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Anechoic chamber registration no.: 3463 (IC)
TCB ID: DE 0001



Accredited by the
German Accreditation Council
DAR-Registration Number
DAT-P-176/94-D1



Independent ETSI
compliance test house



Accredited Bluetooth[®] Test Facility (BQTF)

Test report No.	: 4-2156-01-03/06
Applicant	: Wavecom s. A.
Type	: Q24AU001 / Q24AU002 / Q24CL001 / Q24CL003 / Q24EX001 / Q24PL001 / Q24PL003 / Q24PL005 / Q24PL006
Test Standard	: FCC Part 22, 24 RSS-132, -133

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1 General information

1.1 Administrative data of the test facility

1.1.1 Identification of the testing laboratory

Company name:	Cetecom ICT Services GmbH
Address:	Untertürkheimerstr. 6-10 D-66117 Saarbruecken Germany
Laboratory accreditation:	DAR-Registration No. DAT-P-176/94-D1 Bluetooth Qualification Test Facility (BQTF) Federal Communications Commission (FCC)
Responsible for testing laboratory:	Identification/Registration No : 90462 M. Berg Phone: +49 681 598 0 Fax: +49 681 598 9075 email: info@ict.cetecom.de

1.2 Notes

The test results of this test report relate exclusively to the test item specified in 1.5. The CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalizations 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 ICT Services GmbH.



.....
Responsible for testing
(D. Gillmann)



.....
Responsible for laboratory
(M. Berg)

1.3 Details of Applicant

Name	:	Wavecom s. A.
Address	:	3 esplanade du Fonce
City	:	92442 Issy-les-Moulineux Cedex
Country	:	France
Phone	:	+ 33 (0) 1 46 29 43 60
Fax	:	+ 33 (0) 1 46 29 43 70
Contact	:	Mr. Eric Michel
Phone	:	+ 33 (0) 1 46 29 43 60
Fax	:	+ 33 (0) 1 46 29 43 70
e-mail	:	eric.michel@wavecom.fr

1.4 Application Details

Date of receipt of application	:	2006-09-20
Date of receipt of test item	:	2006-09-25
Date(s) of test	:	2006-09-26 to 2006-09-29
Date of report	:	2006-12-01

1.5 Additional EUT information for IC Canada (appendix 2)

Type of equipment	:	Wireless CPU (850/900/1800/1900)
Type name	:	Q24AU001
Manufacturer	:	Wavecom s.A.
Address	:	3 esplanade du Fonecet
City	:	94442 Issy – les Moulineux Cedex
Country	:	France
Frequency	:	1850.2 – 1909.8 MHz and 824.2 – 848.8 MHz
Type of modulation	:	300KGXW (GMSK)
Number of channels	:	300 (PCS1900) and 125 (PCS850)
Antenna Type	:	Rod areal antenna (23 cm)
Power supply (normal)	:	3.60V DC
Output power GSM 850 / GMSK	:	cond.: 31.8 dBm Peak ERP: 32.9 dBm (Burst);
Output power GSM 1900 / GMSK	:	cond : 29.9 dBm Peak EIRP: 32.1 dBm (Burst)
Transmitter Spurious (worst case)	:	-41.7 dBm
Receiver Spurious (worst case)	:	No peaks detected (noise floor)
FCC ID	:	Q9EQ24AU001
Certification No. IC	:	3651C-Q24AU001
Open Area Test Site IC No.	:	3463
IC Standards	:	RSS132, Issue 2, RSS133, Issue 3

ATTESTATION:

DECLARATION OF COMPLIANCE:

I declare that the testing was performed or supervised by me; that the test measurements were made in accordance with the above-mentioned Industry Canada standard(s); and that the equipment identified in this application has been subjected to all the applicable test conditions specified in the Industry Canada standards and all of the requirements of the standard have been met.

Laboratory Manager :

2006-12-01

D. Gillmann



Date

Name

Signature

Type of equipment	:	Wireless CPU (850/900/1800/1900)
Type name	:	Q24AU002
Manufacturer	:	Wavecom s.A.
Address	:	3 esplanade du Foncet
City	:	94442 Issy – les Moulineux Cedex
Country	:	France
Frequency	:	1850.2 – 1909.8 MHz and 824.2 – 848.8 MHz
Type of modulation	:	300KGXW (GMSK)
Number of channels	:	300 (PCS1900) and 125 (PCS850)
Antenna Type	:	Rod areal antenna (23 cm)
Power supply (normal)	:	3.60V DC
Output power GSM 850 / GMSK	:	cond.: 31.8 dBm Peak ERP: 32.9 dBm (Burst);
Output power GSM 1900 / GMSK	:	cond : 29.9 dBm Peak EIRP: 32.1 dBm (Burst)
Transmitter Spurious (worst case)	:	-41.7 dBm
Receiver Spurious (worst case)	:	No peaks detected (noise floor)
FCC ID	:	Q9EQ24AU002
Certification No. IC	:	3651C-Q24AU002
Open Area Test Site IC No.	:	3463
IC Standards	:	RSS132, Issue 2, RSS133, Issue 3

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Laboratory Manager :

2006-12-01

D. Gillmann



Date

Name

Signature

Type of equipment	:	Wireless CPU (850/900/1800/1900)
Type name	:	Q24CL001
Manufacturer	:	Wavecom s.A.
Address	:	3 esplanade du Foncet
City	:	94442 Issy – les Moulineux Cedex
Country	:	France
Frequency	:	1850.2 – 1909.8 MHz and 824.2 – 848.8 MHz
Type of modulation	:	300KGXW (GMSK)
Number of channels	:	300 (PCS1900) and 125 (PCS850)
Antenna Type	:	Rod areal antenna (23 cm)
Power supply (normal)	:	3.60V DC
Output power GSM 850 / GMSK	:	cond.: 31.8 dBm Peak ERP: 32.9 dBm (Burst);
Output power GSM 1900 / GMSK	:	cond : 29.9 dBm Peak EIRP: 32.1 dBm (Burst)
Transmitter Spurious (worst case)	:	-41.7 dBm
Receiver Spurious (worst case)	:	No peaks detected (noise floor)
FCC ID	:	Q9EQ24CL001
Certification No. IC	:	3651C-Q24CL001
Open Area Test Site IC No.	:	3463
IC Standards	:	RSS132, Issue 2, RSS133, Issue 3

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Laboratory Manager :

2006-12-01

D. Gillmann



Date

Name

Signature

Type of equipment	:	Wireless CPU (850/900/1800/1900)
Type name	:	Q24CL003
Manufacturer	:	Wavecom s.A.
Address	:	3 esplanade du Foncet
City	:	94442 Issy – les Moulineux Cedex
Country	:	France
Frequency	:	1850.2 – 1909.8 MHz and 824.2 – 848.8 MHz
Type of modulation	:	300KGXW (GMSK)
Number of channels	:	300 (PCS1900) and 125 (PCS850)
Antenna Type	:	Rod areal antenna (23 cm)
Power supply (normal)	:	3.60V DC
Output power GSM 850 / GMSK	:	cond.: 31.8 dBm Peak ERP: 32.9 dBm (Burst);
Output power GSM 1900 / GMSK	:	cond : 29.9 dBm Peak EIRP: 32.1 dBm (Burst)
Transmitter Spurious (worst case)	:	-41.7 dBm
Receiver Spurious (worst case)	:	No peaks detected (noise floor)
FCC ID	:	Q9EQ24CL003
Certification No. IC	:	3651C-Q24CL003
Open Area Test Site IC No.	:	3463
IC Standards	:	RSS132, Issue 2, RSS133, Issue 3

ATTESTATION:

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Laboratory Manager :

2006-12-01

D. Gillmann



Date

Name

Signature

Type of equipment	:	Wireless CPU (850/900/1800/1900)
Type name	:	Q24EX001
Manufacturer	:	Wavecom s.A.
Address	:	3 esplanade du Foncet
City	:	94442 Issy – les Moulineux Cedex
Country	:	France
Frequency	:	1850.2 – 1909.8 MHz and 824.2 – 848.8 MHz
Type of modulation	:	300KGXW (GMSK)
Number of channels	:	300 (PCS1900) and 125 (PCS850)
Antenna Type	:	Rod areal antenna (23 cm)
Power supply (normal)	:	3.60V DC
Output power GSM 850 / GMSK	:	cond.: 31.8 dBm Peak ERP: 32.9 dBm (Burst);
Output power GSM 1900 / GMSK	:	cond : 29.9 dBm Peak EIRP: 32.1 dBm (Burst)
Transmitter Spurious (worst case)	:	-41.7 dBm
Receiver Spurious (worst case)	:	No peaks detected (noise floor)
FCC ID	:	Q9EQ24EX001
Certification No. IC	:	3651C-Q24EX001
Open Area Test Site IC No.	:	3463
IC Standards	:	RSS132, Issue 2, RSS133, Issue 3

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Laboratory Manager :

2006-12-01

D. Gillmann



Date

Name

Signature

Type of equipment	:	Wireless CPU (850/900/1800/1900)
Type name	:	Q24PL001
Manufacturer	:	Wavecom s.A.
Address	:	3 esplanade du Foncet
City	:	94442 Issy – les Moulineux Cedex
Country	:	France
Frequency	:	1850.2 – 1909.8 MHz and 824.2 – 848.8 MHz
Type of modulation	:	300KGXW (GMSK)
Number of channels	:	300 (PCS1900) and 125 (PCS850)
Antenna Type	:	Rod areal antenna (23 cm)
Power supply (normal)	:	3.60V DC
Output power GSM 850 / GMSK	:	cond.: 31.8 dBm Peak ERP: 32.9 dBm (Burst);
Output power GSM 1900 / GMSK	:	cond : 29.9 dBm Peak EIRP: 32.1 dBm (Burst)
Transmitter Spurious (worst case)	:	-41.7 dBm
Receiver Spurious (worst case)	:	No peaks detected (noise floor)
FCC ID	:	Q9EQ24PL001
Certification No. IC	:	3651C-Q24PL001
Open Area Test Site IC No.	:	3463
IC Standards	:	RSS132, Issue 2, RSS133, Issue 3

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Laboratory Manager :

2006-12-01

D. Gillmann



Date

Name

Signature

Type of equipment	:	Wireless CPU (850/900/1800/1900)
Type name	:	Q24PL003
Manufacturer	:	Wavecom s.A.
Address	:	3 esplanade du Foncet
City	:	94442 Issy – les Moulineux Cedex
Country	:	France
Frequency	:	1850.2 – 1909.8 MHz and 824.2 – 848.8 MHz
Type of modulation	:	300KGXW (GMSK)
Number of channels	:	300 (PCS1900) and 125 (PCS850)
Antenna Type	:	Rod areal antenna (23 cm)
Power supply (normal)	:	3.60V DC
Output power GSM 850 / GMSK	:	cond.: 31.8 dBm Peak ERP: 32.9 dBm (Burst);
Output power GSM 1900 / GMSK	:	cond : 29.9 dBm Peak EIRP: 32.1 dBm (Burst)
Transmitter Spurious (worst case)	:	-41.7 dBm
Receiver Spurious (worst case)	:	No peaks detected (noise floor)
FCC ID	:	Q9EQ24PL003
Certification No. IC	:	3651C-Q24PL003
Open Area Test Site IC No.	:	3463
IC Standards	:	RSS132, Issue 2, RSS133, Issue 3

ATTESTATION:

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Laboratory Manager :

2006-12-01

D. Gillmann



Date

Name

Signature

Type of equipment	:	Wireless CPU (850/1900)
Type name	:	Q24PL005
Manufacturer	:	Wavecom s.A.
Address	:	3 esplanade du Foncet
City	:	94442 Issy – les Moulineux Cedex
Country	:	France
Frequency	:	1850.2 – 1909.8 MHz and 824.2 – 848.8 MHz
Type of modulation	:	300KGXW (GMSK)
Number of channels	:	300 (PCS1900) and 125 (PCS850)
Antenna Type	:	Rod areal antenna (23 cm)
Power supply (normal)	:	3.60V DC
Output power GSM 850 / GMSK	:	cond.: 31.8 dBm Peak ERP: 32.9 dBm (Burst);
Output power GSM 1900 / GMSK	:	cond : 29.9 dBm Peak EIRP: 32.1 dBm (Burst)
Transmitter Spurious (worst case)	:	-41.7 dBm
Receiver Spurious (worst case)	:	No peaks detected (noise floor)
FCC ID	:	Q9EQ24PL005
Certification No. IC	:	3651C-Q24PL005
Open Area Test Site IC No.	:	3463
IC Standards	:	RSS132, Issue 2, RSS133, Issue 3

ATTESTATION:

DECLARATION OF COMPLIANCE:

I declare that the testing was performed or supervised by me; that the test measurements were made in accordance with the above-mentioned Industry Canada standard(s); and that the equipment identified in this application has been subjected to all the applicable test conditions specified in the Industry Canada standards and all of the requirements of the standard have been met.

Laboratory Manager :

2006-12-01

D. Gillmann



Date

Name

Signature

Type of equipment	:	Wireless CPU (850/1900)
Type name	:	Q24PL006
Manufacturer	:	Wavecom s.A.
Address	:	3 esplanade du Foncet
City	:	94442 Issy – les Moulineux Cedex
Country	:	France
Frequency	:	1850.2 – 1909.8 MHz and 824.2 – 848.8 MHz
Type of modulation	:	300KGXW (GMSK)
Number of channels	:	300 (PCS1900) and 125 (PCS850)
Antenna Type	:	Rod areal antenna (23 cm)
Power supply (normal)	:	3.60V DC
Output power GSM 850 / GMSK	:	cond.: 31.8 dBm Peak ERP: 32.9 dBm (Burst);
Output power GSM 1900 / GMSK	:	cond : 29.9 dBm Peak EIRP: 32.1 dBm (Burst)
Transmitter Spurious (worst case)	:	-41.7 dBm
Receiver Spurious (worst case)	:	No peaks detected (noise floor)
FCC ID	:	Q9EQ24PL006
Certification No. IC	:	3651C-Q24PL006
Open Area Test Site IC No.	:	3463
IC Standards	:	RSS132, Issue 2, RSS133, Issue 3

ATTESTATION:

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Laboratory Manager :

2006-12-01

D. Gillmann



Date

Name

Signature

1.6 Test Setup

Hardware : 304
Software :

Mobile; (cond. measurements) : SN 177886250067 04
Mobile; (rad. measurements) : SN 177886250067 04

The under table give the details of each configuration of Q24NG that are offered to our customers:

Description	Band	BOM version	Marketing reference	BB	Memory		RF connection				SIM
				OneC AMR	Flash size (Mb)	RAM size (Mb)	UFL cps side	MMS	UFL no cps side	IMP	SIM Holder
Q24 Classic	850/900/1800/1900	WMQuik_Q24CL001_300	Q24CL001	Y	32	16	Y	N	N	Y	N
Q24 Classic HR codec	850/900/1800/1900	WMQuik_Q24CL002_301	Q24CL002	N	32	16	Y	N	N	Y	N
Q24 Classic with SIM holder	850/900/1800/1900	WMQuik_Q24CL003_302	Q24CL003	Y	32	16	Y	N	N	Y	Y
Q24 Classic HR coded with SIM holder	850/900/1800/1900	WMQuik_Q24CL004_303	Q24CL004	N	32	16	Y	N	N	Y	Y
Q24 Plus	850/900/1800/1900	WMQuik_Q24PL001_304	Q24PL001	Y	32	16	Y	N	N	Y	N
Q24 Plus HR codec	850/900/1800/1900	WMQuik_Q24PL002_305	Q24PL002	N	32	16	Y	N	N	Y	N
Q24 Plus with Sim holder	850/900/1800/1900	WMQuik_Q24PL003_306	Q24PL003	Y	32	16	Y	N	N	Y	Y
Q24 Plus HR codec with SIM holder	850/900/1800/1900	WMQuik_Q24PL004_307	Q24PL004	N	32	16	Y	N	N	Y	Y
Q24 Plus dual band	850/1900	WMQuik_Q24PL005_312	Q24PL005	Y	32	16	Y	N	N	Y	N
Q24 Plus with SIM holder dual band	850/1900	WMQuik_Q24PL006_313	Q24PL006	Y	32	16	Y	N	N	Y	Y
Q24 Extended	850/900/1800/1900	WMQuik_Q24EX001_308	Q24EX001	Y	32	4	Y	N	N	Y	N
Q24 Extended HR codec	850/900/1800/1900	WMQuik_Q24EX002_309	Q24EX002	N	32	4	Y	N	N	Y	N
Q24 Auto with MMS	850/900/1800/1900	WMQuik_Q24AU001_310	Q24AU001	Y	32	4	N	Y	N	Y	N
Q24 Auto with UFL	850/900/1800/1900	WMQuik_Q24AU002_311	Q24AU002	Y	32	4	N	N	Y	Y	N
Q24 Auto with UFL-HR codec	850/900/1800/1900	WMQuik_Q24AU003_314	Q24AU003	N	32	4	N	N	Y	Y	N

The Q24Plus is considered as the reference product, representative of all features and performances.

1.7 Test Standards

FCC:	CFR Part 22 H
	CFR Part 24 E
IC:	RSS 132, Issue 2
	RSS 133, Issue 3

2 Statement of Compliance

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

2.1 Summary of Measurement Results

2.1.1 PCS 1900

Section in this Report	Test Name	Verdict
3.1.1	RF Power Output	pass
3.1.2	Frequency Stability	pass
3.1.3	Radiated Emissions	pass
3.1.4	Receiver Radiated Emissions	pass
3.1.5	Conducted Spurious Emissions	pass
3.1.6	Block Edge Compliance	pass
3.1.7	Occupied Bandwidth	pass

2.1.2 GSM 850

Section in this Report	Test Name	Verdict
3.2.1	RF Power Output	pass
3.2.2	Frequency Stability	pass
3.2.3	Radiated Emissions	pass
3.2.4	Receiver Radiated Emissions	pass
3.2.5	Conducted Spurious Emissions	pass
3.2.6	Block Edge Compliance	pass
3.2.7	Occupied Bandwidth	pass

3 Measurements and results

For Part 24/22 we use the substitution method (TIA/EIA 603).

All measurements in this report are done in GSM mode. The device is able to transmit data in GPRS mode also.

But because the current measurements are performed in PEAK mode no other results from GPRS mode are possible.

The only different is the modulation average power, which is 3 dB higher (by using 2 timeslots in the Up-link).

All relevant tests have been repeated in 8-PSK Modulation if EDGE Mode is supported.

3.1 PART PCS 1900

3.1.1 RF Power Output

Reference

FCC:	CFR Part 24.232, 2.1046
IC:	RSS 133, Issue 3, Section 4.3

Summary:

This paragraph contains both average/peak output power and EIRP measurements for the mobile station. 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 mobile was set up for the max. output power with pseudo random data modulation.

The power was measured with R&S Signal Analyzer FSIQ 26 (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

Test Results: Output Power (conducted)

Frequency (MHz)	Power Class	Peak Output Power (dBm)	Average Output Power (dBm)
1850.2	0	29.8	29.7
1880.0	0	29.9	29.8
1909.8	0	29.8	29.7
Measurement uncertainty		±0.5 dB	

EIRP Measurements

Description:

This is the test for the maximum radiated power from the phone.

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."

Measuring the EIRP of Spurious/Harmonic Emissions using Substitution Method

(a) The measurements was performed with full rf output power and modulation.

(b) Test was performed at listed 3m test site (listed with FCC, IC).

(c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)

(d) The BICONILOG antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.

(e) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor

$E \text{ (dBuV/m)} = \text{Reading (dBuV)} + \text{Total Correction Factor (dB/m)}$

(f) Set the EMI Receiver and #2 as follows:

Center Frequency: test frequency

Resolution BW: 100 kHz

Video BW: same

Detector Mode: positive

Average: off

Span: 3 x the signal bandwidth

(g) The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.

(h) The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.

(i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.

(j) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.

(k) The above steps were repeated with both transmitters' antenna and test receiving antenna placed in vertical and horizontal polarization. Both readings with the antennas placed in vertical and horizontal polarization shall be recorded.

(l) Repeat for all different test signal frequencies

Measuring the EIRP of Spurious/Harmonic Emissions using Substitution Method

(a) Set the EMI Receiver (for measuring E-Field) and Receiver #2 (for measuring EIRP) as follows:

Center Frequency : equal to the signal source
Resolution BW : 10 kHz
Video BW : same
Detector Mode : positive
Average : off
Span : 3 x the signal bandwidth

(b) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level

Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor

$E \text{ (dBuV/m)} = \text{Reading (dBuV)} + \text{Total Correction Factor (dB/m)}$

(c) Select the frequency and E-field levels for ERP/EIRP measurements.

(d) Substitute the EUT by a signal generator and one of the following transmitting antenna (substitution antenna):

DIPOLE antenna for frequency from 30-1000 MHz or .HORN antenna for frequency above 1 GHz }.

(e) Mount the transmitting antenna at 1.5 meter high from the ground plane.

(f) Use one of the following antenna as a receiving antenna: .DIPOLE antenna for frequency from 30-1000 MHz or .HORN antenna for frequency above 1 GHz }.

(g) If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.

(h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.

(i) Tune the EMI Receivers to the test frequency.

(j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.

(k) The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.

(l) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.

(m) Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.

(n) Record the power level read from the Average Power Meter and calculate the ERP/EIRP as follows:

$$P = P1 - L1 = (P2 + L2) - L1 = P3 + A + L2 - L1$$

$$\text{EIRP} = P + G1 = P3 + L2 - L1 + A + G1$$

$$\text{ERP} = \text{EIRP} - 2.15 \text{ dB}$$

Total Correction factor in EMI Receiver # 2 = $L2 - L1 + G1$

Where: P: Actual RF Power fed into the substitution antenna port after corrected.

P1: Power output from the signal generator

P2: Power measured at attenuator A input

P3: Power reading on the Average Power Meter

EIRP: EIRP after correction

ERP: ERP after correction

(o) Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o)

(p) Repeat step (d) to (o) for different test frequency

(q) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.

(r) Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port.

Correct the antenna gain if necessary.

Limits:

Power Step	Burst PEAK EIRP (dBm)
0	<33

Test Results: Output Power (radiated)

Frequency (MHz)	Power Class	BURST PEAK EIRP (dBm)
1850.2	0	31.9
1880.0	0	32.1
1909.8	0	31.9
Measurement uncertainty	±3 dB	

Sample Calculation:

Freq	SA Reading	SG Setting	Ant. gain	Dipol gain	Cable loss	EIRP Result			
MHz	dBμV	dBm	dBd	dBd	dB	dBm			
1880.0	143.2	27.0	8.4	0.0	3.3	32.1			

$$\text{EIRP} = \text{SG (dBm)} - \text{Cable Loss (dB)} + \text{Ant. gain (dBd)}$$

3.1.2 Frequency Stability

Reference

FCC:	CFR Part 24.235, 2.1055
IC:	RSS 133, Issue 3, Section 4.2

Method of Measurement:

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the mobile station in a "call mode". This is accomplished with the use of a R&S CMU 200 DIGITAL RADIOCOMMUNICATION TESTER..

1. Measure the carrier frequency at room temperature.
2. Subject the mobile station to overnight soak at -30 C.
3. With the mobile station, powered with Vnom, connected to the CMU 200 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.
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, un-powered, before making measurements.
5. Re-measure carrier frequency at room temperature with Vnom. Vary supply voltage from Vmin to Vmax, in 12 steps re-measuring carrier frequency at each voltage. Pause at Vnom for 1 1/2 hours un-powered , to allow any self heating to stabilize, before continuing.
6. Subject the mobile station to overnight soak at +60 C.
7. With the mobile station, powered with Vnom, connected to the CMU 200 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, un-powered, before making measurements.
9. At all temperature levels hold the temperature to +/- 0.5 C during the measurement procedure.

