THE STANDARDS INSTITUTION OF ISRAEL

Electronics & Telematics Laboratory

Test Report No. 9012353272

Applicant: Objet Geometries Ltd.

Equipment Under Test:

RFID module

FCC ID: *YH6-RFID*

From The Standards Institution
Of Israel
Industry Division
Electronics & Telematics Laboratory
EMC Section

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Test Report No.: 9012353272 **Page 1 of 19 pages**

Title: RFID module; **Model: Reader BRD-03014, antenna board BRD-03012**

Applicant:	Objet Geometries Ltd.
Address:	6 Holzman St., Science Park, P.O.B 2496, Rehovot 76124, Israel
Sample for test selected by:	The customer
The date of test:	2, 11 August 2010

Description of Equipment Under Test (EUT):	Assembly of RFID reader and two antenna boards.
Model:	Reader BRD-03014, antenna board BRD-03012
Serial number:	NA
Manufactured by:	Logitag Ltd

Reference Documents:

- CFR 47 FCC: Rules and Regulations; Part 15. "Radio frequency devices";
  Subpart B: "Unintentional radiators" (2009).
  Section 15.109. Radiated emission limits.
  Subpart C: "Intentional radiators" (2009),
  Section 15.207. Conducted limits
  Section 15.209. "Radiated emission limits, general requirements".

This Test Report contains 19 pages and may be used only in full.	This Test Report applies only to the specimen tested and may not be applied to other specimens of the same product.

1. Test summary

Parameter	FCC Part 15 Reference paragraph	Verdict
Radiated emission test.	Subpart C Section 15.209.	Comply
Radiated emission test.	Subpart B Section 15.109 class A	Comply
Conducted emissions test	Subpart C Section 15.207	Comply

Telematics Laboratory

August 2010

Name: Eng. Yuri Rozenberg
Position: Head of EMC Branch

Name: Michael Feldman
Position: Test Technician

Measurement uncertainty.

Were relevant, the following measurement uncertainty level have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:
This uncertainty represents an expended uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Test description	Expanded uncertainty
Radiated emissions in the open field test site at 3 m measuring distance: 30 MHz – 1.0 GHz 1.0 GHz – 18 GHz	 2 Uc (E) = ± 4.32 dB 2 Uc (E) = ± 4.47 dB

Table of Contents

2. EUT Description and operation

2.1. General description:

* Note: the customer supplied all information in clause below.

The EUT is RFID transceiver installed inside 3D printer. Product's main functions are read and write data from RFID Tags attached to the resin material cartridges. Its intended use is to identify the kind of resin, expiration date, physical properties of the resin etc.
Interface is RS-232 connected internally inside a 3D printer.

Transmit frequency:	125 kHz
Type of modulation:	AM
Antenna type:	Loop coil mfr. Logitag mod. BRD-03012

The EUT is powered from printer internal P.S 24VDC.
The EUT block diagram is shown in Figure 1.
The EUT's views are shown in photos #1.

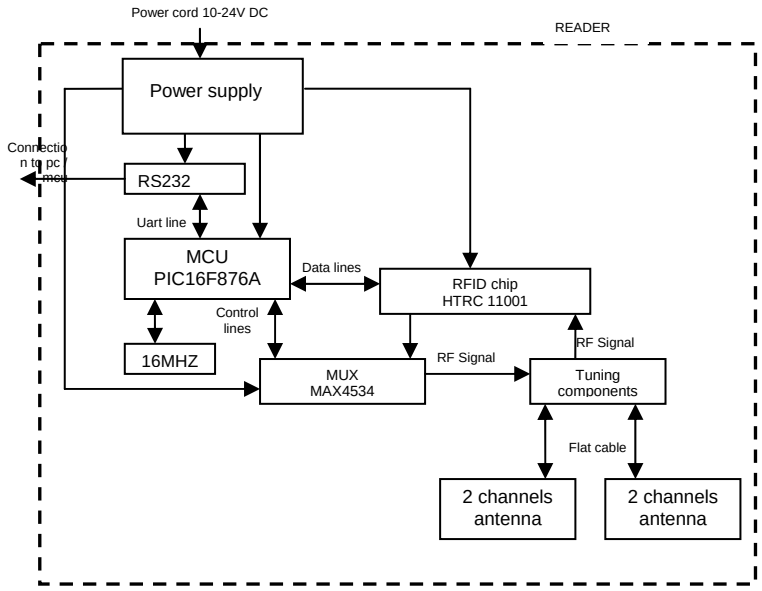


Figure 1. The EUT block-diagram.

