PISO-CAN400-D/T
PISO-CAN200-D/T

User's Manual

Warranty

All products manufactured by ICP DAS are warranted against defective materials for a period of one year from the date of delivery to the original purchaser.

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Contents

1. GENERAL INFORMATION 4

1.1 INTRODUCTION 4
1.2 FEATURES 4
1.3 SPECIFICATIONS 4
1.4 PRODUCT CHECK LIST 5

2. HARDWARE CONFIGURATION 6

2.1 BOARD LAYOUT 6
2.2 JUMPER SELECTION 8
2.3 CONNECTOR PIN ASSIGNMENT 9
2.3.1 5-pin screw terminal connector 9
2.3.2 9-pin D-sub male connectors 10
2.4 INSTALLATION 10

3. SOFTWARE INSTALLATION 11

4. INSTALLATION DLL DRIVER 12

4.1 DLL FUNCTION DEFINITION AND DESCRIPTION 12
4.1.1 CAN_GetDllVersion 13
4.1.2 CAN_TotalBoard 14
4.1.3 CAN_GetBoardInf 15
4.1.4 CAN_ActiveBoard 16
4.1.5 CAN_CloseBoard 16
4.1.6 CAN_BoardIsActive 17
4.1.7 CAN_Reset 17
4.1.8 CAN_Init 18
4.1.9 CAN_Config 19
4.1.10 CAN_EnableRxIrq 21
4.1.11 CAN_DisableRxIrq 22
4.1.12 CAN_RxIrqStatus 23
4.1.13 CAN_InstallIrq 24
4.1.14 CAN_RemoveIrq 25
4.1.15 CAN_IrqStatus 26
4.1.16 CAN_Status 27
4.1.17 CAN_SendMsg 29
4.1.18 CAN_RxMsgCount 30

4.1.19 CAN_ReceiveMsg *31*
4.1.20 CAN_ClearSoftBuffer *32*
4.1.21 CAN_ClearDataOverrun *33*
4.1.22 CAN_GetSystemFreq *33*
4.2 Table of Return Code 34
4.3 Flow Diagram for Application 35
5. DEMO PROGRAMS FOR WINDOWS **38**
6. UTILITY PROGRAM FOR WINDOWS **41**
APPENDIX **44**
Acceptance Filtering 44

1.General Information

1.1 Introduction

The CAN (Controller Area Network) is a serial communication protocol, which efficiently supports distributed real-time control with a very high level of security. It is especially suited for networking "intelligent" devices as well as sensors and actuators within a system or sub-system. In CAN networks, there is no addressing of subscribers or stations in the conventional sense, but instead prioritized messages are transmitted. As a standalone CAN controller, PIO-CAN400/CAN200 represents an economic solution within which an active CAN board can have either two or four independent CAN bus communication ports with either a 5-pin screw terminal connector or a 9-pin D-sub connector. It can be used as master/slave function to cover a wide range of CAN applications. In addition, the PIO-CAN400/CAN200 uses the new Phillips SJA1000T and transceiver 82C250/251, which provide for bus arbitration and error detection with both an auto correction and re-transmission function. It can be installed in a 5V 32-bit PCI slot and is supported with actual “Plug & Play” technology.

1.2 Features

- PCI BUS interface;
- 2500Vrms photo-isolation protection.
- Four or two independent CAN communication ports.
- Compatible with CAN specification 2.0 parts A and B.
- On-board optical isolation protection.
- Programmable transfer-rate up to 1 Mbps.
- Jumper select 120Ω terminator resistor for each port.
- Direct memory mapping to the CAN controllers.
- 33MHz 32bit 5V PCI bus (V2.1) plug and play technology.
- Driver supported for Windows 98/ME/NT4/2000/XP

1.3 Specifications

- CAN controller: Phillips SJA1000T.

- CAN transceiver: Phillips 82C250/251.
- Signal support: CAN_H, CAN_L.
- 16 MHz CAN controller frequency.
- Connector: 5-pin screw terminal connector or 9-pin D-sub male connector.
- Isolation voltage: 2500Vrms.
- Power requirements:

  CAN400: 5V@640mA

  CAN200: 5V@380mA
- Environmental:

  Operating temp: 0~60℃

  Storage temp: -20~80℃

  Humidity: 0~90% non-condensing

  Dimensions: 130mm X 110mm

1.4 Product Check List

In addition to this manual, the package includes the following items:

- □ PIO-CAN400/CAN200 card;
- □ ADP-9 Board (for PIO-CAN400 only)
- □ Software CD ROM;
- □ User manual.

It is recommended that users read the release note first. All the important information needed will be provided in the release note as follows:

- □ Where you can find the software driver, utility and demo programs.
- □ How to install software & utility.
- □ Where is the diagnostic program?
- □ FAQ's and answers.

Attention !

If any of these items are missing or damaged, please contact your local field agent. Keep aside the shipping materials and carton in case you want to ship or store the product in the future.

2.Hardware Configuration

This section will describe the hardware settings of the PIO-CAN, which includes the settings for both the PIO-CAN400 and the PIO-CAN200.

