

Try-out exam

Certified PROFIBUS Engineer



Instructions

This theory exam consists out of 42 questions (a combination of multiple choice and open questions), for which the candidate gets 2 hours time to complete. The candidate is passed when he answers 80 % of the questions correctly.

- Read the questions a couple of times before answering.
- **More answers are possible** with the multiple-choice questions.
- The questions are based on the PROFIBUS guidelines from which should not be deviated.
- **All materials** can be used to complete this exam (books, laptop, calculator, etc).
- It is not allowed to talk to another candidate or make a telephone call.

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1. Basic knowledge

1.1 Addressing

1) *What is the maximum number of stations in a PROFIBUS network, that can be addressed with an 'FDL_Status' SD1 message (including the masters)?*

- (a) 32 stations.
- (b) 125 stations.
- (c) 126 stations.
- (d) 127 stations.
- (e) 256 stations.

2) *Which of the following devices/tools do NOT have a PROFIBUS address?*

- (a) Standard repeater.
- (b) Laptop with a ProfiTrace Analyzer.
- (c) Class 1 DP master.
- (d) Class 2 DP master.
- (e) DB9 connector.
- (f) OLM/Fiber optic coupler.

3) *A DP slave has an address coding according to this dipswitch setting. What is the address number?*

SW 7: OFF (MSB)
SW 6: **ON**
SW 5: **ON**
SW 4: OFF
SW 3: OFF
SW 2: **ON**
SW 1: OFF
SW 0: OFF (LSB)

Fill in the address number (decimal): _____

1.2 Terminology

4) A 'Live List' in a busmonitor/analyzer,

- (a) only displays a list of the class 1 DP masters.
- (b) displays a list of all addressable masters and slaves.
- (c) only displays a list of all configured slaves.
- (d) displays a list of all devices with an RS 485 connection.

5) A "GSD file",

- (a) is loaded in the class 1 DP master after the user has created the network in a configuration tool.
- (b) contains all the necessary data for one DP slave used by the configuration tool to parameterize and configure the device.
- (c) is a database of the complete network, which is used by a class 2 master for diagnostic purposes.
- (d) only consists out of parameters for DP-V1 communication.

6) The "Watchdog" in the DP parameter message (3E -> 3D),

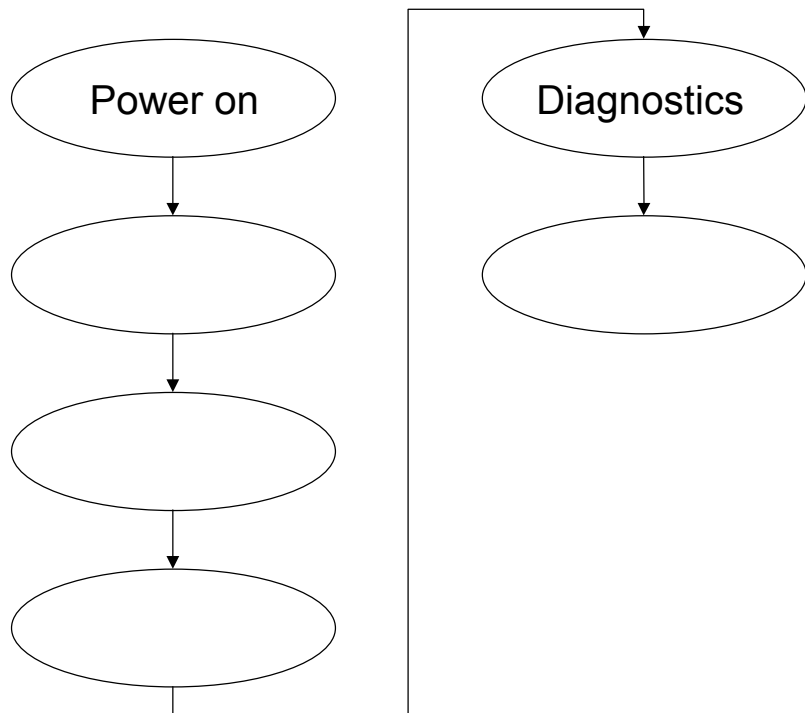
- (a) defines the maximum time for a class 1 DP master to wait for the answer of a DP slave before sending a repeat.
- (b) defines the minimum time for a class 2 DP master to wait for the class 1 DP master when it is communicating with a DP slave.
- (c) defines the minimum time for the DP slave to wait before sending a reply to a class 1 or 2 DP master.
- (d) defines the time for the DP slave to be cyclically polled by its class 1 DP master, before the slave sets its outputs to "0" or to a safe state.

