# USBCAN-2A/I/II

## Intelligent CAN Interface Card

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<table>
<thead>
<tr>
<th>Item</th>
<th>Content</th>
</tr>
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<tr>
<td>Keywords</td>
<td>USBCAN, high performance</td>
</tr>
<tr>
<td>Abstract</td>
<td>The USBCAN-2A/I/II device complies with CAN2.0A/B specification, supports any Baud rate in the range of 5Kbps~1Mbps and provides device drives for multiple operating systems. It provides reliable and high-efficiency solution for industrial communication CAN network, meeting various application requirements.</td>
</tr>
</tbody>
</table>

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Guangzhou ZHIYUAN Electronics Co., Ltd.
# Revision History

<table>
<thead>
<tr>
<th>Version</th>
<th>Rev. Date</th>
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<tr>
<td>V1.00</td>
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<td>Created the document.</td>
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<td>Modified some function descriptions.</td>
</tr>
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Chapter 1: Introduction

1.1 Overview

The USBCAN-2A/II/I intelligent CAN interface card is compatible with the USB1.1 bus and integrated with 1-channel/2-channel CAN interface. Using the USBCAN-2A/II/I intelligent CAN interface card, a PC can be connected with the CAN-bus network through USB bus, which form the CAN-bus network control node to process and acquire data in CAN-bus network fields, such as field bus laboratory, industrial control, intelligent house and automotive electronic network.

The series of USBCAN-2A/II/I intelligent CAN interface cards have three independent models:

- **USBCAN-2A** dual-channel industrial CAN interface card
- **USBCAN-II** dual-channel intelligent CAN interface card
- **USBCAN-I** single-channel intelligent CAN interface card

*USBCAN-2A interface card is the enhanced industrial CAN interface card of the USBCAN-II interface card.*

The USBCAN-2A/II/I intelligent CAN interface card is a powerful tool for CAN-bus product development and CAN-bus data analysis. Furthermore, due to its small size and plug-and-play, the USBCAN-2A/II/I interface card is the best choice for portable system users.

The USBCAN-2A/II/I interface card is equipped with an electrical isolation module, which prevents damage from ground circulation and improves its usage reliability in severe environments.

The USBCAN-2A/II/I interface card supports Win9x/Me, Win2000/XP, Linux2.4, Linux2.6 and other operating systems. It also provides unified application programming interface and complete application demonstration code (including VC, VB, Delphi, C++Builder and other demonstration code examples) for users to develop their application programs.

The USBCAN-2A/II/I interface card also supports OPC interface. That means this card can be used in the configuration software that supports OPC. In addition, the CANTest general testing software is provided for CAN-bus message transmitting, receiving and monitoring.

1.2 Specifications

- **PC interface is compliance with USB2.0 protocol specification, and compatible with USB3.0 and USB1.1.**
- **It supports CAN2.0A and CAN2.0B protocols and conforms to ISO/DIS11898-1/2/3 standards.**
● It is integrated with 1-channel/2-channel CAN-bus interface, and each channel is independent.
● Programmable CAN-bus communication baud rate in the range of 5Kbps~1 Mbps.
● The power supply can be provided via the USB Bus, or use the external power supply (DC+9V~+25V, 400mA).
● The CAN channel is provided with electromagnetic isolation and DC/DC power isolation; the isolation voltage is 2500VDC.
● Maximum frame traffic of single channel: 14000 frames/second for receiving, 1000 frames/second for transmitting.
● It supports Win9x/Me, Win2000, WinXP and other Windows operating systems.
● EMC level of CAN interface: ±8KV contact discharge, ±2KV group pulse.

