TEST REPORT
FROM
RADIO FREQUENCY
INVESTIGATION LTD.

Test Of: Sendo Ltd.
M551 Mobile Telephone Handset.

To: FCC Part 15, 22 and 24

Test Report Serial No:
RFI/MPTB2RP44949JD10A

Supersedes Test Report Serial No.
RFI/MPTB1/RP44949JD10A

This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director: 	**Checked By: Alan McHale** 
Tested By: 	**Release Version No: PDF01**
Issue Date: 22 January 2004	**Test Dates: 31 July 2003 to 19 August 2003**

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Test Of: Sendo Ltd.
M551 Mobile Telephone Handset.
To: FCC Part 15, 22 & 24

Table of Contents

1. Client Information

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

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 Ltd.
Model Name or Number:	M551
IMEI Number:	004400252898455
Battery Serial Number:	8D48-0M1A0 22004
Country of Manufacture:	UK
FCC ID Number:	P6PSND551
Date of Receipt:	31 July 2003

2.2. Accessories Supplied with Equipment Under Test (EUT)

Brand Name:	Netbit
Model Name or Number:	DVR 530
Unique Type Identification:	8D09 02302 20000
Serial Number	3602
Country of Manufacture:	China
Date of Receipt:	31 July 2003

Brand Name:	Personal Hands Free Kit
Model Name or Number:	None stated by Applicant
Unique Type Identification:	None stated by Applicant
Serial Number	None stated by Applicant
Country of Manufacture:	China
Date of Receipt:	31 July 2003

2.3. Description Of EUT

The equipment under test is a dual-band (850, 1900) mobile telephone handset.

2.4. Modifications Incorporated In EUT

The EUT has not been modified from what is described by the Model Number stated above.

2.5. Additional Information Related To Testing

Power Supply Requirement: (Internal, lithium ion battery)	4.2 V DC
Declared Battery End Point Voltage	3.5 V DC
Power Supply Requirement: (AC Battery Charger)	Nominal 115 V, 60 Hz AC Mains Supply
Intended Operating Environment:	Within GSM Network Coverage
Equipment Category:	Portable
Type of Unit:	Handset
Weight:	107 g
Dimensions:	140 x 105 x 15 mm
Interface Ports:	Earpiece Battery Charger Socket
Highest Fundamental Frequency:	1989.8 MHz
Highest Oscillator Frequency:	2438.0 MHz

Additional Information Related To Testing (Continued)

GSM 850 Transmit Frequency Range	824 MHz 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 MHz 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
Maximum Power Output (ERP)	28.0 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
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
Maximum Power Output (EIRP)	31.3 dBm		

2.6. Support Equipment

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

Description:	Li-ion Battery
Brand Name:	SENDO
Model Name or Number:	Not Stated
Serial Number:	8D48-0L1AO-22000
Cable Length And Type:	N/A
Connected to Port:	Battery

3. Test Specification, Methods And Procedures

3.1. Test Specifications

Reference:	FCC Part 15 Subpart B: 2002 (Section 15.107 and 15.109)
Title:	Code of Federal Regulations, Part 15 (47CFR15) Radio Frequency Devices: Unintentional Radiators.
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 22 Subpart H: 2002 (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: 2002 (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.

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.

4. Deviations From The Test Specification

None.

5. Operation Of The EUT During Testing

5.1. Operating Conditions

During testing, the EUT was powered by a nominal 4.2 V DC Battery connected to a 115 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 2.1 of this report connected and then disconnected. The combination that exhibited the worse case mode of operation was then used to perform final measurements.

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 –30.0 ºC through to +50.0 ºC in 10º increments.

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

Idle Modes:

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

5.3. Configuration And Peripherals

The EUT was tested in the following configuration:

Configured with hands free kit, AC battery charger and internal battery.

All tests were performed with the EUT connected via an air link.

6. Summary Of Test Results

Part 22

Range Of Measurements	Specification Reference	Port Type	Compliancy Status
AC Conducted Spurious Emissions Idle mode (150 kHz to 30 MHz)	C.F.R. 47 FCC Part 15: 2002 Section 15.107	AC Mains Input	Complied
Radiated Spurious Emissions Idle mode	C.F.R. 47 FCC Part 15: 2002 Section 15.109	Enclosure	Complied
Transmitter Effective Radiated Power (ERP)	C.F.R. 47 FCC Part 22: 2002 Section 22.913(a)	Antenna	Complied
Transmitter Frequency Stability (Temperature Variation)	C.F.R. 47 FCC Part 22: 2002 Section 22.355	Antenna	Complied
Transmitter Frequency Stability (Voltage Variation)	C.F.R. 47 FCC Part 22: 2002 Section 22.355	Antenna	Complied
Transmitter Occupied Bandwidth	C.F.R. 47 FCC Part 22: 2002 Section 2.1049(i)	Antenna	Complied
Transmitter Out of Band Radiated Emissions	C.F.R. 47 FCC Part 22: 2002 Section 2.1053/22.917	Antenna	Complied
Transmitter Band Edge Radiated Emissions	C.F.R. 47 FCC Part 2: 2002 Section 2.1053	Antenna	Complied

Summary Of Test Results (Continued)

Part 24

Range Of Measurements	Specification Reference	Port Type	Compliancy Status
AC Conducted Spurious Emissions Idle mode (150 kHz to 30 MHz)	C.F.R. 47 FCC Part 15: 2002 Section 15.107	AC Mains Input	Complied
Radiated Spurious Emissions Idle mode	C.F.R. 47 FCC Part 15: 2002 Section 15.109	Enclosure	Complied
Transmitter Effective Isotropic Radiated Power (EIRP)	C.F.R. 47 FCC Part 24: 2002 Section 24.232	Antenna	Complied
Transmitter Frequency Stability (Temperature Variation)	C.F.R. 47 FCC Part 24: 2002 Section 24.235	Antenna	Complied
Transmitter Frequency Stability (Voltage Variation)	C.F.R. 47 FCC Part 24: 2002 Section 24.235	Antenna	Complied
Transmitter Occupied Bandwidth	C.F.R. 47 FCC Part 24: 2002 Section 24.238	Antenna	Complied
Transmitter Out of Band Radiated Emissions	C.F.R. 47 FCC Part 24: 2002 Section 2.1053/24.238	Antenna	Complied
Transmitter Band Edge Radiated Emissions	C.F.R. 47 FCC Part 2: 2002 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.

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 12 for details of measurement uncertainties.

8. Test Results FCC Part 22

8.1. Receiver AC Conducted Spurious Emissions (Idle Mode): 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.

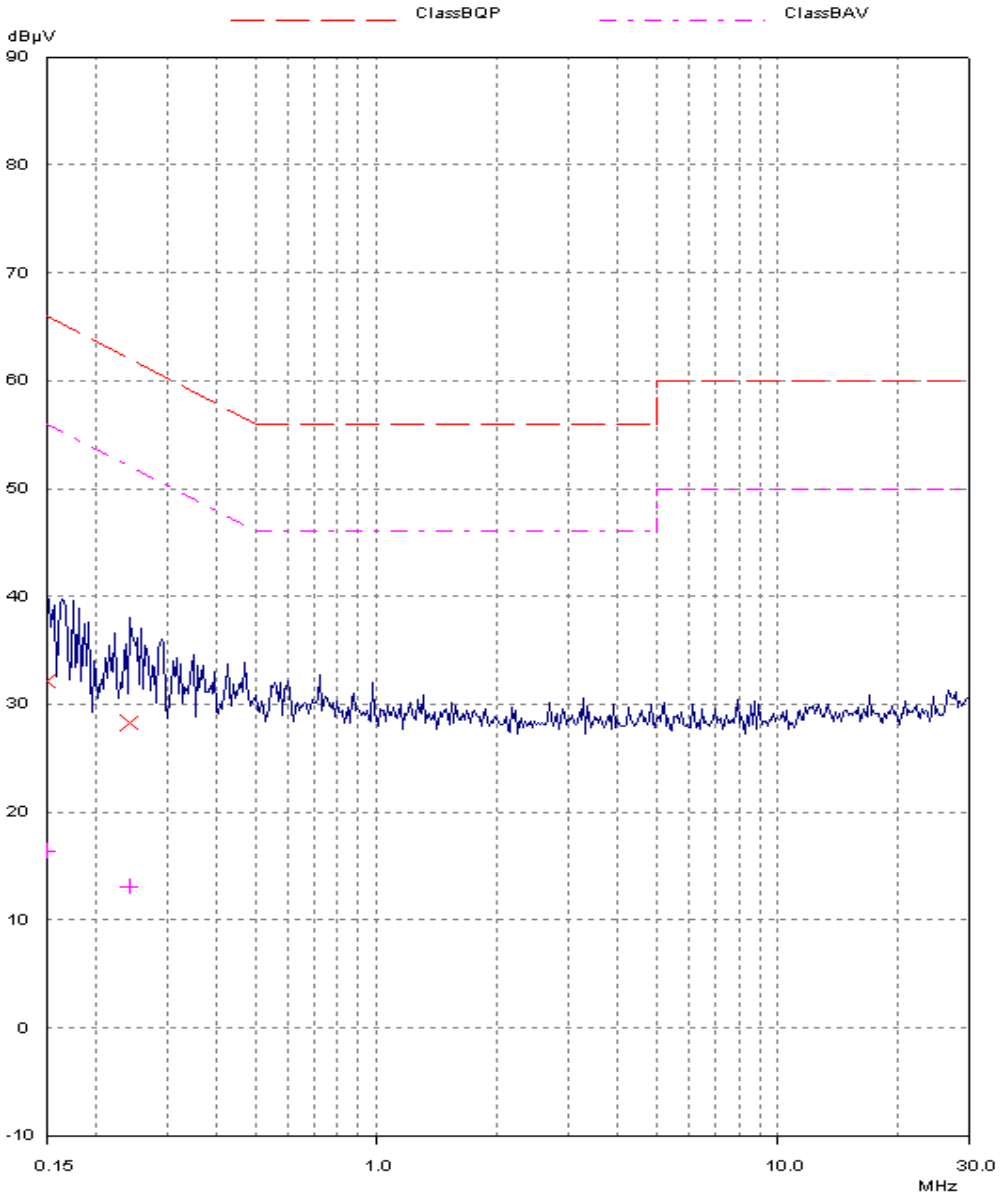
Results: Quasi-Peak Detector Measurements On Live And Neutral Lines

Frequency (MHz)	Line	Q-P Level (dBμV)	Q-P Limit (dBμV)	Margin (dB)	Result
0.150	Neutral	32.1	66.0	33.9	Complied
0.240	Live	28.3	62.1	33.8	Complied

Results: Average Detector Measurements On Live And Neutral Lines

Frequency (MHz)	Line	Av. Level (dBμV)	Av. Limit (dBμV)	Margin (dB)	Result
0.150	Neutral	16.4	56.0	39.6	Complied
0.240	Live	13.1	52.1	39.0	Complied

AC Conducted Spurious Emissions (Continued)



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

8.2. Receiver/Idle Mode Radiated Emission: Section 15.109

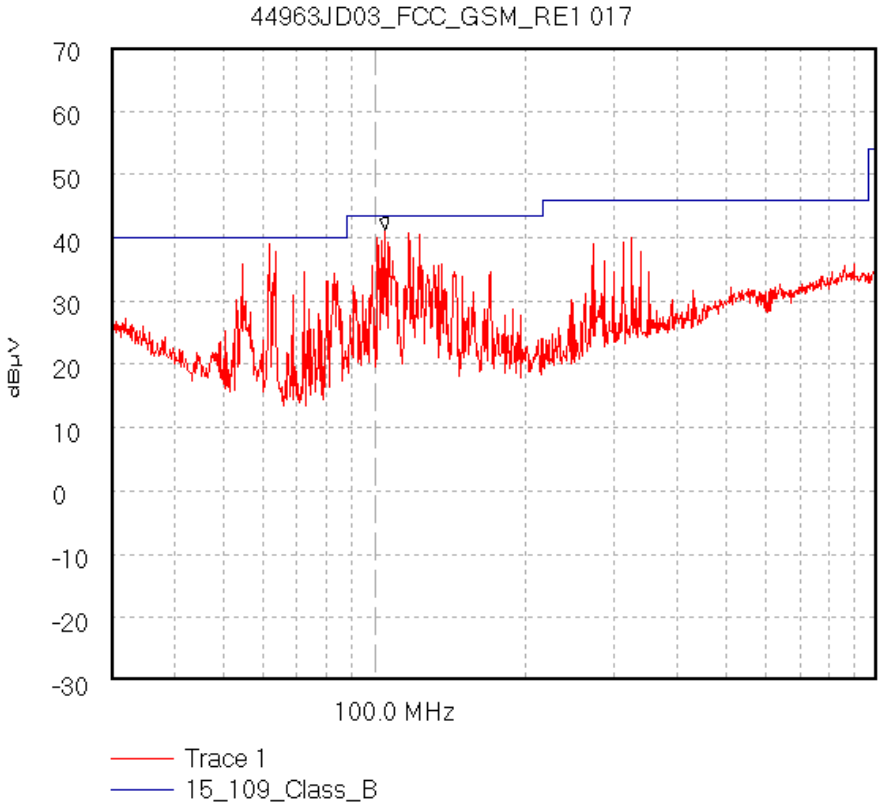
8.2.1.Electric Field Strength Measurements (Frequency Range: 30 to 1000 MHz)

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

8.2.1.2. Tests were performed to identify the maximum radiated emissions levels exhibited while the EUT was in idle mode.

