

Test Program for a Profibus Connection HB-Therm to Siemens S7-300

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1 Introduction

This example of use assumes knowledge in the programming language STEP 7 with Profibus and in the operation of an HB-Therm temperature control unit.

This test program can be used for all Series 4 and Thermo-5 Temperature Control Units. In case of Thermo-5 take note that the parameter **Compatibility Profibus for S4** under menu **Setting \ Remote** must be set to "yes". Otherwise, the Thermo-5 unit will not work with the test program.

The following instruction manuals provide further details:

- Instruction Manual of HB-Therm temperature control units
- Profibus – Interface for HB-Therm (O8241-X, X=language)

2 Content

STEP 7 projects include a S7-300 with one CPU 315-2 DP and one HB-Therm temperature control unit. The communication is implemented via Profibus-DP (Master-Slave).

There exist the following examples:

- Single zone unit: HB-THERM_Z1_jjmm.ZIP ¹
- Multiple zone unit: HB-THERM_Z4_jjmm.ZIP ¹

The projects must be unzipped in the SIMATIC Manager.

Note:

The test program was initially checked on the following Siemens S7 hardware versions:

- CPU 315-2 DP 6ES7 315-2AH14-0AB0
- CPU 315-2 DP 6ES7 315-2AG10-0AB0

There is no guarantee for proper function of the test program in case of other Siemens S7 hardware versions. If there are problems by using hardware versions not listed above, please contact the Siemens Support Office directly.

¹ jjmm = version

3 STEP 7 projects for a single zone unit

3.1 Insert CPU 315-2 DP

Configure the operation mode to Profibus-DP Master.

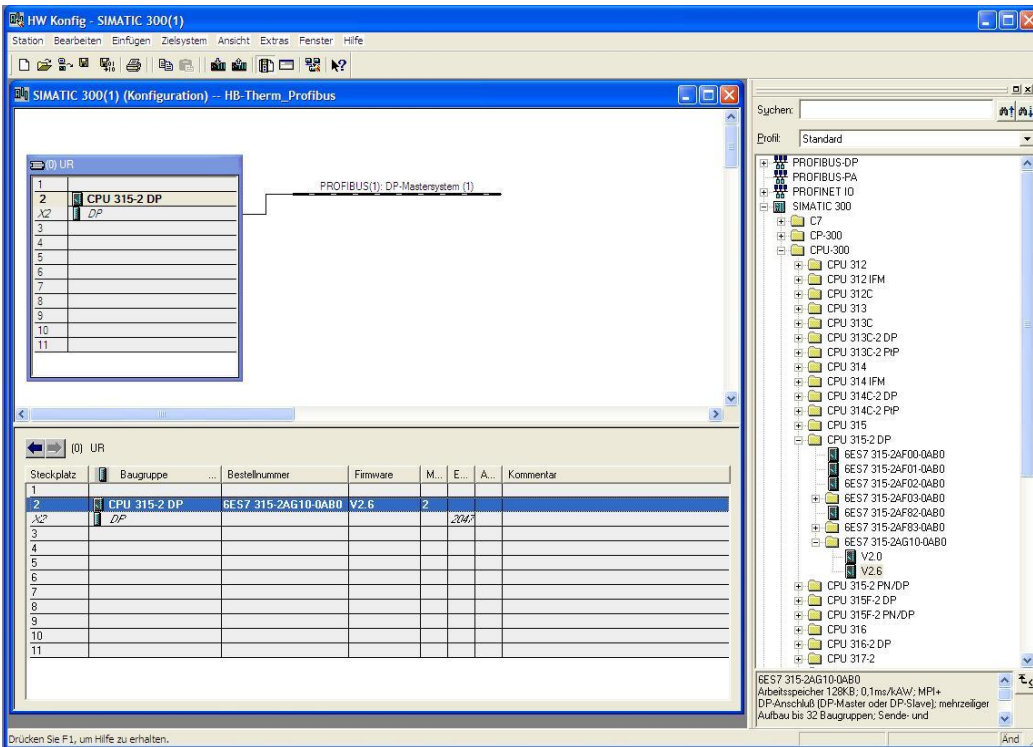


Figure 1: Insert CPU 315-2 DP

3.2 GSD-File installed

If you already work with an existing GSD-file, please check under www.hb-therm.ch if the version matches with the actual one. If not, please replace it.