1.3 Product Appearance

Figure 1-1: USBCAN-2A dual-channel industrial CAN interface card

Figure 1-2: USBCAN-II dual-channel intelligent CAN interface card
1.4 Typical Applications

- CAN-bus diagnosis and test.
- Automotive electronic application.
- Electric power communication network.
- Industrial control device.
- High-speed, large data communication.
Chapter 2: Device Installation

2.1 Power Supply Mode

USBCAN-2A/II/I intelligent CAN interface card is featured with small size and plug-and-play. Users can power for the USBCAN-2A/II/I interface card via the PC's USB port or use an external power supply.

2.1.1 External Power Supply Mode

External power supply mode is suitable for PCs using USB bus hubs, or connected to multiple USB terminal devices, resulting in USB ports cannot provide enough current to USBCAN-2A/II/I interface card.

Use an external power supply (DC+9V ~+25V, 200mA) to connect to the POWER socket of the USBCAN-2A/II/I interface card. At this time, the indicator SYS is red. After connecting the PC and the USBCAN-2A/II/I interface card with the USB cable, the USBCAN-2A/II/I interface card can work correctly.

2.1.2 USB Bus Power Supply Mode

The USB bus power supply mode is suitable for most applications.

The USBCAN-2A/II/I interface card is connected to PC directly via the USB cable, and thus provided +5V for the USBCAN-2A/II/I interface card. At this time, the power indicator SYS is lit and turns red, which indicates device power on. After a while, the SYS indicator flashes and turns green, which indicates the interface card can communicate with PC.

2.2 CAN-bus Connector

The USBCAN-II interface card is integrated with two CAN-bus channels, and the USBCAN-I interface card is integrated with one CAN-bus channel. The USBCAN-II/I interface card connects with the actual CAN-bus network through DB9 pin-type socket or DB9 hole-type socket. The CZ1 and CZ2 represent for channel numbers respectively, which are corresponding to the CAN channel of number “0” and number “1”.

Table 2-1 shows the pin definition of DB9 socket. The pin definition complies with the DeviceNet and CANopen standards. Note, USBCAN-I interface card has two parallel sockets including DB9 pin-type socket and DB9 hole-type socket. The pin number arrangement of DB9 hole-type socket is opposite with the pin number arrangement of DB9 pin-type socket, please pay attention to the digital identification on the socket.
when in usage.

### Table 2-1: CAN-bus signal connection (DB9 socket)

<table>
<thead>
<tr>
<th>DB9 Pin-type Socket</th>
<th>Pin</th>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N.C.</td>
<td>Not used</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>CAN_L</td>
<td>CAN_L signal line</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>CAN_GND</td>
<td>Reference ground</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>N.C.</td>
<td>Not used</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>CAN_SHIELD</td>
<td>Shielded line</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>CAN_GND</td>
<td>Reference ground</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>CAN_H</td>
<td>CAN_H signal line</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>N.C.</td>
<td>Not used</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>N.C.</td>
<td>Not used</td>
<td></td>
</tr>
</tbody>
</table>

The CAN-bus signal of DB9 socket can be converted to the 5-pin OPEN5 connector through the optional DB9OPEN5 converter. The OPEN5 connector is easier to connect and its interface description is shown in Table 2-2.

### Table 2-2: Pin assignment of DB9OPEN5 converter (OPEN5 socket)

<table>
<thead>
<tr>
<th>OPEN5 Socket</th>
<th>Pin</th>
<th>Signal</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>V-</td>
<td>Negative network power supply</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>CAN_L</td>
<td>CAN_L signal line</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>SHIELD</td>
<td>Shielded line (FG)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>CAN_H</td>
<td>CAN_H signal line</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>V+</td>
<td>Positive network power supply</td>
<td></td>
</tr>
</tbody>
</table>

The USBCAN-2A interface card is integrated with two CAN-bus channels. Each channel is independent and can be connected to the CAN-bus network or the device with CAN-bus interface. These two CAN-bus channels use a 10-pin AWG 14-22 PTB output. The pin definition of PTB is shown in Table 2-3.

