

TEST REPORT FROM RFI GLOBAL SERVICES LTD

Test of: Zinwave Ltd
2776 Distributed Narrow Band Antenna System

To: FCC Part 22: 2006 (Subpart H)

Test Report Serial No:
RFI/RPTE1/RP48906JD01A

This Test Report Is Issued Under The Authority
Of Andrew Brown, Operations Manager:



Tested By: Jamie Huckerby



Checked By: Tony Henriques



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RFI Global Services Ltd

Pavilion A, Ashwood Park, Ashwood Way, Basingstoke, Hampshire RG23 8BG
Telephone: +44 (0)1256 312000 Facsimile: +44 (0)1256 312001
Email: info@rfi-global.com Website: www.rfi-global.com

Registered in England and Wales. Company number: 2117901

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1. Client Information

Company Name:	Zinwave Ltd
Address:	Harston Mill Harston Cambridge CB2 5GG UK
Contact Name:	Mr A Bell

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2. Equipment Under Test (EUT)

The following information (with the exception of the Date of Receipt) has been supplied by the client:

2.1. Identification of Equipment Under Test (EUT)

Description:	Hub Unit (HU)
Brand Name:	Zinwave
Model Name or Number:	2700
Serial Number:	0005256380
Hardware Version:	1.08
Software Version:	1.09
FCC ID Number:	UPO2700
Country of Manufacture:	UK
Date of Receipt:	29 January 2007

Description:	Antenna Unit
Brand Name:	Zinwave
Model Name or Number:	2776
Serial Number:	132
Hardware Version:	1.03
Software Version:	1.09
FCC ID Number:	UPO2776
Country of Manufacture:	UK
Date of Receipt:	29 January 2007

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Identification of Equipment Under Test (EUT) (Continued)

Description:	Antenna Unit
Brand Name:	Zinwave
Model Name or Number:	2776
Serial Number:	177
Hardware Version:	1.03
Software Version:	1.09
FCC ID Number:	UPO2776
Country of Manufacture:	UK
Date of Receipt:	29 January 2007

Description:	Antenna Unit
Brand Name:	Zinwave
Model Name or Number:	2776
Serial Number:	167
Hardware Version:	1.03
Software Version:	1.09
FCC ID Number:	UPO2776
Country of Manufacture:	UK
Date of Receipt:	29 January 2007

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Identification of Equipment Under Test (EUT)

Description:	Antenna Unit
Brand Name:	Zinwave
Model Name or Number:	2776
Serial Number:	166
Hardware Version:	1.03
Software Version:	1.09
FCC ID Number:	UPO2776
Country of Manufacture:	UK
Date of Receipt:	29 January 2007

Description:	Antenna Unit
Brand Name:	Zinwave
Model Name or Number:	2776
Serial Number:	171
Hardware Version:	1.03
Software Version:	1.09
FCC ID Number:	UPO2776
Country of Manufacture:	UK
Date of Receipt:	29 January 2007

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Identification of Equipment Under Test (EUT)

Description:	Antenna Unit
Brand Name:	Zinwave
Model Name or Number:	2776
Serial Number:	165
Hardware Version:	1.03
Software Version:	1.09
FCC ID Number:	UPO2776
Country of Manufacture:	UK
Date of Receipt:	29 January 2007

Description:	Antenna Unit
Brand Name:	Zinwave
Model Name or Number:	2776
Serial Number:	157
Hardware Version:	1.03
Software Version:	1.09
FCC ID Number:	UPO2776
Country of Manufacture:	UK
Date of Receipt:	29 January 2007

Description:	Antenna Unit
Brand Name:	Zinwave
Model Name or Number:	2776
Serial Number:	161
Hardware Version:	1.03
Software Version:	1.09
FCC ID Number:	UPO2776
Country of Manufacture:	UK
Date of Receipt:	29 January 2007

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2.2. Accessories

No accessories were supplied with the EUT:

2.3. Description of EUT

The equipment under test is a narrowband antenna system. The system utilises US Cellular (GSM850), PCS 1900 and CDMA2000 (850/1900) technologies.

For certain test cases the technology options above were connected and operating during the test. The results of this test report refer only to the measurements made in the 850 band (both GSM and CDMA2000).

2.4. Modifications Incorporated in EUT

During the course of testing the EUT was not modified.

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2.5. Additional Information Related to Testing

Power Supply Requirement:	Nominal 110 V, 60 Hz AC Mains Supply		
Intended Operating Environment:	Commercial Light Industry Heavy Industry Within GSM Coverage		
Equipment Category:	GSM/CDMA 2000		
Type of Unit:	Base station – Distributed Antenna System (DAS)		
Transmit Frequency Range: (GSM 850)	869 to 894 MHz		
Transmit Channels Tested: (GSM 850)	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	128	869.2
	Middle	190	881.6
	Top	251	893.8
Transmit Frequency Range: (CDMA2000)	869 to 894 MHz		
Transmit Channels Tested: (CDMA2000)	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	1013	869.70
	Middle	384	881.52
	Top	777	893.31
Maximum Power Output (ERP)	+23.8dBm		

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2.6. Port Identification

Port	Description	Type/Length	Applicable
1	AU1 Optical Link to Hub Optic Port 1	Optical Cable 3m	No
2	AU1 Optical Link to Hub Optic Port 2	Optical Cable 3m	No
3	AU1 Optical Link to Hub Optic Port 3	Optical Cable 3m	No
4	AU1 Optical Link to Hub Optic Port 4	Optical Cable 3m	No
5	AU1 Optical Link to Hub Optic Port 5	Optical Cable 3m	No
6	AU1 Optical Link to Hub Optic Port 6	Optical Cable 3m	No
7	AU1 Optical Link to Hub Optic Port 7	Optical Cable 3m	No
8	AU1 Optical Link to Hub Optic Port 8	Optical Cable 3m	No
9	AU1 RF Port to Antenna	2m	Yes (Note 1)
10	AU2 RF Port to 50Ohm Termination	Not Applicable	No
11	AU3 RF Port to 50Ohm Termination	Not Applicable	No
12	AU4 RF Port to 50Ohm Termination	Not Applicable	No
13	AU5 RF Port to 50Ohm Termination	Not Applicable	No
14	AU6 RF Port to 50Ohm Termination	Not Applicable	No
15	AU7 RF Port to 50Ohm Termination	Not Applicable	No
16	AU8 RF Port to 50Ohm Termination	Not Applicable	No
17	HUB RF Rx1 50OHM Termination During DL Tests	Not Applicable	No
18	HUB RF Rx2 50OHM Termination During DL Tests	Not Applicable	No
19	HUB RF Rx3 50OHM Termination During DL Tests	Not Applicable	No
20	HUB RF Rx4 50OHM Termination During DL Tests	Not Applicable	No
21	HUB RF Tx1 US Cellular Signal Generator	2m RF Cable	No
22	HUB RF Tx2 US Cellular Signal Generator	2m RF Cable	No
23	HUB RF Tx3 PCS Signal Generator	2m RF Cable	No
24	HUB RF Tx4 PCS Signal Generator	2m RF Cable	No
25	All 8 AU's to Port POE Power Supplies	Ethernet Cable	No
26	HUB RS232 Port to Laptop1, for control	RS232 Cable	No

Note(s):

1. For conducted measurements this port was the measurement port. For radiated measurements, the port was terminated by a 50 Ohm termination.

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2.7. Support Equipment

The following support equipment was used to exercise the EUT during testing:

Description:	Laptop
Brand Name:	Dell
Model Name or Number:	Inspiron 1300
Serial Number:	CNOR5272-7066- 6+M-06MU
Cable Length and Type:	CAT5-2 Meters
Connected to Port:	Ethernet Port on HU

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3. Test Results

Reference:	FCC Part 22: 2006 Subpart H (Cellular Radiotelephone Service)
Title:	Code of Federal Regulations, Part 22 (47CFR22) Personal Communication Services.

3.1. Methods and Procedures

The methods and procedures used were as detailed in:

ANSI/TIA-603-B-2003

Land Mobile Communications Equipment, Measurements and performance Standards

ANSI C63.2 (1987)

Title: American National Standard for Instrumentation - Electromagnetic noise and field strength.

ANSI C63.4 (2003)

Title: American National Standard Methods of Measurement of Electromagnetic Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

ANSI C63.5 (1988)

Title: American National Standard for the Calibration of antennas used for Radiated Emission measurements in Electromagnetic Interference (EMI) control.

ANSI C63.7 (1988)

Title: American National Standard Guide for Construction of Open Area Test Sites for performing Radiated Emission Measurements.

CISPR 16-1: (1999)

Title: Specification For Radio Disturbance and Immunity Measuring Apparatus and Methods. Part 1: Radio Disturbance and Immunity Measuring Apparatus.

3.2. Definition of Measurement Equipment

The measurement equipment used complied with the requirements of the standards referenced in the methods & procedures section above. Appendix 1 contains a list of the test equipment used.

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4. Deviations from the Test Specification

As the system operates in the US Cellular and PCS bands with CDMA2000, the system for spurious emissions was tested at highest frequency channels with each modulation and band. For radiated spurious emissions the system was only tested fully loaded.

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5. Operation of the EUT during Testing

5.1. Operating Modes

The EUT was tested in the following operating modes, unless otherwise stated.

The system was tested in single band, single modulation mode at a time (GSM/CDMA2000 850, PCS/CDMA2000 1900). A fully loaded system was tested for proof of compliance for both conducted and radiated emissions.

5.2. Configuration and Peripherals

The EUT was tested in the following configuration unless otherwise stated:

The equipment was always set at maximum gain and the input signal was adjusted to give maximum nominal output power. The equipment was tested as follows (unless otherwise stated):

1. Conducted emissions – 4x8 configuration with the multiple band/modulation types
2. Radiated emissions – 4x8 configuration with the multiple band/modulation types
3. All other tests – 1x2 configuration with the individual test signal

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6. Summary of Test Results

Range of Measurements	Specification Reference	Port Type	Compliance Status
Idle AC Conducted Spurious Emissions (150 kHz to 30 MHz)	Section 15.107	AC Mains Input	Complied (see note)
Transmitter Carrier Output Power	Section 2.1046(a)	Antenna Terminals	Complied
Transmitter Frequency Stability (Temperature Variation)	Section 22.355	Antenna Terminals	Complied
Transmitter Frequency Stability (Voltage Variation)	Section 22.355	Antenna Terminals	Complied
Transmitter Occupied Bandwidth	Section 2.1049	Antenna Terminals	Complied
Transmitter Intermodulation Conducted Emissions	Section 2.1051/22.917	Antenna Terminals	Complied
Transmitter Out of Band Conducted Emissions	Section 2.1051/22.917	Antenna Terminals	Complied
Transmitter Band Edge Conducted Emissions	Section 2.1051/22.917	Antenna Terminals	Complied
Transmitter Out of Band Radiated Emissions	Section 2.1053/22.917	Enclosure	Complied
Out of Band Rejection*	N/A	Enclosure	N/A

*For reference purposes only

Note(s):

Although the test refers to Idle AC Conducted Spurious Emissions, for representational use of the equipment, the transmitter was permanently running as the EUT is a base station (fixed use) and does not have a receiver/idle mode only condition.

6.1. Location of Tests

All the measurements described in this report were performed at the premises of RFI Global Services Ltd, Ewhurst Park, Ramsdell, Basingstoke, Hampshire, RG26 5RQ

FCC Site Registration Number: 90895

IC Site Registration Number: 3485

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7. Measurements, Examinations and Derived Results

7.1. General Comments

This section contains test results only.

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to section 8 for details of measurement uncertainties.

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7.2. Test Results

7.2.1. Receiver/Idle Mode AC Conducted Spurious Emissions: Section 15.107

The EUT was configured as for AC conducted emission measurements as described in section 9 of this report.

Tests were performed to identify the maximum emission levels present on the ac mains line of the EUT.

Results: AU Tx

Quasi-Peak Detector Measurements on Live and Neutral Lines (Continued)

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.598000	Live	35.1	56.0	20.9	Complied
0.998000	Live	34.0	56.0	22.0	Complied
1.002000	Live	29.5	56.0	26.5	Complied
4.922000	Neutral	41.1	56.0	14.9	Complied
6.970000	Neutral	54.9	60.0	5.1	Complied
7.034000	Live	48.2	60.0	11.8	Complied
7.050000	Neutral	56.3	60.0	3.7	Complied
7.078000	Live	53.7	60.0	6.3	Complied
7.146000	Neutral	49.1	60.0	10.9	Complied
7.178000	Live	52.1	60.0	7.9	Complied
7.190000	Neutral	56.6	60.0	3.4	Complied
7.230000	Live	33.9	60.0	26.1	Complied
7.250000	Live	46.5	60.0	13.5	Complied
7.286000	Live	49.1	60.0	10.9	Complied
25.410000	Live	45.9	60.0	14.1	Complied
25.710000	Live	46.5	60.0	13.5	Complied

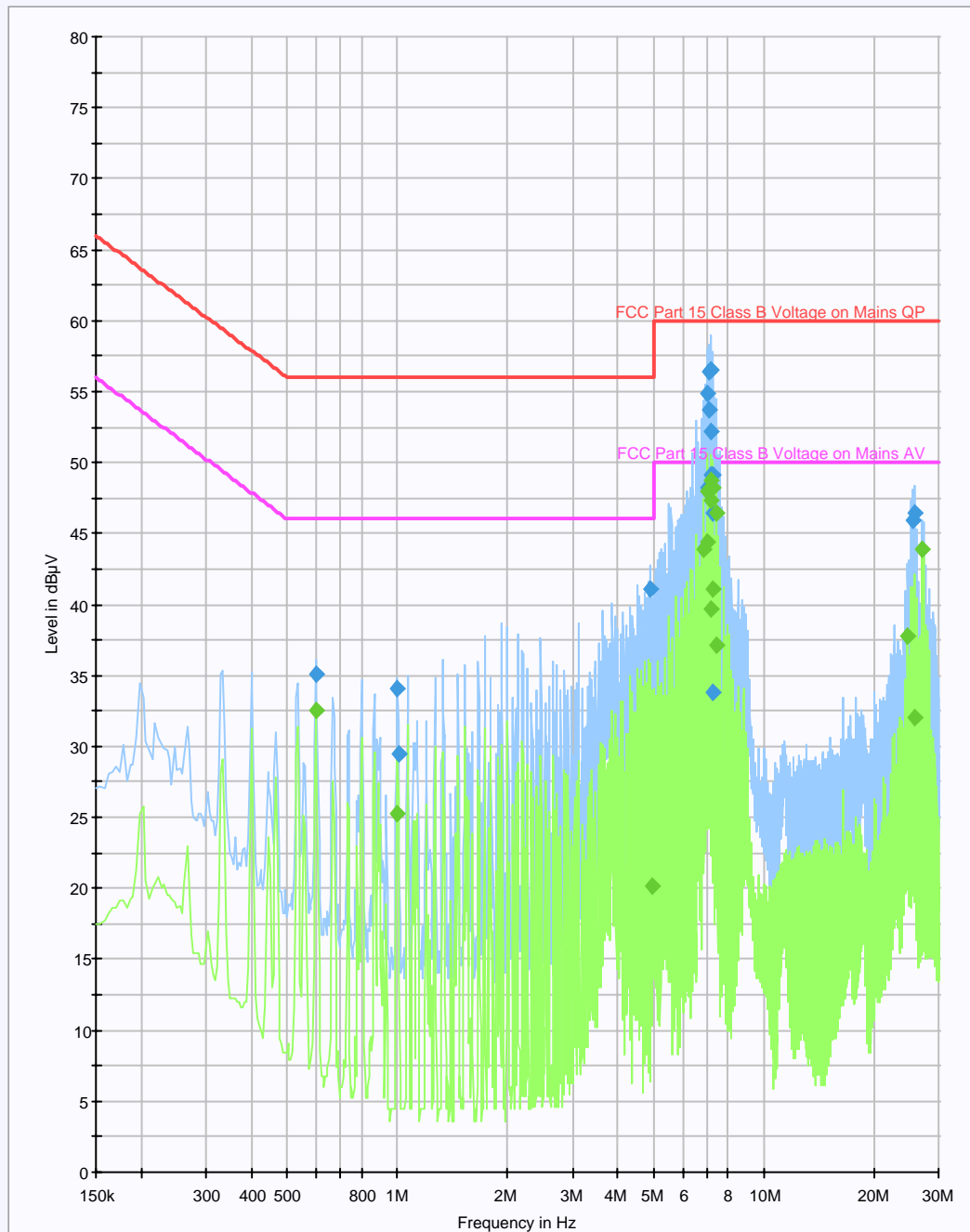
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Average Detector Measurements on Live and Neutral Lines (Continued)

Frequency (MHz)	Line	Level (dBμV)	Limit (dBμV)	Margin (dB)	Result
0.598000	Live	32.6	46.0	13.4	Complied
0.994000	Live	25.3	46.0	20.7	Complied
4.966000	Live	20.2	46.0	25.8	Complied
6.822000	Neutral	43.9	50.0	6.1	Complied
6.970000	Neutral	44.4	50.0	5.6	Complied
7.046000	Neutral	48.0	50.0	2.0	Complied
7.158000	Neutral	47.3	50.0	2.7	Complied
7.178000	Neutral	39.7	50.0	10.3	Complied
7.190000	Neutral	48.7	50.0	1.3	Complied
7.270000	Neutral	48.2	50.0	1.8	Complied
7.290000	Neutral	41.1	50.0	8.9	Complied
7.382000	Neutral	46.4	50.0	3.6	Complied
7.402000	Neutral	37.2	50.0	12.8	Complied
24.790000	Live	37.8	50.0	12.2	Complied
25.702000	Neutral	32.0	50.0	18.0	Complied
27.006000	Neutral	43.9	50.0	6.1	Complied
0.598000	Live	32.6	46.0	13.4	Complied
0.994000	Live	25.3	46.0	20.7	Complied

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Receiver/Idle Mode AC Conducted Spurious Emissions: Section 15.107 (Continued)



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.

