CETECOM

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Accredited Testing Laboratory

DAR-Registration number:
TTI-P-G 166/98-00

Test report no.: 110/2001C
FCC Part 24

FCC ID : TBD

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1 General information

1.1 Notes

The test results of this test report relate exclusively to the test item specified in 1.5. The CETECOM Inc. does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM Inc.

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1.3 Details of applicant

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City : Tao Yuan-335
Country : Taiwan
Telephone : +886 3390 9877
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Contact : Ben Lee
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1.4 Application details

Date of receipt of application : 2001-01-20
Date of receipt of test item : 2001-01-25
Date of test : 2001-02-05 & 2001-02-08

1.5 Test item

Manufacturer : applicant
Type of equipment : Cellular Phone
Model No. : M20001C
Serial number : A10804000002
Additional informations: :
Frequency : PCS-1900
Type of modulation : GSM/PCS
Number of channels :
Antenna : Dipole
Power supply : 3.6 V Lithium Ion Battery
Output power : 29.35dBm Peak / ERP : 29.9dBm (Burst); EIRP: 32.0dBm (Burst)

EUT Temp. Tolerance : Temperature range : -30°C - +50°C

1.6 Test standards: FCC Part 24

2 Technical test

2.1 Summary of test results

No deviations from the technical specification(s) were ascertained in the course of the tests performed.

Technical responsibility for area of testing :

2001-02-08	**EMC**	**Lothar Schmidt**	
Date	**Section**	**Name**	**Signature**

2.2 Test report

TEST REPORT

Test report no.: 110/2001 C

TEST REPORT REFERENCE

LIST OF MEASUREMENTS

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POWER OUTPUT SUBCLAUSE § 24.232

Summary:

This paragraph contains both average , peak output powers and EIRP measurements for the EUT.
In all cases, the peak output power is within the required mask (this mask is specified in the JTC standards, TIA PN3389 Vol. 1 Chap 7, and is no FCC requirement).

Method of Measurements:

The EUT was set up for the max. output power with pseudo random data modulation.
The power was measured with R&S Spectrum Analyzer FSEM 30 (peak and average)
This measurements were done at 3 frequencies, 1850.2 MHz, 1880.0 MHz and 1909.8 MHz (bottom, middle and top of operational frequency range)

Limits:

Power Step	Nominal Peak Output Power (dBm)	Tolerance (dB)
0	+30	± 2

Power Measurements:

Conducted:

Frequency (MHz)	Power Step	Peak Output Power (dBm)	Average Output Power (dBm)
1850.2	0	29.35	20.28
1880.0	0	29.29	20.22
1909.8	0	29.17	20.10
Measurement uncertainty		±0.5 dB	

EIRP Measurements

Description: This is the test for the maximum radiated power from the EUT.
Rule Part 24.232(b) specifies that "Mobile/portable stations are limited to 2 watts e.i.r.p. peak power…" and 24.232(c) specifies that "Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage."
Method of Measurement:
1. In an anechoic antenna test chamber, a half-wave dipole antenna for the frequency band of interest is placed at the reference center of the chamber. An RF Signal source for the frequency band of interest is connected to the dipole with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A known (measured) power (Pin) is applied to the input of the dipole, and the power received (Pr) at the chamber's probe antenna is recorded.
2. A "reference path loss" is established as Pin + 2.1 - Pr.
3. The EUT is substituted for the dipole at the reference center of the chamber. The EUT is put into CW test mode and a scan is performed to obtain the radiation pattern.
4. From the radiation pattern, the co-ordinates where the maximum antenna gain occurs is identified.
5. The EUT is then put into pulse mode at its maximum power level (Power Step 0).
6. "Gated mode" power measurements are performed with the receiving antenna placed at the coordinates determined in Step 3 to determine the output power as defined in FCC Rule 24.232 (b) and (c). The "reference path loss" from Step 1 is added to this result.
7. This value is EIRP since the measurement is calibrated using a half-wave dipole antenna of known gain (2.1 dBi) and known input power (Pin).
8. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP -2.1dBi.

Limits:

Power Step	Burst Average EIRP (dBm)
0	<33

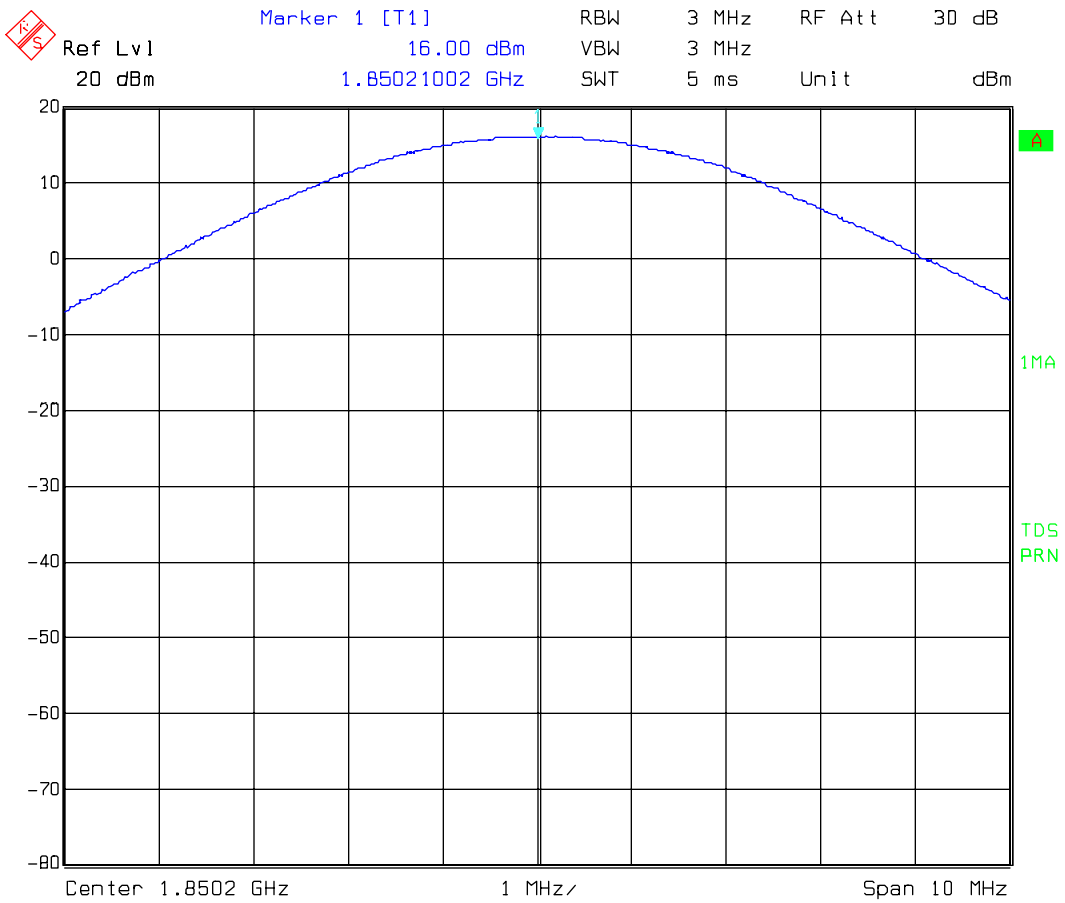
Power Measurements:

Plots are shown on next pages.

Radiated:

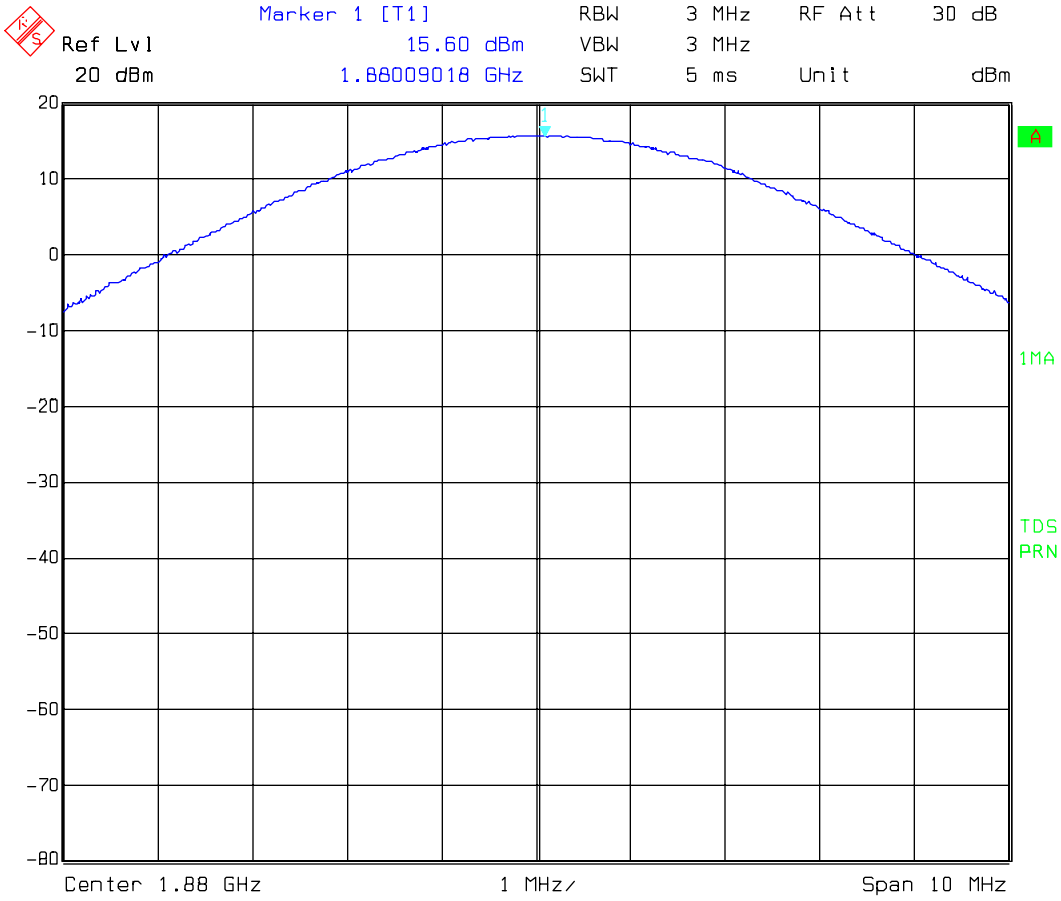
Frequency (MHz)	Power Step	BURST AVERAGE (dBm)		MODULATION AVERAGE (dBm)	
		EIRP	ERP	EIRP	ERP
1850.2	0	32.0	29.9	22.93	20.83
1880.0	0	31.60	29.5	22.53	20.43
1909.8	0	30.98	28.88	21.91	19.81
Measurement uncertainty		±0.5 dB			

CHANNEL 512:
Peak Power
Measurements were made using 16db Attenuator



16:41:50
Date: 05. Feb. 01

CHANNEL 661:
Peak Power
Measurements were made using 16db Attenuator



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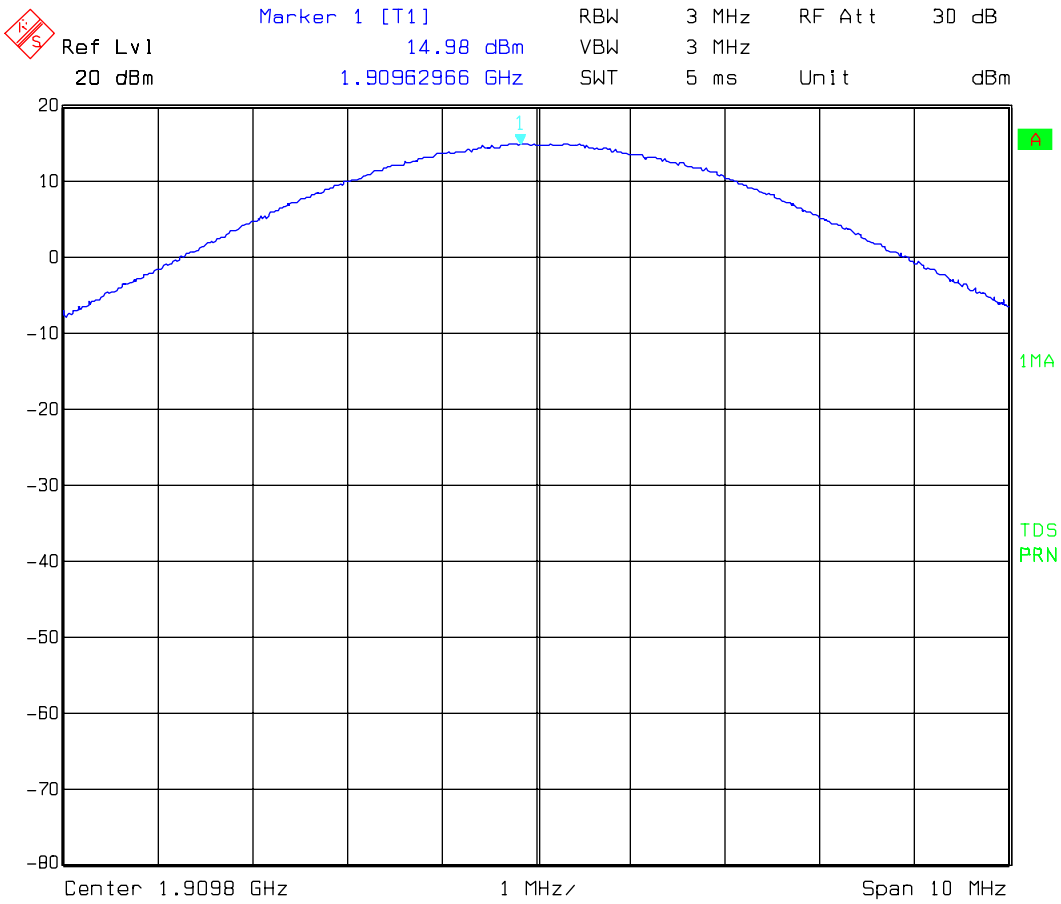
CHANNEL 810:
Peak Power
Measurements were made using 16db Attenuator



Date: 05. Feb. 01 16:48:55

FREQUENCY STABILITY SUBCLAUSE § 24.235

Method of Measurement:

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the EUT in a “call mode”. This is accomplished with the use of a R&S CMD 55 DIGITAL RADIO COMMUNICATION TESTER.

1. Measure the carrier frequency at room temperature.
2. Subject the EUT to overnight soak at -30 C.
3. With the EUT, powered via 3.6 Volts, connected to the CMD 55 and in a simulated call on channel 661 (center channel), measure the carrier frequency. These measurements should be made within 2 minutes of powering up the EUT, to prevent significant self warming.
4. Repeat the above measurements at 10 C increments from -30 C to +60 C. Allow at least 1 1/2 hours at each temperature, unpowered, before making measurements.
5. Remeasure carrier frequency at room temperature with nominal 3.6Volts. Vary supply voltage from minimum 3.3 Volts to maximum 4 Volts, in 1 Volt increments remeasuring carrier frequency at each voltage. Pause at 3.6 Volts for 1 1/2 hours unpowered, to allow any self heating to stabilize, before continuing.
6. Subject the EUT to overnight soak at +60 C.
7. With the EUT, powered via 3.6 Volts, connected to the CMD 55 and in a simulated call on channel 661 (center channel), measure the carrier frequency. These measurements should be made within 2 minutes of powering up the mobile station, to prevent significant self warming.
8. Repeat the above measurements at 10 C increments from +60 C to -30 C. Allow at least 1 1/2 hours at each temperature, unpowered, before making measurements.
9. At all temperature levels hold the temperature to +/- 0.5 C during the measurement procedure.

Measurement Limit:

According to the JTC standard the frequency stability of the carrier shall be accurate to within 0.1 ppm of the received frequency from the base station. This accuracy is sufficient to meet Sec. 24.235, Frequency Stability. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. As this transceiver is considered "Hand carried, battery powered equipment…," Section 2.1055(d)(2) applies. This requires that the lower voltage for frequency stability testing be specified by the manufacturer. This transceiver is specified to operate with an input voltage of between 3.3 VDC and 4 VDC, with a nominal voltage of 3.6 VDC (HP-E3610A). Operation above or below these voltage limits is prohibited by transceiver software in order to prevent improper operation as well as to protect components from overstress. These voltages represent a tolerance of + 11.11 % and – 8.3 %. For the purposes of measuring frequency stability these voltage limits are to be used.