### Table 2-3: CAN-bus signal assignment of USBCAN-2A interface card

<table>
<thead>
<tr>
<th>Pin</th>
<th>Port</th>
<th>Signal</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CAN0</td>
<td>CAN_L</td>
<td>CAN_L signal line</td>
</tr>
<tr>
<td>2</td>
<td>CAN0</td>
<td>R-</td>
<td>Terminal resistance (internally connected to CAN_L)</td>
</tr>
<tr>
<td>3</td>
<td>CAN0</td>
<td>SHIELD</td>
<td>Shielded line (FG)</td>
</tr>
<tr>
<td>4</td>
<td>CAN0</td>
<td>R+</td>
<td>Terminal resistance (internally connected to CAN_H)</td>
</tr>
<tr>
<td>5</td>
<td>CAN0</td>
<td>CAN_H</td>
<td>CAN_H signal line</td>
</tr>
<tr>
<td>6</td>
<td>CAN0</td>
<td>CAN_L</td>
<td>CAN_L signal line</td>
</tr>
<tr>
<td>7</td>
<td>CAN1</td>
<td>R-</td>
<td>Terminal resistance (internally connected to CAN_L)</td>
</tr>
<tr>
<td>8</td>
<td>CAN1</td>
<td>SHIELD</td>
<td>Shielded line (FG)</td>
</tr>
<tr>
<td>9</td>
<td>CAN1</td>
<td>R+</td>
<td>Terminal resistance (internally connected to CAN_H)</td>
</tr>
<tr>
<td>10</td>
<td>CAN1</td>
<td>CAN_H</td>
<td>CAN_H signal line</td>
</tr>
</tbody>
</table>
2.3 Signal Indicator

The USBCAN-I interface card contains one dual-color SYS indicator, one RUN indicator and one ERR indicator to indicate the operating status of device. The function of these three indicators is described in Table 2-4 and Table 2-5.

Table 2-4: Indicators on the USBCAN-I interface card

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Status</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYS</td>
<td>Red</td>
<td>Indicates the device initialization status.</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>Indicates USB interface signal.</td>
</tr>
<tr>
<td>RUN</td>
<td>Green</td>
<td>CAN interface operation</td>
</tr>
<tr>
<td>ERR</td>
<td>Red</td>
<td>CAN interface error</td>
</tr>
</tbody>
</table>

- When the USBCAN-I interface card is powered on, the SYS indicator is red to indicate that the device is powered on and the system is being initialized. Otherwise, it indicates that there is system power supply fault or serious system error.
- After the USB interface is connected properly, the USB signal SYS indicator changes to green, and the system initialization SYS indicator (in Red) is extinguished. When there is data transmission through the USB interface, the USB signal SYS indicator (in Green) flashes.
- When the RUN indicator lights, it indicates the CAN controller has finished initialization and enters into normal operating status.
- When the CAN controller has errors, the ERR indicator is lit; when it has no error, the ERR indicator is extinguished.

Table 2-5: Indicator status of USBCAN-I interface card

<table>
<thead>
<tr>
<th>CAN Indicator Status</th>
<th>CAN Bus Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>RUN indicator and ERR indicator are extinguished</td>
<td>CAN controller and bus are disconnected</td>
</tr>
<tr>
<td>RUN indicator lights</td>
<td>CAN bus works normally</td>
</tr>
<tr>
<td>RUN indicator lights, ERR indicator flashes</td>
<td>CAN-bus has errors or data overflow. It maybe loss frames</td>
</tr>
</tbody>
</table>

The USBCAN-2A/II interface card contains three dual-color indicators, including SYS indicator, CAN1 indicator and CAN2 indicator, to indicate the system operating status. The function of these three indicators is described in Table 2-4 and Table 2-5.
Table 2-6: Indicators on the USBCAN-2A/II interface card