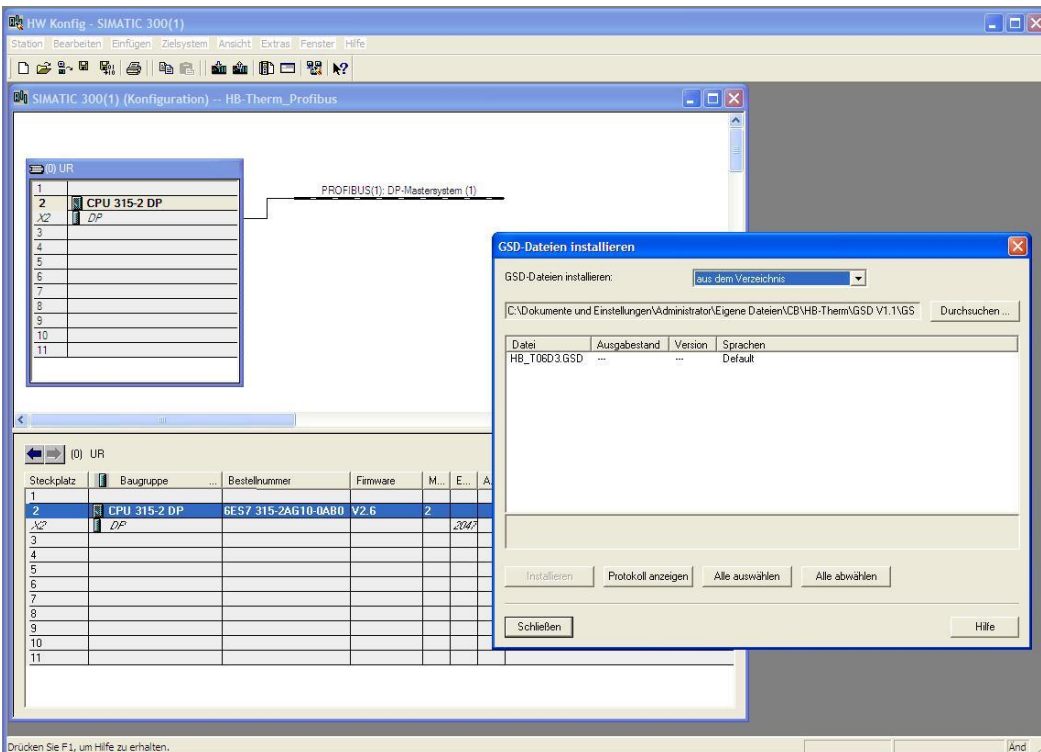


Figure 2: Install GSD-file

3.3 Insert the station HB-Therm USR-41 as DP-Slave

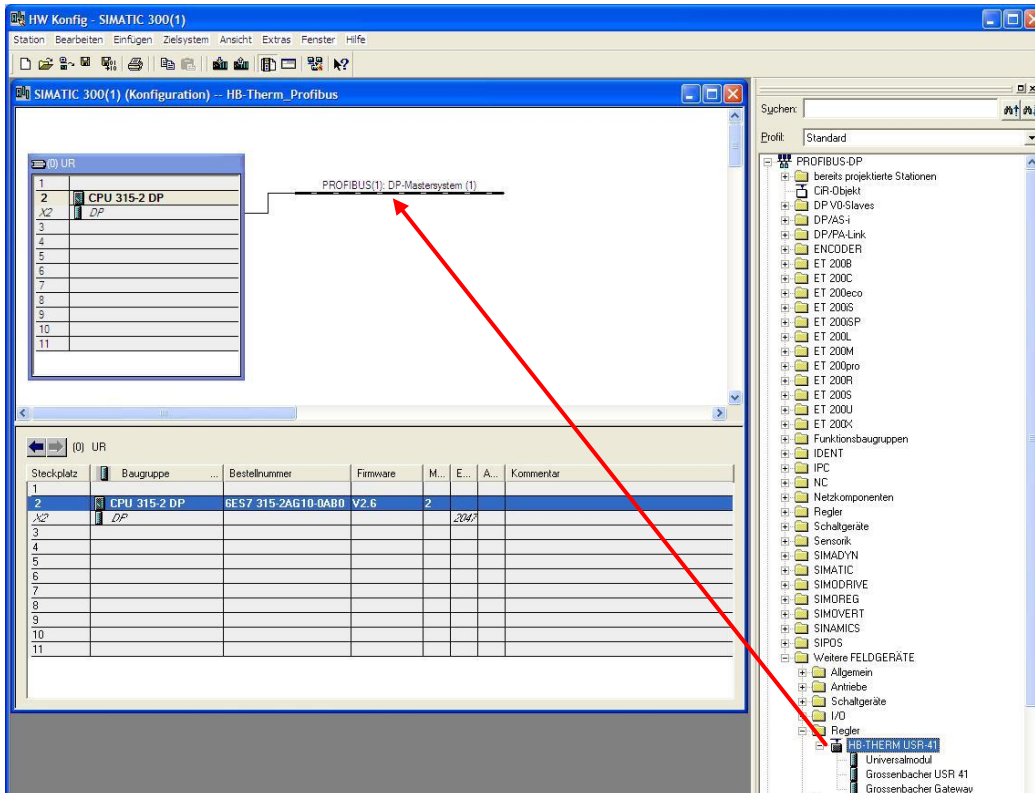


Figure 3: Insert station

3.4 Configure station

- Set the address of the slave (in this case no 5)
- Insert the object Grossenbacher USR 41 and set the I/O address (in this case I/O after 256)

