

# ETSI EN 303 447 V1.3.1 (2022-07)



**Short Range Devices (SRD);  
Harmonised Standard for access to radio spectrum;  
Inductive loop systems for robotic mowers operating  
within the frequency range 100 Hz to 148,5 kHz**

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# Foreword

This Harmonised European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.6] to provide one voluntary means of conforming to the essential requirements of Directive 2014/53/EU on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC [i.3].

Once the present document is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of the present document given in table A.1 confers, within the limits of the scope of the present document, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

National transposition dates	
Date of adoption of this EN:	27 June 2022
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## Introduction

The present document covers Robotic Mowers with Inductive loop systems (RMI) using the frequency range below 148,5 kHz. An RMI system includes:

- RMI docking station: charging stations for the robotic mower and the signal generator/antenna connecting point for the signals on the integral antenna and boundary wire.
- Robotic Mower: receiving part inside the RMI.
- Boundary Wire: user installed antenna.

The present document is structured as follows:

- Clauses 1, 2 and 3 provide a general description on the types of equipment covered by the present document and the definition of terms, symbols and abbreviations used.
- Clause 4 provides the technical requirements specifications, limits and conformance relative to transmitter and receiver.
- Clause 5 specifies the conditions and information for testing of the equipment and interpretation of the measurement results.
- Clause 6 specifies the required measurement methods.
- Annex A (informative) provides the relationship between the present document and the essential requirements of Directive 2014/53/EU [i.3].
- Annex B (normative) provides necessary information on used test sites and procedures.
- Annex C (informative) provides the justification for missing RX-requirements from ETSI EG 203 336 [i.5].
- Annex D (informative) provides information on TX spurious emission limit assessment below 9 kHz.
- Annex E (informative) provides information on Change history.

# 1 Scope

The present document specifies technical characteristics and methods of measurements for Robotic Mowers with Inductive loop systems (RMI) operating within the frequency range 100 Hz to 148,5 kHz.

The present document covers the following RMI systems:

- RMI1 systems: RMI systems without receive only mode
- RMI2 systems: RMI systems with receive only mode

NOTE 1: In RMI1 systems the robotic mower is not able to restart automatically if the boundary signal comes back after the loss of the boundary signal (safe mode, see clause 4.2.2.3), while in RMI2 systems the robotic mower is able to restart automatically after the boundary signal is back. This differentiation has been introduced to cover receiver spurious emissions for RMI2 systems.

These radio equipment types are capable of operating in all or part of the frequency bands given in table 1.

**Table 1: Permitted range of operation**

Permitted range of operation	
Transmit	100 Hz to 148,5 kHz
Receive	100 Hz to 148,5 kHz
NOTE:	It should be noted that the frequency range between 9 kHz and 148,5 kHz is EU wide harmonised for inductive Short Range Devices according to EC Decision 2017/1483/EU [i.2].

NOTE 2: The relationship between the present document and essential requirements of article 3.2 of Directive 2014/53/EU [i.3] is given in Annex A.

The present document only covers RMI systems with antenna sizes smaller than 1,67 km, see CEPT/ERC/REC 70-03 [i.1], Annex 9.

NOTE 3: The antenna size is described by the distance between those two points on the antenna that have the largest distance between them (e.g. for a rectangle shaped antenna the largest diagonal; for a circular shaped antenna the diameter).

## 2 References

### 2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are necessary for the application of the present document.

- [1] ETSI EN 300 330 (V2.1.1) (02-2017): "Short Range Devices (SRD); Radio equipment in the frequency range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU".



## 2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] CEPT/ERC/REC 70-03: "Relating to the use of Short Range Devices (SRD)".
- [i.2] Commission Implementing Decision (EU) 2017/1483 of 8 August 2017 amending Decision 2006/771/EC on harmonisation of the radio spectrum for use by short-range devices and repealing Decision 2006/804/EC.
- [i.3] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of radio equipment and repealing Directive 1999/5/EC.
- [i.4] CEPT/ERC/REC 74-01: "Unwanted emissions in the spurious domain".
- [i.5] ETSI EG 203 336 (V1.2.1): "Guide for the selection of technical parameters for the production of Harmonised Standards covering article 3.1(b) and article 3.2 of Directive 2014/53/EU".
- [i.6] Commission Implementing Decision C(2015) 5376 final of 4.8.2015 on a standardisation request to the European Committee for Electrotechnical Standardisation and to the European Telecommunications Standards Institute as regards radio equipment in support of Directive 2014/53/EU of the European Parliament and of the Council.
- [i.7] EGMF Robotic Mowers Boundary Wire Standard RLM003-1.1/2016.
- [i.8] EN 50636-2-107:2015: "Safety of household and similar appliances - Part 2-107: Particular requirements for robotic battery powered electrical lawnmowers", produced by CENELEC.
- [i.9] Void.
- [i.10] ETSI EN 303 454 (V1.1.1): "Short Range Devices (SRD); Metal and object detection sensors in the frequency range 1 kHz to 148,5 kHz; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU".
- [i.11] Void.
- [i.12] Void.
- [i.13] EN 55016-1-1:2010 + A1:2010 + A2:2014: "Specification for radio disturbance and immunity measuring apparatus and methods -Part 1-1: Radio disturbance and immunity measuring apparatus - Measuring apparatus", produced by CENELEC.
- [i.14] ETSI TS 103 567 (V1.1.1): "Requirements on signal interferer handling".
- [i.15] ETSI TS 103 051 (V1.1.1) (08-2011): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Expanded measurement uncertainty for the measurement of radiated electromagnetic fields".



