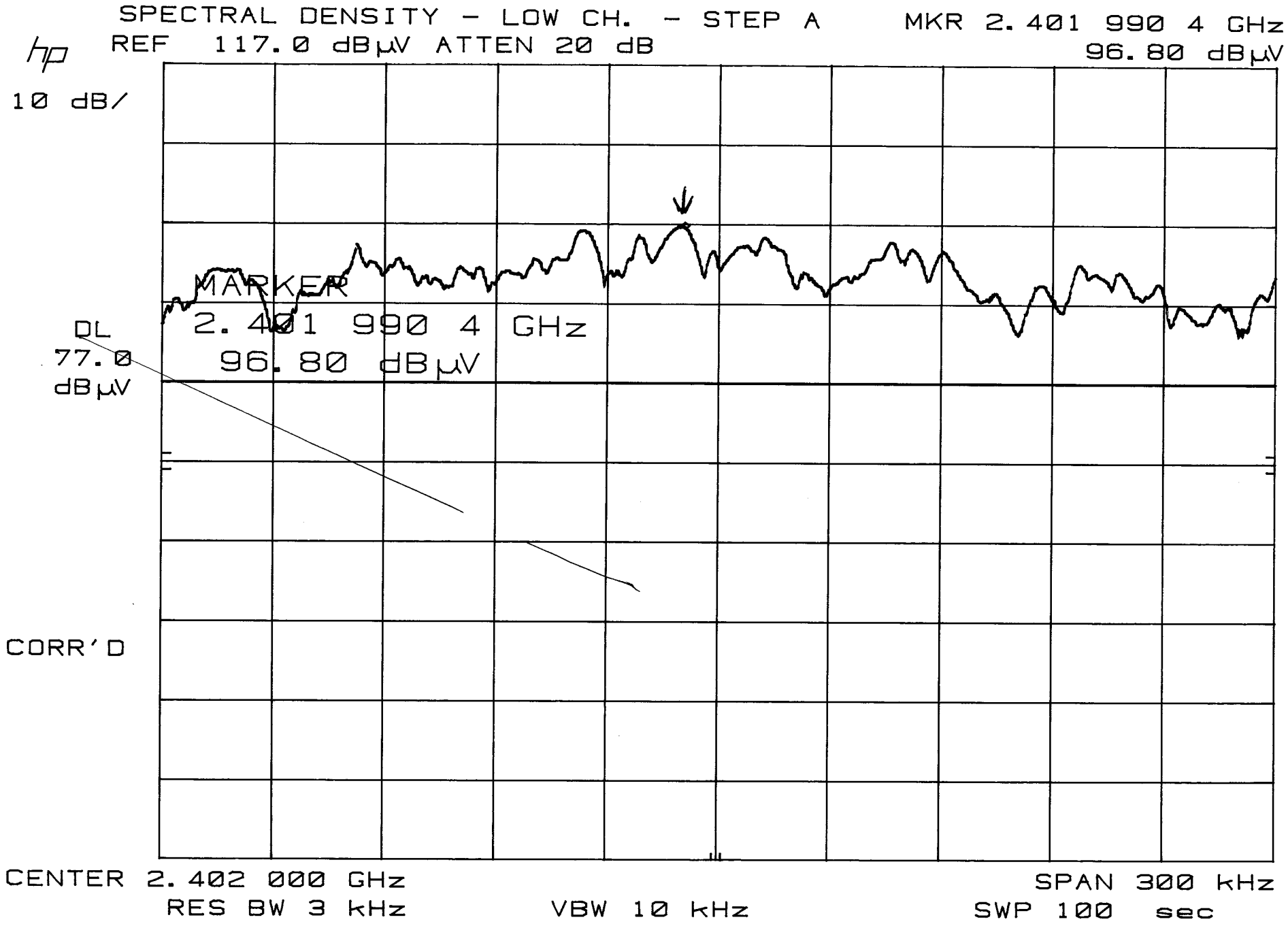
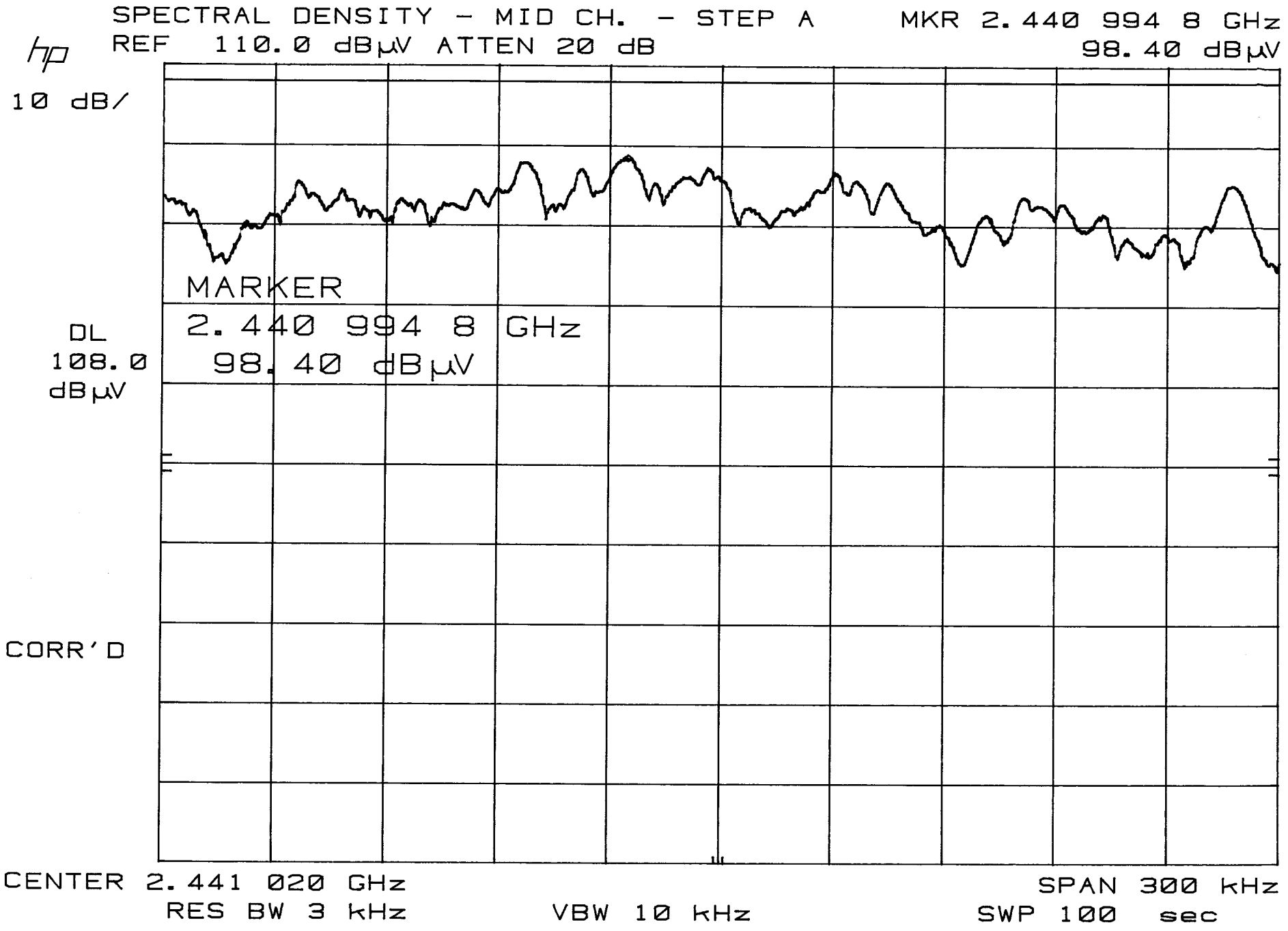