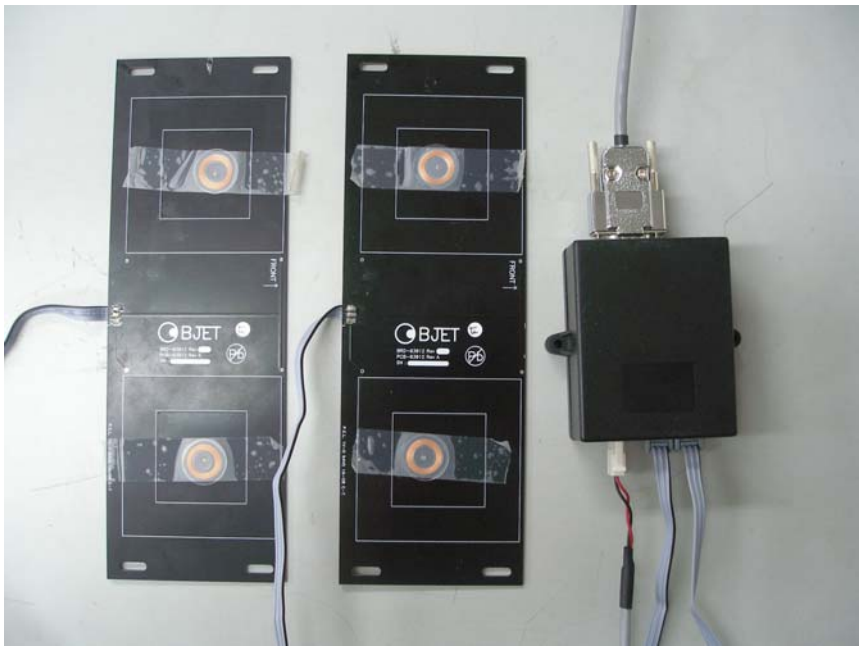
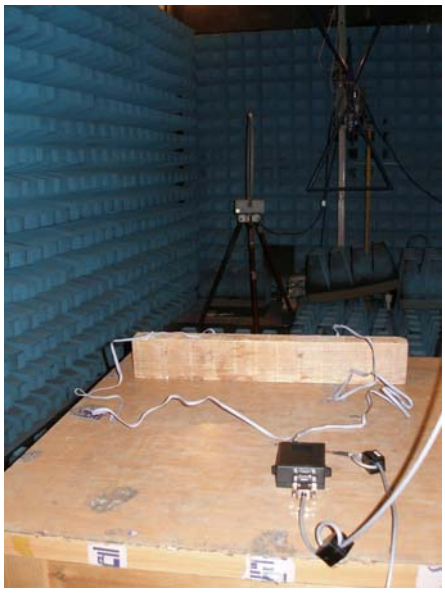


Photo 1. EUT's external view.



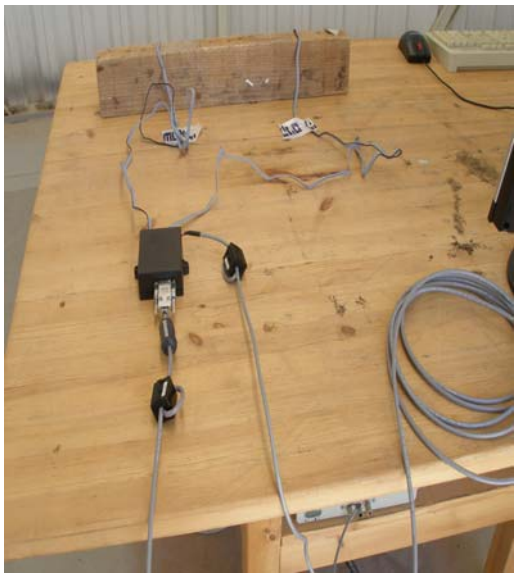


Photo 2. RE test setup.

