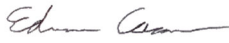





Engineering Test Report No. 2402382-02

| | |
|---------------------------------|--|
| Report Date | October 17, 2024 |
| Manufacturer Name | Milwaukee Electric Tool Corporation |
| Manufacturer Address | 13135 West Lisbon Road Brookfield, WI 53005 |
| Product Name Brand/Model No. | 22802875 |
| Date Received | October 2, 2024 |
| Assessment Date | October 17, 2024 |
| Specifications | FCC 47 CFR Part 2.1093 KDB, 447498 D01 OET Bulletin 65:1997 RSS-102 |
| Test Facility | Elite Electronic Engineering, Inc. 1516 Centre Circle, Downers Grove, IL 60515 |
| Signature |  |
| Tested by | Edwin Casas |
| Signature |  |
| Approved by | Raymond J. Klouda, Registered Professional Engineer of Illinois – 44894 |
| PO Number | MF-1664378 |

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Table of Contents

| | | |
|------|--|----|
| 1. | Report Revision History | 3 |
| 2. | Introduction | 4 |
| 3. | Subject of Investigation | 4 |
| 4. | Standards and Requirements | 4 |
| 5. | Sample Calculations | 4 |
| 6. | Photographs of EUT | 6 |
| 7. | Limits and Requirements | 7 |
| 7.1. | Requirements mandated by the FCC | 7 |
| 7.2. | Requirements mandated by Innovation, Science and Economic Development Canada | 8 |
| 8. | Assessment Results | 10 |
| 8.1. | RF Exposure Evaluation Relevant to the Requirements of the FCC | 10 |
| 8.2. | RF Exposure Evaluation Relevant to the Requirements of the ISED | 10 |
| 9. | Statement of Compliance | 10 |
| 10. | Certification | 10 |

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1. Report Revision History

| Revision | Date | Description |
|----------|-------------|---|
| – | 21 OCT 2024 | Initial Release of Engineering Test Report No. 2402382-02 |

2. Introduction

The FCC, Innovation, Science and Economic Development Canada, European Union and Australia/New Zealand publish standards regarding the evaluation of the RF Exposure hazard of radio communications devices. An evaluation has been performed on the Milwaukee Electric Tool Corporation Underground Cable Cutter Wireless Remote, Model No. 22802875 pursuant to the relevant requirements.

3. Subject of Investigation

This document presents the demonstration of RF Exposure compliance on a Underground Cable Cutter Wireless Remote, (hereinafter referred to as the Equipment under Test (EUT)). The EUT was identified as follows:

| EUT Identification | |
|-------------------------|--|
| Description | Underground Cable Cutter Wireless Remote |
| Model/Part No. | 22802875 |
| S/N | 14, 15, 16 |
| Radio Access Technology | Bluetooth Low Energy |
| Bands of Operation | 2400MHz – 2483.5MHz |
| EIRP | 15.1dBm |
| Conducted Output Power | 14.1dBm |

4. Standards and Requirements

The tests were performed to selected portions of, and in accordance with the following specifications.

- 47 CFR Parts 1.1310, 2.1091 and 2.1093 Code of Federal Regulations, Title 47, Telecommunications
- KDB 447498 D01 – “RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices, General RF Exposure Guidance v06”
- OET Bulletin 65 Edition 97-01:1997 – “Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields”
- ANSI/IEEE C95.1:1992 – "Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,"
- RSS-102, Issue 5 Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

5. Sample Calculations

The far field power density can be calculated using the following formula:

$$S = \frac{PG}{4\pi R^2} \quad (1)$$

where P is the transmit output power (mW), G is the maximum antenna gain relative to an isotropic antenna (linear) and R is the evaluation distance (cm).

In cases where multiple antennas are utilized for a single signal, the following formula is applied to calculate the maximum antenna gain:

$$Gain (dBi) = G + 10 \log N \quad (2)$$

where N is the number of antennas, G is the gain of a single antenna.

A minimum separation distance can be calculated using the following formulas

$$\text{Minimum Separation Distance} = \sqrt{\frac{PG}{4\pi(\text{Power Density Limit})}} \quad (3)$$

where P is the transmit output power (mW) and G is the maximum antenna gain relative to an isotropic antenna (linear).

For sources with frequencies <30MHz

$$\text{Seperation Distance} = R \left(10^{\frac{(FS_{Limit}-FS_R)}{40}} \right)^{-1} \quad (4)$$

For sources with frequencies >30MHz

$$\text{Seperation Distance} = R \left(10^{\frac{(FS_{Limit}-FS_R)}{20}} \right)^{-1} \quad (5)$$

where R is the measurement distance, FS_{Limit} is the field strength limit and FS_R is the measured field strength at distance R.

