

RADIO TEST REPORT

No. 0120073R1

EQUIPMENT UNDER TEST

Equipment : 2.4 GHz Wireless PBX
Type / model : Handset/Compass
Manufacturer : NSM Technology Ltd.
Tested by request of : RTX Telecom A/S

SUMMARY

The equipment complies with the requirements of radiated and conducted emissions according to the following standard.

FCC part 15.247 subpart C (1999)

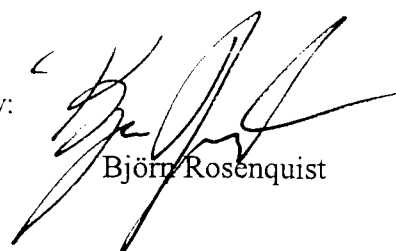
FCC part 15.205(a) restricted bands and part 15.209(a) radiated limits (1999).

Date of issue: May 28, 2001

Tested by:


Martin Gustafsson

Approved by:


Björn Rosenquist

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1. CLIENT INFORMATION

The EUT has been tested by request of

Company: RTX Telecom A/S
Stroemmen 6
DK-9400 Noerresundby
Denmark

Name of contact: Niels Harsberg

2. EQUIPMENT UNDER TEST (EUT)**2.1 Identification of the EUT**

Equipment: 2.4 GHz Wireless PBX
Type/Model: Handset/Compass
Brand name: Cortelco
Manufacturer: NSM Technology Ltd.
Rating: 3.6 V_{Nominal} 3 AAA NiCd batteries of the 300 mAh type

2.2 Additional information about the EUT

The EUT consists of the following units:

Units	Type
2.4 GHz Wireless PBX	Handset

2.2.1 Transmitter technical characteristics.

Frequency range: 2400 – 2483,5 MHz

2.2.2 Transmitter RF power characteristics:

Maximum rated transmitter output power: 25 dBm e.i.r.p

Antenna: Integrated

Transmitter output power is not variable.

2.2.3 Transmitter modulation

Modulation: FHSS, GFSK

Bit rate: 1.024 Mbps

2.2.4 Power source

Power supply: Batteries of the 300 mAh type. Typical 3.6V

2.3 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not included as part of the testing and evaluation of the EUT.

Equipment

RTX 2201 2.4GHz Communication Tester

Cables	Type	Length
Data cable	25 pins parallel Cable	2 m
Power Cable (220-240 V)	2 wire plus ground	2,5 m

3. TEST SPECIFICATIONS

3.1 Standards

FCC Subpart C – Intentional Radiators (1999) §15.247 for frequency hopping systems operating in the 2400 – 2483.5 MHz and 5725 – 5850 MHz. §15.205 for restricted bands and §15.209 for radiated limits.

3.2 Additions, deviations and exclusions from standards and accreditation

No additions, deviations or exclusions have been made from standards and accreditation.

4. TEST SUMMARY

The results in this report apply only to sample tested:

	Test	Result	Note
15.247(b)	Peak output power	Pass	
15.247(a)	20 dB Bandwidth	Pass	
15.247(a)	Carrier frequency separation	Pass	
15.247(a)	Number of hopping channels	Pass	
15.247(c)	Band edge compliance	Pass	
15.247(a)	Time of occupancy (dwell time)	Pass	
15.247(c)	Out of band spurious emission, radiated	Pass	

5. PEAK OUTPUT POWER

5.1 Operating environment

Temperature: 22 °C (15 - 35 °C)
Relative Humidity: 22 % (30 - 60 %)

5.2 Test set-up and test procedure

The EUT was connected to a laptop computer and a test program was used, together with the RTX 2201 2.4GHz Communication Tester, to set the EUT in the specified test mode. The measurement was performed with the EUT connected to a spectrum analyser.

5.3 Measurement uncertainty

Measurement uncertainty: ± 3 dB

5.4 Test equipment

Test site: Radio measuring facility

Equipment	Manufacturer	Type	SEMKO No.
Spectrum analyser:	R&S	FSEM 30	-
Cable	Suhner	Sucoflex 104	5186

R&S = Rohde & Schwarz

5.5 Test protocol

Date of test: May 21, 2001

The EUT was set to TX mode and hopping off.

Spectrum analyser settings:

Span: 5 MHz
RBW: 1 MHz
VBW: 1 MHz
Detector: Peak
Trace: Max Hold

Test conditions	Output power (dBm)		
	F _{min} 2401,28 MHz	F _{max} 2481,15 MHz	Limit (dBm)
V _{min} 3,2 V	25	24	30
V _{nom} 3,6 V	25	24	30
V _{max} 4,14 V	24	25	30

See plots of the measurements in appendix A

6. TX 20 DB BANDWIDTH

6.1 Operating environment

Temperature: 22 °C
Relative Humidity: 22 %

6.2 Test set-up and test procedure

The EUT was connected to a laptop computer and a test program was used, together with the RTX 2201 2.4GHz Communication Tester, to set the EUT in the specified test mode. The measurement was performed with the EUT connected to a spectrum analyser.

6.3 Measurement uncertainty

Measurement uncertainty: ± 3 dB

6.4 Test equipment

Test site: Shielded room

Equipment	Manufacturer	Type	SEMKO No.
Spectrum analyser:	R&S	FSEM 30	-
Cable	Suhner	Sucoflex 104	5186

R&S = Rohde & Schwarz

6.5 Test protocol

Date of test: May 21, 2001

The EUT was set to TX mode and hopping off.

Spectrum analyser settings:

Span: 1,5 MHz
RBW: 30 kHz
VBW: 30 kHz
Detector: Peak
Trace: Max Hold

Test conditions	Frequency range (kHz)		
	F _{min} 2401,28	F _{max} 2481,15 MHz	Limit (MHz)
V _{nom} 3,6 V	959	992	<1
V _{max} 4,14V	956	971	<1

See plots of the measurements in appendix A

7. CARRIER FREQUENCY SEPARATION

7.1 Operating environment

Temperature: 22 °C
Relative Humidity: 22 %

7.2 Test set-up and test procedure

The EUT was connected to a laptop computer and a test program was used, together with the RTX 2201 2.4GHz Communication Tester, to set the EUT in the specified test mode. The measurement was performed with the EUT connected to a spectrum analyser.

7.3 Measurement uncertainty

Measurement uncertainty: ± 3 dB

7.4 Test equipment

Test site: Shielded room

Equipment	Manufacturer	Type	SEMKO No.
Spectrum analyser:	R&S	FSEM 30	-
Cable	Suhner	Sucoflex 104	5186

R&S = Rohde & Schwarz

7.5 Test protocol

Date of test: May 21, 2001

The EUT was set to TX mode and hopping on.

Spectrum analyser settings:

Span: 5 MHz
RBW: 100 kHz
VBW: 100 kHz
Detector: Peak
Trace: Max Hold

Test conditions	Frequency range (MHz)		
	F_{min}	F_{max}	Limit (kHz)
V_{nom} 3.6 V	1,1	2,5	>958

See plots of the measurements in appendix A

8. NUMBER OF HOPPING CHANNELS

8.1 Operating environment

Temperature: 22 °C
Relative Humidity: 22 %

8.2 Test set-up and test procedure

The EUT was connected to a laptop computer and a test program was used, together with the RTX 2201 2.4GHz Communication Tester, to set the EUT in the specified test mode. The measurement was performed while the EUT connected to a spectrum analyser.

8.3 Measurement uncertainty

Measurement uncertainty: ± 3 dB

8.4 Test equipment

Test site: Shielded room

Equipment	Manufacturer	Type	SEMKO No.
Spectrum analyser:	R&S	FSEM 30	-
Cable	Suhner	Sucoflex 104	5186

R&S = Rohde & Schwarz

8.5 Test protocol

Date of test: May 21, 2001

The EUT was set to TX mode and hopping on.

Spectrum analyser settings:

Span: 102 MHz
RBW: 100 kHz
VBW: 100 kHz
Detector: Peak
Trace: Max Hold

Test conditions	Frequency range	
	No. of channels	Limit (no. of channels)
V_{nom} 5 V	79	>75

See plots of the measurements in appendix A

9. BAND EDGE COMPLIANCE

9.1 Operating environment

Temperature: 22 °C
Relative Humidity: 22 %

9.2 Test set-up and test procedure

The EUT was connected to a laptop computer and a test program was used, together with the RTX 2201 2.4GHz Communication Tester, to set the EUT in the specified test mode. The measurement was performed while the EUT connected to a spectrum analyser.

9.3 Measurement uncertainty

Measurement uncertainty: ± 3 dB

9.4 Test equipment

Test site: Shielded room

Equipment	Manufacturer	Type	SEMKO No.
Spectrum analyser:	R&S	FSEM 30	-
Cable	Suhner	Sucoflex 104	5186

R&S = Rohde & Schwarz

9.5 Test protocol

Date of test: May 21, 2001

The EUT was set to TX mode and hopping off and on.

Spectrum analyser settings:

Span: 5 MHz
RBW: 100 kHz
VBW: 100 kHz
Detector: Peak
Trace: Max Hold

Test conditions	Band edge compliance		
	F _{min} 2401,28 MHz	F _{max} 2481,15 MHz	Limit (dBc)
Hopping off	-54 dBc	-54 dBc	<-20
Hopping on	-58 dBc	-55 dBc	<-20

See plots of the measurements in appendix A

10. TIME OF OCCUPANCY (DWELL TIME)

10.1 Operating environment

Temperature: 22 °C
Relative Humidity: 22 %

10.2 Test set-up and test procedure

The EUT was connected to a laptop computer and a test program was used, together with the RTX 2201 2.4GHz Communication Tester, to set the EUT in the specified test mode. The measurement was performed with the EUT connected to a spectrum analyser.

10.3 Measurement uncertainty

Measurement uncertainty: ± 3 dB

10.4 Test equipment

Test site: Shielded room

Equipment	Manufacturer	Type	SEMKO No.
Spectrum analyser:	R&S	FSEM 30	-
Cable	Suhner	Sucoflex 104	5186

R&S = Rohde & Schwarz

10.5 Test protocol

Date of test: May 21, 2001

The EUT was set to TX mode and hopping on, channel 1.

Spectrum analyser settings:

Span: 0 Hz
RBW: 1 MHz
VBW: 1 MHz
Detector: Peak
Trace: Max Hold

Duty cycle = 0,05 = T
Transmit time = 0,5 ms = D
Number of hopping times that channel 1 occurred in 30 s = 37 = n
Time for channel 1 to be active in 30 s = S

Formula: $S = (D \cdot n) / T$

$S = (0,0005 \cdot 37) / 0,05 = 0,37$ s

Limit: 0,4 s

See plots of the measurements in appendix A

11. RADIATED SPURIOUS EMISSION, TRANSMITTER AND RECEIVER**11.1 Operating environment**

Temperature: 22 °C (15 - 35 °C)
Relative Humidity: 22 % (30 - 60 %)

11.2 Measurement uncertainty

Measurement uncertainty: ± 4 dB

11.3 Test equipment

Test site: Semi-anechoic shielded chamber.

10 x 20 x 8,5 m (W x L x H)

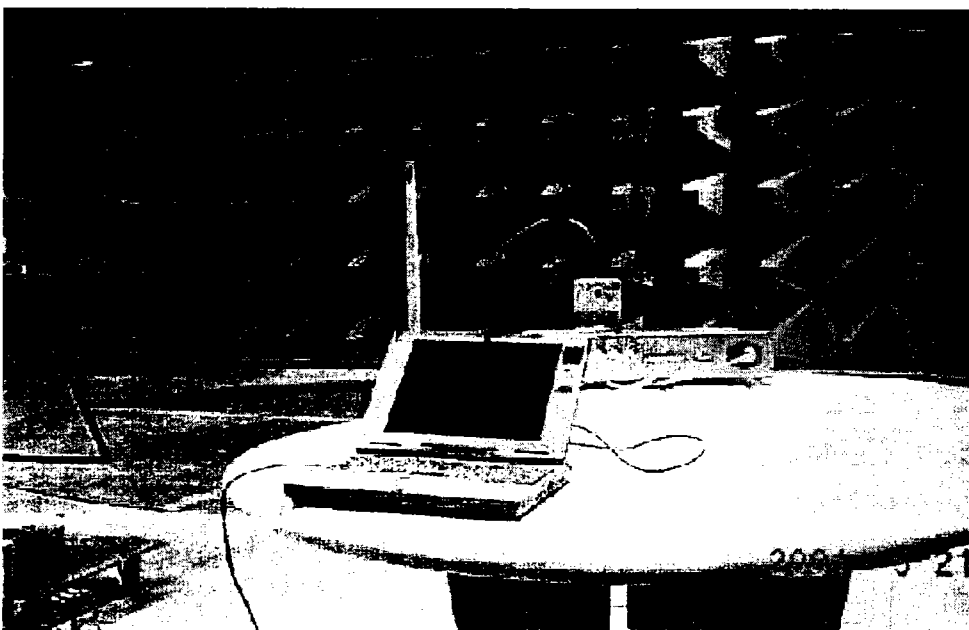
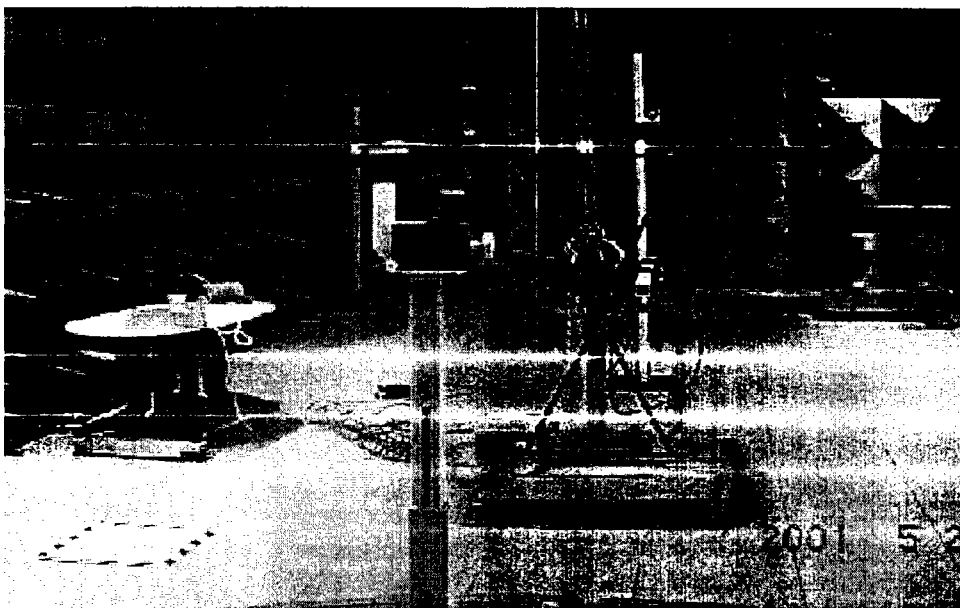
Equipment	Manufacturer	Type	SEMKO No.
Software:	R&S	ES-K1	
Measurement receiver:	R&S	FSEM 30	-
Antenna amplifier:	SEMKO		7992, 7993
Preamplifier:	HP	8449B	6685
High pass filter 4-18GHz:	K&L	4H10-X4500	5133
Antennas:			
Bilog:	Chase	CBL6111A	1550
Double Ridge Waveguide Horn:	EMCO	3115	3006
Pyramidal Horn Antenna:	EMCO	3160-08	30099
Pyramidal Horn Antenna:	EMCO	3160-09	30101

R&S = Rohde & Schwarz

11.4 Measurement set up

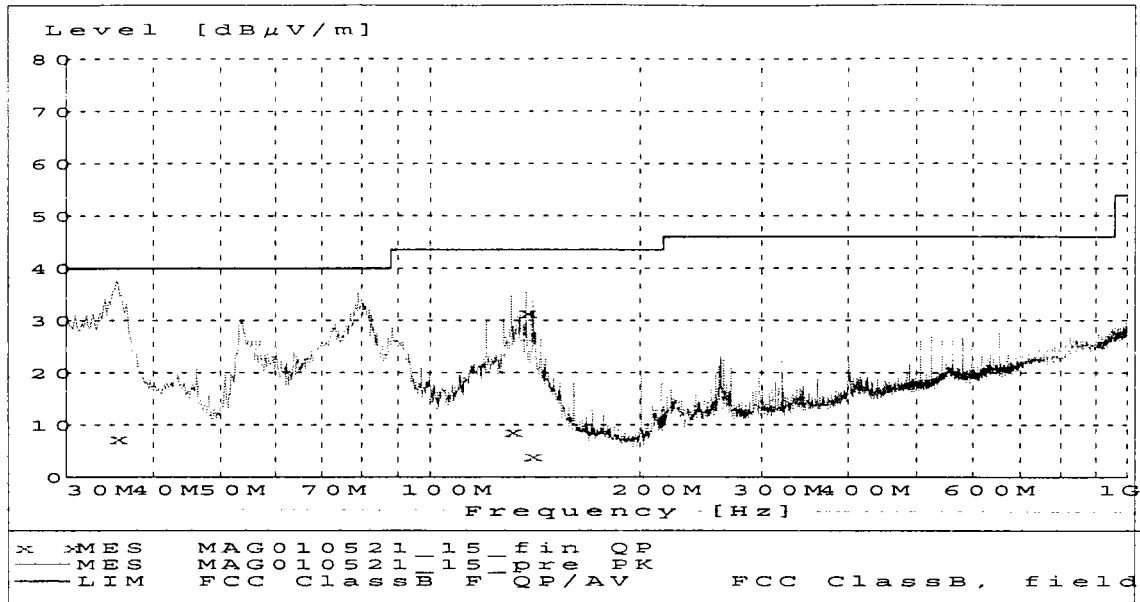
During the radiated measurements 30 – 1000 MHz the RTX 2201 2.4GHz Communication Tester was placed inside the large EMC chamber, behind the measurement antenna. This was necessary to get the EUT to operate at the right test sequence. The second graph below shows a measurement in the large EMC chamber with no test equipment but only the RTX 2201 2.4GHz Communication Tester inside the chamber.

