SLOVENSKI STANDARD
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Nadomešča:

SIST EN 13757-4:2005

Komunikacijski sistemi za števce in daljinsko odbiranje števcev - 4. del: Brezžično odbiranje števcev (radijsko odbiranje števcev v SRD-pasu)

Communication systems for meters and remote reading of meters - Part 4: Wireless meter readout (Radio meter reading for operation in SRD bands)

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

Systèmes de communication et de télérelevé de compteurs - Partie 4: Échange de données des compteurs par radio (Lecture de compteurs dans la bande SRD)

Ta slovenski standard je istoveten z: **EN 13757-4:2013**

ICS:

33.200	Daljinsko krmiljenje, daljinske meritve (telemetrija)	Telecontrol. Telemetering
35.100.10	Fizični 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 SRD bands)

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This European Standard was approved by CEN on 29 June 2013.

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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 CEN-CENELEC Management Centre has the same status as the official versions.

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Foreword

This document (EN 13757-4:2013) 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 DIN.

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of an identical text or by endorsement, at the latest by February 2014, and conflicting national standards shall be withdrawn at the latest by February 2014.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or] CENELEC shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13757-4:2005.

This document has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association.

The main changes since EN 13757-4:2005 are as follows:

— Referenced standards have been updated to the most recent versions.

— Terms and definitions were introduced; see Clause 3.

— Mode C, a compact mode, with more efficient data format has been introduced, see Clause 8.

— Mode N, a narrowband mode for the recently enabled dedicated 169 MHz band has been introduced; see Clause 9.

— Mode F, a frequent receive mode for long range communication in the 433 MHz band has been introduced; see Clause 10.

— The definitions for the Data Link Layer have been moved to a common section; see Clause 11. This includes the existing format, frame format A as well as a more efficient coding, frame format B.

— The address field has been changed from always being the meter address to instead always being the sender address; see 11.5.6.

— Synchronised/predictive timing of transmission to reduce power consumption has been introduced; see 11.6.

— Connections to higher protocol layers to take into account the development of other parts of this standard have been introduced; see Clause 12. This introduces an extension of the Data Link Layer and a Transport Layer.

— An informative example of predictive timing has been added; see Annex D.

— Informative Timing diagrams have been added; see Annex E.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the 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 Device (SRD) unlicensed telemetry bands. 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 documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 13757-1, *Communication system for meters and remote reading of meters — Part 1: Data exchange*

EN 13757-3:2013, *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)*

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

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

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

ETSI EN 300 220-1, V2.4.1:2012, *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, V2.4.1:2012, *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: Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive*

ETSI EN 301 489-1, V1.9.2:2011, *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, V1.4.1:2002, *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 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
BER
bit error rate

3.1.2
frame
unit of transmission at the Data Link Layer

3.1.3
FSK
frequency shift keying

3.1.4
FFSK
filtered frequency shift keying

3.1.5
GFSK
gaussian frequency shift keying

3.1.6
individual transmission interval
exact time between two subsequent synchronous or periodical transmissions which changes with each transmission

3.1.7
message
set of data at the Application Layer

3.1.8
nominal transmission interval
average individual transmission interval between all synchronous or periodical messages (new, old or no data content) for wireless meters

3.1.9
NRZ
non-return-to-zero

3.1.10
Other Device
end device exchanging information with a meter

Note 1 to entry: A repeater is not an Other Device, as it is not exchanging information but just passing it on. A multi utility controller is an Other Device. A physical meter may take this role if supporting additional network functions.

3.1.11
PER
packet error rate

3.1.12
PN9
nine bit pseudo-random pattern

Note 1 to entry: The PN9 needs to be designed according to ITU-T Rec O.150.

3.2 Abbreviations

CI	Control Information Field
Ident. no.	Identification number (serial number) (part of meter address)
Manuf.	Manufacturer Acronym (part of meter address)
Ver.	Version (part of meter address)
Device Type.	Device type (part of meter address)

ACC Access number (refer to EN 13757-3)

STS Status (refer to EN 13757-3)

Conf. Word Configuration Word (refer to EN 13757-3)

4 General

4.1 Introduction

The “meters” may communicate with “other” system components, for example mobile readout devices, stationary receivers, data collectors, multi-utility concentrators or system network components. Such devices are in this document named “Other Device”. 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.

Several different modes of operation are defined for the communication with the meter. Many of the physical and link layer parameters of these different modes 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.

The name of a mode is specified by a letter and a number. The letter specifies a mode and the number specifies whether the modes supports unidirectional (=1) or bidirectional (=2) data transfer.

a) “Stationary mode”, mode S is intended for unidirectional or bidirectional communications between the meter and a stationary or mobile device. A special transmit only sub-mode S1 is 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 3 ms to 8 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.

