

## UC-3N's MODBUS network communication protocol

### 1: Communication format

Control station UC-3N uses Modbus RTU protocol, data is transmitted by RS-485. modbus RTU communication format:

start	address	Function code	Data field 1...n	CRC check code	end
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Address is 1 byte (Hexadecimal), valid range is 0~247, in which, 0 is broadcast address. Factory setting address is 247, when user wants to form a network with UC-3N, user need to readdress the slave stations according to their requirements.

The slave station's quantity of UC-3N network is 1~246 pieces, beyond the maximum quantity of RS-485 bus regulation. In order to guarantee the network operates reliable, 485 repeater or Hub is required to expend the networking control stations quantity and distance.

Function code is one byte (hexadecimal), to identify the function of each communication frame. UC-3N supports one subset of standard modbus function code. Please refer to the following chapters for the detailed definition.

Data field shows the content of the communication. The length will be different according to different function code.

CRC check code is a 2 bytes Cyclic Redundancy Check code. low-order byte is appended first, the calculation polynomial form of CRC-16 is  $X^{16}+X^{15}+X^2+1$ .

Messages start and end with a silent interval of at least 3.5 character times to validate the integrity of the message frame.

RS-485 interface mode is as follow:

Asynchronous half duplex communication. Default format for each byte is 8 data bits, 1 stop bit, even parity, Baud rate 9600.

Available baud rates are 300, 600, 1200, 2400, 4800, 9600, 14400, 19200, 38400

User can configure controllers for No Parity checking, Even or Odd Parity checking.

Note: If No Parity is used, it is 2 stop bits; if Even or Odd Parity is used, it is 1 stop bit.

### Modbus function codes and address assignment supported by UC-3N

We hereby give some examples. Please note: all the samples we offer here using the factory default station number 247. If user wants to other number, please readdress the station and recalculate CRC check code.

## 2: Read input status register

Function code: 02H

It is used to read the input status of 6 switches of UC-3N. Broadcast is not supported.

Address	Description	Read/Write	Meaning (figure in the description content is decimal)
0000 ①	Input switch status	R ②	D0~D3: 0~3 channel signal, D4-external control; D5-oil level; D6D7 invalid

①In the above figure, address and data are all hexadecimal. Address is protocol address. Same as below tables.

②Read/Write: R-read only; W-write only; RW-Read and Write; --reserved address, network Read/Write is not supported.

Address is 0000 only, readable bits are 1-8, but control station always responses 1 byte.

### Example: data frame format

address	Function	Starting address		Read switch bits		CRC parity code	
F7	02	00	00	00	08	6D	5A

### Response frame format

address	function	Bytes of response data	data	CRC parity	code
F7	02	01	31	53	D4

Each bit status of the response data bytes represents the corresponding input status.

## 3: Read holding registers

Function code: 03H

It is used to read internal register of UC-3N. It is only allow to read out a data of one word (2 bytes) each time. Broadcast is not supported.

address	description	R/W	Meaning (the figure in this meaning column is decimal figure. )
0000	Station address	RW	Modbus address。 Range 1~247
0001	MODBUS protocol type	—	
0002	Communication baud rate	W	1200, 2400, 4800, 9600, 14400, 19200, 38400
0003	Parity	W	'N'-no parity; 'E'-even parity; 'O'-odd parity

