d) Circuit arrangements in two-wire configuration (one slave station)

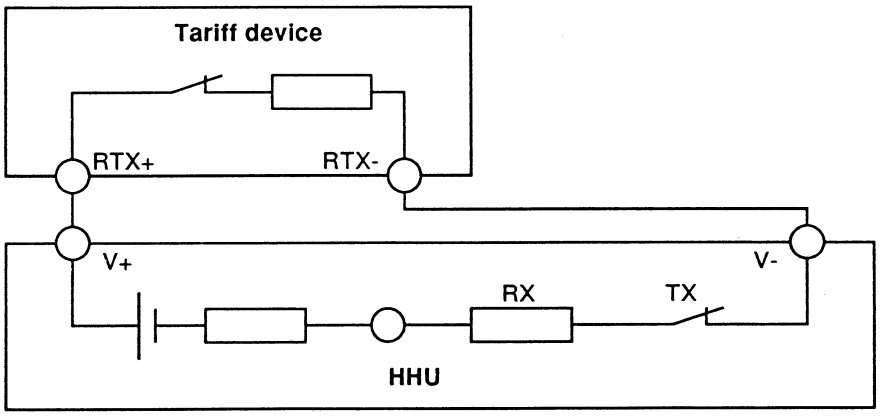


Figure 1a – Circuit diagram of a two-wire single slave configuration

e) Circuit arrangements in two-wire configuration (multiple slave stations)

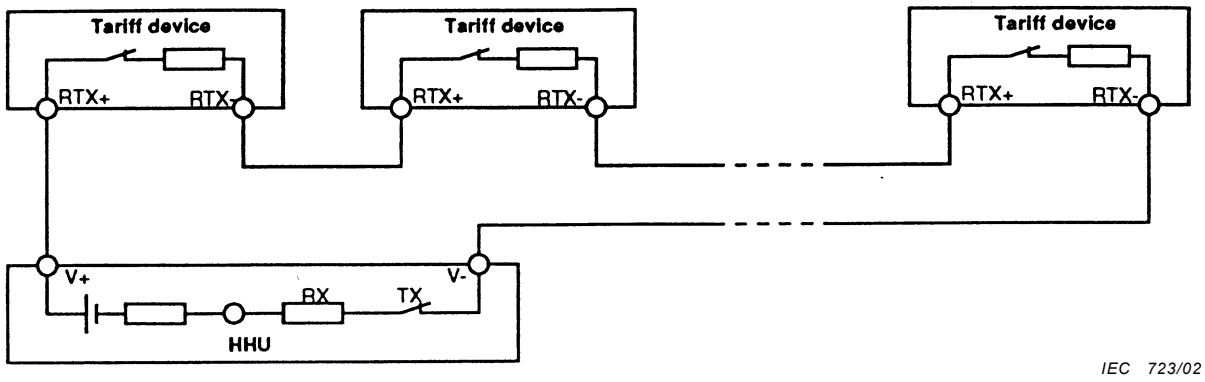


Figure 1b – Circuit diagram of a two-wire multiple slave configuration

f) Circuit arrangements in four-wire configuration (one slave station)

