TÜVRheinland®

Produkte
Products

Prüfbericht - Nr.: 14045645 001 *Test Report No.:*		**Seite 1 von 20** *Page 1 of 20*
Auftraggeber: *Client:*	**Megabyte Limited** **Unit 507, Building 12W, No. 12 Science Park West Avenue** **Hong Kong Science Park, Shatin, N.T., Hong Kong**	
Gegenstand der Prüfung: *Test Item:*	**UHF Mobile RFID Reader**	
Bezeichnung: *Identification:*	**T8-01-MB** **T8-01-39, T8-01-PH**	**Serien-Nr.:** *Serial No.:* **Engineering sample**
Wareneingangs-Nr.: *Receipt No.:*	**A000386196-002**	**Eingangsdatum:** *Date of Receipt:* **30.06.2016**
Prüfort: *Testing Location:*	**TÜV Rheinland Hong Kong Ltd.** 3-4, 11/F., Fou Wah Industrial Building, 10-16 Pun Shan Street, Tsuen Wan, N.T., Hong Kong **Hong Kong Productivity Council** HKPC Building, 78 Tat Chee Avenue, Kowloon, Hong Kong	
Zustand des Prüfgegenstandes bei Anlieferung: *Condition of test item at delivery:*	Test samples are not damaged and suitable for testing.	
Prüfgrundlage: *Test Specification:*	**FCC Part 15 Subpart C** **ANSI C63.10-2013**	
Prüfergebnis: *Test Results:*	**Das vorstehend beschriebene Gerät wurde geprüft und entspricht oben genannter Prüfgrundlage.** The above mentioned product was tested and **passed**.	
Prüflaboratorium: *Testing Laboratory:*	**TÜV Rheinland Hong Kong Ltd.** 3-4, 11/F., Fou Wah Industrial Building, 10-16 Pun Shan Street, Tsuen Wan, N.T., Hong Kong	

geprüft/ *tested by:*			**kontrolliert/** *reviewed by:*		
23.12.2016	Benny Lau Senior Project Manager		23.12.2016	Sharon Li Department Manager	
Datum *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*

Sonstiges: Other Aspects	**FCC ID: XEK-MTRAYT8** This device is a composite device. This report contains the test result of the UHF RFID transceiver portion.

Abkürzungen:				*Abbreviations:*			
P(ass)	=	*entspricht Prüfgrundlage*		*P(ass)*	=	*passed*	
F(ail)	=	*entspricht nicht Prüfgrundlage*		*F(ail)*	=	*failed*	
N/A	=	*nicht anwendbar*		*N/A*	=	*not applicable*	
N/T	=	*nicht getestet*		*N/T*	=	*not tested*	

Table of Content

Page

Product information

Manufacturers declarations

	Transmitter
Operating frequency range	917.4 - 927.2 MHz
Type of modulation	DSB-ASK
Number of channels	50
Channel separation	200 kHz
Type of antenna	Integral FR4 PCB Antenna
Antenna gain (dBi)	0.0 dBi
Power level	fix
Type of equipment	stand alone radio device
Connection to public utility power line	Yes
Nominal voltage	100-240VAC/ 3.7VDC
Independent Operation Modes	Transmitting, Receiving

Product function and intended use

The equipment under test (EUT) is a mobile RFID reader. It is a compact NFC and UHF RFID reader with Bluetooth and WIFI connectivity.

The manufacturer declared that the model: T8-01-39 and T8-01-PH are identical to the model T8-01-MB except the logo plate.

FCC ID: XEK-MTRAYT8

Models	Product description
T8-01-MB T8-01-39, T8-01-PH	UHF Mobile RFID Reader

Submitted documents

Circuit Diagram
Block Diagram
Technical Description
User manual
Label

Independent Operation Modes

The basic operation modes are:

- Transmitting mode.
- Receiving mode

For further information refer to User Manual

Related Submittal(s) Grants

This device is a composite device. This is a single application for certification of the RFID transmitter.
The NFC portion is authorized under the certification procedure (refer to test report 14045648 001 issued by TÜV Rheinland HK Ltd on 23.12.2016).
The Bluetooth portion is authorized under the certification procedure (refer to test report 14045646 001 and 14045647 001 and 14047147 001 issued by TÜV Rheinland HK Ltd on 23.12.2016).
The WIFI portion is authorized under the certification procedure (refer to test report 14045649 001 and 14047148 001 and 14047149 001 issued by TÜV Rheinland HK Ltd on 23.12.2016).

