DOC032.53.90073

Profibus DP/V1

sc100 and sc1000

Quick Reference Document

kw/kt

Table of Contents

Quick reference guide

Profibus DP/V1 for sc100 and sc1000 controllers

Profibus introduction and identification

The sc100 and sc1000 standard controllers are the platform for all Hach-Lange intelligent probes and analyzers. The sc platform is a full digital communication system based on the open Modbus standard. When a Profibus interface card is installed, the sc controllers give the full range of standardized method values and parameters.

The modular structure lets the same GSD file be used for sc100 and sc1000 controllers and all measurements. The HACH-LANGE sc100 and sc1000 are PNO/PTO certified Profibus DP/V1 devices. These devices are compatible with master class 1 (PLC SCADA) and master class 2 systems, e.g., engineering stations. An overview of the system is shown in Figure 1.

Profibus is available as a factory or user installed item.

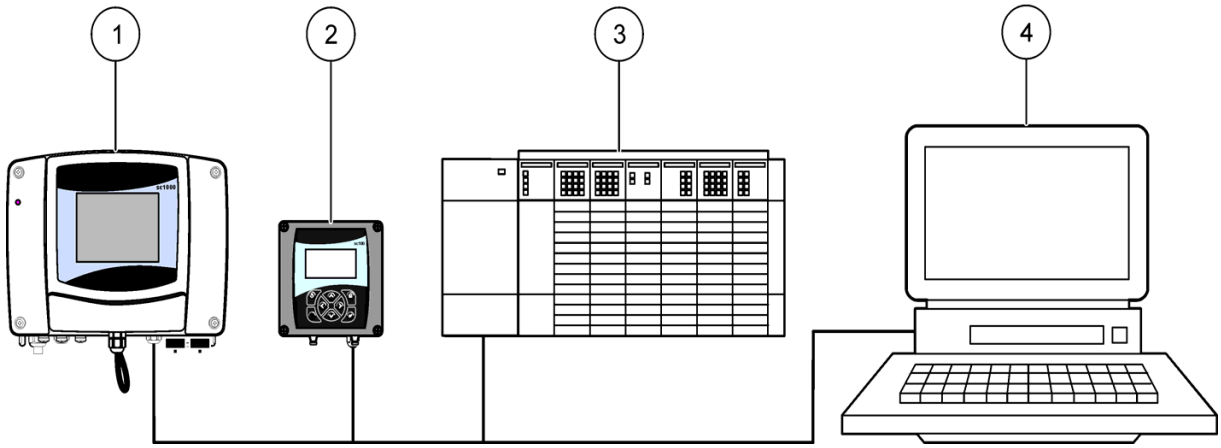


Figure 1 System overview

1	sc1000 controller	**3**	Programmable logic controller
2	sc100 controller	**4**	PCwith software

There are three versions of the Profibus card. Figure 2 shows where to find the card version.

Figure 2 Profibus card label

Table 1 shows data about the available Profibus card versions.

Table 1Profibus types

Article Number	Controller Type	Profibus Type	Certified	Card label
YAB015	sc100	DP/V1 since 04/2007	Yes	V4.0
YAB020	sc1000	DP/V1 since 04/2007	Yes	V4.0
LZV148	sc100	DP/V1 since 04/2007	Yes	V4.0

The new DP/V1 version is downward compatible to the DP/V0. The DP/V1 version can operate as a V0 slave without PLC configuration changes. The new DP/ V1 GSD file is not downward compatible. V4.0 software (DP / V1) is necessary.

Profibus card switch settings

The Profibus card programming switch must be in the correct position as shown in Figure 3, item 1. If the switch is not in this position, correct the position and reboot the controller. The controller will become fully on after sixty seconds.

Set the Profibus card termination switch to the correct position. To find the correct position, refer to Figure 3, items 2 and 3.

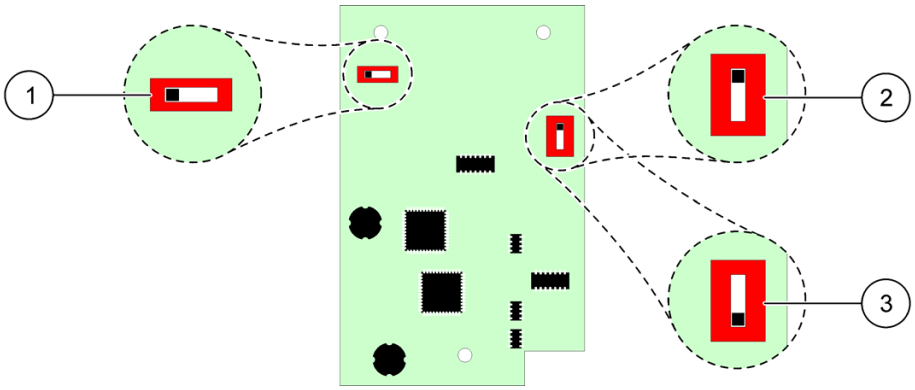


Figure 3 Switch positions on a Profibus card

1	Programming switch–Normal operating position
2	Termination switch–Termination Off. Set the switch to this position if there are other slave devices on the bus.
3	Termination switch–Termination On. Set the switch to this position if this is the last or only slave device on the bus.

sc1000 connections and process data

sc1000 electrical connections

Figure 4 shows a Profibus card installed at expansion slot 2 inside the sc1000 controller. Expansion slot 2 can be used for the Profibus card or mA output or mA input. The YAB020 Profibus card can be installed only in this slot.

Table 2 gives information about the terminal assignments shown in the figure.

Expansion slot 1 is only for a relay card and the protective cover. Expansion slots 3 and 4 are only for mA output and / or mA input.

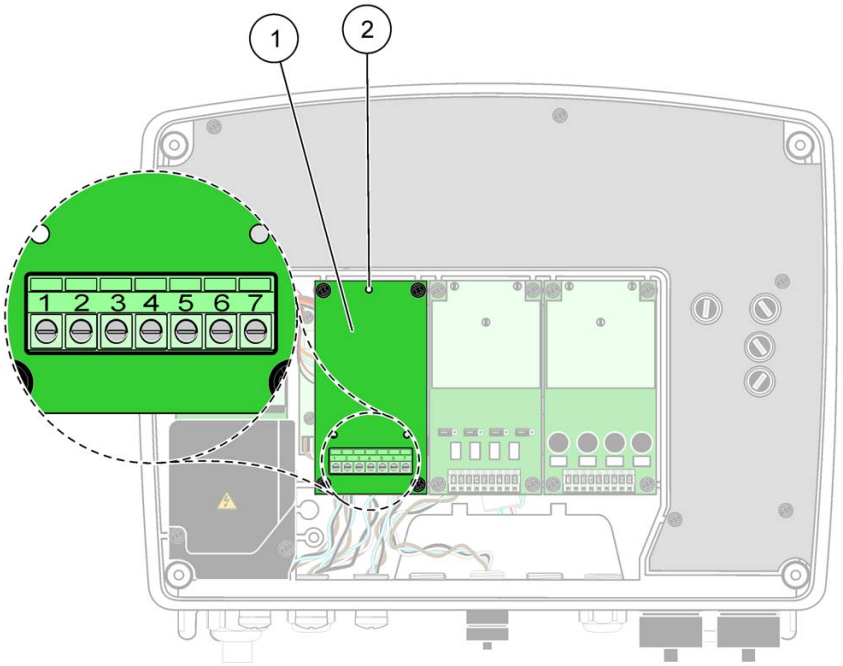


Figure 4 Mounting the YAB020 Profibus card

1 YAB020 Profibus card	**2** Mounting hole location

Table 2 Terminal assignments Profibus DP card

Connection	Designation / significance
1	Repeater
2	Not used
3	B input
4	A input
5	B output
6	A output
7	PE (Protected Earth)

