HARTEQ

Wrocław, 2014-11-03

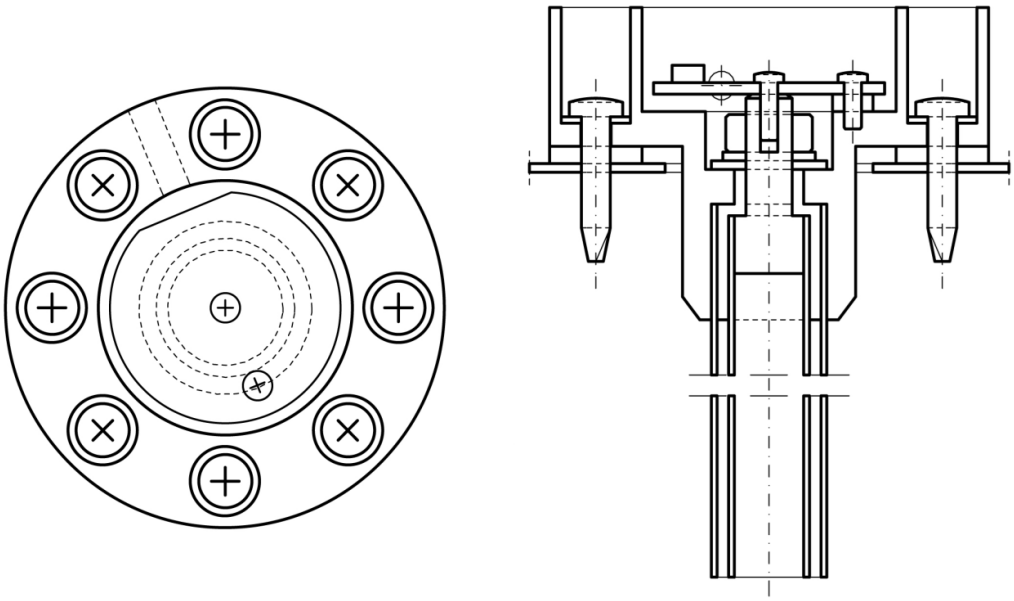
FUEL PROBE H-01

DETAILED DESCRIPTION

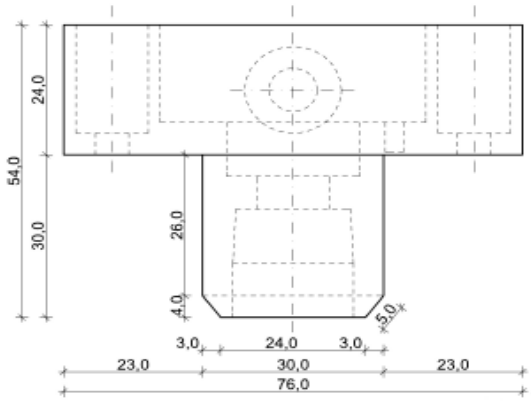
Contents:

1. OPERATING PRINCIPLE

In its operation, the fuel capacity probe uses the phenomenon of the change in the condenser's capacity as result of the change in the type of the dielectric. In the H-01 probe, the measuring condenser is comprised of two aluminous tubes put one into the other with maintenance of a fixed distance between them, open at the "bottom" and a vent opening at the "top". The dielectric is comprised of air and diesel oil submerged in it. The measurements show the capacity of such a constructed condenser at the level of several hundred pF (depending on the length), which is increased when submerged in fuel.



Pic. 1 Probe's head – top view



Pic. 2 Probe's head – side view . All dimensions are given in mm.

2. COMMUNICATION PROTOCOL DESCRIPTION

Communication with the probe is executed on the basis of the J1708 interface, which is very popular in commercial vehicles. It is a modification of the RS485 bus which allows for "simultaneous" access to the bus of many devices (multi-master bus):

