

USB2CAN Device User Manual

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1. General Description:

USB2CAN module is a 'plug and play' and bi-directional port powered USB to CAN converter which realizes long-distance communication between your Raspberry Pi/SBC/PC and other devices stably through CAN- Bus connection.

With small size and convenient operation, It's a cost-effective solution that are safe and reliable for all your data-conversion / device-protection applications for any experienced engineer interfacing to expensive industrial equipment yet simple enough for home use by an amateur hobbyist.

USB2CAN can also be applied to obtain the data of car via the OBD connector, but you need to configured and secondary development by yourself.

Support Linux system , It's a socket-can device in Linux, not need to install any driver and fully compatible with other socket-can software in Linux such as can-utils.

Support Mac OS version equal or above 10.11 and provide development library for help customer develop own applications.

Support Win7/Win8/Win10 and provide C#/C++ demo and dynamic link libraries for help customer develop own applications.

We provide four kinds of USB2CAN, the hardware appearance is different but the software ,firmware features are 100% same.



USB2CAN



USB2CAN-C



USB2CAN-DEV



USB2CAN-X2

2. Features

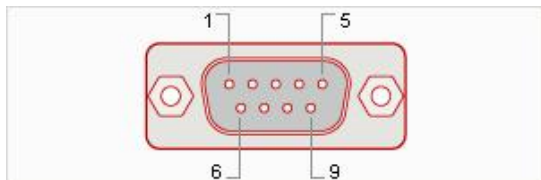
1. The USB to CAN Converter Module compatible with all series Raspberry Pi/Jetson Nano/Tinker Board/any single board computer, desktop and laptop.
2. The USB CAN Module support Windows System, Mac OS and Linux, Raspbian(v5.4 kernel), Ubuntu.
3. Plug and Play USB CAN device. No external power required. Support wider CAN baud rate, from 20Kbps to 1Mbps can be programmed arbitrarily. Support for CAN bus 2.0A and 2.0B specification.
4. Provides 3000V voltage isolation and 2500V ESD isolated protection on signal pins. 120 Ohm resistor selectable jumper feature.
5. Provide C/Python and source code with Socket-CAN for Raspbian(Linux), Dynamic library and demo with IOUSBKit for Mac Os(Big Sur).

3. Technical Specification

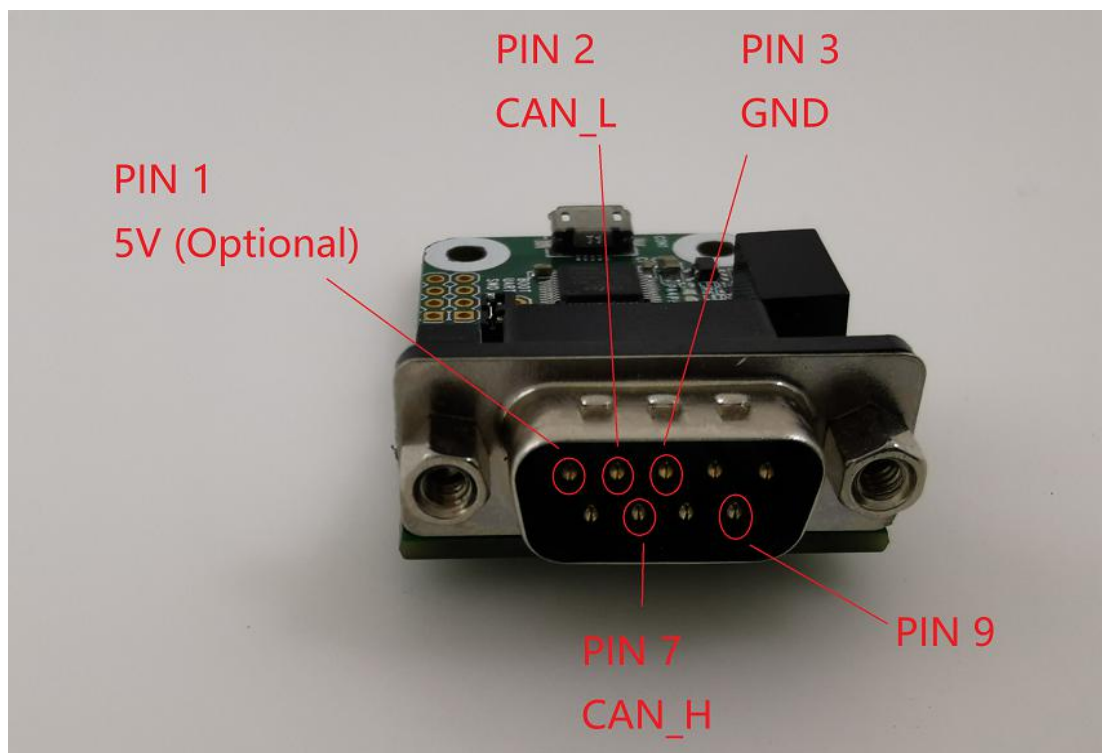
| | |
|---------------------|---|
| Connector | |
| CAN | D-SUB, 9 pins |
| USB | USB 2.0 Full-Speed, Micro USB |
| CAN Features | |
| Specification | 2.0A (standard format) and 2.0B (extended format), ISO 11898-2 High-speed CAN |
| Data Rate | From 20kbps to 1Mbps can be programmed arbitrarily. |
| Isolation Voltage | 1.5K VDC/min, 3K VDC/1s |
| Microcontroller | STM32F0, 48MHz |
| Termination | 120 Ohm resistor selectable jumper |
| CAN Transceiver | ISO1050DUBR ,Texas Instruments |
| Other | |
| Work Temperature | -40° ~ 85° |
| Relative humidity | 15-90%, not condensing |
| Weight | 15.5 g |

4. Hardware Description

4.1 CAN Connector Pinout



| Pin | Description |
|-----|---|
| 1 | 5V/150ma output . Weld 0 Ω resistor on R9 to enable this function(close to the jumper). |
| 2 | CANL bus line (dominant low) |
| 3 | CAN_GND |
| 4 | NC |
| 5 | NC |
| 6 | NC |
| 7 | CANH bus line (dominant high) |
| 8 | NC |
| 9 | NC |

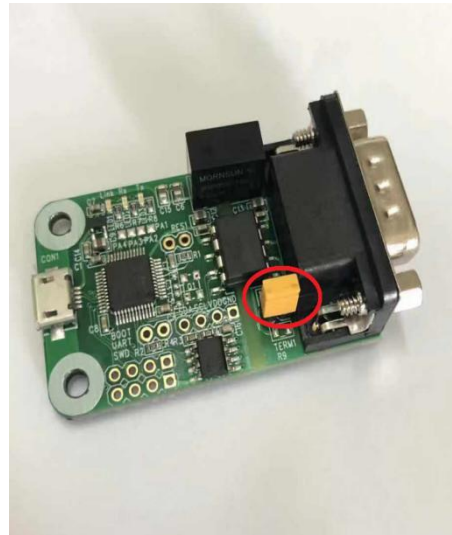


4.2 120 Ohm Resistor Setting.

A High-speed CAN bus (ISO 11898-2) must be terminated on both ends with 120 Ohms. The USB2CAN module with a on-board 120 Ω selectable jumper.



Disable 120 Ohm Resistor.



Enable 120 Ohm Resistor.

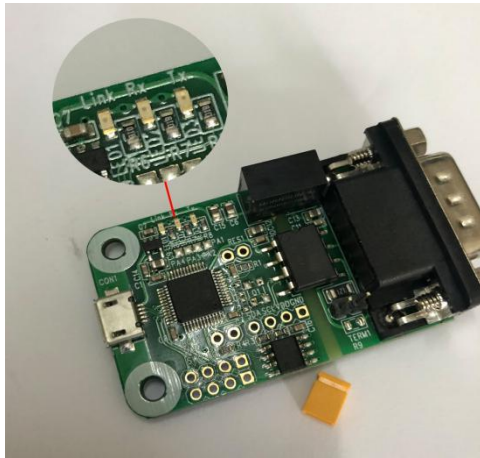


Disable 120 Ohm Resistor.