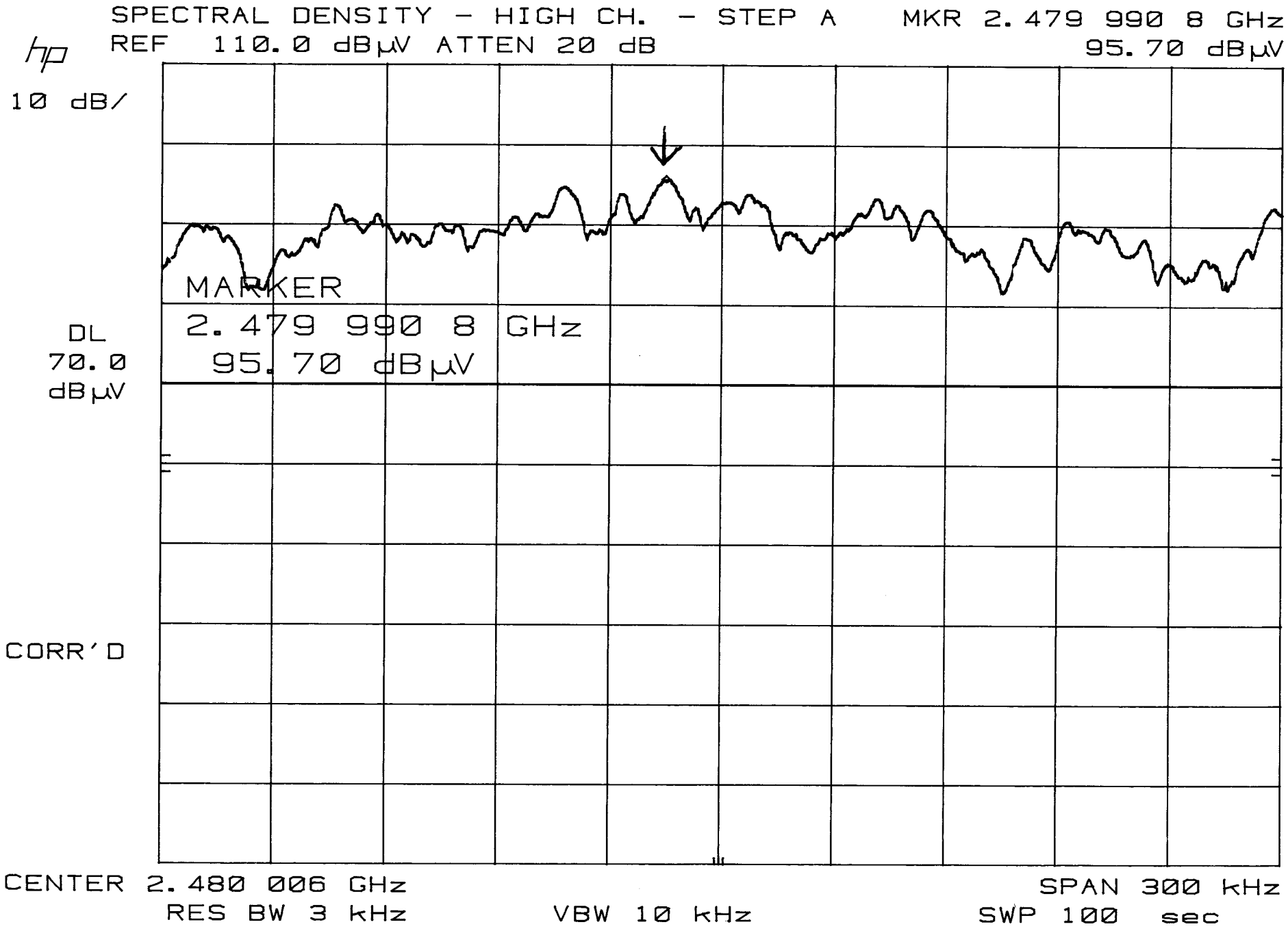
SPECTRAL DENSITY OUTPUT

