EMBC1000-USB1553B-1

User Manual

(Simplified V 1.1)

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User's Manual Information

This document contains the simplified User Manual of EMBC1000-USB1553B-1 device.

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Application of EMBC1000-USB1553B-1

EMBC1000-USB1553B-1 is a USB based device that provides new levels of performance and flexibility for systems interfacing to 1553B data bus, including data transmission, data receiving, real-time data display, data recording and replay, etc..

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Chapter 1 Overview

1.1 About EMBC1000-USB1553B-1

Figure 1-1 EMBC1000-USB1553B-1 Device

The EMBC1000-USB1553B-1 is multi-protocol USB Device that provides new levels of performance and flexibility for systems that interface to a MIL-STD-1553B data bus. Each 1553 channel can emulate a Bus Controller, a Remote Terminal, or a Bus Monitor.

EMBC1000- USB1553B-1 device is powered by an external power supply --- +12VDC power adaptor.

The EMBC1000-USB1553B-1 device comes with driver software, API (Application Programming Interface) library and user oriented application software, running under Windows 2000, Windows XP. The user oriented application software has been designed with the capabilities of simulating the outputs of various airborne systems, receiving inputs from these systems. API library is also provided together with example source code (Visual C++), which allows users to easily develop their own application software or project.

The manual uses Symbols and icons:

The Warning icon presents information pertaining to hazards that will cause damage to the product and possible injury to the user.

The Caution icon identifies important information that presents a possibility of damage to the product if not heeded.

The Note icon signifies important supplementary information that will be useful to the user.

1.2 Applications

EMBC1000-USB1553B-1 device is well suited for all types of ground support work (development, manufacturing test, on-site maintenance, etc.), as well as on-board data acquisition. LRU developers find that this device provides easy access for simulating and/or testing new systems prior to use with actual flight systems. Avionics maintenance and validation teams enjoy on-site testing and analysis with this device. It also used in sensor and control systems including prototype passenger cars, oil platforms subway control systems and the International Space Station.

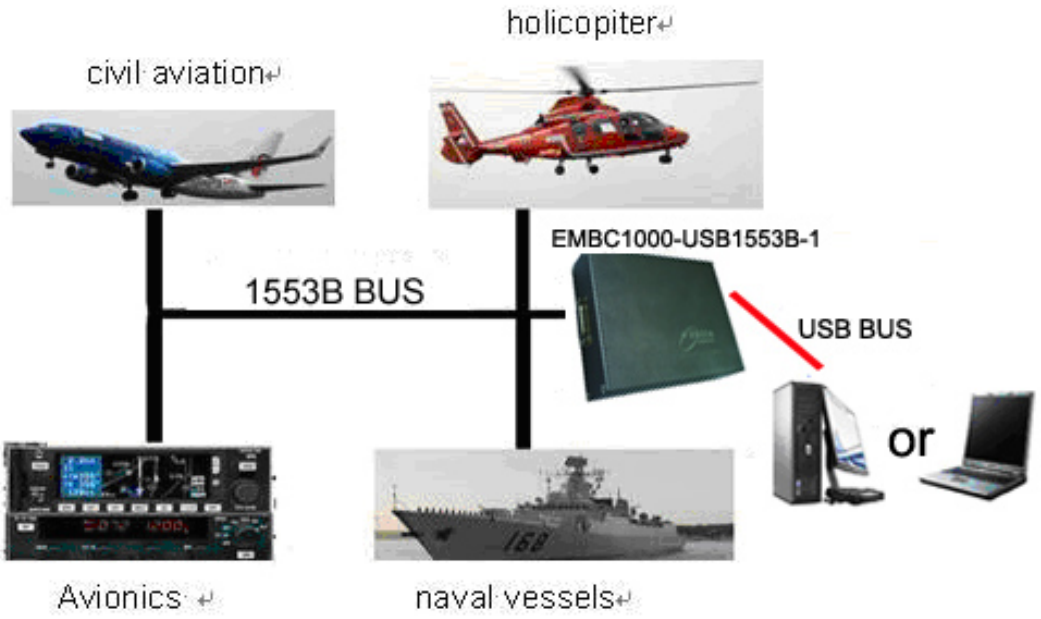

Figure 1-2 Wide Applications

1.3 Characteristics

EMBC1000-USB1553B-1 device come in single-function configurations. Single-function

device allow operation in only one of the three 1553 modes at a time: Bus Controller, Bus Monitor, or Remote Terminal (up to 31 RTs). Although all three modes are available, the board can operate only in one mode at one time.

EMBC1000-USB1553B-1 device features with the following characteristics:

- USB 2.0 or USB1.1 Interface with PC
- Supports the six major categories of message types:
  - BC → RT
  - RT → BC
  - RT → RT
  - Broadcast
  - Mode code
  - Broadcast　Mode code
- Enhanced BC/RT/BM Architecture
  - Supports MIL-STD-1553 A and B Notice 2
  - Transformer or Direct Coupled 1553B Channels
  - 64K-bytes RAM
  - One A/B Dual Redundant Mil-STD-1553 Channel
  - Programmable selected one of BC、RT or BM mode
  - Data Rate 1MHz
  - Programmable Time Tag resolution
  - Bus Controller
    - Programmable Message automatic retries
    - Programmable Frame Time
    - Loop and Single-shot for BC operation
    - Supports multiple Mode Codes
    - Programmable Response time-out and late response
    - Insert periodic messages into a running BC list
    - Supports Error detection
    - Supports Message Data and Status display
    - Supports Setting options and Data saved
  - Remote Terminal
    - One RT simulation
    - Programmable RT ID、Subaddress ID and Mode Code ID
    - Programmable Status Word
    - Programmable RT-RT response time
    - Selectable Broadcast Mode
    - Supports Setting options and Data saved
  - Bus Monitor
    - Capture 100% fully loaded bus traffic with:

      DATA、Time-tagging、 Error status、Word status、 Message status and RT response time
    - Filtering by Subaddress、transmit or receive

  - — Individual DATA and COMMAND Stacks
  - — 32bit, microsecond resolution time-tagging
- Includes high-level API libraries for Windows 2000, XP and Source code
- USB1553B GUI bus analyzer provided
- Power:+12VDC:500mA
- Physical Size: 135mmx114mmx33mm(Length x Width X High)
- Operating temperature range: -40℃～+85℃

1.4 System Requirements

For a single-user system, EMBC1000-USB1553B-1 requires the following:

An IBM compatible PC equipped with USB 2.0 or USB1.1 Interface, Pentium processor 1.6GHz or better CPU, 2-Gbyte Minimum Hard Disk , 256-Mbyte Minimum RAM; CD-ROM drive, monitor, Windows XP or Windows 2000, etc.. Shall be required for installing the USB device and the associated software.

A cable assembly is required to interface to the 1553B bus target hardware or other discrete channels.

1.5 Resources on CD-ROM

The resources on CD-ROM include:

Directory: G:\ (assume G:)

\setup
USB1553B.exe data analysis executable file
1553DLL.dll
1553DLL.lib
setup.exe setup file

\UserDesign for user's development use
\Include
EMBCAPI.h
\Lib
1553DLL.dll
1553DLL.lib
\Samples
\VC++
\BCDemo1
\RTDemo1
\BMDemo1

\Doc

EMBC1000-USB1553B-1 User Manual.pdf User manual

\Driver
\WINDOWS
\driver
EMBC1000-USB1553B.sys
EMBC1000-USB1553B.inf

\training Video files to show the operations
\BC.avi
\RT.avi
\BM.avi
\INSTALL.avi

1.6 Special Handlings and Cautions

Since EMBC1000-USB1553B-1 device uses state-of-the-art components and connectors, properly handlings and cares must be taken to ensure that the device will not be damaged by Electrical Static Discharge (ESD), physical shock, or improper power surges.

- Turn off power to the PC completely;
- NEVER insert or remove device with power turned on;
- Ensure that standard ESD precautions are taken. At least, one hand should be grounded to the power supply in order to eliminate static potentials;
- Do not store the device in environment exposed to excessive heat, magnetic fields or radiation.

Chapter 2 1553B Bus Networking

2.1 Interface Description

The EMBC1000-USB1553B-1 interface description as shown in Figure2-1

Figure 2-1 Interface Description

Power Input:

+12VDC/500mA power adaptor input (the adaptor works between 100VAC and 240VAC).

RESET:

This key-press can be used to generate a system reset.

LED Indication：

POWER LED: Power indicator, GREEN or OFF

GREEN color when power is ON, OFF when power to the device is ABNORMAL;

STATUS LED: Device RUN status indicator, RED, Blinking RED, Blinking GREEN, BLUE or OFF

Table 2-1 *STATUS LED* Description

STATUS LED	Description
OFF	*Power Down or self-testing failure*
RED	*USB device has not been enumerated*
BLUE	*USB device has been enumerated*

Blinking GREEN	*1553B communicate activity*
Blinking RED	*1553B communicate error*

USB interface:

Standard USB 2.0 and USB1.1 port

J1: 1553B Bus Connector, Figure 2-2 show J1 and 1553B Connect Cable

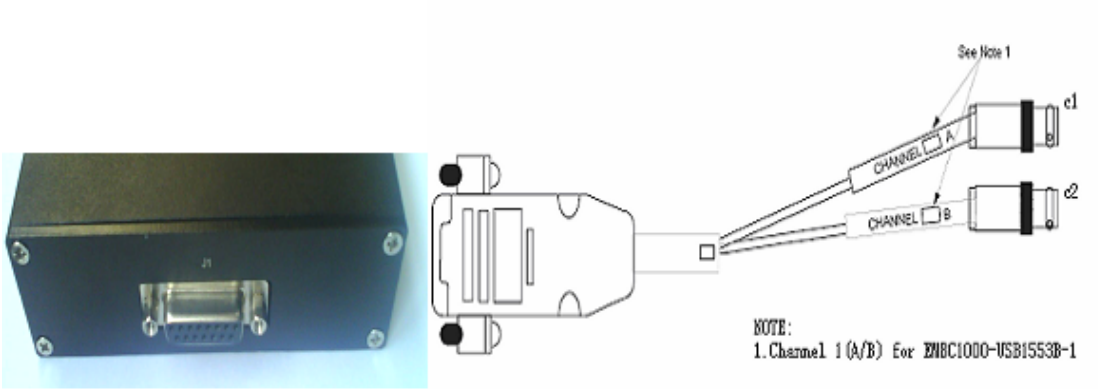

Figure 2-2 1553B Bus Connector and Cable

C1 and C2 are TRB-0102 connector, Channel A and Channel B which can provide the link to outside 1553B network.

Table 2-2 J1:1553B Bus Connector Pin Definition

Pin	Signal	Direction	Description
1	1553B_CHAN	I/O	MIL-STD-1553B bus driver A, negative signal
2	1553B_CHA	I/O	MIL-STD-1553B bus driver A, positive signal
3	GND		POWER GND
4	NC		
5	NC		
6	GND		POWER GND
7	NC		
8	NC		
9	GND		POWER GND
10	GND		POWER GND
11	GND		POWER GND
12	GND		POWER GND
13	1553B_CHB	I/O	MIL-STD-1553B bus driver B,positive signal
14	1553B_CHBN	I/O	MIL-STD-1553B bus driver B,negative signal
15	GND		POWER GND

EMBC1000-USB1553B-1 allows two software configurable bus coupling modes to connect it to the 1553B network:

- **Transformer coupling:** it can provide better isolation over long distances and noise immunity, in this mode, the external transformer couplers are needed.
- **Direct coupling:** this mode is often used in the laboratory and it do not require transformer couplers supported. But cable length less than 30 cm

2.2 1553B Cables and Connectors

The cables used for 1553B bus and stub connections are two-conductor twisted pair wires with twin-axial connectors.

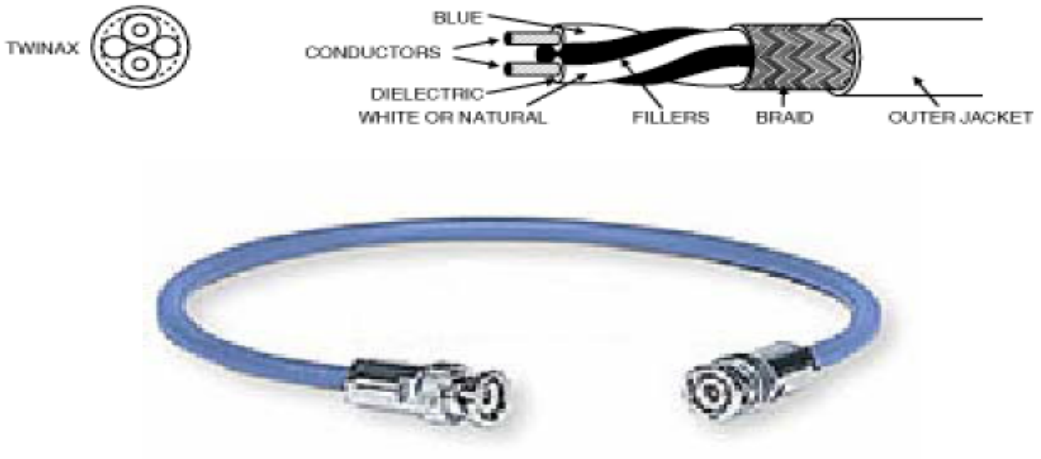

Figure 2-3 1553B Cables and Connector Description

For the twin-axial connector, the center pin is the POSITIVE signal (connect the blue conductor of 1553B cable), and the ring is the NEGATIVE signal (connect the white conductor of 1553B cable). The shield is connected to ground.

2.3 1553B Networking

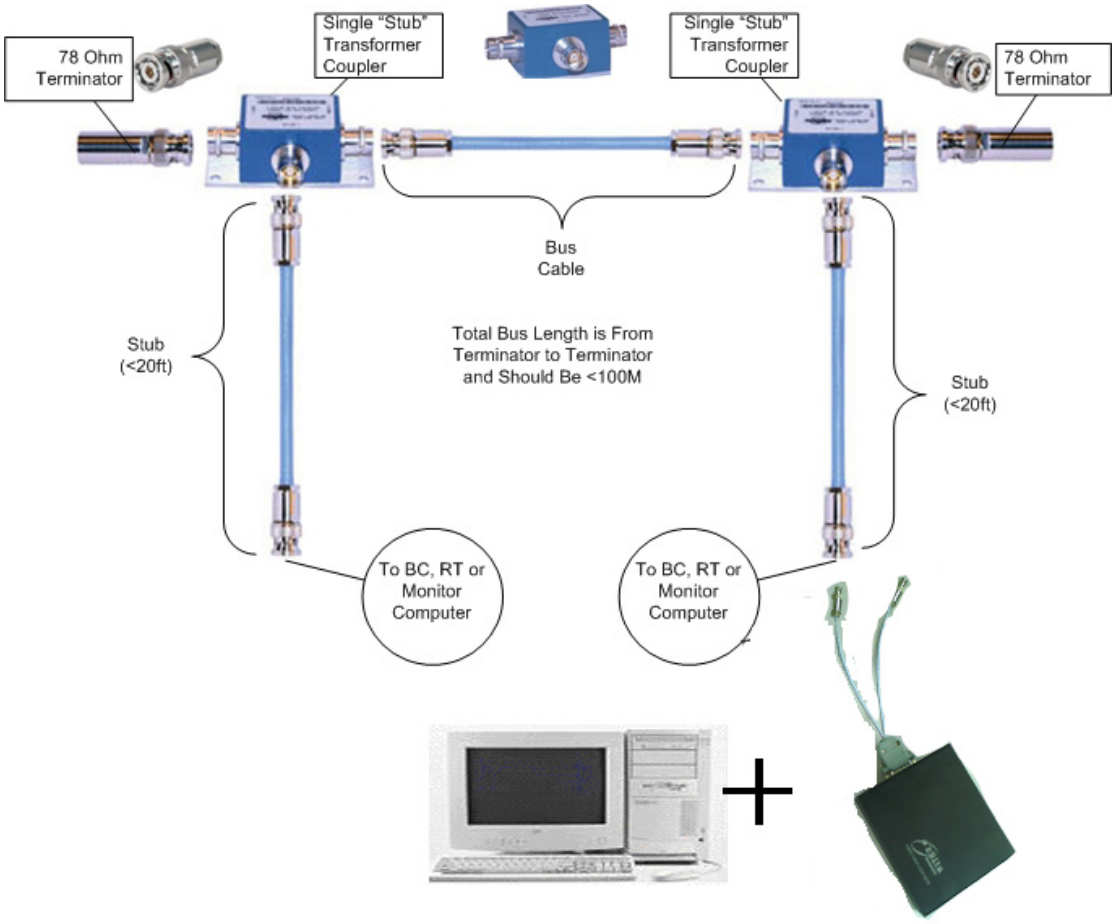

Figure 2-4 1553B Networks

Chapter 3 OPERATION AND SETUP

3.1 Hardware Installation

1. Connect the EMBC1000-USB1553B device to PC with the USB cable

2. Turn on the power adaptor (+12VDC)

3. Insert the provided CD-ROM into you PC with Windows XP/2000, now you are ready to install the drivers onto your PC

4. After the device has been installed into your PC, turn off the power, you should assemble the 1553B cables, and built the link between your device and the 1553B network

3.2 Software Driver Installation

When the hardware installation done, you need to install “Board oriented drivers” software from the provided CD-ROM, which are designed to run under Windows XP or Windows 2000.

