



Test Report

Test Report No.:	KTI08EF07002		
Registration No.:	99058		
Applicant:	BRAINTECH CO., LTD		
Applicant Address:	5 th Fl., Dongyoung Bldg., 580 Pajang-dong, Jangan-gu, Suwon-si, Kyunggi-do, KOREA		
Product:	Access Control Unit		
FCC ID:	WGPFM1000MF	Model No.	FM1000MF
Receipt No.:	08-0634	Date of receipt:	June 23, 2008
Date of Issue:	July 01, 2008		
Testing location	Korea Technology Institute Co., Ltd. 51-19, Sanglim3-Ri, Docheok-Myeun, Gwangju-Shi, Gyeungki-Do, Korea		
Test Standards:	FCC/ANSI. C63.4: 2003		
Rule Parts: FCC	Part 15, Class B		
Equipment Class:	Digital device		
Test Result:	The above-mentioned product has been tested with compliance.		

Tested by: T.W. Lee
/ Engineer

Approved by: G. C. Min
/President

Signature

Date

Signature

Date

Other Aspects:	
Abbreviations:	* OK, Pass=passed * Fail=failed * N/A=not applicable

- This test report is not permitted to copy partly without our permission.

- This test result is dependent on only equipment to be used.

- This test result is based on a single evaluation of one sample of the above mentioned.

- This test report must not be used by the client to claim product endorsement by NVLAP or any agency of the U.S Government.

- We certify this test report has been based on the measurement standards that is traceable to the national or international standards.



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1. General

This equipment has been shown to be capable of compliance with the applicable technical standards and was tested in accordance with the measurement procedures as indicated in this report.

We attest to the accuracy of data. Korea Technology Institute Co., Ltd. performed all measurements reported herein. And were made under Chief Engineer's supervisor.

We assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

2. Test Site

Korea Technology Institute Co., Ltd.

Location

51-19, Sanglim3-Ri, Docheok-Myeon, Gwangju-Shi, Gyeungki-Do, Korea

The Test Site is in compliance with ANSI C63.4/2003 for measurement of radio Interference.



List of Test and Measurement Instruments

Table 1: List of Test and Measurement Equipment

- Conducted Emissions

Kind of Equipment	Type	S/N	Calibrated until
Field Strength Meter	ESIB40	100093	07.2008
LISN	KNW407	8-1157-2	01.2009
LISN	EM-7823	115019	05.2009
Conducted Cable	N/A	N/A	11.2008

- Radiated Emissions

Kind of Equipment	Type	S/N	Calibrated until
Field Strength Meter	ESIB40	100093	07.2008
Loop Antenna	6502	3434	03.2009
Biconic Logarithmic Periodic Antenna	VULB9163	9163-281	09.2008
Horn Antenna	3115	6443	03.2009
Open Site Cable	N/A	N/A	11.2008
Antenna Master	DETT-03	N/A	N / A
Antenna & Turntable controller	DETT-04	91X519	N / A

Test Date

Date of Application: June 23, 2008

Date of Test: June 24, 2008

Test Environment

Indoor: 25°C/38%/1001mbar

Outdoor: 26.7°C/20%/1001mbar



3. Description of the tested samples

The EUT is Access Control Unit

Rating and Physical Characteristics

Function	Spec.
Power Consumption	DC 12 ± 3 V, 700 mA
Communication Interface	RS232, RS485/RS422, USB, 10/100 Base Ethernet (option : Wireless LAN)
Sensor Type	Optical Sensor
1:1 Verification Time	800 ms
1:1,000 Identification Time	970 ms
Template size	256 ~ 384 Bytes (configurable, 384 Bytes default)
Template Capacity	1,900 at 1 MB Flash (option : 9,500 at 4 MB flash)
RF Card Interface	Max. 65,356 User Register
Event Log	Max. 100,000 Event Can Log to Flash Memory (Power Fail Safe)
LCD Display	128 X 64 pixels graphic LCD
Keypad	16 Numeric key and 4 function key : back lighting
Memory	16MB RAM, 16MB Flash Memory, 2MB boot ROM
CPU	32 Bit RISC CPU
Signal Interface	2 output (lock, alarm etc.) 4 input (door/lock status) Wiegand Output
System Software	Access control and Time Attendance
Operating Environment	- 20 ~ + 50 °C / Lower Than 90% RH(Non-Condensing)
RF Reader	Built in 125 kHz RF reader and 13.56 MHz RF reader
Dimensions (Unit : mm)	125 (W) x 163 (H) x 48 (D)
Weight	430 g

Submitted Documents

- User's Guide
- Block Diagram



4. Measurement Conditions

Testing Input Voltage: AC 220V

Modes of Operation

The EUT was in the following operation mode during all testing;