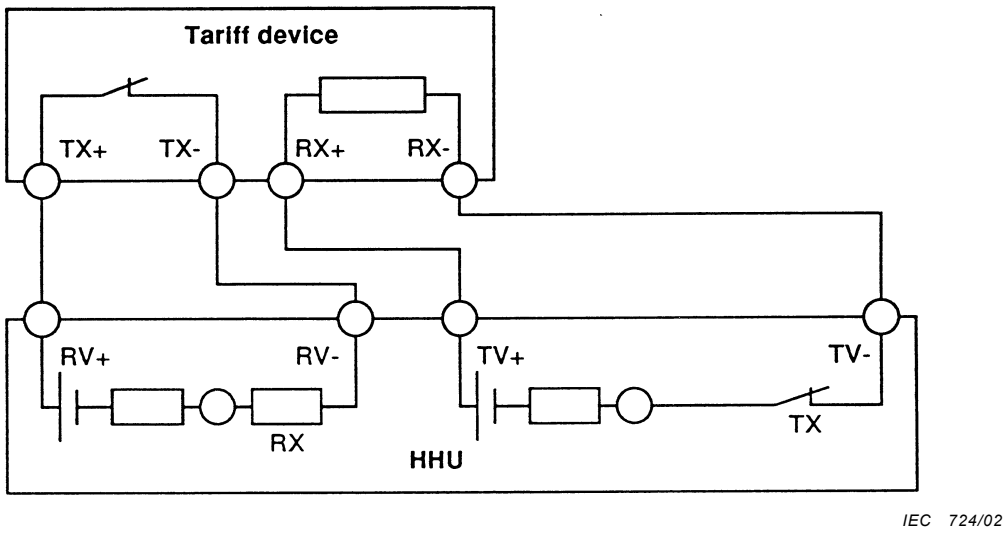


Figure 1c – Circuit diagram of a four-wire single slave configuration

g) Circuit arrangements in four-wire configuration (multiple slave stations)

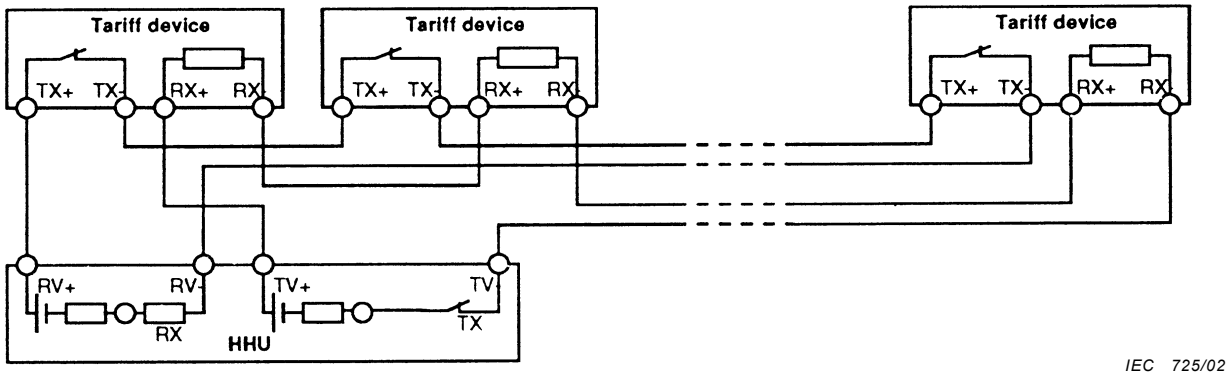


Figure 1d – Circuit diagram of a four-wire multiple slave configuration

Figure 1 – Circuit diagrams

If a nominal voltage of the master station (HHU) of 26 V is assumed, eight slave stations (tariff devices) can be connected in series.

4.2 Electrical interface V.24/V.28

Relevant ITU-T recommendations apply:

ITU-T Recommendation V.24: only circuits No. 102 (Signal ground), 103 (Transmitted data) and 104 (Received data) are used.

ITU-T Recommendation V.28: The electrical characteristics of the interchange circuits shall be according to the ITU-T V.28 Recommendation. These enable signalling rates up to 20 kbit/s.

