SLOVENSKI STANDARD
SIST EN 13757-4:2005

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Communication systems for meters and remote reading of meters - Part 4: Wireless meter readout (Radio meter reading for operation in the 868 MHz to 870 MHz SRD band)

Communication systems for meters and remote reading of meters - Part 4: Wireless meter readout (Radio meter reading for operation in the 868 MHz to 870 MHz SRD band)

Kommunikationssysteme für Zähler und deren Fernablesung - Teil 4: Zählerauslesung über Funk (Fernablesung von Zählern im SRD-Band von 868 MHz bis 870 MHz

Systemes de communication et de télérelevé des compteurs - Partie 4: Echange de données des compteurs par radio (Lecture de compteurs dans la bande SRD 868 MHz a 870 MHz)

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33.200	Daljinsko krmiljenje, daljinske meritve (telemetrija)	Telecontrol. Telemetering
35.100.10	Fiziļ ni sloj	Physical layer
35.100.20	Podatkovni povezovalni sloj	Data link layer

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EUROPEAN STANDARD

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Communication systems for meters and remote reading of meters - Part 4: Wireless meter readout (Radio meter reading for operation in the 868 MHz to 870 MHz SRD band)

Systèmes de communication et de télérelevé des compteurs - Partie 4: Echange de données des compteurs par radio (Lecture de compteurs dans la bande SRD 868 MHz à 870 MHz)

Kommunikationssysteme für Zähler und deren Fernablesung - Teil 4: Zählerauslesung über Funk (Fernablesung von Zählern im SRD-Band von 868 MHz bis 870 MHz)

This European Standard was approved by CEN on 21 February 2005.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Foreword

This European Standard (EN 13757-4:2005) has been prepared by Technical Committee CEN/TC 294 “Communication systems for meters and remote reading of meters”, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2005, and conflicting national standards shall be withdrawn at the latest by December 2005.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

1 Scope

This European Standard specifies the requirements of parameters for the physical and the link layer for systems using radio to read remote Meters. The primary focus is to use the Short Range Devices (SRD) unlicensed telemetry band, 868 MHz to 870 MHz. The standard encompasses systems for walk-by, drive-by and fixed installations. As a broad definition, this European Standard can be applied to various application layers.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13757-3:2004, *Communication systems for and remote reading of meters - Part 3: Dedicated application layer*

EN 60870-5-1, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 1: Transmission frame formats (IEC 60870-5-1:1990)*

EN 60870-5-2, *Telecontrol equipment and systems – Part 5: Transmission protocols – Section 2: Link transmission procedures (IEC 60870-5-2:1992)*

ISO/IEC 646, *Information technology - ISO 7-bit coded character set for information interchange*

CEPT/ERC/REC 70-03 E, *Relating to the use of short range devices (SRD)*

ETSI EN 300 220-1, V1.3.1:2000, *ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); Short range devices (SRD); Radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW; Part 1: Technical characteristics and test methods*

ETSI EN 300 220-2, V1.3.1:2000, *ElectroMagnetic Compatibility and Radio Spectrum Matters (ERM); Short range devices (SRD); Radio equipment to be used in the 25 MHz to 1 000 MHz frequency range with power levels ranging up to 500 mW; Part 2: Supplementary parameters not intended for conformity purposes*

ETSI EN 301 489-1, V1.4.1:2002, *Electromagnetic compatibility and Radio spectrum Matters ERM; ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements*

ETSI EN 301 489-3, V1.3.1:2001, *Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 3: Specific conditions for Short-Range Devices (SRD) operating on frequencies between 9 kHz and 40 GHz*

3 General

3.1 Introduction

The "Meters" may communicate with "Other" system components, for example mobile readout devices, stationary receivers, data collectors or system network components. For the meter side, it is assumed that the communication function will work without any operator's intervention or need for battery replacement over the full lifetime of the radio part of the meter. Other components such as the mobile readout or stationary equipment may have a shorter battery lifetime or require an external power supply as dictated by the technical parameters and use.

Three different modes of operation are defined for the communication with the meter. Many of the physical and link layer parameters of these different modes of this document are identical, allowing the use of common hardware and software. However, due to the operational and technical requirements of these modes some parameters will differ.

a) "Stationary mode", mode S is intended for unidirectional or bi-directional communications between stationary or mobile devices. A special transmit only sub-mode S1 could be optimised for stationary battery operated devices with a long header and the sub-mode S1-m is specialised for mobile receivers.

b) "Frequent transmit mode", mode T. In this mode, the meter transmits a very short frame (typically 2 ms to 5 ms) every few seconds thus allowing walk-by and/or drive-by readout.

Transmit only sub-mode T1. It is the minimal transmission of a meter ID plus a readout value, which is sent periodically or stochastically.

