



Global Product Certification  
EMC-EMF Safety Approvals

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## EMC Technologies Pty. Ltd.

ABN 82 057 105 549

### Melbourne

176 Harrick Road  
Keilor Park, Vic 3042  
Tel: +61 3 9365 1000

### Sydney

Unit 3/87 Station Road  
Seven Hills, NSW 2147  
Tel: +61 2 9624 2777

Email: [emc-general@emctech.com.au](mailto:emc-general@emctech.com.au)

Web: [www.emctech.com.au](http://www.emctech.com.au)

# RF ELECTROMAGNETIC FIELDS SURVEY

## FCC Guidelines for Human Exposure IEEE C95.1

**Report Number: M180325-3**

**Product:** TWR5 Weigh Scale and Reader with  
Sheep Crate Drafter Antenna (G05714)

**Client:** Gallagher Group Ltd

**Date of Issue:** 13 August 2018

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## RF ELECTROMAGNETIC FIELDS SURVEY

**Product:** TWR5 Weigh Scale and Reader with Sheep Crate Drafter Antenna (G05714)

**Scope:** Conduct RF Electric and Magnetic Field measurements in the proximity of the 134.2 KHz RFID Reader (Two Large Inductive Loop Antennas 1.1m x 0.8m)

**Client:** Gallagher Group Ltd  
**Address:** 181 Kahikatea Drive, Melville, Hamilton 3206, New Zealand  
**Contact:** Menardo Lazaro  
**Phone:** +64 7 838 9800  
**Fax:** +64 7 838 9801  
**Email:** Menardo.Lazaro@gallagher.com

**Standard(s):**

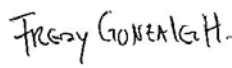
1. **47 CFR 1.1310**  
"Radiofrequency radiation exposure limits"
2. **IEEE Std C95.1: 1999 (2005)**  
"IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz"

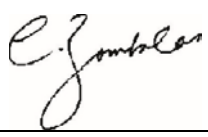
**Survey Date:** 07<sup>th</sup> May 2018

**Result:** Radio Frequency Electric and Magnetic Fields measured at 0.2m from the 134.2 KHz RFID Reader (Two Large Inductive Loop Antenna 1.1m x 0.8m) were below the applicable IEEE Std C95.1 Maximum Permissible Exposure (MPE) levels for uncontrolled environments. Refer to report number M180325-3 for full details.

**Issued by:** **EMC Technologies Pty. Ltd.,**  
176 Harrick Road, Keilor Park, VIC 3042, Australia.  
Phone: +61 3 9365 1000, Web: [www.emctech.com.au](http://www.emctech.com.au)  
FCC registration number: 90560 and  
ISED Canada iOATS number: IC 3569B

**Issue Date:** 13 August 2018

**Test Engineer:**   
Fredy Gonzalez  
EME Test Engineer  
EMC Technologies Pty Ltd

**Authorised Signatory:**   
Chris Zombolas  
Technical Director  
EMC Technologies Pty Ltd

## RF ELECTROMAGNETIC FIELDS SURVEY

### 1.0 INTRODUCTION

Radio Frequency (RF) Electric and Magnetic Field were measured on the TWR5 Weigh Scale Reader (Two Large Inductive Loop Antenna 1.1m x 0.8m)

The purpose of the measurements was to determine RF field levels in the proximity of the 134.2 KHz RFID Reader (Large Inductive Loop Antenna). 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 with Sheep auto-drafter is a weighing and drafting system with RFID functionality that automatically reads the RFID tag from the animal's ear. The TWR5 (Touch Screen) and the RFID reader are connected by a customized cable.

|                                    |                                                              |
|------------------------------------|--------------------------------------------------------------|
| <b>Product:</b>                    | TWR5 Weigh Scale and Reader with Sheep Crate Drafter Antenna |
| <b>Model Number:</b>               | G05714                                                       |
| <b>Manufacturer:</b>               | Gallagher Group Ltd                                          |
| <b>Wireless Interface:</b>         | RFID                                                         |
| <b>Reader Operating Frequency:</b> | 134.2 KHz                                                    |
| <b>Antenna Type:</b>               | Inductive Loop                                               |
| <b>Antenna Dimensions:</b>         | 1.1m x 0.8m. Two antennas, one at each side.                 |

### 3.0 EXECUTIVE SUMMARY

Radio Frequency Electric and Magnetic Fields measured at 0.2m from the 134.2 KHz RFID Reader (Two Large Inductive Loop Antenna 1.1m x 0.8m) were below the applicable IEEE Std C95.1 Maximum Permissible Exposure (MPE) levels for uncontrolled environments. Refer to section 7 for the measurements.