Once EMBC1000-USB1553B-1 device installed into your PC, and the computer is powered on, the PC will perform the detection for all new hardware, and the “Add Hardware Wizard” window will be opened automatically (Figure 3-1).

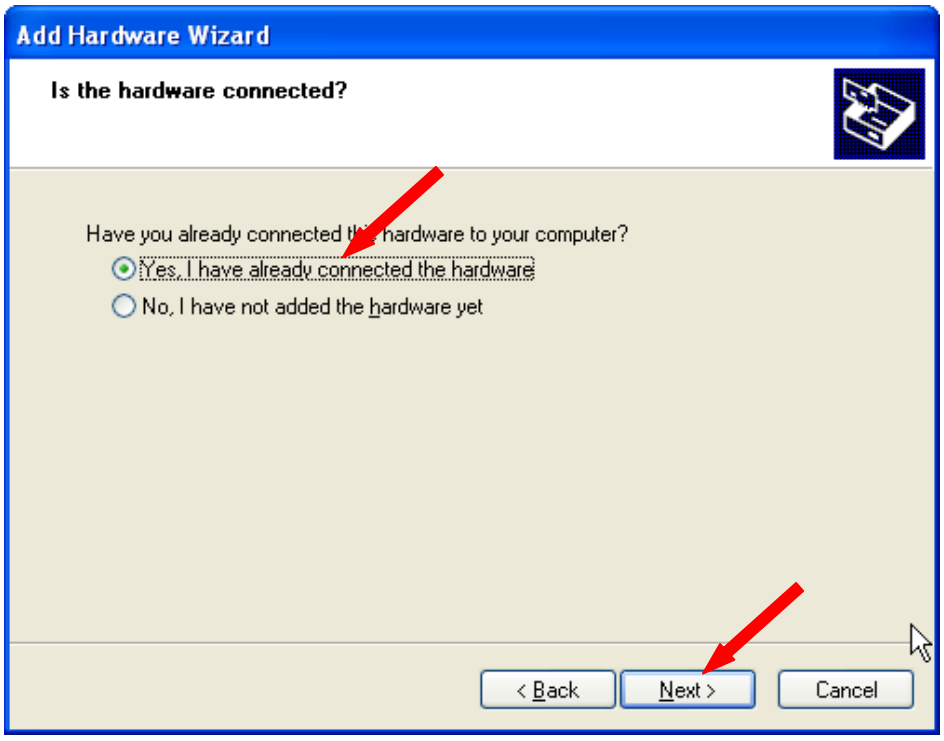

Figure 3-1 Add Hardware Wizard window

Choose "**Yes, I have already connected the hardware**", then click the "**Next**" button, you will get:

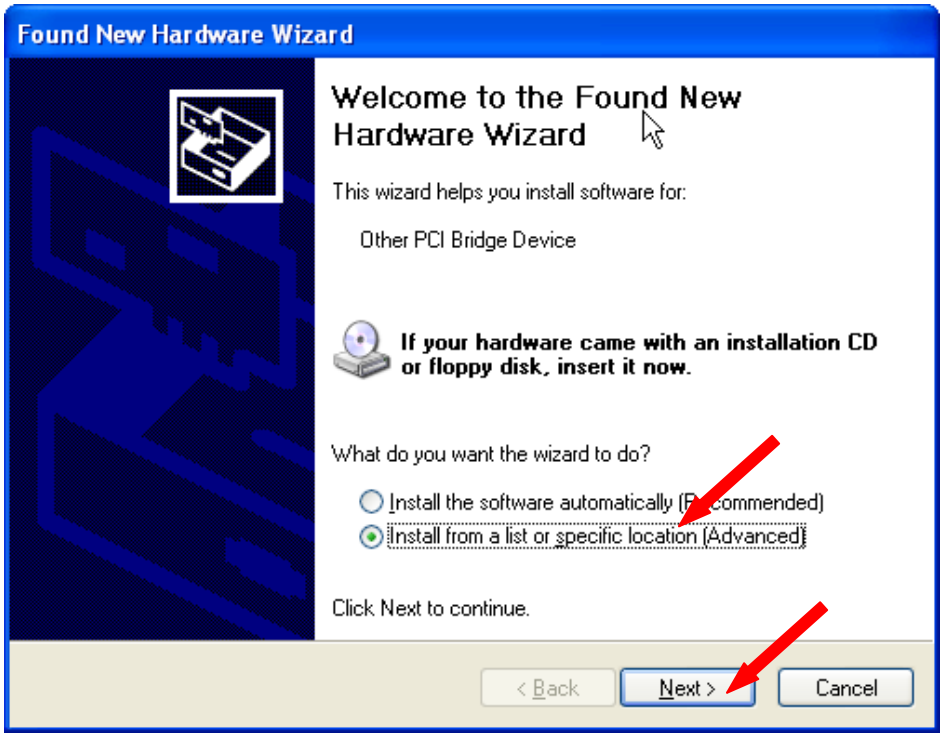

Figure 3-2 Welcome to the Found New Hardware Wizard

Choose "**Install from a list or specific location (Advanced)**", then click the "**Next** "button, you will be asked to choose:

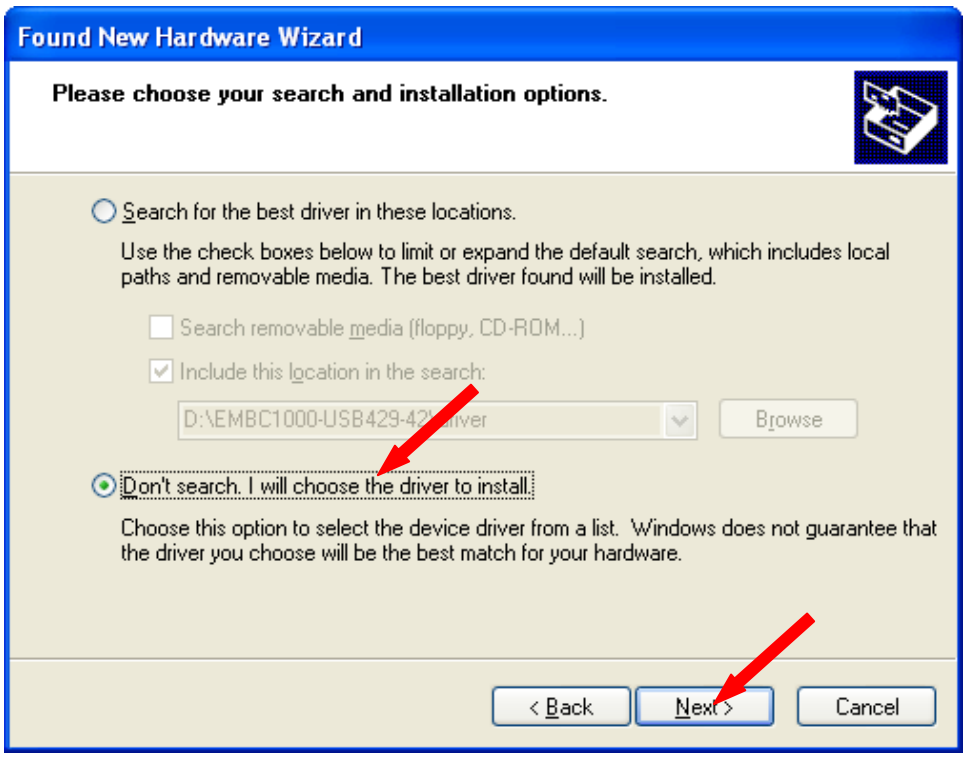

Figure 3-3 Please choose your search and installation options

Choose "**Don't search. I will choose the driver to install**", then click the "**Next**" button, you will guide to:

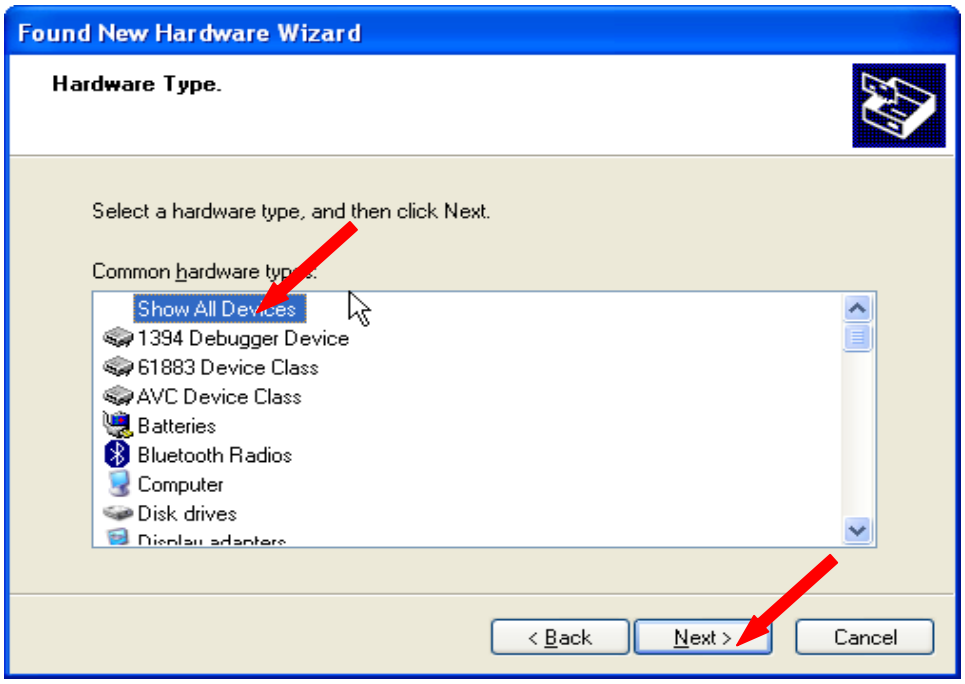

Figure 3-4 select a hardware type

Choose "**Show All Devices**", then click the "**Next**" button, you will be asked to select:

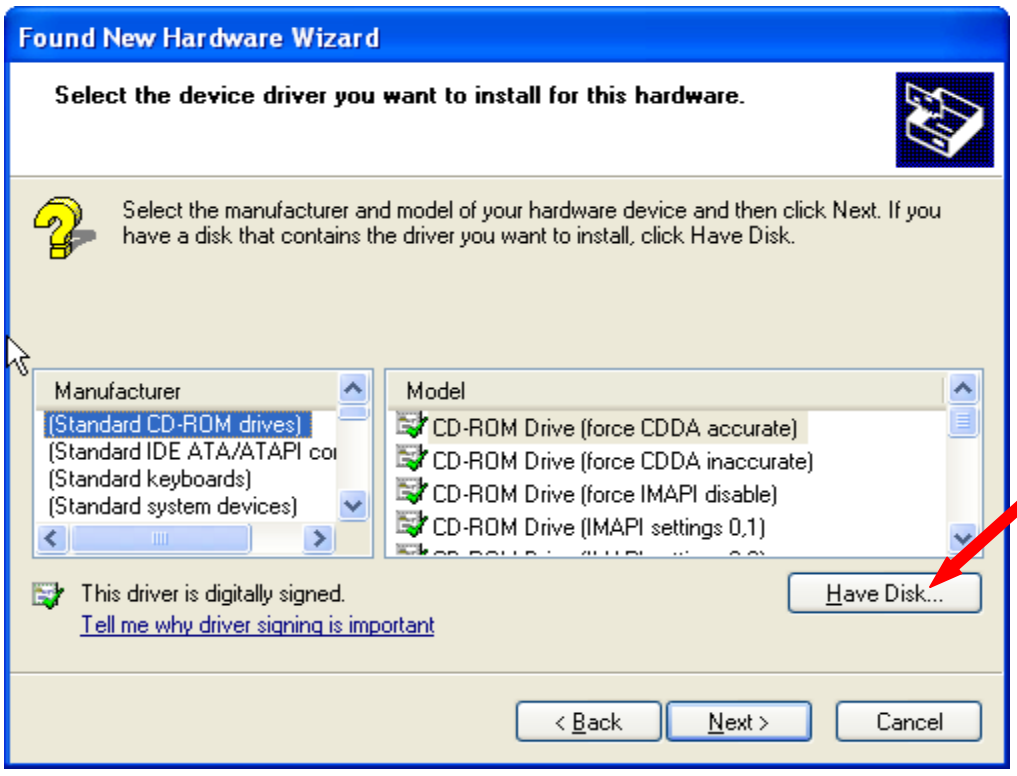

Figure 3-5 Select the device driver

Click"**Have Disk…**" you will get:

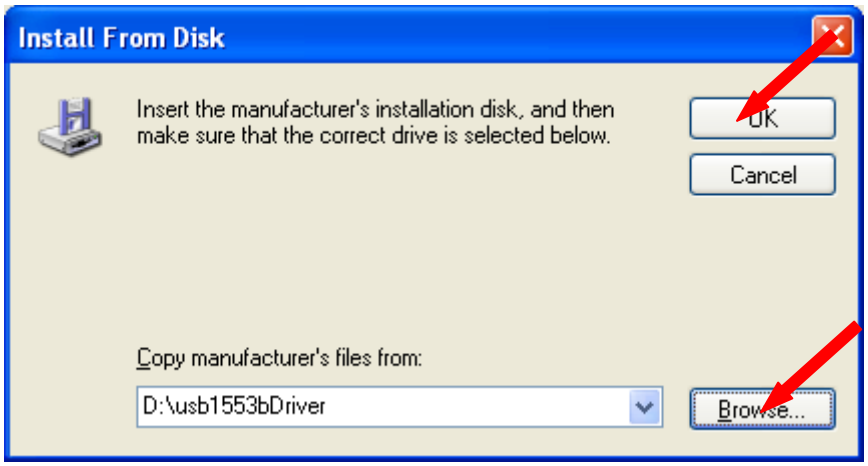

Figure 3-6 Install From Disk

Click"**Browse..**." button to locate the driver software "EMBC1000_USB553B_driver.inf" (you can find it on the CD-ROM, directory \Driver\WINDOWS\usb1553bDriver\), then click "**OK**" button, you will get:

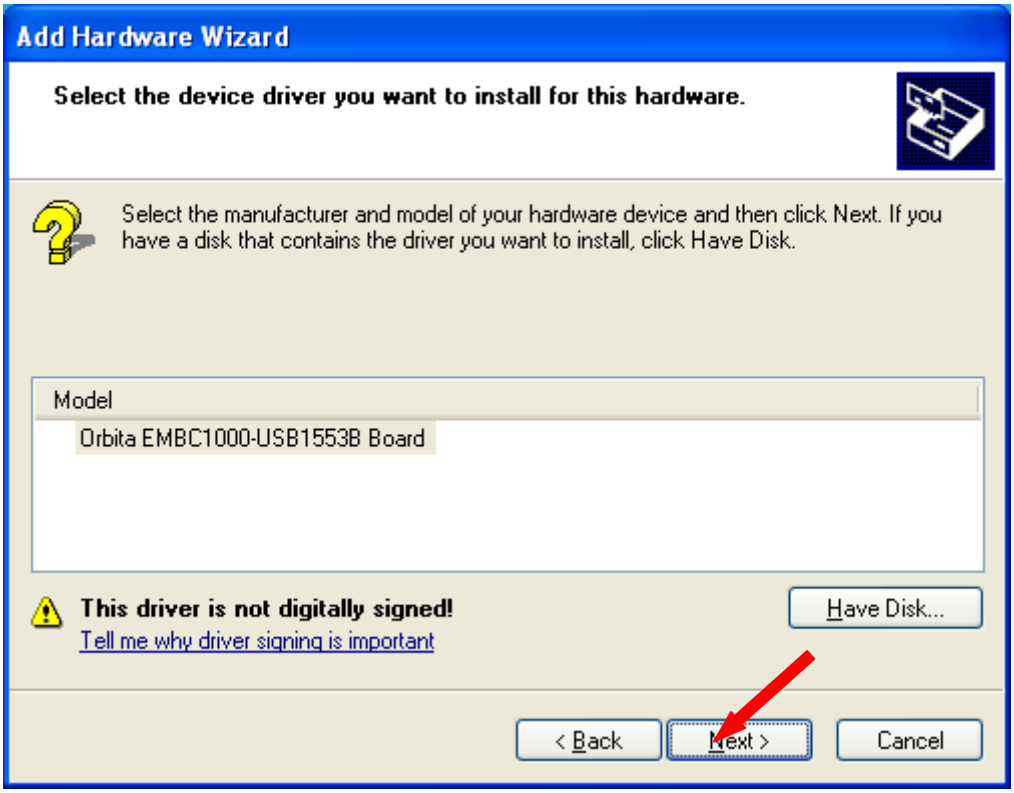

Figure 3-7 Select the device driver

Click "**Next**" button, you will get:

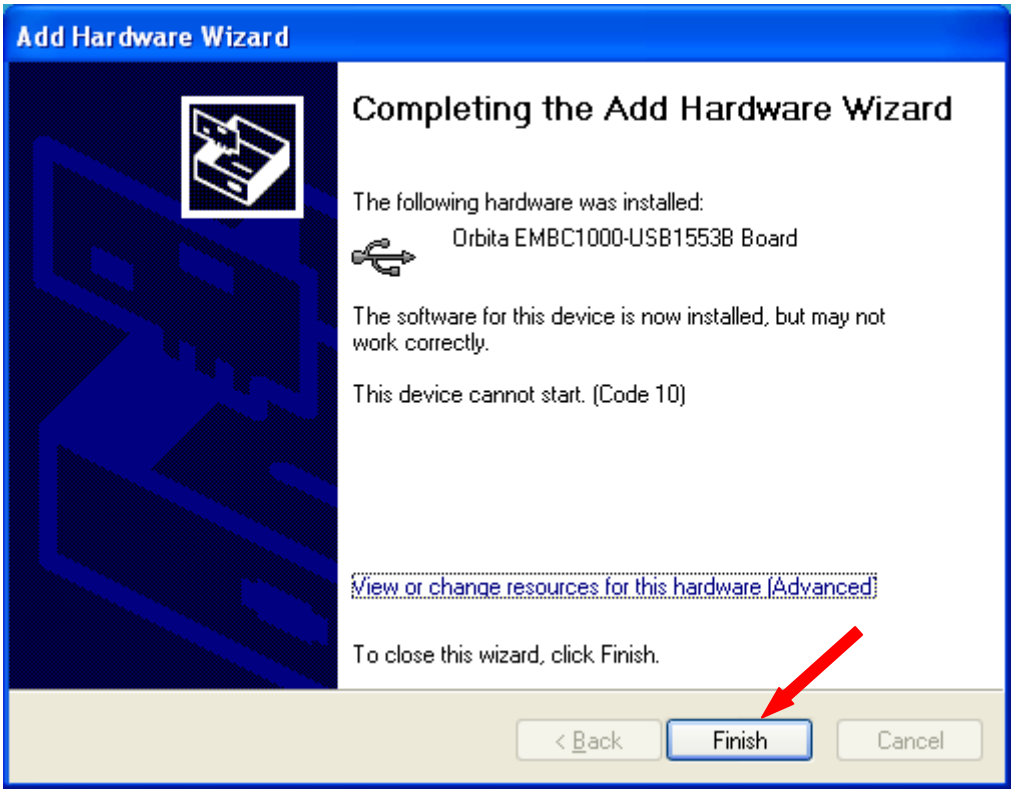

Figure 3-8 Finish

Click on "**Finish**" button to complete this installation procedure. Congratulations! Now you have installed the "Board oriented drivers" onto your PC successfully.

3.3 Application Software installation

Double click SETUP.EXE(you can find it on CD-ROM, \setup), then the setup initialization window will be opened, shown in Figure 3-9：

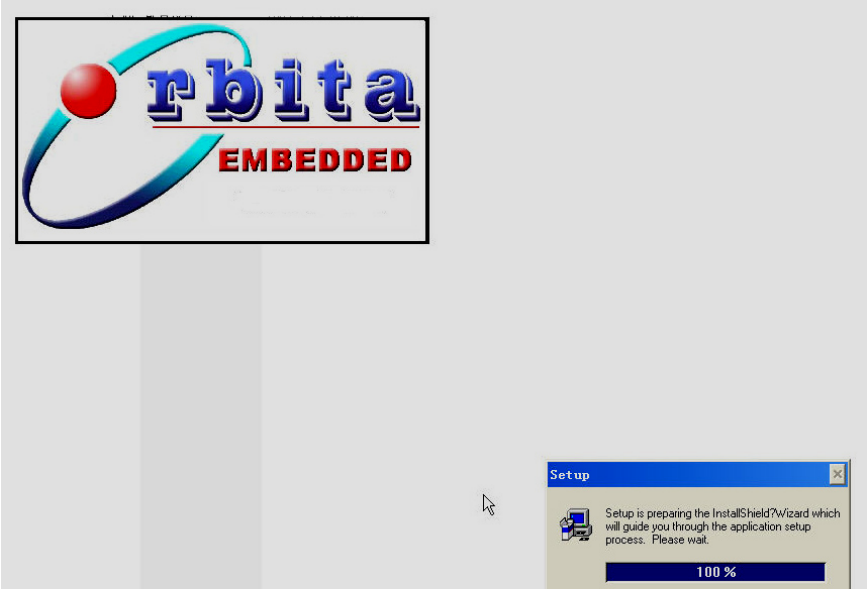

Figure 3-9 Application Software setup initialization windows

A moment later, the application software setup main window will be opened automatically, as shown in Figure 3-10.

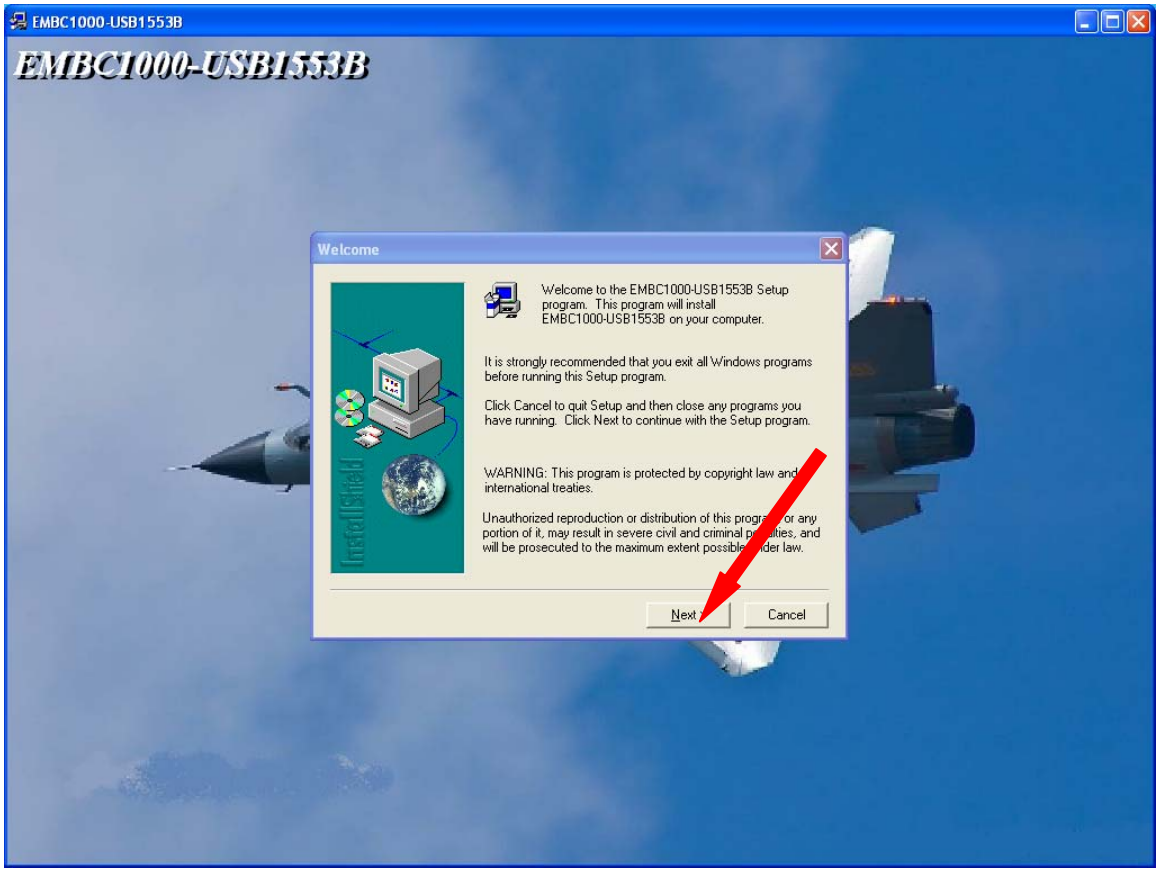

Figure 3-10 Setup main interface

Click the "**Next**" button, then the "Software License agreement" window will be get, as shown in Figure 3-11

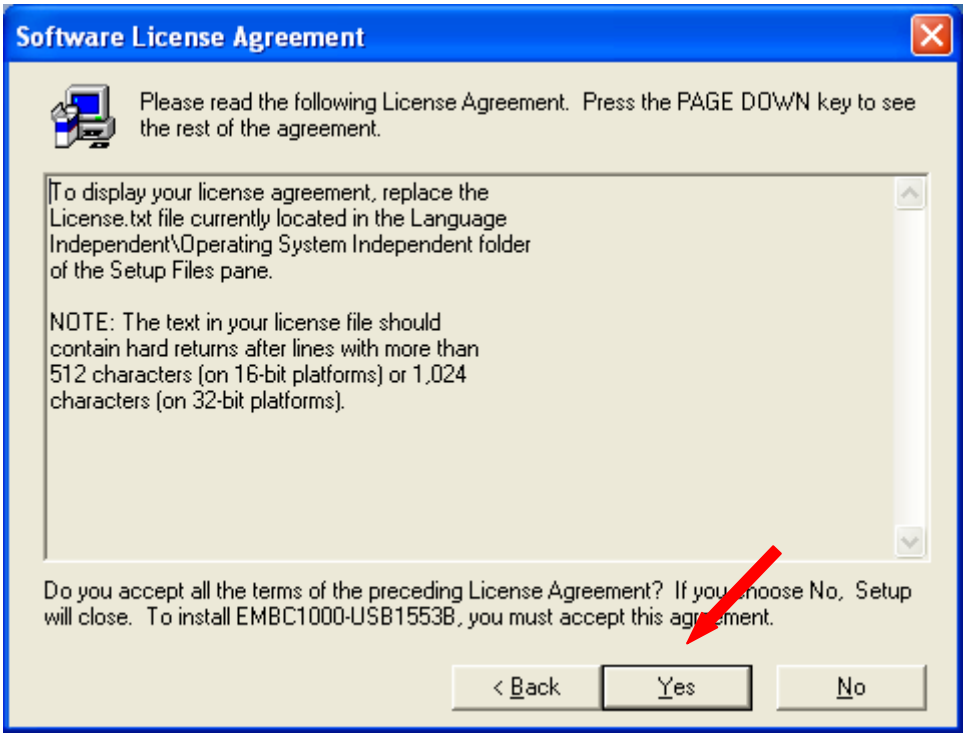

Figure 3-11 software License agreement

Click “Next”, you will get the “User Information” window, Figure 3-12.

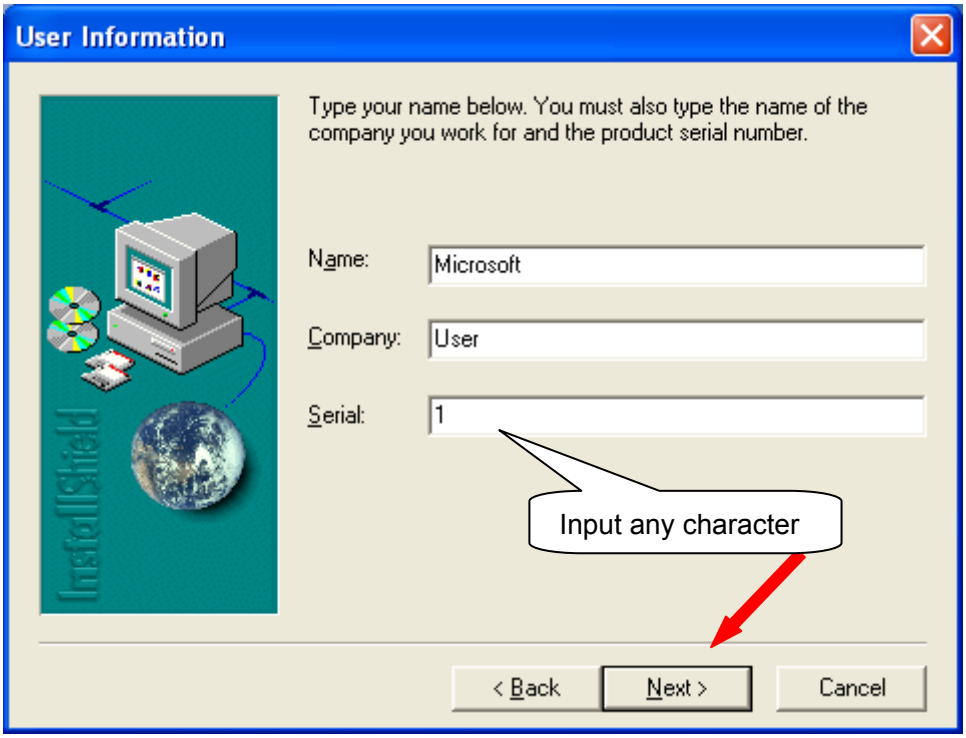

Figure 3-12 User Information

Fill in your own information, then click the **“Next”** button, you will get the “Choose Destination Location” window, Figure 3-13.

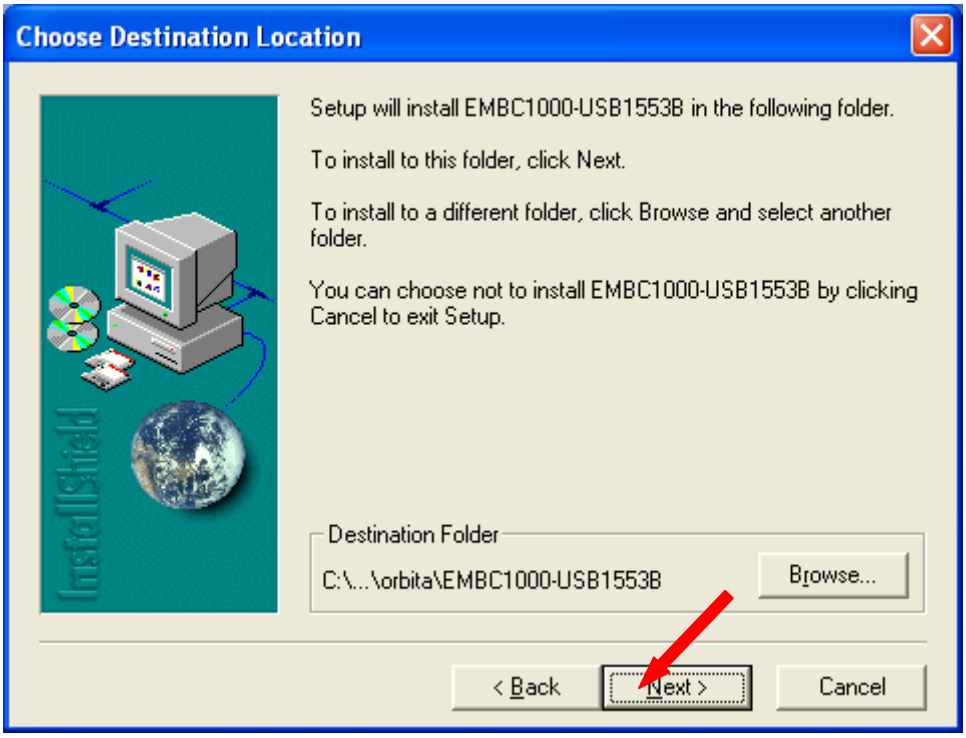

Figure 3-13 Choose Destination Location

Choose the location of the destination of the application software, then click the "**Next**" button, you will get the "setup type" window, as shown in Figure 3-14.