4.3 Optical interface

4.3.1 Construction of the reading head

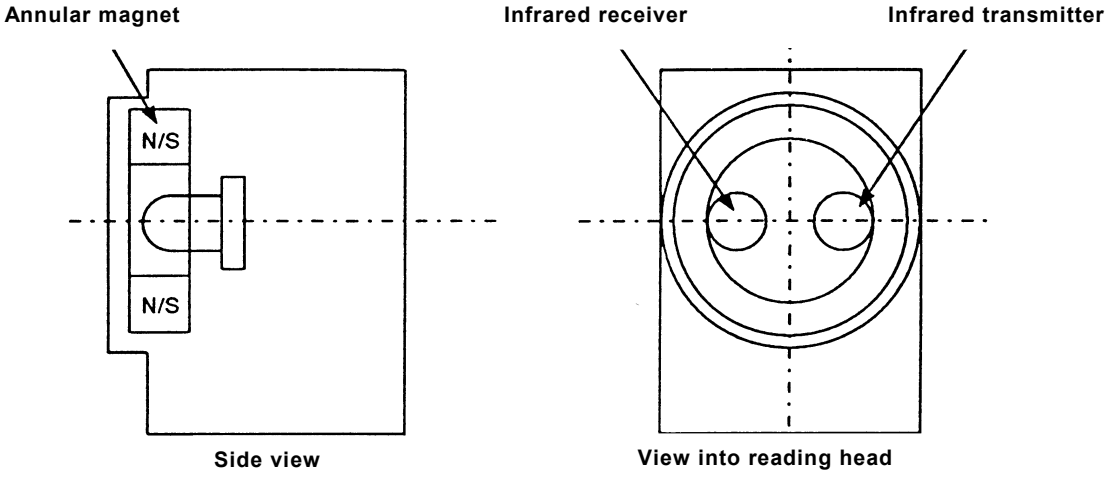


Figure 2a – Arrangement of components

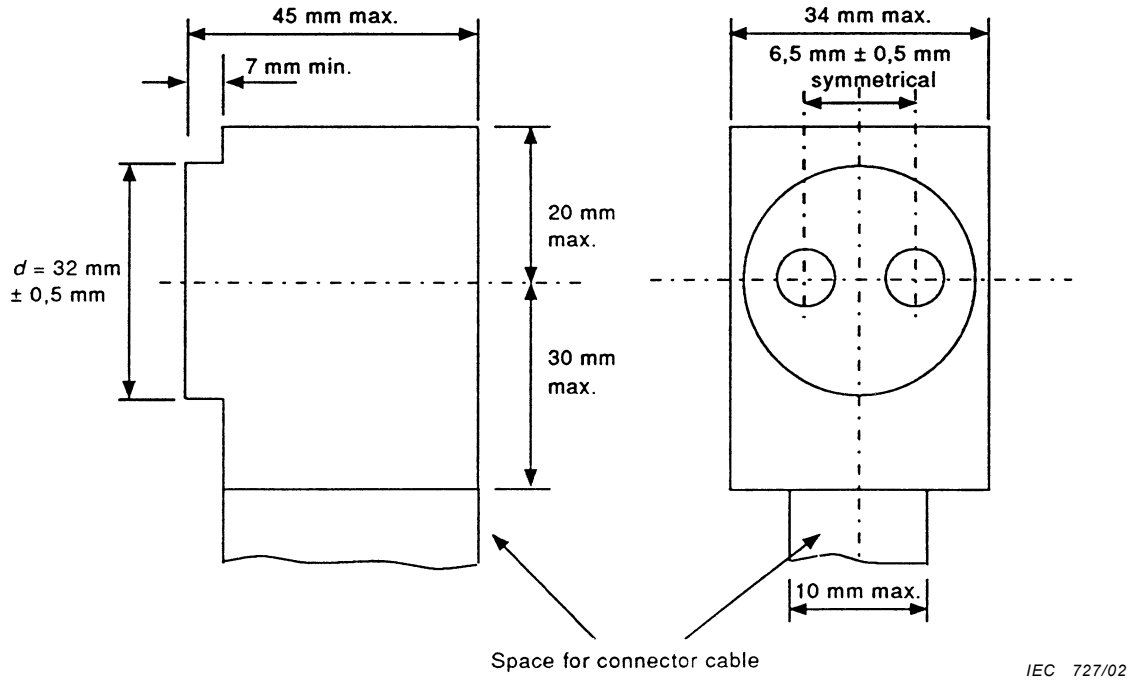


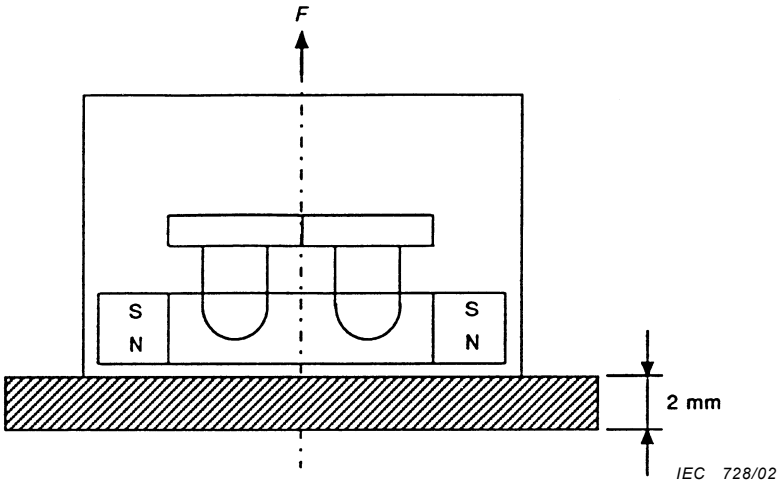
Figure 2b – Dimensions

Figure 2 – Construction of the reading head

4.3.2 Characteristic data of the magnet

Cohesion force

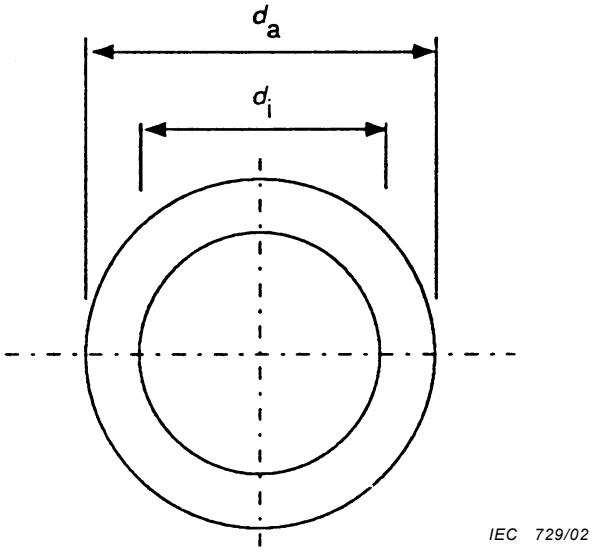
The cohesion force *F* is defined as the perpendicular pulling force measured when the magnet is positioned on a bright 2 mm thick deep-drawing steel plate St 12, minus the weight of the reading head itself.



Cohesion force

F ≥5 N in contact with the steel plate; F > 1.5 N at a distance of 2 mm from the steel plate.

Figure 3a – Cohesion force



Internal diameter d_i = 13 mm ± 1 mm; External diameter d_a = 28 mm minimum

Magnetization: axial, north pole directed towards the tariff device.

Figure 3b – Dimensions

Figure 3 – Characteristic data of the magnet

4.3.3 Arrangement of components in the tariff device

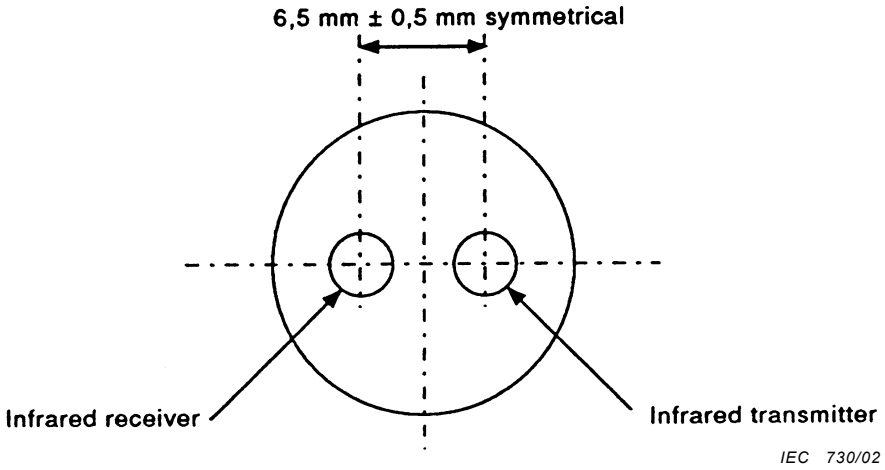


Figure 4 – View into optical port

4.3.4 Alignment

Although no mechanical alignment is specified, optimum data transfer is achieved (under test conditions) when the reading head is in the correct position (cable downwards), the infrared receiver in the tariff device is aligned directly opposite the infrared transmitter in the reading head, and the infrared receiver in the reading head is directly opposite the infrared transmitter in the tariff device.

Slight variations to this position should not affect performance significantly, but for larger variations, degradation of the optical characteristics can occur.

4.3.5 Optical characteristics

4.3.5.1 Wavelength

The wavelength of the radiated signals in both directions is between 800 nm and 1 000 nm (infrared).

4.3.5.2 Transmitter

The transmitter in the tariff device, as well as in the reading head, generates a signal with a radiation strength $E_{e/T}$ over a defined reference surface (optically active area) at a distance of a_1 = 10 mm (±1 mm) from the surface of the tariff device or the reading head.