Enable 120 Ohm Resistor.

4.3 LED Indicate



| LED Name | Description |
|----------|---|
| Link | Red led is normally on to indicate The module is came up without any errors |
| Tx | Red led flash to indicate send data. |
| Rx | Red led flash to indicate receive data. |



| LED Name | Description |
|----------|--|
| Link | Green led is normally on to indicate the module is came up with out any errors |
| Tx | Green led flash to indicate send data. |
| Rx | Green led flash to indicate receive data. |

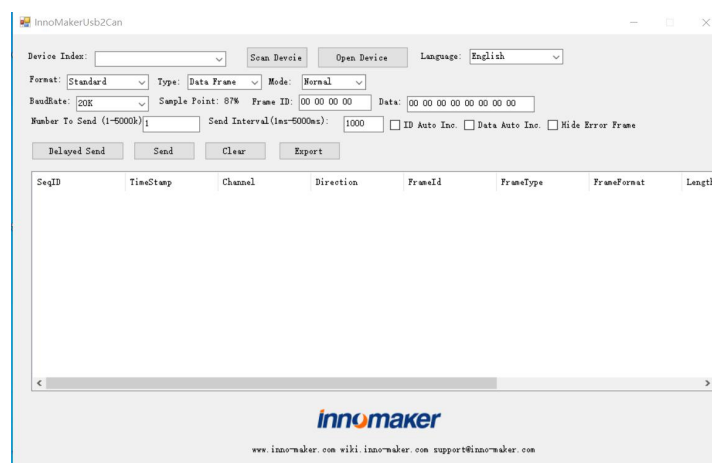
5. Windows/Mac OS Ready-Made Tools

Download the tools installation package from below link:

<https://github.com/INNO-MAKER/usb2can>

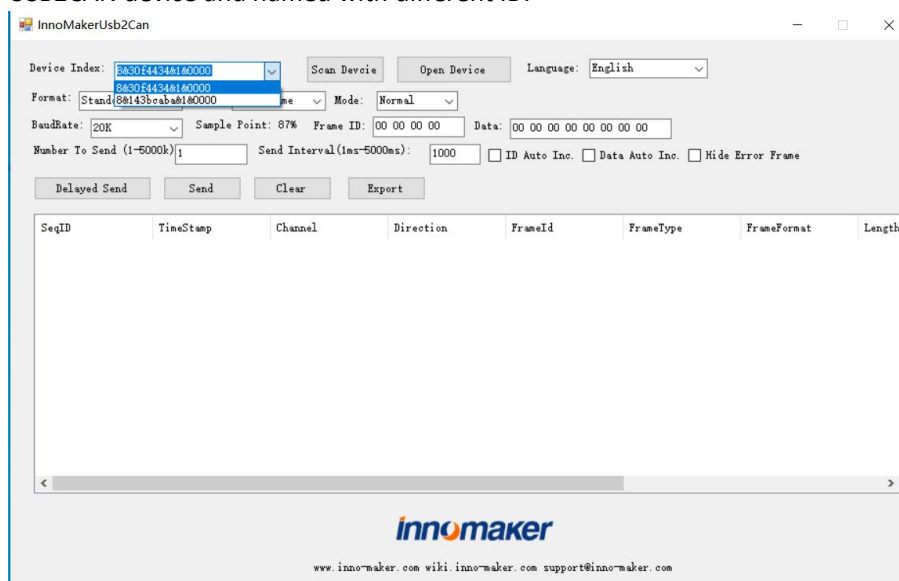
5.1 Open the USB2CAN tools.

Download and install the ready-made tool. One tool interface is only for one device. If you want to use two devices at the same time, Please open two interfaces.



5.2 Scan For Devices

Plug the device into the USB port of your computer, click 'Scan Device' button. You'll Find USB2CAN device and named with different ID.



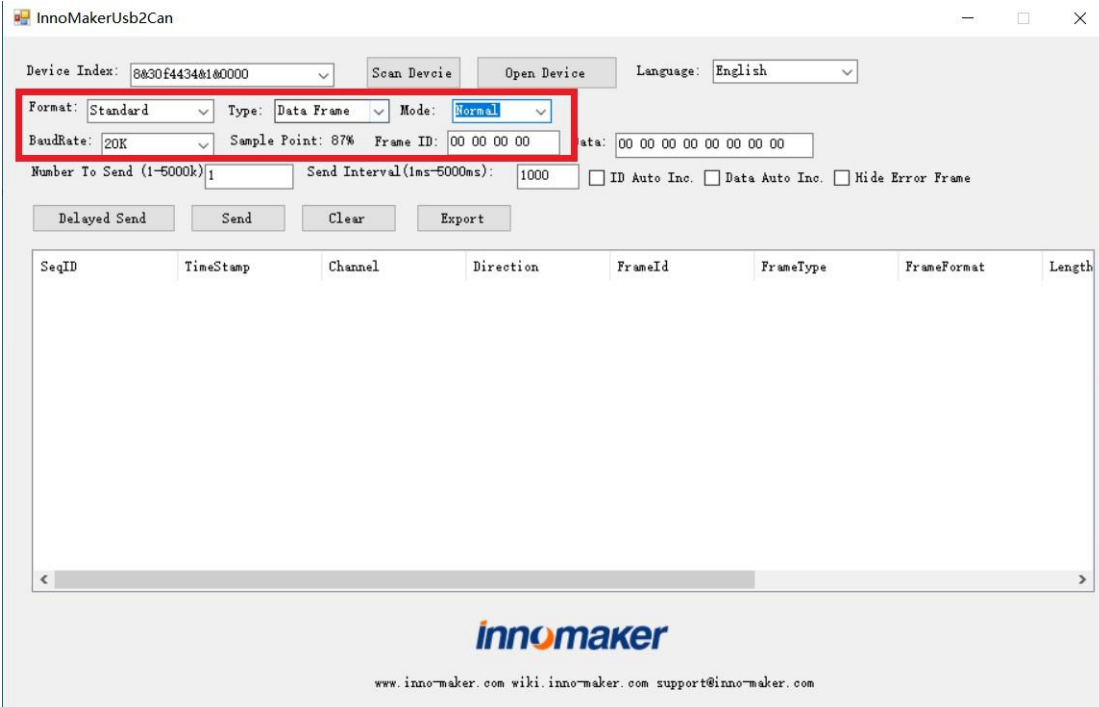
5.3 Setting The BandRate And Working Mode.

Setting below parameters in the red box before open device.

Normal mode: The CAN module will appear on the CAN-bus, and it can send and receive CAN messages, communication with other CAN devices directly.

Silent mode: The module will appear on the CAN-bus, but in a passive state. It can receive CAN messages, but cannot transmit CAN messages or answer. This mode can be used as a bus monitor because it does not affect CAN-bus communications but can observe the CAN-bus states.

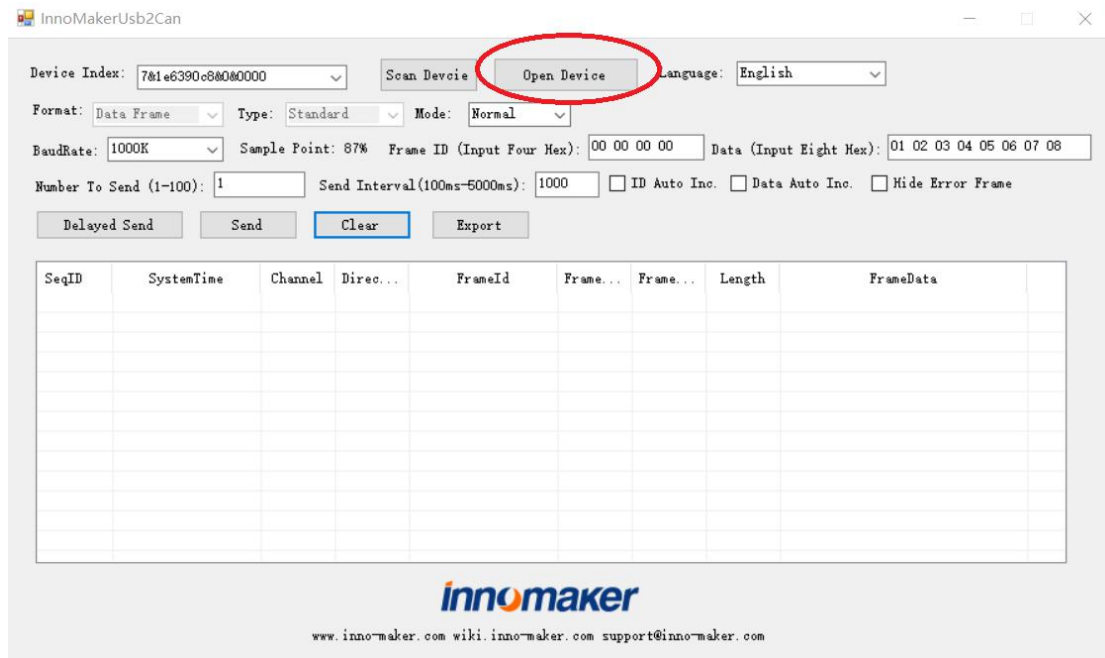
Loopback mode: For USB2CAN self-test, CAN module receives its own messages. In this mode, the send part of the CAN module is connected internally with the reception one.