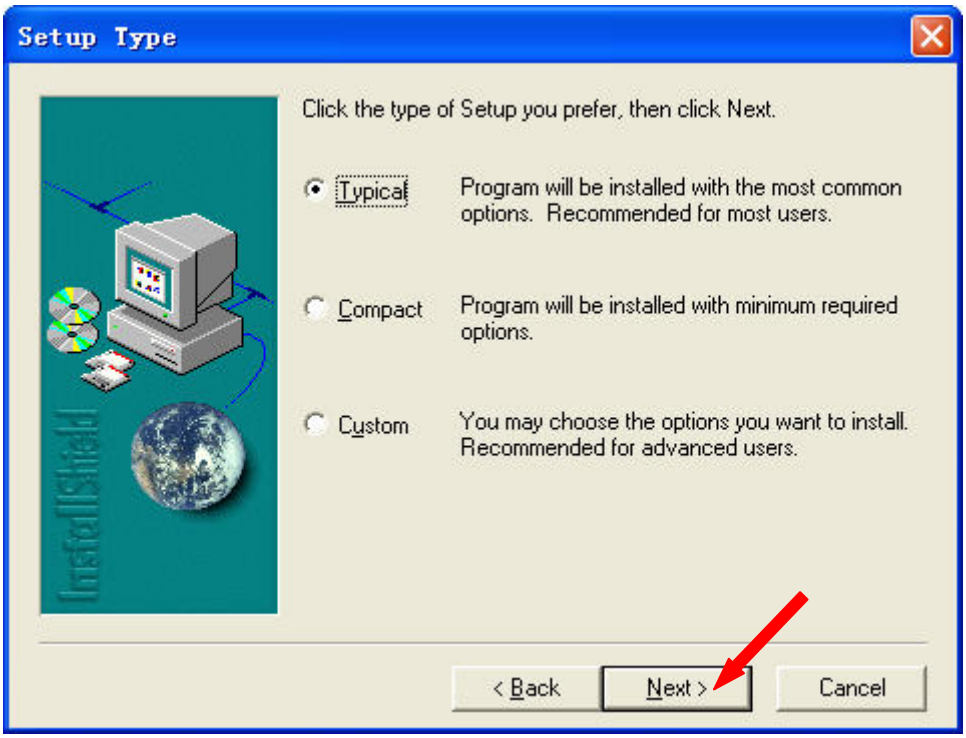

Figure 3-14 Setup Type

Choose a setup type, and then click "**Next**", you will get the "Select Program Folder"

window, as shown in Figure 3-15.

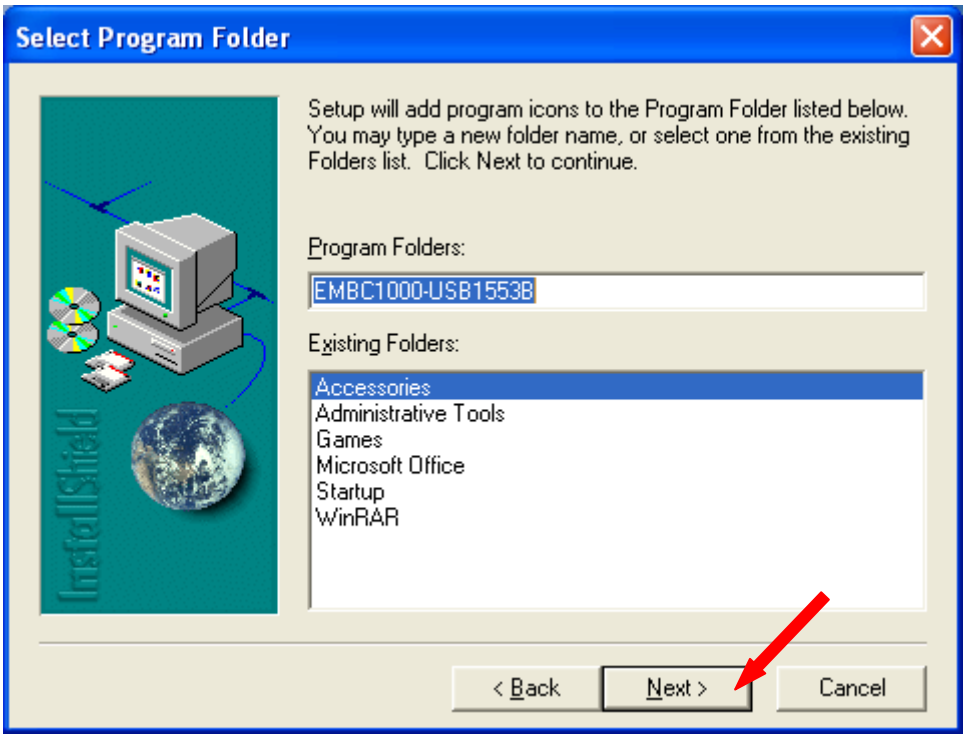

Figure 3-15 Select Program Folder

Fill in the “Program Folder”, and then click “**Next**”, the setup will be started, as shown in Figure 3-16.

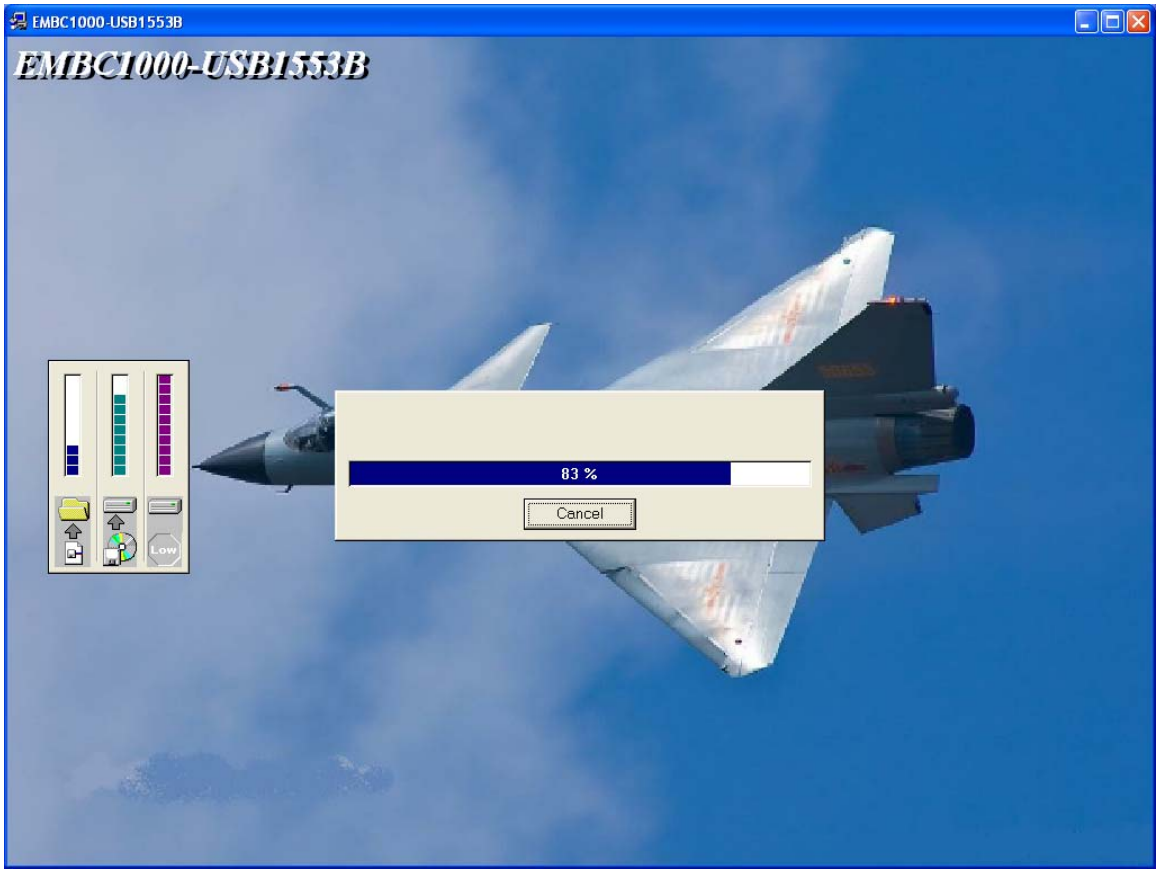

Figure 3-16 Setup in progress

When the setup is done, the “Setup Complete” window will be opened automatically, shown in Figure 3-29, you can click the “Finish” button to complete this installation procedure. ***Congratulations!*** Now you have installed the application software of EMBC1000-USB1553B-1 onto your PC successfully.

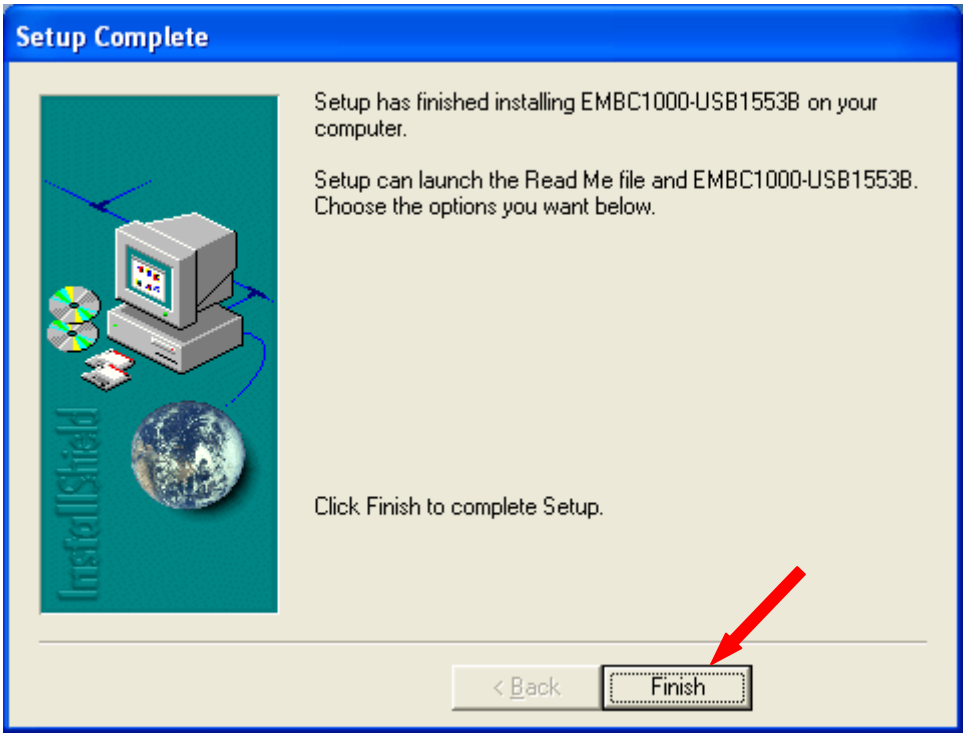

Figure 3-18 setup finish

Chapter 4 Application Software Operation

When the Application Software Installation done, Double click USB1553B.EXE(you can find it on Desktop), then the “Device Setup” window will be opened, shown in Figure 4-1：

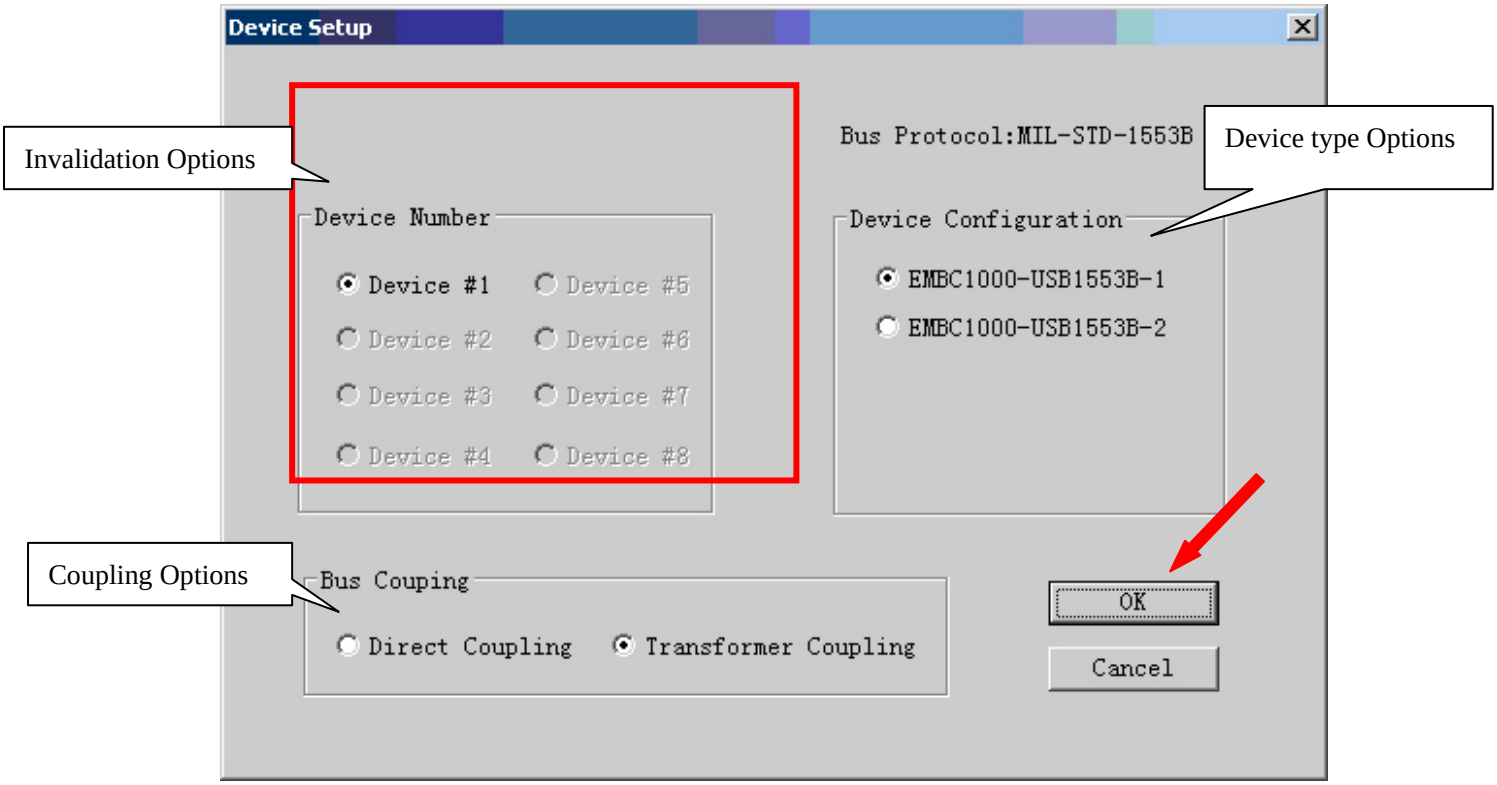

Figure 4-1 EMBC1000-USB1553B Device Setup

Click the **“OK**” button, you will get **USB1553B Main Window**, Figure 4-2：

USB1553B Main Window screen is split into four sections. These sections consist of the Topic Bar, Menu Bar, Tools Bar, Working Editor.

Figure 4-2 USB1553B Main Window

4.1 Bus Control(BC)

Double-click 

(you can find it on the “USB1553B Main Window”),then the “BC Main Widow” window will be opened, shown in Figure 4-3：

The Bus Controller mode provides the ability to create valid MIL-STD-1553B bus controller messages by simple parameter selection in a major and minor message data format.