sc1000 Profibus configuration

If a Profibus card is installed in the sc1000 system, the Profibus settings can be configured through the SYSTEM SETUP menu.

Go to **SYSTEM SETUP > NETWORK MODULES > FIELDBUS**.

Profibus settings include the following:

- Telegram configuration–specifies the structure and content of transmitted Profibus data.
- Slave address
- Data order
  - Normal = IEEE Float Big Endian
  - Swapped = IEEE Float word wise swapped
- Simulation YES–allows the transmission of simulated data instead of real process data.
  - Structure of simulated data: **ERROR** Word, **STATUS** Word, **SIMULATED** Value.

sc1000 Telegram Configuration

The sc1000 Profibus telegrams have no specified structure. The structure and content of the transmitted data can be freely configured. Refer to the figures and directions below to configure the Profibus sc1000 telegrams.

1. Navigate to the **TELEGRAM** menu. When the menu is entered the first time, the display shows an empty telegram.

2. Choose **SELECT** to choose a device as the data source.

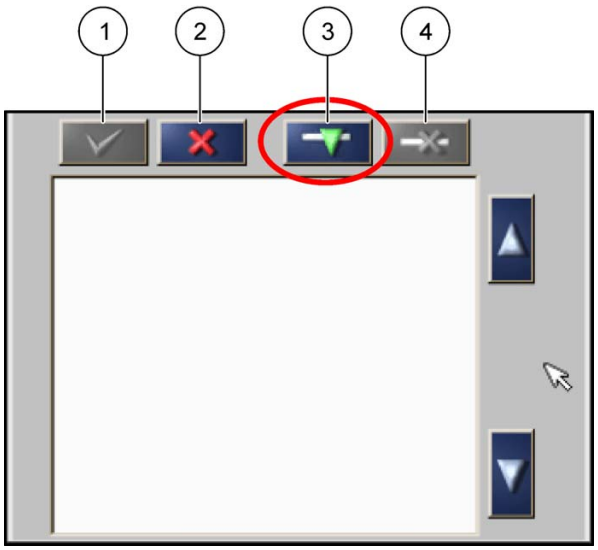


Figure 5 Data source selection

1	OK	**3**	Select
2	Cancel	**4**	Delete

3. The **DEVICE SELECTION** box shows. Use the arrows on the right side for navigation. When the data source (e.g. probe or option card) is highlighted, push O**K** to move the chosen device into the Telegram.

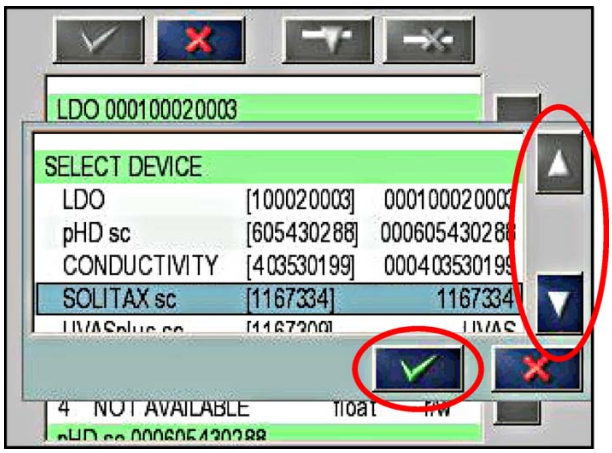


Figure 6 Data source selection

4. Data items such as **ERROR**, **STATUS**, and measured values will show inside the Telegram. Entering a data item highlights the item for 3 seconds. Entering the **SELECT** button while an item is highlighted opens the **TAG** selection box. Choose values from the probe.

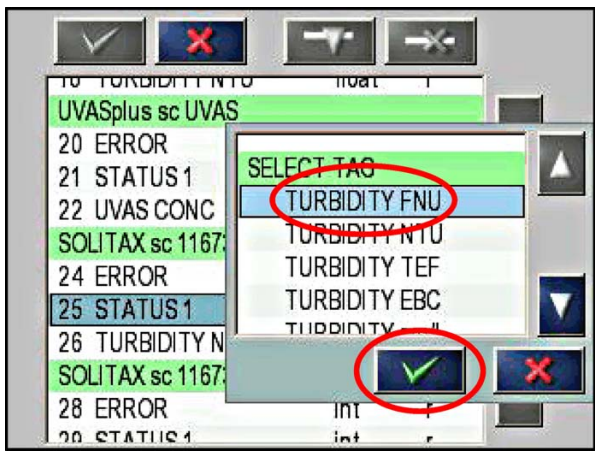


Figure 7 Tag selection

5. Do the procedure again. Choose more devices and tags. Use the arrow button to adjust the Profibus message data to the requested structure. Push the **OK** button to keep the configuration. The configuration will go online after a short time.

sc1000 Telegram Structure

When the GSD file **LANG0671.GSD** is added to the hardware catalogue, the device is found at the GENERAL folder.

Add and append **2 words from slave**. Each word is 4 byes of input space.

The **2 words to slave** module is 4 bytes of output memory space and is reserved for future use.

Note: *After changing the number of modules it is necessary to reboot the controller.*

The data configured at the sc1000 Telegram is mirrored to the PLC module input space. The telegram configuration should be documented in a convenient format such as an Excel spreadsheet.

The structure of a telegram is shown in Figure 8.

