PISO-CM100U-D/T
PCM-CM100

User’s Manual

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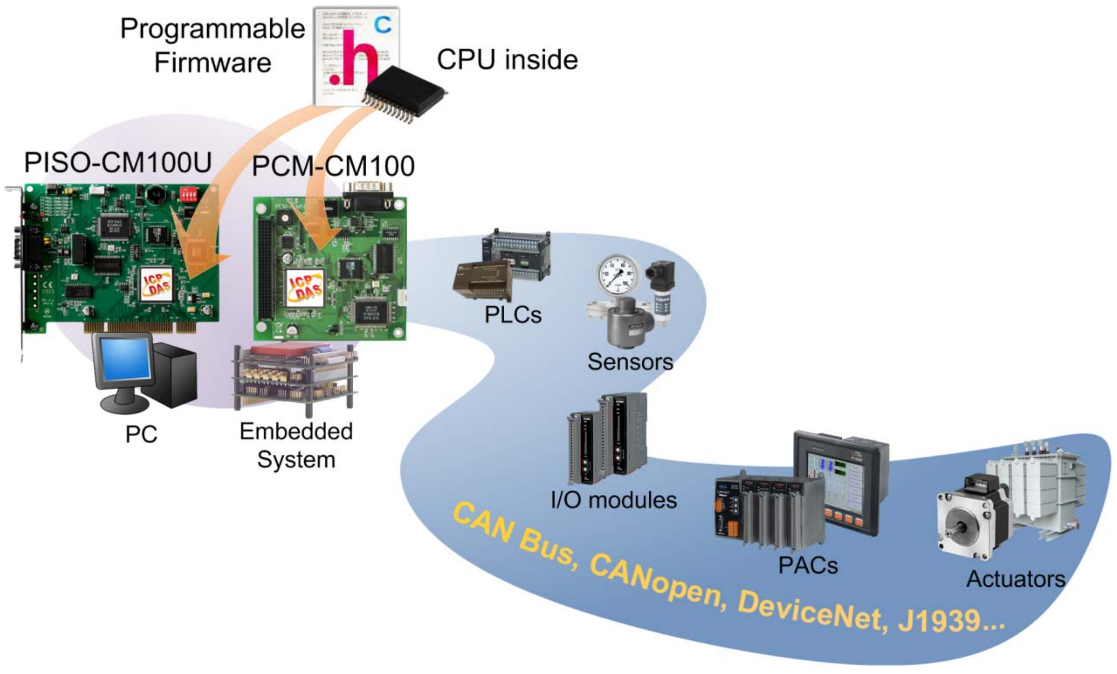
1 General Information

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 stand-alone CAN controller, The PISO-CM100U/PCM-CM100 represents a powerful and economic solution. It has an internal 80186 compactable CPU for the complex protocol interpretations and implementations. Owing to the real-time DOS-like OS, MiniOS7, the PISO-CM100U/PCM-CM100 can cover most of all time-critical CAN-based applications, such as self-define CAN protocol, CANopen, DeviceNet, J1939, and so forth. Therefore, when users develop their projects, the PISO-CM100U/PCM-CM100 is helpful to handle the process of the CAN messages, and share the CPU loading of the PC or embedded system. Besides, the PISO-CM100U/PCM-CM100 allows users designing the firmware of the PISO-CM100U/ PCM-CM100. Through the library and demos, it is easy to finish the user-defined firmware to satisfy the users' requirements.



1.2 Features

- Follow ISO11898-2 specification
- 2500Vrms photo-isolation protection on CAN side
- Jumper select 120Ω terminator resistor for CAN bus
- One CAN communication port
- Compatible with CAN specification 2.0 parts A and B
- Provide default baud 10Kbps, 20Kbps, 50Kbps, 125Kbps, 250Kbps, 500Kbps, 800Kbps, and 1Mbps
- Allow user-defined baud
- 2048 records reception buffer and 256 records transmission buffer
- Cyclic transmission precision: ±0.5ms precision when cyclic time is under 10ms , ±1% error when cyclic time exceeds 10ms.
- Provide 5 sets of cyclic transmission.
- Timestamp of CAN message with at least ±1ms precision
- 186 compactable CPU inside
- Arrange the inside DPRAM flexibly
- RTC(Real Time Clock) inside
- LED indicators for
- Support the default firmware or the user-defined firmware
- Support firmware update
- VC++, VB, BCB demos and libraries are given
- C/C++ function libraries of firmware side is given

1.3 Specifications

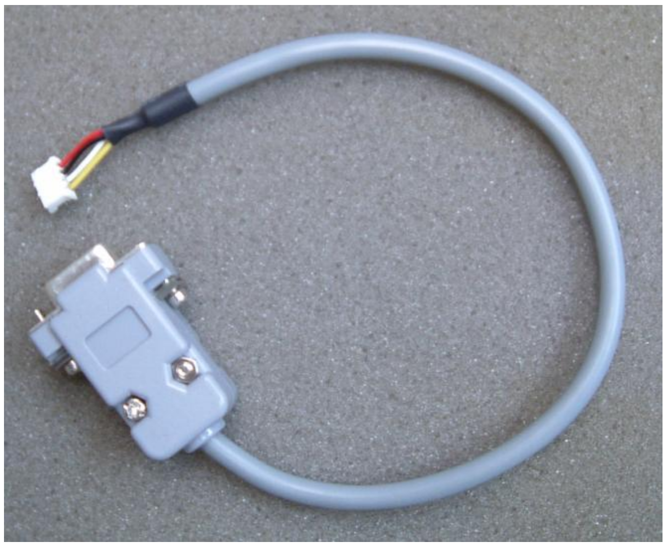
Model Name	PISO-CM100U	PCM-CM100
Hardware		
CPU	80186, 80 MHz or compatible	
SRAM	512 KB	
Flash	512 KB (128 KB for system, 384 KB for users' applications), 64 KB for one sector (erase unit), 100,000 erase/write cycles	
EEPROM	2 KB (1 KB for system information, 15 KB for users' applications), 40-year data retention, 1 million erase/write cycles	
DPRAM	8 KB (1 kB for system, others for users' applications)	
NVRAM	31 bytes (battery backup, data valid for up to 10 years)	
RTC (Real Time Clock)	Seconds, minutes, hours, date of week, date of month, month and year, valid from 1980 to 2079	
Bus Interface		
Type	Universal PCI, 3.3 V and 5 V, 33 MHz, 32-bit, plug and play	PCI-104
Board No.	By DIP switch	By rotary switch
CAN Interface		
Controller	NXP SJA1000T with 16 MHz clock	
Transceiver	NXP 82C250	
Channel number	1	
Connector	5-pin screwed terminal block or 9-pin male D-Sub due to the model number	9-pin male D-Sub
Baud Rate (bps)	10 k, 20 k, 50 k, 125 k, 250 k, 500 k, 800 k, 1 M (allow user-defined baud rate)	
Isolation	3000 VDC for DC-to-DC, 2500 Vrms for photo-couple	
Terminator Resistor	Jumper for 120 Ω terminator resistor	
LED		
LED Indicator	Green LED, red LED (in default firmware: green for Tx/Rx, red for Err)	
Power		
Power Consumption	400 mA @ 5 V	
Software		
Driver	Windows 2K / XP / 7(x32)	
Library	VB 6.0, VC++ 6.0, BCB 6.0, Delphi 4.0	

Mechanism		
Dimensions (L x W)	138mm x 105mm	90mm x 96mm
Environment		
Operating Temp.	0 ~ 60 ℃	
Storage Temp.	-20 ~ 70 ℃	
Humidity	5 ~ 85% RH, non-condensing	

1.4 Product Check List

Besides this manual, the package includes the following items:

- □ PISO-CM100U/PCM-CM100 CAN card
- □ Software CD ROM
- □ Quickstart
- □ One debug cable (model number is 4PCA-0904)



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

- □ Where you can find the software driver, utility and demo programs.
- □ How to install software & utility.
- □ How to program users' applications with PISO-CM100U/PCM-CM100.
- □ The definitions of function library, error code, LED status, and pin assignment.
- □ The basic solution of troubleshooting.

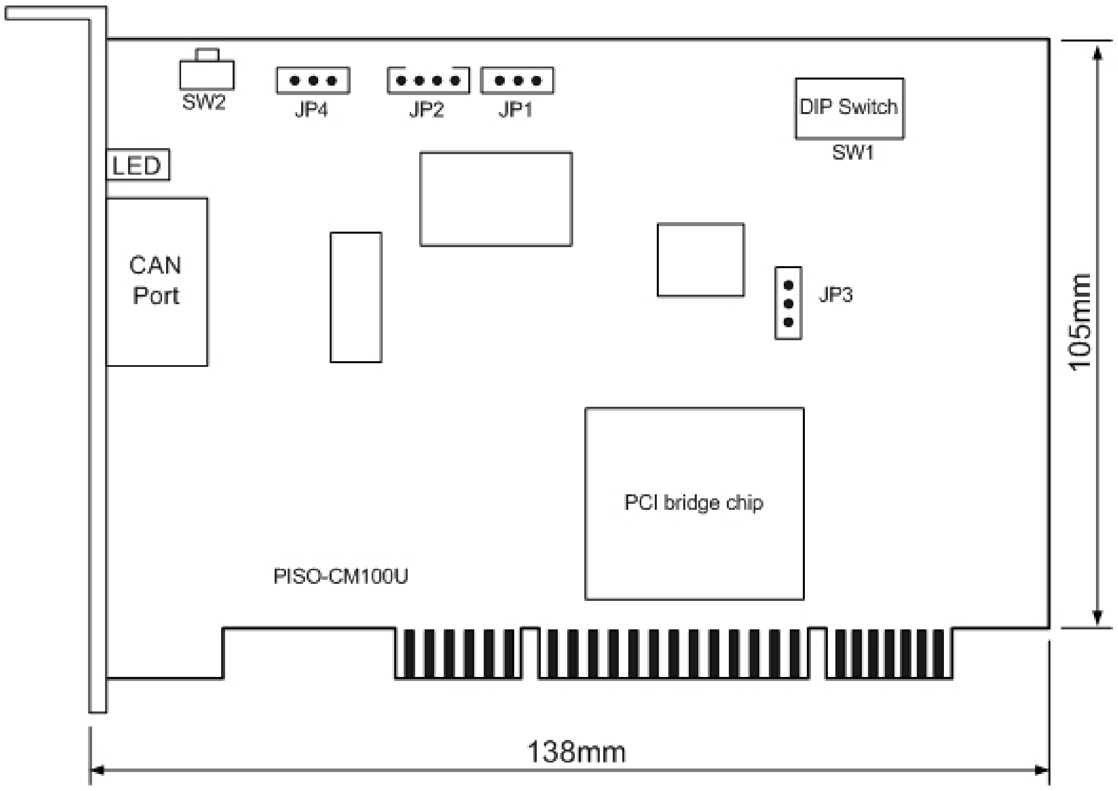
Attention !

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.

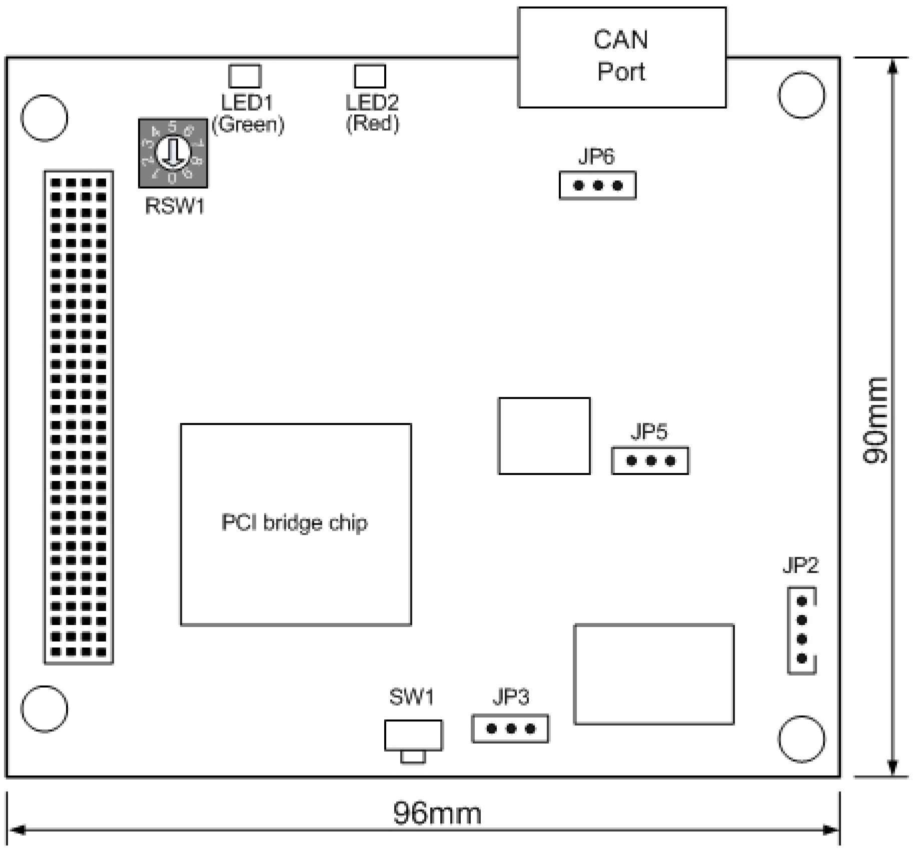
2 Hardware Configuration

This section describes the hardware settings of the PISO-CM100U/ PCM-CM100. This information includes the wire connection and terminal resistance configuration for the CAN network. The PISO-CM100U-T layout is similar with the PISO-CM100U-D. The only difference is the position of CAN port connector.

2.1 Board Layout



PISO-CM100U-D board layout

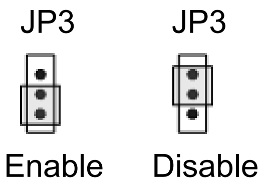
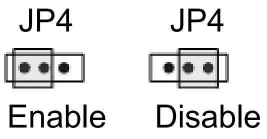
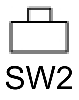
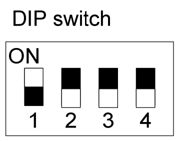


PCM-CM100 board layout

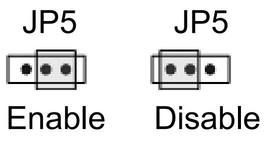
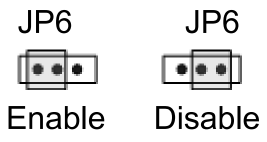
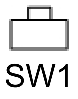
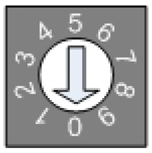
2.2 *Jumper Selection*

The following table shows the definition of jumpers or DIP switch. Users need to refer to the following table to configure the PISO-CM100U-D/T hardware.

PISO-CM100U：

Jumper	Description	Status
JP2	The debug port for the user-defined firmware. Users can connect the debug port with the PC RS-232 port via the debug cable.	4-pin connector for JP2 D-Sub 9 pin connector for PC RS-232 port
JP3	The Flash protection jumper. If users would like to protect the data of the Flash. Enable this jumper. In this case, the firmware can't be updated from the utility.	
JP4	The 120Ω terminal resistance of the CAN bus.	
SW2	The reset button for into the download mode. If users would like force the CAN board into download mode, enable this jumper to reset the firmware and let the PISO-CM100U into the download mode.	
DIP switch	The DIP switch for the PISO-CM100U board No. If the left-hand-side switch (bit No. 1) is ON, the board No. is set to 1. The range of the board No. is from 0 to 15. Be careful that the board No. of each PISO-CM100U, PISO-DNM 100U and PISO-CPM100U in your PC must be unique.	 This situation indicates the board No. 1.

PCM-CM100：

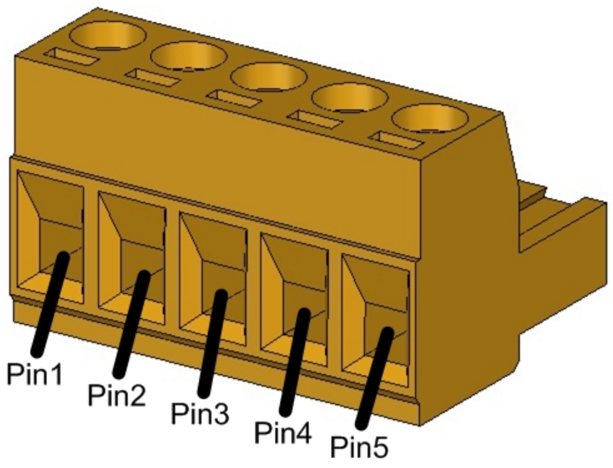
Jumper	Description	Status
JP2	The debug port for the user-defined firmware. Users can connect the debug port with the PC RS-232 port via the debug cable.	4-pin connector for JP2 D-Sub 9 pin connector for PC RS-232 port
JP5	The Flash protection jumper. If users would like to protect the data of the Flash. Enable this jumper. In this case, the firmware can't be updated from the utility.	
JP6	The 120Ω terminal resistance of the CAN bus.	
SW1	The reset button for into the download mode. If users would like force the CAN board into download mode, enable this jumper to reset the firmware and let the PCM-CM100 into the download mode.	
RSW1	The rotary switch for the PCM-CM100 board No. and interrupt line. There are only 4 interrupt lines for the PCI-104 architecture. So, only the value 0 ~ 3 are useful. If users set the rotary switch to 4 ~ 9, the board No will be 4 ~ 9, but the interrupt line is still one of the 0 ~ 3.	 This situation indicates the board No. 0.

2.3 Connector Pin Assignment

The PISO-CM100U-T is equipped with one **5-pin screw terminal connector** and the PISO-CM100U-D/PCM-CM100 is equipped with one **9-pin D-sub male connector** for wire connection of the CAN bus. The connector's pin assignment is specified as following:

2.3.1 5-pin screw terminal connector

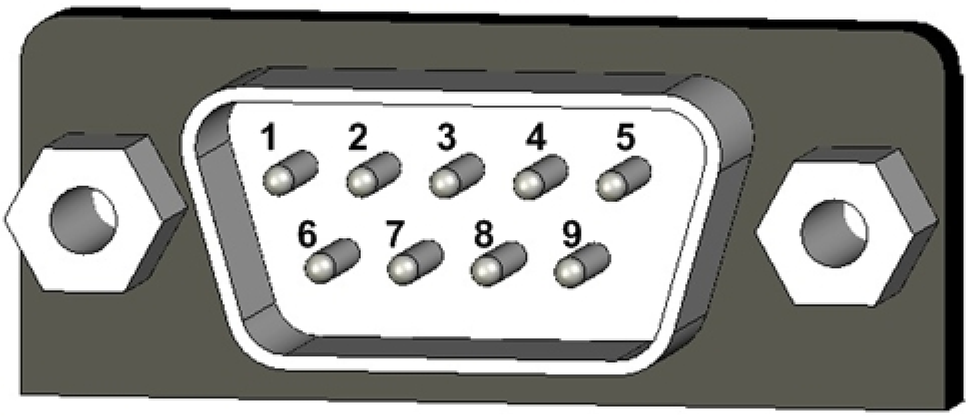
The 5-pin screw terminal connector of the CAN bus interface is shown in the following figure and table.



Pin No.	Signal	Description
1	CAN_GND	Ground
2	CAN_H	CAN_H bus line (dominant high)
3	CAN_SHLD	Optional CAN Shield
4	CAN_L	CAN_L bus line (dominant low)
5	N/A	No use

2.3.2 9-pin D-sub male connectors

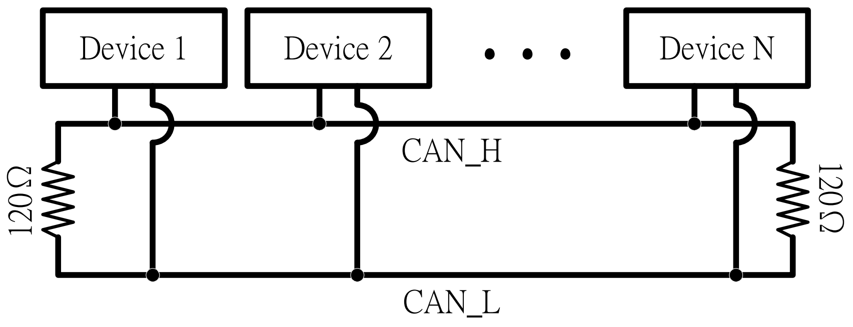
The 9-pin D-sub male connector of the CAN bus interface is shown in the following figure and table.



Pin No.	Signal	Description
1	N/A	No use
2	CAN_L	CAN_L bus line (dominant low)
3	CAN_GND	Ground
4	N/A	No use
5	CAN_SHLD	Optional CAN Shield
6	CAN_GND	Ground
7	CAN_H	CAN_H bus line (dominant high)
8	N/A	No use
9	N/A	No use

2.3.3 Wire connection

In order to minimize the reflection effects on the CAN bus line, the CAN bus line has to be terminated at both ends by two terminal resistances as in the following figure. According to the ISO 11898-2 spec, each terminal resistance is 120Ω (or between 108Ω~132Ω). The length related resistance should have 70 mΩ/m. Users should check the resistances of the CAN bus, before they install a new CAN network.



Moreover, to minimize the voltage drop over long distances, the terminal resistance should be higher than the value defined in the ISO 11898-2. The following table can be used as a good reference.

Bus Length (meter)	Bus Cable Parameters		Terminal Resistance (Ω)
	Length Related Resistance (mΩ/m)	Cross Section (Type)	
0~40	70	0.25(23AWG)~ 0.34mm^2(22AWG)	124 (0.1%)
40~300	< 60	0.34(22AWG)~ 0.6mm^2(20AWG)	127 (0.1%)
300~600	< 40	0.5~0.6mm^2 (20AWG)	150~300
600~1K	< 20	0.75~0.8mm^2 (18AWG)	150~300

2.4 LED Indicator & Operation Mode

The LED status will be changed when PISO-CM100U/PCM-CM100 is in the different modes. There are three modes, and each mode describes as follows:

1. Download mode: In this case, the green LED and red LED will be alternatively flashed once per second. (When the green LED is ON, the red LED is OFF, and vice versa.). The PISO-CM100U/PCM-CM100 is ready for updating the firmware from the Utility. Users can use the software to download the newer default firmware or the user-defined firmware.
2. Firmware mode: If the PISO-CM100U/PCM-CM100 uses default firmware, the green LED is flashed once as the PISO-CM100U/PCM-CM100 receives or transmits one CAN message to CAN bus successfully. If the bus loading is heavy, the green LED may be turned on always. If some error occurs, the red LED is turned on. Users can use CM100_Status() function to obtain the CAN control status except the buffer status. The buffer statuses are obtained from the return codes of the transition or reception functions as users read or send a CAN message. If the PISO-CM100U/PCM-CM100 runs the user-defined firmware, the actions of the green LED or red LED can be designed by the user-defined firmware.
3. Firmware reset mode: If users enable SW2 of the PISO-CM100U or the SW1 of the PCM-CM100 described in section 2.2, both the red and green LEDs will be turned on about 1 second, and the PISO-CM100U/ PCM-CM100 is forced to enter the download mode. If the PISO-CM100U/ PCM-CM100 is out of control because of the bugs of the user-defined firmware or other problems, use this method to reset the firmware and download the newer firmware again.

Note: The color of the LED 1 and LED2 of the PCM-CM100 are green and red respectively.

2.5 Hardware Installation

When users want to use the PISO-CM100U, the hardware installation needs to be finished as the following steps.

1. Shutdown your personal computer.
2. Configure the DIP switch and the JP4 for the board No. and the terminal resistor of the PISO-CM100U. The more detail of the switch and jumper positions can be found at section 2.2.
3. Check the JP3 of the PISO-CM100U. If necessary, enable it.
4. Find an empty PCI slot for the PISO-CM100U on the mother board of the personal computer. Plug the configured PISO-CM100U into this empty PCI slot.
5. Plug the CAN bus cable(s) into the 5-pin screw terminal connector or the 9-pin D-sub connector due to the model number of the PISO-CM100U.

After the procedure described above is completed, turn on the PC.

The hardware installation for the PCM-CM100 is shown as the following steps.

1. Shutdown your embedded system.
2. Configure the rotary switch and the JP6 for the board No. and the terminal resistor of the PCM-CM100. The more detail of the switch and jumper positions can be found at section 2.2.
3. Check the JP5 of the PCM-CM100. If necessary, enable it.
4. Plug the PCM-CM100 on the top of the PCI-104 slot of your embedded system. One embedded may have up to 4 PCM-CM100.
5. Plug the CAN bus cable(s) into the 9-pin D-sub connector.

After the procedure described above is completed, turn on the embedded system.

3 Driver Introduction

3.1 Software Installation

The PISO-CM100U/PCM-CM100 can be used in the Windows 2000/XP environments. Users need to get the proper driver for their operation system. These drivers are in the Field Bus CD in the PISO-CM100U/PCM-CM100 package. The path is CAN\PCI\PISO-CM100U. Also, users can find them from our website as following. (Take a note that the PISO-CM100U and the PCM-CM100 use the same driver.)

ftp://ftp.icpdas.com/pub/cd/fieldbus_cd/can/pci/piso-cm100u/

The recommended installation procedure is given as below:

Step 1: Shut down your system.

Step 2: Plug your PISO-CM100U/PCM-CM100 into your system.

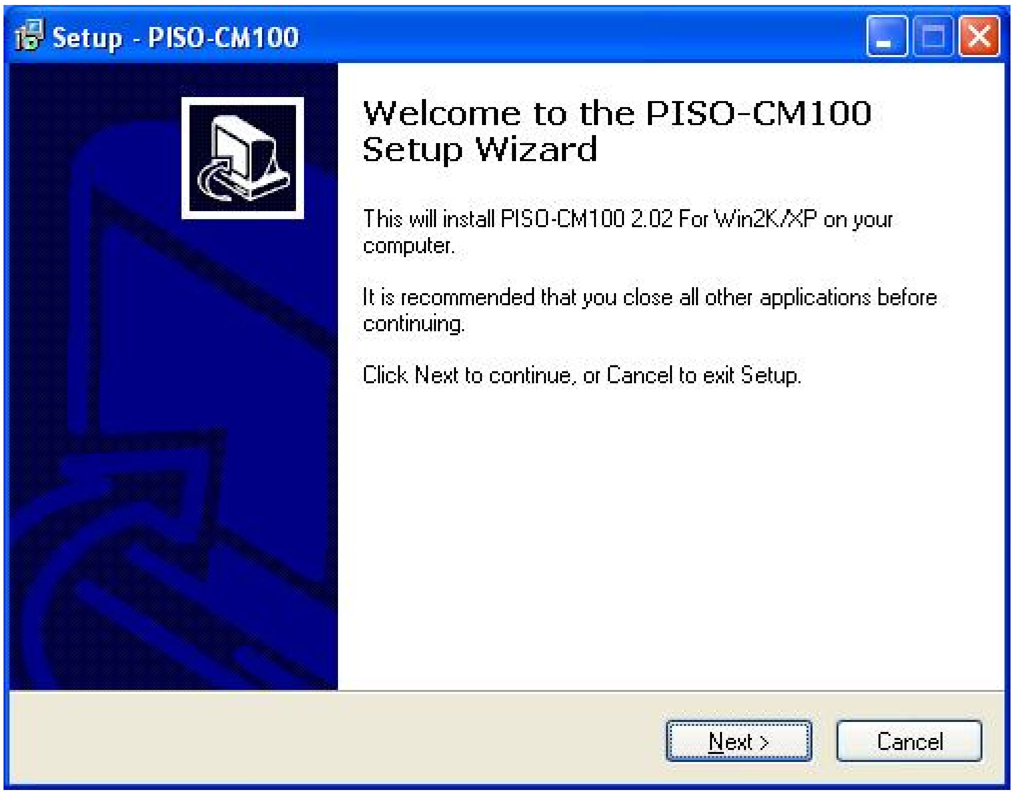
Step 3: Boot up your system. When system detects a new card and pop up a wizard dialog for driver installation, cancel this dialog and skip the procedure of the driver installation.

Step 4: Get the proper PISO-CM100U/PCM-CM100 driver for your operation system. These drivers can be found in CD of PISO-CM100U/ PCM-CM100 package or on the ICP DAS product webpage.

Step 5: Install the driver and reboot your system. In the following description, the installation procedure for Windows XP is given for an example. The installation procedures for other operation systems are similar with the one for the Windows XP.

The driver installation procedure for Window XP is shown as below:

Step1: Execute the driver, piso-cm100_2k_xp.exe, which can be found on the product CD or the website of the ICP DAS.



Setup - PISO-CM100

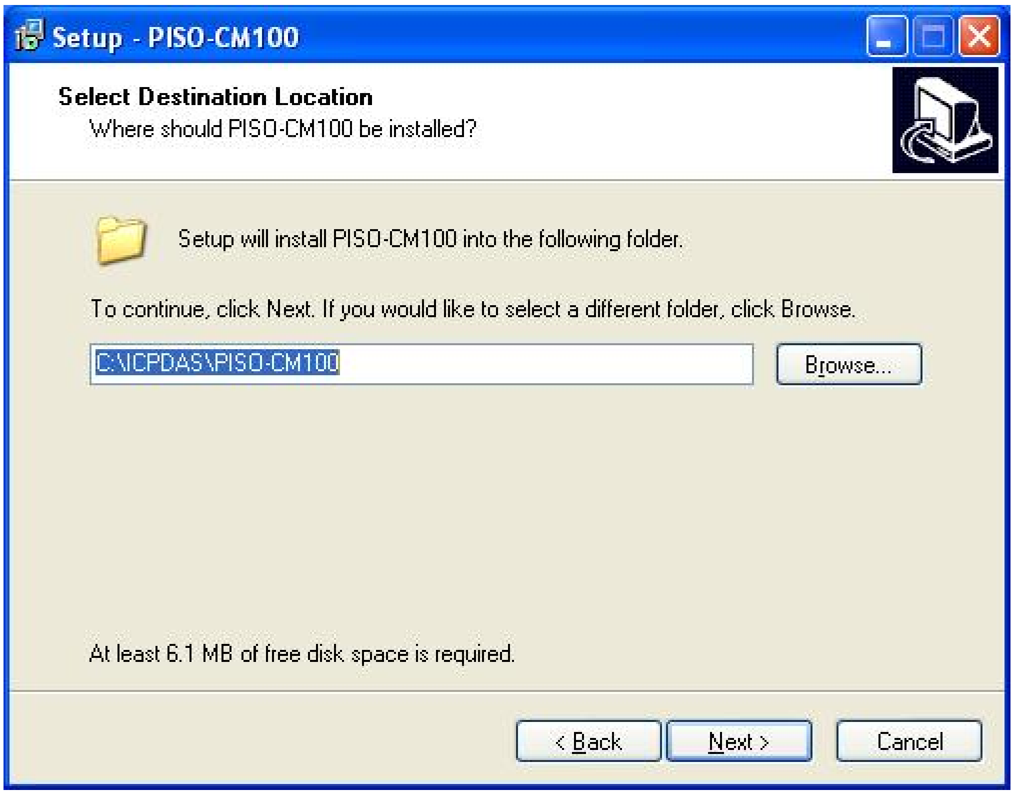
Welcome to the PISO-CM100 Setup Wizard

This will install PISO-CM100 2.02 For Win2K/XP on your computer.

It is recommended that you close all other applications before continuing.

Click Next to continue, or Cancel to exit Setup.

Step2: Confirm the driver installation path. This may concern with where the demos and the utility tool are.



Setup - PISO-CM100

Select Destination Location

Where should PISO-CM100 be installed?

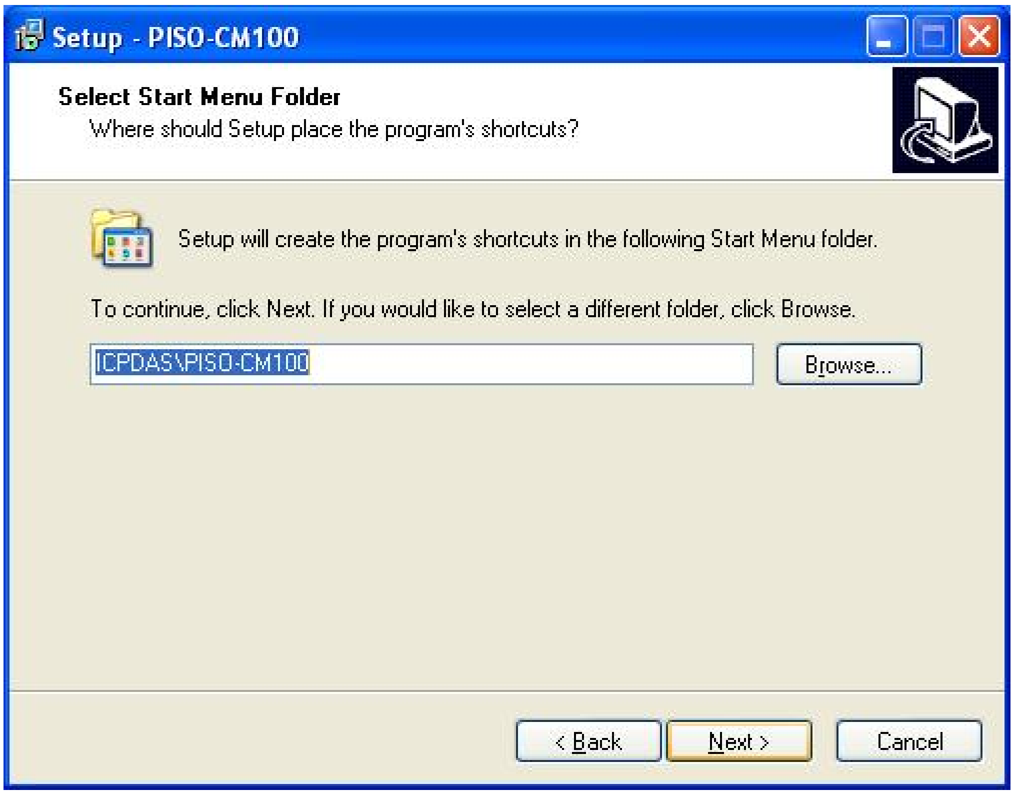
Setup will install PISO-CM100 into the following folder.

To continue, click Next. If you would like to select a different folder, click Browse.

C:\ICPDAS\PISO-CM100

At least 6.1 MB of free disk space is required.

Step3: Confirm the name of the shortcut, and click the next button.


Setup - PISO-CM100

Select Start Menu Folder

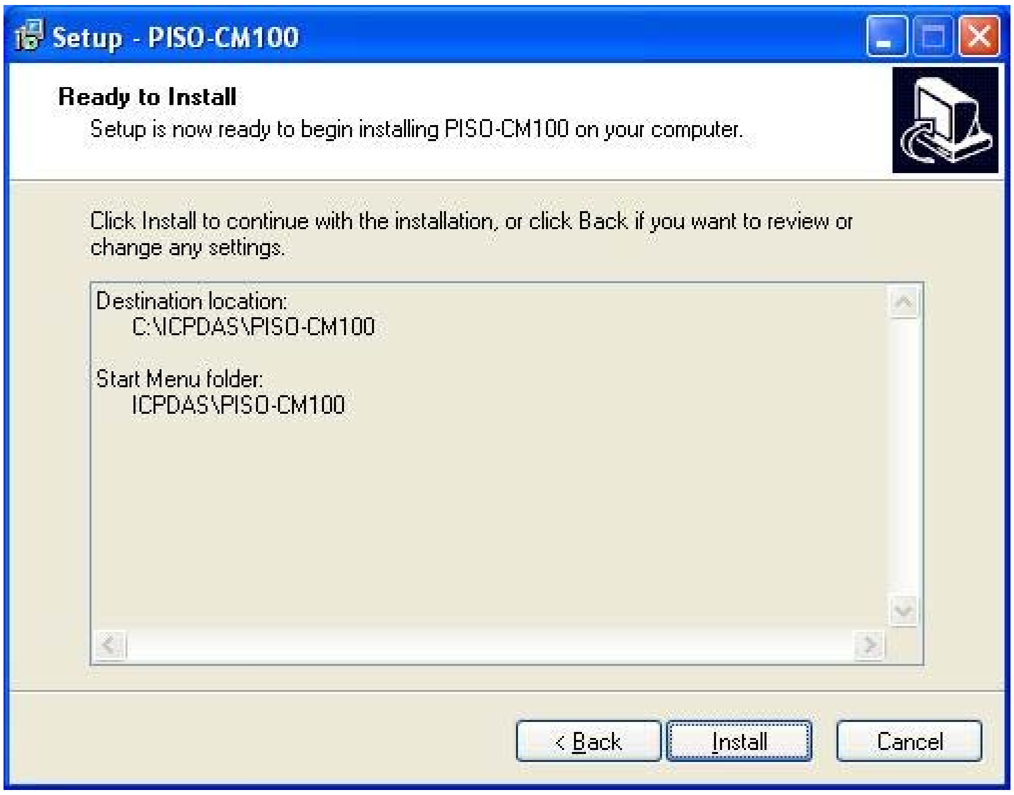
Where should Setup place the program's shortcuts?

Setup will create the program's shortcuts in the following Start Menu folder.

To continue, click Next. If you would like to select a different folder, click Browse.

ICPDAS\PISO-CM100

Step4: The dialog shows the installation path and the name of the shortcut.
Click the install button to go on the installation.


Setup - PISO-CM100

Ready to Install

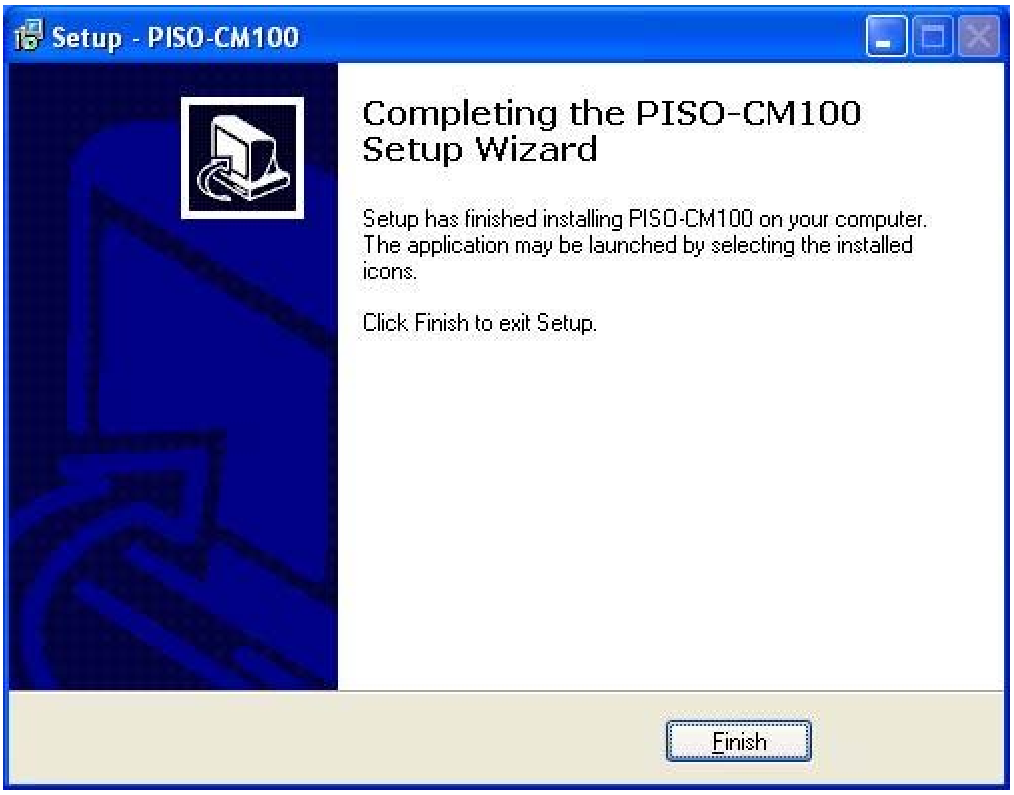
Setup is now ready to begin installing PISO-CM100 on your computer.

Click Install to continue with the installation, or click Back if you want to review or change any settings.

Destination location:
C:\ICPDAS\PISO-CM100

Start Menu folder:
ICPDAS\PISO-CM100

Step5: When all procedures are finished, click the finish button and reset the PC.



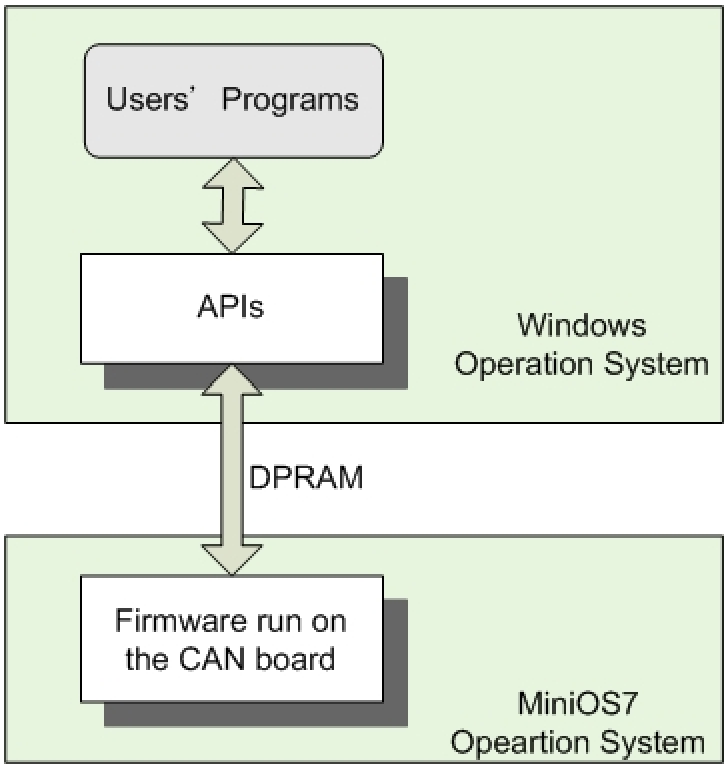
Completing the PISO-CM100 Setup Wizard

Setup has finished installing PISO-CM100 on your computer. The application may be launched by selecting the installed icons.

Click Finish to exit Setup.

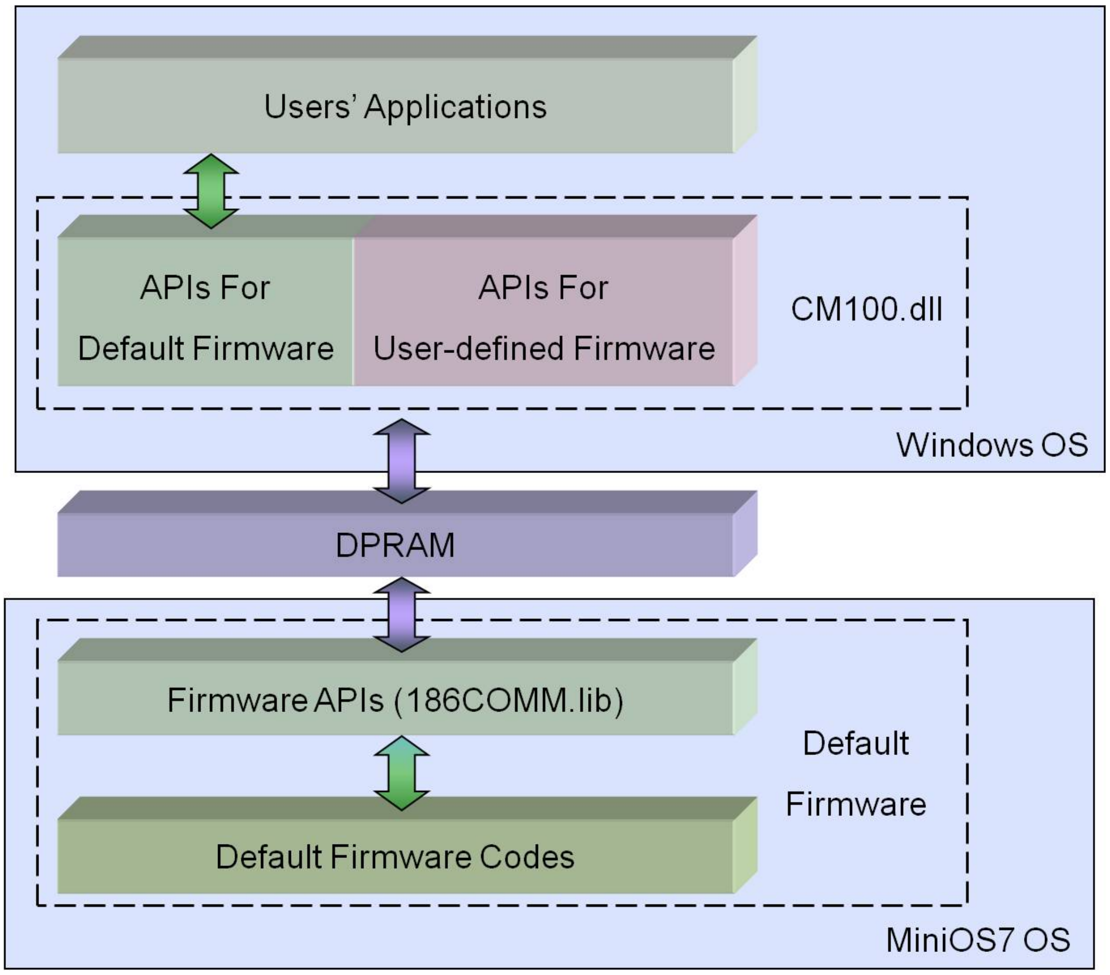
3.2 Software Architecture

The basic software architecture of the PISO-CM100U/PCM-CM100 is shown in the following figure. Users' programs can communicate with the firmware of the PISO-CM100U/PCM-CM100 via APIs. The APIs provide functions for CAN message transmission or reception, DPRAM access, the RTC adjustment and the user-defined firmware communication. Users can apply the default firmware to access the CAN network as a normal CAN card, or program the user-defined firmware to handle the CAN application protocols and process the algorisms as an intelligent CAN card.

