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## Certification Test Report

CFR 47 FCC Part 2 and Part 24, Subpart C

Model: X45 EXPA

FCC ID NO.: VBNEXPA-01

Project Code: W7058-2

Revision: 1

**Prepared for:** Nokia  
6000 Connection Drive  
Building 4  
Irving, Texas 75039

**Author:** Tom Tidwell, Manager of Wireless Services

**Issued:** 20 June, 2007

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NTS Plano, 1701 E. Plano Pkwy., Plano, TX 75074 Tel: (972) 509-2566, Fax: (972) 509-0073

## Report Summary

### NTS Plano

Accreditation Numbers:      FCC: 101741  
   IC: 46405-4319      File # IC-4319A

Applicant:                      Nokia  
   6000 Connection Drive  
   Building 4  
   Irving, Texas 75039

Customer Representative:      Steve Mitchell

#### EUT Description:

EUT Description	Manufacturer	Model	Revision	Serial Number
The Equipment Under Test (EUT) is a wireless base station transceiver operating in the PCS 1900 band using GSM technology	Nokia	X45 EXPA	0	9063800436

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### Test Summary

Appendix	Test/Requirement Description	Deviations from:			Pass / Fail	Applicable Rule Parts
		Base Standard	Test Basis	NTS Procedure		
A	RF Power Output	No	No	No	PASS	CFR 47, Part 2, Para. 2.1046 CFR 47, Part 24, Para.24.232
B	Modulation Characteristics	No	No	No	PASS	CFR 47, Part 2, Para. 2.1047
C	Occupied Bandwidth	No	No	No	PASS	CFR 47, Part 2, Para. 2.1049 CFR 47, Part 24, Para. 24.238
D	Spurious Emissions at Antenna Terminals	No	No	No	PASS	CFR 47, Part 2, Para. 2.1051 CFR 47, Part 24, Para. 24.238
E	Field Strength of Spurious Radiation	No	No	No	PASS	CFR 47, Part 2, Para. 2.1053 CFR 47, Part 24, Para. 24.238
F	Frequency Stability	No	No	No	PASS	CFR 47, Part 2, Para. 2.1055 CFR 47, Part 24, Para. 24.235

Test Result: The product presented for testing complied with test requirements as shown above.

This is to certify that the preceding report is true and correct to the best of my knowledge.

  
 \_\_\_\_\_  
 Robert Stevens,  
 Quality Assurance Manager

  
 \_\_\_\_\_  
 Tom Tidwell,  
 Wireless Test Engineer

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**Register of revisions**

Revision	Reason for Revision	Release Date
0	Original	20 March, 2007
1	Added power meter and power sensor to equipment list	20 June, 2007

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## INTRODUCTION

### 1.1 PURPOSE

The purpose of this document is to describe the tests applied by NTS Plano to demonstrate compliance to FCC Part 24 for Broadband Personal Communication Service in accordance with the certification requirements of CFR 47, Part 2.

## 2.0 EUT DESCRIPTION

### 2.1 CONFIGURATION

#### Description of EUT

	Name	Model	Revision	Serial Number
EUT	X45 EXPA Base Station	X45 EXPA	0	9063800436
RF Exposure Classification	Fixed. The antenna is mounted on a fixed outdoor structure.			
Channels/Frequency Range	1930 – 1990 MHz band (Operates from 1930.2 – 1989.8 MHz)			
RF Power	Rated RF power at antenna port on channels 513 - 809			
	Carrier Mode	Modulation Mode	Rated Power	
	Combined	8PSK	80	
	Single	8PSK	31	
	Combined	GMSK	100	
	Single	GMSK	71	
RF Power	Rated RF power at antenna port on channels 512 and 810			
	Carrier Mode	Modulation Mode	Rated Power	
	Combined	8PSK	17	
	Single	8PSK	14	
	Combined	GMSK	9	
	Single	GMSK	9	
Emission Designator	<b>270KGXW:</b> GMSK(GSM) <b>270KG7W:</b> 8PSK(EDGE)			
TX antenna details	Antenna is specified at time of licensing			
Functional Description	The EUT is used as a base station transceiver in a GSM network.			

#### 2.1.1 EUT POWER

Voltage	208 Vac, 60 Hz (27 Vdc and 48 Vdc supplied by DC supplies in EUT rack)
Number of Feeds	2 phase (X and Y)

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**2.2 EUT CABLES**

Quantity	Model/Type	Routing		Shielded / Unshielded	Description	Cable Length (m)
		From	To			
1	None	EUT	AC power main	Unshielded	Power cord	1.25
1	Gore	EUT	50 ohm load	Shielded (coaxial)	Coaxial cable	2

**2.3 MODE OF OPERATION DURING TESTS**

The device was tested in the following operating modes:

- GSM mode (GMSK modulation) with a single carrier
- EDGE mode (8PSK modulation) with a single carrier
- GSM mode (GMSK modulation) with combined carrier
- EDGE mode (8PSK modulation) with combined carrier

In combined carrier mode two transmitted carriers **on the same channel** are combined with phase adjustment in order to increase the transmitted rf power output.

Rated RF power at antenna port on channels 513 - 809

Carrier Mode	Modulation Mode	Rated Power
Combined	8PSK	80
Single	8PSK	31
Combined	GMSK	100
Single	GMSK	71

Rated RF power at antenna port on channels 512 and 810

Carrier Mode	Modulation Mode	Rated Power
Combined	8PSK	17
Single	8PSK	14
Combined	GMSK	9
Single	GMSK	9

Note that power is reduced when operating on the lowest and highest channels.

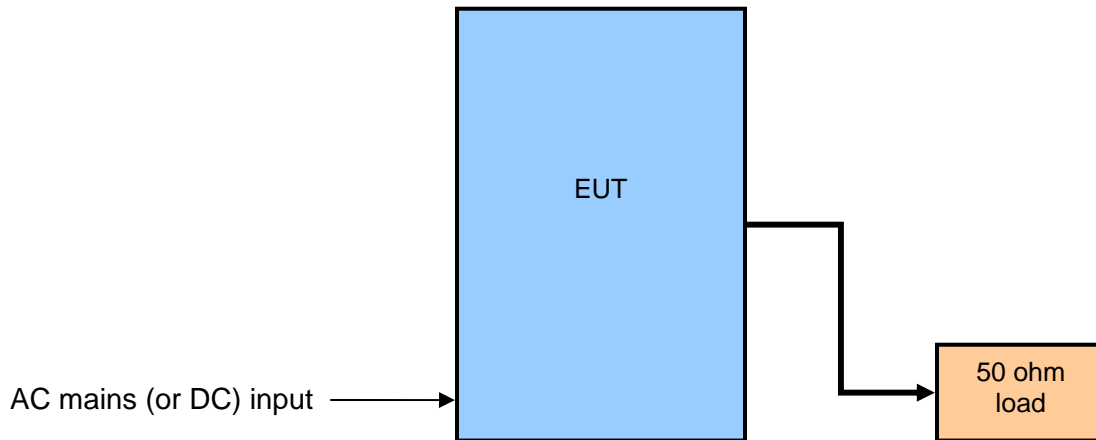
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### 3.0 SUPPORT EQUIPMENT

#### 3.1 CONFIGURATION

The radio was activated using customer-supplied test software. The software allowed the test engineer to change modulation modes and data rates as well as transmit channel.

#### 3.2 TEST BED/PERIPHERAL CABLES



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## APPENDICES

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## APPENDIX A: 2.1046 RF POWER OUTPUT

### A.1. Base Standard & Test Basis

<b>Base Standard</b>	FCC PART 2.1046
<b>Test Basis</b>	TIA 603-C, 2004
<b>Test Method</b>	TIA 603-C, 2004

### A.2. Specifications

24.232 Power and antenna height limits.

(a) Base stations are limited to 1640 watts peak equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT, except as described in paragraph 24.232(b).

(b) Base stations that are located in counties with population densities of 100 persons or fewer per square mile, based upon the most recently available population statistics from the Bureau of the Census, are limited to 3280 watts peak equivalent isotropically radiated power (EIRP) with an antenna height up to 300 meters HAAT.

(c) Mobile/portable stations are limited to 2 watts EIRP peak power and the equipment must employ means to limit the power to the minimum necessary for successful communications.

**Applicable RF Power Limit from Above:** 1640 watts EIRP

### A.3. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
None						

### A.4. Test Procedure

TIA 603-C, 2004 and 24.232(d)

### A.5. Test Results

The EUT is in compliance with the limits as specified above. The maximum rf output power at the antenna terminals is 100 watts.

### A.6. Operating Mode During Test

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The transmitter was tested while in a continuous transmit mode. The EUT was tuned to a low, middle, and high channel.

**A.7. Sample Calculation**

$$\text{Rf power(watts)} = 10^{(\text{rf power(dBm)}/10)} \times 1000$$

**A.8. Test Data**

Band	Channel	Carrier Mode	Modulation Mode	RF Power Output at Antenna Terminals (dBm)	RF Power Output at Antenna Terminals (W)
GSM1900	Low	Combined	GMSK	39.70	9.33
GSM1900	Mid	Combined	GMSK	50.00	100.00
GSM1900	High	Combined	GMSK	39.30	8.51
GSM1900	Low	Combined	8PSK	42.29	16.94
GSM1900	Mid	Combined	8PSK	49.00	79.43
GSM1900	High	Combined	8PSK	42.10	16.22
GSM1900	Low	Single	GMSK	39.29	8.49
GSM1900	Mid	Single	GMSK	48.53	71.29
GSM1900	High	Single	GMSK	39.83	9.62
GSM1900	Low	Single	8PSK	41.64	14.59
GSM1900	Mid	Single	8PSK	44.85	30.55
GSM1900	High	Single	8PSK	41.08	12.82

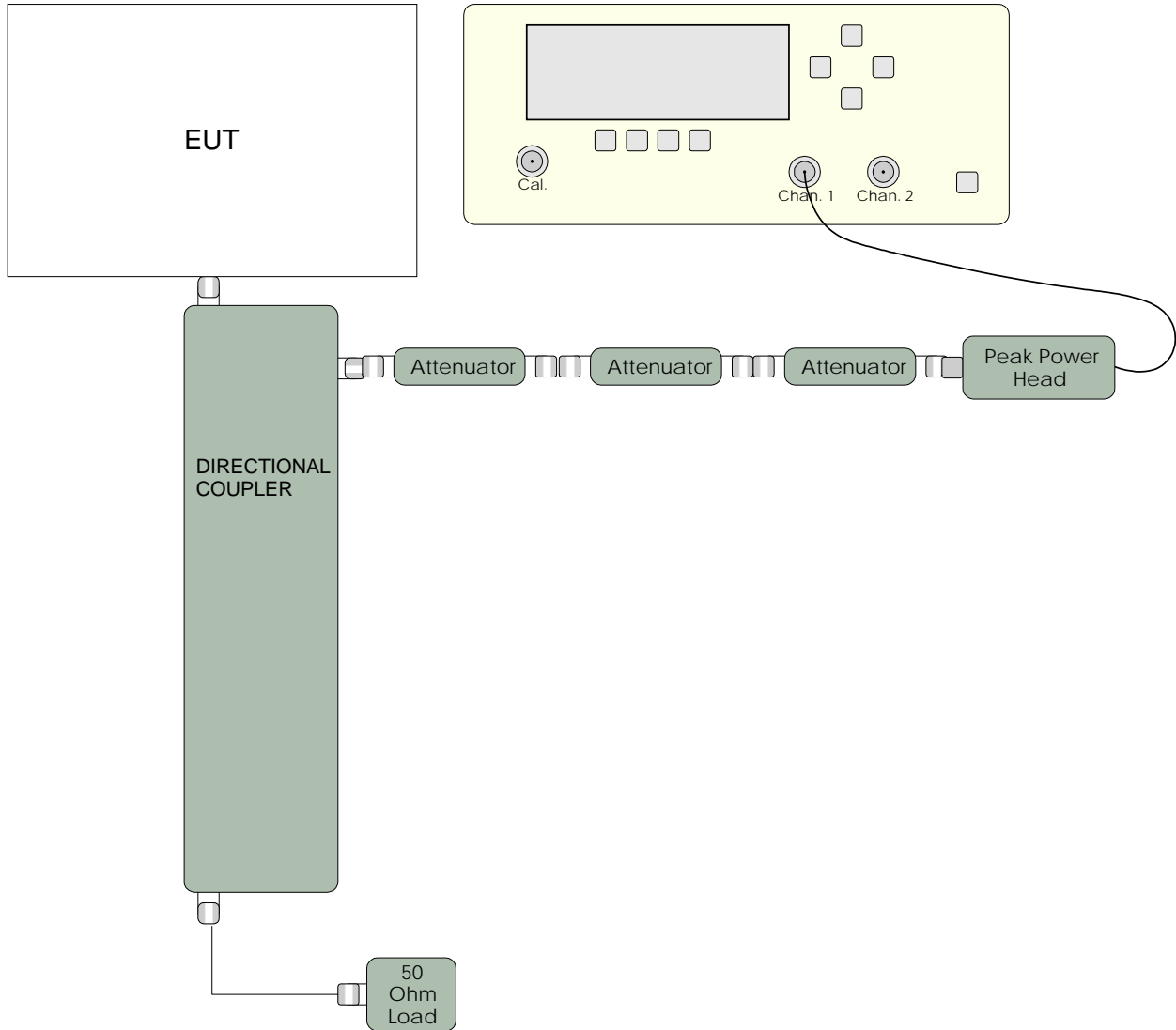
Note: RF power output was measured using a peak rf power meter designed to quantify the true peak power using a high number of samples.

Test Date: 27 – 28 Feb., 2007

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**A.9. Test Diagram**



**A.10. Tested By**

Name: Tom Tidwell,  
Function: Manager of Wireless Services

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## APPENDIX B: 2.1047 MODULATION CHARACTERISTICS

### B.1. Base Standard & Test Basis

<b>Base Standard</b>	FCC 2.1047
<b>Test Basis</b>	FCC 2.1047 Modulation Characteristics
<b>Test Method</b>	TIA 603-C, 2004

### B.2. Specifications

#### 2.1047 – Modulation Characteristics

(a) *Voice modulated communication equipment.* A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

(b) *Equipment which employs modulation limiting.* A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

(c) *Single sideband and independent sideband radiotelephone transmitters which employ a device or circuit to limit peak envelope power.* A curve showing the peak envelope power output versus the modulation input voltage shall be supplied. The modulating signals shall be the same in frequency as specified in paragraph (c) of §2.1049 for the occupied bandwidth tests.

(d) *Other types of equipment.* A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

### B.3. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

### B.4. Test Method

This device is digitally modulated and does not provide for analogue or voice modulation.

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**B.5. Test Results**

The device under test uses digital modulation techniques only. The two modes used by the device are GMSK and 8PSK.

**Test Data Summary**

**Emission Designators**

**270KG7W**  
**270KGXW**

**B.6. Test Diagram**

**N/A**

**B.7. Tested By**

Name: Tom Tidwell  
Function: Manager of Wireless Services

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## APPENDIX C: 2.10.49 OCCUPIED BANDWIDTH

### C.1. Base Standard & Test Basis

<b>Base Standard</b>	FCC 2.1049
<b>Test Basis</b>	FCC 2.1049 Occupied Bandwidth
<b>Test Method</b>	TIA 603-C, 2004

### C.2. Specifications

24.238 Emission limitations for Broadband PCS equipment

(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

(b) *Measurement procedure.* Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (*i.e.* 1 MHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

### C.3. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

### C.4. Test Method

TIA 603-C, 2004 and 24.238(b)

### C.5. Test Results

Compliant. The 26 dB bandwidth plots are presented in this annex.

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**C.6. Deviations from Normal Operating Mode During Test**

None.

**C.7. Sample Calculation**

None.

**C.8. Test Data**

See plots following.

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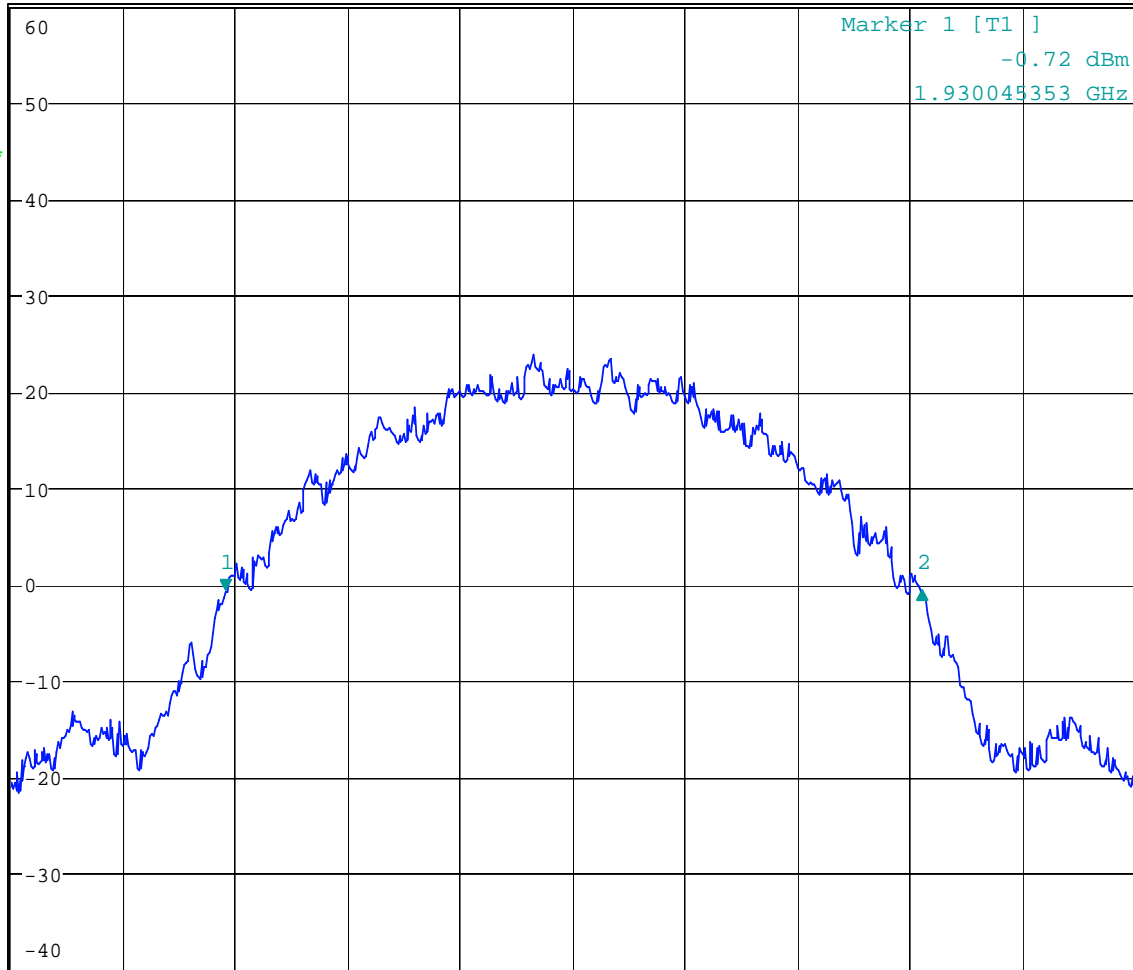


**Figure 1 GMSK Occupied Bandwidth – 1930.2 MHz – Combined Carrier**



\* RBW 3 kHz      Delta 2 [T1 ]  
 \* VBW 3 kHz      -0.13 dB  
 Ref 60 dBm      \* Att 0 dB      SWT 115 ms      310.096153846 kHz

1 RM \*  
 VIEW



Center 1.9302 GHz      50 kHz/      Span 500 kHz

Date: 28.FEB.2007 22:11:07

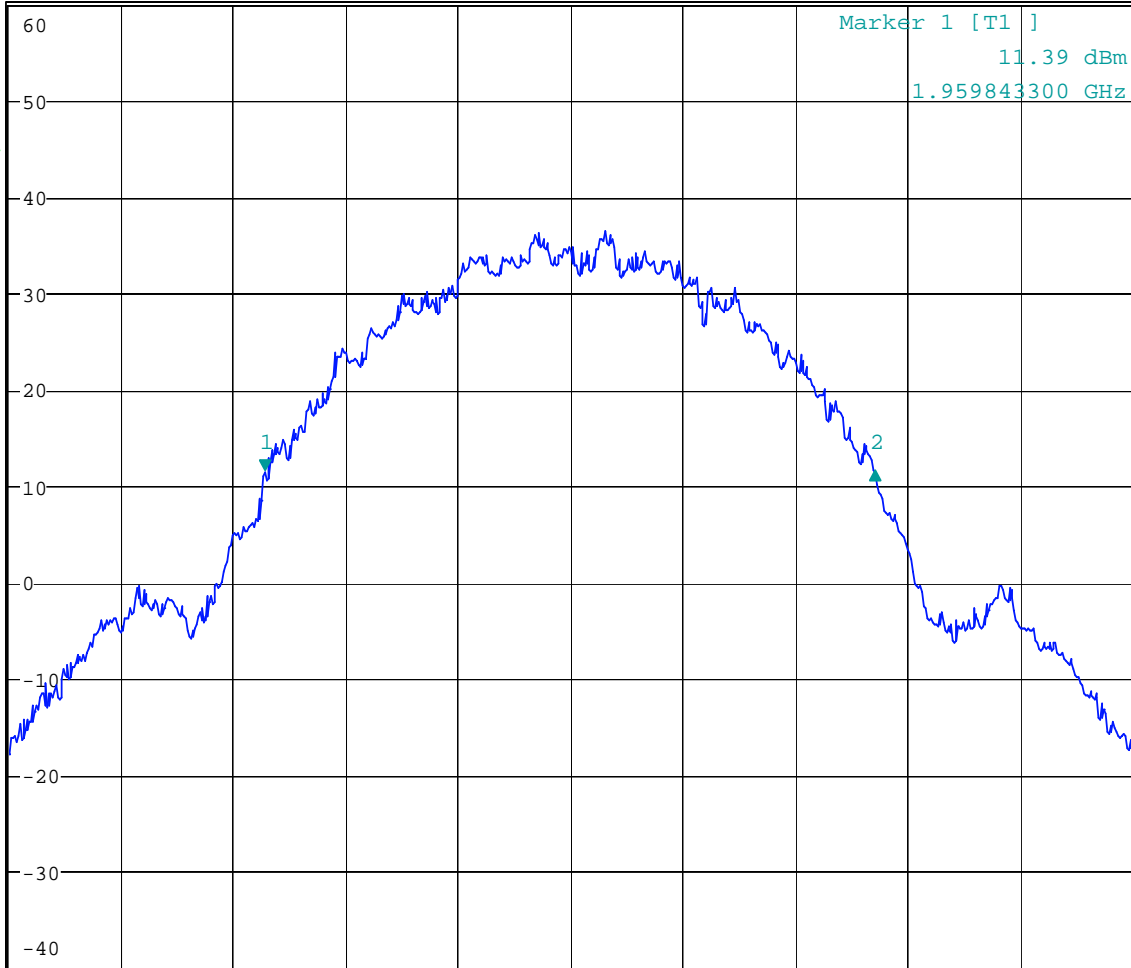
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Figure 2 GMSK Occupied Bandwidth – 1960.0 MHz – Combined Carrier



\* RBW 3 kHz      Delta 2 [T1 ]  
\* VBW 3 kHz      0.01 dB  
Ref 60 dBm      \* Att 0 dB      SWT 130 ms      312.846396555 kHz

1 PK \*  
VIEW



Center 1.96 GHz      57.6539136 kHz/      Span 576.539136 kHz

Date: 28.FEB.2007 22:41:01

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Figure 3 GMSK Occupied Bandwidth – 1989.8 MHz – Combined Carrier



\* RBW 3 kHz      Delta 2 [T1 ]  
\* VBW 3 kHz      -0.19 dB  
SWT 190 ms      312.50000000 kHz

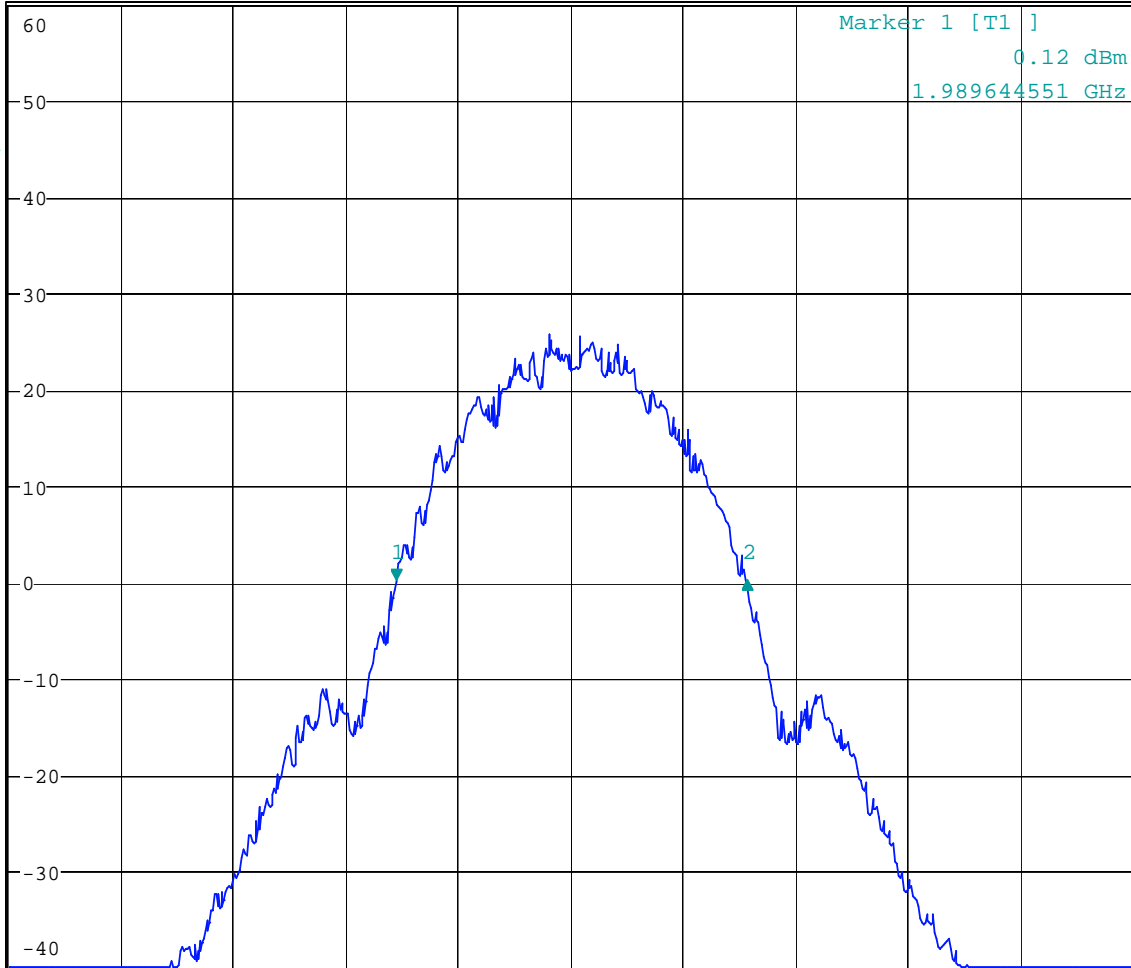
Ref 60 dBm

\* Att 0 dB

SWT 190 ms

312.50000000 kHz

1 PK \*  
VIEW



Center 1.9898 GHz

100 kHz/

Span 1 MHz

Date: 28.FEB.2007 23:07:31

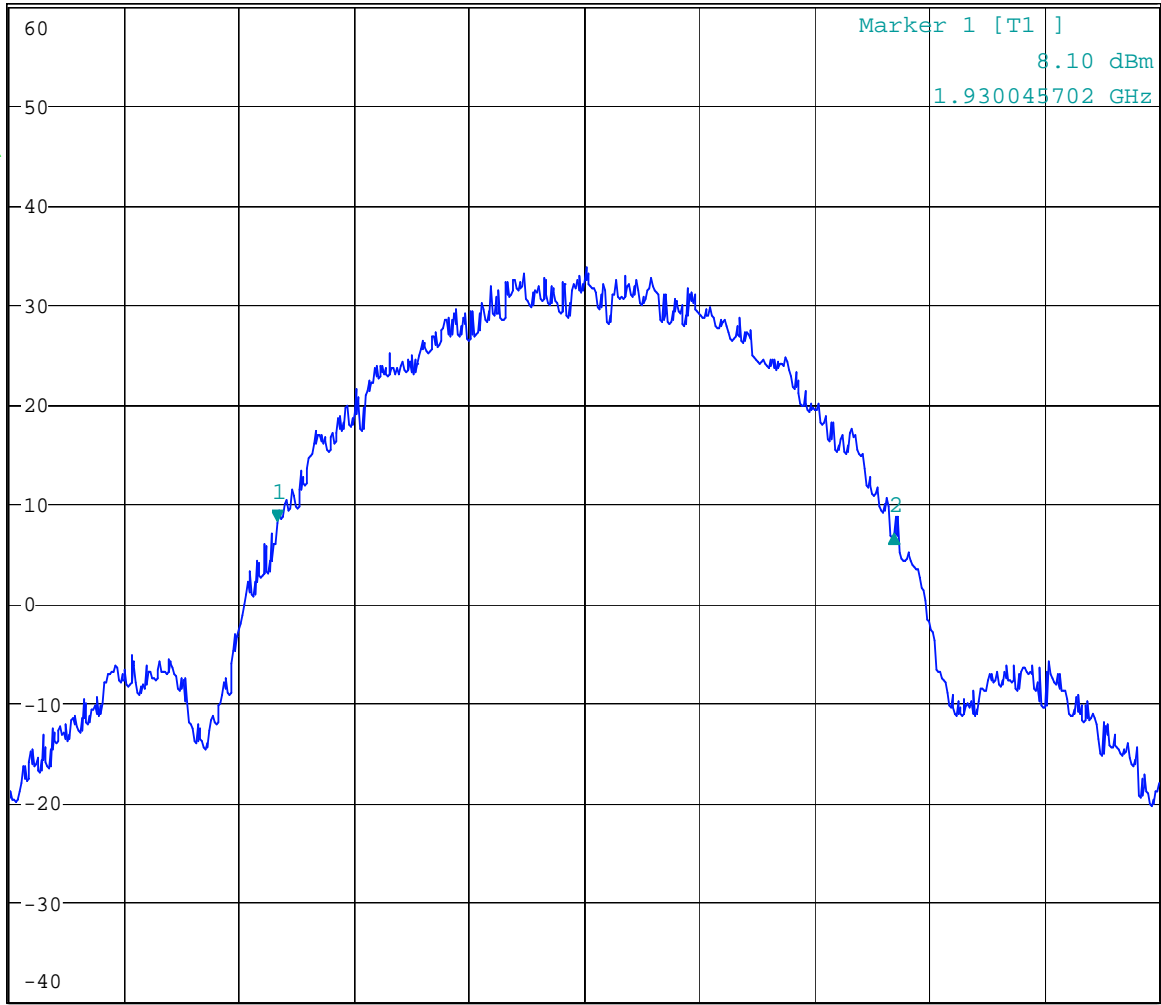
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Figure 4 8PSK Occupied Bandwidth – 1930.2 MHz – Combined Carrier



\* RBW 3 kHz      Delta 2 [T1 ]  
\* VBW 3 kHz      -1.41 dB  
Ref 60 dBm      \* Att 0 dB      SWT 130 ms      309.520209233 kHz

1 PK \*  
VIEW



Center 1.9302 GHz      57.6539136 kHz/      Span 576.539136 kHz

Date: 28.FEB.2007 23:25:49

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Figure 5 8PSK Occupied Bandwidth – 1960.0 MHz – Combined Carrier