- 1) EUT operates a finger print job with connection to Note Pc

Additional Equipment

DEVICE TYPE	Manufacturer	M/N	S/N	FCC ID

Uncertainty

- 1) Radiated disturbance

U_c (Combined standard Uncertainty) = $\pm 1.8\text{dB}$

Expanded uncertainty $U=KU_c$

$K = 2$

$\therefore U = \pm 3.6\text{dB}$

- 2) Conducted disturbance

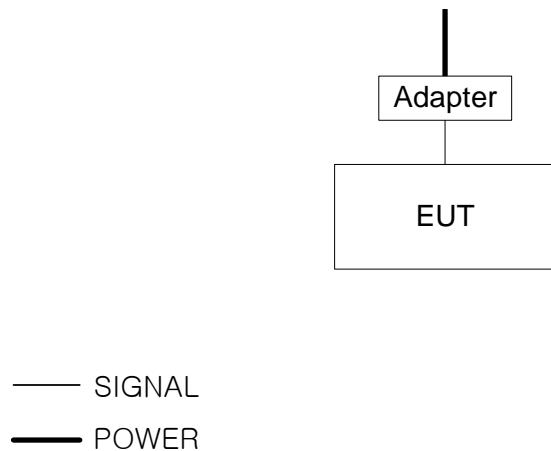
$U_c = \pm 0.88\text{dB}$

$U = KU_c = 2 \times U_c = \pm 1.8\text{dB}$



4.4 Test Setup

Figure 1: Test Setup





5. TEST AND MEASUREMENTS

Summary of Test Results

Requirement	FCC, 47CFR15	Report Section	Test Result
Antenna Requirement	15.203	5.1	PASS
Conducted Emissions			
Radiated Emissions			
Field strength 9 kHz to 30 MHz	15.209 & 15.205	5.2	PASS
Field strength 30 MHz to 1000 MHz			
Spectrum mask and Occupied bandwidth	15.225(a),(b),(c) & (d)	5.3	PASS
Frequency Tolerance of the Carrier Signal	15.225(e)	5.4	PASS

* According to the Section 15.33(b)(1)&(c), Radiated Emissions & Conducted Emissions were reported in Report No. KTI08EF07004.

5.1 ANTENNA REQUIREMENT

5.1.1 Regulation

FCC 47CFR15 – 15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

5.1.2 Result:

PASS

The transmitter has an integral PCB loop antenna that is enclosed within the housing of the EUT, and meets the requirements of this section.



5.2 EMISSION TEST

5.2.1. Conducted Emissions

Result:**Pass**

The line-conducted facility is located inside a 2.3M x 3.5M x 5.5M shielded closure.

The shielding effectiveness of the shielded room is in accordance with MIL-Std-285 or NSA 605-05. A 1m x 1.5m wooden table 80cm high is placed 80cm away from the conducting ground plane and 40cm away from the sidewall of the shielded room. Electro-Metroics Model EM-7823 (9kHz-30MHz)50ohm/50 uH Line-Impedance Stabilization Networks (LISN) are bonded to the shielded room.

The EUT is powered from the Electro-Metroics LISN and the support equipment is powered from the Kyoritsu LISN. Power to the LISN are filtered by a high-current high-insertion loss shield enclosures power line filters (100dB 14kHz-1GHz).

The purpose of the filter is to attenuate ambient signal interference and this filter is also bonded to the shielded enclosure.

All electrical cables are shielded by copper pipe with inner diameter of 1".

If the EUT is a DC-Powered device, power will be derived from the source power supply it normally will be powered from and this supply lines will be connected to the Rohde & Schwarz LISN.

All interconnecting cables more than 1 meter were shortened by non-inductive bundling (serpentine fashion) to a 1-meter length.

Sufficient time for the EUT, Support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer to determine the frequency producing the maximum EME from the EUT.

The frequency producing the maximum level was reexamined using EMI field Intensity meter (ESIB40). The detector function was set to CISPR quasi-peak mode.

The bandwidth of the receiver was set to 10kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was maximized by: switching power lines; varying the mode of operation or resolution; clock or data exchange speed; if applicable; whichever determined the worst-case emission.

Photographs of the worst-case emission can be seen in photograph of conducted test.

Each EME reported was calibrated using self-calibrating mode.



