



Test Report No. 9312313555

Applicant: Athena Smartcard Ltd.

Equipment Under Test:

ASEDrive DI

Model: ASE053

FCC ID: WQCASEDI1

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



***ACCLASS Accreditation Services
Certificate Number: AT-1359***

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Applicant:	Athena Smartcard Ltd.
Address:	10 Aba Even St., Herzliya, Israel.
Sample for test selected by:	The customer
The date of test:	20 November, 25 December 2013 and 21 January 2014

Description of Equipment Under Test (EUT):	ASEDrive DI
Model:	ASE053
Serial number:	NA
Software version of radio unit	8.05
Hardware version of radio unit	ASE053 rev.1.5

Reference Documents:

- ❖ CFR 47 FCC: Rules and Regulations; Part 15. "Radio frequency devices";
Subpart B: "Unintentional radiators" (2009)
Subpart C: "Intentional radiators" (2009),
Section 15.209. "Radiated emission limits, general requirements".
"Radiated Emission Limits, Additional Provisions";
Section 15.225. "Operation within the band 13.110 – 14.010 MHz".

This Test Report contains 23 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.
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1. Test summary

Parameter	FCC Part 15 Reference paragraph	Verdict
Test of field strength emission from intentional radiators	Subpart C Section 15.225.	Comply
Radiated emission test.	Subpart B Section 15.109 Subpart C Section 15.209	Comply
Conducted emissions test	Subpart C Section 15.207	Comply
Frequency stability test	Subpart C Section 15.225	Comply

Electronics & Telematics
Laboratory

January 2014

Name: Eng. Yuri Rozenberg
Position: Head of EMC BranchName: 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
<u>Radiated emissions</u> 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

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2. EUT Description and operation

2.1. General description:

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

The EUT is Access control unit based on RFID reader communicates with RFID tag at 13.56 MHz frequency. It based on the RFID chip from NXP (CLRC663). Reader is powered from PC USB port. ASEDrive DI intended to be used with ISO/IEC 14443 Type B card.

Transmitting frequency	13.56 MHz
Type of modulation:	ASK
Antenna type:	Integrated on PCB

The EUT's block diagrams are shown in Figures 1.

The EUT external views are presented in Photos #1 and #2.

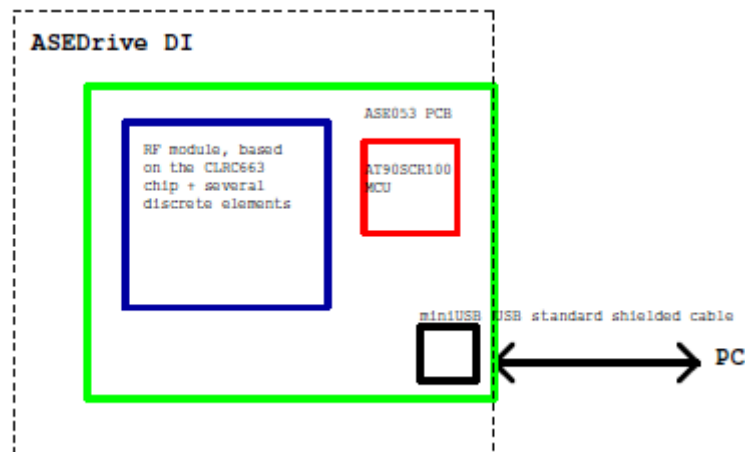


Figure 1. EUT block diagram.



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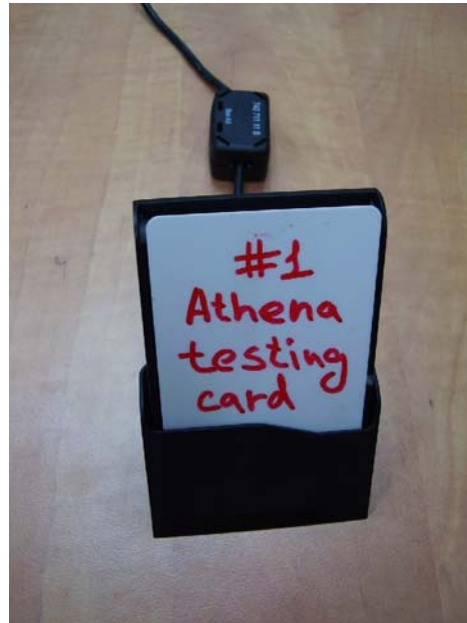


Photo 1. EUT's front view.



