SLOVENSKI STANDARD

SIST EN 13757-2:2005

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Komunikacijski sistemi za merilnike in daljinsko odčitavanje - 2. del: Fizična in povezovalna plast

Communication systems for and remote reading of meters - Part 2: Physical and link layer

Kommunikationssysteme für Zähler und deren Fernablesung - Physical und Link Layer

Systemes de communication et de télérelevé de compteurs - Partie 2: Couches physique et couche de liaison

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35.100.10	Fizični sloj	Physical layer
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Communication systems for and remote reading of meters - Part 2: Physical and link layer

Systèmes de communication et de télérelevé de compteurs - Partie 2: Couches physique et couche de liaison

Kommunikationssysteme für Zähler und deren Fernablesung - Physical und Link Layer

This European Standard was approved by CEN on 23 September 2004.

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
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Contents

Foreword

This document (EN 13757-2:2004) has been prepared by Technical Committee CEN/TC 294 "Communication systems for meters and remote readng 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of an identical text or by endorsement, at the latest by May 2005, and conflicting national standards shall be withdrawn at the latest by May 2005.

This standard consists of the following parts:

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

EN 13757-2, *Communication systems for and remote reading of meters - Part 2: Physical and link layer.*

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

prEN 13757-4, *Communication systems for meters and remote reading of meters - Part 4: Wireless meter readout.*

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.

Introduction

The physical and link layer parameters for baseband communication over twisted pairs has first been described in EN 1434-3:1997 ("M-Bus") for heat meters. This standard is a compatible and interworking update of a part of EN 1434-3:1997 and includes also other measured media (water, gas, heat cost allocators), the master side of the communication and newer technical developments. It should be noted that the EN 1434-3:1997 covers also other communication techniques.

It can be used with various application layers especially the application layer of EN 13757-3.

1 Scope

This document covers the physical and link layer parameters of baseband communication over twisted pair (M-Bus) for meter communication systems. It is especially applicable to heat meters, heat cost allocators, water meters and gas meters.

NOTE It is usable also for other meters (like electricity meters) and for sensors and actuators.

For generic descriptions concerning communication systems for meters and remote reading of meters see EN 13757-1.

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

EN 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 4: Electrical fast transient/burst immunity test – Basic EMV publication (IEC 61000-4-4:1995).*

EN 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 5: Surge immunity test (IEC 61000-4-5:1995).*

3 Terms and definitions

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

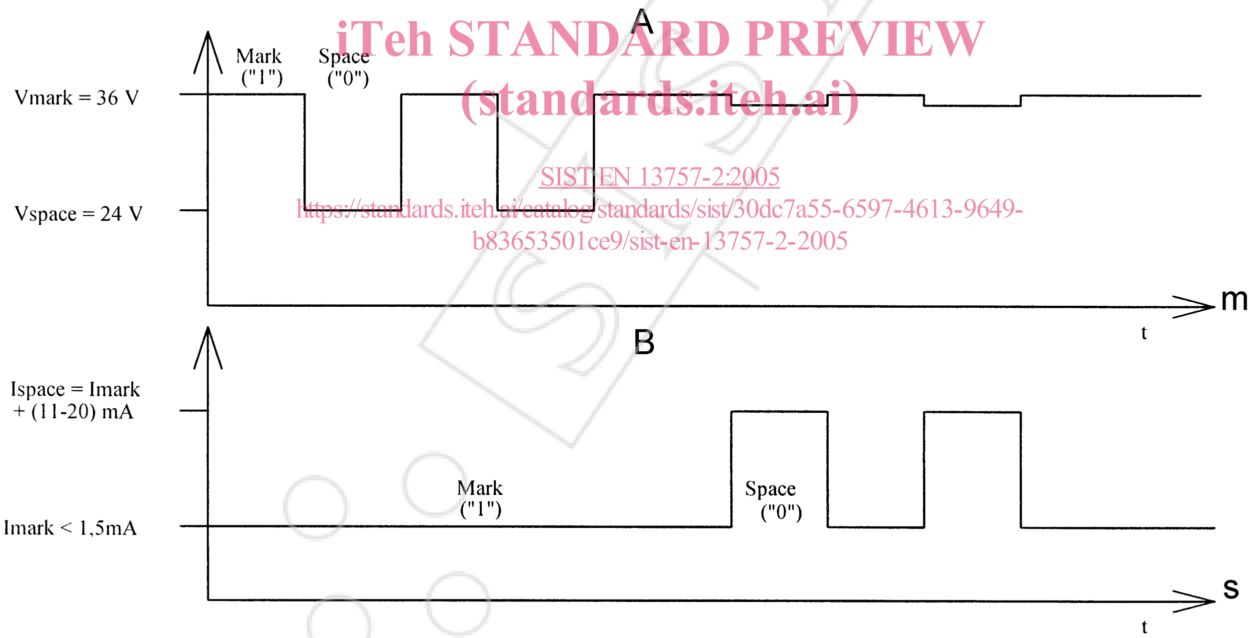
3.1
unit load
one unit load (1 U_L) is the maximum mark state current of 1,5 mA