Photo 3. RE test setup in Anechoic chamber.

Photo 4. RE test setup on OATS.

2.2. Potential emission sources:

The potential emission sources are detailed in Table 1.

Table 1. Potential emission sources

Frequency	Location
125 kHz	RFID (derived from 16 MHz)
16.0 MHz crystal	CPU

2.3. EUT setup and operation:

Measurements of transmitter were performed in continue transmition mode by simulating all four channel antennas and using Max Hold mode.

3. Measurements, examinations and derived results

3.1. Location of the Test Site:

Preliminary radiated test was conducted at the EMC laboratory of the Standards Institution of Israel in Tel-Aviv.

The final radiated emission test was conducted in an Open Area Test Site located at Kibbutz Native Halamed Hai in Emek HaEla, Israel.

3.2. Test condition:

Temperature: 24°C. Humidity: 63 %. Atmospheric pressure: 1012 mbar.

3.3. Initial visual check and functional test:

Initial visual check and brief built- in- test of the EUT was performed before testing.

- No external damages were found.
- The test on the EUT passed successfully.

3.4. Radiated emission test.

3.4.1. General:

Per FCC Part 15 subpart B, C Sections 15.109, 15.209

3.4.2. Preliminary radiated emission tests:

Preliminary investigation measurements were performed up to tenth harmonic of fundamental in a semi-anechoic chamber at distance 3 meter. The EUT was setup in its typical configuration and operated in its various modes. For each mode of operation the frequency spectrum was monitored. EUT configuration, cable configuration and mode of operation, which produced the maximum level of emission, were documented. A list of frequencies to be tested was prepared.

3.4.3. Final measurements procedure:

The final radiated emission measurements were performed at the Open Area Test Site at the same (3 m) test distance. The EUT was operated as described above. The EUT was installed on a turn - table. Measurements were performed with active loop antenna at frequencies below 30 MHz and with Biconilog 30 MHz-2 GHz antenna above 30 MHz. The measurements were performed at each frequency that was founded previously at which the signal level was 10 dB below the limit or less. The levels were maximized by rotating turntable through 360° and changing antenna-to-EUT polarization from vertical to horizontal. The worse case result was noted in tables.

3.4.4. Changes performed in EUT during the tests:

To withstand RE test according part 15.109 class A on OATS three ferrite beads mfr. Fair-Rite were added on cables: p/n 0443167251 (15cm from connector) and p/n 0431164281 (7.5cm from connector) on cable RSS-232. Ferrite bead p/n 0443167251 was added on cable DC (12cm from connector). The mentioned ferrite beads were used during all performed tests.

3.4.5. Radiated emission test results:

All received emissions from the RFID transmitter were found below FCC Part 15 Subpart C sections 15.209 and below FCC part 15.109 class A limit for digital part. Final result measurements are presented in tables #2, #3 in sections 3.5.5 and .3.7.

3.5. Test of field strength emission from intentional radiator.

3.5.1. General:

Per FCC Part 15 Subpart C section 15.209 (a).

3.5.2. Requirements:

The EUT's operation frequency is 125 kHz.
The average field strength emission from intentional radiators operated on this frequency shall comply with the limit of section 15.209 (a).

Emission frequency MHz	Specified Field Strength limit of Fundamental μV/m@300m	Calculated Field Strength limit dBμV/m@3m
0.125	2400/F	105.6

Note: The field strength limit was calculated with 40 dB/decade linear distance extrapolation factor.

The field strength of any unwanted emissions shall not exceed the general radiated emission limits in § 15.209.

3.5.3. Test procedure:

The test was conducted according to clause 15.209.

