BSI Standards Publication

Tanks for transport of dangerous goods — Digital interface for the data transfer between tank vehicle and with stationary facilities

Part 1: Protocol specification — Control, measurement and event data

bsi.

National foreword

This British Standard is the UK implementation of EN 15969-1:2015. It supersedes BS EN 15969-1:2011 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee AUE/18, Tanks for the transport of dangerous goods.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Date	Text affected

EUROPEAN STANDARD

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EN 15969-1

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English Version

Tanks for transport of dangerous goods - Digital interface for the data transfer between tank vehicle and with stationary facilities - Part 1: Protocol specification - Control, measurement and event data

Citernes destinées au transport de matières dangereuses - Interface numérique pour le transfert de données entre des véhicules-citernes et des installations fixes - Partie 1: Spécifications du protocole - Contrôle, données de mesure et d'événements

Tanks für die Beförderung gefährlicher Güter - Digitale Schnittstelle für den Datenaustausch zwischen Tankfahrzeugen und stationären Einrichtungen - Teil 1: Protokollspezifikation - Steuerungs-, Mess- und Ereignisdaten

This European Standard was approved by CEN on 6 June 2015.

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COMITÉ EUROPÉEN DE NORMALISATION
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Contents

European foreword

This document (EN 15969-1:2015) has been prepared by Technical Committee CEN/TC 296 "Tanks for transport of dangerous goods", 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of an identical text or by endorsement, at the latest by January 2016 and conflicting national standards shall be withdrawn at the latest by January 2016.

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 15969-1:2011.

In comparison with EN 15969-1:2011, the following fundamental changes have been made:

— the following fields in Table 13 added: L0403, L2004, L4106 and L4208;

— Table 13 in field L2002 event codes added and in field L4203 access paths added;

— figures in 5.2 corrected;

— examples in 10.2 and Annex B corrected.

EN 15969, *Tanks for transport of dangerous goods — Digital interface for the data transfer between tank vehicle and with stationary facilities* consists of the following parts:

— *Part 1: Protocol Specification — Control, measurement and event data*

— *Part 2: Commercial and logistic data*

This European Standard forms part of a coherent standards programme comprising the following standards:

— EN 13616, *Overfill prevention devices for static tanks for liquid petroleum fuels*

— EN 13922, *Tanks for transport of dangerous goods — Service equipment for tanks — Overfill prevention systems for liquid fuels*

— EN 14116:2012+A1:2014, *Tanks for transport of dangerous goods — Digital interface for the product recognition device for liquid fuels*

— EN 15207, *Tanks for the transport of dangerous goods — Plug/socket connection and supply characteristics for service equipment in hazardous areas with 24 V nominal supply voltage*

— EN 15208, *Tanks for transport of dangerous goods — Sealed parcel delivery systems — Working principles and interface specifications*

— EN 15969-2, *Tanks for transport of dangerous goods — Digital interface for the data transfer between tank vehicle and with stationary facilities — Part 2: Commercial and logistic data*

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.

Introduction

FTL is an acronym for **F**uel **T**ruck **L**ink, the interface between electronic system(s) on board of a tank vehicle (tank-vehicle-equipment) and any external computer, e.g. an on-board-computer installed in the driver's cabin; for illustration see Figure 1.

Key
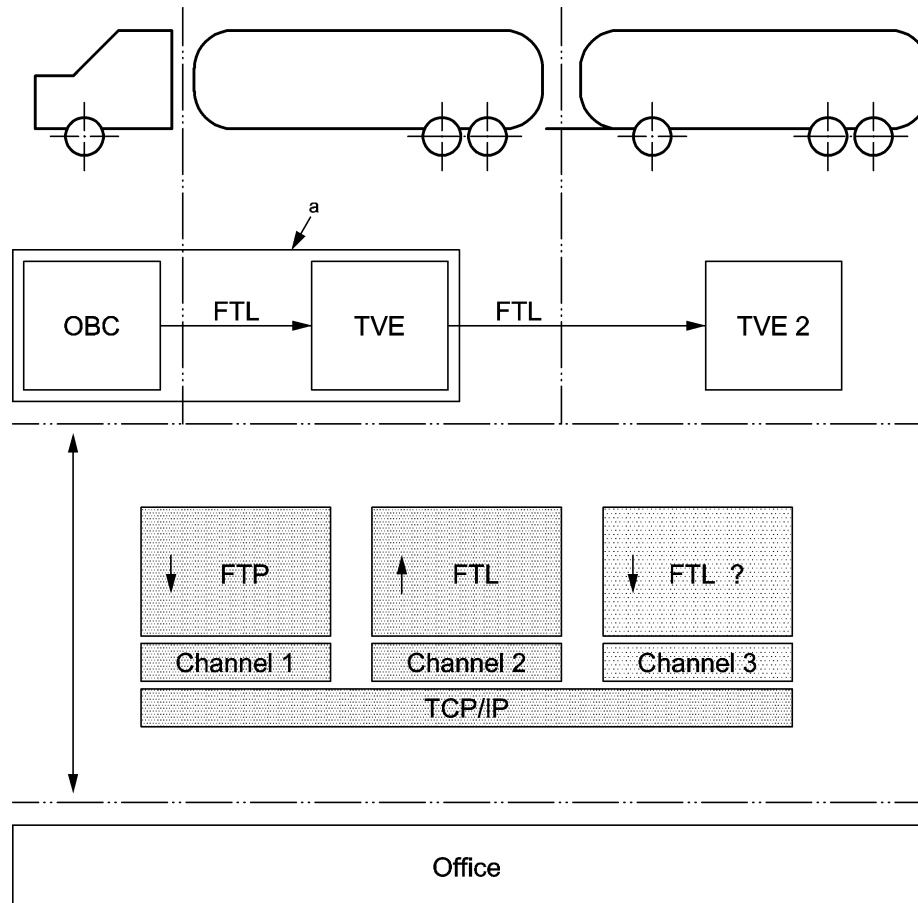
→   direction of communication (client → server)

a   may be either two independent units or one single unit which incorporates both functions OBC and TVE

Figure 1

1 Scope

This European Standard specifies data protocols and data format for the interfaces between electronic equipment (TVE), on-board computer (OBC) of the tank vehicle and stationary equipment for all interconnecting communication paths.

This European Standard specifies the basic protocol FTL used in the communication (basic protocol layer), the format and structure of FTL-data to be transmitted (data protocol layer) and describes the content of the FTL-data.

This data protocol may be used for other application, e.g. between stationary tank equipment and offices.

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 13616, *Overfill prevention devices for static tanks for liquid petroleum fuels*

EN 13922, *Tanks for transport of dangerous goods — Service equipment for tanks — Overfill prevention systems for liquid fuels*

EN 14116:2012+A1:2014, *Tanks for transport of dangerous goods — Digital interface for product recognition devices for liquid fuels*

EN 15208:2014, *Tanks for transport of dangerous goods — Sealed parcel delivery systems — Working principles and interface specifications*

EN 15969-2:2011, *Tanks for transport of dangerous goods — Digital interface for the data transfer between tank vehicle and with stationary facilities — Part 2: Commercial and logistic data*

ISO 639-1, *Codes for the representation of names of languages — Part 1: Alpha-2 code*

ISO/IEC 10646:2014, *Information technology — Universal Coded Character Set (UCS)*

DIN 51757:2011, *Testing of mineral oils and related materials — Determination of density*

3 Terms and definitions, abbreviations and conventions

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

3.1 Abbreviations

ACK	acknowledge controlframe
ADF	additional dataframe
ASCII	American Standard Code for Information Interchange
CAN	cancel controlframe
CRC	cyclic redundancy checksum
CSV	comma separated variable record
COP	crossover prevention

EOR	end of record dataframe
EOT	end of transmission dataframe
FTL	fuel-truck-link name of the interface
FTP	file transfer protocol
L_FILE	log file
LH_FILE	log file header
NAK	not acknowledge controlframe
OBC	on-board-computer

NOTE   One party in the FTL-communication (the client).

PID	product identification device according to EN 14116
SYN	synchronisation controlframe
SPDS	sealed parcel delivery system according to EN 15208
TEF	CRC transmission error controlframe
TVE	tank-vehicle-equipment

NOTE   One party in the FTL-communication (the server).

OpCode	operation code

3.2   Terms and definitions

3.2.1
downgrade
intentional loading and discharge of a higher grade product (substance) into a lower grade product of the same group

3.2.2
answer time
time between last frame character transmitted from OBC (client) and first character frame received from TVE (server)

3.2.3
array
collection of elements which have the same structure and are able to be accessed individually by means of an index

3.2.4
client
responsible for initiation and control of data exchange

3.2.5
field
element of a datagram delimited by separators

3.2.6
frame
data packet with variable length and defined structure

3.2.7
list
type of variables consisting of a number of records

3.2.8
MaxFrameSize
maximum number of characters in a frame

3.2.9
node
part of an address of a variable

3.2.10
graphic character
according to Annex D of ISO/IEC 10646:2014

3.2.11
record
ordered set of fields, stored contiguously

3.2.12
server
program which provides service to client programs

3.2.13
subnode
subpart of an address of a variable

3.2.14
datagram
instruction or answer to an instruction, which comprises an OpCode and operand

3.2.15
transaction
complete request-answer-cycle

3.2.16
type identifier
character code for the frame type

3.3   Conventions

3.3.1   Syntax conventions

When describing the syntax of, e.g. a datagram, some parts are required.

Every abstract part shall get a name, which is encapsulated by "<" and ">". Optional arguments are additionally encapsulated in square brackets.

EXAMPLE   <field>[,<value>]

<field> has always to be given (required). <value> is optional, but when given, it shall be preceded by a comma.

3.3.2   Presentation of communication exchange

In this document several examples can be found, demonstrating the flow of communication.

To illustrate the direction, data sent by the TVE (server) is shown indented.

EXAMPLE

    client request 1

        server response 1
        server response 2
        server response 3

    client request 2

This means, that the command "client request n" shall be transmitted by the OBC, whereas the lines "server response n" were transmitted by the TVE.

3.3.3 Numbers

Numbers may either be coded in decimal format (e.g. 12) or in hexadecimal format (e.g. 1Bh). In the latter case, the number shall followed by the character "h".

4 Hardware interface

Communication shall only take place between two parties (point-to-point) the TVE and OBC.

For communication an asynchronous line shall be used (RS232, RS422 or RS485). The OBC and TVE start up and default settings shall be 9600 baud, 8 data bits, 1 stop bit and no parity.

The TVE may optionally support other baud rates (switching and switching back see 7.3.6).

5 Basic protocol layer

5.1 FTL-frame (frame)

The FTL-frame shall be according to Figure 2.

Frame (7 to MaxFrameSize character)

Start-Flag	Type	Content (optional)	End-Flag	Checksum
1 char	1 char	0 to MaxFrameSize - 7 char	1 char	4 char
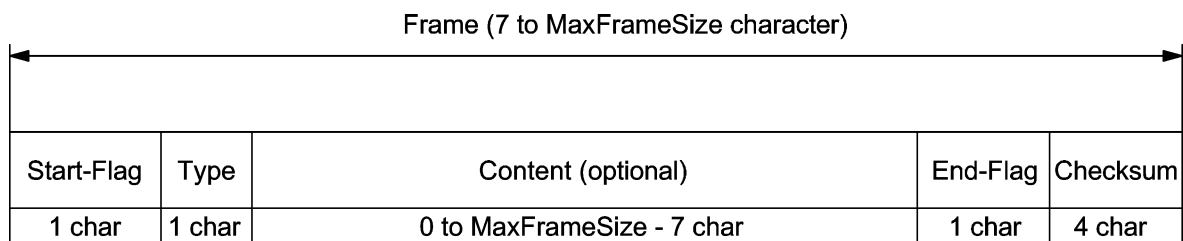
Figure 2

A frame shall have the following minimum requirements:

— always starts with a Start—Flag

— always followed by type identifier

— 1 End-Flag

— 4 character Checksum (valid or invalid)

— frame length limited to MaxFrameSize

Frames which do not fulfil these requirements shall be ignored and not answered. A new frame starts upon the receipt of a Start-Flag. Any character received before the Start-Flag shall be ignored. All devices using the FTL-protocol shall be able to receive complete frames of MaxFrameSize characters. A frame shall be answered even if it contains an invalid checksum or incorrect characters (see 5.2).

If the type identifier in a frame is unknown a NAK shall be sent.

MaxFrameSize

The MaxFrameSize shall be 255 characters.

Start—Flag

The ASCII code 02h (start of text <STX>) shall be used as the Start-Flag.

Type identifier

The type identifier shall be according to Table 1.

Content

The content may be empty or shall contain up to MaxFrameSize minus 7 characters. All characters in the content shall be printable characters.

End-Flag

The ASCII code 03h (End of Text <ETX>) shall be used as the End—Flag.
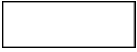
Checksum

The Checksum <CRC> verifies the integrity of a frame. It covers all characters from Start—Flag to End—Flag including these flags. A CRC16 (16 bit) value in hexadecimal format (always 4 characters long) is used and shall consist of the printable ASCII character "0".."9" or "A".."F" (example: the value 1AC9h shall be sent with 4 ASCII character "1AC9"). The algorithm for the calculation is described in 5.4.

5.2 Frame flow (handshake)

The character immediately following the Start-Flag defines the frame type. The different frame groups and their frame types are described in Table 1.

Table 1 — Frame groups and frame types

Frame group	Frame type	Abbreviation	Additional fields	Type identifier client to server	Type identifier server to client
Dataframe	end of record frame	EOR	data	R, V	r, v
	additional dataframe following frame	ADF	data	L, P	l, p
	end of transmission frame	EOT	data	E, I	e, i
Controlframe	acknowledge frame	ACK	no	A	a
	synchronisation/wait frame	SYN	no	_[a]	s
	cancel frame	CAN	no	C	c
	CRC transmission error frame	TEF	no	T	t
	not acknowledge frame	NAK	NAK-ID according to Table 17	_[a]	n

[a] Not applicable.

To distinguish the direction of data (client to server or server to client) upper and lower case type character shall be used.

Every communication shall start with a dataframe.

Every dataframe from the server shall be answered by a controlframe from the client.

Every frame from the client shall be answered by a frame from the server.

If a dataframe is received by the server when an acknowledge is expected it shall be treated as a cancel frame (CAN) regarding the preceding transaction.

Every data frame on each side, independently, shall be flagged alternatively (toggled) with the secondary (V,P,I) and primary (R,L,E) type identifier. If subsequent dataframes with identical type identifier are received, these shall be treated as a repetition with identical data but shall be answered as the original, see Figure 11. This prevents redundant entries in lists resulting from communication faults.

After the startup of the system the first dataframe on each side shall start with the primary type identifier (R,L,E). The first request after startup shall not be a SET-request to a list.

Examples of frame flows:

— Transaction that requires only one datagram in either direction, each fitting into a single frame, see Figure 3.
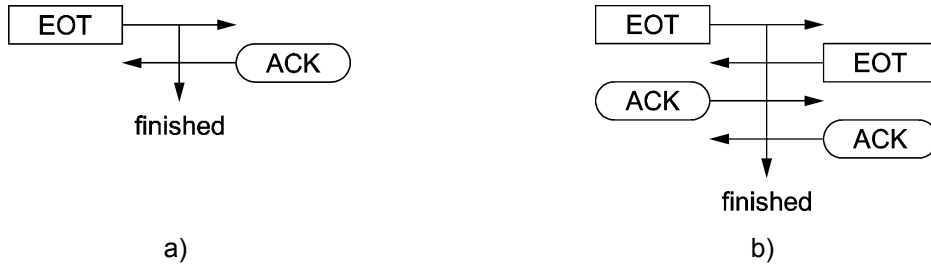
Figure 3

— Transactions that require more than one datagram (e.g multi record transfer), EOR—frames shall indicate that additional datagrames will follow. An EOT—frame shall be the last dataframe of the transaction, see Figure 4.
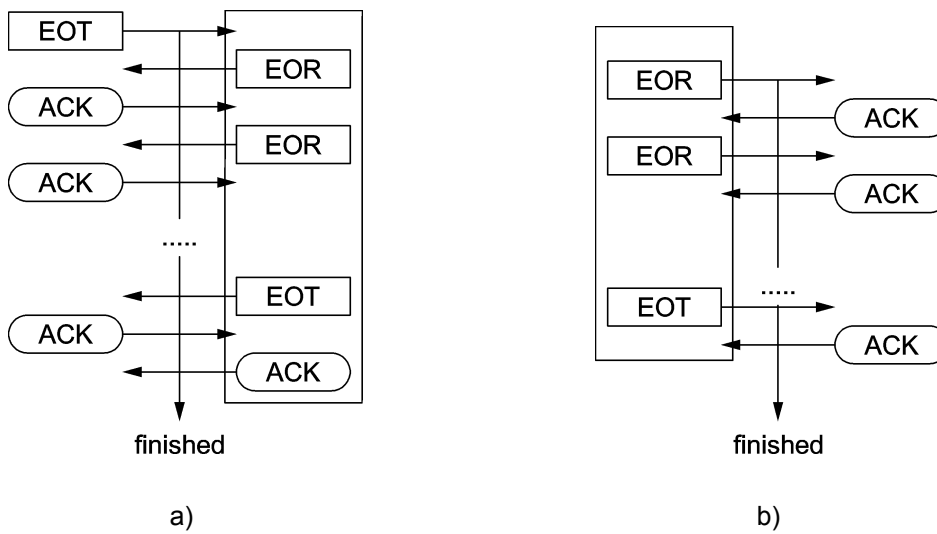
Figure 4

— Datagrams that require more than one frame, because MaxFrameSize is too small to hold a complete datagram shall be split into one or more ADF—frames and an EOT—frame or EOR-frame as appropriate, see Figure 5.
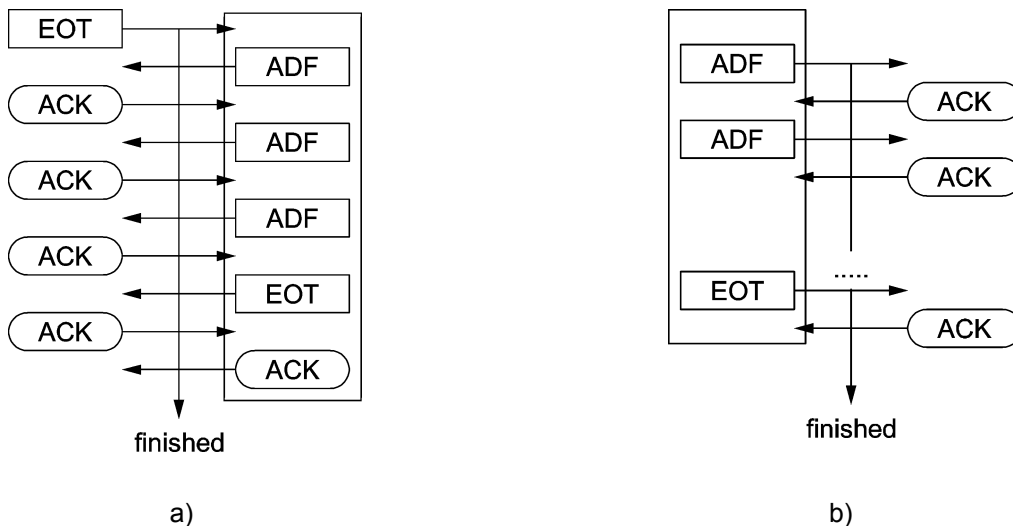
Figure 5

— The preceding examples may be combined as in Figure 6:
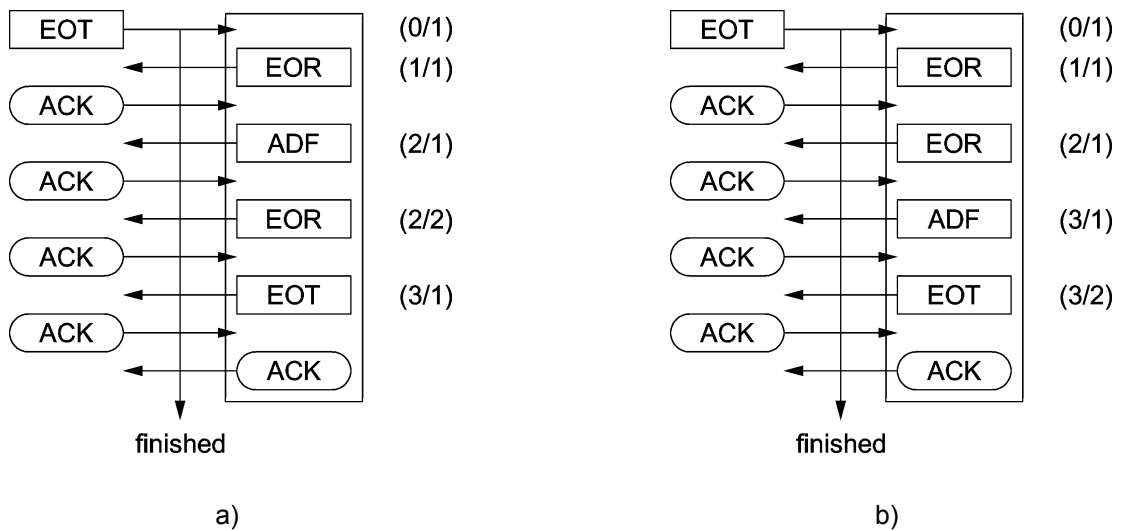
Figure 6

TEF—frame

In case of a CRC error all frametypes shall be answered with a TEF— frame. The frame shall then be repeated, see Figure 7.

