

# ETSI EN 300 674-2-2 V2.2.1 (2019-06)



**Transport and Traffic Telematics (TTT);  
Dedicated Short Range Communication (DSRC)  
transmission equipment (500 kbit/s / 250 kbit/s)  
operating in the 5 795 MHz to 5 815 MHz frequency band;  
Part 2: Harmonised Standard for access to radio spectrum;  
Sub-part 2: On-Board Units (OBU)**

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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.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.

The present document is part 2, sub-part 2 of a multi-part deliverable covering Transport and Traffic Telematics (TTT); Dedicated Short Range Communication (DSRC) transmission equipment (500 kbit/s / 250 kbit/s) operating in the 5 795 MHz to 5 815 MHz frequency band, as identified below:

Part 1: "General characteristics and test methods for Road Side Units (RSU) and On-Board Units (OBU)";

**Part 2: "Harmonised Standard for access to radio spectrum";**

Sub-part 1: "Road Side Units (RSU)";

**Sub-part 2: "On-Board Units (OBU)".**

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Date of withdrawal of any conflicting National Standard (dow):	31 March 2021

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# 1 Scope

The present document specifies technical characteristics and methods of measurements for Transport and Traffic Telematics (TTT) systems:

- with a Radio Frequency (RF) output connection and specified antenna or with an integral antenna;
- for data transmission only;
- operating in the 5 795 MHz to 5 815 MHz frequency band.

The applicability of the present document covers only the On Board Units (OBU).

The present document complies with the Commission Implementing Decision 2017/1483/EU [i.4] and CEPT/ERC Recommendation 70-03 [i.6].

The present document applies to the following radio equipment types operating in all or in part of the following service frequency bands given in table 1.

**Table 1: Frequency bands and centre frequencies  $f_{TX}$  allocated for DSRC**

	Pan European Service Frequencies	National Service Frequencies
Channel 1	5,795 GHz to 5,800 GHz, $f_{TX} = 5,7975$ GHz	
Channel 2	5,800 GHz to 5,805 GHz, $f_{TX} = 5,8025$ GHz	
Channel 3		5,805 GHz to 5,810 GHz, $f_{TX} = 5,8075$ GHz
Channel 4		5,810 GHz to 5,815 GHz, $f_{TX} = 5,8125$ GHz

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

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

- [1] CEN EN 12253 (2004): "Road transport and traffic telematics - Dedicated short-range communication - Physical layer using microwave at 5,8 GHz".
- [2] ISO 14906 (2018): "Electronic fee collection -- Application interface definition for dedicated short-range communication".
- [3] CEPT/ERC Recommendation 74-01E (2011): "Unwanted emissions in the spurious domain".
- [4] CEN EN 13372 (2004): "Road Transport and Traffic Telematics (RTTT) - Dedicated short-range communication - Profiles for RTTT applications".



## 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.

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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] ETSI TS 103 052 (V1.1.1) (03-2011): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Radiated measurement methods and general arrangements for test sites up to 100 GHz".
- [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] 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.5] Void.
- [i.6] CEPT/ERC Recommendation 70-03 (May 2018): "Relating to the use of Short Range Devices (SRD)".
- [i.7] ETSI TR 102 273-2 (V1.2.1) (12-2001): "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.8] ETSI TR 102 273-6 (V1.2.1) (12-2001): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Improvement on Radiated Methods of Measurement (using test site) and evaluation of the corresponding measurement uncertainties; Part 6: Test fixtures".
- [i.9] IEC 60721-3-4 (1995) including Amendment 1 (1996): "Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 4: Stationary use at non-weather protected locations".
- [i.10] IEC 60721-3-5 (1997): "Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 5: Ground vehicle installations".

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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 Directive 2014/53/EU [i.2] and the following apply:

**adjacent channel:** channel at a distance of 5 MHz relative to the centre frequency, i.e. in the channel at the next upper or lower centre frequency within the frequency band allocated for DSRC (see table 3)

**bit:** acronym for "binary digit" which can have one out of two possible values

EXAMPLE: 0/1, or +1/-1, or low/high.