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Results: HU Tx**Quasi-Peak Detector Measurements on Live and Neutral Lines (Continued)**

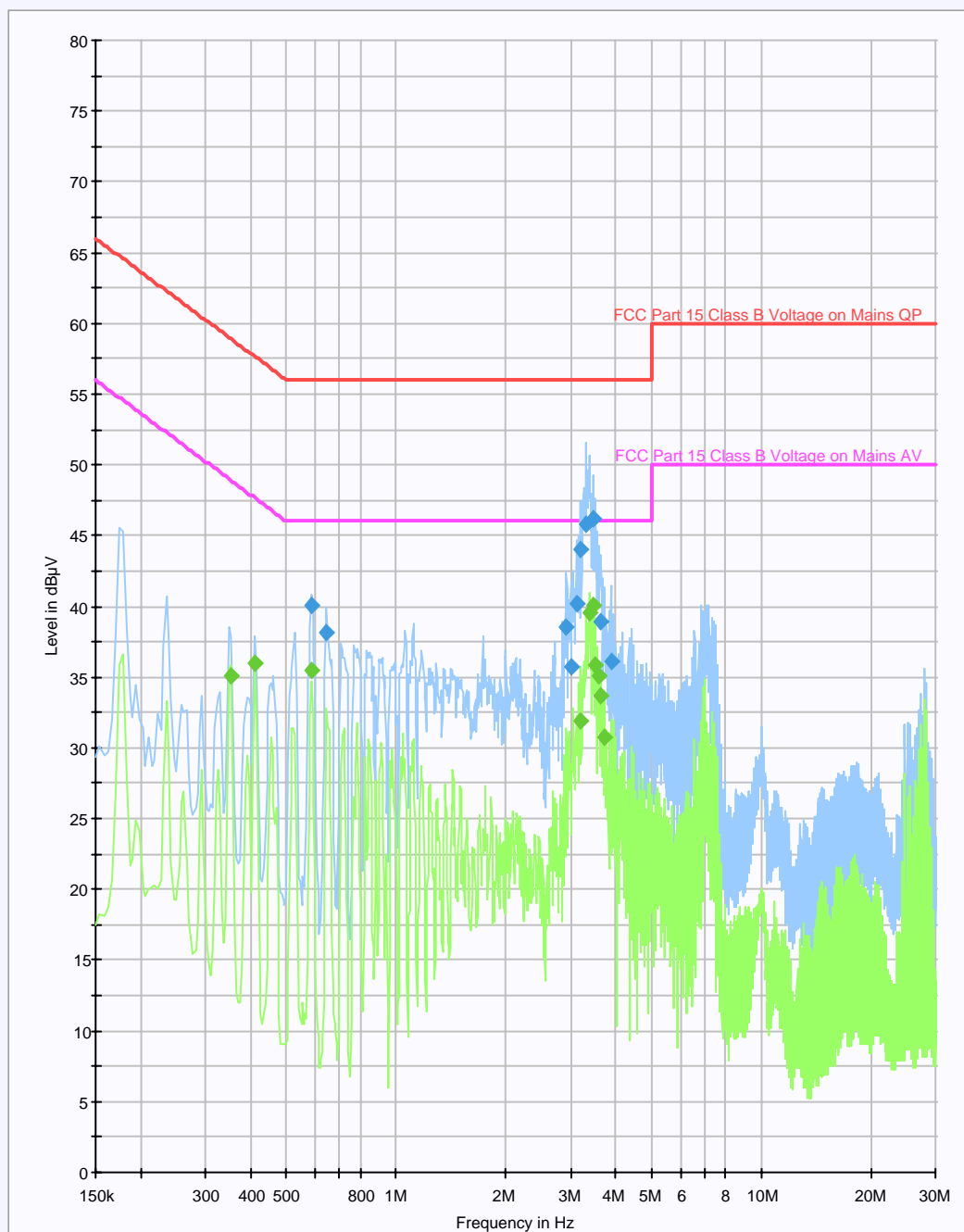
Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.586000	Neutral	40.1	56.0	15.9	Complied
0.646000	Neutral	38.1	56.0	17.9	Complied
2.930000	Live	38.5	56.0	17.5	Complied
3.002000	Live	35.7	56.0	20.3	Complied
3.122000	Neutral	40.3	56.0	15.7	Complied
3.198000	Live	44.0	56.0	12.0	Complied
3.318000	Live	45.8	56.0	10.2	Complied
3.454000	Live	46.2	56.0	9.8	Complied
3.646000	Live	38.9	56.0	17.1	Complied
3.870000	Neutral	36.1	56.0	19.9	Complied

Average Detector Measurements on Live and Neutral Lines

Frequency (MHz)	Line	Level (dB μ V)	Limit (dB μ V)	Margin (dB)	Result
0.354000	Neutral	35.1	48.9	13.8	Complied
0.410000	Neutral	36.0	47.6	11.6	Complied
0.586000	Neutral	35.4	46.0	10.6	Complied
3.194000	Neutral	31.9	46.0	14.1	Complied
3.386000	Live	39.5	46.0	6.5	Complied
3.454000	Live	40.1	46.0	5.9	Complied
3.502000	Live	35.9	46.0	10.1	Complied
3.578000	Live	35.0	46.0	11.0	Complied
3.638000	Live	33.7	46.0	12.3	Complied
3.726000	Live	30.8	46.0	15.2	Complied

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Receiver/Idle Mode AC Conducted Spurious Emissions: Section 15.107 (Continued)



Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.

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7.2.2. Transmitter Carrier Output Power: Section 2.1046(a) – GSM 850

The EUT was configured as for conducted RF output power as described in section 9 of this report.

Tests were performed to identify the EUT's maximum conducted transmit power.

Results:

Channel	Frequency (MHz)	Conducted RF O/P Power (dBm)	Stated Antenna Gain (dB)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
Bottom	869.2	+18.0	5.8	+23.8	+37.0	13.2	Complied
Middle	881.6	+18.0	5.8	+23.8	+37.0	13.2	Complied
Top	893.8	+18.0	5.8	+23.8	+37.0	13.2	Complied

Note(s):

1. ERP limit is referred from Part 90.219 limit for Class A boosters (5W).

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7.2.3. Transmitter Carrier Output Power: Section 2.1046(a) – CDMA 2000

The EUT was configured as for conducted RF output power as described in section 9 of this report.

Tests were performed to identify the EUT's maximum conducted transmit power.

Results:

Channel	Frequency (MHz)	Conducted RF O/P Power (dBm)	Stated Antenna Gain (dB)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
Bottom	869.70	+18.0	5.8	+23.8	+37.0	13.2	Complied
Middle	881.52	+18.0	5.8	+23.8	+37.0	13.2	Complied
Top	893.31	+18.0	5.8	+23.8	+37.0	13.2	Complied

Note(s):

1. ERP limit is referred from Part 90.219 limit for Class A boosters (5W).

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7.2.4. Transmitter Frequency Stability (Temperature Variation): Section 22.355

The EUT was configured as for frequency stability measurements as described in section 9 of this report.

Tests were performed to identify the maximum frequency error of the EUT with variations in ambient temperature.

Results: GSM 850

Bottom Channel (869.2 MHz)

Temperature (°C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
-30	869.200100	100	0.12	1.5	1.38	Complied
-20	869.200169	169	0.19	1.5	1.31	Complied
-10	869.200001	1	0.00	1.5	1.50	Complied
0	869.200000	0	0.00	1.5	1.50	Complied
10	869.200000	0	0.00	1.5	1.50	Complied
20	869.200000	0	0.00	1.5	1.50	Complied
30	869.200000	0	0.00	1.5	1.50	Complied
40	869.200000	0	0.00	1.5	1.50	Complied
50	869.200000	0	0.00	1.5	1.50	Complied

Top Channel (893.8 MHz)

Temperature (°C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
-30	893.800130	130	0.15	1.5	1.35	Complied
-20	893.799914	86	-0.10	1.5	1.40	Complied
-10	893.800000	0	0.00	1.5	1.50	Complied
0	893.800000	0	0.00	1.5	1.50	Complied
10	893.799999	1	0.00	1.5	1.50	Complied
20	893.800000	0	0.00	1.5	1.50	Complied
30	893.800000	0	0.00	1.5	1.50	Complied
40	893.799999	1	0.00	1.5	1.50	Complied
50	893.800000	0	0.00	1.5	1.50	Complied

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7.2.5. Transmitter Frequency Stability (Temperature Variation): Section 22.355 (Continued)

The EUT was configured as for frequency stability measurements as described in section 9 of this report.

Tests were performed to identify the maximum frequency error of the EUT with variations in ambient temperature.

Results: CDMA2000

Bottom Channel (869.70 MHz)

Temperature (°C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
-30	869.700121	121	0.14	1.5	1.36	Complied
-20	869.699738	262	-0.30	1.5	1.20	Complied
-10	869.699999	1	0.00	1.5	1.50	Complied
0	869.700000	0	0.00	1.5	1.50	Complied
10	869.700000	0	0.00	1.5	1.50	Complied
20	869.700000	0	0.00	1.5	1.50	Complied
30	869.700000	0	0.00	1.5	1.50	Complied
40	869.699999	1	0.00	1.5	1.50	Complied
50	869.700000	0	0.00	1.5	1.50	Complied

Top Channel (893.31 MHz)

Temperature (°C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
-30	893.310086	86	0.10	1.5	1.4	Complied
-20	893.309767	233	-0.36	1.5	1.14	Complied
-10	893.309999	1	0.00	1.5	1.50	Complied
0	893.310000	0	0.00	1.5	1.50	Complied
10	893.310000	0	0.00	1.5	1.50	Complied
20	893.310000	0	0.00	1.5	1.50	Complied
30	893.310000	0	0.00	1.5	1.50	Complied
40	893.309999	1	0.00	1.5	1.50	Complied
50	893.310000	0	0.00	1.5	1.50	Complied

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7.2.6. Transmitter Frequency Stability (Voltage Variation): Section 22.355

The EUT was configured as for frequency stability measurements as described in section 9 of this report.

Tests were performed to identify the maximum frequency error of the EUT with variations in nominal operating voltage.

Results: GSM 850**Bottom Channel (869.2 MHz)**

Supply Voltage (V)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
99.0	869.200000	0	0.00	1.5	1.50	Complied
121.0	869.200000	0	0.00	1.5	1.50	Complied

Top Channel (893.8 MHz)

Supply Voltage (V)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
99.0	893.800000	0	0.00	1.5	1.50	Complied
121.0	893.800000	0	0.00	1.5	1.50	Complied

Test of: Zinwave Ltd
2776 Distributed Narrow Band Antenna System
To: FCC Part 22: 2006 (Subpart H)

7.2.7. Transmitter Frequency Stability (Voltage Variation): Section 22.355

The EUT was configured as for frequency stability measurements as described in section 9 of this report.

Tests were performed to identify the maximum frequency error of the EUT with variations in nominal operating voltage.

Results: CDMA2000**Bottom Channel (869.7 MHz)**

Supply Voltage (V)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
99.0	869.700000	0	0.00	1.5	1.50	Complied
121.0	869.700000	0	0.00	1.5	1.50	Complied

Top Channel (893.3 MHz)

Supply Voltage (V)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
99.0	893.310000	0	0.00	1.5	1.50	Complied
121.0	893.310000	0	0.00	1.5	1.50	Complied

Test of: Zinwave Ltd
2776 Distributed Narrow Band Antenna System
To: FCC Part 22: 2006 (Subpart H)

7.2.8. Transmitter Occupied Bandwidth: Section 2.1049

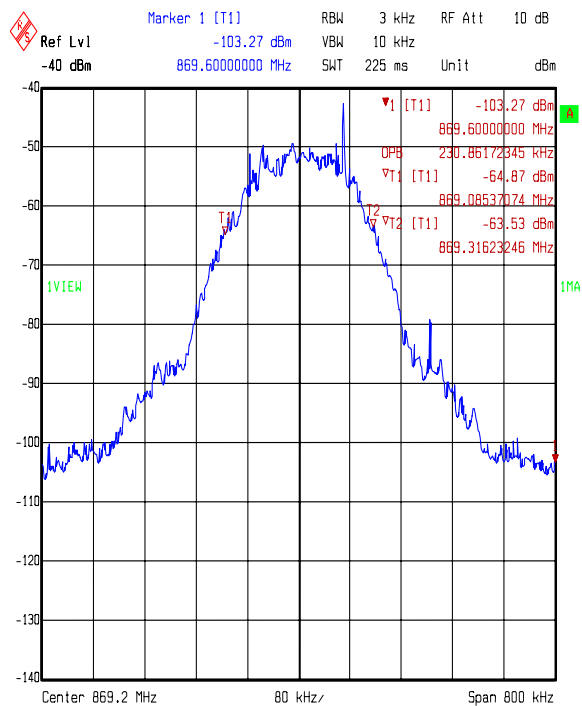
The EUT was configured as for occupied bandwidth measurements as described in section 9 of this report.

Tests were performed to identify the maximum bandwidth occupied by the fundamental frequency of the EUT.