Key

1   controlframe is repeated

2   dataframe is repeated

Figure 7

*S*YN-frame

A SYN—frame is not a final acknowledgement. It notifies a busy status of the server while preparing the answer to prevent a timeout.

Multiple SYN—frame are possible but always a final acknowledge shall follow, see Figure 8. t_W shall be between 30 % and 90 % of the maximum answer time Rt, see 5.3.
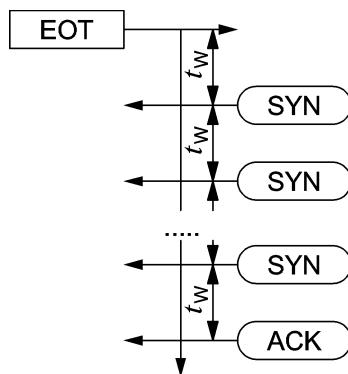
Figure 8

CAN—frame

Transactions can be cancelled if procedures with higher priorities have to be serviced from the higher application layer. Then a CAN—frame shall be sent. It terminates the transaction but does not act as an ACK-frame, see Figure 9.

cancelled
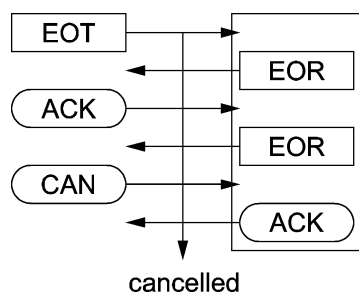
Figure 9

NAK-ID *frame*

If any problems (except for CRC error) occur with the frame or with the "execution" of the frame a NAK-ID frame shall be sent. The NAK ID, which shall be transmitted in its content, shall identify the reason for the NAK, see Figure 10. The application layer shall decide how to continue.

NAK-cancelled

Figure 10

a)   b)
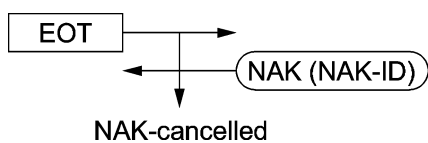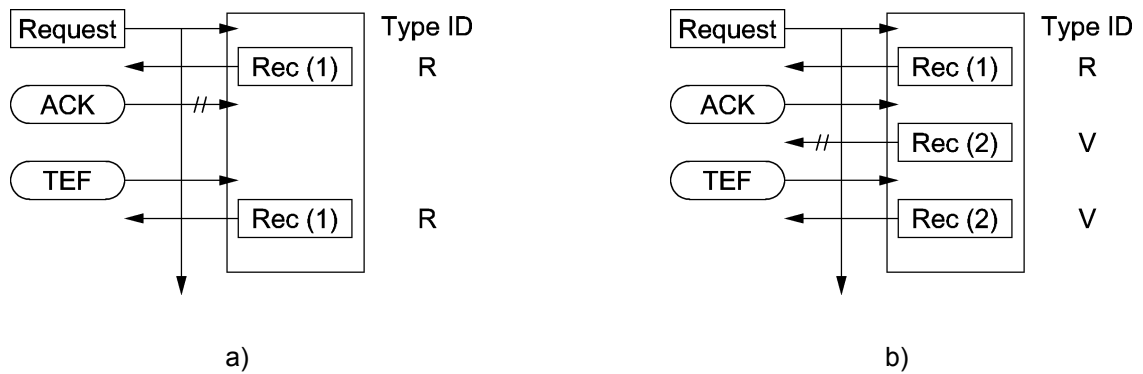
Figure 11

Figure 11 shows the use of the alternating type ID (toggle), which accompanies the record, to identify the receipt of duplicated records.

5.3 Delay and timeout
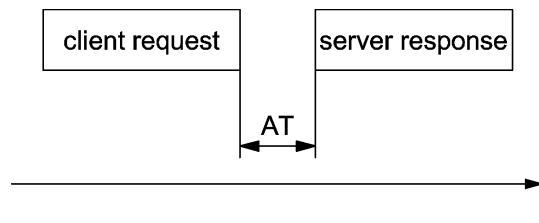
Figure 12

If the answer time (AT), see Figure 12, exceeds Rt, a timeout shall be detected by the client. For short distance (e.g. RS 232, RS485, Low Power Radio) communication "Rt" value shall be 1 s.

NOTE   This value may not be sufficient for long distance (e.g. GSM/GPRS) communication, where additional routing delays may occur.
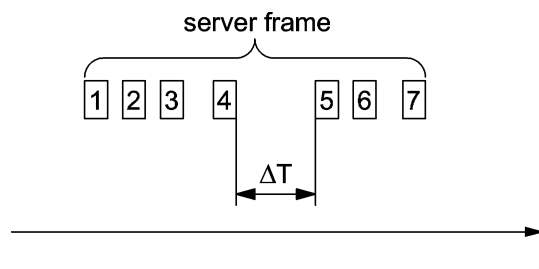
Figure 13

Within a frame transmitted by the server, the delay (ΔT) between two subsequent characters shall not exceed three character times, see Figure 13. For frames transmitted by the client there is no limitation.

If a timeout occurs after a transmission of a dataframe, the previous dataframe shall be repeated by the client. If a timeout occurs after a transmission of a controlframe, a repetition shall be requested by transmission of a TEF-frame.

After three consecutive timeouts (1 initial + 2 retries), the transaction shall be cancelled without a CAN-frame (see 5.2). The application layer shall decide what action shall be taken.

As the client does not know whether the server has received the last ACK-frame before the timeout the last record may be repeated upon the next request to this node.

5.4 CRC16 Checksum

Since a frame might have been corrupted during transmission, a checksum shall be included in each frame. It shall cover all characters from Start—Flag to End—Flag including these flags.

The calculation algorithm for CRC16 shall be according to EN 14116:2012+A1:2014, Annex B.

6 Data protocol layer (FTL-data protocol)

6.1 Client (OBC) and server (TVE)

The TVE shall act as server, providing data to the client, usually the OBC. Only the client shall initiate data exchange. Each frame from the client shall be followed by one frame from the server.

Thus, the only way for the server to transmit information to the client is to let the client poll the appropriate variables in intervals.

6.2 Syntax of data in datagrams

6.2.1 General

Every datagram shall have the following syntax:

<opcode>,<node>[,<subnode>],<variable>[(<index>)][=<value>].

Except for <value> all other are not case-sensitive. Thus, "ENQ" shall be handled equally to "Enq".

<subnode> may consist of a number of subnode levels. <value> may be empty.

6.2.2 Operation codes (OpCodes)

The OpCode defines the type of operation. OpCode according to Table 2 shall be supported:

Table 2 — Operation of FTL protocol

Operation	Opcode	Description
Enquiry	ENQ	Sent by the client to retrieve data from the server ("=" is not allowed)
Set	SET	Sent by the client to set data in the server ("=" shall be present)
Clear	CLR	Sent by the client to delete a list of records ("=" is not allowed)
Report	REP	Sent by the server as a response to a Enquiry (followed by "=" with value). An empty list is identified by a missing equal-sign and no value.
NOTE	A further optional Operation "NEW", which is for channel 3 use only, is given in 9.3.4.	

6.3 Nodes, subnodes, variables

All data provided by server shall be stored in variables which may be accessed by the client (see Clause 7).

Each name identifying <node>, <subnode> and <variable> shall:

— be limited to 10 characters;

— only consist of the characters "A" to "Z", "0" to "9" and "_";

— never start with numerical characters "0" to "9".

Some variables are arrays. By specifying a numerical index enclosed by brackets ( ), one particular array element shall be accessible.

Indexing shall always start with 1.

6.4   Format identifiers

The formatting of values depends on the corresponding variable. The codes according to Table 3 for format identifiers are used in this standard.

Table 3 — Format identifiers

Format identifier	Description
B	Boolean value (0 or 1) Only the values 0 and 1 are valid

	Examples for valid coding:
	    0 False
	    1 True

	Examples for invalid coding:
	    2 invalid value
	    A invalid value
	    0.1 separator not allowed/more than one character not allowed

Nx	Integer decimal value with max x characters (including sign character)

	Examples for valid coding (for N3):
	    1 Value: +1
	    001 Value: +1
	    123 Value: +123
	    +12 Value: +12
	    -12 Value: -12

	Examples for invalid coding (for N3):
	    1234 more than three characters
	    +123 more than three characters
	    0.1 separator not allowed
	    1E2 invalid character 'E'

Nx.y	Floating point value max. x digits in front of the period (including +/-) max. y digits behind the period Only characters 0 to 9 and period are allowed. At least one digit in front and behind the period has to be used. No exponential expressions.

	Examples for valid coding (for N3.2):
	    1.0 Value: +1,0
	    001.2 Value: +1,2
	    001.23 Value: +1,23
	    000.12 Value: +0,12
	    0.1 Value: +0,1
	    +01.23 Value: +1,23
	    -01.23 Value: -1,23

Format identifier	Description

	Valid examples for longitude GPS values N4.6 in degrees:
	  +007.512500 7,512500° E = 7° 30' 45" E = 7° 30,750' E
	  7. 5125 7,512500° E = 7° 30' 45" E
	  -007. 512500 7,512500° W = 7° 30' 45" W
	Valid examples for latitude GPS values N3.6:
	  +07.512500 7,512500° N = 7° 30' 45" N

	Examples for invalid coding (for N3.2):
	  1234.5 more than 3 digits in front of period
	  +123.4 more than 3 digits in front of period
	  -123.4 more than 3 digits in front of period
	  123.456 more than 2 digits behind period
	  0,1 separating character not allowed (use period)
	  123 separating character missing
	  .12 minimum number of digits missing in front of period
	  123. minimum number of digits missing behind period
	  1.E5 invalid character

Cx	Text with maximum number of x bytes. UTF-8 according to ISO/IEC 10646:2014 except for codes less than 0x20 and except for comma 0x2C; All other characters are embedded similar to the mechanism of the C programming language using the "\" character followed by a two nibble hex value (examples \n for LF, \x1B for ESC, \, for comma). Following codes shall be implemented: \\ ("\") \n \r \f \t \, and \xNN (0xNN)

Cx	Examples for valid coding (for C12):
	  abcdoCD=12 < abcdoCD=12 <
	  a\n\x0A a<0x0A><0x0A>"
	                        (<..> .. hex value for control character)
	  a\n\x0A\x1B
	  12345\,67890 12345,67890
	  1\,2 Ab\\yz 1,2 Ab\yz

	Examples for invalid coding (for C12):
	  abcdCD12.3456 more than 12 characters
	  abCD12,345 comma not allowed

S	Time stamp – CCYYMMDDhhmmss Shortened forms of the time stamp string such as (CCYYMMDD) are not allowed. In this case unused fields have to be filled with 00. However a single digit 0 shall be used to represent no time stamp. Is a higher resolution than seconds needed fractions of seconds may be appended at the end of the time stamp string.

	Examples for valid coding:
	  19990109230201 09. January 1999 23:02:01
	  20001224013159.75 24. December 2000 1:31:59,75

	Examples for invalid coding:
	  001224013159 shortened time stamp string
	  200012240131 seconds are missing
	  20001224013159,75 comma not allowed – use period

Format identifier	Description
D	Date – CCYYMMDD see description for format identifier S above
	Examples for valid coding: 19990109 09. January 1999 20001224 24. December 2000
	Examples for invalid coding: 001224 shortened date string
T	Time – hhmmss see description for format identifier S above
	Examples for valid coding: 230259 23:02:59 013159.75 1:31:59,75
Hx	Unsigned hexadecimal value with max x characters, representing a bit pattern with $x \cdot 4$ bits Bit 0 is encoded as value 1 Bit 1 is encoded as value 2 Bit 2 is encoded as value 4 and so on
	Examples for valid coding: 10A8 represents a field of 16 bits where bits 12, 7, 5 and 3 are set. All other Bits are zero.
	Examples for invalid coding: 10a8 lower case character "a" used 0x10A8 invalid character "x" used $10A8 invalid character "$" used

6.5 Types of variable values

6.5.1 Single-Field-Type

<value> represents exactly one field with any one of the variable types given in Table 3.

No separators or special codes for quoting are needed.

6.5.2 CSV Records and quoting

<f1>,<f2>,<f3>,…

In this case, <value> consists of a list of fields separated by the character comma ",". Each field is of one-field-type.

The formatting of a CSV record shall follow the guidelines below:

1) concatenation is done with the separator character comma (",");

2) numeric field of zero-length (empty field) shall be interpreted as not available;

3) trailing commas can optionally be omitted.

6.6   Kinds of nodes

6.6.1   General

When accessing <variable> or <subnode> the behaviour of the server depends on the kind of <variable> or <subnode>. The three kinds in 6.6.2 to 6.6.4 shall be supported.

6.6.2   Values

The simplest kind is a value, which consists of exactly one line, which can either be of type CSV or of any other single-field type, see Table 4.

Table 4 — Operation applicable to simple values

Operation	Effect (if operation allowed in this context)
Enquiry	shall return the current variable contents (<value>)
Set	shall replace the current variable contents (<value>) by the new value given behind the "="-character
Clear	Not allowed

Examples can be found in Clause 10.

6.6.3   Lists

Some subnodes or variables are accessed as lists, which mean that more than one value or line may be stored or read, see Table 5.

Table 5 — Operation applicable to lists

Operation	Effect (if operation allowed in this context)
Enquiry	shall return the current variable contents, line by line.
Set	shall add the new value given behind the "="—character to the list
Clear	shall make the list empty

An enquiry of an empty list (list without elements) shall be answered with a report without equal-sign. In contrast, an enquiry of a list with empty element shall be answered with a report with equal-sign without <value>.

If more than one record is to be added to the list it is recommended to send all frames within one transaction using EOR-frames.

EXAMPLE   ENQ,FTL,SYSTEM,NodeList

REP,FTL,SYSTEM,NodeList=FTL,SYSTEM,NODELIST

REP,FTL,SYSTEM,NodeList=FTL,SYSTEM,FTL_VERS

REP,FTL,SYSTEM,NodeList=FTL,SYSTEM,FTL_FORMAT

REP,FTL,SYSTEM,NodeList=FTL,SYSTEM,DATETIME

6.6.4 Arrays

Arrays may be accessed according to Table 6 either:

— as value, as described in 6.6.2, when an index is specified in the enquiry or set command (see 6.3);

EXAMPLE 1   ENQ,FTL,COMP,Status(1)

    REP,FTL,COMP,Status(1) = 2

— or without index, in which case every answer shall contain the requested variable or subnode and the appropriate index.

EXAMPLE 2   ENQ,FTL,COMP,Status

    REP,FTL,COMP,Status(1) = 2

    REP,FTL,COMP,Status(2) = 2

    REP,FTL,COMP,Status(3) = 2

Table 6 — Operation applicable to arrays

Operation	Effect (if operation allowed in this context)
Enquiry	with index: shall return the addressed array element
	without index: return entire array, starting with the lowest, and ending with the highest index
Set	with index: replace the contents of the given array element
	without index: append the new elements after the last used element
Clear	with index: not allowed
	without index: clears the contents of all array elements

Examples can be found in Clause 10.

7   FTL-Data

7.1   General

The root node shall be called FTL. (see 8.2 for exceptions). The structure of this node shall be fixed. Thus, subnodes and variables not described in this European Standard shall not be implemented.

However, it is allowed to only implement a subset of the structures mentioned in this specification. Please refer to 7.15 for list of variables, which shall be present in every system.

All mentioned subnodes belong to node FTL, see Annex A.

Unless otherwise noted, when the description of TVE-variable refers to a L—FILE-record type, the first two fields (record type and timestamp) shall be omitted (see example in 7.3.1).

7.2   Record and field types

In this document record types are referred to by #L<recno>_<identifier>. Thus, #L01_DEVICE_ID refers to record type 01, called DEVICE_ID, which can be found in the L_FILE specification in Table 13.

Meaning and formats of fields are referred to by #L<recno><fieldno>[_<identifier>]. Thus, #L0202_veh_type refers to field 2 (called veh_type) in record type 2 (VEHICLE_ID).

7.3 Systemwide variables (subnode SYSTEM)

7.3.1 FTL version (variable FTL_VERS)

Variable	FTL,SYSTEM,FTL_Vers=V
Kind	Value, Read Only, required
Enquiry (item)	Returns the version of FTL implemented on the TVE.
Value V	#L00_FTL_VERS

EXAMPLE   ENQ,FTL,SYSTEM,FTL_Vers

    REP,FTL,SYSTEM,FTL_Vers=1.00

7.3.2 Format for dataframes (variable FTL_FORMAT)

Variable	FTL,SYSTEM,FTL_Format=V
Kind	Value, Read Only, optional
Enquiry	Returns the current format used for dataframes.
Value V	"CSV" (default): data is transmitted FTL-formatted

7.3.3 Date and time on TVE (variable DATETIME)

Variable	FTL,SYSTEM,DateTime=V
Kind	Value, Read/Write, optional
Enquiry	Returns the timestamp for current date and time on TVE.
Set	Tries to change the timestamp for current date and time on TVE. May also be used to synchronise TVE real time clock
Format	S (see Table 3)

EXAMPLE   ENQ,FTL,SYSTEM,DateTime

    REP,FTL,SYSTEM,DateTime=20070820104933

7.3.4 Timeout for OBC alive-test (variable TIMEOUT)

Variable	FTL,SYSTEM,TIMEOUT=V
Kind	Value, Read/Write, optional
Enquiry	Returns current timeout setting for alive-test.
Set	Sets a new timeout for alive-test
Value V	Timeout in seconds or 0 to deactivate alive-test. Default value 60 s, maximum time for absence 99999 s (N5)

After each transaction the internal timer shall be reset. When this internal timer exceeds the current timeout setting:

— the connection shall be regarded as timed out;

— the TVE is allowed to initiate processes to be able to work without OBC.

It is recommended to protect the value against power outages to prevent tampering.

7.3.5   Status of OBC alive-test (variable TIMEDOUT)

Variable	FTL,SYSTEM,Timedout=V
Kind	Value, Read/Write , optional
Enquiry	Returns the timestamp when connection to OBC was lost.
Set	Reset Timedout condition (V = 0 only)
Value V	Timestamp, when connection was lost. 0 stands for "no timeout since initialization".

See 7.3.4 for further explanation.

7.3.6   Baudrate for communication (variable BAUD)

Variable	FTL,SYSTEM,Baud=V
Kind	Value, Read/Write, optional
Enquiry	Returns the current baudrate for FTL communication.
Set	Tries to set a new baudrate for FTL communication.
Value V	Valid baudrate: 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 etc.(N6) Default baudrate for communication is V = 9600.

Since change of communication parameters is a rather sensitive process, several safety procedures shall be implemented:

— TVE shall acknowledge the set using the previous baudrate.

— After the TVE switched to the new baudrate, the OBC shall verify the new setting by requesting the variable again within ten seconds. Otherwise, the TVE shall switch to the default baudrate of 9600.

The OBC should wait at least 5 s before verifying the new baudrate, because the TVE possibly needs some time for switching.

If a baud rate is not supported by the TVE it should answer with NAK-ID 10202.

EXAMPLE   ENQ,FTL,SYSTEM,BAUD

    REP,FTL,SYSTEM,BAUD=9600

    SET,FTL,SYSTEM,BAUD=115200

    Verify new baudrate after 5 s:

    ENQ,FTL,SYSTEM,BAUD

REP,FTL,SYSTEM,BAUD=115200

7.3.7   Last system error (variable SYS_ERR)

Variable	FTL,SYSTEM,SYS_ERR=V
Kind	Value, read only, cleared on read, optional
Enquiry	Returns the last system error on TVE.
Value V	#L09_SYS_ERR

EXAMPLE   (problem with sensor for product code occurred):

ENQ,FTL,SYSTEM,SYS_ERR

REP,FTL,SYSTEM,SYS_ERR=90,10301,44326

7.3.8   List of supported nodes and variables (list NODELIST)

Variable	FTL,SYSTEM,NodeList=V
Kind	List, read only, required
Enquiry	Returns a list of nodes and subnodes supported by the answering TVE.
Value V	All supported nodes (including their path)

EXAMPLE   ENQ,FTL,SYSTEM,NodeList

REP,FTL,SYSTEM,NodeList=FTL,SYSTEM,NODELIST

REP,FTL,SYSTEM,NodeList=FTL,SYSTEM,FTL_VERS

REP,FTL,SYSTEM,NodeList=FTL,SYSTEM,FTL_FORMAT

REP,FTL,SYSTEM,NodeList=FTL,SYSTEM,DATETIME

7.3.9   Certificate for electronic signature

Variable	FTL,SYSTEM,CERTIFICATE=V
Kind	List, read only, optional
Enquiry	Returns the certificate of the unit used for electronic signature
Format V	Base64 encoded according to 6.8 of RFC 2045[a]
[a] RFC 2045 is explained in the document " Multi purpose internet mail extension (MIME) subclause 6.8. This document is available at web site, accessed through : www.ietf.org/rfc/rfc2045.txt	

7.3.10   Remote popup message

Variable	FTL,SYSTEM,MESSAGE=V
Kind	Variable, Read/write, optional
Set	message number and text to be displayed as popup information on TVE screen
Enquiry	read back the value previously set
Format V	<nr>, <text> where nr is of format N3 and text is of format C255

7.4 Variables related to global positioning system (subnode GPS)

7.4.1 General

In some systems, both TVE and OBC may use information from a GPS receiver (e.g. time setting, checking for geofencing).