DATA SHEETS


SPECTRAL DENSITY - LOW CH. - STEP A
MKR 2.401 990 4 GHz
REF 117.0 dBµV ATTEN 20 dB
96.80 dBµV
10 dB/
MARKER
2.401 990 4 GHz
96.80 dBµV
DL
77.0
dBµV
CORR'D
CENTER 2.402 000 GHz
SPAN 300 kHz
RES BW 3 kHz
VBW 10 kHz
SWP 100 sec


SPECTRAL DENSITY - MID CH. - STEP A
MKR 2.440 994 8 GHz
REF 110.0 dBµV ATTEN 20 dB
98.40 dBµV
10 dB/
MARKER
2.440 994 8 GHz
98.40 dBµV
DL
108.0
dBµV
CORR'D
CENTER 2.441 020 GHz
SPAN 300 kHz
RES BW 3 kHz
VBW 10 kHz
SWP 100 sec


SPECTRAL DENSITY - HIGH CH. - STEP A
MKR 2.479 990 8 GHz
REF 110.0 dBµV ATTEN 20 dB
95.70 dBµV
10 dB/
MARKER
2.479 990 8 GHz
95.70 dBµV
DL
70.0
dBµV
CORR'D
CENTER 2.480 006 GHz
SPAN 300 kHz
RES BW 3 kHz
VBW 10 kHz
SWP 100 sec

RADIATED EMISSIONS (FCC SECTION 15.205 AND 15.247)

COMPANY	INSIDE OUT NETWORKS	DATE	3/27/03	
EUT	BLUETOOTH CLASS 1 MODULE	DUTY CYCLE	N/A	%
MODEL	29000083	PEAK TO AVG	N/A	dB
S/N	N/A	TEST DIST.	3	Meters
TEST ENGINEER	Kyle Fujimoto	LAB	D	

Frequency MHz	Peak Reading (dBuV)	Average (A) or Quasi-Peak (QP)	Antenna Polar. (V or H)	Antenna Height (meters)	EUT Azimuth (degrees)	EUT Axis (X,Y,Z)	EUT Tx Channel	Antenna Factor (dB)	Cable Loss (dB)	Amplifier Gain (dB)	Distance Factor (dB)	Mixer Factor (dB)	*Corrected Reading (dBuV/m)	Delta ** (dB)	Spec Limit (dBuV/m)	Comments
2402.0000	96.8	A	V	1.0	180	X	HIGH	30.2	3.6	31.6	0.0	0.0	**99.0**			**Power Spectral Density**
																Step "B" High Channel
																(Actual dBm = 0.761)
2441.0000	98.4	A	V	1.0	180	X	HIGH	30.3	3.5	31.5	0.0	0.0	**100.7**			**Power Spectral Density**
																Step "B" High Channel
																(Actual dBm =2.461)
2480.0000	95.7	A	V	1.0	180	X	HIGH	30.4	3.4	31.3	0.0	0.0	**98.2**			**Power Spectral Density**
																Step "B" High Channel
																(Actual dBm = -0.040)

