5 MAXIMUM PERMISSIBLE EXPOSURE (MPE)

5.1 Applicable Standard

According to subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (minutes)**
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f^2)	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;

According with 680106 D01 Wireless Power Transfer v04 clause 3.2

Accordingly, for § 2.1091-Mobile devices, the MPE limits between 100 kHz to 300 kHz are to be considered the same as those at 300 kHz in Table 1 of § 1.1310, that is, 614 V/m and 1.63 A/m, for the electric field and magnetic field, respectively. For § 2.1093-Portable devices below 4 MHz and down to 100 kHz, the MPE limits in § 1.1310 (with the 300 kHz limit applicable all the way down to 100 kHz) can be used for the purpose of equipment authorization in lieu of SAR evaluations.

According to 680106 D01 Wireless Power Transfer v04 clause 5.2

There might be situations where the WPT RF emissions are limited enough that even operations in a "crowded" environment, where many similar WPT devices are present, do not pose significant EMC and RF exposure concerns. In this scenario, and for devices operating within a one-meter distance from the receiver, as defined above, a manufacturer will not have to submit an "Equipment Compliance Review" KDB, and receive FCC concurrence before proceeding with equipment authorization. This exception to the requirement of submitting the ECR to obtain FCC concurrence only applies when all the following criteria (1) through (6) are met:

(1) The power transfer frequency is below 1 MHz.

(2) The output power from each transmitting element (e.g., coil) is less than or equal to 15 watts.

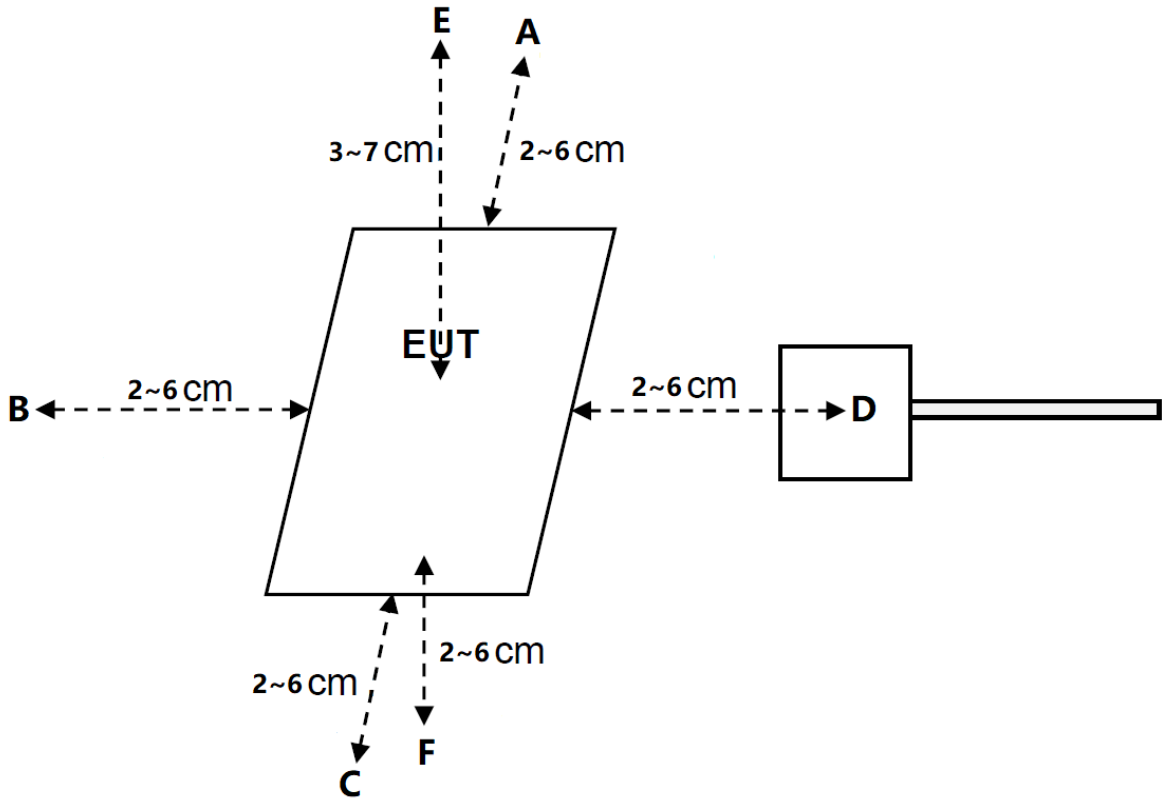
(3) A client device providing the maximum permitted load is placed in physical contact with the transmitter (i.e., the surfaces of the transmitter and client device enclosures need to be in physical contact)