Figure 2: Spectral Diagram, LINE-PE

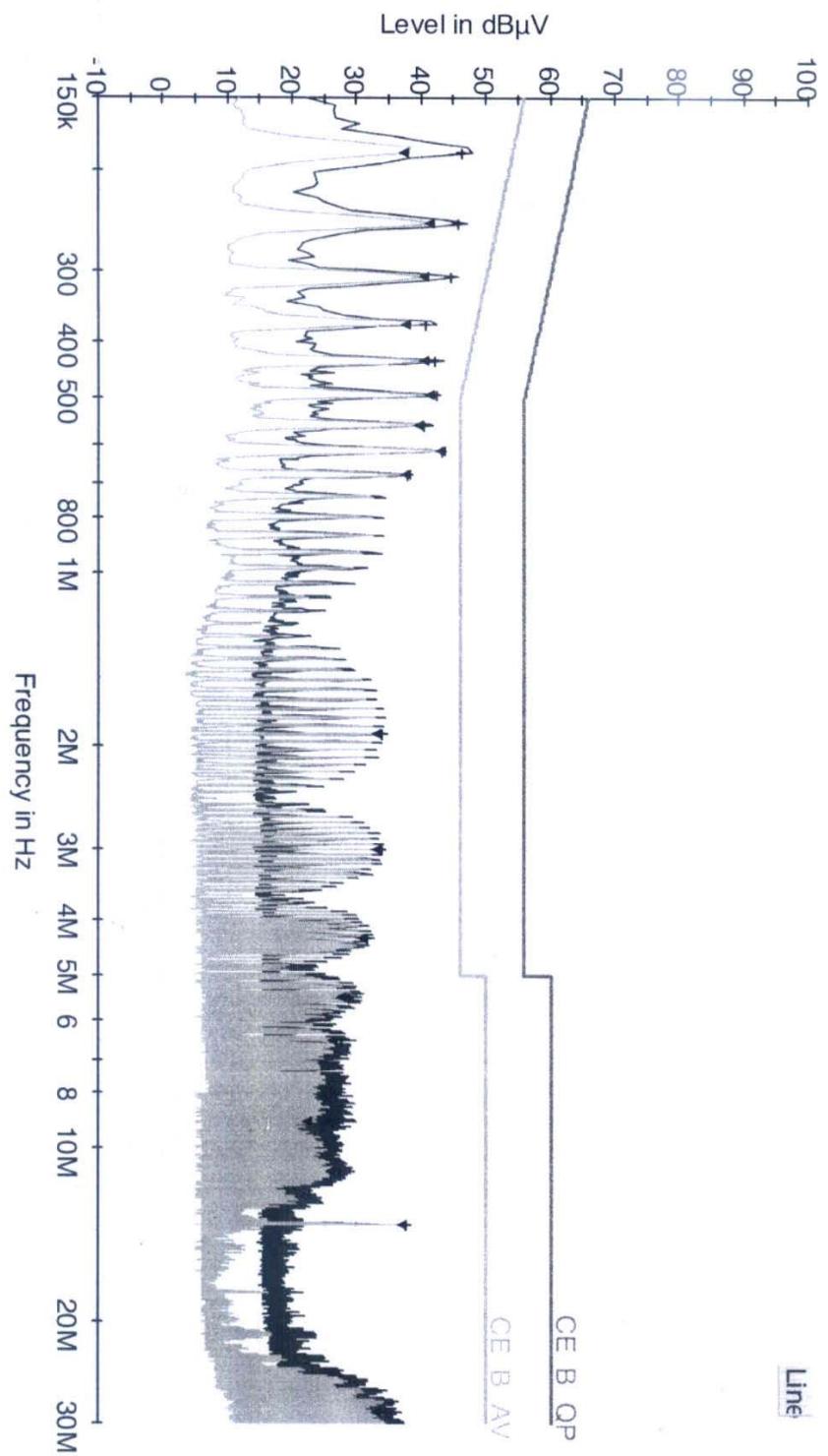




Figure 3: Spectral Diagram, NEUTRAL-PE

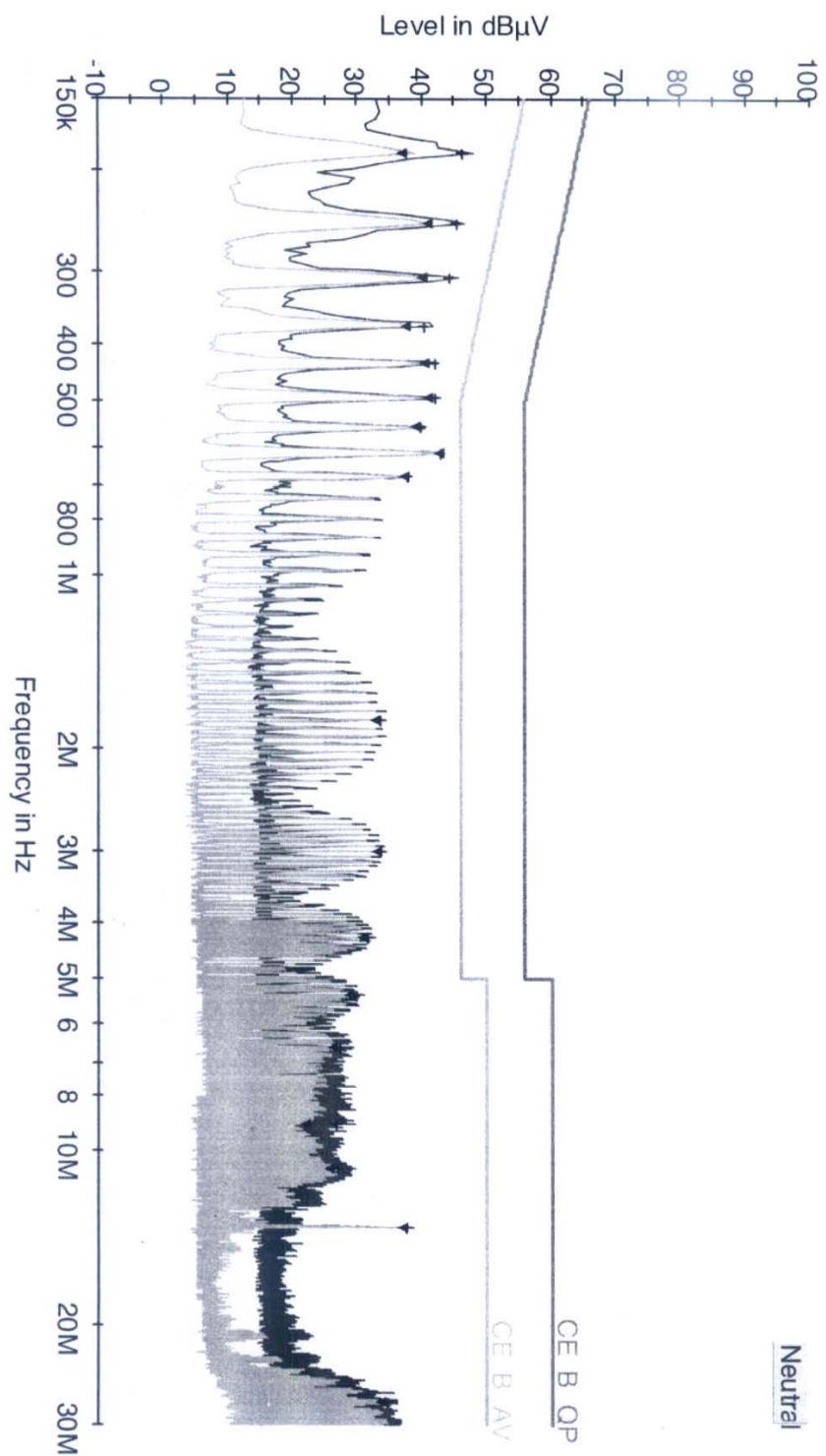




Table 2: Test Data, Conducted Emissions

Frequency (MHz)	(1) Reading (dB μ V)	Line	(2)C/F (dB)	(3)Actual (dB μ V)	(4) Limit (dB μ V)	(5) Margin (dB)
0.19	46.42	L2	0.12	46.54	64.04	17.50
0.25	45.75	L1	0.10	45.85	61.76	15.91
0.31	44.54	L1	0.08	44.62	59.97	15.35
0.37	40.57	L1	0.08	40.65	58.50	17.85
0.43	42.15	L1	0.09	42.24	57.25	15.01
0.49	42.33	L1	0.09	42.42	56.17	13.75

NOTES:

1. All modes of operation were investigated
And the worst-case emissions are reported.
2. All other emissions are non-significant.
3. All readings are calibrated by self-mode in receiver.
4. Measurements using CISPR Quasi-peak mode.
5. L1 = LINE-PE, L2 = NEUTRAL-PE
6. C/F = Correction Factor(LISN factor + Cable loss)
7. The limit for Class B digital device is 66dB μ V to 56dB μ V from 150KHz to 500KHz, 56dB μ V from 500KHz to 5MHz, 60dB μ V Above 5MHz.

