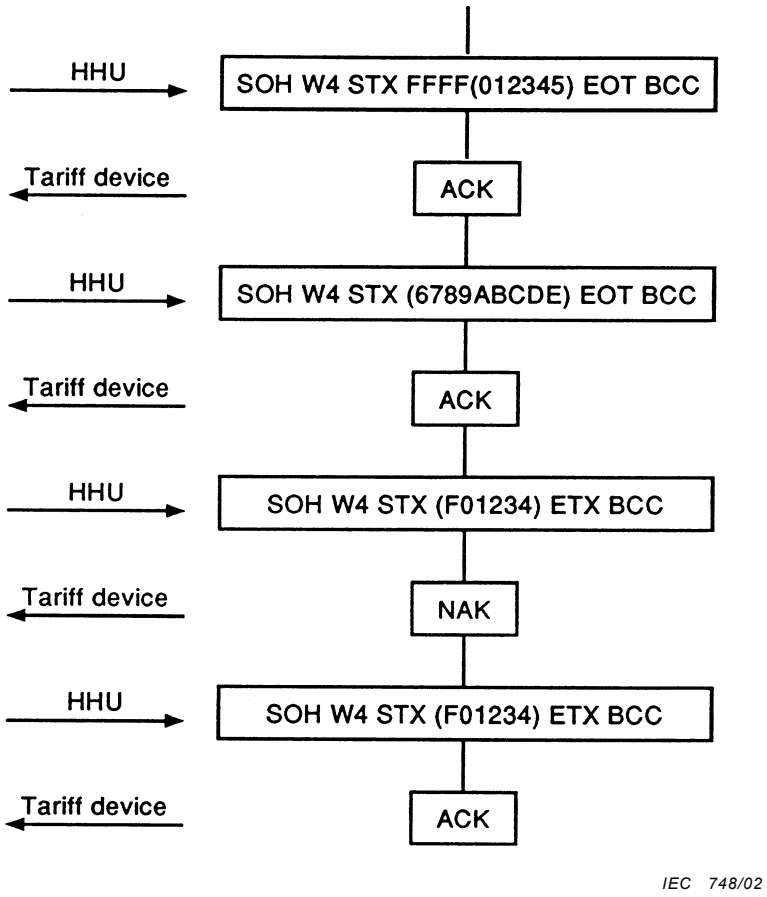



**Figure 22 – Example of a partial block formatted write**

Example of a partial block formatted write. In this case, the HHU is creating partial block data messages of variable length. The third data message had to be repeated. Note that the formatted code (in this example FFFF) is sent from the HHU only once. This is used to indicate the first block and is therefore not repeated in the subsequent blocks.