The following limiting values apply:

ON-condition (ON = SPACE = Binary 0): $500 \leq E_{e/T} \leq 5\,000$ µW/cm²

OFF-condition (OFF = MARK (quiescent state) = Binary 1): $E_{e/T} \leqq 10$ µW/cm²

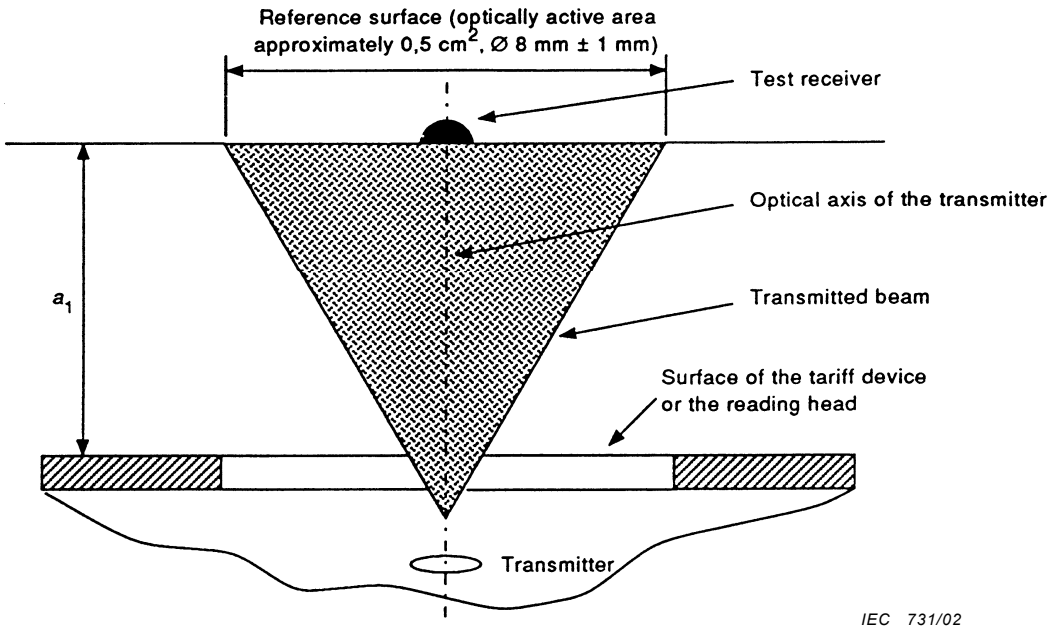


Figure 5 – Test arrangement for the transmitter

4.3.5.3 Receiver

A transmitter which is positioned at a distance a_2 = 10 mm (±1 mm) on the optical axis from the receiver in the tariff device or the reading head generates a signal with a radiation strength $E_{e/R}$ over a defined reference surface (optically active area).

The following limiting values apply:

ON-condition: receiver definitely ON at $E_{e/R} \geq 200$ µW/cm² (ON = SPACE = Binary 0)

OFF-condition: receiver definitely OFF at $E_{e/R} \leq 20$ µW/cm² (OFF = MARK (quiescent state) = Binary 1)

