

SAIA® PCD
Process Control Devices

**Manual
DDC-PLUS-RIO
Field-bus modules**



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Manual

DDC-PLUS-RIO

Field-bus modules

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Subject to technical changes

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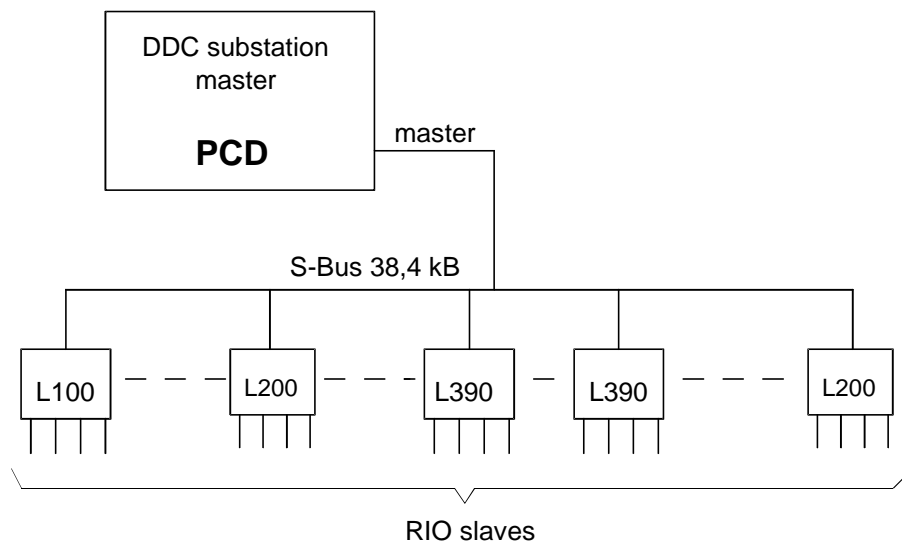
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1. Description and characteristics

What is "DDC-PLUS-RIO" ?

"DDC-PLUS-RIO" is SAIA-Burgess Electronics' field-bus system for building automation. (DDC: Direct Digital Control, RIO: Remote Input/Output). The basic field-bus system consists of a master-PCD as a DDC substation with an S-Bus communications interface. Up to 100 DDC-PLUS-RIO modules can be linked via this interface.



Network programming (i.e. which data points are read or written at which time) is done using FUPLA communication blocks (FBoxes) from the PG4 programming package.

Communication between the DDC substation and RIO stations is via a 2-wire RS-485 network using the SAIA[®] S-Bus protocol. The 24 VDC supply requires 2 additional lines, or individual RIO groups can have their own separate supply.

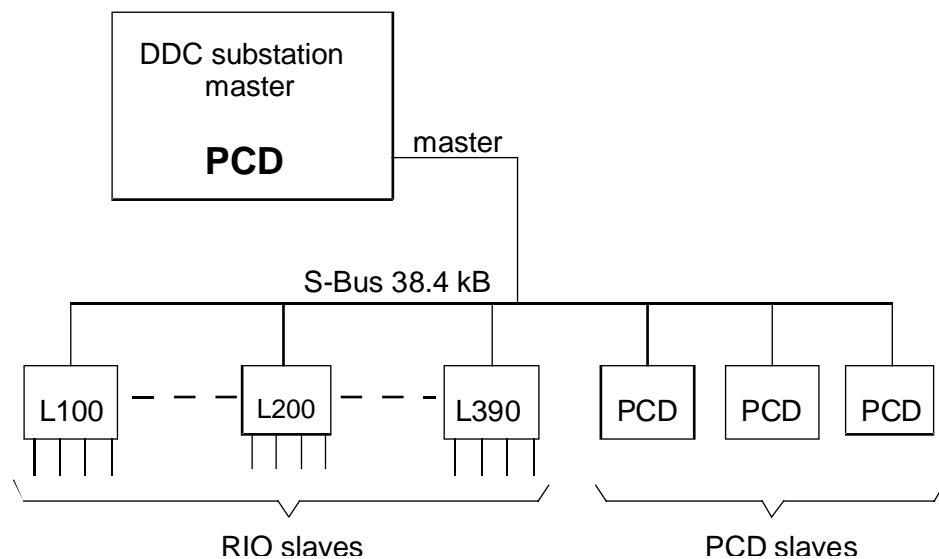
The wiring layout defines the configuration. The station numbers of individual RIO modules are set with switches.

S-Bus Master / Slave

PCD stations can also be used as slaves. In this case, attention should be paid to the electrical load on the S-Bus.

RIO slaves have a higher impedance than PCD stations. For this reason RIO slaves place a lower load on the bus enabling up to 128 RIO slaves (without repeaters) to be used in one segment. However, addressing is restricted to 100 (0 .. 99) because of the two 10-digit address selector switches. If PCD stations are used as slaves, one PCD places the same load on the bus as 8 RIO slaves. The master PCD is also on the bus and also has a load of 8 RIO slaves (see table).

The optimum arrangement is shown below, with 96 RIO slaves, 3 PCD slaves and the master PCD (4 PCDs correspond to 32 RIO slaves + 96 RIO slaves = 128). If more than 3 PCD slaves are used, the S-Bus must should be taken into account.



Each PCD slave has its own user program for the control or monitoring of part of the installation. Some of the resources (inputs, outputs, registers) can be treated as part of DDC-PLUS-RIO system.

Table: Number of PCD systems and number of RIOs in one branch

| PCD *) | RIO | PCD *) | RIO | PCD *) | RIO |
|--------|-----|--------|-----|--------|-----|
| 0 - 7 | 100 | 16 | 64 | 25 | 28 |
| 8 | 96 | 17 | 60 | 26 | 24 |
| 9 | 92 | 18 | 56 | 27 | 20 |
| 10 | 88 | 19 | 52 | 28 | 16 |
| 11 | 84 | 20 | 48 | 29 | 12 |
| 12 | 80 | 21 | 44 | 30 | 8 |
| 13 | 76 | 22 | 40 | 31 | 4 |
| 14 | 72 | 23 | 36 | 32 | 0 |
| 15 | 68 | 24 | 32 | | |

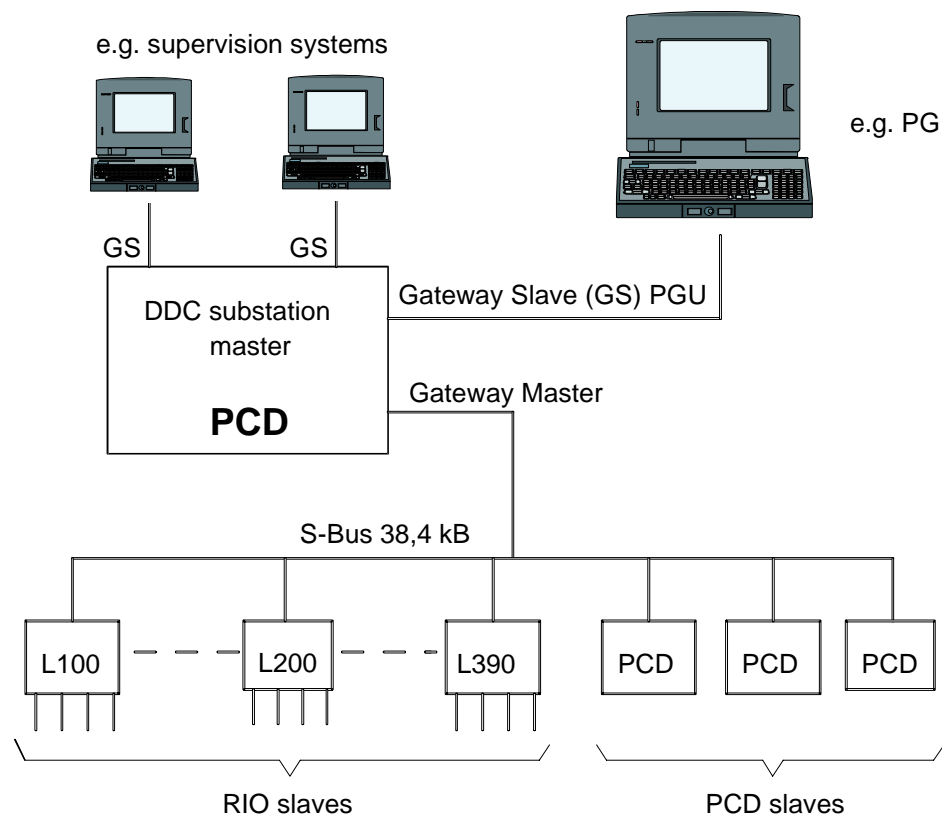
*) incl. master

S-Bus gateway with up to 4 master stations

The arrangement shown below can be viewed as the fully equipped system. It uses the gateway structure.

For example, a PC programming unit is used as the "gateway slave PGU". From the PC the entire installation can be programmed and debugged, i.e. viewed online in FUPLA with the possibility of manually changing individual elements in both the master PCD and all RIO or PCD slaves.

Two further stations can be connected as "gateway slaves", i.e. process control or visual display systems. The gateway stations can also be connected via modems to a DDC substation.



(For 'S-Bus Gateway' see also "SAIA[®] S-Bus manual", chapter 6, PUBLI-26/739 E)

2. Devices for a DDC-PLUS-RIO network

2.1 Which devices can be used as masters?

Basically, all PCD processors can be used as master stations:

| PCD family | from HW version | from FW version |
|------------|-----------------|-----------------|
| PCD1 | all | 005 |
| PCD2 | 'A' | 001 |
| PCD4.Mxx0 | 'G' | 003 |
| PCD4.Mxx5 | all | 00B |
| PCD6.M1/M2 | all | 007 |
| PCD6.M300 | all | 001 |
| PCD6.M540 | 'C' | 002 |

Transmission mode: Parity mode (SM1) up to 38400 Bit/s

See also "SAIA[®] S-Bus" manual, order reference: PUBLI-26/739D.

2.2 Which devices can be used as slaves?

Primarily, RIO modules can be used:

| | |
|------------|--|
| PCD7.L100: | Digital input module with 4 inputs |
| PCD7.L200: | Digital output module with 8 outputs |
| PCD7.L300: | Analogue input module with 8 inputs for 4 Pt 1000 resistance thermometers, resolution: 0.1°C |
| PCD7.L310: | Analogue input module with 8 inputs for 4 Ni 1000 resistance thermometers, resolution: 0.1°C |
| PCD7.L390: | Analogue input module with 4 inputs for 4 Pt 1000 resistance thermometers, resolution: 0.3°C |
| PCD7.L400: | Analogue output module with 4 outputs 0..10 VDC resolution: 10 Bit |

All PCD processors can also be used as slave stations:

| PCD family | from HW version | from FW version |
|------------|-----------------|-----------------|
| PCD1 | all | 001 |
| PCD2 | 'A' | 001 |
| PCD4.Mxx0 | 'G' | 003 |
| PCD4.Mxx5 | all | 00B |
| PCD6.M1/M2 | all | 007 |
| PCD6.M300 | all | 001 |
| PCD6.M540 | 'C' | 002 |

Transmission mode: Parity mode (SS1) up to 38400 Bit/s

See also "SAIA[®] S-Bus" manual, order reference: PUBLI-26/739D.

3. RIO field-bus modules

3.1 General

Each module type has 4 (or 8) inputs or 4 outputs.

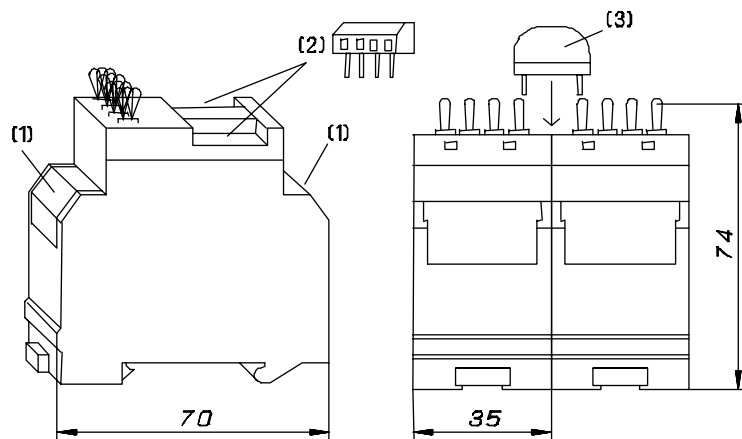
The inputs and outputs are connected to the screw terminals (1). The bus connection and supply voltage plug onto the top (2), so that the connection between the modules is made simply by inserting the jumper (3). The jumper chains the bus and supply voltage to each module (up to a maximum of 15 modules, see section 3.5).

Digital modules have built-in manual override controls. For input modules, switches override the input signals. This means that the switch setting is transferred to the bus. The switch position can be queried by the PCD (ON-AUTO-OFF). For output modules, the switches override the signals from the bus, so that a relay can be forced on or off, regardless of the control signals on the bus.

Two LEDs show the RIO station's status:

green LED: flickers during data reception
 red LED: Error - permanently on if data transmission via the bus is not possible.

Figure: Housing dimensions and connections



Transmission speed is automatically recognized by RIO modules and does not have to be set.

The following types of module are offered:

- PCD7.L100: Digital input module with 4 inputs
- PCD7.L200: Digital output module with 8 outputs
- PCD7.L300: Analogue input module with 8 inputs for 4 Pt 1000 resistance thermometers, resolution: 0.1°C
- PCD7.L310: Analogue input module with 8 inputs for 4 Ni 1000 resistance thermometers, resolution: 0.1°C
- PCD7.L390: Analogue input module with 4 inputs for 4 Pt 1000 resistance thermometers, resolution: 0.3°C (-35°C ... +40°C)
- PCD7.L400: Analogue output module with 4 outputs 0..10 VDC resolution: 10 Bit

3.2 PCD7.L100 digital input module

3.2.1 Description

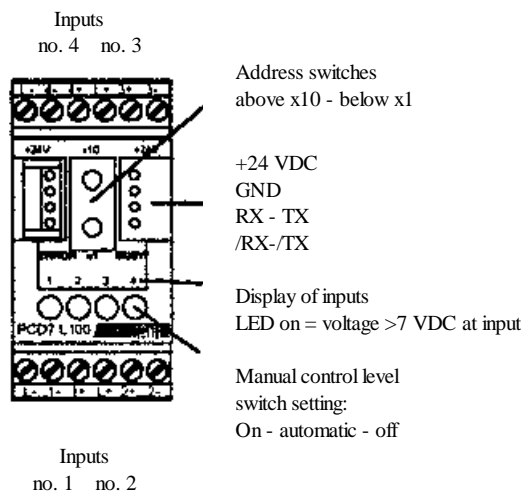
The RIO module was developed as a SAIA[®] S-BUS data node for local switching tasks. Via a PCDx-type DDC, inputs can be read and manual/auto function monitored.

Module addressing and identification are done using the two address switches (x1 x10) behind the front cover. Addresses 00 to 99 can be set, allowing up to 99 RIO modules and 3 PCD stations to be connected onto one bus branch.