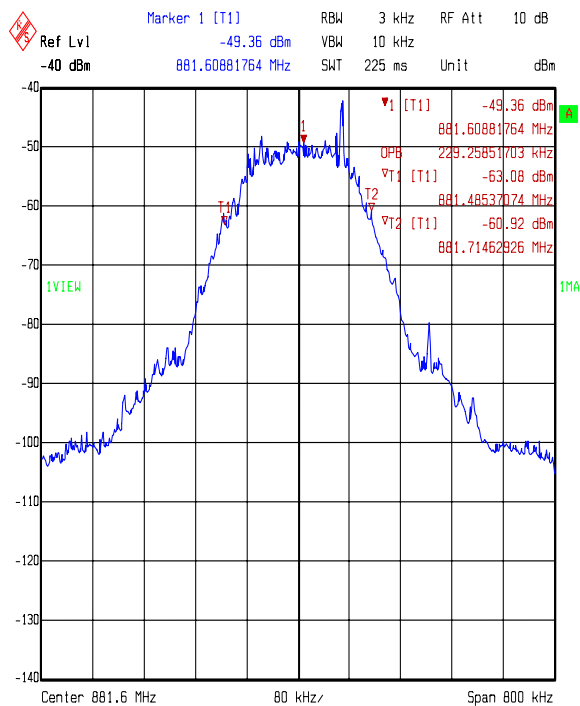
Results: GSM 850

Channel	Frequency (MHz)	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth Before EUT (kHz)	Occupied Bandwidth Through EUT (kHz)
Bottom	869.2	3.0	10.0	230.862	230.862
Middle	881.6	3.0	10.0	229.259	230.862
Top	893.8	3.0	10.0	230.862	230.862

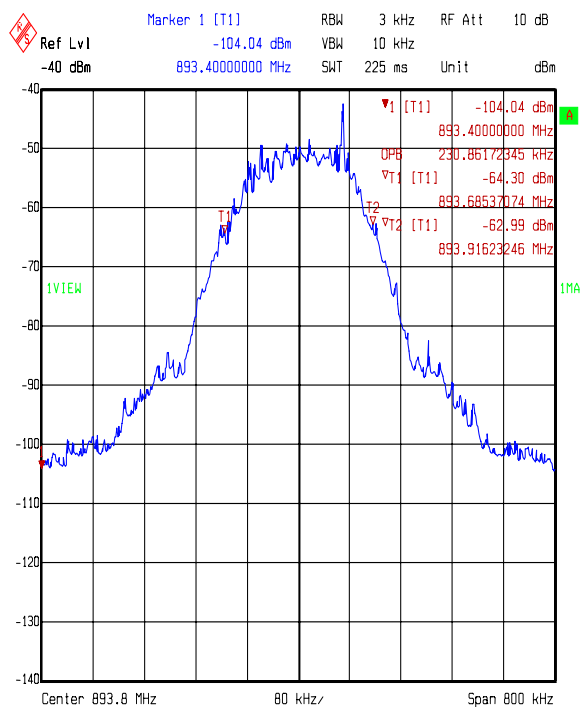
Test of: Zinwave Ltd
2776 Distributed Narrow Band Antenna System
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Transmitter Occupied Bandwidth: Section 2.1049 (Continued)- Before EUT

Date: 31.JAN.2007 11:42:12

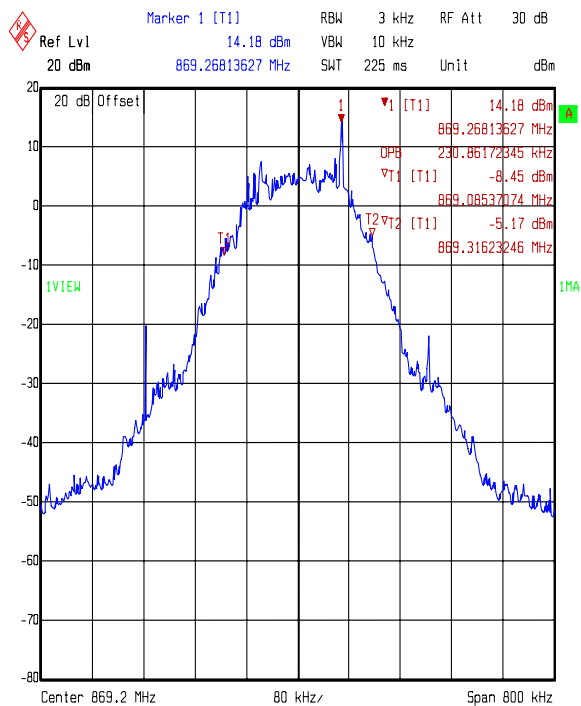


Date: 31.JAN.2007 11:39:58

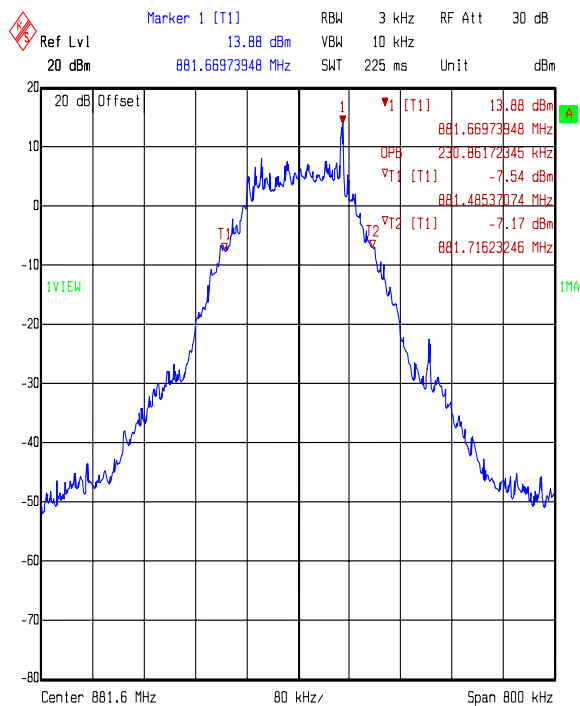


Date: 31.JAN.2007 11:40:55

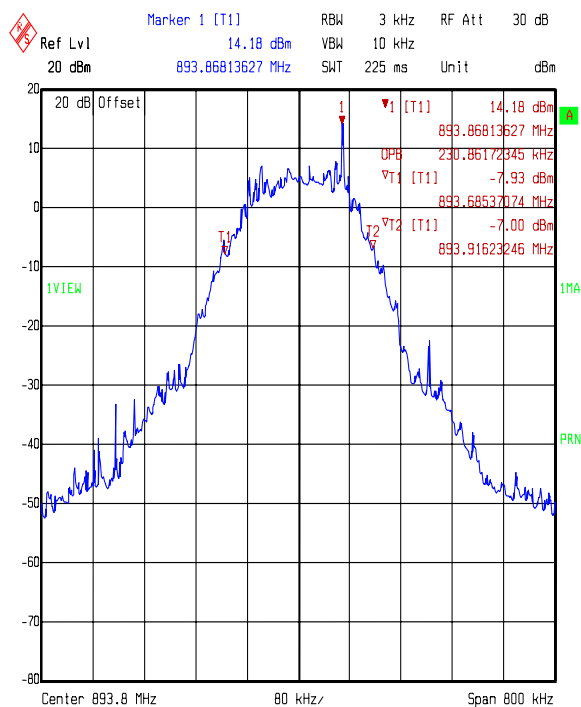
Test of: Zinwave Ltd
2776 Distributed Narrow Band Antenna System
To: FCC Part 22: 2006 (Subpart H)

Transmitter Occupied Bandwidth: Section 2.1049 (Continued)- Through EUT

Date: 01.FEB.2007 16:27:11



Date: 01.FEB.2007 16:29:01



Date: 01.FEB.2007 16:30:52

Test of: Zinwave Ltd
2776 Distributed Narrow Band Antenna System
To: FCC Part 22: 2006 (Subpart H)

7.2.9. Transmitter Occupied Bandwidth: Section 2.1049

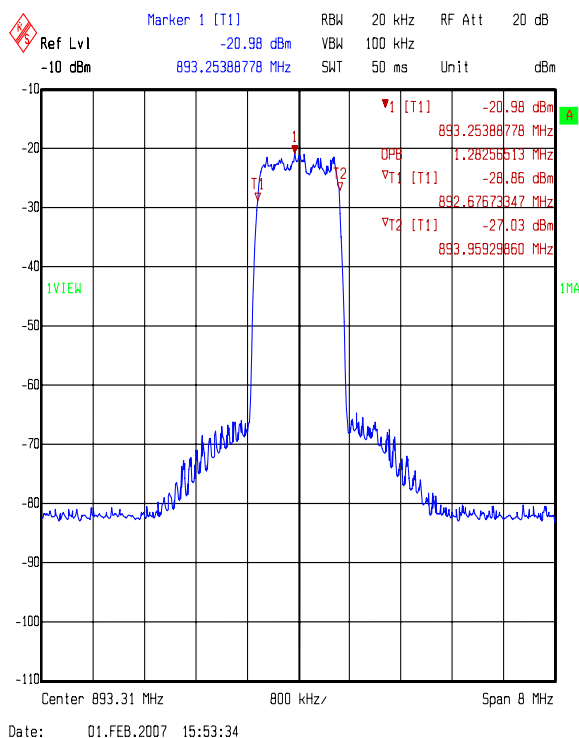
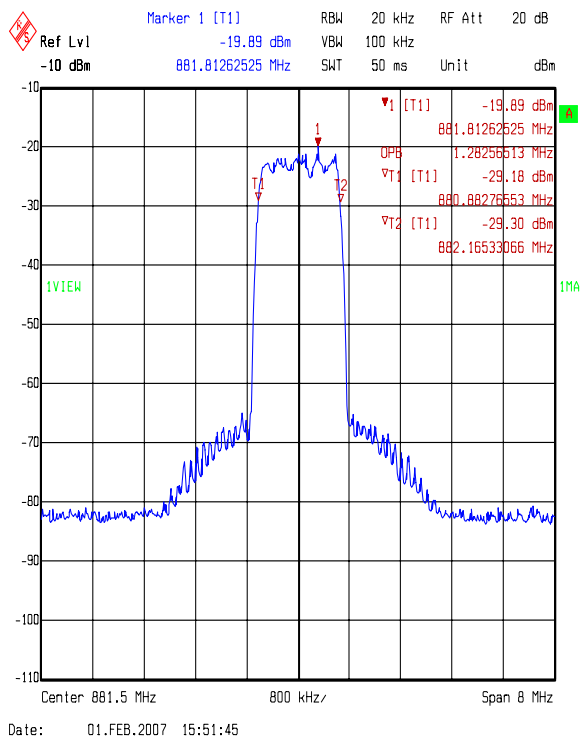
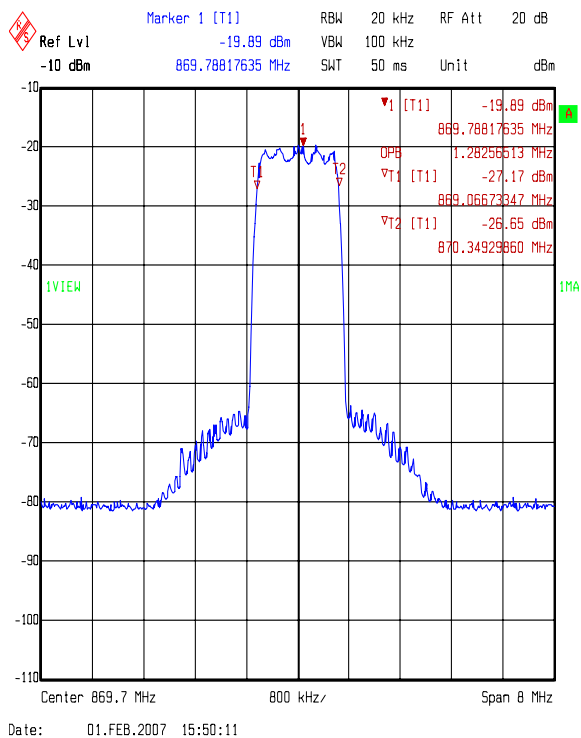
The EUT was configured as for occupied bandwidth measurements as described in section 9 of this report.

Tests were performed to identify the maximum bandwidth occupied by the fundamental frequency of the EUT.

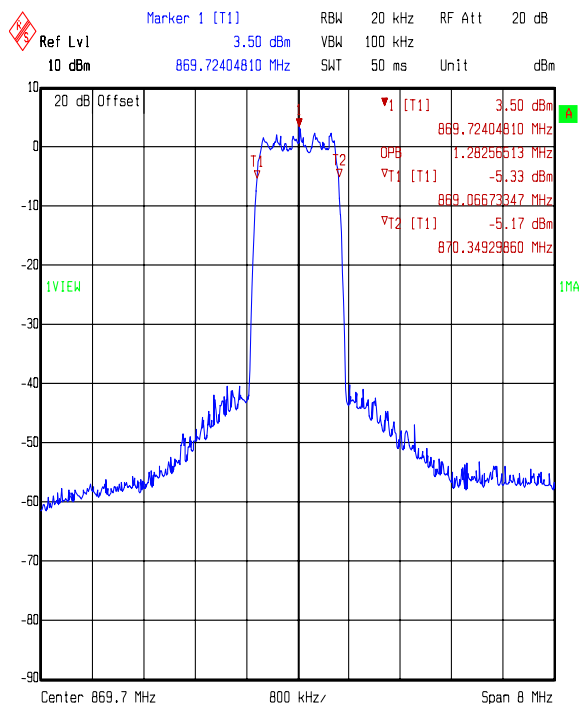
Results: CDMA2000

Channel	Frequency (MHz)	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth Before EUT (MHz)	Occupied Bandwidth Through EUT (MHz)
Bottom	869.7	20.0	100.0	1.283	1.283
Middle	881.5	20.0	100.0	1.283	1.283
Top	893.31	20.0	100.0	1.283	1.283

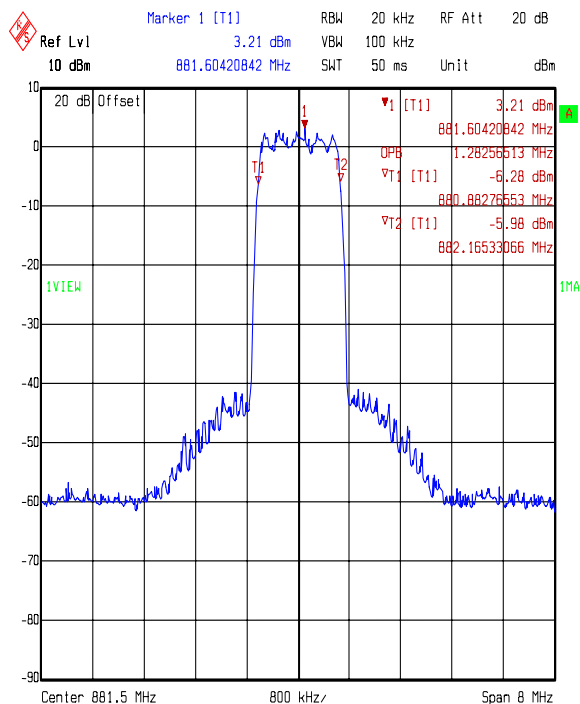
Test of: Zinwave Ltd
2776 Distributed Narrow Band Antenna System
To: FCC Part 22: 2006 (Subpart H)

Transmitter Occupied Bandwidth: Section 2.1049 (Continued)- Before EUT

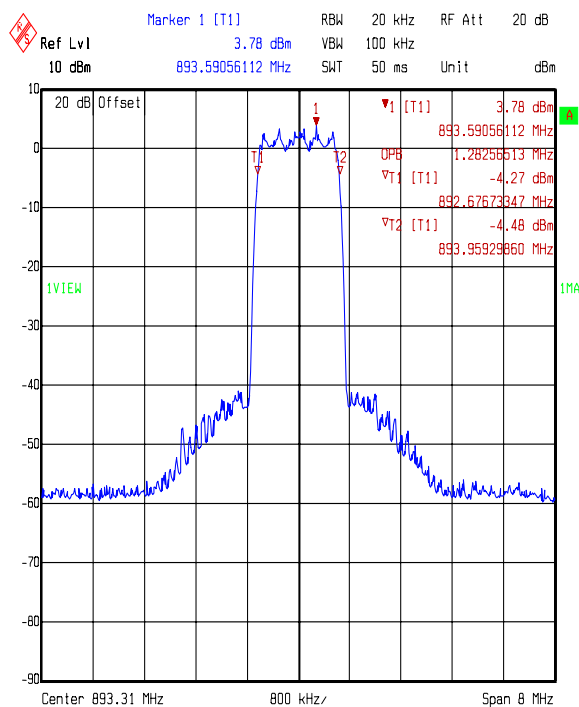
Test of: Zinwave Ltd
2776 Distributed Narrow Band Antenna System
To: FCC Part 22: 2006 (Subpart H)

Transmitter Occupied Bandwidth: Section 2.1049 (Continued)- Through EUT

Date: 01.FEB.2007 16:09:35



Date: 01.FEB.2007 16:08:31



Date: 01.FEB.2007 16:11:36

Test of: Zinwave Ltd
2776 Distributed Narrow Band Antenna System
To: FCC Part 22: 2006 (Subpart H)

7.2.10. Transmitter Intermodulation Conducted Emissions: Section 2.1051/22.917**Results: - Fully Loaded****Emissions Measured**