Frequency (MHz)	Ant. Pol.	Q-P Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
61.133	Vert.	29.2	40.0	10.8	Complied
103.716	Horiz.	26.5	43.5	17.0	Complied
122.666	Vert.	29.8	43.5	13.7	Complied
326.483	Vert.	21.6	46.0	24.4	Complied

Receiver/Idle Mode Radiated Emissions: Section 15.109 (Continued)



Start 30.0 MHz; Stop 1.0 GHz - Log Scale
Ref 70 dBµV; Ref Offset 0.0 dB; 10 dB/div
RBW 120.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 80.0 mS
Peak 105.19 MHz, 41.21 dBµV
Limit/Mask: 15_109_Class_B; ; Limit Test Passed
Transducer Factors: A1037
7/31/2003 10:47:20 AM

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

Receiver/Idle Mode Radiated Emissions: Section 15.109 (Continued)

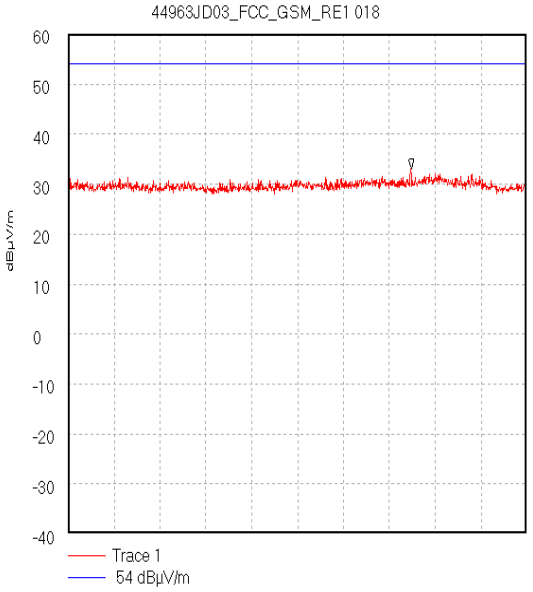
8.2.2. Electric Field Strength Measurements (Frequency Range: 1 to 5 GHz)

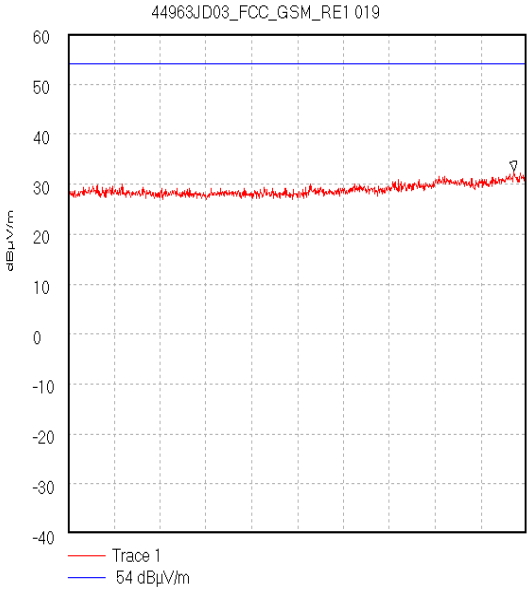
Highest Peak Level:

*Note: No spurious emissions were detected above the noise floor of the measurement receiver. The highest peak noise floor reading of the measuring receiver recorded was 44.6 dBµV/m at 4.893 GHz

Highest Average Level:

*Note: Not recorded, no spurious emissions were detected above the noise floor of the measuring receiver.





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

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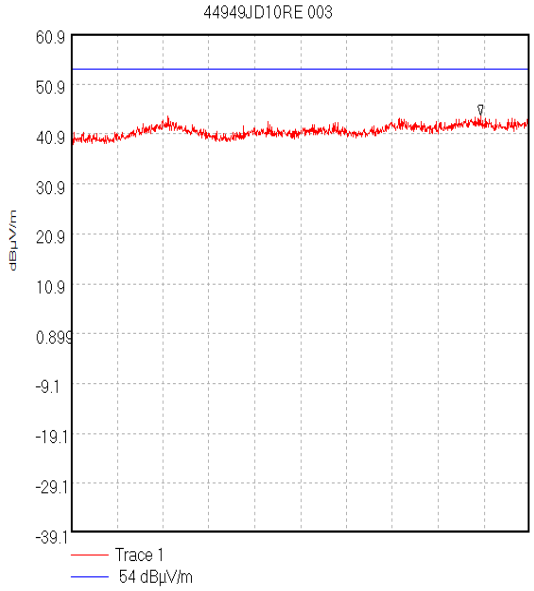
Receiver/Idle Mode Radiated Emissions Section 15.109 (Continued)



Start 4.0 GHz; Stop 5.0 GHz
Ref 60.9 dBµV/m; Ref Offset 17.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 4.893 GHz, 44.6 dBµV/m
Display Line: 54 dBµV/m;
12/08/2003 14:31:38

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

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	V	27.6	38.4	10.8	Complied
Middle	836.6	V	28.0	38.4	10.4	Complied
Top	848.8	V	27.2	38.4	11.2	Complied

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

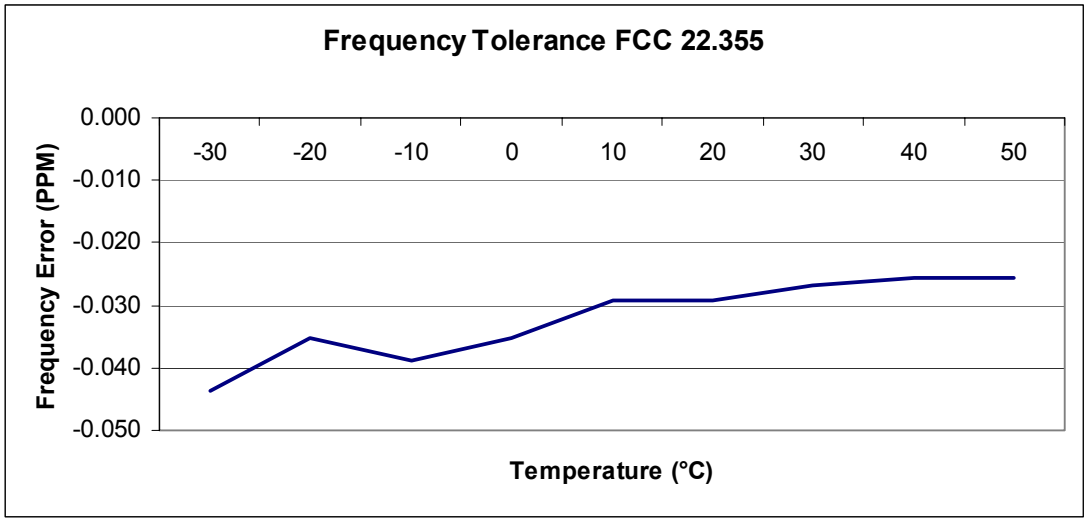
8.4.1. The EUT was configured as for frequency stability measurements as described in Section 9 of this report.

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)

Temperature (°C)	Nominal Frequency	Measured Frequency	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
-30	824.2	824.199964	-36	-0.044	2.5	2.456	Complied
-20	824.2	824.199971	-29	-0.035	2.5	2.465	Complied
-10	824.2	824.199968	-32	-0.039	2.5	2.461	Complied
0	824.2	824.199971	-29	-0.035	2.5	2.465	Complied
10	824.2	824.199976	-24	-0.029	2.5	2.471	Complied
20	824.2	824.199976	-24	-0.029	2.5	2.471	Complied
30	824.2	824.199978	-22	-0.027	2.5	2.473	Complied
40	824.2	824.199979	-21	-0.025	2.5	2.475	Complied
50	824.2	824.199979	-21	-0.025	2.5	2.475	Complied

Frequency Variation From 824.2 MHz

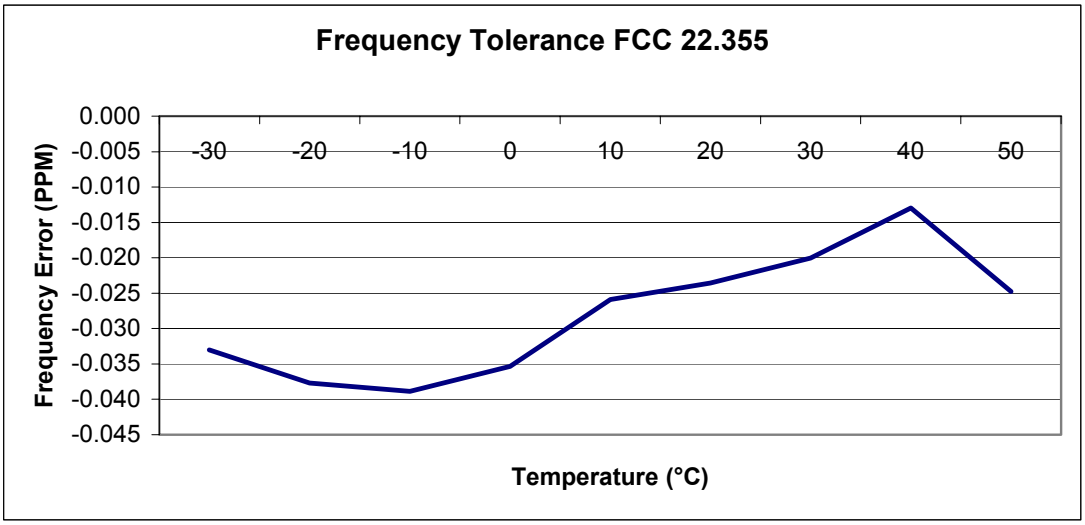


Transmitter Frequency Stability (Temperature Variation): Section 22.355 (Continued)

Results Top Channel (848.8 MHz)

Temperature (°C)	Nominal Frequency	Measured Frequency	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
-30	848.8	848.799972	-28	-0.033	2.5	2.467	Complied
-20	848.8	848.799968	-32	-0.038	2.5	2.462	Complied
-10	848.8	848.799967	-33	-0.039	2.5	2.461	Complied
0	848.8	848.799970	-30	-0.035	2.5	2.465	Complied
10	848.8	848.799978	-22	-0.026	2.5	2.474	Complied
20	848.8	848.799980	-20	-0.024	2.5	2.476	Complied
30	848.8	848.799983	-17	-0.020	2.5	2.480	Complied
40	848.8	848.799989	-11	-0.013	2.5	2.487	Complied
50	848.8	848.799979	-21	-0.025	2.5	2.475	Complied

Frequency Variation From 848.8 MHz



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

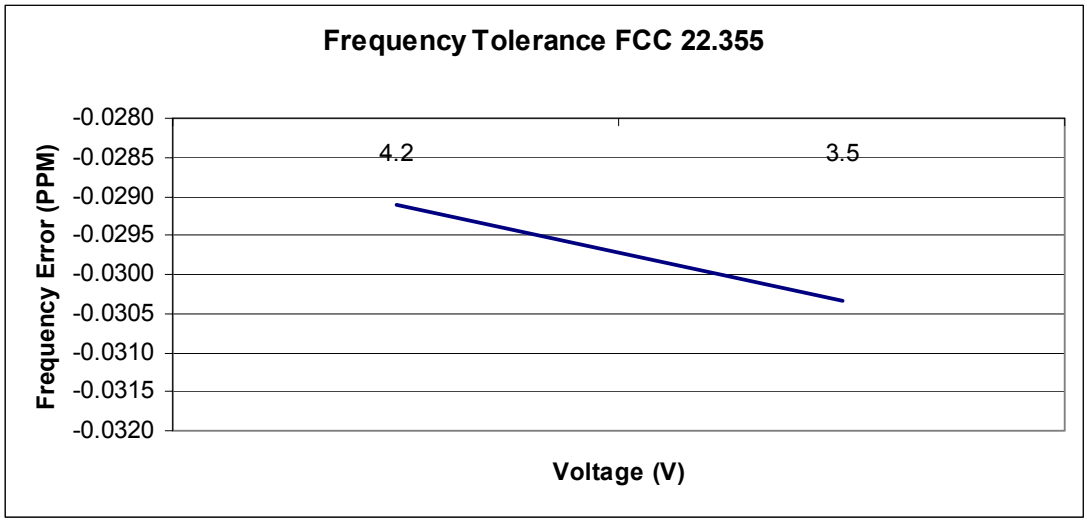
8.5.1. The EUT was configured as for frequency stability measurements as described in Section 9 of this report.

