User Manual

CANDTU-400EWGR User Manual

CAN Bus Message Record and Wireless Data Transmission Equipment

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Category	Contents
Keywords	CAN-BUS message record Ethernet WIFI
Description	Product User Guide

Revision History

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V1.00	2019/08/18	Created

Contents

1. Product Introduction

1.1 Product Overview

It mainly includes: product introduction (overview), product pictures (function instructions may not be provided), and a detailed list of functions.

In the CAN bus troubleshooting, the biggest difficulty is occasional faults. This makes engineers or even CAN experts unable to accurately identify the fault cause. For example, the pitch system of the wind turbine had a CAN data transmission interruption in 72 hours; the dashboard of a new energy vehicle appeared "blank" once during a 10,000 km drive, but this could not reoccur; the high-speed train experienced an emergency deceleration due to abnormal CAN communication during a 2,000 km journey. These occasional CANFD communication exceptions have frightened engineers like time bombs. If one CAN bus data recorder is installed on an occasion prone to faults, it is equivalent to a "black box" to record CAN data, which helps analyze the fault cause.

Guangzhou ZLG Electronics Co., Ltd., as a leading manufacturer of the domestic CAN bus, has developed CANDTU series products for troubleshooting CAN buses, which can record CAN messages offline. It can easily complete the message recording and on-site monitoring of applications such as vehicles, ships, elevators, wind turbines, and construction machinery.

CANDTU-400 series products are 4-channel CAN bus data recorders with storage, which can run independently from PC and store CAN message data for a long time, which helps users analyze and troubleshoot. The recorder can transfer the recorded data to a PC via an SD memory card on the Ethernet. After format conversion of the raw data, users can carry out offline analysis and evaluation of the recorded data by using CANoe and CANScope.

1.2 Features

Table 1.1 Product features

CAN channel	Number of channels: four user-configurable CAN channels
	Interface type: high-speed CAN
	Baud rate: arbitrarily programmable between 5 Kbps and 1 Mbps
	Maximum receive data flow: 4,500 frames/s
	Surge protection: 1 kV (Class A)
	Isolation voltage: 3,500 V
Ethernet Interface	100M/1000M adaptive
Wireless 4G transmission	Support Unicom, Telecom, Mobile 4G
Digital output	Two digital outputs
Digital input	Two digital inputs
Message recording and storage	Storage Capacity: supports SD memory cards of a maximum of 256 GB
	Storage mode: all storage, timing storage

	Full mode: rolling record, full stop
	Trigger mode: conditional trigger, external trigger
	Find and location: Manual time stamping
	Data export: supports multiple data formats, such as .frame, .csv, .txt, and .asc for software analysis
Real-time clock	Built-in rechargeable lithium battery

Continued

Software resources	Supports the general configuration function library, which helps users develop application programs with VC, VB, Delphi and C++ Builder
	Supports the configuration tool CANDTU
Power supply voltage	DC 9 ~ 48V
Power consumption	2.5W
Range of temperature	Operating temperature: -40℃ to +85℃
	Storage temperature: -40℃ to +85℃
External dimension	179mm×131.5mm×50.4mm

1.3 Typical Applications

- High-speed train operation fault detection and troubleshooting
- Subway train running fault detection and troubleshooting
- Train control system operation fault detection and troubleshooting
- Wind turbine CAN communication fault detection
- Multi-channel CAN communication records and fault analysis for traditional vehicles and new energy vehicles
- Ship CANFD communication fault detection and troubleshooting
- Coal mine CAN communication fault analysis
- Elevator operation fault detection and troubleshooting
- Construction machinery operation fault detection and troubleshooting
- Operation detection and troubleshooting of aerospace vehicles and ancillary equipment

2. Specifications

2.1 Electrical Parameters

Table 2.1 Electrical parameters

Parameter Name	Conditions	Rating			Unit
		Minimum	Typical Value	Maximum	
Operating voltage	DC	9	24	48	V
Power consumption		2.04	2.5	5.2	W

2.2 Operating Temperature

Table 2.2 Operating temperature

Parameter Name	Rating			Unit
	Minimum	Typical Value	Maximum	
Operating temperature	-40	-	85	℃
Storage Temperature	-40	-	85	℃

2.3 Protection Level

Table 2.3 Protection level-electrostatic discharge immunity test (IEC61000-4-2)

Interface	Test level	Test Voltage (kV)	Test Result	Remarks
Power supply	Level 4	8	Class A	Contact discharge
CAN bus	Level 4	8	Class A	Contact discharge
Ethernet	Level 4	8	Class A	Contact discharge
Buttons, Indicators	Level 4	15	Class A	Air discharge

Table 2.4 Protection level-electrical fast transient pulse group immunity test (IEC61000-4-4)