In order to avoid the need to install two GPS systems on one tank vehicle, FTL provides two interfacing alternatives.

7.4.2 GPS on OBC-side (variable OBC)

Variable	FTL,GPS,OBC=V
Kind	Value, Read/Write, optional
Enquiry	Returns the value, that has been stored there by OBC last time.
Set	Simply stores V in this variable for usage by TVE.
Format	#L08_GPS_INFO

The OBC shall write GPS-data to the TVE.

To avoid excessive traffic on the bus, it is usually sufficient to set the node value only once by the OBC when a phase of movement ends and the tank vehicle comes to rest.

7.4.3 GPS on TVE-side (variable TVE)

Variable	FTL,GPS,TVE=V
Kind	Value, read only, optional
Enquiry	If TVE includes a GPS receiver, the GPS-data shall be available for use by the OBC.
Format	#L08_GPS_INFO

7.5 Accessing a printer on TVE-side (subnode PRN)

7.5.1 General

When the TVE includes an on board printer (e.g. ticket printer as part of a metrological approved metering system), it may also be used by the OBC to print lists or any other data. In order to avoid conflicts while printing a document, the printer shall be reserved by the OBC before accessing it. Any attempt by the OBC to set a printer node without reserving it first, shall be rejected by the TVE by answering with a NAK-ID frame. If no printer is installed, only the subnode PRN,TYPE is required and shall return 0 (printer not available).

7.5.2 Request for the type of OBC-document to print on TVE (variable PRINTDOC)

Variable	FTL,PRN,PRINTDOC=V
Kind	Value, Read/Write, optional
Enquiry	Returns a value representing the document desired to be printed by OBC on TVE.
Set	Set to zero acknowledges that the request has been handled.
Value V	<doctype>[,<arg1>[,...]]

	Arguments shall be numerical. <doctype> shall be one of
	• 0: no printing request pending
	• 1: delivery note. No argument means "last delivery note". Argument specifies note number.
	• 2: extended delivery note. Arguments like 1.
	• 3 print parameter data (manufacturer specific data, LP_file)
	• 4 print diagnostic data (manufacturer specific data, LD_file)
	• 99: customer specific request. First argument shall be manufacturer number. Further arguments can freely be used.

This variable may be used as remote control for the OBC, using the display of the TVE, e.g. to avoid climbing into the drivers cabin to initiate a printout. The OBC shall poll this variable during time periods where printing may be desired.

After processing this request, the OBC should clear this variable to signal that the job is done.

7.5.3   Printer port to access (variable PORT)

Variable	FTL,PRN,PORT=V
Kind	Value, Read/Write, optional
Enquiry	Returns currently selected port used for printing.
Set	Sets printer port, V
Value V	Numeric value from 0 to 9 describing the printer port to use. V = 0 means default printer port.

7.5.4   Type of printer (variable TYPE)

Variable	FTL,PRN,TYPE=V
Kind	Value, read only, required
Enquiry	Returns the type of the selected printer.
Value V	Numeric value, one of
	• 0: no printer at this port
	• 1: printer installed but generally not available for OBC
	• 2: generalized FTL-printer (UTF-8 shall be used)
	• 3: printing to file
	• 4: unknown printer
	Printers from STAR (10 to 19):
	• 10: STAR SP298
	• 11: STAR DP8340
	Printers from EPSON (20 to 29):
	• 20: EPSON TM290
	• 21: EPSON TM295
	• 22: EPSON LQ570
	Other printers (90 to 99)
	• manufacturer specific

7.5.5 Status of selected printer (variable STATUS)

Variable	FTL,PRN,STATUS=V
Kind	Value, read only, required if PRN, Type is greater than 0
Enquiry (item)	Returns current status of selected printer.
Value V	Numeric value, one of • 0: ready • 1: no paper on top (upper sensor) • 2: no paper on bottom (lower sensor) • 3: no paper (both sensors) • 4: printer offline

7.5.6 Reserving the printer (variable RESERVED)

Variable	FTL,PRN,RESERVED=V
Kind	Value, Read/Write, required if PRN, Type is greater than 0
Enquiry	Returns current reservation state of selected printer.
Set	Set to 1 tries to reserve printer for usage by OBC. Set to 0 frees the printer
Value V	Numeric value, one of • 0: idle, free for usage • 1: currently reserved for OBC • > 1: reserved by TVE

The printer could be in use by TVE or another client. In this case, the TVE reserves the printer itself.

If the OBC tries to reserve the printer by writing V=1, while the printer is already reserved by TVE or another client, the TVE shall answer with a NAK-ID frame.

When the printer was reserved by the OBC and a further request by the OBC for reservation is done, the TVE shall answer with an ACK and shall leave the value at V=1.

7.5.7 Commands to the printer (variable CMD)

Variable	FTL,PRN,CMD=V
Kind	Value, Read/Write, required if PRN, Type is greater than 0
Enquiry	Result undefined
Set	Executes a command, returns ACK-frame after the command was successfully executed, NAK-ID frame otherwise
Value V	Numeric value, one of • 0: no operation • 1: grab paper • 2: eject paper

7.5.8 Text to print (variable TX_TEXT)

Variable	FTL,PRN,TX_TEXT=V
Kind	Value, Read/Write, required if PRN, Type is greater than 0
Enquiry	Result undefined
Set	Prints the text, returns ACK-frame after the text was successfully printed, NAK-ID frame otherwise.
Value V	Text to print, see Table 3, Cx.

7.6 Compartment information (subnode COMP)

7.6.1 General

First compartment (n=1) shall be next to driver cabin.

7.6.2 Number of compartments (variable COUNT)

Variable	FTL,COMP,COUNT=V
Kind	Value, read only, required for SPDS
Enquiry	Returns number of compartments the TVE controls.
Value V	Non negative number (N2)

7.6.3 Current status of a compartment (array STATUS)

Variable	FTL,COMP,STATUS[(n)]= V
Kind	Array, read only, required for SPDS
Enquiry	Returns array with status of all compartments.
Enquiry (n)	Returns status of compartment n.
Format	#L40_COMP_STAT

7.6.4 Current status of load (array CONTENT)

Variable	FTL,COMP, CONTENT [(n)]=V
Kind	Array, read only, optional
Enquiry	Returns array with the current load of all compartments.
Enquiry (n)	Returns the current load of compartment n
Format	#L13_COMP_CONT

7.6.5 Currently connected PIDs (list of PID_INFO)

Variable	FTL,COMP,PID_INFO=V
Kind	List, read only, optional
Enquiry	Returns a list of CSV records with all detected PIDs for all compartments.
Format	#L45_PID_INFO

7.6.6 Loading information from gantry (array LOADING)

The content of the loading information from the gantry shall be according to the following:

Variable	FTL,COMP,Loading(n)=V
Kind	Array, Read/Write, optional
Enquiry	Returns array with loading information for each compartment stored by loading gantry (OBC).
Clear	Erases all previous loading information for compartments.
Enquiry (n)	Returns a CSV record with loading information for compartment n stored from loading gantry (OBC).
Set (n)	Sets new loading information for compartment n.(e.g. from gantry)
Format	#L11_Transfer

This node may be interrogated at any time. Note that the data quality may vary, depending on the timing of the request.

7.7 Notification about changes (subnode NOTIFY)

7.7.1 General

There are several subnodes and variables, which are recommended to be checked frequently. This can lead to heavy load on the communication line, and thus, reducing the band with available for transmission of real data.

Subnode NOTIFY provides a simple method to overcome this drawback. Instead of polling several variables, the OBC polls only one subnode (Notify). The answer is a list of all nodes that were changed since the last time they were read.

Since not all nodes are of interest to the OBC at any time, the OBC may set up a list of all nodes that are subject to notification.

7.7.2 List of Supervised subnodes and variables (list NODELIST)

Variable	FTL,NOTIFY,NodeList=V
Kind	List, optional
Enquiry	Returns a list of all subnodes and variables, which are subject to notification.
Set	Tries to add a new subnode or variable for notification
Clear	Drops the list with the effect, that no subnode or variable is supervised anymore.
Value V	node (including their path) For command SET, V may be "*" (asterisk). In this case, the list will be set to all subnodes and variables, which are providing the supervision feature.

When a subnode or variable cannot be added to the list, because it does not support supervision, a NAK-ID frame with value 10600 is returned.

Set-commands for already added subnodes or variables shall be accepted and acknowledged.

When an array is added for notification (e.g. FTL,COMP,STATUS), all elements of the array shall be monitored for notification. It shall not be possible to only add items of an array.

When a node of type list is added for notification (e.g. L_FILE), it shall be shown as "changed" as soon as new entries have been added or existing entries have been changed.

EXAMPLE   CLR,FTL,NOTIFY,NODELIST

           SET,FTL,NOTIFY,NODELIST=FTL,COMP,STATUS

           SET,FTL,NOTIFY,NODELIST=FTL,PRN,Status

           SET,FTL,NOTIFY,NODELIST=FTL,PRN,Port

           or for adding all possible subnodes and variables,

           SET,FTL,NOTIFY,NODELIST=*

Initially the list is empty.

7.7.3   List of changed subnodes and variables (list CHANGES)

Variable	FTL,NOTIFY,Changes=V
Kind	List, optional
Enquiry	Returns a list of all nodes (including their path), which are on the node list and have changed since the last enquiry of this node.

The TVE shall clear an entry in this list when this node of this entry is read.

EXAMPLE   ENQ,FTL,NOTIFY,Changes

           REP,FTL,NOTIFY,Changes=FTL,COMP,STATUS

           REP,FTL,NOTIFY,Changes=FTL,PRN,STATUS

           REP,FTL,NOTIFY,Changes=FTL,L_FILE

7.8   Information about driver (subnode DRIVER)

7.8.1   List of drivers (list DRIVERS)

Variable	FTL,DRIVER,DRIVERS=V
Kind	List, optional
Enquiry	Returns the list of all drivers according to the record structure described in Table 7.
Set	Adds a new driver to the list.
Clear	Removes all drivers from the database on the TVE.
Value V	See Table 7.

The TVE shall be able to exchange information about drivers with OBC. Table 7 contains the structure on which the subnode shall be based on.

Table 7 — Format of CSV record "DRIVER.DRIVERS"

No	Name	Type	Description
1	DRV_ID	N6	Identification number of driver #L0302
2	DRV_NAME	C30	Name of driver in recommended format <name> <surname>.
3	LNG_ID	C2	ID of language according to ISO 639-1 shall be used for this driver.
4	DRV_PIN	N6	PIN code of driver.
5	PIN_TIME	S	Timestamp of last login.

7.8.2 Driver currently logged in (variable CURRENT)

Variable	FTL,DRIVER,CURRENT=V
Kind	Value, optional
Enquiry	Returns a record for the driver currently logged in.
Set	Sets a new record for the driver logged in on the OBC.
Clear	Stores an empty value in this variable.
Value V	See Table 7

This variable affects both directions. When a driver logs into TVE, the TVE shall update this node. Alternatively, when the driver logs into OBC, the OBC shall set this node.

When the driver logs out, this shall be indicated by value 0 in field DRV_ID.

7.9 Information about the vehicle (variable VEHICLE_ID)

Variable	FTL,VEHICLE_ID
Kind	Value, read only, required
Enquiry	Returns the identification of the vehicle
Format	#L02_VEHICLE_ID

This variable allows the identification of the trailer by the OBC to detect change of trailers.

7.10 Access to filesystem on TVE (subnode FS)

7.10.1 General

Additionally to the possibilities of data transmission FTL provides variables to access the filesystem on the TVE in both directions, reading and writing.

This can be used for downloading updates and configuration files or for transmitting data that isn't covered by one of the other subnodes.

7.10.2 OBC as internet gateway for TVE

In a typical environment, only the OBC has the capability to connect to the internet. The OBC can work as a gateway then, routing updates and other files (e.g. maintenance data, troubleshooting information) from the internet down to the TVE and vice versa.

Before transferring any files, the OBC shall give the command CWD with an empty argument to move into default working directory on TVE.

It is recommended that the OBC obtains all necessary information for the connection from the TVE to avoid the need for special configuration of the OBC. Typically, OBC and TVE are supplied by different companies.

The OBC shall connect to the FTP-server, move into the desired location and shall handle two subdirectories there, one is called IN, representing the direction to TVE, the other one OUT, representing the direction from TVE.

Files on the server in directory IN shall be written to default working directory on TVE. When successfully done, these files shall be moved to subdirectory IN\DONE, possibly overwriting files with the same name.

Files on the TVE in default working directory shall be retrieved and transferred into directory OUT on the FTP—server. When successfully done, these files shall be closed with mode "D" (see 7.10.6) to move them into a DONE-directory.

The OBC isn't responsible for integrity of the transferred data.

7.10.3 FTP—server for TVE (variable FTPSERV)

Variable	FTL,FS,FTPSERV=V
Kind	Value, optional
Enquiry	Returns information how to connect to a FTP-server, configured on the TVE.
Value V	CSV string <server_url>,<username>,... with all necessary information to log in at the FTP server and perform the data transfer tasks described later. Fields: server_url is the name of the FTP-server where the exchange boxes for the TVE are located. May be specified as name of FTP-server (e.g. ftp.myftpserver.com) or as an IP-address (e.g. 111.222.33.44). username is the name to be used for login at this server userpass is the password to be used at login time homedir is the directory path for an initial "cwd" command. The "in" and "out" boxes are to be found at this directory

This node is optional. If it does not exist, the OBC shall use exchange boxes located on the server used by the OBC.

7.10.4 Changing the working directory (variable CWD)

Variable	FTL,FS,CWD=V
Kind	Value, optional
Enquiry	Returns the currently selected working directory (full pathname).
Set	Tries to set a new working directory (may be relative).
Value V	Pathname, consisting of an optional drive-specifier and a list of subdirectories. [<drive>:][<path>] V can be empty to work in default mode (see below). Relative paths shall be accepted except in the default directory.

By default, the working directory shall not be specified, thus, V is empty. In this situation writing access is redirected in a special directory designed for incoming data (an inbox, e.g. for updates), whereas reading access is redirected in a special directory designed for outgoing data (an outbox, e.g. for internal log files).

This means, that the OBC needs not to know, where to place files or where to find the files to be retrieved.

For more complex procedures CWD can be used to move to any directory and/or drive in the file system, which the TVE allows. In this case, access commands for reading and writing act directly on the selected directory.

The requested directory shall either be empty (default behaviour) or the absolute pathname, preceded by a drive specifier, if supported on the TVE.

A value written with command SET may be relative (e.g. ".." or "subdir") provided that an absolute path was specified before. Specifying a relative path from the default directory shall result in a NAK-ID frame with value 10710 according to Table 17.

7.10.5 Creating a directory (variable MKD)

Variable	FTL,FS,MKD=V
Kind	Value, optional
Set	Tries to create the given directory (may be relative).
Value V	Pathname, consisting of an optional drive—specifier and a list of subdirectories. [<drive>:][<path>]

Creation of relatively specified subdirectories in the default directory shall be denied.

EXAMPLE   SET,FTL,FS,MKD=b:\\datadir

7.10.6 Opening directories or files (variable FILE)

Variable	FTL,FS,FILE=V
Kind	Value, optional
Set	Sets a new file command (opening, closing etc.).
Value V	Filemask, data format, access mode etc. <filename>,<mode>[,[<fmt>][,<fileptr>[,<size>]]] See description in Table 8.

Table 8 — Description of fields in value V

Field	Type	Description	
<filename>	C12	Name of file or directory in current directory without path or drive specifier. The naming convention of 8+3 DOS shall be used. For <mode>="S" DOS wildcards like "?" and "*" shall be allowed.	
<mode>	C	Mode of access or command.	
		ID	**Description**
		A	Shall open file for writing and set file pointer to its end. If the file does not exist already, it shall be created.
		C	Shall create new file for writing. If the file exists already, it shall be deleted before.
		D	Shall close a file, that has been opened for reading and shall move it to the subdirectory DONE. If the latter directory does not exist yet, it will be created first. <filename> can be omitted; it shall be ignored anyway.
		E	Shall erase the given file or directory, if it exists. In case of directories, the given directory shall not contain any further files or directories.
		R	Shall open file for reading and set file pointer to its start.
		S	Shall open the current directory and return the directory listing as a file, whereas <filename> may be a mask with wildcards "?" and "*" for only returning a subset of the files in directory. The TVE shall not return the directory entries "." and "..". Each line return shall have the following format: <file/dir>,<type>,<size>,<time> (optional extendable) The special nodes "." and ".." may not be contained. Field code according to FTL (C128,C1,N10,S). <file/dir> = name without path and drive (if so also 8+3-convention required) <type> = (F)ile or (D)irectory <size> = 0 for directories <time> = time stamp of the last modification (optional) Empty fields shall appear for not available values.
		F	Shall close the file. This shall be called by the OBC after writing to file. If the file is already closed, this command shall be silently ignored. <filename> can be omitted as it shall be ignored anyway.
		W	Shall open file for writing and set file pointer to the position given in argument <fileptr>. If the file does not exist already, it shall be created. If <fileptr> is greater than the size of the file, this mode shall have the same meaning as mode A. If working in the default directory, this mode shall only operate in the writing area.

Field	Type	Description	
		Y	Shall calculate a checksum according to the checksum algorithm used for frames. The checksum shall be generated over the amount of bytes defined by argument <size> starting in the file at position given by argument <fileptr>. If <size> is not given or set to 0, all bytes from position <fileptr> up to the end of the file shall be covered. If working in the default directory, files in reading area shall be accessed. The checksum is returned as if a file has been opened in reading mode.
		Z	Shall operate exactly like mode Y, but if working in the default directory, files in the writing area shall be accessed.
<fmt>	C	Format for data transfer.	
		ID	Description
		A	ASCII-mode (default). Data shall be regarded as plain text, formatted in C—style.
		B	Binary mode in hexadecimal notation. See formatting of value in section for further explanation.
		6	Binary mode in BASE64-encoding, see 7.3.9 Data shall be encoded according to the Standard BASE64. Three bytes are encoded into four graphic characters, thus, overhead is much smaller than in <format>="B". Total length of output shall be an integer multiple of four. Trailing equal-signs flag, how many bytes are missing to an integer multiple of three in the input data (in other words: input_len modulo 3 can have three results, 0 means no equal sign, 1 means "==" and 2 means "=").
<fileptr>	H8	Shall position the file pointer to the given value after opening the file. It is recommended to use <fileptr> only when opening a file in binary mode.	
<size>	H8	Shall only be used in conjunction with mode Y and Z (see for description there)	

Files, that are newly created, shall stay "invisible" until they have been closed properly. This may be realized with temporary files or files in a temporary directory.

7.10.7 Accessing files or reading directories (list DATA)

Variable	FTL,FS,Data=V
Kind	List, optional
Enquiry (list)	Returns the contents of the opened file, when it has been opened for reading.
Set (list)	Adds data to the opened file, when it has been opened for writing.
Value V	Data, which shall be formatted according to the way the file is opened for (<fmt> in FILE).

<data> shall be formatted according to the <fmt>-setting in Table 8.

Data shall not be written linewise, although the file has been opened in ASCII-mode. A line in <data> shall be explicitly terminated by "\n". Line endings shall be converted on source and/or target system, when necessary (e.g. to "\r\n").

When transmitting data in ASCII-mode format convention according to Cx of Table 3 shall be used.

7.11 Auxiliary (subnode AUX)

7.11.1 Outputs (array OUT)

Variable	FTL,AUX,OUT(n)=V
Kind	Array, optional
Enquiry	Returns a list with the current state of all fleet specific outputs
Enquiry (n)	Returns the current state of fleet specific output n.
Set (n)	Sets fleet specific output n to the given value.
Format	B: (Boolean)

Some TVEs might not be able to determine the real status of an output. In this case, on a request the TVE shall return the state, that has been set last time.

EXAMPLE   ENQ,FTL,AUX,OUT(3)

              REP,FTL,AUX,OUT(3)=0

7.11.2 Inputs (array IN)

Variable	FTL,AUX,IN(n)=V
Kind	Array, optional
Enquiry	Returns a list with the current state of all inputs.
Enquiry (n)	Returns the current state of input n.
Format	B: (Boolean)

EXAMPLE   ENQ,FTL,AUX,IN(2)

              REP,FTL,AUX,IN(2)=1

7.12 Order management (subnode ORDER)

7.12.1 General

It shall be used to handle single orders, where an order may consist of several order positions. Before the order is executed, OBC shall transmit all details of the order to TVE.

While the order is being processed by TVE, OBC may interrogate the state of the order. No changes of the order are permitted during processing.

When TVE has finished (or aborted) order processing, OBC may interrogate the order details from TVE.