* CORRECTED READING = METER READING + ANTENNA FACTOR + CABLE LOSS - AMPLIFIER GAIN

** DELTA = SPEC LIMIT - CORRECTED READING

SPECTRAL DENSITY OUTPUT

INSIDE OUT NETWORKS

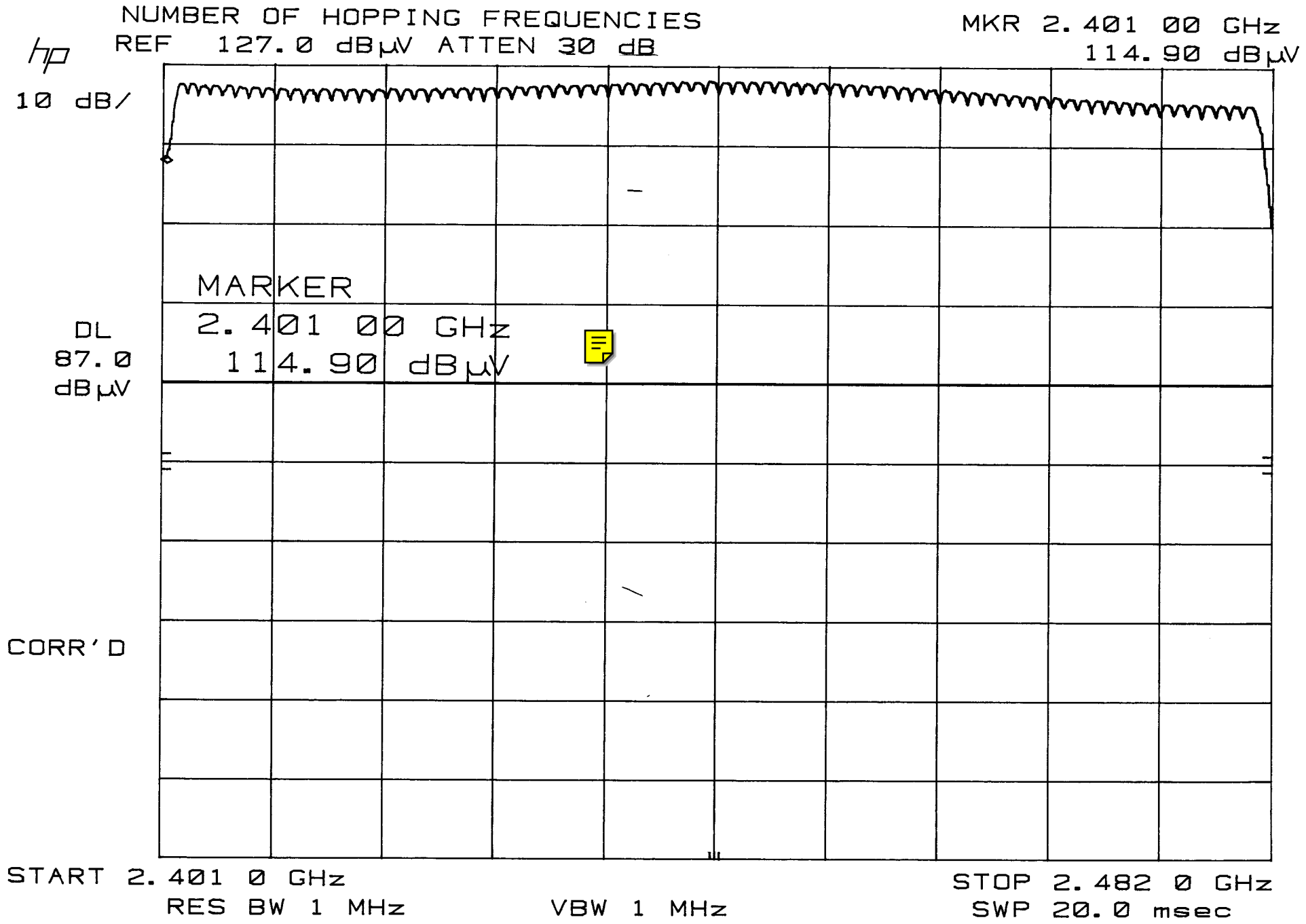
BLUETOOTH CLASS 1 MODULE

MODEL: 55001073

CHANNEL	PEAK POWER OUTPUT (dBm)
LOW	0.761
MIDDLE	2.461
HIGH	-0.040

NUMBER OF HOPPING FREQUENCIES

DATA SHEET


NUMBER OF HOPPING FREQUENCIES