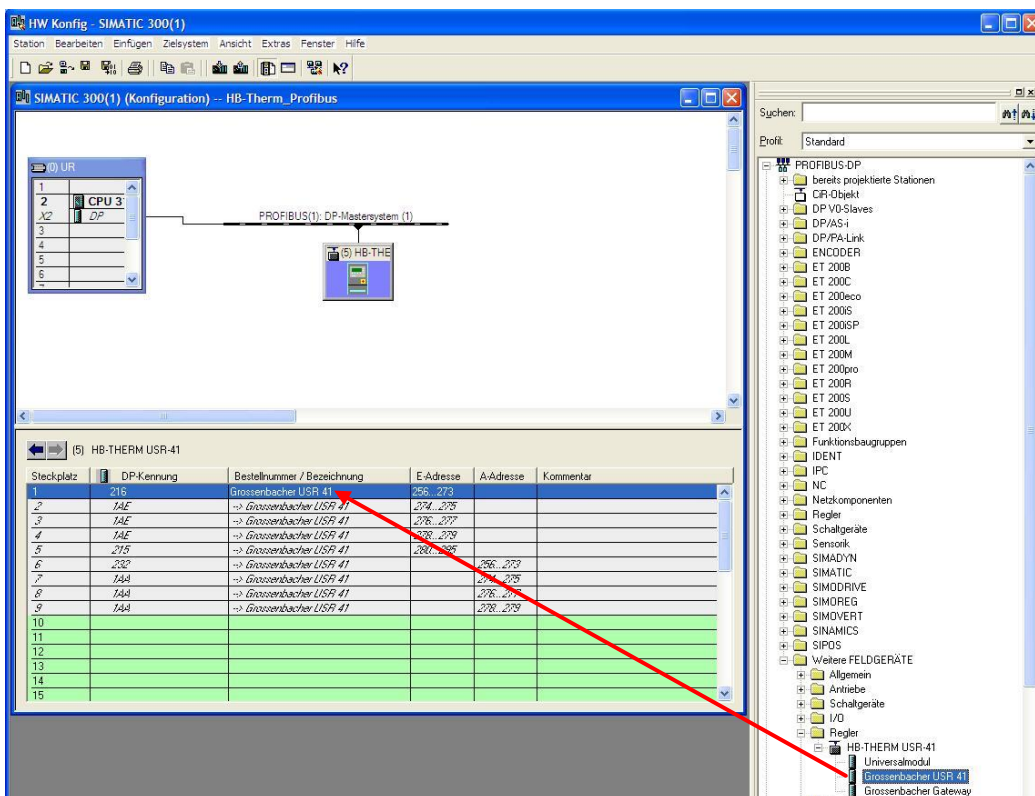


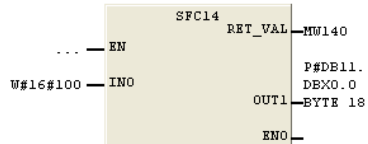
Figure 4: Configure station

3.5 Read the input ports

The data is read from the input ports and saved to the device DB11 for further processing.

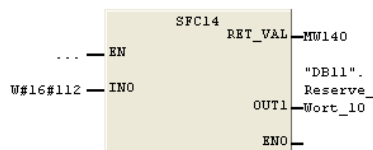
Netzwerk 1: Reading inputs from HB-THERM

```
Reading:
- Counter variable poll
- Nominal value 1
- Nominal value 2
- Valid upper deviation nominal / actual value
- Valid lower deviation nominal / actual value
- Valid temperature difference main / return line
- Valid minimum flow rate
- Valid maximum flow rate
- Operating mode set (Bit-Values)
```



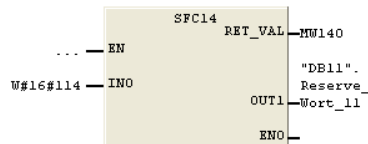
Netzwerk 2: Reading inputs from HB-THERM

```
Reading:
- Reserve Word 10
```