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Status</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYS</td>
<td>Red</td>
<td>Indicates the device initialization status.</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td>Indicates USB interface signal.</td>
</tr>
<tr>
<td>CAN1</td>
<td>Red</td>
<td>CAN1 interface operating status</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td></td>
</tr>
<tr>
<td>CAN2</td>
<td>Red</td>
<td>CAN2 interface operating status</td>
</tr>
<tr>
<td></td>
<td>Green</td>
<td></td>
</tr>
</tbody>
</table>

- When the USBCAN-2A/II interface card is powered on, the system initialization SYS indicator is red to indicate that the device is powered on and the system is being initialized. Otherwise, it indicates that there is system power supply fault or serious system error.
- After the USB interface is connected properly, the USB signal SYS indicator (in Green) lights, and the system initialization SYS indicator (in Red) is extinguished. When there is data transmission through the USB interface, the USB signal SYS indicator (in Green) flashes.
- When the CANx controller is initialized, the CAN interface operating status indicator CANx of the corresponding channel flashes alternately in red and green. After the CANx controller is initialized, the indicator CANx turns green and remained; when an error occurs on the CAN bus, the indicator CANx turns red until the error status is cleared.

Table 2-7: Indicator status of USBCAN-2A/II interface card

<table>
<thead>
<tr>
<th>Indicator Status</th>
<th>CAN Bus Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>All indicators are extinguished</td>
<td>CAN controller and bus are disconnected</td>
</tr>
<tr>
<td>Only Green indicator lights</td>
<td>CAN bus works normally</td>
</tr>
<tr>
<td>Green indicator lights, and Red indicator flashes for one time</td>
<td>Data overflow. It maybe loss frames</td>
</tr>
<tr>
<td>Green indicator lights, and Red indicator flashes</td>
<td>CAN-bus has errors or data overflow. It maybe loss frames</td>
</tr>
</tbody>
</table>

2.4 System Connection

2.4.1 CAN-bus Connection

When the USBCAN-2A/II/I interface card is connected to CAN-bus Bus, users only need to connect CAN_L with CAN_L signal, CAN_H with CAN_H signal.

The CAN-bus network uses linear topology, and the two terminals of bus should be connected with a 120Ω terminal resistance; if the number of nodes is greater than 2, the intermediate node does not need to connect with a 120Ω terminal resistance. For branch connections, the connection distance should not exceed 3m. The CAN-bus connection is shown in Figure 2-1.
2.4.2 Bus Terminal Resistance

In general, the two terminals of CAN-bus network should be added a terminal matching resistance to improve communication reliability, as shown in Figure 2-1. The value of terminal matching resistance is determined by the characteristic impedance of transmission cable. For example, if the characteristic impedance of twisted pair is 120Ω, two terminals of CAN-bus should be connected with a 120Ω terminal resistance. In addition, the USBCAN-2A/II/I interface card uses PCA82C251 transceiver; therefore, if the other nodes on the network use different transceivers, the terminal resistance must be calculated separately.

The USBCAN-II/I intelligent CAN interface card is integrated with an internal 120Ω terminal resistance, without the need of external terminal resistance. USBCAN-2A interface card is not integrated with an internal 120Ω terminal resistance. If the user needs to connect the terminal resistance at the node of the USBCAN-2A interface card, it is necessary to connect the 120Ω terminal resistance to the terminal R+ and R-, as shown in Figure 2-1.

![Figure 2-1: CAN-bus network topology](image)

**Notes:** The CAN-bus can use common twisted pair or shielded twisted pair. If the communication distance exceeds 1Km, the section area of cable should be greater than \( \Phi 1.0 \text{mm}^2 \), which depends on the specific distance. Generally, longer the communication distance is, greater the section area of cable is.

![Figure 2-2: Connection between USBCAN-2A and other CAN devices](image)

As can be seen from the figure, the CAN_H & R+ is directly connected with the CAN_L & R- of the USBCAN-2A interface card in the device. The communication terminal of the USBCAN-2A interface card is physically compatible with the terminal...
of DeviceNet, but is not exactly the same as the electrical structure. Therefore, the
communication terminal of the DeviceNet cannot be directly connected to the terminal
of the USBCAN-2A interface card.