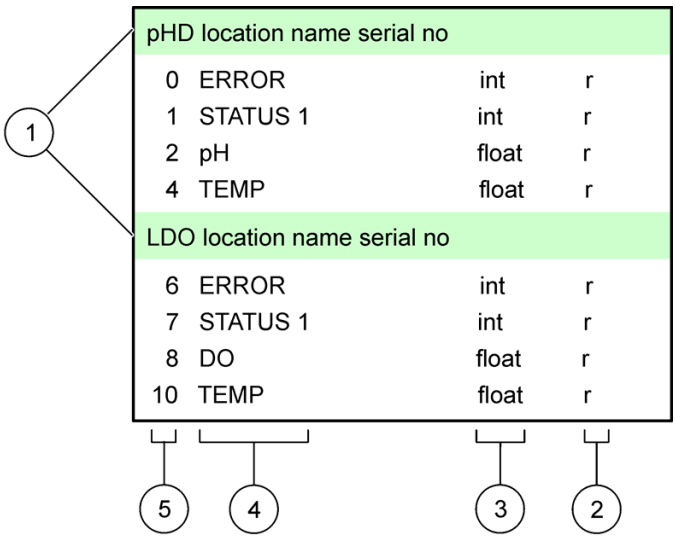


Figure 8 sc1000 telegram structure

1	Headline	**4**	Tag name
2	Access code R=read only RW=read / write	**5**	Address offset in 2 byte words
3	Data type Integer=2 bytes Float=4 bytes		

sc1000 Telegram / PLC relation

The address offset always starts on zero and counts the number of words. The input address range of a PLC is usually expressed in bytes.

The maximum number of modules 2 Words from Slave is 24.

Figure 9 shows the dependency between the Telegram configuration and the PLC address range.

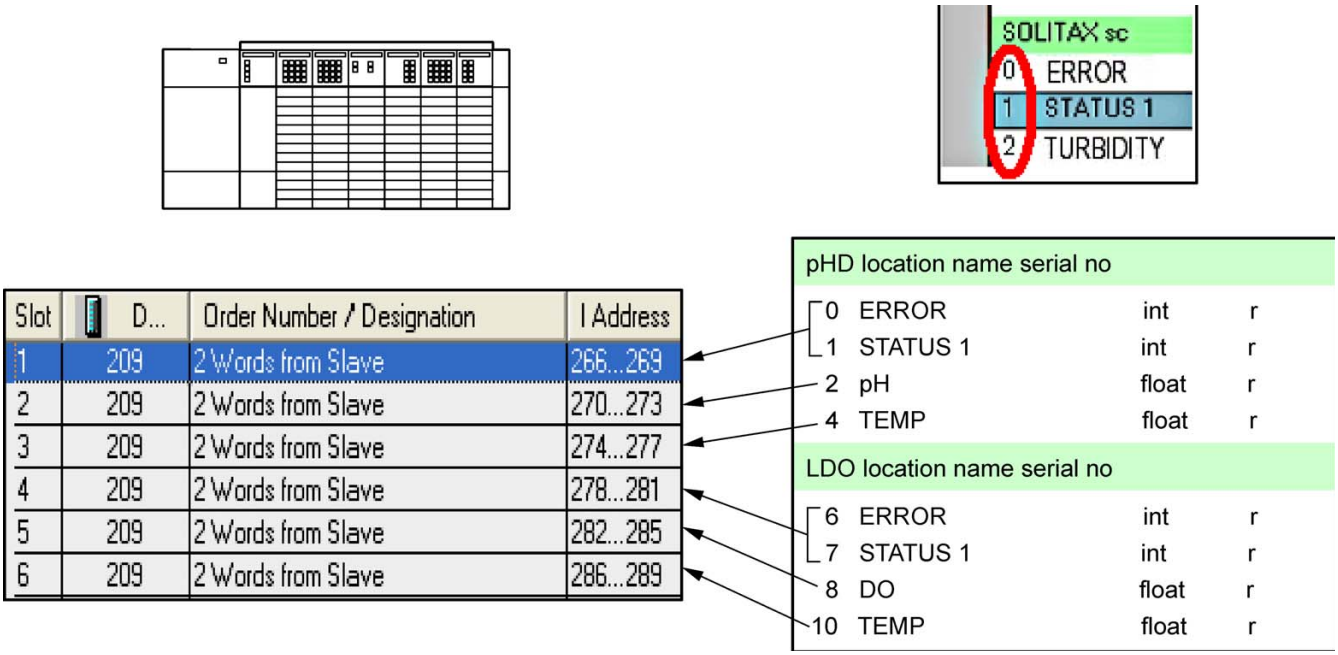


Figure 9 sc1000 telegram / PLC relation

Note: *Error and Status word definitions are valid for all SC probes. For details see Table 6 and Table 7 on page 12.*

For maintenance functions, it is recommended that the configuration data be documented in an Excel spreadsheet. An example is shown in Figure 10.

Note: *PEW/PED under PLC address is the SIMATIC or German code mnemonic. For IEC or English the code mnemonic is PIW/PID.*

pHD location name serial no				PLC address
0	ERROR	int	r	PEW 266
1	STATUS 1	int	r	PEW 268
2	pH	float	r	PED 270
4	TEMP	float	r	PED 274
LDO location name serial no				
6	ERROR	int	r	PEW 278
7	STATUS 1	int	r	PEW 280
8	DO	float	r	PED 282
10	TEMP	float	r	PED 286