BC Operation Steps including:

a. Message Editor

b. Frame Editor

c. BC Setup

d. BC Run

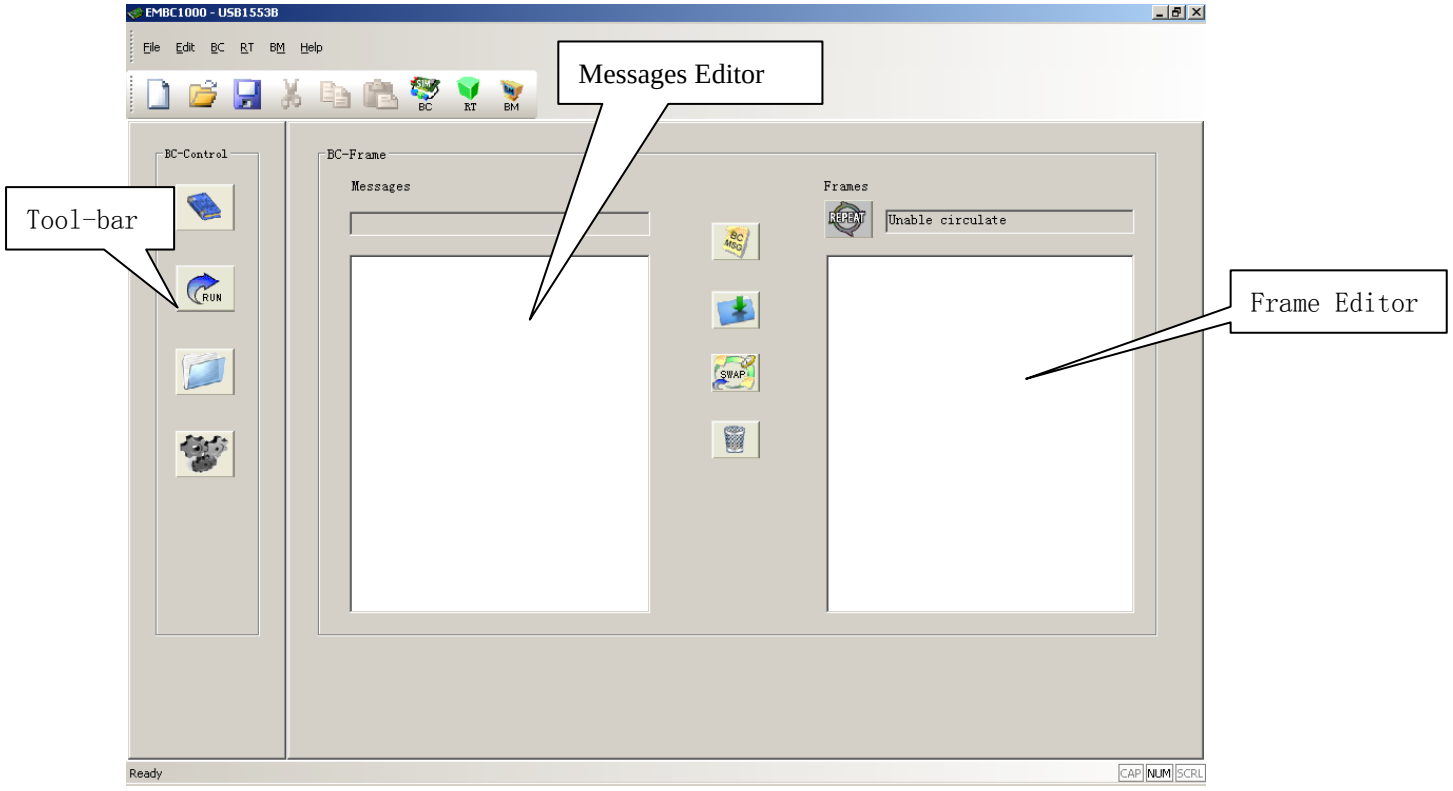

Figure 4-3 BC Main Window

4.1.1 Message Editor

Next, click the  icon; you will get Figure 4-4:

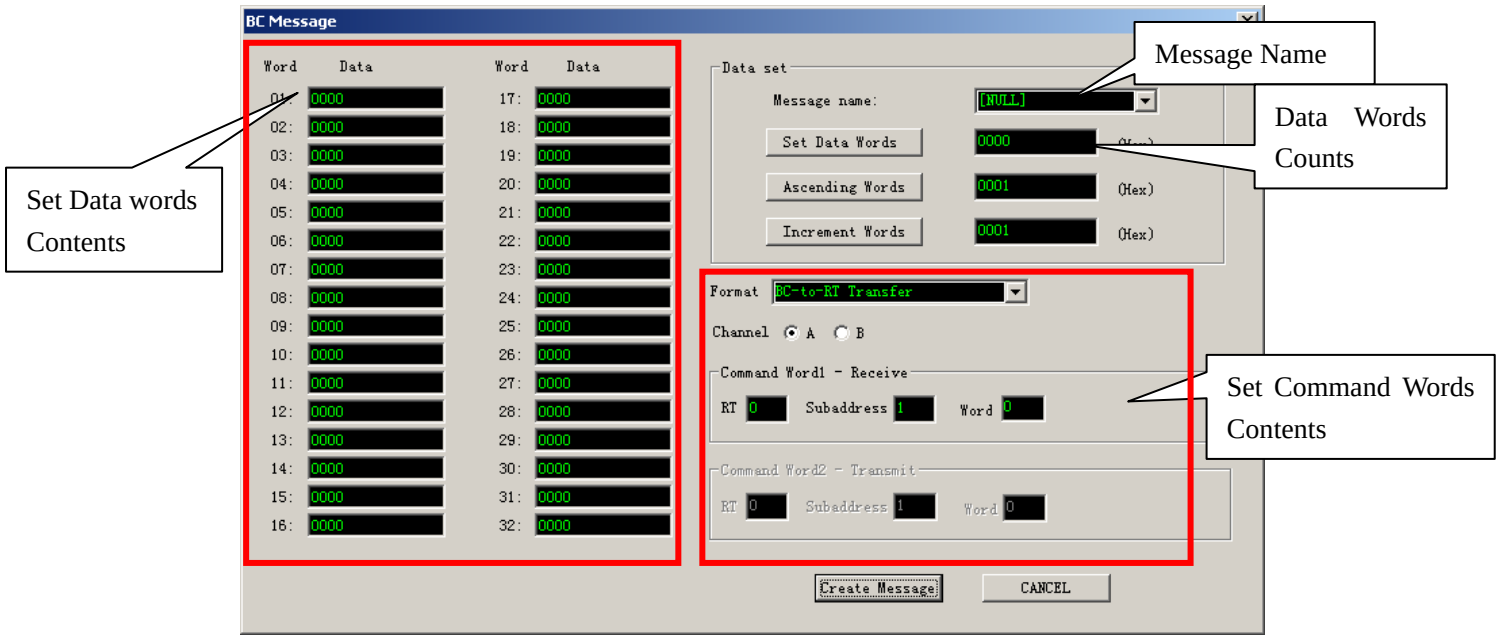

Figure 4-4 BC Message Editor

BC Message Editor Steps:

1) Create Message Name

2 ） Set Data Words Counts

3)Set Data Words Contents

4) Set Command Words Contents. It allows for the selection of the destination Remote Terminal address and subaddresses, channel (A or B) selection and transmit message types. Transmit message types consist of BC to RT Transfer, RT to BC Transfer, RT to RT Transfer, Mode Code, Broadcast, and Broadcast Mode Code.

Next, click 

, to saving the message and create new the message.

4.1.2 Frame Editor

Frame editing is accomplished via selection of previously created messages in the Message Name and adding or inserting them to the Frames list.

Figure 4-5 shows Message1 are added to the list with the Add  . To add a message to the list, select the message to be added from the Message list and click on the Add  . 

is used to swap two messages of your frame.  is used to delete messages of your frame. 

is used to repeat your frame.

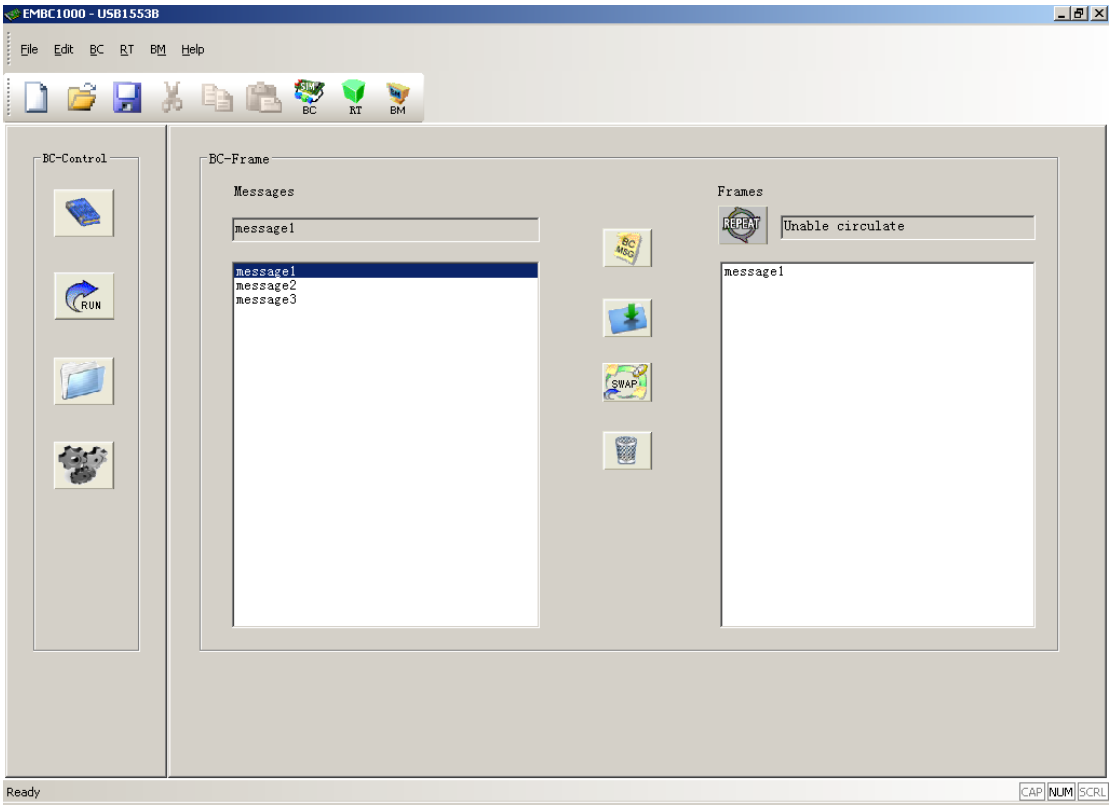

Figure 4-5 Frame Editor

4.1.3 BC Setup

Double-click  (you can find it on the "Frame Editor" Window),then the "BC Setup" window will be opened, shown in Figure 4-6：

This screen has been designed to provide the user with the ability to setup the Bus Controller parameters needed in controlling response timing time tag resolution and error handling.

When the Retry Enable, Retry (Single or Double) option selects whether the Bus Controller will do a Single or a Double retry on message errors. Change-Channel option selects whether the Bus Controller will change channel retry at Single retry. Change-Channel (1st) and Change-Channel (2nd) option select whether the Bus Controller will change channel at First retry or at Second retry.

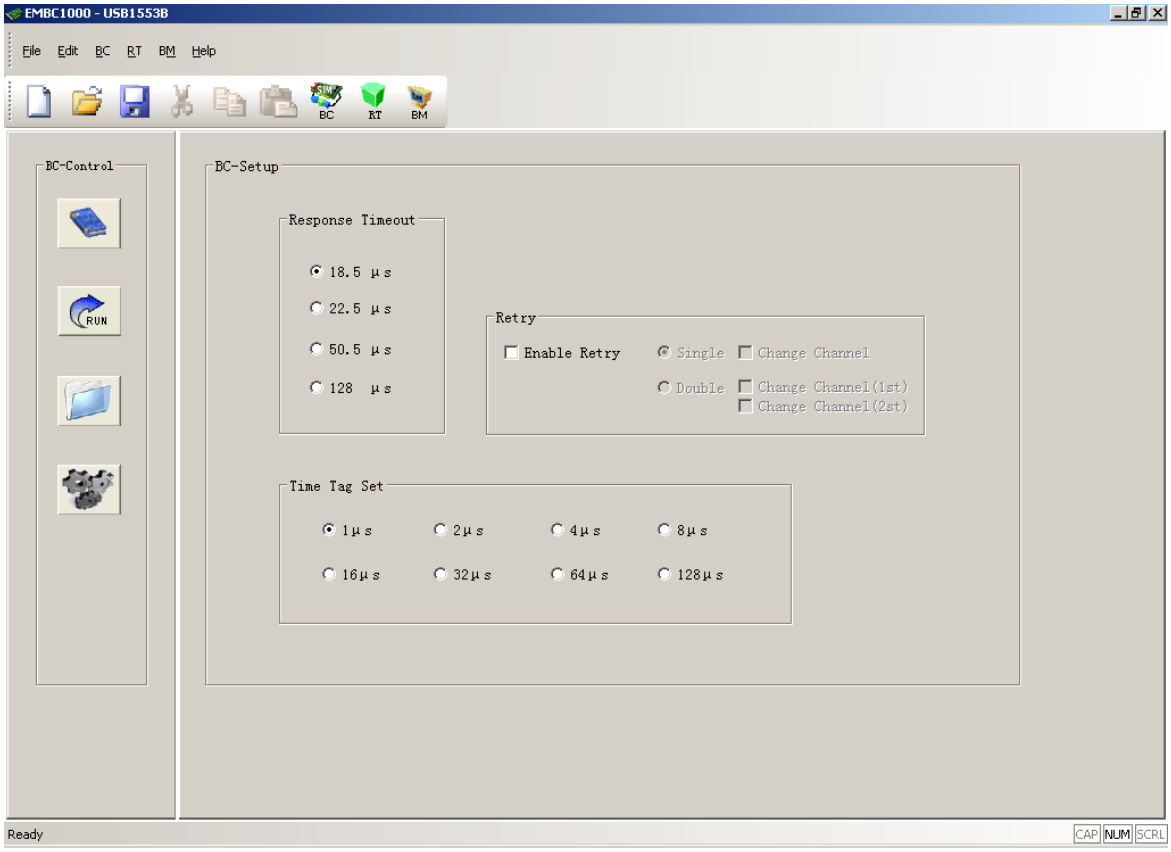

Figure 4-6 BC Setup

4.1.4 BC Run

Double-click 

(you can find it on the "Frame Editor" Window),then the "BC Run" window will be opened, shown in Figure 4-7：

The Save Frame Option section used to select Frame information is being stored or not. The Save Frame, which will be examined in greater detail later, contains detailed information about the MIL-STD-1553B bus activity which has already taken place. In the stack section of this screen, the file name that was selected upon entry into this screen is displayed. This is the file which will hold the Communication Stack for later display and use. Next, if you want open this file please click 
icon.

