- Temperature controllers

STATOP

Serie 15 and 30

MODEL ------

24-15
48-15
48-30
4896-30
96-30

ENGLISH

Application note MODBUS

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Modbus Communications

This chapter specifies the Modbus Communications protocol as RS-485 interface module is installed. Only RTU mode is supported. Data is transmitted as eight-bit binary bytes with 1 start bit,
1 stop bit and optional parity checking (None, Even or Odd). Baud rate may be set to 2400, 4800, 9600, 14400, 19200, 28800 and 38400.
This application note is only applicable in addition to Statop Serie 15 or Serie 30 user's manual

Functions Supported

Only function 03, 06 and 16 are available for this series of controllers.
The message formats for each function are described as follows:

Function code (3)

Query (from master)	Response (from slave)
Slave address (0-255)	←
Starting address of register Hi (0)	←
Starting address of register Lo (0-79,128-131)	Byte count
No. of words Hi (0)	Data 1 Hi
No. of words Lo (1-79)	Data 1 Lo
CRC16 Hi	Data 2 Hi
CRC16 Lo	Data 2 Lo
	•
	•
	•
	CRC16 Hi
	CRC16 Lo

Function 06: Preset single Register

Query (from master)	Response (from slave)
Slave address (0-255)	←
Function code (6)	←
Register address Hi (0)	←
Register address Lo (0-79, 128-131)	←
Data Hi	←
Data Lo	←
CRC16 Hi	←
CRC16 Lo	←

Function 16: Preset Multiple Registers

Query (from master)	Response (from slave)
Slave address (0-255)	←
Function code (16)	←
Starting address of register Hi (0)	←
Starting address of register Lo (0-79,128-131)	←
No. of words Hi (0)	←
No. of words Lo (1-79)	←
Byte count (2-158)	←
Data 1 Hi	←
Data 1 Lo	←
Data 2 Hi	←
Data 2 Lo	←
●	CRC16 Hi
●	CRC16 Lo
●	
CRC16 Hi	
CRC16 Lo	

Exception Responses

If the controller receives a message which contains a corrupted character (parity check error, framing error etc.), or if the CRC16 check fails, the controller ignores the message.
However, if the controller receives a syntactically correct message which contains an illegal value, it will send an exception response, consisting of five bytes as follows:

slave address +offset function code + exception code + CRC16 Hi + CRC16 Lo

Where the offset function code is obtained by adding the function code with 128 (ie. function 3 becomes H'83), and the exception code is equal to the value contained in the following table:

Exception code	Name	Cause
1	Bad function code	Function code is not supported by the controller
2	Illegal data address	Register address out of range
3	Illegal data value	Data value out of rang or attempt to write a read-only protected data

List of parameters

Register Address	Parameter name	Parameter	Low scale	High scale	Notes
0	SP1	Set point 1	*4	*4	L/E
1	SP2	Set point 2	*7	*7	L/E
2	SP3	Set point 3	*6	*6	L/E
3	LOCK	Lock code	0	65535	L/E
4	INPT	Input sensor selection	0	65535	L/E
5	UNIT	Measuring unit	0	65535	L/E
6	DP	Decimal point position	0	65535	L/E
7	INLO	Low scale value for linear input	*4	*4	L/E
8	INHI	High scale value for linear input	*4	*4	L/E
9	SP1L	Low limit of SP1	*4	*4	L/E
10	SP1H	High limit of SP1	*4	*4	L/E
11	SHIF	PV shift value	*4	*4	L/E
12	FILT	Filter time constant	0	65535	L/E
13	DISP	Display form (for C21)	0	65535	L/E
14	PB	P (proportional) band	*5	*5	L/E
15	TI	Integral time	0	65535	L/E
16	TD	Derivative time	0.0	6553.5	L/E
17	OUT1	Output 1 function	0	65535	L/E
18	O1TY	Output 1 signal type	0	65535	L/E
19	O1FT	Output 1 failure transfer	-1999.9	4553.6	L/E
20	O1HY	Output 1 ON-OFF hysteresis	*5	*5	L/E
21	CYC1	Output 1 cycle time	0.0	6553.5	L/E
22	OFST	Offset value for P control	0.0	6553.5	L/E
23	RAMP	Ramp function	0	65535	L/E
24	RR	Ramp rate	*5	*5	L/E
25	OUT2	Output 2 function	0	65535	L/E
26	RELO	Retransmission low scale value	*4	*4	L/E
27	O2TY	Output 2 signal type	0	65535	L/E
28	O2FT	Output 2 failure transfer	-1999.9	4553.6	L/E
29	O2HY	Output 2 ON-OFF hysteresis	*5	*5	L/E
30	CYC2	Output 2 cycle time	0.0	6553.5	L/E
31	CPB	Cooling P band	0	65535	L/E
32	DB	Heating-cooling dead band	-1999,9	4553,6	L/E
33	ALFN	Alarm function	0	65535	L/E
34	REHI	Retransmission high scale value	*4	*4	L/E
35	ALMD	Alarm operation mode	0	65535	L/E
36	ALHY	Alarm hysteresis	*5	*5	L/E
37	ALFT	Alarm failure transfer	0	65535	L/E
38	COMM	Communication function	0	65535	L/E
39	ADDR	Address	0	65535	L/E
40	BAUD	Baud rate	0	65535	L/E
41	DATA	Data bit count	0	65535	L/E
42	PARI	Parity bit	0	65535	L/E
43	STOP	Stop bit count	0	65535	L/E
44	SEL1	Selection 1	0	65535	L/E
45	SEL2	Selection 2	0	65535	L/E
46	SEL3	Selection 3	0	65535	L/E
47	SEL4	Selection 4	0	65535	L/E
48	SEL5	Selection 5	0	65535	L/E
49	SEL6	Selection 6	0	65535	L/E
50	SEL7	Selection 7	0	65535	L/E
51	SEL8	Selection 8	0	65535	L/E
52	ADLO	mV calibration low coefficient	-1999.9	4553.6	L/E
53	ADHI	mV calibration high coefficient	-1999.9	4553.6	L/E