The bi-directional sub-mode T2 transmits frequently a short frame containing at least its ID and then waits for a very short period after each transmission for the reception of an acknowledge. Reception of an acknowledge will open a bi-directional communication channel.

c) "Frequent receive mode", mode R2. In this mode, the meter listens every few seconds for the reception of a wakeup message from a mobile transceiver. After receiving such a wakeup, the device will prepare for a few seconds of communication dialog with the initiating transceiver. In this mode a “multi-channel receive mode” allows the simultaneous readout of several meters, each one operating on a different frequency channel.

Meters or other communication devices may support one, multiple or all of the described modes.

3.2 Meter communications types

The following Table describes the key features of each mode and sub-mode.

Table 1 — Meter communication type

Mode	WAY	Typical Application	Chip-rate kcps	Duty cycle [a]	Maximum duty cycle [b]	Data coding + Header	Description
S1	1	Transmit only meter for stationary receiving readout	32,768	1 %	0,02 %	Manchester + Long header	Transmit only; transmits a number of times per day to a stationary receiving point. Transmits in the 1 % duty cycle frequency band. Due to long header, it is suitable also for battery economised receiver.
S1-m	1	Transmit only meter for mobile or stationary readout	32,768	1 %	0,02 %	Manchester + short header	Transmit only; transmits with a duty cycle limitation of 0,02 % per hour to a mobile or stationary receiving point. Transmits in the 1 % duty cycle frequency band. Requires a continuously enabled receiver.
S2	2	All meter types. Stationary reading	32,768	1 %		Manchester + short header or option long header	Meter unit with a receiver either continuously enabled or synchronised requiring no extended preamble for wakeup. Also usable for node transponders or concentrators. A long header is optional.
T1	1	Frequent transmission (short frame meters)	100	0,1 %		3 to 6 + short header	Transmit only with short data bursts < 5 ms every few seconds, operates in the 0,1 % duty cycle frequency band.
T2	2	Frequent transmission (short frame meter with 2 way capability)	Meter: Tx : 100 Meter Rx : 32,768	0,1 % 1 %		3 to 6 + Short header Manchester + Short header	Meter unit transmits on a regular basis like Type T1 and its receiver is enabled for a short period after the end of each transmission and locks on, if an acknowledge (at 32,768 kcps) is received. Further bi-directional communication in the 0,1 %-frequency band using 100 kcps (meter transmit) and 32,768 kcps (meter receive) may follow. Note that the communication from the meter to the "other" component uses the physical layer of the T1 mode, while the physical layer parameters for the reverse direction are identical to the S2-mode.
R2	2	Frequent reception (long range)	4,8	1 %		Manchester + Medium header	Meter receiver with possible battery economiser, requiring extended preamble for wake-up. Optionally, it may have up to 10 frequency channels with a high precision frequency division multiplexing. Meter response with 4,8 kcps wake-up followed by a 4,8 kcps header.
All		Multi-mode option					A system component may operate simultaneously, sequentially or by command in more than one mode as long as it fulfils all the requirements of each of these modes.

[a] The duty cycle limitation shall conform to the frequency band allocation defined for operation in the 868 MHz to 870 MHz SRD bands according to CEPT/ERC/REC 70-03 E.

[b] The duty cycle per meter shall be limited to 0,02 % per hour to limit the total occupancy of the channel to < 10 % with 500 meters installed within transmission range.

Figure 1 below illustrates the operation between the different modes and components.