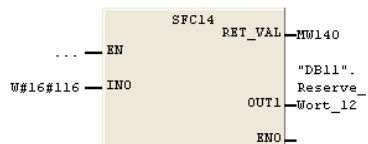
Netzwerk 3: Reading inputs from HB-THERM

```
Reading:
- Reserve Word 11
```



Netzwerk 4: Reading inputs from HB-THERM

```
Reading:
- Reserve Word 12
```



Netzwerk 5: Reading inputs from HB-THERM

```
Reading:
- Actual temperature main line
- Actual temperature return line
- Actual temperature external sensor
- Actual regulation ratio
- Actual flow rate
- Reserve Word 18
- Status Operating mode (Bit-Values)
- Status alarms (Bit-Values)
```

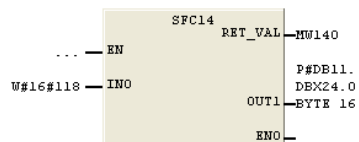


Figure 5: Input data

3.5.1 Device DB11

Address space assignment of the input ports.

Adresse	Name	Typ	Anfangswert	Kommentar
0.0		STRUCT		
+0.0	Zaehlervariable	WORD	W#16#0	Zahlvariable Abfrage, Bereich 0 - ffffH
+2.0	Sollwert_1	INT	0	Sollwert 1, Einheit 0,1°C, Bereich 0-4000
+4.0	Sollwert_2	INT	0	Sollwert 2, Einheit 0,1°C, Bereich 0-4000
+6.0	Abweichung_oben	INT	0	Zulässige Abweichung Soll-/Istwert oben, Einheit 0,1K, Bereich 0-4000
+8.0	Abweichung_unten	INT	0	Zulässige Abweichung Soll-/Istwert unten, Einheit 0,1K, Bereich 0-4000
+10.0	Temp_Diff_Vor_Ruecklauf	INT	0	Zulässige Temperaturdifferenz Vor-/Rücklauf, Einheit 0,1K, Bereich 0-4000
+12.0	Durchfluss_minimum	INT	0	Zulässiger Durchfluss minimum, Einheit L/min, Bereich 0 - 1000
+14.0	Durchfluss_maximum	INT	0	Zulässiger Durchfluss maximum, Einheit L/min, Bereich 0 - 1000
+16.0	BA_Alarm_Reset	BOOL	FALSE	Betriebsart: Alarm-Reset (für quittierbare P- / M-Alarme)
+16.1	BA_Bit_9_Reserve	BOOL	FALSE	Betriebsart: Bit 9 Reserve
+16.2	BA_Bit_10_Reserve	BOOL	FALSE	Betriebsart: Bit 10 Reserve
+16.3	BA_Bit_11_Reserve	BOOL	FALSE	Betriebsart: Bit 11 Reserve
+16.4	BA_Bit_12_Reserve	BOOL	FALSE	Betriebsart: Bit 12 Reserve
+16.5	BA_Bit_13_Reserve	BOOL	FALSE	Betriebsart: Bit 13 Reserve
+16.6	BA_Bit_14_Reserve	BOOL	FALSE	Betriebsart: Bit 14 Reserve
+16.7	BA_Watchdog	BOOL	FALSE	Betriebsart: Watchdog
+17.0	BA_Geraet_Ein_Aus	BOOL	FALSE	Betriebsart: Gerät EIN/AUS
+17.1	BA_Abkuehlen_Ein_Aus	BOOL	FALSE	Betriebsart: Abkühlen EIN/AUS
+17.2	BA_Formentleerung_Ein_A	BOOL	FALSE	Betriebsart: Formentleerung EIN/AUS
+17.3	BA_Leckstopbetrieb_Ein_A	BOOL	FALSE	Betriebsart: Leckstopbetrieb EIN/AUS
+17.4	BA_Externfuehler_Ein_Aus	BOOL	FALSE	Betriebsart: Externfühler EIN/AUS
+17.5	BA_2_Sollwert_Ein_Aus	BOOL	FALSE	Betriebsart: 2. Sollwert EIN/AUS
+17.6	BA_Bit_6_Reserve	BOOL	FALSE	Betriebsart: Bit 6 Reserve
+17.7	BA_Bit_7_Reserve	BOOL	FALSE	Betriebsart: Bit 7 Reserve
+18.0	Reserve_Wort_10	WORD	W#16#0	Reserve Wort 10
+20.0	Reserve_Wort_11	WORD	W#16#0	Reserve Wort 11
+22.0	Reserve_Wort_12	WORD	W#16#0	Reserve Wort 12
+24.0	Istwert_Vorlauf	INT	0	Istwert Vorlauf, Einheit 0,1°C, Bereich 0-4000
+26.0	Istwert_Ruecklauf	INT	0	Istwert Rücklauf, Einheit 0,1°C, Bereich 0-4000
+28.0	Istwert_extern	INT	0	Istwert_extern, Einheit 0,1°C, Bereich 0-4000
