



TEST REPORT FROM RADIO FREQUENCY INVESTIGATION LTD.

Test Of: Sendo Ltd.
S601 GSM Mobile Telephone Handset

To: FCC Part 22 and 24

Test Report Serial No:
RFI/MPTB2/RP46027JD01A

Supersedes Test Report Serial No:
RFI/MPTB1/RP46027JD01A

This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director: 	Checked By: Tony Henriques 
Tested By: Adam Miller 	Release Version No: PDF01
Issue Date: 08 July 2004	Test Dates: 26 April 2004 to 21 May 2004

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RADIO FREQUENCY INVESTIGATION LTD

Operations Department

Test Of: Sendo Ltd.

To: S601 GSM Mobile Telephone Handset

FCC Part 22 & 24

TEST REPORT

S.No. RFI/MPTB2/RP46027JD01A

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1. Client Information

Company Name:	Sendo Ltd.
Address:	Hatchford Brook Hatchford Way Sheldon Birmingham B26 3RZ
Contact Name:	Mr M Bailey

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)

Brand Name:	Sendo
Model Name or Number:	S601
Unique Type Identification:	SND601
IMEI Number:	001031000051007
FCC ID Number:	P6PSND601
Country of Manufacture:	China
Date of Receipt:	26 April 2004

2.2. Description Of EUT

The equipment under test is a dual band GSM 850/1900 MHz mobile telephone.

2.3. Modifications Incorporated In EUT

During the course of testing the EUT was not modified.

2.4. Additional Information Related To Testing

Power Supply Requirement:	Internal 3.8 V (nominal) lithium ion battery
Declared Battery End Point Voltage	3.5 VDC (min) to 4.2 VDC (max)
Power Supply Requirement (AC Battery Charger):	Nominal 110 V 60 Hz AC Mains supply
Intended Operating Environment:	Within GSM Network Coverage
Equipment Category:	Portable
Type of Unit:	Transceiver
Interface Ports:	Charger/Personal Handsfree (single port)
Highest Fundamental Frequency	1909.8 MHz
Highest Unintentionally Generated Frequency	1989.9 MHz

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Additional Information Related To Testing (Continued)

GSM 850 Transmit Frequency Range	824 to 849 MHz		
Transmit Channels Tested	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	128	824.2
	Middle	190	836.6
	Top	251	848.8
GSM 850 Receive Frequency Range	869 to 894 MHz		
Receive Channels Tested	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	128	869.2
	Middle	190	881.6
	Top	251	893.8
GSM 850 Maximum Power Output (ERP)	25.9 dBm		
GSM 1900 Transmit Frequency Range	1850 MHz to 1910 MHz		
Transmit Channels Tested	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	512	1850.2
	Middle	660	1879.8
	Top	810	1909.8
GSM 1900 Receive Frequency Range	1930 MHz to 1990 MHz		
Receive Channels Tested	Channel ID	Channel Number	Channel Frequency (MHz)
	Bottom	512	1930.2
	Middle	660	1960.0
	Top	810	1989.8
GSM 850 Maximum Power Output (EIRP)	26.7 dBm		

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2.5. Accessories

The following accessories were supplied with the EUT:

Description:	AC Battery Charger
Brand Name:	Sendo
Part Number:	8D09-02313-20000
Model Number:	DVR-530
Serial Number:	None stated
Country of Manufacture:	China

Description:	Personal Handsfree Kit
Brand Name	Sendo
Part Number:	8P02-02000-21000
Serial Number:	None stated
Country of Manufacture:	China

2.6. Support Equipment

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

Description:	GSM Test Set
Brand Name:	WillTek
Model Name or Number:	42025
Serial Number:	0513018
Connected to Port:	RF Link

Description:	Test Jig (for external DC Supply)
Brand Name:	AI Electronics Ltd.
Model Name or Number:	9JF1-26112-00000
Serial Number:	011
Connected to Port:	Mobile phone internal battery connector

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3. Test Specification, Methods And Procedures

3.1. Test Specifications

Reference:	FCC Part 22 Subpart H: 2003 (Cellular Radiotelephone Service)
Title:	Code of Federal Regulations, Part 22 (47CFR22) Personal Communication Services.
Comments:	A description of the test facility used for this test is on file with, and has been accepted by, the Federal Communications Commission as required by Section 2.948 of Federal Rules.
Purpose of Test:	To determine whether the equipment complied with the requirements of the specification for the purposes of certification.

Reference:	FCC Part 24 Subpart E: 2003 (Broadband PCS)
Title:	Code of Federal Regulations, Part 24 (47CFR24) Personal Communication Services.
Comments:	A description of the test facility used for this test is on file with, and has been accepted by, the Federal Communications Commission as required by Section 2.948 of Federal Rules.
Purpose of Test:	To determine whether the equipment complied with the requirements of the specification for the purposes of certification.

Reference:	FCC Part 15 Subpart B: 2003 (Section 15.107 and 15.109)
Title:	Code of Federal Regulations, Part 15 (47CFR15) Radio Frequency Devices: Radio Frequency Devices.
Comments:	A description of the test facility used for this test is on file with, and has been accepted by, the Federal Communications Commission as required by Section 2.948 of Federal Rules.
Purpose of Test:	To determine whether the equipment complied with the requirements of the specification for the purposes of certification.

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3.2. Methods And Procedures

The methods and procedures used were as detailed in:

ANSI/TIA-603-B-2002

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 (2001)

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.

DA00-705 (2000)

Title: Filing and Frequency Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

3.3. 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

None.

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5. Operation Of The EUT During Testing

5.1. Operating Conditions

The EUT was tested in a normal laboratory environment.

During testing, the EUT was powered by a 3.8 V (nominal) lithium-ion battery connected to a 110 V 60 Hz AC Mains charger.

5.2. Operating Modes

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

Preliminary radiated scans were performed on the EUT with the accessories stated in section 2.5 of this report connected and then disconnected. The combination that exhibited the worst case mode of operation was then used to perform final measurements. In transmit mode this was to be with the EUT powered by its internal battery and with its personal hands free kit connected. In idle mode this was found to be with the EUT powered directly by its AC battery charger.

Transmitter Modes:

For carrier output power, occupied bandwidth and final transmitter radiated measurements, testing was performed at full power on top, middle and bottom channels of the assigned frequency block.

For frequency stability testing, measurements were performed at full power on the top and bottom channels of the assigned frequency block at -30 °C through to +50 °C in 10° increments.

All transmitter radiated spurious pre-scan tests were performed at full power on the top channel of the assigned frequency block. Final measurements were then performed on the top, middle and bottom channels if an emission was identified.

Receiver/Idle Modes:

Testing was performed with the call terminated from the GSM Test Simulator and the phone left in its Idle mode.

5.3. Configuration And Peripherals

The EUT was tested in the following configuration:

Fitted with it's leather case, configured with the AC battery charger connected to the AC mains supply (or personal handsfree kit*)

** The personal handsfree kit was connected to the dual purpose port instead of the AC charger when establishing the worst case mode of operation. After it was confirmed, for idle mode, that the worst case was with the AC charger connected to the EUT, the personal handsfree kit was disconnected as the EUT does not allow both the AC charger and personal handsfree kit to be connected simultaneously. The worst case for transmit mode was with the personal handsfree kit connected, therefore, the AC charger was disconnected in this mode.*

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6. Summary Of Test Results

Part 22

Range Of Measurements	Specification Reference	Port Type	Compliance Status
Idle Mode AC Conducted Spurious Emissions (150 kHz to 30 MHz)	C.F.R. 47 FCC Part 15: 2003 Section 15.107	AC Mains	Complied
Idle Mode Radiated Emissions	C.F.R. 47 FCC Part 15: 2003 Section 15.109	Antenna	Complied
Transmitter Effective Radiated Power (ERP)	C.F.R. 47 FCC Part 22: 2003 Section 22.913(a)	Antenna	Complied
Transmitter Frequency Stability (Temperature Variation)	C.F.R. 47 FCC Part 22: 2003 Section 22.355	Antenna	Complied
Transmitter Frequency Stability (Voltage Variation)	C.F.R. 47 FCC Part 22: 2003 Section 22.355	Antenna	Complied
Transmitter Occupied Bandwidth	C.F.R. 47 FCC Part 22: 2003 Section 2.1049(i)	Antenna	Complied
Transmitter Out of Band Radiated Emissions	C.F.R. 47 FCC Part 22: 2003 Section 2.1053/22.917	Antenna	Complied
Transmitter Band Edge Radiated Emissions	C.F.R. 47 FCC Part 2: 2003 Section 2.1053	Antenna	Complied

Part 24

Range Of Measurements	Specification Reference	Port Type	Compliance Status
Idle Mode AC Conducted Spurious Emissions (150 kHz to 30 MHz)	C.F.R. 47 FCC Part 15: 2003 Section 15.107	AC Mains	Complied
Idle Mode Radiated Spurious Emissions	C.F.R. 47 FCC Part 15: 2003 Section 15.109	Antenna	Complied
Transmitter Effective Isotropic Radiated Power (EIRP)	C.F.R. 47 FCC Part 24: 2003 Section 24.232	Antenna	Complied
Transmitter Frequency Stability (Temperature Variation)	C.F.R. 47 FCC Part 24: 2003 Section 24.235	Antenna	Complied
Transmitter Frequency Stability (Voltage Variation)	C.F.R. 47 FCC Part 24: 2003 Section 24.235	Antenna	Complied
Transmitter Occupied Bandwidth	C.F.R. 47 FCC Part 24: 2003 Section 24.238	Antenna	Complied
Transmitter Out of Band Radiated Emissions	C.F.R. 47 FCC Part 24: 2003 Section 2.1053/24.238	Antenna	Complied
Transmitter Band Edge Radiated Emissions	C.F.R. 47 FCC Part 2: 2003 Section 2.1053/24.238	Antenna	Complied

6.1. Location Of Tests

All the measurements described in this report were performed at the premises of Radio Frequency Investigation Ltd, Ewhurst Park, Ramsdell, Basingstoke, Hampshire, RG26 5RQ, England.

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7. Measurements, Examinations And Derived Results

7.1. General Comments

7.1.1. This section contains test results only.

7.1.2. 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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8. Test Results FCC Part 22

8.1. Idle Mode AC Conducted Spurious Emissions: Section 15.107

8.1.1. The EUT was configured as for AC conducted emissions measurements as described in Section 9 of this report.

8.1.2. Tests were performed to identify the maximum emissions levels on the AC mains line of the EUT.

Results: Quasi-Peak Detector Measurements On Live And Neutral Lines

Frequency (MHz)	Line	Q-P Level (dB μ V)	Q-P Limit (dB μ V)	Margin (dB)	Result
0.15464	Neutral	34.24	65.75	31.51	Complied
0.49853	Neutral	29.21	56.02	26.81	Complied
0.78361	Neutral	21.75	56.00	34.25	Complied
4.67531	Neutral	23.90	56.00	32.10	Complied
10.05082	Neutral	15.27	60.00	44.73	Complied

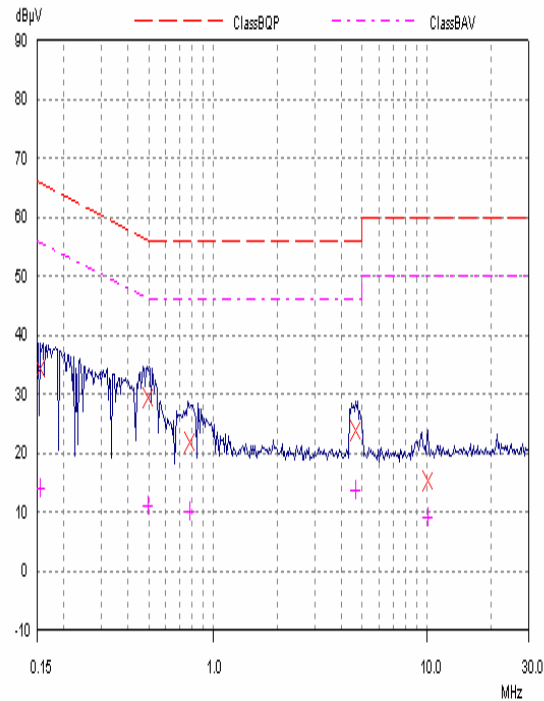
Results: Average Detector Measurements On Live And Neutral Lines

Frequency (MHz)	Line	Av. Level (dB μ V)	Av. Limit (dB μ V)	Margin (dB)	Result
0.15464	Live	13.93	55.75	41.82	Complied
0.49853	Neutral	11.13	46.02	34.89	Complied
0.78361	Neutral	10.12	46.00	35.88	Complied
4.67531	Neutral	13.57	46.00	32.43	Complied
10.05082	Live	9.10	50.00	40.90	Complied

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

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

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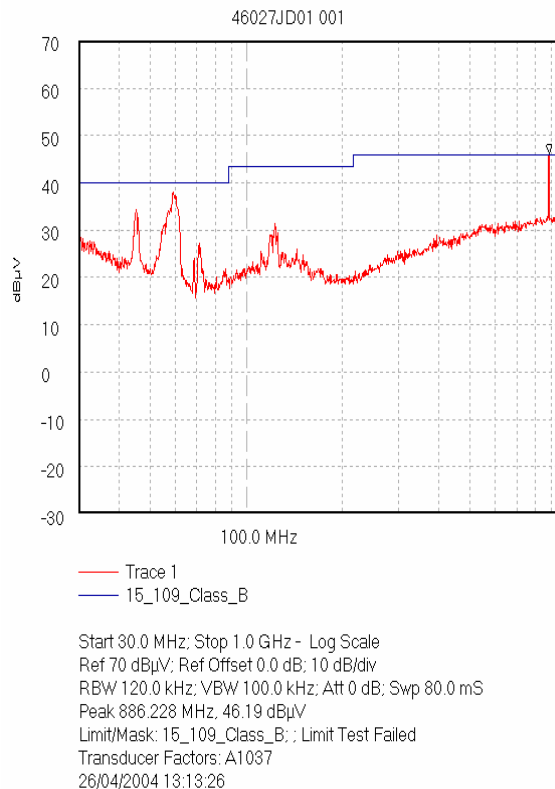
8.2. Idle Mode Radiated Spurious Emissions: Section 15.109

8.2.1. Electric Field Strength Measurements (Frequency Range 30 to 1000 MHz)

8.2.1.1. The EUT was configured as for receiver radiated emissions testing as described in Section 9 of this report.

8.2.1.2. Tests were performed to identify the maximum receiver or standby radiated emissions levels.

Frequency (MHz)	Ant. Pol.	Q-P Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
45.911	Vert.	24.8	40.0	15.2	Complied
58.500	Vert.	25.5	40.0	14.5	Complied
70.913	Vert.	29.0	40.0	11.0	Complied
124.566	Vert.	25.2	43.5	18.3	Complied
143.566	Vert.	24.5	43.5	19.0	Complied



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

Note: the emission shown in the plot at 886.228 MHz emanates from the GSM test set and not the EUT. Because the emission is not from the EUT no level has been recorded in the preceding results table.