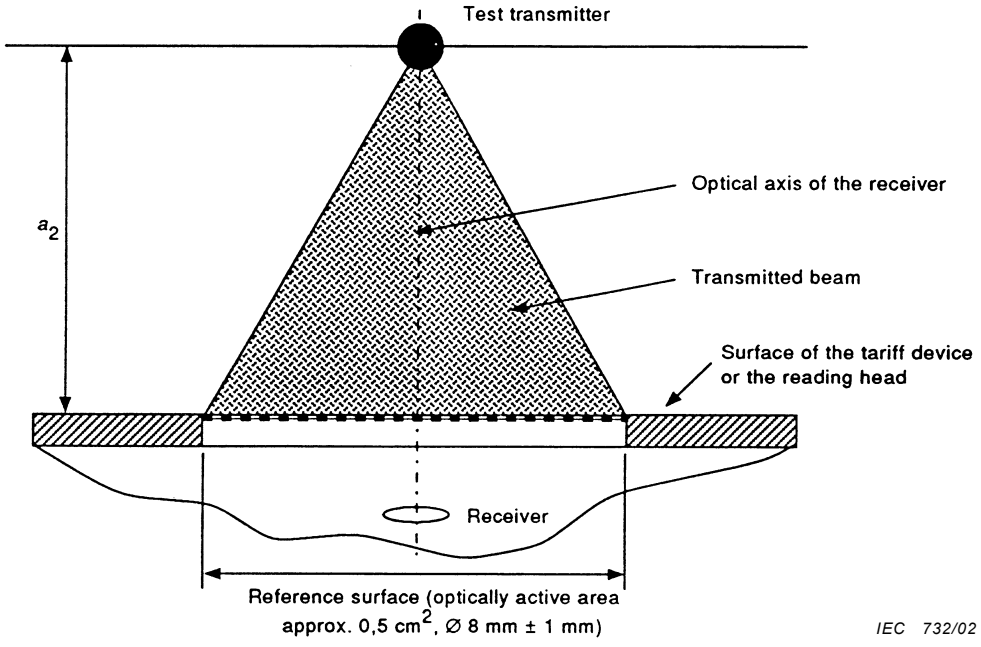


Figure 6 – Test arrangement for the receiver

4.3.5.4 Environmental lighting condition

The optical path (data transmission) shall not be affected by surrounding light with an intensity of up to 16 000 lux (light composition comparable with daylight, including fluorescent light).

4.3.5.5 Environmental temperature condition

The reference temperature is 23 °C ± 2 °C.

5 Character transmission

5.1 Type of transmission

Asynchronous serial bit (Start – Stop) transmission according to ISO/IEC 1177:1985, half-duplex.

5.2 Transmission speed

Initial baud rate – 300

Standard baud rates – 300, 600, 1 200, 2 400, 4 800, 9 600, 19 200

Special baud rate – as desired.

NOTE The maximum speed may be limited by the reading head or the optical port or the ITU-T Recommendation V.28 limitations in the tariff device.

5.3 Signal quality

According to ISO/IEC 7480:1991:

– category 1 for the transmitter;
– category A for the receiver.

5.4 Character format

Character format according to ISO/IEC 1177:1985.

(1 start bit, 7 data bits, 1 parity bit, 1 stop bit).

NOTE Protocol mode E (see 6.4.5) may use byte transparency, 1 start bit, 8 data bits, 1 stop bit (e.g. see Annex E).

5.5 Character code

Character code according to ISO/IEC 646:1991, international reference version. For local use, a national replacement code can be used.

NOTE Protocol mode E (see 6.4.5) may use byte transparency.

5.6 Character security

With parity bit, even parity according to ISO/IEC 1177:1985.

NOTE Protocol mode E (see 6.4.5) may use byte transparency, specific security may be used.

6 Data transmission protocol

6.1 General

The protocol offers five alternative protocol modes, which can be used by the tariff device: A, B, C, D and E. Mode selection is a subset of ISO/IEC 1745, basic mode control procedures.

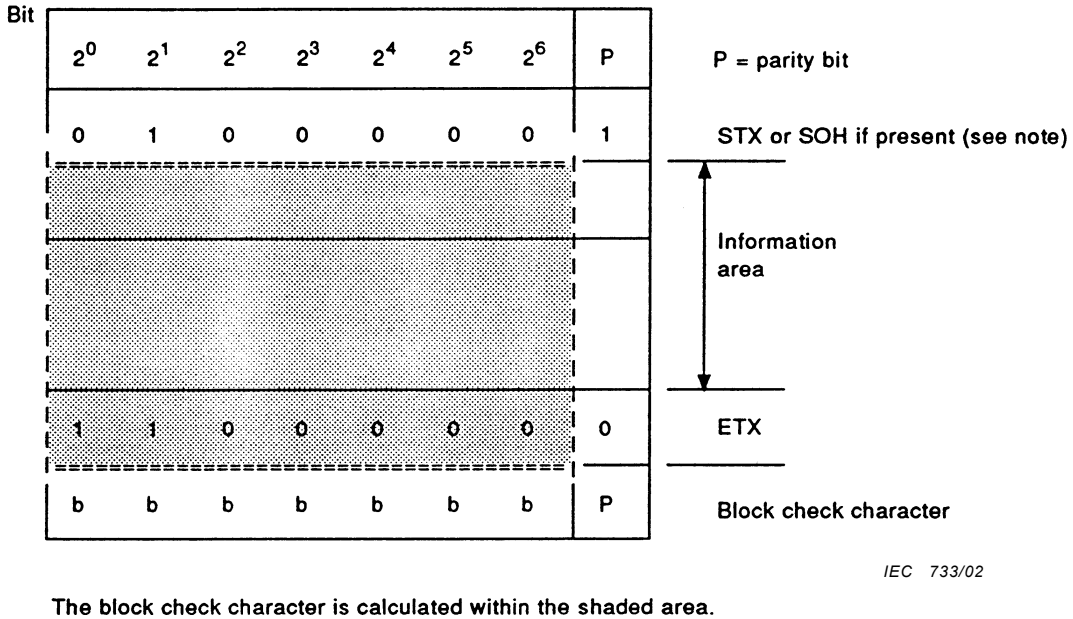
Data exchange is bi-directional in protocol modes A, B, C and E and is always initiated by the HHU with a transmission of a request message. In protocol modes A to C, the HHU acts as a master and the tariff device acts as a slave. In protocol mode E, the HHU acts as a client and the tariff device acts as a server. These protocol modes permit meter reading and programming. Protocol mode E may be a transparent binary mode.