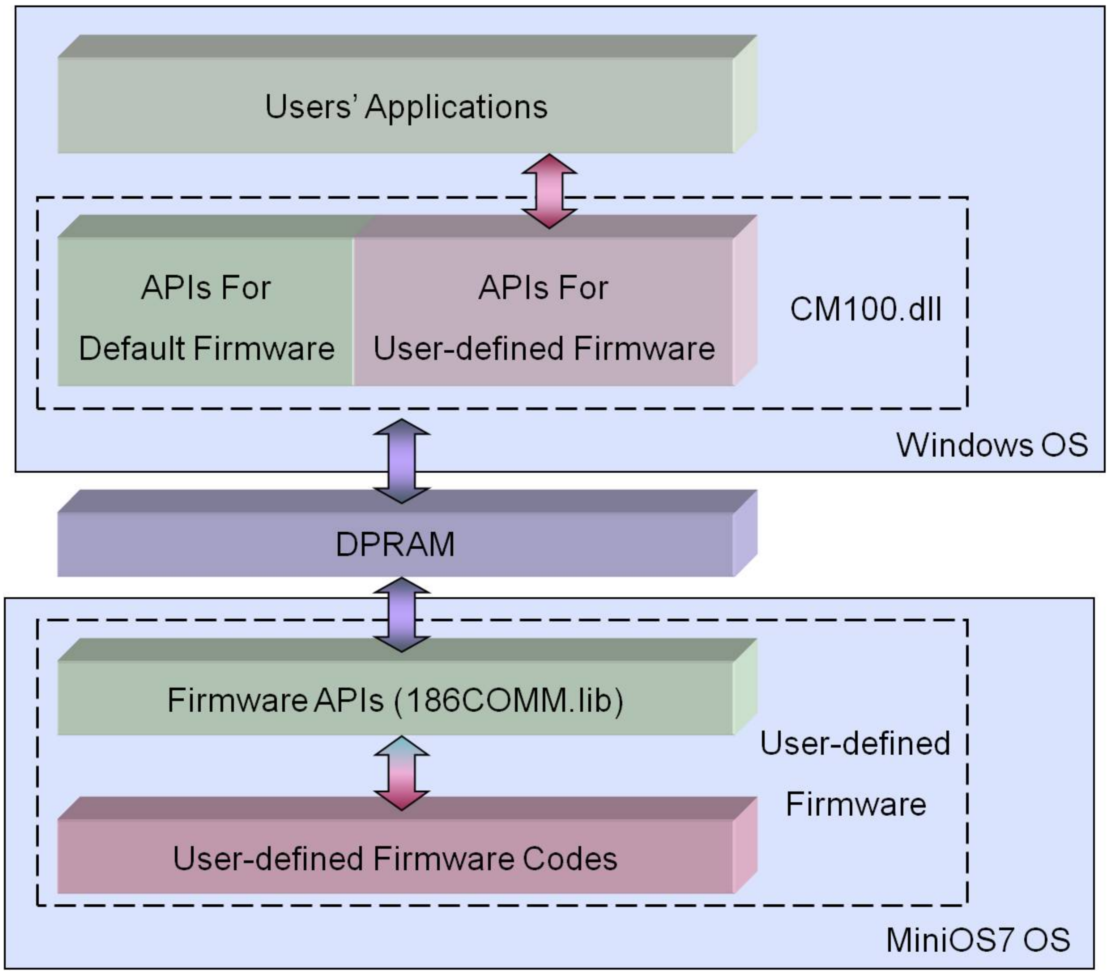


The PISO-CM100U/PCM-CM100 provides the flexibility to design the special firmware to fit the users' applications. Users can use the utility to download the firmware which will be run on the PISO-CM100U/PCM-CM100. The default firmware offers the functions to access the CAN network as a normal CAN board. Through the firmware, users can configure the CAN controller, get the status of the CAN controller, send/receive the CAN messages to/from the CAN bus and send the CAN messages with cyclic transmission engine. These functions are helpful to reach the purposes of bus monitor, bus access, network debugging, basic network set up … and etc.

When using the default firmware, users can only use the APIs which are for the default firmware. The information about what APIs can be used for the default firmware is described in the section 4.1. The software architecture is shown below.



If users' applications need to handle a lot of HMI interfaces or the complex CAN application protocols are applied, it is a good solution to design the special firmware to process the CAN messages. The raw CAN messages can be interpreted by the default firmware, and only the useful data are passed to the users' program of the PC. The CPU of the PC can concentrate on the HMI update, control command implementation, and data-exchange with other devices. Through this method, the CAN-related tasks are done by the user-defined firmware of the PISO-CM100U/PCM-CM100, and the CPU loading of the PC can be effectively shared by the CPU of the PISO-CM100U/PCM-CM100. This software architecture provides the features of the real-time execution, high performance and efficiently reducing the PC CPU loading. The software architecture is shown below.


Users' Applications
APIs For Default Firmware
APIs For User-defined Firmware
CM100.dll
Windows OS
DPRAM
Firmware APIs (186COMM.lib)
User-defined Firmware
User-defined Firmware Codes
MiniOS7 OS

4 APIs for the PC's Program

In this chapter, the APIs for both default firmware and user-defined firmware are described. The content includes the CM100.dll APIs introductions, error code description and the simple method for troubleshooting. It is helpful to develop the users' applications. The section 4.1 shows the list and information of all APIs supported by CM100.dll, and the section 4.2 shows the explication of the return codes of the API functions.

4.1 *Windows API Definitions and Descriptions*

All the functions provided by the CM100.dll are listed in the following table and the detailed information for each function presented in the following sub-section.

Function definition	Page	Note
WORD CM100_GetDllVersion(void)	31	○△
Int CM100_GetBoardInf(BYTE BoardNo, DWORD *dwVID, DWORD *dwDID, DWORD *dwSVID, DWORD *dwSDID, DWORD *dwSAuxID, DWORD *dwIrqNo)	32	○△
Int CM100_TotalBoard(void)	33	○△
Int CM100_TotalCM100Board(void)	33	○△
Int CM100_TotalDNM100Board(void)	34	○△
Int CM100_TotalCPM100Board(void)	34	○△
Int CM100_GetCM100BoardSwitchNo(BYTE BoardCntNo, BYTE *BoardSwitchNo)	35	○△
Int CM100_GetDNM100BoardSwitchNo(BYTE BoardCntNo, BYTE *BoardSwitchNo)	36	○△
Int CM100_GetCPM100BoardSwitchNo(BYTE BoardCntNo, BYTE *BoardSwitchNo)	37	○△
Int CM100_GetCardPortNum(BYTE BoardNo, BYTE *bGetPortNum)	38	○△
Int CM100_ActiveBoard(BYTE BoardNo)	39	○△
Int CM100_CloseBoard(BYTE BoardNo)	40	○△
int CM100_BoardIsActive(BYTE BoardNo)	41	○△
int CM100_AdujstDateTime(BYTE BoardNo)	42	○△
int CM100_Reset(BYTE BoardNo, BYTE Port)	43	○△

Function definition	Page	Note
int CM100_Init(BYTE BoardNo, BYTE Port)	44	○△
int CM100_HardwareReset(BYTE BoardNo, BYTE Port)	45	○△
int CM100_Check186Mode(BYTE BoardNo, BYTE *Mode)	46	○△
int CM100_Status(BYTE BoardNo, BYTE Port, BYTE *bStatus)	47	○△
int CM100_AddCyclicTxMsg(BYTE BoardNo, BYTE Port, BYTE Mode, DWORD MsgID, BYTE RTR, BYTE DataLen, BYTE *Data, DWORD TimePeriod, BYTE *Handle)	49	○△
int CM100_DeleteCyclicTxMsg(BYTE BoardNo, BYTE Port, BYTE Handle)	51	○△
int CM100_EnableCyclicTxMsg(BYTE BoardNo, BYTE Port, BYTE Handle)	52	○△
int CM100_DisableCyclicTxMsg(BYTE BoardNo, BYTE Port, BYTE Handle)	53	○△
void CM100_OutputByte(BYTE BoardNo, BYTE Port, WORD wOffset, BYTE bValue)	54	○△
BYTE CM100_InputByte(BYTE BoardNo, BYTE Port, WORD wOffset)	55	○△
int CM100_IsTxTimeout(BYTE BoardNo, BYTE Port, BYTE *Status)	56	○△
int CM100_SetSystemMsg(BYTE BoardNo, BYTE Port, BYTE Mode)	57	○△
int CM100_ClearSoftBuffer(BYTE BoardNo, BYTE Port)	58	○
int CM100_ClearBufferStatus(BYTE BoardNo, BYTE Port)	59	○
int CM100_ClearDataOverrun(BYTE BoardNo, BYTE Port)	60	○
int CM100_Config(BYTE BoardNo, BYTE Port, ConfigStruct *CanConfig)	61	○
int CM100_ConfigWithoutStruct(BYTE BoardNo, BYTE Port, DWORD AccCode, DWORD AccMask, BYTE BaudRate, BYTE BT0, BYTE BT1)	64	○
int CM100_RxMsgCount(BYTE BoardNo, BYTE Port)	65	○
int CM100_ReceiveMsg(BYTE BoardNo, BYTE Port, PacketStruct *CanPacket)	66	○
int CM100_ReceiveWithoutStruct(BYTE BoardNo, BYTE Port, BYTE *Mode, DWORD *MsgID, BYTE *RTR, BYTE *DataLen, BYTE *Data , DWORD *UpperTime , DWORD *LowerTime)	68	○
int CM100_SendMsg(BYTE BoardNo, BYTE Port, PacketStruct *CanPacket)	70	○
int CM100_SendWithoutStruct(BYTE BoardNo, BYTE Port, BYTE Mode, DWORD MsgID, BYTE RTR, BYTE DataLen, BYTE *Data)	71	○

Function definition	Page	Note
int CM100_SJA1000Config(BYTE BoardNo, BYTE Port, DWORD AccCode, DWORD AccMask, BYTE BaudRate, BYTE BT0, BYTE BT1)	73	△
int CM100_EnableSJA1000(BYTE BoardNo, BYTE Port)	74	△
int CM100_DisableSJA1000(BYTE BoardNo, BYTE Port)	75	△
int CM100_DPRAMInttToCM100(BYTE BoardNo, BYTE Port, BYTE Data)	76	△
int CM100_DPRAMWriteByte(BYTE BoardNo, BYTE Port, WORD Address, BYTE Data)	77	△
int CM100_DPRAMWriteWord(BYTE BoardNo, BYTE Port, WORD Address, WORD Data)	78	△
int CM100_DPRAMWriteDword(BYTE BoardNo, BYTE Port, WORD Address, DWORD Data)	79	△
int CM100_DPRAMWriteMultiByte(BYTE BoardNo, BYTE Port, WORD Address, BYTE *Data, WORD DataNum)	80	△
int CM100_DPRAMReadByte(BYTE BoardNo, BYTE Port, WORD Address, BYTE *Data)	81	△
int CM100_DPRAMReadWord(BYTE BoardNo, BYTE Port, WORD Address, WORD *Data)	82	△
int CM100_DPRAMReadDword(BYTE BoardNo, BYTE Port, WORD Address, DWORD *Data)	83	△
int CM100_DPRAMReadMultiByte(BYTE BoardNo, BYTE Port, WORD Address, BYTE *Data, WORD DataNum)	84	△
int CM100_DPRAMMemset(BYTE BoardNo, BYTE Port, WORD Address, BYTE Data, WORD DataNum)	85	△
int CM100_ReceiveCmd(BYTE BoardNo, BYTE Port, BYTE *Data, WORD *DataNum)	86	△
int CM100_SendCmd(BYTE BoardNo, BYTE Port, BYTE *Data, WORD DataNum)	88	△
int CM100_InstallUserISR(BYTE BoardNo, void (*UserISR)(BYTE BoardNo, BYTE InttValue))	89	△
int CM100_RemoveUserISR(BYTE BoardNo)	90	△

Note: In table 3.1, the mark ○ and △ indicate the use condition of the API functions. The function marked with ○ or △ presents that this function is useful while the default CM100 firmware or the user-defined firmware is running. If the default firmware is running, all of the functions marked with ○ could be applied. If users design their firmware by using the firmware library (firmware library is described in chapter 5), only the functions marked with △ is useful. The functions marked with ○△ can be used with default firmware or user-defined firmware.

In order to make the descriptions simpler and clearer, the attributes for the both of 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

4.1.1 CM100_GetDllVersion

- **Description:**

  Obtains the version information of the CM100.dll driver.

- **Syntax:**

  WORD CM100_GetDllVersion(void)

- **Parameter:**

  None

- **Return:**

  DLL version information. For example: If the value 100(hex) is return, it means the driver version is 1.00.

4.1.2 *CM100_GetBoardInf*

- **Description:**

  This function is used to obtain the information of the PISO-CM100U, PCM-CM100, PISO-DNM100U or PISO-CPM100U, which includes the vender ID, the device ID and the interrupt number.

- **Syntax:**

```
int CM100_GetBoardInf(BYTE BoardNo, DWORD *dwVID,
                      DWORD *dwDID, DWORD *dwSVID,
                      DWORD *dwSDID, DWORD *dwSAuxID,
                      DWORD *dwIrqNo)
```

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or the rotary switch No. (0~9) of the PISO-CM100U, PCM-CM100, PISO-DNM100U or PISO-CPM100U.

  *dwVID: [output] The address of a variable which is used to receive the vendor ID.

  *dwDID: [output] The address of a variable used to receive device ID.

  *dwSVID: [output] The address of a variable applied to receive sub-vendor ID.

  *dwSDID: [output] The address of a variable applied to receive sub-device ID.

  *dwSAuxID: [output] The address of a variable used to receive sub-auxiliary ID.

  *dwIrqNo: [output] The address of a variable used to receive logical interrupt number.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

4.1.3 CM100_TotalBoard

- **Description:**

  This function is used to obtain the total board number of the PISO-CM100U, PCM-CM100, PISO-DNM100U, and PISO-CPM100U boards installed in the PC or embedded system.

- **Syntax:**

  Int CM100_TotalBoard(void)

- **Parameter:**

  None

- **Return:**

  The total scanned board number.

4.1.4 CM100_TotalCM100Board

- **Description:**

  This function is used to obtain the total board number of the PISO-CM100U/PCM-CM100 installed in the PC or embedded system.

- **Syntax:**

  Int CM100_TotalCM100Board(void)

- **Parameter:**

  None

- **Return:**

  The total scanned PISO-CM100U/PCM-CM100 number.

4.1.5 CM100_TotalDNM100Board

- **Description:**

  This function is used to obtain the total board number of the PISO-DNM100U installed in the PC.

- **Syntax:**

  Int CM100_TotalDNM100Board(void)

- **Parameter:**

  None

- **Return:**

  The total scanned PISO-DNM100U number.

4.1.6 CM100_TotalCPM100Board

- **Description:**

  This function is used to obtain the total board number of the PISO-CPM100U plugged in the PC.

- **Syntax:**

  Int CM100_TotalCPM100Board(void)

- **Parameter:**

  None

- **Return:**

  The total scanned PISO-CPM100U number.

4.1.7 CM100_GetCM100BoardSwitchNo

- **Description:**

  Replies the DIP switch No. or rotary switch No. of the PISO-CM100U/PCM-CM100.

- **Syntax:**

```
Int CM100_GetCM100BoardSwitchNo(BYTE BoardCntNo,
                                BYTE *BoardSwitchNo)
```

- **Parameter:**

BoardCntNo:	[input] The number of specified PISO-CM100U/ PCM-CM100. For example, if it is the first PISO-CM100U/ PCM-CM100 in the PC, this value is 0. For second board, this value is 1.
* BoardSwitchNo:	[output] The address of a variable used to get the DIP switch No. or rotary switch No. of the PISO-CM100U/PCM-CM100.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: The parameter BoardCntNo exceeds the current total board numbers of the system.

4.1.8 CM100_GetDNM100BoardSwitchNo

- **Description:**

  Replies the DIP switch No. of the PISO-DNM100U in the PC.

- **Syntax:**

```
Int CM100_GetDNM100BoardSwitchNo(BYTE BoardCntNo,
                                 BYTE *BoardSwitchNo)
```

- **Parameter:**

  BoardCntNo: [input] The number of specified PISO-DNM100U. For example, if it is the first PISO-DNM100U in the PC, this value is 0. For second board, this value is 1.

  * BoardSwitchNo: [output] The address of a variable used to get the DIP switch No. of PISO-DNM100U.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: The parameter Board No. exceeds the current total scanned board number.

4.1.9 CM100_GetCPM100BoardSwitchNo

- **Description:**

  Replies the DIP switch No. of the PISO-CPM100U in the PC.

- **Syntax:**

```
Int CM100_GetCPM100BoardSwitchNo(BYTE BoardCntNo,
                                  BYTE *BoardSwitchNo)
```

- **Parameter:**

  BoardCntNo: [input] The number of specified PISO-CPM100U. For example, if it is the first PISO-CPM100U in the PC, this value is 0. For second board, this value is 1.

  * BoardSwitchNo: [output] The address of a variable used to get the DIP switch No. of PISO-CPM100U.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: The parameter Board No .exceeds the current total scanned board numbers.

4.1.10 CM100_GetCardPortNum

- **Description:**

  Replies the port number of the PISO-CM100U, PCM-CM100, PISO-DNM100U, or PISO-CPM100U installed in the PC or embedded system.

- **Syntax:**

  Int CM100_GetCardPortNum(BYTE BoardNo, BYTE *bGetPortNum)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the PISO-CM100U, PCM-CM100, PISO-DNM100U or PISO-CPM100U.

  * bGetPortNum: [output] The address of a variable used to obtain the port number of the PISO-CM100U, PCM-CM100, PISO-DNM100U or PISO-CPM100U.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can’t find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

4.1.11 CM100_ActiveBoard

- **Description:**

  This function must be called once for activating the board before using the other functions of the APIs.

- **Syntax:**

  int CM100_ActiveBoard(BYTE BoardNo)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can’t find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board can not be activated or the driver file is lost.

4.1.12 CM100_CloseBoard

- **Description:**

  This function must be called once for releasing the system resource before exiting the user's application program.

- **Syntax:**

  int CM100_CloseBoard(BYTE BoardNo)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

4.1.13 CM100_BoardIsActive

- **Description:**

  Checks if the specific board is active.

- **Syntax:**

  int CM100_BoardIsActive(BYTE BoardNo)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

- **Return:**

  0: the board is not active.

  1: the board has been activated.

4.1.14 *CM100_ AdujstDateTime*

- **Description:**

  Adjusts the date and time of the PISO-CM100U/PCM-CM100 by using the system time.

- **Syntax:**

  int CM100_AdujstDateTime(BYTE BoardNo)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can’t find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_SetDateTimeFailure: Sets the date and time failure.

4.1.15 CM100_Reset

- **Description:**

  Resets the CAN controller of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  int CM100_Reset(BYTE BoardNo, BYTE Port)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can’t find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_PortNumberError: The port number is not correct.

4.1.16 CM100_Init

- **Description:**

  Initiates the CAN controller.

- **Syntax:**

  int CM100_Init(BYTE BoardNo, BYTE Port)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_PortNumberError: The port number is not correct.

  CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.

  CM100_ModeError: This board is in download mode, and can't be changed to firmware mode.

4.1.17 CM100_HardwareReset

- **Description:**

  Resets the PISO-CM100U/PCM-CM100 hardware, such as CAN controller, the firmware of the PISO-CM100U/PCM-CM100 and the DPRAM.

- **Syntax:**

  int CM100_HardwareReset(BYTE BoardNo, BYTE Port)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can’t find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_PortNumberError: The port number is not correct.

  CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.

  CM100_ModeError: This board is in download mode, and can’t be changed to firmware mode.

4.1.18 CM100_Check186Mode

- **Description:**

  Replies the operation mode of the specified board.

- **Syntax:**

  int CM100_Check186Mode(BYTE BoardNo, BYTE *Mode)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  *Mode: [output] The address of a variable used to get the operation mode of the PISO-CM100U/PCM-CM100. If this value is 0, the board is in download mode, and the value 1 is for firmware mode. If the board is in download mode, it can only update the firmware. The firmware will not work in this mode. Users can use the function CM100_Init() to change the mode of the board into the firmware mode.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.

  CM100_InitError: The PISO-CM100U/PCM-CM100 replies erroneously.

  CM100_ModeError: This board is in download mode, and can't be changed to firmware mode.

4.1.19 *CM100_Status*

- **Description:**

  Replies the status of the CAN controller of the specified board.

- **Syntax:**

  int CM100_Status(BYTE BoardNo, BYTE Port, BYTE *bStatus)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

  *bStatus: [output] The address of a variable applied to get the status value of the CAN controller.

  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	NAME	VALUE	STATUS
bit 0	Receive Buffer Status	1	full/not empty
		0	empty

- **Return:**

CM100_NoError: OK

CM100_DriverError: The driver is inactive or no board is in the system.

CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

CM100_ActiveBoardError: This board is not activated.

CM100_PortNumberError: The port number is not correct.

4.1.20 CM100_AddCyclicTxMsg

- **Description:**

  Adds a cyclic transmission message into the firmware of the board. Afterwards, users can use the functions CM100_EnableCyclicTxMsg() and CM100_DelectCyclicTxMsg() to enable or disable this cyclic transmission message. The maximum addable number of the transmission messages is 5. After adding a cyclic transmission message, the handle for this message will be returned. The less value of handle indicates the higher priority of the cyclic transmission messages. If there are two cycle transmission messages need to be sent at the same time, the higher priority message will be sent first.

- **Syntax:**

```
int CM100_AddCyclicTxMsg(BYTE BoardNo, BYTE Port, BYTE Mode,
                         DWORD MsgID, BYTE RTR,
                         BYTE DataLen, BYTE *Data,
                         DWORD TimePeriod,
                         DWORD TransmitTimes, BYTE *Handle)
```

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

  Mode: [input] 0 for 11-bit message ID, 1 for 29-bit message ID.

  MsgID: [input] The CAN message ID.

  RTR: [input] 0 for transmitting the remote-transmit-request message, 1 for transmitting the normal message. As this bit is 1, the parameter *Data is useless.

  DataLen: [input] The data length of the CAN message. The maximum value is 8.

  *Data: [input] The start address of the data array of a CAN message. The maximum length of the Data array is 8 bytes.

  TimePeriod: [input] The time period for the cyclic transmission. This parameter is formatted by 0.1ms. The minimum value is 5.

TransmitTimes: [input] The transmission times for the cyclic transmission. After enabling the transmission, the message will be sent for specified times. If the value of the parameter is 0, the transmission goes cyclically until disabling the cyclic transmission.

*Handle: [output] The address of a variable is used to get the handle of a cyclic transmission. When users would like to enable or disable the specified transmission, this value is needed.

- **Return:**

CM100_NoError: OK

CM100_DriverError: The driver is inactive or no board is in the system.

CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

CM100_ActiveBoardError: This board is not activated.

CM100_PortNumberError: The port number is not correct.

CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.

CM100_SetCyclicMsgFailure: The applied cyclic transmission message number is more than 5, the parameter time period is less than 5 (0.5ms). or the PISO-CM100U/PCM-CM100 replies erroneously.

4.1.21 CM100_DeleteCyclicTxMsg

- **Description:**

  Removes the specified cyclic transmission message added by the function CM100_AddCyclicTxMsg().

- **Syntax:**

  int CM100_DeleteCyclicTxMsg(BYTE BoardNo, BYTE Port,
  BYTE Handle)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

  Handle: [input] The handle of the cyclic transmission message, which is obtained by the function CM100_AddCyclicTxMsg().

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can’t find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_PortNumberError: The port number is not correct.

  CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.

  CM100_SetCyclicMsgFailure: The PISO-CM100U/PCM-CM100 replies erroneously.

4.1.22 CM100_EnableCyclicTxMsg

- **Description:**

  Enables the cyclic transmission message added by the function CM100_AddCyclicTxMsg(). After calling this function, the specified cyclic transmission message will be transmitted.

- **Syntax:**

  ```
  int CM100_EnableCyclicTxMsg(BYTE BoardNo, BYTE Port,
                              BYTE Handle)
  ```

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

  Handle: [input] The handle of the cyclic transmission message, which is obtained by the function CM100_AddCyclicTxMsg().

- **Return:**

  CM100_NoError: OK
  CM100_DriverError: The driver is inactive or no board is in the system.
  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.
  CM100_ActiveBoardError: This board is not activated.
  CM100_PortNumberError: The port number is not correct.
  CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.
  CM100_SetCyclicMsgFailure: The PISO-CM100U/PCM-CM100 replies erroneously.

4.1.23 CM100_DisableCyclicTxMsg

- **Description:**

  Disables the cyclic transmission message enabled by the function CM100_EnableCyclicTxMsg().

- **Syntax:**

```
int CM100_DisableCyclicTxMsg(BYTE BoardNo, BYTE Port,
                                         BYTE Handle)
```

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

  Handle: [input] The handle of the cyclic transmission message, which is obtained by the function CM100_AddCyclicTxMsg().

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can’t find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_PortNumberError: The port number is not correct.

  CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.

  CM100_SetCyclicMsgFailure: The PISO-CM100U/PCM-CM100 replies erroneously.

4.1.24 CM100_OutputByte

- **Description:**

  Writes the data to the specified SJA1000 register of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  void CM100_OutputByte(BYTE BoardNo, BYTE Port, WORD wOffset,
  BYTE bValue)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

  wOffset: [input] The register address of the SJA1000.

  bValue: [input] The value written to the specified register.

- **Return:**

  None

4.1.25 CM100_InputByte

- **Description:**

  Reads the data from the specified SJA1000 register of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  BYTE CM100_InputByte(BYTE BoardNo, BYTE Port, WORD wOffset)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

  wOffset: [input] The register address of the SJA1000.

- **Return:**

  The value read from the specified register.

4.1.26 CM100_IsTxTimeout

- **Description:**

  Checks if the CAN controller successfully sends the CAN message.

- **Syntax:**

  BYTE CM100_IsTxTimeout(BYTE BoardNo, BYTE Port, BYTE* Status)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

  *Status: [output] The transmit status. The value 1 means that the CAN controller can't successfully send the CAN message to the network and the value 0 is for no error.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_PortNumberError: The port number is not correct.

  CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.

4.1.27 CM100_SetSystemMsg

- **Description:**

  This function is used to determine if the system information of the firmware of the PISO-CM100U/PCM-CM100 is shown.

- **Syntax:**

```
BYTE CM100_SetSystemMsg(BYTE BoardNo, BYTE Port,
                                        BYTE Mode)
```

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

  Mode: [input] The system information of the firmware is shown through the debug port of PISO-CM100U/PCM-CM100 as the value is 1, and the value 0 for disabling the display.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_PortNumberError: The port number is not correct.

  CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.

4.1.28 *CM100_ClearSoftBuffer* ***<For default firmware>***

- **Description:**

  Cleans the software buffer of the PISO-CM100U/PCM-CM100. After calling this function, all the CAN messages which are not sent yet will be deleted.

- **Syntax:**

  int CM100_ClearSoftBuffer(BYTE BoardNo, BYTE Port)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can’t find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_PortNumberError: The port number is not correct.

  CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.

4.1.29 CM100_ClearBufferStatus <For default firmware>

- **Description:**

  Cleans the statuses of the CAN transmission and reception software buffers. When calling the functions CM100_SendMsg(), CM100_SendWithoutStruct(), CM100_ReceiveMsg() or CM100_ReceiveWithoutStuct(), users may get the error code due to the problems of the CAN message buffers. This function may be needed to clean the buffer and reset the buffer statuses.

- **Syntax:**

  int CM100_ClearBufferStatus(BYTE BoardNo, BYTE Port)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_PortNumberError: The port number is not correct.

  CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.

4.1.30 CM100_ClearDataOverrun ***<For default firmware>***

- **Description:**

  Cleans the data overrun status of the SJA1000.

- **Syntax:**

  int CM100_ClearDataOverrun(BYTE BoardNo, BYTE Port)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_PortNumberError: The port number is not correct.

4.1.31 *CM100_Config <For default firmware>*

- **Description:**

  Configures the baud, message filter of the SJA1000. After calling this function, the board can start to send/receive CAN messages to/from the CAN network.

- **Syntax:**

```
int CM100_Config(BYTE BoardNo, BYTE Port,
                        ConfigStruct *CanConfig)
```

- **Parameter:**

BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

* CanConfig: [input] The address of a ConfigStruct structure variable used to configure the PISO-CM100U/PCM-CM100. The ConfigStruct structure is defined below:

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

AccCode[4]: Acceptance code of CAN controller.

AccMask[4]: Acceptance mask of CAN controller. The AccCode is used to decide which CAN IDs are accepted by the CAN controller. The AccMask is used to decide which bit of the CAN IDs are checked with the AccCode by the CAN controller. If the bit of AccMask is set to 0, it means that the bit in the same position of the CAN IDs need to be checked and the ID bit value needs to match the bit of AccCode in the same position.

AccCode and AccMask Definition For 11-bit ID:

AccCode and AccMask	Bit Position	Filter Target
high byte of the high word	bit7~bit0	bit10 ~ bit3 of ID
low byte of the high word	bit7~bit5	bit2 ~ bit0 of ID
low byte of the high word	bit4	RTR
low byte of the high word	bit3~bit0	no use
high byte of the low word	bit7~bit0	bit7 ~ bit0 of 1st byte data
low byte of the low word	bit7~bit0	bit7 ~ bit0 of 2nd byte data

AccCode and AccMask Definition For 29-bit ID:

AccCode and AccMask	Bit Position	Filter Target
high byte of the high word	bit7~bit0	bit28~ bit21 of ID
low byte of the high word	bit7~bit0	bit20 ~ bit13 of ID
high byte of the low word	bit7~bit0	bit12 ~ bit5 of ID
low byte of the low word	bit7~bit3	bit4 ~ bit0 of ID
low byte of the low word	bit2	RTR
low byte of the low word	bit1~bit0	no use

Example for 29 bit ID message:

		Array[0]	Array[1]	Array[2]	Array[3]	
AccCode	:	00h	00h	00h	A0h	
AccMask	:	FFh	FFh	FFh	1Fh	
ID bit	:	bit28~bit21	bit20~bit13	bit12~bit5	bit4~bit0	
ID Value	:	xxxx xxxx	xxxx xxxx	xxxx xxxx	101x x	will be accepted

(Note: The character “x” means the bit value doesn’t care. The character “h” behind the value means the value is in hex format.)

BaudRate:

Value	Description
0	User-defined baud (BT0,BT1 are needed)
1	10 k bps
2	20 k bps
3	50 k bps
4	125 k bps
5	250 k bps
6	500 k bps
7	800 k bps
8	1000 k bps

BT0, BT1: User-defined baud rate (used only if ths BaudRate is 0). For example, sets the BT0 to 04h and the BT1 to 1Ch, then the CAN controller is running in 100 kbps baud rate. For more details about how to set the BT0 and BT1, please refer to the datasheet of the SJA1000 CAN controller.

- **Return:**

CM100_NoError: OK

CM100_DriverError: The driver is inactive or no board is in the system.

CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

CM100_ActiveBoardError: This board is not activated.

CM100_PortNumberError: The port number is not correct.

CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.

CM100_InitError: The PISO-CM100U/PCM-CM100 replies erroneously.

4.1.32 *CM100_ConfigWithoutStruct* ***<For default firmware>***

- **Description:**

  This function is similar to the function CM100_Config(). The difference is the input parameters. This function uses non-structure parameters so that it is easy to be applied in some program environment, such as VB. About the input parameters of this function, please refer to the function CM100_Config() for the details.

- **Syntax:**

```
int CM100_ConfigWithoutStruct(BYTE BoardNo, BYTE Port,
                              DWORD AccCode, DWORD AccMask,
                              BYTE BaudRate, BYTE BT0,
                              BYTE BT1)
```

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

  AccCode: [input] Acceptance code of CAN controller.

  AccMask: [input] Acceptance mask of CAN controller.

  BaudRate: [input] The baud indicator of CAN controller.

  BT0: [input] User-defined baud.

  BT1: [input] User-defined baud.

  For more information about these parameters, please refer to the description of the function CM100_Config().

- **Return:**

  CM100_NoError: OK

CM100_DriverError: The driver is inactive or no board is in the system.

CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

CM100_ActiveBoardError: This board is not activated.

CM100_PortNumberError: The port number is not correct.

CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.

CM100_InitError: The PISO-CM100U/PCM-CM100 replies erroneously.

4.1.33 CM100_RxMsgCount ***<For default firmware>***

- **Description:**

  Replies the number of CAN messages available in the reception software buffer.

- **Syntax:**

  int CM100_RxMsgCount(BYTE BoardNo, BYTE Port)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

- **Return:**

  The number of CAN messages stored in software buffer.

4.1.34 CM100_ReceiveMsg <For default firmware>

- **Description:**

  Gets one message from the reception software buffer. Before using this function, the CAN controller must be configured by the functions CM100_Config() or CM100_ConfigWithoutStruct().

- **Syntax:**

```
int CM100_ReceiveMsg(BYTE BoardNo, BYTE Port,
                              PacketStruct *CanPacket)
```

- **Parameter:**

BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

*CanPacket: [output] The address of a PacketStruct structure variable used to get a CAN message. The PacketStruct structure is defined below:

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

MsgTimeStamps: As the board gets a CAN message, this parameter records the time which is calculated from the boot time of the CPU of the CAN board. The unit is 0.1 ms.

mode: If the value is 0, the received CAN message is 11-bit-ID CAN message. The 29-bit-ID CAN message has the value 1

id: The CAN message ID.

rtr: 0 for the remote-transmit-request message, 1 for the normal message. As this bit is 1, the parameter data[8] is useless.

len: The data length of a CAN message. The maximum length is 8 bytes.

data[8]: The data of a CAN message

- **Return:**

CM100_NoError: OK

CM100_DriverError: The driver is inactive or no board is in the system.

CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

CM100_ActiveBoardError: This board is not activated.

CM100_PortNumberError: The port number is not correct.

CM100_SoftBufferIsEmpty: There is no CAN message in the reception software buffer.

CM100_SoftBufferIsFull: Users can still get CAN messages from the reception software buffer, but the software buffer is overflow.

CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.

4.1.35 CM100_ReceiveWithoutStruct <For default firmware>

- **Description:**

  Replies a received message from the software buffer. This function is similar to the function CM100_ReceiveMsg(). The difference is that this function doesn't use any structure parameter. It is easy to use in some program environment, such as VB.

- **Syntax:**

```
int CM100_ReceiveWithoutStruct(BYTE BoardNo, BYTE Port,
                               BYTE *Mode, DWORD *MsgID,
                               BYTE *RTR, BYTE *DataLen,
                               BYTE *Data , DWORD *UpperTime ,
                               DWORD *LowerTime)
```

- **Parameter:**

BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

*Mode: [output] The address of a variable used to get the mode of a CAN message. If the value is 0, the received CAN message is 11-bit-ID CAN message. The 29-bit-ID CAN message will have the value 1.

*MsgID: [output] The address of a variable used to get the CAN message ID.

*RTR: [output] The address of a variable used to obtain the status of this CAN message. 0 for the remote-transmit-request message, 1 for the normal message.

*DataLen: [output] The address of a variable used to obtain the data length of a CAN message. The range of this value is 0~8.

*Data: [output] The start address of a buffer used to get the data of a CAN message. Users need to put an 8-byte array in this filed.

*UpperTime: [output] The address of a variable used to obtain the higher 32-bit time stamp of a CAN message.

*LowerTime: [output] The address of a variable used to obtain the lower 32-bit time stamp of a CAN message. The unit of UpperTime and LowerTime are 0.1ms.

- **Return:**

CM100_NoError: OK

CM100_DriverError: The driver is inactive or no board is in the system.

CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

CM100_ActiveBoardError: This board is not activated.

CM100_PortNumberError: The port number is not correct.

CM100_SoftBufferIsEmpty: There is no CAN message in the reception software buffer.

CM100_SoftBufferIsFull: Users can still get CAN messages from the reception software buffer, but the software buffer is overflow.

CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.

4.1.36 CM100_SendMsg <For default firmware>

- **Description:**

  Sends a CAN message to the software transmission buffer. As the CAN bus is idle, the CAN message will be sent to the CAN network. Note that if there are something wrong in the CAN bus wiring and configuration, the CAN message may not be transmitted successfully. In this case, users can use the function API CM100_Status to check if any error is happen.

- **Syntax:**

```
int CM100_SendMsg(BYTE BoardNo, BYTE Port,
                              PacketStruct *CanPacket)
```

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.
  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.
  *CanPacket: [input] The address of a PacketStruct structure variable used to describe the sent CAN message. About the definition of PacketStruct, please refer to the description of the function CM100_ReceiveMsg().

- **Return:**

  CM100_NoError: OK
  CM100_DriverError: The driver is inactive or no board is in the system.
  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.
  CM100_ActiveBoardError: This board is not activated.
  CM100_PortNumberError: The port number is not correct.
  CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.
  CM100_SoftBufferIsFull: The transmission software buffer is overflow.

4.1.37 *CM100_SendWithoutStruct* *<For default firmware>*

- **Description:**

  Sends a CAN message to the software transmission buffer. As the CAN bus is idle, the CAN message will be sent to the CAN network. This function is similar to the function CM100_SendMsg(). The difference is that this function doesn't use any structure parameter. It is easy to use in some program environment, such as VB. Note that if there are something wrong in the CAN bus wiring and configuration, the CAN message may not be transmitted successfully. In this case, users can use the function API CM100_Status to check if any error is happen.

- **Syntax:**

```
int CM100_SendWithoutStruct(BYTE BoardNo, BYTE Port, BYTE Mode,
                            DWORD MsgID, BYTE RTR,
                            BYTE DataLen, BYTE *Data)
```

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

  Mode: [input] 0 for 11-bit message ID, 1 for 29-bit message ID.

  MsgID: [input] CAN message ID.

  RTR: [input] 0 for normal messages, 1 for remote-transmit-request messages. As the value is 1, the parameter *Data is useless.

  DataLen: [input] The data length of a transmitted CAN message. The maximum value is 8.

*Data: [input] The start address of a buffer used to store the transmitted data of a CAN message.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can’t find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_PortNumberError: The port number is not correct.

  CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.

  CM100_SoftBufferIsFull: The transmission software buffer is overflow.

4.1.38 CM100_SJA1000Config <For user-defined firmware>

- **Description:**

  Configures the message filter and baud of the SJA1000. About the input parameters of this function, please refer to the function CM100_Config() for the details. **Note that after using this function to configure the CAN controller, user must call the function CM100_EnableSJA1000 to enable the CAN controller and the configuration.**

- **Syntax:**

```
int CM100_SJA1000Config(BYTE BoardNo, BYTE Port,
                                DWORD AccCode, DWORD AccMask,
                                BYTE BaudRate, BYTE BT0, BYTE BT1)
```

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.
  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.
  AccCode: [input] Acceptance code of CAN controller.
  AccMask: [input] Acceptance mask of CAN controller.
  BT0: [input] User-defined baud.
  BT1: [input] User-defined baud.

- **Return:**

  CM100_NoError: OK
  CM100_DriverError: The driver is inactive or no board is in the system.
  CM100_BoardNumberError: Can’t find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.
  CM100_ActiveBoardError: This board is not activated.
  CM100_PortNumberError: The port number is not correct.
  CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.
  CM100_InitError: The PISO-CM100U/PCM-CM100 replies erroneously.

4.1.39 CM100_EnableSJA1000 *<For user-defined firmware>*

- **Description:**

  After calling the function CM100_SJA1000Config, the CAN controller is reset. So users must to use this function to enable the CAN controller.

- **Syntax:**

  int CM100_EnableSJA1000 (BYTE BoardNo, BYTE Port)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.
  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_PortNumberError: The port number is not correct.

  CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.

  CM100_InitError: The PISO-CM100U/PCM-CM100 replies erroneously.

4.1.40 CM100_DisableSJA1000 <For user-defined firmware>

- **Description:**

  If the function is used, the CAN controller will be disabled and can't receive or send any CAN message until calling the function CM100_EnableSJA1000.

- **Syntax:**

  int CM100_DisableSJA1000(BYTE BoardNo, BYTE Port)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_PortNumberError: The port number is not correct.

  CM100_TimeOut: The PISO-CM100U/PCM-CM100 has no response.

  CM100_InitError: The PISO-CM100U/PCM-CM100 replies erroneously.

4.1.41 CM100_DPRAMInttToCM100 ***<For user-defined firmware>***

- **Description:**

  Sends an interrupt signal to the PISO-CM100U/PCM-CM100. This interrupt signal is passed to the user-defined firmware, and triggers some action designed by users. Be careful about that too many interrupt signals at a short period of time will affect the normal procedure of the user-defined firmware.

- **Syntax:**

  int CM100_DPRAMInttToCM100(BYTE BoardNo, BYTE Port,
  BYTE Data)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.
  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.
  Data: [input] The interrupt indicator. The range is 0x00 ~ 0xdf. Users can define their own interrupt indicator and run the specified tasks depending on the corresponding interrupt indicators in the user-defined firmware.

- **Return:**

  CM100_NoError: OK
  CM100_DriverError: The driver is inactive or no board is in the system.
  CM100_BoardNumberError: Can’t find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.
  CM100_ActiveBoardError: This board is not activated.
  CM100_PortNumberError: The port number is not correct.
  CM100_DpramOverRange: The parameters Data is out of range.

4.1.42 CM100_DPRAMWriteByte *<For user-defined firmware>*

- **Description:**

  Writes one byte data into the specified address of the DPRAM of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  int CM100_DPRAMWriteByte(BYTE BoardNo, BYTE Port,
  WORD Address, BYTE Data)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

  Address: [input] The specified address of the DPRAM where users want to write the data to. The legal address range for the DPRAM is 0 ~ 6999.

  Data: [input] The byte data written to the DPRAM.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_PortNumberError: The port number is not correct.

  CM100_DpramOverRange: The parameter Address is out of range.

4.1.43 CM100_DPRAMWriteWord <For user-defined firmware>

- **Description:**

  Writes one word data into the specified address of the DPRAM of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  int CM100_DPRAMWriteWord(BYTE BoardNo, BYTE Port,
  WORD Address, WORD Data)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

  Address: [input] The specified address of the DPRAM where users want to write the data to. The legal address range for the DPRAM is 0 ~ 6998.

  Data: [input] The word data written to the DPRAM.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_PortNumberError: The port number is not correct.

  CM100_DpramOverRange: The parameter Address is out of range.

4.1.44 *CM100_DPRAMWriteDword* *<For user-defined firmware>*

- **Description:**

  Writes one double-word data into the specified address of the DPRAM of the PISO-CM100U/PCM-CM100.

- **Syntax:**

```
int CM100_DPRAMWriteDword(BYTE BoardNo, BYTE Port,
                                   WORD Address, DWORD Data)
```

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

  Address: [input] The specified address of the DPRAM where users want to write the data to. The legal address range for the DPRAM is 0 ~ 6996.

  Data: [input] The double-word data written to the DPRAM.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can’t find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_PortNumberError: The port number is not correct.

  CM100_DpramOverRange: The parameter Address is out of range.

4.1.45 CM100_DPRAMWriteMultiByte <For user-defined firmware>

- **Description:**

  Writes multi-byte data into the specified address of the DPRAM of the PISO-CM100U/PCM-CM100.

- **Syntax:**

```
int CM100_DPRAMWriteMultiByte(BYTE BoardNo, BYTE Port,
                              WORD Address, BYTE *Data,
                              WORD DataNum)
```

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.
  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.
  Address: [input] The specified address of the DPRAM where users want to write the data to. The legal address range is depended on the parameter DataNum. The sum of the parameters Address and DataNum can't exceed the value 6999.
  *Data: [input] The start address of a byte array written to the DPRAM.
  DataNum: [input] The byte number of an data array written to the DPRAM.

- **Return:**

  CM100_NoError: OK
  CM100_DriverError: The driver is inactive or no board is in the system.
  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.
  CM100_ActiveBoardError: This board is not activated.
  CM100_PortNumberError: The port number is not correct.
  CM100_DpramOverRange: The sum of the parameters Address and DataNum is out of range.

4.1.46 CM100_DPRAMReadByte *<For user-defined firmware>*

- **Description:**

  Reads one byte data from the specified address of the DPRAM of the PISO-CM100U/PCM-CM100.

- **Syntax:**

```
int CM100_DPRAMReadByte(BYTE BoardNo, BYTE Port,
                        WORD Address, BYTE *Data)
```

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.
  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.
  Address: [input] The specified address of the DPRAM where users want to read the data from. The legal address range for the DPRAM is 0 ~ 6999.
  *Data: [output] The address of a variable used to receive the obtained data of the DPRAM.

- **Return:**

  CM100_NoError: OK
  CM100_DriverError: The driver is inactive or no board is in the system.
  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.
  CM100_ActiveBoardError: This board is not activated.
  CM100_PortNumberError: The port number is not correct.
  CM100_DpramOverRange: The parameter Address is out of range.

4.1.47 CM100_DPRAMReadWord <For user-defined firmware>

- **Description:**

  Reads one word data from the specified address of the DPRAM of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  int CM100_DPRAMReadWord(BYTE BoardNo, BYTE Port,
  WORD Address, WORD *Data)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.
  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.
  Address: [input] The specified address of the DPRAM where users want to read the data from. The legal address range for the DPRAM is 0 ~ 6998.
  *Data: [output] The address of a variable used to receive the obtained data of the DPRAM.

- **Return:**

  CM100_NoError: OK
  CM100_DriverError: The driver is inactive or no board is in the system.
  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.
  CM100_ActiveBoardError: This board is not activated.
  CM100_PortNumberError: The port number is not correct.
  CM100_DpramOverRange: The parameter Address is out of range.

4.1.48 CM100_DPRAMReadDword ***<For user-defined firmware>***

- **Description:**

  Reads one double-word data from the specified address of the DPRAM of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  int CM100_DPRAMWriteDword(BYTE BoardNo, BYTE Port,
  WORD Address, DWORD *Data)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.
  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.
  Address: [input] The specified address of the DPRAM where users want to read the data from. The legal address range for the DPRAM is 0 ~ 6996.
  *Data: [output] The address of a variable used to receive the obtained data of the DPRAM.