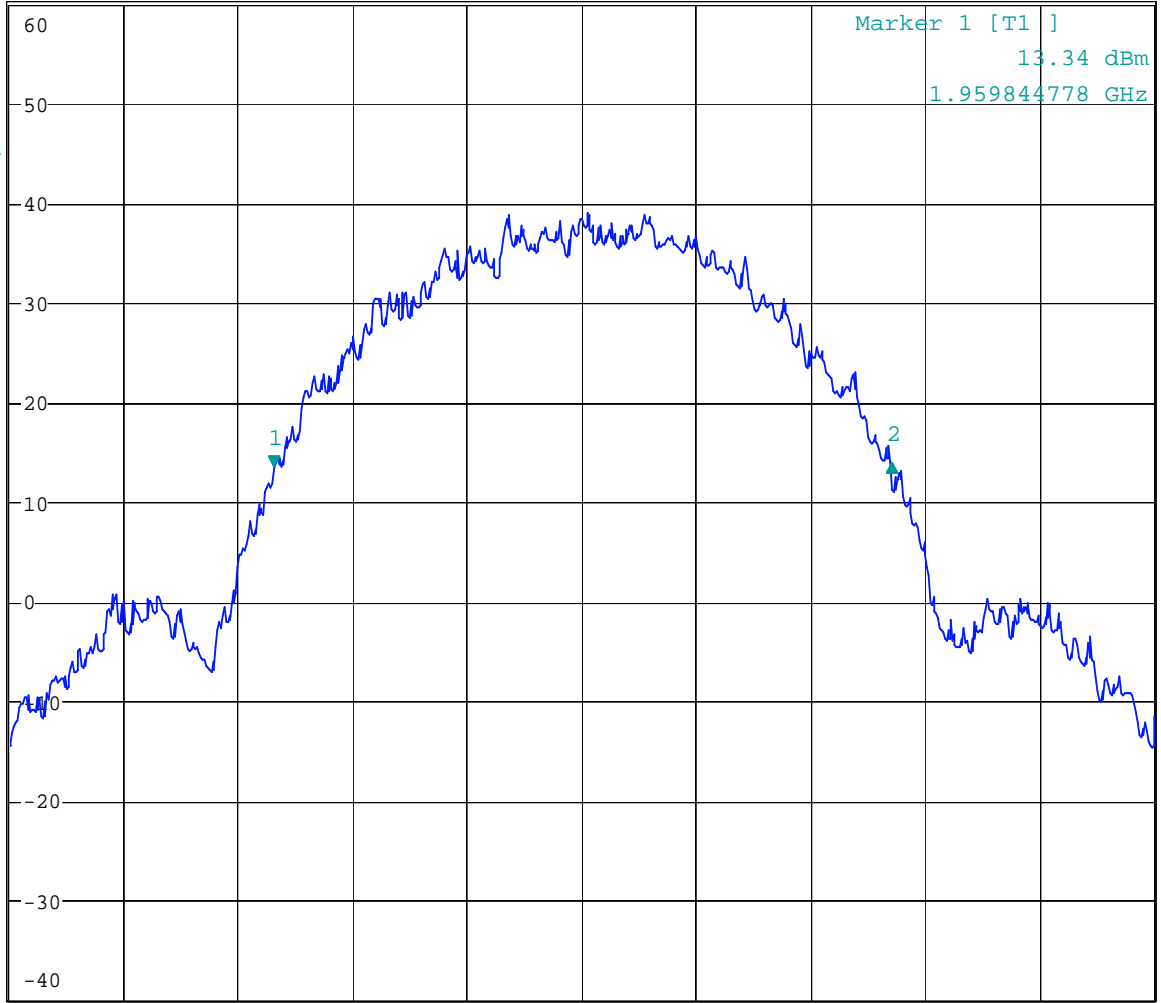


\* RBW 3 kHz Delta 2 [T1 ]  
\* VBW 30 kHz 0.42 dB  
SWT 65 ms 311.368091076 kHz

Ref 60 dBm

\* Att 25 dB

1 PK \*  
VIEW



Center 1.96 GHz

57.6539136 kHz/

Span 576.539136 kHz

Date: 28.FEB.2007 23:49:24

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Figure 6 8PSK Occupied Bandwidth – 1989.8 MHz – Combined Carrier



\*RBW 3 kHz      Delta 2 [T1 ]  
\*VBW 30 kHz      1.57 dB  
SWT 65 ms      310.444150157 kHz

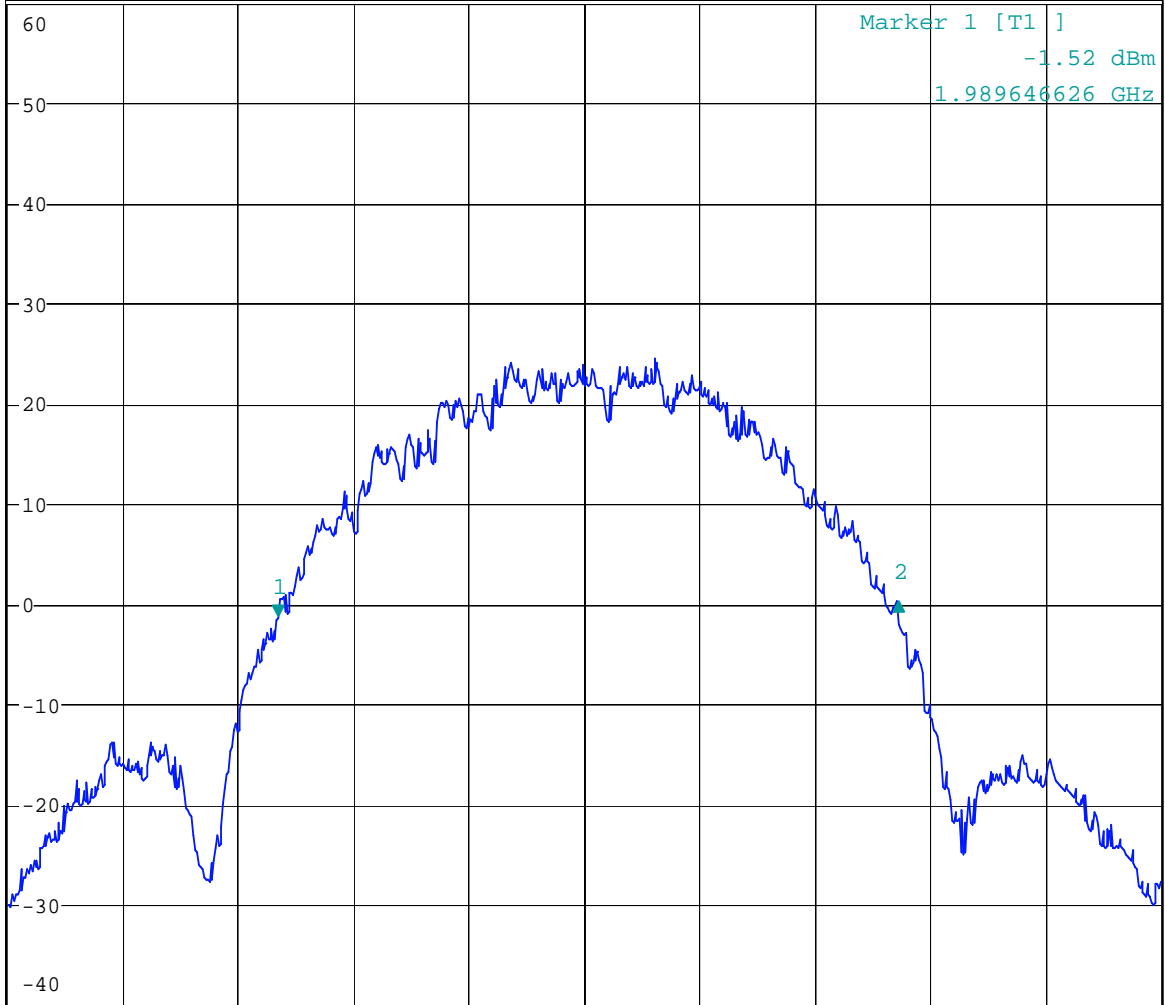
Ref 60 dBm

\* Att 0 dB

SWT 65 ms

310.444150157 kHz

1 PK \*  
VIEW



A

TDF

Center 1.9898 GHz

57.6539136 kHz/

Span 576.539136 kHz

Date: 1.MAR.2007 00:03:57

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Figure 7 GMSK Occupied Bandwidth – 1930.2 MHz – Single Carrier

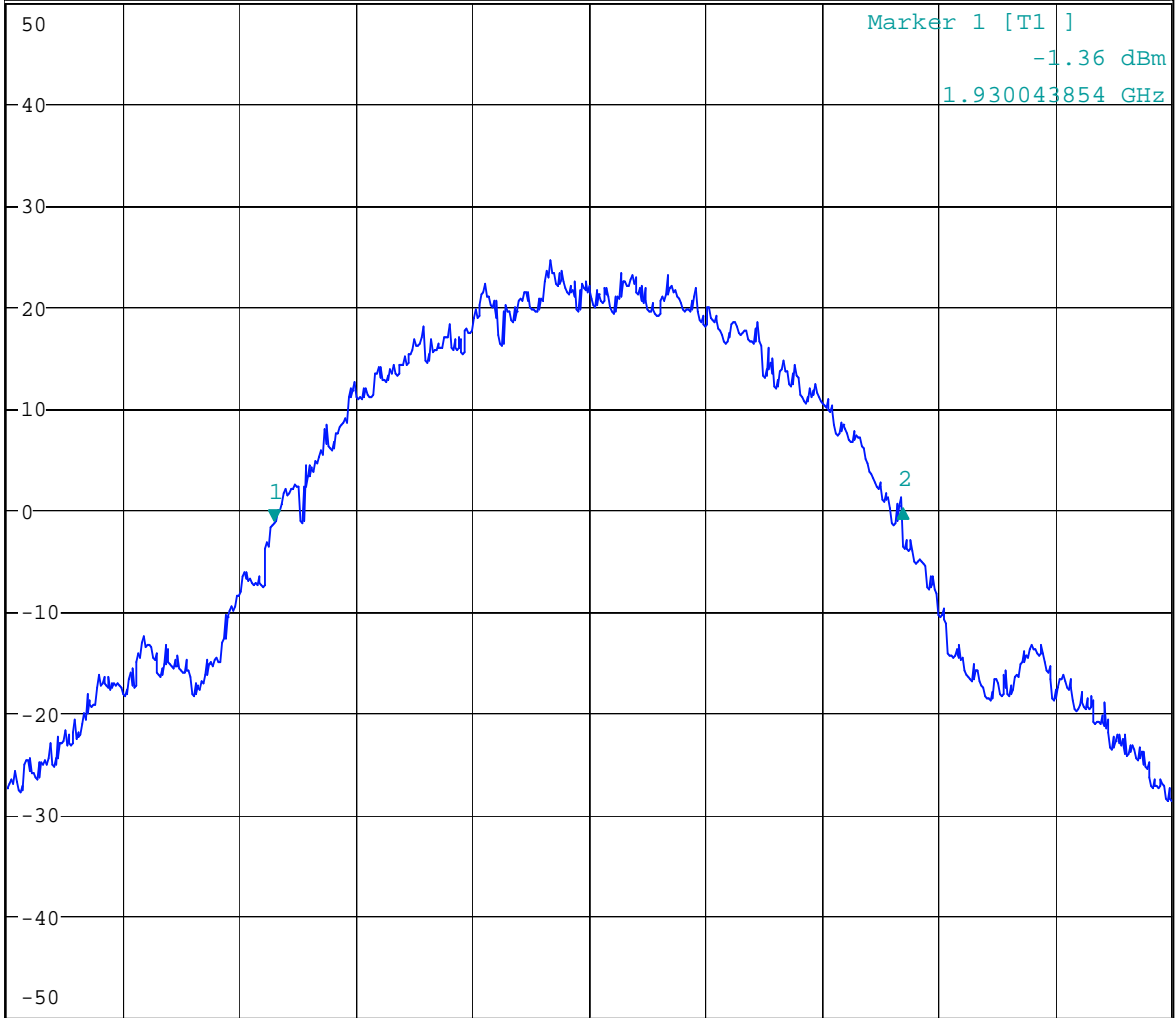


\* RBW 3 kHz      Delta 2 [T1 ]  
\* VBW 30 kHz      1.21 dB  
SWT 65 ms      311.368091077 kHz

Ref 50 dBm

\* Att 15 dB

1 PK \*  
VIEW



Center 1.9302 GHz

57.6539136 kHz/

Span 576.539136 kHz

Date: 1.MAR.2007 15:51:55

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Figure 8 GMSK Occupied Bandwidth – 1960.0 MHz – Single Carrier



\* RBW 3 kHz      Delta 2 [T1 ]  
\* VBW 3 kHz      -0.05 dB  
SWT 130 ms      315.987795692 kHz

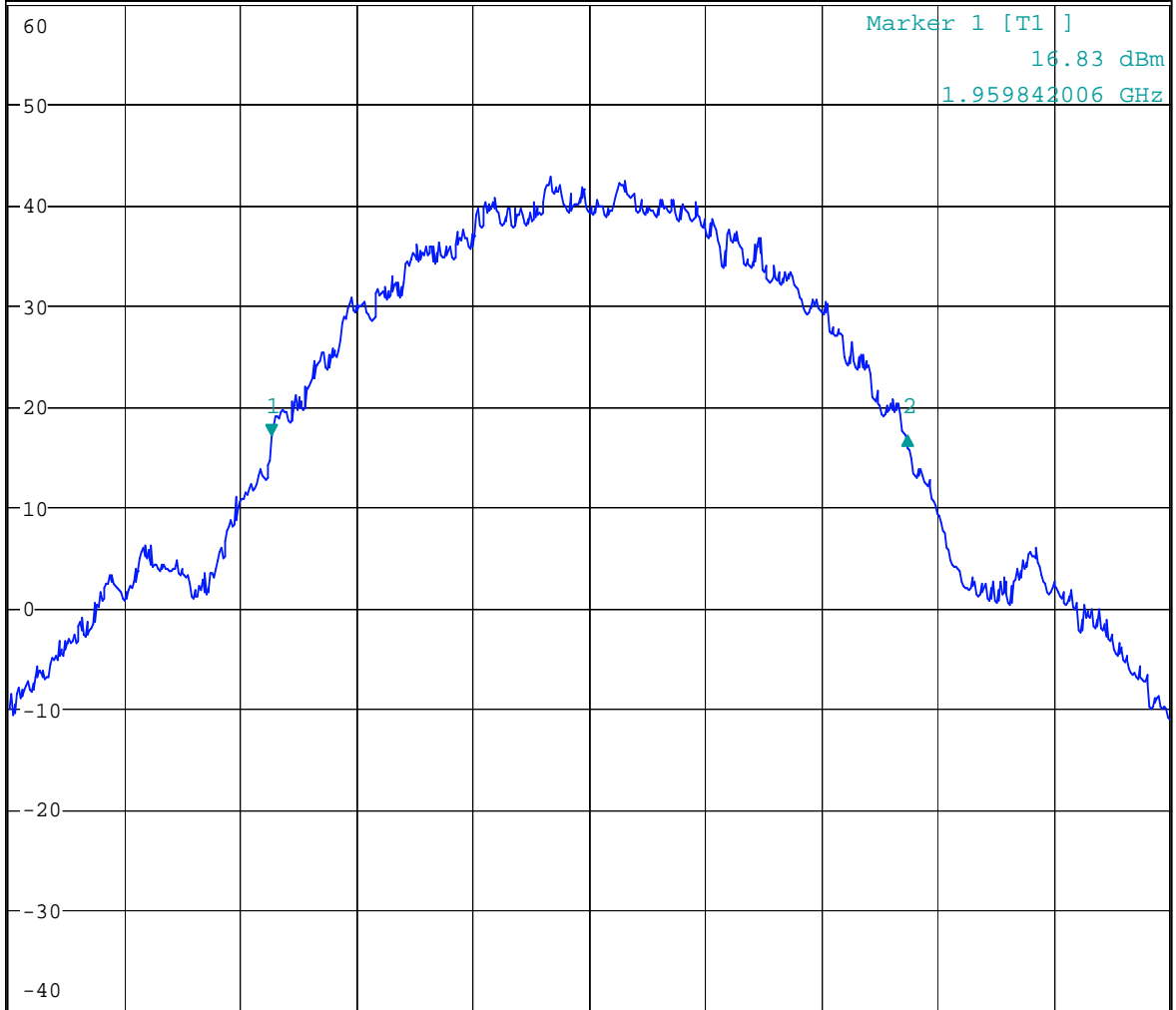
Ref 60 dBm

\* Att 0 dB

SWT 130 ms

315.987795692 kHz

1 PK \*  
VIEW



A

TDF

Center 1.96 GHz

57.6539136 kHz/

Span 576.539136 kHz

Date: 1.MAR.2007 16:18:15

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Figure 9 GMSK Occupied Bandwidth – 1989.8 MHz – Single Carrier



\* RBW 3 kHz      Delta 2 [T1 ]  
\* VBW 3 kHz      -0.44 dB  
SWT 130 ms      315.987795692 kHz

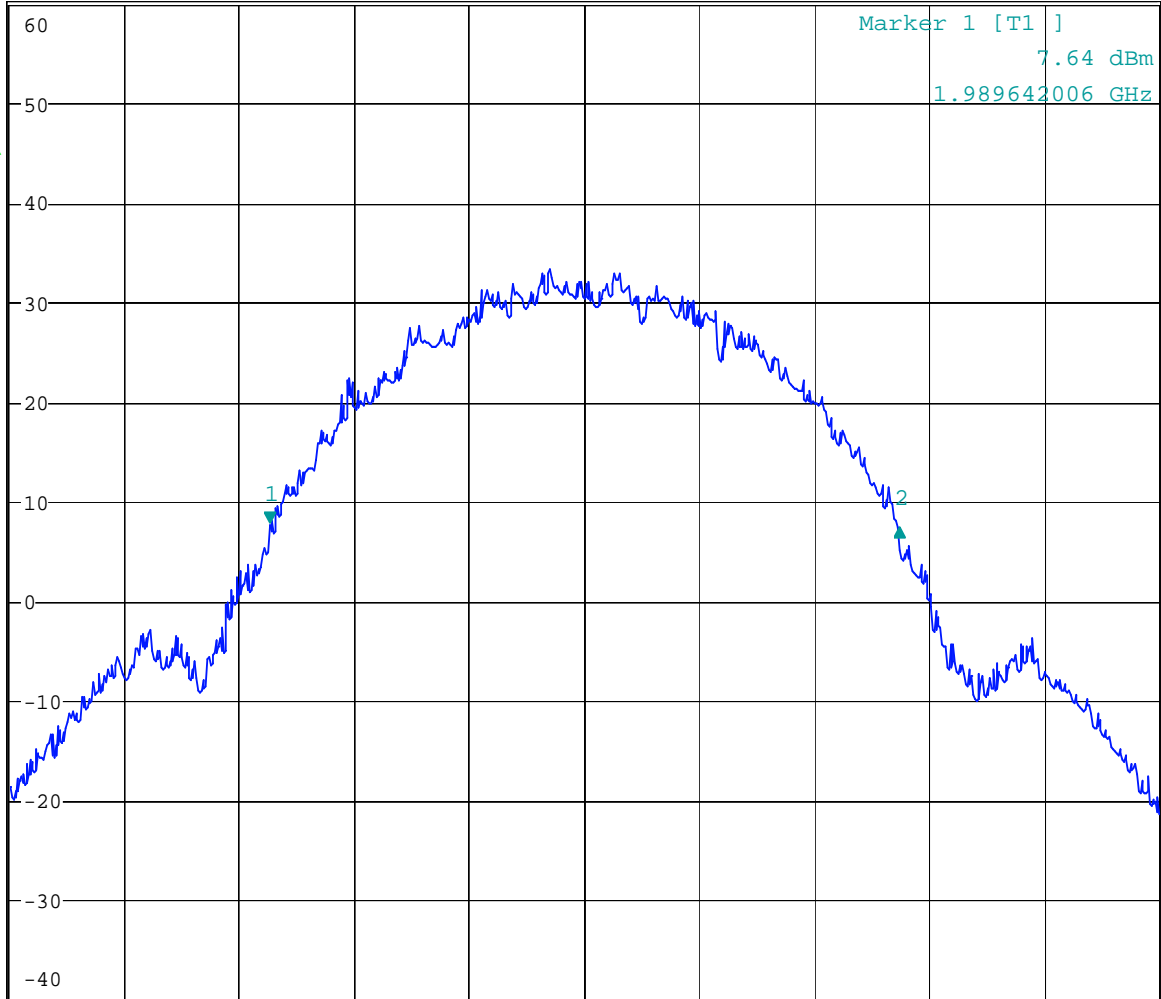
Ref 60 dBm

\* Att 0 dB

SWT 130 ms

315.987795692 kHz

1 PK \*  
VIEW



A

TDF

Center 1.9898 GHz

57.6539136 kHz/

Span 576.539136 kHz

Date: 1.MAR.2007 16:23:44

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Figure 10 8PSK Occupied Bandwidth – 1930.2 MHz – Single Carrier



\*RBW 3 kHz      Delta 2 [T1 ]  
\*VBW 30 kHz      -0.05 dB  
SWT 65 ms      304.900504615 kHz

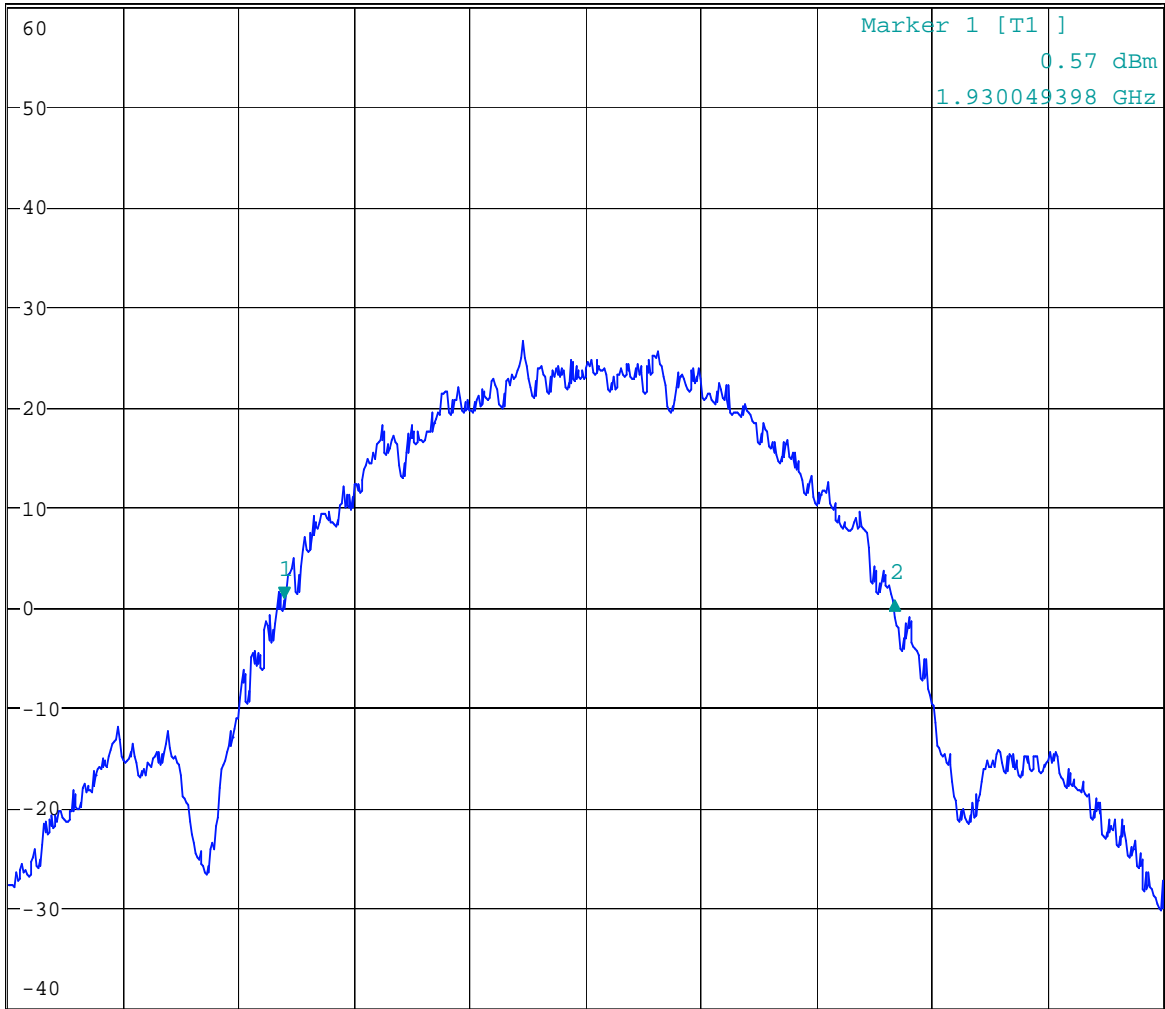
Ref 60 dBm

\*Att 0 dB

SWT 65 ms

304.900504615 kHz

1 PK \*  
VIEW



Center 1.9302 GHz

57.6539136 kHz/

Span 576.539136 kHz

Date: 1.MAR.2007 16:44:00

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Figure 11 8PSK Occupied Bandwidth – 1960.0 MHz – Single Carrier



\*RBW 3 kHz      Delta 2 [T1 ]  
\*VBW 30 kHz      -1.00 dB  
SWT 65 ms      311.368091076 kHz

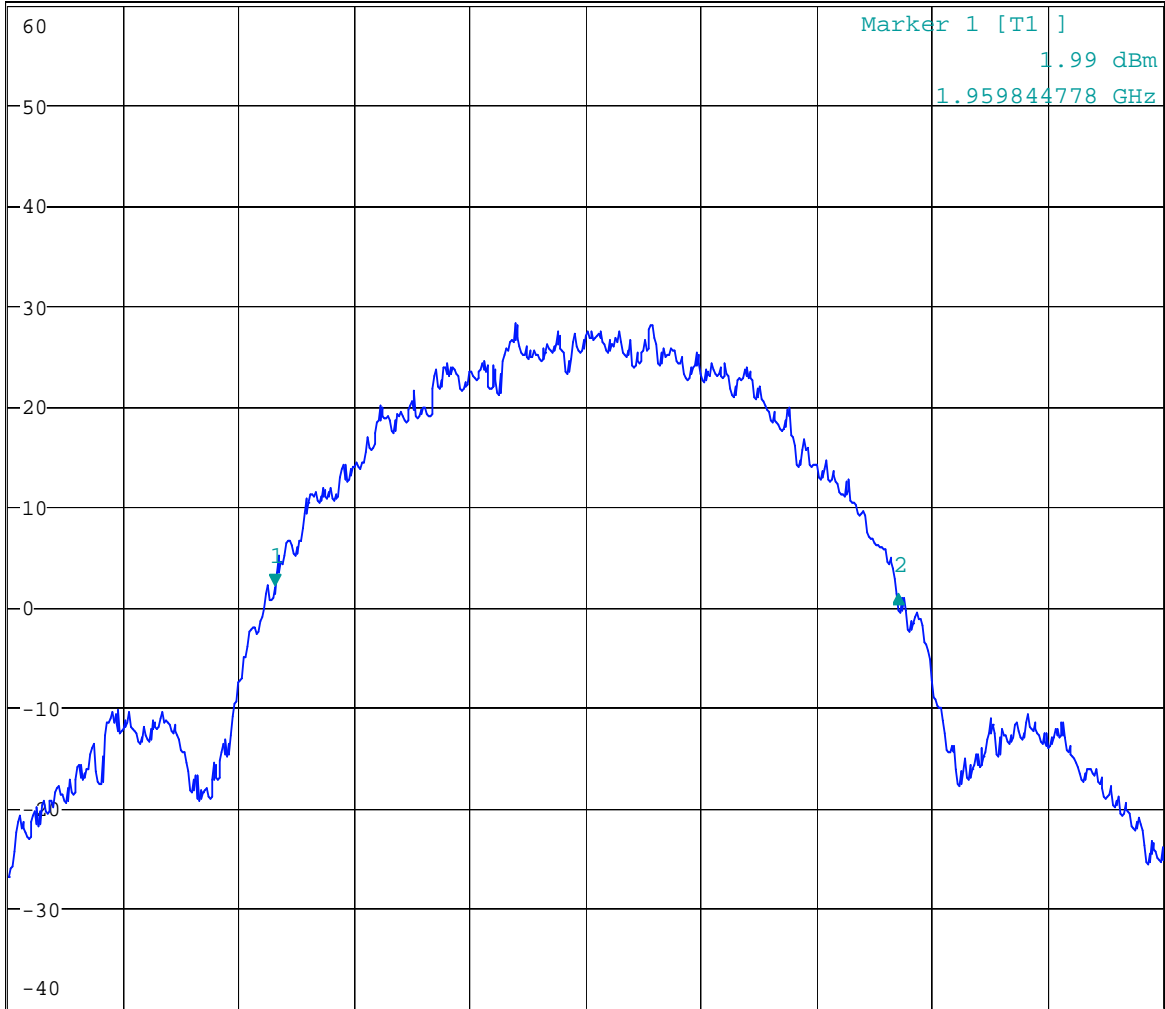
Ref 60 dBm

\*Att 0 dB

SWT 65 ms

311.368091076 kHz

1 PK \*  
VIEW



A

TDF

Center 1.96 GHz

57.6539136 kHz/

Span 576.539136 kHz

Date: 1.MAR.2007 17:14:25

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Figure 12 8PSK Occupied Bandwidth – 1989.8 MHz – Single Carrier



\*RBW 3 kHz      Delta 2 [T1 ]  
\*VBW 30 kHz      0.38 dB  
SWT 65 ms      308.677594666 kHz

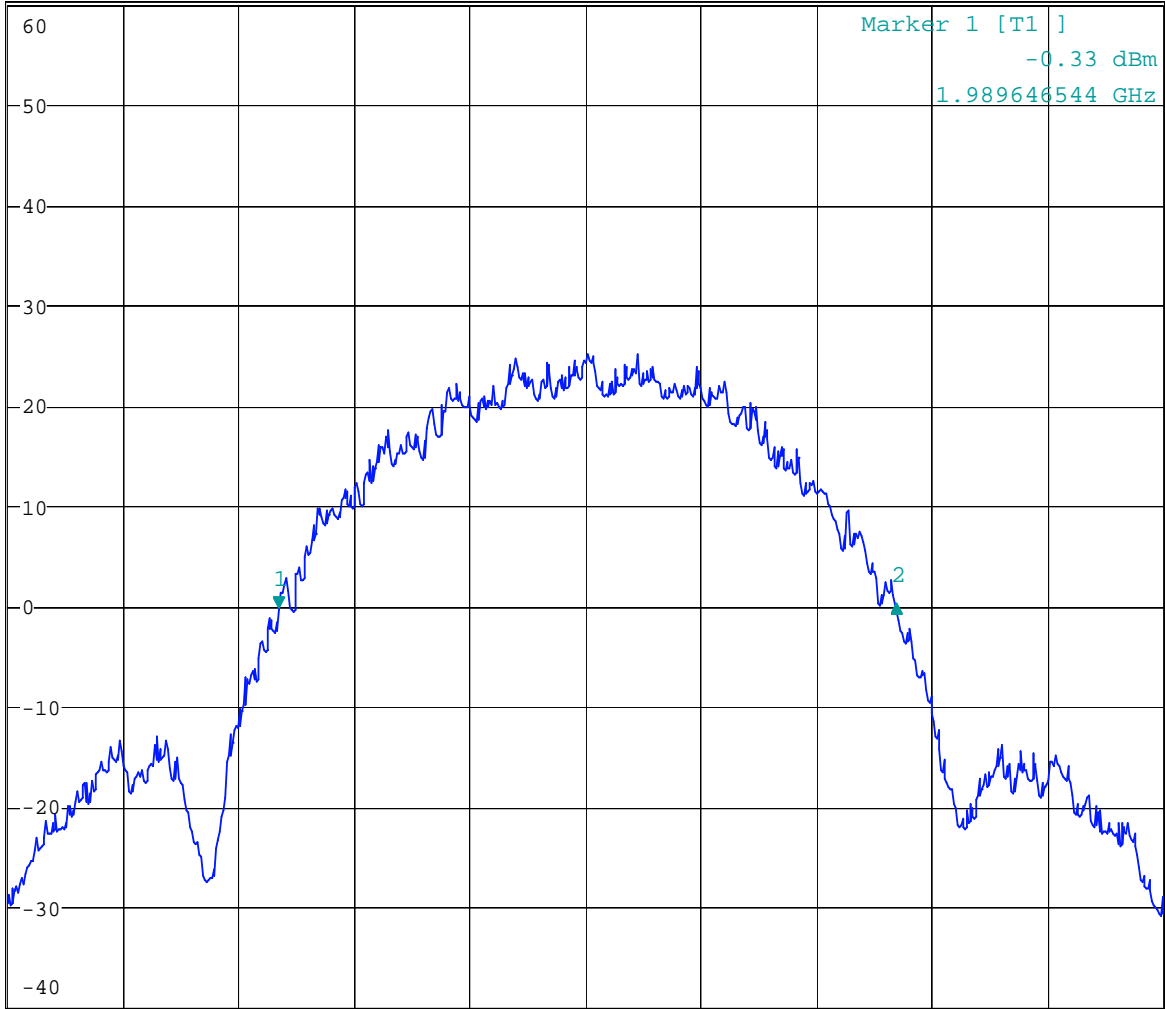
Ref 60 dBm

\*Att 5 dB

SWT 65 ms

308.677594666 kHz

1 PK \*  
VIEW



A

TDF

Center 1.9898 GHz

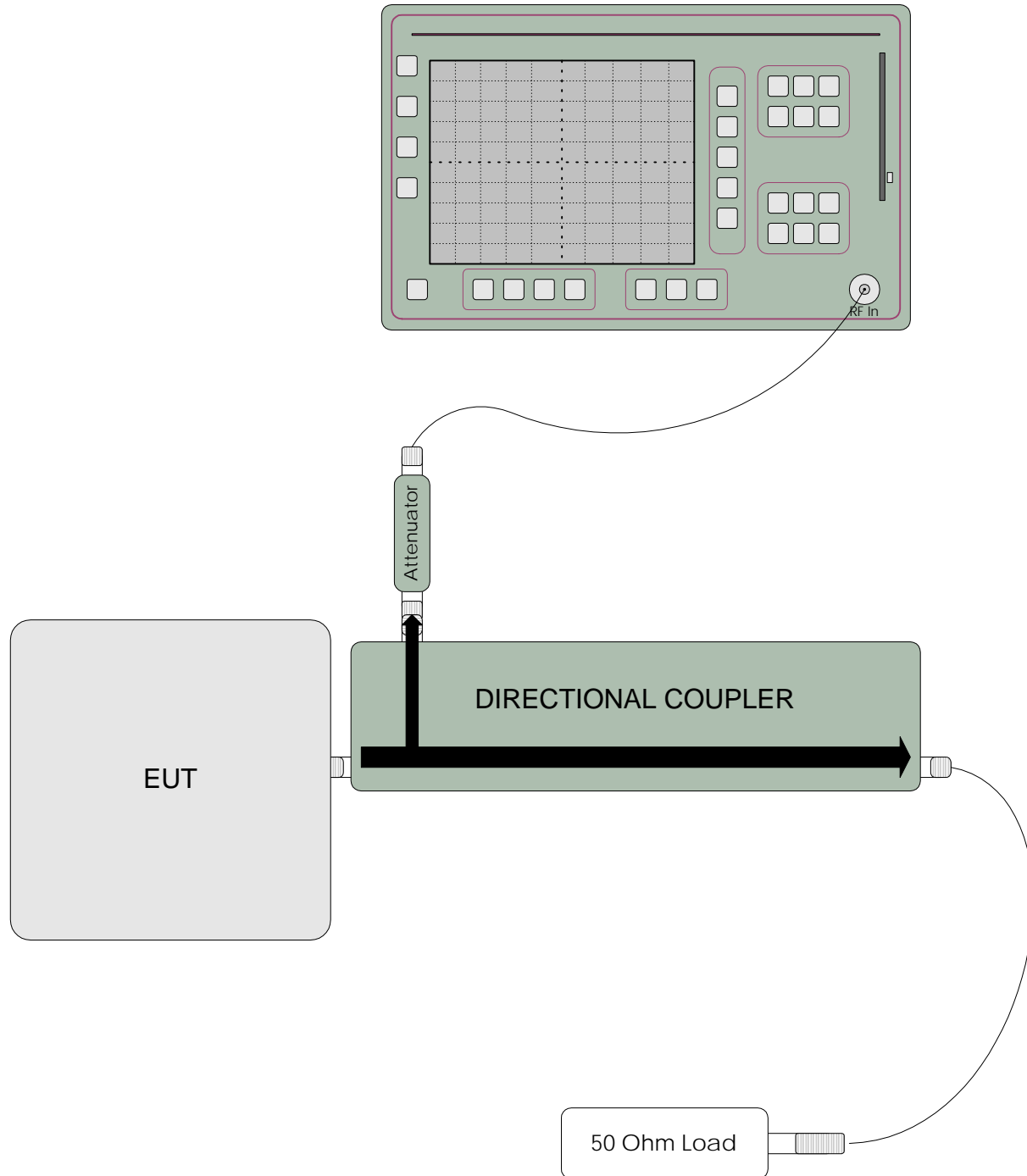
57.6539136 kHz/

Span 576.539136 kHz

Date: 1.MAR.2007 17:29:14

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**C.9. Test Diagram**



**C.10. Tested By**

Name: Tom Tidwell,  
Function: Manager of Wireless Services

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## APPENDIX D: 2.1051 SPURIOUS EMISSIONS AT ANTENNA TERMINALS

### D.1. Base Standard & Test Basis

<b>Base Standard</b>	FCC 2.1051
<b>Test Basis</b>	FCC 2.1051 Spurious Emissions at Antenna Terminals
<b>Test Method</b>	TIA 603-C, 2004

### D.2. Specifications

24.238 Emission limitations for Broadband PCS equipment

(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

### D.3. Measurement Uncertainty

<b>Expanded Uncertainty (K=2)</b>
+1.11/-1.22

### D.4. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

### D.5. Test Results

Complies. All emissions meet the out of band limits.

