

# ARTM 系列温度巡检仪

## ARTM Multi Channel Temperature Controller

安装使用说明书 V1.3

Operation Manual V1.3

# 申 明

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# 1 安装使用指南

## 1 Installation guide

### 1.1 概述

#### 1.1 Introduction

ARTM 系列温度巡检测控仪适用于一路或多路温度的测量和控制，主要应用于火电厂、水电站等场合的温度巡检测量及控制。

ARTM series multi-input temperature controller can measure and control multi temperature signals. It is mainly applied to temperature survey and control in thermal power plant and water power plant.

### 1.2 型号及功能

#### 1.2 Type and function

型号 Type	特点 Features	附加功能 Additional features
ARTM-8	测量 8 通道 Pt100 温度，也可以屏蔽其中任意通道。 Measure 8 channel Pt100 temperature, it can also block any of these channels.	/J: 每一通道温度测量对应 2 段报警，继电器输出可以任意设置报警方向及报警值； /J: Each channel temperature measurement corresponds to 2 alarm, and the output of relay can set the alarm direction and alarm value. /C: 带有 RS485 通讯接口(MODBUS-RTU 协议), 可实现数据远传 /C: With the RS485 communication interface (MODBUS-RTU protocol), the data can be transmitted remotely.

注：ARTM8 的测温通道可由用户指定，具体见订货范例。

Notice: The specific temperature channel of ARTM or ARTM16 can be specified by the user, see the sample order for details.

### 1.3 技术参数

#### 1.3 Technical Features

技术指标 Technical Features	指 标 Features
功能 Function	ARTM8
测量通道数 Channels	8
输入信号 Inputs	热电阻: Pt100 Thermal resistance: Pt100

精度等级 Accuracy		0.5 级 0.5s
辅助电源 Power supply	电压范围 Voltage	AC85~265V, DC 100~350V
	功耗 Consumption	≤2W
报警输出 Alarm	路数 Channels	2 组常开 2 groups normally open
	容量 Capacity	AC250V/5A, DC30V/5A
通讯 Communication	协议 Protocol	MODBUS-RTU
	接口 Interface	RS485
	波特率 Speed	可选 1200, 2400, 4800, 9600, 19200 1200, 2400, 4800, 9600, 19200
工频耐压 Isolation		2kV/1min 交流有效值 2kV/1min Ac effective value
环境 Environment	温度 Temperature	工作: -10~+55℃, 存贮: -25~+70℃ Working: -10~+55℃, Storage: -25~+70℃
	湿度 Humidity	≤95%, 不结露, 无腐蚀性气体场所 ≤95%, No dew, no corrosive gas place
	海拔 Altitude	≤2000m

## 1.4 包装

### 1.4 Packaging

包装内含下列项目:

Packaging contains the following items:

主机 (含插拔式端子排, 铭牌, 安装支架等);

Main engine (including plug-in terminal, nameplate, mounting bracket, etc.)

产品安装使用手册。’

Product installation manual.

在打开产品包装时, 请仔细检查是否有损坏, 如有任何损坏, 请及时通知 ACREL 公司或代理商, 并请保留损坏的外包装。如系 ACREL 公司或代理商责任, 将及时予以更换。

When opening the product packaging, please check if there is any damage, please inform ACREL or agent in time, and please keep the damaged outer packing. If it is the responsibility of ACREL company or agent, it will be replaced in time.

## 1.5 安装和接线方法

### 1.5 Installation and fixing

#### 1.5.1 安装尺寸

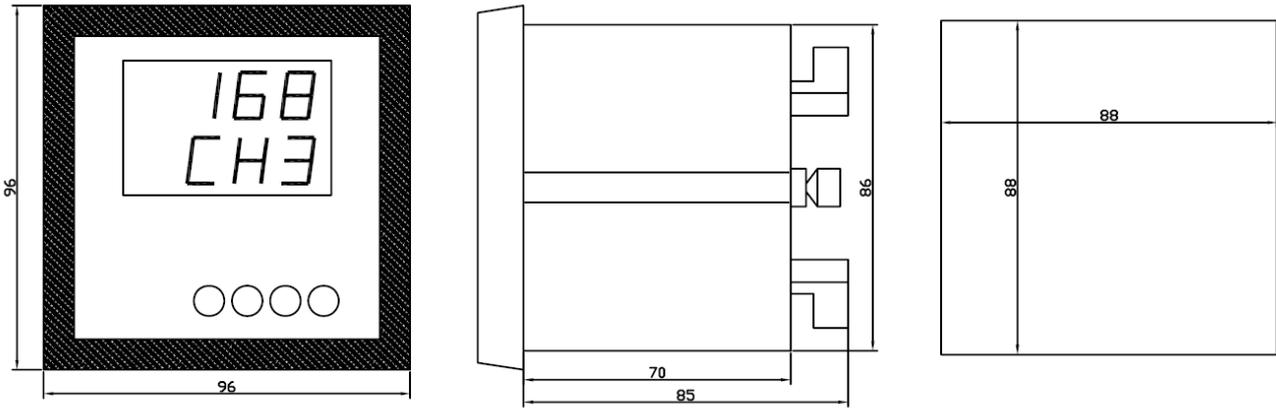
##### 1.5.1 Outlines

##### ■ ARTM8:

正视图  
Front

侧视图  
Side

盘面开孔  
Cut



### 1.5.2 安装方法

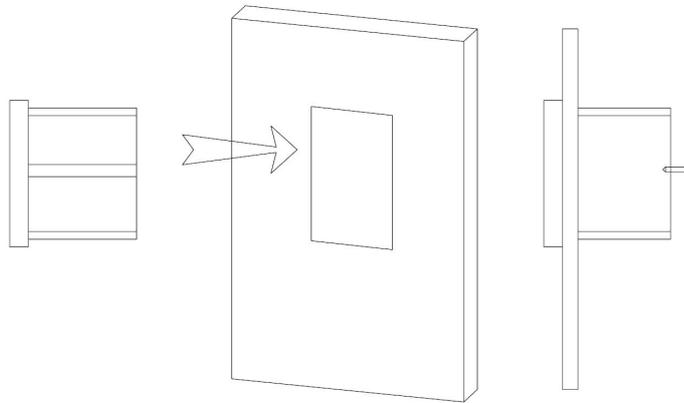
#### 1.5.2 Installation

在您的配电盘上，选择合适的地方开一个与所安装温度巡检仪开孔尺寸相同的安装孔。

On your switchboard, select the appropriate place to open a hole with the same size as the installed temperature inspector.

取出温度巡检仪，松开定位螺钉（逆时针），取下安装支架。

Remove the temperature inspector, loosen the positioning screw (counterclockwise) and remove the mounting bracket.