Photo 2. EUT's rear view.



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Photo 3. RE test setup on OATS.



Photo 4. RE test setup on OATS.

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2.2. Potential emission sources:

The potential emission sources are detailed in Table 1.

Table 1. Potential emission sources

Frequency	Location
8.0 MHz	Main CPU
27.12 MHz crystal	RFID interface clock

2.3. EUT setup and operation:

Measurements of transmitter were performed in continue transmission 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: 22°C. Humidity: 46 %. Atmospheric pressure: 1010 mbar.

3.3. Changes of EUT during the test:

During the RE tests ferrite mfr. "Würth Elektronik" p/n 742 711 11S was added on USB cable at distance 5cm from transmitter plastic cage.

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3.4. Radiated emission test.

3.4.1. General:

Per FCC Part 15 subpart C Section 15.225, 15.209 and subpart B Section 15.109.

- * Initial scans were made using a peak detector but still using the appropriate ANSI IF bandwidth.
- * A tolerance limit was set 10 dB below the specification limit. Levels above the tolerance limit were retested using the Peak and Q. Peak detector.

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. 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. Radiated emission test results:

All received emissions from the EUT were found below FCC Part 15 Subpart B Section 15.109 and Subpart C sections 15.209 and 15.225.

Final result measurements in transmit mode are presented in tables #2, #3 in section 3.5.5.

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3.5. Test of field strength emission from intentional radiator.

3.5.1. General:

Per FCC Part 15 Subpart C section 15.225.

3.5.2. Requirements:

The EUT's operation frequency is 13.56 MHz.

The field strength emissions from intentional radiators operated on this frequency shall comply with the limits of section 15.225 (a) (b) (c) (d).

Emission frequency band, MHz	Specified Field Strength limit of Fundamental $\mu\text{V/m}@30\text{m}$	*Calculated Field Strength limit $\text{dB}\mu\text{V/m}@3\text{m}$
13.553 – 13.567	15.848	124.0
13.410 – 13.553 13.567 – 13.710	334.0	90.5
13.110 – 13.410 13.710 – 14.010	106.0	80.5

*The field strength limit was calculated according to FCC p.15. 31(f)(2) with 40 dB/decade linear distance extrapolation factor.

The field strength of any emissions outside of the 13.110 – 14.010 MHz band shall not exceed the general radiated emission limit of § 15.209.

3.5.3. Test procedure:

The test was conducted according to clause 15.225.

3.5.4. Test summary:

The tested unit meets the standard requirement.

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Carrier frequency MHz	Peak Amplitude dB μ V/m	Limit@ 3m dB μ V/m
13.560	65.2	124.0

For recorded fundamental frequency result see plot #1.

Any received radiated emission result was found below the §15.209 specified limit.

Investigation scans of spurious emissions present in plots ## 2-5.

Table # 3. Spurious emission result.

Freq. MHz	Antenna pol. V/H	Antenna Height (m)	Turn- table angle (°)	*Q.Peak level dB μ V/m	Limit @3m dB μ V/m	Margin dB	Ref. to plot #
40.68	Vertical	1.0	271	36.4	40.0	-3.6	5

*Measurement was performed on OATS at 10 m test distance and calculated by
 $20 \text{ Log } 10/3 = 10.5 \text{ dB}$ factor.