(4) Only § 2.1091-*Mobile* exposure conditions apply (i.e., this provision does not cover § 2.1093-*Portable* exposure conditions).

(5) The E-field and H-field strengths, at and beyond 20 cm surrounding the device surface, are demonstrated to be less than 50% of the applicable MPE limit, per KDB 447498, Table 1. These measurements shall be taken along the principal axes of the device, with one axis oriented along the direction of the estimated maximum field strength, and for three points per axis or until a 1/*d* (inverse distance from the emitter structure) field strength decay is observed. Symmetry considerations may be used for test reduction purposes. The device shall be operated in documented worst-case compliance scenarios (i.e., the ones that lead to the maximum field components), and while all the radiating structures (e.g., coils or antennas) that by design can simultaneously transmit are energized at their nominal maximum power.

(6) For systems with more than one radiating structure, the conditions specified in (5) must be met when the system is fully loaded (i.e., clients absorbing maximum power available), and with all the radiating structures operating at maximum power at the same time, as per design conditions. If the design allows one or more radiating structures to be powered at a higher level while other radiating structures are not powered, then those cases must be tested as well. For instance, a device may use three RF coils powered at 5 W, or one coil powered at 15 W: in this case, both scenarios shall be tested.

5.2 Block Diagram of Test Setup



5.3 MAGPy Probe Information

The full MAGPy-8H3D+E3D V2 probe consists of eight isotropic H-field subprobes and one isotropic E-field subprobe that are all integrated inside the probe head with a flat tip. Each isotropic H-field subprobe comprises three concentric orthogonal loop coil sensors. The isotropic E-field subprobe is composed of three orthogonal sensors (x and y sensors are dipoles and the sensor measuring the z component is a monopole). In total, the MAGPy-8H3D+E3D V2 probe is thus composed of nine subprobes and 27 single sensors that measure in the time-domain. The flat-tip probe design brings the sensors closer to the tip (e.g., the closest H-field sensors are now 7.5mm from the tip). The probe specifications are provided in Table 2.1.

Parameter	Specs
PROBE DESIGN	
Diameter	60 mm
8 isotropic H-field sensors	concentric loops of 1 cm^2 arranged at the corner of a cube of 22 mm side length
1 isotropic E-field sensor	orthogonal dipole/monopole (arm length: 50 mm)
Measurement center	18.5 mm from the probe tip
Temperature range	0–40 °C
Dimensions	110 × 635 × 35 mm (MAGPy-8H3D+E3D V2 & MAGPy-DAS V2)
H-FIELD SPECIFICATION	
Frequency range	3 kHz–10 MHz
Measurement range	0.1–3200 A/m, 0.12 µT–4 mT
Gradient range	0–80 T/m/T
E-FIELD SPECIFICATION	
Frequency range	3 kHz–10 MHz
Measurement range	0.08–2000 V/m

Table 2.1: MAGPy-8H3D+E3D V2 probe specifications

5.4 Test Procedures

1) The measuring distance from the center of the probe to the tip of the probe is 1.85cm, so the minimum measurement distance is 1.85cm. To obtain the H-field and E-field at 0cm, perform the following steps.
2) Perform H-field and E-field measurements for each all sides of the EUT surface at 2~6cm, along all the principal axes defined with respect to the orientation of the transmitting element(e.g., coil or antenna). Step is 1cm. For top side, The measuring distance is 3~7cm, because the wireless charging load has a thickness, and the measuring distance cannot be set to 2cm.
3) The highest emission level was recorded.
4) According to the measurement data, the curve is fitted with the measured distance as the horizontal coordinate and the measured H-field or E- field as the vertical coordinate.
5) The fitted curve needs to be validated through the probe measurements for the two closest points to the device surface. The difference needs to be less than 30%.
6) The H-field or E-field at 0cm is estimated from the fitted curve and compared with limit.

