SER-CAN-M USER'S MANUAL

2019 Edition

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Contents

INTRODUCTION

A Controller Area Network (CAN) is a high-integrity asynchronous serial bus system for networking intelligent devices. It is often used in automotive and industrial systems. The SER-CAN-M is designed to make a fast, simple way to communicate with CAN bus devices. Connected to a serial port on your computer, the SER-CAN-M instantly adds an industrial CAN bus channel to your host system.

The SER-CAN-M provides a cost-effective solution for customers to enable communication with CAN bus devices. The solution designed by ARM Cortex-M0 32-bit microcontroller makes it very flexible in handling small burst of CAN frames at a high speed.

Plugging the SER-CAN-M into the serial port, The SER-CAN-M adapter provides instant connectivity to CAN bus devices. The SER-CAN-M provides an industrial solution for applications of CAN bus multi-drop communications over short and long distances.

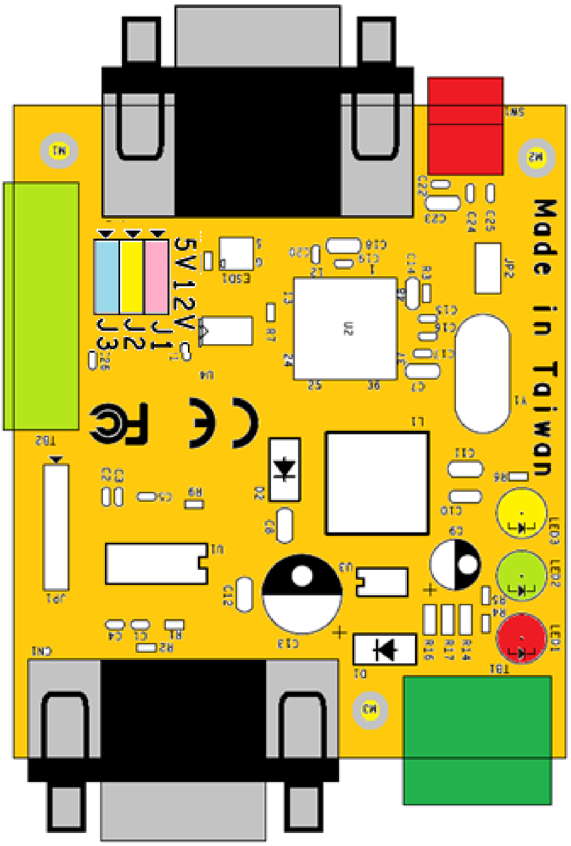
The SER-CAN-M provides DC +5V/+12V 500mA power for external devices and is powered from an external DC 12V power supply.

FEATURES

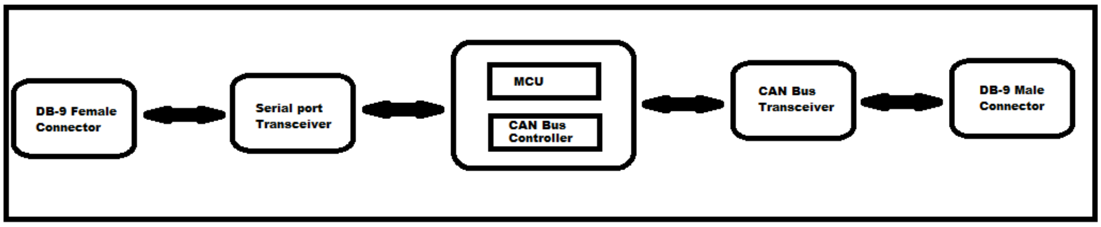
- Adds a CAN bus port on your computer by connecting to the RS-232 serial port
- One DB9 female connector (serial port)
- One DB9 male connector (CAN bus port)
- Includes one serial cable. Cable length: 100cm
- Powered by external DC 12V power adapter
- Provides DC +5V/+12V 500mA power for external devices
- LEDs indicate initialization and CAN bus status
- CAN bus speed up to 1Mbits
- Supports CAN 2.0A and CAN 2.0B protocols
- Supported CAN modes
    - Standard mode: normal operation on CAN bus
    - Listen mode: passive receiving of CAN frames
    - Echo mode: transmitter also receives sent frames (for testing purposes)
- SER-CAN-M can be controlled over serial port using simple ASCII commands
- Wide ambient temperature operation 0°C to 60°C (32°F to 140°F)
- CE, FCC approval
- Designed by ARM Cortex-M0 32-bit microcontroller

DIAGRAM OF SER-CAN-M

PCB LAYOUT



BLOCK DIAGRAM



SPECIFICATIONS

The tables below show the specifications of serial to 1-port CAN bus adapter:

General	
Serial Port	RS-232 Serial Port
CAN Bus	Supports CAN 2.0A and CAN 2.0B
Chipset	ARM Cortex-M0 32-bit microcontroller

CAN Bus	
Number of Ports	One
Connector	DB9 male connector
CAN Bus Speed	5kbits to 1Mbits for CAN data transmit & receive
Signals	CAN_H, CAN_L, CAN_GND, CAN_V+
CAN Bus Controller	Bosch C_CAN module
LED	Power, CAN bus data activity, CAN bus error
CAN Bus Mode	Standard mode: normal operation on CAN bus Listen mode: passive receiving of CAN Frames Echo mode: transmitter also receives sent frames (for testing purposes)
Protection	+/-16 KV ESD protection for CAN signals

Software Features	
API Library	Supports C/C++, C#, VB.NET and LabVIEW
Utility	On-board firmware update utility
Monitoring Tools	Supported by CANHacker, Titan CAN test program

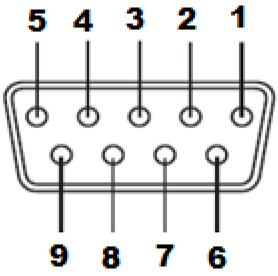
Power Requirement	
Power Input	DC 12V external power adapter
Power Consumption	Max. 80mA@12VDC (no external devices)

Mechanical	
Casing	SECC sheet metal (1mm)
Dimensions	81 mm x 81 mm x 24 mm (L x W x H)
Weight	175g

Environment	
Operating Temperature	0°C to 60°C (32°F to 140°F)
Storage Temperature	-20°C to 75°C (-4°F to 167°F)
Humidity	5% to 95% RH
Safety Approvals	CE, FCC

PIN-OUT INFORMATION

Following are the pin-out of connector for RS-232 serial port signals:

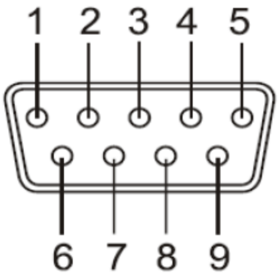


DB9 Female connector pin numbers

RS-232 Serial Port Pin-out for DB9 Female Connector

Pin Number	Signals	Description
1	DCD	Data Carrier Detect
2	RxD	Receive Serial Data
3	TxD	Transmit Serial Data
4	-	Reserved
5	GND	Signal Ground
6	DSR	Data Set Ready
7	RTS	Request To Send
8	CTS	Clear To Send
9	-	Reserved

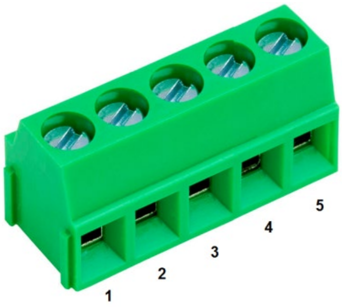
Following are the pin-out of DB-9 male connector and terminal block for CAN bus signals:



DB9 Male connector pin numbers

CAN Bus Pin-out for DB9 Male Connector

Pin Number	Signals	Description
1	CAN_V+	Provides +DC 5V or 12V power (optional)
2	CAN_L	CAN_L bus line (dominant level is low)
3	CAN_GND	Signal ground
4	-	Reserved
5	-	Reserved
6	CAN_GND	Signal ground
7	CAN_H	CAN_H bus line (dominant level is high)
8	-	Reserved
9	CAN_V+	Provides +DC 5V or 12V power (optional)