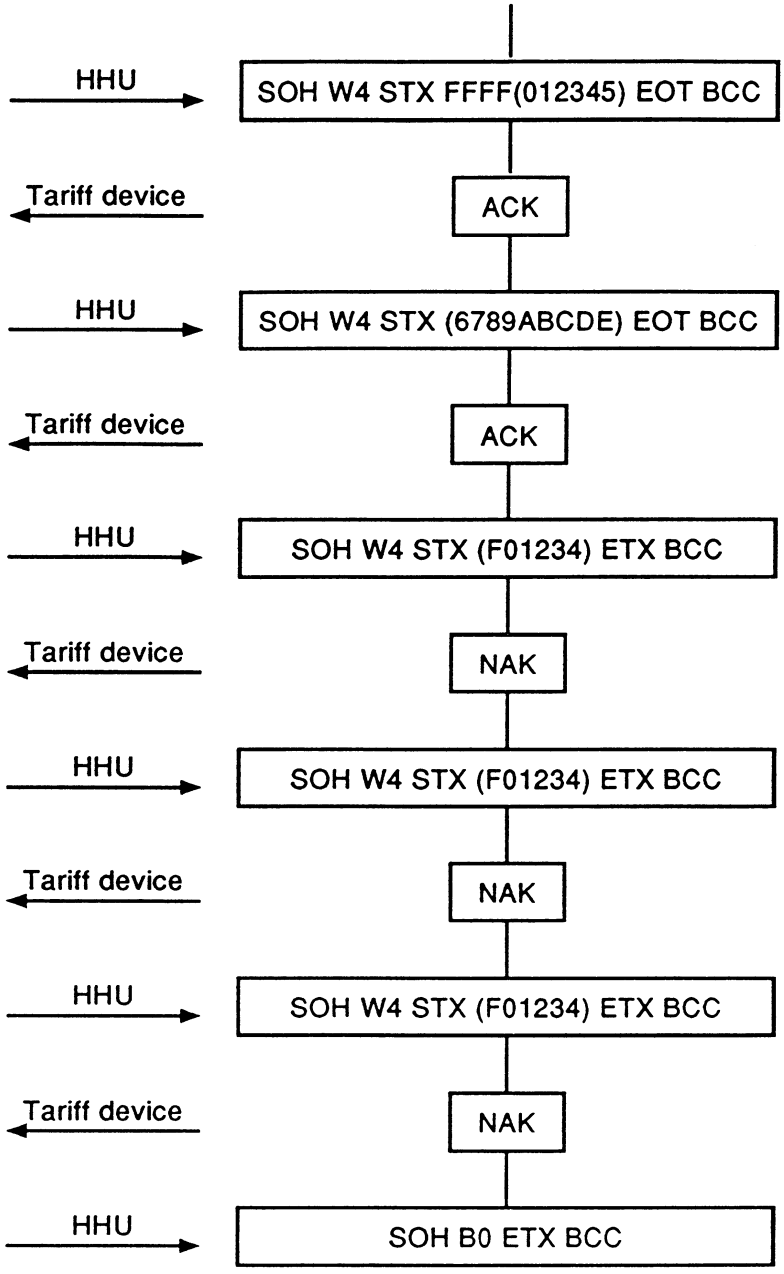



**Figure 23 – Example of a partial block formatted write (with errors)**

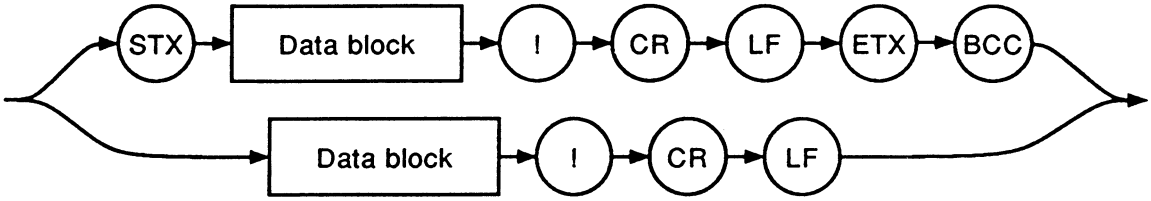
Example of a partial block formatted write with repeated communication errors. In this example, after three retries, the HHU decided to abort the communication.

### 6.5 Syntax diagrams

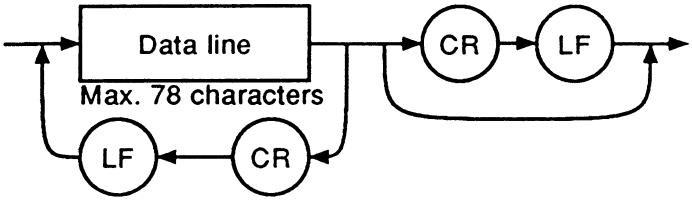
The following syntax diagrams provide help in order to interpret the definitions of the preceding subclauses relating to protocol modes A, B, C and D.

### 6.5.1 Readout mode

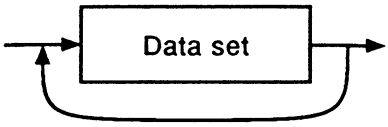
Data message:




Data block:




Data line:




Data set:

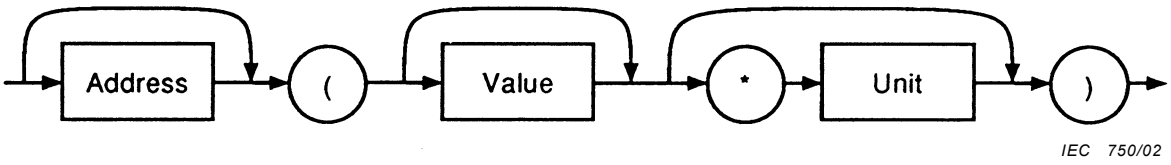



**Figure 24 – Syntax diagrams – readout mode**

A data block consists of a sequence of data lines separated by the characters CR, carriage return, code ASCII 0DH and LF, line feed, code 0AH. A data line consists of one or more data sets. A data set contains, in general, an identification number or address, the value, the unit and various boundary characters. A data line should be not longer than 78 characters* including all boundary, separating and control characters. The sequence of the data sets or data lines is not fixed.