Interface	Test level	Test voltage (kV)	Test Result	Remarks
Power supply	Level 3	2	Class A	Capacitive coupling
CAN bus	Level 3	1	Class B	Capacitive coupling
Ethernet	Level 3	2	Class A	Capacitive coupling

Table 2.5 Protection level-surge (impact) test (IEC61000-4-5)

Interface	Test level	Test voltage (kV)	Test Result	Remarks
Power	Level 3	1	Class A	Line-line

supply	Level 3	2	Class A	Line-ground
CAN bus	Level 3	1	Class B	Line-line
	Level 3	2	Class B	Line-ground
Ethernet	Level 3	1	Class A	Line-line
	Level 3	2	Class A	Line-ground

Note: For details, see the attached *Electromagnetic Compatibility Test Report.pdf*

3. Mechanical Dimensions

The mechanical dimensions are shown in the following figure (unit: mm)

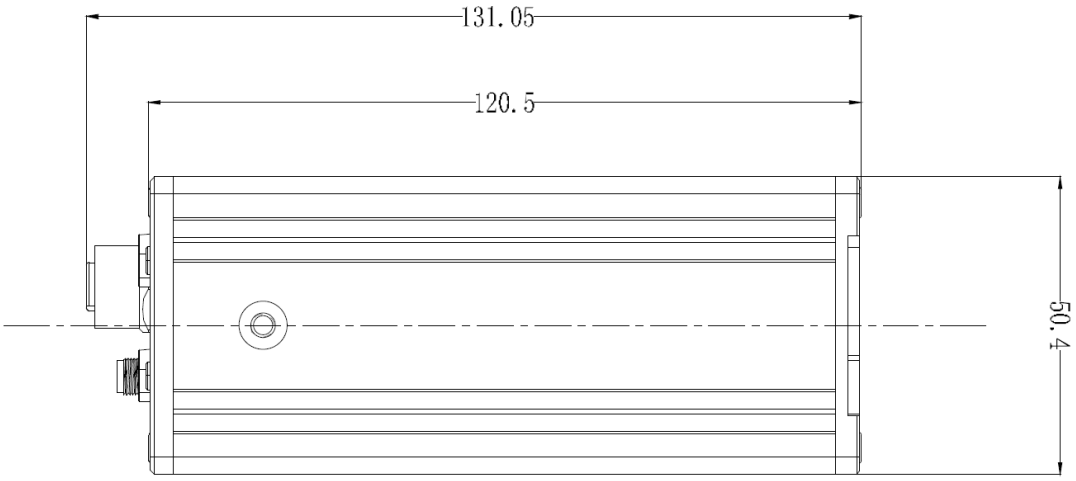


Figure 3.1 Host dimensions diagram 1

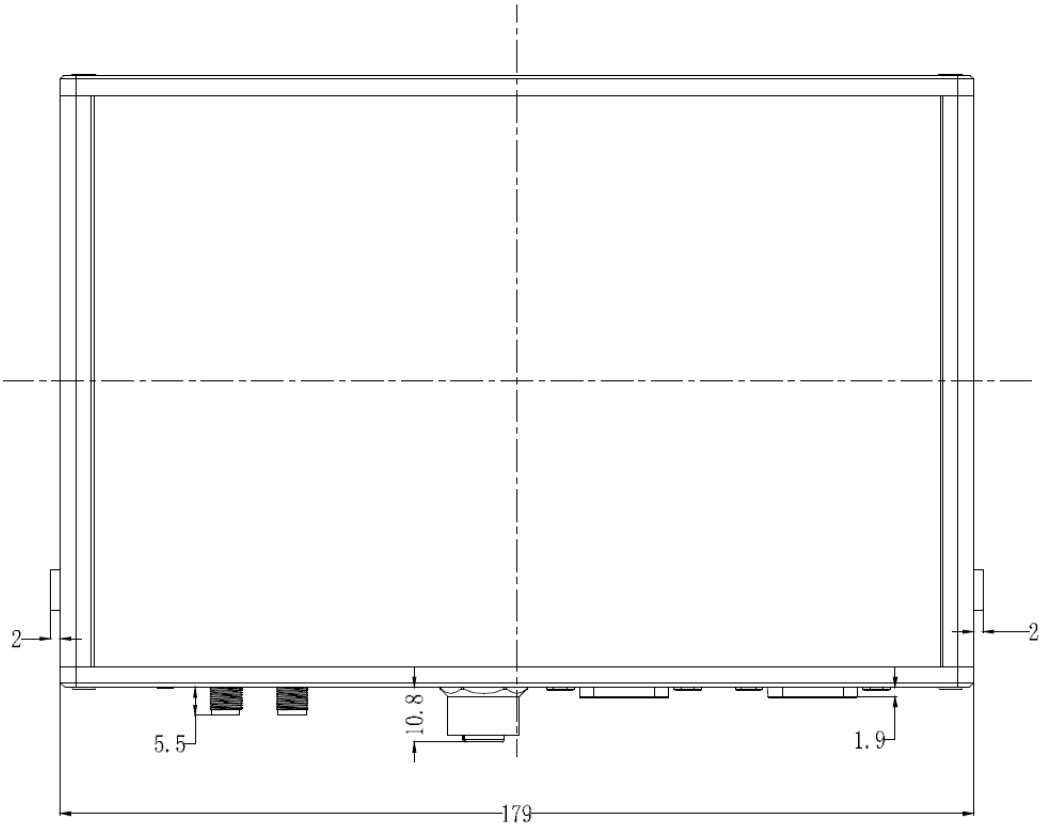


Figure 3.2 Host dimensions diagram 2

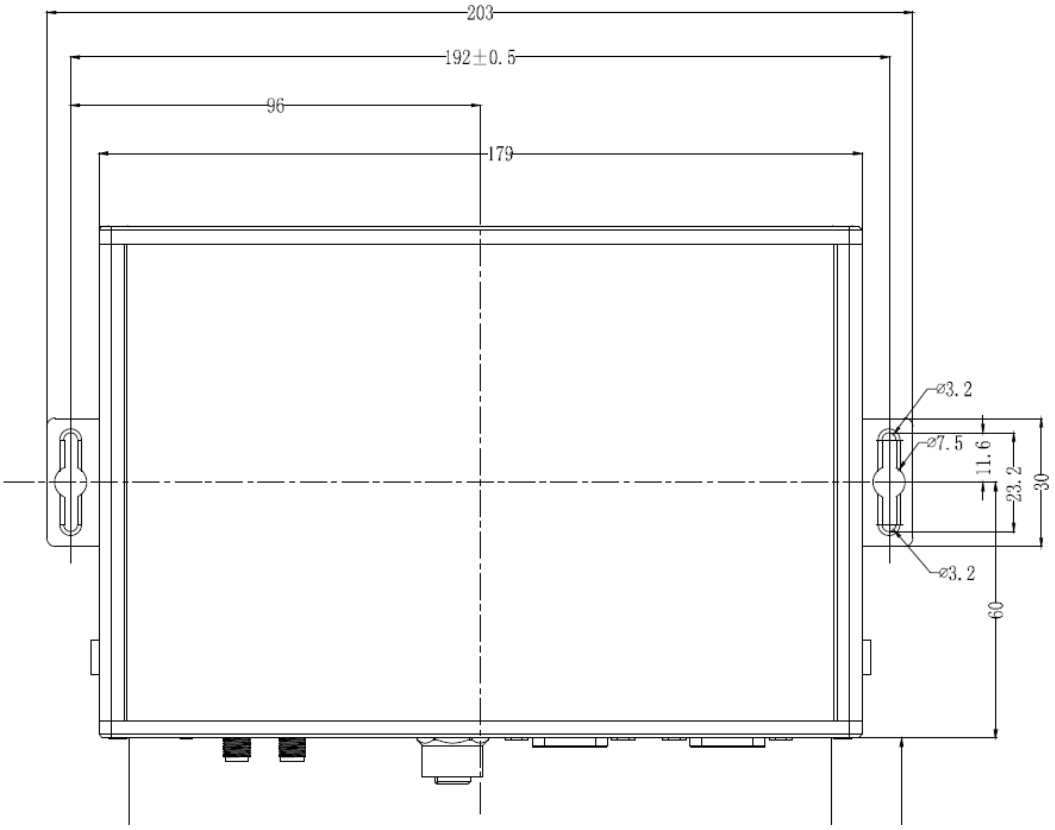


Figure 1 Installation method 1

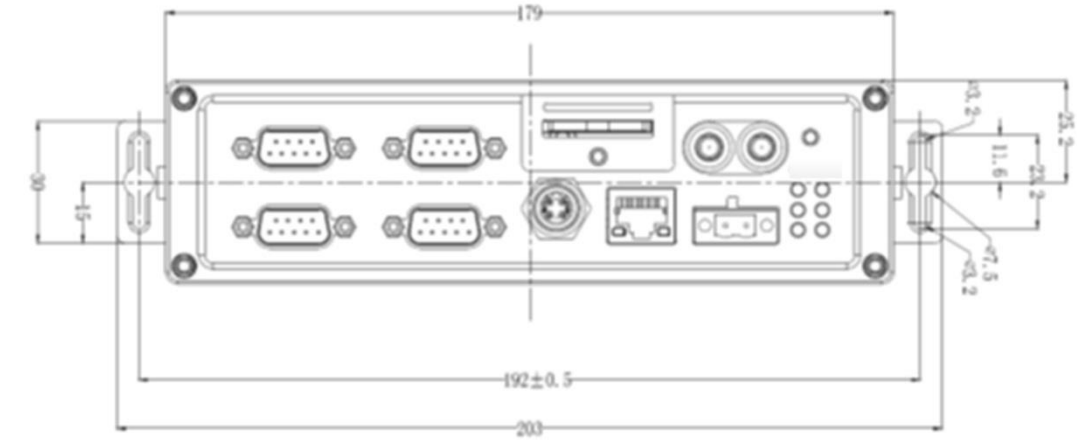


Figure 2 Installation method 2

4. Hardware Interfaces

This section describes the hardware interfaces of CANDTU-400 series equipment.

