

**Nemko Test Report:** 5L0656RUS1

**Applicant:** LXE, Inc.  
125 Technology Parkway  
Norcross, GA 30092

**Equipment Under Test:** RFID Radio Module

**In Accordance With:** **FCC Part 15, Subpart C, 15.247**  
Frequency Hopping Transmitters

**Tested By:** Nemko USA Inc.  
802 N. Kealy  
Lewisville, Texas 75057-3136

**Authorized By:** 

Brian Boyea, Resource Manager

**Date:** April 4<sup>th</sup> 2006

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**Section 1. Summary of Test Results**

Manufacturer: LXE, Inc.

Model No.: KDZLXERFID2

Serial No.: None

General: **All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C, Paragraph 15.247 for Frequency Hopping Spread Spectrum devices. Radiated tests were conducted in accordance with ANSI C63.4-2003. Radiated emissions are made on an open area test site. A description of the test facility is on file with the FCC.



New Submission



Production Unit



Class II Permissive Change



Pre-Production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.

See "Summary of Test Data".

**NVLAP LAB CODE: 100426-0**

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**Summary Of Test Data**

NAME OF TEST	PARA. NO.	SPEC.	RESULT
Powerline Conducted Emissions	15.207(a)	48 dB $\mu$ V	N/A Note 1
Channel Separation	15.247(a)(1)	Greater of 25 kHz or 20 dB Bandwidth	COMPLIES
Pseudorandom Hopping Algorithm	15.247(a)(1)		COMPLIES
Time of Occupancy	15.247(a)(1)(ii)	$\leq 0.4$ sec in 30 sec	COMPLIES
20 dB Occupied Bandwidth	15.247(a)(1)	$\leq 1$ MHz	COMPLIES
Peak Power Output	15.247(b)	1 Watt	COMPLIES
Spurious Emissions (Antenna Conducted)	15.247(c)	-20 dBc	COMPLIES
Spurious Emissions (Radiated)	15.247(c)	Table 15.209(a)	COMPLIES

**Footnotes:**

Note 1: Battery operated device only.

## **Section 2. Equipment Under Test (E.U.T.)**

### **General Equipment Information**

**Frequency Band:** ☒ 902 – 928 MHz  
☐ 2400 – 2483.5 MHz

**Operating Frequencies:** 902.75 to 927.25 MHz

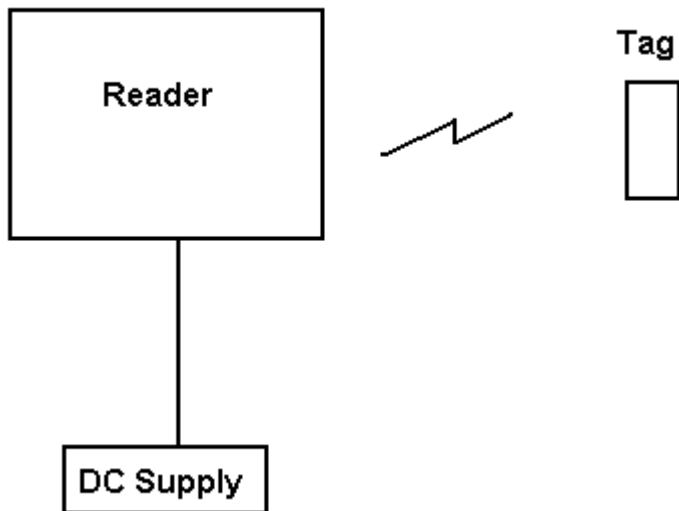
**Number of Channels:** 50

**Channel Spacing:** 500kHz

**User Frequency Adjustment:** Software controlled

**Theory of Operation**

The EUT is a RFID reader operating in the 900 MHz band.

**System Diagram**

**Section 3. Powerline Conducted Emissions**

NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: 15.207(a)
TESTED BY:	DATE:

**Test Results:** Not Applicable

**Measurement Data:** Not Applicable .

**Equipment Used:**

**Measurement Uncertainty:** +/- 1.7 dB

**Temperature:** °C

**Relative Humidity:** %

**Section 4. Channel Separation/Number of Channels**

NAME OF TEST: Channel Separation/Number of Channels	PARA. NO.: 15.247(a)(1)
TESTED BY: Kevin Rose	DATE: December 16, 2005

**Test Results:** Complies.

**Measurement Data:** See 20 dB BW plot 50 Hopping Channels  
Measured 20 dB bandwidth: 329.7  
Channel Separation: 500kHz

**Equipment Used:** 1036,1477, 1472, 1081 with a cable provided by the customer mmcx to N TYPE with a loss of 0.7db

**Measurement Uncertainty:** +/- 1.7 dB

**Temperature:** 22°C

**Relative Humidity:** 29%

## Channel separation



Delta 1 [T1]

RBW 200 kHz

RF Att

20 dB

Ref Lvl

-0.02 dB

VBW 200 kHz

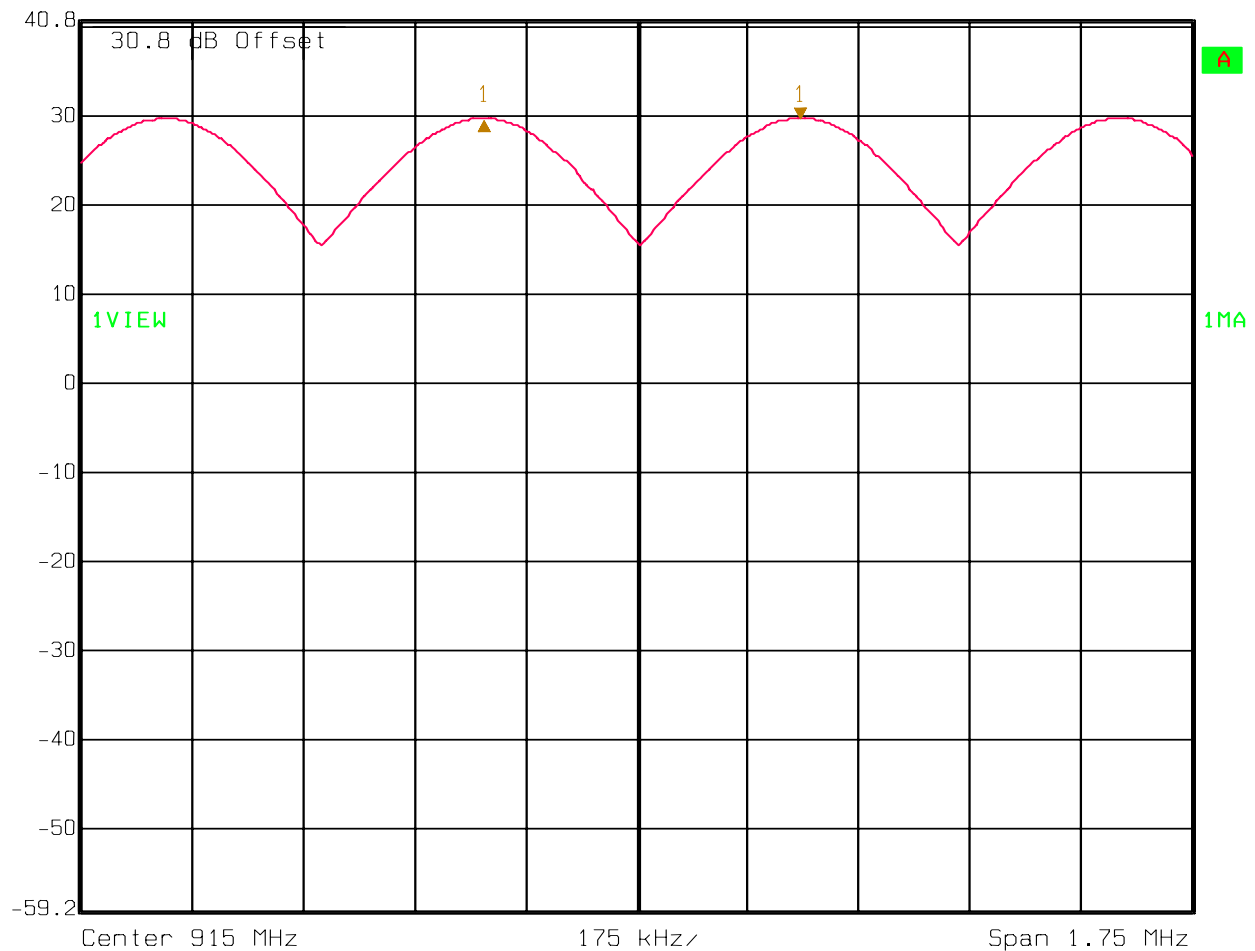
40.8 dBm

-497.99599198 kHz

SWT 5 ms

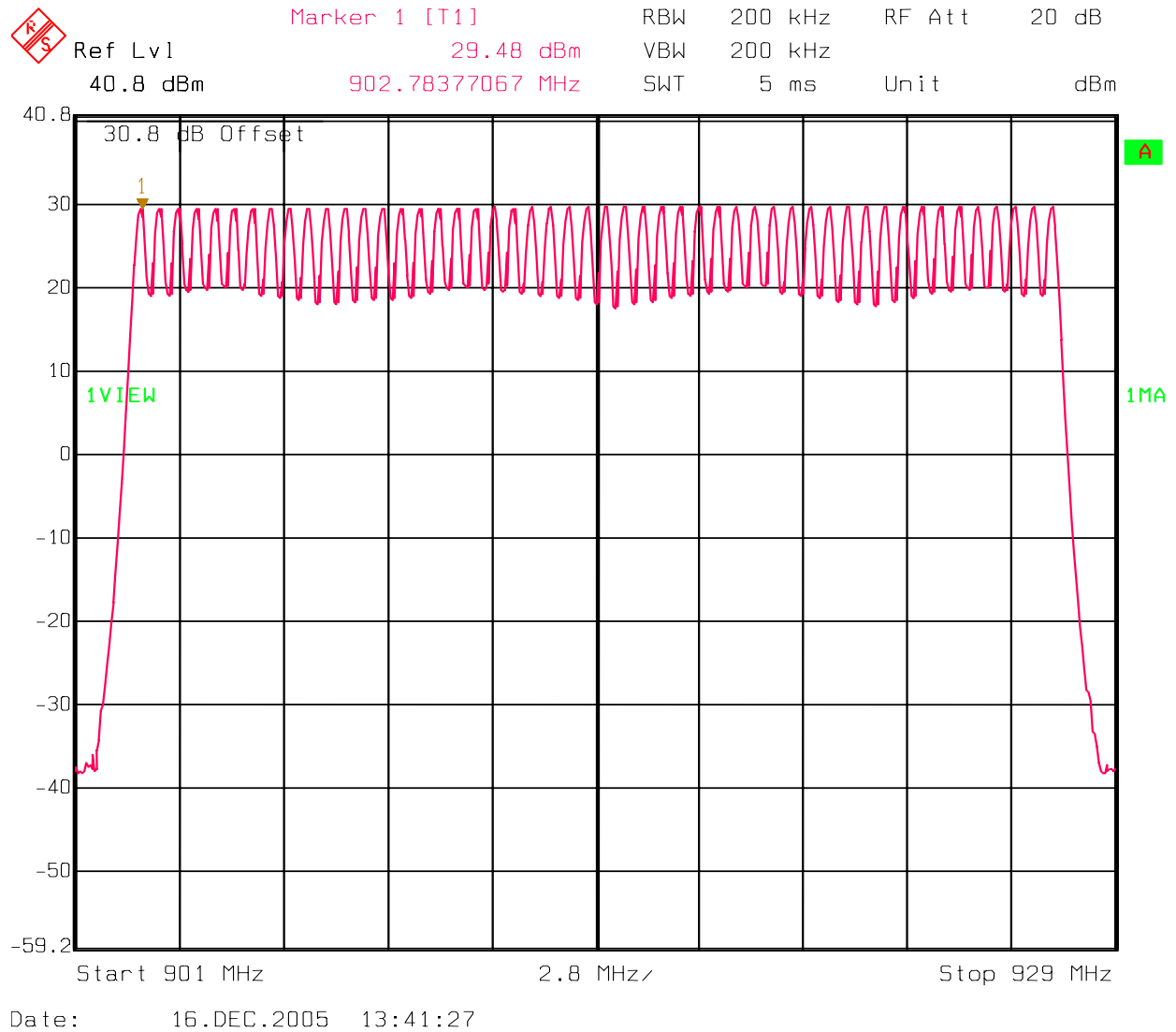
Unit

dBm



Date: 16.DEC.2005 13:42:45

## Number of hopping channels



**Section 5. Pseudorandom Hopping Algorithm**

NAME OF TEST: Pseudorandom Hopping Algorithm	PARA. NO.: 15.247(a)(1)
TESTED BY:	DATE:

**Test Results:** Complies. Supplied by Customer in additional documentation

**Measurement Data:** See sample hopping sequence.  
Number of Hopping Frequencies:  
Number of Hopping Patterns:

**Section 6. Time of Occupancy**

NAME OF TEST: Time of Occupancy	PARA. NO.: 15.247(a)(1)
TESTED BY: Kevin Rose	DATE: December 16, 2005

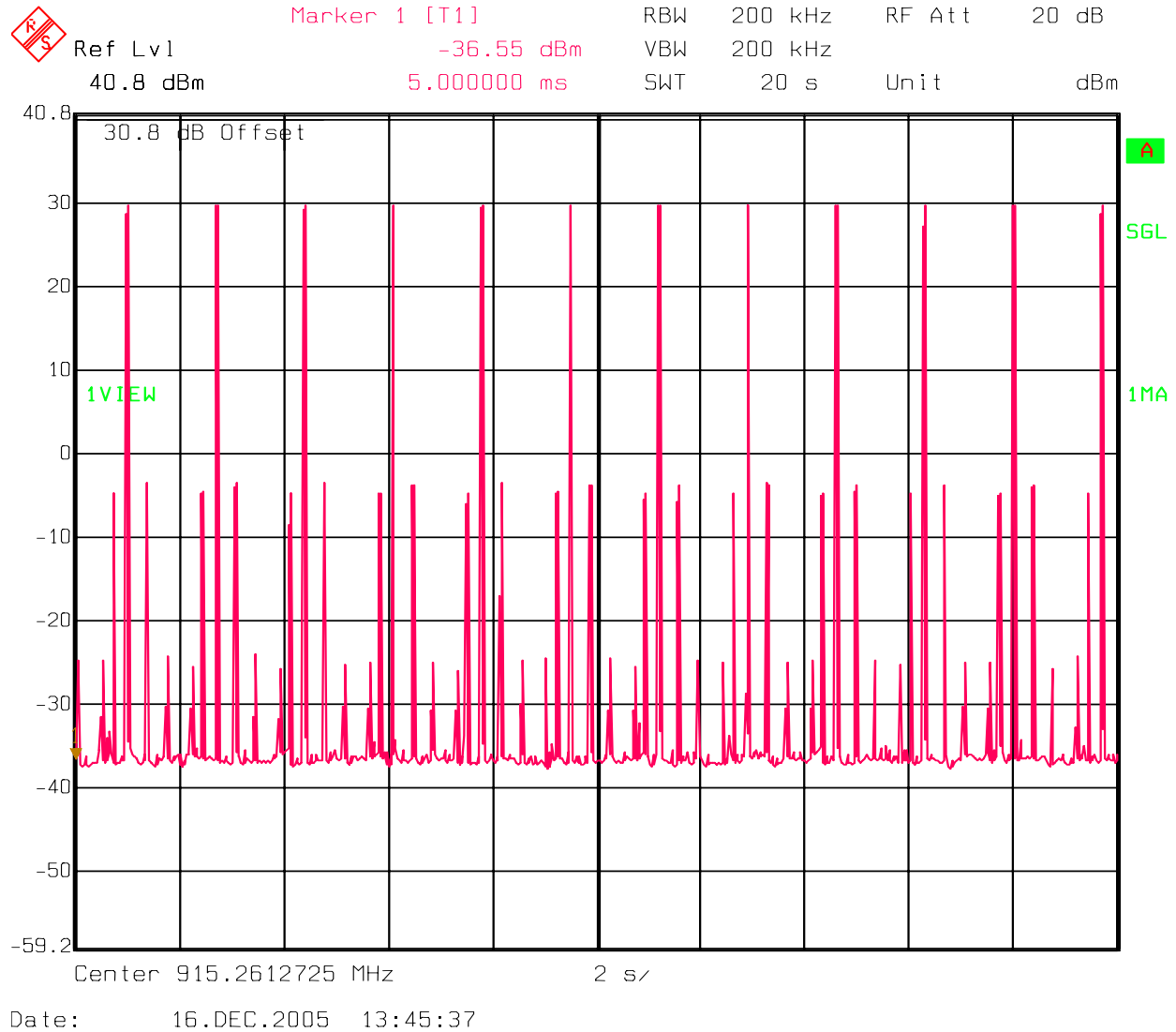
**Test Results:** Complies.

**Measurement Data:**

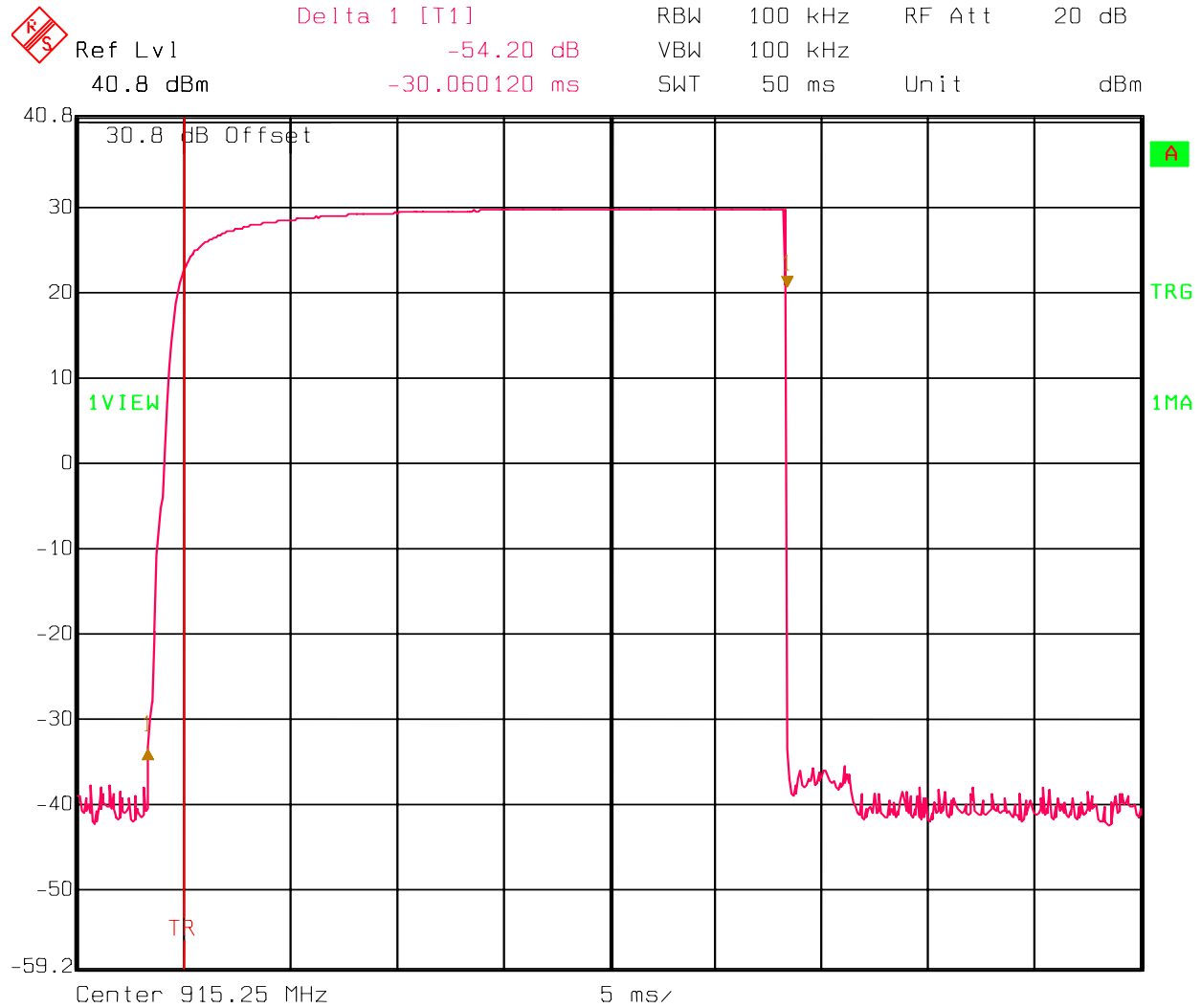
Maximum Dwell Time On Any Channel: 360.72 ms

**Equipment Used:** 1036,1477, 1472, 1081with a cable provided by the customer mmcx to N  
TYPE with a loss of 0.7db

20 second graph 360.72 ms in a 20 second period



## Pulse width



Date: 16.DEC.2005 14:03:20

**Section 7. Occupied Bandwidth**

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(1)(i)
TESTED BY: Kevin Rose	DATE: December 16, 2005

**Test Results:** Complies.

**Measurement Data:** See attached plots.

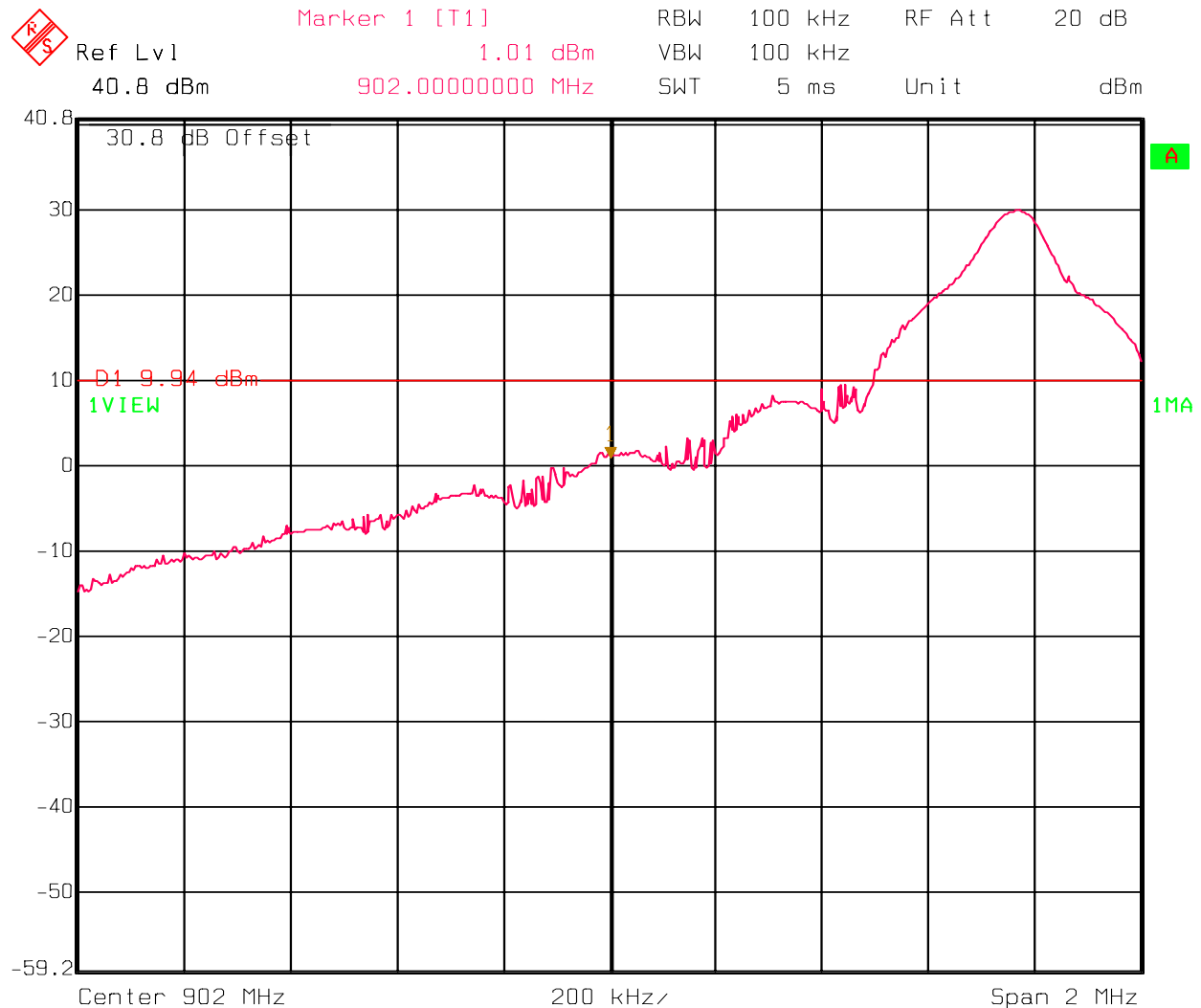
**Equipment Used:** 1036,1477, 1472, 1081 with a cable provided by the customer mmcx to N TYPE with a loss of 0.7db