- **Return:**

  CM100_NoError: OK
  CM100_DriverError: The driver is inactive or no board is in the system.
  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.
  CM100_ActiveBoardError: This board is not activated.
  CM100_PortNumberError: The port number is not correct.
  CM100_DpramOverRange: The parameter Address is out of range.

4.1.49 CM100_DPRAMReadMultiByte <For user-defined firmware>

- **Description:**

  Reads multi-byte data from the specified address of the DPRAM of the PISO-CM100U/PCM-CM100.

- **Syntax:**

```
int CM100_DPRAMReadMultiByte(BYTE BoardNo, BYTE Port,
                             WORD Address, BYTE *Data,
                             WORD DataNum)
```

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

  Address: [input] The specified address of the DPRAM where users want to read the data from. The legal address range is depended on the parameter DataNum. The sum of the parameters Address and DataNum can't exceed the value 6999.

  *Data: [output] The start address of a byte array applied to receive the obtained data of the DPRAM.

  DataNum: [input] The byte number which users want to read from the DPRAM.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

  CM100_PortNumberError: The port number is not correct.

  CM100_DpramOverRange: The sum of the parameters Address and DataNum is out of range.

4.1.50 CM100_DPRAMMemset ***<For user-defined firmware>***

- **Description:**

  Sets multi-byte DPRAM data to be the specified value.

- **Syntax:**

```
int CM100_DPRAMMemset(BYTE BoardNo, BYTE Port,
                      WORD Address, BYTE Data,
                      WORD DataNum)
```

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.
  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.
  Address: [input] The specified address of the DPRAM where users want to write the data to. The legal address range is depended on the parameter DataNum. The sum of the parameters Address and DataNum can't exceed the value 6999.
  Data: [input] The data written to the DPRAM.
  DataNum: [input] The byte number which users want to write to the DPRAM.

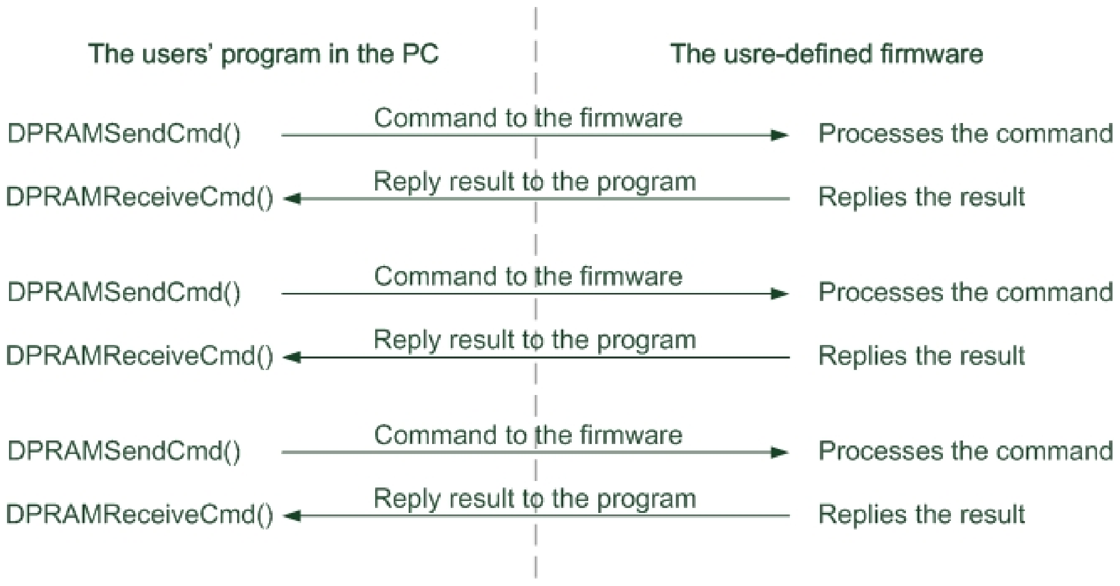
- **Return:**

  CM100_NoError: OK
  CM100_DriverError: The driver is inactive or no board is in the system.
  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.
  CM100_ActiveBoardError: This board is not activated.
  CM100_PortNumberError: The port number is not correct.
  CM100_DpramOverRange: The sum of the parameters Address and DataNum is out of range.

4.1.51 CM100_ReceiveCmd <For user-defined firmware>

- **Description:**

  Use this function to receive the command transmitted from the user-defined firmware. After calling the function DPRAMSendCmd() in the PC program to send a command to the user-defined firmware, call this function to receive the response from the user-defined firmware. If users do not receive the response until another response is given from the user-defined firmware, the former one will be covered by the latter one. It is strongly recommended to use the polling mechanism in the PC program and the user-defined firmware, as the following figure.



- **Syntax:**

  int CM100_ReceiveCmd(BYTE BoardNo, BYTE Port, BYTE *Data, WORD *DataNum)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.

*Data: [output] The start address of a byte array applied to receive the command from DPRAM of PISO-CM100U/PCM-CM100.

*DataNum: [output] The address of a variable applied to receive the command length.

- **Return:**

CM100_NoError: OK

CM100_DriverError: The driver is inactive or no board is in the system.

CM100_BoardNumberError: Can’t find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

CM100_ActiveBoardError: This board is not activated.

CM100_PortNumberError: The port number is not correct.

CM100_NoDpramCmd: There is no command transmitted from the user-defined firmware.

CM100_DpramOverRange: The command length is over 512 bytes.

4.1.52 CM100_SendCmd <For user-defined firmware>

- **Description:**

  Call this function to send the command to the user-defined firmware. The maximum command length is 512 bytes. Afterwards, users can use the function DPRAMReceiveCmd() of the firmware library to get the command, and run the corresponding task in the firmware. About the function DPRAMReceiveCmd(), please refer to chapter 5 for the details.

- **Syntax:**

  int CM100_SendCmd(BYTE BoardNo, BYTE Port, BYTE *Data,
  WORD DataNum)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.
  Port: [input] The CAN port No. of the PISO-CM100U/PCM-CM100. This value is always 1.
  *Data: [input] The start address of a byte array of the sent command.
  DataNum: [input] The word value indicates the length of the command sent to the user-defined firmware.

- **Return:**

  CM100_NoError: OK
  CM100_DriverError: The driver is inactive or no board is in the system.
  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.
  CM100_ActiveBoardError: This board is not activated.
  CM100_PortNumberError: The port number is not correct.
  CM100_DpramOverRange: The command length is over 512 bytes.

4.1.53 CM100_InstallUserISR ***<For user-defined firmware>***

- **Description:**

  This function allows users to apply the ISR (interrupt service routine) to process the reply from the firmware. When users install the ISR by using this function, the interrupt indicators from the user-defined firmware can be read in the ISR, and users can immediately run the tasks in the users' program depending on the interrupt indicator. The interrupt indicator, CAN_COMM_CMD_FROM_CM100, defined in "cm100.h" is also passed to the users' ISR after calling the function DPRAMSendCmd in the user-defined firmware.

- **Syntax:**

  int CM100_InstallUserISR(BYTE BoardNo,
  void (*UserISR)(BYTE BoardNo, BYTE InttValue))

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

  (*UserISR)(BYTE BoardNo, BYTE InttValue)): [input] The pointer which points a function with format "void XXX(Byte BoardNo, Byte InttValue)". The characters XXX are the function name of the users' ISR. The parameter BoardNo of the ISR indicates which board receives the interrupt indicator, and the parameter InttValue is the interrupt indictor from the user-defined firmware.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

4.1.54 CM100_RemoveUserISR <For user-defined firmware>

- **Description:**

  When users don't need the ISR function, call this function to remove users ISR.

- **Syntax:**

  int CM100_RemoveUserISR(BYTE BoardNo)

- **Parameter:**

  BoardNo: [input] The DIP switch No. (0~15) or rotary switch No. (0~9) of the board.

- **Return:**

  CM100_NoError: OK

  CM100_DriverError: The driver is inactive or no board is in the system.

  CM100_BoardNumberError: Can't find the DIP switch No. or rotary switch No. of the board to match with the BoardNo.

  CM100_ActiveBoardError: This board is not activated.

4.2 *Windows API Return Codes Troubleshooting*

Return Code	Error ID (Error Description)	Troubleshooting
0	CM100_NoError	OK
1	CM100_DriverError	1. Reinstall the PISO-CM100U/PCM-CM100 driver correctly. 2. Unplug the PISO-CM100U/PCM-CM100, and plug it again. Turn on the PC and check if the board can be found in the list of the hardware management of the Windows operation system.
2	CM100_ActiveBoardError	1. Set the parameter BoardNo of the function to match the DIP switch No. or rotary switch No. of the board. 2. Turn off all programs which may activate this board. 3. Check if each CAN board has the unique DIP switch No. or rotary switch No.. 4. Reinstall the PISO-CM100U/PCM-CM100 driver correctly. 5. Unplug the PISO-CM100U/PCM-CM100, and plug it again. Turn on the PC and check if the board can be found in the list of the hardware management of the Windows operation system.
3	CM100_BoardNumberError	1. Set the parameter BoardNo of the function to match the DIP switch No. or rotary switch No. of the board. 2. Check if each CAN board has the unique DIP switch No. or rotary switch No.. 3. Unplug the PISO-CM100U/PCM-CM100, and plug it again. Turn on the PC and check if the board can be found in the list of the hardware management of the Windows operation system.
4	CM100_PortNumberError	1. Set the Port parameter to 1 if users use the PISO-CM100U/PCM-CM100 board.
7	CM100_InitError	1. Call the function CM100_Init() and configure the PISO-CM100U/PCM-CM100 again.
21	CM100_SoftBufferIsEmpty	1. Wait for a while and retry it again.
22	CM100_SoftBufferIsFull	1. Use the function CM100_ClearBufferStatus to clean the status of buffer overflow. 2. Reduce the CAN bus loading.
23	CM100_TimeOut	1. Check if the users' program and user-defined firmware follows the polling mechanism. 2. Confirm that only one API or thread can access the board at the same time. 3. Call the function CM100_Init() and configure the PISO-CM100U/PCM-CM100 again. 4. Push the SW1 or SW2 of the board to force the board into the download mode. Update

Return Code	Error ID (Error Description)	Troubleshooting
		the firmware by using the CAN utility. 5. Confirm if the board is in operation mode, not in download mode.
24	CM100_SetCyclicMsgFailure	1. Check if 5 cyclic messages are already used. 2. Call the function CM100_Init() and configure the PISO-CM100U/PCM-CM100 again.
25	CM100_DpramOverRange	1. Check the value of the parameters Address or DataNum of the function.
26	CM100_NoDpramCmd	1. Wait for a while and retry it again.
27	CM100_ModeError	1. Push the SW1 or SW2 of the board to force the board into the download mode. Update the firmware by using the CAN utility.
30	CM100_NoFileInside	1. Push the SW1 or SW2 of the board to force the board into the download mode. Update the firmware by using the CAN utility.
31	CM100_DownloadFailure	1. Close the utility and try to update the firmware one minute later. 2. Call your distributor to solve this problem
32	CM100_EEPROMDamage	1. Call your distributor to solve this problem
33	CM100_NotEnoughSpace	1. The file size of the user-defined firmware is too large to put it into the PISO-CM100U/PCM-CM100.
34	CM100_StillDownloading	1. Close the utility and try to update the firmware one minute later. 2. Call your distributor to solve this problem
35	CM100_BoardModeError	1. Close the utility and try to update the firmware one minute later.
36	CM100_SetDateTimeFailure	1. Call your distributor to solve this problem.
X	Transmit one CAN message successfully, but can't monitor this can messages on the CAN bus.	1. Use the function CM100_Status to check if any error is happen. 2. Check if the CAN bus line is correctly connected with the connector of the PISO-CM100U/PCM-CM100. 3. Check if the baud rate of the PISO-CM100U/PCM-CM100 is correct.

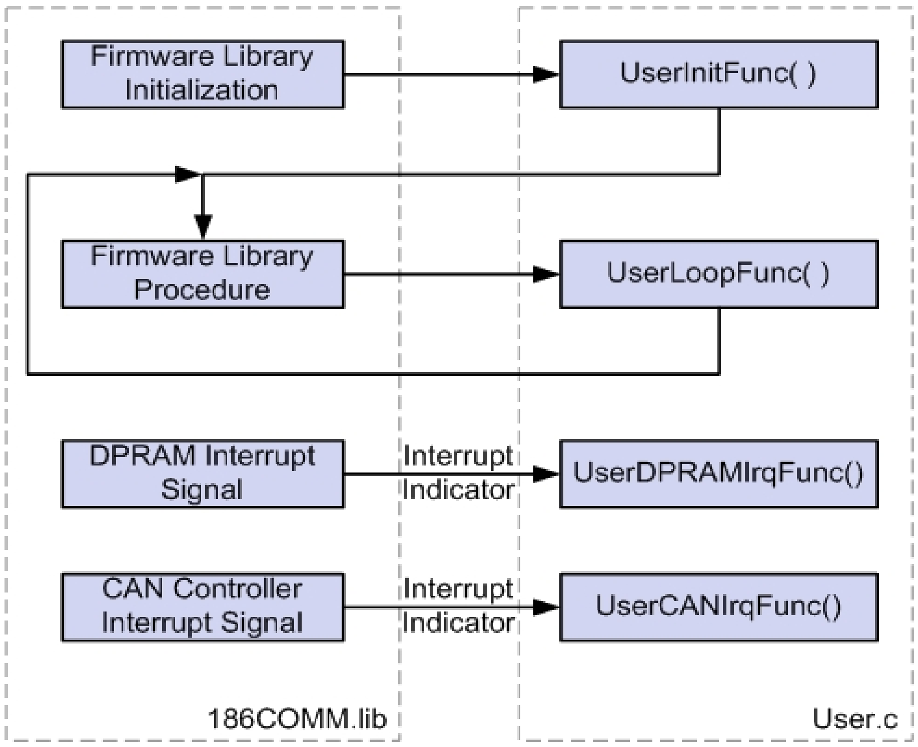
Note: If users' problem can't be fixed after following the recommended methods. Please contact your distributor or email to service@icpdas.com to solve the problem.

5 Functions of Firmware Library

If the default firmware is used, users do not need to read this chapter. This chapter introduces all the functions provided by the firmware library, 186COMM.lib. The content includes the function introduction, error code description, and simple method of troubleshooting. The section 5.1 shows the list and the information of all functions supported by the 186COMM.lib. The section 5.2 shows how to solve the problem if some error occurs.

5.1 Firmware Library Definitions and Descriptions

The firmware library is needed when designing the user-defined firmware. In order to reduce the development cycle, the firmware library provides 4 callback functions. If some initial task need to be run, put the codes into the function UserInitFunc(). The users' loop procedure can be put in the UserLoopFunc(). These callback functions are run as soon as possible while the user-defined firmware boots up. If users would like to process the interrupt indicators from the DPRAM or CAN controller, use callback functions, UserDPRAMIrqFunc() and UserCANIrqFunc(). These 4 callback functions must be applied once in users' .c file even the content of these functions are empty. The architecture is show as following figure.



The 186COMM.lib also supports the functions to handle the hardware of the PISO-CM100U/PCM-CM100, such as the DPRAM, EEPROM, NVRAM, LEDs, real time clock, timer, debug port, and the CAN interface. Users can use Borland C/C++ or Turbo C/C++ to compile the user-defined firmware, and the Turbo C++ 1.01 or Turbo C 2.0 can be free downloaded in the website http://dn.codegear.com/museum. All the functions are listed in the table 5.1 and the details for every function is presented in the following sub-section.

Function definition	Page
void L1Off(void)	97
void L1On(void)	97
void L2Off(void)	98
void L2On(void)	98
void DPRAMInttToHost(char InttValue)	99
void UserDPRAMIrqFunc(unsigned char INTT)	100
int DPRAMWriteByte(unsigned int Address, unsigned char Data)	101
int DPRAMWriteWord(unsigned int Address, unsigned int Data)	102
int DPRAMWriteDword(unsigned int Address, unsigned long Data)	103
int DPRAMWriteMultiByte(unsigned int Address, char *Data, unsigned int DataNum)	104
int DPRAMReadByte(unsigned int Address, unsigned char *Data)	105
int DPRAMReadWord(unsigned int Address, unsigned int *Data)	106
int DPRAMReadDword(unsigned int Address, unsigned long *Data)	107
int DPRAMReadMultiByte(unsigned int Address, char *Data, unsigned int DataNum)	108
int DPRAMMemset(unsigned int Address, char data, unsigned int DataNum)	109
int DPRAMReceiveCmd(char *Data, unsigned int *DataNum)	110
int DPRAMSendCmd(char *Data, unsigned int DataNum)	111
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int GetKbhit(void)	113
int Print(const char *fmt, ...)	114
void GetTime(int *hour, int *minute, int *sec)	115
int SetTime(int hour, int minute, int sec)	116
void GetDate(int *year, int *month, int *day)	117
int SetDate(int year, int month, int day)	118
int GetWeekDay(void)	119
int ReadNVRAM(int Address)	120
int WriteNVRAM(int Address, int data)	121
unsigned long GetTimeTicks100us(void)	122

Function definition	Page
long GetTimeTicks(void)	123
void DelayMs(unsigned int DelayTime_ms)	124
void CM100_InstallUserTimer(void (*Fun)(void))	125
void T_StopWatchStart(STOPWATCH *sw)	126
unsigned long T_StopWatchGetTime(STOPWATCH *sw)	126
void T_StopWatchPause(STOPWATCH *sw)	126
void T_StopWatchContinue(STOPWATCH *sw)	126
void T_CountDownTimerStart(COUNTDOWNTIMER *cdt, unsigned long timems)	128
void T_CountDownTimerPause(COUNTDOWNTIMER *cdt)	128
void T_CountDownTimerContinue(COUNTDOWNTIMER *cdt)	128
int T_CountDownTimerIsTimeUp(COUNTDOWNTIMER *cdt)	128
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int CM100_EEPROMReadByte(unsigned int Block, unsigned int Address, unsigned char *Data)	130
int CM100_EEPROMReadMultiByte(unsigned int Block, unsigned int Address, char *Data, unsigned int DataNum)	131
int CM100_EEPROMWriteByte(unsigned int Block, unsigned int Address, unsigned char Data)	132
int CM100_EEPROMWriteMultiByte(unsigned int Block, unsigned int Address, char *Data, unsigned int DataNum)	133
void UserCANIrqFunc(unsigned char INTT)	134
void SJA1000HardwareReset(void)	135
int SetCANBaud(unsigned long Baud, char BT0, char BT1)	136
void GetCANBaud(unsigned long *Baud, char *BT0, char *BT1)	137
int SetCANMask(long AccCode, long AccMask)	138
void GetCANMask(long *AccCode, long *AccMask)	140
int CANConfig(unsigned long Baud, char BT0, char BT1, long AccMask, long AccCode)	141
int CANConfigBySJA1000Reg(char BaudType, char BT0, char BT1, char *AccCode, char *AccMask);	142
void EnableSJA1000(void)	143
void DisableSJA1000(void)	143
int GetCANStatus(void)	144
void ClearDataOverrunStatus(void)	145
int SendCANMsg(char Mode, unsigned long MsgID, char RTR, char DataLen, char *Data)	146
void ClearTxSoftBuffer(void)	147
int GetCANMsg(char *Mode, unsigned long *MsgID, char *RTR, char *DataLen, char *Data, unsigned long *UpperTime, unsigned long *LowerTime)	148
void ClearRxSoftBuffer(void)	150
int RxMsgCount(void)	150

Function definition	Page
int CheckTxStatus(void)	151
int AddCyclicTxMsg(char Mode, unsigned long MsgID, char RTR, char DataLen, char *Data, unsigned long TimePeriod, unsigned long TransmitTimes, unsigned char *Handle)	152
int DeleteCyclicTxMsg(unsigned char Handle)	154
int EnableCyclicTxMsg(unsigned char Handle)	155
int EnableCyclicTxMsgWithTimes(unsigned char Handle, unsigned long TransmitTimes)	156
int GetRestCyclicTxCnt(unsigned char Handle, unsigned long *RestTimes)	157
int DisableCyclicTxMsg(unsigned char Handle)	158
void ResetCyclicTxBuf(void)	158
void SystemHardwareReset(void)	159
void SystemInit(void)	159
int GetLibVer(void)	160
void RefreshWDT(void)	160
void UserInitFunc(void)	161
void UserLoopFunc(void)	162

5.1.1 L1Off

- **Description:**

  Turns off the red LED of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  void L1Off(void)

- **Parameter:**

  None

- **Return:**

  None

5.1.2 L1On

- **Description:**

  Turns on the red LED of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  void L1On(void)

- **Parameter:**

  None

- **Return:**

  None

5.1.3 L2Off

- **Description:**

  Turns off the green LED of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  void L2Off(void)

- **Parameter:**

  None

- **Return:**

  None

5.1.4 L2On

- **Description:**

  Turns on the green LED of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  void L1Off(void)

- **Parameter:**

  None

- **Return:**

  None

5.1.5 DPRAMInttToHost

- **Description:**

  Call this function to signal the users' program of the PC by an interrupt. When users' program of the PC receives the interrupt indicator from the user-defined firmware, check the value of the indicator to know the meaning of the interrupt. The user-defined firmware can communicate with the program of the PC by the pre-definition of the interrupt indicators. Because of the interrupt mechanism, calling this function frequently increases the PC CPU loading and disturbs the normal procedure of the program of the PCs.

- **Syntax:**

  void DPRAMInttToHost(char InttValue)

- **Parameter:**

  InttValue: [input] The interrupt indicator sent to the users' program of the PC. The range is 0x00 ~ 0xdf.

- **Return:**

  None

5.1.6 UserDPRAMIrqFunc ***<must be called once >***

- **Description:**

  This is a callback function, and must be call once in the user-defined firmware. When the firmware library receives an interrupt indicator from the users' program of the PC, the interrupt indicator will be passed to this function. Users can run the proper procedures in this function to process each interrupt indicator. It is not allowed to put an infinite loop into this function. Users must keep the program of this function as short as possible.

- **Syntax:**

  void UserDPRAMIrqFunc(unsigned char INTT)

- **Parameter:**

  INTT: [input] The interrupt indicator from the users' program of the PC.

- **Return:**

  None

5.1.7 DPRAMWriteByte

- **Description:**

  Writes one byte data into the specified address of the DPRAM of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  int DPRAMWriteByte(unsigned int Address, unsigned char Data)

- **Parameter:**

  Address: [input] The specified address of DPRAM where users want to write data. The legal address range for the DPRAM is 0 ~ 6999.
  Data: [input] The byte data written to the DPRAM.

- **Return:**

  _NO_ERR: OK
  _DPRAM_OVER_RANGE: The parameter Address is out of range.

5.1.8 DPRAMWriteWord

- **Description:**

  Writes one word data into the specified address of the DPRAM of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  int DPRAMWriteWord(unsigned int Address, unsigned int Data)

- **Parameter:**

  Address: [input] The specified address of DPRAM where users want to write data. The legal address range for the DPRAM is 0 ~ 6998.
  Data: [input] The word data written to the DPRAM.

- **Return:**

  _NO_ERR: OK
  _DPRAM_OVER_RANGE: The parameter Address is out of range.

5.1.9 DPRAMWriteDword

- **Description:**

  Writes one double-word data into the specified address of the DPRAM of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  int DPRAMWriteDword(unsigned int Address, unsigned long Data)

- **Parameter:**

  Address: [input] The specified address of DPRAM where users want to write data. The legal address range for the DPRAM is 0 ~ 6996.
  Data: [input] The double-word data written to the DPRAM.

- **Return:**

  _NO_ERR: OK
  _DPRAM_OVER_RANGE: The parameter Address is out of range.

5.1.10 DPRAMWriteMultiByte

- **Description:**

  Writes multi-byte data into the specified address of the DPRAM of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  int DPRAMWriteMultiByte(unsigned int Address, char *Data,
  unsigned int DataNum)

- **Parameter:**

  Address: [input] The specified start address of DPRAM where users want to write data. The sum of the parameters Address and DataNum can’t exceed the value 6999.
  *Data: [input] The start address of a byte array written to the DPRAM.
  DataNum: [input] The byte numbers of an data array written to the DPRAM.

- **Return:**

  _NO_ERR: OK

  _DPRAM_OVER_RANGE: The parameter Address is out of range.

5.1.11 DPRAMReadByte

- **Description:**

  Reads one byte data from specified the address of the DPRAM of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  int DPRAMReadByte(unsigned int Address, unsigned char *Data)

- **Parameter:**

  Address: [input] The specified address of DPRAM where users want to read data. The legal address range for the DPRAM is 0 ~ 6999.

  *Data: [output] The address of a variable used to receive the data from the DPRAM.

- **Return:**

  _NO_ERR: OK

  _DPRAM_OVER_RANGE: The parameter Address is out of range.

5.1.12 DPRAMReadWord

- **Description:**

  Reads one word data from the specified address of the DPRAM of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  int DPRAMReadWord(unsigned int Address, unsigned int *Data)

- **Parameter:**

  Address: [input] The specified address of DPRAM where users want to read data. The legal address range for the DPRAM is 0 ~ 6998.

  *Data: [output] The address of a variable applied to receive the data from the DPRAM.

- **Return:**

  _NO_ERR: OK

  _DPRAM_OVER_RANGE: The parameter Address is out of range.

5.1.13 DPRAMReadDword

- **Description:**

  Reads one double-word data from the specified address of the DPRAM of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  int DPRAMReadDword(unsigned int Address, unsigned long *Data)

- **Parameter:**

  Address: [input] The specified address of DPRAM where users want to read data. The legal address range for the DPRAM is 0 ~ 6996.

  *Data: [output] The address of a variable applied to receive the data from the DPRAM.

- **Return:**

  _NO_ERR: OK

  _DPRAM_OVER_RANGE: The parameter Address is out of range.

5.1.14 DPRAMReadMultiByte

- **Description:**

  Writes the multi-byte data into the specified address of the DPRAM of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  int DPRAMReadMultiByte(unsigned int Address, char *Data,
  unsigned int DataNum)

- **Parameter:**

  Address: [input] The specified start address of DPRAM where users want to read data. The sum of the parameters Address and DataNum can't exceed the value 6999.

  *Data: [output] The start address of a byte array applied to receive the data from the DPRAM.

  DataNum: [input] The byte numbers which users want to read from the DPRAM.

- **Return:**

  _NO_ERR: OK

  _DPRAM_OVER_RANGE: The parameter Address is out of range.

5.1.15 DPRAMMemset

- **Description:**

  Sets the multi-byte DPRAM data to be the specified value.

- **Syntax:**

  int DPRAMMemset(unsigned int Address, char data,
                              unsigned int DataNum)

- **Parameter:**

  Address: [input] The specified start address of DPRAM where users want to write data. The sum of the parameters Address and DataNum can't exceed the value 6999.

  Data: [input] The data written to the DPRAM.

  DataNum: [input] The byte numbers which users want to write to the DPRAM.

- **Return:**

  _NO_ERR: OK

  _DPRAM_OVER_RANGE: The parameter Address is out of range.

5.1.16 DPRAMReceiveCmd

- **Description:**

  Use this function to receive the command from the program of the PC. When users use the function CM100_SendCmd() to a send command in the program of the PC, call this function to receive the command from the users’ program. If this function is not called until another new command comes from the users’ program, the former one will be covered by the latter one.

- **Syntax:**

  int DPRAMReceiveCmd(char *Data, unsigned int *DataNum)

- **Parameter:**

  *Data: [output] The start address of a byte array is applied to receive the command data from the DPRAM.

  *DataNum: [output] The address of a variable is applied to receive the command length.

- **Return:**

  _NO_ERR: OK

  _NO_DPRAM_CMD: There is no command transmitted from user-defined firmware.

  _DPRAM_OVER_RANGE: The command length is over 512 bytes.

5.1.17 DPRAMSendCmd

- **Description:**

  Call this function to send the command to the program of the PC. The maximum command length is 512 bytes. Afterwards, users can use the function CM100_ReceiveCmd() of CM100.dll to get this command.

- **Syntax:**

  int DPRAMSendCmd(char *Data, unsigned int DataNum)

- **Parameter:**

  *Data: [input] The start address of a byte array of a sent command.

  DataNum: [input] The word value indicates the length of the command from the user-defined firmware. The maximum value is 512 bytes.

- **Return:**

  _NO_ERR: OK

  _DPRAM_OVER_RANGE: The command length is out of range.

5.1.18 *DebugPrint* *<assist with CM100_DEBUG_MONITOR.EXE>*

- **Description:**

  This function is used to debug the user-defined firmware. Call this function to send debug the messages from the user-defined firmware to the CM100_DEBUG_MONITOR.exe. The use method of this function is similar with the standard C function printf(). When users use this function, it is necessary to execute the CM100_DEBUG_MONITOR program and active the PISO-CM100U/PCM-CM100. If the PISO-CM100U/PCM-CM100 has been activated by other Windows programs, users don't need to activate the PISO-CM100U/PCM-CM100 in the CM100_DEBUG_MONITOR.exe again. For the more information about the CM100_DEBUG_MONITOR, please refer to chapter 6. The maximum string length can't be more than 100 bytes.

- **Syntax:**

  int DebugPrint(const char *fmt,...)

- **Parameter:**

  * fmt: [input] The string of the debug information. The maximum length of *fmt string is 100 bytes. Please refer to the standard C function printf() to know how to use this parameters. If users need print in the new line, add "\r\n" in the end of the string of the debug information.

- **Return:**

  _NO_ERR: OK

  _DPRAM_OVER_RANGE: The string of the debug information length is over 100 bytes.

5.1.19 GetKbhit <assist with debug cable and 7188xw.exe>

- **Description:**

  This function is used to debug the user-defined firmware. Call this function to get a character keyed from the keyboard. The function GetKbhit() is similar with the standard C function kbhit(). When users connect the debug port of the PISO-CM100U/PCM-CM100 with the available PC RS-232 port via the debug cable shown in the chapter 2 and execute the program 7188xw.exe, any key action to the 7188xw.exe can be caught by this function.

- **Syntax:**

  int GetKbhit(void)

- **Parameter:**

  None

- **Return:**

  The return code is the received character which is keyed in the 7188xw.exe.

5.1.20 Print <assist with debug cable and 7188xw.exe>

- **Description:**

  This function is used to debug the user-defined firmware. Call this function to send the debug information to the 7188xw.exe. The function Print() is similar with standard C function printf().When users connect the debug port of the PISO-CM100U/PCM-CM100 with the available PC RS-232 port via the debug cable shown in the chapter 2 and execute the program 7188xw.exe, the debug information sent by this function will be put to the 7188xw.exe.

- **Syntax:**

  int Print(const char *fmt, ...)

- **Parameter:**

  * fmt: [input] The data format of keyboard input. Please refer to the standard C function printf() to know how to use this parameters.

- **Return:**

  If it is successful, the return code is a non-zero value.

5.1.21 GetTime

- **Description:**

  Use this function to get the current time from the real time clock.

- **Syntax:**

  void GetTime(int *hour, int *minute, int *sec)

- **Parameter:**

  *hour: [output] The address of a variable used to receive the hour value of the current time.

  *minute: [output] The address of a variable used to receive the minute value of the current time.

  *sec: [output] The address of a variable used to receive the second value of the current time.

- **Return:**

  None.

5.1.22 SetTime

- **Description:**

  Use this function to modify the time of the real time clock.

- **Syntax:**

  int SetTime(int hour, int minute, int sec)

- **Parameter:**

  hour: [input] The hour value set to the real time clock.

  minute: [input] The minute value set to the real time clock.

  sec: [input] The second value set to the real time clock.

- **Return:**

  _NO_ERR: OK

  _SET_TIME_ERROR: The input value of hour, minute or sec is invalid.

5.1.23 GetDate

- **Description:**

  Use this function to get the current date from the real time clock.

- **Syntax:**

  void GetDate(int *year, int *month, int *day)

- **Parameter:**

  *year: [output] The address of a variable used to receive the year value of the current date.

  *month: [output] The address of a variable used to receive the month value of the current date.

  *day: [output] The address of a variable used to receive the day value of the current date.

- **Return:**

  None.

5.1.24 SetDate

- **Description:**

  Use this function to modify the date of the real time clock.

- **Syntax:**

  int SetDate(int year, int month, int day)

- **Parameter:**

  year: [input] The year value set to the real time clock.

  month: [input] The month value set to the real time clock.

  day: [input] The day value set to the real time clock.

- **Return:**

  _NO_ERR: OK

  _SET_DATE_ERROR: The input value of year, month or day is invalid.

5.1.25 *GetWeekDay*

- **Description:**

  Use this function to obtain what day is today.

- **Syntax:**

  int GetWeekDay(void)

- **Parameter:**

  None.

- **Return:**

Return Code	Meaning
0	Sunday
1	Monday
2	Tuesday
3	Wednesday
4	Thursday
5	Friday
6	Saturday

5.1.26 ReadNVRAM

- **Description:**

  Use this function to get one-byte data of the NVRAM.

- **Syntax:**

  int ReadNVRAM(int Address)

- **Parameter:**

  Address: [input] The NVRAM address where users want to read the data. The range of this parameter is 0 ~ 30.

- **Return:**

  _ACCESS_NVRAM_FAILE: The address of NVRAM is invalid.

  Others: The value obtained from the NVRAM. The range of return value is 0 ~ 255.

5.1.27 WriteNVRAM

- **Description:**

  Use this function to write one-byte data to specified address of the NVRAM. If the system has no power, the data stored in the NVRAM will not disappear until the Li battery is dead.

- **Syntax:**

  int WriteNVRAM(int Address, int data)

- **Parameter:**

  Address: [input] The NVRAM address where users want to write the data to. The range of this parameter is 0 ~ 30.

  data: [input] The data written to the NVRAM. The range of this parameter is 0 ~ 255. If value is over 255, only low byte of data will be written to the NVRAM.

- **Return:**

  _NO_ERR: OK.

  _ACCESS_NVRAM_FAILE: The address of the NVRAM is invalid.

5.1.28 GetTimeTicks100us

- **Description:**

  Read the time ticks of the PISO-CM100U/PCM-CM100 by using this function. While the board is powered, the time ticks start to be counted. Firmware reset will clean the accumulated counters of this value. If the accumulated counter is over 0xFFFFFFFF, it starts from the value 0.

- **Syntax:**

  unsigned long GetTimeTicks100us(void)

- **Parameter:**

  None.

- **Return:**

  The time ticks value calculated as the firmware starts. The unit is 0.1 ms.

5.1.29 GetTimeTicks

- **Description:**

  Call this function to read PISO-CM100U/PCM-CM100 time ticks. While the board is powered, the time ticks start to be counted. This function can’t be called in the interrupt service routine. If the accumulated counter is over 0xFFFFFFFF, it starts from the value 0.

- **Syntax:**

  long GetTimeTicks(void)

- **Parameter:**

  None

- **Return:**

  The time ticks value calculated as the firmware starts. The unit is 1 ms.

5.1.30 DelayMs

- **Description:**

  Use this function to delay some time for the procedure of the user-defined firmware. Because of the watchdog mechanism, users can’t delay for a long time. The watchdog is trigged every 800 ms. It is recommend that if users want to delay the procedure of the user-defined firmware more than 500 ms. The function RefreshWDT() must be applied to avoid the watchdog timeout. This function is not allowed to put in the interrupt service routine. If users want to use delay functions in interrupt service routine, it is strongly recommended to move this part of the codes from the interrupt service routine into the UserLoopFunc().

- **Syntax:**

  void DelayMs(unsigned int DelayTime_ms)

- **Parameter:**

  DelayTime_ms: [input] The delay time. The unit is 1 ms.

- **Return:**

  None

5.1.31 CM100_InstallUserTimer

- **Description:**

  This function offers the timer interrupt. When users put their timer interrupt service routine in this function, this interrupt service routine will be executed every predefined period. Be careful that too many codes in the interrupt service routine will disturb the normal procedure of the user-defined firmware.

- **Syntax:**

  void CM100_InstallUserTimer(void (*Fun)(void))

- **Parameter:**

  (*Fun)(void): [input] The pointer which points a function with format “void XXX(void)”. The characters XXX are the name of the users’ interrupt service routine.

- **Return:**

  None

5.1.32 T_StopWatchXXX series functions

- **Description:**

  Call this function to use a stopwatch. There are 4 functions for the stopwatch operations. When users want to start a stopwatch, T_StopWatchStart() must be applied. Afterwards, users can use the function T_StopWatchGetTime() to get the current time counted by this stopwatch. If users want to stop time counting, use the function T_StopWatchPause(). Calling the fucntion T_StopWatchContinue() can enable this timer again. If users want to use more than one stopwatch, just input the different structure variable STOPWATCH to these 4 functions. One structure variable is mapped to one stopwatch. The time unit of these 4 functions and the members of the STOPWATCH structure are millisecond.

- **Syntax:**

  void T_StopWatchStart(STOPWATCH *sw)

  unsigned long T_StopWatchGetTime(STOPWATCH *sw)

  void T_StopWatchPause(STOPWATCH *sw)

  void T_StopWatchContinue(STOPWATCH *sw)

- **Parameter:**

  *sw: [output] The address of a STOPWATCH structure variable applied to describe the stopwatch. The member of the STOPWATCH structure is shown as following:

```
typedef struct {
        unsigned long ulStart;
        unsigned long ulPauseTime;
        unsigned int uMode;
}STOPWATCH;
```

The parameter ulStart shows the start time of stopwatch. The parameter ulPauseTime returns the time as the stopwatch is paused. The parameter uMode returns the status of the stopwatch. If uMode is 0, the stopwatch is paused. If uMode is 1, the stopwatch is running.

- **Return:**

  The return code of the function T_StopWatchGetTime() is the current time count after the stopwatch started.

5.1.33 T_CountDownTimerXXX series functions

- **Description:**

  Call this function to use a countdown timer. There are 5 functions for the countdown timer operations. When users want to start a countdown timer, the function T_CountDownTimerStart() must be applied. Afterwards, If users want to stop the countdown timer, use the function T_CountDownTimerPause(). Calling the function T_CountDownTimerContinue() can enable this countdown timer again. Users can use the function T_CountDownTimerIsTimeUp() to check if the countdown timer is timeout or not. Or, use the fucntion T_CountDownTimerGetTimeLeft() to obtain the rest time of the countdown timer. If users want to use more than one countdown timer, just input the different structure variable COUNTDOWNTIMER to these 5 functions. One structure variable is mapped to one countdown timer. The time unit of these 5 functions and the members of the COUNTDOWNTIMER structure are millisecond.

- **Syntax:**

```
void T_CountDownTimerStart(COUNTDOWNTIMER *cdt,
                                    unsigned long timems)
void T_CountDownTimerPause(COUNTDOWNTIMER *cdt)
void T_CountDownTimerContinue(COUNTDOWNTIMER *cdt)
int T_CountDownTimerIsTimeUp(COUNTDOWNTIMER *cdt)
unsigned long T_CountDownTimerGetTimeLeft(
                                        COUNTDOWNTIMER *cdt)
```

- **Parameter:**

  timems: [input] The time interval which indicates that how much time the countdown timer to count down.

  *cdt: [output] The address of a COUNTDOWNTIMER structure variable used to describe the countdown timer. The member of the COUNTDOWNTIMER structure is shown as following:

```
            typedef struct {
                    unsigned long ulTime;
                    unsigned long ulStartTime;
```

```
                unsigned long ulPauseTime;
                unsigned int uMode;
        } COUNTDOWNTIMER;
```

The parameter ulTime is the time interval of the countdown timer. The parameter ulStartTime returns the start time of the countdown timer. The parameter ulPauseTime obtains the time as the countdown timer is paused. The parameter uMode returns the status of the countdown timer. If uMode is 0, it means that the countdown timer is stopped. If uMode is 1, the countdown timer is running.

- **Return:**

The return code of the T_CountDownTimerIsTimeUp() is _NO_ERR or _COUNT_DOWN_TIMER_TIME_UP. If the countdown timer is timeout, the return code is _COUNT_DOWN_TIMER_TIME_UP. If not, the return code is _NO_ERR. The return code of the T_CountDownTimerGetTimeLeft() is the rest time of the countdown timer.

5.1.34 CM100_EEPROMReadByte

- **Description:**

  Use this function to read the data of the specified address of the EEPROM.

- **Syntax:**

```
int CM100_EEPROMReadByte(unsigned int Block,
                         unsigned int Address,
                         unsigned char *Data)
```

- **Parameter:**

  Block: [input] The EEPROM block No.. The range is 0 ~ 6.

  Address: [input] The EEPROM address where users want to read the data from. Each block has 256 bytes. Therefore, the range of this parameter is 0 ~ 255.

  *data: [output] The address of a variable used to obtain the data of specified address of the EEPROM

- **Return:**

  _NO_ERR: OK.

  _EEPROM_OVER_RANGE: The parameter Block is over 6, or the parameter Address is over 255.

5.1.35 CM100_EEPROMReadMultiByte

- **Description:**

  Use this function to read some data from the EEPROM.

- **Syntax:**

```
int CM100_EEPROMReadMultiByte(unsigned int Block,
                              unsigned int Address,
                              char *Data,
                              unsigned int DataNum)
```

- **Parameter:**

  Block: [input] The EEPROM block No.. The range is 0 ~ 6.

  Address: [input] The start EEPROM address where users want to write the data to. Each block has 256 bytes. Therefore, the range of this parameter is 0 ~ 255.

  *data: [output] The start address of a byte array used to receive the data from the EEPROM

  DataNum: [input] The parameter indicates that how many data users want to obtain.

- **Return:**

  _NO_ERR: OK.

  _EEPROM_OVER_RANGE: The parameter Block is over 6, the parameter Address is over 256, or the specified range of reading data is over the block 6 and address 255.

5.1.36 CM100_EEPROMWriteByte

- **Description:**

  Use this function to write the data to the specified address of the EEPROM. If the system has no power, the data stored in EEPROM will not disappear, but the EEPROM has the limitation for erase or write cycles. The data which need to frequently write to memory is not proper to be used in the EEPROM.

- **Syntax:**

  int CM100_EEPROMWriteByte(unsigned int Block,
  unsigned int Address,
  unsigned char Data)

- **Parameter:**

  Block: [input] The EEPROM block No.. The range is from 0 to 6.

  Address: [input] The EEPROM address where users want to write the data to. Each block has 256 bytes. Therefore, the range of this parameter is 0 ~ 255.

  data: [input] The data written to the EEPROM

- **Return:**

  _NO_ERR: OK.

  _EEPROM_ACCESS_ERROR: Can't write data to the specified EEPROM address. The EEPROM may be damaged.

  _EEPROM_OVER_RANGE: The block No. is over 6, or the address is over 256.

5.1.37 CM100_EEPROMWriteMultiByte

- **Description:**

  Use this function to write some data to specified address of EEPROM. If the system has no power, the data stored in EEPROM will not disappear, but the EEPROM has the limitation for erase or write cycles. The data which need to frequently write to memory is not proper to be used in the EEPROM.

- **Syntax:**

```
int CM100_EEPROMWriteMultiByte(unsigned int Block,
                               unsigned int Address,
                               char *Data,
                               unsigned int DataNum)
```

- **Parameter:**

  Block: [input] The EEPROM block No.. The range is from 0 to 6.
  Address: [input] The EEPROM address where users want to write the data to. Each block has 256 bytes. Therefore, the range of this parameter is 0 ~ 255.
  *data: [output] The start address of a byte array used to store the data written to the EEPROM.
  DataNum: [input] The parameter indicates that how many data users want to write.

- **Return:**

  _NO_ERR: OK.
  _EEPROM_ACCESS_ERROR: Can't write data to specified EEPROM address. The EEPROM may be damaged.
  _EEPROM_OVER_RANGE: The parameter Block is over 6, the parameter Address is over 256, or the specified range of writing data is over the block 6 and address 255.

5.1.38 UserCANIrqFunc <must be called once>

- **Description:**

  This is a callback function, and must be call once in the user-defined firmware. When the firmware library receives an interrupt signal from the CAN controller, this function will be called. The interrupt indicator which shows what kind of the CAN controller interrupt is activated is passed to this function. Users are able to design their interrupt routine according to the corresponding interrupt indicators. It is not allowed to put an infinite loop in to this function, and users must keep the codes of this function as short as possible.

- **Syntax:**

  void UserCANIrqFunc(unsigned char INTT)

- **Parameter:**

  INTT: [input] The interrupt indicator from the CAN controller. The meanings of the indicators are shown below.

Indicator (Hex)	Meaning
0x01	Receive a message successfully
0x02	Transmit a message successfully
0x04	Error warring
0x08	Data Overrun
0x10	CAN controller wake-up
0x20	Bus Passive
0x40	Arbitration Lost
0x80	Bus Error

- **Return:**

  None

5.1.39 SJA1000HardwareReset

- **Description:**

  Resets the CAN controller by the reset pin of SJA1000. After calling this function, users must configure the baud and message filter of the CAN controller. Then, use EnableSJA1000() to activate the SJA1000 to send and receive CAN messages.

- **Syntax:**

  void SJA1000HardwareReset(void)

- **Parameter:**

  None

- **Return:**

  None

5.1.40 SetCANBaud

- **Description:**

  Sets the CAN baud of the CAN controller.

- **Syntax:**

  int SetCANBaud(unsigned long Baud, char BT0, char BT1)

- **Parameter:**

  Baud: [input] The baud of the CAN controller. There are 12 kinds of predefined baud, 5 k, 10 k, 20 k, 25 k, 50 k, 100 k, 125 k, 200 k, 250 k, 500 k, 800 k, and 1 M bps. If these bauds cannot satisfy users, set this parameter 12 and define the BT0 and BT1 of the SJA1000.

Value	Description
0	5 k bps
1	10 k bps
2	20 k bps
3	25 k bps
4	50 k bps
5	100 k bps
6	125 k bps
7	200 k bps
8	250 k bps
9	500 k bps
10	800 k bps
11	1000 k bps
others	The user-defined baud (The BT0 and BT1 are needed)

  BT0: [input] The user-defined baud.

  BT1: [input] The user-defined baud. For the more information about how to set the BT0 and BT1, please refer to the datasheet of the SJA1000.

- **Return:**

  _NO_ERR: OK.

  _CAN_CHIP_SOFT_RESET_ERR: The SJA1000 can't be reset by the software. The CAN controller may be damaged.

