Intertek ETL SEMKO

mailed 9/14/05

EMISSIONS TEST REPORT

Report Number: 3082207.EMI-A
Project Number: 3082207

Testing performed on the
Model: GSM 1900 Basestation

to

FCC Part 24

For

Vanu, Inc.

Test Performed by:
Intertek – ETL SEMKO
70 Codman Hill Road
Boxborough, MA 01719

Test Authorized by:
Vanu, Inc.
One Cambridge Center
Cambridge, MA 02142

Prepared by: _____ Date: 9/12/2005
Nicholas Abbondante

Reviewed by: _____ Date: 9-13-2005
Roland W. Gubisch

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1.0 Job Description

1.1 Client Information

This EUT has been tested at the request of

Company:	Vanu, Inc. One Cambridge Center Cambridge, MA 02142
Contact:	Byron Kubert
Telephone:	617-864-1711
Fax:	617-864-1697

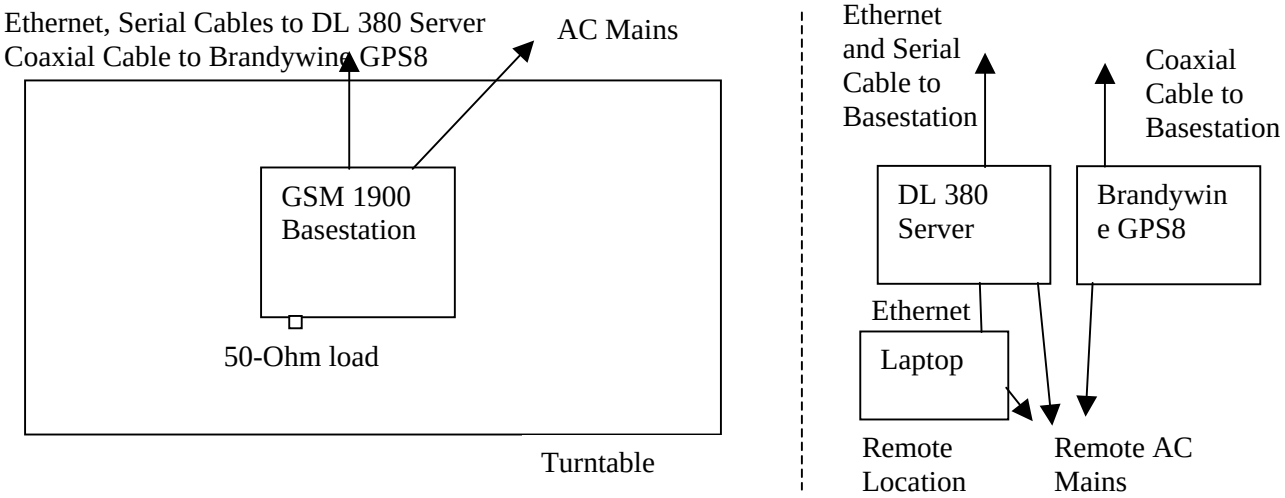
1.2 Equipment Under Test

Equipment Type:	Cellular Basestation
Model Number(s):	GSM 1900 Basestation
Serial number(s):	1526-1
Manufacturer:	Protium Technologies, Inc.
EUT receive date:	08/15/2005
EUT received condition:	Good
Test start date:	08/15/2005
Test end date:	09/09/2005

1.3 Test Plan Reference: Tested according to the standards listed.

1.4 Test Configuration

1.4.1 Block Diagram



1.4.2 Cable List:

Cable	Shielding	Connector	Length (m)	Qty.
DL380 Power Cable	None	Plastic	1.5	1
Serial Cable	Braid	Metal/360 (DB9)	3	1
Ethernet Cable	Braid	Metal	1.5	2
RF Section Power Cable	None	Plastic	2	1
Laptop Power Cable	Braid	Metal/Jack	2.5	1
Brandywine Power Cable	None	Plastic	2.5	1
Coaxial Cable	Braid	Metal/360 (BNC)	2	1

1.4.3 Support Equipment:

Name: Dell Latitude Laptop
Model No.: D505
Serial No.: 1541

Name: Brandywine Communications
Model No.: GPS8
Serial No.: 1611

Name: HP ProLiant DL 380 Server
Model No.: DL380
Serial No.: 1205

1.5 Mode of Operation:

The EUT was activated from 120V/60Hz power and transmitted on low, mid, and high channels across the EUT passband. Various types of data were fed to the modulator, as indicated in the list below and referenced elsewhere in this document. Unless otherwise indicated, bursts of random data were fed to the modulator.

EUT passband: 1930 – 1990 MHz

Channels Tested:
Channel A: 1931 MHz
Channel B: 1960 MHz
Channel C: 1989 MHz

BIT PATTERN TEST MODES (All Software Tests performed at Channel B – 1960 MHz)

Software Test 1 Repeated GSM signal syncburst dropout filling every other page with zeros

Software Test 2 GSM signal program suspended for seconds at a time every couple of seconds

Software Test 3 GSM signal created from a sequence of all zeros (156 zeros)

Software Test 4 Repeated GSM signal with 8 bursts of valid traffic channel data followed by 8 bursts of zeros

Software Test 5 Repeated GSM signal with 1 timeslot of valid traffic channel data and remaining 7 timeslots filled with dummy bursts

Software Test 6 Repeated GSM signal sequence with 4 timeslots of valid traffic channel data and the remaining 4 timeslots filled with dummy bursts

Software Test 7 Repeated GSM signal sequence with 8 timeslots of valid traffic channel data

Software Test 8 GSM signal created from a square wave with a period of four symbols

Software Test 9 GSM signal created from a random sequence of 125000 symbols

Software Test 10 GSM signal created from a sequence of all ones (156 ones)

Software Test 11 Repeated GSM signal with 1 timeslot of valid control channel data and remaining 7 timeslots filled with dummy bursts

2.0 Test Summary

TEST STANDARD	RESULTS	
FCC Part 24		
SUB-TEST	**TEST PARAMETER**	**COMMENT**
RF Output Power FCC 2.1046, 24.232	RF Output Power must not exceed 100 Watts (50 dBm)	Pass
Occupied Bandwidth FCC 2.1049	Emission must stay within assigned band of operation.	Pass
Spurious Conducted Emissions FCC 2.1051, 24.238	Emissions outside the passband must not exceed –13 dBm.	Pass
Spurious Radiated Emissions FCC 2.1053, 24.238	Emissions outside the passband must not exceed –13 dBm.	Pass
Frequency Stability FCC 2.1055, 24.235	Emission must stay within assigned band of operation.	Pass

3.0 Sample Calculations

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

Level in μV/m = [10(32 dBμV/m)/20] = 39.8 μV/m

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF
Where NF = Net Reading in dBμV
RF = Reading from receiver in dBμV
LF = LISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBμV
$UF = 10^{(48.1\ dB\mu V / 20)}$ = 254 μV/m

3.1 Measurement Uncertainty

Compliance of the product is based on the measured value. However, the measurement uncertainty is included for informational purposes.
The expanded uncertainty (k = 2) for radiated emissions from 30 to 1000 MHz has been determined to be:

±3.5 dB at 10m, ±3.8 dB at 3m

The expanded uncertainty (k = 2) for mains conducted emissions from 150 kHz to 30 MHz has been determined to be:

±2.6 dB

The expanded uncertainty (k = 2) for telecom port conducted emissions from 150 kHz to 30 MHz has been determined to be:

±3.2 for ISN and voltage probe measurements
±3.1 for current probe measurements

3.2 Site Description

Test Site(s): 2

Our OATS are 3m and 10m sheltered emissions measurement ranges located in a light commercial environment in Boxborough, Massachusetts. They meet the technical requirements of ANSI C63.4-1992 and CISPR 22:1993/EN 55022:1994 for radiated and conducted emission measurements. The shelter structure is entirely fiberglass and plastic, with outside dimensions of 33 ft x 57 ft. The structure resembles a quonset hut with a center ceiling height of 16.5 ft.

The testing floor is covered by a galvanized sheet metal groundplane that is earth-grounded via copper rods around the perimeter of the site. The joints between individual metal sheets are bridged with a 2 inch wide metal strips to provide low RF impedance contact throughout. The sheets are screwed in place with stainless steel, round-head screws every three inches. Site illumination and HVAC are provided from beneath the ground reference plane through flush entry ports, the port covers are electrically bonded to the ground plane.

A flush metal turntable with 12 ft. diameter and 5000 lb. load capacity (12,000 lb. in Site 3) is provided for floor-standing equipment. A wooden table 80 cm high is used for table-top equipment. The turntable is electrically connected to the ground plane with three copper straps. The straps are connected to the turntable at the center of it with ground braid. The copper strap is directly connected to the groundplane at the edges of the turntable. The turntable is located on the south end of the structure and the antennas are mounted 3 and 10 meters away to the north. The antenna mast is a non-conductive with remote control of antenna height and polarization. The antenna height is adjustable from 1 to 4 meters.

All final radiated emission measurements are performed with the testing personnel and measurement equipment located below the ground reference plane. The site has a full basement underneath the turntable where support equipment may be remotely located. Operation of the antenna, turntable and equipment under test is controlled by remote controls that manipulate the antenna height and polarization and with a turntable control. Test personnel are located below the ellipse when measurements are performed, however the site maintains the ability of having personnel manipulate cables while monitoring test equipment. Ambient radiated emissions are 6 dB or more below the relevant FCC emission limits.

AC mains power is brought to the equipment under test through a power line filter, to remove ambient conducted noise. 50 Hz (240 VAC single phase), 60 Hz power (120 VAC single phase, 208 VAC three phase), and 60 Hz (480 VAC three phase) are available. Conducted emission measurements are performed with a Line Impedance Stabilization Network (LISN) or Artificial Mains Network (AMN) bonded to the ground reference plane. A removable vertical groundplane (2 meter X 2 meter area) is used for line-conducted measurements for table top equipment. The vertical groundplane is electrically connected to the reference groundplane.

The EMC Lab has two Semi-anechoic Chambers and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference groundplanes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

Test Results: Pass

Test Standard: FCC 2.1046, 24.232

Test: RF Output Power

Maximum Test Disturbance Parameters: RF Output Power must not exceed 100 Watts (50 dBm)

Test Date: 08/19-22/2005 **Engineer Initials: _____ Date: _____**
Test Engineer: Nicholas Abbondante **Reviewer Initials: _____ Date: _____**

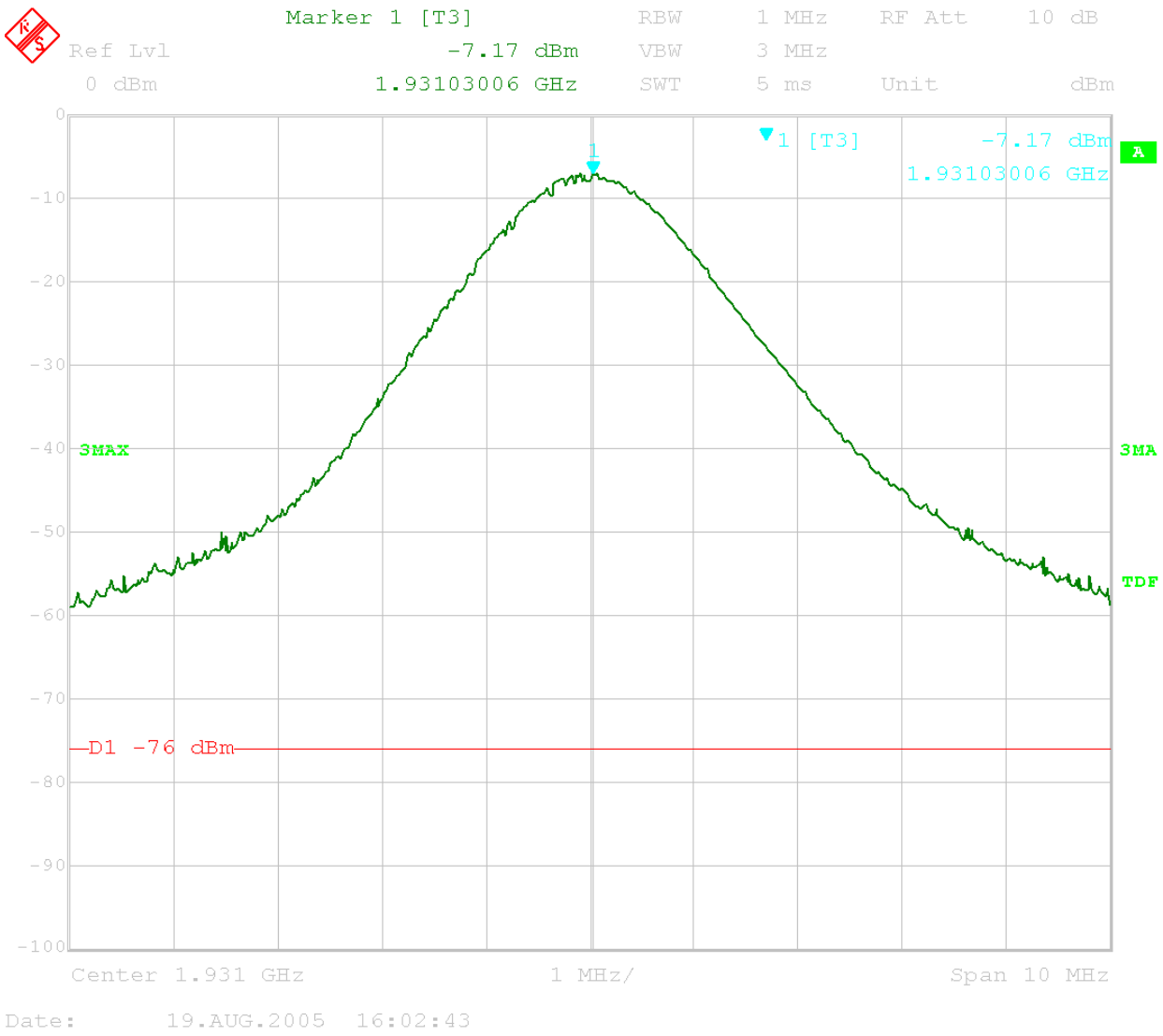
Test Equipment Used:

Intertek ID	Manufacturer	Model	Serial Number	Cal. Due
ROS001	Rohde & Schwarz	FSEK-30	100225	07/26/2006
CBL028	Megaphase	TM40 K1K1 197	CBL028	12/01/2005

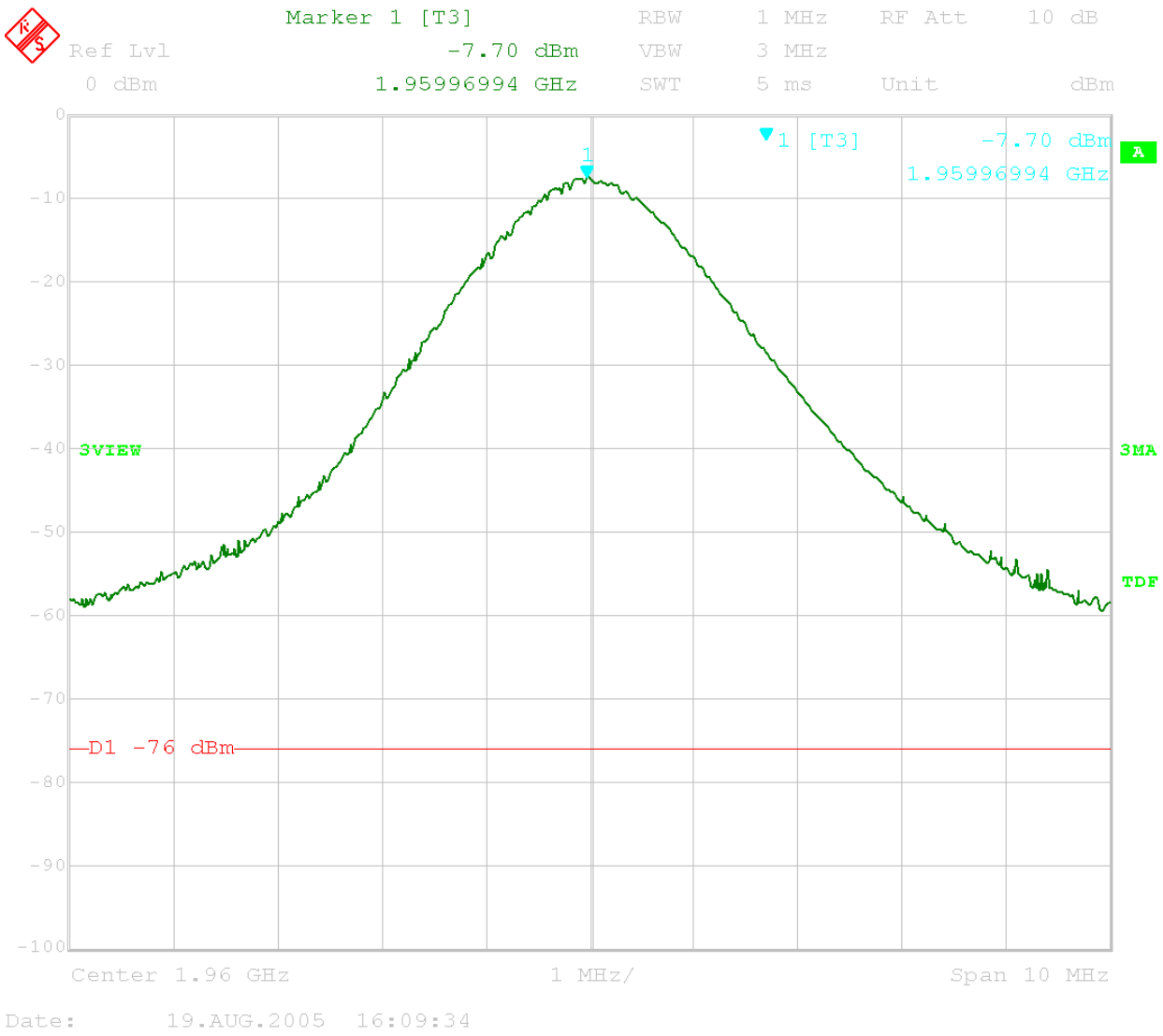
Test Details:

Test	EUT Reading dBm	Standard Limit 100 Watts – 50 dBm	Pass Fail	COMMENT
Channel A	-7.17	50 dBm	Pass	
Channel B	-7.70	50 dBm	Pass	
Channel C	-8.22	50 dBm	Pass	
Software Test 1	-8.17	50 dBm	Pass	
Software Test 2	-8.37	50 dBm	Pass	
Software Test 3	-8.82	50 dBm	Pass	
Software Test 4	-8.65	50 dBm	Pass	
Software Test 5	-8.55	50 dBm	Pass	
Software Test 6	-8.49	50 dBm	Pass	
Software Test 7	-8.55	50 dBm	Pass	
Software Test 8	-7.81	50 dBm	Pass	
Software Test 9	-7.75	50 dBm	Pass	
Software Test 10	-8.54	50 dBm	Pass	
Software Test 11	-8.54	50 dBm	Pass	

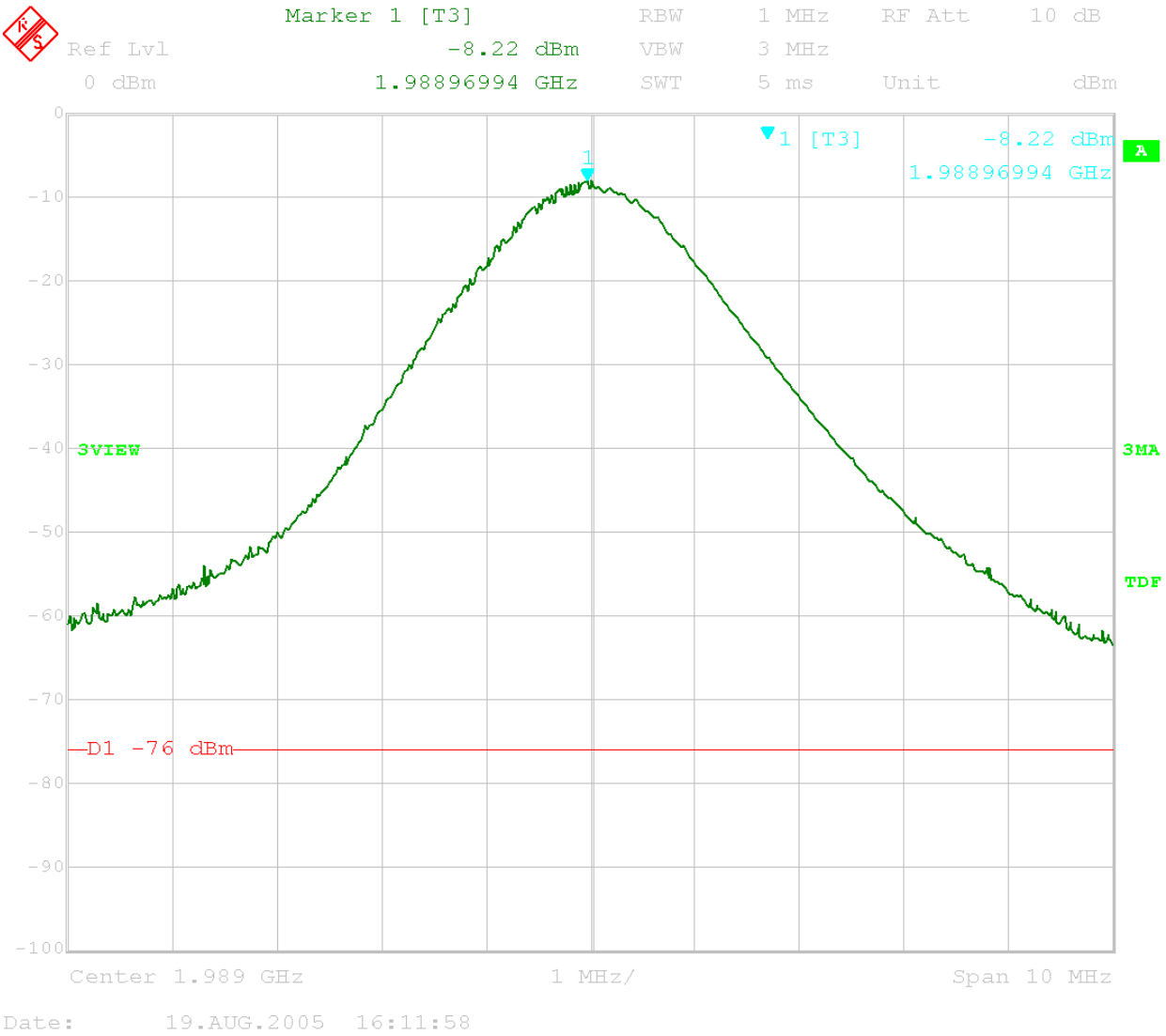
Notes: Transducer factors were programmed into the spectrum analyzer to compensate for cable loss in the test setup. Power was measured at the output of the duplexer. Software test mode plots can be found in Appendix A.


Marker 1 [T3]
RBW 1 MHz
RF Att 10 dB
Ref Lvl
-7.17 dBm
VBW 3 MHz
0 dBm
1.93103006 GHz
SWT 5 ms
Unit dBm
1 [T3]
-7.17 dBm
1.93103006 GHz
A
3MAX
3MA
TDF
D1 -76 dBm
Center 1.931 GHz
1 MHz/
Span 10 MHz
Date: 19.AUG.2005 16:02:43

Channel A


Marker 1 [T3]
RBW 1 MHz
RF Att 10 dB
Ref Lvl
-7.70 dBm
VBW 3 MHz
0 dBm
1.95996994 GHz
SWT 5 ms
Unit dBm
1 [T3]
-7.70 dBm
1.95996994 GHz
A
3VIEW
3MA
TDF
D1 -76 dBm
Center 1.96 GHz
1 MHz/
Span 10 MHz
Date: 19.AUG.2005 16:09:34

Channel B


Marker 1 [T3]
RBW 1 MHz
RF Att 10 dB
Ref Lvl
-8.22 dBm
VBW 3 MHz
0 dBm
1.98896994 GHz
SWT 5 ms
Unit dBm
1 [T3]
-8.22 dBm
1.98896994 GHz
A
3VIEW
3MA
TDF
D1 -76 dBm
Center 1.989 GHz
1 MHz/
Span 10 MHz
Date: 19.AUG.2005 16:11:58

Channel C

Test Results: Pass

Test Standard: FCC 2.1049

Test: Occupied Bandwidth (26 dB Bandwidth)

Maximum Test Disturbance Parameters: Emission must stay within assigned band of operation.

Test Date: 09/09/2005 **Engineer Initials: _____ Date: _____**
Test Engineer: Nicholas Abbondante **Reviewer Initials: _____ Date: _____**

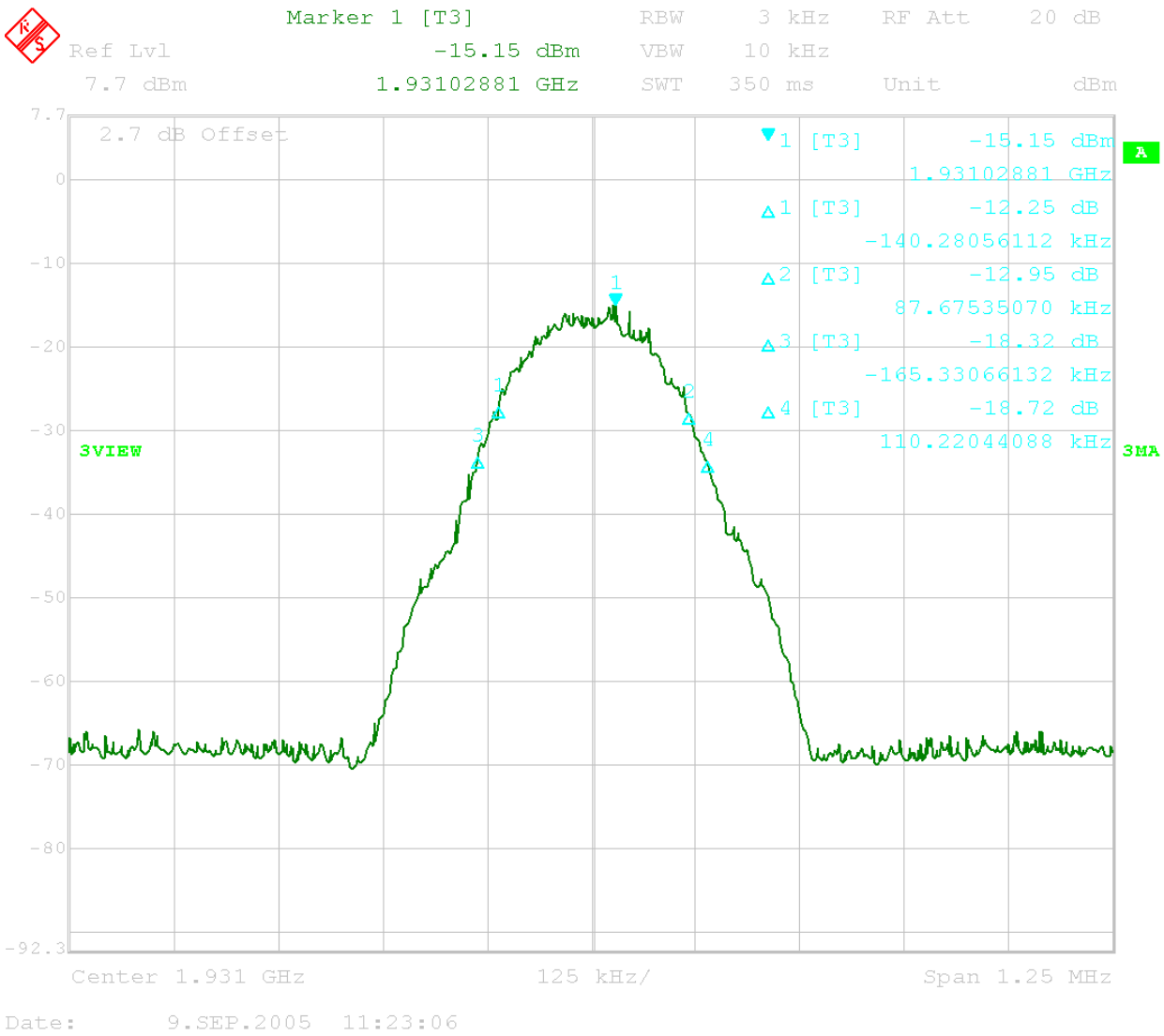
Test Equipment Used:

Intertek ID	Manufacturer	Model	Serial Number	Cal. Due
ROS001	Rohde & Schwarz	FSEK-30	100225	07/26/2006
CBL028	Megaphase	TM40 K1K1 197	CBL028	12/01/2005

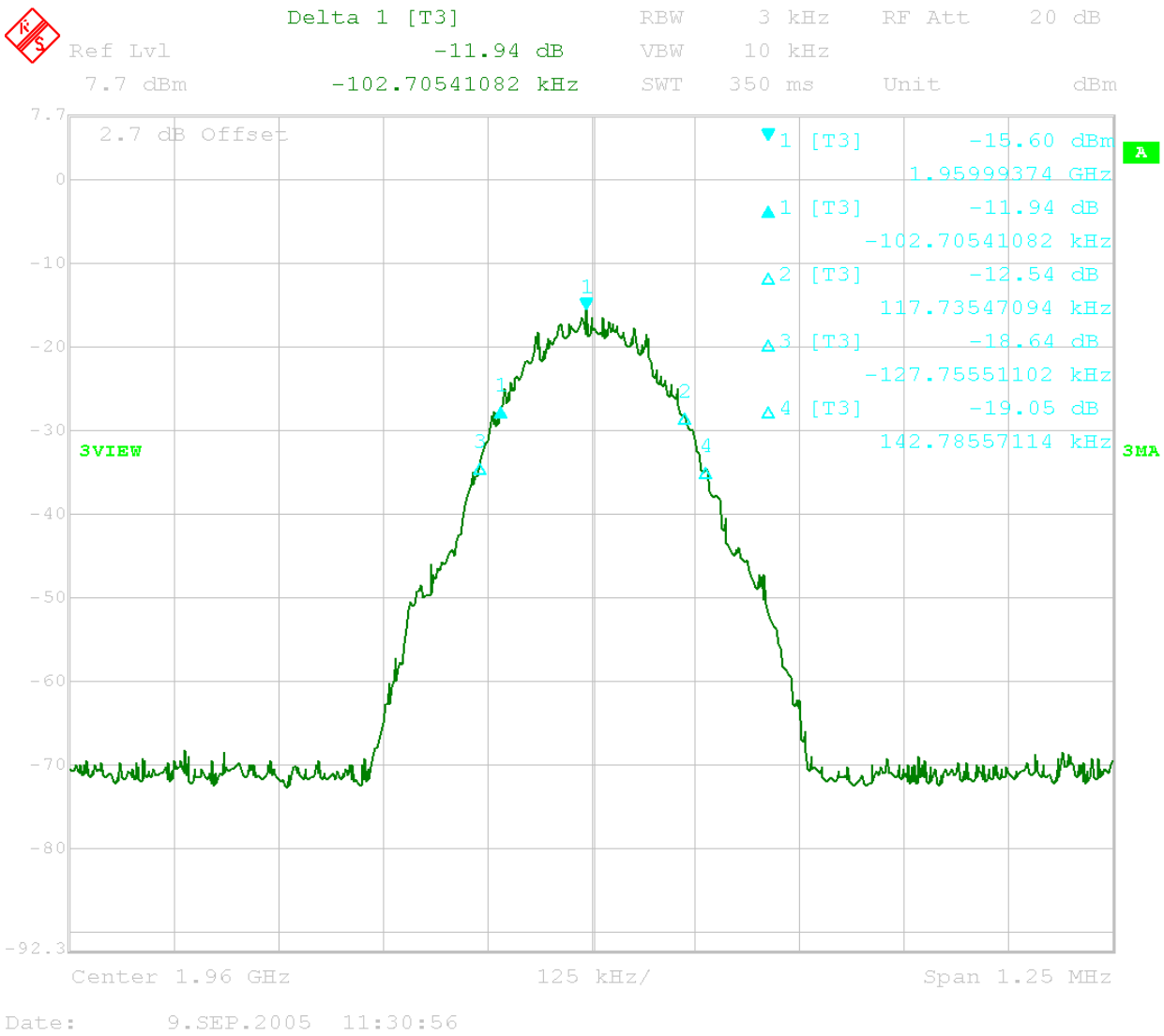
Test Details:

Test	EUT Reading kHz	Standard Limit No limit	Pass Fail	COMMENT
Channel A	275.5	No limit	Pass	
Channel B	270.5	No limit	Pass	
Channel C	280.5	No limit	Pass	
Software Test 1	248.0	No limit	Pass	
Software Test 2	253.0	No limit	Pass	
Software Test 3	90.2	No limit	Pass	
Software Test 4	268.0	No limit	Pass	
Software Test 5	268.0	No limit	Pass	
Software Test 6	268.0	No limit	Pass	
Software Test 7	268.0	No limit	Pass	
Software Test 8	285.6	No limit	Pass	
Software Test 9	283.1	No limit	Pass	
Software Test 10	52.7	No limit	Pass	
Software Test 11	268.0	No limit	Pass	

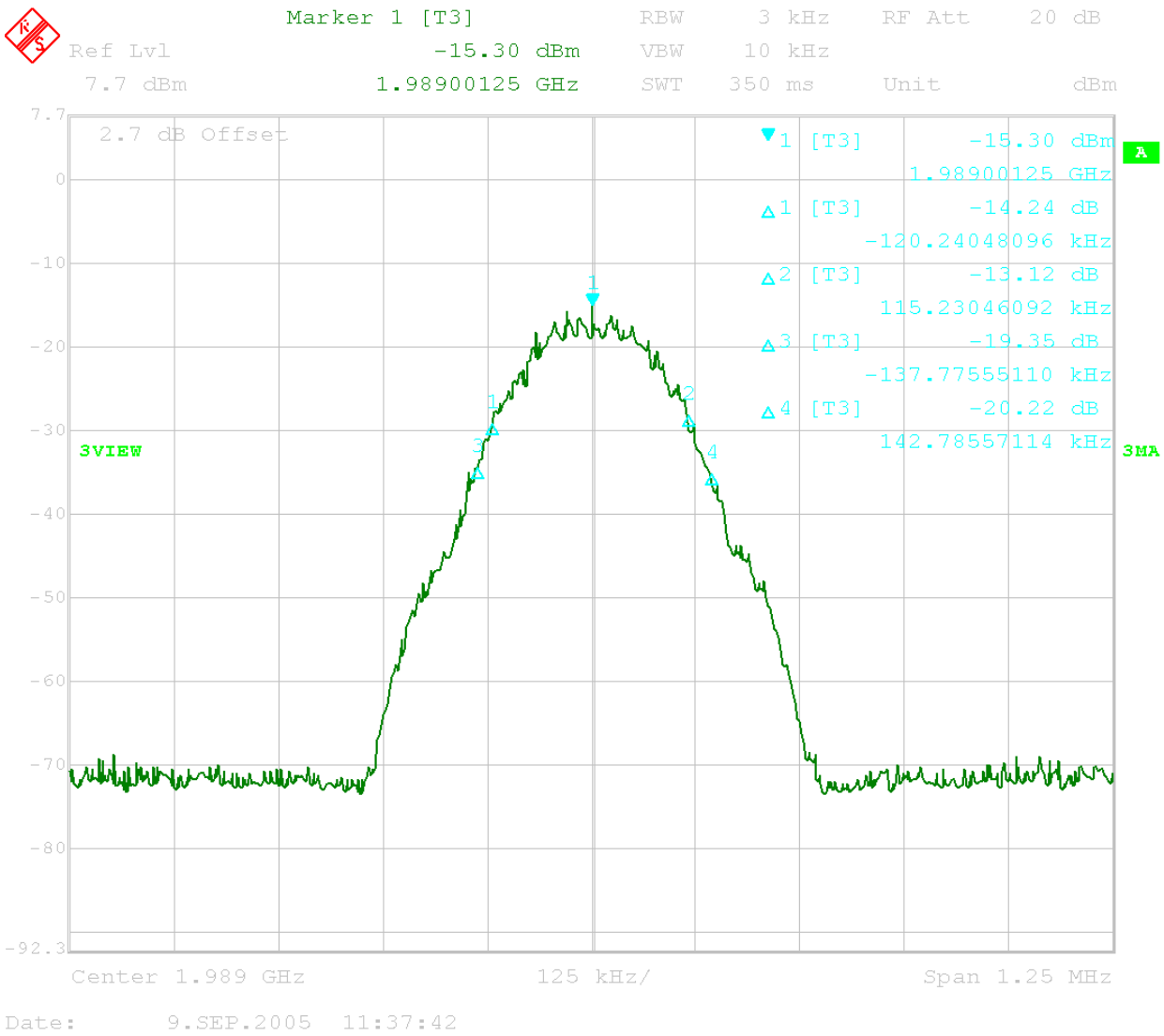
Notes: The RF output power the bandwidth measurements are referenced to was measured at the output of the duplexer. Software test mode plots can be found in Appendix B.


Marker 1 [T3]
RBW 3 kHz
RF Att 20 dB
Ref Lvl
-15.15 dBm
VBW 10 kHz
7.7 dBm
1.93102881 GHz
SWT 350 ms
Unit dBm
2.7 dB Offset
1 [T3] -15.15 dBm
1.93102881 GHz
Δ1 [T3] -12.25 dB
-140.28056112 kHz
Δ2 [T3] -12.95 dB
87.67535070 kHz
Δ3 [T3] -18.32 dB
-165.33066132 kHz
Δ4 [T3] -18.72 dB
110.22044088 kHz
A
3VIEW
3MA
7.7
0
-10
-20
-30
-40
-50
-60
-70
-80
-92.3
Center 1.931 GHz
125 kHz/
Span 1.25 MHz
Date: 9.SEP.2005 11:23:06

Channel A


Delta 1 [T3]
RBW 3 kHz
RF Att 20 dB
Ref Lvl
-11.94 dB
VBW 10 kHz
7.7 dBm
-102.70541082 kHz
SWT 350 ms
Unit dBm
2.7 dB Offset
1 [T3] -15.60 dBm
1.95999374 GHz
1 [T3] -11.94 dB
-102.70541082 kHz
2 [T3] -12.54 dB
117.73547094 kHz
3 [T3] -18.64 dB
-127.75551102 kHz
4 [T3] -19.05 dB
142.78557114 kHz
3VIEW
3MA
A
7.7
0
-10
-20
-30
-40
-50
-60
-70
-80
-92.3
Center 1.96 GHz
125 kHz/
Span 1.25 MHz
Date: 9.SEP.2005 11:30:56

Channel B


Marker 1 [T3]
RBW 3 kHz
RF Att 20 dB
Ref Lvl
-15.30 dBm
VBW 10 kHz
7.7 dBm
1.98900125 GHz
SWT 350 ms
Unit dBm
2.7 dB Offset
1 [T3] -15.30 dBm
1.98900125 GHz
Δ1 [T3] -14.24 dB
-120.24048096 kHz
Δ2 [T3] -13.12 dB
115.23046092 kHz
Δ3 [T3] -19.35 dB
-137.77555110 kHz
Δ4 [T3] -20.22 dB
142.78557114 kHz
3VIEW
3MA
A
7.7
0
-10
-20
-30
-40
-50
-60
-70
-80
-92.3
Center 1.989 GHz
125 kHz/
Span 1.25 MHz
Date: 9.SEP.2005 11:37:42

Channel C

Test Results: Pass

Test Standard: FCC 2.1051, 24.238

Test: Spurious Conducted Emissions

Maximum Test Disturbance Parameters: Emissions outside the passband must not exceed –13 dBm.