Picture of the test set up.

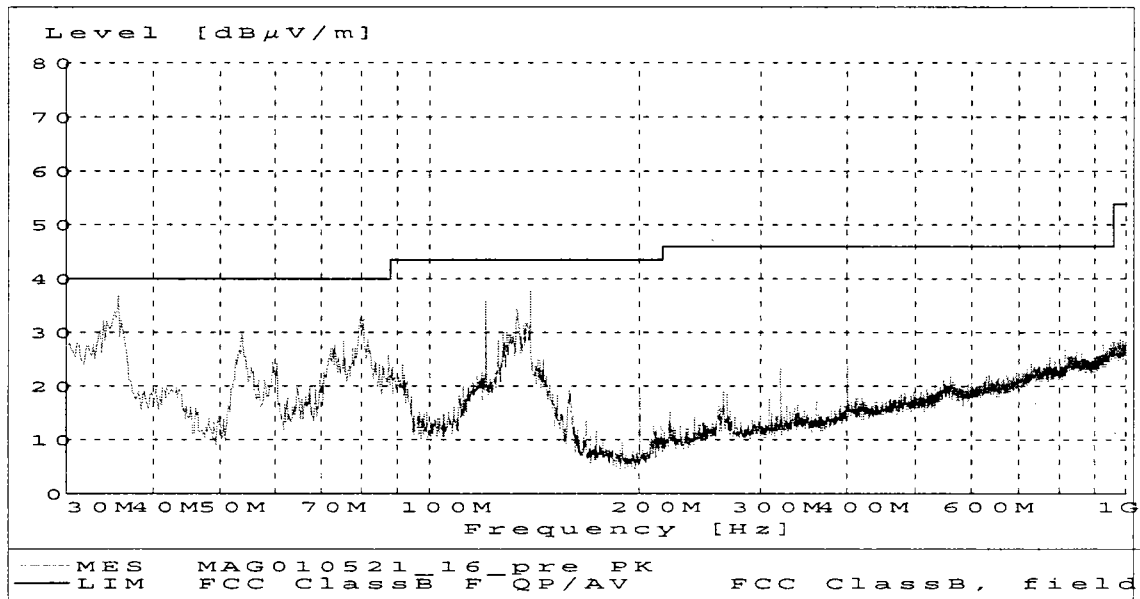


11.5 Test protocol

Date of test: May 21, 2001



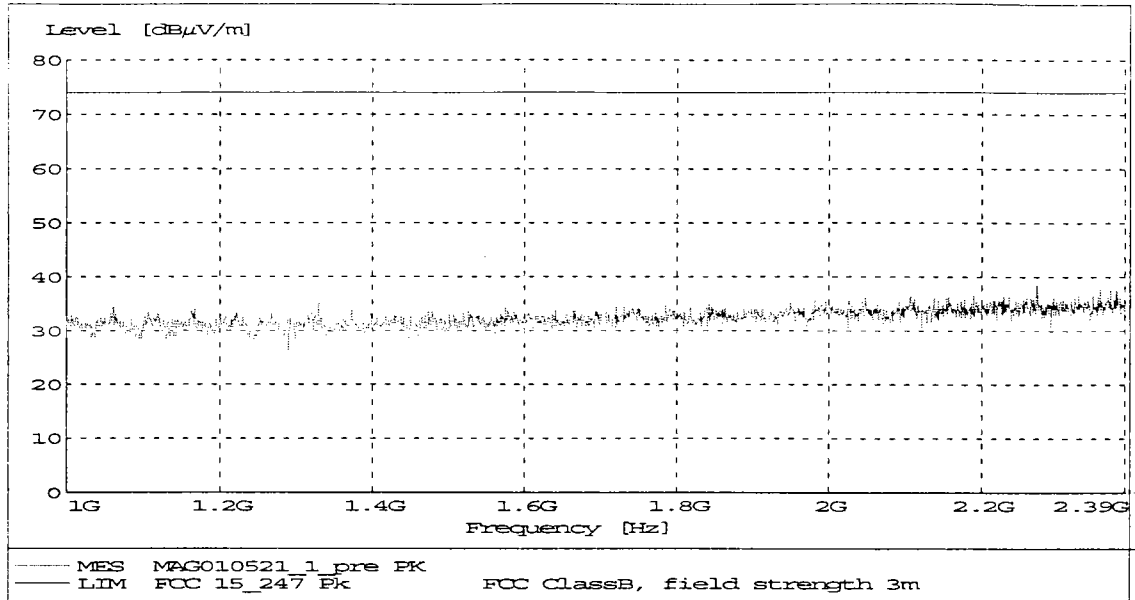
Overview sweep max peak at a distance of 10 m (30 – 1000 MHz)



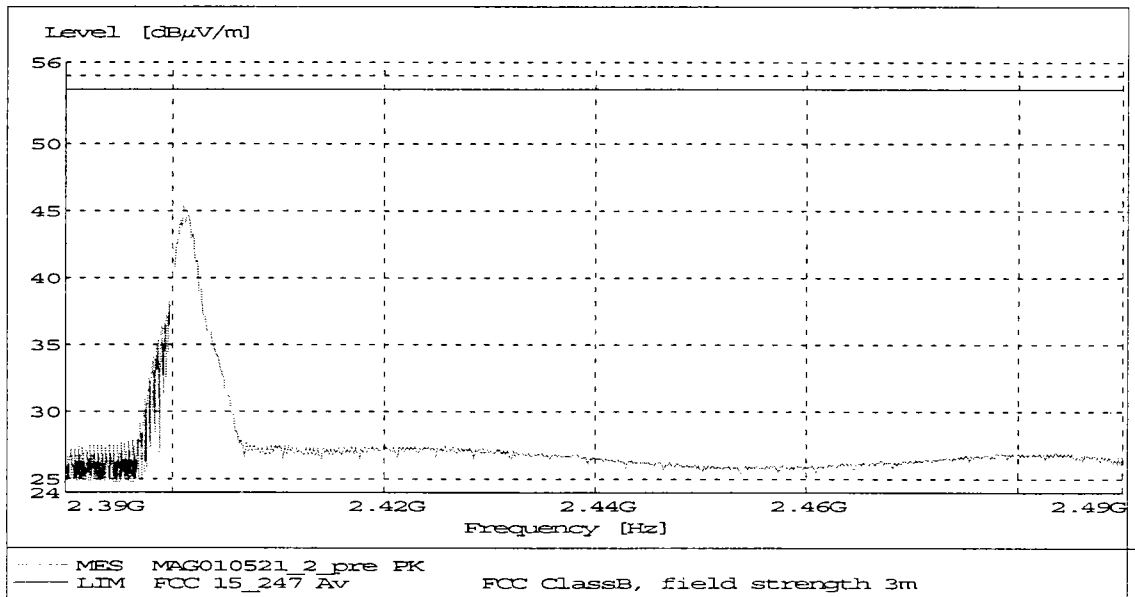
Overview sweep max peak at a distance of 10 m (30 – 1000 MHz) with no EUT inside the chamber, the disturbance comes from the RTX 2201 2.4GHz Communication Tester, se picture above.

RTX Handset: Low channel

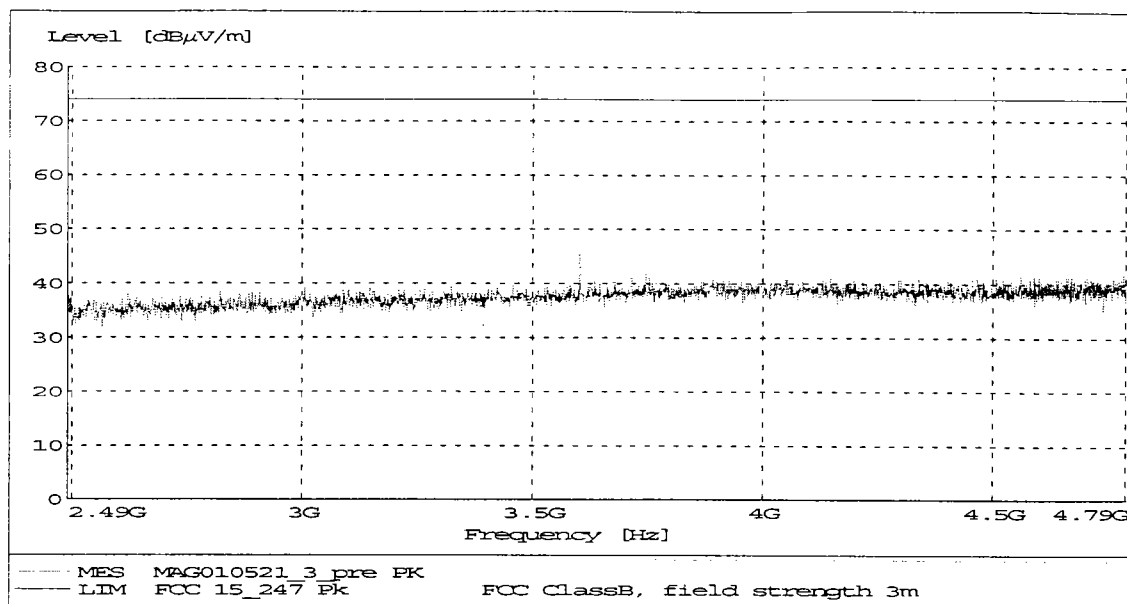
1000 – 2390 MHz Overview sweep max peek at a distance of 3 m



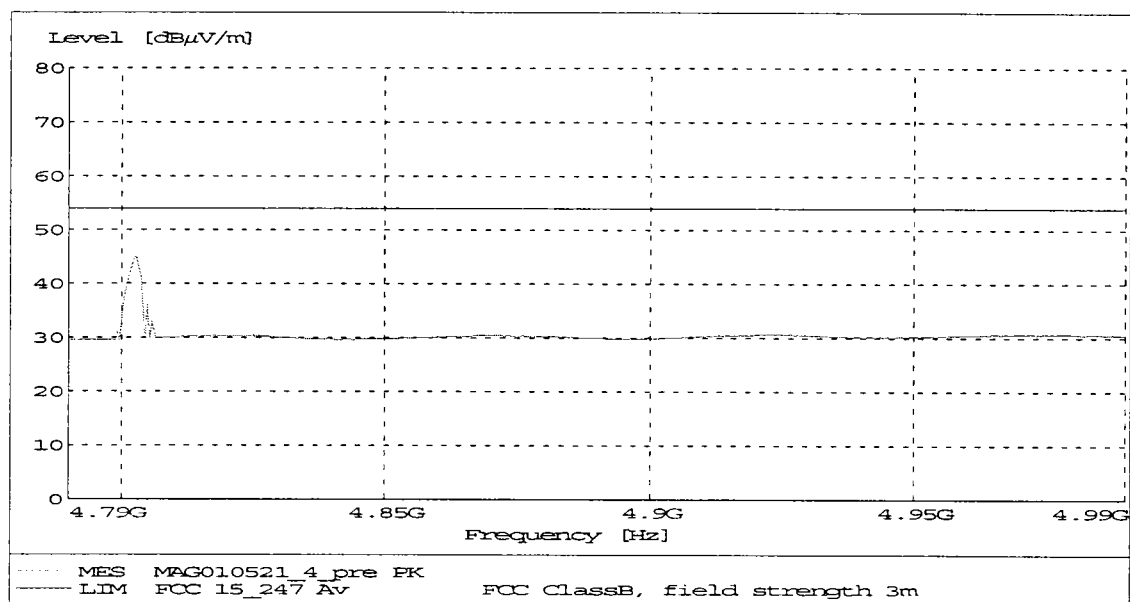
2390 – 2490 MHz Measured with 10 Hz VBW



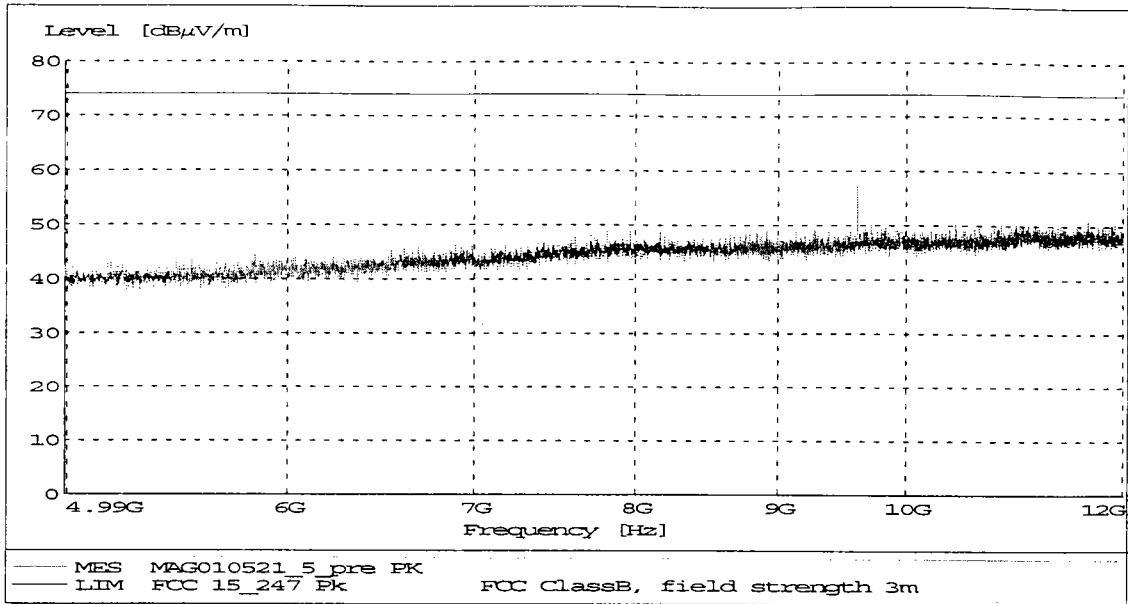
2490 – 4790 MHz Overview sweep max peek at a distance of 3 m