3.2.2 Technical data, connection diagram and dimensions

| | |
|---|---|
| Bus system | SAIA [®] S-BUS (parity mode) |
| Transmission rate | 1200 ... 38400 Bit/s |
| Bus length max. | 1200m (without repeater) |
| <u>Input side:</u> | |
| Nominal voltage UN | 24 VDC (18 ... 32 VDC) |
| Current consumption | <50 mA |
| Power consumption | 1.2W |
| Relative duty cycle | 100% |
| Input voltage max. (control input) | 30 VDC |
| Input current (24 VDC) (control input) | 6 mA |
| High signal recognition | >7 VDC |
| Low signal recognition | <3 VDC |
| Response time | 15 ms (receive data to reaction transmit data) |
| Stand-by recovery time | < 3s (after voltage loss) |
| Operating temperature range | 0°C ... +55°C |
| Storage temperature range | -25°C ... +70°C |
| Protective wiring | reverse battery protection of operating voltage |
| Input status display | yellow LED |
| Function display | green LED for bus activity |
| Error display | red LED for bus error message |
| Special features | - manual control override with status via bus - isolated inputs |
| Test signal input / bus | 2500 VAC / 50 Hz / 1 min |

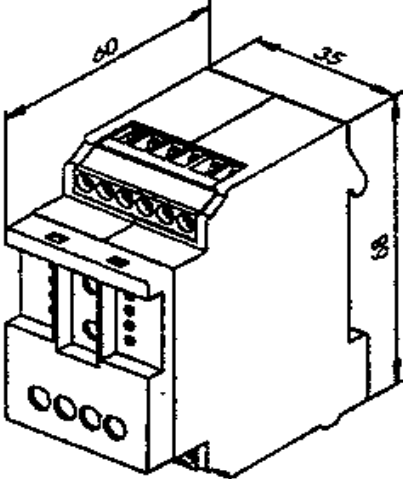
Connection diagram



Housing:

| | | |
|--------------------------|-----------|---|
| Protection type | DIN 40050 | housing IP50, terminals IP20 |
| Humidity class | | F (DIN 40040) |
| Connection cross-section | | |
| Terminals | | 2.5 mm ² |
| Plug-in screw terminals | | 1.5 mm ² |
| Mounting position | | any |
| Weight | | 95g |
| Housing dimensions | | W x H x D: 35 x 68 x 60 mm |
| Chained units | | Up to 15 modules can be chained together, after this a new chain must be started, with a new supply voltage connection. |

Dimensions



3.2.3 Data transmission via S-Bus

Telegrams supported

All SAIA[®] S-Bus telegrams are recognised. Telegrams which do not have any function in the device are answered with a <NAK>. This informs the user that the message was not processed. The module has automatic baud rate recognition, which is enabled automatically after 11 consecutive telegrams from the master with CRC errors. This means that the module adjusts itself automatically to the existing system. It is only necessary to set the station address. 'Write Output' and 'Write Register' to address 255 are recognised as broadcast messages.

"Read Input" Reads inputs and manual switch status

| Address | Information |
|---------|---------------------------------------|
| 1 | Input signal 1: 0 = <3 VDC 1 = >7 VDC |
| 2 | Input signal 2: 0 = <3 VDC 1 = >7 VDC |
| 3 | Input signal 3: 0 = <3 VDC 1 = >7 VDC |
| 4 | Input signal 4: 0 = <3 VDC 1 = >7 VDC |
| 5 | Input signal 1: 0 = Auto, 1 = Manual |
| 6 | Input signal 2: 0 = Auto, 1 = Manual |
| 7 | Input signal 3: 0 = Auto, 1 = Manual |
| 8 | Input signal 4: 0 = Auto, 1 = Manual |

"Read Register" Reads register information

| | |
|--------------|-----------------------|
| 5 | Baudrate (plain text) |
| 6 | Module address |
| 10 (decimal) | Status register |

Status register:

| | |
|---------|--|
| Bit 0: | 1 = Device recognised last transmission 0 = Device did not recognise last transmission |
| Bit 1: | 1 = Last transmission was a broadcast 0 = Last transmission was not a broadcast |
| Bit 2: | 1 = Last transmission came from master 0 = Last transmission came from another slave |
| Bit 3: | 1 = CRC of last message was correct 0 = CRC of last message was incorrect |
| Bit 5: | 1 = Device is working properly 0 = Device has executed an internal reset |
| Bit 8: | 1 = Internal PC bus (EEPROM) is OK 0 = Internal PC bus is not working perfectly |
| Bit 9: | 1 = EEPROM data memory is OK 0 = EEPROM data memory is faulty |
| Bit 10: | 1 = Baud rate has been loaded from EEPROM 0 = Baud rate is at its default value (9600 Baud) |
| Bit 12: | 1 = Switch 1 on automatic 0 = Switch 1 on manual control |
| Bit 13: | 1 = Switch 2 on automatic 0 = Switch 2 on manual control |
| Bit 14: | 1 = Switch 3 on automatic 0 = Switch 3 on manual control |
| Bit 15: | 1 = Switch 4 on automatic 0 = Switch 4 on manual control |

All other bits are not defined and are read as "0".

"Write Register" Sets the baud rate

Address 5:

| Value | Setting (baud) |
|-------|----------------|
| 4 | 1200 |
| 5 | 2400 |
| 6 | 4800 |
| 7 | 9600 |
| 8 | 19200 |
| 9 | 38400 |

Note:

Factory settings: baud rate 9600 baud, address = code switch position.
After a power loss, setting returns to the last used baud rate.

Caution: If a baud rate of 19200 or 38400 is set on the module, baud rates of 1200 and 2400 cannot be recognised automatically.

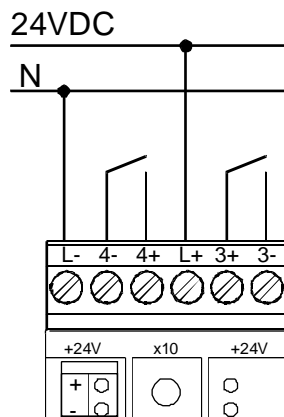
3.2.4 Connection example and block diagram

Inputs are arranged in 2 groups of 2 inputs, making wiring easier. Inputs are isolated from the bus and the rest of the electronics.

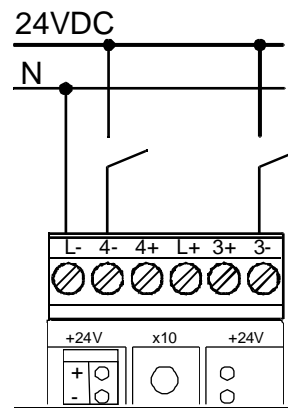
Inputs reliably recognise an “on” voltage of min. 7V DC, and an “off” voltage of max. 3V DC.

Connect the signals or contacts to the inputs as shown in the connection examples below. Connect the busses and the supply voltage, and set the unit’s address. With the supply voltage on, an initial performance test can be made using the manual override switches. Switches should then be set to the mid-way position (automatic).

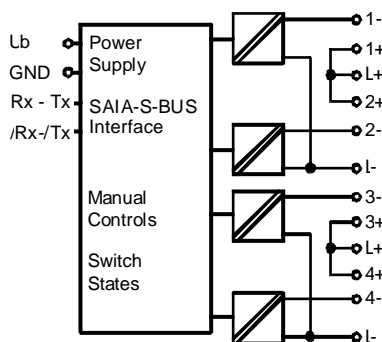
Connection example 1



Connection example 2



Block diagram



3.3 PCD7.L200 digital output module

3.3.1 Description

The RIO module was developed as a SAIA[®] S-BUS data node for local switching tasks. Via a PCDx-type DDC, relay outputs can be controlled and manual/auto function monitored.

Module addressing and identification are done using the two address switches (x1 x10) behind the front cover. Addresses 00 to 99 can be set, allowing up to 99 RIO modules and 3 PCD stations to be connected onto one bus branch.

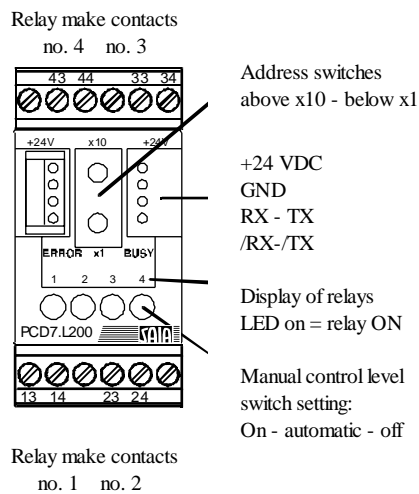
3.3.2 Technical data, connection diagram and dimensions

| | |
|-----------------------------|--|
| Bus system | SAIA® S-BUS (parity mode) |
| Transmission rate | 1200 ... 38400 Bit/s |
| Bus length max. | 1200m (without repeater) |
| <u>Input side:</u> | |
| Nominal voltage UN | 24 VDC (18 ... 32 VDC) |
| Current consumption | <100 mA |
| Power consumption | 2.4W |
| Relative duty cycle | 100% |
| Response time | <20 ms (data received until relay switches) |
| Release time | <20 ms (data received until relay switches) |
| Stand-by recovery time | < 3s (after voltage loss) |
| Operating temperature range | 0°C ... +55°C |
| Storage temperature range | -25°C ... +70°C |
| Protective wiring | reverse polarity protection for supply voltage |
| Relay status display | yellow LED switched on for relay |
| Function display | green LED for bus activity and supply voltage |
| Special features | - manual control override |

Output side:

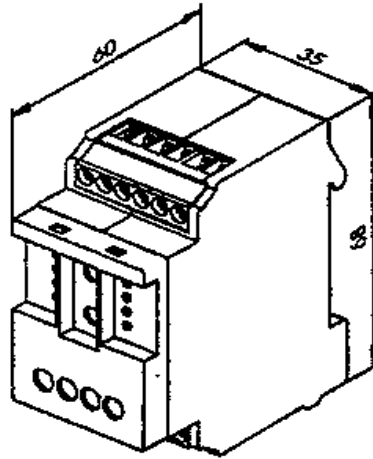
| | |
|----------------------------------|---------------------------------------|
| Output contacts | 4 'make' contacts |
| Contact material | AgNi90/10 |
| Turn-on voltage max. | 250 VAC |
| Constant current max. | 6A/relay but max. 12A/housing |
| Contact fuse protection | 6A |
| Mechanical lifetime | 1 x 10 ⁷ actions |
| Electrical lifetime | 1 x 10 ⁶ actions |
| Permissible continuous operation | 360 actions/hour (at nominal load) |
| Insulation acc. VDE 0110 | C |
| Rated voltage | 250V |
| Overvoltage category | III |
| Contamination level | 3 |
| Test voltage coil/contact | 4000 VAC / 50 Hz / 1 min. |
| Test voltage contact/contact | 1000 VAC / 50 Hz / 1 min. |

Connection diagram



Housing:

| | |
|---------------------------|---|
| Protection type DIN 40050 | housing IP50, terminals IP20 |
| Humidity class | F (DIN 40040) |
| Connection cross-section | |
| Terminals | 2.5 mm ² |
| Plug-in screw terminal | 1.5 mm ² |
| Mounting position | any |
| Weight | 95g |
| Housing dimensions | W x H x D: 35 x 68 x 60 mm |
| Chained units | Up to 15 modules can be chained together, after this a new chain must be started, with a new supply voltage connection. |



3.3.3 Data transmission via S-Bus

Telegrams supported

All SAIA[®] S-Bus telegrams are recognised. Telegrams which do not have any function in the device are answered with a <NAK>. This informs the user that the message was not processed. The module has automatic baud rate recognition, which is enabled automatically after 11 consecutive telegrams from the master with CRC errors. This means that the module adjusts itself automatically to the existing system. It is only necessary to set the station address. 'Write Output' and 'Write Register' to address 255 are recognised as broadcast messages.

"Read Output" Reads relay status

| Address | Information |
|---------|---|
| 1 | Relay 1: 0 = released 1 = picked up |
| 2 | Relay 2: 0 = released 1 = picked up |
| 3 | Relay 3: 0 = released 1 = picked up |
| 4 | Relay 4: 0 = released 1 = picked up |

"Read Register" Reads register information

| | |
|----------|------------------------|
| 5 | Baud rate (plain text) |
| 6 | Module address |
| 10 (dec) | Status register |

Status register:

| | |
|---------|--|
| Bit 0: | 1 = Device recognised last transmission 0 = Device did not recognise last transmission |
| Bit 1: | 1 = Last transmission was a broadcast 0 = Last transmission was not a broadcast |
| Bit 2: | 1 = Last transmission came from master 0 = Last transmission came from another slave |
| Bit 3: | 1 = CRC of last message was correct 0 = CRC of last message was incorrect |
| Bit 5: | 1 = Device is working properly 0 = Device has executed an internal reset |
| Bit 8: | 1 = Internal PC bus (EEPROM) is OK 0 = Internal PC bus is not working perfectly |
| Bit 9: | 1 = EEPROM data memory is OK 0 = EEPROM data memory is faulty |
| Bit 10: | 1 = Baud rate has been loaded from EEPROM 0 = Baud rate is at its default value (9600 Baud) |
| Bit 12: | 1 = Switch 1 on automatic 0 = Switch 1 on manual control |
| Bit 13: | 1 = Switch 2 on automatic 0 = Switch 2 on manual control |
| Bit 14: | 1 = Switch 3 on automatic 0 = Switch 3 on manual control |
| Bit 15: | 1 = Switch 4 on automatic 0 = Switch 4 on manual control |

All other bits are not defined and are read as "0".

"Write Output" Writes output relays

| Address | Information | | |
|---------|-------------|--------------|---------------|
| 1 | Relay 1: | 0 = released | 1 = picked up |
| 2 | Relay 2: | 0 = released | 1 = picked up |
| 3 | Relay 3: | 0 = released | 1 = picked up |
| 4 | Relay 4: | 0 = released | 1 = picked up |

"Write Register" Sets the baud rate

| Address 5: | |
|------------|----------------|
| Value | Setting (baud) |
| 4 | 1200 |
| 5 | 2400 |
| 6 | 4800 |
| 7 | 9600 |
| 8 | 19200 |
| 9 | 38400 |

Note:

Factory settings: baud rate 9600 baud, address = code switch position.
After a power loss, setting returns to the last used baud rate.

Caution: If a baud rate of 19200 or 38400 is set on the module, baud rates of 1200 and 2400 cannot be recognised automatically.

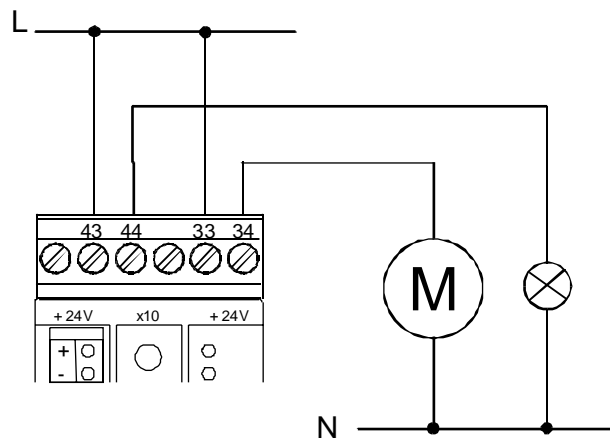
3.3.4 Connection example and block diagram

Relays are of the ‘make’ contact type. Contacts can accept loads up to 250VAC / 6A.

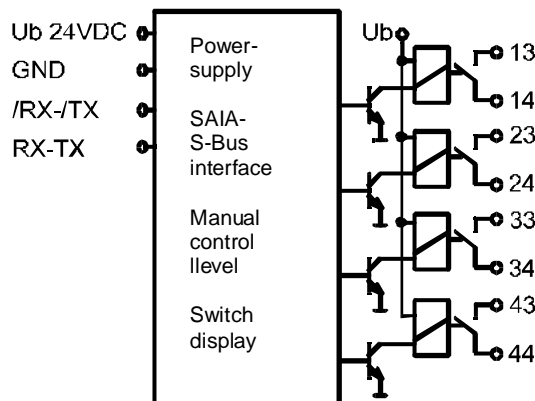
Caution: The total current per device across all 4 contacts should not exceed 12A.

Loads are connected in the normal way via the relay contacts. Connect the busses and the supply voltage, and set the unit’s address. With the supply voltage on, an initial performance test can be made using the manual override switches. Switches should then be set to the mid-way position (automatic).

Connection example



Block diagram



3.4 Analogue input module PCD7.L300 with 8 inputs for 4 Pt 1000 resistance thermometers and 4 voltages from 0 .. 10 VDC

3.4.1 Description

The RIO module was developed as a SAIA[®] S-BUS data node for local measurement tasks. Via a PCDx-type DDC, 4 temperature values between -50 and +150°C and 4 voltages from 0 .. 10 VDC can be read.

Module addressing and identification are done using the two address switches (x1 x10) behind the front cover. Addresses 00 to 99 can be set, allowing up to 100 RIO modules and 3 PCD stations to be connected onto one bus branch.