**Measurement Uncertainty:** +/- 1.7 dB

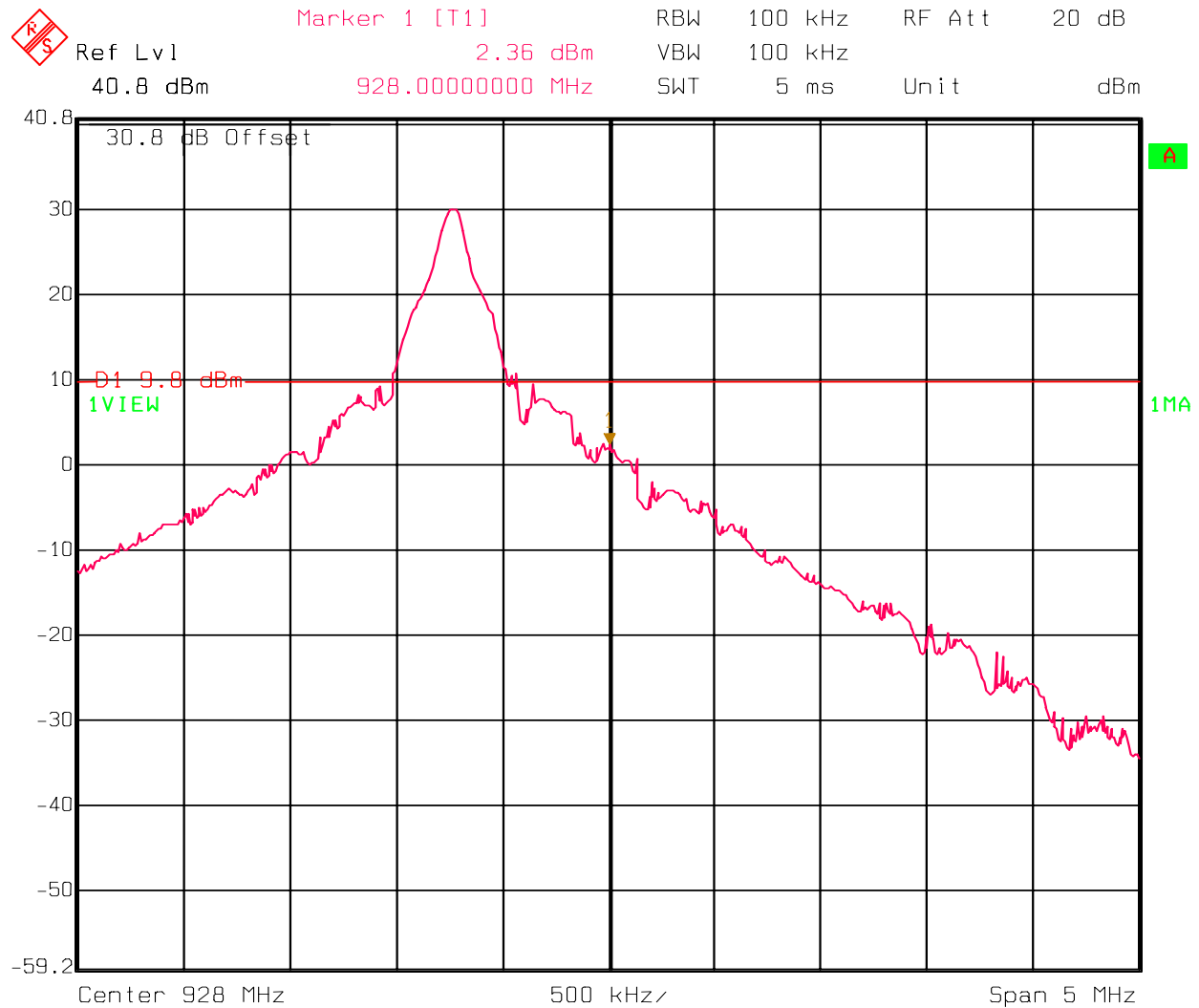
**Temperature:** 22°C

**Relative Humidity:** 29%

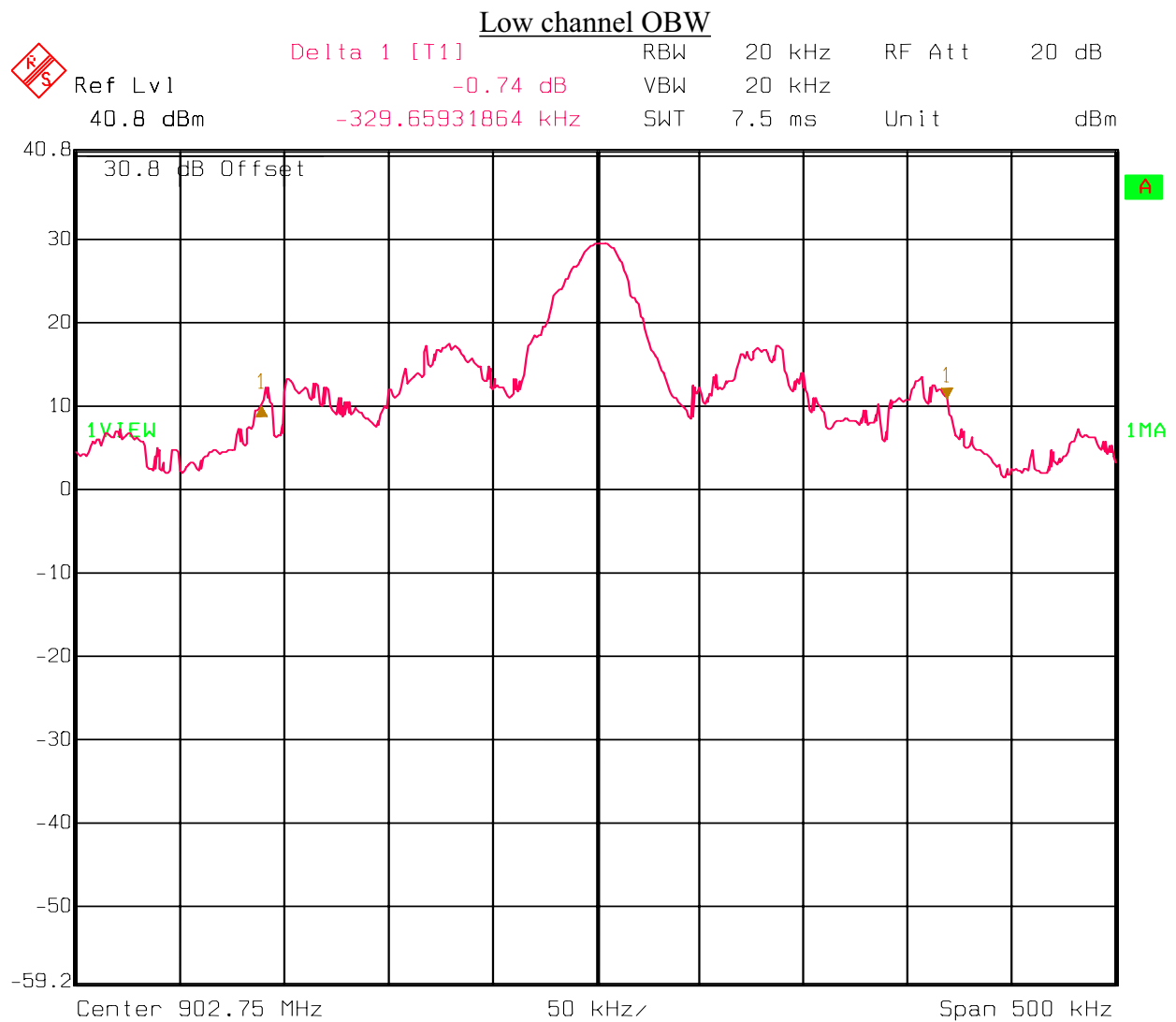
Lower bandedge 20dBc



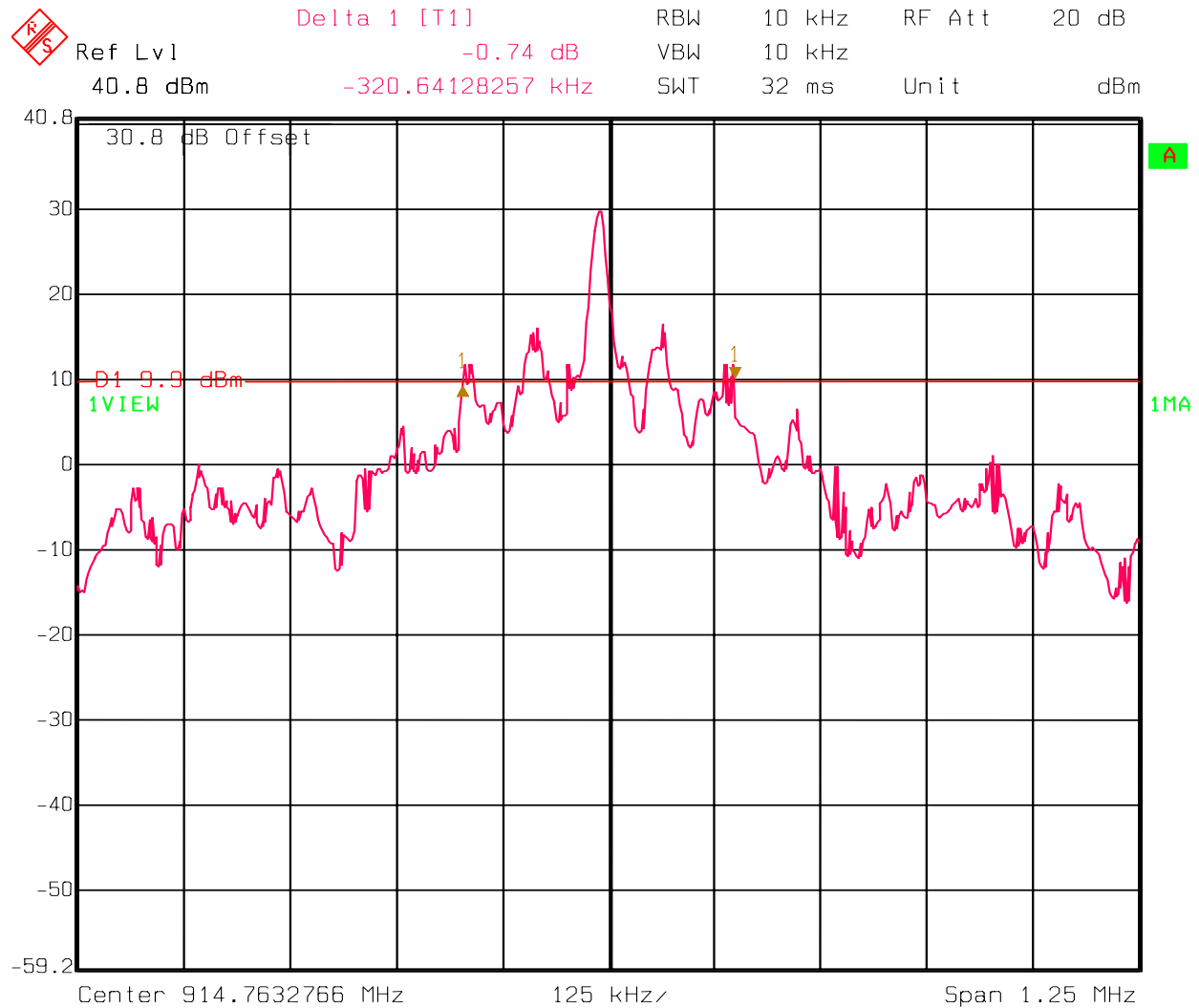
Date: 16.DEC.2005 14:22:51

Upper band edge 20dBc

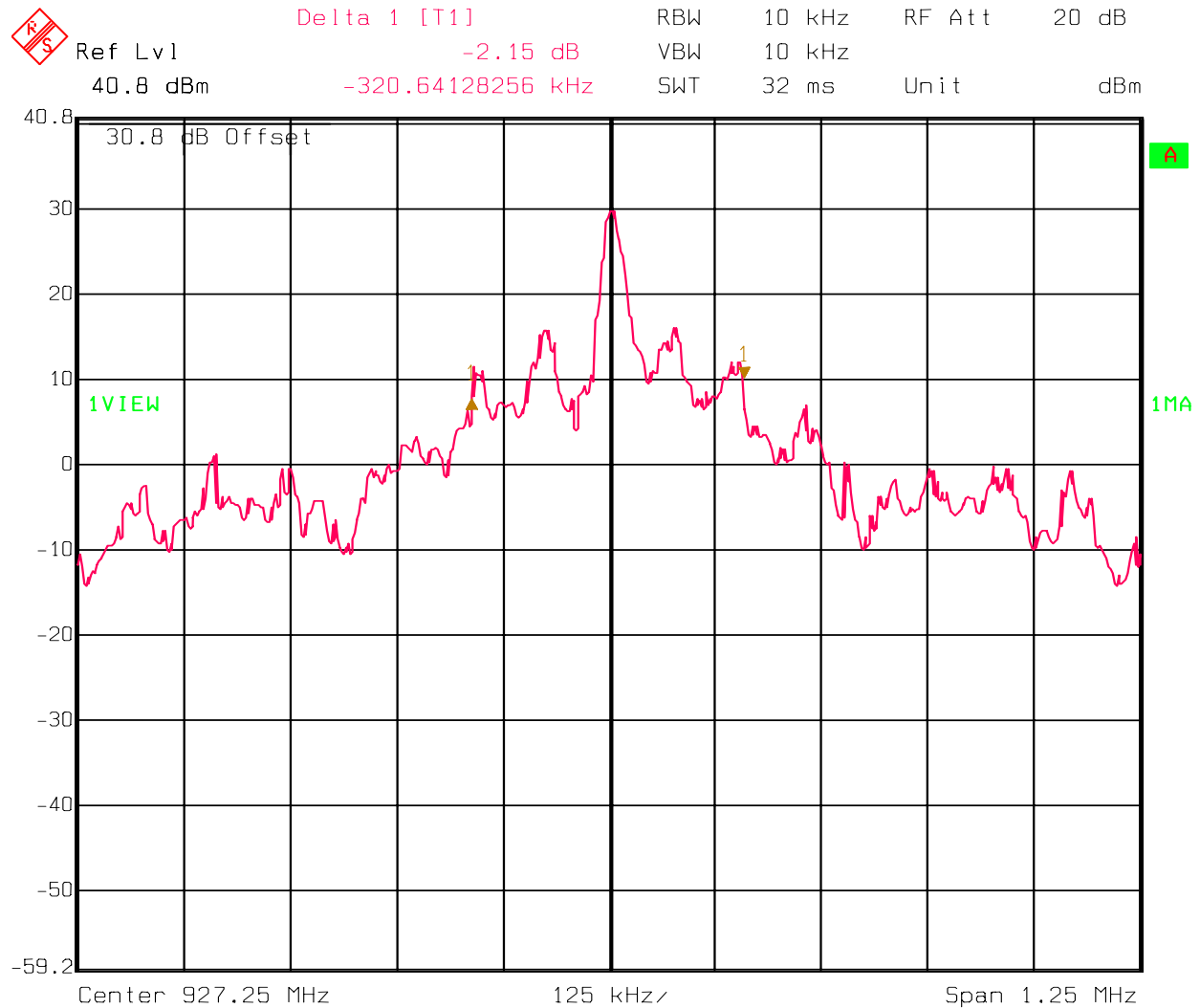
Date: 16.DEC.2005 14:39:11



Date: 16.DEC.2005 14:19:18

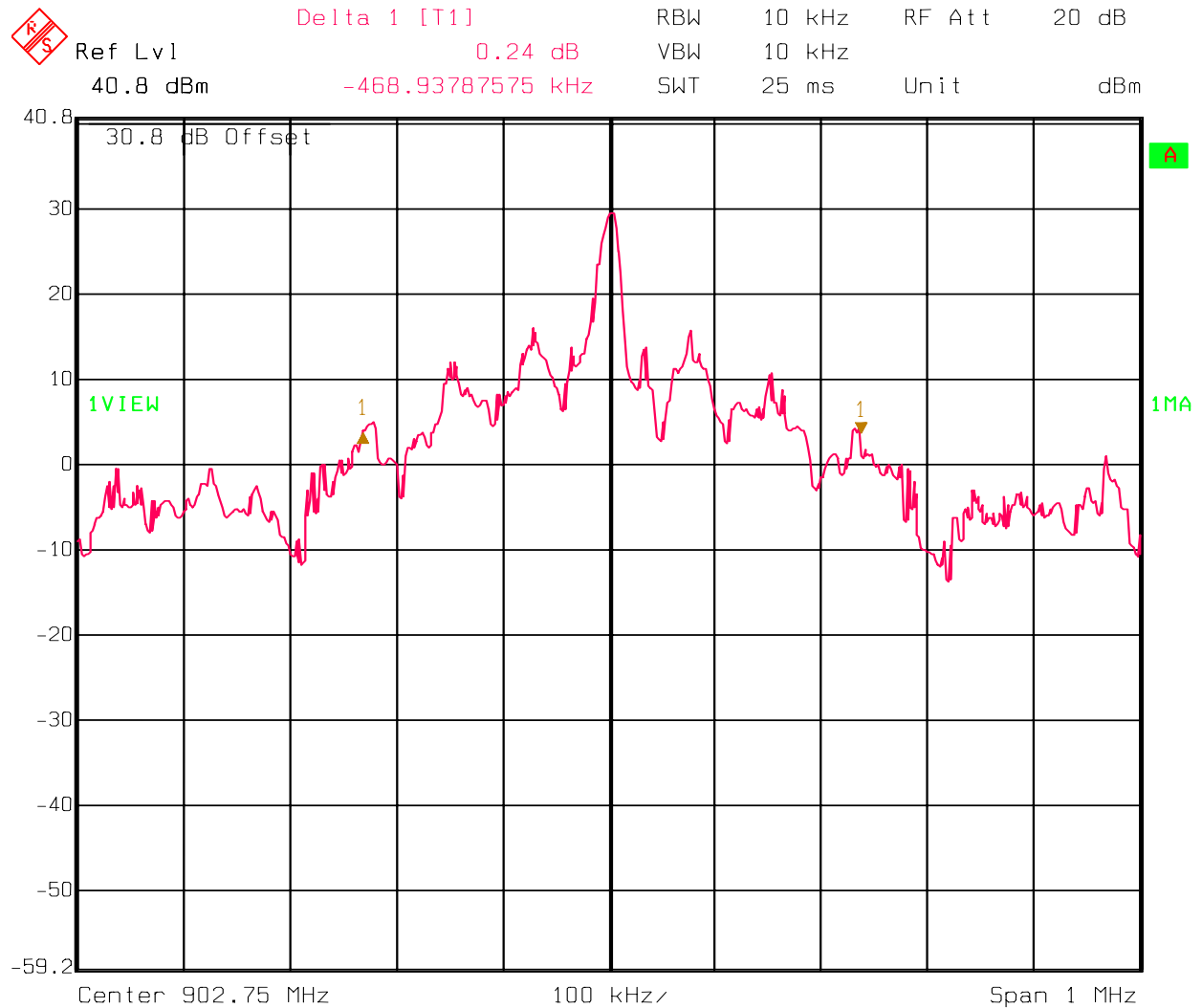
Mid channel OBW

Date: 16.DEC.2005 14:30:45

High channel OBW

Date: 16.DEC.2005 14:34:57

99% BW plot



Date: 16.DEC.2005 14:17:11

**Section 8. Peak Power Output**

NAME OF TEST: Peak Power Output	PARA. NO.: 15.247 (b)