AFC FREQ ERROR vs. VOLTAGE

Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
3.3	-8	-0.0042
3.4	-7	-0.0072
3.5	+10	+0.0053
3.6	+5	+0.0026
3.7	+10	+0.0053
3.8	+11	+0.0058
3.9	+17	+0.0090
4.0	+20	+0.0106

AFC FREQ ERROR vs. TEMPERATURE

TEMPERATURE (°C)	Frequency Error (Hz)	Frequency Error (ppm)
-30	-17	-0.0090
-20	-12	-0.0063
-10	-5	-0.0026
0	-11	-0.0058
+10	+22	+0.0117
+20	+10	+0.0053
+30	+8	+0.0042
+40	-10	-0.0053
+50	+5	+0.0026
+60	-29	-0.0154

EMISSIONS LIMITS §24.238

Measurement Procedure:

The following steps outline the procedure used to measure the radiated emissions from the EUT. The site is constructed in accordance with ANSI C63.4 – 1992 requirements and is recognised by the FCC to be in compliance for a 3 and a10 meter site. The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier that can be as high as 1910 MHz. This was rounded up to 20 GHz. The resolution bandwidth is set as outlined in Part 24.238. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of the USPCS band.

The final open field emission test procedure is as follows:
a) The test item was placed on a 0. 8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.
b) The antenna output was terminated in a 50 ohm load.
c) A double ridged waveguide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.
d) Detected emissions were maximized at each frequency by rotating the test item and adjusting the receive antenna height and polarization. The maximum meter reading was recorded. The radiated emission measurements of the harmonics of the transmit frequency through the 10th harmonic were measured with peak detector and I MHz bandwidth. If the harmonic could not be detected above the noise floor, the ambient level was recorded. The equivalent power into a dipole antenna was calculated from the field intensity levels measured at 3 meters using the equation shown below:

$Pg = E^2 4\pi d^2 / 120\pi = E^2 d^2 /30$

where : P = power in watts
g = arithmetic gain of transmitting antenna over isotropic radiator.
E = maximum field strength in volts/meter
d = measurement distance in meter

Using a dipole gain of 1.67 or 2.2 dB and a test distance of 3 meters, this equation reduces to:

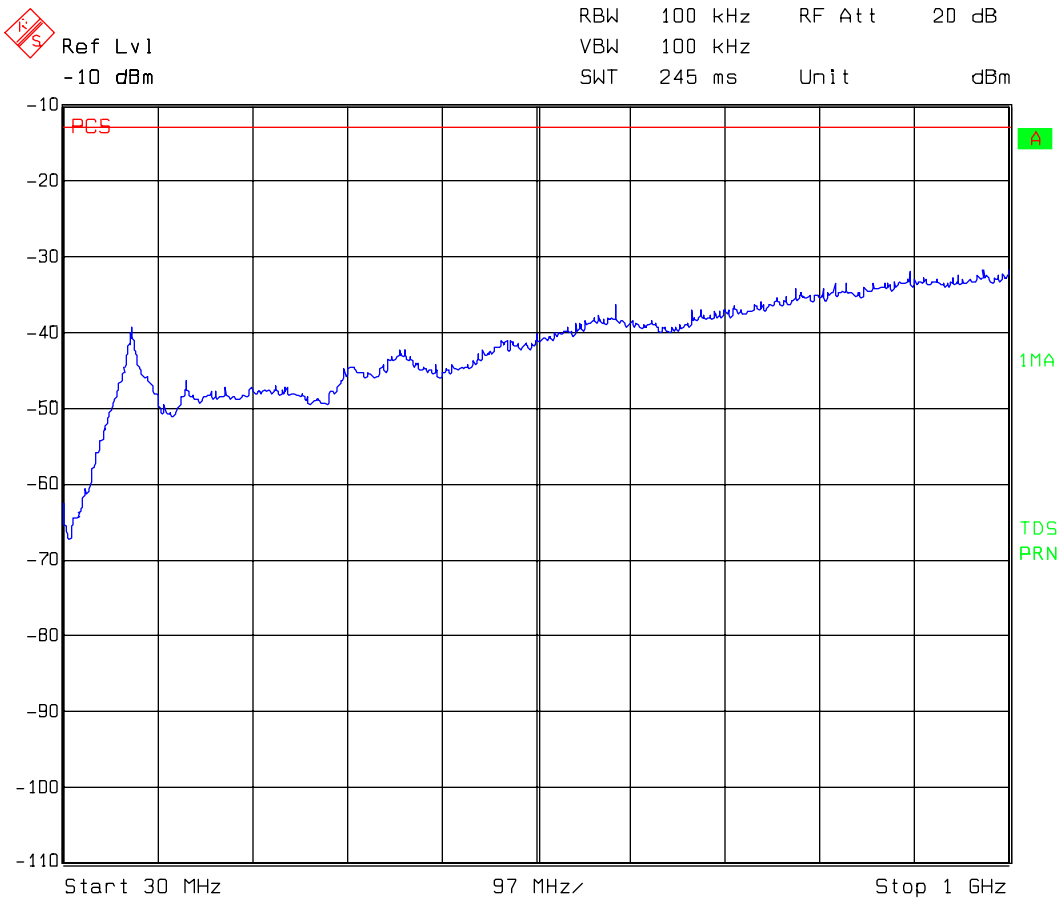
P(dBm) = E(dBuV/m) - 97.2dB

Measurement Limit:
Sec. 24.238 Emission Limits.
(a) On any frequency outside a licensee' s frequency block (e.g. A, D, B, etc.) within the USPCS spectrum, the power of any emission shall be attenuated below the transmitter power (P, in Watts) by at least 43+10Log(P) dB.
The specification that emissions shall be attenuated below the transmitter power (P) by at least 43 + 10 log (P) dB, translates in the relevant power range (1 to 0.001 W) to -13 dBm. At 1 W the specified minimum attenuation becomes 43 dB and relative to a 30 dBm (1 W) carrier becomes a limit of -13 dBm. At 0.001 W (0 dBm) the minimum attenuation is 13 dB which again yields a limit of -13 dBm. In this way a translation of the specification from relative to absolute terms is carried out.

Measurement Results:
Radiated emissions measurements were made only at the upper, center, and lower carrier frequencies of the USPCS band (1850.2 MHz, 1879.8 MHz and 1909.8 MHz). It was decided that measurements at these three carrier frequencies would be sufficient to demonstrate compliance with emissions limits because it was seen that all the significant spurs occur well outside the band and no radiation was seen from a carrier in one block of the USPCS band into any of the other blocks. The equipment must still, however, meet emissions requirements with the carrier at all frequencies over which it is capable of operating and it is the manufacturer's responsibility to verify this.

RESULTS OF OPEN FIELD RADIATED TEST FOR FCC-24:
The final open field radiated levels are presented on the next pages.

Channel 512 :
Spurious emission limit –13dBm



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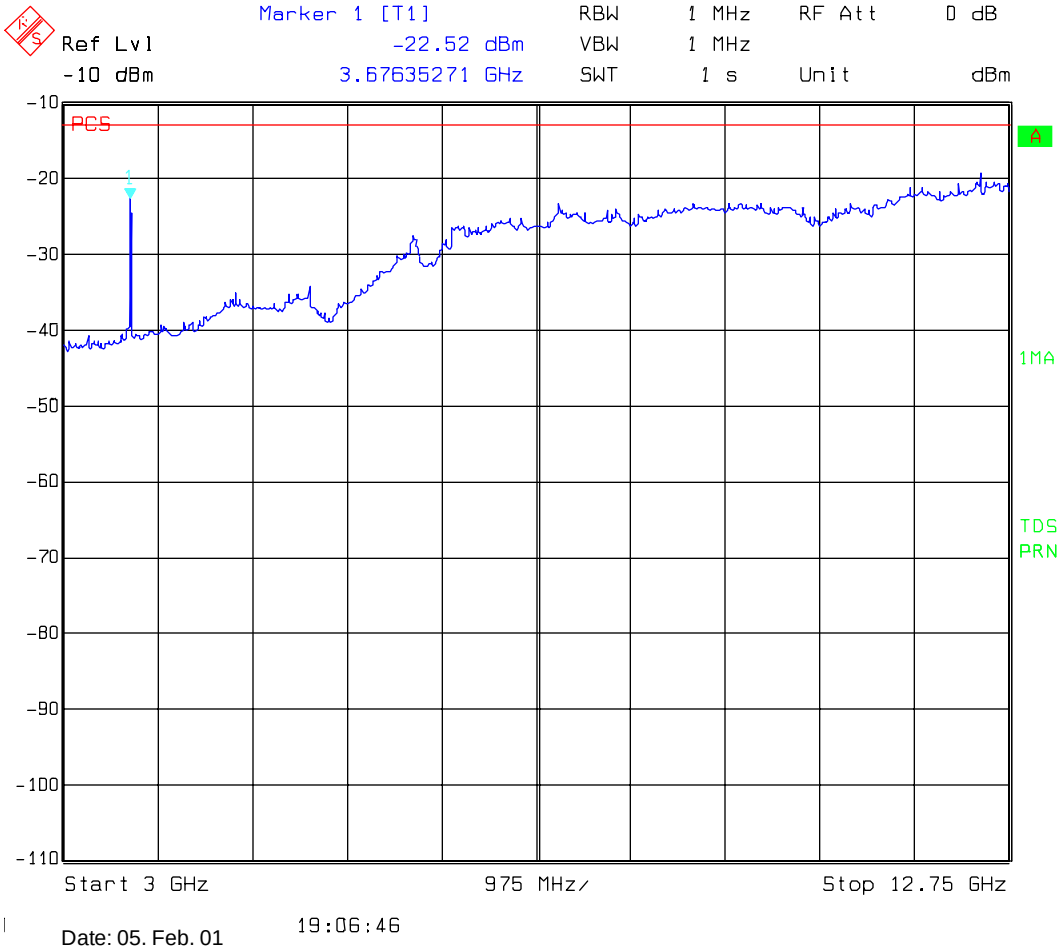
Channel 512 :
Radiated Spurious Emissions
Spurious emission limit –13dBm

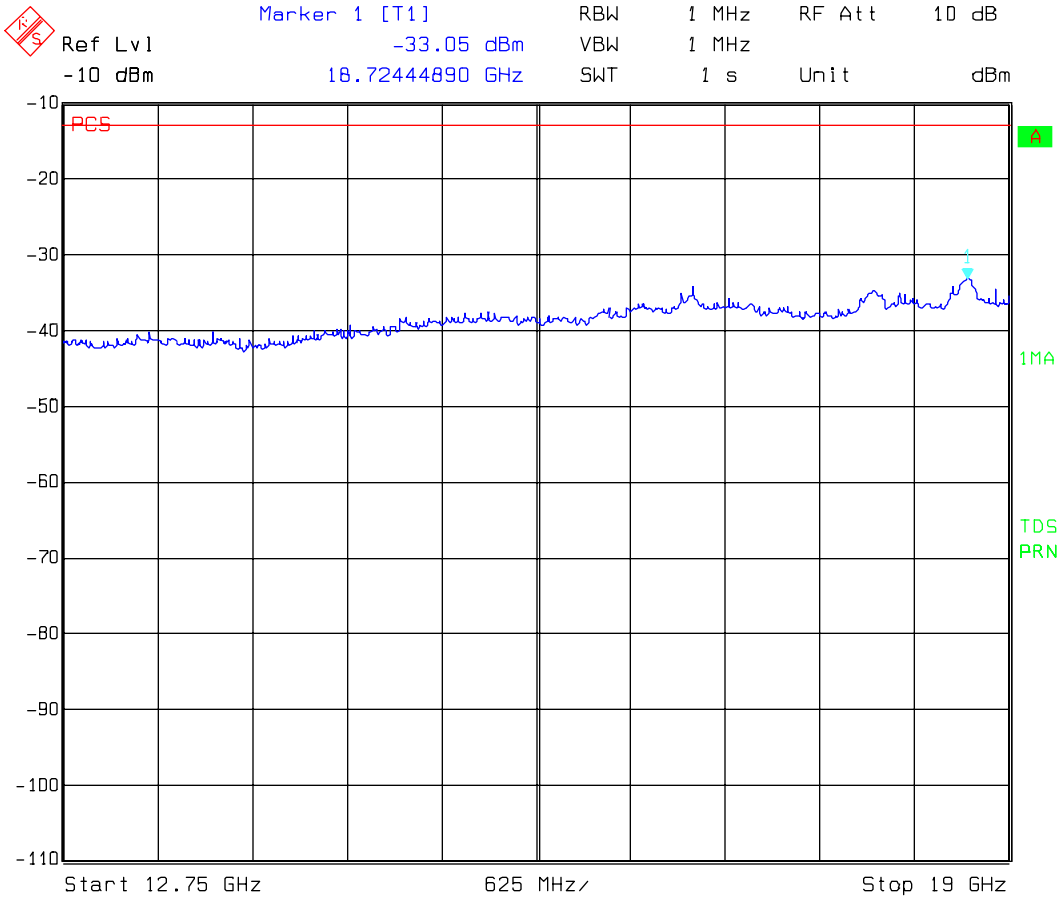
Note: Marker indicates the carrier signal frequency.

Channel 512 :
Radiated Spurious Emissions
Spurious emission limit –13dBm

Note: Marker indicates the carrier signal frequency



Channel 512 :
Radiated Spurious Emissions
Spurious emission limit –13dBm



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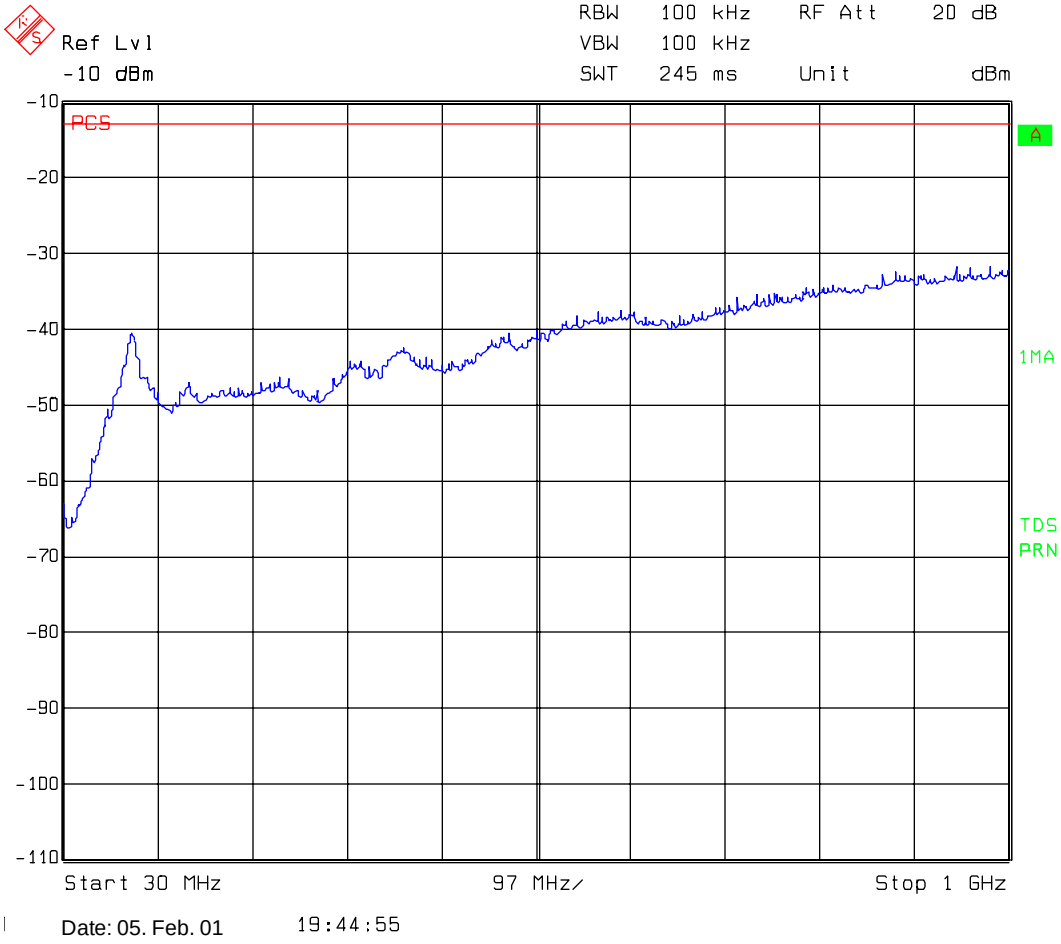
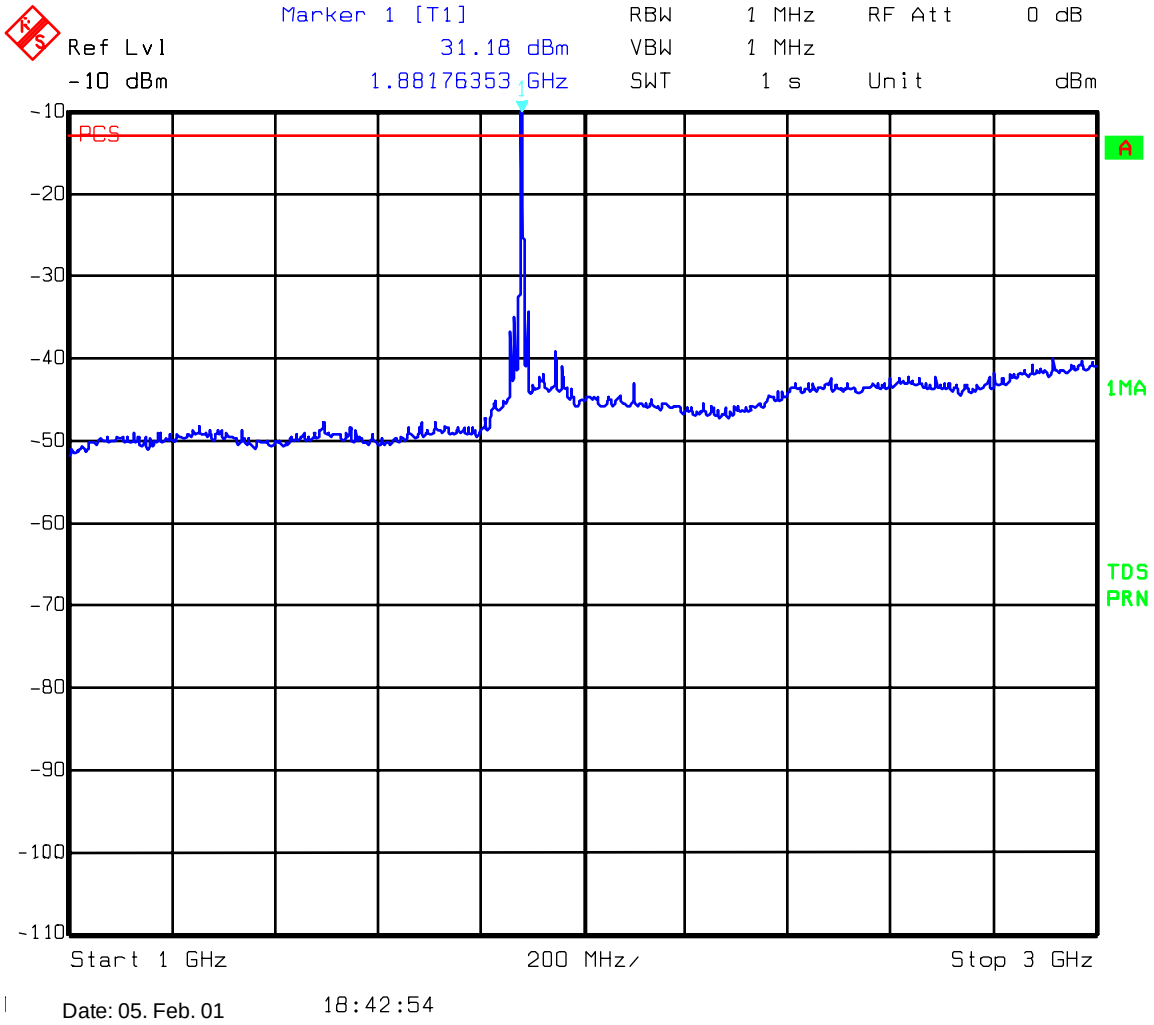
Channel 661:
Radiated Spurious Emissions
Spurious emission limit –13dBm