3.4.2 Technical data, connection diagram and dimensions

| | |
|---------------------------------------|---|
| Bus system | SAIA [®] S-BUS (parity mode) |
| Transmission rate | 1200 ... 38400 Bit/s |
| Bus length max. | 1200m (without repeater) |
| Nominal voltage UN | 24 VDC (15VDC ... 32 VDC) |
| Current consumption | <30 mA |
| Power consumption | 1W |
| Relative duty cycle | 100% |
| Response time | <20 ms |
| (data received until reply data sent) | |
| Stand-by recovery time | < 3s |
| Operating temperature range | 0°C ... +55°C |
| Storage temperature range | -25°C ... +70°C |
| Protective wiring | reverse battery protection of operating voltage |
| Function display | green LED for bus activity |
| Error display | red LED for bus error |

Analogue signal inputs

| | |
|--------------------|--------------------------------|
| <u>Sensor type</u> | 4 x Pt1000, 2-wire measurement |
| Temperature range | -50°C ... +150°C |
| Resolution | 0.1°C |
| Data range | -50.0 ... +150.0°C |
| | HEAVAC lib. format |

Accuracy across the measurement range $\pm (0.1K + \text{sensor tolerance})$

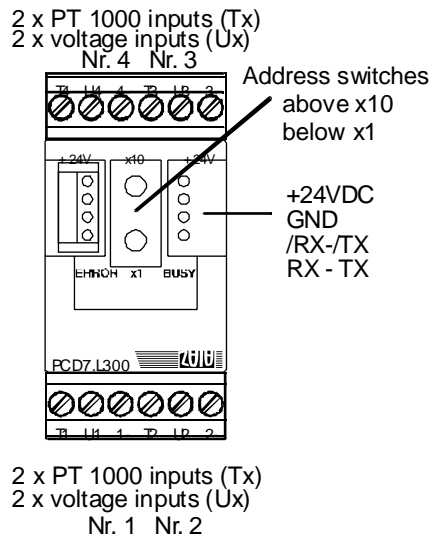
Sensor accuracy according to IEC 751:

| Tolerance class | Tolerance in K | Tolerance at | |
|-----------------|---------------------------------|--------------|-------------|
| | | 0°C | 100°C |
| 1/3 Class B | $\pm (0.15K + 0.0017 \times t)$ | $\pm 0.10K$ | $\pm 0.27K$ |
| Class A | $\pm (0.30K + 0.0020 \times t)$ | $\pm 0.15K$ | $\pm 0.35K$ |
| Class B | $\pm (0.50K + 0.0050 \times t)$ | $\pm 0.30K$ | $\pm 0.80K$ |
| Class 0.5 | $\pm (0.50K + 0.0060 \times t)$ | $\pm 0.50K$ | $\pm 1.10K$ |

t = temperature of sensor

| | |
|---------------------------------------|----------------|
| <u>Voltage inputs</u> | 4 x 0 .. 10VDC |
| Resolution | 10 mV |
| Data range | 0 .. 1000 |
| Accuracy across the measurement range | $\pm 10mV$ |
| Input impedance | 10 k Ω |

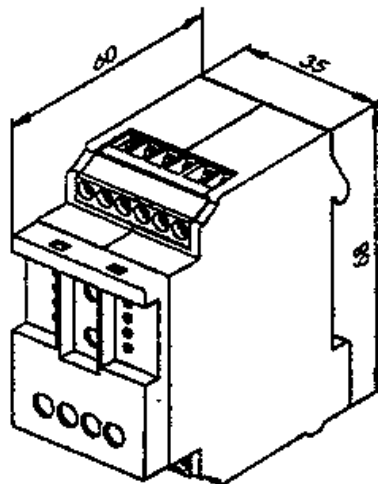
Connection diagram



Housing:

| | |
|---------------------------|---|
| Protection type DIN 40050 | housing IP50, terminals IP20 |
| Humidity class | F (DIN 40040) |
| Connection cross-section | |
| Terminals | 2.5 mm ² |
| Plug-in screw terminal | 1.5 mm ² |
| Mounting position | any |
| Weight | 95g |
| Housing dimensions | W x H x D: 35 x 68 x 60 mm |
| Chained units | Up to 15 modules can be chained together, after this a new chain must be started, with a new supply voltage connection. |

Dimensions



3.4.3 Data transmission via S-Bus

All SAIA[®] S-Bus commands (level 1) are recognised. Commands which do not have any function in the device are answered with a <NAK>. This informs the user that the command is ineffective. The module has automatic baud rate recognition, which is enabled automatically after 11 consecutive telegrams from the master with CRC errors. This means that the module adjusts itself automatically to the existing system. It is only necessary to set the station address. 'Write Output' and 'Write Register' to address 255 are recognised as broadcast messages.

"Read Register"

Caution: The instruction "Read Register x to y" can only be used with parameters "1 to 4" and "5 to 7"!

| Address | Information |
|-----------|------------------------|
| 1 | Temperature 1 |
| 2 | Temperature 2 |
| 3 | Temperature 3 |
| 4 | Temperature 4 |
| 5 | Baud rate (plain text) |
| 6 | Module address |
| 7/10 dec. | Status information |
| 11 | Voltage 1 |
| 12 | Voltage 2 |
| 13 | Voltage 3 |
| 14 | Voltage 4 |

Status register:

| | |
|---------|--|
| Bit 0: | 1 = Device recognised last transmission 0 = Device did not recognise last transmission |
| Bit 1: | 1 = Last transmission was a broadcast 0 = Last transmission was not a broadcast |
| Bit 2: | 1 = Last transmission came from master 0 = Last transmission came from another slave |
| Bit 3: | 1 = CRC of last message was correct 0 = CRC of last message was incorrect |
| Bit 5: | 1 = Device has executed an internal reset 0 = Device is working properly |
| Bit 8: | 0 = Internal I ² C-BUS bus (EEPROM) is OK 1 = Internal I ² C-BUS bus is not working perfectly |
| Bit 9: | 1 = EEPROM data memory is OK 0 = EEPROM data memory is faulty |
| Bit 10: | 1 = Baud rate has been loaded from EEPROM 0 = Baud rate is at its default value (9600 Baud) |

All other bits are reserved for factory tests.

"Write Register"

Address 5:

Sets the baud rate

| Value | Setting (Baud) |
|-------|----------------|
| 4 | 1200 |
| 5 | 2400 |
| 6 | 4800 |
| 7 | 9600 |
| 8 | 19200 |
| 9 | 38400 |

Note:

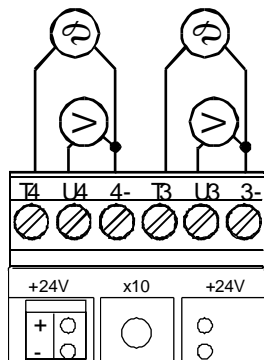
Factory settings: baud rate 9600 baud, address = code switch position.
After a power loss, setting returns to the last used baud rate.

Caution: If a baud rate of 19200 or 38400 is set on the module, baud rates of 1200 and 2400 cannot be recognised automatically.

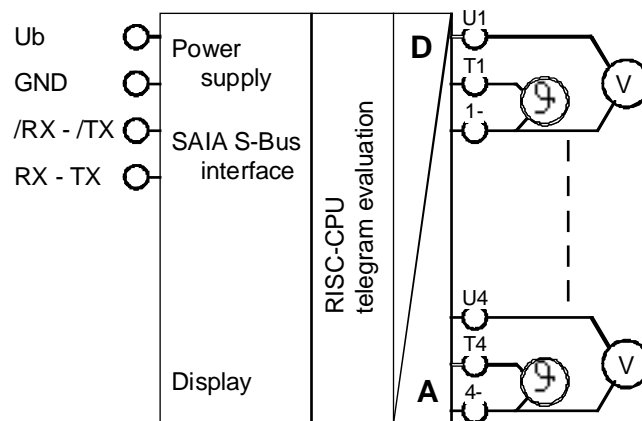
3.4.4 Connection example and block diagram

Connection example

PT-1000 sensor.
 Please keep connections as short as possible to avoid affecting the accuracy of measurement.
 3.9 Ohm copper resistance corresponds to 1°C



Block diagram



PCD7.L300 24 VDC
 S-Bus module 4 x PT1000 4 x 0 .. 10 VDC

3.5 Analogue input module PCD7.L310 with 8 inputs for 4 Ni 1000 resistance thermometers and 4 voltages from 0 .. 10 VDC

3.5.1 Description

The RIO module was developed as a SAIA[®] S-BUS data node for local measurement tasks. Via a PCDx-type DDC, 4 temperature values between -50 and +150°C and 4 voltages from 0 .. 10 VDC can be read.

Module addressing and identification are done using the two address switches (x1 x10) behind the front cover. Addresses 00 to 99 can be set, allowing up to 100 RIO modules and 3 PCD stations to be connected onto one bus branch.

3.5.2 Technical data, connection diagram and dimensions

| | |
|--|--|
| Bus system | SAIA [®] S-BUS (parity mode) |
| Transmission rate | 1200 ... 38400 Bit/s |
| Bus length max. | 1200m (without repeater) |
| Nominal voltage UN | 24 VDC (15VDC ... 32 VDC) |
| Current consumption | <30 mA |
| Power consumption | 1W |
| Relative duty cycle | 100% |
| Response time | <20 ms |
| (data received until reply data sent) | |
| Stand-by recovery time | < 3s |
| Operating temperature range | 0°C ... +55°C |
| Storage temperature range | -25°C ... +70°C |
| Protective wiring | reverse battery protection of operating voltage |
| Function display | green LED for bus activity |
| Error display | red LED for bus error |

Analogue signal inputs

| | |
|--|--------------------------------|
| <u>Sensor type</u> | 4 x Ni1000, 2-wire measurement |
| Temperature range | -50°C ... +150°C |
| Resolution | 0.1°C |
| Data range | -50.0 ... +150.0°C |
| | HEAVAC lib. format |
| Accuracy across the measurement range | ± (0.1K + sensor tolerance) |

Sensor accuracy according to IEC 751:

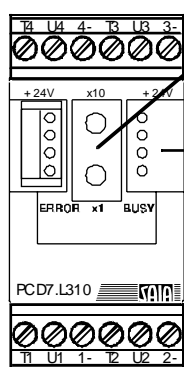
| Tolerance class | Tolerance in K | Tolerance at | |
|-----------------|-----------------------|--------------|---------|
| | | 0°C | 100°C |
| Class AA | ± (0.10K + 0.007 x t) | ± 0.10K | ± 0.80K |
| Class A | ± (0.20K + 0.014 x t) | ± 0.25K | ± 1.60K |
| Class B | ± (0.40K + 0.028 x t) | ± 0.40K | ± 3.20K |

t = temperature of sensor

| | |
|--|----------------|
| <u>Voltage inputs</u> | 4 x 0 .. 10VDC |
| Resolution | 10 mV |
| Data range | 0 .. 1000 |
| Accuracy across the measurement range | ± 10mV |
| Input impedance | 10 kΩ |

Connection diagram

2 x Ni1000 Eingänge (Tx)
2 x Spannungseingänge (Ux)
Nr. 4 Nr. 3



Adressschalter
oben x10
unten x1

+24VDC
GND
/RX-/TX
RX - TX

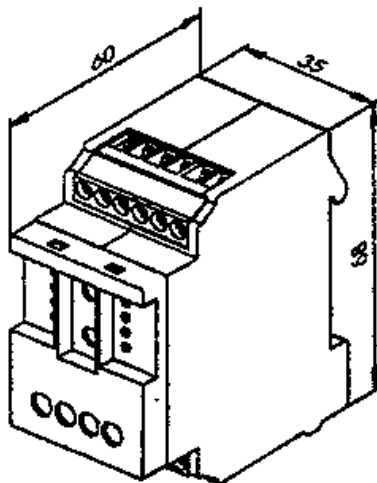
2 x Ni 1000 inputs (Tx)
2 x voltage inputs (Ux)
No. 4 No. 3
Address switches
above x 10
below x 1

2 x Ni1000 Eingänge (Tx)
2 x Spannungseingänge (Ux)
Nr. 1 Nr. 2

Housing

| | |
|---------------------------|--|
| Protection type DIN 40050 | housing IP50, terminals IP20 |
| Humidity class | F (DIN 40040) |
| Connection cross-section | |
| Terminals | 2.5 mm ² |
| Plug-in screw terminal | 1.5 mm ² |
| Mounting position | any |
| Weight | 95g |
| Housing dimensions | W x H x D: 35 x 68 x 60 mm |
| Chained units | Up to 15 modules can be chained together, after this a new chain must be started, |
| with | a new supply voltage connection. |

Dimensions



3.5.3 Data transmission via S-Bus

All SAIA[®] S-Bus commands (level 1) are recognised. Commands which do not have any function in the device are answered with a <NAK>. This informs the user that the command is ineffective. The module has automatic baud rate recognition, which is enabled automatically after 11 consecutive telegrams from the master with CRC errors. This means that the module adjusts itself automatically to the existing system. It is only necessary to set the station address. 'Write Output' and 'Write Register' to address 255 are recognised as broadcast messages.

"Read Register"

Caution: The instruction "Read Register x to y" can only be used with parameters "1 to 4" and "5 to 7"!

| Address | Information |
|-----------|------------------------|
| 1 | Temperature 1 |
| 2 | Temperature 2 |
| 3 | Temperature 3 |
| 4 | Temperature 4 |
| 5 | Baud rate (plain text) |
| 6 | Module address |
| 7/10 dec. | Status information |
| 11 | Voltage 1 |
| 12 | Voltage 2 |
| 13 | Voltage 3 |
| 14 | Voltage 4 |

Status register:

| | |
|---------|--|
| Bit 0: | 1 = Device recognised last transmission 0 = Device did not recognise last transmission |
| Bit 1: | 1 = Last transmission was a broadcast 0 = Last transmission was not a broadcast |
| Bit 2: | 1 = Last transmission came from master 0 = Last transmission came from another slave |
| Bit 3: | 1 = CRC of last message was correct 0 = CRC of last message was incorrect |
| Bit 5: | 1 = Device has executed an internal reset 0 = Device is working properly |
| Bit 8: | 0 = Internal I ² C-BUS bus (EEPROM) is OK 1 = Internal I ² C-BUS bus is not working perfectly |
| Bit 9: | 1 = EEPROM data memory is OK 0 = EEPROM data memory is faulty |
| Bit 10: | 1 = Baud rate has been loaded from EEPROM 0 = Baud rate is at its default value (9600 Baud) |

All other bits are reserved for factory tests.

"Write Register"

Address 5:

Sets the baud rate

| Value | Setting (Baud) |
|-------|----------------|
| 4 | 1200 |
| 5 | 2400 |
| 6 | 4800 |
| 7 | 9600 |
| 8 | 19200 |
| 9 | 38400 |

Note:

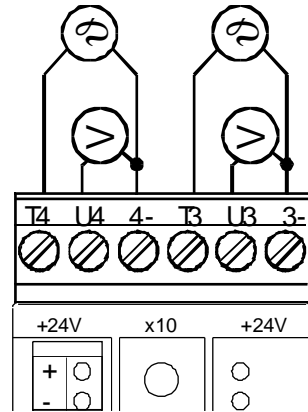
Factory settings: baud rate 9600 baud, address = code switch position.
After a power loss, setting returns to the last used baud rate.

Caution: If a baud rate of 19200 or 38400 is set on the module, baud rates of 1200 and 2400 cannot be recognised automatically.