The screenshot shows the InnoMakerUsb2Can application window. At the top, there's a 'Device Index' dropdown set to '8&30F4434&1&0000', 'Scan Device' and 'Open Device' buttons, and a 'Language' dropdown set to 'English'. Below this, a red rectangular box highlights the configuration section. Inside this box, 'Format' is set to 'Standard', 'Type' is 'Data Frame', and 'Mode' is 'Normal'. Below these, 'BaudRate' is '20K', 'Sample Point' is '87%', and 'Frame ID' is '00 00 00 00'. To the right of the red box, there's a 'Data' field with '00 00 00 00 00 00 00 00'. Below the red box, there are fields for 'Number To Send (1-5000k)' set to '1' and 'Send Interval (ms-5000ms)' set to '1000'. There are also three checkboxes: 'ID Auto Inc.', 'Data Auto Inc.', and 'Hide Error Frame', all of which are currently unchecked. Below these fields are four buttons: 'Delayed Send', 'Send', 'Clear', and 'Export'. At the bottom of the window is a table with columns: SeqID, TimeStamp, Channel, Direction, FrameId, FrameType, FrameFormat, and Length. The table is currently empty. At the very bottom of the window, the 'inno-maker' logo is displayed, along with the website 'www.inno-maker.com' and contact information: 'wiki.inno-maker.com' and 'support@inno-maker.com'.

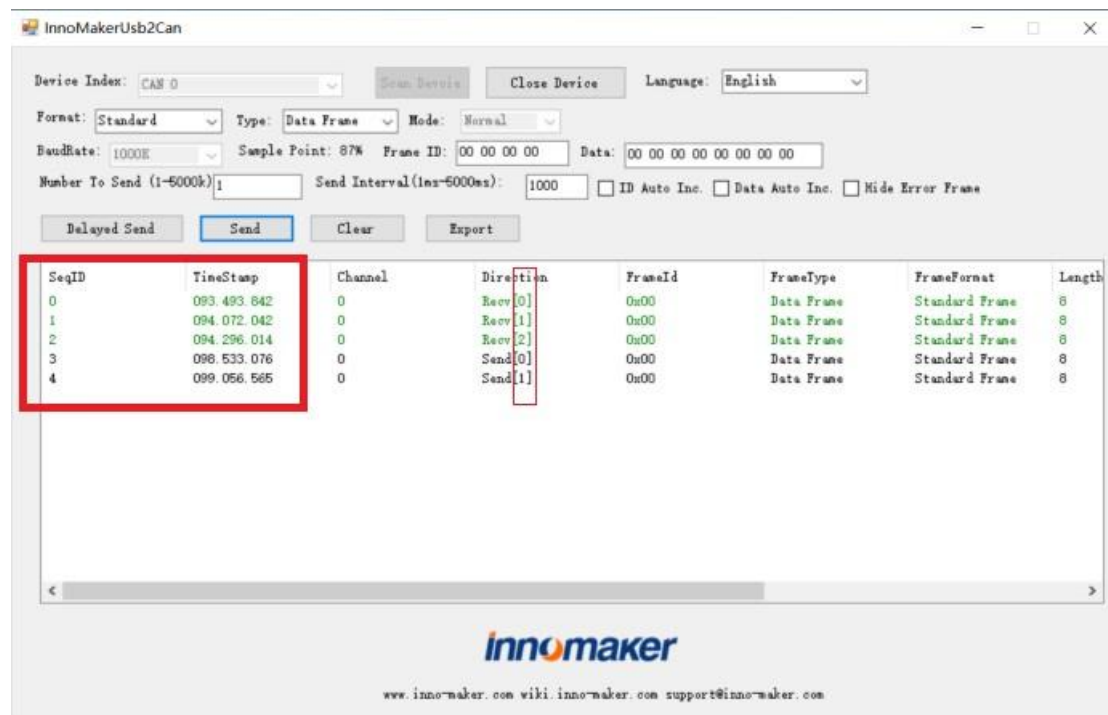
5.4 Enable Device.

Click 'Open device', the TX/RX LED light up.s



5.5 Send/Receive Data

After Open device, the device will automatic received data. The send data will be marked in black, Receive data will be marked in green. Error Frame will be marked in red. Every message will comes with the time stamp and serial number.



5.6 Windows Real Time Setting

If you want to test the USB2CAN module on at high speed and mass data mode(such as send/receive one million frames with 1 millisecond interval), please change the base priority level, That would be very helpful.

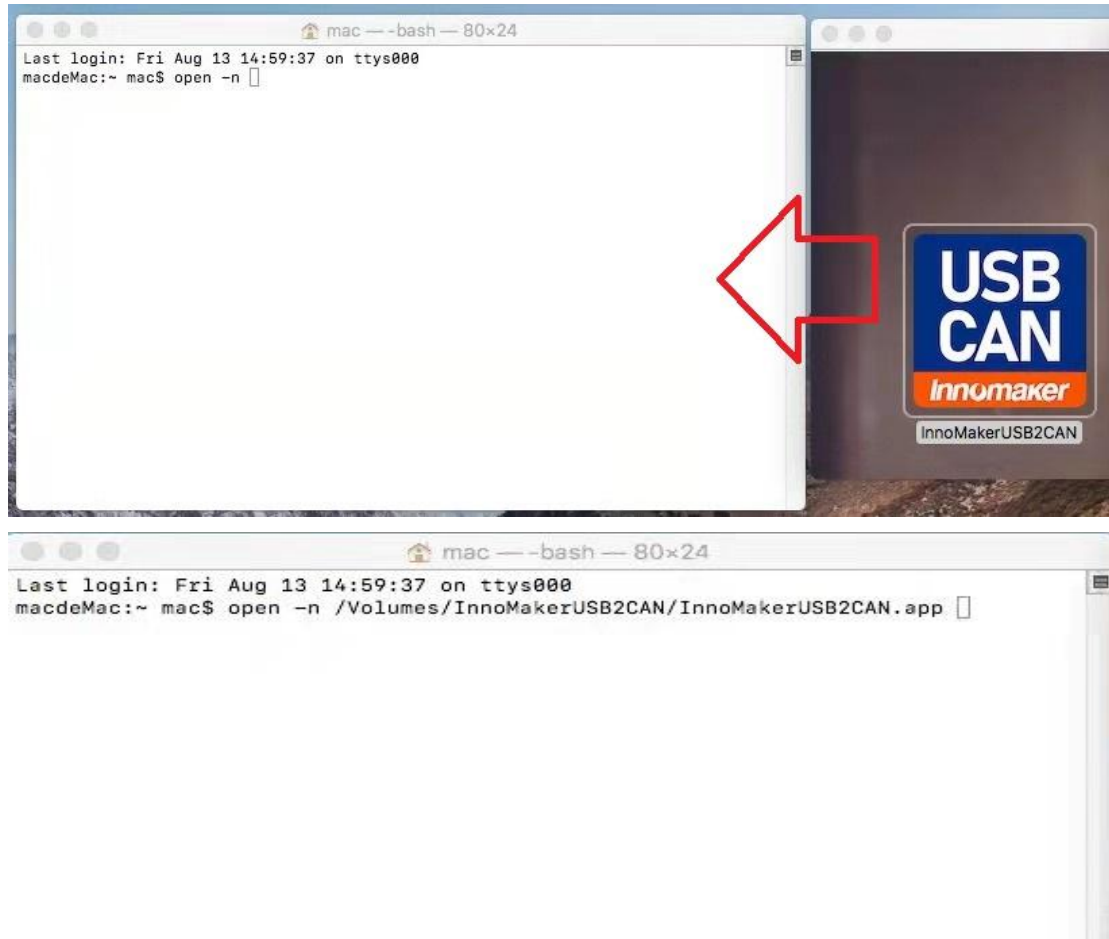
I take Windows 10 for example.

