HDW3 iTR326H controller
MODBUS-RTU Version
(V1.1)

I. Agreement Overview

1. Physical layer
   Transmission mode: RS485 / RS422
   Communication address: 0-255
   Communication baud rate: 9600BPS, 19200BPS, 38400BPS, 115200BPS
   Communication distance: up to 1,000 meters
   Communication medium: shielded twisted pair
   Communication protocol: MODBUS-RTU

2. Link layer

- Transmission mode: Master-slave half-duplex mode.
  First, the signal from the master device is addressed to a unique terminal device (slave), and then the response signal issued from the terminal device is transmitted to the host in the opposite direction.
  The protocol only allows data to be exchanged between the master device and the terminal device rather than between the independent devices. Therefore, they will not occupy the communication line during initialization, but only the corresponding inquiry signals that reach the machine are transmitted through this line.

- A data frame format:
  1 starting bit, 8 data bits, 1 stop bit, no parity bit.

- A data packet format

Address	Function code	Data	Check code
8-Bits	8-Bits	N x 8-Bits	16-Bits

The protocol defines check codes and data sequences in detail, all of which are necessary for specific data exchange.
When reaching the terminal device, the data frame enters the addressed device through a simple "port". The device removes the "envelope" (data header) of the data frame, reads the data, and executes the task request by data if there is no error. Then, this device adds the data it generates to the "envelope" it gets, and returns the data frame to the sender. The returned response data contains the following contents: the terminal slave address (Address), the executed command (Function), the requested data (Data) generated by executing the command, and a check code (Check). The terminal slave can identify the error communication from the master and give different error responses.

3. Address field
   The starting part of the frame in the address field consists of 8 bits (from 1 to 99). These bits indicate the address of the terminal device specified by the user, and this device will receive data from the master device connected to it. The address of each terminal device must be unique, and only the addressed terminal will respond to queries containing that address. When the terminal sends back a response, the slave address data in the response tells the master device which terminal is communicating with it.

4. Function field
   The function field code tells the address terminal which function will be executed. Table 1 – 1 lists all function codes, their meanings and their initial functions.

Table 1 – 1 Function Code

Code	Definition	Action
3	Read the data register	To get the current binary value of one or more registers
5	DO output control	To place a specific binary value into a DO command register
6	Preset single register	To place a specific binary value into a register
8	Communication diagnosis	Communication diagnosis
16	Preset multiple registers	To place specific binary values into a series of registers

Sub-function code of communication diagnosis function code 08H:

Sub-function code	Function
00	The original query data is returned
0A	Resets the event register and counts of sub-function codes 0B to 12.
0B	Total device information count. (Counter 1)
0C	CRC check error count. (Counter 2)
0D	Count of error responses issued by the device. (Counter 3)
0E	Correct count of requests for communication with this device. (Counter 4)
0F	Reserved
10	Reserved
11	Reserved
12	Reserved

5. Data field
   The data field contains data required by the terminal to perform a specific function or data collected by the terminal in response to a query. The contents of these data may be numerical values, reference addresses or limit values. For example: when the function field code tells the terminal to read a register, the data field needs to specify which register to start from and how much data to read. The embedded address and data vary according to the type and the different capabilities between the slaves.

6. Error check field
   This field allows master device and terminals to check for errors during transmission. Sometimes, a group of data may change on the line when they are transmitted from one device to another because there are electrical noise and other interferences. Error checking can ensure that the master device or terminal does not respond to data that has changed during transmission, thus improving the security and efficiency of the system. The error check uses a 16-bit cyclic redundancy method.

7. Error detection
   The cyclic redundancy check (CRC) field occupies two bytes containing a 16-bit binary value. The CRC value is calculated by the transmitting device and then appended to the data frame. The receiving device recalculates the CRC value when receiving the data and then compares it with the received value in the CRC field. If the two values are not equal, and error will occur.
   In CRC operation, a 16-bit register is preset to all 1, and then 8-bit bytes in the data frame are continuously calculated with the current value in this register. Only 8 data bits of each byte are involved in generating the CRC. The CRC is not affected by the start and stop bits and the possible parity bits used.
   When generating the CRC, each 8-bit byte is XORed with the contents of the register, and then the result is shifted to the low bit. The high bit is supplemented with "0", and the least significant bit (LSB) is shifted out and detected. If it is 1, the register is XORed with a preset fixed value. If the least significant bit is 0, no processing is required.

The above process is repeated until 8 shift operations are performed. After the least significant bit (the 8th bit) has been shifted, the next 8-bit byte is XORed with the current value in the register. Similarly, the above eight shift XOR operations re performed. When all bytes in the data frame have been processed, the final value generated is the CRC value.

The process of generating a CRC is as follows:

(1) A 16-bit register is preset to 0FFFFH (all 1s), which is called as CRC register.
(2) The first 8-bit byte in the data frame is XORed with the low byte in the CRC register, and the result is restored in the CRC register.
(3) Shift the CRC register one bit to the right, fill the highest bit with 0, and shift out the lowest bit and check it.
(4) If the least significant bit is 0: repeat the third step (next shift).

If the least significant bit is 1: XOR the CRC register with a preset fixed value (0A001H).

(5) Repeat steps 3 and 4 until 8 shifts are performed. Therefore, full eight bits are processed.
(6) Repeat steps 2 through 5 to process the next eight bits until all the bytes have been processed.
(7) The final CRC register value is the CRC value.

II. Communication connection

1. Communication address

   The communication address can be set from 0 to 255. After the address is set, the controller only receives and responds to the request issued by the set address. After the communication address changes during operation, the controller will receive and respond with the new address.

2. Communication baud rate

   The communication baud rate can be set to 9600BPS, 19200BPS, 38400BPS, 115200BPS. After the baud rate is set, the controller always receives and responds the information at its set baud rate. If the baud rate changes during operation, the control will receive and respond at the new baud rate.