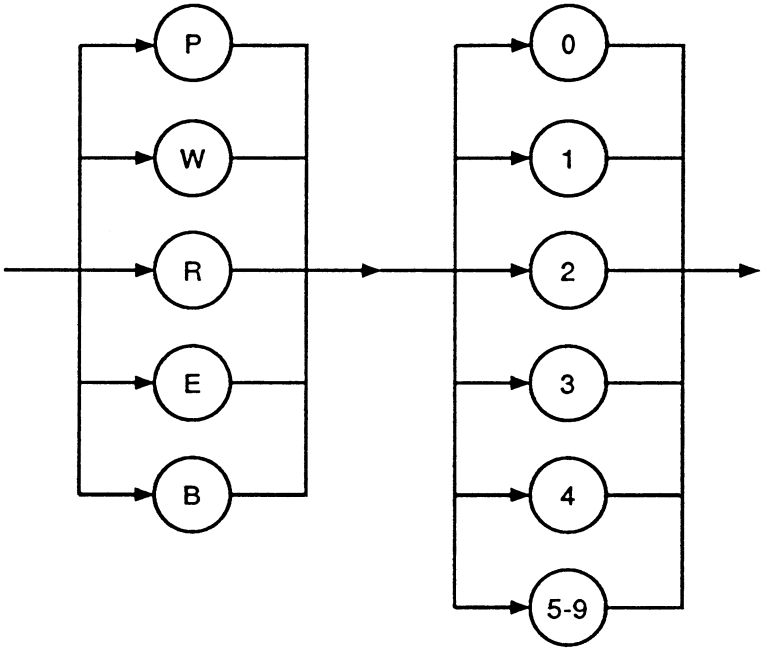
NOTE * For mode D, the data lines need not be separated by CR LF characters. In this case, security check information can be embedded as the last character(s) in the data block.

### 6.5.2 Programming mode

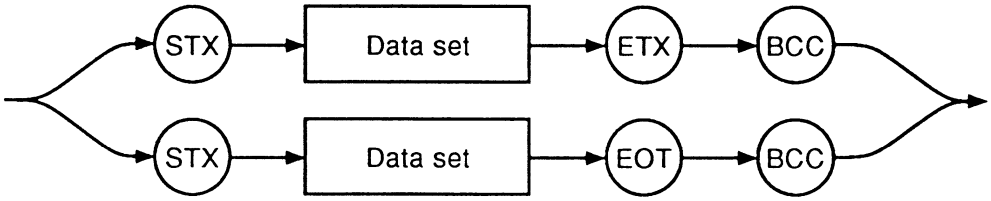
COMMAND

Command message:


Command identifier:




Data message:




Data set:

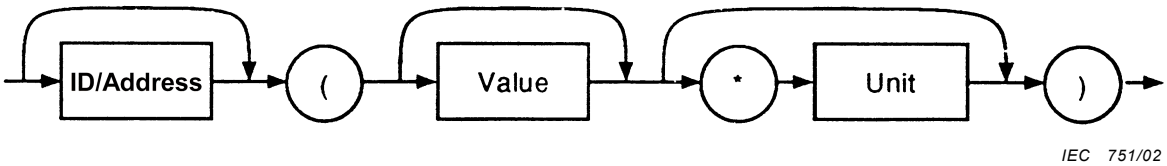
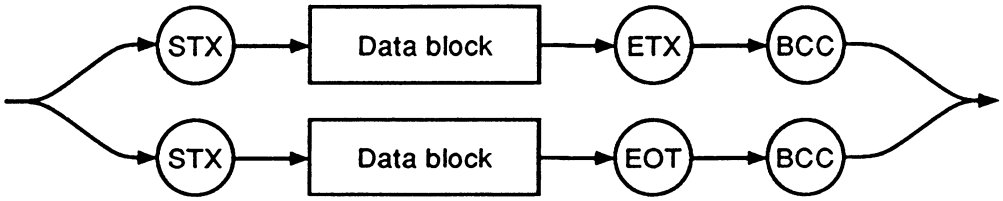