6. Photographs of EUT



7. Limits and Requirements

7.1. Requirements mandated by the FCC

Equipment pursuing compliance to the requirements with respect to the limits of human exposure to RF provided in FCC 1.1310, need follow the criteria in FCC 1.1307(b)(1).

Equipment exemption qualification must be demonstrated pursuant to FCC 1.1307(b)(3).

For single RF sources (i.e., any single portable device, mobile device or fixed RF source): A single RF source is exempt if:

- FCC 1.1307(b)(3)(i)(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance.
- FCC 1.1307(b)(3)(i)(B) The available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold Pth (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). Pth is given by:

$$P_{th}(mW) = \begin{cases} ERP_{20cm} \left(\frac{d}{20cm} \right)^x & d \leq 20cm \\ ERP_{20cm} & 20cm < d \leq 40cm \end{cases}$$

With

$$x = -\log_{10} \left(\frac{60}{ERP_{20cm} \sqrt{f}} \right)$$

Where f is in GHz, and

$$ERP_{20cm}(mW) = \begin{cases} 2040f & 0.3GHz \leq f < 1.5GHz \\ 3060 & 1.5GHz \leq f < 6GHz \end{cases}$$

- FCC 1.1307(b)(3)(i)(C) Using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

| RF Source frequency (MHz) | Threshold ERP (watts) |
|---------------------------|--------------------------------------|
| 0.3 – 1.34 | 1920 R ² |
| 1.34 – 30 | 3450 R ² / f ² |
| 30 – 300 | 3.83 R ² |
| 300 – 1,500 | 0.0128 R ² |
| 1,500 – 100,000 | 19.2 R ² |

If it is determined that the equipment under investigation is not exempt from routine evaluation an assessment must be performed to determine compliance in regard to the RF exposure limits by means of measurement or calculation of the electric field, magnetic field or power density. It may be the case that a

minimum separation distance will need to be calculated or measured and maintained from the source of RF to meet the basic restrictions.

Per 1.1310(e)(1), the power density shall not exceed the levels below:

| Limits for Occupational/Controlled Exposure | | | |
|---|-------------------------------|-------------------------------|-------------------------------------|
| Frequency Range (MHz) | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm ²) |
| 0.3 - 3.0 | 614 | 1.63 | *100 |
| 3.0 - 30 | 1842 / f | 4.89 / f | *900 / f ² |
| 30 - 300 | 61.4 | 0.163 | 1.0 |
| 300 - 1,500 | — | — | f / 300 |
| 1,500 - 100,000 | — | — | 5 |
| Limits for General/Uncontrolled Exposure | | | |
| Frequency Range (MHz) | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (mW/cm ²) |
| 0.3 - 1.34 | 614 | 1.63 | *100 |
| 1.34 - 30 | 842 / f | 2.19 / f | *180 / f ² |
| 30 - 300 | 27.5 | 0.073 | 0.2 |
| 300 - 1,500 | — | — | f / 1500 |
| 1,500 - 100,000 | — | — | 1.0 |
| f – Frequency in MHz * – Plane wave Equivalent Power Density | | | |

7.2. Requirements mandated by Innovation, Science and Economic Development Canada

The RF exposure level shall be determined by either measurement or by calculating the power density at an evaluation distance of 2cm, as specified by ANSI/IEEE C95.1-1992.

If it is found that the product meets the low power exclusion level criteria listed in RSS 102 Section 2.5.2, no further RF exposure evaluation is required. The low power exclusion level criteria are given in the following table (f is given in MHz):

| RF Source Frequency (MHz) | Threshold ERP (watts) |
|---|--|
| $f < 20 \text{ MHz}$ | $x \leq 1$ |
| $20 \text{ MHz} \leq f < 48 \text{ MHz}$ | $x \leq \frac{4.49}{f^{0.5}}$ |
| $48 \text{ MHz} \leq f < 300 \text{ MHz}$ | $x \leq 0.6$ |
| $300 \text{ MHz} \leq f < 6 \text{ GHz}$ | $x \leq (1.31 * 10^{-2}) * f^{0.6834}$ |
| $6 \text{ GHz} \leq f$ | $x \leq 5$ |

If it is determined that the measured or calculated power density does not meet the basic restrictions, a separation distance must be measured or calculated such that the basic restrictions are met.