Terminal block connector pin numbers

CAN Bus Pin-out for 5-pin Terminal Block

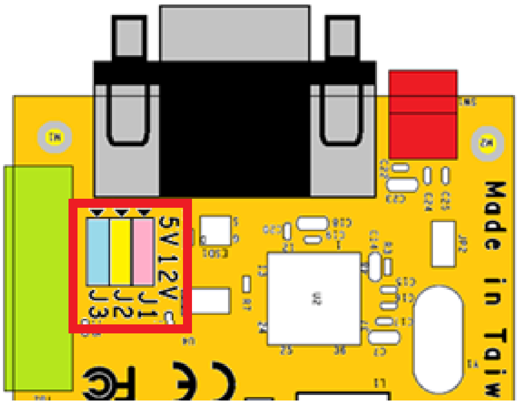
Pin Number	Signals	Description
1	CAN_GND	Signal ground
2	CAN_H	CAN_H bus line (dominant level is high)
3	CAN_L	CAN_L bus line (dominant level is low)
4	CAN_V+	Provides +DC 5V or 12V power (optional)
5	CAN_GND	Signal ground

Enabling the DC +5V or DC +12V Power for External Devices

Outside the unit, there is a 3-pin DIP switch (SW) which are settings used for enabling 5V or 12V (500mA max.) power for external devices.

SW		Function
Pin 1	ON	Enable DB9 pin 1 to provide 5V or 12V power for external devices
	OFF	Disable the 5V or 12V power on pin 1
Pin 2	ON	Enable DB9 pin 9 to provide 5V or 12V power for external devices
	OFF	Disable the 5V or 12V power on pin 9
Pin 3	ON	Enable terminal block pin 4 to provide 5V or 12V power for external devices
	OFF	Disable the 5V or 12V power on terminal block pin 4

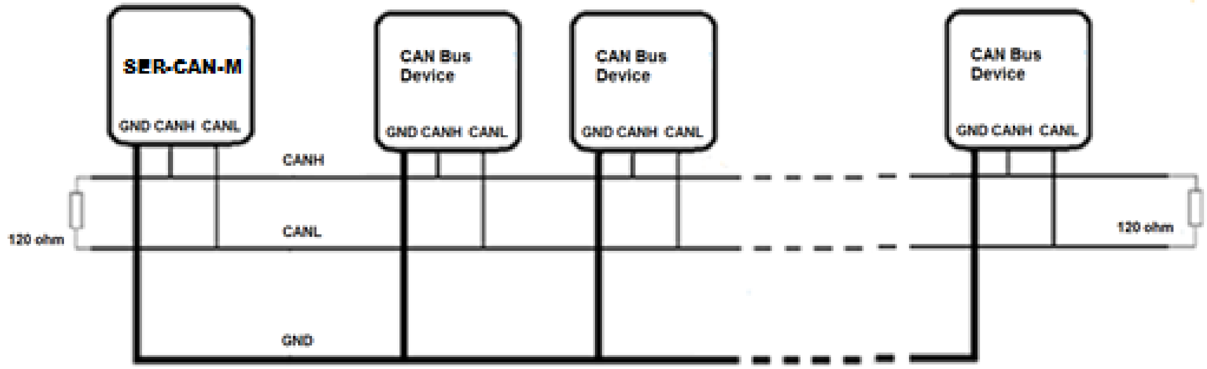
Inside the unit, there are three 3-pin header block (J1, J2, J3) which are jumpers for selecting 5V or 12V power for external devices.



Jumper	Function
J1 pin 1, 2 short	Select DB9 pin 1 to provide 5V power for external devices
J1 pin 2, 3 short	Select DB9 pin 1 to provide 12V power for external devices
J2 pin 1, 2 short	Select DB9 pin 9 to provide 5V power for external devices
J2 pin 2, 3 short	Select DB9 pin 9 to provide 12V power for external devices
J3 pin 1, 2 short	Select terminal block pin 4 to provide 5V power for external devices
J3 pin 2, 3 short	Select terminal block pin 4 to provide 12V power for external devices

Termination Resistors

The serial to CAN adapter does not provide CAN bus termination resistors. A CAN bus network requires 120Ω termination resistors at each end. Generally, this must be done in the cabling. Since this depends on the installation of connections, please check your CAN bus cable specification for proper impedance matching.



FUNCTION DESCRIPTION

LED Indicators

The SER-CAN-M adapter has three LEDs (red LED, green LED, yellow LED) to indicate power and CAN bus statuses. The red LED indicates SER-CAN-M adapter power; the green LED indicates CAN bus data activity and the yellow LED indicates a CAN bus error.

Following are the definition of different LED combinations:

A: Power up (device initialized)
After SER-CAN-M powers up (device initialized), the red LED turns on and the green & yellow LEDs flash four times to indicate that the SER-CAN-M adapter has been initialized.

B: CAN bus channel open/close
When CAN bus channel opens, the green LED will turn on to indicate that the CAN bus channel is open; When CAN bus channel closes, the green LED will turn off to indicate that the CAN bus channel is closed.

C: CAN Bus Data Activity
When CAN data frame is sent or received, the green LED flashes continuously to indicate CAN bus data I/O activity.

D: CAN Bus Error
When an error occurs on the CAN bus, the yellow LED flashes continuously to indicated CAN bus error.

ASCII Command Set

With simple ASCII commands the SER-CAN-M adapter can be controlled over the serial port. User can send/receive commands from any simple serial terminal program.

Example: Set bitrate to 500Kbps, open CAN channel, send CAN frame (ID = 002h, DLC = 3, Data = 11 22 33), close CAN:

Command	Response	Function
S6[CR]	[CR]	Set bitrate of SER-CAN-M adapter to 500Kbps
O[CR]	[CR]	Open CAN channel
t0023112233[CR]	z[CR]	Send CAN message (ID = 002h, DLC = 3, Data = 11 22 33)
C[CR]	[CR]	Close CAN channel

Command List

The commands are line based and terminated with newline character CR (0xD). On error the response will be 0x7 (BELL).

The “help” command (‘**H’, ‘h’ or ‘?’)** will list supported commands.

Command	Response	Function
H[CR]	[CR]	List all supported commands
h[CR]	[CR]	
?[CR]	[CR]	

Example: H[CR]

Return Code
List of Supported Commands:
‘O’ – Open the channel in Normal mode
‘L’ – Open the channel in Listen Only mode
‘Y’ – Open the channel in Loopback mode
‘C’ – Close CAN Channel
‘S’ – Set standard CAN bitrate
‘s’ – Set non-standard CAN bitrate
‘t’ – Transmit a standard frame
‘T’ – Transmit an extended frame
‘r’ – Transmit a standard remote request frame
‘R’ – Transmit an extended remote request frame
‘Z’ – Set timestamp on/off
‘m’ – Set acceptance mask
‘M’ – Set acceptance filter
‘F’ – Read status flag
‘V’ – Check software version
‘N’ – Check serial number
‘m’ – Set acceptance mask
‘M’ – Set acceptance filter
‘RST’ – Reset SER-CAN-M Adapter
‘H’, ‘h’ or ‘?’ – List supported commands

Opening the CAN Bus Channel

The CAN bus channel will be opened with the command O[CR], L[CR] or Y[CR]. The command O[CR] will open the CAN bus channel in normal operation mode, the command L[CR] will open the CAN bus channel in listen only mode, in which no bus interaction will be done from the controller. the command Y[CR] will open the CAN bus channel in a loop-back mode, in which the SER-CAN-M adapter will also receive the frames that it sends. Before you use one of the commands, you should set a bitrate with the commands S or s.