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)	Nominal Frequency	Measured Frequency	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
4.2	824.2	824.199976	-24	-0.0291	2.5	2.471	Complied
3.5	824.2	824.199975	-25	-0.0303	2.5	2.470	Complied

Frequency Variation From 824.2 MHz

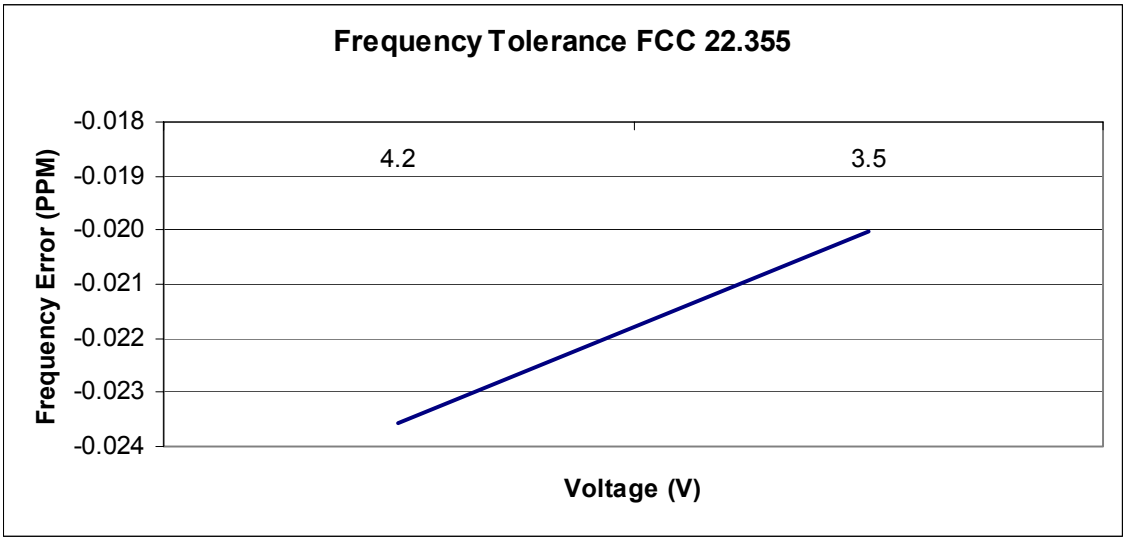


Transmitter Frequency Stability (Voltage Variation): Section 22.355 (Continued)

Results Top Channel (848.8 MHz)

Supply Voltage (V)	Nominal Frequency	Measured Frequency	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
4.2	848.8	848.799980	-20	-0.024	2.5	2.476	Complied
3.5	848.8	848.799983	-17	-0.020	2.5	2.480	Complied

Frequency Variation From 848.8 MHz



8.6. Transmitter Occupied Bandwidth: Section 2.1049(i)

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	252.5
Middle	836.6	3.0	10.0	250.1
Top	848.8	3.0	10.0	250.1

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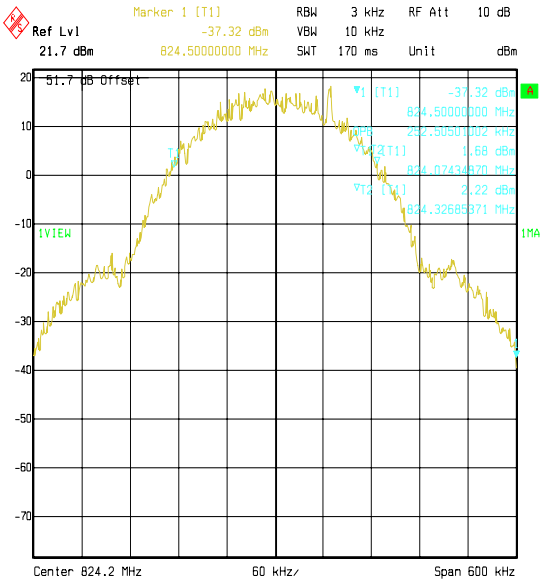
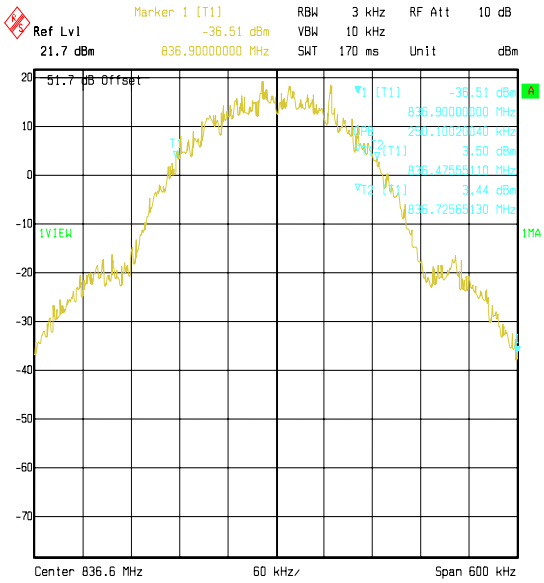
Transmitter Occupied Bandwidth: (Continued)

Bottom Channel



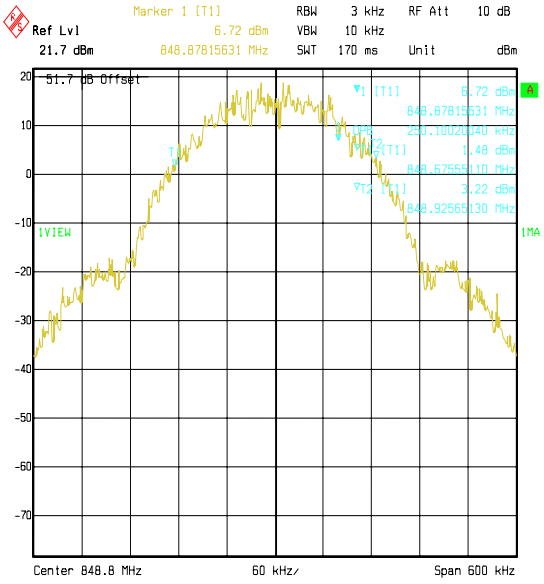
Title: OBW GSM850 Band Bot Channel@Sendo M551
Comment A: 449490BW03
Date: 13.AUG.2003 15:22:45

Middle Channel



Title: OBW GSM850 Band Mid Channel@Sendo M551
Comment A: 449490BW02
Date: 13.AUG.2003 15:20:14

Top Channel



Title: OBW GSM850 Band Top Channel@Sendo M551
Comment A: 449490BW01
Date: 13.AUG.2003 15:18:14

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.

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

8.7.1. The EUT was configured as for 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
1684.4	-39.8	-13.0	26.8	Complied
2472.6	-37.0	-13.0	24.0	Complied

Result: Middle Channel

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1673.2	-40.4	-13.0	27.4	Complied
2509.8	-38.8	-13.0	25.8	Complied

Result: Top Channel

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1697.6	-38.1	-13.0	25.1	Complied
2546.4	-39.1	-13.0	26.1	Complied

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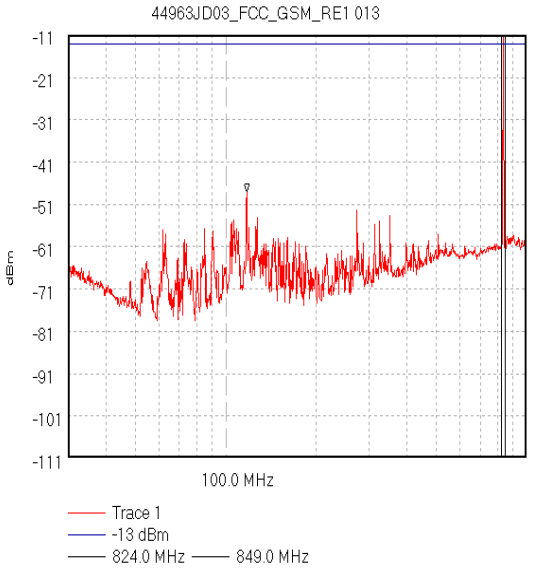
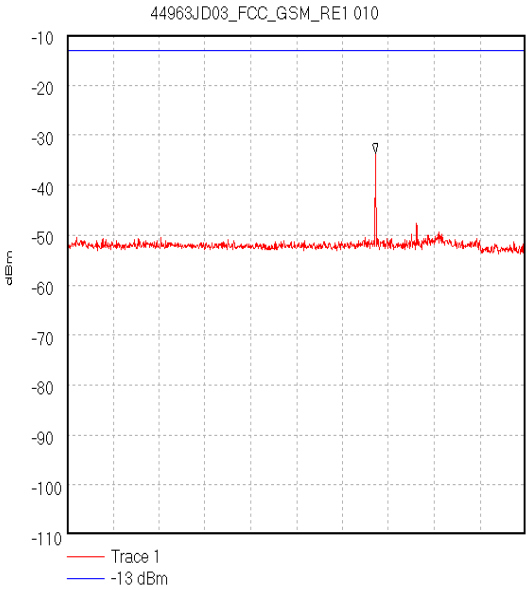
Transmitter Out of Band Emissions: Section 2.1053 & 22.917 (Continued)



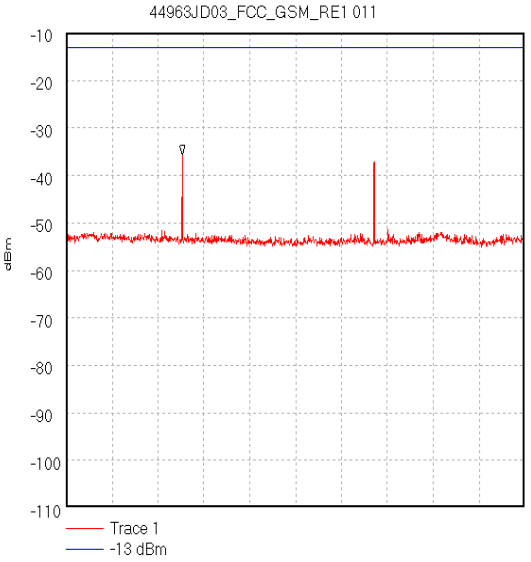
Start 30.0 MHz; Stop 1.0 GHz - Log Scale
Ref -11 dBm; Ref Offset 10.0 dB; 10 dB/div
RBW 120.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 80.0 mS
Marker 117.773 MHz, -48.02 dBm
Display Line: -13 dBm; ; Limit Test Failed
Transducer Factors: A1037
7/31/2003 10:28:56 AM



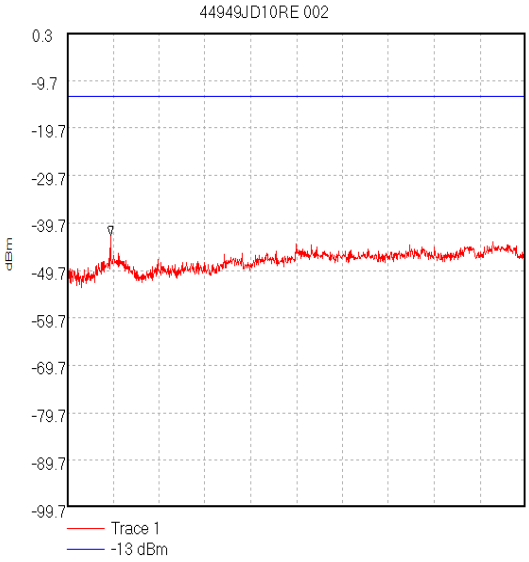
Start 1.0 GHz; Stop 2.0 GHz
Ref -10 dBm; Ref Offset 37.0 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 1.672 GHz, -33.64 dBm
Display Line: -13 dBm; ; Limit Test Passed
7/31/2003 10:16:52 AM

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

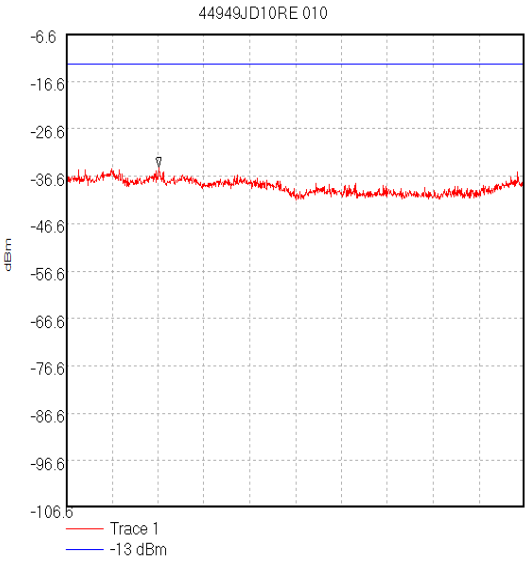
Transmitter Out of Band Emissions: Section 2.1053 & 22.917 (Continued)



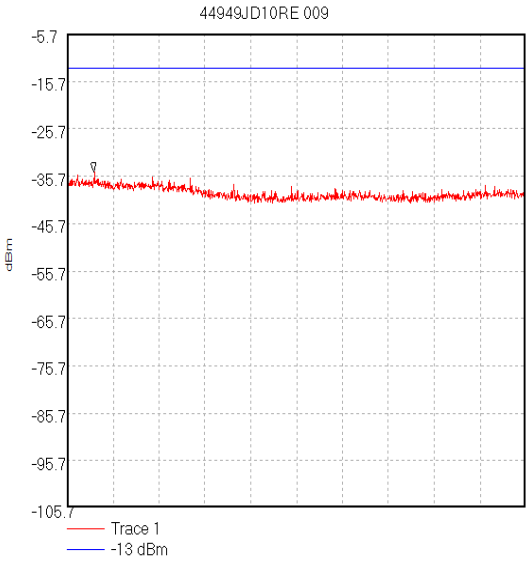
Start 2.0 GHz; Stop 4.0 GHz
Ref -10 dBm; Ref Offset 36.0 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 2.507 GHz, -35.72 dBm
Display Line: -13 dBm; ; Limit Test Passed
7/31/2003 10:20:33 AM



Start 4.0 GHz; Stop 6.0 GHz
Ref 0.3 dBm; Ref Offset 30.3 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 4.189 GHz, -42.38 dBm
Display Line: -13 dBm;
12/08/2003 14:06:33



Start 6.0 GHz; Stop 8.0 GHz
Ref -6.6 dBm; Ref Offset 33.4 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 20.0 mS
Peak 6.404 GHz, -34.6 dBm
Display Line: -13 dBm;
12/08/2003 15:15:24



Start 8.0 GHz; Stop 8.5 GHz
Ref -5.7 dBm; Ref Offset 34.3 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 20.0 mS
Peak 8.029 GHz, -34.85 dBm
Display Line: -13 dBm;
12/08/2003 15:10:03

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

8.8. Transmitter Radiated Emissions At Band Edges: Section 2.1053

8.8.1. The EUT was configured as for 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 band that the EUT will operate over.