Remark

The test results in this test report are only relevant to the tested sample and does not involve any assessment in the production.

Test Set-up and Operation Mode

Principle of Configuration Selection

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the instructions for use.

Test Operation and Test Software

Test operation should refer to test methodology.

- During test, Channel & Power Controlling Software provided by the customer was used to control the operating channel as well as the maximum output power level. The maximum RF output power and the operating frequencies was selected according to the instruction given by the manufacturer. The setting of the maximum RF output power and the operating frequency range expected by the customer shall be fixed on the firmware of the final end product.

- The RF output of the RFID module is connected to a RF switch and then to two antennas with identical antenna gain. One is called check-in antenna and one is called check-out antenna. The two antenna will not transmit at the same time and the RF path to the antennas are identical. Pre-scan has been conducted and the check-in antenna is found to produce the worst cases. Only the worst cases is shown in this report.

Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

- AC-DC adaptor Model: EA1024AR-050 Input: 100-240 VAC 50/60 Hz; Output: 5.0VDC 2A) (Provided by the applicant)

Countermeasures to achieve EMC Compliance

- Nil

Test Methodology

Radiated Emission

The radiated emission measurements of the transmitter part were performed according to the procedures in ANSI C63.10-2013. The radiated emission measurements of the receiver part were performed according to the procedures in ANSI C63.4-2014.

For measurement below 1GHz - the equipment under test (EUT) was placed at the middle of the 80 cm height turntable. For measurement above 1GHz - the EUT was placed at the middle of the 1.5 m height turntable and RF absorbing material was placed on ground plane between turntable and measuring antenna. During the testing, the EUT was operated standalone and arranged for maximum emissions. The EUT was tested in three orthogonal planes.

The investigation is performed with the EUT rotated 360°, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Repeat the measurement steps until the maximum emissions were obtained.

All radiated tests were performed at an antenna to EUT with 3 meters distance, unless stated otherwise in particular parts of this test report.

Field Strength Calculation

The field strength at 3 m was established by adding the meter reading of the spectrum analyzer to the factors associated with antenna correction factor, cable loss, preamplifiers and filter attenuation.

The equation is expressed as follow:

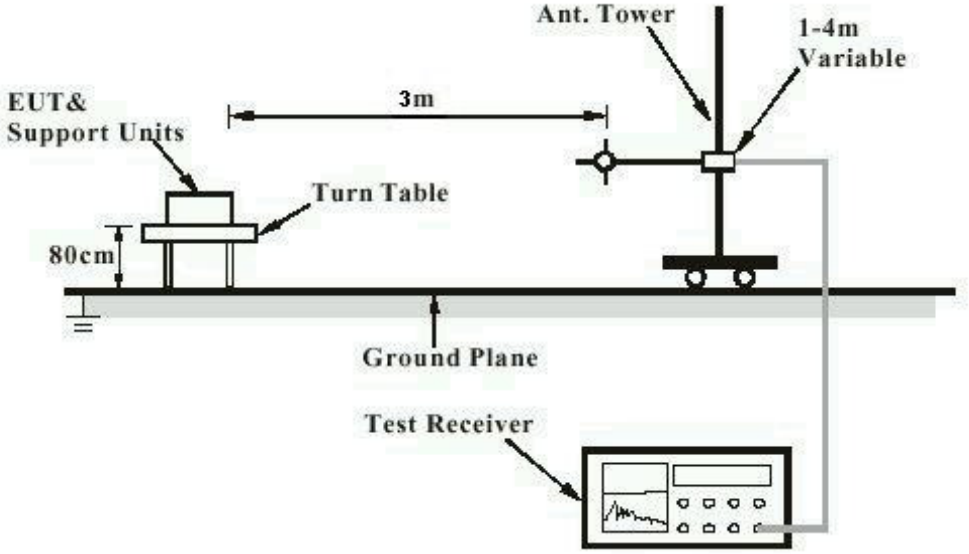
FS = R + AF + CF + FA – PA

Where FS = Field Strength in dBuV/m at 3 meters.
R = Reading of Spectrum Analyzer in dBuV.
AF = Antenna Factor in dB.
CF = Cable Attenuation Factor in dB.
FA = Filter Attenuation Factor in dB.
PA = Preamplifier Factor in dB.