TESTED BY: Kevin Rose	DATE: December 16, 2005

**Test Results:** Complies.

**Measurement Data:** See attached plots.  
Detachable antenna? ☒ Yes ☐ No  
If yes, state the type of non-standard connector used: MMCX

**Antennas:**

Model	Type	Manufacturer	CONDUCTED (dBm)	Gain (dBi)	E.I.R.P. (dBm)
RX2	PATCH	LXE	29.75	5	34.75
The antenna is a Right Hand, circularly polarized (RHCP) single-patch antenna with 5 dBi linear gain					

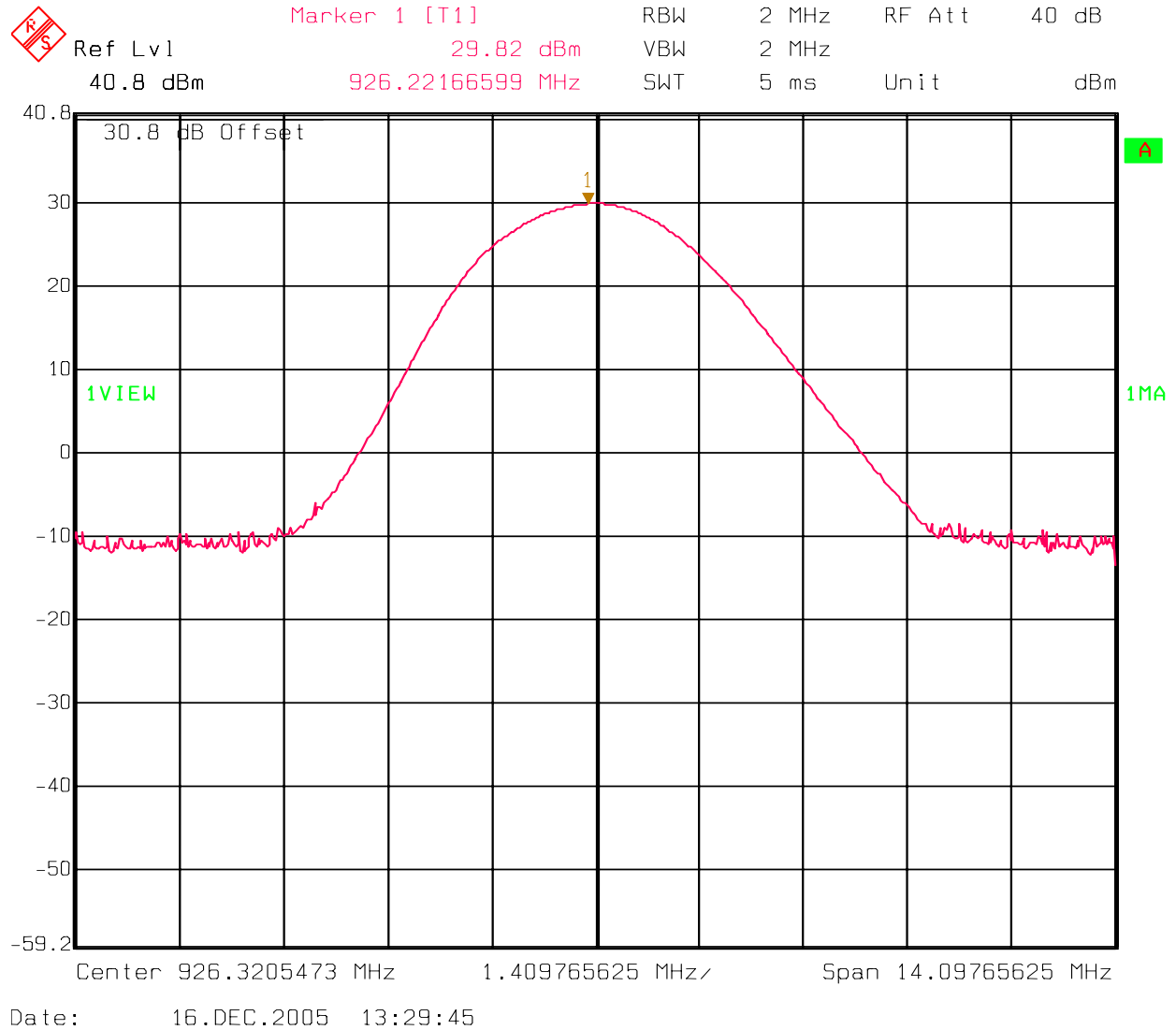
**Equipment Used:** 1036,1477, 1472, 1081 with a cable provided by the customer mmcx to N  
TYPE with a loss of 0.7db