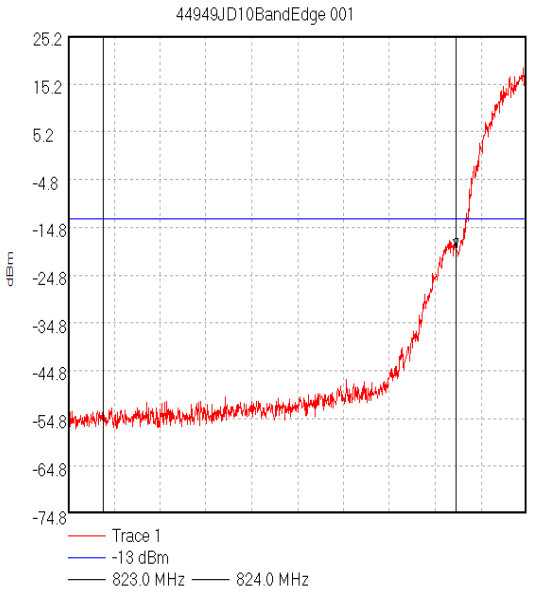
Results:

Bottom Band Edge

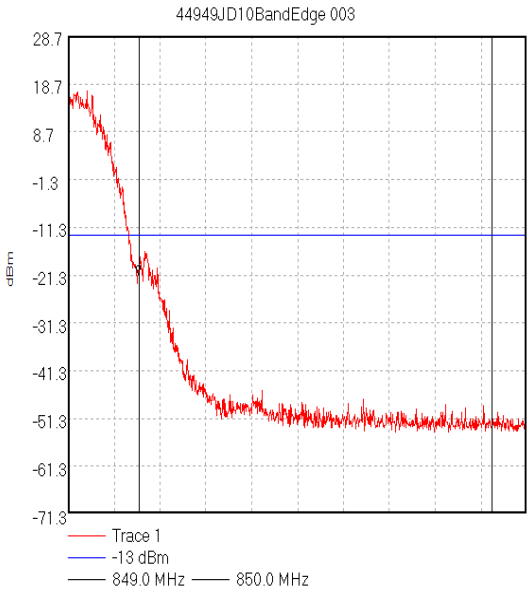
Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
824.0	-17.4	-13.0	3.4	Complied

Top Band Edge

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
849.0	-16.0	-13.0	3.0	Complied



Centre 823.55 MHz; Span 1.3 MHz
Ref 25.2 dBm; Ref Offset 35.2 dB; 10 dB/div
RBW 0.0 Hz; VBW 30.0 kHz; Att 20 dB; Swp 440.0 mS
Marker 824.0 MHz, -19.08 dBm
Display Line: -13 dBm; ; Limit Test Passed
13/08/2003 10:26:22



Centre 849.45 MHz; Span 1.3 MHz
Ref 28.7 dBm; Ref Offset 38.7 dB; 10 dB/div
RBW 0.0 Hz; VBW 30.0 kHz; Att 20 dB; Swp 440.0 mS
Marker 849.0 MHz, -21.27 dBm
Display Line: -13 dBm; ; Limit Test Passed
13/08/2003 10:43:53

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 as requested by EIA/TIA-603-B. 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 level was observed.

The turntable was then rotated through 360 degrees and a 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 repeated with the EUT oriented in the Y and Z planes.

The highest peak reading taken in all 3 planes was recorded.

The entire procedure was then repeated with the test antenna set in the Vertical polarity.

Once a final maximum amplitude had been obtained, the EUT was substituted with a dipole antenna.

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 PAD.

The signal generator was tuned to the EUT 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.

Effective Radiated Power (ERP) (Continued)

The signal generator level was noted.

This procedure was repeated with both test antenna and substitution antenna vertically polarised. The ERP was calculated as:-

ERP = Signal Generator Level - Cable Loss + Antenna Gain

Circumstances where the signal generator could not produce the desired power level, 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 EIRP.

Delta (dB) = EUT – 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:

ERP SG= Signal Generator Level - Cable Loss + Antenna Gain

The EUT ERP is calculated as:

ERP EUT = ERP SG + Delta.

9.2. Frequency Stability

The EUT was situated within an environmental test chamber and connected to test equipment via an air link radiated from the antenna.

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

Measurements were also performed at voltage extremes between the declared nominal supply voltage and at the declared endpoint voltage.

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

Measurements were made on the top, middle 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 :-

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

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 then the relevant limits in order to comply.

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 on the bottom middle and top channels.

As the EUT is a PCS phone, no modulation input port was available. A call was thus setup using the PCS/GSM test simulator and using normal modulation, this was deemed as being worst case. The Occupied Bandwidth was measured in this configuration.

The Occupied Bandwidth was measured using the built in occupied bandwidth function of either 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 FSEB user manual for this measurement, i.e., RBW <= 1/20 of occupied bandwidth. A value of 3kHz was used.

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.

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.

During the swept measurements (and also during subsequent final measurements on single frequencies) 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.

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

9.5. 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 'n' times the highest fundamental frequency stated in section 2.5 of this report where 'n' is either 5 or 10 dependant upon whether the emission was produced via a transmitter/receiver or idle mode.

The pre-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.

The initial scans were performed using an antenna height of 1.5 m and at 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 was then used with the EUT being set to the appropriate test distance.

A measurement 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 above procedure was repeated for the horizontal polarisation.

Once the final amplitude (maximised) had been obtained, the EUT was substituted with an 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.

Radiated Emissions (Continued)

The substitution antenna was matched into a signal generator using a 6dB or greater PAD.

The signal generator was tuned to the spurious emission frequency under investigation.

The test antenna was raised and lowered to obtain a maximum reading on the spectrum analyser.

The level of the signal generators output was then adjusted until the maximum level recorded earlier from the EUT 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:-

EIRP/ERP = Signal Generator Level - Cable Loss + Antenna Gain

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Radiated Emissions (Continued)

The standard states that an emission shall either be attenuated by at least 43+10 Log(P) dB below the transmitter power (P) for transmitters, where (P) is the maximum measured fundamental power for the channel under test, or at the limit specified in part 15.109/209 for receivers or idle modes.

The transmit limit always reduces to –13dBm as such, the limit line presented on the accompanying plots is set to –13dBm.

Any spurious emission measured is compared to the –13dBm limit or that specified in part 15. The requirement is for the emission to be less than the relevant limit to show 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 bandwidth were invariable calculated as a fraction, thus the next largest bandwidth was used. This was found to be 3 kHz

10. Test Results FCC Part 24

10.1. Receiver AC Conducted Spurious Emissions (Idle Mode): 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

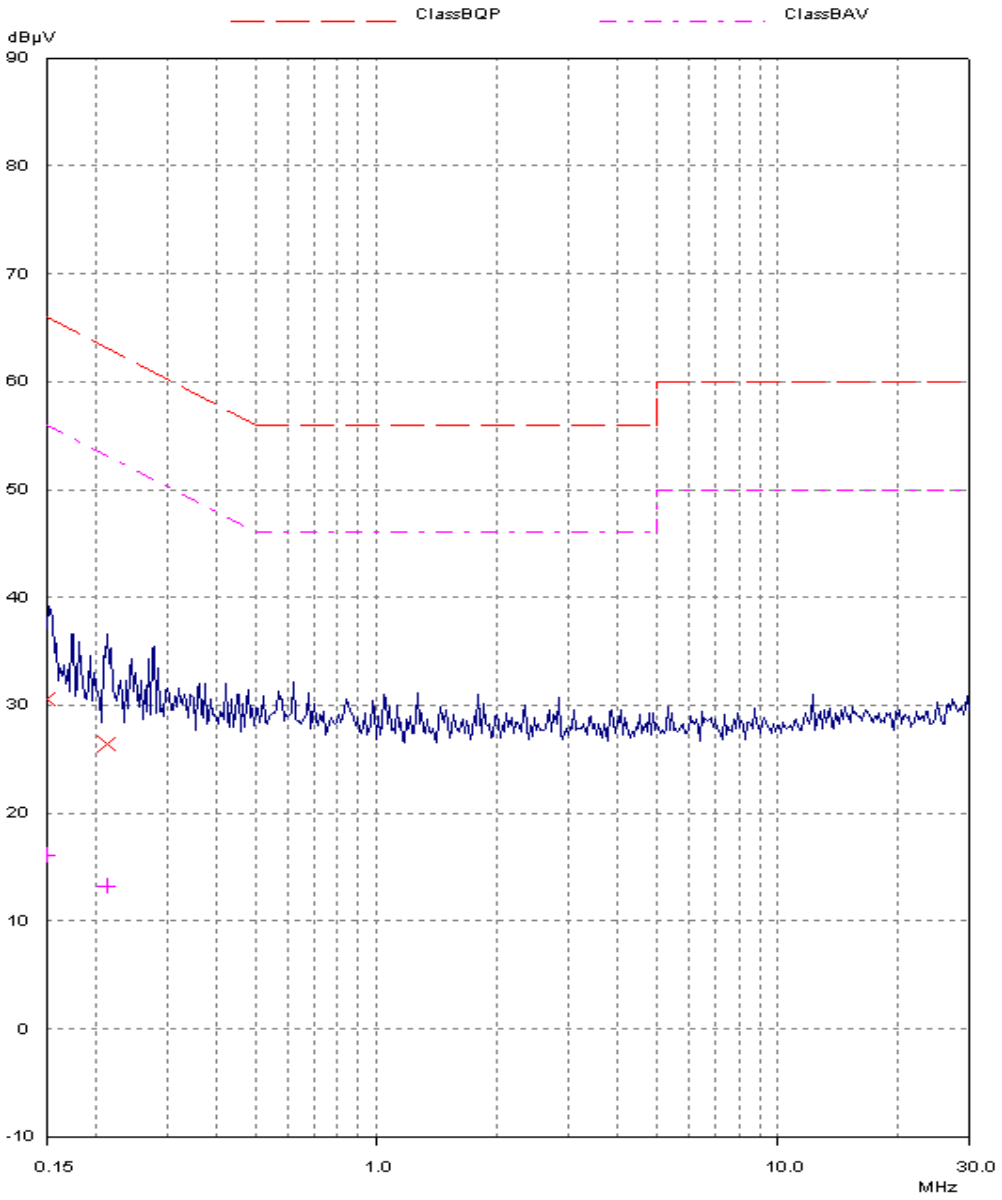
Frequency (MHz)	Line	Q-P Level (dBμV)	Q-P Limit (dBμV)	Margin (dB)	Result
0.150	Neutral	30.6	66.0	35.4	Complied
0.211	Neutral	26.4	63.2	36.8	Complied

Results: Average Detector Measurements On Live And Neutral Lines

Frequency (MHz)	Line	Av. Level (dBμV)	Av. Limit (dBμV)	Margin (dB)	Result
0.150	Live	16.1	56.0	39.9	Complied
0.211	Neutral	13.2	53.2	40.0	Complied

Test Of: **Sendo Ltd.**
M551 Mobile Telephone Handset.
To: **FCC Part 15, 22 & 24**

Receiver AC Conducted Spurious Emissions (Continued)



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

10.2. Idle Mode Radiated Emission: Section 15.109

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

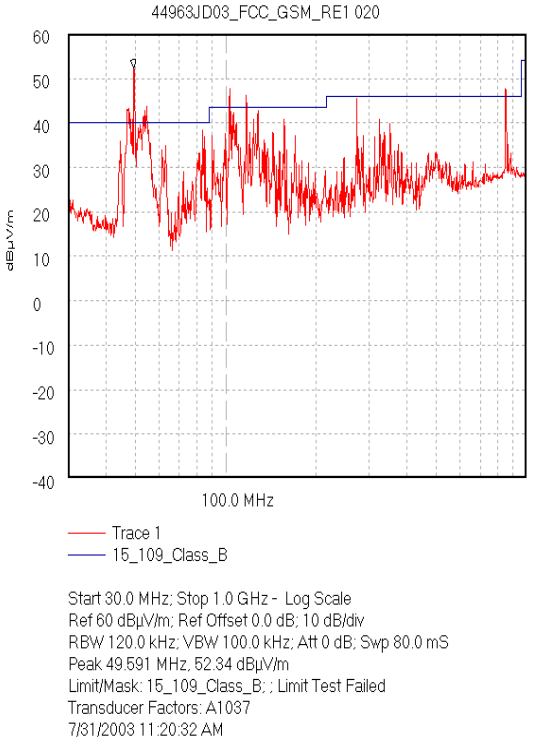
10.2.1.1. The EUT was configured as for radiated emissions testing as described in Section 11 of this report.