7) A "Token" is a message,

- (a) to 'look' for new masters.
- (b) which the master uses to indicate it is ready for data exchange.
- (c) which the master uses to indicate it is ready for communication.
- (d) that is used to pass the access rights of the network to another master.
- (e) that is used to indicate that diagnostics are available.

1.3 Protocol

8) *The illustration on the right shows the start-up communication sequence between a DP master (class 1) and an assigned DP slave (given that everything is OK). Please add the missing steps in the start-up sequence.*



9) *For the communication between DP masters and DP slaves, so-called "Service Access Points" (SAPs) are used to identify the service being requested. Please fill in the SAP numbers in the following table:*

DP communication service	SSAP	DSAP
Set Parameters		
Set Slave Address		
Check Config		
Data Exchange		

10) *Explain the function of this message, which is captured with a busmonitor/analyzer.*

68_h 05_h 05_h 68_h 83_h 81_h 5D_h 3C_h 3E_h xx_h 16_h

Function of the message: _____

11) *Explain why this message is correct or false?*

68 _h	09 _h	09 _h	68 _h	01 _h	0A _h	08 _h	02 _h	FC _h	02 _h	0C _h	00 _h
-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------

Explanation: _____

12) *Which busparameter sets the reaction time of the slave?*

- (a) Tslot.
- (b) Tqui.
- (c) Tset.
- (d) MinTSDR.

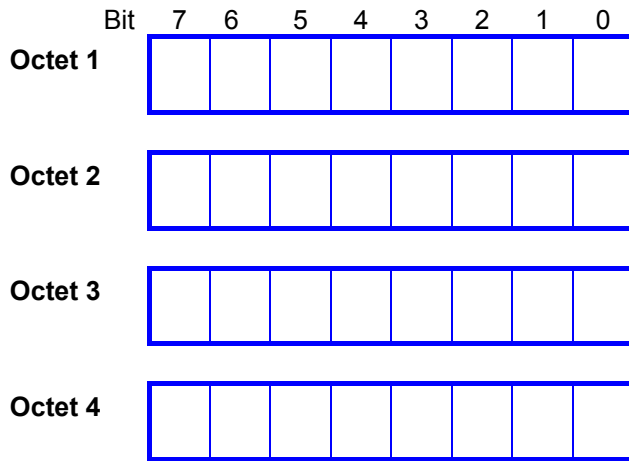
13) *Which of the following statements have a NOTICEABLE influence on the overall DP cycle time?*

- (a) The number of configured slaves connected to the bus.
- (b) The number of ProfiTrace Analyzers connected to the bus.
- (c) The baudrate.
- (d) A connected repeater.
- (e) The overall amount of input and output data.
- (f) Connector types used.

14) *A slave wants to inform the master that it has diagnostic information. What is the procedure to transfer it to the master?*

- (a) The slave claims the bus directly and sends the information to the master.
- (b) When the slave has to reply with the inputs, it appends the diagnostic information to this message.
- (c) When the slave has to reply with the inputs, it indicates that it has diagnostics, so that the master can fetch it with a separate message.
- (d) When the slave receives the token, all the diagnostic messages will be send to the master first, before the slave starts exchanging data with the master.

15) Using the blocks below, create an I/O configuration identifier for a module with 3 bytes input and 6 words output (less blocks are allowed).



16) Fill-in the table with the maximum length of useable data that you can transfer with the communication services (SD headers, SAPs and standard information not included).

DP communication service	Maximum length
Set Parameters (<i>request</i>)	
Check Config (<i>request</i>)	
Get Diagnostics (<i>reply</i>)	
Data Exchange (<i>outputs</i>)	
Data Exchange (<i>inputs</i>)	

2. Transmission technology & Cabling

17) The characteristic impedance of a standard PROFIBUS DP – RS 485 cable (3-20 MHz) is,

- (a) 220 Ohm.
- (b) 150 Ohm.
- (c) 100 Ohm.