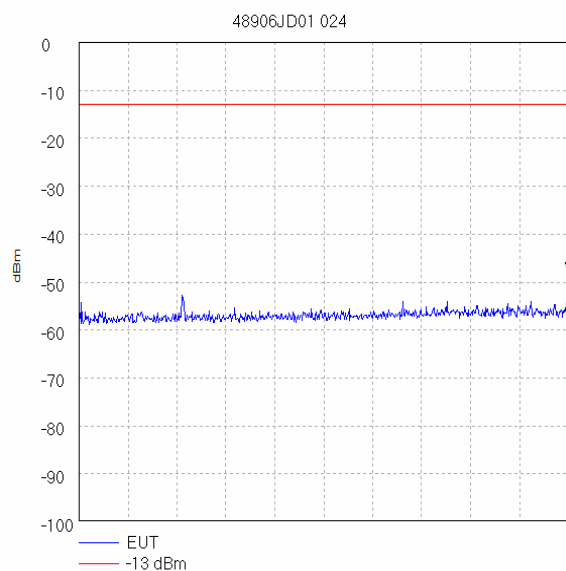
Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
886.308	-35.5	-13.0	22.5	Complied

Note(s):

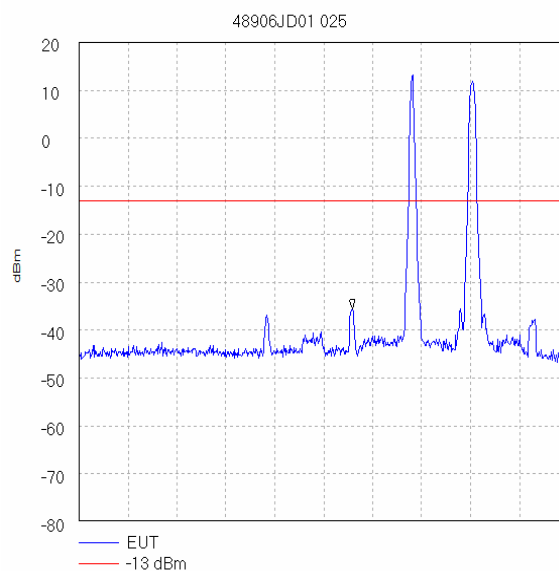
1. Fully loaded system is running on a 4x8 configuration with the following input signals:
GSM 850 – 893.8 MHz
CW CDMA2000 850 – 890.0 MHz
CW GSM 1900 – 1989.8 MHz
CDMA2000 1900 – 1983.5 MHz

Test of: Zinwave Ltd
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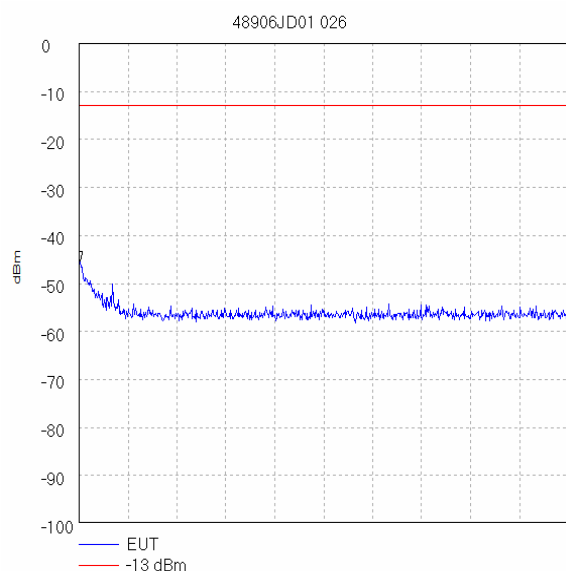
Transmitter Intermodulation Conducted Emissions: Section 2.1051/22.917 (Continued)



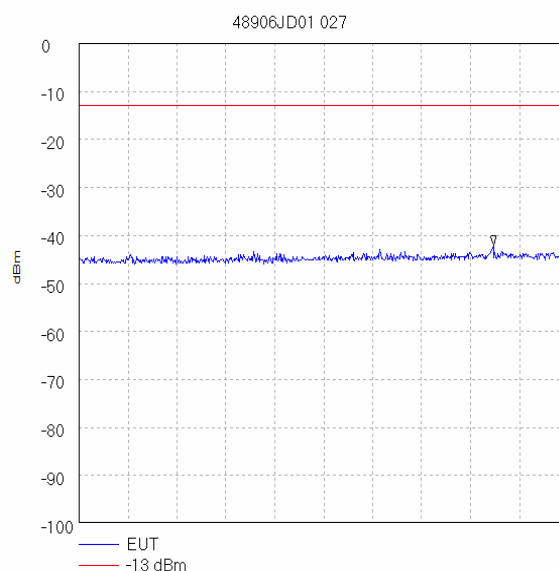
Start 30.0 MHz; Stop 869.0 MHz
Ref 0 dBm; Ref Offset 20.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 10 dB; Swp 210.0 mS
Peak 869.0 MHz, -47.67 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by JXH 05/02/2007 09:32:15



Start 869.0 MHz; Stop 900.0 MHz
Ref 20 dBm; Ref Offset 20.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 10 dB; Swp 50.0 mS
Marker 886.30833 MHz, -35.5 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by JXH 05/02/2007 09:33:20



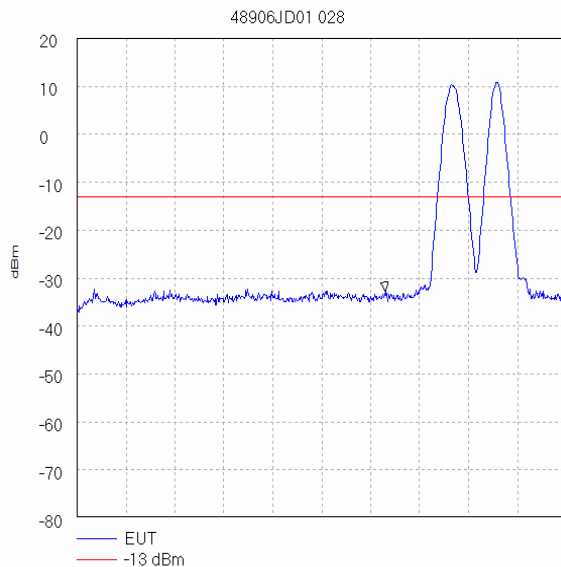
Start 900.0 MHz; Stop 1.0 GHz
Ref 0 dBm; Ref Offset 20.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 10 dB; Swp 50.0 mS
Peak 900.16667 MHz, -45.33 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by JXH 05/02/2007 09:37:35



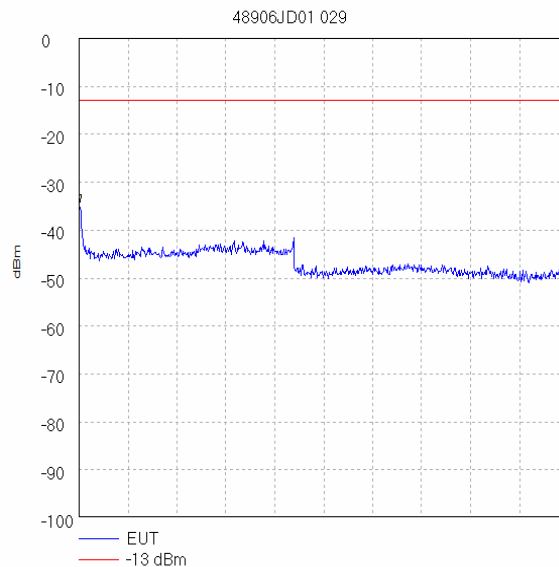
Start 1.0 GHz; Stop 1.93 GHz
Ref 0 dBm; Ref Offset 20.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 50.0 mS
Peak 1.7874 GHz, -42.0 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by JXH 05/02/2007 09:40:39

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Test of: Zinwave Ltd
2776 Distributed Narrow Band Antenna System
To: FCC Part 22: 2006 (Subpart H)

Transmitter Intermodulation Conducted Emissions: Section 2.1051/22.917 (Continued)

Start 1.93 GHz; Stop 2.0 GHz
Ref 20 dBm; Ref Offset 20.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 50.0 mS
Marker 1.9741 GHz, -32.67 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by JXH 05/02/2007 09:44:59



Start 2.0 GHz; Stop 4.0 GHz
Ref 0 dBm; Ref Offset 20.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 50.0 mS
Peak 2.0 GHz, -34.5 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by JXH 05/02/2007 09:48:25

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Test of: Zinwave Ltd
2776 Distributed Narrow Band Antenna System
To: FCC Part 22: 2006 (Subpart H)

7.2.11. Transmitter Intermodulation Conducted Emissions: Section 2.1051/22.917**Results: - 850 Band****Emissions Measured**

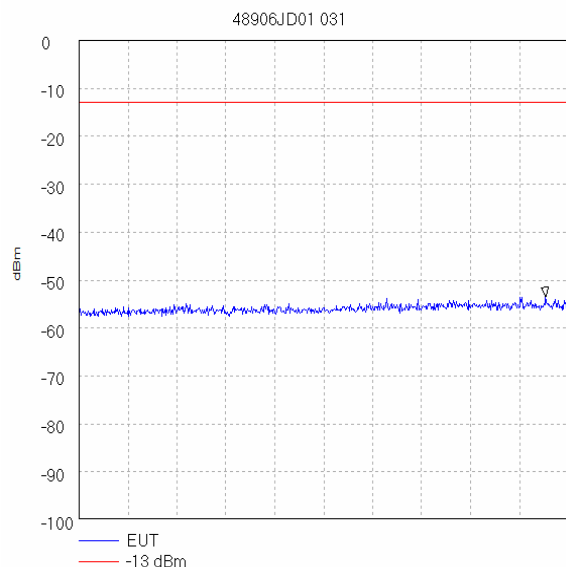
Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
880.933	-31.8	-13.0	18.8	Complied
888.200	-32.2	-13.0	19.2	Complied
899.800	-33.7	-13.0	20.7	Complied

Note(s):

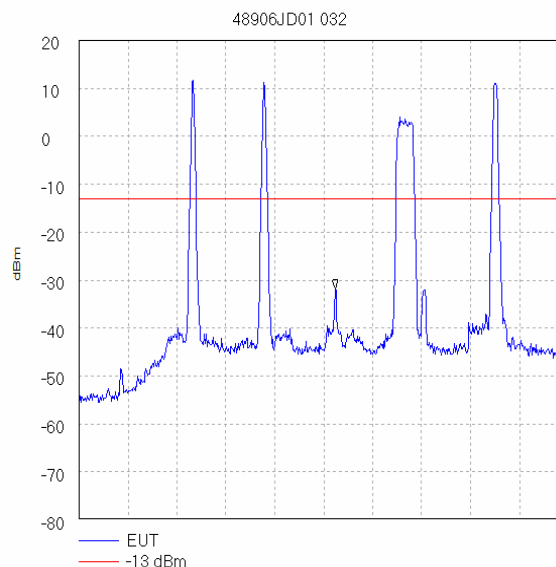
1. Fully loaded system is running on a 4x8 configuration with the following input signals:
CW GSM 869.2 MHz
CW CDMA2000 875.0 MHz
CDMA2000 886.47 MHz
GSM 893.8 MHz

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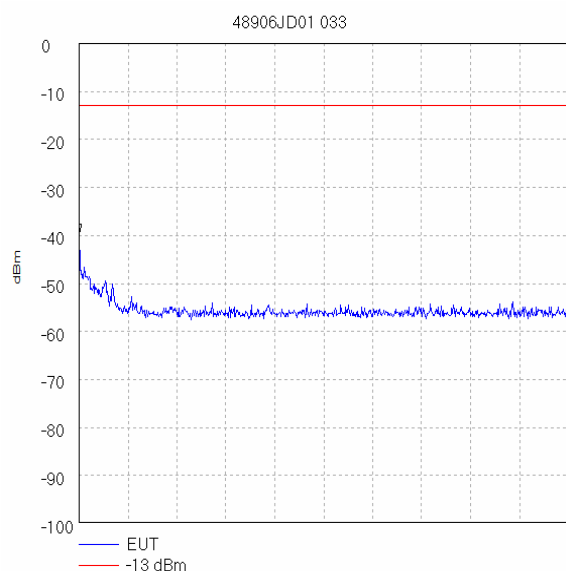
Transmitter Intermodulation Conducted Emissions: Section 2.1051/22.917 (Continued)



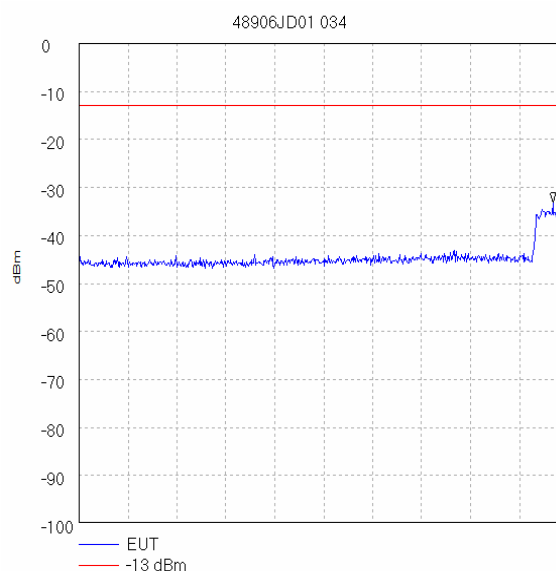
Start 30.0 MHz; Stop 860.0 MHz
Ref 0 dBm; Ref Offset 20.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 10 dB; Swp 210.0 mS
Peak 821.26667 MHz, -53.5 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by JXH 05/02/2007 09:57:12



Start 860.0 MHz; Stop 900.0 MHz
Ref 20 dBm; Ref Offset 20.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 10 dB; Swp 50.0 mS
Marker 880.93333 MHz, -31.83 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by JXH 05/02/2007 09:58:21



Start 900.0 MHz; Stop 1.0 GHz
Ref 0 dBm; Ref Offset 20.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 10 dB; Swp 50.0 mS
Peak 900.0 MHz, -39.67 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by JXH 05/02/2007 10:01:43



Start 1.0 GHz; Stop 2.0 GHz
Ref 0 dBm; Ref Offset 20.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 50.0 mS
Peak 1.96833 GHz, -33.17 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by JXH 05/02/2007 10:02:25

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

Test of: Zinwave Ltd
2776 Distributed Narrow Band Antenna System
To: FCC Part 22: 2006 (Subpart H)

7.2.12. Transmitter Out of Band Conducted Emissions: Section 2.1051 & 22.917

The EUT was configured as for transmitter conducted emission measurements as described in section 9 of this report.

Tests were performed to identify the maximum transmitter conducted emission levels.

Results:

Bottom Channel

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1993.750	-31.0	-13.0	18.0	Complied

Middle Channel

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1993.500	-31.9	-13.0	18.9	Complied

Top Channel

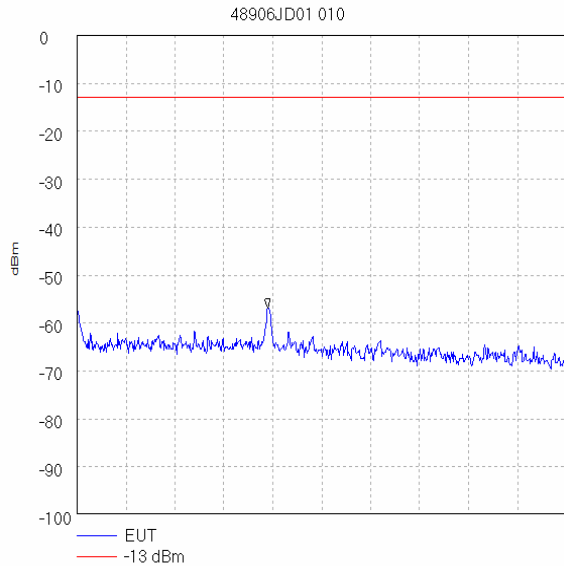
Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1997.820	-31.8	-13.0	18.8	Complied

Note(s):

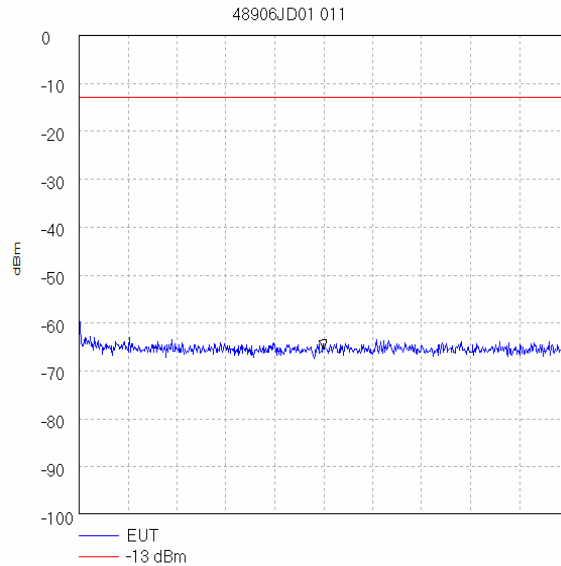
- System was running on a 2x4 Configuration, the input signals used are as follows:
Observed ports – 1: GSM850 893.8 MHz – 2: CDMA2000 1900 1988.75 MHz
Alternative ports – 3: CDMA2000 850 893.31 MHz – 4: GSM1900 1989.8 MHz
Power on a 2x4 configuration is 3dB lower per port than a 1x2 configuration
i.e. 1x2 = +18 dBm per port – 2x4 = +15 dBm per port.
Where substitutions were performed, both bands of GSM/CDMA were altered together, i.e. GSM850 bottom channel / CDMA2000 bottom channel.
- Plot numbers 015, 016, 017 represent the different channels that were measured as they fell within 20dB of the limit.