把仪表插入配电盘仪表孔中。

Insert the meter into the dial gauge hole.

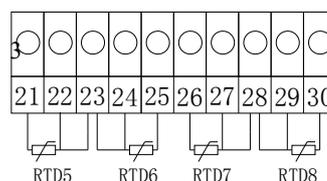
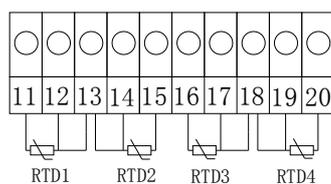
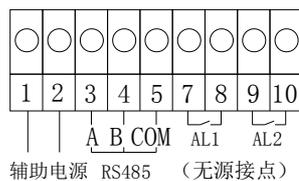
插入仪表后装上安装支架、定位螺钉（顺时针）。

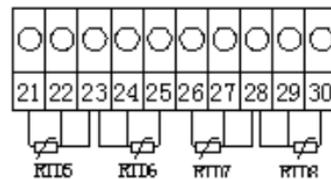
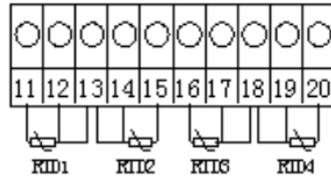
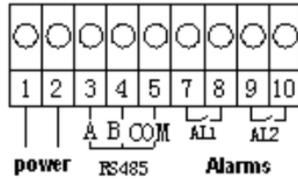
Insert mounting bracket and positioning screw (clockwise) after instrumentation.

### 1.5.3 接线方法（请以仪表上的接线图为准）

#### 1.5.3 Fixing (Please refer to the wiring diagram on the meter)

■ ARTM8:





注意：二线制接线时必须按照图示，将热电阻传感器的其中一根引线接到 2 个端子上。

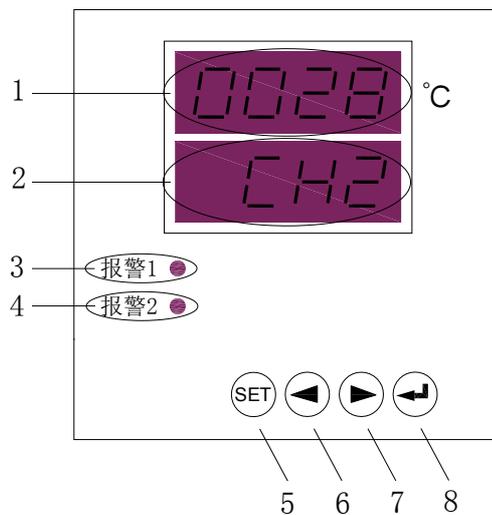
Notice: In the second wire connection, one of the wires of the thermal resistance sensor must be connected to two terminals according to the diagram.

## 2 操作指南

### 2.1 显示介绍

#### 2.1 Display explanation

- ARTM8 的面板图示
- ARTM8 Panel graphic



编号 Number	名称 Name	状态示例 State of the sample	说明 Explanation
1	LEDA	0028	显示当前通道测得的温度值，单位℃，4 位数数码管，分辨率±1℃ Display the temperature value, unit C, 4digitals, resolution ±1℃
2	LEDB	CH2	当前显示的测量通道 Display the number of measured channel
3	AL1	指示灯点亮 Indicator light	报警 1 触发，所有测量通道的任意一路报警 1 触发 Alarm 1 LED, any one - way alarm 1 of all measurement channels is triggered.

4	AL2	指示灯点亮 Indicator light	报警 2 触发, 所有测量通道的任意一路报警 2 触发 Alarm 2 LED, any one - way alarm 2 of all measurement channels is triggered.
5	SET	按键按下 Press the button	选择操作功能或返回上一级菜单 Enter the programming menu or return previous menu
6	左方向键 Left key	按键按下 Press the button	查看数据或数字量增减 Choose menu or reduce number
7	右方向键 Right key	按键按下 Press the button	查看数据或数字量增减 Choose menu or add number
8	ENTER 键 ENTER key	按键按下 Press the button	确定功能或进入下一级菜单 Enter the menu or confirm

## 2.2 系统上电

### 2.2 System power on

依照说明正确接线后, 接通工作电源即进入测量状态。

After the correct wiring is indicated, the working power is connected to the measuring state.

## 2.3 系统设置模式

### 2.3 System setting mode

#### 2.3.1 进入/退出系统设置模式

##### 2.3.1 Enter/exit system setting mode

在正常情况下, 仪表处于正常工作状态, 此时按下 SET 键大于 3 秒, 会进入系统设置模式, 进入系统设置模式前, 首先需要输入正确的密码 (出厂时一般设置为 0001)。

Under normal circumstances, the normal work of the instrument, press the SET key at this time more than 3 seconds, will enter the system setup mode, before entering the system setup mode, you first need to enter the correct password (factory generally SET to 0001).

进入系统设置模式的具体操作如下:

The specific operation of entering the system setting mode is as follows:

(1) 按住 SET 键, 直至画面显示“**Prog**”, 再单击回车键, 显示“**code**”, 提示要输入密码, 再单击回车键出现“**0000**”, 按左右方向键减小或增大数值大小至正确的密码;

(1) Press SET key, until it showed "**Prog**", then click the enter key to display "**code**", prompt to enter a password, then click the enter key in "**0000**", according to the or so direction key numerical size to decrease or increase the correct password.

(2) 密码正确, 则画面显示“**PASS**”, 单击回车即进入系统设置的最高一层菜单; 否则显示“**Err**” (error), 单击回车返回正常模式。

(2) The password is correct, the screen shows "**PASS**", and click enter to enter the highest level menu of system Settings; otherwise, "**Err**" (error) is displayed, and click return to return to normal mode.

系统设置包括报警点设置 (菜单“**SET**”), 回滞量及报警延时设置 (菜单“**HyS**”), 显示模式设置 (菜单“**DISP**”), 通讯设置 (菜单“**BUS**”), 设置新密码 (菜单“**n.cod**”), 查看软件版本号 (菜单“**UErn**”).

System Settings includes emergency alarm Settings (menu "**SET**"), the amount of hysteresis and alarm delay Settings (menu "**HyS**"), the display mode Settings (menu "**DISP**"), communication Settings (menu "**BUS**"), setting a new password (menu "**n.cod**"), to check the software version number (menu "**UErn**").

### 2.3.2 系统设置模式下的操作

#### 2.3.2 Operation under system setting mode.

进入系统设置模式后，选择菜单状态进入。

After entering the system Settings mode, select menu status to enter.