Command	Response	Function
O[CR]	[CR]	Open the channel in Normal mode
L[CR]	[CR]	Open the channel in Listen Only mode
Y[CR]	[CR]	Open the channel in Loopback mode

Closing the CAN Bus Channel

The CAN bus channel will be closed with the command C[CR]. The command can only be used if the CAN bus channel is open.

Command	Response	Function
C[CR]	[CR]	Close the CAN channel if it is opened

Setting CAN Bitrate (Standard)

The CAN bus bitrate can be set with the command SX[CR]. The command can only be used if the CAN bus channel is closed.

Command	Response	Function
S00[CR]	[CR]	Set the CAN bus bitrate to 5K
S0[CR]	[CR]	Set the CAN bus bitrate to 10K
S1[CR]	[CR]	Set the CAN bus bitrate to 20K
S2[CR]	[CR]	Set the CAN bus bitrate to 50K
S3[CR]	[CR]	Set the CAN bus bitrate to 100K
S4[CR]	[CR]	Set the CAN bus bitrate to 125K
S5[CR]	[CR]	Set the CAN bus bitrate to 250K
S6[CR]	[CR]	Set the CAN bus bitrate to 500K
S7[CR]	[CR]	Set the CAN bus bitrate to 800K
S8[CR]	[CR]	Set the CAN bus bitrate to 1M

Example: S6[CR] will be set SER-CAN-M adapter to 500K bps CAN Bitrates.

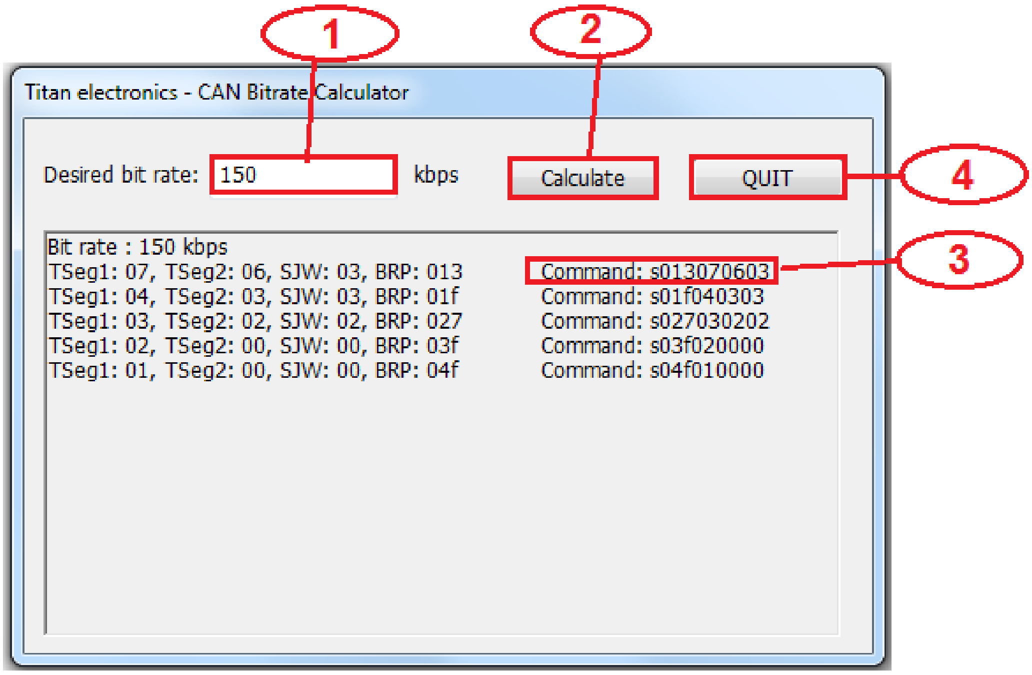
Setting CAN Bitrate (Advanced)

A more user defined bus bitrate can be configured with the command sXXXXXXXXX[CR]. As with the standard bus timing command above, you can only use this command when the CAN bus channel is closed.

sXXXXXXXXX [CR] sets the bitrate registers of the CAN controller. Users can set **non-standard bitrates** which are not supported by the "SX" command.

The SER-CAN-M adapter provides a CAN Bitrate Calculator program to calculate the value of CAN bitrate registers for setting **non-standard bitrates**. Follow these steps to calculate and set **non-standard bitrates** for the SER-CAN-M adapter:

1. Open the CAN Bitrate Calculator program.
2. Enter CAN Bitrate (“150” for 150Kbps CAN Bitrate) in the field “Desired bitrate:”.
3. Click “Calculate” to calculate the value of CAN bitrate registers.
4. Remember the topmost value of CAN bitrate registers.
5. **e.g. Command: s013070603** for 150 kbps CAN Bitrate.
6. Click “Quit” to exit the CAN Bitrate Calculator program.



Desired bit rate: 150 kbps

```
Bit rate : 150 kbps
TSeg1: 07, TSeg2: 06, SJW: 03, BRP: 013      Command: s013070603
TSeg1: 04, TSeg2: 03, SJW: 03, BRP: 01f      Command: s01f040303
TSeg1: 03, TSeg2: 02, SJW: 02, BRP: 027      Command: s027030202
TSeg1: 02, TSeg2: 00, SJW: 00, BRP: 03f      Command: s03f020000
TSeg1: 01, TSeg2: 00, SJW: 00, BRP: 04f      Command: s04f010000
```

Example: s013070603[CR] will be set the bitrate to 150Kbps.

Transmitting a Standard CAN Frame

Transmitting a standard CAN frame (ID: 11 bit) over a CAN bus can be done with the command tiiildddd...dd[CR]. The return value will be z[CR] or the normal error byte (BELL). The command is only available when the CAN bus channel is open.

Command	Response	Function
tiiildddd...dd[CR]	z[CR]	Transmits a standard CAN message (11 bit) over the CAN bus

iii: Standard CAN frame (11 bit) identifier in hexadecimal format (000-7FF).
l: CAN data length (0-8) DLC, with the maximum value being 8 (8 bytes).
dd: Data byte value in hexadecimal format (00-FF). The number of bytes must be equal to the data length field.
Example: t00231199FF[CR] will send a standard CAN frame with ID = 002h, DLC = 3, Data = 11 99 FF.

Transmitting a Standard Remote Request CAN Frame

Transmitting a standard remote request CAN frame (ID: 11 bit) over a CAN bus can be done with the command riiil[CR]. The return value will be z[CR] or the normal error byte (BELL). The command is only available when the CAN bus channel is open.

Command	Response	Function
riiil[CR]	z[CR]	Transmits a standard remote request (11 bit) over the CAN bus

iii: Standard remote request CAN frame (11 bit) identifier in hexadecimal format (000-7FF).
l: CAN data length to request (0-8) DLC, with the maximum value being 8 (8 bytes).
Example: r0023[CR] will send a standard remote request CAN frame with ID = 002h, DLC = 3 and request 3 data bytes.

Transmitting an Extended CAN Frame

Transmitting an extended CAN frame (ID: 29 bit) over a CAN bus can be done with the command Tiiiiiiiildddd...dd[CR]. The return value will be Z[CR] or the normal error byte (BELL). The command is only available when the CAN bus channel is open.

Command	Response	Function
Tiiiiiiiildddd…dd[CR]	Z[CR]	Transmits an extended CAN frame (11 bit) over the CAN bus

iiiiiii: Extended CAN frame (29 bit) identifier in hexadecimal format (00000000-1FFFFFFF).
l: CAN data length (0-8) DLC, with the maximum value being 8 (8 bytes).
dd: Data byte value in hexadecimal format (00-FF). The number of bytes must be equal to the data length field.
Example: T1FFFFFFF3112233[CR] will send an extended CAN frame with ID = 1FFFFFFFh, DLC = 3, data = 11 22 33.

