

BTLT-3

Chain Type Temperature Transmitter



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1. Introduction

The BTLT-3 Chain Type Temperature Transmitter provides multi-point continuous temperature measurement. This structure adopts integrated vulcanization molding, and double steel wires are used inside the cable for reinforcement. The temperature sensor is fixed inside the reinforced cable, and the temperature-sensing part is reasonably protruded to ensure the accuracy and real-time performance of the measurement.

Each temperature measurement point is designed in a bus parallel connection relationship and distinguished by different IDs. The measurements between them are not interfered with, and each measurement point can be used independently. At the same time, the structure supports trimming for use (with proper sealing of the unused end required).

The unique integrated structure ensures its use in a variety of harsh environments and is applicable to media compatible with stainless steel and vulcanized rubber. This includes monitoring in environments such as drill holes, soil, rivers, groundwater, frozen soil, and inside concrete.

2. Product Features and Advantages

- Customizable temperature measurement spacing and number of temperature measurement points
- RS485 standard MODBUS-RTU protocol
- Low power consumption - suitable for field measurements
- Each temperature measurement point stores its own serial number, ID information, and location information (longitudinal depth, lateral coordinate information).
- Built-in double steel wire reinforced cable, can adapt to harsh environments such as frozen soil deformation.
- High-precision imported temperature measurement components, high accuracy, high stability
- Wide voltage supply range of 9-30V
- Power reverse connection protection
- Integrated vulcanized structure, IP68 protection
- The temperature-sensing part of the measurement point is reasonably protruded to ensure direct contact with the measured medium, ensuring high measurement real-time performance

3. Technical Specifications

Main Performance Indicators Specifications	
Accuracy	$\pm 0.1^{\circ}\text{C}$ (typical)
Resolution	0.01°C
Range	$-55\sim 85^{\circ}\text{C}$
Operating Temperature	$-55\sim 125^{\circ}\text{C}$
Storage Temperature	$-55\sim 125^{\circ}\text{C}$
Maximum Number of Temperature Measurement Points	247
Electrical Characteristics	
Power Supply Voltage	9-30VDC
Power Protection	Reverse connection protection
Output Mode	RS485 standard MODBUS-RTU protocol
Insulation	$100\text{M}\Omega@50\text{V}$

4. Wiring Definitions

No.	Wire Color	Definition
1	Red	24V+
2	Blue	RS485+
3	Green	RS485-
4	Yellow	GND

5. Application Scenarios

5.1 Geotechnical & Geological Survey

1) Borehole & Underground Temperature Profiling

Temperature transmitter chain can be used for deep geothermal exploration, mapping temperature fields in underground mines, and monitoring ground temperatures within fault zones.

2) Permafrost & Frozen Soil Deformation Monitoring

Temperature sensor chains are designed for monitoring freeze-thaw cycles in permafrost beneath railway and highway embankments in high-altitude, frigid regions; their built-in dual-steel-wire tensile structure effectively withstands the pressures exerted by freezing soil and surface creep.

5.2 Hydrology & Environmental Monitoring

1) Groundwater & Soil Stratification Temperature

Temperature sensor chains are suitable for long-term monitoring in applications such as agricultural meteorological stations, studies on groundwater movement patterns, wetland ecology, and the heat conduction processes occurring at various soil depths.

2) River, Reservoir & Lake Thermal Profiling

Temperature chains are used to monitor thermal stratification in

reservoirs, assisting water resource authorities in assessing the aquatic environment and the temperature of water released for ecological purposes.

5.3 Civil Infrastructure & Construction Safety

1) Concrete Mass Curing Temperature (Monitoring of hydration heat within mass concrete):

Temperature sensor chains can be used to monitor temperature gradients resulting from the heat of hydration during the pouring of mass concrete for dams, bridge piers, and high-rise buildings, helping to prevent structural cracks caused by temperature differentials between the interior and exterior.

2) Tunnel & Foundation Trench Safety (Monitoring for Tunnel and Foundation Pit Construction Using the Ground Freezing Method)

Temperature sensor strings can be used for real-time monitoring of the temperature field within the frozen wall during construction processes that employ artificial ground freezing to create ice-based retaining walls.

6. Communication Protocol

6.1 RTU Transmission Mode

The default serial communication configuration of the recorder at the factory is: 9600bps, no parity, 1 stop bit.