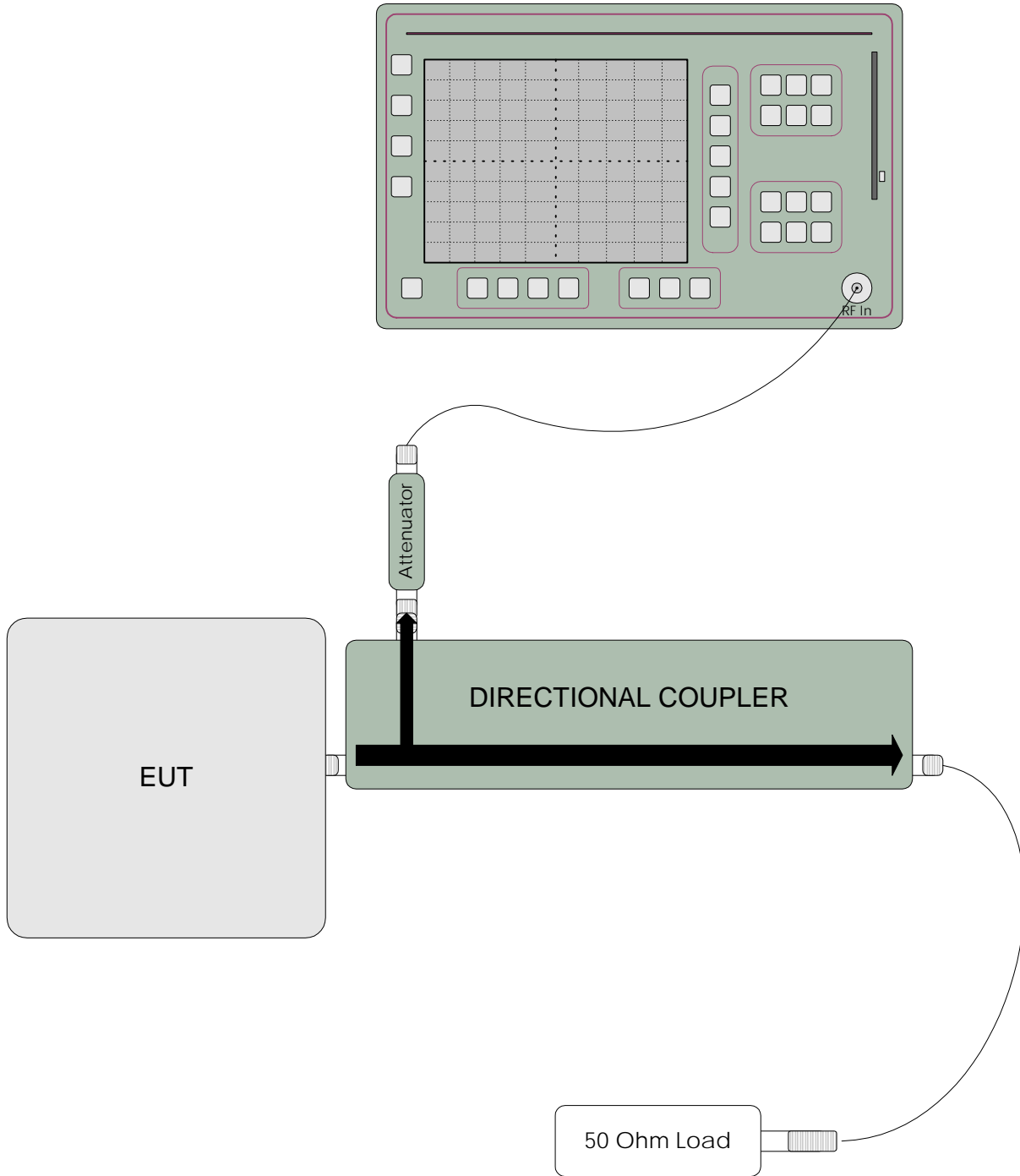
Out-of-Band Emissions limit is  $43 + 10 \log(P)$  which relates to -13 dBm absolute power.

Attenuation limit =  $43 + 10 \log(100) = 63$  dB

---

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**D.6. Test Diagram**



**D.7. Test Data**

See following pages.

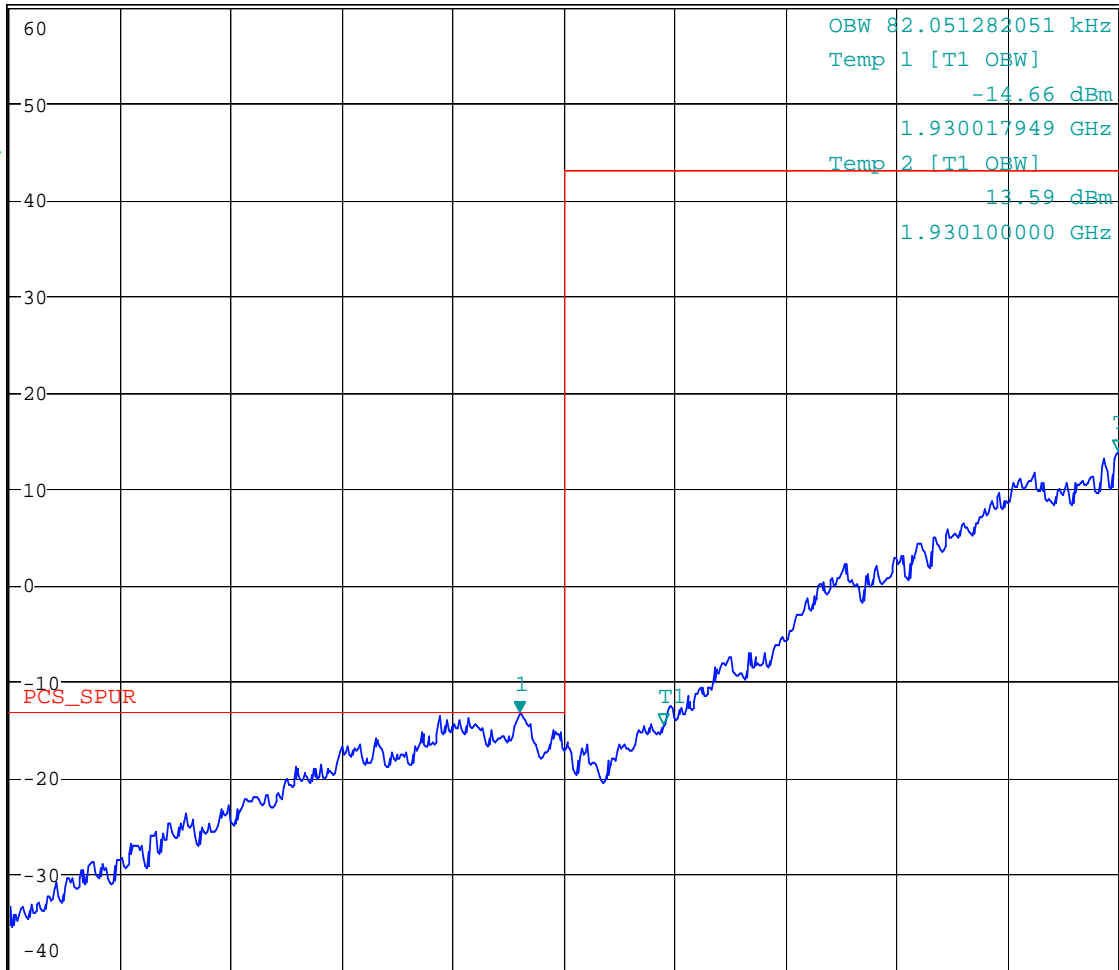
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Figure 13 Antenna Conducted Spurious – Lower Band Edge – GMSK mode – Combined Carrier – PCS Band



\*RBW 3 kHz      Marker 1 [T1 ]  
\*VBW 3 kHz      -13.36 dBm  
Ref 60 dBm      \*Att 0 dB      SWT 45 ms      1.929991907 GHz

1 RM \*  
VIEW



Center 1.93 GHz      20 kHz/      Span 200 kHz

Date: 28.FEB.2007 21:51:34

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Figure 14 Antenna Conducted Spurious – Upper Band Edge – GMSK mode – Combined Carrier – PCS Band

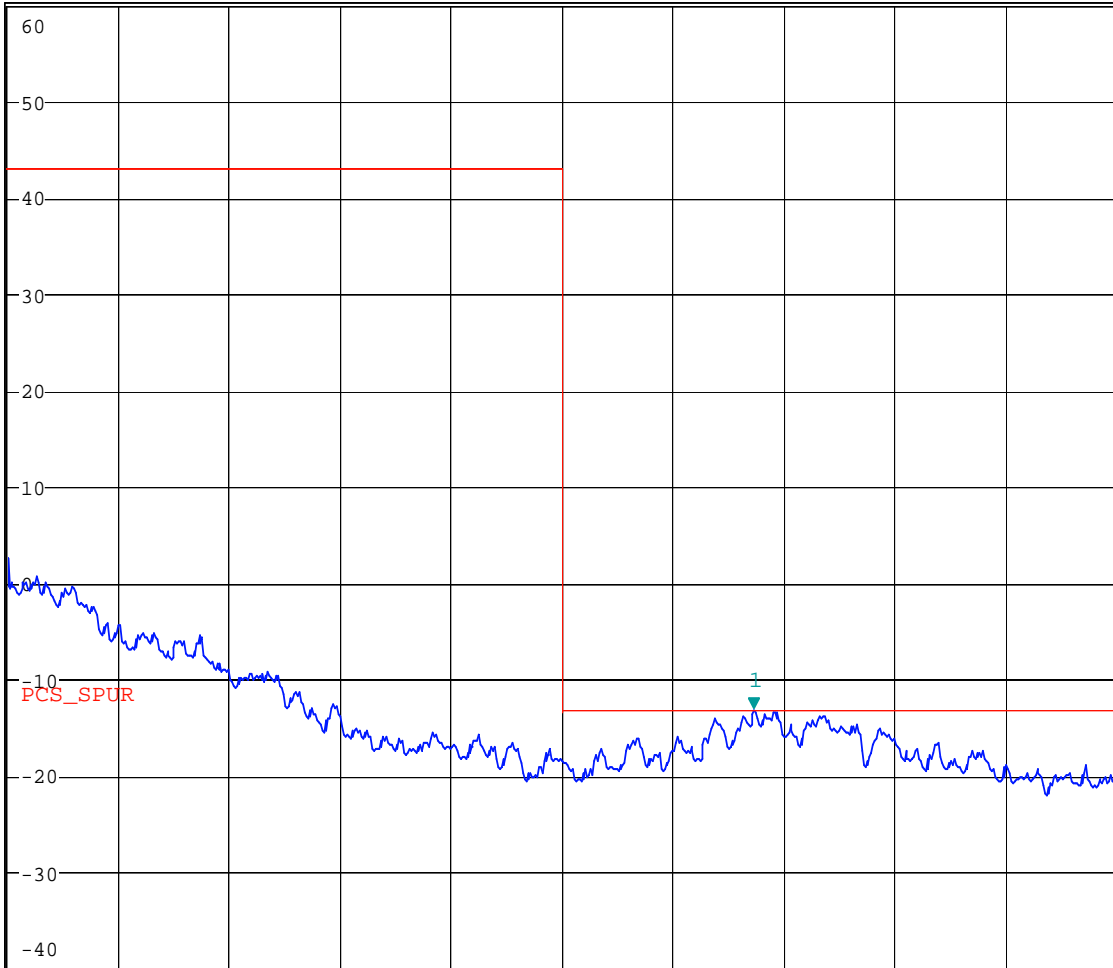


\* RBW 3 kHz  
\* VBW 3 kHz  
SWT 25 ms  
Marker 1 [T1 ]  
-13.19 dBm  
1.990017241 GHz

Ref 60 dBm

\* Att 0 dB

1 PK \*  
VIEW



Center 1.99 GHz

10 kHz/

Span 100 kHz

Date: 28.FEB.2007 23:05:14

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Figure 15 Antenna Conducted Spurious – Lower Band Edge – 8PSK mode – Combined Carrier – PCS Band

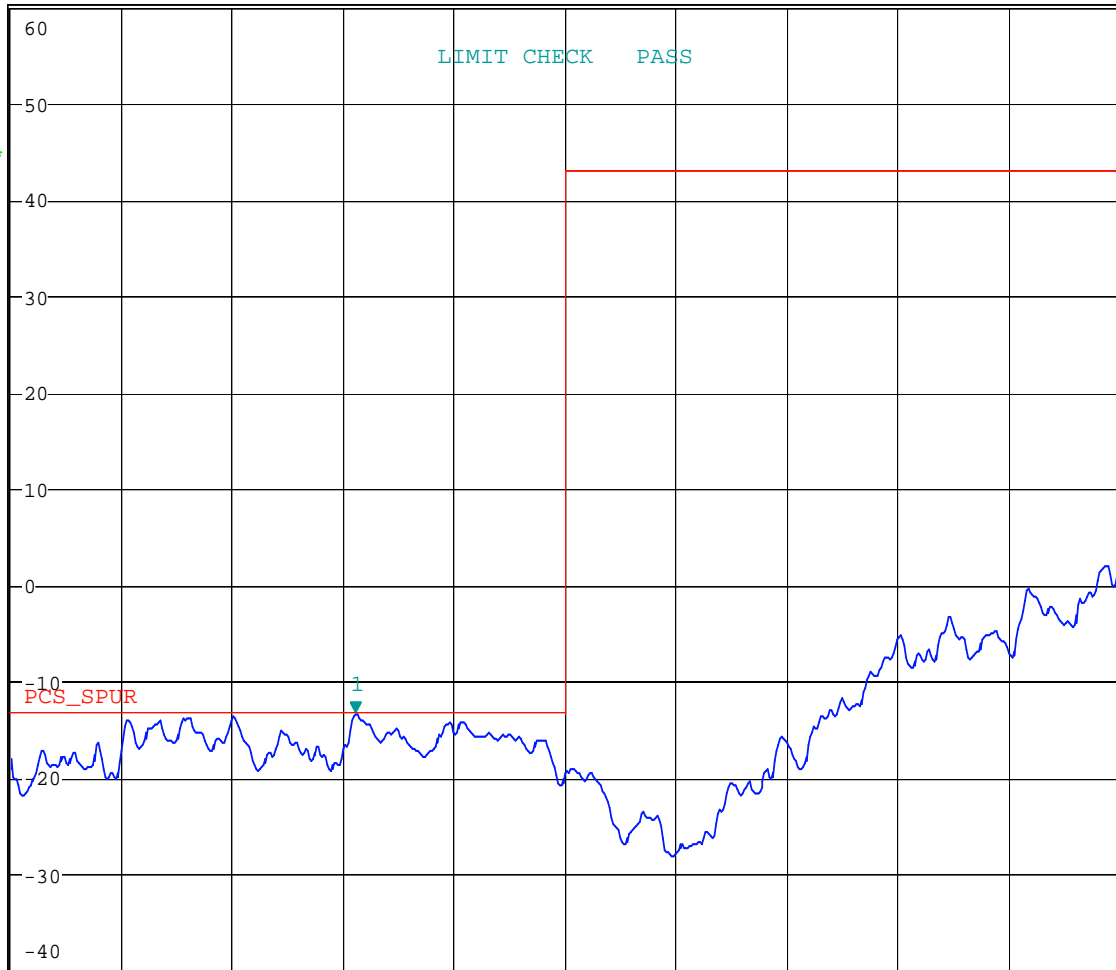


\* RBW 3 kHz      Marker 1 [T1 ]  
\* VBW 3 kHz      -13.46 dBm  
SWT 25 ms      1.929981060 GHz

Ref 60 dBm

\* Att 0 dB

1 RM \*  
VIEW



Center 1.93 GHz

10 kHz/

Span 100 kHz

Date: 28.FEB.2007 23:30:15

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Figure 16 Antenna Conducted Spurious – Upper Band Edge – 8PSK mode – Combined Carrier – PCS Band



\*RBW 3 kHz      Delta 2 [T1 ]  
\*VBW 3 kHz      -31.95 dB  
SWT 45 ms      123.095597952 kHz

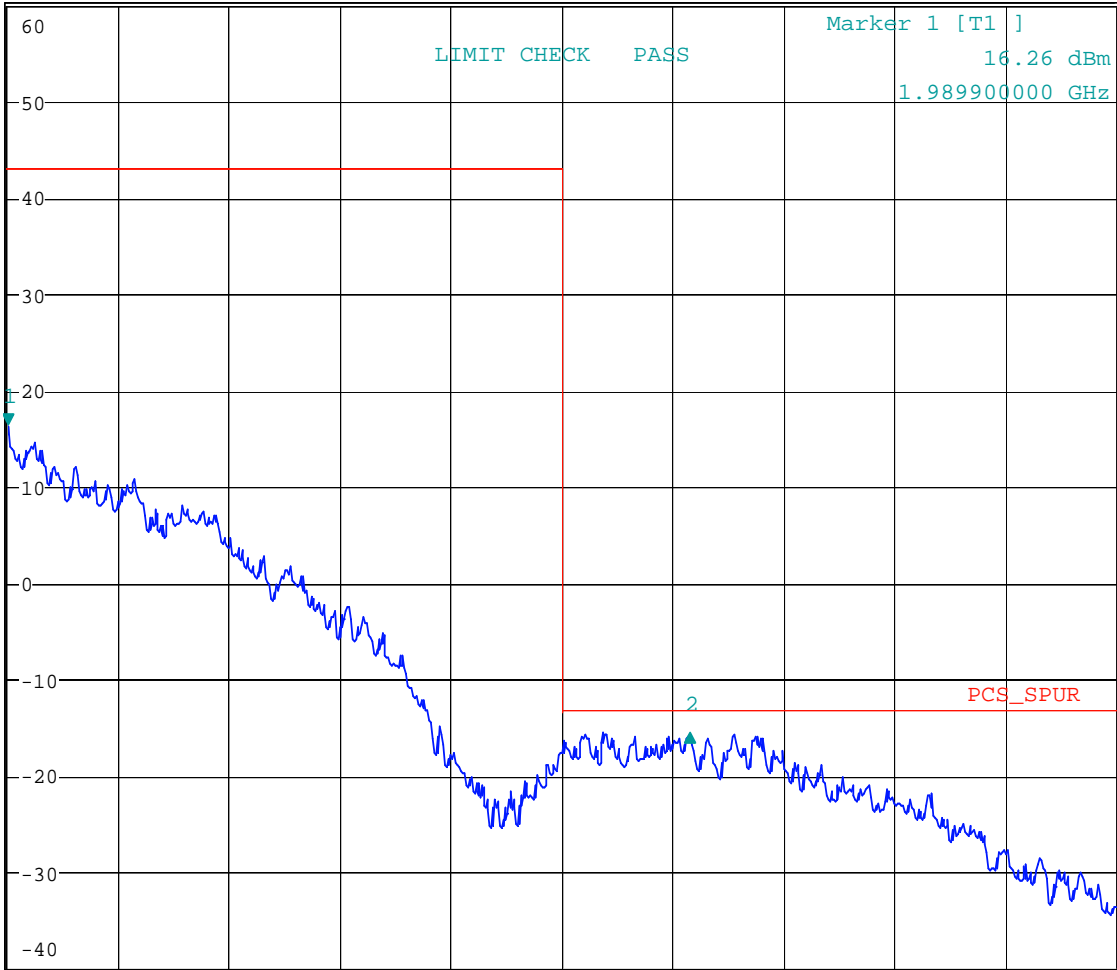
Ref 60 dBm

\*Att 0 dB

SWT 45 ms

123.095597952 kHz

1 PK \*  
VIEW



Center 1.99 GHz

20 kHz/

Span 200 kHz

Date: 1.MAR.2007 00:06:09

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Figure 17 Antenna Conducted Spurious – Lower Band Edge – GMSK mode – Single Carrier – PCS Band



\* RBW 3 kHz  
\* VBW 3 kHz  
SWT 45 ms  
Marker 1 [T1 ]  
-13.80 dBm  
1.929985082 GHz

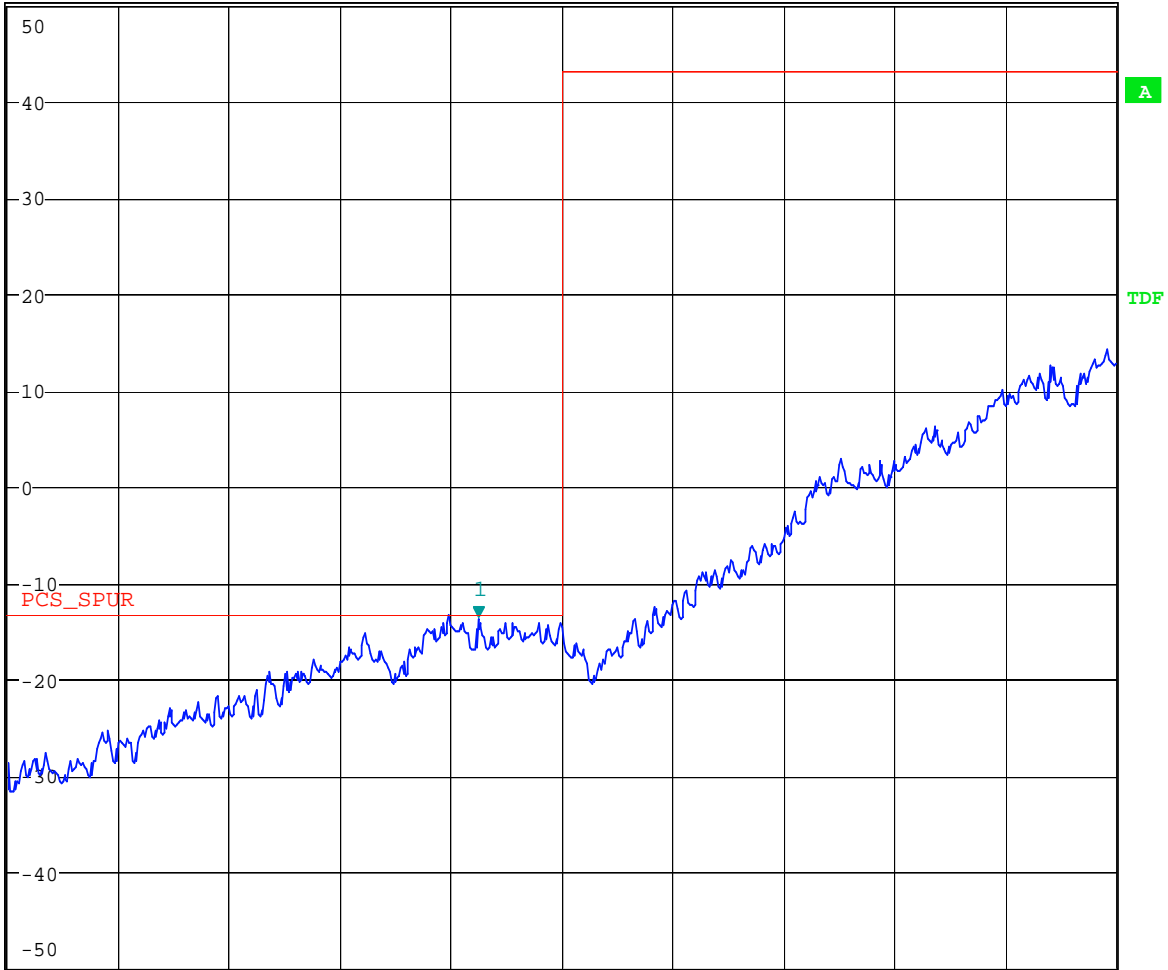
Ref 50 dBm

\* Att 15 dB

SWT 45 ms

1.929985082 GHz

1 PK \*  
VIEW



Center 1.93 GHz

20 kHz/

Span 200 kHz

Date: 1.MAR.2007 15:45:56

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Figure 18 Antenna Conducted Spurious – Upper Band Edge – GMSK mode – Single Carrier – PCS Band



\* RBW 3 kHz  
\* VBW 3 kHz  
SWT 25 ms  
Marker 1 [T1 ]  
-13.23 dBm  
1.990025801 GHz

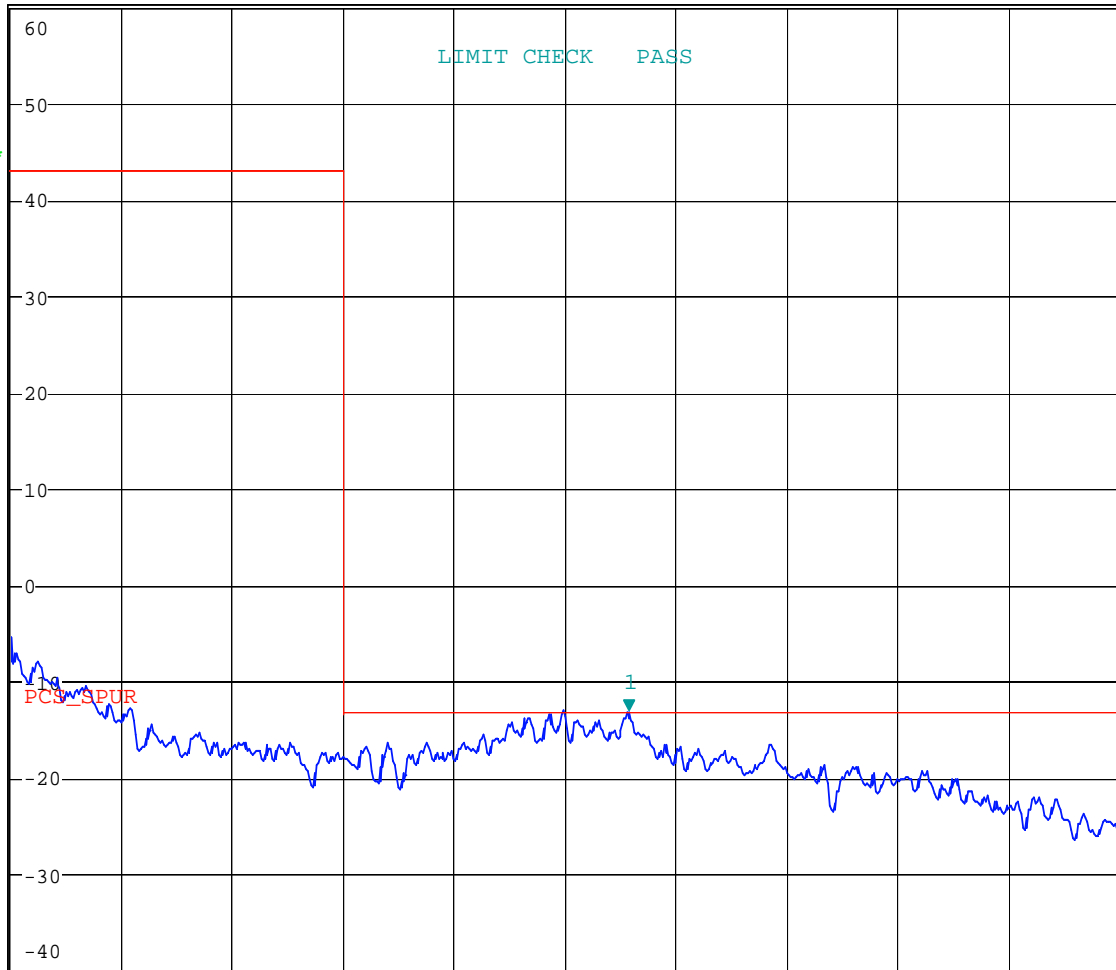
Ref 60 dBm

\* Att 0 dB

SWT 25 ms

1.990025801 GHz

1 PK \*  
VIEW



Center 1.99002 GHz

10 kHz/

Span 100 kHz

Date: 1.MAR.2007 16:29:00

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Figure 19 Antenna Conducted Spurious – Lower Band Edge – 8PSK mode –Single Carrier – PCS Band



\* RBW 3 kHz  
\* VBW 3 kHz  
SWT 45 ms

Marker 1 [T1 ]  
-13.80 dBm  
1.929988462 GHz

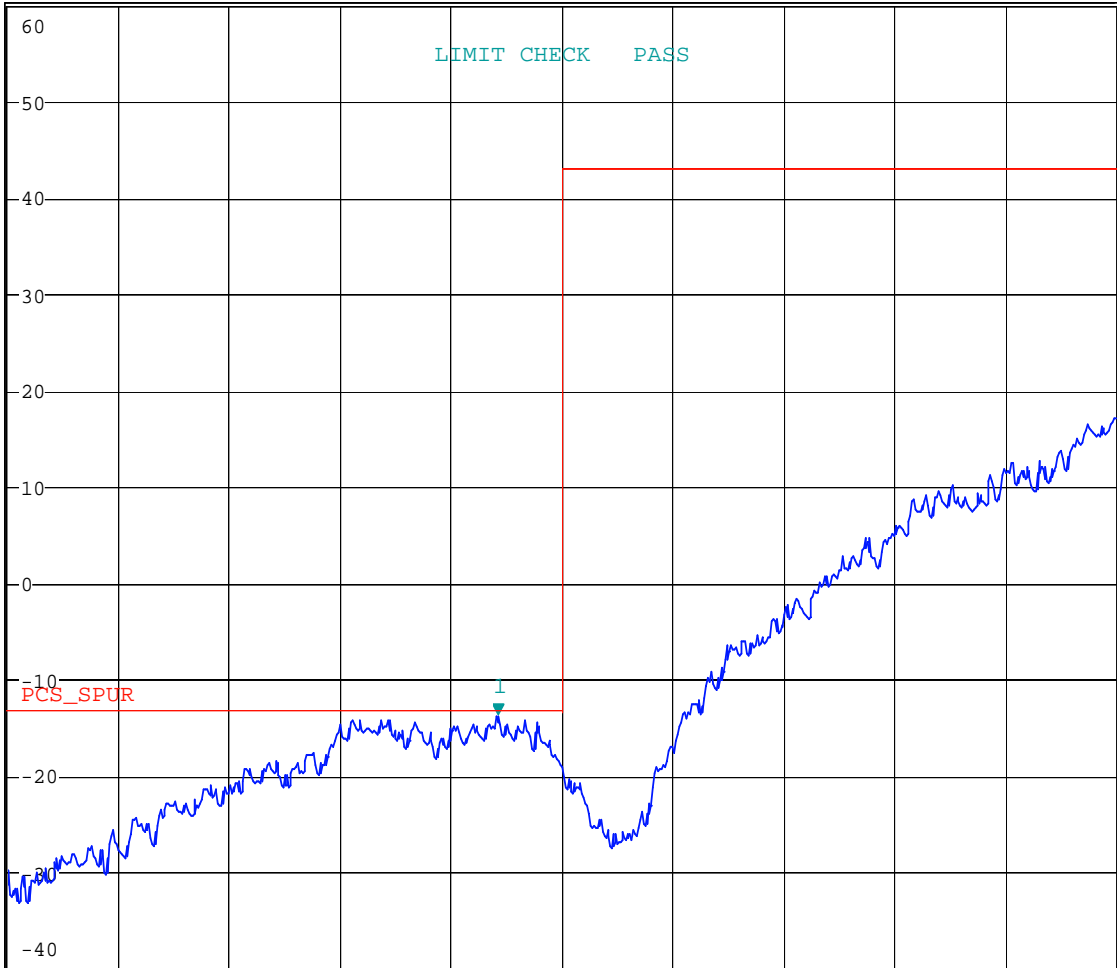
Ref 60 dBm

\* Att 0 dB

SWT 45 ms

1.929988462 GHz

1 PK \*  
VIEW



Center 1.93 GHz

20 kHz/

Span 200 kHz

Date: 1.MAR.2007 16:40:59

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Figure 20 Antenna Conducted Spurious – Upper Band Edge – 8PSK mode – Single Carrier – PCS Band

