Supplementary
Operating Instructions
For Serial Data Communication

Aug. 06. Ver 1.0

SDU Temperature Controller

MODBUS® Protocol

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SDU with RS485

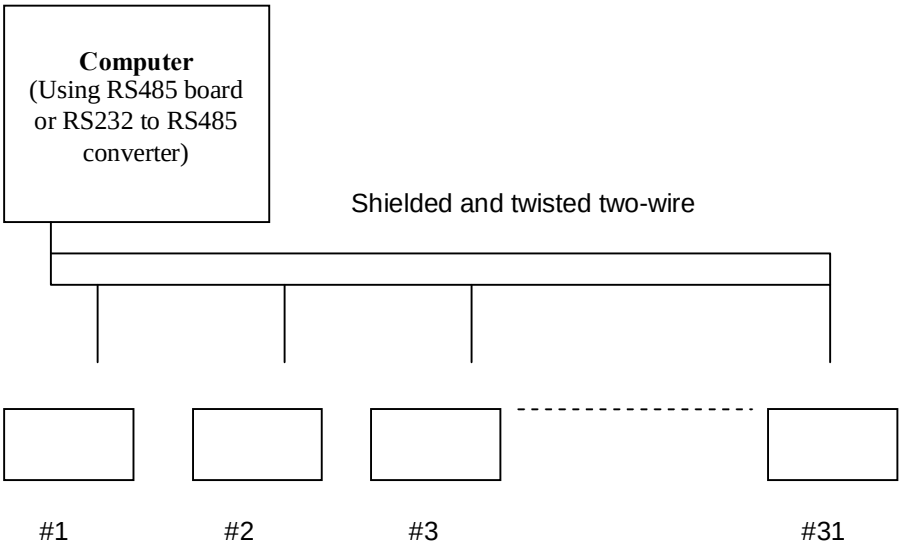
1. Description

The SDU with RS485 option uses serial communication allowing it to communicate over long distances with a computer or other types of instruments. It uses a two-wire system and does not need additional communication lines.

When used with a computer, the maximum length of communication wire is 1.2km (4600 ft). In addition, to increase communication reliability, the communication line of the system can be connected in a ring shape.

1) Communication method: HDX (half duplex) RS485
2) Maximum distance: 1.2km (4600ft)
3) Maximum number of connections: 31 / port
4) Communication data: 1 START, 8 DATA, 1 STOP Bit, NO PARITY
5) Speed: Selectable between 2400, 4800, 9600 BPS
6) Protocol: **MODBUS®** ASCII

2. SDU series Communication number and speed set up



Prior to using the RS485 feature, the address and communication speed need to be set up.

1) Apply power to the SDU and go to parameter group 6 (communication). Refer to the SDU user manual for instructions on changing parameter groups.

2) Set up the address (AddS) and speed (SPEd) of the SDU communication.

NOTE 1: Set the speed parameter (SPEd) to 2400 for communication speed of 2400 BPS
Set the speed parameter (SPEd) to 4800 for communication speed of 4800 BPS

Set the speed parameter (SPEd) to 9600 for communication speed of 9600 BPS

NOTE 2: Set the address parameter (AddS) to give the SDU a communication number. Setting the AddS parameter to 0 disables communication.

NOTE 3: See the SDU user manual for details on how to use the controller.

WARNING: Every SDU controller connected to the communication line must have the same speed and each controller must have a different communication number to operate properly.

3. Connecting Communication Wire

When making the communication connection observe the correct polarity. When the distance between a computer and SDU is short (i.e. less than 10m or 33 feet) a twisted pair of wires can be used. Shielded wire should be used for longer distances.

For optimum performance the communication line must use matching resistance. To accomplish this there is a jumper on the inside of the controller. This jumper is set to the ñMò position from the factory and should be left in this position if only one controller is being used. If more than one controller is used, only the final controller should have the jumper set to ñMò All other controllers should have the jumper set to the other position.

Referring to the following figures, connect the matching resistor of the final controller by putting the jumper in ñMòlocation on the PC board of SDU controller.

Make all other connections as outlined in the SDU user manual.

WARNING: The last SDU in the communication line must have the jumper set to "M". When SDUs are added or removed, the jumper position should be checked to ensure correct connection.

4. Reading internal variable data of the SDU (MODBUS® Function Code 03)

Function code 03 is a used to request variable data from the SDU via a computer or an external instrument. The procedure to receive data is as follows.

NOTE: Refer to general MODBUS® communication rules for detailed Check-Sum method, response time, and definitions of other function codes.