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## 3 Definition of terms, symbols and abbreviations

### 3.1 Terms

For the purposes of the present document, the terms given in ETSI EN 300 330 [1] and the following apply:

**99 % OBW function:** measurement function of a spectrum analyser to measure the OBW

**antenna:** integral antenna, boundary loop, and/or guidance loop (both dependent and independent) which are used in the RMI

NOTE 1: The inductive wire loops are installed dependent from the shape of the garden.

NOTE 2: To clarify the different loops see figure 2.

**boundary loop:** inductive wire loop which is defined by manufacturer and prepared by the user

NOTE 1: It can be implemented as a single or multiple turn coil installed by the user in accordance with instruction from the manufacturer for the purpose of generating magnetic fields to determine the working area.

NOTE 2: To clarify the different loops see figure 2.

**dependent guidance loop:** guidance loop which is connected to boundary loop (e.g. via a T-junction) and the RMI docking station

NOTE: To clarify the different loops see figure 2.

**guidance loop:** inductive wire loop which is defined by manufacturer and prepared by the user

NOTE: To clarify the different loops see figure 2.

**inductive loop:** all electrical loop either wire or coil, where current is fed in order to generate a magnetic field intended for guidance and/or communication with the robotic mower

NOTE: In figure 2 different inductive loops are shown and named based on their function within the RMI system, e.g. boundary loop, guidance loop.

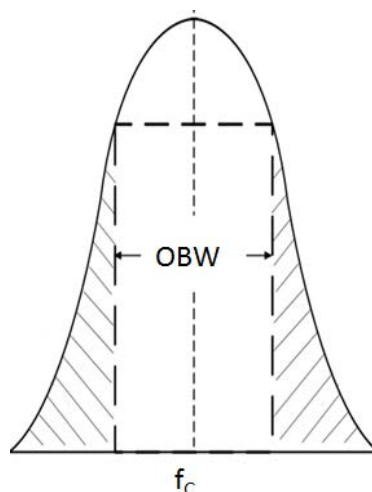
**integral antenna:** single or multiple turn inductive loop preinstalled inside the RMI docking station

NOTE: To clarify the different loops see figure 2.

**integral receiving antenna:** single or multiple turn inductive loop preinstalled inside the robotic mower

**Occupied BandWidth (OBW):** width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0,5 % of the total mean power of a given emission

NOTE: To clarify Occupied BandWidth (OBW), see figure 1.



**Figure 1: Occupied BandWidth (OBW)**

**RMI docking station:** charging station for the robotic mower and the signal generator for the inductive loop(s) and, if applicable, integral antenna(s)