3.5.4. Test summery:

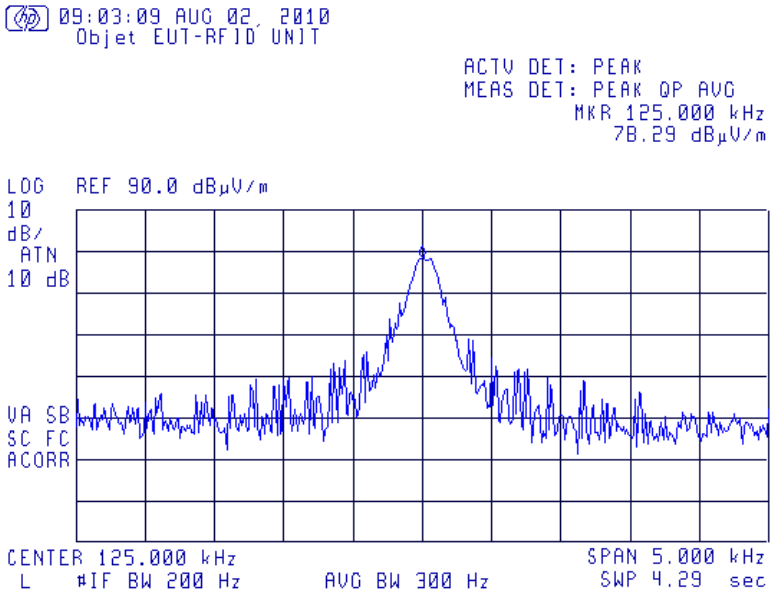
The tested unit meets the standard requirement.

3.5.5. Test results:

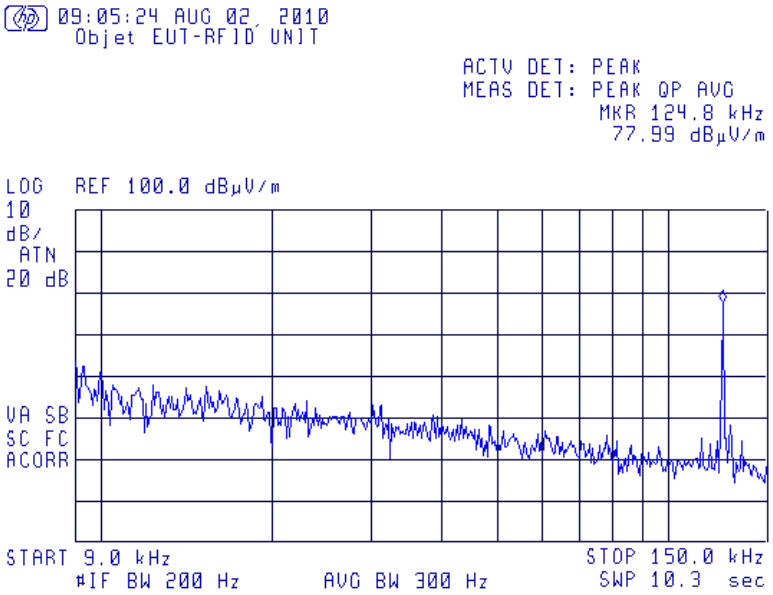
Table # 2. Fundamental frequency test result

Carrier frequency MHz	Average amplitude dBµV/m	Limit@ 3m dBµV/m
0.125	77.5	105.6

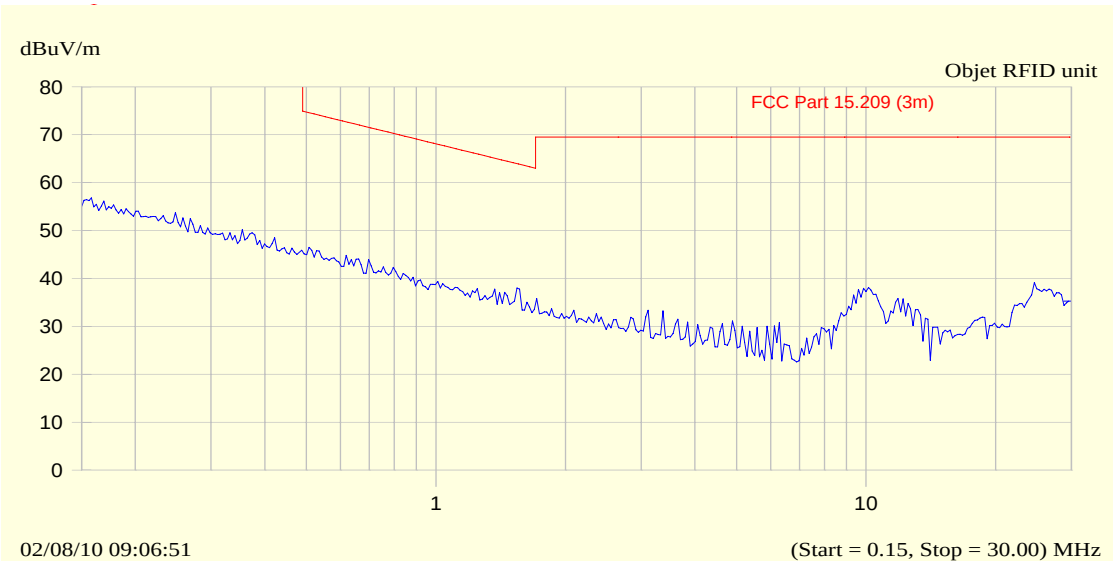
For recorded fundamental frequency result see plot #1.
The received radiated emission result was found below the § 15.209 specified limit.
Investigation scans of spurious emission present in plots #2 and #3