Data exchange is unidirectional in protocol mode D and permits readout only. The information flows from the tariff device to the HHU. Data transmission is initiated, for example by operating a push button or other sensor on the tariff device.

The protocol mode used by the tariff device is indicated to the HHU by the identification message. Protocol modes A to D are identified by the baud rate identification character (see item 13 in 6.3.3) while protocol mode E is identified by an escape sequence (see items 23 and 24 in 6.3.2). Protocol mode E enables to use various protocols, one of them being the METERING HDLC protocol as described in Annex E.

6.2 Calculation of the block check character

The readout of data may be performed without block check character. Whenever used, the block check character shall comply with ISO/IEC 1155:1978.



NOTE The scope of the block check character BCC is as specified in ISO/IEC 1745:1975, and is from the character immediately following the first SOH or STX character detected up to and including the ETX character which terminates the message. The calculated BCC is placed immediately following the ETX.

Figure 7 – Setting up a block check character (example according to ISO/IEC 1155)

6.3 Message definitions

Explanations of message contents see 6.3.14.

6.3.1 Request message

Opening message from the HHU to the tariff device. The device address is optional.

I	?	Device address	!	CR	LF
1)	9)	22)	2)	3)	3)

6.3.2 Identification message

Answer of a tariff device. Fields 23) and 24) are optional, they are part of field 14).

I	X	X	X	Z	\	W	Identification	CR	LF
1)	12)	12)	12)	13)	23)	24)	14)	3)	3)

6.3.3 Acknowledgement/option select message

Negotiation of advanced features (only used in protocol mode C and E).

ACK	V	Z	Y	CR	LF
4)	10)	13)	11)	3)	3)

6.3.4 Data message (except in programming mode)

Normal response of a tariff device, for example the full data set (not used in protocol mode E).

STX	Data block	!	CR	LF	ETX	BCC
5)	15)	2)	3)	3)	6)	8)

6.3.5 Acknowledgement message

If appropriate, see also flow charts in the annexes.

ACK
4)

6.3.6 Repeat-request message

If appropriate, see also flow charts in the annexes.

NAK
16)

6.3.7 Programming command message

Used for programming and block oriented data transfer, see also 6.5.

SOH	C	D	STX	Data set	ETX	BCC
17)	18)	19)	5)	20)	6)	8)

6.3.8 Programming command message using optional partial blocks

Used for long messages, see also 6.5 and flow charts in the annexes (only in protocol mode C).

SOH	C	D	STX	Data set	EOT	BCC
17)	18)	19)	5)	20)	7)	8)

6.3.9 Data message (programming mode)

Used for block oriented data transfer, see also 6.5 and flow charts in the annexes.

STX	Data set	ETX	BCC
5)	20)	6)	8)

6.3.10 Data message (programming mode) using optional partial blocks

Used for long messages of block oriented data transfer, see also 6.5 and flow charts in the annexes (only in protocol mode C).

STX	Data set	EOT	BCC
5)	20)	7)	8)

6.3.11 Error message (programming mode)

Used for block oriented data transfer, see also flow charts in the annexes.

