



Global Product Certification
EMC-EMF Safety Approvals

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RF ELECTROMAGNETIC FIELDS SURVEY

FCC Guidelines for Human Exposure IEEE C95.1

Report Number: M171220-4

Product: TWR5 Weigh Scale and Reader

Client: Gallagher Group Ltd

Date of Issue: 09 April 2018

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RF ELECTROMAGNETIC FIELDS SURVEY

Product: TWR5 Weigh Scale and Reader

Scope: Conduct RF Electric and Magnetic Field measurements in the proximity of the 134.2 KHz RFID Reader (Large Inductive Loop Antenna 1.3m x 0.6m and Small Inductive Loop Antenna 0.6m x 0.4m)

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Standard(s):

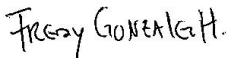
1. **47 CFR 1.1310**
"Radiofrequency radiation exposure limits"
2. **IEEE Std C95.1: 1999 (2005)**
"IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz"


Survey Date: 09th March 2018

Result: Radio Frequency Electric and Magnetic Fields measured at 0.2m from the 134.2 KHz RFID Reader (Large Inductive Loop Antenna 1.3m x 0.6m and Small Inductive Loop Antenna 0.6m x 0.4m) were below the IEEE Std C95.1 Maximum Permissible Exposure (MPE) levels for uncontrolled environments. Refer to report number M171220-4 for full details.

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RF ELECTROMAGNETIC FIELDS SURVEY

1.0 INTRODUCTION

Radio Frequency (RF) Electric and Magnetic Field were measured on the TWR5 Weigh Scale Reader (Large Inductive Loop Antenna 1.3m x 0.6m and Small Inductive Loop Antenna 0.6m x 0.4m)

The purpose of the measurements was to determine RF field levels in the proximity of the 134.2 KHz RFID Reader (Inductive Loop Antennas). Radiofrequency fields measurements were performed following adopted FCC Guidelines and the results compared against the Maximum Permissible Exposure (MPE) levels for uncontrolled environments of the IEEE Std C95.1: 1999 (2005).

The terms RF (Radio Frequency) fields, Electromagnetic Radiation (EMR), Electromagnetic Fields (EMF) and Electromagnetic Energy (EME) have the same meaning when used in this report.

2.0 PRODUCT DESCRIPTION

The TWR5 Weigh Scale and Reader is specifically designed to weigh live animals through the load bars. The external RFID reader automatically reads the RFID tag from the animal's ear. The TWR5 (Touch Screen) and the RFID reader are connected by a customized cable.

Product:	Weigh Scale and Reader
Model Number:	TWR5
Manufacturer:	Gallagher Group Ltd
Wireless Interface:	RFID
Reader Operating Frequency:	134.2 KHz
Antenna Type:	Inductive Loop
Large Antenna Dimensions:	1.3m x 0.6m (Option 1)
Small Antenna Dimensions:	0.6m x 0.4m (Option 2)

3.0 EXECUTIVE SUMMARY

Radio Frequency Electric and Magnetic Fields measured at 0.2m from the 134.2 KHz RFID Reader (Large Inductive Loop Antenna 1.3m x 0.6m and Small Inductive Loop Antenna 0.6m x 0.4m) were below the IEEE Std C95.1 Maximum Permissible Exposure (MPE) levels for uncontrolled environments. Refer to section 7 for the measurements.

Although the results in this report refer to measurements done in front of the Reader, they may be also applicable in the back of it due to the characteristics of the electromagnetic field around Inductive Loop Antennas.

4.0 ELECTROMAGNETIC FIELD STANDARDS

4.1 IEEE Std C95.1: 1999 (2005)

This IEEE Standard set Maximum Permissible Exposure (MPE) levels to RF Electromagnetic fields in the frequency range from 3 kHz to 300 GHz in order to prevent adverse health effects for humans. The Standard specifies limits for controlled and uncontrolled environments. It also provides criteria to assist in the determination of compliance with the specified levels and specifies procedures for the measurement of RF electromagnetic fields.