**Measurement Uncertainty:** +/- 1.7 dB

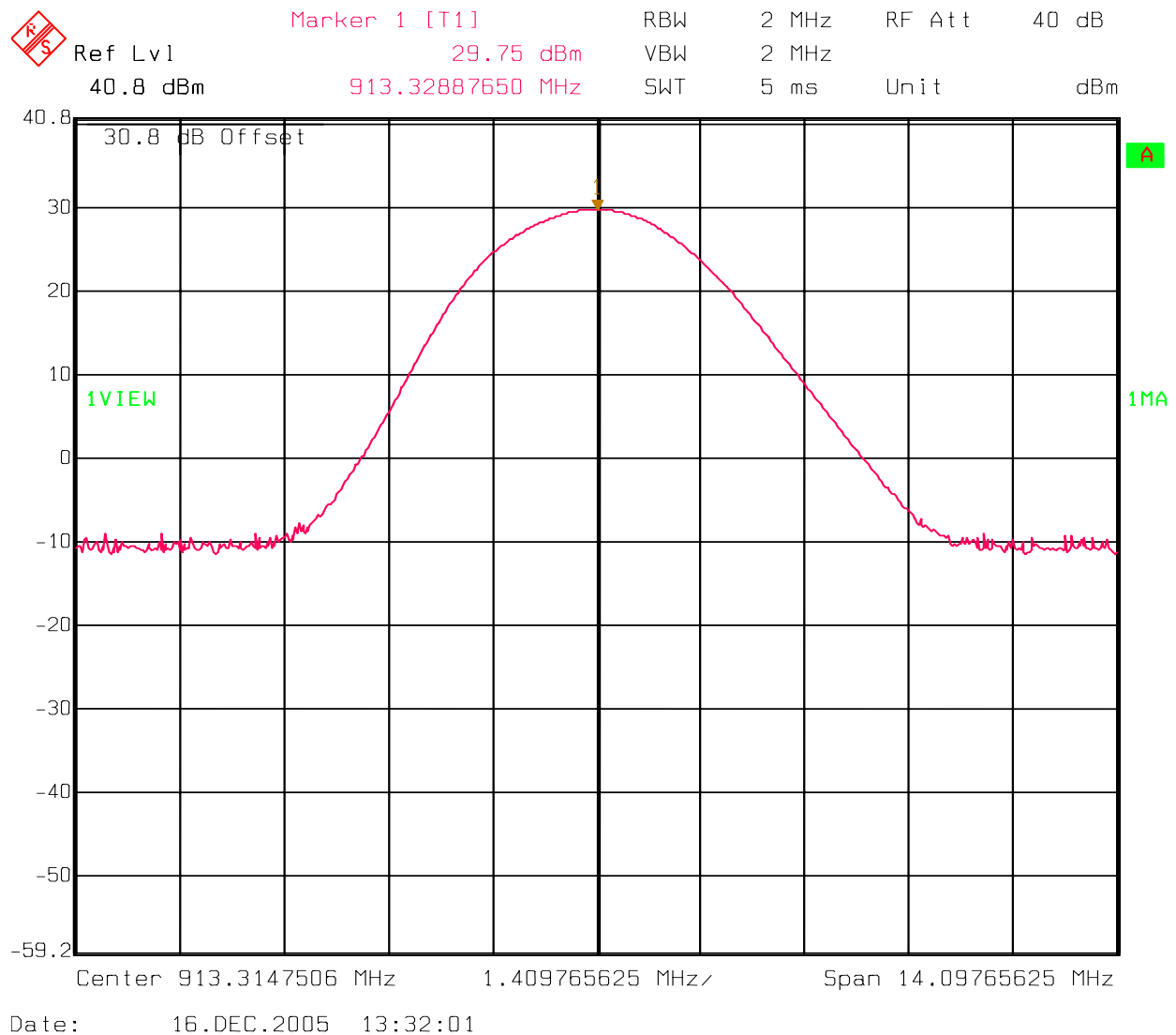
**Temperature:** 22°C

**Relative Humidity:** 29%

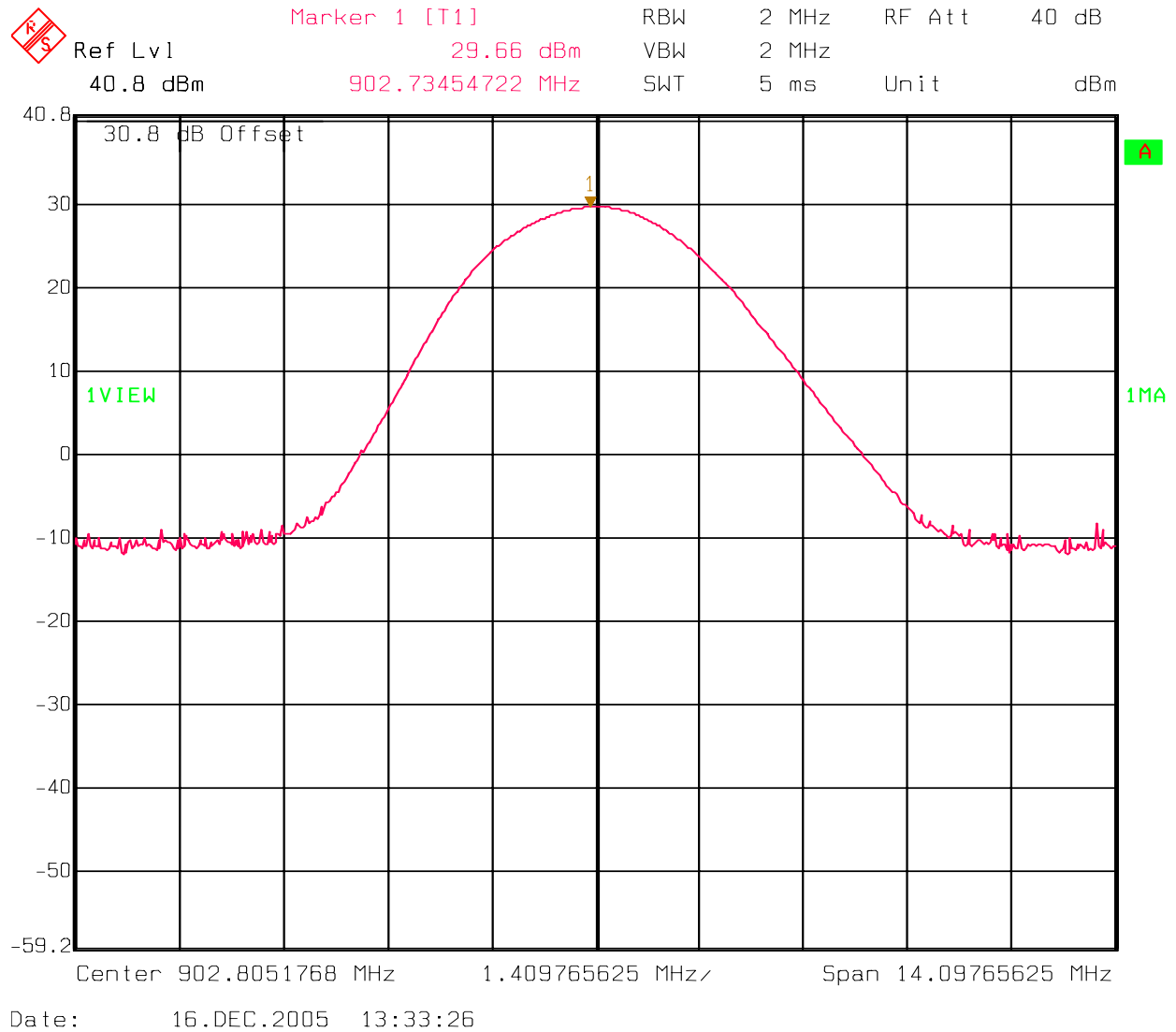
High channel conducted power



## Mid channel conducted power output



## Low channel conducted power output



**Section 9. Spurious Emissions (Antenna Conducted)**

NAME OF TEST: Spurious Emissions (Antenna Conducted)	PARA. NO.: 15.247(c)
TESTED BY: Kevin Rose	DATE: December 16, 2005

**Test Results:** Complies.

**Measurement Data:** See attached plots.

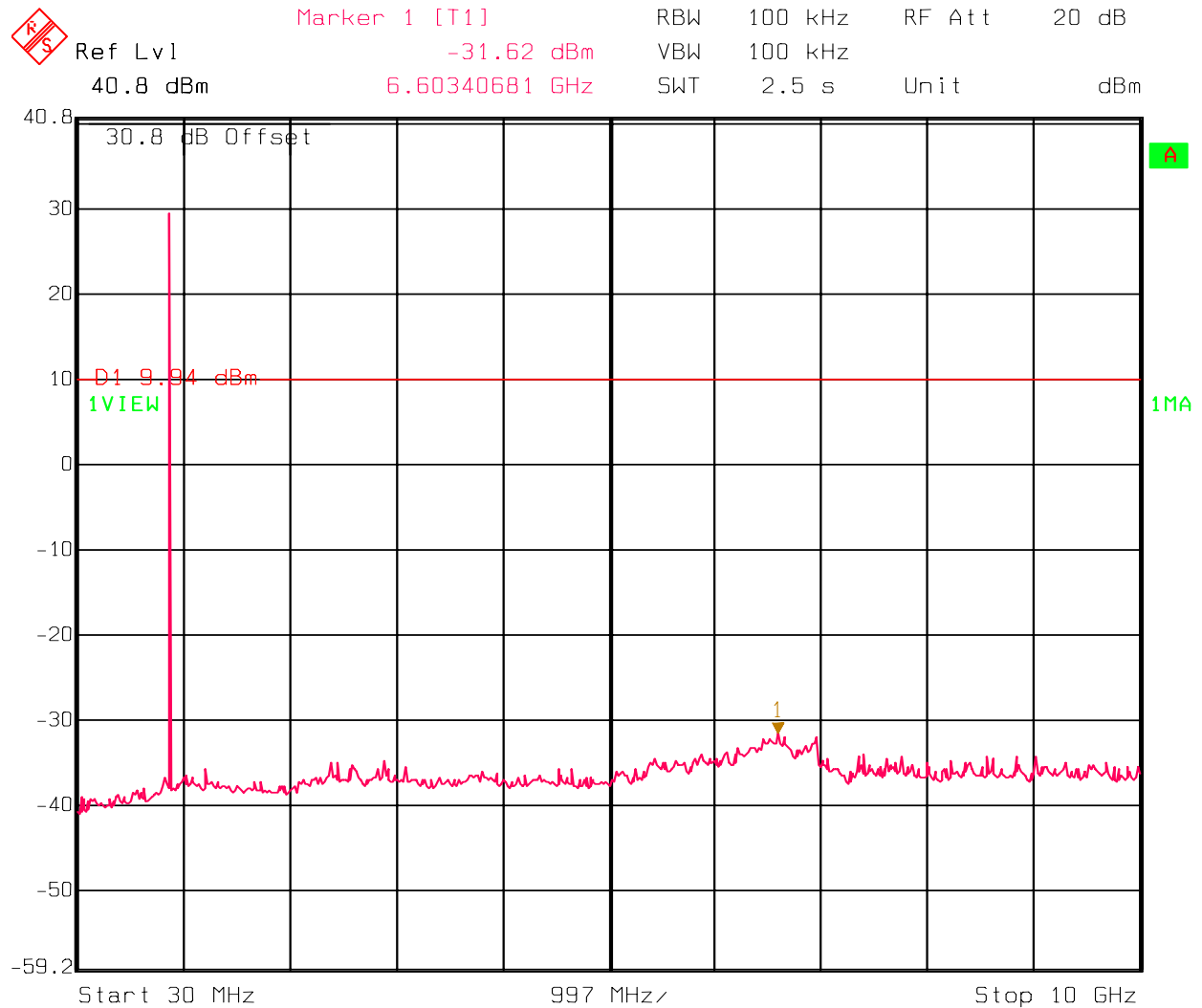
**Equipment Used:** 1036,1477, 1472, 1081 with a cable provided by the customer mmcx to N TYPE with a loss of 0.7db