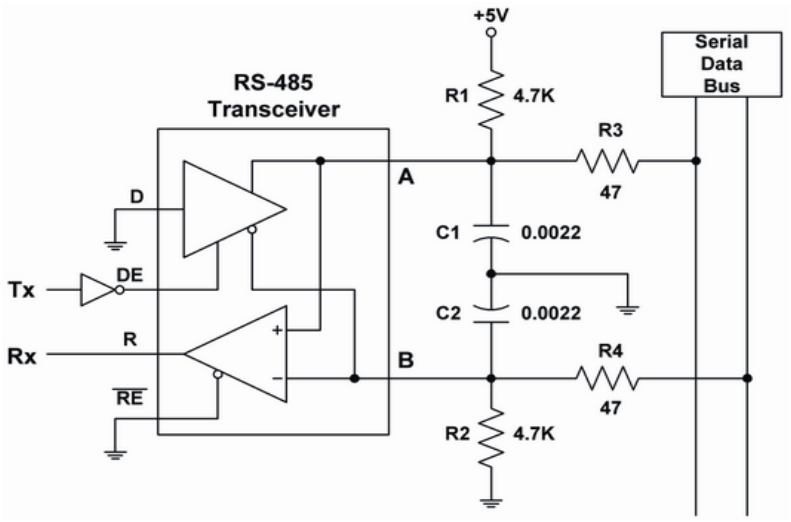
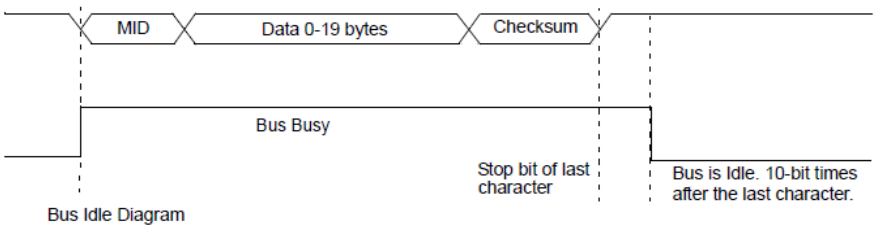


FIGURE A1—SERIAL DATA BUS STANDARD NODE DIAGRAM

Pic. 3

The communication is executed with the rate of 9600 bits per second, the data frame features one stop bit and no parity bit. Transmission of data by devices is possible when the bus is "idle" (Bus Idle):



Pic. 4

The higher the message's priority, the "faster" it can be transmitted after detecting the "Bus Idle" status:

TABLE 1: CLASSES OF MESSAGE PRIORITIES

Priority	Message Assignment
1 and 2	Messages that require immediate access to the bus
3 and 4	Messages that prevent Mechanical Damage
5 and 6	Messages that control economy or efficiency
7 and 8	All other messages

EQUATION 1:

$$Pd = Tb * 2 * P$$

Pd = Priority Delay in µS

Tb = Bit time or 104.16 µS

P = Message Priority

For example, a message with the priority of "1" is transmitted after the time of 2 data bits (208.32uS) from the entry of the bus into the "idle" status, whereas a message with the priority of "8" – after the time of 16 data bits (1.6mS).

In case of "collision", the first transmitted data byte (MID), which identifies the sender and should be unique, is subject to distortion:

TABLE 3: MESSAGE IDENTIFIER COLLISION ARBITRATION EXAMPLE

	Bit 0	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7
MID128	0	0	0	0	0	0	0	1
MID140	0	0	1	1	0	0	0	1
Result	0	0	0	0	0	0	0	1

When the fed MID identifier is not compliant with the received one, it means that the device lost the bus access and must wait for the next time the bus is idle. In such case, the device should add an additional random time from 0 to 7 bits (n * 104.16uS) to the bus access time (depending on the priority).

The transmitted frame is comprised of the following fields:

TABLE 2: DATA FORMAT

byte 0	byte 1	byte 2	byte 3 to N (N not to exceed 20)	byte N + 1
MID	PID	Data	Additional PIDs and Data	Checksum

TABLE 4: PARAMETER IDENTIFIER USAGE

MID	PID	DATA	PID	DATA	PID	DATA	Checksum

The data field (bytes from 1 to 20) features PID parameter identifiers and data.

Depending on the PID parameter value, the field with the data can be a 1, 2 or multi-byte field:

PID	Data quantity	Data field
0-127	1 byte	BYTE
128-191	2 bytes	LOBYTE, HIBYTE
192-253	many	COUNT, DATA1, DATA2, DATAn, …
254	undefined	specified by the manufacturer
255	---	reserved for increasing the quantity of available PID's

The last field of the frame is a checksum of all previous data bytes calculated according to the following algorithm:

- Add all bytes
- Negate the result bytes
- Add 1 to the obtained value

3. J1708/J1587 PARAMETERS IMPLEMENTED IN THE H-01 PROBE

The H-01 fuel probe, depending on the address parameter configuration, features the following logical addresses in the J1708 bus (MID):

ADDRESS	MID
0	240
1	241
2	242
3	243

In addition, the probe receives commands from the devices with MID=235 (e.g. calibration).