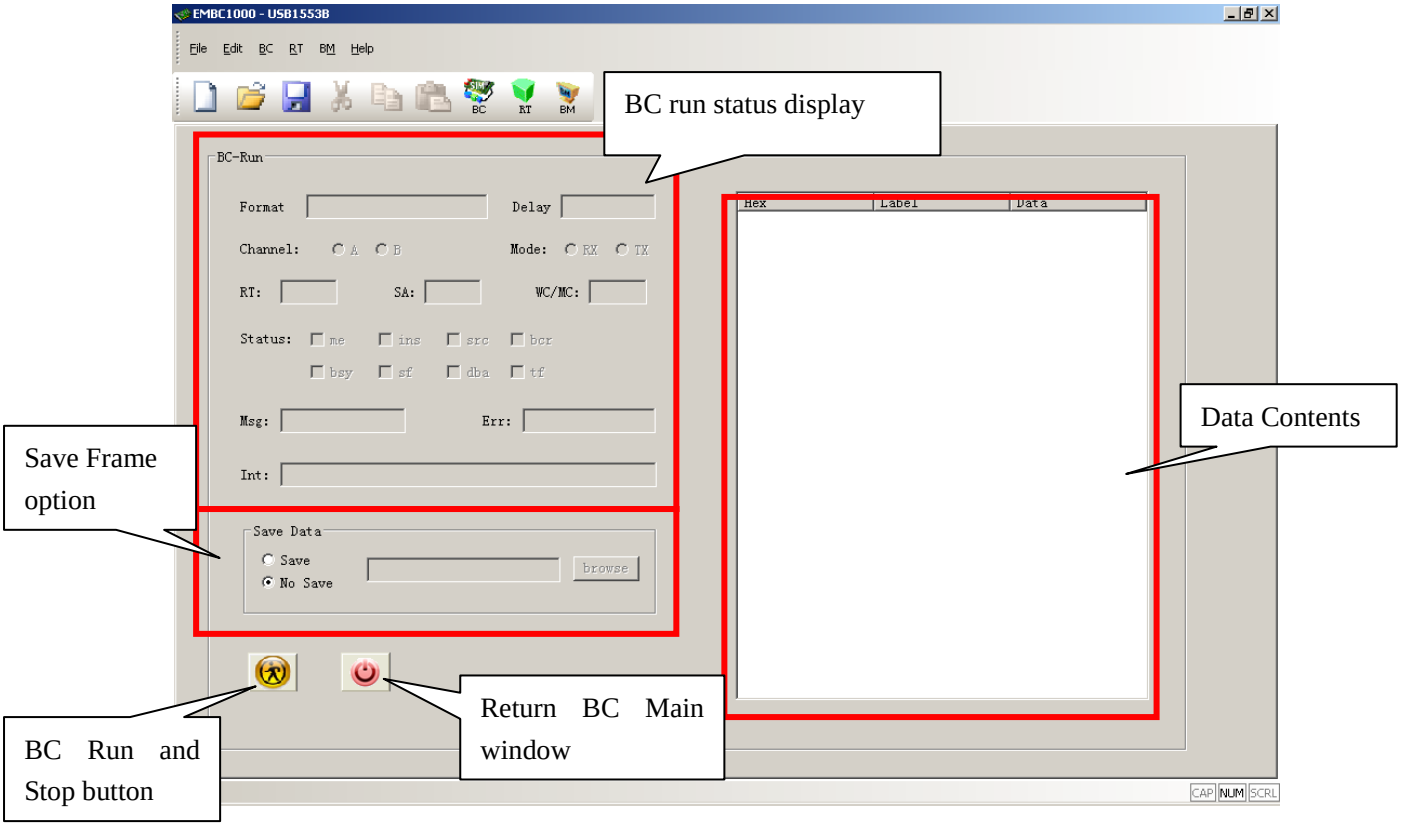

Figure 4-7 BC Run Status Display

4.2 Remote Terminal(RT) Receiving

Double-click 

(you can find it on the “USB1553B Main Window”),then the “RT Main Widow” window will be opened, shown in Figure 4-8：

RT Receiving Operation Steps including:

a. RT Setup

b. RT Run

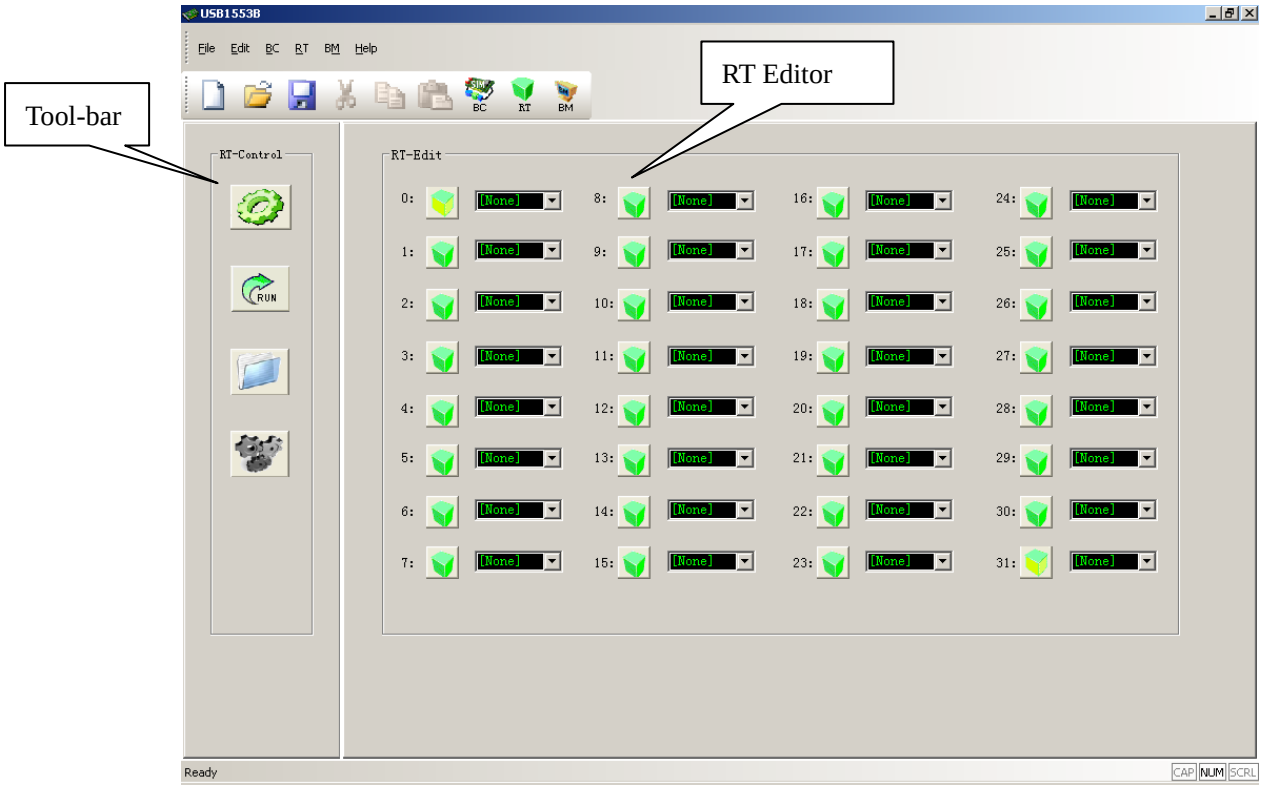

Figure 4-8 RT Main Window

4.2.1 RT Setup

Double-click  (you can find it on the “RT Main Window”),then the “RT Receiving Setup” window will be opened, shown in Figure 4-9：

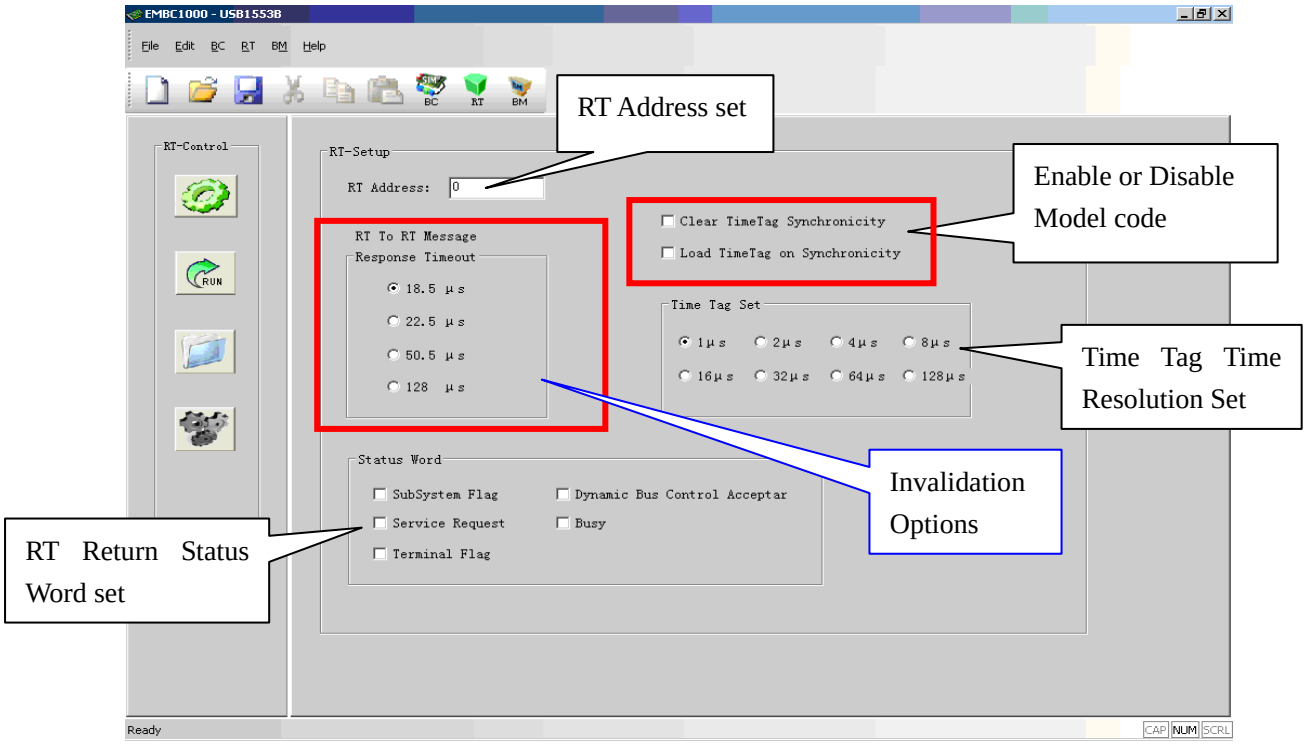

Figure 4-9 RT Receiving Setup

4.2.3 RT Run

Double-click  (you can find it on the "RT Receiving Setup" Window)，then the "RT Run" window will be opened, shown in Figure 4-10. Next, Click  ,then RT is active.

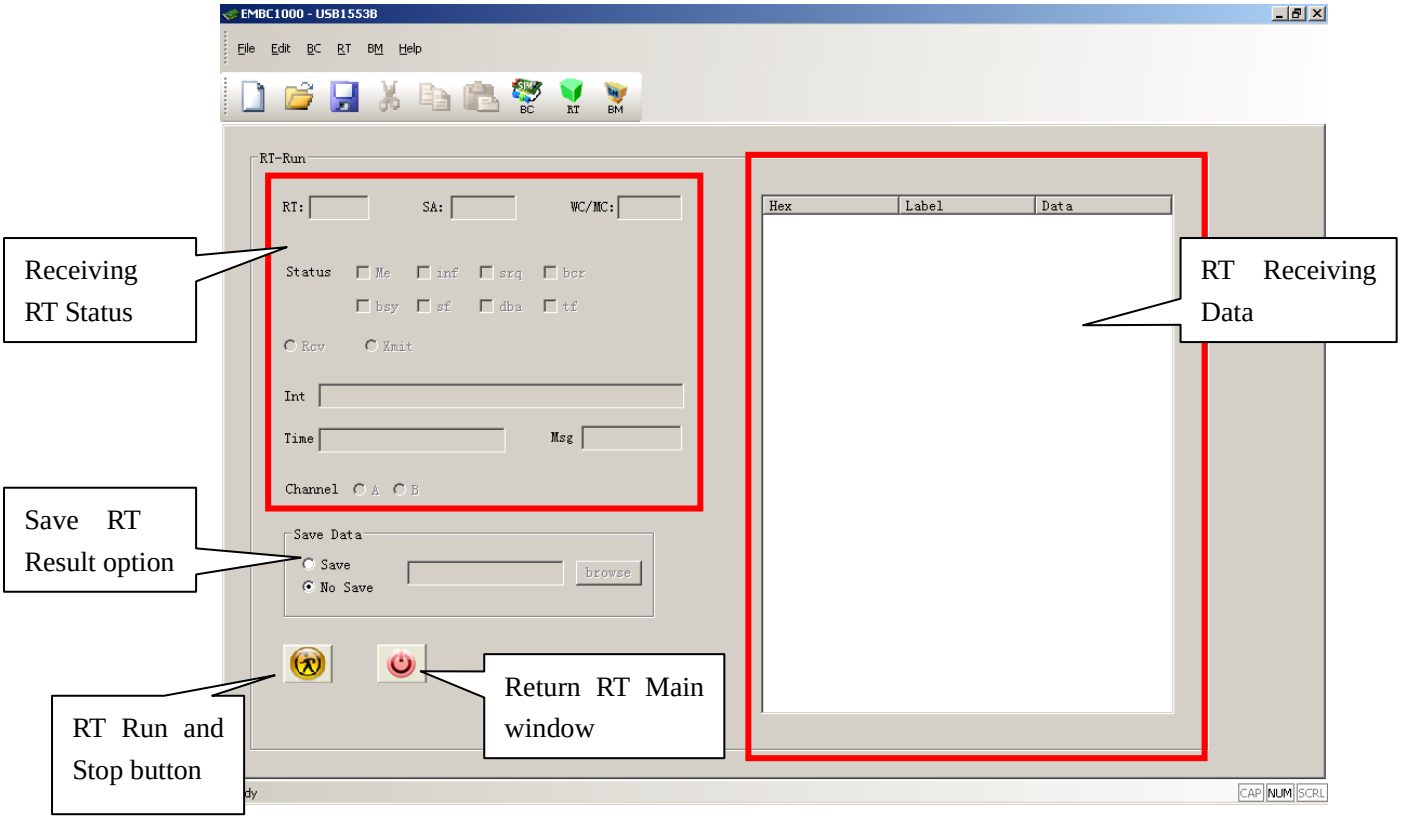

Figure 4-10 RT Receiving Run

4.3 Remote Terminal(RT) Transmit

Double-click  (you can find it on the "USB1553B Main Window"),then the "RT Main Widow" window will be opened, shown in Figure 4-8：

RT transmit Operation Steps including:

a. RT Setup

b. RT Message Editor

c. RT Run

4.3.1 RT Setup

Double-click  (you can find it on the “RT Main Window”),then the “RT Transmit Setup” window will be opened, shown in Figure 4-11：

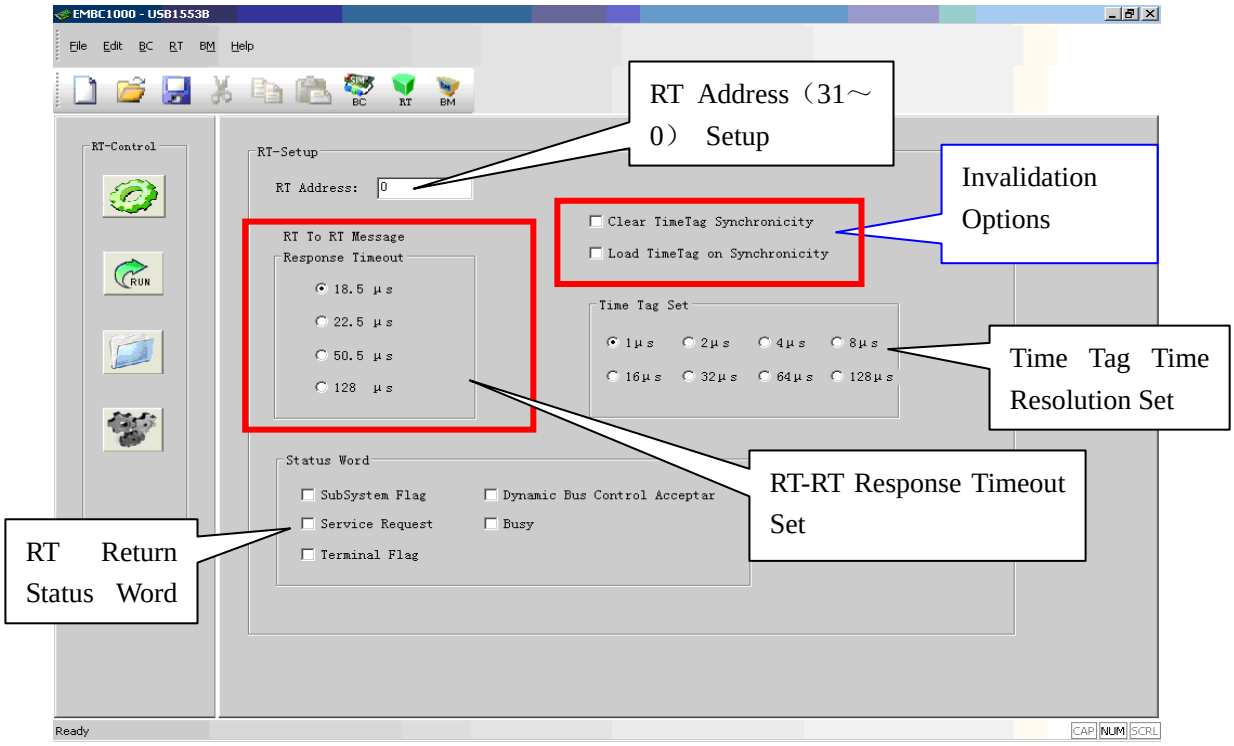

Figure 4-11 RT Transmit Setup

4.3.2 RT Message Editor

Double-click  (you can find it on the “RT Main Window”),then the “RT Message Editor” window will be opened, shown in Figure 4-12：