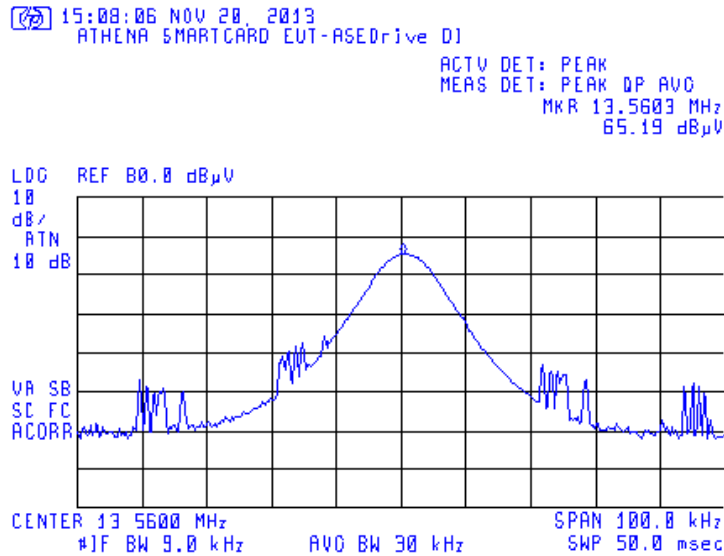
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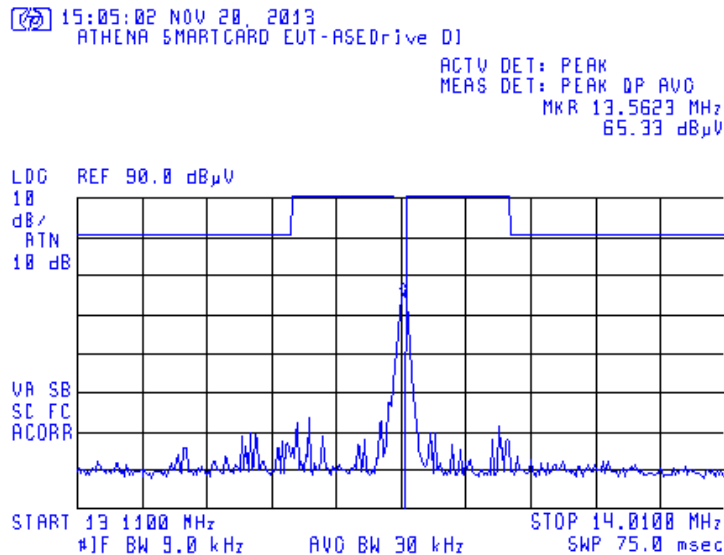
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Plot # 1. Field strength of fundamental frequency 13.56 MHz.



Plot # 2. Frequencies scan 13.11 – 14.01 MHz. Test distance =3m.