Plot # 1. Field strength of fundamental frequency 125 kHz.



Plot # 2. Frequency scan 0.09 - 0.15 MHz. Test distance =3m.



Plot # 3. Frequency scan 0.15 – 30 MHz. Test distance =3m.

3.6. AC main conducted emissions test

Per FCC Part 15 subpart C Section 15.207

Test configuration:

The EUT was placed on a non-metallic table in a shielded room at a height of 80 cm from the floor and 40 cm from the vertical ground plane (wall) of the room.

3.6.1. Test procedure:

The EUT was operated in charging mode.
First, initial scans were performed. Final measurements were performed at the frequencies where emission exceeded the tolerance limit.

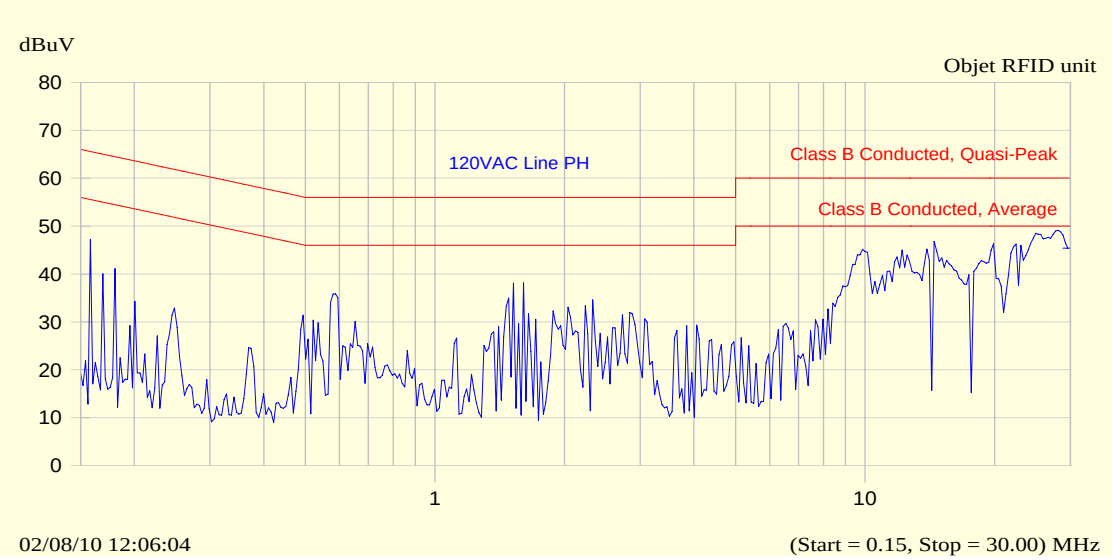
Test equipment (EMI receiver) setup was as follow:

Initial scan:	
Detector type	Peak
Mode	Max hold
Bandwidth	9 kHz
Sweep time	>100 msec

Measurements:	
Detector type	Quasi-peak (CISPR), Average
Bandwidth	9 kHz
Observation	>15 seconds

