RS485 MODBUS Protocol

80G FMCW Radar Level Sensors

HCCK

2021.11.26

Catalog

1. Communication protocol hardware interface parameters

HCDAR-8X series radar level sensors adopts RS485(4-wire) or UART(2-wire) serial port to communicate external. Default parameters as follow:

Parameter	Serial port level	Baud rate/bps	Parity check	Data length/bit	Stop/bit
Serial port	RS485	9600	none	8	1

2. Communication protocol format

External communication of radar level sensor adopts ModBus RTU communication protocol, and each complete data frame contains address code, function code, data and packet tail. The end of the packet is the CRC16 check data of the data frame. The low byte is first and the high byte is last. The default address of radar level sensor is 1. The radar address can be changed by display control module.

The format of the request command and the format of the radar reply data are described as below:

1. Request command format:

Device Add	Function code	Address	CRC
1 byte	1 byte	4 bytes	2 bytes

2. Request command reply data format

Device add	Function code	Data length	Data	CRC
1 byte	1 byte	1 byte	X bytes	2 bytes

3. Setting command format

Device add	Function code	Address	Data length	Data	CRC
1 byte	1 byte	4 bytes	1 byte	X bytes	2 bytes

4. Setting command reply data format

Device add	Function code	Address	CRC
1 byte	1 byte	4 bytes	2 bytes

3. Communication protocol command description

3.1 Data query command

1. Radar communication test command

Request command:

Device add	Function code	Address	CRC
0x01(default)	0x66	0xAA 55 00 01	0xF9 CA

Reply data:

Device add	Function code	Data length	Data	CRC
0x01	0x66	0x02	0x00 00	0xA6 88

Remarks: receive reply means communication is normal.

2. Measurement value (damped) query command

Request command:

Device add	Function code	Address	CRC
0x01(default)	0x04	0x0A 0F 00 02	0x12 10

Reply data:

Device add	Function code	Data length	Data	CRC
0x01	0x04	0x04	0xXX XX XX XX	0xXX XX

Remarks: The measurement value is Float type data, in meters, and the data length is 4. The data format is lower 16 bits first and higher 16 bits after. The measured value represents the basis of meaning determined by [Sensor mode] .

3. Measurement value (undamped) query command

Request command:

Device add	Function code	Address	CRC
0x01(default)	0x04	0x0A 11 00 02	0x22 16

Reply data:

Device add	Function code	Data length	Data	CRC
0x01	0x04	0x04	0xXX XX XX XX	0xXX XX

Remarks: The measurement value is Float type data, in meters, and the data length is 4. The data format is lower 16 bits first and higher 16 bits after. The measured value represents the basis of meaning determined by [Sensor mode] .

4. Current value query command

Request command:

Device add	Function code	Address	CRC
0x01(default)	0x04	0x0A 0A 00 01	0x12 10

Reply data:

Device add	Function code	Data length	Data	CRC
0x01	0x04	0x02	0xXX XX	0xXX XX

Remarks: Data type unsigned integer, unit is uA.

5. The selected echo amplitude query command

Request command:

Device add	Function code	Address	CRC
0x01(default)	0x04	0x0A 0B 00 01	0x43 D0

Reply data:

Device add	Function code	Data length	Data	CRC
0x01	0x04	0x02	0xXX XX	0xXX XX

Remarks: The value is an unsigned integer in the unit of dB.

6. Application type query command

Request command:

Device Address	Function Code	Address	CRC
0x01(default)	0x03	0x20 69 00 01	0x5F D6

Reply data:

Device Address	Function code	Data Length	Data	CRC
0x01	0x03	0x02	0xXX XX	0xXX XX

Remarks: Data definition of application type: 0-Solid; 1-Liquid.