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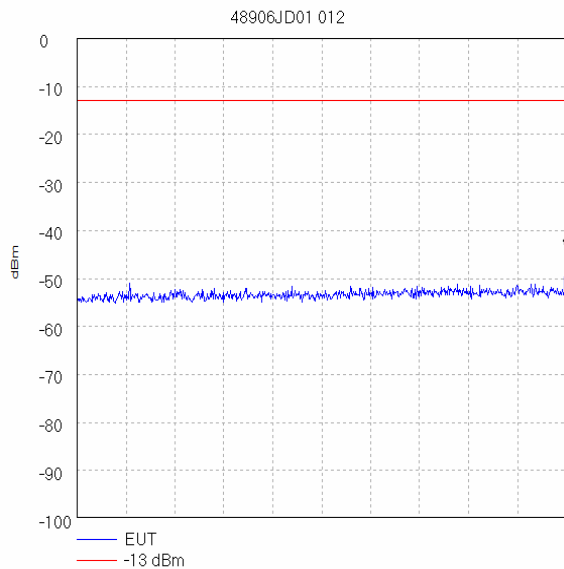
Transmitter Out of Band Conducted Emissions: Section 2.1051 & 22.917 (Continued)



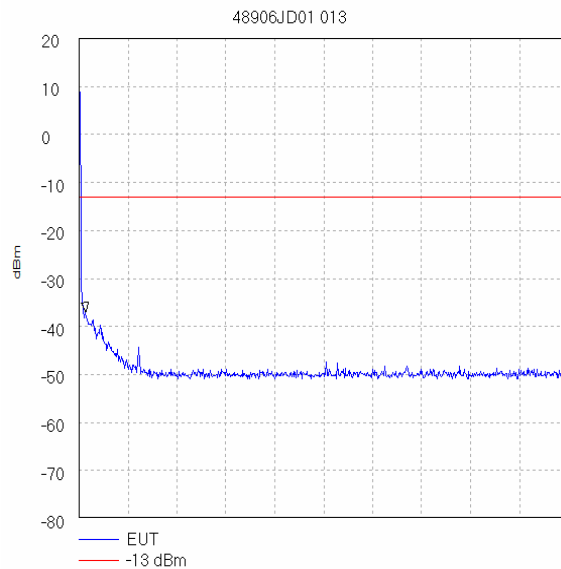
Start 9.0 kHz; Stop 150.0 kHz
Ref 0 dBm; Ref Offset 23.0 dB; 10 dB/div
RBW 1.0 kHz; VBW 1.0 kHz; Att 10 dB; Swp 360.0 mS
Peak 63.99 kHz; -56.83 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by jph 02/02/2007 11:43:13



Start 150.0 kHz; Stop 30.0 MHz
Ref 0 dBm; Ref Offset 23.0 dB; 10 dB/div
RBW 10.0 kHz; VBW 10.0 kHz; Att 10 dB; Swp 750.0 mS
Peak 15.075 MHz; -65.5 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by jph 02/02/2007 11:44:09



Start 30.0 MHz; Stop 869.0 MHz
Ref 0 dBm; Ref Offset 23.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 10 dB; Swp 210.0 mS
Peak 869.0 MHz; -43.83 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by jph 02/02/2007 11:45:22

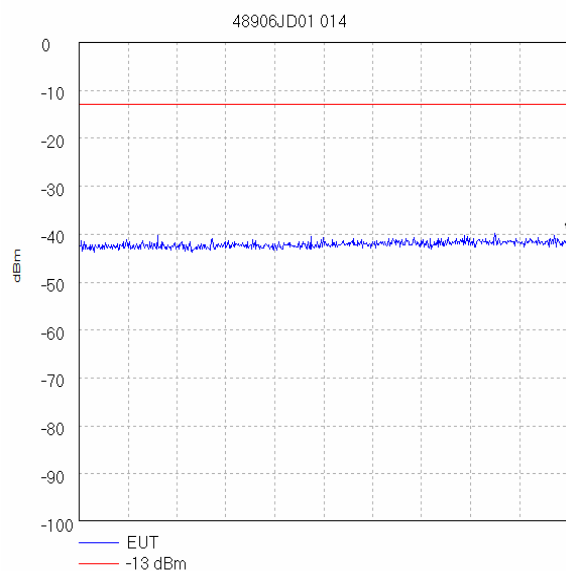


Start 894.0 MHz; Stop 1.0 GHz
Ref 20 dBm; Ref Offset 23.0 dB; 10 dB/div
RBW 100.0 kHz; VBW 100.0 kHz; Att 10 dB; Swp 50.0 mS
Marker 895.41333 MHz; -37.0 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by jph 02/02/2007 12:41:31

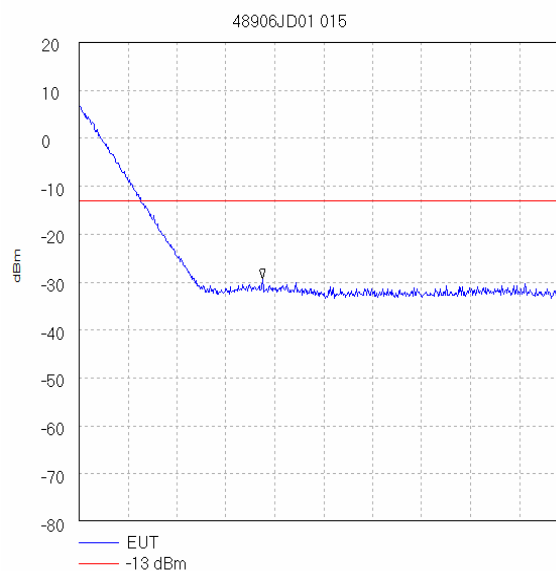
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

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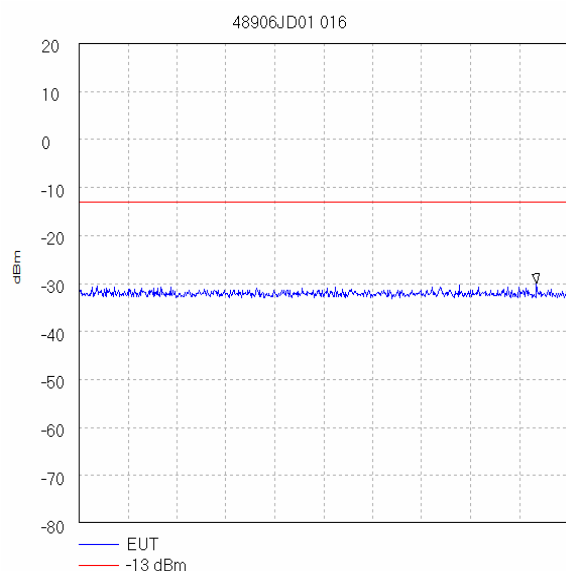
Transmitter Out of Band Conducted Emissions: Section 2.1051 & 22.917 (Continued)



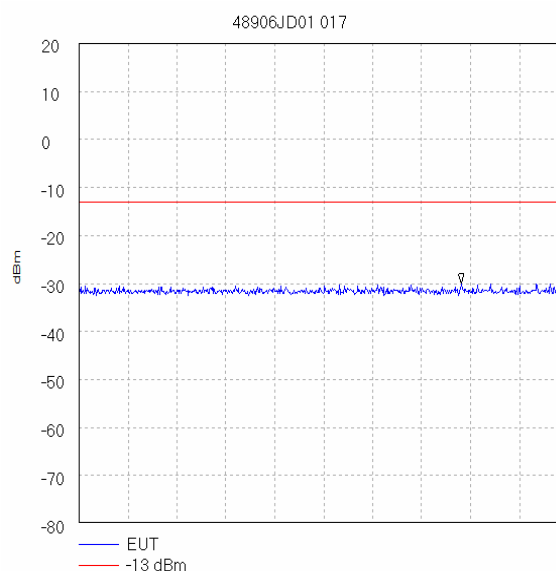
Start 1.0 GHz; Stop 1.93 GHz
Ref 0 dBm; Ref Offset 23.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 50.0 mS
Peak 1.93 GHz, -39.67 dBm
Display Line: -13 dBm; : Limit Test Passed
Tested by jph 02/02/2007 12:47:13



Start 1.99 GHz; Stop 2.0 GHz
Ref 20 dBm; Ref Offset 23.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 50.0 mS
Marker 1.99375 GHz, -29.33 dBm
Display Line: -13 dBm; : Limit Test Passed
Tested by jph 02/02/2007 12:48:22



Start 1.99 GHz; Stop 2.0 GHz
Ref 20 dBm; Ref Offset 23.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 50.0 mS
Peak 1.99935 GHz, -30.0 dBm
Display Line: -13 dBm; : Limit Test Passed
Tested by jph 02/02/2007 12:55:51

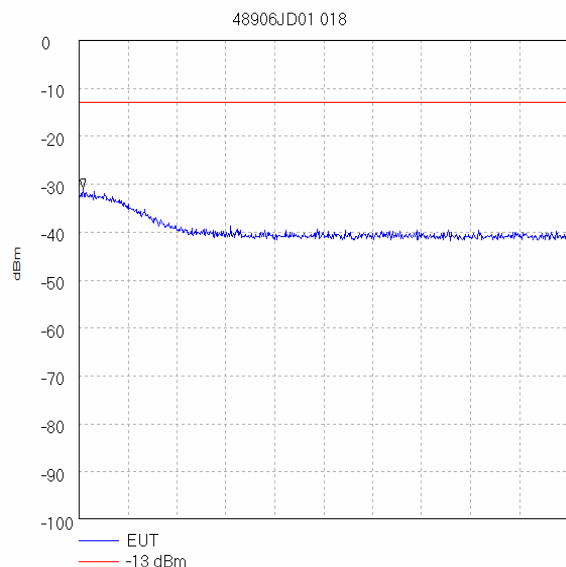


Start 1.99 GHz; Stop 2.0 GHz
Ref 20 dBm; Ref Offset 23.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 50.0 mS
Peak 1.99782 GHz, -30.0 dBm
Display Line: -13 dBm; : Limit Test Passed
Tested by jph 02/02/2007 12:58:40

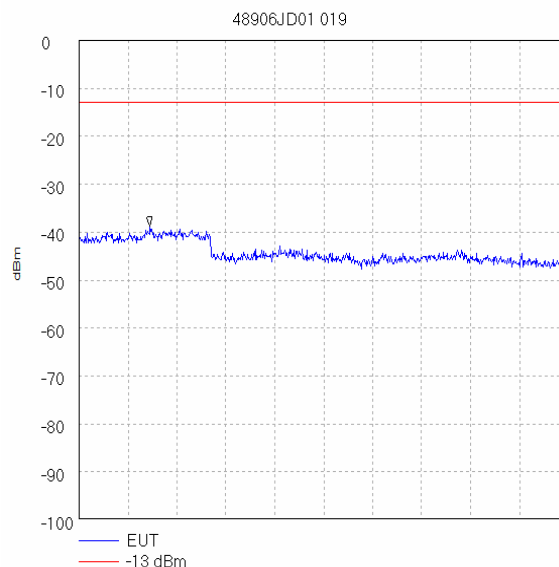
Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

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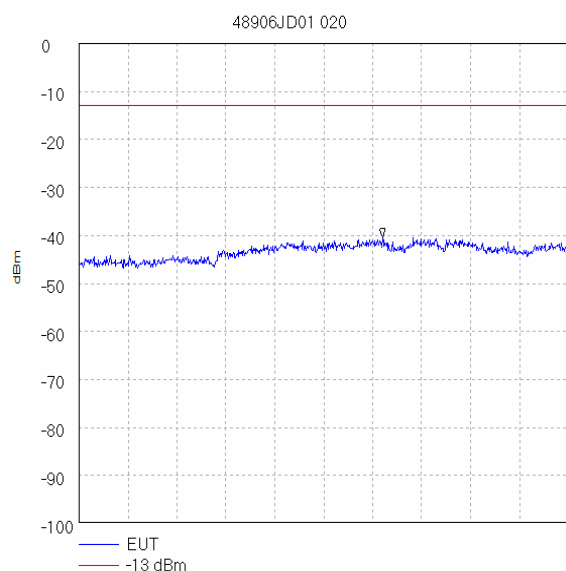
Transmitter Out of Band Conducted Emissions: Section 2.1051 & 22.917 (Continued)



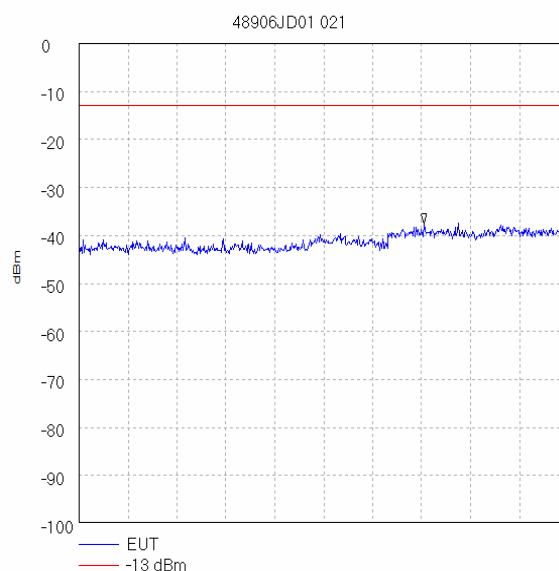
Start 2.0 GHz; Stop 2.1 GHz
Ref 0 dBm; Ref Offset 23.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 50.0 mS
Peak 2.00083 GHz, -30.83 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by jph 02/02/2007 13:02:07



Start 2.1 GHz; Stop 5.0 GHz
Ref 0 dBm; Ref Offset 23.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 58.0 mS
Peak 2.5205 GHz, -38.67 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by jph 02/02/2007 13:03:00



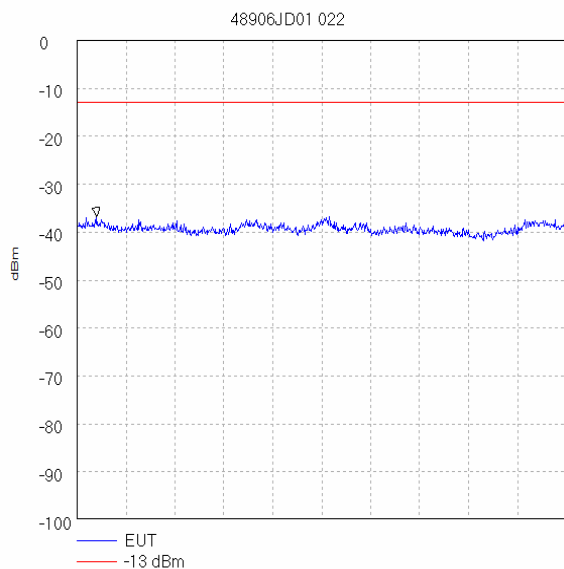
Start 5.0 GHz; Stop 10.0 GHz
Ref 0 dBm; Ref Offset 23.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 100.0 mS
Peak 8.1 GHz, -40.5 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by jph 02/02/2007 13:03:38