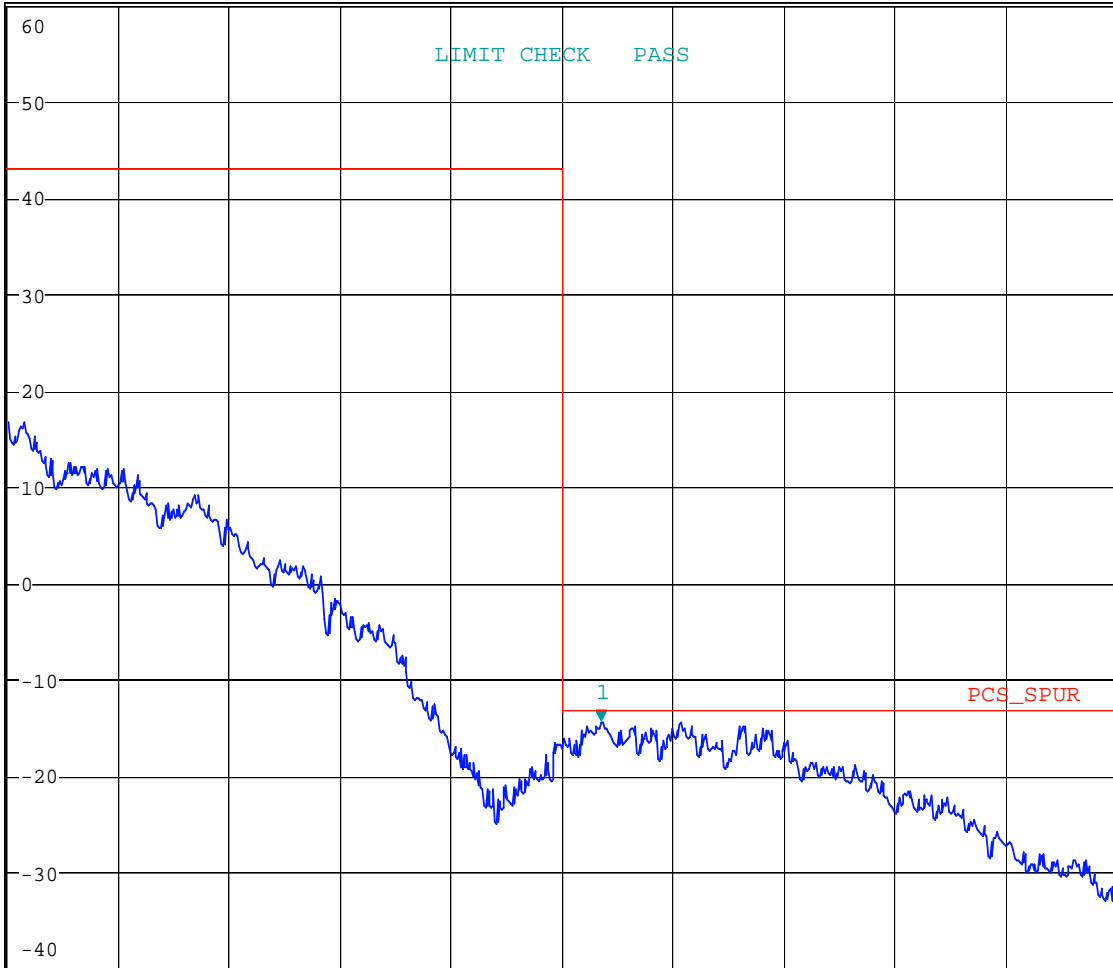


\* RBW 3 kHz      Marker 1 [T1 ]  
\* VBW 3 kHz      -14.45 dBm  
SWT 45 ms      1.990007051 GHz

Ref 60 dBm

\* Att 0 dB

1 PK \*  
VIEW



A

TDF

Center 1.99 GHz

20 kHz/

Span 200 kHz

Date: 1.MAR.2007 17:24:51

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Figure 21 Antenna Conducted Spurious – GMSK 1930.2 MHz – Combined Carrier Mode

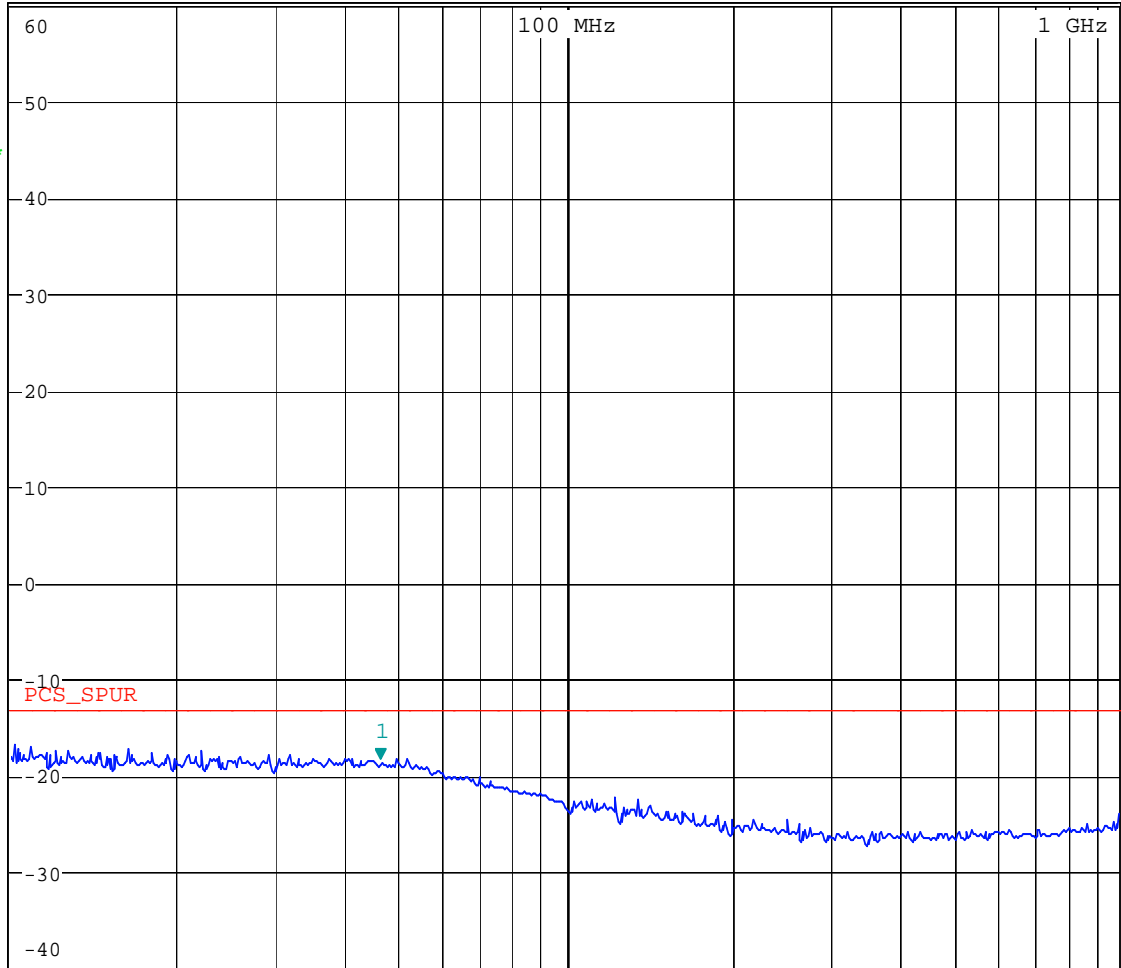


\* RBW 1 MHz      Marker 1 [T1 ]  
VBW 10 MHz      -18.47 dBm  
SWT 20 ms      46.415888336 MHz

Ref 60 dBm

\* Att 10 dB

1 RM \*  
CLRWR



Start 10 MHz

Stop 1 GHz

Date: 28.FEB.2007 22:17:08

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Figure 22 Antenna Conducted Spurious – GMSK 1930.2 MHz – Combined Carrier Mode

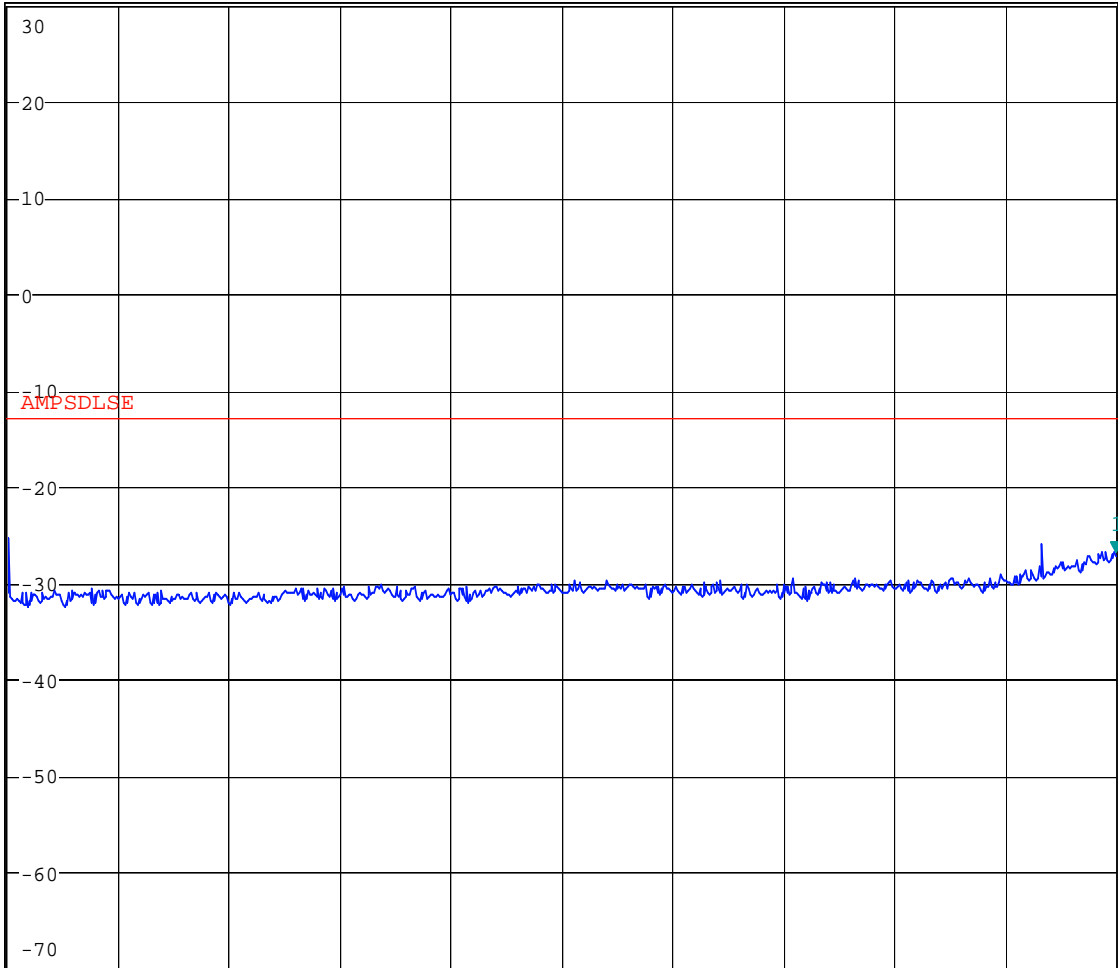


\* RBW 1 MHz  
\* VBW 1 MHz  
SWT 2.5 ms  
Marker 1 [T1 ]  
-27.12 dBm  
2.000000000 GHz

Ref 30 dBm

\* Att 10 dB

1 RM \*  
AVG



Start 1 GHz

100 MHz/

Stop 2 GHz

Date: 28.FEB.2007 22:20:15

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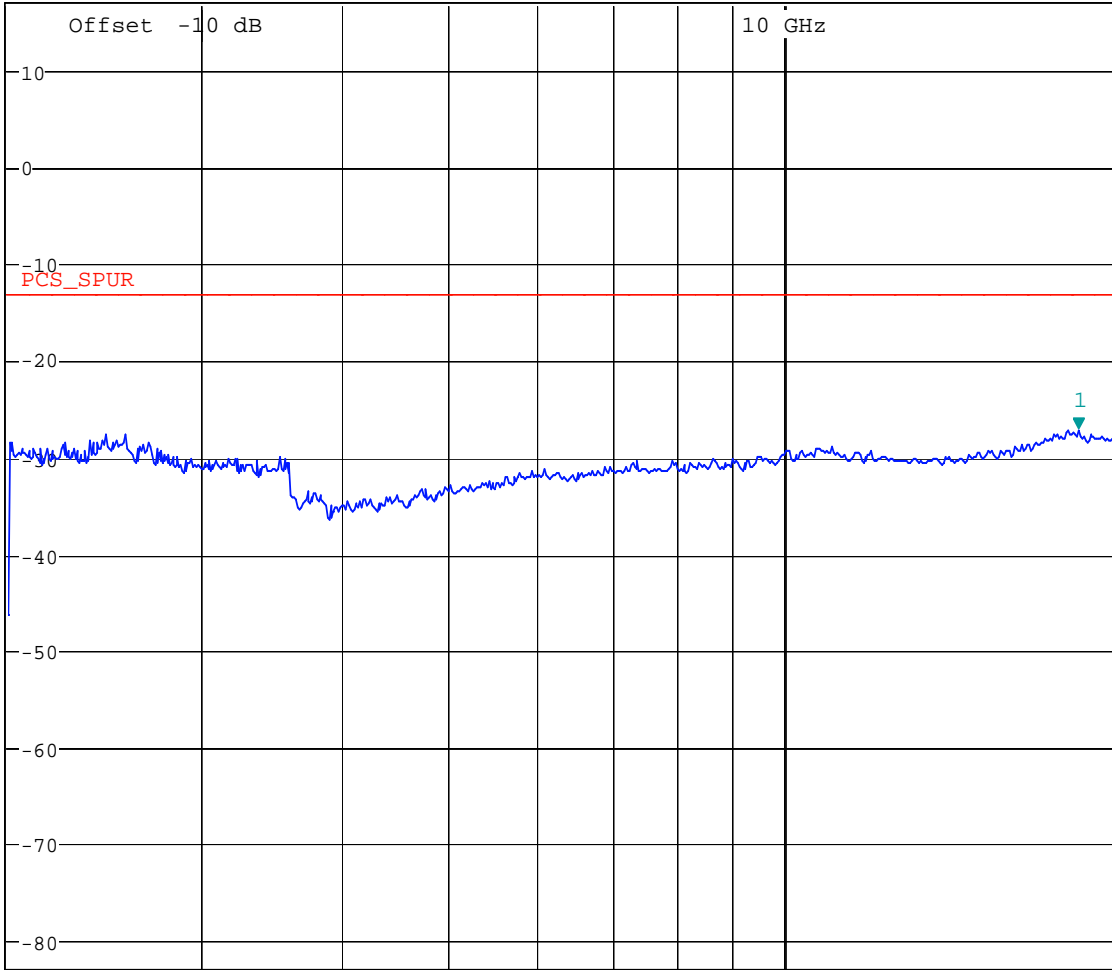
**Figure 23 Antenna Conducted Spurious – GMSK 1930.2 MHz – Combined Carrier Mode**



\*RBW 1 MHz      Marker 1 [T1 ]  
\*VBW 1 MHz      -27.15 dBm  
SWT 105 ms      18.508709944 GHz

Ref 17 dBm

\*Att 0 dB



Start 2 GHz

Stop 20 GHz

Date: 28.FEB.2007 22:23:06

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Figure 24 Antenna Conducted Spurious – GMSK 1960.0 MHz –Combined Carrier Mode

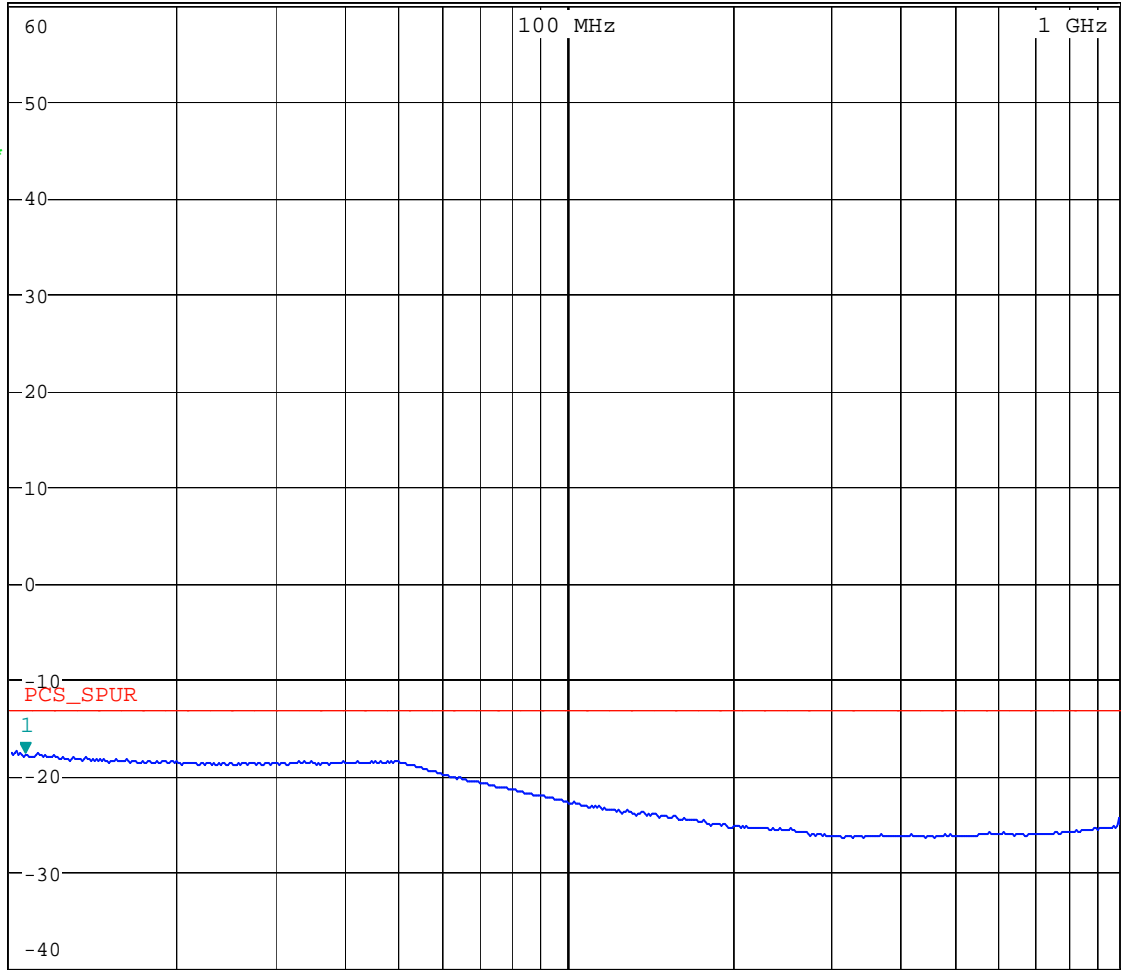


\* RBW 1 MHz      Marker 1 [T1 ]  
VBW 10 MHz      -17.84 dBm  
SWT 20 ms      10.608183551 MHz

Ref 60 dBm

\* Att 10 dB

1 RM \*  
AVG



Start 10 MHz

Stop 1 GHz

Date: 28.FEB.2007 22:50:01

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Figure 25 Antenna Conducted Spurious – GMSK 1960.0 MHz – Combined Carrier Mode

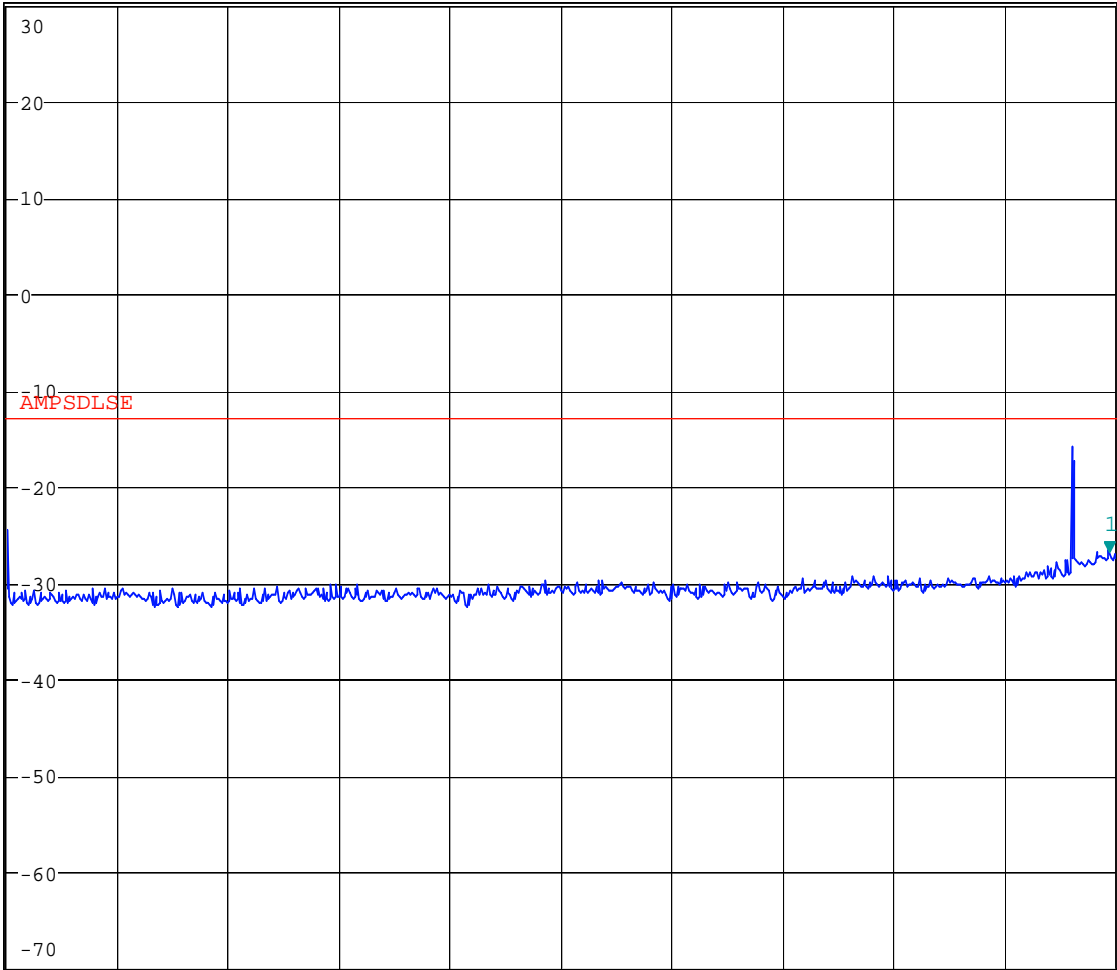


\* RBW 1 MHz      Marker 1 [T1 ]  
\* VBW 1 MHz      -26.97 dBm  
SWT 2.5 ms      1.995264103 GHz

Ref 30 dBm

\* Att 10 dB

1 RM \*  
AVG



Start 1 GHz

100 MHz/

Stop 2 GHz

Date: 28.FEB.2007 22:47:00

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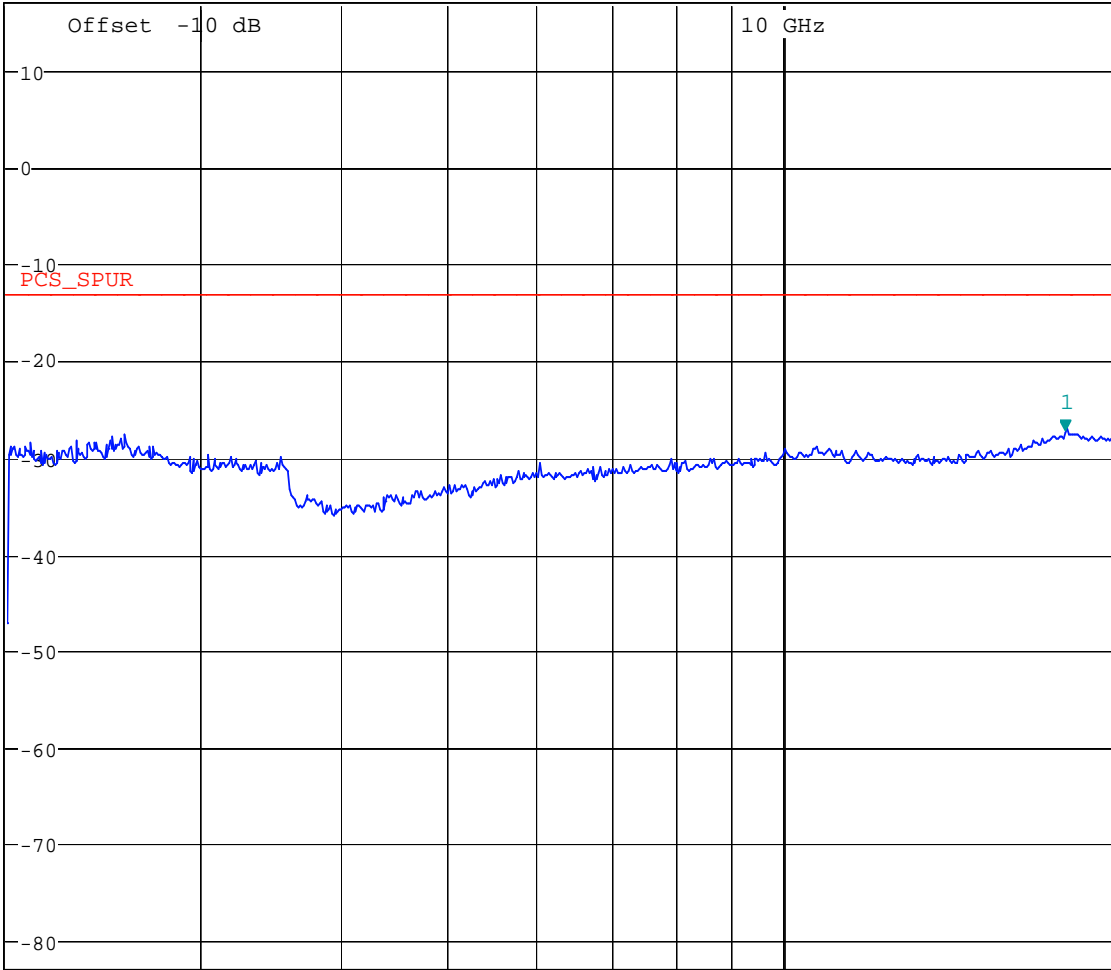
**Figure 26 Antenna Conducted Spurious – GMSK 1960.0 MHz – Combined Carrier Mode**



\* RBW 1 MHz      Marker 1 [T1 ]  
\* VBW 1 MHz      -27.39 dBm  
SWT 105 ms      18.036746472 GHz

Ref 17 dBm

\* Att 0 dB



Start 2 GHz

Stop 20 GHz

Date: 28.FEB.2007 22:48:36

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**Figure 27 Antenna Conducted Spurious – GMSK 1989.8 MHz – Combined Carrier Mode**

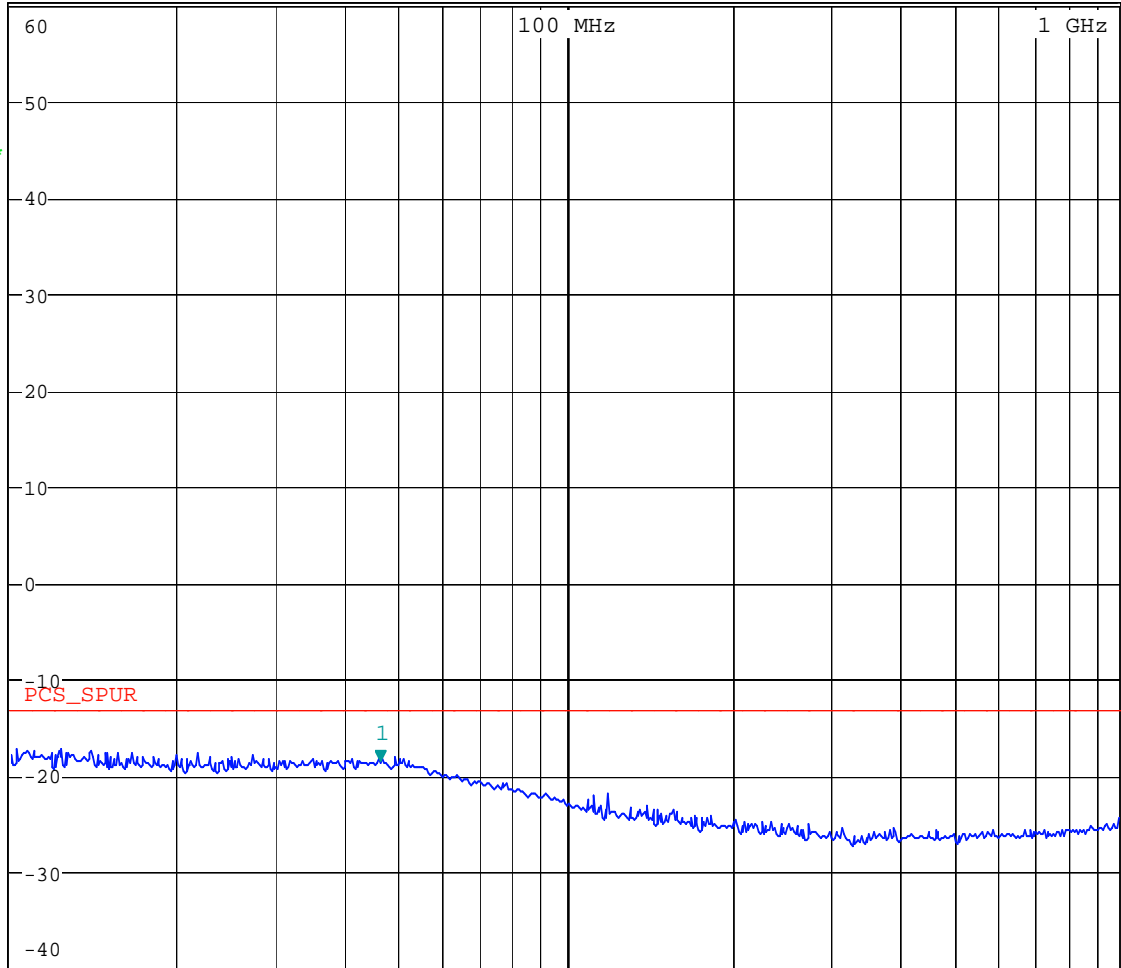


\* RBW 1 MHz      Marker 1 [T1 ]  
VBW 10 MHz      -18.60 dBm  
SWT 20 ms      46.415888336 MHz

Ref 60 dBm

\* Att 10 dB

1 RM \*  
CLRWR



Center 100 MHz

Span 990 MHz

Date: 28.FEB.2007 23:11:02

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Figure 28 Antenna Conducted Spurious – GMSK 1989.8 MHz – Combined Carrier Mode

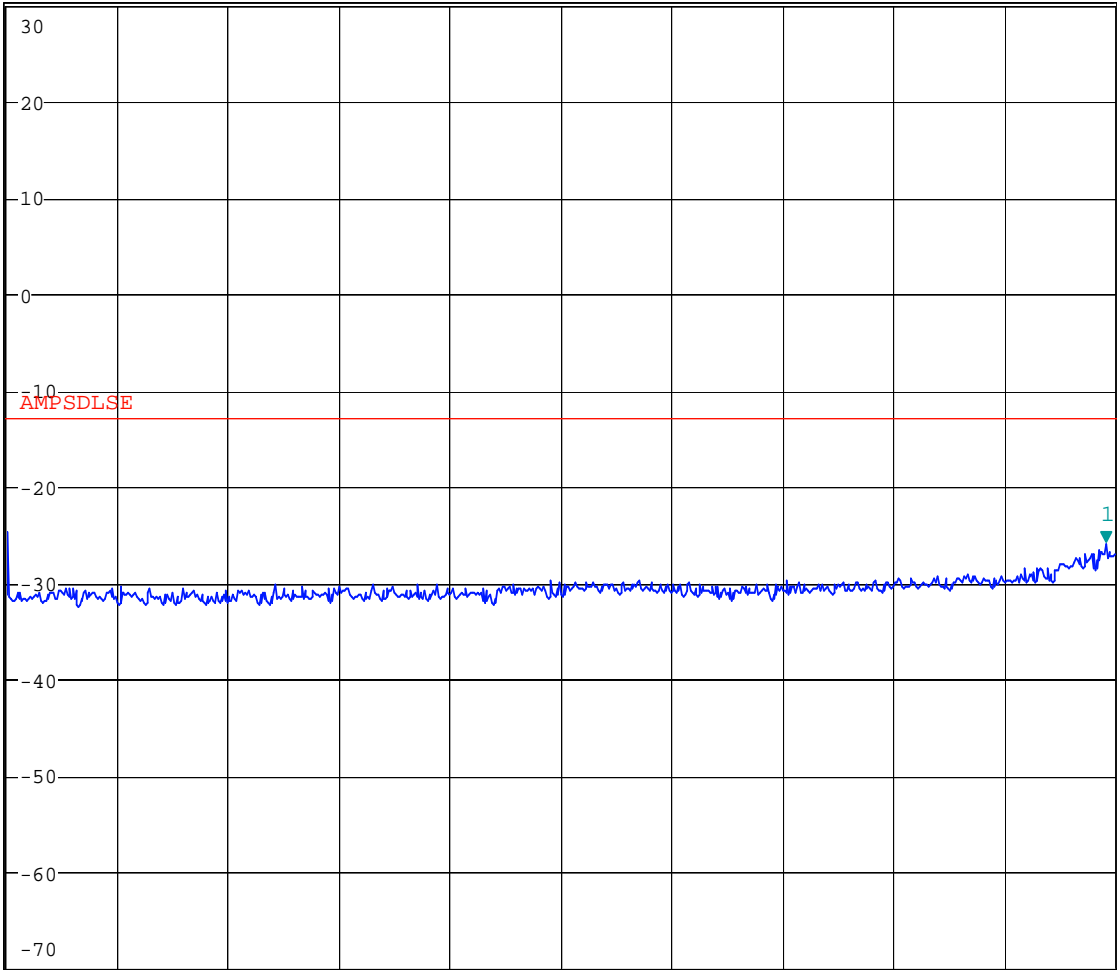


\* RBW 1 MHz      Marker 1 [T1 ]  
\* VBW 1 MHz      -25.93 dBm  
SWT 2.5 ms      1.991987179 GHz

