High Performance Single-phase Thyristor Unit

20 A/30 A/45 A
60 A/80 A/100 A

THV-A1 Communication Quick Manual

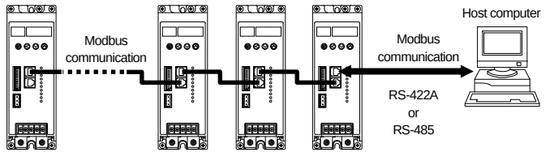
IMR02D03-E3

This manual describes the connection method with host computer, communication parameters and communication data of the THV-A1. For detailed host communication such as protocol, refer to the THV-A1 Communication Instruction Manual [Detailed version] (IMR02D05-E☐).

The THV-A1 Communication Instruction Manual [Detailed version] (IMR02D05-E☐) can be download from the official RKC website:
http://www.rkcinst.com/english/manual_load.htm.

1. OUTLINE

High Performance Single-phase Thyristor Unit THV-A1 (hereafter, called THV-A1) interfaces with the host computer via Modbus. RS-422A and RS-485 is used for the communication interface.



Maximum connections of THV-A1: 31 instruments (RS-422A, RS-485)

Data send/receive state for Modbus can be monitored by using PROTEM2 (communication tool).
The PROTEM2 can be downloaded from the RKC official website:
http://www.rkcinst.com/.

2. WIRING

WARNING

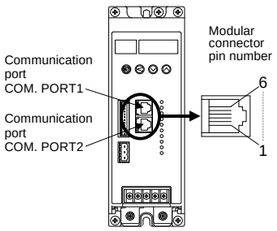
To prevent electric shock or instrument failure, turn off the power before connecting or disconnecting the instrument and peripheral equipment.

2.1 RS-422A

The communication cable must be provided by the customer. If communication errors occur frequently, connect termination resistors to the THV-A1.

■ Pin number and signal name

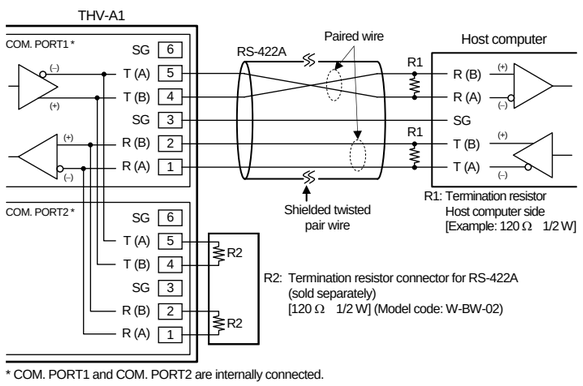
The signals are the same in the communication ports COM.PORT1 and COM.PORT2.



■ RS-422A

Pin No.	Signal name	Symbol
1	Receive data	R (A)
2	Receive data	R (B)
3	Signal ground	SG
4	Send data	T (B)
5	Send data	T (A)
6	Signal ground	SG

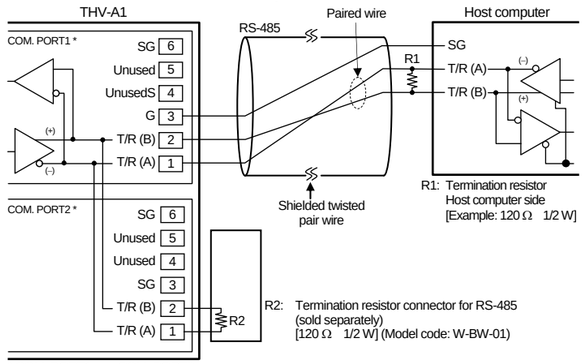
■ When the interface of host computer is RS-422A



* COM. PORT1 and COM. PORT2 are internally connected.