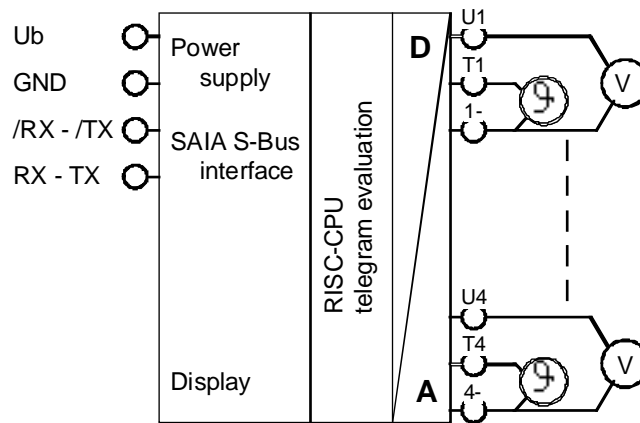
3.5.4 Connection example and block diagram

Connection example

Ni-1000 sensor.
 Please keep connections as short as possible to avoid affecting the accuracy of measurement.



Block diagram



PCD7.L310 24 VDC
 S-Bus module 4 x Ni1000 4 x 0 .. 10 VDC

3.6 PCD7.L390 temperature measurement module

3.6.1 Description

The RIO module was developed as a SAIA[®] S-BUS data node for local temperature measurement in refrigeration plants. Via a PCDx-type DDC, temperatures can be read as 8-bit figures from -350 to +400 (→ -30.0°C ... +40.0°C using the HLK Library).

Module addressing and identification are done using the two address switches (x1 x10) behind the front cover. Addresses 00 to 99 can be set, allowing up to 99 RIO modules and 3 PCD stations to be connected onto one bus branch.

3.6.2 Technical data, connection diagram and dimensions

| | |
|-------------------|---------------------------|
| Bus system | SAIA® S-BUS (parity mode) |
| Transmission rate | 1200 ... 38400 Bit/s |
| Bus length max. | 1200m (without repeater) |

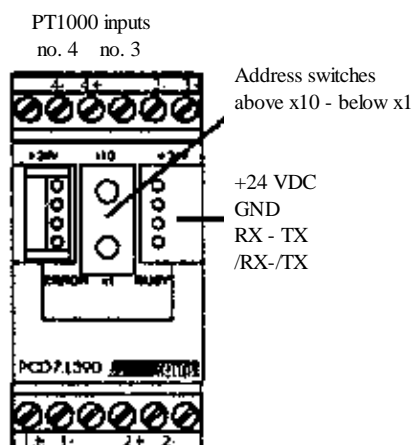
Input side:

| | |
|-----------------------------|---|
| Nominal voltage UN | 24 VDC (18 ... 32 VDC) |
| Current consumption | <100 mA |
| Power consumption | 2.4W |
| Relative duty cycle | 100% |
| Response time | <20 ms (data received until reply to PCD) |
| Stand-by recovery time | < 3s (after voltage loss) |
| Operating temperature range | 0°C ... +55°C |
| Storage temperature range | -25°C ... +70°C |
| Protective wiring | reverse battery protection of operating voltage |
| Function display | green LED for bus activity |
| Error display | red LED for bus error |

Analogue signal inputs:

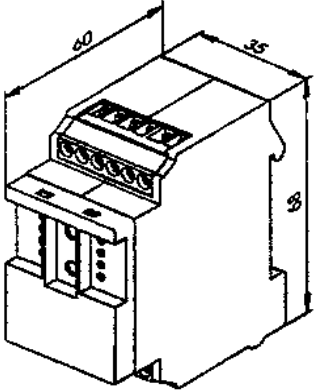
| | |
|----------------------|--------------------------------------|
| Sensor type | 4 x Pt1000 |
| Temperature range | -35°C ... +40°C |
| Resolution | approx. 0.3°C (8 bit data value) |
| Data range | 0 ... 255 hexadecimal |
| Data range via S-Bus | -35.0 ... +40.0 (HEAVAC lib. format) |

Connection diagram:



Housing:

| | | |
|--------------------------|-----------|---|
| Protection type | DIN 40050 | housing IP50, terminals IP20 |
| Humidity class | | F (DIN 40040) |
| Connection cross-section | | |
| Terminals | | 2.5 mm ² |
| Plug-in screw terminal | | 1.5 mm ² |
| Mounting position | | any |
| Weight | | 95g |
| Housing dimensions | | W x H x D: 35 x 68 x 60 mm |
| Chained units | | Up to 15 modules can be chained together, after this a new chain must be started, with a new supply voltage connection. |



3.6.3 Data transmission via S-Bus

Telegrams supported

All SAIA[®] S-Bus telegrams are recognised. Telegrams which do not have any function in the device are answered with a <NAK>. This informs the user that the message was not processed. The module has automatic baud rate recognition, which is enabled automatically after 11 consecutive telegrams from the master with CRC errors. This means that the module adjusts itself automatically to the existing system. It is only necessary to set the station address. 'Write Output' and 'Write Register' to address 255 are recognised as broadcast messages.

"Read Register" Reads analogue values

| Address | Information |
|--------------|------------------------|
| 1 | A/D value terminal 1 |
| 2 | A/D value terminal 2 |
| 3 | A/D value terminal 3 |
| 4 | A/D value terminal 4 |
| 5 | Baud rate (plain text) |
| 6 | Module address |
| 10 (decimal) | Status information |

Status register:

| | |
|---------|--|
| Bit 0: | 1 = Device recognised last transmission 0 = Device did not recognise last transmission |
| Bit 1: | 1 = Last transmission was a broadcast 0 = Last transmission was not a broadcast |
| Bit 2: | 1 = Last transmission came from master 0 = Last transmission came from another slave |
| Bit 3: | 1 = CRC of last message was correct 0 = CRC of last message was incorrect |
| Bit 5: | 1 = Device is working properly 0 = Device has executed an internal reset |
| Bit 8: | 1 = Internal PC bus (EEPROM) is OK 0 = Internal PC bus is not working perfectly |
| Bit 9: | 1 = EEPROM data memory is OK 0 = EEPROM data memory is faulty |
| Bit 10: | 1 = Baud rate has been loaded from EEPROM 0 = Baud rate is at its default value (9600 Baud) |

"Write Register" Sets the baud rate

Address 5:

| Value | Setting (Baud) |
|-------|----------------|
| 4 | 1200 |
| 5 | 2400 |
| 6 | 4800 |
| 7 | 9600 |
| 8 | 19200 |
| 9 | 38400 |

Note:

Factory settings: baud rate 9600 baud, address = code switch position.
After a power loss, setting returns to the last used baud rate.

Caution: If a baud rate of 19200 or 38400 is set on the module, baud rates of 1200 and 2400 cannot be recognised automatically.

3.6.4 Connection example and block diagram

The analogue modules for Pt1000 are designed for two-wire measurement. The Pt1000 probe is connected directly to the inputs. Measuring range is -35°C to +40°C with 8-bit resolution.

Data is transferred as integers (-350 ... +400).

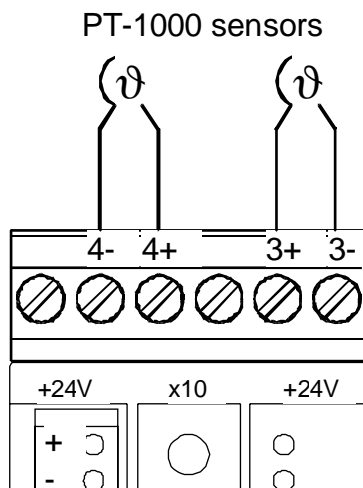
The Pt1000 sensors are connected directly to the terminals. Inputs which are not connected return a reading of +41°C to the controller.

It should be noted that the connection length of measurement sensor lines can corrupt the measurement signal. For a Pt1000 sensor, a change in resistance of approx. 4 Ohm results in a temperature modification of 1°C.

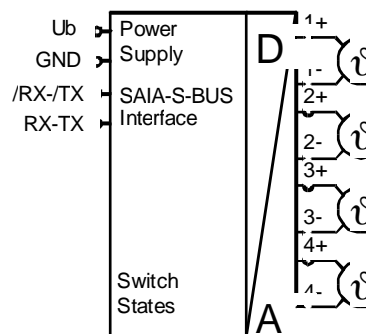
Calculation example:

A sensor is fitted 50m away from the module. This sensor is connected with cable LiYCY-CY (1 x 2 x 0.25 mm²). The cable is specified for 75 Ohm/km. This means that, at 2 x 50m, the cable has a copper resistance of 7.5 Ohm. 7.5 Ohm corresponds to a loss of approx. 1.9°C. The measurement error can be added to the temperature actually measured.

Connection example



Block diagram



3.7 Analogue output module PCD7.L400 with 4 outputs 0 .. 10 VDC, resolution: 10 Bit

3.7.1 Description

The RIO module was developed as a SAIA[®] S-BUS data node for the output of 4 voltage values from 0 .. 10 VDC can be read.

Module addressing and identification are done using the two address switches (x1 x10) behind the front cover. Addresses 00 to 99 can be set, allowing up to 100 RIO modules and 3 PCD stations to be connected onto one bus branch.

3.7.2 Technical data, connection diagram and dimensions

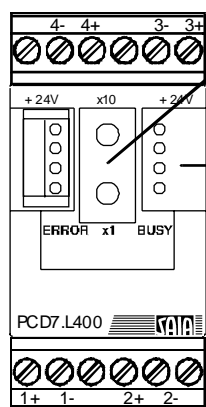
| | |
|---------------------------------------|---|
| Bus system | SAIA® S-BUS |
| Transmission rate | 1200 ... 38400 Bit/s |
| Bus length max. | 1200m (without repeater) |
| Nominal voltage UN | 24 VDC (15VDC ... 32 VDC) |
| Current consumption | <30 mA |
| Power consumption | 1W |
| Relative duty cycle | 100% |
| Response time | <20 ms |
| (data received until reply data sent) | |
| Stand-by recovery time | < 3s |
| Operating temperature range | 0°C ... +55°C |
| Storage temperature range | -25°C ... +70°C |
| Protective wiring | reverse battery protection of operating voltage |
| Function display | green LED for bus activity |
| Error display | red LED for bus error |

Analogue signal outputs

| | |
|---------------------------------------|--------------------|
| Type | 4 x 0 .. 10VDC |
| Resolution | 10 mV |
| Data range | 0 .. 1000 |
| | HEAVAC lib. format |
| Accuracy across the measurement range | ± 10 mV |

Connection diagram

0..10VDC Ausgänge
Nr. 4 Nr. 3



Adressschalter
oben x10
unten x1

+24VDC
GND
/RX-/TX
RX - TX

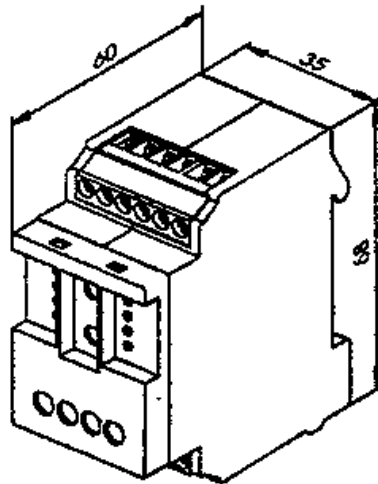
*0 .. 10 VDC outputs
No. 4 No. 3
Address switches
above x 10
below x 1*

0..10VDC Ausgänge
Nr. 1 Nr. 2

Housing

| | | |
|--------------------------|-----------|---|
| Protection type | DIN 40050 | housing IP50, terminals IP20 |
| Humidity class | | F (DIN 40040) |
| Connection cross-section | | |
| Terminals | | 2.5 mm ² |
| Plug-in screw terminal | | 1.5 mm ² |
| Mounting position | | any |
| Weight | | 95g |
| Housing dimensions | | W x H x D: 35 x 68 x 60 mm |
| Chained units | | Up to 15 modules can be chained together, after this a new chain must be started, with a new supply voltage connection. |

Dimensions



3.7.3 Data transmission via S-Bus

All SAIA[®] S-Bus commands (level 1) are recognised. Commands which do not have any function in the device are answered with a <NAK>. This informs the user that the command is ineffective. The module has automatic baud rate recognition, which is enabled automatically after 11 consecutive telegrams from the master with CRC errors. This means that the module adjusts itself automatically to the existing system. It is only necessary to set the station address. 'Write Output' and 'Write Register' to address 255 are recognised as broadcast messages.

"Read Register"

Caution: The instruction "Read Register x to y" can only be used with parameters "1 to 4" and "5 to 7"!

| Address | Information |
|-----------|------------------------|
| 5 | Baud rate (plain text) |
| 6 | Module address |
| 7/10 dec. | Status information |

Status register:

| | |
|---------|--|
| Bit 0: | 1 = Device recognised last transmission 0 = Device did not recognise last transmission |
| Bit 1: | 1 = Last transmission was a broadcast 0 = Last transmission was not a broadcast |
| Bit 2: | 1 = Last transmission came from master 0 = Last transmission came from another slave |
| Bit 3: | 1 = CRC of last message was correct 0 = CRC of last message was incorrect |
| Bit 5: | 1 = Device has executed an internal reset 0 = Device is working properly |
| Bit 8: | 0 = Internal I ² C-BUS bus (EEPROM) is OK 1 = Internal I ² C-BUS bus is not working perfectly |
| Bit 9: | 1 = EEPROM data memory is OK 0 = EEPROM data memory is faulty |
| Bit 10: | 1 = Baud rate has been loaded from EEPROM 0 = Baud rate is at its default value (9600 Baud) |

All other bits are reserved for factory tests.

"Write Register"

Address 5:

Setting the baud rate

| Value | Setting (Baud) |
|-------|----------------|
| 4 | 1 200 |
| 5 | 2 400 |
| 6 | 4 800 |
| 7 | 9 600 |
| 8 | 19 200 |
| 9 | 38 400 |

Address

| | |
|---|-------------------------|
| 1 | Analogue value output 1 |
| 2 | Analogue value output 2 |
| 3 | Analogue value output 3 |
| 4 | Analogue value output 4 |

N.B.: Outputs cannot be written block by block.

Note:

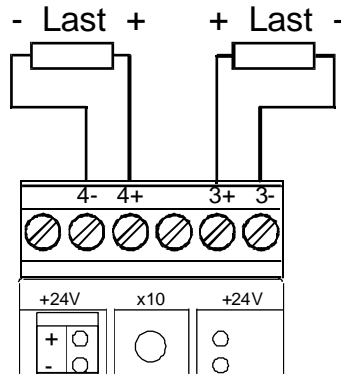
Factory settings: baud rate 9600 baud, address = code switch position.
After a power loss, setting returns to the last used baud rate.

Caution: If a baud rate of 19200 or 38400 is set on the module, baud rates of 1200 and 2400 cannot be recognised automatically.

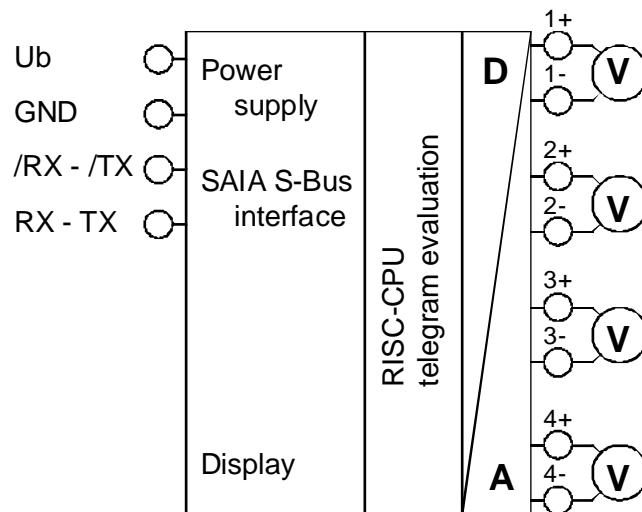
3.7.4 Connection example and block diagram

Connection example

Voltage outputs 0 .. 10VDC
max. output current 10 mA



Block diagram



PCD7.L400 24 VDC
S-Bus module 4 x 0 .. 10 VDC

3.8 Design and construction of a RIO network

3.8.1 Bus connection

Topology

SAIA S-Bus is a highly interference resistant field bus based on the RS485 interface. Resistance to interference is increased by a sophisticated software protocol (see chapter 1).

On a single bus branch, up to 100 RIO modules and 3 PCDx stations can be connected.

Each module has a user-definable address in the range 0 .. 99.