5.1.41 GetCANBaud

- **Description:**

  Gets the current CAN baud of the CAN controller.

- **Syntax:**

  void GetCANBaud(unsigned long *Baud, char *BT0, char *BT1)

- **Parameter:**

  *Baud: [output] The address of a variable used to obtain the baud of the CAN controller. If this parameter is more than 12, the BT0 and BT1 are useful. Please refer to the function SetCANBaud() for the details.

  *BT0: [output] The address of a variable used to get the BT0 value obtained from the SJA1000.

  *BT1: [output] The address of a variable used to get the BT1 value obtained from the SJA1000. For more information about how to use the BT0 and BT1, please refer to the datasheet of the SJA1000.

- **Return:**

  None

5.1.42 SetCANMask

- **Description:**

  Sets the message filter of the CAN controller.

- **Syntax:**

  int SetCANMask(long AccCode, long AccMask)

- **Parameter:**

  AccCode: [input] Acceptance code of CAN controller

  AccMask: [input] Acceptance mask of CAN controller.

  The AccCode is used to decide which CAN IDs are accepted by the CAN controller. The AccMask is used to decide which bit of the CAN IDs are checked with the AccCode by the CAN controller. If the bit of AccMask is set to 0, it means that the bit in the same position of the CAN IDs need to be checked and the ID bit value needs to match the bit of AccCode in the same position.

  AccCode and AccMask Definition For 11-bit ID:

AccCode and AccMask	Bit Position	Filter Target
high byte of the high word	bit7~bit0	bit10 ~ bit3 of ID
low byte of the high word	bit7~bit5	bit2 ~ bit0 of ID
low byte of the high word	bit4	RTR
low byte of the high word	bit3~bit0	no use
high byte of the low word	bit7~bit0	bit7 ~ bit0 of 1st byte data
low byte of the low word	bit7~bit0	bit7 ~ bit0 of 2nd byte data

  AccCode and AccMask Definition For 29-bit ID:

AccCode and AccMask	Bit Position	Filter Target
high byte of the high word	bit7~bit0	bit28~ bit21 of ID
low byte of the high word	bit7~bit0	bit20 ~ bit13 of ID

high byte of the low word	bit7~bit0	bit12 ~ bit5 of ID
low byte of the low word	bit7~bit3	bit4 ~ bit0 of ID
low byte of the low word	bit2	RTR
low byte of the low word	bit1~bit0	no use

<u>Example for 29 bit ID message:</u>

		Array[0]	Array[1]	Array[2]	Array[3]	
AccCode	:	00h	00h	00h	A0h	
AccMask	:	FFh	FFh	FFh	1Fh	
ID bit	:	bit28~bit21	bit20~bit13	bit12~bit5	bit4~bit0	
ID Value	:	xxxx xxxx	xxxx xxxx	xxxx xxxx	101x x	will be accepted

(Note: The character “x” means the bit value doesn’t care. The character “h” behind the value means the value is in hex format.)

- **Return:**

  _NO_ERR: OK.
  _CAN_CHIP_SOFT_RESET_ERR: The SJA1000 can’t be reset by the software. The CAN controller may be damaged.

5.1.43 GetCANMask

- **Description:**

  Gets the current message filter configuration of the CAN controller.

- **Syntax:**

  void GetCANMask(long *AccCode, long *AccMask)

- **Parameter:**

  * AccCode: [output] The address of a variable used to obtain the acceptance code of SJA1000.

  * AccMask: [output] The address of a variable used to obtain the acceptance mask of SJA1000.

- **Return:**

  None

5.1.44 CANConfig

- **Description:**

  Configures the baud, message filter of the CAN controller. After calling this function, users need to call the EnableSJA1000() to active the CAN controller.

- **Syntax:**

  int CANConfig(unsigned long Baud, char BT0, char BT1, long AccMask,

  long AccCode)

- **Parameter:**

  Baud: [input] The baud of CAN controller.

  BT0: [input] The user-defined baud.

  BT1: [input] The user-defined baud.

  AccCode: [input] The acceptance code of the CAN controller.

  AccMask: [input] The acceptance mask of the CAN controller.

  For the more information about these parameters, please refer to the functions SetCANBaud() and SetCANMask().

- **Return:**

  _NO_ERR: OK.

  _CAN_CHIP_SOFT_RESET_ERR: The SJA1000 can’t be reset by the software. The CAN controller may be damaged.

5.1.45 CANConfigBySJA1000Reg

- **Description:**

  This function is similar to the function CANConfig. The difference is the input parameters. This function uses non-structure parameters.

- **Syntax:**

```
int CANConfigBySJA1000Reg(char BaudType, char BT0,
                          char BT1, char *AccCode,
                          char *AccMask)
```

- **Parameter:**

BaudType: [input] The baud of CAN controller.

BT0: [input] The user-defined baud.

BT1: [input] The user-defined baud.

* AccCode: [output] The address of a variable used to obtain the acceptance code of SJA1000. The first element is the LSB of the AccCode and the forth is the MSB of the AccCode.

* AccMask: [output] The address of a variable used to obtain the acceptance mask of SJA1000. The first element is the LSB of the AccMask and the forth is the MSB of the AccMask.

For the more information about these parameters, please refer to the functions SetCANBaud() and SetCANMask().

- **Return:**

_NO_ERR: OK.

_CAN_CHIP_SOFT_RESET_ERR: The SJA1000 can’t be reset by the software. The CAN controller may be damaged.

5.1.46 EnableSJA1000

- **Description:**

  Use this function to activate the SJA1000. Afterwards, users can send/receive CAN messages by other functions.

- **Syntax:**

  void EnableSJA1000(void)

- **Parameter:**

  None

- **Return:**

  None

5.1.47 DisableSJA1000

- **Description:**

  Call the function DisableSJA1000() to disable the SJA1000. If users want to enable the SJA1000 again, the configuration of the SJA1000 must be don first.

- **Syntax:**

  void DisableSJA1000(void)

- **Parameter:**

  None

- **Return:**

  None

5.1.48 GetCANStatus

- **Description:**

  Obtains the status register of the SJA1000.

- **Syntax:**

  int GetCANStatus(void)

- **Parameter:**

  None

- **Return:**

  The return codes are the value of the status register of the SJA1000, and are described below.

Bit NO.	Description
7 (MSB)	Bus status. 1 for bus off, 0 for bus on.
6	Error status. 1 for at least one error, 0 for OK.
5	SJA1000 Transmit status. 1 for transmitting, 0 for idle.
4	SJA1000Receive status. 1 for receiving, 0 for idle.
3	SJA1000 Transmit complete status. 1 for complete, 0 for incomplete.
2	SJA1000 Transmit buffer status. 1 for released, 0 for locked
1	Data overrun status. 1 for SJA1000 reception buffer overrun, 0 for OK.
0 (LSB)	Receive buffer status. 1 for at least one message stored in the SJA1000 reception buffer, 0 for empty.

5.1.49 ClearDataOverrunStatus

- **Description:**

  When the data overrun status is obtained by using the function GetCANStatus(), call this function to clean this status.

- **Syntax:**

  void ClearDataOverrunStatus(void)

- **Parameter:**

  None

- **Return:**

  None

5.1.50 SendCANMsg

- **Description:**

  Sends a CAN message to the software transmission buffer. When the CAN bus is idle, this CAN message will be send to the CAN network.

- **Syntax:**

```
int SendCANMsg(char Mode, unsigned long MsgID, char RTR,
                        char DataLen, char *Data)
```

- **Parameter:**

  Mode: [input] 0 for 11-bit message ID, 1 for 29-bit message ID.

  MsgID: [input] CAN message ID.

  RTR: [input] 0 for normal messages, 1 for remote-transmit-request messages. As the value is 1, the parameter *Data is useless.

  DataLen: [input] The data length of a transmitted CAN message. The maximum value is 8.

  *Data: [input] The start address of a buffer used to store the transmitted data of a CAN message.

- **Return:**

  _NO_ERR: OK.

  _SOFT_BUF_FULL: The transmission software buffer is full. Users need to transmit the CAN message later, or use the function ClearTxSoftBuffer() to clean the CAN transmission buffer.

5.1.51 ClearTxSoftBuffer

- **Description:**

  Call this function to clean the transmission software buffer of the CAN messages.

- **Syntax:**

  void ClearTxSoftBuffer(void)

- **Parameter:**

  None

- **Return:**

  None

5.1.52 GetCANMsg

- **Description:**

  Obtain a received CAN message from the software buffer.

- **Syntax:**

```
int GetCANMsg(char *Mode, unsigned long *MsgID, char *RTR,
              char *DataLen, char *Data, unsigned long *UpperTime,
              unsigned long *LowerTime)
```

- **Parameter:**

*Mode: [output] The address of a variable used to get the mode of a CAN message. If the value is 0, the received CAN message is 11-bit-ID CAN message. The 29-bit-ID CAN message will have the value 1.

*MsgID: [output] The address of a variable used to get the CAN message ID.

*RTR: [output] The address of a variable used to obtain the status of this CAN message. 0 for the remote-transmit-request message, 1 for the normal message.

*DataLen: [output] The address of a variable used to obtain the data length of a CAN message. The range of this value is 0~8.

*Data: [output] The start address of a buffer used to get the data of a CAN message. Users need to put an 8-byte array in this filed.

*UpperTime: [output] The address of a variable used to obtain the higher 32-bit time stamp of a CAN message.

*LowerTime: [output] The address of a variable used to obtain the lower

32-bit time stamp of a CAN message. The unit of UpperTime and LowerTime are 0.1ms.

- **Return:**

_NO_ERR: OK.

_RX_SOFT_BUF_EMPTY: There is no message stored in the reception software buffer.

_SOFT_BUF_FULL: The reception software buffer of the CAN messages is full. Use the function ClearRxSoftBuffer() to clean the status when receiving the return code.

5.1.53 ClearRxSoftBuffer

- **Description:**

  Call this function to clean the reception software buffer of the CAN messages.

- **Syntax:**

  void ClearRxSoftBuffer(void)

- **Parameter:**

  None

- **Return:**

  None

5.1.54 RxMsgCount

- **Description:**

  Call this function to know how many available CAN messages stored in the reception software buffer.

- **Syntax:**

  int RxMsgCount(void)

- **Parameter:**

  None

- **Return:**

  The return code is the number of the CAN messages stored in the reception software buffer.

5.1.55 ChcekTxStatus

- **Description:**

  Checks if the CAN controller successfully sends the CAN message.

- **Syntax:**

  int CheckTxStatus(void)

- **Parameter:**

  None

- **Return:**

  The value 1 means that the CAN controller can't successfully send the CAN message to the network and the value 0 is for no error.

5.1.56 AddCyclicTxMsg

- **Description:**

  Adds a cyclic transmission message into the firmware of the board. Afterwards, users can use the functions EnableCyclicTxMsg() and DelectCyclicTxMsg() to enable or disable this cyclic transmission message. The maximum addable number of the transmission messages is 5. After adding a cyclic transmission message, the handle for this message will be returned. The less value of handle indicates the higher priority of the cyclic transmission messages. If there are two cycle transmission messages need to be sent at the same time, the higher priority message will be sent first.

- **Syntax:**

```
int AddCyclicTxMsg(char Mode, unsigned long MsgID, char RTR,
                   char DataLen, char *Data,
                   unsigned long TimePeriod,
                   unsigned long TransmitTimes,
                   unsigned char *Handle)
```

- **Parameter:**

  Mode: [input] 0 for 11-bit message ID, 1 for 29-bit message ID.

  MsgID: [input] The CAN message ID.

  RTR: [input] 0 for transmitting the remote-transmit-request message, 1 for transmitting the normal message. As this bit is 1, the parameter *Data is useless.

  DataLen: [input] The data length of the CAN message. The maximum value is 8.

  *Data: [input] The start address of the data array of a CAN message. The maximum length of the Data array is 8 bytes.

TimePeriod: [input] The time period for the cyclic transmission. This parameter is formatted by 0.1ms. The minimum value is 5.

TransmitTimes: [input] The transmission times for the cyclic transmission. After enabling the transmission, the message will be sent for specified times. If the value of the parameter is 0, the transmission goes cyclically until disabling the cyclic transmission.

*Handle: [output] The address of a variable is used to get the handle of a cyclic transmission. When users would like to enable or disable the specified transmission, this value is needed.

- **Return:**

_NO_ERR: OK

_CYCLIC_CONFIG_ERR: The applied cyclic transmission message number is more than 5, or the parameter time period is less than 5 (0.5ms).

5.1.57 DeleteCyclicTxMsg

- **Description:**

  Removes the specified cyclic transmission message added by the function AddCyclicTxMsg().

- **Syntax:**

  int DeleteCyclicTxMsg(unsigned char Handle)

- **Parameter:**

  Handle: [input] The handle of the cyclic transmission message which is obtained by AddCyclicTxMsg() function.

- **Return:**

  _NO_ERR: OK
  _CYCLIC_HANDLE_ERR: The handle value can’t be found in the cyclic transmission engine.

5.1.58 *EnableCyclicTxMsg*

- **Description:**

  Enables the cyclic transmission message added by the function AddCyclicTxMsg(). After calling this function, the specified cyclic transmission message will be transmitted.

- **Syntax:**

  int EnableCyclicTxMsg(unsigned char Handle)

- **Parameter:**

  Handle: [input] The handle of the cyclic transmission message which is obtained by the function AddCyclicTxMsg().

- **Return:**

  _NO_ERR: OK

  _CYCLIC_HANDLE_ERR: The handle value can’t be found in the cyclic transmission engine.

5.1.59 EnableCyclicTxMsgWithTimes

- **Description:**

  Enables the cyclic transmission message added by the function AddCyclicTxMsg() with the specified times. After calling this function, the specified cyclic transmission message will be transmitted.

- **Syntax:**

```
int EnableCyclicTxMsgWithTimes(unsigned char Handle,
                               unsigned long TransmitTimes)
```

- **Parameter:**

  Handle: [input] The handle of the cyclic transmission message which is obtained by the function AddCyclicTxMsg().

  TransmitTimes: [input] The cyclic message number which will be transmitted. After enabling the transmission, the message will be sent for specified times. If the value of the parameter is 0, the transmission goes cyclically until disabling the cyclic transmission.

- **Return:**

  _NO_ERR: OK

  _CYCLIC_HANDLE_ERR: The handle value can’t be found in the cyclic transmission engine.

5.1.60 GetRestCyclicTxCnt

- **Description:**

  This function returns the rest number of the cyclic messages which will not be transmitted. If users configure the cyclic message with the specified times or use the function EnableCyclicTxMsgWithTimes() to start the cyclic transmission. Calling this function can obtain how many cyclic messages are not sent to the CAN bus.

- **Syntax:**

```
int GetRestCyclicTxCnt(unsigned char Handle,
                       unsigned long *RestTimes)
```

- **Parameter:**

  Handle: [input] The handle of the cyclic transmission message which is obtained by the function AddCyclicTxMsg().

  *RestTimes: [output] The rest number of the cyclic messages which will not be transmitted.

- **Return:**

  _NO_ERR: OK

  _CYCLIC_HANDLE_ERR: The handle value can’t be found in the cyclic transmission engine.

5.1.61 DisableCyclicTxMsg

- **Description:**

  Disable a cyclic transmission message which is enabled by EnableCyclicTxMsg() function before.

- **Syntax:**

  int DisableCyclicTxMsg(unsigned char Handle)

- **Parameter:**

  Handle: [input] The handle of the cyclic transmission message which is obtained by the function AddCyclicTxMsg().

- **Return:**

  _NO_ERR: OK
  _CYCLIC_HANDLE_ERR: The handle value can't be found in the cyclic transmission engine.

5.1.62 ResetCyclicTxBuf

- **Description:**

  Cleans the software buffer of the cyclic transmission engine. After calling this function, the transmission of all cyclic messages are stopped, and all of the cyclic messages are removed from the cyclic transmission engine.

- **Syntax:**

  void ResetCyclicTxBuf(void)

- **Parameter:**

  None

- **Return:**None

5.1.63 SystemHardwareReset

- **Description:**

  Uses this function to reset the hardware of the PISO-CM100U/PCM-CM100.

- **Syntax:**

  void SystemHardwareReset(void)

- **Parameter:**

  None

- **Return:**

  None

5.1.64 SystemInit

- **Description:**

  Use this function to initiate the DPRAM, LEDs, cyclic transmission engine, CAN transmission software buffer, and CAN controller.

- **Syntax:**

  void SystemInit(void)

- **Parameter:**

  None

- **Return:**

  None

5.1.65 GetLibVer

- **Description:**

  Gets the version of the firmware library.

- **Syntax:**

  int GetLibVer(void)

- **Parameter:**

  None

- **Return:**

  The return code is the version of the firmware library. For example: If 100(hex) is return, it means driver version is 1.00.

5.1.66 RefreshWDT

- **Description:**

  Call this function to refresh the watchdog timer of the PISO-CM100U/PCM-CM100. When users design the user-defined firmware, this function must be called where the users' procedure may have a processed period more than 500ms. If the function RefreshWDT() is not called in 800ms, the CPU of the board will be reset.

- **Syntax:**

  void RefreshWDT(void)

- **Parameter:**

  None

- **Return:**

  None

5.1.67 UserInitFunc <must be called once>

- **Description:**

  When users design the user-defined firmware, this callback function must be used. Users can put some procedures into this function. These procedures are those which will be executed only one time in the user-defined firmware. When the CPU of the PISO-CM100U/PCM-CM100 boots up, the firmware library will call this callback function once.

- **Syntax:**

  void UserInitFunc(void)

- **Parameter:**

  None

- **Return:**

  None

5.1.68 UserLoopFunc <must be called once>

- **Description:**

  When users design the user-defined firmware, this callback function must be used. Users can put their main procedures into this function. The main procedure will be cyclic executed as soon as possible. The time period is correlated with the complexity of the users' main procedure. When the CPU of the PISO-CM100U/PCM-CM100 boots up, the firmware library will call the function UserInitFunc() once and then call the function UserLoopFunc() cyclically until the CPU of the PISO-CM100U/PCM-CM100 is turned off. It is not allowed to put an infinite loop in this function.

- **Syntax:**

  void UserLoopFunc(void)

- **Parameter:**

  None

- **Return:**

  None

5.2 *Firmware Library Return Codes Troubleshooting*

If the default firmware is used, users do not need to read this section.

Return Code	Error ID	Troubleshooting
-19	_SET_TIME_ERROR	1. Check the time format of the input parameters.
-18	_SET_DATE_ERROR	1. Check the date format of the input parameters.
-9	_ACCESS_NVRAM_FAILE	1. Try it again. 2. Call your distributor to solve this problem.
0	_NO_ERR	OK
1	_COUNT_DOWN_TIMER_TIME_UP	1. The countdown timer started by users is timeout.
101	_CAN_CHIP_SOFT_RESET_ERR	1. Call SJA1000HardwareReset(), and try it again. 2. Call your distributor to solve this problem
102	_CAN_CHIP_CONFIG_ERR	1. Check the parameters of baud, BT0, BT1, acceptance code, and acceptance mask.
103	_RX_SOFT_BUF_EMPTY	1. Wait for a while and call the function again.
104	_SOFT_BUF_FULL	1. Use the function ClearTxSoftBuffer() or the function ClearRxSoftBuffer() to clear the status of the buffer overflow. 2. Reduce the bus loading of the CAN network.
105	_DPRAM_WRITE_ERR	1. Wait for a while and call the function again. 2. Call your distributor to solve this problem
106	_DPRAM_READ_ERR	1. Wait for a while and call the function again. 2. Call your distributor to solve this problem.
107	_DPRAM_OVER_RANGE	1. Check the address or space range of the written DPRAM.
108	_NO_DPRAM_CMD	1. Wait for a while and call the function again.
109	_CYCLIC_CONFIG_ERR	1. Check if users already use 5 cyclic messages. 2. Set the parameters TimePeriod to be more than 5.
110	_CYCLIC_HANDLE_ERR	1. Check the parameter Handle.
111	_EEPROM_OVER_RANGE	1. Check the address or space range of written EEPROM.
112	_EEPROM_ACCESS_ERROR	1. Wait for a while and call the function again. 2. Call your distributor to solve this problem.

Table 5.6 Return Code Troubleshooting

Note: If users' problems can't be fixed after following the recommended methods. Please contact your distributor or email to service@icpdas.com to solve the problem.

6 Application Programming

In this chapter, the program skills about how to use the default firmware and the design user-defined firmware are shown. Section 6.1 describes the program basic architecture of an application and briefs some demo programs. Section 6.2 introduces the CANUtility tool. It is a useful free tool for monitoring and accessing the CAN network. Furthermore, when users want to update the default firmware or download user-defined firmware into the PISO-CM100U/PCM-CM100. This tool must be used. Section 6.3 gives a profile about how to design the user-defined firmware, and the corresponding application on the Windows platform. Some demo programs for the user-defined firmware are also shown. Section 6.4 provides two ways to debug the user-defined firmware. If users just use the default firmware, the Section 6.3 and 6.4 can be ignored.

6.1 *Windows Programming With Default Firmware*

This section is only for the default firmware. It is useless if users want to design the user-defined firmware. The figure 6.1 presents the “Send CAN Message” procedure. When users want to design their application by using the APIs of CM100.dll on the Windows platform, this flowchart may be a good reference. The figure 6.2 is a standard procedure for receiving a CAN messages. This procedure let users obtain the CAN messages from the CAN bus easily. If users need to send some specified CAN messages every period of time, the flowchart shown in the figure 6.3 may give a good example. The figure 6.4 shows the flowchart to send and receive CAN messages in one process or thread. Because it is impossible for the CAN board to be accessed by more than one APIs of the CM100.dll at the same time, the flowchart of the figure 6.4 can be a good reference. Owing to these 4 flowcharts, it may satisfy most application of the users’ program of the PC with the default firmware of the PISO-CM100U/PCM-CM100. Following these principles can help users to build their application easier and faster. When users want to design the Windows program, the functions, CM100_ActiveBoard(), CM100_Init(), and CM100_Config(), are only called once when the program starts. If the program needs to be terminated, call the function CM100_CloseBoard() once to release the system resource.

Note: It is impossible to access the same CAN board with more than two procedure or threads. Users need to confirm the completion of the API of the CM100.dll before calling a next API of the CM100.dll.

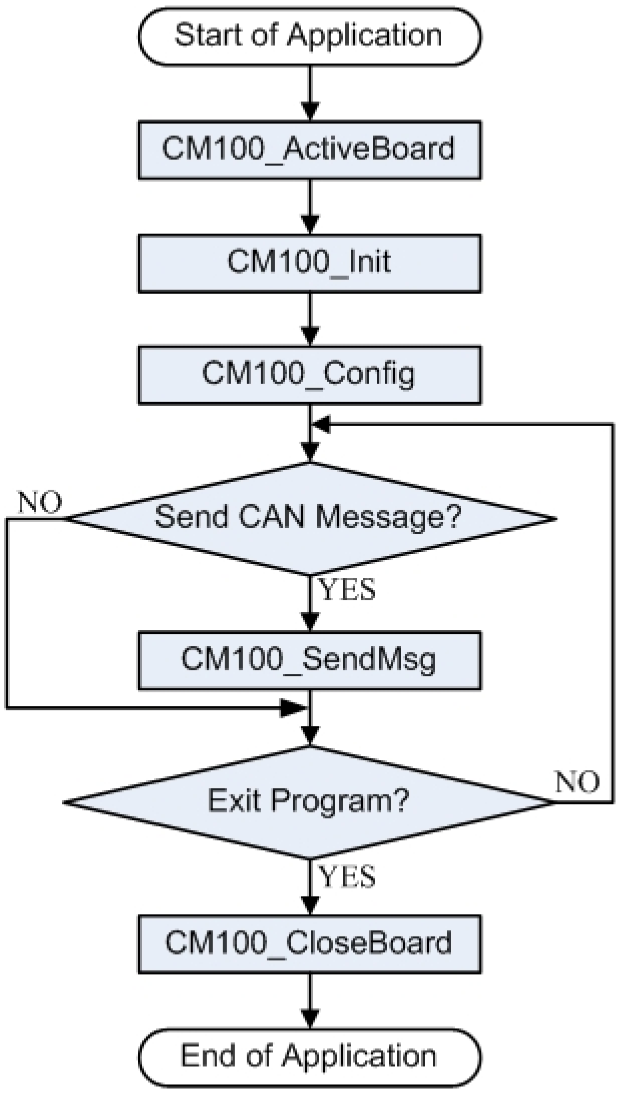


Figure 6.1 Flowchart of Sending CAN Massages

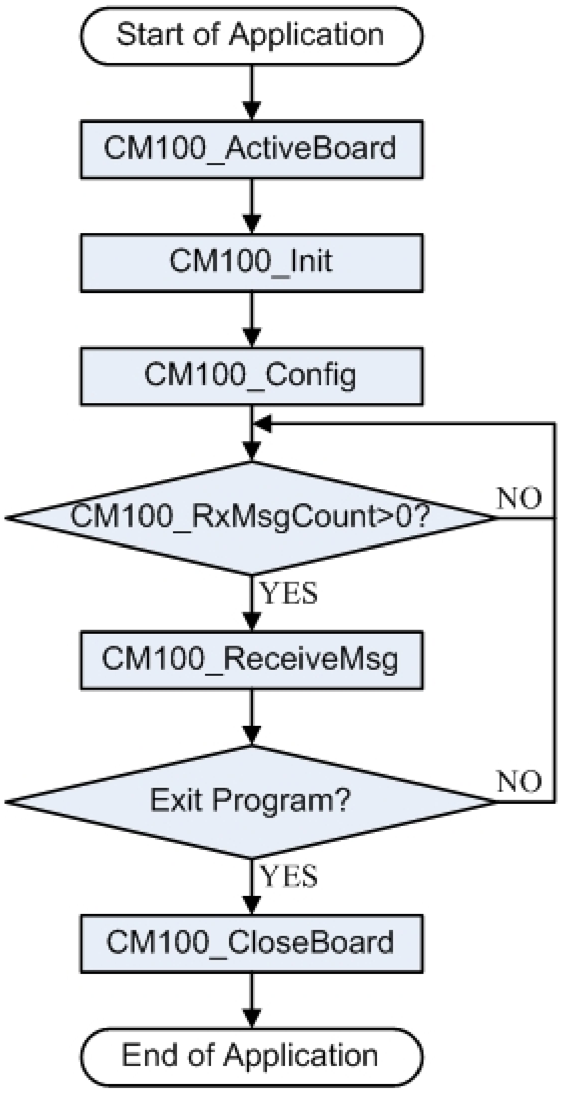


Figure 6.2 Flowchart of Receiving CAN Massages

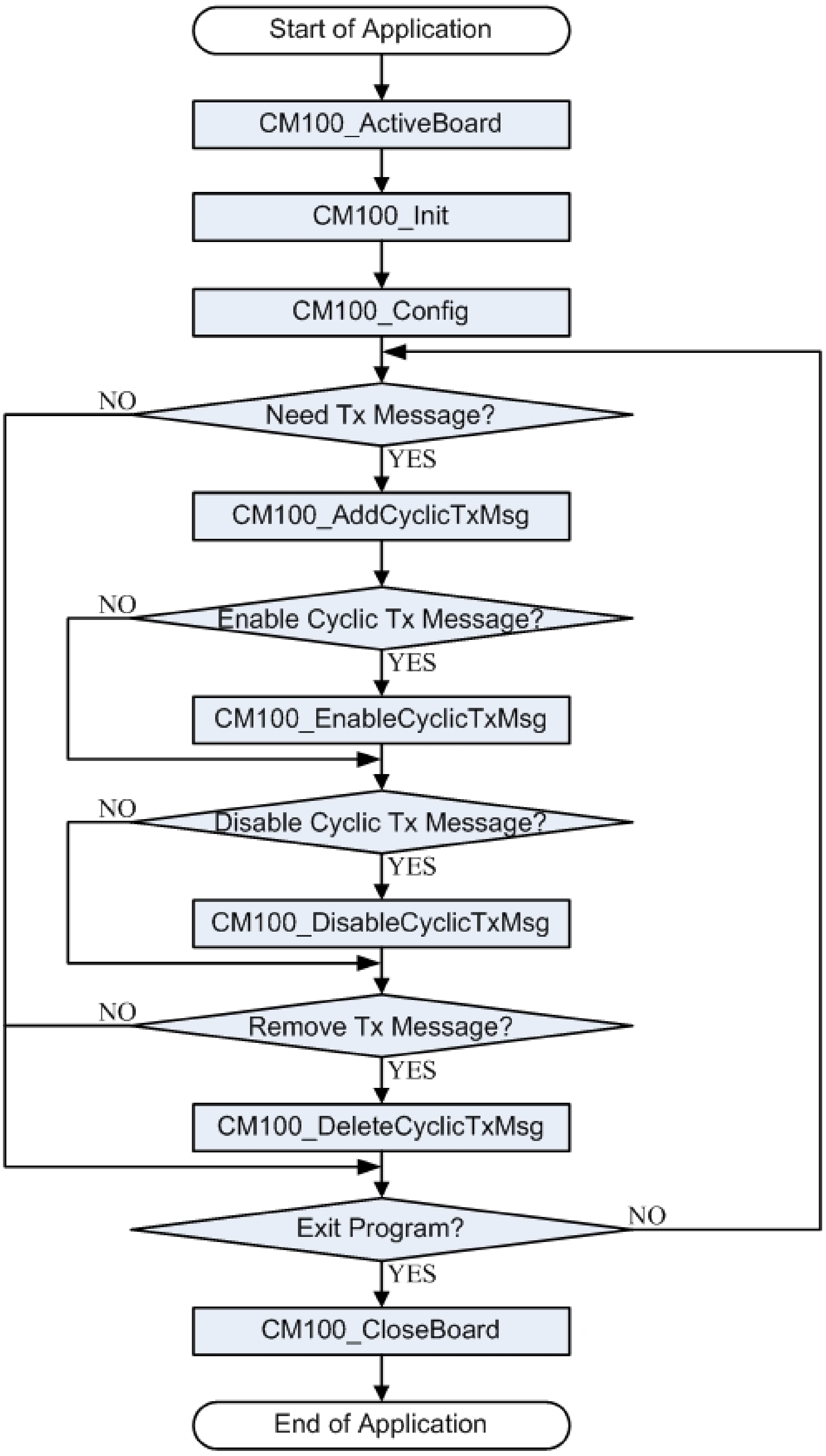


Figure 6.3 Flowchart of Cyclic Transmitting CAN Massages

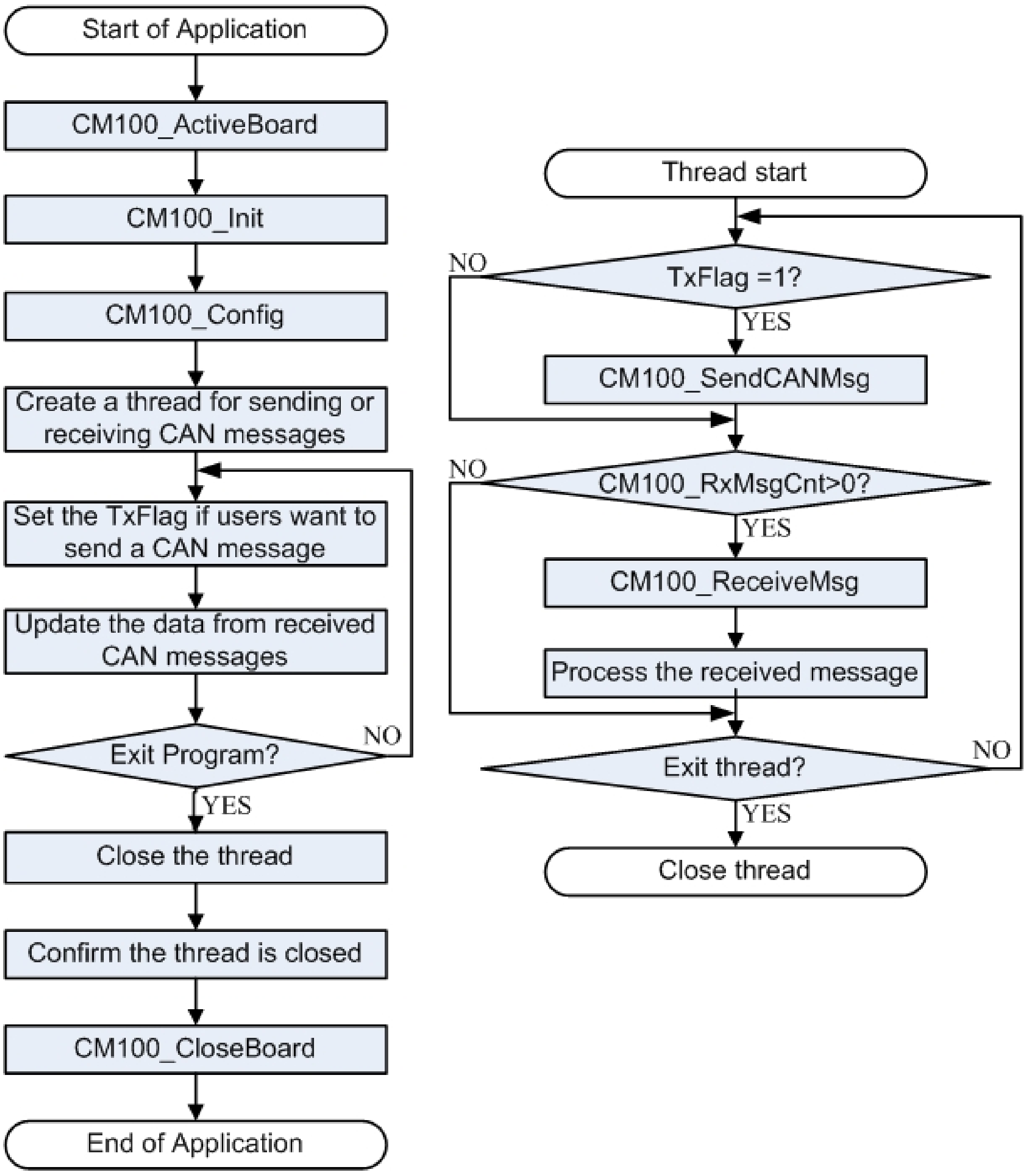


Figure 6.4 Flowchart of sending and receiving CAN Massages

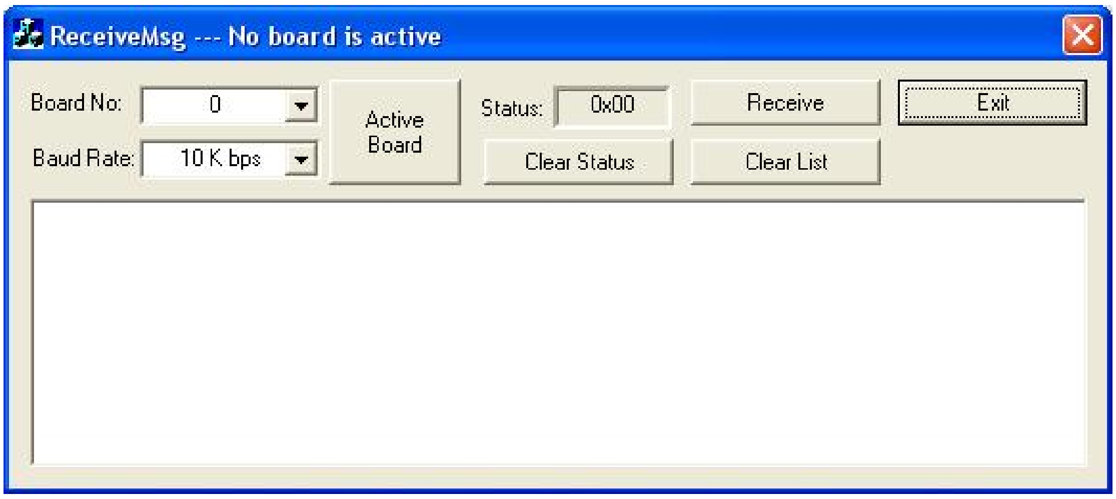
Briefs of the demo programs:

All of demo programs described here need to assist with the default firmware of the PISO-CM100U/PCM-CM100. Each demo can’t work normally if the DLL driver would not be installed correctly. During the installation process of the DLL driver, the installation program also copy the demo programs to the proper position which is based on the path selected before. After installing the driver installation, the related demo programs, development library and declaration header files for different development environments are presented as follows.

```
|--\Demos                         → PISO-CM100U/PCM-CM100 demo
   |--\For_Default_Firmware       programs
      |--\BCB                     → For default firmware
         |--\Library              → For Borland C++ Builder 3
         |--\ReceiveMsg           → Folder for library
         |--\TransmitMsg          → Demo for getting CAN messages
         |--\TransmitMsgCyclically → Demo for sending CAN messages
      |--\VC++                    → Demo for sending CAN messages cyclically
         |--\Library              → for Visual C++ 6.0
         |--\ReceiveMsg           → Folder for library
         |--\TransmitMsg          → Demo for getting CAN messages
         |--\TransmitMsgCyclically → Demo for sending CAN messages
      |--\VB                      → Demo for sending CAN messages cyclically
         |--\Module               → For Visual Basic 6.0
         |--\ReceiveMsg           → Folder for library
         |--\TransmitMsg          → Demo for getting CAN messages
         |--\TransmitMsgCyclically → Demo for sending CAN messages
      |--\Default_Firmware        → Demo for sending CAN messages cyclically
                                  → Default firmware copy
```

ReceiveMsg:

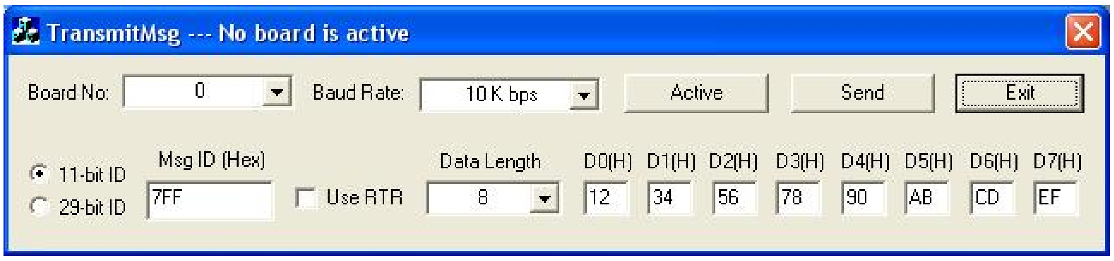
The ReceiveMsg demo is a sample example for demonstrating about how to receive CAN messages from CAN network by using the APIs of the CM100.dll with the default firmware. The dialog of this demo is shown in the follow figure.



Select the CAN baud and board No. of the specified PISO-CM100U/PCM-CM100. Click the “Active Board” button to start this demo. Afterwards, the title of the dialog will display the name of the activated board. The SJA1000 status shown in the status filed will be updated every 500ms. Click the “Clear Status” button when the buffer of the SJA1000 is overflow. If there is any CAN message received by the PISO-CM100U/PCM-CM100, users need to click “Receive” button to get these CAN messages from the reception software buffer. Of cause, users can put this part of the demo codes into the timer function or thread. The action of the receiving messages will always be checked by the program instead of the manual operation. If users need to clean the message list in the bottom of this dialog, click the “Clear List” button to do this.

TransmitMsg:

This demo is very useful if users want to send CAN messages. The dialog of the TransmitMsg demo is shown in the following figure.


TransmitMsg --- No board is active

Board No: 0 Baud Rate: 10 K bps

11-bit ID (selected) / 29-bit ID

Msg ID (Hex): 7FF

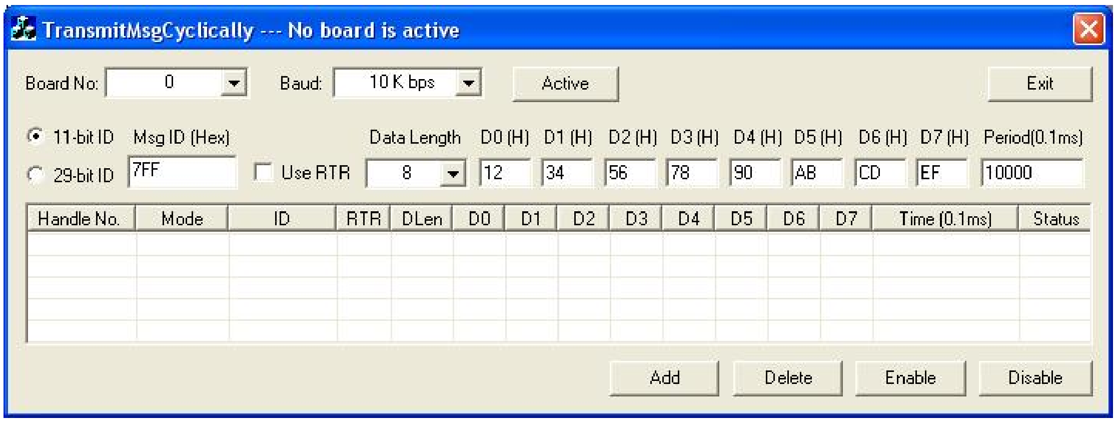
Use RTR: unchecked

Data Length: 8

D0(H)	D1(H)	D2(H)	D3(H)	D4(H)	D5(H)	D6(H)	D7(H)
12	34	56	78	90	AB	CD	EF

As the description above, select the CAN baud and board No. of the specified PISO-CM100U/PCM-CM100 firstly. Then, click the “Active Board” button to start this demo. The title of the dialog will display the name of the activated board. After filling all parameters of a CAN message, users can click the “Send” button to send it out.

TransmitMsgCyclically:

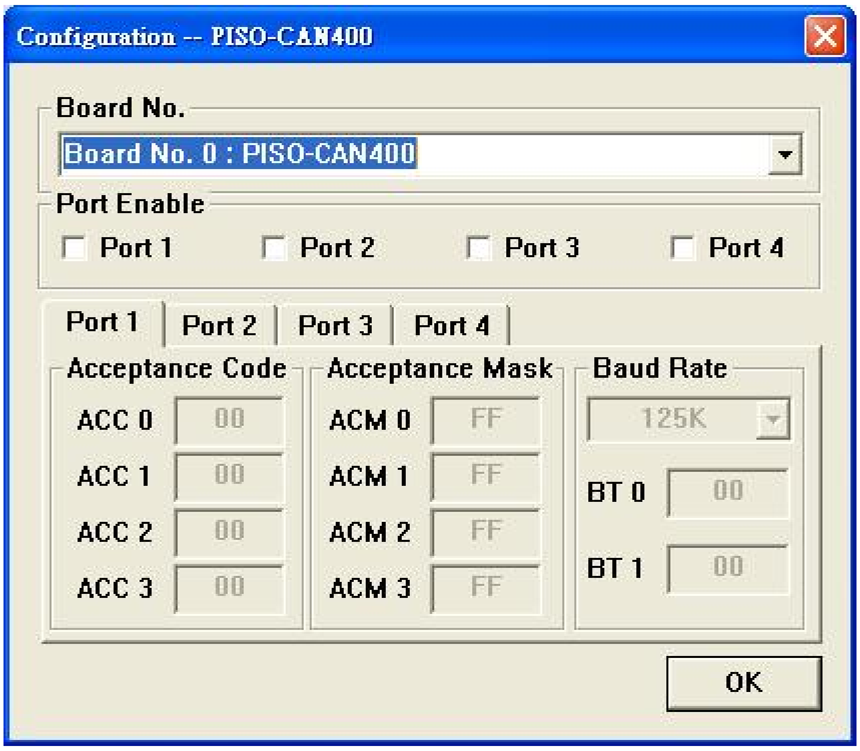


Board No: 0; Baud: 10 K bps; 11-bit ID selected; Msg ID (Hex): 7FF; Use RTR unchecked; Data Length: 8; D0 (H): 12; D1 (H): 34; D2 (H): 56; D3 (H): 78; D4 (H): 90; D5 (H): AB; D6 (H): CD; D7 (H): EF; Period(0.1ms): 10000

The dialog is shown as above figure. Firstly, select board No., baud and click the “Active” button to activate the specified PISO-CM100U/PCM-CM100. Secondly, configure all parameters of the cyclic CAN message. Be careful that the parameter Period is the unit of 0.1ms. The value of this parameter must be more than 5. Click the “Add” button to add this message into the cyclic transmission engine. This message will also be shown in the message list in the bottom of the dialog. Afterwards, users can select a cyclic message listed in the message list, and click “Enable” button to start the message transmission. If users want to stop it, select it from the message list, and click the “Disable” button. The action of deleting a cyclic message from cyclic transmission engine is similar with the action of disable a cyclic transmission. Just select the cyclic message from the message list, and click the “Delete” button.

6.2 Introduction of CANUtility Tool

The CANUtility is designed for the CAN boards of the ICP DAS. It provides useful functions when users want to debug users' CAN application, monitor CAN devices and access a CAN network. Users can find it in the folder of PISO-CM100U where you installed the driver before. The default path is "c:\ICPDAS\PISO-CM100U\". When you execute the CANUtility.exe, the Configuration dialog is popped up below. All CAN board searched by the CANUtility.exe will be listed in the Board No. filed. If users do not want to do the configuration, click the button " ❌ " to skip this procedure. Here, select PISO-CM100 for the demonstration.