Transmitting an Extended Remote Request CAN Frame

Transmitting an extended remote request CAN frame (ID: 29 bit) over a CAN bus can be done with the command Riiiiiiiil[CR]. The return value will be Z[CR] or the normal error byte (BELL). The command is only available when the CAN bus channel is open.

Command	Response	Function
Riiiiiiiil[CR]	Z[CR]	Transmits an extended remote request (29 bit) over the CAN bus

iiiiiii: Extended remote request CAN frame (29 bit) identifier in hexadecimal format (00000000-1FFFFFFF).
l: CAN data length to request (0-8) DLC, with the DLC maximum value being 8 (8 bytes).
Example: R100000023[CR] will send an extended remote request CAN frame with ID = 10000002h, DLC = 3 and request 3 data bytes.

Setting Timestamps ON/OFF

The timestamp command will set the timestamp functionality of received frames ON or OFF. This command is only available when the CAN channel is closed.

Command	Response	Function
Z1[CR]	[CR]	Set the timestamp functionality on received frames ON
Z0[CR]	[CR]	Set the timestamp functionality on received frames OFF

Setting Acceptance Mask

The acceptance mask, in conjunction with the acceptance code (M), defines which CAN message frames (i.e. of a specific ID or range of CAN IDs) will be passed to the serial interface. The acceptance mask value corresponds to bits within a range of valid CAN IDs for either standard or extended CAN frames. This command is only active if the CAN channel is initiated and not opened.

Set Acceptance Mask (m) command should be executed *prior* to Set Acceptance Code (M).

*Note**:** The CAN channel will revert to its prior state after execution. For example, if the channel is open when this command is executed, the channel will update the setting and return to the open state.*

Command	Response	Function
miii[CR]	[CR]	Set acceptance mask for standard CAN frame (11 bit) identifier
miiiiiiii[CR]	[CR]	Set acceptance mask for extended CAN frame (29 bit) identifier

iii = standard 11-bit CAN mask (0x000 through 0x7FF)
iiiiiii = extended 29-bit CAN mask (0x00000000 through 0x1FFFFFFF)

A value of "0" in a bit location indicates that the bit location ID value is to be *ignored* when filtering messages.
Default is to pass all frames (acceptance mask = 0x000 for standard messages and 0x00000000 for extended messages)

Example: m700[CR] set acceptance mask to check bits 10, 9 and 8 against the filter. Bits 7 through 0 are ignored as "don't care". Use the acceptance mask in conjunction with the acceptance code, which is explained next.

Setting Acceptance Code

The acceptance code/filter, in conjunction with the acceptance mask (m), defines which CAN message frames (i.e. of a specific ID or range of CAN IDs) will be passed to the serial interface. The acceptance code value corresponds to a valid CAN IDs for either standard or extended CAN frames. This command is only active if the CAN channel is initiated and not opened.

The Set Acceptance Mask (m) command should be executed *prior* to the Set Acceptance Code (M) command.

Note: The CAN channel will revert to its prior state after execution. For example, if the channel is open when this command is executed, the channel will update the setting and return to the open state.

Command	Response	Function
Miii[CR]	[CR]	Set acceptance code for standard CAN frame (11 bit) identifier
Miiiiiiii[CR]	[CR]	Set acceptance code for extended CAN frame (29 bit) identifier

iii = standard 11-bit CAN mask (0x000 through 0x7FF)
iiiiiii = extended 29-bit CAN mask (0x00000000 through 0x1FFFFFFF)

Default is to pass all frames (acceptance code = 0x7FF for standard messages and 0x1FFFFFF for extended messages)

Example: m1FF[CR] sets acceptance code to receive standard messages with the CAN ID of 0x1FF. If used in conjunction with the acceptance mask example above, frames of the range 0x100 through 0x1FF will be passed, and all other CAN IDs will be blocked.

Getting Status Flags

User can use the command F[CR] to get the status bits when an error occurs. A two-byte BCD number is returned to correspond to the 8-bits of the internal register of the CAN controller.

Command	Response	Function
F[CR]	XX[CR]	Get CAN bus status

Return Codes
XX[CR]
XX = CAN bus status (A bit set to “1” indicates a true condition):

Bits 2, 1, 0**:** Last Error Code(LEC), The LEC field holds a code, which indicates the type of the last error to occur on the CAN bus.

LEC Bits 2, 1, 0	Meaning
Error Code 0 0, 0, 0	No error.
Error Code 1 0, 0, 1	Stuff error: more than 5 equal bits in a sequence have occurred in a part of a received message where this is not allowed.
Error Code 2 0, 1, 0	Form error: a fixed format part of a received frame has the wrong format.
Error Code 3 0, 1, 1	ACK Error: the message this CAN core transmitted was not acknowledged by another node.
Error Code 4 1, 0, 0	Bit 1 error: during the transmission of a message (with the exception of the arbitration field), the device wanted to send a recessive level (bit of logical value “1”), but the monitored bus value was dominant.
Error Code 5 1, 0, 1	Bit 0 error: Bit 1 error: during the transmission of a message (or acknowledged bit, or active error flag, or overload flag), the device wanted to send a dominant level (bit of logical value “0”), but the monitored bus value was recessive. During the bus-off recovery, this status is set each time a sequence of 11 recessive bits have been monitored. This enables the CPU to monitor the proceedings of the bus-off recovery sequence (indicating the bus is not stuck at dominant or continuously disturbed).
Error Code 6 1, 1, 0	CRC error: the CRC checksum was incorrect in the message received, the CRC received for an incoming message does not match with the calculated CRC for the received data.
Error Code 7 1, 1, 1	Unused: no CAN bus event was detected since the CPU wrote this value to the LEC.

Bit 3: Transmitted a message successfully
1 = Since this bit was last reset by CPU, a message has been successfully (error-free and acknowledged by at least one other node) transmitted.
0 = Since this bit was last reset by CPU, no message has been transmitted.

Bit 4: Received a message successfully
1 = A message has been successfully received since this bit was last reset by CPU (independent of the result of acceptance filtering).
0 = No message has been successfully received since this bit was last reset by CPU

Bit 5: Error Passive (Read only)
1 = The CAN core is in the error passive state as defined in the CAN specification.
0 = The CAN core is in the error active.

Bit 6: Error Warning Status (Read only)
1 = At least one of the error counters in the EML (Error Management Logic) has reached the error warning limit of 96.
= Both error counters are below the error warning limit of 96.

Bit 7: Bus-off Status (Read only)
1 = The CAN Module is in bus-off state.
0 = The CAN Module is not in bus-off state.

<BELL> = ERROR

Bit 0 ~ Bit 7 returned to correspond to the 8-bits of the internal register of the CAN controller.

Getting Version Information

The command V[CR] to retrieve the current firmware version of the SER-CAN-M adapter.

Command	Response	Function
V[CR]	VXXXX[CR]	Get the current firmware version of the SER-CAN-M adapter

This command is always available and will return the version information formatted like this: VXXXX[CR].

Getting Serial Number

The command N[CR] will retrieve the serial number of the SER-CAN-M adapter.

Command	Response	Function
N[CR]	TXXXXXXXX[CR]	Get the serial number of the SER-CAN-M adapter

This command is always available and will return the decimal serial number like this: TXXXXXXX[CR].

Resetting the SER-CAN-M adapter

The command RST[CR] will reset the SER-CAN-M adapter.

Command	Response	Function
RST[CR]	-	Reset the SER-CAN-M adapter

This command is always available.