Per RSS 102 Section 4, the power density shall not exceed the levels below:

| Limits for Occupational/Controlled Exposure | | | |
|---|-------------------------------|--|-----------------------------------|
| Frequency Range (MHz) | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (W/m ²) |
| 0.003 – 10* | 170 | 180 | — |
| 0.1 – 10* | — | 1.6 / f | — |
| 1.29 – 10* | 193 / f ^{0.5} | — | — |
| 10 – 20 | 61.4 | 0.163 | 10 |
| 20 – 48 | 129.8 / f ^{0.25} | 0.3444 / f ^{0.25} | 44.72 / f ^{0.5} |
| 48 – 100 | 49.33 | 0.1309 | 6.455 |
| 100 – 6000 | 15.60 f ^{0.25} | 0.04138 f ^{0.25} | 0.6455 f ^{0.5} |
| 6000 – 15000 | 137 | 0.364 | 50 |
| 15000 – 150000 | 137 | 0.364 | 50 |
| 150000 – 300000 | 0.354 f ^{0.5} | 9.40x10 ⁻⁴ f ^{0.5} | 3.33x10 ⁻⁴ f |
| Limits for General/Uncontrolled Exposure | | | |
| Frequency Range (MHz) | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density (W/m ²) |
| 0.003 – 10* | 83 | 90 | — |
| 0.1 – 10* | — | 0.73 / f | — |
| 1.1 – 10* | 87 / f ^{0.5} | — | — |
| 10 – 20 | 27.46 | 0.0728 | 2 |
| 20 – 48 | 58.07 / f ^{0.25} | 0.1540 / f ^{0.25} | 8.944 / f ^{0.5} |
| 48 – 300 | 22.06 | 0.05852 | 1.291 |
| 300 – 6000 | 3.142 f ^{0.3417} | 0.008335 f ^{0.3417} | 0.02619 f ^{0.6834} |
| 6000 – 15000 | 61.4 | 0.163 | 10 |
| 15000 – 150000 | 61.4 | 0.163 | 10 |
| 150000 – 300000 | 0.158 f ^{0.5} | 4.21x10 ⁻⁴ f ^{0.5} | 6.67x10 ⁻⁵ f |
| f – Frequency in MHz | | | |

*Limits only apply to Specific Absorption Rate and Nerve Stimulation requirements.

8. Assessment Results

8.1. RF Exposure Evaluation Relevant to the Requirements of the FCC

| Radio Access Technology | f Transmit Frequency (MHz) | P Conducted Output Power (dBm) | ERP (dBm) | EIRP (dBm) |
|-------------------------|---------------------------------|-----------------------------------|-----------|------------|
| BLE | 2440 | 12.1 | 12.95 | 15.1 |

| Radio Access Technology | f Transmit Frequency (MHz) | P Conducted Output Power (mW) | ERP (mW) | Pth (mW) |
|-------------------------|---------------------------------|----------------------------------|-----------|-----------|
| BLE | 2440 | 16.218101 | 19.724227 | 38.411064 |

The equipment under investigation is determined to be exempt from routine evaluation.

8.2. RF Exposure Evaluation Relevant to the Requirements of the ISED

| Radio Access Technology | f Transmit Frequency (MHz) | P Conducted Output Power (dBm) | ERP (dBm) | EIRP (dBm) |
|-------------------------|---------------------------------|-----------------------------------|-----------|------------|
| BLE | 2440 | 12.1 | 12.95 | 15.1 |

| Radio Access Technology | f Transmit Frequency (MHz) | P Conducted Output Power (mW) | SAR Exemption Limit (mW) | Radio Access Technology |
|-------------------------|---------------------------------|----------------------------------|--------------------------|-------------------------|
| BLE | 2440 | 16.218101 | 32 | BLE |

The equipment under investigation is determined to be exempt from routine evaluation.

9. Statement of Compliance

The Milwaukee Electric Tool Corporation Underground Cable Cutter Wireless Remote, Model 22802875 is in compliance with the FCC and Innovation, Science and Economic Development Canada requirements for RF Exposure at a minimum separation distance of 2cm.

10. Certification

Elite Electronic Engineering Incorporated certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the FCC and Innovation, Science and Economic Development Canada requirements for RF Exposure test specifications. The data presented in this test report pertains to the EUT as provided by the customer on the test date specified. Any electrical or mechanical modifications made to the EUT subsequent to the specified test date will serve to invalidate the data and void this certification.