Test Date: 08/19-22/2005 **Engineer Initials: _____ Date: _____**
Test Engineer: Nicholas Abbondante **Reviewer Initials: _____ Date: _____**

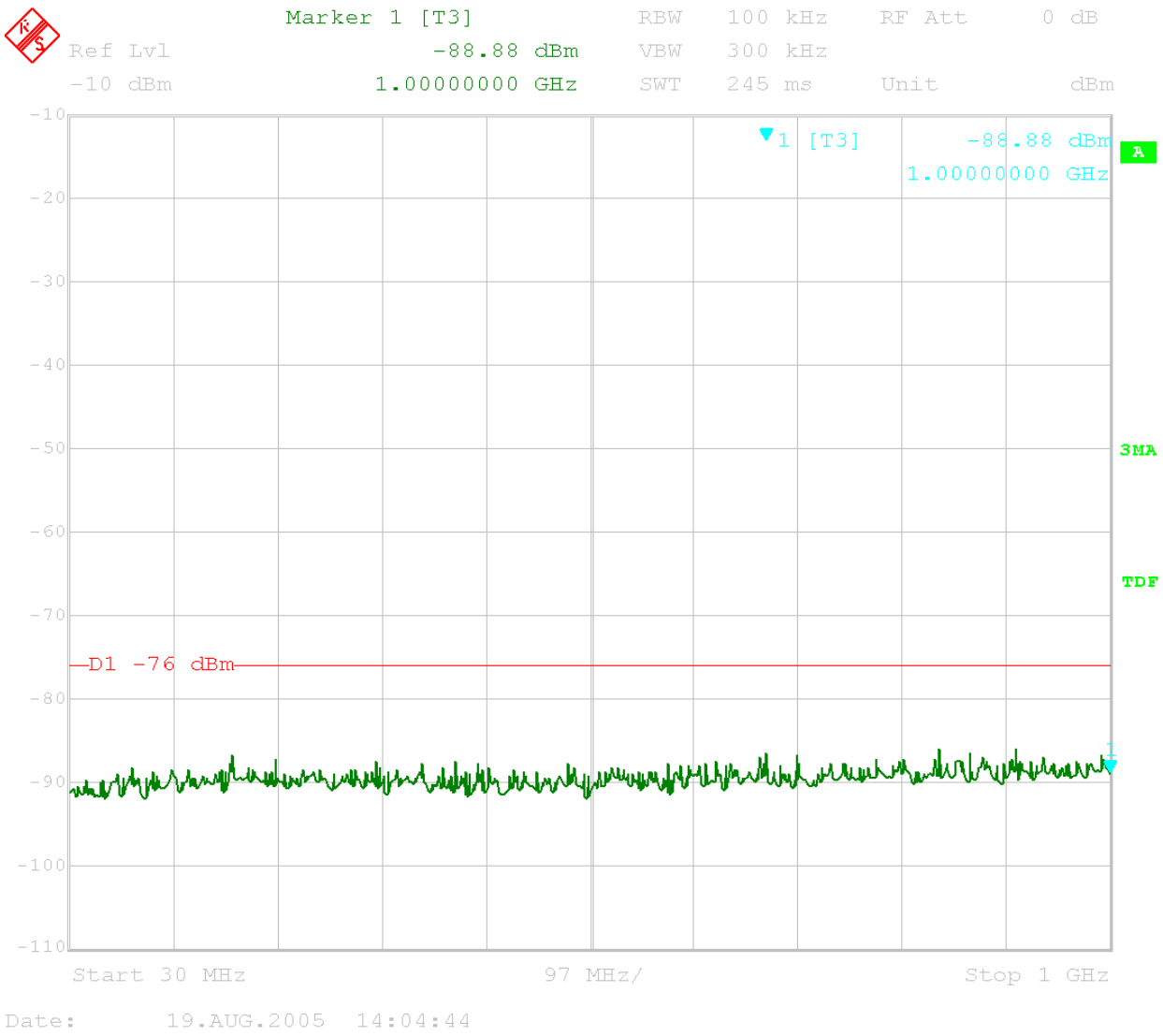
Test Equipment Used:

Intertek ID	Manufacturer	Model	Serial Number	Cal. Due
ROS001	Rohde & Schwarz	FSEK-30	100225	07/26/2006
CBL028	Megaphase	TM40 K1K1 197	CBL028	12/01/2005

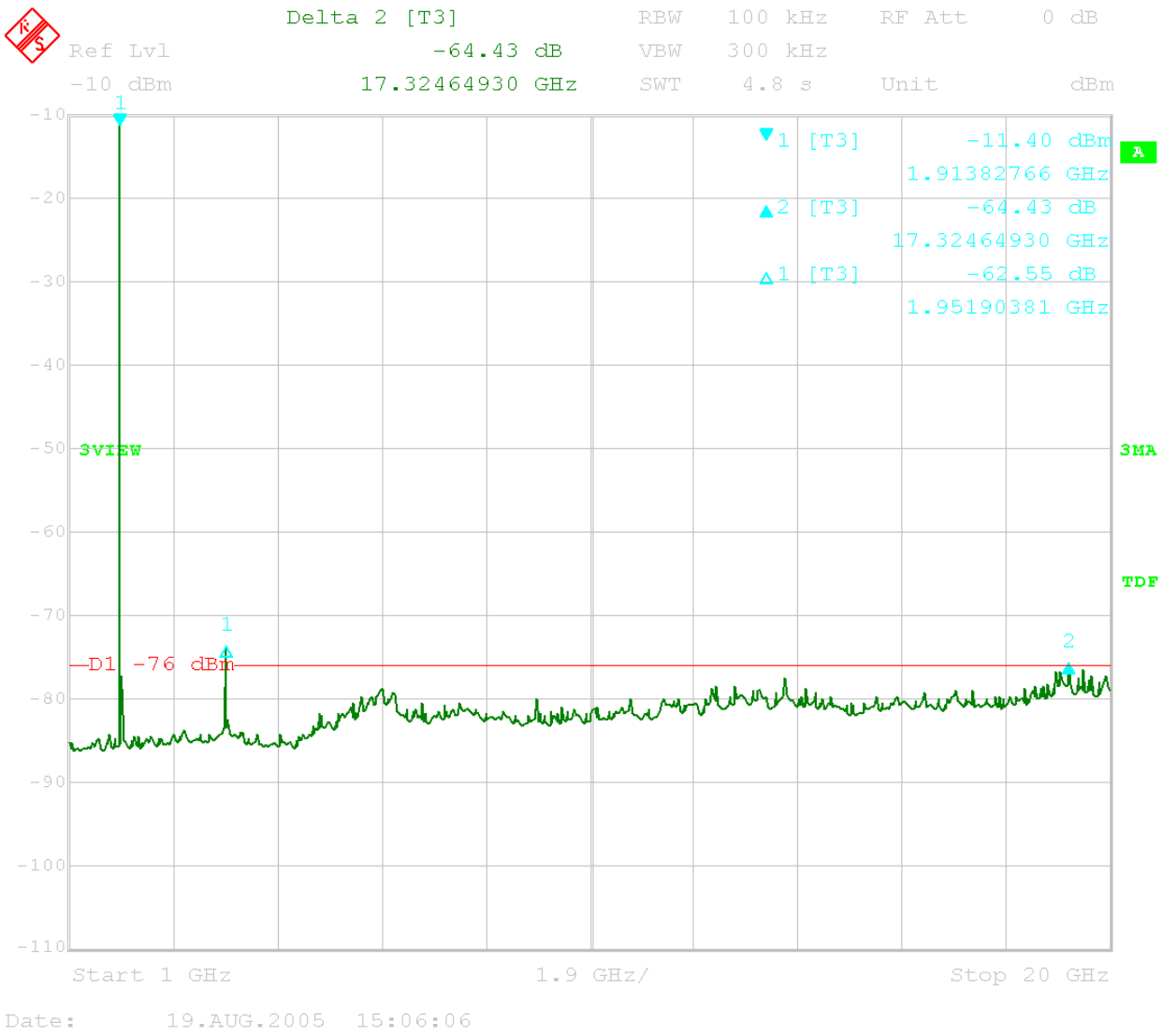
Test Details:

The EUT was tested without an amplifier, at the output of the duplexer. While the limit on spurious emissions is –13 dBm, plots were taken with a display line located 63 dB down from the –13 dBm limit, in order to establish the level of spurious emissions for the purposes of determining allowable amplifier gain, required filtration, and maximum output power at the time of licensing. Since the measuring equipment noise floor sometimes exceeds the –76 dBm display line, plots were taken with 100 kHz bandwidth to show whether there are emissions located in these frequency ranges. Plots were then taken using 1 MHz bandwidth for the purposes of showing compliance with the limit and the actual signal level of any spurious detected. Delta markers were placed at spurious peaks detected in order to show dBc values. Note that in the 30-1000 MHz plots, the marker shown has been placed in the noise floor to show the noise floor signal level. In the 1-20 GHz plots, marker 2 is similarly placed at the highest point of the noise floor of the measuring equipment. The only spurious emission detected was the 2nd harmonic of the EUT fundamental, all other peaks are transient noise floor spikes. Modes tested include low, mid, and high channels as well as 3 tone continuous-wave intermodulation product tests with two of the three tones alternately at the low and the high end of the passband. The intermodulation product test was performed twice because the EUT can only generate channels with a maximum separation of 26 MHz.

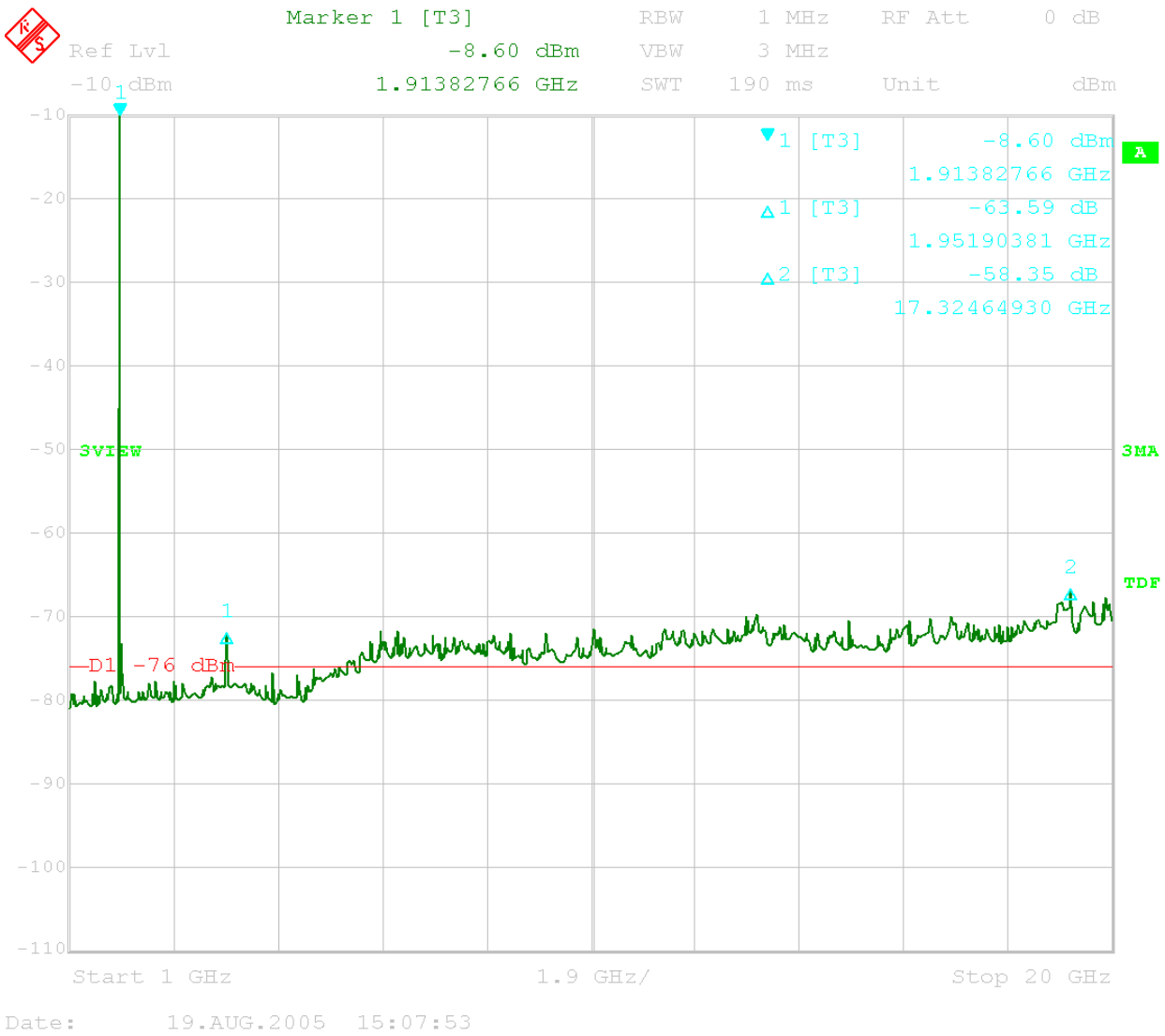
Notes: Transducer factors were programmed into the spectrum analyzer to compensate for cable loss in the test setup. Software test mode plots can be found in Appendix C.


Marker 1 [T3]
RBW 100 kHz
RF Att 0 dB
Ref Lvl
-88.88 dBm
VBW 300 kHz
-10 dBm
1.00000000 GHz
SWT 245 ms
Unit dBm
1 [T3]
-88.88 dBm
1.00000000 GHz
A
3MA
TDF
D1 -76 dBm
Start 30 MHz
97 MHz/
Stop 1 GHz
Date: 19.AUG.2005 14:04:44

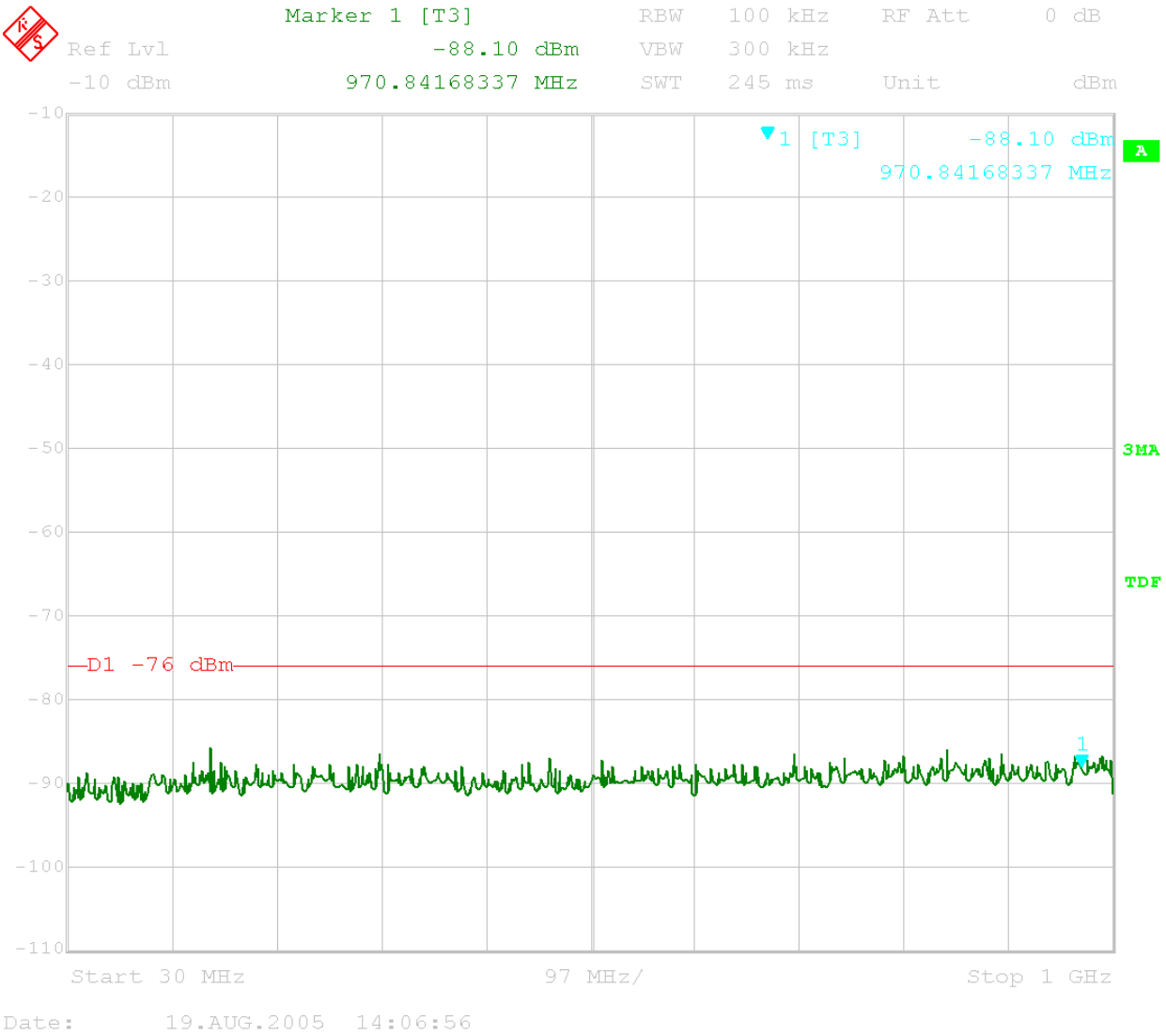
Channel A


Delta 2 [T3]
RBW 100 kHz
RF Att 0 dB
Ref Lvl
-64.43 dB
VBW 300 kHz
-10 dBm
17.32464930 GHz
SWT 4.8 s
Unit dBm
1 [T3] -11.40 dBm
1.91382766 GHz
2 [T3] -64.43 dB
17.32464930 GHz
Δ1 [T3] -62.55 dB
1.95190381 GHz
A
3VIEW
3MA
TDF
D1 -76 dBm
Start 1 GHz
1.9 GHz/
Stop 20 GHz
Date: 19.AUG.2005 15:06:06

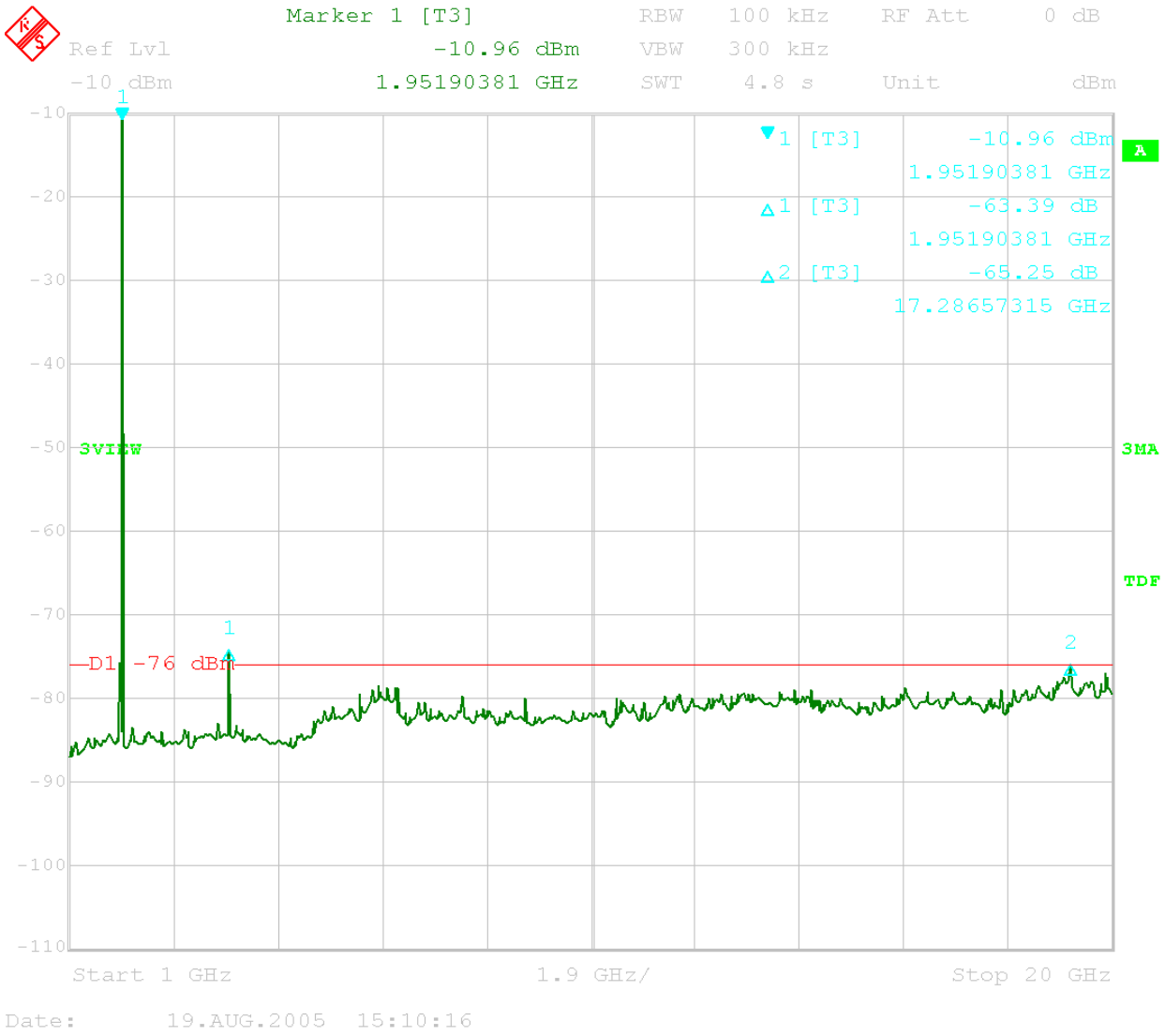
Channel A


Marker 1 [T3]
RBW 1 MHz
RF Att 0 dB
Ref Lvl
-8.60 dBm
VBW 3 MHz
-10 dBm
1.91382766 GHz
SWT 190 ms
Unit dBm
1 [T3] -8.60 dBm
1.91382766 GHz
Δ1 [T3] -63.59 dB
1.95190381 GHz
Δ2 [T3] -58.35 dB
17.32464930 GHz
A
3VIEW
3MA
TDF
D1 -76 dBm
Start 1 GHz
1.9 GHz/
Stop 20 GHz
Date: 19.AUG.2005 15:07:53

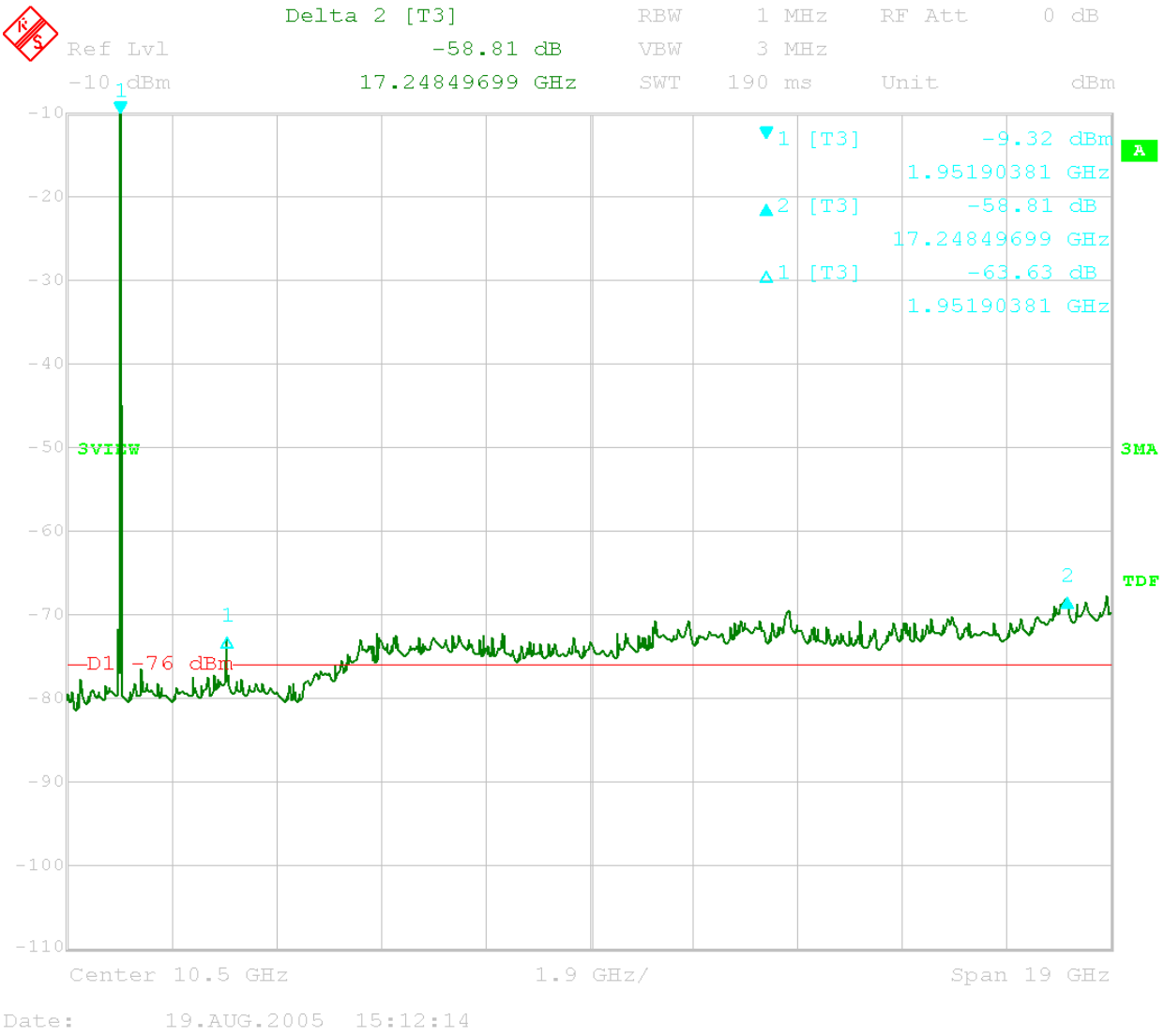
Channel A


Marker 1 [T3]
RBW 100 kHz
RF Att 0 dB
Ref Lvl
-88.10 dBm
VBW 300 kHz
-10 dBm
970.84168337 MHz
SWT 245 ms
Unit dBm
1 [T3] -88.10 dBm
970.84168337 MHz
A
3MA
TDF
D1 -76 dBm
Start 30 MHz
97 MHz/
Stop 1 GHz
Date: 19.AUG.2005 14:06:56

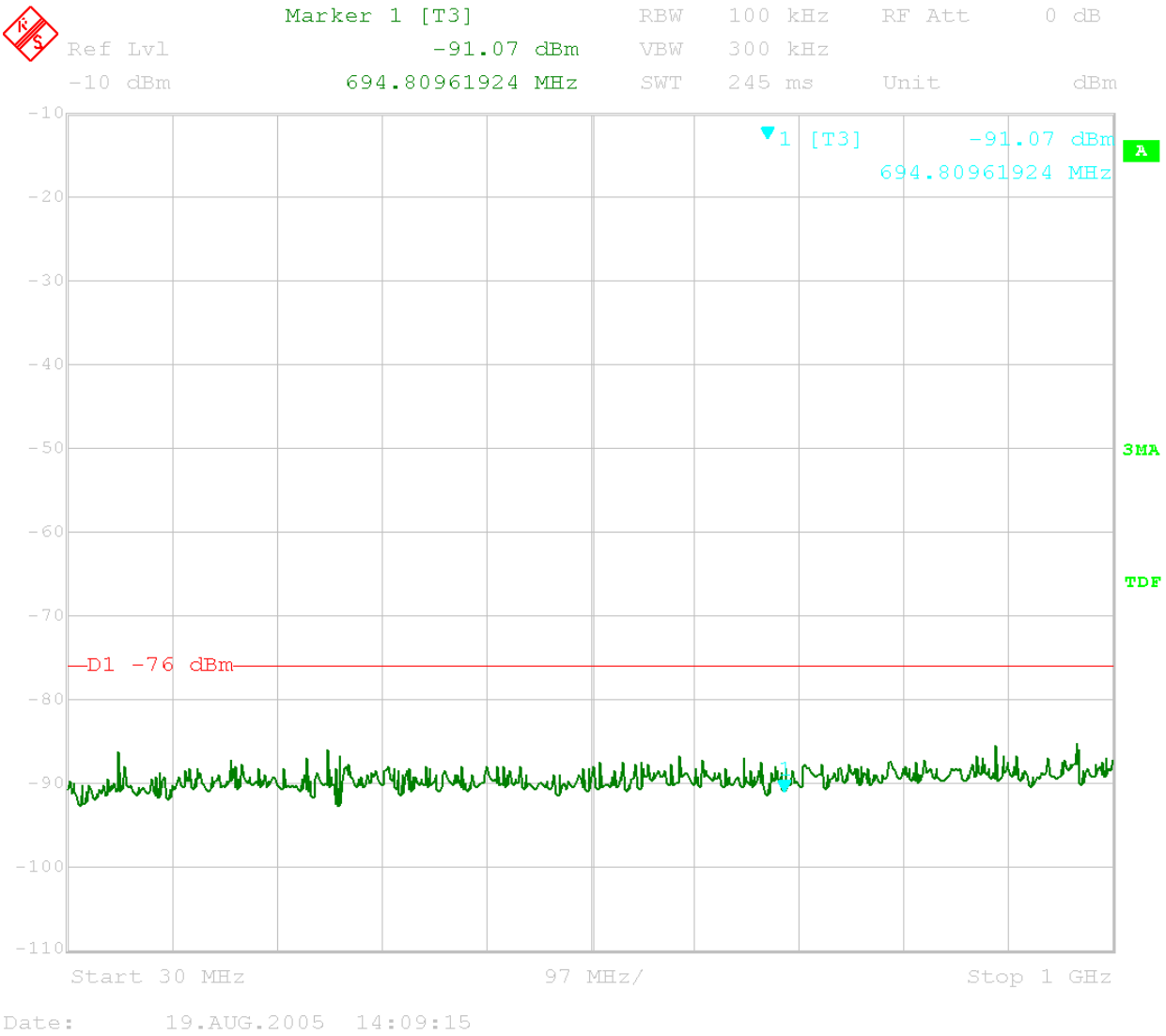
Channel B


Marker 1 [T3]
RBW 100 kHz
RF Att 0 dB
Ref Lvl
-10.96 dBm
VBW 300 kHz
-10 dBm
1.95190381 GHz
SWT 4.8 s
Unit dBm
1 [T3] -10.96 dBm
1.95190381 GHz
Δ1 [T3] -63.39 dB
1.95190381 GHz
Δ2 [T3] -65.25 dB
17.28657315 GHz
A
3MA
TDF
D1 -76 dBm
Start 1 GHz
1.9 GHz/
Stop 20 GHz
Date: 19.AUG.2005 15:10:16

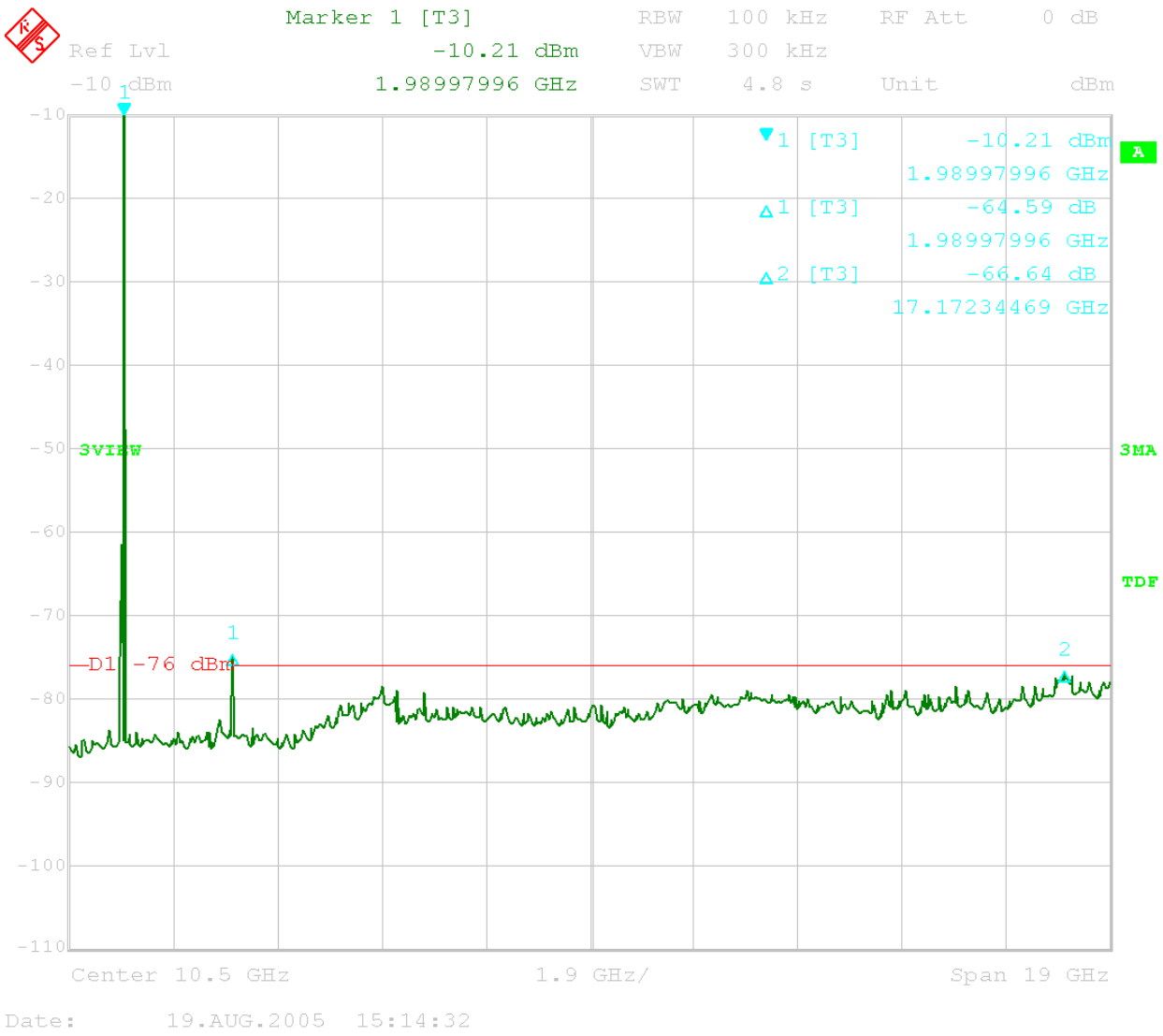
Channel B


Delta 2 [T3]
RBW 1 MHz
RF Att 0 dB
Ref Lvl
-58.81 dB
VBW 3 MHz
-10 dBm
17.24849699 GHz
SWT 190 ms
Unit dBm
1 [T3] -9.32 dBm
1.95190381 GHz
2 [T3] -58.81 dB
17.24849699 GHz
1 [T3] -63.63 dB
1.95190381 GHz
A
3MA
TDF
D1 -76 dBm
Center 10.5 GHz
1.9 GHz/
Span 19 GHz
Date: 19.AUG.2005 15:12:14

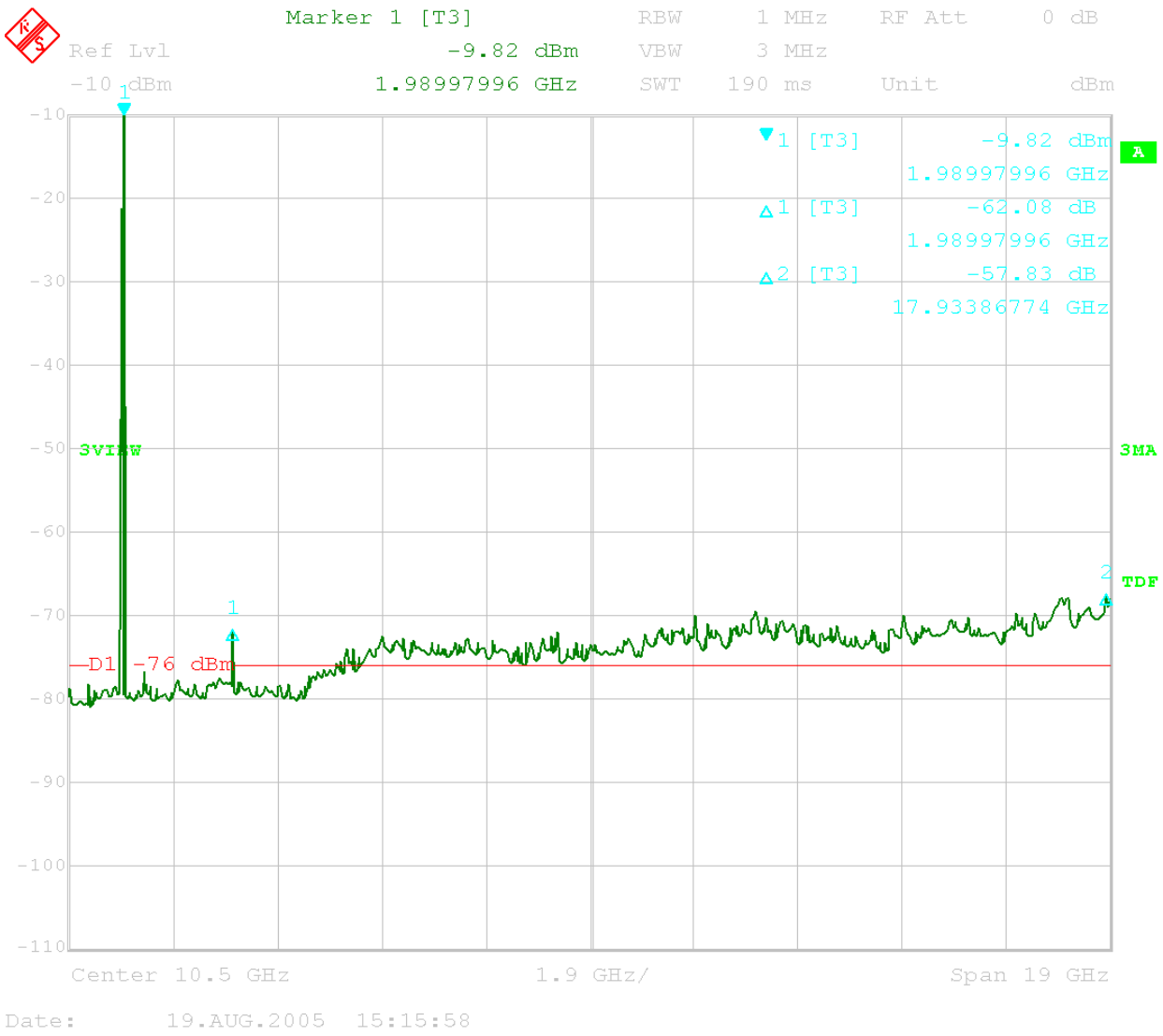
Channel B


Marker 1 [T3]
RBW 100 kHz
RF Att 0 dB
Ref Lvl
-91.07 dBm
VBW 300 kHz
-10 dBm
694.80961924 MHz
SWT 245 ms
Unit dBm
1 [T3] -91.07 dBm
694.80961924 MHz
A
3MA
TDF
D1 -76 dBm
Start 30 MHz
97 MHz/
Stop 1 GHz
Date: 19.AUG.2005 14:09:15

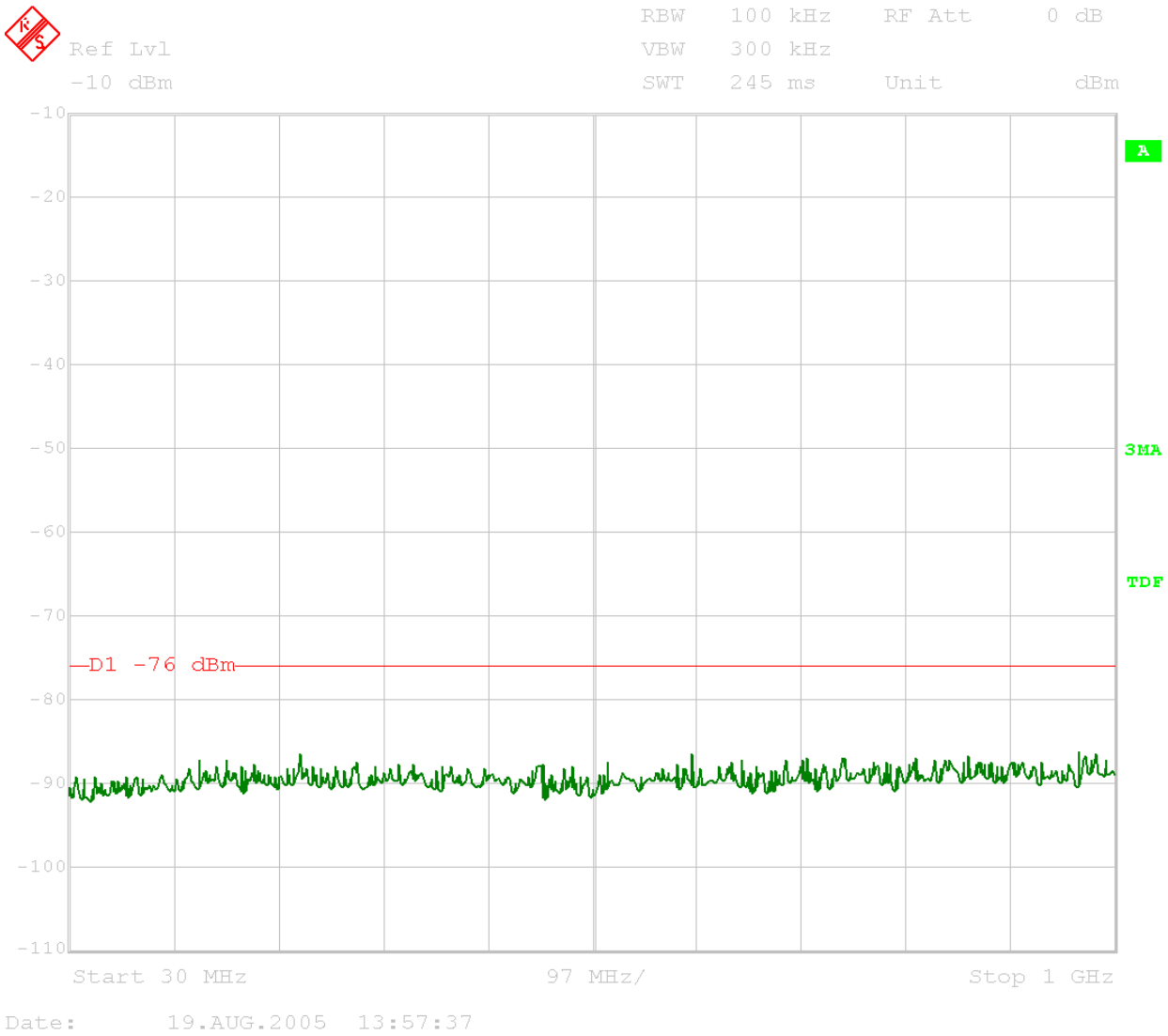
Channel C


Marker 1 [T3]
RBW 100 kHz
RF Att 0 dB
Ref Lvl
-10.21 dBm
VBW 300 kHz
-10 dBm
1.98997996 GHz
SWT 4.8 s
Unit dBm
1 [T3] -10.21 dBm
1.98997996 GHz
Δ1 [T3] -64.59 dB
1.98997996 GHz
Δ2 [T3] -66.64 dB
17.17234469 GHz
A
3VIEW
3MA
TDF
D1 -76 dBm
Center 10.5 GHz
1.9 GHz/
Span 19 GHz
Date: 19.AUG.2005 15:14:32