18) Which of the following statements about RS 485 segments are correct?

- (a) A maximum of 32 stations can be connected to a segment.
- (b) Every segment must be provided with termination at the ends.
- (c) Termination must always be powered.
- (d) The maximum cable length is dependent on the baudrate.
- (e) RS 485 segments and optical fiber rings can be used in 1 network.

19) Which signals are mandatory and must be provided by each PROFIBUS device with a 9-pin Sub-D connector?

- (a) A-line
- (b) B-line
- (c) RTS
- (d) +5 V
- (f) +24 V

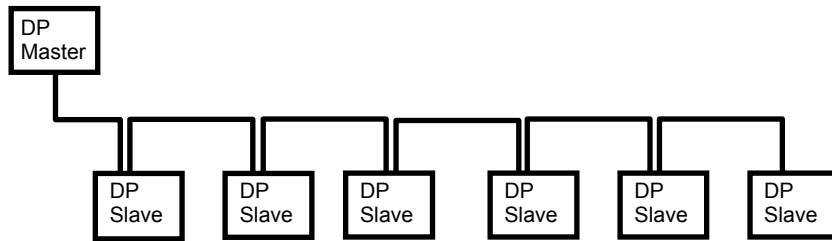
20) What causes reflections on a DP segment and can disturb the data communication?

- (a) Spurs/Stubs.
- (b) Powered termination on both ends.
- (c) The use of repeaters.
- (d) 30 connected stations with more than 1 m cable between.
- (e) A device connection capacitance of 10 pF.
- (f) A device connection capacitance of 50 nF.

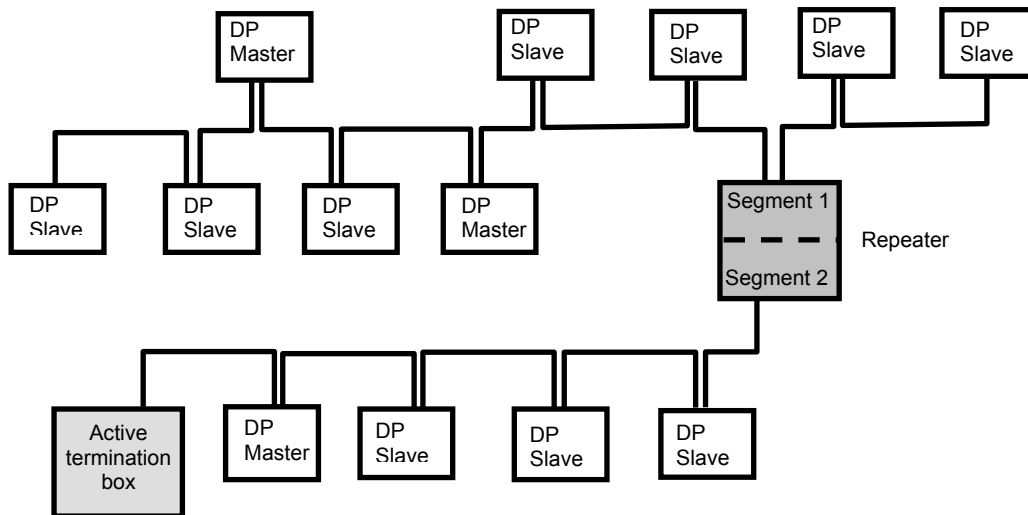
21) *What is the wire colour of the B-line of a PROFIBUS DP – RS 485 cable?*