Measurement Limit:

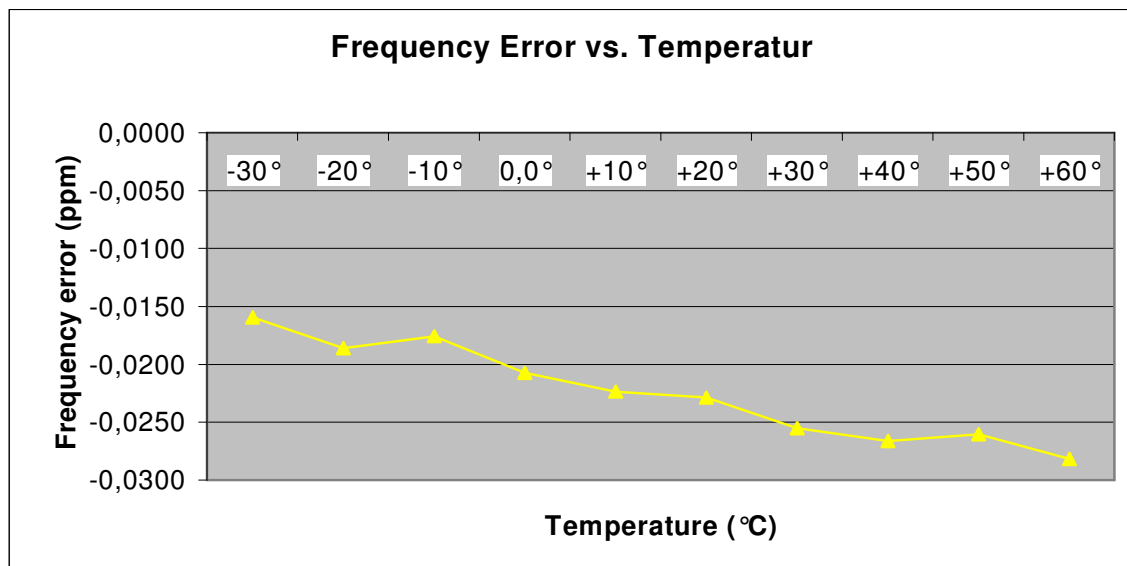
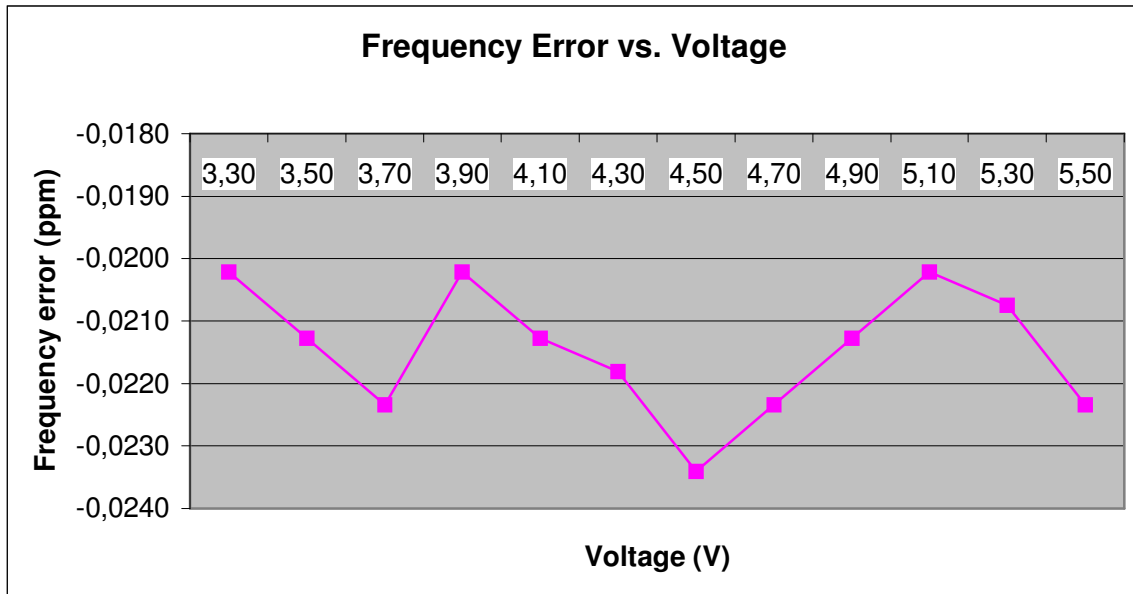
According to the JTC standard the frequency stability of the carrier shall be accurate to within 0.1 ppm of the received frequency from the base station. This accuracy is sufficient to meet Sec. 24.235, Frequency Stability. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block..

Test Results: AFC FREQ ERROR vs. VOLTAGE

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
3.3	-38	-0,00000202	-0,0202
3.5	-40	-0,00000213	-0,0213
3.5	-42	-0,00000223	-0,0223
3.7	-38	-0,00000202	-0,0202
3.9	-40	-0,00000213	-0,0213
4.1	-41	-0,00000218	-0,0218
4.3	-44	-0,00000234	-0,0234
4.5	-42	-0,00000223	-0,0223
4.7	-40	-0,00000213	-0,0213
4.9	-38	-0,00000202	-0,0202
5.1	-39	-0,00000207	-0,0207
5.3	-38	-0,00000202	-0,0202

Test Results: AFC FREQ ERROR vs. TEMPERATURE

TEMPERATURE (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	-30	-0,00000160	-0,0160
-20	-35	-0,00000186	-0,0186
-10	-33	-0,00000176	-0,0176
±0.0	-39	-0,00000207	-0,0207
+10	-42	-0,00000223	-0,0223
+20	-43	-0,00000229	-0,0229
+30	-48	-0,00000255	-0,0255
+40	-50	-0,00000266	-0,0266
+50	-49	-0,00000261	-0,0261
+60	-53	-0,00000282	-0,0282



3.1.3 Radiated Emissions

Reference

FCC:	CFR Part 24.238, 2.1053
IC:	RSS 133, Issue 3, Section 4.4

Measurement Procedure:

The following steps outline the procedure used to measure the radiated emissions from the mobile station. The site is constructed in accordance with ANSI C63.4:2003 requirements and is recognized by the FCC to be in compliance for a 3 and a 10 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 (here 10m semi-anechoic chamber listed by FCC) test procedure is as follows:

- The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.
- The antenna output was terminated in a 50 ohm load.
- A double ridged waveguide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.
- 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 1 MHz bandwidth. If the harmonic could not be detected above the noise floor, the ambient level was recorded.
- Now each detected emissions were substituted by the Substitution method, in accordance with the TIA/EIA 603.

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 $43+10\log(P)$ 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

Radiated emissions measurements were made only at the upper, center, and lower carrier frequencies of the USPCS band (1850.2 MHz, 1880.0 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.

The final open field radiated levels are presented on the next table.

All measurements were done in horizontal and vertical polarization, the plots show the worst case. As can be seen from this data, the emissions from the test item were within the specification limit.

Harmonic	Tx ch.-512 Freq. (MHz)	Level (dBm)	Tx ch.-661 Freq. (MHz)	Level (dBm)	Tx ch.-810 Freq. (MHz)	Level (dBm)
2	3700.4	-	3760	-	3819.6	-
3	5550.6	- 45.6	5640	- 46.8	5729.4	- 41.7
4	7400.8	-	7520	-	7639.2	-
5	9251.0	-	9400	-	9549.0	-
6	11101.2	-	11280	- 43.5	11458.8	-
7	12951.4	-	13160	-	13368.6	-
8	14801.6	-	15040	-	15278.4	-
9	16651.8	-	16920	-	17188.2	-
10	18502.0	-	18800	-	19098.0	-

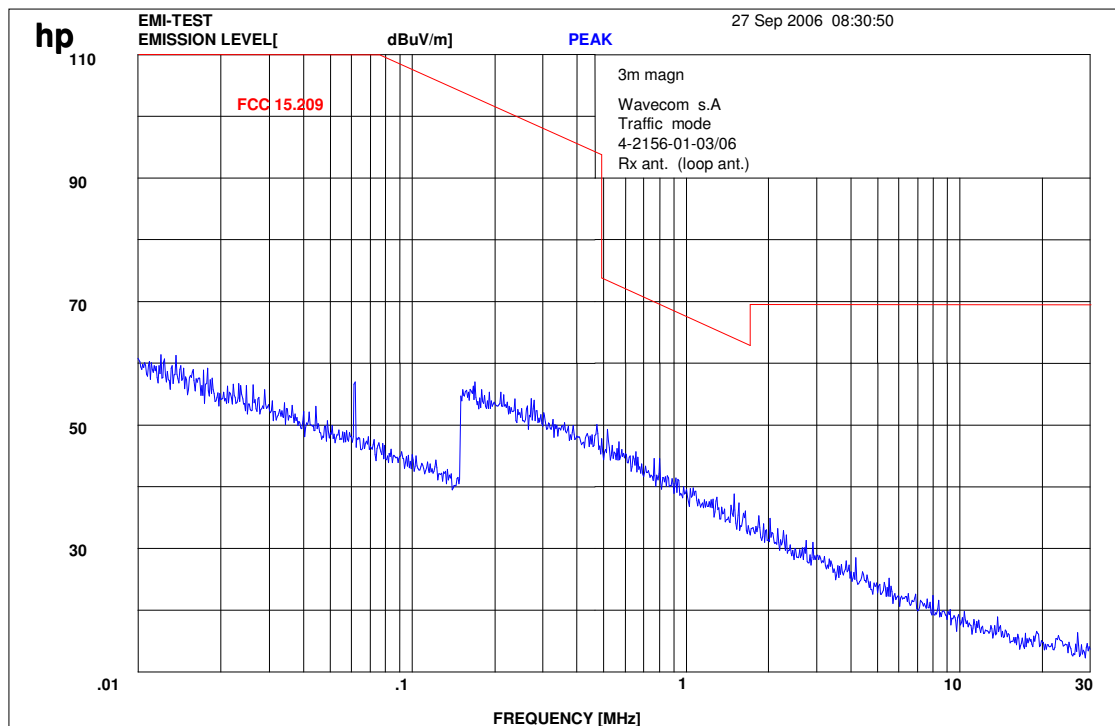
No peaks found < 20 dB below limit.

Sample calculation:

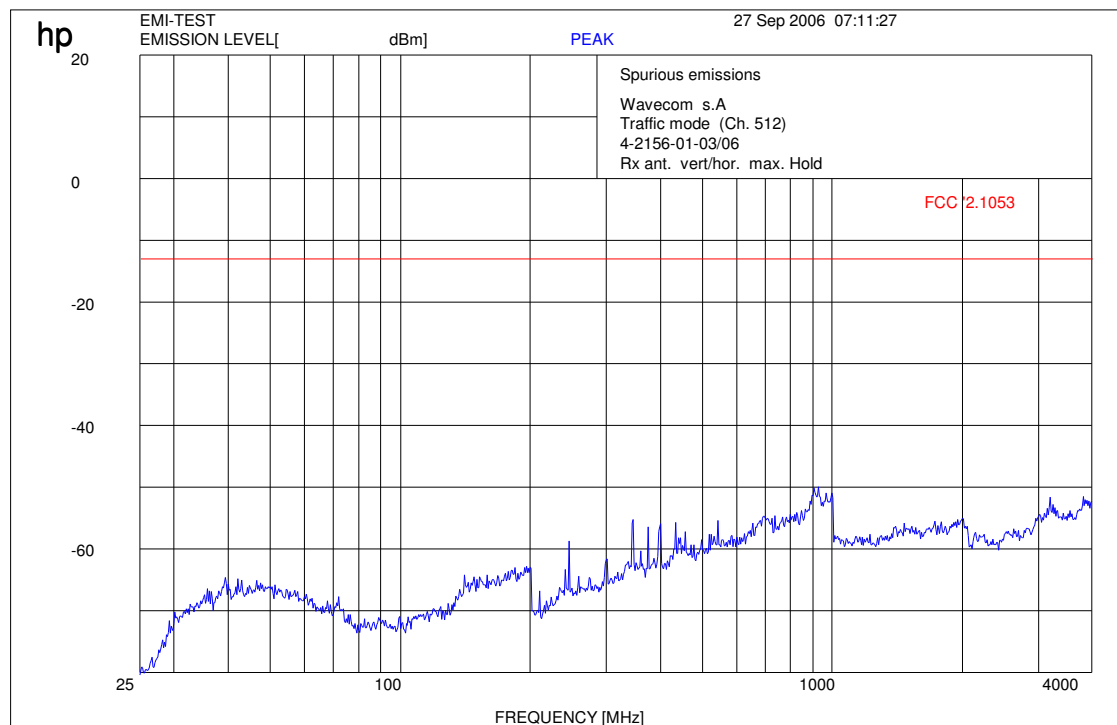
Freq	SA Reading	SG Setting	Ant. gain	Dipol gain	Cable loss	EIRP Result			
MHz	dBμV	dBm	dB	dBd	dB	dBm			
1880.0	143.2	27.0	8.4	0.0	3.3	32.1			

EIRP = SG (dBm) - Cable Loss (dB) + Ant. gain (dBi)

Traffic mode up to 30 MHz (Valid for all 3 channels)



Channel 512 (30 MHz - 4 GHz)

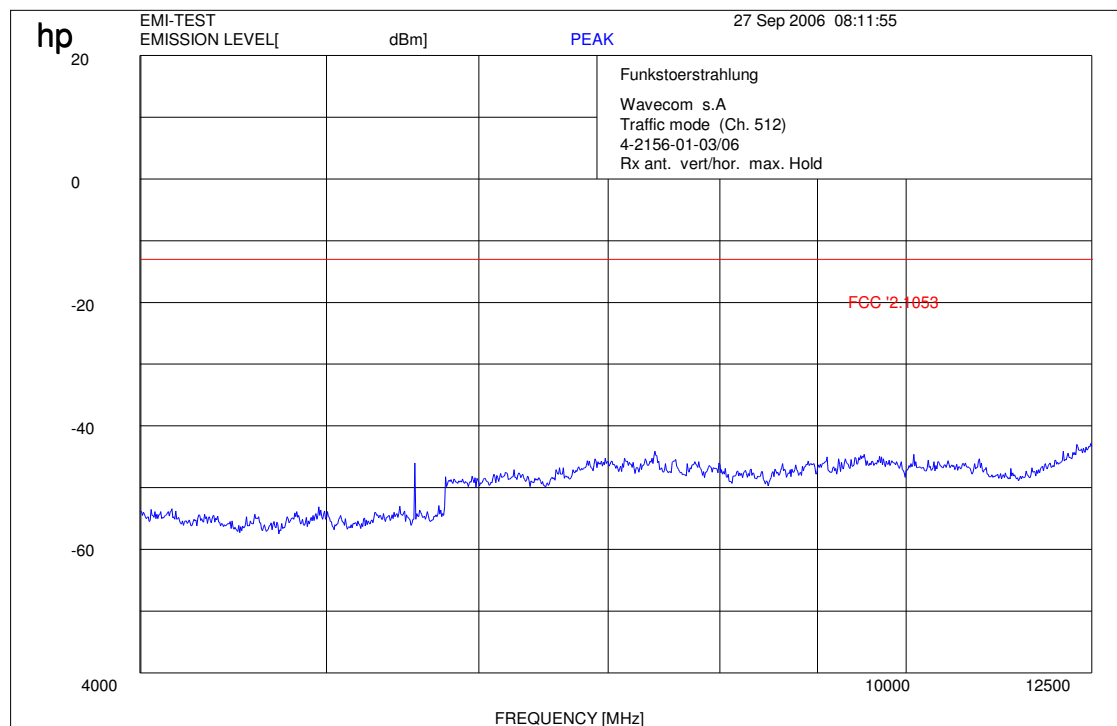


$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW / VBW 1 MHz

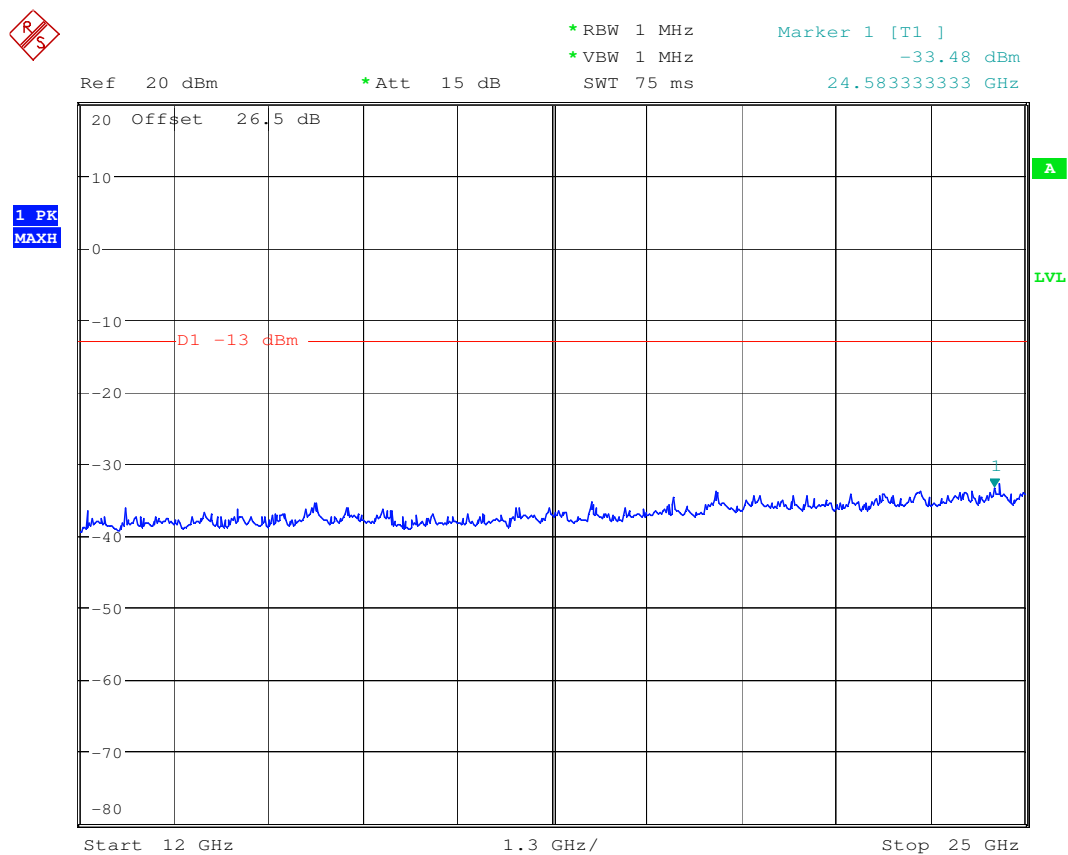
Carrier suppressed with a rejection filter

Channel 512 (4 GHz – 12.5 GHz)



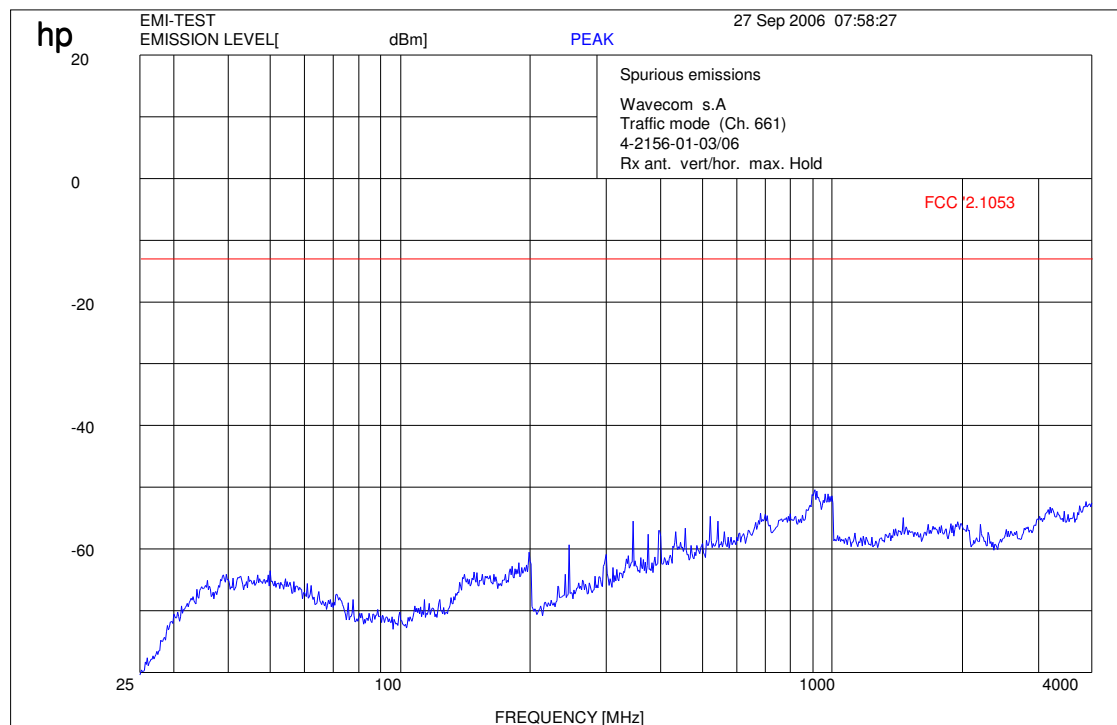
$f \geq 1\text{GHz}$: RBW / VBW 1 MHz

Channel 512 (12 GHz - 25 GHz) valid for all 3 channels



Date: 26.SEP.2006 13:33:58

Channel 661 (30 MHz - 4 GHz)

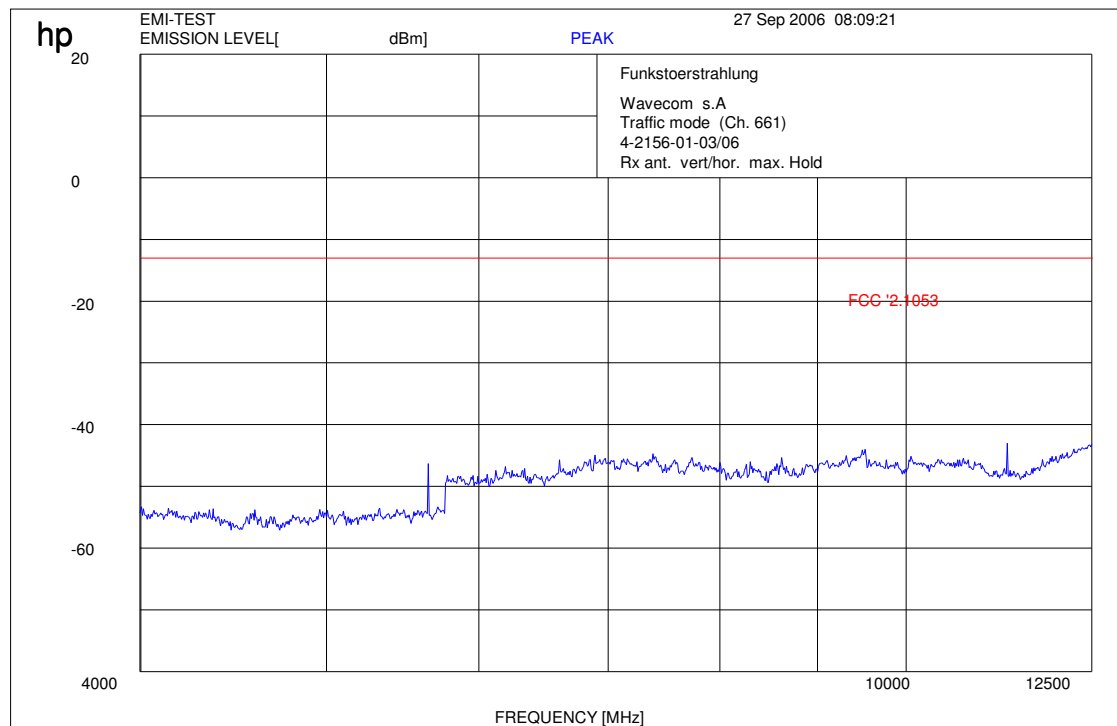


$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW / VBW 1 MHz

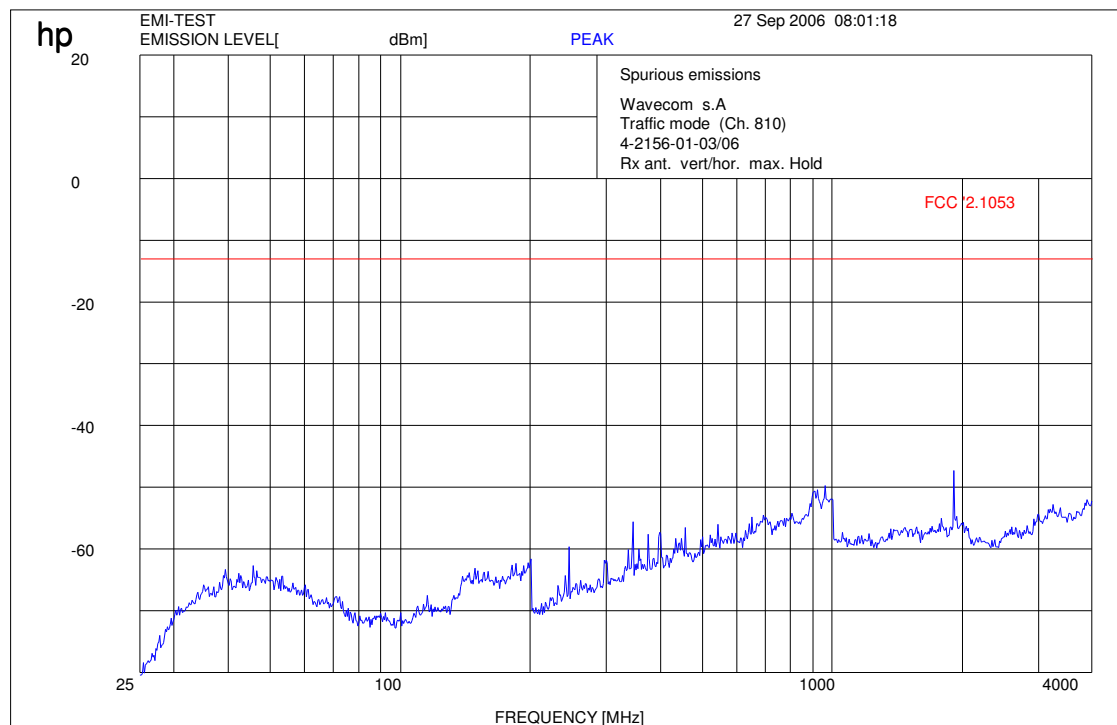
Carrier suppressed with a rejection filter