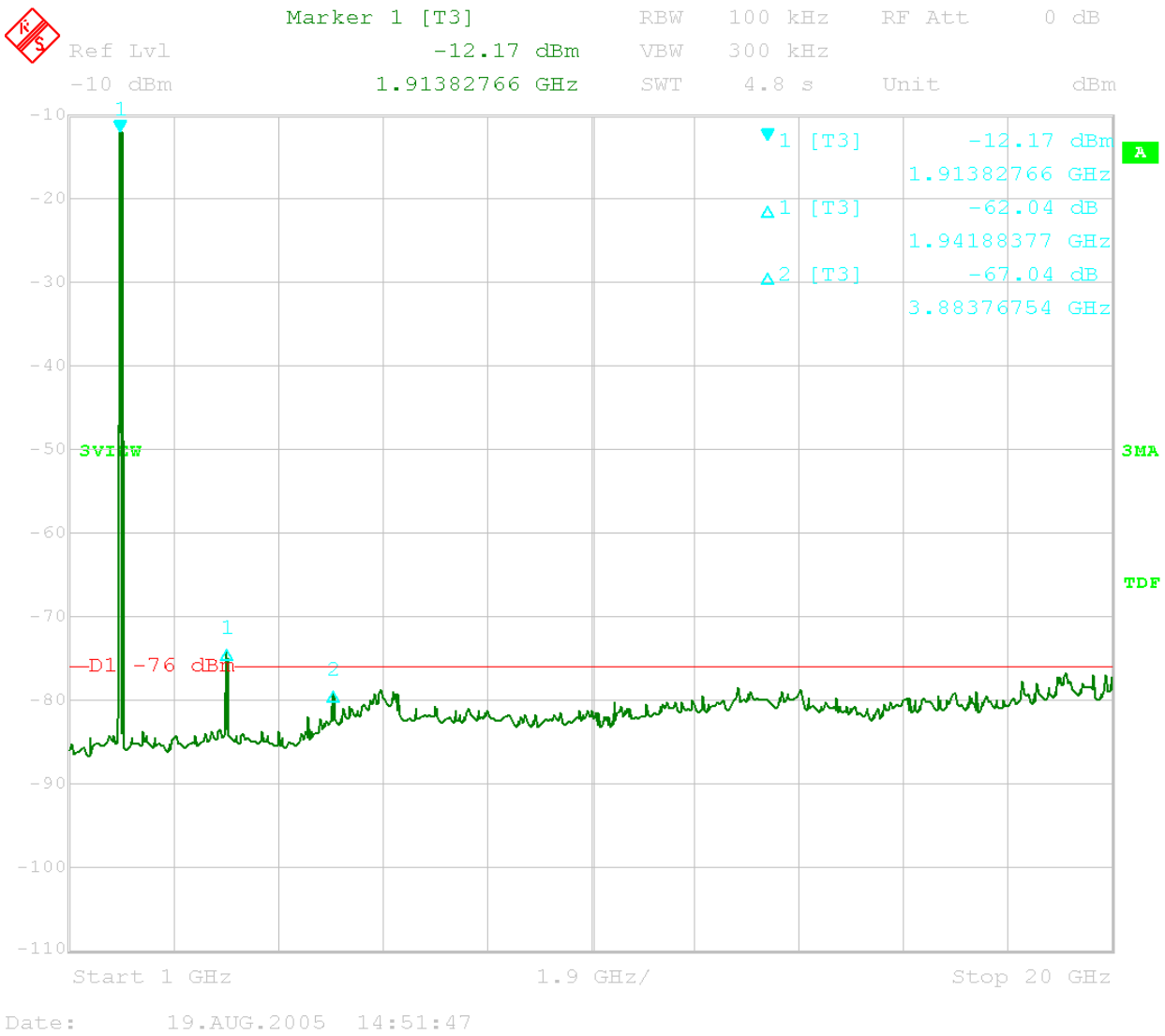
Channel C


Marker 1 [T3]
RBW 1 MHz
RF Att 0 dB
Ref Lvl
-9.82 dBm
VBW 3 MHz
-10 dBm
1.98997996 GHz
SWT 190 ms
Unit dBm
1 [T3] -9.82 dBm
1.98997996 GHz
Δ1 [T3] -62.08 dB
1.98997996 GHz
Δ2 [T3] -57.83 dB
17.93386774 GHz
A
3MA
TDF
D1 -76 dBm
Center 10.5 GHz
1.9 GHz/
Span 19 GHz
Date: 19.AUG.2005 15:15:58

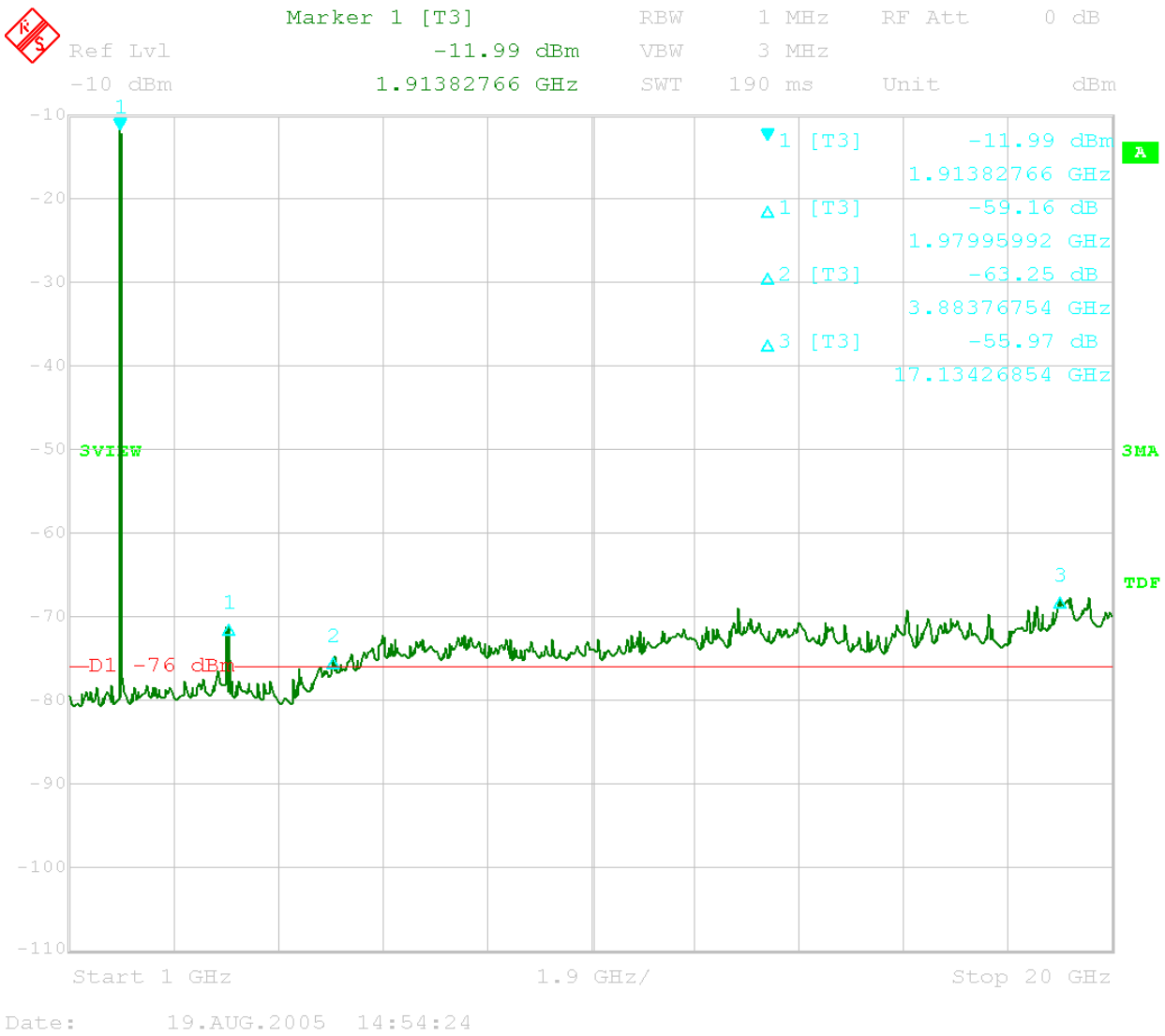
Channel C



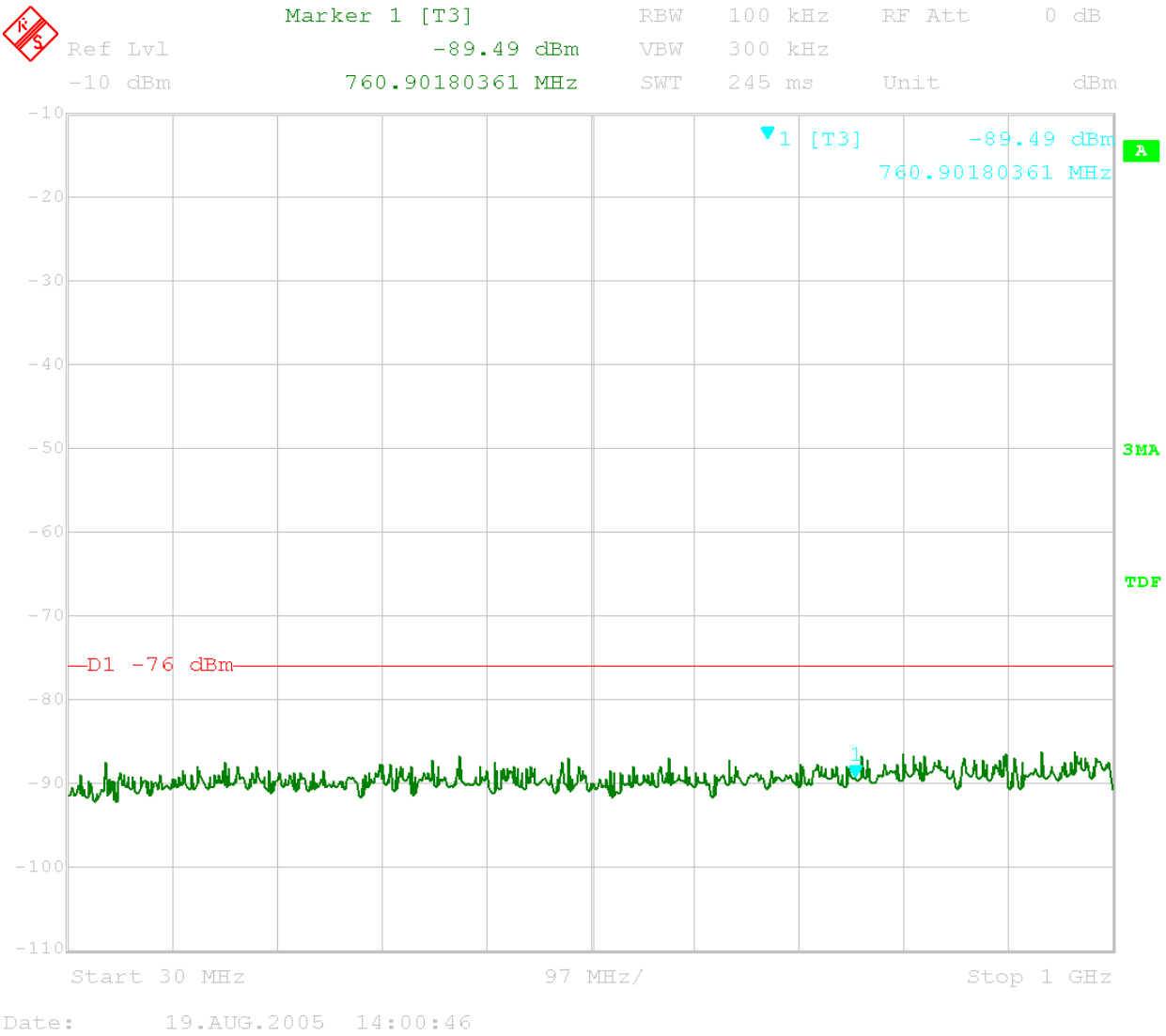
IMD Low Band Edge



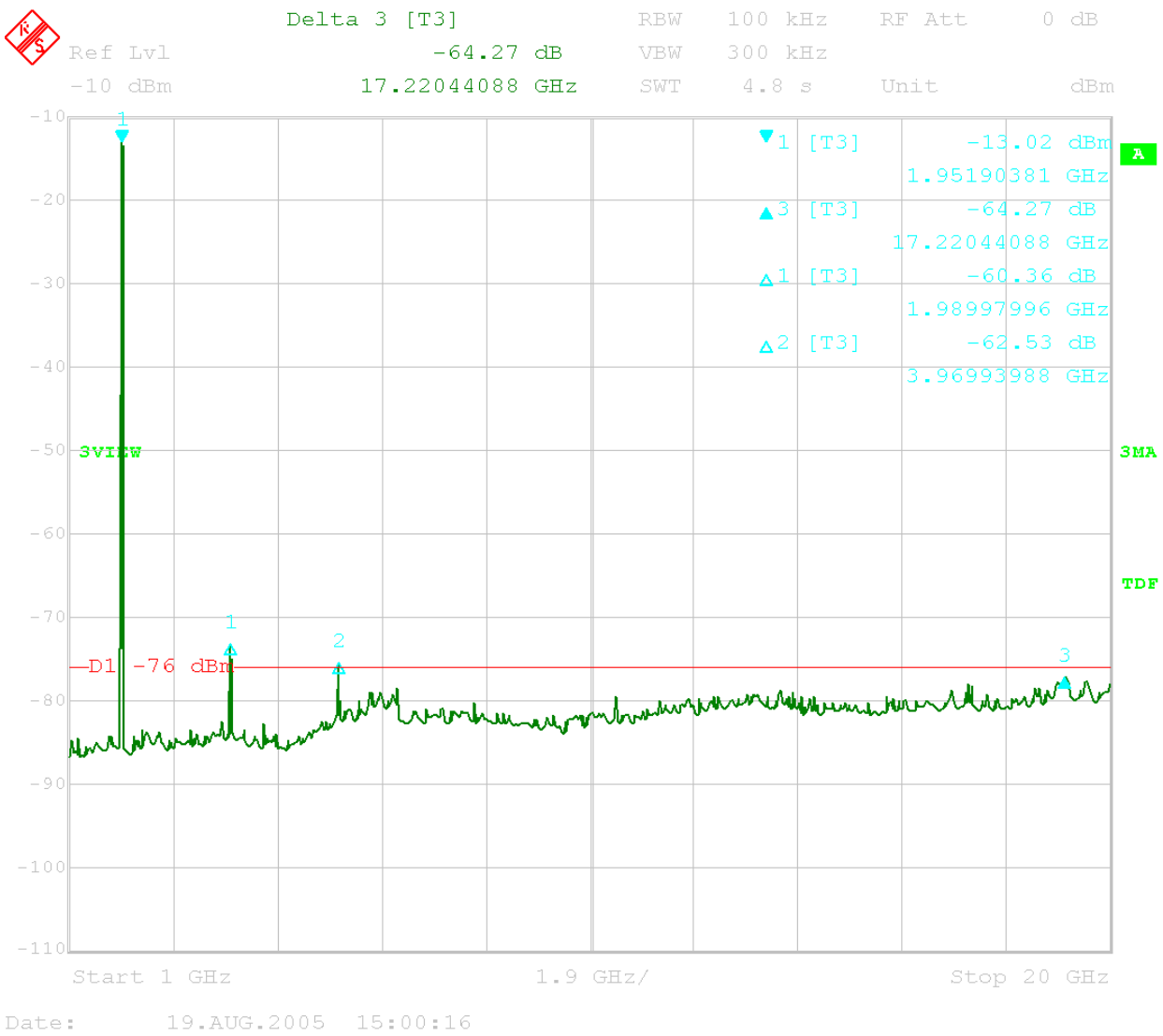
IMD Low Band Edge



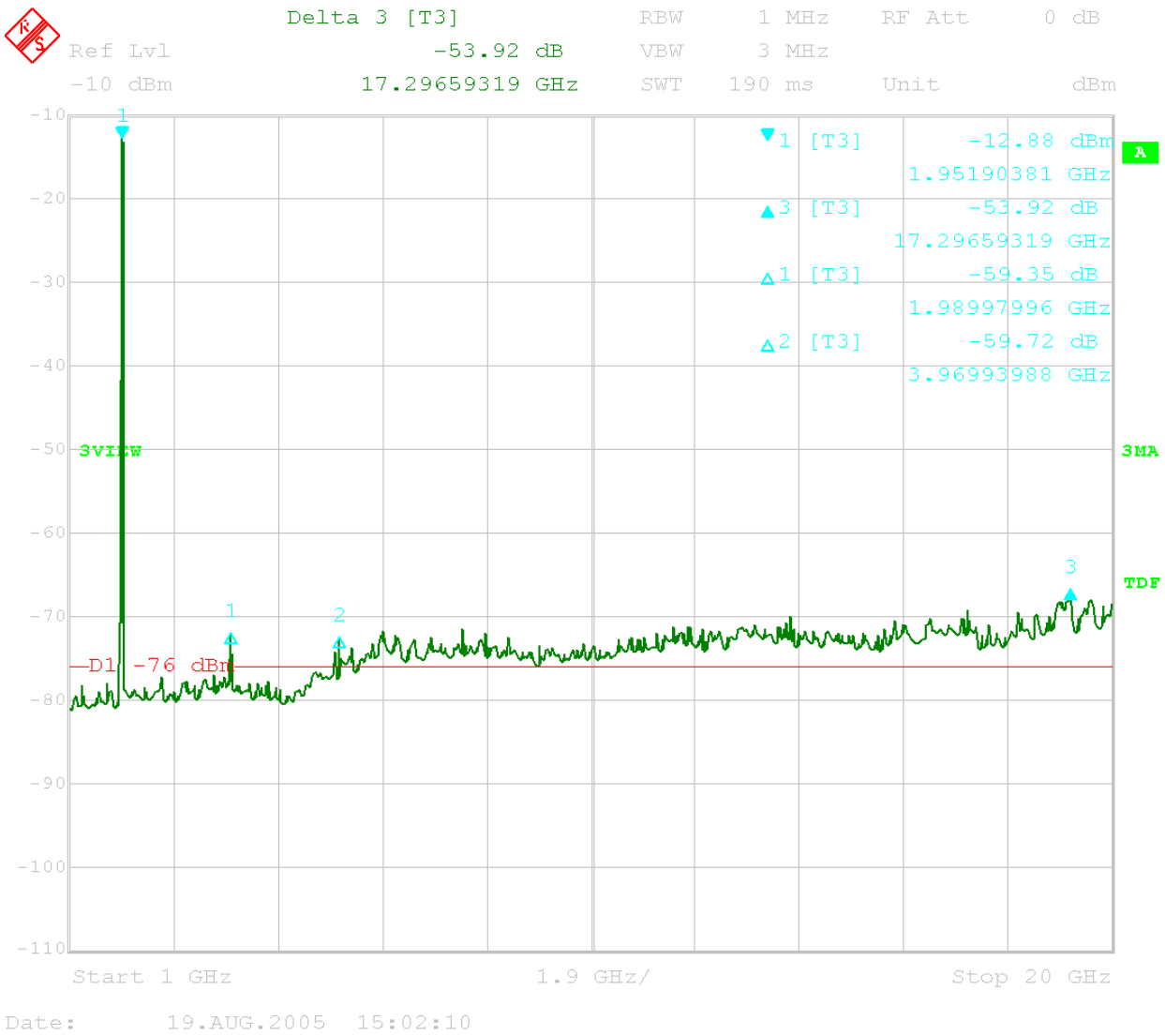
IMD Low Band Edge



IMD High Band Edge



IMD High Band Edge



IMD High Band Edge

Test Results: Pass

Test Standard: FCC 2.1053, 24.238

Test: Spurious Radiated Emissions

Test Environment:

Temp: 22 and 22°C **Humidity:** 68 and 59%
Pressure: 1002 and 1004mbar

Maximum Test Disturbance Parameters: Emissions outside the passband must not exceed –13 dBm.
Software:

Name	Manufacturer	Version
EXCEL 2000	Microsoft Corporation	9.0.6926 SP-3
EMI BOXBOROUGH	Intertek	2/07/05 Revision

Test Date: 08/22-24/2005 **Engineer Initials: _____ Date: _____**
Test Engineer: Nicholas Abbondante **Reviewer Initials: _____ Date: _____**

Test Equipment Used:

Intertek ID	Manufacturer	Model	Serial Number	Cal. Due
LOG2	EMCO	3142	9711-1223	12/13/2005
ROS001	Rohde & Schwarz	FSEK-30	100225	07/26/2006
BAR2	Mannix	0ABA116	BAR2	08/02/2006
HEW62	Hewlett Packard	83620A	3213A01244	01/25/2006
ANT4A	Compliance Design	B100	3317	09/13/2005
ANT4B	Compliance Design	B200	3245	09/13/2005
ANT4C	Compliance Design	B300	3352	09/13/2005
S2 10M FLR	ITS	RG214B/U	S2 10M FLR	09/15/2005
CBL028	Megaphase	TM40 K1K1 197	CBL028	12/01/2005
CBL030	Megaphase	TM40 K1K1 80	CBL030	12/01/2005
HORN1	EMCO	3115	9512-4632	11/24/2005
HORN3	EMCO	3115	9610-4980	09/20/2005
EMCO4	EMCO	3116	2090	11/30/2005
PRE8	Miteq	NSP4000-NF	507145	11/16/2005
CBLSHF101	Sucoflex	104PE	CBLSHF101	Calibrated during test

Test Details:

Radiated Emissions / Interference

Company: Vanu, Inc. Model #: GSM 1900 Basestation
Engineer: Nicholas Abbondante Barometer: BAR2 Serial #: 1526-1
Project #: 3082207 Pressure: 1002mB Receiver: R&S FSEK-30 (ROS001)
Date: 08/22/05 Temp: 22c N Antenna: LOG2 12-13-05 V10.txt LOG2 12-13-05 H10.txt
Standard: FCC Part 24 Humidity: 68% LF Antenna: NONE. NONE.
Class: - Group: - HF Antenna: HORN3 9-20-05 V3m.ant HORN3 9-20-05 H3m.ant
Antenna Band: N Bands: N, LF, HF, SHF SHF Antenna: EMC04 11-30-05 V1.ant EMC04 11-30-05 H1.ant
PreAmp: NONE. Cable(s): Site2, 10M Floor 9-15-05.cbl NONE.
Limit Distance: N/A meters Test Distance: 10 meters Location: Site 2
Voltage/Frequency: 120V/60Hz Frequency Range: 30 MHz - 1 GHz
Tx Signal Generator: HEW62 Tx Antenna: ANT4 Rx Antenna: LOG2
Rx Cable: Site 2 10M Floor Tx Cable: CBL030
Net = Generator Level (0.00 dBm) + (EUT reading - Generator reading) - Cable Loss + Antenna Gain
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	EUT Reading dB(uV)	Generator Reading dB(uV)	Transmit Cable Loss dB	Transmit Antenna Factor dBi	Generator Level dBm	Net dBm	Limit dBm	Margin dB	Bandwidth
Channel A - 1931 MHz											
QP	V	30.900	8.2	59.5	0.1	-9.3	0.0	-60.7	-13.0	-47.7	120/300 kHz
QP	V	43.400	15.4	70.5	0.1	-8.4	0.0	-63.6	-13.0	-50.6	120/300 kHz
QP	V	49.030	16.8	73.7	0.1	-6.6	0.0	-63.7	-13.0	-50.7	120/300 kHz
QP	V	74.440	10.5	82.3	0.2	1.8	0.0	-70.1	-13.0	-57.1	120/300 kHz
QP	V	128.200	8.6	80.9	0.2	1.4	0.0	-71.1	-13.0	-58.1	120/300 kHz
QP	V	139.200	11.0	81.7	0.2	2.3	0.0	-68.6	-13.0	-55.6	120/300 kHz
QP	V	208.000	13.1	74.6	0.3	0.5	0.0	-61.3	-13.0	-48.3	120/300 kHz
QP	V	228.500	7.8	73.2	0.3	0.3	0.0	-65.4	-13.0	-52.4	120/300 kHz
QP	V	300.000	4.1	73.0	0.4	-0.4	0.0	-69.7	-13.0	-56.7	120/300 kHz
QP	V	375.000	5.7	60.4	0.4	-0.7	0.0	-55.8	-13.0	-42.8	120/300 kHz
Channel B - 1960 MHz											
QP	V	30.850	6.8	59.5	0.1	-9.3	0.0	-62.1	-13.0	-49.1	120/300 kHz
QP	V	43.580	16.7	70.5	0.1	-8.4	0.0	-62.3	-13.0	-49.3	120/300 kHz
QP	V	50.700	14.8	73.2	0.1	-6.6	0.0	-65.1	-13.0	-52.1	120/300 kHz
QP	V	113.400	10.2	77.2	0.2	0.2	0.0	-67.0	-13.0	-54.0	120/300 kHz
QP	V	123.600	11.7	80.8	0.2	1.3	0.0	-68.1	-13.0	-55.1	120/300 kHz
QP	V	206.700	12.9	74.6	0.3	0.6	0.0	-61.4	-13.0	-48.4	120/300 kHz
QP	V	229.500	8.1	73.2	0.3	0.3	0.0	-65.1	-13.0	-52.1	120/300 kHz
QP	V	300.000	6.1	73.0	0.4	-0.4	0.0	-67.7	-13.0	-54.7	120/300 kHz
QP	V	375.000	6.6	60.4	0.4	-0.7	0.0	-54.9	-13.0	-41.9	120/300 kHz
Channel C - 1989 MHz											
QP	V	31.070	7.7	59.8	0.1	-9.3	0.0	-61.5	-13.0	-48.5	120/300 kHz
QP	V	44.130	13.9	69.9	0.1	-8.4	0.0	-64.6	-13.0	-51.6	120/300 kHz
QP	V	50.830	15.9	73.0	0.1	-6.6	0.0	-63.9	-13.0	-50.9	120/300 kHz
QP	V	63.130	10.3	79.8	0.2	-1.8	0.0	-71.4	-13.0	-58.4	120/300 kHz
QP	V	74.630	9.3	82.4	0.2	1.8	0.0	-71.5	-13.0	-58.5	120/300 kHz
QP	V	111.600	8.2	76.9	0.2	-0.2	0.0	-69.1	-13.0	-56.1	120/300 kHz
QP	V	129.500	9.1	80.9	0.2	1.4	0.0	-70.6	-13.0	-57.6	120/300 kHz
QP	V	207.500	13.1	74.6	0.3	0.6	0.0	-61.2	-13.0	-48.2	120/300 kHz
QP	V	230.700	7.2	73.2	0.3	0.3	0.0	-66.0	-13.0	-53.0	120/300 kHz
QP	V	302.100	3.0	73.0	0.4	-0.4	0.0	-70.8	-13.0	-57.8	120/300 kHz
QP	V	375.000	8.0	60.4	0.4	-0.7	0.0	-53.5	-13.0	-40.5	120/300 kHz

Radiated Emissions / Interference

Company: Vanu, Inc. Model #: GSM 1900 Basestation
Engineer: Nicholas Abbondante Barometer: BAR2 Serial #: 1526-1
Project #: 3082207 Pressure: 1002mB Receiver: R&S FSEK-30 (ROS001)
Date: 08/22/05 Temp: 22c N Antenna: LOG2 12-13-05 V10.txt LOG2 12-13-05 H10.txt
Standard: FCC Part 24 Humidity: 68% LF Antenna: NONE. NONE.
Class: - Group: - HF Antenna: HORN3 9-20-05 V3m.ant HORN3 9-20-05 H3m.ant
Antenna Band: N Bands: N, LF, HF, SHF SHF Antenna: EMC04 11-30-05 V1.ant EMC04 11-30-05 H1.ant
PreAmp: NONE. Cable(s): Site2, 10M Floor 9-15-05.cbl NONE.
Limit Distance: N/A meters Test Distance: 10 meters Location: Site 2
Voltage/Frequency: 120V/60Hz Frequency Range: 30 MHz - 1 GHz
Tx Signal Generator: HEW62 Tx Antenna: ANT4 Rx Antenna: LOG2
Rx Cable: Site 2 10M Floor Tx Cable: CBL030
Net = Generator Level (0.00 dBm) + (EUT reading - Generator reading) - Cable Loss + Antenna Gain
Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	EUT Reading dB(uV)	Generator Reading dB(uV)	Transmit Cable Loss dB	Transmit Antenna Factor dBi	Generator Level dBm	Net dBm	Limit dBm	Margin dB	Bandwidth
Low Intermods											
QP	V	31.090	7.1	59.8	0.1	-9.3	0.0	-62.1	-13.0	-49.1	120/300 kHz
QP	V	43.810	14.7	70.5	0.1	-8.4	0.0	-64.3	-13.0	-51.3	120/300 kHz
QP	V	49.570	16.9	73.9	0.1	-6.6	0.0	-63.8	-13.0	-50.8	120/300 kHz
QP	V	63.890	11.8	80.2	0.2	-1.8	0.0	-70.3	-13.0	-57.3	120/300 kHz
QP	V	113.700	9.0	77.2	0.2	0.2	0.0	-68.2	-13.0	-55.2	120/300 kHz
QP	V	124.600	12.2	81.3	0.2	1.3	0.0	-68.0	-13.0	-55.0	120/300 kHz
QP	V	207.500	13.5	74.6	0.3	0.6	0.0	-60.8	-13.0	-47.8	120/300 kHz
QP	V	229.900	7.2	73.2	0.3	0.3	0.0	-66.0	-13.0	-53.0	120/300 kHz
QP	V	299.900	3.1	73.0	0.4	-0.4	0.0	-70.7	-13.0	-57.7	120/300 kHz
QP	V	375.000	8.6	60.4	0.4	-0.7	0.0	-52.9	-13.0	-39.9	120/300 kHz
High Intermods											
QP	V	31.090	7.2	59.8	0.1	-9.3	0.0	-62.0	-13.0	-49.0	120/300 kHz
QP	V	43.530	15.7	70.5	0.1	-8.4	0.0	-63.3	-13.0	-50.3	120/300 kHz
QP	V	52.060	14.4	73.6	0.1	-6.6	0.0	-66.0	-13.0	-53.0	120/300 kHz
QP	V	63.860	13.3	80.2	0.2	-1.8	0.0	-68.8	-13.0	-55.8	120/300 kHz
QP	V	112.100	6.1	77.0	0.2	-0.1	0.0	-71.2	-13.0	-58.2	120/300 kHz
QP	V	124.600	13.5	81.3	0.2	1.3	0.0	-66.7	-13.0	-53.7	120/300 kHz
QP	V	208.600	13.1	74.6	0.3	0.4	0.0	-61.4	-13.0	-48.4	120/300 kHz
QP	V	229.700	8.1	73.2	0.3	0.3	0.0	-65.1	-13.0	-52.1	120/300 kHz
QP	V	300.000	4.9	73.0	0.4	-0.4	0.0	-68.9	-13.0	-55.9	120/300 kHz
QP	V	375.000	6.1	60.4	0.4	-0.7	0.0	-55.4	-13.0	-42.4	120/300 kHz

Radiated Emissions / Interference

Company:	Vanu, Inc.			Model #:	GSM 1900 Basestation		
Engineer:	Nicholas Abbondante	Barometer:	BAR2	Serial #:	1526-1		
Project #:	3082207	Pressure:	1004mB	Receiver:	R&S FSEK-30 (ROS001)		
Date:	08/23/05	Temp:	22c	N Antenna:	LOG2 12-13-05 V10.txt	LOG2 12-13-05 H10.txt	
Standard:	FCC Part 24	Humidity:	59%	LF Antenna:	NONE.	NONE.	
Class:	-	Group:	-	HF Antenna:	HORN3 9-20-05 V3m.ant	HORN3 9-20-05 H3m.ant	
Antenna Band:	HF	Bands: N, LF, HF, SHF		SHF Antenna:	EMC04 11-30-05 V1.ant	EMC04 11-30-05 H1.ant	
PreAmp:	PRE8 11-16-05.amp			Cable(s):	CBL028 12-1-2005.cbl	CBL030 12-1-2005.cbl	
Limit Distance:	N/A meters		Test Distance:	3 meters	Location:	Site 2	
Voltage/Frequency:	120V/60Hz		Frequency Range:	1-20 GHz			

Tx Signal Generator: HEW62 Tx Antenna: HORN1 Rx Antenna: HORN3, EMCO4

Rx Cable: CBL028, CBL030 Tx Cable: SHF101

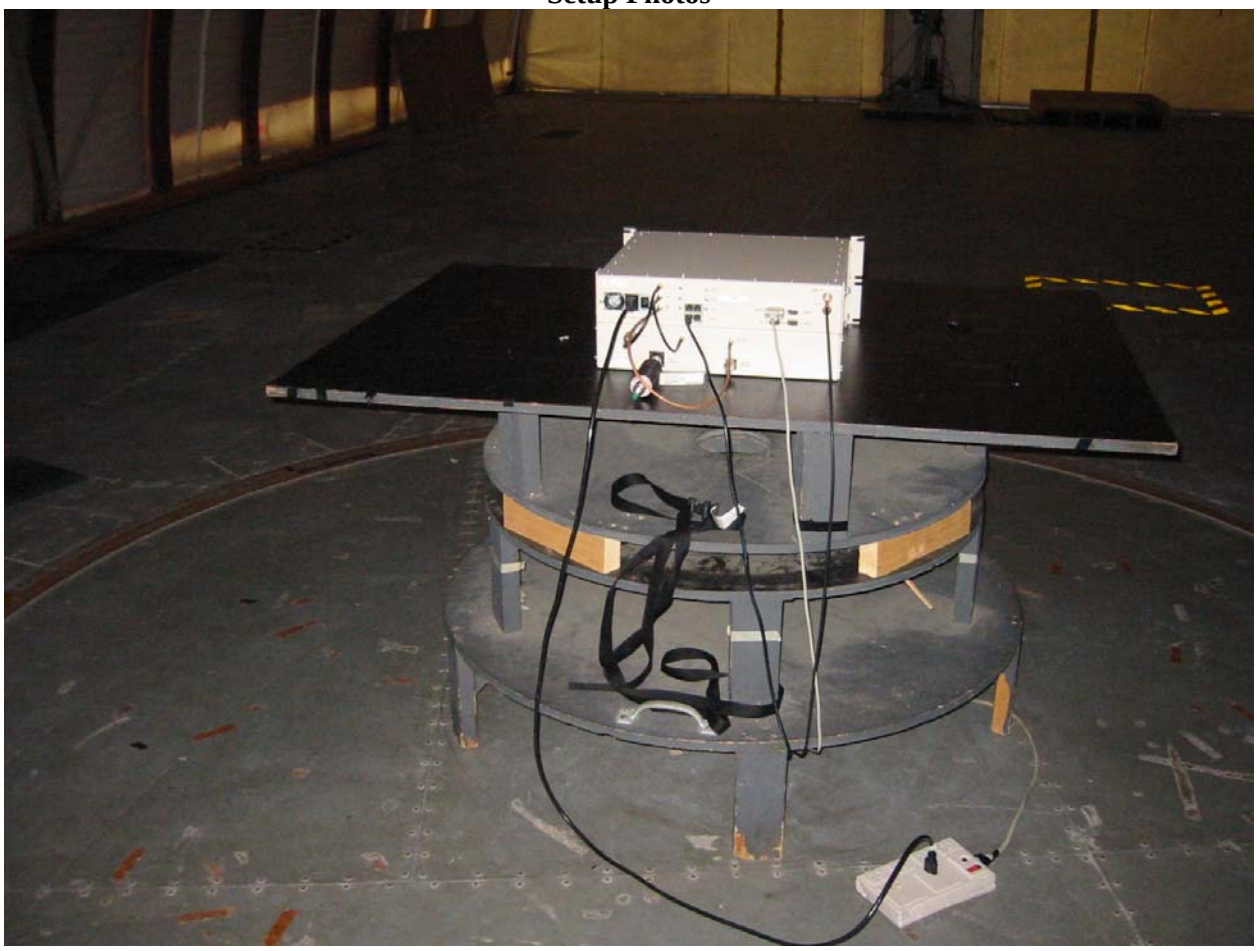
Net = Generator Level (0.00 dBm) + (EUT reading - Generator reading) - Cable Loss + Antenna Gain

Peak: PK Quasi-Peak: QP Average: AVG RMS: RMS; Bandwidth denoted as RBW/VBW

Detector Type	Ant. Pol. (V/H)	Frequency MHz	EUT Reading dB(uV)	Generator Reading dB(uV)	Transmit Cable Loss dB	Transmit Antenna Factor dBi	Generator Level dBm	Net dBm	Limit dBm	Margin dB	Bandwidth
Low Intermods											
PK	V	1040.000	34.1	73.0	0.1	5.8	-20.0	-53.2	-13.0	-40.2	1/3 MHz
PK	V	1125.000	31.0	68.4	0.6	6.2	-20.0	-51.7	-13.0	-38.7	1/3 MHz
High Intermods											
PK	V	1040.000	35.0	73.0	0.1	5.8	-20.0	-52.3	-13.0	-39.3	1/3 MHz
PK	V	1125.000	32.9	68.4	0.6	6.2	-20.0	-49.8	-13.0	-36.8	1/3 MHz
Channel A - 1931 MHz											
PK	V	1040.000	32.8	73.0	0.1	5.8	-20.0	-54.5	-13.0	-41.5	1/3 MHz
PK	V	1125.000	31.5	68.4	0.6	6.2	-20.0	-51.2	-13.0	-38.2	1/3 MHz
Channel B - 1960 MHz											
PK	V	1040.000	32.3	73.0	0.1	5.8	-20.0	-55.0	-13.0	-42.0	1/3 MHz
PK	V	1125.000	28.6	68.4	0.6	6.2	-20.0	-54.1	-13.0	-41.1	1/3 MHz
Channel C - 1989 MHz											
PK	V	1040.000	33.5	73.0	0.1	5.8	-20.0	-53.8	-13.0	-40.8	1/3 MHz
PK	V	1125.000	27.8	68.4	0.6	6.2	-20.0	-54.9	-13.0	-41.9	1/3 MHz
Noise Floor											
PK	V	4503.000	28.3	78.0	0.6	9.1	-20.0	-61.2	-13.0	-48.2	1/3 MHz
PK	V	7005.000	31.6	66.7	0.6	10.2	-20.0	-45.6	-13.0	-32.6	1/3 MHz
PK	V	12996.000	31.0	60.2	1.1	11.8	-20.0	-38.5	-13.0	-25.5	1/3 MHz
PK	V	17750.000	30.3	48.9	1.5	8.5	-20.0	-31.6	-13.0	-18.6	1/3 MHz

Notes: The EUT was tested with a 50-Ohm load at the antenna port. Modes tested include low, mid, and high channels as well as 3 tone continuous-wave intermodulation product tests with two of the three tones alternately at the low and the high end of the passband. The intermodulation product test was performed twice because the EUT can only generate channels with a maximum separation of 26 MHz. No emissions were observed above 1125 MHz, so noise floor readings were taken instead. The substitution method was used to convert spurious field strength values to ERP.