REF 127.0 dBµV ATTEN 30 dB
MKR 2.401 00 GHz
114.90 dBµV
10 dB/
MARKER
2.401 00 GHz
114.90 dBµV
DL
87.0
dBµV
CORR'D
START 2.401 0 GHz
RES BW 1 MHz
VBW 1 MHz
STOP 2.482 0 GHz
SWP 20.0 msec

DUTY CYCLE

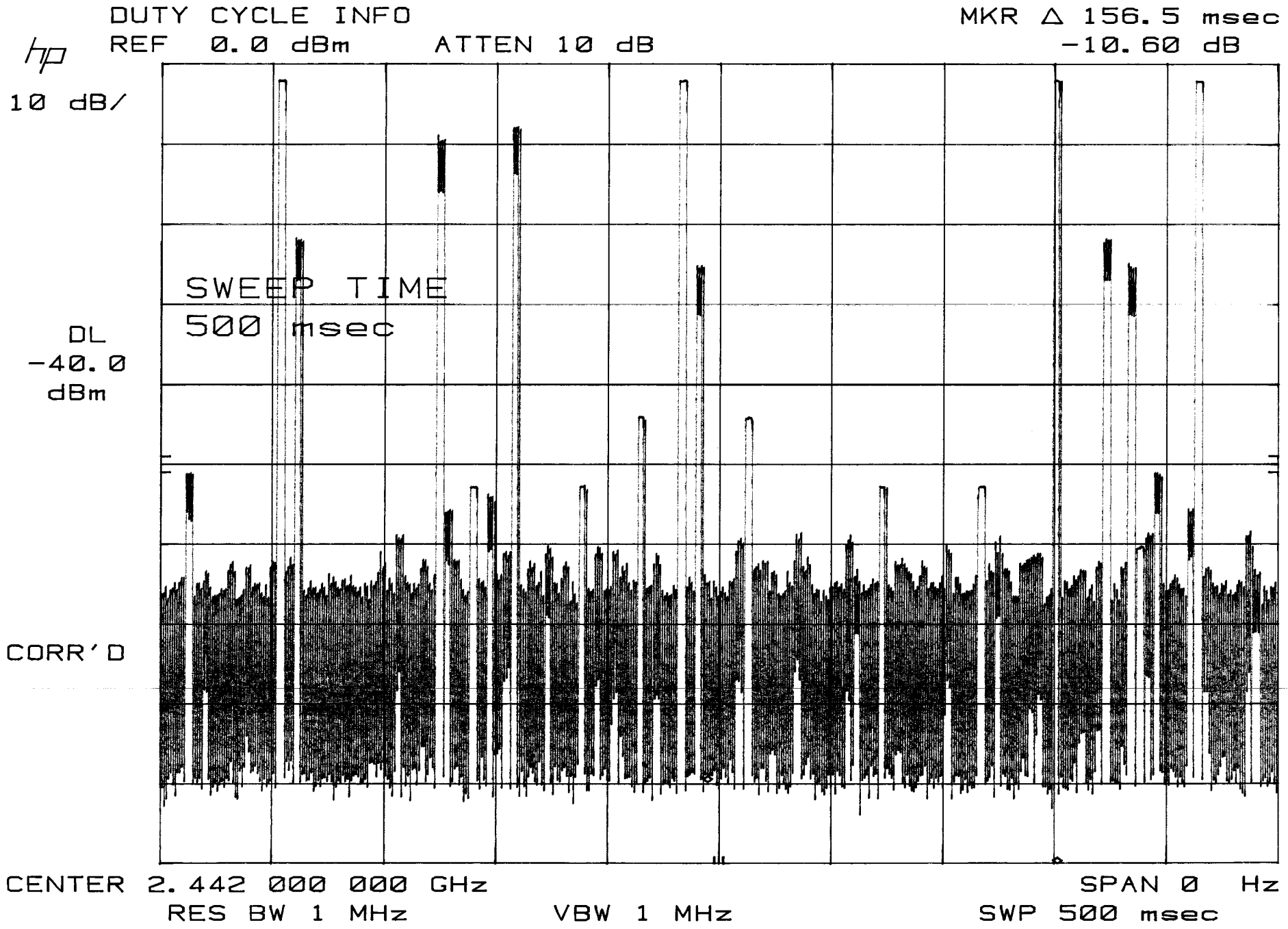
INFORMATION AND DATA SHEET

Company: 15.247 Interpretation	**Subject:** Spurious emission		1227
Remarks:		**Keyword:**	
Rule Parts: 15.247	**City:**	**State:**	**Country:**