The six-pin type modular connector should be used for the connection to the THV-A1.
Recommended manufacture and model: Hirose Electric, TM4P-66P

■ When the interface of host computer is RS-485

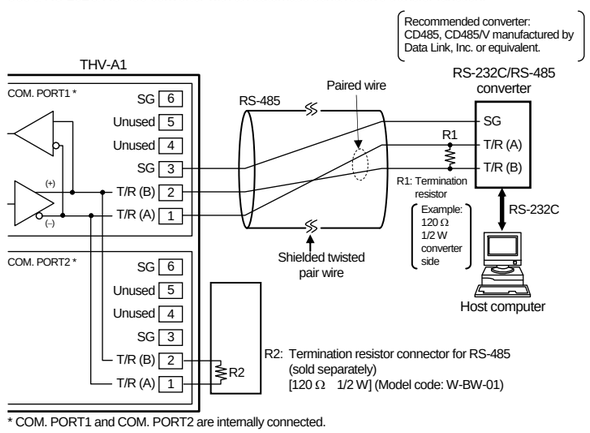


* COM. PORT1 and COM. PORT2 are internally connected.

The six-pin type modular connector should be used for the connection to the THV-A1.
Recommended manufacture and model: Hirose Electric, TM4P-66P

■ When the interface of host computer is RS-232C

Use a RS-232C/RS-485 converter with an automatic send/receive transfer function.

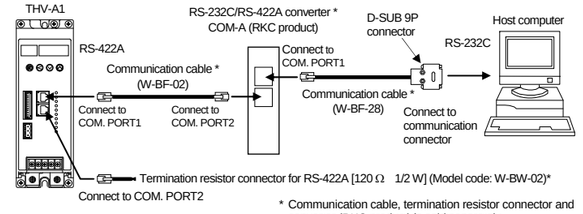


* COM. PORT1 and COM. PORT2 are internally connected.

The six-pin type modular connector should be used for the connection to the THV-A1.
Recommended manufacture and model: Hirose Electric, TM4P-66P

■ When the interface of host computer is RS-232C

When the interface of host computer is RS-232C, connect the RS-232C/RS-422A converter between the host computer and the THV-A1.



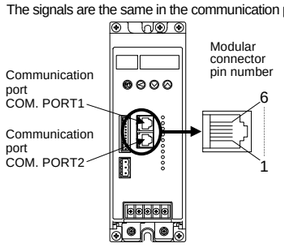
* Communication cable, termination resistor connector and converter (RKC product) is sold separately.

2.2 RS-485

The communication cable must be provided by the customer. If communication errors occur frequently, connect termination resistors to the THV-A1.

■ Pin number and signal name

The signals are the same in the communication ports COM.PORT1 and COM.PORT2.



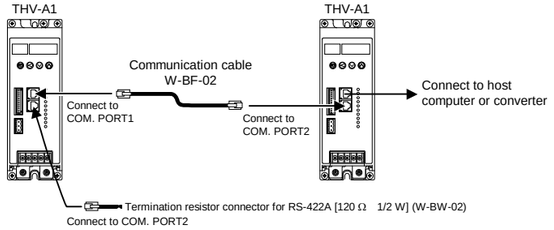
■ RS-485

Pin No.	Signal name	Symbol
1	Send/receive data	T/R (A)
2	Send/receive data	T/R (B)
3	Signal ground	SG
4	Unused	—
5	Unused	—
6	Signal ground	SG

2.3 Multiple THV-A1 Connections

Connections can be added using our communication cable (sold separately: W-BF-02).
W-BF-02 cable can be used for both RS-422A and RS-485.

Connection example (RS-422A)



3. SETTING

To establish communication parameters between host computer and THV-A1, it is necessary to set the device address (THV-A1 device address) and interval time on each THV-A1 in the setting mode 1.
The communication speed and data bit configuration of the THV-A1 are fixed at the values indicated below. Set the communication speed and data bit configuration of the host computer to the same values as the THV-A1.