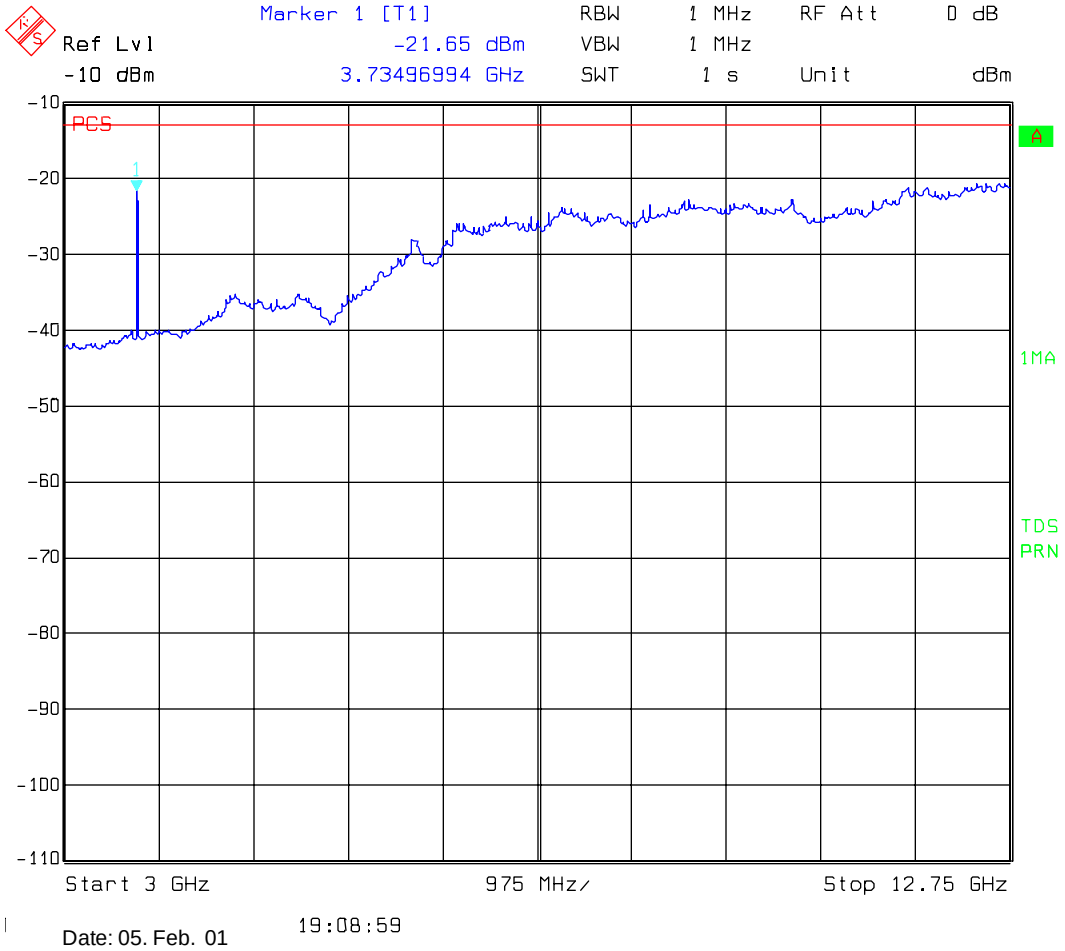
Channel 661 :
Radiated Spurious Emissions
Spurious emission limit –13dBm

Note: Marker indicates the carrier signal frequency

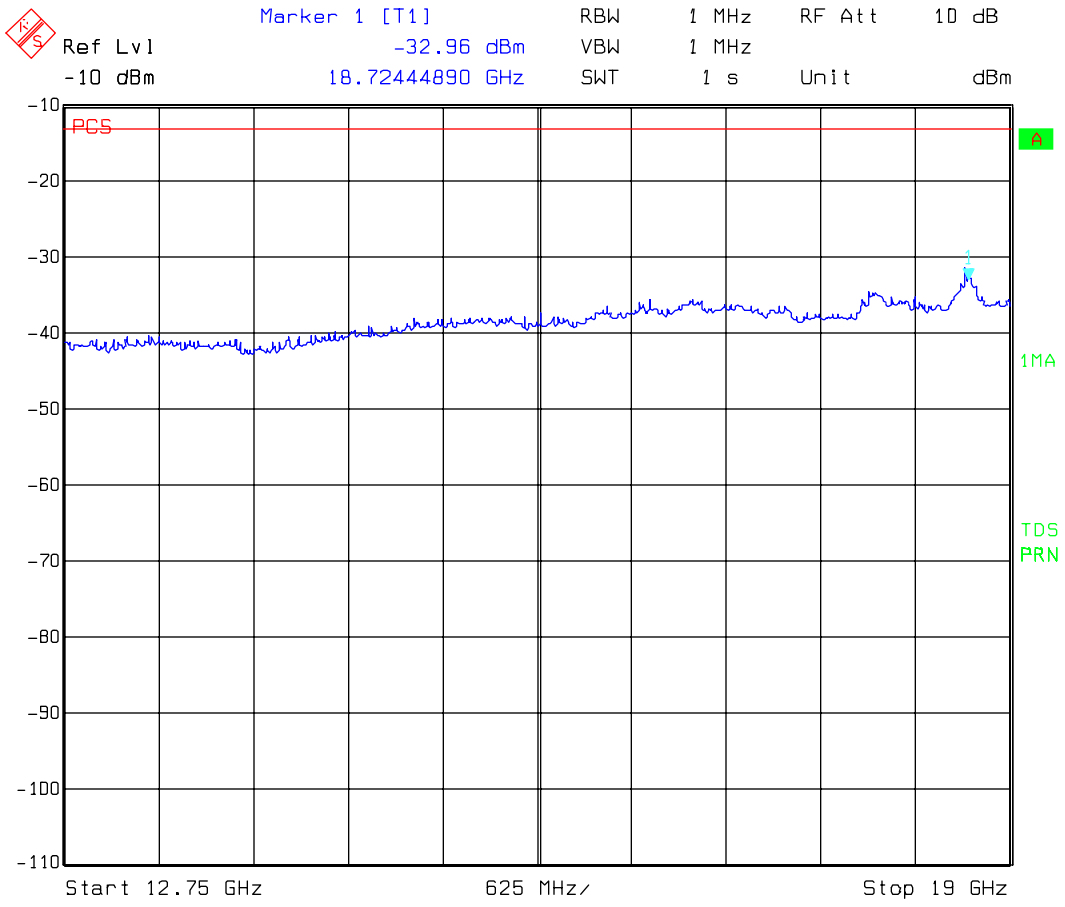


Channel 661 :
Radiated Spurious Emissions
Spurious emission limit –13dBm

Note: Marker indicates the carrier signal frequency



Channel 661 :
Radiated Spurious Emissions
Spurious emission limit –13dBm



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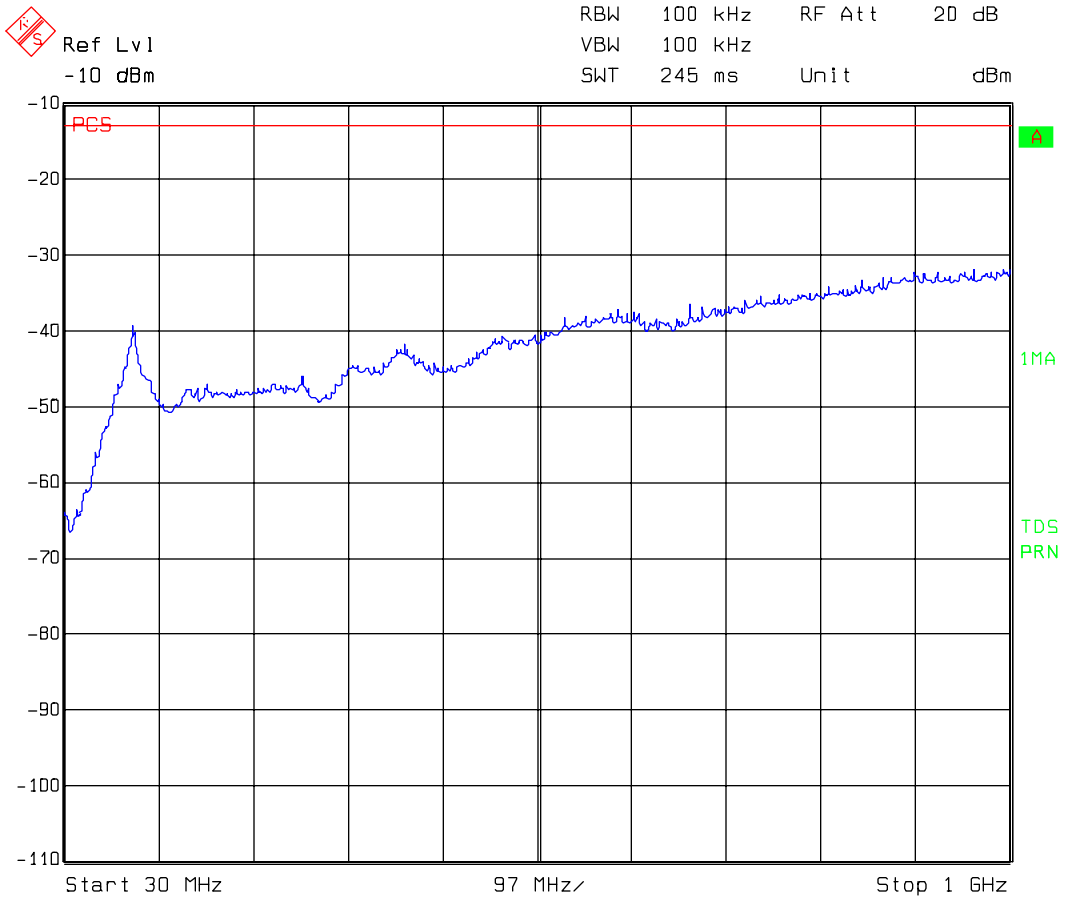
Channel 810 :
Radiated Spurious Emissions
Spurious emission limit –13dBm