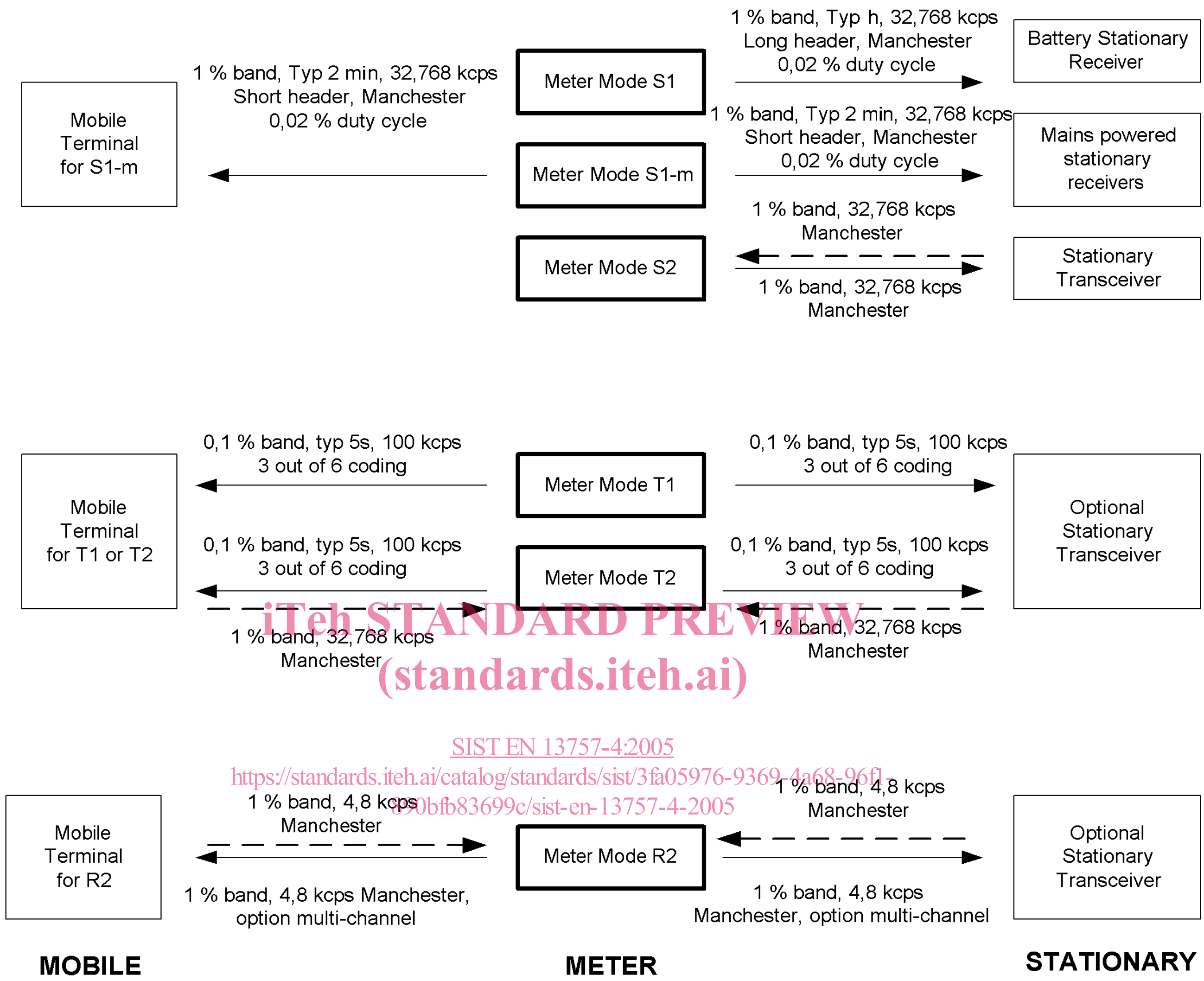

Figure 1 — Meter communication types

3.3 Performance classes

The transmitters shall belong to one of three class levels ranging from low and medium to high radiated power.

The maximum allowable radiated power for the transmitter is defined by CEPT/ERC/REC 70-03 E or as permitted by local radio regulation.

When existing, the receiver shall belong to one of three classes in sensitivity and blocking performance, from low and medium to high.

The performance class of the transmitter and the receiver may be different.

Description of performances – the class of receivers and transmitters defines power, sensitivity and selectivity.

The transmission power shall be measured as the effective radiated power (ERP) according to 8.3 of ETSI EN 300 220-1, V1.3.1:2000.

The maximum usable sensitivity shall be measured in conducted mode according to 4.1 of ETSI EN 300 220-2, V1.3.1:2000. In addition, the manufacturer shall state the antenna gain, which can be measured according to ANSI C63.5.

Table 2 — Transmitter performance classes

Transmitter Class	Typical Application	Description	Minimum ERP P_{erp}
L_T	Lowest performance	Limited transmission power	- 5 dBm
M_T	Medium performance	Medium transmission power	0 dBm
H_T	Highest performance	Highest transmission power	meter to other + 5 dBm other to meter + 8 dBm

Table 3 — Receiver performance classes

Receiver Class	Typical Application	Description	Maximum usable sensitivity at (BER < 10^{-2}) [a] OR at (Block acceptance rate > 80 %) [b] P_0	Antenna gain dBi G_a
L_R	Lowest performance	Limited sensitivity, minimum blocking performances	- 80 dBm	c
M_R	Medium performance	Medium sensitivity, good blocking performances	- 90 dBm	c
H_R	Highest performance	Best sensitivity and best blocking performances	see Tables 6, 10 and 15	c

a In practice, the sensitivity shall be measured in conducted mode according to 4.1 of EN 300 220- 2, V1.3.1:2000. For the user, an important parameter is the radiated sensitivity, that could be estimated by combining the conducted sensitivity and the antenna gain.

b If the conducted mode is not possible, the sensitivity shall be measured by sending a signal with a known field strength to the receiver, according to 4.2 of EN 300 220-2, V1.3.1:2000. The radiated sensitivity could then be measured via the block acceptance rate.

c The antenna gain shall be stated by the manufacturer.