5.0 DEFINITIONS AND MPE LEVELS

5.1 MPE in Uncontrolled Environments (General Public)

Exposure associated with an uncontrolled environment is the exposure of individuals who have no knowledge or control of their exposure. The exposure may occur in living quarters or workplaces where there are no expectations that the exposure levels may exceed those shown in Table 1.

5.2 MPE in Controlled Environments (Occupational)

Exposure associated with a controlled environment includes exposure that may be incurred by persons who are aware of the potential for exposure as a concomitant of employment, exposure of other cognizant individuals, or exposure that is the incidental result of passage through areas where analysis shows the exposure levels may be above the MPE in uncontrolled environments but do not exceed MPE in controlled environments.

5.2.1 Maximum Permissible Exposure for Uncontrolled Environments

Frequency range (MHz)	Electric field strength (E) (V/m)	Magnetic field strength (H) (A/m)	Power density (S) E-field, H-field (mW/cm ²)	Averaging time $ E ^2, S$ or $ H ^2$ (min)	
0.003–0.1	614	163	(100, 1 000 000) [‡]	6	6
0.1–1.34	614	$16.3/f$	$(100, 10\,000/f^2)^{‡}$	6	6
1.34–3.0	$823.8/f$	$16.3/f$	$(180/f^2, 10\,000/f^2)$	$f^2/0.3$	6
3.0–30	$823.8/f$	$16.3/f$	$(180/f^2, 10\,000/f^2)$	30	6
30–100	27.5	$158.3/f^{1.668}$	$(0.2, 940\,000/f^{3.336})$	30	$0.0636 f^{1.337}$
100–300	27.5	0.0729	0.2	30	30
300–3000	—	—	$f/1500$	30	
3000–15 000	—	—	$f/1500$	$90\,000/f$	
15 000–300 000			10	$616\,000/f^{1.2}$	

Table 1: MPE levels for controlled environments

Notes:

1. f is the frequency in MHz
2. The exposure values in terms of electric and magnetic field strengths are the mean values obtained by spatially averaging the squares of the fields over an area equivalent to the vertical cross section of the human body (projected area).
3. These plane-wave equivalent power density values, although not appropriate for near-field conditions, are commonly used as a convenient comparison with MPEs at higher frequencies and are displayed on some instruments in use.

4. Highlighted yellow row denotes the applicable limits at 134.2KHz.

5.3 Units of Measurement

At RF frequencies the Electric Field is referred to as the E-field and the measurement unit is Volts per metre (V/m) and the Magnetic Field is referred to as the H-field and the measurement unit is Amps per metre (A/m)

5.3.1 Applicable Exposure Limits

The applicable MPE levels in uncontrolled environments for the RF field strength measurements in this report is 614 V/m for E-Field and 121.46 A/m for H-Field.

6.0 MEASUREMENT METHOD

6.1 Test Equipment

Equipment Type	Make/Model/Serial Number	Due Date dd/mm/yy	Cal. Interval
Meter	Asset Number: P-179-1 Manufacturer: NARDA Model Number: NBM-550 Serial Number: E-0743	25/09/2019	2 Year, *1
E-Field Probe	Asset Number: P-179-3 Manufacturer: NARDA Model Number: EF0392 (100KHz-3GHz) Serial Number: D-0157	25/09/2019	2 Year, *1
Meter	Asset Number: P-060 Manufacturer: Wandel & Goltermann Model Number: EMR 300 Serial Number: N-0055	24/04/2019	2 Year, *1
H-Field Probe	Asset Number: P-060-12 Manufacturer: Narda Model Number: Type 12.1 (30KHz-30MHz) Serial Number: Z-0019	24/04/2019	2 Year, *1

Table 2: Test Equipment List

Note *1. Internal NATA calibration.

The equipment was verified by EMC Technologies before and after the survey.
Verification Procedure: probe_verify rev1.3

6.2 Measurement Procedures

RFID transmission at 134.2KHz was activated by placing a 5Kg mass on the load bar. E-field (V/m) and H-field (A/m) measurements (Meter was set to max. hold mode) were performed in front of the Reader (Large Inductive Loop Antenna 1.3m x 0.6m and Small Inductive Loop Antenna 0.6m x 0.4m) at 0.1m, 0.2m and 0.5m.