Open Task Manger

- right click on inno-maker application process
- left click on 'go to details'
- right click on inno-maker application process
- left click on 'set priority'
- left click on 'realtime'

5.7 Mac Os Double Open The USB2CAN Tool

Open the terminal of MacOS, if you can't find it, please googling it. Type 'open -n' + the software path. If you don't know the path, drag and drop the application icon.





6. Windows API

If you are not familiar with the CAN communication and WINDOWS software development, it is strongly recommended you that use the ready-made application we provide or entrust us with the development.

Released Date: 2021-07-16

Version No: 1.2.0

6.1 Dynamic Link Libraries

| Name | Size | Modified Time |
|---|--------|---------------|
|  InnoMakerUsb2CanLib.dll | 12 KB | 2020-06-27 |
|  LibUsbDotNet.LibUsbDotNet.dll | 153 KB | 2018-09-25 |

InnoMakerUsb2CanLib.dll: USB2CAN function dynamic link libraries.

LibUsbDotNetLibUsbDotNet.dll : WINDOWS USB Universal Interface dynamic link libraries.

6.2 Structure

```
public struct innomaker_host_frame
{
    public UInt32 echo_id; //The echo-id identifies the frame from (echos the id from a
                          //previous UCAN_OUT_TX message).

    public UInt32 can_id;    //CAN ID   Reserved for dual CAN Device
    public Byte can_dlc;    // data len   0~8
    public Byte channel;    // channel number,
    public Byte flags;      //additional flags
    public Byte reserved;   //reserved / padding
    [MarshalAs(UnmanagedType.ByValArray, SizeConst = 8)]
    public Byte[] data;     //CAN data
    public UInt32 timestamp_us; //times stamp
}
```

```
public struct innomaker_device_bittming
{
    public UInt32 prop_seg;           //propagation Segment
    public UInt32 phase_seg1;        //phase segment 1 (1~15)
    public UInt32 phase_seg2;        //phase segment 2 (1~8)
    public UInt32 sjw;               //synchronization segment (1~4)
    public UInt32 brp;               //clock divider, USB2CAN module clock is 48M
}
```

```
public enum UsbCanMode
{
    UsbCanModeNormal,               //Normal working mode
    UsbCanModeLoopback,             // Loopback mode
    UsbCanModeListenOnly,           // Listen only, not ACK
}
```

6.3 CallBack

(1) public delegate void AddDeviceNotifyDelegate() ;

-Summary: If Device Plug In, it will call the delegate

(2) RemoveDeviceNotifyDelegate();

```
public delegate void RemoveDeviceNotifyDelegate();
```

-Summary: If Device Plug Out, it will call the delegate

6.4 Function

(1) GetDllVersion

public String GetDllVersion()

-Summary: Return Current Dll Version

-Return: Current Dll Version

(2) scanInnoMakerDevices

public bool scanInnoMakerDevices()

-Summary: Scann Inno Maker Devices

-Return: Scan success return true , else return false

(3) getInnoMakerDeviceCount

public int getInnoMakerDeviceCount()

-Summary: Get Device Count

-Return: Device count

(4) getInnoMakerDevice

public InnoMakerDevice getInnoMakerDevice(int devIndex)

-Summary: Get Inno Maker device by device index

-devIndex: Device index

-return: Inno Maker Device Instance

(5) openInnoMakerDevice

public bool openInnoMakerDevice(InnoMakerDevice device)

-Summary: Open Device

-param: device

-return: if open success return true, else return false

(6) closeInnoMakerDevice

public bool closeInnoMakerDevice(InnoMakerDevice device)

-Summary: Close Device

-param: device

-return: if Close success return true, else return false

(7) asyncGetInnoMakerDeviceBuf

**public bool asyncGetInnoMakerDeviceBuf(InnoMakerDevice device,
Byte[] buf,
int size,
int transferredIn,
int timeout)**

-Summary: Read buffer from device async

-param: device

-param: buf, buffer reads in

-param: size, buffer size

-param: transferredIn, actually buffer length reads

-param: timeout, read buffer timeout, This is specified in milliseconds

-return: if read device success, return true, else return false

(8) syncGetInnoMakerDeviceBuf

**public bool syncGetInnoMakerDeviceBuf(InnoMakerDevice device,
Byte[] buf,
int size,
int transferredIn,
int timeout)**

-Summary: Read buffer from device sync

-param: device

-param: buf, buffer reads in

-param: size, buffer size

-param: transferredIn, actually buffer length reads

-param: timeout, read buffer timeout, This is specified in milliseconds.

-return: if read device success, return true, else return false

(9) asyncGetInnoMakerDeviceBuf

```
public bool asyncGetInnoMakerDeviceBuf(InnoMakerDevice device,
                                       Byte[] buf,
                                       int size,
                                       int timeout,int transferredOut)
```

- Summary: write buffer to device async
- param: device
- param: buf, buffer writes out
- param: size, buffer size
- param: transferredOut, actually buffer length writes
- param: timeout, write buffer timeout, This is specified in milliseconds.
- return: if write device success, return true, else return false

(10) syncGetInnoMakerDeviceBuf

```
public bool syncGetInnoMakerDeviceBuf(InnoMakerDevice device,
                                       Byte[] buf,
                                       int size,
                                       int timeout,
                                       int transferredOut)
```

- Summary: write buffer to device sync
- param: device
- param: buf, buffer writes out
- param: size, buffer size
- param: transferredOut, actually buffer length writes
- param: timeout, write buffer timeout
- return: if write success, return true, else return false

(11) UrbResetDevice

```
public bool UrbResetDevice(InnoMakerDevice device)
```

- Summary: Reset Device
- param: Device Instance
- return: If reset device success return true, else return false

(12) UrbSetupDevice

```
public bool UrbSetupDevice(InnoMakerDevice device,  
                           UsbCanMode canMode,  
                           innomaker_device_bittming bittming)
```

-Summary: Setup device

-param: Device Instance

-param: canMode, usbCanMode

-param: bittming, usb bittming params

-return: if setup device success return true, else return false

7. Mac Os API

Download the tools and SDK of Mac Os from below link:

<https://www.jianguoyun.com/p/DVvY6VIQpdSrBxjyqKUB>

<https://github.com/INNO-MAKER/usb2can>

There are consists of four parts:

-  doc_html
-  InnoMaker USB2CAN Tools
-  Lib
-  Tools Source Code

| Folder name | Description |
|--------------------------------|---|
| InnoMaker USB2CAN Tools | InnoMaker USB2CAN test tools, You can run natively on Mac OS version equal or above 10.11. If Mac os |
| Tools Source Code | The source of InnoMaker USB2CAN test tools, to show you how to use the SDK to develop a usb to can application. |
| Lib | The Library function for develop USB2CAN applications. These libraries are not open source. If you have any problem and suggestion, feel free to contract us. |
| doc_html | Simple document for library description. |

7.1 Library








Open the Lib folder, There are three files in it:

| | |
|--|-----------------|
|  .DS_Store | 2020/5/10 14:58 |
|  libInnoMakerUSBIOLib.dylib | 2020/5/10 14:57 |
|  UsbIO.h | 2020/5/10 14:55 |
|  USBIO+USBCAN.h | 2020/5/10 14:50 |

| Filename | Description |
|----------------------------|-------------------------------|
| UsbIO.h | USB Common Interface |
| USBIO+USBCAN.h | USB Special For CAN Interface |
| libInnoMakerUSBIOLib.dylib | Dynamic library file |