Wire colour: _____

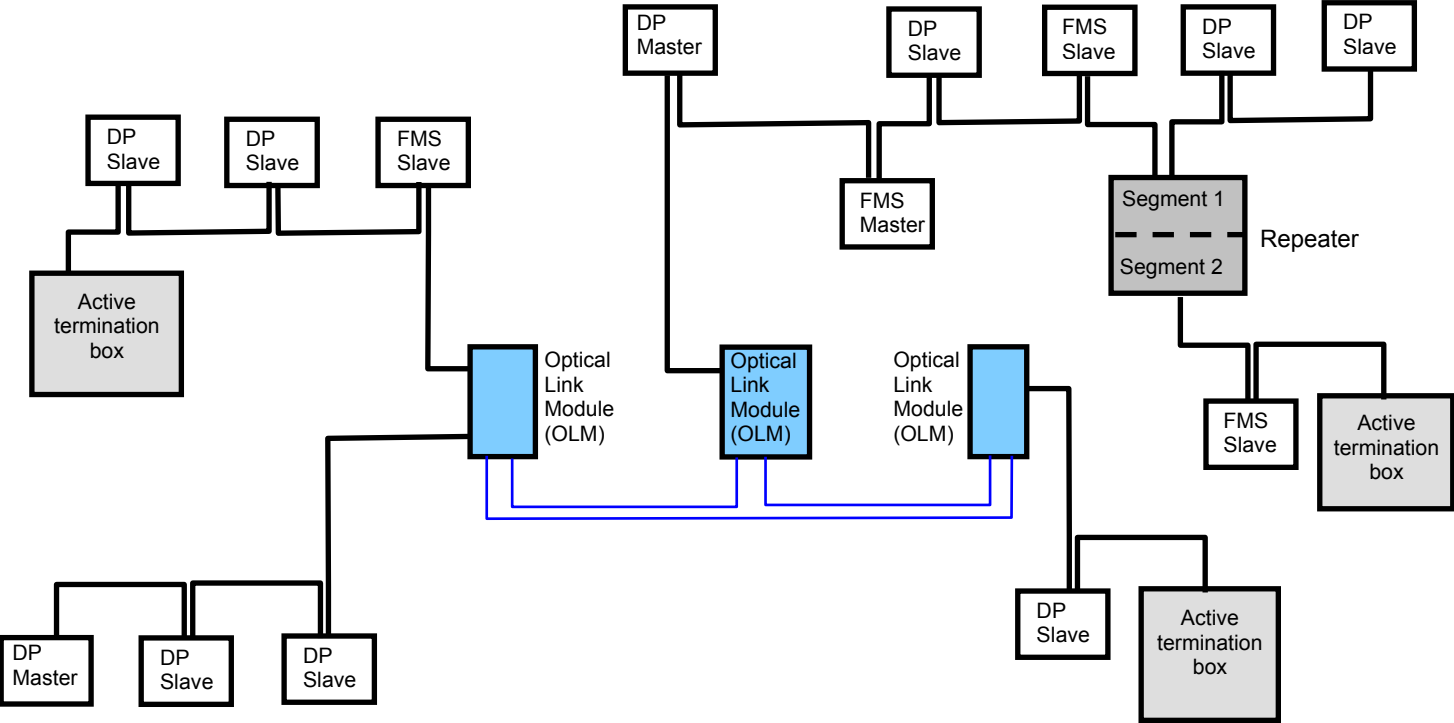
22) *Mark all stations/devices on which the termination should be “ON”.*



23) *Mark all stations/devices on which the termination should be “ON”.*



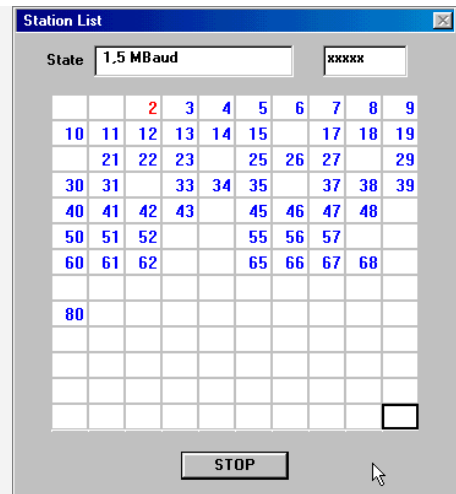
24) *Mark all stations/devices on which the termination should be "ON".*



3. Troubleshooting & Commissioning

The next 4 questions are based on the network specifications and the screen shot of the Live List, which is made with the busmonitor "Amprolyzer". The busmonitor is connected with the PG connector of the master (from this point the bus cable starts).