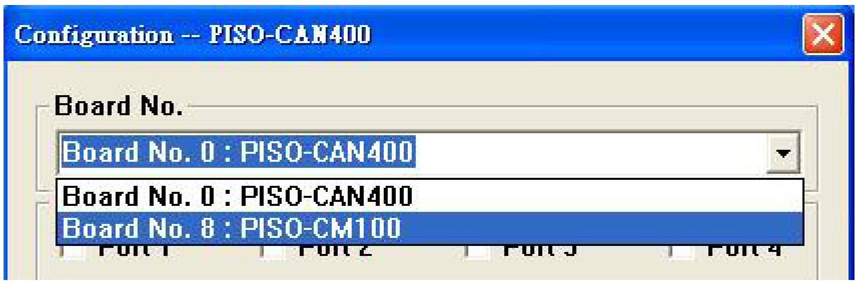

Configuration -- PISO-CAN400

Board No.: Board No. 0 : PISO-CAN400

Port Enable: Port 1, Port 2, Port 3, Port 4

Port 1 | Port 2 | Port 3 | Port 4

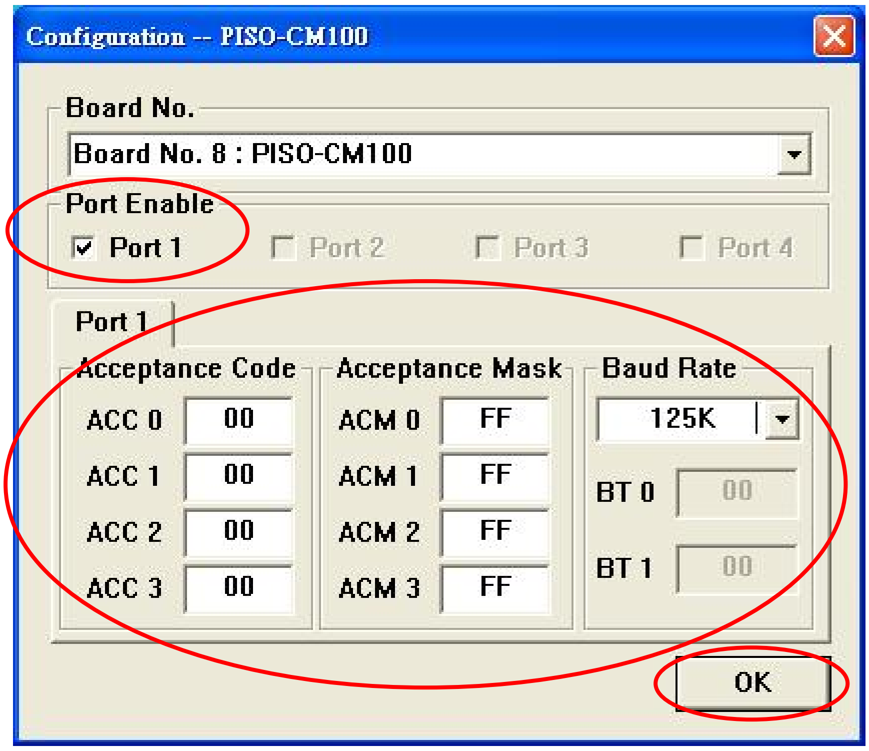
Acceptance Code		Acceptance Mask		Baud Rate	
ACC 0	00	ACM 0	FF	125K	
ACC 1	00	ACM 1	FF	BT 0	00
ACC 2	00	ACM 2	FF	BT 1	00
ACC 3	00	ACM 3	FF		


Configuration -- PISO-CAN400

Board No.: Board No. 0 : PISO-CAN400

Board No. 0 : PISO-CAN400
Board No. 8 : PISO-CM100

Because the PISO-CM100 has only one CAN port, the Port2, Port3 and Port4 are disabled. Check the checkbox Port1 to enable it. Afterwards, you can modify the parameters of the acceptance code, acceptance mask and baud. The description of the function CM100_Config in chapter 4 can give a good reference about how to set the acceptance code and acceptance mask.


Configuration -- PISO-CM100

Board No.: Board No. 8 : PISO-CM100

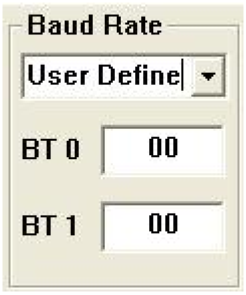
Port Enable: [✓ Port 1] Port 2 Port 3 Port 4

Port 1

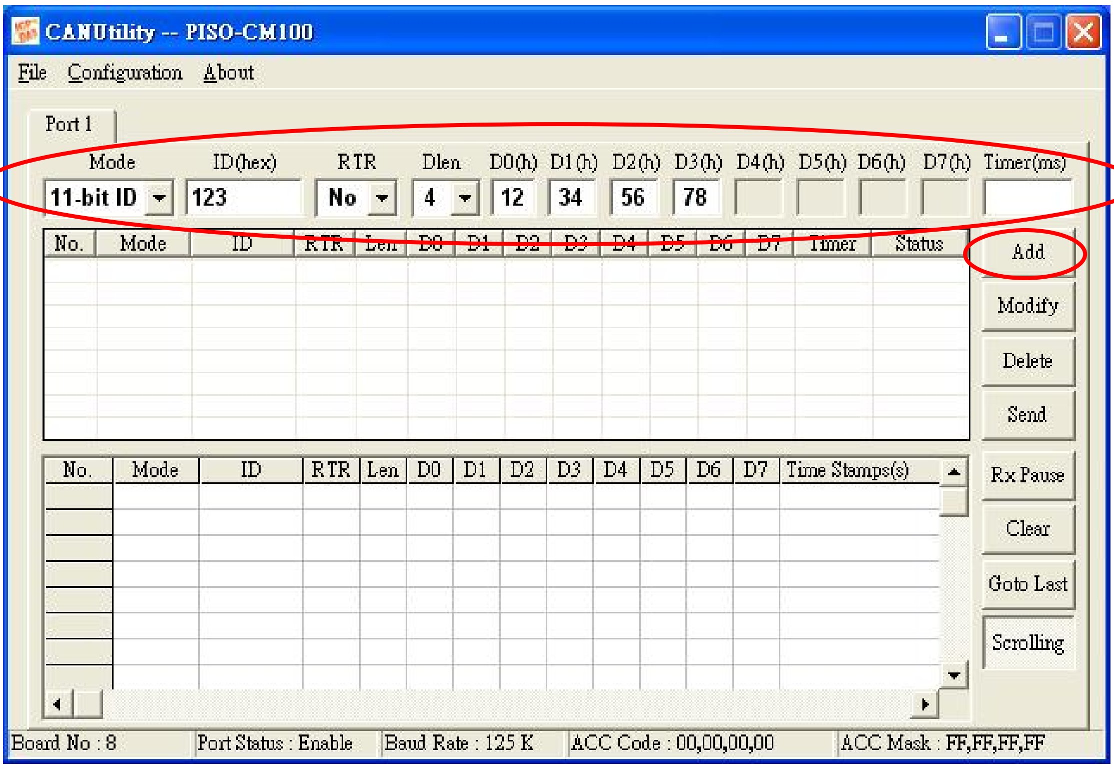
Acceptance Code		Acceptance Mask	
ACC 0	00	ACM 0	FF
ACC 1	00	ACM 1	FF
ACC 2	00	ACM 2	FF
ACC 3	00	ACM 3	FF

Baud Rate: 125K
BT 0: 00
BT 1: 00

If the proper baud can't be found in the Baud list, select the "User Define" to define special baud by using the BT0 and BT1 of the SJA1000. In this case, users need to study the datasheet of the SJA1000 to know how to use the registers BT0 and BT1 to configure the baud.


Baud Rate: User Define
BT 0: 00
BT 1: 00

After finishing the configuration and clicking the button “OK”, the main screen of the CANUtility is displayed. The title of the CANUtility shows the activated board name. The status of this board is shown on the status bar in the bottom of the window.



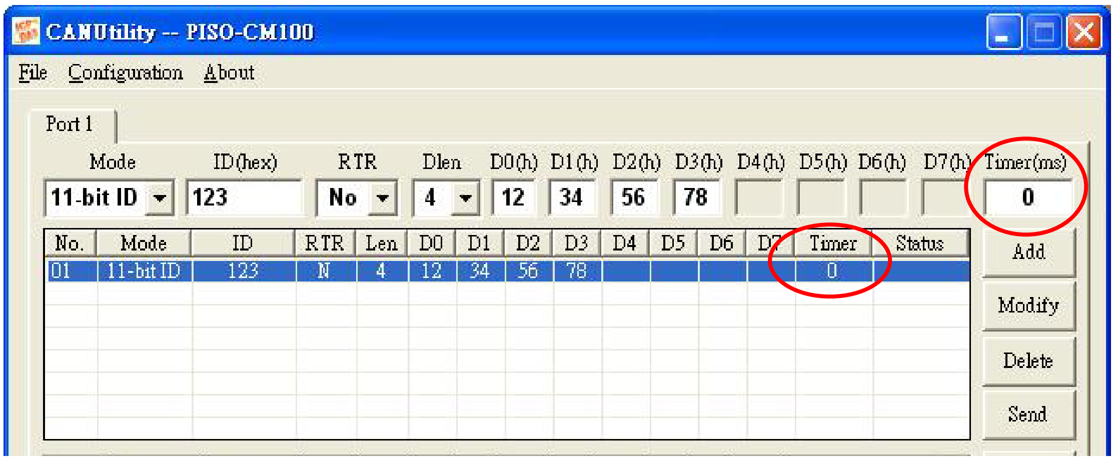
Mode	ID(hex)	RTR	Dlen	D0(h)	D1(h)	D2(h)	D3(h)	D4(h)	D5(h)	D6(h)	D7(h)	Timer(ms)
11-bit ID	123	No	4	12	34	56	78					

No.	Mode	ID	RTR	Len	D0	D1	D2	D3	D4	D5	D6	D7	Timer	Status

No.	Mode	ID	RTR	Len	D0	D1	D2	D3	D4	D5	D6	D7	Time Stamps(s)

Board No : 8 Port Status : Enable Baud Rate : 125 K ACC Code : 00,00,00,00 ACC Mask : FF,FF,FF,FF

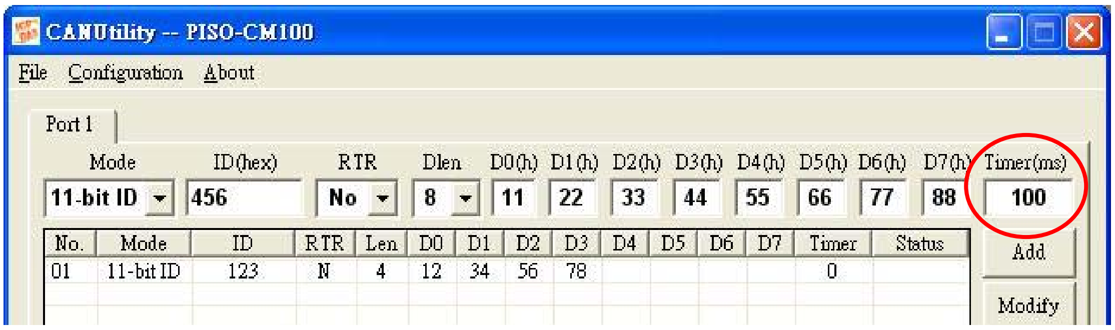
Users can set the parameters of a transmitted CAN message, and click Add button to put it into the list. If users just need to send one CAN message, please let the Timer filed to be 0 or empty.



Mode	ID(hex)	RTR	Dlen	D0(h)	D1(h)	D2(h)	D3(h)	D4(h)	D5(h)	D6(h)	D7(h)	Timer(ms)
11-bit ID	123	No	4	12	34	56	78					0

No.	Mode	ID	RTR	Len	D0	D1	D2	D3	D4	D5	D6	D7	Timer	Status
01	11-bit ID	123	N	4	12	34	56	78					0	

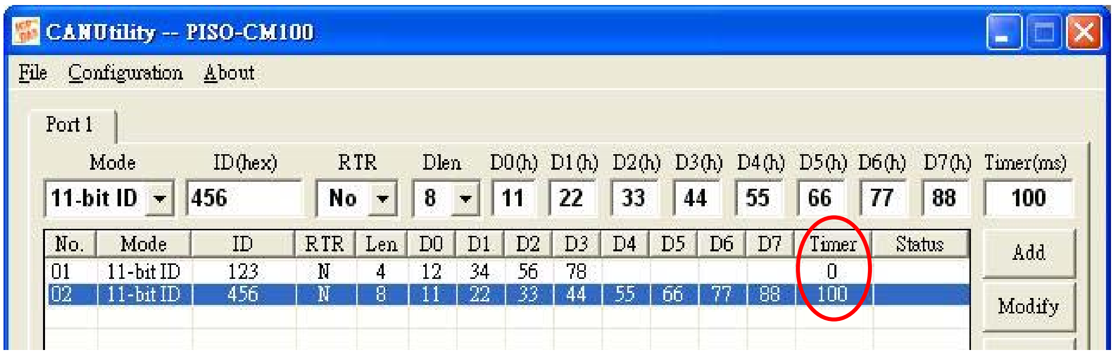
If the cyclic transmission messages are demanded, users can configure the message parameters with the timer filed.



Mode	ID(hex)	RTR	Dlen	D0(h)	D1(h)	D2(h)	D3(h)	D4(h)	D5(h)	D6(h)	D7(h)	Timer(ms)
11-bit ID	456	No	8	11	22	33	44	55	66	77	88	100

No.	Mode	ID	RTR	Len	D0	D1	D2	D3	D4	D5	D6	D7	Timer	Status
01	11-bit ID	123	N	4	12	34	56	78					0	

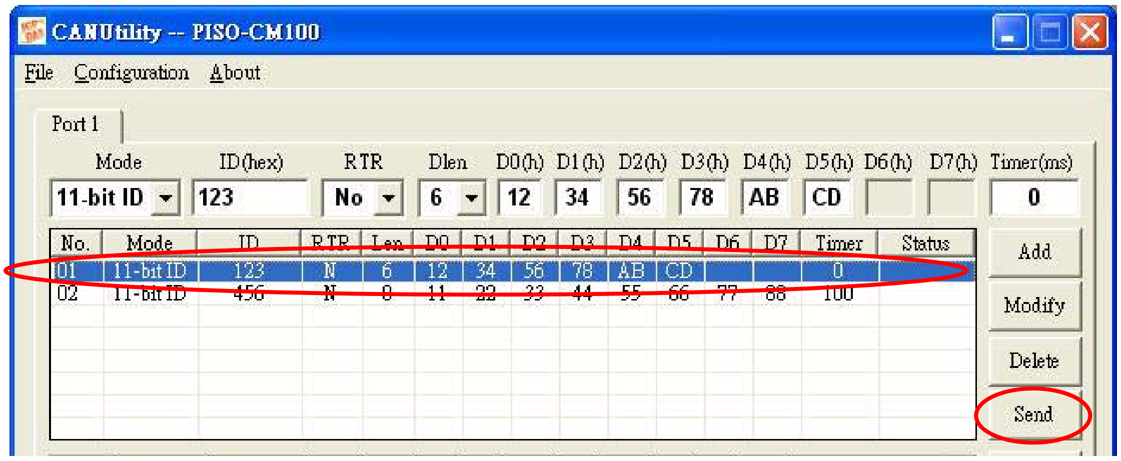
After finishing the configuration, click the button “Add” to add the cyclic transmission message into the list.



Mode	ID(hex)	RTR	Dlen	D0(h)	D1(h)	D2(h)	D3(h)	D4(h)	D5(h)	D6(h)	D7(h)	Timer(ms)
11-bit ID	456	No	8	11	22	33	44	55	66	77	88	100

No.	Mode	ID	RTR	Len	D0	D1	D2	D3	D4	D5	D6	D7	Timer	Status
01	11-bit ID	123	N	4	12	34	56	78					0	
02	11-bit ID	456	N	8	11	22	33	44	55	66	77	88	100	

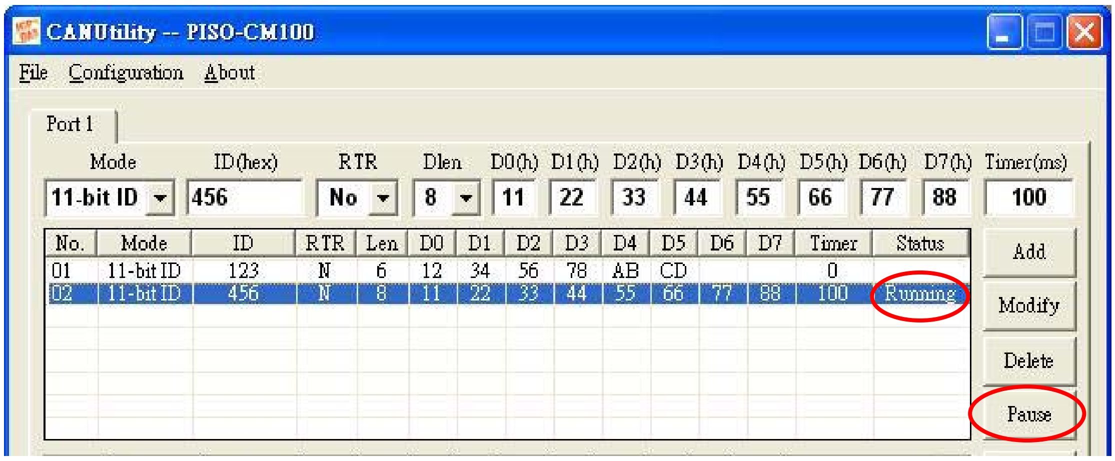
When the CAN messages are added into the list, the PISO-CM100 will not send them to the CAN network until users click the button “Send”. Therefore, select the CAN messages which you want to send from the list, and click the button “Send” to send it.



Mode	ID(hex)	RTR	Dlen	D0(h)	D1(h)	D2(h)	D3(h)	D4(h)	D5(h)	D6(h)	D7(h)	Timer(ms)
11-bit ID	123	No	6	12	34	56	78	AB	CD			0

No.	Mode	ID	RTR	Len	D0	D1	D2	D3	D4	D5	D6	D7	Timer	Status
01	11-bit ID	123	N	6	12	34	56	78	AB	CD			0	
02	11-bit ID	456	N	8	11	22	33	44	55	66	77	88	100	

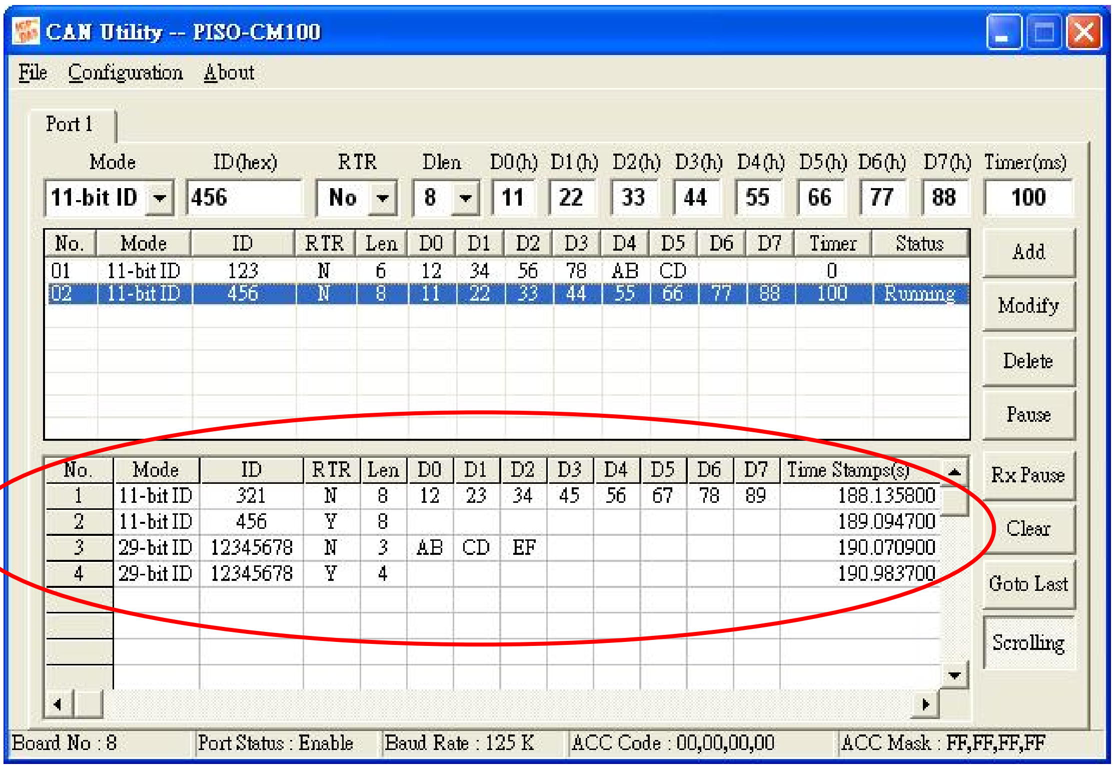
Similarly, select the cyclic transmission messages from the list, and click button “Send” to send the cyclic transmission. Afterwards, the status of the sent cyclic transmission message is changed to “Running”, and the button “Send” is also changed to the button “Pause”. If users want to stop the transmission, select the sent cyclic transmission message from the list, and click the button “Pause” to stop it.



Mode	ID(hex)	RTR	Dlen	D0(h)	D1(h)	D2(h)	D3(h)	D4(h)	D5(h)	D6(h)	D7(h)	Timer(ms)
11-bit ID	456	No	8	11	22	33	44	55	66	77	88	100

No.	Mode	ID	RTR	Len	D0	D1	D2	D3	D4	D5	D6	D7	Timer	Status
01	11-bit ID	123	N	6	12	34	56	78	AB	CD			0	
02	11-bit ID	456	N	8	11	22	33	44	55	66	77	88	100	Running

If any CAN message is obtained by the CANUtility, it will be put into the reception list in the bottom of the window. The filed “Time Stamps” shows the time when a message is got. The time base is the boot up time of the CPU of the PISO-CM100U (Take a note that the board which has no CPU uses the system time to be the time stamp while the kernel driver gets this message.



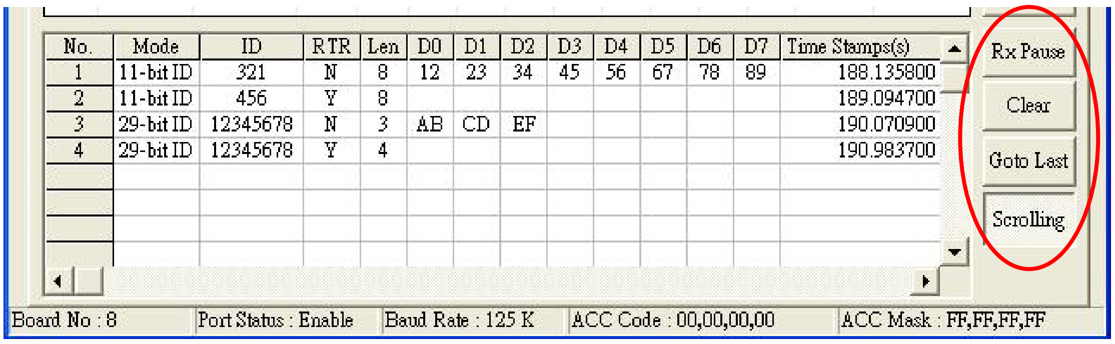
Mode	ID(hex)	RTR	Dlen	D0(h)	D1(h)	D2(h)	D3(h)	D4(h)	D5(h)	D6(h)	D7(h)	Timer(ms)
11-bit ID	456	No	8	11	22	33	44	55	66	77	88	100

No.	Mode	ID	RTR	Len	D0	D1	D2	D3	D4	D5	D6	D7	Timer	Status
01	11-bit ID	123	N	6	12	34	56	78	AB	CD			0	
02	11-bit ID	456	N	8	11	22	33	44	55	66	77	88	100	Running

No.	Mode	ID	RTR	Len	D0	D1	D2	D3	D4	D5	D6	D7	Time Stamps(s)
1	11-bit ID	321	N	8	12	23	34	45	56	67	78	89	188.135800
2	11-bit ID	456	Y	8									189.094700
3	29-bit ID	12345678	N	3	AB	CD	EF						190.070900
4	29-bit ID	12345678	Y	4									190.983700

Board No : 8 | Port Status : Enable | Baud Rate : 125 K | ACC Code : 00,00,00,00 | ACC Mask : FF,FF,FF,FF

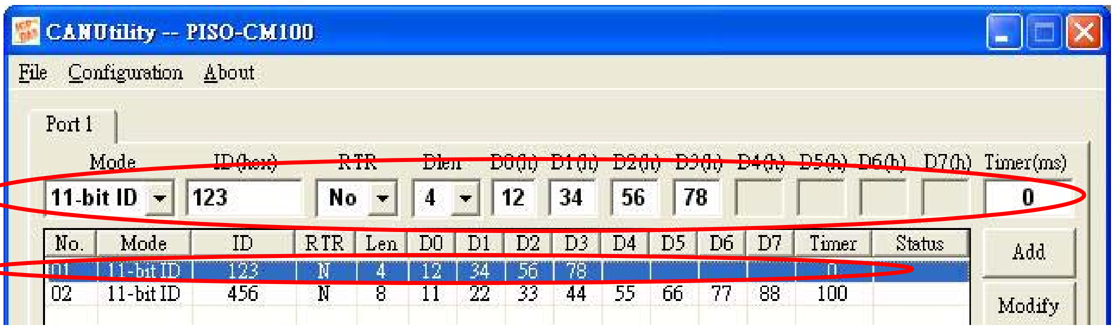
Users can click the button “Rx Pause” to pause the reception of the CAN messages. Or click this button again to continue the reception. Click the button “Clear” to empty the reception list. The button “Goto Last” is used to move the scroll bar of the reception list to the last record of the received CAN message. If the button “Scrolling” is activated as the following figure, the reception list will be scrolled automatically when any CAN message is received. If the button “Scrolling” is inactivated, the auto-scrolling stops, but the received CAN messages are still put into the reception list.



No.	Mode	ID	RTR	Len	D0	D1	D2	D3	D4	D5	D6	D7	Time Stamps(s)
1	11-bit ID	321	N	8	12	23	34	45	56	67	78	89	188.135800
2	11-bit ID	456	Y	8									189.094700
3	29-bit ID	12345678	N	3	AB	CD	EF						190.070900
4	29-bit ID	12345678	Y	4									190.983700

Board No : 8   Port Status : Enable   Baud Rate : 125 K   ACC Code : 00,00,00,00   ACC Mask : FF,FF,FF,FF

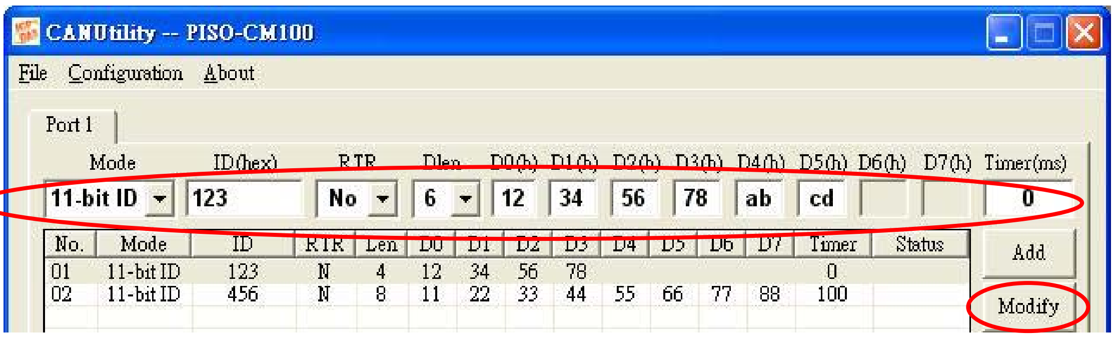
If users want to modify the parameters of the CAN message added before, select the specified CAN message from the list. Then the configuration fileds will be filled with the parameters of the specified CAN message.



Mode	ID(hex)	RTR	Dlen	D0(h)	D1(h)	D2(h)	D3(h)	D4(h)	D5(h)	D6(h)	D7(h)	Timer(ms)
11-bit ID	123	No	4	12	34	56	78					0

No.	Mode	ID	RTR	Len	D0	D1	D2	D3	D4	D5	D6	D7	Timer	Status
01	11-bit ID	123	N	4	12	34	56	78					0	
02	11-bit ID	456	N	8	11	22	33	44	55	66	77	88	100	

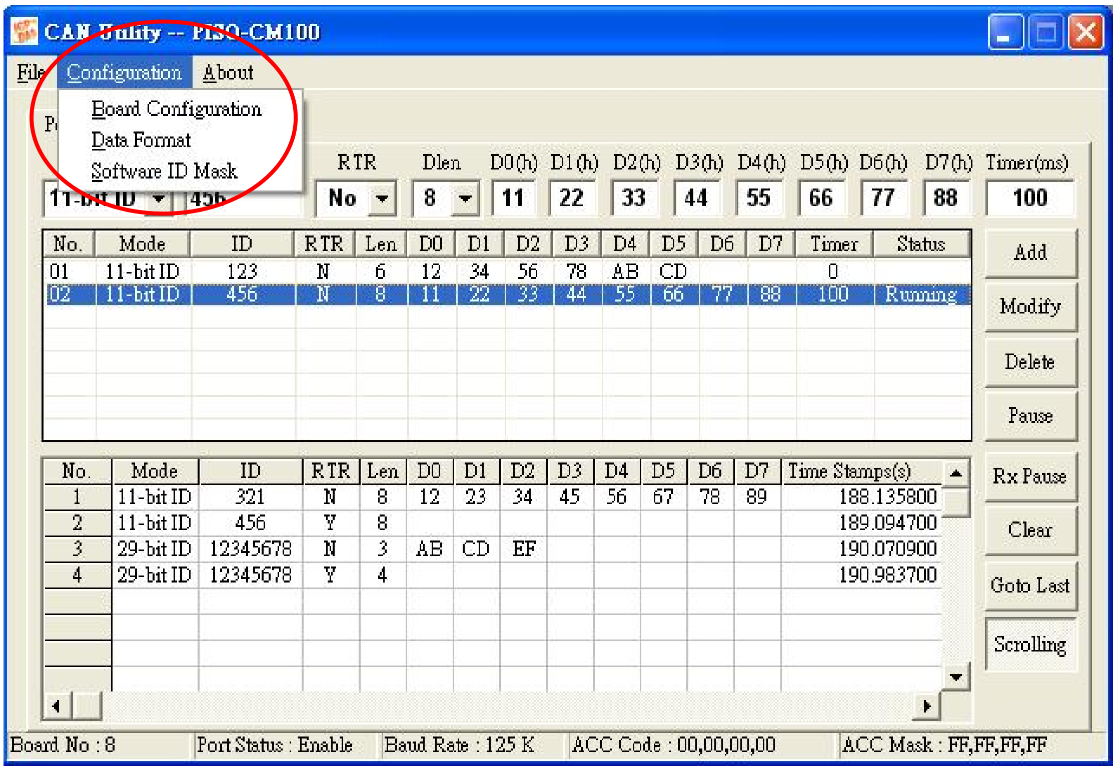
Users can modify the parameters in these configuration fields. Then, click the button “Modify” to modify it.



Mode	ID(hex)	RTR	Dlen	D0(h)	D1(h)	D2(h)	D3(h)	D4(h)	D5(h)	D6(h)	D7(h)	Timer(ms)
11-bit ID	123	No	6	12	34	56	78	ab	cd			0

No.	Mode	ID	RTR	Len	D0	D1	D2	D3	D4	D5	D6	D7	Timer	Status
01	11-bit ID	123	N	4	12	34	56	78					0	
02	11-bit ID	456	N	8	11	22	33	44	55	66	77	88	100	

The CAN utility also provides the special functions when reading the CAN data. For example, some CAN messages with specified message ID need to be notified, or some bytes of the data filed of a CAN message need to be transferred to the ASCII characters. These demands can be achieved by using the functions of the Configuration item of the menu. The Board Configuration function let users modify the configuration of the specified board. It is the same as the dialog popped up when the CANUtility.exe is starting. The Data Format function provides a human interface to set the data format for each byte of the data filed of a specified CAN message. The Software ID Mask function is similar with the functions of the acceptance code and acceptance mask of Configuration dialog popped up in the start of the CANUtility.exe. The former uses software method to filter the useless CAN messages, the latter uses hardware method to do this. The feature of the Software ID Mask is that it allows users to filter any CAN messages which you wouldn't need by select the "Un Pass" and the interesting messages by select the "To Pass". It is more flexible than setting the acceptance code and acceptance mask. But its performance is not good enough as the hardware message filter.



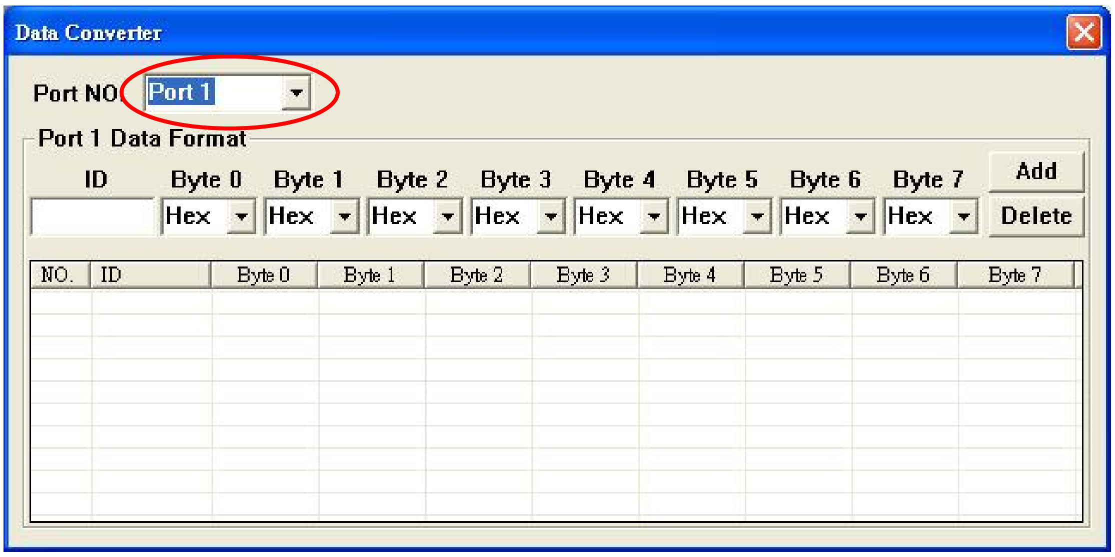
	ID	RTR	Dlen	D0(h)	D1(h)	D2(h)	D3(h)	D4(h)	D5(h)	D6(h)	D7(h)	Timer(ms)
11-bit ID	456	No	8	11	22	33	44	55	66	77	88	100

No.	Mode	ID	RTR	Len	D0	D1	D2	D3	D4	D5	D6	D7	Timer	Status
01	11-bit ID	123	N	6	12	34	56	78	AB	CD			0	
02	11-bit ID	456	N	8	11	22	33	44	55	66	77	88	100	Running

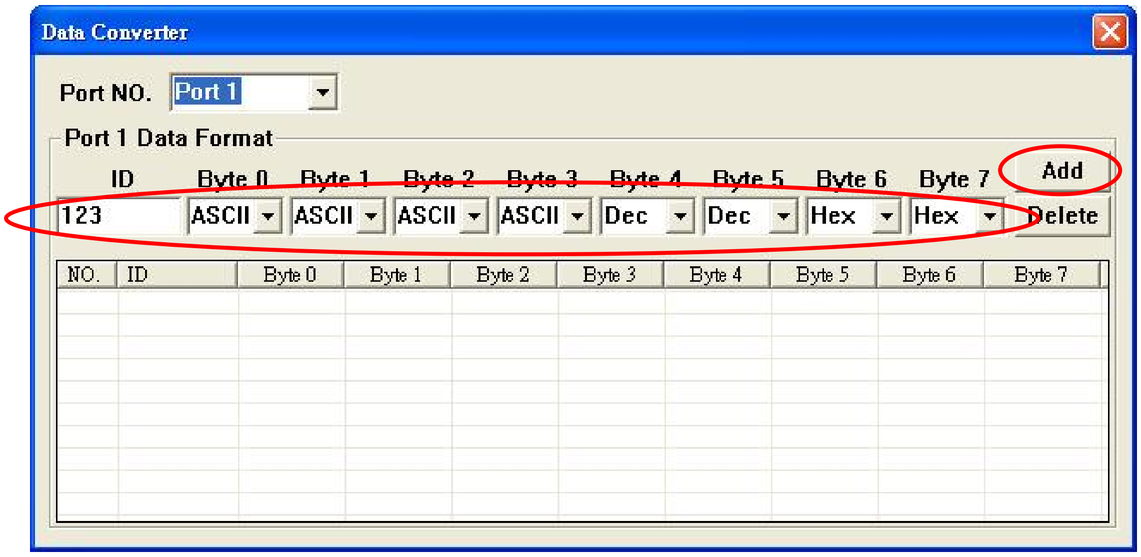
No.	Mode	ID	RTR	Len	D0	D1	D2	D3	D4	D5	D6	D7	Time Stamps(s)
1	11-bit ID	321	N	8	12	23	34	45	56	67	78	89	188.135800
2	11-bit ID	456	Y	8									189.094700
3	29-bit ID	12345678	N	3	AB	CD	EF						190.070900
4	29-bit ID	12345678	Y	4									190.983700

Board No : 8 | Port Status : Enable | Baud Rate : 125 K | ACC Code : 00,00,00,00 | ACC Mask : FF,FF,FF,FF

After clicking the item of the Data Format, the Data Converter dialog is popped up. Users can select the port No. to set the port which will transfer the received messages to the specified data format.

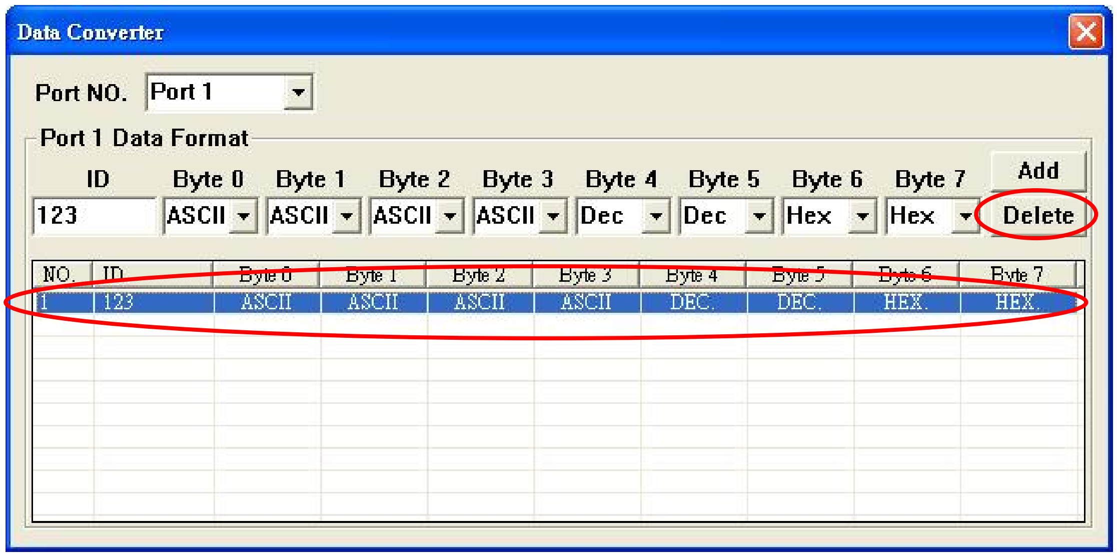


When finishing the settings of the data format for the specified message ID, click Add button to save the configuration. Here provides three kinds of data format, Hex., Dec. and ASCII. The default setting for received CAN messages is hexadecimal format.



ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
123	ASCII	ASCII	ASCII	ASCII	Dec	Dec	Hex	Hex

If users want to cancel the configuration which is set before, select the record from the list firstly, then click “Delete” button to remove it.


Data Converter

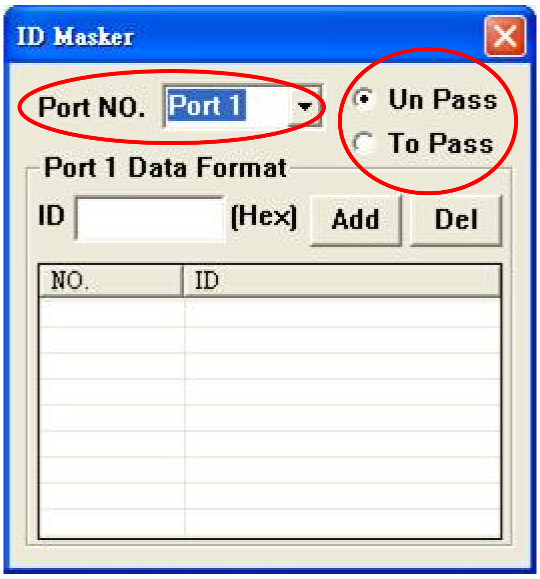
Port NO. Port 1

Port 1 Data Format

ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
123	ASCII	ASCII	ASCII	ASCII	Dec	Dec	Hex	Hex

NO.	ID	Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7
1	123	ASCII	ASCII	ASCII	ASCII	DEC.	DEC.	HEX.	HEX.

The “Software ID Mask” function is executed in the “ID Masker” dialog. Select the port No. and the “Pass” type firstly. Fill the message IDs of the CAN messages which you want to drop. Finally, click “Add” button to store the result.

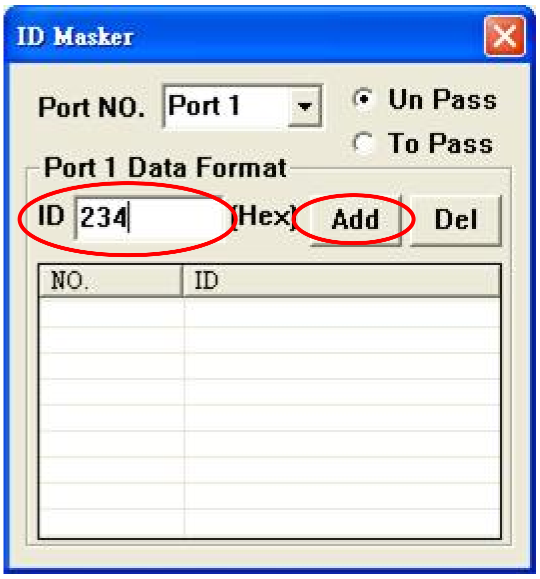

ID Masker

Port NO. Port 1

[✓ Un Pass] To Pass

Port 1 Data Format

ID (Hex)


ID Masker

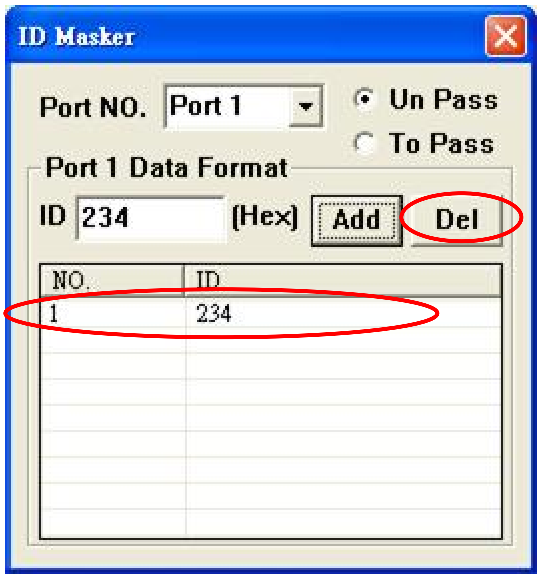
Port NO. Port 1

[✓ Un Pass] To Pass

Port 1 Data Format

ID 234 (Hex)

Select the record from the list and click Del button to remove the record added before. The maximum content of the list is 20 records.



Port NO. Port 1

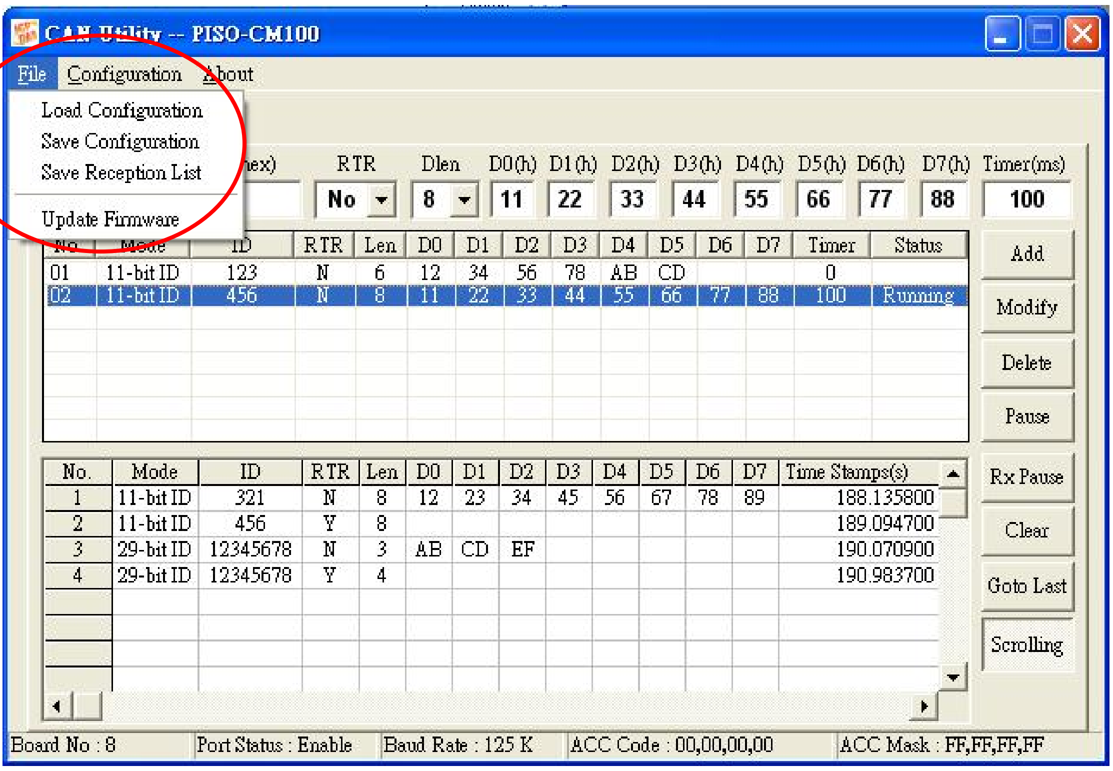
[✓ Un Pass] To Pass

Port 1 Data Format

ID 234 (Hex)

NO.	ID
1	234

Besides the functions described above, the CANUtility allows users to save and load the configuration parameters by applying the Load Configuration or Save Configuration of the “File” item in the menu. The Save Reception List function helps users to store the records of the received CAN messages into .txt file. The Update Firmware function let users update the default firmware or download the user-defined firmware. This function is only for PISO-CM100U/PCM-CM100 series cards.