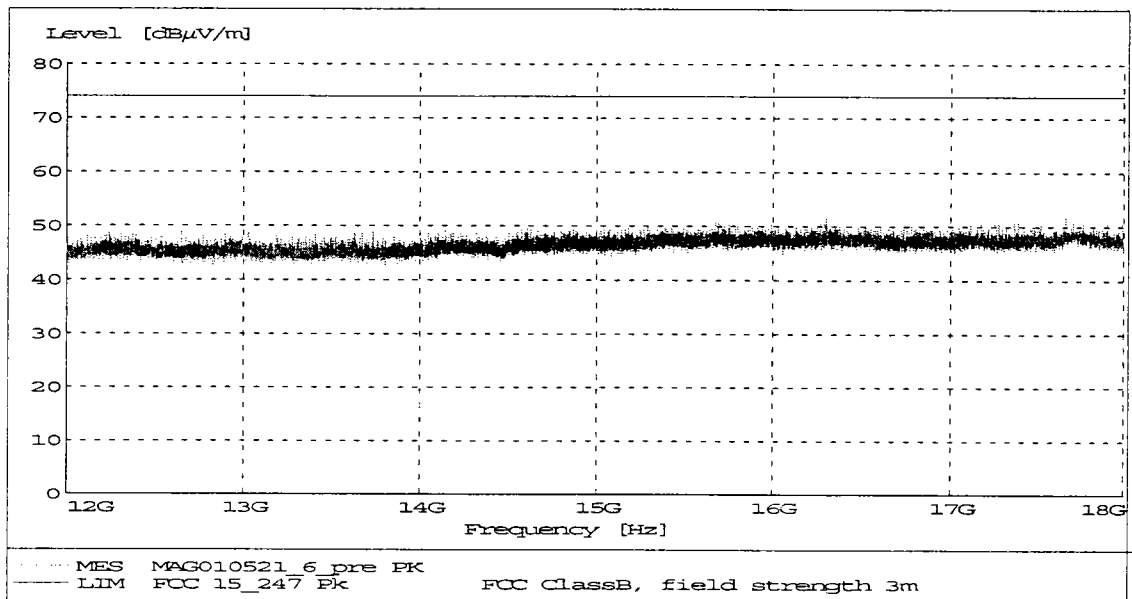
4790 – 4990 MHz Measured with 10 Hz VBW



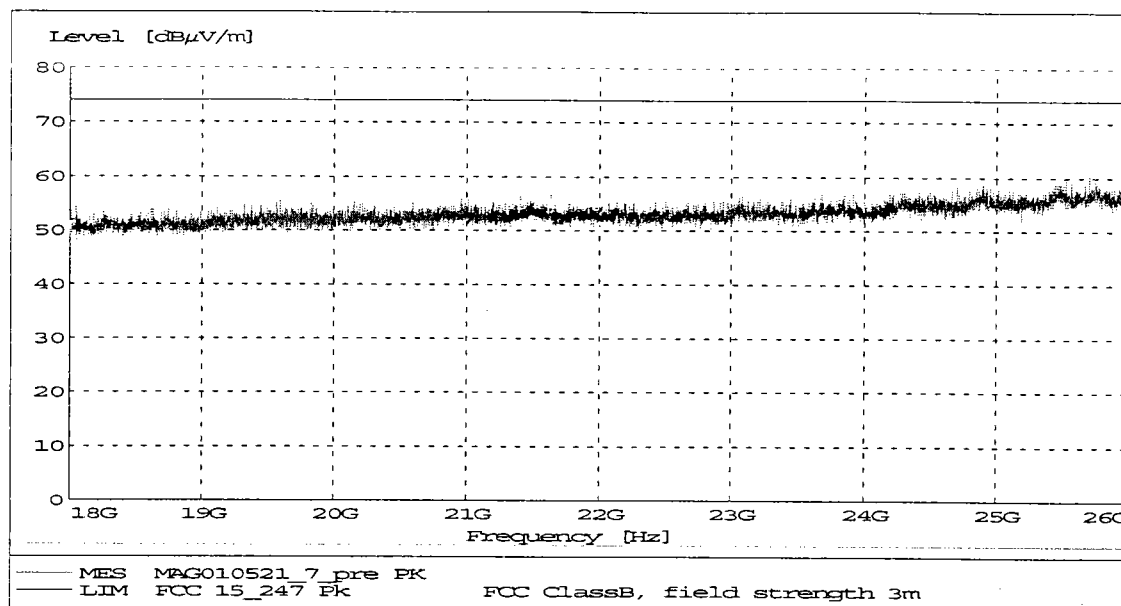
4990 – 12000 MHz Overview sweep max peek at a distance of 3 m



12000 – 18000 MHz Overview sweep max peek at a distance of 3 m

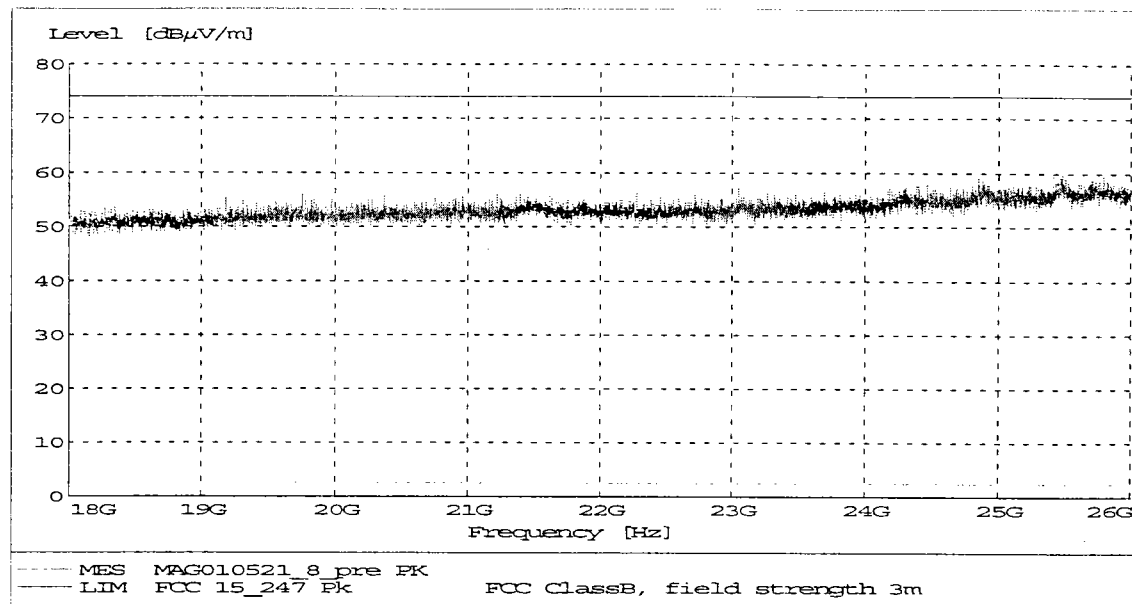


18000 – 26000 MHz Overview sweep max peek at a distance of 3 m

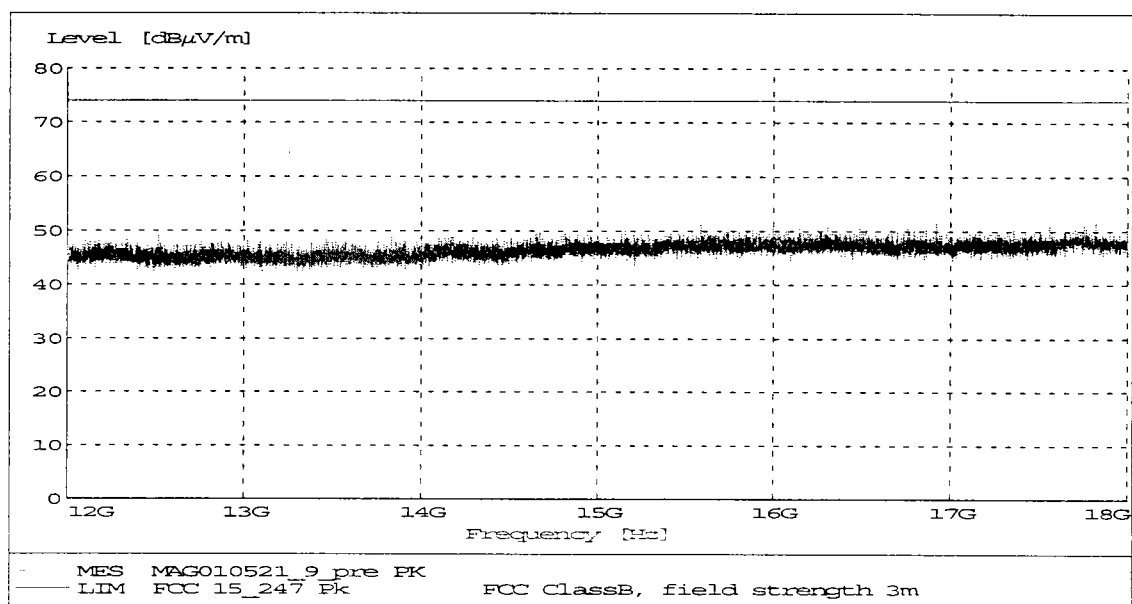


High Channel

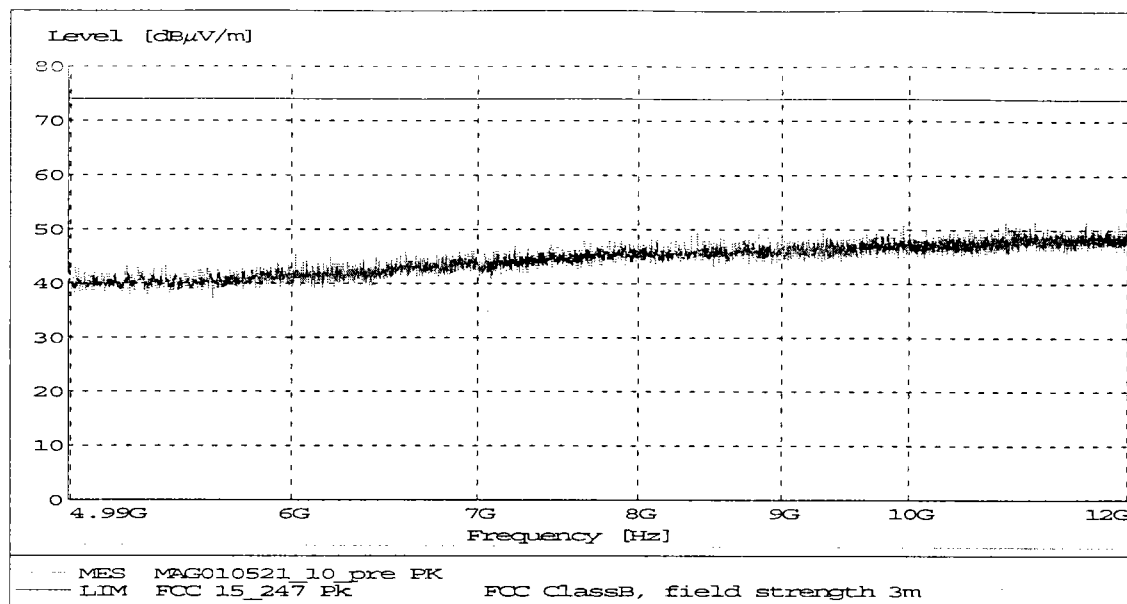
18000 – 26000 MHz Overview sweep max peek at a distance of 3 m



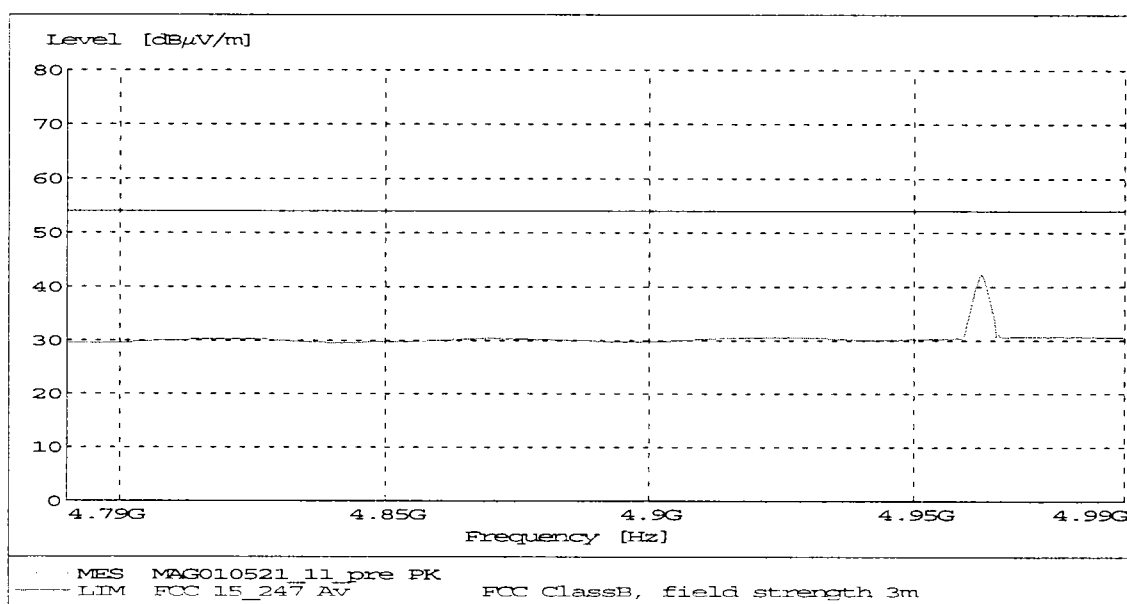
12000 – 18000 MHz Overview sweep max peek at a distance of 3 m



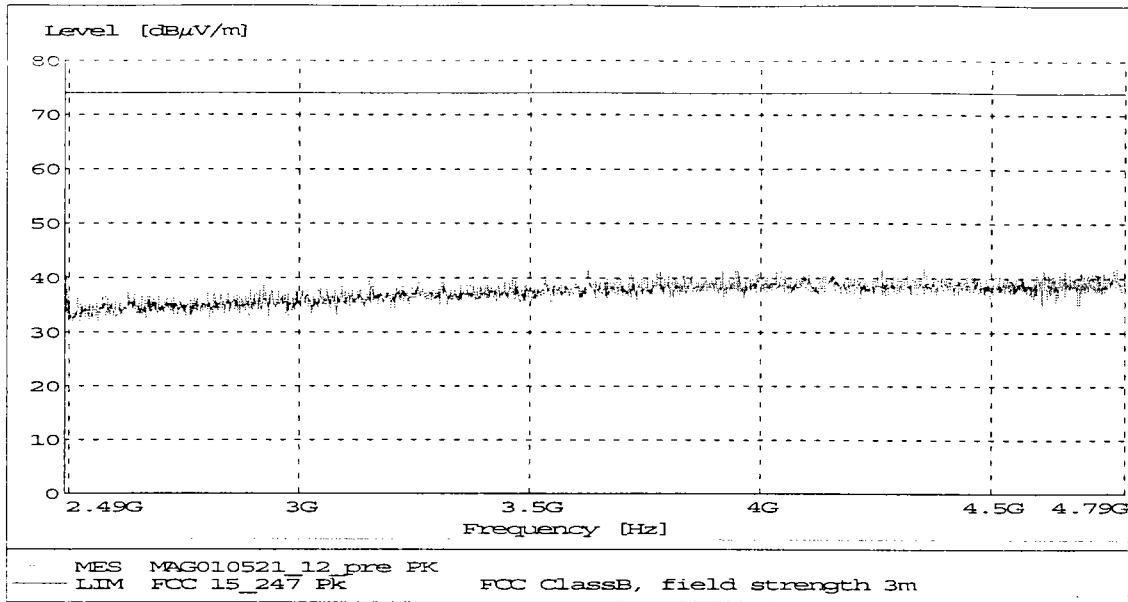
4990 – 12000 MHz Overview sweep max peek at a distance of 3 m