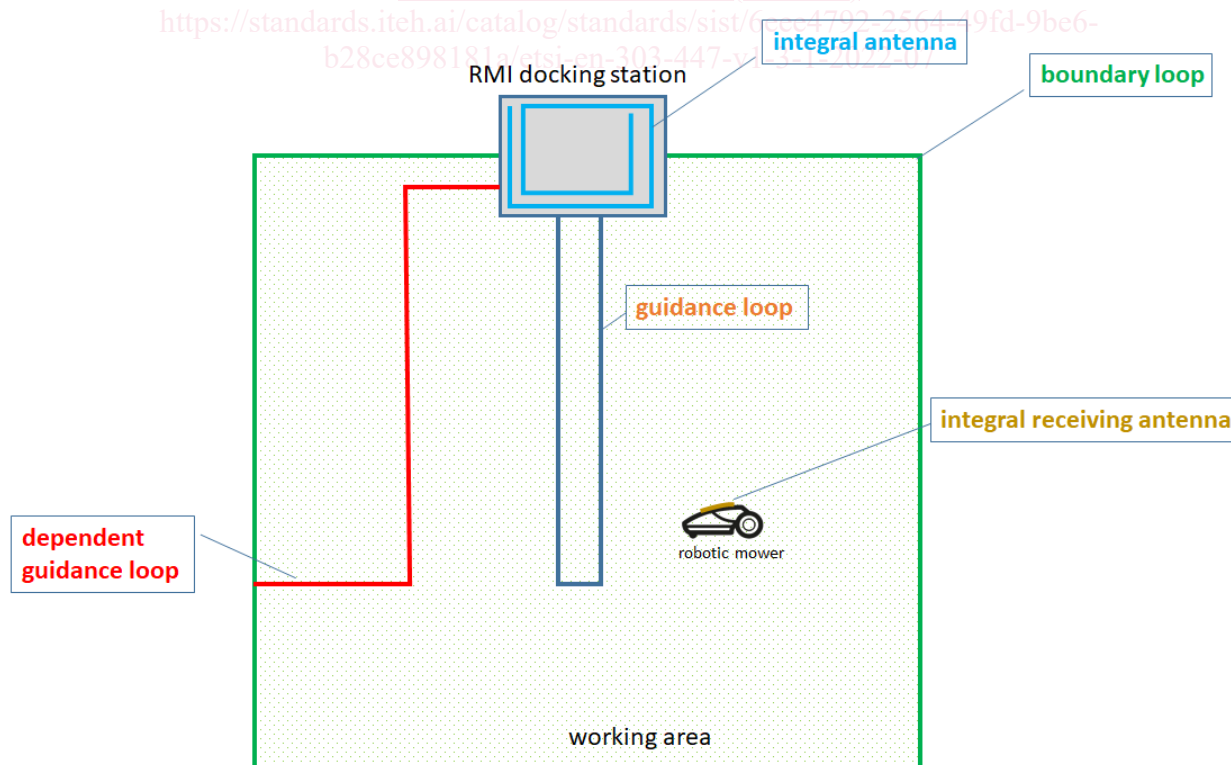
NOTE: The RMI docking station can be seen as the signal generator/antenna connecting point. In addition, it is the automatic battery charging facility located on or within the working area.

**robotic mower:** mobile part of the RMI including cutting means

NOTE: It is the receiving part inside the RMI.

**Robotic Mower with Inductive loop system (RMI):** system that includes robotic mower, power supply, docking station, and inductive loop(s)

**working area:** area in which the RMI can function



**Figure 2: Overview of an RMI system, including the different possible antenna/loops**

## 3.2 Symbols

For the purposes of the present document, the symbols given in ETSI EN 300 330 [1] and the following apply:

$C_A$	filtering capacitors of the artificial antenna
$f_C$	centre frequency of the OFR
$f_H$	highest frequency of the OFR
$f_L$	lowest frequency of the OFR
$f_{SH}$	higher frequency border between OOB and spurious domain
$f_{SL}$	lower frequency border between OOB and spurious domain
$I_{CM}$	common mode current
$I_{DM}$	differential mode current
$L_A$	inductive part of the artificial antenna
$R_A$	low frequency resistive part of the artificial antenna
$R_C$	common mode resistive part of the artificial antenna
$R_D$	high frequency resistive part of the artificial antenna
$t_{SWT}$	swept time for TX measurement

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI EN 300 330 [1] and the following apply:

CDMA	Code Division Multiple Access
CF	Conversion Factor
CM	Common Mode
CW	Continuous Wave
DM	Differential Mode
EGMF	European Garden Machinery industry Federation
IHR	Interferer Handling Requirements
LO	Local Oscillator
OBW	Occupied BandWidth
OFR	Operating Frequency Range
OOB	Out Of Band
PT SRD-MG	Project Team Short Range Device-Maintenance Group
RBR	Receiver Baseline Resilience
RMI	Robotic Mower with Inductive loop system
RX	Receiver
TX	Transmitter
WG FM	Working Group Frequency Management

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# 4 Technical requirements specifications

## 4.1 Environmental profile

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be in accordance with its intended use. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the operational environmental profile defined by its intended use.

## 4.2 General

### 4.2.1 Wanted technical performance criteria

In general, the robotic mower shall stay in its current operational mode (see clause 4.2.2.2), this is the wanted technical performance criteria of the RMI system.