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Idle Mode Radiated Spurious Emissions: Section 15.109 (Continued)**8.2.2. Electric Field Strength Measurements (Frequency Range: 1 to 5 GHz)****Highest Peak Level**

Frequency (GHz)	Antenna. Polarity	Peak Detector Level (dBµV)	Antenna Factor	Cable Loss	Actual Peak Level (dBµV/m)	**Average Limit (dBµV/m)	Margin (dB)	Result
*4.630	Vert.	18.2	24.2	1.7	44.1	54.0	9.9	Complied

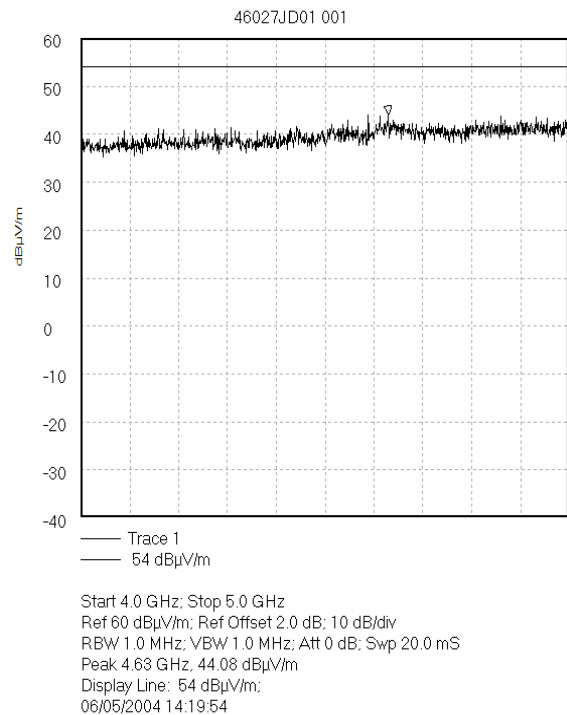
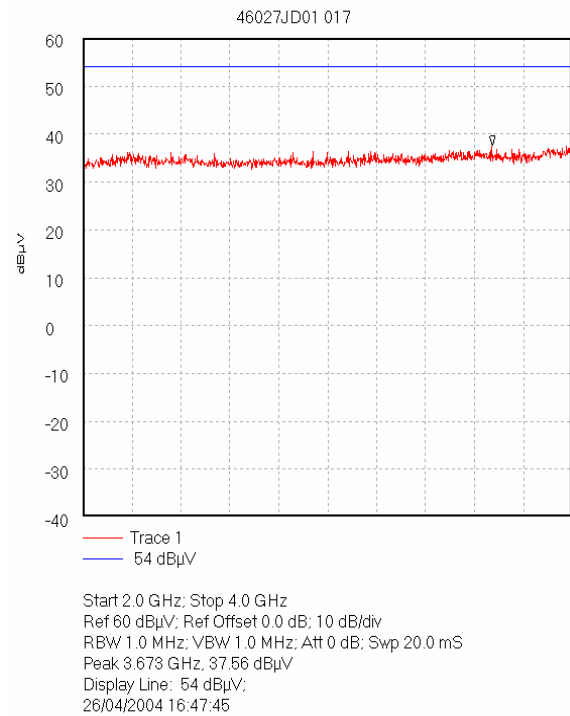
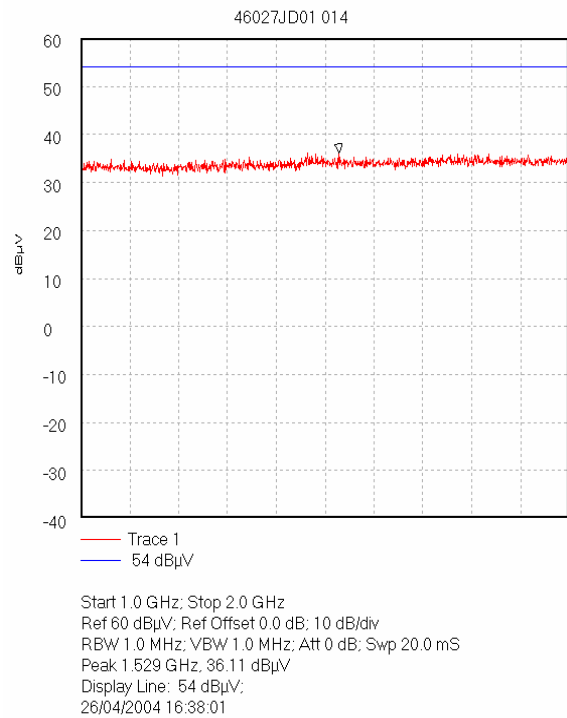
**Note: No spurious emissions were detected above the noise floor of the measuring receiver; therefore, the highest peak noise floor reading of the measuring receiver was recorded as shown in the table above.*

***Note: The peak level was compared to the average limit as opposed to being compared to the peak limit because this is the more onerous limit.*

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Idle Mode Radiated Spurious Emissions: Section 15.109 (Continued)

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

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8.3. Transmitter Effective Radiated Power (ERP): Section 22.913(a)

8.3.1. The EUT was configured as for Effective Radiated Power as described in Section 9 of this report.

8.3.2. Tests were performed to identify the maximum Effective Radiated Power (ERP).

Results:

Channel	Measured Frequency (MHz)	Antenna Polarity	Maximum Transmitter ERP (dBm)	Limit ERP (dBm)	Margin (dB)	Result
Bottom	824.2	Vert.	25.6	38.4	12.8	Complied
Middle	836.6	Vert.	25.9	38.4	12.5	Complied
Top	848.8	Vert.	24.8	38.4	13.6	Complied

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

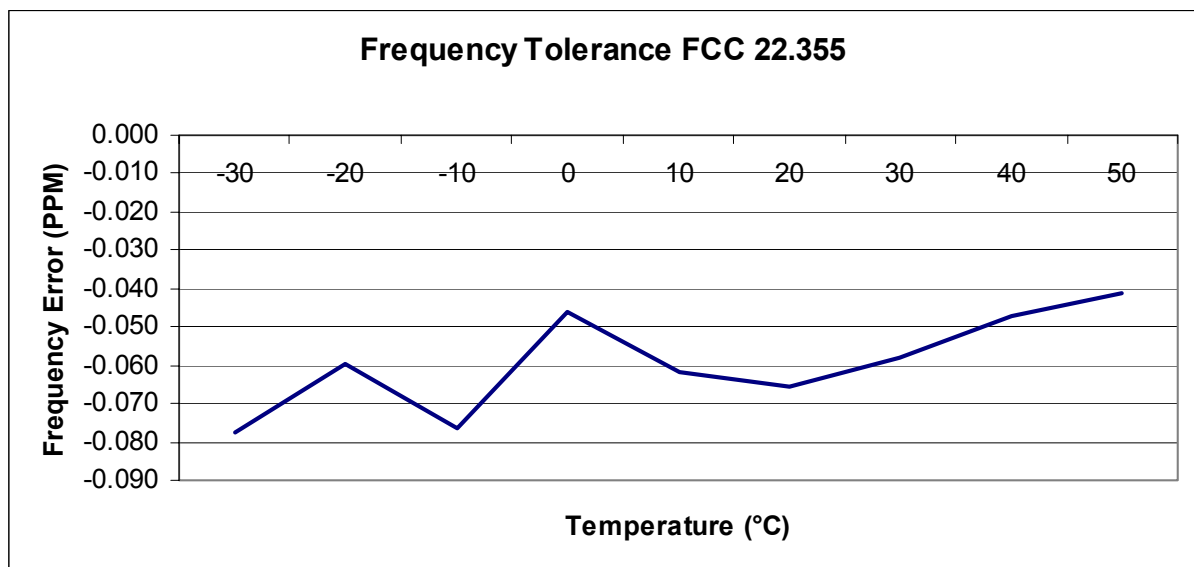
8.4.1. The EUT was configured as for frequency stability measurements as described in Section 9 of this report.

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

Results: Bottom Channel (824.2 MHz)

Temp (°C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
-30	824.199936	-64	0.08	2.5	2.42	Complied
-20	824.199951	-49	0.06	2.5	2.44	Complied
-10	824.199937	-63	0.08	2.5	2.42	Complied
0	824.199962	-38	0.05	2.5	2.45	Complied
10	824.199949	-51	0.06	2.5	2.44	Complied
20	824.199946	-54	0.07	2.5	2.43	Complied
30	824.199952	-48	0.06	2.5	2.44	Complied
40	824.199961	-39	0.05	2.5	2.45	Complied
50	824.199966	-34	0.04	2.5	2.46	Complied

Frequency Variation From 824.2MHz



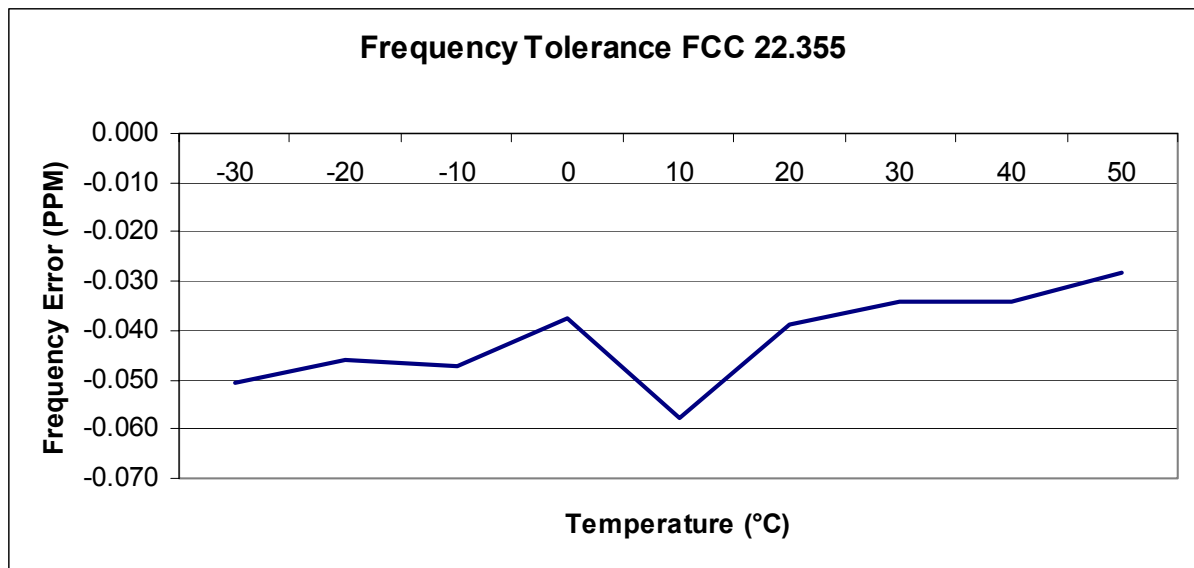
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Transmitter Frequency Stability (Temperature Variation): Section 22.355 (Continued)**Results: Top Channel (848.8 MHz)**

Temp (°C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
-30	848.799957	-43	0.05	2.5	2.45	Complied
-20	848.799961	-39	0.05	2.5	2.45	Complied
-10	848.799960	-40	0.05	2.5	2.45	Complied
0	848.799968	-32	0.04	2.5	2.46	Complied
10	848.799951	-49	0.06	2.5	2.44	Complied
20	848.799967	-33	0.04	2.5	2.46	Complied
30	848.799971	-29	0.03	2.5	2.47	Complied
40	848.799971	-29	0.03	2.5	2.47	Complied
50	848.799976	-24	0.03	2.5	2.47	Complied

Frequency Variation From 848.8MHz

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

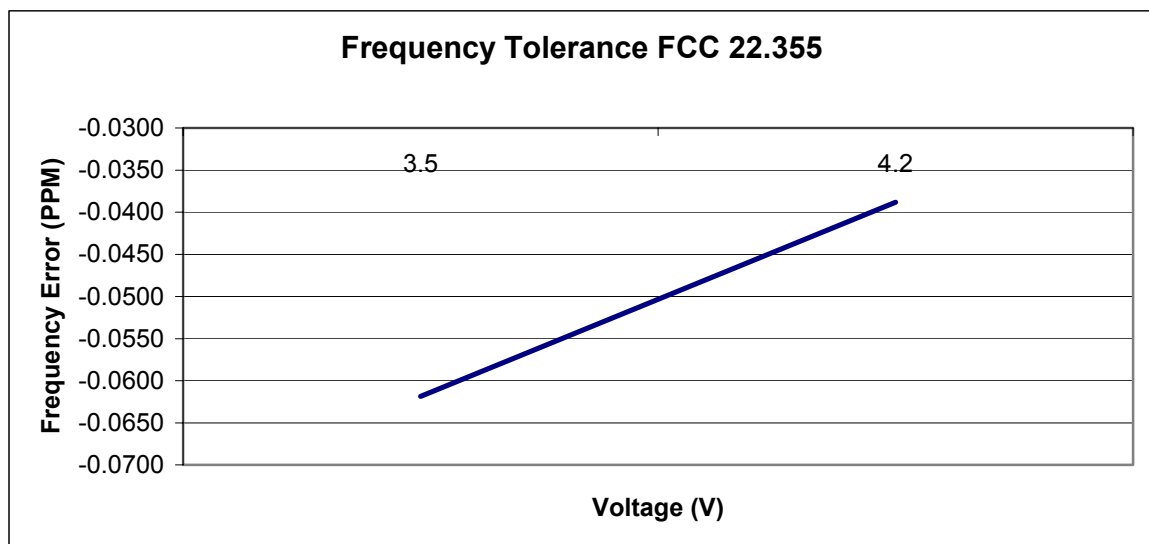
8.5.1. The EUT was configured as for frequency stability measurements as described in Section 9 of this report.