7. Container Type Query Command

Request command:

Device Address	Function Code	Address	CRC
0x01(default)	0x03	0x20 08 00 01	0x0E 08

Reply data:

Device Address	Function Code	Data Length	Data	CRC
0x01	0x03	0x02	0xXX XX	0xXX XX

Remarks: according to the application type, the data definition of the container type:

（1） Solid: 0-Large volume container; 1-Mediul volume container; 2-Thin & high container; 3-Demonstation; 4-Fast feeding;

（2） Liquid: 0-Large volume container; 1-Mediul volume container; 2-Thin & high container; 3-Demonstation; 4-stirrer；

8. Medium Type Query Command

Request command：

Device Address	Function Code	Address	CRC
0x01(default)	0x03	0x20 30 00 01	0x8F C5

Reply data:

Device Address	Function Code	Data length	Address	CRC
0x01	0x03	0x02	0xXX XX	0xXX XX

Remarks: according to the application type， the data definition of medium type

（1） Solid： 0-Powder; 1-Small particle solid; 2-Bulk solid.

（2） Liquid： 0-DK value>10; 1-DK value 3~10; 2-DK value<3.

9. High Level Adjustment Query Command

Request command:

Device Address	Function Code	Address	CRC
0x01(default)	0x03	0x20 4A 00 02	0xEE 1D

Reply data:

Device Address	Function Code	Data Length	Data	CRC
0x01	0x03	0x04	0xXX XX XX XX	0xXX XX

Remarks: the data value is Float type data, the unit is meter, the data length value is 4. The data format is the low 16-bit data first and the high 16-bit data after.

10. Low level adjustment query command

Request command:

Device Address	Function Code	Address	CRC
0x01(default)	0x03	0x20 48 00 02	0x4F DD

Reply data:

Device Address	Function Code	Data Length	Data	CRC
0x01	0x03	0x04	0xXX XX XX XX	0xXX XX

Remarks: the data value is Float type data, the unit is meter, the data length value is 4. The data format is the low 16-bit data first and the high 16-bit data after.

11. Dead band query command

Request command:

Device Address	Function Code	Address	CRC
0x01(default)	0x03	0x20 44 00 02	0x8F DE

Reply data:

Device Address	Function Code	Data Length	Data	CRC
0x01	0x03	0x04	0xXX XX XX XX	0xXX XX

Remarks: the data value is Float type data, the unit is meter, the data length value is 4.
The data format is the low 16-bit data first and the high 16-bit data after.

12. Measuring Range Query Command

Request command:

Device Address	Function Code	Address	CRC
0x01(default)	0x03	0x20 46 00 02	0x2E 1E

Reply data:

Device Address	Function Code	Data Length	Data	CRC
0x01	0x03	0x04	0xXX XX XX XX	0xXX XX

Remarks: the data value is Float type data, the unit is meter, the data length value is 4.
The data format is the low 16-bit data first and the high 16-bit data after.

13. Sensor mode command

Request command:

Device Address	Function Code	Address	CRC
0x01(default)	0x03	0x20 0A 00 01	0xAF C8

Reply data:

Device Address	Function Code	Data Length	Data	CRC
0x01	0x03	0x02	0xXX XX	0xXX XX

Remarks: the data value represents the radar sensor model setting, the data definition:
0-Level mode; 1-Empty height model; 2-Distance mode.

14. Current output function query command

Request command:

Device Address	Function Code	Address	CRC
0x01(default)	0x03	0x20 15 00 01	0x9E 0E

Reply data:

Device Address	Function Code	Data Length	Data	CRC
0x01	0x03	0x02	0xXX XX	0xXX XX

Remarks: the data value represents the current output value model setting, data definition:
0-Level; 1-Empty height; 2-Distance

15. Waveform query start/stop command

Setting command:

Device Address	Function Code	Address	Length	Data	CRC
0x01(default)	0x10	0x20 34 00 01	0x02	0xXX XX	0xXX XX

Replay data:

Device Address	Function Code	Address	CRC
0x01	0x10	0x20 34 00 01	0xXX XX

Remarks: the reply data address is the same as the setting command, then setting is successful.
The setting command data is defined as follows:
0x0000-End reading；
0x0001-Star reading. The echo and threshold curve length are both 64 registers. Before reading the waveform data, you need to send "Start Reading", and after reading the waveform data, you need to send "End Reading"；
0x0004-Star reading. The echo and threshold curve length are both 60 registers. Before reading the waveform data, you need to send "Start Reading", and after reading the waveform data, you need to send "End Reading"；