7.12.2 General order data (ORDER)

It shall contain general header data which are valid for all positions, namely address information. Data may be used by TVE when printing tickets, or when asking the driver for confirmation of order processing.

Variable	FTL,ORDER,Order=V
Kind	List limited to one element, optional
Enquiry	Returns a record with data fields as described in Table 9
Set	Set the order header to the given value
Clear	Clear ORDER.Order, ORDER.Plan, ORDER. Delivery and set ORDER. State to zero.
Format	See Table 9

Table 9 — Structure of record "ORDER.ORDER"

Index	Field name	Data type	Required	Description
0	ord_no	C16	-	Order number of host (back office) system
1	cus_no	N8	-	Customer number as provided by host
2	name01	C30	-	Name of customer
3	name02	C30	-	Name of customer, line 2
4	name03	C30	-	Name of customer, line 3
5	street	C30	-	Name of street, including house number
6	area	C30	-	Area / region / …
7	city	C30	-	Name of town
8	cntry	C30	-	Country
9	txt01	C30	-	Free text field 1
10	txt02	C30	-	Free text field 2
11	geo_long	N4.6	-	#L0802
12	geo_lat	N3.6	-	#L0803
13	max_dist	N8	-	Maximum distance between TVE position and position given by index 11 and 12
14	stat_ok	N1	-	geofencing 0 use TVE defaults 1 manual override by OBC 2 correct position detected by OBC
15	stat_type	N1	-	0 tank vehicle 1 gantry 2 refinery 3 workshop 4 service station 5 client 6 trailer
16	op_flags	H1	-	Permitted operations Bit0: discharge permitted Bit1: loading permitted Bit2: Service functions permitted (e.g. workshop)

Index	Field name	Data type	Required	Description
17	bypass	H2	-	Explicitly allowed bypass, driver shall choose bypass after warning message if no sensors are connected
				Bit0: magnetic product code
				Bit1: electrical product code (PID according to EN 14116)
				Bit2: overfill protection system assignment
				Bit3: vapour recovery hose assignment
				Bit4: overfill protection system present
				Bit5: vapour recovery hose present
				Bit6: hose supervision system present
18	defbypass	H2	-	Shall be bypassed for this location without confirmation of driver if no sensors are connected
				List according to index 16
19	nevbypass	H2	-	May in no case be bypassed
				List according to index 16
				Values logic "OR" `d
NOTE				For bits which are not set in index 16 to 18 the set up values of TVE are relevant.

The TVE shall be configurable not to allow any delivery unless a data set is set in the node "ORDER.ORDER" with an order number greater than 0.

7.12.3 Orderplan (list PLAN)

Variable	FTL,ORDER,Plan=V
Kind	List, optional
Enquiry	Returns a list of records according to Table 10
Set	Adds one entry to the list of planned order positions. New ORDER.Plan may be added at any time
Format	See Table 10

Table 10 — Fields of records of ORDER.PLAN

Index	Field name	Data type	Description
0	plan_id	N2	unique index number of this position (will be used by TVE when returning order results)
1	art_no	N3	short product identification number (usually index in product table of TVE)
2	art_id	C16	host article "number" to identify the product
3	art_txt	C30	host article name
4	unit_msr	N1	See #L1007 unit of measure
5	ord_amnt	N8.2	Quantity ordered (positive number in case of delivery, negative number for loadings)
6	base_tmp	N2	base temperature in centigrade, if the quantity given in ord_amnt is a temperature compensated quantity, or zero if the quantity is gross volume
7	dens_t0	N6.1	Density of product in kg m^{-3} at base temperature
8	cpt_no	N2	compartment number referred, or 0 if free choice by driver
9	tnk_loc	N12	tank number or PID serial number of the target tank (or loading arm)
10	met_prd	N2	metrological product code according to EN 14116 message #2
11	pmp_rate	N4	maximum flow rate for deliveries (0 = don't care)
12	ord_no	C15	host order number for this position
13	del_path	N2	desired delivery path according to #L4206, or empty if free choice
14	down_grade	N1	Downgrade: 0 allowed according to current state of downgrade matrix 1 not allowed
15	PID_grade	N3	0 loading of any grade allowed > 0 grade of product to be loaded, i.e. loading of product grades not identical to PID_grade shall be prohibited by TVE. Met_prod and PID_grade shall be consistent.

7.12.4 State of order (variable STATE)

Variable	FTL,ORDER,State=V
Kind	Value, optional
Enquiry	Returns the status of the current oder.
Value V	Numerical code according to the following list: 0 undefined, no order present 2 order data received, at least one order plan item present, TVE ready for processing 3 planned order is being processed 4 unplanned order in process (manual start on TVE, if enabled) 9 order processing finished, but with error 10 order processing finished without error

When the subnodes ORDER and PLAN have been provided by the OBC, the order will now be processed by the driver, using the TVE user interface.

7.12.5 Return of delivery data (list ORDER.DELIVERY)

The data in this list is automatically cleared with command CLEAR to subnode ORDER or PLAN.

The data is only final (i.e. no longer subject to modifications) when the value read back in ORDER.STATE is 9 or 10.

Variable	FTL,ORDER,Delivery=V
Kind	List, optional
Enquiry	Returns a list of all processed deliveries of the current order.
Format	#L11_TRANSFER, the time stamp shall be included #L1101.

7.13 Goods and service database

7.13.1 General

To provide information about articles and their compatibilities a separate subnode "product" may be implemented.

7.13.2 Product definition (subnode PRODUCT.ARTICLE)

Variable	FTL,PRODUCT,ARTICLE
Kind	List, optional
Enquiry	Returns the list of all goods and service
Set	Adds a new record to the list.
Clear	Removes all records from the database on the TVE.
Value V	See Table 5, A00 to Ann of EN 15969-2:2011. A00 is only included for compatibility reasons and shall be ignored by the TVE.

7.13.3 Compatibility matrix (subnode PRODUCT,OVERRIDE)

Under special circumstances it may be desired for economical or ecological reasons to "downgrade" a product at discharge or at loading time. The decision may not entirely be up to the driver, but restrictions should apply. It shall be possible to dynamically modify these restrictions from case to case, i.e. for one specific order.

Since downgrading is at least partially in contradiction with the idea of crossover prevention, and there is also a danger that it may be abused for fraud, this subject is to be handled with great care and precautions should apply for any implementation (see proposal below).

Examples showing all three types of downgrading actions which might be needed:

— Downgrade while delivering:

    A planned delivery of RON95 is not possible because there is no more, or not enough of this product on board. The driver shall be permitted to deliver the "better" product RON98 into the tank, which would normally be prohibited by the COP system.

— Downgrade while loading:

    The depot is running out of supply of RON95. In this case, a compartment scheduled to be loaded with RON95 may be loaded with RON98 instead, but for the rest of the trip the product is to be treated as if it were RON95. If the compartment to be loaded is empty, downgrading would not be necessary (it could be

done at discharge time instead). Downgrading while loading is necessary, however when the compartment contains a residual quantity of RON95 upon arrival on the depot.

— Downgrade of residuals in the compartment:

The vehicle returns with a residual of RON98 to the depot. The compartment with the residual is scheduled to be loaded with RON95. Instead of dumping the residual into a slop tank, it shall be possible to downgrade the residual product in the compartment so that loading with RON95 is then possible.

A suitable mathematical presentation of all downgrading operations which could be thought of is a matrix, containing in the rows all source products, and in the columns all destination products. Since the number of products should not be restricted, the complete matrix could become a rather voluminous data set. It may safely be expected that this matrix is sparse, i.e. apart from the diagonal elements with implicit value = 1, only very few of the non-diagonal elements will contain values different from 0. Thus, instead of transferring the complete matrix, only the non-diagonal elements different from zero shall be transferred. The number of these elements should not be limited, thus the node type to be used for this purpose is a list.

Variable	FTL,PRODUCT,Override=V
Kind	List, optional
ENQUIRY	Returns a list of records according to Table 11
SET	adds another entry to the override matrix which may relax or tighten an existing compatibility condition of the setup table.
	If a corresponding entry does not exist in the setup table or if max_ratio is less than that fixed in the setup table, the SET command shall be answered with a NAK.
CLEAR	Clears the override table, leaving the setup table in force.
Format	See Table 11

Table 11 — Fields of records COMPATMAT

Index	Field name	Data type	Description
0	grade_src	N3	PID grade code of the (pure) product to be "degraded"
1	grade_dst	N3	PID grade of the product to which the source product is to be added
2	condition	N2	condition code for compatibility 0: mixing is not allowed 1: mixing is allowed without any special limitation, but the driver is asked / warned before the mixing takes place. 2 to 8: mixing is only allowed after the driver acknowledges an additional question, which may vary with the type code. The coding for all reasons with code 2 and above is not subject to this standard. 9: Grade_dst product is not permitted to be loaded if the previous compartment load was grade_src product, even if the compartment is empty e.g. to prevent contamination by vapour phase. Example: an attempt to downgrade a product under the condition code 2 may lead to the question: "Did you obtain the ok of your dispatcher for this downgrade?" Only if the driver acknowledges this question with yes, the valve will open.
3	max_ratio	N4	If different from zero, this figure denotes the maximum permitted contamination of the source product by residuals of the product with grade_dst: grade_src / grade_dst ≥ max_ratio. Example: If max_ratio is 100, the delivered quantity of grade_src shall be at least 100 times of the residual quantity of grade_dst.
NOTE			PID-grade refer to the field name "Grade" in PID message #1 according to EN 14116.

Variable	FTL,PRODUCT,Setup=V
Kind	List, optional
ENQUIRY	Returns a list of records according to Table 11
Format	See Table 11

7.14 FTL—logfile (subnodes LOG)

7.14.1 File structure

Variable	FTL,LOG,LH_file
Kind	List, required
ENQUIRY	Returns a list of static data records e.g. configuration
Format	Record type, time stamp, type specific data

Variable	FTL,LOG,L_file
Kind	List, required
ENQUIRY	Returns a list of event based records
Format	Record type, time stamp, type specific data

The first part (LH_file) contains static information about the TVE system whereas the second part (L-file) contains all event based (dynamic) data.

The purpose of this separation of static and dynamic data is to avoid redundant data transfer. The static data is necessary to interpret the meaning of the dynamic part. If the OBC requests the log file data frequently, e.g. every minute, and the static data would precede the dynamic part every time, this would cause a lot of redundant data transfer. This is avoided when the header is transferred separately, i.e. the OBC requests the header data only once, e.g. at the start of the shift.

7.14.2 Record structure

The structure of each record is given by the record type as defined in the dataset_id field.

The first field of each record contains the record type code and may be used to retrieve the structure according to Table 13.

The second field of each record contains a time stamp which is related to the time at which the corresponding event happened.

7.14.3 Field names

Each field is described by an alphanumeric code, starting with "L" (for "L-File" or "LH-File"), followed by two digits for the record type, and two more digits for the sequence number of the field within the record (numbering starts at 0).

Within the text, references to fields shall be flagged by a preceding "#".

The additional descriptive field names shall be alphanumeric, having a maximum length of 10 characters, and shall be entirely composed of lower case characters.

7.14.4 Record description

Record types are grouped as described in Table 12 to facilitate decoding and improve readability of the protocol file.

Manufacturer specific data/events may only be included in records of type 91, 92 and 93. It is not allowed to use other record types than those contained in Table 13.

Fields in records marked as required (X) in Table 13 shall be completed if the applicable system is installed. Groups of fields marked as required (M) shall have at least one field of the group completed. However if a field is marked as required it does not mean that the complete record itself is required.

7.14.5 L file enquiry

The L file is requested with the datagram ENQ,FTL,LOG,L_FILE. No time or date start parameter has to be specified. Per default a L file shall start with the first record which is not reported at the last L file enquiry. This could be the first one of a new list of records, which was not available at the last time or it could be the first not positive acknowledged record of a cancelled transaction. Requesting the L file in intervals shall never build gaps or double records when succeeding L files are concatenate together on higher application layer.

7.14.6 Change of the starting point

If the L file shall start at a definite time a variable shall be set with this timestamp value.

Variable	FTL,LOG,TimeStamp=V
Kind	Value, optional
ENQUIRY	Returns the time stamp of the last reported L File record or the timestamp which was just set.
SET	Sets the start time stamp for the next L File enquiry.
Format	S (see Table 3)

7.14.7 Initiate log of current status of sensors (variable SNAPSHOT)

The status of a sensor is appended to the log file only when the sensor changes its state.

In case of sensors whose state changes rarely, e.g. a manipulation sensor, the sensor may be in an "alarm state" without showing any trace in the actual log file.

Variable	FTL,LOG,SNAPSHOT=1
Kind	Value, optional
SET	Set this value to 1 to initiate a snapshot recording in the actual L_FILE, on completion <ACK> is returned
Format	B (see Table 3)

The records generated by means of the SNAPSHOT command are marked in the L_FILE to distinguish them from being triggered by a change of the sensor state:

An event record #L20 with #L2002_event_code=61 precedes the first of the SNAPSHOT records, and an event record with #L2002_event_code=62 follows the last one.

Under certain conditions, TVE may by itself trigger a snapshot recording. Marking of the snapshot data block will be done in the same way.

Table 12 — Record type groups

Record type	Description
0 to 9	System data
10 to19	Measuring results
20 to 29	Operating data, e.g. working times
30 to 39	Reserved
40 to 49	Quality, safety and sealing data (e.g. crossover prevention, overfill prevention)
50 to 59	GSM-Data
60 to 69	Reserved
70 to 79	Reserved
80 to 89	Reserved
90 to 99	Maintenance data

Table 13— L file record types

Index	Field name	Data type	Required	Description
System data				
00 FTL_VERS				
Version number of FTL-protocol (->LH-File)				
L0000	dataset_id	N2	X	0
L0001	timestamp	S	X	Time stamp
L0002	ftl_vers	N2.2	X	1.00 FTL version code
01 DEVICE_ID				
Enumeration of devices (->LH-File)				
L0100	dataset_id	N2	X	1
L0101	timestamp	S	X	Time stamp
L0102	man_name	C32	X	Manufacturer name
L0103	dev_code	C16	X	Manufacturer specific device code
L0104	hard_vers	C8		Hardware version
L0105	hard_conf	C64		Hardware configuration
L0106	soft_vers	C8		Software version
L0107	soft_conf	C64		Software configuration
L0108	dev_id	N3	X	Unique code number for the device within the system (e.g. bus address). This number is used to identify the data source, also in case of several devices of the same type.
L0109	dev_serial	C20		Serial number of the device which shall be unique for each manufacturer.
L0110	app_name	C20		Name of application
L0111	seal_cnt	N8		Seal counter if present
02 VEHICLE_ID				
Vehicle identification (->LH-File)				
L0200	dataset_ID	N2	X	2
L0201	timestamp	S	X	Time stamp
L0202	veh_type	N1	X	Vehicle type 0 tank truck (rigid) 1 tractor 2 semitrailer 3 trailer 4 hydrant vehicle 5 IBC 6 other
L0203	veh_no	C16	X	Vehicle identifier (e.g. number plate)
L0204	tank_no	C20		Tank number
L0205	tank_man	C16		Tank-/vehicle manufacturer
L0206	pattern	C20		Pattern number or code
03 DRIVER_ID				
Driver identification (->LH-File optional)				
L0300	dataset_id	N2	X	3

Index	Field name	Data type	Required	Description
L0301	timestamp	S	X	Time stamp
L0302	drv_id	N6	X	Driver number
04	**TOUR_ID**			
trip number (->LH-File optional)				
L0400	dataset_id	N2	X	4
L0401	tour_start	S	X	Time stamp
L0402	tour_no	N6	X	Internal tour number
L0403	Tour_id	C16		Host tour number
05	**COMP_ID**			
Company (->LH-File optional)				
L0500	dataset_id	N2	X	5
L0501	timestamp	S	X	Time stamp
L0502	comp_id	N3	X	Company code
L0503	bra_id	N3		Branch code
06	**TRUCK_SETUP**			
general truck configuration (->LH-File)				
L0600	dataset_id	N2	X	6
L0601	timestamp	S	X	Time stamp
L0602	outp_drv	N2		Number of power outputs (e.g. pneumatic valve drivers)
L0603	dip_stick	N1	X	Electronic dipstick system 0 no dipstick system 1 dipstick not metrologically approved 2 dipstick metrologically approved
L0604	delv_type	N1	X	Tank truck type 0 undefined 1 direct outlet 2 flow metering system(s) (with collector(s)) 3 Hybrid system (1 and 2)
L0605	delv_side	N1	X	Delivery side(s)
L0606	load_side	N1	X	Loading side(s) 0 undefined 1 left 2 right 3 left and right 4 rear 5 left and rear 6 right and rear 7 left and right and rear Note Left and right as seen in the direction of travel.
L0607	no_cpts	N2	X	Number of compartments
L0608	no_ops	N1		Number of overfill prevention controllers according to EN 13616 (equal to the maximum number of simultaneously deliveries)

Index	Field name	Data type	Required	Description
L0609	bv_presbal	B		Bottom valves pressure balanced 0 no 1 yes
L0610	wleg_conf	N1	X	Wetleg configuration 0 none 1 one sensor low in each pipe 2 one sensor left, one right, both in low position 3 one sensor low, one sensor high in each 4 one sensor in each compartment 5 combination of 4 + 1 6 combination of 4 + 2 7 combination of 4 + 3 8 other configuration with four or more sensors
L0611	sep_cvctrl	B		In line valve individually controlled 0 no (valve opens with foot valve) 1 yes (valve opens independent of foot valve)
L0612	cab_lock	N1		Cabinet monitoring / locking0 none 1 cabinet monitoring 2 cabinet locking 3 combination of 1+2 4 cabinet lock monitoring 5 reserved 6 combination of 4 + 2 7 combination of 4 + 3
L0613	load_mode	N1		Foot valve control at loading time 0 all compartments open simultaneously 1 individual control for each valve
L0614	load_start	N1		Automatic load permissive according to EN 13922 0 none 1 when entering loading state 2 when connected (with loading arm)
L0615	load_stop	N1		Automatic deactivation of load permissive according to EN 13922 0 none 1 on error
L0616	ld_auto_op	N1		Automatic opening of loading valves 0 no 1 yes 2 no, if load plan has been entered manually
L0617	ld_auto_cl	B		Automatic closure of foot valve after loading
L0618	rpmon	N1		Automatic compartment empty test (using wetleg sensor while foot valve is open) 0 no 1 yes, with bypass 2 yes, no bypass
L0619	rpm_remop	B		Leave foot valve open after empty test
L0620	delv_lside	N1		Delivery on loading side through API coupling 0 no 1 yes, manual 2 yes, electro-pneumatic

Index	Field name	Data type	Required	Description
L0621	mhole_mon	N1	X	Manlid cover monitoring 0 none, free access 1 none, covers mechanically sealed 2 per compartment 3 common for all compartments
L0622	api_mon	B	X	API monitoring (of closed state)
L0623	bv_mon	N1	X	Foot valve monitoring 0 none 1 pneumatic monitoring of "closed state" 2 pneumatic monitoring of "fully opened state" 3 combination of 1 and 2 4 electromechanical monitoring of "closed state" 5 electromechanical monitoring of "fully opened state" 6 combination of 4 and 5
L0624	cv_mon	N1	X	In line valve monitoring as L0623
L0625	ops_type	N1		Overfill prevention (of own compartments) 0 none 1 sensors according to EN 13922 2 additional local overfill prevention acting on foot valves (e.g. for self loading)
L0626	ops_mon	N1		Logging of overfill status 0 no logging 1 sensor state according to EN 13922 2 sensor state of local overfill prevention system 3 both 1 and 2
L0627	dens_sens	B		Density sensor(s) present
L0628	water_sens	B		Water sensor(s) present
L0629	spds_sys	C1		A, B or C according to corresponding annexes of EN 15208:2014
L0630	spds_empty	N2		Type of empty detection according to EN 15208:2014, Table 2
07 COMP_PROP				
Properties of compartment (->LH-file optional)				
L0700	dataset_id	N2	X	7
L0701	timestamp	S	X	Time stamp
L0702	cpt_no	N2	X	Compartment number
L0703	capacity	N5	M	maximum permissible volume to be loaded in litres
L0704	min_pitch	N3.1		Signed value in degrees Minimum pitch angle at which emptying of the compartment is possible (positive pitch=nose up, negative pitch=nose down)
L0705	max_pitch	N3.1		Signed value in degrees Maximum pitch angle at which emptying of the compartment is possible
L0706	min_roll	N3.1		Signed value in degrees Minimum roll angle at which emptying of the compartment is possible (positive=right side up) Note Right as seen in the direction of travel.
L0707	max_roll	N3.1		Signed value in degrees Maximum roll angle at which emptying of the compartment is possible

Index	Field name	Data type	Required	Description
L0708	v_undelv	N4		Volume in litres assumed to remain in compartment and associated pipework if actual inclination is not in range specified by L0704 to L0707
08 GPS_INFO				
Position of vehicle				
Loss of GPS signal shall be logged with the last valid position (geo_qlty!=1) short before the loss.				
L0800	dataset_id	N2	X	8
L0801	timestamp	S	X	Time stamp
L0802	geo_long	N4.6	X	Longitude in degrees (positive values for east, negative values for west)
L0803	geo_lat	N3.6	X	Latitude in degrees (positive values for north, negative values for south)
L0804	geo_hght	N4	X	Altitude above seal level in metres
L0805	geo_qlty	N2	X	Quality of position data 0 no position data or unknown quality 1 Matching Postcode only 2 Matching Town only 3 Matching Postcode and Town (uncertain) 4 Matching Postcode and Town (exact match) 5 Matching up to Town district (uncertain) 6 Matching up to Street (uncertain) 7 Matching up to Street No. (uncertain) 8 Matching up to Town District (exact match) 9 Matching up to Street (exact match) 10 Matching up to Street No. (exact match) 11 GPS positioning (unknown quality) 12 Manually assigned in digital map 13 GPS positioning (dead reckoning) 14 GPS positioning (single measurement) 15 GPS positioning (differential) 16 GPS positioning (averaged)
L0806	sat_in_use	N2		Number of satellites used
L0807	hdop	N4	X	horizontal positioning error in metres (estimated from HDOP)
L0808	time_diff	N3		Time difference in seconds (local, GPS synchronised time — system time)
L0809	speed	N3		speed in km/h
L0810	drv_dir	N3		Driving direction, in degrees (0 to 359) (at rest, keep last direction before stop)
09 SYS_ERR				
Error messages				
L0900	dataset_id	N2	X	9
L0901	timestamp	S	X	Time of registration of the error condition
L0902	dev_id	N3	X	Device index L0108
L0903	error_code	N5	X	Error code according to Table 14 and Table 15
L0904	rcpt_no	N6		Measurement sequence number, see L1102
L0905	met_no	N8		Meter number see L1002
L0906	submod_id	N3		Manufacturer specific code for sub-module / sub-element of the device with the error condition

Index	Field name	Data type	Required	Description
L0907	err_add	N2	X	Number of error_info fields to follow, or 0 if no additional info is provided.
L0908+	err_info0... err_infon	C20		Manufacturer specific details about the error. Number of fields used shall match that given in L0907.