4.1 Panel Layout

Figure 4.1 shows the device panel layout.

Figure 4.1 Panel layout

4.2 Indicators

Table 4.1 LED indicators

Identification	Function	Status	Description
SYS	System running status indicator	Continuous green light	The device is normal
		The red indicator flashes slowly	Recording is not activated
		The red indicator flashes quickly	SD card abnormal
4G	Indicates 4G status	Continuous green light	The 4G module is waiting for connection
		Green flashing light	The 4G module is in data transmission
		The red indicator is on	The 4G module is abnormal
		The indicator is off	The 4G module is not enabled
CAN0、1 CAN2、3	CAN channel transceiver status indicator	The indicator is off	The CAN channel is not activated
		Green flashing light	The CAN channel receives data properly
		The red indicator is on	The CAN channel received an error frame

4.3 Button

The device provides a trigger button. The shell is identified as "Trigger". Its function is to mark the CAN message data, so that the user can locate the data recorded in the SD card. In addition, this button can be used for firmware upgrade.

Table 4.2 Button functions

Operation	Function	Conditions	Description	Symptom
Stop recording	Stop storing CAN message data	Normal recording, or resumed recording	Hold down the button for more than 3 seconds and less than 10 seconds to stop recording. Then you can safely eject the SD card	The buzzer beeps
Recover records	Recover storage CAN message data	Recording has stopped, and the card exists	Short-press the button to resume recording	Return to the state before the stop; The buzzer beeps twice
			Once the configuration is downloaded, the recording can be resumed	
		Recording has stopped but the card does not exist	Reinsert the card to resume recording	
User tag	Mark CAN message data	Normal record	Press the button for more than 200 ms and no more than 2s to mark the data.	The REC indicator flashes once; The buzzer beeps briefly.
User upgrade	Upgrade device firmware	Power-on process	Insert the SD card, press and hold the button, and power on the device; Release the button after three short buzzer beeps	The buzzer makes three short beeps
Restore network parameters	Restore default network parameters	Device running process	Hold down the button for more than 10s, and release the button	The buzzer beeps long while the button is pressed When the button is released, the buzzer beeps four times in a row

4.4 Power Interface

The rated voltage of the power input of the equipment is DC 9-48 V, and the casing is marked as "DC 9-48V". The physical form of the interface is 5.08 terminals. 错误!未找到

引用源。, 错误!未找到引用源。 and 错误!未找到引用源。 list the interface diagram, signal definition, and interface specifications.

Table 4.3 Power interfaces

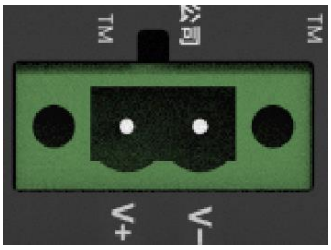
Type	Schematic Diagram
5.08 terminal	

Table 4.4 Terminal signal definitions

Function interface	Signal definition	Signal description	Interface Type
			5.08 interface
Power supply	V+	positive electrode of power	√
	V-	negative electrode of power	√

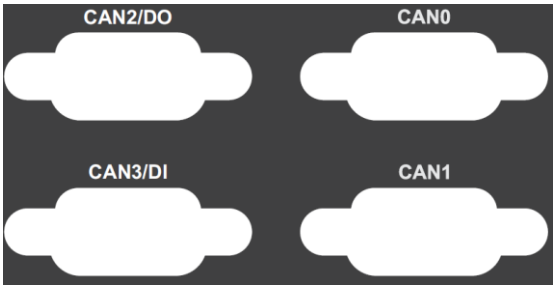
Table 4.5 Power interface specifications

Parameter Name	Conditions	Rating			Unit
		Minimum	Typical value	Maximum	
Working voltage	DC	9		48	V
Power consumption			2.5		W

4.5 CAN-bus Interface and DI DO

The device provides four isolated CAN-Bus interfaces. The shell identification is "CAN0", "CAN1", "CAN2/DO", and "CAN3/DI". The physical form of the interface is the DB9 terminal. 错误!未找到引用源。, 错误!未找到引用源。 and 错误!未找到引用源。 list the interface diagram, signal definition, and interface specifications.