♦ Margin Calculation

$$(5) \text{ Margin} = (4) \text{ Limit} - (3) \text{ Actual}$$

$$[(3) \text{ Actual} = (1) \text{ Reading} + (2) \text{ C/F}]$$



5.2.2 Radiated Emissions

5.2.2.1 Regulation

FCC 47CFR15 – 15.209

(a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field strength limit (uV/m)	Field strength limit (dBuV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	48.5-13.8	300
0.490 – 1.705	24000/F(kHz)	33.8-23.0	30
1.705 – 30.0	30	29.5	30
30 – 88	100	40.0	3
88 – 216	150	43.5	3
216 – 960	200	46.0	3
Above 960	500	54.0	3

5.2.2.2 Measurement Procedure

Radiated Emissions Test, 9kHz to 30MHz (Magnetic Field Test)

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions at a distance of 3 meters according to Section 15.31(f)(2).
2. The EUT was placed on the top of the 0.8-meter height, 1 x 1.5 meter non-metallic table.
3. Emissions from the EUT are maximized by adjusting the orientation of the Loop antenna and rotating the EUT on the turntable. Manipulating the system cables also maximizes EUT emissions if applicable.
4. To obtain the final measurement data, each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector with specified bandwidth.



Radiated Emissions Test, 30 MHz to 1000 MHz

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters.
2. The EUT was placed on the top of the 0.8-meter height, 1 x 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360
3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 30 to 1000 MHz using the Biconical and Logperiodue broadband antenna,
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 x 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6. The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT

5.2.2.3 Calculation of the field strength limits below 30 MHz

1. No special calculation for obtaining the field strength in dBuV/m is necessary, because the EMI receiver and the active loop antenna operate as a system, where the reading gives directly the field strength result (dBuV/m). The antenna factors and cable losses are already taken into consideration.
2. For test distance other than what is specified, but fulfilling the requirements of section 15.31 (f)(2) the field strength is calculated by adding additionally an extrapolation factor of 40dB/decade (inverse linear distance for field strength measurements).
3. All following emission measurements were performed using the test receiver's average, peak, and quasi-peak detector function with specified bandwidth.


5.2.2.4 Test Results (Test mode : TX on) PASS

Table 3: Test Data, Fundamental Frequency (Ver / Hor)

Frequency (MHz)	Pol.	Reading (dB μ V)	AFCL (dB/m)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
13.560	V	30.41	9.94	40.35	124	83.65	QP
13.560	V	30.18	9.94	40.12	-	-	AV

Frequency (MHz)	Pol.	Reading (dB μ V)	AFCL (dB/m)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Detector
13.560	H	32.91	9.94	42.85	124	81.15	QP
13.560	H	32.69	9.94	42.63	-	-	AV

FCC 47CFR15 – 15.209 (9 kHz - 30 MHz)

Table 4: Test Data, Radiated Emission below 30 MHz

Frequency (MHz)	Pol.	Height [m]	Angle [°]	(1) Reading (dB μ V)	(2) AFCL (dB/m)	(3) Actual (dB μ V/m)	(4) Limit (dB μ V/m)	(5) Margin (dB)
0.588	H	1.35	178	33.39	5.23	38.62	72.22	33.60
0.652	H	1.40	172	29.84	7.70	37.54	71.32	33.78
0.724	H	1.25	175	27.95	10.61	38.56	70.41	31.85
3.768	H	1.23	180	23.19	10.72	33.91	69.54	35.63
5.016	H	1.38	185	20.81	10.64	31.45	69.54	38.09
5.940	V	1.38	170	21.87	10.53	32.40	69.54	37.14

Margin (dB) = Limit – Actual
[Actual = FS + AF + CL]