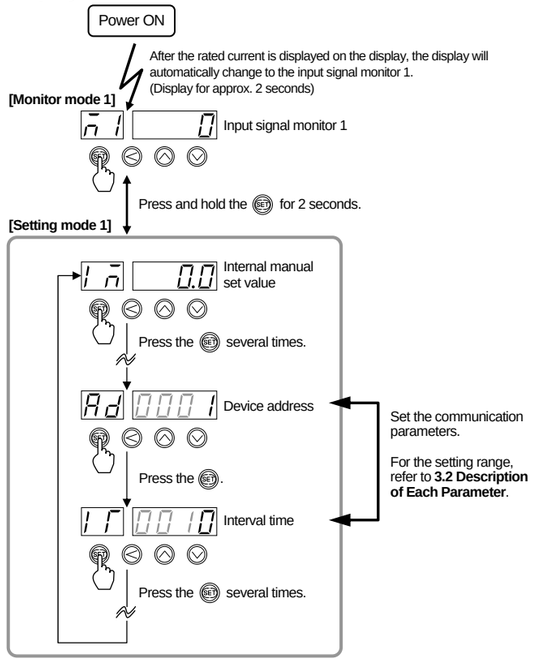
Communication speed: 9600 bps
Data bit configuration: Data 8-bit, Without parity, Stop 1-bit

Setting mode 1 automatically returns to the monitor mode 1 if no key operation is performed for more than 1 minute.

After completing the device address (Ad) and interval time (IT) settings, turn on the power again, and register the set value which changed.

This section describes the parameters which must be set for host communication.
For the screen operation and key operation, refer to the **THV-A1 Quick Operation Manual (IMR02D02-E☐)**.

3.1 Display Flowchart



3.2 Description of Each Parameter

Symbol	Name	Data range	Description	Factory set value
Ad (Ad)	Device address	0 to 99	Do not use the same device address for more than one THV-A1 in multi-drop connection. Communication is not possible when the address is 0.	1
IT (IT)	Interval time *	0 to 250 ms	The interval time for the THV-A1 should be set to provide a time for host computer to finish sending all data including stop bit and to switch the line to receive status for the host.	10

* The interval time for the THV-A1 should be set to provide a time for host computer to finish sending all data including stop bit and to switch the line to receive status for host. If the interval time between the two is too short, the THV-A1 may send data before the host computer is ready to receive it. In this case, communication transmission cannot be conducted correctly.

3.3 Communication Requirements

■ Processing times during data send/receive

THV-A1 requires the following processing times during data send/receive. Have the host computer switch from reception to transmission after the times below elapse.

Response send time is time when interval time is set at 0 ms.

Procedure details	Time
Read holding registers [03H] Response send time after the slave receives the query message (When 80 registers are collectively read)	10 ms max.
Preset single register [06H] Response send time after the slave receives the query message	5 ms max.
Diagnostics (loopback test) [08H] Response send time after the slave receives the query message	5 ms max.
Preset multiple registers [10H] Response send time after the slave receives the query message (When 68 registers are collectively write)	10 ms max.

■ RS-422A/RS-485 Fail-safe

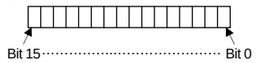
A transmission error may occur with the transmission line disconnected, shorted or set to the high-impedance state.
In order to prevent the above error, it is recommended that the fail-safe function be provided on the receiver side of the host computer.
The fail-safe function can prevent a framing error from its occurrence by making the receiver output stable to the MARK (1) when the transmission line is in the high-impedance state.

■ Data backup

The nonvolatile memory (EEPROM) for data backup has limitations on the number of memory rewrite times (Approx. One million times).

4. HOST COMMUNICATION DATA MAP

- Modbus register address
  HEX: Hexadecimal DEC: Decimal
- Attribute
  RO: Read only data (Host computer ← THV-A1)
  R/W: Read and Write data (Host computer ↔ THV-A1)
- Data
  16-bit data



No. 27 to 64 are engineering mode data. Engineering mode data are locked prior to shipping. Release the engineering mode lock using the set data lock (address: 0013H).