The transmission speed is recognised automatically by each RIO module and does not need to be manually set.

How should the installation be wired?

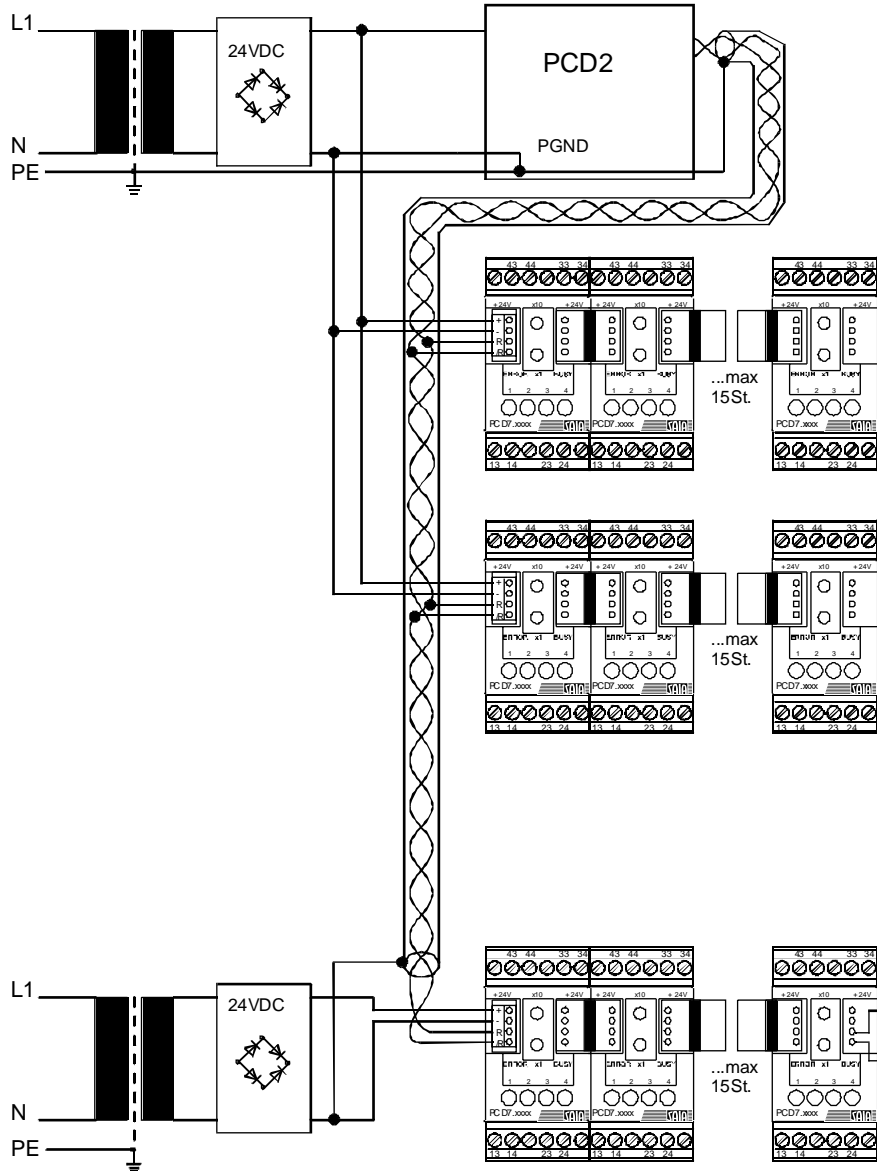
If the distances between modules is very large, it may be necessary to use a separate network segment.

Please note that the supply voltage range of 18 to 32 VDC must be respected. The maximum line length of the supply voltage should be checked for each application, since this depends on the wire resistance and the number of devices.

The following picture shows connection of the bus to a PCD2 master.

SAIA RIO Relay output module

Connection plans for a control box or for short connections



Connection plans for distances greater than 20 m

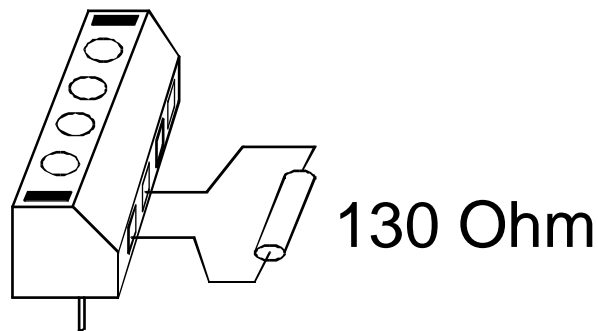
Line termination resistance
130 Ohm
on last module

This data sheet is not subject to the updating service
Subject to technical modification or error

The illustration on the preceding page shows the structure of the bus system. Please note that a line termination resistor must be fitted to the first and last stations on the bus.

On the PCD side, termination can be made with a jumper (see PCD hardware manuals)

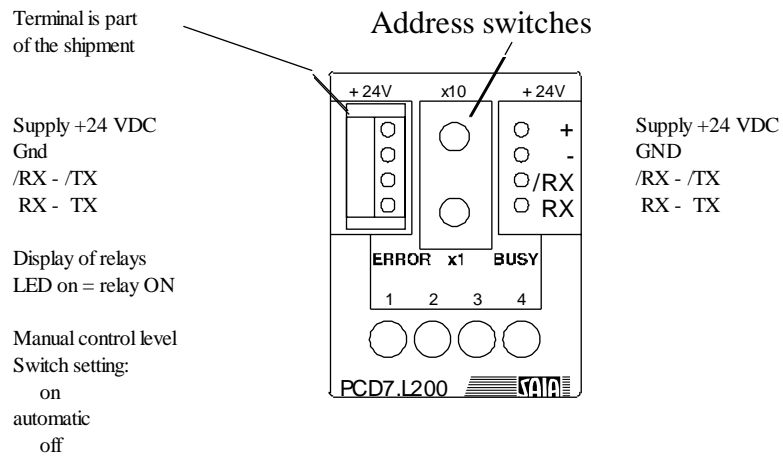
The following diagram shows a simple way of fixing the line termination resistor to a RIO module.



The earth connection method should also be noted. In order to avoid earth loops and their resulting errors, only one end of the bus should be earthed.

3.8.2 Connection to the field bus

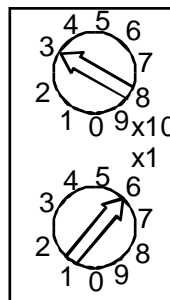
Connection with the field bus is via the plug-in screw terminal included in the package.



3.8.3 Station number selection

Module address is set with the address switches using a screwdriver.

Example for the address setting
(address 36)



3.8.4 Manual control

With the PCD7.L100 and PCD7.L200 modules, the manual controls can be used to carry out switching functions by hand. A wiring check of the installation (or in an emergency the switching on of outputs) can therefore be done quickly. In the relay module, the switch overrides the signals from interface, which means that switch state determines the relay state (ON, AUTO, OFF).

In digital input modules the switch setting overrides the input's state (ON, AUTO → read input, OFF).

3.8.5 Status LEDs

- After power-up the red and green LEDs are turned on for about 2 seconds.
- The green status LED flashes with the frequency of messages received.
- The red status LED (ERROR) is permanently on if the EEPROM in the RIO module is faulty.
- The red ERROR LED flashes if
 - bus connections are mixed up: exchange RX-TX - /RX-/TX.
 - there is interference on the bus (CRC errors): check wiring.
- Red and green LEDs flash: hardware error, module faulty.

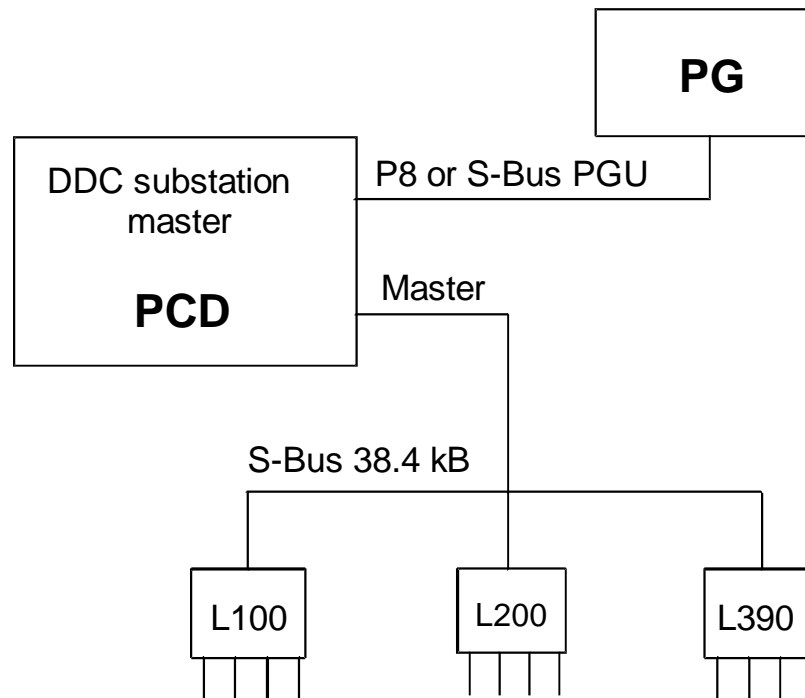
Notes

4. Programming

4.1 Introductory example with direct PGU connection

A simple example is used to demonstrate use of the DDC-PLUS-RIO. Programming is done in FUPLA.

This first example does without application of the gateway technique, i.e. the connection between the programming unit (PG) and PCD is by a direct PGU connection using the P8 protocol, or by a direct S-Bus connection.



4.1.1 Task

The task is to construct a small network with 1 RIO master station (PCD2), 1 RIO input module (PCD7.L100), 1 RIO output module (PCD7.L200) and 1 RIO temperature measurement module (PCD7.L390).

The 4 L100 inputs should be transferred to digital outputs 36 - 39 of the PCD2 master station.

The 4 L200 outputs should be actuated via the network by digital inputs 0 - 3 of the PCD2 master station.

The L390's 4 analogue input values should be transferred to registers 10 - 13 of the master PCD2. A (simulated) Pt1000 probe at analogue input 3 of the L390 should monitor and report the temperature of a refrigeration chamber by switching master PCD2 outputs on and off:

| | | |
|--------------------------------|---|------------------|
| Temperature > 4.0°C | → | PCD output 32 on |
| Temperature + 2.0°C bis +4.0°C | → | PCD output 33 on |
| Temperature < 2.0°C | → | PCD output 34 on |

The RIO network is connected to interface no. 1.

Transmission speed on the RIO network should be 19200 Baud.

The project name is 'DDC-RIO' and the program is called 'test-01'.

Master station:

| | |
|-----------------|---------------------------|
| Station number: | 10 |
| PCD type: | PCD2 |
| Interface: | PCD7.F110 or F150 (RS485) |
| I/O modules: | address 00 - 07 E110 |
| | address 32 - 39 A400 |

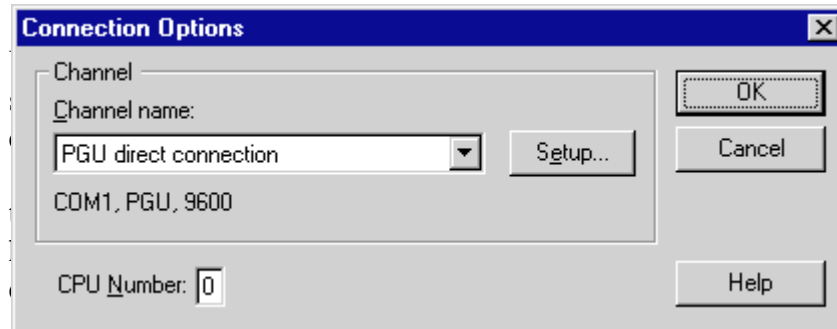
Slave stations:

| | |
|-----------------|-----------|
| Module type: | PCD7.L100 |
| Station number: | 70 |
| Module type: | PCD7.L200 |
| Station number: | 17 |
| Module type: | PCD7.L390 |
| Station number: | 26 |

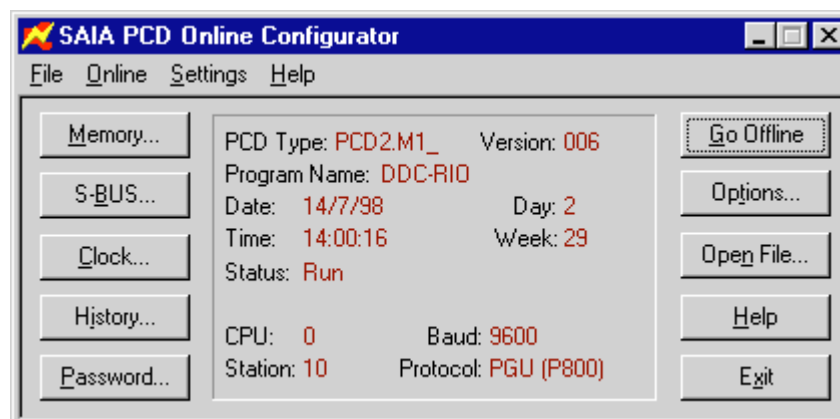
4.1.2 Settings on PCD

This section deals with connection of the PCD to the programming unit (PC).

While the PCD is offline, go to 'Online - 'Connection Options...' and select "PGU direct connection".



'Tools' - 'PCD Online Configurator' command to display the online configuration data.

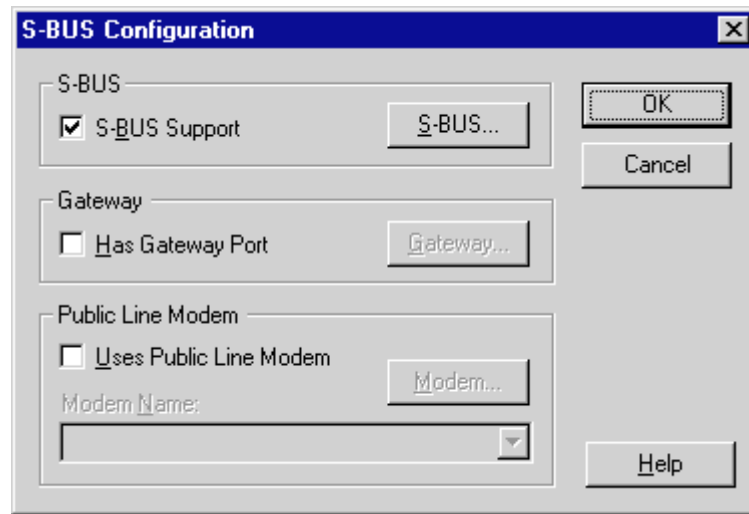


Although for this initial example S-Bus configuration is not relevant, it is still necessary to verify that the "Gateway" and "Modem" options are **not** activated.

In order to obtain an **S-Bus** PGU connection, the S-Bus configuration of the PCD should first be defined. In P800 mode, therefore, go to 'Tools' and again run the 'PCD Online Configurator' (see figure above).

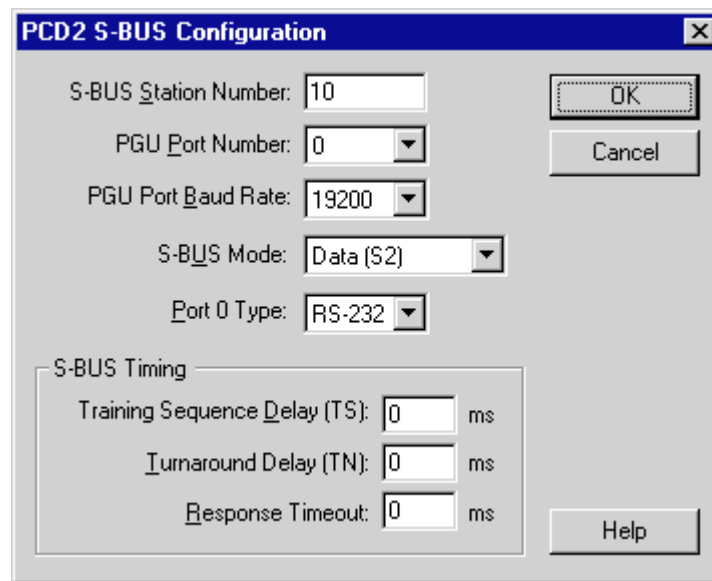
Via the PCD's PGU port (Port 0), an S-Bus PGU connection of 19200 Baud is to be established with the programming unit (PC). The PCD station number is to be '10'. from the 'SAIA PCD Online Configurator', click on the 'S-BUS...' button.