Channel 661 (4 GHz – 12.5 GHz)



$f \geq 1\text{GHz}$: RBW / VBW 1 MHz

Channel 810 (30 MHz - 4 GHz)

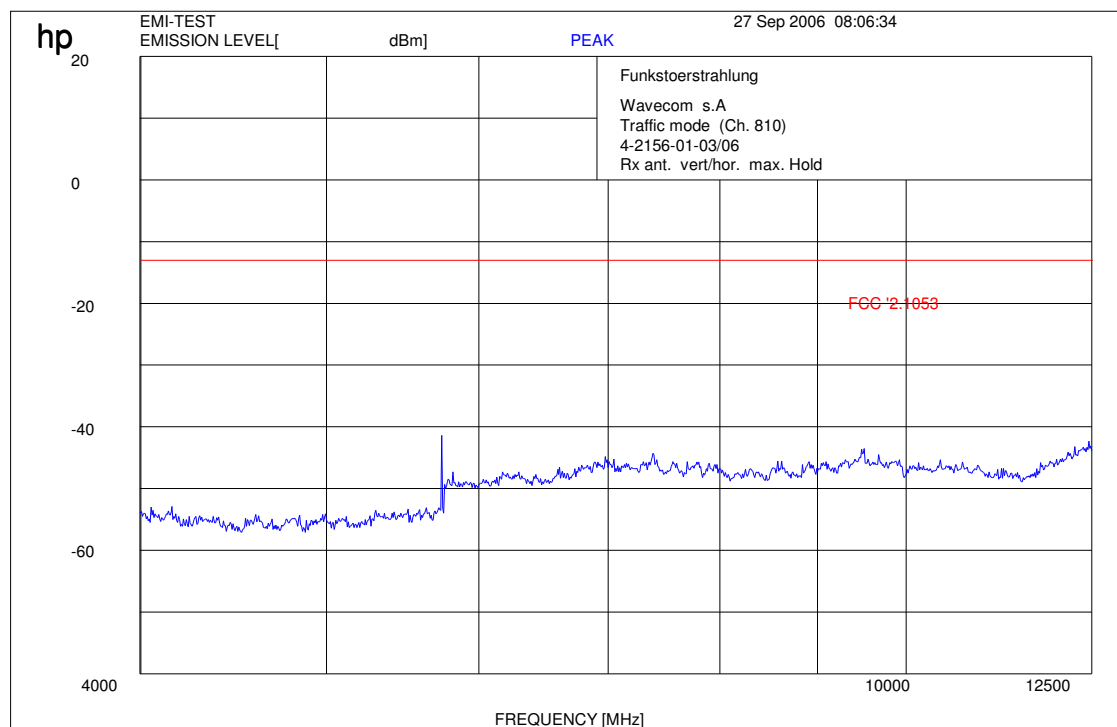


$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW / VBW 1 MHz

Carrier suppressed with a rejection filter

Channel 810 (4 GHz – 12.5 GHz)



$f \geq 1\text{GHz}$: RBW / VBW 1 MHz

3.1.4 Receiver Radiated Emissions

Reference

FCC:	CFR Part 15.109, 2.1053
IC:	RSS 133, Issue 3, Section 4.5

Measurement Results

SPURIOUS EMISSIONS LEVEL (μV/m)								
Idle mode								
f (MHz)	Detector	Level (μV/m)	f (MHz)	Detector	Level (μV/m)	f (MHz)	Detector	Level (μV/m)
-	no spurious or more than 20 dB under limit	-	-	-	-	-	-	-
-		-	-	-	-	-	-	-
-		-	-	-	-	-	-	-
-		-	-	-	-	-	-	-
-		-	-	-	-	-	-	-
-		-	-	-	-	-	-	-
-		-	-	-	-	-	-	-
-		-	-	-	-	-	-	-
Measurement uncertainty			±3 dB					

$f < 1$ GHz : RBW/VBW: 100 kHz

$f \geq 1$ GHz : RBW/VBW: 1 MHz

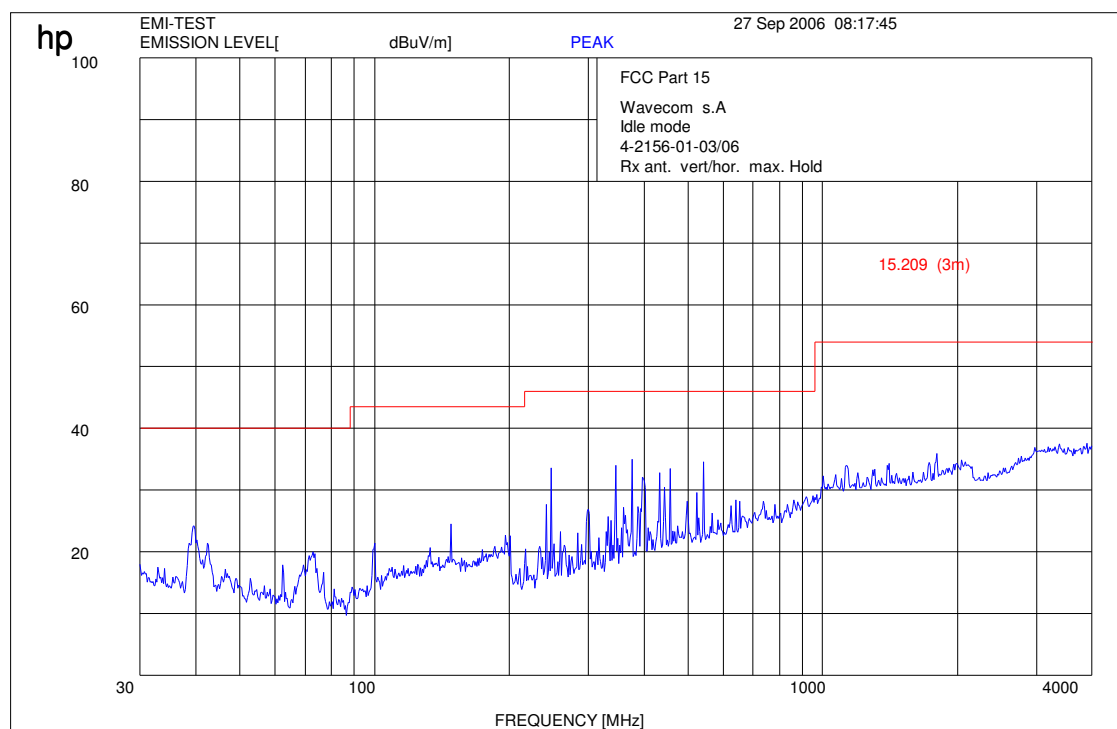
H = Horizontal ; V= Vertical

For measurement distance see table below

Limits: § 15.109

Frequency (MHz)	Field strength ($\mu\text{V/m}$)	Measurement distance (m)
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
above 960	500	3

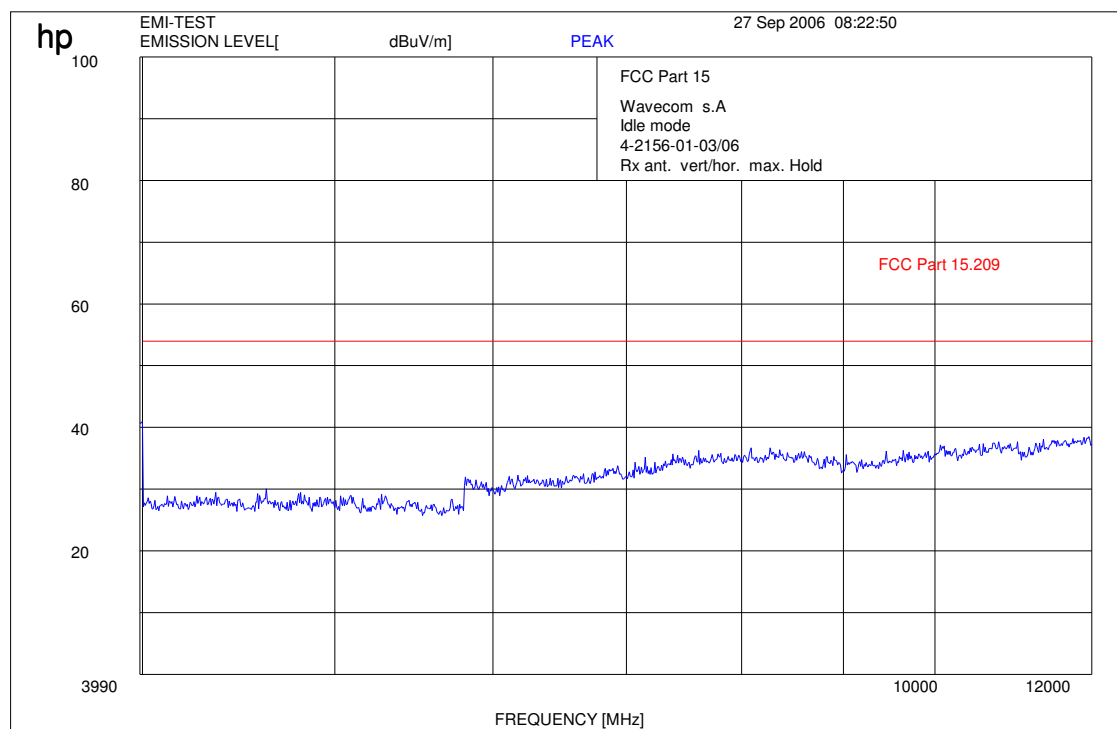
IDLE MODE (30 MHz - 4 GHz)



$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW / VBW 1 MHz

Idle Mode (4 GHz – 12.0 GHz)



$f \geq 1\text{GHz}$: RBW / VBW 1 MHz

Idle Mode (12 GHz - 25 GHz)



*RBW 1 MHz

Marker 1 [T1]

*VBW 1 MHz

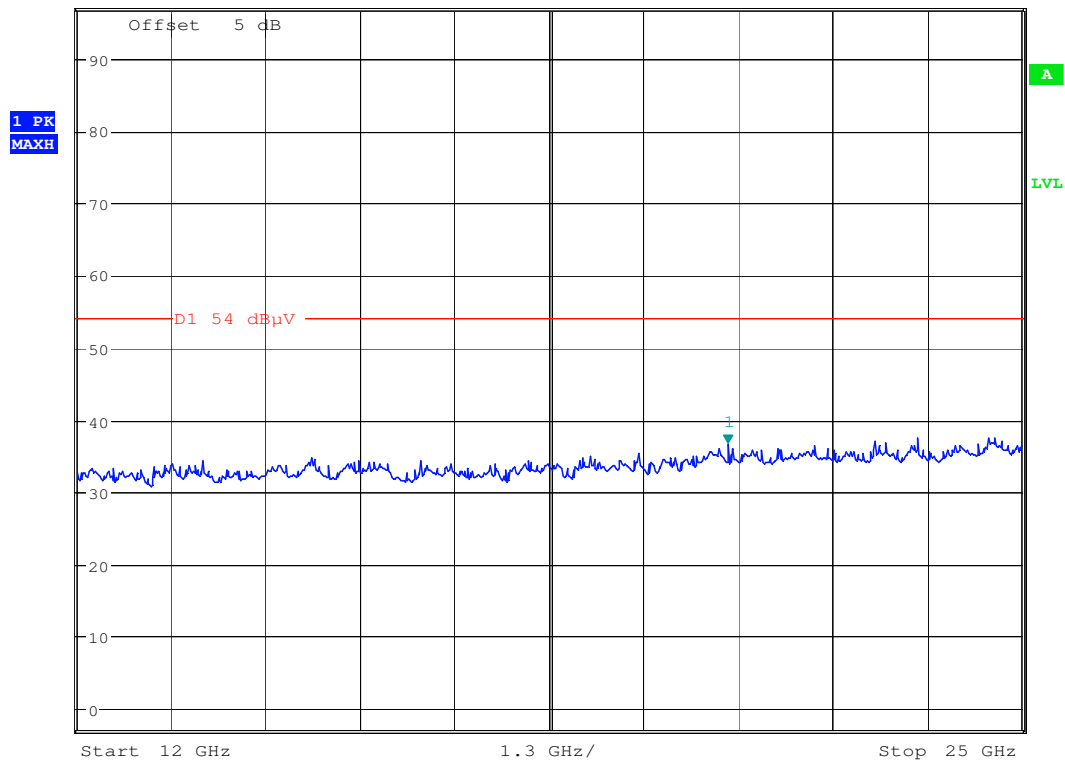
36.50 dBμV

Ref 97 dBμV

*Att 0 dB

SWT 75 ms

20.958333333 GHz



3.1.5 Conducted Spurious Emissions

Reference

FCC:	CFR Part 24.238, 2.10.51
IC:	RSS 133, Issue 3, Section 4.4

Measurement Procedure:

The following steps outline the procedure used to measure the conducted emissions from the mobile station.

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 mobile station equipment tested, this equates to a frequency range of 13 MHz to 19.1 GHz, data taken from 10 MHz to 20 GHz.

2. Determine mobile station 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

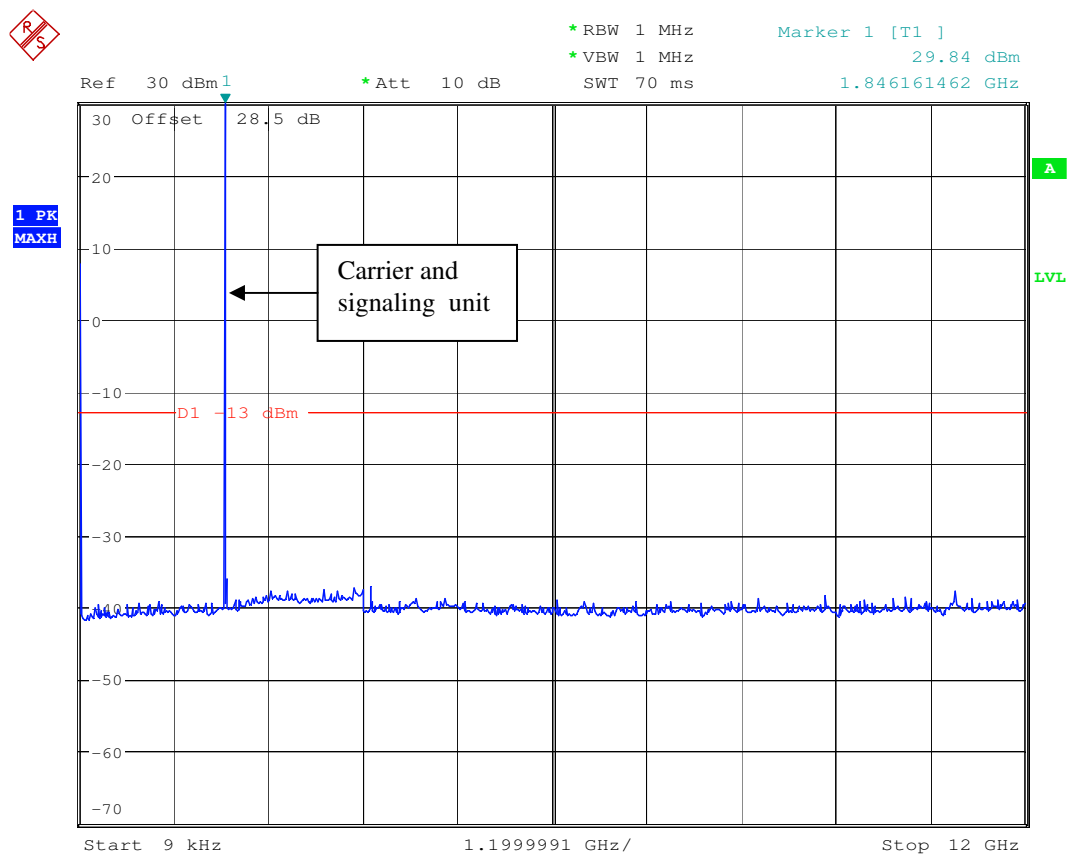
Measurement Limit:

(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 $43+10\log(P)$ dB. For all power levels +30 dBm to 0 dBm, this becomes a constant specification limit of -13 dBm.

Measurement Results:

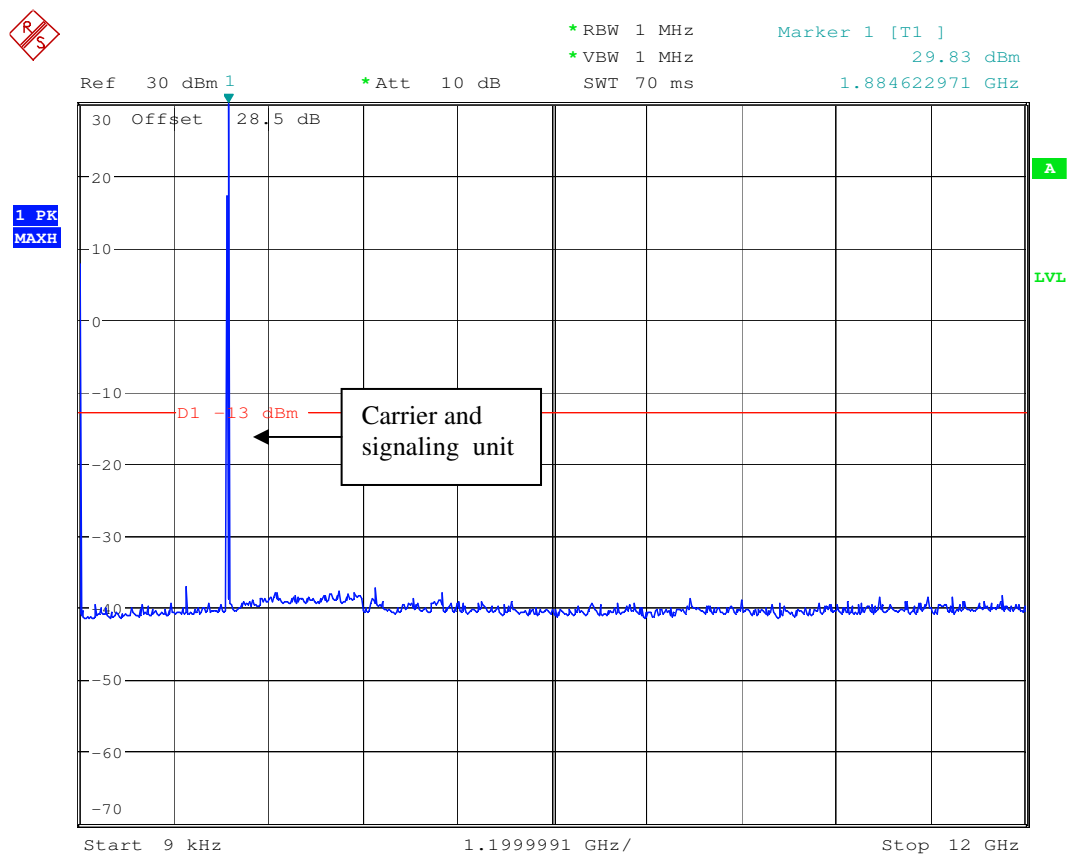
Harmonic	Tx ch.-512 Freq. (MHz)	Level (dBm)	Tx ch.-661 Freq. (MHz)	Level (dBm)	Tx ch.-810 Freq. (MHz)	Level (dBm)
2	3700.4	no spurious or more than 20 dB under limit	3760	no spurious or more than 20 dB under limit	3819.6	no spurious or more than 20 dB under limit
3	5550.6		5640		5729.4	
4	7400.8		7520		7639.2	
5	9251.0		9400		9549.0	
6	11101.2		11280		11458.8	
7	12951.4		13160		13368.6	
8	14801.6		15040		15278.4	
9	16651.8		16920		17188.2	
10	18502.0		18800		19098.0	

Channel: 512



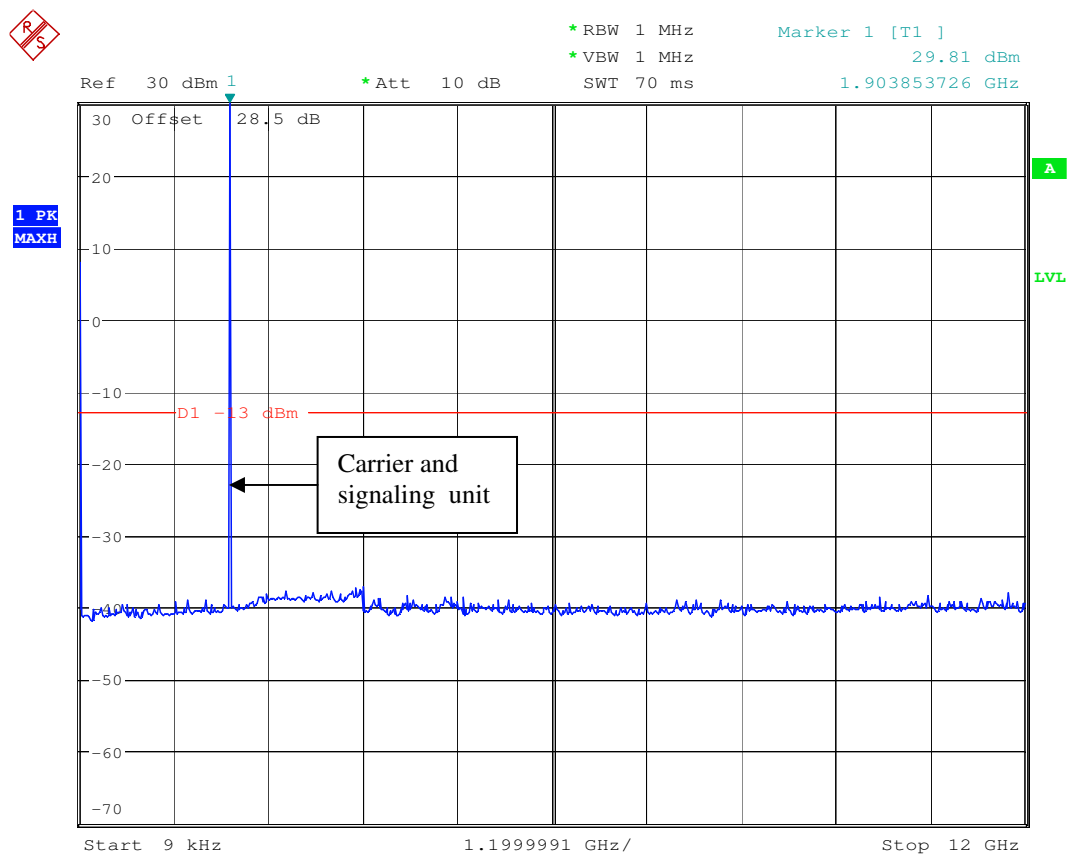
Date: 26.SEP.2006 10:57:57

Channel 661



Date: 26.SEP.2006 10:56:50

Channel 810



Date: 26.SEP.2006 10:55:06

3.1.6 Block Edge Compliance

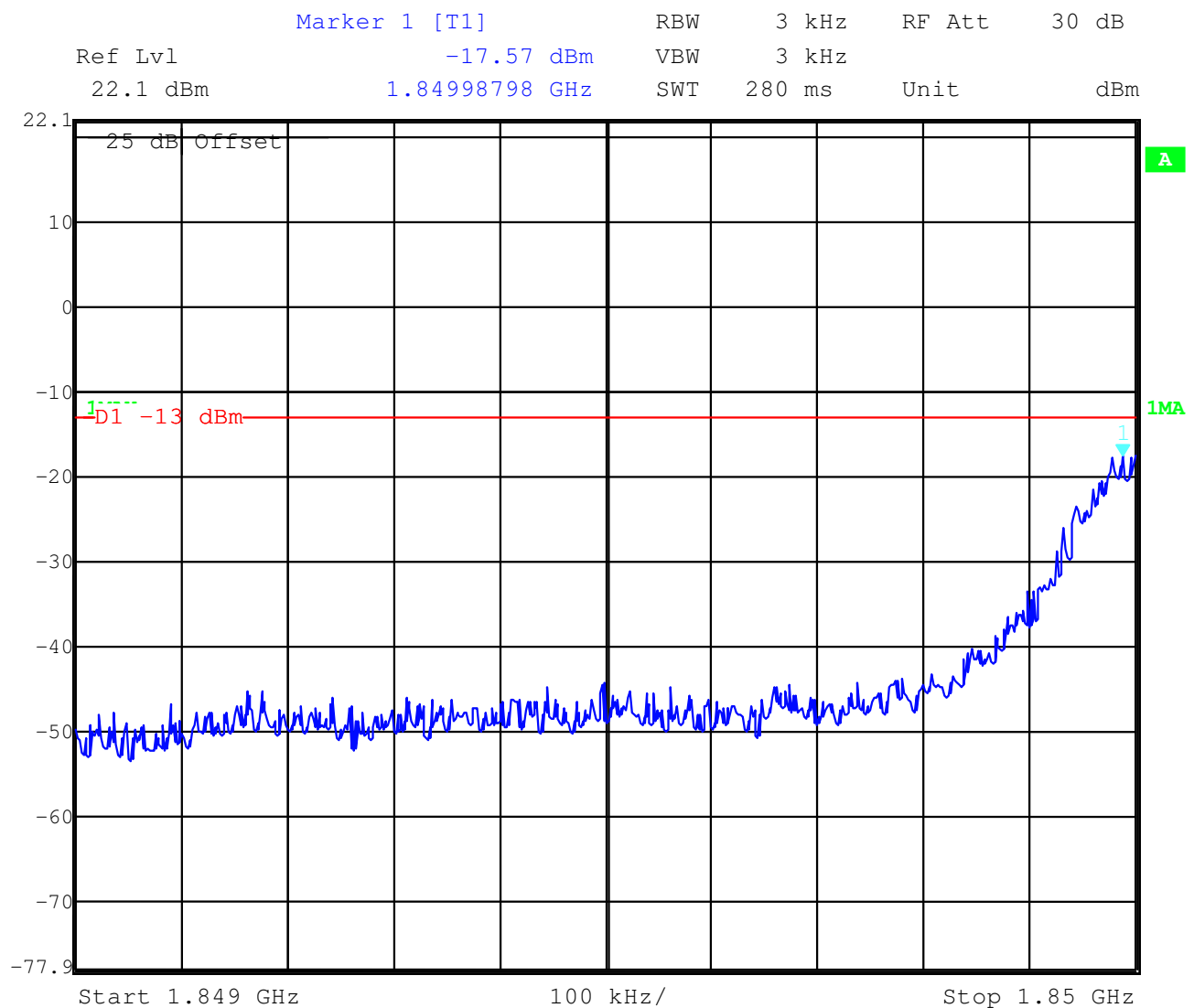
Reference

FCC:	CFR Part 24.238
IC:	RSS 133, Issue 3, Section 6.5

Measurement Limit:

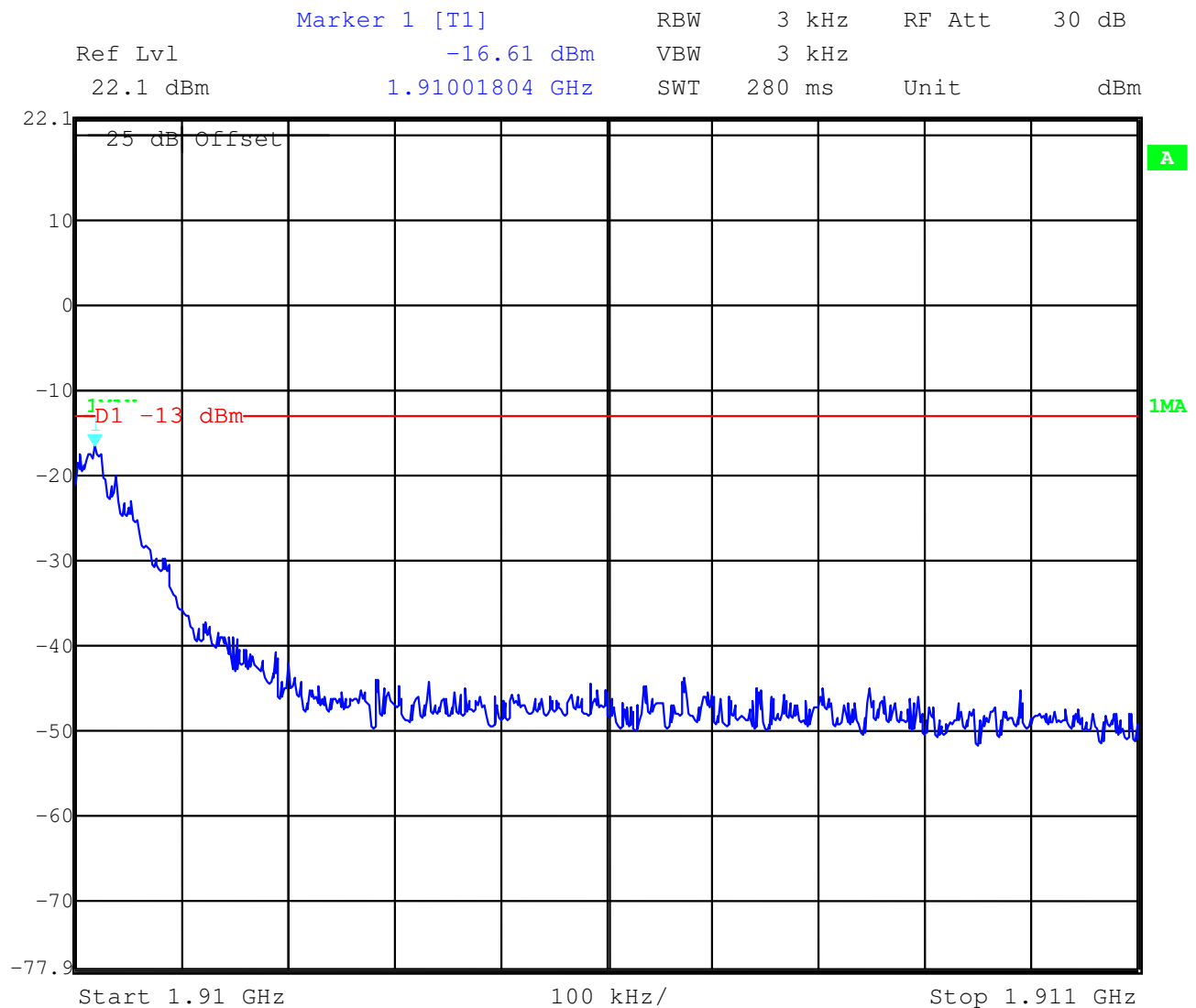
(a) On any frequency outside frequency band of the USPCS spectrum, the power of any emission shall be attenuated below the transmitter power (P, in Watts) by at least $43+10\log(P)$ dB. For all power levels +30 dBm to 0 dBm, this becomes a constant specification limit of -13 dBm.

Block 1 Channel 512



Date: 26.SEP.2006 10:24:15

Block 6 Channel 810



Date: 26.SEP.2006 10:24:12

3.1.7 Occupied Bandwidth

Reference

FCC:	CFR Part 24.238, 2.1049
IC:	RSS 133, Issue 3, Section 6.5

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.

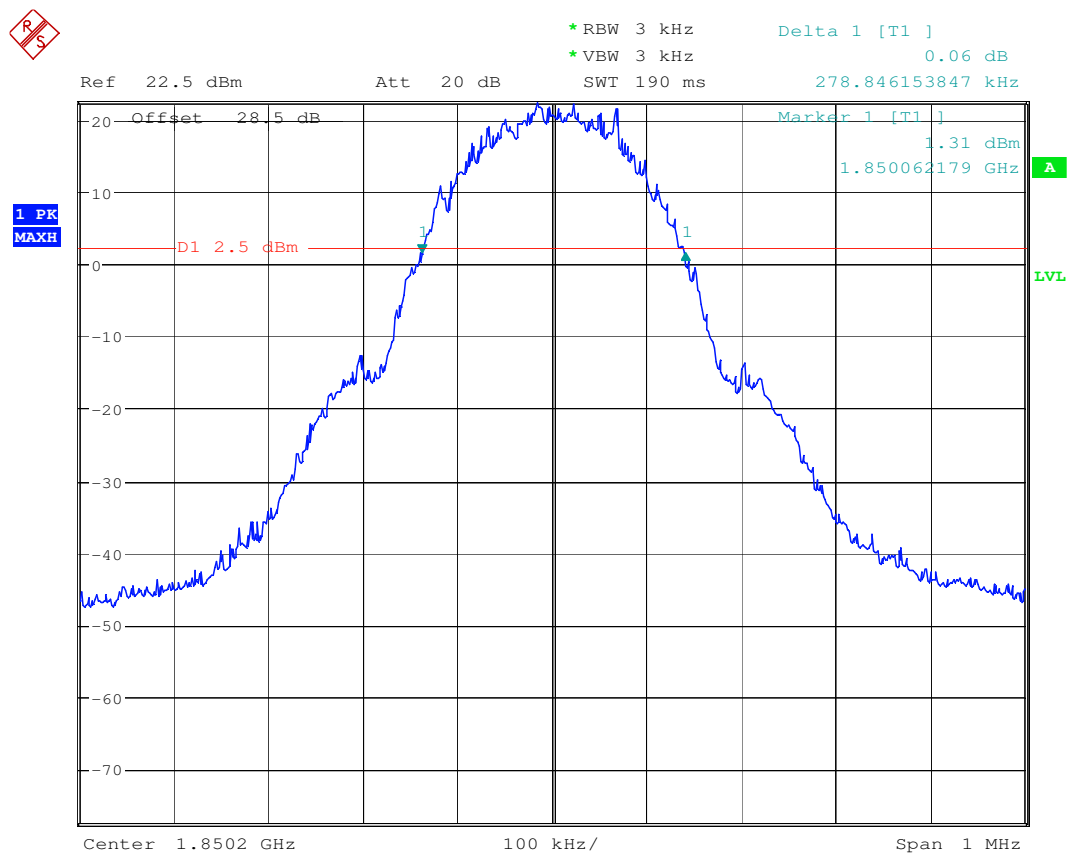
Normal mode

Frequency	99% Occupied Bandwidth kHz	-26 dBc Bandwidth kHz
1850.2 MHz	278.846	314.102
1880.0 MHz	277.243	312.500
1909.8 MHz	269.230	312.500

Part 24.238 (a) requires a measurement bandwidth of at least 1% of the occupied bandwidth. For ca. 300.0 kHz, this equates to a resolution bandwidth of at least 3.0 kHz. For this testing, a resolution bandwidth 3.0 kHz was used.

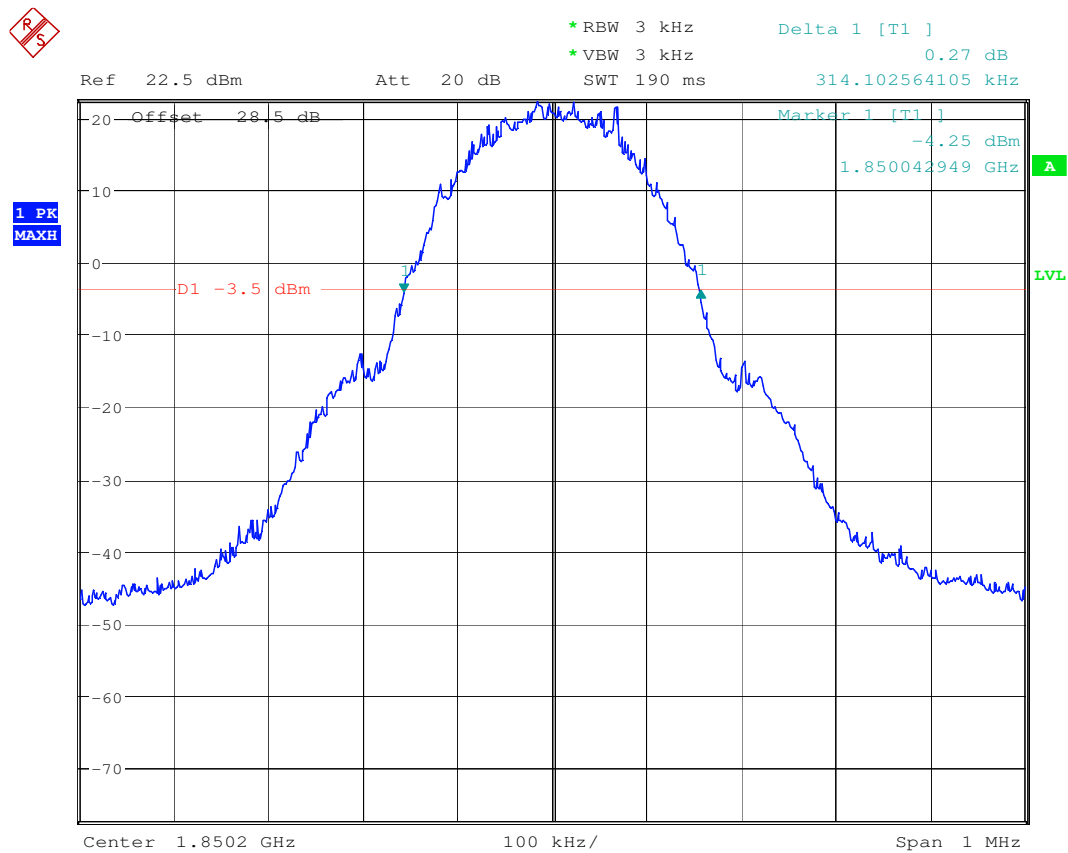
Channel 512

99% (-20 dB) Occupied Bandwidth



Date: 26.SEP.2006 09:57:46

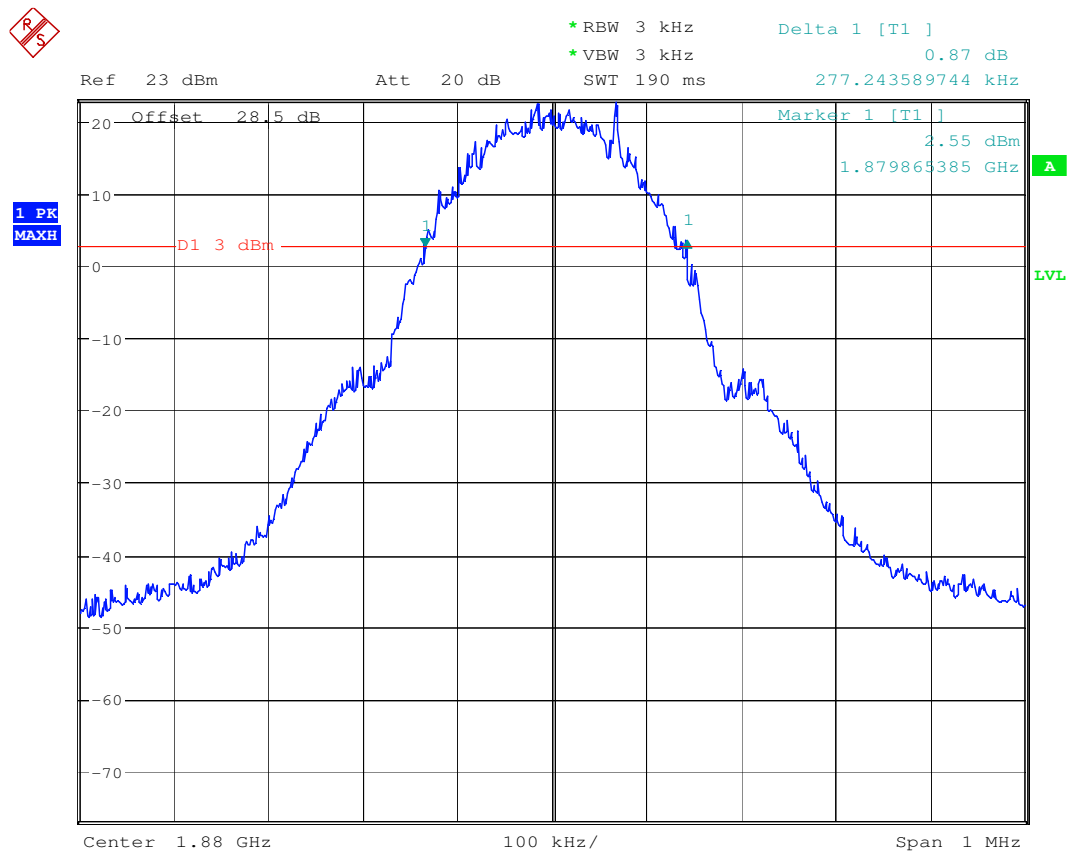
Channel 512 -26 dBc Bandwidth



Date: 26.SEP.2006 09:58:51

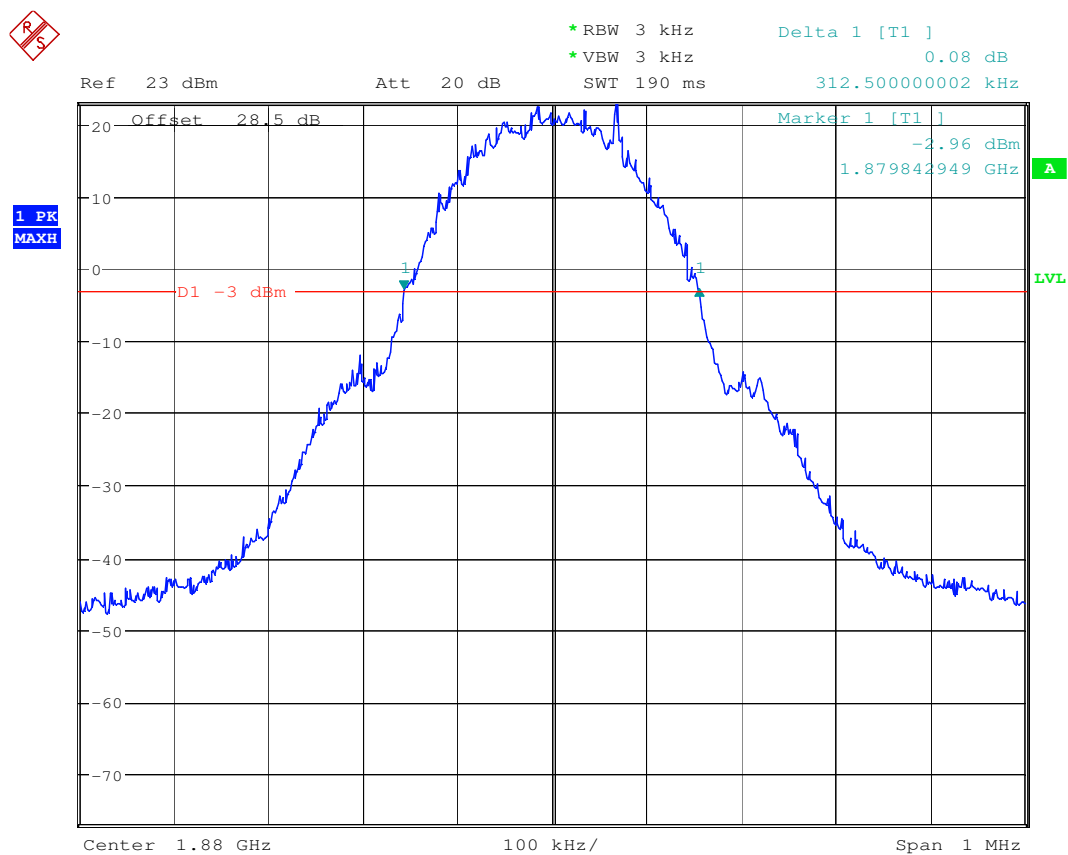
Channel 661

99% (-20 dB) Occupied Bandwidth



Date: 26.SEP.2006 10:10:39

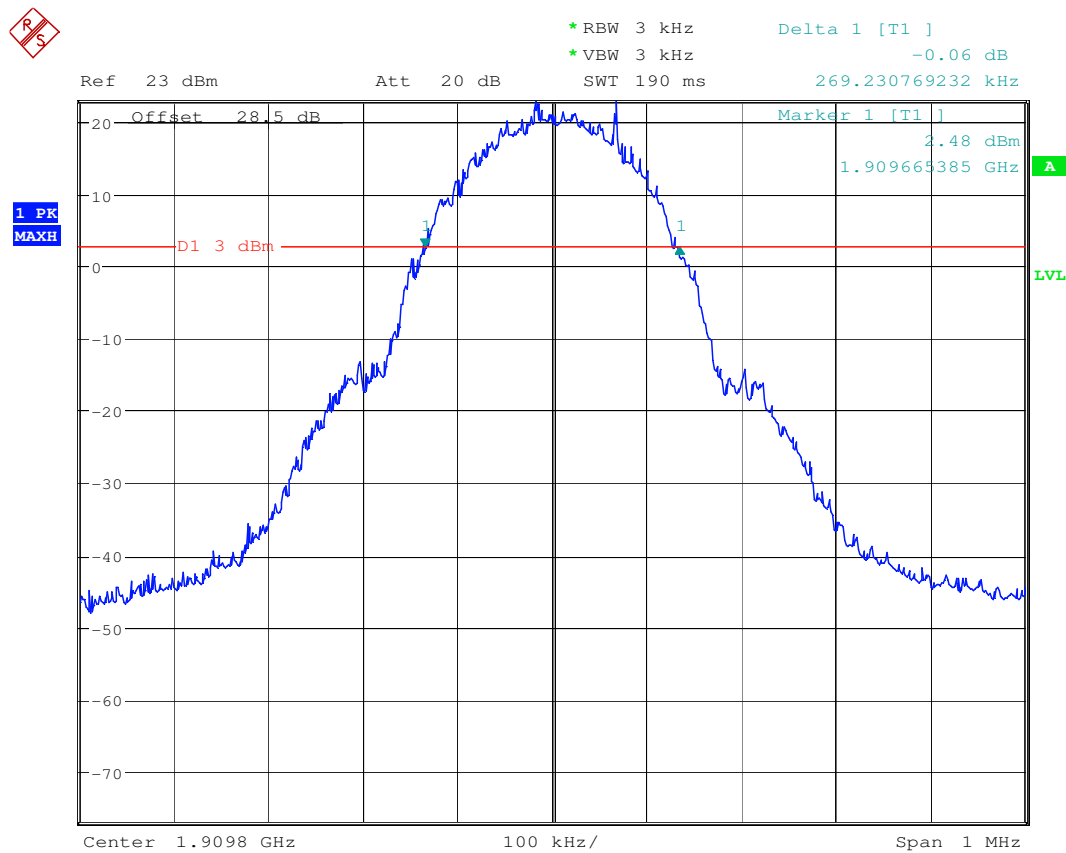
Channel 661 -26 dBc Bandwidth



Date: 26.SEP.2006 10:13:16

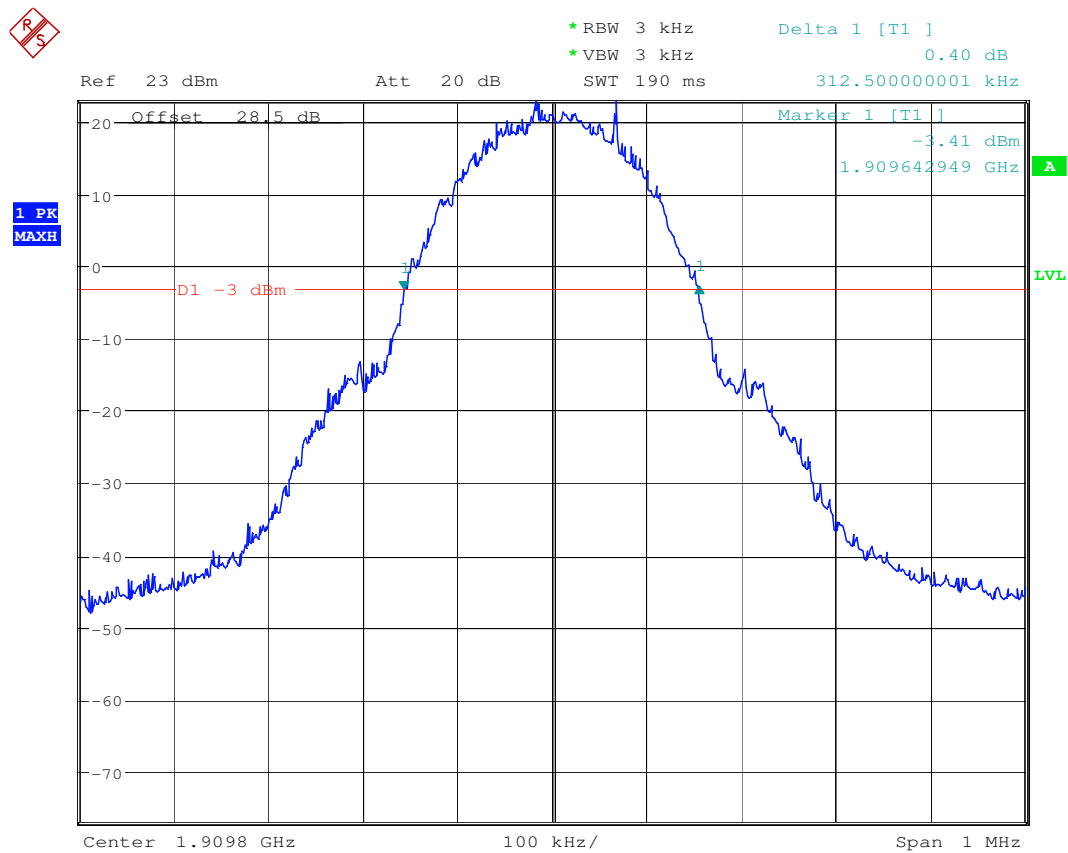
Channel 810

99% (-20 dB) Occupied Bandwidth



Date: 26.SEP.2006 10:49:53

Channel 810 -26 dBc Bandwidth



Date: 26.SEP.2006 10:50:39

3.2 PART GSM 850

3.2.1 RF Power Output

Reference

FCC:	CFR Part 22.9.1.3, 2.1046
IC:	RSS 132, Issue 2, Section 4.4 and 6.4

Summary:

This paragraph contains both average , peak output powers and EIRP measurements for the mobile station.
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 mobile was set up for the max. output power with pseudo random data modulation.
The power was measured with R&S Signal Analyzer FSIQ 26 (peak and average)
This measurements were done at 3 frequencies, 824.2 MHz, 836.2 MHz and 848.8 MHz (bottom, middle and top of operational frequency range).