3. Link failure operation

   The link failure execution mode can be set to: alarm or ignore;
   The link timeout time can be set to: 2 ~ 200S, and the step size is 1S;
   If the controller does not receive a valid data frame within the set scanning period, it considers that the link has failed and the corresponding failed operation will be executed.

6. Total device information count

   Starting from power-on or the last counter reset, the valid data frames received by the controller are counted up.

7. CRC check error count

   If receiving a data frame of the check code error, the controller will accumulate the CRC error count.

8. Error response count

   After receiving the data frame of the error message, the controller will accumulate the error message response count.

III. Description of the application layer function

The goal of this chapter is to define a common format for specific valid commands for ST system programmers. Following the description of each data query format is an explanation and examples of the functions performed by the data query.

The protocols described in this chapter will use the format shown in Table 3.1 below whenever possible. (Numbers are in hexadecimal)

Device address	Function code	Variable start address high byte	Variable start address low byte	High byte of the number of variables	Low byte of the number of variables	Check code low byte	Check code high byte
03H	03H	00H	01H	00H	03H	55H	E9H

Table 3.1 Protocol example description

1. Read data register (03H)

The 03 function code allows the user to obtain any data and system parameters collected and recorded by the device.

The following example reads the 3 basic data namely Phase A voltage, Phase B voltage, and Phase C voltage collected from the 3# slave device (each address occupies 2 bytes in the data frame). The address of Phase A voltage in the controller is 0100H, with 0101H for phase B voltage and 0102H for phase C

Downlink message (from the master to the slave):

Device address	Function code	Variable start address high byte	Variable start address low byte	High byte of the number of variables	Low byte of the number of variables	Check code low byte	Check code high byte
03H	03H	01H	00H	00H	03H	05H	D5H

Table 3.2 Example of 03 Function Code Downlink

Uplink message (from the slave to the master):

The response contains slave address, function code, number of data, and CRC error check.

Address	Function code	The total number of bytes in the variable	Variable value high byte	Variable value low byte	Variable value high byte	Variable value low byte	Variable value high byte	Variable value low byte	Check code low byte	Check code high byte
03H	03H	06H	00H	00H	00H	00H	00H	00H	38H	15H

Table 3.3 Example of Function Code Uplink

2. DO output control (05H)

The controller has multiple output relays, and its forced action and reset can be achieved through 05 function code. When setting to "Common DO", the DO function is controlled only by the communication command; when setting to other functions, the DO will be controlled by the communication command to perform the forced operation, and also perform its own set function operation.

The 05 function code forcibly sets an independent DO as "action" or "reset". The address of the DO in the controller starts from 0000H (DO1 = 0000H, DO2 = 0001H, DO3 = 0002H, DO4 = 0003H).

When the variable value is FF00H, DO will be set to the "action" state, and 0000H will be set DO to the "reset" state; all other values are error values without affecting the DO state. In the example below, 17# slave is requested to set DO1 to the "action" state.

Downlink message (from the master to the slave):

Device address	Function code	Variable address high byte	Variable address low byte	Variable value high byte	Variable value low byte	Check code low byte	Check code high byte

11H	05H	00H	00H	FFH	00H	8EH	AAH

Table 3.4 Example of 05 Function Code Downlink

Uplink message (from the slave to the master):

Device address	Function code	Variable address high byte	Variable address low byte	Variable value high byte	Variable value low byte	Check code low byte	Check code high byte
11H	05H	00H	00H	FFH	00H	8EH	AAH

Table 3.5 Example of 05 Function Code Uplink

Notes:
1. Controller DO execution mode can be set as: normally open level, normally closed level, normally open pulse, normally closed pulse;
2. The corresponding DO must be set to the "reset" state before the communication is forced to perform the "action";

3. Preset Single Register (06H)

Function code 06 allows the user to change the content of a single register. Any writable single register inside the controller can use this function code to change its value. Example: The value of the preset overload action current register is 03E0H, and the address is 0500H

Downlink message (from the master to the slave):

Address	Function code	Variable start address high byte	Variable start address low byte	Variable value high byte	Variable value low byte	Check code low byte	Check code high byte
03H	06H	05H	00H	03H	0E8 H	88H	5AH

Table 3.6 Example of 06 function code downlink

The normal response to a request issued by a preset single register request is to transfer the received data back after the register value has changed.

Uplink message (from the slave to the master):

Address	Function code	Variable start address high byte	Variable start address low byte	Variable value high byte	Variable value low byte	Check code low byte	Check code high byte
03H	06H	05H	00H	03H	0E8 H	88H	5AH

Table 3.7 Example of 06 function code uplink

4. Preset Multiple Registers (10H)

Function code 16 (decimal) (10H if hexadecimal) allows the user to change the contents of multiple consecutive address registers. Except for the control command (address 400H) in the controller, writable parameters that can be written with the 06 function are written with this function code.

In the example below, the maximum current values of phase A, B and C of 17# slave are cleared. Its addresses are 408H, 409H, and 40AH, respectively. There are 3 variables, occupying 6 bytes.

Downlink message (from the master to the slave):

Device address	Function code	Variable start address high byte	Variable start address low byte	High byte of the number of variables	Low byte of the number of variables	The number of bytes of word count
11H	10H	04H	08H	00H	03 H	06H

Variable value high byte	Variable value low byte	Variable value high byte	Variable value low byte	Variable value high byte	Variable value low byte	Check code low byte	Check code high byte
00H	00H	00H	00H	00H	00 H	4CH	OCAH

Table 3.8 Example of 16 function code downlink

Uplink message (from the slave to the master):

Device address	Function code	Variable start address high byte	Variable start address low byte	High byte of the number of variables	Low byte of the number of variables	Check code low byte	Check code high byte
11H	10H	04H	08H	00H	03 H	02H	6AH

Table 3.9 Example of 16 function code uplink

5. Communication diagnosis (08H)

Function code 08 provides the user with a series of conditions for testing, verifying the communication system between the master and the controller, or checking for errors in the slave.