The following window is displayed:



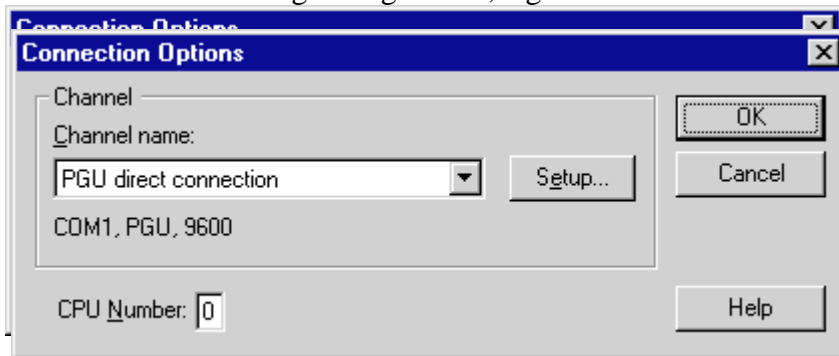
'S-BUS Support' should be selected, deselect 'Has Gateway Port' and 'Uses Public Line Modem'.

The 'S-BUS...' button should now be clicked on. The following window is displayed,

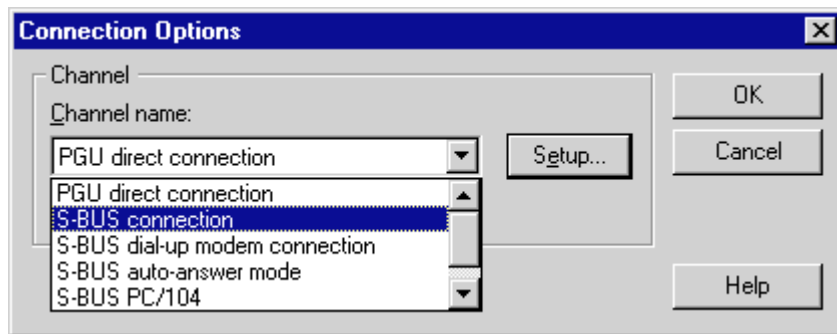


and should be configured as shown. ('S-BUS Mode' is not relevant in this case, but must agree with the setting on the PCD side). In this and the next window, confirm configuration with 'OK'. The 'SAIA PCD Online Configurator' is now exited. The PCD has been configured.

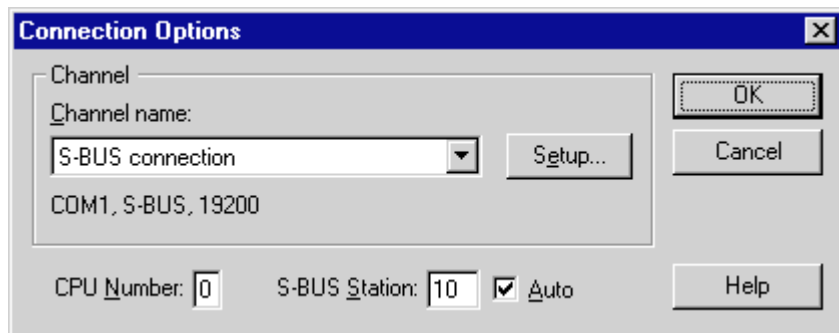
'Online' -'Connection Options...'
This shows the existing configuration, e.g.:



From 'Channel name' list, select the desired option is chosen (in our example, 'S-BUS connection').

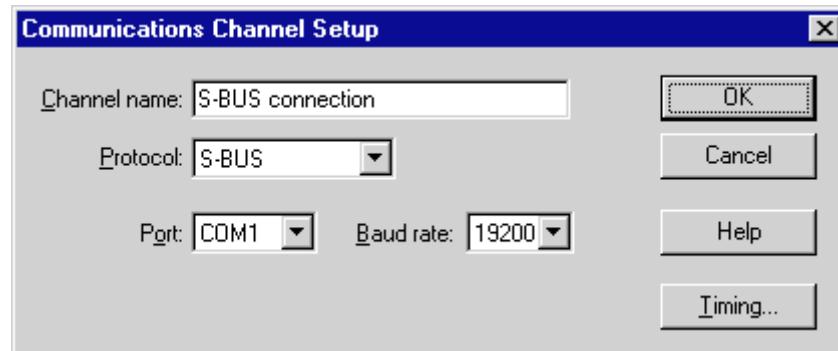


single click on 'S-BUS connection' the following is displayed:



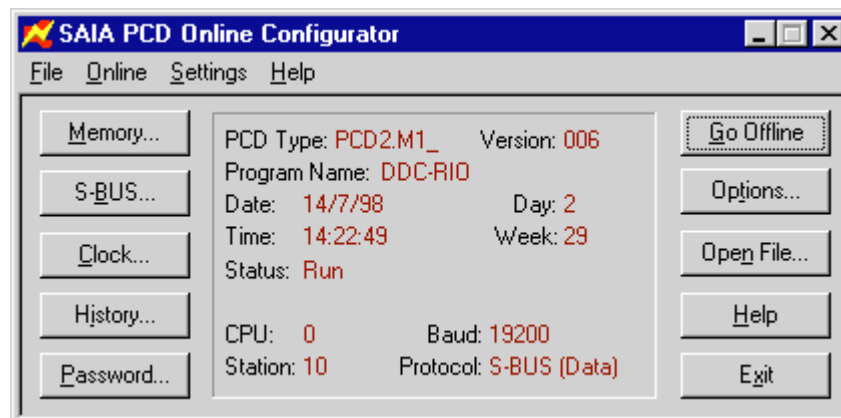
If 'Auto' is activated, the station number already assigned is automatically used. Confirm with 'OK'.

Press 'Setup..' to display this window:

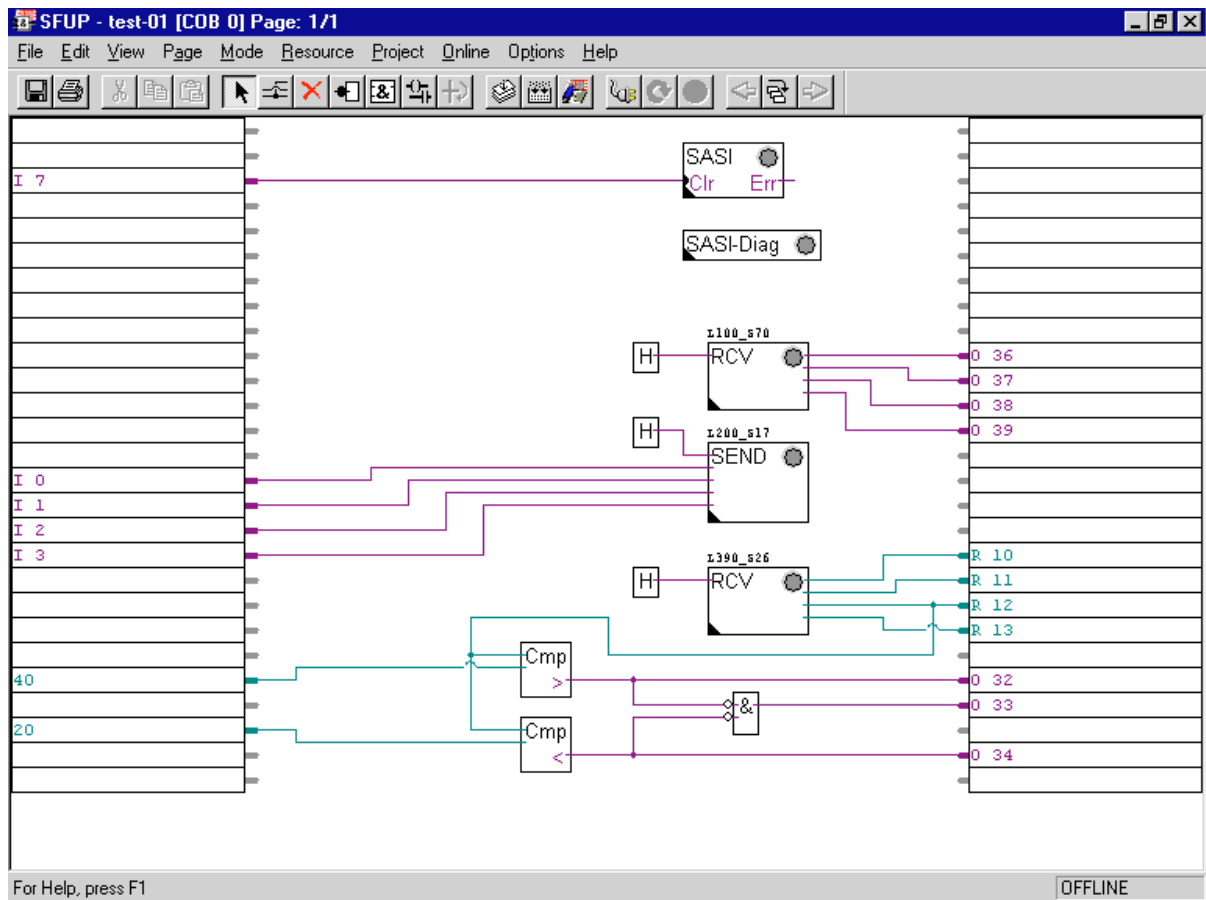


The 'Protocol:' and 'Baud rate:' parameters must be set. (In this example they have already been correctly entered.) Confirm with 'OK' in both windows.

If the 'SAIA PCD Online Configurator' is now called again, the completed S-Bus connection can be viewed.



4.1.3 User program in FUPLA



The 'SASI', 'RCV' and 'SEND' FBoxes should be positioned approximately as shown in the above example.

The 4 L100 inputs pass via the 'RCV' FBox (Receive 1-20 I/O/F) to reach PCD outputs 36 - 39. In this example, the FBox is kept permanently active ('H' at Input 'Enable' *).

The 4 L200 outputs are written to via the 'SEND' FBox (Transmit 1-20 I/O/F) by PCD inputs 0 -3. In this example, the FBox is kept permanently active ('H' at Input 'Enable' *).

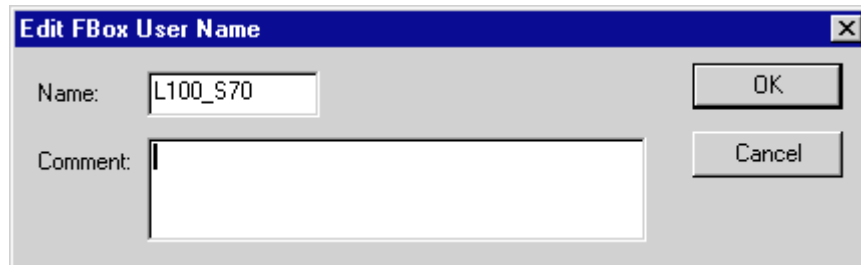
The next 'RCV' FBox (Receive 1-20 R/T/C/Clock) takes the 4 integer outputs which transfer input values to the 4 PCD registers R 10 to R 13. In this example, the FBox is kept permanently active ('H' at Input 'Enable' *). There is a hardware connection of the Pt1000 probe to channel 3 of the PCD7.L390 module. The measured value is therefore written to PCD register R 12.

*) In practice it is necessary to clarify whether a communications FBox should be active permanently or only conditionally, to avoid unnecessary load on the S-Bus.

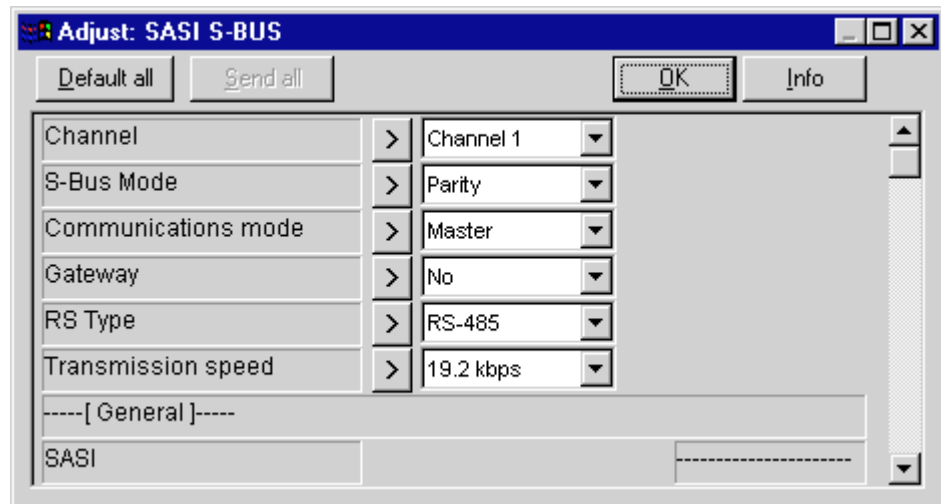
When several communications FBoxes are positioned, an internal mechanism regulates the order of processing. For values which are not time-critical, permanent activity should be avoided, with activation taking place using a blinker function for example, so that S-Bus communication is only executed at certain intervals.

The 'SASI-Diag' FBox is not necessary for the program to function. However, if there are problems with the bus, this FBox can provide important information, especially during initial commissioning.

The (optional but useful) comments at individual FBoxes are edited via the 'Edit FBox User Name' window. This window is opened with one mouse click on the **right-hand** mouse button (User Name...).

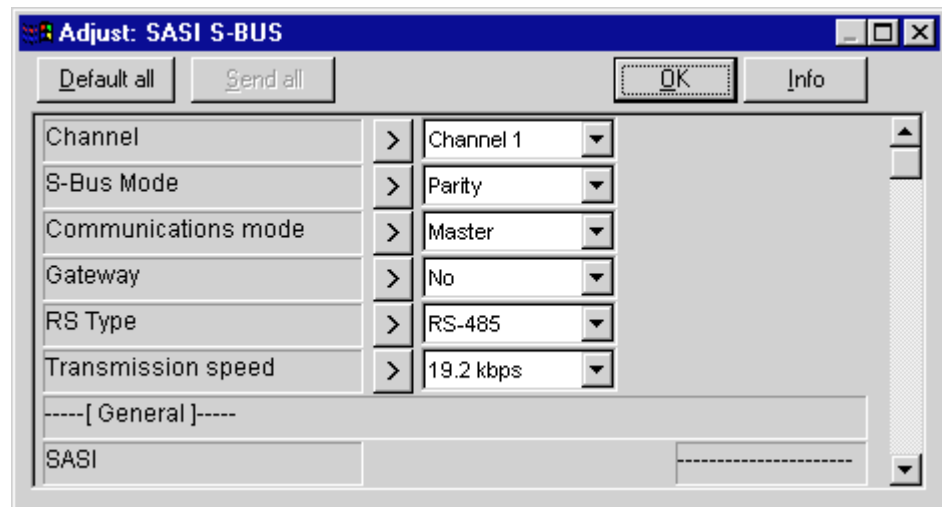


'SASI' adjust window is filled in as shown.



Here it is **important** to select '**Parity**' as the 'S-Bus Mode' as this is the only suitable mode for a RIO connection.