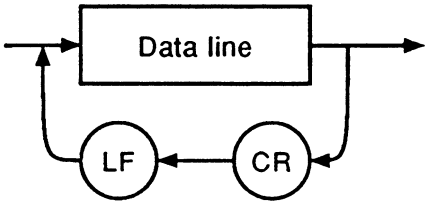

**Figure 25 – Syntax diagrams – programming mode – command**

ANSWER

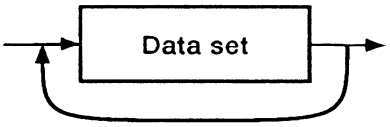
Data message:




Data block:




Data line:




Data set:

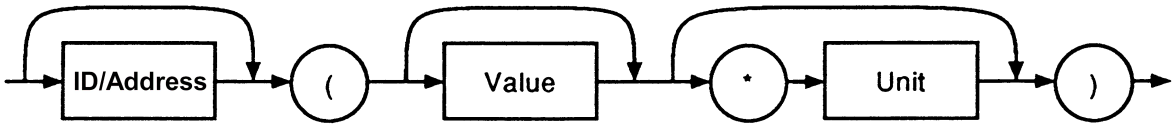



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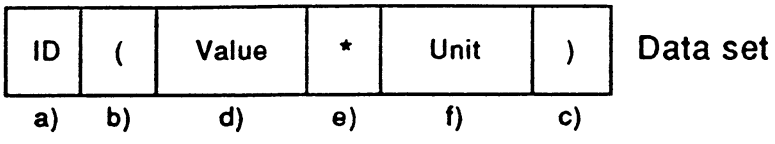
**Figure 26 – Syntax diagram – programming mode – answer**

## 6.6 Data set structure




IEC 753/02

**Figure 27 – Data set structure**

a) Identification number or address: 16 printable characters maximum with the exception of (, ), /, and !. The identification string is the code given to the value and is taken from the identification code in the glossary system of the equipment concerned.

b) Front boundary character of the data information (.

c) Rear boundary character of the data information ).

d) Value: 32 printable characters maximum with the exception of (, ), *, / and !. For decimal values, only points (not commas) shall be used and shall be counted as characters.

e) The separator character "*" between value and unit is not needed if there are no units.

f) Unit: 16 printable characters maximum except for (, ), / and !.

NOTE 1 Remarks regarding items a), e) and f): to reduce the quantity of data, the identification code a) and/or the unit information e) and f) can be dispensed with, provided that an unambiguous correlation exists. For example, the identification code or the unit information is not necessary for a sequence of similar values (sequence of historical values) on condition that the evaluation unit can clearly establish the identification code and unit of the succeeding values from the first value of a sequence.

NOTE 2 Remarks regarding programming mode, protocol mode C: item a), the identification number may be used as an address; item d), the value portion may contain up to 128 characters.