3.2
other definitions
for further definitions see 4.6 and annex C of EN 13757-1:2002

4 Physical layer specifications

4.1 General

Figure 1 shows the principal electrical concept of the physical layer: Information from the master to the slaves is transmitted via voltage level changes. A (high) quiescent voltage level Umark (idle state, typically 36 V) and an active voltage level (space state) which is typically 12 V below Umark (but at least 12 V) is used for the data transmission. The high voltage step improves the noise immunity in the master to slave direction. The required minimum voltage supports continuous remote powering of all slaves of a segment. Signalling via a voltage change rather than by absolute voltage levels supports even large voltage drops due to wiring resistance of the cable installation. All slaves are constant current sinks. Their idle (mark state) current of typically 1,0 mA to 1,5 mA can be used for powering the transceiver IC in the slave and optionally also the slave (meter). The active (space state) current transmit of a slave is signalled by an increase of this constant current by (11…20) mA. Signalling via constant current improves the immunity against induced voltages and is independent on wiring resistance. On the input of each slave transceiver a rectifier bridge makes each slave independent of the wiring polarity and reduces installation errors. Protective resistors in front of each slave transceiver simplify the implementation of overvoltage protection and safeguards the bus against a semiconductor short circuit in a slave by limiting the current of such a defective slave to 100 mA. Annex A shows the principal function of a slave transceiver. Integrated slave transceivers which include a regulated buffered voltage output for slave (meter) powering, support of battery supply with supply switchover and power down signallong are commercially available.



Key

A Bus Voltage at Repeater

B Current composition of a Slave

t Time

m Master transmits to Slave

s Slave transmits to Master

Figure 1 — Representation of bits on the M-Bus

All specification requirements shall be held over the full range of temperature and operating voltage for the responsible system component.

4.2 Electrical requirements slave

4.2.1 Master to slave bus voltages

Maximum permanent voltage : – 50 V … 0 V … + 50 V (no damage).

Voltage range for meeting all specifications: ± (12 V … 42 V).

The Bus voltage at the slave terminals in mark-(quiescent) state of master slave communication (= U_{Mark}) shall be ± (21 V … 42 V).

The mark voltage shall be stored by a voltage maximum detector with an asymmetric time constant. The discharge time constant shall be greater than 30 × (charge constant) but less than 1 s.

The stored voltage maximum U_{Mark} may drop in 50 ms by not more than 0,2 V for all voltages between 12 V and U_{Mark}.

Bus voltage Mark/Space state for master slave communication.

Space: $U_{Bus} < U_{Mark} - 8{,}2$ V

Mark: $U_{Bus} \geq U_{Mark} - 5{,}7$ V

Maximum space state time 50 ms.

Maximum space state duty cycle: 0,92.

4.2.2 Slave bus current and multiple unit loads

4.2.2.1 General

A slave device may require a maximum mark current of an integer multiple N (in the range 1 … 4) unit loads. Each terminal device shall be marked with the unit load number N (If > 1) and the device description shall contain a note on the multiple unit loads for this device.

4.2.2.2 Mark state bus current of a slave device

The mark state current I_{Mark} shall be $\leq N$ unit loads.

4.2.2.3 Variation of the mark state current over bus voltage

For bus voltages in the range of ± (12 V … 42 V) a voltage variation of 1 V … 15 V shall not change the bus current by more than $N \times 3$ µA/V.

4.2.2.4 Short term variation of the mark state current

At constant bus voltage the bus current shall not change by more than ± 1 % within 10 s.

4.2.2.5 Total variation over allowed temperature and voltage range of slave device

The total variation of the mark state current of a slave device shall not vary by more than ± 10 % over the full voltage and temperature range of the slave device.

4.2.2.6 Max. bus current for any single semiconductor or capacitor defect

1 min after any single semiconductor or capacitor defect the max. current of any slave device shall be less than 100 mA for any bus voltage ≤ 42 V.

4.2.2.7 Slow start

For any bus voltage in the range of (0 … ± 42) V the bus current shall be limited to $\leq N \times U_L$.

4.2.2.8 Fast change

After any bus voltage change the bus current shall be $\leq N \times U_L$ within 1 ms.

4.2.2.9 Space-Send current

The bus current for a slave space state send shall be higher by (11 … 20) mA than in the mark state for all allowed bus voltages:

$I_{Space} = I_{Mark}$ + (11 … 20) mA.

4.2.2.10 Input capacitance at the slave terminals: ≤ 0,5 nF

This capacitance shall be measured with a DC-bias of (15 to 30) V.

4.2.2.11 Startup delay

In case of a bus voltage drop below 12 V for longer than 0,1 s the recovery time after applying an allowed mark state voltage until reaching full communication capabilities shall be less than 3 s.

