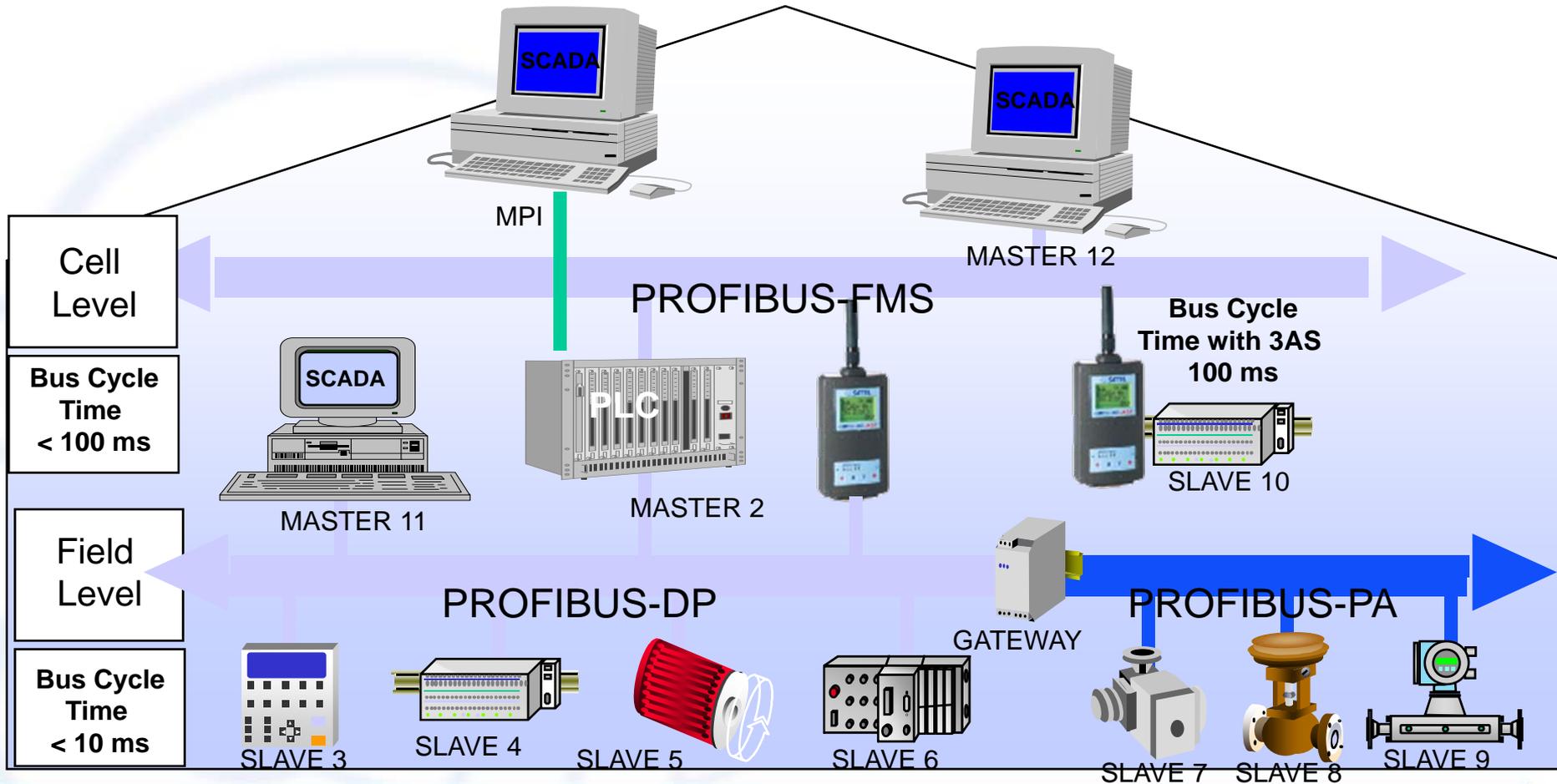


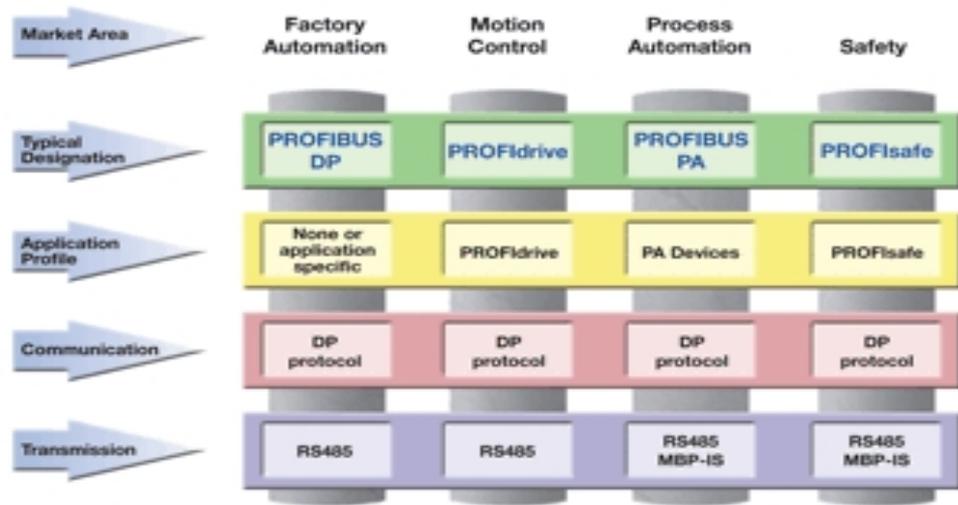
PROFIBUS

www.profibus.com



INSTALLATION EXAMPLE (with different SCADA connections)





PROFIBUS DP is used in factory automation and it is possible to use it with radio modems.

PROFIBUS FMS is the same as DP but it is used between masters.

PROFdrive is almost same as DP but it is used with motor drives and the slaves can talk to each other. Not tested with radio modems.

PROFIBUS PA has a special 2-wire cabling(MDB-IS) for intrinsic safety. MDB-IS can not be connected to radio modems.

PROFIsafe is used for safety for humans with presses, saws and robotics. Not tested with radio modems.

PROFINET (not in picture) is Ethernet based automation with special network hardware to keep the response time very low. Can be used in standard Ethernet in mixed environment with office hardware.

Typical PROFIBUS-DP System

A typical PROFIBUS-DP System consists of:

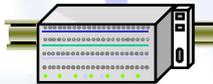
- One PLC/PC as central controller which is usually
- connected to SCADA
- connected to SCADA
- Various peripheral devices such as:
 - Digital or analog I/O
 - AC or DC drives
 - Magnetic or pneumatic valves
 - Human machine interface (HMI)

Master 2



RS 485 up to 12 Mbps, with 3AS 9.6 or 19.2 kbps

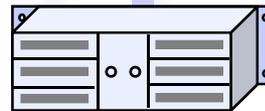
PROFIBUS-DP



Slave 3



Slave 4



Slave 5



Slave 6

PROFIBUS-DP System with 3AS



System with one bus segment (max. 127 stations).

This limits the whole system speed to same as in radio modem serial speed



System with two bus segments. The master has a separate interface card for radio modems. The wireline system can run at the full speed.