■ Communication data

No.	Name	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
1	Input signal monitor 1	0000	0	RO	0 to 100 %	—
2	Phase angle ratio monitor	0001	1	RO	0 to 100 %	—
3	CT input monitor [1]	0002	2	RO	0.0 to 27.0 A (20 A type) 0.0 to 40.5 A (30 A type) 0.0 to 60.8 A (45 A type) 0.0 to 81.0 A (60 A type) 0.0 to 108.0 A (80 A type) 0.0 to 135.0 A (100 A type)	—
4	Voltage value monitor	0003	3	RO	0 to 280 V (90 to 264 V AC [Power supply voltage range] Rating 100 to 240 V AC)	—
5	Power value monitor [2]	0004	4	RO	0.00 to 7.56 kW (20 A type) 0.00 to 11.34 kW (30 A type) 0.00 to 17.01 kW (45 A type) 0.00 to 22.68 kW (60 A type) 0.00 to 30.24 kW (80 A type) 0.00 to 37.80 kW (100 A type)	—
6	Power frequency monitor	0005	5	RO	40 to 70 Hz	—
7	Power supply voltage monitor	0006	6	RO	0 to 280 V (90 to 264 V AC [Power supply voltage range] Rating 100 to 240 V AC)	—
8	Input signal monitor 2	0007	7	RO	0 to 100 %	—
9	External gradient set value monitor	0008	8	RO	0 to 100 %	—
10	External manual set value monitor	0009	9	RO	0 to 100 %	—
11	Contact input state monitor	000A	10	RO	Bit data Bit 0: Contact input 1 (DI1) Bit 1: Contact input 2 (DI2) Bit 2: Contact input 3 (DI3) Bit 3 to Bit 15: Unused Data 0: Contact open 1: Contact closed [Decimal number: 0 to 7]	—
12	Memory area monitor [1]	000B	11	RO	1 to 4	—

[1] This data becomes valid on the instrument with a constant current control or constant power control.
[2] This data becomes valid on the instrument with a constant power control.

No.	Name	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
13	Internal manual set value	000C	12	R/W	0.0 to 100.0 %	0.0
14	Internal gradient set value [1]	000D	13	R/W	0.00 to 2.00 (0.00: Internal gradient 0 % 2.00: Internal gradient 200 %)	1.00
15	Soft-start time [2]	000E	14	R/W	0.0 to 100.0 seconds (0.0: Soft-start function unused)	0.1
16	Soft-down time [2]	000F	15	R/W	0.0 to 100.0 seconds (0.0: Soft-down function unused)	0.1
17	Unused	0010	16	—	—	—
18	Interval time	0011	17	R/W	0 to 250 ms	10
19	Memory area setting [3, 4]	0012	18	R/W	1 to 4	1
20	Set data lock	0013	19	R/W	0000 to 9999 The ones place: Setting mode 1, Setting mode 2 The tens place: Engineering mode The hundreds place: Unused The thousands place: Unused Data 0: Lock 1: Unlock Do not set any values other than 0 and 1.	0001
21	Memory area selection [3]	0014	20	R/W	1 to 4	1
22	Maximum load current set value for alarm [3] ★	0015	21	R/W	0.0 to 22.0 A (20 A type) 0.0 to 33.0 A (30 A type) 0.0 to 50.0 A (45 A type) 0.0 to 66.0 A (60 A type) 0.0 to 88.0 A (80 A type) 0.0 to 110.0 A (100 A type)	20.0 30.0 45.0 60.0 80.0 100.0
23	Heater break alarm 1 set value setting [3, 5] ★	0016	22	R/W	0 to 100 % of maximum load current set value (0: Heater break alarm 1 unused)	20
24	Thyristor break-down set value setting [3, 6] ★	0017	23	R/W	0 to 100 % of maximum load current set value (0: Thyristor break-down alarm unused)	20
25	Heater break alarm 2 set value setting [3, 7] ★	0018	24	R/W	0 to 100 % of maximum load current set value (0: Heater break alarm 2 unused)	15
26	Current limit value setting [2, 3, 8] ★	0019	25	R/W	0.0 to 22.0 A (20 A type) 0.0 to 33.0 A (30 A type) 0.0 to 50.0 A (45 A type) 0.0 to 66.0 A (60 A type) 0.0 to 88.0 A (80 A type) 0.0 to 110.0 A (100 A type)	22.0 33.0 50.0 66.0 88.0 110.0

★ Parameters which can be registered in the memory area

[1] This data becomes valid when the control method is the phase control or zero-cross control (continuous).

[2] This data becomes valid when the control method is the phase control.

[3] This data becomes valid on the instrument with a constant current control or constant power control.

[4] When the memory area setting is changed, the memory area selection changes to the same memory area number. When a contact input (DI) is used, the contact input (DI) setting has priority.