5.5 Test Data:

Sample Number:	2TBR-1	Test Date:	2024/11/18
Test Site:	MPE	Test Mode:	Wireless Charging
Tester:	David Huang	Test Result:	Pass

Environmental Conditions:					
Temperature: (℃)	25.1	Relative Humidity: (%)	48	ATM Pressure: (kPa)	101.2

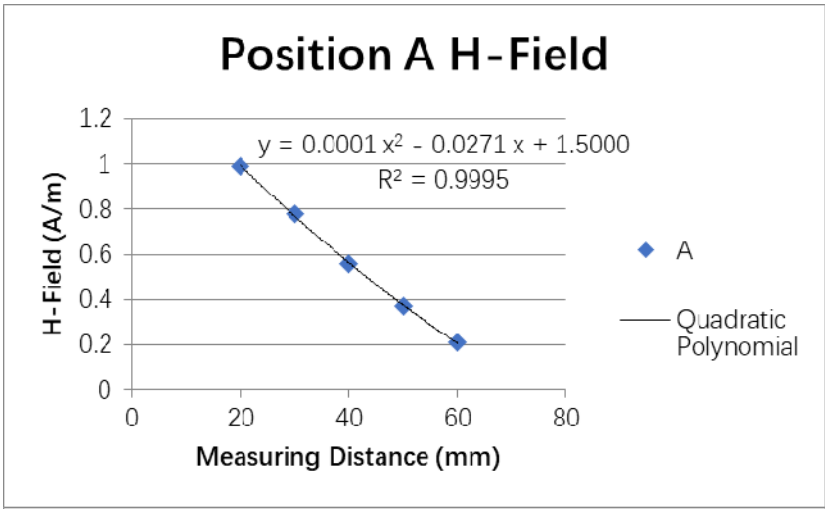
Test Equipment List and Details:

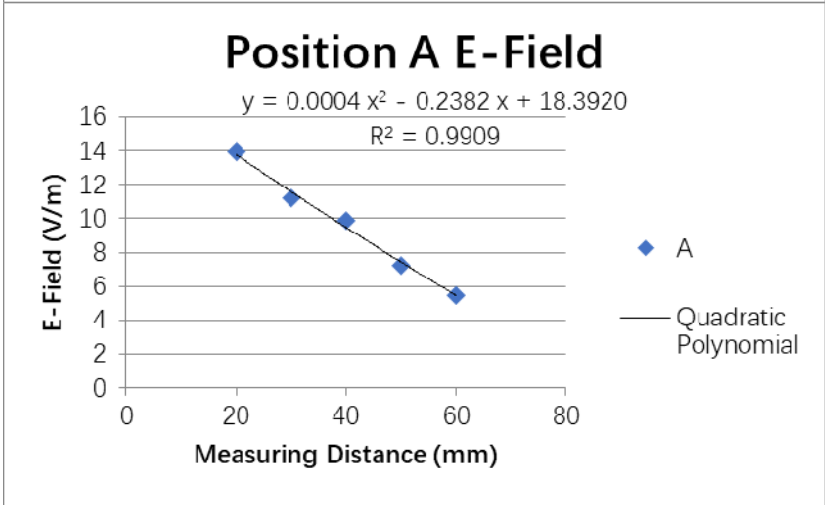
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
speag	Probe	MAGPY-8H3D+E3D	3081	2024/9/14	2025/9/13
speag	Data Acquisition System	MAPGPY-DAS	1018	2024/9/14	2025/9/13