TOOLS

Firmware Upgrade

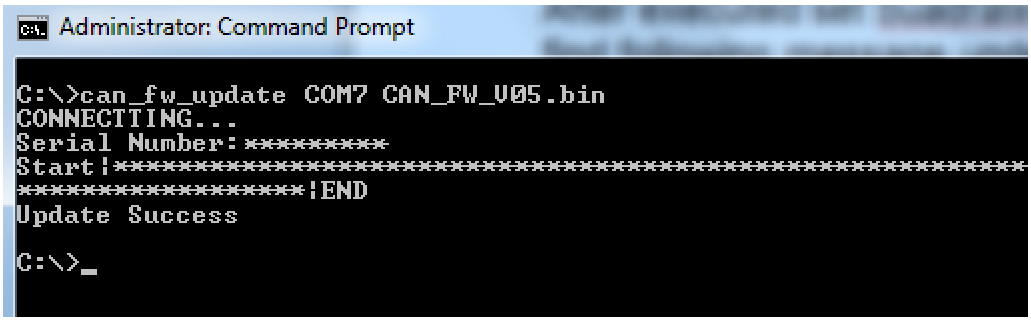
The SER-CAN-M adapter firmware can be updated for bug fixes and enhanced features. You can use our tool program to upgrade the firmware contents via serial port.

The firmware upgrade program (can_fw_update.exe) must be executed under "Command Prompt" with administrative privileges.

Following is the firmware upgrade command:

```
can_fw_update <COM-PORT> <FIRMWARE FILE>"
```

Example: can_fw_update COM7 CAN_FW_V05.bin



```
C:\>can_fw_update COM7 CAN_FW_V05.bin
CONNECTTING...
Serial Number:**********
Start|**********************************************************
******************|END
Update Success

C:\>_
```

COM7: a free RS-232 serial port in your host computer.

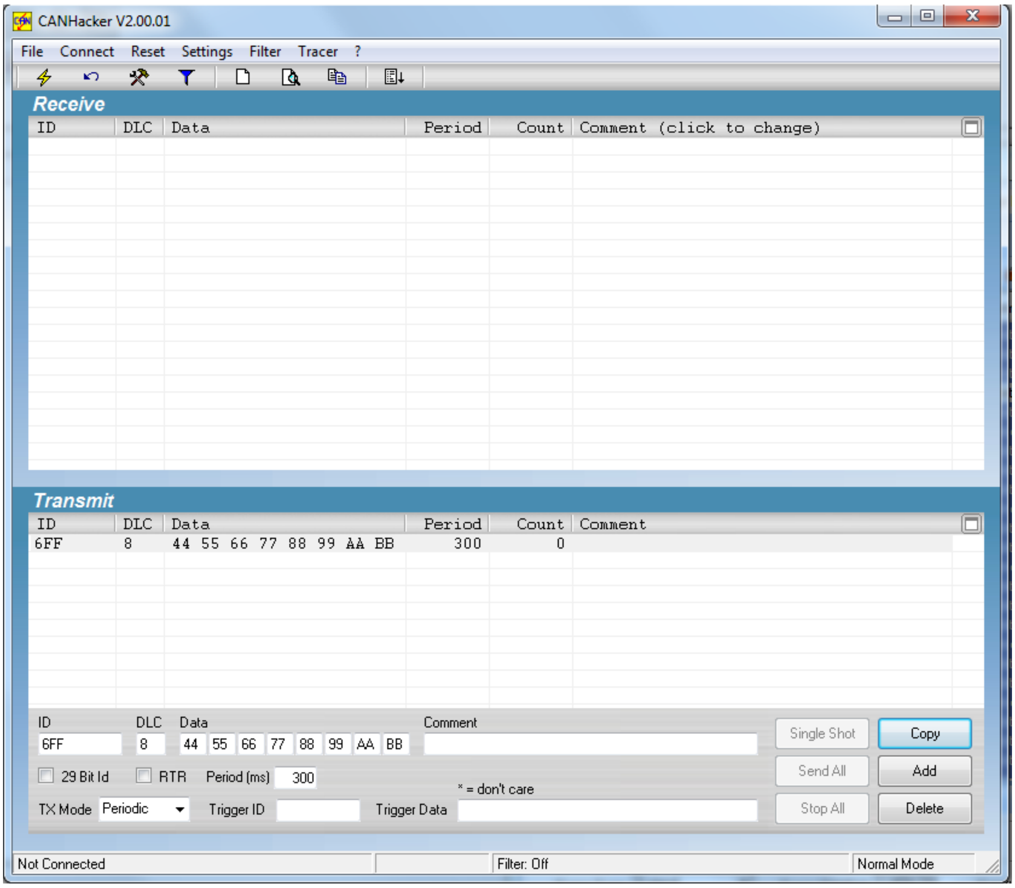
CAN_FW_V5.bin: new firmware file (binary file) of SER-CAN-M adapter.

After executing the firmware upgrade successfully, you will find following message under "Command Prompt":

```
CONNECTING…
Serial Number: T12345678
Start:
****************************************************************
***********************************************: END
Update Success
```

CANHacker

CANHacker is a Windows application software for analyzing and transmitting/receiving CAN frames. The CANHacker software has a friendly interface and is easy to use. Through the software user can easily test and analyze the CAN frames. Following shows its main panel:



ID	DLC	Data	Period	Count	Comment (click to change)

ID	DLC	Data	Period	Count	Comment
6FF	8	44 55 66 77 88 99 AA BB	300	0	

ID 6FF DLC 8 Data 44 55 66 77 88 99 AA BB Comment

☐ 29 Bit Id ☐ RTR Period (ms) 300

* = don't care

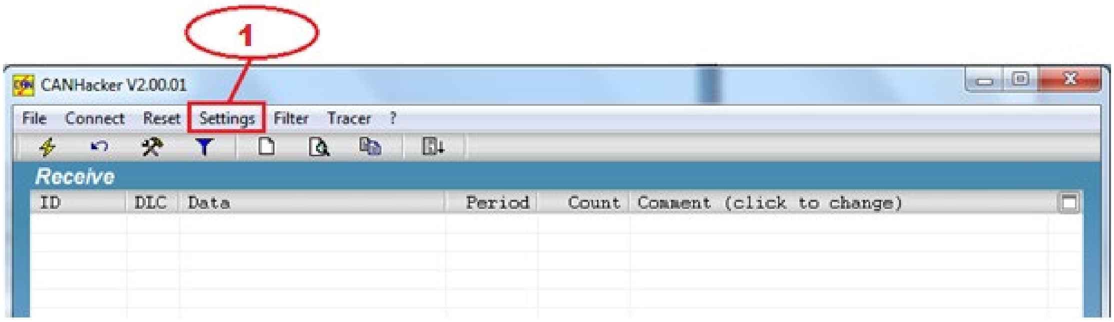
TX Mode Periodic Trigger ID Trigger Data

Not Connected | Filter: Off | Normal Mode

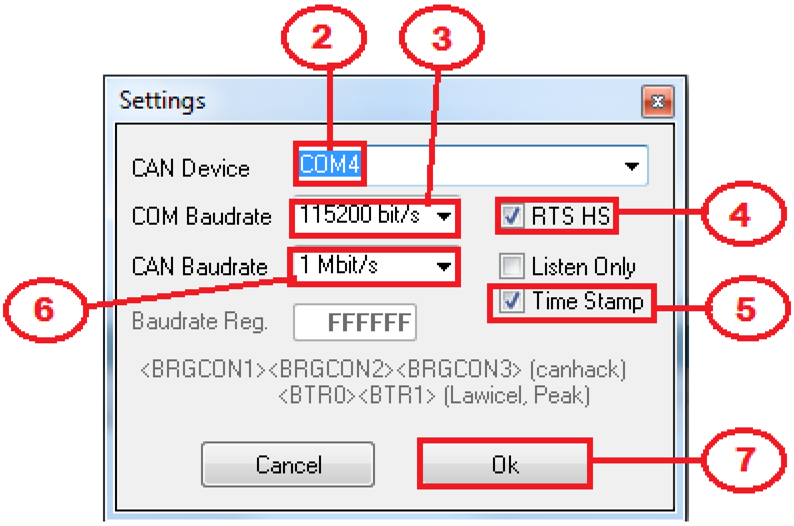
The following sections will briefly introduce the necessary steps on how to use the software.