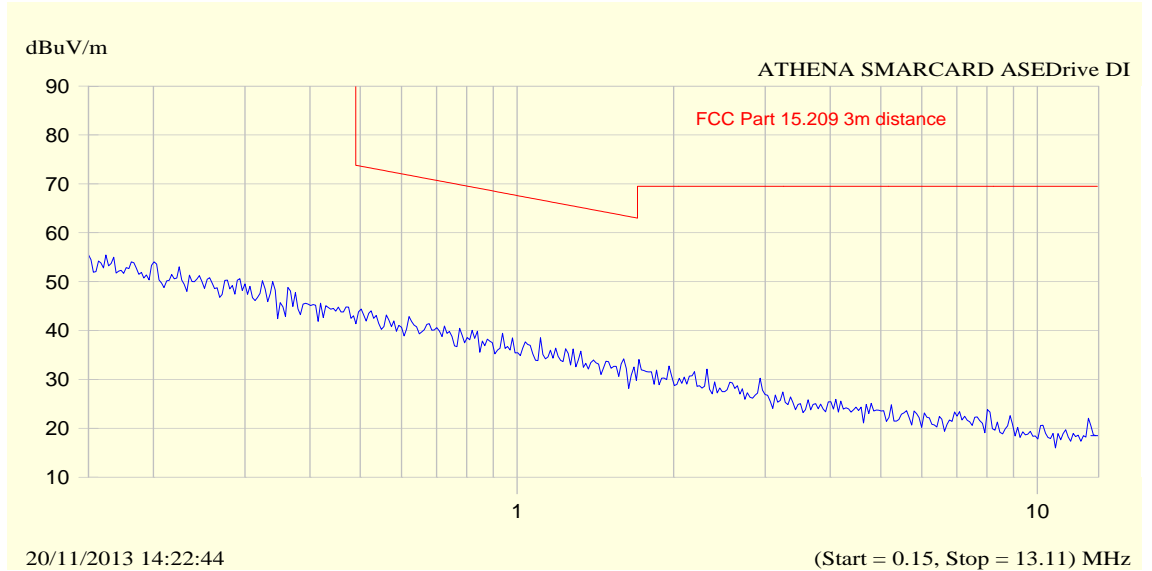
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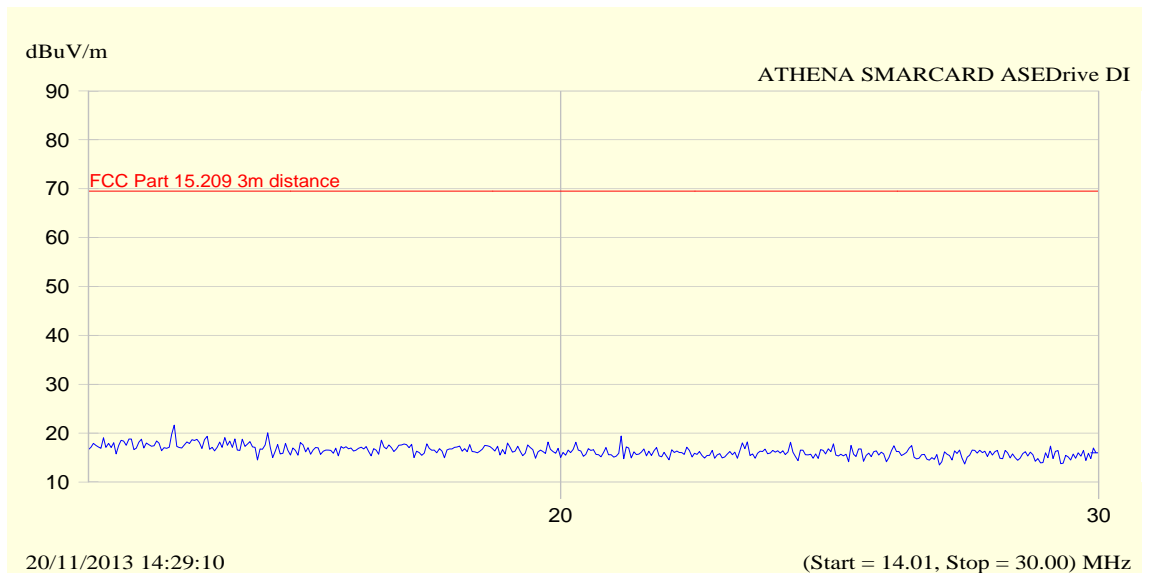
Title: ASEDrive DI

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Plot # 3. Frequencies scan 0.15 – 13.11 MHz. Test distance =3m.



Plot # 4. Frequencies scan 14.01 – 30 MHz. Test distance =3m.