Figure 10 Configuration details spreadsheet

sc100 connections and process data

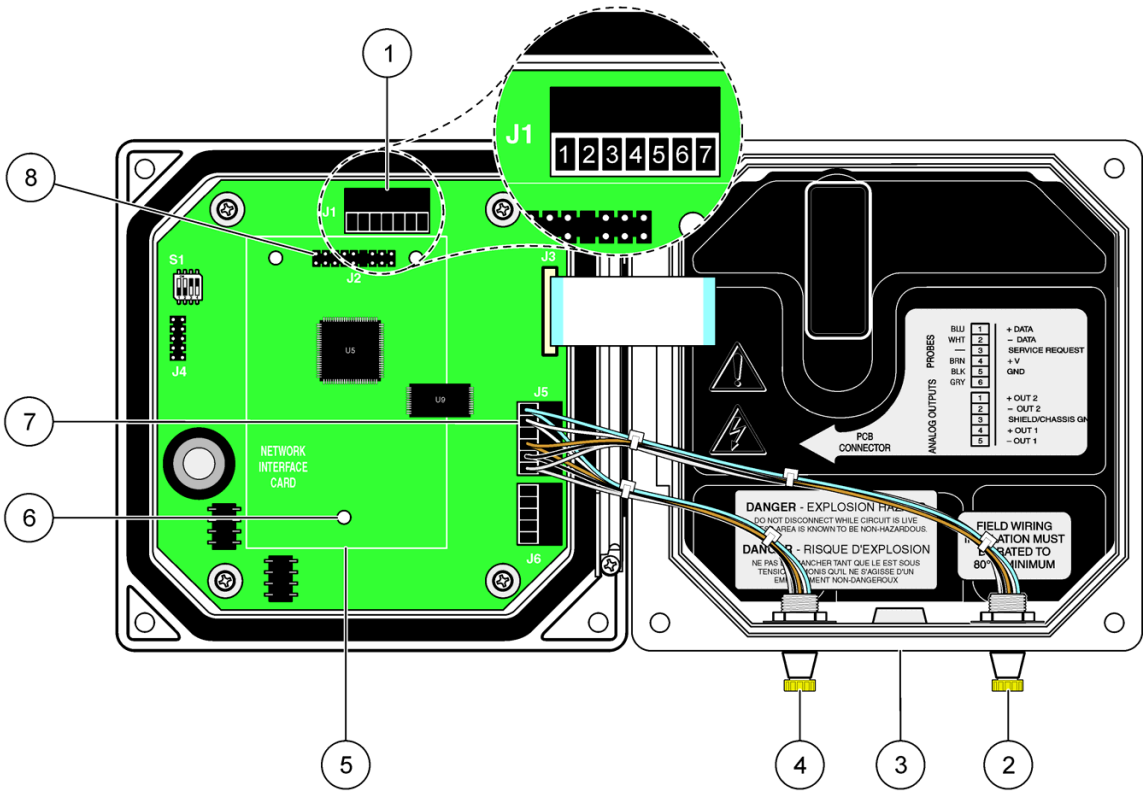


Figure 11 sc100 wiring connections

1	J1 connection block	**5**	Position for network interface card
2	Right sensor connector	**6**	Mounting hole (3x) for network interface card
3	Conduit opening with plug	**7**	J5 sensor connection block
4	Left sensor connector	**8**	J2 Header for optional network interface card

Table 3 Network connections in sc100 terminal block J1

Pin	Profibus
1	A1 input
2	B1 input
3	A2 output
4	B2 output
5	No connection
6	No connection
7	Shield

sc100 Profibus configuration

When the Profibus network card is installed, the sc100 controller requires the correct configuration of the device and data order. The sc100 controller supports acyclic Profibus communication and provides access to 256 application registers for the sc100 controller and each connected device.

The Profibus remap mode sets the structure of the cyclic Profibus telegram.

Refer to the information below and Table 4 to configure the necessary settings.

Table 4 sc100 Process data setup menu

SYSTEM SETUP		
NETWORK SETUP		
	PROFIBUS ADDRESS	Set Slave Address.
	MODBUS ADDRESS	To set the device order, choose the MODBUS ADDRESS menu option in the NETWORK SETUP menu. Then, choose the device you want to assign as the first device. Set the Modbus address to +1. If a second device is present, return to the SELECT SOURCE menu, choose the other device, and set its Modbus address to +2. Do not set both devices to the same address. To check the device order, choose from the menu SYSTEM SETUP > NETWORK SETUP > MODBUS ADDRESS > SELECT SOURCE. The devices are presented in order of lowest Modbus to highest Modbus Address
	SELECT SOURCE	Choose the device you want to assign a Modbus address to.
	DATA ORDER	Go to NETWORK SETUP. Choose DATA ORDER and select one of the following: NORMAL = IEEE Float big endian (default) SWAPPED = IEEE Float word wise swapped

Profibus address

If the menu item “PROFIBUS ADDRESS” is not shown, please check if a Profibus card is installed and that programming switch 1 is in Normal Operating position. Also make sure that the BAUD RATE is set to 19200, and the MODE is RTU.

Device order

The internal **MODBUS ADDRESS** defines the order in which the devices are given to the Profibus network card. The device with the lower Modbus address comes first. By default, the sc100 controller maps a device to Modbus address 1 or Modbus address 2. The sc100 controller maps itself to Modbus address 3.

When one sensor is connected, the sc100 presents two devices to the Profibus network card. By default, the sensor is the first device, and the sc100 is the second device. This sequence is based on the given Modbus addresses. If two sensors are connected, the sensors are the first two devices, and the sc100 is the third device. This is important when mapping Profibus block numbers to devices and when mapping device driver files to devices.

Data order

The sc100 controller can transmit cyclic data in either SWAPPED or NORMAL register order. NORMAL mode places the most significant register first. SWAPPED mode places the most significant register second. NORMAL data order is the default mode.

To set the data order, follow the steps go to **NETWORK SETUP > DATA ORDER**. Select **NORMAL** or **SWAPPED**.

For more information refer to Byte order inside a Profibus telegram on page 16.

Remap mode

The sc100 controller supports two modes of cyclic Profibus network card operation. These are specified by the PROFIBUS REMAP setting in the NETWORK SETUP menu.

Enabled

If PROFIBUS REMAP is set to ENABLED, the sc100 configures the Profibus network card to supply a standard Profibus telegram for connected devices. REMAP ENABLED is the default mode.This mode should be used for most Profibus implementations.

To enable the remap mode, go to **NETWORK SETUP > PROFIBUS REMAP > ENABLED.**

Disabled

If PROFIBUS REMAP is set to DISABLED, the Profibus network card sends the first 8 registers of each connected device. The controller only reads the first eight registers. It does not supply a standard telegram for sensors. This is the backward compatibility mode for legacy Profibus implementations.

The register data types are specific to each device. For example, when accessing the sc100 controller, the first two registers are of type Float and the other six are Unsigned Integers.

To disable the remap mode, go to **NETWORK SETUP > PROFIBUS REMAP > DISABLED**.

Data structure with remap mode enabled

If Profibus Remap mode is enabled, the Profibus network card in the sc100 supplies a predefined data telegram for each device. The telegram has all the important data about that device.

The data block structure of sc100 Profibus messages is standardized for all types of probes. The structure is shown in Table 5 and Figure 12.

Table 5 8 register Profibus data telegram

Register number	Data	Data type
1	Classified error	Integer (2 bytes)
2	Classified status 1	Integer (2 bytes)
3–4	Measurement 1	Floating (4 bytes)
5–6	Measurement 2	Floating (4 bytes)
7–8	Measurement 3	Floating (4 bytes)

Error and status words

Error and Status words follow the same standard definition for all SC probes and analyzers. See Table 9 on page 14 and Table 10 on page 15.

Display values

The primary value is always the measured value as shown in the display.

The secondary value could be the temperature if available. Otherwise it is filled with zero.

The tertiary value if not available is filled with zero.

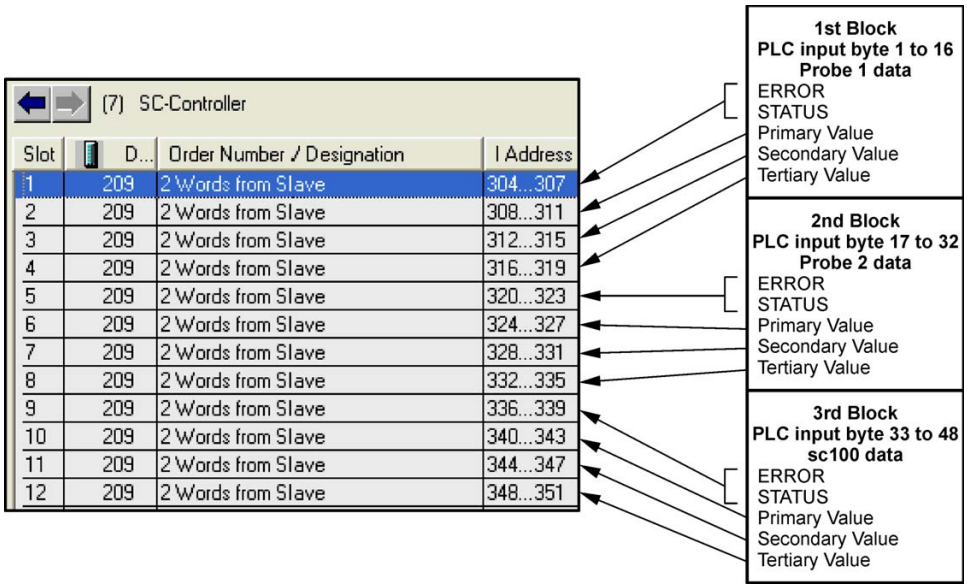


Figure 12 sc100 Profibus message data block structure

This format allows a sc pH probe to replace a different sc pH probe without changes in the PLC configuration.

