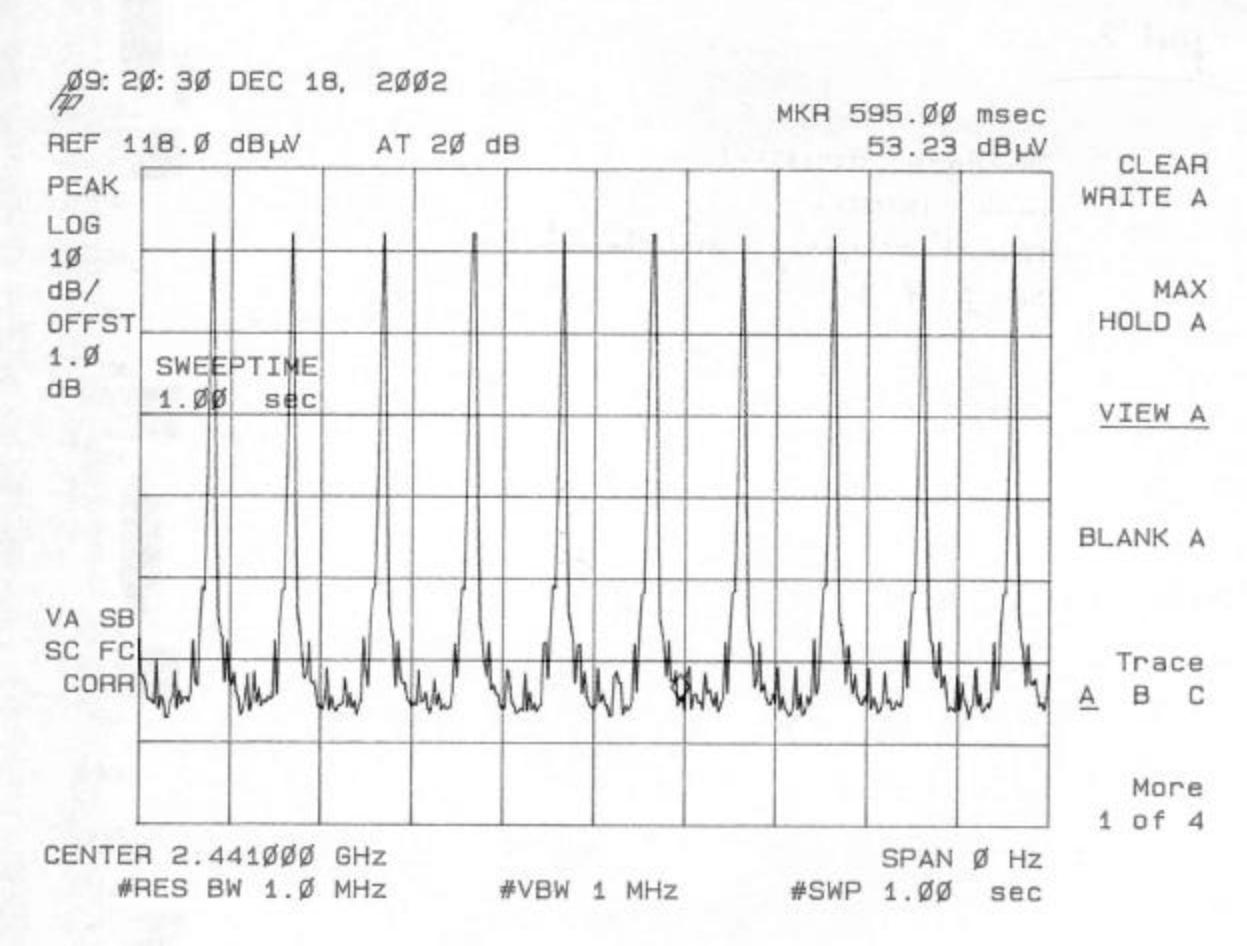
No non-compliance noted:

Refer to plots below.