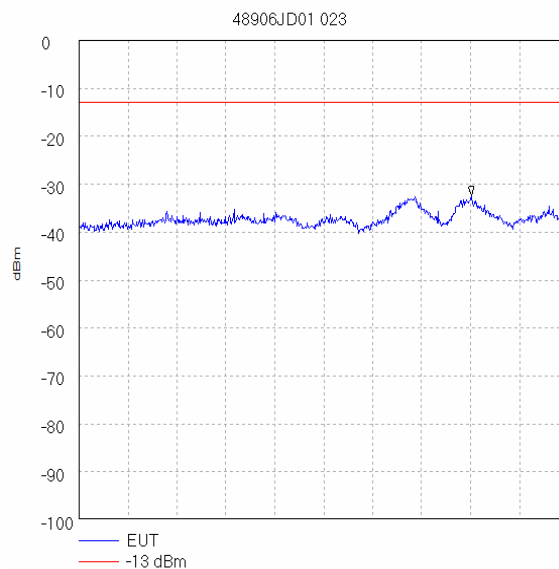
Start 10.0 GHz; Stop 15.0 GHz
Ref 0 dBm; Ref Offset 23.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 100.0 mS
Peak 13.525 GHz, -37.5 dBm
Display Line: -13 dBm; ; Limit Test Passed
Tested by jph 02/02/2007 13:04:14

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

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Transmitter Out of Band Conducted Emissions: Section 2.1051 & 22.917 (Continued)

Start 15.0 GHz; Stop 20.0 GHz
Ref 0 dBm; Ref Offset 23.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 100.0 mS
Peak 15.2 GHz, -36.83 dBm
Display Line: -13 dBm; : Limit Test Passed
Tested by jph 02/02/2007 13:04:52



Start 20.0 GHz; Stop 26.0 GHz
Ref 0 dBm; Ref Offset 23.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 120.0 mS
Peak 24.81 GHz, -32.33 dBm
Display Line: -13 dBm; : Limit Test Passed
Tested by jph 02/02/2007 13:05:29

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

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7.2.13. Transmitter Conducted Emissions at Band Edges: Section 2.1051 & 22.917

The EUT was configured as for transmitter conducted emission testing described in section 9 of this report.

Tests were performed to identify the maximum emissions level at the band edges of the frequency block that the EUT will operate over.

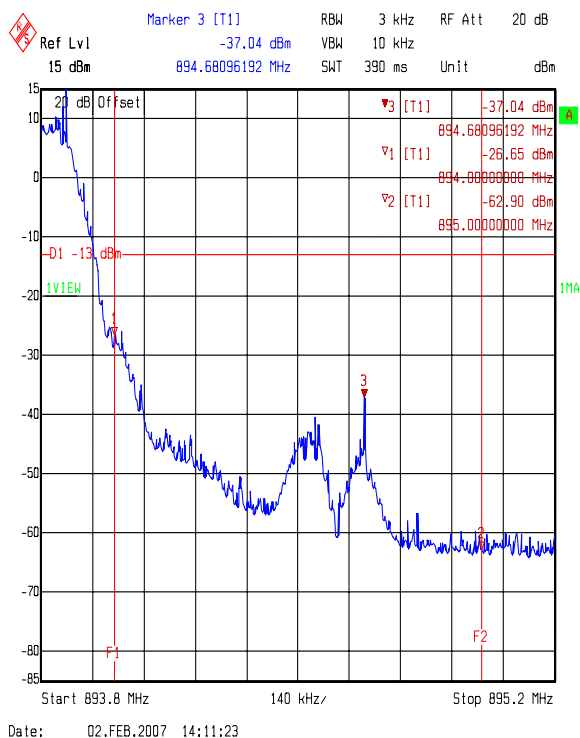
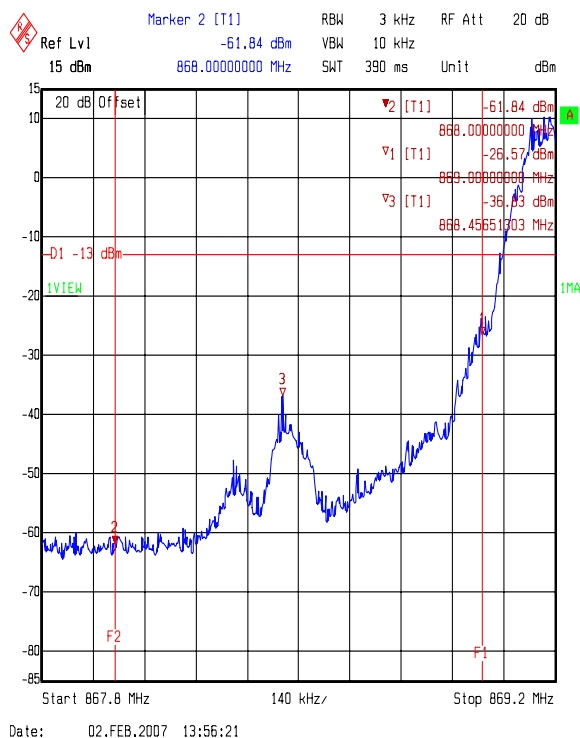
Results: GSM 850

Bottom Band Edge

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
869	-26.6	-13.0	13.6	Complied

Top Band Edge

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
894	-26.7	-13.0	13.7	Complied



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7.2.14. Transmitter Conducted Emissions at Band Edges: Section 2.1051 & 22.917

The EUT was configured as for transmitter conducted emission testing described in section 9 of this report.

Tests were performed to identify the maximum emissions level at the band edges of the frequency block that the EUT will operate over.

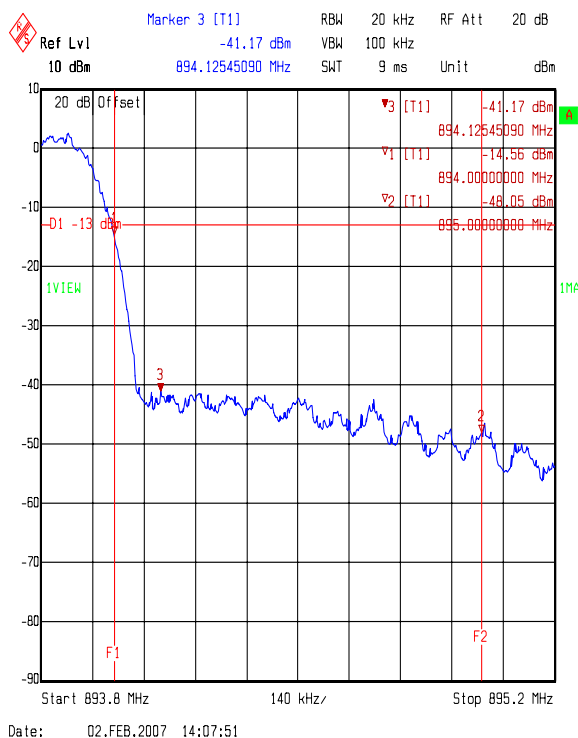
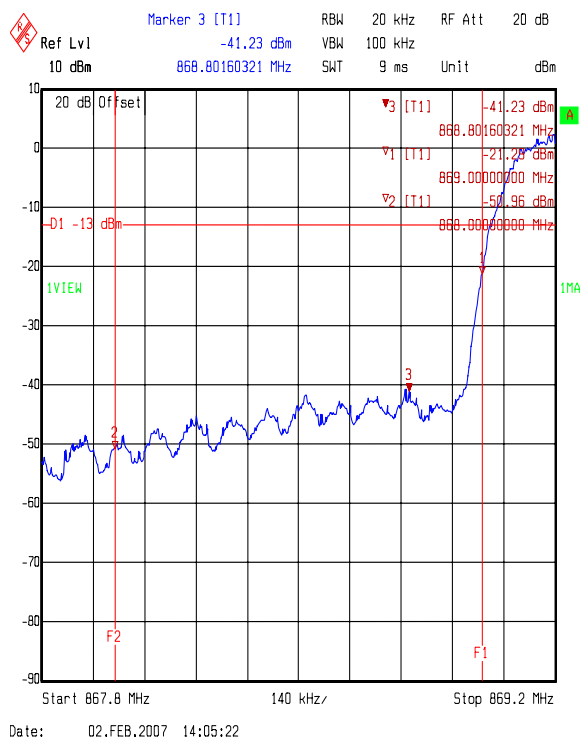
Results: CDMA2000

Bottom Band Edge

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
869	-21.3	-13.0	8.3	Complied

Top Band Edge

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
894	-14.6	-13.0	1.6	Complied



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7.2.15. Transmitter Out of Band Radiated Emissions: Section 2.1053 & 22.917

The EUT was configured as for transmitter radiated emission testing as described in section 9 of this report.

Tests were performed to identify the maximum transmitter radiated emission levels.

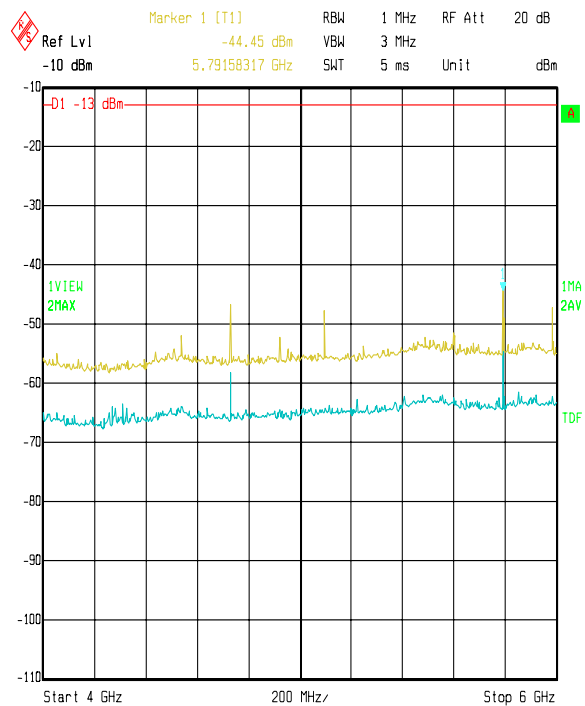
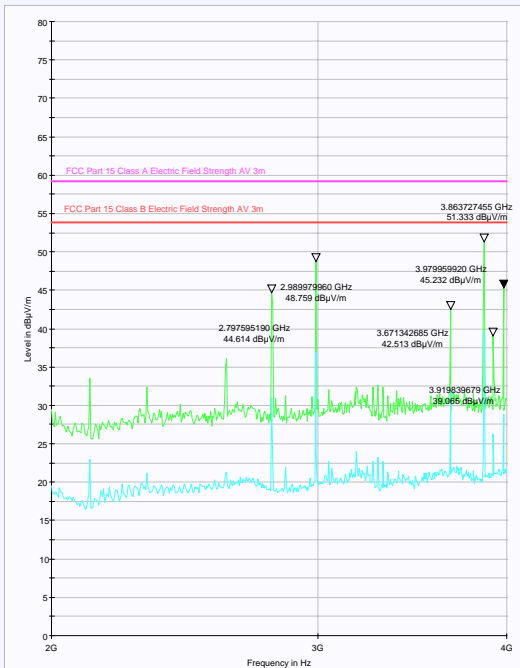
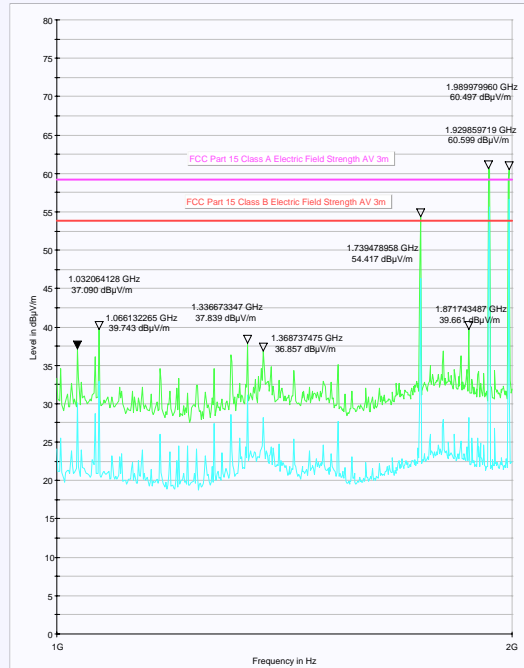
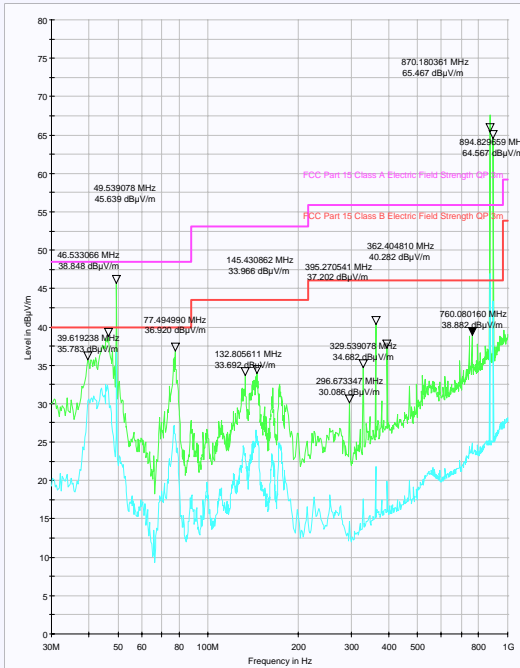
Results:

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1738.135	-37.4	-13.0	24.4	Complied
7723.645	-35.8	-13.0	22.8	Complied
12365.468	-35.9	-13.0	22.9	Complied
14793.149	-37.6	-13.0	24.6	Complied
21305.564	-38.8	-13.0	25.8	Complied

Note(s):

- 1. The limit line on the plots showing the frequency ranges 30 MHz to 1 GHz, 1 GHz to 2 GHz and 2 GHz to 4 GHz are incorrect for a limit of -13 dBm. The actual limit line in fieldstrength corresponding to -13 dBm is 84.4 dBμV/m. This figured was derived by subtracting 97.4dB (to convert from fieldstrength to an equivalent peak ERP in dBm) e.g. 84.4 - 97.4 = -13.0 dBm. The figure of 97.4dB is arrived at using the formula $P = (V/m \times d)^2 / 30$.*
- 2. All other emissions were at least 20 dB below the -13 dBm limit and therefore not reported.*
- 3. All plots also show an additional lower trace which is an Average measurement trace. This should be disregarded.*
- 4. The high level emissions on the plots showing the frequency ranges 30 MHz to 1 GHz and 1 GHz to 2 GHz at approximately 894 MHz, 870 MHz, 1.930 GHz and 1.990 GHz were the input signals to the EUT and not emissions. These were wanted signals and should be disregarded for the purposes of measurement.*

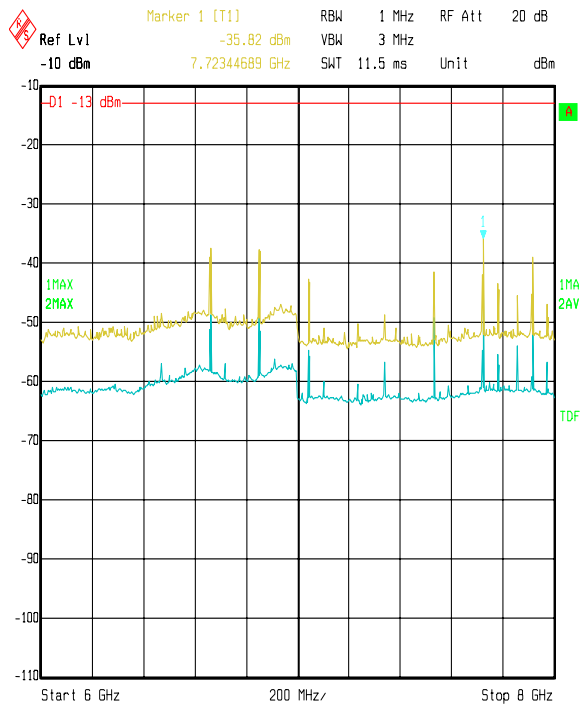
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Transmitter Out of Band Radiated Emissions: Section 2.1053 & 22.917 (Continued)

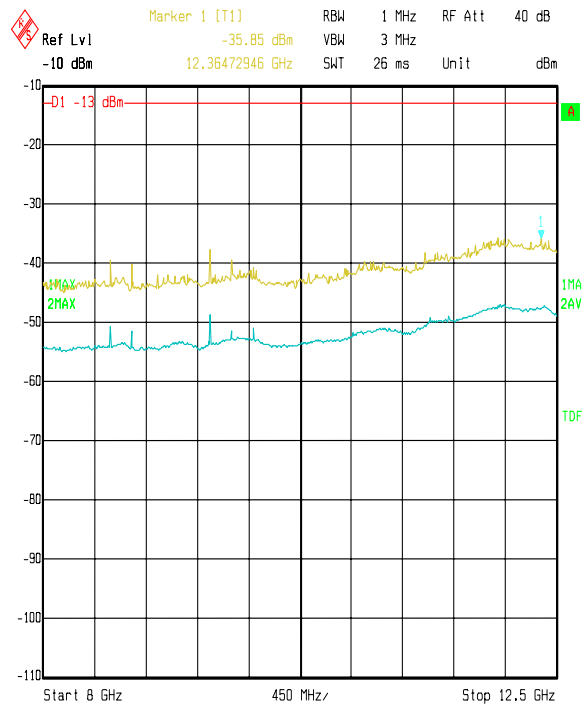
Date: 06.FEB.2007 12:45:26

Note: This plot is a pre-scan and for indication purposes only. For final measurements, see accompanying tables.