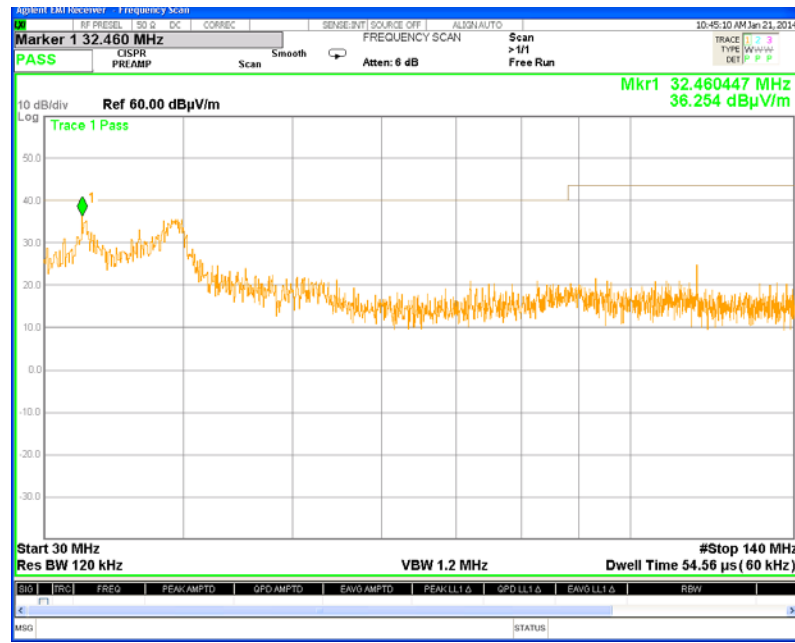
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**Plot # 5. Pre compliance frequencies scan from 30 to 140 MHz.
Test distance 3m.**

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3.6. AC main conducted emissions test

Per FCC Part 15 subpart B section 15.107 and subpart C section 15.207.

Test configuration:

The EUT was placed on a non-conductive table in a shielded room at a height of 80 cm above the floor and 40 cm from the vertical ground plane (wall) of the room and connected to 120VAC main via auxiliary PC.

3.6.1. Test procedure:

The EUT was operated in transmit 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:

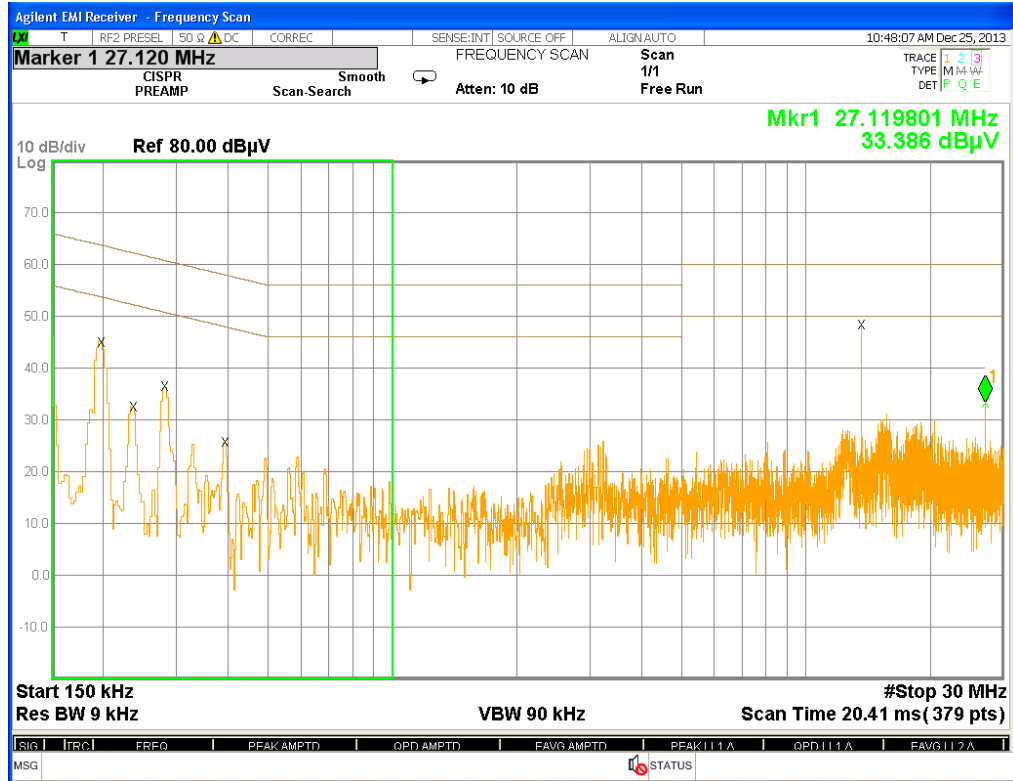
Detector type	Peak
Mode	Max hold
Bandwidth	9 kHz
Step size	Continuous sweep
Sweep time	>100 msec

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 15.107, 15.207 limits (see plots ## 6,7 below).