**** Statement of Traceability:*** *China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).*

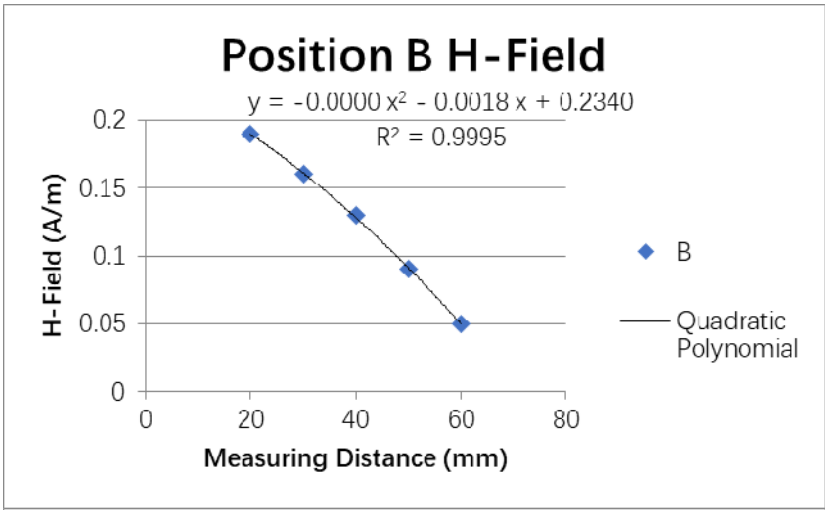
Test Data:

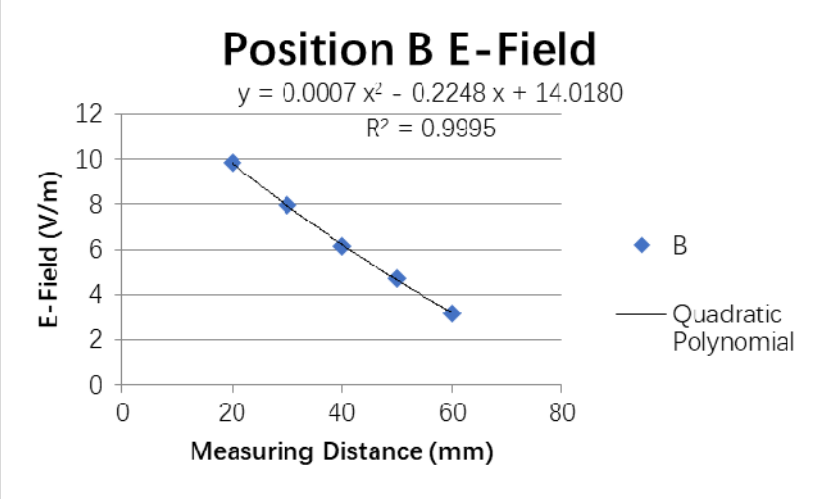
Test Frequency (kHz)	Measuring Position	Measuring Distance (mm)	H-Field (A/m)	E-Field (V/m)
114.71	A	20	0.99	13.9
		30	0.78	11.2
		40	0.56	9.91
		50	0.37	7.23
		60	0.21	5.49