## 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 <sup>2</sup> ) | Averaging time $ E ^2, S$ or $ H ^2$ (min) |                    |
|-----------------------|-----------------------------------|-----------------------------------|----------------------------------------------------------|--------------------------------------------|--------------------|
| 0.003–0.1             | 614                               | 163                               | (100, 1 000 000) <sup>‡</sup>                            | 6                                          | 6                  |
| 0.1–1.34              | 614                               | $16.3/f$                          | (100, 10 000/ $f^2$ ) <sup>‡</sup>                       | 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<br>Manufacturer: NARDA<br>Model Number: NBM-550<br>Serial Number: E-0743                  | 25/09/2019        | 2 Year, *1    |
| E-Field Probe  | Asset Number: P-179-3<br>Manufacturer: NARDA<br>Model Number: EF0392 (100KHz-3GHz)<br>Serial Number: D-0157     | 25/09/2019        | 2 Year, *1    |
| Meter          | Asset Number: P-060<br>Manufacturer: Wandel & Goltermann<br>Model Number: EMR 300<br>Serial Number: N-0055      | 24/04/2019        | 2 Year, *1    |
| H-Field Probe  | Asset Number: P-060-12<br>Manufacturer: Narda<br>Model Number: Type 12.1 (30KHz-30MHz)<br>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 (Two Large Inductive Loop Antenna 1.1m x 0.8m) at 0.1m, 0.2m and 0.3m.

### 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                       $\pm 3.0$  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 0.3m from it. Refer to section 7.0 for detailed results.

**Side A (First Antenna):** Behind TWR5 (Touch Screen)



Image 1: First Large Inductive Loop Antenna 1.1m x 0.8m

Side B (Second Antenna): In front TWR5 (Touch Screen)



Image 2: Second Large Inductive Loop Antenna 1.1m x 0.8m

## 7.0 MEASUREMENT RESULTS

### 7.1 Side A (First 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             | 56.50                              | 57.63                                 | 9.4%                                               |
|              | 2             | 93.40                              | 95.27                                 | 15.5%                                              |
|              | 3             | 108.40                             | 110.57                                | 18.0%                                              |
|              | 4             | 62.70                              | 63.95                                 | 10.4%                                              |
|              | 5             | 78.90                              | 80.48                                 | 13.1%                                              |
|              | 6             | 97.40                              | 99.35                                 | 16.2%                                              |
|              | 7             | 44.52                              | 45.41                                 | 7.4%                                               |
|              | 8             | 97.19                              | 99.13                                 | 16.1%                                              |
|              | 9             | 91.85                              | 93.69                                 | 15.3%                                              |
| 0.2          | 1             | 41.59                              | 42.42                                 | 6.9%                                               |
|              | 2             | 67.10                              | 68.44                                 | 11.1%                                              |
|              | 3             | 78.00                              | 79.56                                 | 13.0%                                              |
|              | 4             | 39.18                              | 39.96                                 | 6.5%                                               |
|              | 5             | 60.40                              | 61.61                                 | 10.0%                                              |
|              | 6             | 67.30                              | 68.65                                 | 11.2%                                              |
|              | 7             | 33.76                              | 34.44                                 | 5.6%                                               |
|              | 8             | 63.93                              | 65.21                                 | 10.6%                                              |
|              | 9             | 65.95                              | 67.27                                 | 11.0%                                              |
| 0.3          | 1             | 31.12                              | 31.74                                 | 5.2%                                               |
|              | 2             | 49.30                              | 50.29                                 | 8.2%                                               |
|              | 3             | 55.83                              | 56.95                                 | 9.3%                                               |
|              | 4             | 33.61                              | 34.28                                 | 5.6%                                               |
|              | 5             | 48.37                              | 49.34                                 | 8.0%                                               |
|              | 6             | 52.40                              | 53.45                                 | 8.7%                                               |
|              | 7             | 27.07                              | 27.61                                 | 4.5%                                               |
|              | 8             | 48.71                              | 49.68                                 | 8.1%                                               |
|              | 9             | 50.38                              | 51.39                                 | 8.4%                                               |

