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Nemko Canada Inc., 303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2

Report number:	147578-1TRFWL
Apparatus:	Bi-directional Amplifier
Model:	BDA-CELLAB-2/25W-90-OA
Applicant:	G-Wave, Incorporated 15 Ron's Edge Road Springfield, New Jersey 07081, USA
FCC ID:	8QKCELLAB25W90

Test specification:

Title 47 – Telecommunication
Chapter I – Federal Communications Commission
Subchapter A – General
Part 22 – Public Mobile Services
Subpart H – Cellular Radiotelephone Service

Reviewed by: Kevin Ma
Signature
Kevin Ma, Wireless/EMC Specialist

April 28, 2010
Date

Tested by: Andrey Adelberg, Senior Wireless/EMC Specialist

SCC Accredited LAB
LAB Accrédité CCN

Nemko Canada Inc., a testing laboratory, is accredited by the Standards Council of Canada.
The tests included in this report are within the scope of this accreditation.

Table of contents

Section 1: Report summary

This report contains an assessment of apparatus against specifications based upon tests carried out on samples submitted at Nemko Canada Inc.

Test specification:
FCC Part 22 Subpart H, Cellular Radiotelephone Service

Compliance status:	Complies
Exclusions:	None
Non-compliances:	None
Report release history:	Original release
Test location:	Nemko Canada Inc. 303 River Road, R.R. 5, Ottawa, Ontario, Canada, K1V 1H2
Registration number:	176392 (3 m Semi anechoic chamber)

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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Section 2: Equipment under test

2.1 Identification of equipment under test (EUT)

The following information identifies the EUT under test:

Type of equipment:	Bi-Directional Cellular Amplifier
Product marketing name:	G-Wave
Model number:	BDA-CELLAB-2/25W-90-OA
Serial number:	10041001
Nemko sample number:	1
FCC ID:	8QKCELLAB25W90
Date of receipt:	April 8, 2010

2.2 EUT description

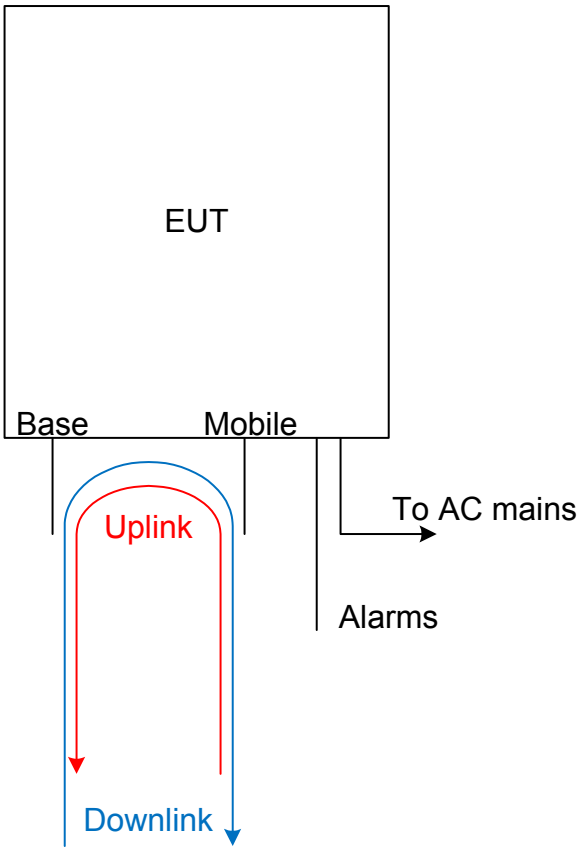
The BDA assembly extends the coverage area of radio communications in buildings and RF shielded environments.
The BDA Downlink path receives RF signals from the base station and amplifies and transmits them to the subscriber. The BDA Uplink path receives RF signals from the subscriber and amplifies and transmits them to the base station. The Uplink and Downlink occupy two distinct frequency bands. For example, the CELLAB frequency bands are as follows: 824–849 MHz for the Uplink and 869–894 MHz for the Downlink. Two diplexers isolate the paths and route each signal to the proper amplifying channel.

2.3 Technical specifications of the EUT

Operating band:	824–849 MHz (Uplink) 869–894 MHz (Downlink)
Operating frequencies:	825.25–847.75 MHz (CDMA Uplink) 824.28–848.72 MHz (GSM Uplink) 870.25–892.75 MHz (CDMA Downlink) 869.28–893.72 MHz (GSM Downlink)
Modulation type:	GSM, CDMA
Emission designator:	F9W (GSM), GXW (CDMA)
Antenna type:	External Antenna (Equipment that has an external 50 Ω RF connector)
Power source	120 VAC, 60 Hz external

Section 2: Equipment under test, continued

2.4 EUT setup diagram



2.5 Operation of the EUT during testing

Signal generator with CDMA or GSM modulation was connected to the EUT's input or output.

2.6 Modifications incorporated in the EUT

There were no modifications performed to the EUT during this assessment.

Section 3: Test conditions

3.1 Deviations from laboratory tests procedures

No deviations were made from laboratory test procedures.

3.2 Test conditions, power source and ambient temperatures

Normal temperature, humidity and air pressure test conditions	Temperature: 15–30 °C Relative humidity: 20–75 % Air pressure: 86–106 kPa When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.
Power supply range:	The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 3: Test conditions, continued

3.3 Measurement uncertainty

Nemko Canada measurement uncertainty has been calculated using guidance of UKAS LAB 34:2003 and TIA-603-B Nov 7, 2002. All calculations have been performed to provide a confidence level of 95 % and can be found in Nemko Canada document MU-003.

3.4 Test equipment

Equipment	Manufacturer	Model No.	Asset/Serial No.	Next cal.
3 m EMI Test Chamber	TDK	SAC-3	FA002047	Mar. 09/11
Flush Mount Turntable	Sunol	FM2022	FA002082	NCR
Controller	Sunol	SC104V	FA002060	NCR
Antenna Mast	Sunol	TLT2	FA002061	NCR
Receiver/Spectrum Analyzer	Rohde & Schwarz	ESU 26	FA002043	Jan. 14/11
Bilog Antenna	Sunol	JB3	FA002108	Jan. 18/11
Horn Antenna #2	EMCO	3115	FA000825	Jan. 18/11
1–18 GHz Amplifier	JCA	JCA118-503	FA002091	Oct 07/10

Note: N/A = Not Applicable, NCR = No Cal Required, COU = CAL On Use

Section 4: Result summary

4.1 Test results

The apparatus was assessed against the following specifications:

FCC Part 2 Subpart J, Equipment Authorization Procedures
FCC Part 22 Subpart H Cellular Radiotelephone Service
FCC 2-11-04/EAB/RF Amplifier, Booster, and Repeater Reminder Sheet

The column headed 'Required' indicates whether the associated clauses were invoked for the apparatus under test. The following abbreviations are used:

N	No : not applicable / not relevant.
Y	Yes : Mandatory i.e. the apparatus shall conform to these tests.
N/T	Not Tested, mandatory but not assessed. (See report summary)

Parts		Test description	Required	Result
§22.913	§2.1046	RF power output	Y	Pass
–		Gain	Y	Pass
	2-11-04/EAB/RF	Occupied bandwidth	Y	Pass
§22.917	§2.1051	Spurious emissions at antenna terminal	Y	Pass
§22.917	§2.1053	Field strength of spurious radiation	Y	Pass
	2-11-04/EAB/RF	Out of band rejection	Y	Pass

Notes: None

Appendix A: Test results

Clause 2.1046(a)/22.913(a) RF output power

The effective radiated power (ERP) of transmitters in the Cellular Radiotelephone Service must not exceed the limits in this section.

(a) Maximum ERP. In general, the effective radiated power (ERP) of base transmitters and cellular repeaters must not exceed 500 Watts (57 dBm). However, for those systems operating in areas more than 72 km (45 miles) from international borders that:

(1) Are located in counties with population densities of 100 persons or fewer per square mile, based upon the most recently available population statistics from the Bureau of the Census; or,

(2) Extend coverage on a secondary basis into cellular unserved areas, as those areas are defined in §22.949, the ERP of base transmitters and cellular repeaters of such systems must not exceed 1000 Watts (60 dBm). The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts (38.45 dBm).

Test date: April 8, 2010

Test results: Pass

Special notes

- All measurements were performed using a peak detector with 2 MHz/3 MHz RBW/VBW settings.
- The input from the signal generator is set such that the maximum output is provided at the antenna terminals.
- Measured power is at the 1 dB compression point for a single carrier.

Clause 2.1046(a)/22.913(a) RF output power, continued

Test data

Conducted measurements

Frequency, MHz	Modulation	Power output, dBm	Limit, dBm
Downlink			
870.25	CDMA	35.75	57.00
881.50	CDMA	36.18	57.00
892.75	CDMA	35.04	57.00
869.28	GSM	35.65	57.00
881.50	GSM	36.07	57.00
893.72	GSM	35.05	57.00
Uplink			
825.25	CDMA	25.06	57.00
836.50	CDMA	25.66	57.00
847.75	CDMA	25.05	57.00
824.28	GSM	25.28	57.00
836.50	GSM	26.49	57.00
848.72	GSM	25.53	57.00

The maximum antenna gain to be used on the **downlink** path is 20.82 dBd.
If transmitting antennas of directional gain greater than 20.82 dBd are used, the conducted output power shall be reduced below the stated values by the amount in dB that the directional gain of the antenna exceeds 20.82 dBd.

The maximum antenna gain to be used on the **uplink** path is 30.51 dBd.
If transmitting antennas of directional gain greater than 30.51 dBd are used, the conducted output power shall be reduced below the stated values by the amount in dB that the directional gain of the antenna exceeds 30.51 dBd.

Gain

Signal booster gain shall be measured.

Test date: April 8, 2010

Test results: Pass

Special notes

- The difference between maximum input and maximum output levels was calculated.

Clause 2.1049 Gain, continued

Test data

Frequency, MHz	Modulation	Power input, dBm	Power output, dBm	Gain, dB
Downlink				
870.25	CDMA	-58.19	35.75	93.94
881.50	CDMA	-58.35	36.18	94.53
892.75	CDMA	-58.42	35.04	93.46
869.28	GSM	-58.19	35.65	93.84
881.50	GSM	-58.35	36.07	94.42
893.72	GSM	-58.42	35.05	93.47
Uplink				
825.25	CDMA	-65.93	25.06	90.99
836.50	CDMA	-65.74	25.66	91.40
847.75	CDMA	-65.47	25.05	90.52
824.28	GSM	-65.93	25.28	91.21
881.50	GSM	-65.74	26.49	92.23
848.72	GSM	-65.47	25.53	91.00

Clause 2-11-04/EAB/RF Occupied bandwidth

Using an RBW of 300 Hz or 1 % of the emission bandwidth, The spectral shape of the output should look similar to the input for all modulations.

Test date: April 8, 2010

Test results: Pass

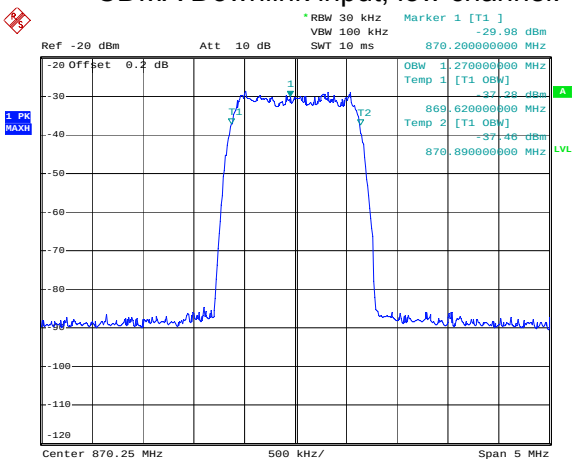
Special notes

For CDMA modulation RBW/VBW was set to 30/100 kHz. For GSM modulation RBW/VBW was set to 10/30 kHz.
Peak detector was used for measurement.
Both the input and output bandwidths were evaluated to show similar characteristics of the emissions.