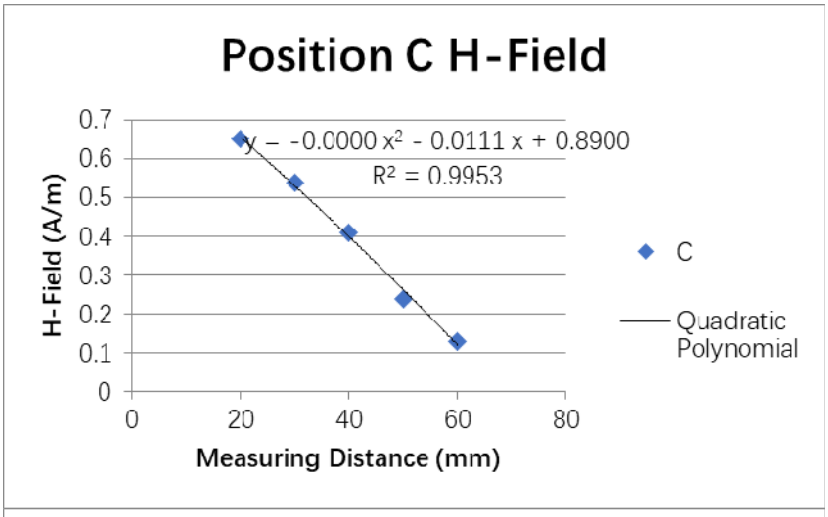


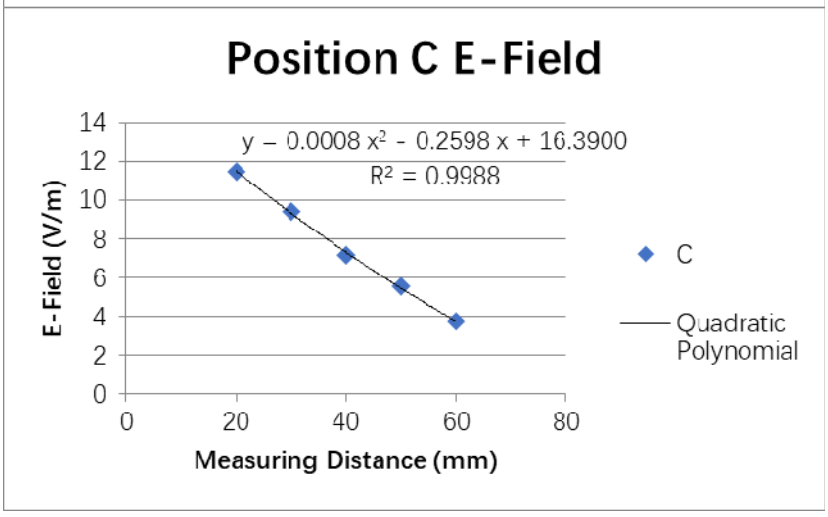
Test Frequency (kHz)	Measuring Position	Measuring Distance (mm)	H-Field (A/m)	E-Field (V/m)
114.71	B	20	0.19	9.83
		30	0.16	7.94
		40	0.13	6.15
		50	0.09	4.72
		60	0.05	3.17