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

Results: Bottom Channel (824.2 MHz)

Supply Voltage (V)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
3.5	824.199949	-51	0.06	2.5	2.44	Complied
4.2	824.199968	-32	0.04	2.5	2.46	Complied

Frequency Variation From 824.2MHz



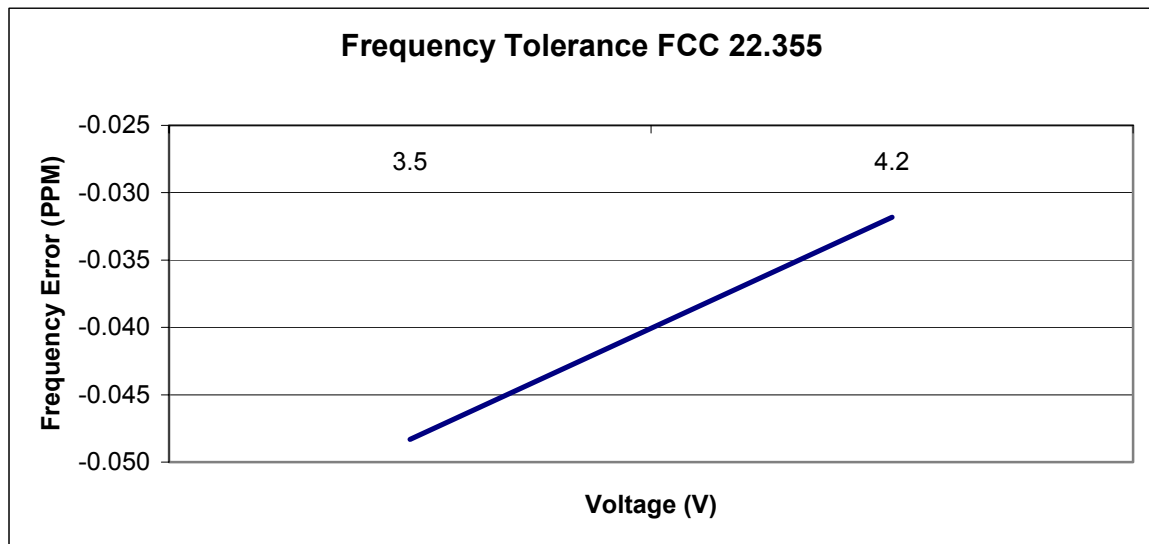
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Transmitter Frequency Stability (Voltage Variation): Section 22.355 (Continued)**Results: Top Channel (848.8 MHz)**

Supply Voltage (V)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
3.5	848.799959	-41	0.05	2.5	2.45	Complied
4.2	848.799973	-27	0.03	2.5	2.47	Complied

Frequency Variation From 848.8 MHz

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8.6. Transmitter Occupied Bandwidth: Section 2.1049

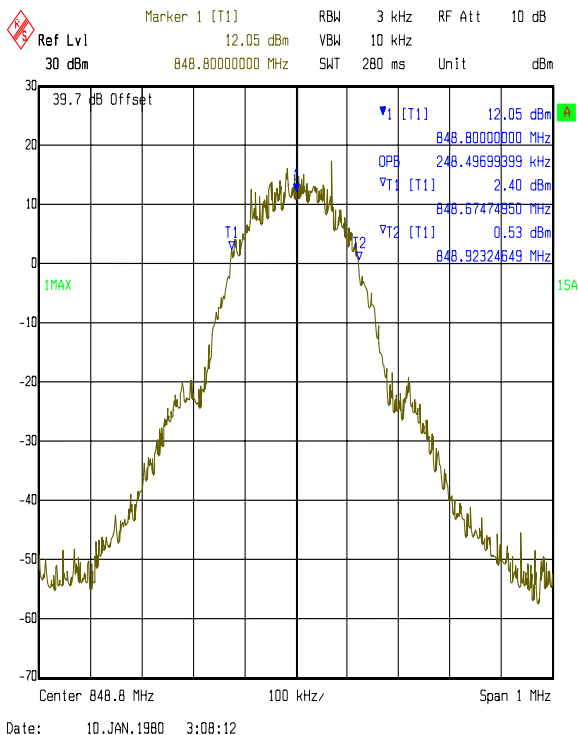
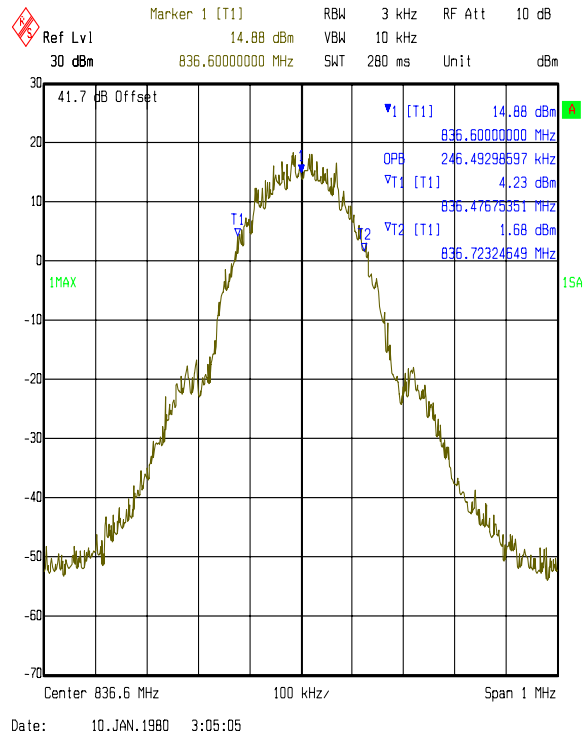
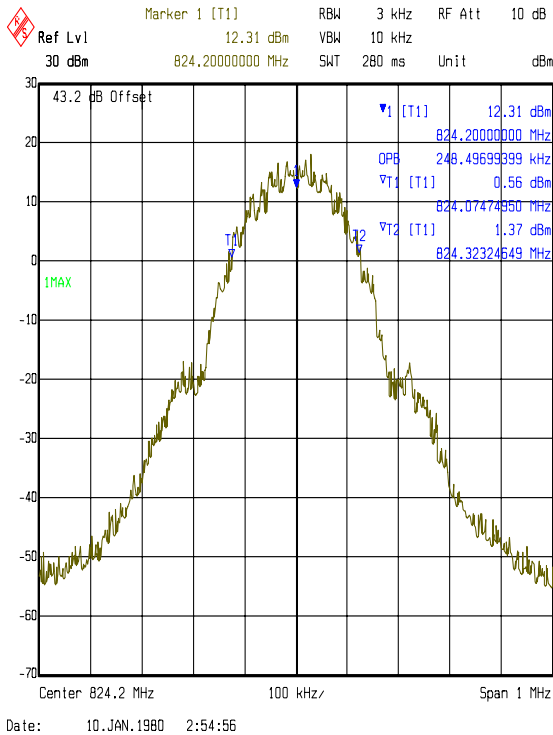
8.6.1. The EUT was configured as for Occupied Bandwidth measurements as described in Section 9 of this report.

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

Results:

Channel	Frequency (MHz)	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (kHz)
Bottom	824.2	3.0	10.0	248.5
Middle	836.6	3.0	10.0	246.5
Top	848.8	3.0	10.0	248.5

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Transmitter Occupied Bandwidth: Section 2.1049 (Continued)

Note: The occupied bandwidth is measured using the internal OBW function of the measurement analyser. The analyser automatically configures the measurement bandwidths to make an accurate measurement. The vital data is reported in the upper right portion of the screen. See attached graphs.

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

8.7.1. The EUT was configured as for transmitter radiated emissions testing as described in Section 9 of this report.

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

Result: Bottom Channel

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1648.320	-35.5	-13.0	22.5	Complied

Result: Middle Channel

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1673.233	-33.3	-13.0	20.3	Complied

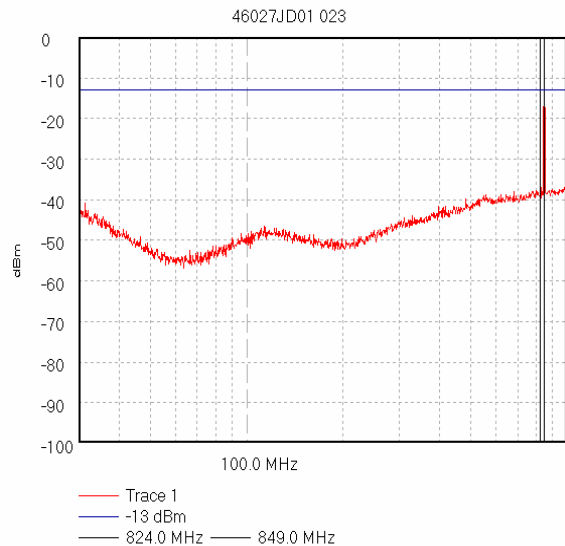
Result: Top Channel

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1697.657	-32.6	-13.0	19.6	Complied

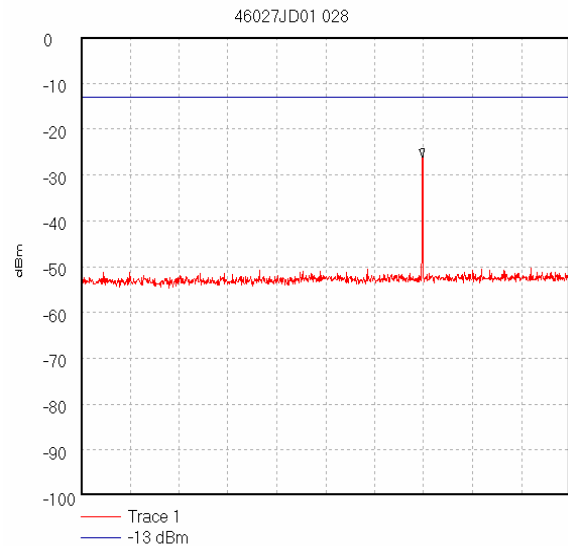
Note: All other emissions were at least 20 dB better than the stated limit.

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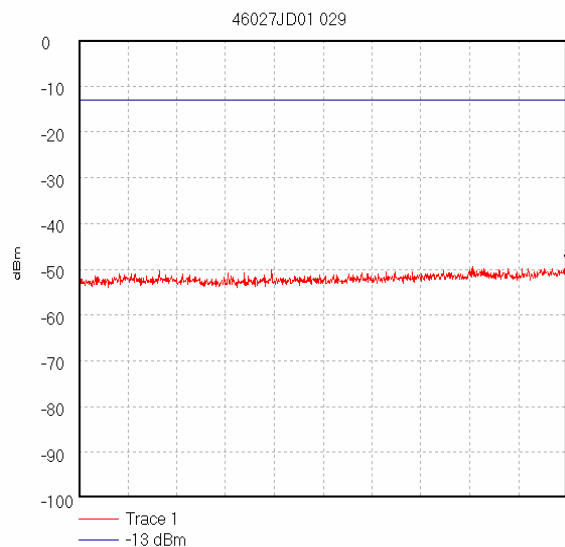
Transmitter Out of Band Emissions: Section 2.1053 & 22.917 (Continued)



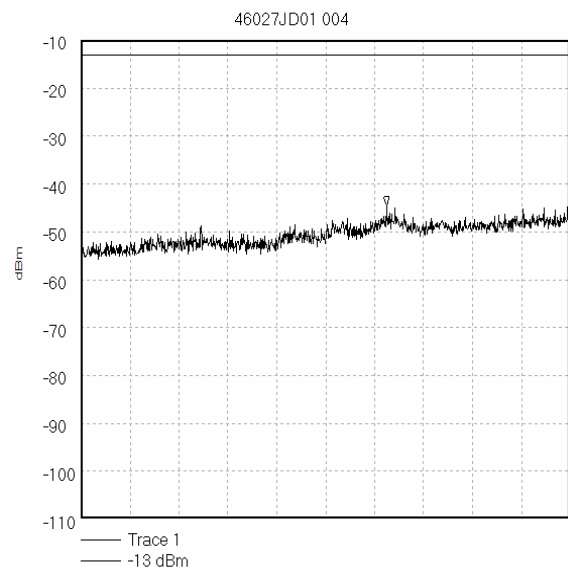
Start 80.0 MHz; Stop 1.0 GHz - Log Scale
Ref 0 dBm; Ref Offset 11.8 dB; 10 dB/div
RBW 120.0 kHz; VBW 100.0 kHz; Att 30 dB; Swp 380.0 mS
Peak 849.048 MHz; 3.98 dBm
Display Line: -13 dBm; Limit Test Failed
Transducer Factors: A1037
28/04/2004 09:56:46



Start 1.0 GHz; Stop 2.0 GHz
Ref 0 dBm; Ref Offset 11.8 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 10 dB; Swp 20.0 mS
Peak 1.698 GHz; -26.23 dBm
Display Line: -13 dBm; Limit Test Passed
Transducer Factors: A1037
28/04/2004 10:50:48



Start 2.0 GHz; Stop 4.0 GHz
Ref 0 dBm; Ref Offset 11.8 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 10 dB; Swp 20.0 mS
Peak 4.0 GHz; -48.78 dBm
Display Line: -13 dBm; Limit Test Passed
Transducer Factors: A1037
28/04/2004 10:56:04



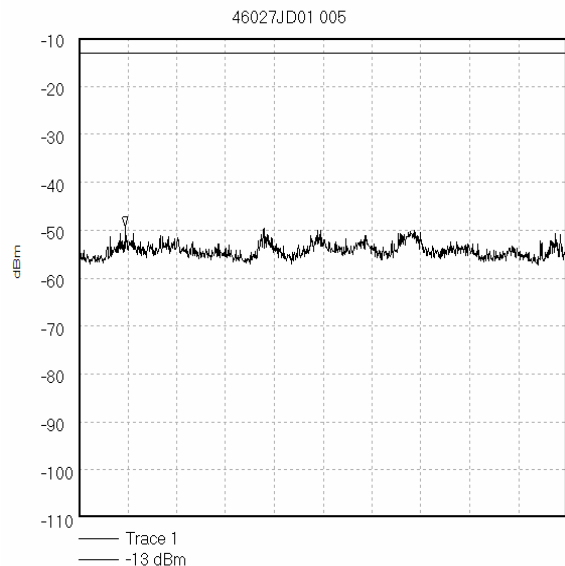
Start 4.0 GHz; Stop 5.0 GHz
Ref -10 dBm; Ref Offset 13.8 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 4.624444 GHz; -44.63 dBm
Display Line: -13 dBm;
06/05/2004 14:25:23