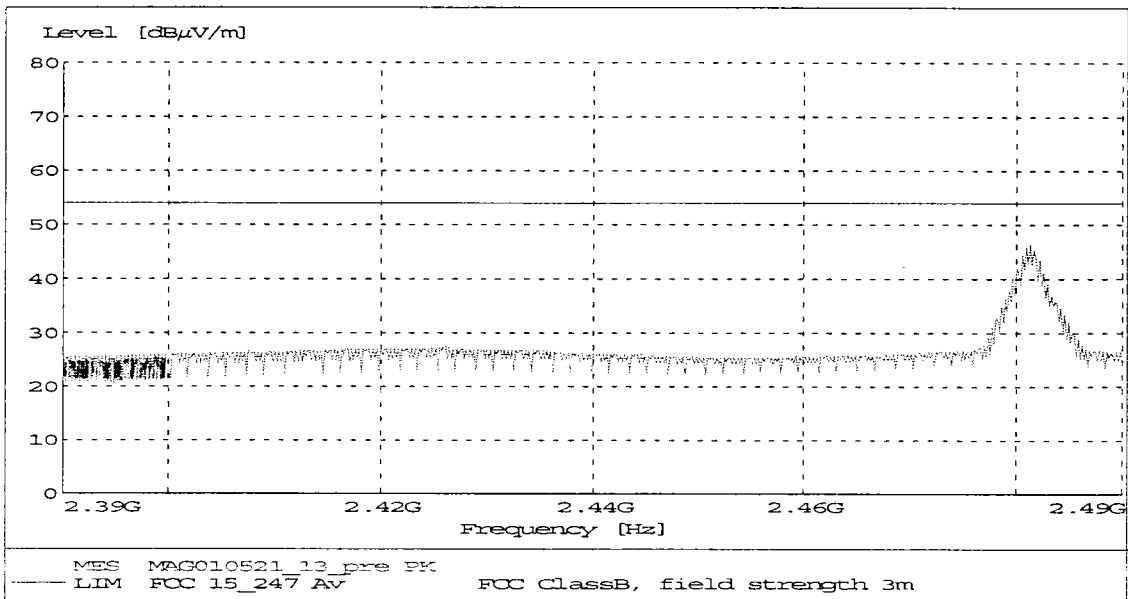
4790 – 4990 MHz Measured with 10 Hz VBW



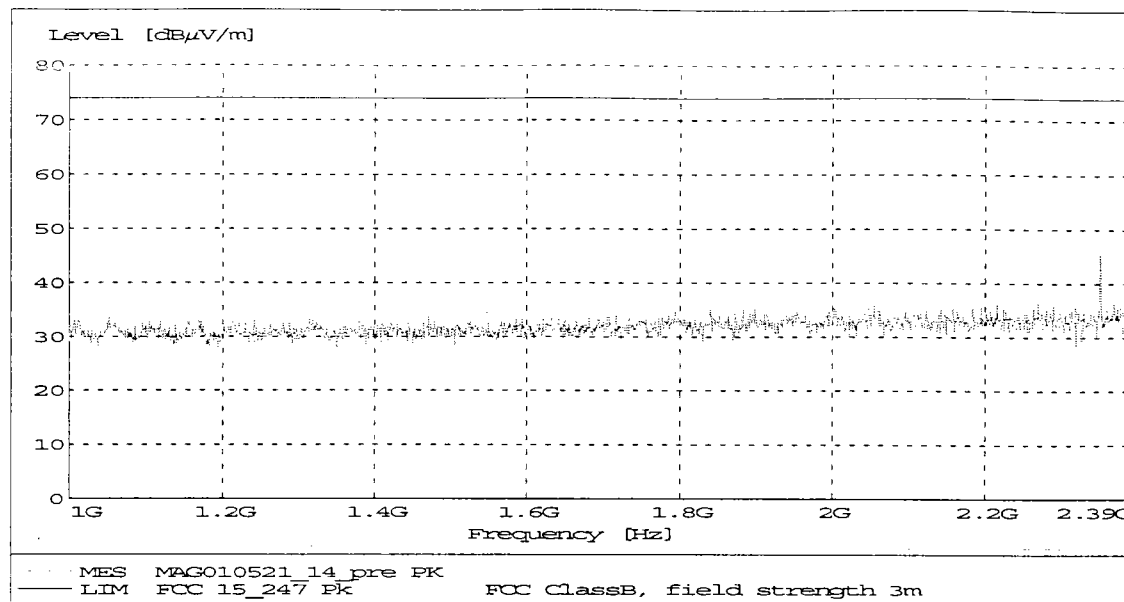
2490 – 4790 MHz Overview sweep max peek at a distance of 3 m



2390 – 2490 MHz Measured with 10 Hz VBW



1000 – 2390 MHz Overview sweep max peek at a distance of 3 m



Field strength of spurious emission. Tx test data sequence						
Frequency [MHz]	RBW [kHz]	Measured level		Limit		Note
		Peak [dBμV/m]	QP/AV [dBμV/m]	Peak [dBμV/m]	QP/AV [dBμV/m]	
30 – 88	120	<36	7	-	40	1
88 – 216	120	<35	31	-	43,5	1
216 – 960	120	<30	-	-	46	1
960 – 1000	120	<30	-	-	54	1
1000 – 2400	1000	<45	-	74	54	2
2483,5 – 4500	1000	<42	-	74	54	2
4500 – 12500	1000	<50	<42	74	54	2
12500 – 18000	1000	<52	-	74	54	2
18000 - 26000	1000	<60	-	74	54	2

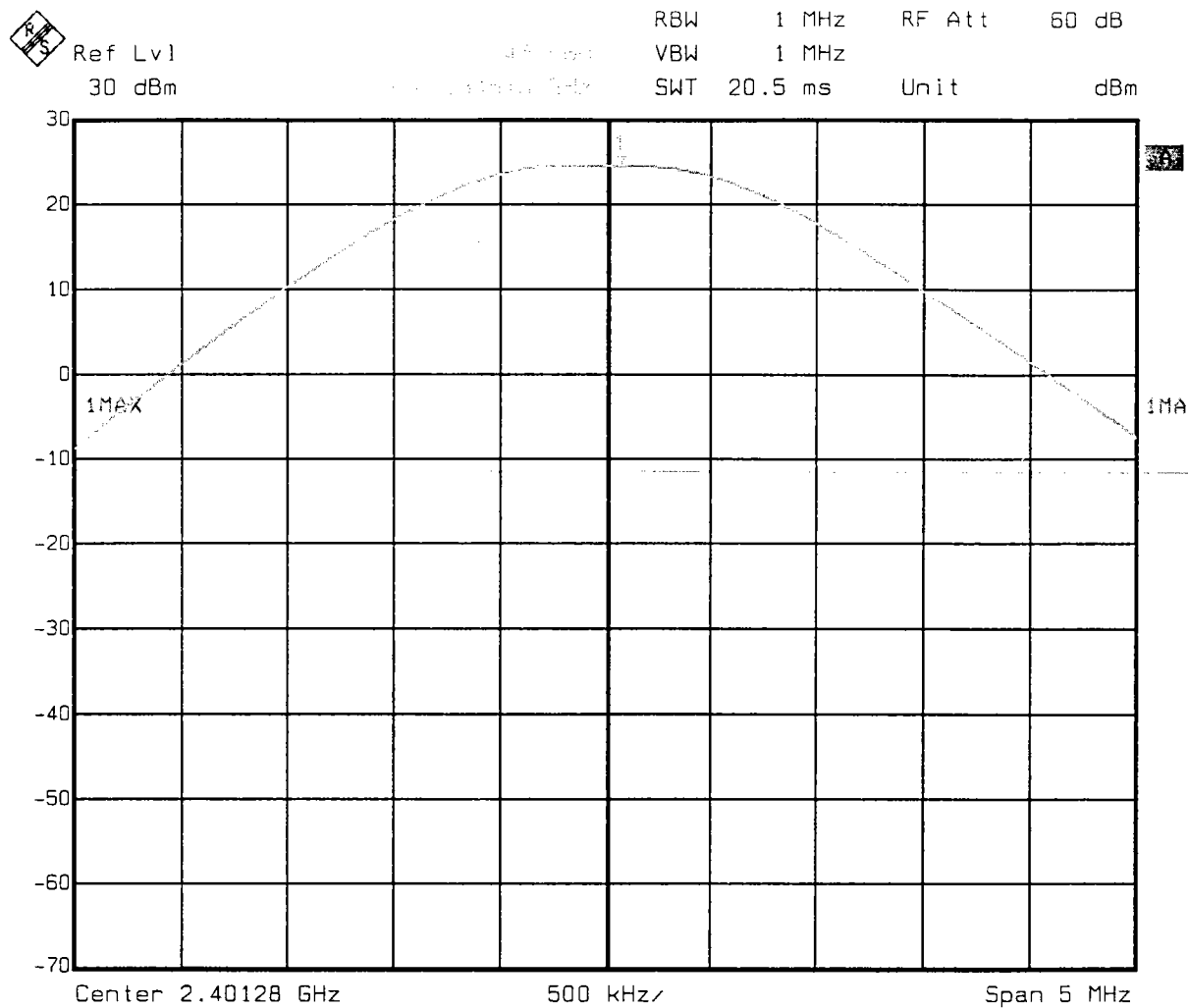
Note 1. Calculated from 10 m distance.

Note 2. Calculated from 3 m distance.