4 Mode S

4.1 Mode S: General

The radio part of a meter shall, for all parameters, as a minimum conform to the requirements of ETSI EN 300 220, Part 1 and Part 2, even if some application requires extended temperature or voltage range.

Table 4 — Mode S, General

Characteristic	Min	Typical	Max.	Unit
Frequency band [a]	868,0	868,3	868,6	MHz
Transmitter duty cycle S2 [b]		0,02	1	%
Transmitter duty cycle S1 & S1-m [c]			0,02	%

[a] This European Standard is optimised for the 868 MHz to 870 MHz band, although with an appropriate transmission licence, other frequency bands could be used, i.e. 433 MHz.

[b] Duty cycle as defined by ETSI EN 300 220-1.

[c] The duty cycle is limited to 0,02 % per hour to limit the total occupancy of the channel, see Table 1 footnote b.

NOTE See the graphics in Annex A for frequency and power recommendations.

4.2 Mode S: Transmitter

The parameters for the transmitters shall be as listed in Table 5 below:

Table 5 — Mode S, Transmitter

Characteristic	Mode	Sym	Min	Typ	Max	Unit	Note
Centre frequency (transmit only meter, S1-submode)			868,25	868,30	868,35	MHz	~ 60×10^{-6} (ppm)
Centre frequency (other and S2-mode)			868,278	868,300	868,322	MHz	~ 25×10^{-6} (ppm)
FSK Deviation			±40	±50	±80	kHz	
Chip rate transmit		f_{chip}		32,768		kcps	
Chip rate tolerance					±1,5	%	
Digital bit jitter [a]					±3	us	
Data rate (Manchester) [b]				$f_{chip} \times ½$		bps	
Preamble length including bit / byte-sync, both directions	S2, S1-M		48			chips	
Preamble length including bit/byte-sync	S1	PL	576			chips	Optional for S2
Postamble (trailer) length [c]			2		8	chips	
Response delay [d]		t_{RO}	3		50	ms	

a The bit jitter shall be measured at the output of the micro-controller or encoder circuit.

b Each bit shall be coded as 2 chips (Manchester encoding).

c The postamble (trailer) shall consist of n=1 to 4 "ones" i.e. the chip sequence is n*(01).

d Response delay: after transmitting a frame in the S2-mode, the receiver shall be ready for the reception of a response in a time shorter than the minimum response delay, and shall be receiving at least for the duration of the maximum response delay.

4.3 Mode S: Receiver

Table 6 — Mode S, Receiver

Characteristic	Class	Symb	Min	Typ	Max	Unit	Note
Sensitivity (BER < 10^{-2}) or (Block acceptance rate > 80 %)	H_R	P_o	-100	-105		dBm	
Blocking performance [a]	L_R		3			Class	
Blocking performance [a c]	M_R		2			Class	
Blocking performance [a b c]	H_R		2			Class	
Acceptable Chip rate tolerance		D_{fchip}			± 2	%	
Chip rate (meter)		f_{chip}		32,768		kcps	

[a] Receiver class according to ETSI EN 300 220-1, V1.3.1:2000, 9.3

[b] Additional requirement for class H_R receivers: Adjacent band selectivity shall be > 40 dB when measured according to ETSI EN 300 220-1, V1.3.1:2000, 9.2.

[c] Additional requirement for class M_R and class H_R receivers: The equipment shall meet the immunity requirements as specified in ETSI EN 301 489-1, V1.4.1:2002, 9.2

4.4 Mode S: Data encoding

4.4.1 Mode S: Manchester encoding

Manchester encoding shall be used for this mode to allow simple encoding/decoding and occupy a narrower base-band. Each bit shall be encoded as either a "10" chip sequence representing a "zero" or as a "01" representing a "one". The lower frequency shall correspond to a chip value of "0".

4.4.2 Mode S: Order of transmission of the encoded data

Each data byte shall be transmitted with the most significant bit first.

The byte sequence of the CRC shall be transferred with the high byte first. The byte sequence of the manufacturer field shall be transferred with the low byte first. The byte sequence of other multi-byte fields is not defined in this document. Such multi-byte fields should be transferred with the low byte first.

4.4.3 Mode S: Preamble chip sequences

The total preamble (header + synchronisation) chip sequence for this mode shall be n×(01) 0001110110 10010110:

with n ≥ 279 for the sub-mode S1 (long header)

with n ≥ 15 for the sub-mode S2 (short header)

with n ≥ 279 for the sub-mode S2 optional long header

All chips of each frame, including pre- and postamble, shall form an uninterrupted sequence.

NOTE 1 In Manchester coding, the chip sequence 000111 is invalid but it is used near the end of the header to allow a receiver to detect the start of a new or a stronger transmission. This applies even during reception of a weaker transmission. The capture effect allows efficient communication even in a channel where many weak transmitters from a large area might otherwise effectively block the reception of a nearer (stronger) transmitter. In addition it allows pulsed