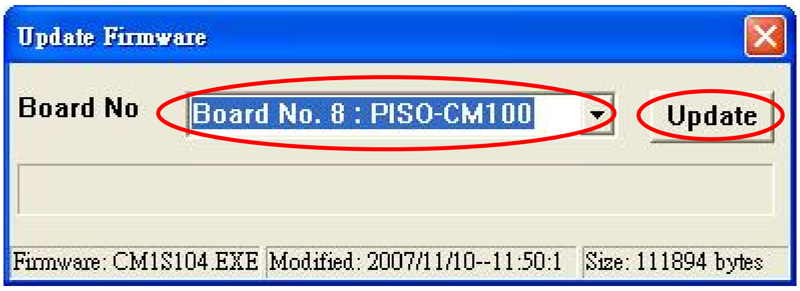
RTR	Dlen	D0(h)	D1(h)	D2(h)	D3(h)	D4(h)	D5(h)	D6(h)	D7(h)	Timer(ms)
No	8	11	22	33	44	55	66	77	88	100

No	Mode	ID	RTR	Len	D0	D1	D2	D3	D4	D5	D6	D7	Timer	Status
01	11-bit ID	123	N	6	12	34	56	78	AB	CD			0	
02	11-bit ID	456	N	8	11	22	33	44	55	66	77	88	100	Running

No.	Mode	ID	RTR	Len	D0	D1	D2	D3	D4	D5	D6	D7	Time Stamps(s)
1	11-bit ID	321	N	8	12	23	34	45	56	67	78	89	188.135800
2	11-bit ID	456	Y	8									189.094700
3	29-bit ID	12345678	N	3	AB	CD	EF						190.070900
4	29-bit ID	12345678	Y	4									190.983700

Board No : 8 | Port Status : Enable | Baud Rate : 125 K | ACC Code : 00,00,00,00 | ACC Mask : FF,FF,FF,FF

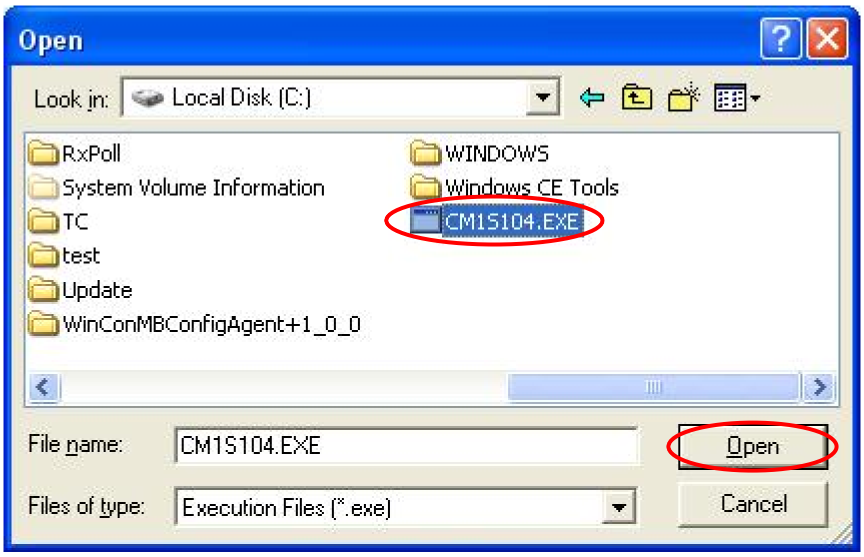
When users apply the Update Firmware function, select the specified board firstly. Only the PISO-CM100U/PCM-CM100, PISO-CPM100U and PISO-DNM100U series are listed in the Combo box. Click the Update button to select the proper firmware for the specified board.



Board No. 8 : PISO-CM100

Firmware: CM1S104.EXE | Modified: 2007/11/10--11:50:1 | Size: 111894 bytes

Only the .exe file can be downloaded into PISO-CM100U/PCM-CM100 series.



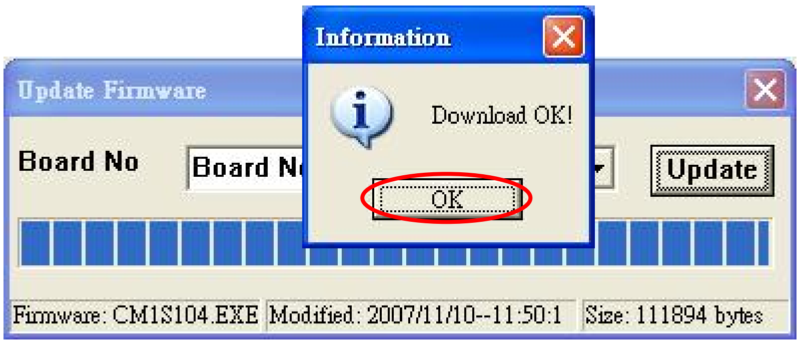
Local Disk (C:)

RxPoll
System Volume Information
TC
test
Update
WinConMBConfigAgent+1_0_0
WINDOWS
Windows CE Tools
CM1S104.EXE

File name: CM1S104.EXE

Files of type: Execution Files (*.exe)

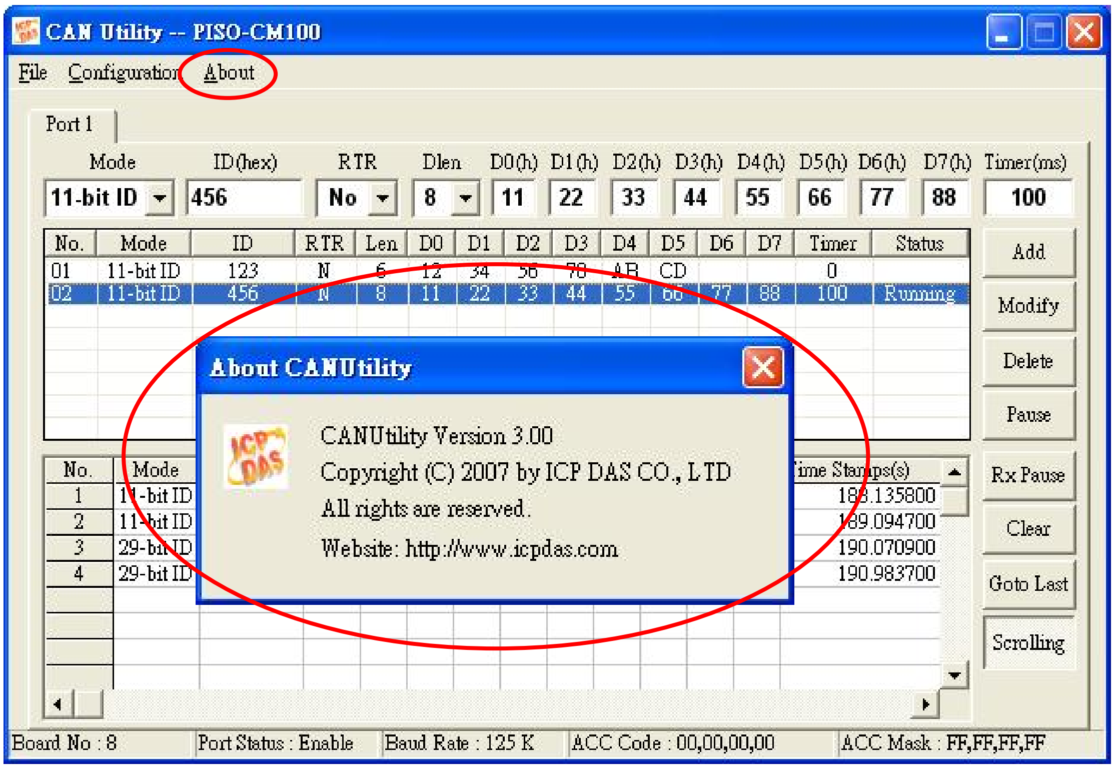
When finishing the download procedure, the Download OK dialog is popped up. Click the OK button to continue.



Download OK!

Firmware: CM1S104.EXE | Modified: 2007/11/10--11:50:1 | Size: 111894 bytes

If you want to check the version of the CAN Utility, please click the "About" item of the menu to get the information. The version No. of the CAN Utility you use may be different with the following picture.



Mode	ID(hex)	RTR	Dlen	D0(h)	D1(h)	D2(h)	D3(h)	D4(h)	D5(h)	D6(h)	D7(h)	Timer(ms)
11-bit ID	456	No	8	11	22	33	44	55	66	77	88	100

No.	Mode	ID	RTR	Len	D0	D1	D2	D3	D4	D5	D6	D7	Timer	Status
01	11-bit ID	123	N	6	12	34	56	78	AB	CD			0	
02	11-bit ID	456	N	8	11	22	33	44	55	66	77	88	100	Running

About CANUtility

CANUtility Version 3.00
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Website: http://www.icpdas.com

No.	Mode	Time Stamps(s)
1	11-bit ID	188.135800
2	11-bit ID	189.094700
3	29-bit ID	190.070900
4	29-bit ID	190.983700

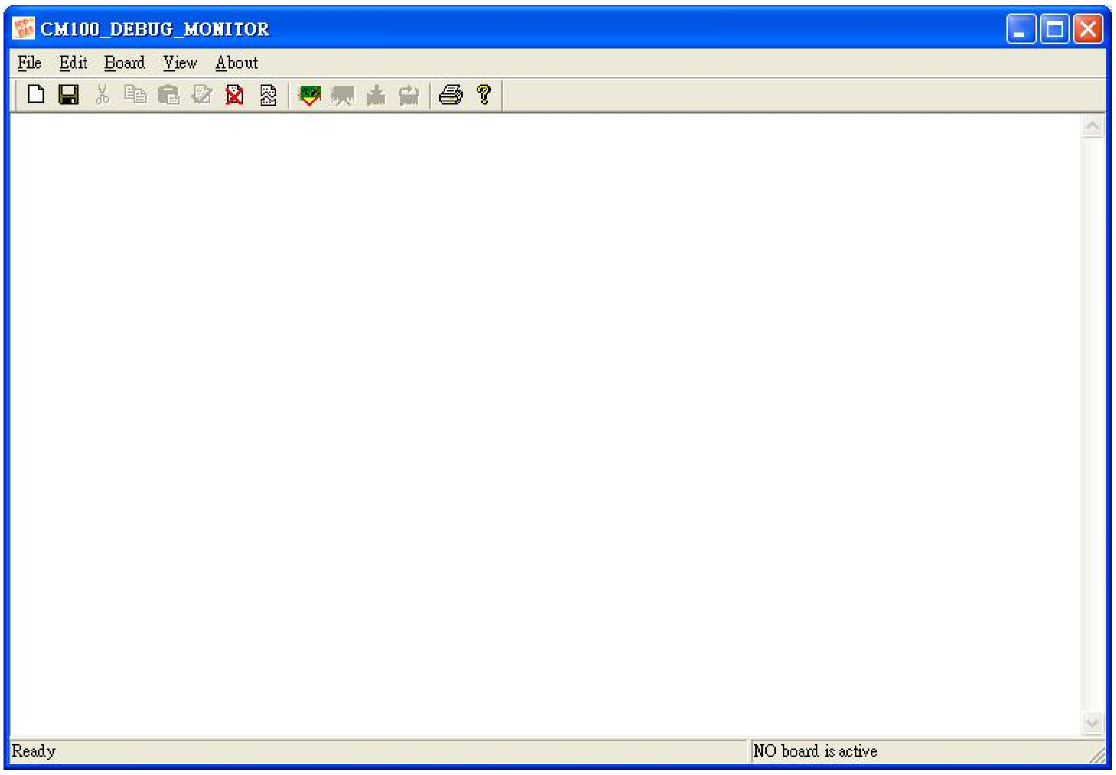
Board No : 8 | Port Status : Enable | Baud Rate : 125 K | ACC Code : 00,00,00,00 | ACC Mask : FF,FF,FF,FF

6.3 *Debug Tools for User-defined Firmware Programming*

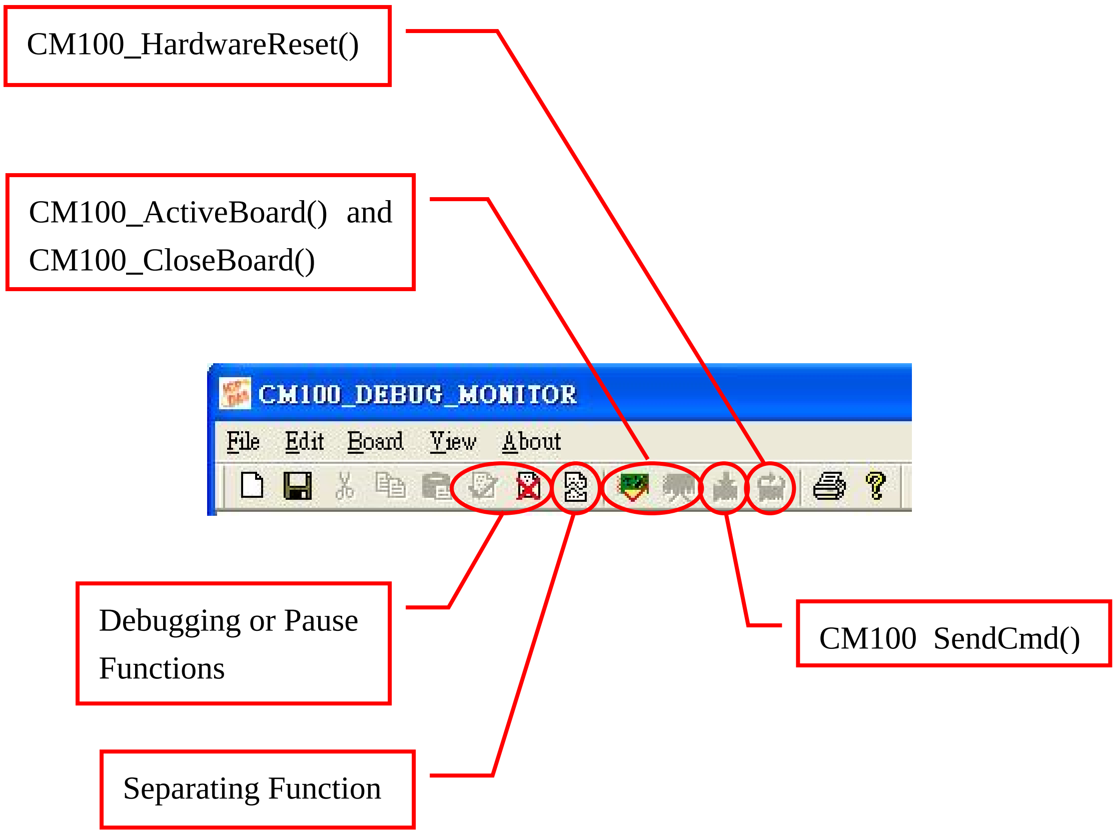
If users just apply the default firmware for their application, this section can be ignored. This section introduces the debug methods when users deign their firmware. Basically, when users develop the user-defined firmware, the debug message can be put into the code section of the user-defined firmware which may have bugs inside. Then, compile the user-defined firmware, and download it into the PISO-CM100U/PCM-CM100. Owing to check the debug message, the bugs could be found. The debug methods are shown below.

CM100_DEBUG_MONITOR.exe:

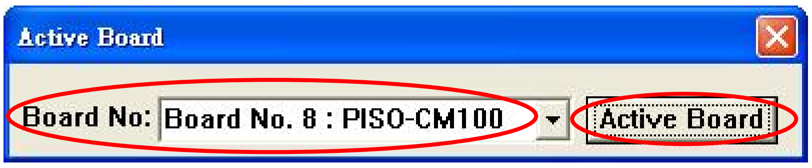
If the functions DebugPrint() is applied in the user-defined firmware. Users need to check the debug message by using the CM100_Debug_Monitor.exe. It is displayed as following figure. Users can find it in the Fieldbus CD. The path is CAN\PCI\PISO-CM100\.



Because of the software architecture of the PISO-CM100U/PCM-CM100, the CM100_Debug_Monitor.exe is useful only if the PISO-CM100U/ PCM-CM100 is activated. Therefore, this debug program provides the CM100_ActiveBoard() function and CM100_CloseBoard() function. If users want to send the commands to user-defined firmware or restart the user-defined firmware, they are also provided by CM100_SendCmd() and CM100_HardwareReset() functions in the CM100_DEBUG_MONITOR.exe These functions are built in the tool bar as below.

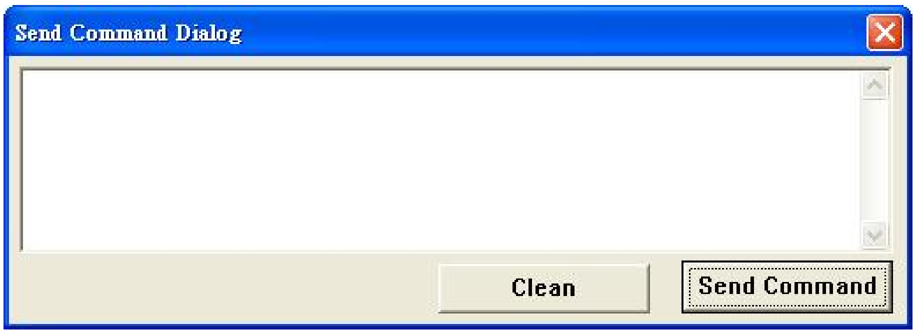

CM100_HardwareReset()
CM100_ActiveBoard() and CM100_CloseBoard()
CM100_DEBUG_MONITOR
File Edit Board View About
Debugging or Pause Functions
CM100_SendCmd()
Separating Function

If any other program has activated the specified PISO-CM100U/PCM-CM100, the functions CM100_ActiveBoard() and CM100_CloseBoard() of the CM100_DEBUG_MONITOR.exe are not needed because one PISO-CM100U/PCM-CM100 can be activated by only one program at the same time. After clicking the CM100_ActiveBoard() function, the dialog is popped up as below.

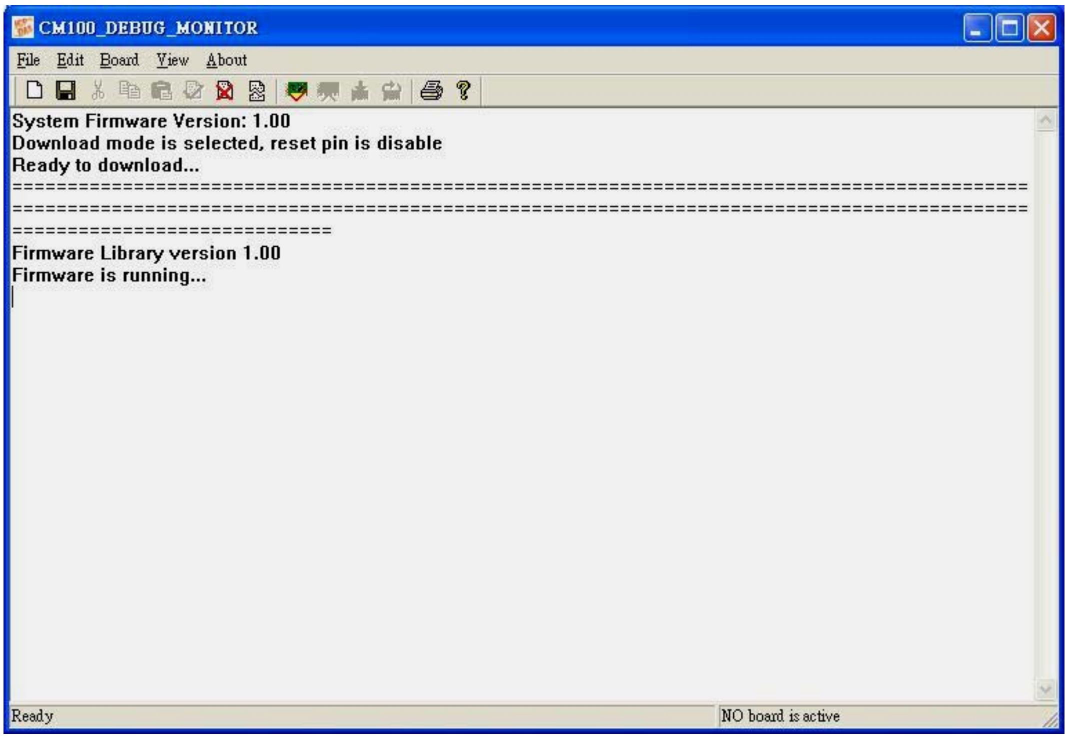


Users can select the proper board name and click "Active Board" button to activate this board. When board is activated, users can use CM100_SendCmd() function to send command to the user-defined firmware.

The sending command dialog is shown below. Users can key the ASCII string in the edit box and click the button “Send Command” to the user-defined firmware. If users need to clean the edit box, use the “Clean” button to do this.



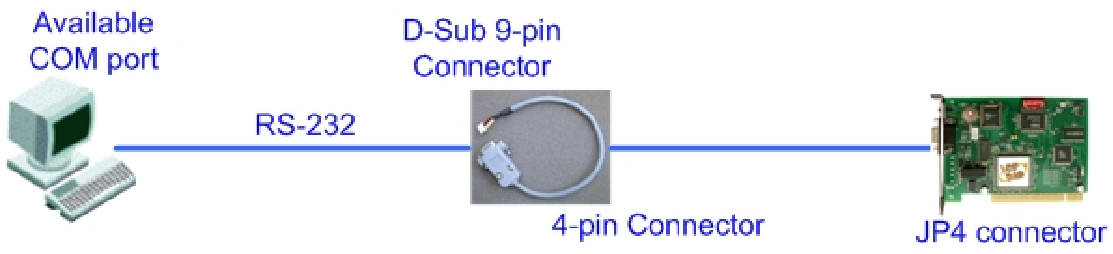
The debugging and pause functions are used to decide if the CM100_DEBUG_MONITOR.exe shows the received debug messages or not. If not, the debug messages will be dropped. The separating function is applied when users want to separate the debug messages. After using this function, the screen of the CM100_DEBUG_MONITOR.exe is shown below. The end of content of debug messages will be separated by the equal marks. When newer debug messages are received by the CM100_DEBUG_MONITOR.exe, they are put in the end of these equal marks.



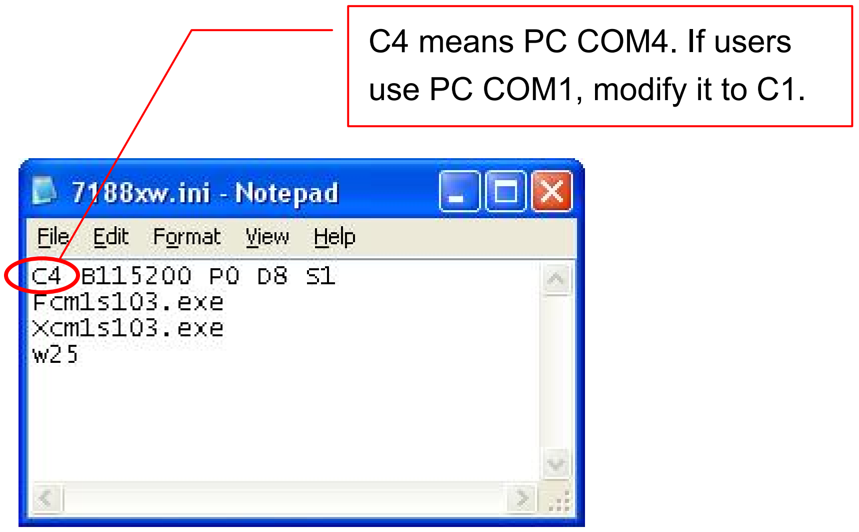
```
System Firmware Version: 1.00
Download mode is selected, reset pin is disable
Ready to download...
==========================================================================================
==========================================================================================
============================
Firmware Library version 1.00
Firmware is running...
```

7188xw.exe:

The firmware library provides two functions for debugging. The function GetKbhit() allows users to received a inputted character from 7188xw.exe. Therefore, users can use this feature to trigger some specified event for debugging. The function Print() allows users to send debug messages to 7188xw.exe. Then, 7188xw.exe will put these debug messages on the screen of 7188xw.exe. Before implementing this method, users need to use the debug cable. Plug the debug cable to the JP2 of PISO-CM100U/PCM-CM100 described in the chapter 2. Connect an available PC COM port with the D-Sub 9-pin connector of debug cable. The situation is shown as following figure.



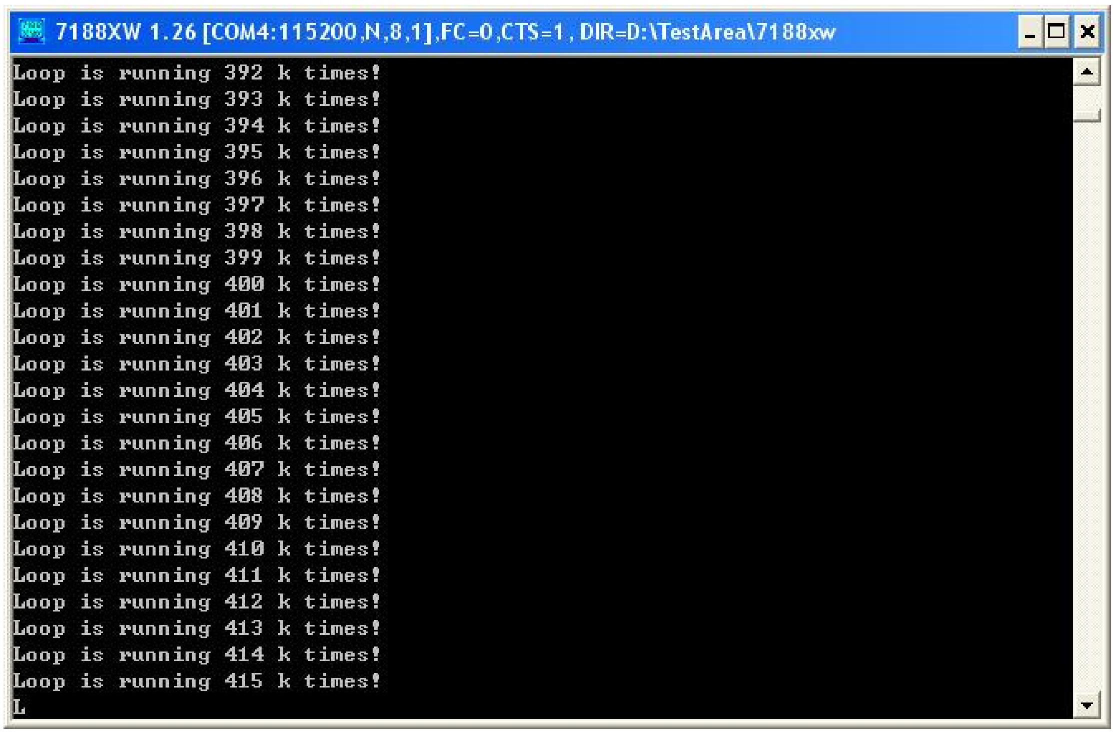
Then, use Notepad.exe to configure the 7188xw.ini to set the number of the specified PC COM port which is connected with the debug cable, and execute the 7188xw.exe. The configuration screen is displayed as following figure. Users can find the 7188xw.ini and 7188xw.exe in the Field Bus CD. The path is CAN\PCI\PISO-CM100U\.



C4 means PC COM4. If users use PC COM1, modify it to C1.

```
C4 B115200 P0 D8 S1
Fcm1s103.exe
Xcm1s103.exe
w25
```

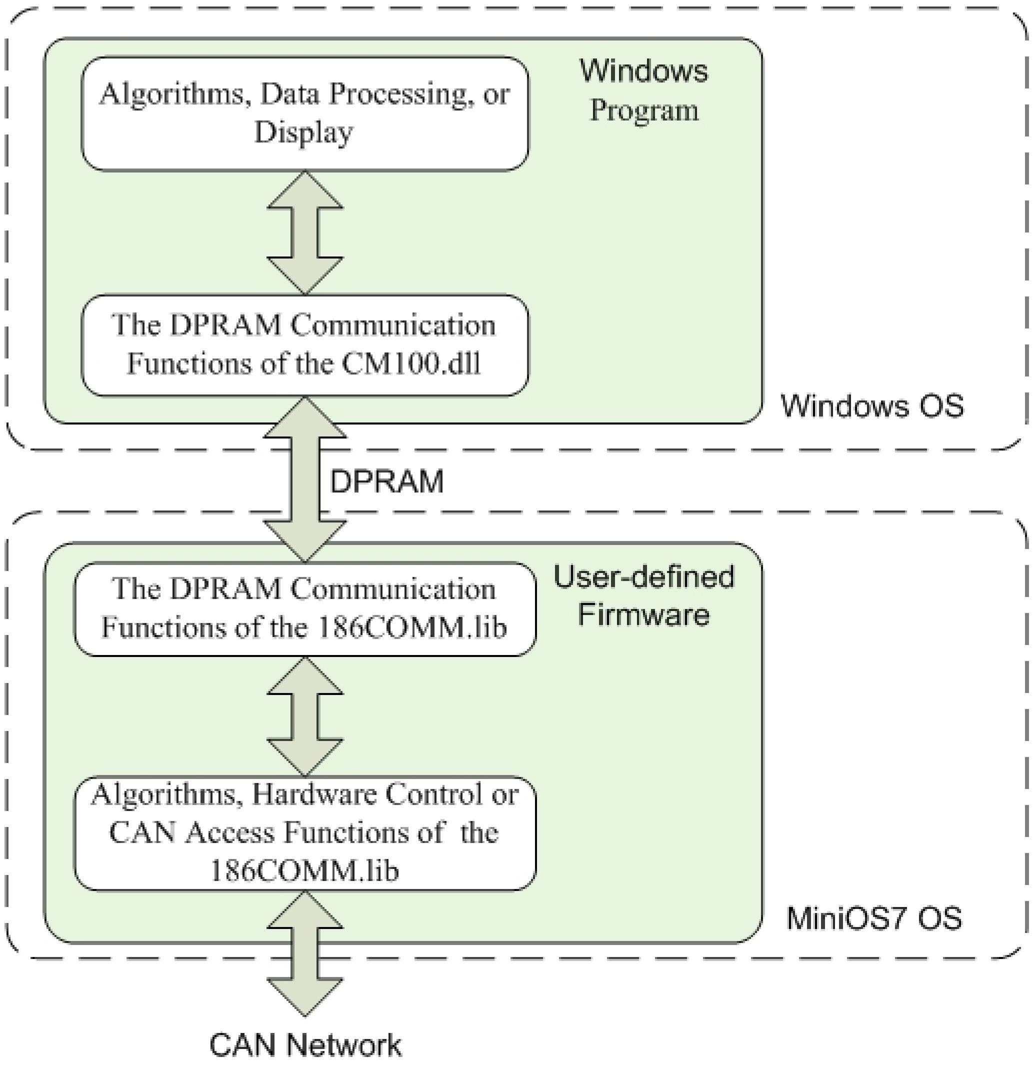
Any keyboard input will be caught by the user-defined firmware via the GetKbhit() function. The debug messages sent by the function Print() will also be displayed on the screen of the 7188xw.exe.

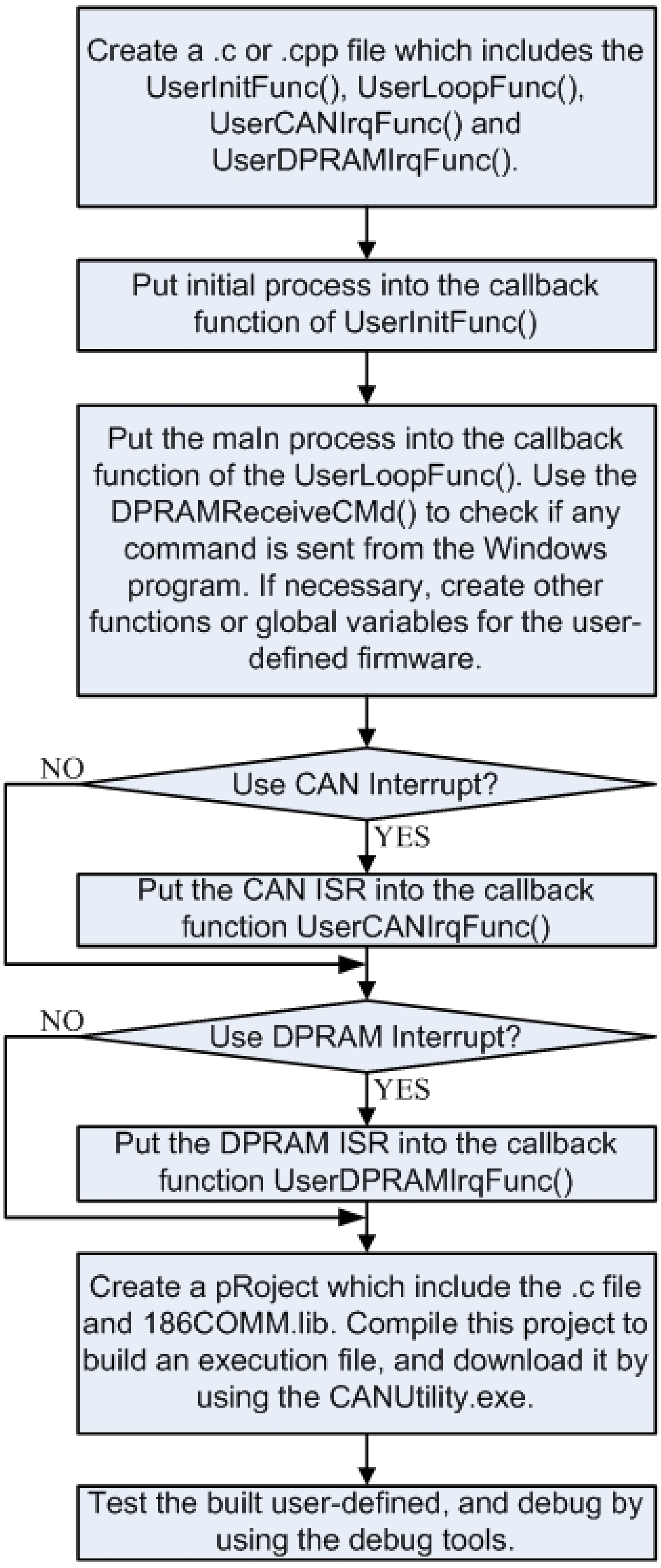

7188XW 1.26 [COM4:115200,N,8,1],FC=0,CTS=1, DIR=D:\TestArea\7188xw

```
Loop is running 392 k times!
Loop is running 393 k times!
Loop is running 394 k times!
Loop is running 395 k times!
Loop is running 396 k times!
Loop is running 397 k times!
Loop is running 398 k times!
Loop is running 399 k times!
Loop is running 400 k times!
Loop is running 401 k times!
Loop is running 402 k times!
Loop is running 403 k times!
Loop is running 404 k times!
Loop is running 405 k times!
Loop is running 406 k times!
Loop is running 407 k times!
Loop is running 408 k times!
Loop is running 409 k times!
Loop is running 410 k times!
Loop is running 411 k times!
Loop is running 412 k times!
Loop is running 413 k times!
Loop is running 414 k times!
Loop is running 415 k times!
L
```

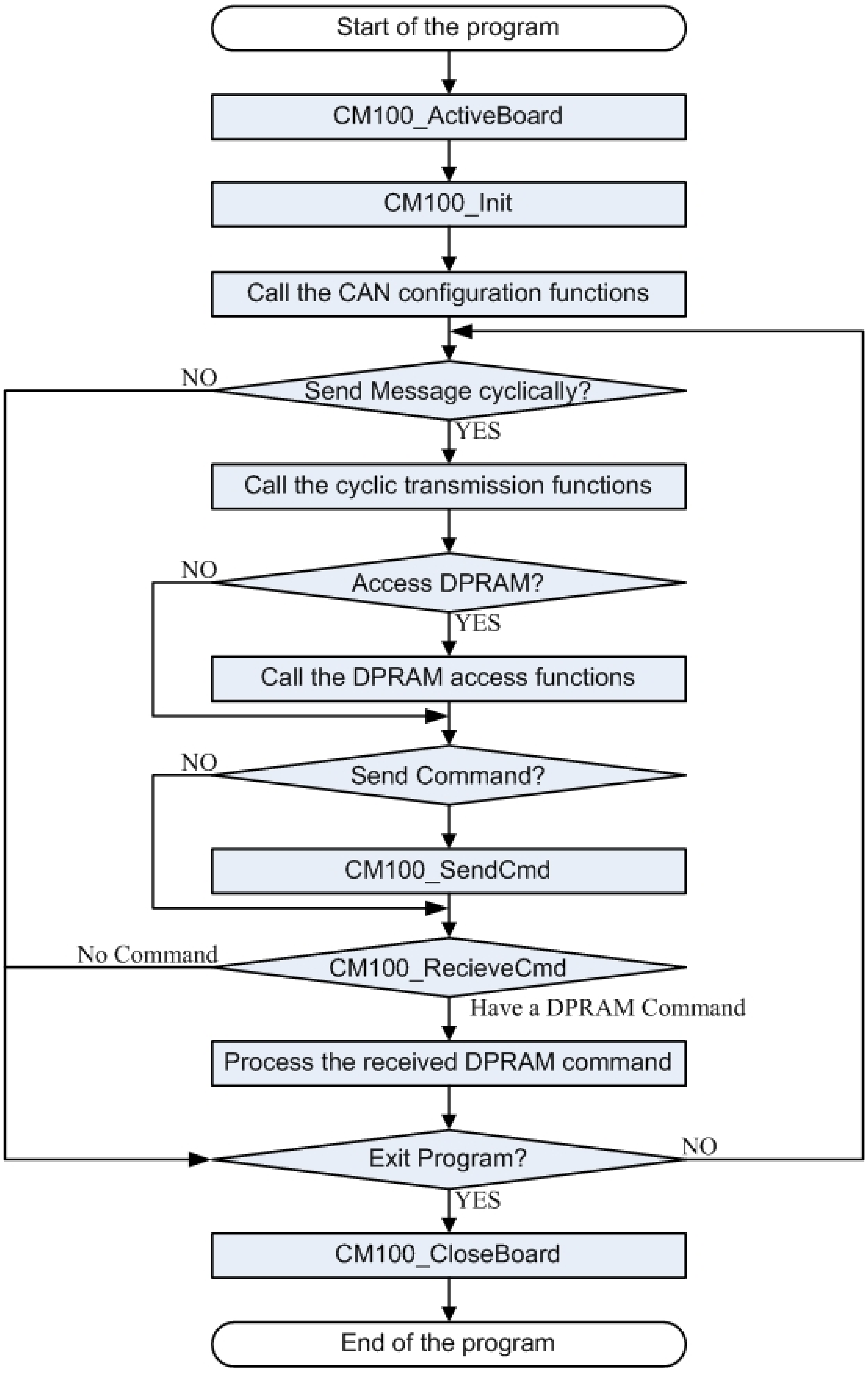
6.4 *User-defined Firmware Programming*

If users just apply the default firmware for their application, this section can be ignored. This section describes about how to build a user-defined firmware. A CAN application can be implemented corresponding to the good cooperation of the Windows application and the user-defined firmware. Generally speaking, the user-defined firmware processes the interpretation of the CAN communication protocol and the algorithms of sending the required CAN messages. The Windows program can use the processed data from the user-defined firmware to implement the applications or shows these data on the HMI. The windows program can also give a command to the user-defined firmware for sending the data to the CAN network. The relationship between Windows applications and the user-defined firmware is shown as the following figure.


Algorithms, Data Processing, or Display
Windows Program
The DPRAM Communication Functions of the CM100.dll
Windows OS
DPRAM
The DPRAM Communication Functions of the 186COMM.lib
User-defined Firmware
Algorithms, Hardware Control or CAN Access Functions of the 186COMM.lib
MiniOS7 OS
CAN Network


Create a .c or .cpp file which includes the UserInitFunc(), UserLoopFunc(), UserCANIrqFunc() and UserDPRAMIrqFunc().
Put initial process into the callback function of UserInitFunc()
Put the maIn process into the callback function of the UserLoopFunc(). Use the DPRAMReceiveCMd() to check if any command is sent from the Windows program. If necessary, create other functions or global variables for the user-defined firmware.
Use CAN Interrupt?
NO
YES
Put the CAN ISR into the callback function UserCANIrqFunc()
Use DPRAM Interrupt?
NO
YES
Put the DPRAM ISR into the callback function UserDPRAMIrqFunc()
Create a pRoject which include the .c file and 186COMM.lib. Compile this project to build an execution file, and download it by using the CANUtility.exe.
Test the built user-defined, and debug by using the debug tools.

The development procedure of the user-defined firmware



The development procedure of the corresponding Windows program

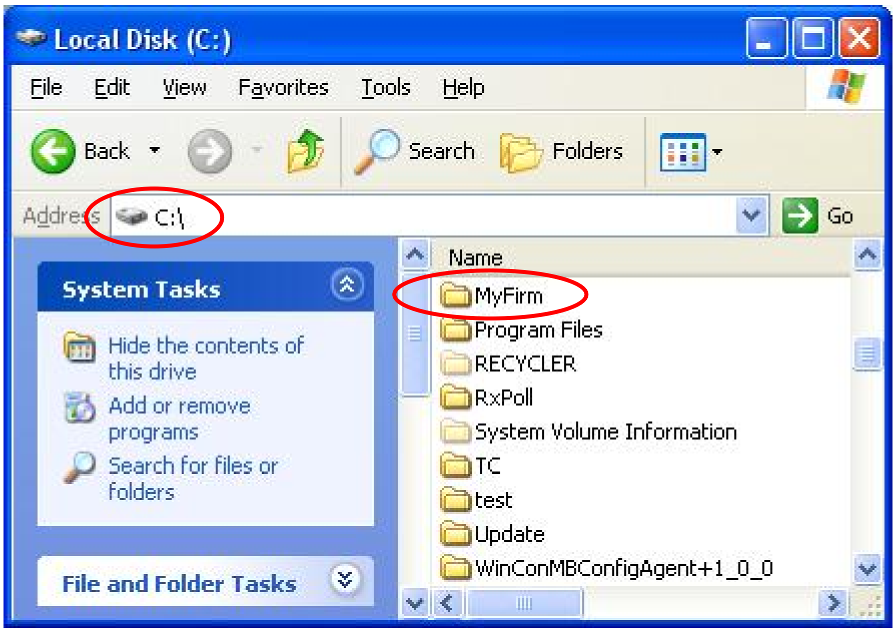
The above two figures shows the basic flowchart of developing the user-defined firmware and corresponding Windows program. For the user-defined firmware development, users can create a C/C++ project, and include the .c files and 186COMM.lib. Put the 4 callback functions in one of these .c file. Program the codes into these 4 callback functions. If necessary, build your functions and global variables. Then, compile this project, and you can get the user-defined firmware. Download it by using the CANUtility.exe and test it. Afterwards, according to the user-defined firmware, design your Windows program to communicate with the firmware via the DPRAM access functions of the CM100.lib and the 186COMM.lib. Besides the DPRAM access functions, the firmware library supports most APIs for the hardware on the PISO-CM100U/PCM-CM100, such as the EEPROM accessing, the RTC access, the timer functions… and so forth.

When you want to design a Windows program, the BCB, VC++, or VB development environment are needed. Users can refer to the textbook of the BCB, VC++ or VB for more information about how to use the APIs of the .dll library in these development environments. The user-defined firmware can be programmed by the BC/BC++/TC/TC++ development environments. Here, it is considered that how to build an execution file with the 186COMM.lib by using the TC++1.01 compiler. Before starting the step-by-step procedures, users need to install the TC++1.01 compiler and the PISO-CM100U/PCM-CM100 Windows driver. Users can free download the TC++1.01 compiler on the following website.

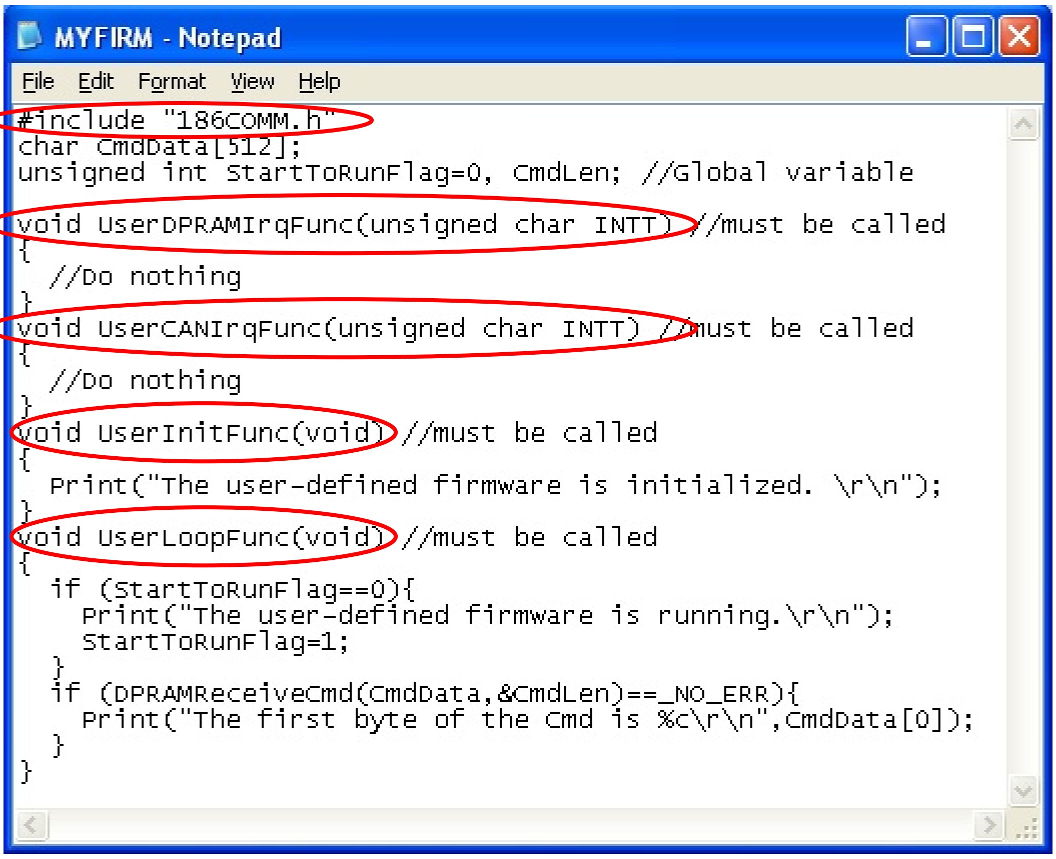
http://www.icpdas.com/download/download-list.htm

The PISO-CM100U/PCM-CM100 Windows driver can be found in the Fieldbus CD or our website. Please refer to the chapter 3 for more details. The following paragraph is a step-by-step description about how to build the user-defined firmware.