Measuring Data

10   METER_ID

measuring data (->LH-File)

Index	Field name	Data type	Required	Description
L1000	dataset_ID	N2	X	10
L1001	timestamp	S	X	Time stamp
L1002	cntr_no	N8	X	Metrological meter number
L1003	cntr_loc	N1		Location of meter 0 tank vehicle 1 gantry 2 refinery 3 workshop 4 service station 5 client 6 trailer
L1004	volsum_grs	N10.2		Gross total volume (unit of measure in L1007)
L1005	volsum_t0	N10.2		Net (temperature compensated) total volume (unit of measure in L1007)
L1006	met_no	C16	X	Metering point number(controller) identifier/number One controller may be connected to one or more metrological meter.
Index	Field name	Data type	Required	Description
L1007	unit_msr	N1		Unit of measure 0 litres 1 gallons 2 kilograms 3 cubic metres 4 millimetres 5 hPa (pressure) 6 pieces

11   TRANSFER

data of a terminated delivery / loading transaction

Remark: unmeasured loadings/deliveries shall not be logged.

Index	Field name	Data type	Required	Description
L1100	dataset_ID	N2	X	11
L1101	end_time	S	X	Date/time of end of transaction
L1102	rcpt_no	N6	X	Measurement sequence number at this meter, will be incremented for each delivery. The value 0 is not permitted.
L1103	dl_type	N1	X	Type of transaction 0 delivery from vehicle measured by vehicle 1 loading to vehicle measured by vehicle 2 delivery from vehicle measured by receiver 3 loading to vehicle measured by loader 4 planned delivery 5 planned loading 6 delivery from vehicle measured by loader
L1104	met_prod	N3	X	Metrological product code (EN 14116 Message #2)

Index	Field name	Data type	Required	Description
L1105	cntr_no	N8		Meter number L1002
L1106	unit_msr	N1	X	Unit of measure L1007
L1107	vol_grs	N8.2	M	Gross volume
L1108	vol_t0	N8.2	M	net volume (temperature compensated), if applicable
L1109	avg_temp	N4.1		Average temperature of liquid in centigrade
L1110	cpt_no	N2		Compartment number (if known and applicable)
L1111	del_path	N2		Delivery path L4206
L1112	add_no	N3		If additive was injected, additive short product code, otherwise 0
L1113	add_id	C16		Customer specific additive code (e.g. ordering number)
L1114	add_txt	C30		Customer specific additive name
L1115	add_vol	N4.3		Additive quantity in litres Negative value: injected before meter, i.e. the additive quantity is contained within #L1107 Positive value: injected after the meter, i.e. the additive quantity is not contained within #L1107
L1116	vol_sum	N10.2		Totaliser for this meter (gross volume)
L1117	start_time	T		Time of start of measurement
L1118	ord_amnt	N6.2		Quantity pre-set (last pre-set in case of several consecutive pre-set value are entered), or 0 in case of unlimited
L1119	art_no	N3		Short product code
L1120	art_id	C16		Customer specific product code (i.e. ordering number)
L1121	art_txt	C30		Customer specific product name
L1122	vol_weight	N6.2		Mass of product (kg)
L1123	plan_id	N2		Plan index (see node order.plan), or 0 if unplanned transaction
L1124	ord_no	C8		Host order number for this transaction
L1125	pmp_rate	N4		Average delivery/loading rate in unit as per L1106 per min
L1126	del_stat	N1		Measuring status 0 transaction completed successfully 1 aborted, reason: compartment empty 2 aborted, reason: customer tank full 3 other technical problem 4 transaction in progress (only online request of node delivery)
L1127	approved	B	X	Metrologically approved 0 not metrologically approved, see detail in L1136 1 metrologically approved
L1128	pid_man	N3		Manufacturer ID (of PID according to EN 14116, Message #1)
L1129	pid_serial	N8		PID serial number of PID mounted on loading arm or on customer tank according to EN 14116, Message #1
L1130	pid_grade	N3		Product grade according to EN 14116, Message #1, Field „Grade"

Index	Field name	Data type	Required	Description
L1131	object_id	N8		Terminal/station code according to EN 14116, Message #3; Loading rack or station identification number
L1132	gantry_id	N3		Gantry code according to EN 14116, Message #3
L1133	connect_id	N3		Loading arm or tank id according to EN 14116, Message #3
L1134	error	N5		Error code (L0903) of the most significant error, 0 means no error
L1135	add_error	N5		Error code (L0903) of the most significant error of the additive injection unit, 0 means no error
L1136	met_err	H8		Metrological error, see L1127: Bit 0 collector not empty Bit 1 power fail Bit 2 system not metrologically approved Bit 3 below minimum delivery volume Bit 4 maximum inclination of compartment exceeded Bit 5 inclination correction fault Bit 6 seal broken Bit 7 maximum flow rate exceeded Bit 8 below minimum flow rate Bit 9 pulse transmission error Bit 10 printer error Bit 11 temperature sensor Bit 12 soft ware failure Bit 13 memory failure Bit 14 backup battery failure Bit 15 product temperature too high Bit 16 product temperature too low Bit 17 air elimination failure Bit 18 other
L1137	deviations	H2		Deviations: Bit 0 additive volume Bit 1 preset not reached Bit 2 other
L1138	print_no	N2		Number of documents printed
L1139	stop_time	T		Time of end of measurement, if deviating from L1101 (e.g. in POS applications)
L1140	metp_no	C16		Metering point number L1006 (controller number)
L1141	tr_id	N15		Truck terminal identification number
L1142	lr_id	N15		Loading rack or station terminal identification number
L1143	lr_random	N5		Loading rack or station delivery session random number
L1144	reseal_t	S		last resealing time (frustrated delivery)
L1145	col_no	N1		Collector number L4207
L1146	signature	C150		Electronic signature (e.g. CRC 16 or elliptical curves)
12 DELV_MODE				
Start of a measured delivery/loading				
L1200	dataset_id	N2	X	12
L1201	start_time	S	X	Time of start / continuation of delivery/loading
L1202	cpt_no	N2		Compartment number, if known and applicable
L1203	del_path	N2		Delivery path L4206

Index	Field name	Data type	Required	Description
L1204	cntr_no	N8		Metrological meter number L1002
13 COMP_CONT				
content of compartment				
L1300	dataset_ID	N2	X	13
L1301	timestamp	S	X	Time stamp
L1302	cpt_no	N2	X	Compartment number
L1303	cntr_loc	N1		Location of meter L1003
L1304	met_prod	N3	X	Metrological product code according to EN 14116 Message #2
L1305	unit_msr	N1	X	Unit of measure L1007
L1306	vol_grs	N6.2	M	Gross content in compartment, unit of measure in L1305
L1307	vol_t0	N6.2		Net content in compartment, unit of measure in L1305
L1308	avg_temp	N4.1		Average temperature in grade Celsius (°C)
L1309	ullage	N6		Ullage, unit of measure L1305
L1310	unit_src_v	N1		Unit of measure of supplementary measuring value L1007
L1311	srv_val	N6.2		Supplementary measuring value (e.g. level, pressure) on which the volume calculation is based
L1312	pid_grade	N3		Product grade according to EN 14116, Message #1, field „Grade"
L1313	art_no	N3		Short product code
L1314	art_id	C16		Customer specific product code (i.e. ordering number)
L1315	art_txt	C30		Customer specific product name
14 DENSITY				
L1400	dataset_id	N2	X	14
L1401	timestamp	S	X	Time stamp
L1402	cpt_no	N2	X	Compartment number
L1403	met_prod	N3	X	Metrological product code according to EN 14116 Message #2
L1404	density	N4.1	X	Measured density in kg m^{-3}
L1405	temp	N4.1		Measured temperature in °C
15 INCLINOM				
vehicle inclination				
L1500	dataset_id	N2	X	15
L1501	timestamp	S	X	Time stamp
L1502	incl_pitch	N2.1	M	Pitch angle in degrees (positive: nose up)
L1503	incl_roll	N2.1		Roll angle in degrees (positive: right side up) Note Right as seen in the direction of travel.
L1504	in_p_stat	N1		Status of pitch angle measurement 0 undefined 1 valid result 2 out of range 3 not stable, value fluctuating
L1505	in_r_stat	N1		Status of roll angle L1504

Index	Field name	Data type	Required	Description
16 BATTVOLT				
battery condition				
L1600	dataset_ID	N2	X	16
L1601	timestamp	S	X	Time stamp
L1602	batt_src	N1	X	Power source 0 undefined 1 main battery 2 backup battery
L1603	batt_volt	N2.1	M	voltage
L1604	batt_stat	N1		Battery status 0 undefined 1 normal (within given limits) 2 high (pre-warning level exceeded) 3 low (below pre-warning level) 4 over voltage (warning level exceeded) 5 brown out (below warning level)
17 PRESSURE				
Measured value of pressure				
L1700	dataset_ID	N2	X	17
L1701	timestamp	S	X	Time stamp
L1702	cpt_no	N2		Compartment number if known and applicable
L1703	acc_path	N3	X	Access path (pressure sensor location) L4203
L1704	acc_state	N2		New state (beginning with time of recording) 0 undefined 1 over-/under-pressure 2 normal, no over-/under-pressure 13 under-pressure 14 over-pressure
L1705	acc_idx	N2		Index L4204 0 means not applicable If more than one of the elements specified in L4204 are installed, these shall be numbered from left to right or from front to rear, starting at 1.
L1706	press_val	N5	X	Pressure in hPa
Operational Data and Time Capture				
20 EVENT				
Event				
L2000	Dataset_ID	N2	X	20
L2001	timestamp	S	X	Time stamp

Index	Field name	Data type	Required	Description
L2002	event_code	N2	X	Event code
				0 undefined
				1 filter change
				2 end of pause
				3 start of pause
				4 end of maintenance
				5 start of maintenance
				6 reserved
				7 automatic change of time/date (e.g. daylight saving)
				8 end of trip
				9 start of trip
				10 end of order
				11 start of order
				12 end of measurement
				13 start of measurement
				14 end of shift
				15 start of shift
				16 power up
				17 flow rate out of range
				18 start loading mode (top)
				19 down grade confirmed
				20 start pipe volume test
				21 end of pipe volume test
				22 start empty test
				23 end of empty test
				24 drain sump
				25 start draining collector
				26 end draining collector
				27 start filling collector
				28 end filling collector
				29 supervisor check/confirmation
				30 to 48 reserved
				49 power down
				50 pumping duration
				52 duration of flow
				54 start of cruising or duration of cruising
				56 duration of preparation for delivery/loading (between arrival time and start of transaction)
				58 duration of post processing of delivery/loading (between end of transaction and departure)
				60 start or duration of a stop-over
				61 start snapshot registration

Index	Field name	Data type	Required	Description
				62 end of snapshot registration
				63 start of historic data (recorded with time stamps in the past)
				64 end of historic data
				65 start loading mode (bottom)
				66 end loading mode (bottom/top)
				67 start delivery mode
				68 end delivery mode
				69 start self loading mode
				70 end self loading mode
				71 start transfer mode
				72 end transfer mode
				73 operation not started because outside geo fence
				74 operation not started because object does not exist in database
				75 operation not started for other reasons
				76 internal monotonous sequence number, incremented on every occurrence, to be used with L21
				77 emergency stop
				78 start of loading plan change
				79 end of loading plan change
L2003	man_ts	S		(Manual) time stamp of event, if different from L2001
L2004	event_idx	N2		Index to L2002 identifying corresponding compartment number, meter number or similar
				0 means not applicable
				If more than one of the elements specified in L2002 are installed, these shall be numbered from left to right or from front to rear, starting at 1.

21   INTERVAL

time interval / duration of event

Index	Field name	Data type	Required	Description
L2100	dataset_id	N2	X	21
L2101	timestamp	S	X	Time stamp
L2102	event_code	N2	X	Event code L2002
L2103	interval	N5	X	Time interval / duration in seconds / sequence number

22   SHIFT

Shift

Index	Field name	Data type	Required	Description
L2200	dataset_ID	N2	X	22
L2201	timestamp	S	X	Time stamp
L2202	shift_code	N3	X	Customer specific shift code

23   ODOMETER

Mileage

Index	Field name	Data type	Required	Description
L2300	dataset_ID	N2	X	23
L2301	timestamp	S	X	Time stamp
L2302	odo_val	N6.1	X	Odometer reading

24   DISTANCE

distance driven

Index	Field name	Data type	Required	Description
L2400	dataset_ID	N2	X	24
L2401	timestamp	S	X	Time stamp

Index	Field name	Data type	Required	Description
L2402	odo_dist	N6.1	X	Distance driven since the last registration of record type 24.
25 AUTHENTLV				
Access authorisation/password level				
L2500	dataset_ID	N2	X	25
L2501	timestamp	S	X	Time stamp
L2502	login_ID	N6		Number of the account
L2503	level	N1	X	Authorisation level after password input 0 no authorisation 1 driver 2 to 8 intermediate level 9 metrological set up mode
L2504	status	N1	X	Result: 0 end of authorisation period 1 wrong password 2 login_ID invalid 3 metrological seal broken 4 correct password
L2505	req_level	N1		Requested authorisation level 0 unknown 1 driver 2 to 8 intermediate level 9 metrological set up mode
L2506	seal_cnt	N8		Seal counter present, see L0111
26 DATETIME				
change of date and time				
L2600	dataset_ID	N2	X	26
L2601	timestamp	S	X	Time stamp before change
L2602	initiator	N2	X	0 unknown 1 RTC re-synchronised system time 2 automatic day light saving time change 3 manually changed over diagnostic interface 4 manually changed at display 5 GPS synchronised system time 6 OBC synchronised system time on TVE 7 synchronised by radio clock 8 synchronised by network time server 9 unexpected change
L2603	ts_after	S	X	Time stamp after change
L2604	auth_level	N1		Authorisation level, see L2503
L2605+	manu_data			Further manufacturer data, if required.

Index	Field name	Data type	Required	Description
Quality, Protection, Sealing data				
40 COMP_STAT				
parcel / compartment state				
L4000	dataset_ID	N2	X	40
L4001	timestamp	S	X	Time stamp
L4002	cpt_no	N2	X	Compartment number
L4003	met_prod	N3		Metrological product code according to EN 14116 Message #2
L4004	cpt_state	N1	M	Compartment status 0 empty 1 not empty 2 as loaded 3 accepted 4 unknown
L4005	seal_state	N1	M	Parcel status 0 unknown 1 sealed 2 resealed after additional loading 3 seal broken 4 resealed after frustrated delivery 5 error 6 tampered
L4006	correl_st	N1		Correlation status 0 not used 1 guaranteed cargo 2 minimum guaranteed cargo 3 non-guaranteed cargo 4 empty parcel 5 unknown cargo 6 correlation error
41 PROD_INFO				
			loading/delivery information	
L4100	dataset_ID	N2	X	41
L4101	timestamp	S	X	Time stamp
L4102	cpt_no	N2	X	Compartment number
L4103	met_prod	N3	X	Metrological product code according to EN 14116 Message #2
L4104	dir	N1	X	Direction (seen from truck) 0 discharge (from truck) 1 loading (into truck)
L4105	stype_flgs	H1		Product sensor type Bit 0: API magnetic PID (only Germany) Bit 1: overfill prevention plug magnetic PID (only Germany) Bit 2: electronic PID according to EN 14116 Bit 3: manual input (bypass)
L4106	art_no	N3		Short product code
42 ACC_STAT				
access status				
L4200	dataset_ID	N2	X	42

Index	Field name	Data type	Required	Description
L4201	timestamp	S	X	Time stamp
L4202	cpt_no	N2		Compartment number if known and applicable
L4203	acc_path	N3	X	0 undefined 1 foot valve / tank valve 2 API coupler 3 hatch, manlid cover 4 dip tube cover 5 product hose connection 6 pressure / pneumatic system 7 cabinet door 8 guard bar 9 hose connection to trailer 10 full sensor 11 in line valve (direct delivery) 12 wet leg high in pipe 13 wet leg low in pipe 14 wet leg in compartment 15 external wet leg 16 overfill sensor (EN 13922) 17 additional overfill sensor in compartment 18 collector valve (loading/discharge) 19 other valves, not electrically controlled 20 overfill prevention sensor in customer tank (e.g. thermistor according to EN 13616) 21 overpressure sensor in vapour return system 22 vacuum sensor in vapour return system 23 pump 24 emergency operation 25 handbrake 26 sabotage sensor (in electronic boxes) 27 dead-man button / alive button 28 electro-pneumatic valve 29 water detector 30 PID overfill prevention sensor in customer tank (EN 13616) 31 metrology seal 32 vapour return hose (separate) 33 vapour return hose (collective) 34 pressure sensor in compartment (top) 35 pressure sensor in compartment (bottom) 36 filter (e.g. pressure sensor) 37 control of pressure relief valve at pump 38 magnetic product code in overfill prevent socket 39 electronic product code PID (product hose) 40 electronic product code PID (vapour return hose) 41 automatic overfill prevention channel assignment 42 automatic vapour return hose assignment 43 vapour transfer valve 44 product return valve/adapter 45 remote control 46 electronic gas sensor 47 temperature limit sensor 48 emergency stop

Index	Field name	Data type	Required	Description
				49 delivery valve
				>100 free for manufacturer specific extensions
L4204	acc_state	N2	X	New state (beginning with time of recording)
				0 undefined
				1 closed
				or wet
				or over-/under-pressure
				or (hose) connected
				or pump in forward direction
				2 open
				or dry
				or no over-/under-pressure
				or (hose) disconnected
				or pump in backward direction
				3 moving (between 1 and 2)
				4 uncovered
				5 short circuit
				6 circuit break
				7 manipulation
				8 valve/actor control signal for "open" or "pump forward"
				9 valve/actor control signal for "closed" or "pump stopped"
				10 pump control signal for "pump backwards"
				11 deactivated
				12 (re-)activated
				15 closed and locked
				16 attempt to open prevented by cross over prevention system
L4205	acc_idx	N2		Index to L4204
				0 means not applicable
				If more than one of the elements specified in L4204 are installed, these shall be numbered from left to right or from front to rear, starting at 1.
L4206	del_path	N2		Delivery path or hose connection
				0 not applicable
				1 dry hose, gravity, unmeasured
				2 dry hose, pumped, unmeasured
				3 dry hose, gravity, measured
				4 dry hose, pumped, measured
				5 draining
				6 ... 9 wet hose Nr. (n − 5)
				10 … 13 wet hose Nr. (n − 9) at reduced flow
L4207	col_no	N1		Collector number, if applicable.
L4208	seal_tamp	H2		Seals tampered
				Sealed compartments that have been tampered due to this access,
				Bit 0: compartment 1
				Bit 1: compartment 2
				…
				Bit 15: compartment 16