16. Curve Wave Query Command

1 . When the waveform query starts, the register is 0x0001
Request command:

Device Address	Function Code	Address	CRC
0x01(default)	0x04	0x80 00 00 40	0xD8 3A

Reply data:

Device Address	Function Code	Data Length	Data	CRC
0x01	0x04	0x80	0xXX XX XX……	0xXX XX

Remarks: （1）There are 128 points of curve data, and the value of each point is 1 byte (0-255). Read 128 bytes of data in turn to obtain the complete curve data.

（2） Before reading the curve data, you must send the [Start reading curve] setting command (the setting value is 0x0001), otherwise the real-time waveform data cannot be obtained. After reading, send [End reading].

2. When the waveform query starts, the register is 0x0004

Request command：

Device Address	Function Code	Address	CRC
0x01(default)	0x04	0x80 00 00 3C	0xD9 DB

Reply data:

Device Address	Function Code	Data Length	Data	CRC
0x01	0x04	0x78	0xXX XX XX……	0xXX XX

Remarks:（1） There are 120 points of curve data, and the value of each point is 1 byte (0-255). Read 120 bytes of data in turn to obtain the complete curve data.

(2) Before reading the curve data, you must send the [Start reading curve] setting command (the setting value is 0x0004), otherwise the real-time waveform data cannot be obtained. After reading, send [End reading].

17. Threshold Curve Query Command

1. When the waveform query starts, the register is 0x0001

Request command：

Device Address	Function Code	Address	CRC
0x01(default)	0x04	0x80 40 00 40	0xD8 3A

Reply data:

Device Address	Function Code	Data Length	Data	CRC
0x01	0x04	0x80	0xXX XX XX……	0xXX XX

Remarks: （1） There are 128 points in the threshold curve data, and the value of each point is 1 byte (0-255). Read 128 bytes of data in turn to obtain the complete curve data.

（2） Before reading the threshold curve data, you must send the [Start reading curve] setting command (setting value is 0x0001), otherwise the real-time waveform data cannot be obtained. After reading, send [End reading].

2. When the waveform query starts, the register is 0x0004

Request command:

Device Address	Function Code	Address	CRC
0x01(default)	0x04	0x80 3C 00 3C	0x19 D7

Reply data:

Device Address	Function Code	Data Length	Data	CRC
0x01	0x04	0x78	0xXX XX XX……	0xXX XX

Remarks: （1）There are totally 120 points in the threshold curve data，the value of each point is 1 byte（0-255），read 120 bytes of data in sequence to obtain complete curve data .
（2） Before reading threshold curve data, the [start reading curve] setting command must be sent the setting value is 0x0004），otherwise, real-time waveform data cannot be obtained. Send [end reading] after reading,

18. Query of measured distance value (with damping) under waveform interface

Request command:

Device address	Function code	Address	CRC
0x01(default)	0x04	0x80 78 00 02	0xFB 84

Reply data:

Device Address	Function code	Data length	Data	CRC
0x01	0x04	0x04	0xXX XX XX XX	0xXX XX

Remarks: (1) The measured value is float type data in meters, the data length value is 4, and the data format is low 16 bit data in front and high 16 bit data in back. The measured value represents the distance.
(2)Before reading data, the [start reading curve] setting command must be sent (the setting value is 0x0004), otherwise the real-time distance data cannot be obtained.

19. Query of measured distance value (without damping) under waveform Interface

Request command:

Device address	Function code	Address	CRC
0x01(default)	0x04	0x80 7A 00 02	0x79 D2

Reply data:

Device address	Function code	Data length	Data	CRC
0x01	0x04	0x04	0xXX XX XX XX	0xXX XX

Remarks: (1) The measured value is float type data in meters, the data length value is 4, and the data format is low 16 bit data in front and high 16 bit data in back. The measured value represents the distance.

(2)Before reading data, the [start reading curve] setting command must be sent (the setting value is 0x0004), otherwise the real-time distance data cannot be obtained.