Table 4.6 Pin definitions

Type	Schematic Diagram
DB9 terminal	

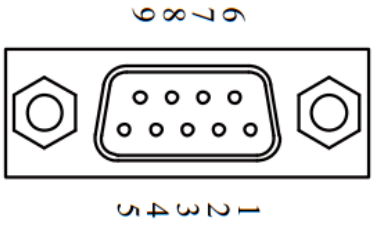
Pin definitions	

Table 4.7 Signal definitions

Function Interface	Signal Definition	Signal Description	Pin Number
CAN0~CAN1	CAN0_L	CAN0 data transceiver differential inverted signal	2
	CAN0_GND	CAN0 isolated ground	3、6
	CAN0_H	CAN0 data transceiver differential positive phase signal	7
	CAN_FG	Shielding ground	5
	NC	Not connected	1、4、8、9
CAN2	CAN0_L	CAN0 data transceiver differential inverted signal	2
	CAN0_GND	CAN0 isolated ground	3、6
	CAN0_H	CAN0 data transceiver differential positive phase signal	7
	CAN_FG	Shielding ground	5
	DO0_P	Digital 0 output channel positive	8
	DO0_N	Digital 0 output channel negative	4
	DO1_P	Digital 1 output channel positive	1
	DO1_N	Digital 1 output channel negative	9
CAN3	CAN1_L	CAN1 data transceiver differential inversion signal	2
	CAN1_GND	CAN1 isolated ground	3、6
	CAN1_H	CAN1 data transceiver differential positive phase signal	7
	CAN_FG	Shielding ground	5
	DI0_P	Digital 0 input channel positive	8
	DI0_N	Digital 0 input channel negative	1

	DI1_P	Digital 1 input channel positive	9
	DI1_N	Digital 1 input channel negative	4

Table 4.8 CAN-Bus interface specifications

parameter		Minimum	Typical value	Maximum	Unit
Communication baud rate		5k		1M	bps
Number of nodes				110	pcs
Dominant level (logic 0)	CANH	2.75	3.5	4.5	V
	CANL	0.5	1.5	2	
Recessive level (logic 1)	CANH	2	2.5	3	
	CANL	2	2.5	3	
Differential level	Dominant (logic 0)	1.2	2	3.1	
	Recessive (logic 1)	-0.5	0	0.05	
Maximum withstand voltage of the bus pin		-18		18	
Instantaneous voltage of the bus		-100		+100	
Isolation voltage (DC)		3500			V

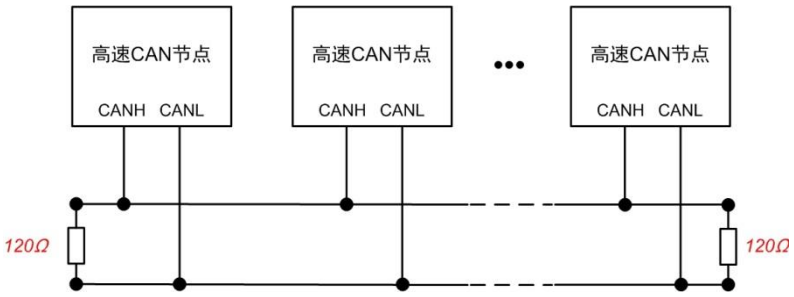


Figure 4 Typical network connection of high-speed CAN

The CAN bus adopts balanced transmission. ISO11898-2 stipulates: In the high-speed CAN, a 120 ohm terminal resistor needs to be connected to the network terminal node to eliminate signal reflection on the bus and avoid signal distortion. Figure 3.2 shows the high-speed CAN network topology.

The device has a built-in 120 ohm terminal resistance, which can be configured to turn on or off by using the configuration tool CANDTU. For operation details, see 4.3.1.

Note: The bus communication distance and communication rate are related to the field application and can be designed according to the actual application and related standards. The CAN-Bus cable can use ordinary twisted pair, shielded twisted pair or standard bus communication cable. In long-distance communication, the terminal resistance value needs to be selected according to the communication distance, cable impedance and number of nodes.

The device provides two digital outputs. The physical form of the interface is a flange terminal. 错误!未找到引用源。 and 错误!未找到引用源。 list the interface schematic diagram, signal definition, and interface specifications.