Setup Photos



Test Results: Pass

Test Standard: FCC 2.1055, 24.235

Test: Frequency Stability

Maximum Test Disturbance Parameters: Emission must stay within assigned band of operation.
Software:

Test Date: 08/17/2005 **Engineer Initials: _____ Date: _____**
Test Engineer: Nicholas Abbondante **Reviewer Initials: _____ Date: _____**

Test Equipment Used:

Intertek ID	Manufacturer	Model	Serial Number	Cal. Due
HP3	Hewlett Packard	8593A	3009A00659	05/16/2006
CBL028	Megaphase	TM40 K1K1 197	CBL028	12/01/2005
SAF187	Bryant Manufacturing	TH-5S	1207	04/06/2006
MET2	Meterman	15XP	050407779	07/28/2006
SAF418	Powerstat	3PN126	SAF418	Verified with MET2

Test Details:

Channels	Freq MHz
Low:	1931
Mid:	1960
High:	1989

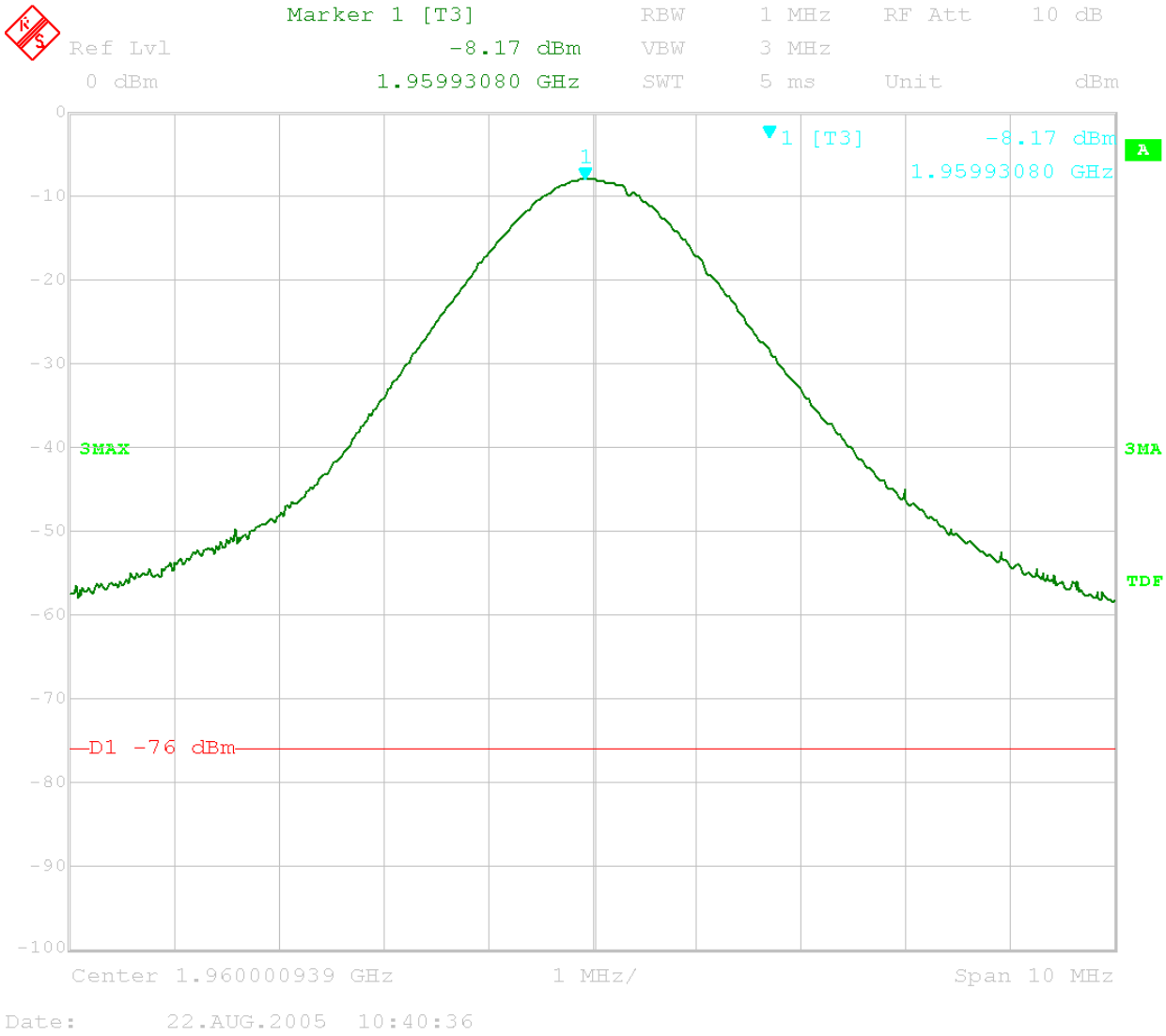
Passband: 1930-1990 MHz

CBL028 Loss in the range from 1930-1990 MHz: 2.71 dB

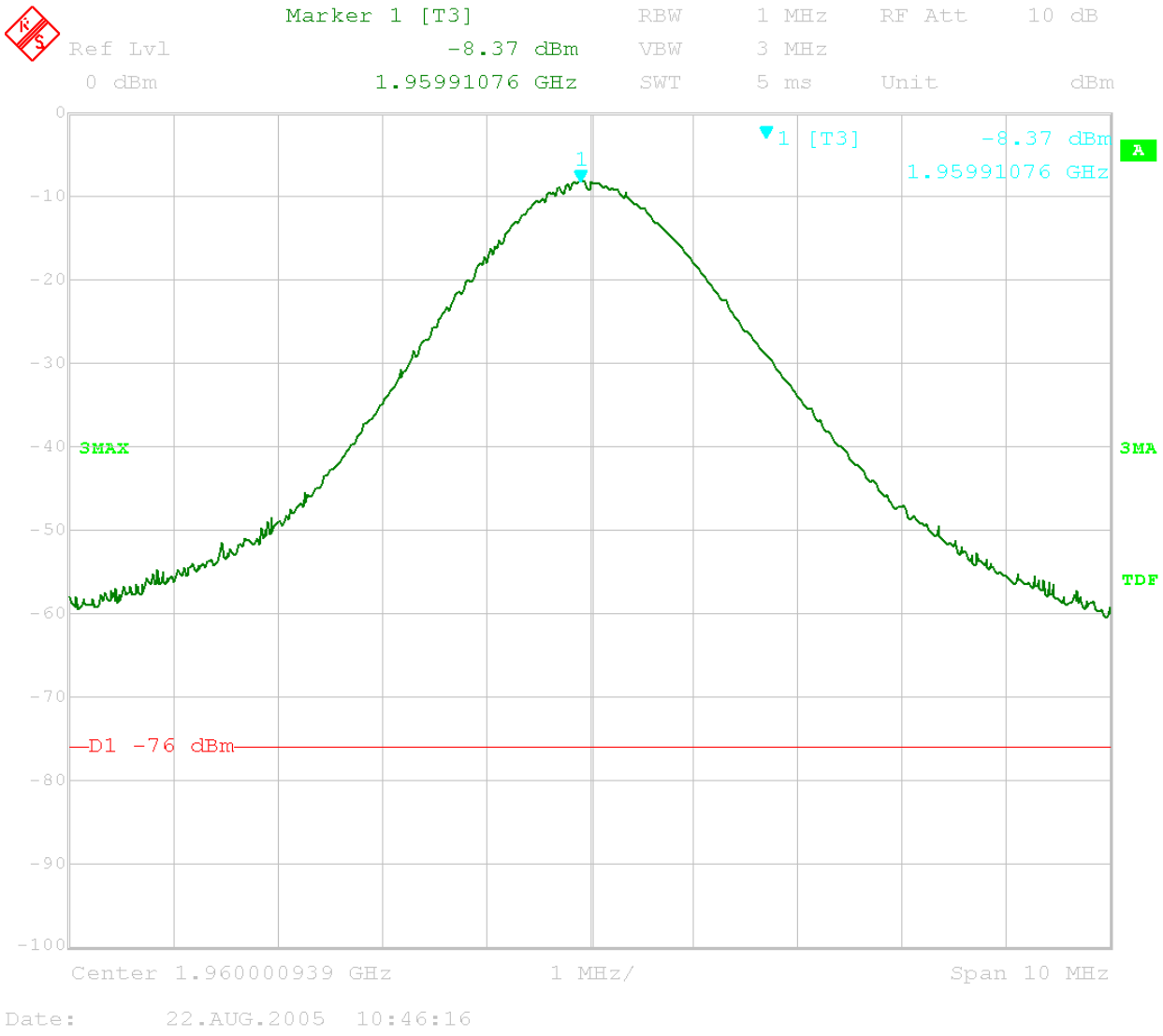
Frequency and Power Stability over Voltage and Temperature 8/17/05 performed by Nicholas Abbondante								
Temp	Channel	Freq MHz	Deviation, Hz	Deviation, MHz	PPM	Power dBm	Deviation, dB	
-30	LOW	1930.999938	-350	-0.000350	-0.18	-2.70	1.19	
-30	MID	1959.999975	-238	-0.000238	-0.12	-3.12	1.10	
-30	HIGH	1989.000195	20	0.000020	0.01	-3.68	1.54	
-20	LOW	1931.000094	-194	-0.000194	-0.10	-2.68	1.21	
-20	MID	1960.000038	-175	-0.000175	-0.09	-2.84	1.38	
-20	HIGH	1988.999945	-230	-0.000230	-0.12	-3.72	1.50	
-10	LOW	1930.999857	-431	-0.000431	-0.22	-2.80	1.09	
-10	MID	1960.000097	-116	-0.000116	-0.06	-3.15	1.07	
-10	HIGH	1989.000131	-44	-0.000044	-0.02	-3.77	1.45	
0	LOW	1930.999813	-475	-0.000475	-0.25	-3.18	0.71	
0	MID	1959.999788	-425	-0.000425	-0.22	-3.45	0.77	
0	HIGH	1988.999718	-457	-0.000457	-0.23	-4.23	0.99	
10	LOW	1930.999725	-563	-0.000563	-0.29	-3.34	0.55	
10	MID	1959.999625	-588	-0.000588	-0.30	-3.71	0.51	
10	HIGH	1988.999562	-613	-0.000613	-0.31	-4.44	0.78	
20	LOW	1931.000288	0	0.000000	0.00	-3.89	0.00	*
20	MID	1960.000213	0	0.000000	0.00	-4.22	0.00	*
20	HIGH	1989.000175	0	0.000000	0.00	-5.22	0.00	*
30	LOW	1930.999588	-700	-0.000700	-0.36	-3.99	-0.10	
30	MID	1959.999688	-525	-0.000525	-0.27	-4.38	-0.16	
30	HIGH	1988.999638	-537	-0.000537	-0.27	-5.47	-0.25	
40	LOW	1931.000113	-175	-0.000175	-0.09	-4.36	-0.47	
40	MID	1960.000100	-113	-0.000113	-0.06	-4.90	-0.68	
40	HIGH	1989.000087	-88	-0.000088	-0.04	-6.29	-1.07	
50	LOW	1930.999813	-475	-0.000475	-0.25	-4.79	-0.90	
50	MID	1959.999863	-350	-0.000350	-0.18	-5.41	-1.19	
50	HIGH	1988.999875	-300	-0.000300	-0.15	-6.78	-1.56	
Voltage	Channel	Freq MHz	Deviation, Hz	Deviation, MHz	PPM	Power dBm	Deviation, dB	
102V	LOW	1931.000250	-38	-0.000038	-0.02	-3.96	-0.07	
102V	MID	1960.000375	162	0.000162	0.08	-4.26	-0.04	
102V	HIGH	1989.000226	51	0.000051	0.03	-5.55	-0.33	
120V	LOW	1931.000288	0	0.000000	0.00	-3.89	0.00	*
120V	MID	1960.000213	0	0.000000	0.00	-4.22	0.00	*
120V	HIGH	1989.000175	0	0.000000	0.00	-5.22	0.00	*
138V	LOW	1931.000388	100	0.000100	0.05	-3.94	-0.05	
138V	MID	1960.000425	212	0.000212	0.11	-4.14	0.08	
138V	HIGH	1989.000313	138	0.000138	0.07	-5.53	-0.31	

Notes: A continuous wave signal was used for this test. The maximum frequency deviation measured is 700 Hertz. The maximum occupied bandwidth measured is 285.6 kHz. Given that the nearest channels to the band edges are located at 1931.000288 and 1989.000313 MHz, even in a case where the entire occupied bandwidth of the signal is located to the left or to the right of the fundamental frequency, the 26 dB down points of the EUT waveform will never be closer than 713.7 kHz from the band edges.

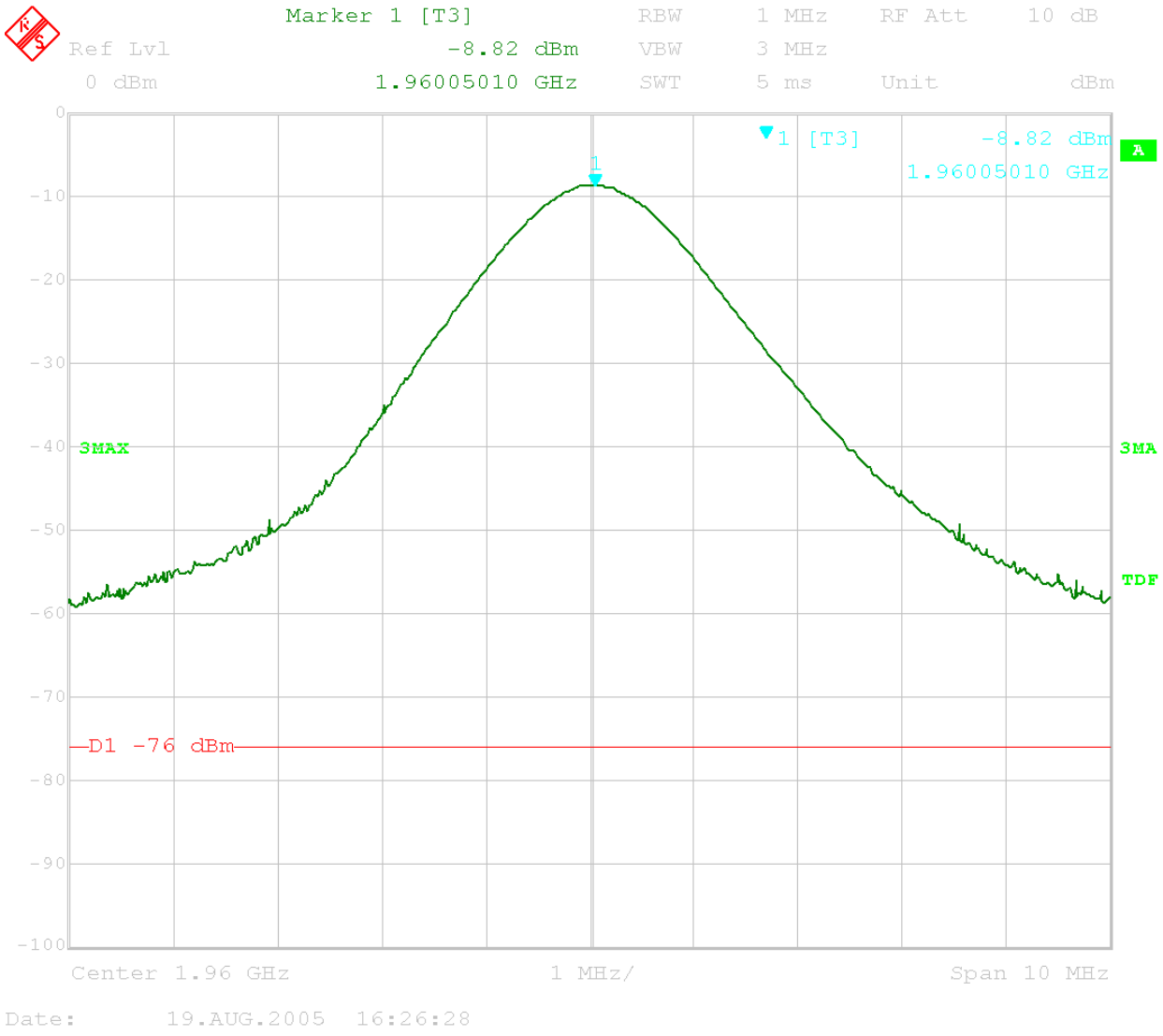
Appendix A – RF Output Power – Software Test Modes