6.3 Measurement Uncertainty

EMC Technologies has evaluated the equipment and the methods used to measure Electromagnetic Fields. The estimated measurement uncertainties for the test shown within this report are as follows:

Radiated Electromagnetic Fields

9 kHz to 45.5 GHz ± 3.0 dB

The above expanded uncertainties are based on standard uncertainties multiplied by a coverage factor of $k=2$, providing a level of confidence of approximately 95%.

6.4 Measurement Limitations

The measurement results are indicative only. The actual level of exposure is dependent on the actual environment, installation and the transmission state of the RF source.

6.5 Measurement Reading Points

Measurements were made at 9 points around the 134.2 KHz RFID Reader at 0.1m, 0.2m and 0.5m from it. Refer to section 7.0 for detailed results.

Option 1: Large Antenna



Image 1: Large Inductive Loop Antenna 1.3m x 0.6m

Option 2: Small Antenna

Image 2: Small Inductive Loop Antenna 0.6m x 0.4m

7.0 MEASUREMENT RESULTS

7.1 Large Antenna E-field

A Probe calibration factor (1.02) was applied to the measured E-Field values to reduce the uncertainty due to systematic errors.

Distance [m]	Reading Point	Max. Measured Electric Field [V/m]	Max. Final Probe Electric Field [V/m]	Percentage of the MPE in Uncontrolled Environments
0.1	1	95.1	97	16%
	2	94.6	96.5	16%
	3	67.4	68.8	11%
	4	108	110.2	18%
	5	78.5	80.1	13%
	6	60.1	61.3	10%
	7	100.9	102.9	17%
	8	104.8	106.9	17%
	9	112.2	114.4	19%
0.2	1	68.50	69.87	11%
	2	65.93	67.25	11%
	3	52.47	53.52	9%
	4	81.67	83.30	14%
	5	69.89	71.29	12%
	6	59.21	60.39	10%
	7	81.32	82.95	14%
	8	72.11	73.55	12%
	9	78.97	80.55	13%
0.5	1	32.09	32.73	5%
	2	30.51	31.12	5%
	3	28.40	28.97	5%
	4	44.49	45.38	7%
	5	43.02	43.88	7%
	6	40.41	41.22	7%
	7	36.62	37.35	6%
	8	35.44	36.15	6%
	9	35.86	36.58	6%

Table 3: E-Field Measurements

The applicable General Public limit is 614 V/m. The highest measured E-Field at 0.2m from the 134.2 KHz RFID Reader (Large Inductive Loop Antenna 1.3m x 0.6m) was 83.30 V/m and it is equivalent to 14% of the MPE in Uncontrolled Environments.

7.2 Large Antenna H-field

A conservative Probe calibration factor (2.23) was applied to the measured H-Field values to reduce the uncertainty due to systematic errors.

Distance [m]	Reading Point	Max. Measured Magnetic Field [A/m]	Max. Final Probe Magnetic Field [A/m]	Percentage of the MPE in Uncontrolled Environments
0.1	1	2.302	5.133	4%
	2	2.273	5.069	4%
	3	2.302	5.133	4%
	4	1.762	3.929	3%
	5	2.759	6.153	5%
	6	2.224	4.960	4%
	7	2.384	5.316	4%
	8	2.504	5.584	5%
	9	2.308	5.147	4%
0.2	1	1.380	3.077	3%
	2	1.323	2.950	2%
	3	1.508	3.363	3%
	4	1.405	3.133	3%
	5	1.877	4.186	3%
	6	1.646	3.671	3%
	7	0.834	1.859	2%
	8	1.113	2.482	2%
	9	1.149	2.562	2%
0.5	1	0.531	1.185	1%
	2	0.559	1.247	1%
	3	0.589	1.314	1%
	4	0.535	1.192	1%
	5	0.641	1.429	1%
	6	0.565	1.259	1%
	7	0.264	0.590	0.5%
	8	0.265	0.590	0.5%
	9	0.221	0.493	0.4%

Table 4: H-Field Measurements

The applicable General Public limit is 121.46 A/m. The highest measured H-Field at 0.2m from the 134.2 KHz RFID Reader (Large Inductive Loop Antenna 1.3m x 0.6m) was 4.186 A/m and it is equivalent to 3% of the MPE in Uncontrolled Environments.