FA and PA are only be used for the measuring frequency above 1 GHz.

Test Setup Diagram

Diagram of Measurement Configuration for Radiation Test



Note: Measurements above 1 GHz are done with a table height of 1.5m. In addition, there is RF absorbing material on the floor of the test site for above 1GHz measurement.

Diagram of Measurement Equipment Configuration for Mains Conduction Measurement (if applicable)

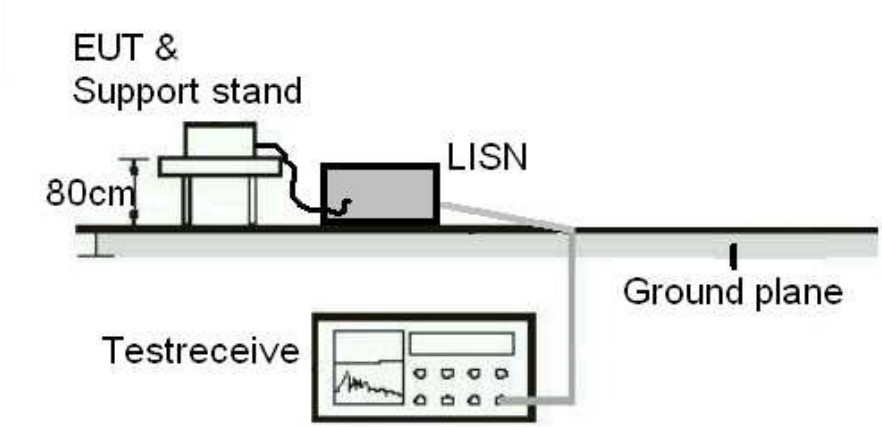
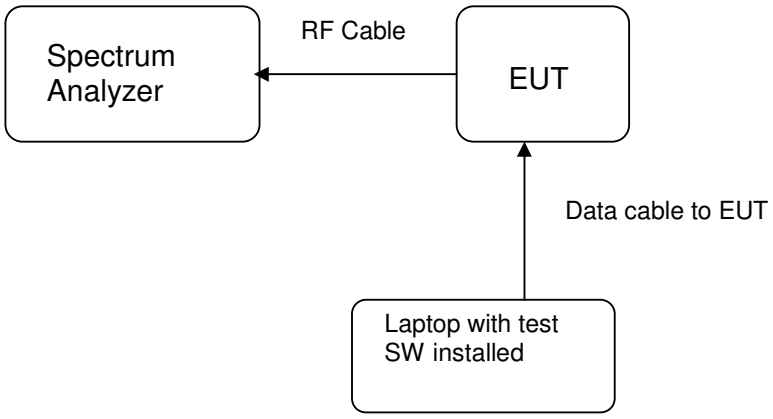


Diagram of Equipment Configuration for Antenna-port Conducted Measurement (if applicable)



List of Test and Measurement Instruments

Hong Kong Productivity Council (FCC Registration number: 90656)

Radiated Emission

Equipment	Manufacturer	Type	Cal. Date	Due Date
Semi-anechoic Chamber	Frankonia	Nil	25-Apr-16	25-Apr-17
New Fully Ancheonic Chamber	TDK	N/A	19-Apr-16	19-Apr-17
Cable	Hubersuhner	SUCOFLEX 104	31-Mar-16	31-Mar-18
Test Receiver	R & S	ESU26	7-Dec-15	7-Dec-16
Bi-conical Antenna	R & S	HK116	1-Sep-15	1-Sep-17
Log Periodic Antenna	R & S	HL223	1-Sep-15	1-Sep-17
Coaxial cable	Harbour	LL335	10-Jun-16	10-Jun-18
Microwave amplifer 0.5-26.5GHz, 25dB gain	HP	83017A	18-Jul-16	18-Jul-18
High Pass Filter (cutoff freq. =1000MHz)	Trilithic	23042	28-Oct-15	28-Oct-17
Horn Antenna	EMCO	3115	26-Aug-15	26-Aug-17
Active Loop Antenna	EMCO	6502	27-Oct-16	27-Oct-17

AC Mains Conducted Emission

Equipment	Manufacturer	Type	Cal. Date	Due Date
Test Receiver	R & S	ESU40	26-Jul-16	26-Jul-17
RF Voltage Probe	Schwarzbeck	TK9416	11-Feb-16	11-Feb-17
LISN	R&S	ESH3-Z5	15-Jun-16	15-Jun-17
Double Shield Cable	Radiall	RG142	14-Sep-15	14-Sep-17
Pulse Limiter	R&S	ESH3-Z2	3-Jun-16	3-Jun-18

TÜV Rheinland Hong Kong Ltd

Radio Test

Equipment	Manufacturer	Type	Cal. Date	Due Date
Spectrum Analyzer	R & S	FSP30	12-Jan-15	12-Jan-2017

Measurement Uncertainty

The estimated combined standard uncertainty for power-line conducted emissions measurements is ±3.43dB.