INQUIRY: I'm writing the regulatory sections for a new wireless standard, the IEEE 802.15.4 Personal Area Network standard. This is the IEEE's answer to a need for something a bit lower cost than Bluetooth. Since these standards have in the past not done a particularly good job of documenting and interpreting FCC and other applicable regs, I'm really making a special effort to get it right for these guys. However, I've run into a problem on interpretation of Part 15.247 that no one knows the answer to, though it is quite fundamental and should have probably been spelled out in the rules. 15.247 allows harmonics at -20 dBc (easy) for ISM band spread spectrum equipment, but where the harmonics fall in the restricted bands of FCC 15.205 the general level of FCC 15.209 must be met. This is 500 uV/m at 3 meters, or -41.2 dBm ERP. The 2nd, 3rd, and 5th harmonics of 2400 MHz band gear falls into restricted, as does the 3rd and 5th of 902-928 MHz. At a transmit power level of 100 mW steady state, the equipment must attain -61 dBc harmonic rejection, or with higher antenna gain (say on the third where a quarterwave whip resonates) it must get even more. This is a real bear for cheap gear to meet. Now it is common practice to use the provisions of FCC 15.35 to average the transmission over 100 mS and allow the electric field strength to go up inversely with the average from 0 to 100% duty cycle. This may be done to a maximum of 20 dB allowed higher spurious emissions. For example, at 10% duty cycle over 100 mS, the electric field of harmonics may go up 10X, and since power is the square of electric field the peak power of spurs landing in restricted bands may go up 100X, or 20 dB. This is the max allowed, and in this case it makes a hell of a difference. Now the key question is: Do the averaging provisions of FCC 15.35 apply to hoppers? This is true if the standard practice when measuring frequency hopping systems for harmonics is to let the transmitter hop while the test system takes its data in a fixed 1 MHz channel that the system hops through. Or, has the standard practice been to FORCE the transmitter to transmit on a fixed non-hopping frequency and measure harmonics on a fixed channel using the averaging detector? I have pinged the Part 15 author, John Reed, and he is apparently not sure how he intended this to be interpreted when he wrote the rules. Both he and Ray Laforge have referred me to you on this key question. If a policy on this has not been previously spelled out, then whatever is standard practice on Bluetooth would seem to be the standard for all ISM band hopping systems. On the Bluetooth standard with 79 channels, 1600 hops per second, and an average of two hits on a test channel per 100 mS test period, the full 20 dB relaxation on spurious emissions would be attained. This basically allows about 40 dB harmonic suppression (not so hard to get) vs. 60 if the relaxation via averaging does not apply RESPONSE: The spurious emissions that fall in the restricted bands above 1 GHz would be subject to a peak field strength level at 3 meters of 74 dBuV/m (5000uV/m) and an average field strength level of 54 dBuV/m(500uV/m) . The following procedure should be used when measuring the peak level. During these tests the hopping function is disabled. I understand that the hopping channels may overlap in a 1 MHz band in this new proposal. Therefore, the duty factor should take this into account. This was not an issue in the current bluetooth specification as the channel separation is 1 MHz and the 20 db bandwidths do not overlap. Spurious Radiated Emissions This test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings: Span = wide enough to fully capture the emission being measured RBW = 1 MHz for f > 1 GHz, 100 kHz for f < 1 GHz VBW > RBW Sweep = auto Detector function = peak Trace = max hold Follow the guidelines in ANSI C63.4-1992 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc. A pre-amp and a high pass filter are required for this test, in order to provide the measuring system with sufficient sensitivity. Allow the trace to stabilize. The peak reading of the emission, after being corrected by the antenna factor, cable loss, pre-amp gain, etc., is the peak field strength, which must comply with the limit specified in Section 15.35(b). Submit this data. Now set the VBW to 10 Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time per channel of the hopping signal is less than 100 ms, then the reading obtained with the 10 Hz VBW may be further adjusted by a "duty cycle correction factor", derived from 20log(dwell time/100 ms), in an effort to demonstrate compliance with the 15.209 limit. Submit this data.

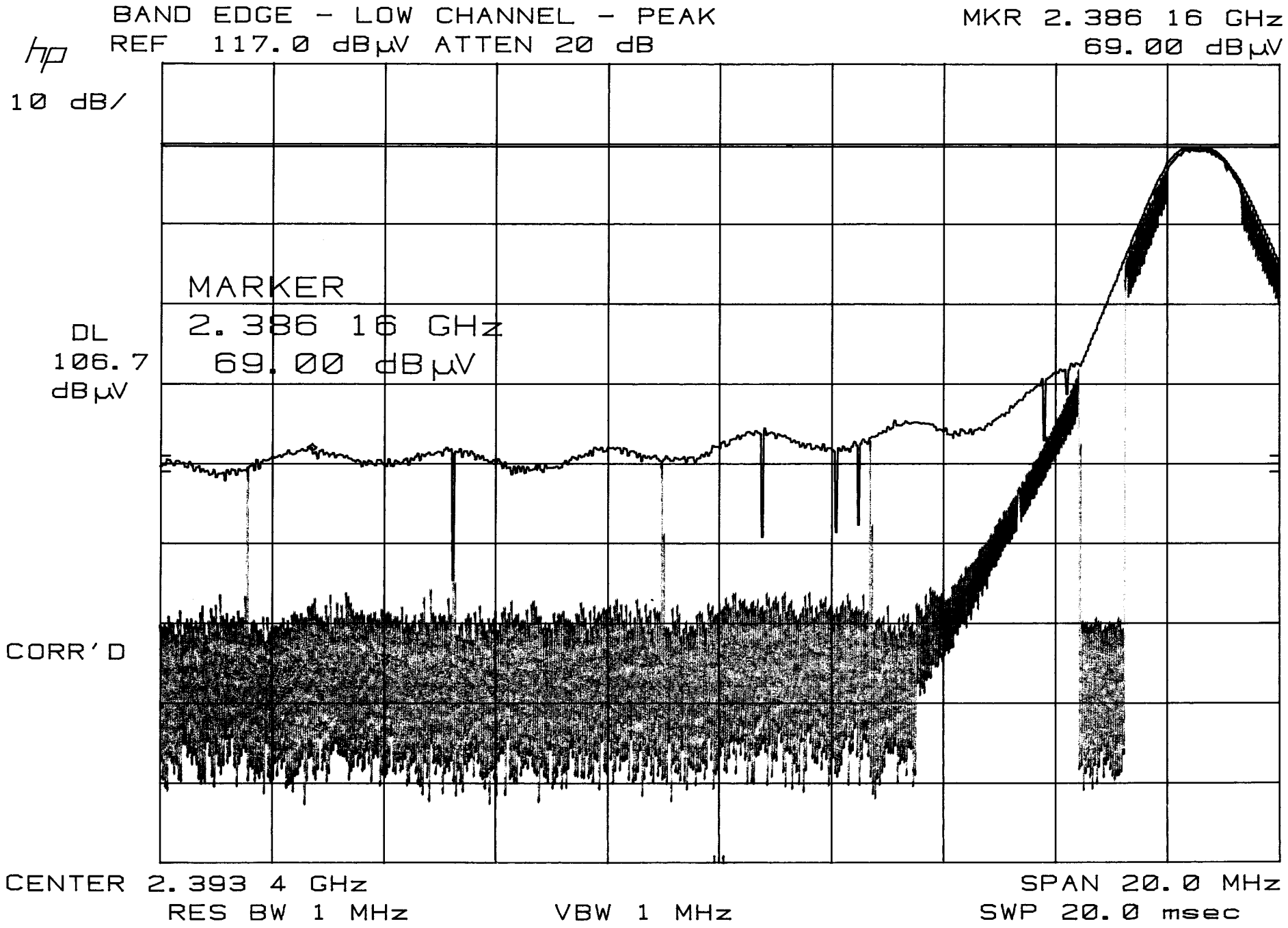
Supporting Images:

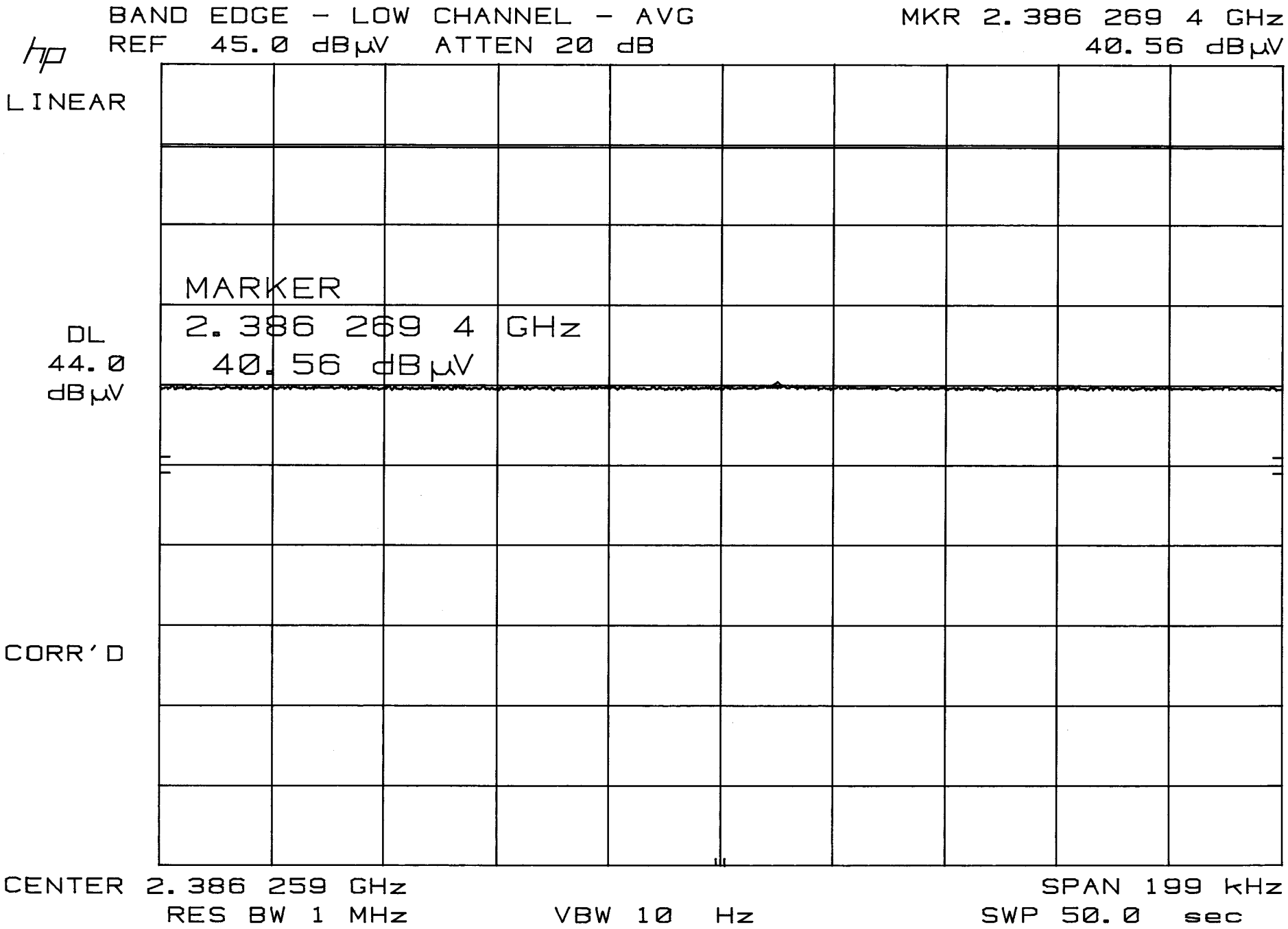
ID	Description	File Type

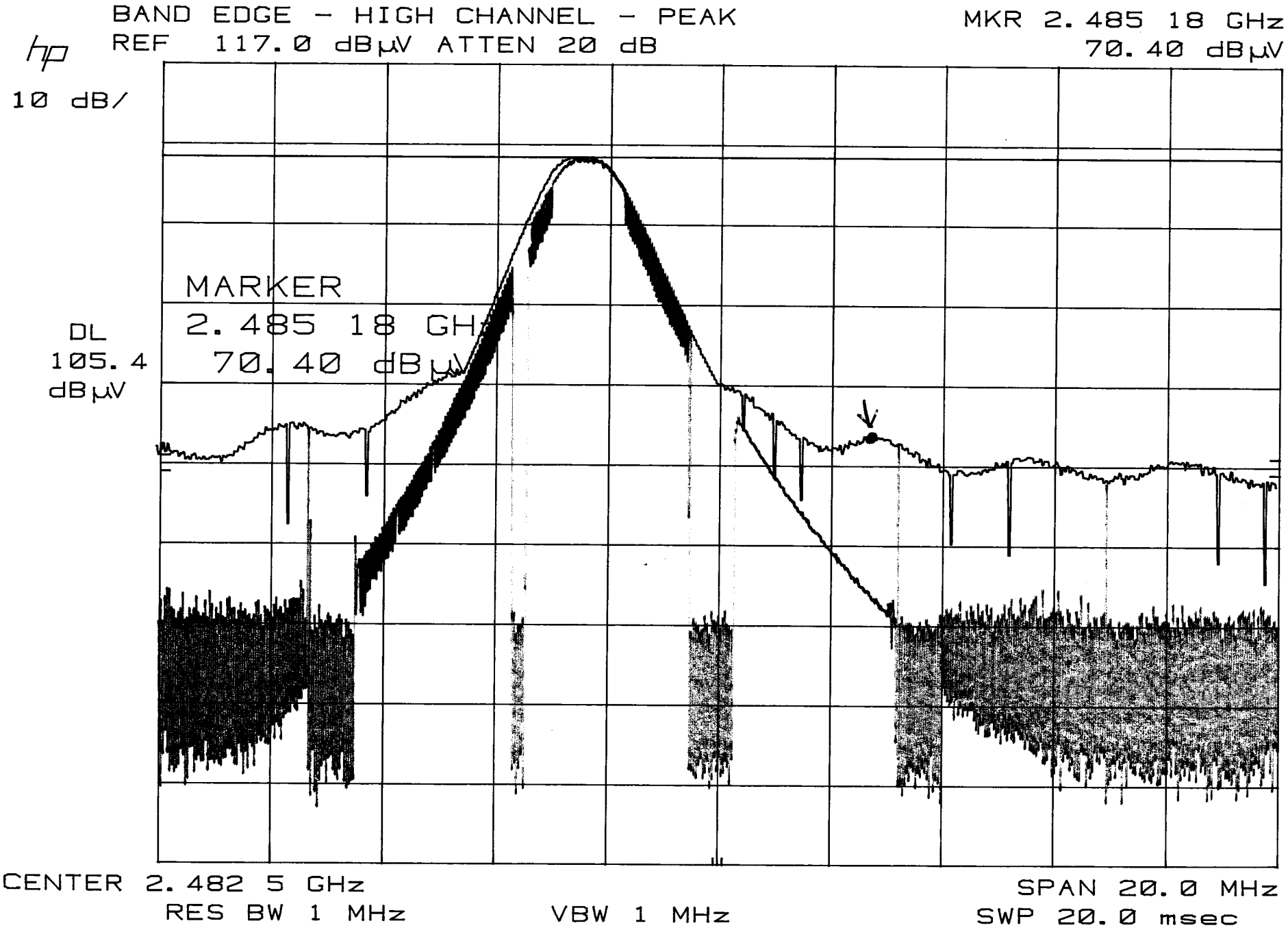

DUTY CYCLE INFO
MKR Δ 156.5 msec
REF 0.0 dBm
ATTEN 10 dB
-10.60 dB
10 dB/
SWEEP TIME
500 msec
DL
-40.0
dBm
CORR'D
CENTER 2.442 000 000 GHz
SPAN 0 Hz
RES BW 1 MHz
VBW 1 MHz
SWP 500 msec