+30.0	Stellgrad	INT	0	Stellgrad, Einheit %, Bereich -100 - +100
+32.0	Durchfluss	INT	0	Durchfluss, Einheit L/min, Bereich 0 - 1000
+34.0	Reserve_Wort_18	WORD	W#16#0	Reserve Wort 18
+36.0	SBA_Sammelalarm_Prozess	BOOL	FALSE	Status Betriebsart: Sammelalarm Prozess (P)
+36.1	SBA_Sammelalarm_Geraet	BOOL	FALSE	Status Betriebsart: Sammelalarm Gerät (M)
+36.2	SBA_Sammelalarm_Bedien	BOOL	FALSE	Status Betriebsart: Sammelalarm Bedienung (B)
+36.3	SBA_Bit_11_Reserve	BOOL	FALSE	Status Betriebsart: Bit 11 Reserve
+36.4	SBA_Bit_12_Reserve	BOOL	FALSE	Status Betriebsart: Bit 12 Reserve
+36.5	SBA_Bit_13_Reserve	BOOL	FALSE	Status Betriebsart: Bit 13 Reserve
+36.6	SBA_Bit_14_Reserve	BOOL	FALSE	Status Betriebsart: Bit 14 Reserve
+36.7	SBA_Bit_15_Reserve	BOOL	FALSE	Status Betriebsart: Bit 15 Reserve
+37.0	SBA_Geraet_Ein_Aus	BOOL	FALSE	Status Betriebsart: Gerät EIN/AUS
+37.1	SBA_Abkuehlen_Ein_Aus	BOOL	FALSE	Status Betriebsart: Abkühlen EIN/AUS
+37.2	SBA_Formentleerung_Ein_A	BOOL	FALSE	Status Betriebsart: Formentleerung EIN/AUS
+37.3	SBA_Leckstopbetrieb_E_A	BOOL	FALSE	Status Betriebsart: Leckstopbetrieb EIN/AUS
+37.4	SBA_Externfuehler_Ein_A	BOOL	FALSE	Status Betriebsart: Externfühler EIN/AUS
+37.5	SBA_2_Sollwert_Ein_Aus	BOOL	FALSE	Status Betriebsart: 2. Sollwert EIN/AUS
+37.6	SBA_Fernsteuerbetrieb_EA	BOOL	FALSE	Status Betriebsart: Fernsteuerbetrieb EIN/AUS
+37.7	SBA_Bit_6_Reserve	BOOL	FALSE	Status Betriebsart: Bit 6 Reserve
+38.0	SA_Uebertemperatur	BOOL	FALSE	Status Alarme: Störung Uebertemperatur (M)
+38.1	SA_Fuehlerbruch	BOOL	FALSE	Status Alarme: Störung Fühlerbruch (M)
+38.2	SA_Netz	BOOL	FALSE	Status Alarme: Störung Netz (M)
+38.3	SA_Andere	BOOL	FALSE	Status Alarme: Störung andere
+38.4	SA_Bit_12_Reserve	BOOL	FALSE	Status Alarme: Bit 12 Reserve
+38.5	SA_unzulaessiger_Wert	BOOL	FALSE	Status Alarme: unzulässiger Wert (Soll- oder Grenzwert) (B)
+38.6	SA_unzulaessiger_Funkt	BOOL	FALSE	Status Alarme: unzulässige Funktion (Betriebsart) (B)
+38.7	SA_Bit_15_Reserve	BOOL	FALSE	Status Alarme: Bit 15 Reserve
+39.0	SA_obere_Abweichung	BOOL	FALSE	Status Alarme: Obere Abweichung überschritten (P)
+39.1	SA_untere_Abweichung	BOOL	FALSE	Status Alarme: Untere Abweichung überschritten (P)
+39.2	SA_Temp_Differenz	BOOL	FALSE	Status Alarme: Temperaturdifferenz überschritten (P)
+39.3	SA_Durchfluss_ueberschr	BOOL	FALSE	Status Alarme: Durchfluss überschritten (P)
+39.4	SA_Durchfluss_unterschr	BOOL	FALSE	Status Alarme: Durchfluss unterschritten (P)
+39.5	SA_Prozessalarm_andere	BOOL	FALSE	Status Alarme: Prozessalarm andere (P)
+39.6	SA_Bit_6_Reserve	BOOL	FALSE	Status Alarme: Bit 6 Reserve
+39.7	SA_Fuellstand	BOOL	FALSE	Status Alarme: Störung Fullstand (M)
+40.0		END_STRUCT		

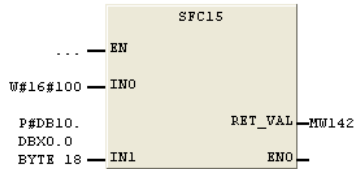
Figure 6: Device DB11

3.6 Output to the temperature control unit

The output is triggered on the chip DB10. The data is written to the output ports.