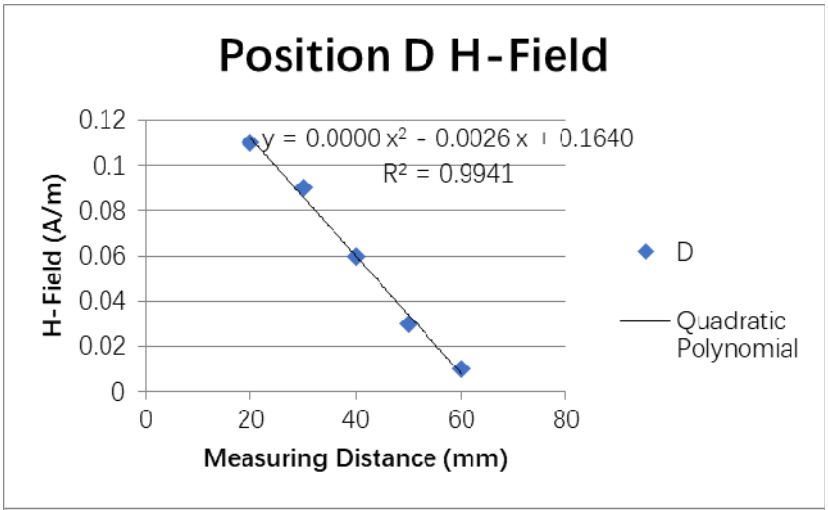


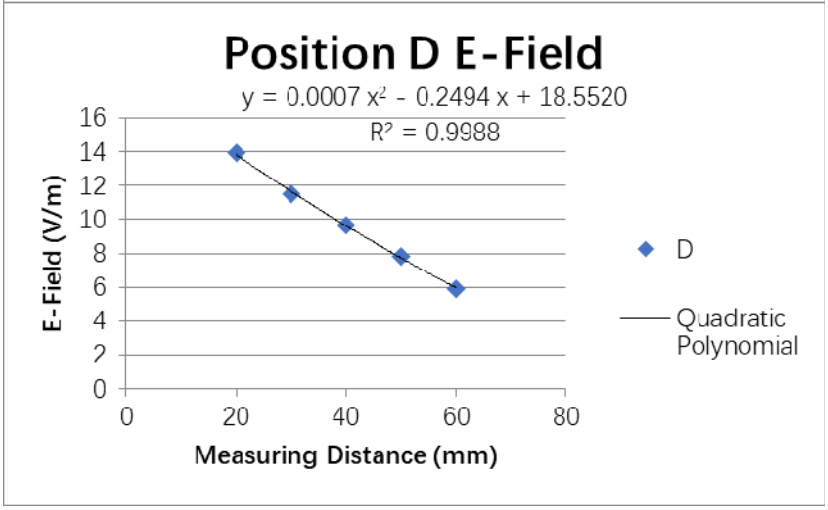
Test Frequency (kHz)	Measuring Position	Measuring Distance (mm)	H-Field (A/m)	E-Field (V/m)
114.71	C	20	0.65	11.5
		30	0.54	9.43
		40	0.41	7.16
		50	0.24	5.56
		60	0.13	3.73



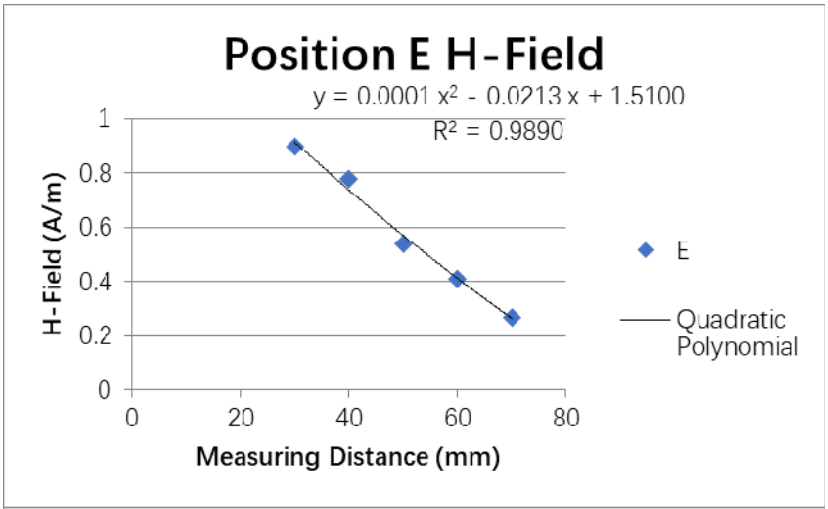


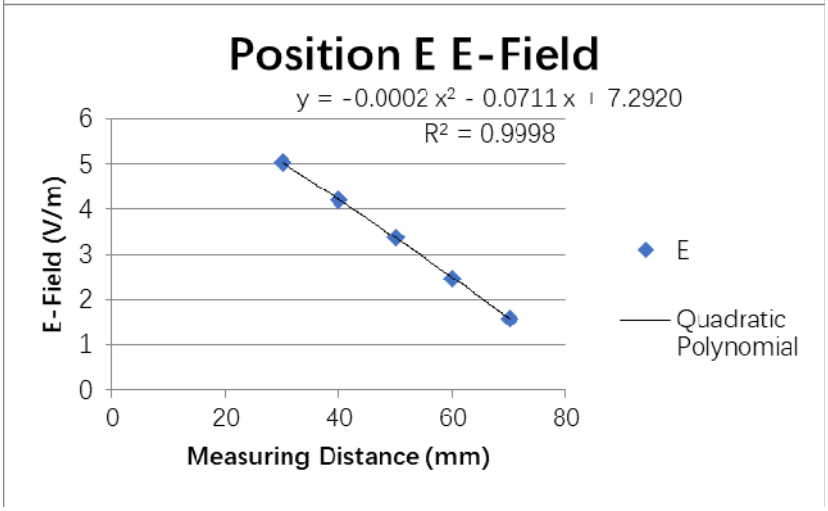
Test Frequency (kHz)	Measuring Position	Measuring Distance (mm)	H-Field (A/m)	E-Field (V/m)
114.71	D	20	0.11	13.9
		30	0.09	11.5
		40	0.06	9.68
		50	0.03	7.82
		60	0.01	5.9