Table 9 Flange terminal signal definition

Function	Signal	Signal description

interface	definition	
DO	DO_P	Positive pole of the digital output channel
	DO_N	Negative pole of the digital output channel

Table 10 DO interface specifications

parameter	Conditions	Minimum	Typical value	Maximum	Unit
Contact load	DC 3A, resistive			30	V
Contact load	AC 3A, resistive			250	V
Contact Resistance	DC 1A, 24V		0.1		Ω
Isolation voltage	Valid value		4000		V

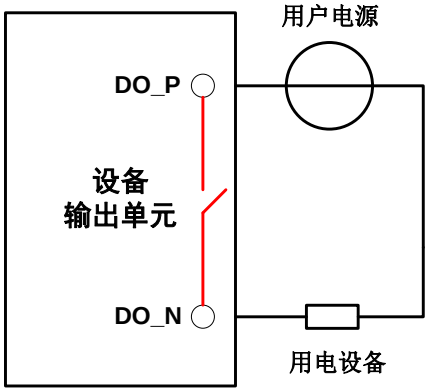


Figure 1 DO network connections

The switch output interface is a relay output type, and the interior is a relay contact. The output control circuit is not limited by voltage and polarity, and can be 24 V DC or 220 V AC. Since it is a dry contact output, users need an external power supply to supply power to alarm devices (such as buzzers). 错误!未找到引用源。 shows the connection.

The switch output interface is used to output the alarm signal. Through the configuration tool, configurable trigger events include record full, CAN bus error, and SD card status abnormality. In addition, the relay can be configured to be normally open or normally closed based on user needs.

Note: The DO function only supports the CANDTU-400EWGR device model

The device provides two digital inputs. The physical form of the interface is a flange terminal. 错误!未找到引用源。 and 错误!未找到引用源。 list the interface diagrams, signal definitions, and interface specifications.

Table 4.11 Flange terminal signal definition

Function interface	Signal definition	Signal description

DI	DI_P	Positive pole of the digital input channel
	DI_N	Negative pole of the digital input channel

Table 11 DI interface specifications

parameter	Conditions	Minimum	Typical value	Maximum	Unit
Logic 0 signal	DC	0		3	V
Logic 1 signal	DC	5		24	V
Isolation voltage	Valid value		3750		V

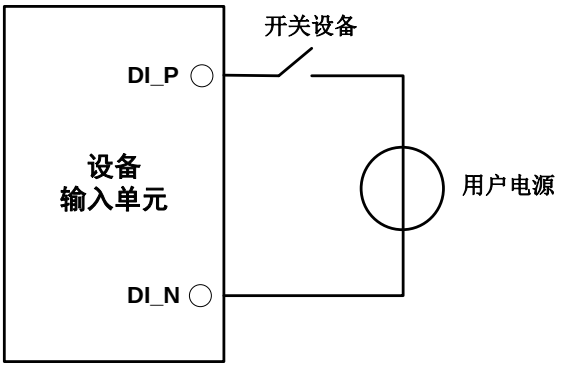


Figure 2 DI network connections

By using the configuration tool, the switch input interface can be configured as timing recording mode and analog key-pressing mode.

1) The timing recording mode is used to regularly collect the switching status of external equipment, such as valve closing and opening, motor start and stop, and contact connection and disconnection. 错误!未找到引用源。 shows the connection diagram.
2) Simulate button mode can be used to simulate on-board buttons, including message marking, pause recording, and resume recording.

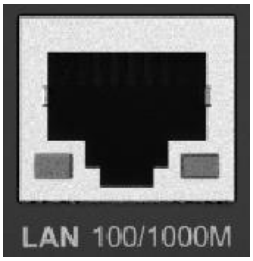
Note: The DI function only supports the CANDTU-400EWGR device model

4.6 Ethernet Interface

The device provides one Ethernet interface. The physical form of the interface is RJ45, which realizes the communication between the device and the PC. The interface 100/1000M specification, interface schematic diagram and signal definition are shown in Table 4.13.

Table 4.12 Ethernet Interface

Type	Schematic Diagram

RJ45 terminal	

4.7 SD Card Interface

The device provides one SD card interface, which supports a maximum of 256 GB SD memory card for storing CAN bus message data. The interface adopts a self-locking card slot, and the SD card can be locked after the card is inserted according to the direction of the casing logo to prevent accidental falling off during use. When pulling out the card, just push it inwards to eject the SD card.

The SD card uses the EXT4 file system. Connecting the SD card through a card reader cannot directly view the SD card data in the Windows system. You need to install a tool plug-in that supports the EXT file system (for example, Ext2Fsd).

Note: Do not forcibly pull out the card during the device operation; otherwise, it may cause data loss or damage to the memory card and device exceptions! If necessary, after powering off the device, open the SD card slot cover, push in gently and eject the SD card.

4.8 4G Interface

The device provides one 4G interface. Table 4.14 lists the physical form of the interface.

Table 4.13 4G interface

Type	Schematic Diagram
4G interface	

4G antenna	

Note: The 4G function only supports the CANDTU-400EWGR device model

4.9 GPS Interface

The device provides one GPS interface. The physical form of the interface is shown in Table 4.15.