Limits:

Power Step	Nominal Peak Output Power (dBm)	Tolerance (dB)
5	+33	± 2

Measurements Results Output Power (conducted)

Frequency (MHz)	Power Class	Peak Output Power (dBm)	Average Output Power (dBm)
824.2	5	31.8	31.7
836.4	5	31.6	31.5
848.8	5	31.7	31.6
Measurement uncertainty		±0.5 dB	

ERP Measurements

Description: This is the test for the maximum radiated power from the phone.

Rule Part 22.913 specifies that "Mobile/portable stations are limited to 7 watts ERP.

Measuring the EIRP of Spurious/Harmonic Emissions using Substitution Method

- (a) The measurements was performed with full rf output power and modulation.
- (b) Test was performed at listed 3m test site (listed with FCC, IC).
- (c) The transmitter under test was placed at the specified height on a non-conducting turntable (80 cm height)
- (d) The BICONILOG antenna (20 MHz to 1 GHz) or HORN antenna (1 GHz to 18 GHz) was used for measuring.
- (e) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level
Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
 $E \text{ (dBuV/m)} = \text{Reading (dBuV)} + \text{Total Correction Factor (dB/m)}$
- (f) Set the EMI Receiver and #2 as follows:
Center Frequency: test frequency
Resolution BW: 100 kHz
Video BW: same
Detector Mode: positive
Average: off
Span: 3 x the signal bandwidth
- (g) The test antenna was lowered or raised from 1 to 4 meters until the maximum signal level was detected.
- (h) The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.
- (i) The test antenna was lowered or raised again from 1 to 4 meters until a maximum was obtained. This level was recorded.
- (j) The recorded reading was corrected to the true field strength level by adding the antenna factor, cable loss and subtracting the pre-amplifier gain.
- (k) The above steps were repeated with both transmitters' antenna and test receiving antenna placed in vertical and horizontal polarization. Both readings with the antennas placed in vertical and horizontal polarization shall be recorded.
- (l) Repeat for all different test signal frequencies

Measuring the ERP of Spurious/Harmonic Emissions using Substitution Method

- (a) Set the EMI Receiver (for measuring E-Field) and Receiver #2 (for measuring ERP) as follows:
Center Frequency : equal to the signal source
Resolution BW : 10 kHz
Video BW : same
Detector Mode : positive
Average : off
Span : 3 x the signal bandwidth
- (b) Load an appropriate correction factors file in EMI Receiver for correcting the field strength reading level
Total Correction Factor recorded in the EMI Receiver = Cable Loss + Antenna Factor
 $E \text{ (dBuV/m)} = \text{Reading (dBuV)} + \text{Total Correction Factor (dB/m)}$
- (c) Select the frequency and E-field levels for ERP/EIRP measurements.
- (d) Substitute the EUT by a signal generator and one of the following transmitting antenna (substitution antenna):
.DIPOLE antenna for frequency from 30-1000 MHz or .HORN antenna for frequency above 1 GHz }.
- (e) Mount the transmitting antenna at 1.5 meter high from the ground plane.
- (f) Use one of the following antenna as a receiving antenna: .DIPOLE antenna for frequency from 30-1000 MHz or .HORN antenna for frequency above 1 GHz }.
- (g) If the DIPOLE antenna is used, tune it's elements to the frequency as specified in the calibration manual.
- (h) Adjust both transmitting and receiving antenna in a VERTICAL polarization.
- (i) Tune the EMI Receivers to the test frequency.
- (j) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
- (k) The transmitter was rotated through 360° about a vertical axis until a higher maximum signal was received.
- (l) Lower or raise the test antenna from 1 to 4 meters until the maximum signal level was detected.
- (m) Adjust input signal to the substitution antenna until an equal or a known related level to that detected from the transmitter was obtained in the test receiver.
- (n) Record the power level read from the Average Power Meter and calculate the ERP/EIRP as follows:
 $P = P1 - L1 = (P2 + L2) - L1 = P3 + A + L2 - L1$

$$\text{EIRP} = P + G1 = P3 + L2 - L1 + A + G1$$

$$\text{ERP} = \text{EIRP} - 2.15 \text{ dB}$$

$$\text{Total Correction factor in EMI Receiver \# 2} = L2 - L1 + G1$$

Where: P: Actual RF Power fed into the substitution antenna port after corrected.

P1: Power output from the signal generator

P2: Power measured at attenuator A input

P3: Power reading on the Average Power Meter

EIRP: EIRP after correction

ERP: ERP after correction

(o) Adjust both transmitting and receiving antenna in a HORIZONTAL polarization, then repeat step (k) to (o)

(p) Repeat step (d) to (o) for different test frequency

(q) Repeat steps (c) to (j) with the substitution antenna oriented in horizontal polarization.

(r) Actual gain of the EUT's antenna is the difference of the measured EIRP and measured RF power at the RF port.
Correct the antenna gain if necessary.

Limits:

Power Step	Burst Peak (dBm)
0	<33

Measurement Results Output Power (Radiated)

Frequency (MHz)	Power Class	BURST Peak (dBm)
		ERP
824.2	5	32.8
836.4	5	32.8
848.8	5	32.9
Measurement uncertainty: 1.5%		

Sample calculation:

Freq	SA Reading	SG Setting	Ant. gain	Dipol gain	Cable loss	ERP	Substitution Antenna
MHz	dBμV	dBm	dB	dBd	dB	dBm	
848.8	156.1		45.1	-10.50	1.67	32.9	UHAP Schwarzbeck S/N 460

$$\text{ERP} = \text{SG (dBm)} - \text{Cable Loss (dB)} + \text{Ant. gain (dB)}$$

*ERP can be calculated from EIRP by subtracting the gain of the dipole, $\text{ERP} = \text{EIRP} - 2.1 \text{ dB}$

3.2.2 Frequency Stability

Reference

FCC:	CFR Part 22.355, 2.1055
IC:	RSS 132, Issue 2, Section 4.3 and 6.3

Method of Measurement:

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the mobile station in a "call mode". This is accomplished with the use of a R&S CMU 200 DIGITAL RADIOCOMMUNICATION TESTER..

1. Measure the carrier frequency at room temperature.
2. Subject the mobile station to overnight soak at -30 C.
3. With the mobile station, powered with 3.7 Volts, connected to the CMU 200 and in a simulated call on channel 661 (centre channel), measure the carrier frequency. These measurements should be made within 2 minutes of powering up the mobile station, 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, un-powered, before making measurements.
5. Re-measure carrier frequency at room temperature with nominal 3.7 Volts. Vary supply voltage from minimum 3.3 Volts to maximum 4.4 Volts, in 13 steps re-measuring carrier frequency at each voltage. Pause at 3.7 V ac Volts for 1 1/2 hours un-powered, to allow any self heating to stabilize, before continuing.
6. Subject the mobile station to overnight soak at +60 C.
7. With the mobile station, powered with 3.7 Volts, connected to the CMU 200 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, un-powered, before making measurements.
9. At all temperature levels hold the temperature to +/- 0.5 C during the measurement procedure.

Measurement Limit:

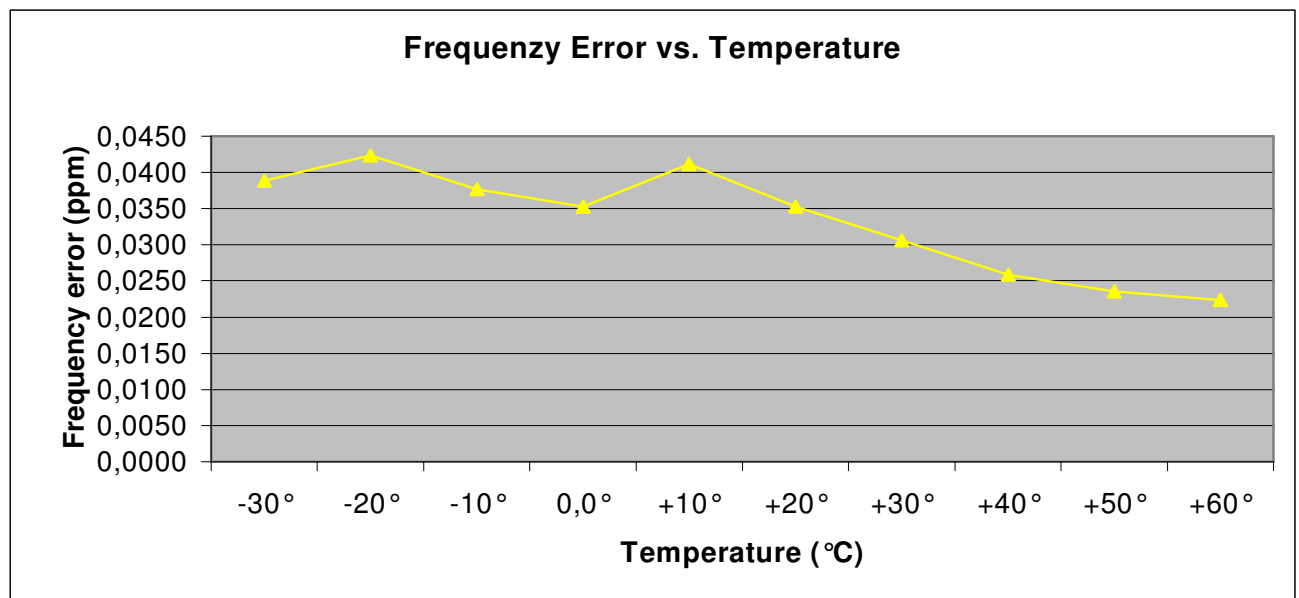
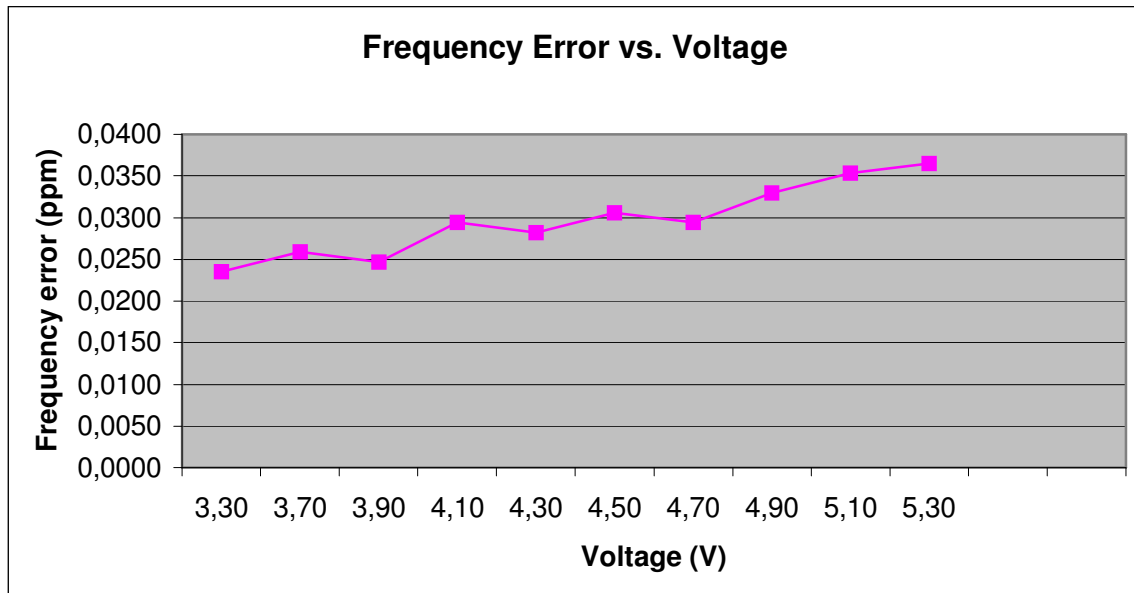
According to the JTC standard the frequency stability of the carrier shall be accurate to within 0.1 ppm of the received frequency from the base station. This accuracy is sufficient to meet Sec. 22.355, Frequency Stability. The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.. This transceiver is specified to operate with an input voltage of between 3.3 V dc and 4.4 V dc, with a nominal voltage of 3.7 V dc.

Measurement Results: AFC FREQ ERROR vs. VOLTAGE

Voltage (V)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
3.3	20	0,00000235	0,0235
3.5	22	0,00000259	0,0259
3.7	21	0,00000247	0,0247
3.9	25	0,00000294	0,0294
4.1	24	0,00000282	0,0282
4.3	26	0,00000306	0,0306
4.5	25	0,00000294	0,0294
4.7	28	0,00000329	0,0329
4.9	30	0,00000353	0,0353
5.1	31	0,00000365	0,0365
5.3	32	0,00000235	0,0235

Measurement Results: AFC FREQ ERROR vs. TEMPERATURE

TEMPERATURE (°C)	Frequency Error (Hz)	Frequency Error (%)	Frequency Error (ppm)
-30	33	0,00000388	0,0388
-20	36	0,00000424	0,0424
-10	32	0,00000376	0,0376
±0.0	30	0,00000353	0,0353
+10	35	0,00000412	0,0412
+20	30	0,00000353	0,0353
+30	26	0,00000306	0,0306
+40	22	0,00000259	0,0259
+50	20	0,00000235	0,0235
+60	19	0,00000224	0,0224



3.2.3 Radiated Emissions

Reference

FCC:	CFR Part 22.917, 2.1053
IC:	RSS 132, Issue 2, Section 4.5 and 6.5

Measurement Procedure:

The following steps outline the procedure used to measure the radiated emissions from the mobile station. The site is constructed in accordance with ANSI C63.4:2003 requirements and is recognized 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 848.8 MHz. This was rounded up to 12 GHz. The resolution bandwidth is set as outlined in Part 22.917. 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 (here 10m semi-anechoic chamber listed by FCC) test procedure is as follows:

- The test item was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna.
- The antenna output was terminated in a 50 ohm load.
- A double ridged wave guide antenna was placed on an adjustable height antenna mast 3 meters from the test item for emission measurements.
- 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 1 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:
- Now each detected emissions were substituted by the Substitution method, in accordance with the TIA/EIA 603 .

Measurement Limit:

Sec. 22.917 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 $43+10\log(P)$ 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 (824.2 MHz, 836.4 MHz and 848.8 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.

The final open field radiated levels are presented on the next pages.

All measurements were done in horizontal and vertical polarization, the plots shows the worst case.

As can be seen from this data, the emissions from the test item were within the specification limit.

Harmonic	Tx ch.-128 Freq. (MHz)	Level (dBm)	Tx ch.-189 Freq. (MHz)	Level (dBm)	Tx ch.-251 Freq. (MHz)	Level (dBm)
2	1648.4	no spurious or more than 20 dB under limit	1672.8	no spurious or more than 20 dB under limit	1697.6	no spurious or more than 20 dB under limit
3	2472.6		2509.2		2546.4	
4	3296.8		3345.6		3395.2	
5	4121.0		4182.0		4244.0	
6	4945.2		5018.4		5092.8	
7	5769.4		5854.8		5941.6	
8	6593.6		6691.2		6790.4	
9	7417.8		7527.6		7639.2	
10	8242.0		8364.0		8488.0	

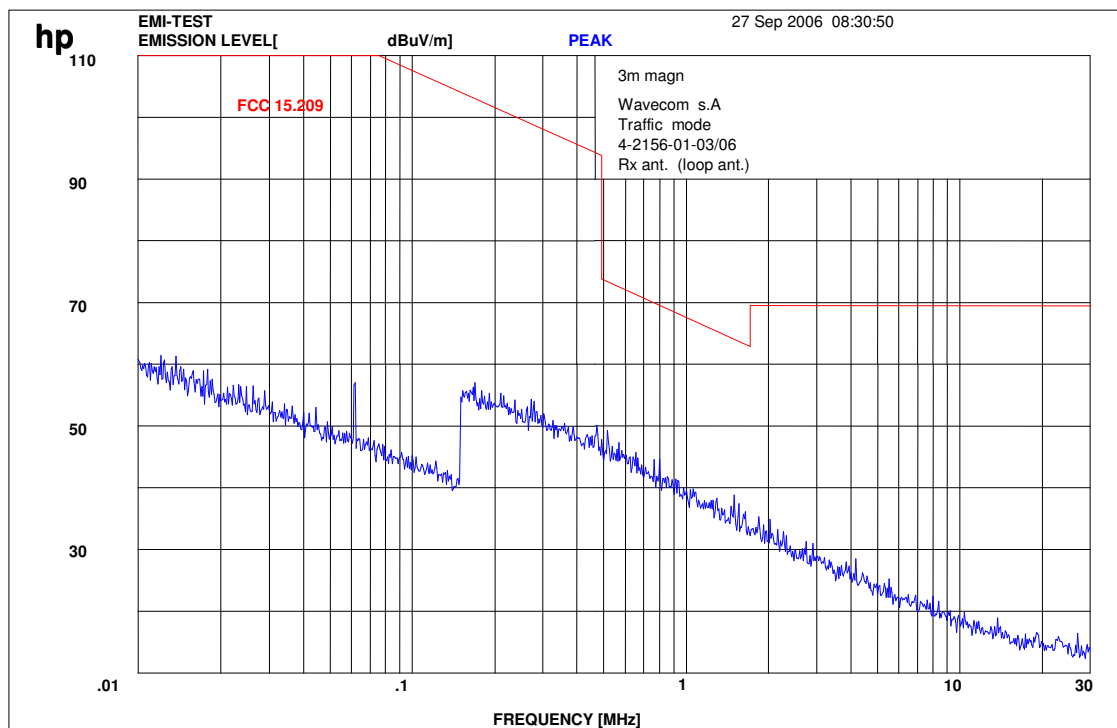
Sample calculation:

Freq	SA Reading	SG Setting	Ant. gain	Dipol gain	Cable loss	ERP	Substitution Antenna
MHz	dBμV	dBm	dB _i	dB _d	dB	dBm	
848.8	156.1		45.1	-10.50	1.67	32.9	UHAP Schwarzbeck S/N 460

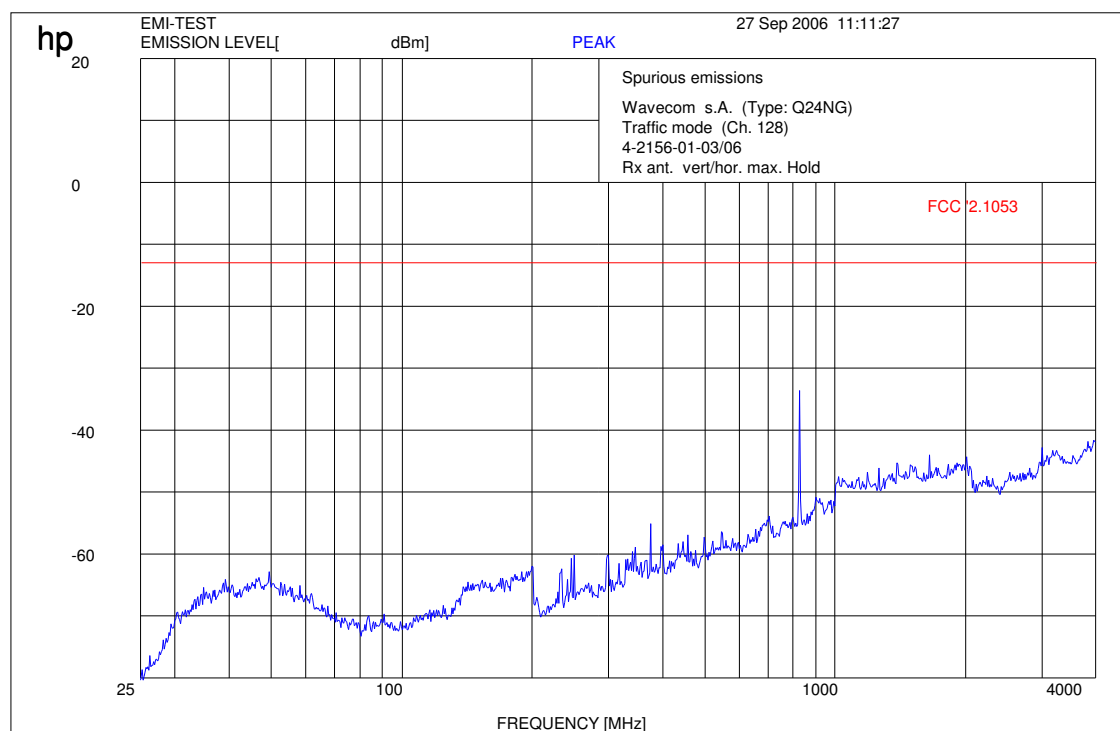
$$\text{ERP} = \text{SG (dBm)} - \text{Cable Loss (dB)} + \text{Ant. gain (dB)}$$

*ERP can be calculated from EIRP by subtracting the gain of the dipole, $\text{ERP} = \text{EIRP} - 2.1\text{dB}_i$

Traffic mode up to 30 MHz (Valid for all 3 channels)



Channel 128 (30 MHz - 4 GHz)