Clause 2-11-04/EAB/RF Occupied bandwidth, continued

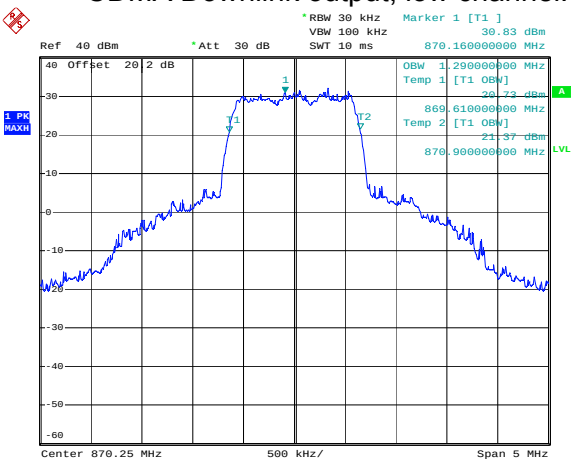
Test data

CDMA Downlink input, low channel:



Date: 9.APR.2010 08:47:05

CDMA Downlink output, low channel:



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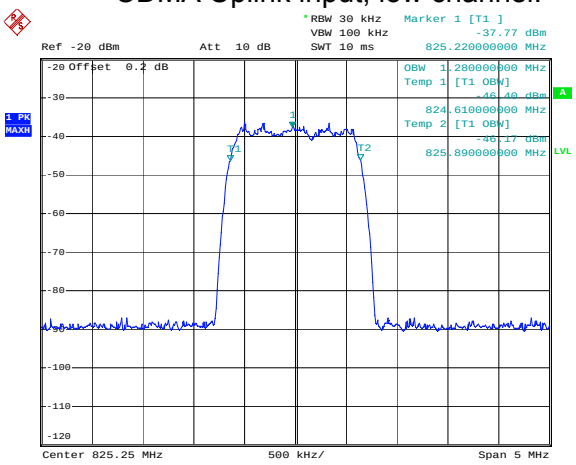
CDMA Uplink input, low channel:



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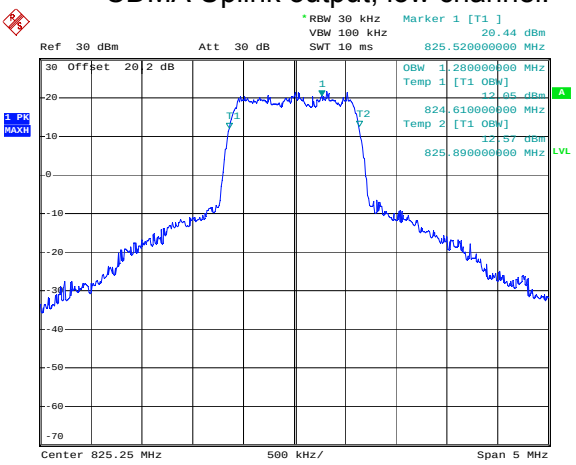
CDMA Uplink output, low channel:



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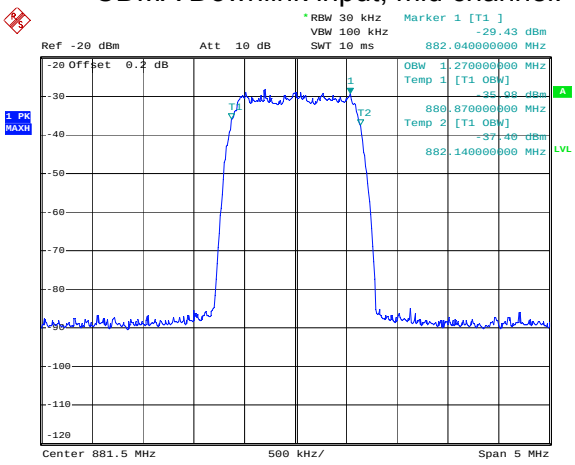
Clause 2-11-04/EAB/RF Occupied bandwidth, continued

Test data, continued

CDMA Downlink input, mid channel:



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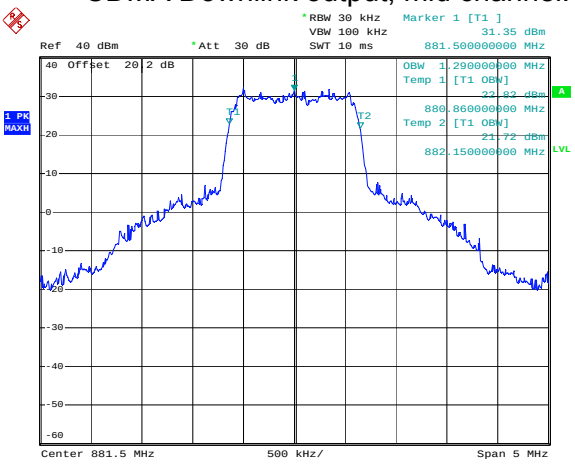
CDMA Downlink output, mid channel:



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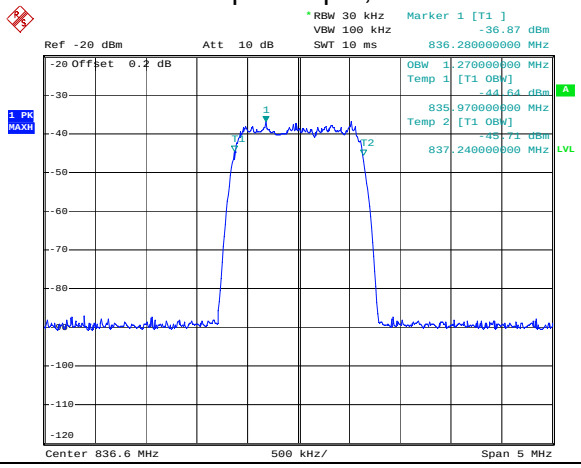
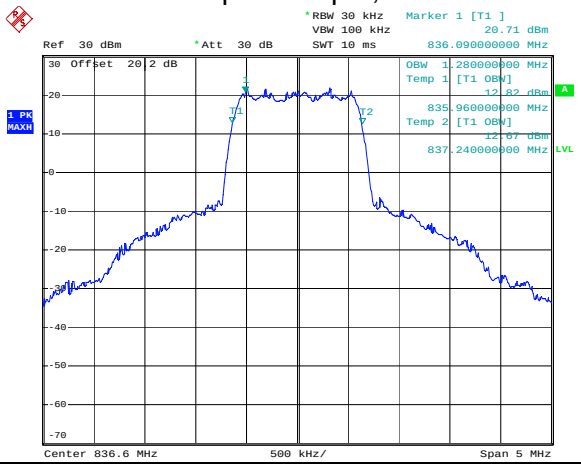
CDMA Uplink input, mid channel:



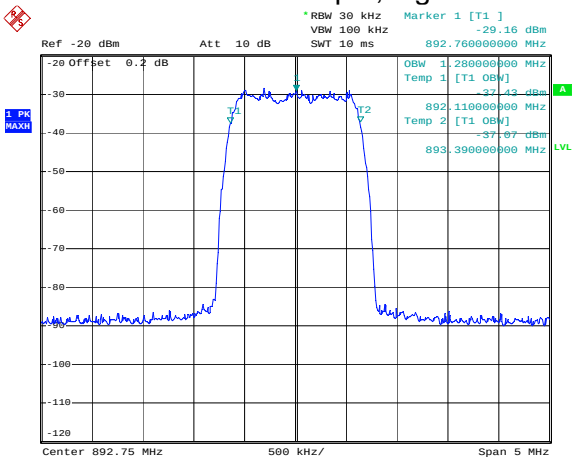
CDMA Uplink output, mid channel:



Clause 2-11-04/EAB/RF Occupied bandwidth, continued

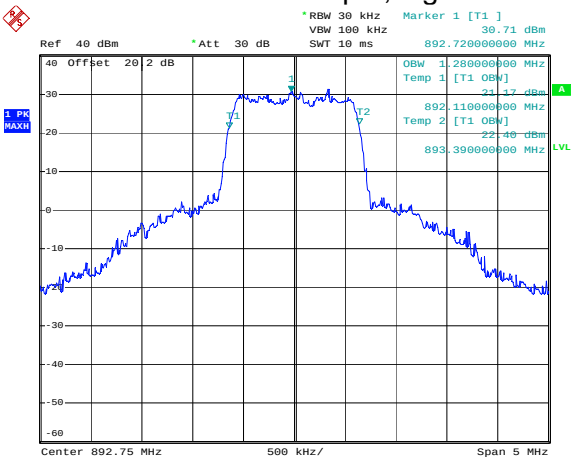
Test data

CDMA Downlink input, high channel:



Date: 9.APR.2010 08:46:29

CDMA Downlink output, high channel:



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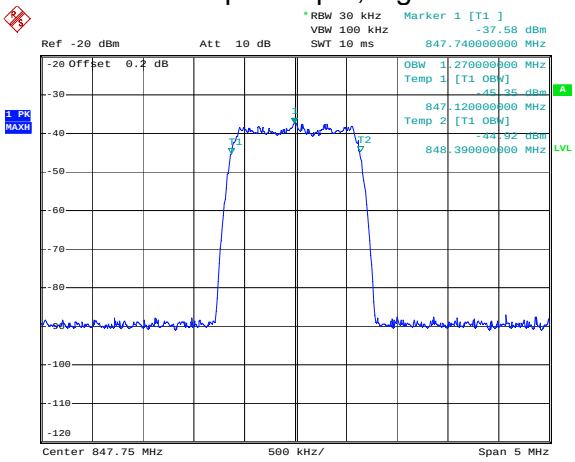
CDMA Uplink input, high channel:



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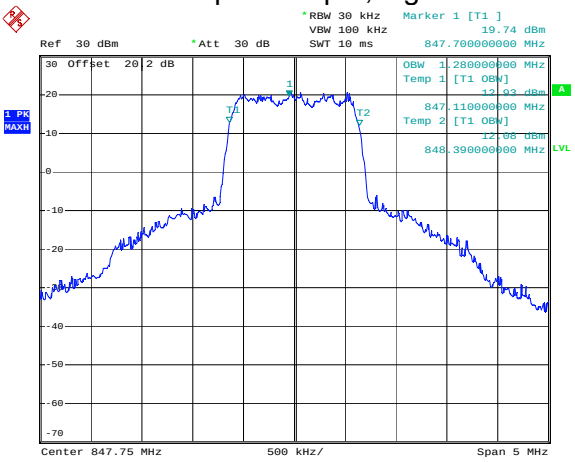
CDMA Uplink output, high channel:

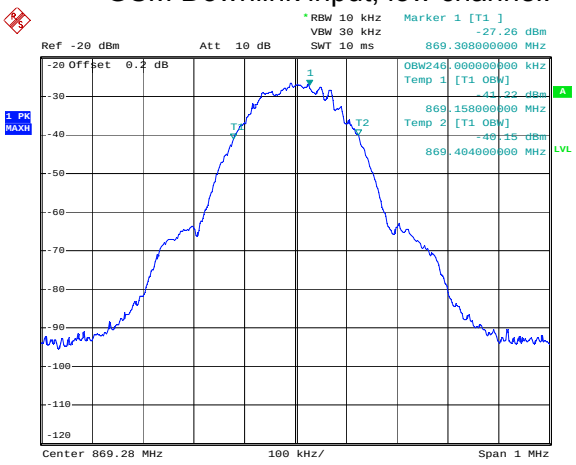


Date: 9.APR.2010 08:33:58

Clause 2-11-04/EAB/RF Occupied bandwidth, continued

Test data

GSM Downlink input, low channel:



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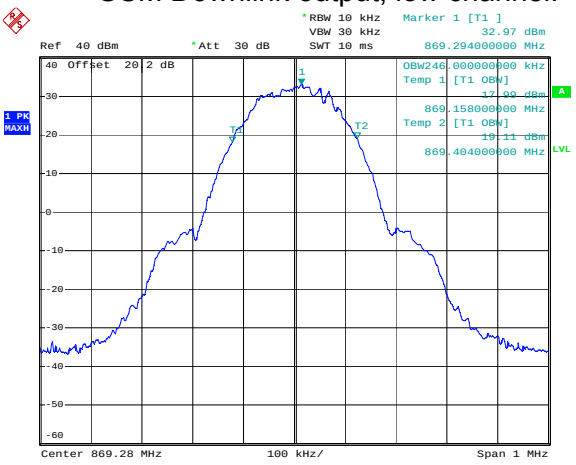
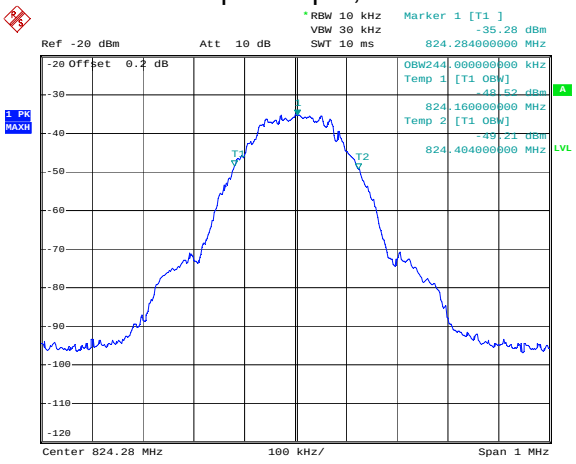
GSM Downlink output, low channel:



Date: 9.APR.2010 08:40:51

GSM Uplink input, low channel:



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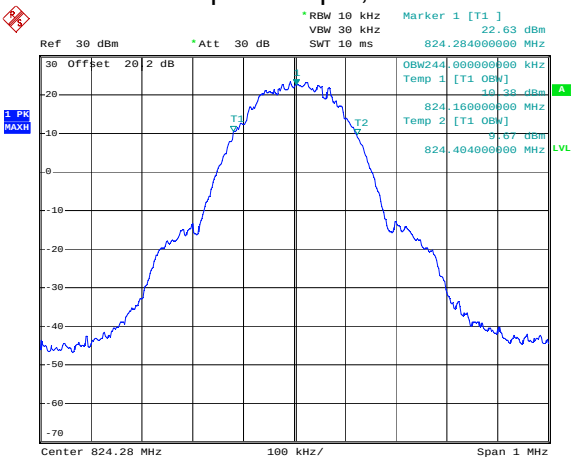
GSM Uplink output, low channel:



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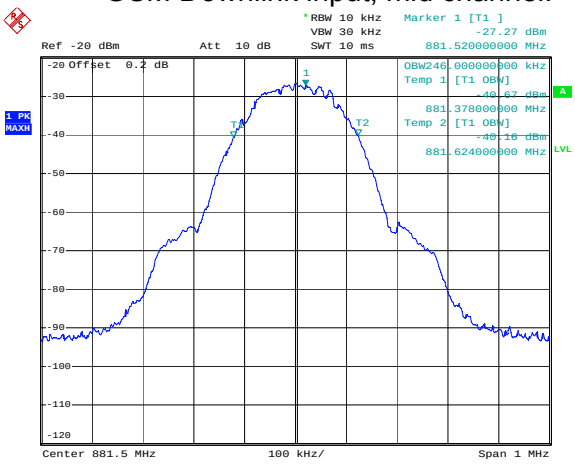
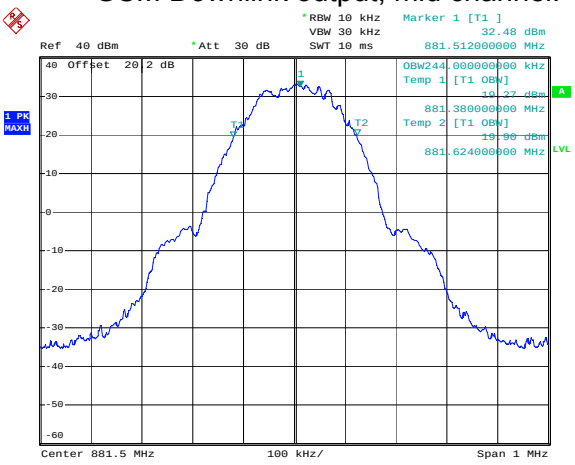
Clause 2-11-04/EAB/RF Occupied bandwidth, continued

Test data, continued

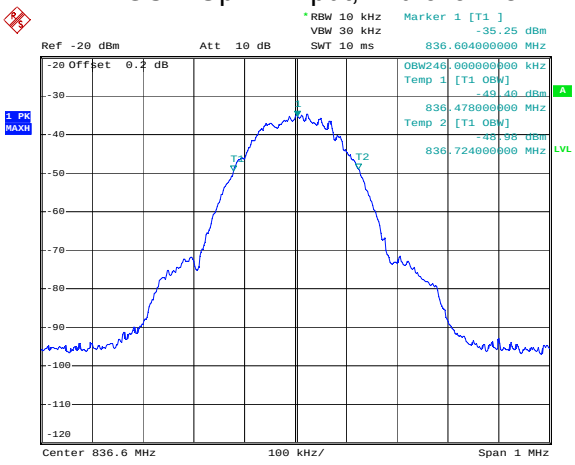
GSM Downlink input, mid channel:



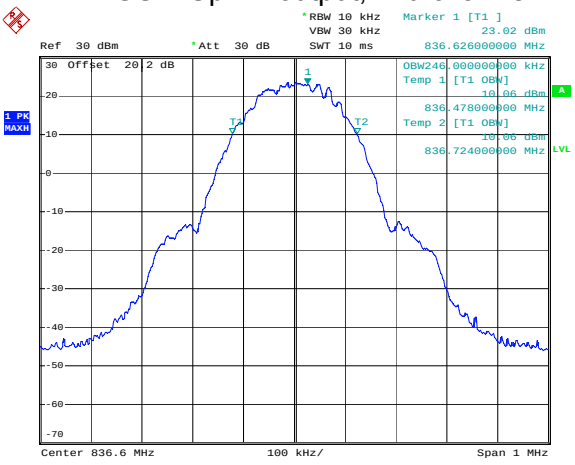
GSM Downlink output, mid channel:



GSM Uplink input, mid channel:



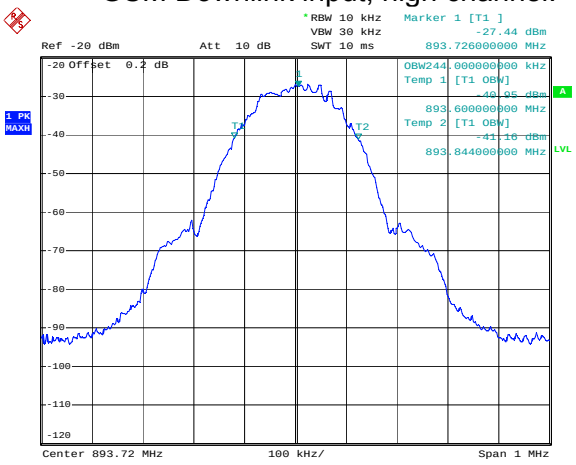
GSM Uplink output, mid channel:



Clause 2-11-04/EAB/RF Occupied bandwidth, continued

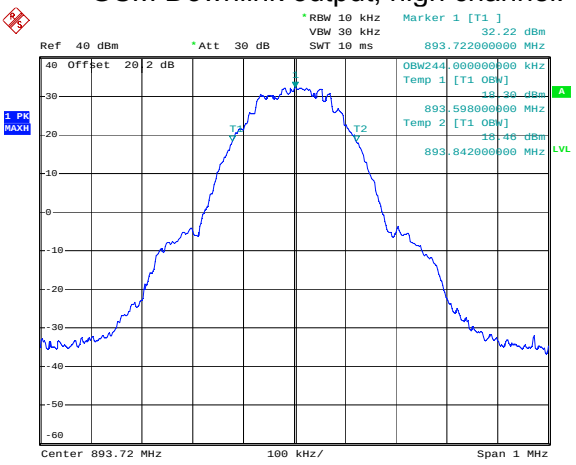
Test data

GSM Downlink input, high channel:



Date: 9.APR.2010 08:49:47

GSM Downlink output, high channel:



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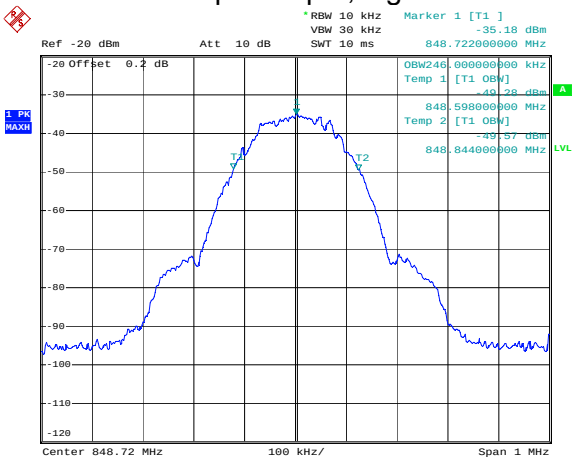
GSM Uplink input, high channel:



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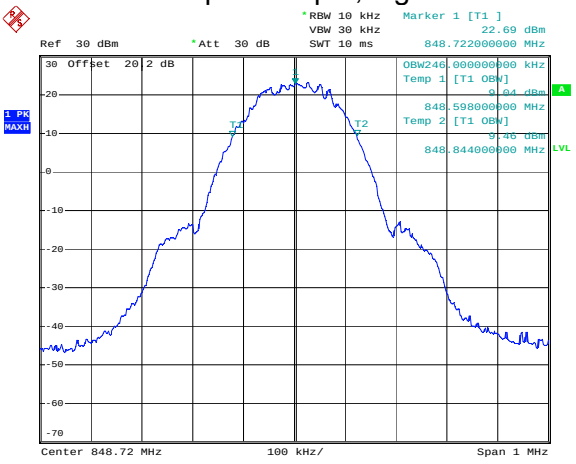
GSM Uplink output, high channel:



Date: 9.APR.2010 08:37:43

Clause 2.1051/22.917(a) Spurious emissions at antenna terminal

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

Test date: April 9, 2010

Test results: Pass

Special notes

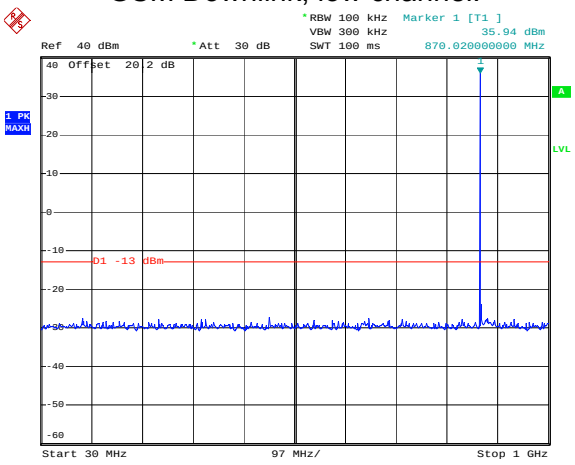
- The spectrum was searched from 30 MHz up to 10th harmonic
- Only the worst data presented in the test report.
- For Intermodulation products test two tones were placed at the lower band-edge and upper band-edge.
- Intermodulation attenuation test for CDMA 30 kHz/300 kHz RBW/VBW was used for Downlink
- Intermodulation attenuation test for CDMA 100 kHz/1000 kHz RBW/VBW was used for Uplink
- Intermodulation attenuation test for GSM 30 kHz/300 kHz RBW/VBW was used for Downlink
- Intermodulation attenuation test for GSM 100 kHz/1000 kHz RBW/VBW was used for Uplink

(b) Measurement procedure.
Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 100 kHz or 1 percent of emission bandwidth, as specified).