PROFIBUS operation

In PROFIBUS every station has an individual number between 0-127.

The radio modems do not have any address, they are transparent.

PROFIBUS is based on a continuous polling from the master(s) to the slave(s). The master polls the slaves in the active list one at a time in order.

If the slave fails to respond after the specified amount of retries it is dropped from the active stations list. After the polling cycle when all the active slaves are polled, new one or dropped ones are searched. The searching is done only between polling cycles. So if multiple slaves drop from the active list it might take a little longer to get them active than just one polling cycle.

The bus parameters control the delay between the polls. They are the same for every station in the segment and the master tells the parameters to the slaves. The default parameters are too fast for 3AS.

Changing the parameters suitable for 3AS also increases overall system polling time. This makes the response times longer.

Longer response time sounds usually bad but in many cases the system builders are just used to using the maximum speed.

More important question is "how fast is needed ?" If one slave takes about 100 ms to poll with radio modems, ten slaves takes one second. This is close to a reaction time of the human using the SCADA. If the application monitors tank levels, the critical response times are in minutes.

The parameters are given in t_bits . One t_bit is 1 bit time divided at the bus speed
For example at 9600 bps one t_bit is about 0.1 millisecond. So 1000 t_bit is about 100 milliseconds at 9600 bps and about 50 milliseconds at 19200 bps.