STX	Error message	ETX	BCC
5)	21)	6)	8)

6.3.12 Break message (programming mode)

Used for block oriented data transfer, see also flow charts in the annexes.

SOH	B	0	ETX	BCC
17)	18)	19)	6)	8)

6.3.13 Block message (other protocols)

Block messages are used in conformance with the protocol selected, as specified in "other protocol", see 6.4.5 and Annex E.

6.3.14 Explanations of message contents

1) Start character "/" (forward oblique, code 2FH).
2) End character "!" (exclamation mark, code 21H).
3) Completion character (CR, carriage return, code 0DH; LF, line feed, code 0AH).
4) Acknowledge character (ACK, acknowledge, code 06H).
5) Frame start character (STX, start of text code 02H) indicating where the calculation of BCC shall start from. This character is not required if there is no data set to follow.
6) End character in the block (ETX, end of text, code 03H).
7) End character in a partial block (EOT, end of text block, code 04H).
8) Block check character (BCC), if required, in accordance with the characters 5) and 6). Items 5) and 6) do not apply when the data block is transmitted without check characters.
9) Transmission request command "?" (question mark, code 3FH)
10) Protocol control character (see 6.4.5.2).
11) Mode control character (see 6.4.5.3).
12) Manufacturer's identification comprising three upper case letters except as noted below:

    If a tariff device transmits the third letter in lower case, the minimum reaction time t_r for the device is 20 ms instead of 200 ms. Even though a tariff device transmits an upper case third letter, this does not preclude supporting a 20 ms reaction time.

    These letters shall be registered with the administrator: The FLAG Association (see the foreword).

13) Baud rate identification (for baud rate changeover)

    The request message, the identification message and the acknowledgement/option select message are transmitted at the initial rate of 300 Bd (except protocol mode D). The baud rate of the data message depends on the baud rate determined by the protocol.

    a) Protocol mode A (without baud rate changeover)

       Any desired printable characters except "/", "!" and as long as they are not specified for protocol mode B or protocol mode C.

    b) Protocol mode B (with baud rate changeover, without acknowledgement/option select message)

       A - 600 Bd

       B - 1 200 Bd

       C - 2 400 Bd

       D - 4 800 Bd

       E - 9 600 Bd

       F - 19 200 Bd

       G, H, I - reserved for later extensions.

    c) Protocol mode C and protocol mode E (with baud rate changeover, with acknowledgement / option select message or other protocols)

       0 - 300 Bd

       1 - 600 Bd

       2 - 1 200 Bd

       3 - 2 400 Bd

4 - 4 800 Bd
5 - 9 600 Bd
6 - 19 200 Bd
7, 8, 9 - reserved for later extensions.

d) Protocol mode D (data transmission at 2 400 Bd)
Baud rate character is always 3.

14) Identification, manufacturer-specific, 16 printable characters maximum except for "/" and "!". "\" is only allowed as an escape character, see 23) and 24).

15) Data block with the measured values (see syntax diagram for normal reading). All printable characters may be used in the data block, as well as line feed and carriage return, except for "/" and "!".

16) Repeat request character (NAK, negative acknowledge, code 15H).

17) Start-of-header character (SOH, start-of-header, code 01H).

18) Command message identifier

P - Password command
W - Write command
R - Read command
E - Execute command
B - Exit command (break)

Other characters are reserved for future use.

19) Command type identifier (signifies the variant of the command)

Values:

a) for password P command

0 - data is operand for secure algorithm
1 - data is operand for comparison with internally held password
2 - data is result of secure algorithm (manufacturer-specific)
3-9 - reserved for future use.

b) for write W command

0 - reserved for future use
1 - write ASCII-coded data
2 - formatted communication coding method write (optional, see Annex C)
3 - write ASCII-coded with partial block (optional)
4 - formatted communication coding method write (optional, see Annex C) with partial block
5 - reserved for national use
6-9 - reserved for future use.

c) for read R command

0 - reserved for future use
1 - read ASCII-coded data
2 - formatted communication coding method read (optional, see Annex C)
3 - read ASCII-coded with partial block (optional)
4 - formatted communication coding method read (optional, see Annex C) with partial block
5,6 - reserved for national use
7-9 - reserved for future use.