This function code uses a sub-function code (2 bytes) to define the test type. Most diagnostic tests use a 2-byte data area to send diagnostic data and control information to the controller. For some diagnoses, data are returned by the controller and stored in the normal response data area.

The example below is to check the number of CRC check errors of the address received by the 17# slave. Its sub-function code is 0CH.

Downlink message (from the master to the slave):

Device address	Function code	Subfunction code high byte	Subfunction code low byte	Diagnostic data high byte	Diagnostic data low byte	Check code low byte	Check code high byte
11H	08H	00H	0CH	00H	00H	1AH	60H

Table 3.10 Example of 08 function code downlink

Uplink message (from the slave to the master):

Device address	Function code	Subfunction code high byte	Subfunction code low byte	Diagnostic data high byte	Diagnostic data low byte	Check code low byte	Check code high byte
11H	08H	00H	OCH	00H	1AH	9BH	OABH

Table 3.11 Example of 08 Function Code Uplink

Note:

1. For sub-function codes other than 00H, the diagnostic data of downlink messages must be 0

IV. Communication address table

1. Measurement information

Address	Definition	Variable type	Unit	Attributes	Variable format
256(100H)	Phase A voltage	Uint	V	R	×1
257	Phase B voltage	Uint	V	R	×1
258	Phase C voltage	Uint	V	R	×1
259	Phase voltage average	Uint	V	R	×1
260	Line AB voltage	Uint	V	R	×1
261	Line BC voltage	Uint	V	R	×1
262	Line CA voltage	Uint	V	R	×1
263	Line voltage average	Uint	V	R	×1
264	Line AB voltage imbalance rate	Uint		R	%
265	Line BC voltage imbalance rate	Uint		R	%
266	Line CA voltage imbalance rate	Uint		R	%
267	Maximum imbalance rate of line voltage	Uint		R	%
268	Phase A current	Uint	A	R	×1 or ×2[note 1]

269	Phase B current	Uint	A	R	×1 or ×2[note 1]
270	Phase C current	Uint	A	R	×1 or ×2[note 1]
271	Medium phase current	Uint	A	R	×1 or ×2[note 1]
272	Maximum phase current	Uint	A	R	×1 or ×2[note 1]
273	Three-phase average current	Uint	A	R	×1 or ×2[note 1]
274	Ground (leakage) current	Uint	A	R	Ground: ×1 or ×2[note 1] Leakage: ×0.01
275	Phase A current imbalance rate	Uint		R	%
276	Phase B current imbalance rate	Uint		R	%
277	Phase C current imbalance rate	Uint		R	%
278	Maximum current imbalance rate	Uint		R	%
279	Current heat capacity	Uint		R	%
280	Phase A active power	Int	kW	R	×1
281	Phase A reactive power	Int	kvar	R	×1
282	Phase A apparent power	Uint	Kva	R	×1
283	Phase B active power	Int	kW	R	×1
284	Phase B reactive power	Int	kvar	R	×1
285	Phase B apparent power	Uint	Kva	R	×1
286	Phase C active power	Int	kW	R	×1
287	Phase C reactive power	Int	kvar	R	×1
288	Phase C apparent power	Uint	Kva	R	×1
289	Total active system power	Int	kW	R	×1
290	Total reactive system power	Int	kvar	R	×1
291	Total apparent system power	Uint	Kva	R	×1
292	Phase A power factor	Int		R	×0.01
293	Phase B power factor	Int		R	×0.01
294	Phase C power factor	Int		R	×0.01
295	System power factor	Int		R	×0.01
296	System frequency	Uint	Hz	R	×0.01
298	Inductive (input) active energy H	Long	kWh	R	×1
297	Inductive (input) active energy L				
300	Inductive (input) reactive energy H	Long	Kvarh	R	×1
299	Inductive (input) reactive energy L				
302	Capacitive (output) active energy H	Long	kWh	R	×1
301	Capacitive (output) active energy L				
304	Capacitive (output) reactive energy H	Long	Kvarh	R	×1
303	Capacitive (output) reactive energy L				
306	Total active energy H	Long	kWh	R	×1
305	Total active energy L				
308	Total reactive energy H	Long	Kvarh	R	×1
307	Total reactive energy L				
310	Total apparent energy H	Long	Kvah	R	×1
309	Total apparent energy L				

311	Phase A current demand value	Uint	A	R	×1 or 2[Note 1]
312	Phase B current demand value	Uint	A	R	×1 or 2[Note 1]
313	Phase C current demand value	Uint	A	R	×1 or 2[Note 1]
314	Phase N current demand value	Uint	A	R	×1 or 2[Note 1]
315	Total active system power demand value	Int	kW	R	×1
316	Total reactive system power demand value	Int	kvar	R	×1
317	Total apparent system power demand value	Int	Kva	R	×1
318	Phase sequence measurement value (bit)	Uint		R	See 5.1

Notes:

1. When the rated current is ≥11, × 2 is available, otherwise × 1.
2. Rated current value: Low byte of variable address 610H.