[5] Although the following values are recommended, the alarm set value varies depending on the load type and the number of connection. Set the value suited to your system.

When the control method is Phase Control, RKC recommends:

- Set the heater break alarm set value to approximately 20 % of the maximum load current value for heater break alarm Type 1 (constant resistance type, deviation alarm).
- Set the heater break alarm set value to approximately 10 % of the maximum load current value for heater break alarm Type 2 (linearity resistor type, absolute value alarm).
- In the case of a non-linear resistance heater break alarm, there is no recommended value because the load characteristics vary depending on the non-linear load type.

When the control method is Zero-cross Control, RKC recommends:

- Set the heater break alarm set value to approximately 80 % of the reading of current transformer input.
- Set the heater break alarm set value to a slightly smaller value to prevent a false alarm when power supply variation is large.
- Set the heater break alarm set value to a slightly larger value to detect a failure of one heater when more than one heaters are connected in parallel. But the set value should be less than the maximum reading of current transformer input.

[6] Although the following values are recommended, the alarm set value varies depending on the load type and the number of connection. Set the value suited to your system.

When the control method is Phase Control, RKC recommends:

- Set the thyristor break-down set value to approximately 20 % of the maximum load current value for heater break alarm Type 1 (constant resistance type, deviation alarm).
- Set the thyristor break-down set value to approximately 10 % of the maximum load current value for heater break alarm Type 2 (linearity resistor type, absolute value alarm). Do not set the thyristor break-down set value to more than 15 %.
- In the case of a non-linear resistance heater break alarm, there is no recommended value because the load characteristics vary depending on the non-linear load type.

When the control method is Zero-cross Control, RKC recommends:

Set the thyristor break-down set value to approximately 80 % of the maximum load current value.

[7] Although the following values are recommended, the alarm set value varies depending on the load type and the number of connection. Set the value suited to your system.

When the control method is Phase Control and heater break alarm Type 1 (constant resistance type, deviation alarm) is selected, RKC recommends:

- Set the value must be equal or less than the heater break alarm 1 set value.

When the control method is Phase Control and heater break alarm Type 2 (linearity resistor type, absolute value alarm) is selected:

- For the type 2, this item is not available. Set the "0: Heater break alarm 2 unused."

The heater break alarm 2 set value cannot be used as the non-linear resistance heater break alarm. The heater break alarm 2 set value is activated as the standard heater break alarm.

When the control method is Zero-cross Control, RKC recommends:

- If the alarm needs to be output before a heater break occurs, set the set value of heater break alarm 2 to any value slightly larger than that of heater break alarm 1.
- If the alarm needs to be output before thyristor break-down occurs, set the set value of heater break alarm 2 to any value slightly smaller than that of heater break alarm 1.

[8] If a current limit value is set to its maximum value, the current limit function is deactivated. When set to 0.0, the output of the THV-A1 turns off.