Settings procedure for selecting and configuring the SER-CAN-M adapter

1. Open CANHacker and click “Settings” under the menu.



2. Select COM port of the SER-CAN-M adapter.
3. **Select “COM Baudrate” to 115200 bit/s.**
4. Check “RTS HS” to enable RTS handshake function.
5. Check “Time Stamp” to enable timestamp function.
6. Select CAN Baudrate for the CAN bus operating speed.
7. Finally, click “OK” to finish the settings and return to the main panel.


Settings

CAN Device: COM4

COM Baudrate: 115200 bit/s

CAN Baudrate: 1 Mbit/s

☑ RTS HS

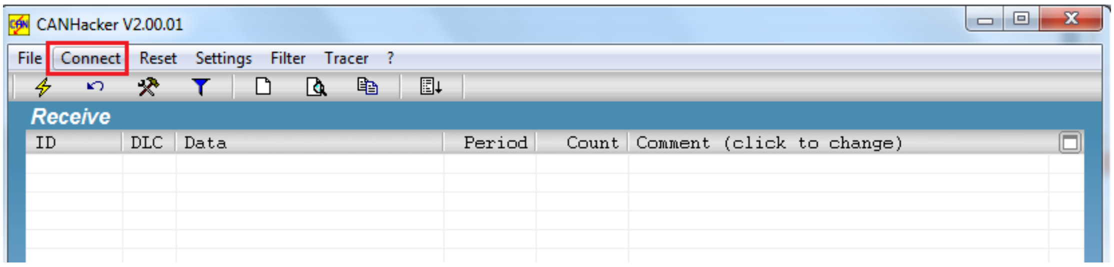
□ Listen Only

☑ Time Stamp

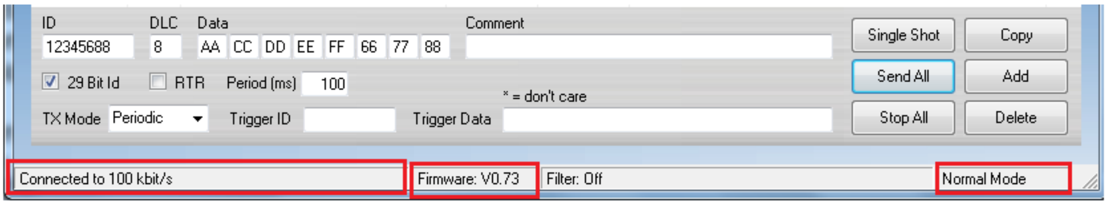
Baudrate Reg.: FFFFFF

<BRGCON1><BRGCON2><BRGCON3> (canhack)
<BTR0><BTR1> (Lawicel, Peak)

You may connect the SER-CAN-M adapter after configuration. Click “Connect”, as shown in the figure, to start the CANHacker software operation.



When SER-CAN-M adapter successfully connects, you will find the message “Connected to XXX kbits/s”, firmware version VXXXX and operation mode at the bottom of the main panel.



ID 12345688

DLC 8

Data AA CC DD EE FF 66 77 88

Comment

☑ 29 Bit Id

□ RTR

Period (ms) 100

* = don't care

TX Mode Periodic

Trigger ID

Trigger Data

Connected to 100 kbit/s

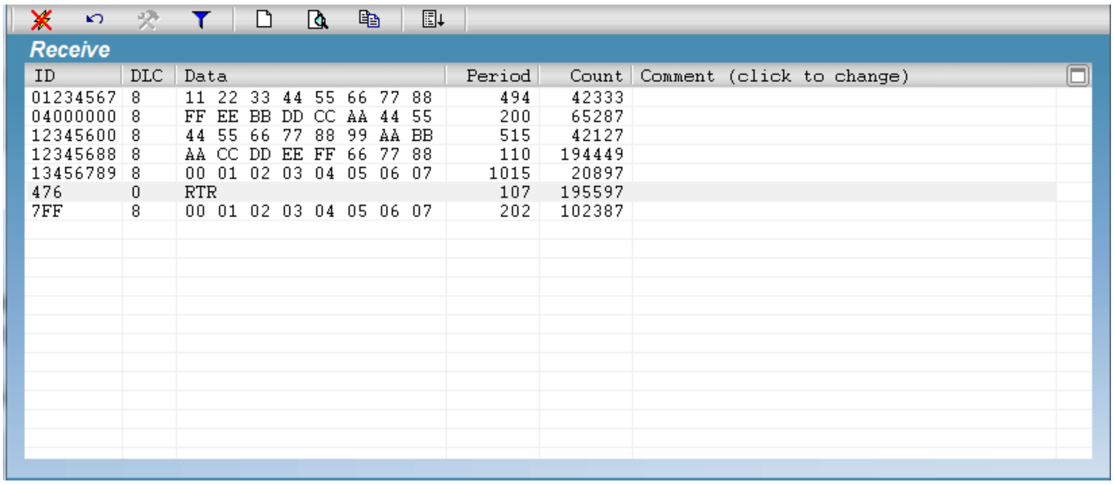
Firmware: V0.73

Filter: Off

Normal Mode

Receiving CAN frames

When CANHacker receives CAN frames from another CAN node, it will show all CAN frame messages in the middle of main panel. The CAN frame messages includes ID, DLC, Data, Period, Count.

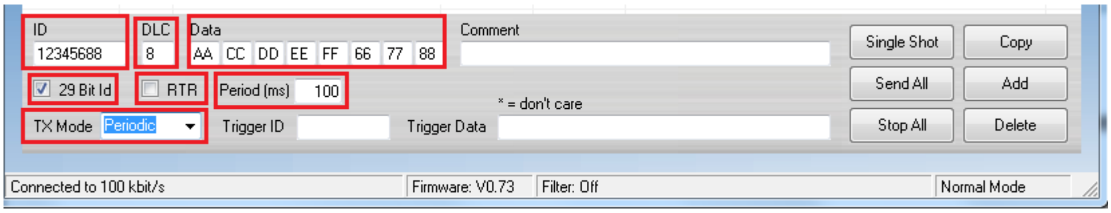


Receive

ID	DLC	Data	Period	Count	Comment (click to change)
01234567	8	11 22 33 44 55 66 77 88	494	42333	
04000000	8	FF EE BB DD CC AA 44 55	200	65287	
12345600	8	44 55 66 77 88 99 AA BB	515	42127	
12345688	8	AA CC DD EE FF 66 77 88	110	194449	
13456789	8	00 01 02 03 04 05 06 07	1015	20897	
476	0	RTR	107	195597	
7FF	8	00 01 02 03 04 05 06 07	202	102387	

Sending CAN frames

CANHacker provides many parameters for sending CAN frames to another CAN node, you can set the following parameters on the bottom of the main panel for CAN data transmission:



ID: 12345688

DLC: 8

Data: AA CC DD EE FF 66 77 88

Comment:

☑ 29 Bit Id

□ RTR

Period (ms): 100

* = don't care

TX Mode: Periodic

Trigger ID:

Trigger Data:

Connected to 100 kbit/s | Firmware: V0.73 | Filter: Off | Normal Mode

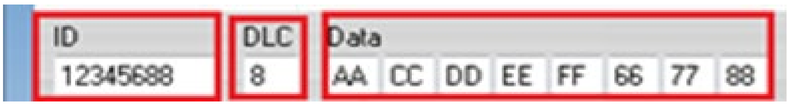
Select transmit an extended CAN Frame (29 bits ID) or a standard CAN frame (11 bits ID).

Check “29 Bit Id” ☑ 29 Bit Id to transmit an extended CAN Frame (29 bits ID) and uncheck “29 Bit Id” □ 29 Bit Id to transmit a standard CAN frame (11 bits ID).

