SLOVENSKI STANDARD
SIST EN 302 372 V2.1.1:2017

01-februar-2017

Naprave kratkega dosega (SRD) - Oprema radarja za sondiranje nivoja v rezervoarjih (TLPR), ki deluje v frekvenčnih območjih od 4,5 GHz do 7 GHz, od 8,5 GHz do 10,6 GHz, od 24,05 GHz do 27 GHz, od 57 GHz do 64 GHz in od 75 GHz do 85 GHz - Harmonizirani standard, ki zajema bistvene zahteve člena 3.2 direktive 2014/53/EU

Short Range Devices (SRD) - Tank Level Probing Radar (TLPR) equipment operating in the frequency ranges 4,5 GHz to 7 GHz, 8,5 GHz to 10,6 GHz, 24,05 GHz to 27 GHz, 57 GHz to 64 GHz, 75 GHz to 85 GHz - Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU

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ETSI EN 302 372 V2.1.1 (2016-12)

Short Range Devices (SRD);
Tank Level Probing Radar (TLPR) equipment operating in the frequency ranges 4,5 GHz to 7 GHz, 8,5 GHz to 10,6 GHz, 24,05 GHz to 27 GHz, 57 GHz to 64 GHz, 75 GHz to 85 GHz;
Harmonised Standard covering the essential requirements of article 3.2 of the Directive 2014/53/EU

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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.8] 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.6].

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:	5 December 2016
Date of latest announcement of this EN (doa):	31 March 2017
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	30 September 2017
Date of withdrawal of any conflicting National Standard (dow):	30 September 2018

There have been no significant technical changes incorporated from the previous version of the present document.

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).

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Introduction

Clauses 1 and 3 provide a general description on the types of equipment covered by the present document and the definitions and abbreviations above.

Clause 2 provides the information on normative and informative reference documentation.

Clause 4 lists all technical requirements specifications. This includes transmitter and receiver conformance requirements as well as requirements for spectrum access, antennas and mitigation techniques.

Clause 5 addresses the conditions for testing. This includes the environmental conditions and product information of the equipment to be tested. It also gives advice on the interpretation of the measurement results and gives the maximum measurement uncertainty values.

Clause 6 provides the information on conformance test suites. This includes test suites for transmitter and receiver parameters as well as test suites for spectrum access, antenna requirements and others.

Annex A explains the relationship between the present document and the essential requirements of Directive 2014/53/EU [i.6].

Annex B provides an application form for facilitating the test preparation.

Annex C lists general requirements on radiated test setups.

Annex D provides information about the requirements of conducted measurements.

Annex E lists the installation requirements of a Tank Level Probing Radar (TLPR) on a tank.

Annex F establishes the requirements on the test tank.

Annex G deals with electromagnetic leakage from a tank with an installed TLPR.

Annex H gives recommendations on measurement antennas and preamplifiers.

Annex I deals with practically useful approximations of the far field conditions for radiated measurements.

Annex J describes the range of modulation parameters for TLPR instruments.

Annex K gives information on the atmospheric absorption of electromagnetic waves as a function of frequency.

Annex L gives practical information on RF measurements, especially in higher frequency bands.

Annex M gives information on radar targets for radiated measurements.

Annex N describes the boundary conditions for the Radar equation.

Annex O (bibliography) lists further related documents.

Annex P contains the change history of the present document.

1 Scope

The present document applies to the following equipment types:

Tank Level Probing Radar (TLPR) applications are based on pulse RF, FMCW or similar wideband techniques. TLPR radio equipment types are capable of operating in all or part of the frequency bands as specified in table 1.

Table 1: Tank Level Probing Radar (TLPR) permitted frequency bands [i.7]

	TLPR assigned frequency bands (GHz)
Transmit and Receive	4,5 to 7
Transmit and Receive	8,5 to 10,6
Transmit and Receive	24,05 to 27
Transmit and Receive	57 to 64
Transmit and Receive	75 to 85

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

Table 1 shows a list of the frequency bands as assigned to Tank Level Probing Radars in the EC Decision 2013/752/EU [i.7] and CEPT/ERC Recommendation 70-03 [i.1] as known at the date of publication of the present document.