Netzwerk 6 : Output to HB-THERM

```
Output:
- Reserve Word 0
- Nominal value 1
- Nominal value 2
- Valid upper deviation nominal / actual value
- Valid lower deviation nominal / actual value
- Valid temperature difference main / return line
- Valid minimum flow rate
- Valid maximum flow rate
- Operating mode (Bit-Values)
```



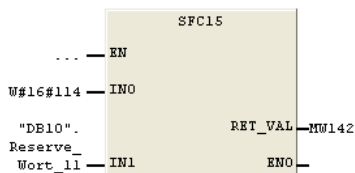
Netzwerk 7 : Output to HB-THERM

```
Output:
- Actual value external sensor
```



Netzwerk 8 : Output to HB-THERM

```
Output:
- Reserve Word 11
```



Netzwerk 9 : Output to HB-THERM

```
Output:
- Reserve Word 12
```

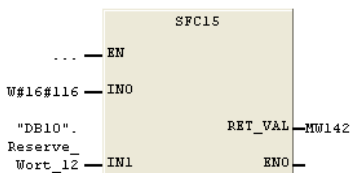


Figure 7: Output

3.6.1 Device DB10

Data source for control

Adresse	Name	Typ	Anfangswert	Kommentar
0.0		STRUCT		
+0.0	Reserve_Wort_0	WORD	W#16#0	Reserve Wort 0
+2.0	Sollwert_1	INT	432	Sollwert 1, Einheit 0,1°C, Bereich 0-4000
+4.0	Sollwert_2	INT	321	Sollwert 2, Einheit 0,1°C, Bereich 0-4000
+6.0	Abweichung_oben	INT	0	Zulässige Abweichung Soll-/Istwert oben, Einheit 0,1K, Bereich 0-4000
+8.0	Abweichung_unten	INT	0	Zulässige Abweichung Soll-/Istwert unten, Einheit 0,1K, Bereich 0-4000
+10.0	Temp_Diff_Vor_Ruecklauf	INT	0	Zulässige Temperaturdifferenz Vor-/Rücklauf, Einheit 0,1K, Bereich 0-4000
+12.0	Durchfluss_minimum	INT	0	Zulässiger Durchfluss minimum, Einheit L/min, Bereich 0 - 1000
+14.0	Durchfluss_maximum	INT	0	Zulässiger Durchfluss maximum, Einheit L/min, Bereich 0 - 1000
+16.0	BA_Alarm_Reset	BOOL	FALSE	Betriebsart: Alarm-Reset (für quittierbare F- / M-Alarme)
+16.1	BA_Bit_9_Reserve	BOOL	FALSE	Betriebsart: Bit 9 Reserve
+16.2	BA_Bit_10_Reserve	BOOL	FALSE	Betriebsart: Bit 10 Reserve
+16.3	BA_Bit_11_Reserve	BOOL	FALSE	Betriebsart: Bit 11 Reserve
+16.4	BA_Bit_12_Reserve	BOOL	FALSE	Betriebsart: Bit 12 Reserve
+16.5	BA_Bit_13_Reserve	BOOL	FALSE	Betriebsart: Bit 13 Reserve
+16.6	BA_Bit_14_Reserve	BOOL	FALSE	Betriebsart: Bit 14 Reserve
+16.7	BA_Watchdog	BOOL	TRUE	Betriebsart: Watchdog
+17.0	BA_Geraet_Ein_Aus	BOOL	TRUE	Betriebsart: Gerät EIN/AUS
+17.1	BA_Abkuehlen_Ein_Aus	BOOL	FALSE	Betriebsart: Abkühlen EIN/AUS
+17.2	BA_Foermentleerung_Ein_A	BOOL	FALSE	Betriebsart: Foermentleerung EIN/AUS
+17.3	BA_Leckstopbetrieb_Ein_A	BOOL	FALSE	Betriebsart: Leckstopbetrieb EIN/AUS
+17.4	BA_Externfuehler_Ein_Aus	BOOL	FALSE	Betriebsart: Externfühler EIN/AUS
+17.5	BA_2_Sollwert_Ein_Aus	BOOL	FALSE	Betriebsart: 2. Sollwert EIN/AUS
+17.6	BA_Bit_6_Reserve	BOOL	FALSE	Betriebsart: Bit 6 Reserve
+17.7	BA_Bit_7_Reserve	BOOL	FALSE	Betriebsart: Bit 7 Reserve
+18.0	Istwert_Externfuehler_1	WORD	W#16#0	Istwert Externfühler 1
+20.0	Reserve_Wort_11	WORD	W#16#0	Reserve Wort 11
+22.0	Reserve_Wort_12	WORD	W#16#0	Reserve Wort 12
=24.0		END_STRUCT		

Figure 8: Device DB10

3.7 Panel

A STEP 7 project includes a panel for simulation. It is run with the software WinCC-flexible-Runtime 2008.