The estimated combined standard uncertainty for radiated emissions measurements is ±5.10dB (30MHz to 200MHz) and ±5.08dB (200MHz to 1000MHz) and is ±5.10dB (30MHz to 200MHz) and ±5.08dB (above 1GHz).

The estimated combined standard uncertainty for antenna conducted emission is ±1.56dB

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor of k=2, which for the level of confidence is approximately 95%.

Results FCC Part 15 – Subpart C

FCC 15.203 – Antenna Requirement 1		**Pass**
FCC Requirement:	No antenna other than that furnished by the responsible party shall be used with the device	
Results:	a) Antenna type:	Integral FR4 PCB antenna
	b) Manufacturer and model no:	CIROCOMM 43C58E030000100 CIROCOMM 43C58E030000200
	c) Peak Gain:	0.0 dBi
Verdict:	Pass	

FCC 15.204 – Antenna Requirement 2		**N/A**
FCC Requirement:	An intentional radiator may be operated only with the antenna with which it is authorized. If an antenna is marketed with the intentional radiator, it shall be of a type which is authorized with the intentional radiator.	
Results:	Only the integral antennas can be used.	
Verdict:	N/A	

FCC 15.207 – Conducted Emission on AC Mains **Pass**

Test Specification : ANSI C63.10 – 2013
Mode of operation : TX mode
Port of testing : AC Mains input port of power supply
Supply voltage : 120Vac 60Hz
Temperature : 23ºC
Humidity : 50%

Requirement: 15.207(a)

Results: Pass

Live measurement

Frequency range (MHz)	Frequency (MHz)	Quasi-peak dBµV	Average dBµV	Limit QP (dBµV)	Limit AV (dBµV)	Verdict
0,15 – 0,5	0.150	59.4	41.3	66 - 56	56 - 46	Pass
> 0,5 - 5	No peak found	---	---	56	46	Pass
> 5 - 30	No peak found	---	---	60	50	Pass

Neutral measurement

Frequency range (MHz)	Frequency (MHz)	Quasi-peak dBµV	Average dBµV	Limit QP (dBµV)	Limit AV (dBµV)	Verdict
0,15 – 0,5	0.150	58.9	39.6	66 - 56	56 - 46	Pass
> 0,5 - 5	No peak found	---	---	56	46	Pass
> 5 - 30	No peak found	---	---	60	50	Pass

Results:	Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and data rate. The radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150kHz to 30MHz does not exceed the limits. For test Results plots refer to Appendix 1.

FCC 15.247 (b)(2) – Peak Output Power **Pass**

Test Specification : ANSI C63.10 – 2013
Mode of operation : Tx mode
Port of testing : Temporary antenna port
Supply voltage : 120VAC
Temperature : 23ºC
Humidity : 50%

FCC Requirement :
For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels.

Results: For test protocols please refer to Appendix 1.

Frequency (MHz)	Maximum peak output power (dBm)	Limit (dBm)	Verdict
917.4	24.21	30.0	Pass
922.2	24.20	30.0	Pass
927.2	24.09	30.0	Pass

FCC 15.247 (a)(1)(i) – 20 dB Bandwidth **Pass**

Test Specification : ANSI C63.10 – 2013
Mode of operation : Tx mode
Port of testing : Temporary antenna port
Supply voltage : 120VAC
Temperature : 23ºC
Humidity : 50%

FCC Requirement :
The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Results: Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types.

For test protocols refer to Appendix 1.

