



**Wireless Industrial Applications (WIA);  
Equipment operating in the 5 725 MHz to 5 875 MHz  
frequency range with power levels ranging up to 400 mW;  
Harmonised Standard for access to radio spectrum**

**Industrial Applications  
Operating in the 5 725 MHz  
with power levels ranging  
standard for access to radars**

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DEN/ERM-TG41-003

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**ETSI**

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650 Route des Lucioles  
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C  
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# Foreword

This final draft Harmonised European Standard (EN) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM), and is now submitted for the Vote phase of the ETSI standards EN Approval Procedure.

The present document has been prepared under the Commission's standardisation request C(2015) 5376 final [i.3] 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.2].

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.

Proposed national transposition dates	
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# Modal verbs terminology

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## Introduction

The market is in need of network solutions, each with different performance characteristics and functional capabilities, matching diverse application requirements. Industrial automation applications, covering different industrial application domains such as:

- process automation, covering for example the following industry branches:
  - oil and gas, refining;
  - chemical;
  - pharmaceutical;
  - mining;
  - pulp and paper;
  - water & wastewater;
  - steel;
- electric power like:
  - power generation, e.g. wind turbine;
  - power distribution (grid);
- factory automation, e.g. covering the following industry branches:
  - food and beverage;
  - automotive;
  - machinery;
  - semiconductor.

The technical characteristics and applications specific to radio spectrum requirements are identified in ETSI TR 102 889-2 [i.18].

In industrial automation, many different wireless communication networks may operate in the same premises. Examples of these networks are IEC 62591 (WirelessHART®, see note) [i.10], IEC 62601 (WIA-PA) [i.11] and IEC 62734 (ISA100.11a) [i.12]; all these networks use IEEE 802.15.4 [i.6] for the process automation applications. Other examples of wireless networks are specified in IEC 61784-1 [i.8] and IEC 61784-2 [i.9] CPs that use IEEE 802.11 [i.4] and IEEE 802.15.1 [i.5] for factory automation applications. Different to wired fieldbuses, the wireless communication interfaces can interfere with others on the same premises or environment, disturbing each other. Therefore, without a predictable assuredness of coexistence, it could be problematic to have multiple wireless communication networks in the same facility or environment, especially because the time-criticality, the safety and the security of the operation may not be ensured in such an environment.

**NOTE:** WirelessHART® is the registered trade name of the HART Communication Foundation. This information is given for the convenience of users of the present document and does not constitute an endorsement by ETSI of the product named. Equivalent products may be used if they can be shown to lead to the same results.

The mitigation techniques which have to be implemented to protect primary radio services limit the applicability to non-real-time applications with relaxed latencies e.g. above 1 s and limits the probability to fulfil the demands on high reliability and high Quality of Services (non-critical links) of the wireless industrial applications. Thus, the 5,8 GHz WIA band may be appropriate for non-real time, non-critical purposes, e.g. monitoring in wireless industrial applications.

Equipment covered by the present document is operated in accordance with the CEPT ECC ERC Recommendation 70-03 [i.7], annex 2.

# 1 Scope

The present document specifies technical characteristics and methods of measurements for Wireless Industrial Applications equipment operating in the 5 725 MHz to 5 875 MHz frequency band. The present document also specifies spectrum sharing mechanisms to enable co-existence with other equipment operating in the 5 725 MHz to 5 875 MHz frequency band.

The present document covers the essential requirements of article 3.2 of Directive 2014/53/EU [i.2] under the conditions identified in annex A.

# 2 References

## 2.1 Normative references

References are specific, identified by date of publication and/or edition number or version number. Only the cited version applies.

Referenced documents which are not found to be publicly available in the expected location might be found at <https://docbox.etsi.org/Reference/>.

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

Not applicable.

## 2.2 Informative references

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

- [i.1] IEC/EN 62657-1 (Edition 1): "Industrial communication networks - Wireless communication networks - Part 1: Wireless communication requirements and spectrum considerations".
- [i.2] 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.3] 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.4] IEEE Std. 802.11<sup>TM</sup>-2016: "IEEE Standard for Information Technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements. Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".
- [i.5] IEEE Std. 802.15.1<sup>TM</sup>: "IEEE Standard for Information technology - Wireless medium access control (MAC) and physical layer (PHY) specifications for wireless personal area networks (WPANs)".