2. Operating state information

Address	Definition	Variable type	Unit	Attributes	Variable format
512(200H)	Operation state (bit)	Uint		R	See 5.2
514 513	Current alarm (bit)	Long		R	See 5.3
515	H: Current fault type (char) L: Current fault phase (char)	Uint		R	See 5.4
516	Current fault data 0	Uint		R	See 5.5
517	Current fault data 1	Uint		R	
518	Current fault data 2	Uint		R	
519	Current fault data 3	Uint		R	
520	Current fault data 4	Uint		R	
521	Current fault data 5	Uint		R	
522	Current fault data 6	Uint		R	
523	Current fault data 7	Uint		R	
524	H: System clock, year L: System clock, month	Uint		R	BCD code
525	H: System clock, day L: System clock, hour	Uint		R	BCD code
526	H: System clock, minute L: System clock, second	Uint		R	BCD code

3. Event record

Address	Definition	Variable type	Unit	Attributes	Variable format
768(300H)	H: Fault record clock, year L: Fault record clock, month	Uint		R	BCD code
769	H: Fault record clock, day L: Fault record clock, hour	Uint		R	BCD code

770	H: Fault record clock, minute L: Fault record clock, second	Uint		R	BCD code
771	H: Fault record type (char) L: fault record phase (char)	Uint		R	See 5.4
772	Fault data 0	Uint		R	See 5.5
773	Fault data 1	Uint		R	
774	Fault data 2	Uint		R	
775	Fault data 3	Uint		R	
776	Fault data 4	Uint		R	
777	Fault data 5	Uint		R	
778	Fault data 6	Uint		R	
779	Fault data 7	Uint		R	
780	H: The current power-on time, year L: The current power-on time, month	Uint		R	BCD code
781	H: The current power-on time, day L: The current power-on time, hour	Uint		R	BCD code
782	H: The current power-on time, minute L: The current power-on time, second	Uint		R	BCD code
783	Reserved	Uint			
784	Fault record status flag (bit)	Uint		R	See 5.6
785	H: Specify which record to read (char) L: Specify the record type (char) to read	Uint		R/W	See 5.7

4. System maintenance parameters

Address	Definition	Variable type	Unit	Attributes	Variable format
1024(400H)	Remote command (only support 06H function code writing)	Uint		R/W	See 5.8
1025	H: System clock setting year L: system clock setting month	Uint		W	BCD code [Note 1]
1026	H: System clock setting day L: System clock setting hour	Uint		W	BCD code [Note 1]
1027	H: System clock setting minute L: System clock setting second	Uint		W	BCD code [Note 1]
1028	Contact wear percentage	Uint		R/W	× 0.01, only 0 can be written
1029	Total contact equivalent	Uint		R	× 0.01
1030	Number of operations	Uint		R/W	×1, only 0 can be written
1031	Total number of operations	Uint		R	×1
1032	Phase A current maximum value c	Uint	A	R/W	×1 or x2 [Note 2], only 0 can be written
1033	Phase B current maximum value c	Uint	A	R/W	×1 or x2 [Note 2], only 0 can be written
1034	Phase C current maximum value c	Uint	A	R/W	×1 or x2 [Note 2], only 0 can be written
1035	Phase N current maximum value c	Uint	A	R/W	×1 or x2 [Note 2], only 0 can be written

1036	Grounding current maximum value c	Uint	A	R/W	×1 or x2 Note 2, only 0 can be written
1037	Leakage current maximum value c	Uint	A	R/W	×0.01, only 0 can be written
1038	Phase A current maximum demand value c	Uint	A	R/W	×1 or x2 Note 2, only 0 can be written
1039	Phase B current maximum demand value c	Uint	A	R/W	×1 or x2 Note 2, only 0 can be written
1040	Phase C current maximum demand value c	Uint	A	R/W	×1 or x2 Note 2, only 0 can be written
1041	Phase N current maximum demand value c	Uint	A	R/W	×1 or x2 Note 2, only 0 can be written
1042	System active power maximum demand value c	Int	kW	R/W	×1, only 0 can be written
1043	System reactive power maximum demand value c	Int	kvar	R/W	×1, only 0 can be written
1044	System apparent power maximum demand value c	Uint	Kva	R/W	×1, only 0 can be written
1045	DO2 function setting (char) DO1 function setting (char)	Uint		R/W	See 5.9
1046	DO4 function setting (char) DO3 function setting (char)	Uint		R/W	
1047	DO, DI working mode (Bit)	Uint		R/W	See 5.10
1048	DO1 pulse width	Uint	20mS	R/W	50~1800, with step size of 50
1049	DO2 pulse width	Uint		R/W	
1050	DO3 pulse width	Uint		R/W	
1051	DO4 pulse width	Uint		R/W	
1052	Measurement table setting information (Bit)	Uint		R/W	See 5.11
1053	H: Power demand value time window value (char)	Uint	Min	R/W	5~60, with step size of 1
	L: Current demand value time window value (char)			R/W	5~60, with step size of 1
1054	Link timeout setting time	Uint	20mS	R/W	100~10000, with step size of 50
1055	Reserved	Uint		R/W	
1056	Reserved	Uint		R/W	
1057	Communication settings, lock (Bit)	Uint		R/W	See 5.12
1058	Parameter setting lock password H	Uint		R/W	0~9999
1059					

Notes:

1. Meaningless when reading;
2. When the rated current is ≥11, × 2 is available, otherwise × 1.

5. Protection settings

Address	Internal address	Definition	Variable type	Unit	Attributes	Variable format
1280(500H)		Overload action value	Uint	A	R/W	×1 or ×2 Note 1; 0, lower limit 0.2, 0.3 or 0.4 times; upper limit 1.0 or 1.25 times rated current, with the step size of 1.
1281		Curve selection (Bit) Curve type (Bit) Cooling time (Bit)	Uint		R/W	See 5.13
1282		Short-circuit definite time current set value	Uint	A	R/W	×1 or ×2 Note 1;