**bit rate:** in a bit stream, the number of bits occurring per unit time, usually expressed in bits per second

**boresight:** direction of maximum radiation of a directional antenna

NOTE: If boresight cannot be determined unambiguously, then boresight may be declared by the manufacturer.

**carrier frequency:** frequency  $f_{TX}$  to which the RSU transmitter is tuned

NOTE: In DSRC, the carrier frequency is in the centre of a channel, see table 3 of the present document.

**carrier signal or carrier:** harmonic signal whose nominal single frequency  $f_{TX}$  can vary within a range specified by the carrier frequency tolerance and which is capable of being modulated by a second, symbol-carrying signal

**channel:** continuous part of the radio-frequency spectrum to be used for a specified emission or transmission

NOTE: A radio-frequency channel may be defined by two specified limits, or by its centre frequency and its bandwidth, or any equivalent indication. It is often designated by a sequential number. A radio-frequency channel may be time-shared in order to allow radio communication in both directions by simplex operation. The term "channel" is sometimes used to denote two associated radio-frequency channels, each of which is used for one of two directions of transmission, i.e. in fact a telecommunication circuit.

**co-channel:** transmission using the same channel (frequency band of 5 MHz width)

**cross-polar discrimination (XPD):** the ratio  $P_{LHCP} / P_{RHCP}$  of power  $P_{LHCP}$  of the left hand circular polarized wave to the power  $P_{RHCP}$  of the right hand circular wave when the total power of the transmitted wave is  $P_{LHCP} + P_{RHCP}$

**downlink:** transmission in direction from RSU to OBU

**ellipticity of polarization:** ratio of the polarization main axes of an elliptic polarized radio wave

EXAMPLE: The ellipticity of circular polarized radio waves is one.  
The ellipticity of linear polarized waves is infinity.

**environmental profile:** range of environmental conditions

**equivalent isotropically radiated power:** signal power fed into an ideal loss-less antenna radiating equally in all directions that generates the same power flux at a reference distance as the one generated by a signal fed into the antenna under consideration in a predefined direction within its far field region

**integral antenna:** antenna, with or without a connector, designed as an indispensable part of the equipment

**OBU sleep mode:** optional mode for battery powered OBUs that allows to save battery power

NOTE: In this mode, the OBU can only detect the presence of a DSRC downlink signal to initiate under certain defined conditions a transition to the stand-by mode.

**OBU stand-by mode:** mode, in which the OBU is capable of receiving DSRC downlink signals, but is never transmitting

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

NOTE: Equipment may be able to operate at more than one operating frequency.

**out-of-band emissions:** emissions on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process and which cannot be reduced without affecting the corresponding transmission of information, but excluding spurious emissions (see also CEPT/ERC Recommendation 74-01E [3])

**polarization:** locus of the tip of the electrical field vector in a plane perpendicular to the direction of transmission

EXAMPLE: Horizontal and vertical linear polarization  
Left and right hand circular polarization.

**Portable Equipment (PE):** generally intended to be self-contained, free standing and portable

NOTE: A PE would normally consist of a single module, but may consist of several interconnected modules. It is powered by one or more internal batteries.

**radiated measurements:** measurements which involve the measurement of a radiated electromagnetic field

**spurious emissions:** emission on a frequency, or frequencies, which are outside an exclusion band of  $\pm 2,5$  times the channel spacing around the selected centre frequency  $f_{Tx}$ , 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 (see also CEPT/ERC Recommendation 74-01E [3]).