1) In the following example the data of the ñIntegral Timeòvariable is requested from the SDU with and AddS number of 01. When requesting data from the SDU using a computer the request is formatted as follows:

:	Address	F-Code	Data Address	Amount of data requested	C1	C2	CR	LF
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

(1) Start bit: (**:**)
(2) SDL address (Adds) number: (01 ï 31)
(3) MODBUS® function code: (03)
(4) Four digit address of data: 0003 (See the Tables at 7.1)
(5) Amount of data requested: 0001 (# of bytes in four digits)
(6) CHECK-SUM HIGH: (C1)
(7) CHECK-SUM LOW: (C2)
(8) Carriage return: (CR)
(9) Line feed: (LF)

e.g.: The above data would look like this: :**010300020001** C1, C2, CR, LF

2) The response of the SDU to the request is formatted as follows:

:	Address number	F-Code	Number of responding bytes	Value of data requested	C1	C2	CR	LF
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

(1) Start bit: (:)
(2) SDL address (AddS) number: (01 ï 31)
(3) Repeat of the MODBUS® function Code: (03)
(4) Number of responding bytes: (0001)
(5) Value of data requested: 000A (2 bytes in HEX code)
(6) CHECK-SUM HIGH: (C1)
(7) CHECK-SUM LOW: (C2)
(8) Carriage return: (CR)
(9) Line feed: (LF)

e.g.: The response would look like this: **010302000A** and C1,C2,CR, LF
The response indicates the integral time is 10 seconds (000A HEX).

5. Changing Data in the SDU (MODBUS® Function Code 06)

Function code 06 is used to change the data of variables in the SDU via a computer or external instrument. The procedure to change data is as follows.

NOTE: Refer to general MODBUS® communication rules for detailed Check-Sum method, response time, and definitions of other function codes.

1) In the following example the data contained in the SDU data address number 3 (integral time) will be changed to 15 seconds (HEX 000F).

:	Address	F-Code	Data Address	Amount of data requested	C1	C2	CR	LF
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

(1) Start bit: (:)
(2) SDL Address (AddS) Number: (01 ï 31)
(3) MODBUS® Function Code: (06)
(4) Address of data to be changed: (0003)
(5) New data: (000F) (HEX for 15)
(6) CHECK-SUM HIGH: (C1)
(7) CHECK-SUM LOW: (C2)
(8) Carriage return: (CR)
(9) Line feed: (LF)

e.g.: The above data being transmitted to the SDU would look like this :**01060003000F** C1, C2, CR, LF and the integral time would be changed to 15 seconds (000F).

2) SDU response after data change

1) If the data change was completed properly the SDU will respond by sending back the original request.

2) If the data transfer was not completed properly the SDU will respond with the following message.

:	Address	F-Code	Data failure code	C1	C2	CR	LF
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

(1) Start bit: (:)
(2) SDL address (AddS) number: (1 ï 31)
(3) MODBUS® function code: (86)
(4) Data failure code: (02)
(5) CHECK-SUM HIGH: (C1)
(6) CHECK-SUM LOW: (C2)
(7) Carriage return: (CR)
(8) Line feed: (LF)

e.g.: For example if the integral time change was not completed properly or if the integral time is too low the response from the SDU would look like this: :**018602** C1,C2,CR, LF

6. SDU Parameter Addresses and Functions

The following tables contain all of the SDU parameters. The table lists their address numbers and functions.

The tables are set up as follows:

1) Parameter address: The addresses are in hexadecimal code.
2) Symbol: The parameter symbol as shown on the SDU display.
3) Parameter adjustment range: The minimum and maximum allowable limits for the given parameter.
4) Parameter function: Description of the variable.
5) All parameters are in integer form only. All numbers after the decimal point will be removed.
6) Parameters are classified into groups by functions.

NOTE: Refer to the SDU manual for details on parameter functions and adjustment ranges.

6-1. Tuning Parameter Group

This is the group of parameters used during operation of the controller.
In this group it is possible to adjust the Tuning parameters. (Desired Value selection, Output intervals, PID, Dead zone, Alarm set up, Auto-tuning start)

Parameter Address (HEX)	Symbol	Parameter Adjustment Range	Parameter Function	Parameter Type
0000	**----**	Set value	Shows current set value. It is Read only.	R
0001	**P**	Proportional Band(0.0~999.8%)	Set up the proportional band. The unit is %	R/W
0002	**I**	Integral Time (5~9998 sec.)	Set up the integral time. The unit is seconds. Note) When 0 is selected, operates in proportional mode.	R/W
0003	**d**	Derivative Time	Set up derivative time. The unit is seconds. Note) When 0 is selected, the derivative function is disabled.	R/W
0004	**HyS**	Dead Zone	Set up the dead zone when ON/OFF control mode is selected	R/W
0005	**AL-1**	Alarm 1	Set up Alarm 1 Note) if Alarm 1 is set up as LBA, pattern completed, or Contact cooled-output, alarm related to the measured value will not be performed	R/W
0006	**AL-2**	Alarm 2	Set up Alarm 2	R/W
0007	**CP**	Control Period (1~60 sec.)	Set up Relay and SSR output control interval. The unit is seconds.	R/W