Ref 30 dBm

\* Att 10 dB

1 RM \*  
AVG



Start 1 GHz

100 MHz/

Stop 2 GHz

Date: 28.FEB.2007 23:13:07

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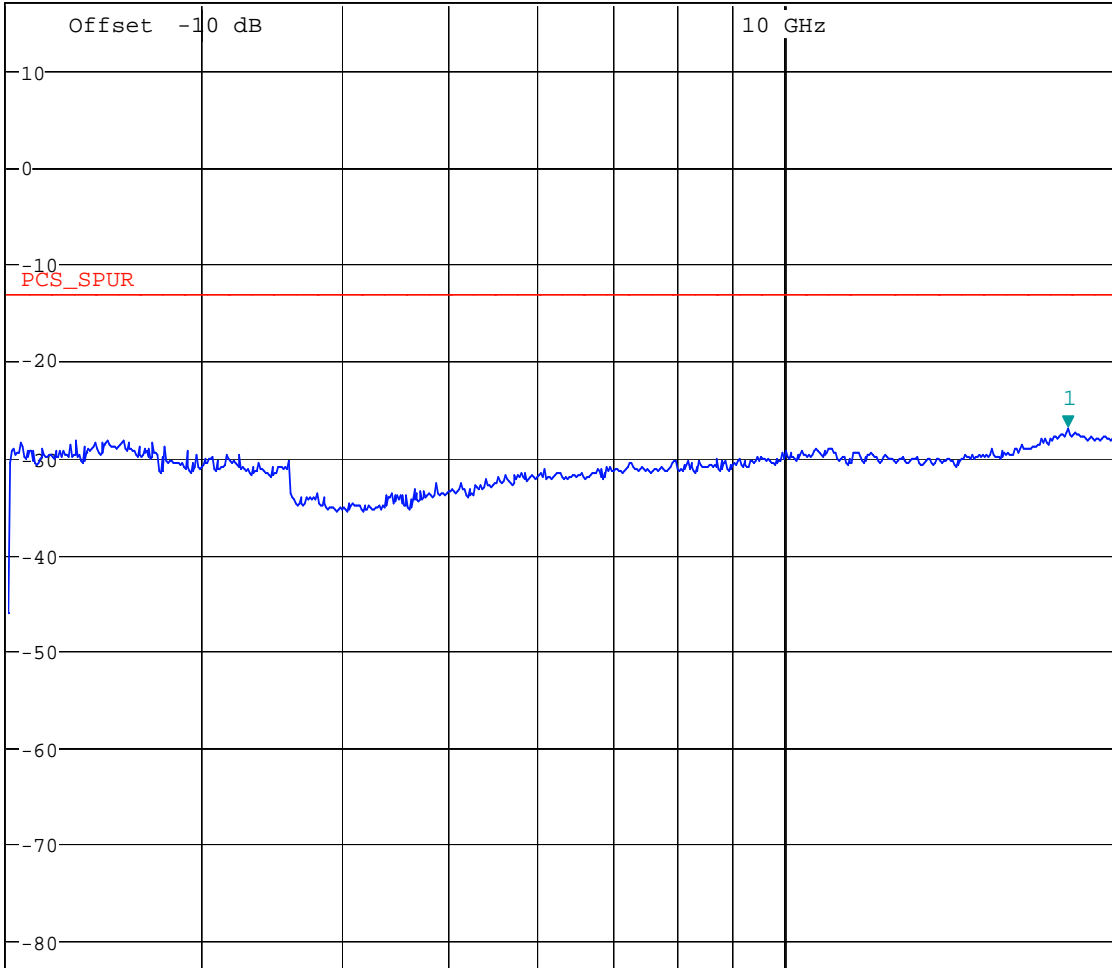
Figure 29 Antenna Conducted Spurious – GMSK 1989.8 MHz – Combined Carrier Mode



\* RBW 1 MHz                      Marker 1 [T1 ]  
\* VBW 1 MHz                      -27.02 dBm  
SWT 105 ms                      18.103425741 GHz

Ref 17 dBm

\* Att 0 dB



Center 6.32455532 GHz

Span 18 GHz

Date: 28.FEB.2007 23:14:03

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**Figure 30 Antenna Conducted Spurious – 8PSK 1930.28 MHz – Combined Carrier Mode**

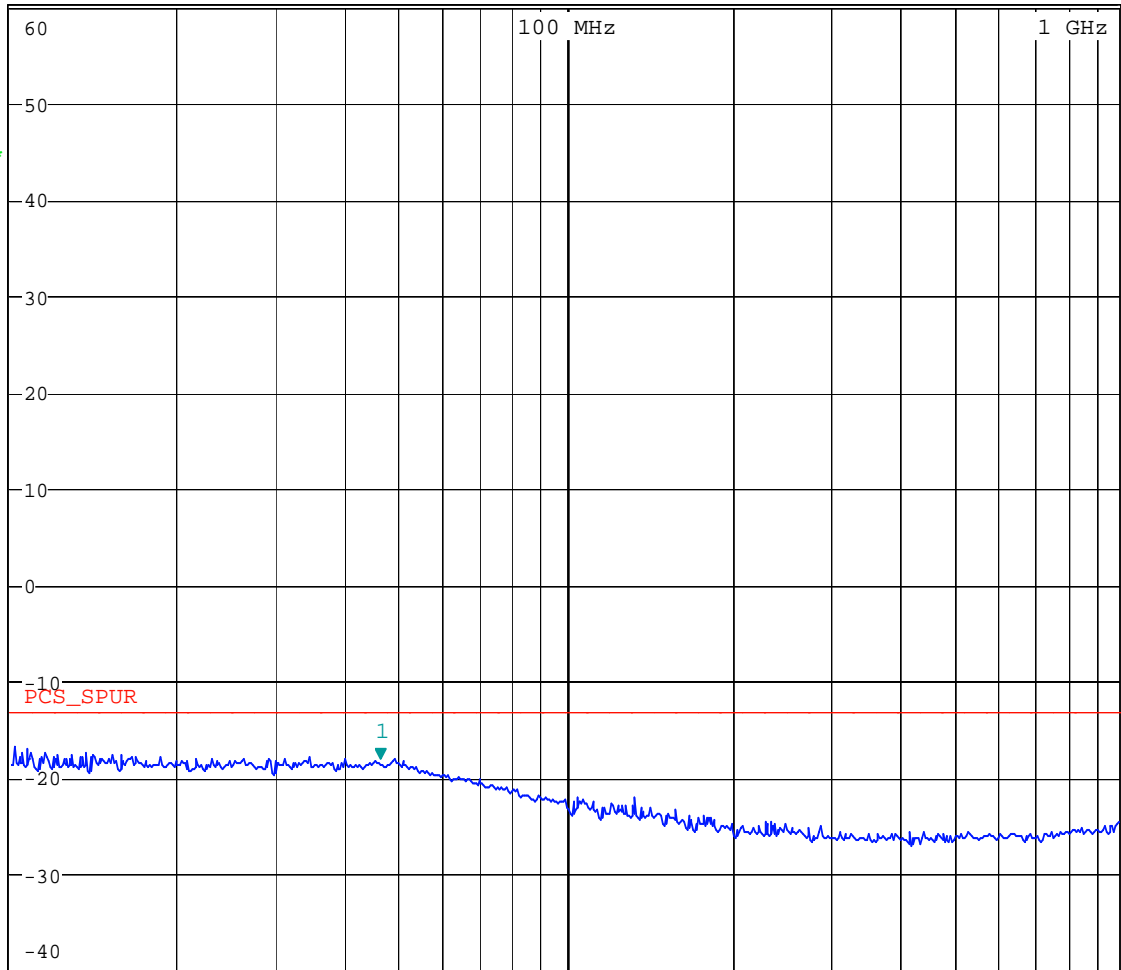


\* RBW 1 MHz      Marker 1 [T1 ]  
VBW 10 MHz      -18.34 dBm  
SWT 20 ms      46.415888336 MHz

Ref 60 dBm

\* Att 10 dB

1 RM \*  
CLRWR



Start 10 MHz

Stop 1 GHz

Date: 28.FEB.2007 23:34:21

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Figure 31 Antenna Conducted Spurious – 8PSK 1930.28 MHz – Combined Carrier Mode

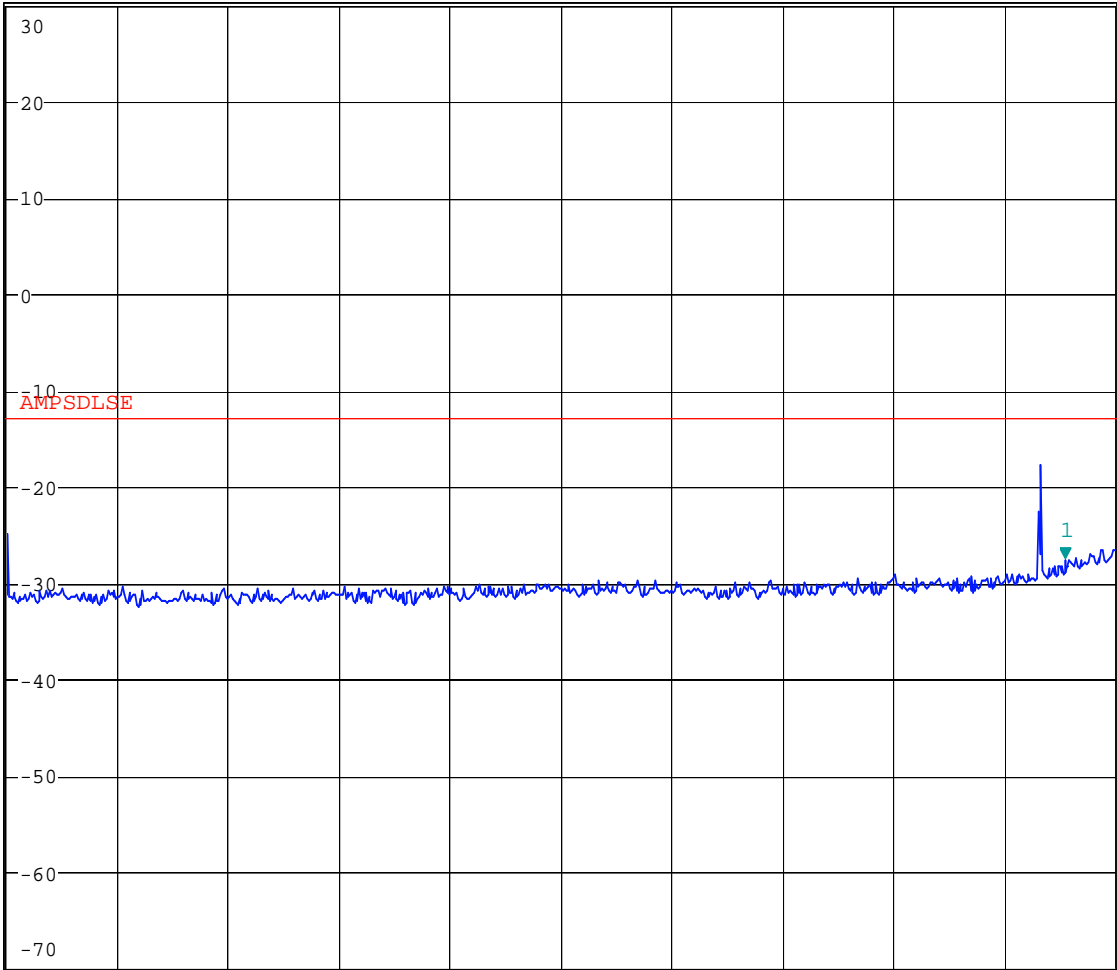


\* RBW 1 MHz      Marker 1 [T1 ]  
\* VBW 1 MHz      -27.70 dBm  
SWT 2.5 ms      1.955200000 GHz

Ref 30 dBm

\* Att 10 dB

1 RM \*  
AVG



Start 1 GHz

100 MHz/

Stop 2 GHz

Date: 28.FEB.2007 23:36:16

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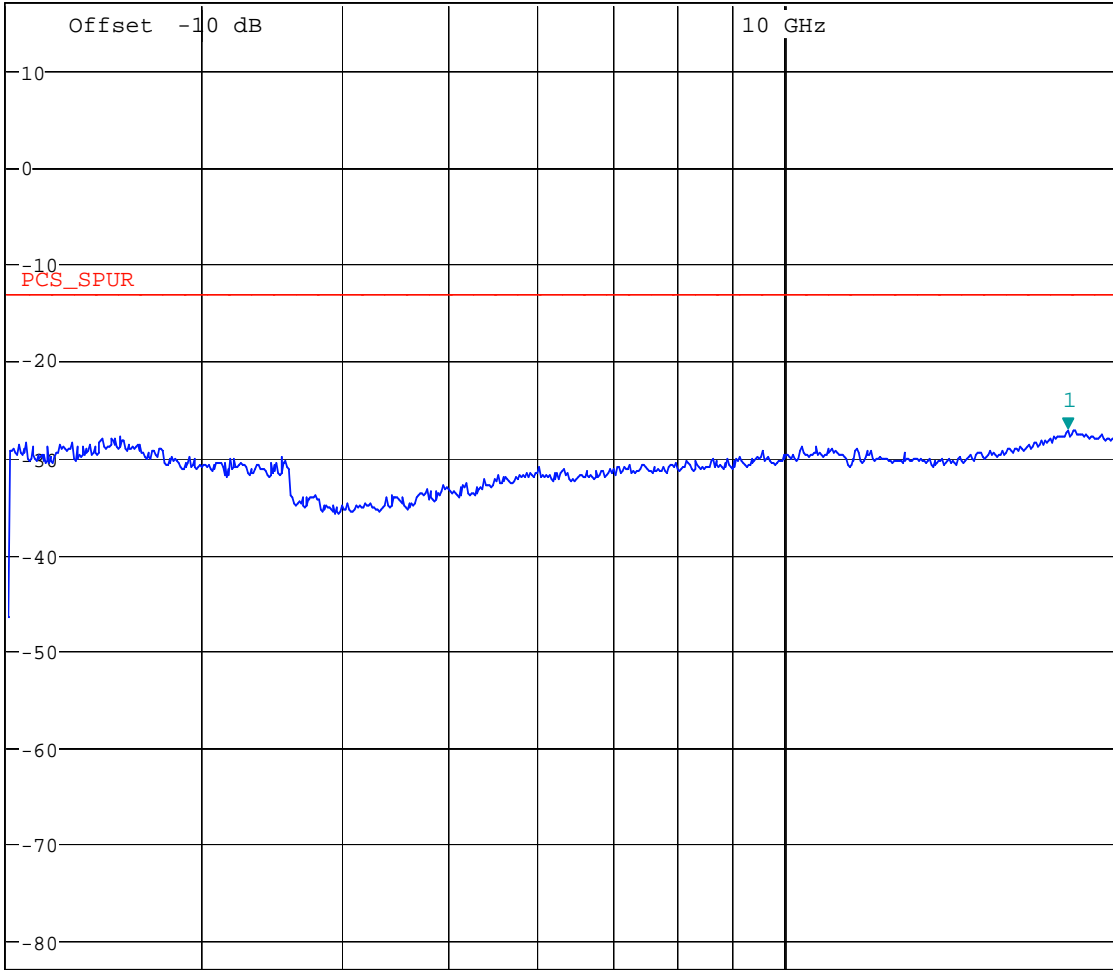
Figure 32 Antenna Conducted Spurious – 8PSK 1930.28 MHz – Combined Carrier Mode



\* RBW 1 MHz                      Marker 1 [T1 ]  
\* VBW 1 MHz                      -27.20 dBm  
SWT 105 ms                      18.103425741 GHz

Ref 17 dBm

\* Att 0 dB



Start 2 GHz

Stop 20 GHz

Date: 28.FEB.2007 23:37:15

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Figure 33 Antenna Conducted Spurious – 8PSK 1960.0 MHz – Combined Carrier Mode

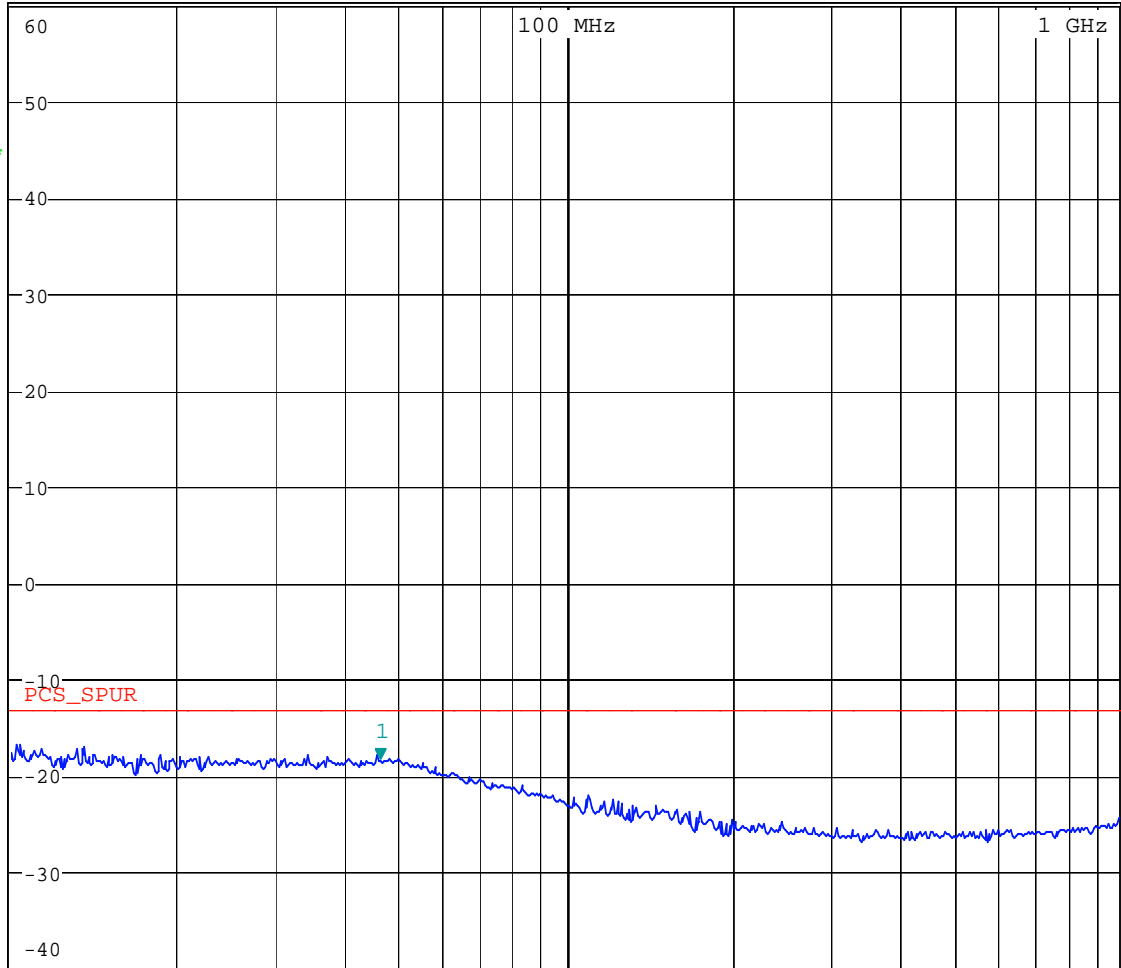


\* RBW 1 MHz      Marker 1 [T1 ]  
VBW 10 MHz      -18.39 dBm  
SWT 20 ms      46.415888336 MHz

Ref 60 dBm

\* Att 10 dB

1 RM \*  
CLRWR



Start 10 MHz

Stop 1 GHz

Date: 28.FEB.2007 23:45:46

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Figure 34 Antenna Conducted Spurious – 8PSK 1960.0 MHz – Combined Carrier Mode

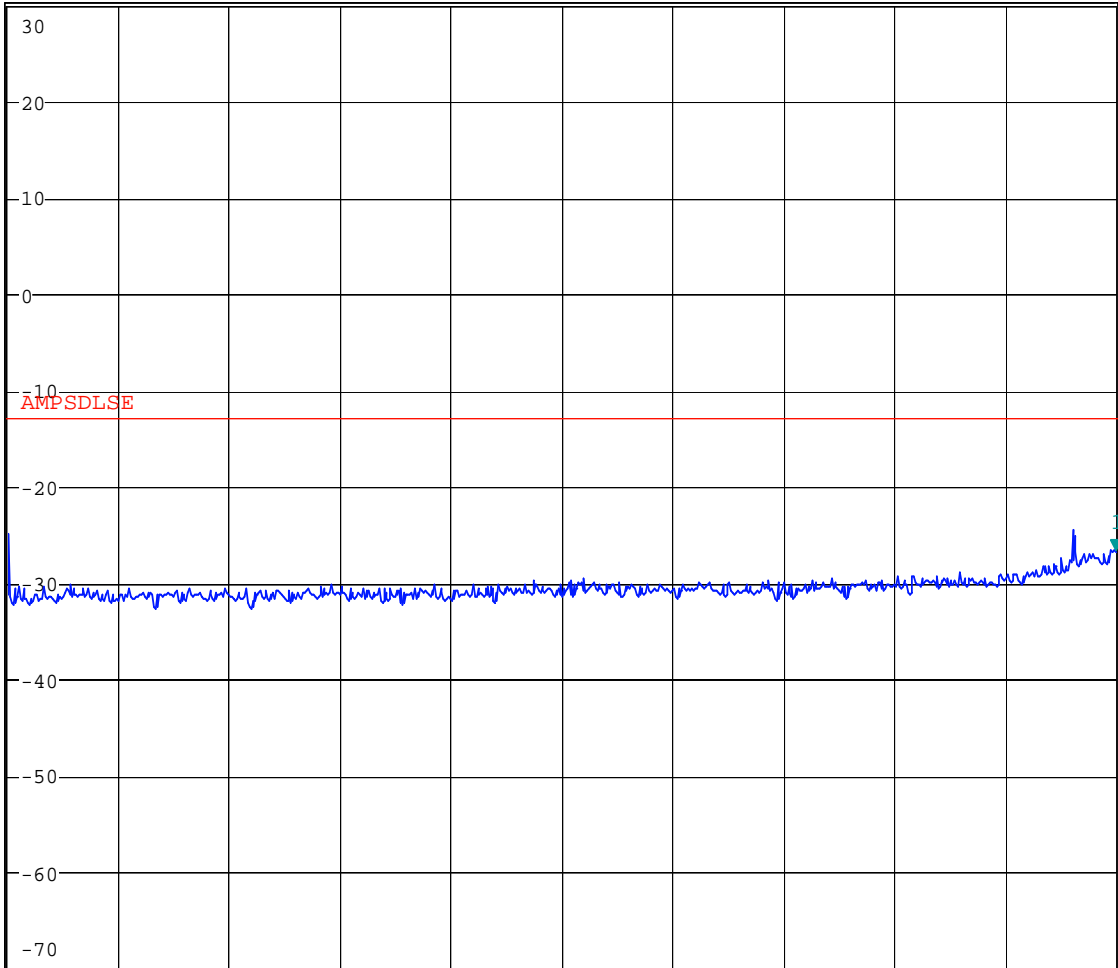


\* RBW 1 MHz      Marker 1 [T1 ]  
\* VBW 1 MHz      -26.78 dBm  
SWT 2.5 ms      2.000000000 GHz

Ref 30 dBm

\* Att 10 dB

1 RM \*  
AVG



Start 1 GHz

100 MHz/

Stop 2 GHz

Date: 28.FEB.2007 23:44:59

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**Figure 35 Antenna Conducted Spurious – 8PSK 1960.0 MHz – Combined Carrier Mode**

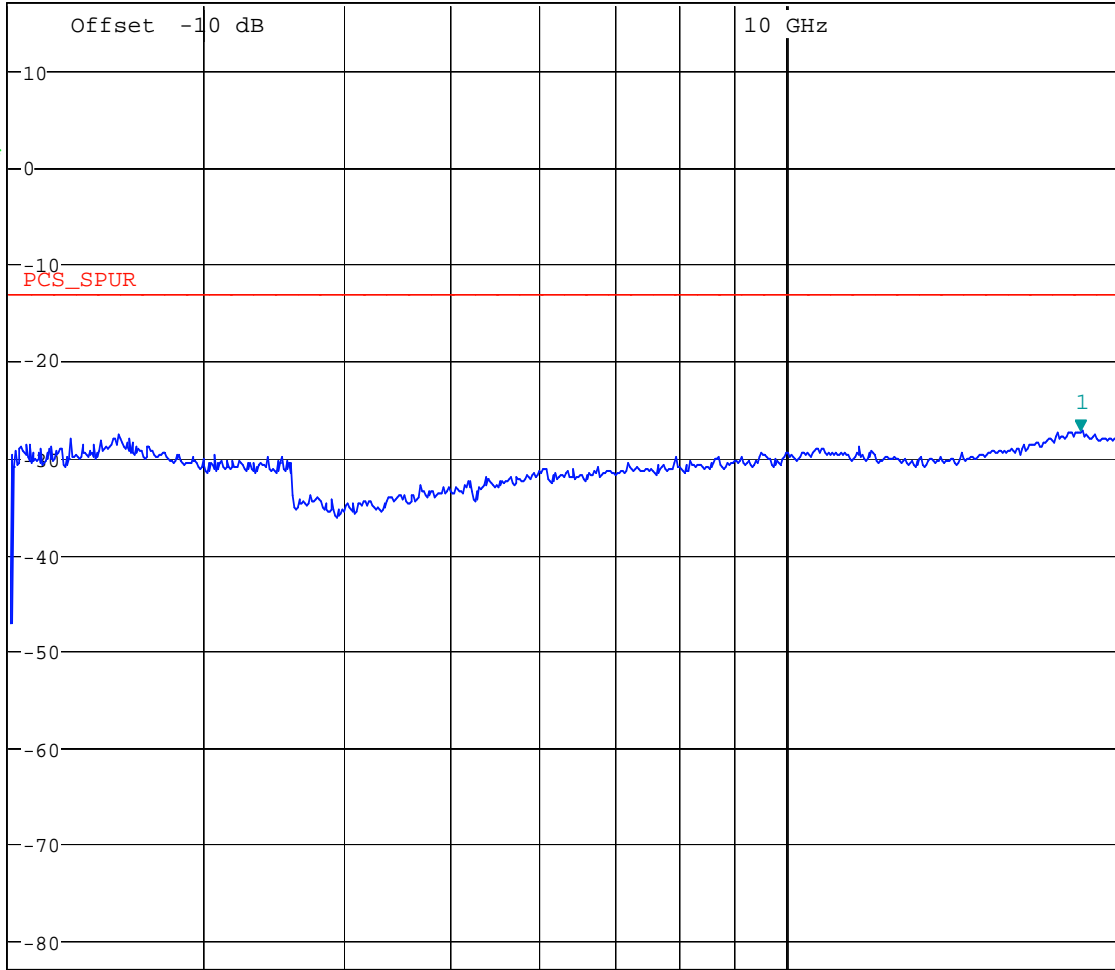


\* RBW 1 MHz      Marker 1 [T1 ]  
\* VBW 1 MHz      -27.39 dBm  
SWT 105 ms      18.508709944 GHz

Ref 17 dBm

\* Att 0 dB

1 RM \*  
CLRWR



Start 2 GHz

Stop 20 GHz

Date: 28.FEB.2007 23:43:04

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**Figure 36 Antenna Conducted Spurious – 8PSK 1989.80 MHz – Combined Carrier Mode**

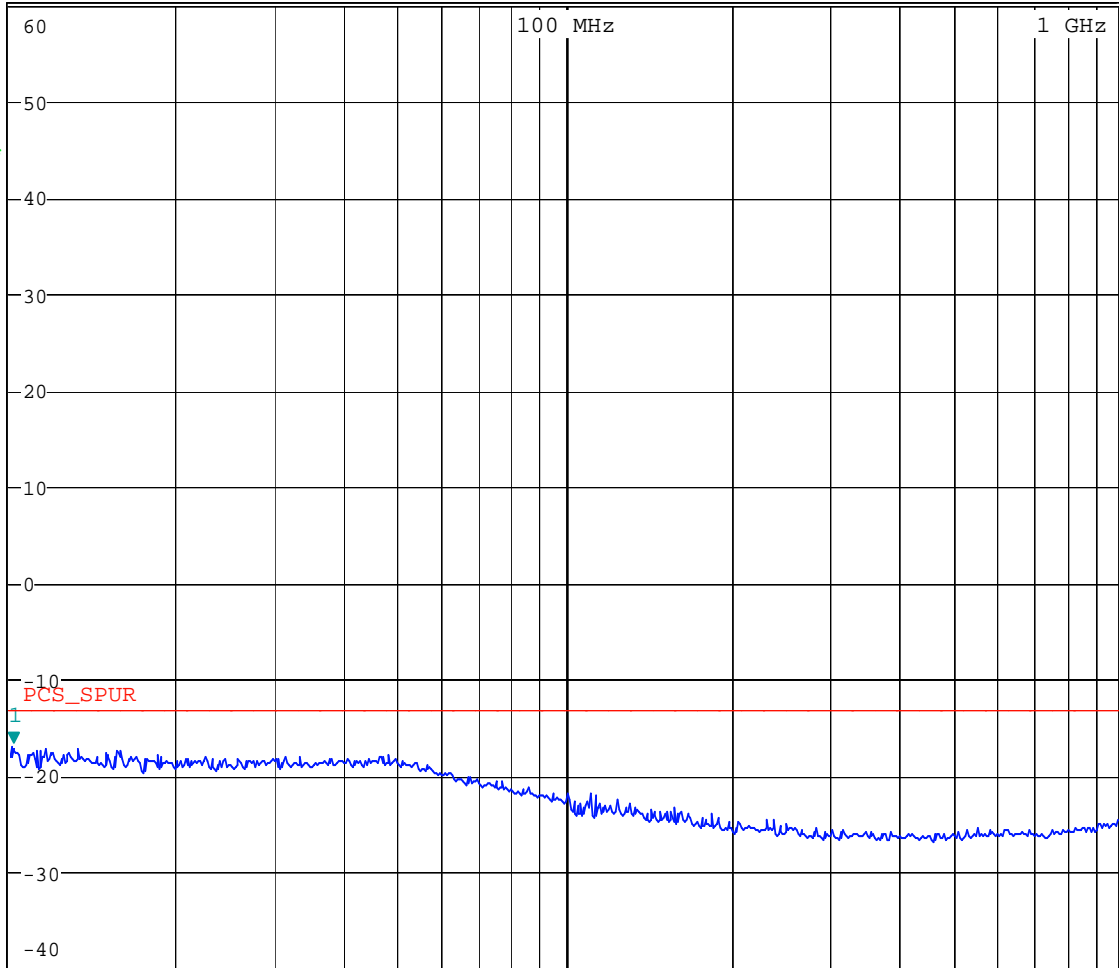


\* RBW 1 MHz      Marker 1 [T1 ]  
VBW 10 MHz      -16.72 dBm  
SWT 20 ms      10.148696300 MHz

Ref 60 dBm

\* Att 10 dB

1 RM \*  
CLRWR



Start 10 MHz

Stop 1 GHz

Date: 1.MAR.2007 00:09:44

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Figure 37 Antenna Conducted Spurious – 8PSK 1989.80 MHz – Combined Carrier Mode