TLPRs are used for tank level measurement applications in many industries concerned with process control to measure the amount of various substances (mostly liquids or granulates). TLPRs are used for a wide range of applications such as process control, custody transfer measurement (government legal measurements), water and other liquid monitoring, spilling prevention and other industrial applications. The main purposes of using TLPRs are:

- to increase reliability by preventing accidents;
- to increase industrial efficiency, quality and process control;
- to improve environmental conditions in production processes.

The present document applies to TLPRs radiating RF signals towards the surface of a substance contained in a closed tank. Any radiation outside of the tank is caused by leakage and is considered as unintentional emission. 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, it applies only to TLPRs fitted with dedicated antennas.

TLPRs always consist of a combined transmitter and receiver and are used with an integral or dedicated antenna. The TLPR equipment is for professional applications where installation and maintenance are performed by professionally trained individuals only.

The scope is limited to TLPRs operating as Short Range Devices (SRD), in which the devices are installed in closed metallic tanks or reinforced concrete tanks, or similar enclosure structures made of comparable attenuating material, holding a substance, liquid or powder.

The TLPR applications in the present document are not intended for communication purposes. Their intended usage excludes any intended radiation into free space.

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.

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

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

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

[3] ETSI TR 102 273 (all parts) (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".

[4] ANSI C63.5 (2006): "American National Standard for Electromagnetic Compatibility - Radiated Emission Measurements in Electromagnetic Interference (EMI) Control - Calibration of Antennas (9 kHz to 40 GHz)".

[5] ETSI EN 303 883 (V1.1.1) (09-2016): "Short Range Devices (SRD) using Ultra Wide Band (UWB); Measurement Techniques".

[6] ETSI TS 103 361 (V1.1.1) (03-2016): "Short Range Devices (SRD) using Ultra Wide Band technology (UWB); Receiver technical requirements, parameters and measurement procedures to fulfil the requirements of the 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/Recommendation 70-03: "Relating to the use of Short Range Devices (SRD)".

[i.2] Recommendation ITU-R SM.1754: "Measurement techniques of Ultra-wideband transmissions".

[i.3] ETSI TS 103 051: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Expanded measurement uncertainty for the measurement of radiated electromagnetic fields".

[i.4] ETSI TS 103 052: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Radiated measurement methods and general arrangements for test sites up to 100 GHz".

[i.5] Recommendation ITU-R P.676-10 (09-2013): "Attenuation by atmospheric gases".

[i.6] 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, (OJ L153, 22.5.2014, p62).

[i.7] European Commission Decision 2013/752/EU amending Decision 2006/771/EC on harmonisation of the radio spectrum for use by short-range devices and repealing Decision 2005/928/EC.

[i.8] 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.9] European Commission Decision 2009/343/EC amending Decision 2007/131/EC on allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonised manner in the Community.

[i.10] ETSI TR 102 215: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Recommended approach, and possible limits for measurement uncertainty for the measurement of radiated electromagnetic fields above 1 GHz".

[i.11] CEPT/ERC Recommendation 74-01: "Unwanted emissions in the spurious domain" (Siófok 98, Nice 99, Sesimbra 02, Hradec Kralove 05, Cardiff 11).

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

ActivityFactor (AF): factor which is used to describe different modulation parameters and activity levels of TLPR devices and defined as the ratio of active measurement periods t_{meas} (bursts, sweeps, scans) within the overall repetitive measurement cycle T_{meas_cycle}, i.e. t_{meas}/T_{meas_cycle}

dedicated antenna: antenna that is designed as an indispensable part of the equipment

Device Under Test (DUT): TLPR under test without a test tank

Duty cycle (DC): ratio of the total on time of the transmitter to the total time in any one hour period reflecting normal operational mode

emissions: signals that leaked or are scattered into the air within the frequency range (that includes harmonics) which depend on equipment's operating bandwidth

NOTE: For TLPRs there is no intended emission outside the tank.