0008	**tIm**	Timer	Set to operating time 99h 59m max.	R/W
0009	**At**	Auto Tuning Check Timer Control	Auto-Tuning start or stop 0: AT stop 1: AT start 2. Timer ON 3: Timer End	R/W
000A	**PASS**	Password	Set password no. 5 is for move to extension group. 15 is for move to optional group.	N
Extension and Optional Parameter Group				
000B	**InPt**	Input	Set input sensor type. See table 1.	R/W
000C	**UnIt**	Unit	Set display unit on temperature.	R/W
000D	**dP**	Decimal Point	Set decimal point when V/mA dc input mode. 0/0.0/0.00/0.000	R/W
000E	**SC-H**	Scale High	Set high scale limit when V/mA dc input mode.	R/W
0010	**SC-L**	Scale Low	Set low scale limit when V/mA dc input mode.	R/W
0011	**ALS1**	Al 1 Mode	Set alarm mode. See table 2.	R/W
0012	**HyS1**	Al 1 Hysteresis	Set alarm on-off band. 1~100	R/W
0013	**ALS2**	Al 2 Mode	Set alarm mode. See table 2.	R/W
0014	**HyS2**	Al 2 Hysteresis	Set alarm on-off band. 1~100	R/W
0015	**CACt**	Control Mode	Set control mode. 0: Reverse 1: Direct	R/W
0016	**mV-H**	Output High Limit	Set control output high limit. Unit is %. -If set under 99.9%, auto-tuning will be disable.	R/W
0017	**mV-L**	Output Low Limit	Set control output low limit. Unit is %. -If set over 0.1%, auto-tuning will be disable.	R/W
0018	**d-tm**	Delay Time	Set output delay time when use 4~20mA output. 0~30 min.	R/W
0019	**b.OUt**	Burn Output	Output ratio when burn-out. 0~100%	R/W
001A	**FILt**	Input Filter	Set PV filtering time. 0~60 sec.	R/W
001B	**InS**	Compensation	PV compensation.	R/W
001C	**----**	PV	PV	R
001D	**----**	Control Output	MV	R
001E	**----**	SV1	SV 1	R/W
0020	**SP-2**	SV2	SV 2	R/W
0021	**t-H**	Retransmission high limit	Set retransmission output high limit.	R/W
0022	**t-L**	Retransmission low limit	Set retransmission output low limit.	R/W

NOTE: the range of Alarm set up is limited by the input type.

Table 1. Input Sensor Type Parameter InPt Values (Address 000B)

Value	Symbol	Input Sensor Type	Measuring Range	
			Celsius	Fahrenheit
0000	**K-tC**	K-TYPE	-70 ~ 1370°C	-94 ~ 2498°F
0001	**J-tC**	J-TYPE	-70 ~ 950°C	-94 ~ 1742°F
0002	**E-tC**	E-TYPE	-70 ~ 750°C	-94 ~ 1382°F
0003	**n-tC**	N-TYPE	-100 ~ 1300°C	-148 ~ 2372°F
0004	**C-tC**	C-TYPE	0 ~ 2300°C	32 ~ 4172°F
0005	**t-tC**	T-TYPE	-130 ~ 400°C	-202 ~ 752°F
0006	**K1tC**	K-TYPE	-100.0~400.0°C	-148~752°F
0007	**r-tC**	R-TYPE	0 ~ 1760°C	32 ~ 3200°F
0008	**S-tC**	S-TYPE	0 ~ 1760°C	32 ~ 3200°F
0009	**b-tC**	B-TYPE	0 ~ 1800°C	32 ~ 3272°F
000A	**JPt**	JIS Pt100 RTD	-200 ~ 600°C	-328 ~ 1112°F
000B	**dPt**	DIN Pt100 RTD	-200 ~ 600°C	-328 ~ 1112°F
000C	**JPt1**	JIS Pt100 RTD	-200.0 ~ 600.0°C	-328 ~ 1112°F
000D	**dPt1**	DIN Pt100 RTD	-200.0 ~ 600.0°C	-328 ~ 1112°F
000E	**1-5**	1-5V dc		
0010	**0-5**	0-5V dc		

Table 2. Alarm

Value	Symbol	Action
0001	**----**	Off
0001	**-HI-**	High
0002	**-SH-**	Standby high
0003	**-LO-**	Low
0004	**-SL-**	Standby low
0005	**-Hd-**	Deviation high
0006	**-Ld-**	Deviation low
0007	**-dE-**	Deviation
0008	**-tm-**	End timer