7.3 Small Antenna E-field

A Probe calibration factor (1.02) was applied to the measured E-Field values to reduce the uncertainty due to systematic errors.

Distance [m]	Reading Point	Max. Measured Electric Field [V/m]	Max. Final Probe Electric Field [V/m]	Percentage of the MPE in Uncontrolled Environments
0.1	1	125.3	127.81	21%
	2	133.6	136.27	22%
	3	125.1	127.60	21%
	4	151.6	154.63	25%
	5	97.97	99.93	16%
	6	120.4	122.81	20%
	7	134.9	137.60	22%
	8	114.5	116.79	19%
	9	128.4	130.97	21%
0.2	1	80.81	82.43	13%
	2	82.27	83.92	14%
	3	75	76.50	12%
	4	85.27	86.98	14%
	5	87.68	89.43	15%
	6	85.5	87.21	14%
	7	84.91	86.61	14%
	8	82.4	84.05	14%
	9	81.5	83.13	14%
0.5	1	34.89	35.59	6%
	2	33.13	33.79	6%
	3	31.88	32.52	5%
	4	41.01	41.83	7%
	5	39.63	40.42	7%
	6	38.37	39.14	6%
	7	37.94	38.70	6%
	8	38.05	38.81	6%
	9	36.32	37.05	6%

Table 5: E-Field Measurements

The applicable General Public limit is 614 V/m. The highest measured E-Field at 0.2m from the 134.2 KHz RFID Reader (Small Inductive Antenna 1.3m x 0.6m) was 89.43 V/m and it is equivalent to 15% of the MPE in Uncontrolled Environments.

7.4 Small Antenna H-field

A conservative Probe calibration factor (2.23) was applied to the measured H-Field values to reduce the uncertainty due to systematic errors.

Distance [m]	Reading Point	Max. Measured Magnetic Field [A/m]	Max. Final Probe Magnetic Field [A/m]	Percentage of the MPE in Uncontrolled Environments
0.1	1	1.445	3.222	3%
	2	2.498	5.571	5%
	3	2.922	6.516	5%
	4	2.200	4.906	4%
	5	3.612	8.055	7%
	6	3.461	7.718	6%
	7	2.863	6.384	5%
	8	3.325	7.415	6%
	9	2.714	6.052	5%
0.2	1	0.896	1.998	2%
	2	1.564	3.488	3%
	3	1.688	3.764	3%
	4	1.235	2.754	2%
	5	2.338	5.214	4%
	6	2.248	5.013	4%
	7	1.549	3.454	3%
	8	1.742	3.885	3%
	9	1.481	3.303	3%
0.5	1	0.358	0.798	1%
	2	0.503	1.122	1%
	3	0.519	1.157	1%
	4	0.522	1.163	1%
	5	0.639	1.425	1%
	6	0.625	1.394	1%
	7	0.482	1.074	1%
	8	0.501	1.117	1%
	9	0.446	0.995	1%

Table 6: H-Field Measurements

The applicable General Public limit is 121.46 A/m. The highest measured H-Field at 0.2m from the 134.2 KHz RFID Reader (Small Inductive Loop Antenna 1.3m x 0.6m) was 5.214 A/m and it is equivalent to 4% of the MPE in Uncontrolled Environments.

8.0 CONCLUSION

Radio Frequency Electric and Magnetic Fields measured at 0.2m from the 134.2 KHz RFID Reader (Large Inductive Loop Antenna 1.3m x 0.6m and Small Inductive Loop Antenna 0.6m x 0.4m) were below the IEEE Std C95.1 Maximum Permissible Exposure (MPE) levels for uncontrolled environments. Refer to section 7 for the measurements.

Although the results in this report refer to measurements done in front of the Reader, they may be also applicable in the back of it due to the characteristics of the electromagnetic field around Inductive Loop Antennas.

APPENDIX A MEASUREMENT SETUP PHOTOS