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

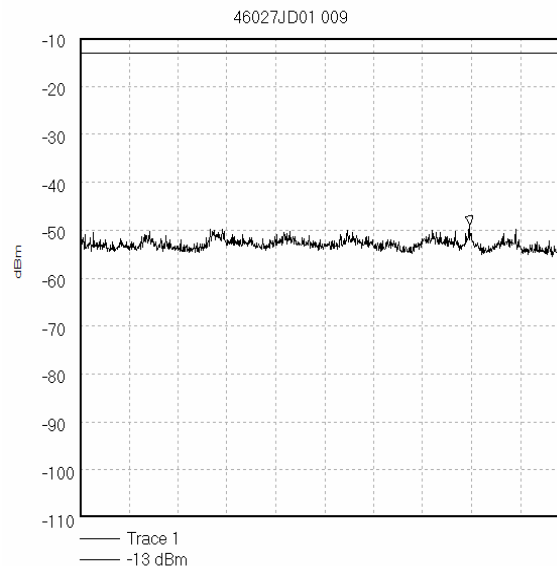
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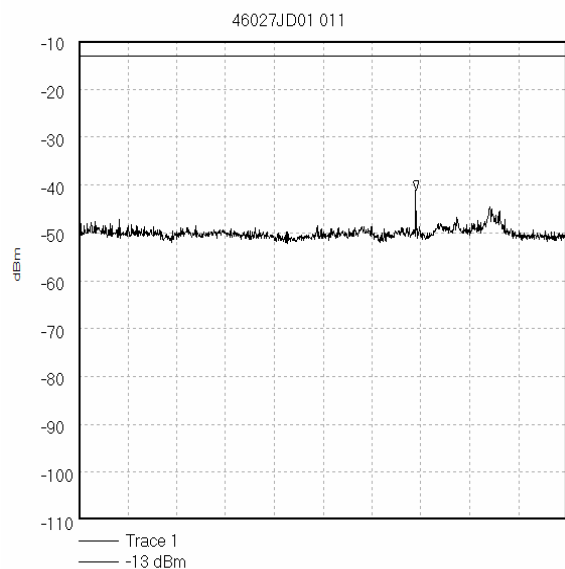
To: FCC Part 22 & 24

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

Start 5.0 GHz; Stop 6.0 GHz
Ref -10 dBm; Ref Offset 13.8 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 5.095556 GHz, -49.3 dBm
Display Line: -13 dBm;
06/05/2004 14:26:53



Start 6.0 GHz; Stop 8.0 GHz
Ref -10 dBm; Ref Offset 14.1 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 7.593333 GHz, -48.95 dBm
Display Line: -13 dBm;
06/05/2004 14:41:00



Start 8.0 GHz; Stop 10.0 GHz
Ref -10 dBm; Ref Offset 14.1 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 9.38 GHz, -41.13 dBm
Display Line: -13 dBm;
06/05/2004 14:50:11

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

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8.8. Transmitter Radiated Emissions At Band Edges: Section 2.1053/22.917

8.8.1. The EUT was configured as for transmitter radiated emissions testing described in Section 9 of this report.

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

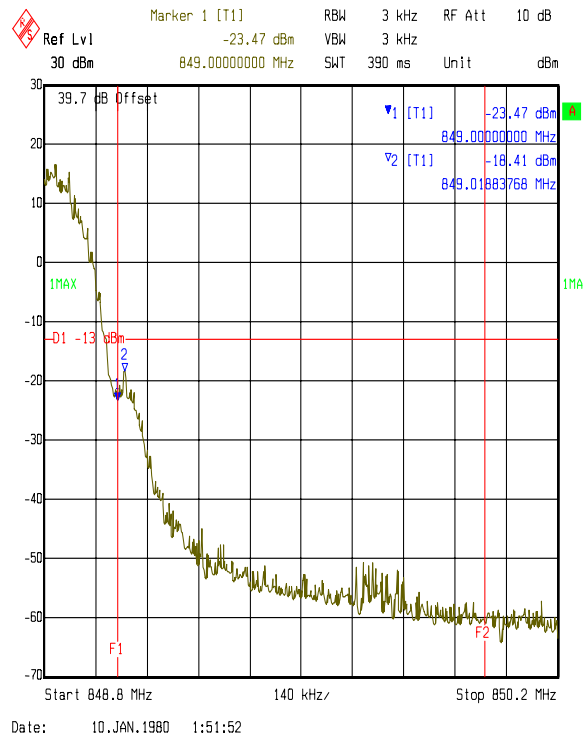
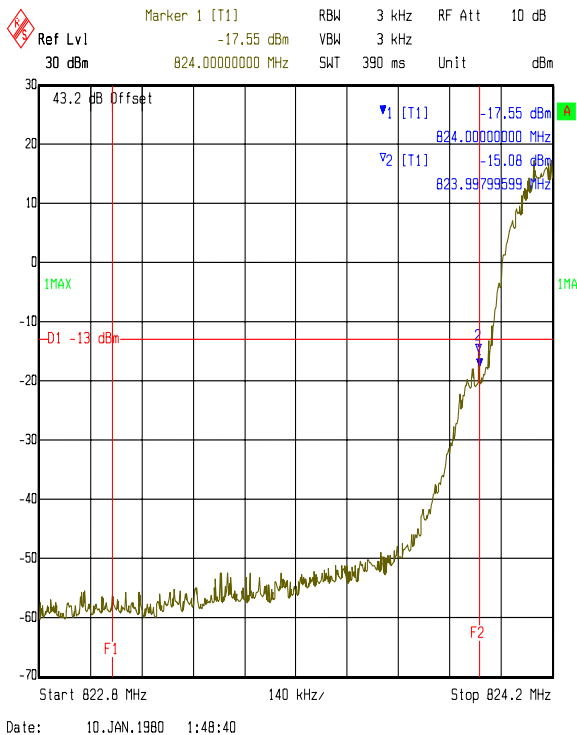
Results:

Bottom Band Edge

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
824	-17.6	-13.0	4.6	Complied

Top Band Edge

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
849	-23.5	-13.0	10.5	Complied



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9. Measurement Methods – Part 22

9.1. Effective Radiated Power (ERP)

ERP measurements were performed in accordance with the standard, against appropriate limits.

The ERP was measured with the EUT arranged on a non-conducting turn table on a standard test site compliant with ANSI C63.4 – 2001 Clause 5.4. The transmitter was fitted with an integral antenna; as such all radiated tests were performed with the unit operating into the integral antenna.

The level of the ERP was measured using a spectrum analyser.

The test antenna was positioned in the horizontal plane. The EUT was oriented in the X plane. The test antenna was then raised and lowered until a maximum peak was observed. The turntable was then rotated through 360 degrees and the maximum peak reading obtained. The height search was then repeated to take into consideration the new angular position of the turntable. The maximum reading observed was then recorded. This procedure was then repeated with the EUT oriented in the Y and Z planes. The highest reading taken in all 3 planes was recorded. The entire procedure was then repeated with the test antenna set in the Vertical polarity.

Once the final amplitude (maximised) had been obtained, the EUT was substituted with a substitution antenna. For ERP measurements a dipole antenna was used. 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 ERP was calculated as:-

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

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Effective Radiated Power (ERP) (Continued)

Circumstances where the signal generator could not produce the desired power substitution was performed with the signal generator set to 0 dBm. The radiated signal was maximised as previously described. The level indicated on the measuring receiver was noted. The delta between this level and the maximum level for the EUT was calculated and also noted. The ERP of the signal generator was calculated using the above formulae. The recorded delta was added to the calculated ERP to obtain the substituted EUT ERP.

$$\text{Delta (dB)} = \text{EUT} - \text{SG}$$

Where :

EUT = spectrum analyser indicated EUT raw level

SG = spectrum analyser indicated signal generator raw level

The signal generator actual ERP is calculated as:

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

The EUT ERP is calculated as:

$$\text{ERP EUT} = \text{ERP SG} + \text{Delta.}$$

The test equipment settings for ERP measurements were as follows:

Receiver Function	Setting
Detector Type:	Peak
Mode:	Not applicable
Bandwidth:	$\geq$ Emission Bandwidth
Amplitude Range:	100 dB
Sweep Time:	Coupled

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9.2. FCC Part 2.1055: Frequency Stability

The EUT was situated within an environmental test chamber and connected to the GSM test set via an air link.

Measurements were performed with the EUT operating under extremes of temperature in 10 degree increments within the range –30 to 50 degrees 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 an air link.

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.

As the EUT is a PCS phone, no modulation input port was available. A call was thus set up using the PCS/GSM simulator and using normal modulation. The Occupied Bandwidth was measured in this configuration.

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. AC Mains Conducted Emissions

AC mains conducted emissions 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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9.5. Transmitter Radiated Emissions

Radiated emissions 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 20dB of this limit were measured where possible, on occasion; the receiver noise floor came within the 20dB 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 6dB 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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9.6. Receiver Radiated Emissions

Radiated emissions 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 5 times the highest unintentionally generated frequency were performed within a screened chamber in order to identify frequencies on which the EUT was generating interference. This determined the frequencies from the EUT which required further examination. In order to minimise the time taken for the swept measurements, a peak detector was used in conjunction with the appropriate detector measuring bandwidth (see table below). 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. Levels within 20dB of this limit were measured where possible, on occasion, the receiver noise floor came within the 20dB 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 Quasi-Peak detector was used for measurements below 1000 MHz, for measurements above 1000 MHz average and peak detectors were used.

For the final measurements the EUT was arranged on a non-conducting turn table on a standard test site compliant with ANSI C63.4 – 2001 Clause 5.4.

On the open area test site, at each frequency where a signal was found, 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 horizontal 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 vertical polarisation.

The final field strength was determined as the indicated level in dB μ V plus cable loss and antenna factor.

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

Receiver Function	Initial Scan	Final Measurements Below 1GHz	Final Measurements Above 1 GHz
Detector Type:	Peak	Quasi-Peak (CISPR)	Peak/Average
Mode:	Max Hold	Not applicable	Not applicable
Bandwidth:	(120 kHz < 1GHz) (1MHz > 1GHz)	120 kHz	1 MHz (If Applicable)
Amplitude Range:	60 dB	20 dB	20 dB (typical)
Step Size:	Continuous sweep	Not applicable	Not applicable
Sweep Time:	Coupled	Not applicable	Not applicable

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10. Test Results FCC Part 24

10.1. Idle Mode AC Conducted Spurious Emissions: Section 15.107

10.1.1. The EUT was configured as for AC conducted emissions measurements as described in Section 11 of this report.

10.1.2. Tests were performed to identify the maximum emissions levels on the AC mains line of the EUT.

Results: Quasi-Peak Detector Measurements On Live And Neutral Lines

Frequency (MHz)	Line	Q-P Level (dB μ V)	Q-P Limit (dB μ V)	Margin (dB)	Result
0.16008	Neutral	31.98	65.46	33.48	Complied
0.46866	Neutral	27.28	56.54	29.26	Complied
0.80632	Neutral	19.38	56.00	36.62	Complied
4.43267	Live	23.47	56.00	32.53	Complied
8.99338	Neutral	15.65	60.00	44.35	Complied

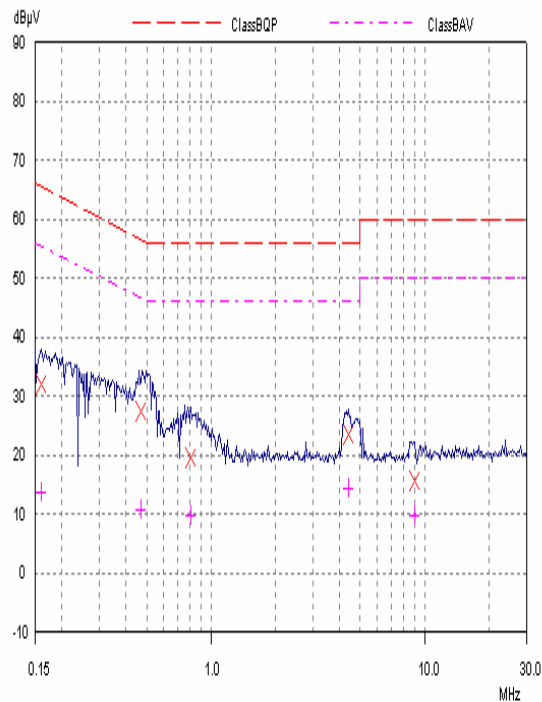
Results: Average Detector Measurements On Live And Neutral Lines

Frequency (MHz)	Line	Av. Level (dB μ V)	Av. Limit (dB μ V)	Margin (dB)	Result
0.16008	Neutral	13.47	55.46	41.99	Complied
0.46866	Neutral	10.75	46.54	35.79	Complied
0.80632	Neutral	9.68	46.00	36.32	Complied
4.43267	Neutral	14.23	46.00	31.77	Complied
8.99338	Neutral	9.71	50.00	40.29	Complied

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

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

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10.2. Idle Mode Radiated Spurious Emissions: Section 15.109

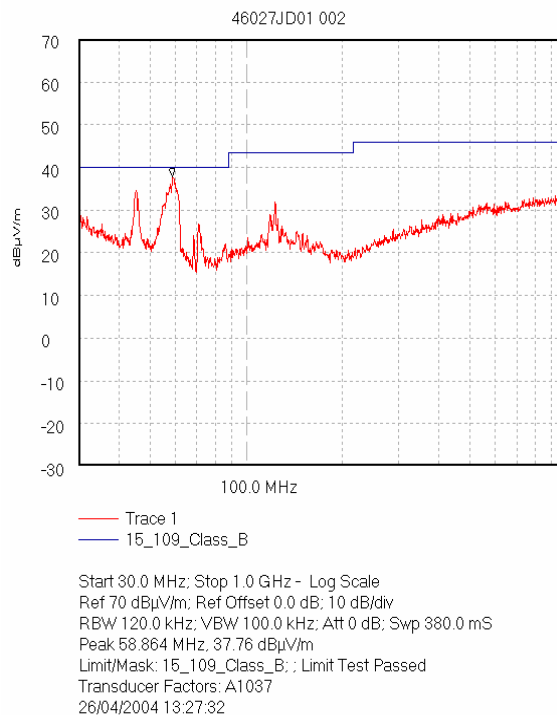
10.2.1. Electric Field Strength Measurements (Frequency Range: 30 to 1000 MHz)

10.2.1.1. The EUT was configured as for receiver radiated emissions testing as described in Section 11 of this report.

10.2.1.2. Tests were performed to identify the maximum receiver or standby radiated emissions levels.

Result:

Frequency (MHz)	Ant. Pol.	Q-P Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
45.190	Vert.	26.4	40.0	13.6	Complied
60.127	Vert.	25.2	40.0	14.8	Complied
70.913	Vert.	29.0	40.0	11.0	Complied
122.880	Vert.	25.0	43.5	18.5	Complied