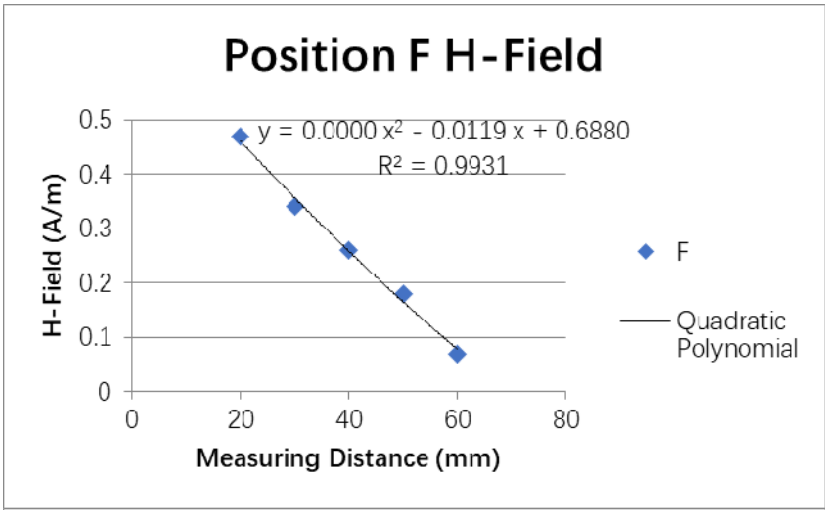


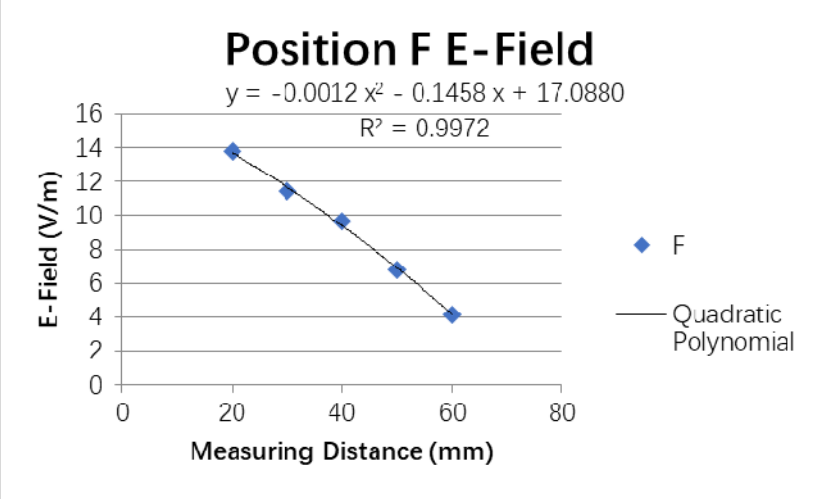
Test Frequency (kHz)	Measuring Position	Measuring Distance (mm)	H-Field (A/m)	E-Field (V/m)
114.71	E	30	0.9	5.02
		40	0.78	4.21
		50	0.54	3.38
		60	0.41	2.46
		70	0.27	1.59





Test Frequency (kHz)	Measuring Position	Measuring Distance (mm)	H-Field (A/m)	E-Field (V/m)
0	F	20	0.47	13.8
		30	0.34	11.4
		40	0.26	9.67
		50	0.18	6.82
		60	0.07	4.17