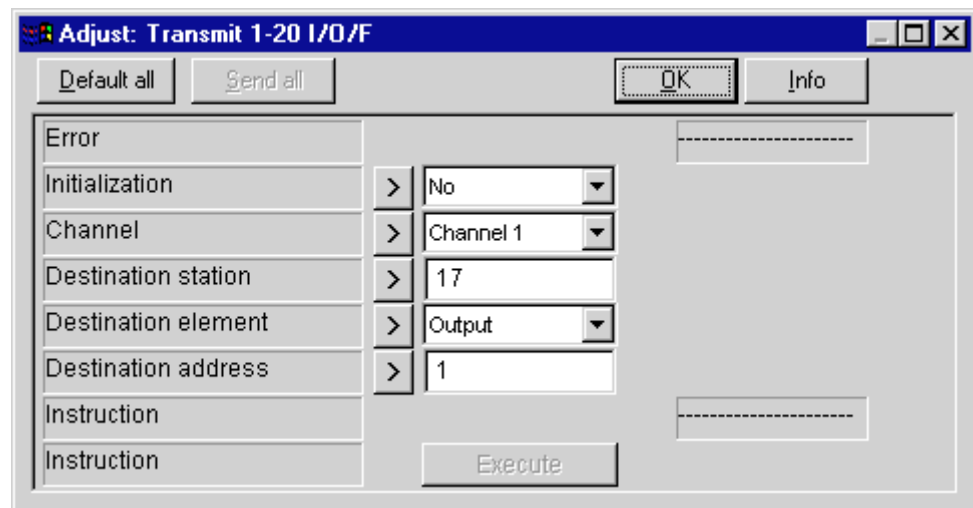
The L100's 'RCV' adjust window is filled in as follows:



'Source station' must agree with the address set on the front plate of the RIO module.

'Source address' is the first address of the input package from the RIO module's "Read Input" information.

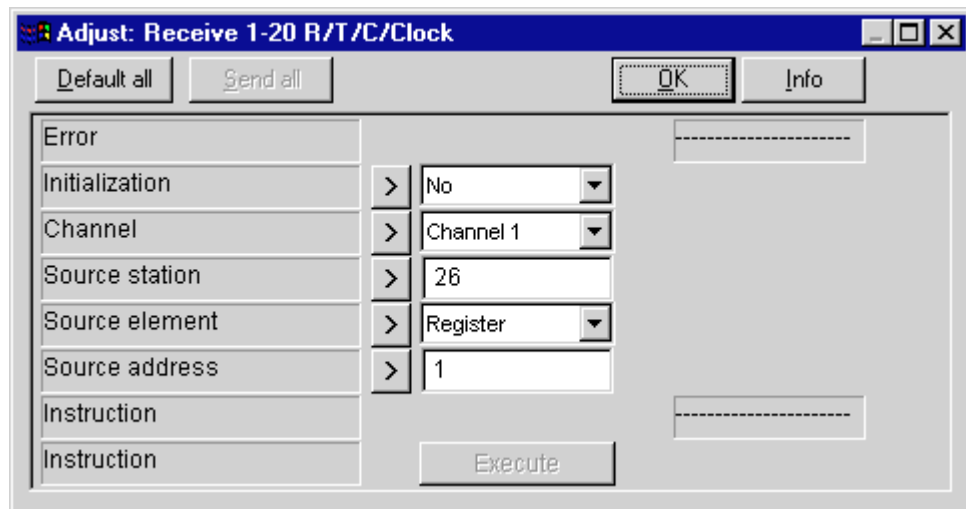
The L200's 'SEND' adjust window is filled in as follows:



'Destination station' must agree with the address set on the RIO module's switches.

'Destination address' is the first address of the output package from the RIO module's "Write Output" information.

The L390's 'RCV' adjust window is filled in as follows:



'Source station' must agree with the address set on the RIO module's switches.

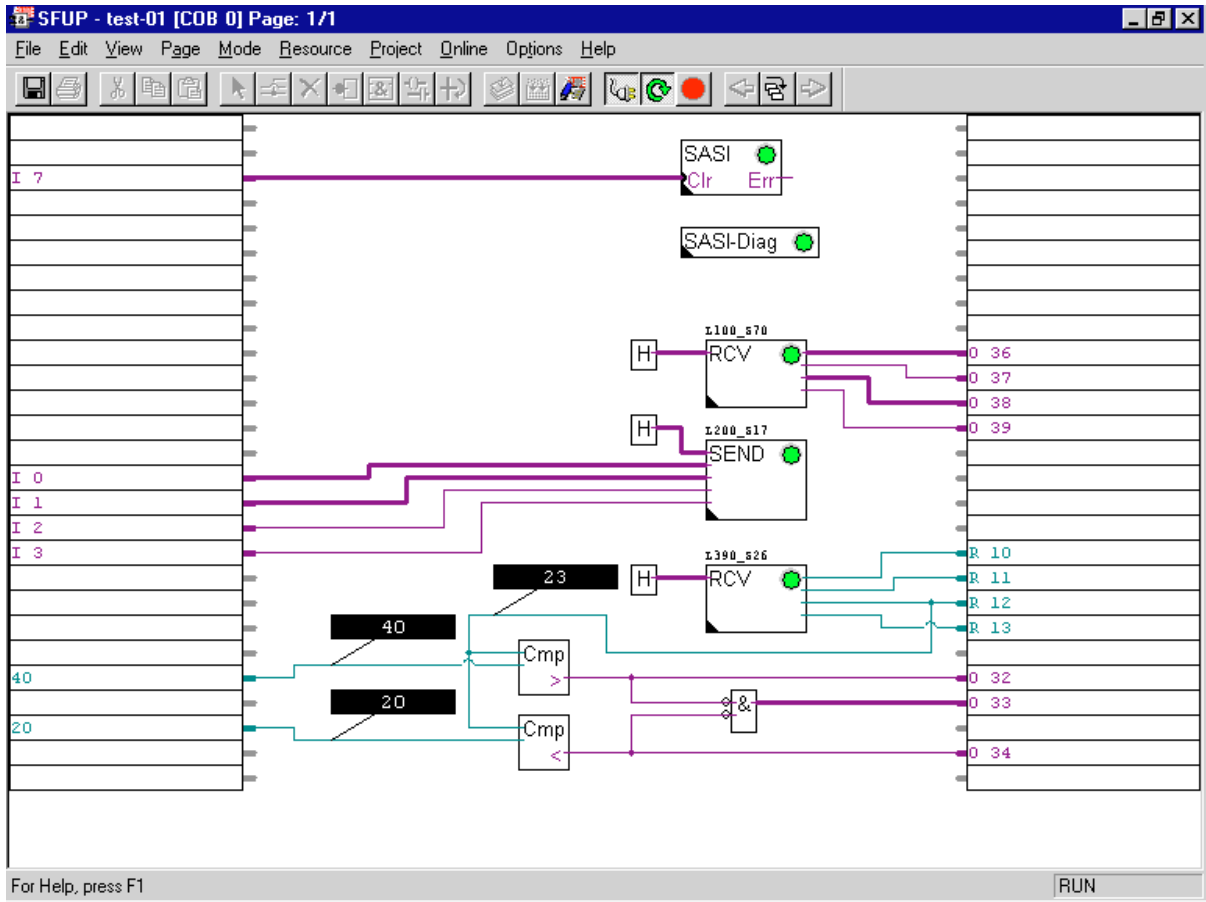
'Source address' is the first address of the register package from the RIO module's "Read Register" information.

Evaluation of measurements at output 3 of the PCD7.L390 temperature measurement module uses the FBoxes 'Is greater than' and 'Is smaller than' plus an AND gate. It should be noted that temperatures are always given in 1/10°C, both for entry as comparative values and during online display.

Program preparation

With 'Make', the program can now be processed and downloaded to the PCD. If everything has been correctly installed and powered up, the installation should be functional. The Pt1000 probe can be simulated with a resistance decade. Resistance values of 1000 to around 1030Ω should be set.

The program can be displayed online and any required online probes can be attached.

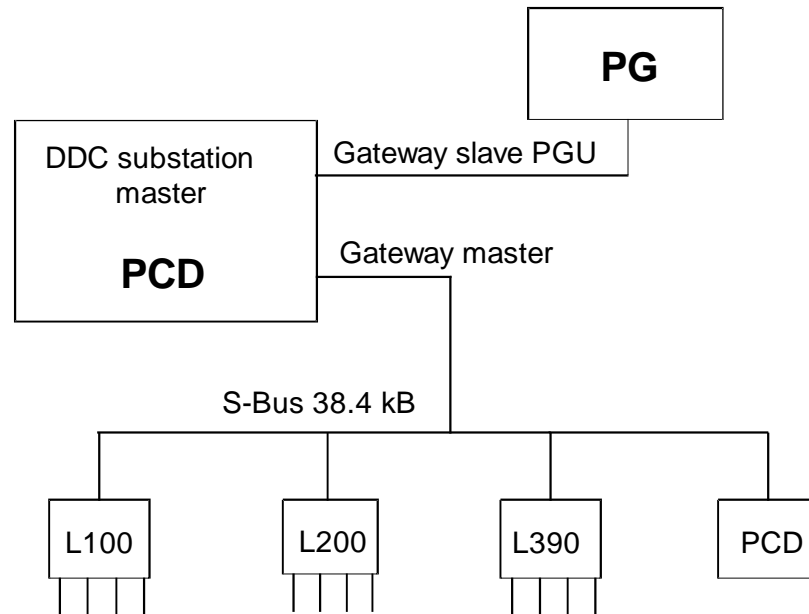


If it is necessary to modify the transmission speed of the RIO network, this is easily done by adjusting the baud rate in the 'SASI' FBox adjust window. After this, a new 'Make' must be executed.

The RIO slaves adjust automatically to the new transmission speed. Even a subsequently inserted RIO station adjusts automatically, so that no settings are necessary even when a station is exchanged.

4.2 Example with gateway connection

This second example is to show the gateway technique and integration of a PCD as a RIO slave station.



With direct PGU connection (as in the previous example) access is only possible from the programming unit (PG) to the master PCD. With the gateway configuration there is the additional possibility of addressing all RIO slave stations directly via the programming unit. Moreover, 1 or 2 further gateway slave stations can be connected to the PCD master as process control or visual display systems. This kind of arrangement is shown in chapter 1.

(For 'S-Bus Gateway' see also "SAIA[®] S-Bus manual", chapter 6, PUBLI-26/739 E)

4.2.1 Task

The basic layout is the same as in the previous example where the RIO slaves only have the addition of one PCD1.

The 4 L100 inputs should be transferred to digital outputs 36 - 39 of the PCD2 master station. In addition, inputs 3 and 4 of the L100 should be transferred to outputs 48 and 49 of the PCD1 slave station.

The 4 L200 outputs should be activated via the network by digital inputs 0 - 3 of the PCD2 master station.

The L390's 4 analogue input values should be transferred to registers 10 - 13 of the master PCD2.

The 4 inputs 2 - 5 of the PCD2 master station should be transferred to outputs 50 - 53 of the PCD1 slave station.

The RIO network is connected to interface no. 1.

Transmission speed should be 38400 baud on the RIO network and 9600 Baud for the S-Bus-PGU connection. (Note restrictions on transmission speeds of the different ports.)

The project name is 'DDC-RIO' and the program is called 'test-02'.

Master station:

| | |
|-----------------|---------------------------|
| Station number: | 10 |
| PCD type: | PCD2 |
| Interface: | PCD7.F110 or F150 (RS485) |
| I/O modules: | address 00 - 07 E110 |
| | address 32 - 39 A400 |

Slave stations:

| | |
|-----------------|-----------|
| Module type: | PCD7.L100 |
| Station number: | 70 |

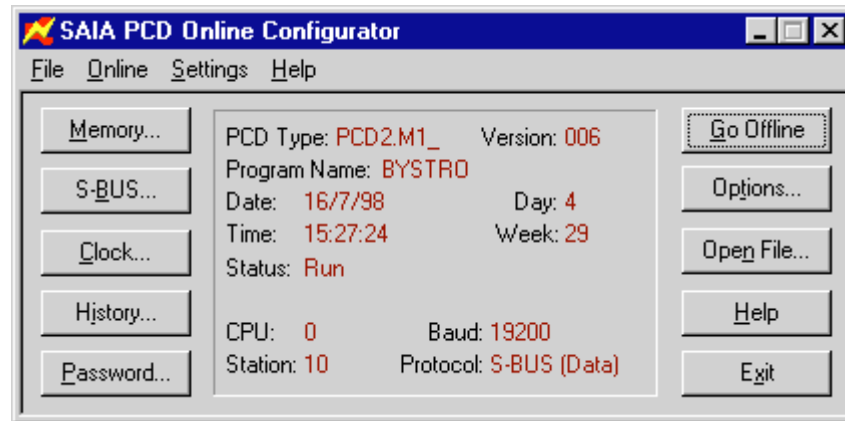
| | |
|-----------------|-----------|
| Module type: | PCD7.L200 |
| Station number: | 17 |

| | |
|-----------------|-----------|
| Module type: | PCD7.L390 |
| Station number: | 26 |

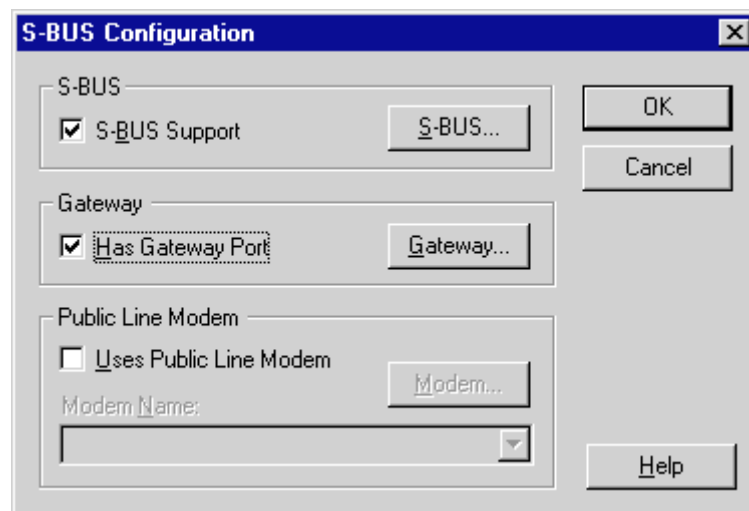
| | |
|-----------------|---------------------------|
| Module type: | PCD1 |
| Station number: | 1 |
| I/O modules | address 48 - 55 A400 |

4.2.2 Settings on PCD

For the PGU connection, the S-Bus protocol should be selected. After calling the Online Configurator, the following window is displayed:

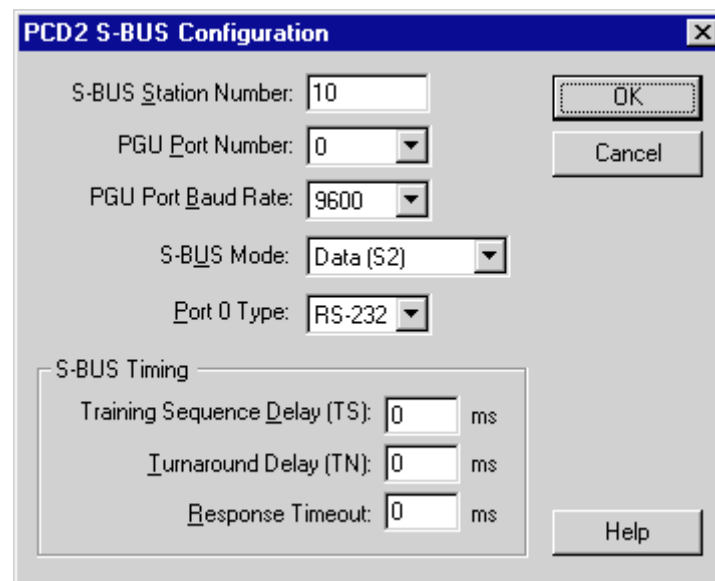


'S-BUS...' to configure the gateway connection. The window shown is displayed.