Process data sc100 remap mode controller block

The data block for the sc100 controller is similar to the data block for sensors. For example, if two sensors are connected to the sc100, the controller is mapped as shown in the above figure. The data block will have the following data:

- sc100_ERROR
- sc100_STATUS
- Primary value
- Secondary value
- Tertiary value

Table 6 and Table 7 show the data definitions for error and status in the sc100 controller when in remap mode.

Table 6 sc100 error word

Bit	Error	Note
0	Sensor 1 communication error	A communication error has occurred between the sc100 controller and sensor 1. Sensor may be disconnected.
1	Sensor 2 communication error.	A communication error has occurred between the sc100 controller and sensor 2. Sensor may be disconnected.
2-15	Not used	Not used

Table 7 sc100 status word

Bit	Status 1	Note
0	Sensor 1 connected	Sensor 1 is successfully installed
1	Sensor 2 connected	Sensor 2 is successfully installed
2	Relay A is ON	
3	Relay B is ON	
4	Relay C is ON	
5-15	Not used	

sc100 values

The sc100 primary value shows the result of a calculation.

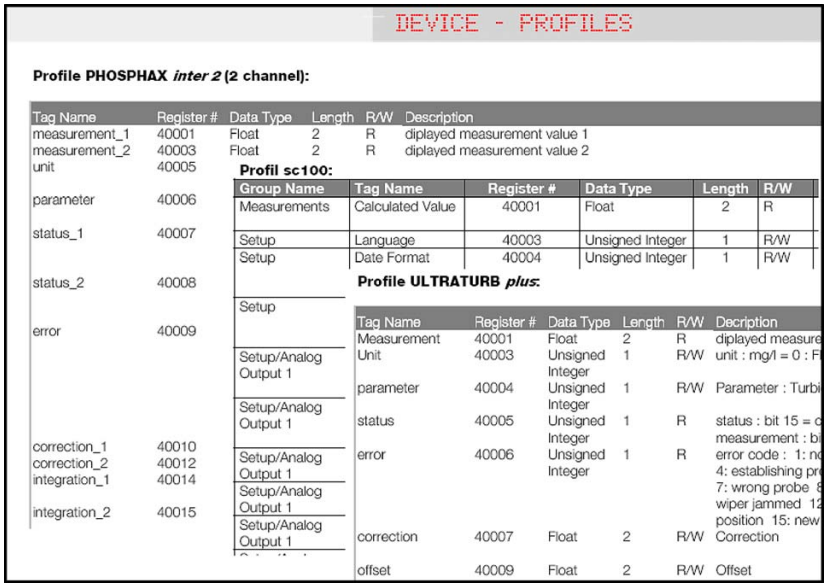
The sc100 secondary value shows the 4–20 mA output from Channel 1.

The sc100 tertiary value shows the 4–20 mA output from Channel 2.

Data structure with remap mode disabled

The data structure of sc100 Profibus messages is set. The Profibus card is a gateway between the internal Modbus and the external Profibus. The first 8 registers from the probe Modbus profile are written into the Profibus message. The data content and data type is defined in the Modbus Profile section of the probe manual.

The Modbus profile with remap mode disabled is shown in Figure 13. The data block structure is shown in Table 8.


DEVICE - PROFILES

Profile PHOSPHAX *inter 2* (2 channel):

Tag Name	Register #	Data Type	Length	R/W	Description
measurement_1	40001	Float	2	R	diplayed measurement value 1
measurement_2	40003	Float	2	R	diplayed measurement value 2
unit	40005				
parameter	40006				
status_1	40007				
status_2	40008				
error	40009				
correction_1	40010				
correction_2	40012				
integration_1	40014				
integration_2	40015				

Profil sc100:

Group Name	Tag Name	Register #	Data Type	Length	R/W
Measurements	Calculated Value	40001	Float	2	R
Setup	Language	40003	Unsigned Integer	1	R/W
Setup	Date Format	40004	Unsigned Integer	1	R/W
Setup					
Setup/Analog Output 1					
Setup/Analog Output 1					
Setup/Analog Output 1					
Setup/Analog Output 1					
Setup/Analog Output 1					

Profile ULTRATURB *plus*:

Tag Name	Register #	Data Type	Length	R/W	Decription
Measurement	40001	Float	2	R	diplayed measure
Unit	40003	Unsigned Integer	1	R/W	unit : mg/l = 0 : F
parameter	40004	Unsigned Integer	1	R/W	Parameter : Turbi
status	40005	Unsigned Integer	1	R	status : bit 15 = c measurement : bi
error	40006	Unsigned Integer	1	R	error code : 1: nc 4: establishing pr 7: wrong probe 8 wiper jammed 12 position 15: new
correction	40007	Float	2	R/W	Correction
offset	40009	Float	2	R/W	Offset

Figure 13 sc100 sensor data content and types

Table 8 Data block structure

Block number	PLC input byte	Structure	Source
1st Block	1 to 16	16 byte, 8 registers, 4 modules	Copy 40001–40008 from the first device
2nd Block	17 to 32	16 byte, 8 registers, 4 modules	Copy 40001–40008 from the second device
3rd Block	33 to 48	16 byte, 8 registers, 4 modules	Copy 40001–40008 from the third device

Figure 14 shows how an sc100 controller and two connected sensors are mapped to Profibus addresses when remap mode is disabled.