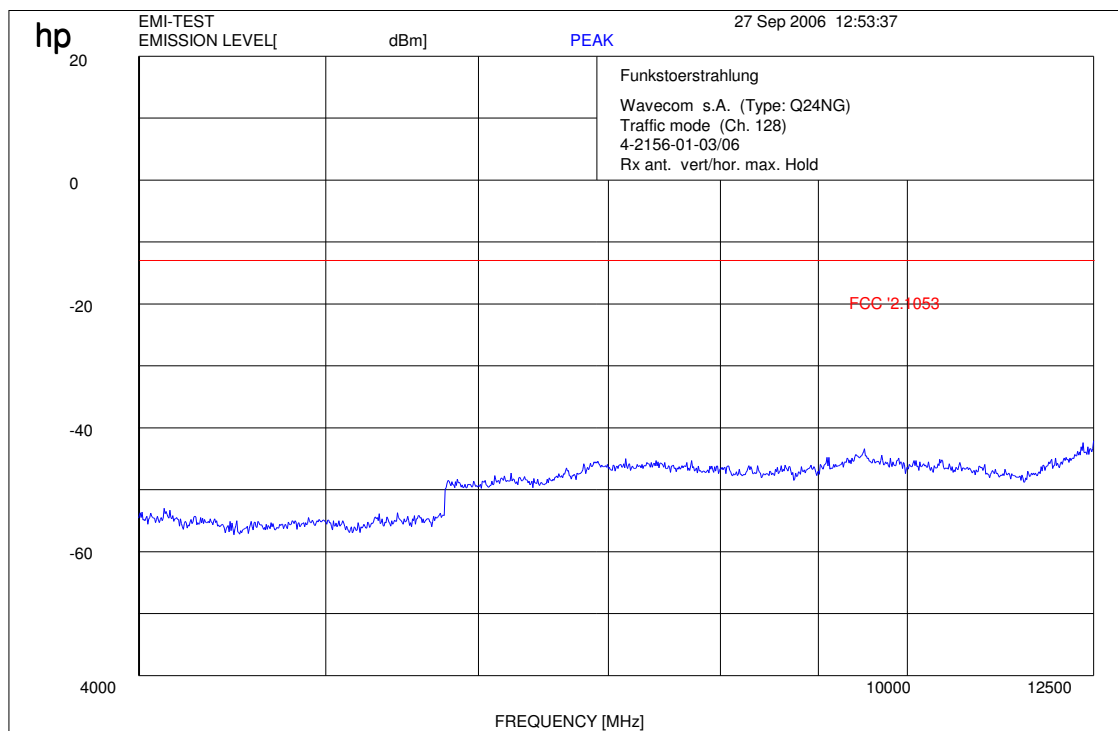


$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW / VBW 1 MHz

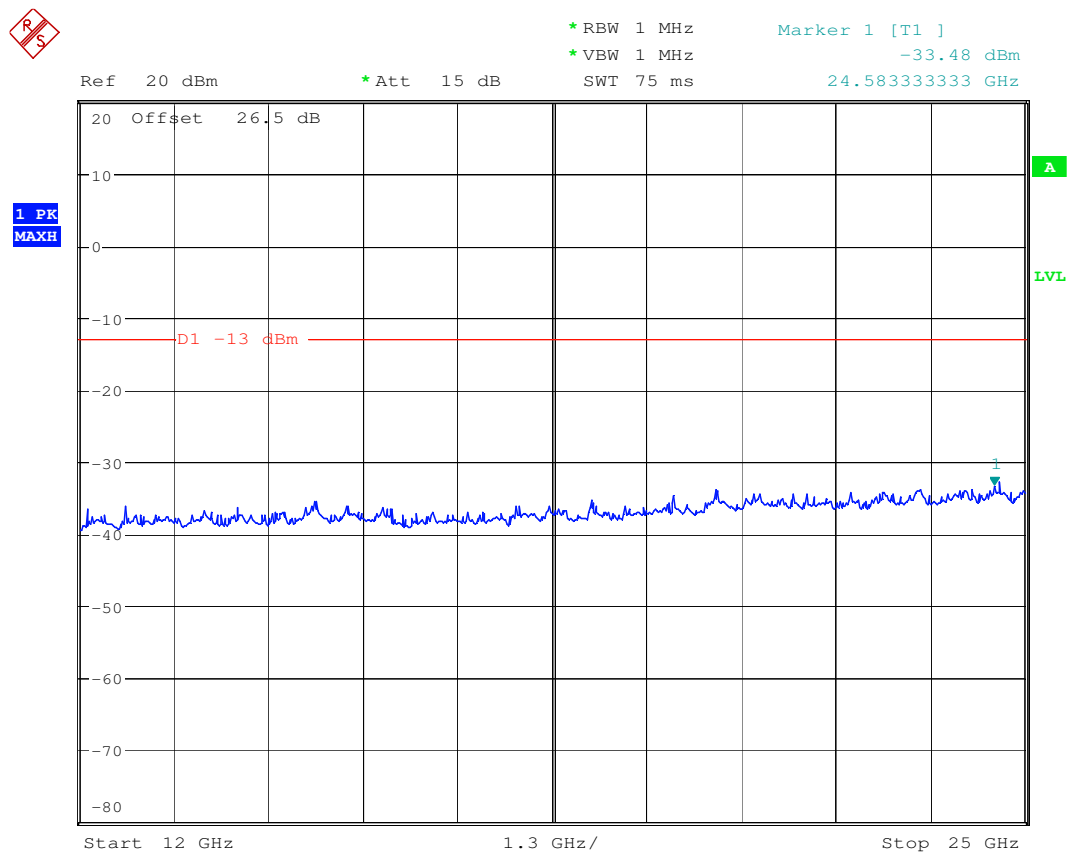
Carrier suppressed with a rejection filter

Channel 128 (4 GHz – 12.5 GHz)



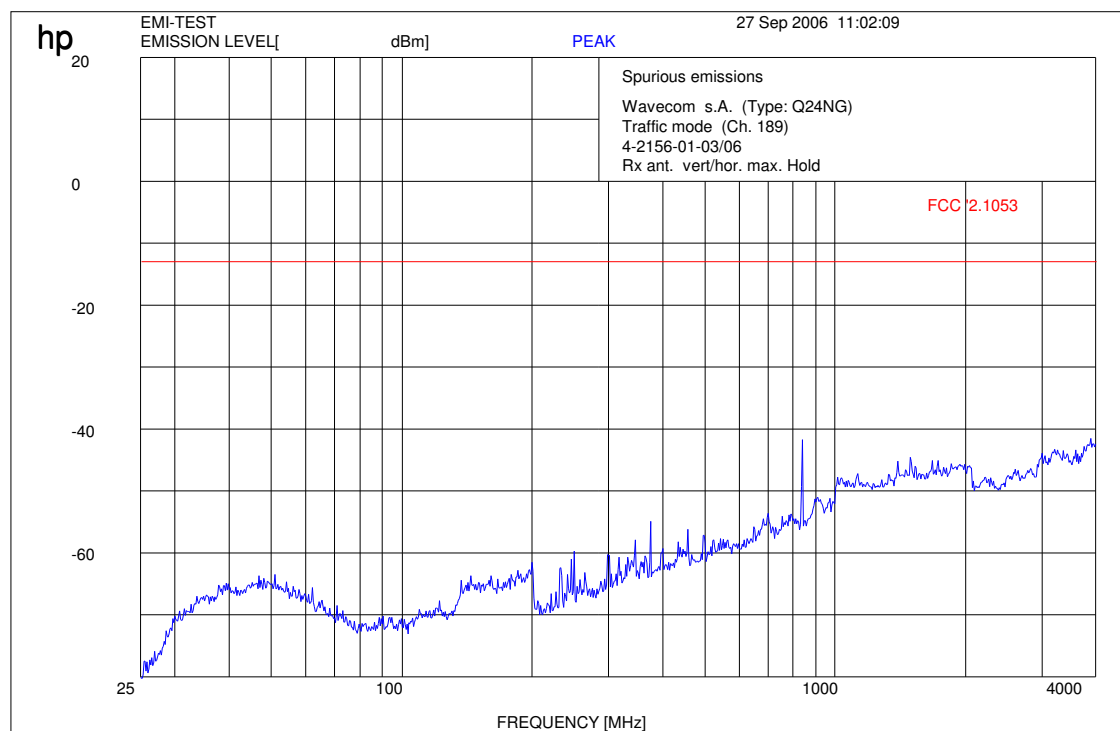
$f \geq 1\text{GHz}$: RBW / VBW 1 MHz

Channel 128 (12 GHz - 25 GHz) valid for all 3 channels



Date: 26.SEP.2006 13:33:58

Channel 189 (30 MHz - 4 GHz)

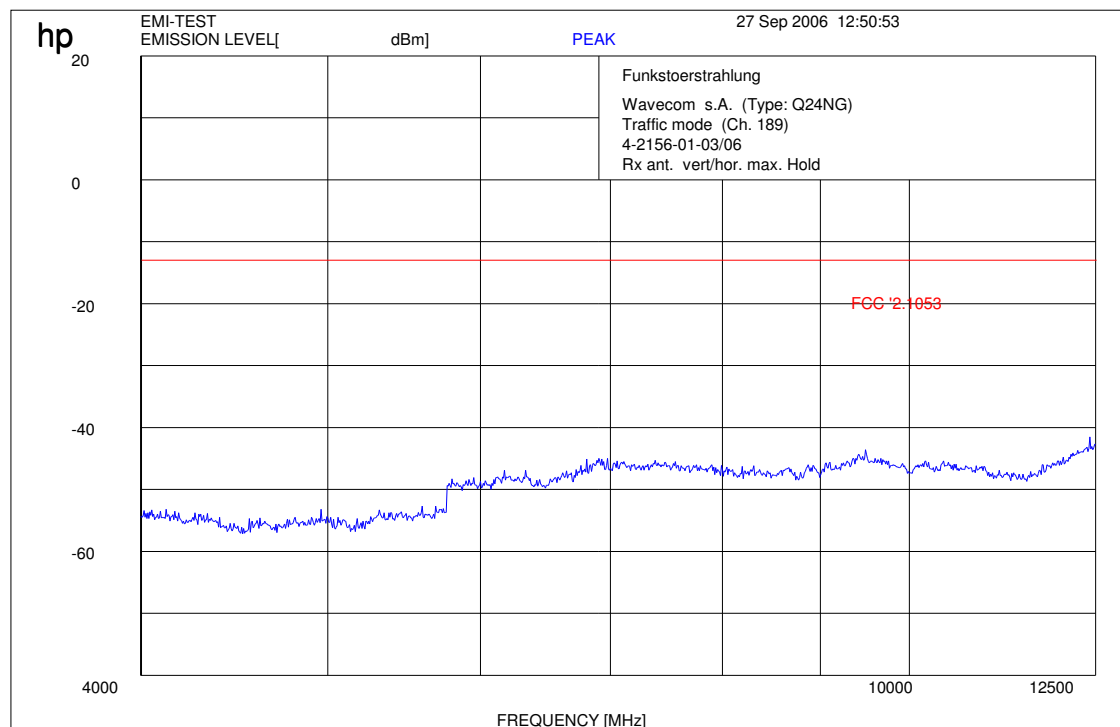


$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW / VBW 1 MHz

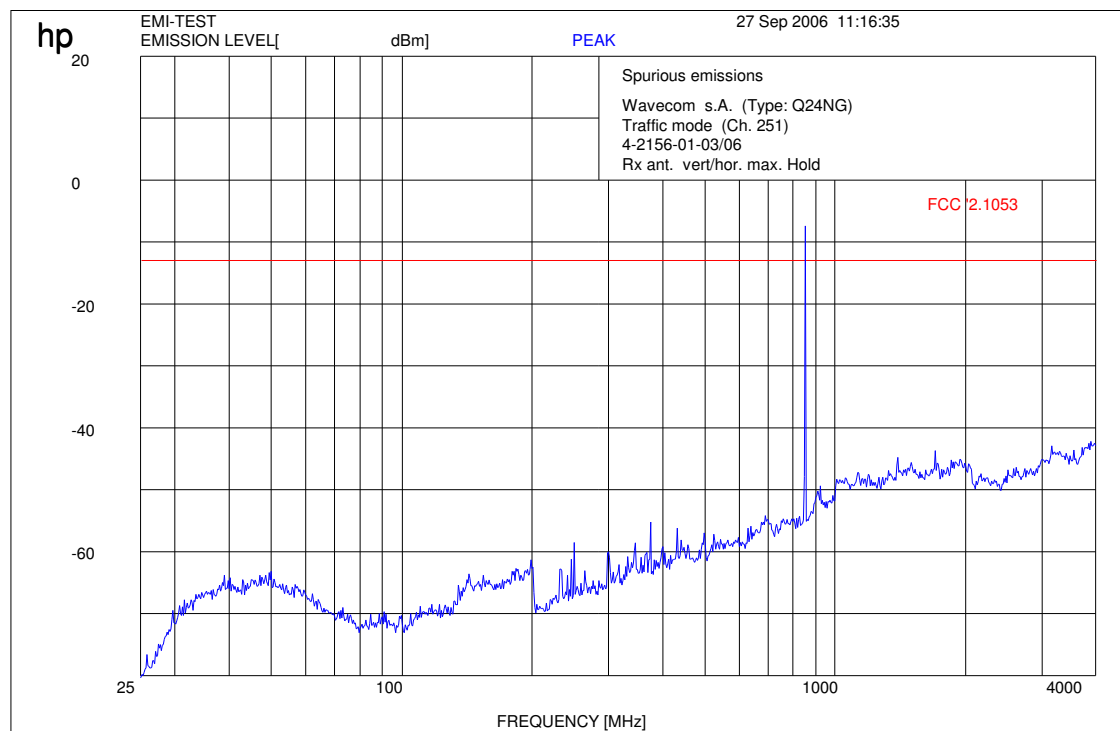
Carrier suppressed with a rejection filter

Channel 189 (4 GHz – 12.5 GHz)



$f \geq 1\text{GHz}$: RBW / VBW 1 MHz

Channel 251 (30 MHz - 4 GHz)

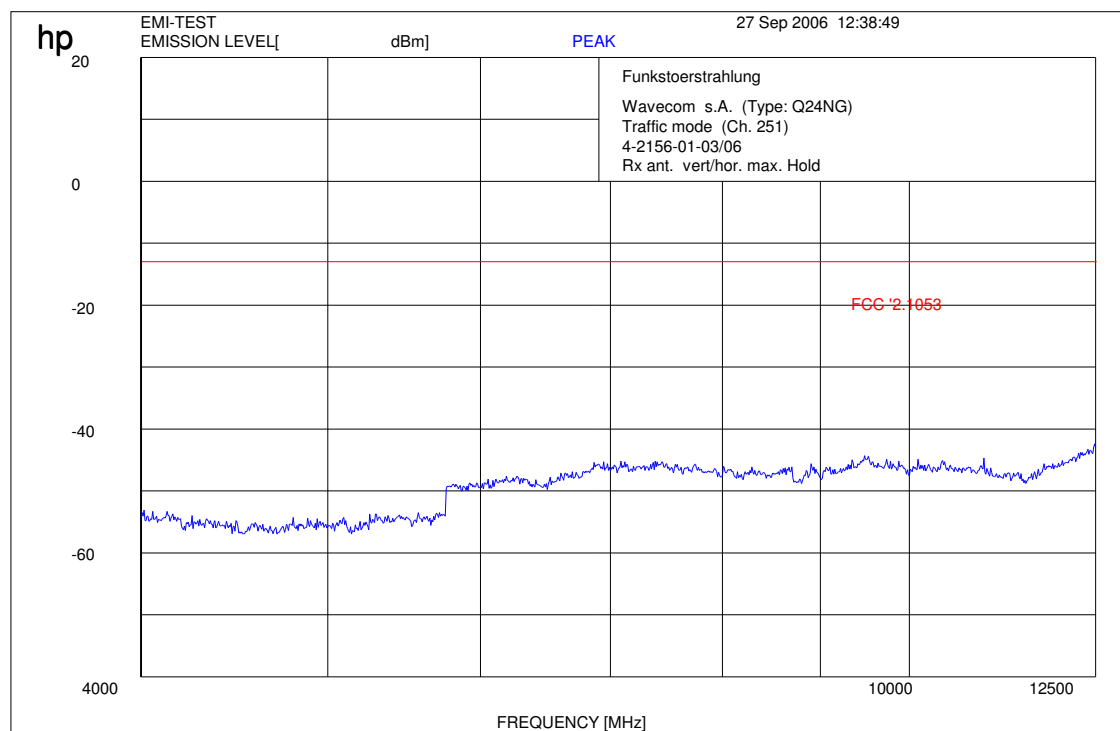


$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

$f \geq 1 \text{ GHz}$: RBW / VBW 1 MHz

Carrier suppressed with a rejection filter

Channel 251 (4 GHz – 12.5 GHz)



$f \geq 1\text{GHz}$: RBW / VBW 1 MHz

3.2.4 Receiver Radiated Emissions

Reference

FCC:	CFR Part 15.109, 2.1053
IC:	RSS 132, Issue 2, Section 4.6 and 6.6

SPURIOUS EMISSIONS LEVEL (μV/m)								
Idle Mode								
f (MHz)	Detector	Level (μV/m)	f (MHz)	Detector	Level (μV/m)	f (MHz)	Detector	Level (μV/m)
-	no spurious or more than 20 dB under limit	-	-	-	-	-	-	-
-		-	-	-	-	-	-	-
-		-	-	-	-	-	-	-
-		-	-	-	-	-	-	-
-		-	-	-	-	-	-	-
-		-	-	-	-	-	-	-
-		-	-	-	-	-	-	-
-		-	-	-	-	-	-	-
-		-	-	-	-	-	-	-
-		-	-	-	-	-	-	-
-		-	-	-	-	-	-	-
Measurement uncertainty			±3 dB					

$f < 1$ GHz : RBW/VBW: 100 kHz

$f \geq 1$ GHz : RBW/VBW: 1 MHz

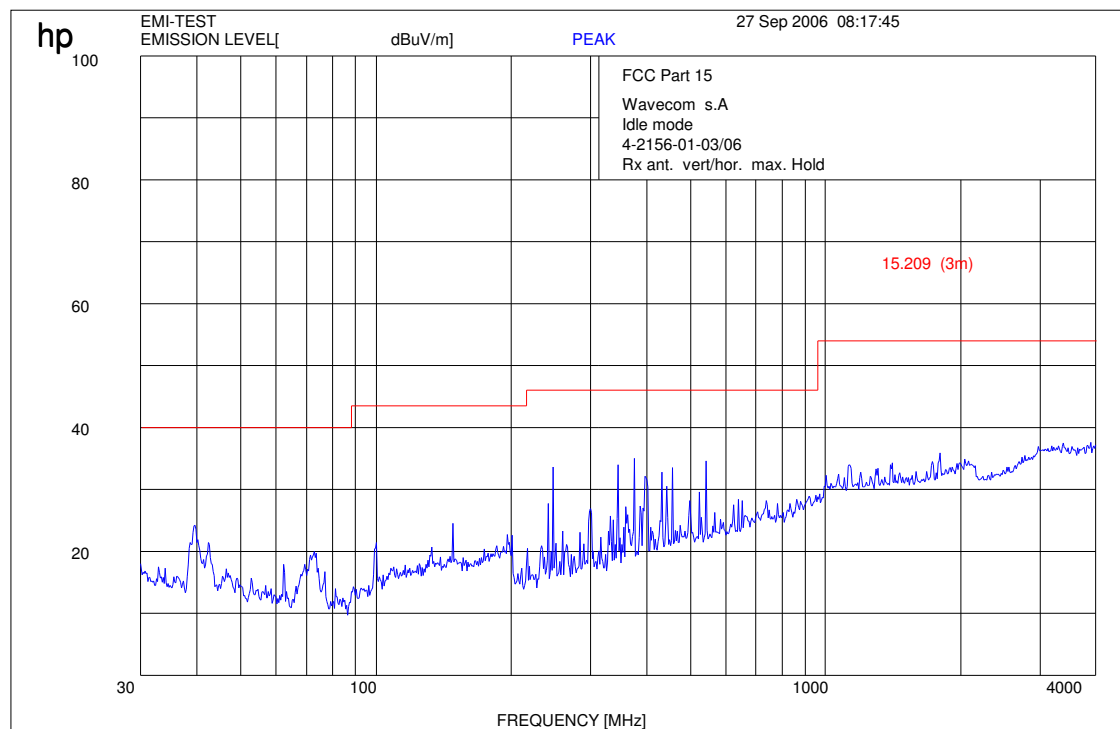
H = Horizontal ; V= Vertical

Measurement distance see table

Limits: § 15.109

Frequency (MHz)	Field strength ($\mu\text{V/m}$)	Measurement distance (m)
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
above 960	500	3

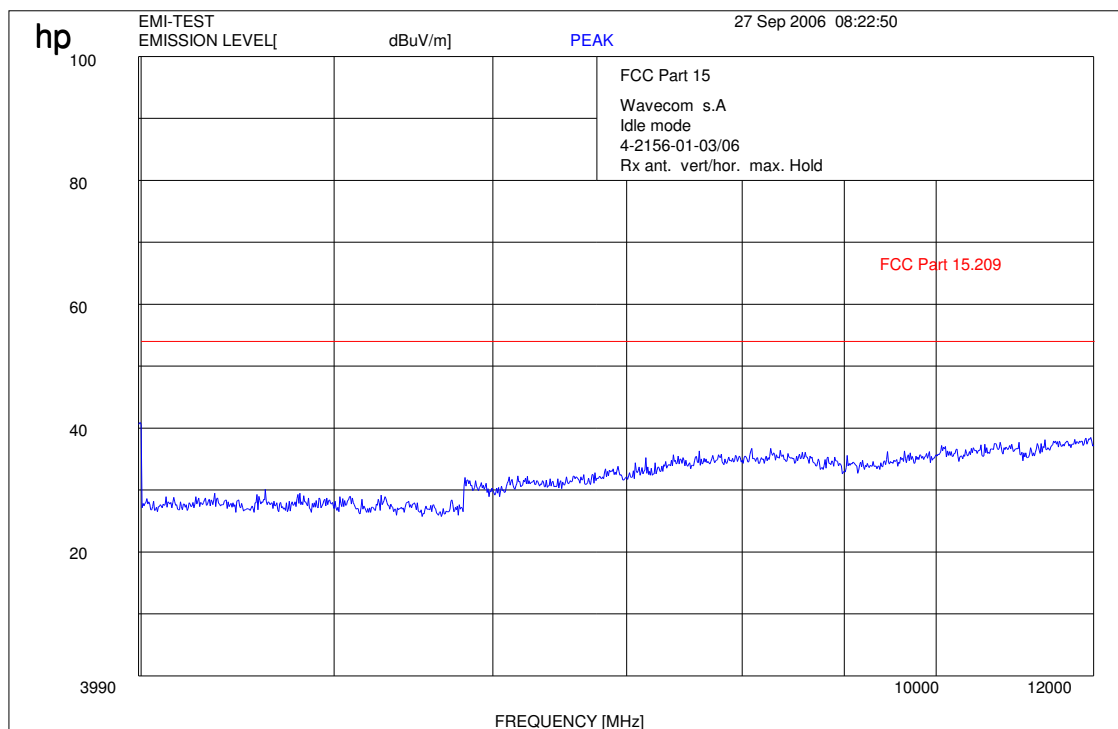
Idle-Mode (30 MHz - 4 GHz)



$f < 1 \text{ GHz}$: RBW/VBW: 100 kHz

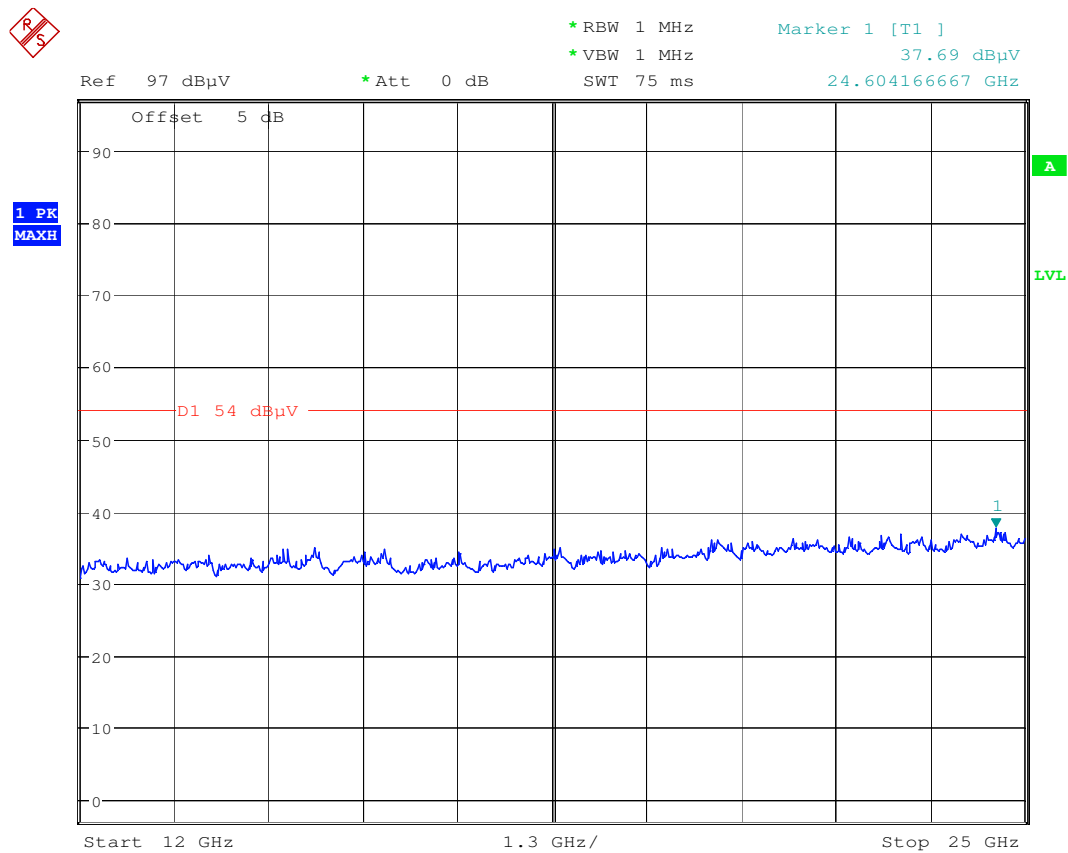
$f \geq 1 \text{ GHz}$: RBW / VBW 1 MHz

IDLE-MODE (4 GHz – 12.0 GHz)



$f \geq 1\text{GHz}$: RBW / VBW 1 MHz

IDLE-MODE (12 GHz - 25 GHz)



Date: 26.SEP.2006 13:37:10

3.2.5 Conducted Spurious Emissions

Reference

FCC:	CFR Part 22.917, 1.1051
IC:	RSS 132, Issue 2, Section 4.5 and 6.5

Measurement Procedure

The following steps outline the procedure used to measure the conducted emissions from the mobile station.