0010	Serial number (Low)	R	0~9 9999 9999
0011	Serial number (high)	R	Must read the high order, then low order
0012	Software version	R	The high byte is the primary version number, low byte is the minor version number
0013	language	—	
0020	System protection password	RW	Password range: 0000~9999
0021	Power off protection setting	RW	'N'-off, 'E'-on
0022	Power off protection starting pressure	RW	0~1023, represents 0~50V
0023	External control setting	RW	Low-order byte 'N'-off, 'E'-on. Ignore high-order byte
0024	Oil level monitoring setting	RW	'N'-off, 'E'-on *
0025	Monitoring state register	R	Low-order byte D7-power off protection state; D6-operational control state; D5-oil level monitoring state
0100	Current state of channel 1	R	'C'-lubricating, 'M'-inserted lubrication, 'P'-pause, 'H'-halt, 'T'-stop①
0101	Lubrication control mode of channel 1	RW	'C'-Counter, 'T'-Timer, 'P'-Pulse burst②
0102	Lubrication control parameter of channel 1	RW	1~65535 s or 1~65535 pulses
0103	Lubrication rest parameter of channel 1	R	
0104	Pause control mode of channel 1	RW	'C'-counter, 'T'-timer
0105	Pause parameter of channel 1 (low)	RW	combine the high and low order bytes to get 0~42949 67295 s or 0~42949 67295 pulses③
0106	Pause parameter of channel 1 (high)	RW	Must read high-order byte first, followed by low-order byte.
0107	Pause rest parameter of channel 1 (low)	R	
0108	Pause rest parameter of channel 1 (high)	R	Must read high-order byte first, followed by low-order byte.
0110	Channel 1 pulse time	RW	1~65535, unit 10ms
0111	Channel 1 pulse time	RW	0~65535, unit 10ms④
0112	Channel 1 pulse ratio	—	
0113	Channel 1 injection tuning	—	

0120	Signal monitoring level of channel 1	RW	'N'-off, 'A'-alarm, 'T'-stop
0121	Signal monitoring state of channel 1	R	'N'-no fault, 'A'-alarm, 'T'-stop
0122	Signal monitoring parameter of channel 1	RW	0~65535 s
0123	Monitoring rest parameter of channel 1	R	
0124	Channel 1 signal counting	RW	To do loop count based on modulo 65536 for signal rising edge.
0200	Current state of channel 2	R	The orders of all parameters are same as those of channel 1.

- ① In response data, low-order bytes ASCII character represents the current status of the channel.
- ② In the set or response data, low-order bytes ASCII character represents channel's control mode.
- ③ Pause parameter value across two data fields, it has to be divided into two segments to read/ write. Read/write high-order word first, then low-order word. Otherwise, the result is unpredictable.
- ④ Pump on time and interval time settings only take affects on pulse burst ('P') control mode. Although read/write also can be done under other control modes, the results of the read/write have no meaning.

### Example 1: Read system monitoring status registers

Data frame format

address	Function	Starting address		Read out data quantity		CRC parity code	
F7	03	00	20	00	01	91	56

Response frame format

address	Function	Bytes of response data	Response data		CRC parity code	
F7	03	02	00	40	71	A1

Response data 0040H, the bit status of low order byte ( 01000000B ) represents corresponding monitoring status. D6 is 1, which means external control function is now playing its role.

### Example 2: Read the current status of channel 1

Data frame format

address	Function	Starting address		Read out data quantity		CRC parity code	
F7	03	01	00	00	01	91	60

Response frame format

address	Function	Bytes of response data	Response data		CRC parity code	
F7	03	02	00	43	31	A0

Response data 0043H low-order byte is letter C's ASCII code, which represents channel 1 is now in lubrication state.

### Example 3: Read lubrication rest parameter of channel 1

Data frame format

address	Function	Starting address		Read out data quantity		CRC parity code	
F7	03	01	13	00	01	60	A5

Response frame format

address	Function	Bytes of response data	Response data		CRC parity code	
F7	03	02	00	2A	71	8E

Response data 002AH is lubrication state's rest parameter. Convert it to decimal value is 42.

**Example 4:** Read channel 1's current rest PAUSE value by words. This has to be divided into 2 words to read, and high order word must be read first, followed low order word. Combine the high and low order to a double-word data.

Data frame format

address	Function	Starting address		Read out data quantity		CRC parity code	
F7	03	01	24	00	01	D1	6B

Response frame format

address	Function	Bytes of response data	Response data		CRC parity code	
F7	03	02	87	65	D3	8A

Then read low order:

Data frame format

address	Function	Starting address		Read out data quantity		CRC parity code	
F7	03	01	23	00	01	60	AA

Response frame format

address	Function	Bytes of response data	Response data		CRC parity code	
F7	03	02	43	21	81	79

Response data of read high-order byte is 8765H, and response data of read low-order byte is 4321H. Combine these two segments to form a 4 bytes hexadecimal value 8765 4321H, this is the pause rest parameter.