Select remote request frame mode or transmit CAN frame mode.

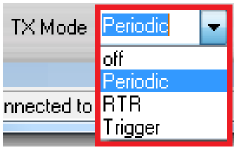
Check “RTR” ☑ RTR for a remote request frame mode or uncheck “RTR” □ RTR for transmit CAN frame mode.

Enter CAN frame messages in the respective fields, including ID, DLC, Data.



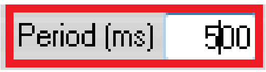
ID	DLC	Data
12345688	8	AA CC DD EE FF 66 77 88

In “TX Mode” dialog box, you can select “off”, “Periodic”, “RTR”, “Trigger” modes.



TX Mode: Periodic

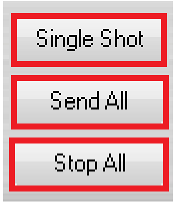
When “Periodic” mode is selected, you can enter “Period(ms)” to send CAN frames message repeatedly (enter “500” to send CAN messages every 500ms).



Period (ms) 500

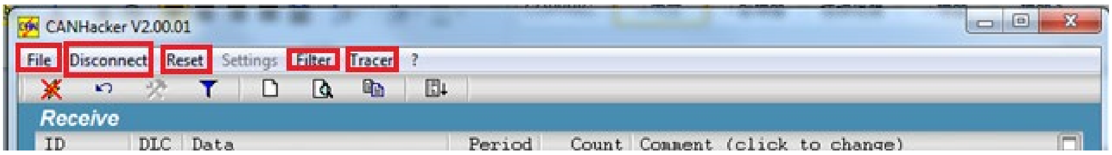
To send a single CAN frame message, click “Single Shot”. Click “Send All” to send CAN frames message repeatedly.

To stop sending CAN frame messages, click “Stop All”.



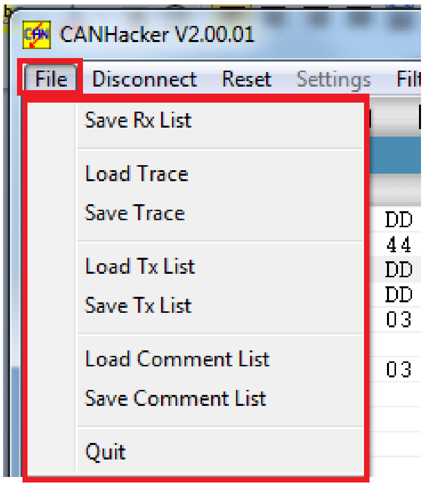
Assistant features

There are many assistant features included in CANHacker, as shown in the figure below:

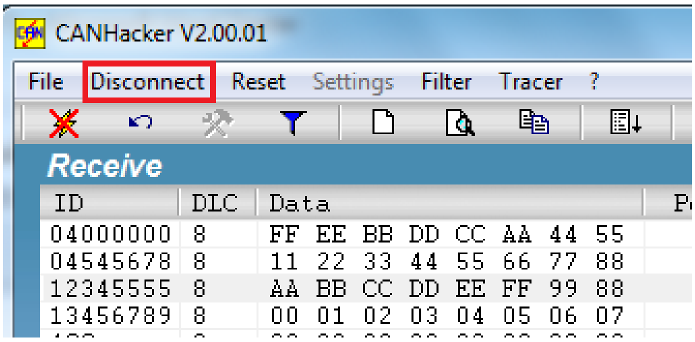


Saving data to file or loading data from file:

Select “File” option to save Rx List, Trace, Tx List, Command List and Load Trace, Tx List, Command List.

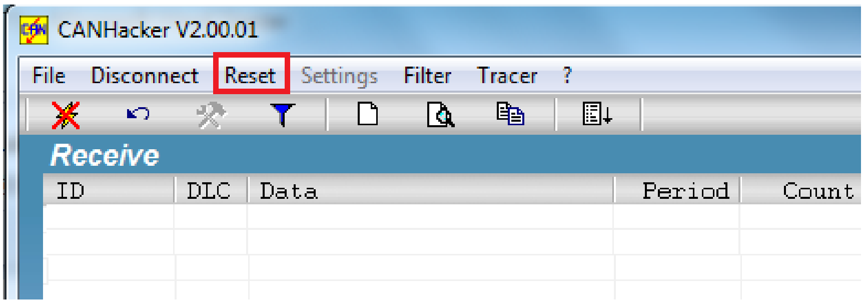


Click “Disconnect” to stop CANHacker.



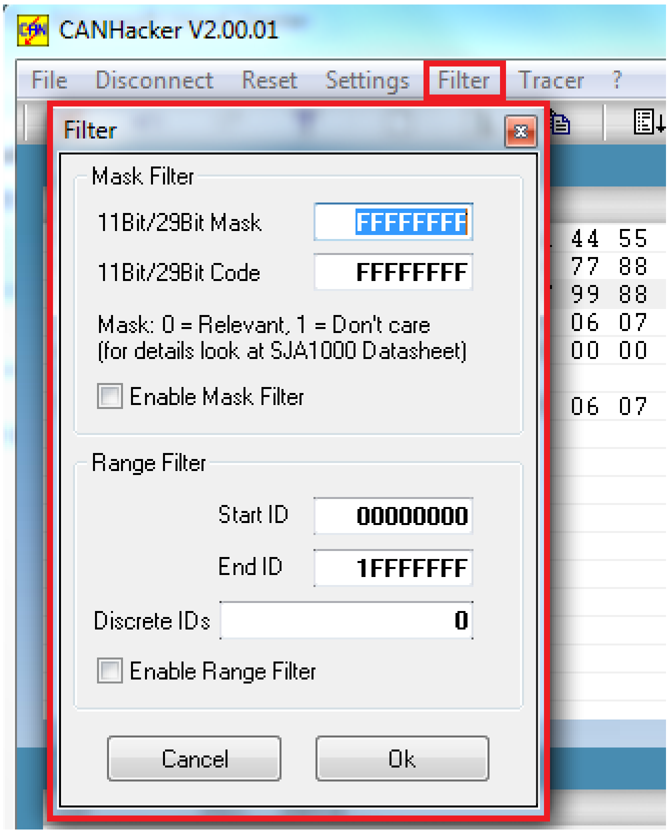
ID	DLC	Data	P
04000000	8	FF EE BB DD CC AA 44 55	
04545678	8	11 22 33 44 55 66 77 88	
12345555	8	AA BB CC DD EE FF 99 88	
13456789	8	00 01 02 03 04 05 06 07	

Click “Reset” to renew the received CAN frame messages and reset the transmission (received) count.



ID	DLC	Data	Period	Count

Select “Filter” to set mask filter and range filter.



Filter

Mask Filter

11Bit/29Bit Mask: FFFFFFFF

11Bit/29Bit Code: FFFFFFFF

Mask: 0 = Relevant, 1 = Don't care
(for details look at SJA1000 Datasheet)

□ Enable Mask Filter

Range Filter

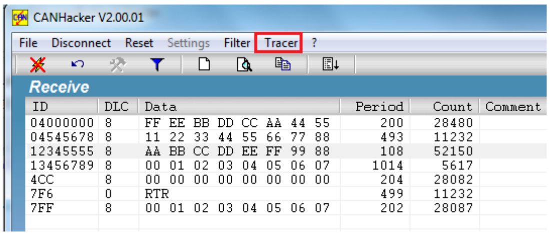
Start ID: 00000000

End ID: 1FFFFFFF

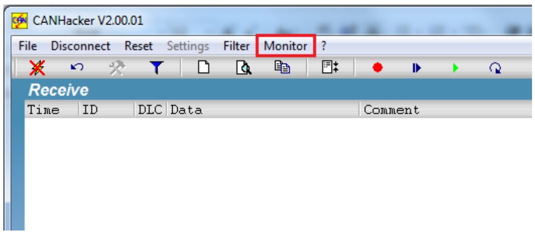
Discrete IDs: 0

□ Enable Range Filter

Select “Tracer” or “Monitor” to trace or monitor the CAN frame messages.