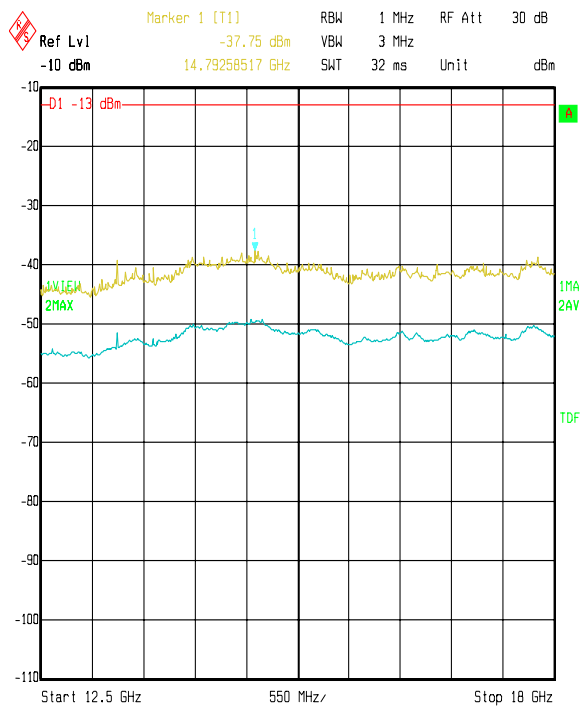
Test of: Zinwave Ltd
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Transmitter Out of Band Radiated Emissions: Section 2.1053 & 22.917 (Continued)

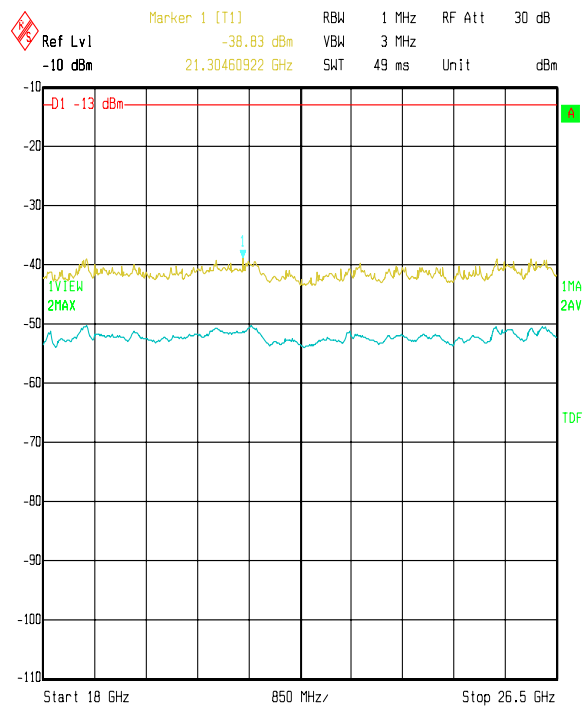
Date: 06.FEB.2007 14:35:42



Date: 06.FEB.2007 14:47:24



Date: 06.FEB.2007 14:52:34



Date: 06.FEB.2007 14:59:08

Note: These plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

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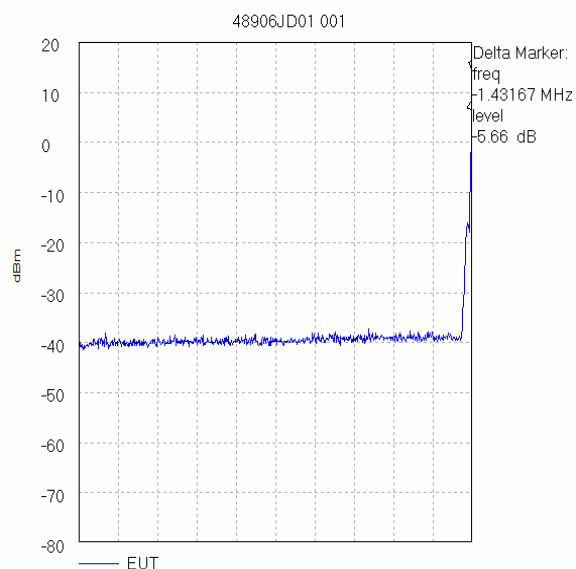
7.2.16. Out of Band Rejection**Results:**

Plot Number	Start Frequency (MHz)	Stop Frequency (MHz)	Frequency of Maximum Gain (MHz)	Maximum Gain Measured (dB)
001	10.0	869.0	869.0	20.3
003	894.0	1930.0	894.0	22.8
005	1990.0	5000.0	1990.0	22.5
006	5000.0	10000.0	-	-
007	10000.0	15000.0	-	-
008	15000.0	20000.0	-	-
009	20000.0	26000.0	-	-

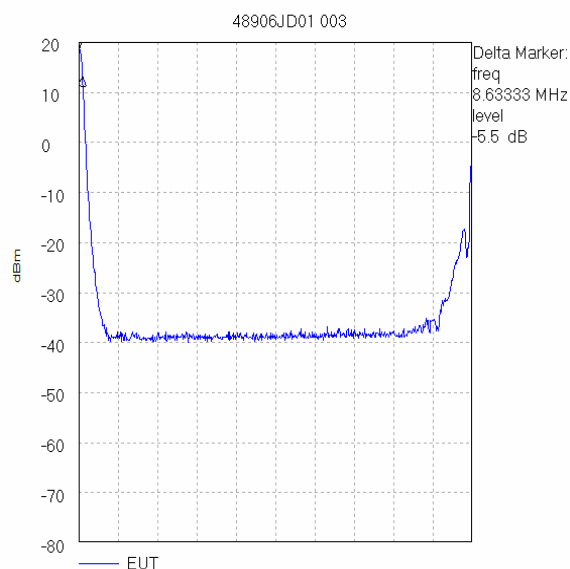
Note(s):

1. Both GSM 850 and 1900 bands have been excluded from the plots as this is operational freq range of the equipment and will show high gain through out.

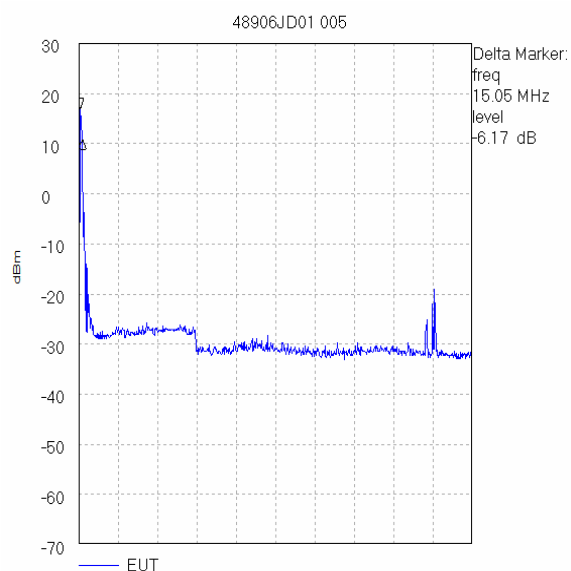
Test of: Zinwave Ltd
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Out of Band Rejection (Continued)

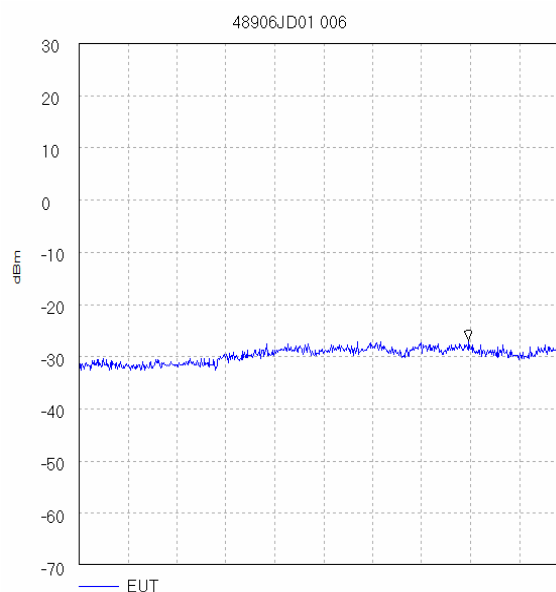
Start 10.0 MHz; Stop 869.0 MHz
Ref 20 dBm; Ref Offset 20.0 dB; 10 dB/div
RBW 2.0 MHz; VBW 3.0 MHz; Att 10 dB; Swp 50.0 mS
Marker 869.0 MHz, 14.93 dBm
Delta 867.56833 MHz, 8.67 dBm
Tested by JXH 29/01/2007 14:53:10



Start 894.0 MHz; Stop 1.93 GHz
Ref 20 dBm; Ref Offset 20.0 dB; 10 dB/div
RBW 2.0 MHz; VBW 3.0 MHz; Att 10 dB; Swp 50.0 mS
Marker 894.0 MHz, 18.67 dBm
Delta 902.63333 MHz, 13.17 dBm
Tested by JXH 29/01/2007 15:10:54

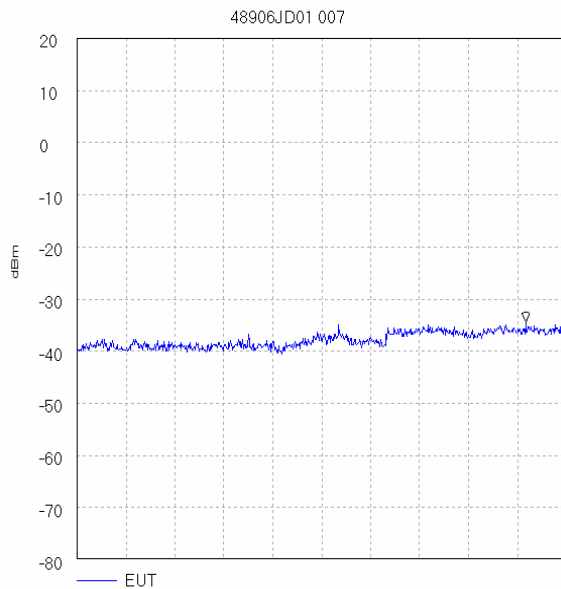


Start 1.99 GHz; Stop 5.0 GHz
Ref 30 dBm; Ref Offset 20.0 dB; 10 dB/div
RBW 2.0 MHz; VBW 3.0 MHz; Att 20 dB; Swp 61.0 mS
Marker 2.00003 GHz, 17.0 dBm
Delta 2.01508 GHz, 10.83 dBm
Tested by JXH 29/01/2007 15:55:55

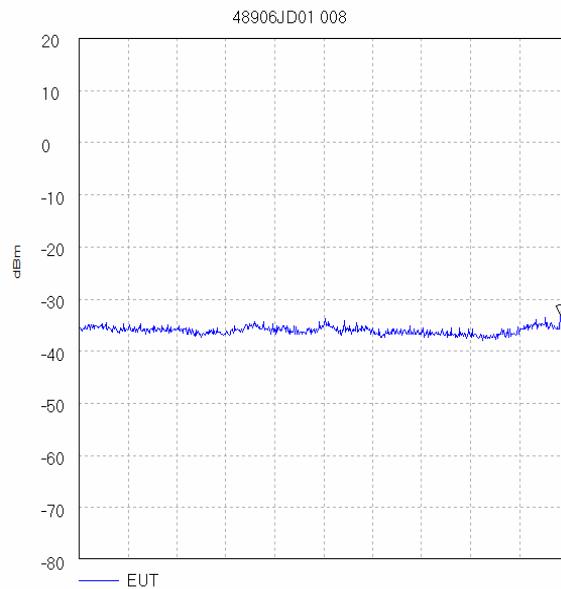


Start 5.0 GHz; Stop 10.0 GHz
Ref 30 dBm; Ref Offset 20.0 dB; 10 dB/div
RBW 2.0 MHz; VBW 3.0 MHz; Att 20 dB; Swp 100.0 mS
Peak 8.98333 GHz, -27.0 dBm
Tested by JXH 29/01/2007 15:59:19

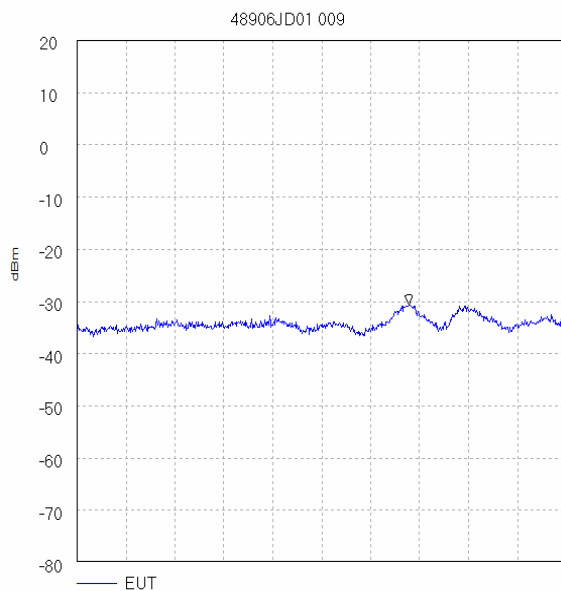
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Out of Band Rejection (Continued)

Start 10.0 GHz; Stop 15.0 GHz
Ref 20 dBm; Ref Offset 20.0 dB; 10 dB/div
RBW 2.0 MHz; VBW 3.0 MHz; Att 10 dB; Swp 100.0 mS
Peak 14.58333 GHz, -34.5 dBm
Tested by JXH 29/01/2007 16:01:47



Start 15.0 GHz; Stop 20.0 GHz
Ref 20 dBm; Ref Offset 20.0 dB; 10 dB/div
RBW 2.0 MHz; VBW 3.0 MHz; Att 10 dB; Swp 100.0 mS
Peak 19.91667 GHz, -33.17 dBm
Tested by JXH 29/01/2007 16:04:07



Start 20.0 GHz; Stop 26.0 GHz
Ref 20 dBm; Ref Offset 20.0 dB; 10 dB/div
RBW 2.0 MHz; VBW 3.0 MHz; Att 10 dB; Swp 120.0 mS
Peak 24.07 GHz, -30.67 dBm
Tested by JXH 29/01/2007 16:08:17

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8. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor, such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
AC Conducted Spurious Emissions	0.15 MHz to 30 MHz	95%	±3.25 dB
Conducted Emissions	9 kHz to 26 GHz	95%	±1.2 dB
Conducted Intermodulation Emissions	9 kHz to 26 GHz	95%	±1.2 dB
Occupied Bandwidth	869 to 894 MHz	95%	±0.12%
Radiated Spurious Emissions	30 MHz to 26 GHz	95%	±2.94 dB
Out of Band Rejection	30 MHz to 26 GHz	95%	±3.2 dB

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

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9. Measurement Methods

9.1. Conducted Output Power

The EUT was connected to a peak power sensor and to a GSM test set via suitable cables, RF attenuators and combiners.