(1) “SET”状态设置

(1) “SET” state setting

密码设置成功，进入系统设置模式以后，按左或右方向键直到显示“SET”，回车确认后显示“CH1”，再次回车后显示“ON”或“OFF”，可按左或右方向键选择。选择“OFF”，回车，即屏蔽通道 1 的温度测量和监控，画面返回“CH1”；选择“ON”，回车，即打开通道 1 的温度测量和监控，并显示“AL1”，即通道 1 的报警点 1 的设定，回车进入显示“HI”或“LO”，首先按左或右键选择设定报警点 1 的报警趋势，“HI”表示高超限报警，“LO”表示低超限报警，回车确认后设定具体数值，按左右方向键减小或增大数值大小，达到要求后回车确定，系统返回“AL1”。

After entering the system setting mode, press left or right arrow keys until the "SET" is displayed. After returning the car, the "CH1" will be displayed, and the "ON" or "OFF" will be displayed after enter, and the left or right arrow keys can be selected. Select "OFF", enter, the temperature measurement and monitoring of shield channel 1, and return "CH1"; Choose "ON", press enter, or open channel 1 temperature measurement and monitoring, and display the "AL1", namely channel 1 emergency alarm 1 set, enter into the show "HI" or "LO", firstly, according to the left or the right to choose to set alarm trend of emergency alarm 1, said "HI" the high limit alarm, "LO" said low limit alarm, press enter to confirm after setting specific values, press the left right direction key numerical size, decrease or increase after reaching requirements determine rate of return, return to "AL1" system.

在“AL1”状态下按左或右键选择“AL2”，即通道 1 的报警点 2 的设定，设定方法与“AL1”完全相同。

In the "AL1" state, press left or right select "AL2", which is the setting of alarm point 2 of channel 1, and the setting method is exactly the same as "AL1".

在“AL1”或“AL2”状态下，按“SET”键返回“CH1”，此时再按左或右键选择可进入其他通道的设置，设置方法与通道 1 完全相同。

Under the condition of "AL1" or "AL2", press "SET" to return "CH1". At this time, select the Settings that can enter other channels on the left or right button, and the setting method is exactly the same as channel 1.

在“CH1”、“CH2”、“CH3”等状态下按“SET”键返回最高一层菜单“SET”。

Press "SET" to return the top menu "SET" in "CH1", "CH2" and "CH3".

(2) “HyS”状态设置

(2) “HyS” state setting

进入系统设置模式以后，按左或右方向键直到显示“HyS”，即设置报警的回滞量和报警延时。按回车键进入，选择“HyS1”设定所有通道报警 1 的回滞量；选择“HyS2”设定所有通道报警 2 的回滞量，选择“DEL”设定报警延时时间。报警延时设定的范围是 1~10，而单位并非秒，假定现设定报警延时值为 4，即连续“4”次测得某一通道的温度处于报警位置，才触发报警。

After entering the system setting mode, press the left or right arrow keys until the "HyS" is displayed, that is, set the alarm back delay and alarm delay. Press enter key to enter, select "HyS1" to set the return amount of all channel alarm 1; select "HyS2" to set the back delay of all channel alarm 2, and select "DEL" to set alarm delay time. **The range of alarm delay setting is 1~10, and the unit is not seconds, assuming that the alarm delay value is 4, that is, the temperature of a channel must be set at the alarm setting in a continuous "4" test, then the alarm will be triggered.**

(3) “DISP”状态设置

(3) “DISP” state setting

进入系统设置模式以后，按左或右方向键直到显示“DISP”，按回车键进入“cyc”状态，即设置循环显示各通道温度值的间隔时间，回车进入数值设置，设置范围 0~20，其中 0 表示正常模式下静态显示某一通道的温度值，其余数值即正常模式下循环显示的间隔时间（单位：秒）。回车确认后返回“DISP”状态。

Into system setting mode, press left or right direction until the show "DISP", press the enter key to enter "cyc"

state, which set up the cycle time interval of each channel temperature value, enter into the value set, the set range 0 ~ 20, where 0 means normal mode shows a static channel temperature value, the rest of the numerical display of cycle in the normal mode namely time interval (unit: second). Enter the **"DISP"** state after the enter confirmation.

设定静态显示，在正常模式下按住左或右键不放，可快速切换到需要的通道温度显示，并保持。

Set the static display, press left or right button in normal mode, can accelerate the switch to the required channel temperature display, and maintain.

设定循环显示，在正常模式下按住右键不放，可加快循环显示速度。

Set the cycle to display, under normal mode, hold right button, can speed up the circulation display speed.

(4) **"BUS"**状态设置

(4) **"BUS"** state setting

进入系统设置模式以后，按左或右方向键直到显示**"BUS"**，即通讯设定，回车确认后显示**"Addr"**状态，再次回车后就可以设置地址的值，通过左或右方向键改变地址值，按回车确认后返回**"Addr"**状态，按左或右方向键选择**"Baud"**状态，回车进入后通过左或右方向键选择合适的波特率，按回车键确认退出。

Enter the system after setting mode, press left or right direction until the show **"Bus"**, namely the communication setting, press enter to confirm after the **"Addr"** status display, enter again after can set the value of address, change address values by left or right direction key, press enter to confirm back the **"Addr"** status, according to the left or right direction key to choose **"Baud"** state, after enter into by left or right direction key to choose the appropriate Baud rate, press enter to confirm.

显示状态 Display state	解释 Explanation	可设定范围 Adjustable range
Addr	通讯地址 Communication address	0001~0247
Baud	通讯波特率 Communication baud rate	1200、2400、4800、9600、19200

(5) **"n.cod"**状态设置

(5) **"n.cod"** state setting

进入系统设置模式以后，按左或右方向键直到显示**"n.cod"**，即设置新的系统密码，按回车进入后，按左或右键输入合适的新密码后，按回车确认。

Enter the system after setting mode, press left or right direction until the show **"n.cod"**, set up new system password, press enter to enter, press the left or right input right after the new password, and press enter to confirm.

(6) **"UErn"**状态设置

(6) **"UErn"** state setting

进入系统设置模式以后，按左或右方向键直到显示**"UErn"**，即查看产品软件版本号，按回车后进入查看状态。

After entering the system setting mode, press the left or right arrow keys until the **"UErn"** is displayed, that is, check the product software version number, and press enter to enter the viewing status.