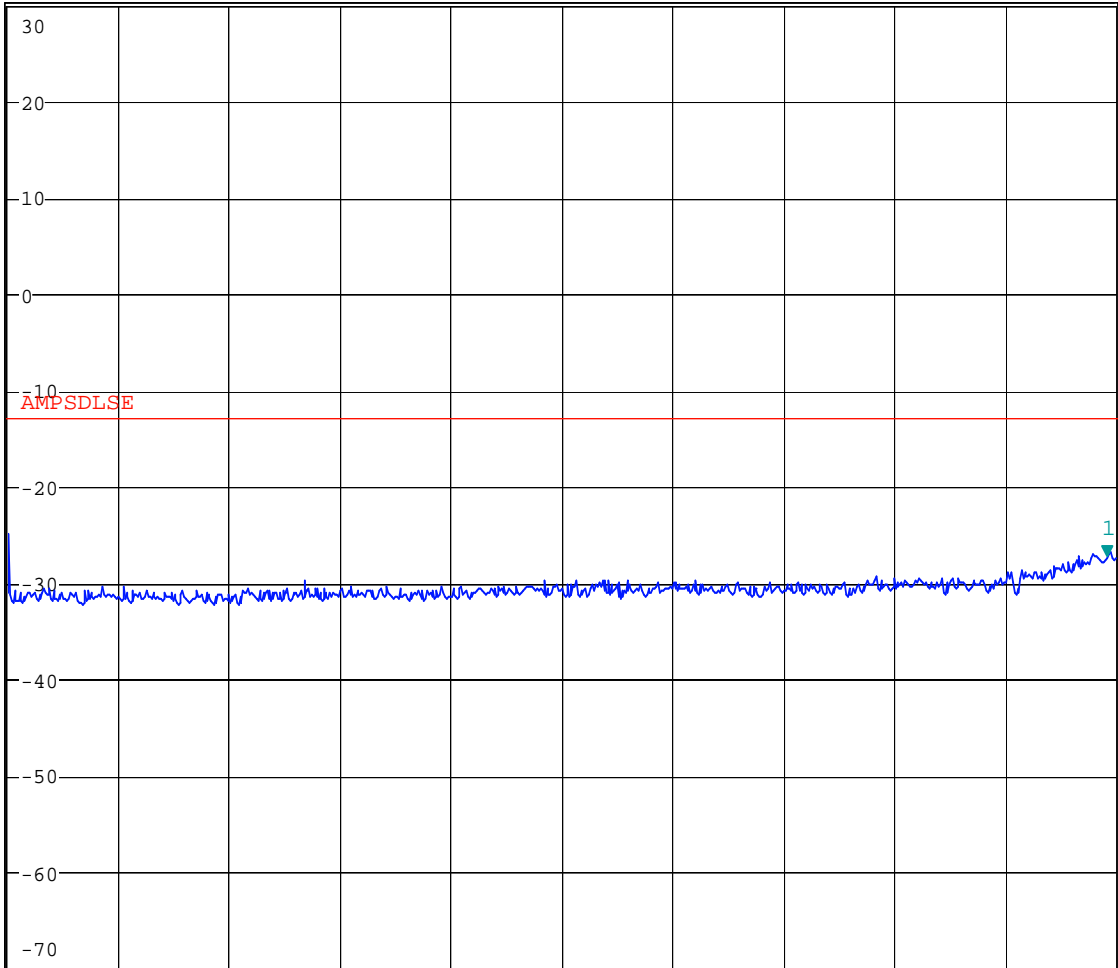


\* RBW 1 MHz                      Marker 1 [T1 ]  
\* VBW 1 MHz                      -27.49 dBm  
SWT 2.5 ms                      1.991987179 GHz

Ref 30 dBm

\* Att 10 dB

1 RM \*  
AVG



Start 1 GHz

100 MHz/

Stop 2 GHz

Date: 1.MAR.2007 00:08:40

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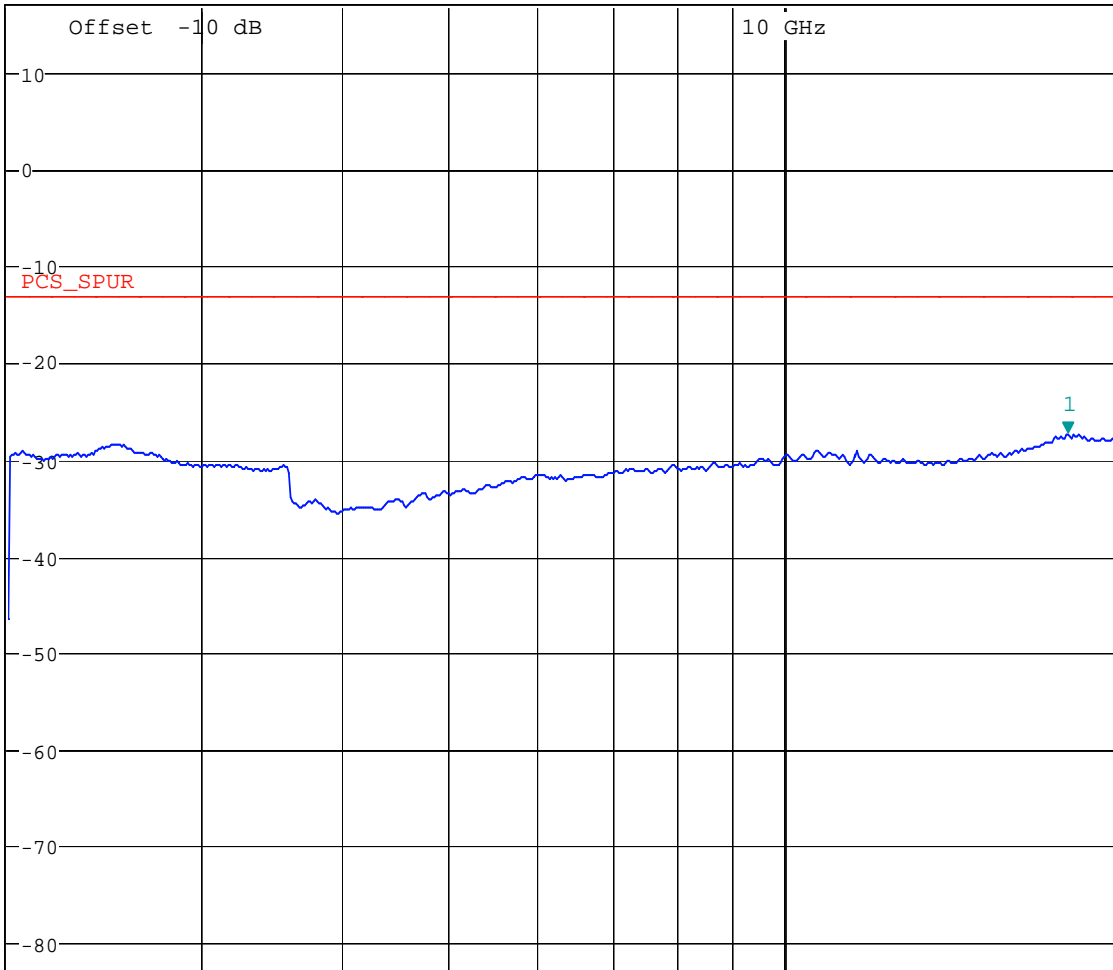
**Figure 38 Antenna Conducted Spurious – 8PSK 1989.80 MHz – Combined Carrier Mode**



\*RBW 1 MHz      Marker 1 [T1 ]  
\*VBW 1 MHz      -27.33 dBm  
SWT 105 ms      18.103425741 GHz

Ref 17 dBm

\*Att 0 dB



Start 2 GHz

Stop 20 GHz

Date: 1.MAR.2007 00:11:04

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Figure 39 Antenna Conducted Spurious – GMSK 1930.20 MHz – Single Carrier Mode

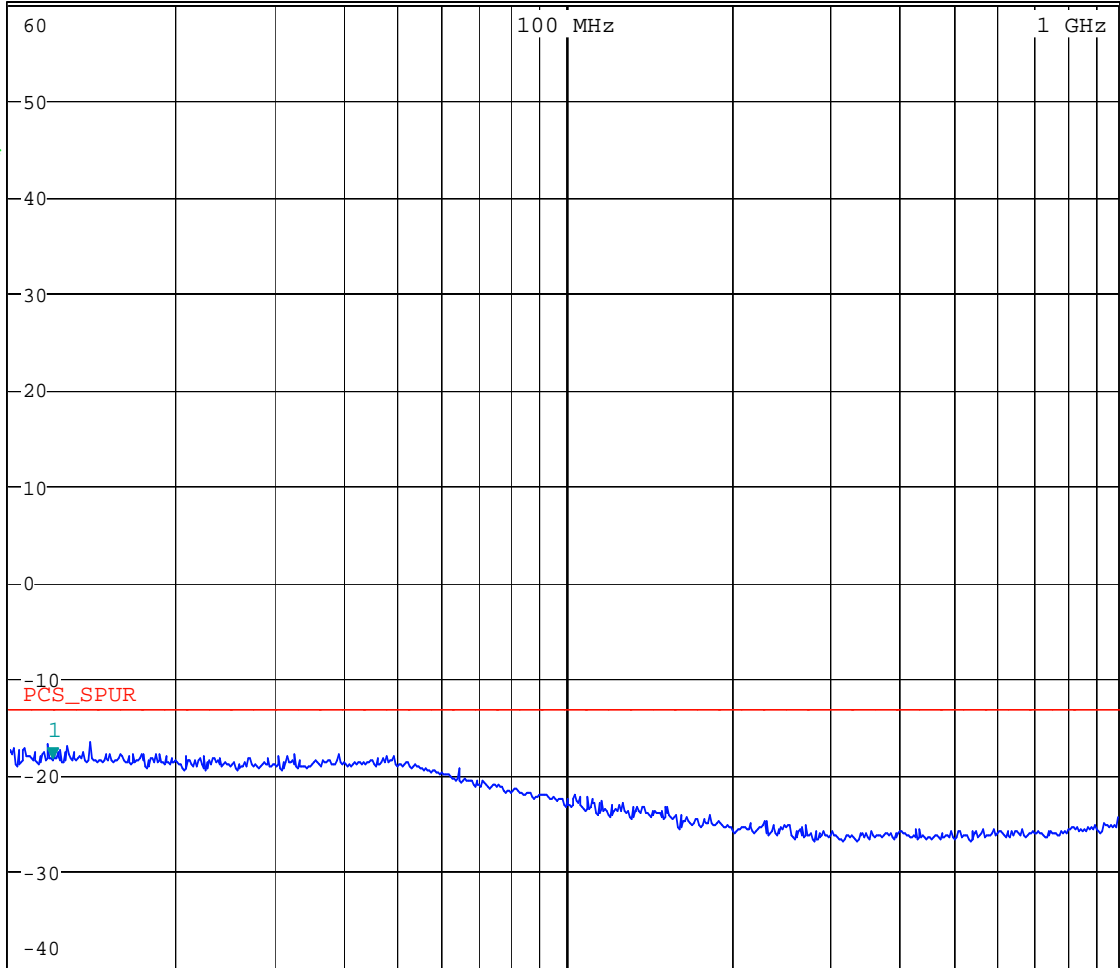


\*RBW 1 MHz      Marker 1 [T1 ]  
VBW 10 MHz      -18.52 dBm  
SWT 20 ms      11.937766417 MHz

Ref 60 dBm

\*Att 10 dB

1 RM \*  
CLRWR



Start 10 MHz

Stop 1 GHz

Date: 1.MAR.2007 16:14:05

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**Figure 40 Antenna Conducted Spurious – GMSK 1930.20 MHz – Single Carrier Mode**



\* RBW 1 MHz      Marker 1 [T1 ]  
\* VBW 1 MHz      -26.66 dBm  
SWT 2.5 ms      2.000000000 GHz

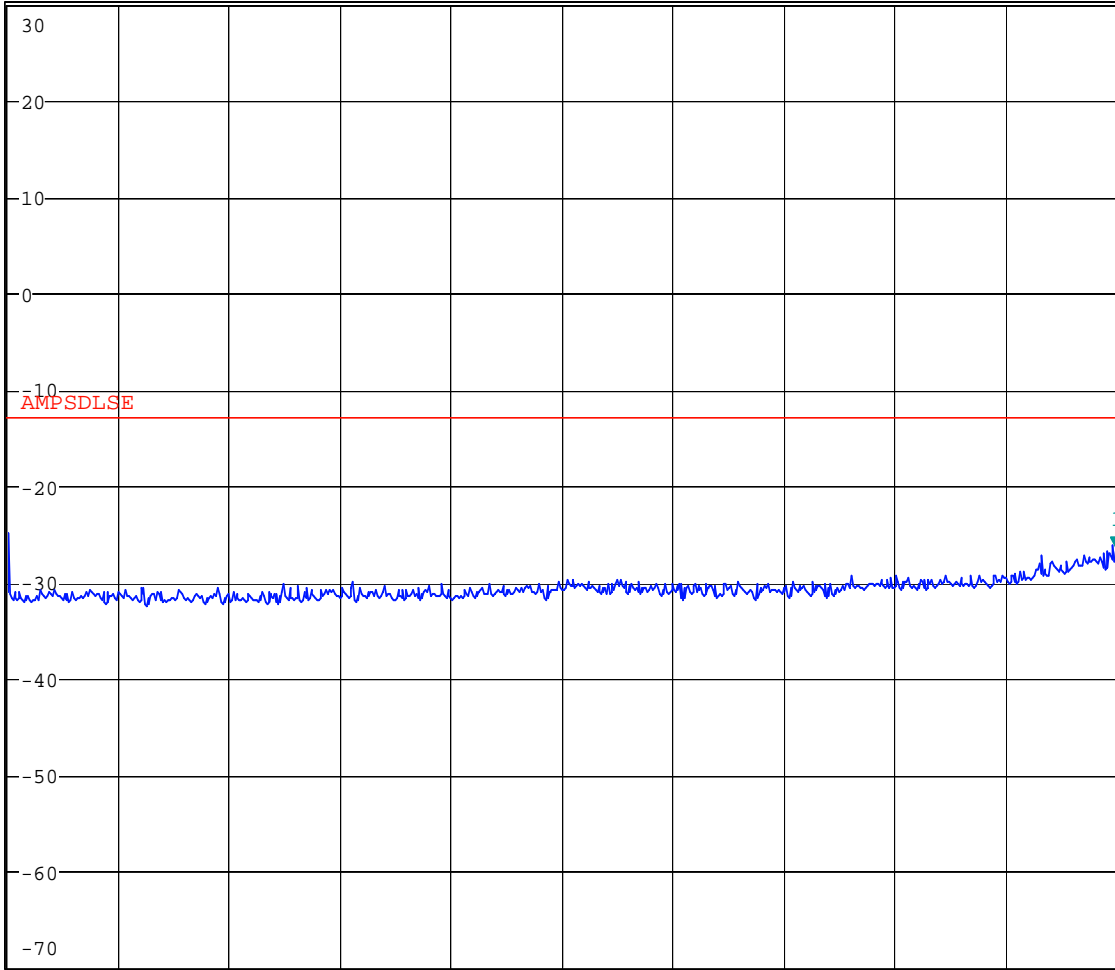
Ref 30 dBm

\* Att 10 dB

SWT 2.5 ms

2.000000000 GHz

1 RM  
AVG



Start 1 GHz

100 MHz/

Stop 2 GHz

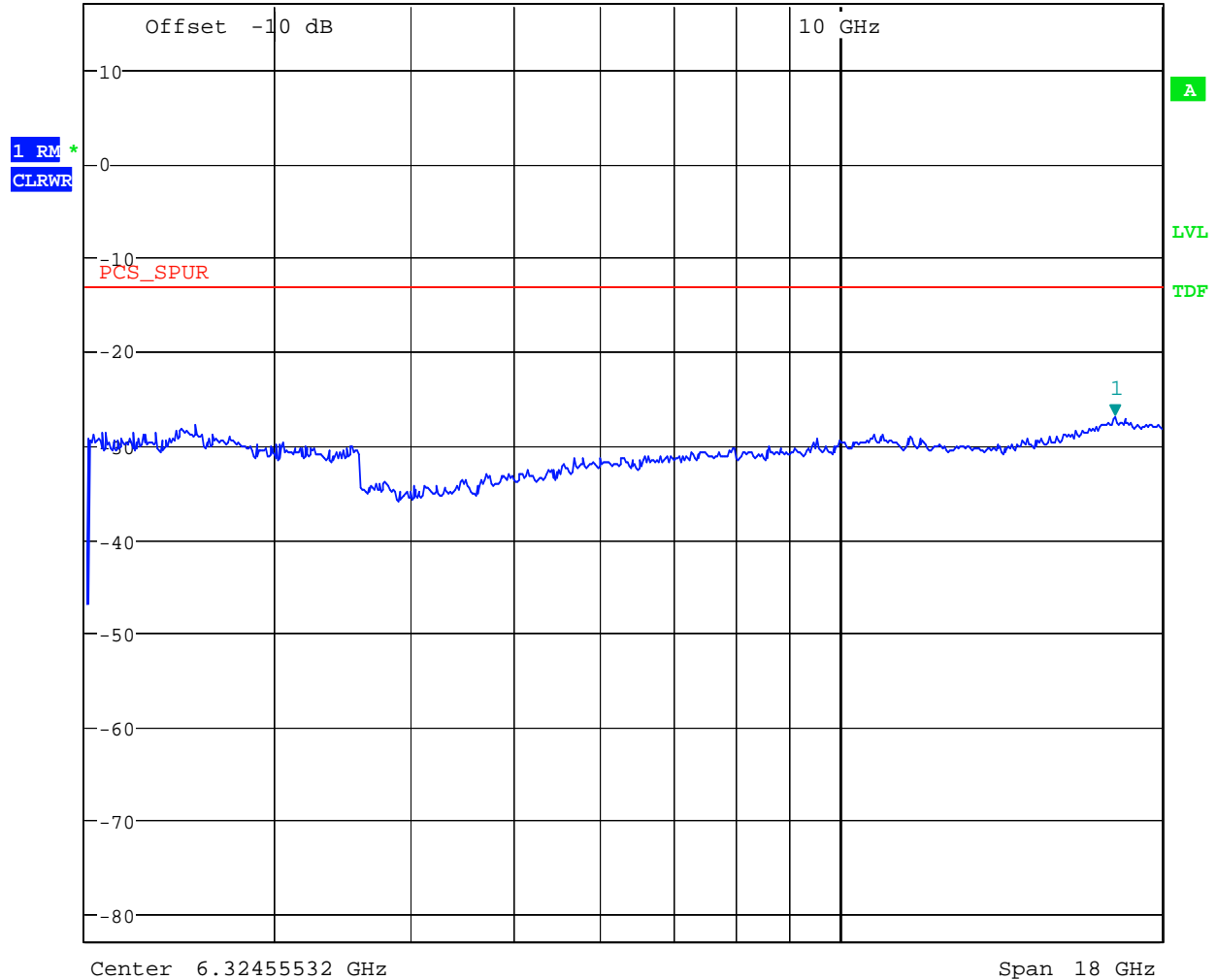
Date: 1.MAR.2007 16:10:58

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Figure 41 Antenna Conducted Spurious – GMSK 1930.20 MHz – Single Carrier Mode



\* RBW 1 MHz      Marker 1 [T1 ]  
\* VBW 1 MHz      -27.07 dBm  
Ref 17 dBm      \* Att 0 dB      SWT 105 ms      18.103425741 GHz



Date: 1.MAR.2007 16:12:00

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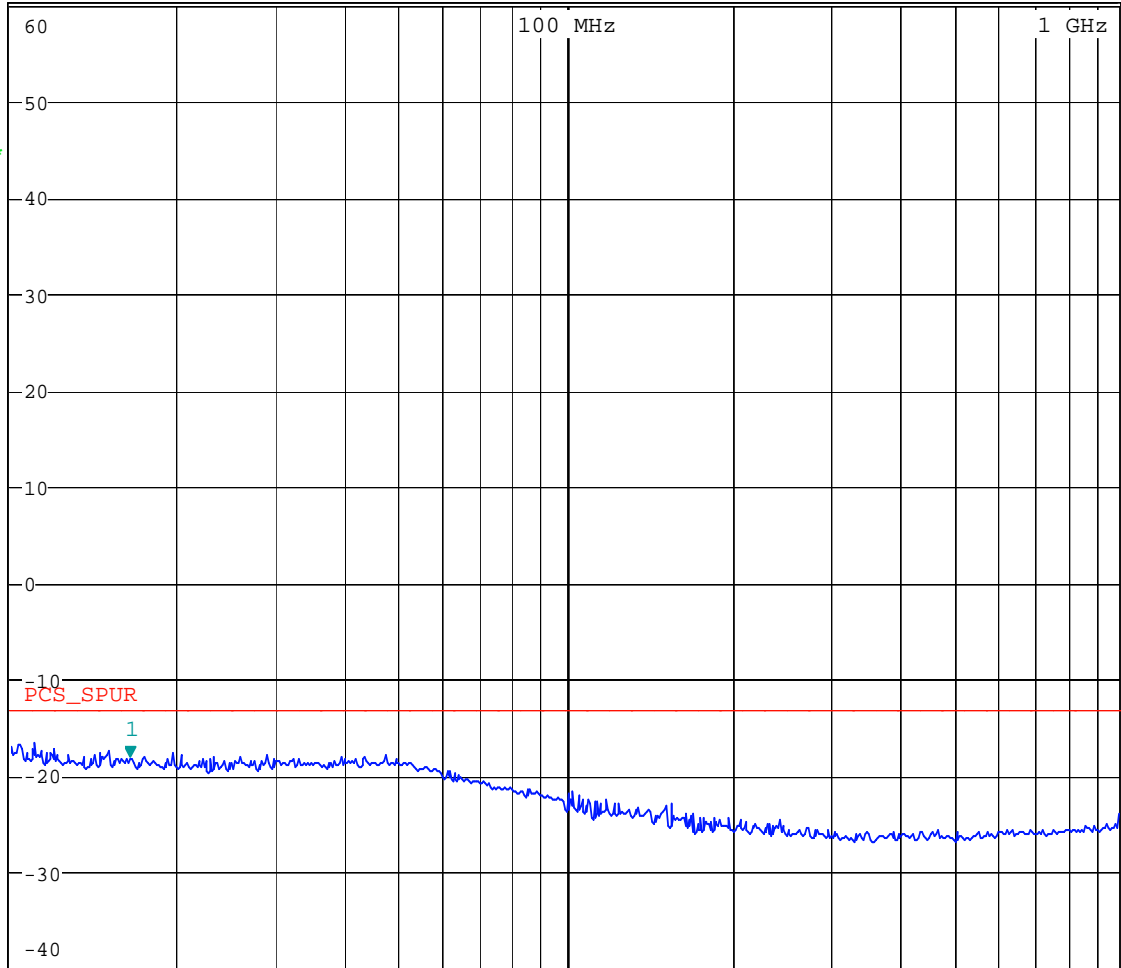
Figure 42 Antenna Conducted Spurious – GMSK 1960.00 MHz – Single Carrier Mode

\* RBW 1 MHz      Marker 1 [T1 ]  
VBW 10 MHz      -18.31 dBm  
SWT 20 ms      16.396214443 MHz

Ref 60 dBm

\* Att 10 dB

1 RM \*  
CLRWR



Center 100 MHz

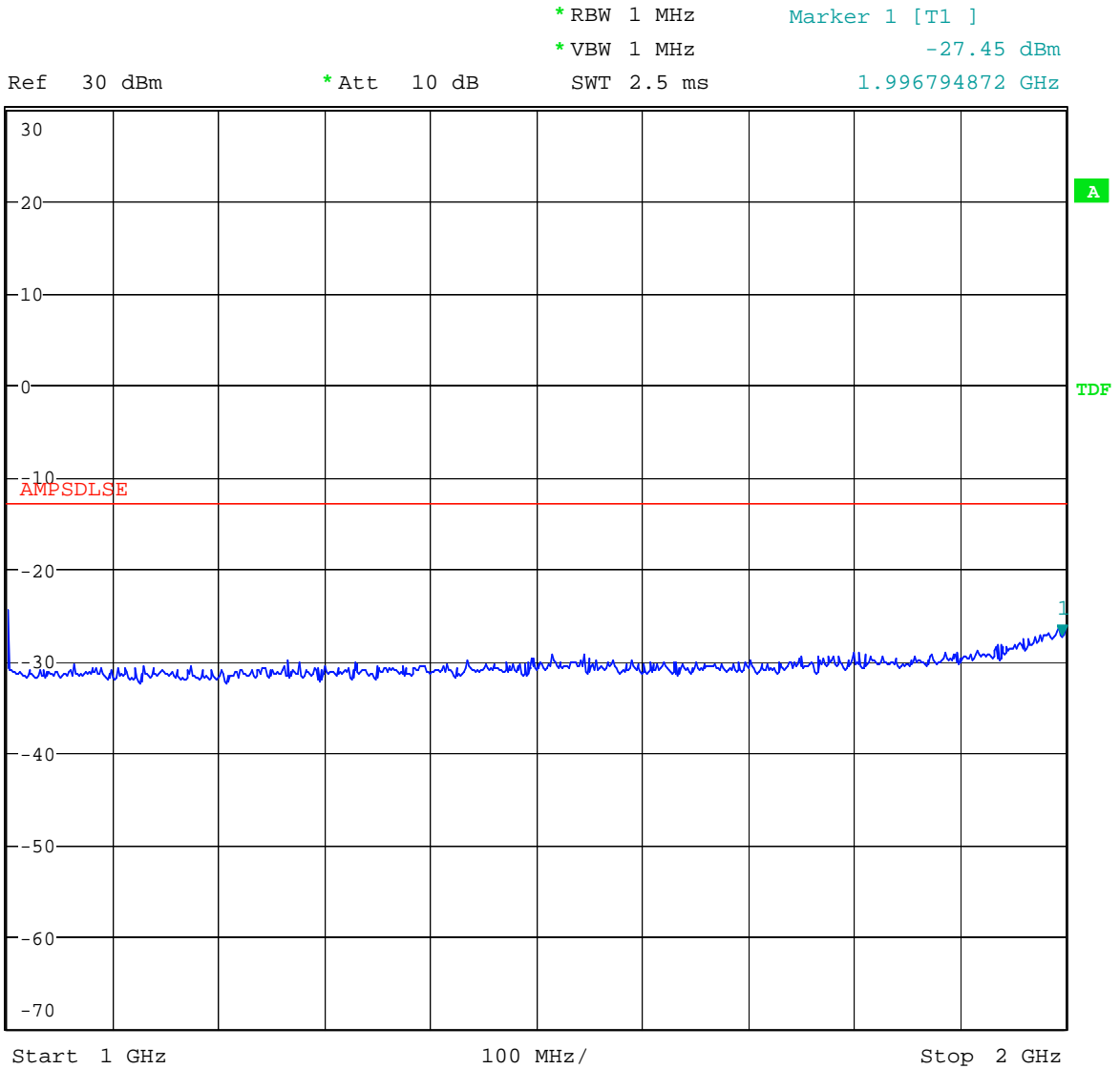
Span 990 MHz

Date: 1.MAR.2007 16:30:34

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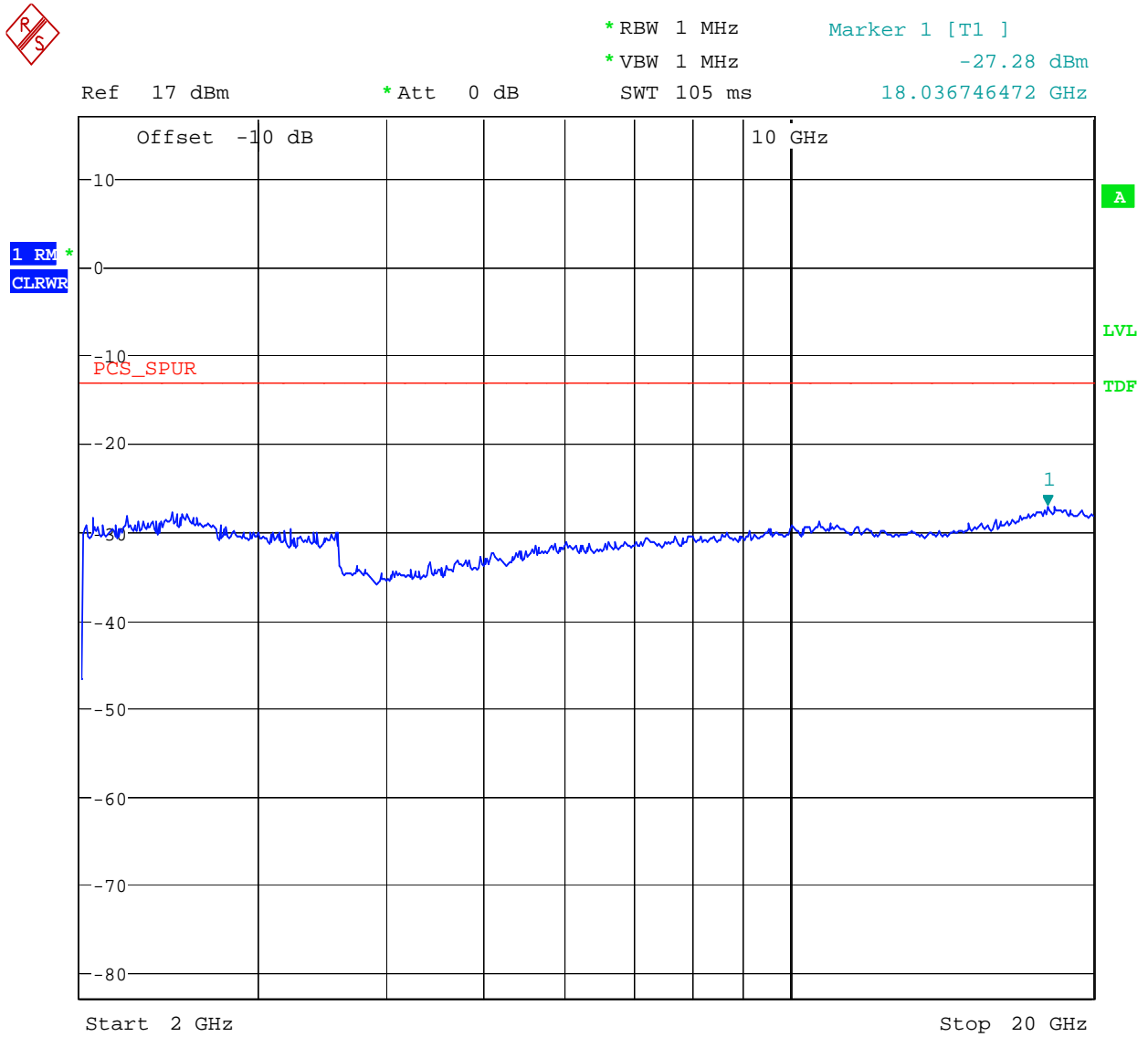
**Figure 43 Antenna Conducted Spurious – GMSK 1960.00 MHz – Single Carrier Mode**



Date: 1.MAR.2007 16:32:30

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**Figure 44 Antenna Conducted Spurious – GMSK 1960.00 MHz – Single Carrier Mode**

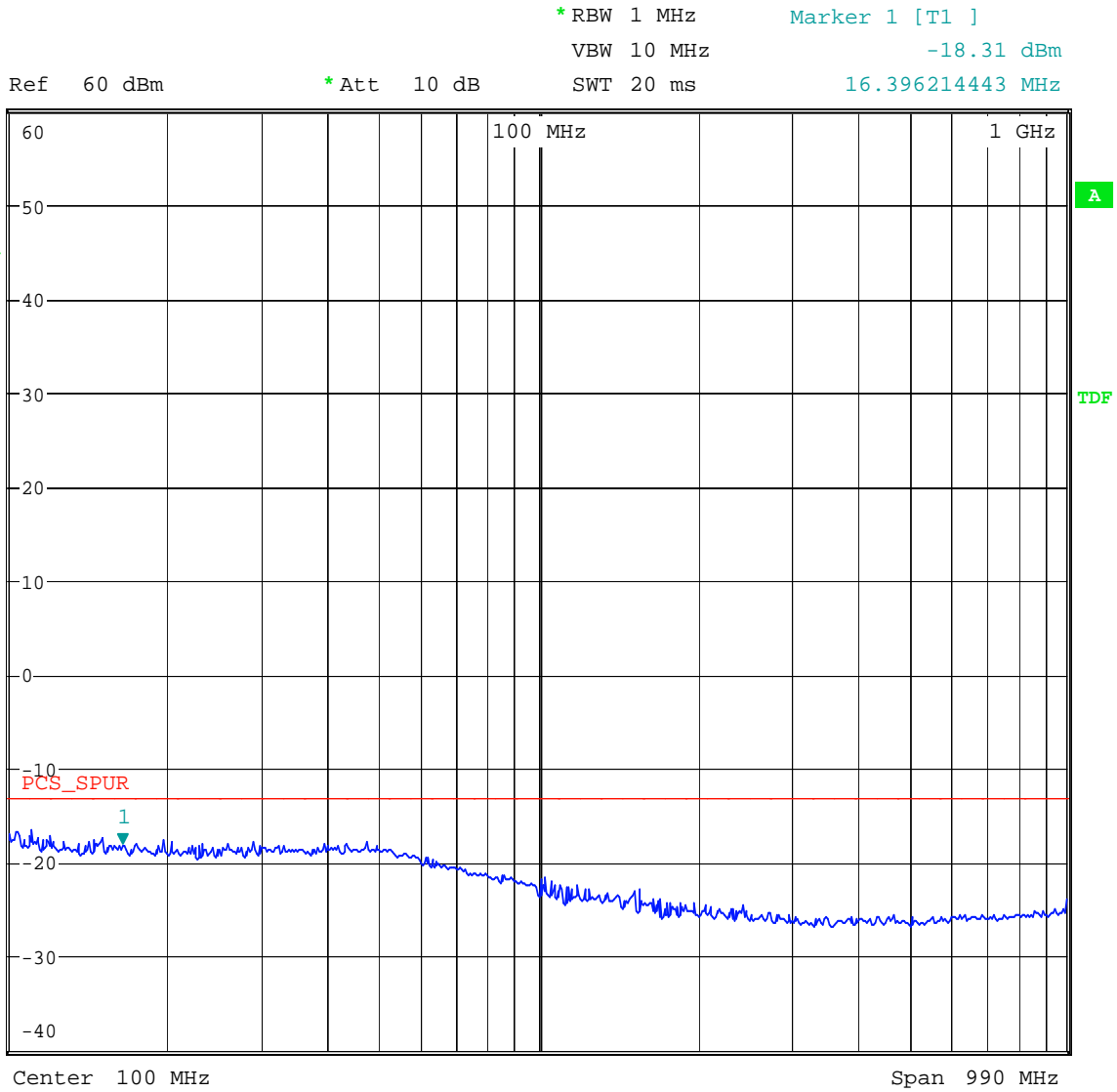


Date: 1.MAR.2007 16:34:50

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Figure 45 Antenna Conducted Spurious – GMSK 1989.8 MHz – Single Carrier Mode