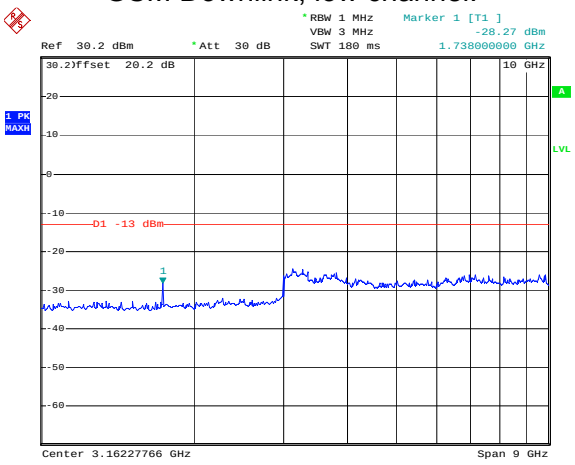
Clause 2.1051/22.917(a) Spurious emissions at antenna terminal, continued

Test data

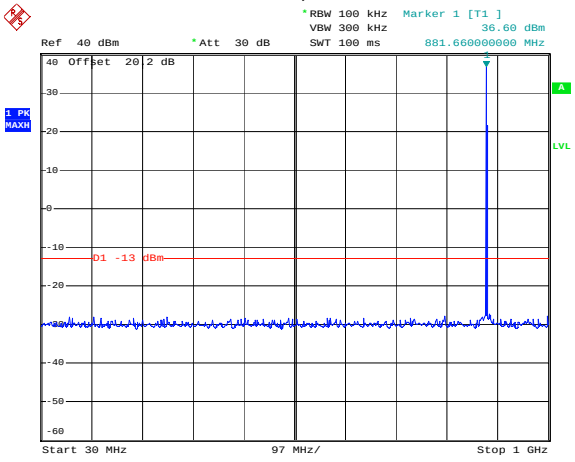
GSM Downlink, low channel:



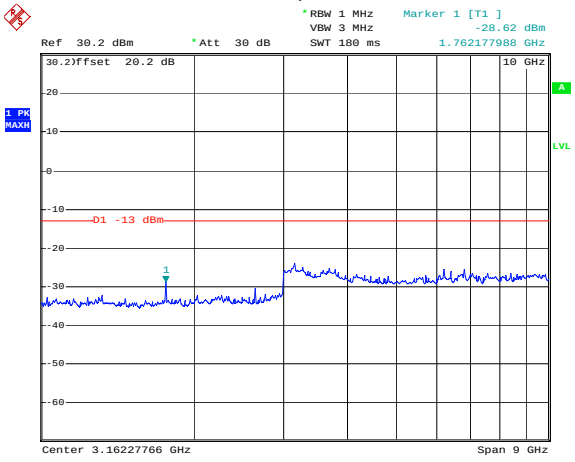
GSM Downlink, low channel:



GSM Downlink, mid channel:



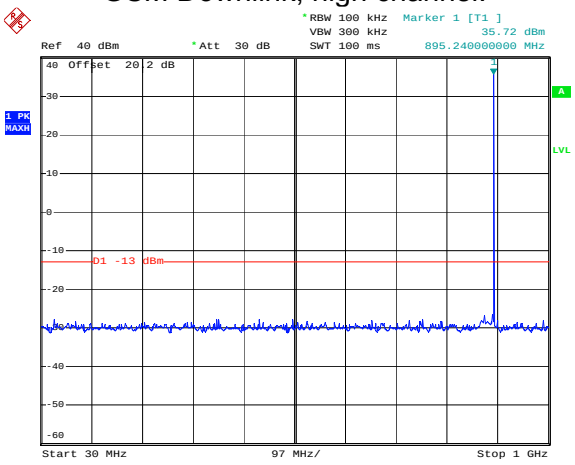
GSM Downlink, mid channel:



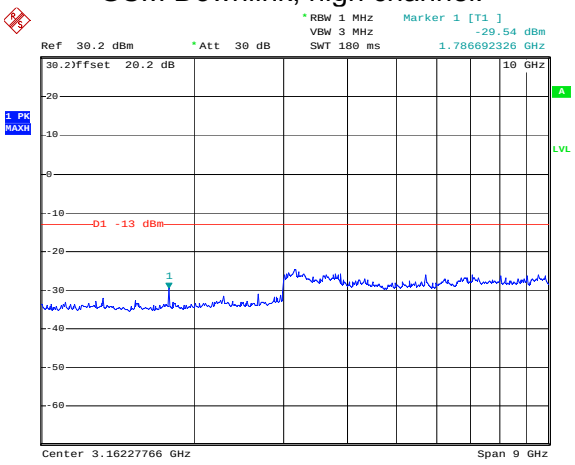
Clause 2.1051/22.917(a) Spurious emissions at antenna terminal, continued

Test data, continued

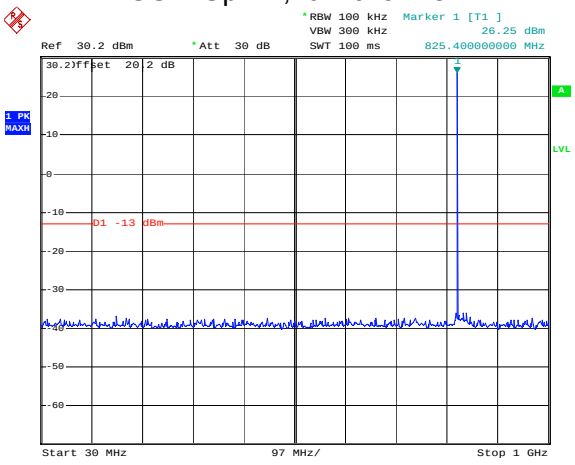
GSM Downlink, high channel:



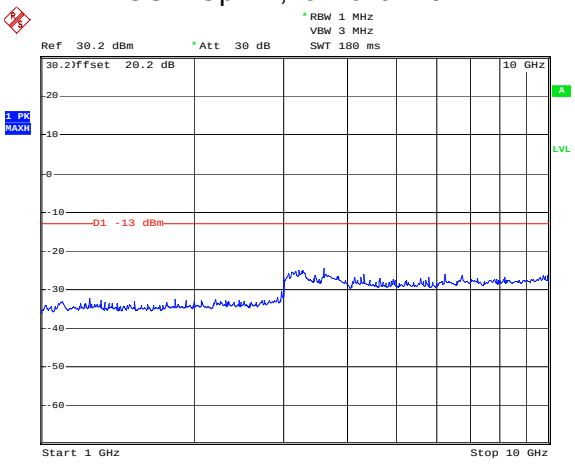
GSM Downlink, high channel:



GSM Uplink, low channel:



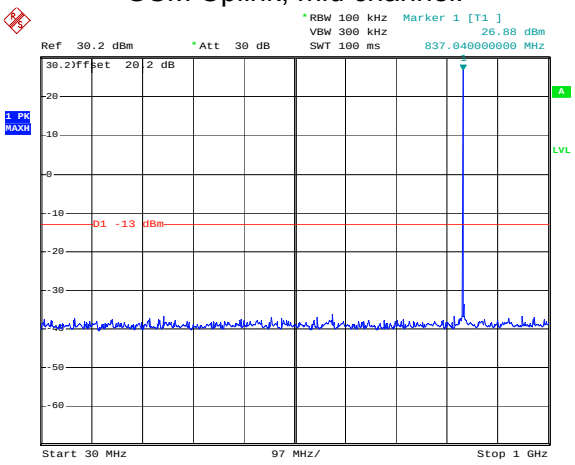
GSM Uplink, low channel:



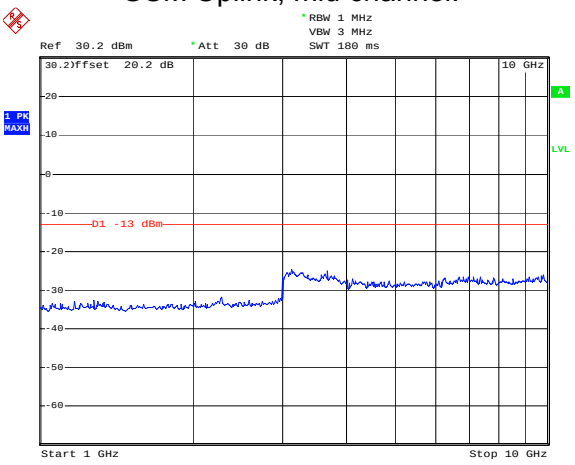
Clause 2.1051/22.917(a) Spurious emissions at antenna terminal, continued

Test data, continued

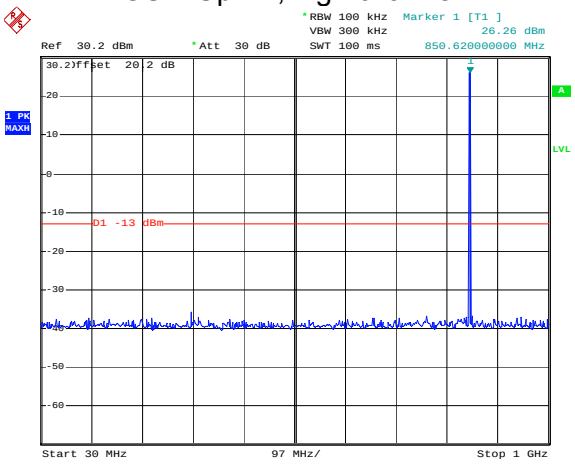
GSM Uplink, mid channel:



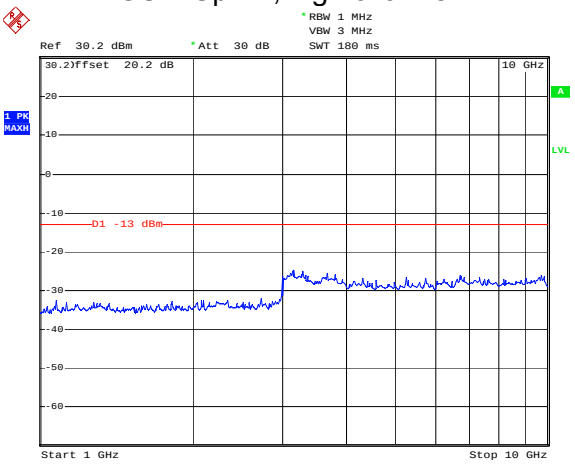
GSM Uplink, mid channel:



GSM Uplink, high channel:



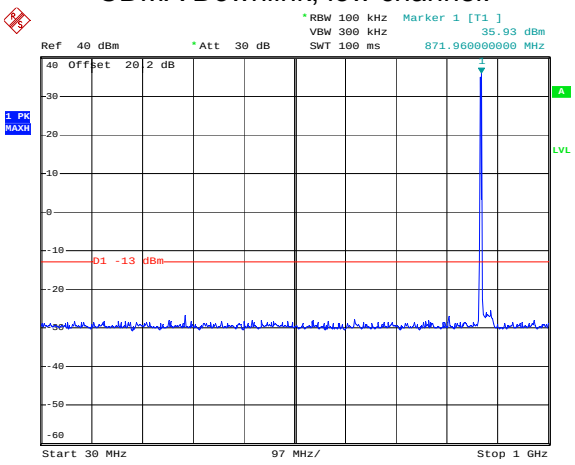
GSM Uplink, high channel:



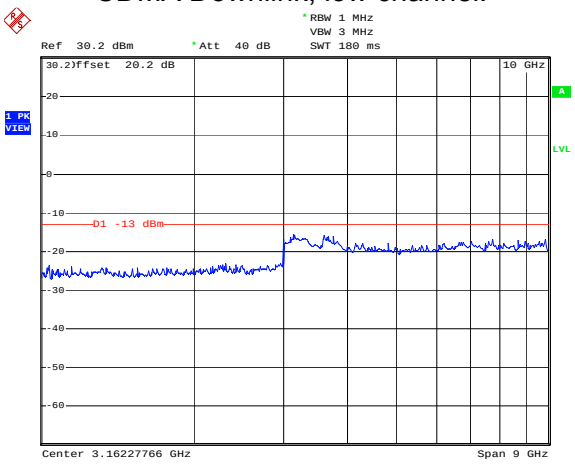
Clause 2.1051/22.917(a) Spurious emissions at antenna terminal, continued

Test data, continued

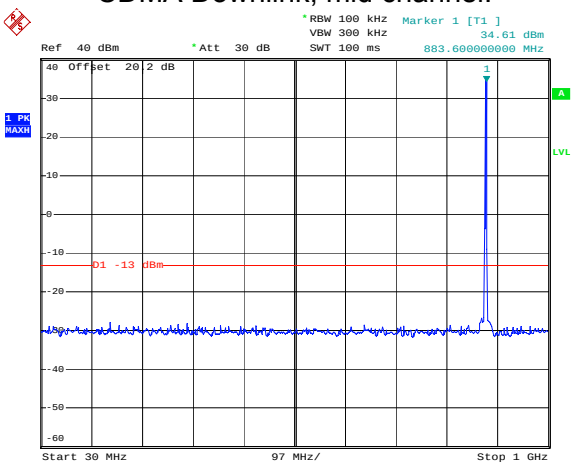
CDMA Downlink, low channel:



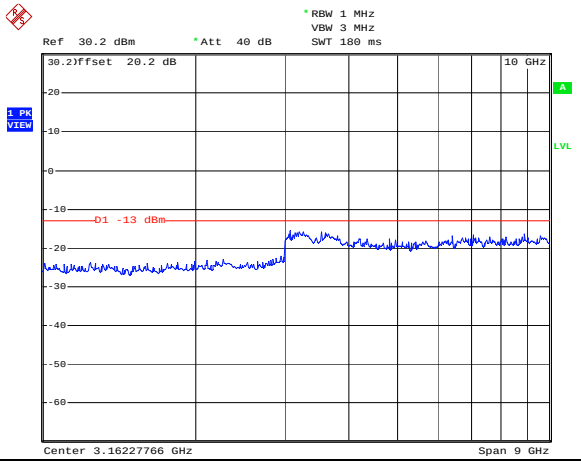
CDMA Downlink, low channel:



CDMA Downlink, mid channel:



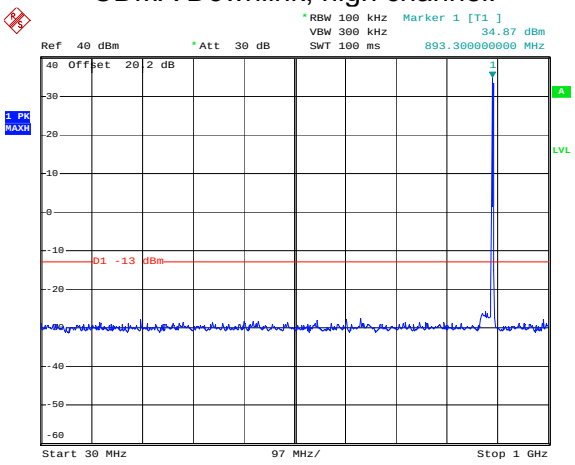
CDMA Downlink, mid channel:



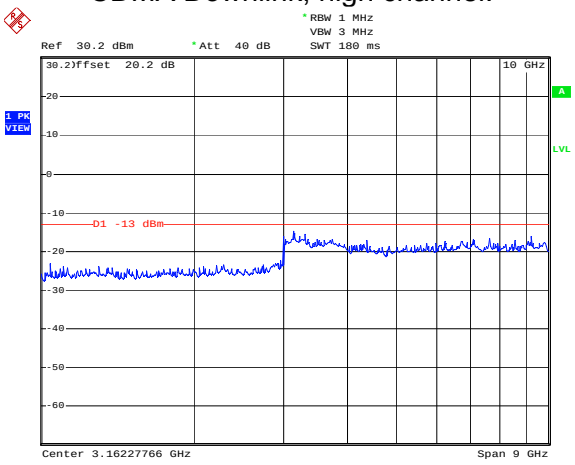
Clause 2.1051/22.917(a) Spurious emissions at antenna terminal, continued

Test data, continued

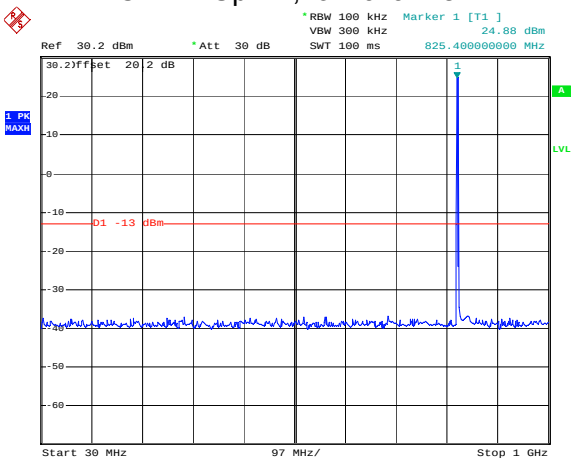
CDMA Downlink, high channel:



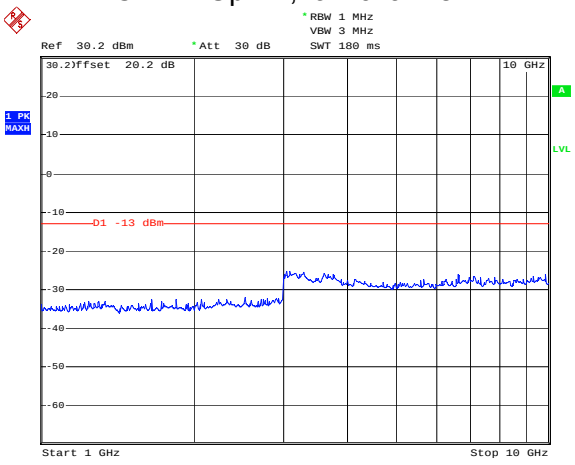
CDMA Downlink, high channel:



CDMA Uplink, low channel:



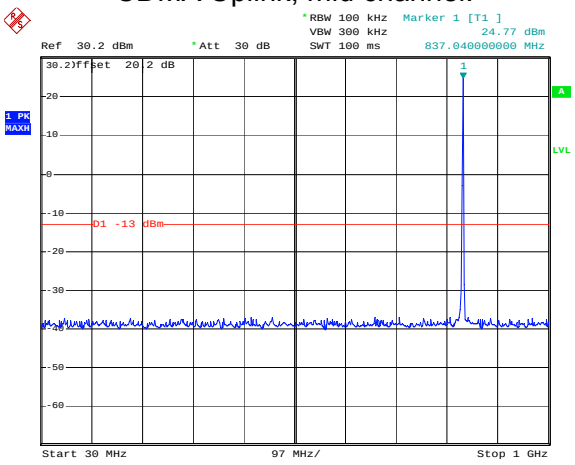
CDMA Uplink, low channel:



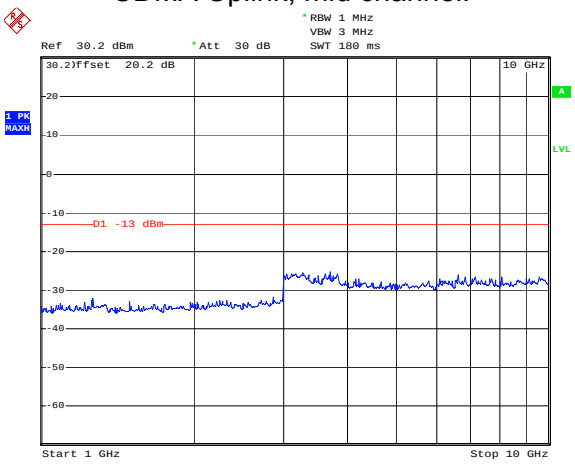
Clause 2.1051/22.917(a) Spurious emissions at antenna terminal, continued

Test data, continued

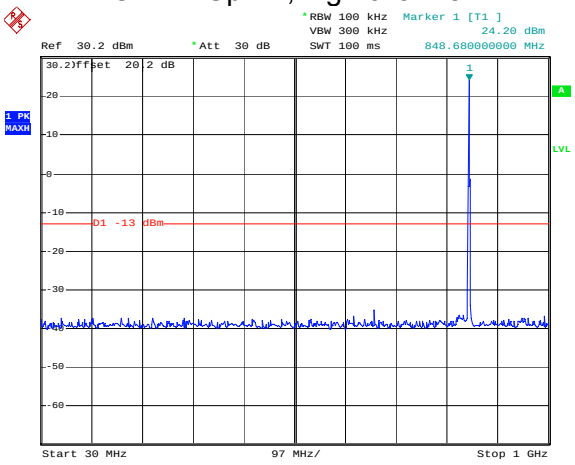
CDMA Uplink, mid channel:



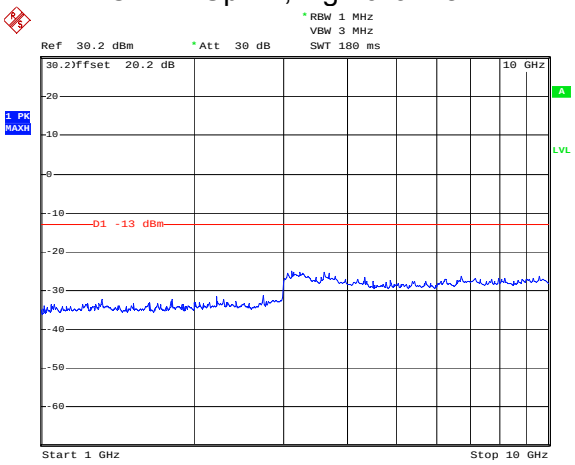
CDMA Uplink, mid channel:



CDMA Uplink, high channel:



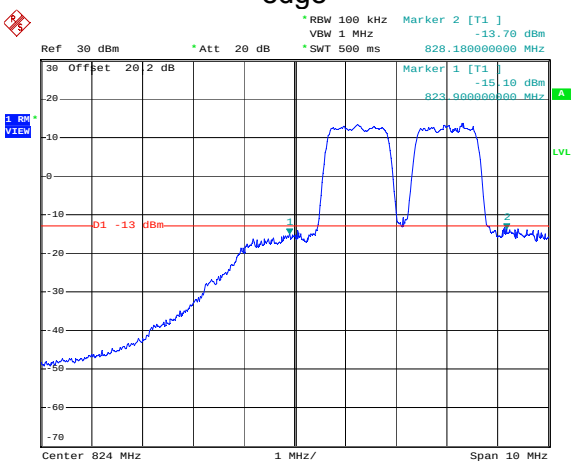
CDMA Uplink, high channel:



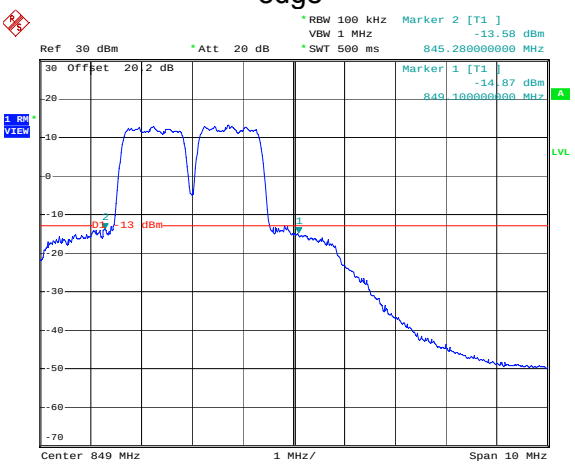
Clause 22.917(a) Spurious emissions at antenna terminal, continued

Test data, continued

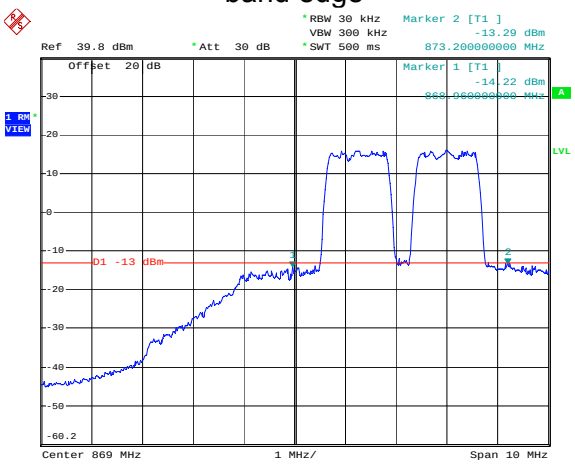
CDMA Uplink, Intermodulation on the lower band edge



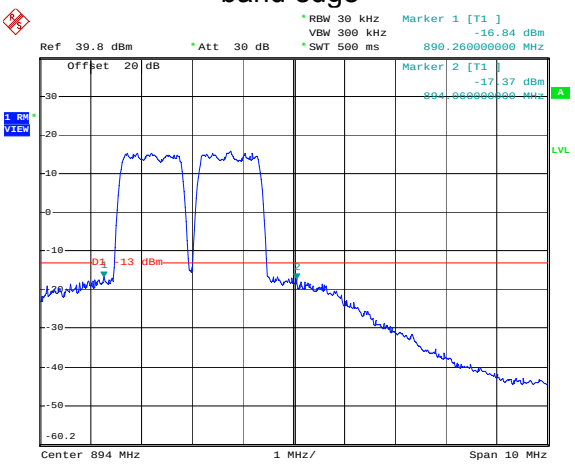
CDMA Uplink, Intermodulation on the upper band edge