Specifications of the network:
 Protocol: **DP**
 Baudrate: **1,5 Mbps**
 Medium: **Only RS 485**
 Cable length: **not documented**
 Number of repeaters: **Not documented**



25) *How many repeaters should be at least installed in this network?*

Number of repeaters: _____

26) *If the minimum number of repeaters is placed in series, what is the maximum cable length that can be installed?*

Cable length: _____

27) *What is the maximum allowable stub/spur length on the segment where the busmonitor is connected?*

Spur/Stub length: _____

28) *If the busmonitor is removed and connected to the segment after the first repeater, will you see the same screen shot of the Live List?*

Answer: _____

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29) This trace of a PROFIBUS DP network is made with a busmonitor/analyzer. Give your judgement about this network.

	T [bit]	Title	Attention	Service	Sd	Adr	Sap	Fc	Data Len
50	14653.	41.		fdl_status	SD1	01 -> 56		49	
51	15041.	322.		token	SD4	01 -> 01			
52	15115.	41.		token	SD4	01 -> 01			
53	15189.	41.		fdl_status	SD1	01 -> 57		49	
54	15564.	309.	Sync	SRD_HIGH	SD2	01 -> 32	(3E) -> (3D)	6D	008 F8 01 08 0B 21 51 00 00
55	15795.	22.		OK	SC				
56	15845.	39.		token	SD4	01 -> 01			
57	15919.	41.		fdl_status	SD1	01 -> 58		49	
58	15999.	14.	impossible Frame						
59	16106.	107.		token	SD4	01 -> 01			
60	16180.	41.		token	SD4	01 -> 01			
61	16254.	41.		token	SD4	01 -> 01			
62	16328.	41.		token	SD4	01 -> 01			
63	16402.	41.		token	SD4	01 -> 01			
64	16476.	41.		fdl_status	SD1	01 -> 59		49	
65	16553.	11.	incomplete Msg						
66	16661.	108.		token	SD4	01 -> 01			
67	16735.	41.		token	SD4	01 -> 01			
68	16809.	41.		token	SD4	01 -> 01			
69	16883.	41.		token	SD4	01 -> 01			
70	16957.	41.		token	SD4	01 -> 01			
71	17031.	41.		fdl_status	SD1	01 -> 5A		49	
72									

- (a) OK, this network has no faults.
- (b) Not OK, there are physical bus problems or a double address on station 58h and 59h. The transmission rate is probably set too high.
- (c) Not OK, the master is still sending tokens to itself.
- (d) Not OK, there are 5 slaves missing in this network.
- (e) Not OK, the FDL transparent repeaters with address 58h and 59h answer too late to the requests and cause collisions on the bus.

30) This trace of a PROFIBUS DP network is made with a busmonitor/analyzer. Give your judgement about this network.

	T [us]	Title	Attention	Service	Sd	Adr	Sap	Fc	Data Len
1	70.0	0.0		DL	SD2	01 ← 03	() ← ()	08	001 00
2	171.3	28.0	Sync	SRD_HIGH	SD1	01 → 0E	(3E) → (3C)	6D	
3	462.7	247.3	Sync	SRD_HIGH	SD1	01 → 18	(3E) → (3C)	6D	
4	764.0	257.3		token	SD4	01 → 01			
5	814.0	28.0		fdl_status	SD1	01 → 11		49	
6	1064.0	206.0	Sync	SRD_HIGH	SD1	01 → 22	(3E) → (3C)	6D	
7	1355.3	247.3		SRD_HIGH	SD2	01 → 04	() → ()	7D	001 00
8	1437.3	8.7		DL	SD2	01 ← 04	() ← ()	08	001 00
9	1539.3	28.7		SRD_HIGH	SD2	01 → 03	() → ()	7D	006 00 00 00 00 00
10	1657.3	8.0		DL	SD2	01 ← 03	() ← ()	08	001 00
11	1758.7	28.0	Sync	SRD_HIGH	SD1	01 → 0E	(3E) → (3C)	6D	
12	2050.0	247.3	Sync	SRD_HIGH	SD1	01 → 18	(3E) → (3C)	6D	
13	2351.3	257.3		token	SD4	01 → 01			
14	2401.3	28.0		fdl_status	SD1	01 → 12		49	
15	2651.3	206.0	Sync	SRD_HIGH	SD1	01 → 22	(3E) → (3C)	6D	
16	2942.7	247.3		SRD_HIGH	SD2	01 → 04	() → ()	5D	001 00
17	3024.7	8.7		DL	SD2	01 ← 04	() ← ()	08	001 00
18	3126.7	28.7		SRD_HIGH	SD2	01 → 03	() → ()	5D	006 00 00 00 00 00
19	3244.7	8.0		DL	SD2	01 ← 03	() ← ()	08	001 00

- (a) OK, this network has no faults.
- (b) Not OK, 3 slaves are missing in this network.
- (c) Not OK, 4 slaves are missing in this network.
- (d) Not OK, 6 slaves are missing in this network.
- (e) Not OK, the master is still sending tokens to itself.