Frequency (MHz)	20 dB left (MHz)	20 dB right (MHz)	20dB bandwidth (kHz)
917.4	917.3676	917.4316	64.0
922.2	922.1676	922.2316	64.0
927.2	927.1684	927.2328	64.4

FCC 15.247(a)(1) – Carrier Frequency Separation		Pass

Test Specification : ANSI C63.10 – 2013
Mode of operation : Tx mode (hopping on)
Port of testing : Temporary antenna port
Supply voltage : 120VAC
Temperature : 23ºC
Humidity : 50%

FCC Requirement:
Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

Results: Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types.

For test Results plots refer to Appendix 1.

Channel Separation (kHz)	Limit (kHz)	Verdict
200	64.4	Pass

FCC 15.247 (a)(1)(iii) – Number of hopping channels		Pass

Test Specification : ANSI C63.10 – 2013
Mode of operation : Tx mode (hopping on)
Port of testing : Temporary antenna port
Supply voltage : 120VAC
Temperature : 23ºC
Humidity : 50%

FCC Requirement:
For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies.

Results: For test Results plots refer to Appendix 1.

No. of hopping channels	Limit	Verdict
50	50	Pass

FCC 15.247 (a)(1)(iii) – Time of Occupancy (Dwell Time)	Pass

Test Specification : ANSI C63.10 – 2013
Mode of operation : Tx mode (hopping on)
Port of testing : Temporary antenna port
Supply voltage : 120VAC
Temperature : 23ºC
Humidity : 50%

FCC Requirement:
The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period.

Results: For test Results plots refer to Appendix 1.

No. of TX in 20 sec	TX time (ms)	Dwell Time (ms)	Limit (ms)	Verdict
1	374	374	400	Pass

FCC 15.247 (a) – Hopping Sequence	Pass

FCC Requirement: The system radio frequency (RF) bandwidth is equal to the channel bandwidth multiplied by the number of channels in the hopset. The hopset shall be such that the near-term distribution of frequencies appears random, with sequential hops randomly distributed in both direction and magnitude of change in the hopset, while the long-term distribution appears evenly distributed.

As stated in the technical description, the hopping sequence is a pseudorandom sequence generated by the deterministic random bit generator routine in the Firmware, initially seeded with a truly random number, that hops are randomly distributed in both direction and magnitude of change in the hop set which meet the requirement specified in the definition of FCC part 2 section 2.1.

FCC 15.247 (a) – Equal Hopping Frequency Use	Pass

FCC Requirement: Each of the transmitter's hopping channels is used equally on average.

The system radio frequency (RF) bandwidth is equal to the channel bandwidth multiplied by the number of channels in the hopset. The hopset shall be such that the near-term distribution of frequencies appears random, with sequential hops randomly distributed in both direction and magnitude of change in the hopset, while the long-term distribution appears evenly distributed.

As stated in the technical description, the formula will generate a pseudorandom repeating hopping sequence which each hopping channels is used equally on average in long term.

FCC 15.247 (a) – Receiver Input Bandwidth	Pass
FCC Requirement: The associated receiver(s) complies with the requirement that its input bandwidth matches the bandwidth of the transmitted signal.	
As stated in the technical description, in each hopping channel, the RFID module send the command to the tag or receiving backscatter from the tag alternately. The receiver bandwidth is equal to the transmitter bandwidth in the hopping channels	

FCC 15.247 (a) – Receiver Hopping Capability	Pass
FCC Requirement: The associated receiver has the ability to shift frequencies in synchronisation with the transmitted signals.	
As stated in the technical description, when the RFID module is sending command to the tag, the reader is sending out continuous wave signal with AC power and clock signal. Then, tag converts the AC power to DC and energizes the tag microchip. Clock signal is also extracted from the received signal. Tag modulates the received signal encoding its data and transmits it back to the reader antenna in the same channel. The reader decodes the received signal to extract the tag data.	

FCC 15.247 (d) – Spurious Conducted Emissions	Pass
Test Specification : ANSI C63.10 – 2013 Mode of operation : Tx mode Port of testing : Temporary antenna port Supply voltage : 120VAC Temperature : 23 ºC Humidity : 50 %	
FCC Requirement: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.	
Results: Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types. There is no peak found outside any 100kHz bandwidth of the operating frequency band in the three transmit frequency. All three transmit frequency modes comply with the limit stated in subclause 15.247(d). For test protocols refer to Appendix 1.	