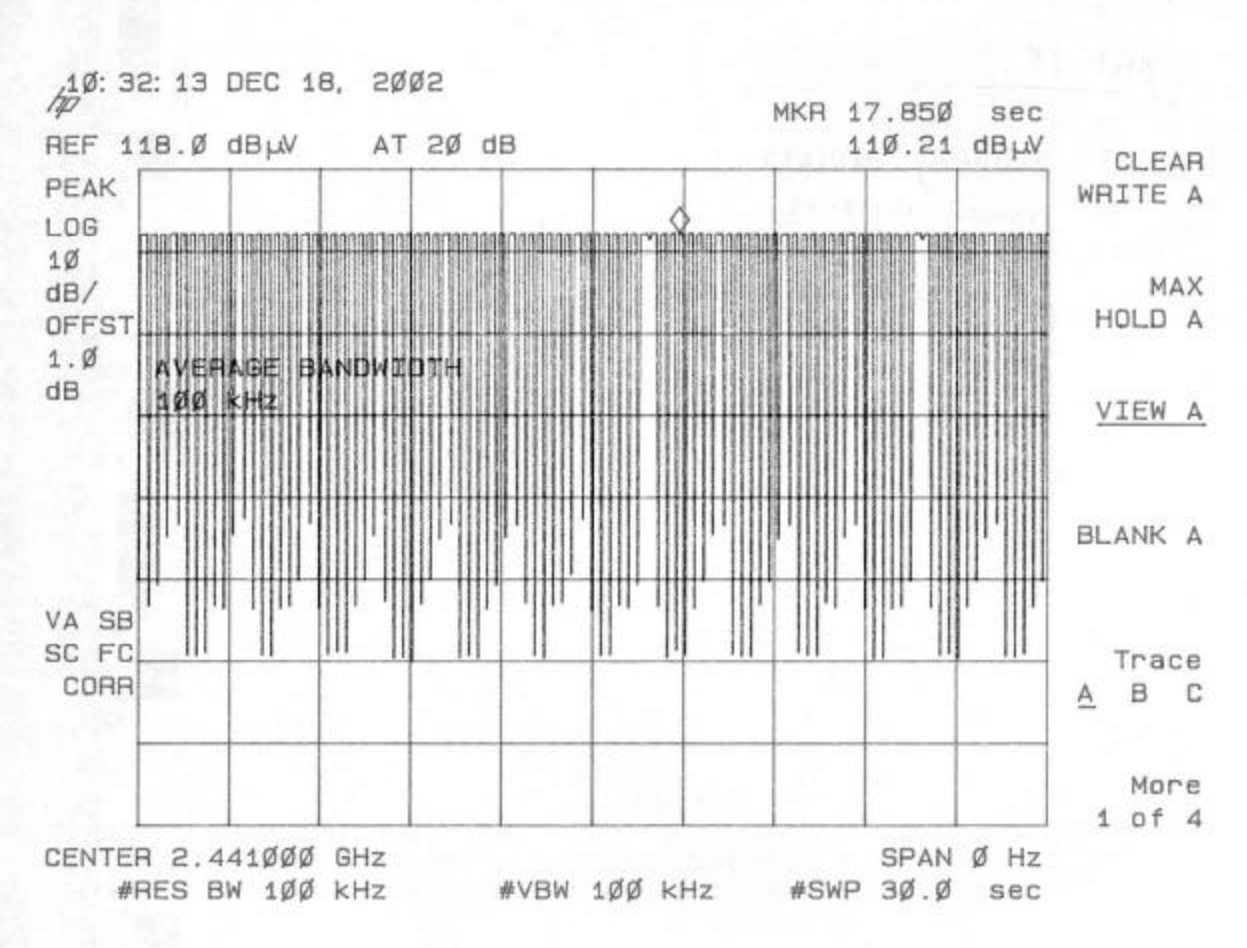
Time of Occupancy, Middle Channel Plot 1 of 3



Time of Occupancy, Middle Channel Plot 2 of 3

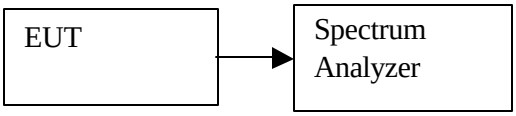


Time of Occupancy, Middle Channel Plot 3 of 3



8.5. PEAK POWER

TEST SETUP



TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth and the video bandwidth are set to greater than 1 MHz.