- [i.6] IEEE Std. 802.15.4™-2015: "IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements. Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low-Rate Wireless Personal Area Networks (WPANs)".
- [i.7] CEPT ECC ERC Recommendation 70-03: "Relating to the use of Short Range Devices (SRD)".
- [i.8] IEC 61784-1: "Industrial communication networks - Profiles - Part 1: Fieldbus profiles".
- [i.9] IEC 61784-2: "Industrial communication networks - Profiles - Part 2: Additional fieldbus profiles for real-time networks based on ISO/IEC 8802-3".
- [i.10] IEC 62591: "Industrial communication networks - Wireless communication network and communication profiles - WirelessHART®".
- [i.11] IEC 62601: "Industrial communication networks - Fieldbus specifications - WIA-PA communication network and communication profile".
- [i.12] IEC 62734: "Industrial communication networks - Fieldbus specifications - Wireless Systems for Industrial Automation: Process Control and Related Applications (based on ISA 100.11a)".
- [i.13] ETSI TR 100 028-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 1".
- [i.14] ETSI TR 100 028-2 (V1.4.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics; Part 2".
- [i.15] ETSI TR 102 273-2: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties; Part 2: Anechoic chamber".
- [i.16] ETSI TR 102 273-3: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties; Part 3: Anechoic chamber with a ground plane".
- [i.17] ETSI TR 102 273-4: " Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties; Part 4: Open area test site".
- [i.18] ETSI TR 102 889-2 (V1.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); System Reference Document; Short Range Devices (SRD); Part 2: Technical characteristics for SRD equipment for wireless industrial applications using technologies different from Ultra-Wide Band (UWB)".
- [i.19] CEN EN 12253:2004: "Road transport and traffic telematics - Dedicated short-range communication - Physical layer using microwave at 5,8 GHz".
- [i.20] CEN EN 12795:2003: "Road transport and traffic telematics - Dedicated Short Range Communication (DSRC) - DSRC data link layer: medium access and logical link control".
- [i.21] CEPT ECC Report 206: "Compatibility studies in the band 5725-5875 MHz between SRD equipment for wireless industrial applications and other systems".
- [i.22] ETSI EG 203 336 (V1.1.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); 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".

## 3 Definition of terms, symbols and abbreviations

### 3.1 Terms

For the purposes of the present document, the terms given in Directive 2014/53/EU [i.2], IEC/EN 62657-1 [i.1] and the following apply:

**5,8 GHz WIA band:** Wireless Industrial Applications (WIA) assigned total frequency range of 5 725 MHz to 5 875 MHz

**available channel:** channel identified as available for immediate use as an *Operating Channel*:

- Channel Move Time.
- Channel Shutdown.
- Channel Closing Transmission Time.

**channel closing transmission time:** limitation of the aggregate duration of all transmissions of the device on this channel during the *Channel Move Time*

**channel move time:** time difference between the instant when the UUT has ceased all transmissions on the channel and the end of the radar test signal

**channel shutdown:** process initiated by the WIA device on an *Operating Channel* after a radar signal has been detected during the *In-Service Monitoring* on that channel

**frequency range:** range of operating frequencies over which the equipment can be adjusted

**nominal channel bandwidth:** band of frequencies assigned to a single channel

**operating frequency:** nominal frequency at which the equipment can be operated; this is also referred to as the operating centre frequency

NOTE: Equipment may be adjustable for operation at more than one operating frequency.

**outdoor:** outside of a building

**plant:** complete set of technical equipment and facilities to accomplish a defined technical task for process automation and factory automation

NOTE: A plant includes apparatus, machines, instruments, devices, means of transportation, control equipment and other operating equipment.

**spurious emissions:** emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information

NOTE: Spurious emissions include harmonic emissions, parasitic emissions, intermodulation products and frequency conversion products, but exclude out-of-band emissions.