2.4.3 USB Bus Connection

The USB port on the USBCAN-2A/II/I interface card is compliance with USB1.1
protocol specification, and can be connected to a PC with USB1.1 or USB2.0
standard.

There are two ways for connecting the USBCAN-2A/II/I interface card to the PC:

- The attached USB cable is connected to the PC’s USB port directly; at this time,
  it uses bus power supply mode to provide +5V voltage for the USBCAN-2A/II/I
  interface card via the USB port.

- The USBCAN-2A/II/I interface card is connected to the PC via an external USB
  bus hub. If a USB hub powered by the bus is used, the USBCAN-2A/II/I interface
  card must use an external power supply (DC +9~+25V, 200mA) and use the
  external power supply mode.
Chapter 3: Driver Installation

3.1 Install the driver in Windows system for the first time

A. Find usbcan.inf file in the “\USBCAN\Driver” directory and copy it to the “windows\inf” directory, and find usbcan.sys file and copy it to the “windows\system32\driver”.

B. After the files are copied successfully, connect the USBCAN-2A/II/I intelligent CAN interface card with a PC through the USB cable; Then the window system will detect a new hardware device and automatically start the “Find new hardware device” wizard, you can click “Next” to continue.

C. Start to search the new hardware device in the wizard.
D. After a while, the warning about incompatibility between the driver and the operating system may be issued in the Windows XP/Windows 2000, please ignore it and click the “Continue” button directly.

![Image of warning]

E. Continue to install the driver. The installation is completed after find the new hardware device.

![Image of successful installation]

F. Click the “Finish” button. The SYS indicator (in red) on the USBCAN-2A/II/I interface card is extinguished, which indicates the hardware driver is installed successfully and can be used.

### 3.2 Check whether the device is installed successfully

#### 3.2.1 Open the Device Manager in the Windows system

A. Right click the “My Computer” icon on the desktop.
B. Select the “Properties” option on the dropdown menu.
C. Select the “Hardware” tag.
D. Click the “Device Manager” button to open the current hardware device list.

3.2.2 **Confirm whether the new device is installed successfully**

Check the “Universal serial bus device” device class to view whether the “USBCAN” device is already in the current hardware list. If the device driver is installed successfully, the “USBCAN” device will be seen under the “Universal serial bus device” device class in the “Device Manager” interface. The following figure shows the interface after the “ZLG USBCAN series intelligent CAN interface card” device is installed properly.

When the data transmission is performed between the USBCAN-2A/I/I intelligent CAN interface card and a PC, the SYS indicator (in green) on the interface card flashes.
Chapter 4: Inspection and Maintenance

The main electrical components of USBCAN-2A/II/I interface card are semiconductor parts. Although these parts have long life time, they may age quickly if used in improper environment. Therefore, the device should be inspected regularly to guarantee it is used in the allowable condition. The device is recommended to be inspected at least once per 6 months to 1 year, and it should be inspected more frequently if used in the improper environment.

If there is a problem occurred during the device maintenance, please read the following table to find the cause. If the problem can not be solved yet, please contact ZLG ZHIYUAN Electronics.