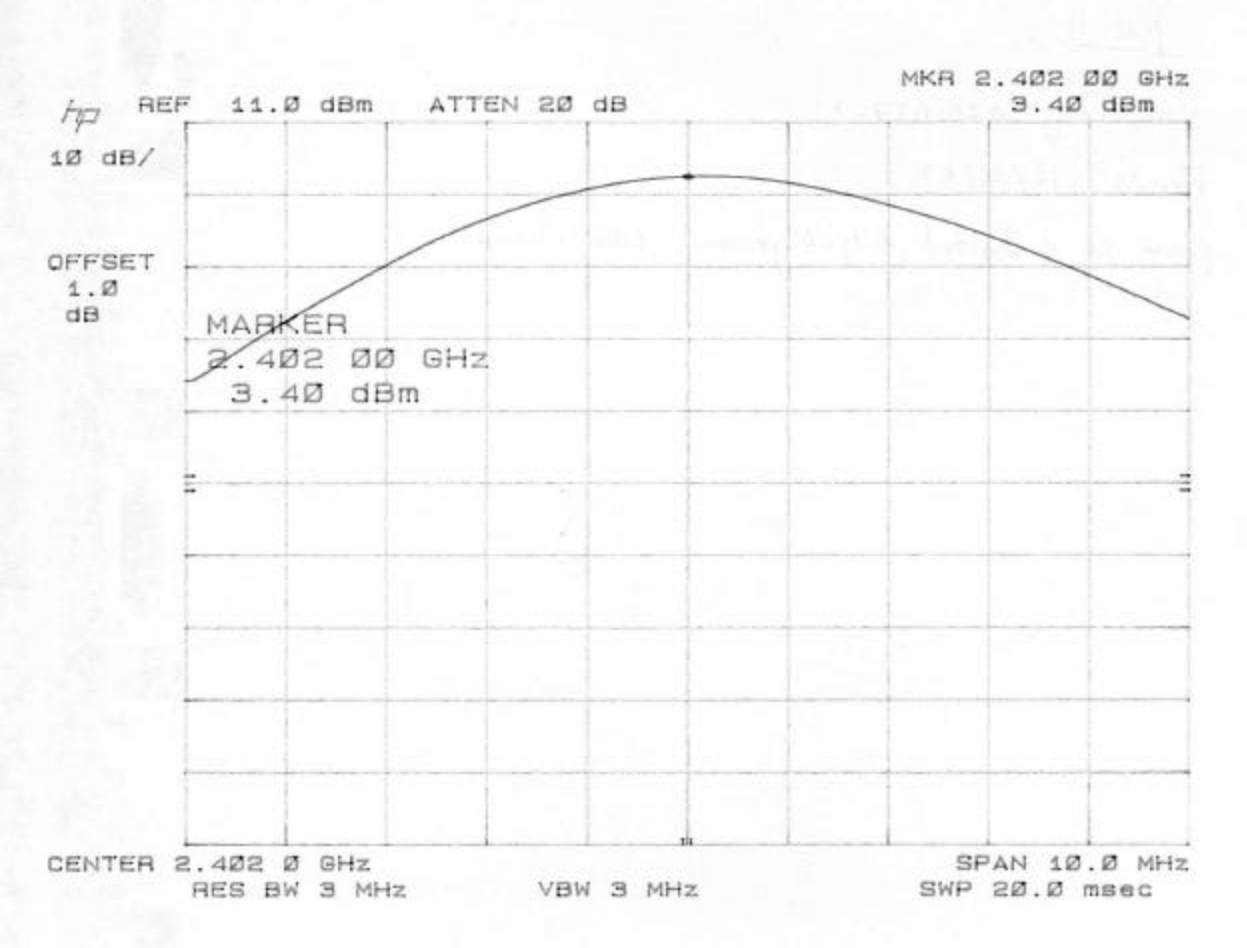
RESULTS

No non-compliance noted:

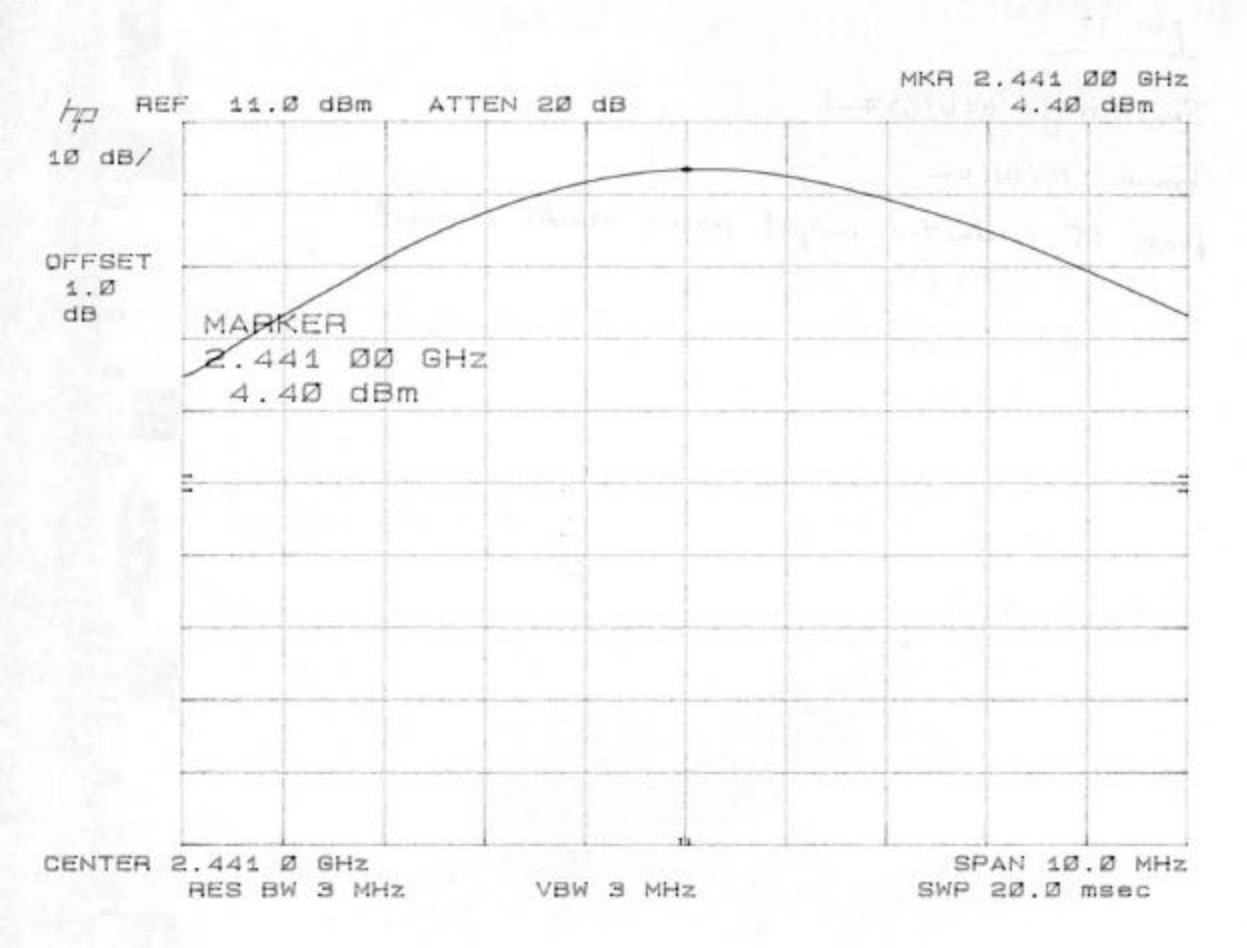
Channel	Frequency (MHz)	Peak Power (dBm)	Limit (dBm)	Margin dB
Low	2402	3.4	30	-26.6
Middle	2441	4.4	30	-25.6
High	2480	3.8	30	-26.2

Refer to plots below.