			Uint		R/W	0, 1.5 times ~ 15 times overload action value (address 1280), with the step size of 1
1283		Short-circuit definite time current set value	Uint	20mS	R/W	5~(20), with the step size of 5
1284		Short-circuit inverse definite time current set value	Uint	A	R/W	×1 or ×2 Note 1; 0, 1.5 times ~ 15 times overload action value (address 1280), with the step size of 1
1285		Instantaneous current set value	Uint	A	R/W	×1 or ×2 Note 1; 0, 1.0~20 times rated current value, with the step size of 1
1286		Phase N protection setting	Uint		R/W	See 5.14
1287		Ground / Leakage Protection Action Value	Uint	A/0.01A	R/W	Grounding: ×1 or ×2 Note 1; 0, 0.2~20 times rated current value, with the step size of 1; Electric leakage: 0, 50~3000, with the step size of 10
1288		Ground / Leakage Protection Action Time	Uint		R/W	Grounding: 5~50, with the step size of 5 Electric leakage: see 5.15 "Double leakage time without action"
1289		H: Load monitoring mode L: grounding / leakage protection shear factor (char)	Uint		R/W	See 5.15
1290		Load monitoring set value 1	Uint		R/W	See 5.16
1291		Load monitoring set value 2	Uint		R/W	
1292		Load monitoring set time 1	Uint		R/W	
1293		Load monitoring set time 2	Uint		R/W	
1294		Protection working mode 1 (Bit)	Uint		R/W	See 5.17
1295		Protection working mode 2 (Bit)	Uint		R/W	See 5.18
1296		Ground / Leakage Alarm Start Value	Uint	A/00.1A	R/W	Grounding: ×1 or ×2 Note 1; 0.2~1.0 times rated current value, with the step size of 1; Electric leakage: 50~3000, with the step size of 10
1297		Ground / Leakage Alarm Return Value H	Uint	A/0.01A	R/W	Grounding: ×1 or ×2 Note 1; 0.2 times rated current value ~ starting value, with the step size of 1; Electric leakage: 50~starting value, with the step size of 10
1298		H: Ground / Leakage Alarm Return Time (char) L: Ground / Leakage Alarm Startup time (char)	Uint	20mS	R/W	Grounding: 5~50, step size: 5 Electric leakage: 0~50, step size: 5 Grounding: 5~50, step size: 5 Electric leakage: 0~50, step size: 5
1299		H: I unbalanced return value (char) L: I imbalance start value (char)	Uint	1%	R/W	5~starting value; step size: 1 5~60; step size: 1
1300		I Unbalanced startup time	Uint	20mS	R/W	5~2000; step size: 5
1301		I unbalanced return time	Uint	20mS	R/W	500~10000; step size: 50
1302		Phase A maximum demand starting value	Uint	A	R/W	×1 or ×2 Note 1

						0.2~1.0 time rated current value
1303		Phase A maximum demand starting time	Uint	S	R/W	15~1500, step size: 1
1304		Phase A maximum demand return value	Uint	A	R/W	×1 or ×2 Note 1; 0.2 times rated current value ~ starting value
1305		Phase A maximum demand return time	Uint	S	R/W	15~3000; step size: 1
1306		Phase B maximum demand starting value	Uint	A	R/W	×1 or ×2 Note 1; 0.2~1.0 times rated current value
1307		Phase B maximum demand startup time	Uint	S	R/W	15~1500, step size: 1
1308		Phase B maximum demand return value	Uint	A	R/W	×1 or ×2 Note 1; 0.2 times rated current value ~ starting value
1309		Phase B maximum demand return time	Uint	S	R/W	15~3000, step size: 1
1310		Phase C maximum demand starting value	Uint	A	R/W	×1 or ×2 Note 1; 0.2~1.0 times rated current value
1311		Phase C maximum demand startup time	Uint	S	R/W	15~1500, step size: 1
1312		Phase C maximum demand return value	Uint	A	R/W	×1 or ×2 Note 1; 0.2 times rated current value
1313		Phase C maximum demand return time	Uint	S	R/W	15~1500, step size: 1
1314		Phase N maximum demand starting value	Uint	A	R/W	×1 or ×2 Note 1; 0.2~1.0 times rated current value
1315		Phase N maximum demand startup time	Uint	S	R/W	15~1500, step size: 1
1316		Phase N maximum demand return value	Uint	A	R/W	×1 or ×2 Note 1; 0.2 times rated current value
1317		Phase N maximum demand return time	Uint	S	R/W	15~3000, step size: 1
1318		Undervoltage starting value	Uint	V	R/W	100~1200, step size: 1 Note 2
1319		Undervoltage startup time	Uint	20mS	R/W	10~3000, step size: 5
1320		Undervoltage return value	Uint	V	R/W	100~1200, step size: 1 Note 2
1321		Undervoltage return time	Uint	20mS	R/W	10~3000, step size: 5
1322		Overvoltage starting value	Uint	V	R/W	100~1200, step size: 1 Note 2
1323		Overvoltage startup time	Uint	20mS	R/W	100~3000, step size: 5
1324		Overvoltage return value	Uint	V	R/W	100~1200, step size: 1 Note 2
1325		Overpressure return time	Uint	20mS	R/W	10~3000, step size: 5
1326		U imbalance starting value	Uint	1%	R/W	2~30, step size: 1
1327		U unbalanced startup time	Uint	20mS	R/W	10~3000, step size: 5
1328		U unbalanced return value	Uint	1%	R/W	2~starting value, step size: 1
1329		U unbalanced return time	Uint	20mS	R/W	10~3000, step size: 5
1330		Underfrequency starting value	Uint	Hz	R/W	/100; 4500~6500, step size: 50 Note 2
1331		Underfrequency startup time	Uint	20mS	R/W	10~250, step size: 5
1332		Underfrequency return value	Uint	Hz	R/W	/100; 4500~6500, step size: 50 Note 2
1333		Under frequency return time	Uint	20mS	R/W	10~1800, step size: 5
1334		Overfrequency starting value	Uint	Hz	R/W	/100; 4500~6500, step size: 50 Note 2