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

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Idle Mode Radiated Emissions: Section 15.109 (Continued)**10.2.2. Electric Field Strength Measurements (Frequency Range: 1 to 10 GHz)****Highest Peak Level**

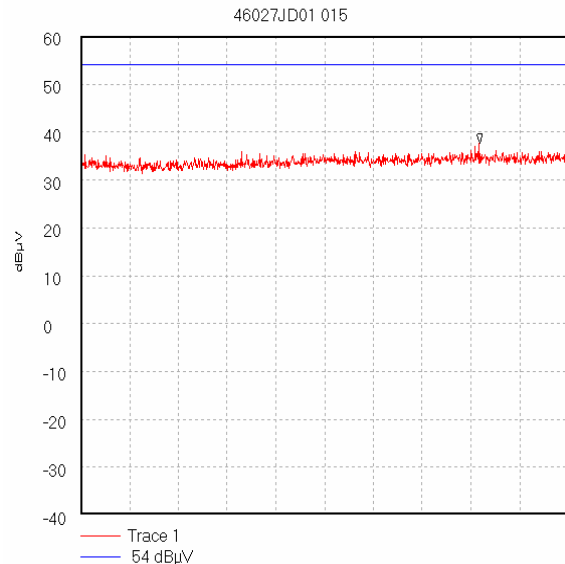
Frequency (GHz)	Antenna. Polarity	Peak Detector Level (dBµV)	Antenna Factor	Cable Loss	Actual Peak Level (dBµV/m)	**Average Limit (dBµV/m)	Margin (dB)	Result
*4.605556	Vert.	18.7	24.2	1.7	44.6	54.0	9.4	Complied

**Note: No spurious emissions were detected above the noise floor of the measuring receiver; therefore, the highest peak noise floor reading of the measuring receiver was recorded as shown in the table above.*

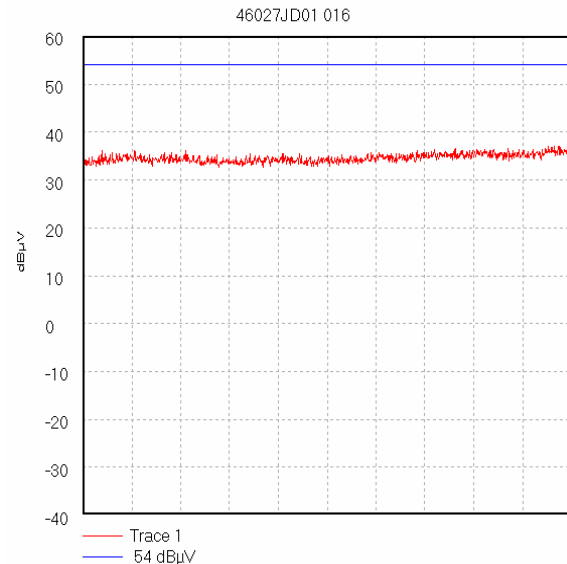
***Note: The peak level was compared to the average limit as opposed to being compared to the peak limit because this is the more onerous limit.*

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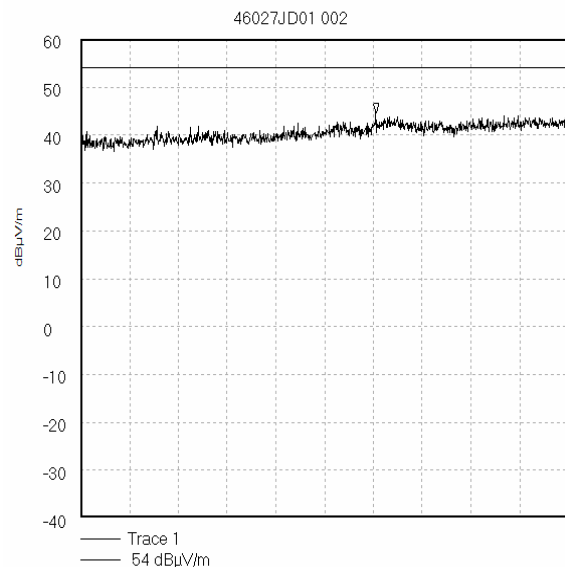
Idle Mode Radiated Emissions: Section 15.109 (Continued)



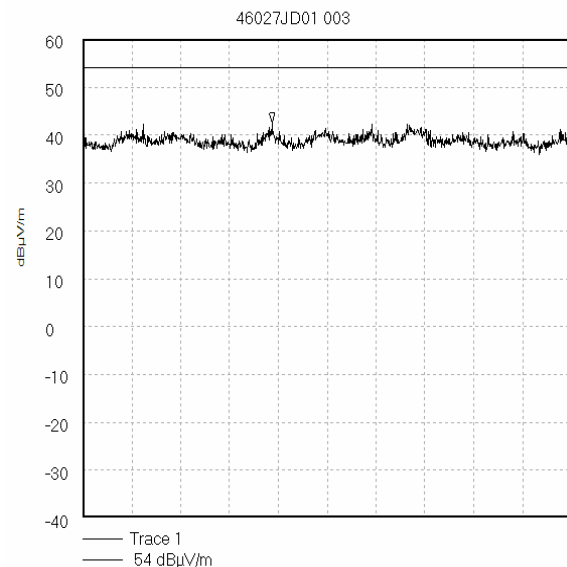
Start 1.0 GHz; Stop 2.0 GHz
Ref 60 dBμV; Ref Offset 0.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 1.818 GHz, 37.61 dBμV
Display Line: 54 dBμV;
26/04/2004 16:40:05



Start 2.0 GHz; Stop 4.0 GHz
Ref 60 dBμV; Ref Offset 0.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 4.0 GHz, 37.4 dBμV
Display Line: 54 dBμV;
26/04/2004 16:45:27



Start 4.0 GHz; Stop 5.0 GHz
Ref 60 dBμV/m; Ref Offset 2.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 4.60556 GHz, 44.59 dBμV/m
Display Line: 54 dBμV/m;
06/05/2004 14:21:01

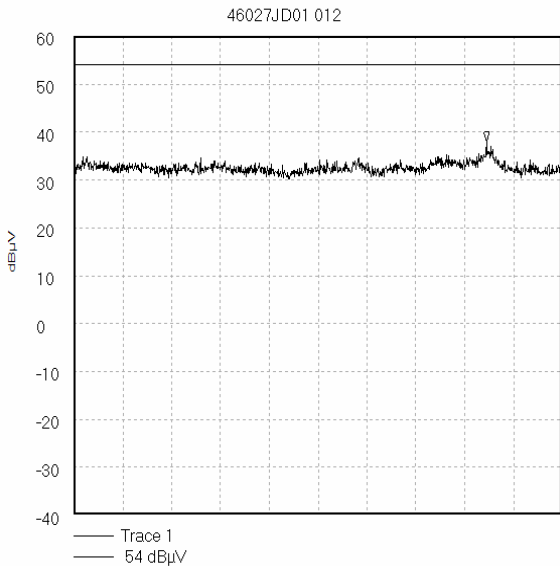
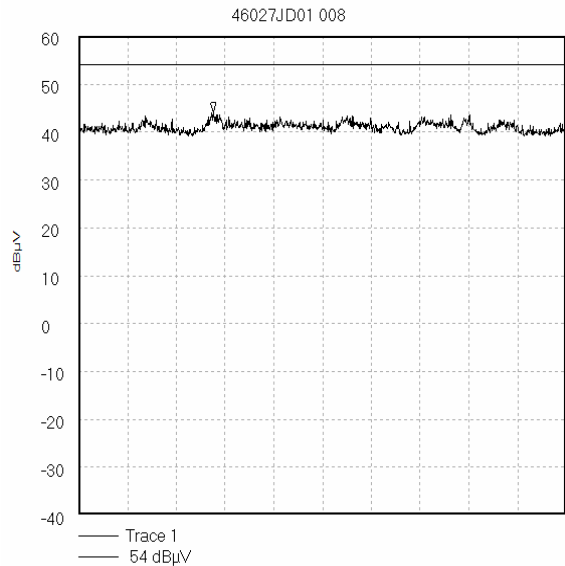


Start 5.0 GHz; Stop 6.0 GHz
Ref 60 dBμV/m; Ref Offset 2.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 5.38778 GHz, 42.58 dBμV/m
Display Line: 54 dBμV/m;
06/05/2004 14:21:38

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

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Idle Mode Radiated Emissions: Section 15.109 (Continued)



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

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10.3. Transmitter Effective Isotropic Radiated Power (EIRP): Section 24.232

10.3.1. The EUT was configured as for Effective Isotropic Radiated Power as described in Section 11 of this report.

10.3.2. Tests were performed to identify the maximum Effective Isotropic Radiated Power (EIRP).

Results:

Channel	Measured Frequency (MHz)	Antenna Polarity	Maximum Transmitter EIRP (dBm)	Limit EIRP (dBm)	Margin (dB)	Result
Bottom	1850.2	Vert.	22.9	33.0	10.1	Complied
Middle	1879.8	Vert.	24.6	33.0	8.4	Complied
Top	1909.8	Vert.	26.7	33.0	6.3	Complied

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10.4. Transmitter Frequency Stability (Temperature Variation): Section 24.235

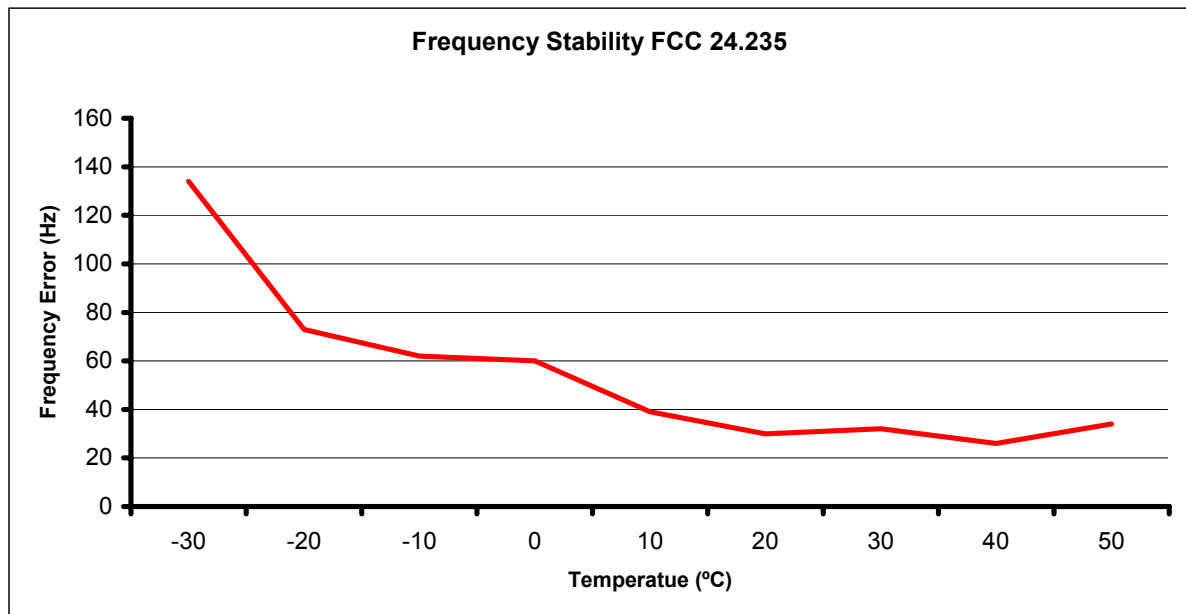
10.4.1. The EUT was configured as for frequency stability measurements as described in Section 11 of this report.

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

Results Bottom Channel (1850.2 MHz)

Temp (°C)	Frequency Error (Hz)	Measured Frequency (MHz)	Lower Band Edge Limit (MHz)	Margin (MHz)	Result
-30	134	1850.200134	1850.0	0.200134	Complied
-20	73	1850.200073	1850.0	0.200073	Complied
-10	62	1850.200062	1850.0	0.200062	Complied
0	60	1850.200060	1850.0	0.200060	Complied
10	39	1850.200039	1850.0	0.200039	Complied
20	30	1850.200030	1850.0	0.200030	Complied
30	32	1850.200032	1850.0	0.200032	Complied
40	26	1850.200026	1850.0	0.200026	Complied
50	34	1850.200034	1850.0	0.200034	Complied

Frequency Variation From 1850.2 MHz



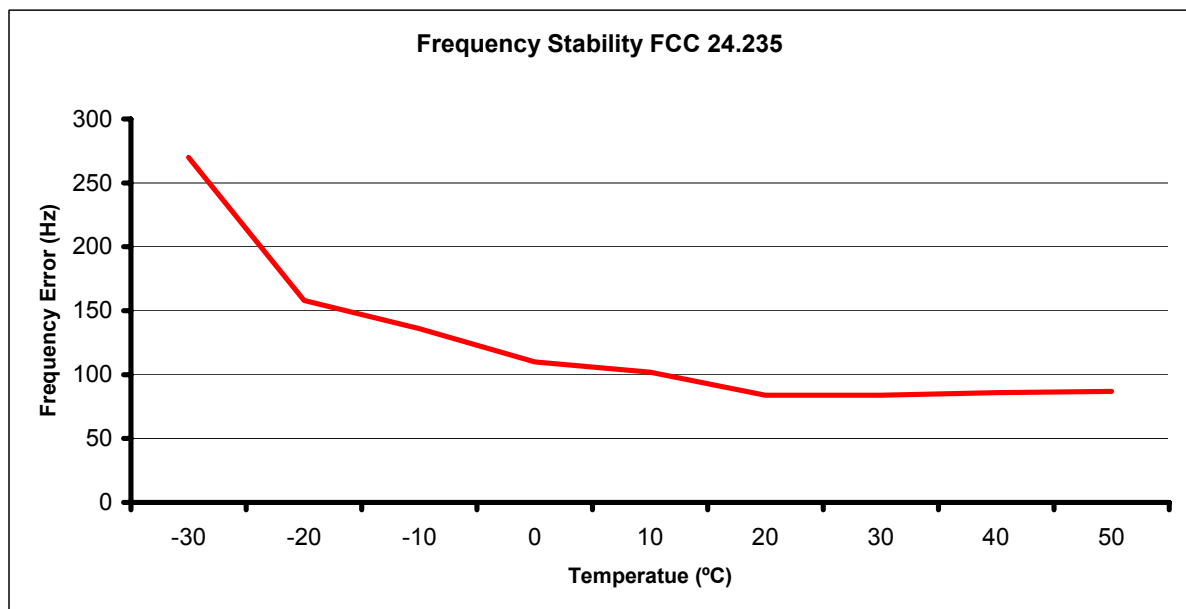
Test Of: Sendo Ltd.