Fulfil requirements: Yes

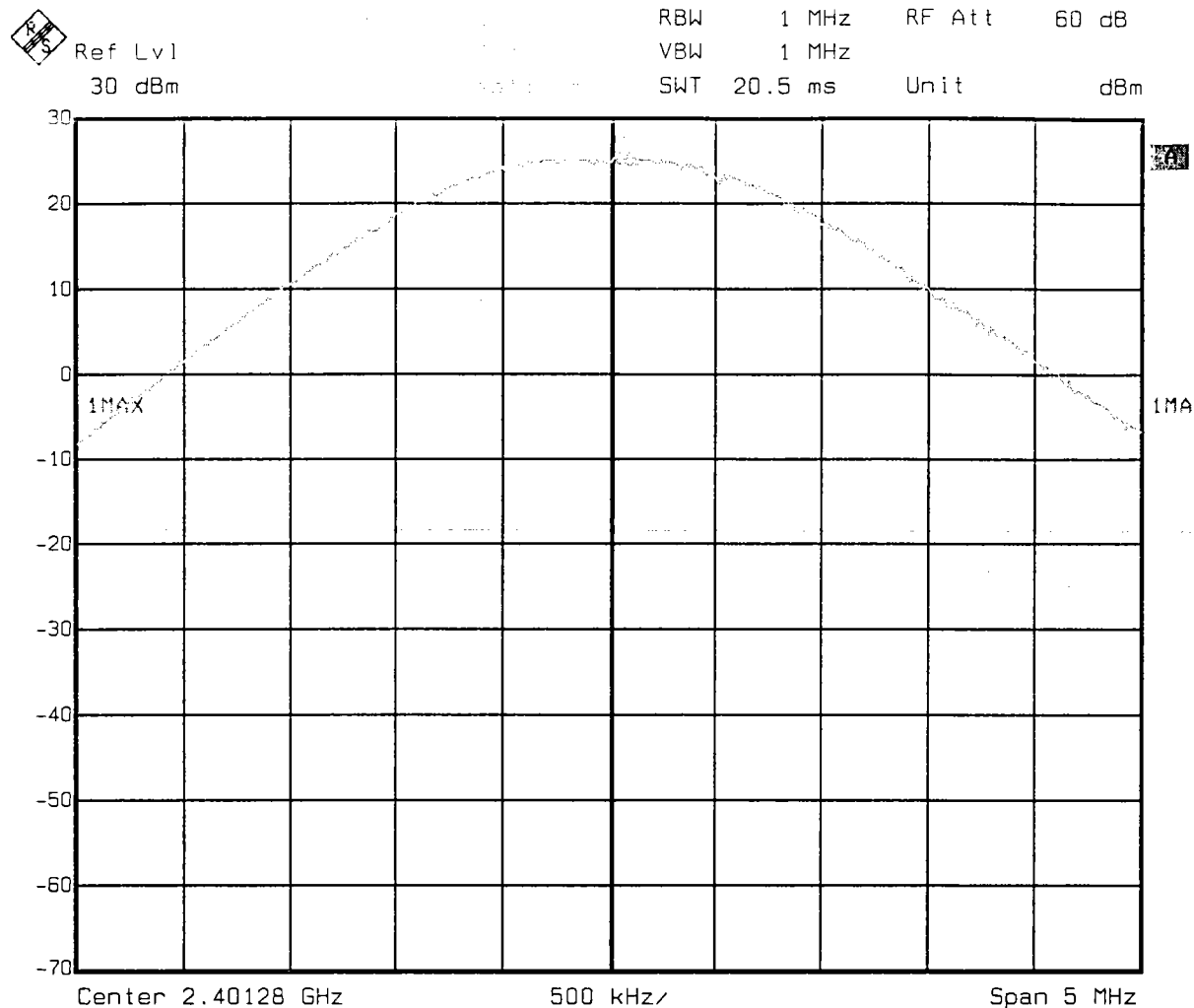
APPENDIX A

Peak output power at frequency 2401.28 MHz, +5 V DC



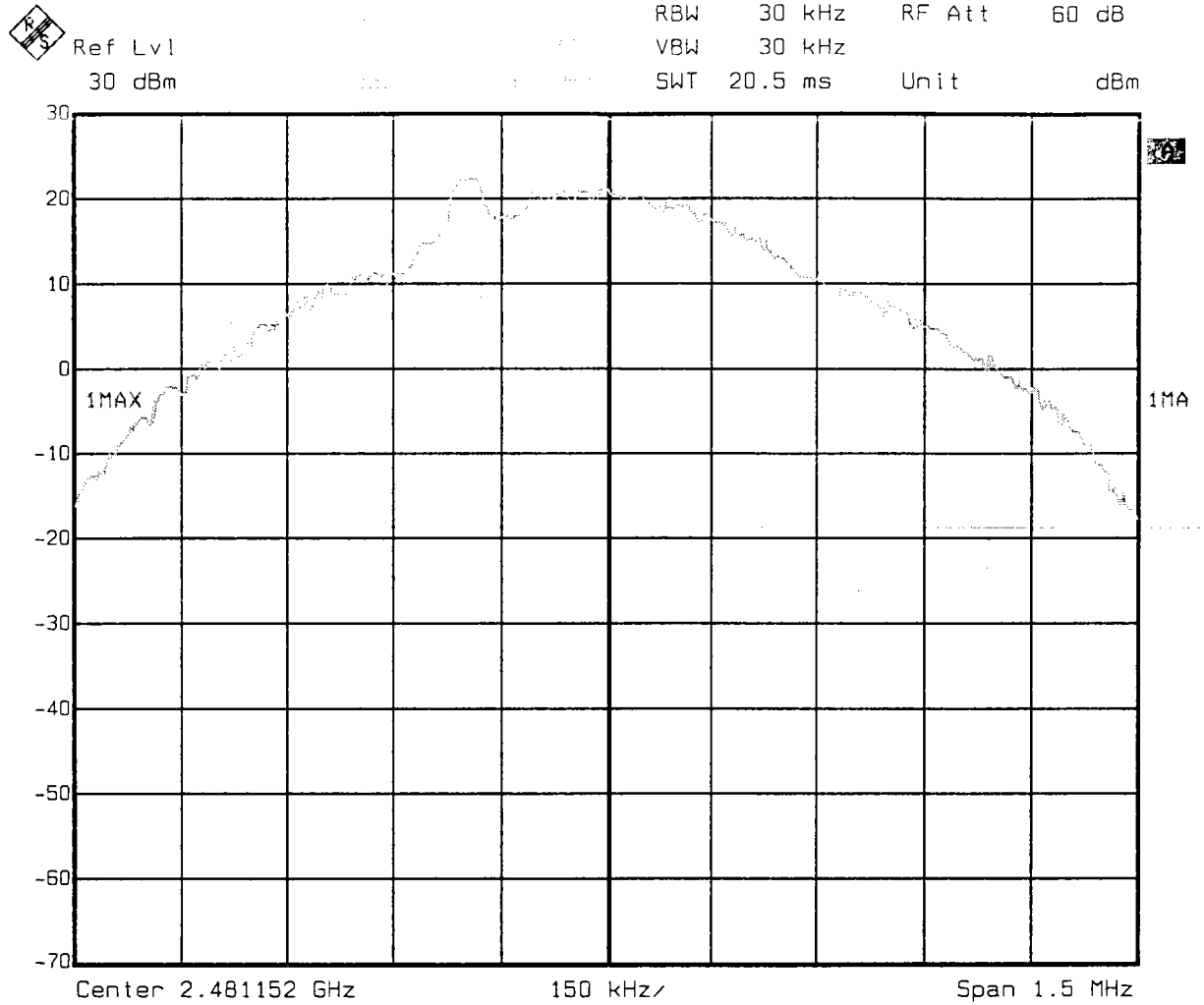
Date: 21.MAY.2001 8:47:42

Peak output power at frequency 2401,28 MHz, +5,75 V DC



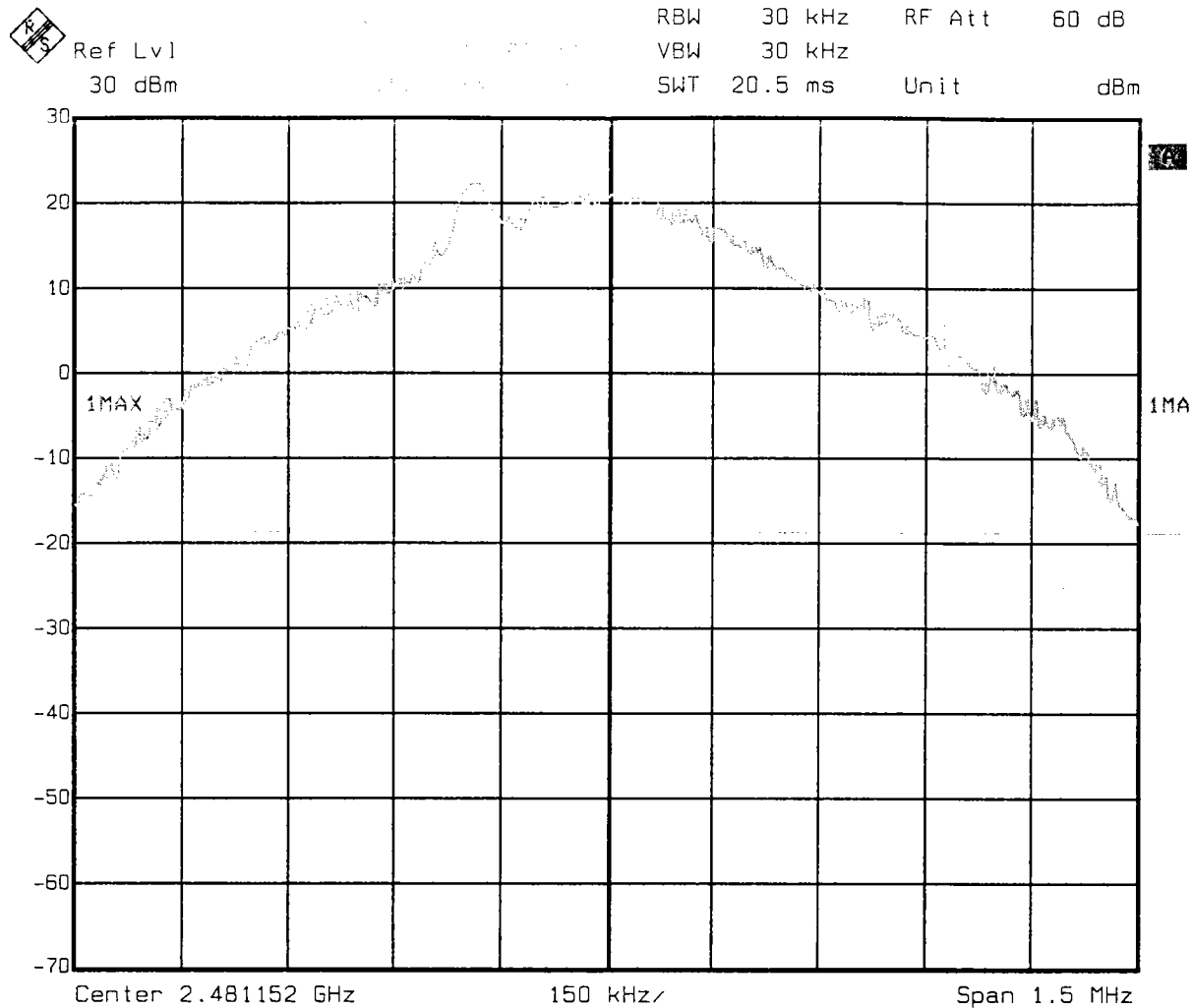
Date: 21.MAY.2001 9:03:50

TX 20 dB Bandwidth low side 2481,15 MHz, +5 V DC



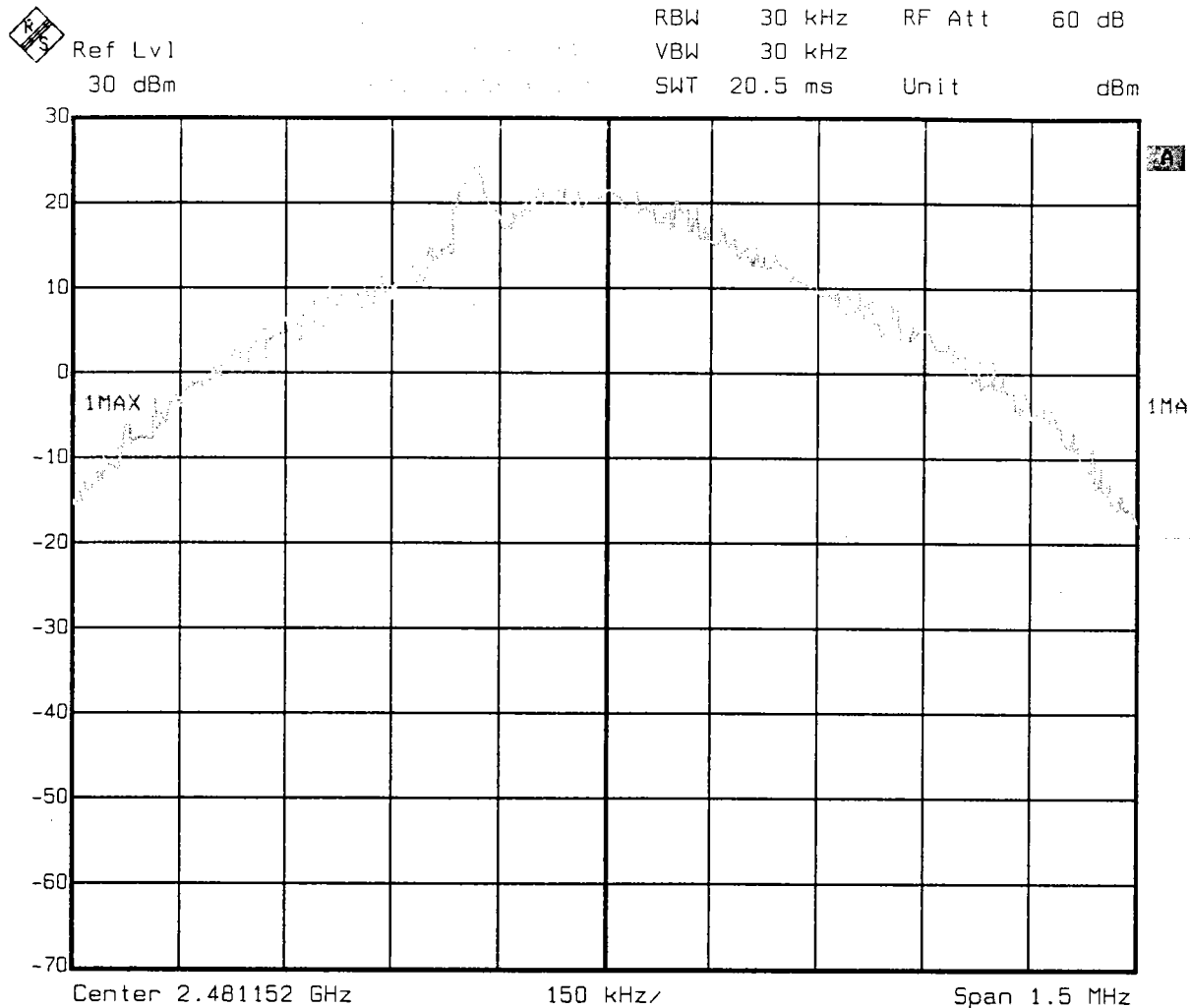
Date: 21.MAY.2001 9:25:13

TX 20 dB Bandwidth high side 2481,15 MHz, +5 V DC



Date: 21.MAY.2001 9:31:43

TX 20 dB Bandwidth low side 2481,15 MHz, +5,75 V DC