Index	Field name	Data type	Required	Description
45 PID_INFO				
Raw data of connected PID				
L4500	dataset_ID	N2	X	45
L4501	timestamp	S	X	Time stamp
L4502	cpt_no	N2	X	Compartment number
L4503	acc_path	N3		Access path L4203
L4504	acc_idx	N2		Index L4205
L4505	del_path	N2		Delivery path L4206
L4506	col_no	N1		Collector number L4207
L4507	link_opsno	N1		Overfill prevention index, if assigned
L4508	met_prod	N3		Metrological product code according to EN 14116 Message #2
L4509	pid_grade	N3		Product grade according to EN 14116, Message #1, field „Grade"
L4510	pid_man	N3		PID manufacturer code according to EN 14116, Message #1
L4511	pid_serial	N8		PID serial number according to EN 14116, Message #1
L4512	pid_type	N1		PID type according to EN 14116, Message #1 1 Station liquid 2 Depot liquid 3 Station vapour 4 Depot vapour
L4513	cop_permis	N1		0 not supported or undefined 1 busy 2 no crossover 3 crossover 4 possible crossover
L4514	pid_vr	N1		Vapour return according to EN 14116, Message #1 0 vehicle configuration 1 reserved 2 no vapour recovery 3 vapour recovery required
L4515	pid_msgcnt	N2		Number of additional messages (except message #1), or 0
L4516	object_id	N8		Depot/station code according to EN 14116, Message #2
L4517	island_id	N3		Island code according to EN 14116, Message #2
L4518	coupl_id	N3		Coupling code according to EN 14116, Message #2
46 BYPASS				
Manual bypass of a sensor or condition.				
Cancellation of a previously activated bypass condition shall be logged with "0" in field L4604.				
L4600	dataset_id	N2	X	46
L4601	timestamp	S	X	Time stamp

Index	Field name	Data type	Required	Description
L4602	cpt_no	N2		Compartment number if known and applicable
L4603	acc_path	N3	X	Sensor/access path L4203
L4604	org_state	N2		State before bypass L4204
L4605	acc_idx	N2		index L4205
L4606	del_path	N2		Delivery path L4206
L4607	col_no	N1		Collector number L4207
L4608	byp_state	N2	X	Manually entered bypass condition L4204, 0 means cancellation of an existing bypass condition.
L4609	byp_reasn	N2	X	Code for reason of the bypass: 0 unknown, undefined 1 technical problem on truck 2 technical problem on gantry 3 technical problem on service station 4 gantry not equipped 5 service station not equipped 6 operational reason
L4610	byp_detail	N2		Customer specific classification for bypassing to detail L4609
L4611	auth_level	N1		Authorisation level, see L2503
47 ABORT				
Transaction was aborted or a transaction was blocked by the COP system				
L4700	dataset_id	N2	X	
L4701	timestamp	S	X	Time stamp
L4702	cpt_no	N2		Compartment number if known and applicable
L4703	del_path	N2		Delivery path L4206
L4704	col_no	N8		Collector number L4207 or metrological meter number L1002
L4705	block_rsn	H4		Reason for abort: Bit0: invalid /not matching magnet code Bit1: invalid /not matching PID Bit2: no assignment of overfill prevention Bit3: vapour recovery not ok Bit4: overfill prevention triggered Bit5: danger of product cross over Bit6: no product hose connection Bit7: no product identification Bit8: magnet code and PID different Bit9: wrong current profile of overfill prevention system Bit10: no vapour hose assignment Bit11: wrong PID type Bit12 to Bit15: reserved

Index	Field name	Data type	Required	Description
GSM-Data				
51 GSM_STATUS				
GSM data (ref. GSM V7.07)				
L5100	dataset_ID	N2	X	51
L5101	timestamp	S	X	Time stamp
L5102	sgl_strgth	N2	X	Field strength (AT+CSQ)
L5103	area_code	N5		Local area code (AT+CREG)
L5104	cell_code	N5		Cell ID code (AT+CREG)
L5105	oper_code	C16		Operator code (AT+COPS)
52 GSM_CALL				
GSM-connection data				
L5200	dataset_ID	N2	X	52
L5201	timestamp	S	X	Date/time of end of connection
L5202	call_dir	N1	X	Direction of call 0 going 1 incoming
L5203	call_type	N1	X	Type of connection 0 voice call 1 data call 2 GPRS connection
L5204	call_id	C16	X	Subscriber number of called/calling device, including country code (e.g.+49 for Germany) In case of GPRS connection: IP-Address assigned to local GSM modem
L5205	call_state	N1	X	Connection result 0 success 1 no answer 2 busy 3 no carrier 4 network overload
L5206	call_time	N4		Duration of connection in seconds
L5207	tx_bytes	N8		Bytes sent
L5208	rx_bytes	N8		Bytes received
L5209	retx_cnt	N3		Number of retrials (if applicable)
53 SMS_CALL				
SMS-data				
L5300	dataset_ID	N2	X	53
L5301	timestamp	S	X	Time stamp
L5302	sms_dir	N1	X	Direction 0 outgoing

Index	Field name	Data type	Required	Description
				1 incoming
L5303	sms_len	N3		Length of SMS (L5305)
L5304	call_id	C16	X	Subscriber number of called/calling device, including country code (e.g.+49 for Germany)
L5305	sms_text	C140		SMS body (plain text)
Maintenance Data				
90 CALIBR				
metrological configuration. (parameters under metrology control). For each product supported, one record shall be supplied (->LH-File)				
L9000	dataset_ID	N2	X	90
L9001	timestamp	S	X	Time stamp
L9002	cntr_no	N8	X	Metrological meter number
L9003	met_no	C16	X	Measuring point number
L9004	met_prod	N3	X	Metrological product code according to EN 14116 Message #2
L9005	base_temp	N3.1	X	Base temperature for this product (if temperature compensation is enabled)
L9006	density_t0	N4.1	M	Density in kg m^{-3} at base temperature
L9007	comp_coeff	N1.4		Thermal coefficient of expansion for this product in %/°C
L9008	tvc_type	N1	X	Temperature compensation method for this product 0 no temperature compensation 1 Method B according to DIN 51757: 2011 3 Method D according to DIN 51757: 2011 4 Method X according to DIN 51757: 2011 5 linear (using L9007)
L9009	cal	N2.4	X	Main meter factor (determined during official pre-verification)
L9010	flowrate1	N4		flow 1 in l/min
L9011	corr1	N1.4		Correction of #L9009 for flow between 0 and L9010, in %,
L9012	flowrate2	N4		Flow 2 in l/min
L9013	corr2	N1.4		Correction of L9009 for flow between L9010 and L9012 in %,
L9014+				Further flow correction data sets if required.
91 NODE_CONF				
device configuration (manufacturer specific) (->LH-File)				
L9100	dataset_ID	N2	X	91
L9101	timestamp	S	X	Time stamp
L9102	dev_id	N3	X	Device index L0108
L9103+	cnf_info0... cnf_infon			Manufacturer specific configuration data of the given device. Data may use as many fields as required, starting with L9103.

Index	Field name	Data type	Required	Description
92 NODE_STAT				
device status (manufacturer specific) (->LH-File)				
L9200	dataset_ID	N2	X	92
L9201	timestamp	S	X	Time stamp
L9202	dev_id	N3	X	Device index L0108
L9203+	sta_info0... sta_infon			Manufacturer specific status data of the given device. Data may use as many fields as required, starting with L9203.
93 DR_ACT				
Recording of driver actions for diagnostic purposes				
L9300	dataset_id	N2	X	93
L9301	timestamp	S	X	Time stamp
L9302	dev_id	N3	X	Device index L0108
L9303	act_type	N1	X	Type of action 0 undefined 1 key pressed 2 pneumatic control element actuated 3 vehicle control actuated 4 power down of supply 5 power up of supply 6 configuration/calibration mode activated 7 parameter modified
L9304	act_info0... act_infon			Manufacturer specific data of the given device/action. Data may use as many fields as required, starting with L9304.

Table 14 — Error groups

1. digit	Group	Description
0	Connection	General system errors (e.g. communication problems)
1	Meter data	Errors related to metering, temperature compensation, and sensors
2	Operational data	Errors related to time, distance, ...
3	Commercial data	Reserved
4	Quality, safety, seal	Errors relating to quality, safety and seal functions, e.g. overfill prevention
5	GPS	Errors related to GPS
9	maintenance	Errors relating to maintenance actions, (e.g. device replacement, re-calibration,...)

Table 15 —Source and type of error

2nd and 3rd digit	Source	Description
		NOTE 4th and 5th digit = 00 means other type not specified below. Values above 50 may be used for custom errors which are not covered by the ones specified in this table.
00	Power supply	Error in power supply 4th and 5th digit: 01 power supply failure 02 other problem in power supply unit 03 back up battery low
01	Communication	Error in data communication 4th and 5th digit: 01 locally, between any two devices on the tank vehicle 02 between TVE and OBC 03 between TVE and station 04 between TVE and depot 05 between OBC and office
02	Printer	Error during printing 4th and 5th digit: 01 printer not ready 02 no paper
03	Actor/Sensor	Actor/Sensor error 4th and 5th digit: 01 product code 02 temperature sensor 03 pressure sensor 04 density sensor 05 meter chamber encoder 06 solenoid valve 07 hydraulic valve (with feedback)
04	Memory	Memory error 4th and 5th digit:

2nd and 3rd digit	Source	Description
		NOTE 4th and 5th digit = 00 means other type not specified below. Values above 50 may be used for custom errors which are not covered by the ones specified in this table.
		01 EEPROM checksum error 02 RAM checksum error 03 FLASH checksum error 04 NVRAM checksum error 05 removable memory error
05	Display/audible	Fault with visual/audible signals 4th and 5th digit: 01 display 02 lamp 03 audible
06	Controller	Fault of the master controller of the TVE 4th and 5th digit: 01 watchdog faulty 02 watchdog has triggered 03 fault during activation 04 shortcut 05 fuse/breaker defective 06 buffer overflow 07 unknown reset 08 loss of real time 09 real time clock defective (hardware)
07	Magnetic card reader	Fault at reader or source 4th and 5th digit: 01 card fault 02 reader fault
08	Bar code reader	Fault at reader or source 4th and 5th digit: 01 card fault 02 reader fault
09	Chip card reader	Fault at reader or source 4th and 5th digit 01 card fault 02 reader fault
10	Device	Device fault 4th and 5th digit 01 I/O interface device (e.g. magnetic valve driver, input box...) 02 overfill protection device 03 PRD device 04 dip stick device 05 bubble detector device 06 additive dosing unit

2nd and 3rd digit	Source	Description
		NOTE 4th and 5th digit = 00 means other type not specified below. Values above 50 may be used for custom errors which are not covered by the ones specified in this table.
11	Configuration	Change of configuration The configuration and/or calibration of a unit/metering unit has been changed.
12	Meter	Fault measuring process (delivery/loading) 4th and 5th digit 01 maximum inclination exceeded 02 collector not empty 03 unauthorized opening of additional delivery path 04 paused for too long 05 no dip stick reading 06 volume counter error 07 too many encoder pulses out of phase 08 too many reverse encoder pulses 09 product temperature too low 10 product temperature too high 11 dry hose blow down pressure low 12 preset above loaded volume
13	Additive injection	Additive injection unit fault 4th and 5th digit 01 reservoir empty 02 product flow rate too high, not enough additive added 03 cycle fault
14	Database	Database fault 4th and 5th digit 01 driver database 02 location database 03 product database
15 to 48	Reserved	—
49	Miscellaneous	Other faults
50 to 99	Custom error sources	Defined by manufacturer for sources which are not covered by the sources specified in this table

7.15 Required variables

A FTL compatible TVE does not necessarily provide all nodes described in this standard. Table 16 shows the required variables which shall be present on each FTL compatible TVE.

Table 16 — List of required variables

Variables	Description
SYSTEM, FTL, VERS	FTL version
SYSTEM, DATETIME	Date and time
SYSTEM, NODELIST	List of supported nodes and variables
VEHICLE_ID	Information about the vehicle
LOG, LH_FILE	Static information about the TVE
LOG, L_FILE	Event data
PRN, TYPE	Information about connected printer

7.16 NAK ID

When the TVE cannot fulfil a command or any other error occurred, an appropriate error code shall be returned as NAK—ID according to Table 17 in a NAK-ID frame.

Table 17 — List of NAK-ID codes

Code	Description
00000	No error
10100	Unknown opcode received
10101	Unknown subnode or variable accessed
10102	Transmission of frame failed
10103	Type identifier not correct
10106	Array index out of boundaries
10107	Frame exceeded internal buffer size
10200	Assigned value was trimmed to fit buffer
10201	Assignment denied, incorrect frame
10202	Assignment denied, value out of boundaries
10203	Assignment denied, invalid value type
10300	Write access denied, variable read-only
10301	Write access denied, because subnode/variable in use
10302	Write access denied, list capacity exceed
10400	Time/date change not permitted out of bounds
10500	Printer occupied
10501	No paper in printer
10502	Printer offline
10503	Printer not reserved for OBC
10504	No answer from printer
10600	Subnode/variable not capable of notification
10700	Not enough disk space
10701	Invalid filename
10702	Invalid file access mode

Code	Description
10703	File does not exist
10704	File is read only
10705	No wildcards allowed
10706	Directory does not exist
10707	Can't create directory
10708	No file or directory given
10709	File/Directory not opened
10710	Relative path not permitted
10800	Communication fault between FTL-interface module and controller (within TVE)
10850	routing target temporarily not available (try again later)
10851	route does not exist
10852	TVE on route does not respond (but route exist)
≥11000	Custom error codes, defined by manufacturer

8 Routing for multiple TVE

8.1 Purpose

In an FTL connection, only two communication parties are involved. Sometimes it could be necessary, however, to link more than one TVE with the OBC, e.g. if a truck and a trailer are involved.

One solution for this problem is to use an OBC with two serial ports, both acting as clients addressing the servers separately.

8.2 Routing solution

However, it may also be useful for the truck system (TVE) to be able to exchange data locally with the trailer system (TVE2), see Figure 1. This could be accomplished by a kind of daisy-chain connection OBC---TVE---TVE2. Only one interface is used on the OBC, while TVE shall be equipped with two interfaces.

The OBC specifies separate node names to select the communication partner:

— FTL when addressing the truck (TVE), and

— FTL2 when addressing the trailer (TVE2).

TVE shall accept datagrams with both destination node names "FTL" and "FTL2" in this case. While the datagrams addressed to "FTL" shall be answered directly, those with the destination node "FTL2" shall be translated to the node name "FTL" and sent out by the second RS232 interface of TVE. The response received from the TVE2 server on the trailer shall then be translated back to the original "TVE" node name, and returned to the OBC.

Thus, for TVE2 it is no difference in the communication whether it is performed directly between OBC and TVE2, or whether it is handled through the gateway TVE.

8.3 Routing example

The following example demonstrates how the OBC would request the current input state from the trailer TVE2 through the gateway TVE, see Table 18.

Table 18 — Routing example

OBC ↔ TVE	TVE ↔ TVE2
ENQ,FTL2,SYSTEM,ln	
	ENQ,FTL,SYSTEM,ln
	REP,FTL,SYSTEM,ln(0)=1
REP,FTL2,SYSTEM,ln(0)=1	REP,FTL,SYSTEM,ln(1)=0
REP,FTL2,SYSTEM,ln(1)=0	

TVE shall translate the nodename FTLn to FTL[m], depending on the structure of communication or wiring. Consequently, daisy chains with more than two TVE in a line could be supported by translating FTL2 to FTL1 and so on.

9 Communication with office

9.1 General

Key
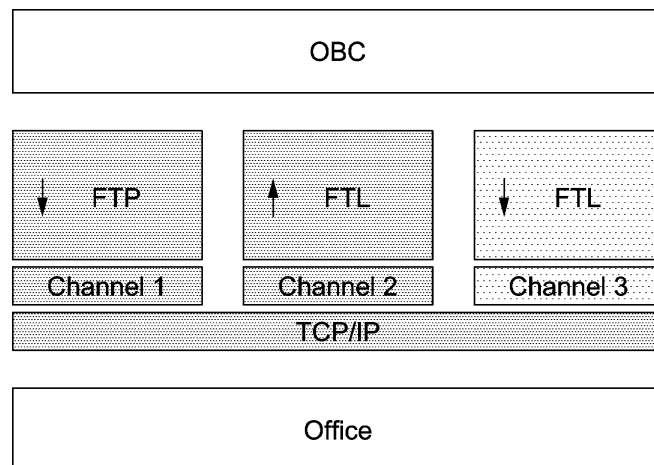
→   direction of communication (client → server)

For channel 1 and channel 3 the OBC is the client.

For channel 2 the office is the client.

Figure 14 — Connection paths OBC to Office

There are 3 channels available for communication with the office, see Figure 14.

— Channel 1 is used for simple file transfer.

— Channel 2 is used for direct connection initiated by the office.

— Channel 3 provides a separate channel for unsolicited reports.

Each subsequent channel requires the existence of the previous channel:

— to use channel 2, channel 1 shall exist;

— to use channel 3, channel 1 and channel 2 shall exist.

9.2   Simple file transfer

9.2.1   General

If the link between office and TVE is only used for occasional transfer of file structured data, e.g. at the end of shift, the mailbox method described below may be used to exchange any desired data, using standard FTP server software for the office side.

The procedure given below is a recommendation for the set up and operation of a simple file transfer facility.

9.2.2   FTP Server

The FTP server shall be accessed through a wireless network, using the standard TCP/IP protocol.

The FTP server shall support the following FTP standard operations:

— login (preferably individual, password protected accounts per TVE, if no other means of restricting data access are available);

— logout;

— change directory;

— list directory;

— make directory;

— file transfer in both directions;

— rename and delete files.

9.2.3   ASCII file format

An ASCII file shall consist of a sequence of lines. There is no limitation to line size.

Each line of an ASCII file incoming to the FTP-server shall be terminated by a CR LF sequence. When transferring FTL list data, e.g. L-file, they shall only contain the value part, see 6.2.1 (e.g. OpCode up to equal sign is not included).

When processing ASCII files outgoing from the FTP-server, LF shall be accepted as line terminator and CR, if present, shall be ignored.

9.2.4   Mailboxes

On the server, individual home directories shall be available for each TVE. The name of the home directory may for example be equal to the FTP user name used by each TVE to login to the server.

In each home directory, at least two subdirectories shall be available, or it shall be possible for the clients to generate such directories automatically after login.

The name of these subdirectories shall be fixed:

— "out" for the outgoing data (seen from the client, i.e. sent from client to office);

— "in" for the incoming data (seen from the client, i.e. sent from office to client).

In each of these directories, a subdirectory "done" shall exist, into which the files being processed shall be moved. Alternatively, a simpler mode of operation would be to delete the files being processed, but the "move" method has been proven to be more helpful in case of data transfer problems.

Additional application-specific subdirectories, e.g. for manufacturer specific data, may exist and may be processed during a session. The way this is done is not part of this standard.

9.2.5 Sequence of operations during FTP session

Each time a data transfer is performed by OBC, the client may follow for example this sequence:

— login to FTP server, using <username> and <password> specific for this OBC;

— change to home directory (if not by default done by server);

— check presence of "in" and "out" boxes, and if not present, create them;

— check presence of "in/done" and "out/done" boxes, and if not present, create them;

— change working directory to "out" box;

— upload all relevant data from OBC to the out box. As a minimum, L_FILE is generated as an ASCII file, see 9.2.3, with all events recorded since the last successful FTP transfer of L_FILE. Optionally, depending on OBC configuration, further files may be transferred, e.g. LH_FILE. Overwriting of files already existing on the server shall be avoided. For this purpose, the name of the file generated on the server shall be named LOG_CCYYMMDDhhmmss.FTL, where CCYYMMDDhhmmss is the time stamp of the opening of the file, according to Table 3;

— uploading of a file shall be initiated using a temporary name "_<filename>" to avoid potential conflicts with the processing software of the office, which might otherwise try to access a file while the upload is still in progress. Should a temporary file of the same name already exist, it should be considered as a residual of a previous unsuccessful transfer and may be erased. Only at the end of the upload, after closing the temporary file, it should be renamed to the final file name. For the purpose of this standard, files with names starting with an underline "_" character shall be considered as being temporary files and ignored by the processing software on the server side;

— after each successfully finished upload operation of a file, the appropriate file on the OBC side shall be marked as "transferred" to avoid double data transfer;

— the files within a directory may be transferred in any sequence;

— change working directory to "in" box;

— get a list of all files on "in" box, by performing a directory list command;

— process the list file by file, skipping temporary files whose name starts with "_";

— Each file shall be downloaded to the client, and after successful download, it shall be renamed from "<file>" to "./done/<file>" (where <file> is the actual name of the file being processed). Should renaming not be possible, because a previous file with the same name already exists, the new name shall be made unique by appending a time stamp ".ccyymmhhmmss" to the original name;

— perform other application specific operations, if the OBC is configured to do so (e.g. transfer manufacturer specific additional data in both directions);

— log off from the server.

The sequence of operations is provided for information only. The FTP session is controlled by the client and usually subject to OBC configuration and/or script files provided.

9.3 FTL over TCP/IP

9.3.1 General

Radio link/internet communication suffers from significant time delay.

To reduce handshake cycles and reduce total transmission time, requests and answers may be grouped to files. The files are then automatically transferred using FTP on a communication channel parallel to the FTL protocol channel, see Figure 14.

For channel 2 port number 49445 and for channel 3 port number 49446 shall be used.

9.3.2 Connecting to the office

If a static IP-address is assigned to the OBC, the office shall establish a socket connection to the server on port 49445 (channel 2, see Figure 14) when data is to be transferred.