Operating frequency (MHz)	Spurious frequency (MHz)	Spurious Level (dBm)	Reference value (dBm)	Delta (dB)	Verdict
917.4	7438.000	-20.21	24.24	44.45	Pass
922.2	7410.000	-20.65	24.27	44.92	Pass
927.2	928.160	-9.76	24.03	33.79	Pass

FCC 15.205 – Radiated Emissions in Restricted Frequency Bands	Pass

Test Specification : ANSI C63.10 – 2013
Mode of operation : TX mode
Port of testing : Enclosure
Supply voltage : 120VAC
Temperature : 23ºC
Humidity : 50%

FCC Requirement: In any 100kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in section15.205(a), must also comply with the radiated emission limits specified in section 15.205(c).

Results: Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and data rate.

Simultaneous transmission was investigated and no new emissions were found.

All three transmit frequency modes comply with the field strength within the restricted bands. There is no spurious found below 30MHz.

Mode: 917.4 MHz TX Vertical Polarization

Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
182.220	39.3	43.5 / QP
902.000	25.7	46.0 / QP
1834.864	56.57	74.0 / PK
1834.832	43.11	54.0 / AV
2752.124	51.47	74.0 / PK
2752.188	44.39	54.0 / AV

Mode: 917.4 MHz TX Horizontal Polarization

Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
182.790	39.3	43.5 / QP
902.000	25.7	46.0 / QP
1834.768	59.70	74.0 / PK
1834.816	44.63	54.0 / AV
2752.040	57.64	74.0 / PK
2752.200	50.92	54.0 / AV

Mode: 922.2MHz TX Vertical Polarization

Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
182.340	39.3	43.5 / QP
1844.712	58.42	74.0 / PK
1844.744	40.17	54.0 / AV

Mode: 922.2 MHz TX	Horizontal Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
182.700	39.1	43.5 / QP
1844.872	59.72	74.0 / PK
1844.744	48.75	54.0 / AV
Mode: 927.2 MHz TX	Vertical Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
182.730	39.3	43.5 / QP
928.000	36.5	46.0 / QP
1854.396	57.98	74.0 / PK
1854.412	44.10	54.0 / AV
2781.808	56.21	74.0 / PK
2781.648	40.24	54.0 / AV
Mode: 927.2 MHz TX	Horizontal Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
183.150	38.6	43.5 / QP
928.000	45.8	46.0 / QP
1854.421	56.28	74.0 / PK
1854.404	44.05	54.0 / AV
2781.781	54.18	74.0 / PK
2781.653	41.59	54.0 / AV

Results FCC Part 15 – Subpart B

FCC 15.107 – Conducted Emission on AC Mains						**Pass**
Test Specification : ANSI C63.4 – 2014 Mode of operation : RX mode Port of testing : AC Mains input port of power supply Supply voltage : 120Vac 60Hz Temperature : 23ºC Humidity : 50%						
Requirement: 15.107(a)						
Results: Pass						
Live measurement						
Frequency range (MHz)	**Frequency (MHz)**	**Quasi-peak dBµV**	**Average dBµV**	**Limit QP (dBµV)**	**Limit AV (dBµV)**	**Verdict**
0,15 – 0,5	0.150	51.9	36.3	66 - 56	56 - 46	Pass
> 0,5 - 5	No peak found	---	---	56	46	Pass
> 5 - 30	No peak found	---	---	60	50	Pass
Neutral measurement						
Frequency range (MHz)	**Frequency (MHz)**	**Quasi-peak dBµV**	**Average dBµV**	**Limit QP (dBµV)**	**Limit AV (dBµV)**	**Verdict**
0,15 – 0,5	0.150	52.4	34.3	66 - 56	56 - 46	Pass
> 0,5 - 5	No peak found	---	---	56	46	Pass
> 5 - 30	No peak found	---	---	60	50	Pass

FCC 15.109 – Radiated Emission			**Pass**
Test Specification : ANSI C63.4 – 2014 Mode of operation : RX mode Port of testing : Enclosure Frequency range : 30MHz to 5GHz Supply voltage : 120VAC Temperature : 23ºC Humidity : 50%			
FCC Requirement: 15.109(a)			
Results: Pass			
Vertical Polarization			
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**	
183.030	39.5	43.5 / QP	
51.539	32.7	43.5 / QP	
300.000	33.3	46.0 / QP	
4948.717	51.2	54.0 / AV	
Horizontal Polarization			
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**	
183.910	40.2	43.5 / QP	
300.000	22.2	46.0 / QP	
800.000	31.3	46.0 / QP	
3576.923	51.4	54.0 / AV	