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Transmitter Frequency Stability (Temperature Variation): Section 24.235
(Continued)**Results Top Channel (1909.8 MHz)**

Temp (°C)	Frequency Error (Hz)	Measured Frequency (MHz)	Upper Band Edge Limit (MHz)	Margin (MHz)	Result
-30	270	1909.800270	1910.0	0.199730	Complied
-20	158	1909.800158	1910.0	0.199842	Complied
-10	136	1909.800136	1910.0	0.199864	Complied
0	110	1909.800110	1910.0	0.199890	Complied
10	102	1909.800102	1910.0	0.199898	Complied
20	84	1909.800084	1910.0	0.199916	Complied
30	84	1909.800084	1910.0	0.199916	Complied
40	86	1909.800086	1910.0	0.199914	Complied
50	87	1909.800087	1910.0	0.199913	Complied

Frequency Variation From 1909.8 MHz

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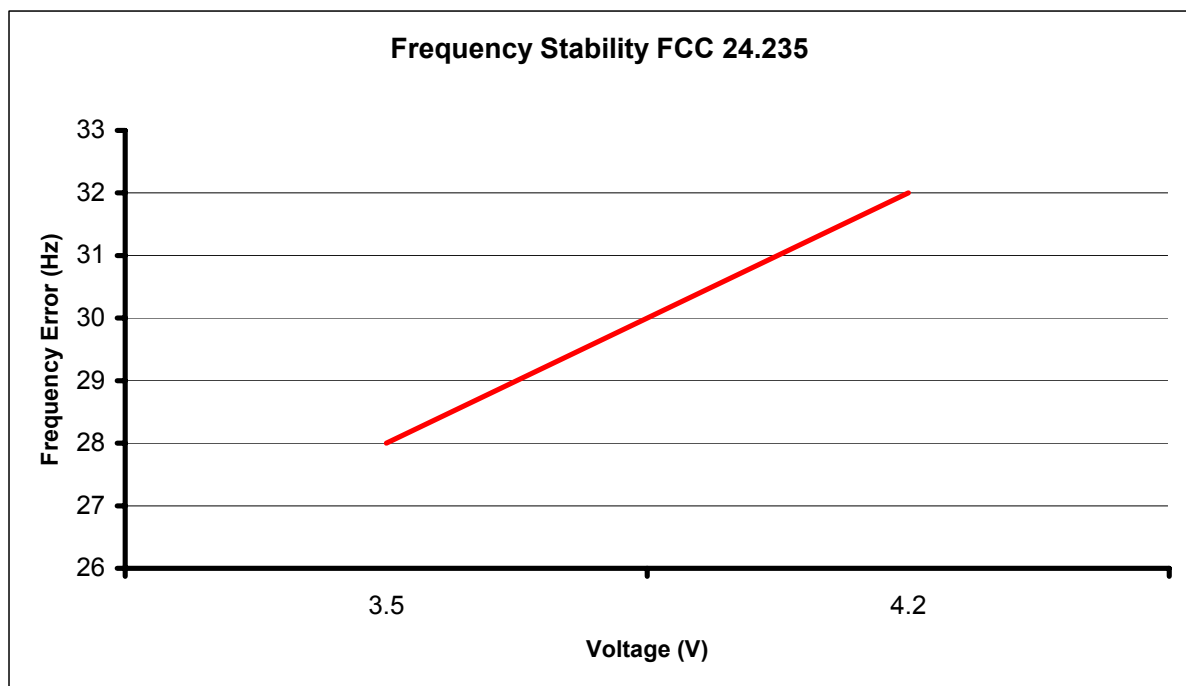
10.5. Transmitter Frequency Stability (Voltage Variation): Section 24.235

10.5.1. The EUT was configured as for frequency stability measurements as described in Section 11 of this report.

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

Results Bottom Channel (1850.2 MHz)

Supply Voltage (V)	Frequency Error (Hz)	Measured Frequency (MHz)	Lower Band Edge Limit (MHz)	Margin (MHz)	Result
3.5	28	1850.200028	1850	0.200028	Complied
4.2	32	1850.200032	1850	0.200032	Complied

Frequency Variation From 1850.2 MHz

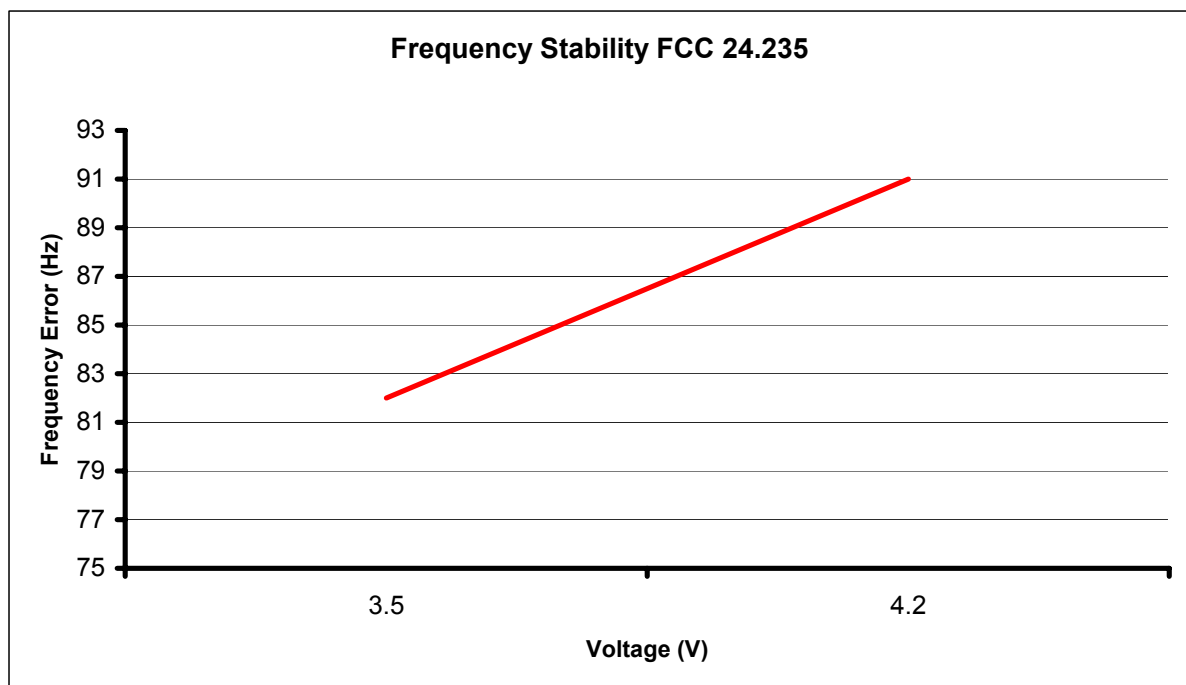
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Transmitter Frequency Stability (Voltage Variation): Section 24.235 (Continued)**Results Top Channel (1909.8 MHz)**

Supply Voltage (V)	Frequency Error (Hz)	Measured Frequency (MHz)	Lower Band Edge Limit (MHz)	Margin (MHz)	Result
3.5	82	1909.800082	1910	0.199918	Complied
4.2	91	1909.800091	1910	0.199909	Complied

Frequency Variation From 1909.8 MHz

Test Of: Sendo Ltd.

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10.6. Transmitter Occupied Bandwidth: Section 24.238

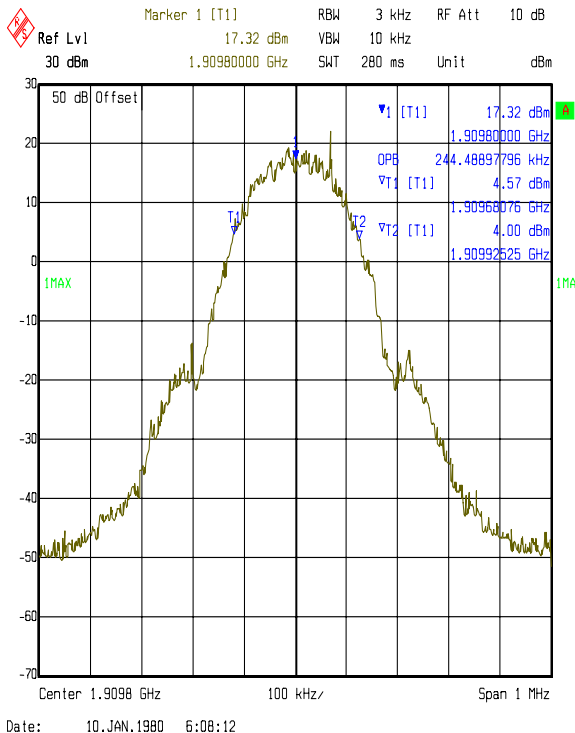
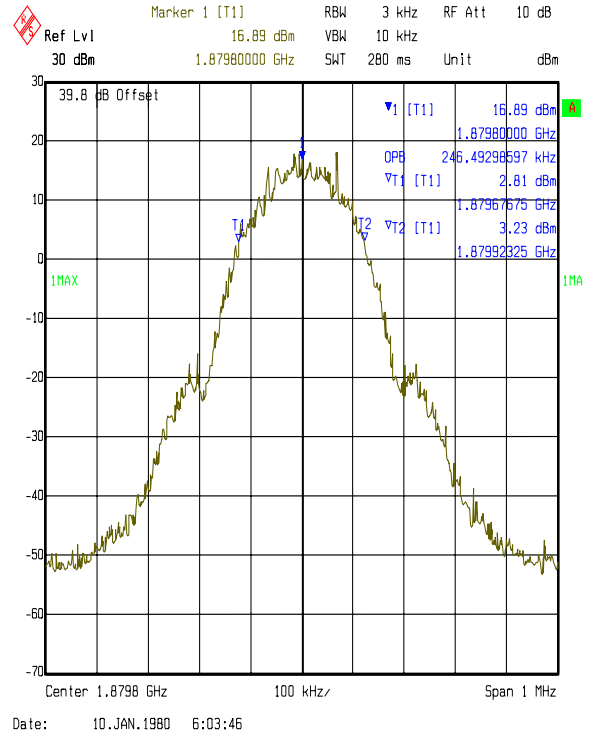
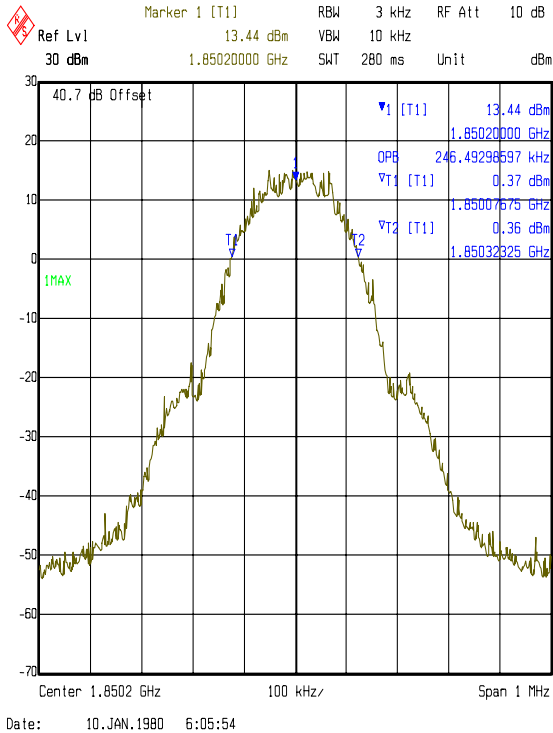
10.6.1. The EUT was configured as for Occupied Bandwidth measurements as described in Section 11 of this report.

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

Results:

Channel	Frequency (MHz)	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (kHz)
Bottom	1850.2	3.0	10.0	246.5
Middle	1879.8	3.0	10.0	246.5
Top	1909.8	3.0	10.0	244.5

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Transmitter Occupied Bandwidth: Section 24.238 (Continued)

Note: The occupied bandwidth is measured using the internal OBW function of the measurement analyser. The analyser automatically configures the measurement bandwidths to make an accurate measurement. The vital data is reported in the upper right portion of the screen. See attached graphs.

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10.7. Transmitter Out of Band Radiated Emissions: Section 2.1053/24.238

10.7.1. The EUT was configured as for transmitter radiated emissions testing as described in Section 11 of this report.

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

Result: Bottom Channel

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3700.768	-34.6	-13.0	21.6	Complied

Result: Middle Channel

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3759.686	-29.5	-13.0	16.5	Complied

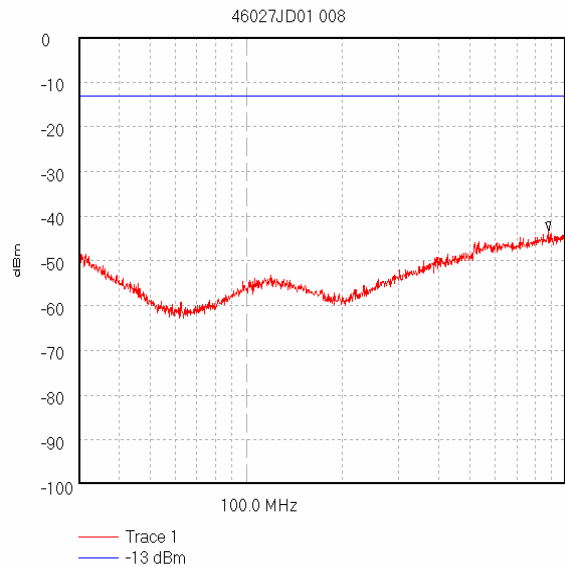
Result: Top Channel

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3819.877	-30.6	-13.0	17.6	Complied

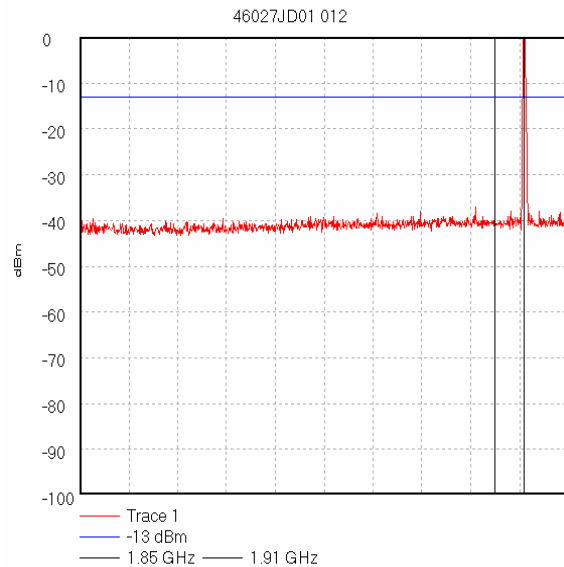
Note: All other emissions were at least 20 dB better than the stated limit.