No.	Name	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
27	Contact input 1 (DI1) function assignment	001A	26	R/W	0: No function 1: Auto mode/Manual mode transfer [1, 2] 2: RUN/STOP transfer [2] 3: Alarm interlock release [2] 4: Heater break alarm enable/disable [2, 3] 5: Soft-start, soft-down enable/disable [2, 4] 6: Set data lock/unlock [2, 5] 7: Over current alarm enable/disable [2, 3] 8: Memory area transfer [3, 6, 7, 8] Take care that assignments of functions 1 to 7 are not duplicated.	0
28	Contact input 2 (DI2) function assignment	001B	27	R/W		0
29	Contact input 3 (DI3) function assignment	001C	28	R/W		0
30	Control method	001D	29	R/W	0: Phase control 1: Zero-cross control (continuous) [9] 2: Zero-cross control (input synchronous type) [9]	0
31	Input signal selection	001E	30	R/W	0: 0 to 20 mA DC, 0 to 5 V DC, 0 to 10 V DC [10], 0/12 V DC, 0/24 V DC 1: 4 to 20 mA DC, 1 to 5 V DC, 0/12 V DC, 0/24 V DC	Factory set value varies depending on the instrument specification.
32	Contact input action	001F	31	R/W	0: External manual mode ↔ Auto mode [11, 12] 1: Internal manual mode ↔ Auto mode [11, 12] 2: Internal manual mode (fixed) [11] 3: External manual mode (fixed) [11]	0
33	RUN/STOP transfer [7]	0020	32	R/W	0: STOP (THV-A1 output OFF) 1: RUN (THV-A1 output ON)	1
34	Alarm interlock [13]	0021	33	R/W	0: Unused 1: Use	0
35	Soft-start, soft-down enable/disable [4, 7]	0022	34	R/W	0: Soft-start, soft-down disable 1: Soft-start, soft-down enable	1
36	Heater break alarm enable/disable [3, 7]	0023	35	R/W	0: Heater break alarm disable 1: Heater break alarm enable	1
37	Over current alarm enable/disable [3, 7]	0024	36	R/W	0: Over current alarm disable 1: Over current alarm enable	1
38	Output mode for phase control [4]	0025	37	R/W	0: Proportional phase angle to input 1: Proportional voltage to input 2: Proportional square voltage (electric power) to input 3: Constant current control [3] 4: Constant voltage control 5: Constant power control [14] 6: Square voltage feedback	Factory set value varies depending on the instrument specification.

[1] Select the setting mode by Contact input action (address: 001FH).

[2] Contact input (DI) state
When a contact input (DI) is used, the contact input (DI) setting has priority (Excluding the set data lock/unlock).

Name	Items selected depending on DI state: Open	Items selected depending on DI state: Closed
Auto mode/Manual mode transfer	Auto mode	Manual mode
RUN/STOP transfer	STOP	RUN
Alarm interlock release		Alarm interlock release
Heater break alarm enable/disable	Enable	Disable
Soft-start, soft-down enable/disable	Enable	Disable
Set data lock/unlock	Lock	Unlock
Over current alarm enable/disable	Enable	Disable

[3] This data becomes valid on the instrument with a constant current control or constant power control.

[4] This data becomes valid when the control method is the phase control.

[5] The mode locked by the contact input (DI) accords with the set data lock (address: 0013H) setting.

[6] When the non-linear resistance heater break alarm is used, this data becomes invalid.

[7] When a contact input (DI) is used, the contact input (DI) setting has priority.

[8] Memory area transfer uses two contact input (DI) points.
Assign memory area transfer to contact input 1 (DI1). When assigned to contact input 1 (DI1), memory area transfer is also automatically assigned to contact input 2 (DI2).
Memory area transfer cannot be assigned to contact input 2 (DI2) and contact input 3 (DI3).

DI No.	Memory areas selected depending on DI state: Memory area 1	Memory area 2	Memory area 3	Memory area 4
DI1	Open	Closed	Open	Closed
DI2	Open	Open	Closed	Closed

[9] When the zero-cross control is selected, the data of output mode (address: 0025H) becomes invalid.

[10] If 0 to 10 V DC is specified at the time of ordering, this cannot be changed to an input signal other than voltage pulse input (0/12 V DC, 0/24 V DC).

[11] Settings that become effective based on the contact input (DI) setting:

Contact input action (dA) setting	Settings that become effective based on the DI setting: Closed	Settings that become effective based on the DI setting: Open
0: External manual mode ↔ Auto mode	External manual mode	Auto mode
1: Internal manual mode ↔ Auto mode	Internal manual mode	
2: Internal manual mode (fixed)	Internal manual mode	
3: External manual mode (fixed)	External manual mode	

[12] When the contact input action is set to "0: External manual mode ↔ Auto mode" or "1: Internal manual mode ↔ Auto mode," the contact input (DI) setting has priority.

[13] To use the alarm interlock release function in a contact input (DI), set to "1: Use."
When in the alarm interlock release (contact closed) state, the alarm interlock function will not operate.
The contact input (DI) setting has priority.

[14] This data becomes valid on the instrument with a constant power control.