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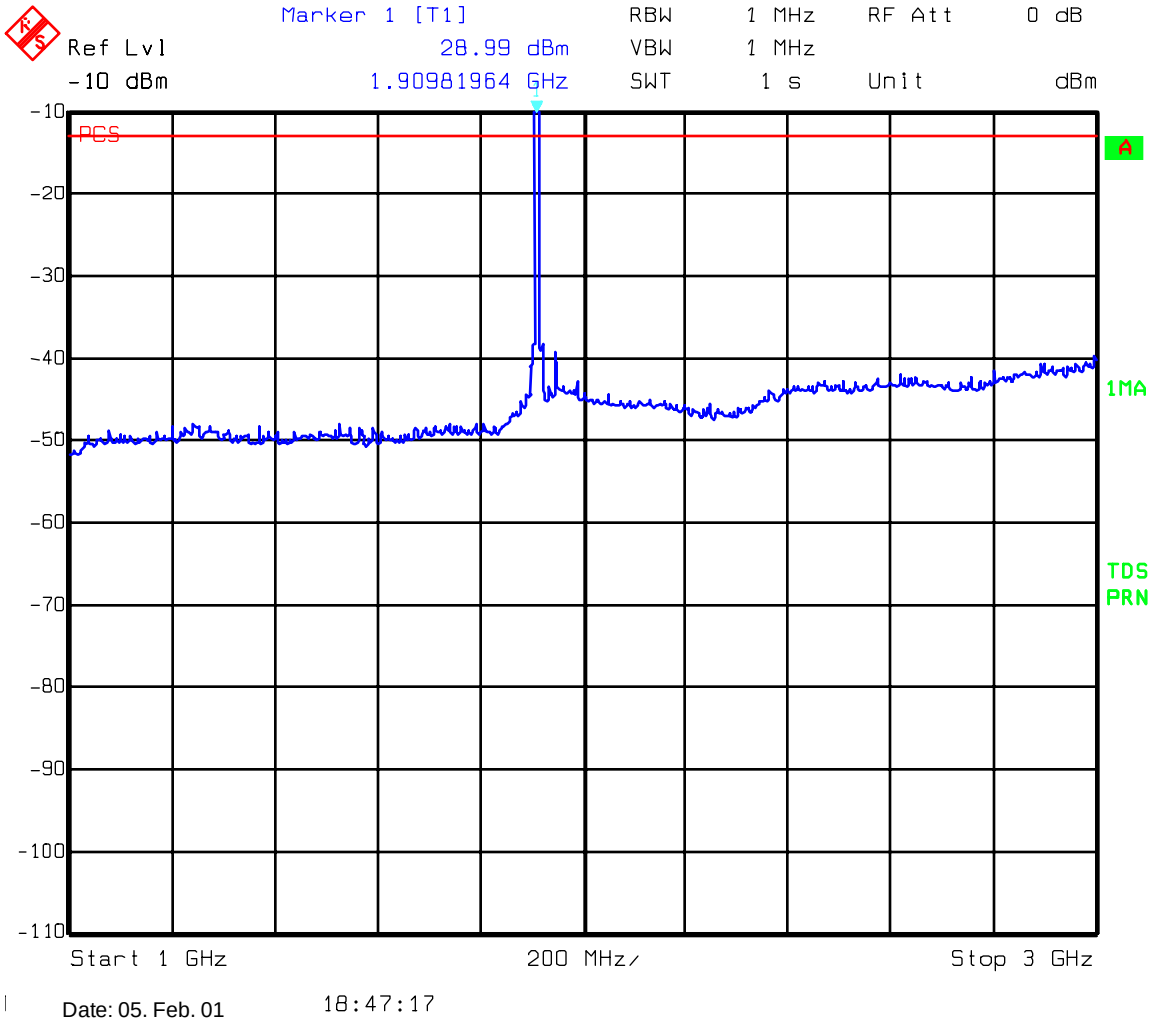
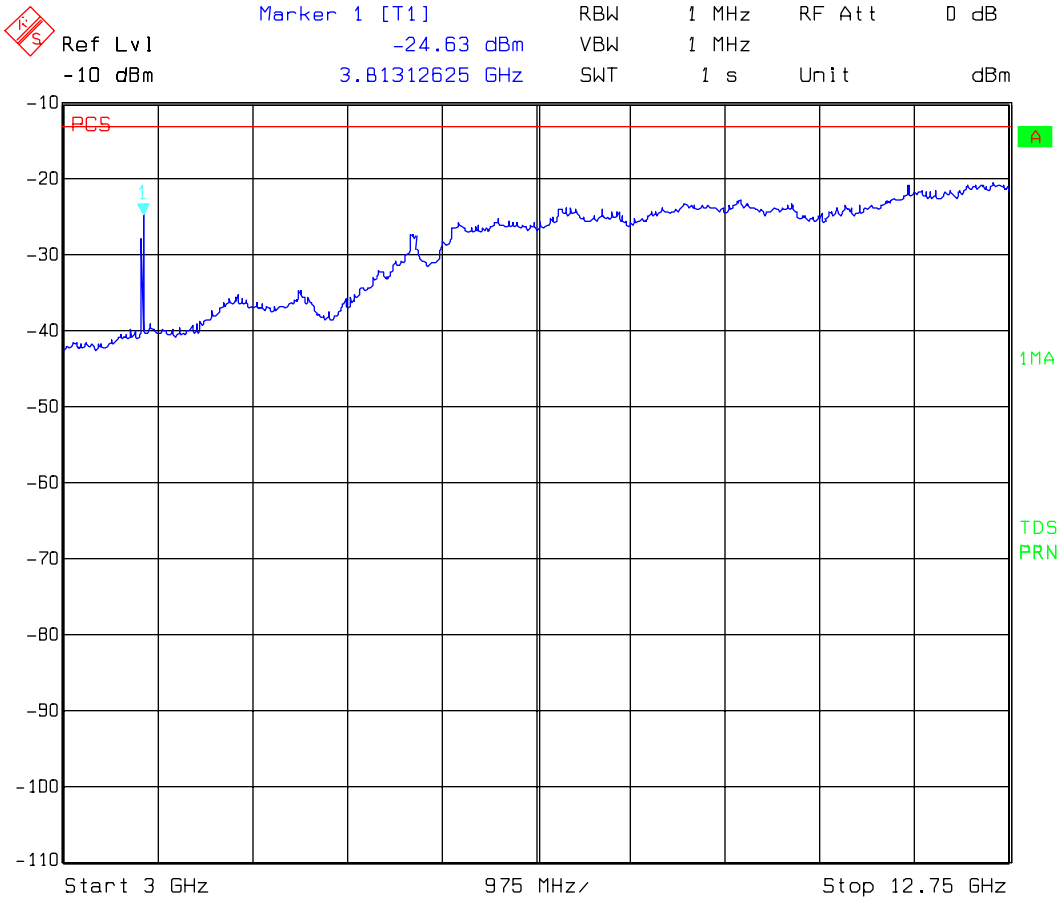
Channel 810 :
Radiated Spurious Emissions
Spurious emission limit –13dBm

Note: Marker indicates the carrier signal frequency.



Channel 810 :
Radiated Spurious Emissions
Spurious emission limit –13dBm

Note: Marker indicates the carrier signal frequency



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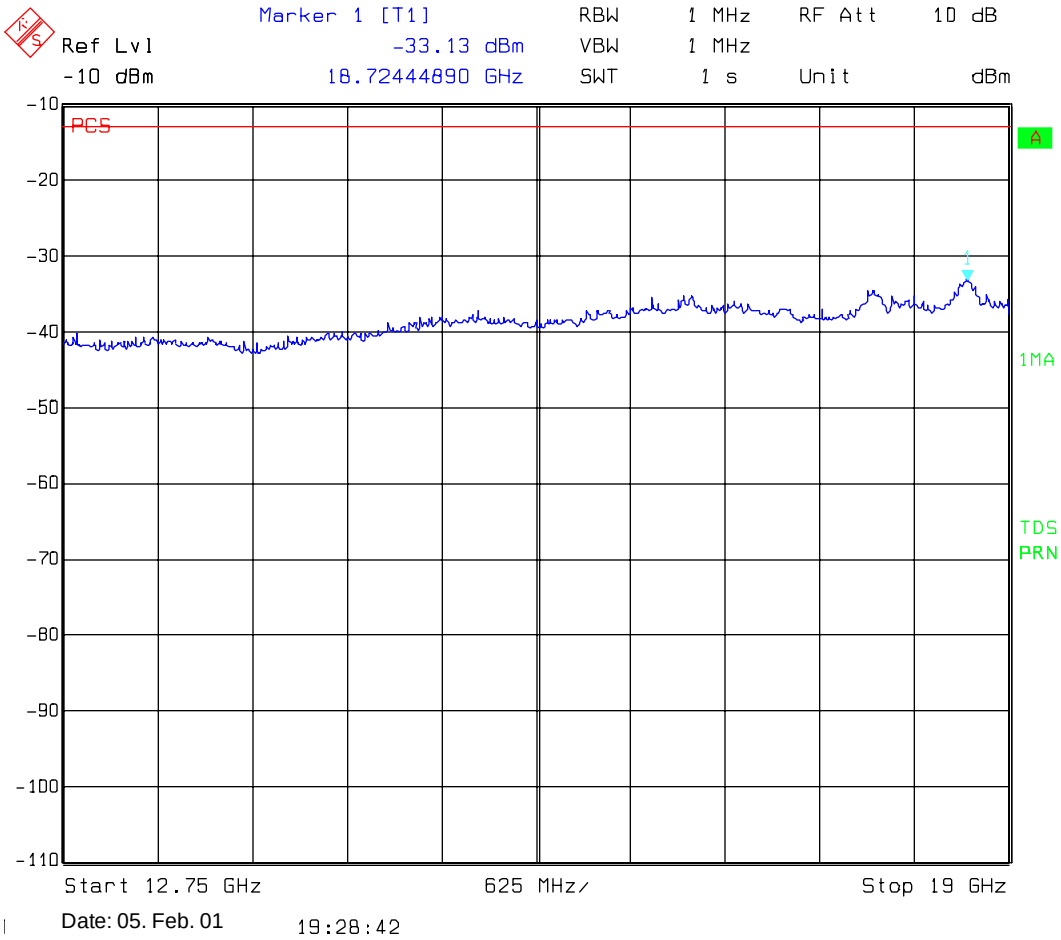
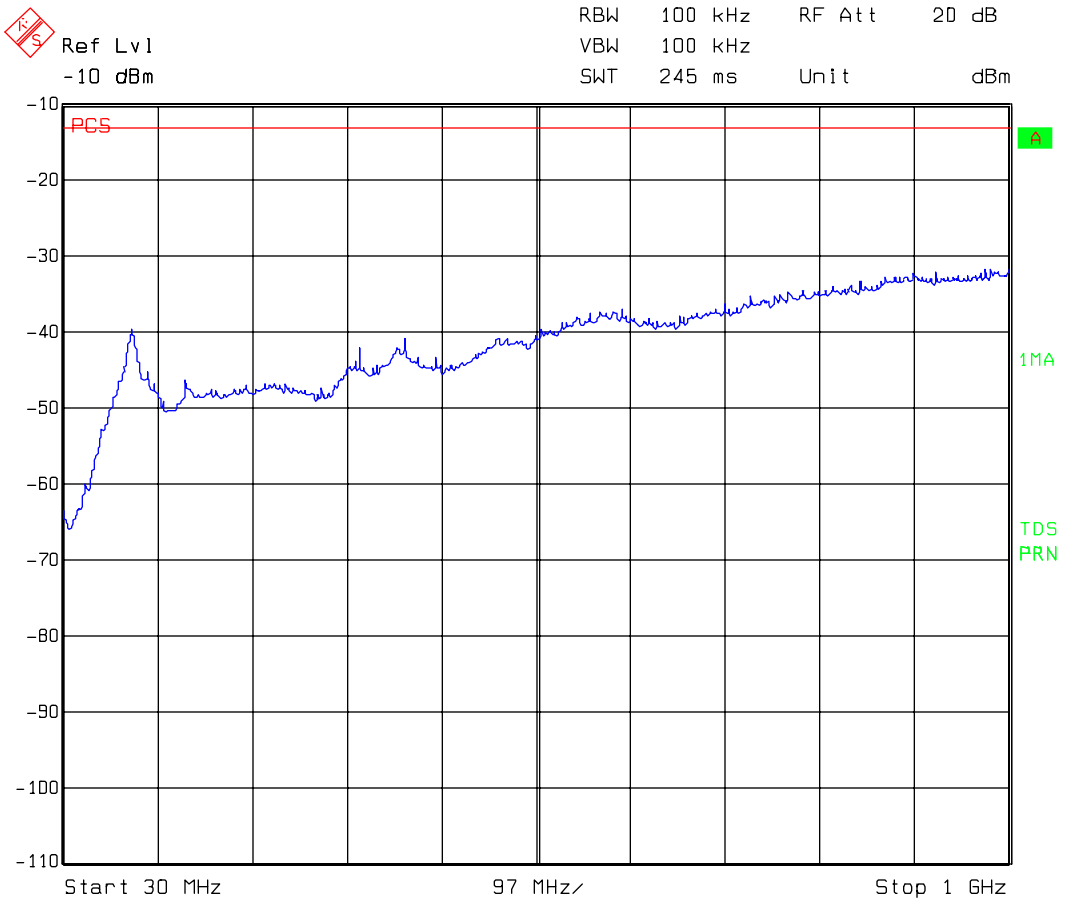
Channel 810 :
Radiated Spurious Emissions
Spurious emission limit –13dBm



EUT in Idle Mode
Radiated Spurious Emissions



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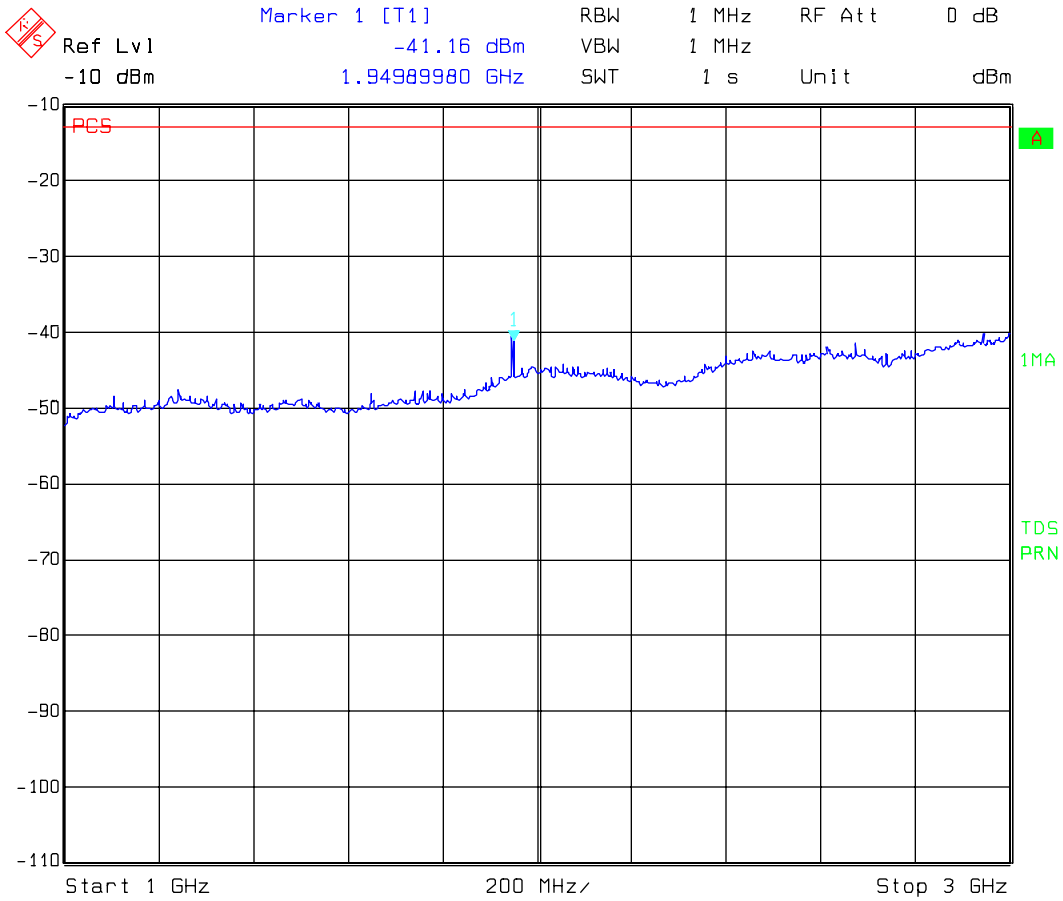
EUT in Idle Mode
Radiated Spurious Emissions



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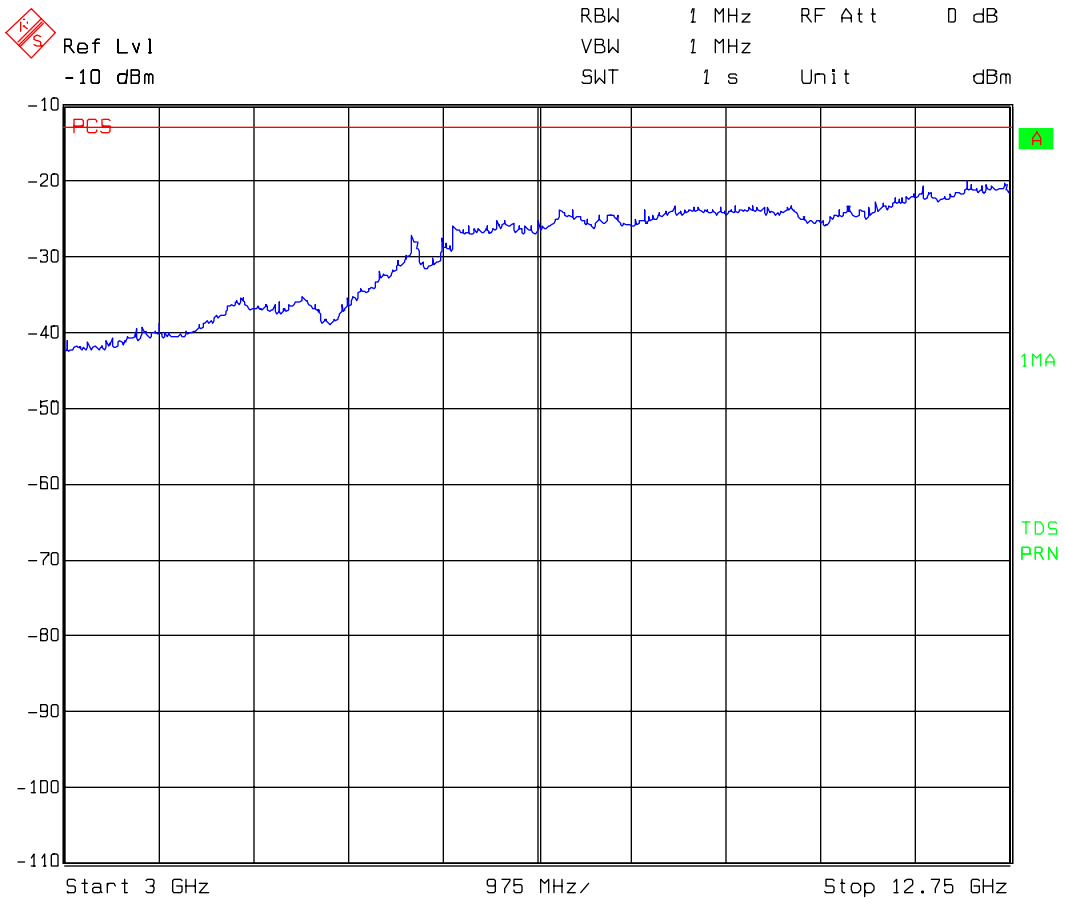
EUT in Idle Mode
Radiated Spurious Emissions