The bidirectional 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 a response. The reception of a response will open a bidirectional communication channel. Alternatively, the initial frame contains the readout value as well, and the response is a reverse channel only used for special services.

c) “Frequent receive mode”, mode R. In this mode only R2 is relevant, as R1 makes no sense. 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. This mode is as well applicable to stationary Other Device's.

d) “Compact Mode” mode C. This mode is similar to mode T but it allows for transmission of more data within the same energy budget and with the same duty cycle. It supports the sub-modes C1 and C2 for unidirectional and bidirectional devices. It is suitable for walk-by and/or drive-by readout. The common reception of mode T and mode C frames with a single receiver is possible.

e) “Narrowband VHF”, mode N. Optimised for narrowband operation in the 169 MHz frequency band, allocated for meter reading and a few other services. Transmit only sub-modes N1a-f, and bidirectional sub-modes N2a-f. The range of sub-modes can be extended using repeaters. Sub-mode N2g is intended for, but not limited to, long range secondary communication using multi-hop repeaters.

f) “Frequent receive and transmit mode”, mode F. Used in the 433 MHz frequency band for long range communications. In the bidirectional sub-modes F2-m, the meter listens every few seconds for the reception of a wake up message from a stationary or mobile transceiver. After receiving such a wake up message, the device prepares for a few seconds of communication dialog with the initiating transceiver. The bidirectional sub-mode F2 transmits a frame and waits for a short period for the reception of a response. The response will open for bidirectional communication.

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

NOTE Additional modes, supporting repeating and routing of data, are specified in EN 13757-5.

The detailed handling of broadcast and multicast transmissions is not specified in this standard. The transmission shall be interpreted as multicast if no Extended Link Layer or Transport Layer is used.

4.2 Meter communications types

Table 1 describes the key features of each mode and sub-mode.

Table 1 — Meter communication type

Modes and sub-modes	**WAY**	**Typical application**	**Chip-rate** kcps	**Maximum duty cycle** [a]	**Data coding** **+** **header**	**Description**
S1	1	Transmit only meter for stationary receiving readout	32,768	0,02 % [b]	Manchester and 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	0,02 % [b]	Manchester and 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 readout	32,768	1 %	Manchester and short header or optionally 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 and short header	Transmit only with short data bursts typically 3 ms to 8 ms every few seconds, operates in the 0,1 % duty cycle frequency band.
T2	2	Frequent transmission (short frame meter with two way capability)	Meter to Other Device: 100 Other Device to Meter 32,768	0,1 % 1 %	3 to 6 and short header Manchester and 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 bidirectional 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 and 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.
C1	1	Frequent transmit only	100	0,1 %	NRZ	Transmit only, on a regular basis, with short data bursts < 22 ms, operates in the 0,1 % duty cycle frequency

Modes and sub-modes	WAY	Typical application	Chip-rate kcps	Maximum duty cycle [a]	Data coding + header	Description
		meter for mobile or stationary readout			+ Short header	band.
C2	2	Frequent transmit meter for mobile or stationary readout	Meter to Other Device: 100 Other Device to Meter: 50	Meter to Other Device: 0,1 % Other Device to Meter 10 %	NRZ + Short header	Meter unit transmits on a regular basis like Type C1 and its receiver is enabled for a short period after the end of each transmission and locks on if a proper preamble and synchronisation word is detected. Data frames received by the meter are used for protocol updates and commands.
N1a-f	1	Long range transmit for stationary readout.	2,4 or 4,8	10 % [c]	NRZ	Transmit only; transmits on a regular basis to a stationary receiving point.
N2a-f	2	Long range two-way communi-cation for stationary readout.	2,4 or 4,8	10 % [c]	NRZ	Meter unit transmits on a regular basis like mode N1 and its receiver is enabled for a short period after the end of each transmission and locks on if a proper preamble and synchronisation word is detected.
N2g	2	Long range communication	9,6 (19,2 kbps)	10 % [c]	NRZ	Secondary communication using multi-hop repeaters, or bidirectional communication similar to mode N2a-f.
F2-m	2	Long range two-way communication	2,4	10 %	NRZ	Meter receiver with possible battery economiser, requiring extended preamble for wake-up.
F2	2	Long range two-way communication for stationary readout.	2,4	10 %	NRZ	Meter unit transmits on a regular basis. Its receiver is enabled for a short period after the end of each transmission. It locks on if a proper preamble and synchronisation word is detected.
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 applicable frequency bands according to CEPT/ERC/REC 70-03.