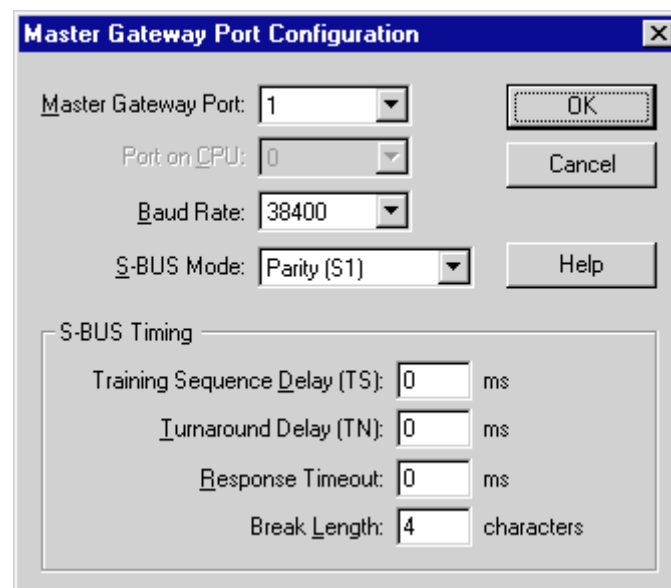
'Has Gateway Port' should be activated.

To configure the S-Bus - PGU connection, select 'S-BUS...'. The transmission speed of the PGU connection should be set here: 9600 in our example:



'SBUS mode' is not relevant for PGU connection. 'Has gateway port' should be activated.

After clicking on 'Gateway...' the following window is displayed:



Settings for the RIO network are made in this window. Select gateway port '1'. Baud rate is 38400 in accordance with the task specification. Setting of 'Parity Mode' is obligatory. S-BUS timing is left at the standard setting. Confirm with 'OK' to accept the configuration.

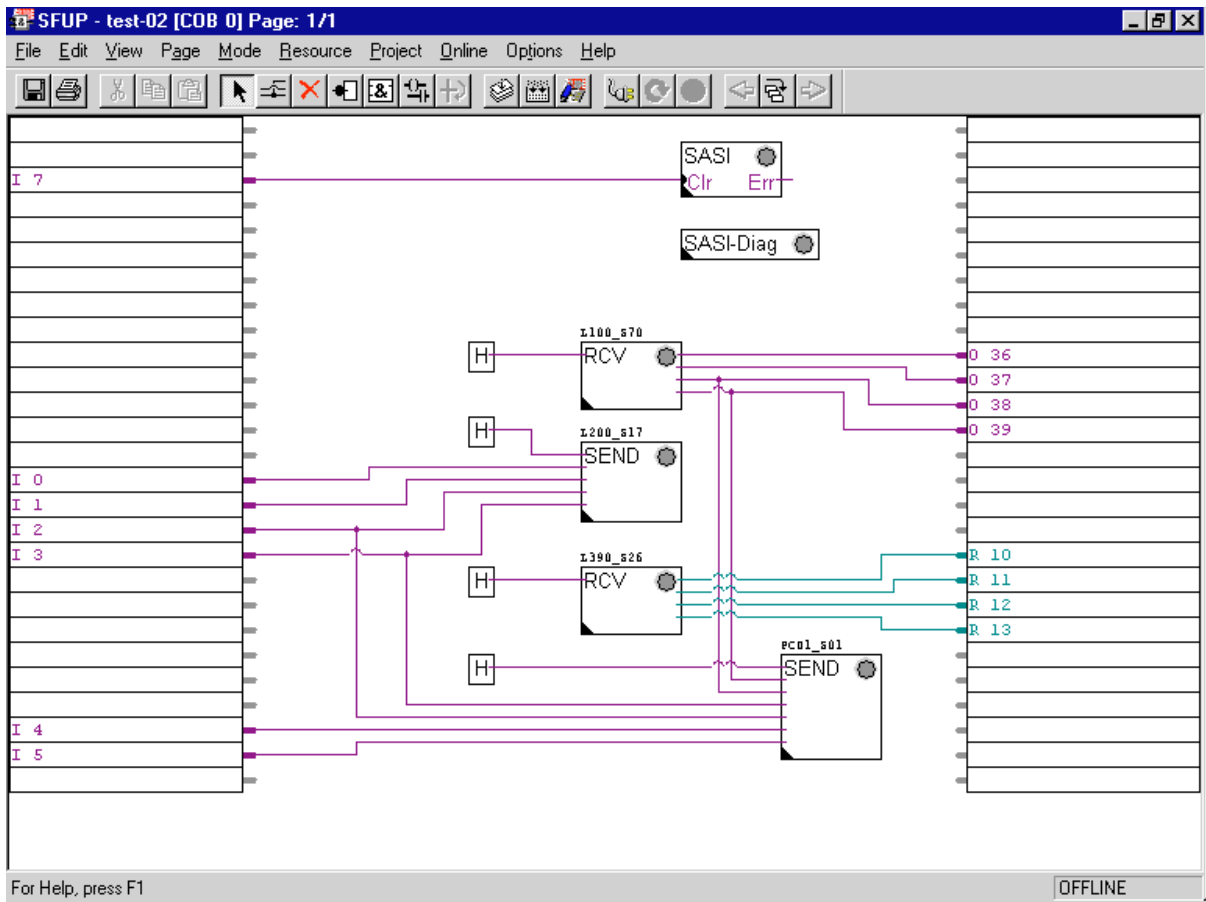
Note: For more detailed explanation of S-Bus configuration, consult "SAIA[®] S-Bus manual" Ref. 26/739. One important restriction is repeated here:

With interfaces 0 + 1 (DUART 1) and 2 + 3 (DUART 2) respectively, the following combinations of baud rates are not possible for physical reasons:

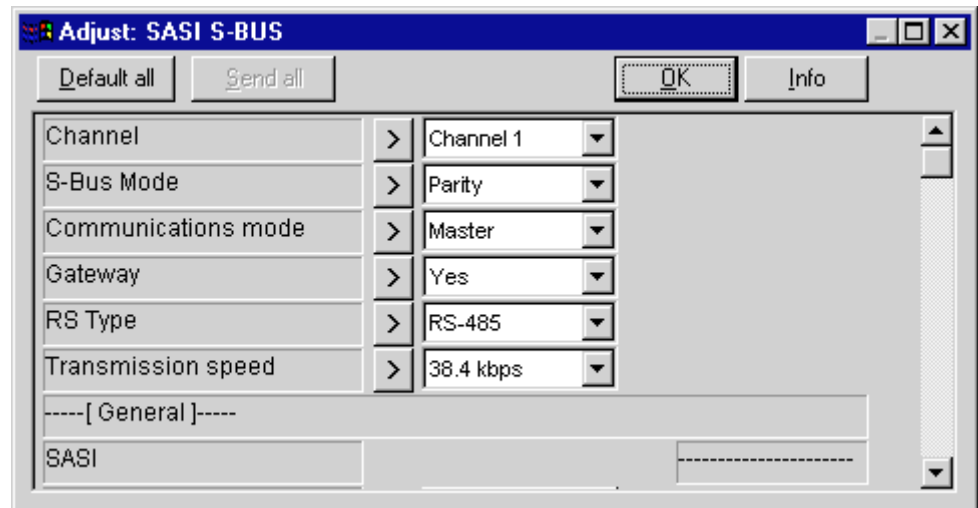
| | | | |
|----|------------|---|------------|
| | 38400 Baud | + | 38400 Baud |
| or | 38400 Baud | + | 19200 Baud |
| or | 38400 Baud | + | 150 Baud |
| or | 38400 Baud | + | 110 Baud |

Since in the present example 38400 Baud has been selected for the RIO bus at interface 1, it is **not** possible to use 38400 or 19200 Baud for the PGU connection.

4.2.3 User program in FUPLA



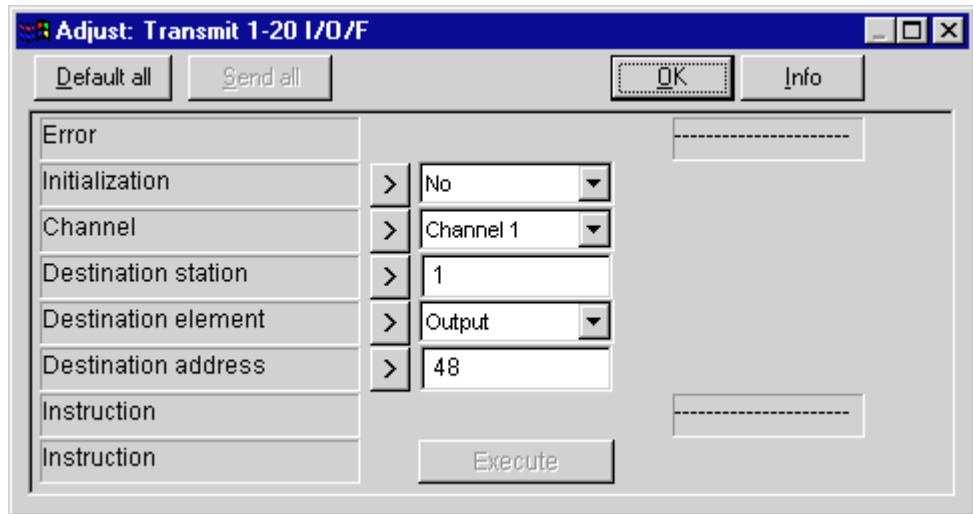
The 'SASI' adjust window is set as follows:



Select 'Parity' mode. Switch on gateway. 'Yes'. RIO network Baud rate (transmission speed) should be set to 38.4 kbps.

The adjust windows of the next 3 FBoxes should be completed in the same way as the preceding example.

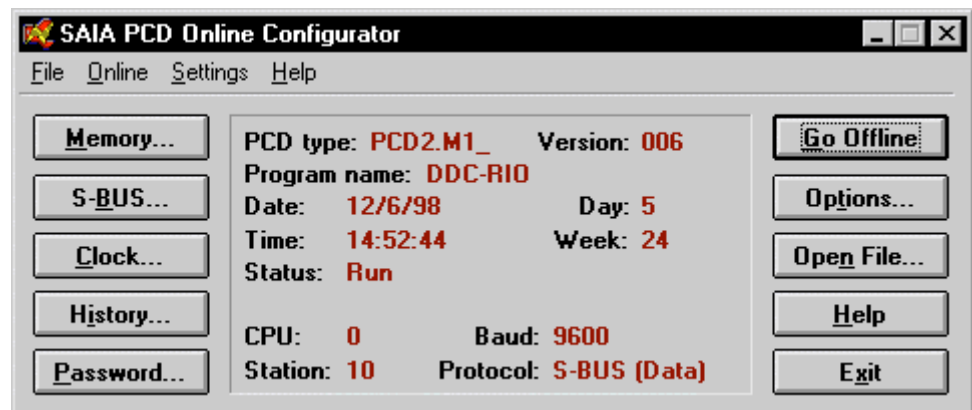
The FBox adjust window of the PCD1 slave station is given the following settings:



Since the outputs used as RIOs in the present example are only those on the output module in address range from 48, enter 'Output' for 'Destination element' and '48' for 'Destination address'. The 'Destination station' (RIO station number) as defined in the task specification is '1'.

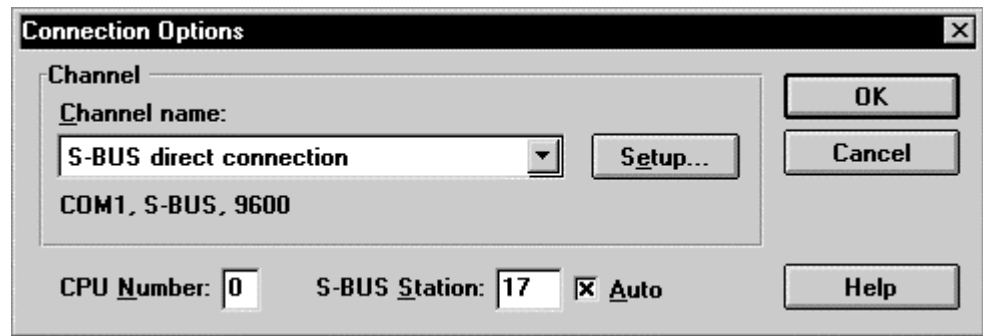
In online mode it is now possible, with FUPLA running online in the online configurator and in the debugger, to access each individual RIO station. The following procedure is possible:

Call the 'Online Configurator'

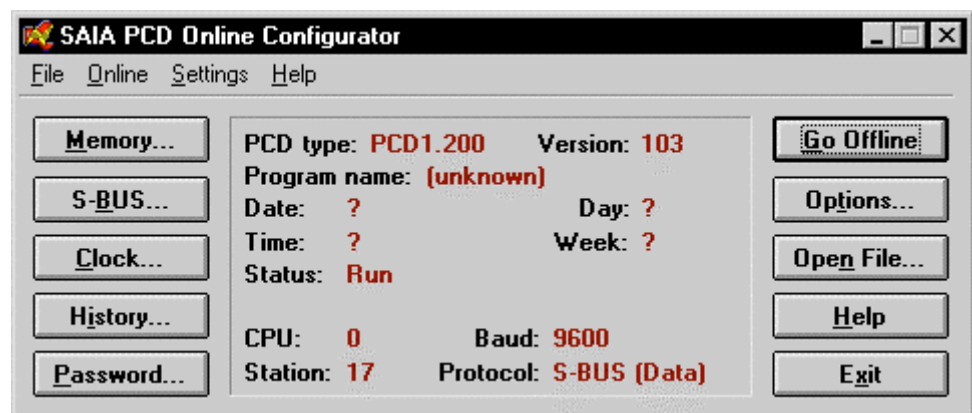


Master station no. 10 is displayed. After 'Go Offline', select 'Options...'

The following window is displayed:



For example, select S-BUS station '17'. After 'OK' you are returned to the 'Online Configurator'.



Some data from station 17 is displayed. 'PCD1.200' indicates a PCD7.L200 RIO module.

The debugger offers significantly more. After calling the debugger from Project Manager, the master PCD is displayed, in this case station no. 10. To reach station no. 17, enter

```
<cOnnect><Sbus-station><17><CR>
```

```
After <Display><Output><1><Count><4><Refresh><CR>
```

the 4 RIO module outputs are visible in the debugger's online window.

If outputs are also to be set or reset via the debugger, the master PCD (station no. 10) should first be switched to 'Stop'. Use <cOnnect> to return to station no. 10, switch that station to <Stop> and return to S-Bus station no. 17.

For example, with <Write><Output><3><1> (or <0>) <CR> or <Manual> it is possible via the debugger to switch on or off output 3 of RIO station 17.

```
SAIA PCD DEBUG V2.1 Stn: 17 CPU: 0 Type: D1200103 Status: RUN
Output 1 Count 4 Refresh
1234
0001: 1011

COMMUNICATIONS: S-BUS, 9600 Baud, COM1, Station 10
S-BUS MODE: Data ($2)
DEFAULT BATCH FILE "SBUG.DBA" LOADED
ON LINE
STOPPED
*000090 JR H -3 (87) A1 Z0 N1 P0 E0 IX3 COB0
>Connect Sbus-station 17
CONNECTED TO STATION 17, CPU 0
RUNNING
>Display Output 1 Count 4 Refresh
>Write Output 3 Manual
0003: 1

MANUAL OUTPUT: <1> set output, <0> clear output, <ESC> exits,
<DOWN ARROW> or <CR> next address, <UP ARROW> previous address.
```

This procedure can be applied to all stations on the RIO bus.

In the present example, if the temperature measurement module PCD7.L390 is switched to station no. 26, the 4 values in registers 1 to 4 can be viewed online.

```
SAIA PCD DEBUG V2.1 Stn: 26 CPU: 0 Type: D1390110 Status: RUN
Register 1 Count 4 Refresh
0001: 410 0002: 410 0003: 23 0004: 410

COMMUNICATIONS: S-BUS, 9600 Baud, COM1, Station 10
S-BUS MODE: Data ($2)
DEFAULT BATCH FILE "SBUG.DBA" LOADED
ON LINE
RUNNING
>Connect Sbus-station 26
CONNECTED TO STATION 26, CPU 0
RUNNING
>Display Register 1 Count 4 Refresh
>
Run Stop Display Write Batch Clear rEstart Locate Print File Help
cConnect broAdcast Quit
```

The format of register values here is also 'xx.x'.

410 → 41.0 (°C)
 23 → 2.3 (°C)