Frequency MHz	QP dBµV	QP Limit dBµV	Margin dB	Avg dBµV	Avg Limit dBµV	Margin dB
0.197	45.0	63.6	-18.6	38.4	53.6	-15.3
0.235	35.1	62.1	-27.0	28.7	52.1	-23.5
0.280	37.3	60.7	-23.4	33.1	50.7	-17.6
0.392	29.6	57.9	-28.3	26.7	47.9	-21.2
13.560	44.8	60.0	-15.2	44.2	50.0	-5.8
27.12	33.7	60.0	-26.3	32.3	50.0	-17.7

Plot # 6. Tested line Phase.



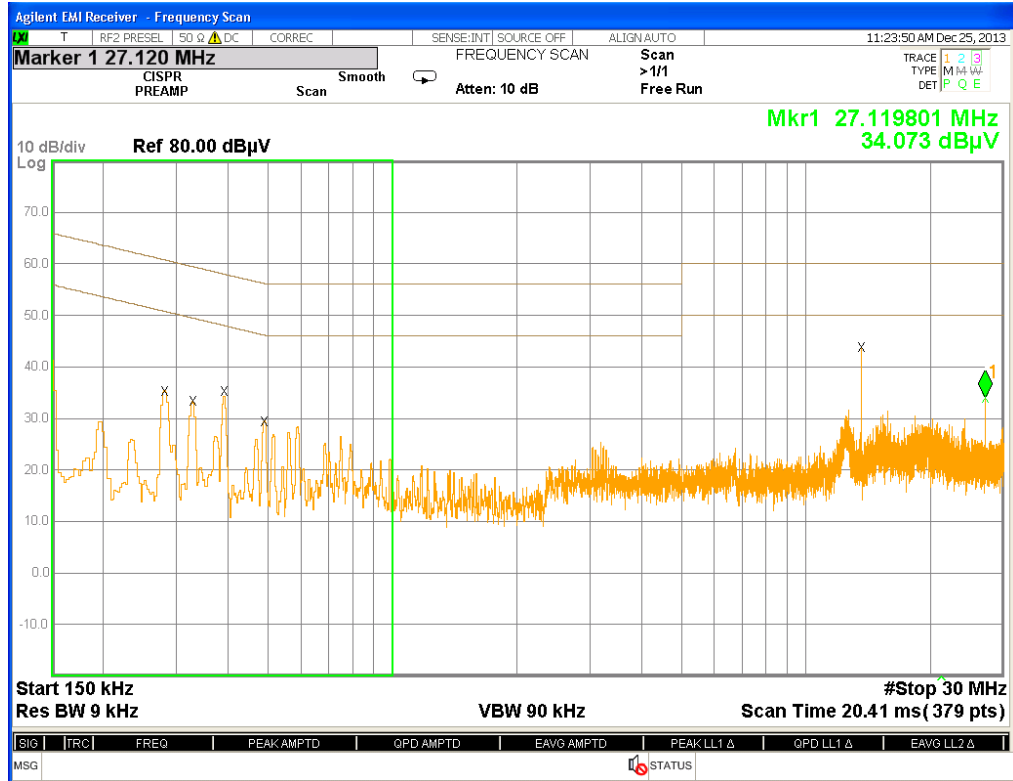
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Frequency MHz	QP dBµV	QP Limit dBµV	Margin dB	Avg dBµV	Avg Limit dBµV	Margin dB
0.280	35.7	60.8	-25.1	32.1	50.8	-18.7
0.327	33.5	59.5	-26.0	29.1	49.5	-20.4
0.390	34.5	58.0	-23.5	30.2	48.0	-17.8
0.487	28.7	56.1	-27.4	23.8	46.1	-22.3
13.560	43.7	60.0	-16.3	43.1	50.0	-6.9
27.12	35.2	60.0	-24.8	33.9	50.0	-16.1

Plot # 7. Tested line Neutral

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Per FCC Part 15 subpart B Section 15.109

3.7.1. Test procedure:

Final measurements were performed according to clause 3.4.3.