Step1: Create a folder named "MyFirm" in the C disk.

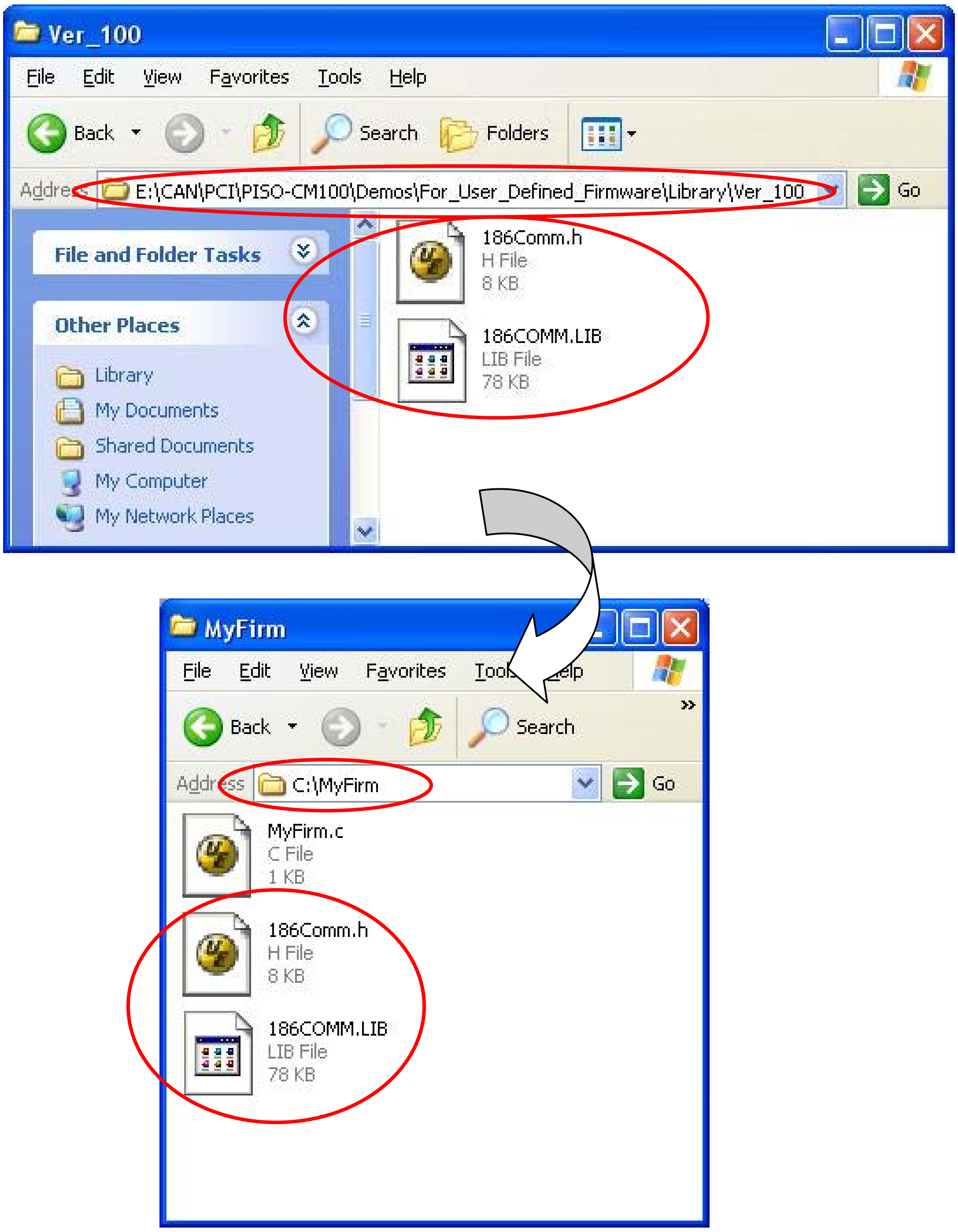


Step2: In the folder MyFirm, create a .c file and name it as "MyFirm.c". Design the MyFirm.c file as follows. The 4 callback functions must be used in user-defined function.

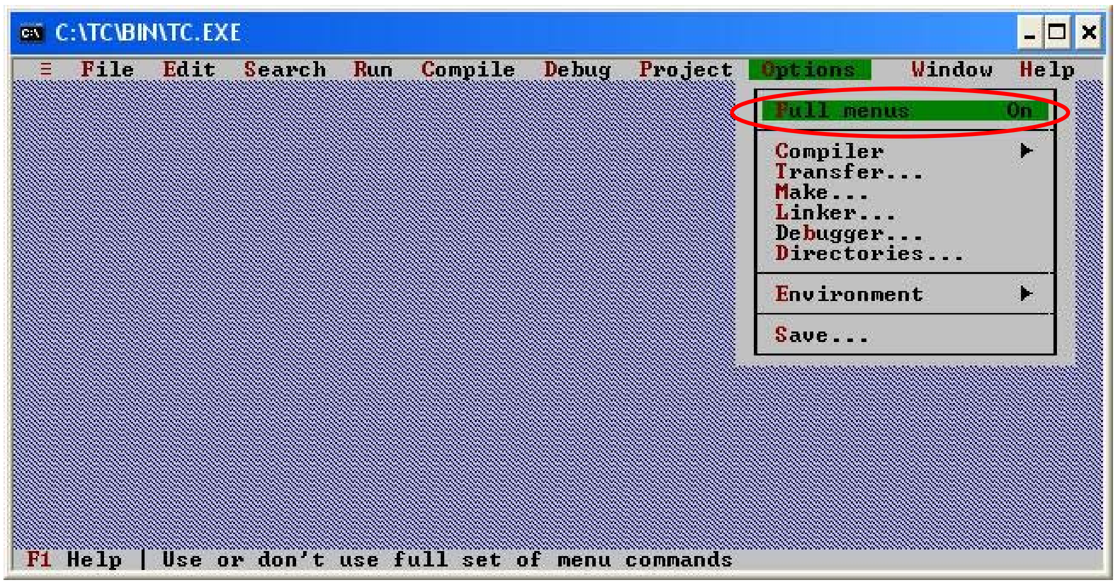


```
#include "186COMM.h"
char CmdData[512];
unsigned int StartToRunFlag=0, CmdLen; //Global variable

void UserDPRAMIrqFunc(unsigned char INTT) //must be called
{
  //Do nothing
}
void UserCANIrqFunc(unsigned char INTT) //must be called
{
  //Do nothing
}
void UserInitFunc(void) //must be called
{
  Print("The user-defined firmware is initialized. \r\n");
}
void UserLoopFunc(void) //must be called
{
  if (StartToRunFlag==0){
    Print("The user-defined firmware is running.\r\n");
    StartToRunFlag=1;
  }
  if (DPRAMReceiveCmd(CmdData,&CmdLen)==_NO_ERR){
    Print("The first byte of the Cmd is %c\r\n",CmdData[0]);
  }
}
```

Step3: Copy the 186COMM.lib file and the 186COMM.h file into the MyFirm folder. Users can find them with version 1.00 in the path CAN\PCI\PISO-CM100U\Demos\For_User_Defined_Firmware\ver_100 in the Fieldbus CD. If there is newest version library, use it for the user-defined firmware.

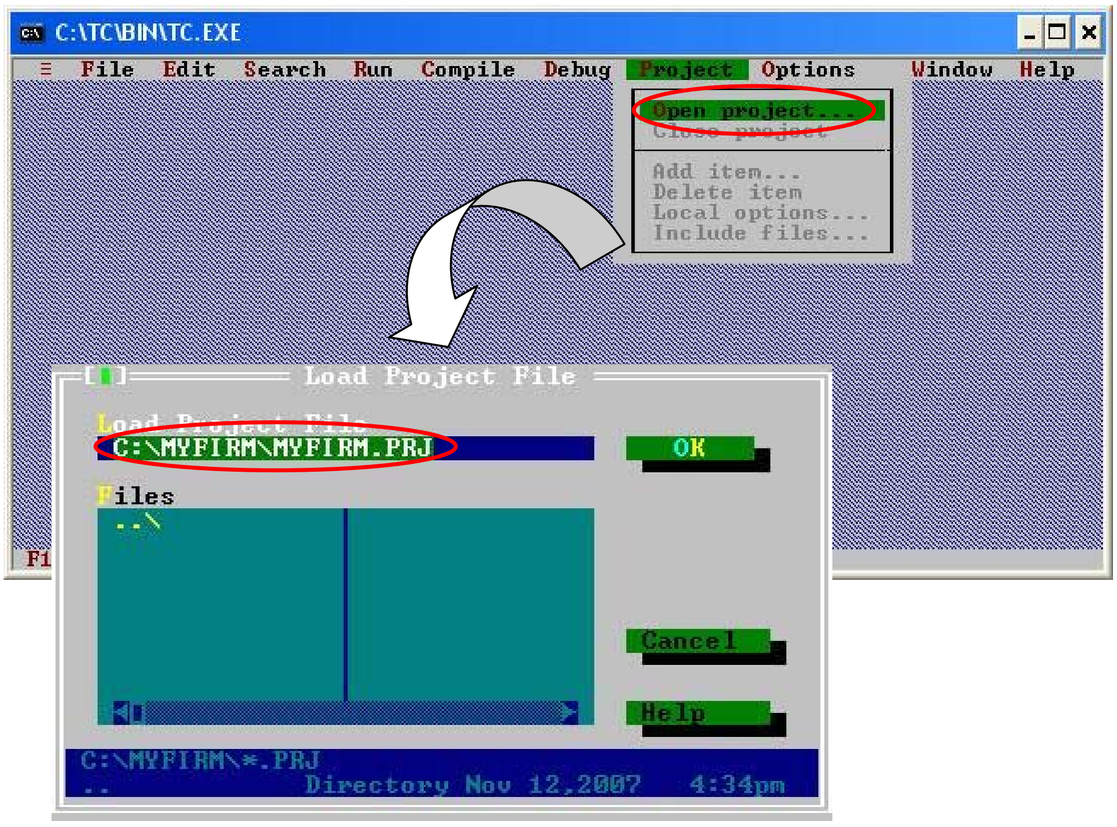


Step4: Run the TC++1.01 development environment. Click the “Options\Full menus” to expand the all functions listed in the menus.



F1 Help | Use or don't use full set of menu commands

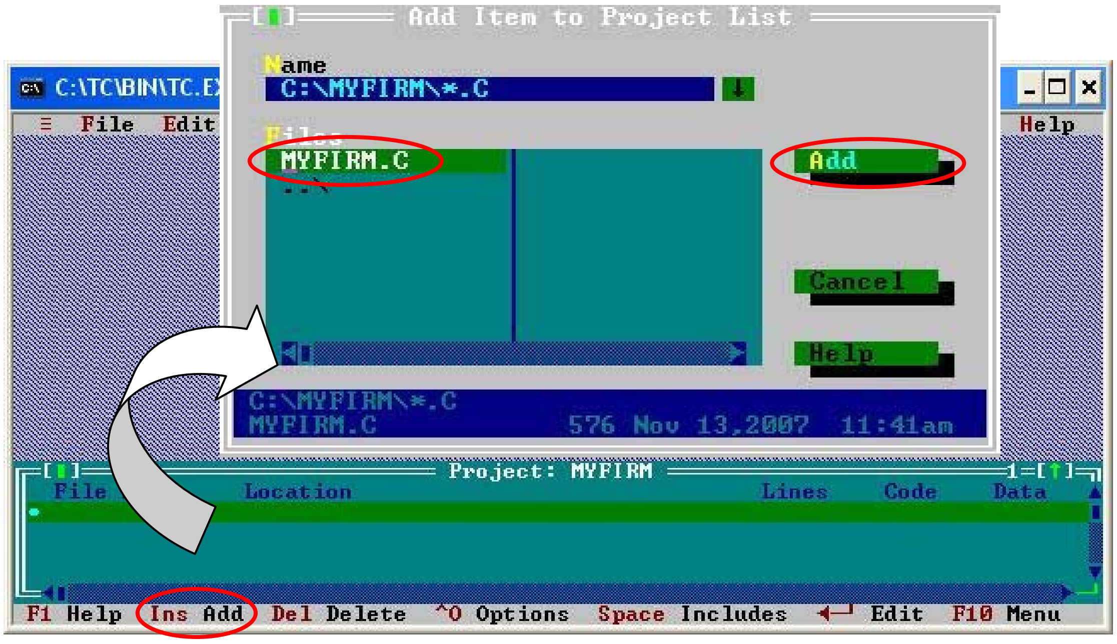
Step5: Click the “Project\Open project…” to create a new project. Input the project name “MyFirm.PRJ”, and click the OK button to continue.



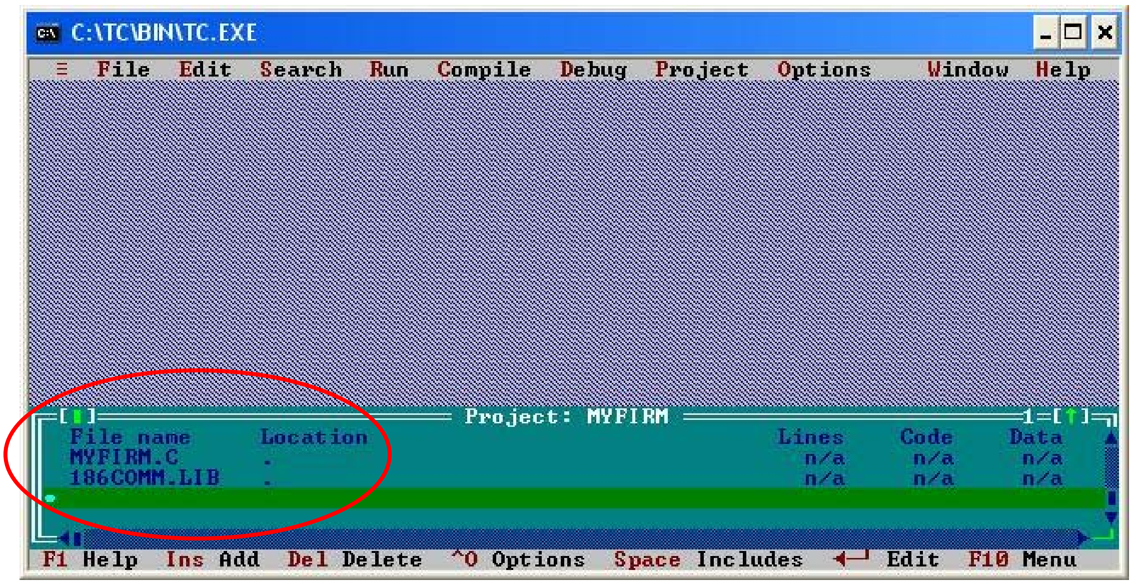
Load Project File
C:\MYFIRM\MYFIRM.PRJ

C:\MYFIRM\*.PRJ
.. Directory Nov 12,2007 4:34pm

Step6: Click the "Add" item on the bottom of the TC++1.01 window. Search all .c file by setting "c:\MyFirm\*.c" in the Name field of the popup window. Use the "Add" button to add the MyFirm' .c file in to MyFirm project. Then, change the search command from "c:\MyFirm\*.c" to "c:\MyFirm\*.lib" in the Name field. Add the library file 186COMM.lib into the MyFirm project as the same way.

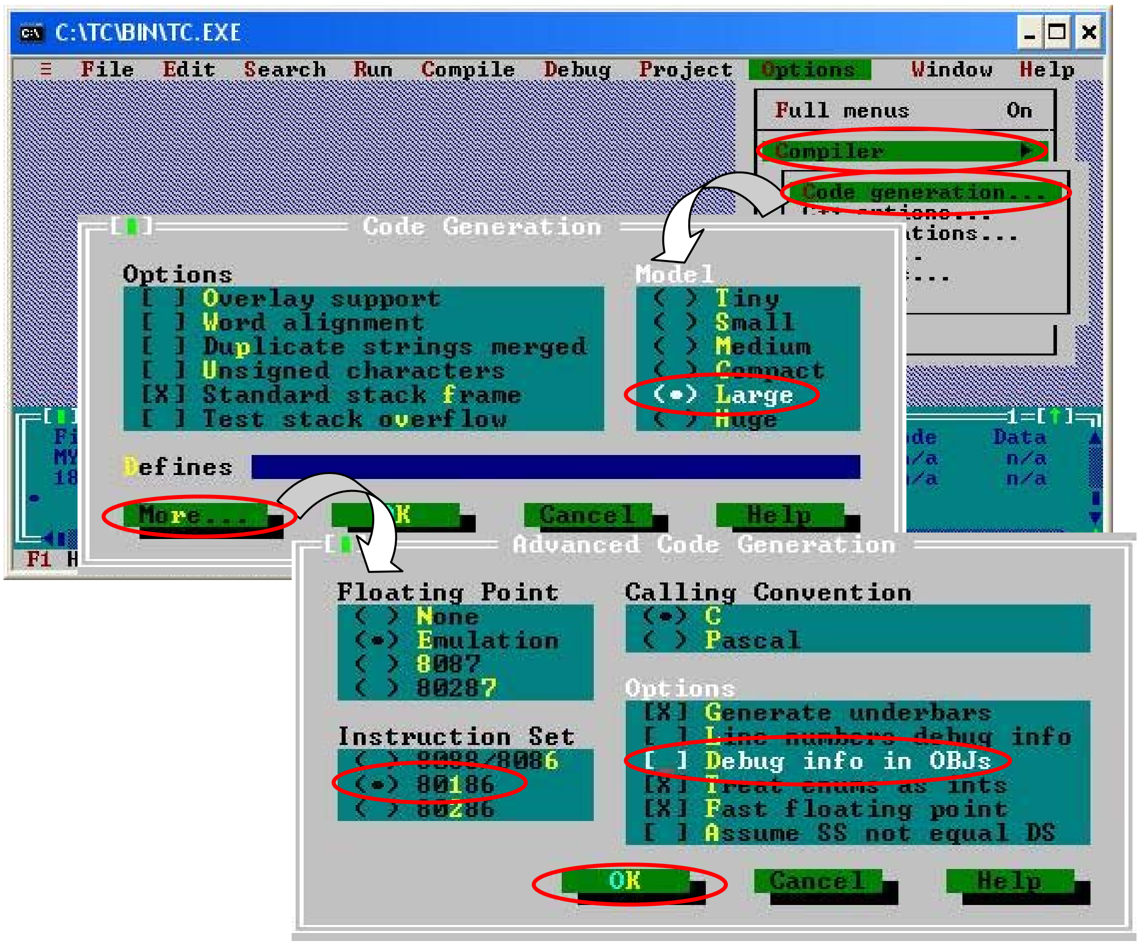

C:\TC\BIN\TC.EX
File Edit
Help
Add Item to Project List
Name
C:\MYFIRM\*.C
Files
MYFIRM.C
..\
Add
Cancel
Help
C:\MYFIRM\*.C
MYFIRM.C 576 Nov 13,2007 11:41am
Project: MYFIRM
File Location Lines Code Data
F1 Help Ins Add Del Delete ^O Options Space Includes Edit F10 Menu

Step7: After finishing the Step6, the TC++1.01 window will look like as follows.


C:\TC\BIN\TC.EXE
File Edit Search Run Compile Debug Project Options Window Help
Project: MYFIRM
F1 Help Ins Add Del Delete ^O Options Space Includes Edit F10 Menu

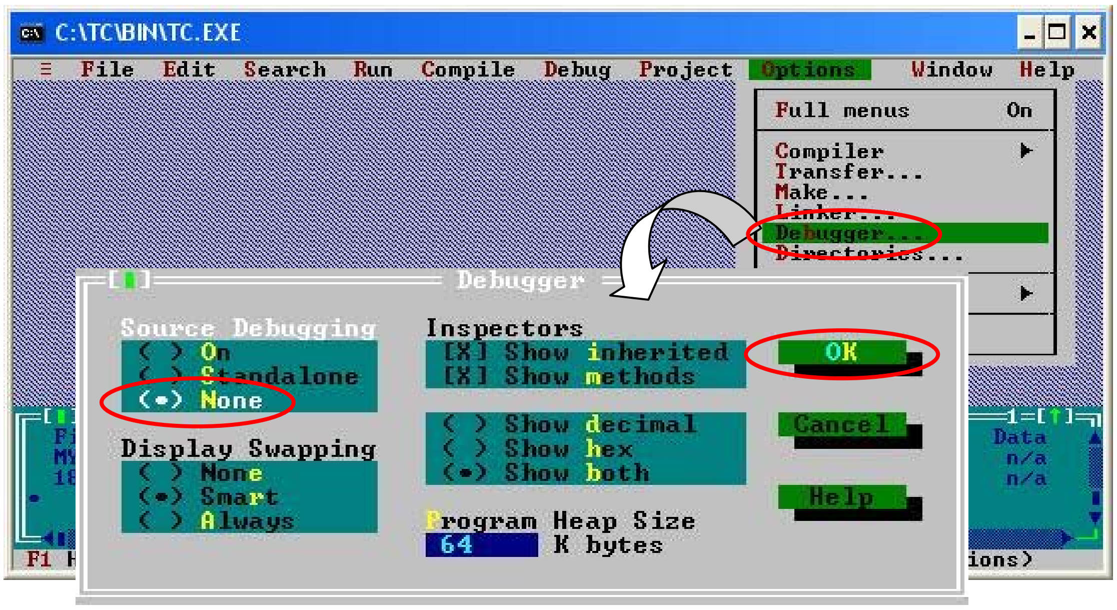
```
File name      Location          Lines   Code   Data
MYFIRM.C       .                   n/a    n/a    n/a
186COMM.LIB    .                   n/a    n/a    n/a
```

Step8: Click the “Options/Compiler/Code generation…” to set the compiler model to the large mode. Click “More…” to set the “Floating point” and “Instruction Set” parameters, the Emulation and 80186 item will be used respectively. Then, click the OK button to save the configuration.



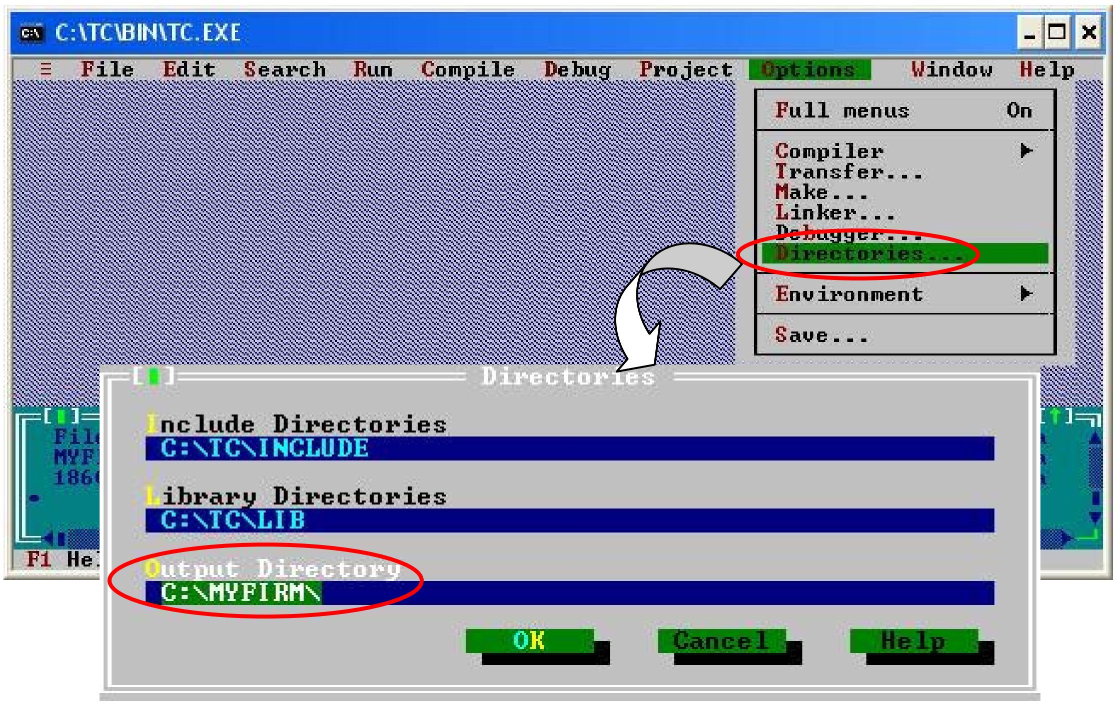
```
C:\TC\BIN\TC.EXE
 ≡  File  Edit  Search  Run  Compile  Debug  Project  Options  Window  Help

                                        Full menus    On
                                        Compiler      ►
                                          Code generation...

                  Code Generation
Options                                   Model
[ ] Overlay support                       ( ) Tiny
[ ] Word alignment                        ( ) Small
[ ] Duplicate strings merged              ( ) Medium
[ ] Unsigned characters                   ( ) Compact
[X] Standard stack frame                  (•) Large
[ ] Test stack overflow                   ( ) Huge

Defines

  More...        OK        Cancel        Help

                  Advanced Code Generation
Floating Point            Calling Convention
( ) None                  (•) C
(•) Emulation             ( ) Pascal
( ) 8087
( ) 80287                 Options
                          [X] Generate underbars
Instruction Set           [ ] Line numbers debug info
( ) 8088/8086             [ ] Debug info in OBJs
(•) 80186                 [X] Treat enums as ints
( ) 80286                 [X] Fast floating point
                          [ ] Assume SS not equal DS

            OK        Cancel        Help
```

Step9: Click the “Option/Debugger...” to set the “Source Debugging” parameter. Here, select the “None” item for this parameter.



```
C:\TC\BIN\TC.EXE
 ≡  File  Edit  Search  Run  Compile  Debug  Project  Options  Window  Help

                                        Full menus    On
                                        Compiler      ►
                                        Transfer...
                                        Make...
                                        Linker...
                                        Debugger...
                                        Directories...

                  Debugger
Source Debugging      Inspectors
( ) On                [X] Show inherited        OK
( ) Standalone        [X] Show methods
(•) None
                                                Cancel
Display Swapping      ( ) Show decimal
( ) None              ( ) Show hex
(•) Smart             (•) Show both             Help
( ) Always
                      Program Heap Size
                      64     K bytes
```

Step10: Click the "Option/Directories..." to set the "Output Directory" parameter. Here, set the "C:\MyFirm" for the "Output Directory" parameter.

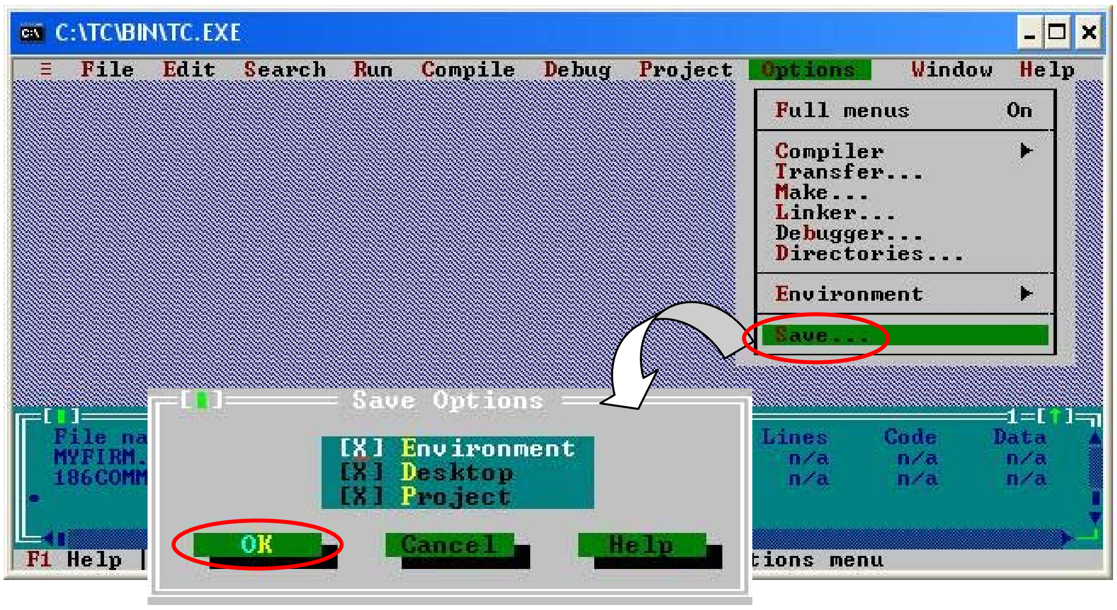


Include Directories
C:\TC\INCLUDE

Library Directories
C:\TC\LIB

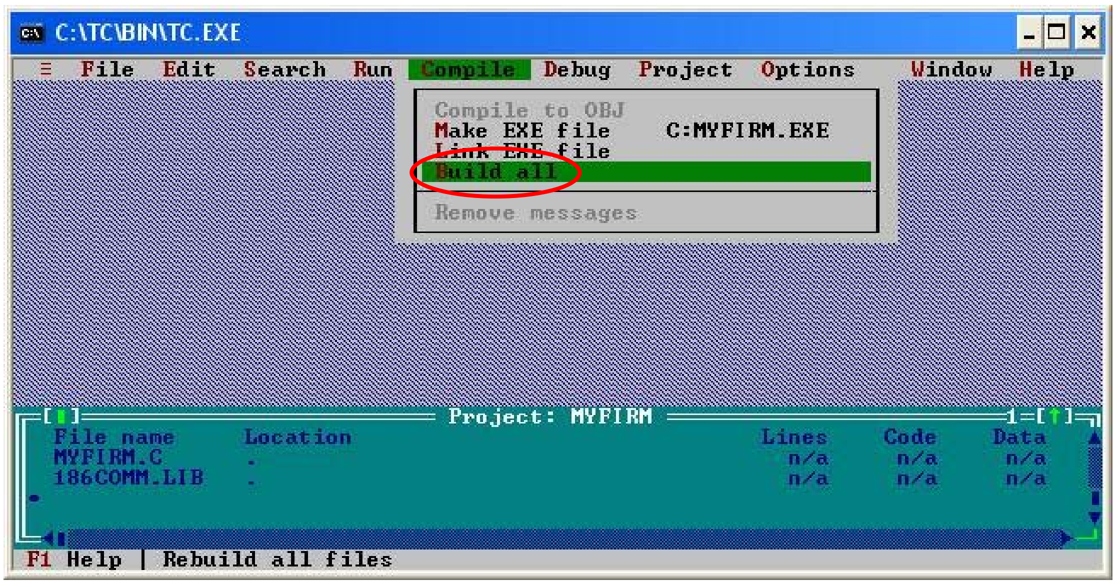
Output Directory
C:\MYFIRM\

Step11: After finishing the parameters setting, click the "Options/save" to save this project.

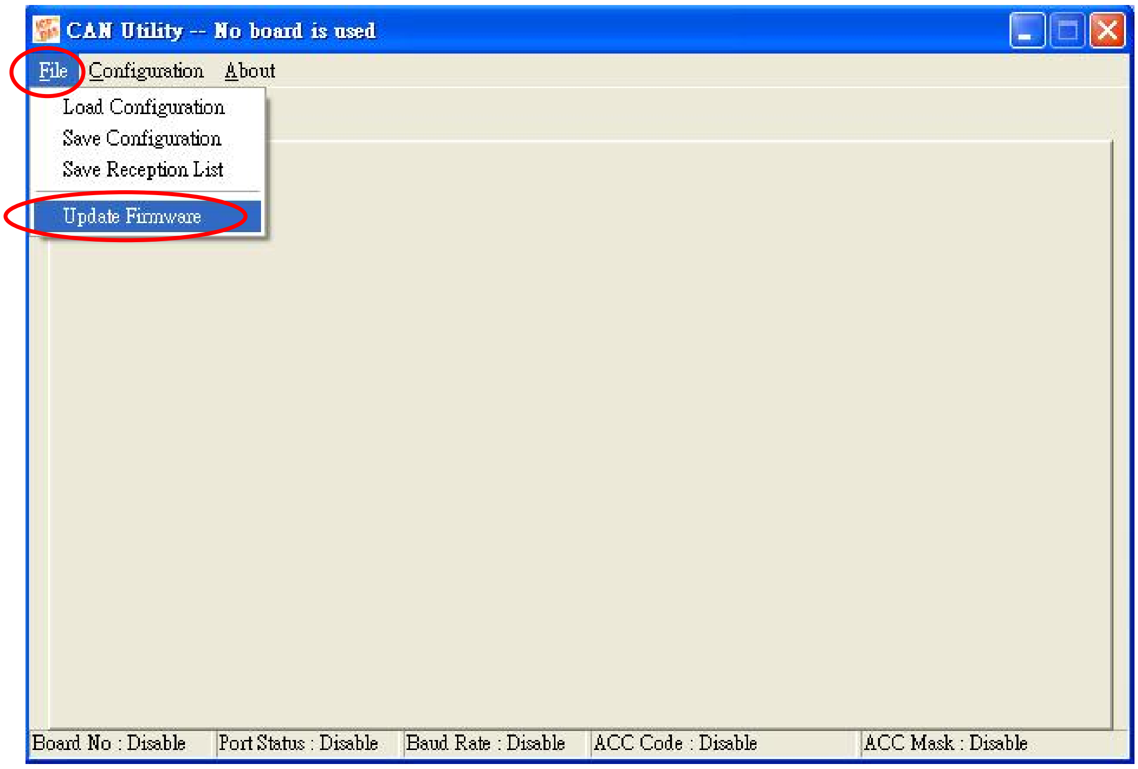


[X] Environment
[X] Desktop
[X] Project

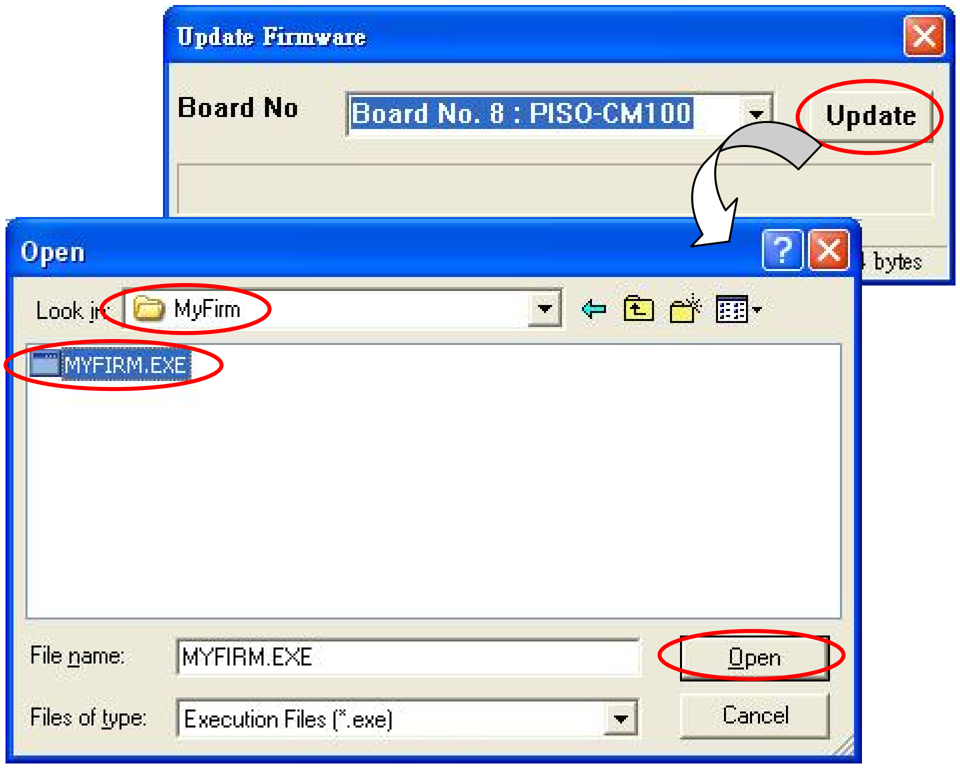
Step12: After finishing the parameters configuration, click the "Compile/build all" to produce the execution file. Users can find the execution file named as MyDemo.exe in the MyFirm folder. The warning messages may occur during the compiling procedure because the INTT parameters of the UserCANIrqFunc() and UserDPRAMIrqFunc() are not used. These warnings will not have any affection.


C:\TC\BIN\TC.EXE
≡ File Edit Search Run Compile Debug Project Options Window Help
Compile to OBJ
Make EXE file C:MYFIRM.EXE
Link EXE file
Build all
Remove messages
Project: MYFIRM
File name Location Lines Code Data
MYFIRM.C . n/a n/a n/a
186COMM.LIB . n/a n/a n/a
F1 Help | Rebuild all files

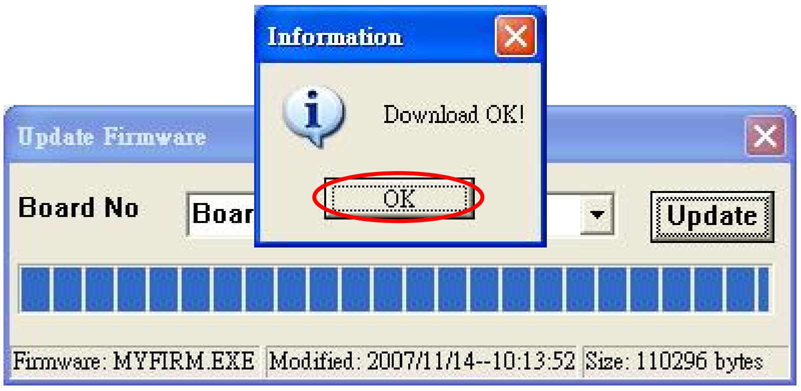
Step13: Execute the CANUtility.exe, and select the "File\Update Firmware" to download the user-defined firmware.



Step14: Select the board name, click the “Update” button, and find the MyFirm.exe file from the dialog.

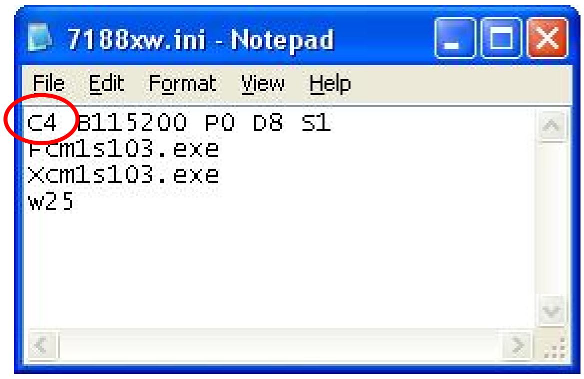


Step15: When finishing, the Download OK messages is shown.



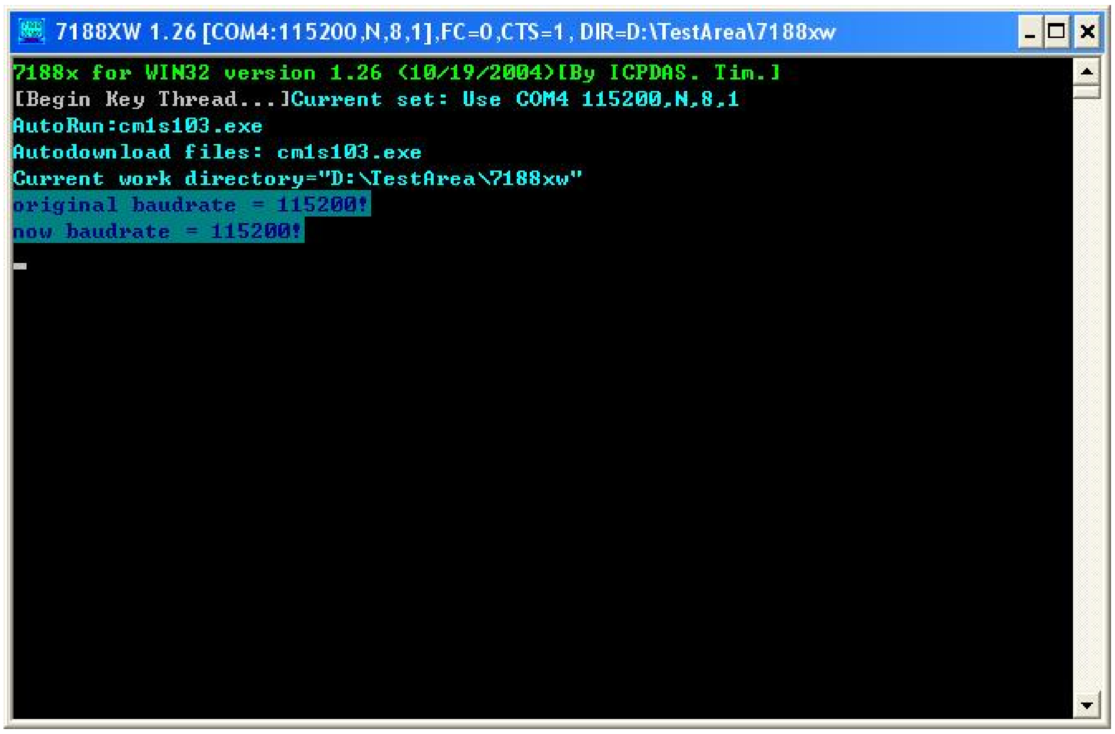
Firmware: MYFIRM.EXE | Modified: 2007/11/14--10:13:52 | Size: 110296 bytes

Step16: Check the 7188xw.ini. Here, use the PC COM4 to connect the debug cable of the PISO-CM100U/PCM-CM100-D/T. Set the COM No. value to “C4” for the PC COM4. If users use COM1, set the value to “C1”. The 7188xw.ini and 7188xw.exe can be found in the driver installation path. The default is “C:\ICPDAS\PISO-CM100U\”.



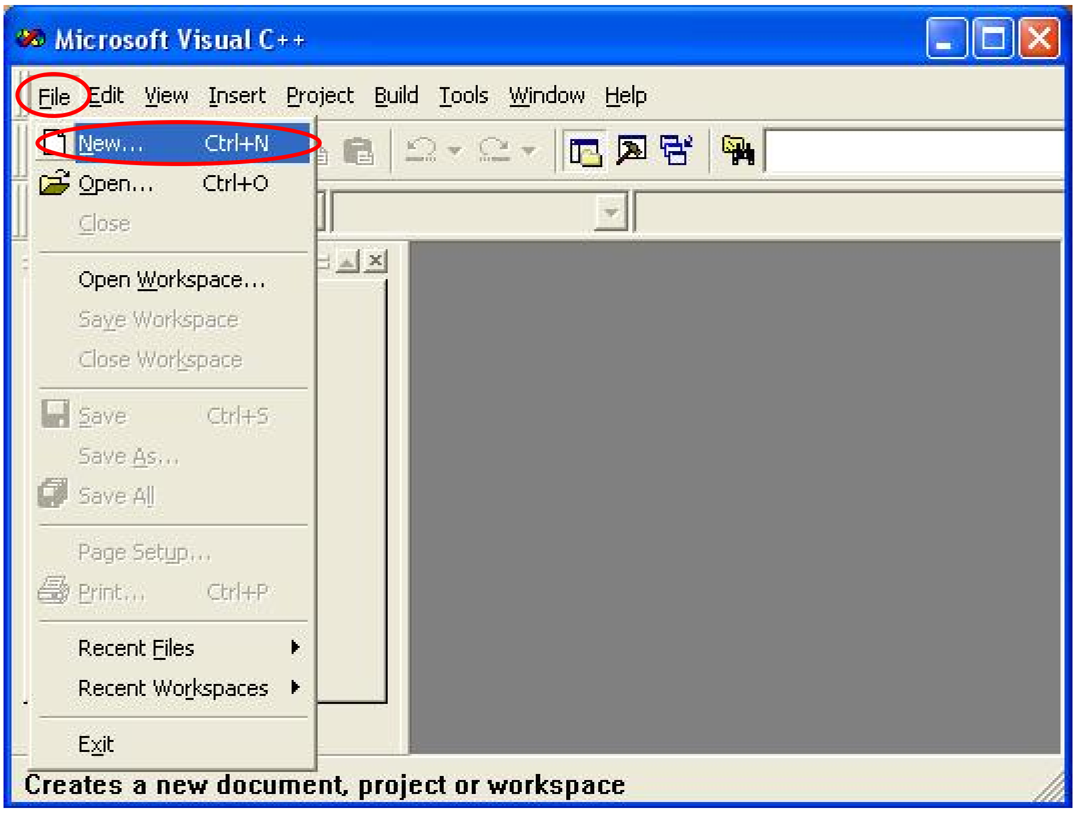
```
C4 B115200 P0 D8 S1
Fcm1s103.exe
Xcm1s103.exe
w25
```

Step17: Connect the debug cable introduced in the chapter 2 with the CAN board. Run the 7188xw.exe.