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 1.1m x 0.8m) was 79.56 V/m and it is equivalent to 13% of the MPE in Uncontrolled Environments.

## 7.2 Side A (First Antenna) H-field

A 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             | 0.347                              | 0.774                                 | 0.6%                                               |
|              | 2             | 1.001                              | 2.232                                 | 1.8%                                               |
|              | 3             | 0.837                              | 1.867                                 | 1.5%                                               |
|              | 4             | 0.291                              | 0.650                                 | 0.5%                                               |
|              | 5             | 1.909                              | 4.257                                 | 3.5%                                               |
|              | 6             | 0.567                              | 1.264                                 | 1.0%                                               |
|              | 7             | 0.329                              | 0.733                                 | 0.6%                                               |
|              | 8             | 1.307                              | 2.915                                 | 2.4%                                               |
|              | 9             | 0.380                              | 0.848                                 | 0.7%                                               |
| 0.2          | 1             | 0.274                              | 0.611                                 | 0.5%                                               |
|              | 2             | 0.618                              | 1.377                                 | 1.1%                                               |
|              | 3             | 0.473                              | 1.054                                 | 0.9%                                               |
|              | 4             | 0.278                              | 0.621                                 | 0.5%                                               |
|              | 5             | 0.833                              | 1.857                                 | 1.5%                                               |
|              | 6             | 0.324                              | 0.722                                 | 0.6%                                               |
|              | 7             | 0.307                              | 0.684                                 | 0.6%                                               |
|              | 8             | 0.710                              | 1.583                                 | 1.3%                                               |
|              | 9             | 0.327                              | 0.728                                 | 0.6%                                               |
| 0.3          | 1             | 0.258                              | 0.576                                 | 0.5%                                               |
|              | 2             | 0.336                              | 0.750                                 | 0.6%                                               |
|              | 3             | 0.284                              | 0.632                                 | 0.5%                                               |
|              | 4             | 0.214                              | 0.476                                 | 0.4%                                               |
|              | 5             | 0.616                              | 1.373                                 | 1.1%                                               |
|              | 6             | 0.307                              | 0.684                                 | 0.6%                                               |
|              | 7             | 0.222                              | 0.495                                 | 0.4%                                               |
|              | 8             | 0.406                              | 0.905                                 | 0.7%                                               |
|              | 9             | 0.293                              | 0.652                                 | 0.5%                                               |

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 1.1m x 0.8m) was 1.857 A/m and it is equivalent to 1.5% of the MPE in Uncontrolled Environments.