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

[c] The duty-cycle limit is according to EU Commission Decision 2005/928/EC.

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

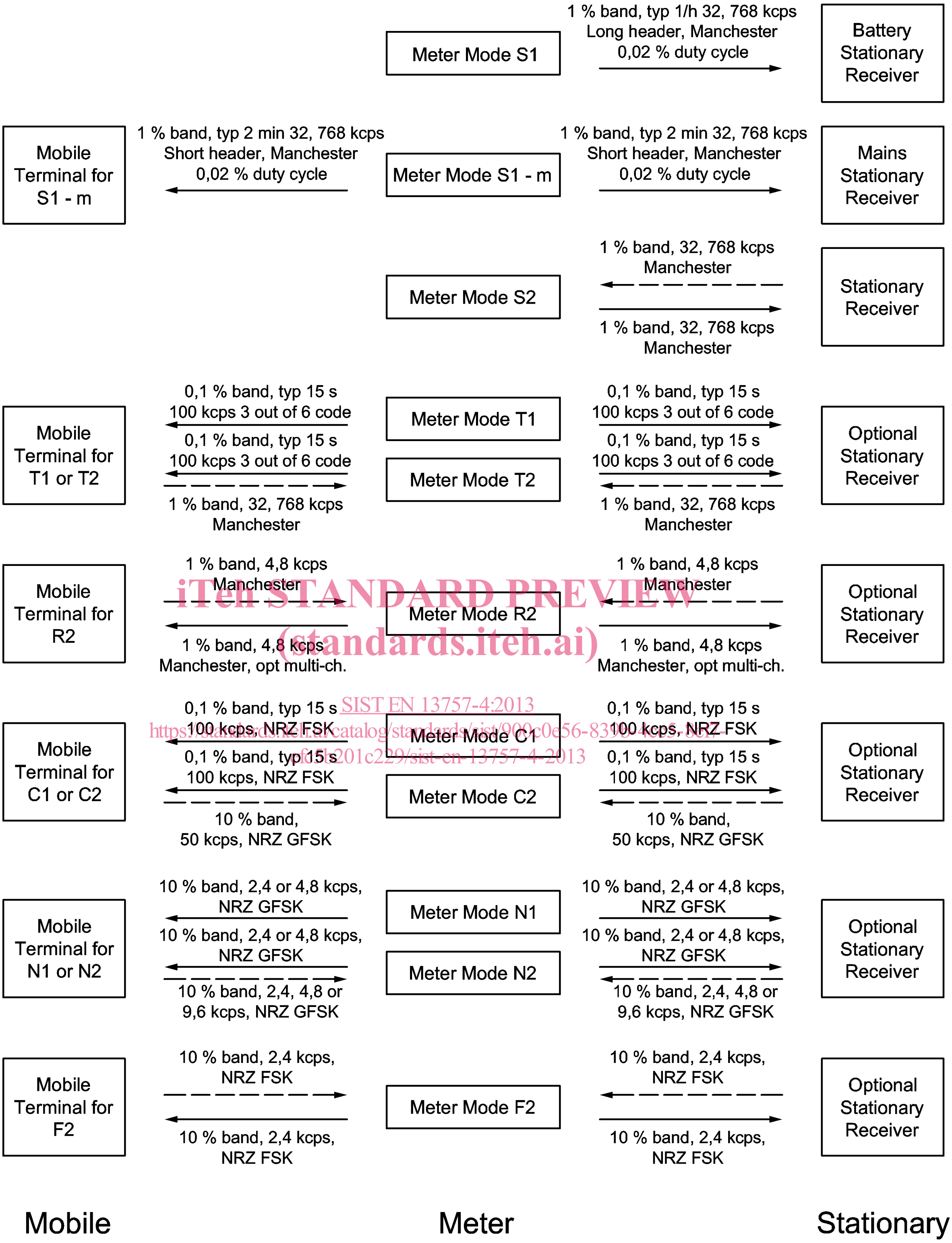

Figure 1 — Meter communication types

4.3 Performance Classes

The transmitters shall belong to one of three Classes ranging from low and medium to high radiated power (see Table 2).

The maximum allowable radiated power for the transmitter is defined by CEPT/ERC/REC 70-03 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 (see Table 3).

The performance Class of receivers and transmitters defines power, sensitivity and selectivity. The performance Class of the transmitter and the receiver may be different.

The transmission power shall be measured as the effective radiated power (ERP) according to 7.3 of ETSI EN 300 220-1, V2.4.1:2012.

The maximum usable sensitivity shall be measured according to 8.1 of ETSI EN 300 220-1, V2.4.1:2012.