#### 4: Read input registers

Function code: 04H

It is used to read the 4+1 analog input values of UC-3N. Broadcast is not supported.

address	description	Meaning (the figure in this meaning column is decimal figure. )
0000	The 1 <sup>st</sup> analogue signal measuring value	Range 0~1023 represents 0-20mA①
0001	The 2 <sup>nd</sup> analogue signal measuring value	
0002	The 3 <sup>rd</sup> analogue measuring value	
0003	The 4 <sup>th</sup> analogue measuring value	
0010	power voltage	0~1023, represents 0~50.5V <b>Voltage (V)=measured value × 0.0493</b>
0011	Controller's environment temperature	Control station temperature (°C)= measured value / 3.333-50 ②
FFFE	Input terminal status	Bit definition is as same as function code 02H. It is used to help those modbus masters who do not support function code 02H.

① Analog is handled by first-order low-pass filter, accuracy is 0.5%, refresh rate is about 10ms/channel

② This function is available in enhanced version.

Read out data quantity is only 1.

### Example: Read voltage

Data frame format

address	Function code	Starting address		Read out data quantity		CRC parity code	
F7	04	00	10	00	01	24	99

Response frame format

address	Function code	Bytes of response data	Response data		CRC parity code	
F7	04	02	01	EE	F0	F9

Response data 01EEH is the current voltage value to the controller. Convert to real voltage is 24.2V

## 5: Preset single register

Function code: 06H

It is used to set UC-3N's internal register. Except the named station number ( address 0000 ), all the other addresses support broadcast.

The follow addresses that marked as PRESERVED are not allowed to read; those marked as READ ONLY are not allowed to write.

Address	Description	Meaning (the figure in this meaning column is decimal figure. )
0000	Station number	Modbus station number, range 1~247
0001	MODBUS protocol type	preserve
0002	Baud rate	300, 600, 1200, 2400, 4800, 9600, 14400, 19200, 38400
0003	Parity	'N'-No parity; 'E'-even; 'O'-Odd
0010	Production model	Read only
0011	Serial number(Low)	Read only
0012	Serial number(High)	Read only
0013	Software version	Read only
0014	Language setting	preserve

0015	System protection password	Range 0000~9999
0020	Monitoring status register	Read only
0021	Power off protection setting	'N'-off, 'E'-on
0022	Power off protection start voltage	0~1023
0023	External control setting	Low byte 'N'-off, 'E'-on
0024	Oil level monitoring setting	Low byte 'N'-off, 'E'-on
0100	Current state of CH1	Read only
0110	LUBE control mode of CH1	Low byte 'C'-counter, 'T'-Timer, 'P'-Pulse burst
0111	LUBE control parameters of CH1	1~65535s or 1~65535 pulses
0113	LUBE remain value of CH1	Read only
0120	PAUSE control mode of CH1	Low byte 'C'-Counter, 'T'-Timer
0121	CH1 PAUSE value (Low)	Merge high and low order by 0~42949 67295 s or 0~42949 67295 pulses
0122	CH1 PAUSE value (high)	Must set high-order first, then low-order
0123	PAUSE remain value (Low) of CH1	Read only
0124	PAUSE remain value (High) of CH1	Read only
0130	Pulse time of CH1	1~65535 /10ms
0131	Pulse interval of CH1	0~65535 /10ms
0132	Pulse ratio of CH1	preserve
0133	Projection adjustment of CH1	preserve
0140	Signal monitoring state of CH1	Read only
0141	Signal monitoring level of CH1	'N'-Off, 'A'-Alarm, 'T'-Stop
0142	Signal monitoring parameter of CH1	0~65535 s
0143	Signal monitoring remain value of CH1	Read only
0144	Signal counting of CH1	Read only
0200	Current state of CH2	All parameters order are as same as CH1



**Example 1:** Named address is 1

Data frame format

address	function	Starting address		Read-in data		CRC parity code	
F7	06	00	00	00	01	5C	9C