7.2 Document

Open the doc_html folder and open the index.html files. You can see InnoMakerUSB IO LIB reference.

| | | | |
|--|-----------------|-------------------|------|
|  Classes | 2020/5/11 13:10 | 文件夹 | |
|  css | 2020/5/11 12:53 | 文件夹 | |
|  img | 2020/5/11 12:53 | 文件夹 | |
|  js | 2020/5/11 12:53 | 文件夹 | |
|  Protocols | 2020/5/11 13:10 | 文件夹 | |
|  hierarchy.html | 2020/5/11 13:10 | 360 se HTML Do... | 2 KB |
|  index.html | 2020/5/11 13:10 | 360 se HTML Do... | 2 KB |

InnoMakerUSBIOLib

innomaker

Hierarchy

InnoMakerUSBIOLib Reference

Class References

- [InnoMakerDevice](#)
- [UsbIO](#)

Protocol References

- [InnoMakerDeviceDelegate](#)

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Generated by [appledoc 2.2.1 \(build 1334\)](#).

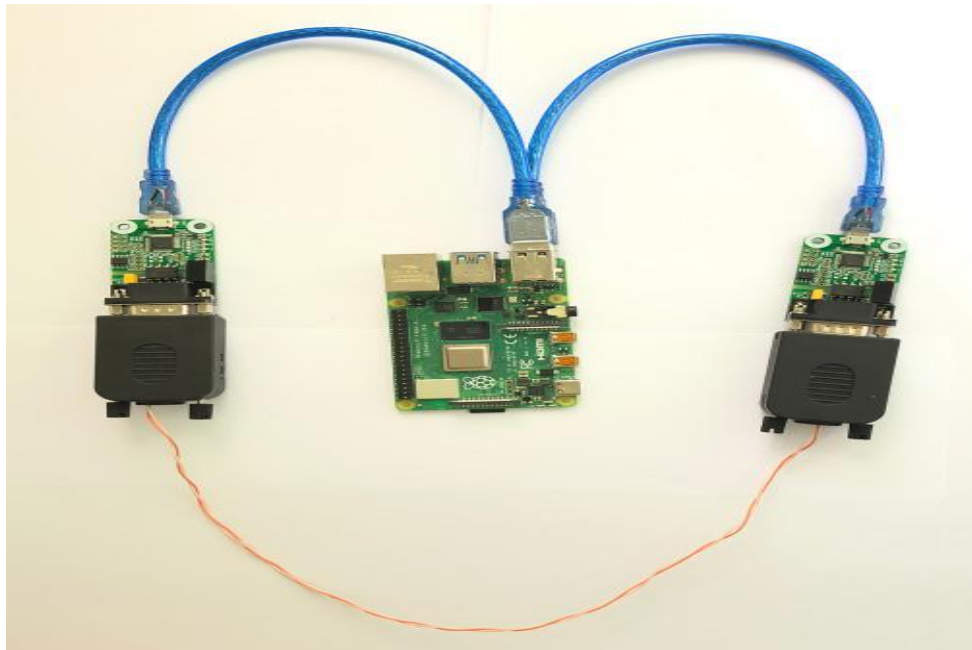
8. Linux/Ubuntu/Raspbian

8.1 Run Test Demo

USB2CAN device can run properly without any additional driver request on all Linux system since version 3.9. such as Ubuntu, Debian and Raspbian. If you meet driver problem on the old version You need to reconfigure the kernel drivers. Enable 'gs_usb.c' and install 'gs_usb.ko' into system. So notice that if you only compile this drivers, It may fail to load in system. At this time, compile fully with new configures. If you have any question, feel free to e-mail to our support team(support@inno-maker.com).

You can test the USB2CAN device with all single board computer or PC with the right Linux version. We take Raspberry Pi 4 as an example to show you how to run the C/Python and can-utils demo.

For demonstration purposes, I take two USB2CAN device to show the communication.



Please download the codes and tools from below links:

<https://github.com/INNO-MAKER/usb2can>

8.1.1 Preparatory work

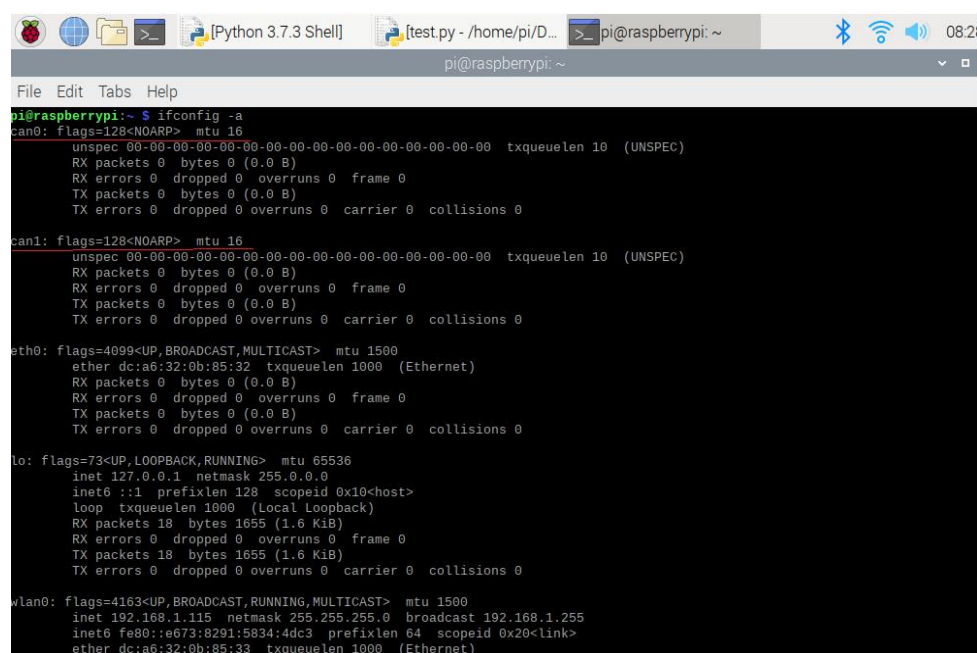
8.1.1.1 Connection

Plug the USB2CAN device into the USB Host of Raspberry Pi. And then connect the CAN_H pin and CAN_L pin to each other. No GND pin connection requirement.

| CAN 0 Channel | Connection | CAN 1 Channel |
|---------------|------------|---------------|
| CAN_L(pin 2) | ----- | CAN_L(pin 2) |
| CAN_H(pin 7) | ----- | CAN_H(pin 7) |

8.1.1.2 ifconfig -a

Type command 'ifconfig -a' to check 'can0' and 'can1' device is available in system.



```

pi@raspberrypi:~$ ifconfig -a
can0: flags=128<NOARP> mtu 16
    unspec 00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00 txqueuelen 10 (UNSPEC)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

can1: flags=128<NOARP> mtu 16
    unspec 00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00 txqueuelen 10 (UNSPEC)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

eth0: flags=4099<UP,BROADCAST,MULTICAST> mtu 1500
    ether dc:a6:32:0b:85:32 txqueuelen 1000 (Ethernet)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    inet6 ::1 prefixlen 128 scopeid 0x10<host>
    loop txqueuelen 1000 (Local Loopback)
    RX packets 18 bytes 1655 (1.6 KiB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 18 bytes 1655 (1.6 KiB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

wlan0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.1.115 netmask 255.255.255.0 broadcast 192.168.1.255
    inet6 fe80::e673:8291:5834:4dc3 prefixlen 64 scopeid 0x20<link>
    ether dc:a6:32:0b:85:33 txqueuelen 1000 (Ethernet)
  
```


8.1.1.3 dmesg

You can type command 'dmesg' for see more information about USB2CAN module at the bottom.

```
3.100730] usb 1-1.1.1: New USB device found, idVendor=1d50, idProduct=606f, bcdDevice= 0.00
3.100755] usb 1-1.1.1: New USB device strings: Mfr=1, Product=2, SerialNumber=3
3.100773] usb 1-1.1.1: Product: USB2CAN v1
3.100790] usb 1-1.1.1: Manufacturer: InnoMaker
3.100807] usb 1-1.1.1: SerialNumber: 002C00325353530620313737
3.184277] i2c /dev entries driver
3.303669] usb 1-1.1.2: new full-speed USB device number 6 using xhci_hcd
3.542779] usb 1-1.1.2: New USB device found, idVendor=1d50, idProduct=606f, bcdDevice= 0.00
3.542803] usb 1-1.1.2: New USB device strings: Mfr=1, Product=2, SerialNumber=3
3.542822] usb 1-1.1.2: Product: USB2CAN v1
3.542839] usb 1-1.1.2: Manufacturer: InnoMaker
3.542856] usb 1-1.1.2: SerialNumber: 002B00315353530620313737
```

8.1.2 Use can-utils Tool

This tool is a very easy way to test USB2CAN module communication. There is only a simple use instruction. For more details, please refer to can-utils usermanual and source code.