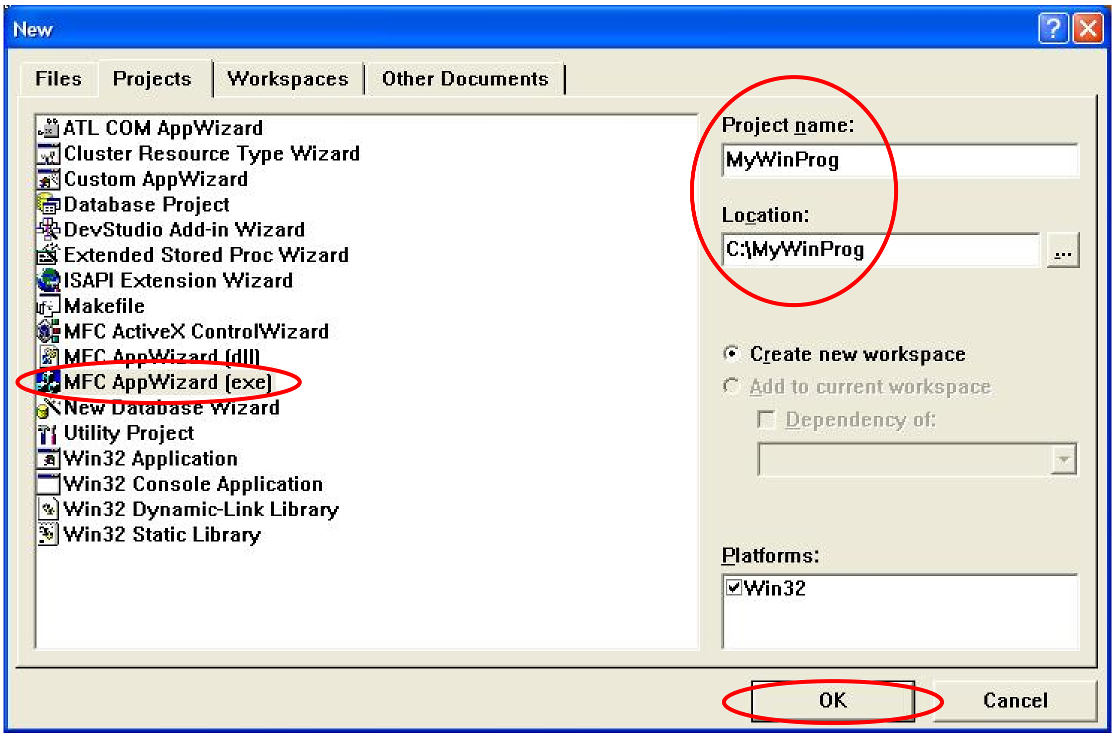

7188XW 1.26 [COM4:115200,N,8,1],FC=0,CTS=1, DIR=D:\TestArea\7188xw

```
7188x for WIN32 version 1.26 (10/19/2004)[By ICPDAS. Tim.]
[Begin Key Thread...]Current set: Use COM4 115200,N,8,1
AutoRun:cm1s103.exe
Autodownload files: cm1s103.exe
Current work directory="D:\TestArea\7188xw"
original baudrate = 115200!
now baudrate = 115200!
-
```

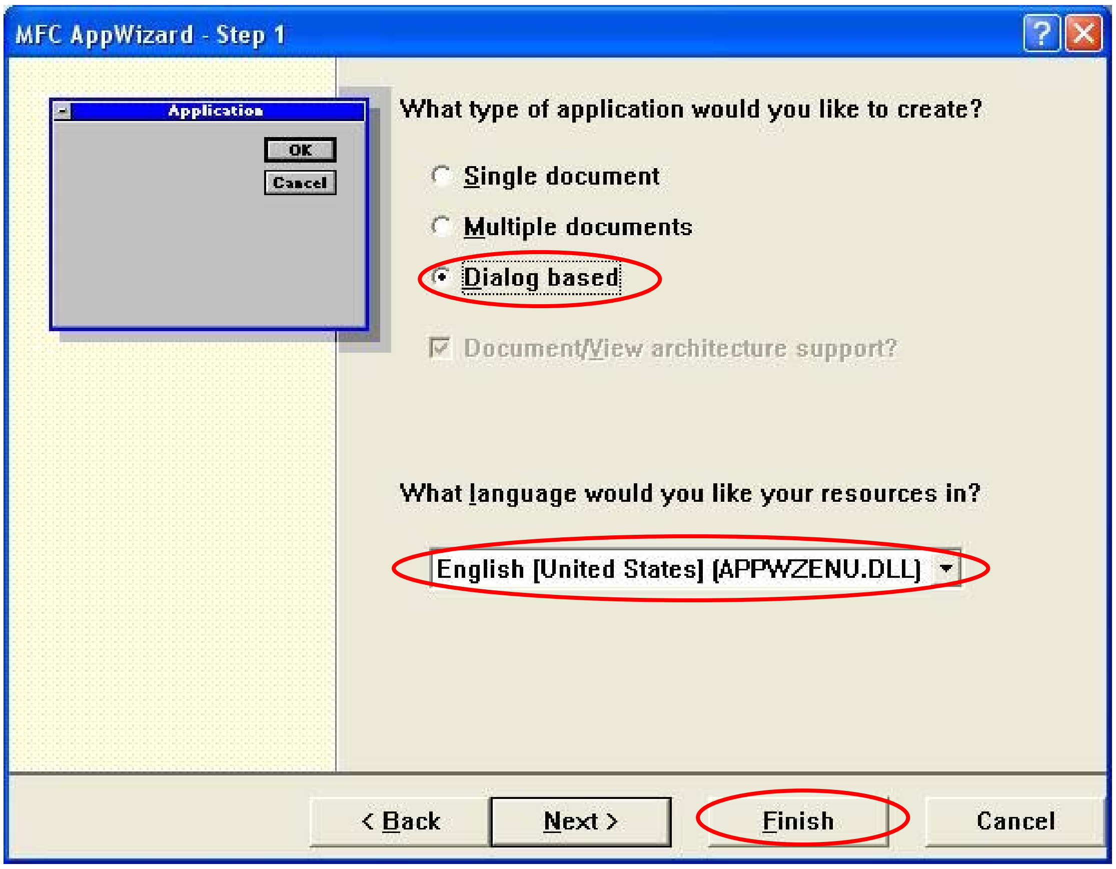
Step18: After finishing the user-defined firmware, run the VC++ 6.0 to set up a corresponding Windows program. Select the "File/New…" to create a project.



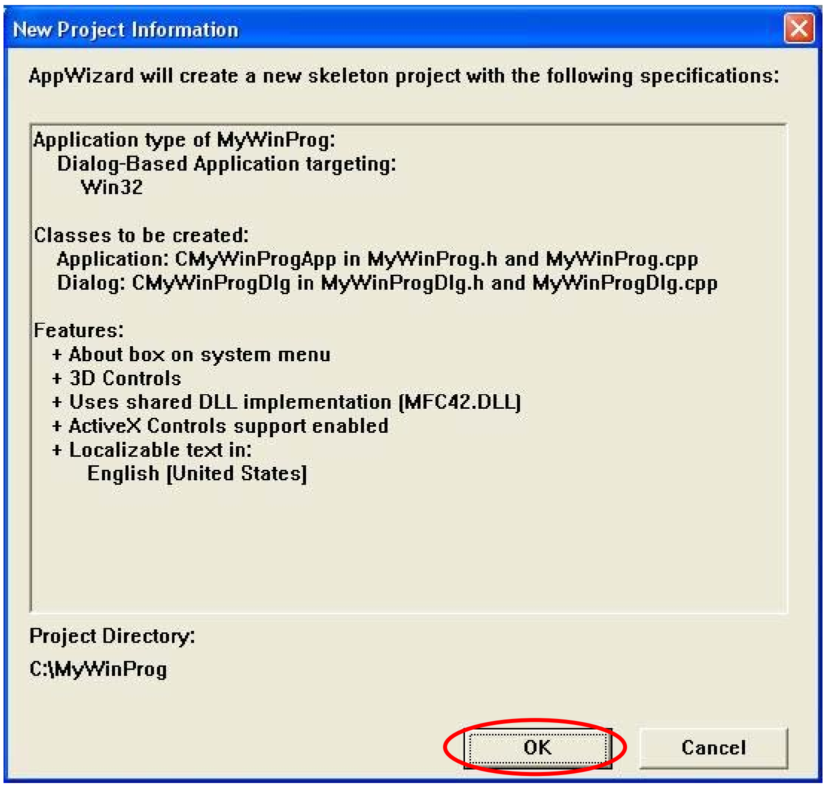
Setp19: Use the "MFC AppWizard (exe) for the project. The project name and location are given as following figure. Click the OK button to continue.



Step20: Set the project by using the following parameters, and click the Finish button to continue.


MFC AppWizard - Step 1
Application
OK
Cancel
What type of application would you like to create?
Single document
Multiple documents
[✓ Dialog based]
Document/View architecture support?
What language would you like your resources in?
English [United States] (APPWZENU.DLL)
< Back
Next >
Finish
Cancel

Step21: The relative project information is shown in the popped up dialog.

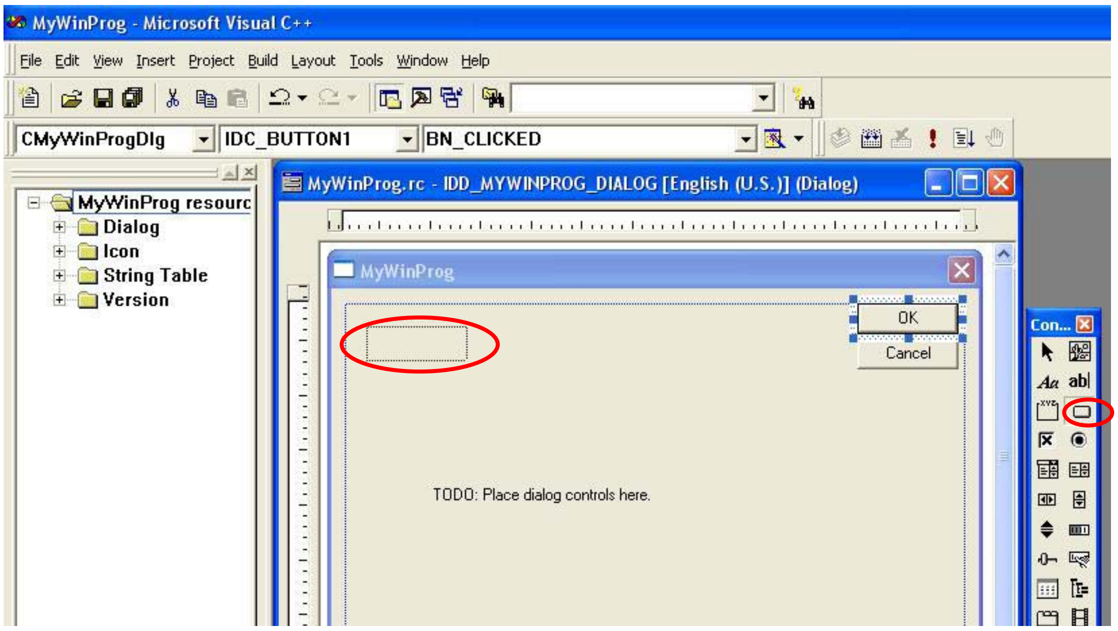


AppWizard will create a new skeleton project with the following specifications:

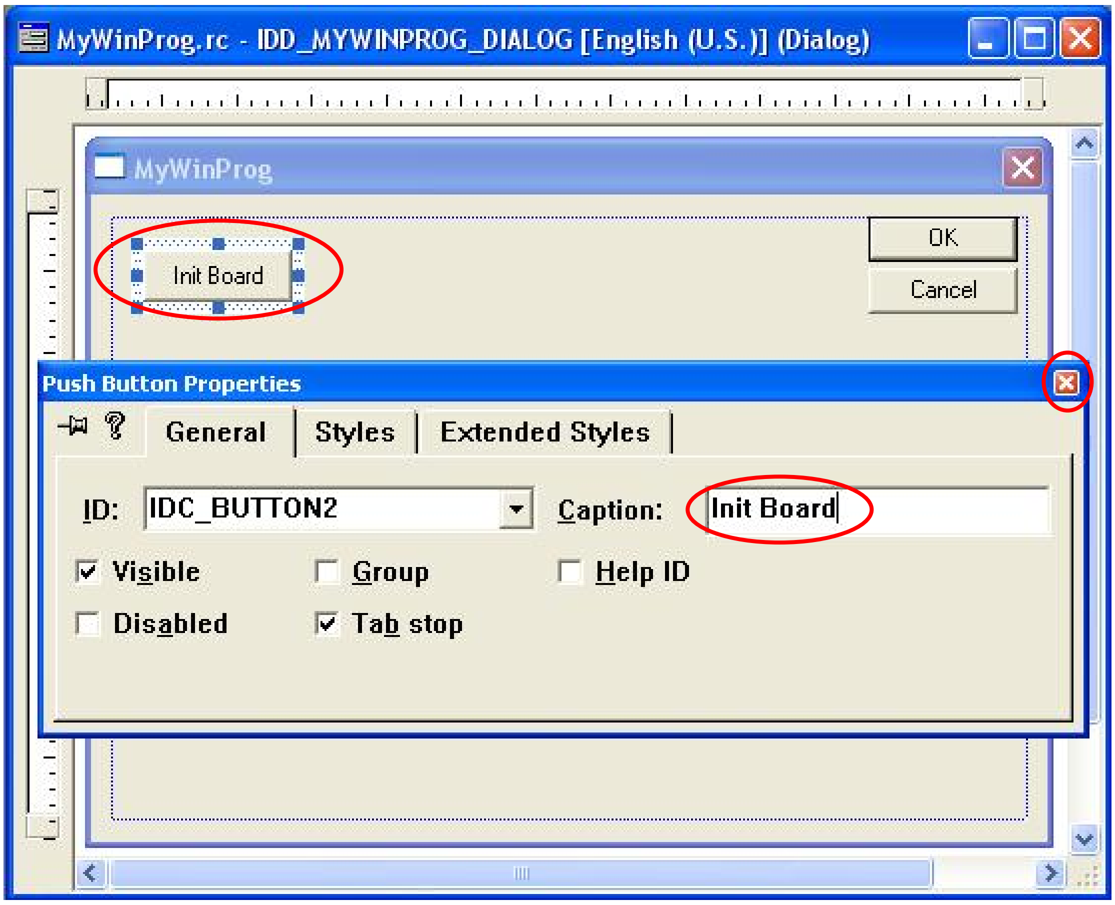
```
Application type of MyWinProg:
    Dialog-Based Application targeting:
        Win32

Classes to be created:
    Application: CMyWinProgApp in MyWinProg.h and MyWinProg.cpp
    Dialog: CMyWinProgDlg in MyWinProgDlg.h and MyWinProgDlg.cpp

Features:
   + About box on system menu
   + 3D Controls
   + Uses shared DLL implementation (MFC42.DLL)
   + ActiveX Controls support enabled
   + Localizable text in:
         English [United States]
```

Project Directory:
C:\MyWinProg

Step22: Add a button to the Windows program. Select the button icon from the tool box, drag and drop the mouse pointer to build a button.

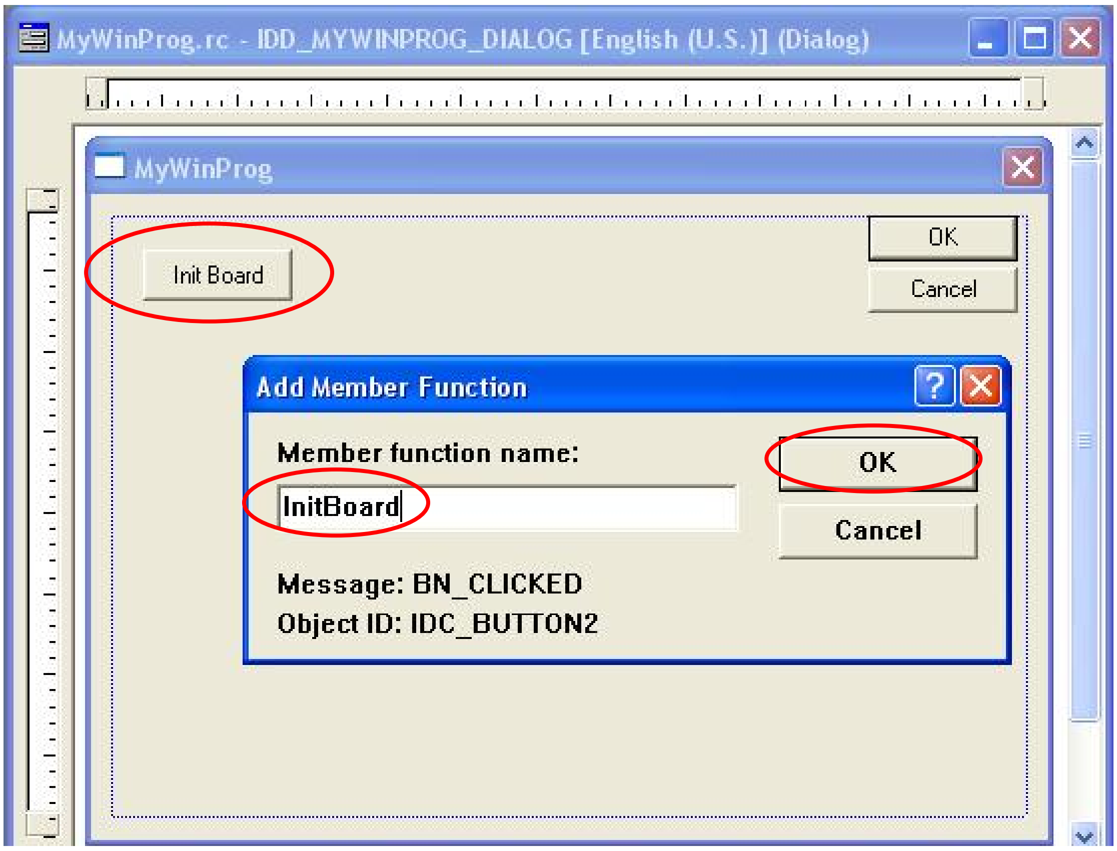

MyWinProg - Microsoft Visual C++
File Edit View Insert Project Build Layout Tools Window Help
CMyWinProgDlg
IDC_BUTTON1
BN_CLICKED
MyWinProg resourc
Dialog
Icon
String Table
Version
MyWinProg.rc - IDD_MYWINPROG_DIALOG [English (U.S.)] (Dialog)
MyWinProg
OK
Cancel
TODO: Place dialog controls here.
Con...

Step23: Select the button, and key the characters “Init Board” directly. Then the property dialog is popped up. Afterwards, close the property dialog.



ID: IDC_BUTTON2
Caption: Init Board
[✓] Visible
[ ] Group
[ ] Help ID
[ ] Disabled
[✓] Tab stop

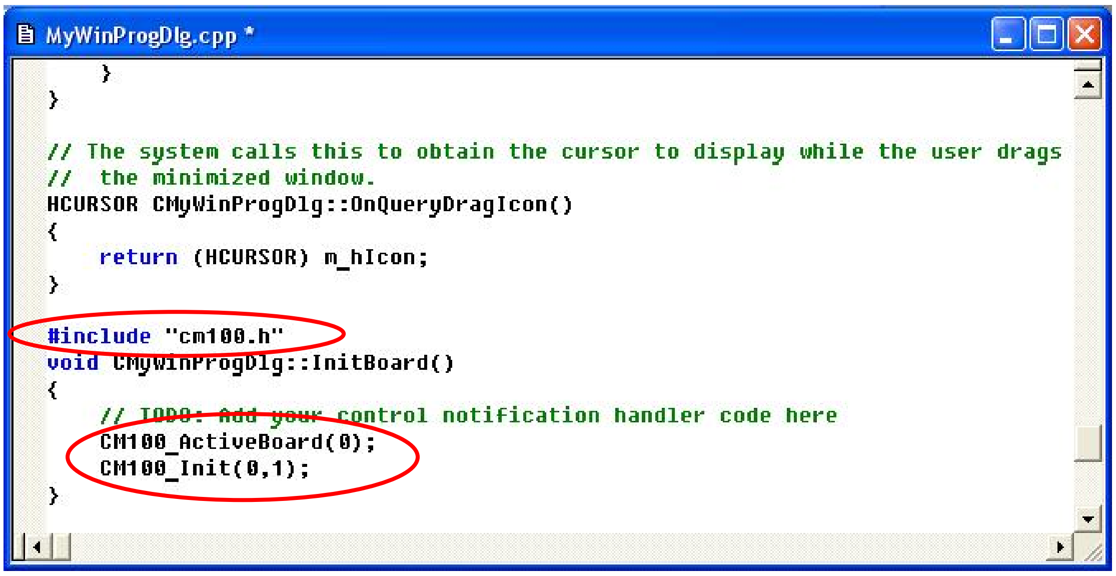
Step24: Double click the button "Init Board", and key the characters "InitBoard" for creating a member function. Click the OK button to continue.


MyWinProg.rc - IDD_MYWINPROG_DIALOG [English (U.S.)] (Dialog)
MyWinProg
Init Board
OK
Cancel
Add Member Function

Member function name: InitBoard

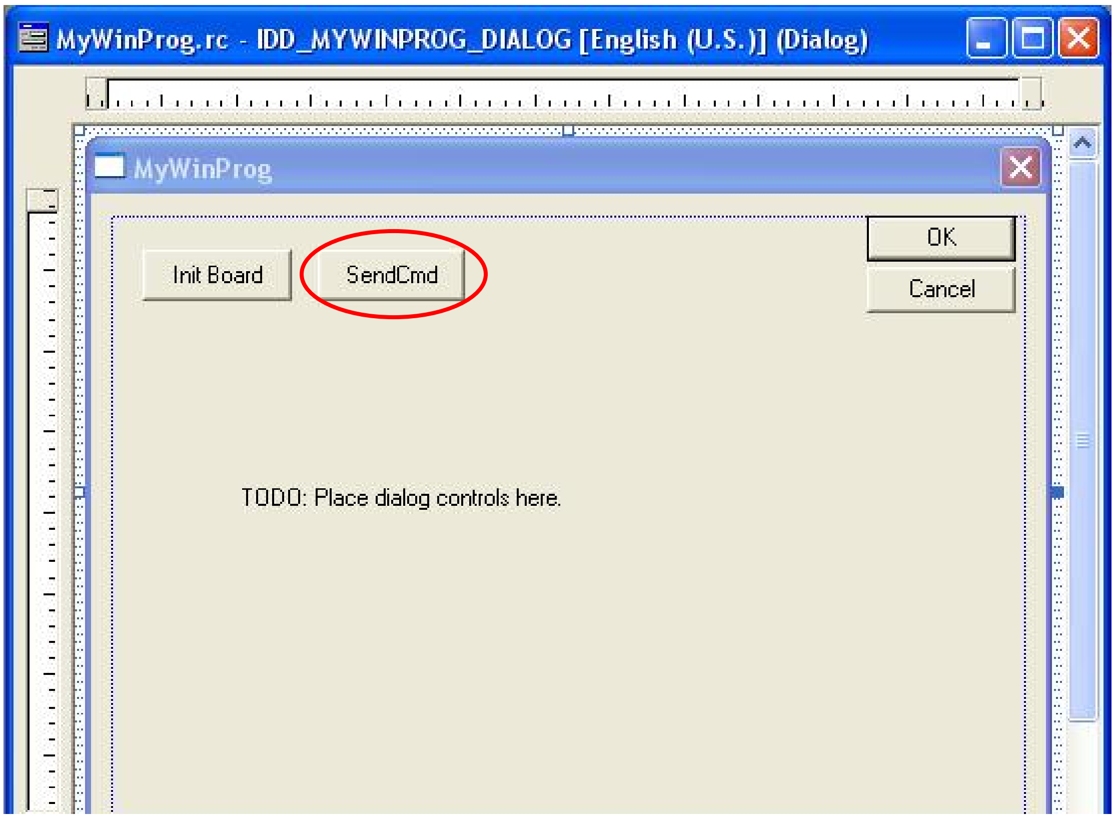
Message: BN_CLICKED
Object ID: IDC_BUTTON2

Step25: Add the codes in the member function.

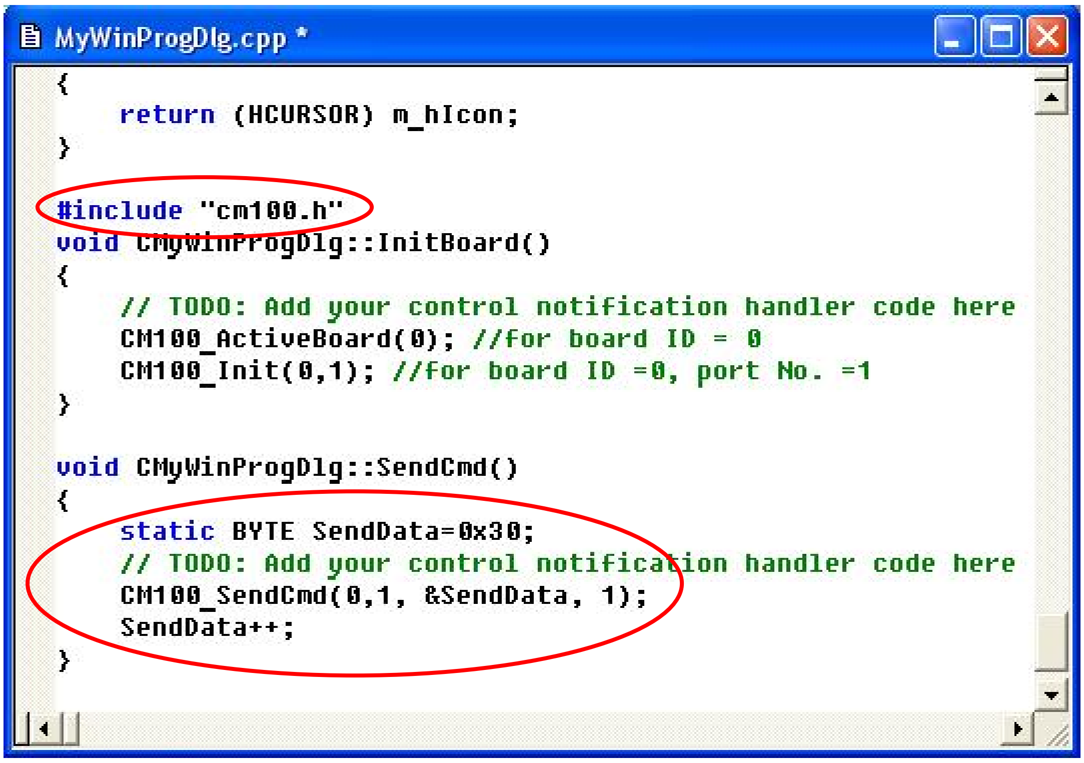


```
    }
}

// The system calls this to obtain the cursor to display while the user drags
//  the minimized window.
HCURSOR CMyWinProgDlg::OnQueryDragIcon()
{
    return (HCURSOR) m_hIcon;
}

#include "cm100.h"
void CMyWinProgDlg::InitBoard()
{
    // TODO: Add your control notification handler code here
    CM100_ActiveBoard(0);
    CM100_Init(0,1);
}
```

Step26: Repeater Step 22 to Step 25 to create another button named as "SendCmd", and add a member function named as "SendCmd" for this button.

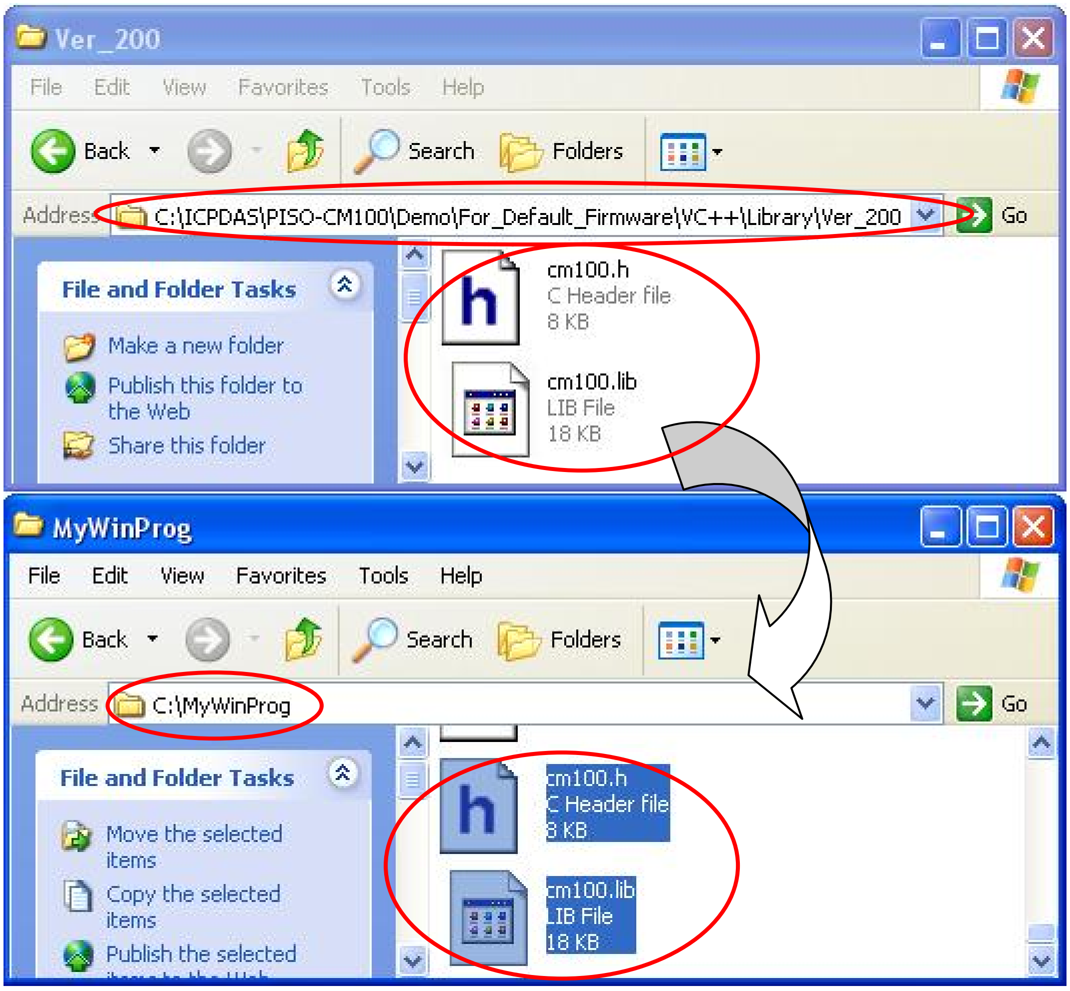

MyWinProg.rc - IDD_MYWINPROG_DIALOG [English (U.S.)] (Dialog)
MyWinProg
Init Board
SendCmd
OK
Cancel
TODO: Place dialog controls here.

Step27: The codes of the member function are as follows.

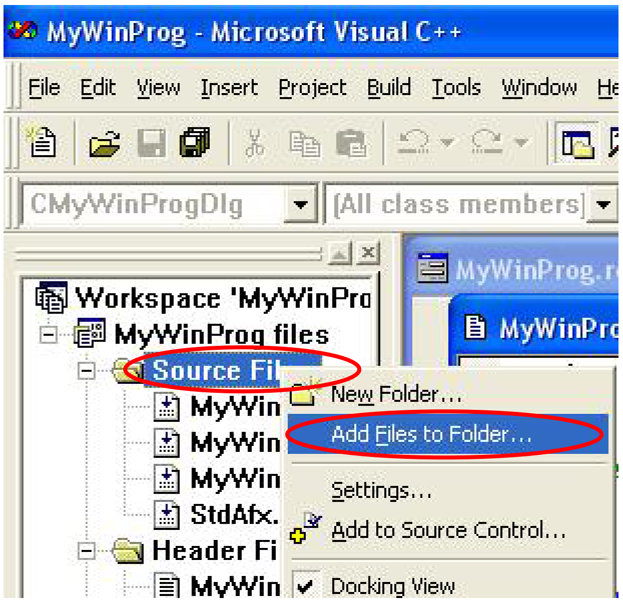


```
{
    return (HCURSOR) m_hIcon;
}

#include "cm100.h"
void CMyWinProgDlg::InitBoard()
{
    // TODO: Add your control notification handler code here
    CM100_ActiveBoard(0); //for board ID = 0
    CM100_Init(0,1); //for board ID =0, port No. =1
}

void CMyWinProgDlg::SendCmd()
{
    static BYTE SendData=0x30;
    // TODO: Add your control notification handler code here
    CM100_SendCmd(0,1, &SendData, 1);
    SendData++;
}
```

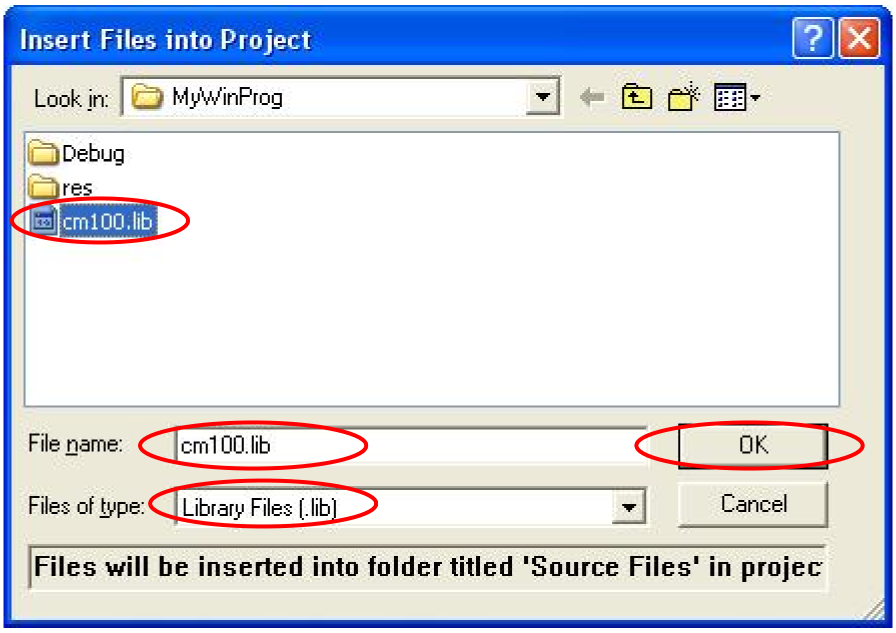
Step28: Copy the cm100.h and cm100.lib files to the folder of the project. You can find the two files in the PISO-CM100U driver installation path.



Step29: In order to add the CM100.lib into your project. Right click on the "Source File" item. Select the "Add Files to Folder" item.



Step30: Select the "Files of type" to the "Library Files (.lib)" first. Add the cm100.lib into your project. Click the OK button to continue.


Insert Files into Project

Look in: MyWinProg

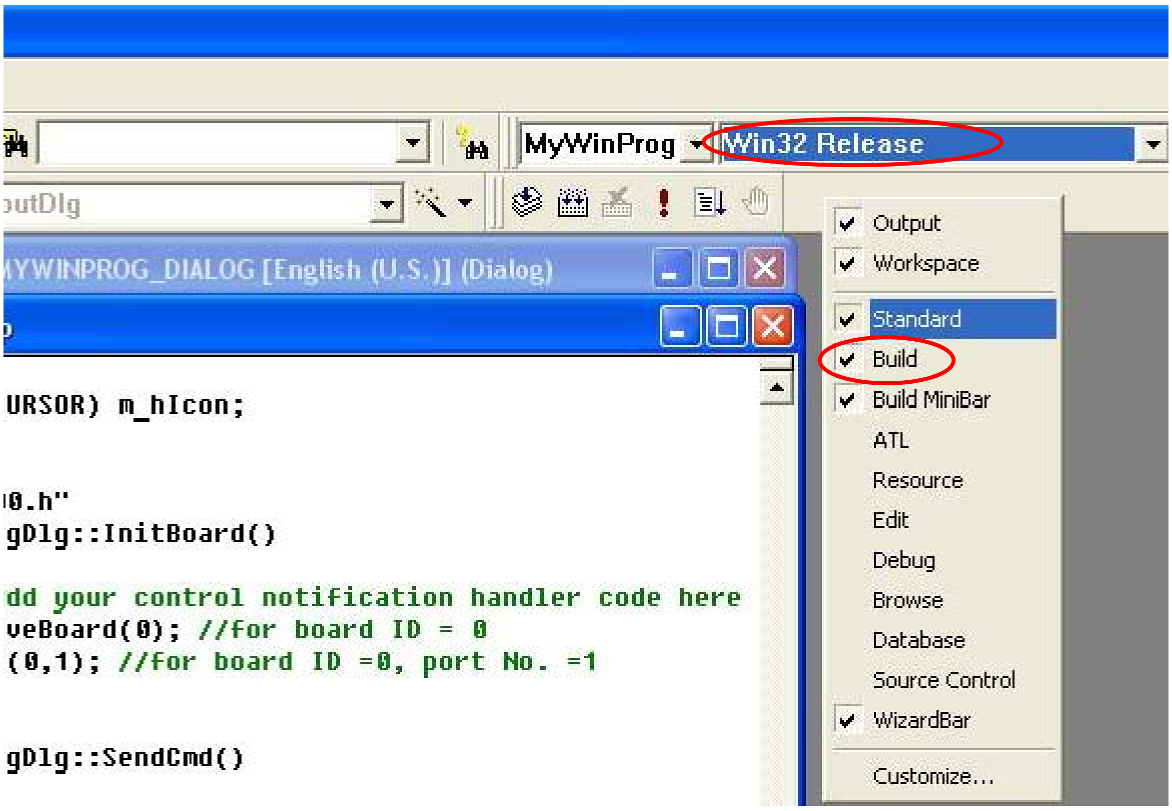
Debug
res
cm100.lib

File name: cm100.lib

Files of type: Library Files (.lib)

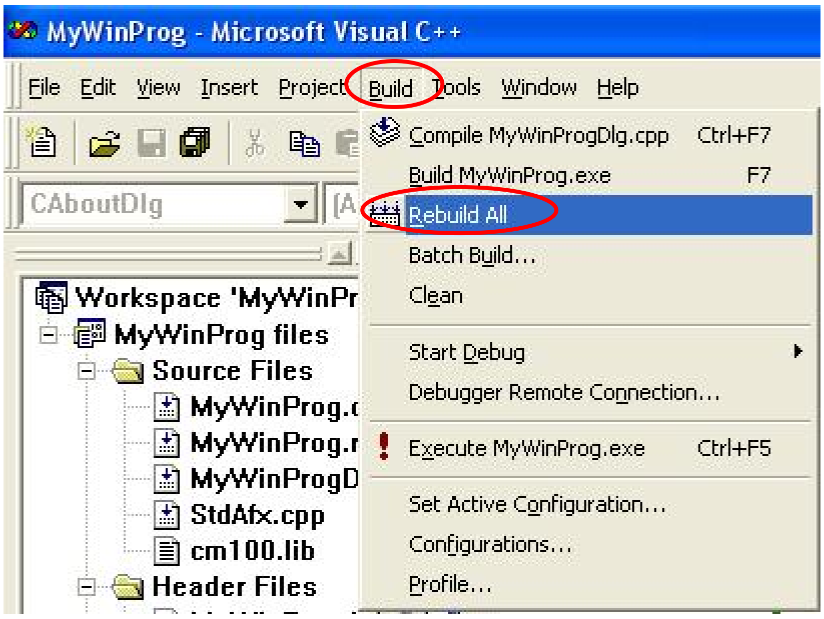
Files will be inserted into folder titled 'Source Files' in projec

Step31: In the space of the toolbar, right click to add the "Build" toolbar. Select the "Win32 Release".

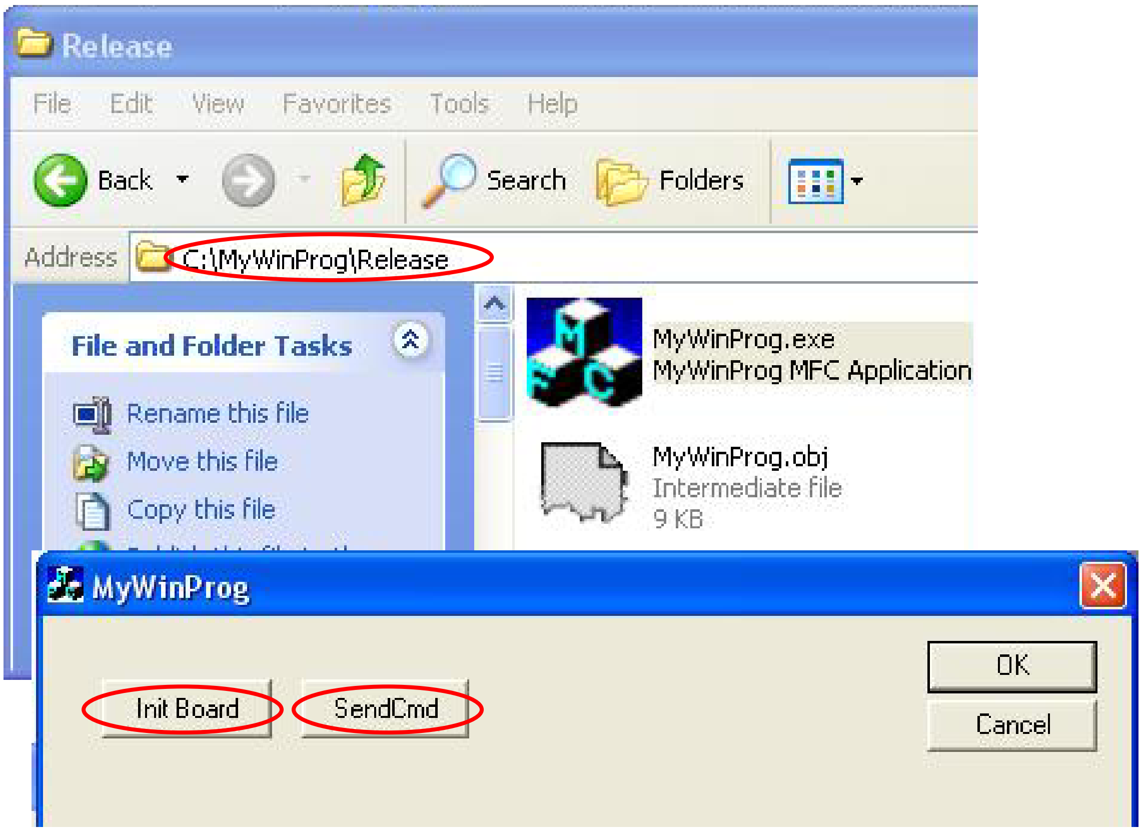

MyWinProg
Win32 Release
utDlg
YWINPROG_DIALOG [English (U.S.)] (Dialog)

```
URSOR) m_hIcon;


0.h"
gDlg::InitBoard()

dd your control notification handler code here
veBoard(0); //for board ID = 0
(0,1); //for board ID =0, port No. =1


gDlg::SendCmd()
```

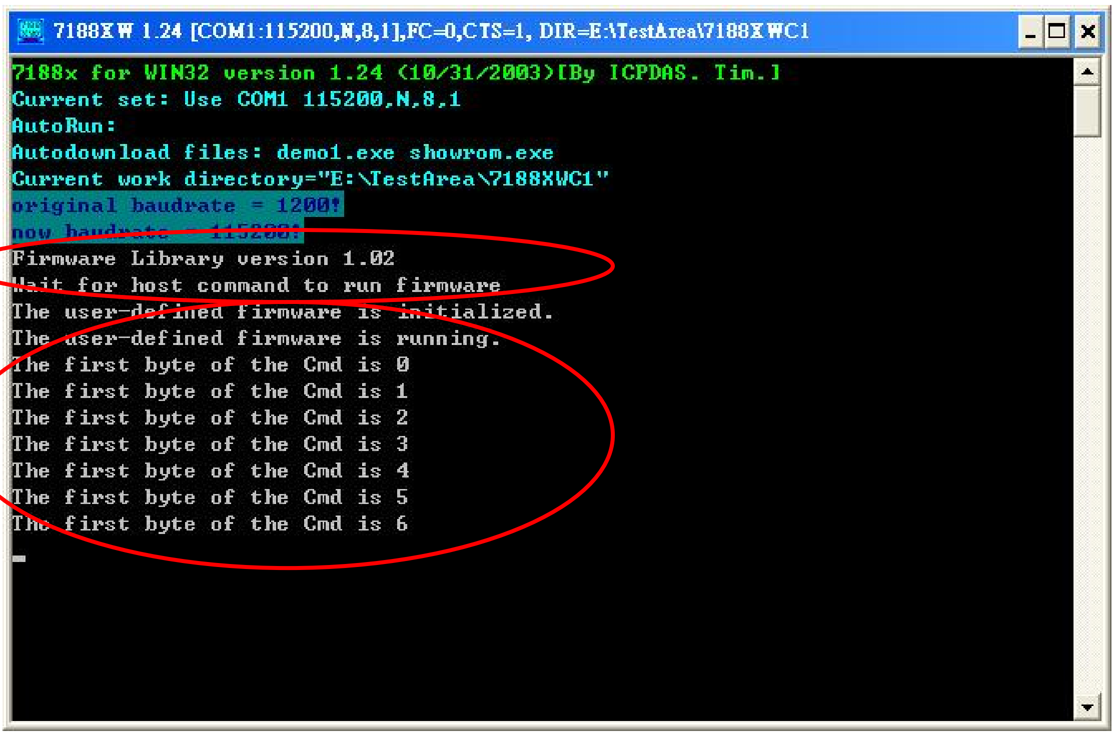
Step32: Select the “Build/Rebuild All” in the menu to compile the project.



Step33: Set the CAN board ID to 0, and run the MyWinProg.exe in the Release folder of the project. Click the “Init Board” button first. Then, use the “SendCmd” button to send the command to the user-defined firmware.



Step34: Each click on the “SendCmd” button of the Windows program sends a command to the user-defined firmware, and the command will be caught by the user-defined firmware. The first two lines of the debug information are shown by the CAN board system. The other debug messages are shown by the user-defined firmware.


7188XW 1.24 [COM1:115200,N,8,1],FC=0,CTS=1, DIR=E:\TestArea\7188XWC1

```
7188x for WIN32 version 1.24 (10/31/2003)[By ICPDAS. Tim.]
Current set: Use COM1 115200,N,8,1
AutoRun:
Autodownload files: demo1.exe showrom.exe
Current work directory="E:\TestArea\7188XWC1"
original baudrate = 1200!
now baudrate = 115200!
Firmware Library version 1.02
Wait for host command to run firmware
The user-defined firmware is initialized.
The user-defined firmware is running.
The first byte of the Cmd is 0
The first byte of the Cmd is 1
The first byte of the Cmd is 2
The first byte of the Cmd is 3
The first byte of the Cmd is 4
The first byte of the Cmd is 5
The first byte of the Cmd is 6
```