1335		Over-frequency startup time	Uint	20mS	R/W	10~250, step size: 5
1336		Over-frequency return value	Uint	Hz	R/W	/100; 4500~6500, step size: 50 Note 2
1337		Over-frequency return time	Uint	20mS	R/W	10~1800, step size: 5
1338		Phase sequence protection starting value	Uint		R/W	0=A,B,C 1=A,C,B
1339		Reverse power starting value	Uint	KW	R/W	5~500, step size: 1
1340		Reverse power startup time	Uint	20mS	R/W	10~1000, step size: 5
1341		Inverse power return value	Uint	KW	R/W	5~starting value, step size: 1
1342	53EH	Reverse power return time	Uint	20mS	R/W	50~18000, step size: 50

Notes:

1. When the rated current value ≥ 11, ×2 will be available, otherwise ×1.
2. Requirements:
   Undervoltage return value ≥undervoltage starting value; overvoltage return value ≤overvoltage starting value
   Underfrequency return value ≥ underfrequency starting value; over-frequency return value ≤ over-frequency starting value. If the condition is not met, it will be controlled forcedly by the controller.

V. Description of data type

5.1 Phase sequence measured value

Bit	Range	Phase	Meaning
0~1	0~2	0=No phase sequence 1=ABC 2=ACB	Phase sequence measured value
2~15		Reserved	Reserved

5.2 Operation state

Bit	Range	Phase	Meaning
0~1	0~3	0=Open 1=Opening 2=Close 3=Closing	Circuit breaker state
2	0,1	0= No 1= Yes	Alarm mark
3	0,1	0= No 1= Yes	Fault trip mark
4	0,1	0=Reset 1=Act	DI1 state
5	0,1	0=Reset 1=Act	DI2 state
6	0,1	0=Open 1=Closed	DO1 state

7	0,1	0=Open 1=Closed	DO2 state
8	0,1	0=Open 1=Closed	DO3 state
9	0,1	0=Open 1=Closed	DO4 state
10	0,1	0=No 1=Yes	New fault trip
11	0,1	0=No 1=Yes	New alarm
12	0,1	0=No 1=Yes	New shift event
13~15	0,1	0 = No 1 = EEPROM error 2 = AD sampling error 3 = RAM error 4 = ROM error	Controller self-diagnostic information

5.3 Current alarm

Bit	Range	Value	Meaning
0	0~2	0=No 1=Yes	Load monitoring 1 alarm
1	0,1	0=No 1=Yes	Load monitoring 2 alarm
2	0,1	0=No 1=Yes	Overload pre-alarm
3	0,1	0=No 1=Yes	Ground / Leakage Alarm
4	0,1	0=No 1=Yes	Current imbalance alarm
5	0,1	0=No 1=Yes	Phase A maximum demand value alarm
6	0,1	0=No 1=Yes	Phase B maximum demand alarm
7	0,1	0=No 1=Yes	Phase C maximum demand value alarm
8	0,1	0=No 1=Yes	Phase N maximum demand value alarm
9	0,1	0=No 1=Yes	Voltage imbalance alarm
10	0,1	0=No	Undervoltage alarm

		1=Yes	
11	0,1	0=No 1=Yes	Over-voltage alarm
12	0,1	0=No 1=Yes	Reverse power alarm
13		0=No 1=Yes	Under-frequency alarm
14		0=No 1=Yes	Over-frequency alarm
15		0=No 1=Yes	Phase sequence alarm
16		0=No 1=Yes	Input 1 alarm
17		0=No 1=Yes	Input 2 alarm
18		0=No 1=Yes	Communication failure alarm
19		0=No 1=Yes	Contact wear alarm
20		0=No 1=Yes	Self-diagnostic alarm
21~31		Reserved	Reserved

5.4 Fault type, phase

Bit	Range	Value	Meaning
0~7	0~4	0 = Phase A 1 = Phase B 2 = Phase C 3 = Phase N 4 = Meaningless	Fault phase
	0,1	When fault type = 18: 0 = DI1 1 = DI2	
8~15	0~2	See Table below	Fault type

Note:

When the fault type is "Switching (DI) State Change Trip",

Fault type table

Fault code value	Fault type description
0	No fault
1	Phase sequence fault

2	Underfrequency fault
3	Over-frequency fault
4	Undervoltage fault
5	Overvoltage fault
6	Voltage imbalance fault
7	Overload fault
8	Short-circuit short delay inverse time failt
9	Short circuit short delay definite time fault
10	Short-circuit transient fault
11	MCR action
12	HSISC action (out-of-limit trip)
13	Ground Fault
14	Leakage fault trip
15	Current imbalance fault
16	Maximum demand value overrun
17	Reverse power fault
18	Switching (DI) state change trip
19	Grounding area interlock trip
20	Short-circuit area interlock trip
21	Test overload fault
22	Test short-circuit short delay inverse time failt
23	Test short circuit short delay definite time fault
24	Test short-circuit transient fault
25	Test MCR action
26	Test HSISC action (out-of-limit trip)
27	Test ground fault
28	Test leakage fault

5.5 Fault data

Int	Event type	Meaning	Unit	Variable format
0	Overload fault, transient fault, short circuit interlock, ground interlock, short circuit definite / inverse time protection, ground / leakage protection, test overload fault, test short circuit fault test ground / leakage fault	Fault current	A	× 1 or × 2 Note 1 Leakage: × 0.01 Test leakage: × 0.01
	Current imbalance protection	Maximum current imbalance rate	%	× 1
	Phase A demand value protection	Phase A failure demand value	A	× 1 or × 2 Note 1
	Phase B demand value protection	Phase B failure demand value	A	×1 or × 2 Note 1
	Phase C demand value protection	Phase C failure demand value	A	× 1 or × 2 Note 1
	Phase N demand value protection	Phase N failure demand value	A	× 1 or × 2 Note 1
	Under voltage protection	Maximum fault line voltage	V	× 1
	Overvoltage protection	Minimum fault line voltage	V	× 1