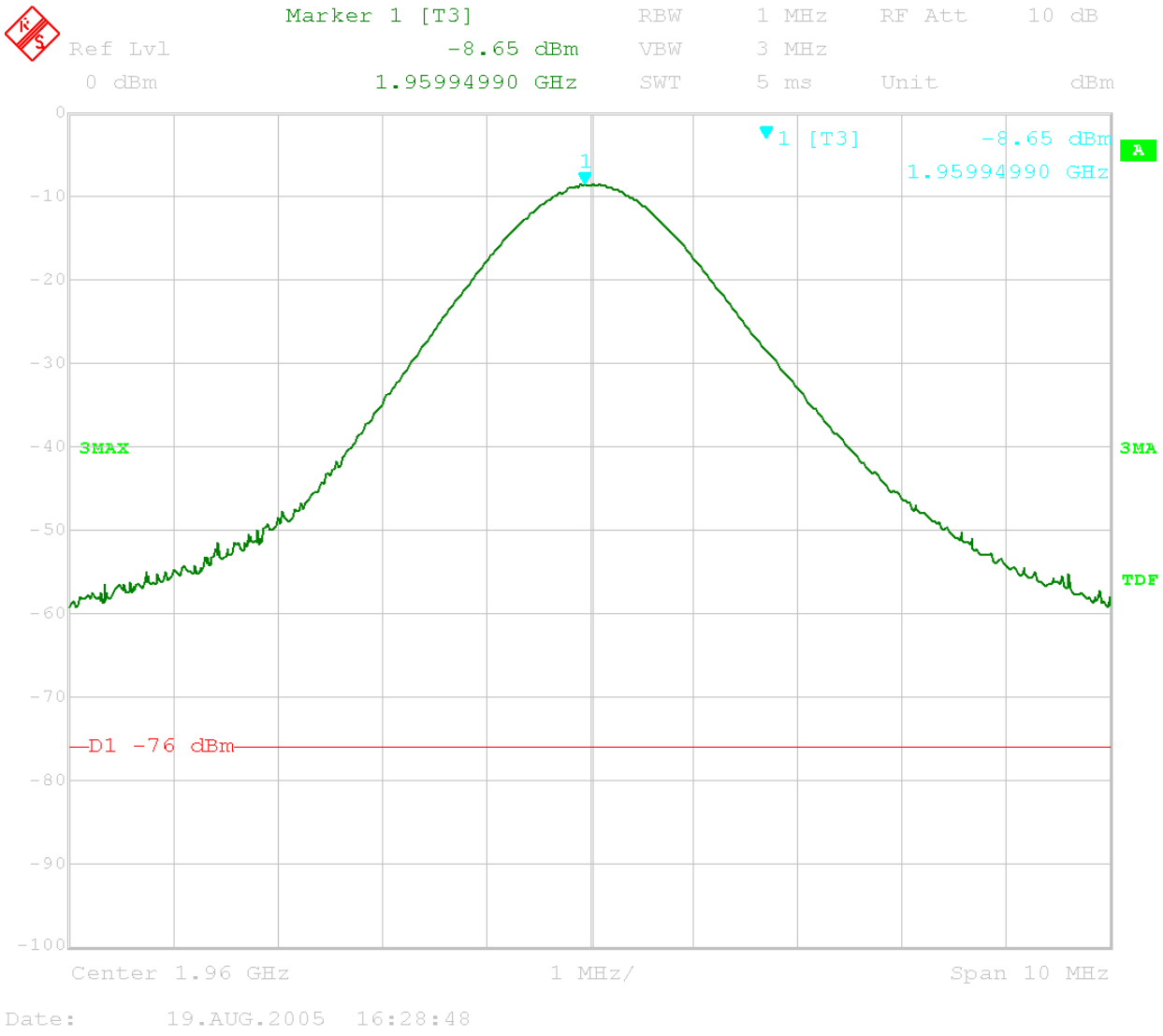
Software Test 1



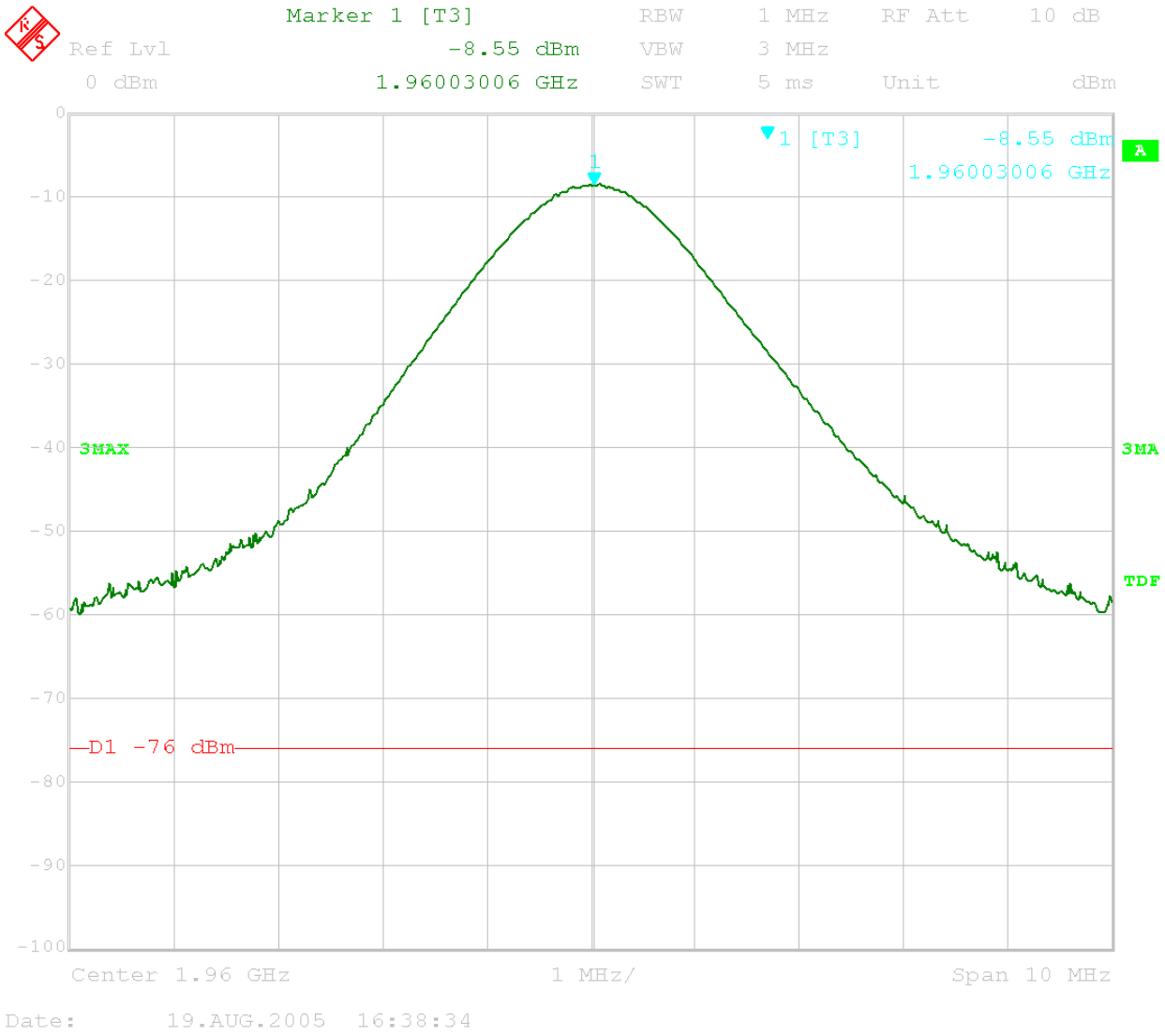
Software Test 2



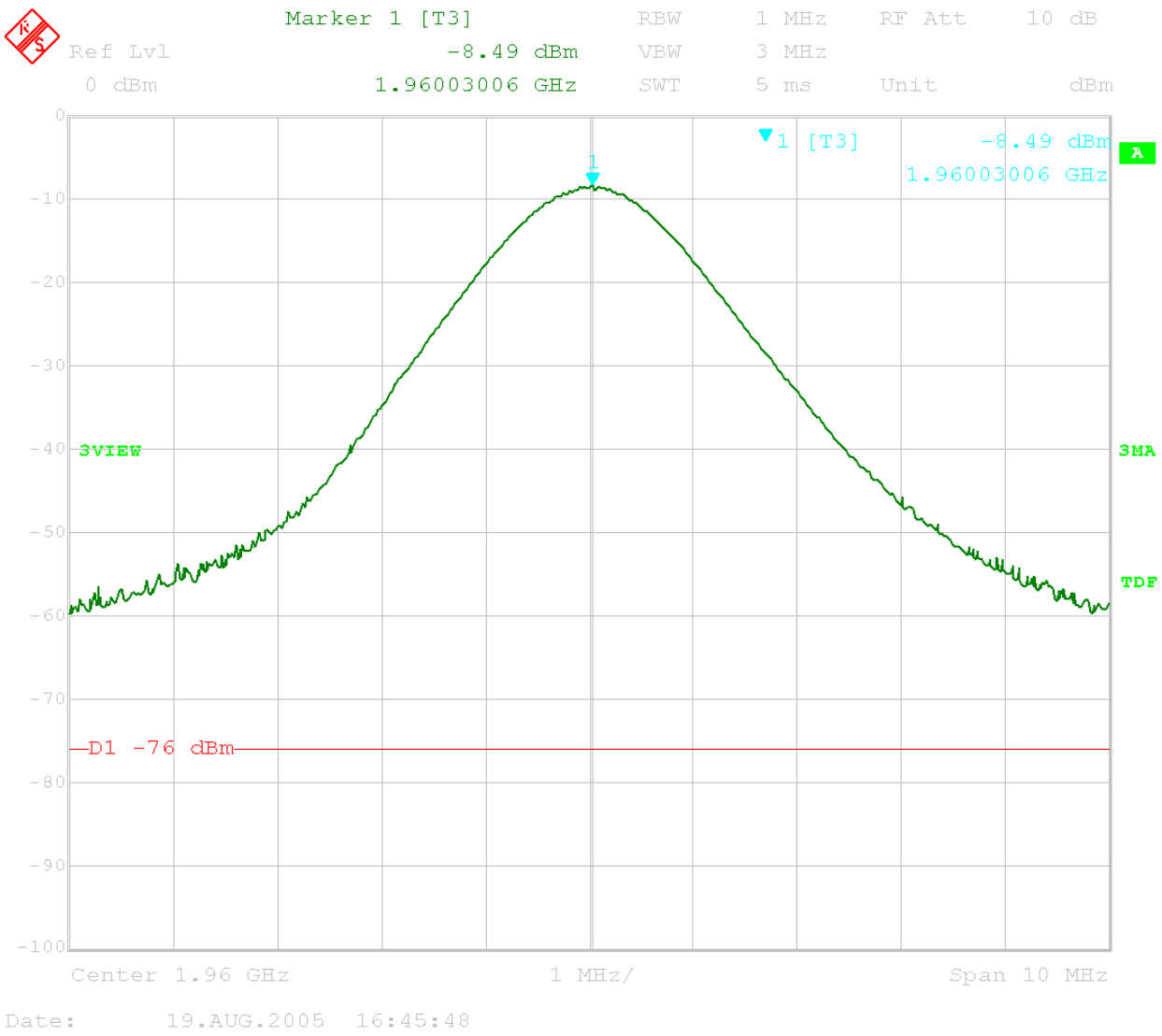
Software Test 3



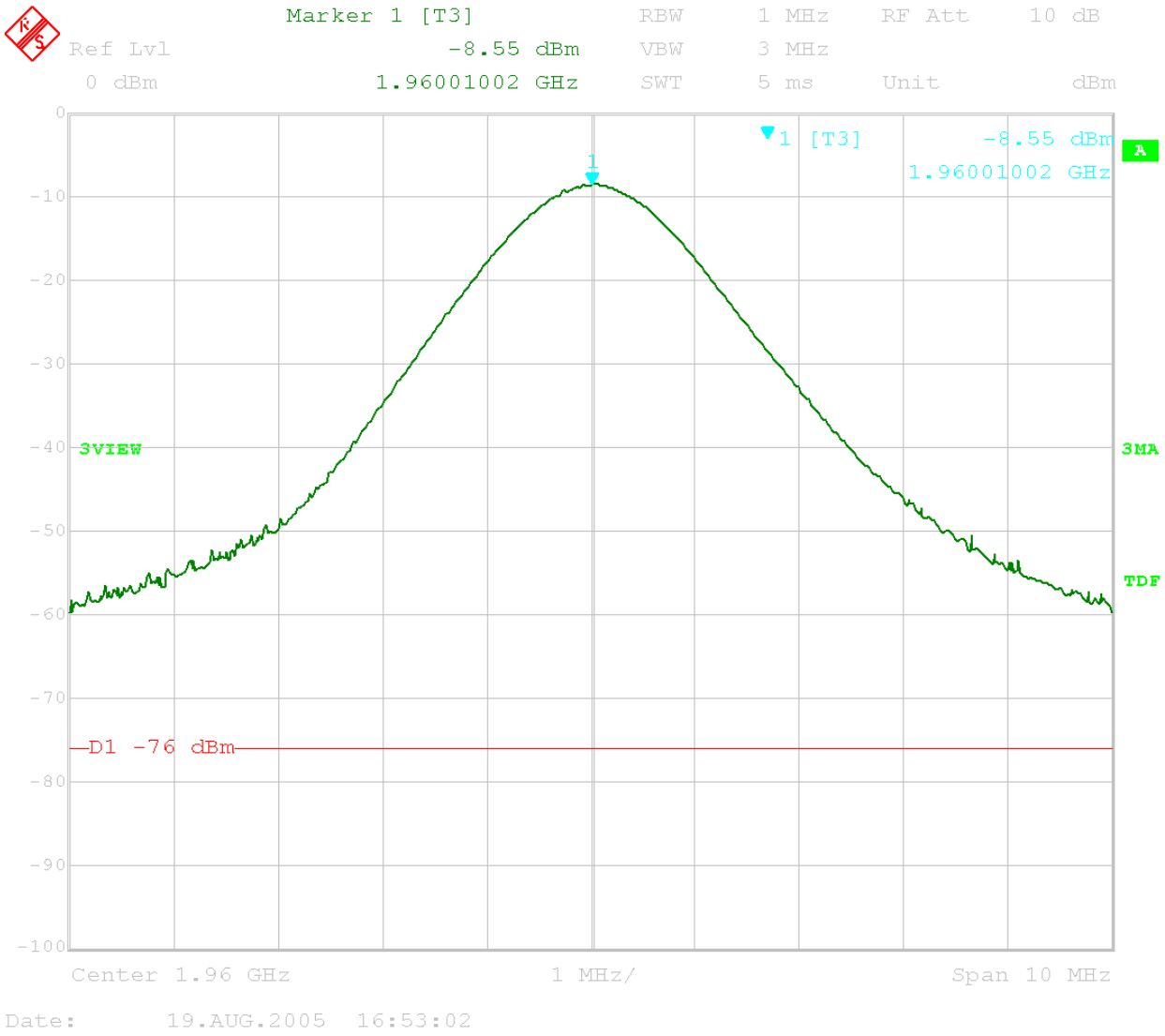
Software Test 4



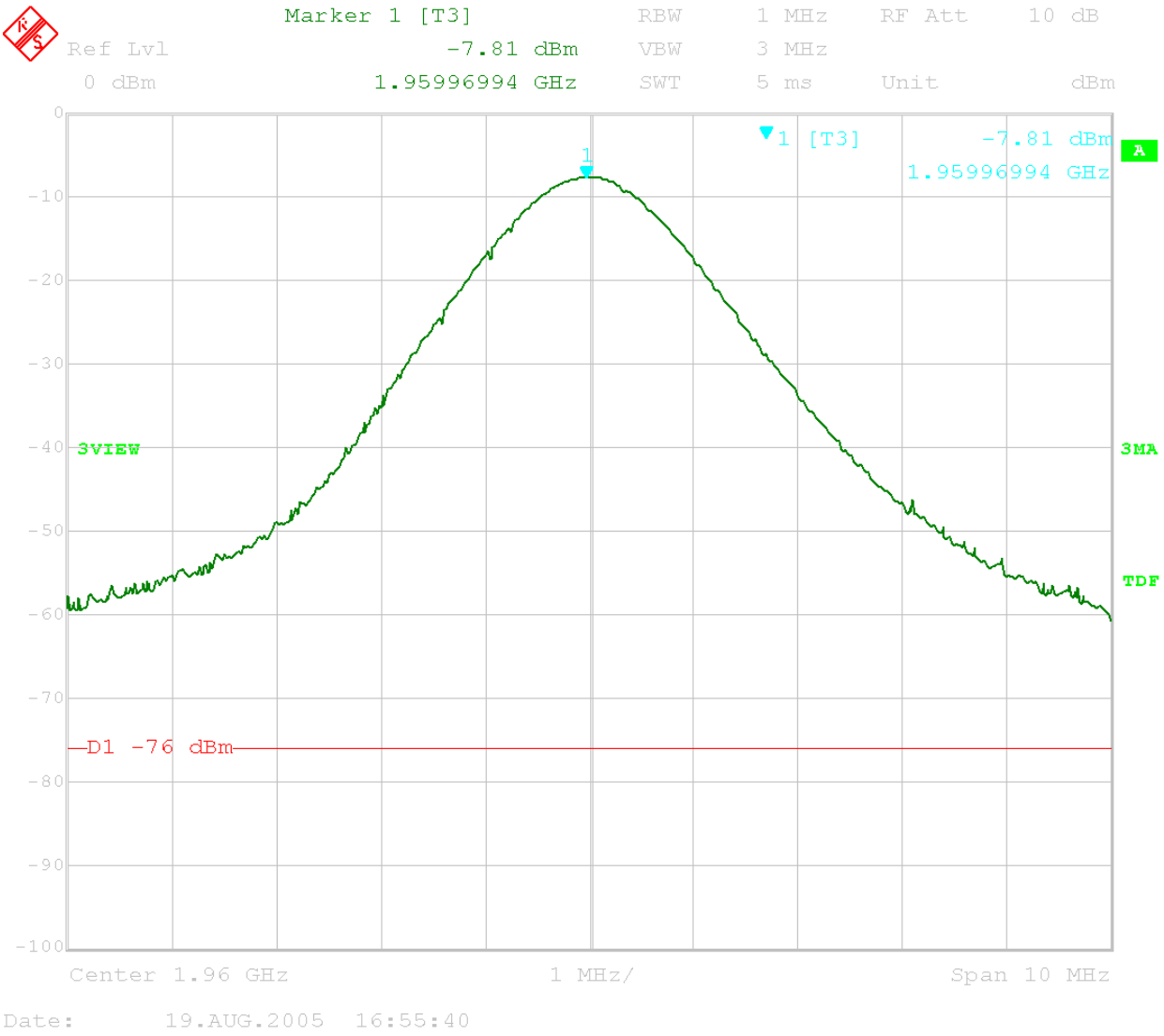
Software Test 5



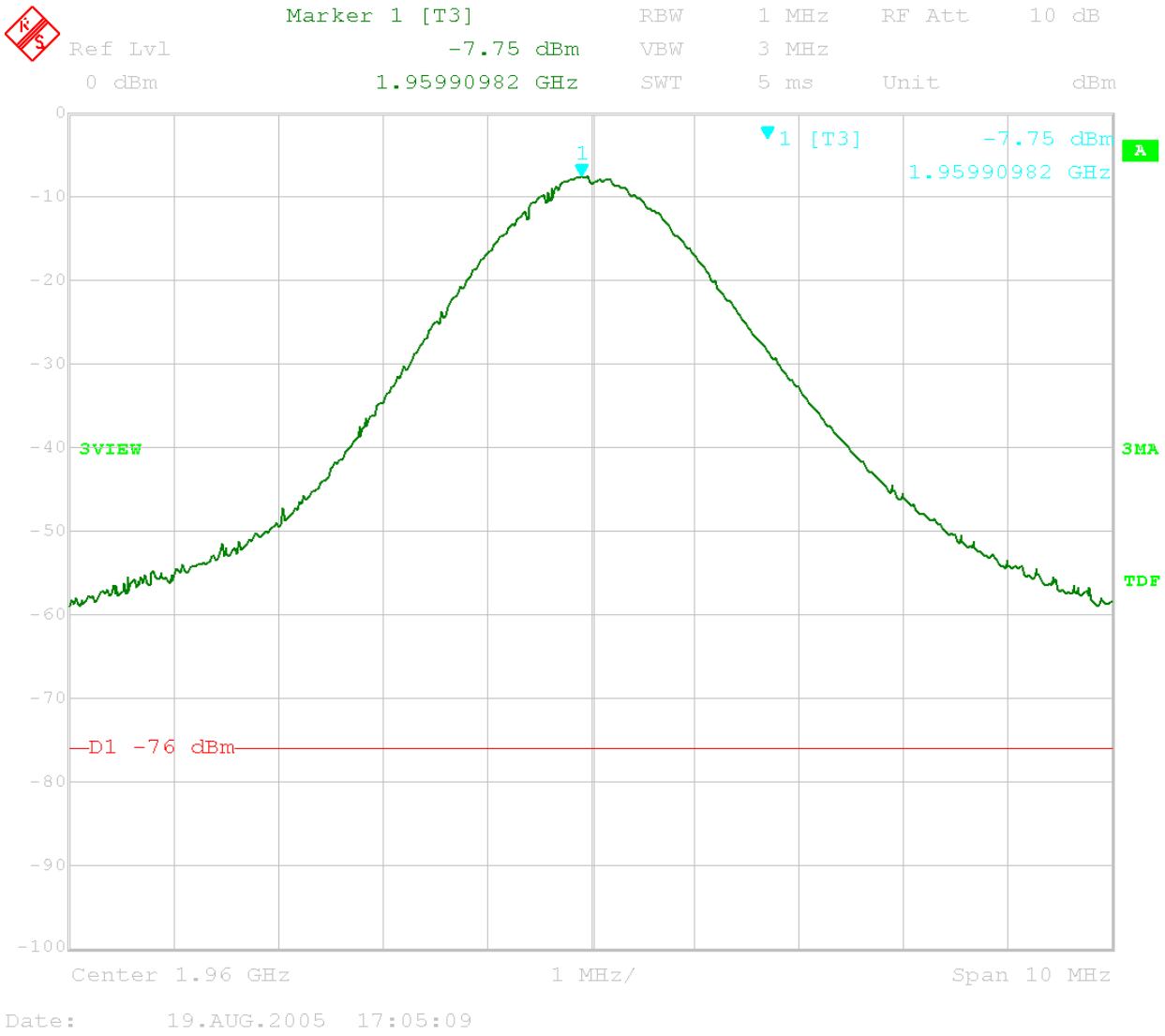
Software Test 6



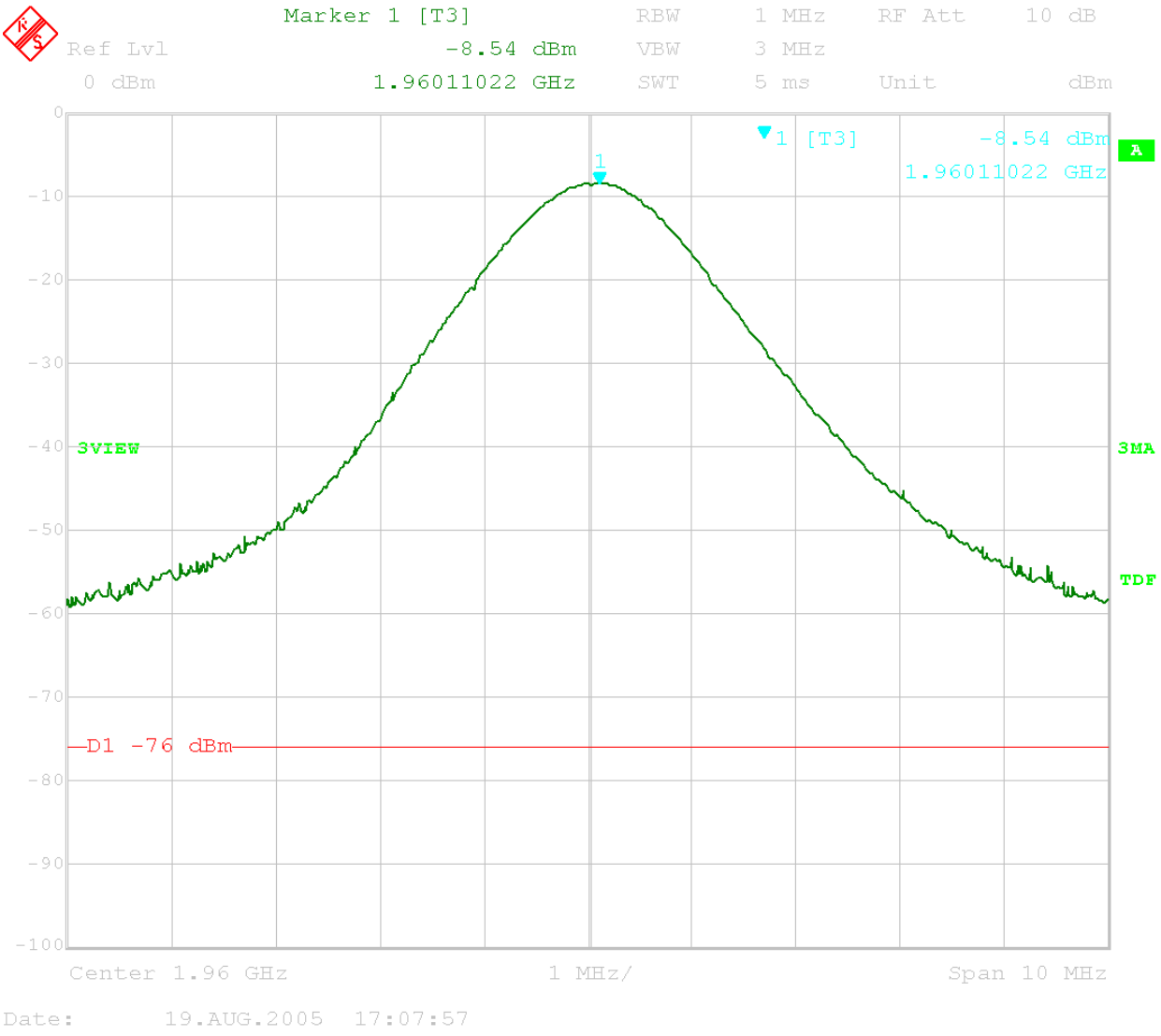
Software Test 7



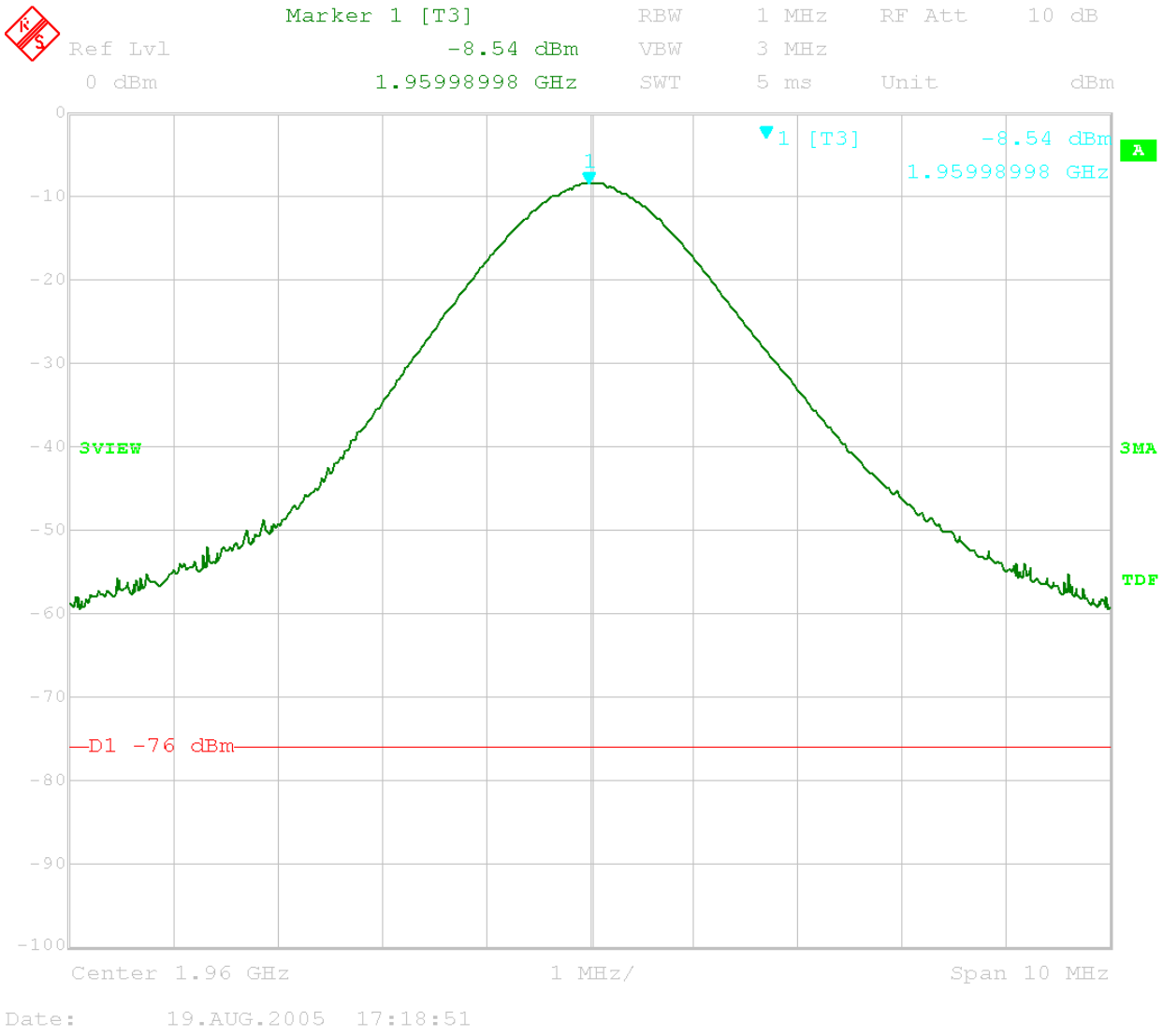
Software Test 8



Software Test 9

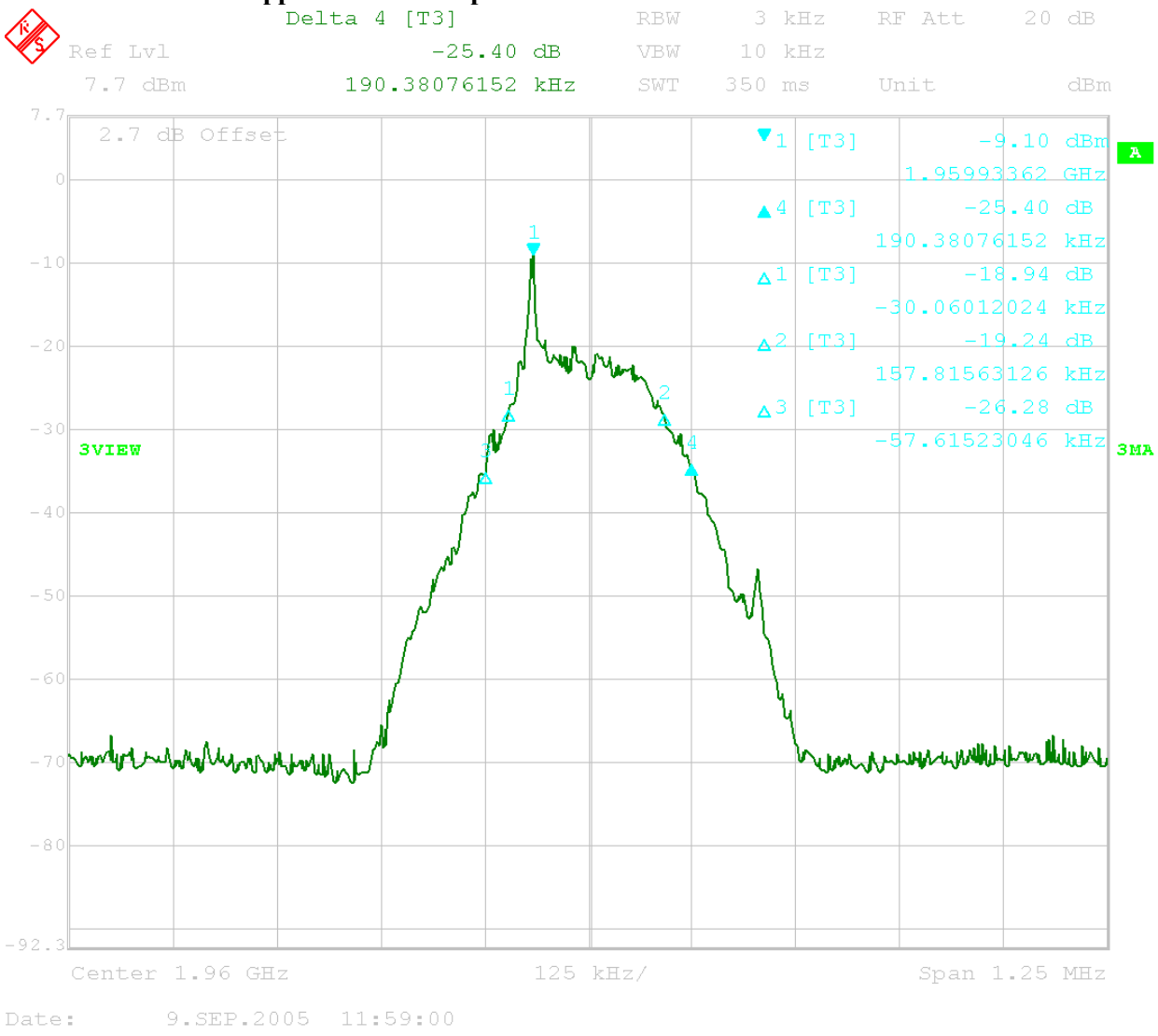


Software Test 10

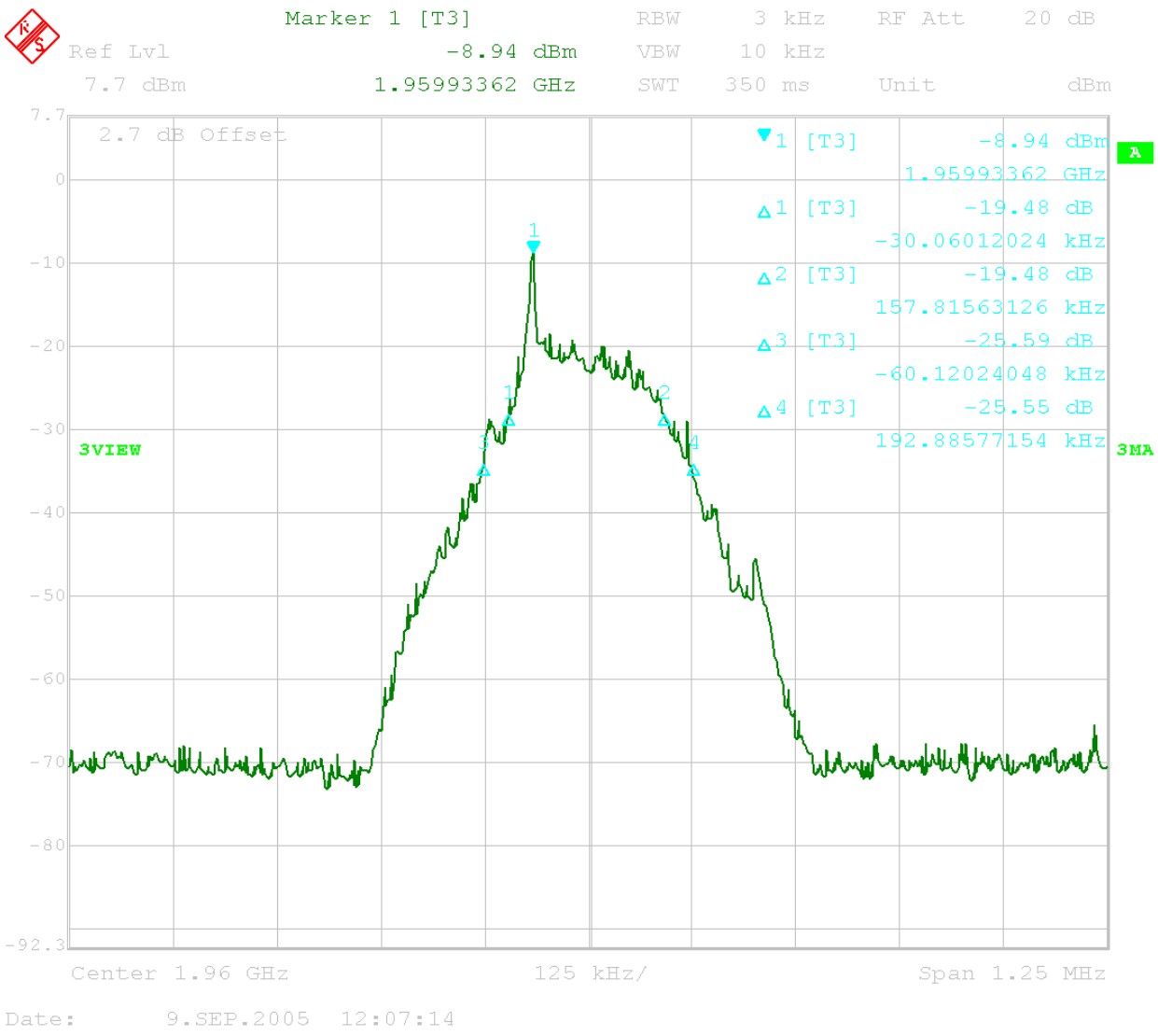


Software Test 11

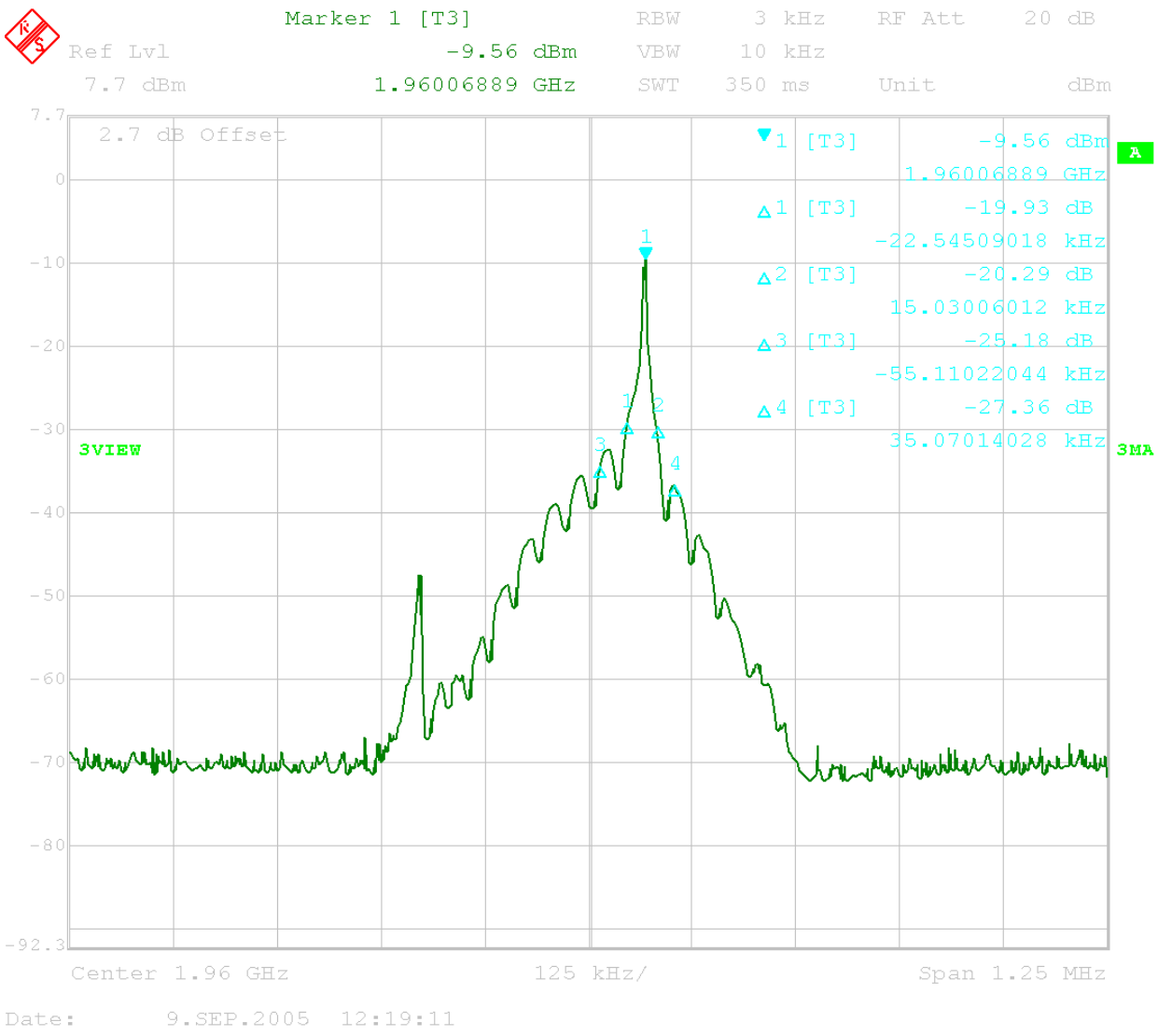
Appendix B – Occupied Bandwidth – Software Test Modes