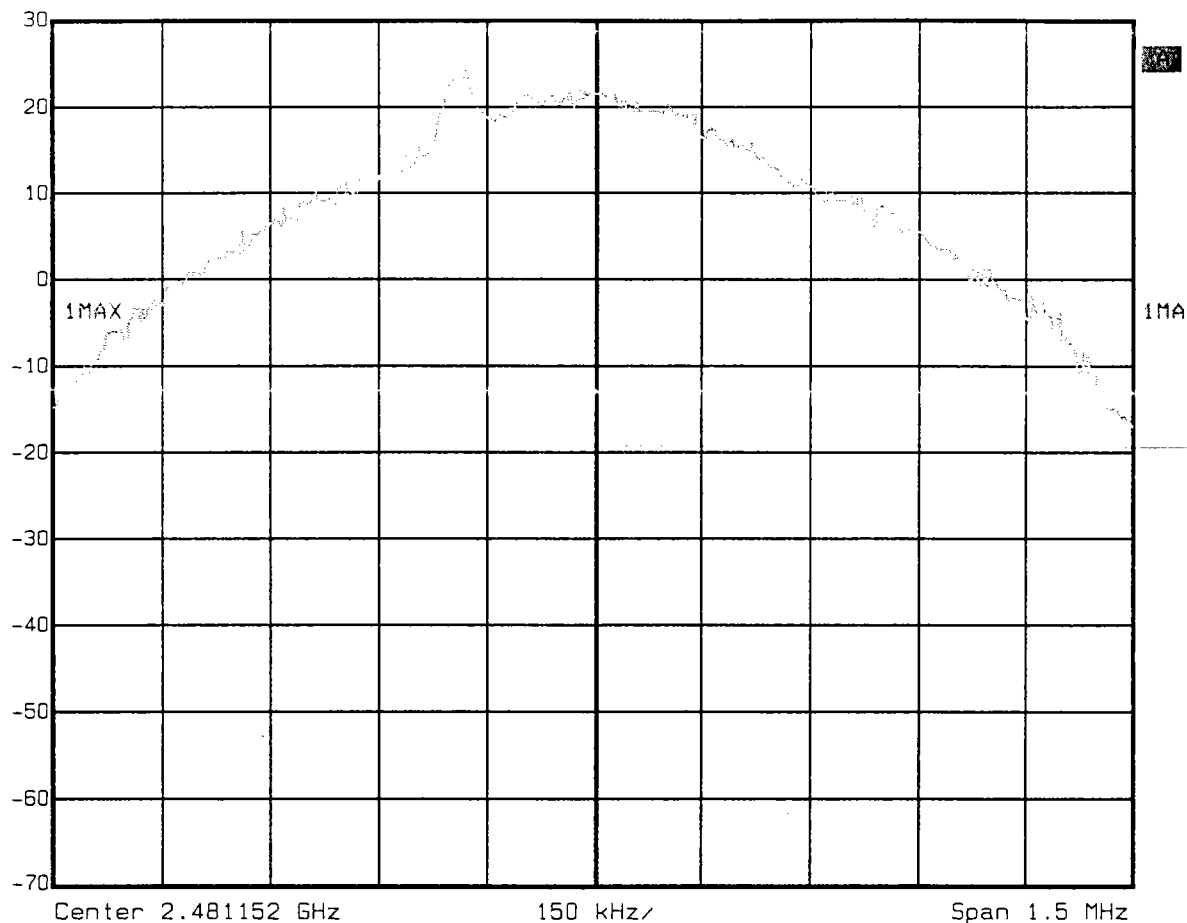
Date: 21.MAY.2001 9:34:56

TX 20 dB Bandwidth high side 2481,15 MHz, +5,75 V DC



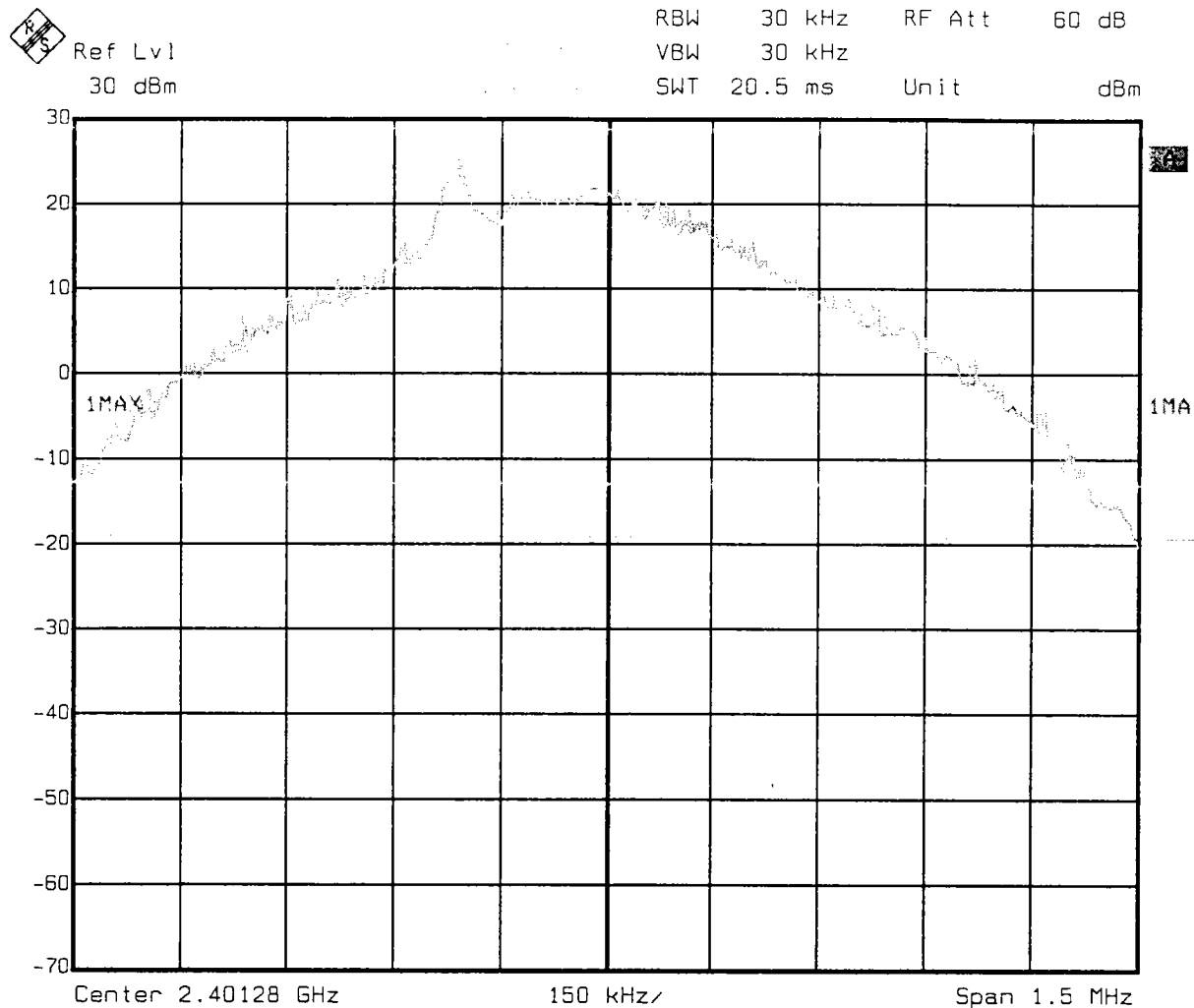
Ref Lvl
30 dBm

RBW 30 kHz RF Att 60 dB
VBW 30 kHz
SWT 20.5 ms Unit dBm



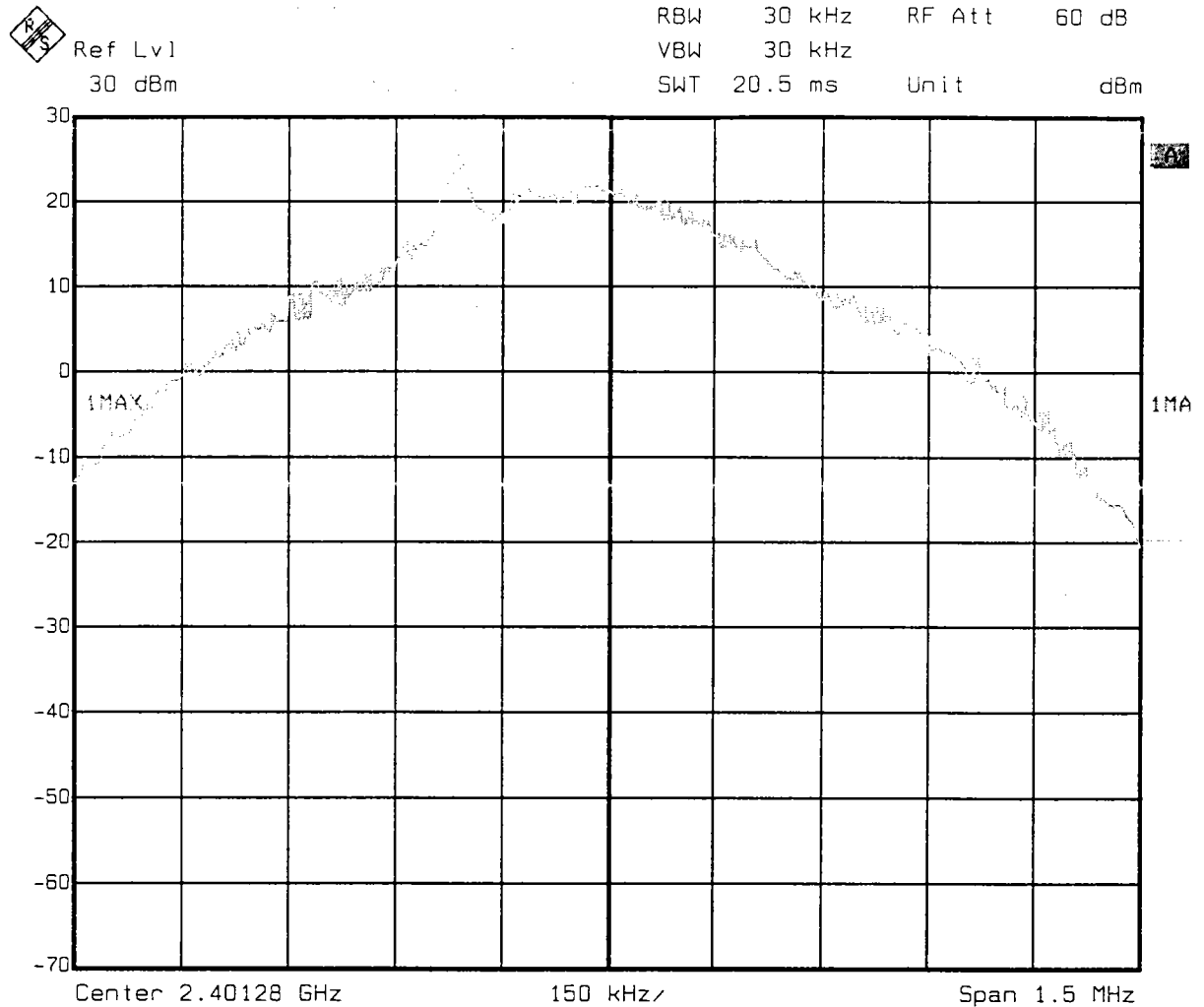
Date: 21.MAY.2001 9:37:26

TX 20 dB Bandwidth low side 2401,28 MHz, +5 V DC



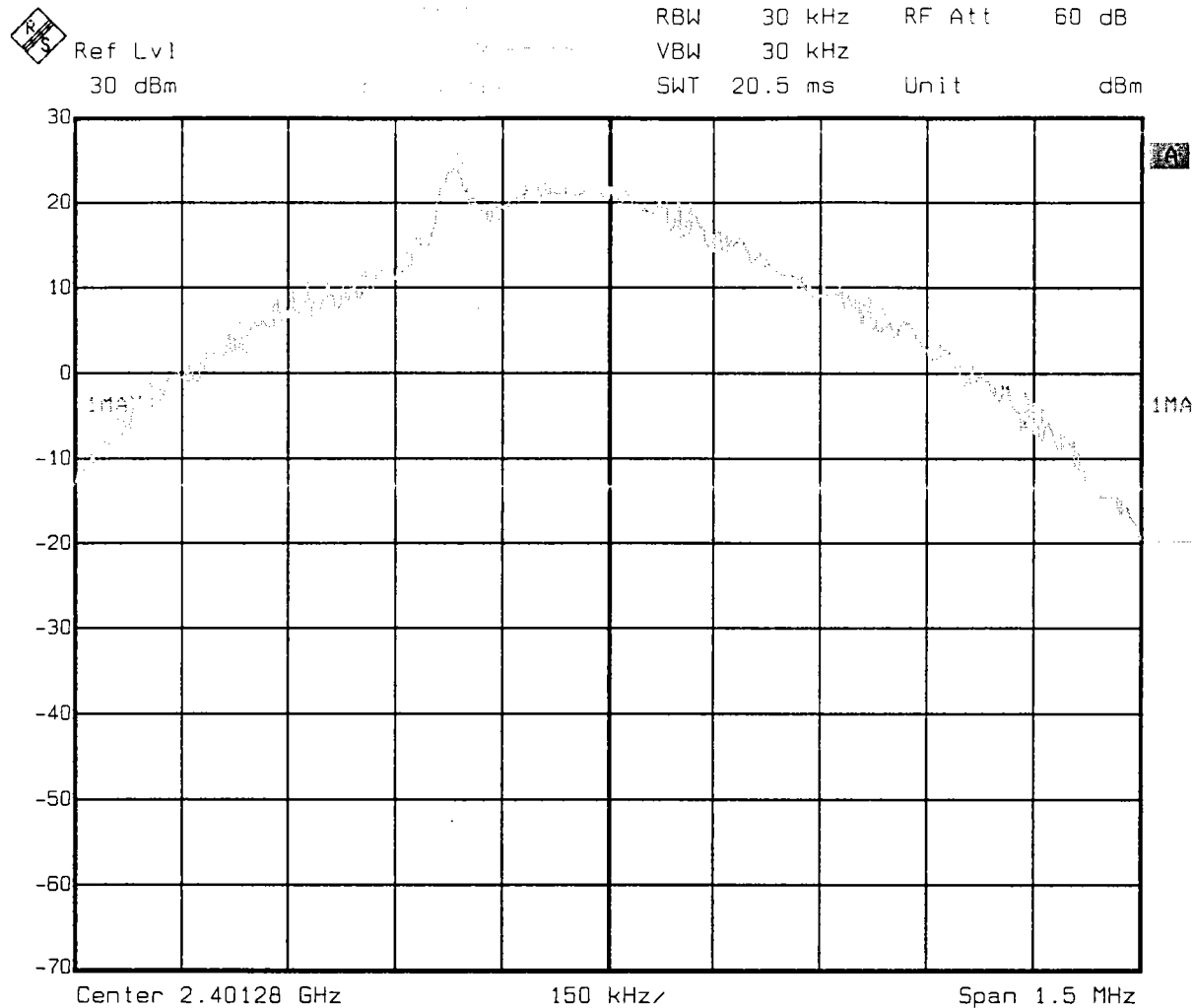
Date: 21.MAY.2001 9:41:45

TX 20 dB Bandwidth high side 2401,28 MHz, +5 V DC



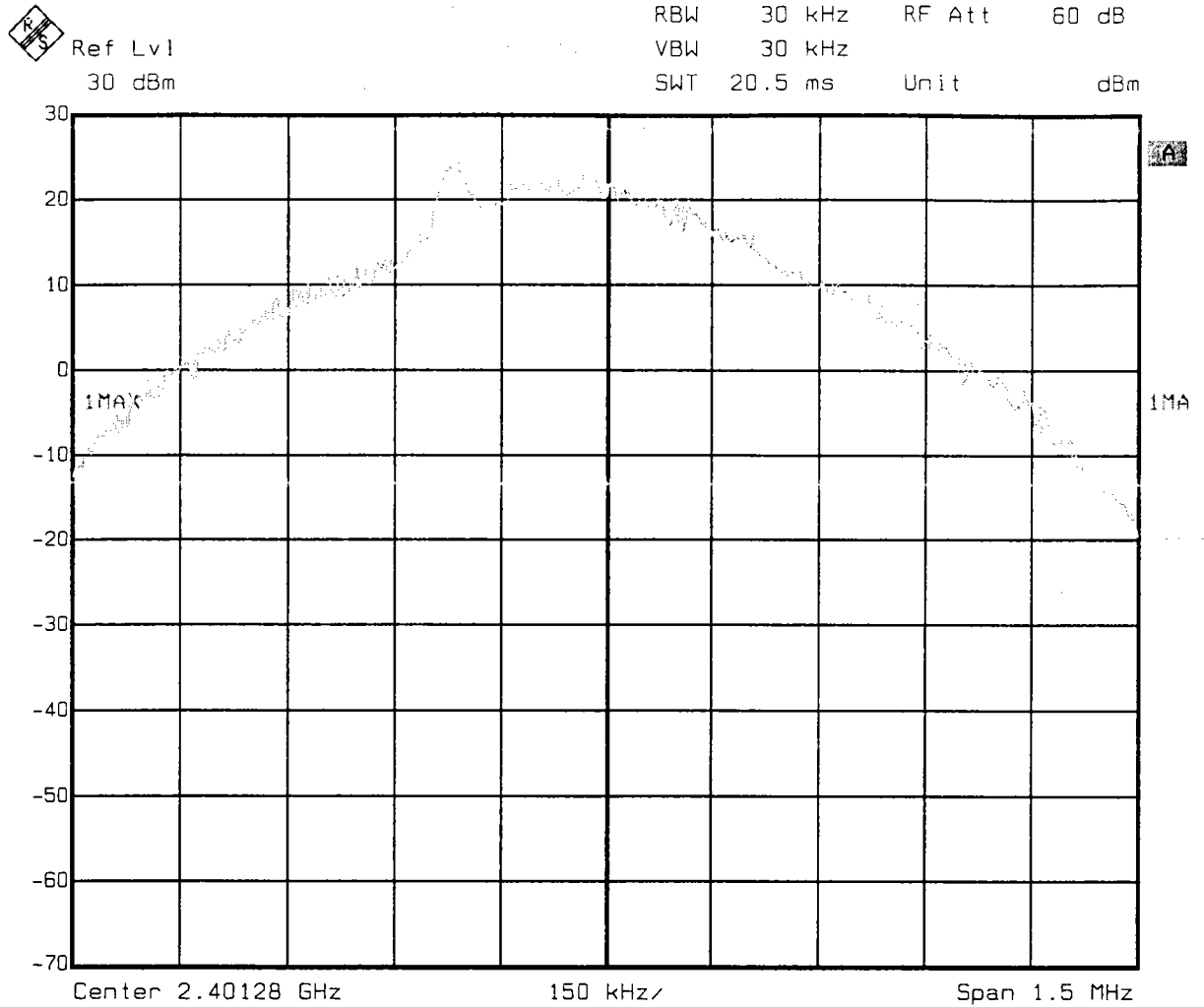