### 7.3 Side B (Second 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             | 52.10                              | 53.14                                 | 8.7%                                               |
|              | 2             | 57.10                              | 58.24                                 | 9.5%                                               |
|              | 3             | 37.45                              | 38.20                                 | 6.2%                                               |
|              | 4             | 42.48                              | 43.33                                 | 7.1%                                               |
|              | 5             | 42.54                              | 43.39                                 | 7.1%                                               |
|              | 6             | 32.69                              | 33.34                                 | 5.4%                                               |
|              | 7             | 40.26                              | 41.07                                 | 6.7%                                               |
|              | 8             | 42.68                              | 43.53                                 | 7.1%                                               |
|              | 9             | 26.21                              | 26.73                                 | 4.4%                                               |
| 0.2          | 1             | 37.51                              | 38.26                                 | 6.2%                                               |
|              | 2             | 38.18                              | 38.94                                 | 6.3%                                               |
|              | 3             | 25.73                              | 26.24                                 | 4.3%                                               |
|              | 4             | 33.54                              | 34.21                                 | 5.6%                                               |
|              | 5             | 32.62                              | 33.27                                 | 5.4%                                               |
|              | 6             | 24.78                              | 25.28                                 | 4.1%                                               |
|              | 7             | 29.19                              | 29.77                                 | 4.8%                                               |
|              | 8             | 32.41                              | 33.06                                 | 5.4%                                               |
|              | 9             | 20.76                              | 21.18                                 | 3.4%                                               |
| 0.3          | 1             | 30.33                              | 30.94                                 | 5.0%                                               |
|              | 2             | 29.92                              | 30.52                                 | 5.0%                                               |
|              | 3             | 20.45                              | 20.86                                 | 3.4%                                               |
|              | 4             | 25.44                              | 25.95                                 | 4.2%                                               |
|              | 5             | 26.36                              | 26.89                                 | 4.4%                                               |
|              | 6             | 19.94                              | 20.34                                 | 3.3%                                               |
|              | 7             | 23.08                              | 23.54                                 | 3.8%                                               |
|              | 8             | 25.47                              | 25.98                                 | 4.2%                                               |
|              | 9             | 18.15                              | 18.51                                 | 3.0%                                               |

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 (Large Inductive Loop Antenna 1.1m x 0.8m) was 38.94 V/m and it is equivalent to 6.3% of the MPE in Uncontrolled Environments.

## 7.4 Side B (Second 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             | 0.912                              | 2.034                                 | 1.7%                                               |
|              | 2             | 1.014                              | 2.261                                 | 1.9%                                               |
|              | 3             | 0.459                              | 1.024                                 | 0.8%                                               |
|              | 4             | 1.321                              | 2.946                                 | 2.4%                                               |
|              | 5             | 0.699                              | 1.558                                 | 1.3%                                               |
|              | 6             | 0.459                              | 1.023                                 | 0.8%                                               |
|              | 7             | 0.998                              | 2.226                                 | 1.8%                                               |
|              | 8             | 0.826                              | 1.842                                 | 1.5%                                               |
|              | 9             | 0.680                              | 1.516                                 | 1.2%                                               |
| 0.2          | 1             | 0.490                              | 1.092                                 | 0.9%                                               |
|              | 2             | 0.511                              | 1.140                                 | 0.9%                                               |
|              | 3             | 0.436                              | 0.972                                 | 0.8%                                               |
|              | 4             | 0.703                              | 1.568                                 | 1.3%                                               |
|              | 5             | 0.420                              | 0.936                                 | 0.8%                                               |
|              | 6             | 0.358                              | 0.799                                 | 0.7%                                               |
|              | 7             | 0.529                              | 1.180                                 | 1.0%                                               |
|              | 8             | 0.571                              | 1.272                                 | 1.0%                                               |
|              | 9             | 0.561                              | 1.250                                 | 1.0%                                               |
| 0.5          | 1             | 0.412                              | 0.918                                 | 0.8%                                               |
|              | 2             | 0.483                              | 1.076                                 | 0.9%                                               |
|              | 3             | 0.377                              | 0.841                                 | 0.7%                                               |
|              | 4             | 0.469                              | 1.046                                 | 0.9%                                               |
|              | 5             | 0.411                              | 0.916                                 | 0.8%                                               |
|              | 6             | 0.259                              | 0.577                                 | 0.5%                                               |
|              | 7             | 0.425                              | 0.947                                 | 0.8%                                               |
|              | 8             | 0.386                              | 0.861                                 | 0.7%                                               |
|              | 9             | 0.450                              | 1.002                                 | 0.8%                                               |

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 (Large Inductive Loop Antenna 1.1m x 0.8m) was 1.568 A/m and it is equivalent to 1.3% 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 (Two Large Inductive Loop Antenna 1.1m x 0.8m) were below the applicable IEEE Std C95.1 Maximum Permissible Exposure (MPE) levels for uncontrolled environments. Refer to section 7 for the measurements.

## APPENDIX A MEASUREMENT SETUP PHOTOS