If no static IP-address is assigned to the OBC, the following mechanism shall be used:

every time the OBC connects or reconnects to the network, the OBC shall establish a socket connection to the client on port 49445 (channel 2, see Figure 14). This allows the office to retrieve the current IP-address of the OBC.

The office may request further information about the identity of the OBC by

ENQ,FTL,Vehicle_ID.

NOTE 1   Office may support multiple simultaneous OBC connections.

NOTE 2   Safety mechanism can be required, e.g. SSL.

9.3.3 Batch processing of FTL transactions

A sequence of FTL transactions may be grouped to a batch file. The execution of the batch file shall initiated by writing to the node EXECBATCH.

SET,FTL,EXECBATCH={foldername}<filename>

where <filename> is a string describing an ASCII file (see 9.2.3) which shall be available on the FTP server addressed by folder name. If no folder name is specified the file shall be retrieved from the IN directory of the OBC of this vehicle on the office server, see 9.2.4.

The TVE server acknowledges this command right away, i.e. before "executing" the batch file.

It shall then initiate an FTP session (if an FTP session is not already active) and fetches the file.

The file shall only contain FTL compliant command lines, just the start and end flag and the checksum shall be omitted. The frame type characters shall be included in this file.

The OBC shall read the file using FTP on communication channel 1 and executes each transaction/line of the file one by one.

The result shall be written into an ASCII file (see 9.2.3), which shall have the file extension .FBR and shall contain exactly one FTL transaction per line. In the first line the initiating command shall be repeated. Each line of the input file shall be copied into the result file, followed by response frames.

After completion of the input file, the result file shall be transferred to the FTP server using the folder name given in the initiating command. If no folder name is specified the out folder of the vehicle on the office server shall be used.

EXAMPLE

File in IN directory, named e.g. "123.FBC" (for "FTL batch command file")

> EENQ,FTL,IN(0)

> ESET,FTL,OUT(3)=1

> EENQ,FTL,LOG,L_FILE

The result would be the following file, placed in the directory "out" and named "123.FBR" (for "FTL batch result file")

> ESET,EXECBATCH=abc

> a

> EENQ,FTL,IN(0)

> eREP,FTL,IN(0)=0

> ESET,FTL,OUT(3)=1

> a

> EENQ,FTL,LOG,L_FILE

> rREP,FTL,LOG,L_FILE=12,...

> rREP,FTL,LOG,L_FILE=34,...

> eREP,FTL,LOG,L_FILE=41,

In case of errors, these shall be included in the appropriate answer line.

Repeating the initiating command in the result file guarantees that there is always a result file, even if, for example, the command file could not be found during the FTP session.

9.3.4   News channel (channel 3)

The OBC cannot initiate any communication by itself on channel 2 because the office is the client. However, due to the propagation delay and the cost of the radio link between OBC and office a polling mechanism often is not suitable.

Therefore a separate channel called "news channel" with opposite direction is defined between OBC and office (channel 3). This channel shall only use the OpCode according to Table 19.

Operation	OpCode	Description
NEW	NEW	Sent by the server without preceding enquiry only through the separate news channel (channel 3, see Figure 14), if this channel exists. The syntax shall be identical to REP.

Similar to the notification node NOTIFY, the office may set up the node names for which it would like to receive news by the OBC through the news channel if their values change. To activate news transmission the node names to be monitored shall be written by the office to the node NEWS through communication channel 2.

SET,FTL,NEWS=FTL,COMP,STATUS

SET,FTL,NEWS=FTL,ORDER,PLAN

Whenever one of the specified nodes changes its value the OBC initiates a news event to the office using channel 3 as follows:

NEW,FTL,COMP,STATUS(1)=1,…

Should several changes occur between news messages only the actual/most recent state should be transferred.

10 Communication Examples

10.1 Examples for Basic Protocol Layer level

In these examples every character is mentioned to give the most detailed view.

1. Example for a SET operation to change the current time on the TVE:

OBC starts the communication to the TVE with an EOT-frame (45 character):

Frame				
Start-Flag	**Type**	**Content**	**End-Flag**	**Checksum**
2	E	SET,FTL,SYSTEM,DateTime=20081224200000	3	47E3

TVE response to the OBC with a ACK-frame (7 character):

Frame				
Start-Flag	**Type**	**Content**	**End-Flag**	**Checksum**
2	a		3	91B9

2. Example for an invalid ENQUIRY operation:

OBC starts the communication to the TVE with an EOT-frame (32 character):

Frame				
Start-Flag	**Type**	**Content**	**End-Flag**	**Checksum**
2	E	ENQ,FTL,xSYSTEM,yDateTime	3	45D6

TVE response to the OBC with a NAK-ID frame (12 character):

NAK-ID = 10101 >> Unknown subnode or variable accessed (see Table 18)

Frame				
Start-Flag	**Type**	**Content**	**End-Flag**	**Checksum**
2	n	10101	3	5351

3. Example for an operation with an invalid Checksum in the ACK-frame:

OBC starts the communication to the TVE with a EOT-frame (45 character):

Frame				
Start-Flag	**Type**	**Content**	**End-Flag**	**Checksum**
2	E	SET,FTL,SYSTEM,DateTime=20081224200000	3	47E3

TVE response to the OBC with an ACK-frame (7 character) with an invalid Checksum:

Frame				
Start-Flag	**Type**	**Content**	**End-Flag**	**Checksum**
2	a		3	91BX

OBC response to the TVE with a TEF-frame (7 character):

Frame				
Start-Flag	**Type**	**Content**	**End-Flag**	**Checksum**
2	T		3	C1AE

TVE response to the OBC with an valid ACK-frame (7 character):

Frame				
Start-Flag	**Type**	**Content**	**End-Flag**	**Checksum**
2	a		3	91B9

10.2 Examples for data protocol layer

In the examples in Table 20 Start-Flag, End-Flag, and Checksum are omitted. All examples of Table 20 are sent one after another, to show the toggling of the type character. The toggling continues throughout this whole sequence of examples.

Table 20 — Examples for data protocol layer

Direction	Frame type	Type character	Content
Example for simple SET transaction			
OBC → TVE	EOT	E	SET,FTL,SYSTEM,DateTime=20081224200000
TVE → OBC	ACK	a	
Example for ENQ transaction with invalid node name and NAK response			
OBC → TVE	EOT	I	ENQ,FTL,xSYSTEM,yDateTime
TVE → OBC	NAK	n	10101
Example for single ENQ transaction			
OBC → TVE	EOT	E	ENQ,FTL,SYSTEM,DateTime
TVE → OBC	EOT	e	REP,FTL,SYSTEM,DateTime=20081224200001
OBC → TVE	ACK	A	
TVE → OBC	ACK	a	
Example for multiple transaction (implicit ACK) First read and then correct real time clock setting of TVE			
OBC → TVE	EOT	I	ENQ,FTL,SYSTEM,DateTime
TVE → OBC	EOT	i	REP,FTL,SYSTEM,DateTime=20081224200001
OBC → TVE	EOT	E	SET,FTL,SYSTEM,DateTime=20081224200000
TVE → OBC	ACK	a	
Example for array element enquiry Get the status of the second input			
OBC → TVE	EOT	I	ENQ,FTL,AUX,IN(2)
TVE → OBC	EOT	e	REP,TDL,AUX,IN(2)=1
TVE → OBC	ACK	a	
Example for enquiry of complete array			
OBC → TVE	EOT	E	ENQ,FTL,AUX,IN
TVE → OBC	EOR	v	REP,TDL,AUX,IN(1)=1
OBC → TVE	ACK	A	
TVE → OBC	EOR	r	REP,TDL,AUX,IN(2)=1
OBC → TVE	ACK	A	
TVE → OBC	EOT	i	REP,TDL,AUX,IN(3)=1
OBC → TVE	ACK	A	
TVE → OBC	ACK	a	
Example for list enquiry Get the latest non-read entries of the log file			
OBC → TVE	EOT	I	ENQ,FTL,LOG,L_File
TVE → OBC	EOR	r	REP,TDL,LOG,L_FILE=20,20080510110805,16

Direction	Frame type	Type character	Content
OBC → TVE	ACK	A	
TVE → OBC	EOR	v	REP,TDL,LOG,L_FILE=42,20080510110823,,7,2
OBC → TVE	ACK	A	
TVE → OBC	EOT	e	REP,TDL,LOG,L_FILE=42,20080510110833,,7,2
OBC → TVE	ACK	A	
TVE → OBC	ACK	a	
Example for set operation on a list variable Transfer the list of all drivers to TVE			
OBC → TVE	EOR	R	SET,FTL,DRIVER,Drivers=1236,W.Wacker,DE,2468
TVE → OBC	ACK	a	
OBC → TVE	EOR	V	SET,FTL,DRIVER,Drivers=1257,T. Müller,DE,1351
TVE →OBC	ACK	a	
OBC → TVE	EOT	E	SET,FTL, DRIVER,Drivers=1246,G.Schmit,DE,5443
TVE → OBC	ACK	a	

Annex A
(normative)
Node tree

The node tree is given in Figure A.1.
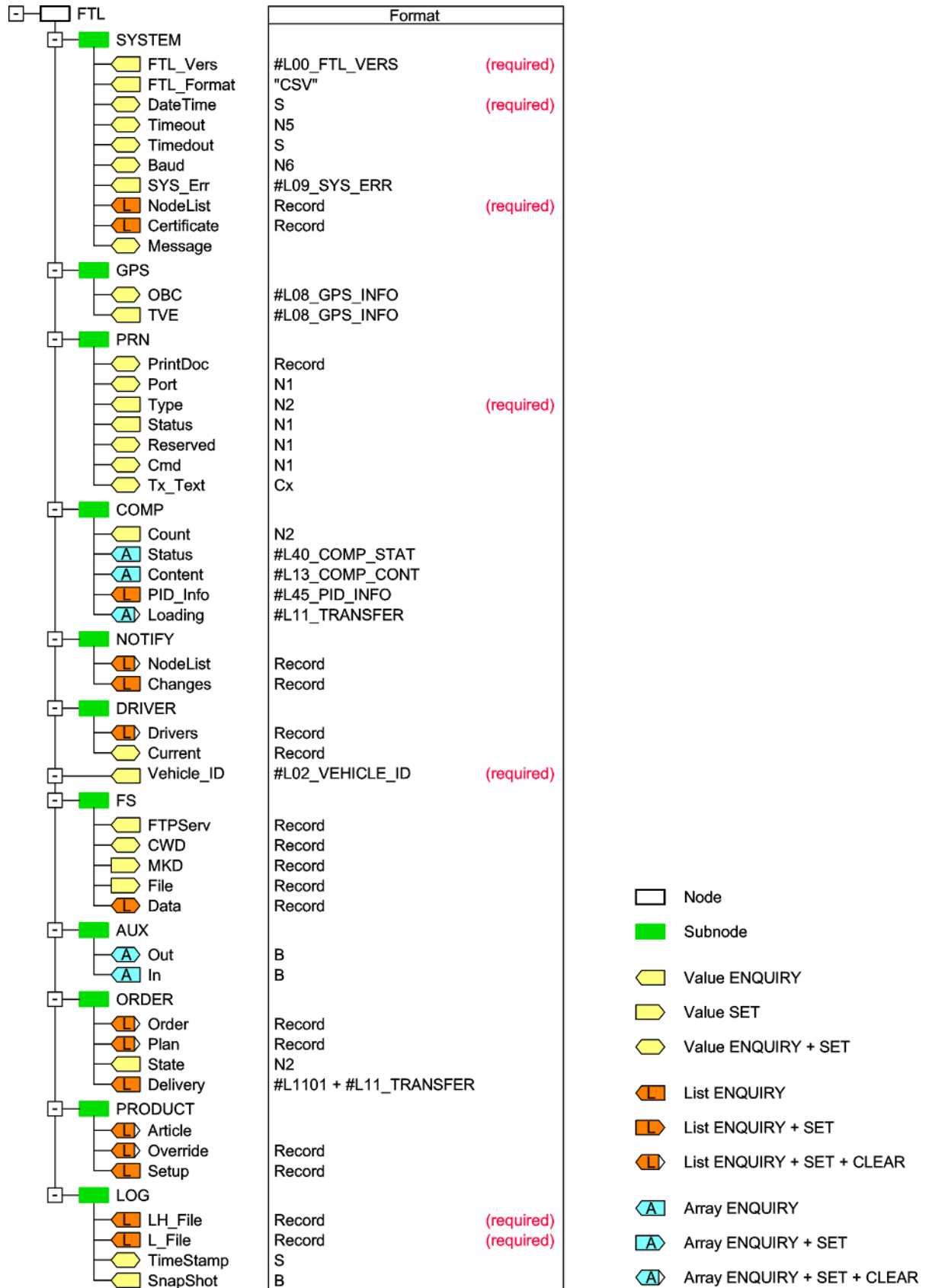
Figure A.1

Annex B
(normative)

Test FTL

B.1 Overview

This annex describes the test procedures which shall be used as a basis for test cases to determine the conformity of tank vehicle equipment.

These test features include:

— the basic protocol layer,

— the data protocol layer, and

— application related data contents and procedures.

For the test contents of the data protocol layer the required nodes shall be included as well as the optional nodes.

The tests shall be aimed at the communication of an OBC (client) with a TVE (server) via a serial RS 232 interface.

NOTE 1   Conformity to the standard does not guarantee interoperability.

NOTE 2   No test definitions are made for clients, e.g. on-board-computers (OBC).

B.2 Basic Protocol Layer

B.2.1 Frame Tests

The Basic protocol layer shall be tested by sending appropriate FTL-frames from client to server according to Table B.1.

Table B.1 — Tests for the basic protocol layer

Condition	Expected Result
length FTL-frame< 7 characters, 1st value STX (02h)	Server ignores FTL-frame
FTL-frame starts with STX, length and contents are valid, does not end with ETX	Server ignores FTL-frame
FTL-frame does not start with STX, length and contents are valid, ends with ETX	Server ignores FTL-frame
Client sends random characters and afterwards a valid FTL-frame	FTL-frame is accepted, random characters are ignored
Client starts communication with (valid) control frame	Server ignores FTL-frame
frame contains invalid type	Server sends NAK-frame with ID 10103

B.2.2 CRC-error

B.2.2.1 CRC-error on client side

1)   the client sends a valid FTL-frame with a wrong CRC to the server;

2)   the server answers with a TEF;

3)   the client corrects the CRC sum and sends the frame anew;

4)   the server answers with ACK.

B.2.2.2 Simulation of a CRC-error on server side

1)   the server sends a valid FTL-frame with a valid CRC to the client;

2)   the client answers with a TEF;

3)   the server sends the last sent frame anew;

4)   the client answers with ACK.

B.2.3 Delay and Timeout

The communication frames, including the answer delay of the server during all tests shall be recorded.

The answer delay shall be ≤ 1 s or SYN characters shall be sent according to 5.2 and 5.3 otherwise the complete examination shall be void.

The Frame Type characters of the server response frames shall be according to Table B.1.

B.3 Data Protocol Layer

B.3.1 Test of Toggling

All dataframes in a sequence shall use primary and secondary type identifiers in an alternating manner as described in 5.2.

1)   power up of system;

2)   enquiry of FTL,SYSTEM,FTL_VERS three times in a sequence;

3)   enquiry of FTL,SYSTEM,Nodelist;

4)   the type identifiers of the data frames shall match the Table B.2.

Table B.2 — Communication example Toggling

Type		Content	Remark / Test Condition
OBC	TVE		
E		ENQ,FTL,SYSTEM,FTL_Vers	First type identifier after power-up has to be "E"
	e	REP,FTL,SYSTEM,FTL_Vers=1.00	First type identifier after power-up has to be "e"
A			
	a		
I		ENQ,FTL,SYSTEM,FTL_Vers	Type identifier has to be "I"
	i	REP,FTL,SYSTEM,FTL_Vers=1.00	Type identifier has to be "i"
A			
	a		
E		ENQ,FTL,SYSTEM,FTL_Vers	Type identifier has to be "E"
	e	REP,FTL,SYSTEM,FTL_Vers=1.00	Type identifier has to be "e"
A			
	a		
I		ENQ,FTL,SYSTEM,NodeList	Type identifier has to be "I"
	v	REP,FTL,SYSTEM,NodeList = FTL,SYSTEM,NODELIST	Type identifier has to be "v"
A			
	r	REP,FTL,SYSTEM,NodeList = FTL,SYSTEM,FTL_Vers	Type identifier has to be "r"
A			
....Continued until last entry			(Sequence of node names not relevant)

B.3.2 Test of the FTL data layer

B.3.2.1 Invalid node name

If an invalid node name is enquired, the Server shall answer with a NAK-controlframe with ID 10101 according to Table B.3.

Table B.3 — Communication example for invalid node name

Type		Content
OBC	TVE	
E/I		ENQ,FTL,SYSTEMx,DATETIMEy
	n	10101

B.3.2.2 Invalid operation code

If an invalid operation code is sent (e.g. "FRAGE" instead of "ENQ"), the Server shall answer with a NAK-controlframe with ID 10100.

B.3.2.3 Further NAK-IDs

If the causes are known which lead to the sending of a NAK-frame with a certain ID and they can be manipulated or simulated, further tests of the data layer shall be carried out.

B.3.3 Test of the required FTL nodes

B.3.3.1 General

Required nodes/sub-nodes are:

— FTL,SYSTEM,NodeList;

— FTL,SYSTEM,FTL_Vers;

— FTL,SYSTEM,DateTime;

— FTL,PRN,TYPE;

— FTL,VEHICLE_ID;

— FTL,LOG,LH_File;

— FTL,LOG,L_File.

All required variables shall be supported. If an optional variable is available it shall be supported. All supported variable shall be tested.

An ENQUIRY of FTL,SYSTEM,NodeList should be carried out to find out which subnode/variable are supported.

B.3.3.2 Test of the node and variable List (FTL,SYSTEM,NODELIST)

The list of all available nodes and variables is determined by ENQUIRY of the variable list FTL,SYSTEM,NodeList as given in Table B.4. As a result, a list of all nodes and subnodes available on the TVE is returned.

This list shall at least contain all required nodes and subnodes.

Table B.4 — Communication example ENQ,FTL,SYSTEM,NODELIST

Type		Content	Remark / Test Condition
OBC	TVE		
E/I		ENQ,FTL,SYSTEM,NODELIST	
	r/v	REP,FTL,SYSTEM,NodeList=FTL,SYSTEM,NODELIST	
A			
....Continued until last entry			(Sequence of node names not relevant)
	e/i	REP,FTL,SYSTEM,NodeList=FTL,LOG,L_File	
A			
	a		

B.3.3.3 Test of the version number (FTL,SYSTEM,FTL_Vers)

The value of this variable can only be read. The value 1,00 is expected as return value according to Table B.5.

Table B.5 — Communication example ENQ,FTL,SYSTEM,FTL_Vers

Type		Content (example)	Remark / Test Condition
OBC	TVE		
E/I		ENQ,FTL,SYSTEM,FTL_Vers	
	e/i	REP,FTL,SYSTEM,FTL_VERS=1.00	
A			
	a		

B.3.3.4 Test of date (FTL,SYSTEM,DATETIME)

The test according to Table B.6 shall be carried out:

Table B.6 — Communication example ENQ + SET FTL,SYSTEM,DateTime

Type		Content (example)	Remark / Test Condition
OBC	TVE		
E/I		ENQ,FTL,SYSTEM,DateTime	
	e/i	REP,FTL,SYSTEM,DateTime=200903311 73324	Returned timestamp referred to Z1
A			
	a		

Type		Content (example)	Remark / Test Condition
OBC	TVE		
E/I		SET,FTL,SYSTEM,DateTime=2009033117 4000	Timestamp referred to Z2
			NOTE In some systems restrictions can apply e.g. on the amount of time and/or date change or a restart can be necessary between step 2 and step 3.
	a		

Type		Content (example)	Remark / Test Condition
OBC	TVE		
E/I		ENQ,FTL,SYSTEM,DateTime	
	e/i	REP,FTL,SYSTEM,DateTime =20090331174005	Returned timestamp referred to Z3
A			
	a		

Comparing of Z3 and Z2: the value set in step 2 has to be equal to or smaller than the value obtained in step 3.

NOTE   The timestamp in the response of the server can differ from the time stamp set by the client, depending on the time interval between SET and ENQ operations.

B.3.3.5 Test of variable FTL,PRN,TYPE

The FTL variable PRN,TYPE shall be tested according to Table B.7.

Table B.7 — Communication example ENQ,FTL,PRN,TYPE

Type		Content (example)	Remark / Test Condition
OBC	TVE		
E/I		ENQ,FTL,PRN,TYPE	Enquire the variable
	e/i	REP,FTL,PRN,TYPE= 0	Response shall be exactly one digit
A			
	a		

If the returned type is ≠ 0, the optional variables/

— FTL,PRN,STATUS

— FTL,PRN,RESERVED

— FTL,PRN,CMD

— FTL,PRN,TX_TEXT

shall be supported, i.e. these node names shall also be contained in the node list read according to B.3.3.2 and shall be tested as described in B.3.4.

B.3.3.6 Test of variable FTL,VEHICLE_ID

The FTL-variable Vehicle ID shall be tested according to Table B.8.