The connection was made to the EUT either via an antenna port or by antenna terminals made available by the client.

The total loss of the cables, attenuators and combiner were measured and entered as a reference level offset into the measuring power meter to correct for the losses.

The EUT was set to the required channel and the transmitter set to operate at full power.

This test was performed on the bottom, middle and top channels.

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9.2. Frequency Stability

The EUT was situated within an environmental test chamber and connected directly to the GSM test set via an access port.

Measurements were performed with the EUT operating under extremes of temperature in 10 degree increments within the range -30 to 50 °C.

Measurements were also performed at voltage extremes between the declared nominal supply voltage and at the declared endpoint voltage (for hand carried battery operated equipment) or by varying the primary supply voltage from 85% to 115% of the nominal value for all other equipment types.

The requirement was to determine the frequency stability of the device under specified environmental operating conditions.

Measurements were made on the top and bottom channels.

The EUT was switched off for a minimum of 30 minutes between each stage of testing while the environmental chamber stabilised at the next temperature within the stated temperature range.

The frequency error measured was converted to an error in ppm using the following formula as defined by TIA_EIA_603A :-

$$\text{ppm error} = \left(\frac{MCF_{\text{MHz}}}{ACF_{\text{MHz}}} - 1 \right) * 10^6$$

where MCF_{MHz} is the measured carrier frequency in MHz
 ACF_{MHz} is the assigned carrier frequency in MHz

The measured ppm had to be less than the relevant limits in order to comply.

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9.3. Occupied Bandwidth

The EUT was connected to a spectrum analyser enabled with an occupied bandwidth function and a GSM test set via its input port.

Measurements were performed to determine the occupied bandwidth in accordance with FCC Part 2.1049. The occupied bandwidth was measured from the fundamental emission at the bottom, middle and top channels, both before connecting the EUT and through the EUT.

The occupied bandwidth was measured using the built in occupied bandwidth function of the Rohde and Schwarz FSEB or ESIB spectrum analyser. It was set to measure the bandwidth where 99% of the signal power was contained. The analyser settings were set as per those outlined in the spectrum analyser user manual for this measurement, i.e., $RBW \geq 1\%$ of occupied bandwidth. A value of 3 kHz was used.

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9.4. Transmitter Conducted Emissions Measurements (including Intermodulation tests)

Spurious emission measurements at the antenna port were performed from the lowest declared frequency to 10 times the highest EUT fundamental frequency.

A measuring receiver was connected to the antenna port of the EUT via a suitable cable and RF attenuator. The total loss of both the cable and the attenuator were measured and entered as a reference level offset into the measuring receiver to correct for the losses.

The limit in the standard states that emissions shall be attenuated by at least $43+10 \log (P)$ dB below the transmitter power (P), where (P) is the maximum measured fundamental power for the channel under test. This limit always reduces to -13 dBm therefore, the limit line presented on the accompanying plots is set to -13 dBm.

The frequency band described above was investigated with the transmitter operating at full power on the top, bottom and middle channels. Any spurious observed were then recorded and compared to the -13 dBm limit. The requirement is for the emission to be less than -13 dBm. The margin between emission and limit is recorded and should always be positive to indicate compliance.

It should be noted that FCC Part 22.917 states that the 1st MHz band immediately adjacent to the applicants declared frequency block may be measured using a resolution bandwidth of at least 1% of the emission bandwidth. This bandwidth was found to be 3 kHz

The test equipment settings for conducted antenna port measurements were as follows:

Receiver Function	Settings
Detector Type:	Peak
Mode:	Max Hold
Bandwidth:	1 MHz >1 GHz
Bandwidth:	100 kHz <1 GHz
Amplitude Range:	100 dB
Step Size:	Continuous sweep
Sweep Time:	Coupled

The resolution bandwidth used for measurements in the 1 MHz blocks either side of the declared operating frequency block were set as described in the procedure above.

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9.5. AC Mains Conducted Emissions

AC mains conducted emission measurements were performed in accordance with the standard, against appropriate limits for each detector function.

The test was performed in a shielded enclosure with the equipment arranged as detailed in the standard on a wooden bench using the floor of the screened enclosure as the ground reference plane. The EUT was powered with 115V 60 Hz AC mains supplied via a line impedance stabilisation network (LISN).

Initial measurements in the form of swept scans covering the entire measurement band were performed in order to identify frequencies on which the EUT was generating interference. In order to minimise the time taken for these swept measurements, a peak detector was used in conjunction with the appropriate detector IF measuring bandwidths (see table below). Repetitive scans were performed to allow for emissions with low repetition rates, and the duty cycle of the EUT. The test configuration was the same for the initial scans as for the final measurements.

Following the initial scans, a graph was produced giving an overview of the emissions from the EUT plotted against the appropriate specification limit. A tolerance line was set 6 dB below the specification limit and levels above the tolerance line were re-tested (at individual frequencies) using the appropriate detector function.

The test equipment settings for conducted emissions measurements were as follows:

Receiver Function	Initial Scan	Final Measurements
Detector Type:	Peak	Quasi-Peak (CISPR)/Average
Mode:	Max Hold	Not applicable
Bandwidth:	10 kHz	9 kHz
Amplitude Range:	60 dB	20 dB
Measurement Time:	Not applicable	> 1 s
Observation Time:	Not applicable	> 15 s
Step Size:	Continuous sweep	Not applicable
Sweep Time:	Coupled	Not applicable

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9.6. Transmitter Radiated Emissions

Radiated emission measurements were performed in accordance with the standard, against appropriate limits for each detector function.

Initial pre-scans covering the entire measurement band from the lowest generated frequency declared up to 10 times the highest fundamental frequency. The scans were performed within a screened chamber in order to identify frequencies on which the EUT was generating spurious. This procedure identified the frequencies from the EUT, which required further examination. Repetitive scans were performed to allow for emissions with low repetition rates, and for the duty cycle of the EUT.

The initial scans were performed using an antenna height of 1.5 m and a measurement distance of 3 m. A limit line was set to the specification limit by characterising the screen room using a known signal source set at exactly the same location as the EUT. The signal source was derived from either a horn antenna or a dipole dependant on the frequency band under investigation. Any levels within 20 dB of this limit were measured where possible, on occasion; the receiver noise floor came within the 20 dB boundary. On these occasions, the system noise floor may have been recorded.

An open area test site using the appropriate test distance and measuring receiver with a peak detector was used for final measurements at each frequency recorded in the screen room.

The levels were maximised by initially rotating the turntable through 360° and then varying the antenna height between 1 m and 4 m in the vertical polarisation. At this point, any signals found to be between the limit and a level 6 dB below it were further maximised by changing the configuration of the EUT, e.g. re-routing cables to peripherals and moving peripherals with respect to the EUT. The procedure was repeated for the horizontal polarisation.

Once the final amplitude (maximised) had been obtained, the EUT was substituted with a substitution antenna. For EIRP measurements a horn antenna whose gain was based on an isotropic antenna was used, ERP measurements were done using a dipole. The centre of the substitution antenna was set to approximately the same centre location as the EUT. The substitution antenna was set to the horizontal polarity. The substitution antenna was matched into a signal generator using a 6 dB or greater attenuator. The signal generator was tuned to the EUT's frequency under test.

The test antenna was then raised and lowered to obtain a maximum reading on the spectrum analyser. The level of the signal generator output was then adjusted until the maximum recorded EUT level was observed. The signal generator level was noted. This procedure was repeated with both test antenna and substitution antenna vertically polarised. The radiated power was calculated as:-

$$\text{EIRP/ERP} = \text{Signal Generator Level} - \text{Cable Loss} + \text{Antenna Gain}$$

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Transmitter Radiated Emissions (Continued)

The limit in the standard states that emissions shall be attenuated by at least $43+10 \log (P)$ dB below the transmitter power (P), where (P) is the maximum measured fundamental power for the channel under test. This limit always reduces to -13dBm therefore, the limit line presented on the accompanying plots is set to -13dBm.

Any spurious measured were then compared to the -13dBm limit. The requirement is for the emission to be less than -13dBm. The margin between emission and limit is recorded and should always be positive to indicate compliance.

It should be noted that FCC Part 22.917 states that the 1st MHz band immediately adjacent to the applicants declared frequency block may be measured using a resolution bandwidth of at least 1% of the emission bandwidth. This bandwidth was found by calculating 1% of the bandwidth measured in the transmitter occupied bandwidth section of this report. The next largest available bandwidth above this calculated figure was, therefore, used i.e. 3 kHz.

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9.7. Out of Band Rejection

The test was performed in a laboratory environment.

The measurements were performed at the antenna port.

The EUT was connected to a spectrum analyser with a swept CW signal feed from a signal generator. The CW signal swept from 30 MHz up to 26 GHz to test the performance of the out of band rejection. The response of the system gain was measured and recorded.

The in band gain of the EUT was not measured during this test case.

All settings for the spectrum analyser were followed as per section 9.5, conducted emissions, of the present document.

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Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval
A031	Horn Antenna	Eaton	91889-2	557	08 Jun 2006	36
A032	Horn Antenna	EMCO	3115	2874	15 Dec 2006	36
A067	LISN	Rohde & Schwarz	ESH3-Z5	890603/002	27 Mar 2006	12
A1227	Pre Amp	Agilent	8449B	3008A01566	30 Aug 2006	12
A1534	Preamplifier	Hewlett Packard	8449B OPT H02	3008A00405	Cal before use	N/A
A1737	Attenuator	Atlantic Microwave	BBS40-20	R4722	05 May 2006	12
A1829	Pulse Limiter	Rhode & Schwarz	ESH3-Z2	100671	08 Jan 2007	12
A253	Horn Antenna	Flann Microwave	12240-20	128	17 Nov 2006	36
A254	Horn Antenna	Flann Microwave	14240-20	139	17 Nov 2006	36
A259	Bilog Antenna	Chase	CBL6111	1513	03 Mar 2006	12
A429	Horn Antenna	Flann	16240-20	561	17 Nov 2006	36
A430	Horn Antenna	Flann	18240-20	425	17 Nov 2006	36
A436	Horn Antenna	Flann	20240-20	330	24 Apr 2006	36
E0513	Environmental Chamber	TAS	LT600	23900506	Cal During Use	N/A
G017	Signal Genrator	Rohde & Schwarz	SMH	863 771/023	02 Oct 2006	24
G0543	Amplifier	Sonoma	310N	230801	22 Jan 2007	12
L0893	Agilent CDMA2000 Comms Tester	Agilent	E5515A	U540100150	None	N/A
M023	Test Receiver	Rohde & Schwarz	ESVP	872 991/027	10 Apr 2006	12
M024	Spectrum Monitor	Rohde & Schwarz	EZM	873 952/006	None	N/A
M1093	Communications Test Set	Willtek	4202S	0513018	None	N/A
M1122	Peak Power Sensor	Boonton Electronics	57340	3297	17 May 2006	12
M1123	RF Power Meter	Boonton	4531	138201	17 May 2006	12
M1140	Radio Communications Analyser	Anritsu	MT8820A	6K0000647	Cal Before Use	N/A
M1242	Spectrum Analyser	Rohde & Schwarz	FSEM30	845986_022	08 Sep 2006	12

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Test Equipment Used (Continued)

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval
M1249	Thermocouple	Fluke	52II	88800049	23 Oct 2006	12
M1252	Signal Generator	HP	83640A	3119A00489	10 Aug 2006	12
M1253	Spectrum Analyser	HP	8564E	3442A00262	30 Oct 2006	12
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016	07 Aug 2006	12
M1379	Test Receiver	Rohde & Schwarz	ESIB7	100330	03 July 2006	12
M211	Digital Multimeter	Fluke	70 Series 3	71210457	16 Mar 2006	12
S201	3m OATS	RFI	1		18 Jul 2006	12
S202	3m OATS	RFI	2		6 Oct 2006	12

NB In accordance with UKAS requirements, all the measurement equipment is on a calibration schedule.

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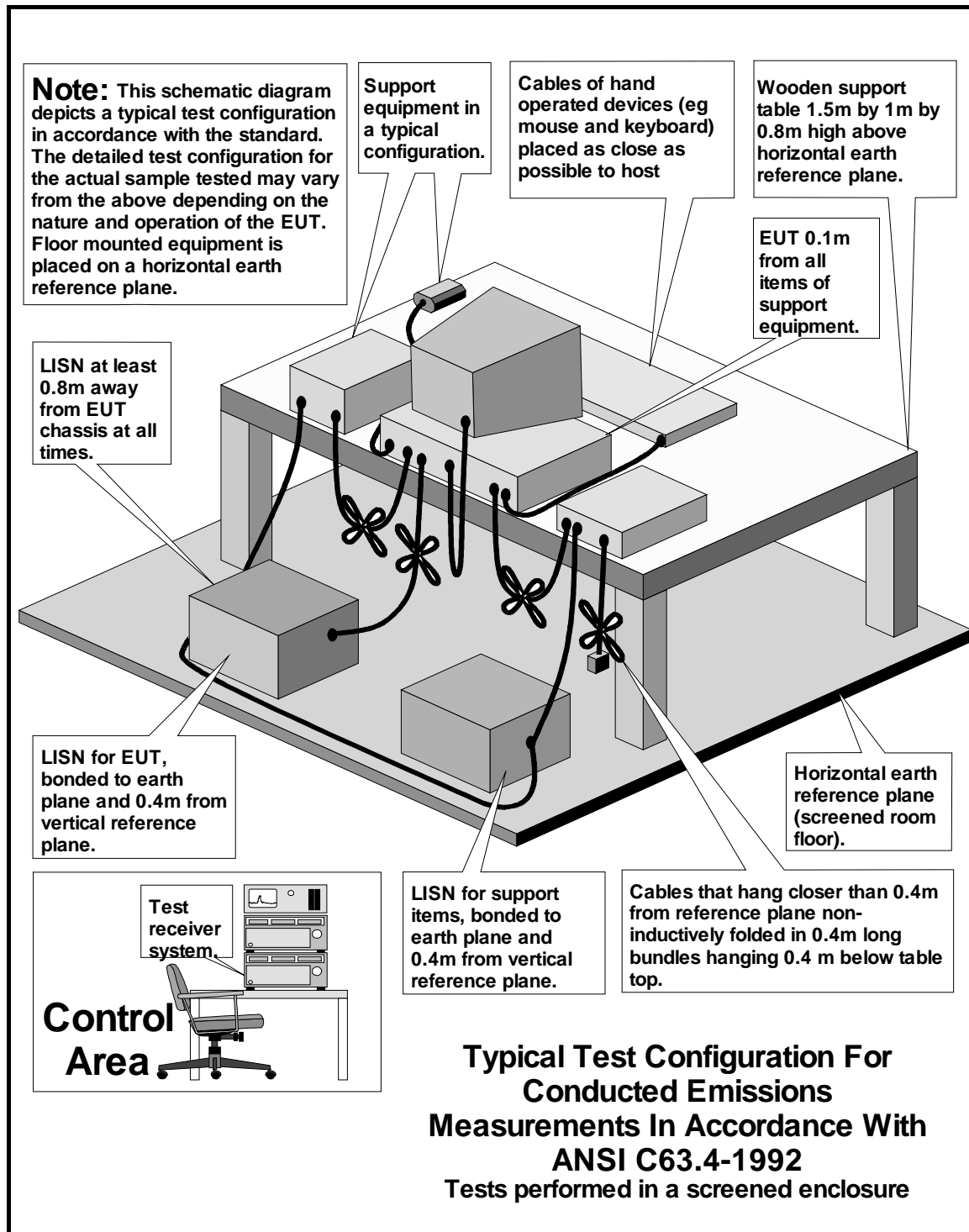
Appendix 2. Test Configuration Drawings

This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\48906JD01A\EMICON	Test configuration for measurement of conducted emissions.
DRG\48906JD01A\EMIRAD	Test configuration for measurement of radiated emissions.

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DRG\48906JD01A\EMIRAD