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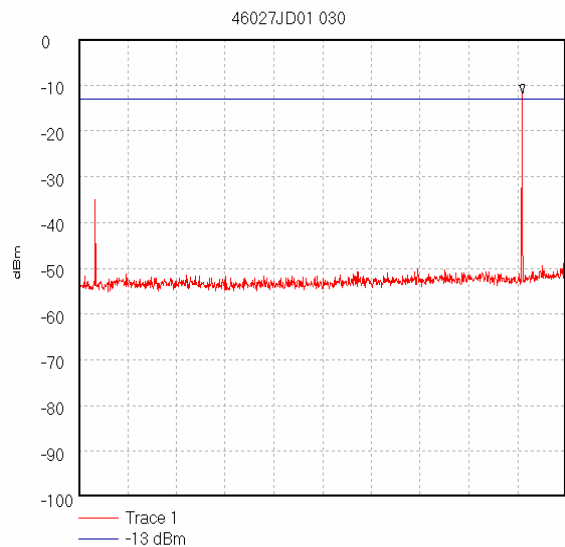
Transmitter Out of Band Radiated Emissions: Section 2.1053/24.238 (Continued)



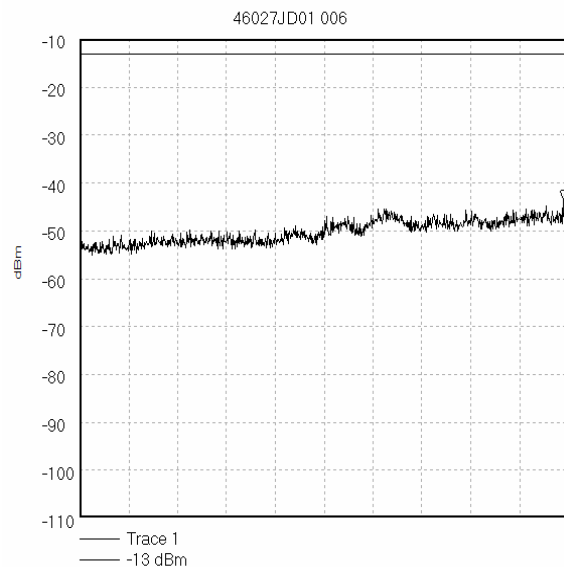
Start 30.0 MHz; Stop 1.0 GHz - Log Scale
Ref 0 dBm; Ref Offset 11.8 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 10 dB; Swp 20.0 mS
Peak 879.348544 MHz; -43.21 dBm
Display Line: -13 dBm; Limit Test Passed
26/04/2004 15:20:36



Start 1.0 GHz; Stop 2.0 GHz
Ref 0 dBm; Ref Offset 11.8 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 20.0 mS
Peak 1.91 GHz; -3.98 dBm
Display Line: -13 dBm;
26/04/2004 16:03:36



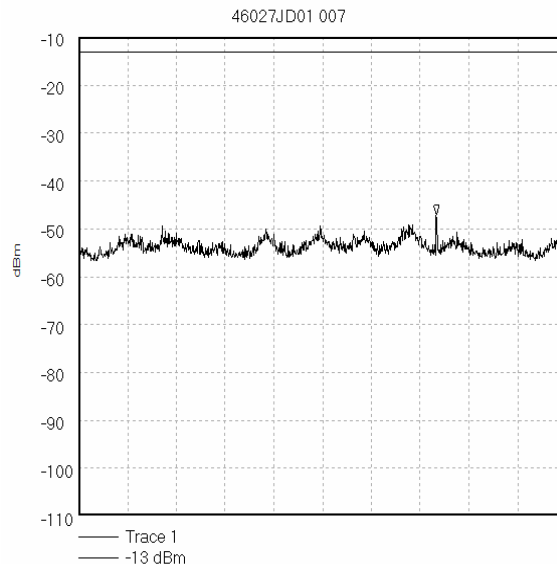
Start 2.0 GHz; Stop 4.0 GHz
Ref 0 dBm; Ref Offset 11.8 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 10 dB; Swp 20.0 mS
Peak 3.82 GHz; -11.73 dBm
Display Line: -13 dBm; Limit Test Failed
Transducer Factors: A1037
28/04/2004 10:57:59



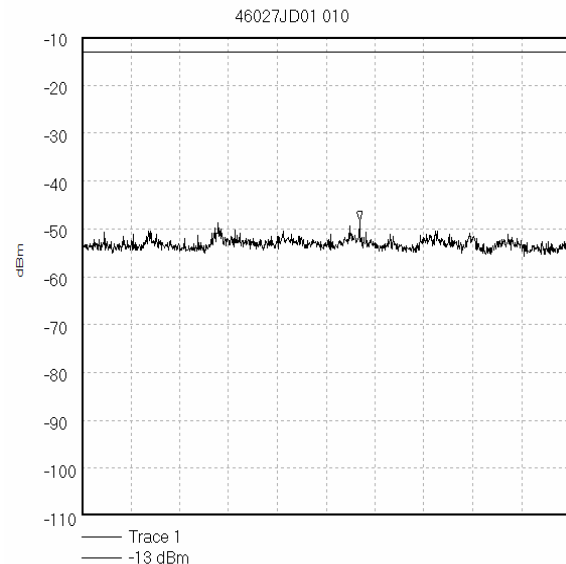
Start 4.0 GHz; Stop 5.0 GHz
Ref -10 dBm; Ref Offset 13.8 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 4.99 GHz; -43.41 dBm
Display Line: -13 dBm;
06/05/2004 14:29:50

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

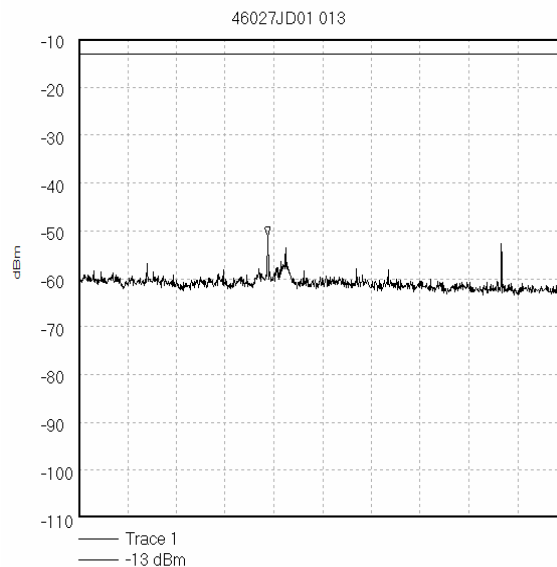
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Transmitter Out of Band Radiated Emissions: Section 2.1053/24.238 (Continued)

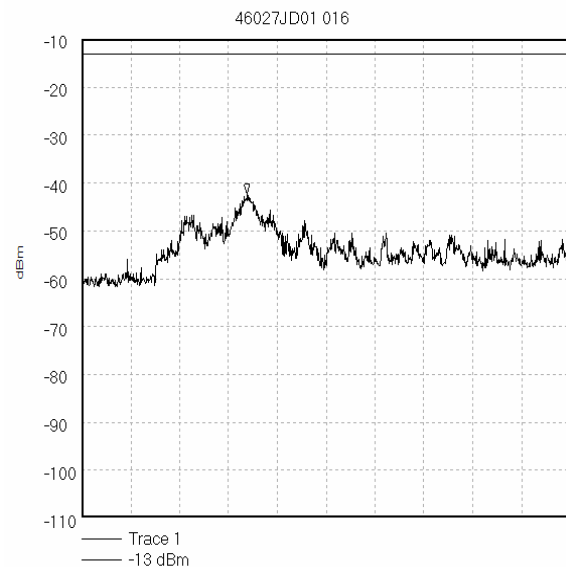
Start 5.0 GHz; Stop 6.0 GHz
Ref -10 dBm; Ref Offset 13.8 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 5.73333 GHz, -47.1 dBm
Display Line: -13 dBm;
06/05/2004 14:31:45



Start 6.0 GHz; Stop 8.0 GHz
Ref -10 dBm; Ref Offset 14.1 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 7.13778 GHz, -48.29 dBm
Display Line: -13 dBm;
06/05/2004 14:43:34



Start 8.0 GHz; Stop 12.0 GHz
Ref -10 dBm; Ref Offset 14.1 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 9.55111 GHz, -51.13 dBm
Display Line: -13 dBm;
06/05/2004 15:12:28



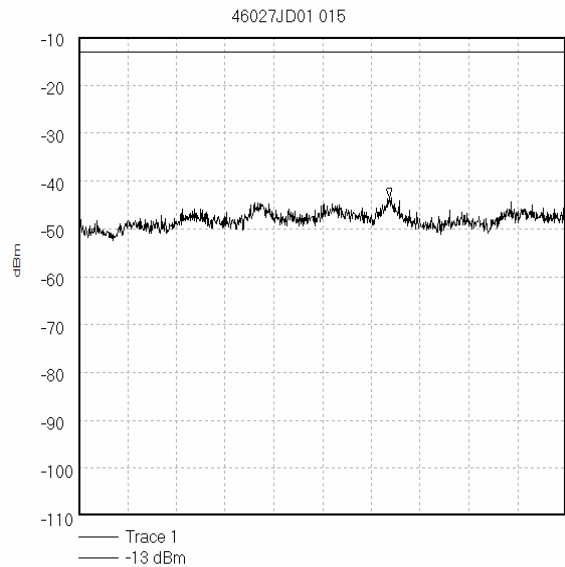
Start 12.0 GHz; Stop 18.0 GHz
Ref -10 dBm; Ref Offset 15.4 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 40.0 mS
Peak 14.03333 GHz, -42.3 dBm
Display Line: -13 dBm;
06/05/2004 15:55:26

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 Radiated Emissions: Section 2.1053/24.238 (Continued)

Start 18.0 GHz; Stop 20.0 GHz
Ref -10 dBm; Ref Offset 15.8 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 19.275556 GHz, -43.54 dBm
Display Line: -13 dBm;
06/05/2004 15:47:03

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Transmitter Out of Band Radiated Emissions: Section 2.1053/24.238 (Continued)**Integrated Power Over 1 MHz Strip Band: 1911 to 1912 MHz**1st 1 MHz block immediately outside adjacent frequency block

100 kHz Strip Number	Peak Power (nW/100 kHz)	100 kHz Strip Number	Peak Power (nW/100 kHz)
1	358	6	410
2	386	7	272
3	365	8	606
4	459	9	376
5	330	10	425
Total Peak Power:		3987 nW/MHz	

Integrated Power Over 1 MHz Strip Band: 1912 to 1913 MHz2nd 1 MHz block immediately outside adjacent frequency block

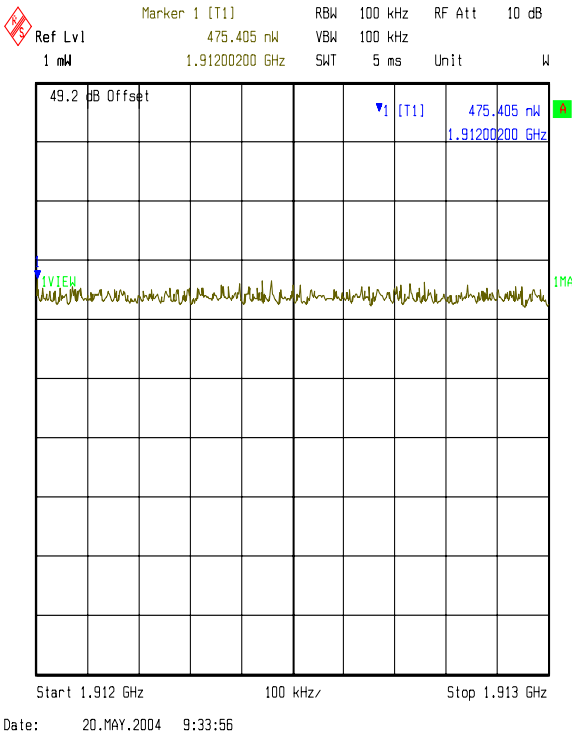
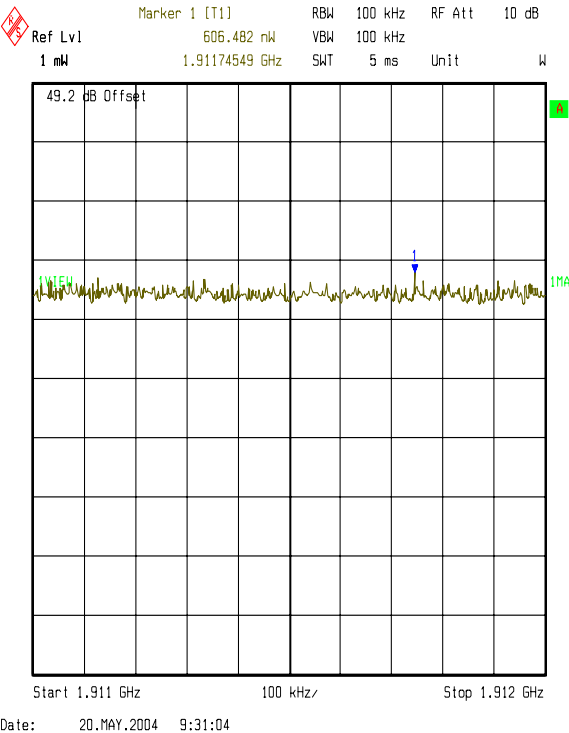
100 kHz Strip Number	Peak Power (nW/100 kHz)	100 kHz Strip Number	Peak Power (nW/100 kHz)
1	475	6	300
2	315	7	345
3	326	8	404
4	366	9	357
5	421	10	336
Total Peak Power:		3645 nW/MHz	

Result:

Band (MHz)	Peak Power (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)	Status
1911 to 1912	-24.0	-13.0	9.0	Complied
1912 to 1913	-24.4	-13.0	9.4	Complied

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Transmitter Out of Band Radiated Emissions: Section 2.1053/24.238 (Continued)



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10.8. Transmitter Radiated Emissions At Band Edges: Section 2.1053/24.238