# Annex A
(normative)

## Flow chart for direct local data exchange protocol, protocol mode C

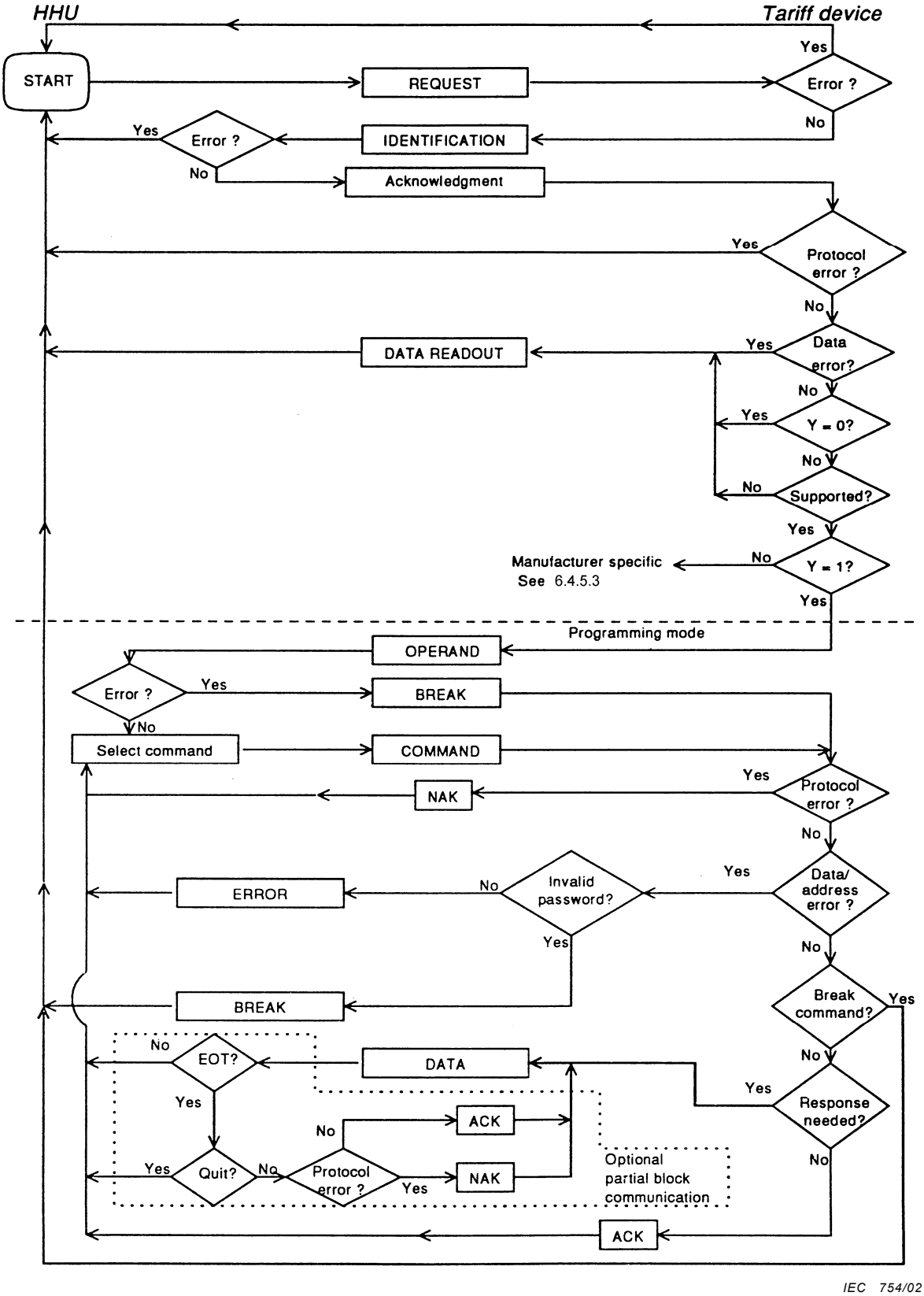



**Figure A.1 – Flow chart for direct local data exchange protocol, protocol mode C**

Key to protocol mode C flow diagram

Message formats

For a complete message format definition, see 6.3.

| | |
|---|---|
| REQUEST | / ? Device Address ! CR LF |
| IDENTIFICATION | / XXX Z Ident CR LF |
| ACKNOWLEDGEMENT | ACK 0 Z Y CR LF |
| DATA READOUT | STX DATA ! CR LF ETX BCC |
| OPERAND | SOH P 0 STX (d . . . d) ETX BCC |
| | SOH P 0 STX (d . . . d) EOT BCC |
| COMMAND | SOH C D STX a . . a (d . . . d) ETX BCC |
| | optionally: SOH C D STX a . . a (d . . . d) EOT BCC |
| DATA | STX (d . . d) ETX BCC |
| | optionally: STX (d . . d) EOT BCC |
| ERROR | STX (e . . e) ETX BCC |
| BREAK | SOH B 0 ETX BCC |

NOTE 1 The inactivity time-out period for the tariff device is 60 s to 120 s after which the operation moves from any point to the start.

NOTE 2 A break message can be issued at any point. Operation then moves to the start after finishing the current operation.

NOTE 3 ACK and NAK are used for error diagnosis at the command protocol level, with the following definition:

ACK is returned from a tariff device, if the command meets protocol requirements, and a successful operation is performed within the tariff device (e.g. memory write).

NAK is returned from a tariff device, if the command does not meet protocol requirements.