**Measurement Uncertainty:** +/- 1.7 dB

**Temperature:** 22°C

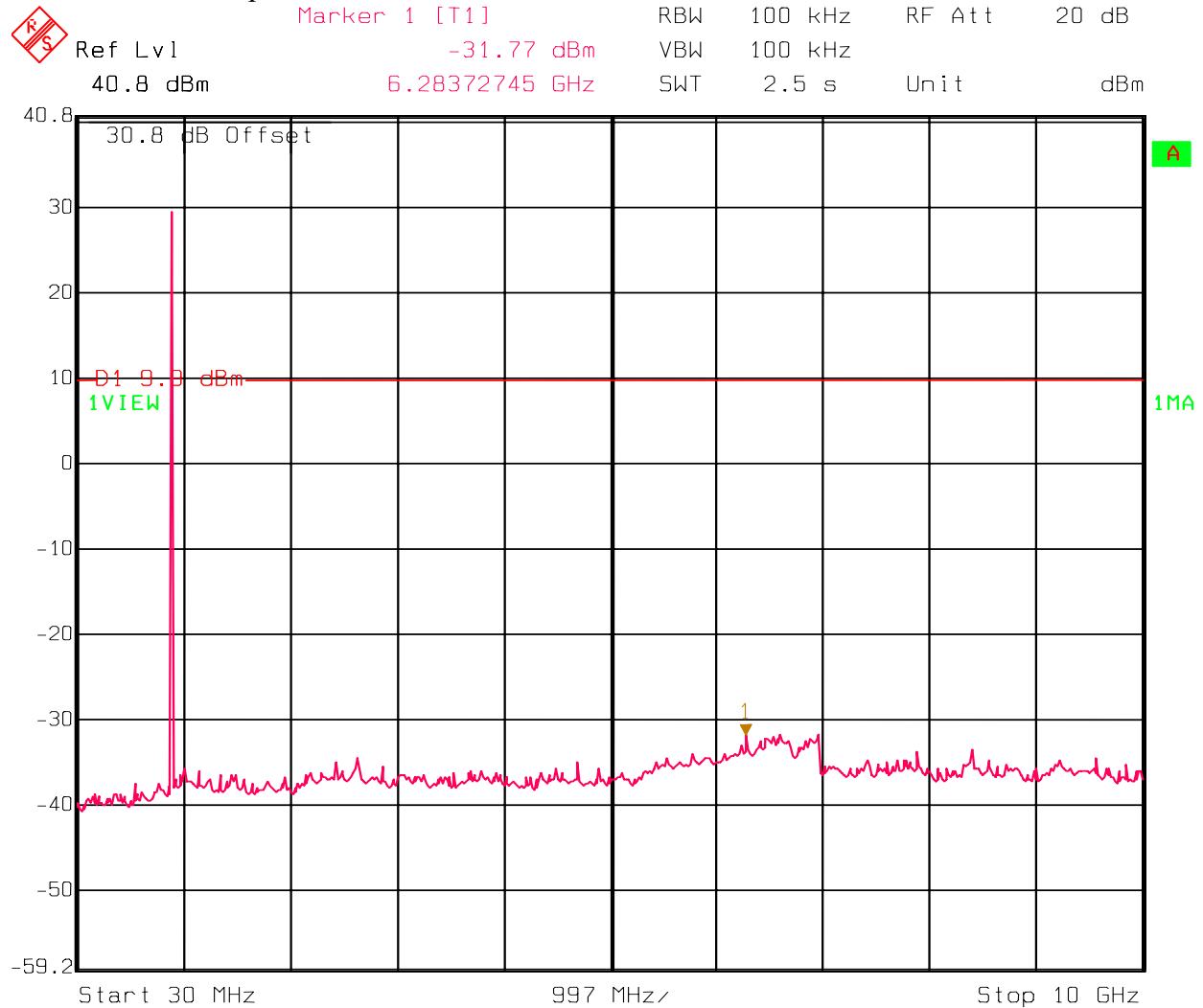
**Relative Humidity:** 29%

## LOW CHANNEL Spurious Emissions



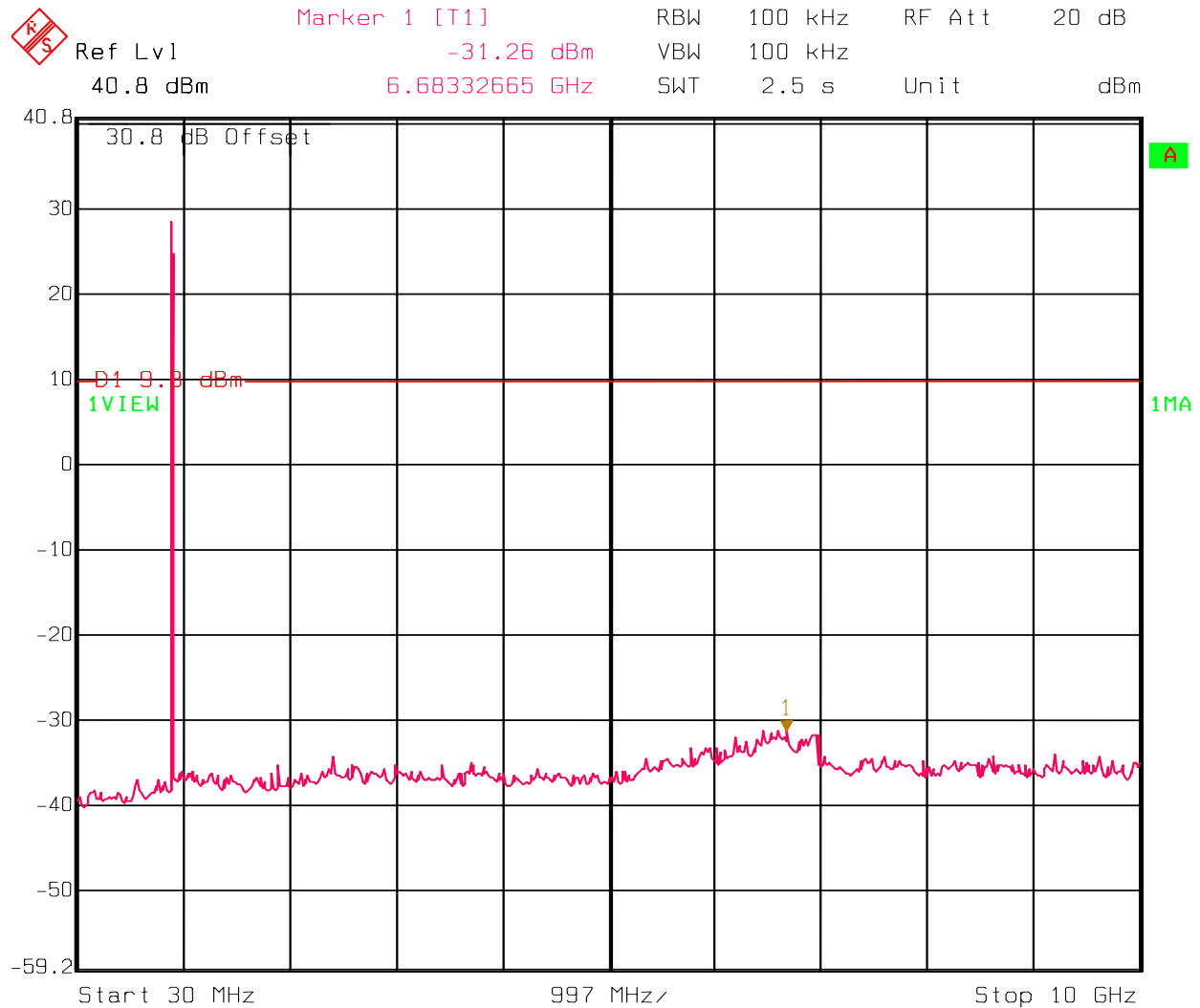
Date: 16.DEC.2005 14:24:31

## MID CHANNEL Spurious Emissions



Date: 16.DEC.2005 14:28:13

## HIGH CHANNEL Spurious Emissions

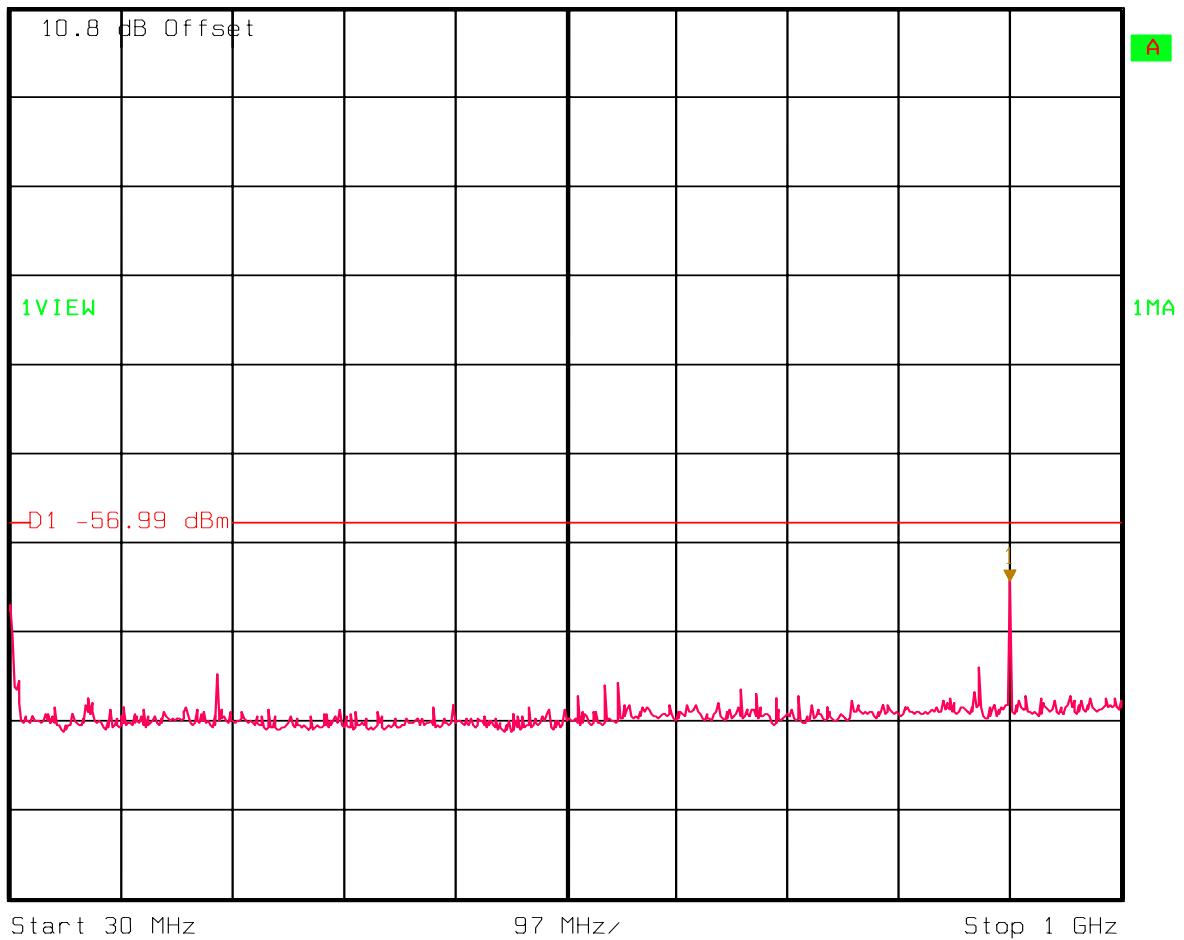


Date: 16.DEC.2005 14:37:51

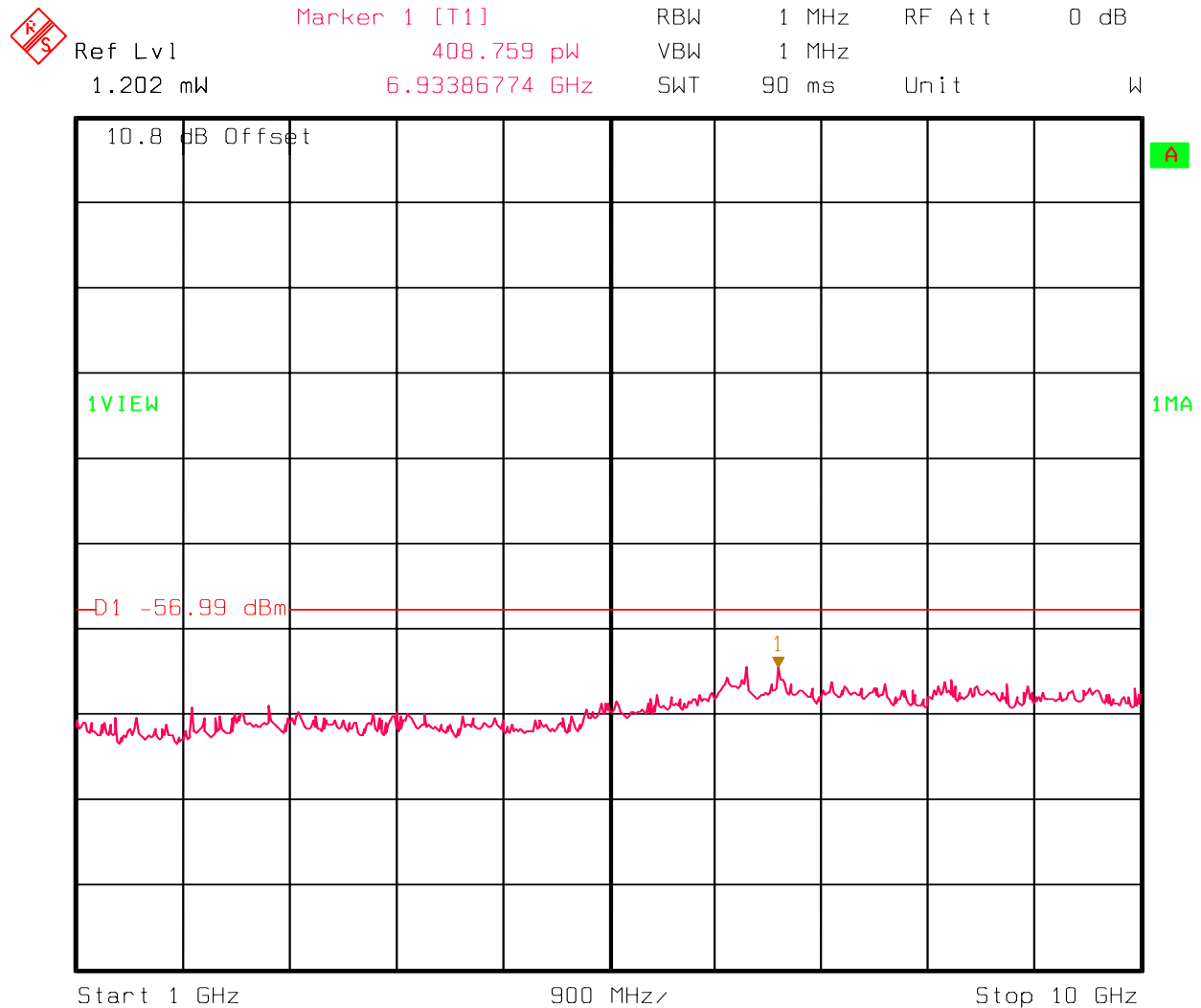
## Receiver conducted plots



Ref Lvl 1.202 mW  
Marker 1 [T1] 451.634 pW  
902.80561122 MHz  
RBW 100 kHz  
VBW 100 kHz  
SWT 245 ms  
RF Att 0 dB  
Unit W



Date: 16.DEC.2005 14:50:09



Date: 16.DEC.2005 14:54:04

**Section 10. Spurious Emissions (Radiated)**

NAME OF TEST: Spurious Emissions (Radiated)	PARA. NO.: 15.247(c)
TESTED BY: Kevin Rose	DATE: December 16, 2005

**Test Results:** Complies.

**Measurement Data:** See attached table.

**Duty Cycle Calculation:** No Duty Cycle

Duty Cycle correction factor (dB) =  $20 \log (rf_{ON} \text{ in ms}/100\text{ms})$

**Equipment Used:** 1484, 1485, 993, 1016, 1464.

**Measurement Uncertainty:** +/- 1.7 dB

**Temperature:** 22°C

**Relative Humidity:** 29%

**Note: The spectrum was searched from 30 MHz up to 9.5 GHz.**

Note: There were no emissions detected within 20db of the Limit

100 kHz RBW/VBW below 1GHz.

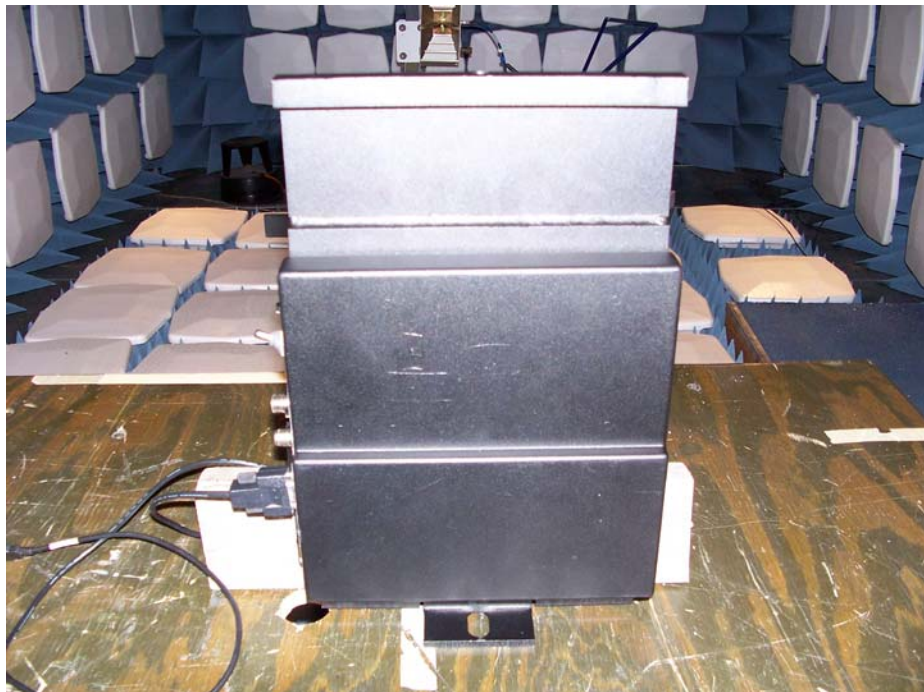
1MHz RBW/VBW above 1GHz.

**Radiated Photographs (Worst Case Configuration)**

FRONT VIEW



REAR VIEW



## Section 11. Test Equipment List

Nemko ID	Description	Manufacturer	Serial Number	Calibration Date	Calibration Due
		Model Number			
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	08/26/05	08/26/06
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	08/02/05	08/26/06
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	03/23/05	03/23/06
993	Horn antenna	A.H. Systems SAS-200/571	XXX	08/04/05	08/04/07
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	11/12/05	11/12/06
791	PREAMP, 25dB	ICC LNA25	398	11/12/05	11/12/06
760	Antenna biconical	Electro Metrics MFC-25	477	08/04/05	08/04/06
759	ANTENNA, LOG PERIODIC	A.H. SYSTEMS SAS-200/510	556	08/04/05	08/04/06
1482	Band Pass Filter	K & L 11SH10-4000/T12000-0/0	2	Cal B4 Use	N/A
1481	Microwave Highpass Filter	K & L 3DH1-2000/T8000-0/0	4	Cal B4 Use	N/A
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/14/05	01/15/07