	Voltage imbalance protection	Maximum voltage imbalance rate	%	
	Underfrequency protection, over-frequency protection	Failure frequency	Hz	× 0.01
	Phase sequence protection	Fault phase sequence		1: ABC 2: ACB
	Reverse power protection	Fault power	KW	× 1 (signed integer)
	MCR / HSISC, test MCR / HSISC	Meaningless		
1		Delay time low byte	S	/50
2		Delay time high byte		
3		Fault setting action value		The unit kA is available for MCR / HSISC and test MCR / HSISC. For other faults, refer to the protection settings.
4	Overload fault, short delay definite / inverse time fault, transient fault, ground / leakage fault, current imbalance fault, maximum demand value overrun, reverse power fault, DI input trip, ground interlock, short circuit interlock, test overload fault, test short-circuit fault, test transient fault, test ground / leakage fault	Phase A current	A	× 1 or × 2 Note 1
	Phase sequence fault, under frequency fault, over frequency fault, under voltage fault, over voltage fault, voltage imbalance fault	Uab	V	× 1
5	Overload fault, short delay definite / inverse time fault, transient fault, ground / leakage fault, current imbalance fault, maximum demand value overrun, reverse power fault, DI input trip, ground interlock, short circuit interlock, test overload fault, test short-circuit fault, test transient fault, test ground / leakage fault	Phase B current	A	× 1 or × 2 Note 1
	Phase sequence fault, under frequency fault, over frequency fault, under voltage fault, over voltage fault, voltage imbalance fault	Uab		× 1
6	Overload fault, short delay definite / inverse time fault, transient fault, ground / leakage fault, current imbalance fault, maximum demand value overrun, reverse power fault, DI input trip, ground interlock, short circuit interlock, test overload fault, test short-circuit fault, test transient fault, test ground / leakage fault	Phase C current	A	× 1 or × 2 Note 1
	Phase sequence fault, under frequency fault, over frequency fault, under voltage fault, over voltage fault, voltage imbalance fault	Uab		×1
7	Overload fault, short delay definite / inverse time fault, transient fault, ground / leakage fault, current imbalance fault, maximum demand value overrun, reverse power fault, DI input trip, ground interlock, short circuit interlock, test overload fault, test short-circuit fault, test transient fault, test ground / leakage fault	Phase N current	A	× 1 or × 2 Note 1

	Phase sequence fault, under frequency fault, over frequency fault, under voltage fault, over voltage fault, voltage imbalance fault	System frequency	Hz	× 0.01

5.6 Fault record status flag

Bit	Range	Value	Meaning
0	0,1	0 = unreadable 1 = readable	The host computer specifies whether the record to be read is ready
1~3	0~7		Total number of device fault records
4~6	0~7		Total number of device alarm records
7~9	0~7		Total number of device shift records
10~15		Reserved	Reserved

5.7 Specify the record to read

Bit	Range	Value	Meaning
0~7	0~2	0 = Fault trip record 1 = Alarm log 2 = Shift record	The host computer specifies the type of record to be read
8~15	0~7		The host computer specifies which record to read

5.8 Remote commands table

Bit	Range	Value	Meaning
0~15		AAAAH = Closing command (close DO is performed when open) CCCCH = Trip command (Flux converter will work when closed) 5555H = Opening command (open DO is performed when closed) 8888H = Reset command	Remote command

5.9 DO function settings

1045（415H）

Bit	Range	Value	Meaning
0~7	0~32	See the function settings table	DO1 function setting
8~15	0~32	See the function settings table	DO2 function setting

1046（416H）

Bit	Range	Value	Meaning
0~7	0~32	See the function settings table	DO3 function setting
8~15	0~32	See the function settings table	DO4 function setting

DO function settings table

Set value	Function description
0	Common DO

1	Alarm DO
2	Fault trip
3	Self-diagnostic alarm
4	Load monitoring 1
5	Load monitoring 2
6	Overload pre-alarm
7	Overload fault
8	Short delay fault
9	Transient fault
10	Earth / Leakage Fault
11	Ground / Leakage Alarm
12	Current imbalance fault
13	Phase N fault
14	Undervoltage fault
15	Overvoltage fault
16	Voltage imbalance fault
17	Underfrequency fault
18	Over-frequency fault
19	Demand value fault
20	Power failure
21	Regional interlock
22	Closed
23	Open
24	Phase sequence failure
25	MCR / HSISC fault
26	Ground area interlock
27	Short circuit interlock
28	Phase A demand value fault
29	Phase B demand value fault
30	Phase C demand value fault
31	Phase D demand value fault
32	Demand value out of the limit

5.10 DO, DI working mode

Bit	Range	Value	Meaning
0~2	0~5	0 = Alarm 1 = Trip 2 = Area interlock 3 = Common DI 4 = Grounding area interlock 5 = Short circuit area interlock	DI1 function setting
3~5	0~5	0 = Alarm	DI2 function setting

		1 = Trip 2 = Area interlock 3 = Common DI 4 = Grounding area interlock 5 = Short circuit area interlock	
6	0,1	0 = Normally open 1 = Normally closed	DI1 working mode
7	0,1	0 = Normally open 1 = Normally closed	DI2 working mode
8,9	0~3	0 = Normally open level 1 = normally closed level 2 = Normally open pulse 3 = Normally closed pulse	DO1 working mode
10,11	0~3	0 = Normally open level 1 = normally closed level 2 = Normally open pulse 3 = Normally closed pulse	DO2 working mode
12,13	0~3	0 = Normally open level 1 = normally closed level 2 = Normally open pulse 3 = Normally closed pulse	DO3 working mode
14,15	0~3	0 = Normally open level 1 = normally closed level 2 = Normally open pulse 3 = Normally closed pulse	DO4 working mode