<https://github.com/linux-can/can-utils/>

8.1.2.1 -Install Tools

```
sudo apt-get install can-utils
```

8.1.2.2 -Send And Receive Test

(1) Initialize CAN port, After below command, you could see the the TX/RX light on for CAN0 and CAN1 channels.

```
sudo ip link set can0 down
```

```
sudo ip link set can0 type can bitrate 125000
```

```
sudo ip link set can0 up
```

```
sudo ip link set can1 down
```

```
sudo ip link set can1 type can bitrate 125000
```

```
sudo ip link set can1 up
```

(2) Set CAN0 as receiver

```
candump can0
```

(3) Set CAN1 as sender

```
cansend can1 123#1234567890
```

The image shows two terminal windows on a Raspberry Pi desktop. The background is a sunset wallpaper. The left window shows the following commands and output:

```
pi@raspberrypi:~$ sudo ip link set can0 down
pi@raspberrypi:~$ sudo ip link set can0 type can bitrate 125000
pi@raspberrypi:~$ sudo ip link set can0 up
pi@raspberrypi:~$ candump can0
can0 123 [5] 12 34 56 78 90
```

The right window shows the following commands:

```
pi@raspberrypi:~$ sudo ip link set can1 down
pi@raspberrypi:~$ sudo ip link set can1 type can bitrate 125000
pi@raspberrypi:~$ sudo ip link set can1 up
pi@raspberrypi:~$ cansend can1 123#1234567890
pi@raspberrypi:~$
```

8.1.2.3 -Loopback Mode Test

```
sudo ip link set can0 down
```

```
sudo ip link set can0 type can bitrate 125000 loopback on
```

```
sudo ip link set can0 up
```

```
candump can0 & cansend can0
```

The image shows a terminal window on a Raspberry Pi desktop. The desktop has a taskbar with icons for a Raspberry Pi, a globe, a folder, and two terminal windows. The terminal window shows the following commands and output:

```
pi@raspberrypi:~$ sudo ip link set can0 down
pi@raspberrypi:~$ sudo ip link set can0 type can bitrate 125000 loopback on
pi@raspberrypi:~$ sudo ip link set can0 up
pi@raspberrypi:~$ candump can0 & cansend can0 123#1234567890
[1] 1551
can0 123 [5] 12 34 56 78 90
can0 123 [5] 12 34 56 78 90
pi@raspberrypi:~$
```

8.1.3 Run C Demo

(1) Load C Demo named 'usb2cantest' from our Wiki and up-zip it to the desktop of Raspbian.

http://www.inno-maker.com/wiki/doku.php?id=usb_can

Or <http://www.inno-maker.com/wiki/doku.php>

(2) Go to folder named 'c' and change the permissions.

`chmod -R a+rwX *`



(3) Set one as receiver, execute following commands in serial terminal. Now this Raspberry pi is blocked.

`./can0_receive`

(4) Set the other Pi as sender, execute following commands.

`./can1_send`

```

pi@raspberrypi: ~/Desktop/usb2cantest
File Edit Tabs Help
pi@raspberrypi:~$ cd Desktop
pi@raspberrypi:~/Desktop$ cd usb2cantest
pi@raspberrypi:~/Desktop/usb2cantest$ chmod -R a+x *
pi@raspberrypi:~/Desktop/usb2cantest$ ls
can0_receive  can1_receive  can1_test  can_send  cantool  can-utils-master  rs485_test  setup
can0_send     can1_send     can_receive can_server cantool-sh can-utils-master.zip rs485_test-sh
pi@raspberrypi:~/Desktop/usb2cantest$ ./can0_receive
This is a can receive demo, can0 with 1Mbps!
Received standard frame!
can_id = 0x123
can_dlc = 8
data[0] = 1
data[1] = 2
data[2] = 3
data[3] = 4
data[4] = 5
data[5] = 6
data[6] = 7
data[7] = 8
pi@raspberrypi:~/Desktop/usb2cantest$

pi@raspberrypi: ~/Desktop/usb2cantest
File Edit Tabs Help
pi@raspberrypi:~$ cd Desktop
pi@raspberrypi:~/Desktop$ cd usb2cantest
pi@raspberrypi:~/Desktop/usb2cantest$ ls
can0_receive  can1_send  can_send  cantool-sh  rs485_test
can0_send     can1_test  can_server can-utils-master  rs485_test-sh
can1_receive  can_receive cantool    can-utils-master.zip  setup
pi@raspberrypi:~/Desktop/usb2cantest$ ./can1_send
This is a socket can transmit demo program ,can1 with 1Mbps baud rate
Transmit standard frame!
can_id = 0x123
can_dlc = 8
data[0] = 1
data[1] = 2
data[2] = 3
data[3] = 4
data[4] = 5
data[5] = 6
data[6] = 7
data[7] = 8
pi@raspberrypi:~/Desktop/usb2cantest$

```

8.1.4 Run Python3 Demo

Download Python Demo named 'python3' from our Wiki and up-zip it to Desktop(or wherever you want put it).

http://www.inno-maker.com/wiki/doku.php?id=usb_can

Or <http://www.inno-maker.com/wiki/doku.php>

There are three files in the 'c' folder. send.py and receive.py is for testing send and receive function separately and test.py is use for automatic testing.

(1) Check the Python version of your Raspbian. Python 3.7.3 default in 2019-09-26-Raspbian.img. Our Demo can run on any Python3 version.

python3 -V

```

pi@raspberrypi: ~
File Edit Tabs Help
pi@raspberrypi:~$ python3 -V
Python 3.7.3
pi@raspberrypi:~$

```

(2) If you can't find the Python3 in system. Install the Python3

sudo apt-get install python3-pip

(3) If you are testing on Ubuntu system, It may can't use the 'ifconfig' command. Please install the net tools.

```
sudo apt install net-tools
```

(4) Install Python CAN library.

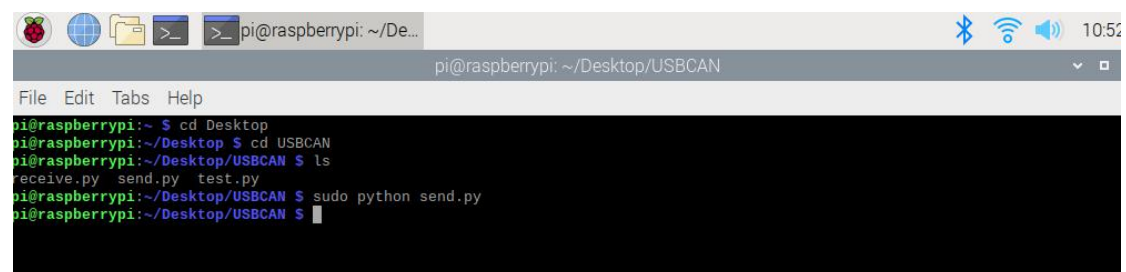
```
sudo pip3 install python-can
```

(5) Set one Raspberry Pi as receiver.

```
sudo python3 receive.py
```

(6) Set the other as sender.

```
sudo python3 receive.py
```



```
pi@raspberrypi: ~/Desktop/USBCAN
File Edit Tabs Help
pi@raspberrypi:~$ cd Desktop
pi@raspberrypi:~/Desktop$ cd USBCAN
pi@raspberrypi:~/Desktop/USBCAN$ ls
receive.py send.py test.py
pi@raspberrypi:~/Desktop/USBCAN$ sudo python send.py
pi@raspberrypi:~/Desktop/USBCAN$
```