2.1 Board Layout

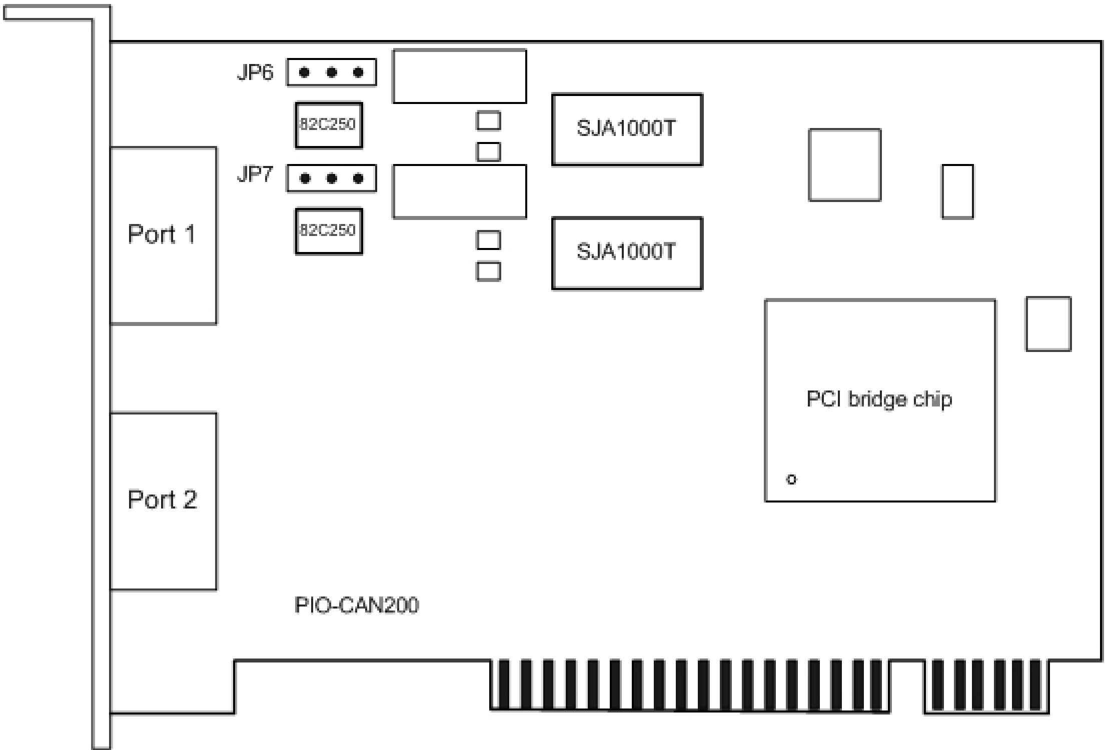


Figure2.1 PIO-CAN200 Board LAYOUT

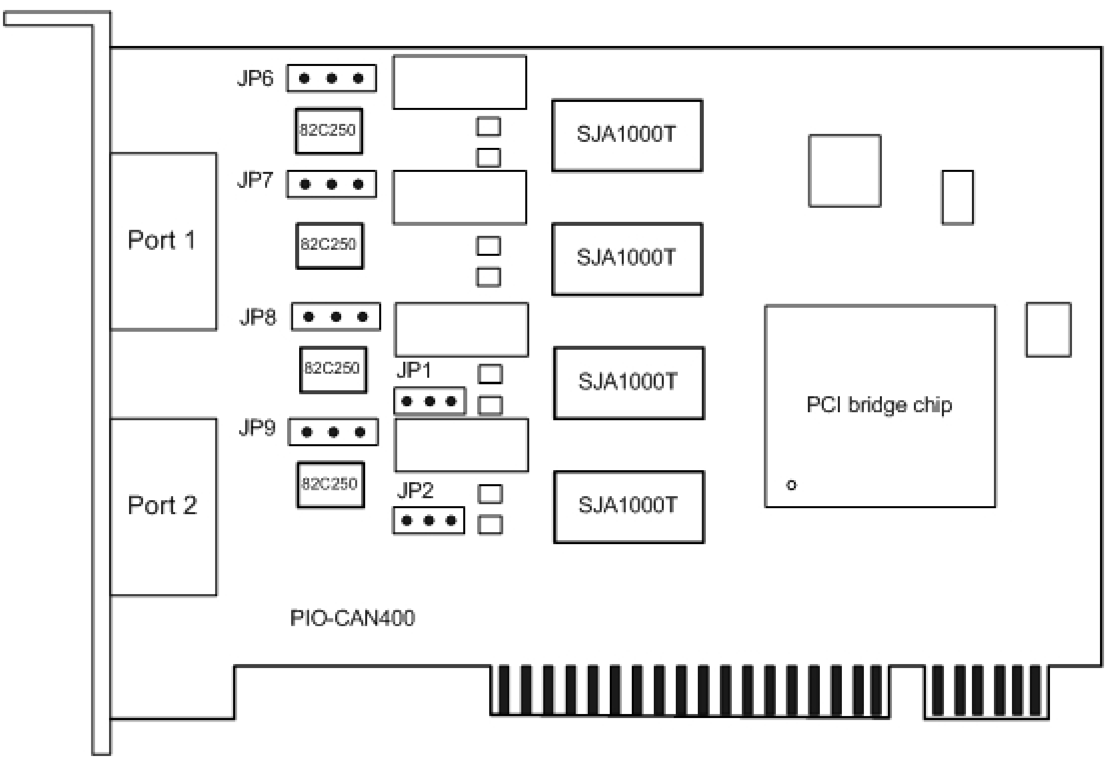


Figure2.2 PIO-CAN400 Board LAYOUT

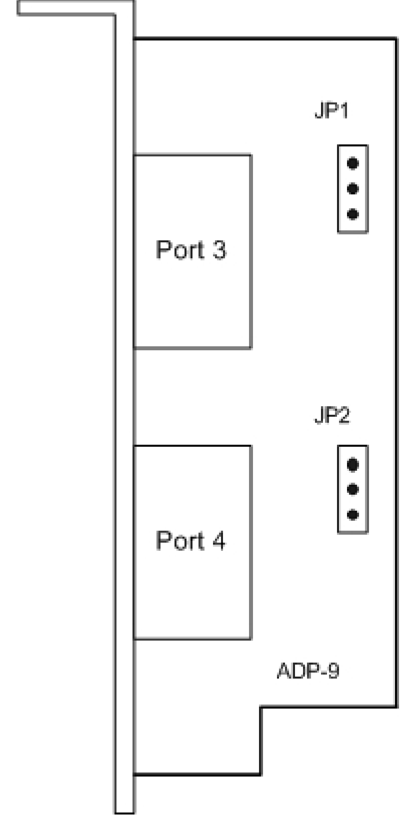


Figure2.3 ADP-9 Board LAYOUT (For PIO-CAN400 Only)

2.2 Jumper Selection

Table 2.1 Jumper Selections

Jumper	Description	Status	
JP1	CAN Port 3 Connector, connecting PIO-CAN400 board and ADP-9 board.	JP1 1 2 3 / JP1 1 2 3 Pin1: CAN_L Pin2: CAN_H Pin3: Shield	
JP2	CAN Port 4 Connector, connecting PIO-CAN400 board and ADP-9 board.	JP2 1 2 3 / JP2 1 2 3 Pin1: CAN_L Pin2: CAN_H Pin3: Shield	
		Enable	**Disable**
JP6	Port 1 terminator resister(120Ω) selection	1 2 3	1 2 3
JP7	Port 2 terminator resister(120Ω) selection	1 2 3	1 2 3
JP8	Port 3 terminator resister(120Ω) selection	1 2 3	1 2 3
JP9	Port 4 terminator resister(120Ω) selection	1 2 3	1 2 3

2.3 Connector Pin Assignment

The PIO-CAN400-T/PIO-CAN200-T are equipped with four/two sets of **5-pin screw terminal connectors** and the PIO-CAN400-D/PIO-CAN200-D are equipped with four/two sets of **9-pin D-sub male connectors** for wire connection of the CAN bus. The connector's pin assignment is specified as follows:

2.3.1 5-pin screw terminal connector

The 5-pin screw terminal connector for the CAN bus is shown in Figure 2.4. The details for the pin assignment are presented in Table 2.2.

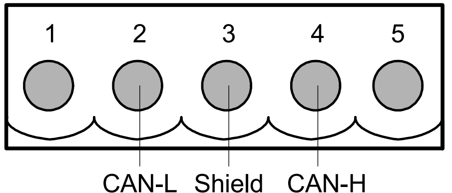


Figure2.4 5-pin screw terminal connector

Table 2.2: Pin assignment of 5-pin screw terminal connector

5-pin screw terminal connectors pin assignment	
1	No Use
2	CAN_L
3	Shield
4	CAN_H
5	No Use

2.3.2 9-pin D-sub male connectors

The 9-pin D-sub male connector of the CAN bus interface is shown in Figure 2.5 and the corresponding pin assignments are given in Table 2.3.

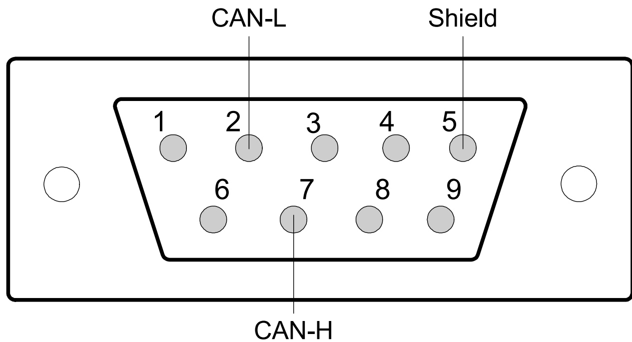


Figure2.5 9-pin D-sub male connector

Table 2.3 Pin assignment of the 9-pin D-sub male connector

D-sub male connector pin assignment	
1	No Use
2	CAN_L
3	No Use
4	No Use
5	Shield
6	No Use
7	CAN_H
8	No Use
9	No Use

2.4 Installation

1. Configure the jumper settings on your PIO-CAN400/CAN200 in accordance with your particular requirements.
2. Shutdown your system and take off the chassis of your machine.
3. Plug in your PIO-CAN400/CAN200 into a suitable empty PCI slot.
4. Replace your chassis.

5. Plug your CAN bus cable(s) into the 5-pin screw terminal connector or the 9-pin D-sub connector.
6. When the hardware installation is complete, please turn on the computer again.

3. Software Installation

The PIO-CAN400/CAN200 can be used in 98/Me/NT/2000/XP Windows environments. For these Windows operation systems, the recommended installation procedure is given as follows:

Step 1: Insert the companion CD into the CD-ROM driver and wait a few seconds until the installation program starts automatically. If it cannot be started automatically for some reason, please double-click the file **\NAPDOS\AUTO32.EXE** on this CD.

Step 2: Click the first item; Toolkits (Software) / Manuals.

Step 3: Click the item PCI Bus DAQ Card.

Step 4: Click PIO-CAN 400/200.

Step 5: Click “install Toolkit for Windows 98 (Or Me, NT, 2000, XP), which is based on the operation system you used”.