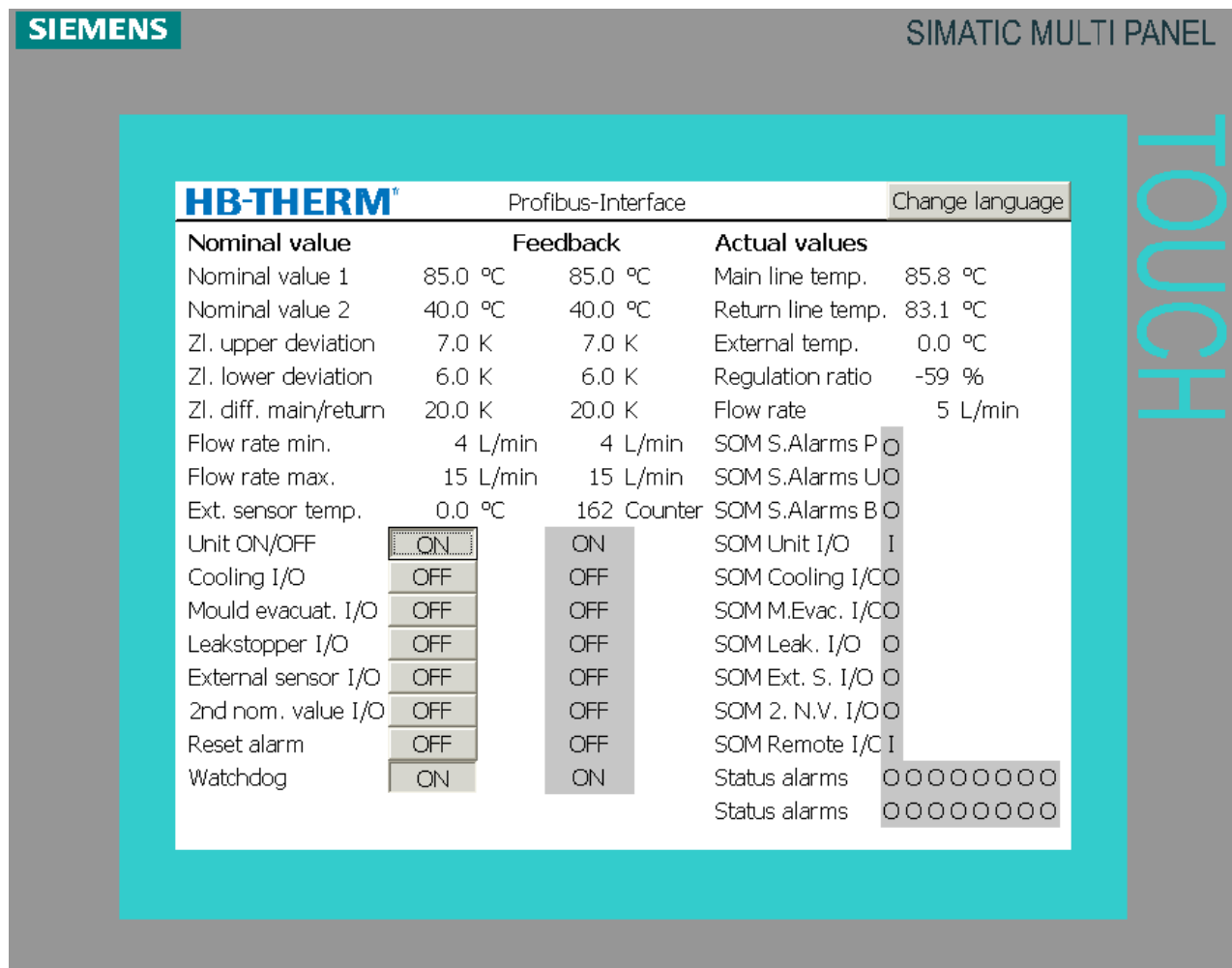


Figure 9: Example for a single zone unit

- Legend:**
- SBA ... Status operation mode
 - S.Alarm ... Collective alarm
 - I/O ... ON/OFF
 - 2. N.V. ... 2. nominal value

3.8 Settings of the HB-Therm temperature control unit

The HB-Therm temperature control unit requires the following settings:

Menu **Setting \ Remote**

- Set parameter **Protocol** to "15" (Profibus-DP)
- Set parameter **Address** to the desired value (in this case "5")
- Set parameter **Compatibility Profibus to S4** to "yes" (only Thermo-5)

Menu **Functions**

- Select and activate the **Remote** control mode function

Further details are provided in the instruction manual of the temperature control unit.