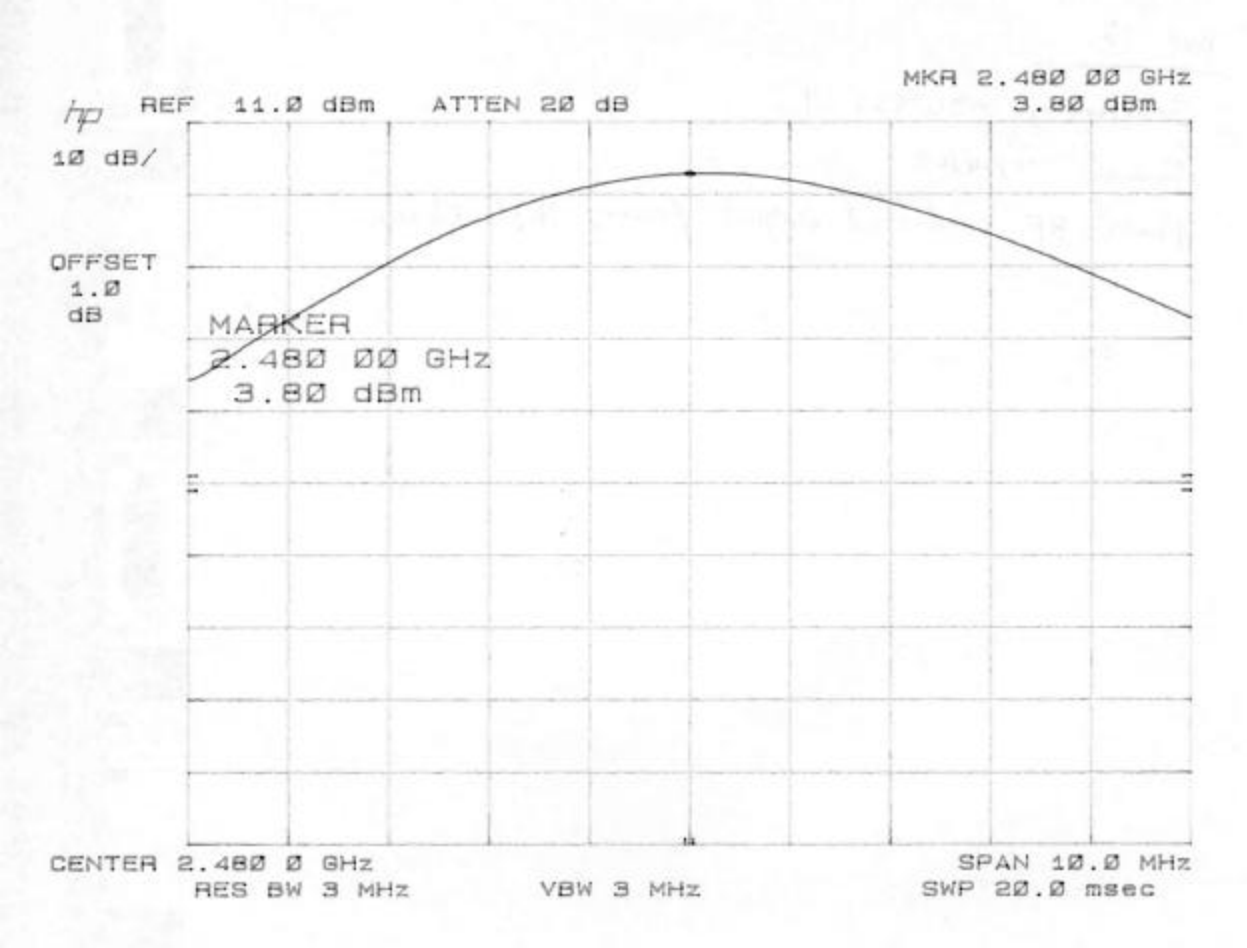
Peak RF Conducted Output Power, Low Channel



Peak RF Conducted Output Power, Middle Channel

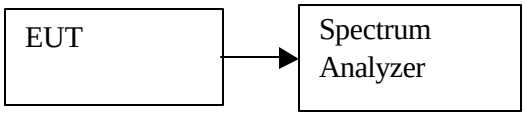


Peak RF Conducted Output Power, High Channel



8.6. PEAK POWER SPECTRAL DENSITY

TEST SETUP



TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer, the maximum level in a 3 kHz bandwidth is measured with the spectrum analyzer using RBW = 3kHz, VBW = 10kHz, sweep time = span / 3 kHz, and video averaging is turned off. The PPSD is the highest level found across the emission in any 3 kHz band.