If the command meets protocol requirements but is not executed due to tariff device functionality (e.g. memory write protect, illegal command, etc.) an error message is returned.

ACK and NAK are also used as "continue" and "repeat last partial block" commands issued by the receiving device when in partial block mode (command type = 3 or 4).

NOTE 4 All other error diagnosis is done by time-out, i.e. if the tariff device does not respond within 1 500 ms of a command, there has been an error and the HHU should take appropriate action.

NOTE 5 A protocol error occurs when a parity, or the BCC, or the message syntax is incorrect.

NOTE 6 An address/data error occurs when the received address or command is unknown or the data set structure or content is incorrect. In this case, the command cannot be carried out.

NOTE 7 An error refers to any type of error (protocol, address/data, etc.).

NOTE 8 The diagram does not explicitly indicate the partial block write method. See 6.4.7 for further details.

# Annex B
(normative)

# Wake-up methods for battery-operated tariff devices

## B.1 Provision for battery-operated tariff devices

In order to make the optical interface work with battery-operated tariff devices, it is necessary to send a preliminary wake-up message from the HHU to the tariff device.

The wake-up message is a string of NUL characters (code 00H) during 2,1 s to 2,3 s.

Between two NUL characters of this message a maximum delay time of 5 ms is allowed.

After the last character of the wake-up message, the HHU shall wait 1,5 s to 1,7 s until the request message can be sent.

Transmission speed for the start procedure is 300 Bd. Then the data communication can continue in mode A, B, C, or E.

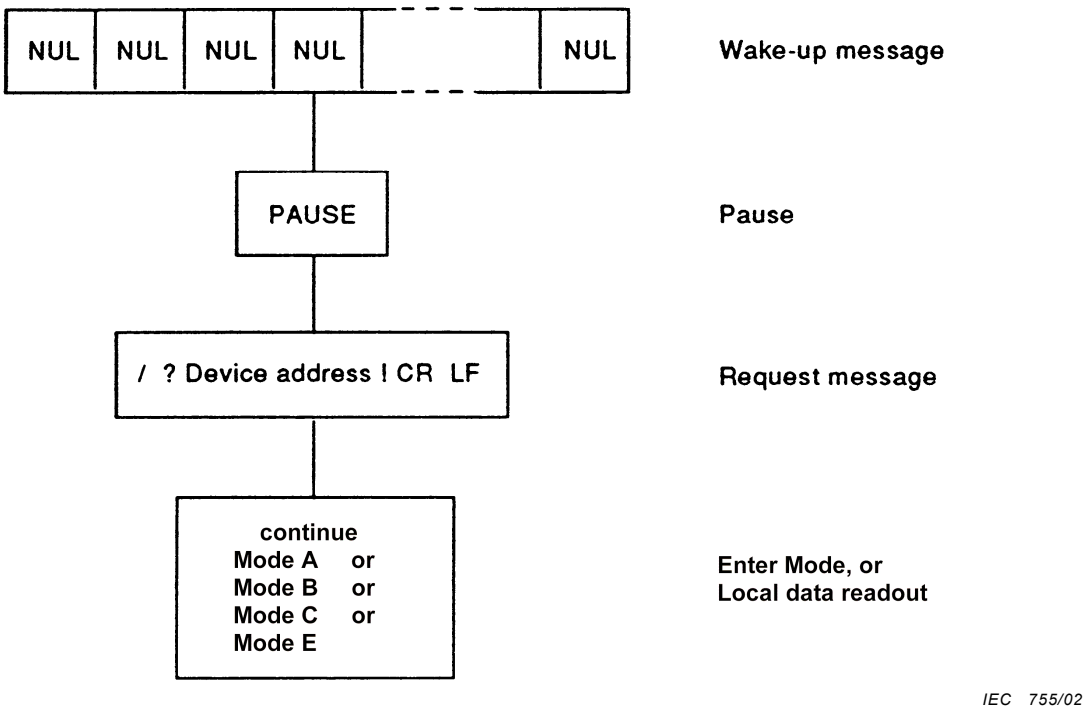



**Figure B.1 – The start sequence for battery-operated devices**

*End of transmission*

A data transmission is complete after the data message has been transmitted by the tariff device. An acknowledge signal is not provided for.