Register Address	Parameter name	Parameter	Low scale	High scale	Notes
54	RTDL	RTD calibration low coefficient	-1999.9	4553.6	L/E
55	RTDH	RTD calibration high coefficient	-1999.9	4553.6	L/E
56	CJLO	Cold junction calibration low coefficient	-199.99	455.36	L/E
57	CJHI	Cold junction calibration high coefficient	-1999.9	4553.6	L/E
58	DATE	Date Code	0	65535	L/E
59	SRNO	Serial Number	0	65535	L/E
60	HOUR	Working hours of the controller	0	65535	L/E
61	BPL1	Bumpless transfer of OP1	0.00	655.35	L
62	BPL2	Bumpless transfer of OP2	0.00	655.35	L
63	CJCL	Cold junction signal low	0.000	65.535	L
64	PV	Process value	*4	*4	L
65	SV	Current set point value	*4	*4	L
66 130	MV1	OP1 control output value	0.00	655.35	Lecture seule, sauf en commande manuelle
67 131	MV2	OP2 control output value	0.00	655.35	Lecture seule, sauf en commande manuelle
68	TIMER	Remaining time of dwell timer	-1999.9	4553.6	L
69	EROR	Error code *1	0	65535	L
70	MODE	Operation mode & alarm status *2	0	65535	L
71	PROG	Program code *3	0.00	655.35	L
72	CMND	Command code	0	65535	L/E
73	JOB1	Job code	0	65535	L/E
74	JOB2	Job code	0	65535	L/E
75	JOB3	Job code	0	65535	L/E
76	CJCT	Cold Junction Temperature	-199.99	455.36	L
77		Reserved	0	65535	L
78		Reserved	0	65535	L
79		Reserved	0	65535	L

*1: The error code is show in the first column of Table A.1.

*2: Definition for the value of MODE register
H'000X = Normal mode
H'010X = Calibration mode
H'020X = Auto-tuning mode
H'030X = Manual control mode
H'040X = Failure mode
H'0X00 = Alarm status is off
H'0x01 = Alarm status is on
The alarm status is shown in MV2 instead of MODE for Statop Serie 15

*3: The PROG Code is defined in the following table:

Model No.	ST48-30	ST4896-30	ST96-30	Réserve	ST24-15	ST48-15
PROG Code	6.XX	11.XX	12-XX	13-XX	33-XX	34-XX

Where XX denotes the software version number.
For example: PROG=34.18 means that the controller is a STATOP48-15 with software version 18.

*4: The scale high/low values are defined in the following table for SP1, INLO, INHI, SP1L, SP1H, SHIF, PV, SV, RELO and REHI:

Conditions	Non-linear Input	Linear input DP=0	Linear input DP=1	Linear input DP=2	Linear input DP=3
Scale low	-1999.9	-19999	-1999.9	-199.99	-19.999
Scale high	4553.6	45536	4553.6	455.36	45.536

*5: The scale high/low values are defined in the following table for PB, O1HY, RR, O2HY and ALHY

Conditions	Non-linear Input	Linear input DP=0	Linear input DP=1	Linear input DP=2	Linear input DP=3
Scale low	0.0	0	0.0	0.00	0.000
Scale high	6553.5	65535	6553.5	655.35	65.535

*6: The scale high/low values are defined in the following table for SP3:

Conditions	ALFN=1 (TIMR)	Non-linear Input	Linear input DP=0	Linear input DP=1	Linear input DP=2	Linear input DP=3
Scale low	-1999.9	-1999.9	-19999	-1999.9	-199.99	-19.999
Scale high	4553.6	4553.6	45536	4553.6	455.36	45.536

*7: The scale high/low values are defined in the following table for SP2 :
For Statop serie ST24-15

Conditions	OUT2=1 (TIMR)	Non-linear Input	Linear input DP=0	Linear input DP=1	Linear input DP=2	Linear input DP=3
Scale low	-1999.9	-1999.9	-19999	-1999.9	-199.99	-19.999
Scale high	4553.6	4553.6	45536	4553.6	455.36	45.536

For Statop Serie 30:

Conditions	Non-linear Input	Linear input DP=0	Linear input DP=1	Linear input DP=2	Linear input DP=3
Scale low	-1999.9	-19999	-1999.9	-199.99	-19.999
Scale high	4553.6	45536	4553.6	455.36	45.536

Data Conversion

The word data are regarded as unsigned (positive) data in the Modbus message. However, the actual value of the parameter may be negative value with decimal point. The high/low scale values for each parameter are used for the purpose of such conversion.

M = Value of Modbus message
A = Actual value of the parameter
SL = Scale low value of the parameter
SH = Scale high value of the parameter

The conversion formulas are as follow:

$$M = \frac{65535}{SH-SL} * (A - SL)$$

$$A = \frac{SH - SL}{65535} * (M + SL)$$

Communication Examples :

Example 1: Download the default values via the programming port

The programming port can perform Modbus communications regardless of the incorrect setup values of address, baud, parity, stop bit etc. It is especially useful during the first time configuration for the controller. The host must be set with 9600 baud rate, 8 data bits, even parity and 1 stop bit.
The Modbus message frame with hexadecimal values is shown as follow:

01	10	00	00	00	34	68	4F	19	4E	83	4E	83
Addr.	Function	Start Addr		No of words		Bytes	SP1=25.0		SP2=10.0		SP3=10.0	

00	00	00	01	00	00	00	01	4D	6D	51	C4
LOCK=0		INPT=1		UNIT=0		DP1=1		INLO=-17.8		INHI=93.3	

4D	6D	63	21	4E	1F	00	02	00	00	00	64
SP1L=-17.8		SP1H=537.8		SHIF=0.0		FILT=2		DISP=0		PB=10.0	

00	64	00	FA	00	00	00	00	4E	1F	00	01
TI=100		TD=25.0		OUT1=0		O1TY=0		O1FT=0		O1HY=0.1	

00	B4	00	FA	00	00	00	00	00	02	4E	1F
CYC1=18.0		OFST=25.0		RAMP=0		RR=0.0		OUT2=2		RELO=0.0	

00	00	4E	1F	00	01	00	B4	00	64	4E	1F
O2TY=0		O2FT=0		O2HY=0.1		CYC2=18.0		CPB=100		DB=0	

00	02	52	07	00	00	00	01	00	00	00	01
ALFN=2		REHI=100.0		ALMD=0		ALHY=0.1		ALFT=0		COMM=1	

00	01	00	02	00	01	00	00	00	00	00	02
ADDR=1		BAUD=2		DATA=1		PARI=0		STOP=0		SEL1=2	

00	03	00	04	00	06	00	07	00	08	00	OA
SEL2=3		SEL3=4		SEL4=6		SEL5=7		SEL6=8		SEL7=10	

00	11	HI	LO
SEL8=17		CRC16	

Example 2: Read PV, SV, MV1 and MV2.
Send the following message to the controller via the COMM port or programming port:

	03	00	H'40 H'80	00	04	Hi	Lo
Addr.	Fonction	Start Addr		No of words		CRC16	

Example 3: Perform Reset Function (same effect as pressing R key)

	06	00	H'48	H'68	H'25	Hi	Lo
Addr.	Fonction	Register Addr		Data Hi/Lo		CRC16	

Example 4: Enter Auto-tuning Mode

	06	00	H'48	H'68	H'28	Hi	Lo
Addr.	Fonction	Register Addr		Data Hi/Lo		CRC16	

Example 5: Enter Manual Control Mode

	06	00	H'48	H'68	H'27	Hi	Lo
Addr.	Fonction	Register Addr		Data Hi/Lo		CRC16	

Example 6: Read All Parameters

	03	00	00	00	H'50	Hi	Lo
Addr.	Fonction	Start Addr		No of words		CRC16	

Example 7: Modify the Calibration Coefficient
Preset the CMND register with 26669 before attempting to change the calibration coefficient.

	06	00	H'48	H'68	H'2D	Hi	Lo
Addr.	Fonction	Register Addr		Data Hi/Lo		CRC16	

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