### 2.3.3 保存设置选择

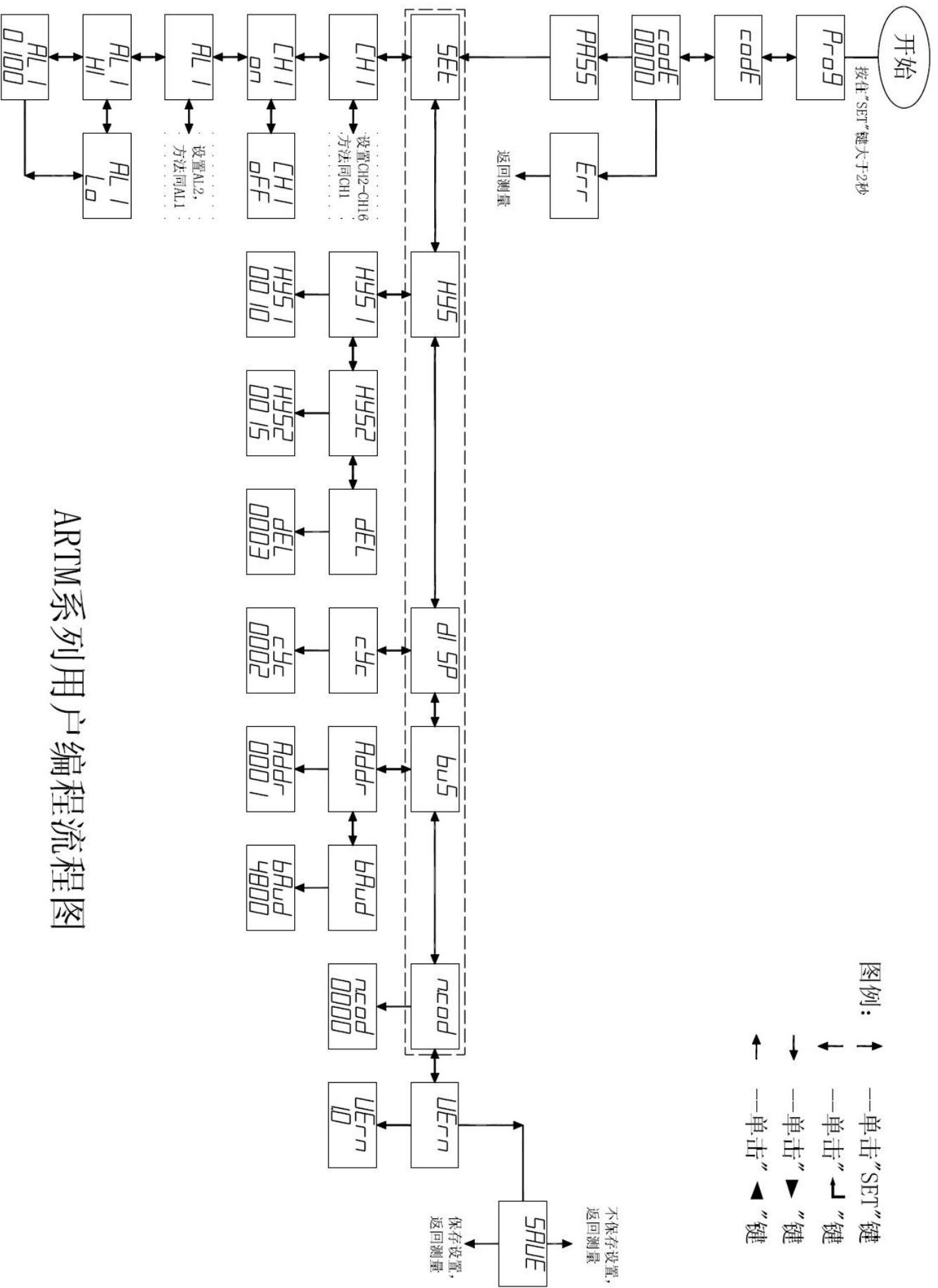
#### 2.3.3 Save Settings selection

全部参数设置完成后，在上述六个状态中的任意一个状态下按**"SET"**键，进入**"SAUE"**状态，即保存数据。此时，按回车键保存设置的内容，按**"SET"**键直接退出系统设置模式，不保存所设置的内容，返回正常模式后按原有参数运行。

After all the parameter Settings are completed, press the **"SET"** button in any of the above six states to enter the **"SAVE"** state, which is to save the data. At this time, press enter key to save the Settings, press the **"SET"** key to directly exit the system setting mode, do not save the contents SET, return to normal mode and follow the original parameters.

#### 2.3.4 用户编程流程图

#### 2.3.4 The Programming chart



图例：

↑ 单击“SET”键

↓ 单击“↵”键

→ 单击“▶”键

← 单击“◀”键

ARTM系列用户编程流程图

## 3 通讯指南

### 3 Communication

在本章主要讲述如何利用软件通过通讯口来操控该系列仪表。本章内容的掌握需要您具有 MODBUS 协议的知识储备并且通读了本册其他章节所有内容，对本产品功能和应用概念有较全面的了解。

This chapter focuses on how to use software to manipulate the series of instruments through a communication port. The mastery of the content of this chapter requires that you have the knowledge reserve of MODBUS protocol and read all the contents of the other chapters of this book, and have a comprehensive understanding of the functions and application concepts of the product.

本章内容包括：MODBUS 协议简述，通讯应用格式详解，本机的应用细节及参量地址表。

The contents of this chapter include: brief introduction of MODBUS protocol, details of communication application format, application details of the machine and parameter address table.

#### 3.1 协议简述

#### 3.1 The protocol explanation

##### 3.1.1 传输方式

##### 3.1.1 Transmission format

传输方式是指一个数据帧内，一系列独立的数据结构以及用于传输的数据的有限规则，下面定义了与 MODBUS 协议（RTU 方式）相兼容的传输方式。

Transport refers to a data frame, a series of separate data structure and used for the transmission of data to limited rules, the following defines that is compatible with the MODBUS protocol (RTU) transmission mode.

每个字节的位

Bits per byte

- 1 个起始位
- 1 start bit
- 8 个数据位，最小的有效位先发送
- 8 data bits, the smallest valid bit is sent firstly
- 无奇偶校验位
- Unexciting parity bit
- 1 个停止位
- 1 stop bit

错误检测：CRC（循环冗余校验）

Error detection: CRC (Cyclic redundancy check)

##### 3.1.2 协议

##### 3.1.2 Protocol

当数据帧到达终端设备时，它通过一个简单的“端口”进入被寻址的设备，该设备去掉数据帧的“信封”（数据头），读取数据，如果没有错误，就执行数据所请求的任务，然后，它将自己生成的数据加入到取得的“信封”中，把数据帧返回给发送者。返回的响应数据帧中包含了以下内容：终端从机地址（Address）、被执行了的命令（Function）、执行命令生成的被请求数据（Data）和一个校验码（Check）。发生任何错误都不会有成功的响应。

When data frames to terminal equipment, it by a simple "ports" to be addressing device, the device to remove the "envelope" data frames (data), read the data, if there are no mistakes, will carry out the tasks of the requested data, then, it will generate its own data to join the "envelope" of the data frame is returned to the sender. The response returned Data frame contains the following contents: the terminal Address (Address), was carried out from the machine's command (Function), execute the command to generate the requested Data (Data) and a Check code (Check). There will be no

successful response to any errors.