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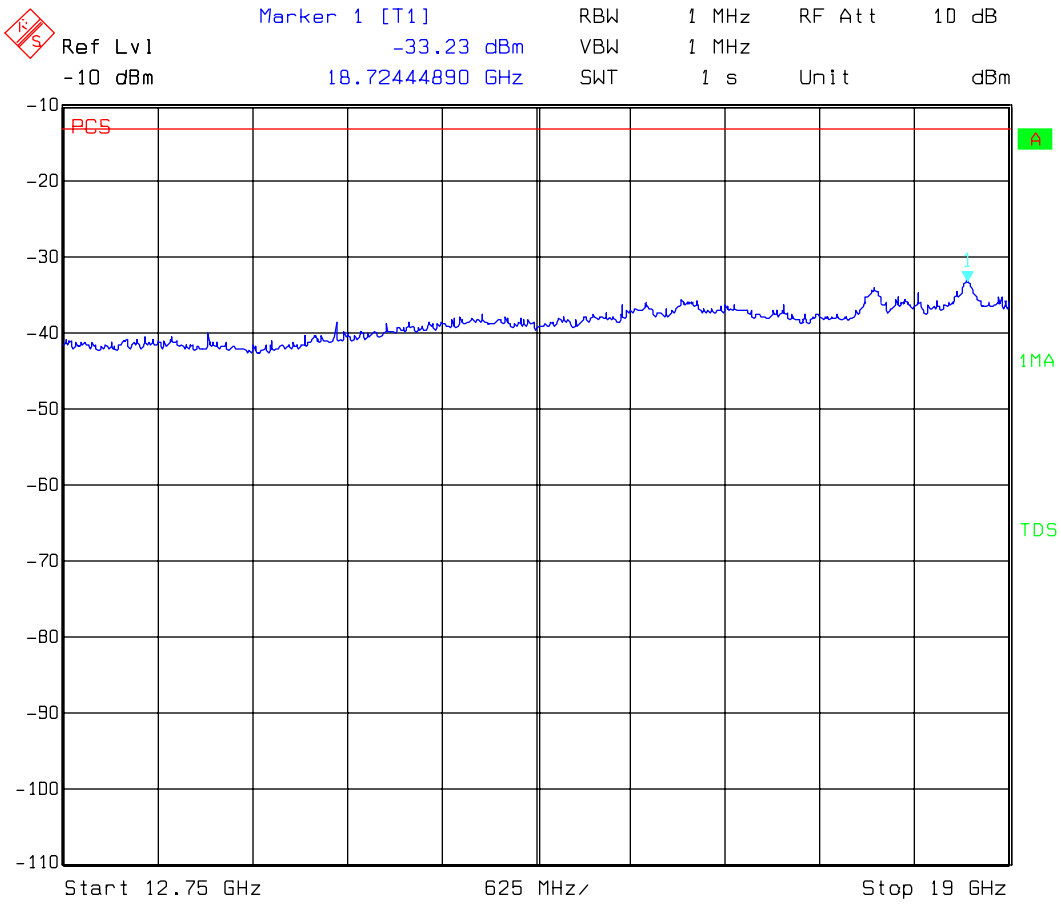
EUT in Idle Mode
Radiated Spurious Emissions



Date: 05. Feb. 01 19:31:54

Conducted Spurious Emissions

Measurement Procedure:
The following steps outline the procedure used to measure the conducted emissions from the EUT.
1. Determine frequency range for measurements: From CFR 2.1057 the spectrum should be investigated from the lowest radio frequency generated in the equipment up to at least the 10th harmonic of the carrier frequency.
For the equipment under test, this equates to a frequency range of 13 MHz to 19.1 GHz, data taken from 10 MHz to 20 GHz.
2. Determine EUT transmit frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

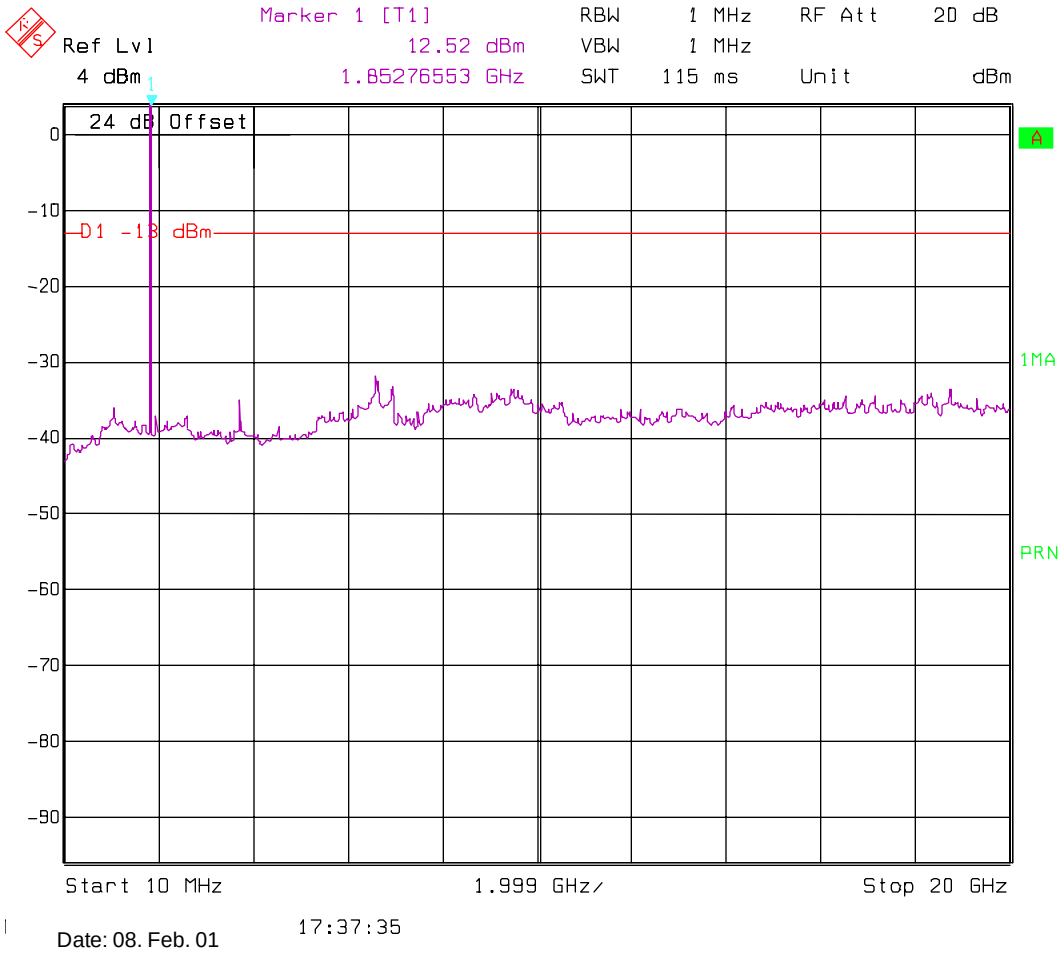
USPCS Transmitter
Channel Frequency
512 1850.2 MHz
661 1880.0 MHz
810 1909.8 MHz

Measurement Limit:
Sec. 24.238 Emission Limits.
(a) On any frequency outside frequency band of the USPCS spectrum, the power of any emission shall be attenuated below the transmitter power (P, in Watts) by at least 43+10Log(P) dB. For all power levels +30 dBm to 0 dBm, this becomes a constant specification limit of -13 dBm.

Measurements:

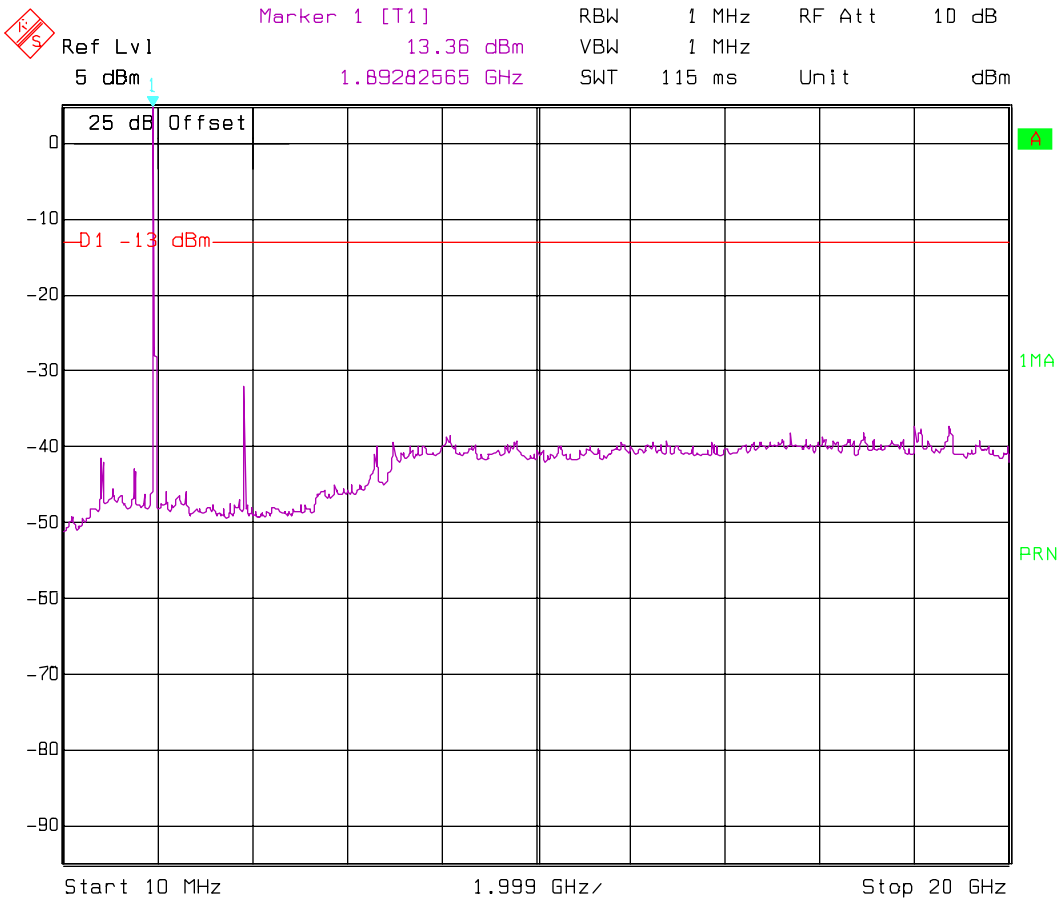
Channel: 512
Conducted Spurious Emissions

Note: Marker indicates the carrier signal frequency



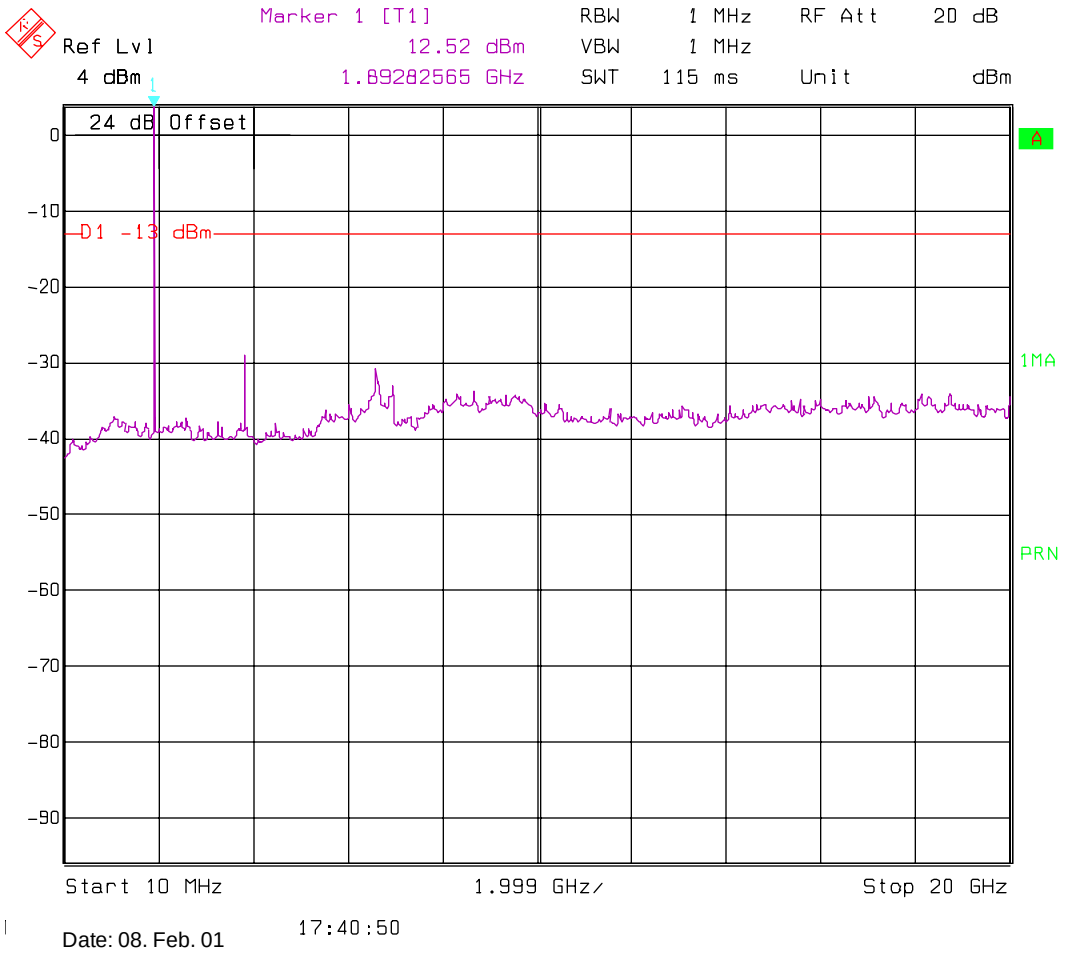
Channel 661
Conducted Spurious Emissions