Initial scan:

Detector type	Peak
Mode	Continuous
Bandwidth	120 kHz
Step size	Continuous sweep

Measurements:

Detector type	Quasi-peak (CISPR)
Bandwidth	120 kHz
Measurement time	20 seconds/MHz
Observation	>15 seconds

3.7.2. Radiated emission test results:

All received emissions were found below FCC Part 15.109 class B limit and presented in table below.

**Table 4. Radiated emission test results
Subpart B class B 3m distance.**

Frequency MHz	Antenna Polariz. V/H	Antenna Height m	Turn- table angle (°)	*Emission Level Note 1 dB μ V/m	Specified 3 m dist. limit dB μ V/m	Margin dB	Verdict
32.6	V	1.0	114	35.2	40.0	-4.8	Complies
36.0	V	1.0	246	34.9	40.0	-5.1	Complies
39.5	V	1.0	243	34.4	40.0	-5.6	Complies
44.2	V	1.0	212	34.6	40.0	-5.4	Complies
45.0	V	1.0	6	33.7	40.0	-6.3	Complies
114.6	V	1.0	72	27.1	43.5	-16.4	Complies

*Measurements were performed on OATS at 10 m test distance and calculated by 20 Log 10/3 = 10.5 dB factor.

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

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TEST CONDITIONS		Carrier frequency, MHz.	Frequency deviation. Hz
Test temperature	Test voltage.		
+20°C	102	13.560580	-20
	120	13.560600	0
	138	13.560600	0
-20°C	120	13.560080	-20
-10°C	120	13.560600	0
0°C	120	13.560620	+20
+10°C	120	13.560620	+20
+30°C	120	13.560580	-20
+40°C	120	13.560560	-40
+50°C	120	13.560560	-40
Maximum measured deviation		-40 Hz	

3.8.1. Test procedure

According to customer declaration the EUT intended for operation in follow temperature condition: from -20°C to +50°C. The EUT was placed in a climatic chamber and allowed to stabilize at 20°C temperature and nominal voltage for at list 15 min. The reference carrier frequency was taken. The input voltage was changed from 85% of nominal to 115% of nominal. Frequency changes were noted. The temperature in climatic chamber was varied from -20°C to +50°C.

Measured changes of frequencies were noted in table #5.

3.8.2. Requirements:

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency (1.356 kHz) over a temperature variation of -20 degrees to +50 degrees C at nominal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage.

3.8.3. Test result:

The tested unit meets the standards requirements.

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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	May 2014
EMI Analyser 9 kHz - 26.5 GHz	HP	E7405A	SII 4944	April 2014
MXE EMI Receiver 20 Hz – 26.5 GHz	Agilent	N9038A	MY52130048	Jan. 2014
Active Loop Antenna 10 kHz – 30 MHz	EMCO	6502	3283	Dec. 2014
Antenna Biconilog 30 – 2000 MHz	Schaffner- Chase	CBL6112D	23181	Dec. 2014
LISN 9 kHz – 30 MHz	FCC	LISN 250-32- 4-16	SII5023	Oct. 2014
Transient limiter 0.009-200 MHz	HP	11947A	3107105	Oct. 2014
Oscilloscope	HP	54610B	US37340682	May 2014
RF cable, 4m	Sucoflex	104PE	21328/4PE	Oct. 2014
Temperature/Humidity cabinet	Heraeus	HC 4033	SII 4062	Jan. 2014
Antenna Mast	Frankonia	FAM6	5952	N/A
Metallic turntable	Frankonia	FTM2-2	5952	N/A
Positioning controller	Frankonia	FCO2	5952	N/A

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5. Appendix 2: Antenna Factor and Cable Loss

Table 6. 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



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Table 7. 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

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Table 8. 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

Table 9. 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