Response frame format (data frame is an echo of the query)

address	function	Starting address		Read-in data		CRC parity code	
F7	06	00	00	00	01	5C	9C

**Example 2:** Set control mode as counter mode for channel 1 ( 'C', ASCII 43H )

Data frame format

address	function	Starting address		Read-in data		CRC parity code	
F7	06	01	10	00	43	DC	94

Response frame format (data frame is an echo of the query)

address	function	Starting address		Read-in data		CRC parity code	
F7	06	01	10	00	43	DC	94

**Example 3:** Set lubrication control parameter 1000 (03E8H) for channel 1

Data frame format

address	function	Starting address		Read-in data		CRC parity code	
F7	06	01	11	03	E8	CC	1B

Response frame format (data frame is an echo of the query)

address	function	Starting address		Read-in data		CRC parity code	
F7	06	01	11	03	E8	CC	1B

**6: Force channel status change** ( force single coil)

Function code: 05H

It is used to force one of those four channels of UC-3N to change state.

Broadcast is supported.

address	description	Meaning ( the digits in this column are decimal )
0000	Channel 1 (CH1) state	The value of 1 requests the channel to be in lubrication state 'C' (counting mode). The value of 0 (zero) requests the channel go to pause state 'P'①
0001	CH 2 state	
0002	CH 3 state	
0003	CH 4 state	
FFFF	Reboot system	The value of 0 (zero) requests the system to reboot. Other values are invalid.

① If the channel is in halt state 'H', it cannot perform this function, then it will response error code 07H; If user is carrying out local manual operation (the corresponding channel state is already 'M'), or user is programming/viewing menu, slave will ignore this query and response error code 06H (slave device busy).

Constants in data field regulated the forced channel states. The value FF00H force the channel is 1 (lubricating); the value of 0000H force the channel is 0 (pause). Write other values are invalid and slave will response error code 03H ( illegal data ) .

### Example 1: Address channel 1 as 0

Data frame format

address	Function code	Starting address		Control constants		CRC parity codes	
F7	05	00	00	00	00	D9	5C

Response frame format (data frame is an echo of the query)

address	Function code	Starting address		Read-in data		CRC parity codes	
F7	05	00	00	00	00	D9	5C

### Example 2: Address channel 1 as 1

Data frame format

address	Function code	Starting address		control constants		CRC parity codes	
F7	05	00	00	FF	00	98	AC

Response frame format (data frame is an echo of the query )

address	Function code	Starting address		Read-in data		CRC parity codes	
F7	05	00	00	FF	00	98	AC

## 7: Preset multiple registers

Function code: 10H

It is used to set UC-3N's internal register. Except the named station number (address 0000), all other addresses support broadcast. Limited data quantity is 1.

Address same as 5: preset single registers

**Example:** named station number is 1

Data frame format

address	Function code	Starting address			Data number	Bytes	Read-in data		CRC codes	parity
F7	10	00	00	00	01	02	00	01	48	34

Response

address	Function code	Starting address			Data quantity		CRC parity codes	
F7	06	00	00	00	01	15	5F	

## 8: Error code

Function code: slave received function code **+80H**

Function code	description	Meaning ( the digits in this column are decimal)
01	Illegal function	The function code received in the query is not an allowable action for the slave.
02	Illegal data address	The data address received in the query is not an allowable address for the slave.
03	Illegal data	The value contained in the data field is not an allowable value for the slave.
06	Slave device busy	Slave device is engaged. Typical reasons are the slave is busy in processing a local manual operation, viewing or setting parameters.
07	Negative acknowledge	The slave cannot perform the program function received in the query. For example, ask slave to perform force status change when channel is in halt state.

If a slave receives a frame with CRC checking error, or a odd even parity error is detected during data transmission process, slave will keep silent.

**Example: response "illegal data" frame format**

Address	Function code	Error code	CRC Parity codes	
F7	<b>82</b>	<b>02</b>	D9	5C

Response function code **82H** means slave detected error, error code is 02H(illegal data address).