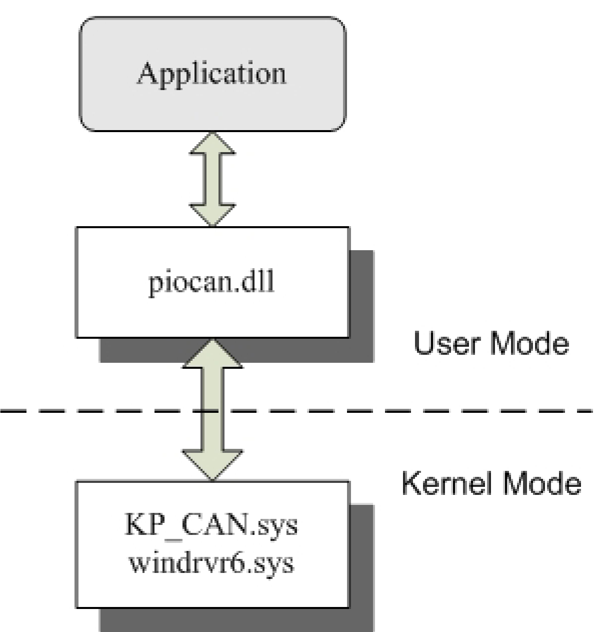
Then the Install-Shield will start the driver installation process and copy the related material to the indicated directory and then register the driver on your computer. The driver target directory is as below for the different systems.

Windows NT/2000 – **WINNT\SYSTEM32\DRIVERS**

Windows 98/Me/XP – **WINDOWS\SYSTEM32\DRIVERS**

4. Installation DLL Driver

The DLL driver is the collection of function calls on the PIO-CAN400/CAN200 cards used for Windows 98/Me/NT/2000/XP systems. The application structure is presented in the following figure. The user application programs which have been developed by the following designated tools: VB, Delphi and Borland C++ Builder…etc, can call the PIOCAN.DLL driver in user mode. And then the DLL driver will bypass the function call into the KP_CAN.sys and windrvr6.sys to access the hardware system, as shown in the following Figure.



4.1 DLL Function Definition and Description

All the functions provided in the PIO-CAN400/200 are listed in the following table and detailed information for every function is presented in the following sub-section. However, in order to make the descriptions more simplified and clear, the attributes for the both the input and output parameter functions are given as **[input]** and **[output]** respectively, as shown in following table.

Keyword	Set parameter by user before calling this function?	Get the data from this parameter after calling this function?
[input]	Yes	No
[output]	No	Yes

Table 4.1 DLL function definition

Function definition	Page
Int CAN_GetDllVersion();	14
Int CAN_TotalBoard();	14
Int CAN_GetCardInf(BYTE BoardNo, DWORD *dwVID, DWORD *dwDID, DWORD *dwSVID, DWORD *dwSDID, DWORD *dwIrqNo);	15
Int CAN_ActiveBoard(BYTE wBoardNo)	16
Int CAN_CloseBoard(BYTE wBoardNo);	16
int CAN_BoardIsActive(BYTE BoardNo);	17
int CAN_Reset(BYTE BoardNo, BYTE Port);	17
int CAN_Init(BYTE wBoardNo, BYTE Port);	18
int CAN_Config(BYTE BoardNo, BYTE Port, ConfigStruct *CanConfig);	18
int CAN_EnableRxIrq(BYTE BoardNo ,BYTE Port);	20
int CAN_DisableRxIrq(BYTE BoardNo, BYTE Port);	20
int CAN_RxIrqStatus(BYTE BoardNo, BYTE Port, BYTE *bStatus);	21
int CAN_InstallIrq(BYTE BoardNo);	22
int CAN_RemoveIrq(BYTE BoardNo);	22
int CAN_IrqStatus(BYTE BoardNo, BYTE *bStatus);	23
int CAN_Status(BYTE BoardNo, BYTE Port, BYTE *bStatus);	24
int CAN_SendMsg(BYTE BoardNo, BYTE Port, PacketStruct *CanPacket);	25
int CAN_RxMsgCount(BYTE BoardNo, BYTE Port);	26
int CAN_ReceiveMsg(BYTE BoardNo, BYTE Port, PacketStruct *CanPacket);	27
int CAN_ClearSoftBuffer(BYTE BoardNo, BYTE Port);	28
int CAN_ClearDataOverrun(BYTE BoardNo, BYTE Port);	29
LONGLONG CAN_GetSystemFreq(void);	29

4.1.1 CAN_GetDllVersion

- **Description:**

Obtain the version information of PIOCAN.dll driver.

- **Syntax:**

  WORD CAN_GetDllVersion(viod)

- **Parameter:**

  None

- **Return:**

  DLL version information. For example: If 101(hex) is return, it means driver version is 1.01.

4.1.2 CAN_TotalBoard

- **Description:**

  Obtain the total board number of PIO-CAN boards installed in the PCI bus.

- **Syntax:**

  int CAN_TotalBoard(void)

- **Parameter:**

  None

- **Return:**

  Return the total board number.

4.1.3 CAN_GetBoardInf

- **Description:**

  Obtain the information of PIO-CAN boards, which include vender ID, device ID and interrupt number.

- **Syntax:**

  WORD CAN_GetCardInf(BYTE BoardNo, DWORD *dwVID, DWORD *dwDID, DWORD *dwSVID,DWORD *dwSDID, DWORD *dwSAuxID, DWORD *dwIrqNo)

- **Parameter:**

BoardNo:	[input] PIO-CAN board number
*dwVID:	[output] vendor ID of this board
*dwDID:	[output] device ID of this board
*dwSVID:	[output] sub-vendor ID of this board
*dwSDID:	[output] sub-device ID of this board
*dwSAuxID:	[output] sub-auxiliary ID of this board
*dwIrq:	[output] logical interrupt number of this board

- **Return:**

  CAN_NoError: OK

  CAN_DriverError: Kernel driver can not be opened.

  CAN_BoardNumberError: BoardNo exceeds the current total board number.

4.1.4 CAN_ActiveBoard

- **Description:**
  Activate the device. **It must be called once before using the other functions of PIO-CAN400/200 board.**

- **Syntax:**
  int CAN_ActiveBoard(BYTE BoardNo)

- **Parameter:**
  BoardNo: [input] PIO-CAN400/200 board number (0~7).

- **Return:**
  CAN_NoError: OK
  CAN_BoardNumberError: BoardNo exceeds the current total board number.
  CAN_ActiveBoardError: This board can not be activated or kernel driver can not be found.

4.1.5 CAN_CloseBoard

- **Description:**
  Stop and close the kernel driver and release the device resource from computer device resource. This method must be called once before exiting the user's application program.

- **Syntax:**
  int CAN_CloseBoard(BYTE BoardNo)

- **Parameter:**
  BoardNo: [input] PIO-CAN400/200 board number (0~7).

- **Return:**
  CAN_NoError: OK
  CAN_ActiveBoardError: The board is not activated
  CAN_BoardNumberError: BoardNo exceeds the current total board number.

4.1.6 CAN_BoardIsActive

- **Description:**
  Obtain the information about the specific board is active or not.

- **Syntax:**
  int CAN_BoardIsActive(BYTE BoardNo)

- **Parameter:**
  BoardNo: [input] PIO-CAN400/200 board number

- **Return:**
  0: means the board is inactive.
  1: means the board is active.

4.1.7 CAN_Reset

- **Description:**
  Hardware reset CAN controller.

- **Syntax:**
  int CAN_Reset(BYTE BoardNo, BYTE Port)

- **Parameter:**
  BoardNo: [input] PIO-CAN board number (0~7).
  Port: [input] CAN port number (1~4 or 1~2)

- **Return:**
  CAN_NoError: OK
  CAN_DriverError: Kernel driver can't be opened.
  CAN_BoardNumberError: BoardNo is not correct or exceeds the current total board number.
  CAN_PortNumberError: Port number is not correct.
  CAN_ActiveBoardError: This board is not activated.

4.1.8 CAN_Init

- **Description:**
  Initiate CAN controller.

- **Syntax:**
  int CAN_Init(BYTE BoardNo, BYTE Port)

- **Parameter:**
  BoardNo: [input] PIO-CAN board number (0~7).
  Port: [input] CAN port number (1~4 or 1~2)

- **Return:**
  CAN_NoError: OK
  CAN_DriverError: Kernel driver can't be opened.
  CAN_BoardNumberError: BoardNo is not correct or exceeds the current total board number.
  CAN_PortNumberError: Port number is not correct.
  CAN_ActiveBoardError: This board is not activated.
  CAN_InitError: Initiating CAN controller failure

4.1.9 CAN_Config

- **Description:**

  Configure CAN controller. After calling this function, the CAN controller will enter operating mode.

- **Syntax:**

  Int CAN_Config(BYTE BoardNo, BYTE Port,ConfigStruct *CanConfig);

- **Parameter:**

  BoardNo: [input] PIO-CAN board number (0~7).