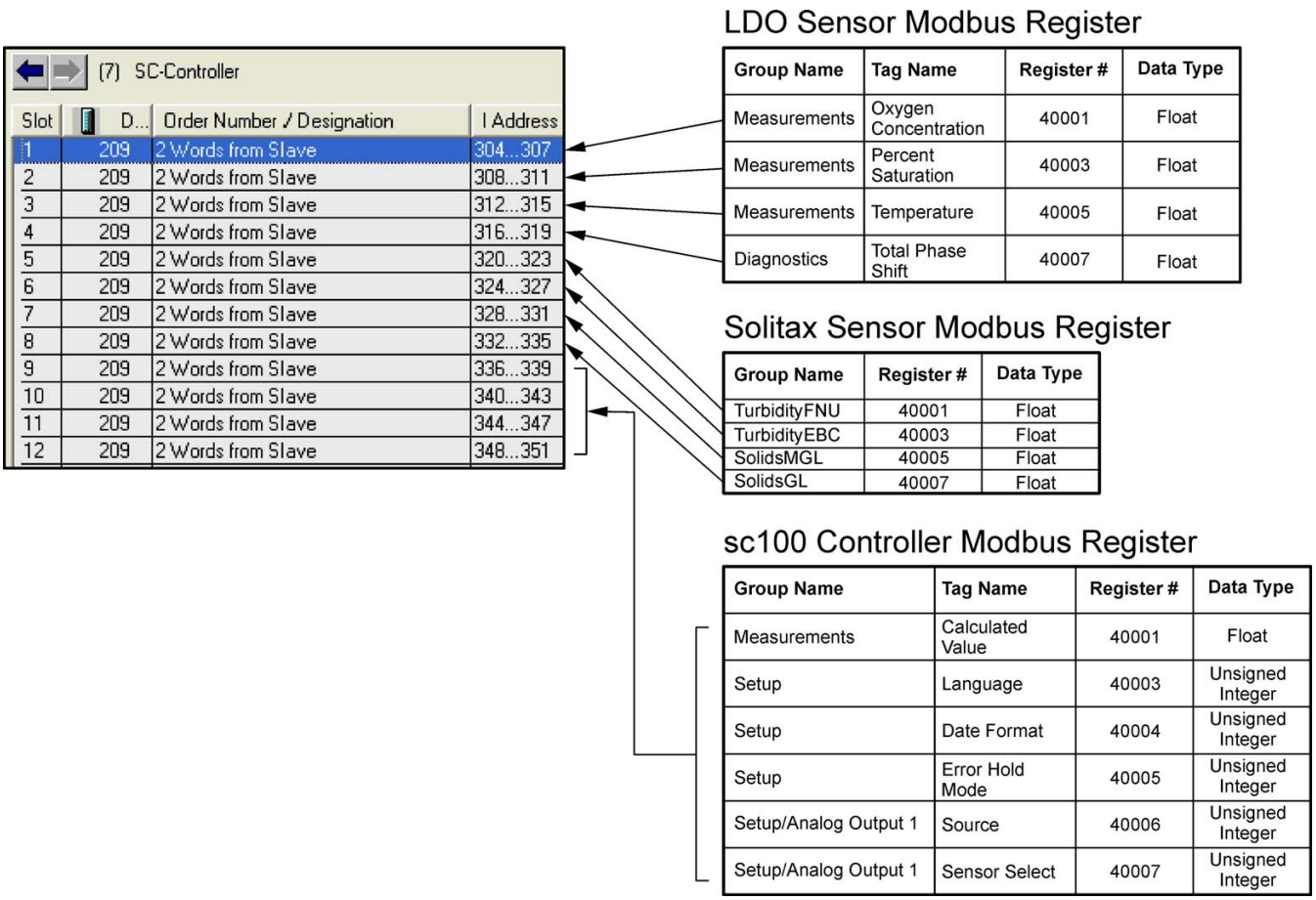


Figure 14 sc100 with LDO and SOLITAX

Error and Status Indicators

Table 9 lists bit position and their **ERROR** messages. Table 10 lists bit position and their **STATUS** messages. There is one standard for all sc probes.

A bit value of zero shows the error or status condition is not true.

A bit value of 1 shows the error or status condition is true. For example, if Bit 0 has the value of 1, a measurement calibration has occurred.

Table 9 Error messages

Bit	Message	Indication
0	Measurement calibration error	An error has occurred during the last calibration
1	Electronic adjustment error	An error has occurred during the last electronic calibration
2	Cleaning error	The last cleaning cycle failed
3	Measuring module error	A failure has been detected in the Measurement Module
4	System re-initialization error	Some settings are inconsistent and have been reset to factory defaults
5	Hardware error	A general hardware error has been detected
6	Internal communication error	A communication failure within the device has been detected
7	Humidity error	Excessive humidity has been detected within the device
8	Temperature error	Temperature within the device exceeds a specified limit
9		
10	Sample warning	Some action is required with the sample system
11	Questionable calibration warning	The last calibration may not be accurate
12	Questionable measurement warning	One or more of the device measurements are out of range or are of questionable accuracy
13	Safety warning	A condition has been detected which may result in a safety hazard
14	Reagent warning	The reagent system requires attention
15	Maintenance required warning	The device requires maintenance

Table 10 Status indicator messages

Bit	Status 1	Note
0	Calibration in progress	The device is in a calibration mode. Measurements may not be valid.
1	Cleaning in progress	The device is in a cleaning mode. Measurements may not be valid.
2	Service / Maintenance menu	The device is in a service or maintenance mode. Measurements may not be valid.
3	Common error	The device has recognized an error. See Error Register for Error Class.
4	Measurement 0 Quality Bad	Precision of measurement is out of specified limits.
5	Measurement 0 Low Limit	Measurement is below specified range.
6	Measurement 0 High Limit	Measurement is above specified range.
7	Measurement 1 Quality Bad	Precision of measurement is out of specified limits.
8	Measurement 1 Low Limit	Measurement is below specified range.
9	Measurement 1 High Limit	Measurement is above specified range.
10	Measurement 2 Quality Bad	Precision of measurement is out of specified limits.
11	Measurement 2 Low Limit	Measurement is below specified range.
12	Measurement 2 High Limit	Measurement is above specified range.
13	Measurement 3 Quality Bad	Precision of measurement is out of specified limits.
14	Measurement 3 Low Limit	Measurement is below specified range.
15	Measurement 3 High Limit	Measurement is above specified range.

IEEE floating point definition

Profibus uses 32-bit single precision IEEE floating point definition. The definition has twenty three bits for the mantissa and eight bits for the exponent. There is one bit for the sign of the mantissa. Refer to Figure 15.