For the purpose of the receiver performance tests, the RMI shall be able to handle two interference scenarios:

- Scenario 1: under the presence of an interfering signal, the robotic mower shall be able to detect a loss of the boundary loop signal (see clause 6.3.3.2).
- If the mower detects the loss of boundary signal, it shall react in the same way as required within the "safe mode" (see clause 4.2.2.3). The loss of the boundary loop signal can be based on, but not limited to, switching off the boundary loop signal, disconnection of the boundary loop, or blocking of the receiver within the mower.
- Scenario 2: under the presence of an interfering signal, the robotic mower shall be able to detect the passage of the boundary wire (see clause 6.3.3.3).

## 4.2.2 RMI modes

### 4.2.2.1 General

In this clause all general considerations for the testing of the inductive parts for the RMI in the frequency range from 100 Hz to 148,5 kHz are given.

Modes being part of an RMI are explained in the following clauses.

The manufacturer shall provide information (e.g. installation requirements), number and kind of antennas used by the RMI (e.g. boundary loop(s), guidance loop(s), integral antenna(s), etc.), see figure 2. A RMI is fabricated by one manufacturer. There is no option to swap e.g. a mower to another boundary installation. Based on the general nature (TX and RX) of an RMI, covered by the present document, the RMI shall be tested as a system.

The test set-up of the different modes shall be performed as described in clause 6.1 and Annex B.

### 4.2.2.2 Operational Modes

Operational modes of an RMI are when the robotic mower is travelling around, mowing grass, returning to the docking station and charging the battery in the docking station.

During the operational modes different combinations of the RMI antennas are active.

The test shall be performed for each active antenna in each operational mode, unless the transmitting signal to the same antenna is identical over different modes, the test of the active antenna shall be performed only once.

### 4.2.2.3 Safe Mode

If the robotic mower does not receive its boundary signal adequately, the robotic mower switches into safe mode. This loss of signal may either be caused by a stop of the signal generation or by interference.

The safe mode is indicated that after a loss of signal the robotic mower does not travel more than 1 m and the cutting means stops within 5 seconds, see EN 50636-2-107 [i.8], clause 22.104.2.

## 4.2.3 Presentation of equipment for testing purposes

Each RMI submitted for testing shall fulfil the requirements of the present document.

Additionally, technical documentation and operating manuals, sufficient to make the test, shall be supplied.

To simplify and harmonise the testing procedures between different testing laboratories, measurements shall be performed, according to the present document, on samples defined in clause 4.2.2 of ETSI EN 300 330 [1].

## 4.3 Transmitter conformance requirements

### 4.3.1 Operating Frequency Range (OFR)

#### 4.3.1.1 Applicability

This requirement applies to all RMI systems.

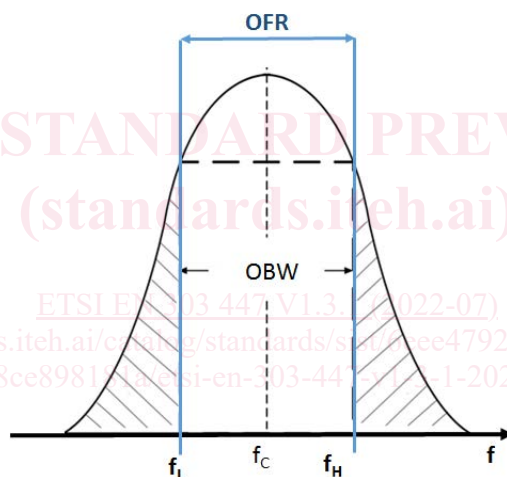
#### 4.3.1.2 Description

The operating frequency range is the frequency range over which the RMI is transmitting. The operating frequency range of the RMI is determined by the lowest ( $f_L$ ) and highest frequency ( $f_H$ ):

$$\text{OFR} = f_H - f_L$$

An RMI can have more than one operating frequency range (relating to the operational modes and antennas of the RMI system, see clause 4.2.2).

For a single frequency system the OFR is equal to the Occupied BandWidth (OBW) of the RMI system as described in figure 3.



**Figure 3: Operating Frequency Range (OFR)**

#### 4.3.1.3 Limits

The operating frequency range for intentional emissions shall be within the following limits:

- Upper edge of the operating frequency range:  $f_H \leq 148,5 \text{ kHz}$ .
- Lower edge of the operating frequency range:  $f_L \geq 100 \text{ Hz}$ .

For the spurious and OOB emission measurement procedures in clauses 4.3.3 and 4.3.4 the OFR shall be calculated as:

$$f_H - f_L$$

and the centre frequency as:

$$f_c = \frac{f_H + f_L}{2}$$

#### 4.3.1.4 Conformance

The conformance test suite for operational frequency range shall be as defined in clause 6.2.1.