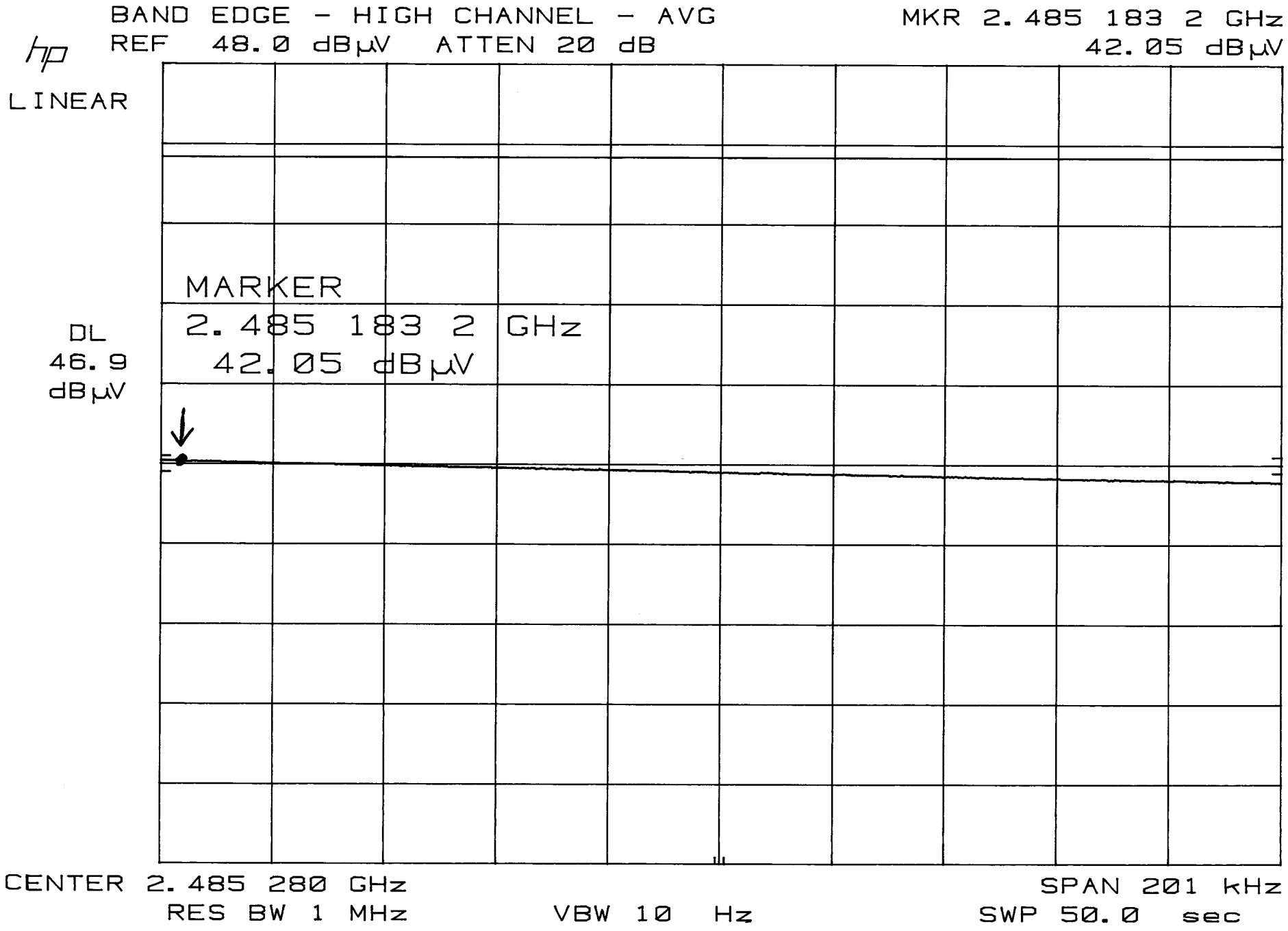
BAND EDGES

DATA SHEETS


BAND EDGE - LOW CHANNEL - PEAK
MKR 2.386 16 GHz
REF 117.0 dBµV ATTEN 20 dB
69.00 dBµV
10 dB/
MARKER
2.386 16 GHz
69.00 dBµV
DL
106.7
dBµV
CORR'D
CENTER 2.393 4 GHz
SPAN 20.0 MHz
RES BW 1 MHz
VBW 1 MHz
SWP 20.0 msec


BAND EDGE - LOW CHANNEL - AVG
REF 45.0 dBµV ATTEN 20 dB
MKR 2.386 269 4 GHz
40.56 dBµV
LINEAR
MARKER
2.386 269 4 GHz
40.56 dBµV
DL
44.0
dBµV
CORR'D
CENTER 2.386 259 GHz
RES BW 1 MHz
VBW 10 Hz
SPAN 199 kHz
SWP 50.0 sec


BAND EDGE - HIGH CHANNEL - PEAK
REF 117.0 dBµV ATTEN 20 dB
MKR 2.485 18 GHz
70.40 dBµV
10 dB/
MARKER
2.485 18 GHz
70.40 dBµV
DL
105.4
dBµV
CENTER 2.482 5 GHz
RES BW 1 MHz
VBW 1 MHz
SPAN 20.0 MHz
SWP 20.0 msec


BAND EDGE - HIGH CHANNEL - AVG
MKR 2.485 183 2 GHz
REF 48.0 dBµV ATTEN 20 dB
42.05 dBµV
LINEAR
MARKER
2.485 183 2 GHz
42.05 dBµV
DL
46.9
dBµV
CENTER 2.485 280 GHz
SPAN 201 kHz
RES BW 1 MHz
VBW 10 Hz
SWP 50.0 sec

RADIATED EMISSIONS (FCC SECTION 15.205 AND 15.247)

COMPANY	INSIDE OUT NETWORKS	DATE	3/27/03
EUT	BLUETOOTH CLASS 1 MODULE	DUTY CYCLE	N/A %
MODEL	55001073	PEAK TO AVG	N/A dB
S/N	N/A	TEST DIST.	3 Meters
TEST ENGINEER	Kyle Fujimoto	LAB	D

Frequency MHz	Peak Reading (dBuV)	Average (A) or Quasi-Peak (QP)	Antenna Polar. (V or H)	Antenna Height (meters)	EUT Azimuth (degrees)	EUT Axis (X,Y,Z)	EUT Tx Channel	Antenna Factor (dB)	Cable Loss (dB)	Amplifier Gain (dB)	Distance Factor (dB)	Mixer Factor (dB)	*Corrected Reading (dBuV/m)	Delta ** (dB)	Spec Limit (dBuV/m)	Comments
2388.7000	69.0	A	H	1.5	90	X	LOW	30.4	3.4	31.3	0.0	0.0	71.6	-2.4	74.0	PEAK BAND EDGE -
																LOW CHANNEL
2388.7400	69.0	40.6 A	H	1.5	90	X	LOW	30.4	3.4	31.3	0.0	0.0	43.2	-10.8	54.0	AVERAGE BAND EDGE -
																LOW CHANNEL
2488.3000	70.4	A	H	1.5	90	X	HIGH	30.4	3.4	31.3	0.0	0.0	73.0	-1.0	74.0	PEAK BAND EDGE -
																HIGH CHANNEL
2488.3000	70.4	42.1 A	H	1.5	90	X	HIGH	30.4	3.4	31.3	0.0	0.0	44.7	-9.3	54.0	AVERAGE BAND EDGE -
																HIGH CHANNEL

* CORRECTED READING = METER READING + ANTENNA FACTOR + CABLE LOSS - AMPLIFIER GAIN

** DELTA = SPEC LIMIT - CORRECTED READING