Date: 1.MAR.2007 16:30:34

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**Figure 46 Antenna Conducted Spurious – GMSK 1989.8 MHz – Single Carrier Mode**



\* RBW 1 MHz      Marker 1 [T1 ]  
\* VBW 1 MHz      -27.45 dBm  
SWT 2.5 ms      1.996794872 GHz

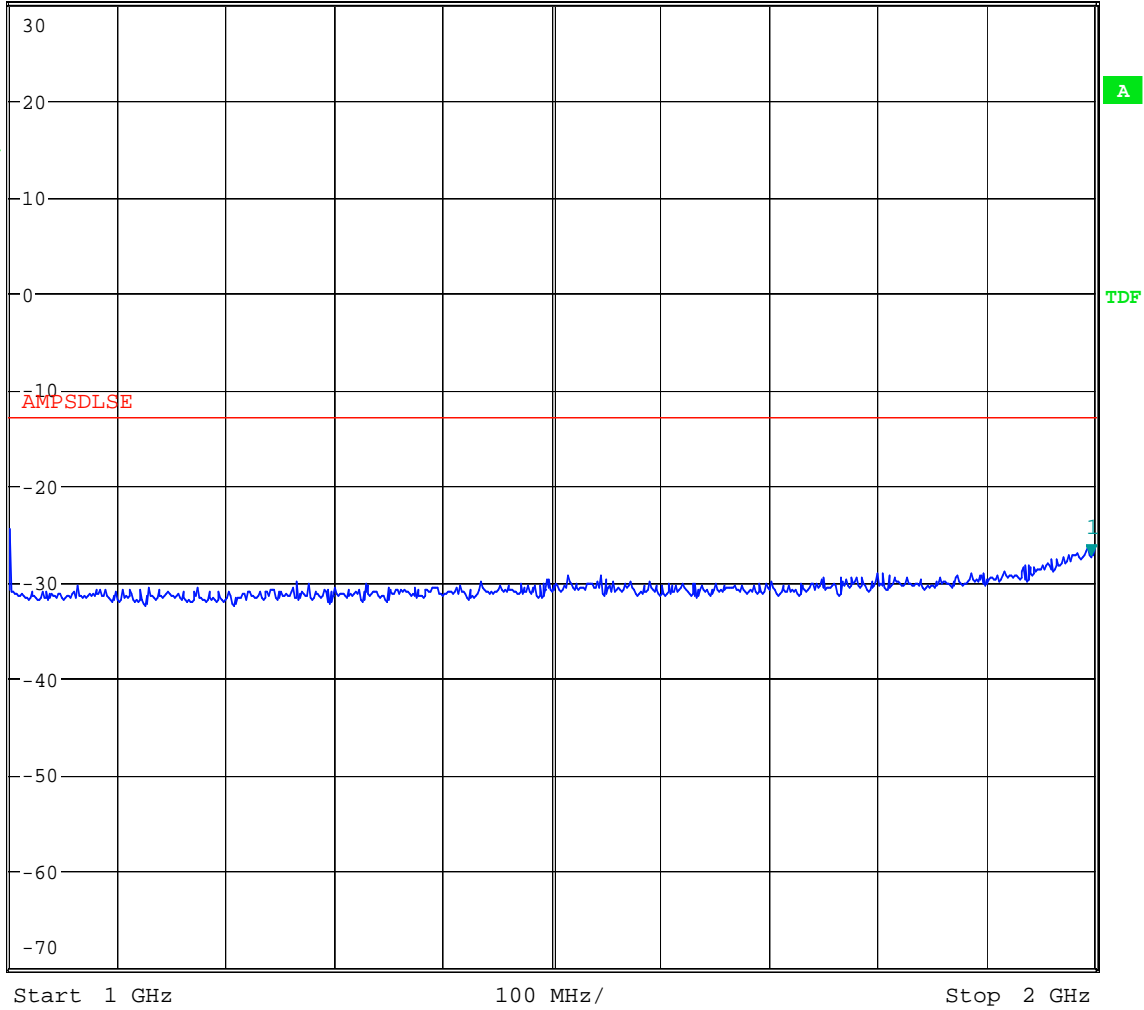
Ref 30 dBm

\* Att 10 dB

SWT 2.5 ms

1.996794872 GHz

1 RM  
AVG



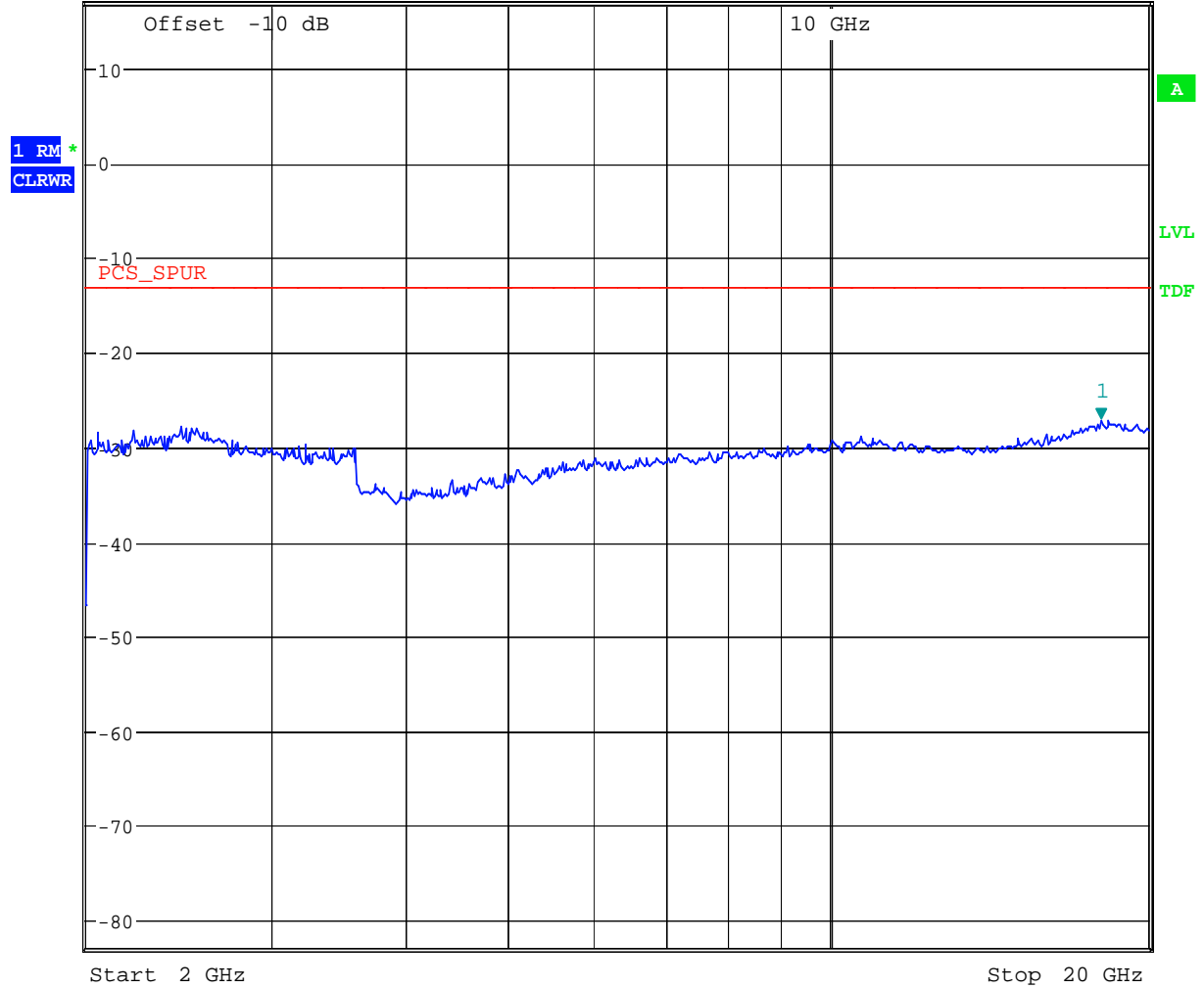
Date: 1.MAR.2007 16:32:30

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Figure 47 Antenna Conducted Spurious – GMSK 1989.8 MHz – Single Carrier Mode



\* RBW 1 MHz      Marker 1 [T1 ]  
\* VBW 1 MHz      -27.28 dBm  
Ref 17 dBm      \* Att 0 dB      SWT 105 ms      18.036746472 GHz

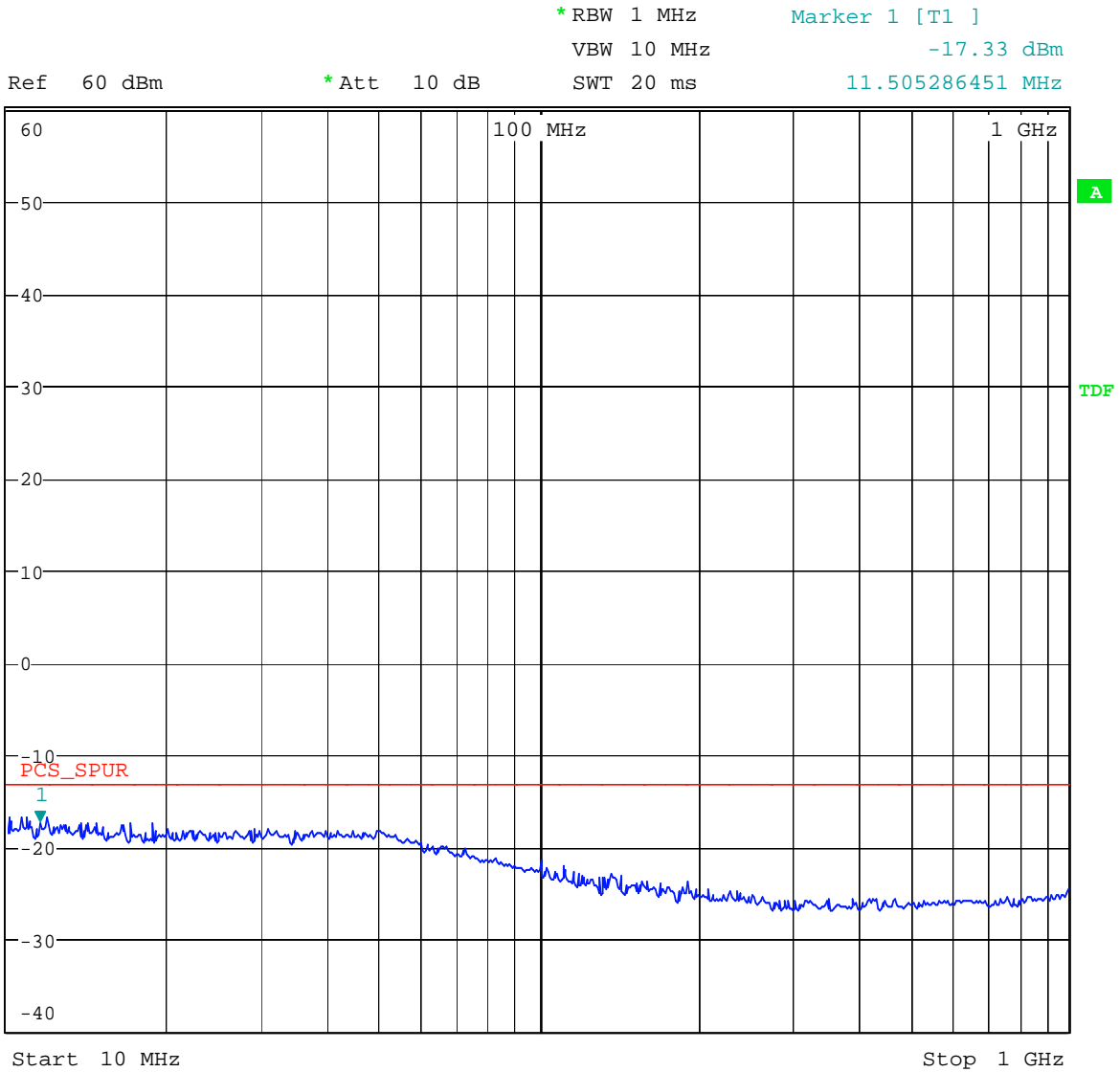


Date: 1.MAR.2007 16:34:50

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**Figure 48 Antenna Conducted Spurious – 8PSK 1930.2 MHz – Single Carrier Mode**



Date: 1.MAR.2007 17:02:33

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**Figure 49 Antenna Conducted Spurious – 8PSK 1930.2 MHz – Single Carrier Mode**



\* RBW 1 MHz      Marker 1 [T1 ]  
\* VBW 1 MHz      -26.75 dBm  
SWT 2.5 ms      2.000000000 GHz

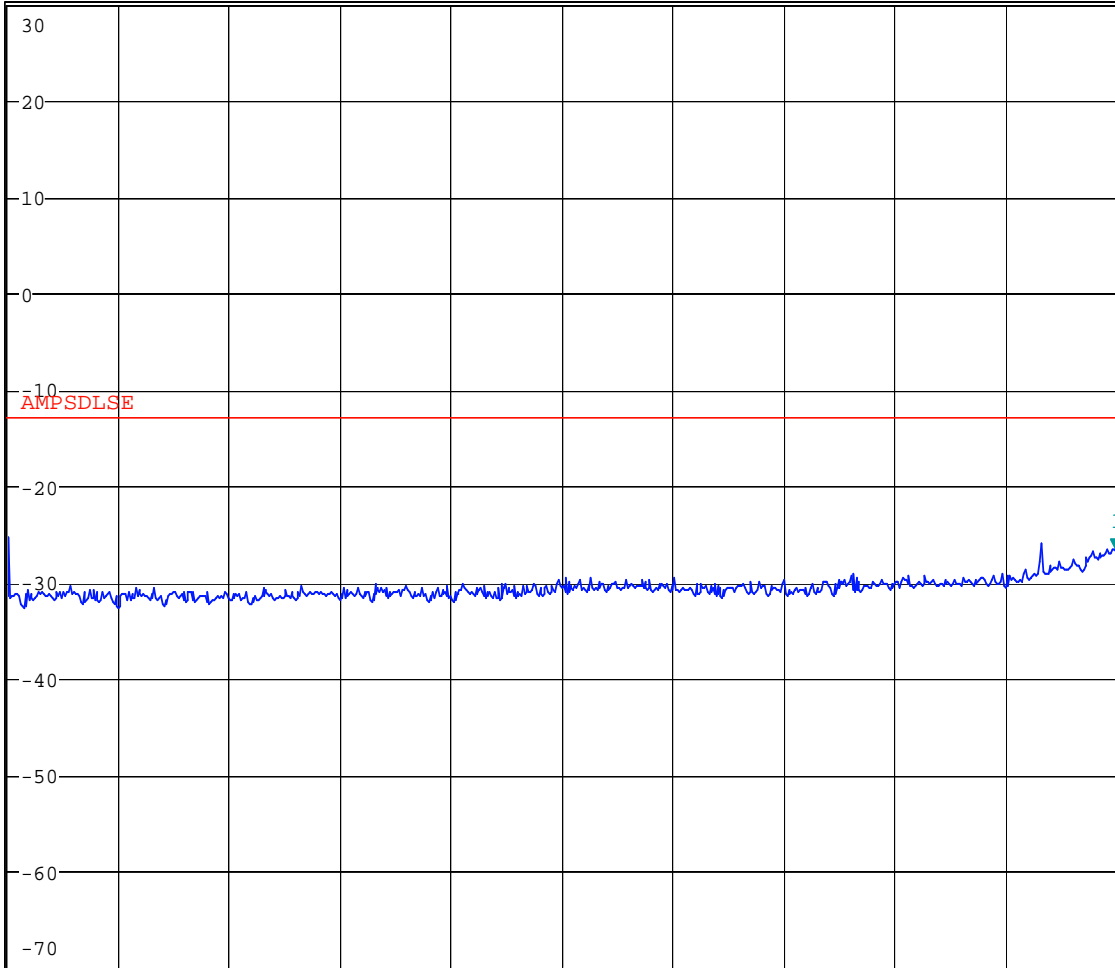
Ref 30 dBm

\* Att 10 dB

SWT 2.5 ms

2.000000000 GHz

1 RM \*  
AVG



Start 1 GHz

100 MHz/

Stop 2 GHz

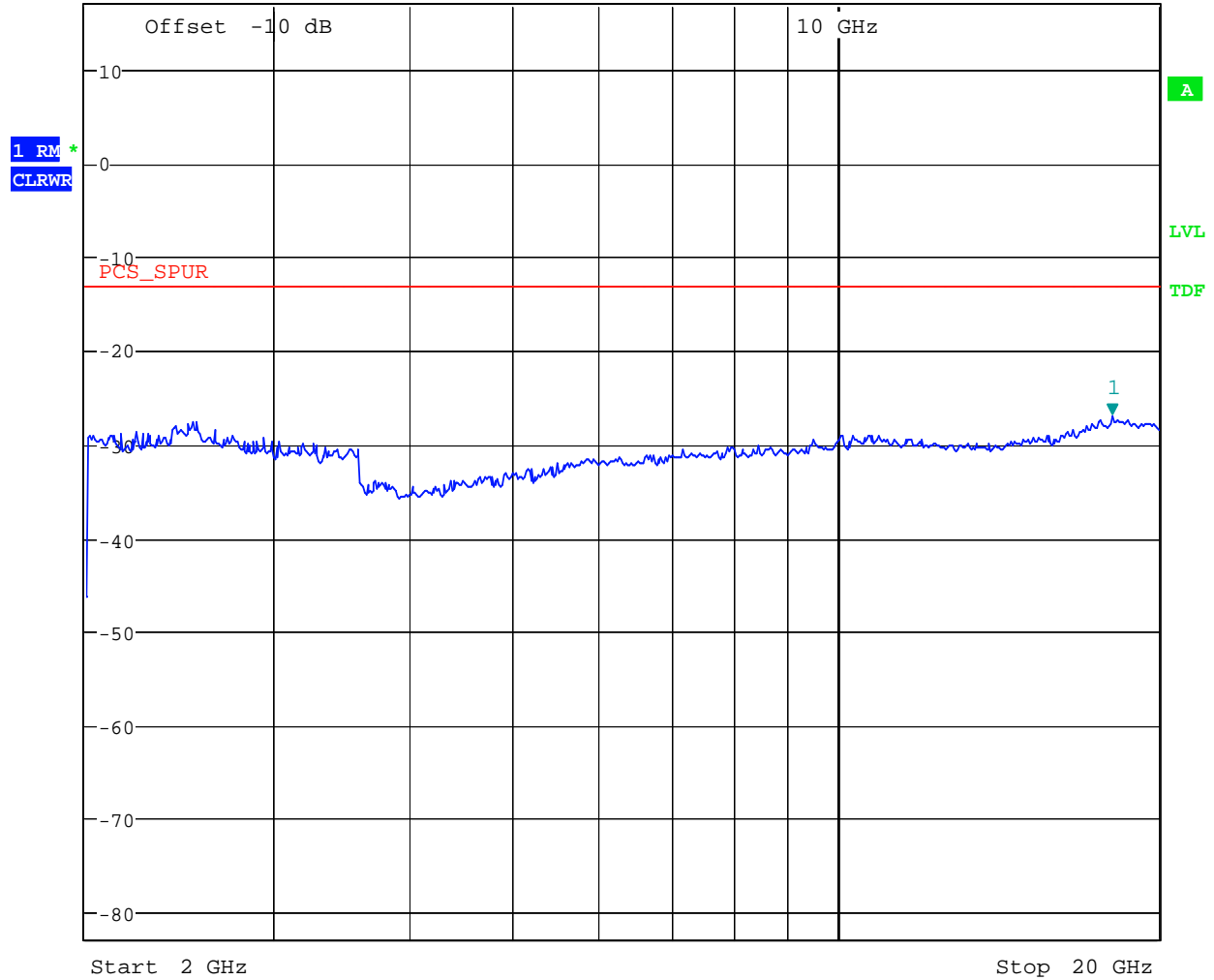
Date: 1.MAR.2007 17:04:04

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Figure 50 Antenna Conducted Spurious – 8PSK 1930.2 MHz – Single Carrier Mode



\* RBW 1 MHz      Marker 1 [T1 ]  
\* VBW 1 MHz      -27.11 dBm  
Ref 17 dBm      \* Att 0 dB      SWT 105 ms      18.103425741 GHz

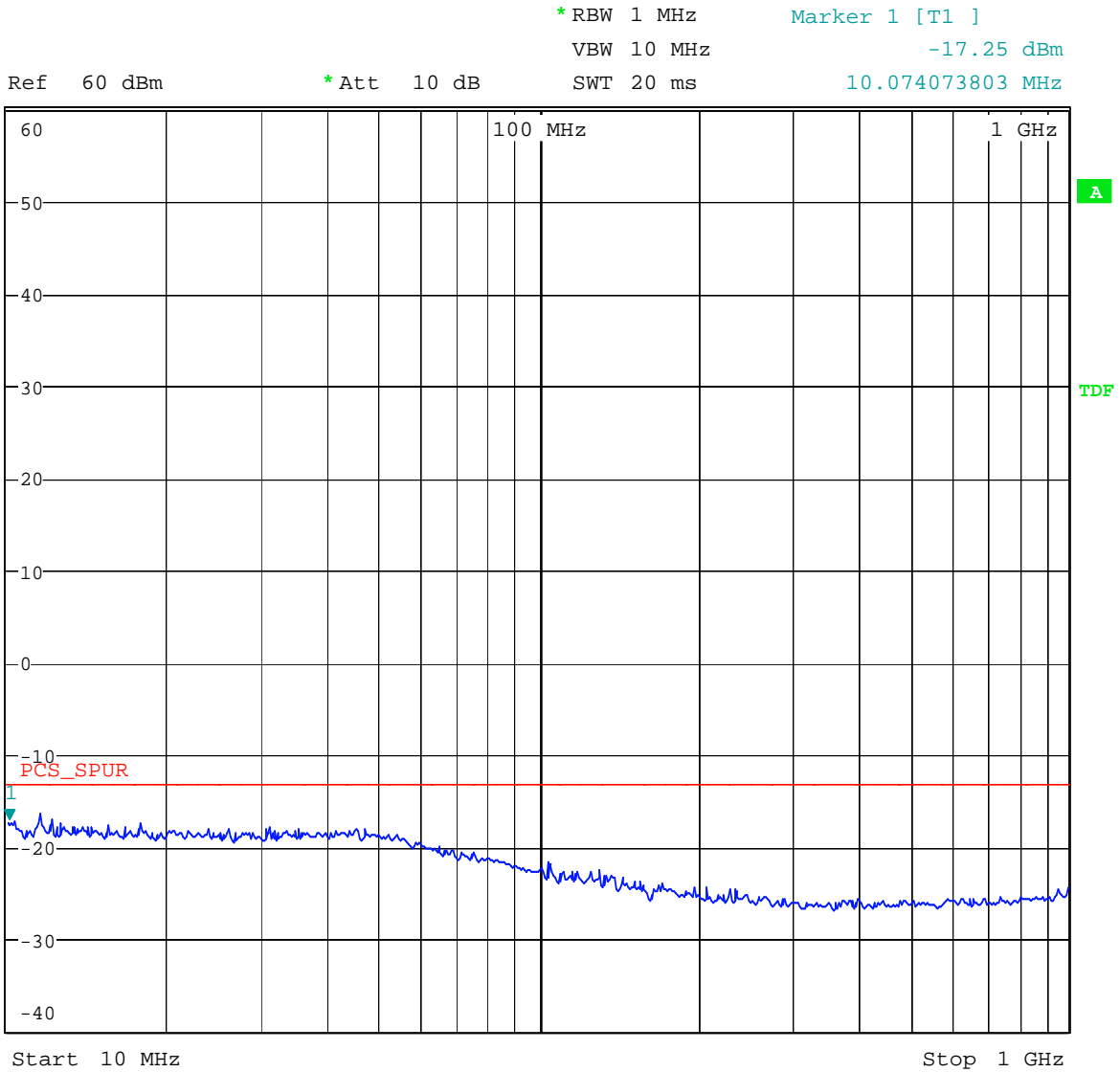


Date: 1.MAR.2007 17:05:06

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Figure 51 Antenna Conducted Spurious – 8PSK 1960.0 MHz – Single Carrier Mode

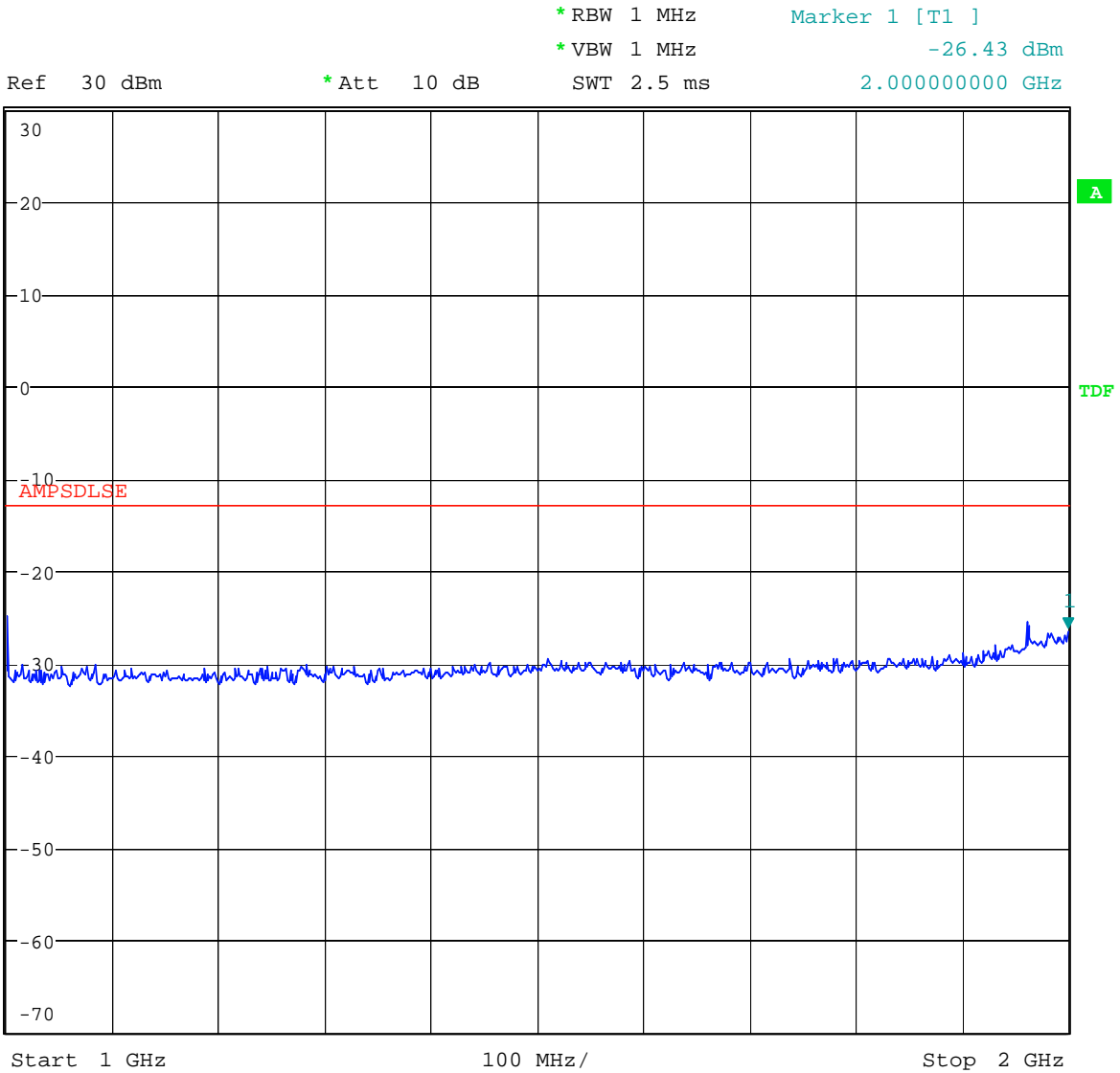


Date: 1.MAR.2007 17:19:18

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**Figure 52 Antenna Conducted Spurious – 8PSK 1960.0 MHz – Single Carrier Mode**



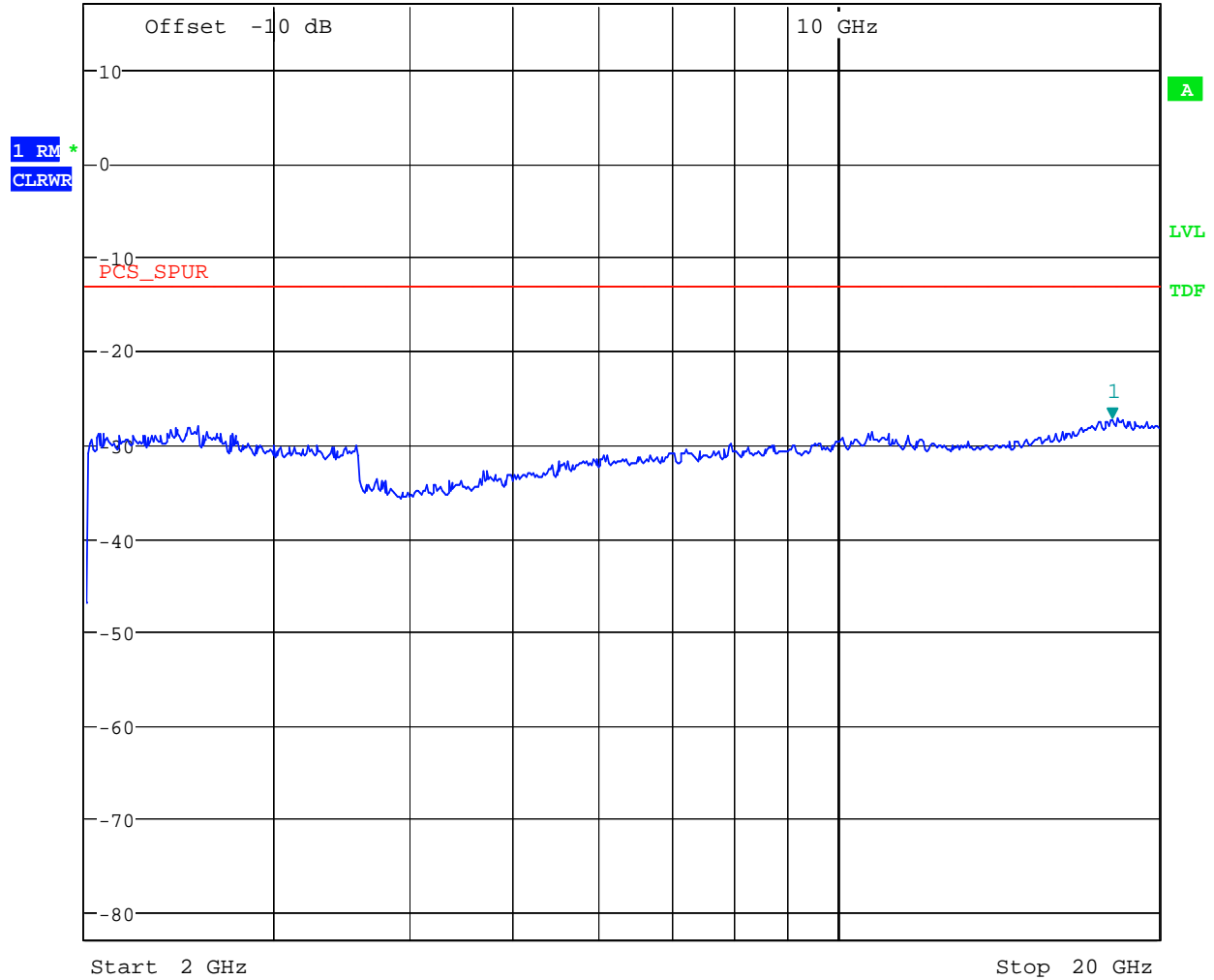
Date: 1.MAR.2007 17:18:00

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Figure 53 Antenna Conducted Spurious – 8PSK 1960.0 MHz – Single Carrier Mode



\* RBW 1 MHz                      Marker 1 [T1 ]  
\* VBW 1 MHz                      -27.34 dBm  
Ref 17 dBm                      \* Att 0 dB                      SWT 105 ms                      18.103425741 GHz