20. Echo curve, threshold curve, distance measurement results together query

In the waveform interface, when the [Start reading curve] setting command (set value is 0x0004), the register addresses of the curve waveform, threshold curve, damping distance value and undamped distance value are continuous, and the total register length is 124. The following request commands can be sent, and one message completes the reading of these four data.

Request data:

Device Address	Function code	Address	CRC
0x01(default)	0x04	0x80 00 00 7C	0xD8 2B

Reply data:

Device Address	Function code	Data length	Data	CRC
0x01	0x04	0xF8	0xXX XX XX XX	0xXX XX

Remarks: Before reading data, the [start reading curve] setting command must be sent (the setting value is 0x0004), otherwise real-time data cannot be obtained.

21. Alarm information query

Request command:

Device Address	Function code	Address	CRC
0x01(default)	0x04	0x0A 08 00	0xB3 D0

Reply data:

Device Address	Function code	Data length	Data	CRC
0x01	0x04	0x02	0xXX XX	0xXX XX

Remarks：The meaning of alarm data fault is defined as follows:

（1）0x0001 - No valid echo was found in the range ;
（2）0x0002 - No TR Data
（3）0x0004 - No factory threshold learning
（4）0x0008 - 4-20mA Chip error
（5）0x0010 - 4-20mA The current output is in manual mode
（6）0x0020 - LCD Communication error
（7）0x0040 - Abnormal external high-speed crystal oscillator
（8）0x0080 - Low speed clock abnormality
（9）0x0100 - Configure MSI clock error
（10）0x0200 - Configure MSI clock error
（11）0x0400 - AD Acquisition error

3.2 Data set command

1. Application type setting

Set command：

Device address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 69 00 01	0x02	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 69 00 01	0xXX XX

Remark：Data definition of application type ： 0-solid ； 1-liquid .

2. Container type setting

Set command:

Device Address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 08 00 01	0x02	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 08 00 01	0xXX XX

Remarks：According to different application types, the meaning of container type data is defined as follows :

1. solid ：0-Large volume container ； 1-Medium volume container；2-Thin high container；3-Demonstration ； 4-Rapid feeding ；
2. liquid: 0-Large volume container ； 1-Medium volume container；2-Thin high container；3-Demonstration ； 4-Agitator；

3. Medium type setting

Set command:

Device Address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 30 00 01	0x02	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 30 00 01	0xXX XX

Remarks：Data definition of media type ：

For solid ： 0-Powder ； 1-Small particle solid ； 2-Bulk solid 。

For liquid：0-Dielectric constant >10; 1-Dielectric constant 3~10; 2-Dielectric constant <3。

4. High level adjustment setting

Set command:

Device Address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 4A 00 02	0x04	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 4A 00 02	0xXX XX

Remarks： The measured value is float type data in meters, the data length value is 4 bytes, and the data format is low 16 bit data in front and high 16 bit data in back.

5. Low level adjustment setting

Set command:

Device Address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 48 00 02	0x04	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 48 00 02	0xXX XX

Remarks：The measured value is float type data in meters, the data length value is 4, and the data format is low 16 bit data in front and high 16 bit data in back.

6. Dead band setting

Set command:

Device address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 44 00 02	0x04	0xXX XX	0xXX XX

Reply data:

Device address	Function code	Address	CRC
0x01	0x10	0x20 44 00 02	0xXX XX

Remark： The measured value is float type data in meters, the data length value is 4, and the data format is low 16 bit data in front and high 16 bit data in back.

7. Range setting

Set command:

Device Address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 46 00 02	0x04	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 46 00 02	0xXX XX

Remark： The measured value is float type data in meters, the data length value is 4, and the data format is low 16 bit data in front and high 16 bit data in back.

8. Damping filter time setting

Set command:

Device address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 0B 00 01	0x02	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 0B 00 01	0xXX XX

Remark：The data type is unsigned integer. The data is 2 bytes in seconds .

9. Sensor mode setting

Set command:

Device address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 0A 00 01	0x02	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 0A 00 01	0xXX XX

Remark：Data length is 2 bytes，Data definition：0-Level mode；1-Free height mode；2-Distance mode.