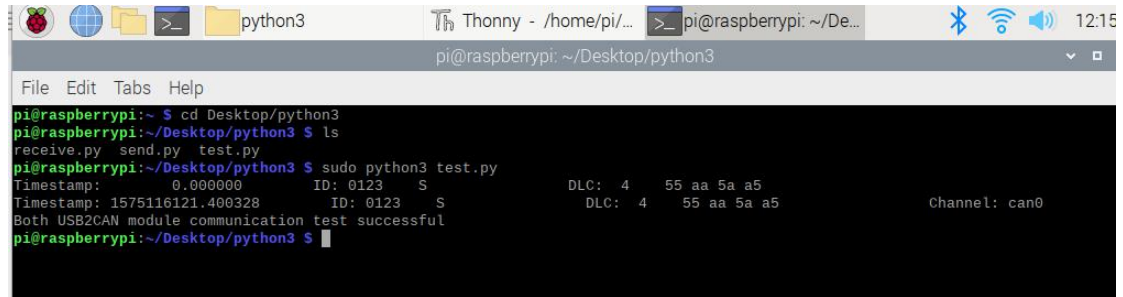
(7) You will see the data received.



```
pi@raspberrypi: ~/Desktop/USBCAN
File Edit Tabs Help
None
No message was received
None
No message was received
None
No message was received
None
No message was received
None
No message was received
None
No message was received
None
No message was received
None
No message was received
Timestamp: 1567158754.555561 ID: 0123 S DLC: 4 00 01 02 03 Channel: can0
None
```

(8) If you use one Raspberry Pi and two USB2CAN module for testing. Run 'test.py' and check the result.

```
sudo python3 test.py
```



The screenshot shows a terminal window on a Raspberry Pi. The user has navigated to the directory ~/Desktop/python3 and listed the files, which include receive.py, send.py, and test.py. They then executed the command sudo python3 test.py. The output shows two successful CAN bus messages with ID 0123 and DLC 4, transmitted on the can0 channel. The first message has a timestamp of 0.000000, and the second has a timestamp of 1575116121.400328. The test is confirmed as successful.

```
pi@raspberrypi:~ $ cd Desktop/python3
pi@raspberrypi:~/Desktop/python3 $ ls
receive.py  send.py  test.py
pi@raspberrypi:~/Desktop/python3 $ sudo python3 test.py
Timestamp: 0.000000      ID: 0123      S      DLC: 4      55 aa 5a a5
Timestamp: 1575116121.400328      ID: 0123      S      DLC: 4      55 aa 5a a5      Channel: can0
Both USB2CAN module communication test successful
pi@raspberrypi:~/Desktop/python3 $
```

8.2 Software Description

Now with previous demo's code to show you how to program socket can in Raspbian with C and Python . The socket can is an implementation of CAN protocols(Controllor Area Network) for Linux. CAN is a networking technology which has widespread use in automation, embedded devices, and automotive fields. While there have been other CAN implementations for Linux based on character devices, Socket CAN uses the Berkeley socket API, the Linux network stack and implements the CAN device drivers as network interfaces. The CAN socket API has been designed as similar as possible to the TCP/IP protocols to allow programmers, familiar with network programming, to easily learn how to use CAN sockets.

For more Socket CAN detail please refer to below link:

<https://www.kernel.org/doc/Documentation/networking/can.txt>

https://elinux.org/CAN_Bus

8.2.1 Programming in C

8.2.1.1- For Sender's codes

(1): Create the socket, If an error occurs then the return result is -1.

```
/*Create socket*/
s = socket(PF_CAN, SOCK_RAW, CAN_RAW);
if (s < 0) {
    perror("Create socket PF_CAN failed");
    return 1;
}
```

(2): Locate the interface to "can0" or other name you wish to use. The name will show when you execute `./ifconfig -a`.

```
/*Specify can0 device*/
strcpy(ifr.ifr_name, "can0");
ret = ioctl(s, SIOCGIFINDEX, &ifr);
if (ret < 0) {
    perror("ioctl interface index failed!");
    return 1;
}
```


(3): Bind the socket to "can0".

```
/*Bind the socket to can0*/
addr.can_family = PF_CAN;
addr.can_ifindex = ifr.ifr_ifindex;
ret = bind(s, (struct sockaddr *)&addr, sizeof(addr));
if (ret < 0) {
    perror("bind failed");
    return 1;
}
```

(4): Disable sender's filtering rules, this program only send message do not receive packets.

```
/*Disable filtering rules, this program only send message do not receive packets */
setsockopt(s, SOL_CAN_RAW, CAN_RAW_FILTER, NULL, 0);
```

(5): Assembly data to send.

```
/*assembly message data! */
frame.can_id = 0x123;
frame.can_dlc = 8;
frame.data[0] = 1;
frame.data[1] = 2;
frame.data[2] = 3;
frame.data[3] = 4;
frame.data[4] = 5;
frame.data[5] = 6;
frame.data[6] = 7;
frame.data[7] = 8;
//if(frame.can_id&CAN_EFF_FLAG==0)
if(!(frame.can_id&CAN_EFF_FLAG))
    printf("Transmit standard frame!\n");
else
    printf("Transmit extended frame!\n");
```

(6): Send message to the can bus. You can use the return value of write() to check whether all data has been sent successfully .

```
/*Send message out */
nbytes = write(s, &frame, sizeof(frame));
if(nbytes != sizeof(frame)) {
    printf("Send frame incompletely!\r\n");
    system("sudo ifconfig can0 down");
}
```

(7): Close can0 device and disable socket.

```
/*Close can0 device and destroy socket!*/
close(s);
```


8.2.1.2 -For Receiver's codes

(1) step 1 and (2) is same as Sender's code.

(3): It's different from Sender's.

```
/*Bind the socket to can0*/
addr.can_family = PF_CAN;
addr.can_ifindex = ifr.ifr_ifindex;
ret = bind(s, (struct sockaddr *)&addr, sizeof(addr));
if (ret < 0) {
    perror("bind failed");
    return 1;
}
```

(4): Define receive filter rules, we can set more than one filter rule.

```
/*Define receive filter rules, we can set more than one filter rule!*/
struct can_filter rfilter[2];
rfilter[0].can_id = 0x123; //Standard frame id !
rfilter[0].can_mask = CAN_SFF_MASK;
rfilter[1].can_id = 0x12345678; //extend frame id!
rfilter[1].can_mask = CAN_EFF_MASK;
```

(5): Read data back from can bus.

```
if (1) {
    nbytes = read(s, &frame, sizeof(frame));
}
```

8.2.2 Programming in Python

8.2.2.1- Import

import os

The OS module in Python provides a way of using operating system dependent functionality. The functions that the OS module provides allows you to interface with the underlying operating system that Python is running on – be that Windows, Mac or Linux. We usually use os.system() function to execute a shell command to set CAN.

import can

The python-can library provides Controller Area Network support for Python, providing common abstractions to different hardware devices, and a suite of utilities for sending and receiving messages on a CAN bus.