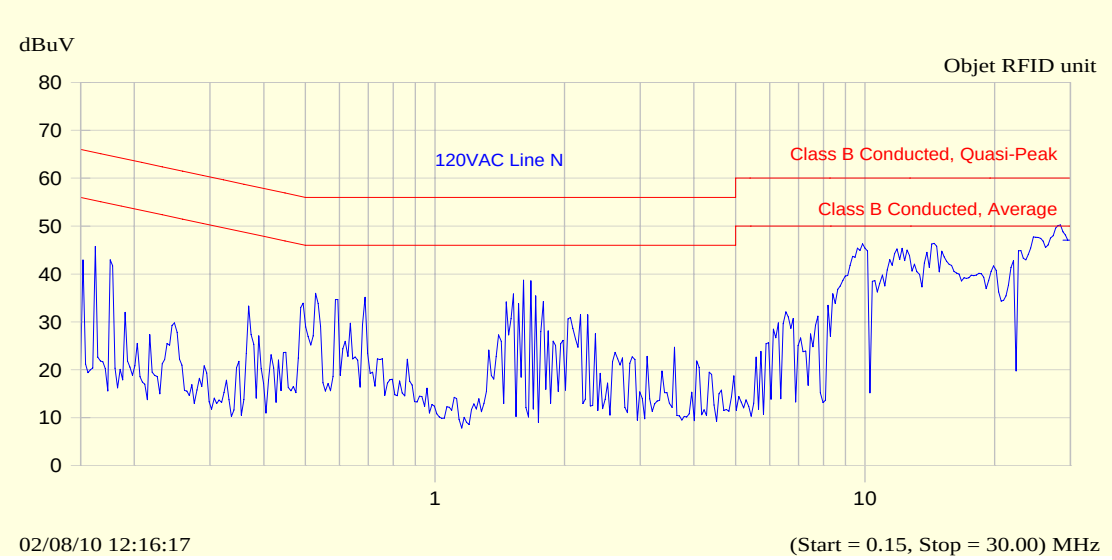
3.6.2. Test results:

All received emissions from EUT were found below FCC Part 15.207 limits (see plots ##4, 5 below).



Frequency MHz	Peak dBµV	QP dBµV	QP Limit dBµV	Margin dB	Avg dBµV	Avg Limit dBµV	Margin dB
0.532	41.3	38.6	56.0	-17.4	35.0	46.0	-11.0
1.540	40.2	31.4	56.0	-24.6	9.9	46.0	-36.1
10.001	45.1	44.6	60.0	-15.4	43.7	50.0	-6.3
11.752	47.0	45.9	60.0	-14.1	43.5	50.0	-6.5
14.753	46.6	46.2	60.0	-13.8	45.1	50.0	-4.9
20.128	46.6	46.0	60.0	-14.0	45.4	50.0	-4.6
28.130	49.5	49.0	60.0	-11.0	48.4	50.0	-1.6

Plot # 4. Tested line Phase



Frequency MHz	Peak dBµV	QP dBµV	QP Limit dBµV	Margin dB	Avg dBµV	Avg Limit dBµV	Margin dB
0.531	38.8	35.7	56.0	-20.3	32.7	46.0	-13.3
10.002	46.4	45.7	60.0	-14.3	45.5	50.0	-4.5
11.752	45.9	45.2	60.0	-14.8	44.0	50.0	-6.0
14.753	46.2	45.7	60.0	-14.3	45.1	50.0	-4.9
20.128	41.1	41.0	60.0	-19.0	39.7	50.0	-10.3
28.130	46.8	46.4	60.0	-13.6	45.3	50.0	-4.7

Plot # 5. Tested line Neutral

3.7. Test of radiated emissions from unintentional radiator

Per FCC Part 15 subpart B Section 15.109

3.7.1. Test procedure:

The EUT was on at normal performance.
First, initial scans were performed. Final measurements were performed according to clause 3.4.3.

Initial scan:	
Detector type	Peak
Mode	Max hold
Bandwidth	120 kHz
Sweep time	>1 seconds/MHz

Measurements:	
Detector type	Quasi-peak (CISPR)
Bandwidth	120 kHz
Measurement time	20 seconds/MHz

3.7.2. Radiated emission test results:

All received emissions were found below FCC Part 15 class A limits and presented in table # 3 below.