  Port: [input] CAN port number (1~4 or 1~2)

  *ConfigStruct: [input] The point of structure for ConfigStruct is defined as following,

```
typedef struct config
{
        BYTE AccCode[4];
        BYTE AccMask[4];
        BYTE BaudRate;
        BYTE BT0,BT1;
} ConfigStruct;
```

  AccCode[4]: Acceptance code for CAN controller.

  AccMask[4]: Acceptance mask for CAN controller.

  BaudRate: 0→user-defined(must to set BT0,BT1), 1→10Kbps,
  2→20Kbps, 3→50Kbps, 4→125Kbps, 5→250Kbps,
  6→500Kbps, 7→800Kbps, 8→1Mbps.

  BT0, BT1: user-defined baud rate (used only if BaudRate=0)). For example, BT0=0x04, BT1=0x1C, then baud rate setting for the CAN controller is 100Kbps. For more detail baud rate setting, please refer to manual of SJA1000 CAN controller.

- **Return:**

  CAN_NoError: OK

CAN_DriverError: Kernel driver can’t be opened.

CAN_BoardNumberError: BoardNo is not correct or exceeds the current total board number.

CAN_PortNumberError: Port number is not correct.

CAN_ActiveBoardError: This board is not activated.

CAN_SoftResetError: CAN controller software reset error.

CAN_SetACRError: Set Acceptance code to CAN controller error

CAN_SetAMRError: Set Acceptance mask to CAN controller error

CAN_SetBaudRateError: Set baud rate to CAN controller error

CAN_ConfigError: CAN controller enter operating mode failure.

4.1.10 CAN_EnableRxIrq

- **Description:**

  Enable receive interrupt for CAN controller.

- **Syntax:**

  int CAN_EnableRxIrq(BYTE BoardNo, BYTE Port)

- **Parameter:**

  BoardNo: [input] PIO-CAN board number (0~7).

  Port: [input] CAN port number (1~4 or 1~2)

- **Return:**

  CAN_NoError: OK

  CAN_DriverError: Kernel driver can’t be opened.

  CAN_BoardNumberError: BoardNo is not correct or exceeds the current total board number.

  CAN_PortNumberError: Port number is not correct.

  CAN_ActiveBoardError: This board is not activated.

  CAN_EnableRxIrqFailure: Enable receive interrupt failure.

4.1.11 CAN_DisableRxIrq

- **Description:**

  Disable receive interrupt of the CAN controller.

- **Syntax:**

  int CAN_DisableRxIrq(BYTE BoardNo, BYTE Port)

- **Parameter:**

  BoardNo: [input] PIO-CAN board number (0~7)

  Port: [input] CAN port number (1~4 or 1~2)

- **Return:**

  CAN_NoError: OK

  CAN_DriverError: Kernel driver can't be opened.

  CAN_BoardNumberError: BoardNo is not correct or exceeds the current total board number.

  CAN_PortNumberError: Port number is not correct.

  CAN_ActiveBoardError: This board is not activated.

  CAN_DisableRxIrqFailure: Disable receive interrupt failure.

4.1.12 CAN_RxIrqStatus

- **Description:**

  Obtain receive interrupt status of the CAN controller.

- **Syntax:**

  int CAN_RxIrqStatus(BYTE BoardNo, BYTE Port, BYTE *bStatus)

- **Parameter:**

  BoardNo: [input] PIO-CAN board number (0~7)

  Port: [input] CAN port number (1~4 or 1~2)

  *bStatus:[output] 0→receive interrupt disable;

  1→ receive interrupt enable.

- **Return:**

  CAN_NoError: OK

  CAN_DriverError: Kernel driver can't be opened.

  CAN_BoardNumberError: BoardNo is not correct or exceeds the current total board number.

  CAN_PortNumberError: Port number is not correct.

  CAN_ActiveBoardError: This board is not activated.

4.1.13 CAN_InstallIrq

- **Description:**
  Enable or start IRQ for PIO-CAN400/200 Board. Before calling this function, **CAN_EnableRxIrq** must to be called first.

- **Syntax:**
  int CAN_InstallIrq(BYTE BoardNo)

- **Parameter:**
  BoardNo: [input] PIO-CAN board number (0~7).

- **Return:**
  CAN_NoError: OK
  CAN_DriverError: Kernel driver can't be opened.
  CAN_BoardNumberError: BoardNo is not correct or exceeds the current total board number.
  CAN_ActiveBoardError: This board is not activated.
  CAN_InstallIrqFailure: Enable or start IRQ failure.

4.1.14 CAN_RemoveIrq

- **Description:**
  Disable or stop IRQ for PIO-CAN400/200 Board. After calling this function, the interrupts for all CAN controllers on board will be disabled.

- **Syntax:**
  Int CAN_RemoveIrq(BYTE BoardNo)

- **Parameter:**
  BoardNo: [input] PIO-CAN board number (0~7).

- **Return:**
  CAN_NoError: OK
  CAN_DriverError: Kernel driver can't be opened.
  CAN_BoardNumberError: BoardNo is not correct or exceeds the current total board number.
  CAN_ActiveBoardError: This board is not activated.
  CAN_RemoveIrqFailure: Disable or stop IRQ failure.

4.1.15 CAN_IrqStatus

- **Description:**

  Obtain IRQ status of the PIO-CAN200/400 board.

- **Syntax:**

  int CAN_IrqStatus(BYTE BoardNo, BYTE *bStatus)

- **Parameter:**

  BoardNo: [input] PIO-CAN board number (0~7).

  *bStatus:[output] 0→IRQ disable;

  1→ IRQ enable.

- **Return:**

  CAN_NoError: OK

  CAN_DriverError: Kernel driver can't be opened.

  CAN_BoardNumberError: BoardNo is not correct or exceeds the current total board number.

  CAN_ActiveBoardError: This board is not activated.

4.1.16 CAN_Status

- **Description:**

  Obtain the status of CAN controller for PIO-CAN400/200 board.

- **Syntax:**

  int CAN_Status(BYTE BoardNo, BYTE Port,BYTE *bStatus)

- **Parameter:**

  BoardNo: [input] PIO-CAN board number (0~7).

  *bStatus:[output] Status value of CAN controller.

Table 4.2 Bit interpretation of the bStatus.

Bit	NAME	VALUE	STATUS
bit 7	Bus Status	1	bus-off
		0	bus-on
bit 6	Error Status	1	error
		0	ok
bit 5	Transmit Status	1	transmit
		0	idle
bit 4	Receive Status	1	receive
		0	idle
bit 3	Transmission Complete Status	1	complete
		0	incomplete
bit 2	Transmit Buffer Status	1	release
		0	locked
bit 1	Data Overrun Status	1	overrun
		0	absent
bit 0	Receive Buffer Status	1	full/not empty
		0	empty

- **Return:**

  CAN_NoError: OK

  CAN_BoardNumberError: BoardNo is not correct or exceeds the current total board number.

  CAN_PortNumberError: Port number is not correct.

  CAN_ActiveBoardError: This board is not activated.

4.1.17 CAN_SendMsg

- **Description:**

  Send a CAN message immediately.

- **Syntax:**

  int CAN_SendMsg(BYTE BoardNo, BYTE Port, PacketStruct *CanPacket)

- **Parameter:**

  BoardNo: [input] PIO-CAN board number (0~7)

  Port: [input] CAN port number (1~4 or 1~2)

  *CanPacket: [input] The point of structure for CanPacket is defined as following,

```
typedef struct packet
{
     LONGLONG MsgTimeStamps;
     BYTE  mode;
     DWORD id;
     BYTE  rtr;
     BYTE  len;
     BYTE  data[8];
} PacketStruct;
```

  MsgTimeStamps: Not use in this function.

  mode: 0→ 11-bit identifier, 1 → 29-bit identifier.

  id: Identifier

  rtr: Remote transmission request

  len: Data length

  data[8]: data byte

- **Return:**

  CAN_NoError: OK

  CAN_BoardNumberError: BoardNo is not correct or exceeds the current total board number.

  CAN_PortNumberError: Port number is not correct.

CAN_ActiveBoardError: This board is not activated.

CAN_TransmitBufferLocked: Transmit buffer in CAN chip is locked.

CAN_TransmitIncomplete: Transmission is not yet completed.

CAN_ConfigError: Port has not been configured successfully.