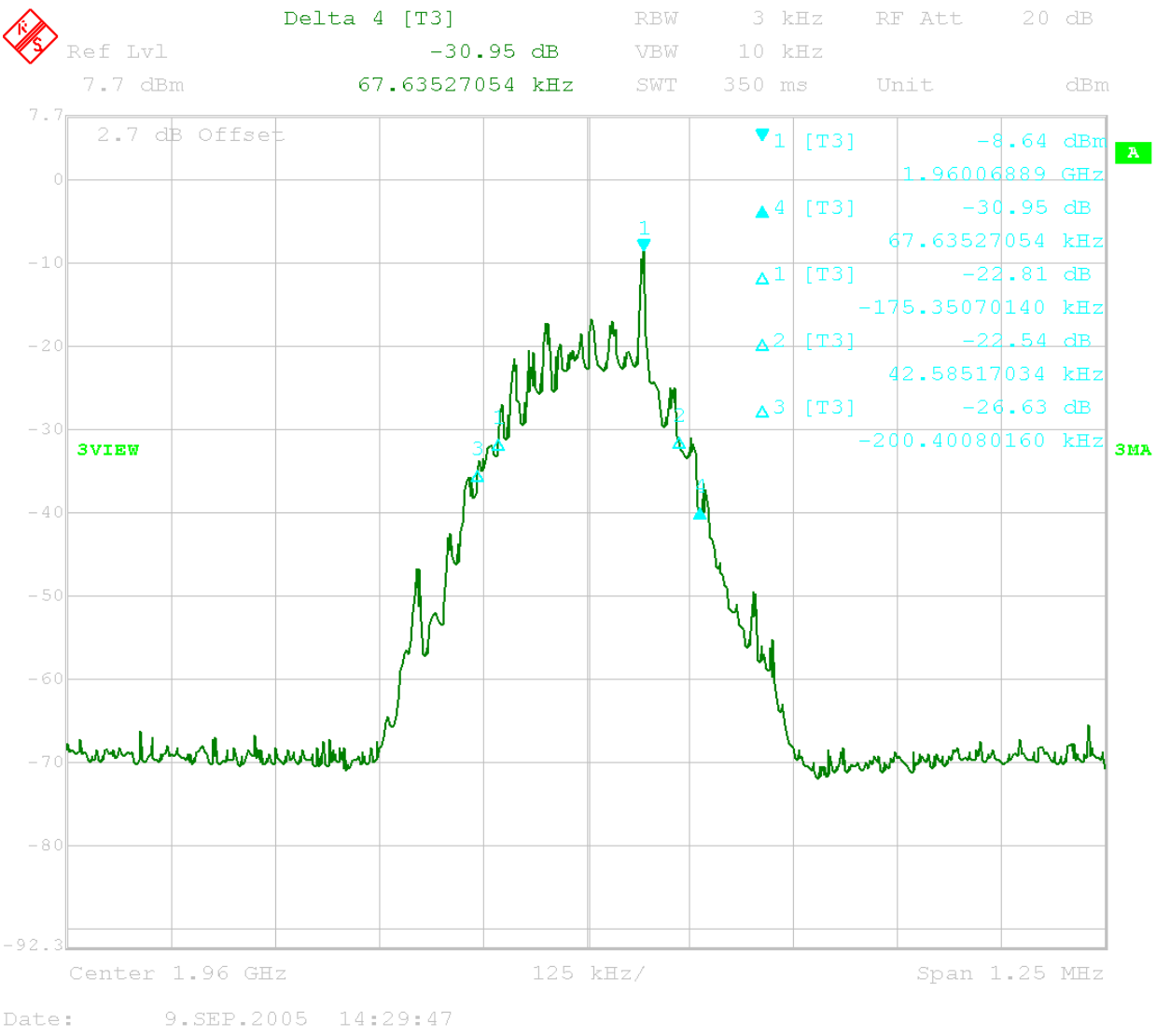
Software Test 1



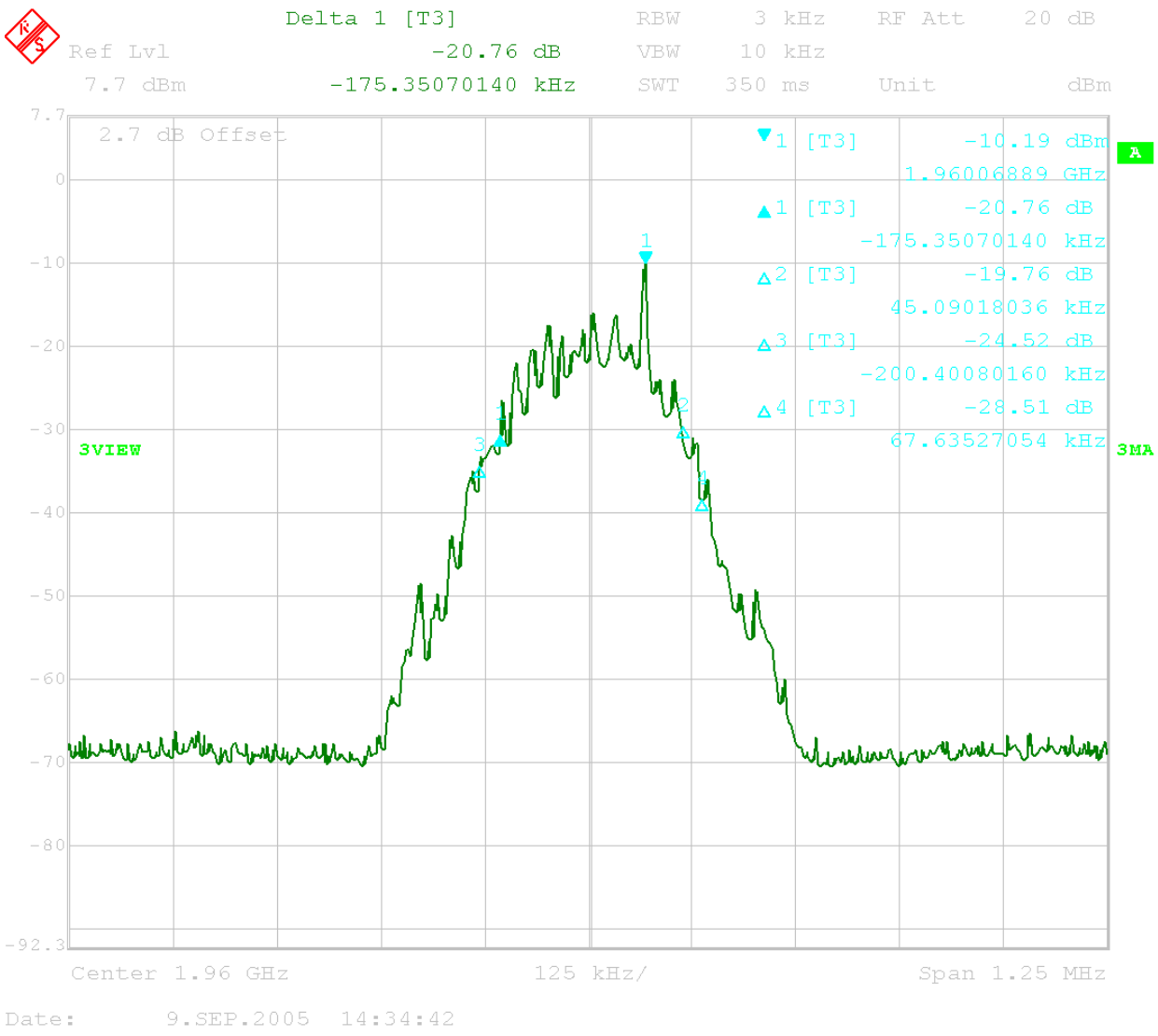
Software Test 2



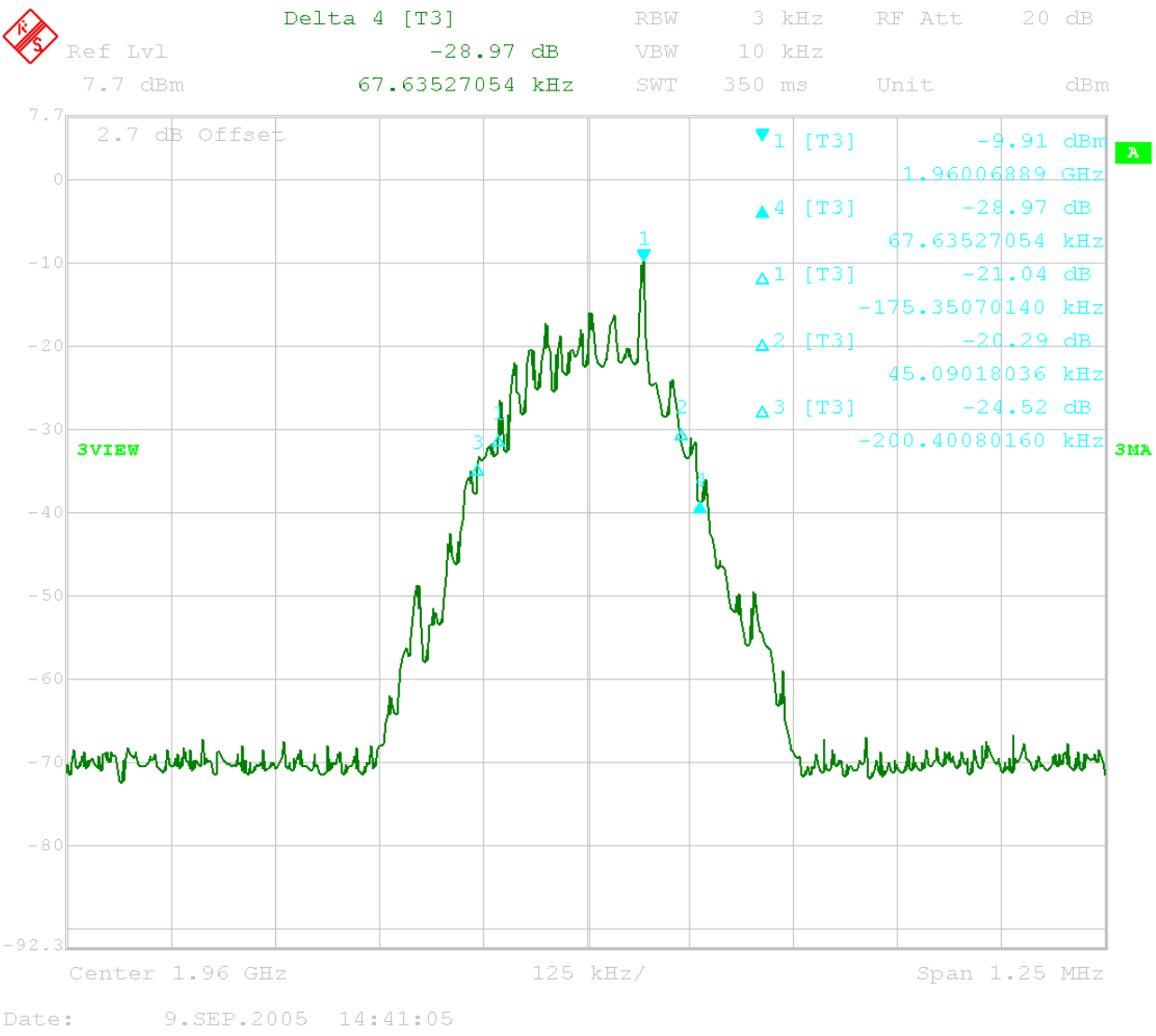
Software Test 3



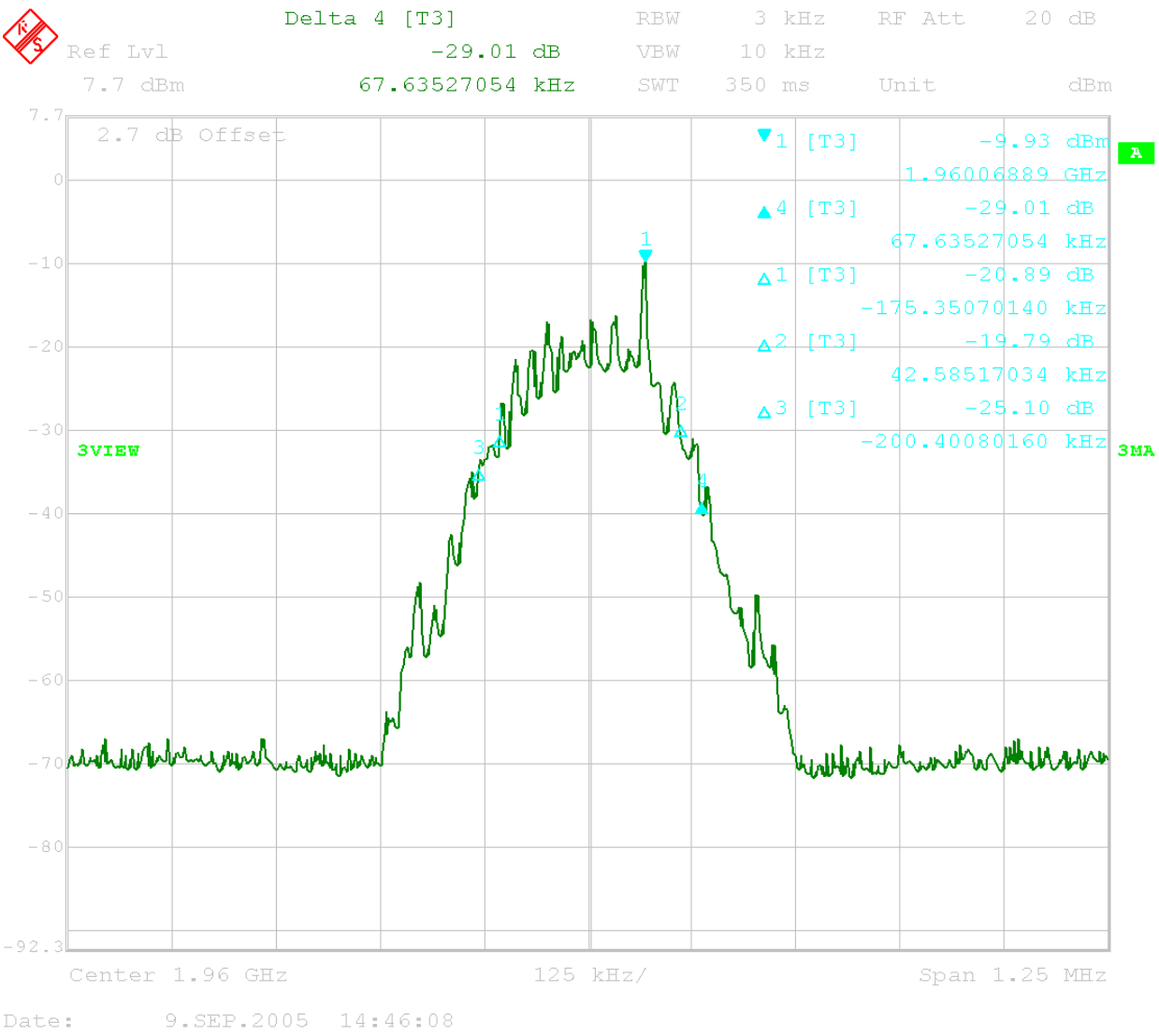
Software Test 4



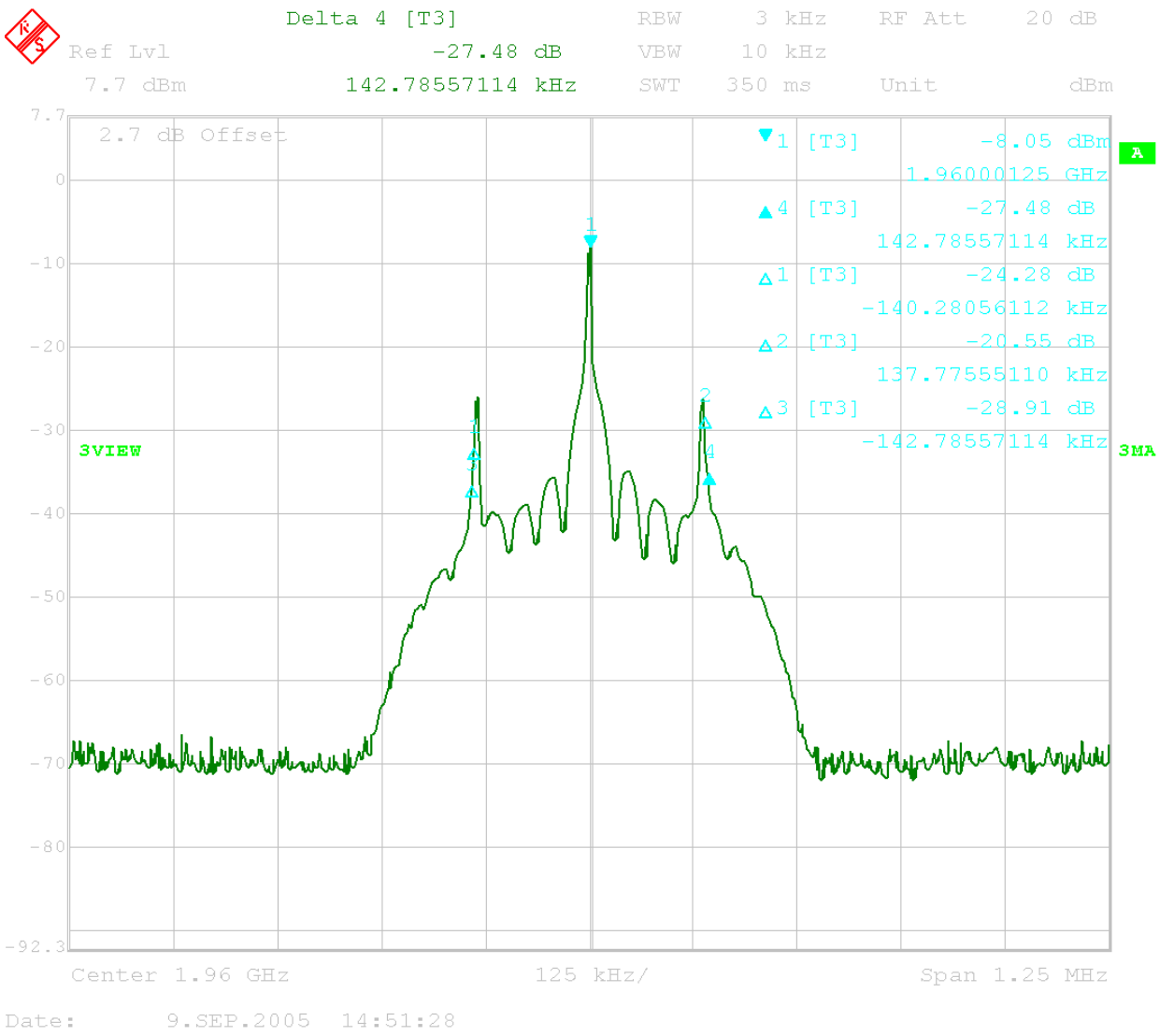
Software Test 5



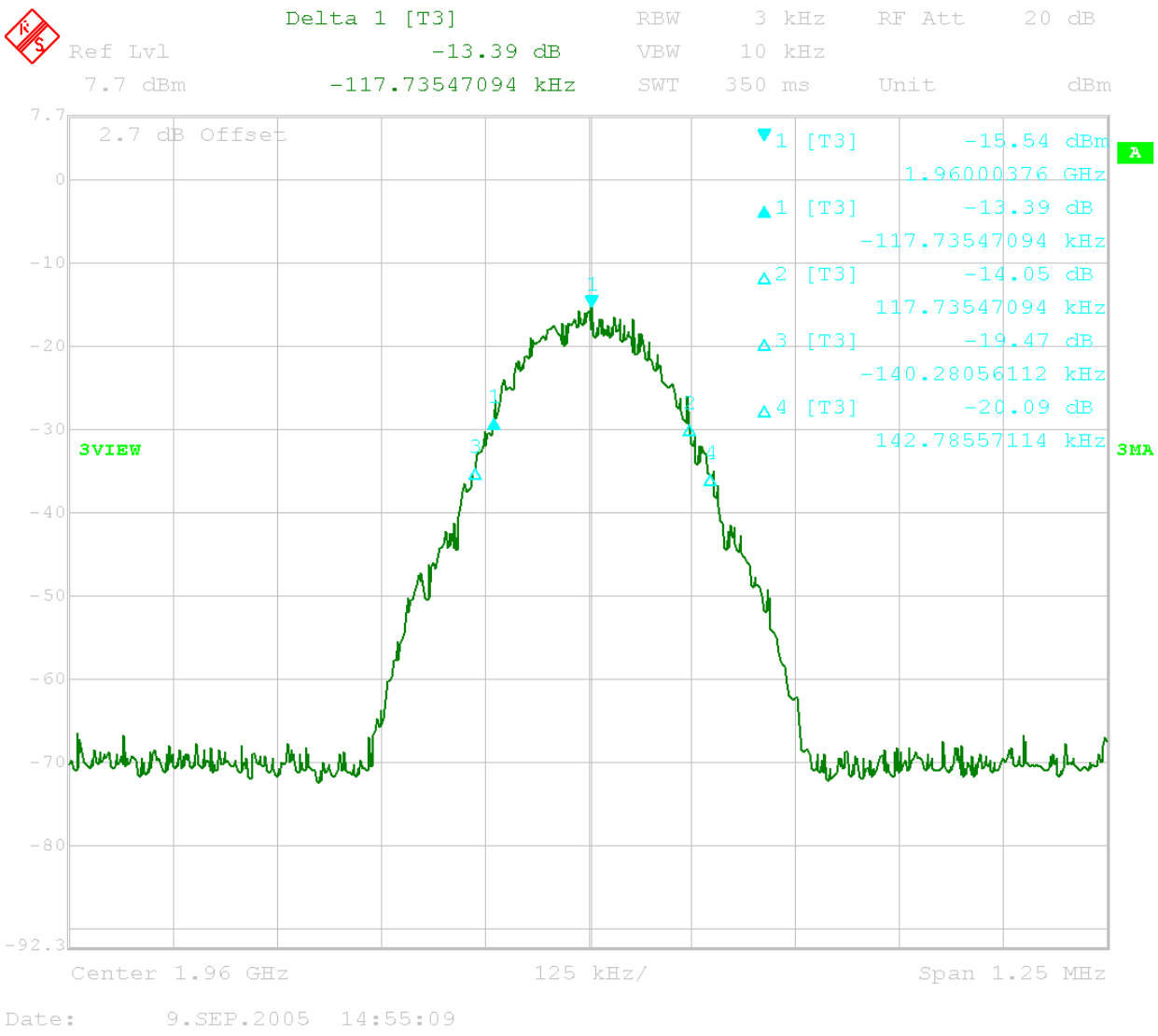
Software Test 6



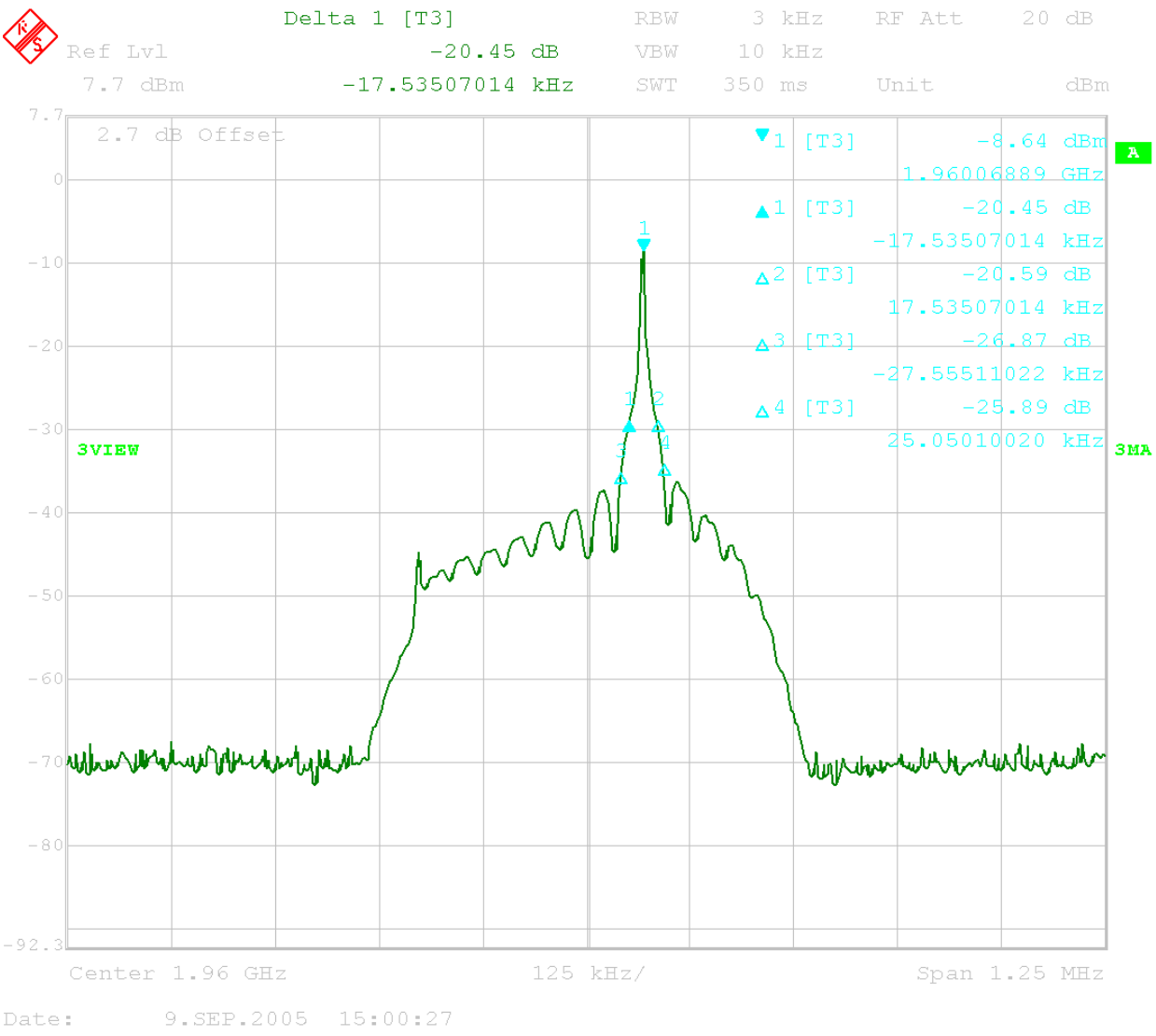
Software Test 7



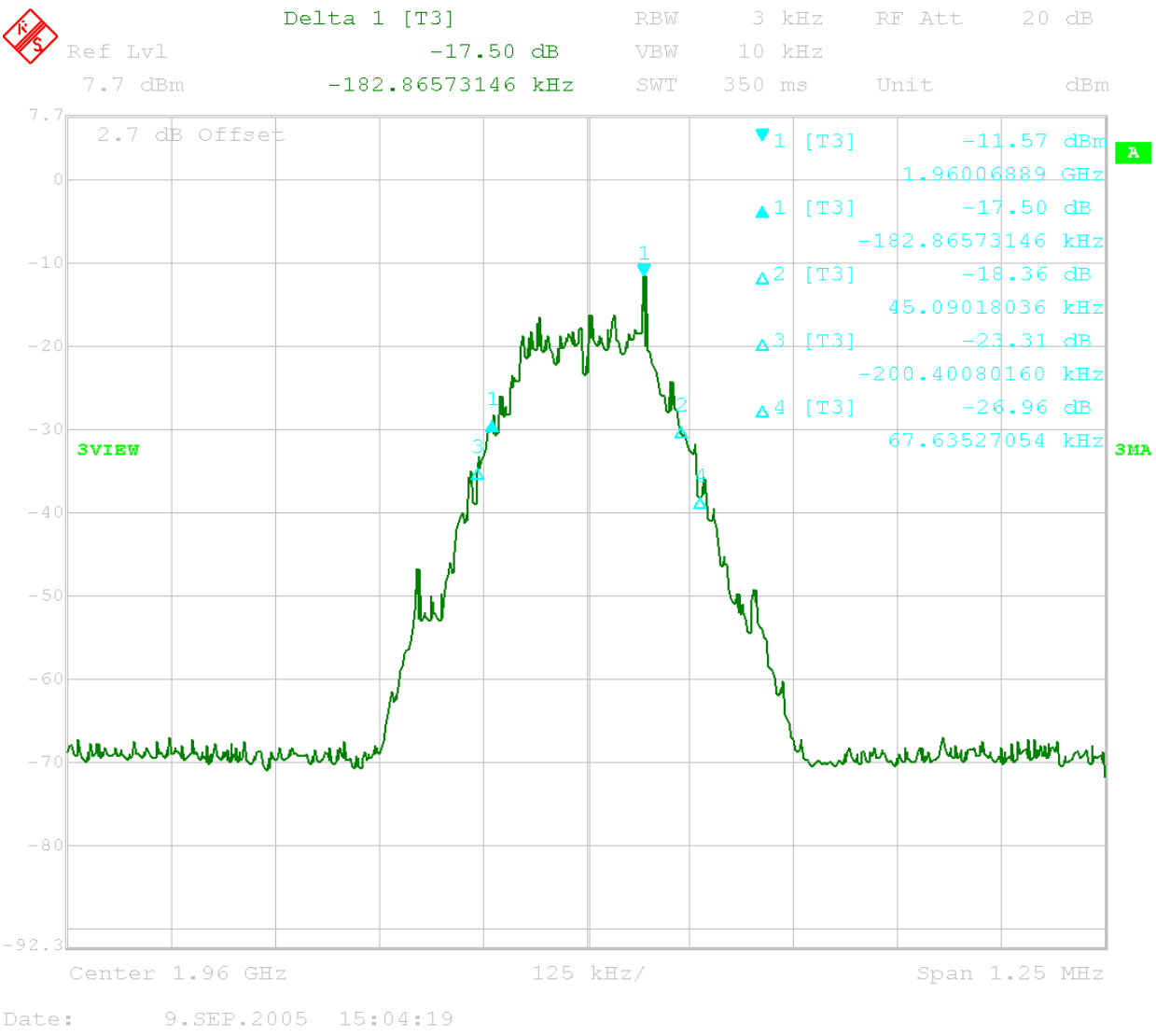
Software Test 8



Software Test 9

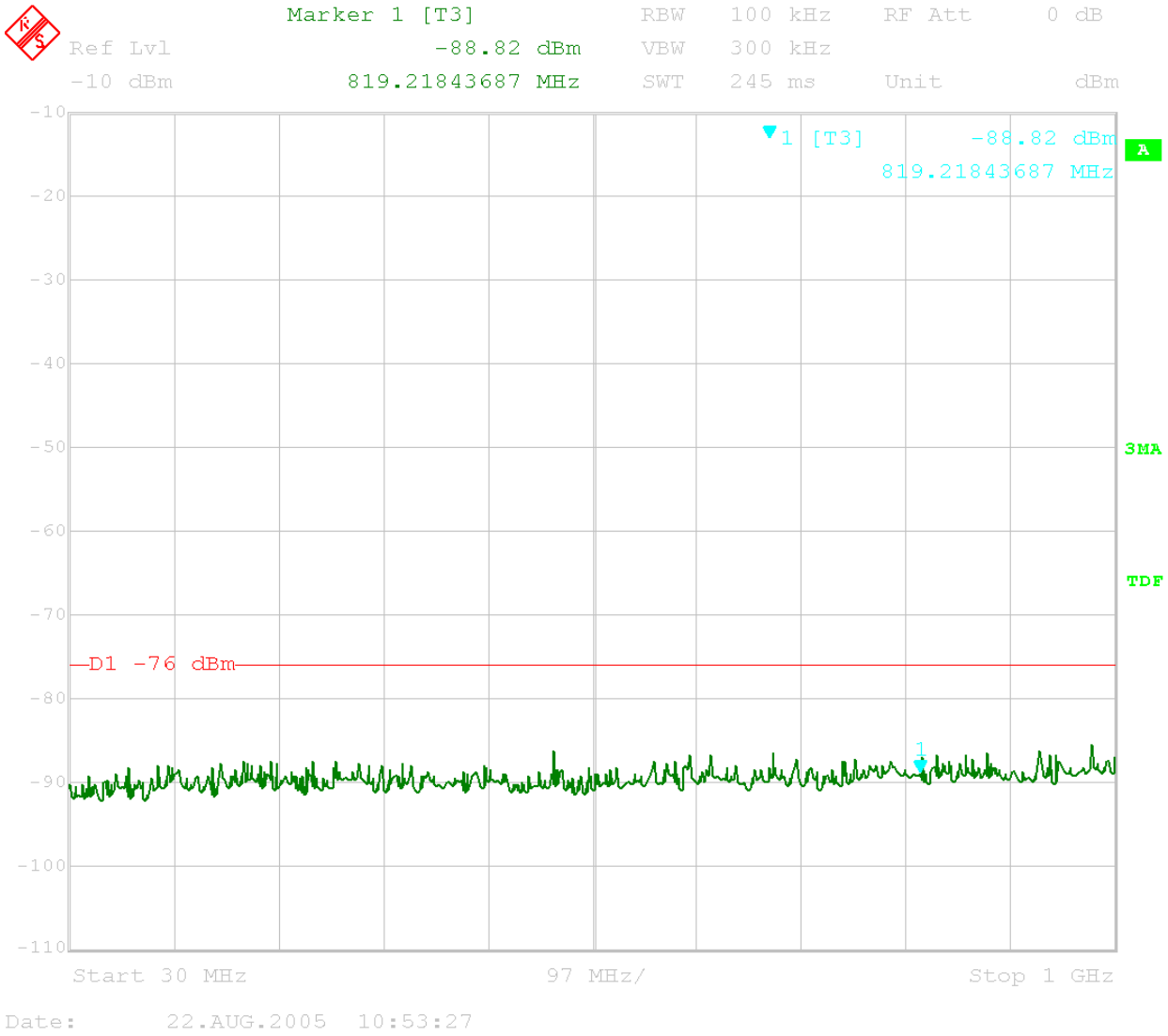


Software Test 10

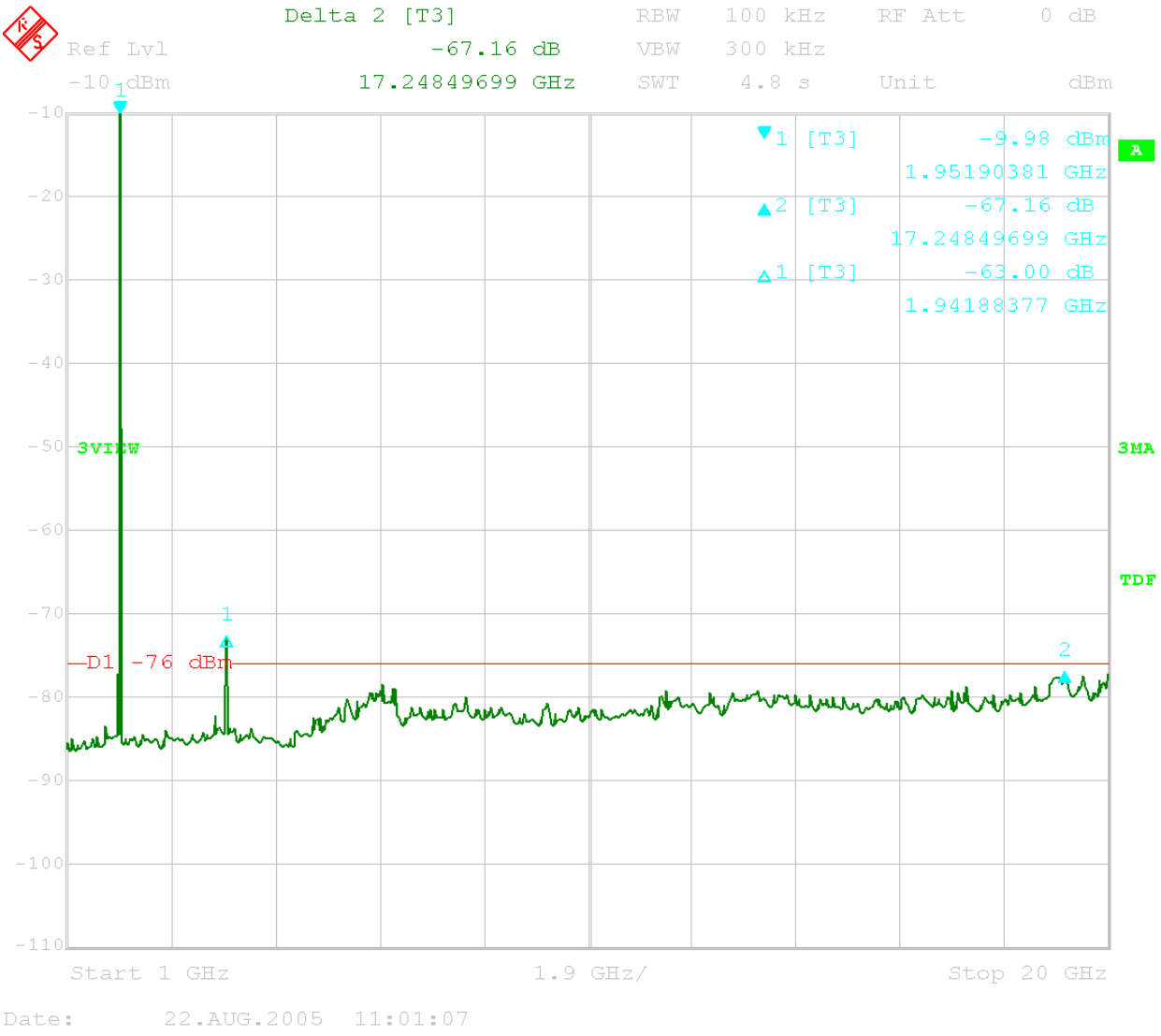


Software Test 11

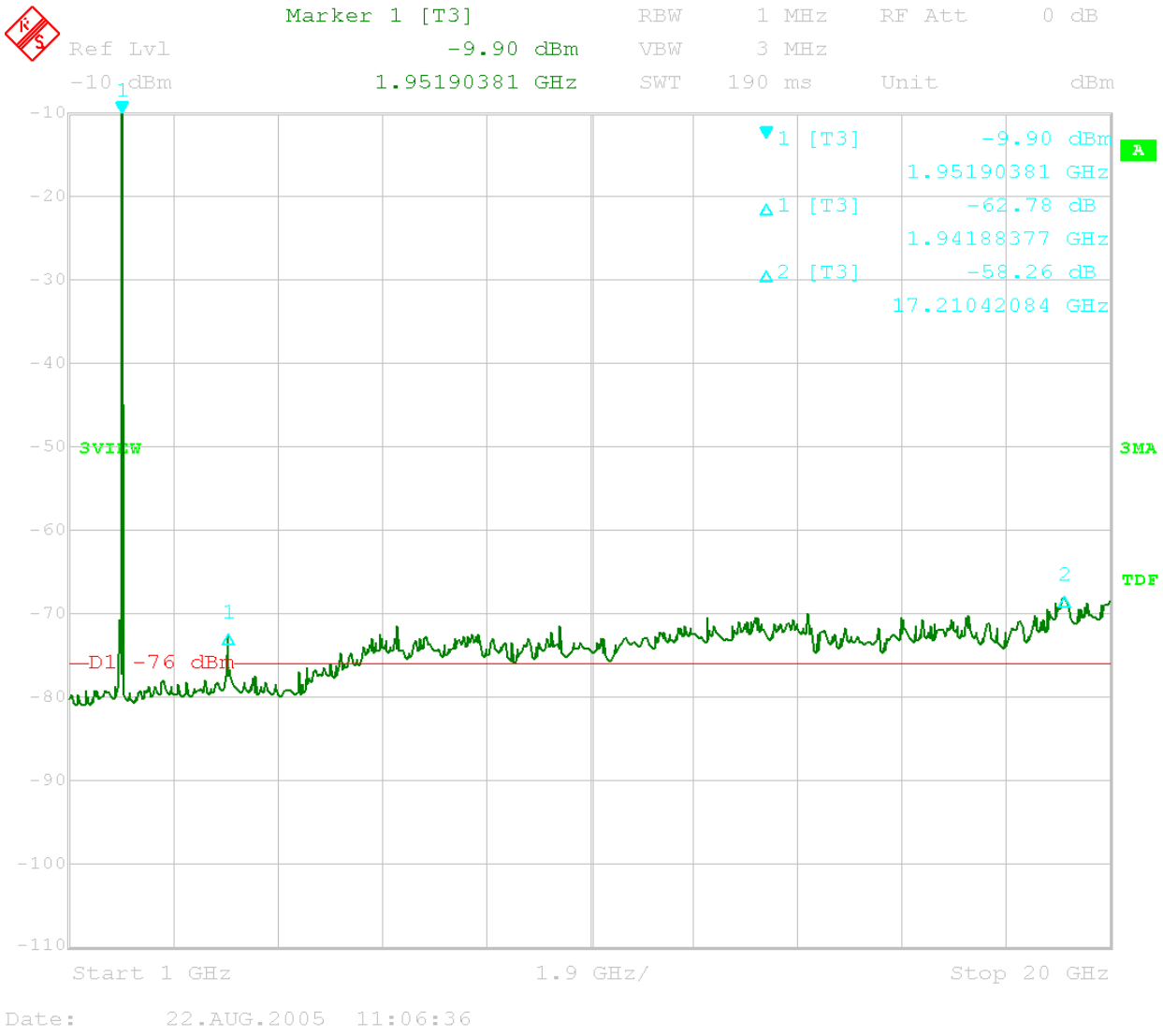
Appendix C – Spurious Conducted Emissions – Software Test Modes