### 3.1.2.1 数据帧格式

#### 3.1.2.1 Data frame format

Address	Function	Data	Check
8-bits	8-bits	N×8-bits	16-bits

### 3.1.2.2 地址域

#### 3.1.2.2 Address code

地址域在帧的开始部分，由一个字节（8 位二进制码）组成，十进制为 0~255，在我们的系统中只留用 1~247，其它地址保留。这些位标明了用户指定的终端设备地址，该设备将接收来自与之相连的主机数据。每个终端设备的地址必须是唯一的，仅仅被寻址到的终端会响应包含了该地址的查询。当终端发送回一个响应，响应中的从机地址数据便告诉了主机哪台终端正与之进行通讯。

The Address is at head of the data, and it has 1 byte (8-bits binary code). The decimal is 0~255. In ARTM, it just uses 1~247. It stores the slave address. These bits indicate the address of the terminal device specified by the user, which will receive the host data that is connected to it. The address of each terminal device must be only one, and only the addressable terminal will respond to the query containing the address. When the terminal sends back a response, the data from the machine address in the response tells the host which terminal is communicating with it.

### 3.1.2.3 功能域

#### 3.1.2.3 Function code

功能域代码告诉了被寻址到的终端执行何种功能。下表列出了该系列仪表用到的功能码，以及它们的意义和功能。

The functional domain code tells what function the addressable terminal performs. The following table lists the functional codes used in this series of instruments, as well as their meanings and functions.

代码 Code	意义 Meaning	行为 Action
03 或 04 03 or 04	读数据寄存器 Read/hold register	获得一个或多个寄存器的当前二进制值 Get the current binary value from one or multi hold register
16	预置多寄存器 multiregister	设定二进制值到一系列多寄存器中 Put the binary value into multi hold register

### 3.1.2.4 数据域

#### 3.1.2.4 Data code

数据域包括了终端执行特定功能所需要的数据或者终端响应查询时采集到的数据。这些数据的内容可能是数值、参考地址或者设置值。例如：功能域码告诉终端读取一个寄存器，数据域则要指明从哪个寄存器开始及读取多少个数据，内嵌的地址和数据依照类型和从机之间的不同内容而有所不同。

The data domain includes the data that the terminal needs to perform a particular function, or the data collected when the terminal responds to the query. The contents of these data may be numeric, reference addresses, or set values. For example, code tells terminal functional domains to read from a register, data domain to indicate the starting which register and read how many data, the embedded address and data in accordance with the type and different content varies between machine.

### 3.1.2.5 错误校验域

#### 3.1.2.5 Check code

该域允许主机和终端检查传输过程中的错误。有时，由于电噪声和其它干扰，一组数据在从一个设备传输到另一个设备时在线路上可能会发生一些改变，出错校验能够保证主机或者终端不去响应那些传输过程中发生了改变的数据，这就提高了系统的安全性和效率，错误校验使用了 16 位循环冗余的方法。

This code allows the error of transmission between the master and slave. Sometimes, there will be the errors when a data transferred from equipment to another in the interference due to the electrical noise and other disturbances. The check code can make the slave not to answer the error data in the transmission. This improves the security and efficiency

of the system. Check node uses 16-bits cyclic redundancy.

### 3.1.3 错误检测的方法

#### 3.1.3 Check mode

错误校验 (CRC) 域占用两个字节, 包含了一个 16 位的二进制值。CRC 值有传输设备计算出来, 然后附加到数据帧上, 接收设备在接收数据时重新计算 CRC 值, 然后与就收到的 CRC 域中的值进行比较, 如果这两个值不相等, 就发生了错误。

CRC occupies 2 bytes, and it contains a binary value of 16 bits. It is got by the transmission equipment, and than it is added in the data frame. The master will recalculate the CRC value, and then it compares the value to that received. If 2 values is not same, there must be error.

CRC 运算时, 首先将一个 16 位的寄存器预置为全 1, 然后连续把数据帧中的每个字节中的 8 位与该寄存器的当前值进行运算, 仅仅每个字节的 8 个数据位参与生成 CRC, 起始位和终止位以及可能使用的奇偶位都不影响 CRC。在生成 CRC 时, 每个字节的 8 位与寄存器中的内容进行异或, 然后将结果向低位移位, 高位则用 0 补充, 最低位 (LSB) 移出并检测, 如果是 1, 该寄存器就与一个预设的固定值 (0A001H) 进行一次异或运算, 如果最低位为 0, 则不作任何处理。

The CRC algorithm, you will preset a 16-bit register all to 1, then each byte in the data frame of eight consecutive operation with the current value of the register, only 8 bits of each byte in generate CRC, start bit and stop bit and the possibility of using parity bit does not affect the CRC. When generate CRC, each byte of eight different XOR with the contents of the registers, then the results to the low displacement, high use 0, lowest (LSB) removed and test, if it is 1, the register is fixed with a preset value (0A001H) for an XOR operation, if the lowest is 0, do not make any processing.

上述处理重复进行, 直到执行完了 8 次移位操作, 当最后一位 (第 8 位) 移位完成以后, 下一个 8 位字节与寄存器的当前值进行异或运算, 同样进行上述的另一个 8 次移位异或操作, 当数据帧中的所有字节都作了处理, 生成的最终值就是 CRC 值。

The above process repeated, until the end of the eight times perform shift operation, when the last one (eighth) after the completion of the shift, an 8-bit bytes and register under the current value of XOR operation, another eight times for the same shift XOR operation, when all the bytes of a data frame processing, generate the final value is CRC value.

生成一个 CRC 的流程为:

The process of generating a CRC is:

1、预置一个 16 位寄存器为 0FFFFH (全 1), 称之为 CRC 寄存器。

1、Preset a 16-bit register to be 0FFFFH (all 1), which is called CRC register.

2、把数据帧的第一个字节的 8 位与 CRC 寄存器中的低字节进行异或运算, 结果存回 CRC 寄存器。

2、XORing the 8 bits of the first byte of the data frame with the low byte in the CRC register, and the result is saved back to the CRC register.

3、将 CRC 寄存器向右移一位, 最高位填以 0, 最低位移出并检测。

3、Move the CRC register to the right one, the highest position is 0, and the minimum displacement is detected.