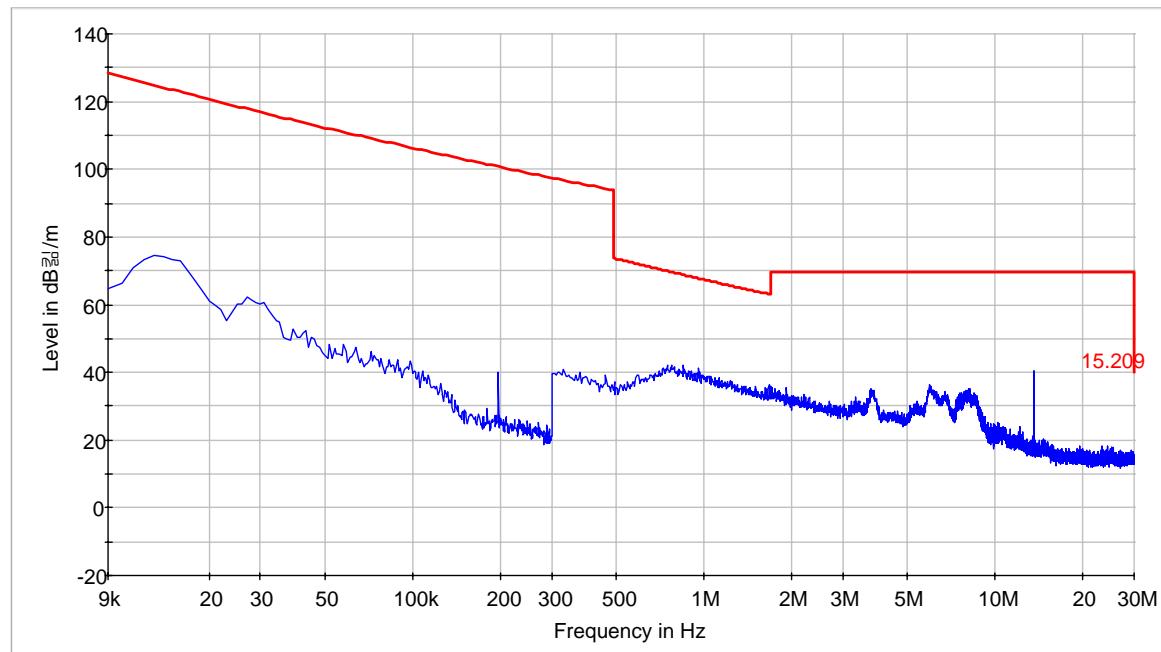
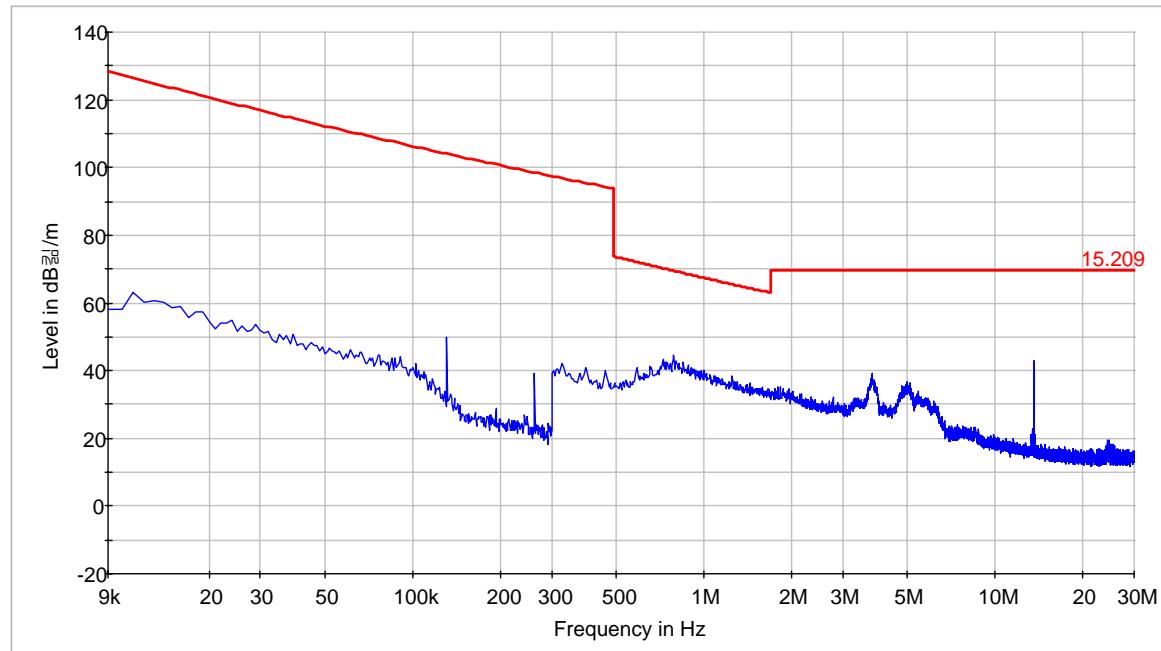
1.H = Horizontal, V = Vertical Polarization

2.AF/CL = Antenna Factor and Cable Loss

3.FS = RA + DF

Where FS = Field strength in dB μ V/mRA = Reciever Amplitude in dB μ V/m

DF = Distance Extrapolation Factor in dB

**Figure 4: Radiated spurious emissions below 30 MHz****Spurious Emissions from 9 kHz to 30 MHz – Vertical****Spurious Emissions from 9 kHz to 30 MHz – Horizontal**



5.2.2.5 Calculation of the field strength limits above 30 MHz

1. No special calculation for obtaining the field strength in dB μ V/m is necessary, because the EMI receiver and the active loop antenna operate as a system, where the reading gives directly the field strength result (dB μ V/m). The antenna factors and cable losses are already taken into consideration.
2. For test distance other than what is specified, but fulfilling the requirements of section 15.31 (f)(2) the field strength is calculated by adding additionally an extrapolation factor of 40dB/decade (inverse linear distance for field strength measurements).
3. All following emission measurements were performed using the test receiver's average, peak, and quasi-peak detector function with specified bandwidth.

5.2.2.6 Test Results (Test mode : TX on)

PASS

FCC 47CFR15 – 15.209

Table 5: Test Data, Radiated Emission above 30 MHz

Frequency (MHz)	Pol.	Height [m]	Angle [°]	Reading (dB μ V)	AFCL (dB/m)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
200.00	V	1.35	171	27.77	10.35	38.12	43.5	5.38
650.00	V	1.40	175	30.05	12.27	42.32	46.0	3.68
700.00	H	1.43	176	22.52	19.86	42.38	46.0	3.62
750.00	H	1.48	178	21.57	20.93	42.50	46.0	3.50
800.00	V	1.50	173	19.51	21.12	40.63	46.0	5.37
850.00	V	1.53	173	16.85	21.70	38.55	46.0	7.45