Note: Marker indicates the carrier signal frequency

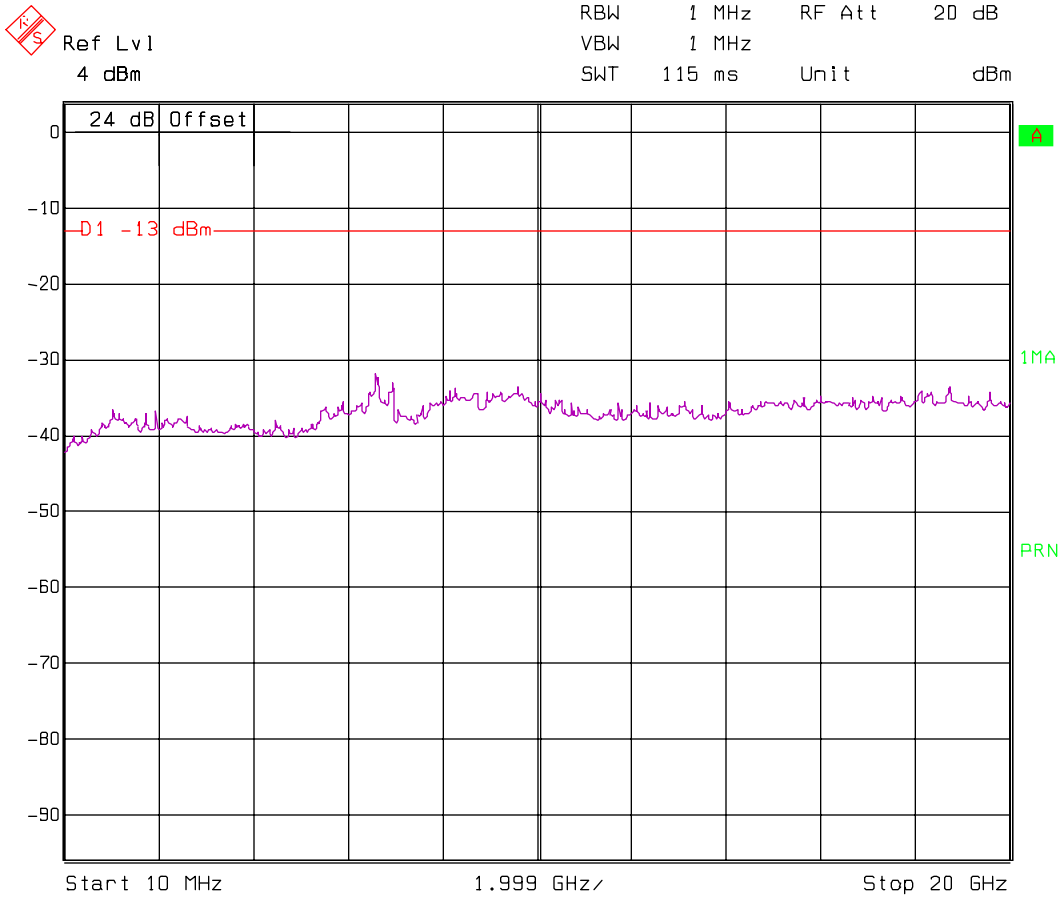


Channel 810
Conducted Spurious Emissions

Note: Marker indicates the carrier signal frequency



EUT in Idle Mode
Conducted Spurious Emissions



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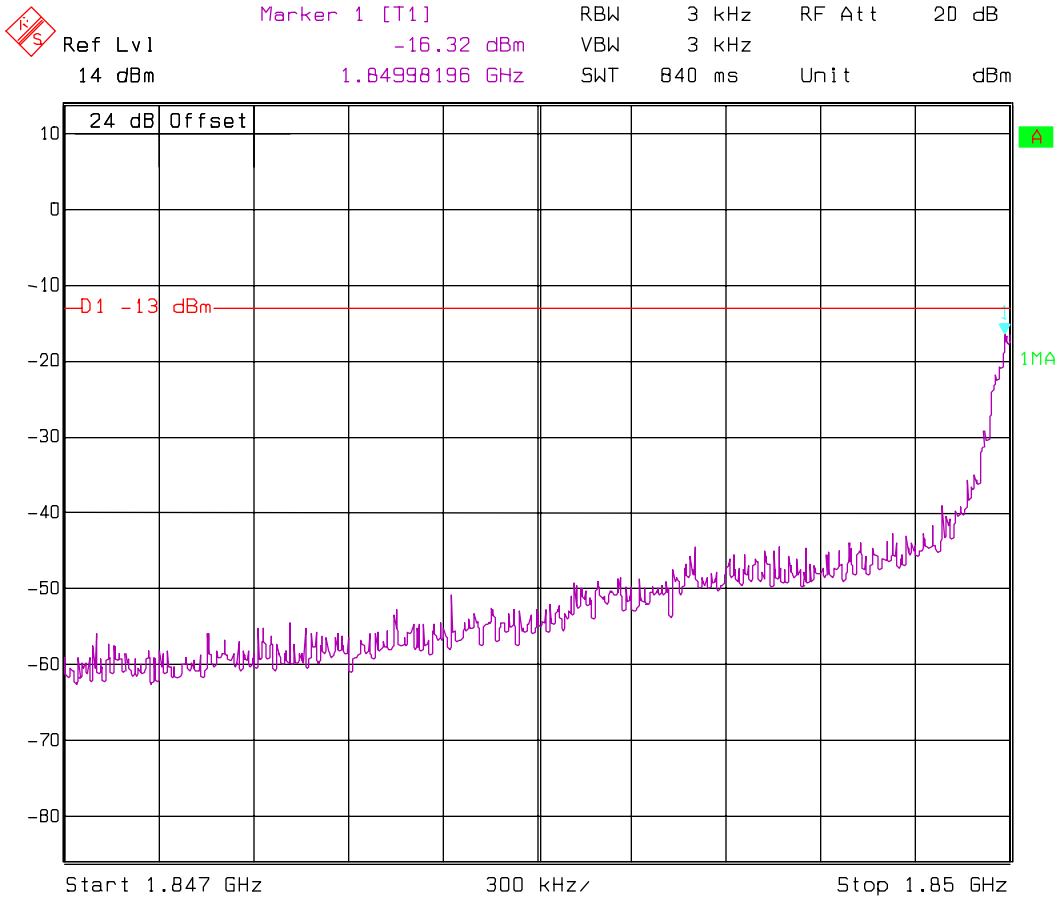
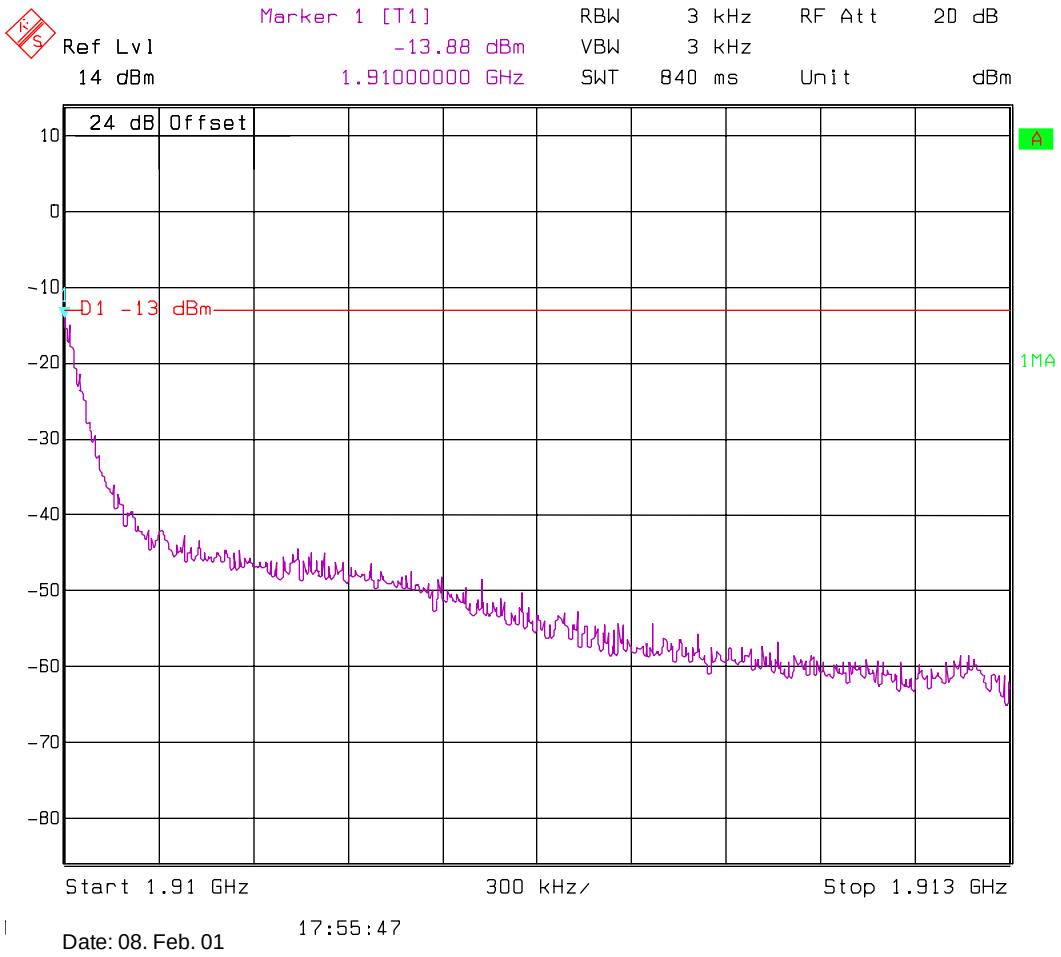
Lower Band Edge:



Date: 08. Feb. 01 17:58:38

Higher Band Edge:



OCCUPIED BANDWIDTH §2.989

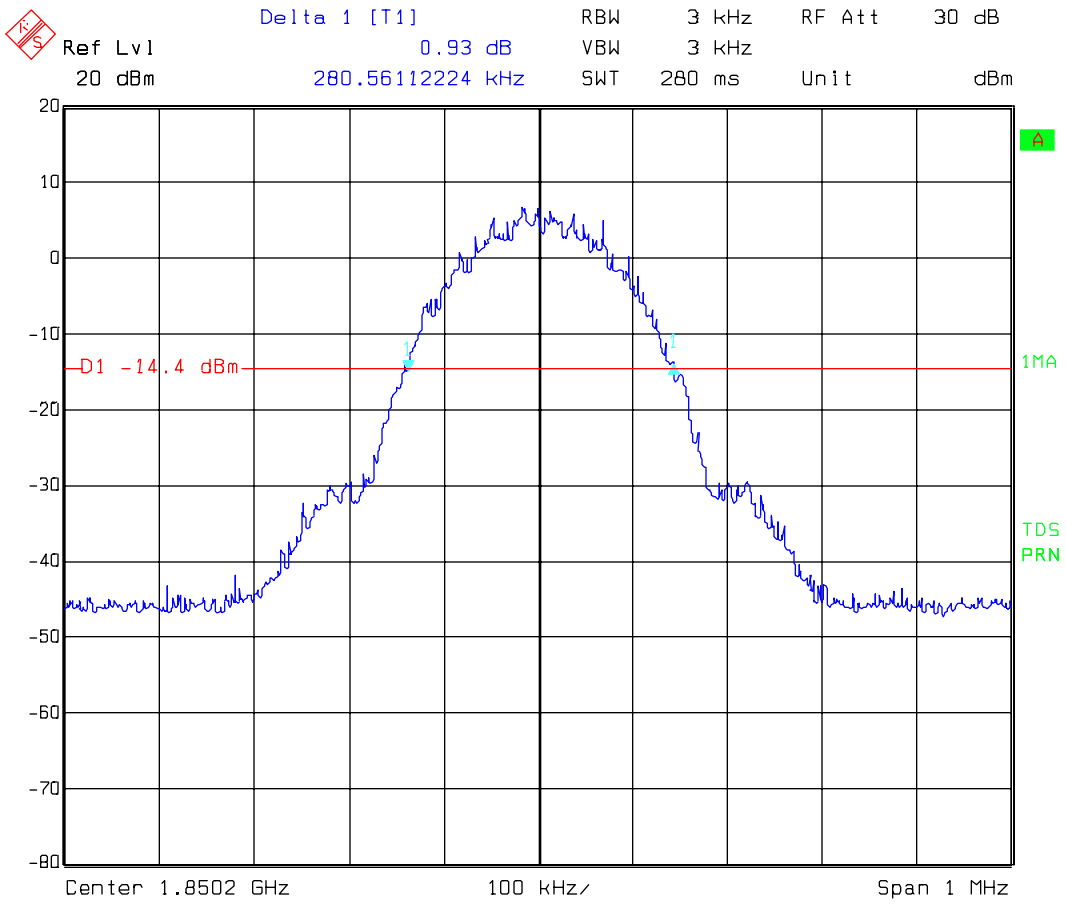
Occupied Bandwidth Results

Similar to conducted emissions, occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the extreme and mid frequencies of the USPCS frequency band. Table 8.2 below lists the measured 99% power and -26dBC occupied bandwidths. Spectrum analyzer plots are included on the following pages.

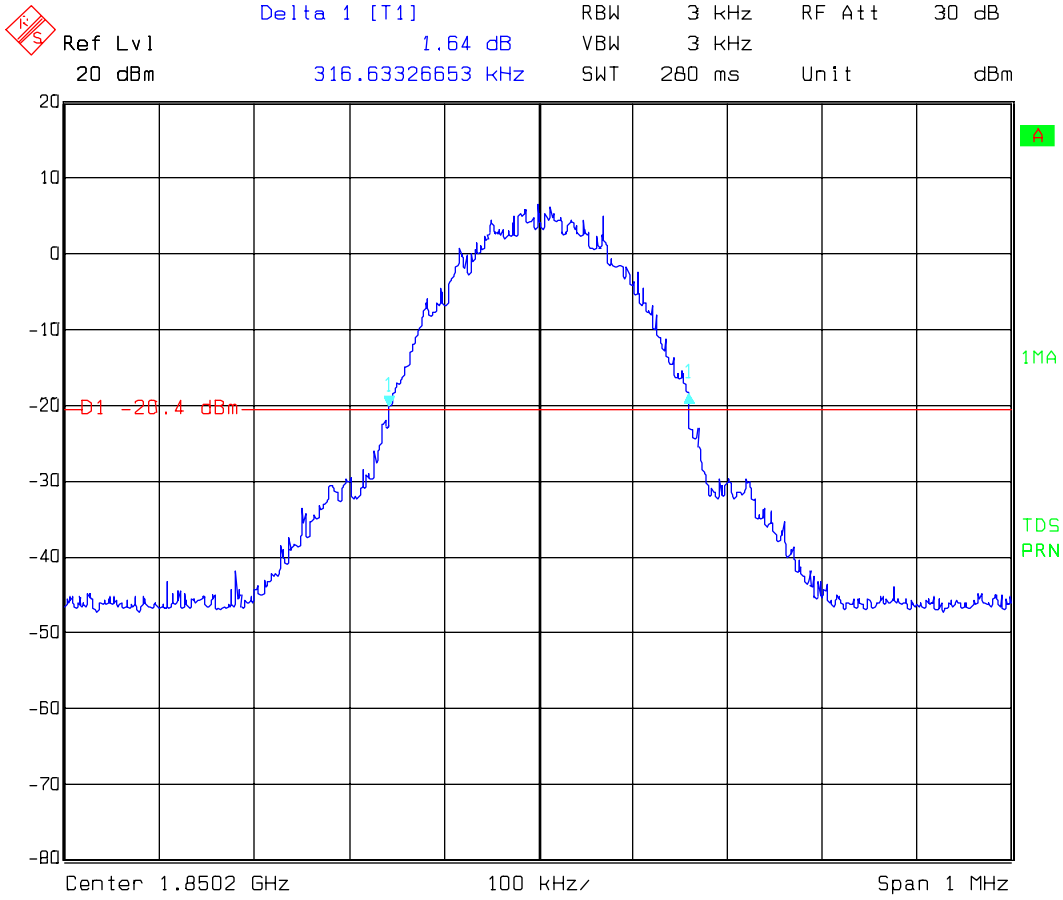
Frequency	99% Occupied Bandwidth	-26 dBc Bandwidth
1850.2 MHz	280.5 kHz	316.6 KHz
1880.0 MHz	292.5 kHz	322.6 KHz
1909.2 MHz	290.6 kHz	324.6 KHz

Part 24.238 (a) requires a measurement bandwidth of at least 1% of the occupied bandwidth. For ca. 290 kHz, this equates to a resolution bandwidth of at least 2.96 kHz. For this testing, a resolution bandwidth 3.0 kHz was used.