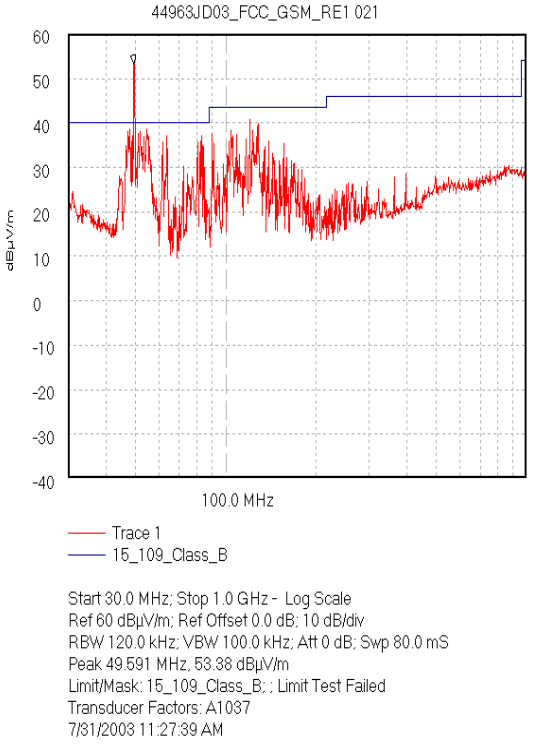
10.2.1.2. Tests were performed to identify the maximum receiver or standby radiated emissions levels.

Result:

Frequency (MHz)	Antenna. Polarity	Q-P Level (dBµV/m)	Q-P Limit (dBµV/m)	Margin (dB)	Result
103.716	Horiz.	26.5	43.5	17.0	Complied
116.986	Vert.	27.2	43.5	16.3	Complied
251.626	Vert.	30.6	46.0	15.4	Complied

Note: The emission at 49.591 MHz shown in plot 44949JD10_FCC_GSM_RE1_020 is an ambient emission emanating from the Will' Tek communication test set 4202S used to set up a link with the EUT. With the EUT powered off, it can be clearly seen, in background scan plot 44949JD10_FCC_GSM_RE1_021, That the emission at 49.591 MHz is still present and of equivalent amplitude. This emission was, therefore excluded.





Idle Mode Radiated Spurious Emission: Section 15.109 (Continued)

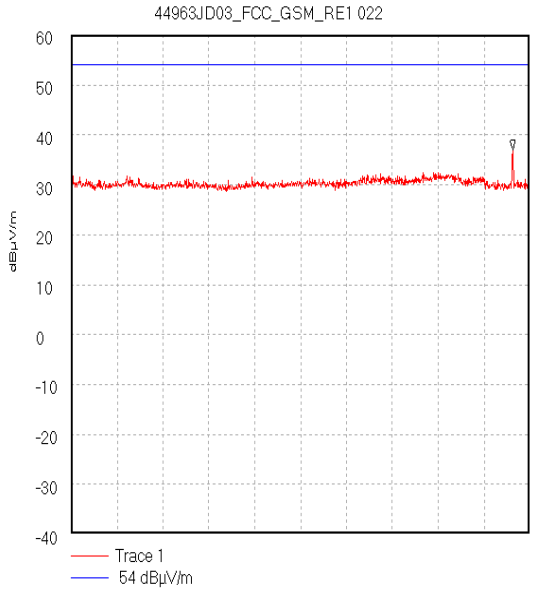
10.2.2. Electronic Field Strength Measurements (Frequency Range: 1.0 to 10.0 GHz)

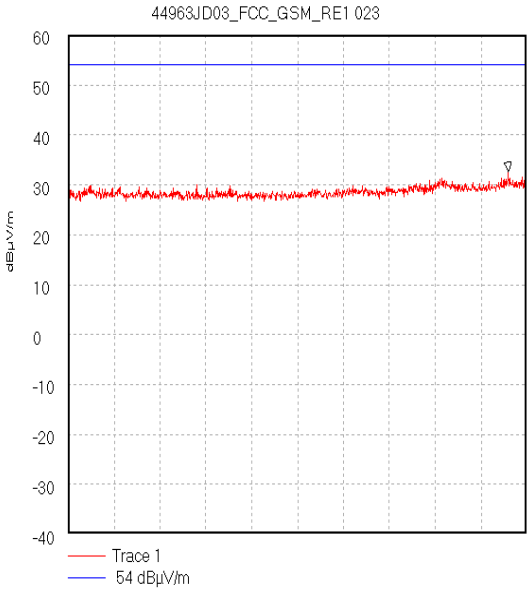
Highest Average Level:

Note: Not recorded, no spurious emissions were detected above the noise floor of the measuring receiver.

Highest Peak Level:

Note: No spurious emissions were detected above the noise floor of the measuring receiver, the highest peak noise floor reading of the measuring receiver recorded was 47.7 dBµV/m at 8.004 GHz.

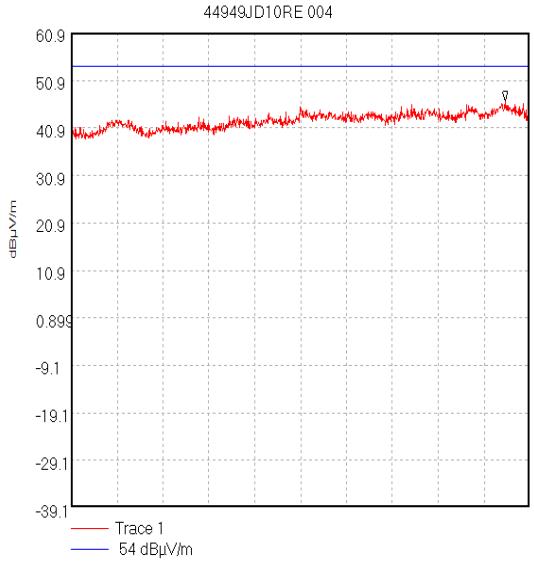




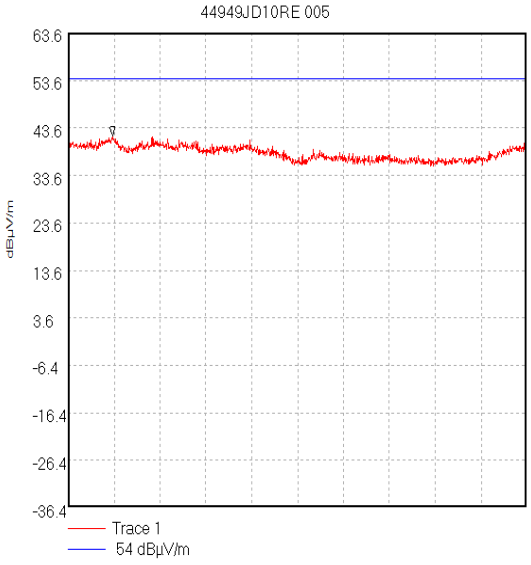
Note: these plots are pre-scans and for indication purposes only. For final measurements, see notes above..

Test Of: **Sendo Ltd.**
M551 Mobile Telephone Handset.
To: **FCC Part 15, 22 & 24**

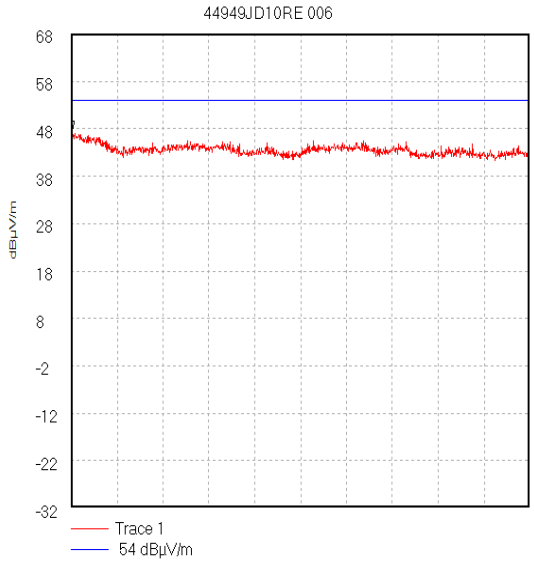
Idle Mode Radiated Spurious Emission: Section 15.109 (Continued)



Start 4.0 GHz; Stop 6.0 GHz
Ref 60.9 dBµV/m; Ref Offset 17.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 5.893 GHz, 46.56 dBµV/m
Display Line: 54 dBµV/m;
12/08/2003 14:34:27



Start 6.0 GHz; Stop 8.0 GHz
Ref 63.6 dBµV/m; Ref Offset 19.7 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 6.193 GHz, 41.97 dBµV/m
Display Line: 54 dBµV/m;
12/08/2003 14:47:19



Start 8.0 GHz; Stop 10.0 GHz
Ref 68 dBµV/m; Ref Offset 24.1 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 8.004 GHz, 47.72 dBµV/m
Display Line: 54 dBµV/m;
12/08/2003 14:52:47

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

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.	29.3	33.0	3.7	Complied
Middle	1879.8	Vert.	29.0	33.0	4.0	Complied
Top	1909.8	Vert.	31.3	33.0	1.7	Complied

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

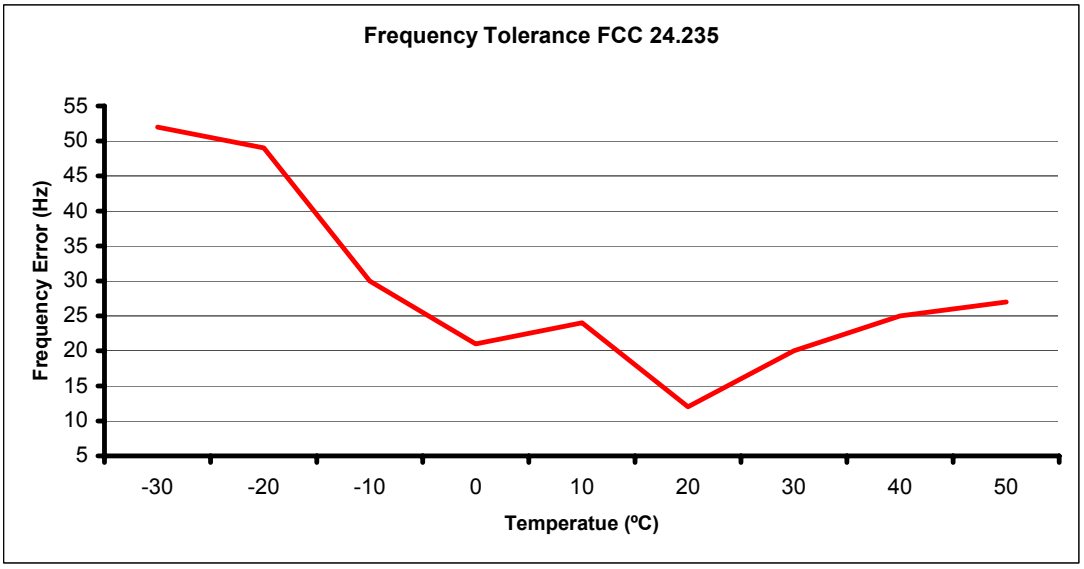
10.4.1. The EUT was configured as for frequency stability measurements as described in Section 11 of this report.