Table 3. Radiated emission test results
Subpart B class A 10m distance.

Frequency (MHz)	Antenna Polariz. V/H	Antenna Height (m)	Turn-table Angle (°)	Emission Level Note 1 (dBμV/m)	Limit @ 10 m (dBμV/m)	Margin Note 2 (dB)	Results
30.3	V	1.0	13	36.8	39.0	-2.2	Complies
34.0	V	1.0	63	36.6	39.0	-2.4	Complies
38.0	V	1.0	348	33.0	39.0	-6.0	Complies
42.0	V	1.0	216	32.4	39.0	-6.6	Complies
45.0	V	1.0	161	28.8	39.0	-10.2	Complies
176.0	V	1.0	72	21.3	43.5	-22.2	Complies

Note 1: Emission level = E Reading (dBμV) + Cable loss (dB) + Antenna Factor (dB/m)
For Cable Loss and Antenna Factor refer to Appendix 2

4. Appendix 1. Test equipment used.

All measurements equipment is on SII calibration schedule with a recalibration interval not exceeding one year.

Instrument	MFR	Model	Serial No.	Due calibration date
EMI Receiver 9 kHz – 6.5 GHz	HP	8546A+85460 A	SII 4068	April 2011
Active Loop Antenna 10 kHz – 30 MHz	EMCO	6502	3283	Oct 2010
Antenna Biconilog 30 – 2000 MHz	Schaffner-Chase	CBL6112B	S/N 23181	Oct 2010
EMI Analyser 9 kHz - 26.5 GHz	HP	E7405A	SII 4944	Dec 2010
LISN 9 kHz – 30 MHz	FCC	LISN 250-32-4-16	SII5023	Oct 2010
Transient limiter 0.009-200 MHz	HP	11947A	3107105	May 2011
Oscilloscope	HP	54610B	US37340682	May 2011
RF cable, 4m	Sucoflex	104PE	21328/4PE	Oct 2010
Temperature/Humidity cabinet	Heraeus	HC 4033	SII 4062	Jan 2011
Antenna Mast	R&S	HCM	100002	N/A
Metallic turntable	R&S	HCT12	100001	N/A
Positioning controller	R&S	HCC	100002	N/A

5. Appendix 1: Antenna Factor and Cable Loss

Table 4. Cables #8 and #10 loss (10m cable + Mast).

Point	Frequency (MHz)	Cable Loss (dB)	Point	Frequency (MHz)	Cable Loss (dB)
1	30	0.53	21	1000	3.68
2	50	0.75	22	1100	3.82
3	100	1.08	23	1200	4.07
4	150	1.39	24	1300	4.24
5	200	1.61	25	1400	4.43
6	250	1.752	26	1500	4.6
7	300	2.00	27	1600	4.7
8	350	2.15	28	1700	4.85
9	400	2.26	29	1800	4.98
10	450	2.383	30	1900	5.19
11	500	2.52	31	2000	5.34
12	550	2.606	32	2100	5.51
13	600	2.75	33	2200	5.69
14	650	2.856	34	2300	5.89
15	700	3.06	35	2400	6.07
16	750	3.20	36	2500	6.22
17	800	3.27	37	2600	6.28
18	850	3.38	38	2700	6.41
19	900	3.46	39	2800	6.53
20	950	3.55	40	2900	6.84