4、如果最低位为 0: 重复第三步 (下一次移位); 如果最低位为 1: 将 CRC 寄存器与一个预设的固定值 (0A001H) 进行异或运算。

4、If the lowest level is 0: repeat step 3 (the next shift); If the lowest level is 1: the CRC register is XORed with a preset fixed value (0A001H).

5、重复第三步和第四步直到 8 次移位。这样处理完了一个完整的 8 位。

5、Repeat step 3 and step 4 up to 8 shifts. This completes a complete 8 bit.

6、重复第 2 步到第 5 步来处理下一个 8 位, 直到所有的字节处理结束。

6、Repeat step 2 to step 5 to handle the next 8 bit, knowing that all byte processing ends.

7、最终 CRC 寄存器的值就是 CRC 的值。

7、The value of the final CRC register is the value of CRC.

此外, 还有一种利用预设的表格计算 CRC 的方法, 它的主要特点是计算速度快, 但是表格需要较大的存储空间, 该方法此处不再赘述, 请参阅相关资料。

In addition, there is a way to use the default form of CRC calculation method, its main characteristic is computing speed, but the form needs large storage space, the method is no longer here, please refer to the relevant information.

### 3.2 通讯应用格式详解

#### 3.2 Communication example

本节所举实例将尽可能的使用如下表所示的格式，（数字为 16 进制）。

The examples in this section will use the format shown in the following table as much as possible (the number is hexadecimal).

Addr	Fun	Data start reg hi	Data start reg lo	Data #of reg hi	Data #of reg lo	CRC16 lo	CRC16 hi
01H	03H	00H	00H	00H	03H	05H	CBH

Addr: 从机地址

Addr: slave address

Fun: 功能码

Fun: function code

Data start reg hi: 数据起始地址 寄存器高字节

Data start reg hi: the start of data code, the high byte

Data start reg lo: 数据起始地址 寄存器低字节

Data start reg lo: the start of data code, the low byte

Data #of reg hi: 数据读取个数 寄存器高字节

Data #of reg hi: the number of data, the high byte

Data #of reg lo: 数据读取个数 寄存器低字节

Data #of reg lo: the number of data, the low byte

CRC16 hi: 循环冗余校验 高字节

CRC16 hi: check data, the high byte

CRC16 lo: 循环冗余校验 低字节

CRC16 lo: check data, the low byte

##### 3.2.1 读数据（功能码 03/04）

##### 3.2.1 Read data (function code 03/04)

- 查询数据帧
- The read data frame

此功能允许用户获得设备采集与记录的数据及系统参数。主机一次请求的数据个数没有限制，但不能超出定义的范围。

This function allows the user to get the data measured and registered by slave and its system parameters. There is not the asking limit, but the data cannot exceed the defined code domain.

下面的例子是从 01 号从机读 3 个采集到的基本数据（数据帧中的每个地址占用 2 个字节）T1、T2、T3，其中 T1 的地址为 0006H，T2 的地址为 0007H，T3 的地址为 0008H。

For example, the 3 data (T1, T2, T3) is read by slave No.01. Each code in the data frame has 2 bytes. T1 is 0006H, T2 is 0007H, T3 is 0008H.

Addr	Fun	Data start Addr hi	Data start Addr lo	Data #of Reg hi	Data #of Reg lo	CRC16 lo	CRC16 hi
01H	03H	00H	06H	00H	03H	E5	CA

- 响应数据帧
- The answer data frame

响应数据帧包括从机地址、功能码、数据的数量、采集的数据和 CRC 错误校验。

The answer data frame includes slave address code, function code, data number code, the measured data code and CRC code.

下面的例子是读取 T1、T2、T3 (T1=016AH, T2=016BH, T3=0169H) 的响应。

The example as below: T1, T2, T3 (T1=016AH, T2=016BH, T3=0169H)

Addr	Fun	Byte Count	Data1 Hi	Data1 Lo	Data2 Hi	Data2 Lo	Data3 Hi	Data3 Lo	CRC16 Lo	CRC16 Hi
01H	03H	06H	01H	6AH	01H	6BH	01H	69H	89H	33H

### 3.2.2 预置多寄存器 (功能码 16)

#### 3.2.2 Multi register (function code 16)

- 查询数据帧
- The read data frame

功能码 16 允许用户改变多个寄存器的内容, 该仪表中系统参数等可用此功能码写入。

The function code 16 allows user to change the content in the register. The system parameters of ARTM can be changed by this code.

下面的例子是预置 ARTM8 或 ARTM16, 设定温度显示的间隔时间为 4 秒, 并关闭通道 1 和通道 2 的温度测量。显示控制字的地址为 0003H, 通道开/关状态控制寄存器的地址为 0004H。

The example as below, set the interval of loop display is 4 seconds; and turn off temperature input channel 1 and channel 2. The code of display control word is 0003H, the code of state of NO/OFF is 0004H.

Addr	Fun	Data start hi	Data start lo	Data #of reg hi	Data #of reg lo	Byte Count	Value1 Hi	Value1 Lo	Value2 Hi	Value2 Lo	CRC16 Lo	CRC16 hi
01H	10H	00H	03H	00H	02H	04H	00H	04H	FFH	FCH	B3H	CAH

- 响应数据帧
- The answer data frame

对于预置寄存器请求的正常响应数是在寄存器值改变后回应机器地址、功能码、数据起始地址、数据个数、CRC 校验码。

The normal response number for the preset register request is to respond to the machine address, function code, data start address, data number and CRC check code after the register value changes.

Addr	Fun	Data start Addr hi	Data start Addr lo	Data #of Reg hi	Data #of Reg lo	CRC16 lo	CRC16 hi
01H	10H	00H	03H	00H	02H	B1H	C8H

### 3.3 参量地址表

#### 3.3 Parameter list

地址 Code	参数 Parameter	读写属性 R/W	数值范围 Value	数据类型 Format
0000H 高字节 High byte	仪表型号 The type of ARTM	R	1: ARTM8; 2: ARTM16	word
0000H 低字节 Low byte	传感器类型 The type of sensor	R	1: Pt100; 2: Cu50	
0001H	保护密码 Password	R/W	0000~9999	word