Channel 512
99% Occupied Bandwidth

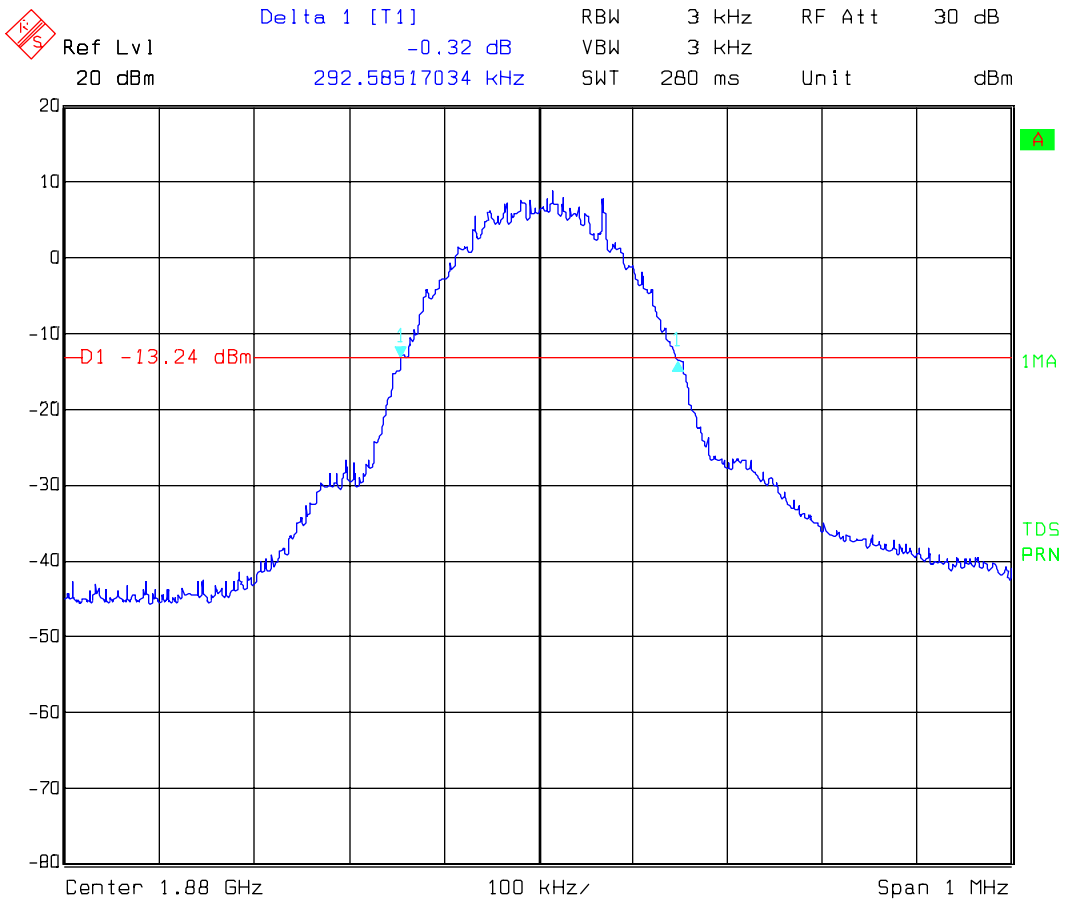


Channel 512
-26 dBc Bandwidth



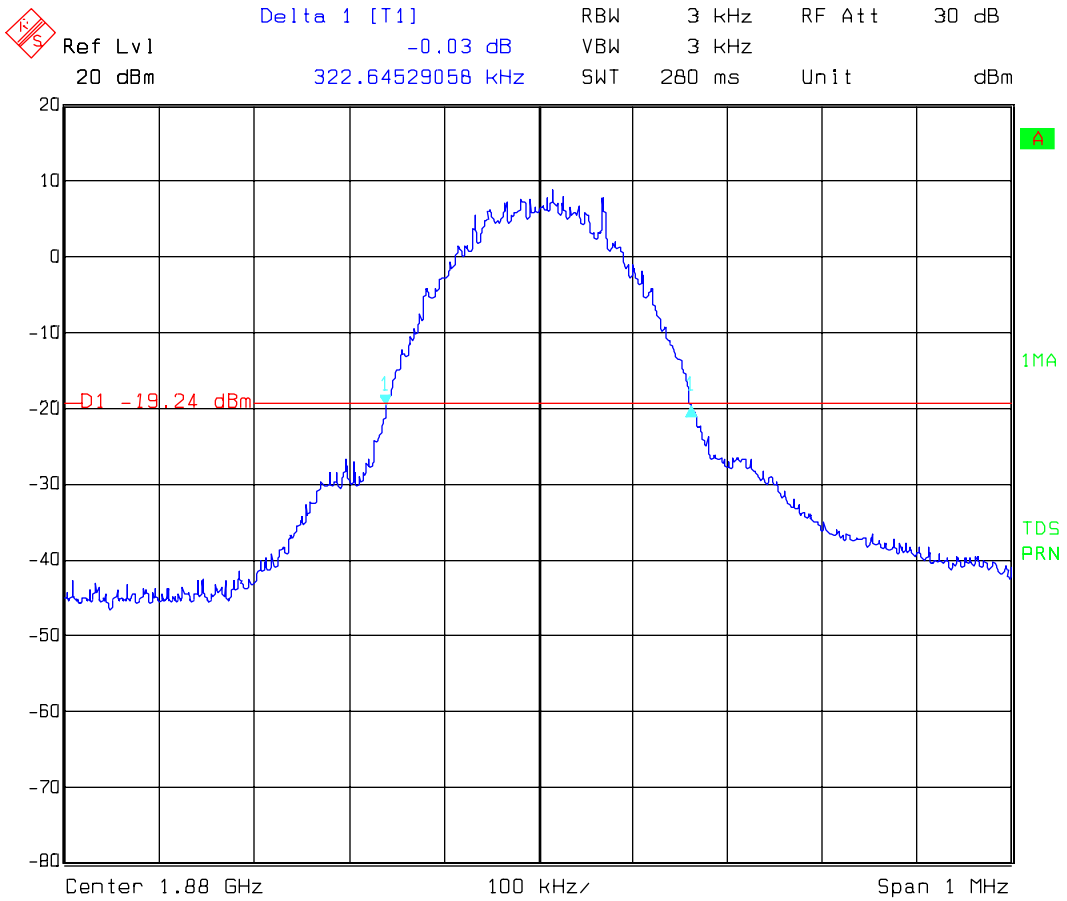
Date: 08. Feb. 01 17:30:04

Channel 661
99% Occupied Bandwidth



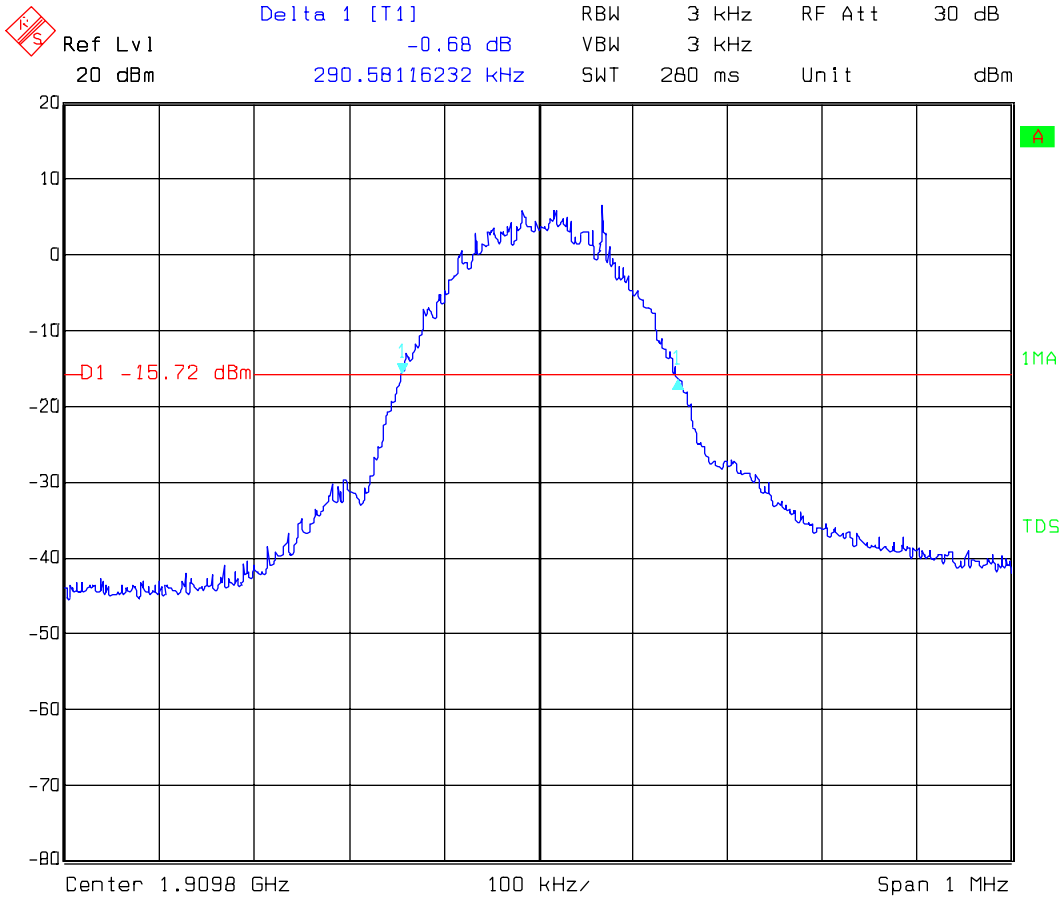
Date: 08. Feb. 01 17:15:11

Channel 661
-26 dBc Bandwidth



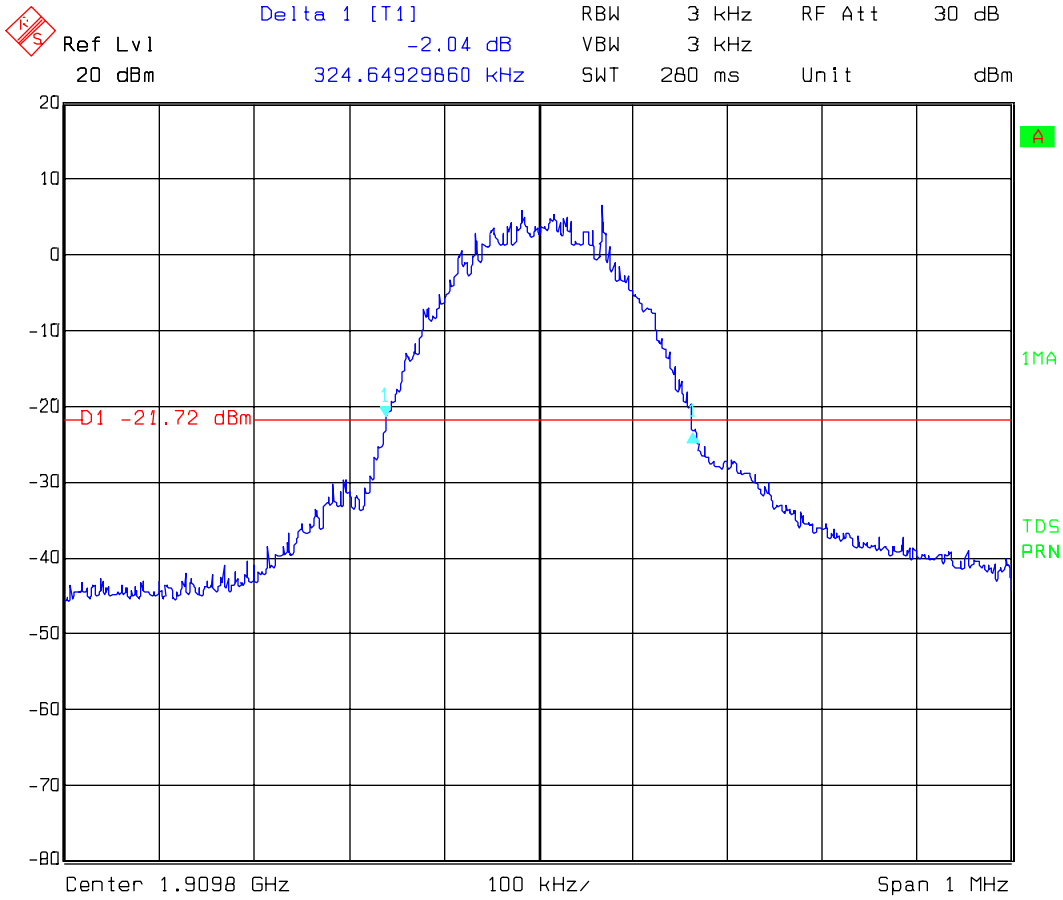
Date: 08. Feb. 01 17:12:34

Channel 810
99% Occupied Bandwidth



Date: 08. Feb. 01 17:25:38

Channel 810
-26 dBc Bandwidth

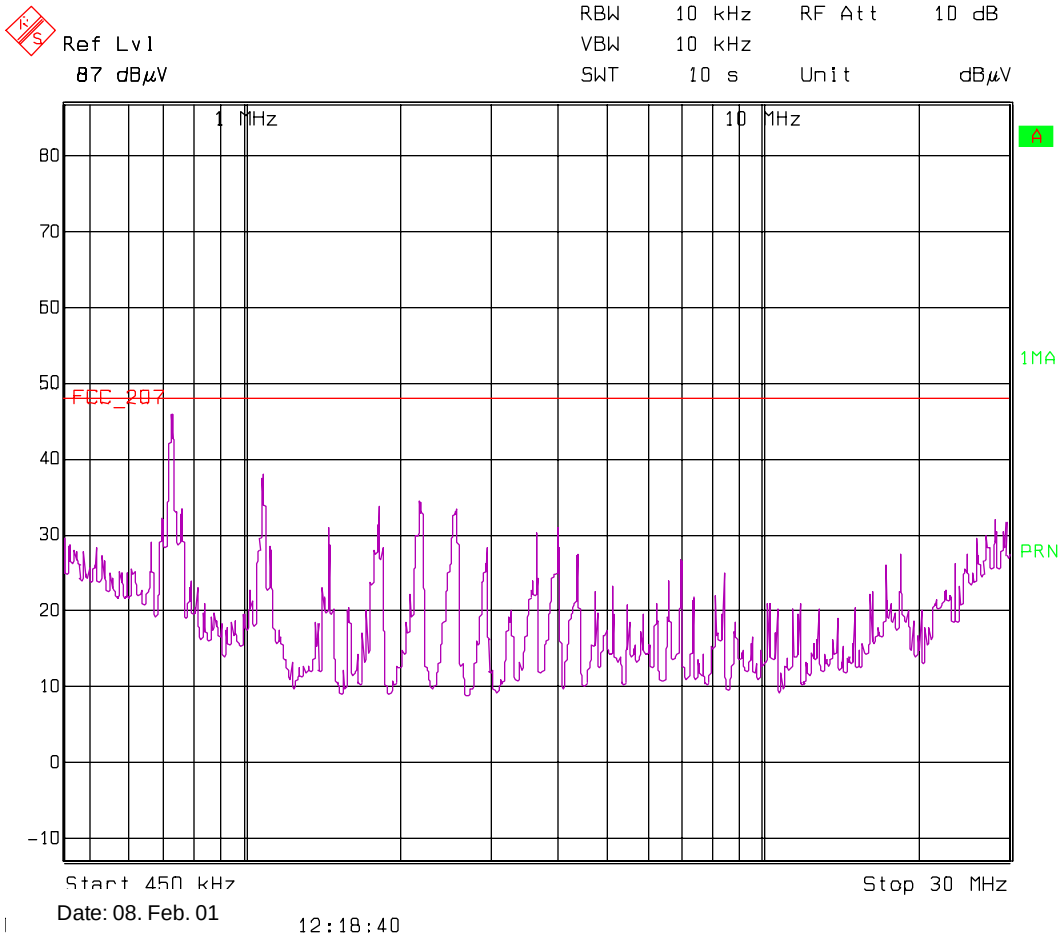


Date: 08. Feb. 01 17:23:09

CONDUCTED EMISSIONS **§ 15.107/207**

Measured with AC/DC power adapter plugged in LISN

Phase: Line

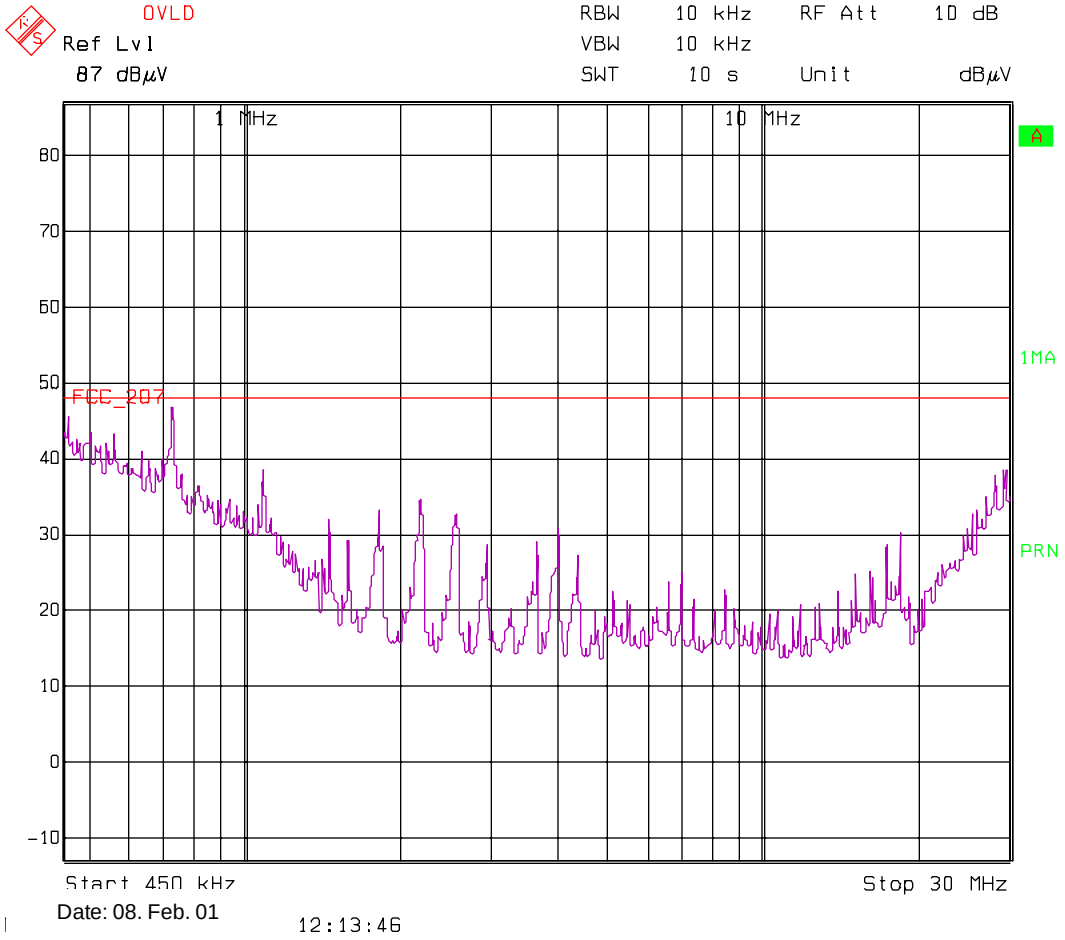


Technical specification : 15.107 / 15.207 (Revised as of October 1, 1991)