Date: 21.MAY.2001 9:42:37

TX 20 dB Bandwidth low side 2401,28 MHz, +5,75 V DC



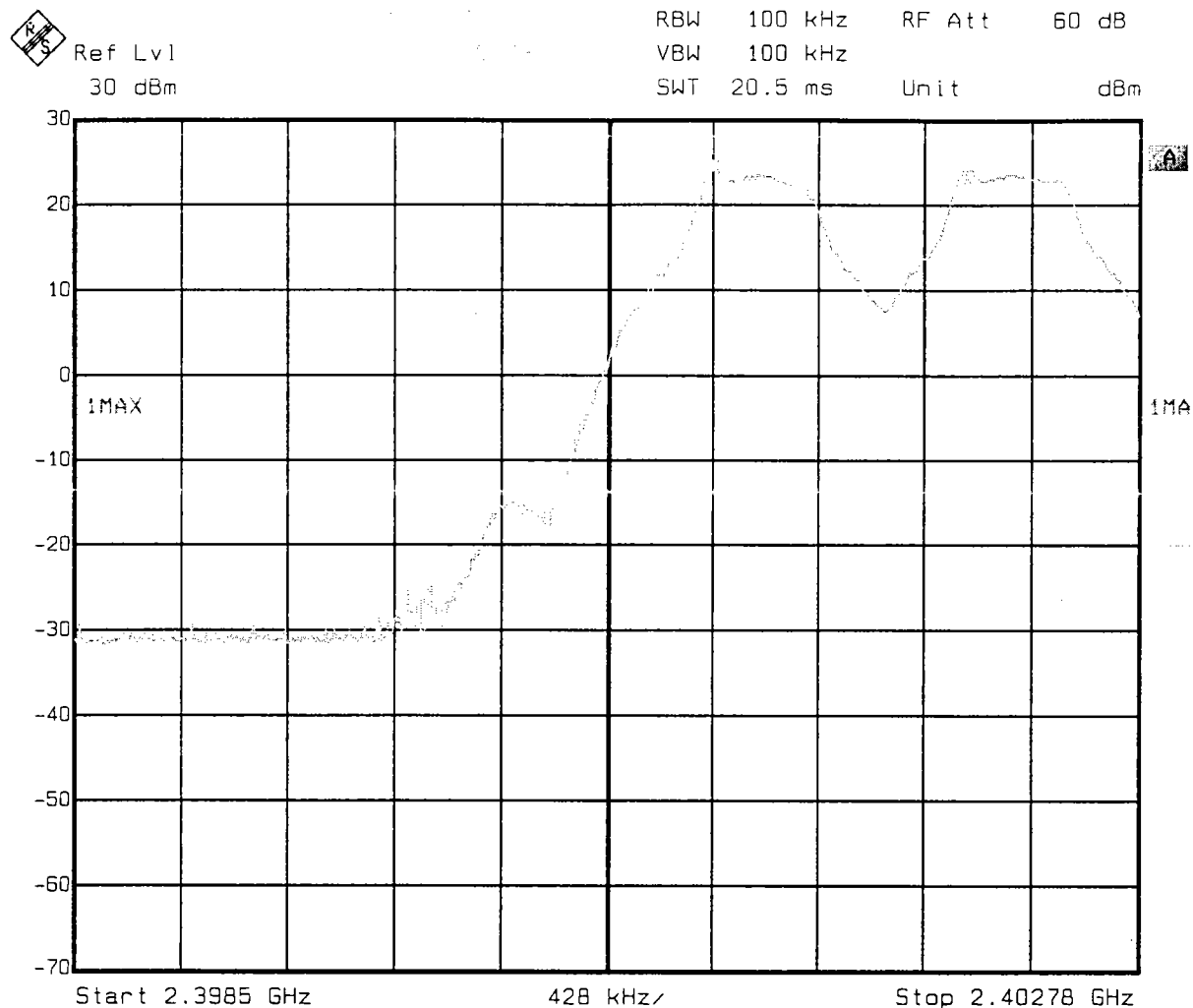
Date: 21.MAY.2001 9:44:13

TX 20 dB Bandwidth high side 2401,28 MHz, +5,75 V DC



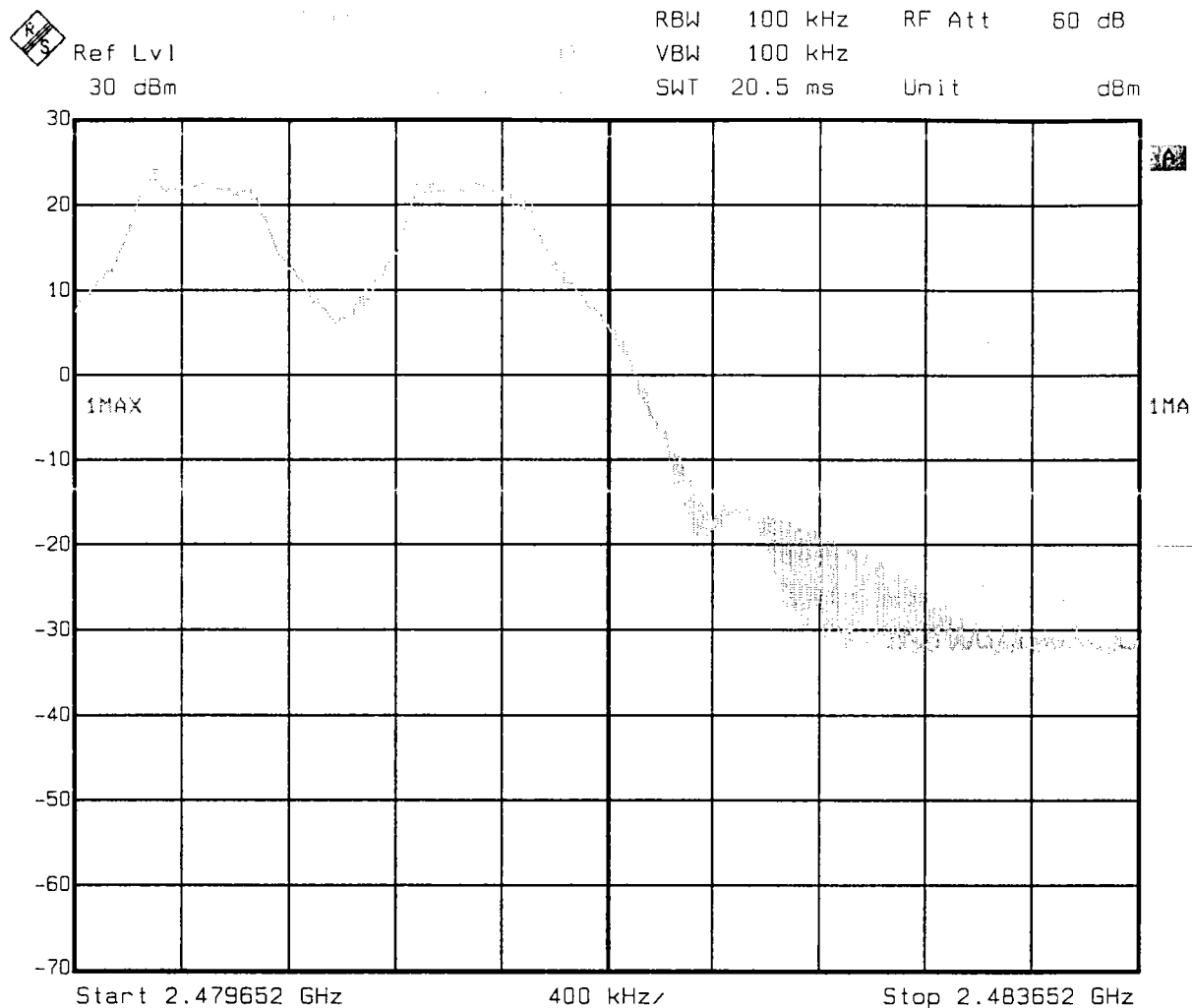
Date: 21.MAY.2001 9:45:08

Carrier frequency separation (2401,15 MHz)



Date: 21.MAY.2001 9:58:49

Carrier frequency separation (2481,15 MHz)



Date: 21.MAY.2001 10:02:35

SEMKO is part of the global network of

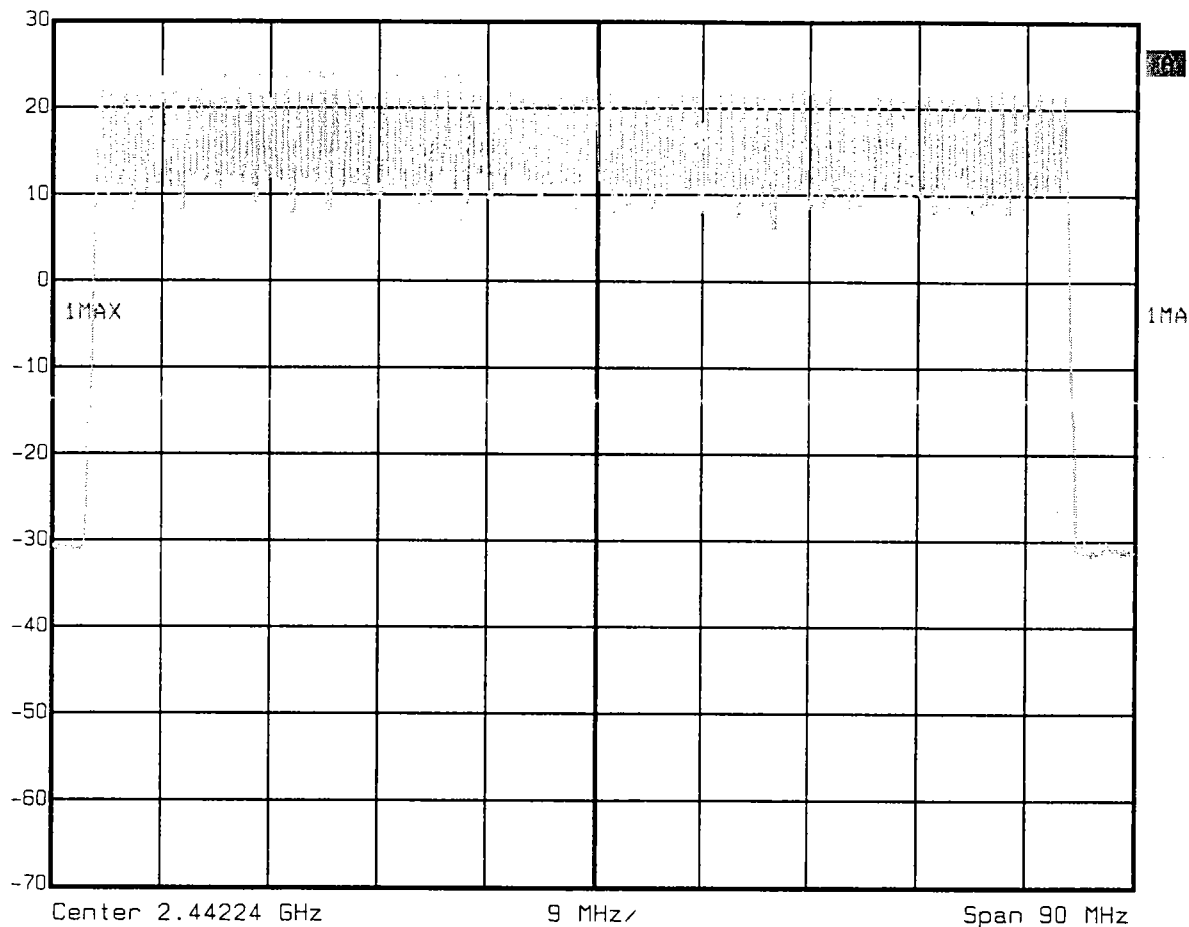
ITS Intertek Testing Services

Number of hopping channels (79)