0002H 高字节 High byte	通讯地址 Slave address	R/W	0001~0247	word
0002H 低字节 Low byte	通讯波特率 Communication speed	R/W	0-4: 对应 1200、2400、4800、9600、19200 0-4: for 1200、2400、4800、9600、19200	
0003H	显示控制字 Display setting	R/W	0~20, 0 表示静态显示, 其余表示循环显示的间隔时间 0~20, 0 normal display; the others is the interval of loop display	word
0004H 高字节 High byte	9~16 通道状态: 打开/屏蔽 (仅 ARTM16 有效) 9~16 channel state: ON/OFF (just for ARTM16)	R/W	每一位分别对应一个通道的状态: 0—屏蔽, 1—打开 Each bit corresponds one channel: 0-OFF, 1-ON	word
0004H 低字节 Low byte	1~8 通道状态: 打开/屏蔽 1~8 channel: ON/OFF	R/W	每一位分别对应一个通道的状态: 0—屏蔽, 1—打开 Each bit corresponds one channel: 0-OFF, 1-ON	
0005H 高字节 High byte	9~16 通道的传感器状态 (仅 ARTM16 有效) 9~16 channel sensor state: (just for ARTM16)	R	每一位分别对应一个通道传感器的状态: 0—正常, 1—错误 Each bit corresponds one channel: 0-OK, 1-ERRO	word
0005H 低字节 Low byte	1~8 通道的传感器状态 1~8 channel sensor state	R	每一位分别对应一个通道传感器的状态: 0—正常, 1—错误 Each bit corresponds one channel: 0-OK, 1-ERRO	
0006H	温度测量值 T1 Temperature value T1	R	Pt100: -200~600; Cu50: -50~150	word
0007H	温度测量值 T2 Temperature value T2	R	Pt100: -200~600; Cu50: -50~150	word
0008H	温度测量值 T3 Temperature value T3	R	Pt100: -200~600; Cu50: -50~150	word
0009H	温度测量值 T4 Temperature value T4	R	Pt100: -200~600; Cu50: -50~150	word
000AH	温度测量值 T5 Temperature value T5	R	Pt100: -200~600; Cu50: -50~150	word
000BH	温度测量值 T6 Temperature value T6	R	Pt100: -200~600; Cu50: -50~150	word
000CH	温度测量值 T7 Temperature value T7	R	Pt100: -200~600; Cu50: -50~150	word
000DH	温度测量值 T8 Temperature value T8	R	Pt100: -200~600; Cu50: -50~150	word
000EH	温度测量值 T9 (仅 ARTM16 有效) Temperature value T9 (just for ARTM16)	R	Pt100: -200~600; Cu50: -50~150	word

000FH	温度测量值 T10 (仅 ARTM16 有效) Temperature value T10 (just for ARTM16)	R	Pt100: -200~600; Cu50: -50~150	word
0010H	温度测量值 T11 (仅 ARTM16 有效) Temperature value T11 (just for ARTM16)	R	Pt100: -200~600; Cu50: -50~150	word
0011H	温度测量值 T12 (仅 ARTM16 有效) Temperature value T12 (just for ARTM16)	R	Pt100: -200~600; Cu50: -50~150	word
0012H	温度测量值 T13 (仅 ARTM16 有效) Temperature value T13 (just for ARTM16)	R	Pt100: -200~600; Cu50: -50~150	word
0013H	温度测量值 T14 (仅 ARTM16 有效) Temperature value T14 (just for ARTM16)	R	Pt100: -200~600; Cu50: -50~150	word
0014H	温度测量值 T15 (仅 ARTM16 有效) Temperature value T15 (just for ARTM16)	R	Pt100: -200~600; Cu50: -50~150	word
0015H	温度测量值 T16 (仅 ARTM16 有效) Temperature value T16 (just for ARTM16)	R	Pt100: -200~600; Cu50: -50~150	word
0016H 高字节 High byte	9~16 通道 AL1 的报警趋势 (仅 ARTM16 有效) 9 <sup>th</sup> ~16 <sup>th</sup> channel AL1 alarm trend (just for ARTM16)	R/W	每一位分别对应一个通道 AL1 的报警趋势: 0—低报警, 1—高报警 Each bit corresponds one channel AL1: 0-low alarm, 1-high alarm	word
0016H 低字节 Low byte	1~8 通道 AL1 的报警趋势 1 <sup>th</sup> ~8 <sup>th</sup> channel AL1 alarm trend	R/W	每一位分别对应一个通道 AL1 的报警趋势: 0—低报警, 1—高报警 Each bit corresponds one channel AL1: 0-low alarm, 1-high alarm	
0017H 高字节 High byte	9~16 通道 AL2 的报警趋势 (仅 ARTM16 有效) 9 <sup>th</sup> ~16 <sup>th</sup> channel AL2 alarm trend (just for ARTM16)	R/W	每一位分别对应一个通道 AL2 的报警趋势: 0—低报警, 1—高报警 Each bit corresponds one channel AL2: 0-low alarm, 1-high alarm	word
0017H 低字节 Low byte	1~8 通道 AL2 的报警趋势 1 <sup>th</sup> ~8 <sup>th</sup> channel AL2 alarm trend	R/W	每一位分别对应一个通道 AL2 的报警趋势: 0—低报警, 1—高报警 Each bit corresponds one channel AL2: 0-low alarm, 1-high alarm	
0018H	通道 1 的 AL1 报警设定值 Setpoint of AL1 for 1 <sup>st</sup> channel	R/W	Pt100: -200~600; Cu50: -50~150	word