No.	Name	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
39	Output limiter (high) [1]	0026	38	R/W	0.0 to 100.0 % [Output limiter (low) ≤ Output limiter (high)]	100.0
40	Output limiter (low) [1]	0027	39	R/W	0.0 to 100.0 % [Output limiter (low) ≤ Output limiter (high)]	0
41	Output limiter (high) at operation start [2]	0028	40	R/W	0.0 to 100.0 % [Output limiter (high) at operation start ≤ Output limiter (high)]	50.0
42	Output limiter (high) time at operation start [2]	0029	41	R/W	0.0 to 600.0 seconds (0.0: Output limiter function at operation start disable)	0.0
43	Base-up set value [1]	002A	42	R/W	–10.0 to +100.0 % [3] [Base-up set value ≤ Output limiter (high)]	0.0
44	Alarm 1 output logic [4]	002B	43	R/W	0: No output 1: Power frequency error (energized) 2: Board error (energized) 4: Power supply voltage error (energized) 8: Heater break alarm 1 (energized) [5] 16: Heater break alarm 2 (energized) [5] 32: Thyristor break-down alarm (energized) [5] 64: Over current (energized) [5] 128: Fuse break (energized) 256: Heat sink temperature abnormality (energized) [6] 512: FAIL (de-energized) • To set the alarm output to "de-energized," set the thousands digit to "1." (However, excluding FAIL) For example, to set the alarm output of "2: Board error (energized)" as "de-energized," set "1002." • To output the alarm output by logical *OR*, set the sum of the set values. For example, to generate the alarm output of "board error (energized)" and "over current error (energized)" by logical *OR*, set to "66." To set it as "de-energized," set to "1066." • Mixed output of energized and de-energized is not possible. In addition, logical add output of FAIL (de-energized) is not possible, and thus this must be set independently.	0
45	Alarm 2 output logic [4]	002C	44	R/W		0
46	Number of heater break alarm 1 delay times [5]	002D	45	R/W	1 to 100 times	30
47	Heater break alarm 1 type [2, 5]	002E	46	R/W	0: Type 1 (constant resistance type, deviation alarm) 1: Type 2 (linearity resistor type, absolute value alarm)	0
48	Number of heater break alarm 2 delay times [5]	002F	47	R/W	1 to 1000 times	300
49	Heater break alarm 2 type [2, 5]	0030	48	R/W	0: Type 1 (constant resistance type, deviation alarm) 1: Type 2 (linearity resistor type, absolute value alarm)	0
50	ROM version	0031	49	RO	Display the version of loading software.	—
51	Integrated operation time [upper 2 digits]	0032	50	RO	0 to 99 (Resolution of display: 10, 000 hours) [7]	—
52	Integrated operation time [lower 4 digits]	0033	51	RO	0 to 9999 (Resolution of display: 1 hours) [8]	—
53	Output time setting for automatic calculation of inflection point [9]	0034	52	R/W	0.0 to 100.0 seconds (0.0: Inflection point calculation function unused)	20.0
54	Action selection of heater break alarm [9]	0035	53	R/W	0: Standard heater break alarm 1: Non-linear resistance heater break alarm 2: Start inflection point calculation [10]	0
55	Manipulated output value setting of inflection point 1 [9]	0036	54	R/W	0.0 to 100.0 %	0.0
56	Current value setting of inflection point 1 [9]	0037	55	R/W	0.0 to 22.0 A (20 A type) 0.0 to 33.0 A (30 A type) 0.0 to 50.0 A (45 A type) 0.0 to 66.0 A (60 A type) 0.0 to 88.0 A (80 A type) 0.0 to 110.0 A (100 A type)	0.0

[1] This data becomes valid when the control method is the phase control or zero-cross control (continuous).

[2] This data becomes valid when the control method is the phase control.

[3] The base-up set value is effective only when the output limiter (low) is set to 0.0.

[4] Alarm output is outputted on the instrument with an alarm output 2 points.

[5] This data becomes valid on the instrument with a constant current control or constant power control.

[6] The data becomes valid on the instrument with a heat sink temperature detection function.

[7] Up to 999,999 from 0 including the upper and lower digits can be displayed.

[8] If the total integrated operating time exceeds 9,999 hours, these digits move to the integrated operating time display [upper 2 digits].