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 (ºC)	Frequency Error (Hz)	Measured Frequency (MHz)	Lower Band Edge Limit (MHz)	Margin (MHz)	Result
-30	52	1850.200052	1850.0	0.200052	Complied
-20	49	1850.200049	1850.0	0.200049	Complied
-10	30	1850.200030	1850.0	0.200030	Complied
0	21	1850.200021	1850.0	0.200021	Complied
10	24	1850.200024	1850.0	0.200024	Complied
20	12	1850.200012	1850.0	0.200012	Complied
30	20	1850.200020	1850.0	0.200020	Complied
40	25	1850.200025	1850.0	0.200025	Complied
50	27	1850.200027	1850.0	0.200027	Complied

Frequency Variation From 1850.2 MHz

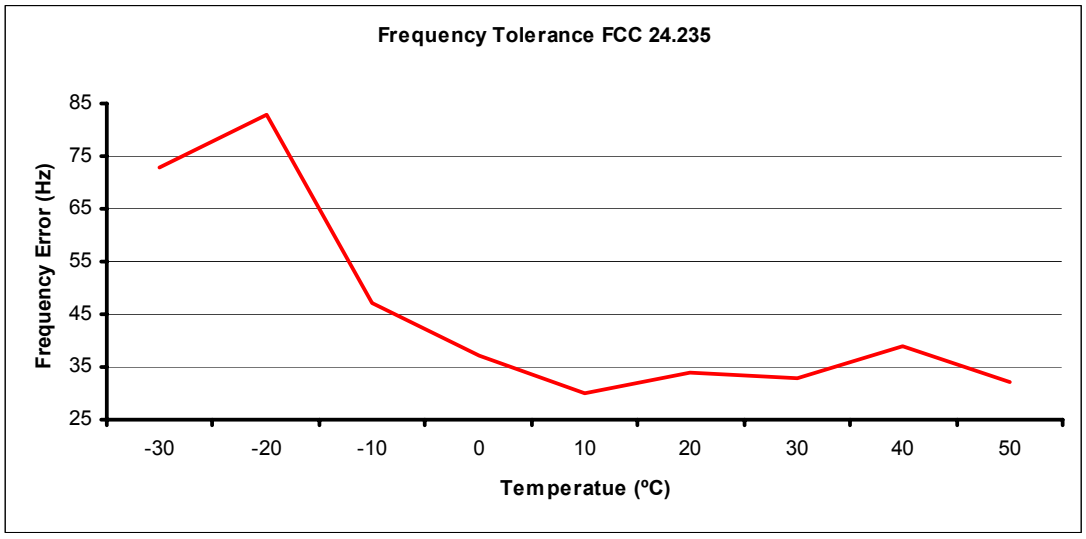


Transmitter Frequency Stability (Temperature Variation): Section 24.235 (continued)

Results Top Channel (1909.8 MHz)

Temp (ºC)	Frequency Error (Hz)	Measured Frequency (MHz)	Upper Band Edge Limit (MHz)	Margin (MHz)	Result
-30	73	1909.800073	1910.0	0.199927	Complied
-20	83	1909.800083	1910.0	0.199917	Complied
-10	47	1909.800047	1910.0	0.199953	Complied
0	37	1909.800037	1910.0	0.199963	Complied
10	30	1909.800030	1910.0	0.199970	Complied
20	34	1909.800034	1910.0	0.199966	Complied
30	33	1909.800033	1910.0	0.199967	Complied
40	39	1909.800039	1910.0	0.199961	Complied
50	32	1909.800032	1910.0	0.199968	Complied

Frequency Variation From 1909.8 MHz



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

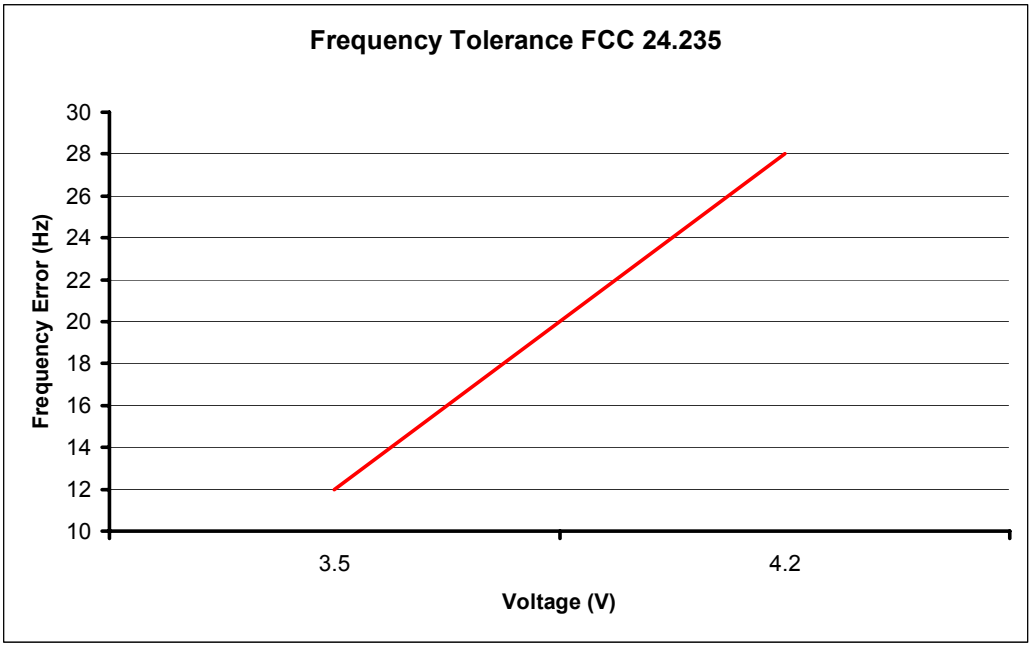
10.5.1. The EUT was configured as for frequency stability measurements as described in Section 11 of this report.

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
4.2	12	1850.200012	1850.0	0.200012	Complied
3.5	28	1850.200028	1850.0	0.200028	Complied

Frequency Variation From 1850.2 MHz

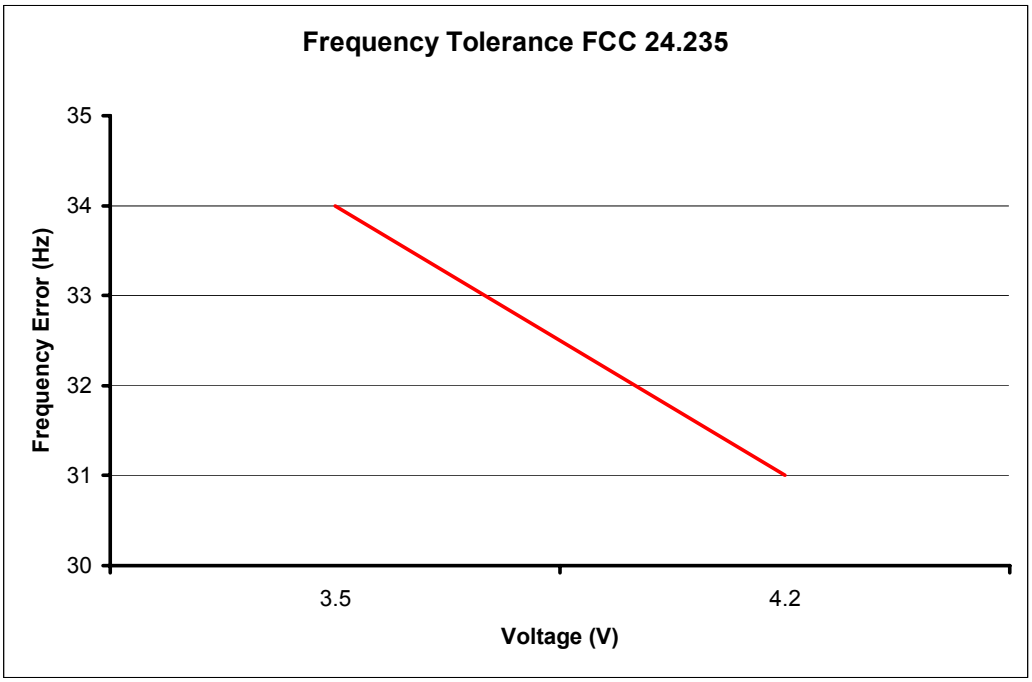


Transmitter Frequency Stability (Voltage Variation): Section 24.235 (Continued)

Results Top Channel (1909.8 MHz)

Supply Voltage (V)	Frequency Error (Hz)	Measured Frequency (MHz)	Lower Band Edge Limit (MHz)	Margin (MHz)	Result
4.2	34	1909.800034	1910.0	0.199966	Complied
3.5	31	1909.800031	1910.0	0.199969	Complied

Frequency Variation From 1909.8 MHz



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.

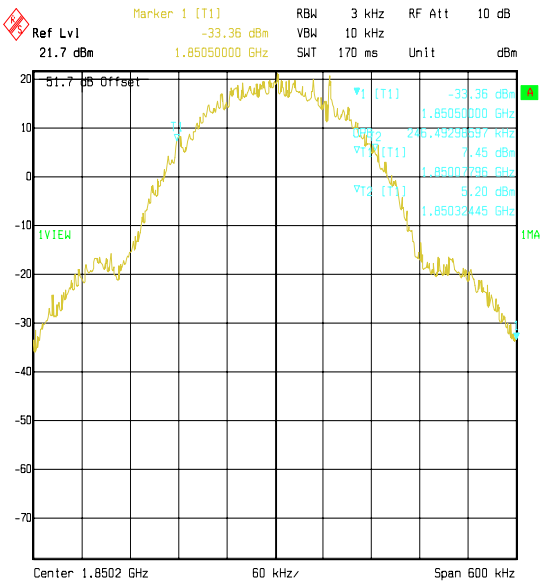
Results:

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	247.7
Top	1909.8	3.0	10.0	248.9

Test Of: **Sendo Ltd.**
M551 Mobile Telephone Handset.
To: **FCC Part 15, 22 & 24**

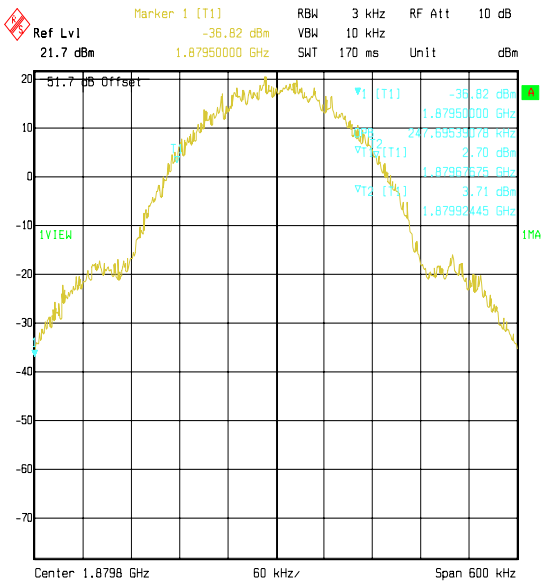
Transmitter Occupied Bandwidth: Section 24.238 (Continued)

Bottom Channel



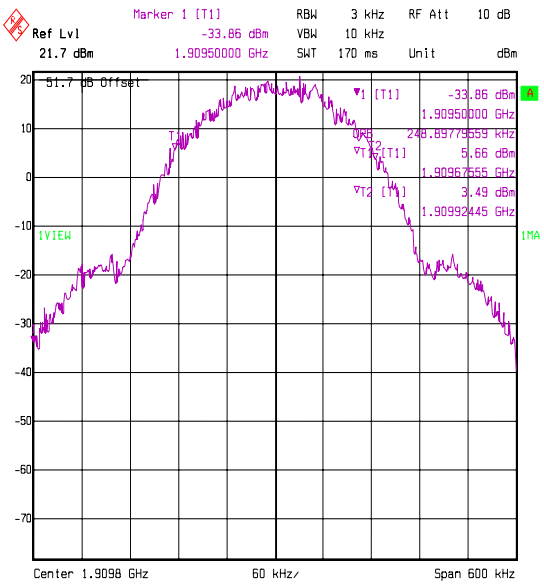
Title: OBW GSM1900 Band Bot Channel@Sendo M551
Comment A: 449490BW05
Date: 14.AUG.2003 8:33:03

Middle Channel



Title: OBW GSM1900 Band Mid Channel@Sendo M551
Comment A: 449490BW04
Date: 14.AUG.2003 8:30:36

Top Channel



Title: OBW GSM1900 Band Top Channel@Sendo M551
Comment A: 449490BW06
Date: 14.AUG.2003 8:38:41

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.