Table 5. Antenna Factor

For Biconilog Antenna, Model Number: CBL 6112D, S/N: 23181

No.	f / MHz)	AF / dB/m	f / MHz)	AF / dB/m	f / MHz)	AF / dB/m	f / MHz)	AF / dB/m
1	30	17.90	170	9.40	530	17.70	1040	22.20
2	32	16.70	175	9.00	540	18.25	1060	22.50
3	34	15.55	180	8.50	550	18.60	1080	22.50
4	36	14.35	185	8.45	560	14.45	1100	22.40
5	38	13.30	190	8.60	570	18.40	1120	22.60
6	40	12.20	195	8.85	580	18.50	1140	22.45
7	42	11.05	200	8.95	590	18.60	1160	22.50
8	44	9.95	205	8.80	600	18.60	1180	22.40
9	46	8.90	210	8.50	610	18.80	1200	22.80
10	48	8.05	215	8.20	620	18.99	1220	22.95
11	50	7.30	220	8.50	630	19.05	1240	23.10
12	52	6.80	225	9.00	640	19.23	1260	23.40
13	54	6.45	230	9.65	650	19.10	1280	23.35
14	56	6.00	235	10.30	660	19.13	1300	23.62
15	58	5.70	240	11.00	670	19.04	1320	23.64
16	60	5.45	245	11.60	680	19.00	1340	23.86
17	62	5.30	250	12.00	690	19.17	1360	23.95
18	64	5.20	255	12.45	700	19.28	1380	23.90
19	66	5.30	260	12.85	710	19.25	1400	24.45
20	68	5.30	265	12.50	720	19.45	1420	24.74
21	70	5.35	270	12.45	730	19.75	1440	24.93
22	72	5.50	275	12.40	740	19.95	1460	25.03
23	74	5.80	280	12.55	750	20.07	1480	25.45
24	76	6.00	285	12.65	760	19.85	1500	25.30
25	78	6.60	290	12.75	770	19.80	1520	25.25
26	80	6.70	295	12.95	780	19.85	1540	25.36
27	82	7.15	300	13.00	790	19.95	1560	25.58
28	84	7.60	310	13.35	800	20.05	1580	25.50
29	86	8.10	320	13.75	810	20.10	1600	25.65
30	88	8.50	330	13.85	820	20.35	1620	25.60
31	90	8.90	340	14.10	830	20.40	1640	25.70
32	92	9.20	350	14.50	840	20.35	1660	25.83
33	94	9.75	360	14.70	850	20.46	1680	25.97
34	96	9.95	370	14.90	860	20.39	1700	26.10
35	98	10.20	380	15.10	870	20.29	1720	26.25
36	100	10.50	390	15.45	880	20.24	1740	26.04
37	105	11.25	400	16.00	890	20.35	1760	26.14
38	110	11.70	410	16.40	900	20.55	1780	26.20
39	115	11.70	420	16.70	910	20.45	1800	26.40
40	120	11.80	430	16.35	920	20.60	1820	26.64
41	125	11.80	440	16.30	930	20.60	1840	26.86
42	130	11.70	450	16.30	940	20.66	1860	27.12
43	135	11.35	460	16.70	950	20.88	1880	27.00
44	140	10.95	470	17.05	960	21.11	1900	27.25
45	145	10.35	480	17.20	970	20.93	1920	27.36
46	150	10.05	490	17.30	980	21.03	1940	27.68
47	155	9.70	500	17.40	990	21.05	1960	27.10
48	160	9.70	510	17.50	1000	21.10	1980	27.06
49	165	9.45	520	17.60	1020	21.40	2000	27.25

Antenna factor
Active Loop antenna mfr.EMCO mod. 6502 S/N 3424

Frequency (MHz)	Magnetic Antenna Factor (dBS/m)	Electric Antenna Factor (dB)
0.009	-31.46	20.07
0.010	-32.34	19.18
0.020	-36.15	15.38
0.050	-38.57	12.96
0.075	-38.78	12.75
0.100	-39.07	12.46
0.150	-39.07	12.45
0.250	-39.18	12.35
0.500	-39.29	12.24
0.750	-39.38	12.14
1.000	-39.57	11.95
2.000	-39.84	11.69
3.000	-40.09	11.44
4.000	-40.13	11.40
5.000	-40.24	11.28
10.000	-40.26	11.27
15.000	-40.70	10.83
20.000	-41.02	10.51
25.000	-41.94	9.59
30.000	-43.39	8.14

Cable Loss
Type: Sucoflex 104PE; Ser.No.21328/4PE; 4 m length

Point	Frequency (GHz)	Cable Loss (dB)
1	0.0-1.0	1.7
2	1.0– 3.5	3.2
3	3.5– 5.5	4.0
4	5.5 – 7.5	4.7
5	7.5 – 9.5	5.3
6	9.5 – 10.5	5.6
7	10.5 – 12.5	6.2
8	12.5 – 14.5	6.8
9	14.5 – 16.5	7.5
10	16.5 – 18.0	8.1