Parameter definition:

$T_slot_init/Tslot$ - the maximum time the sender of a frame waits until the addressed station responds

$Tsdr_min/Min Tsdr$ - the shortest protocol processing time at the station

$Tsdr_max/Max Tsdr$ - the longest protocol processing time at the station

T_set - the time that may elapse between an event and reaction to that event

$Tqui$ - the time allowed for bus drivers to change from send to receive

Gap/ Gap Factor - how often address gaps between the masters are checked.

Gaps result if some masters are removed from the system

Retry limit - the maximum number of call retries to a slave that fails to answer.

Ttr - the additional time allowance to additional for other masters (e.g. FMS masters) that are not part of the current configuration

Here is an example of changing the parameters with Siemens S7 software.

Select "Hardware" from "Project Window".

Highlight the "PROFIBUS line" and right click "Object Properties".

Hardware

CPU 315-2 DP

HW Config - SIMATIC 300(1)

Station Edit Insert PLC View Options Window Help

SIMATIC 300(1) (Configuration) -- DemoProject

(0) UR

1	PS 307 5A
2	CPU 315-2 DP
X2	DP
3	

PROFIBUS(1): DP master system (1)

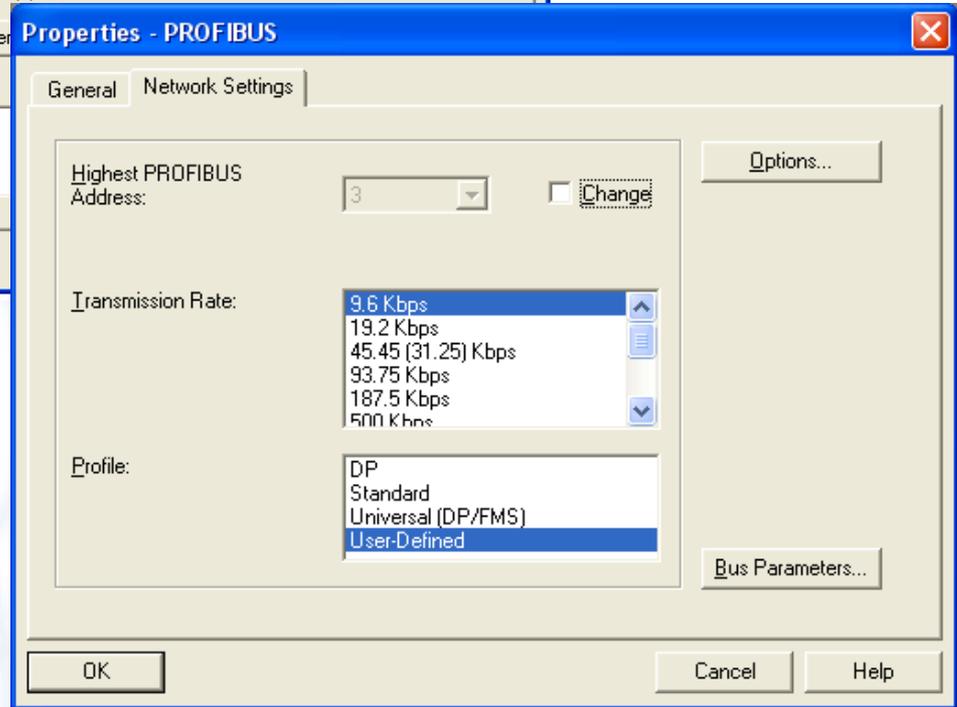
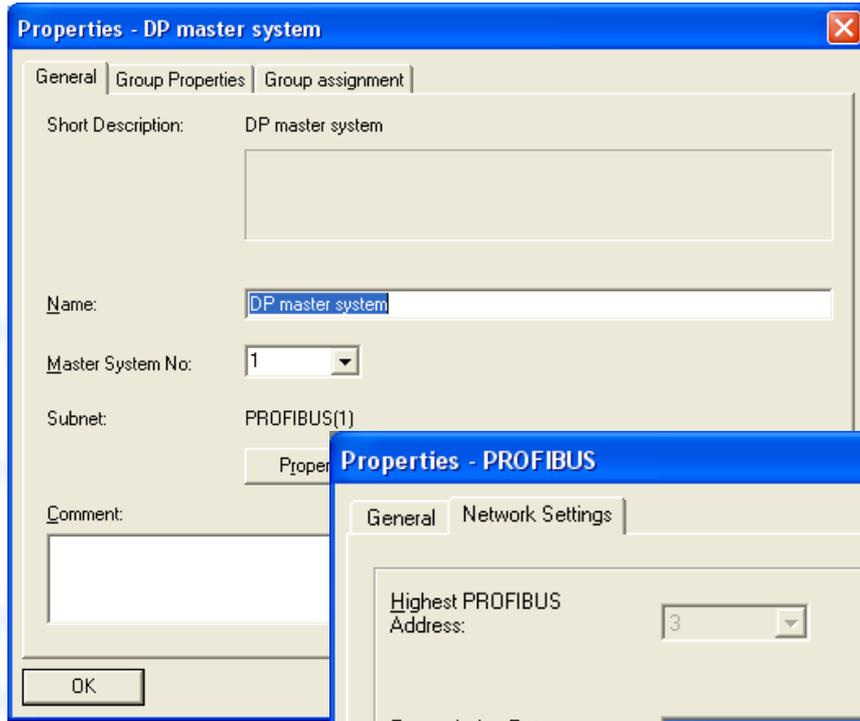
(3) B-8DI/8