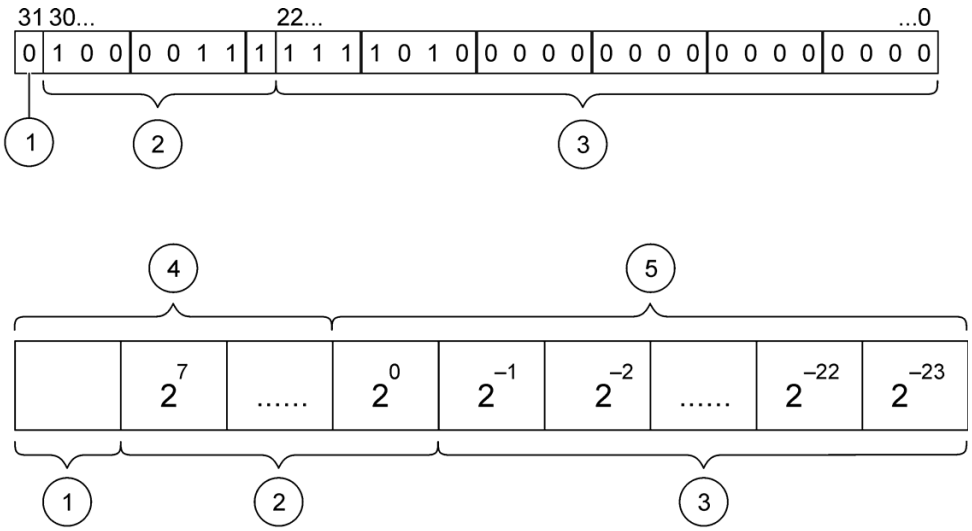


Figure 15 Floating point definition

1	Sign bit	**4**	Exponent
2	Exponent	**5**	Mantissa
3	Mantissa		

Byte order inside a Profibus telegram

Word wise swapping

Table 11 shows swapped and normal byte sequences. In word wise swapping the third and fourth bytes are interchanged in order with the first and second bytes. This results in a byte order of 3 4 1 2.

Table 11 Byte order inside Profibus telegram

sc1000, sc100 swapped	sc1000, sc100 normal
Byte T1 value 0 x 91	Byte T1 value 0 x 3F
Byte T2 value 0 x B9	Byte T2 value 0 x 67
Byte T3 value 0 x 3F	Byte T3 value 0 x 91
Byte T4 value 0 x 67	Byte T4 value 0 x B9

Direct access byte sequence is 1 2 3 4.

From the information in the table, the IEEE Big Endian Float Value equals 0,9046.

PLC examples

Example Simatic

When the LANG0671.GSD is imported, the slave will be located at **PROFIBUS DP > ADDITIONAL FIELD DEVICES > GENERAL.**

Choose **2 Words from Slave** module. Each module is 4 bytes of the input address range.

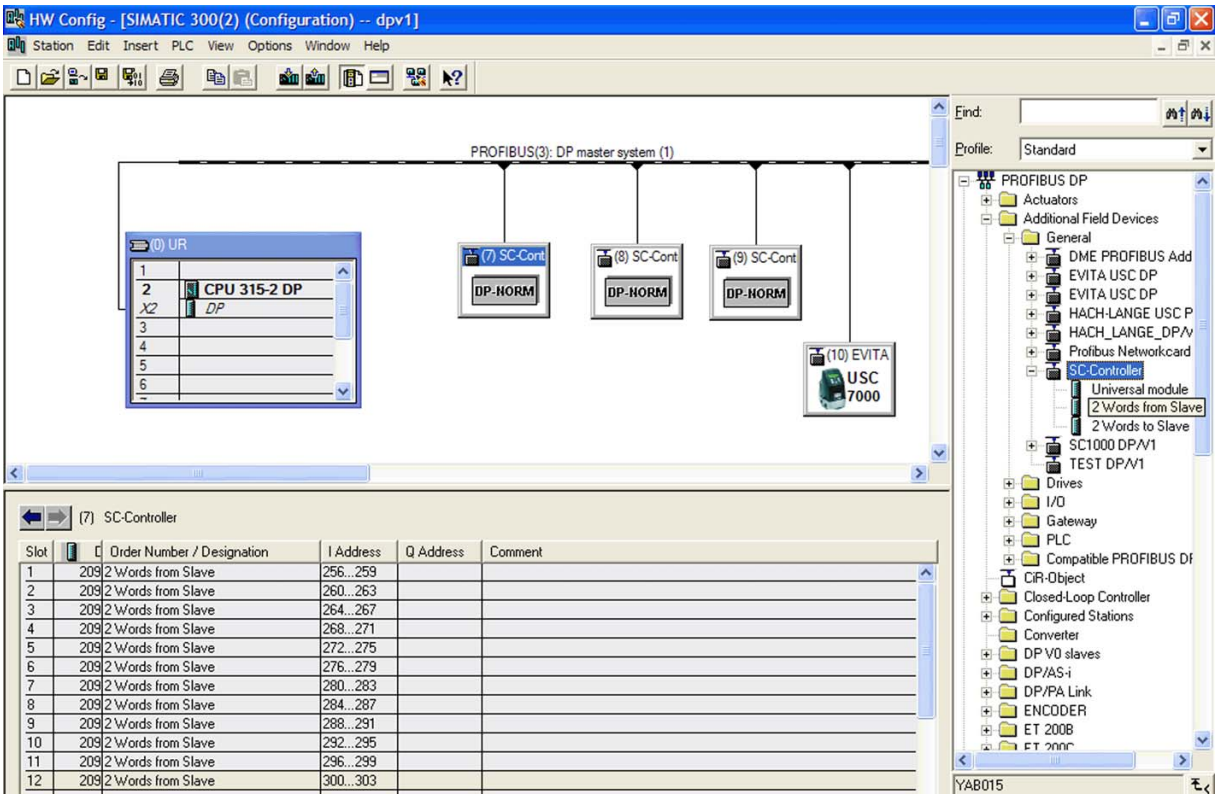


Figure 16 Example Simatic

Read Data

For usual data sequence, use **L PED** at the module starting address to read a floating point object. There is no need for more conversions.

Note: *PEW/PED is the SIMATIC or German code mnemonic. Use PIW/PID for IEC or English.*

Read ERROR or STATUS words

Use the **L PEW** instruction.

Build a Float with swapped data order

1. **L PEW 262** //Loads the second of two words
2. **SLD 16** //Moves the second word 16 bits to the left
3. **L PEW 260** //Loads the first of two words
4. **+D** //Adds both Words in a 32 bit IEEE float
5. **T MD 18** //Transfers the result to its destination

Example Allen Bradley

Allen Bradley PLC – Woodhead SST Profibus card.

Use Normal data order.

The COP or MOV instruction to move data from SST to SLC moves 2 integers in a pair to a Float destination. There is no need for more conversions.