Table 4.15 GPS interface

Type	Schematic Diagram
4G interface	
GPS antenna	

Note: The GPS function only supports the CANDTU-400EWGR device model

5. Appendix

5.1 Network Data Format

The CANDTU device supports two network data formats: network data packets and network data frames.

错误!未找到引用源。 shows the network data packet format, and **错误!未找到引用源。** shows the network data frame format. The two network data formats need to be switched through the configuration tool.

Network data packets are composed of multiple network data frames, device IDs, and absolute timestamps.

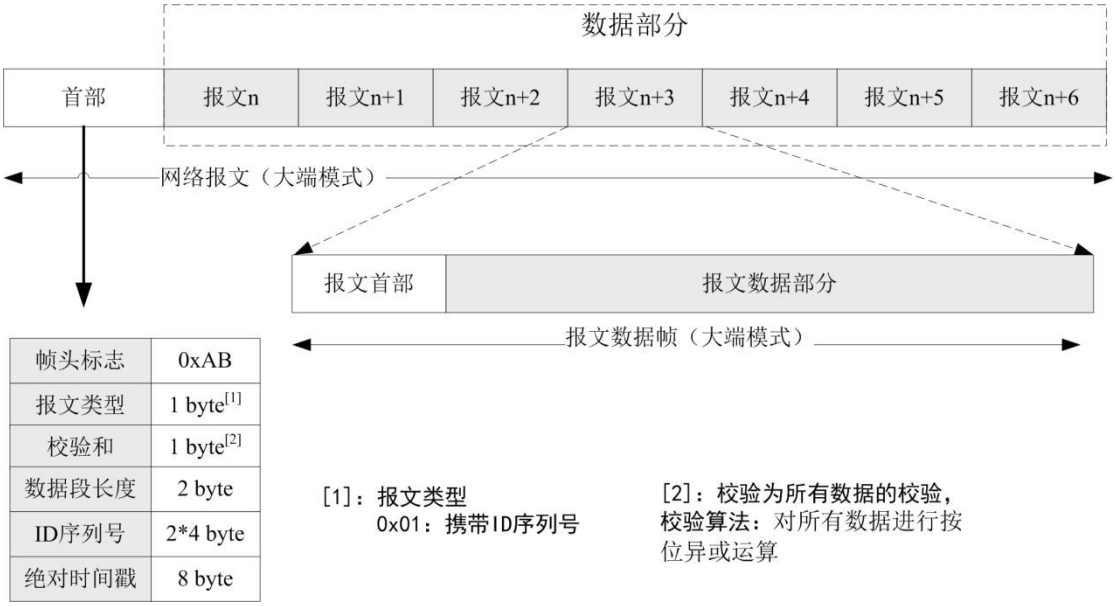


Figure 5.1 Network packet format

The device ID serial number is added to the header of the network data packet, and the data part is a specific data message. Each packet of network data packets may contain different types of packet data. The packet data needs to be obtained after parsing according to the specific data protocol. **错误!未找到引用源。** shows the message data protocol.