Verify The Fitted Curve

Measuring Position	Measuring Distance (mm)	Estimated H-Field (A/m)	Measured H-Field (A/m)	Agreement Between Estimated and Measured (%)	Limit (%)
A	20	1	0.99	1.01	±30
	30	0.78	0.78	0.00	±30
B	20	0.2	0.19	5.26	±30
	30	0.18	0.16	12.50	±30
C	20	0.67	0.65	3.08	±30
	30	0.56	0.54	3.70	±30
D	20	0.11	0.11	0.00	±30
	30	0.09	0.09	0.00	±30
E	30	0.96	0.9	6.67	±30
	40	0.82	0.78	5.13	±30
F	20	0.45	0.47	-4.26	±30
	30	0.33	0.34	-2.94	±30

Note: Agreement Between Estimated and Measured(%) = (Estimated E-Field (V/m) - Measured E-Field (V/m)) / Measured E-Field (V/m) x 100

Measuring Position	Measuring Distance (mm)	Estimated E-Field (V/m)	Measured E-Field (V/m)	Agreement Between Estimated and Measured (%)	Limit (%)
A	20	13.79	13.9	-0.79	±30
	30	11.61	11.2	3.66	±30
B	20	9.8	9.83	-0.31	±30
	30	7.9	7.94	-0.50	±30
C	20	11.51	11.5	0.09	±30
	30	9.32	9.43	-1.17	±30
D	20	13.84	13.9	-0.43	±30
	30	11.7	11.5	1.74	±30
E	30	4.98	5.02	-0.80	±30
	40	4.13	4.21	-1.90	±30
F	20	13.69	13.8	-0.80	±30
	30	11.63	11.4	2.02	±30

Note: Agreement Between Estimated and Measured(%) = (Estimated E-Field (V/m) - Measured E-Field (V/m)) / Measured E-Field (V/m) x 100

Conclusion: The validation is considered sufficient, because within 30% agreement between the estimated model and the (E-Field and H-Field) probe measurements is demonstrated

Test Distance: 0cm(estimated from the fitted curve)

H-Field Strength:

Test Frequency (kHz)	Test Position (A/m)						Limit (A/m)
	A	B	C	D	E	F	
114.7	1.5	0.23	0.89	0.16	1.51	0.69	1.63

E-Field Strength:

Test Frequency (kHz)	Test Position (V/m)						Limit (V/m)
	A	B	C	D	E	F	
114.7	18.39	14.02	16.39	18.55	7.29	17.09	614

Considerations of compliance 680106 D01 Wireless Power Transfer v04 clause 5.2:

(1) Power transfer frequency is less than 1 MHz

Yes, the operation frequency is 114.71 kHz.

(2) The output power from each transmitting element (e.g., coil) is less than or equal to 15 watts.

Yes, the maximum output power of primary coil is 4 Watts.

(3) A client device providing the maximum permitted load is placed in physical contact with the transmitter (i.e., the surfaces of the transmitter and client device enclosures need to be in physical contact)

Yes, client device is placed directly in contact with the transmitter

(4) Only § 2.1091-Mobile exposure conditions apply (i.e., this provision does not cover § 2.1093-Portable exposure conditions).

No, portable exposure conditions.

(5) The E-field and H-field strengths, at and beyond 20 cm surrounding the device surface, are demonstrated to be less than 50% of the applicable MPE limit, per KDB 447498, Table 1. These measurements shall be taken along the principal axes of the device, with one axis oriented along the direction of the estimated maximum field strength, and for three points per axis or until a 1/d (inverse distance from the emitter structure) field strength decay is observed. Symmetry considerations may be used for test reduction purposes. The device shall be operated in documented worst-case compliance scenarios (i.e., the ones that lead to the maximum field components), and while all the radiating structures (e.g., coils or antennas) that by design can simultaneously transmit are energized at their nominal maximum power.

No, the test result for H-field strength not less than 50% of the MPE limit.

(6) For systems with more than one radiating structure, the conditions specified in (5) must be met when the system is fully loaded (i.e., clients absorbing maximum power available), and with all the radiating structures operating at maximum power at the same time, as per design conditions. If the design allows one or more radiating structures to be powered at a higher level while other radiating structures are not powered, then those cases must be tested as well. For instance, a device may use three RF coils powered at 5 W, or one coil powered at 15 W: in this case, both scenarios shall be tested.

Yes,. all the radiating structures operating at maximum power at the same time.