4.1.18 CAN_RxMsgCount

- **Description:**

  Obtain the number of messages available within the CAN controller's RXFIFO or the software buffer(4KBytes). After calling **CAN_EnableRxIrq** and **CAN_InstallIrq**, the number of messages is within the software buffer; otherwise it is within the CAN controller's RXFIFO.

- **Syntax:**

  int CAN_RxMsgCount(BYTE BoardNo, BYTE Port);

- **Parameter:**

  BoardNo: [input] PIO-CAN board number (0~7)

  Port: [input] CAN port number (1~4 or 1~2)

- **Return:**

  The number of messages.

  Note. If the parameter for *BoardNo* or *Port* isn't correct, the return value will always be 0.

4.1.19 CAN_ReceiveMsg

- **Description:**

  Obtain receive message from CAN controller's RXFIFO or software buffer. After calling **CAN_EnableRxIrq** and **CAN_InstallIrq**, the messages is within the software buffer, otherwise it is within the CAN controller's RXFIFO.

- **Syntax:**

  Int CAN_ReceiveMsg(BYTE BoardNo, BYTE Port, PacketStruct *CanPacket)

- **Parameter:**

  BoardNo: [input] PIO-CAN board number (0~7)

  Port: [input] CAN port number (1~4 or 1~2)

  *CanPacket: [output] The point of structure for CanPacket is defined as following,

```
typedef struct packet
{
    LONGLONG MsgTimeStamps;
    BYTE  mode;
    DWORD id;
    BYTE  rtr;
    BYTE  len;
    BYTE  data[8];
} PacketStruct;
```

  MsgTimeStamps: This parameter will record the time with system clock counter when the CAN message is received from SJA1000. The system clock counter starts to count after the PC boots up. If more than one CAN messages are received and stored in the 64-byte SJA1000 FIFO, the time stamps of these CAN messages may be closed.

mode: 0→ 11-bit identifier, 1 → 29-bit identifier.

id: Identifier

rtr: Remote transmission request

len: Data length

data[8]: data byte

- **Return:**

CAN_NoError: OK

CAN_BoardNumberError: BoardNo is not correct or exceeds the current total board number.

CAN_PortNumberError: Port number is not correct.

CAN_ActiveBoardError: This board is not activated.

CAN_ConfigError: Port has not been configured successfully.

CAN_ReceiveBufferEmpty: CAN controller's RXFIFO is empty.

CAN_SoftBufferIsEmpty: Software RX Buffer Is empty.

CAN_SoftBufferIsFull: Software RX Buffer Is full.

4.1.20 CAN_ClearSoftBuffer

- **Description:**

Clear the software buffer of the PIOCAN.DLL driver.

- **Syntax:**

Int CAN_ClearSoftBuffer(BYTE BoardNo, BYTE Port)

- **Parameter:**

BoardNo: [input] PIO-CAN board number (0~7)

Port: [input] CAN port number (1~4 or 1~2)

- **Return:**

CAN_NoError: OK

CAN_BoardNumberError: BoardNo is not correct or exceeds the current total board number.

CAN_PortNumberError: Port number is not correct.

4.1.21 CAN_ClearDataOverrun

- **Description:**
  Clear the data overrun status bit for the CAN controller.

- **Syntax:**
  Int CAN_ClearDataOverrun(BYTE BoardNo, BYTE Port)

- **Parameter:**
  BoardNo: [input] PIO-CAN board number (0~7)
  Port: [input] CAN port number (1~4 or 1~2)

- **Return:**
  CAN_NoError: OK
  CAN_BoardNumberError: BoardNo is not correct or exceeds the current total board number.
  CAN_PortNumberError: Port number is not correct.
  CAN_ActiveBoardError: This board is not activated.
  CAN_ConfigError: CAN controller enter operating mode failure.

4.1.22 CAN_GetSystemFreq

- **Description:**
  Get the system clock frequency. It is useful for calculate the time of the time stamp of the reception message.

- **Syntax:**
  LONGLONG CAN_GetSystemFreq()

- **Parameter:**
  None

- **Return:**
  Return the system clock frequency.

4.2 Table of Return Code

Table 4.3 Interpretation of the return code

Return Code	Error ID	Comment
0	CAN_NoError	OK
1	CAN_DriverError	Driver error
2	CAN_ActiveBoardError	This board can't be activated.
3	CAN_BoardNumberError	The board number exceeds the maximum board number (7).
4	CAN_PortNumberError	The port number exceed the maximum port number.
5	CAN_ResetError	CAN chip hardware reset error
6	CAN_SoftResetError	CAN chip software reset error
7	CAN_InitError	CAN chip initiation error
8	CAN_ConfigError	CAN chip configure error
9	CAN_SetACRError	Set to Acceptance Code Register error
10	CAN_SetAMRError	Set to Acceptance Mask Register error
11	CAN_SetBaudRateError	Set Baud Rate error
12	CAN_EnableRxIrqFailure	Enable CAN chip receive interrupt failure
13	CAN_DisableRxIrqFailure	Disable CAN chip receive interrupt failure
14	CAN_InstallIrqFailure	Installing PCI board IRQ failure
15	CAN_RemoveIrqFailure	Removing PCI board IRQ failure
16	CAN_TransmitBufferLocked	Transmit buffer in CAN chip is locked
17	CAN_TransmitIncomplete	Previously transmission is not yet completed
18	CAN_ReceiveBufferEmpty	CAN chip RXFIFO is empty
19	CAN_DataOverrun	Data was lost because there was not enough space in CAN chip RXFIFO
20	CAN_ReceiveError	Receive data is not completed
21	CAN_SoftBufferIsEmpty	Software buffer in driver is empty
22	CAN_SoftBufferIsFull	Software buffer in driver is full

4.3 Flow Diagram for Application

In this section, we will show the operation procedure of PIO-CAN board for sending and receiving CAN message. Figure 4.1 presents the "Send CAN Message" procedure. Figure 4.2 and 4.3 stand for the "receiving CAN Message" in polling and in interrupt mode, respectively. Users need to follow the operation principle of PIO-CAN board for correctly and easily send and receive the CAN message through CAN network. For more detail information, please refer to the demo programs in section 5.

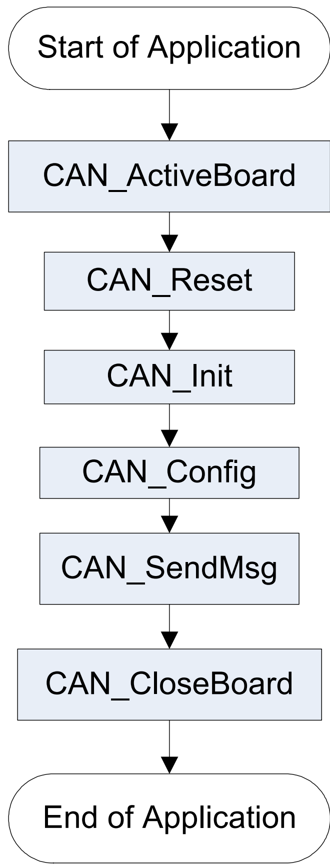


Figure 4.1 Flow Diagram "Send CAN Massage"

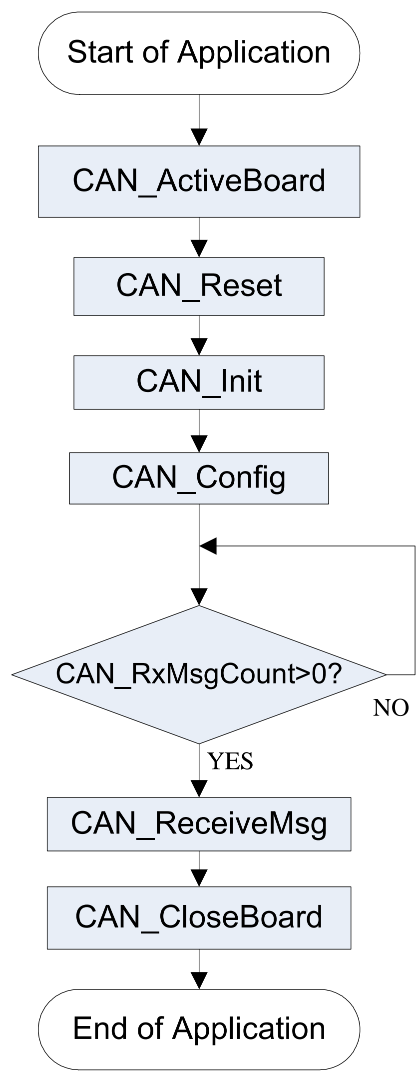


Figure 4.2 Flow Diagram “Receive CAN Massage”