<table>
<thead>
<tr>
<th>No.</th>
<th>Content</th>
<th>Inspection</th>
<th>Criterion</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Power supply</td>
<td>Check the voltage fluctuation of power supply input</td>
<td>+9V ~ +25VDC or +5V DC USB port power supply</td>
<td>Use a voltmeter to measure the USB port voltage on the power supply input terminal.</td>
</tr>
<tr>
<td>2</td>
<td>Ambient environment</td>
<td>Check ambient temperature (including internal temperature in the closed environment)</td>
<td>-25°C~+85℃</td>
<td>Use a thermometer to measure temperature and ensure the ambient temperature remains within the allowable range.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check ambient humidity (including internal humidity in the closed environment)</td>
<td>The relative humidity should be 10%~90% without air-conditioning.</td>
<td>Use a hygrometer to measure humidity and ensure the ambient humidity remains within the allowable range.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the accumulation of dust, powder, salt, metal shavings</td>
<td>No accumulation</td>
<td>Clean and protect the device.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check whether water, oil, or chemical spray touches the device</td>
<td>No spray touches the device.</td>
<td>If necessary, please clean and protect the device.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check whether there is corrosive or flammable gases around the device</td>
<td>No corrosive or flammable gas</td>
<td>Smell or use a sensor to check whether there is corrosive or flammable gas.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check vibration and shock</td>
<td>Vibration and shock within the specified limits</td>
<td>If necessary, please install a gasket or other shock absorber.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the noise source near the device</td>
<td>No important noise signal source</td>
<td>Isolate the device from noise source or protect the device.</td>
</tr>
<tr>
<td>No.</td>
<td>Content</td>
<td>Inspection</td>
<td>Criterion</td>
<td>Operation</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------</td>
<td>---------------------------------------------------------------------------</td>
<td>-----------------</td>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>3</td>
<td>Installation and wiring</td>
<td>Check the connection of each unit and whether each unit has been securely locked with next unit.</td>
<td>No loosening</td>
<td>Fully press the connectors together and lock them with the slider</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check whether the cable connector is inserted and locked completely.</td>
<td>No loosening</td>
<td>Correct any error connection installation.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check whether there is a loose screw in the external wiring.</td>
<td>No loosening</td>
<td>Tighten the screw with a screwdriver.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check the crimp connector in the external wiring</td>
<td>There is enough space between connectors.</td>
<td>Check it visually, and adjust it if necessary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check whether there is any damage in the external cable.</td>
<td>No damage</td>
<td>Check it visually, and replace the cable if necessary</td>
</tr>
</tbody>
</table>
Chapter 5: Rights & Statements

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Appendix A: CAN Message Filter Settings

The CAN message filter of this converter is designed based on the PeliCAN mode of PHILIPS SJA1000 CAN controller. The filter of SJA1000 is composed of 4 groups (4 bytes) of acceptance code register (ACR) and 4 groups (4 bytes) of acceptance mask register (AMR). The ACR value is predefined acceptance code value, and the AMR value indicates whether the corresponding ACR value is used for acceptance filtering.

However, some registers of the filter are not used in some modes of the SJA1000. For ease of use, only the actual value of the filter is involved in the configuration software and the irrelevant data is discarded.

The general rule of filtering is that each acceptance mask bit corresponds to an acceptance code bit. When the acceptance mask bit is 1 (that is, don’t care), it indicates acceptance regardless of whether the received frame ID bit is equal to the corresponding acceptance code bit; however, when the acceptance mask bit is 0 (relevant), it indicates acceptance only if the received frame ID bit is equal to the corresponding acceptance code bit. And only when all bits signal acceptance, CAN controller will receive the frame message.

The filter mode is divided into single filter and dual filter. The filter is slightly different between standard frame and extended frame. If the “user-defined acceptance mask” is set in the configuration software, all filter function is enabled, which is described as follows:

A.1 Single Filter Configuration

In this filter configuration, one long filter could be defined. The bit correspondences between the filter bytes and the message bytes depend on the currently received frame format.

**Standard frame**: if a standard frame format is used, only part of data bits (lower 11 bits) of the first two ACR bytes (ACR3 and ACR4) is used for acceptance filtering; similarly, only lower 11 bits of AMR3 and AMR4 are used for acceptance filtering.

If a bit in AMR is 0 (relevant), when the corresponding bit (such as, ACR1.0 corresponds to AMR1.0 and ID.00) in ACR is equal to the received frame identifier bit, it indicates “acceptance” (logic 1); when the values of two bits are not equal, it indicates “not acceptance” (logic 0). On the other hand, if a bit in AMR is 1, it indicates “acceptance” (logic 1) regardless of whether the corresponding bit in ACR is equal to the received frame identifier bit.