Table B.8 — Test example FTL,VEHICLE_ID

Type		Content (example)	Remark / Test Condition
OBC	TVE		
E/I		ENQ,FTL,VEHICLE_ID	Enquire the variable
	e/i	REP,FTL,VEHICLE_ID=2,1234,DEG-DD888,Volvo,PTB_3321/472	At least two data fields (Vehicle Type and Vehicle Identifier) shall be returned. Content may vary according to configuration
A			
	a		

B.3.3.7 Test of list FTL,LOG,L-File

The FTL-list LOG,L_FILE shall be tested according to B.4.1.

B.3.3.8 Test of list FTL,LOG,LH-File

The FTL-list LOG,L_FILE shall be tested according to B.4.2.

B.3.4 Optional System Subnodes

B.3.4.1 Enquiry of the format of the dataframe (FTL,SYSTEM,FTL_Format)

The format used for the dataframe shall be determined by ENQUIRY of the variable FTL,SYSTEM,FTL_Format. "CSV" shall be returned.

B.3.4.2 Test of timeout for the OBC alive-test (FTL,SYSTEM,Timeout)

The following test sequence shall be carried out:

1) enquire the current timeout (T1);

2) set of a new timeout T2, (T2 > T1);

3) enquire the current timeout T3;

4) T3 shall be equal to T2.

B.3.4.3 Test of the Timeout Condition (FTL,SYSTEM,Timedout)

The following test sequence shall be carried out:

1) enquire the current state of the node SYSTEM,TIMEDOUT. A timestamp is expected as result. If the value of this timestamp is 0, this means that no timeout has occurred since initialization;

2) enquire the subnode SYSTEM,DATETIME. Response timestamp T1;

3) wait for a time > T3 according to B.3.4.2;

4) enquire the subnode again. Response timestamp T2 shall be approximately T1 + T3;

5) reset the TIMEDOUT subnode by calling SET;

6) enquire the subnode again. The response shall be 0.

It has to be made sure, that step 4 takes place within the time interval given in FTL,SYSTEM,TimeOut.

B.3.4.4 Test of baud rate (FTL,SYSTEM,Baud)

The following test sequence shall be carried out:

1) The TVE shall be switched off and on again. Enquire the current baud rate. The response shall be 9600.

2) Enquire the baud rate.

3) Set baud rate to 19200.

4) TVE responds to the setting with acknowledge at the old baud rate.

5) Wait for 15 s and re-enquire the baud rate.

If the TVE does not receive a valid frame with the new baud rate from the OBC within 10 s then the TVE should automatically revert back to the default baud rate of 9600.

6) Set baud rate to 19200.

7) TVE responds to the setting with acknowledge at the old baud rate.

8) OBC switches to new baud rate.

9) OBC enquires the baud rate after at least 5 s (but not more than 10 s) have passed.

10) TVE returns the baud rate 19200.

B.3.4.5 Enquiry of the last system error (FTL,SYSTEM,SYS_ERR)

Enquire the value of subnode SYSTEM,SYS_ERR. It shall contain a record with the structure #L09_SYS_ERR.

B.3.4.6 Enquiry of the electronic signature (FTL,SYSTEM,CERTIFICATE)

Enquire the value of subnode SYSTEM,CERTIFICATE. It shall be an empty string or a valid certificate.

NOTE   At the test time no valid certificate can be expected.

B.3.4.7 Test of GPS on OBC-Side (FTL,GPS,OBC)

This variable contains a value with the structure described in #L08_GPS_INFO. The variable shall be read and written.

The following test sequence shall be carried out:

1) enquire the value (GPS1), value read is not relevant;

2) set the value (GPS2), whereat GPS2 ≠ GPS1;

3) enquire the value (GPS3). GPS3 shall be equal to GPS2.

B.3.4.8 Enquiry of GPS on TVE-Side (FTL,GPS,TVE)

This variable contains a value with the structure described in #L08_GPS_INFO. The variable can only be read. The value read depends on the receiving conditions of the GPS signals at the location of the TVE. Validity of the GPS position is not part of the test.

B.3.5 Optional Node Prn

B.3.5.1 General

If the printer type returned in B.3.3.5 ≠ 0 the following tests shall be carried out.

B.3.5.2 Test of the printer reservation (FTL,PRN,RESERVED)

Enquire the current reservation status:

In case return value = 0 (means idle) or value = 1 (means reserved for OBC)

Test 1:

1) set value to 1 (means reserve printer);

2) enquire reservation status, result shall be 1 (means reserved for OBC);

3) set value to 0 (means release printer);

4) enquire reservation status, result shall be 0 (means printer idle).

In case return value >1 (reserved for TVE).

Test 2:

1) set value to 1 (means reserve printer);

2) TVE returns NAK-ID code 10500;

3) enquire reservation status, shall be >1.

B.3.5.3 Test of the type of an OBC-document (FTL,PRN,PRINTDOC) to be printed on the TVE

This subnode can only be tested in conjunction with fully functional OBC. Consequently no test can be performed.

B.3.5.4 Test of the port (FTL,PRN,PORT)

The following test sequence shall be carried out:

1) reserve access to the printer (see B.3.5.2);

2) enquire current port, result e.g. P1;

3) set port to P2 (different from P1);

4) enquire port, result P3. P3 shall be equal to P2;

5) set an invalid port;

6) TVE shall return NAK ID code 10202 (means value out of boundary);

7) free the printer, see B.3.5.2;

8) repeat step 3);

9) TVE shall return NAK ID code 10503 (means printer not reserved for OBC).

B.3.5.5 Enquiry of the status of the printer (FTL,PRN,STATUS)

The following test sequence shall be carried out:

1) reserve access to the printer (see B.3.5.2);

2) enquire current printer status, result shall be according to 7.5.5.

B.3.5.6 Sending of commands to the printer (FTL,PRN,CMD)

The following test sequence shall be carried out:

1) free printer (see B.3.5.2);

2) set command code 1 (means grab paper, if applicable);

3) TVE shall return NAK-ID code 10503 (means printer not reserved for OBC);

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4) reserve access to the printer (see B.3.5.2);

5) insert paper in printer;

6) set command code 1 (means grab paper, if applicable);

7) TVE shall return ACK and the printer shall grab the paper;

8) set command code 9 (means invalid command);

9) TVE shall return NAK-ID code 10202 (means value out of boundary).

B.3.5.7 Sending of the text to be printed (FTL,PRN,TX_TEXT)

The following test sequence shall be carried out:

1) free printer (see B.3.5.2);

2) set text to be printed, e.g. "test line";

3) TVE shall return NAK-ID code 10503 (means printer not reserved for OBC);

4) reserve access to the printer (see B.3.5.2);

5) insert paper in printer;

6) set text to be printed, e.g. "test line";

7) TVE shall return ACK and text shall be printed.

B.3.6 Node Comp

B.3.6.1 Enquiry of the number of tank compartments (FTL,COMP,COUNT)

The following test sequence shall be carried out:

1) enquire subnode COMP,COUNT;

2) TVE shall return a numerical value c > 0.

B.3.6.2 Enquiry of the current state of the tank compartments (FTL,COMP,STATUS)

The following test sequence shall be carried out:

1) enquire subnode COMP,STATUS;

2) TVE shall return a list of c records, each structured as given #L40_COMP_STAT;

3) enquire subnode COMP,STATUS(n), where n > 0 and n ≤ c according to B.3.6.1;step 2);

4) TVE shall return a record structured as given #L40_COMP_STAT;

5) enquire subnode COMP,STATUS(n), where n > c according to B.3.6.1;step 2);

6) TVE shall return NAK-ID code 10106 (means array index out of boundaries).

B.3.6.3   Enquiry of the current state of the compartment contents (FTL,COMP,CONTENT)

The following test sequence shall be carried out:

1)   enquire subnode COMP,CONTENT;

2)   TVE shall return a list of c records, each structured as given #L13_COMP_CONT;

3)   enquire subnode COMP,CONTENT(n), where n > 0 and n ≤ c according to B.3.6.1;step 2);

4)   TVE shall return a record structured as given #L13_COMP_CONT;

5)   enquire subnode COMP,CONTENT(n), where n > c according to B.3.6.1;step 2);

6)   TVE shall return NAK-ID code 10106 (means array index out of boundaries).

B.3.6.4   Enquiry of the currently connected PIDs (FTL,COMP,PID_INFO)

The following test sequence shall be carried out:

1)   connect PIDs to one or more PRD ports of the TVE;

2)   enquire subnode COMP,PID_INFO;

3)   TVE shall return a list of c records, each structured as given #L45_PID_INFO.

B.3.6.5   Test of loading information (FTL,COMP,LOADING)

The following test sequence shall be carried out:

1)   enquire subnode COMP,LOADING;

2)   TVE shall return a list of c records, each structured as given #L11_Transfer;

3)   enquire subnode COMP,LOADING(n), where n > 0 and n ≤ c according to B.3.6.1;step 2);

4)   TVE shall return a record structured as given #L11_Transfer;

5)   enquire subnode COMP,LOADING(n), where n > c according to B.3.6.1;step 2);

6)   TVE shall return NAK-ID code 10106 (means array index out of boundaries);

7)   clear subnode COMP,LOADING;

8)   enquire subnode COMP,LOADING;

9)   TVE shall return a list of c records, each structured as given #L11_Transfer, but containing zero quantities;

10)   set subnode COMP,LOADING(n) to a record structure as given #L11, where n > 0 and n ≤ c according to B.3.6.1;step 2);

11)   enquire same subnode element;

12)   TVE shall return a record structured as given #L11_Transfer with the same content as set in step 10);

13)   set subnode COMP,LOADING(n), where n > c according to B.3.6.1;step 2);

14) TVE shall return NAK-ID code 10106 (means array index out of boundaries).

B.3.6.6   Test of the list of monitored subnodes and variables (FTL,NOTIFY,NodeList)

This test shall be carried out according to B.4.3.

B.3.6.7   Test of the list of modified subnodes and variables (FTL,NOTIFY,Changes)

This test shall be carried out according to B.4.4.

B.3.6.8   Test of the list of drivers (FTL,DRIVER,DRIVERS)

The following test sequence shall be carried out:

1)   enquire subnode DRIVER,DRIVERS;

2)   TVE shall return a list of records, each structured as given Table 7;

NOTE   The list may be empty.

3)   clear subnode DRIVER,DRIVERS;

4)   enquire subnode DRIVER,DRIVERS;

5)   TVE shall return an empty list;

6)   set subnode DRIVER,DRIVERS to a record structure as given in Table 7;

7)   enquire subnode DRIVER,DRIVERS;

8)   TVE shall return a record with the same content as set in step 6).

B.3.6.9   Test of the currently logged in driver (FTL,DRIVER,CURRENT)

The following test sequence shall be carried out:

1)   ensure that test according to B.3.6.8 is carried out;

2)   log on to the TVE, specifying one of the driver names of test according to B.3.6.8;

3)   enquire subnode DRIVER,CURRENT;

4)   it shall contain the record of the appropriate driver;

5)   clear the subnode DRIVER,CURRENT;

6)   enquire subnode DRIVER,CURRENT;

7)   it shall contain a record with empty fields;

8)   set the subnode DRIVER,CURRENT using data of a valid driver;

9)   enquire subnode DRIVER,CURRENT;

10) it shall contain the same record as set in step 8).

B.3.6.10 Enquiry of the FTP-server for TVE (FTL,FS,FTPSERV)

Enquire a value of subnode FS,FTPSERV. The response shall be a valid CSV string according to 7.10.3.

B.3.6.11 Test of the file system (FTL,FS and subnodes)

The following test sequence shall be carried out:

1) enquire the value of subnode FS,CWD. The response shall be an empty string or a valid pathname;

2) set subnode FS,CWD to an empty string (means default working directory on TVE);

3) enquire the value of subnode FS,CWD. The response shall be an empty string;

4) set subnode FS,FILE to the value "_tmp,C" to create a new file named "TMP";

5) set subnode FS,DATA to the value "testline1" to start writing to the file;

6) set subnode FS,DATA to the value "testline2" to continue writing to the file;

7) set subnode FS,FILE to the value ",F" to close the file;

8) set subnode FS,FILE to the value "_tmp,R" to open the file again;

9) enquire the subnode FS,DATA to download the contents of the file;

10) TVE shall return a list of two records which shall be identical with records of step 7 and step 8;

11) set subnode FS,FILE to the value ",F" to close the file;

12) set subnode FS,FILE to the value "_tmp,E" to delete the file.

B.3.6.12 Test of the Auxiliary/Outputs (FTL,AUX,OUT)

FTL,AUX,OUT describes fleet specific outputs. This array can be read completely or as separate entries. Individual entries can be set.

The following tests shall be carried out:

Test 1:

1) Reading of the complete array by means of ENQUIRY.

2) Individual reading using an index and comparison with the entry in the array.

Test 2:

1) Reading of one entry (O1).

2) Setting the entry to another value than O1 (O2).

3) Reading of the entry, expected: O3 == O2.

B.3.6.13 Enquiry of the Auxiliary/Inputs (FTL,AUX,IN)

FTL,AUX,IN describes fleet specific inputs. This array can be read completely or as separate entries.

The following test shall be carried out:

Test 1:

1) Reading of the complete array by means of ENQUIRY.

2) Individual reading using an index and comparison with the entry in the array.

B.3.6.14 Test of the order handling(FTL,ORDER)

FTL,ORDER,Order is a list with one element of a defined structure. The order data can be polled, set and reset. The associated planned transfers (loadings/deliveries) of the order are contained in the list FTL,ORDER,Plan while their results of execution are placed in the list FTL,ORDER,Delivery.

The variable FTL,ORDER,State returns the current state of the execution of the current order. The operation Clear of FTL,ORDER,Order clears all associated nodes FTL,ORDER,Order, FTL,ORDER,Plan, ORDER,Delivery and sets FTL,ORDER,State to 0.

The following tests shall be carried out:

Test 1:

1) Call Clear for FTL,ORDER,Order to remove possibly existing results of previous tests.

2) Enquire value for FTL,ORDER,State. It shall be zero.

3) Set a new order to FTL,ORDER,Order.

4) Enquire list for FTL,ORDER,Order. It shall contain the order set in step 3.

5) Set two plan items to FTL,ORDER,Plan.

6) Enquire list for FTL,ORDER,Plan. It shall contain the two items set in step 5.

7) Set another plan item to FTL,ORDER,Plan.

8) Enquire list for FTL,ORDER,Plan. It shall contain all three items set in step 5 and 7.

9) Enquire value for FTL,ORDER,State. It shall be 2.

10) Process the three plan items on the TVE (perform the loadings/deliveries).

11) Enquire list for FTL,ORDER,Delivery. It shall contain the two results of the three plan items set in step 5 and 7.

12) Call Clear for FTL,ORDER,Order to clear complete order and accompanied data.

13) Enquire list for FTL,ORDER,Order. It shall be empty.

14) Enquire list for FTL,ORDER,Plan. It shall be empty.

15) Enquire list for FTL,ORDER,Delivery. It shall be empty.

16) Enquire value for FTL,ORDER,State. It shall be 0.

B.3.6.15 Enquiry of the compatibility matrix (FTL,COMPATMAT,Setup)

A list of records with a defined structure is returned.

B.3.6.16 Test for the overwriting of the compatibility matrix (FTL,COMPATMAT,OVERRIDE)

There is a matrix containing the data for the overwriting. This matrix has the same structure as the compatibility matrix and can be deleted, supplemented and read out.

There are boundary conditions for the adding of entries, If FTL,COMPATMAT,Override exists, FTL,COMPATMAT,Setup has to exist too.

The following tests shall be carried out:

<u>Test 1:</u>

1) Enquiry of the overwrite matrix, determine the number of entries.

2) Adding of a valid, not yet existing entry to the overwrite matrix.

3) Enquiry of the overwrite matrix, determine the number of entries, expected: number has increased by one.

<u>Test 2:</u>

1) Precondition: overwrite matrix contains at least one entry. If necessary, a valid entry has to be added to the overwrite matrix.

2) Enquiry of the overwrite matrix, determine the number of entries.

3) Enquiry of the compatibility matrix, determine the number of entries.

4) Deleting of the overwrite matrix.

5) Enquiry of the overwrite matrix, determine the number of entries, expected: 0.

6) Enquiry of the compatibility matrix, determine the number of entries, expected: number of entries in step 6 = number of entries in step 3.

<u>Test 3:</u>

1) Enquiry of the compatibility matrix.

2) Generate entry, which is not contained in the compatibility matrix, set this entry.

3) Expected: TVE returns NAK-frame.

<u>Test 4:</u>

1) Enquiry of the compatibility matrix.

2) Select one entry and generate a new entry from this for which max_ratio is less than the value given in the entry.

3) Set entry.

4) Expected: TVE returns NAK-frame.

<u>Test 5:</u>

1) Generate two valid entries for the same position and set them.

B.3.6.17 Test of the starting point (FTL,LOG,Timestamp)

FTL,LOG,TimeStamp can be read. At reading, either the timestamp of the last saved L-file or the last set timestamp is returned.

The following test shall be carried out:

1) Polling of the timestamp using ENQUIRY (Z1).

2) Setting of another timestamp (Z2) using SET.

3) Polling of the timestamp using ENQUIRY (Z3), expected: Z2 == Z3.

B.3.6.18 Initiate Log of the current state of the sensors (FTL,LOG,SNAPSHOT)

FTL,LOG,SNAPSHOT can only be written.

The following tests shall be carried out:

Test 1

1) Set FTL,LOG,SNAPSHOT to 1.

2) TVE responds with ACK after finishing.

3) Enquire L_File, expected: L-File contains a record #L20 with #L2002_event_code=61, the current state of the sensors, followed by a record #L20 with #L2002_event_code=62.

Test 2

1) Set FTL,LOG,SNAPSHOT with a value ≠ 1.

2) TVE responds with NAK.

B.4 Application Layer

B.4.1 Test of the L-File

The L-file can be polled calling the method ENQUIRY of the subnode FTL,LOG, L_file. A list with event-based records is returned.

The returned list entries can be evaluated considering the following criteria:

— The structure corresponds with the structure described in the table "L file records".

— All entries marked as required do exist.

— The entries correspond with the given data types and value ranges.

The extension of a Log-files is tested within the scope of the test feature sequence test.

B.4.2 Test of the LH-File

The LH-file can be polled calling the method ENQUIRY of the subnode FTL,LOG,LH_file. A list with static records is returned.

The returned list entries can be evaluated considering the following criteria:

— The structure corresponds with the structure described in the table "L file records". The entries relevant for the LH-file are marked with (->LH-File).

— All entries marked as required do exist.

— The entries correspond with the given data types and value ranges.

B.4.3 Test for the Filling of the NodeList

This test checks the functionality of the NodeList, see Table B.9.

Table B.9 — Description of a test for the filling of the FTL,Notify,NodeList

Step	Content	Result
1	Detecting of all available nodes (ENQ,FTL,SYSTEM,NodeList)	list L1
2	Setting of all nodes that can be monitored (SET,FTL,NOTIFY,NodeList= *)	ACK
3	Enquire list of all monitored nodes (ENQ, FTL,NOTIFY,NodeList)	list L2
If L2 not empty		
4	Clear list using CLR,FTL,NOTIFY,NodeList	
5	Enquire list of monitored nodes (ENQ,FTL,NOTIFY,NodeList)	empty list
For all elements, which are in L1 as well as in L2		
6	Add element using SET	ACK
7	Poll list using ENQ	list L3, content of list 2 corresponds with content of list 3
For an element contained in L3		
8	Add using SET	ACK
9	Poll list using ENQ	list 4, list 4 == list 3
10	Clear list using CLR,FTL,NOTIFY,NodeList	
For an element contained in L1 but not in L2		
11	Add element using SET	NAK with NAK-ID 10600
12	Poll list using ENQ	empty list

B.4.4 Sequence Test

The sequence test is used to check the notify-mechanism.

To be able to use the notify-mechanism, the subnodes FTL,Notify,NodeList and FTL,Notify,CHANGES have to be defined. FTL,Notify,NodeList describes the list of all subnodes and variables, which shall be used for notifications. FTL,Notify,CHANGES returns a list of all nodes contained in the NodeList, which have changed their value since the last enquiry of this node.

The node FTL,Notify,CHANGES can only be read, the node content of the node FTL,Notify,NodeList can be read, extended and deleted.

The sequence test is described externally and is based upon a sample configuration.

A number of subnodes and variables given in the sequence test is added to the NodeList (FTL,NOTIFY,NodeList).

The sequence test modifies the described subnodes/variables.

The list of modified nodes and subnodes (FTL,NOTIFY,Changes) is polled in regular intervals.

The following activities are carried out for all nodes and subnodes in the list of modified nodes and subnodes:

1) The current value of the subnode/variable is enquired (and stored).

2) The L-file is enquired. Only entries that have been made after the starting point (FTL,LOG,TimeStamp) shall be contained. The current value of the respective subnode/variable is determined from the transferred data and compared to the value detected in step 1. In addition, it is checked if the L-file entry correspond to the standard (see test of L-file).

3) Compared to the externally described test, it is checked that the modifications for all affected nodes have been registered.

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