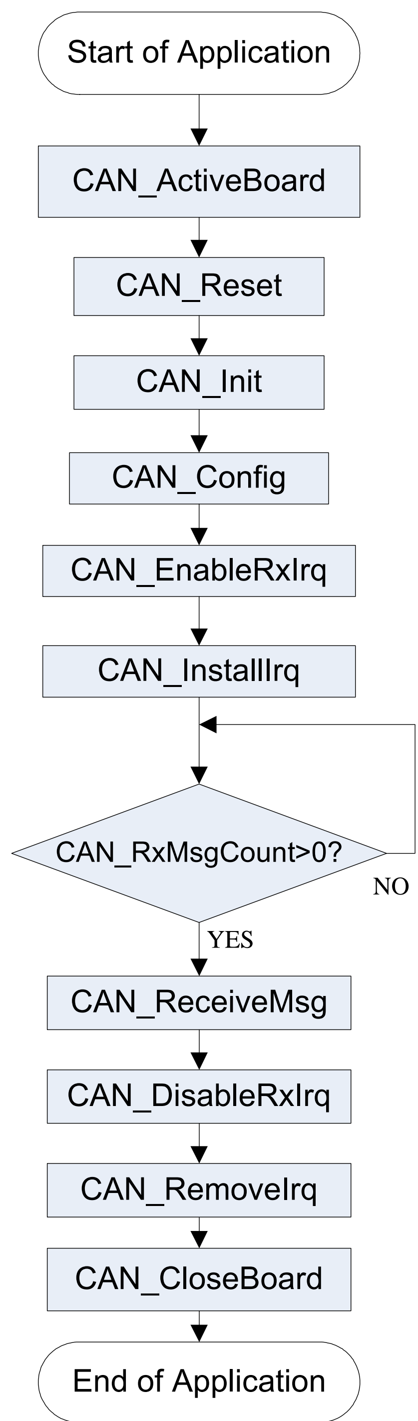


Figure 4.3 Flow Diagram “Receive CAN Massage with IRQ”

5. Demo Programs for Windows

All of demo programs will not work normally if DLL driver would not be installed correctly. During the installation process of DLL driver, the install-shields will register the correct kernel driver to the operation system and copy the DLL driver and demo programs to the correct position based on the driver software package you have selected (Win98,Me,NT,win2000,XP). After driver installation, the related demo programs and development library and declaration header files for different development environments are presented as follows.

```
|--\Demo                          →demo program
   |--\BCB3                       → for Borland C++ Builder 3
   |   |--\CAN.H                  → Header file
   |       \PIOCAN.LIB            → Linkage library for BCB
   |
   |--\Delphi4                    → for Delphi 4
   |   |--\CAN.PAS                → Declaration file
   |
   |--\VB6                        → for Visual Basic 6
       |--\CAN.BAS                →Declaration file
```

The list of demo programs:

DEMO1: Transmit and receive CAN messages.
DEMO2: Transmit and receive CAN messages with IRQ

A brief introduction of the demo programs

DEMO1:

Demo1 is the example used for starting the PIO-CAN board. This demo program is designed to send out the CAN message through Port 1 and receive the CAN message immediately at port 2 in the same PIO-CAN board. Before exercising this demo, the user needs to finish the CAN median wiring connection between port 1 and port 2. Based on this demo, the user can key in the CAN message into the port 1 frame area and then click the “Send” button in order to send out the CAN message to port 2. If you click the “Receive” button in the CAN port 2 frame area, the CAN message received by CAN port 2 will be presented in “TEXT” box. This is shown in the below screenshot. Note that if port 2 displays a warning message like CAN Data Overrun, then it is an indication that the un-read messages within the 64 bytes RXFIFO CAN buffer have been covered by another message. This means that the messages that are being received from the CAN bus may be in error and/or they may be missing part of the message. Then the user can click on the “Clear Overrun” button to clear the RXFIFO buffer overrun status within the CAN controller.

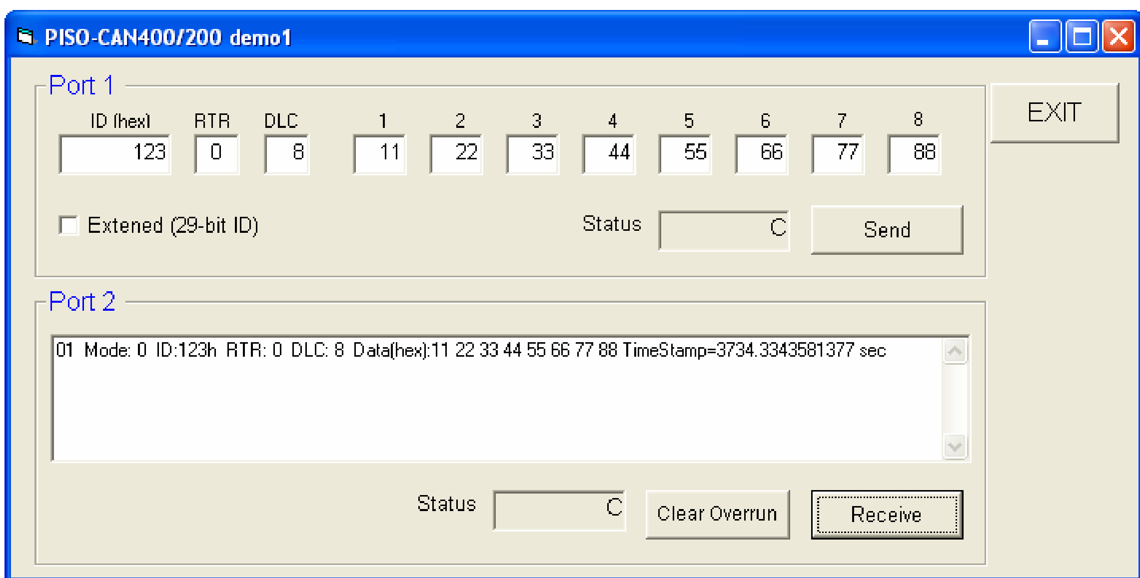


Figure 6.1: The form of demo1 program

DEMO2:

In demo 2, we provide a demonstration on how to send out a CAN message through port 1 and receive the CAN message in port 2 by means of the interrupt mode. Contained within this operation, the user can key in the CAN message into the port 1 frame area and click on the “Send” button to send out the CAN message. At the same time, the CAN message will be received at port 2 by means of the interrupt mode. As shown in the following figure, port 2 can automatically receive the CAN message and store it within the 4K bytes of buffer software. When the user clicks the “Receive” button, all the messages stored in the 4K bytes buffer will all be presented in the TEXT edit area, as shown in the following figure.

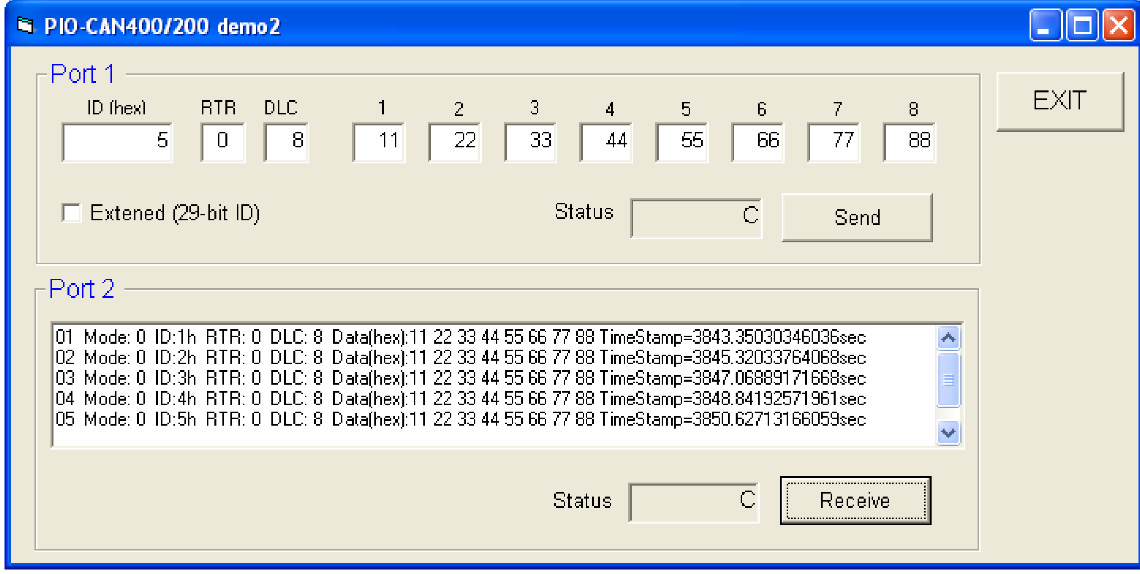


Figure 6.2: The form of demo2 program

6. Utility Program for Windows

For PIO_CAN200/CAN400 we also provide a CANbus utility to allow user to easily and friendly send and receive the CAN messages to and from CAN network. It can be thought as a useful tool for monitoring or testing CAN messages on the CAN network, which includes the raw CAN messages, DeivceNet, CANopen, … and etc. The operation principle will be addressed in the following sub-section.