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

10.7.1. The EUT was configured as for 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
3700.4	-36.3	-13.0	23.3	Complied

Result: Middle Channel

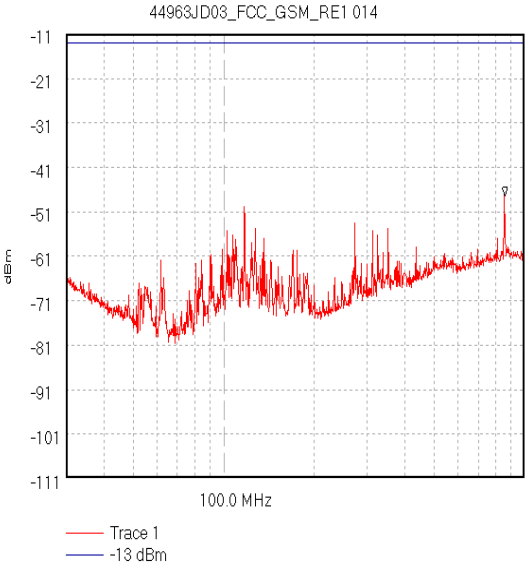
Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3759.6	-37.8	-13.0	24.8	Complied

Result: Top Channel

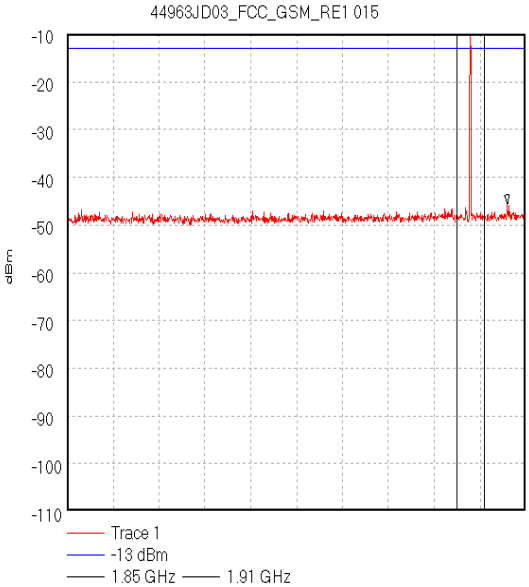
Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3819.6	-37.0	-13.0	24.0	Complied

Test Of: **Sendo Ltd.**
M551 Mobile Telephone Handset.
To: **FCC Part 15, 22 & 24**

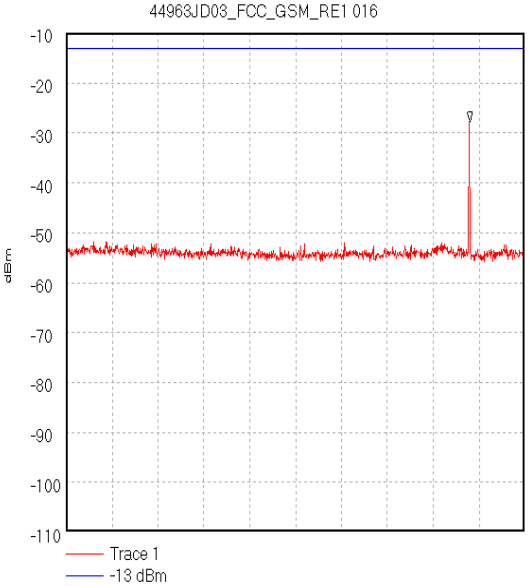
Transmitter Out of Band Emissions: Section 2.1053/24.238 (Continued)



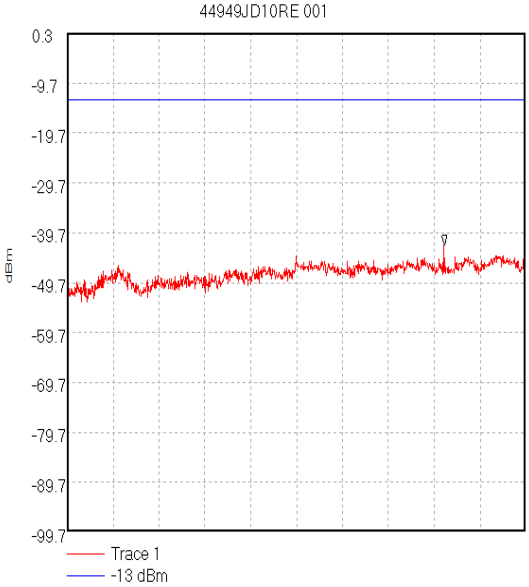
Start 30.0 MHz; Stop 1.0 GHz - Log Scale
Ref -11 dBm; Ref Offset 10.0 dB; 10 dB/div
RBW 120.0 kHz; VBW 100.0 kHz; Att 0 dB; Swp 80.0 mS
Peak 859.03 MHz, -47.46 dBm
Display Line: -13 dBm; ; Limit Test Passed
Transducer Factors: A1037
7/31/2003 10:31:44 AM



Start 1.0 GHz; Stop 2.0 GHz
Ref -10 dBm; Ref Offset 37.0 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Marker 1.96 GHz, -45.6 dBm
Display Line: -13 dBm; ; Limit Test Failed
7/31/2003 10:35:28 AM



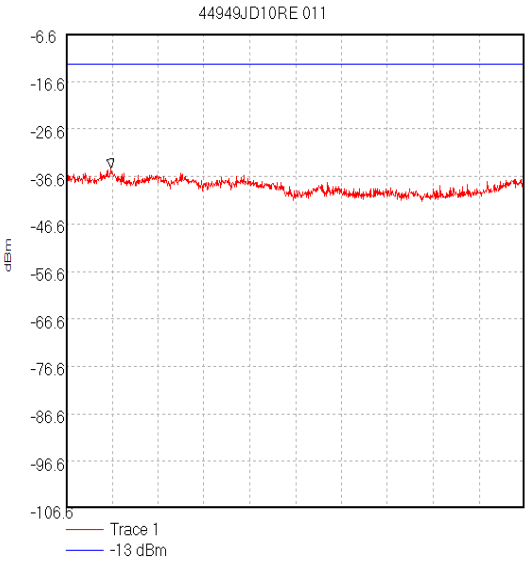
Start 2.0 GHz; Stop 4.0 GHz
Ref -10 dBm; Ref Offset 36.0 dB; 10 dB/div
RBW 1000.0 kHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 3.76 GHz, -27.67 dBm
Display Line: -13 dBm; ; Limit Test Passed
7/31/2003 10:42:03 AM



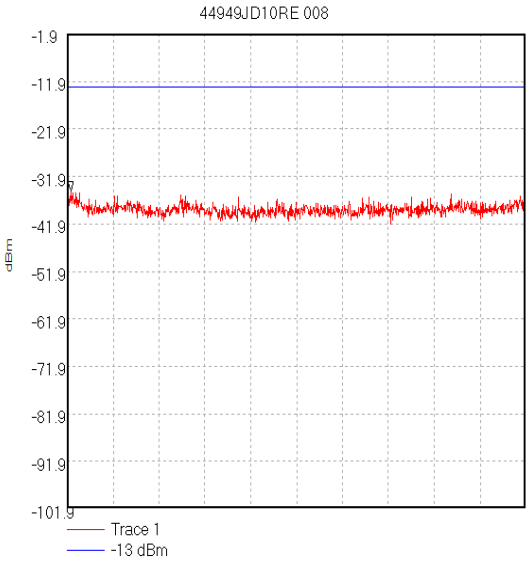
Start 4.0 GHz; Stop 6.0 GHz
Ref 0.3 dBm; Ref Offset 30.3 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 5.644 GHz, -42.23 dBm
Display Line: -13 dBm;
12/08/2003 14:02:46

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

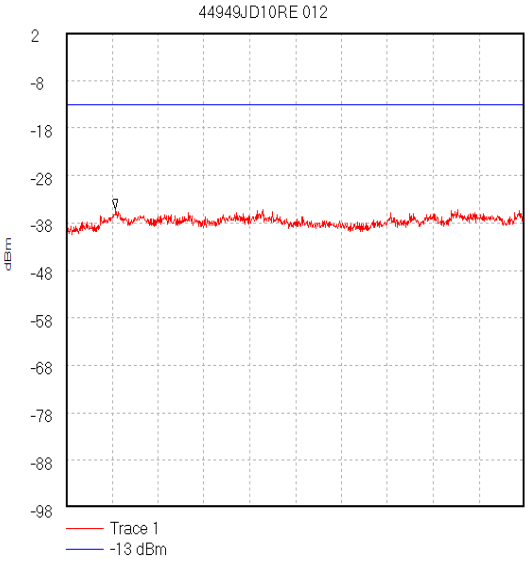
Test Of: **Sendo Ltd.**
M551 Mobile Telephone Handset.
To: **FCC Part 15, 22 & 24**



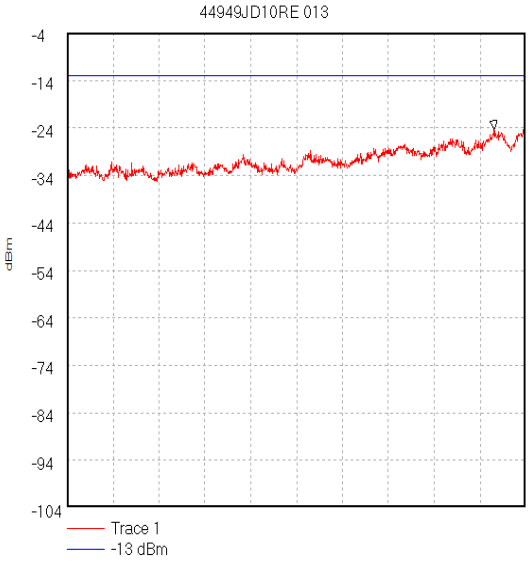
Start 6.0 GHz; Stop 8.0 GHz
Ref -6.6 dBm; Ref Offset 33.4 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 20.0 mS
Peak 6.196 GHz, -34.81 dBm
Display Line: -13 dBm;
12/08/2003 15:18:00



Start 8.0 GHz; Stop 12.5 GHz
Ref -1.9 dBm; Ref Offset 38.1 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 10 dB; Swp 20.0 mS
Peak 8.035 GHz, -35.01 dBm
Display Line: -13 dBm;
12/08/2003 15:05:00



Start 12.5 GHz; Stop 18.0 GHz
Ref 2 dBm; Ref Offset 42.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 40.0 mS
Peak 13.093 GHz, -35.07 dBm
Display Line: -13 dBm;
12/08/2003 15:53:20



Start 18.0 GHz; Stop 25.0 GHz
Ref -4 dBm; Ref Offset 46.0 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 40.0 mS
Peak 24.518 GHz, -24.31 dBm
Display Line: -13 dBm;
12/08/2003 15:58:49

Note: these plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables. If any final emission measurement fell below the limit by more than 20dB it was not recorded.

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

10.8.1. The EUT was configured as for 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 band that the EUT will operate over.

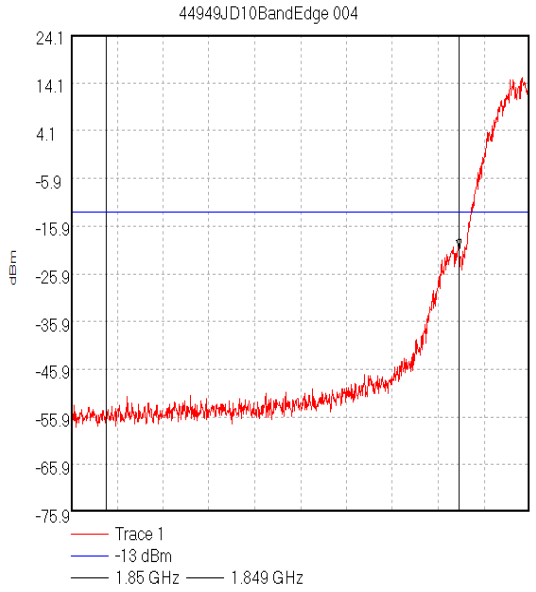
Results:

Bottom Band Edge

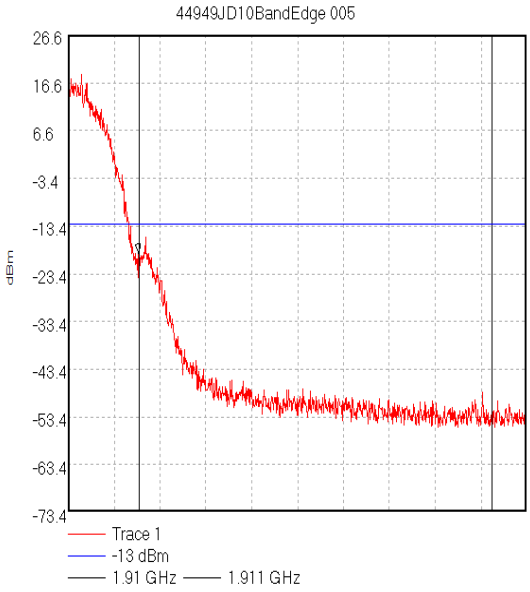
Frequency (MHz)	Spurious Emission (dBm)	Limit (dBm)	Margin (dB)	Result
1850.0	-20.1	-13.0	7.1	Complied

Top Band Edge

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
1910.0	-15.7	-13.0	2.7	Complied



Centre 1.84955 GHz; Span 1.3 MHz
Ref 24.1 dBm; Ref Offset 34.1 dB; 10 dB/div
RBW 0.0 Hz; VBW 30.0 kHz; Att 20 dB; Swp 440.0 mS
Marker 1.85 GHz, -20.66 dBm
Display Line: -13 dBm; ; Limit Test Passed
13/08/2003 10:55:27



Centre 1.91045 GHz; Span 1.3 MHz
Ref 26.6 dBm; Ref Offset 36.6 dB; 10 dB/div
RBW 0.0 Hz; VBW 30.0 kHz; Att 20 dB; Swp 440.0 mS
Marker 1.91 GHz, -19.15 dBm
Display Line: -13 dBm; ; Limit Test Passed
13/08/2003 11:01:53

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 as required by EIA/TIA-603-B.