**Tx-off time:** period where a device remains off after a transmission or a polling sequence

**Tx power:** maximum RF output power; if the equipment is designed to operate with different power levels, the rated power for each level or range of levels, frequency or range of frequencies

**unavailable channel:** channel which cannot be considered by WIA device for a certain period of time (*Non Occupancy Period*) after a radar signal was detected on that channel

**WIA device:** radio equipment used for wireless industrial applications operating in the 5,8 GHz WIA band

**wireless communication:** communication in which electromagnetic radiations are used to transfer information

**wireless industrial application:** any use of electromagnetic waves with devices or equipment for the generation and use of radio frequency energy in a plant

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

A	power output A in dBm
ChS	Nominal occupied channel bandwidth
DAAthr	DAA threshold in dBm at the receiver input port
dBm	dB relative to 1 milliwatt
dBr	dB relative to peak power
dBW	dB relative to 1 Watt
G	Antenna gain in dBi
GHz	Gigahertz
Hz	Hertz
k	Total number of samples
kHz	kilohertz
MHz	Megahertz
mW	milliwatt
MS/s	Mega Samples per second
n	actual sample number or number of adjacent channels
P <sub>burst</sub>	Power over the burst in dB
P <sub>d</sub>	Detection probability
P <sub>H</sub>	highest power level e.i.r.p. in dBm
P <sub>sample</sub>	Power of the sample in dBm
Ptx	Transmit power e.i.r.p. for WIA device in dBm
t <sub>F</sub>	Fixed listening time
t <sub>L</sub>	Total listening time
t <sub>PS</sub>	Pseudo random part of listening time
x	duty cycle
Y	Beamforming gain in dB

## 3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AFA	Adaptive Frequency Agility
APC	Adaptive Power Control
BFWA	Broadband Fixed Wireless Access
BW	BandWidth
CEN	Comité Européen de Normalisation (European Committee for Standardization)
CEPT	European Conference of Postal and Telecommunications administrations
CON	Conformance test condition
CP	Communication Profile
CW	Continuous Wave
DAA	Detect And Avoid
DFS	Dynamic Frequency Selection
dow	date of withdrawal
DSRC	Dedicated Short Range Communication
DUT	Device Under Test
ECC	Electronic Communications Committee
e.i.r.p.	equivalent isotropically radiated power
EN	European Norm
e.r.p.	equivalent radiated power
ERC	European Radiocommunications Committee
FAR	Fully Anechoic Room
GNSS	Global Navigation Satellite System
IEC	International Electrotechnical Commission
ITS	Intelligent Transport Systems
LPDA	Logarithmic Periodic Dipole Antenna
OATS	Open Area Test Site

PER	Packet Error Rate
PPB	Pulses Per Burst
ppm	parts per million
PPS	Pulses Per Second
PRF	Pulse Repetition Frequency
RBW	Resolution BandWidth
RF	Radio Frequency
RMS	Root Mean Square
SAR	Semi Anechoic Room
TP	Transmit Power
TTT	Transport and Traffic Telematics
Tx	Transmitter
UUT	Unit Under Test
VBW	Video BandWidth
VSWR	Voltage Standing Wave Ratio
WIA	Wireless Industrial Applications

## 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 under intended use. The equipment shall comply with all the technical requirements of the present document which are identified as applicable in annex A at all times when operating within the boundary limits of the declared operational environmental profile.

### 4.2 Conformance requirements

#### 4.2.1 RF output power and Adaptive Power Control

##### 4.2.1.1 Definitions

###### 4.2.1.1.1 RF Output Power

The RF Output Power is the mean equivalent isotropically radiated power (e.i.r.p.) during a transmission burst.

###### 4.2.1.1.2 Adaptive Power Control

Adaptive Power Control (APC) is a mechanism to be used by the WIA device to adjust the RF Output Power to the minimum necessary in order to maintain a reliable link.

###### 4.2.1.2 Limits

###### 4.2.1.2.1 General requirements

The limits given in clause 4.2.1.2.2 shall be applicable to the system as a whole and in any possible configuration.

###### 4.2.1.2.2 Limits for RF output power and APC range

Devices shall use APC. The maximum RF output power is 26 dBm e.i.r.p. The minimum APC range shall be 12 dB.

###### 4.2.1.3 Conformance

Conformance tests as defined in clause 5.3.2 shall be carried out.