Equipment Under Test (EUT): TLPR under test mounted on a test tank

equivalent isotropically radiated power (e.i.r.p.): total power transmitted, assuming an isotropic radiator

NOTE: e.i.r.p. is conventionally the product of "power into the antenna" and "antenna gain". e.i.r.p. is used for both peak and average power.

equivalent radiated power (e.r.p.): total power transmitted, assuming a directional power transmitted from a theoretical half-wave dipole antenna radiator

Frequency Modulated Continuous Wave (FMCW) radar: radar where the transmitter power is fairly constant but possibly zero during periods giving a big duty cycle (such as 0,1 to 1)

NOTE: The frequency is modulated in some way giving a very wideband spectrum with a power versus time variation which is clearly not pulsed.

integral antenna: permanent fixed antenna, which may be built-in, designed as an indispensable part of the equipment

operating frequency (operating centre frequency): nominal frequency at which equipment is operated

power spectral density (psd): amount of the total power inside the measuring receiver bandwidth expressed in dBm/MHz

pulsed radar (or here simply "pulsed TLPR"): radar where the transmitter signal has a microwave power consisting of short RF pulses

Pulse Repetition Frequency (PRF): inverse of the Pulse Repetition Interval (PRI), averaged over a sufficiently long time to cover all PRF variations

Pulse Repetition Interval (PRI): time period between two consecutive transmit pulses in a pulsed TLPR

radiated measurements: measurements that involve the absolute measurement of a radiated field

radiation: signals emitted intentionally inside a tank for level measurements

step response time (of a TLPR): time span after a sudden distance change until the output value (distance value) reaches 90 % of the final value for the first time

3.2 Symbols

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

AF	Activity factor
f	Frequency
f_C	Frequency at which the peak power of the emission is at maximum
f_H	Highest frequency of the operating bandwidth
f_L	Lowest frequency of the operating bandwidth
t	Time
t_{meas}	active measurement period
T_{meas_cycle}	overall repetitive measurement cycle
t_G	blanking time
k	Boltzmann constant
c	speed of light
T	Temperature
G	efficient antenna gain of radiating structure or gain of the TLPR antenna in the direction of main radiation (main lobe axis)
G_α	gain of the TLPR antenna in an angle α off the main lobe axis (see figure 5)
G_t	gain of the test antenna in the direction of main radiation (main lobe axis)
G_a	declared measurement antenna gain
d	Largest dimension of the antenna aperture of the TLPR or extent of the main lobe in slant distance R_T
d_1	Largest dimension of the TLPR antenna (m)
d_2	Largest dimension of the test antenna (m)
DC	Duty cycle
P_s	Output power of the signal generator measured by power meter
Δf	Bandwidth
BW_{ref}	reference bandwidth
$BW_{measured}$	measurement bandwidth
X	Minimum radial distance (m) between the DUT and the test antenna
λ	wavelength in general or wavelength of the TLPR transmit signal at centre frequency
dB	deciBel
dBi	antenna gain in deciBel relative to an isotropic antenna
ε_r	relative permittivity of the surface material in the real measurement scenario
R_{max}	maximum measurement distance which the individual sensor is still able to reliably measure under the influence of an interferer
Δd	measurement value variation over time during a distance measurement
t_{pulse}	pulse duration in a pulsed system or the duration of an individual frequency step in an SFCW modulation scheme
P_{r_real} $(P_{r\_real}^{dBm})$	received echo power in the real measurement scenario in Watt (in dBm)
P_t (P_t^{dBm})	maximum value of peak power of the TLPR in Watt (in dBm) in the real measurement scenario
R_{max}	maximum measurement distance of the TLPR under interference conditions
R_T	slant distance between TLPR and target
R	distance between TLPR and test antenna
r	reflection coefficient of the considered surface in the real measurement scenario
r_{sphere}	radius of the conducting sphere
$P_{r\_equivalent}$ $(P_{r\_\mathrm{equivalent}}^{dBm})$	received echo power in the equivalent measurement scenario in Watt (in dBm)