FCC 47CFR15-15.205 Restricted Band

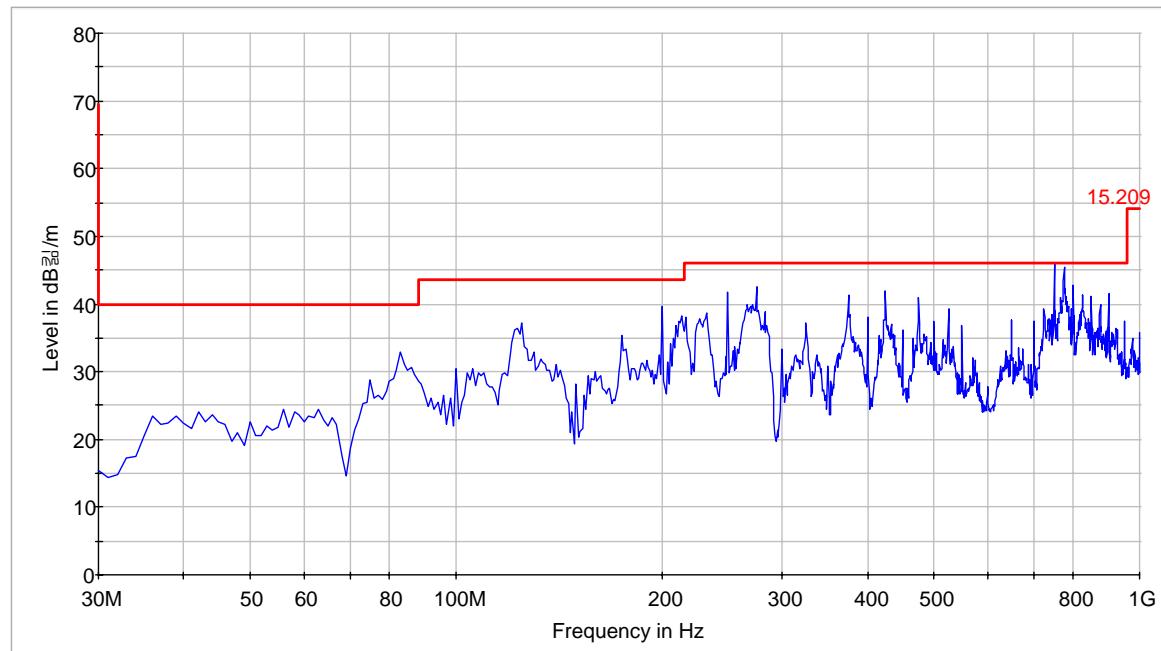
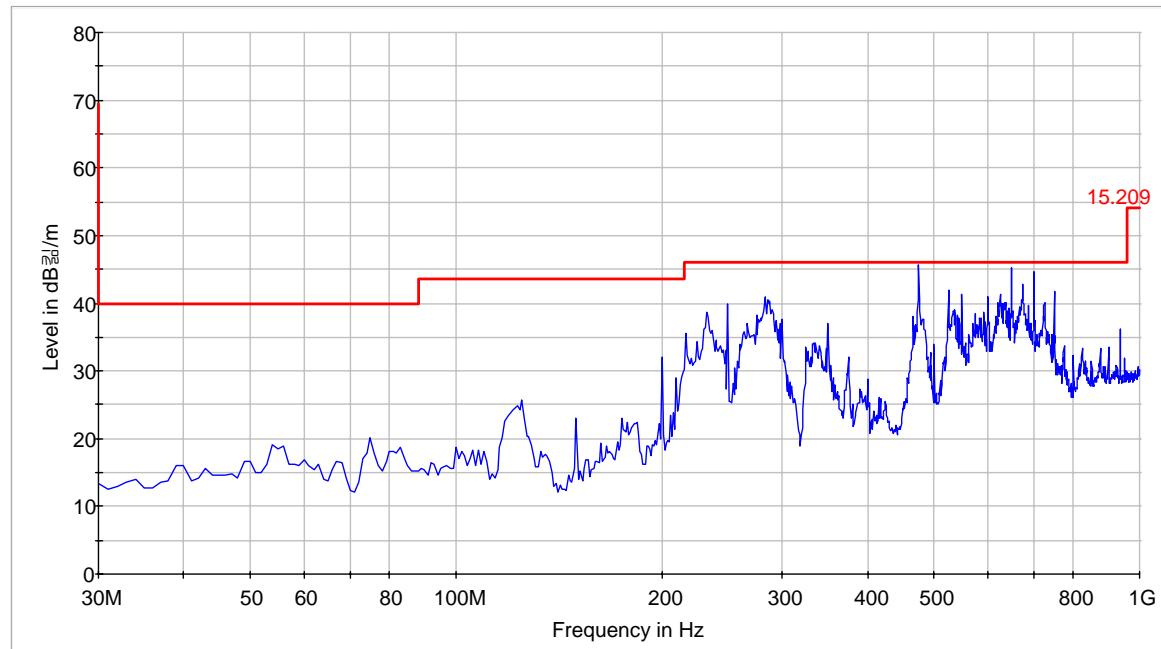
Frequency (MHz)	Pol.	Height [m]	Angle [°]	Reading (dB μ V)	AFCL (dB/m)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
125.00	V	1.35	170	22.29	8.63	30.92	43.5	12.58
250.00	H	1.40	179	25.43	12.21	37.64	46.0	8.36
325.00	V	1.25	176	17.11	13.90	31.01	46.0	14.99
350.00	H	1.23	183	19.57	14.73	34.30	46.0	11.70
375.00	V	1.38	172	19.72	15.11	34.83	46.0	11.17
400.00	V	1.40	179	20.05	15.62	35.67	46.0	10.33

Margin (dB) = Limit – Actual

[Actual = Reading + AF + CL]

1.H = Horizontal, V = Vertical Polarization

2.AF/CL = Antenna Factor and Cable Loss

**Figure 5: Radiated spurious emissions above 30 MHz****Spurious Emissions from 30 MHz to 1 GHz – Vertical****Spurious Emissions from 30 MHz to 1 GHz – Horizontal**