10.8.1. The EUT was configured as for transmitter radiated emissions testing described in Section 11 of this report.

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

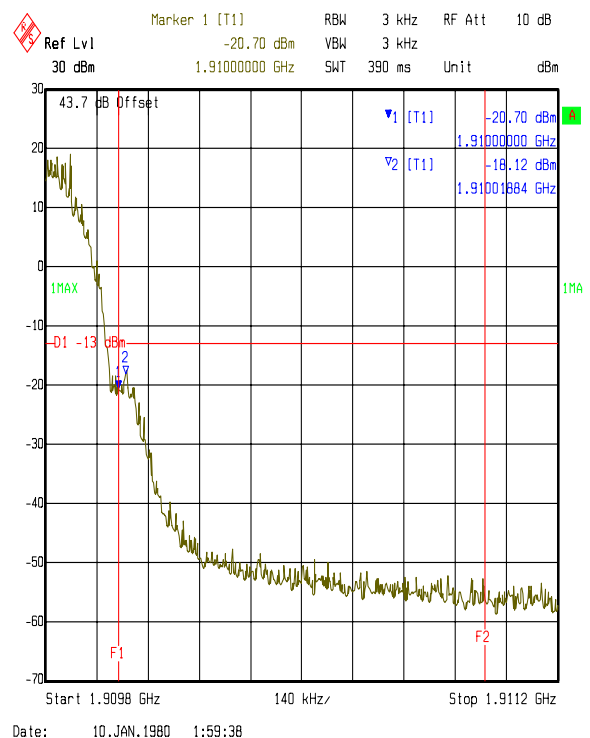
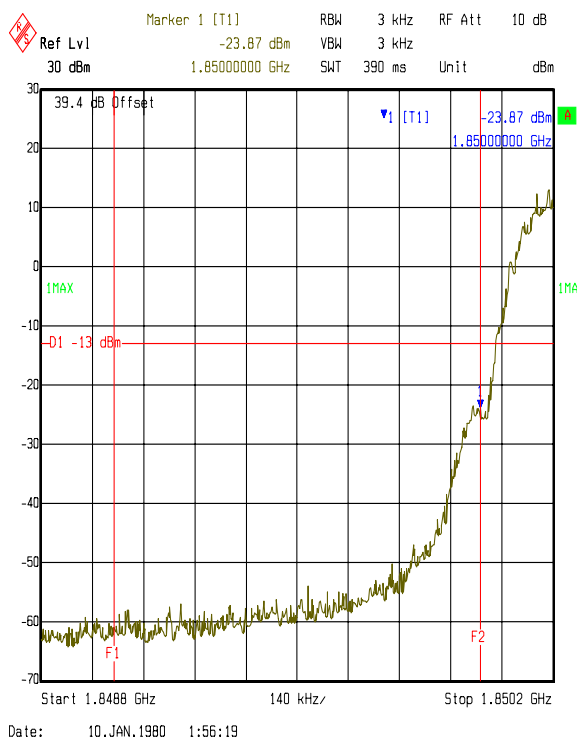
Results:

Bottom Band Edge

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1850	-23.9	-13.0	10.9	Complied

Top Band Edge

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1910	-20.7	-13.0	7.7	Complied



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11. Measurement Methods – Part 24

11.1. Effective Isotropic Radiated Power (EIRP)

EIRP measurements were performed in accordance with the standard, against appropriate limits.

The EIRP was measured with the EUT arranged on a non-conducting turn table on a standard test site compliant with ANSI C63.4 – 2001 Clause 5.4. The transmitter was fitted with an integral antenna; therefore all radiated tests were performed with the unit operating into the integral antenna.

The level of the EIRP was measured using a spectrum analyser.

The test antenna was positioned in the horizontal plane. The EUT was oriented in the X plane. The test antenna was then raised and lowered until a maximum peak was observed. The turntable was then rotated through 360 degrees and the maximum peak reading obtained. The height search was then repeated to take into consideration the new angular position of the turntable. The maximum reading observed was then recorded. This procedure was then repeated with the EUT oriented in the Y and Z planes. The highest reading taken in all 3 planes was recorded. The entire procedure was then repeated with the test antenna set in the Vertical polarity.

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 EIRP was calculated as:-

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

All measurements were performed using broadband Horn antennas.

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Effective Isotropic Radiated Power (EIRP) (Continued)

Circumstances where the signal generator could not produce the desired power substitution was performed with the signal generator set to 0 dBm. The radiated signal was maximised as previously described. The level indicated on the measuring receiver was noted. The delta between this level and the maximum level for the EUT was calculated and also noted. The EIRP of the signal generator was calculated using the above formulae. The recorded delta was added to the calculated EIRP to obtain the substituted EUT EIRP.

$$\text{Delta (dB)} = \text{EUT} - \text{SG}$$

where :

EUT = spectrum analyser indicated EUT raw level

SG = spectrum analyser indicated signal generator raw level

The signal generator actual EIRP is calculated as:

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

The EUT EIRP is calculated as:

$$\text{EIRP EUT} = \text{EIRP SG} + \text{Delta.}$$

The test equipment settings for EIRP measurements were as follows:

Receiver Function	Setting
Detector Type:	Peak
Mode:	Not applicable
Bandwidth:	1 MHz
Amplitude Range:	100 dB
Sweep Time:	Coupled

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11.2. Frequency Stability

The EUT was situated within an environmental test chamber and connected to the GSM test set via an air link.

Measurements were performed with the EUT operating under extremes of temperature in 10 degree increments within the range –30 to 50 degrees 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 and ensure they remained within specified operating parameters.

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.

Once the environmental chamber had reached thermal equilibrium, the nominal frequency of the EUT was measured and recorded. The recorded frequency was compared to the applicants declared operating frequency band edges.

In order to show compliance, the measured frequency must remain within the declared frequency band.

The reported data shows the nominal frequency drift and its margin from the band edge. In order to get the margin from the lower band edge, subtract the lower band edge limit from the measured frequency. The margin from the upper band edge is found by subtracting the measured frequency from the upper band edge limit. In order to show compliance the margin must be positive. A negative margin shows non-compliance.

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11.3. Occupied Bandwidth

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

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.

As the EUT is a PCS phone, no modulation input port was available. A call was therefore set up using the PCS/GSM simulator and using normal modulation. The Occupied Bandwidth was measured in this configuration.

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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11.4. AC Mains Conducted Emissions

AC mains conducted emissions 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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11.5. Transmitter Radiated Emissions

Radiated emissions 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 EIRP was calculated as:-

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

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.

Any spurious measured were then 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 24.238 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.

The measurements in the 2nd and 3rd 1 MHz blocks away from the adjacent 1 MHz block from 1911 MHz to 1912 MHz and 1912 MHz to 1913 MHz were carried out using an analyser span of 1 MHz and a 100 kHz receiver resolution bandwidth (RBW). 10 linear readings were taken for each 100 kHz strip across the 1 MHz band. These readings were integrated to give the emission level in an equivalent 1 MHz bandwidth.

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11.6. Receiver Radiated Emissions

Radiated emissions 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 5 times the highest unintentionally generated frequency were performed within a screened chamber in order to identify frequencies on which the EUT was generating interference. This determined the frequencies from the EUT, which required further examination. In order to minimise the time taken for the swept measurements, a peak detector was used in conjunction with the appropriate detector measuring bandwidth (see table below). 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. 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 Quasi-Peak detector was used for measurements below 1000 MHz, for measurements above 1000 MHz average and peak detectors were used.

For the final measurements the EUT was arranged on a non-conducting turn table on a standard test site compliant with ANSI C63.4 – 2001 Clause 5.4.

On the open area test site, at each frequency where a signal was found, 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 horizontal 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 vertical polarisation.

The final field strength was determined as the indicated level in dBµV plus cable loss and antenna factor.

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

Receiver Function	Initial Scan	Final Measurements Below 1 GHz	Final Measurements Above 1 GHz
Detector Type:	Peak	Quasi-Peak (CISPR)	Peak/Average
Mode:	Max Hold	Not applicable	Not applicable
Bandwidth:	(120 kHz < 1 GHz) (1 MHz > 1 GHz)	120 kHz	1 MHz (If Applicable)
Amplitude Range:	60 dB	20 dB	20 dB (typical)
Step Size:	Continuous sweep	Not applicable	Not applicable
Sweep Time:	Coupled	Not applicable	Not applicable

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12. Measurement Uncertainty

12.1. 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.

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

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

12.4. 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
Effective Radiated Power (ERP)	Not applicable	95%	+/- 1.78 dB
Effective Isotropic Radiated Power (ERP)	Not applicable	95%	+/- 1.78 dB
Frequency Stability	Not applicable	95%	+/- 20 Hz
Minimum Bandwidth	Not applicable	95%	+/- 0.12 %
Occupied Bandwidth	824 to 849 MHz	95%	+/- 0.12 %
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	+/- 5.26 dB
Radiated Spurious Emissions	1 GHz to 26 GHz	95%	+/- 1.78 dB

12.5. 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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Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.
A027	Horn Antenna	Eaton	9188-2	301
A028	Horn Antenna	Eaton	91888-2	304
A031	Horn Antenna	Eaton	91889-2	557
A059	Log Periodic Antenna	EMCO	3146	8902-2378
A1037	Bilog Antenna	Chase EMC Ltd	CBL6112B	2413
A1069	Test Receiver	Rohde & Schwarz	ESH3-Z5	837469/012
A254	WG 14 Microwave Horn	Flann Microwave	14240-20	139
A259	Bilog Antenna	Chase	CBL6111	1513
A392	3 dB attenuator	Suhner	6803.17.B	None
A428	WG 12 Horn Antenna	Flann	12240-20	134
A429	WG 16 Horn Antenna	Flann	16240-20	561
A430	WG 18 Horn Antenna	Flann	18240-20	425
A436	WG 20 Horn Antenna	Flann	20240-20	330
C468	Cable	Rosenberger	UFA210A-1-3937-504504	98L0440
E013	PCN Environmental Chamber	Sanyo	ATMOS chamber	None
M003	Spectrum Monitor	Rohde & Schwarz	EZM	883 580/008
M028	Spectrum Analyser	Rohde & Schwarz	FSB	860 001/009 (RF), 860 161/007 (Display)
M044	Test Receiver	Rohde & Schwarz	ESVP	891 845/026
M058	Multimeter	Fluke	79	54940691
M069	Spectrum Analyser / Receiver	Rohde & Schwarz	ESMI	829 808/007 (DU) / 827 063/008 (RU)
M1093	GSM Test Set	Will tek	4202S	0513018
M1138	GSM Test Set	Rohde & Schwarz	CMU 200-1100.0008.02	836202/093
M506	Spectrum Analyser	Rohde & Schwarz	ESBI	827060/004
S010	D.C. PSU	INSTEK	PC-3060	9401927
S202	Site 2	RFI	2	S202-15011990
S201	Site 1	RFI	1	

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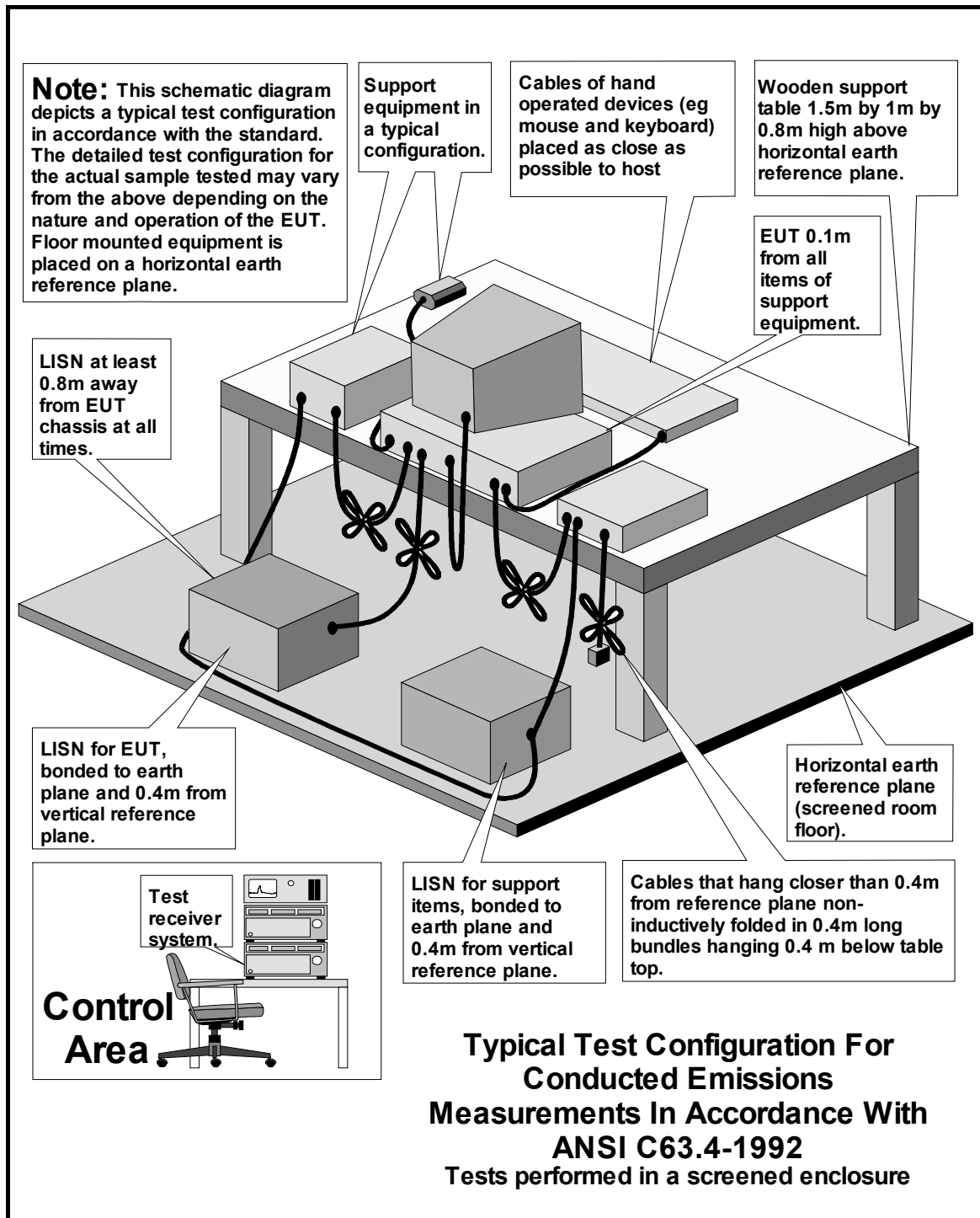
Appendix 2. Test Configuration Drawings

This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\46027JD01\EMICON	Test configuration for measurement of conducted emissions
DRG\46027JD01\EMIRAD	Test configuration for measurement of radiated emissions

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DRG\46027JD01\EMIRAD