0019H	通道 1 的 AL2 报警设定值 Setpoint of AL2 for 1 <sup>st</sup> channel	R/W	Pt100: -200~600; Cu50: -50~150	word
001AH	通道 2 的 AL1 报警设定值 Setpoint of AL1 for 2 <sup>st</sup> channel	R/W	Pt100: -200~600; Cu50: -50~150	word
001BH	通道 2 的 AL2 报警设定值 Setpoint of AL2 for 2 <sup>st</sup> channel	R/W	Pt100: -200~600; Cu50: -50~150	word
001CH	通道 3 的 AL1 报警设定值 Setpoint of AL1 for 3 <sup>st</sup> channel	R/W	Pt100: -200~600; Cu50: -50~150	word
001DH	通道 3 的 AL2 报警设定值 Setpoint of AL2 for 3 <sup>st</sup> channel	R/W	Pt100: -200~600; Cu50: -50~150	word
001EH	通道 4 的 AL1 报警设定值 Setpoint of AL1 for 4 <sup>st</sup> channel	R/W	Pt100: -200~600; Cu50: -50~150	word
001FH	通道 4 的 AL2 报警设定值 Setpoint of AL2 for 4 <sup>st</sup> channel	R/W	Pt100: -200~600; Cu50: -50~150	word
0020H	通道 5 的 AL1 报警设定值 Setpoint of AL1 for 5 <sup>st</sup> channel	R/W	Pt100: -200~600; Cu50: -50~150	word
0021H	通道 5 的 AL2 报警设定值 Setpoint of AL2 for 5 <sup>st</sup> channel	R/W	Pt100: -200~600; Cu50: -50~150	word
0022H	通道 6 的 AL1 报警设定值 Setpoint of AL1 for 6 <sup>st</sup> channel	R/W	Pt100: -200~600; Cu50: -50~150	word
0023H	通道 6 的 AL2 报警设定值 Setpoint of AL2 for 6 <sup>st</sup> channel	R/W	Pt100: -200~600; Cu50: -50~150	word
0024H	通道 7 的 AL1 报警设定值 Setpoint of AL1 for 7 <sup>st</sup> channel	R/W	Pt100: -200~600; Cu50: -50~150	word
0025H	通道 7 的 AL2 报警设定值 Setpoint of AL2 for 7 <sup>st</sup> channel	R/W	Pt100: -200~600; Cu50: -50~150	word
0026H	通道 8 的 AL1 报警设定值 Setpoint of AL1 for 8 <sup>st</sup> channel	R/W	Pt100: -200~600; Cu50: -50~150	word
0027H	通道 8 的 AL2 报警设定值 Setpoint of AL2 for 8 <sup>st</sup> channel	R/W	Pt100: -200~600; Cu50: -50~150	word
0028H	通道 9 的 AL1 报警设定值 (仅 ARTM16 有效) Setpoint of AL1 for 9 <sup>st</sup> channel (just for ARTM16)	R/W	Pt100: -200~600; Cu50: -50~150	word
0029H	通道 9 的 AL2 报警设定值 (仅 ARTM16 有效) Setpoint of AL2 for 9 <sup>st</sup> channel (just for ARTM16)	R/W	Pt100: -200~600; Cu50: -50~150	word
002AH	通道 10 的 AL1 报警设定值 (仅 ARTM16 有效) Setpoint of AL1 for 10 <sup>st</sup> channel (just for ARTM16)	R/W	Pt100: -200~600; Cu50: -50~150	word
002BH	通道 10 的 AL2 报警设定值 (仅 ARTM16 有效) Setpoint of AL2 for 10 <sup>st</sup> channel (just for ARTM16)	R/W	Pt100: -200~600; Cu50: -50~150	word

002CH	通道 11 的 AL1 报警设定值 (仅 ARTM16 有效) Setpoint of AL1 for 11 <sup>st</sup> channel (just for ARTM16)	R/W	Pt100: -200~600; Cu50: -50~150	word
002DH	通道 11 的 AL2 报警设定值 (仅 ARTM16 有效) Setpoint of AL2 for 11 <sup>st</sup> channel (just for ARTM16)	R/W	Pt100: -200~600; Cu50: -50~150	word
002EH	通道 12 的 AL1 报警设定值 (仅 ARTM16 有效) Setpoint of AL1 for 12 <sup>st</sup> channel (just for ARTM16)	R/W	Pt100: -200~600; Cu50: -50~150	word
002FH	通道 12 的 AL2 报警设定值 (仅 ARTM16 有效) Setpoint of AL2 for 12 <sup>st</sup> channel (just for ARTM16)	R/W	Pt100: -200~600; Cu50: -50~150	word
0030H	通道 13 的 AL1 报警设定值 (仅 ARTM16 有效) Setpoint of AL1 for 13 <sup>st</sup> channel (just for ARTM16)	R/W	Pt100: -200~600; Cu50: -50~150	word
0031H	通道 13 的 AL2 报警设定值 (仅 ARTM16 有效) Setpoint of AL2 for 13 <sup>st</sup> channel (just for ARTM16)	R/W	Pt100: -200~600; Cu50: -50~150	word
0032H	通道 14 的 AL1 报警设定值 (仅 ARTM16 有效) Setpoint of AL1 for 14 <sup>st</sup> channel (just for ARTM16)	R/W	Pt100: -200~600; Cu50: -50~150	word
0033H	通道 14 的 AL2 报警设定值 (仅 ARTM16 有效) Setpoint of AL2 for 14 <sup>st</sup> channel (just for ARTM16)	R/W	Pt100: -200~600; Cu50: -50~150	word
0034H	通道 15 的 AL1 报警设定值 (仅 ARTM16 有效) Setpoint of AL1 for 15 <sup>st</sup> channel (just for ARTM16)	R/W	Pt100: -200~600; Cu50: -50~150	word
0035H	通道 15 的 AL2 报警设定值 (仅 ARTM16 有效) Setpoint of AL2 for 15 <sup>st</sup> channel (just for ARTM16)	R/W	Pt100: -200~600; Cu50: -50~150	word
0036H	通道 16 的 AL1 报警设定值 (仅 ARTM16 有效) Setpoint of AL1 for 16 <sup>st</sup> channel (just for ARTM16)	R/W	Pt100: -200~600; Cu50: -50~150	word
0037H	通道 16 的 AL2 报警设定值 (仅 ARTM16 有效)	R/W	Pt100: -200~600; Cu50: -50~150	word

	Setpoint of AL2 for 16 <sup>st</sup> channel (just for ARTM16)			
0038H	AL1 的报警回滞量 The hysteresis of AL1	R/W	0~100	word
0039H	AL2 的报警回滞量 The hysteresis of AL2	R/W	0~100	word
003AH	报警延时 The delay of alarm	R/W	0~10, 延时时间单位为完成对所有开启的通道循环测量一次的周期 0~10, the delay time unit is to complete the cycle of measurement of all open channels.	word
003BH~ 003FH	保留 Reserved	—	—	5 words
0040H 高字节 High byte	9~16 通道 AL1 触发状态 (仅 ARTM16 有效) 9 <sup>th</sup> ~ 16 <sup>th</sup> channel AL1 state (just for ARTM16)	R	每一位分别对应一个通道 AL1 的是否触发: 0—无, 1—有 Each bit corresponds one channel AL1: 0-no, 1-active	word
0040H 低字节 Low byte	1~8 通道 AL1 触发状态 1 <sup>th</sup> ~8 <sup>th</sup> channel AL1 state	R	每一位分别对应一个通道 AL1 的是否触发: 0—无, 1—有 Each bit corresponds one channel AL1: 0-no, 1-active	
0041H 高字节 High byte	9~16 通道 AL2 触发状态 (仅 ARTM16 有效) 9 <sup>th</sup> ~ 16 <sup>th</sup> channel AL2 state (just for ARTM16)	R	每一位分别对应一个通道 AL2 的是否触发: 0—无, 1—有 Each bit corresponds one channel AL2: 0-no, 1-active	word
0041H 低字节 Low byte	1~8 通道 AL2 触发状态 1 <sup>th</sup> ~8 <sup>th</sup> channel AL2 state	R	每一位分别对应一个通道 AL2 的是否触发: 0—无, 1—有 Each bit corresponds one channel AL2: 0-no, 1-active	



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