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 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 level 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 maximum amplitude had been obtained, the EUT was substituted with a horn antenna.

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 PAD.

The signal generator was tuned to the EUT's frequency under test.

Effective Isotropic Radiated Power (EIRP) (Continued)

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:-

EIRP = Signal Generator Level - Cable Loss + Antenna Gain

Circumstances where the signal generator could not produce the desired power level, 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.

Delta (dB) = EUT – 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:

EIRP SG= Signal Generator Level - Cable Loss + Antenna Gain

The EUT EIRP is calculated as:

EIRP EUT = EIRP SG + Delta.

11.2. Frequency Stability

The EUT was situated within an environmental test chamber and coupled 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 Deg C.

Measurements were also performed at voltage extremes between the declared nominal supply voltage and at the declared endpoint voltage.

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 using the GSM test set described in Appendix 1.

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. If this margin is positive, the result is compliant. If it goes negative, the result is a non-compliance. There is also a frequency graph presented offering the frequency variation around nominal frequency.

11.3. Occupied Bandwidth

The EUT was coupled to a spectrum analyser enabled with an occupied bandwidth function and to a GSM test set.

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 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 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 FSEB user manual for this measurement, i.e., RBW <= 1/20 of occupied bandwidth. A value of 3 kHz was used.

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.

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.

During the swept measurements (and also during subsequent final measurements on single frequencies) 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.

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

11.5. 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 'n' times the highest fundamental frequency stated in section 2.5 of this report where 'n' is either 5 or 10 dependant upon whether the emission was produced via a transmitter/receiver or idle mode.

The pre-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.

The initial scans were performed using an antenna height of 1.5 m and at 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 was then used with the EUT being set to the appropriate test distance.

A measurement 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 above procedure was repeated for the horizontal polarisation.

Once the final amplitude (maximised) had been obtained, the EUT was substituted with an 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.

Radiated Emissions (Continued)

The substitution antenna was matched into a signal generator using a 6dB or greater PAD.

The signal generator was tuned to the spurious emission frequency under investigation.

The test antenna was raised and lowered to obtain a maximum reading on the spectrum analyser.

The level of the signal generators output was then adjusted until the maximum level recorded earlier from the EUT 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:-

EIRP/ERP = Signal Generator Level - Cable Loss + Antenna Gain

The standard states that an emission shall either be attenuated by at least 43+10 Log(P) dB below the transmitter power (P) for transmitters, where (P) is the maximum measured fundamental power for the channel under test, or at the limit specified in part 15.109/209 for receivers or idle modes.

The transmit limit always reduces to –13dBm as such, the limit line presented on the accompanying plots is set to –13dBm.

Any spurious emission measured is compared to the –13dBm limit or that specified in part 15. The requirement is for the emission to be less than the relevant limit to show 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 bandwidth were invariable calculated as a fraction, thus the next largest bandwidth was used. This was found to be 3 kHz

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 30.0 MHz	95%	+/- 3.25 dB
Effective Radiated power / Effective Isotropic Radiated Power (ERP / EIRP)	Not applicable	95%	+/- 1.78 dB
Frequency Stability	Not applicable	95%	+/- 20 Hz
Occupied Bandwidth	Not applicable	95%	+/- 0.12 %
Radiated Spurious Emissions	30.0 MHz to 1000.0 MHz	95%	+/- 5.26 dB
Radiated Spurious Emissions	1.0 GHz to 26.0 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.

Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.
A003	ESH3-Z2 Pulse Limiter	Rohde & Schwarz	ESH3-Z2	357 881/052
A027	Horn Antenna	Eaton	9188-2	301
A031	2 to 4 GHz Eaton Horn Antenna	Eaton	91889-2	557
A059	3146 Log Periodic Antenna	EMCO	3146	8902-2378
A067	LISN	Rohde & Schwarz	ESH3-Z5	890603/002
A1255	Power supply	Farnell	11E302BT	000263
A244	20 dB Attenuator	Schaffner	6820-17-B	None
A248	60 dB Variable Attenuator	Narda	743-60	01411
A253	WG 12 Microwave Horn	Flann Microwave	12240-20	128
A254	WG 14 Microwave Horn	Flann Microwave	14240-20	139
A255	WG 16 Microwave Horn	Flann Microwave	16240-20	519
A259	Bilog Antenna	Chase	CBL6111	1513
A392	3 dB attenuator (9)	Suhner	6803.17.B	None
A430	WG 18 Microwave Horn	Flann	18240-20	425
A435	WG 22 Microwave Horn	Flann	22240-20	400
E013	PCN Environmental Chamber	Sanyo	ATMOS chamber	None
M003	Spectrum Monitor	Rohde & Schwarz	EZM	883 580/008
M023	ESVP Receiver	Rohde & Schwarz	ESVP	872 991/027
M028	FSB Spectrum Analyser	Rohde & Schwarz	FSB	860 001/009 (RF), 860 161/007 (Display)
M072	FSM Spectrum Analyser	Rohde & Schwarz	FSM	862 967/010 (RF) & 863 912/048 (Display)
M088	Receiver / Spectrum Analyser System	Rohde & Schwarz	ESBI	DU:835862/018 RU:835387/006
M1013	GSM Test set	Hewlett Packard	8922M	3503U00372

Test Equipment Used (Continued)

RFI No.	Instrument	Manufacturer	Type No.	Serial No.
M1014	DCS Test set	Hewlett Packard	83220E	3741U02702
M1093	Will tek	Will tek	4202S	0513018
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016
M139	Digital Multimeter	Fluke	11	65830028
S201	Site 1	RFI	1	
S202	Site 2	RFI	2	S202-15011990
S212	Site 12	RFI	12	

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

Appendix 2. Test Configuration Drawings

This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\44949JD10\EMICON	Test configuration for measurement of conducted emissions
DRG\44949JD10\EMIRAD	Test configuration for measurement of radiated emissions

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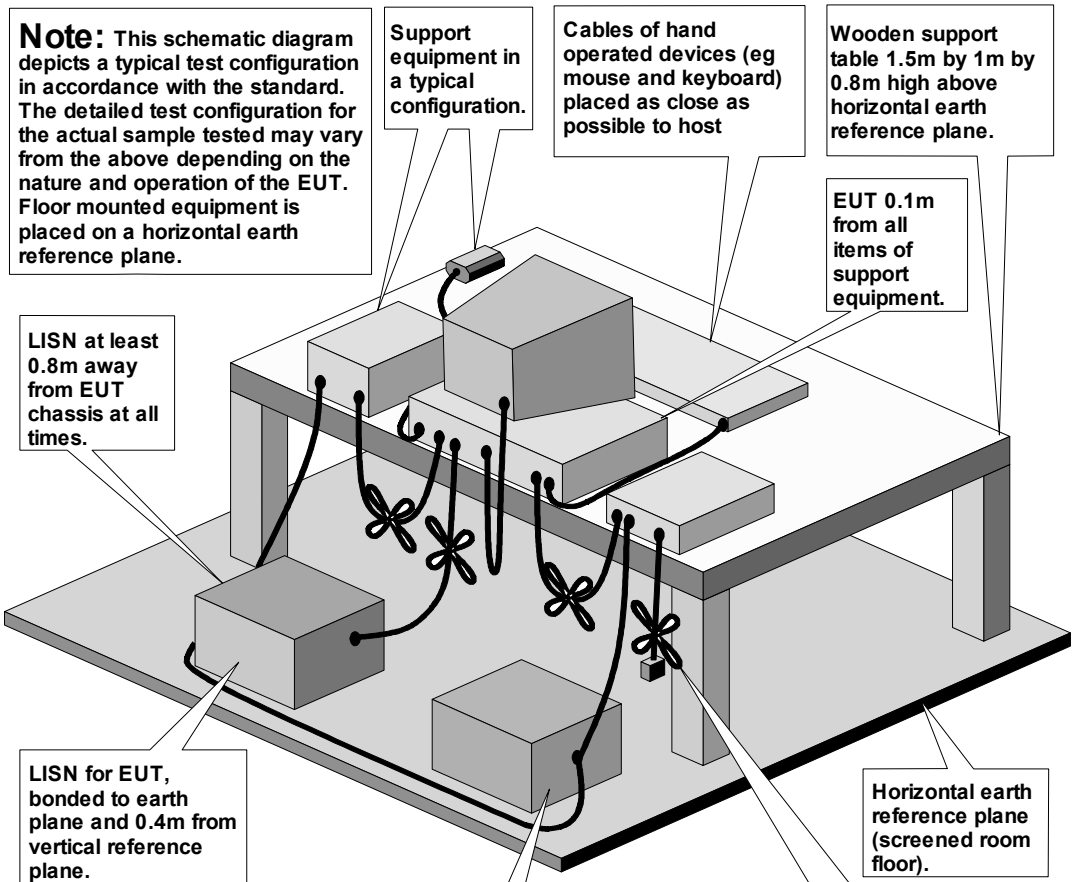
Test Of: Sendo Ltd.
M551 Mobile Telephone Handset.
To: FCC Part 15, 22 & 24

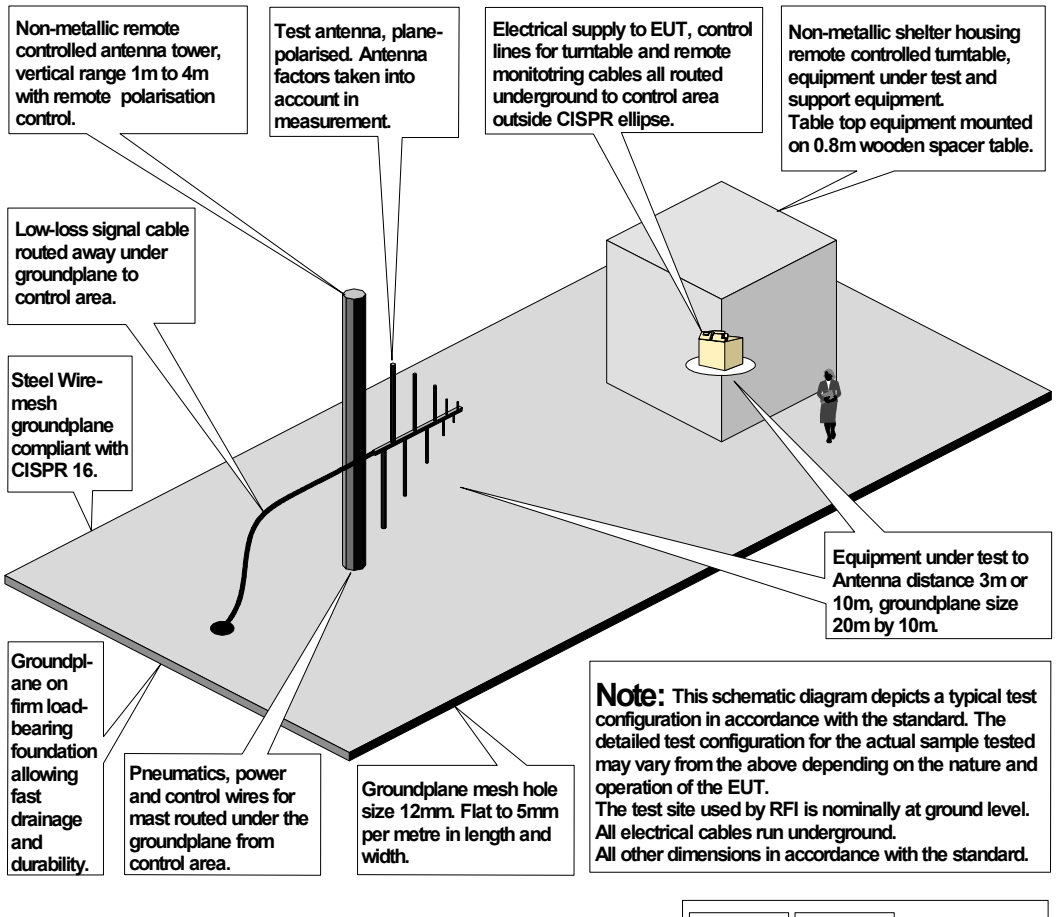
DRG\44949JD10\EMICON



Typical Test Configuration For Conducted Emissions Measurements In Accordance With ANSI C63.4-1992
Tests performed in a screened enclosure

Test Of: **Sendo Ltd.**
M551 Mobile Telephone Handset.
To: **FCC Part 15, 22 & 24**

DRG\44949JD10\EMIRAD



Note: This schematic diagram depicts a typical test configuration in accordance with the standard. The detailed test configuration for the actual sample tested may vary from the above depending on the nature and operation of the EUT.
The test site used by RFI is nominally at ground level.
All electrical cables run underground.
All other dimensions in accordance with the standard.

Test Configuration For Radiated Emissions Measurements

Reflection-free area: >60m by 52m (CISPR ellipse)
Groundplane Earthed
Control room outside CISPR ellipse