Table 2 — Transmitter performance Classes

Transmitter Class	Typical application	Description	Minimum ERP P_{erp}
L_T	Lowest performance	Limited transmission power	–5 dBm (all but mode N) 0 dBm (mode N)
M_T	Medium performance	Medium transmission power	0 dBm (all but mode N) 10 dBm (mode N)
H_T	Highest performance	Highest transmission power	Meter to Other Device +5 dBm (mode R, S, T, C) Meter to Other Device +3 dBm (mode F) Other Device to Meter +8 dBm (mode R, S, T, C) Other Device to Meter +7 dBm (mode F) 20 dBm (mode N)

Table 3 — Receiver performance Classes

Receiver Class	Typical application	Description	Maximum usable sensitivity P_0	Antenna gain dBi G_a
L_R	Lowest performance	Limited sensitivity, minimum blocking performances	–80 dBm (mode R,S,T,C) –90 dBm (mode N) –105 dBm (mode F)	[a]
M_R	Medium performance	Medium sensitivity, good blocking performances	–90 dBm (mode R,S,T,C) –100 dBm (mode N) –110 dBm (mode F)	[a]
H_R	Highest performance	Best sensitivity and best blocking performances	see, Table 6, Table 9, Table 13, Table 16, Table 20 and Table 23	[a]

[a] Refer to 8.1 and for integral or dedicated antenna, refer to E.2 in ETSI EN 300 220-1 V2.4.1:2012.

5 Mode S

5.1 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 parts 1 and 2 even if some application requires extended temperature or voltage range. The specific requirements for frequency band duty cycle are given in Table 4.

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.

b Duty cycle as defined by ETSI EN 300 220-1, V2.4.1:2012.

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 Figure A.1 for additional information on frequency and power recommendations.

5.2 Mode S: Transmitter

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

Table 5 — Mode S, Transmitter

Characteristic	Mode	Symbol	min.	Type	max.	Unit	Note
Centre frequency (transmit only Meter, S1-submode)			868,25	868,30	868,35	MHz	~ 60 × 10^{-6} (ppm)
Centre frequency (Other Device 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} × 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] (Other Device to Meter communication)		t_{RO}	3		50	ms	
FAC Transmission delay [e f]	S2	t_{TxD}	N×1 000 −0,5	N×1 000	N×1 00 0+0,5	ms	N=2, 3,or 5
FAC Time out [g]	S2	t_{TO}	25		30	s	

[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: 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 until the maximum response delay (referred to the end of previous transmission).

[e] FAC Transmission delay: describes the duration which a meter shall delay the first response to a received message from Other Device referred to its last transmission. This delay shall also be applied between the first response of the Meter and the next repeated response of the Meter and all following repeated responses during the Frequent Access Cycle (FAC). The reference time point shall be the end of preamble (end of sync sequence) of the meter transmission. For timing diagrams see Annex E.

[f] The selected timeslot N shall be the same throughout the Frequent Access Cycle.

[g] FAC Time out: is the time period between the last successful reception of a frame from the Other Device during the Frequent Access Cycle (FAC) and the moment where the repetition of the last response of the Meter shall be stopped (end of Frequent Access Cycle).

5.3 Mode S: Receiver

The parameters for the receiver shall be as listed in Table 6 below.

Table 6 — Mode S, Receiver

Characteristic	Class	Symbol	min.	Type	max.	Unit	Note
Sensitivity (BER < 10^{-2}) or (PER < 0,8) [a]	H_R	P_o	–100	-105		dBm	
Blocking performance [b]	L_R		3			Category	
Blocking performance [b c]	M_R		2			Category	
Blocking performance [b c d]	H_R		2			Category	
Acceptable chip rate tolerance		D_{fchip}			± 2	%	
Chip rate (Meter)		f_{chip}		32,768		kcps	

[a] At a frame size of 20 bytes.

[b] Receiver category according to ETSI EN 300 220-1, V2.4.1:2012, 4.1.1.

[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, V1.9.2:2011, 9.2.

[d] Additional requirement for Class H_R receivers: Adjacent band selectivity shall be > 40 dB when measured according to ETSI EN 300 220-1, V2.4.1:2012, 8.3.

5.4 Mode S: Data encoding

5.4.1 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”.

5.4.2 Mode S: Order of transmission of the encoded data

Each data byte shall be transmitted with the most significant bit first. The order of multi byte fields is defined in 11.2.

5.4.3 Mode S: Preamble and synchronisation pattern

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. After this preamble a frame of the format A shall follow.

NOTE 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 receivers to distinguish safely between the start of a valid frame and the detection of an accidental “sync” sequence within an ongoing transmission.