Communication Address	Function Code	Data Stream	CRC16 Checksum
1byte	1byte	0~252 bytes	2 bytes

Sub-node Address: Slave device address, ranging from 1 to 247 (0x01~0xF7)

Function Code: Indicates the requested operation command to be executed by the slave, which can be standard or user-defined function codes. The values range from 1 to 127 (common function codes, user-defined function codes, reserved function codes), with each value corresponding to an operation command.

Data Stream: The data information necessary to complete the requested command operation, such as addresses and data, with a maximum of 252 bytes.

CRC16: CRC check bits, with the low byte first and the high byte second.

In MODBUS-RTU transmission mode, the structure of the host

request frame and the slave response frame is the same, and the sub-node address and function code content are also the same, with only differences in the data stream and CRC checksum.

6.2 Function Code Description

The function codes in the MODBUS-RTU protocol specify the types of protocol data access operations, capable of completing single-bit operations, 16-bit operations (register operations), file record access, and other functions. The recorder supports responses to four function codes, namely querying the slave address, reading register operations, writing register operations, and reading file record operations, as shown in Table 1.

Table 1 Function Code Definitions

Function Code	Function Definition
03H	Read single or multiple consecutive registers
10H	Write single or multiple consecutive registers

6.2.1 03H Function Code

Function: Reads single or multiple registers. This function code can be used to read the product's parameter registers, data registers,

and status registers.

03H Request Frame Format:

Slave Address	Function Code	Starting Address	Number of Registers	CRC Checksum
1 BYTE	1 BYTE	2 BYTE	2 BYTE	2 BYTE
XX	03	XX XX	XX XX	Checksum

6.2.2 10H Function Code

Function: Writes single or multiple registers. This function code can be used to configure the product's parameter registers to complete parameter settings such as device address, serial port format, sampling time, and zero adjustment.

10H Request Frame Format:

Slave Address	Function Code	Starting Address	Number of Registers	Number of Bytes	Configuration Word	CRC Checksum
1 BYTE	1 BYTE	2 BYTE	2 BYTE	1 BYTE	N*2 BYTE	2 BYTE
XX	10	XX XX	XX XX	XX	XX.....XX	Checksum

6.3 Register List

6.3.1 Parameter Registers

The recorder's general parameter registers store the product's manufacturing information, communication settings, measurement settings, and storage settings. Most of these parameters are configurable (register attribute is R/W), allowing users to modify the configuration as needed; a small portion is set to default factory



settings (register attribute is R), which users cannot configure.

Register Address Register Length Data Type Attribute Description

Device Serial Number 0012 3 ULONG R 6-byte integer,
12-digit serial number

Manufacture Date 0015 2 ULONG R 4-byte integer

Version Number 0017 1 ULONG R 2-byte integer, device
version number

Communication Address 0018 1 UINT R/W The address can
be set to 1~247. Example: To modify the address to 247, the
register configuration value is: 00 F7

Register Name	Register Address	Register Length	Data Type	Attribute	Description
Device Serial Number	0012	3	ULONG	R	6-byte integer, 12-digit serial number
Manufacture Date	0015	2	ULONG	R	4-byte integer
Version Number	0017	1	ULONG	R	2-byte integer, device version number
Communication Address	0018	1	UINT	R/W	The address can be set to 1~247. Example: To modify the address to 247, the register configuration value is: 00 F7

Baud Rate	0019	1	UINT	R/W	2-byte integer, baud rate settings: 1-9600, 2-19200, 3-38400, 4-57600. The default value is 1, which is 9600bps.
Parity Bit	0020	1	UINT	R/W	2-byte integer, parity bit setting: 0-odd parity, 1-even parity, 2-no parity (2 stop bits), 3-no parity (1 stop bit); default value is 3, no parity, 1 stop bit.

After the recorder performs a collection, it will write the water level, temperature, and water pressure into the data registers. Users can use the 03H function code to read the corresponding parameters based on the register address, allowing for the reading of individual parameters or multiple parameters simultaneously.

Register Name	Register Addresses	Register Length	Data Type	Attribute	Description
Position Coordinate Code	0001	2	ULONG	R	The position coordinate code is set during installation and can be left unset.
Temperature	0003	1	UINT	R	Temperature (°C), 2-byte integer. The register value is a signed number, and the actual temperature is obtained by dividing the register value by 100.
Installation Depth	0004	2	ULONG	R	4-byte long integer, indicating the depth of the temperature measurement point (calculated from the reference point), in centimeters. Measured and set before installation, can be left unset.

Note: The register addresses in the list are in decimal, and they need to be converted to their corresponding hexadecimal values



during testing. For example, If the communication address is 00 18,
the corresponding hexadecimal is 00 12.