4 STEP 7 projects for a multiple zone unit

For multiple zone units, the object Grossenbacher USR 41 must be inserted multiple times. Each zone has then its own I/O address space.

The screenshot shows the HW Config interface for a SIMATIC 300(1) system. A PROFIBUS-DP connection is established between a CPU 3 and an HB-THERM USR-41 unit. The table below details the configuration for each slot:

Steckplatz	DP-Kennung	Bestellnummer / Bezeichnung	E-Adresse	A-Adresse	Kommentar
1	216	Grossenbacher USR 41	256...273		
2	1A4	→ Grossenbacher USR 41	274...275		
3	1A4	→ Grossenbacher USR 41	276...277		
4	1A4	→ Grossenbacher USR 41	278...279		
5	215	→ Grossenbacher USR 41	280...285		
6	232	→ Grossenbacher USR 41	286...293		
7	1A4	→ Grossenbacher USR 41	294...295		
8	1A4	→ Grossenbacher USR 41	296...297		
9	1A4	→ Grossenbacher USR 41	298...299		
10	216	Grossenbacher USR 41	296...313		
11	1A4	→ Grossenbacher USR 41	314...315		
12	1A4	→ Grossenbacher USR 41	316...317		
13	1A4	→ Grossenbacher USR 41	318...319		
14	215	→ Grossenbacher USR 41	320...325		
15	232	→ Grossenbacher USR 41	326...327		
16	1A4	→ Grossenbacher USR 41	328...329		
17	1A4	→ Grossenbacher USR 41	300...301		
18	1A4	→ Grossenbacher USR 41	302...303		
19	216	Grossenbacher USR 41	336...353		
20	1A4	→ Grossenbacher USR 41	354...355		
21	1A4	→ Grossenbacher USR 41	356...357		
22	1A4	→ Grossenbacher USR 41	358...359		
23	215	→ Grossenbacher USR 41	360...375		
24	232	→ Grossenbacher USR 41	304...321		
25	1A4	→ Grossenbacher USR 41	322...323		
26	1A4	→ Grossenbacher USR 41	324...325		
27	1A4	→ Grossenbacher USR 41	326...327		
28	216	Grossenbacher USR 41	376...393		
29	1A4	→ Grossenbacher USR 41	394...395		
30	1A4	→ Grossenbacher USR 41	396...397		
31	1A4	→ Grossenbacher USR 41	398...399		
32	215	→ Grossenbacher USR 41	400...415		
33	232	→ Grossenbacher USR 41	328...345		
34	1A4	→ Grossenbacher USR 41	346...347		
35	1A4	→ Grossenbacher USR 41	348...349		
36	1A4	→ Grossenbacher USR 41	350...351		

Figure 10: Insert object

5 Definitions of Profibus

5.1 Data transfer method according to EIA Standard RS-485

The data transfer method RS-485 complies with the symmetrical data transfer as defined in EIA Standard RS-485 /4/. This method is specified by PROFIBUS-Norm EN 50170 for two wire circuit that is shielded and twisted. The maximum length of the circuit depends on:

- speed of transmission
- type of wire
- number of devices
- type and number of overload protection devices

5.2 Network topology

Serial or tree topology with repeaters, bus terminals and bus plug-ins can be used to connect the Profibus devices.

Open ends are terminated with impedances on each end. All devices are connected either directly with the bus plug-ins or to the bus terminals with direct links. The total length of the Profibus network can be extended with maximal 9 RS 485 repeaters to the length of a maximum of 10 segments, keeping the maximal bandwidth. The repeaters must be between two devices.

Segment length and maximal throughput:

- 1000 m maximal throughput: 93,75 kBit/s
- 800 m maximal throughput: 187,5 kBit/s
- 400 m maximal throughput: 500 kBit/s
- 200 m maximal throughput: 1,5 MBit/s
- 100 m maximal throughput: 3, 6, and 12 MBit/s

Number of devices: Maximum 32 devices on a single bus segment, maximum 127 on a network with repeater. The minimal length of the bus segment between two Profibus devices is 1 meter.