PROFIBUS address	Module	Order number	Firmware	Diagnostic address
3	B-8DI/8DO DP	6ES7 133-0BH0-0XB0		1022

Press F1 to get Help.

Click "Properties".

Select tab "Network Settings", "9.6 Kbps" and "User-Defined" and click "Bus Parameters".



In this picture the values have been changed. Click "OK" and download the new settings to the PLC.

PROFIBUS(1)

Bus Parameters

Turn on cyclic distribution of the bus parameters

Tslot_Init:	2000	t_bit	Tslot:	2000	t_bit
Max.Tsdr:	60	t_bit	Tid2:	60	t_bit
Mjn.Tsdr:	11	t_bit	Trdy:	11	t_bit
Tset:	1	t_bit	Tid1:	37	t_bit
Tgui:	0	t_bit	Ttr:	58531	t_bit
			=	5888.6	ms
Gap Factor:	10		Ttr	4570	t_bit
Retry limit:	5		=	476.0	ms
			Watchdog	109659	t_bit
			=	11422.8	ms

Recalculate

OK Cancel Help

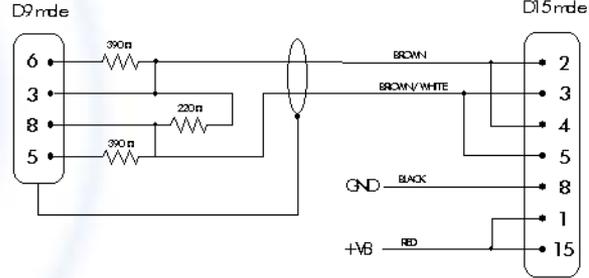
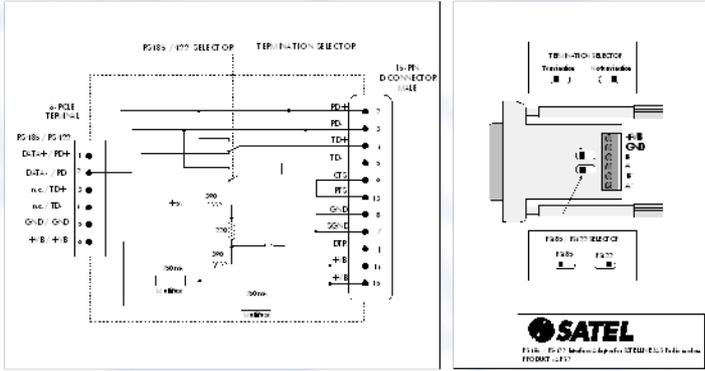
The transmission errors should also be taken into account in PLC software (in these examples Siemens S7) and SCADA software (not in these examples).

It is recommended to use timers in the PLC software for reading the values in slaves so short communication error in Profibus will not cause errors in PLC software.

The errors in PLC software usually reflect directly to the SCADA software so delays can also be added there where applicable. Some times the PLC contractor can change the PROFIBUS parameters in PLC software but not the SCADA or the end users can change the settings for SCADA but not for the PLC program (and usually not for the PROFIBUS either).

