

Communication systems for and remote reading of meters —

Part 2: Physical and link layer

The European Standard EN 13757-2:2004 has the status of a
British Standard

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National foreword

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English version

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.

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Foreword

This document (EN 13757-2:2004) 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of an identical text or by endorsement, at the latest by May 2005, and conflicting national standards shall be withdrawn at the latest by May 2005.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.*

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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

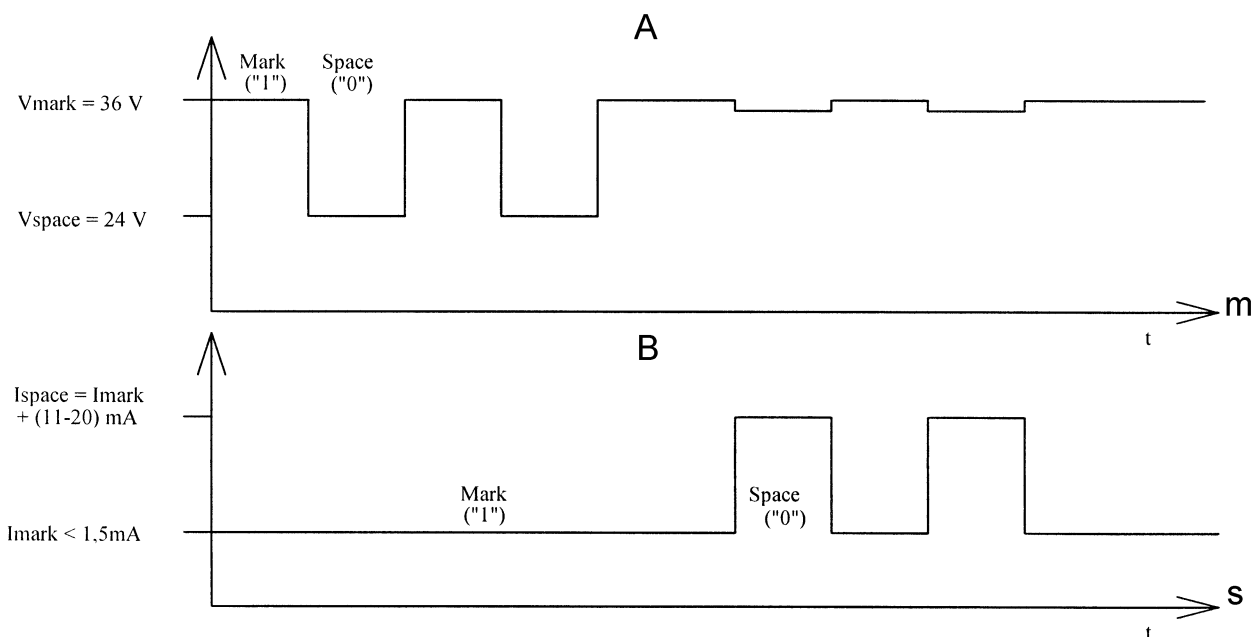
other definitions

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 U_{mark} (idle state, typically 36 V) and an active voltage level (space state) which is typically 12 V below U_{mark} (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 signalling 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 : $-50\text{ V} \dots 0\text{ V} \dots +50\text{ V}$ (no damage).

Voltage range for meeting all specifications: $\pm (12\text{ V} \dots 42\text{ V})$.

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

The mark voltage shall be stored by a voltage maximum detector with an asymmetric time constant. The discharge time constant shall be greater than $30 \times$ (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: $U_{\text{Bus}} < U_{\text{Mark}} - 8,2\text{ V}$

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

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 $\pm (12\text{ V} \dots 42\text{ V})$ a voltage variation of 1 V ... 15 V shall not change the bus current by more than $N \times 3\text{ }\mu\text{A/V}$.

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 $\pm 1\%$ 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 $\pm 10\%$ 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 $(0 \dots \pm 42)$ 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:

$$I_{\text{Space}} = I_{\text{Mark}} + (11 \dots 20) \text{ mA.}$$

4.2.2.10 Input capacitance at the slave terminals: $\leq 0,5$ 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 $230 \text{ V} + 10 \%$ 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.