The next question is based on the following 2 messages, which are captured with a busmonitor/analyzer. It concerns a DP network where slave 16h is not functioning.

Parameter message (from master to slave):

68 _h	0C _h	0C _h	68 _h	96 _h	81 _h	5D _h	3D _h	3E _h	B8 _h	01 _h	63 _h	0B _h	05 _h	AA _h	22 _h	xx _h	16 _h
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Monitor: Adr SAP Fc DataLen Data
 01→16 3E→3D 5D 07 B8 01 63 0B 05 AA 22

<time fragment later>

Diagnostic message (from slave to master):

68 _h	0B _h	0B _h	68 _h	81 _h	96 _h	08 _h	3E _h	3C _h	42 _h	05 _h	00 _h	FF _h	50 _h	AA _h	xx _h	16 _h
-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------

Monitor: Adr SAP Fc DataLen Data
 01←16 3E←3C 08 06 42 05 00 FF 50 AA

31) What is the exact reason that slave 16h is not functioning?

Reason: _____

The next 2 questions are based on the following message, which is captured with a busmonitor/analyzer. It concerns a DP network where slave 17h is not functioning.

Diagnostic message (from slave to master):

68 _h	0D _h	0D _h	68 _h	81 _h	97 _h	08 _h	3E _h	3C _h	06 _h	05 _h	00 _h	FF _h	30 _h	BA _h	02 _h	00 _h	xx _h	16 _h
-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------	-----------------

<u>Monitor:</u>	Adr	SAP	Fc	DataLen	Data
	01←17	3E←3C	08	08	06 05 00 FF 30 BA 02 00

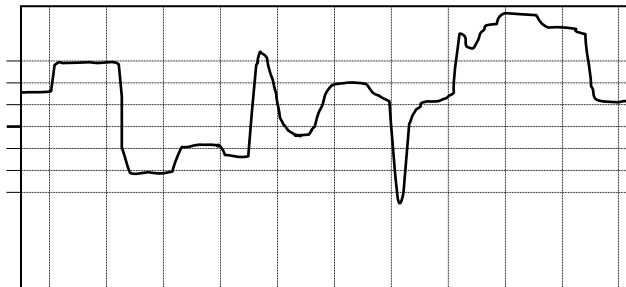
32) What is the reason that slave 17h is not functioning?

Reason: _____

33) If this slave has to be adjusted in the master, which GSD file has to be selected?

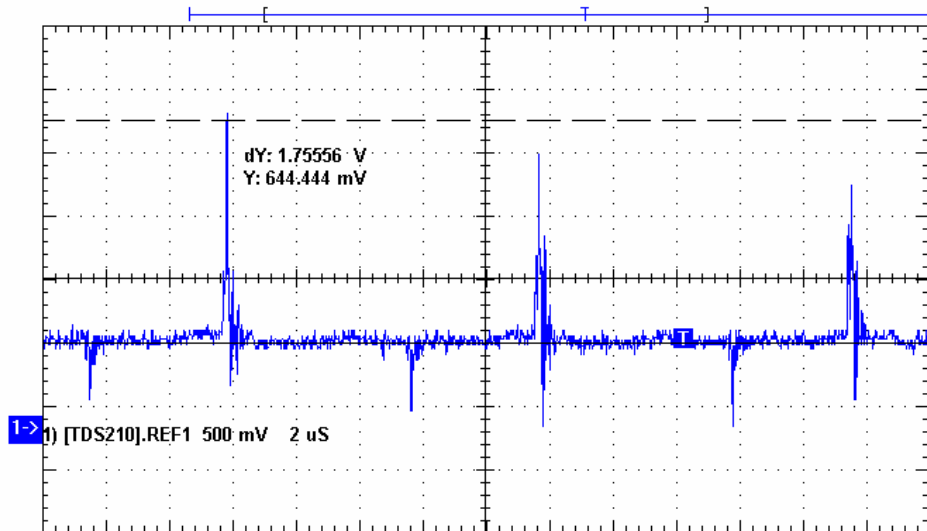
- (a) ABB_0605.GSD
- (b) TEKL0500.GSD
- (c) SIEM0200.GSD
- (d) TRCKFF30.GSD
- (e) DEXX30BA.GSD