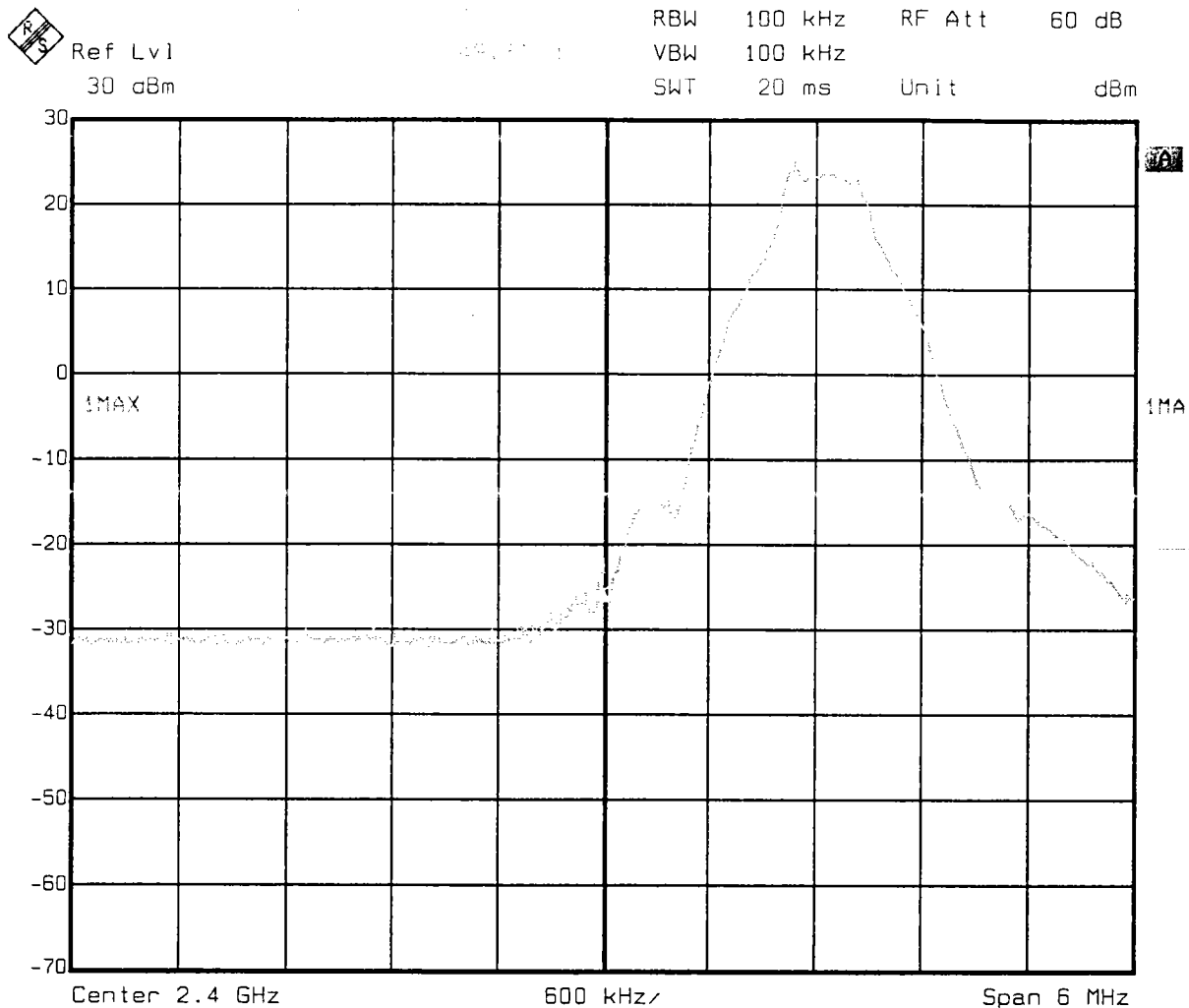
Ref Lvl
30 dBm

RBW 100 kHz RF Att 60 dB
VBW 100 kHz
SWT 25 ms Unit dBm



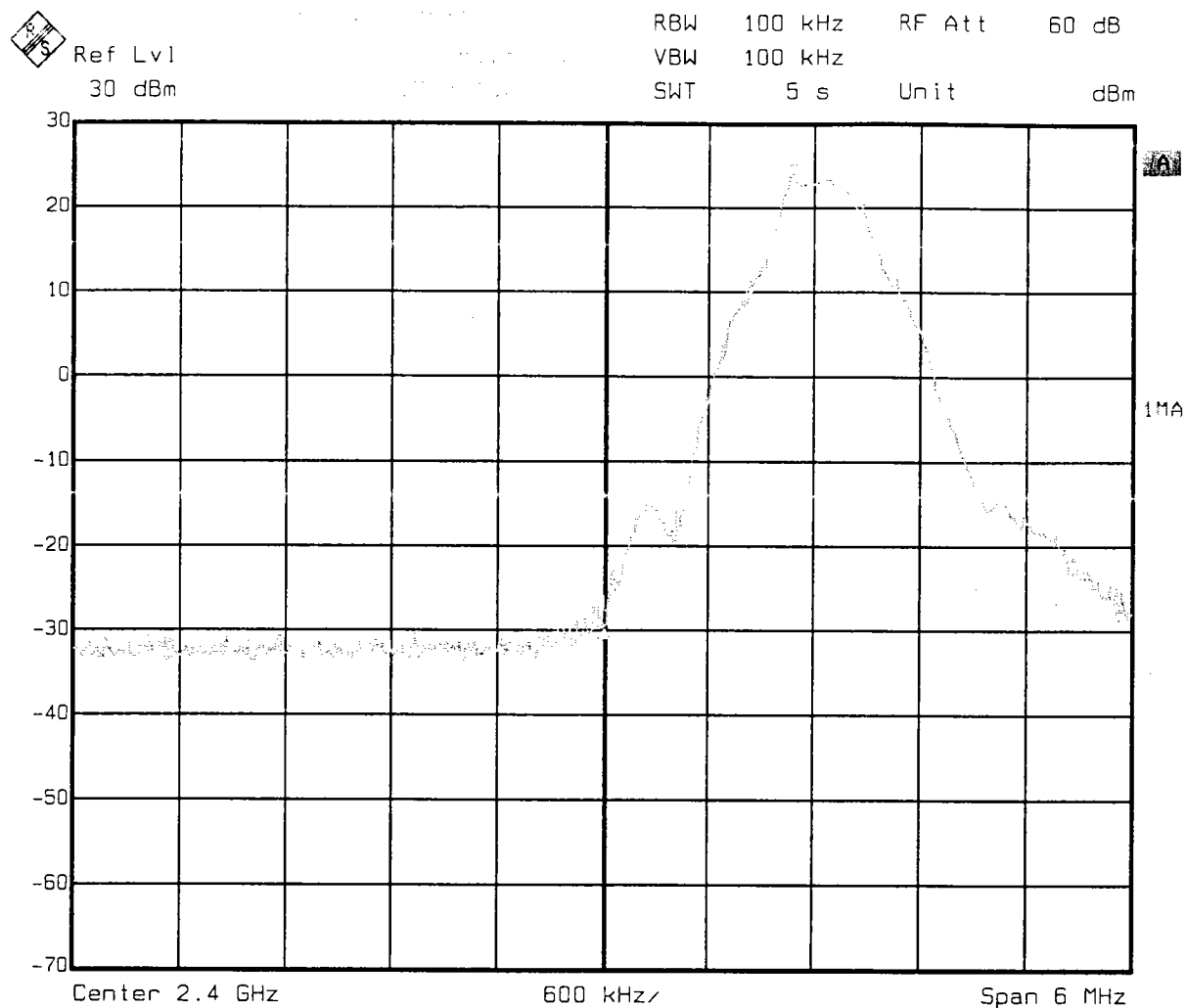
Date: 21.MAY.2001 10:26:05

Band edge compliance measured at 2400 MHz, hopping on



Date: 21.MAY.2001 10:38:42

Band edge compliance measured at 2400 MHz, hopping off

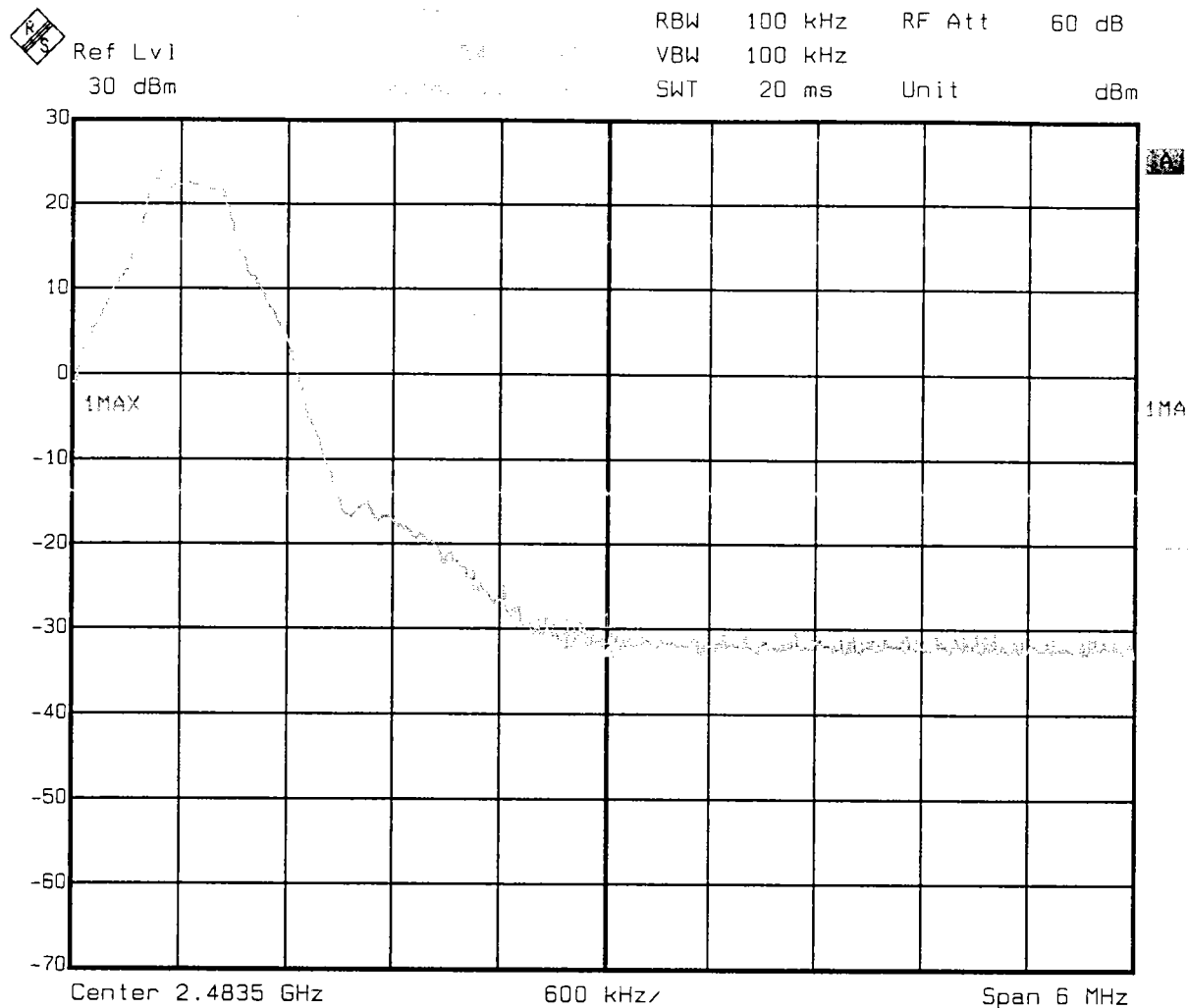


Date: 21.MAY.2001 10:45:25

SEMKO is part of the global network of

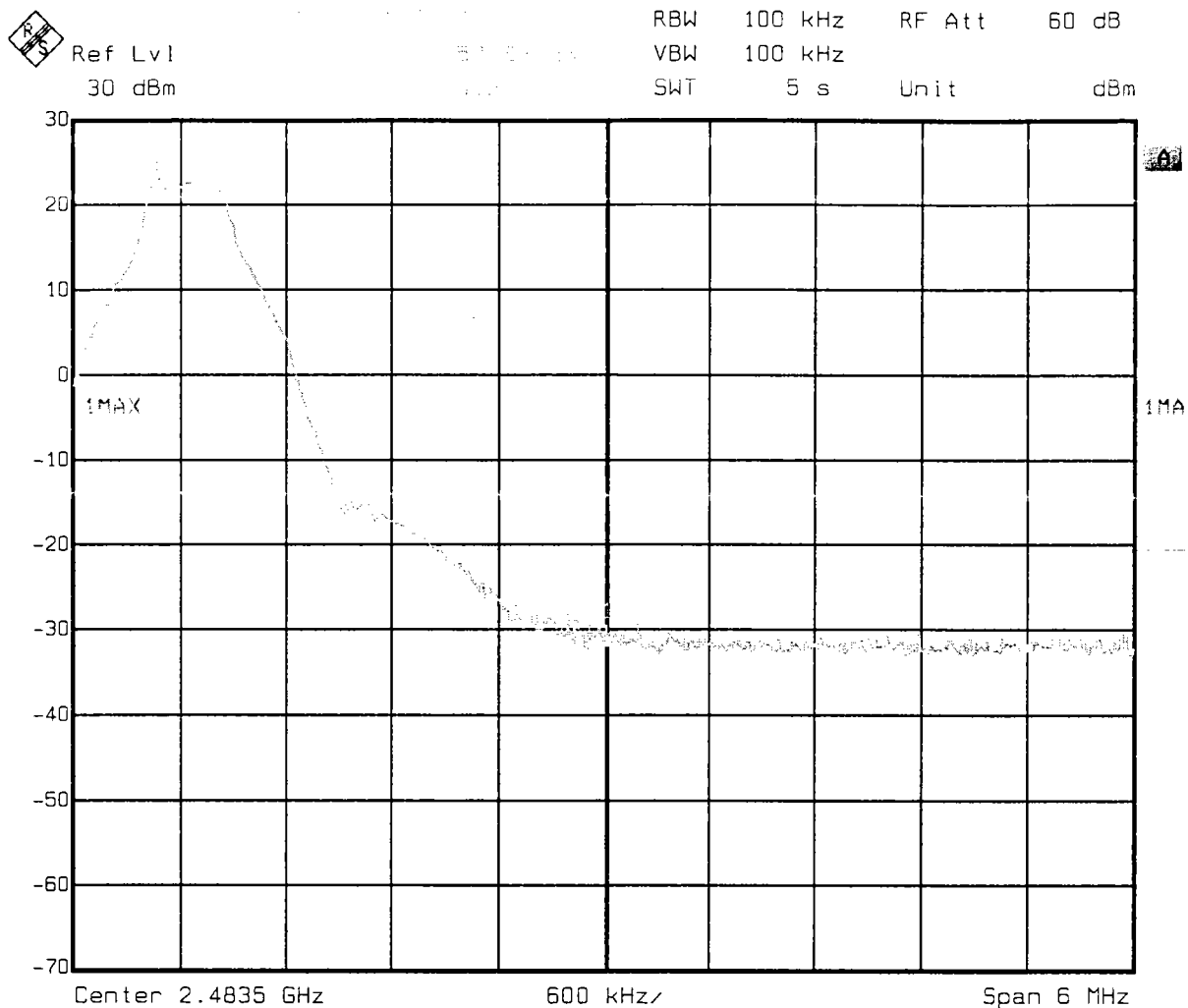
ITS Intertek Testing Services

Band edge compliance measured at 2483,5 MHz, hopping on



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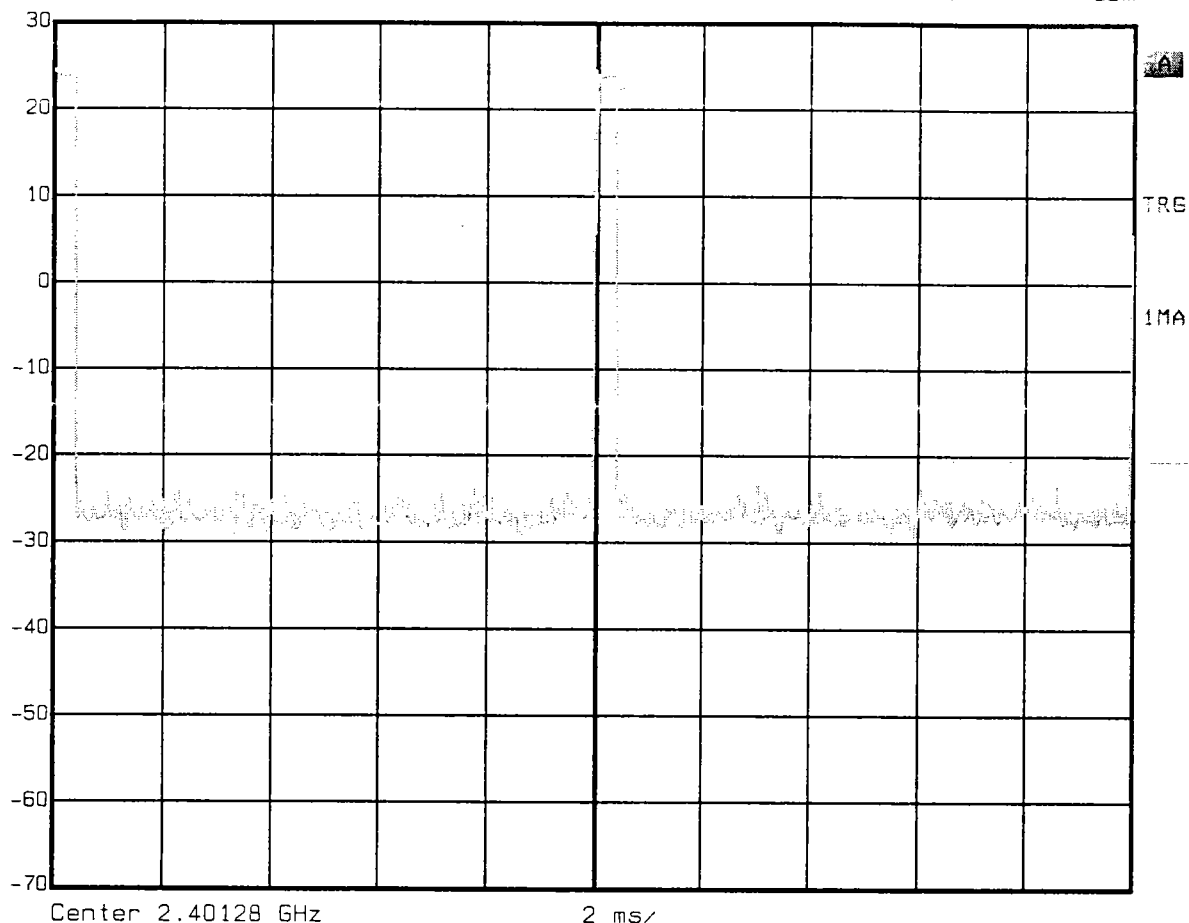
Band edge compliance measured at 2483,5 MHz, hopping off



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Time of occupancy (dwell time) (2401,28 MHz)

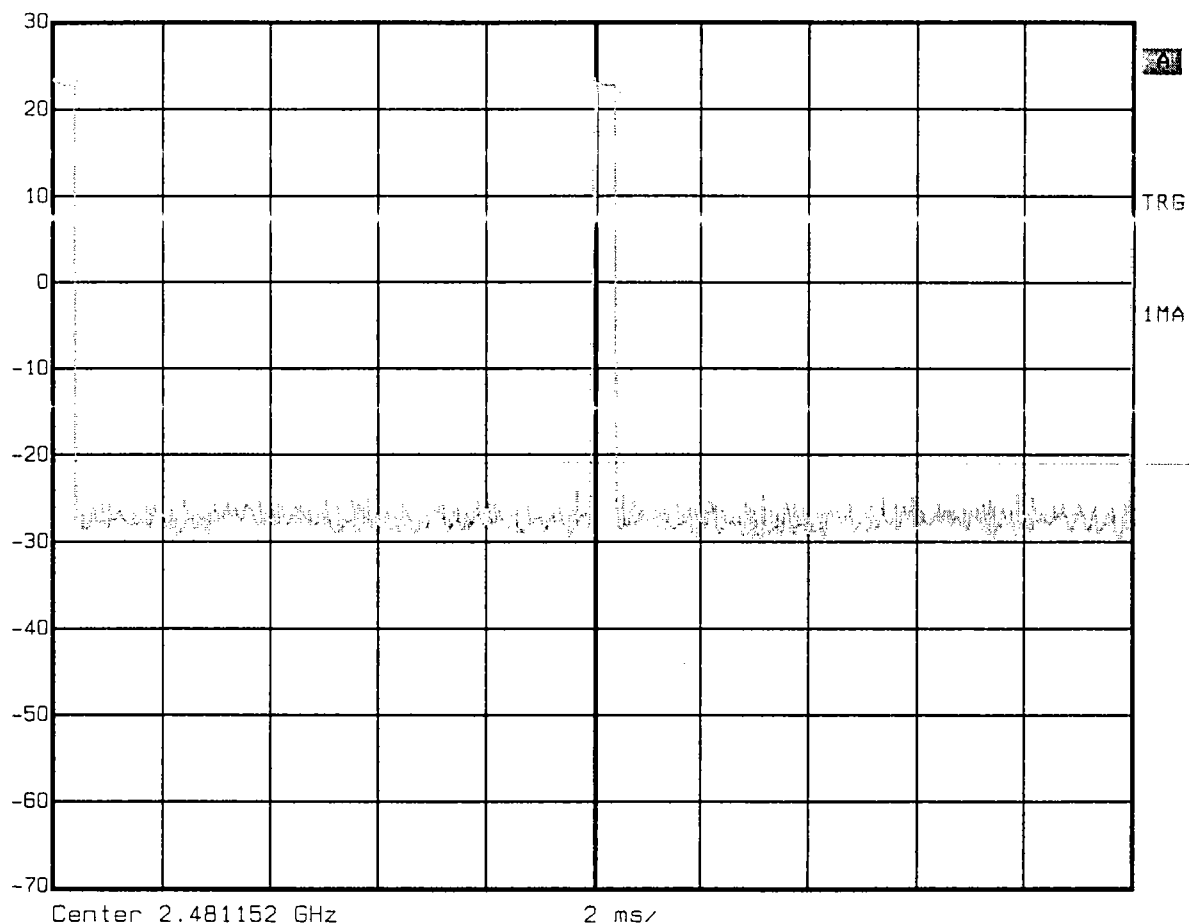
 Ref Lvl 30 dBm
 RBW 1 MHz RF Att 60 dB
 VBW 1 MHz
 SWT 20 ms Unit dBm



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Time of occupancy (dwell time) (2481,15 MHz)

 Ref Lvl 30 dBm
 RBW 1 MHz RF Att 60 dB
 VBW 1 MHz
 SWT 20 ms Unit dBm



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