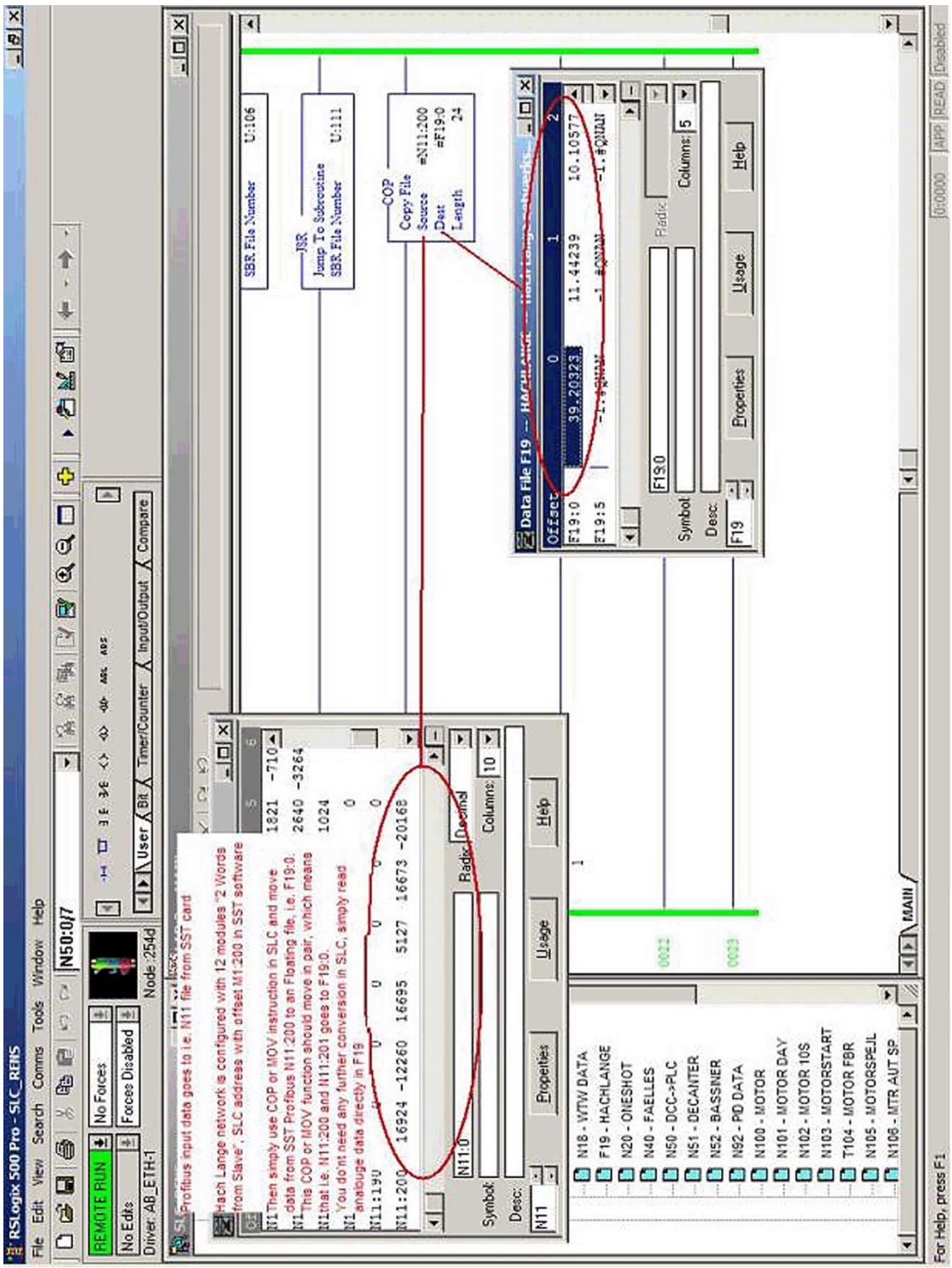


Figure 17 Example Simatic

Example Emerson Delta V

Use Normal data order.

The Delta V configuration refers one SLOT (32 bit) to one Module, 2 Words from Slave according to the GSD file definition. The data format is calculated as IEEE float. This number can be read as Little Endian or Big Endian with a normal data order.

Signal Properties:

- Data Mapping = Standard network byte order
- Data Type = Floating point

Once the LANG0671.GSD is imported, the slave can be found at the following location:

Library > Profibus DP devices > General.

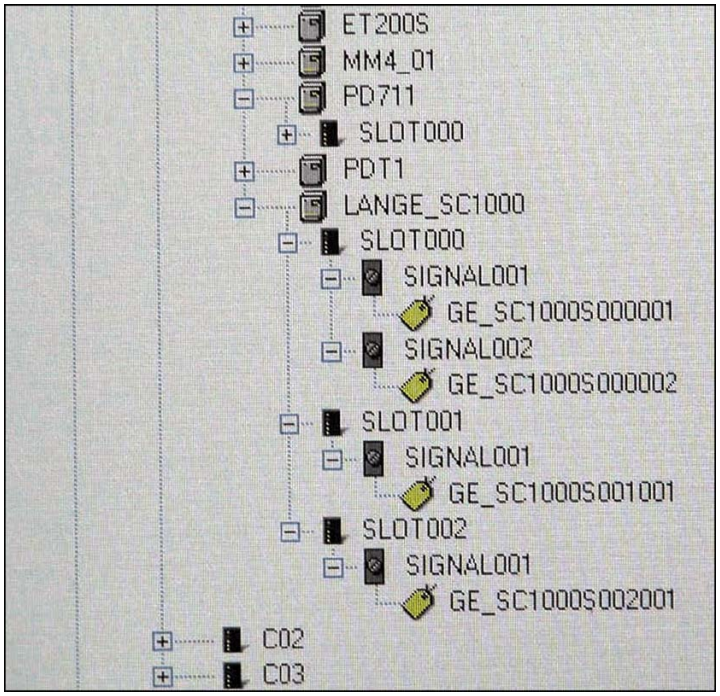


Figure 18 Example Emerson Delta V

SLOT000 SIGNAL001 ERROR

SLOT000 SIGNAL002 STATUS 1

SLOT001 SIGNAL001 MEASURED VALUE IN µS/cm

SLOT002 SIGNAL001 TEMPERATURE

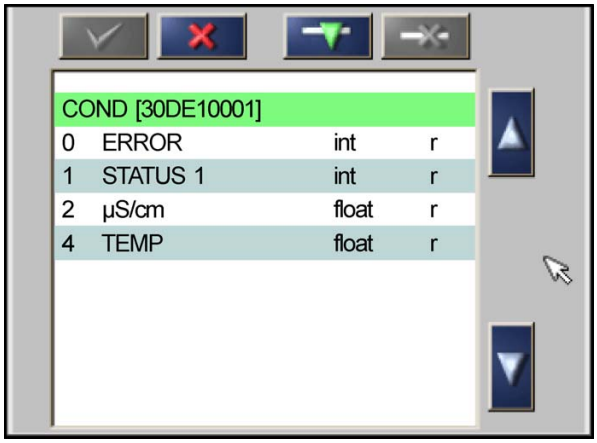


Figure 19 Emerson DeltaV signal status

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HACH Company
Ames Service
100 Dayton Avenue
Ames, Iowa 50010
Tel (800) 227-4224
(U.S.A. only)
Fax (515) 232-3835

Repair Service in Canada:
Hach Sales & Service
Canada Ltd.
1313 Border Street, Unit 34
Winnipeg, Manitoba
R3H 0X4
Tel (800) 665-7635
(Canada only)
Tel (204) 632-5598
Fax (204) 694-5134
canada@hach.com

Repair Service in Latin America, the Caribbean, the Far East, Indian Subcontinent, Africa, Europe, or the Middle East:
Hach Company World
Headquarters,
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80539-0389 U.S.A.
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Edition 2 May 2008 kw/kt