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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 covering the essential requirements of article 3.2 of Directive 2014/53/EU; Sub-part 2: On-Board Units (OBU)

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REN/ERM-TG37-27

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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.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.5].

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 covering the essential requirements of article 3.2 of Directive 2014/53/EU";

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

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

Proposed national transposition dates	
Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
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Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

1 Scope

The present document applies to 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 on radio frequencies in the 5 725 MHz to 5 875 MHz Short Range Devices frequency band.

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

The present document does not necessarily include all the characteristics which may be required by a user, nor does it necessarily represent the optimum performance achievable.

The present document complies with the Commission Implementing Decision 2013/752/EU [1] and CEPT/ERC Recommendation 70-03 [2]. It is a specific standard covering various TTT applications.

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

The present document contains requirements to demonstrate that radio equipment both effectively uses and supports the efficient use of radio spectrum in order to avoid harmful interference.

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.

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

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] Commission Decision 2013/752/EU: "Commission Implementing Decision of 11 December 2013 amending Decision 2006/771/EC on harmonisation of the radio spectrum for use by short-range devices and repealing Decision 2005/928/EC".

[2] CEPT/ERC Recommendation 70-03 (2015): "Relating to the use of Short Range Devices (SRD)".

[3] CEN EN 12253 (2004): "Road transport and traffic telematics - Dedicated short-range communication - Physical layer using microwave at 5,8 GHz".

[4] ETSI TR 100 028 (V1.4.1) (12-2001) - (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".

[5] 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-weatherprotected locations".

[6] 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".

[7] CEN EN 12795 (2003): "Road transport and traffic telematics - Dedicated Short Range Communication (DSRC) - DSRC data link layer: medium access and logical link control".

[8] CEN EN 12834 (2003): "Road transport and traffic telematics - Dedicated Short Range Communication (DSRC) - DSRC application layer".

[9] ISO 14906 (2011): "Electronic fee collection - Application interface definition for dedicated short-range communication".

[10] CEPT/ERC Recommendation 74-01E (2011): "Unwanted emissions in the spurious domain".

[11] 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".

[12] 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".

[13] CEN EN 13372 (2004): "Road Transport and Traffic Telematics (RTTT) - Dedicated short-range communication - Profiles for RTTT applications".

[14] CISPR 16-1 (2015): "Specification for radio disturbance and immunity measuring apparatus and methods - Part 1: Radio disturbance and immunity measuring apparatus".

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 EN 300 674-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Road Transport and Traffic Telematics (RTTT); Dedicated Short Range Communication (DSRC) transmission equipment (500 kbit/s / 250 kbit/s) operating in the 5,8 GHz Industrial, Scientific and Medical (ISM) band; Part 1: General characteristics and test methods for Road Side Units (RSU) and On-Board Units (OBU)".

[i.2] ETSI EN 300 674-2-1: "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 covering the essential requirements of article 3.2 of Directive 2014/53/EU; Sub-part 1: Road Side Units (RSU)".

[i.3] ETSI TR 102 273-4 (V1.2.1): "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.4] Commission Directive 95/54/EC of 31 October 1995 adapting to technical progress Council Directive 72/245/EEC on the approximation of the laws of the Member States relating to the suppression of radio interference produced by spark-ignition engines fitted to motor vehicles and amending Directive 70/156/EEC on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers.

[i.5] 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.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.

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in Directive 2014/53/EU [i.5] 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 under which equipment within the scope of the present document is required to comply with the provisions of the present document

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 [10])

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 ±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 [10]).

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 calibrated 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
Δf_{RSU}	Frequency error of RSU
Δf_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_{RSA}	Gain of receiving substitution antenna
G_{TA}	Gain of test antenna
G_{TSA}	Gain of transmitting substitution antenna
$G_{RSU,Tx}$	Gain of RSU transmitting antenna
k	Expansion factor (coverage factor)
lg(.)	Logarithm to the base ten
m	Modulation index
N	Total number of transmitted bits within a single frame
P_{CW}	Power of CW signal
P_{D11a}	Power limit for communication (upper)
P_{D11b}	Power limit for communication (lower)
P_{inc}	Incident signal power as received by an ideal isotropical receiving antenna
$P_{inc,scan}$	Incident signal power obtained from a scanning process
$P_{inc,dBm}$	P_{inc} in dBm
P_{LHCP}	Signal power of left hand circular polarized wave
P_{max}	Maximum signal power
P_{mod}	Power of modulated signal
P_{MMS1}	Output signal power of MSS1
P_{MMS2}	Output signal power of MSS2
P_{ObuRx}	Incident signal power to OBU, referred to an ideal isotropical receiving antenna
P_{pol}	Signal power of wave with corresponding polarization
P_v	Signal power of wave featuring vertical polarization
P_h	Signal power of wave featuring horizontal polarization

P_{PM1}	Signal power measured by the power meter 1
P_{ref}	Reference signal power limit in Watt
$P_{ref,dBm}$	Reference signal power limit in dBm
P_{reTx}	Retransmitted signal power
P_{RSA}	Signal power obtained from receiving substitution antenna
P_{RHCP}	Signal power of right hand circular polarized wave
P_{ssb}	Signal power within single side band
P_{sens}	Declared sensitivity of receiver
$P_{spurious}$	Signal power of spurious signal
P_{tot}	Sum of signal power $P_1 + P_2$, or $P_1 + P_2 + ... + P_5$, whichever applies
$P_{tot,dBm}$	P_{tot} in dBm
P_{TSM}	Transmitter spectrum mask
P_u	Power of unwanted signal at OBU antenna
$P_{u\ max}$	Unwanted signal power limit at OBU antenna
P_w	Signal power of wanted signal
P_0	Reference signal power of 1 mW corresponding to 0 dBm
RBW	Resolution bandwidth
T_{CW}	Duration of CW signal
T_{mod}	Duration of modulated signal
V_{max}, V_{min}	Maximal amplitude of modulated output signal of RSU caused by data bit 1, or 0
α	Tilt angle of test antenna
$\alpha_{displace}$	Displacement angle between TTA and RTA
θ	Angle relative to OBU boresight indicating worst case direction
$\theta°$	Value of θ measured in degree
λ	Wavelength
ρ_{RSA}	Reflection coefficient at antenna connector of the receiving substitution antenna
ρ_{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 [3] 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
DC	Direct Current
DEC	DECision
doa	date of announcement
dop	date of publication
dow	date of withdrawal
DSRC	Dedicated Short Range Communication
e.i.r.p.	Equivalent Isotropically Radiated Power also called EIRP, eirp, E.I.R.P.
EC	European Community
EFC	Electronic Fee Collection
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
Mc	Location of the OBU antenna phase centre
M_{centre}	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
ppm	parts per million (10^{-6})
PSTN	Public Switched Telephone Network
R&TTE	Radio and Telecommunications Terminal Equipment
RBW	Resolution BandWidth
RD	Receiving Device
REC	RECommendation
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
TD	Technical Document
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 BandWidth
VST	Vehicle Service table
VSWR	Voltage Standing Wave Ratio
XP	Cross Polarized
XPD	Cross-Polar Discrimination

4 Technical requirements specifications

4.1 Mechanical and electrical design

4.1.1 Units

The present document specifies the characteristics of On Board Units.

Transmitters and receivers may be individual or combination units; some units may be transmitter only, some units may be receiver only and some units may combine transmitter and receiver functionalities.

4.1.2 Controls

Those controls which if maladjusted might increase the interference possibilities to and from the equipment shall only be accessible by partial or complete disassembly of the device and requiring the use of tools.