For more information about python-can, please to below link:

<https://python-can.readthedocs.io/en/stable/index.html>

ifconfig

If you are use Ubuntu system, It may can't use the 'ifconfig' command. Please install the net tools.

```
sudo apt install net-tools
```

8.2.2.2 -Simple common functions

(1) Set bitrate and start up CAN device.

```
os.system('sudo ip link set can0 type can bitrate 1000000')
```

```
os.system('sudo ifconfig can0 up')
```

(2) Bind the socket to 'can0'.

```
can0 = can.interface.Bus(channel = 'can0', bustype = 'socketcan ctypes')
```

(3) Assembly data to send.

```
msg = can.Message(arbitration_id=0x123, data=[0, 1, 2, 3], extended_id=False)
```

(4) Send data.

```
can0.send(msg)
```

(5) Receive data.

```
msg = can0.recv(30.0)
```

(6) Close CAN device

```
os.system('sudo ifconfig can0 down')
```

9. Error Frame

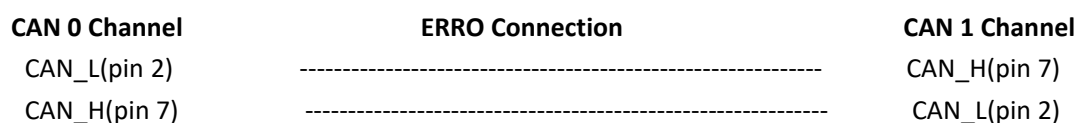
You may receive some error frame marked in red when you use the USB2CAN module. They will tell you what problem does the USB2CAN module meet on your CAN Bus.

Some people would say why didn't they meet the error frame with other tool or USB to CAN module before. The truth is that most of the tool filter out the error frame to avoid controversy and support. They just show nothing when there are some error on the CAN Bus. We want to show the all raw data to help you to analyze your CAN BUS. Some error can be ignored, but some error maybe the hidden danger for your CAN BUS.

For the error frame ID description, please refer to below link:

<https://github.com/linux-can/can-utils/blob/master/include/linux/can/error.h>

Now we take a simple case to show you how to analyze the error frame ID. I made the incorrect connection between the USB2CAN module and the CAN Bus, to see what happens.



| SeqID | SystemTime | Channel | Direc... | FrameId | Frame... | Frame... | Length | FrameData |
|-------|--------------------|---------|----------|------------|----------|----------|--------|----------------------------|
| 4 | 2020/6/29 14:44:08 | 0 | Recv | 0x20000024 | Data ... | Stand... | 8 | 0x 00 00 00 00 00 00 00 00 |
| 5 | 2020/6/29 14:44:08 | 0 | Recv | 0x20000024 | Data ... | Stand... | 8 | 0x 00 00 00 00 00 00 00 00 |
| 6 | 2020/6/29 14:44:08 | 0 | Recv | 0x20000024 | Data ... | Stand... | 8 | 0x 00 00 00 00 00 00 00 00 |
| 7 | 2020/6/29 14:44:08 | 0 | Recv | 0x20000024 | Data ... | Stand... | 8 | 0x 00 00 00 00 00 00 00 00 |
| 8 | 2020/6/29 14:44:08 | 0 | Recv | 0x20000024 | Data ... | Stand... | 8 | 0x 00 00 00 00 00 00 00 00 |
| 9 | 2020/6/29 14:44:08 | 0 | Recv | 0x20000024 | Data ... | Stand... | 8 | 0x 00 00 00 00 00 00 00 00 |
| 10 | 2020/6/29 14:44:08 | 0 | Recv | 0x20000024 | Data ... | Stand... | 8 | 0x 00 00 00 00 00 00 00 00 |
| 11 | 2020/6/29 14:44:08 | 0 | Recv | 0x20000024 | Data ... | Stand... | 8 | 0x 00 00 00 00 00 00 00 00 |
| 12 | 2020/6/29 14:44:08 | 0 | Recv | 0x20000024 | Data ... | Stand... | 8 | 0x 00 0C 00 00 00 00 00 00 |
| 13 | 2020/6/29 14:44:08 | 0 | Recv | 0x20000024 | Data ... | Stand... | 8 | 0x 00 0C 00 00 00 00 00 00 |
| 14 | 2020/6/29 14:44:08 | 0 | Recv | 0x20000024 | Data ... | Stand... | 8 | 0x 00 0C 00 00 00 00 00 00 |
| 15 | 2020/6/29 14:44:08 | 0 | Recv | 0x20000024 | Data ... | Stand... | 8 | 0x 00 0C 00 00 00 00 00 00 |
| 16 | 2020/6/29 14:44:08 | 0 | Recv | 0x20000024 | Data ... | Stand... | 8 | 0x 00 30 00 00 00 00 00 00 |

As Above, We received error frame Id: 0x20000024 and 2 set of 8 byte Frame Data:

data[0]=0x00, data[1]=0x0C, data[3] to data[7] are all 0x00 .

data[0]=0x00, data[1]=0x30, data[3] to data[7] are all 0x00 .

According the above error frame ID description link:

```
/* error class (mask) in can_id */
#define CAN_ERR_TX_TIMEOUT 0x00000001U /* TX timeout (by netdevice driver) */
#define CAN_ERR_LOSTARB 0x00000002U /* lost arbitration / data[0] */
#define CAN_ERR_CRTL 0x00000004U /* controller problems / data[1] */
#define CAN_ERR_PROT 0x00000008U /* protocol violations / data[2..3] */
#define CAN_ERR_TRX 0x00000010U /* transceiver status / data[4] */
#define CAN_ERR_ACK 0x00000020U /* received no ACK on transmission */
#define CAN_ERR_BUSOFF 0x00000040U /* bus off */
#define CAN_ERR_BUSERROR 0x00000080U /* bus error (may flood!) */
#define CAN_ERR_RESTARTED 0x00000100U /* controller restarted */
```

This Error frame ID = 0x200000000 | 0x00000020 | 0x00000004
= 0x200000000 | CAN_ERR_ACK | CAN_ERR_CRTL

So the USB2CAN meet two problem 'received no ACK on transmission' and 'controller problems'.

For problem 'received no ACK on transmission' may case by the not CAN-BUS or other module on the CAN BUS are only listen mode(No ACK).

For problem 'controller problems', refer to the data[1] description:

```
/* error status of CAN-controller / data[1] */
#define CAN_ERR_CRTL_UNSPEC 0x00 /* unspecified */
#define CAN_ERR_CRTL_RX_OVERFLOW 0x01 /* RX buffer overflow */
#define CAN_ERR_CRTL_TX_OVERFLOW 0x02 /* TX buffer overflow */
#define CAN_ERR_CRTL_RX_WARNING 0x04 /* reached warning level for RX errors */
#define CAN_ERR_CRTL_TX_WARNING 0x08 /* reached warning level for TX errors */
#define CAN_ERR_CRTL_RX_PASSIVE 0x10 /* reached error passive status RX */
#define CAN_ERR_CRTL_TX_PASSIVE 0x20 /* reached error passive status TX */
/* (at least one error counter exceeds */
/* the protocol-defined level of 127) */
#define CAN_ERR_CRTL_ACTIVE 0x40 /* recovered to error active state */
```

data[1] = 0x0C = 0x04 | 0x08 = CAN_ERR_CRTL_RX_WARNING | CAN_ERR_CRTL_TX_WARNING
It means the USB2CAN module can't send/receive data properly and reached warning level.

data[1] = 0x30 = 0x10 | 0x20 = CAN_ERR_CRTL_RX_PASSIVE | CAN_ERR_CRTL_TX_PASSIVE
It means the USB2CAN module can't send/receive data too much, USB2CAN module into error status.

Summing up the above, the error frame tell us, USB2CAN module can't get ACK from CAN BUS and can't send data to the CAN Bus. So the CAN Bus may not inexistence or the connection error.

10. User Manual Version Descriptions

| Version | Description | Date | E-mail |
|---------|---|------------|--|
| V1.1 | | 2019.02.02 | support@inno-maker.com sales@inno-maker.com |
| V1.2 | Add Python Add can-utils | 2019.08.26 | calvin@inno-maker.com |
| V1.3 | Correct description | 2019.08.26 | calvin@inno-maker.com |
| V1.4 | Added DB9 Description Added CAN utils tools loopback mode description | 2020.10.11 | calvin@inno-maker.com |
| V1.5 | Added description for how to install net tools on Ubuntu system | 2021.05.01 | calvin@inno-maker.com |
| V1.6 | Added USB2CAN-DEVKIT ,USB2CAN-Cable,USB description Merged Mas Os , WINDOWS, LINUX description | 2021.10.10 | calvin@inno-maker.com |

If you have any suggestions, ideas, codes and tools please feel free to email to me. I will update the user manual and record your name and E-mail in list. Look forward to your letter and kindly share.