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 mobile station equipment tested, this equates to a frequency range of 13 MHz to 19.1 GHz, data taken from 10 MHz to 20 GHz.
2. Determine mobile station transmit frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.

USPCS Transmitter Channel Frequency

128 824.2 MHz

189 836.4 MHz

251 848.8 MHz

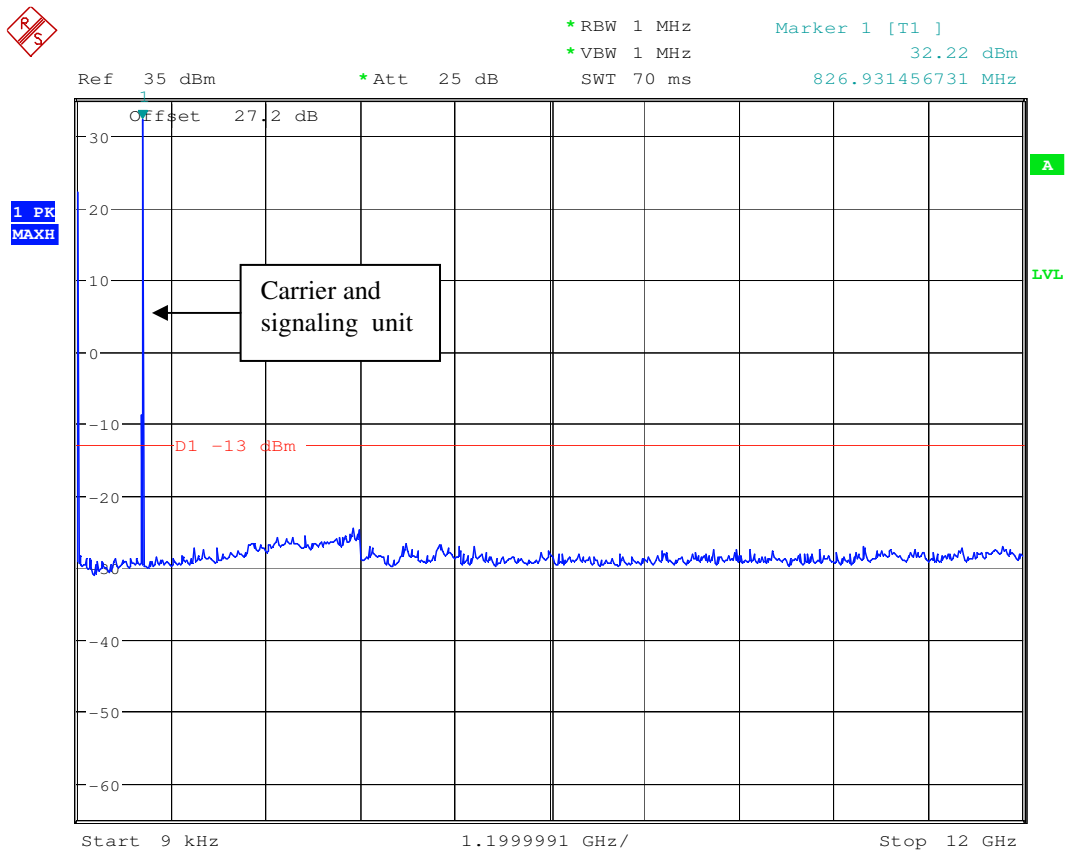
Measurement Limit

(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 $43+10\log(P)$ dB. For all power levels +30 dBm to 0 dBm, this becomes a constant specification limit of -13 dBm.

Measurement Results

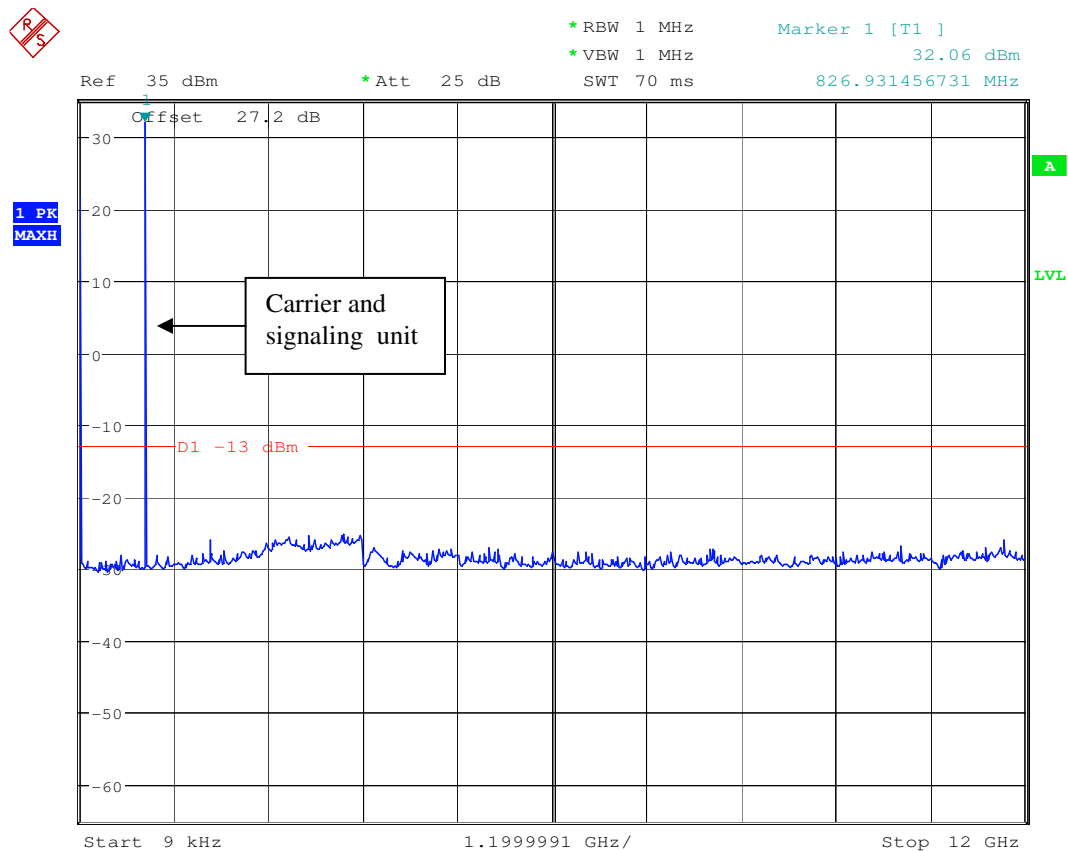
Harmonic	Tx CH.-128 Freq. (MHz)	Level (dBm)	Tx CH.-189 Freq. (MHz)	Level (dBm)	Tx CH.-251 Freq. (MHz)	Level (dBm)
2	1648.4	no spurious or more than 20 dB under limit	1672.8	no spurious or more than 20 dB under limit	1697.6	no spurious or more than 20 dB under limit
3	2472.6		2509.2		2546.4	
4	3296.8		3345.6		3395.2	
5	4121.0		4182.0		4244.0	
6	4945.2		5018.4		5092.8	
7	5769.4		5854.8		5941.6	
8	6593.6		6691.2		6790.4	
9	7417.8		7527.6		7639.2	
10	8242.0		8364.0		8488.0	

Channel: 128



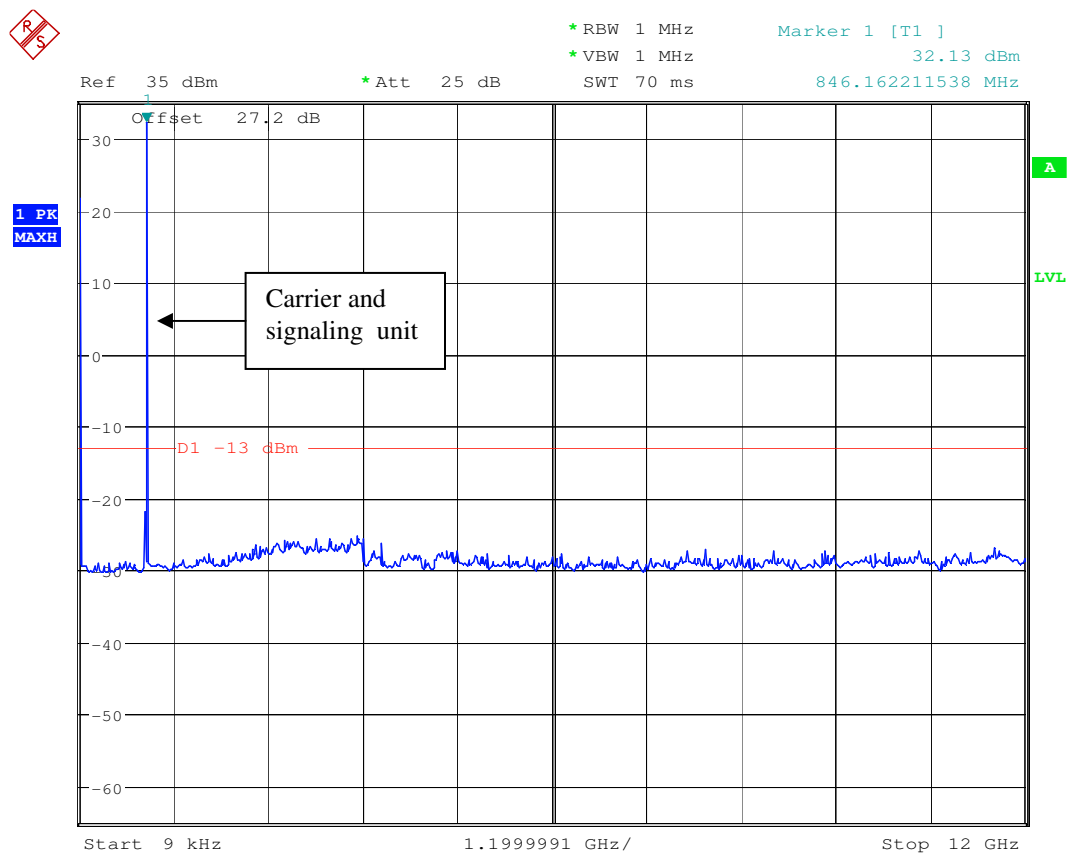
Date: 26.SEP.2006 13:27:49

Channel 189



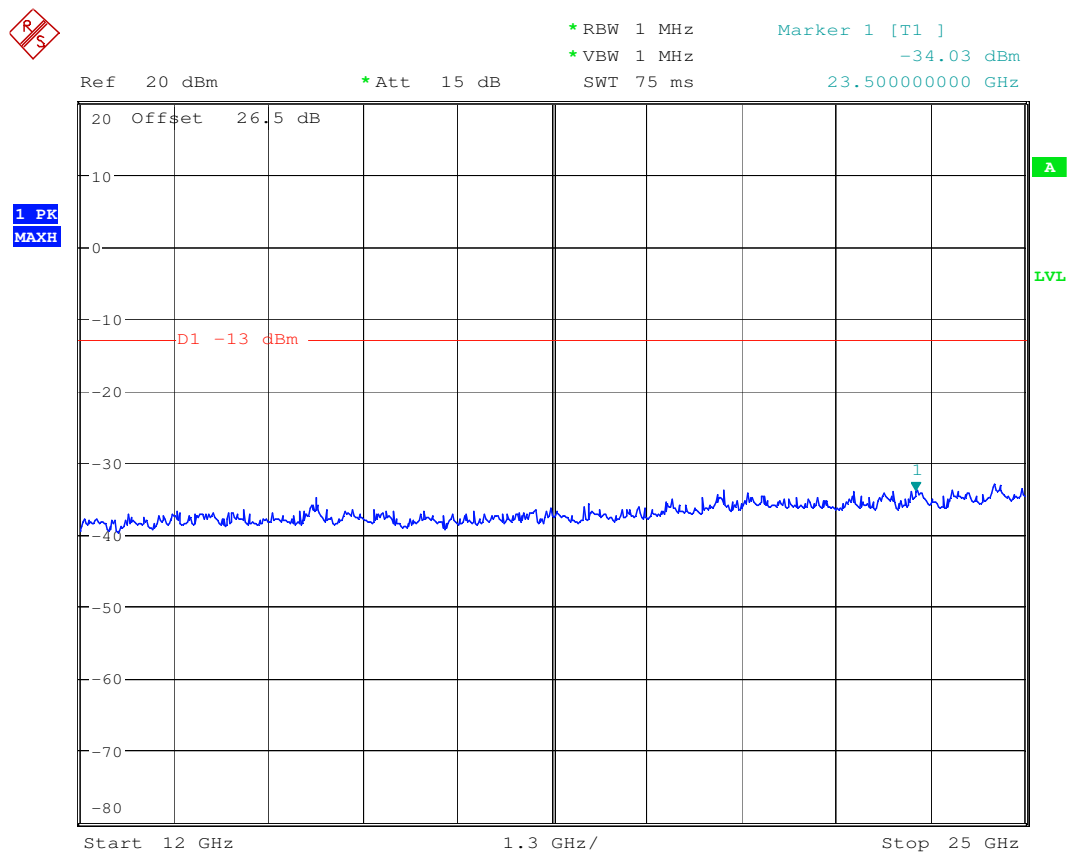
Date: 26.SEP.2006 13:28:52

Channel 251



Date: 26.SEP.2006 13:29:40

Channel 251 (12 GHz - 25 GHz) valid for all 3 channels



Date: 26.SEP.2006 13:34:43

3.2.6 Block Edge Compliance

Reference

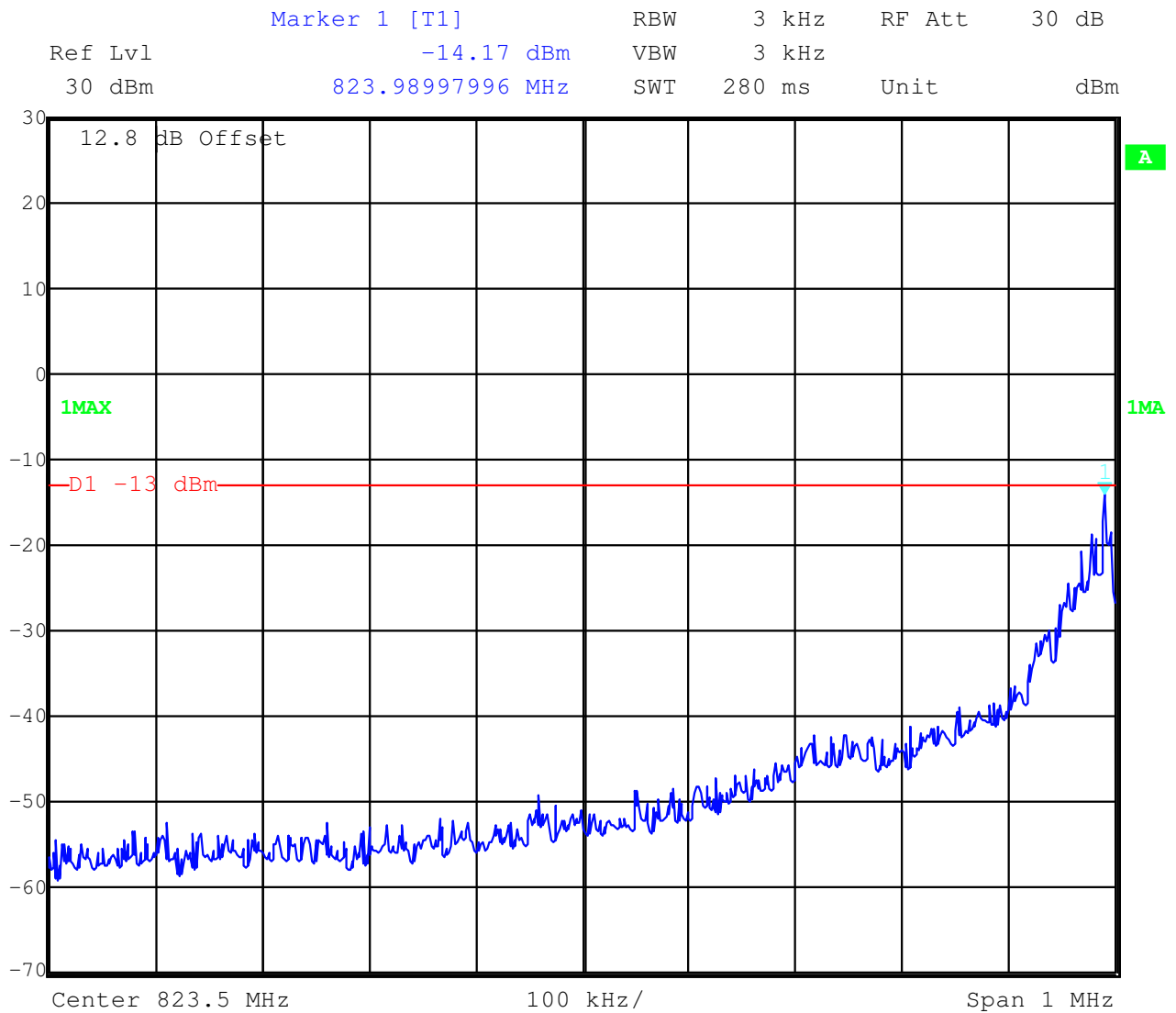
FCC:	CFR Part 22.917
IC:	RSS 132, Issue 2, Section 6.5

Measurement Limit:

Sec. 22.917(b) 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 $43+10\log(P)$ dB. For all power levels +33 dBm to 0 dBm, this becomes a constant specification limit of -13 dBm.

Block 1 Channel 128



Date: 26.SEP.2006 11:16:16

Block 4 Channel 251



Date: 26.SEP.2006 11:14:59

3.2.7 Occupied Bandwidth

Reference

FCC:	CFR Part 22.917, 2.1049
IC:	RSS 132, Issue 2, Section 4.2

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 below lists the measured 99% power and -26dBC occupied bandwidths. Spectrum analyzer plots are included on the following pages.

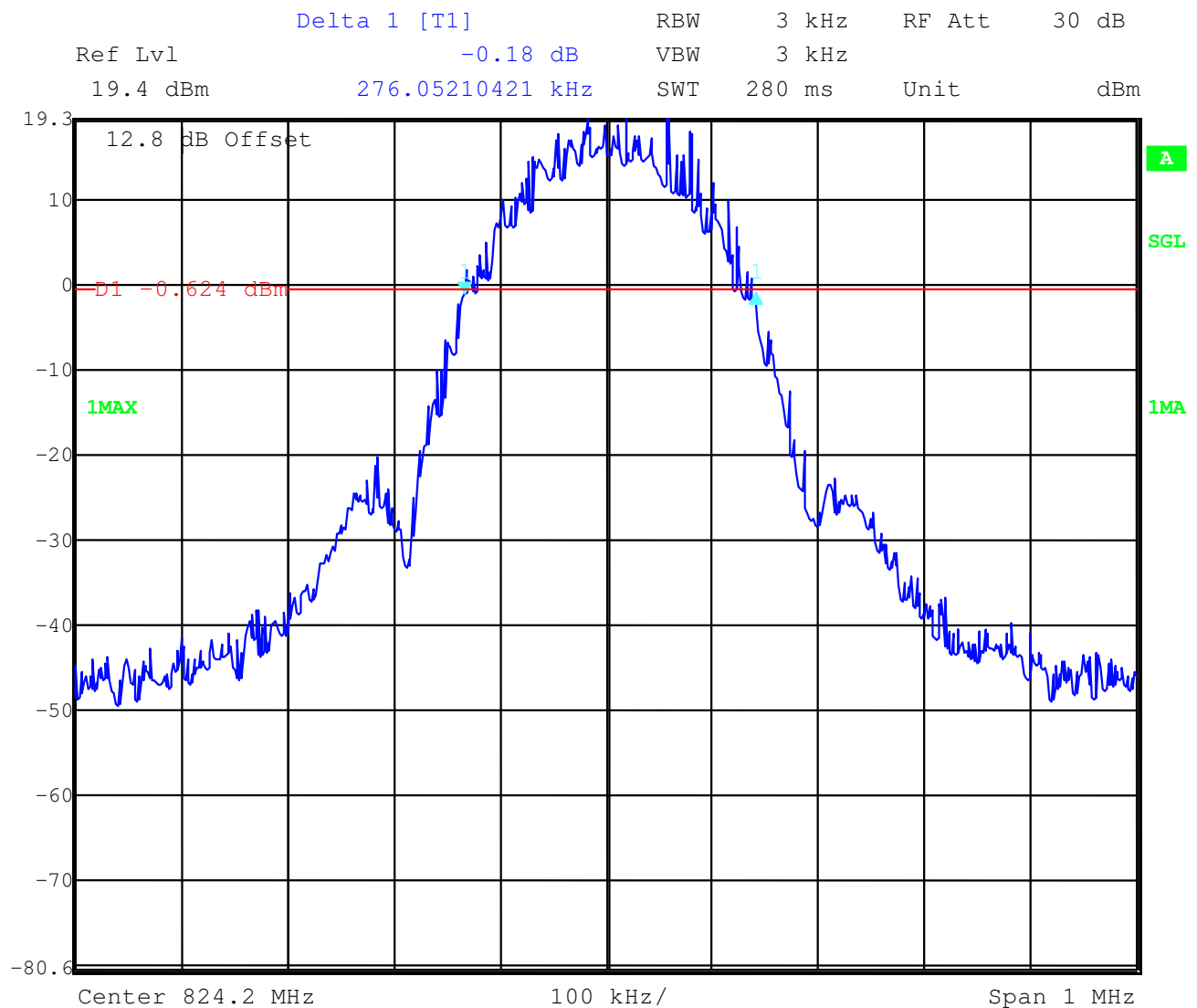
Normal mode

Frequency	99% Occupied Bandwidth (kHz)	-26 dBc Bandwidth (kHz)
824.2 MHz	276.052	298.016
836.4 MHz	272.044	296.032
848.8 MHz	254.028	312.044

Part 22 requires a measurement bandwidth of at least 1% of the occupied bandwidth. For ca. 300 kHz, this equates to a resolution bandwidth of at least 3 kHz. For this testing, a resolution bandwidth 3.0 kHz was used.