(1) CAN Configure

Please select the CAN port and focus on the CAN port configuration area. According to CAN communication requirement, user need to setup the Baudrate, acceptance and acceptance mask. And then select transmit or receive function and finally click enable to open transmit or receive mode of the relative CAN port。

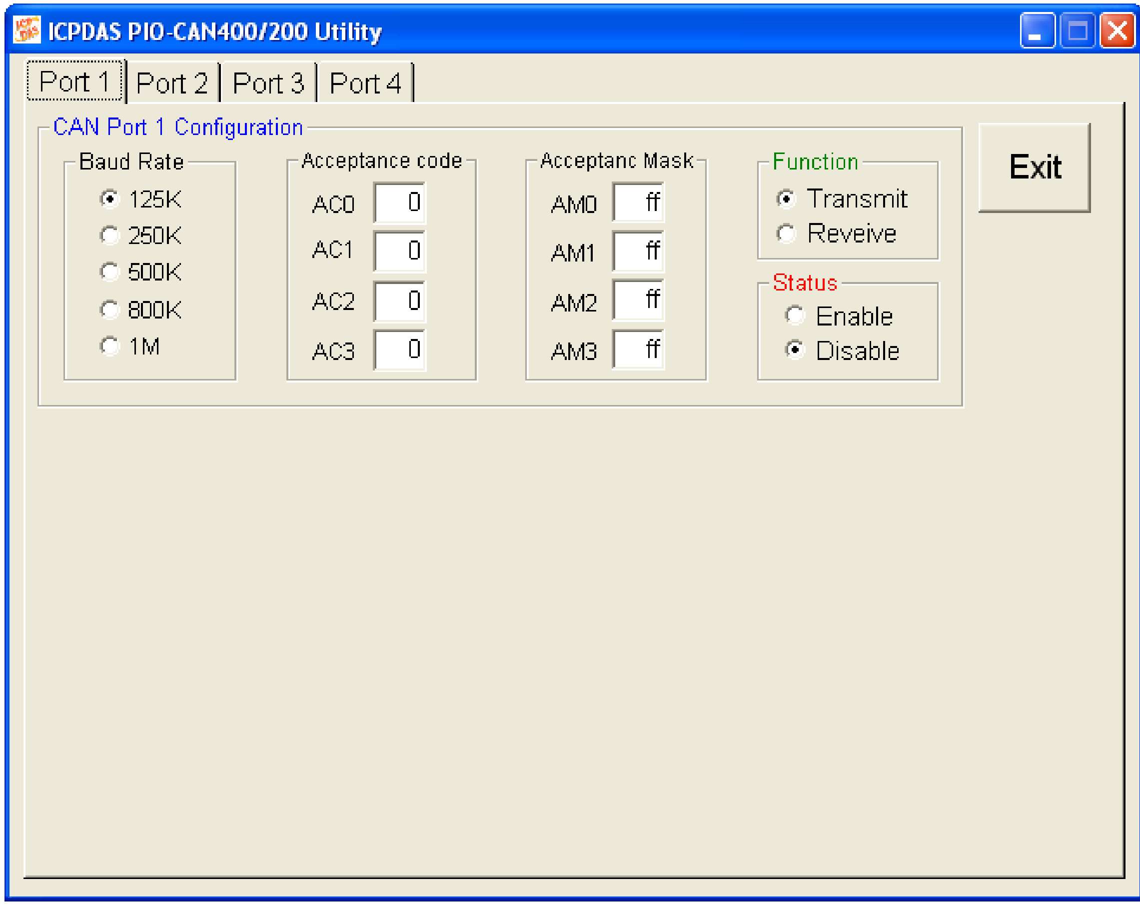


Figure 6.1 Initial page of the Utility tool

(2) CAN Transmit function

In the Figure 6.2, the CAN Port Transmit mode is opened. User can key in the CAN message into the framework of the CAN port transmit area and then click the “send” button to send out the CAN message into the CAN network. Note that user can key in all of the CAN messages into transmit area and click the relative “send” button to send out CAN message in sequence. For example, user can key in the DeviceNet ot CANopen message in the transmit frame and click the relative “send” button to send out DeviceNet or CANopen message.

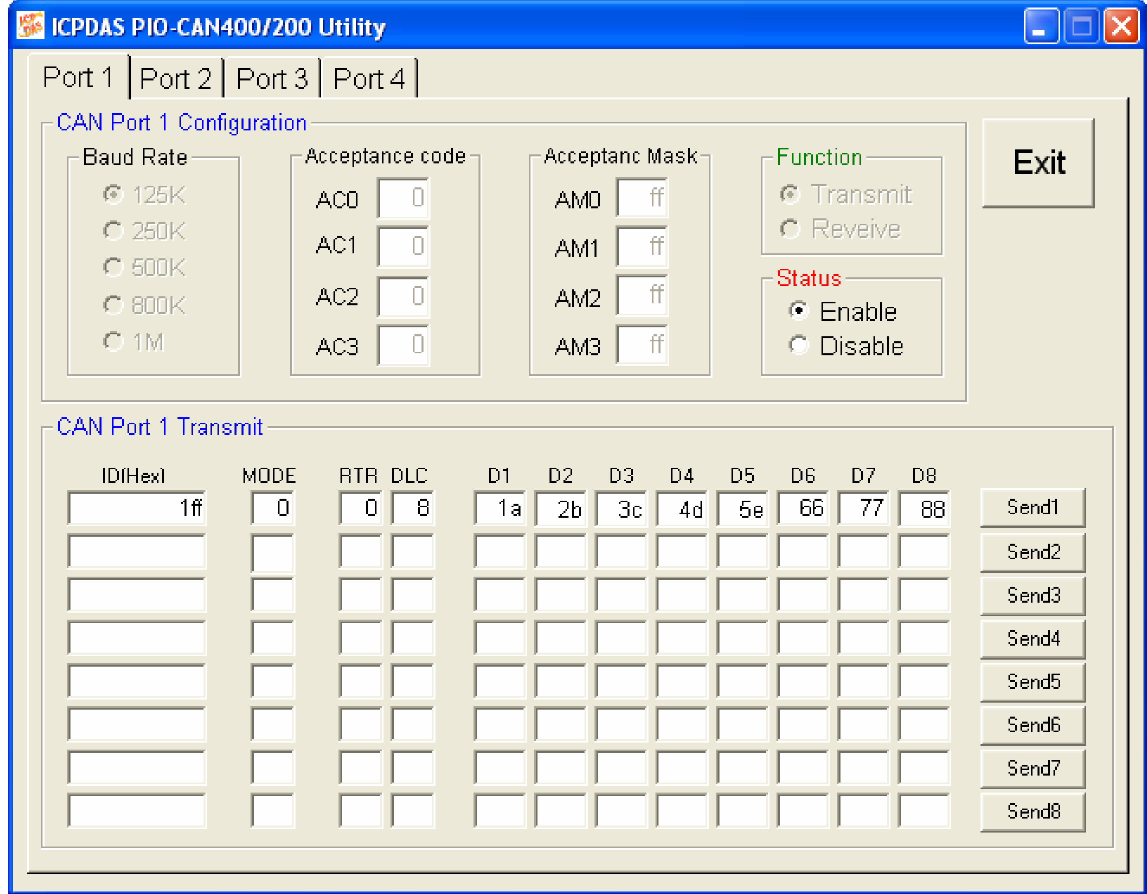


Figure 6.2 Transmit mode

(3) CAN Receive function

Figure 6.3 shows the CAN receive mode. Note that CAN port receive mode is working on the interrupt receiving mode. Once CAN port receive the CAN message, it will be shown on the CAN port receive framework. It is especially valuable for working on CAN bus message monitor analysis.