If the transmission was faulty the HHU shall wait at least 1,5 s until a repeat wake-up message can be sent.

## B.2 Provision for battery-operated tariff devices fast wake-up method

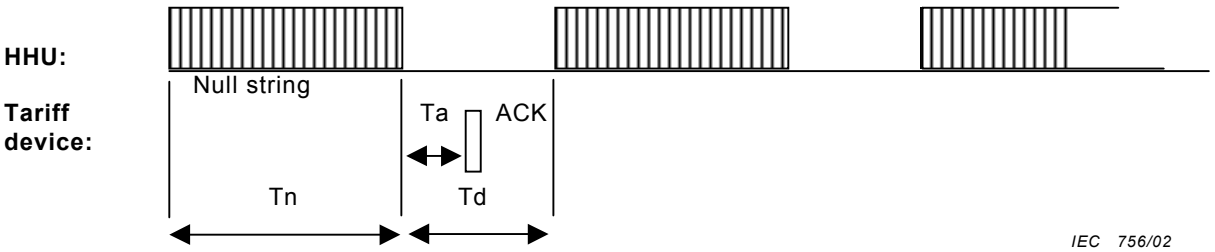
In order to make the optical interface work with battery-operated tariff devices, it is necessary to send a preliminary wake-up message from the HHU to the tariff device.

The fast wake-up message is a string of NUL characters (code 00H), an intermittent null string comprising 0,5 s of null characters, followed by a wait period of two characters + 20 ms. During a wait period, if the tariff device detects null activity and is ready to proceed with a sign-on protocol, the tariff device responds with an ACK character at the baudrate of the detected null string.

After transmission of the ACK character, the tariff device shall be ready to receive an ident request within 200 ms, at the baudrate of the detected null string. When the HHU receives an ACK character, it will terminate transmission of null strings and transmit an ident request message 200..1500 ms after the ACK receipt.

A recommended minimum time of 4,5 s is made for the HHU to transmit the intermittent null string wakeup.

The baudrate of the wake-up can be at any valid baudrate specified in 5.2. Then the data can continue in protocol mode A, B, C or E.




| Parameter | Time |
|---|---|
| Tn min | 500 ms |
| Tn max | 600 ms |
| Td min | 20 ms + two characters |
| Td max | Td min + 20 ms |
| Ta min | 10 ms |

**Figure B.2 – Diagram for the start sequence of battery-operated devices by fast wake-up mode**

*End of transmission*

The data transmission is complete after the data message has been transmitted by the tariff device. An acknowledge signal is provided for by the SOH B1 ETX BCC which requires the tariff device to transmit an ACK before the tariff device terminates the communication session. This provides feedback to the HHU that the tariff device has accepted and will execute the sign-off command.

If the transmission was faulty, the HHU shall wait at least 1,5 s until a repeat wake-up message can be sent.

# Annex C
(informative)

# Formatted codes

## C.1 General

This annex defines a data protocol for accessing metering devices within the framework of this standard (protocol mode E is excluded). The protocol is designed to allow access to all information within a given metering device. The protocol can be viewed on two levels. The first level defines a data structure that can be applied to various metering applications. This requires the decomposition of data into items such as channels, data types, registers and tariffs. The second level defines the content of these categories, that is the unit of measurement recorded in register 0; whether it is kilowatt-hours or cubic meters of water. Eight different data categories have been defined in which to organise metering data. These are: Register, Seasonal, Load profile, Group, Variable, Parameter, Extended function and Manufacturer-specific. An additional category has been reserved for future applications.

Reading and writing are supported using the R2/R4 and W2/W4 commands in programming mode in the form of programming command messages. Additionally, execute commands, such as trigger a seasonal cumulation, are supported using the E2 programming command messages. All formatted commands have the syntax of command messages. In order to simplify processing within the metering unit, the coding method uses a four digit hex code, an associated mnemonic, and a data field. Within the command message, the code field corresponds to the data set "address field", and the data field corresponds to the data set "value field". The mnemonic is a general purpose one, in that it does not refer to any particular application, electrical metering, gas metering, etc. A set of mnemonics could be generated for a specific application for clarity as the need arises. The data field follows the syntax for data set structure. Some codes require a predefined data field format. These are listed explicitly. The last section defines how the coding scheme is applied to electricity metering applications. In the rest of this annex, reference will only be made to R2 and W2, although in most cases an R4 or W4 command could be used.