1477	20db Attenuator DC 18 Ghz	MCL Inc. BW-S20W5	NONE	CBU	N/A
1081	CABLE 2m	Astrolab 32027-2-29094-72TC	N/A	08/26/05	08/26/06
1471	10 db Attenuator DC 18 Ghz	MCL Inc. BW-S10W2 10db-2WDC	NONE	CBU	N/A
1472	20db Attenuator DC 18 Ghz	Omni Spectra 20600-20db	NONE	CBU	N/A

## **ANNEX A - TEST DETAILS**

**Nemko USA**

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

*EQUIPMENT:* RFID Radio Module

PROJECT NO.: 5L0656RUS1

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NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: 15.207(a)
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**Minimum Standard:**

The R.F. that is conducted back onto the AC power line on any frequency within the band 0.45 to 30 MHz shall not exceed 250 $\mu$ V (48 dB $\mu$ V) across 50 ohms.

NAME OF TEST: Channel Separation	PARA. NO.: 15.247(a)(1)(i)
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**Minimum Standard:**

(i) For frequency hopping systems operating in the 902-928 MHz band:

if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the

system shall use at least 50 hopping frequencies and the average time of

occupancy on any frequency shall not be greater than 0.4 seconds within

a 20 second period; if the 20 dB bandwidth of the hopping channel is 250

kHz or greater, the system shall use at least 25 hopping frequencies and

the average time of occupancy on any frequency shall not be greater than

0.4 seconds within a 10 second period. The maximum allowed 20 dB

bandwidth of the hopping channel is 500 kHz.

NAME OF TEST: Pseudorandom Hopping Algorithm	PARA. NO.: 15.247(a)(1)
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**Minimum Standard:**

The system shall hop to channel frequencies that are selected from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their transmitters and shall shift frequencies in synchronization with the transmitted signals.

NAME OF TEST: Time of Occupancy

PARA. NO.: 15.247(a)(1)(ii)

**Minimum Standard:**

Frequency Band (MHz)	20 dB Bandwidth	No. of Hopping Channels	Average Time of Occupancy
902 - 928	<250 kHz	50	=<0.4 sec. in 20 sec.
902 - 928	=>250 kHz	25	=<0.4 sec. in 10 sec.
2400 - 2483.5	-----	75	=<0.4 sec. in 30 sec.
5725 - 5850	-----	75	=<0.4 sec. in 30 sec.

**Method Of Measurement:**

The spectrum analyzer is set as follows:

RBW: 1 MHz

VBW: = RBW

Span: 0 Hz

LOG dB/div.: 10 dB

Sweep: Sufficient to see one hop time sequence.