5.3 Spectrum mask and Occupied bandwidth

5.3.1 Regulation

FCC 47CFR15 – 15.225

- (a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.
- (b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.
- (c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.
- (d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

Frequency (MHz)	Field strength limit (uV/m) @ 30m	Field strength limit (dBuV/m) @ 30m	Field strength limit (dBuV/m) @ 3m
13.110 – 13.410	106	40.5	80.5
13.410 – 13.553	334	50.5	90.5
13.553 – 13.567	15,848	84.0	124.0
13.567 – 13.710	334	50.5	90.5
13.710 – 14.010	106	40.5	80.5

5.3.2 Measurement Procedure

Spectrum Mask

1. Place the EUT in the text fixture and switch it on
2. Use the following spectrum analyzer settings: RBW = VBW =1 kHz, Span = wide enough to capture the whole 13 MHz band including the frequency ranges where the 15.209 limit applies, Trace mode = Max Hold, select the limit line 15.225(a),(b),(c)
3. After trace stabilization, set the marker to the single peak.
4. The reference level will be calculated by the amount of the margin of the wanted signal to its 30 m emission limit plus marker value.
5. The whole signal trace has to be below the limit line.



Occupied Bandwidth

1. Place the EUT in the test fixture and switch it on.
2. Use the following spectrum analyzer settings: RBW = VBW = 1 kHz, Span = wide enough to capture the 20 dB bandwidth, Trace mode = Max Hold.
3. After trace stabilization, set the first marker and the first display line to the signal peak. Set the second display line 20 dB below the first display line. The Second marker and its delta marker shall be set to cross point of the spectrum line and the second display line and note these frequencies.
4. Alternatively the 20 dB down function of the analyzer could be used, if this function will be applicable to the displayed spectrum.

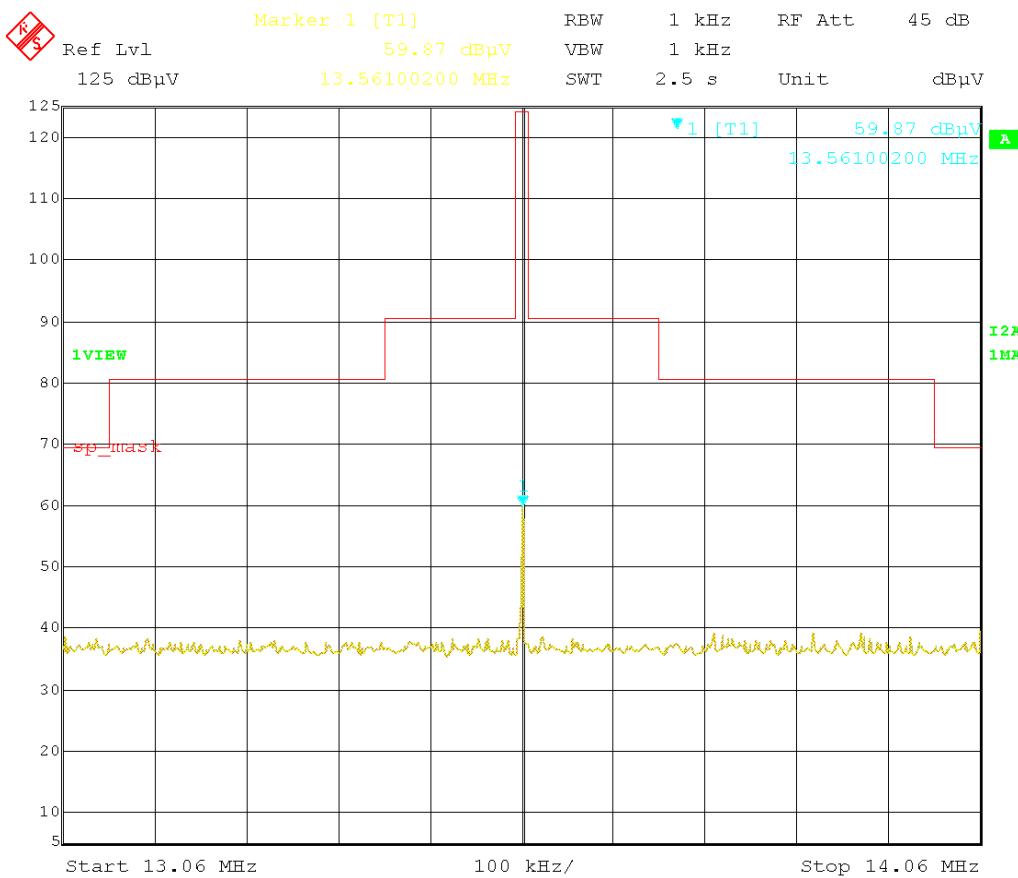
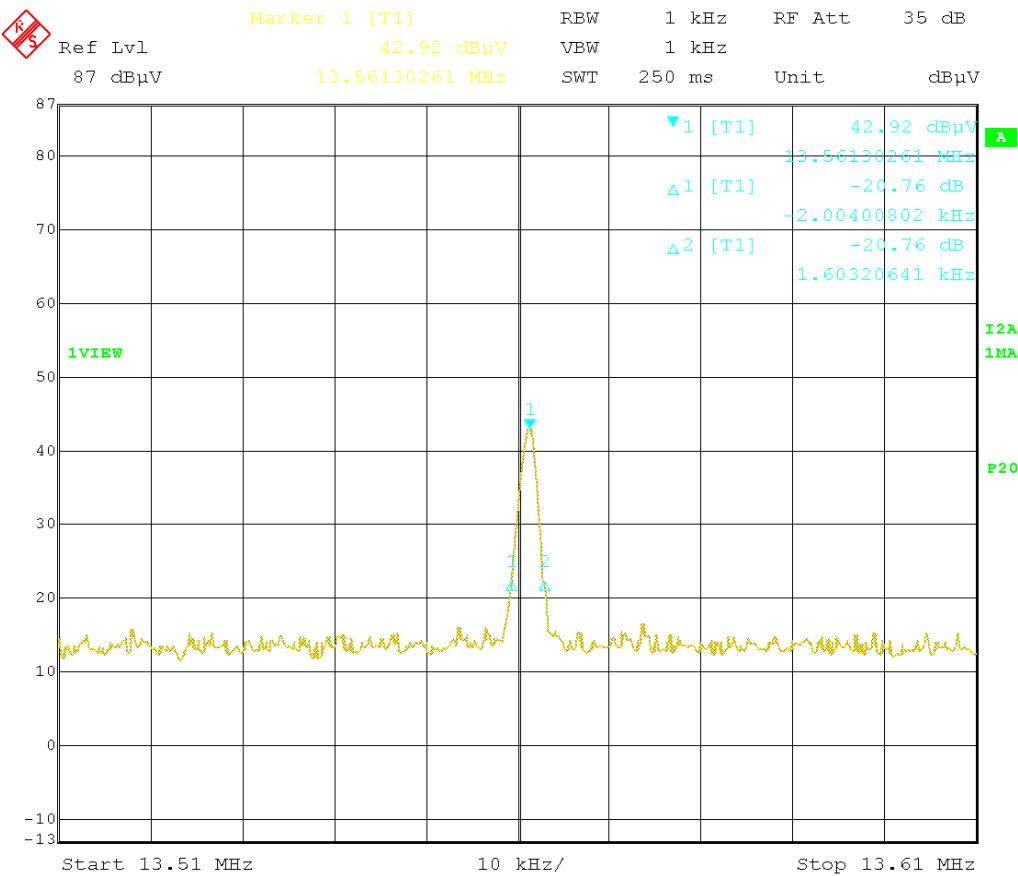
5.3.3 Test Results (Test mode : Modulated)**PASS****Figure 6: Spectrum Mask**