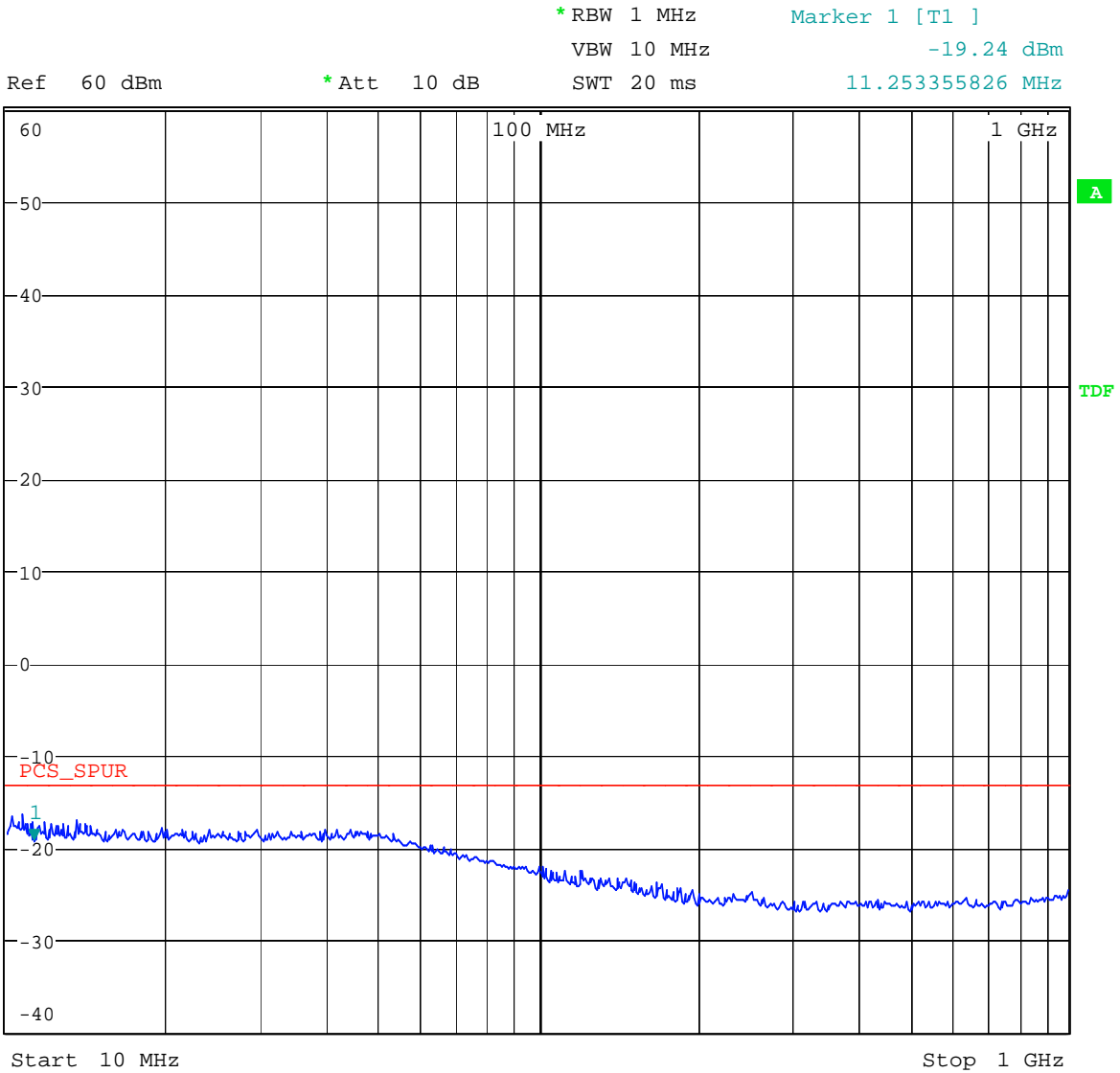
Date: 1.MAR.2007 17:21:05

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**Figure 54 Antenna Conducted Spurious – 8PSK 1989.8 MHz – Single Carrier Mode**



Date: 1.MAR.2007 17:34:51

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Figure 55 Antenna Conducted Spurious – 8PSK 1989.8 MHz – Single Carrier Mode



\* RBW 1 MHz      Marker 1 [T1 ]  
\* VBW 1 MHz      -27.12 dBm  
SWT 2.5 ms      2.000000000 GHz

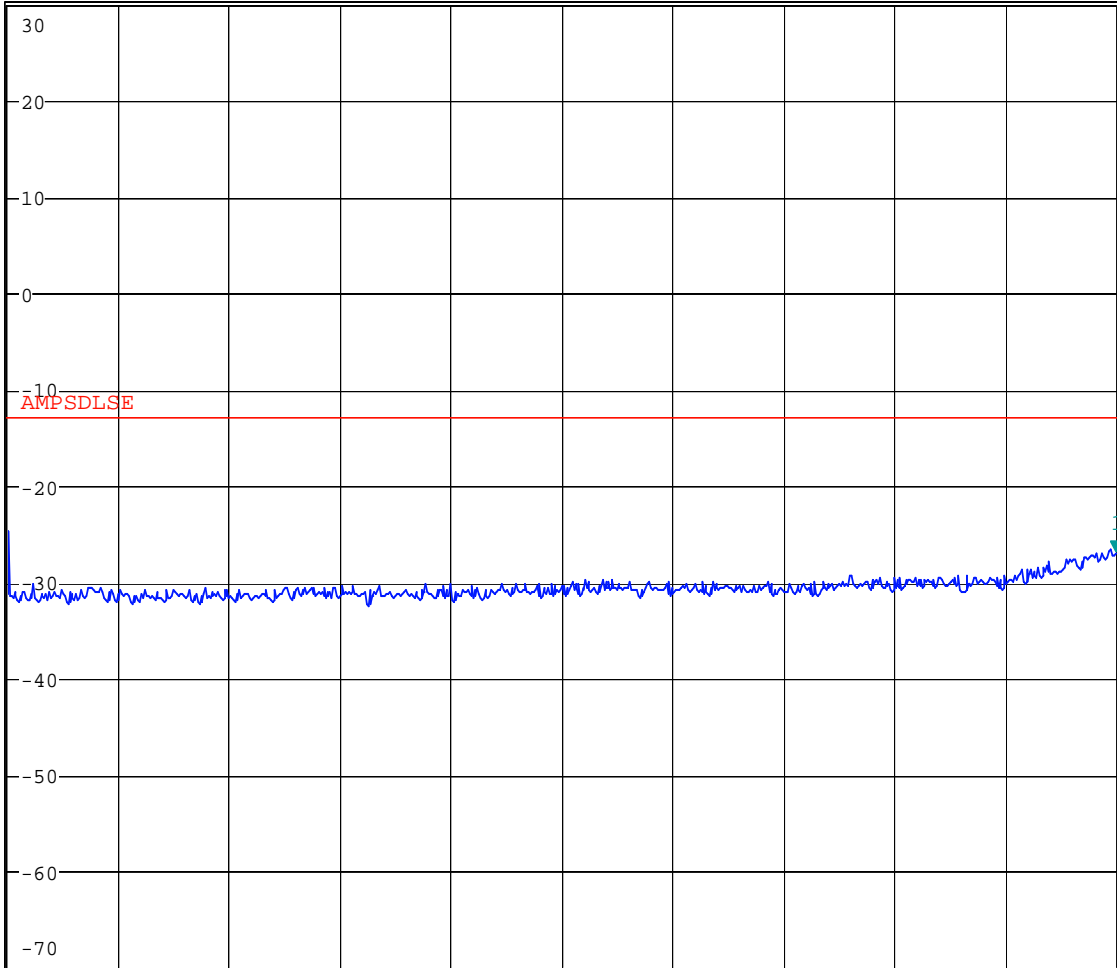
Ref 30 dBm

\* Att 10 dB

SWT 2.5 ms

2.000000000 GHz

1 RM  
AVG



Start 1 GHz

100 MHz/

Stop 2 GHz

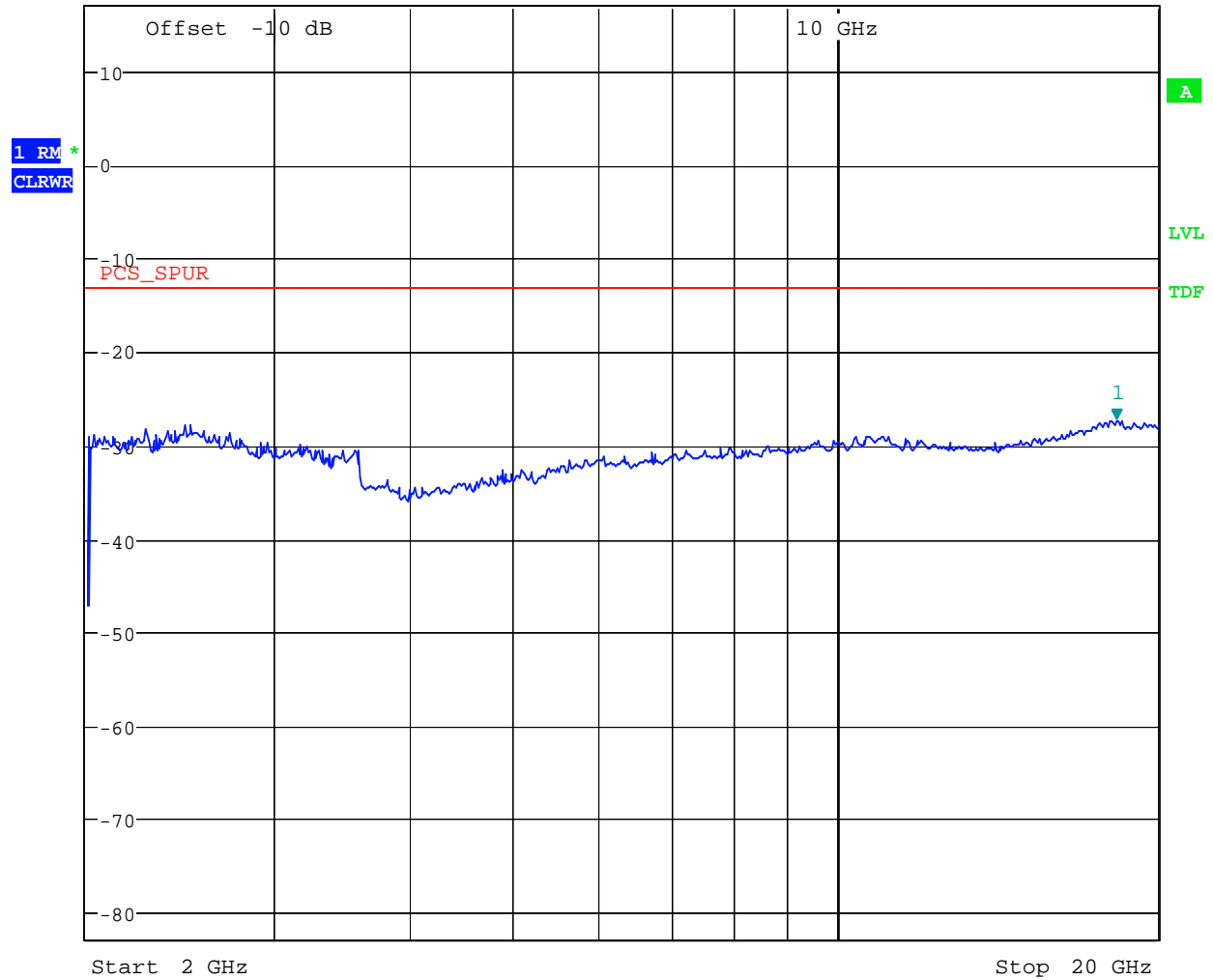
Date: 1.MAR.2007 17:32:08

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**Figure 56 Antenna Conducted Spurious – 8PSK 1989.8 MHz – Single Carrier Mode**



\* RBW 1 MHz                      Marker 1 [T1 ]  
 \* VBW 1 MHz                      -27.37 dBm  
 Ref 17 dBm                      \* Att 0 dB                      SWT 105 ms                      18.304946218 GHz



Date: 1.MAR.2007 17:33:36

**D.8. Tested By**

Name: Tom Tidwell,  
 Function: Manager of Wireless Services

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## APPENDIX E: 2.1053 FIELD STRENGTH OF SPURIOUS RADIATION

### E.1. Base Standard & Test Basis

<b>Base Standard</b>	FCC 2.1053
<b>Test Basis</b>	FCC 2.1053 Field Strength of Spurious Radiation
<b>Test Method</b>	TIA 603-C, 2004 Substitution Antenna Method

### E.2. Limits

24.238 Emission limitations for Broadband PCS equipment

(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

### E.3. Test Results

Compliant. The worst-case spurious emission level was -33.6 dBm at 19600 MHz. This level is 29.1 dB below the specification limit of -13 dBm. The spectrum was searched up to 10 GHz with the device operating on lower, mid, and upper channels.

### E.4. Deviations from Normal Operating Mode During Test

None.

### E.5. Sample Calculation

**Final measured value (dBm) = Substitution level (dBm) + Antenna Gain (dBi)**

**Minimum attenuation limit (dB) =  $43 + 10 \log(P)$  where P = Peak power of the carrier in watts.**

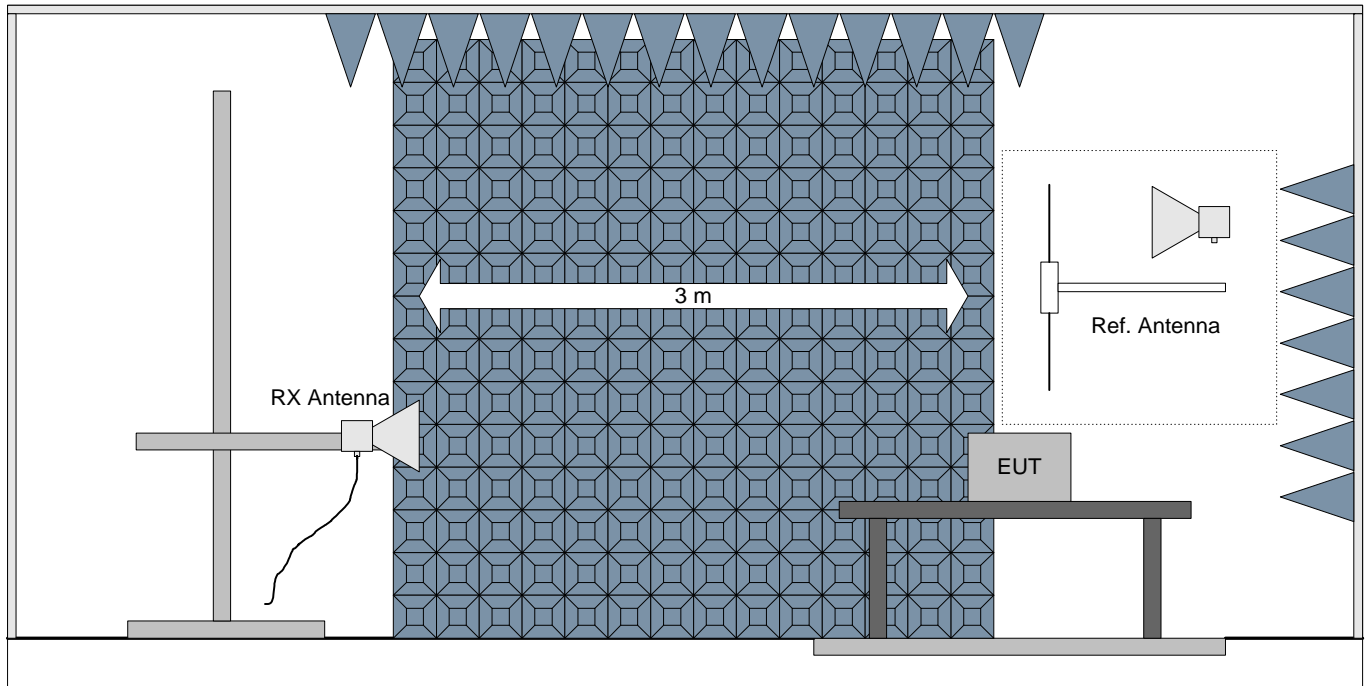
$$\begin{aligned}
 \text{Min. Atten. Limit (dB)} &= 43 + 10 * \log(100 \text{ watts}) \\
 &= 43 + 10 * 2 \\
 &= 43 + 20 \\
 &= 63 \text{ dB}
 \end{aligned}$$

$$+50 \text{ dBm} - 63 \text{ dB} = -13 \text{ dBm}$$

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**E.6. Test Diagram**



Note: The EUT is set to repeat a signal at maximum rf output power into a coaxial load for this testing.

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**E.7. Test Data**

	Project No: W7058-2 Model: EXPA-01 Comments: Operated in combined carrier mode (maximum power) at low mid and high channels
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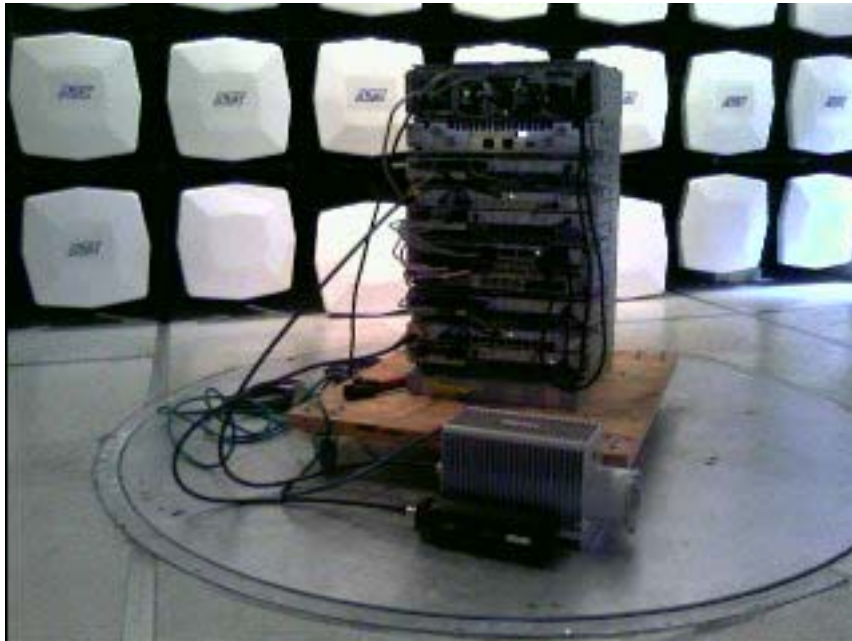
Distance: 3 m	Standard: CFR 47, Part 2	RBW: (unless <1GHz = 120kHz >1GHz = noted) 1MHz	VBW: (unless Peak = RBW noted) Avg. = 10 Hz
---------------	--------------------------	---	---

Notes	Polarization	Frequency (MHz)	Measured (dBm)	Substitution Level (dBm)	Substitution Antenna Gain (dBi)	Final Measured Value		Peak Carrier Power		Limit (dBm)	Margin (dB)
	(V/H)					(dBm)	(watts)	(dBm)	(watts)		
	H	3860.4	-68.8	-51.3	9.2	-42.1	6.16595E-08	48.57	72	-13	29.10
	V	3860.4	-74.7	-56.7	9.2	-47.5	1.77828E-08	48.57	72	-13	34.50
	H	3920	-69.3	-52.1	9.2	-42.9	5.12861E-08	48.57	72	-13	29.90
	V	3920	-88.2	-63.4	9.2	-54.2	3.80189E-09	48.57	72	-13	41.20
	H	3979.6	-70.7	-52.6	9.2	-43.4	4.57088E-08	48.57	72	-13	30.40
	V	3979.6	-93.3	-61	9.2	-51.8	6.60693E-09	48.57	72	-13	38.80
Noise Floor	H	5790.6	-100.5	-46	10.8	-35.2	3.01995E-07	48.57	72	-13	22.20
Noise Floor	V	5790.6	-100.5	-46	10.8	-35.2	3.01995E-07	48.57	72	-13	22.20
Noise Floor	H	5880	-100.5	-46	10.8	-35.2	3.01995E-07	48.57	72	-13	22.20
Noise Floor	V	5880	-100.5	-46	10.8	-35.2	3.01995E-07	48.57	72	-13	22.20
Noise Floor	H	5969.4	-100.5	-46	10.8	-35.2	3.01995E-07	48.57	72	-13	22.20
Noise Floor	V	5969.4	-100.5	-46	10.8	-35.2	3.01995E-07	48.57	72	-13	22.20
Noise Floor	H	19600	-94.8	-45	11.4	-33.6	4.36516E-07	48.57	72	-13	20.60
Noise Floor	V	19600	-94.8	-45	11.4	-33.6	4.36516E-07	48.57	72	-13	20.60

NOTE: The spectrum was searched up to 20 GHz.

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**E.8. Test Photo**



**E.9. Tested By**

Name: Tom Tidwell,  
Function: Manager of Wireless Services

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## APPENDIX F: 2.1055 FREQUENCY STABILITY

### F.1. Base Standard & Test Basis

<b>Base Standard</b>	FCC 2.1055
<b>Test Method</b>	TIA 603-C, 2004

### Specifications

#### 24.235 Frequency Stability

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

### F.2. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

### F.3. Test Results

#### Compliant.

The maximum frequency drift was 0.0357 ppm (70 Hz). This is sufficient to ensure that the emission stays wholly within its assigned frequency block based on band edge spurious emission measurements included in this report.

### F.4. Observations

None

### F.5. Deviations from Normal Operating Mode During Test

None.

### F.6. Sample Calculation

Frequency drift (ppm) = Frequency Drift (Hz)/Authorized frequency (MHz)

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**F.7. Test Data**

**Frequency Stability vs. Temperature**

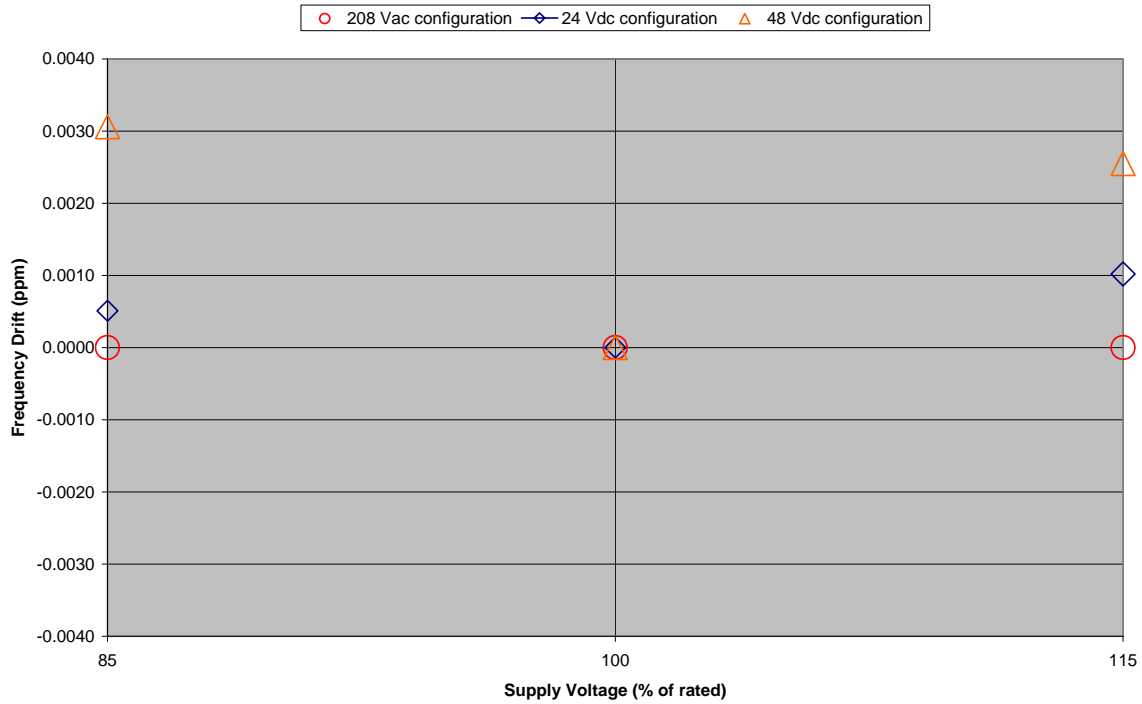
Supply Voltage % of rated	Ambient temperature Deg. Celsius	Reference Transmit Frequency MHz	Measured Frequency MHz	Frequency Drift (Hz)	Frequency Drift (ppm)
100	-30	1960.067569	1960.067616	47	0.0240
100	-20	1960.067569	1960.067623	54	0.0276
100	-10	1960.067569	1960.067626	57	0.0291
100	0	1960.067569	1960.067629	60	0.0306
100	10	1960.067569	1960.067632	63	0.0321
100	20	1960.067569	1960.067569	0	0.0000
100	30	1960.067569	1960.067633	64	0.0327
100	40	1960.067569	1960.067636	67	0.0342
100	50	1960.067569	1960.067639	70	0.0357

**Frequency Drift vs. Supply Voltage Variation**

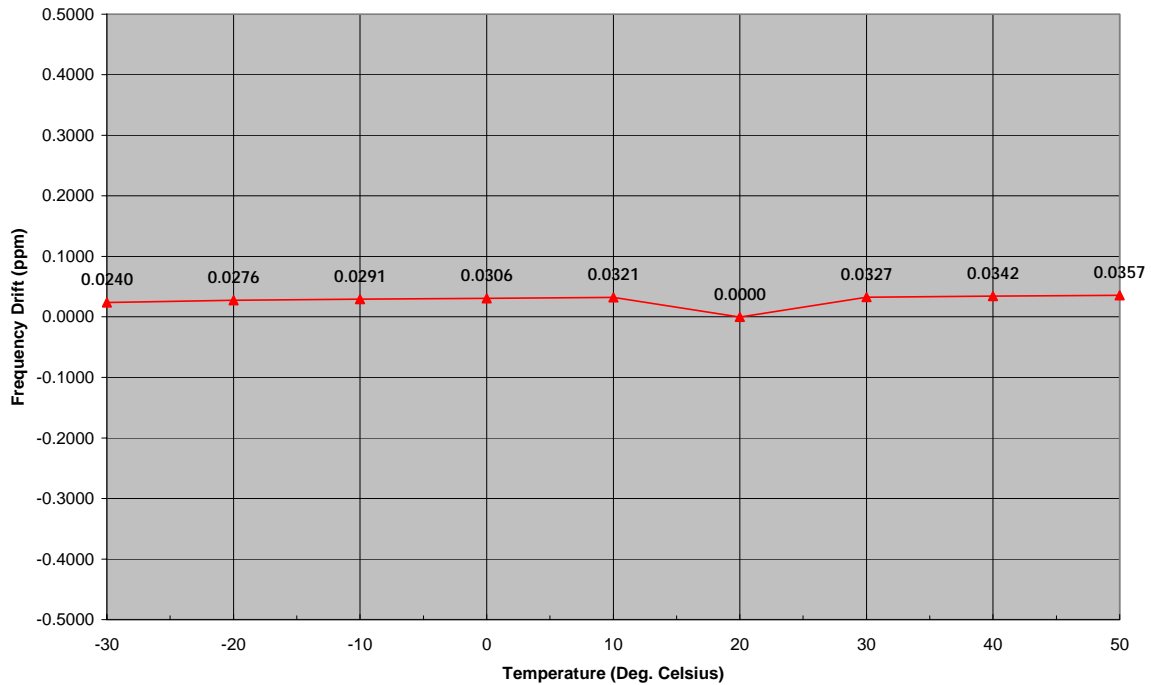
Supply Voltage	Ambient temperature Deg. Celsius	Reference Transmit Frequency MHz	Measured Frequency MHz	Frequency Drift (Hz)	Frequency Drift (ppm)
176.8 Vac	20	1960.067657	1960.067657	0	0.0000
208 Vac	20	1960.067657	1960.067657	0	0.0000
239.2 Vac	20	1960.067657	1960.067657	0	0.0000
20.4 Vdc	20	1960.067655	1960.067656	1	0.0005
24 Vdc	20	1960.067655	1960.067655	0	0.0000
27.6 Vdc	20	1960.067655	1960.067657	2	0.0010
40.8 Vdc	20	1960.067655	1960.067661	6	0.0031
48 Vdc	20	1960.067659	1960.067659	0	0.0000
55.2 Vdc	20	1960.067655	1960.067660	5	0.0026

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**Frequency Drift with Supply Voltage Variation**

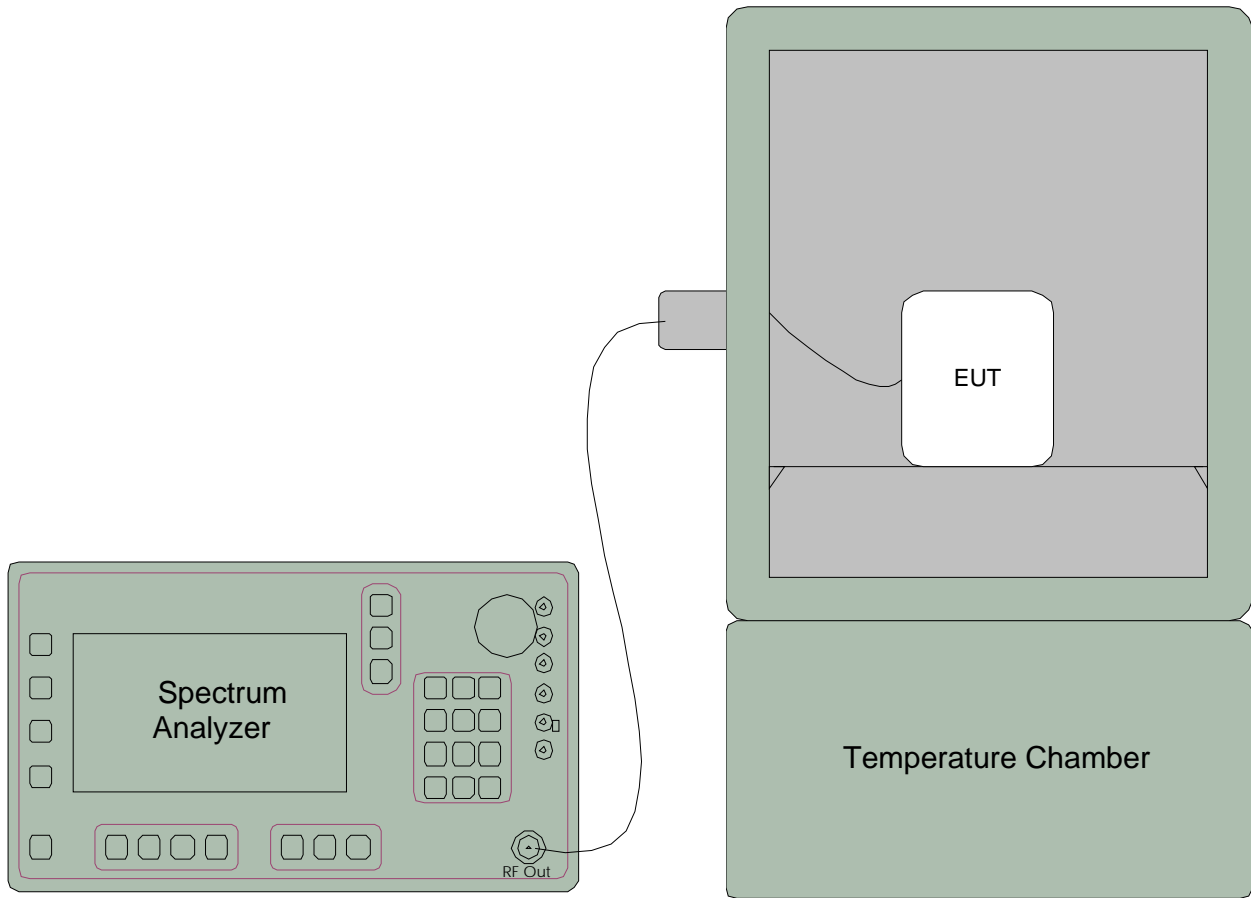


**Frequency Drift with Temperature Variation**



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**F.8. Test Diagram**



**F.9. Tested By**

Name: Tom Tidwell,  
Function: Manager of Wireless Services

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## APPENDIX G: TEST EQUIPMENT LIST

### G.1. Field Strength of Spurious Emissions 30 MHz – 26.5 GHz Measurement Equipment

Description	Manufacturer	Type/Model	Calibration Frequency	Cal Due	NTS Control No.
<b>3m ANECHOIC CHAMBER</b>					
RX Bilog Antenna	ETS	3142C	12 Months	8/17/07	E1288P
Ref. Horn Antenna	ETS	3115	12 Months	11/1/07	E1019P
RX Horn Antenna	ETS	3115	12 Months		E1022P
High Frequency - Cable 1	MegaPhase	TM26-3135-144	12 Months	8/23/07	W1010P
Reference Antenna	ETS	3121 Dipole Set	12 months	8/8/07	S/N. 274
<b>CONTROL ROOM</b>					
Test Receiver	Rohde & Schwarz	FSQ 26	12 Months	9/21/07	W1020P
High Frequency - Cable 2	MegaPhase	NA	12 Months	8/23/07	W1011P
Amplifier	HP	8449B	12 Months	5/4/07	E1010P

### G.2. Antenna Conducted Emissions Measurement Equipment

Instrument	Manufacturer	Model	Calibration Frequency	Calibration Due
<b>ANTENNA CONDUCTED EMISSIONS</b>				
Spectrum Analyzer	Rohde & Schwarz	FSQ 26	12 Months	9/21/07
High Frequency - Cable 1	MegaPhase	TM26-3135-144	12 Months	8/23/07
Power Meter	Boonton	4531	12 Months	9/1/07
Peak Power Sensor	Boonton	57340		9/1/07
Directional Coupler	Narda	3020A	12 Months	8/28/07
Directional Coupler	Narda	4242-10	12 Months	8/28/07
50 ohm loads	Amphenol	50R	12 Months	8/28/07
I/Q Signal Generator	Rohde & Schwarz	SMIQ 03	12 Months	8/25/07
I/Q Modulation Generator	Rohde & Schwarz	AMIQ	12 Months	8/28/07
Combiner	Mini-Circuits	ZFSC-2-2500	N/A	N/A*
IS-95 CDMA BTS simulator	Rohde & Schwarz	CMD80	N/A	N/A*

\* This device was not used for calibrated measurements.

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