Trigger: Video

The occupancy time of one hop is measured as above. The average time of occupancy is calculated over the appropriate period of time from above table (10, 20, or 30 seconds).

Avg. time of occupancy = (period from table/duration of one hop)/no. of channels multiplied by the duration of one hop.

For instance:

If a 2.4 GHz system has a measured hop duration time of 1 msec. and uses 75 channels, then the average time of occupancy would be:

$(30 \text{ sec.} / .001 \text{ sec.}) / 75 \text{ chan.} = 400 \times 1 \text{ msec.} = 400 \text{ msec. or } 0.4 \text{ sec. in } 30 \text{ sec.}$

NAME OF TEST: Occupied Bandwidth

PARA. NO.: 15.247(a)(2)

**Minimum Standard:**

Frequency Band (MHz)	Maximum 20 dB Bandwidth
902 - 928	500 kHz
2400 – 2483.5	1 MHz
5725 – 5850	1 MHz

**Method Of Measurement:**

The spectrum analyzer is set as follows:

RBW: At least 1% of span/div.

VBW: >RBW

Span: Sufficient to display 20 dB bandwidth

LOG dB/div.: 10 dB

Sweep: Auto

**Number of channels tested:**

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Peak Power Output

PARA. NO.: 15.247(b)

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**Minimum Standard:**

Frequency Band (MHz)	No. of Hopping Channels	Maximum Peak Power Output at Antenna Port
902 - 928	at least 50	1 watt
902 – 928	25 - 49	0.25 watts
2400 – 2483.5	75	1 watt
5725 – 5850	75	1 watt

If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point to point operation may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceed 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operation may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

**Direct Measurement Method For Detachable Antennas:**

If the antenna is detachable, a peak power meter is used to measure the power output with the transmitter operating into a 50 ohm load. The dBi gain of the antenna(s) employed shall be reported.

**Calculation Of EIRP For Integral Antenna:**

If the antenna is not detachable from the circuit then the Peak Power Output is derived from the peak radiated field strength of the fundamental emission by using the plane wave relation  $GP/4\pi R^2 = E^2/120\pi$  and proceeding as follows:

$$P = \frac{E^2 R^2}{30G} = \frac{E^2 3^2}{30G}$$

where,

P = the equivalent isotropic radiated power in watts

E = the maximum measured field strength in V/m

R = the measurement range (3 meters)

G = the numeric gain of the transmit antenna in relation to an isotropic radiator

The RBW of the spectrum analyzer shall be set to a value greater than the measured 20 dB occupied bandwidth of the E.U.T.

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Spurious Emissions at Antenna Terminals	PARA. NO.: 15.247(c)
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**Minimum Standard:**

In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits. Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

Frequency (MHz)	Field Strength ( $\mu\text{V/m}$ @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

**THE SPECTRUM WAS SEARCHED TO THE 10th HARMONIC****Method Of Measurement:**

30 MHz - 10th harmonic plot

RBW: 100 kHz

VBW: 300 kHz

Sweep: Auto

Display line: -20 dBc

Lower Band Edge

RBW: At least 1% of span/div.

VBW: &gt;RBW

Span: As necessary to display any spurious at band edge.

Sweep: Auto

Center Frequency: 902 MHz, 2400 MHz, or 5725 MHz

Marker: Peak of fundamental emission

Marker  $\Delta$ : Peak of highest spurious level below center frequency.Upper Band Edge

RBW: At least 1% of span/div.

VBW: &gt;RBW

Span: As necessary to display any spurious at band edge.

Sweep: Auto

Center Frequency: 928 MHz, 2483.5 MHz, or 5850 MHz

Marker: Peak of fundamental emission

Marker  $\Delta$ : Peak of highest spurious level above center frequency.

## Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Radiated Spurious Emissions

PARA. NO.: 15.247(c)

**Minimum Standard:** In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits:

**Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:**

Frequency (MHz)	Field Strength ( $\mu\text{V/m}$ @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

**THE SPECTRUM WAS SEARCHED TO THE 10th HARMONIC**

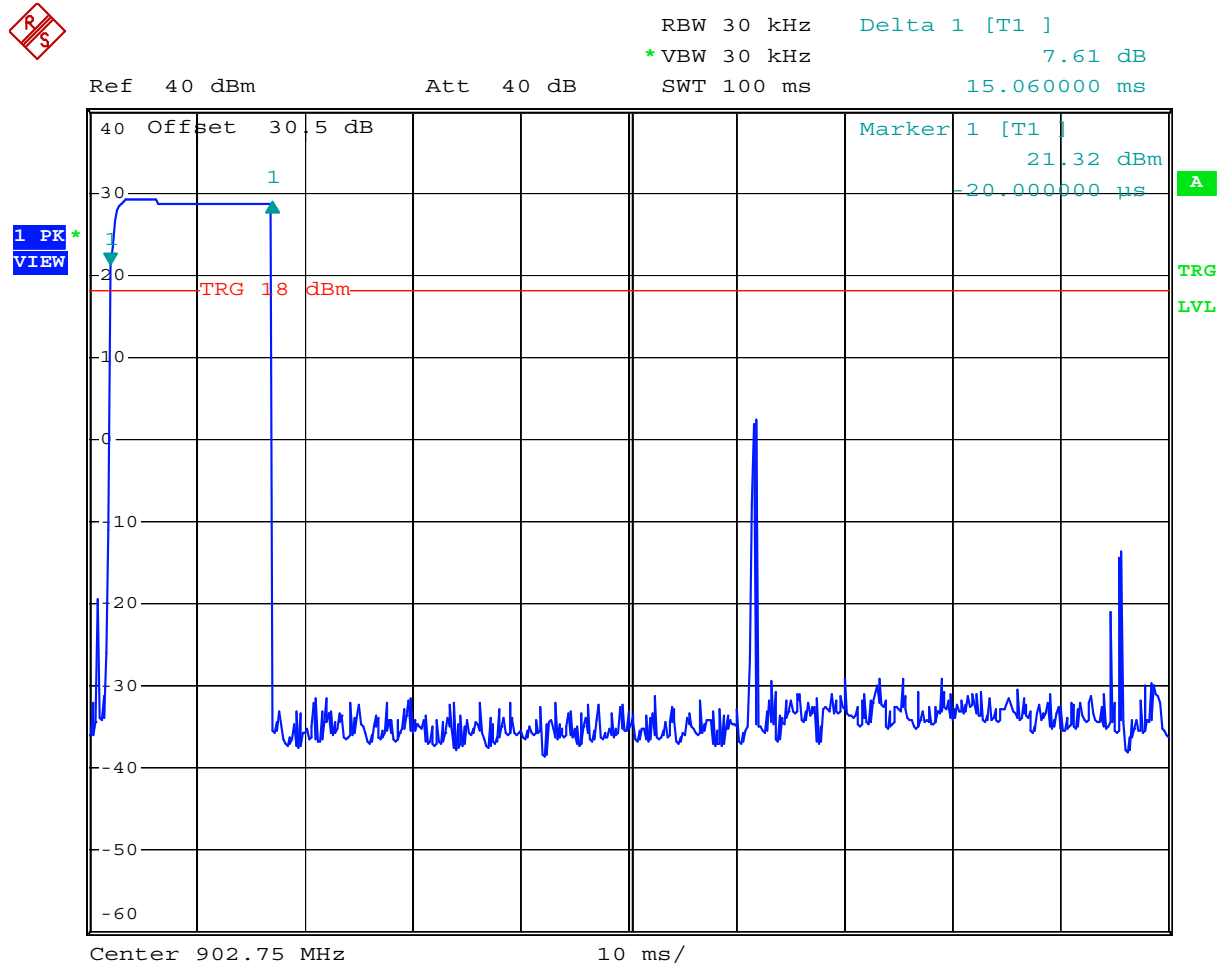
#### **15.205 Restricted Bands**

MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
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
6.125-6.218	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	Above 38.6
13.36-13.41	1718		

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

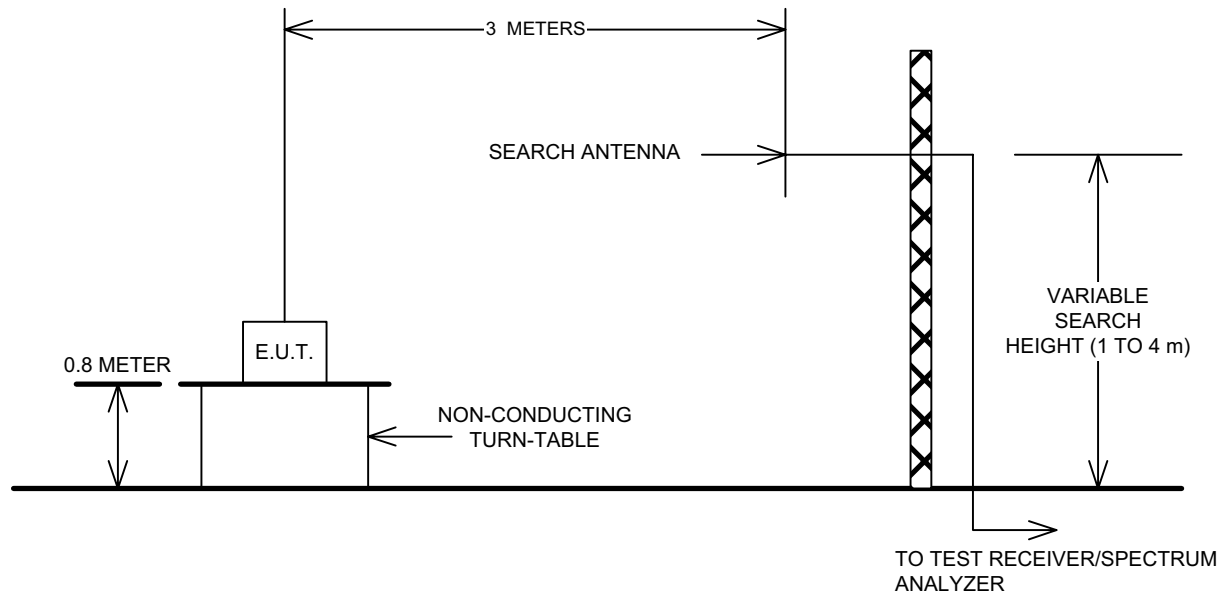
Duty cycle 15.06 ms on time in 100ms =16.5db



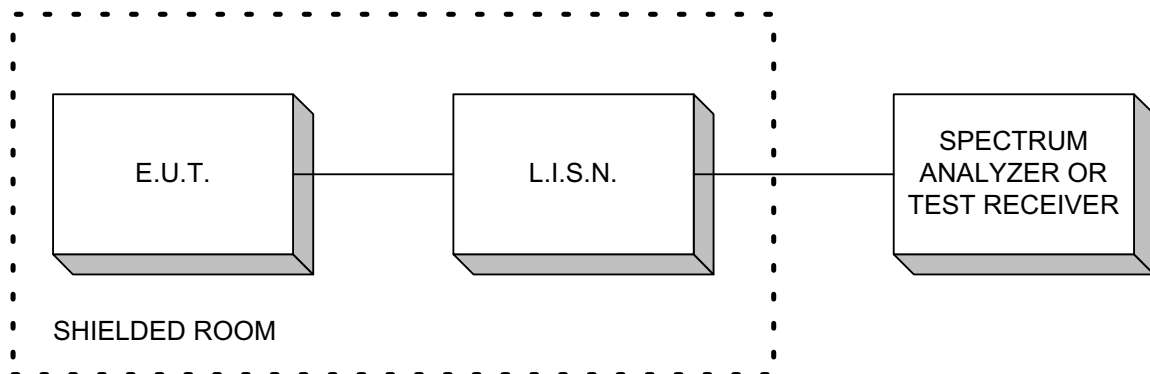
Date: 7.AUG.2005 11:38:14

## **ANNEX B - TEST DIAGRAMS**

## Test Site For Radiated Emissions



## Conducted Emissions



**Peak Power At Antenna Terminals**