For example, if the communication is lost for a 100 milliseconds there should be no reason to generate error in SCADA software, if the application does not need extreme response times. In SCADA software the errors usually need to be checked, which might get slightly annoying for the operating personnel over time.

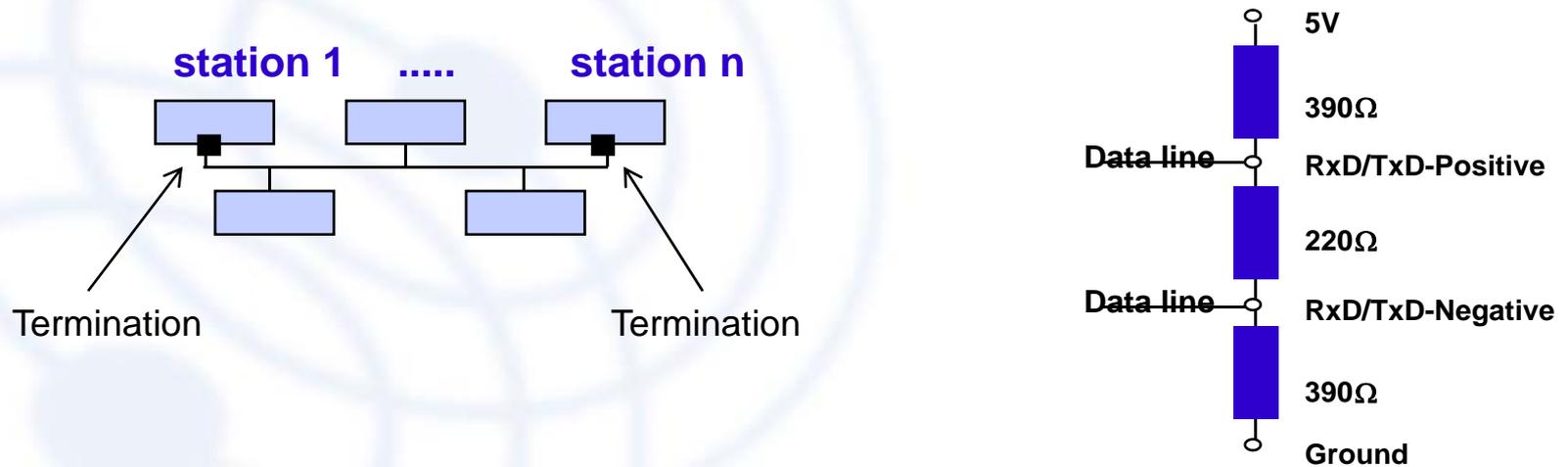
Profibus is using RS-485 as an electrical standard for serial ports. RS-485 is a differential two-wire interface with half-duplex operation. Sateline-3AS radio modem can be connected to Profibus cable by using NARS-2 interface adapter or with a CRS-PB interface cable. Note when installing the radio modems that the NARS-2 and CRS-PB are NOT galvanically isolated. So the PLC device should have galvanic isolation in the RS-485 or (and also preferably) the grounding for the PLC and for the radio modem should be the same. The radio modem antenna ground is connected to the operating voltage ground and signal ground inside the radio modem. The galvanic isolation and/or common ground(PLC+radio modem) is needed to avoid potential differences especially on the long wires. The potential difference might break the serial interface chip in the radio modem.



Schematic diagram of CRS-PB interface cable
 (left) Schematic diagram of NARS-2 interface adapter

PROFIBUS uses a bus topology with termination at both ends. The two-wired cable is usually shielded. Make sure the connections at the both ends are similar. The letter 'A' (negative) in some PROFIBUS- connectors is not the same as 'A' (positive) specified by EIA and used in 3AS manual. Coupling and uncoupling of stations during operation without affecting other stations is possible. It is important that the cable is terminated only at the both ends. With short cable lengths one-sided termination is usually enough. Too many terminations cause non-functionality.

The signal lines are connected to DB-9 connector pins 3 (positive, 'B') and 8 (negative, 'A'). The wires may have colors but they are not specified. Wiring should be straight, positive to positive and negative to negative.



TROUBLESHOOTING

Troubleshooting the PROFIBUS system can be done first at looking at the red BF-LED (Bus Failure) in the slave. The BF-LED should go OFF when the system (master) is started. In master the same led is called BUSF (in Siemens).