Limit

0.45 to 30 MHz	250 µV / 47.96 dBµV

Phase: Neutral



Technical specification : 15.107 / 15.207 (Revised as of October 1, 1991)
Limit

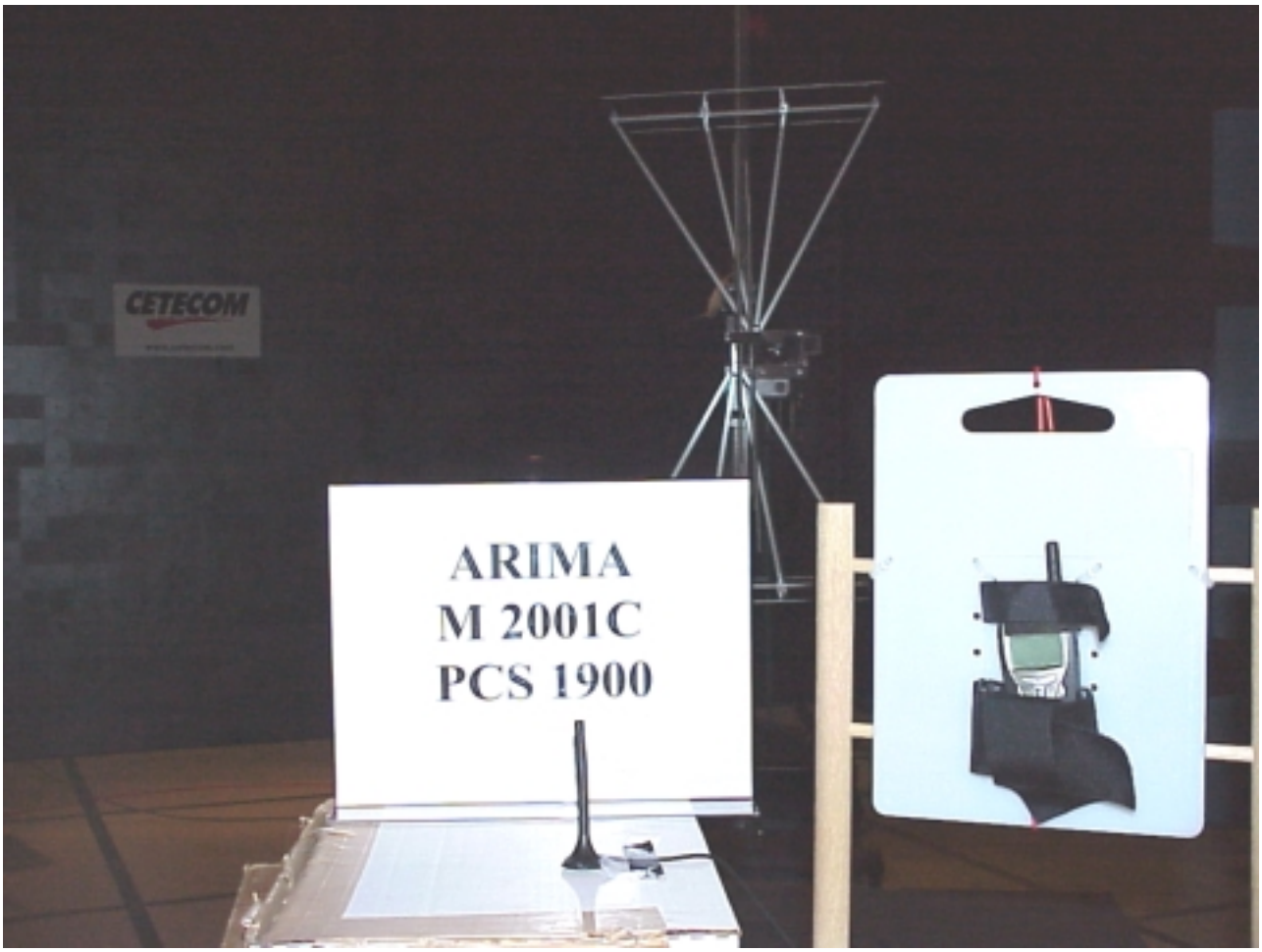
0.45 to 30 MHz	250 µV / 47.96 dBµV

TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

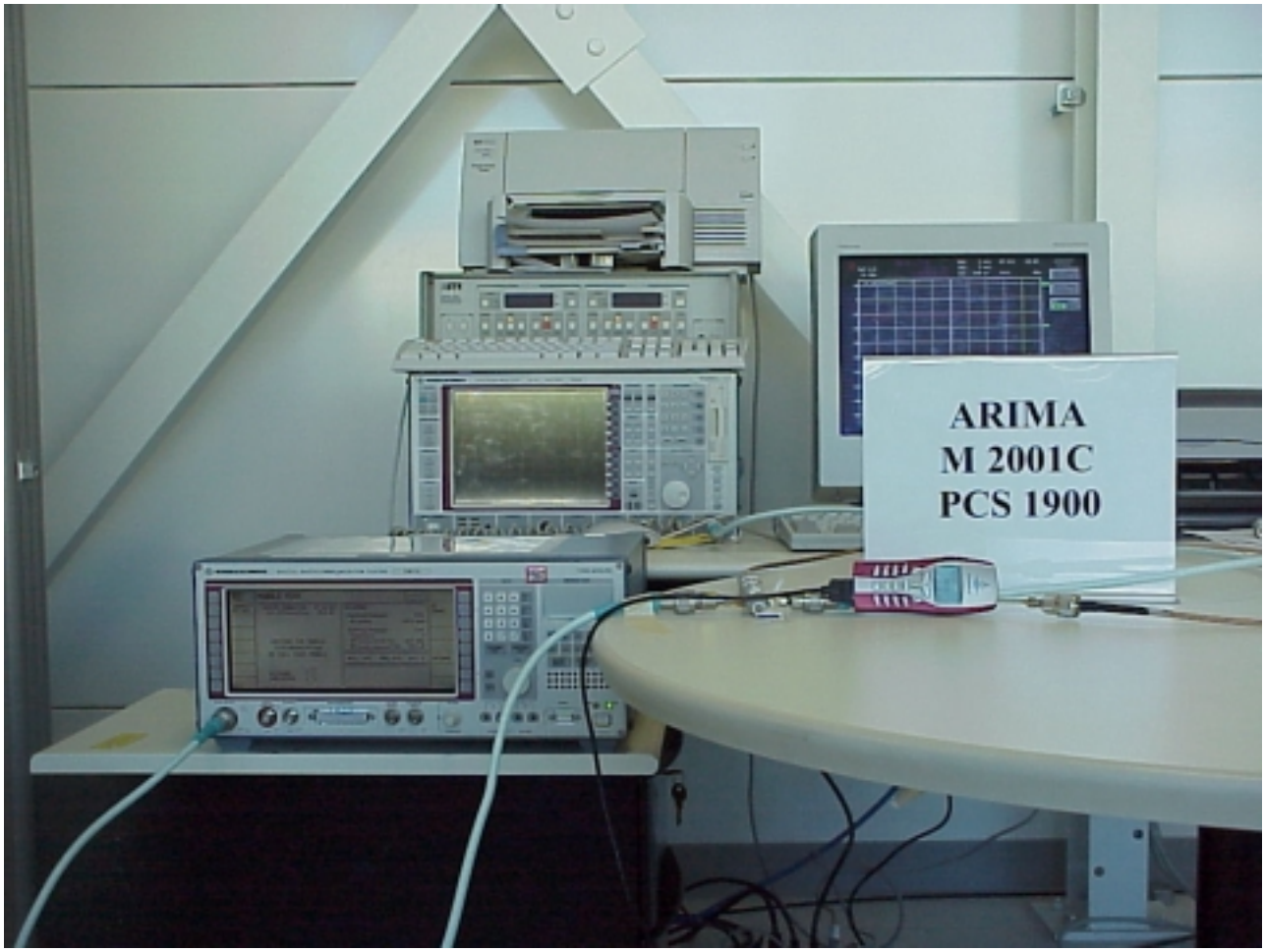
No	Instrument/Ancillary	Type	Manufacturer	Serial No.
01	Spectrum Analyzer	FSEM 30	Rohde & Schwarz	826 880/010
02	Digital Radio Communication Tester	CMD 55	Rohde & Schwarz	847958/008
03	Power Splitter	HP11667B	Hewlett Packard	00616
04	Pre-amplifier	JS4-00102600	Miteg	340123
05	High Pass Filter	5HC2700	Trilithic Inc.	9926013
06	DC Power Supply	HPE3610A	Hewlett Packard	KR83 23316
07	Horn Antenna	SAS-200/571	AH Systems Inc.	326
08	Biconilog Antenna	3141	ETS	0005-1186
09	LISN	836679	Rohde & Schwarz	003
10	Climatic Chamber	VT4004	Votsch	G1115

Test site

RADIATED EMISSIONS

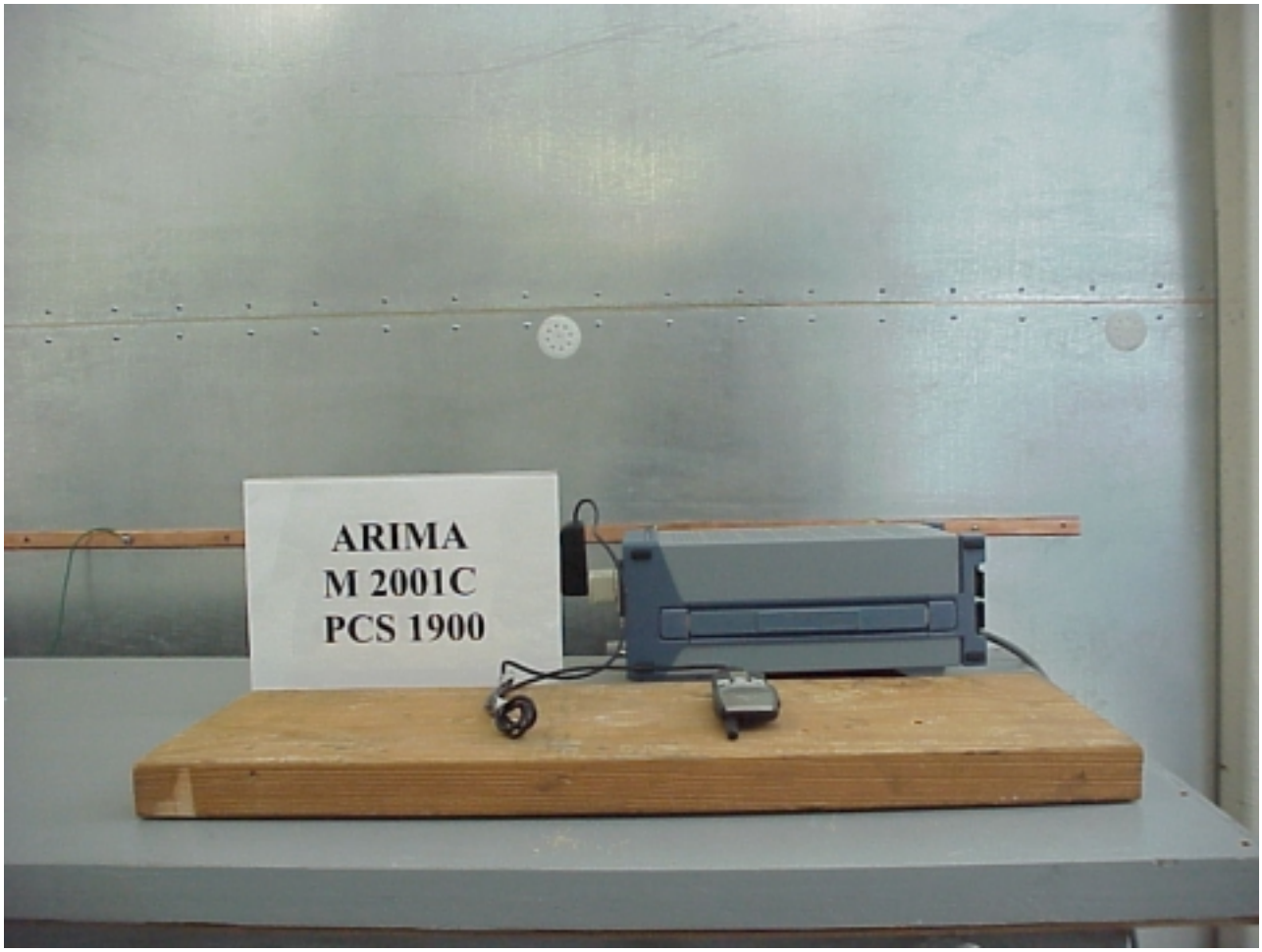


Test site:
CONDUCTED EMISSIONS



Test site:

CONDUCTED EMISSIONS



Test site:
EUT in Climatic Chamber

Photographs of the equipment

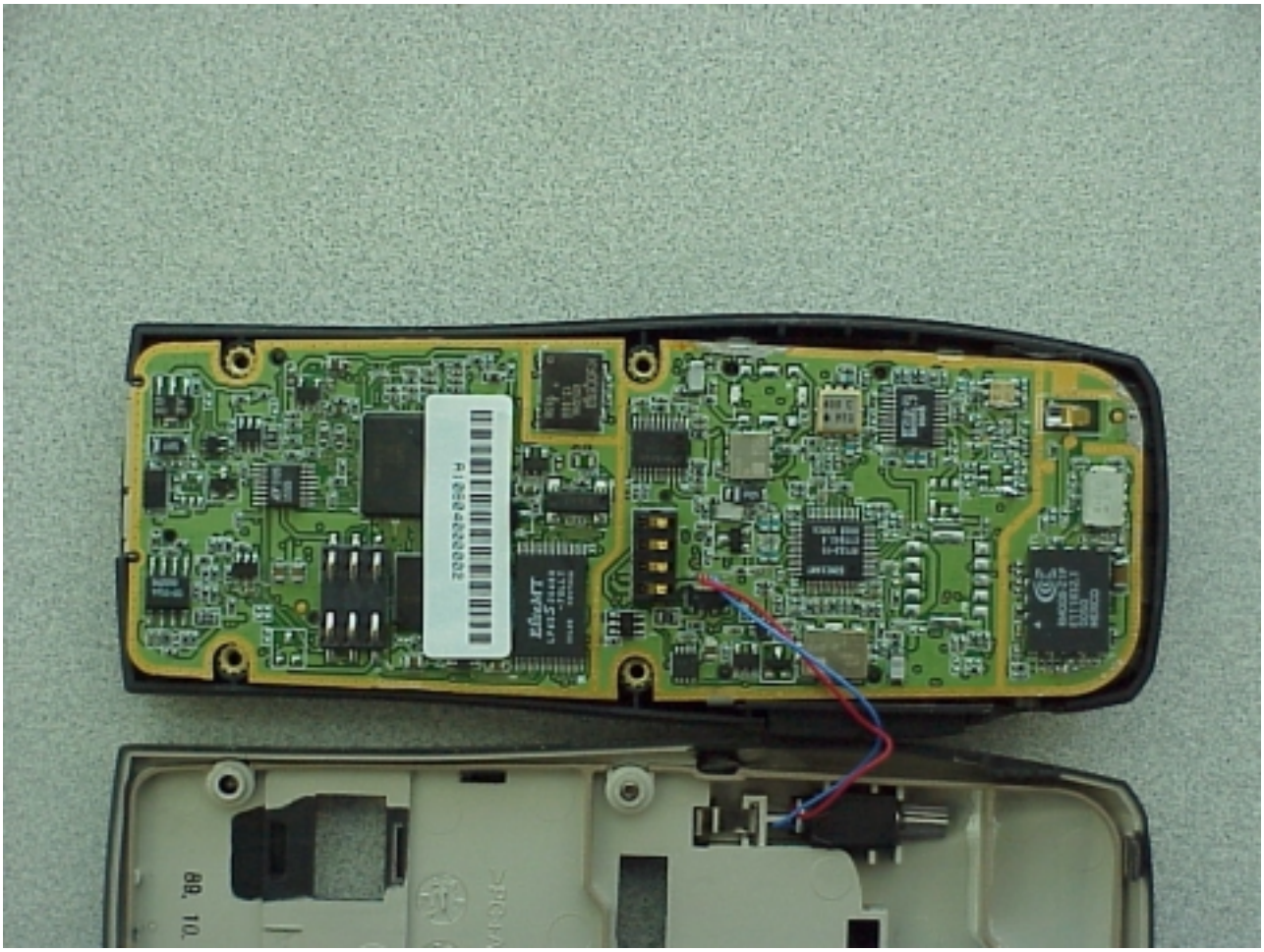
Photograph no.: 1

Photographs of the equipment

Photograph no.: 2

Photographs of the equipment
Photograph no.: 3

Photographs of the equipment
Photograph no.: 4



Photographs of the equipment
Photograph no.: 5

Photographs of the equipment
Photogtaph no. 6