The probe includes the following implemented PID parameters:

PID	Description
129	"Raw" value of the measured capacity *0.1pF
130	Probe supply voltage, "raw" result from the A/D transducer (10 bytes)
131	Ambient temperature, "raw" result from the A/D transducer (10 bytes)
132	Calculated fuel level with consideration of the calibration
133	Probe address, higher values are "wrapped" in modulo 4
134	"Zero" indication calibration
135	Analogue output sensitivity calibration (8-bit) 50-1000 (1000 to 1:1)
136	Maximum calibration (including "zero"), specifies the max. value of PID132

Parameters PID 129, 130, 131, 132 are transmitted by the probe in cycles of 10 seconds.

Exemplary frame transmitted in cycles by the probe is as follows:

0xf0	0x81	0xd0	0x08	0x82	0xd0	0x02	0x83	0x4f	0x01	0x84	0x02	0x00	0x0a
MID	PID			PID			PID			PID			CRCC

In addition, the following "control" parameters are implemented:

PID	Description
128	Parameter enquiry, data field: PID,MID PID: 133-136, MID: 240-243 Responds only to frames from the MID=235 address
200	Parameter calibration. 4-byte parameter: (COUNT), PID, MID, LO, HI PID: 133-136, MID: 240-243, LO/HI new parameter value, 0xFFFF: automatically. Reacts only to frames from the MID=235 address
254	Used during the upload of firmware Data field includes the record number (2 bytes) and data fields (up to 16 bytes) Reacts only to frames from the MID=235 address

Limitations:

- Implementation of the PID 128 parameter does not allow the enquiry regarding PID 129-132.
- Implementation of the PID 128 parameter does not allow the simultaneous enquiry regarding more than one parameter. Other PID's in the frame will be ignored despite the fact that they are acceptable.
- Implementation of the PID 200 parameter does not allow the simultaneous configuration of more than one parameter. Other PID's in the frame will be ignored despite the fact that they are acceptable.

4. EXAMPLES

The examples were prepared on the basis of the CAN Tools product, which is available separately. The first digit in the following examples specifies the length of the transmitted message of J1708:

J1708=08 EB C8 04 85 F0 01 00 D3 – changes the address of the MID=240 probe (ADDR=0x0000) to MID=241 (ADDR=0x0001)

J1708=08 EB C8 04 85 F1 00 00 D3 – changes the address of the MID=241 probe (ADDR=0x0000) to MID=240 (ADDR=0x0000)

J1708=08 EB C8 04 86 F0 84 08 47 – sets the "zero" in the MID=240 probe to PID134=0x0884

J1708=05 EB 80 85 F0 20 – makes an enquiry in the MID=240 probe about PID=133 (address)

J1708=05 EB 80 86 F0 1F – makes an enquiry in the MID=240 probe about PID=134 („zero")

J1708=05 EB 80 87 F1 1D – makes an enquiry in the MID=241 probe about PID=135 (sensitivity)

J1708=05 EB 80 88 F1 1C – makes an enquiry in the MID=241 probe about PID=136 (max)

Enquiry:

0xeb	0x80	0x86	0xf0	0x1f
MID	PID			CRCC

Response:

0xf0	0x86	0x84	0x08	0xfe
MID	PID			CRCC

Exemplary configuration of the Skaut recorder in a configuration with two probes:

Parameter	Value
Configuration number (FMSID)	50
Parameter 1 (PGN00, SPN00)	61569,101
Parameter 2 (PGN01, SPN01)	61569,102
Parameter 3 (PGN02, SPN02)	61570,101
Parameter 4 (PGN03, SPN03)	61570,102
Parameter 5 (PGN04, SPN04)	61571,101
Parameter 6 (PGN05, SPN05)	61571,102
Parameter 7 (PGN06, SPN06)	61572,101
Parameter 8 (PGN07, SPN07)	61570,102
Parameter 9 (PGN08, SPN08)	61825,101
Parameter 10 (PGN09, SPN09)	61825,102
Parameter 11 (PGN10, SPN10)	61826,101
Parameter 12 (PGN11, SPN11)	61826,102
Parameter 13 (PGN12, SPN12)	61827,101
Parameter 14 (PGN13, SPN13)	61827,102
Parameter 15 (PGN14, SPN14)	61828,101
Parameter 16 (PGN15, SPN15)	61828,102