Figure 7: Occupied bandwidth

Occupied Bandwidth = 3.206 kHz

F_L	F_H	Bandwidth ($F_H - F_L$)
13.559699 (MHz)	13.562905 (MHz)	3.206 (kHz)



5.4 FREQUENCY TOLERANCE OF CARRIER SIGNAL

5.4.1 Regulation

FCC 47CFR15 – 15.225(e)

The frequency tolerance of the carrier signal shall be maintained within +/- 0.01% of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery-operated equipment, the equipment tests shall be performed using a new battery.

5.4.2 Measurement Procedure

Frequency stability versus environmental temperature

1. Supply the EUT with nominal DC voltage.
2. Turn the EUT off, and place it inside an environmental temperature chamber. For devices that are normally operated continuously, the EUT may be energized while inside the test chamber. For devices that have oscillator heaters, energize only the heater circuit while the EUT is inside the chamber.
3. RF output was connected to a frequency counter or other frequency-measuring instrument via feed through attenuators.
4. Set the temperature control on the chamber to the highest specified EUT operating temperature, and allow the temperature inside the chamber to stabilize at the set temperature before starting frequency measurements.
5. While maintaining a constant temperature inside the environmental chamber, turn the EUT on and record the operating frequency at startup and two, five, and ten minutes after the EUT is energized.
6. After all measurements have been made at the highest specified temperature turn the EUT off.
7. Repeat the above measurement process for the EUT with the test chamber set at the appropriate temperature.

Frequency Stability versus Input Voltage

1. At temperature (20 ± 5°C), supply the EUT with nominal DC voltage.
2. Couple RF output to a frequency counter or other frequency-measuring instrument.
3. Turn the EUT on, and measure the EUT operating frequency at startup and two, five, and ten minutes after startup.
4. Supply it with 85% of the nominal DC voltage and repeat above procedure.
5. Supply it with 115% of the nominal DC voltage and repeat above procedure.



5.4.3 Test Results :

PASS

TEST MODE : TX on

Table 6: Test Data, Frequency Tolerance of carrier signal

Reference Frequency : 13.5600MHz, LIMIT : within ±1356Hz

Environment Temperature [°C]	Power Supplied [V _{AC}]	Carrier Frequency Measured with Time Elapsed							
		STARTUP		2 minutes		5 minutes		10 minutes	
		[MHz]	Err[Hz]	[MHz]	Err[Hz]	[MHz]	Err[Hz]	[MHz]	Err[Hz]
+50	120	13.560982	982	13.560982	982	13.560982	982	13.560981	981
+40	120	13.560985	985	13.560985	985	13.560985	985	13.560986	986
+30	120	13.560993	993	13.560992	992	13.560992	992	13.560991	991
+20	120	13.561000	1000	13.561000	1000	13.561003	1003	13.561003	1003
+10	120	13.561006	1006	13.561006	1006	13.561006	1006	13.561005	1005
0	120	13.561008	1008	13.561008	1008	13.561006	1006	13.561007	1007
-10	120	13.561010	1010	13.561010	1010	13.561008	1008	13.561008	1008
-20	120	13.561012	1012	13.561012	1013	13.561013	1013	13.561013	1013

Reference Frequency : 13.5600MHz, LIMIT : within ±1356Hz

Power Supplied [V _{AC}]	Carrier Frequency Measured with Time Elapsed							
	STARTUP		2 minutes		5 minutes		10 minutes	
	[MHz]	Err[Hz]	[MHz]	Err[Hz]	[MHz]	Err[Hz]	[MHz]	Err[Hz]
85 %	13.560995	995	13.560996	996	13.560995	995	13.560995	995
100 %	13.560994	994	13.560994	994	13.560993	993	13.560993	993
115 %	13.560996	996	13.560996	996	13.560996	996	13.560997	997

Err[Hz] = Measured carrier frequency (MHz) – Reference Frequency (13.56 MHz)