For a successful reception of a message, all single bit comparisons have to signal acceptance, as shown in Figure 6-1.
**Figure 6-1: Single filter configuration, receiving standard frame messages**

**Extended frame:** when an extended frame format is used, since the frame identifier is 29 bits, part of data bits (lower 29 bits) of four ACR bytes is used for acceptance filtering; similarly, only lower 29 bits of AMR are used for acceptance filtering.

The logic relationship of reception is similar as the standard frame, and the logic presentation is shown in Figure 6-2.

**Figure 6-2: Single filter configuration, receiving extended frame messages**
A.2 Dual Filter Configuration

In this filter configuration, two short filters can be defined. A received message is compared with both filters to decide whether this message should be copied into the receive buffer or not. If at least one of the filters signals an acceptance, the received message becomes valid. The bit correspondences between the filter bytes and the message bytes depend on the currently received frame format.

**Standard frame**: for a standard frame, it means the acceptance filtering is performed for the received frame identifier in the case of two single filters. The acceptance logic is shown in Figure 6-3.

For a successful reception of a message, all single bit comparisons of at least one complete filter have to signal acceptance.

The message frame can be received only when at least one filter signals acceptance.

![Figure 6-3: Dual filter configuration, receiving standard frame messages](image)

**Extended frame**: for an extended frame, the two defined filters are identical. Both two filters only compare the first two bytes of extended identifier (i.e., ID.28~ID.13), not the whole 29 bit identifier, as shown in Figure 6-4.
For a successful reception of a message, all single bit comparisons of at least one complete filter have to signal acceptance.

The message frame can be received only when at least one filter signals acceptance.

Figure 6-4: Dual filter configuration, receiving extended frame messages
Sales Information

Guangzhou ZHIYUAN Electronics Co., Ltd

Address: Floor 2, Building No.7, Huangzhou Industrial Estate, Chebei Road, Tianhe District, Guangzhou.

Zip Code: 510660
Website: www.zlg.cn

Nationwide service hotline: 400-888-4005

Sales and service network:

Guangzhou Sales Office
Floor 2, Building No.7, Huangzhou Industrial Estate, Chebei Road, Tianhe District, Guangzhou.
TEL: (020)28267985  22644261

Shanghai Branch: Shanghai
Room 12E, Jingcheng Building (E), No.668 Beijing Road (E), Shanghai.
TEL: (021)53865521  53083451

Beijing Branch
F/19, Haojing Building A, No.108 Zhichun Road, Haidian District, Beijing.
TEL: (010)62536178  62635573

Shanghai Branch: Nanjing
Room 1501, Pearl River Building, No.280 Pearl River Road, Nanjing.
TEL: (025)68123923  68123920

Shenzhen Office
Room 1203, F/12 Electronics Building, No.2072 Shennan Road (M), Futian District, Shenzhen.
TEL: (0755)83640169  83783155

Shanghai Branch: Hangzhou
Room 502, Jiangnan Electronics Building, No.217 Tianmushan Road, Hangzhou.
TEL: (0571)89719491  89719493

Wuhan Office
Room 12128, No.158 Luoyu Road, Guangbu Village, Hongshan District, Wuhan.
TEL: (027)87168497  87168397

Chongqing Office
Room 2705, Atlantic International Building (SEG Electronics Market), Shiqiaopu Science and Technology Park Road I, Chongqing.
TEL: (023)68796438  68797619

Chengdu Office
Room 403, Digital Technology Building, No.1 Yihuan Road, South 2nd section, Chengdu.
TEL: (028)85439836  85432683

Xi’an Office
Room 1201, Pacific Building, No.54 Changan Road (N), Xi’an.
TEL: (029)87881295  87881296

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