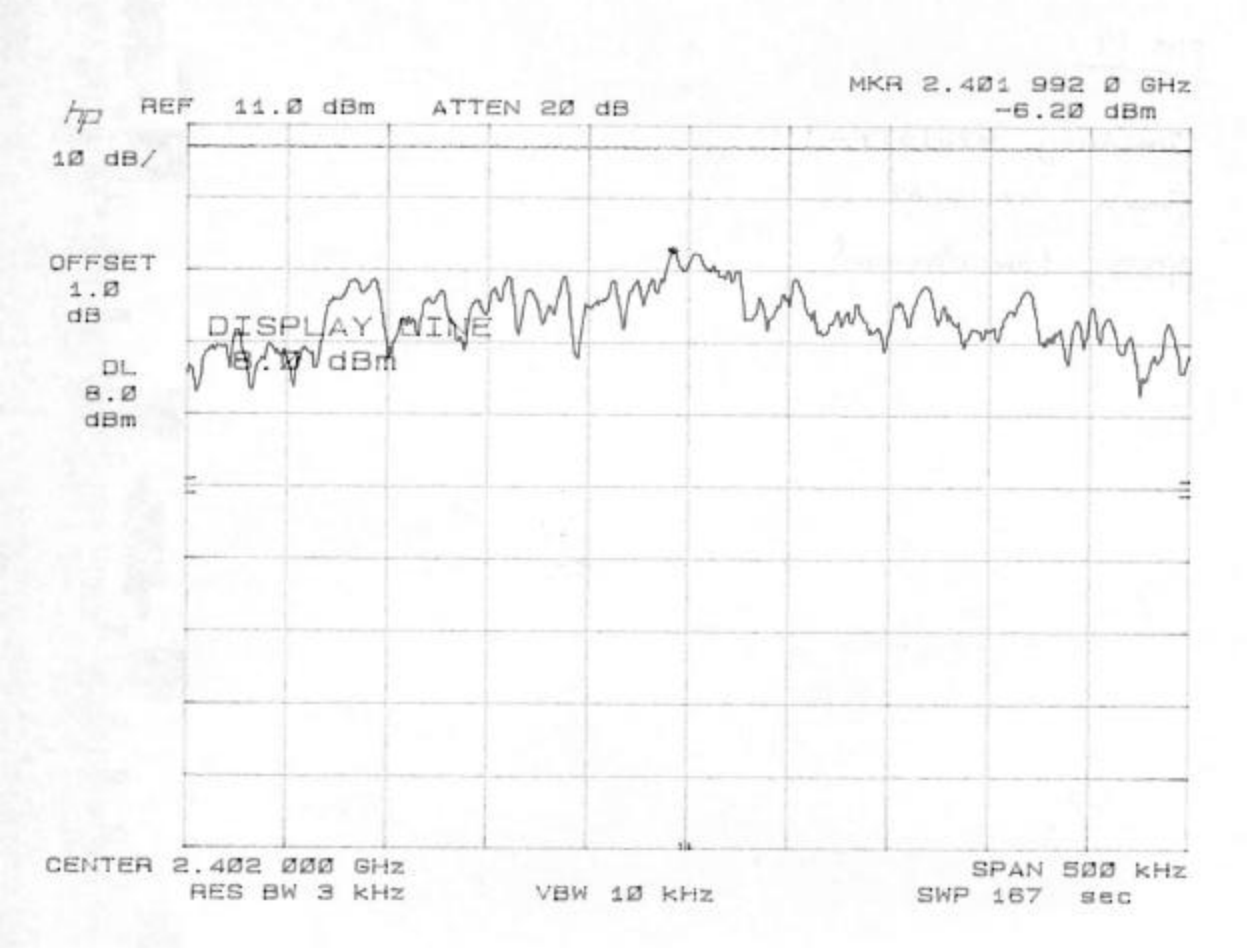
RESULTS

No non-compliance noted:

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin dB
Low	2402	-6.20	8	-14.20
Middle	2441	-5.60	8	-13.60
High	2480	-5.90	8	-13.90

Refer to plots below.

PPSD, Low Channel



PPSD, Middle Channel