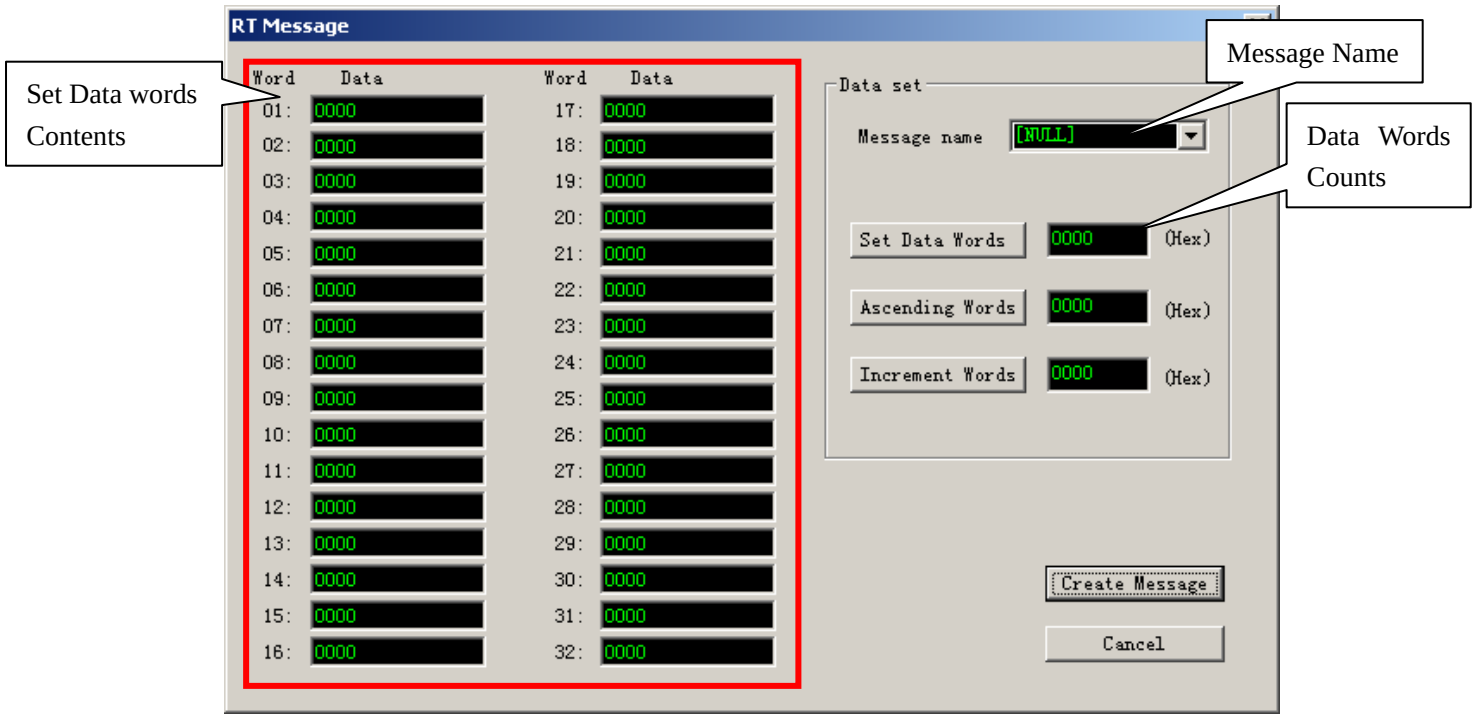

Figure 4-12 RT Message Editor

RT Message Editor Steps:

1) Create Message Name

2 ） Set Data Words Counts

3)Set Data Words Contents

Next, click 

, to saving the message and create new the message.

4.3.3 RT Run

Double-click 

(you can find it on the “RT Receiving Setup” Window)，then the “RT Run” window will be opened, shown in Figure 4-13. Next, Click  ,then RT is active.

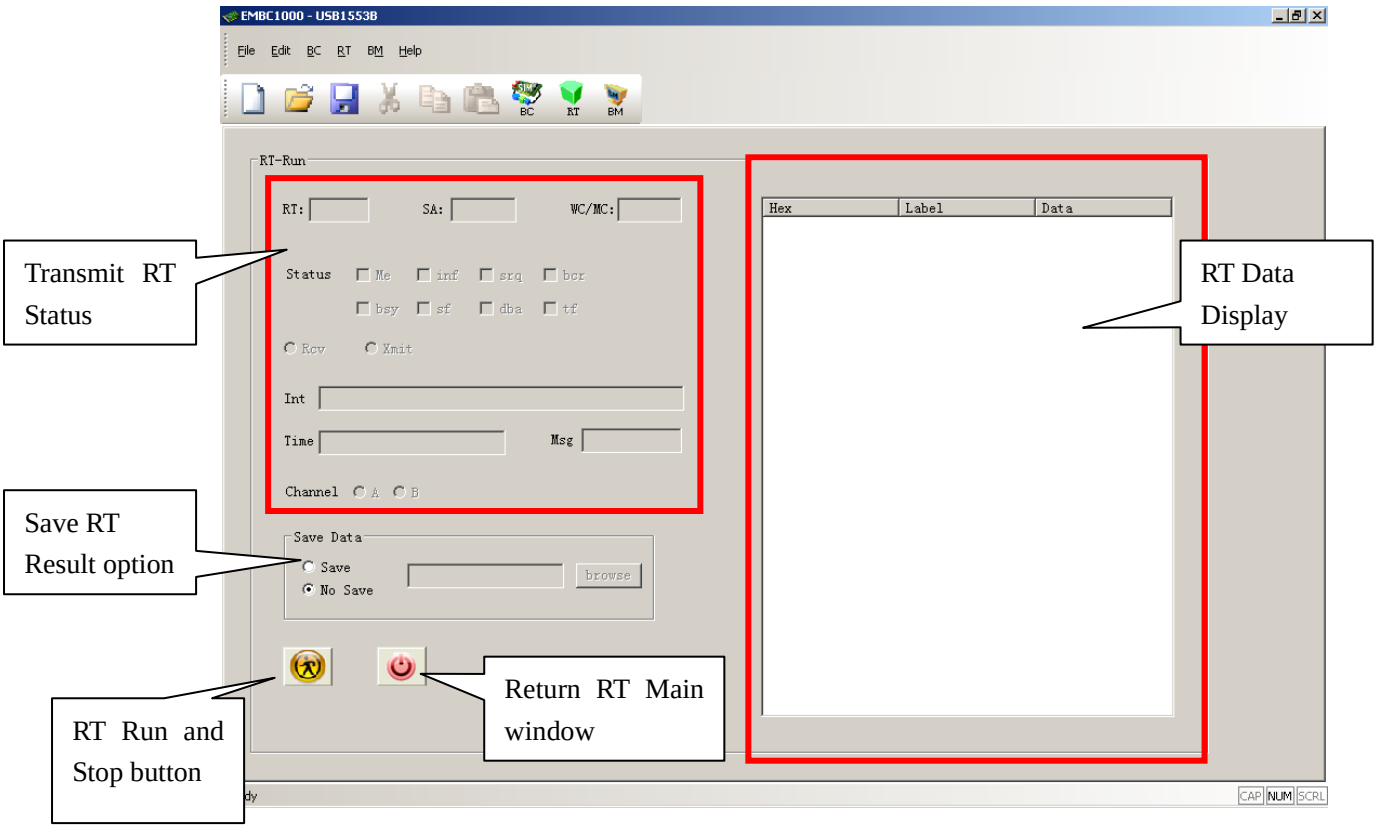

Figure 4-13 RT Transmit Run

4.4 Bus Monitor（BM）

Double-click 

(you can find it on the “USB1553B Main Window”),then the “BM Main Widow” window will be opened, shown in Figure 4-14：

BM Operation Steps including:

a. BM Filter Options

b. BM Setup

c. BM Run

4.4.1 BM Filter Options

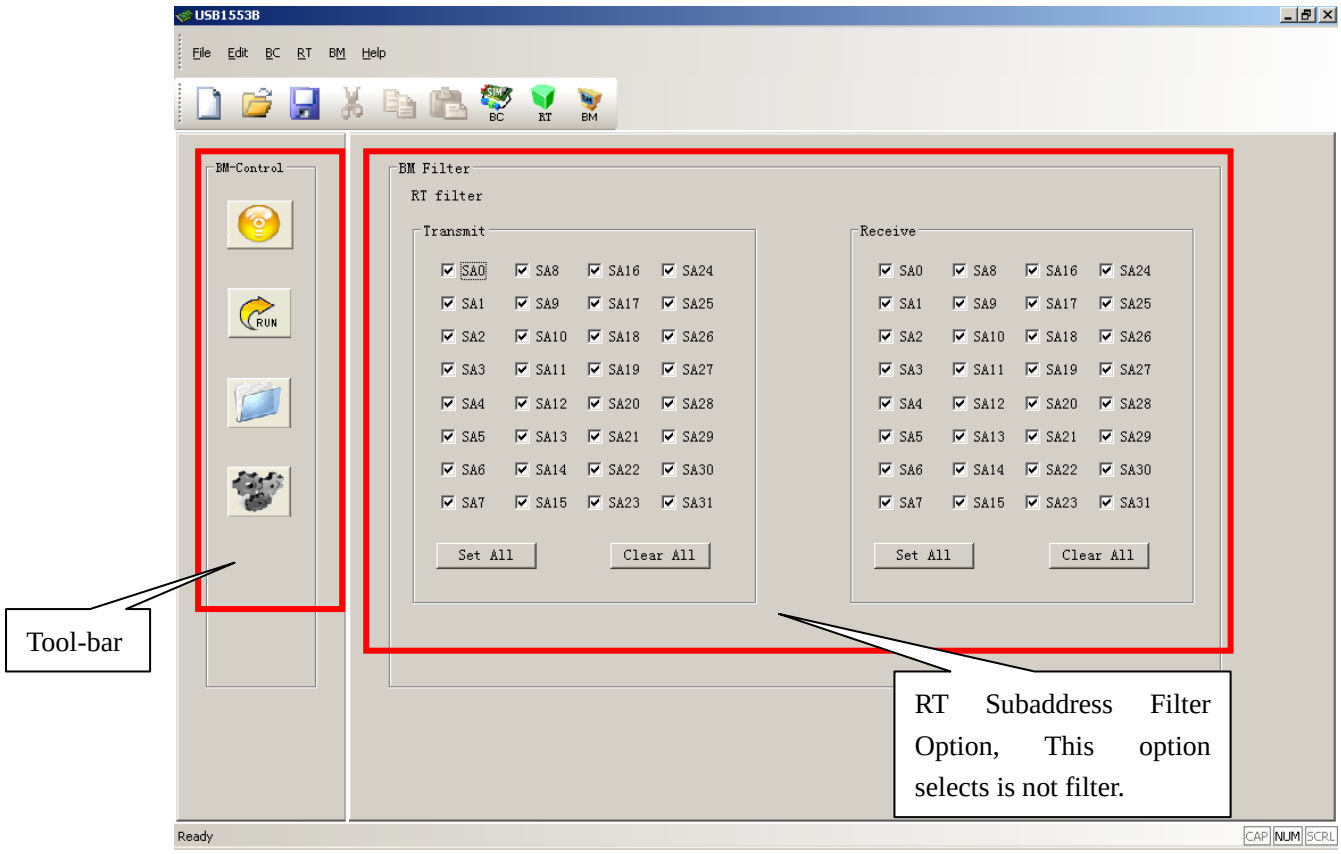

Figure 4-14 BM Main Window

4.4.2 BM Setup

Double-click  (you can find it on the "BM Main Window" Window),then the "BM Setup" window will be opened, shown in Figure 4-15：

This screen has been designed to provide the user with the ability to setup the Bus Monitor parameters needed in controlling response timing time tag resolution.

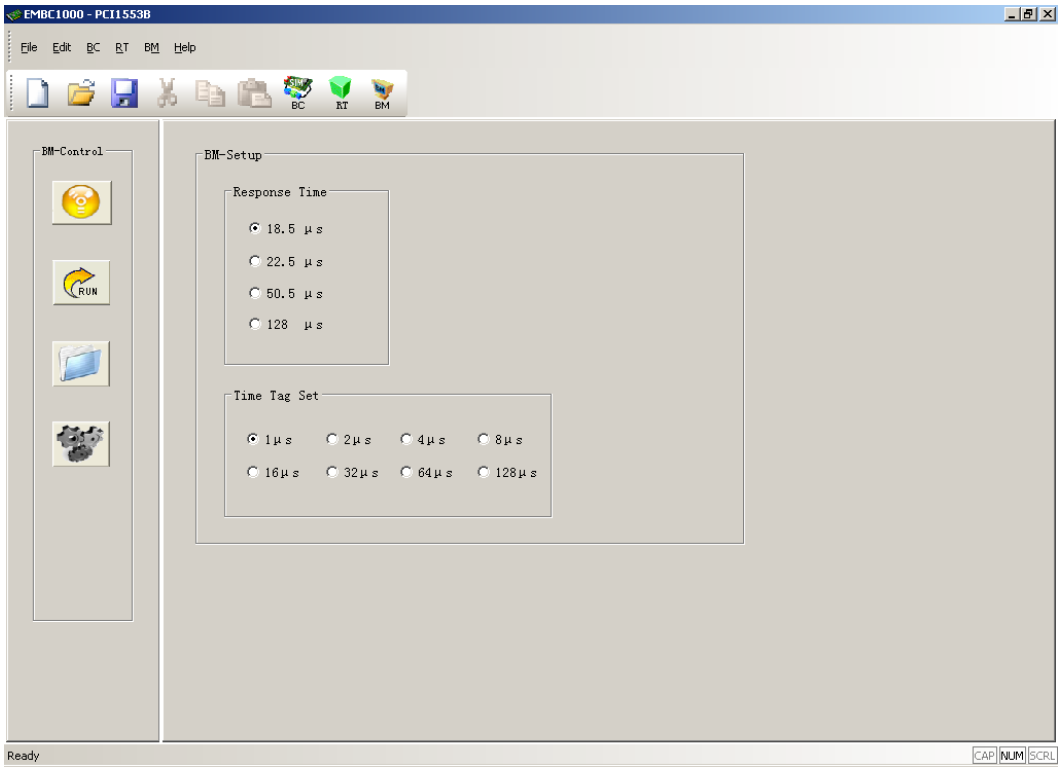

Figure 4-15 BM Setup

4.4.3 BM Run

Double-click 

(you can find it on the “BM Main Window” Window), and then the “BM Run” window will be opened, shown in Figure 4-16. Next, Click  ,then BM is active.