[9] This data becomes valid on the instrument with a non-linear resistance heater break alarm.
In addition, when the zero-cross control is used, the non-linear resistance heater break alarm cannot be used.

[10] When the calculation of the inflection point is finished, the set value returns to "1." If calculation of the inflection point ends abnormally, the display will revert to the values below and the inflection point data will not be updated.
- If action selection of heater break alarm was changed from 0 to 2, it will revert to 0.
- If action selection of heater break alarm was changed from 1 to 2, it will revert to 1.

No.	Name	Register address HEX	Register address DEC	Attribute	Data range	Factory set value
57	Manipulated output value setting of inflection point 2 [1]	0038	56	R/W	0.0 to 100.0 %	0.0
58	Current value setting of inflection point 2 [1]	0039	57	R/W	0.0 to 22.0 A (20 A type) 0.0 to 33.0 A (30 A type) 0.0 to 50.0 A (45 A type) 0.0 to 66.0 A (60 A type) 0.0 to 88.0 A (80 A type) 0.0 to 110.0 A (100 A type)	0.0
59	Manipulated output value setting of inflection point 3 [1]	003A	58	R/W	0.0 to 100.0 %	0.0
60	Current value setting of inflection point 3 [1]	003B	59	R/W	0.0 to 22.0 A (20 A type) 0.0 to 33.0 A (30 A type) 0.0 to 50.0 A (45 A type) 0.0 to 66.0 A (60 A type) 0.0 to 88.0 A (80 A type) 0.0 to 110.0 A (100 A type)	0.0
61	Protection function for control of primary side of a transformer [2]	004C	76	R/W	0: Protection function for control of primary side of a transformer disable 1: Protection function for control of primary side of a transformer enable	0
62	Determination set value in case of a break on the secondary side of the transformer [2, 3]	004D	77	R/W	0 to 100 % of computed heater current value	70
63	Output limiter setting in case of a break on the secondary side of the transformer [2, 3]	004E	78	R/W	15.0 to 50.0 % of phase angle	15.0
64	Soft-start time in case of break on the secondary side of the transformer [2, 3]	004F	79	R/W	0.1 to 100.0 seconds	0.1
65	Error number	003C	60	RO	1: Calibration data error 2: Back-up error 4: A/D conversion error 32: Power frequency error 64: Power supply voltage error 128: Watchdog timer error	—
66	Alarm code	003D	61	RO	0: No output 1: Power frequency error 2: Board error 4: Power supply voltage error 8: Heater break alarm 1 16: Heater break alarm 2 32: Thyristor break-down alarm 64: Over current 128: Fuse break 256: Heat sink temperature abnormality If two or more error occurs simultaneously, the sum of all alarm codes is displayed.	—

[1] This data becomes valid on the instrument with a non-linear resistance heater break alarm. In addition, when the zero-cross control is used, the non-linear resistance heater break alarm function cannot be used.

[2] This data becomes valid on the instrument with a constant current control or constant power control.

[3] This data becomes valid when protection function for control of primary side of a transformer is set to "1: Protection function for control of primary side of a transformer enable."

- **It may not be possible to use the non-linear resistance heater break alarm function with some heater types.**
- **Use this function in a system with a current capacity of 10 A or more.**
  As the measuring accuracy of the current transformer (CT) is within ±2 % of the THV-A1 rated current, no heater break alarm may normally operate if used at a smaller load current value.

5. COMMUNICATION SPECIFICATION

Interface: Based on RS-422A, EIA standard
Based on RS-485, EIA standard
(Specify when ordering)

Connection method: RS-422A: 4-wire system, half-duplex multi-drop connection
RS-485: 2-wire system, half-duplex multi-drop connection

Synchronous method: Start-stop synchronous type

Communication speed: 9600 bps

Data bit configuration: Start bit: 1
Data bit 8
Parity bit: Without
Stop bit: 1

Protocol: Modbus-RTU

Function code: 03H (Read holding registers)
06H (Preset single register)
08H (Diagnostics: loopback test)
10H (Preset multiple registers)

Error check method: CRC-16

Termination resistor: Connect a separately sold termination resistor to the communication port.

Maximum connections: 31 instruments (RS-422A, RS-485)

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