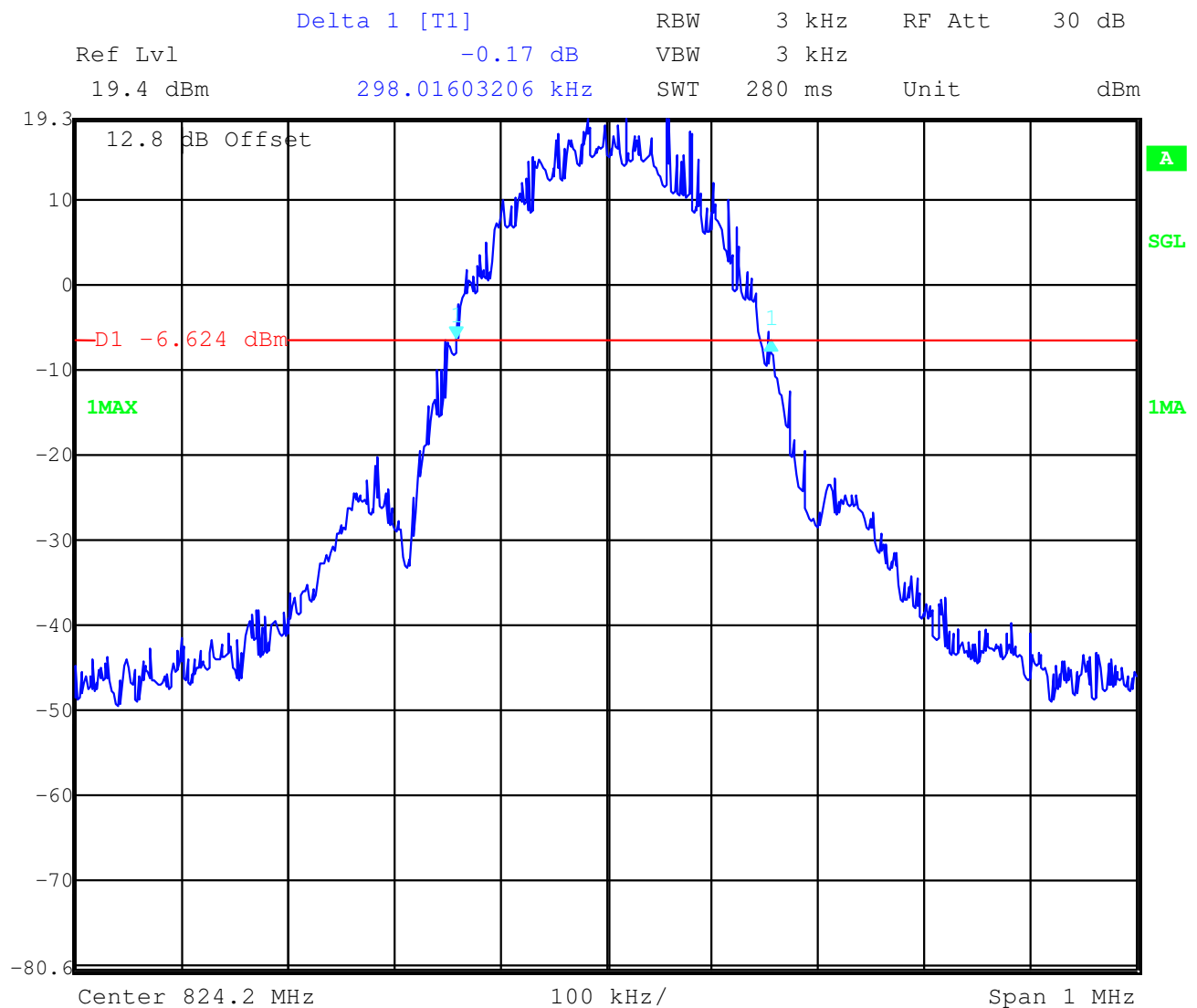
Channel 128

99% (-20 dB) Occupied Bandwidth



Date: 26.SEP.2006 11:05:37

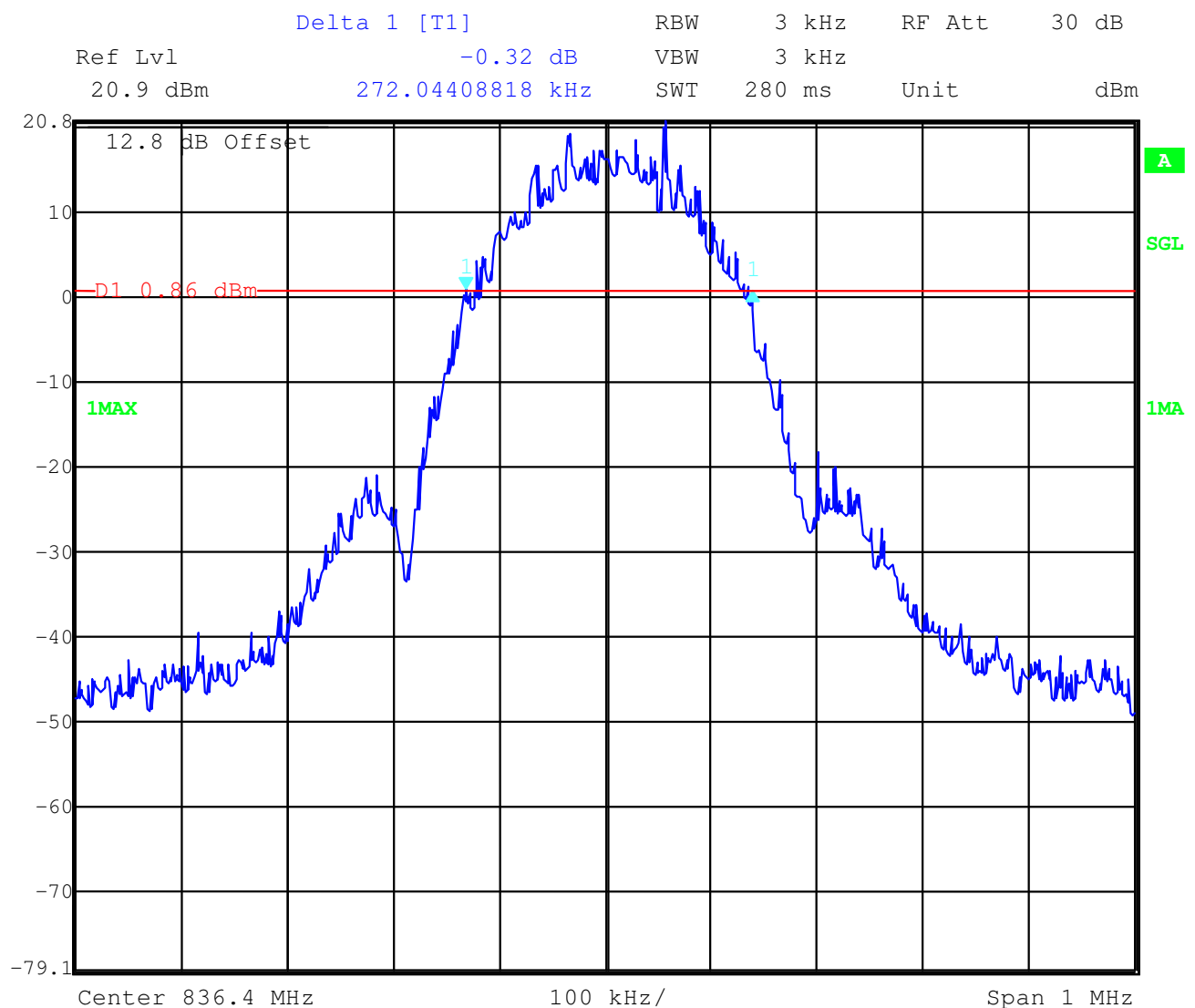
Channel 128 -26 dBc Bandwidth



Date: 26.SEP.2006 11:06:41

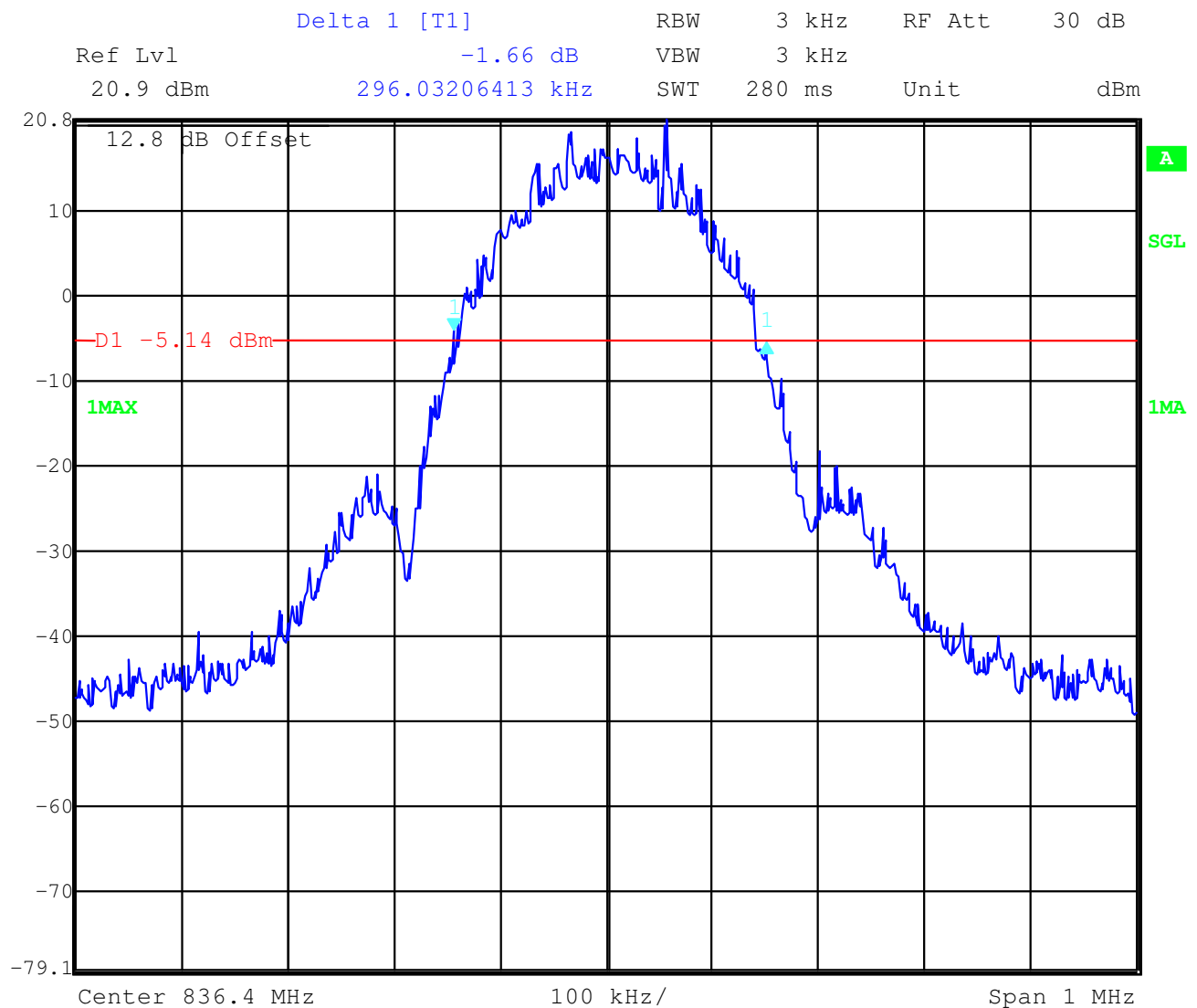
Channel 189

99% (-20 dB) Occupied Bandwidth



Date: 26.SEP.2006 11:03:24

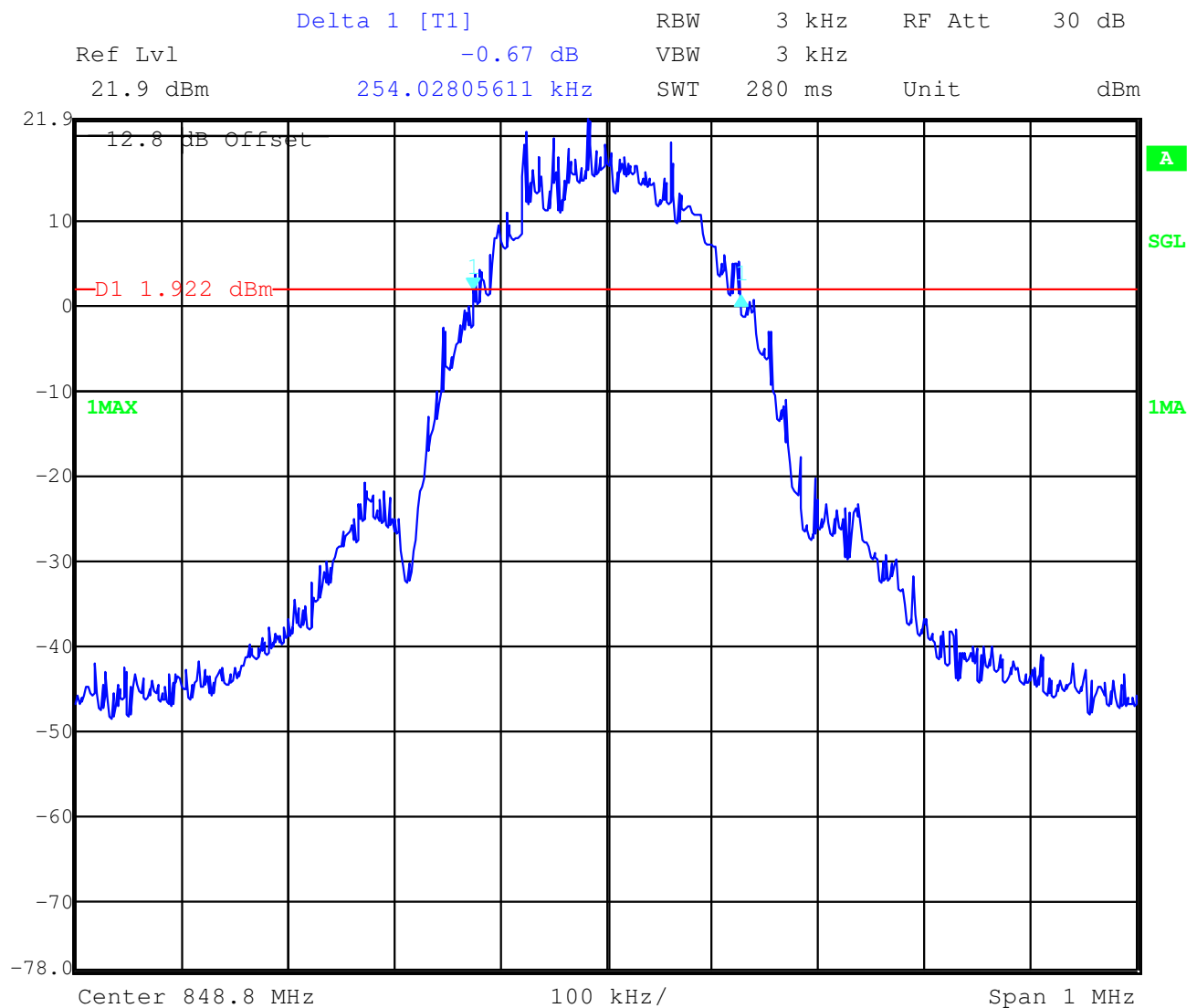
Channel 189 -26 dBc Bandwidth



Date: 26.SEP.2006 11:02:18

Channel 251

99% (-20 dB) Occupied Bandwidth



Date: 26.SEP.2006 10:59:17

Channel 251 -26 dBc Bandwidth



Date: 26.SEP.2006 11:00:15

4 Used Test Equipment

No.	Instrument/ Ancillary	Manufacturer	Type	Serial-No.	Internal ID No.		
Anechoic chamber							
1.	Anechoic chamber	MWB		87400/02	300000996		
2.	Bi conical antenna	EMCO	3104C	9909-4868	300002590		
3.	Log. Per. antenna	EMCO	3146	2130	300001603		
4.	Double ridge horn	EMCO	3115P	3088	300001032		
5.	Active loop antenna	EMCO	6502	2210	300001015		
6.	Loop antenna	Rohde & Schwarz	HFH2-Z2	891847-35	300001169		
7.	Spectrum analyzer	Hewlett-Packard	8566B	2747A05306	300001000		
8.	Spectrum analyzer display	Hewlett-Packard	85662A	2816A16541	300002297		
9.	Quasi peak adapter	Hewlett-Packard	85650A	2811A01131	300000999		
10.	RF pre selector	Hewlett-Packard	85685A	2833A00768	400000081		
11.	Workstation	Hewlett-Packard	Vectra VL		300001688		
12.	Software	Hewlett-Packard	EMI Halle C		300000983		
13.	Power attenuator	Byrd	8325	1530	300001595		
14.	Band reject filter	Wainwright	WRCG1855/1910	7	300003350		
15.	Band reject filter	Wainwright	WRCG2400/2483	11	300003351		
16.	Power supply unit	Hewlett-Packard	6032A	2818A03450	300001040		
17.	Universal communication tester	Rohde & Schwarz	CMU 200	103992	300003231		
Laboratories Short Range Devices							
18.	Amplifier	Parzich GMBH	js42-00502650- 28-5a	928979	300003143		
19.	Analog-/Digital multi- meter		DF-971A	438309, 438320, 438361	400000082		
20.	Audio Analyzer 2Hz - 300 kHz	Rohde & Schwarz	UPD	841074/009	300001236		
21.	Bit error analyzer	Hewlett-Packard	37732A	3606U03073	300001446		
22.	Communication tester	Rohde & Schwarz	CMD55	831050/082	300003018		
23.	Communication test Set	Schlumberger	4040	1725117	300001387		
24.	Directional coupler	Amplifier Research	DC 3010	12709	300001226		
25.	Directional coupler	EMV	DC3010	12306	300001429		
26.	Field strength meter (Near field probe)	EMCO	7405	9202-2150	300001203		
27.	Frequency Counter	Hewlett-Packard	5386A	2704A01243	300000998		
28.	Climatic chamber	Heraeus Voetsch	VT 4002	5,8566E+13	300003019		
29.	Climatic chamber	Heraeus Voetsch	VT 4002	521/83761	300002326		
30.	Power sensor	Hewlett-Packard	8484A	2237A10156	300001140		
31.	Power sensor	Hewlett-Packard	8482A	2237A06016	300001139		
32.	Power sensor	Hewlett-Packard	8484A	2237A10494	300001666		
33.	Power sensor	Hewlett-Packard	8482A	1925A04674	300001667		
34.	Power sensor	Hewlett-Packard	8485A	2238A00849	300001668		
35.	Power sensor	Hewlett-Packard	8482A	2237A06009	300001267		
36.	Power sensor (attenuator)	Hewlett-Packard	8482B	2703A02586	300001492		
37.	Local Oscillator	Hewlett-Packard	70900A	2842A02221	300002019		
38.	Measurement Receiver	Rohde & Schwarz	ESH 2	871921/095	300002505		
39.	Multi-meter (Hand)	Siemens	Multizet		300001102		
40.	Multi-meter (Hand)	Goerz	6EP		300001116		
41.	Multi-meter (Hand)	MetraWatt	MA4S		300001740		
42.	Multi-meter digital	Rohde & Schwarz	UDS 5	872677/042	300001325		
43.	Power supply	Hewlett-Packard	6038A	3122A11097	300001204		
44.	Power supply	Hewlett-Packard	6038A	2848A07027	300001174		
45.	Power supply	Zentro	2X30V	2007	300001109		
46.	Power supply	Hewlett-Packard	6038A	2752A04866	300001161		
47.	Power supply	Heiden	1108-32	1701	300001392		
48.	Power supply	Heiden	1108-32	1802	300001383		
49.	Power supply	Heiden	1108-32	3202	300001187		

No.	Instrument/ Ancillary	Manufacturer	Type	Serial-No.	Internal ID No.		
50.	Power supply	Zentro	LA 2x30/5GB2	2012	300001275		
51.	Power supply	Systrom	M5P 40/15A	828233	300001291		
52.	V-network AC	Rohde & Schwarz	ESH3-Z5	828576/020	300001210		
53.	Oscilloscope	Hewlett-Packard	54502A	2934A01917	300001374		
54.	Power meter	Hewlett-Packard	436A	2101A12378	300001136		
55.	Power meter	Hewlett-Packard	436A	2031U01461	300001105		
56.	Precision – frequency – reference	Hewlett-Packard	70310A	2736A00707	300002018		
57.	Radio communication analyzer	Rohde & Schwarz	CMTA 54	894043/010	300001175		
58.	Radio communication analyzer	Rohde & Schwarz	CMTA 84	894199/012	300001176		
59.	Radio communication analyzer	Rohde & Schwarz	CMTA 84	894581/013	300001355		
60.	Signal generator	Hewlett-Packard	8111A	2215G00867	300001117		
61.	Signal generator	Rohde & Schwarz	SMPC	882416/019	300001162		
62.	Function signal generator	Rohde & Schwarz	AFGU	862490/032	300001201		
63.	Function signal generator	Rohde & Schwarz	APN-04	894326/014	300001184		
64.	Signal generator 0.01- 1280 MHz	Hewlett-Packard	8662A		300001110		
65.	Signal generator 0.01- 1280 MHz	Hewlett-Packard	8662A	2232A01038	300001264		
66.	Signal generator 0.1- 2000 MHz	Rohde & Schwarz	SMH	864219/033	300001410		
67.	Signal generator 0.1- 2000 MHz	Rohde & Schwarz	SMH	883909/010	300001183		
68.	Signal generator 0.1- 2060 MHz	Hewlett-Packard	8657A	2838U00736	300001009		
69.	Signal generator 0.1- 4200 MHz	Hewlett-Packard	8665A	2833A00109	300001177		
70.	Signal generator 0.1- 4200 MHz	Hewlett-Packard	8665A	2833A00112	300001373		
71.	Signal generator 0.1- 4320 MHz	Rohde & Schwarz	SMHU	2790575	300001404		
72.	Signal generator 0.1- 4320 MHz	Rohde & Schwarz	SMHU	894055/005	300001190		
73.	Signal generator DC- 600 KHz	Hewlett-Packard	8904A	2822A01213	300001157		
74.	Signal generator DC- 600 KHz	Hewlett-Packard	8904A	2822A01214	300001158		
75.	Signal generator DC- 600 KHz	Hewlett-Packard	8904A	2822A01203	300001367		
76.	Function signal generator	Rohde & Schwarz	APN 04	2273637	300001395		
77.	Signal generator NF	Rohde & Schwarz	SPN	880139/068	300001142		
78.	Spectrum Analyzer	Rohde & Schwarz	FSiQ26	835111/0004	300002678		
79.	Spectrum analyzer	Hewlett-Packard	71210A (70000)	2731A02347	300000321		
80.	Spectrum analyzer	Rohde & Schwarz	FSMS	826067/004	300001223		
81.	Spectrum analyzer 2	Hewlett-Packard	85660B	3138A07614	300001207		
82.	Spectrum analyzer 3	Hewlett-Packard	8566A	1925A00257	300001098		
83.	Spectrum analyzer Display	Hewlett-Packard	70206A	2840A01553	300002017		
84.	Spectrum analyzer Display 2	Hewlett-Packard	85662A	3144A20627	300001208		
85.	Spectrum analyzer Display 3	Hewlett-Packard	85662	1925A00860	300002306		
86.	Isolating transformer	Erft	913501		300001205		
87.	Isolating transformer	Erft	MPL	91350	300001155		
88.	Isolating transformer	Erft	MPL	91350	300001151		
89.	Isolating transformer	Erft	6210		300001179		
90.	Isolating transformer	Grundig	RT5A	8781	300001277		
91.	Isolating transformer	Grundig	RT5A	9242	300001263		
92.	Amplifier	Hewlett-Packard	8447D	2648A04780	300001360		
93.	Amplifier	EMV	10W1000	9549	300001377		

No.	Instrument/ Ancillary	Manufacturer	Type	Serial-No.	Internal ID No.		
94.	Amplifier	EMV	25W1000	12948	300001440		
95.	Amplifier 5W	Amplifier Research	5W1000	9725	300001592		
Laboratory Bluetooth							
96.	Power splitter	Inmet Corp.	1499382		300002841		
97.	Power sensor	Rohde & Schwarz	NRV-Z1	833894/011	300002681-0010		
98.	Signal generator	Rohde & Schwarz	SMIQ03	836206/0092	300002680		
99.	Bluetooth RF-test system	Rohde & Schwarz	TS8960		300002681-0000		
100.	Signal generator	Rohde & Schwarz	SMIQ03	835541/055	300002681-0001		
101.	Signal generator	Rohde & Schwarz	SMIQ03	835541/056	300002681-0002		
102.	Signal generator	Rohde & Schwarz	SMP02	835133/011	300002681-0003		
103.	Power meter	Rohde & Schwarz	NRVD	835430/044	300002681-0004		
104.	Spectrum - analyzer	Rohde & Schwarz	FSIQ	835540/018	300002681-0005		
105.	Switch unit	Rohde & Schwarz	SSCU		300002681-0006		
106.	Attenuator-step	Rohde & Schwarz	RSP	834500/010	300002681-0007		
107.	Frequency normal	Rohde & Schwarz	Rubidium		300002681-0009		
108.	Power sensor	Rohde & Schwarz	NRV-Z1	833894/012	300002681-0013		
Conducted emission on AC line Room 006							
109.	Measurement receiver	Rohde & Schwarz	ESH3	881515/002	300002490		
110.	Measurement receiver	Rohde & Schwarz	ESVP	881487/021	300002491		
111.	Measurement receiver	Rohde & Schwarz	ESH3	890174/002	300000296		
112.	V-network AC	Rohde & Schwarz	ESH3-Z5	892475/017	300002209		
113.	V-network AC	Rohde & Schwarz	ESH3-Z5	892239/020	300002506		
114.	Software	Rohde & Schwarz	ESK-1				
115.	DC power supply	Hewlett-Packard	6032A	2743A02600	300001498		
116.	V-network AC	Rohde & Schwarz	ESH3-Z5	861189/014	300001458		
117.	V-network DC	Rohde & Schwarz	ESH3-Z6	893689/012	300001504		
118.	V-network DC	Rohde & Schwarz	ESH3-Z6	861406/005	300001518		
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