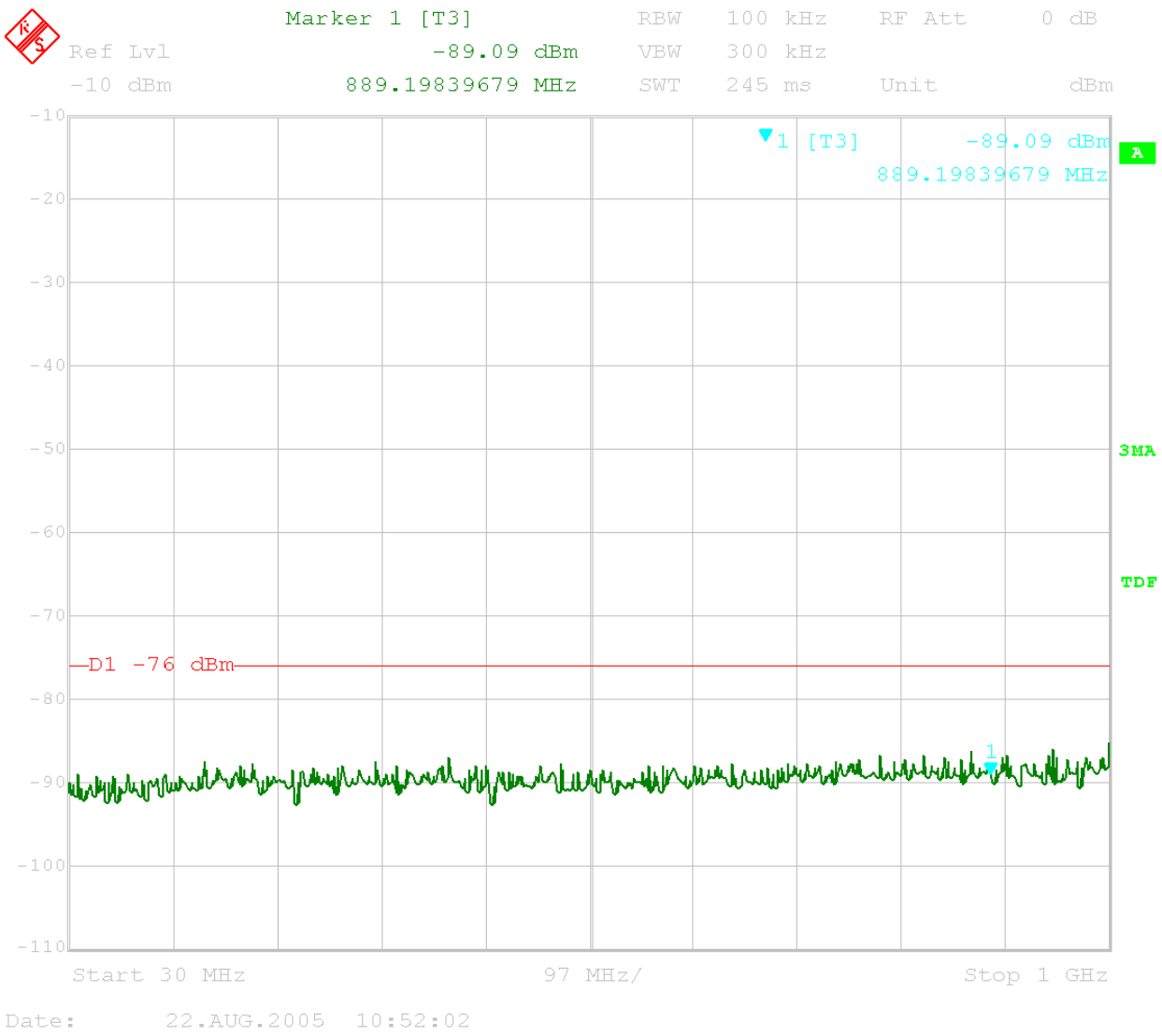
Software Test 1



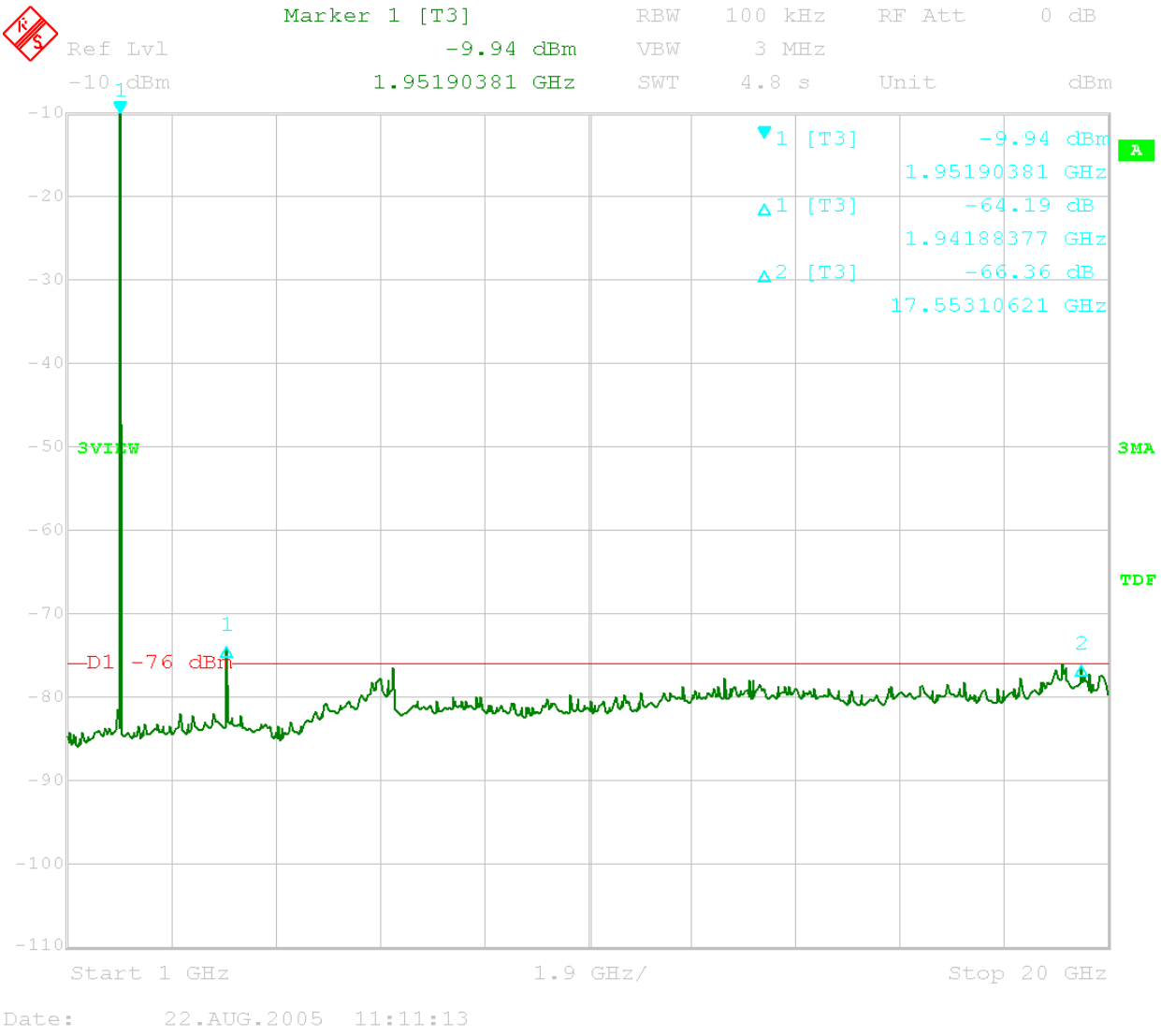
Software Test 1



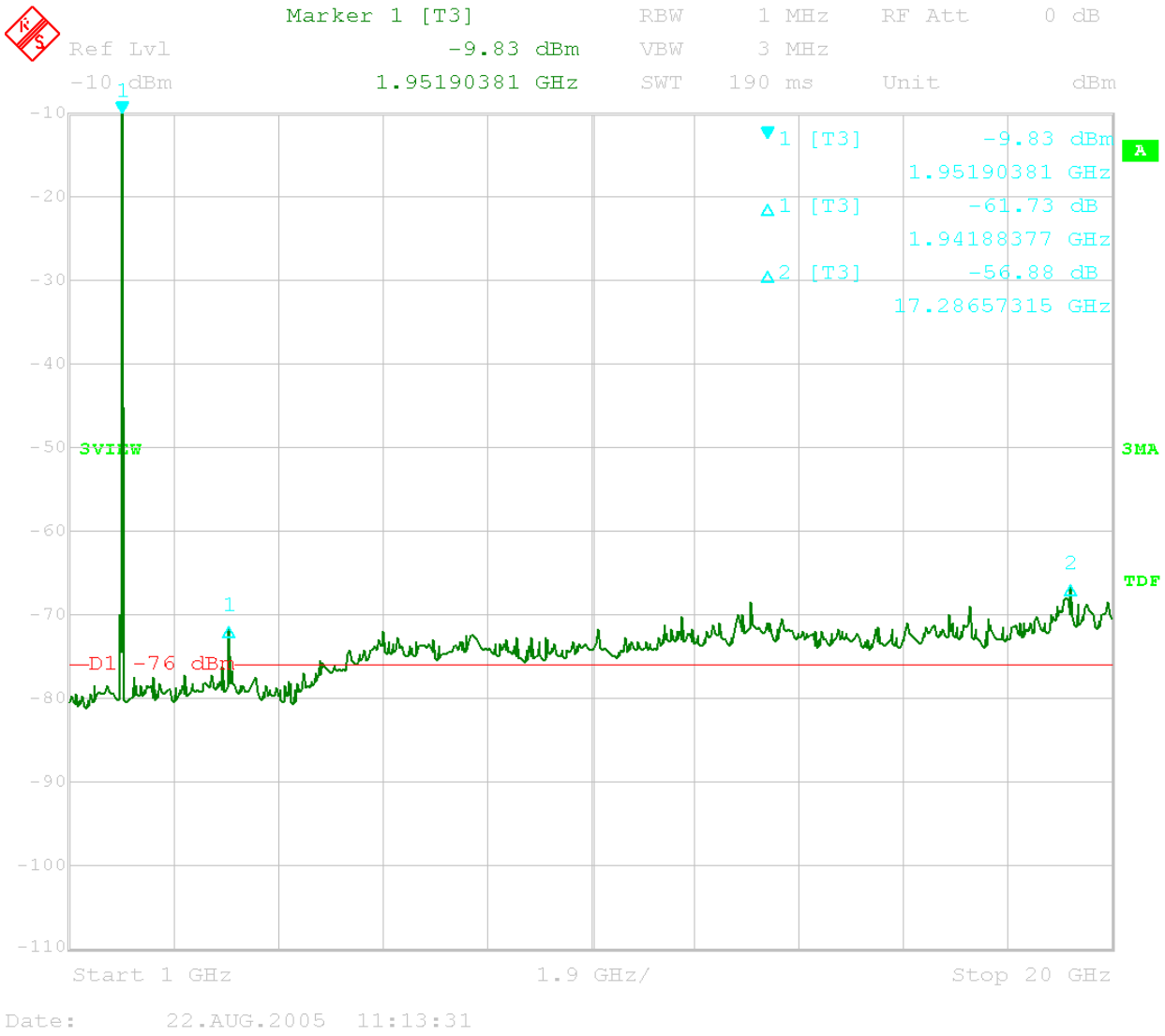
Software Test 1



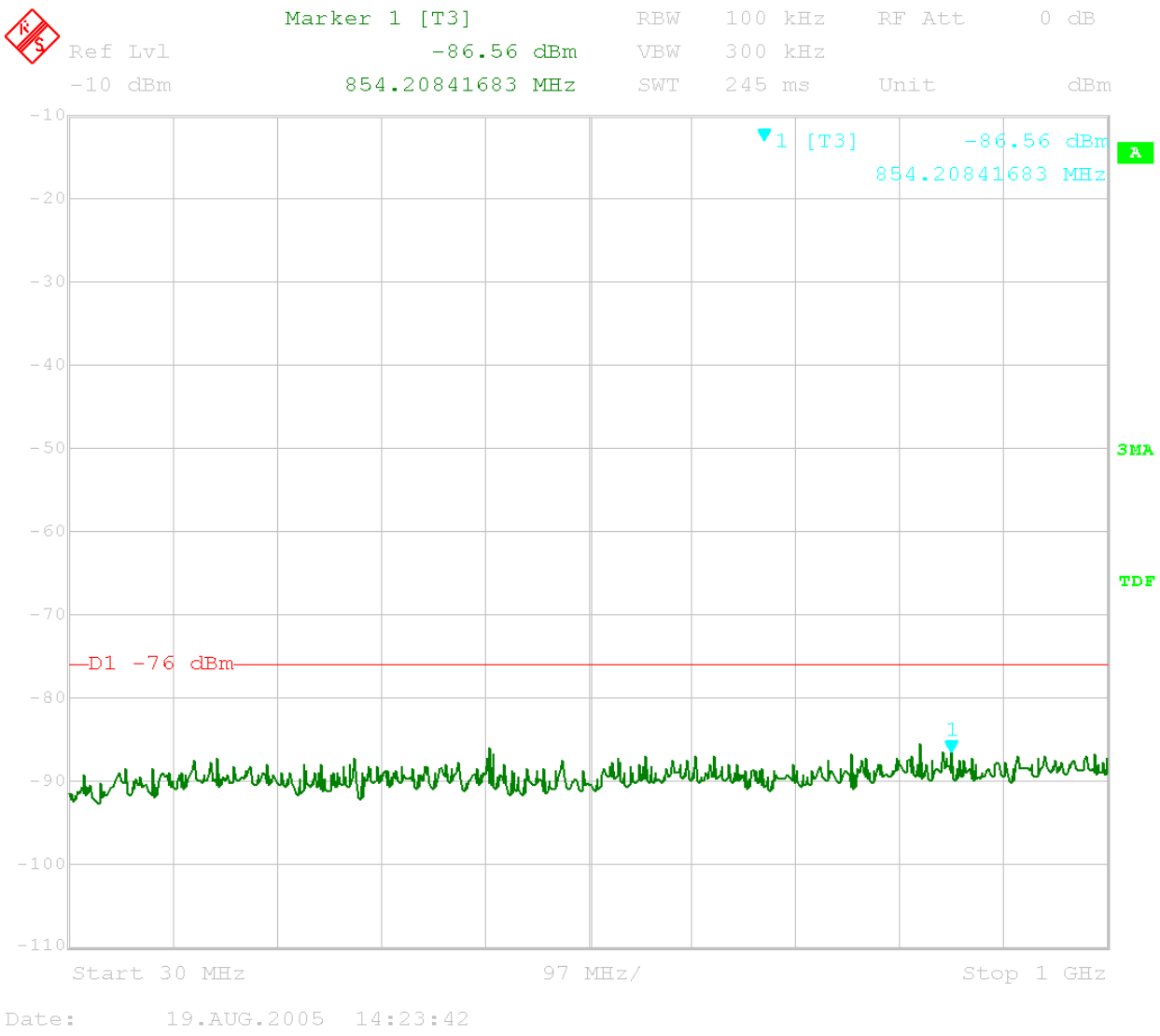
Software Test 2



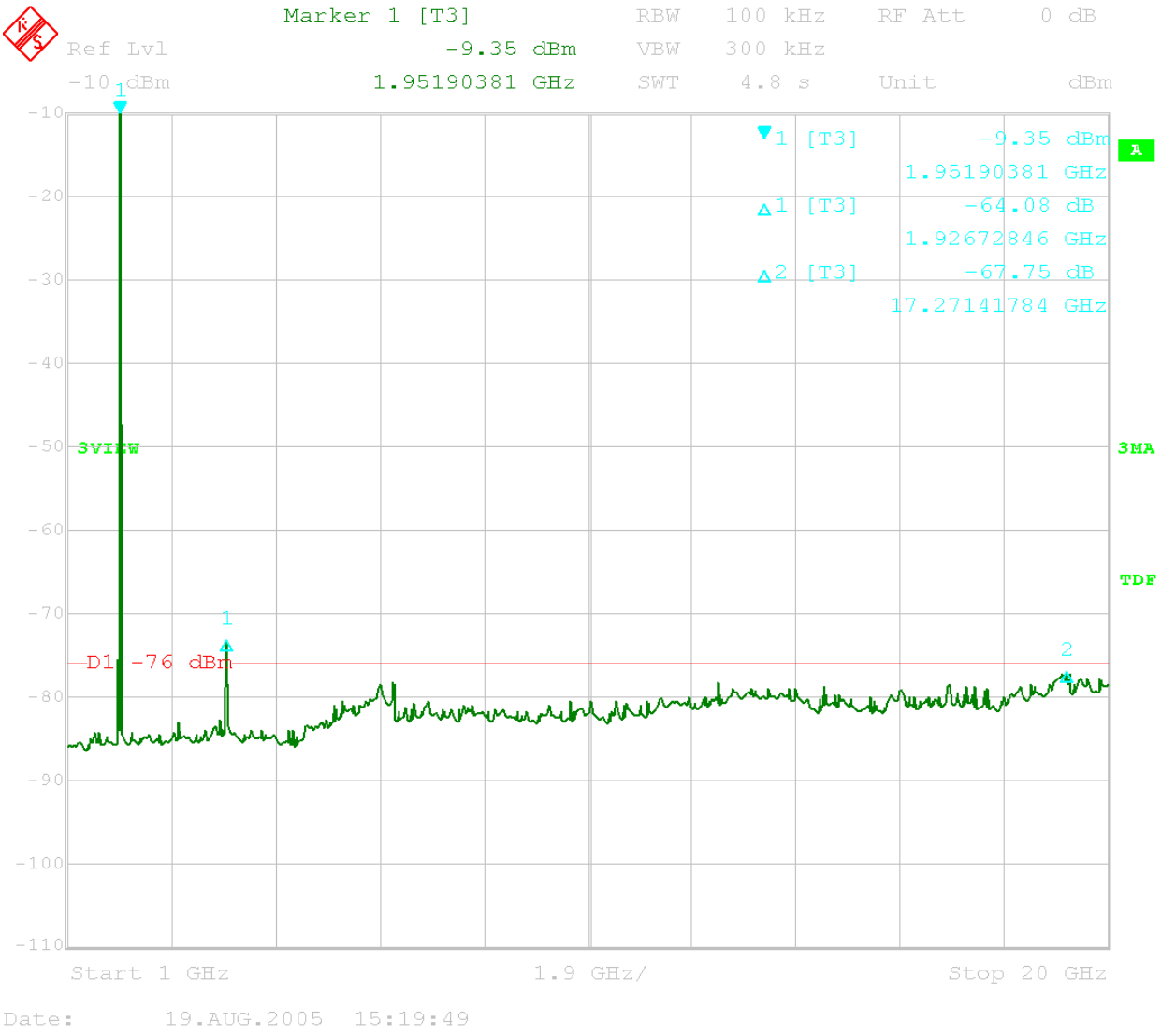
Software Test 2



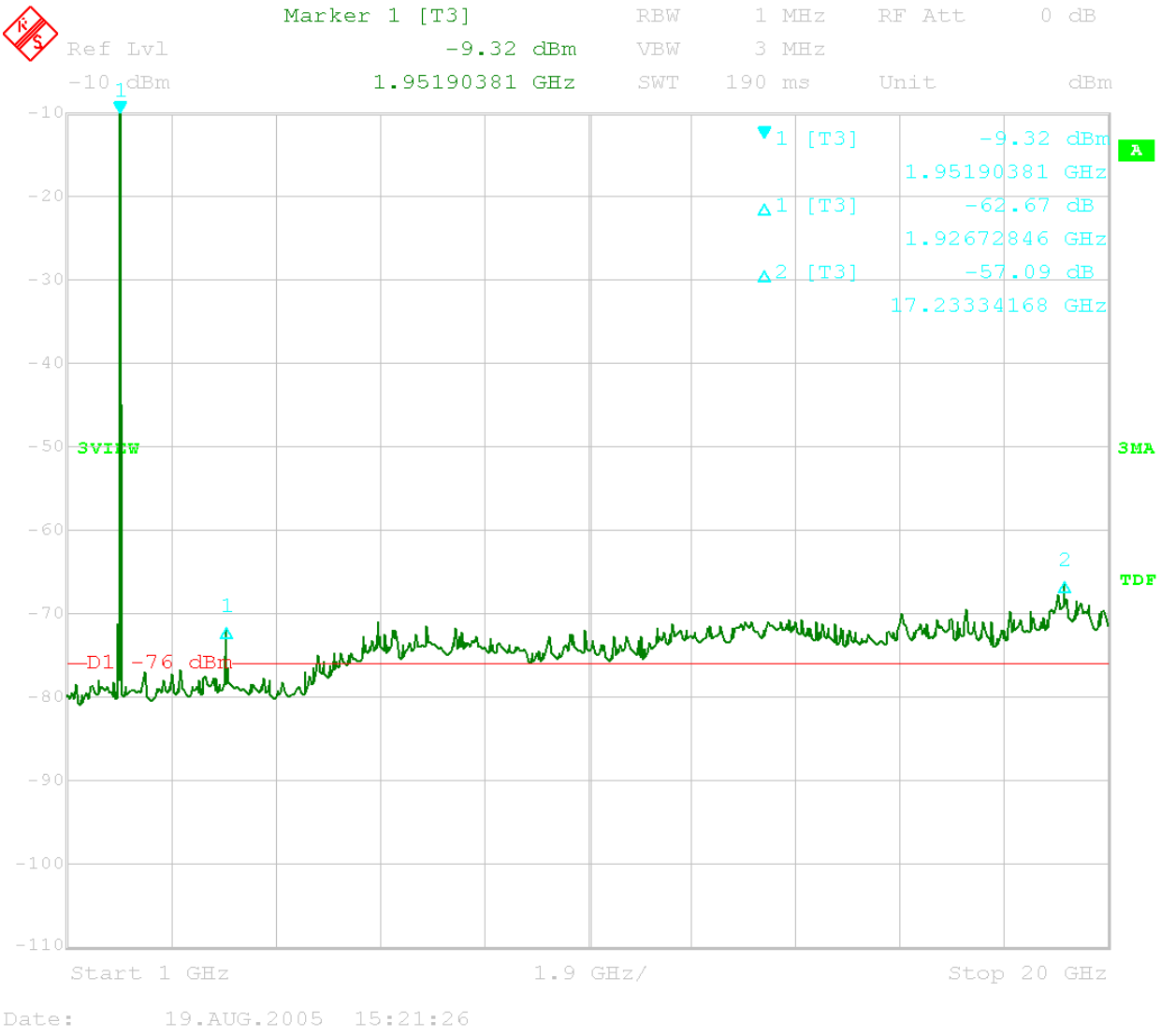
Software Test 2



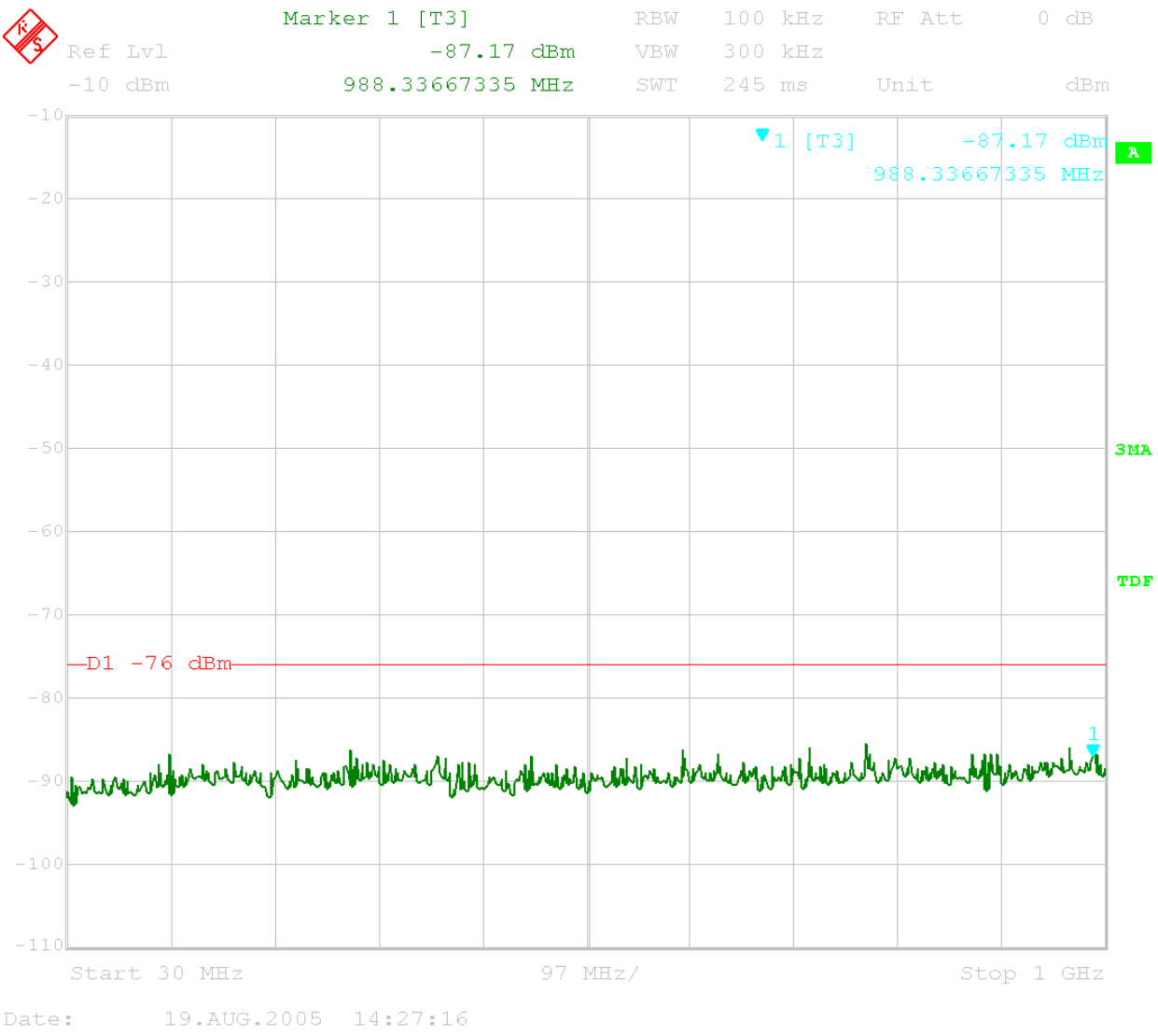
Software Test 3



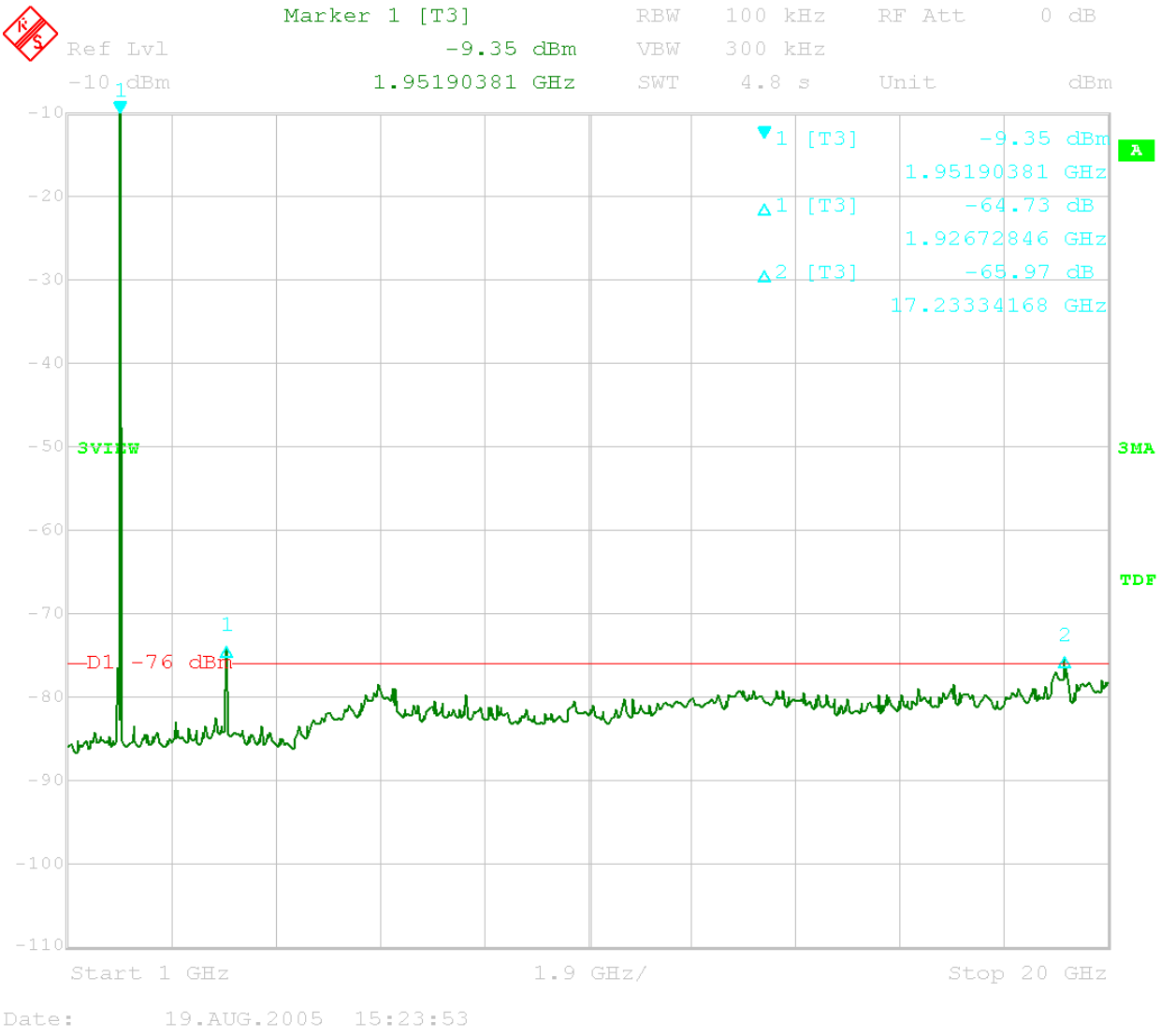
Software Test 3



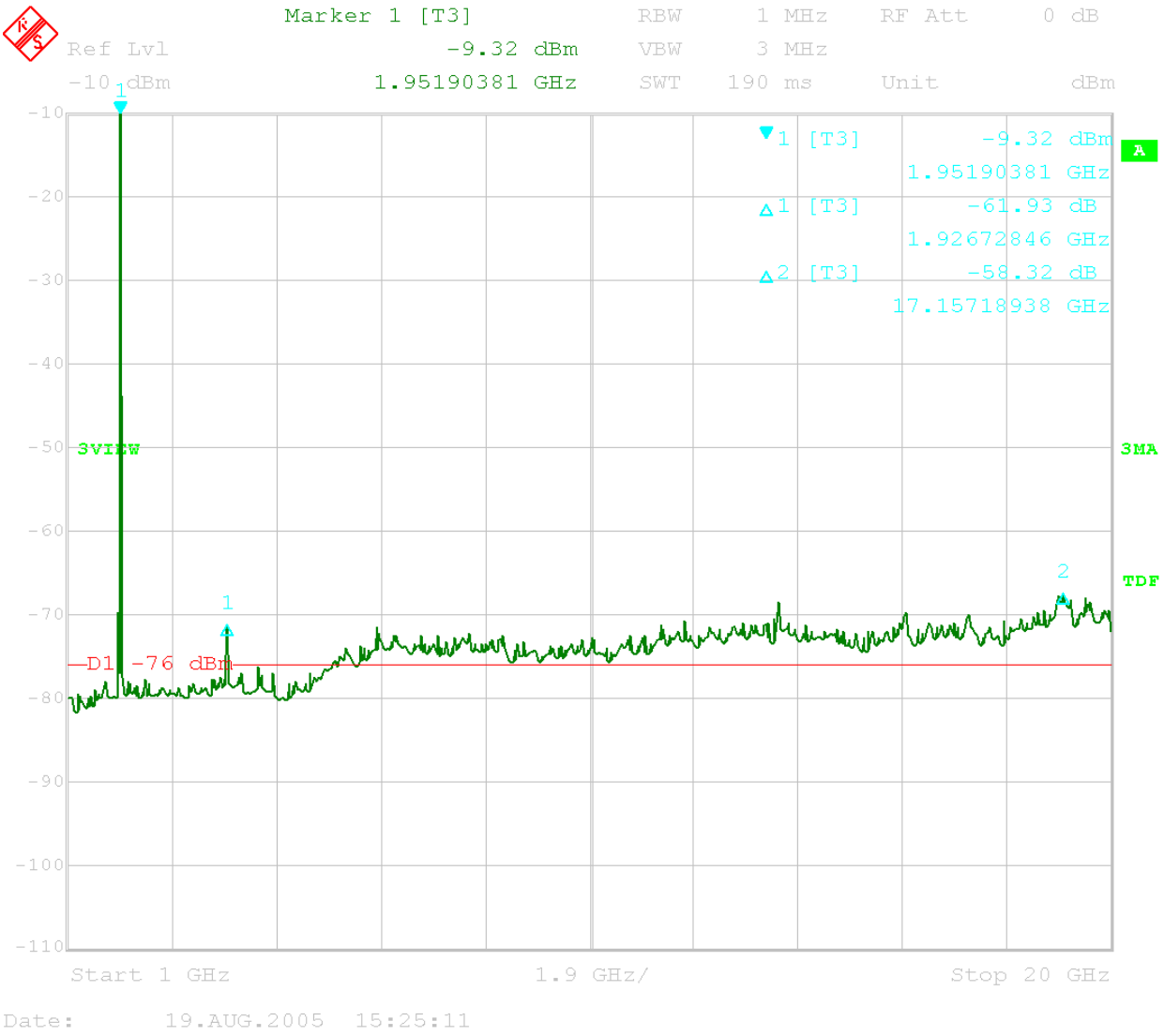
Software Test 3



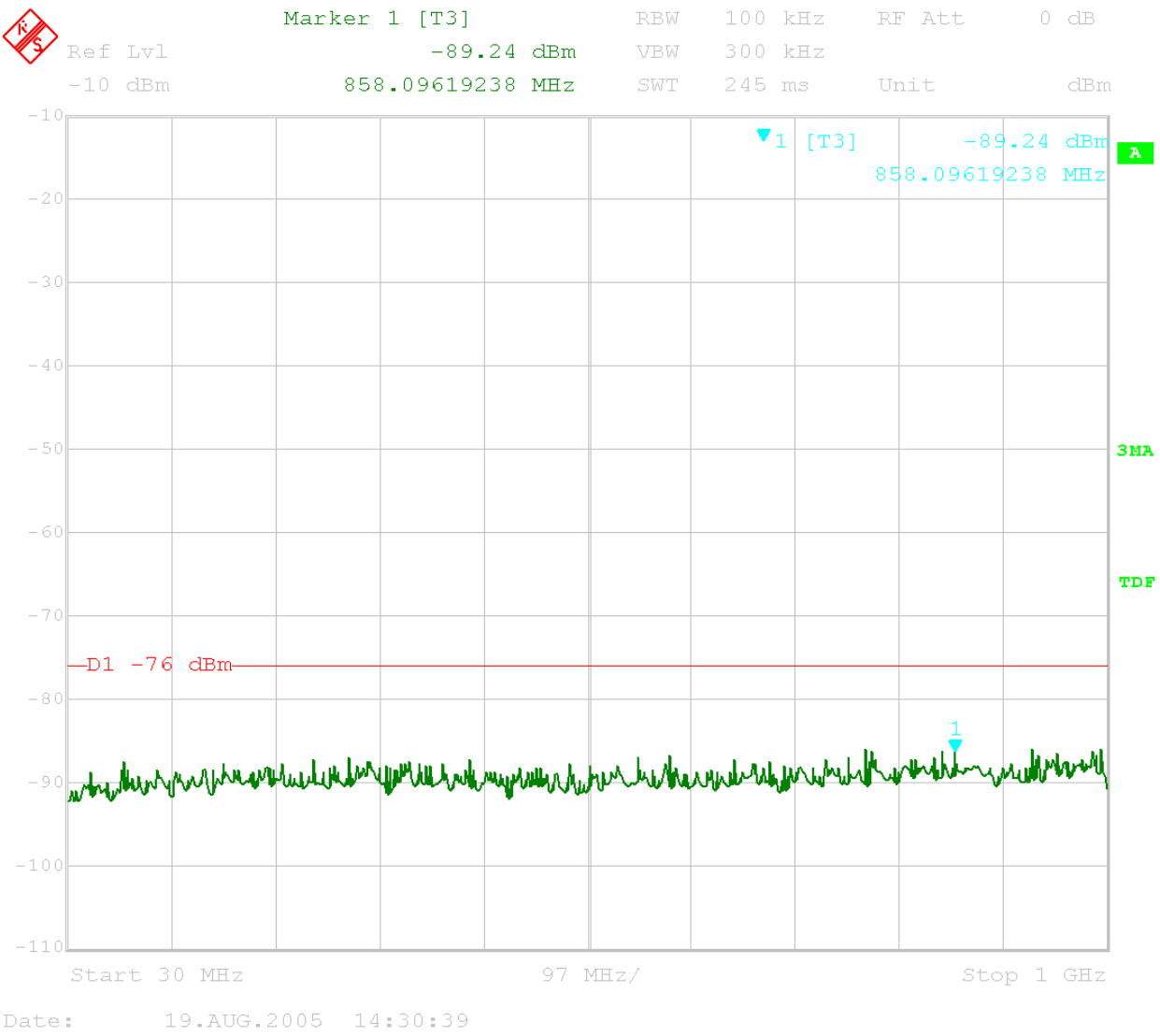
Software Test 4



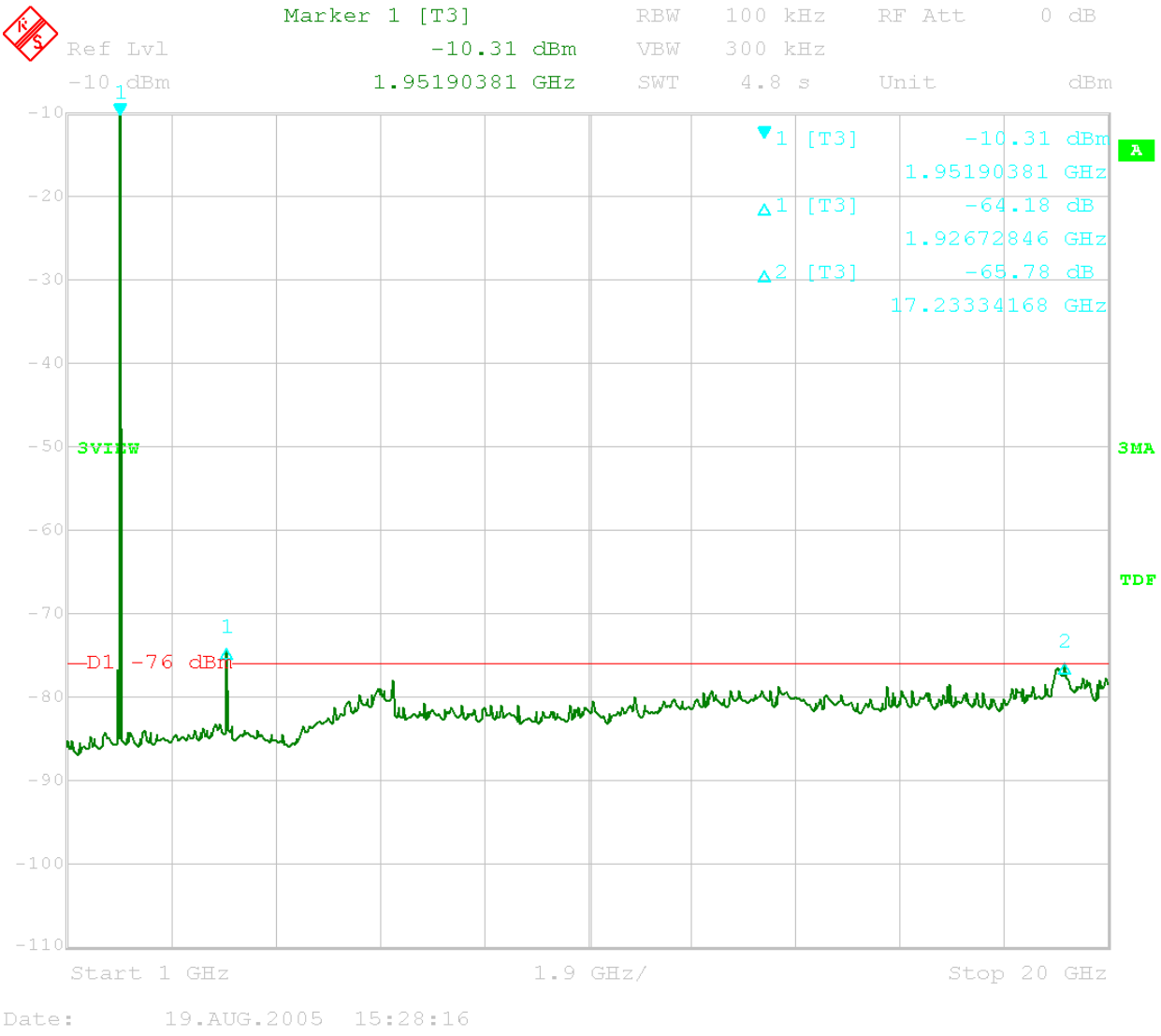
Software Test 4



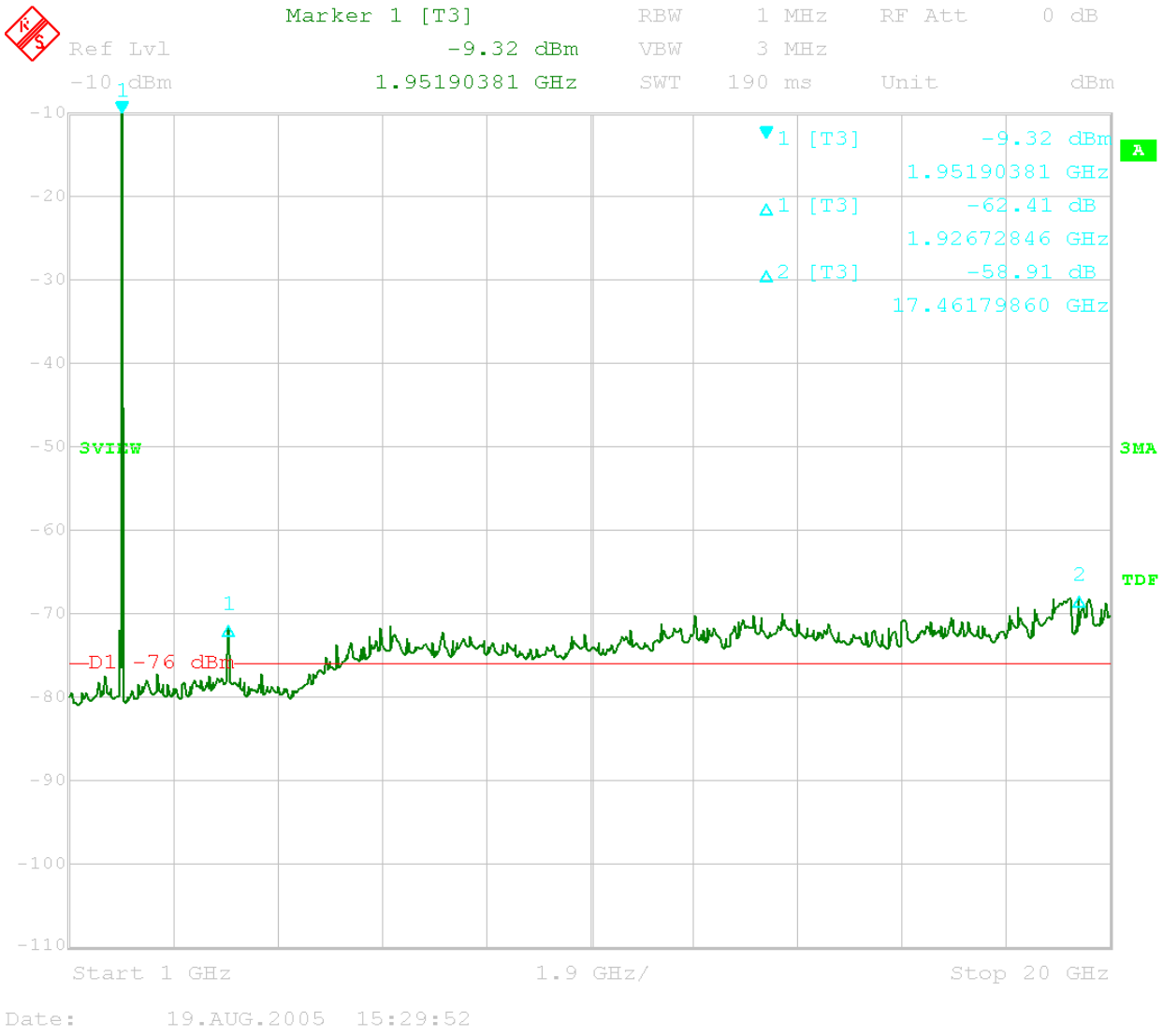
Software Test 4



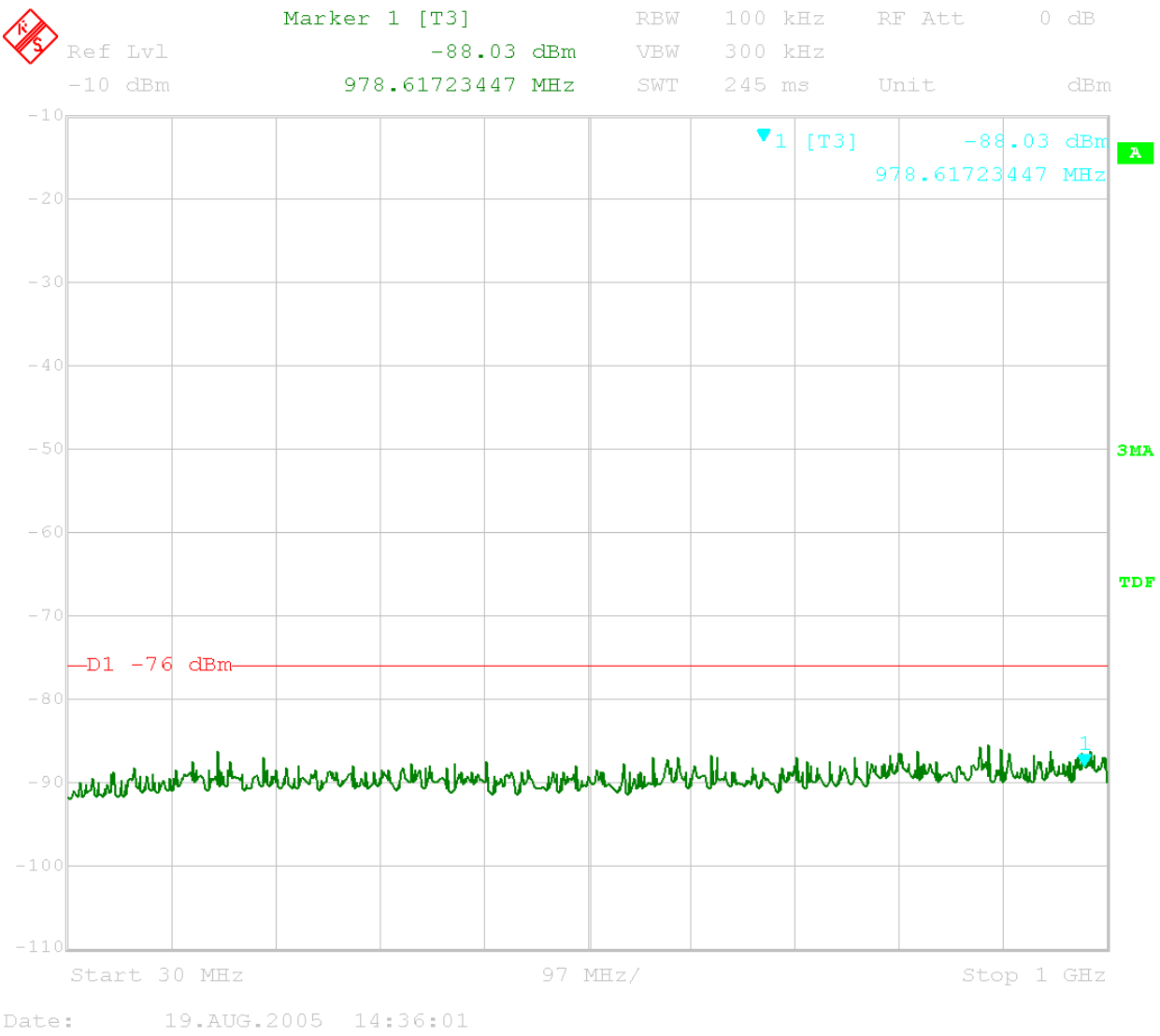
Software Test 5



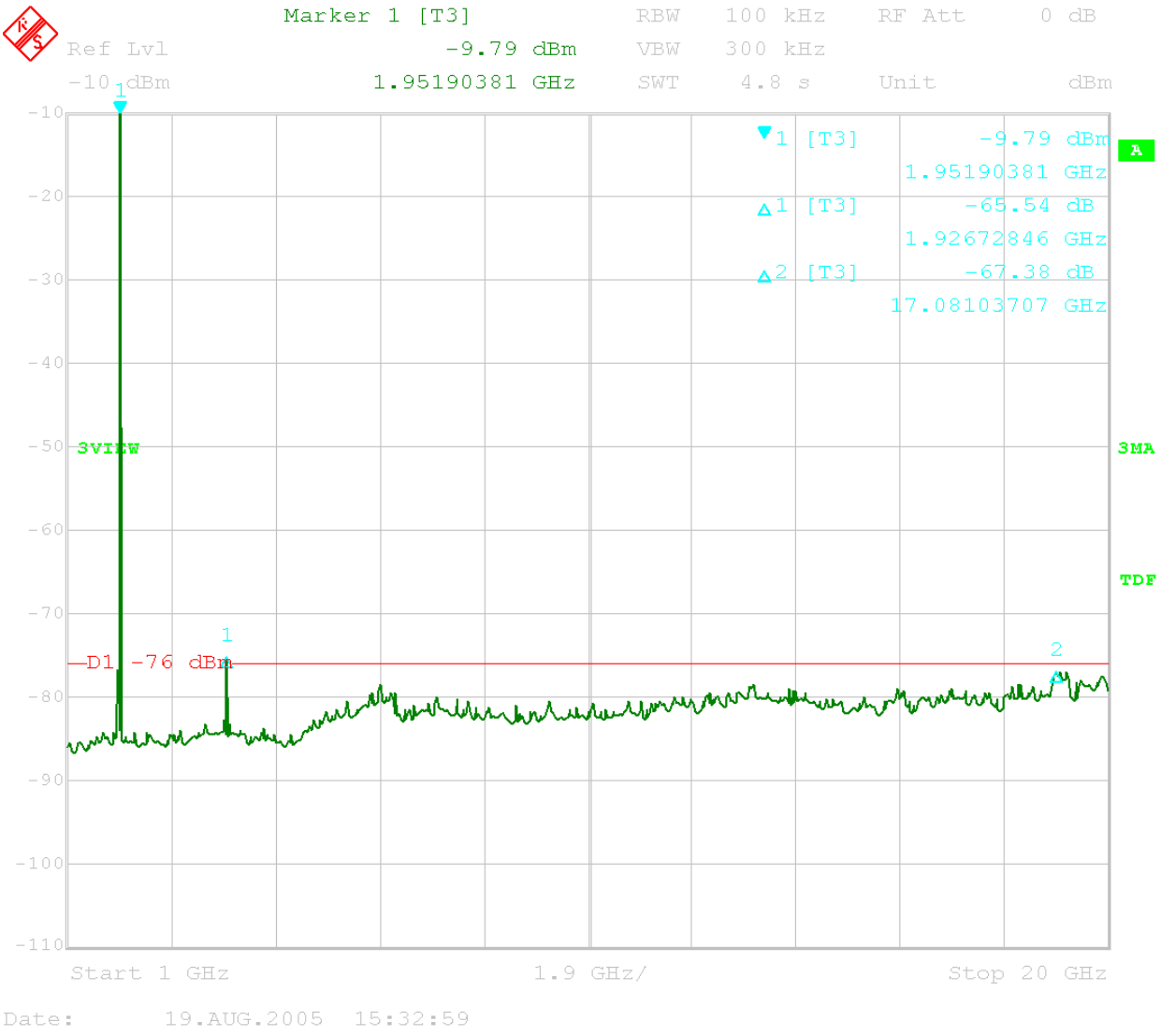
Software Test 5



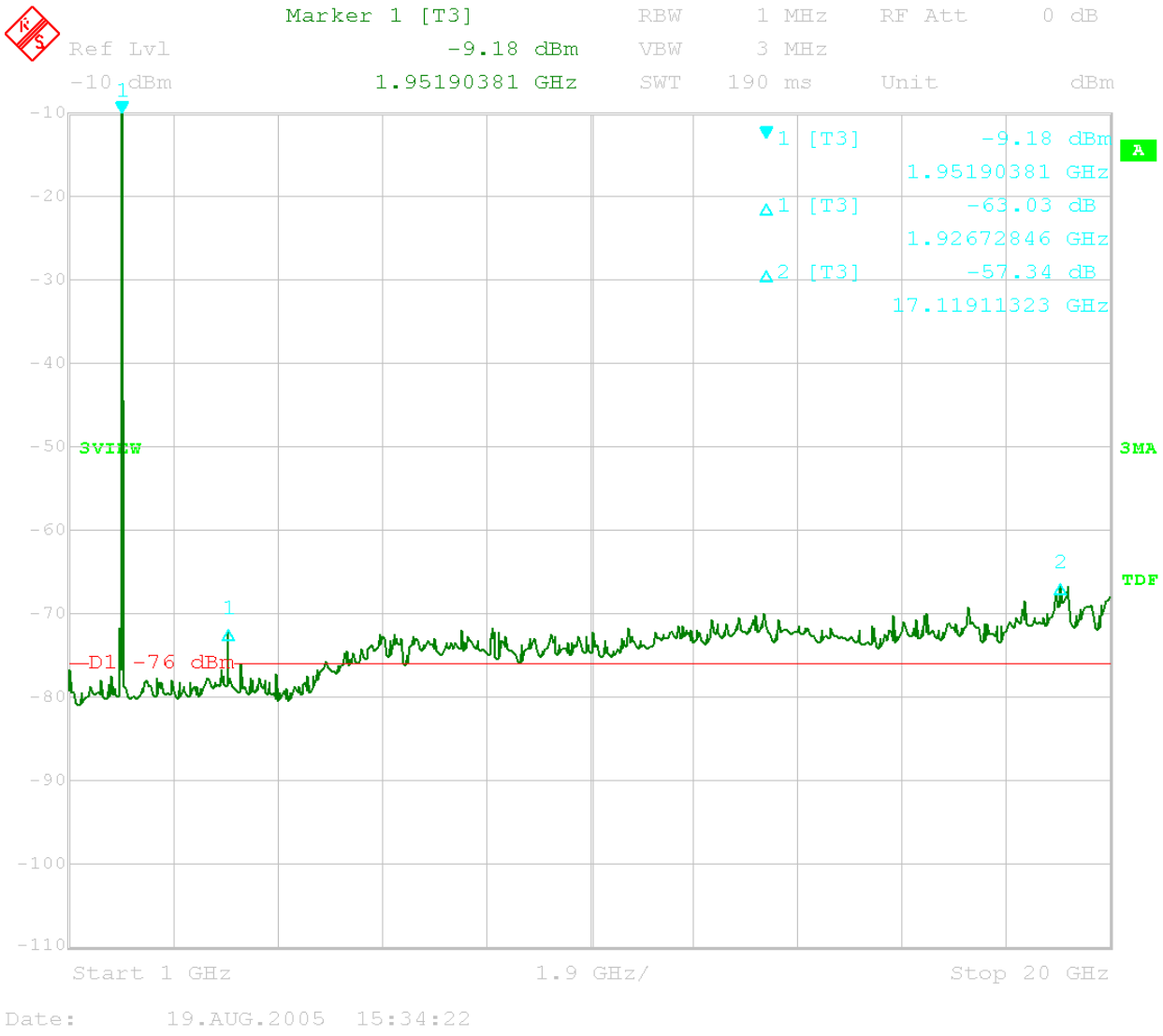
Software Test 5



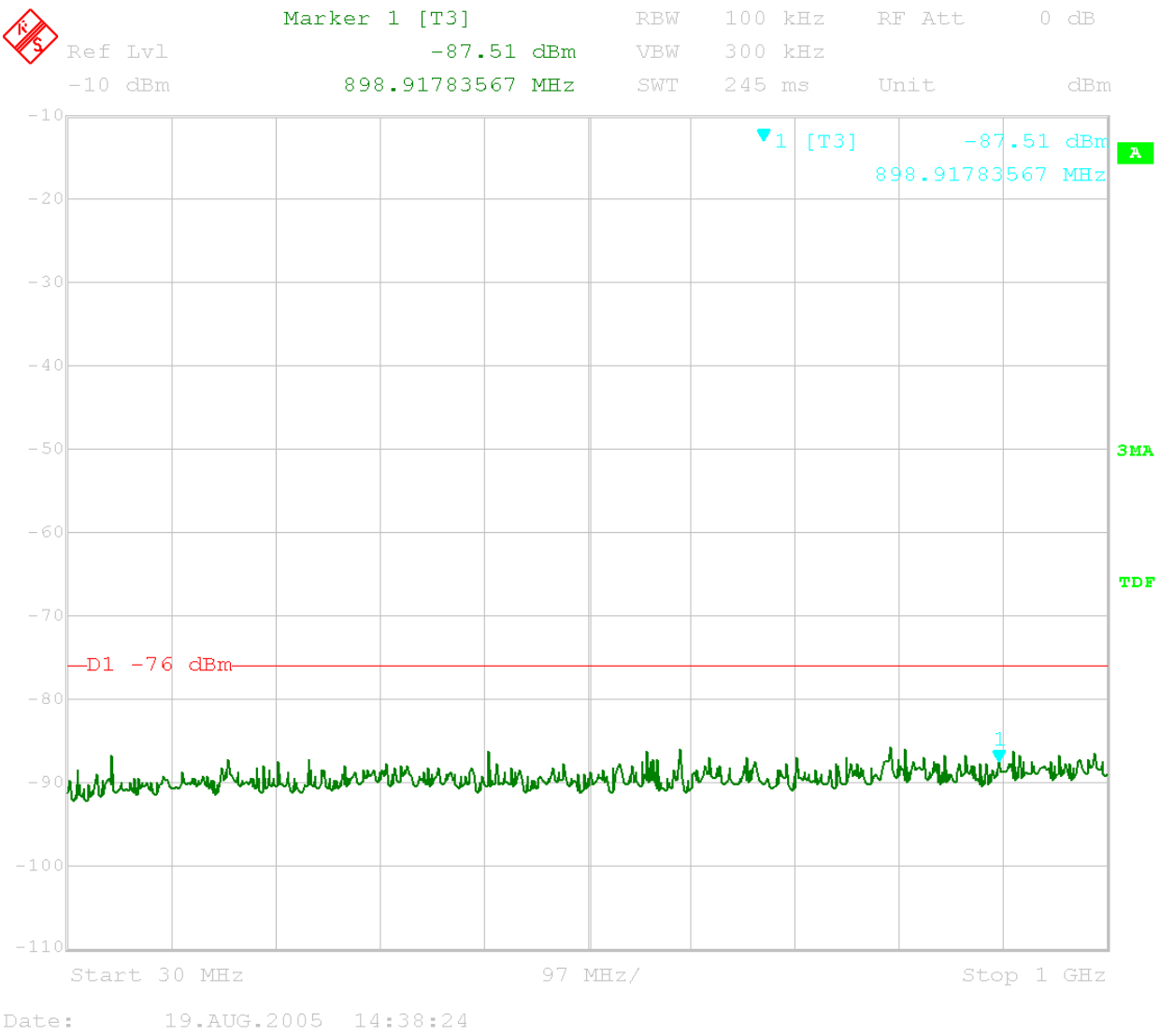
Software Test 6



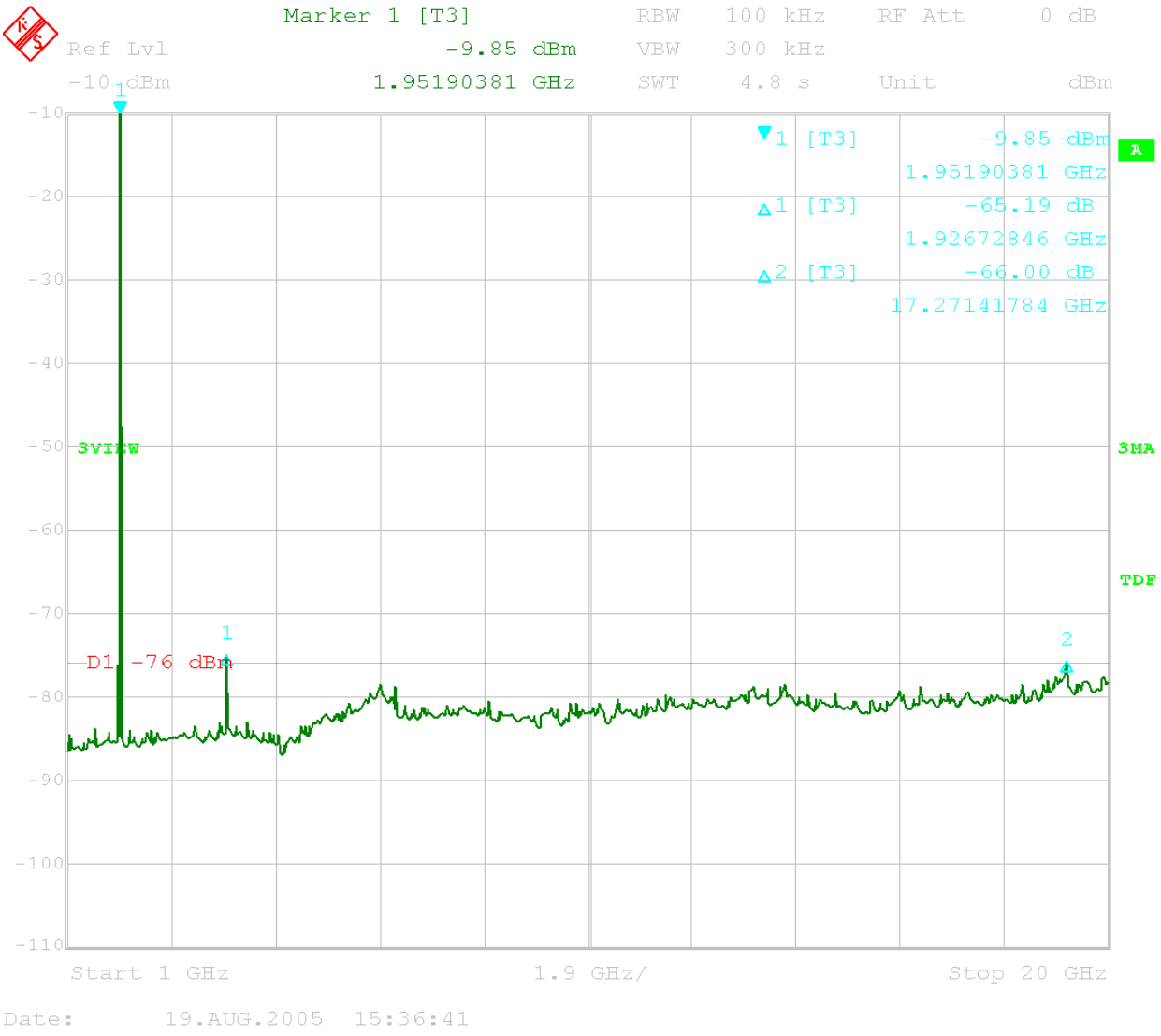
Software Test 6



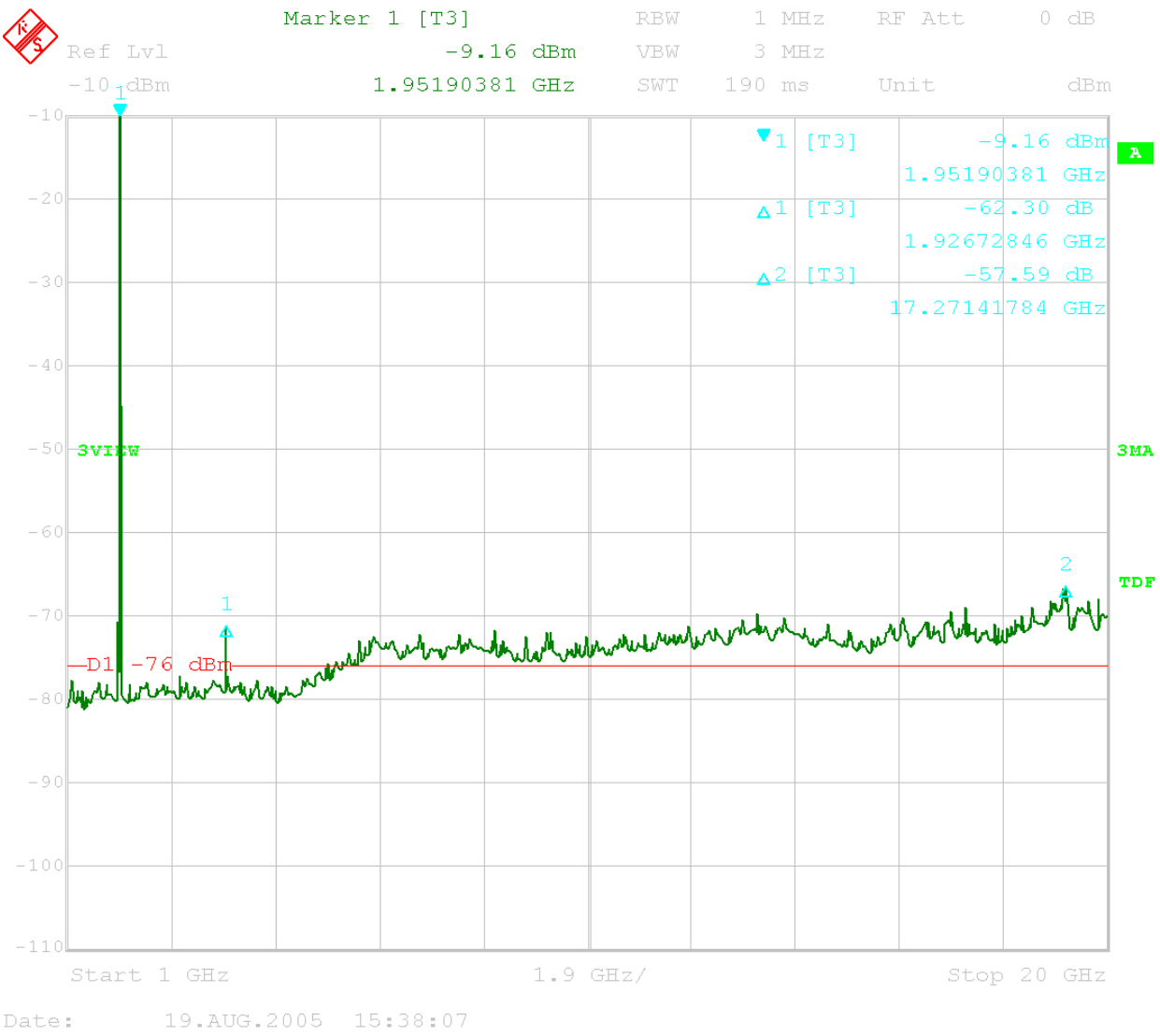