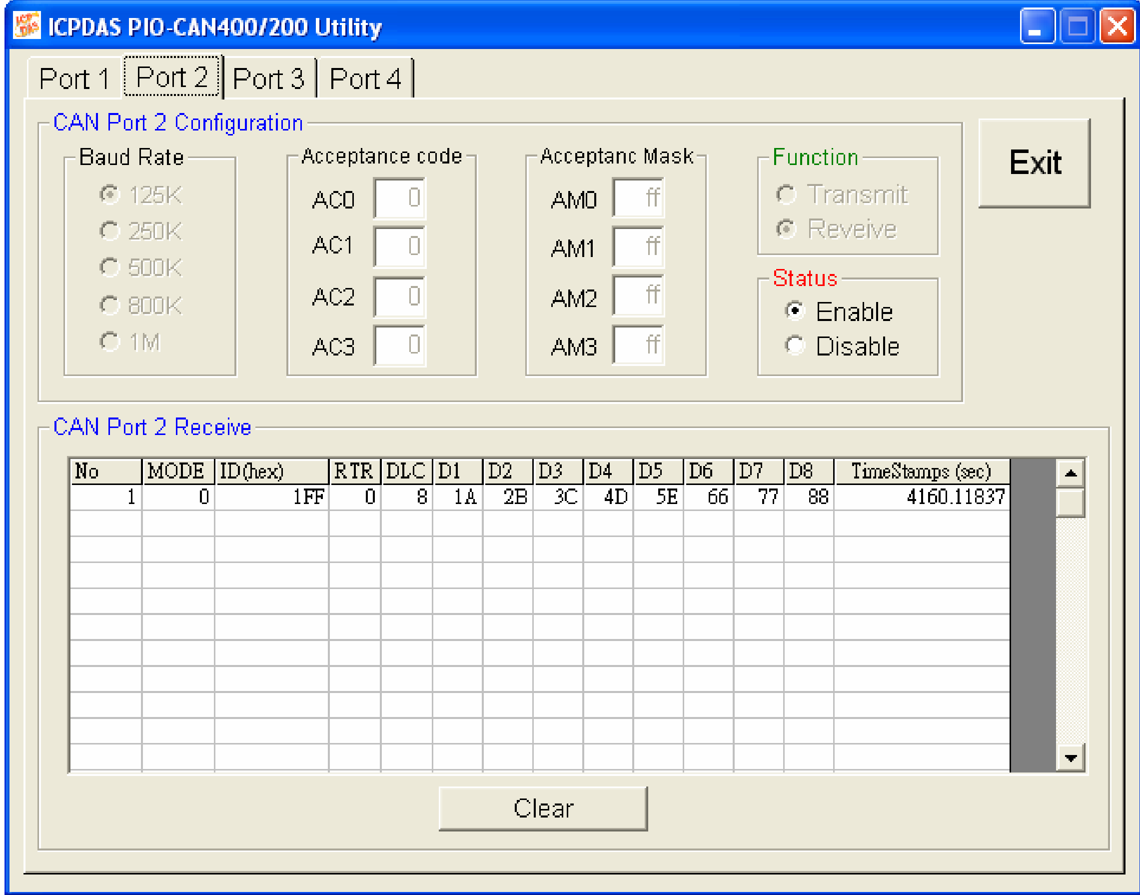


Figure 6.3 Receive mode

Appendix

Acceptance Filtering

Four 8-bits wide Acceptance Code registers(AC0, AC1, AC2 and AC3) and Acceptance Mask registers(AM0,AM1,AM2 and AM3) are available for a versatile filtering of messages. These registers can be used for controlling a single long filter, as shown in Figure A.1 Which bits of the message are used for the acceptance filtering, depend on the received frame (Standard or Extended).

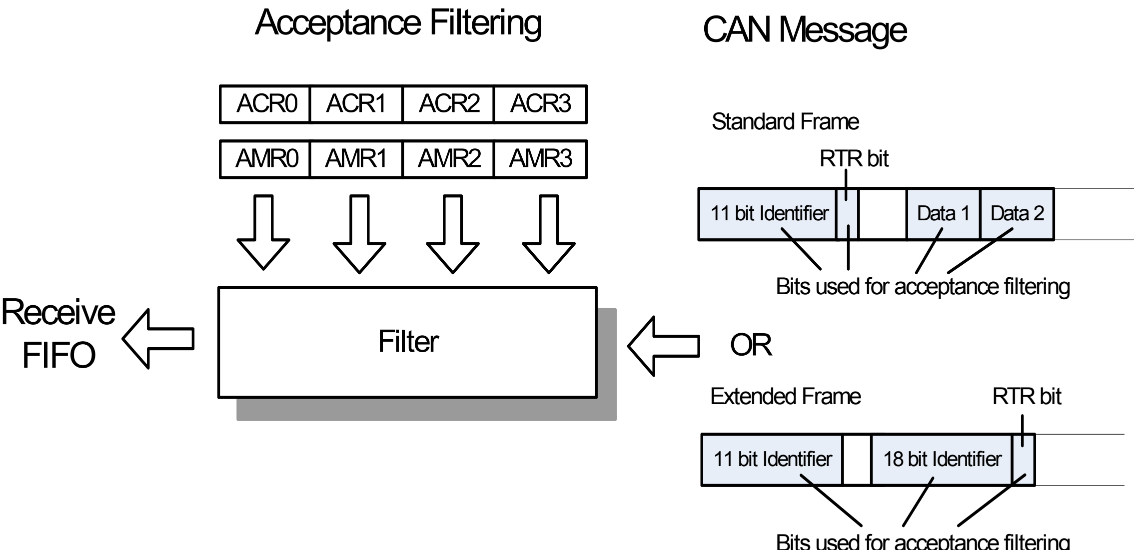


Figure A.1 Acceptance Filtering

Example 1:

Suppose a messages with a **Standard Frame**. The Acceptance Code Registers (ACRn) and Acceptance Mask Registers (AMRn) contain:

n	0	1 (upper 4 bits)	2	3
ACRn	01XX X010	XXXX	XXXX XXXX	XXXX XXXX
AMRn	0011 1000	1111	1111 1111	1111 1111
Accepted messages (ID.28..ID.18 RTR)	01xx x010	xxxx		

(“X”=irrelevant,”x”=don’t care,only the upper 4 bits of ACR1 and AMR1 are used)

At the bit positions containing a ”1” in the Acceptance Mask Registers, any value

is allowed in the composition of the identifier,for the Remote Tranmission Request bit and for the bits of data byte1 and 2.

Example 2:

Suppose the following 2 messages with a **Standard Frame** Identifier have to be accepted without any further decoding of the identifier bits. Data and Remote Frames have to be received correctly. Data bytes are not involved in the acceptance filtering.

Message 1: (ID.28) 1**0**11 **1**100 101 (ID.18)
Message 1: (ID.28) 1**1**11 **0**100 101 (ID.18)

Using the Single Filter result in accepting four message and not only the request two:

n	0	1 (upper 4 bits)	2	3
ACRn	1X11 X100	101X	XXXX XXXX	XXXX XXXX
AMRn	0100 1000	1111	1111 1111	1111 1111
Accepted messages (ID.28..ID.18 RTR)	1011 0100 1111 0100 1011 1100 1111 1100	101x 101x 101x 101x	 (message 2) (message 1) 	

("X"=irrelevant, "x"=don't care, only the upper 4 bits of ACR1 and AMR1 are used)

This result does **not** meet the request for receiving 2 messages without any further decoding.

Example 3:

In this example a group of messages with an Extended Frame Identifier are filtered using a long single acceptance filter.

n	0	1	2	3(upper 6 bits)
ACRn	1011 0100	1011 000X	1100 XXXX	0011 0XXX
AMRn	0000 0000	0000 0001	0000 1111	0000 0111
Accepted messages (ID.28..ID.0 RTR)	1011 0100	1011 000x	1100 xxxx	0011 0x

("X"=irrelevant, "x"=don't care, only the upper 6 bits of ACR3 and AMR3 are used)