**uplink:** transmission in direction from OBU to RSU

## 3.2 Symbols

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

$A_{CW}$	Amplitude of CW signal
$A_{mod}$	Amplitude of modulated signal
$ATN_{AT2}$	Attenuation of attenuator AT2
$ATN_{BLN}$	Attenuation of balun BLN
$ATN_{CA1}$	Attenuation of coaxial cable 1
$BER$	Bit error ratio
$C_F$	Number of frames transmitted
$C_E$	Number of erroneous frames received
$d$	Distance between phase centres of transmitting and receiving antenna
$d_{displace}$	Horizontal displacement of TTA and RTA antenna phase centres
$d_{F1}$	Distance from transmitting antenna to first Fresnel ellipse
$d_{F2}$	Distance from first Fresnel ellipse to receiving antenna
$D_{fb}$	Distance between neighbouring ferrite beads
$D_i$	Directivity relative to an isotropic radiator
$D_{0,TA}$	Largest linear dimension of test antenna
$D_{0,EUT}$	Largest linear dimension of EUT antenna
$EIRP_{max}$	Maximum e.i.r.p. of RSU
$EIRP_{MaxObuTx}$	Maximum e.i.r.p. generated by the OBU in a single side band
$EIRP_{ObuTx}$	e.i.r.p. generated by the OBU within a single side band
$EIRP_{OBU}$	e.i.r.p. generated by the OBU antenna
$EIRP_{TSM}$	e.i.r.p. referred to transmitter spectrum mask
$\Delta f_{RSU}$	Frequency error of RSU
$\Delta f_s$	Sub-carrier frequency error
$f$	Frequency
$f_c$	Centre frequency of receiving device or of MSS2 used for calibration
$FER$	Frame error ratio
$f_{ObuTx}$	Actual centre frequency of the lower and upper side band of the OBU uplink channel
$f_{MSS1}$	Frequency of MSS1
$f_{offset}$	Offset frequency
$f_s$	Nominal OBU sub-carrier frequency
$f_{Tx}$	Nominal RSU carrier frequency
$f_{Tx,actual}$	Actual centre frequency of the downlink carrier
$f_u$	Nominal centre frequency of unwanted signal
$f_{u1}, f_{u2}$	Centre frequencies of unwanted signal
$G_c$	Conversion gain
$G_{corr}$	Correction gain
$G_{OBU,Rx}$	Gain of OBU receiving antenna
$G_{OBU,Tx}$	Gain of OBU transmitting antenna