Software Test 6



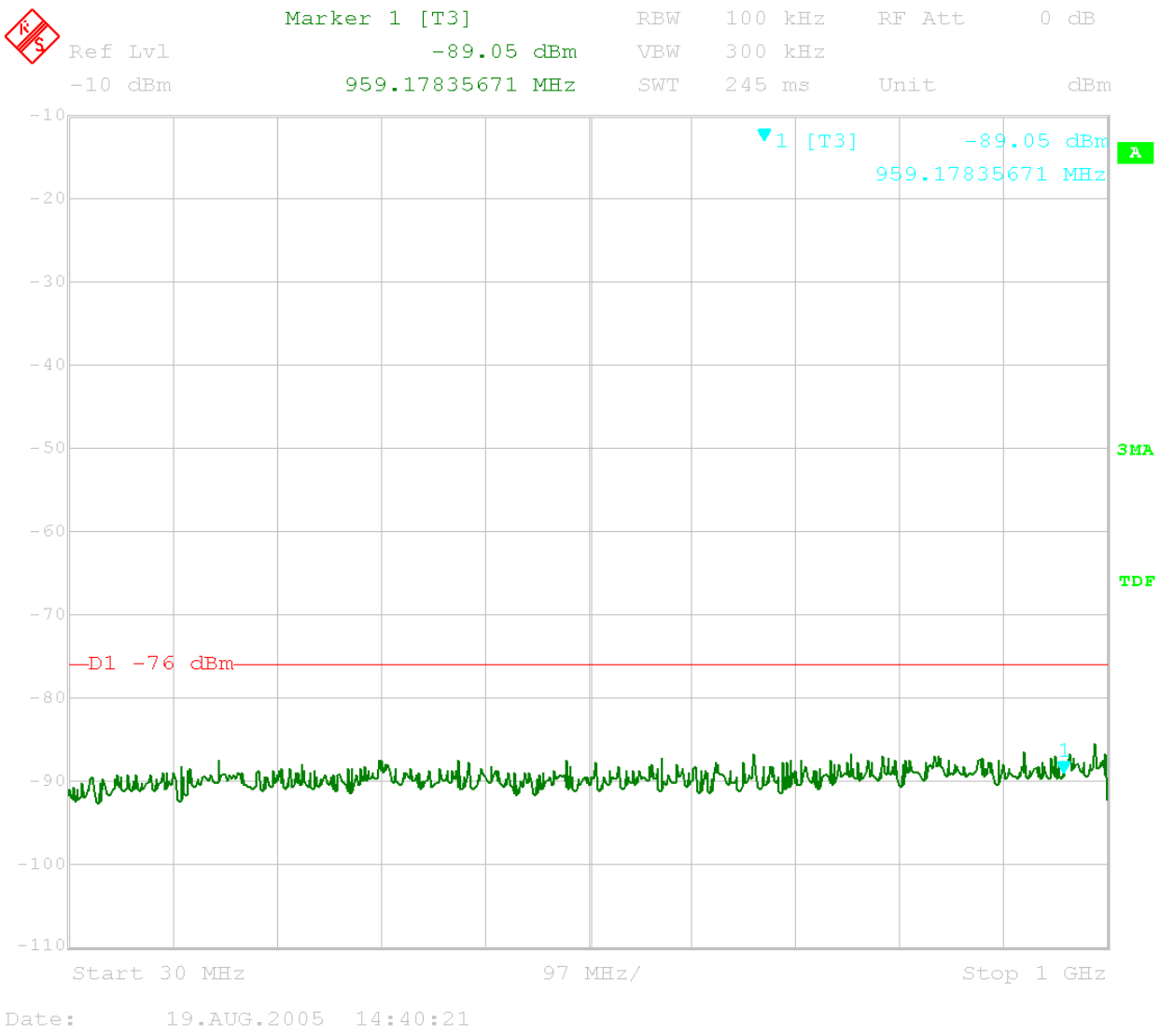
Software Test 7



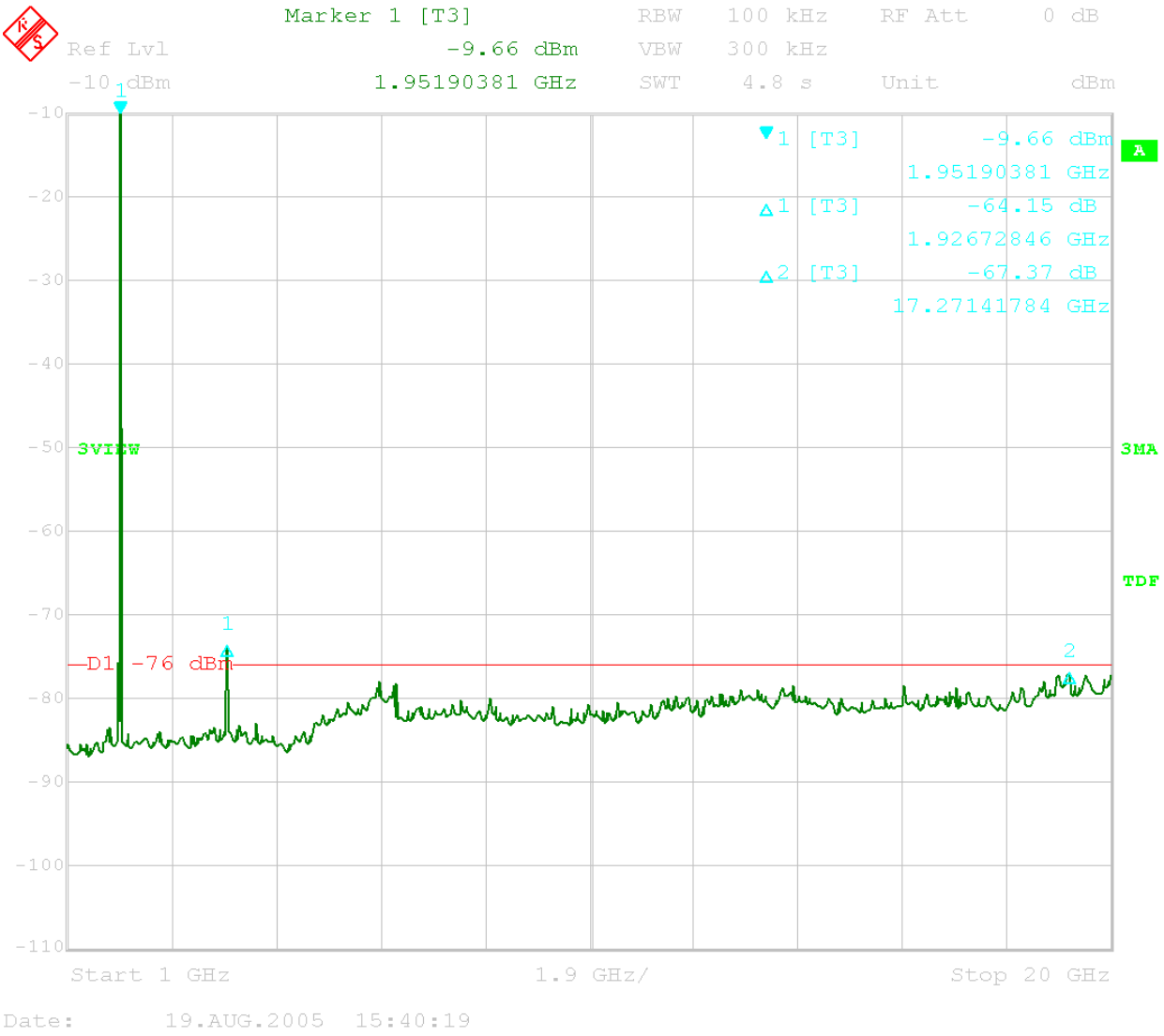
Software Test 7



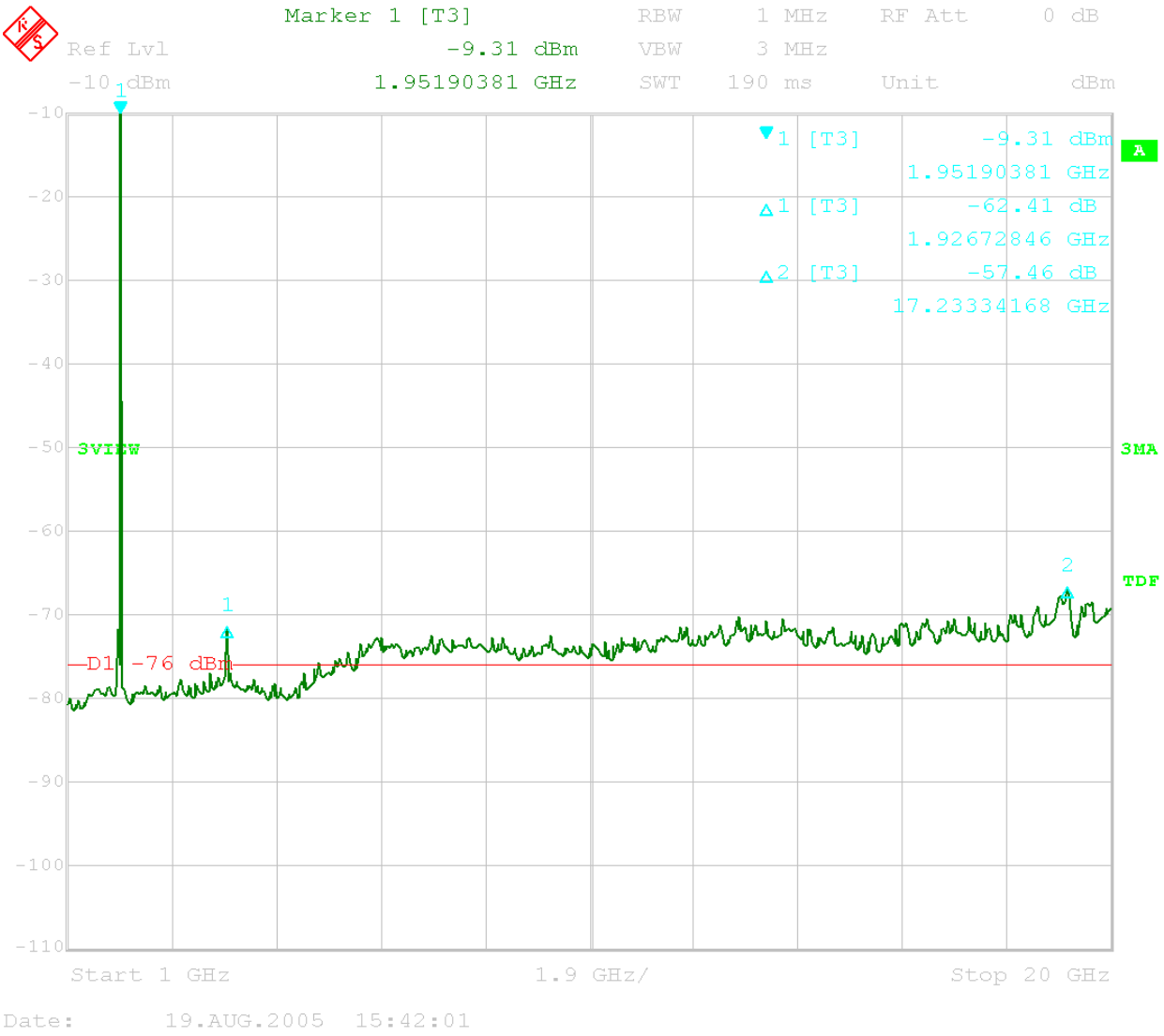
Software Test 7



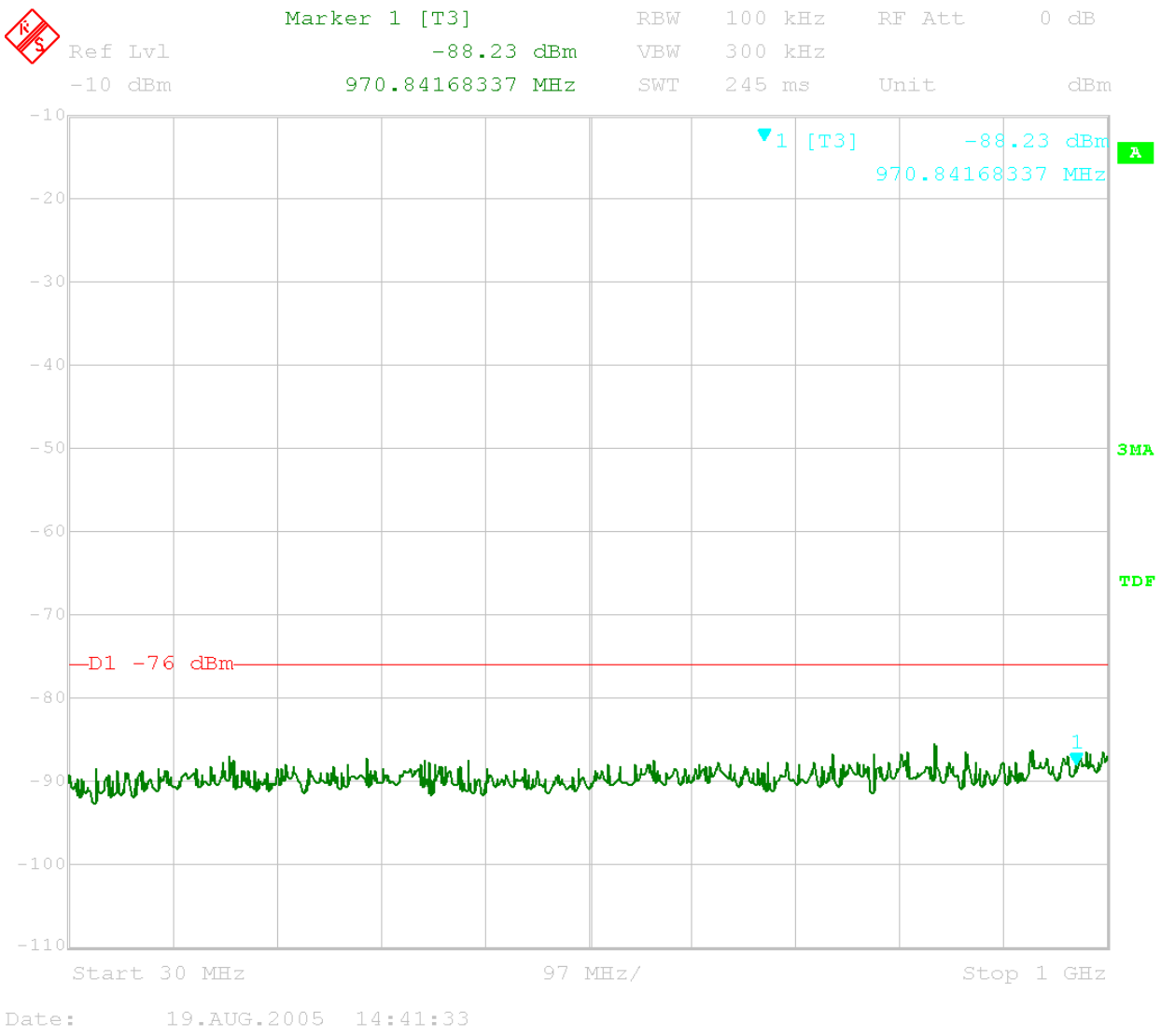
Software Test 8



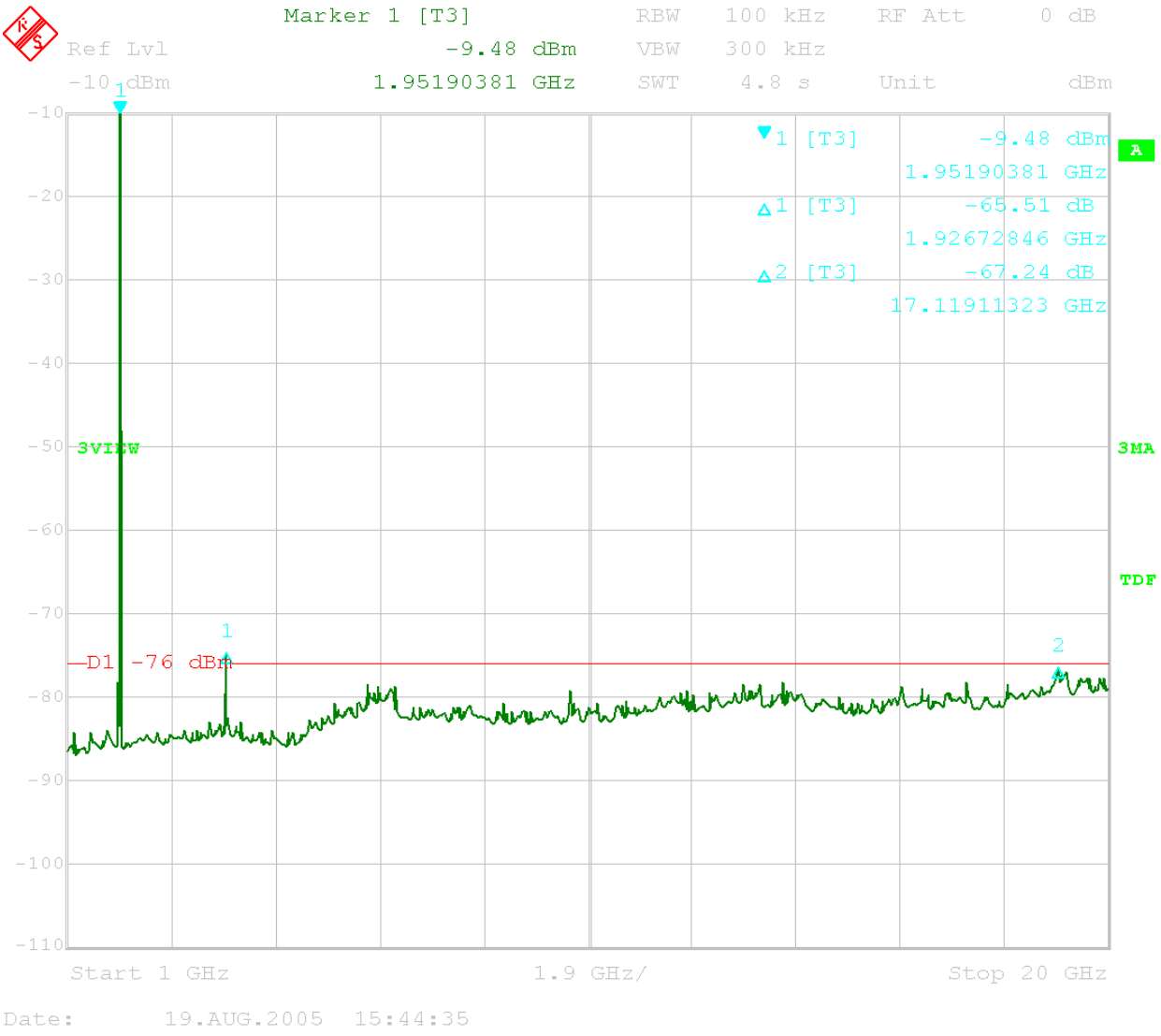
Software Test 8



Software Test 8



Software Test 9



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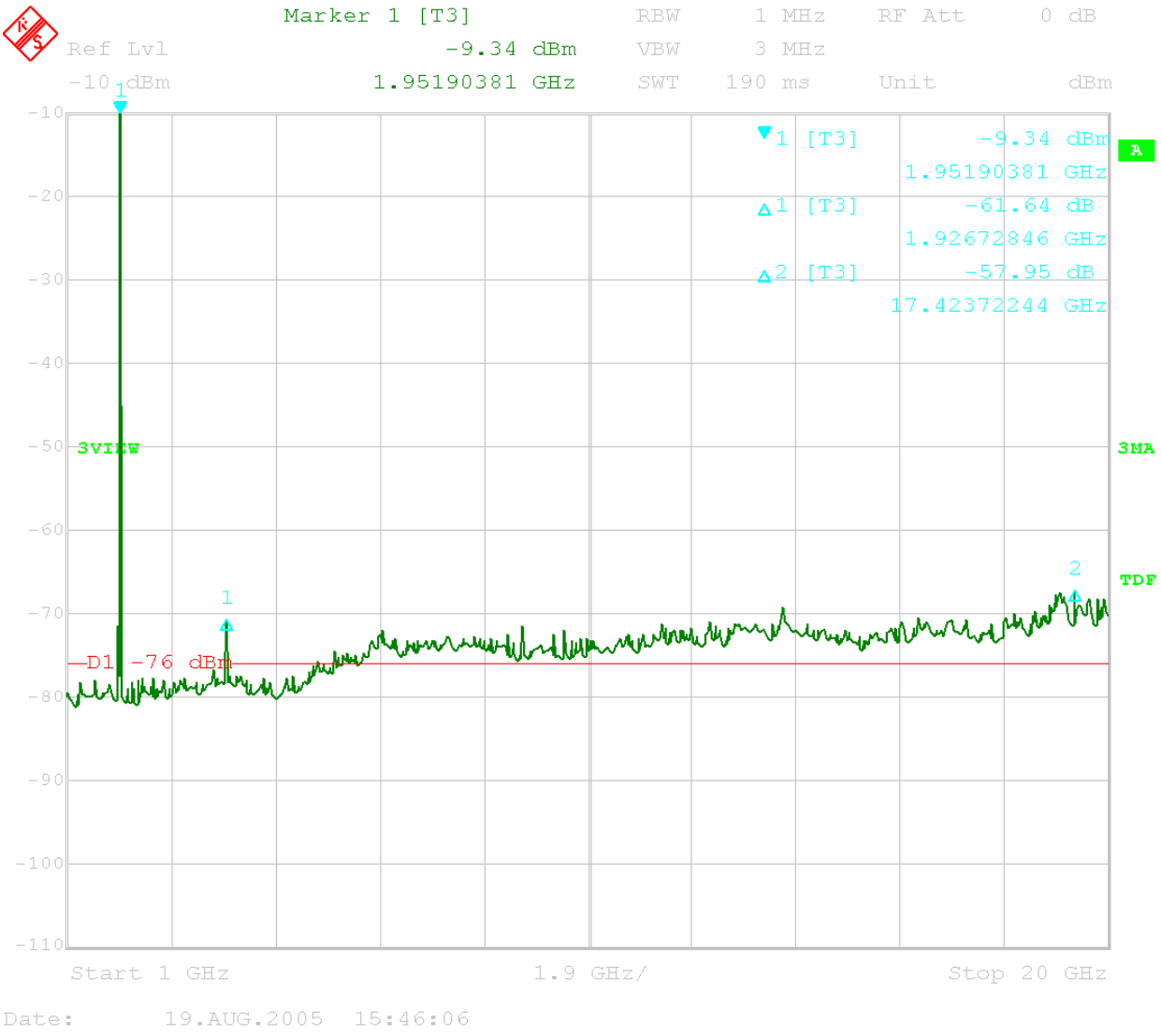

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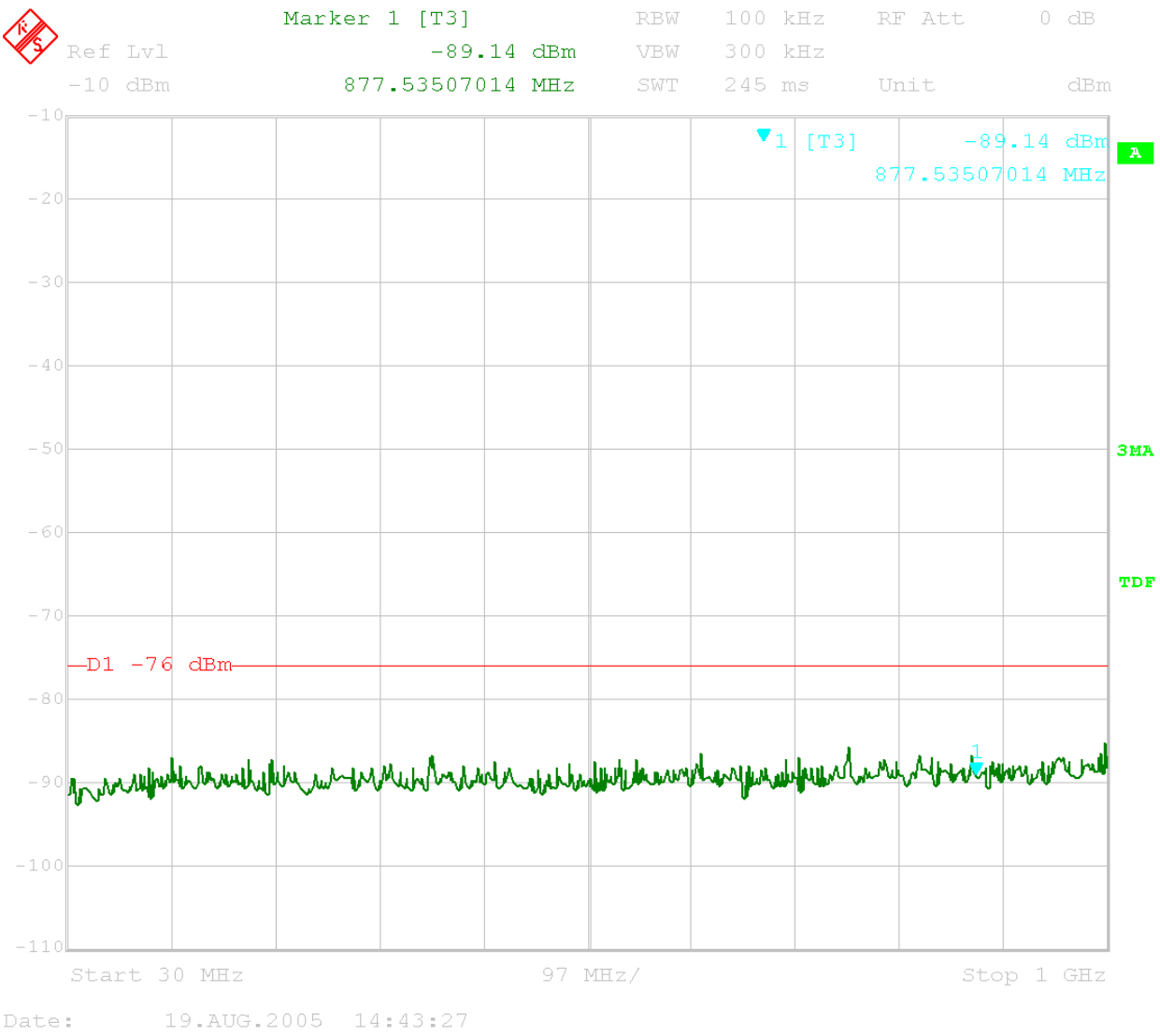

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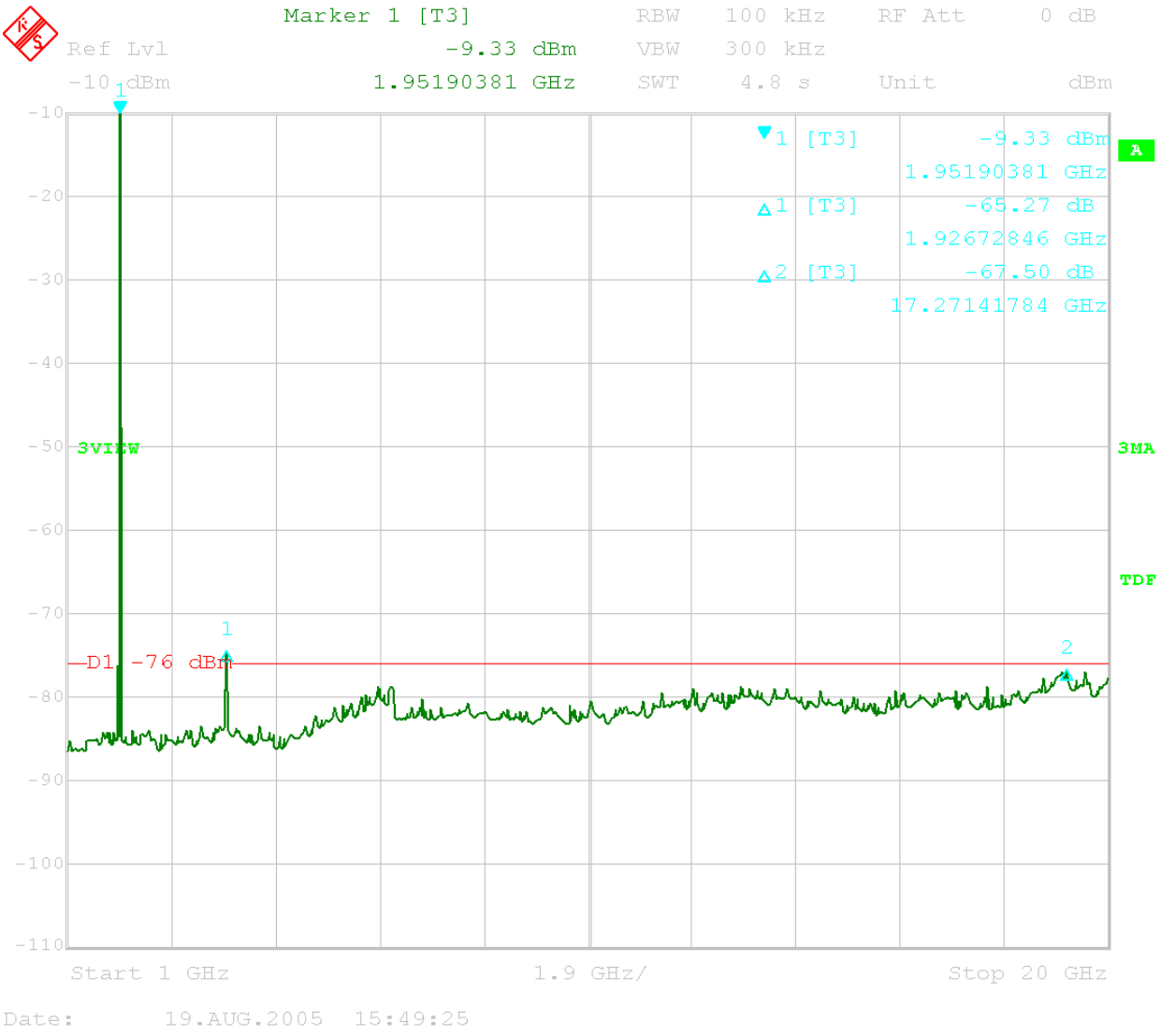

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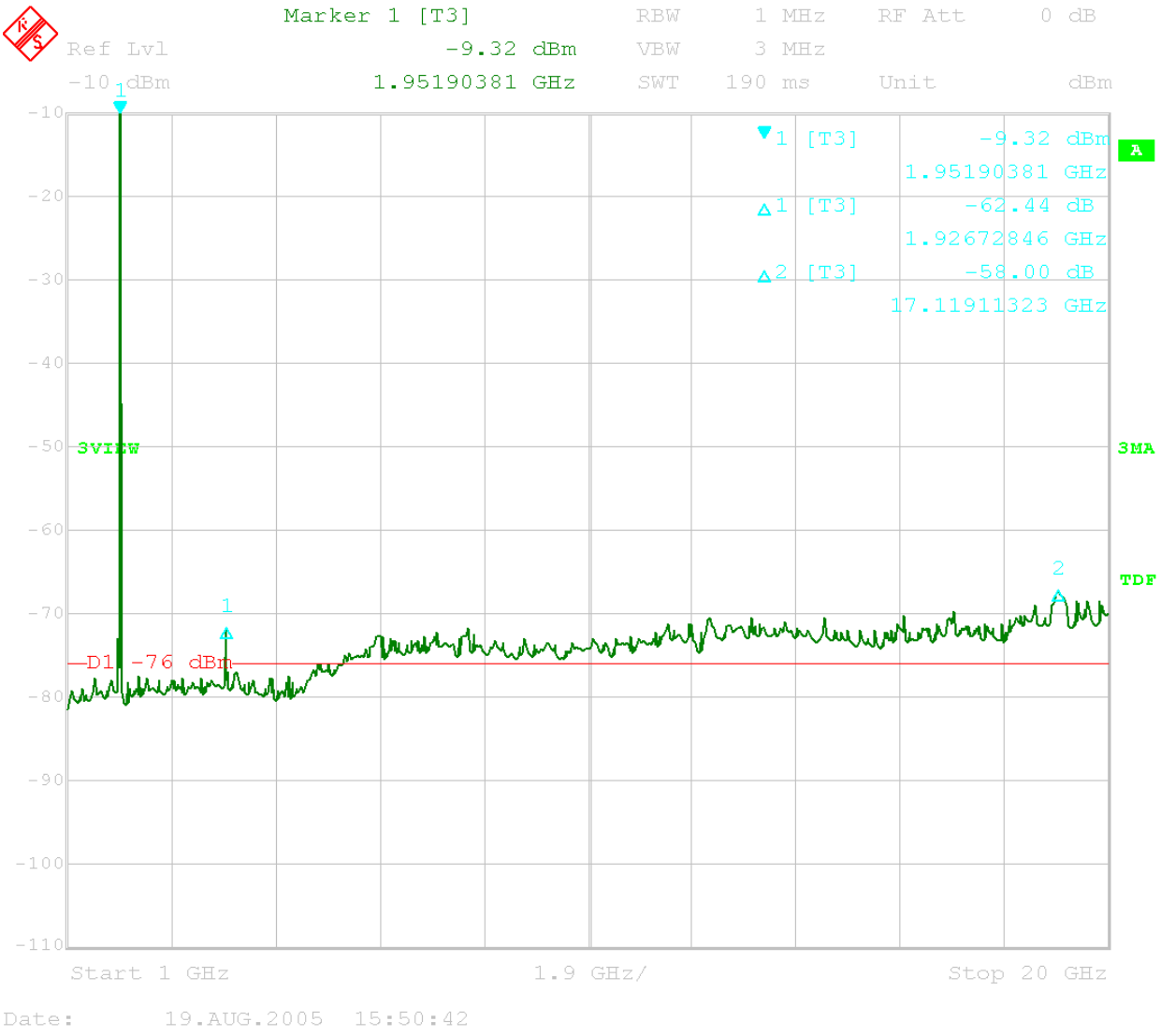

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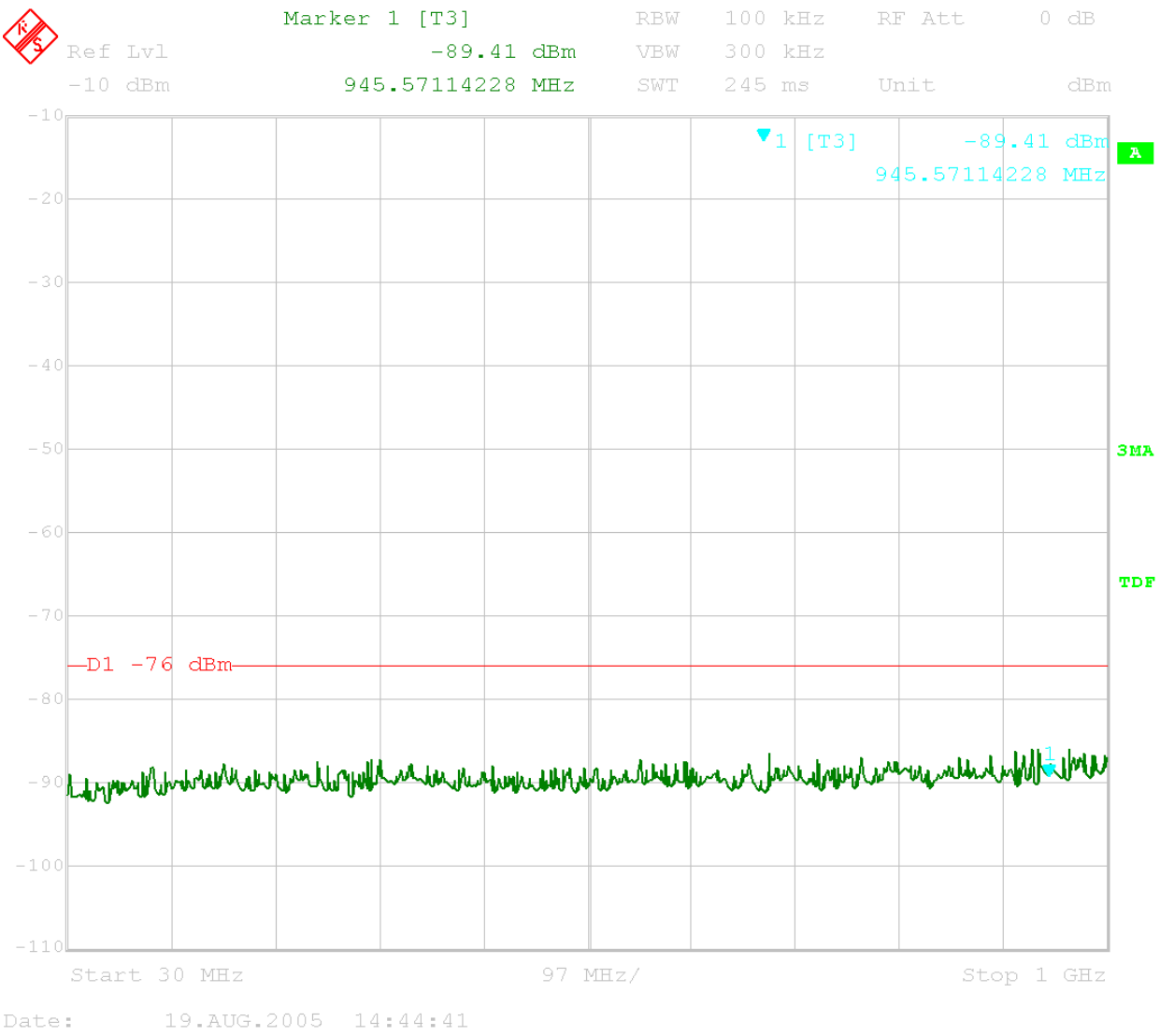

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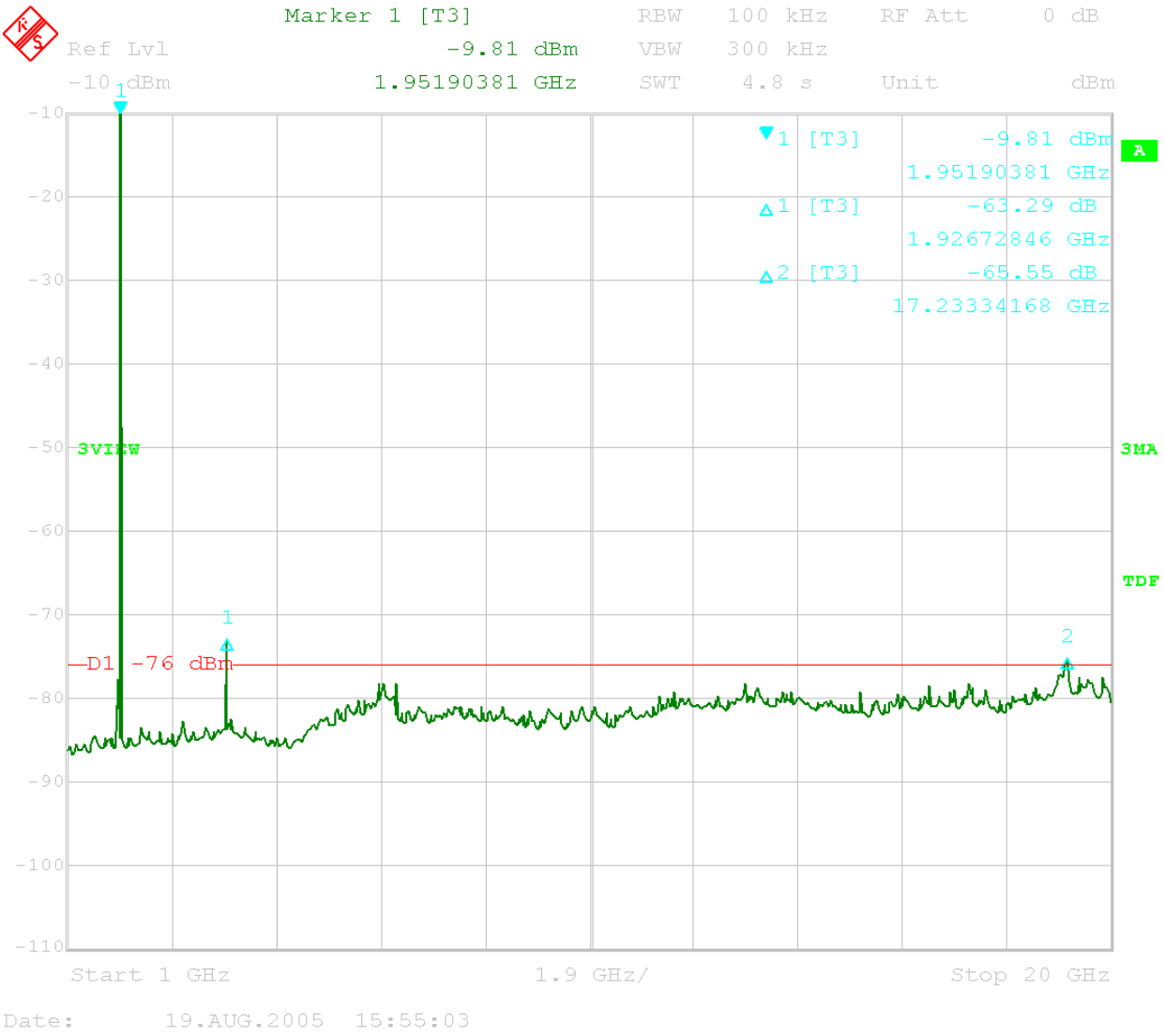

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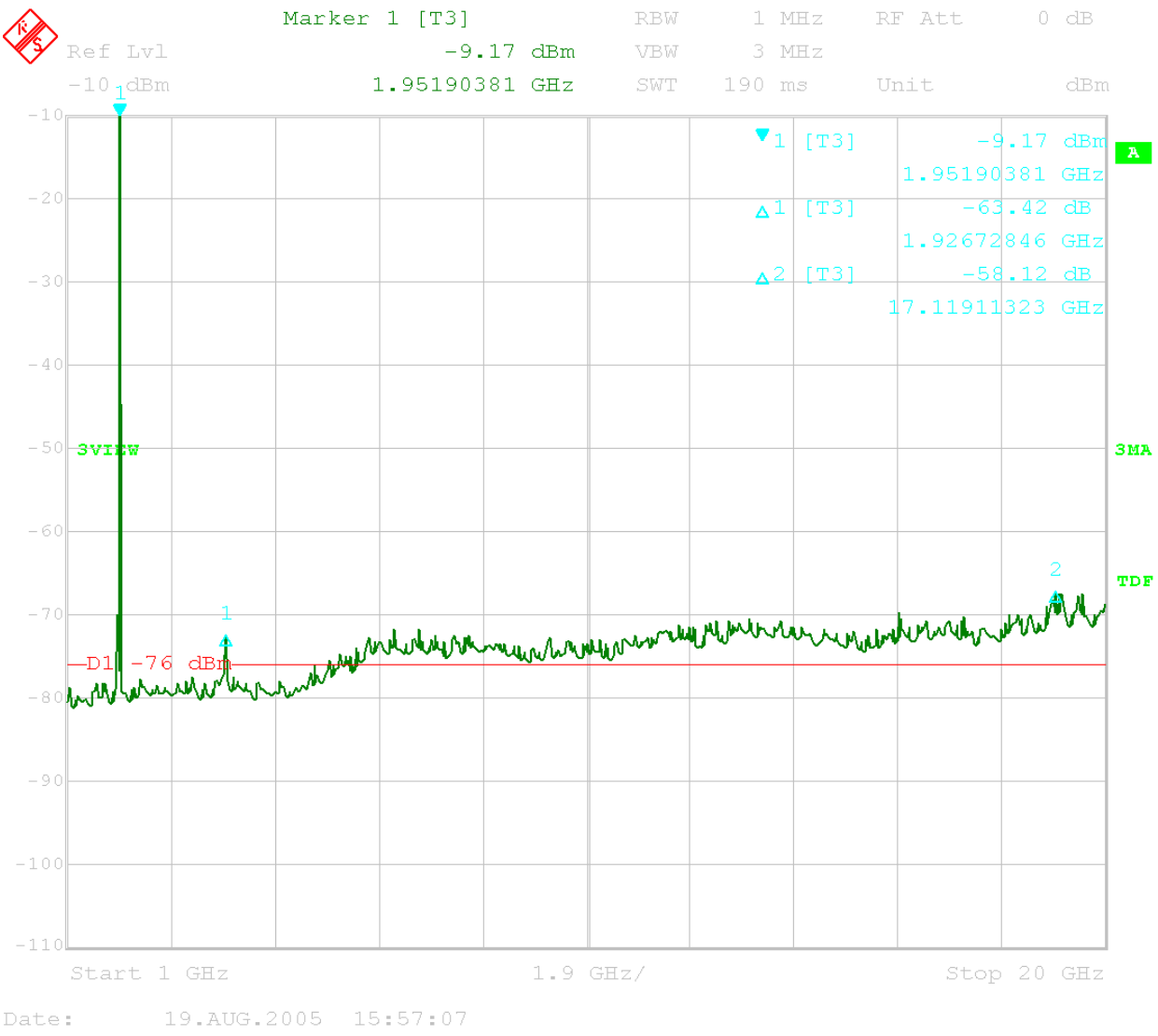

Software Test 11