5.11 Measurement table setting information

Bit	Range	Value	Meaning
0~1	0~2	0 = Three-phase three-wire 3CT 1 = Three-phase four-wire 3CT 2 = Three-phase four-wire 4CT	System wiring method
2	0,1	0=P+ 1=P-	System power direction
3	0,1	0=Lower incoming 1=Upper incoming	System incoming way
4	0	0 = Arithmetic method	Demand current calculation method
5	0	0 = Slide	Demand current time window type
6~7	0	0 = Arithmetic method	Demand power calculation method
8	0	0 = Slide	Demand power time window type
9~15		Reserved	Reserved

5.12 Communication settings, locks

Bit	Range	Value	Meaning
0~7	0~255		Communication address
8~11	0~3	0=9.6k 1=19.2k 2=38.4k 3=115.2k	Communication baud rate
12	0,1	0=Unlock 1=Lock	Remote control lock
13	0,1	0=Unlock 1=Lock	Parameter lock
14~15		Reserved	Reserved

5.13 Curve selection

Bit	Range	Value	Meaning
0~3	0~15	0= C01, 1= C02, 2= C03, 3= C04, 4= C05, 5= C06, 6= C07, 7= C08, 8= C09, 9= C10, 10= C11, 11= C12, 12= C13, 13= C14, 14= C15, 15= C16	Curve selection (Note)
4~6	0~5	0= SI 1= VI 2= EI (Genral) 3= EI (Motor) 4= HV 5= I^2T	Curve type
7~9	0~7	0 = Transient 1 = 10 minutes 2 = 20 minutes 3 = 30 minutes 4 = 45 minutes 5 = 1 hour 6 = 2 hours 7 = 3 hours	Cooling time (Meaningless when curve type is EI (Motor))
10~15		Reserved	Reserved

.Note: When the curve type is: I^2T, this item is 0-10

5.14 Phase N protection setting

Bit	Range	Value	Meaning
0~15	0~4	0= 50% 1= 100% 2= 160% 3= 200% 4 = Closed	Phase N protection setting

5.15 Ground/Leakage

Double leakage time without action

Variable	0	1	2	3	4	5	6	7	8	9	10	11
Value (S)	Transient	0.06	0.08	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.83

Load monitoring mode, ground / leakage protection shear factor

Bit	Range	Value	Meaning
0~7	Ground: 0, 15 ~ 60, step size: 5 Leakage: 60	/10	Ground / leakage protection shear factor
8~15	0 = Current mode 1 1 = Current mode 2 2 = Power mode 1 3 = Power mode 2 4 = Off ≥5 reserved		Load monitoring mode

5.16 Load monitoring

Load monitoring mode		Unit	Range	Variable format
Current mode 1	Set value 1	A	0.2~1.0 times rated current value; step size: 1	×1 or ×2 Note 1
	Set value 2	A	0.2~1.0 times rated current value; step size: 1	×1 or ×2 Note 1
	Set time 1	1%Tr	20~80	×1Note 2
	Set time 2	1%Tr	20~80	×1Note 2
Current mode 2	Set value 1	A	0.2~1.0 times rated current value; step size: 1	×1 or ×2 Note 1
	Set value 2	A	0.2 times rated current ~ Set value 1, step size: 1	×1 or ×2 Note 1
	Set time 1	1%Tr	20~80	×1Note 2
	Set time 2	S	10~600	×1
Power mode 1	Set value 1	KW	200~10000	×1
	Set value 2	KW	200~10000	×1
	Set time 1	S	10~3600	×1
	Set time 2	S	10~3600	×1
Power mode 2	Set value 1	KW	200~10000	×1
	Set value 2	KW	100~ Set value 1	×1
	Set time 1	S	10~3600	×1
	Set time 2	S	10~3600	×1

Notes:
1. When the rated current is ≥2500A, × 2 is available, otherwise × 1.
2. Tr is overload set time.

5.17 Protection working mode 1

Bit	Range	Value	Meaning
0	0,1	0 = Alarm 1 = Off	Ground alarm
1	0,1	0 = Trip 1 = Off	Ground trip
2~3	0~2	0 = Alarm 1 = Trip 2 = Off	Current imbalance
4~5	0~2	0 = Alarm 1 = Trip 2 = Off	Phase A demand protection
6~7	0~2	0 = Alarm 1 = Trip 2 = Off	Phase B demand protection
8~9	0~2	0 = Alarm 1 = Trip 2 = Off	Phase C demand protection
10~11	0~2	0 = Alarm 1 = Trip 2 = Off	Phase N demand protection
12~13	0~2	0 = Alarm 1 = Trip 2 = Off	Under voltage protection
14~15		Reserved	Reserved

5.18 Protection working mode 2

Bit	Range	Value	Meaning
0~1	0~2	0 = Alarm 1 = Trip 2 = Off	Overvoltage protection
2~3	0~2	0 = Alarm 1 = Trip 2 = Off	Voltage imbalance protection
4~5	0~2	0 = Alarm 1 = Trip 2 = Off	Underfrequency protection
6~7	0~2	0 = Alarm 1 = Trip 2 = Off	Over-frequency protection
8~9	0~2	0 = Alarm 1 = Trip 2 = Off	Reverse power protection
10~11	0~2	0 = Alarm	Phase sequence protection

		1 = Trip 2 = Off	
12	0~2	0=Ignore 1=Alarm	Communication link failed
13~15		Reserved	Reserved

VI. Response to error

The controller will respond to possible communication as an auxiliary function for communication link error diagnosis. Communication error codes are explained as follows:
02: Variable address error;
03: Variable value error;
04: This operation permission is not available at this time

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