$G_{\text{RSA}}$	Gain of receiving substitution antenna
$G_{\text{TA}}$	Gain of test antenna
$G_{\text{TSA}}$	Gain of transmitting substitution antenna
$G_{\text{RSU,Tx}}$	Gain of RSU transmitting antenna
$k$	Expansion factor (coverage factor)
$\lg(\cdot)$	Logarithm to the base ten
$m$	Modulation index
$Mc$	Location of the OBU antenna phase centre
$N$	Total number of transmitted bits within a single frame
$P_{\text{CW}}$	Power of CW signal
$P_{\text{D11a}}$	Power limit for communication (upper)
$P_{\text{D11b}}$	Power limit for communication (lower)
$P_{\text{inc}}$	Incident signal power as received by an ideal isotropical receiving antenna
$P_{\text{inc,scan}}$	Incident signal power obtained from a scanning process
$P_{\text{inc,dBm}}$	$P_{\text{inc}}$ in dBm
$P_{\text{LHCP}}$	Signal power of left hand circular polarized wave
$P_{\text{max}}$	Maximum signal power
$P_{\text{mod}}$	Power of modulated signal
$P_{\text{MMS1}}$	Output signal power of MSS1
$P_{\text{MMS2}}$	Output signal power of MSS2
$P_{\text{ObuRx}}$	Incident signal power to OBU, referred to an ideal isotropical receiving antenna
$P_{\text{pol}}$	Signal power of wave with corresponding polarization
$P_{\text{v}}$	Signal power of wave featuring vertical polarization
$P_{\text{h}}$	Signal power of wave featuring horizontal polarization
$P_{\text{PM1}}$	Signal power measured by the power meter 1
$P_{\text{ref}}$	Reference signal power limit in Watt
$P_{\text{ref,dBm}}$	Reference signal power limit in dBm
$P_{\text{reTx}}$	Retransmitted signal power
$P_{\text{RSA}}$	Signal power obtained from receiving substitution antenna
$P_{\text{RHCP}}$	Signal power of right hand circular polarized wave
$P_{\text{ssb}}$	Signal power within single side band
$P_{\text{sens}}$	Sensitivity of receiver
$P_{\text{spurious}}$	Signal power of spurious signal
$P_{\text{tot}}$	Sum of signal power $P_1 + P_2$ , or $P_1 + P_2 + \dots + P_5$ , whichever applies
$P_{\text{tot,dBm}}$	$P_{\text{tot}}$ in dBm
$P_{\text{TSM}}$	Transmitter spectrum mask
$P_{\text{u}}$	Power of unwanted signal at OBU antenna
$P_{\text{u,max}}$	Unwanted signal power limit at OBU antenna
$P_{\text{w}}$	Signal power of wanted signal
$P_0$	Reference signal power of 1 mW corresponding to 0 dBm
$RBW$	Resolution bandwidth
$T_{\text{CW}}$	Duration of CW signal
$T_{\text{mod}}$	Duration of modulated signal
$V_{\text{max}}, V_{\text{min}}$	Maximal amplitude of modulated output signal of RSU caused by data bit 1, or 0
$\alpha$	Tilt angle of test antenna
$\alpha_{\text{displace}}$	Displacement angle between TTA and RTA
$\theta$	Angle relative to OBU boresight indicating worst case direction
$\theta^\circ$	Value of $\theta$ measured in degree
$\lambda$	Wavelength
$\rho_{\text{RSA}}$	Reflection coefficient at antenna connector of the receiving substitution antenna
$\rho_{\text{TSA}}$	Reflection coefficient at antenna connector of the transmitting substitution antenna

### 3.3 Abbreviations

For the purposes of the present document the abbreviations given in CEN EN 12253 [1] and the following apply:

ASG	Arbitrary Signal Generator
AT1	ATtenuator 1
AT2	ATtenuator 2
BER	Bit Error Ratio
BLN	BaLuN
BST	Beacon Service Table
CA	Corresponding Antenna
CC	Coaxial Circulator
CRC	Cyclic Redundancy Checking
CW	Continuous Wave
DSRC	Dedicated Short Range Communication
e.i.r.p.	equivalent isotropically radiated power

NOTE: Also called EIRP, eirp, E.I.R.P.

EC	European Community
EUT	Equipment Under Test
FCCA	Ferrited Coaxial Cable
FCCA1	Ferrited Coaxial Cable 1
FER	Frame Error Ratio
LHCP	Left Hand Circular Polarized
LOS	Line-Of-Sight
LP	Linear Polarized
M <sub>centre</sub>	Centre point between phase centres of TTA and RTA
MSS1	Monochromatic Signal Source 1
MSS2	Monochromatic Signal Source 2
n.a.	not applicable
OBU	On Board Unit
PE	Portable Equipment
PM1	Power Meter 1
RBW	Resolution BandWidth
RD	Receiving Device
RF	Radio Frequency
RRxA	RSU Receiving Antenna
RSA	Receiving Substitution Antenna
RSU	Road Side Unit
RTA	Receiving Test Antenna
RTTT	Road Transport and Traffic Telematics
RTxA	RSU Transmitting Antenna
Rx	Receiver
SMS1	Signal or Message Source 1
SR	Special Report
SSB	Single Side Band
TA	Test Antenna
TM1	Test Message 1
TS1	Test Signal 1
TS2	Test Signal 2
TSA	Transmitting Substitution Antenna
TSM	Transmitter Spectrum Mask
TTA	Transmitting Test Antenna
Tx	Transmitter
VBW	Video Band Width
VST	Vehicle Service Table
VSWR	Voltage Standing Wave Ratio
XP	Cross Polarized
XPD	Cross-Polar Discrimination