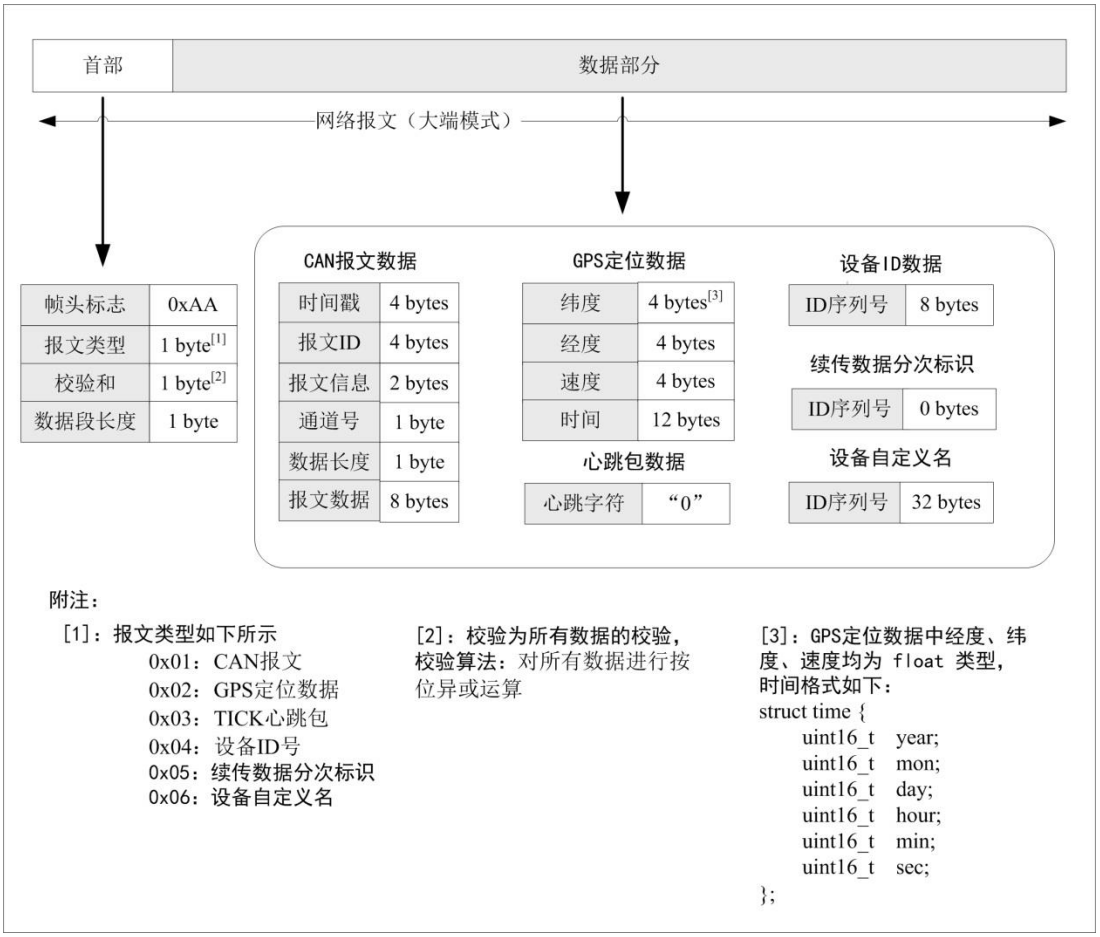


Figure 1 Message data format

Data parsing operation after the network packet is received:

1. Judge and identify network data packets according to the packet header flag (0xAB) and checksum;
2. Get the device ID;
3. Get the absolute timestamp;
4. Get the data length;
5. The specific message is obtained according to the data length and the message protocol.

When parsing a specific message in step 5, the checksum of the message can be not calculated any longer.

Data parsing operation after the network packet is received:

1. Judge and identify network data frames according to the frame header flag (0xAA) and checksum
2. Get the frame type
3. Parse the specific message content according to the frame type

For the definition of CAN message data format, **错误!未找到引用源。** appendix below.

Calculation method of the absolute time of the CAN message:

$$\text{Absolute timestamp of CAN messages T} = \frac{(\text{Absolute timestamp } T_{base} + \text{Relative timestamp of CAN messages } T_{can} * 0.1)}{1000} - 8 * 3600$$

The absolute time can be converted by calling the system function localtime.

5.2 CAN Data Frame Format

Table 5 CAN message packet format definition

Parameter	Parameter Size (Byte)	Description
Time stamp	4	Current message received (time unit: 100 us)
Message ID	4	CAN frame ID [bit28:0]: Frame ID [bit31:29]: Packet type: 0: CAN frame 3: Error frame
Message flag	2	CAN message flag: [bit7]: 1: Error message 0: Normal message [bit6]: 1: Extended frame, 0: Standard frame [bit5]: 1: Remote frame, 0: Data frame [bit4]: Reserved [bit3:0]: Send type: 0: normal send 1: single send 2: Self-send and self-receive 3: One-time self-send and self-receive
Message channel	1	CAN channel
Data length	1	CAN message data length
Data	8	CAN message data

When [bit7] in the message flag is an error message or the value of [bit31:29] in the message ID is 3, the message is an error frame.

The data length of the error frame is 5 bytes. Its data format is as follows.

Table 1 Error frame data description

Data area	Data description
Byte0	Bus state. Its value is defined as shown in 错误!未找到引用源。.
Byte1	Bus error type; When Byte0 is 0xE1, the byte is valid; Its value is defined as shown in 错误!未找到引用源。.
Byte2	0x00
Byte3	Receive error count
Byte4	Send error count

Table 2 Definition of bus status

Error type	Error type description
0x00	Bus normal
0xE1	Bus error
0xE2	Bus alarm
0xE3	Bus negative
0xE4	Bus off
0xE5	Bus overload
0xE6	Bus wake-up

Table 5 Definition of bus error value

Error value	Error description
0x01	Bit error
0x02	Acknowledgment error
0x04	CRC error
0x08	Format error
0x10	Fill error
0x20	Overload error
0x40	Receive buffer full
0x80	Send buffer full

6. Disclaimer

Based on the principle of providing better service for users, Guangzhou ZLG Electronics Co., Ltd. ("ZLG Electronics") will try to present detailed and accurate product information in this manual. However, due to the effectiveness of this manual within a particular period of time, ZLG Electronics does not guarantee the applicability of this document at any time. ZLG Electronics shall reserve the right to update this manual without prior notice. To get the latest version, please visit the official website of ZLG Electronics regularly or contact ZLG Electronics. Thank you!

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