If it does not go OFF, check the settings of the bus parameters. Change them and download to master if needed.

Check the cabling, especially the settings in the ARS-2.

Check the radio modem settings, RS-485 and 8E1.

The radio connection should also be checked. This can be done with Terminal program and a computer with two serial ports. Or two computers with one serial port in each. This needs the radio modems to be changed to RS-232.

If the BF-LED goes OFF at the startup but is ON occasionally either the PROFIBUS parameters are too fast or more probably there are errors in the radio connection.

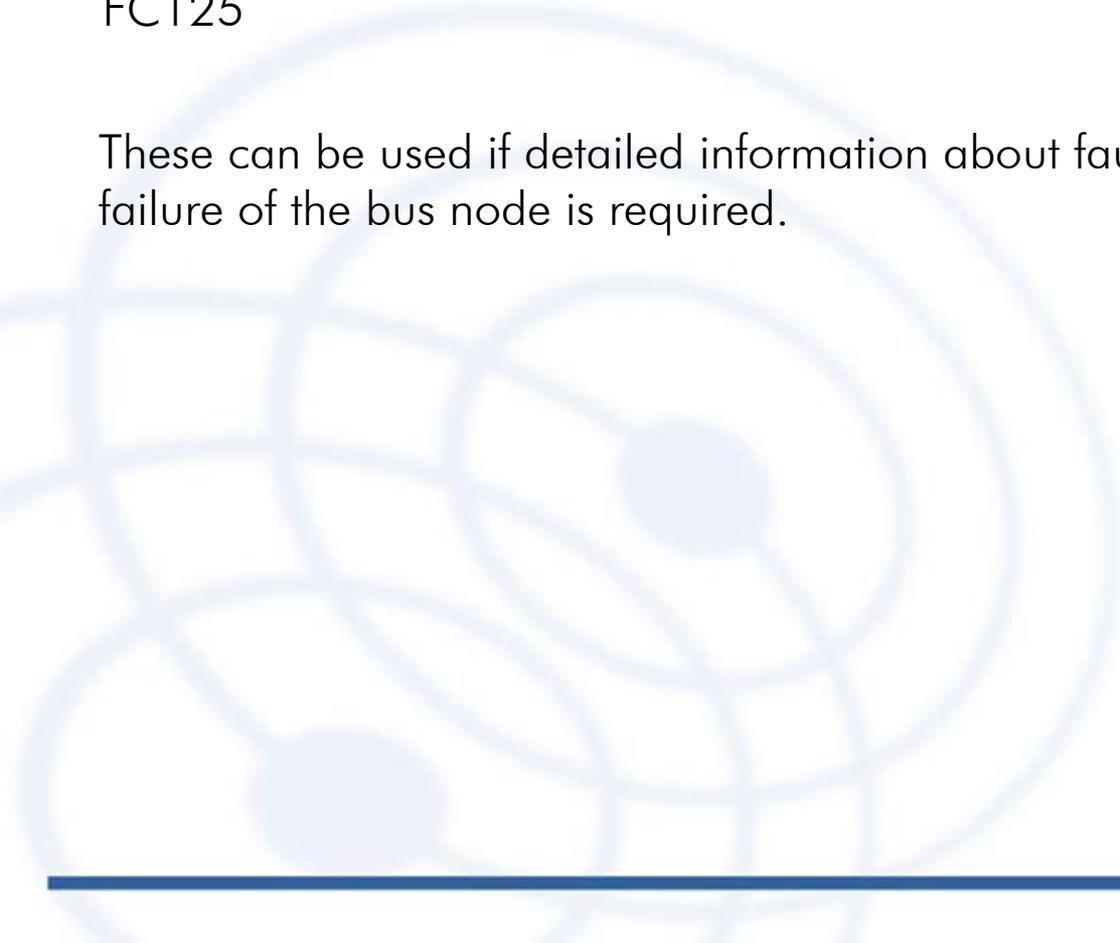
TROUBLESHOOTING

Special diagnostic blocks are available by request.

FB 125

FC125

These can be used if detailed information about fault or failure of the bus node is required.



UPDATED BUS PARAMETRES

Tslot init 1000-1500

Max Tsdr 980

Min Tsdr 150

Tqui 0

GapFactor 50