10. Distance unit setting

Set command:

Device address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 09 00 01	0x02	0xXX XX	0xXX XX

Reply data:

Device address	Function code	Address	CRC
0x01	0x10	0x20 09 00 01	0xXX XX

Remarks: data length 2 bytes, data definition : 0-m； 1-cm ； 2-mm； 3-foot； 4-inch。

11. Temperature unit setting

Set command:

Device address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 16 00 01	0x02	0xXX XX	0xXX XX

Reply data:

Device address	Function code	Address	CRC
0x01	0x10	0x20 16 00 01	0xXX XX

Remarks：Data length 2 byte ， Data definition ： 0-℃； 1-K。

12. False echo area mode setting

Set command:

Device Address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 3E 00 01	0x02	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 3E 00 01	0xXX XX

Remark：Data length 2 byte ， Data definition ： 0-Whole process learning ;1-Regional Learning ; 2-Learning remaining areas .

13. False echo initial position setting

Set command:

Device address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 3F 00 02	0x04	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 3F 00 02	0xXX XX

Remark：(1) The measured value is float type data in meters, the data length value is 4, and the data format is low 16 bit data in front and high 16 bit data in back.

14. False echo end position setting

Set command:

Device Address	Functio n code	Address	length	Data	CRC
0x01(default)	0x10	0x20 41 00 02	0x04	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 41 00 02	0xXX XX

Remark：(1) The measured value is float type data in meters, the data length value is 4, and the data format is low 16 bit data in front and high 16 bit data in back.

15. False echo learning mode setting

Set command:

Device Address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 43 00 01	0x02	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 43 00 01	0xXX XX

Remark：Data length 2 byte，Data definition：1-false echo learning；2-false echo clear

16. Current output mode setting

Set command:

Device Address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 1A 00 01	0x02	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC

0x01	0x10	0x20 1A 00 01	0xXX XX

Remark：Data length 2 byte ， Data definition ： 0-Manual ； 1-automatic ； 2-Disable

17. Current manual output value setting

Set command:

Device Address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 1B 00 01	0x02	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 1B 00 01	0xXX XX

Remark：The data type is unsigned integer, and the data length is 2 bytes, in mA.

18. Feeding speed setting

Set command:

Device Address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 56 00 01	0x02	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 56 00 01	0xXX XX

Remarks：The value type is unsigned integer, data length is 2 bytes, unit is cm / min .

19. Discharge speed setting

Set command:

Device Address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 57 00 01	0x02	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC

0x01	0x10	0x20 57 00 01	0xXX XX

Remark：The value type is unsigned integer, the data length is 2 bytes, and the unit is cm / min.

20. Factory restore command

Set command:

Device Address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x10 00 00 01	0x02	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x10 00 00 01	0xXX XX

Remarks：Data length 2 byte ， Data definition ： 0-Restore factory ； 1-Device restart.

21. Distance offset setting

Set command:

Device Address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 4E 00 02	0x04	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 4E 00 02	0xXX XX

Remarks：(1) The measured value is float type data in meters, the data length value is 4, and the data format is low 16 bit data in front and high 16 bit data in back. The measured value represents the distance.

22. Current output function setting

Set command:

Device Address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 15 00 01	0x02	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 15 00 01	0xXX XX

Remark：Data length 2 byte，Data definition：0-Level mode；1-Free height mode； 2-Distance mode.

23. Echo loss fault output current setting

Set command:

Device Address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 14 00 01	0x02	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 11 00 01	0xXX XX

Remark：Data length 2 byte，Data definition：0-3.8mA；1-4mA；2-20mA； 3-21mA；4-fixed.

24. Fault timer setting

Set command:

Device Address	Function code	Address	length	Data	CRC
0x01(default)	0x10	0x20 14 00 01	0x02	0xXX XX	0xXX XX

Reply data:

Device Address	Function code	Address	CRC
0x01	0x10	0x20 11 00 01	0xXX XX

Remarks： The data type is unsigned integer. The length of the value is 2 bytes, in seconds.