34) This is an illustration, which is made by an oscilloscope on a DP - RS 485 network. Are the signals OK?



- (a) Yes, the signals are according to the standard.
- (b) No, there is probably a terminator missing.
- (c) No, probably the A and B line are swapped.
- (d) No, in this network are no DB9 connectors used.

35) A DP network consists out of 2 masters and 10 slaves. At a certain moment all the masters are physically removed and a measurement is performed on the RS 485 cable. The results show repeating peaks with a top value of 1,75556 V. Is this normal behavior?



- (a) Yes, this is acceptable behaviour in this situation.
- (b) Yes, if the slave notices that the masters are not active anymore, he tries to make them active with pulses.
- (c) No, if no master is active, the bus should be quiet. Probably this network has EMC problems.
- (d) No, this behavior is only seen when the masters are removed and the slave still wants to put diagnostic information on the bus. The slave, 'has lost it' and keeps putting the information on the bus.
- (e) No, in this network are no DB9 connectors used.

4. Design techniques

The next questions are based on the GSD file of a DP slave, which will probably be used in a project.

```
#Profibus_DP
GSD Revision      = 2
Vendor Name       = "BARTEC GmbH"
Model Name        = "Bartec Ex I/O"
Revision          = "22.04.1999"
Ident_Number      = 0x2305
Protocol Ident    = 0
Station Type      = 0
FMS supp         = 0
Hardware Release  = "HR1"
Software_Release  = "SR1"

9.6 supp         = 1
19.2 supp        = 1
93.75 supp       = 1
187.5 supp       = 1
500_supp         = 1
1.5M_supp        = 1

MaxTsdr 9.6      = 60
MaxTsdr 19.2     = 60
MaxTsdr 93.75    = 60
MaxTsdr 187.5    = 60
MaxTsdr_500     = 100
MaxTsdr 1.5M    = 150

Freeze Mode supp = 1
Sync Mode supp   = 1
Auto_Baud_supp   = 1
Set_Slave_Add_supp = 0
Min Slave Intervall = 1

Modular Station  = 0
User_Prm_Data_Len = 5
User_Prm_Data     = 0x00, 0x00, 0x00, 0x00, 0x00

Fail Safe        = 0
Slave Family     = 3
Max Diag Data Len = 13

Unit_Diag_Bit(16) = "IN ch.1 short circ. / wire break"
Unit_Diag_Bit(17) = "IN ch.2 short circ. / wire break"
Unit_Diag_Bit(24) = "OUT ch.1 short circ. / overload"
Unit_Diag_Bit(25) = "OUT ch.2 short circ. / overload"
Unit_Diag_Bit(28) = "power U2 missing"

Module = "module 1" 0x20,0x10
EndModule

;----END OF FILE----
```

- 36) *Can this product work on a network that runs on 12 Mbps?* - Yes
 - No
- 37) *Can this product indicate process diagnostics to the user?* - Yes
 - No
- 38) *Can the user choose how many bytes he cyclically wants to transfer?* - Yes
 - No
- 39) *Can the network address be set with a class 2 master?* - Yes
 - No

40) *In which GSD group is this slave placed?*

GSD group name: _____

41) *How many input and output bytes are cyclically transferred?*

Number of input bytes: _____

Number of output bytes: _____

++++++

42) *A PROFIBUS DP network has to be designed with 1 PLC and 32 slaves. The baudrate is set to 1,5 Mbps and the total cable length has to be 800 m. How many repeaters should be placed?*

- (a) None.
- (b) At least 1.
- (c) At least 2.
- (d) At least 3.

+++++ END OF THE EXAM +++++