4.2.2.12 Galvanic Isolation

The isolation resistance between any bus terminal and all metal parts accessible without violating seals shall be > 1 MOhm. Excluded are terminals for the connection of other floating or isolated external components. The test voltage is 500 V. For mains operated terminal devices the appropriate safety rules apply.

4.2.2.13 Optional reversible mains protection

The slave interface can be equipped with an optional reversible mains protection. This guarantees that even for a prolonged period (test duration: 1 min) the slave interface can withstand mains voltages of 230 V + 10 % and 50 Hz or 60 Hz and that afterwards all specifications are met again. This mains protection function is recommended for all mains operated terminal devices. For possible implementations see annex B.

4.2.3 Dynamic requirements

Any link layer or application layer protocol of up to 38 400 Baud is acceptable if it guarantees that a mark state is reached for at least one bit time at least once in every 11 bit times and not later than after 50 ms. Note that this is true for any asynchronous protocol with 5 data bits to 8 data bits (with or without a parity bit) for any baud rate of at least 300 Baud, including a break signal of 50 ms. It is also true for many synchronous protocols with or without bit coding.

4.3 Electrical requirements master

4.3.1 Parameters

4.3.1.1 Max current (I_{Max})

A master for this physical layer is characterized by its maximum current I_{Max}. For all bus currents between zero and I_{Max} it shall meet all functional and parametric requirements. For example a maximally loaded segment with up to 250 slaves with 1 U_L each (375 mA) plus an allowance for one slave with a short circuit (+ 100 mA) plus the maximum space send current (+ 20 mA) an $I_{Max} \geq 0{,}5$ A is required.

4.3.1.2 Max allowable voltage drop (U_r)

The max. voltage drop U_r (> 0 V) is defined as the minimum space state voltage minus 12 V. U_r divided by the maximum segment resistance between the master and any terminal device (meter) gives the maximum usable bus current for a given combination of segment resistance and master.

4.3.1.3 Max baud rate (B_{Max})

Another characterisation of a master is the maximum baud rate B_{Max} up to which all specifications are met. The minimum baud rate is always 300 Baud.

4.3.1.4 Application description

Each master device shall include a description about the required cable and device installation for proper functioning.

4.3.2 Function types

4.3.2.1 Simple level converter

The master function can be realized as a logically transparent level converter between the M-bus physical layer and some other (standardized) physical layer (e.g. V24). It is then bit transparent for allowable baud rates of 300 … B_{Max}. No bit time recovery is possible. Hence a simple level converter can not be used as a repeater.

4.3.2.2 Intelligent level converter

An intelligent level converter can perform space bit time recovery for any asynchronous byte protocol at its maximum baud rate B_{Max}. Other baud rates B_{Max}/L (L = 2 … L_{Max}) are allowed, but bit time recovery can not be guaranteed for these other baud rates. Such a level converter can be used as a physical layer repeater for its maximum baud rate.

4.3.2.3 Bridge

The master function can be integrated with a link layer unit thus forming a (link layer) bridge. If this bridge can support the required physical and link layer management functions it can support also multiple baud rates.

4.3.2.4 Gateway

The master function can be integrated into the application layer of a gateway or it can be fully integrated into an application.

4.3.3 Requirements

4.3.3.1 Mark state (quiescent state) voltage

For currents between 0 … I_{Max}: U_{Mark} = (24 V + U_r) … 42 V.

4.3.3.2 Space state (signal state) voltage

$U_{Space} < U_{Mark}$ – 12 V, but ≥ 12 V + U_r.

4.3.3.3 Bus short circuit

Reversible automatic recovery shall guarantee full function not later than 3 s after the end of any current higher than I_{Max}.

1 ms after the beginning of a short circuit situation the bus current shall be limited to < 3 A.

4.3.3.4 Minimum voltage slope

The transition time between space state and mark state voltages from 10 % to 90 % of the steady state voltages shall be ≤ 1/2 of a nominal bit time. The asymmetry of these transition times shall be ≤ 1/8 of a nominal bit time.

Test conditions (C_{Load} selected from the E12 value series):

— baud rate 300 Baud: C_{Load} = 1,5 µF;

— baud rate 2 400 Baud: C_{Load} = 1,2 µF;

— baud rate 9 600 Baud: C_{Load} = 0,82 µF;

— baud rate 38 400 Baud: C_{Load} = 0,39 µF.

4.3.3.5 Effective source impedance

The voltage drop of the bus voltage for a short (< 50 ms) increase of the bus current by 20 mA shall be ≤ 1,2 V.

4.3.3.6 Hum, ripple and short term (< 10 s) stability of the bus voltages: < 200 mV peak to peak

4.3.3.7 Data detection current (Reception of slave current pulses)

Bus current ≤ Bus idle current + 6 mA: Mark state receive.

Bus current ≥ Bus idle current + 9 mA: Space state receive.

Measurement with current pulses of < 50 ms, duty cycle < 0,92.