## C.2 Channels

Channels play a specific part in coding. They are the link between the first and second levels of coding. This is accomplished by defining channel types, of which there can be a limitless number. A type is assigned to each channel used in a metering unit, be it water, gas, heat or electricity. This depends on the data being stored within that channel. When assigning channels within a metering unit, the designation may or may not refer to physical channels. In the case of a metering unit that registers the electrical energy, water and gas usage at a particular installation, the channel designation could logically be applied to each item resulting in three channels. But in a single electricity meter, where the device may measure various kinds of information, such as kWh, kW and kVA, the data may all be accessed as one logical channel, even though the information is delivered to the metering device on different physical channels. The channel type only plays a role in the following data categories: Register, Season, Load profile and Group. The other data categories, Extended function, Variable, Parameter, and Manufacturer-specific, do not require the channel to be specified, and are therefore not defined by the channel type, but are available independent of channel type. The following diagram is an example of the use of channel types.

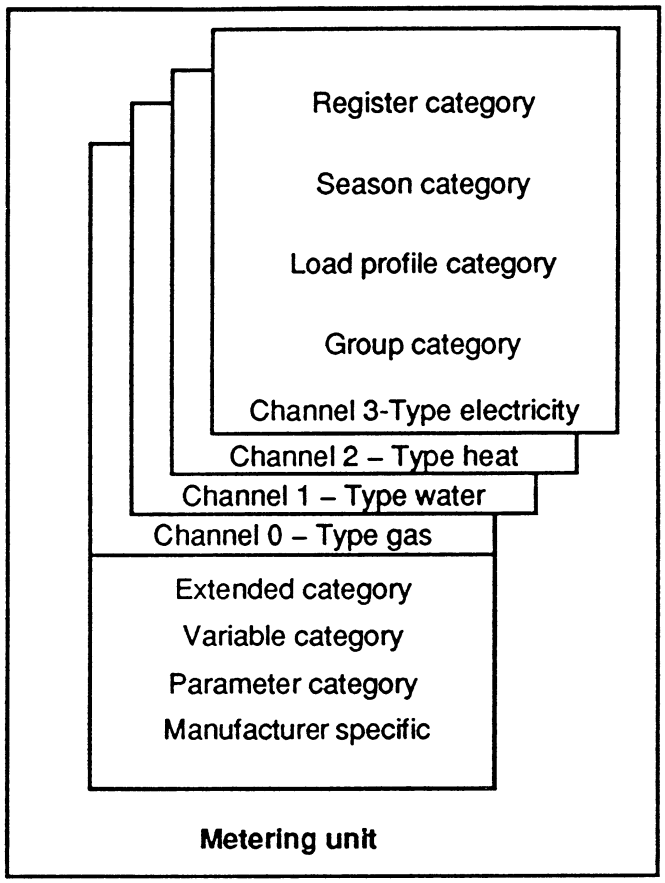



**Figure C.1 – Example of channel types**

Here, channels 0, 1, 2, and 3 are being used to collect information on gas, water, heat and electricity usage respectively. This does not mean that channel 3 is always electricity or that channel 1 is always water; the channel assignment is arbitrary. What is important is to know the channel type present on each channel.

Channel types allow for future expansion in the case where a new type of metering is desired, or when a particular type has no more free registers to define, and a new type of measurement is desired. This could occur when a new type of electrical measurement is desired, but all the registers for an available channel type have already been defined. It is also feasible that when a new channel type is defined, the whole register/tariff structure could also be redefined to better describe the application.

Instead of trying to include the channel type information in the identification message, a set of commands is supported in the parameter category that allows the user to question the meter as to which type is to be found on which channel.

## C.3 Formatted reading and writing (commands R2, R4, W2, and W4)

For the R2 and W2 commands, the various codes can normally be used for formatted reading or writing. When used for reading, the data field in the read command shall be left blank except where noted. In this case, the parentheses, (), shall remain to retain protocol integrity. Returned information is in the form of data messages. Although preferred, the metering device is not required to send decimal point or unit information within the returned data set. If the information is not included in the returned data set, then provision shall be made so that this information can be accessed using other device independent commands.