CDMA Downlink, Intermodulation on the lower band edge



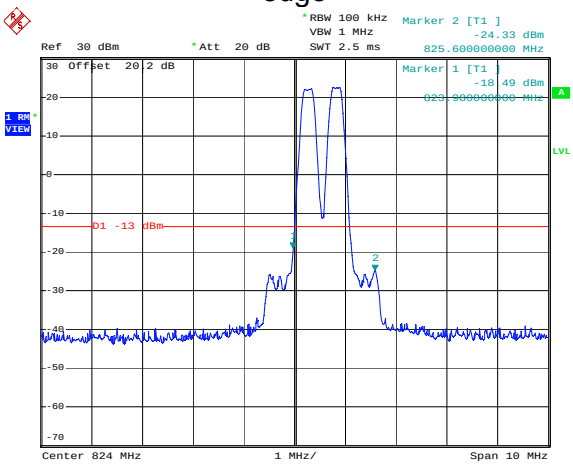
CDMA Downlink, Intermodulation on the upper band edge



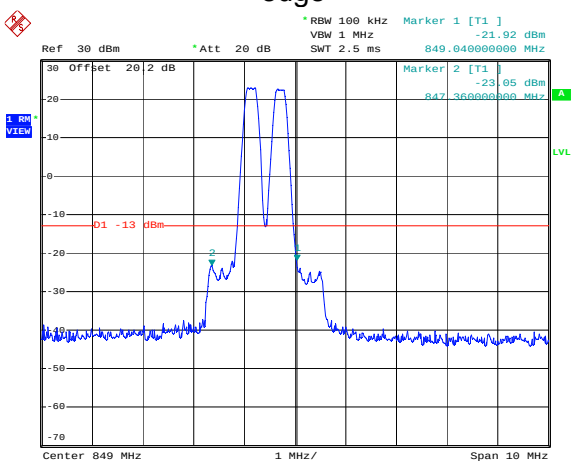
Clause 22.917(a) Spurious emissions at antenna terminal, continued

Test data, continued

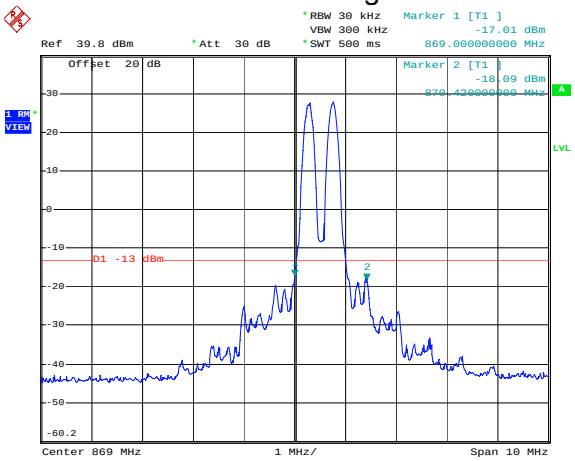
GSM Uplink, Intermodulation on the lower band edge



GSM Uplink, Intermodulation on the upper band edge

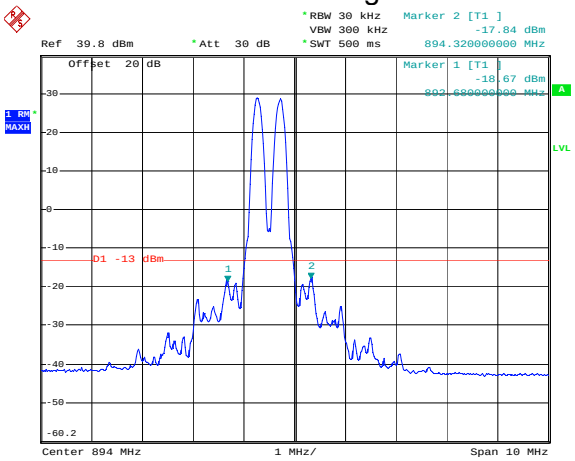


GSM Downlink, Intermodulation on the lower band edge



Date: 13.APR.2010 13:29:00

GSM Downlink, Intermodulation on the upper band edge



Date: 13.APR.2010 13:26:51

Clause 2.1053/22.917(a) Field strength of emissions

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

Test date: April 9, 2010

Test results: Pass

Special notes

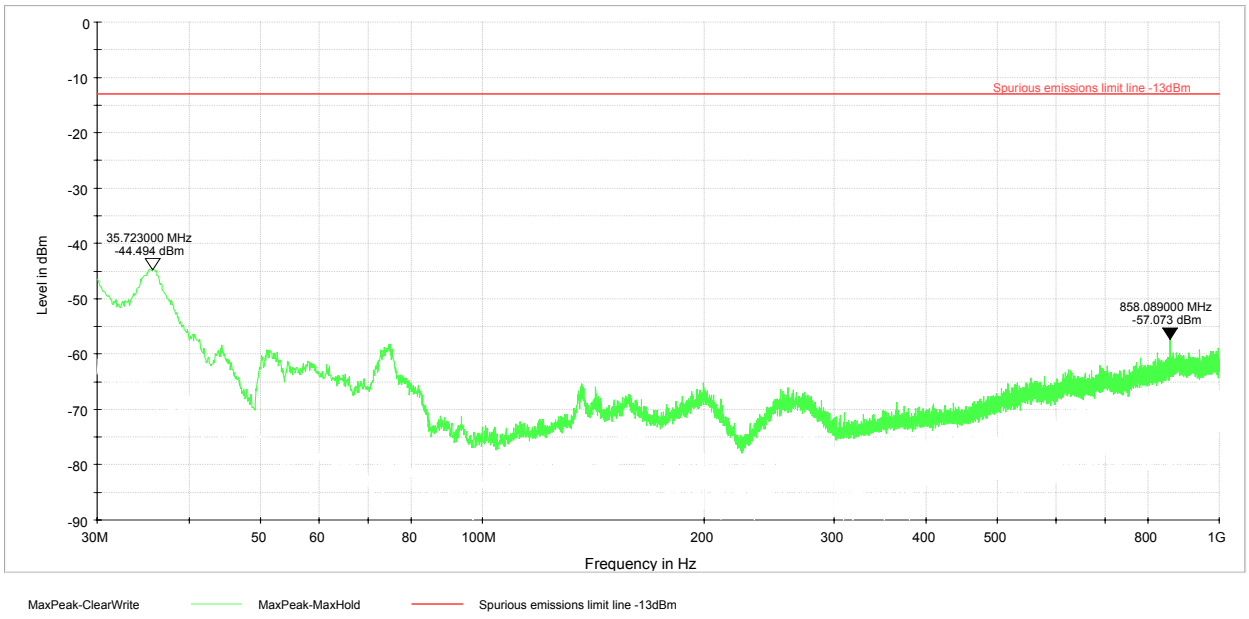
- The spectrum was searched from 30 MHz up to 10th harmonic
- All measurements were performed at a distance of 3 m.
- Only the worst data presented in the test report.
- A CW was used for both uplink and downlink for low, middle and high channels.
- The EUT's antenna port was terminated with 50 Ω termination.

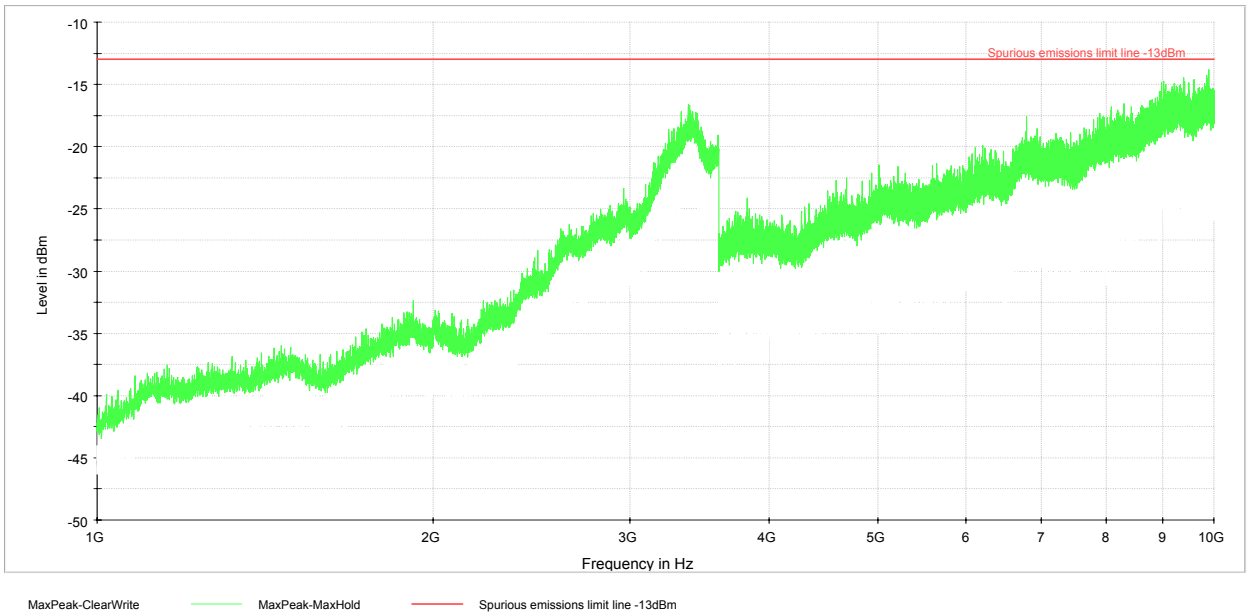
(b) Measurement procedure.
Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 100 kHz or 1 percent of emission bandwidth, as specified).

Clause 2.1053/22.917(a) Field strength of emissions, continued

Test data

Uplink, low channel:

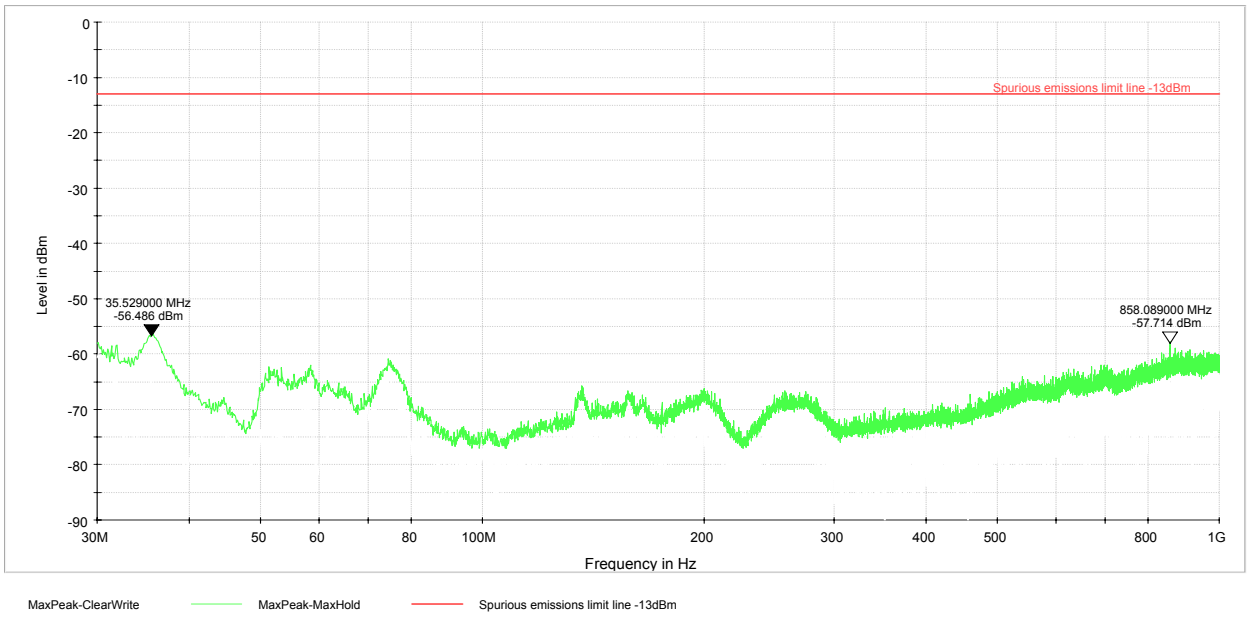




Clause 2.1053/22.917(a) Field strength of emissions, continued

Test data

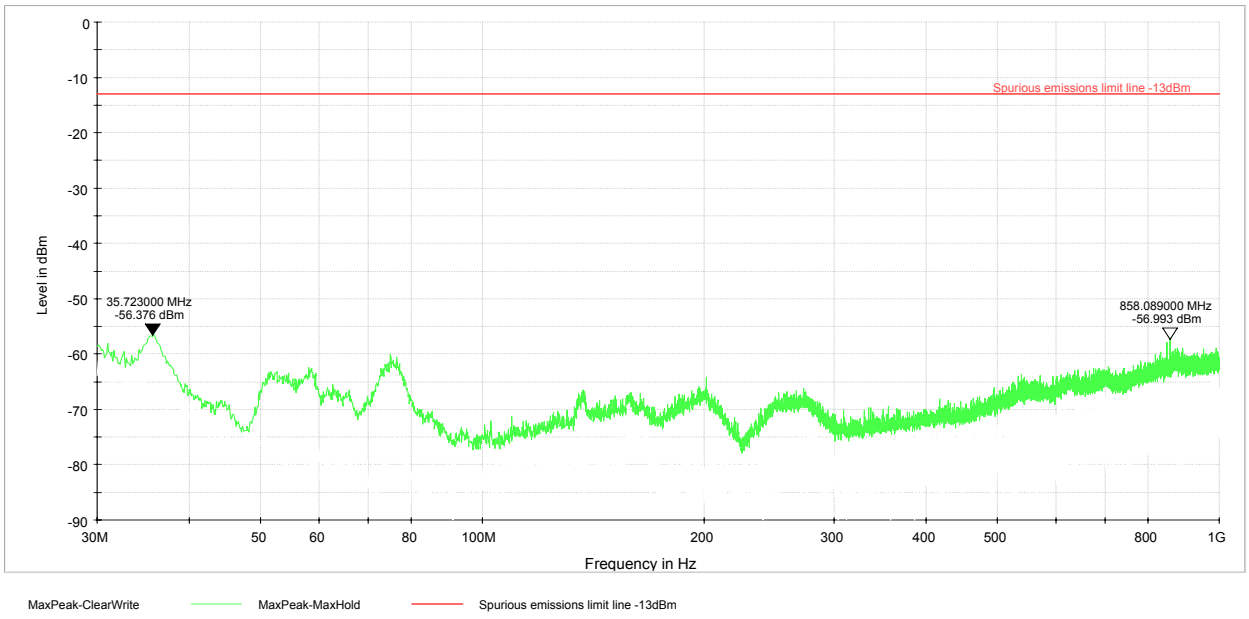
Uplink, mid channel:

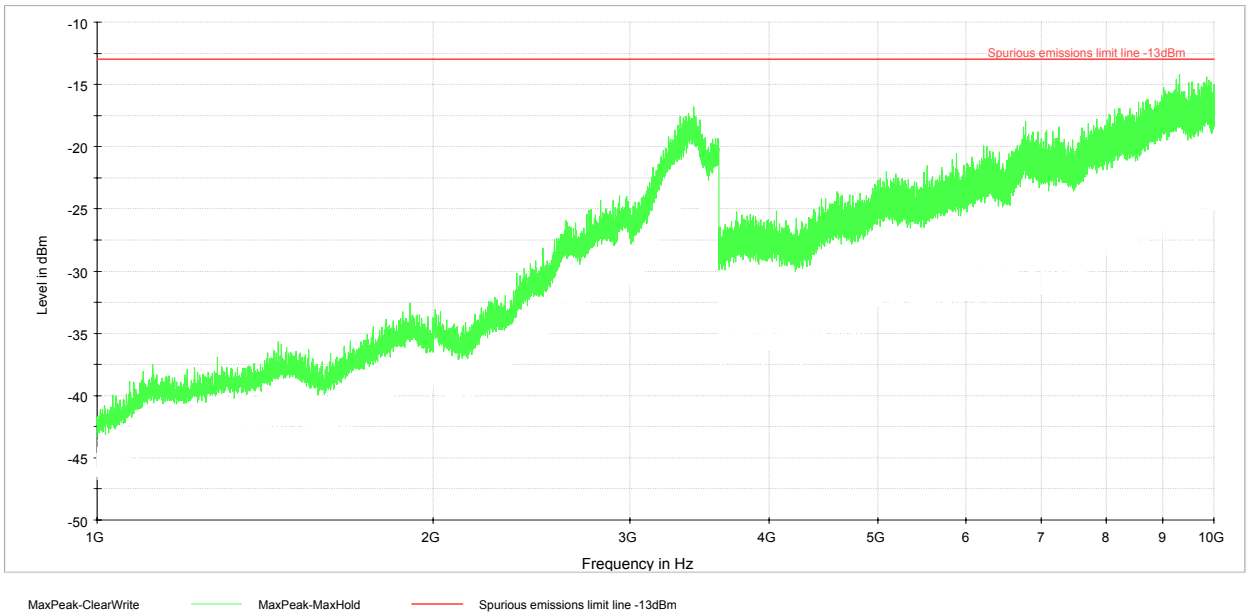


Clause 2.1053/22.917(a) Field strength of emissions, continued

Test data

Uplink, high channel:

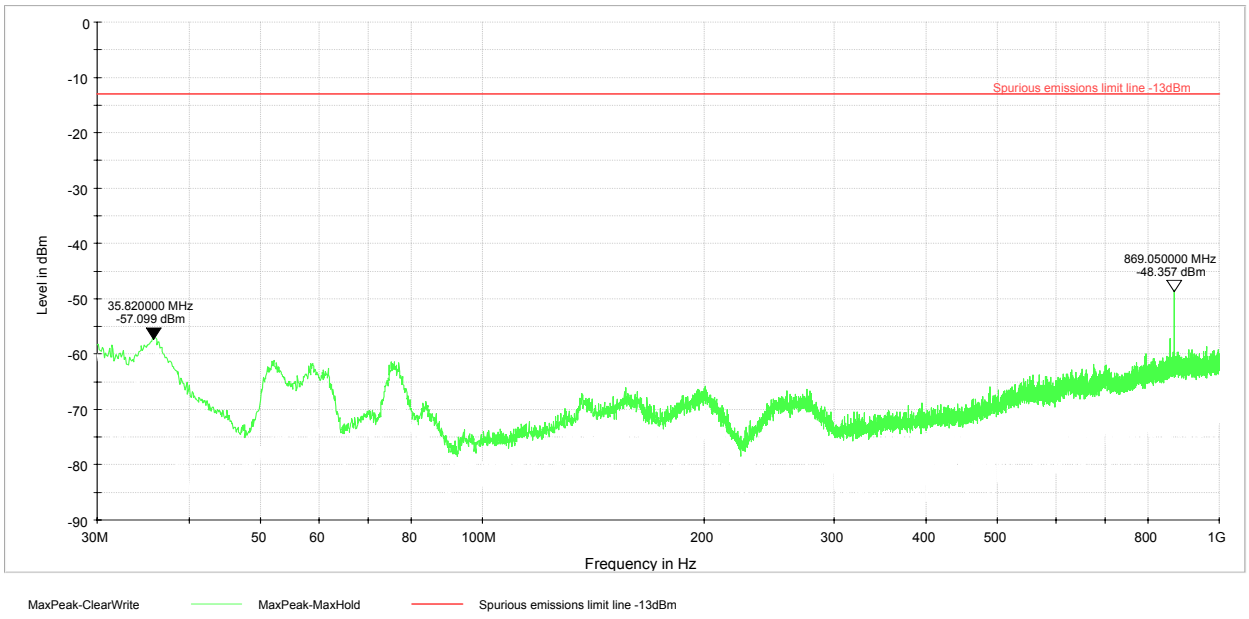


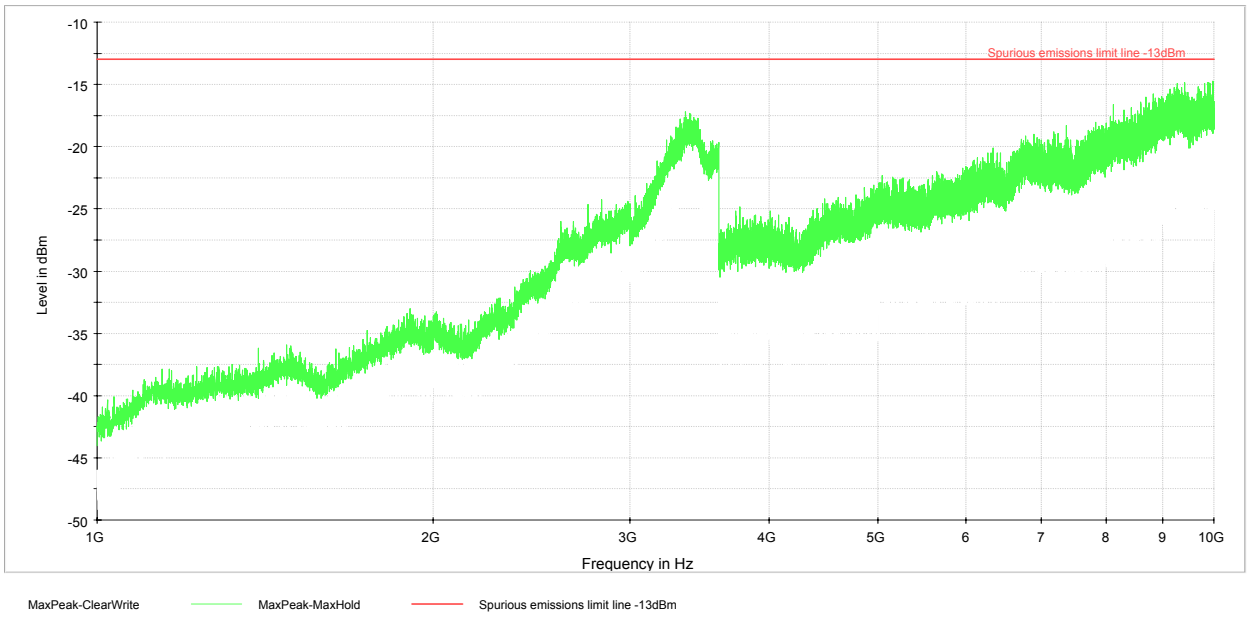


Clause 2.1053/22.917(a) Field strength of emissions, continued

Test data

Downlink, low channel:

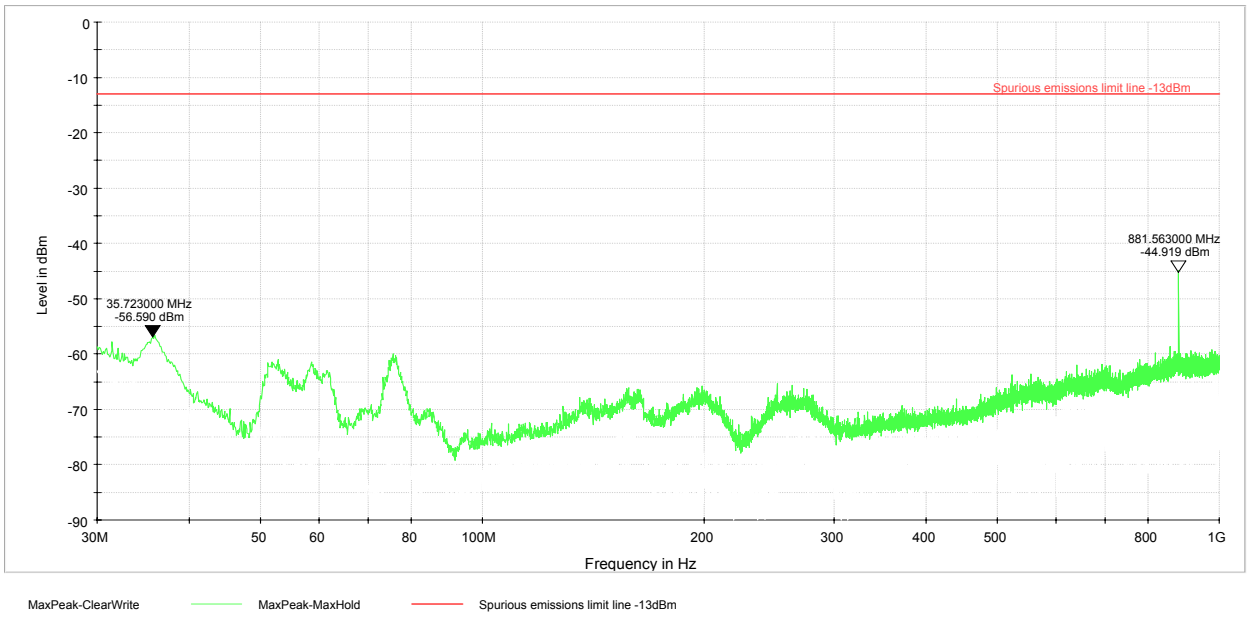




Clause 2.1053/22.917(a) Field strength of emissions, continued

Test data

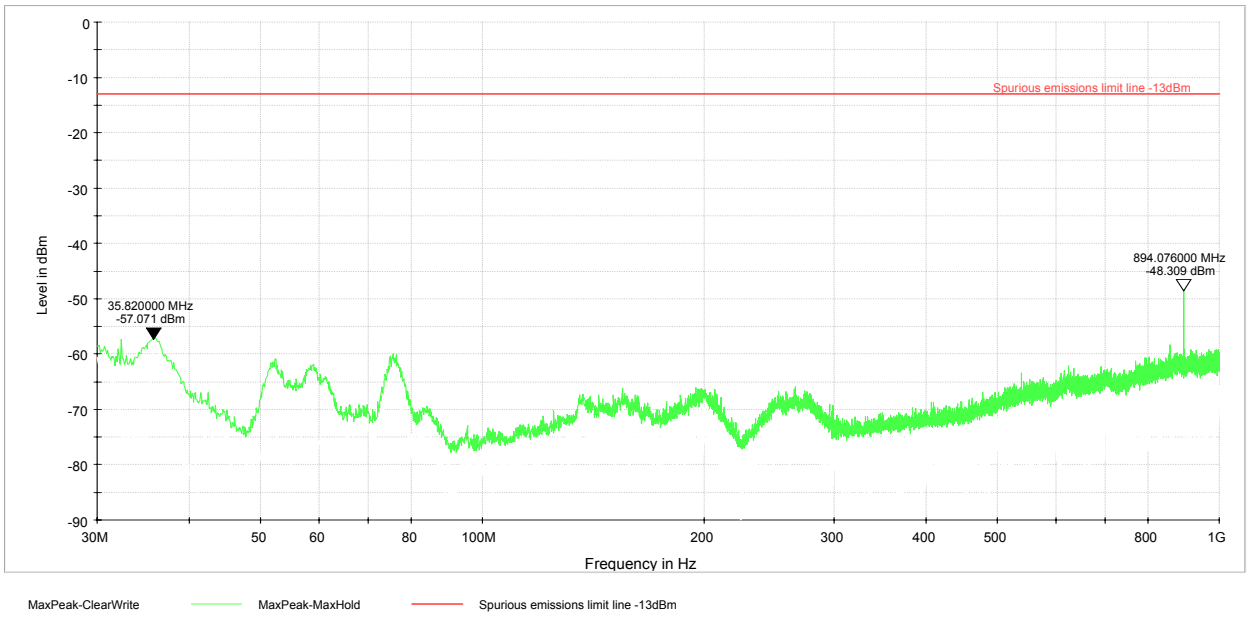
Downlink, mid channel:

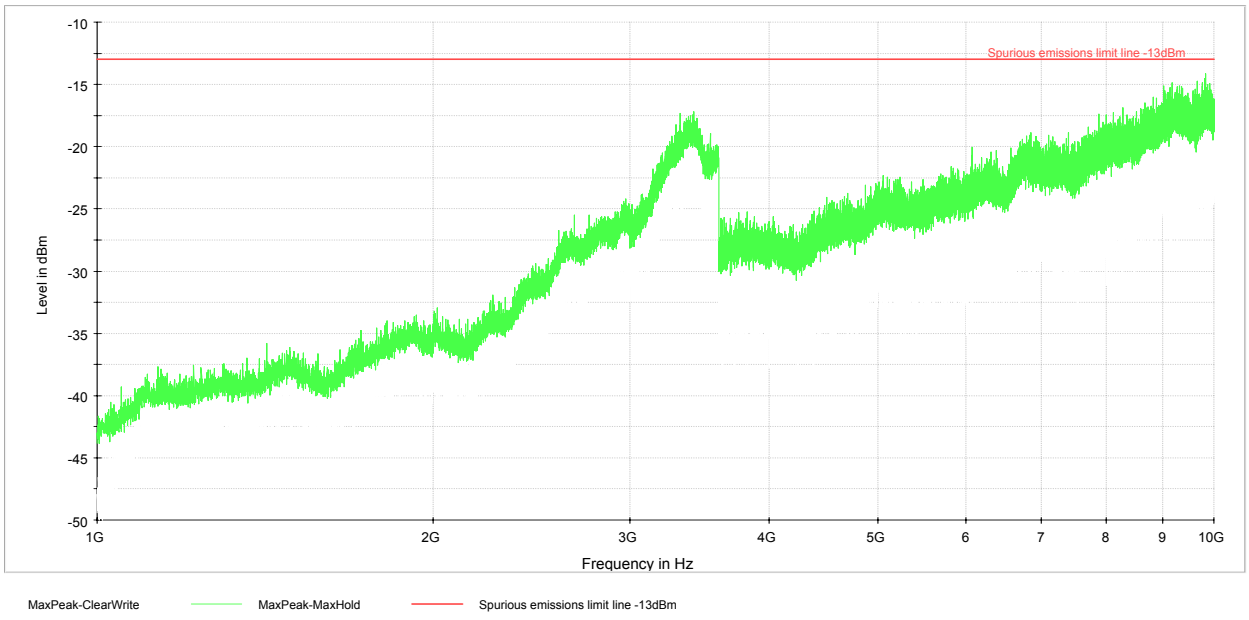


Clause 2.1053/22.917(a) Field strength of emissions, continued

Test data

Downlink, high channel:





Clause 2-11-04/EAB/RF Out of Band Rejection

Test date: April 9, 2010

Test results: Pass

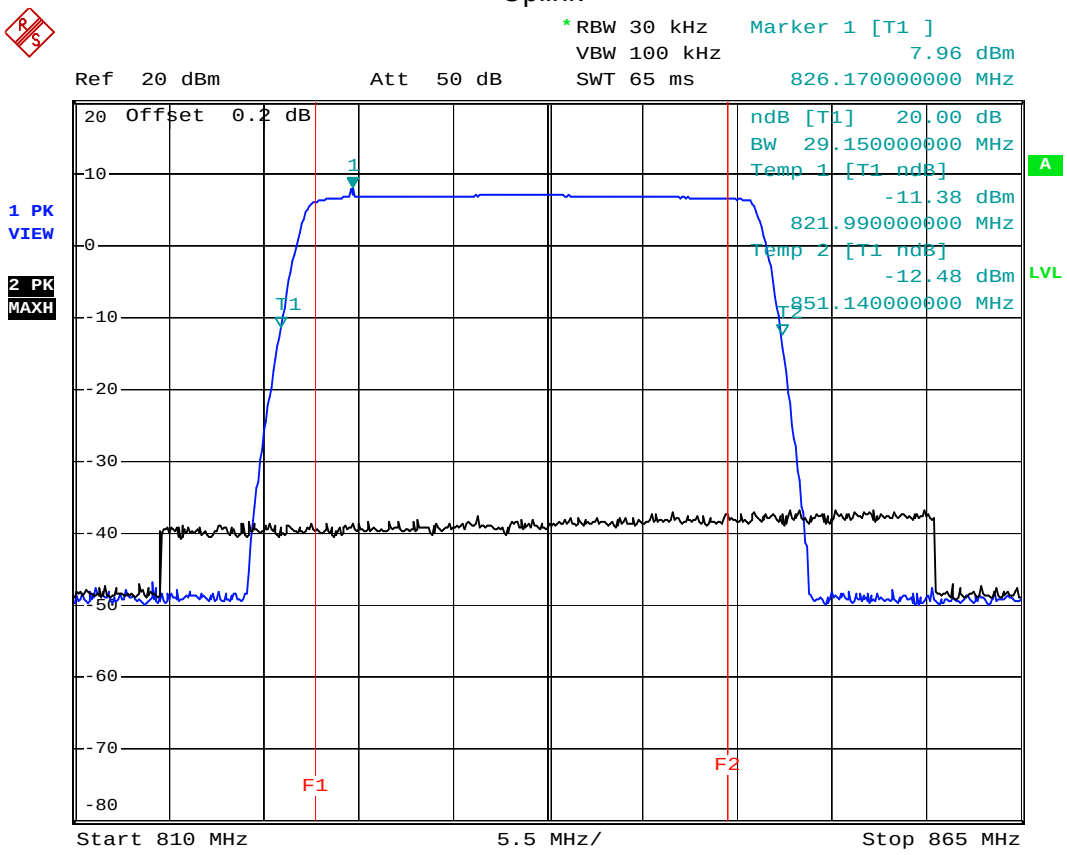
Special notes

The RF output of the equipment under test was directly connected to the input of the Spectrum Analyzer. The analyzer was set for Max Hold using a peak detector. Using a signal generator, the frequency was swept across the entire range of the EUT operation. The EUT was removed and the signal generator connected directly to the input of the spectrum analyzer. The signal generator was swept across the frequency range of operation to measure gain.

Clause 2-11-04/EAB/RF Out of Band Rejection, continued

Test data

Uplink

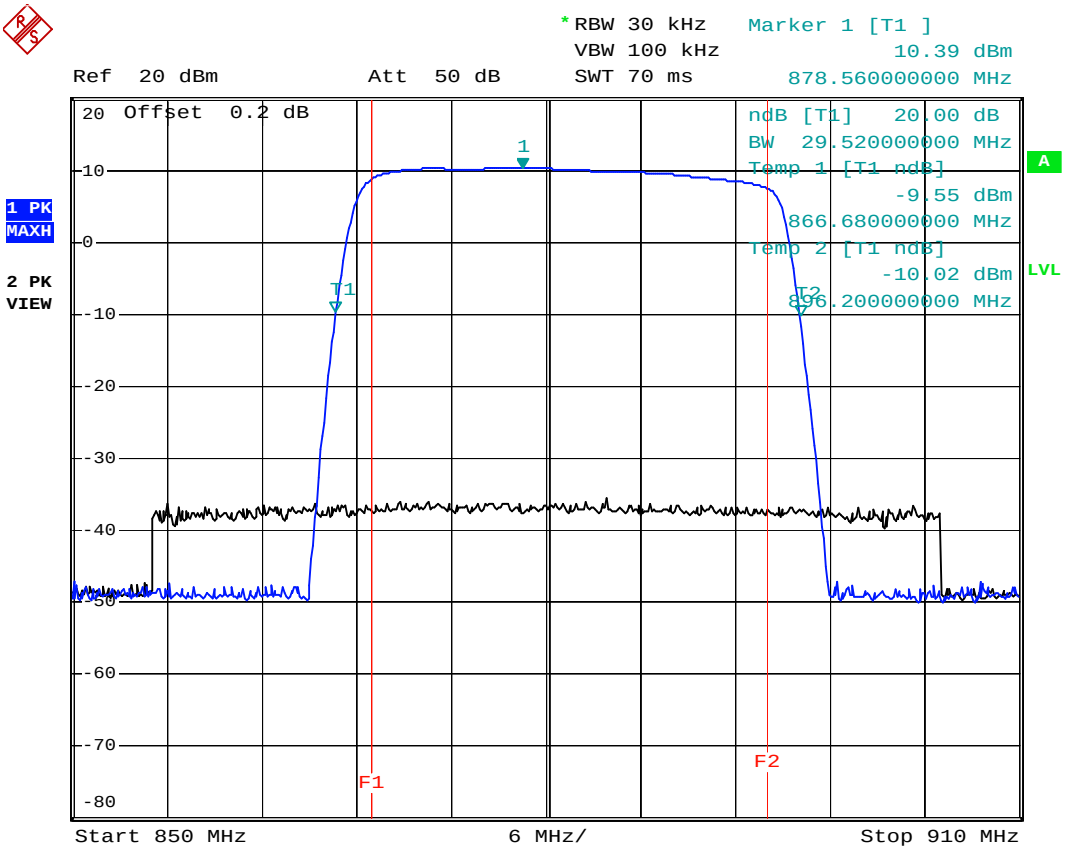


Note: Black trace = input; blue trace = output; red lines = band edges

Clause 2-11-04/EAB/RF Out of Band Rejection, continued

Test data

Downlink



Note: Black trace = input; blue trace = output; red lines = band edges

Appendix B: Block diagrams of test set-ups

Radiated emissions set-up