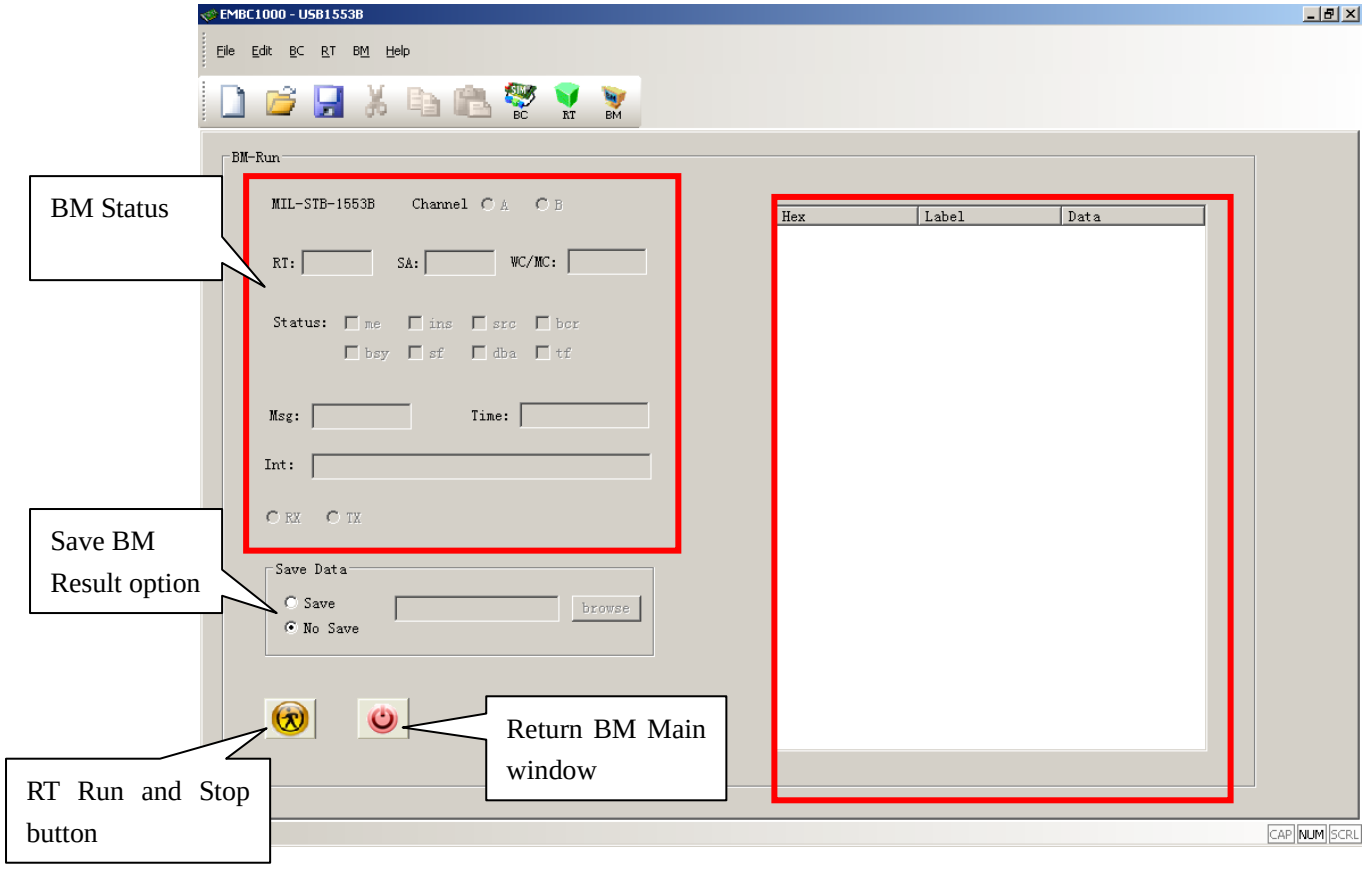

Figure 4-16 BM Run

Chapter 5 Develop Your Application Software

To allow the user to develop his own application software or project, EMBC1000-USB1553B-1 device comes with software drivers, API (Application Programming Interface) library and user oriented application software, running under Windows 2000 or Windows XP. The user oriented application software has been designed with the capabilities of simulating the outputs of various airborne systems, receiving inputs from these systems, and providing bus data analysis functions. API library is also provided together with example source code (Visual C++), which allows users to easily develop their own application software or project based on the real world applications.

5.1 API Library

When you begin to develop your own application software for this USB device, you should finish the settings below in you project (build in Visual C++ 6.0):

Copy 1553DLL.dll、1553DLL.lib、1553BUSBhead.h (you can find them on CD-ROM \setup\UserDesign\Lib) to your project working directory.

Add the 1553DLL.lib to the project: Project→Setting→Link, as shown in Figure 5-1.

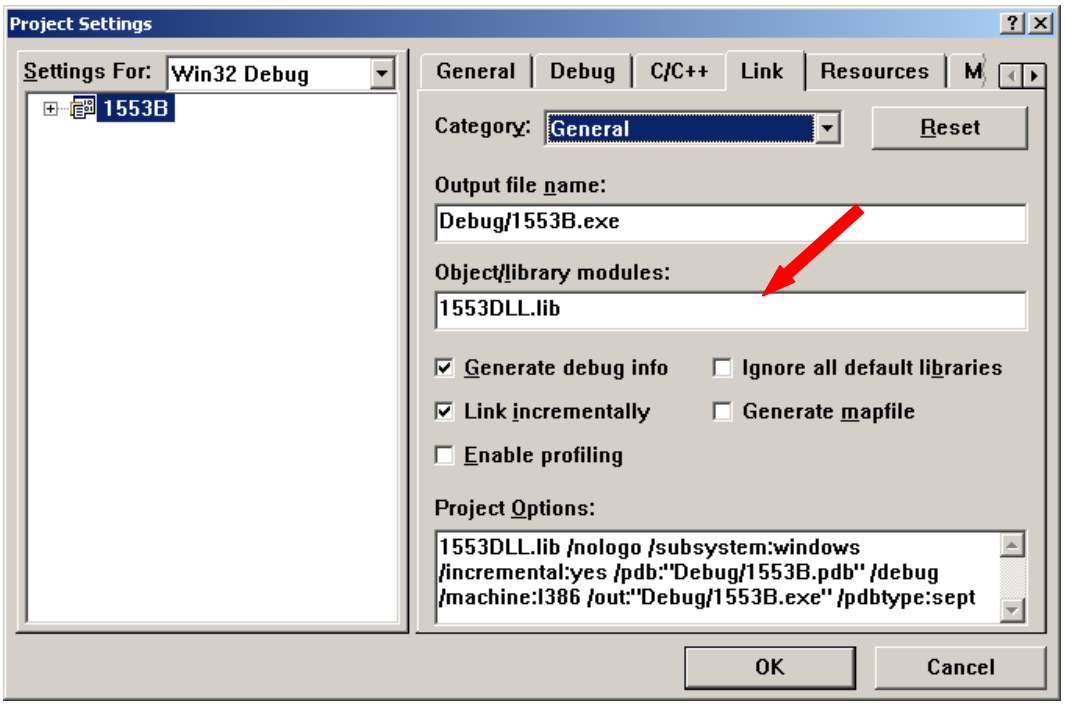

Figure 5-1 Add the 1553DLL.lib to the project

Edit the head file; refer to the source code below:

```
#include "1553BUSBhead.h "
```

Now the API setup is done. When you build your project, VC++ will link the APIs automatically and add them to your project.

5.2 Function Describe

1. USB1553B_Init

function	BOOL USB1553B_Init(int Coupling)
Purpose	initialization
parameter	Coupling:0－Direct Coupling ,1－Transformer Coupling
Return	true－succeed false －fault

2. Set_BoardMode

function	void Set_BoardMode(int mode)
Purpose	Set EMBC1000-USB1553B Mode
parameter	Mode：(BCMODE/RTMODE/BMMODE)
Return	NULL

3. Set_BCInit

function	void Set_BCInit(int enable_retry,int retry_num,int change1,int change2,int timeout,int time_precision)
Purpose	Initialize Bus Controller Mode
parameter	enable_retry： 0－enable，1－disable retry_num： 0－single，1－double change1、 change2： 0－disable change，1－enable change timeout: 0－18.5 uS，1－22.5uS，2－50.5 uS，3－128 uS time_precision: 0－1uS,1－2uS,2－4uS,3－8uS,4－16uS,5－32uS,6－64uS,7－128uS.
Return	NULL

4. Set_RTInit

function	void Set_RTInit(int timeout,int time_precision,int rt_address,int subsys,int dynbus,int terflag,int service,int busy,int cleartt,int loadtt,int rxmode16)

Purpose	RT initialization
parameter	timeout: 0－18.5 uS，1－22.5uS，2－50.5 uS，3－128 uS time_precision: 0－1uS,1－2uS,2－4uS,3－8uS,4－16uS,5－32uS,6－64uS,7－128uS. rt_address: 0x00 ~ 0x1F subsys: 0－false，1－true dynbus: 0－false，1－true terflag: 0－false，1－true service: 0－false，1－true busy: 0－false，1－true cleartt: 0－false，1－true loadtt: 0－false，1－true rxmode16: 0－false，1－true
Return	NULL

5. Set_BMInit

function	void Set_BMInit(int* Transmit_SA,int* Receive_SA,int timeout,int time_precision)
Purpose	BM initialization
parameter	Transmit_SA: 1－enable，0－disable Receive_SA：1－enable，0－disable timeout: 0－18.5 uS，1－22.5uS，2－50.5 uS，3－128 uS time_precision: 0－1uS,1－2uS,2－4uS,3－8uS,4－16uS,5－32uS,6－64uS,7－128uS.
Return	NULL

6. Send_BCData

function	void Send_BCData(BC_MsgBlock &BC_Msg)
Purpose	BC mode ,write a message to EMBC1000-USB1553B memory
parameter	BC_Msg :the struct of BC Message
Return	NULL

7. Read_BCdata

function	int Read_BCdata(int msgnum,BC_STATUS &BC_set)

Purpose	BC mode ,read single message
parameter	msgnum：message number（0-63） BC_set ： the pointer of message struct
Return	1－succeed 0－fault

8. Send_RTData

function	void Send_RTData(unsigned int *RTdata,int msgnum)
Purpose	Write data to designate address
parameter	msgnum ： designate sa-address RTdata： pointer of data memory
Return	NULL

9. Read_RTdata

function	int Read_RTdata(RT_STATUS &RT_set)
Purpose	RT mode,read single message
parameter	RT_set ： message struct pointer
Return	1－succeed 0－fault

10. Read_BMdata(BM_STATUS &BM_set)

function	int Read_BMdata(BM_STATUS &BM_set)
Purpose	BM mode,read single message
parameter	BM_set : message struct pointer
Return	1－succeed 0－fault

5.3 Samples

This example source code will show you how to use the API. You can get the details from the CD-ROM (G:\Samples) directory. (VC++ 6.0 environment),

Chapter 6 PRODUCT ORDERING INFO

Table 6-1 Product ordering information

Product Number	Description	Baud rate	Software support
EMBC1000-1553B-1	Single-function boards allow operation in only one of the three 1553 modes at a time: Bus Controller, Bus Monitor, or Remote Terminal (up to 31 RTs). Although all three modes are available, the board can operate only in one mode at any one time.	1Mbps	Windows 2000 or Windows XP based drivers and application software

Appendix A: MIL-STD-1553B Introduction

A.1. MIL-STD-1553B Defined

So now that we understand the driving need for the development of a data bus, and a little of its history and application, what exactly is MIL-STD-1553B/A summary of the characteristics of MIL-STD-1553B is found in Table A-1.

Table A-1. Summary of MIL-STD-1553 Characteristics

Data Rate	1 MHz
Word Length	20 bits
Data Bits / Word	16 bits
Message Length	Maximum of 32 data words
Transmission Technique	Half-duplex
Operation	Asynchronous
Encoding	Manchester II bi-phase
Protocol	Command/response
Bus Control	Single or Multiple
Fault Tolerance	Typically Dual Redundant, second bus in "Hot Backup" status
Message Formats	Controller to terminal Terminal to controller Terminal to terminal Broadcast System control
Number of Remote Terminals	Maximum of 31
Terminal Types	Remote terminal Bus controller Bus monitor
Transmission Media	Twisted shielded pair
Coupling	Transformer and direct

The primary purpose of the data bus is to move data between black boxes. How these boxes are connected and the methodology with which the communication is accomplished is central to the operation of the data bus. However, before we delve into the protocol, it is necessary to understand a little of the data bus hardware.

A.2. Hardware Elements

MIL-STD-1553 defines certain aspects regarding the design of the data bus system and the black boxes to which the data bus is connected. The standard defines four hardware elements. They are:

- The transmission media
- Remote terminals.
- Bus controllers.
- Bus monitors.

A.2.1 Transmission Media

The transmission media, or data bus, is defined as a twisted shielded pair transmission line consisting of the main bus and a number of stubs. There is one stub for each terminal connected to the bus. The main data bus is terminated at each end with a resistance equal to the cable's characteristic impedance (plus or minus two percent). This termination makes the data bus behave electrically like an infinite transmission line.

A.2.2 Remote Terminals

Remote terminals are defined within the standard as “All terminals not operating as the bus controller or as a bus monitor”. Therefore if it is not a controller, monitor, or the main bus or stub, it must be a remote terminal. The remote terminal comprises the electronics necessary to transfer data between the data bus and the subsystem. So what is a subsystem. For 1553 applications, the subsystem is the sender or user of the data being transferred.

A.2.3 Bus Controller

The bus controller is responsible for directing the flow of data on the data bus. While several terminals may be capable of performing as the bus controller, only one bus controller may be active at a time. The bus controller is the only one allowed to issue commands onto the data bus. The commands may be for the transfer of data or the control and management of the bus (referred to as mode commands).

A.2.4 Bus Monitor

A bus monitor is a terminal that listens (monitors) to the exchange of information on the data bus. The standard strictly defines how bus monitors may be used, stating that the information obtained by a bus monitor be used “for off-line applications (e.g., flight test recording, maintenance recording or mission analysis) or to provide the back-up bus controller sufficient information to take over as the bus controller.” A monitor may collect all the data from the bus or may collect selected data. The reason for restricting its use is that while a monitor may collect data, it deviates from the command-response protocol of the

standard, in that a monitor is a passive device that doesn't transmit a status word and therefore cannot report on the status of the information transferred. Bus monitors fall into two categories:

- A recorder for testing.
- A terminal functioning as a back-up bus controller.

A.3. Protocol

Now that you understand a little of the hardware requirements, it's time to discuss the methodology by which the information transfer occurs. The rules under which the transfers occur are referred to as "protocol". The control, data flow, status reporting, and management of the bus are provided by three word types.

A.3.1 Word Types

Three distinct word types are defined by the standard. They are:

- Command words.
- Data words.
- Status words.

Each word type has a unique format, yet all three maintain a common structure. Each word is twenty bits in length. The first three bits are used as a synchronization field, thereby allowing the decode clock to re-sync at the beginning of each new word. The next sixteen bits are the information field and are different between the three word types. The last bit is the parity bit. Parity is based on odd parity for the single word. The three word types are shown in Figure A-1.

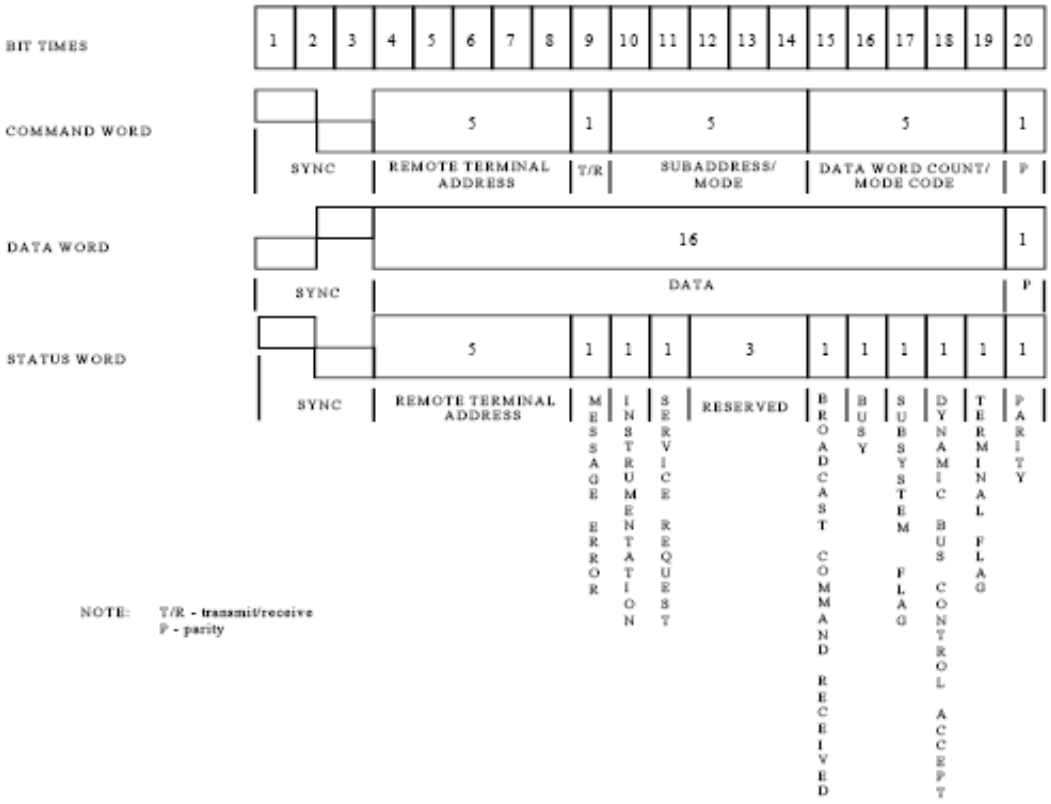

Figure A-1 1553B Word Formats