ID	DLC	Data	Period	Count	Comment
04000000	8	FF EE BB DD CC AA 44 55	200	28480	
04545678	8	11 22 33 44 55 66 77 88	493	11232	
12345555	8	AA BB CC DD EE FF 99 88	108	52150	
13456789	8	00 01 02 03 04 05 06 07	1014	5617	
4CC	8	00 00 00 00 00 00 00 00	204	28082	
7F6	0	RTR	499	11232	
7FF	8	00 01 02 03 04 05 06 07	202	28087	

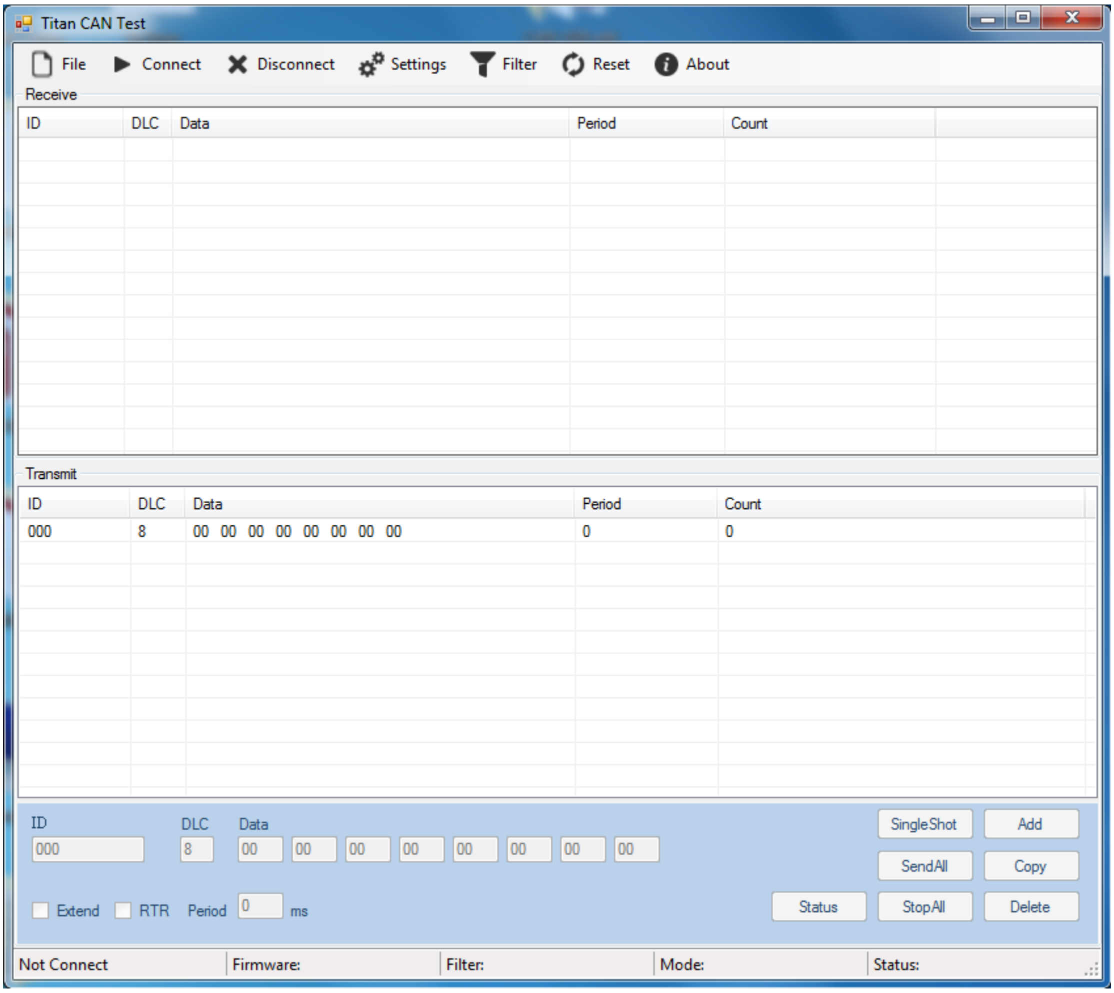


Time	ID	DLC	Data	Comment

Titan CAN Test Program

Titan CAN test program is a Windows application software for testing and transmitting/receiving CAN frames. The Titan CAN test program is an easy to use software. Through the software users can easily test and analyze the CAN frames.

Following shows its main panel:



Receive

ID	DLC	Data	Period	Count

Transmit

ID	DLC	Data	Period	Count
000	8	00 00 00 00 00 00 00 00	0	0

ID 000 DLC 8 Data 00 00 00 00 00 00 00 00

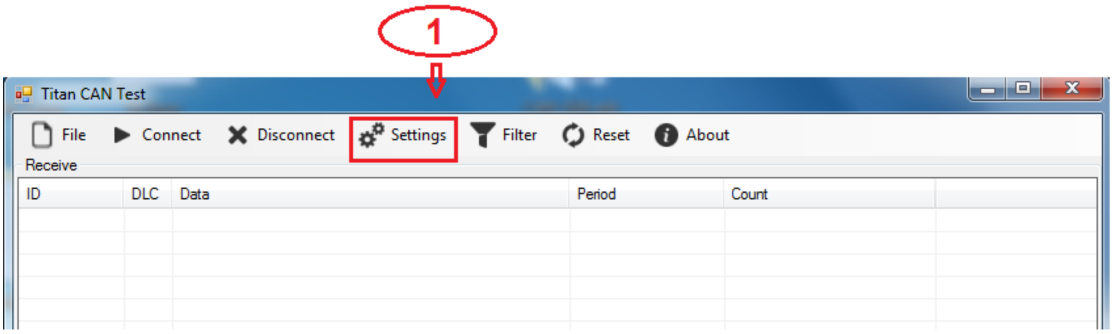
□ Extend □ RTR Period 0 ms

Not Connect | Firmware: | Filter: | Mode: | Status:

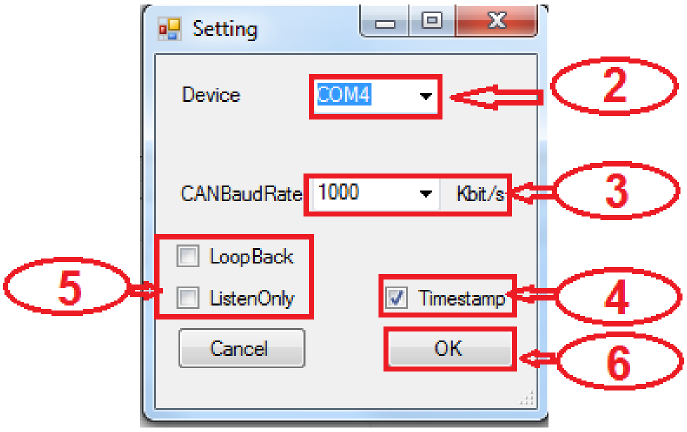
The following section will briefly introduce the necessary steps on how to use the Titan CAN test program.

Settings procedure for selecting and configuring the SER-CAN-M adapter

1. Open Titan CAN test program and click “**Settings**” under the menu.



2. Select COM port of the SER-CAN-M adapter.
3. Select CAN Baudrate for the CAN bus operating speed.
4. Check “Time Stamp” to enable timestamp function.
5. Check “LoopBack” or “ListenOnly” to open the CAN bus adapter in loopback or listen only operation mode, otherwise the CAN bus adapter will open in normal operation mode.
6. Finally, click “OK” to finish the settings and return to the main panel.



Device COM4

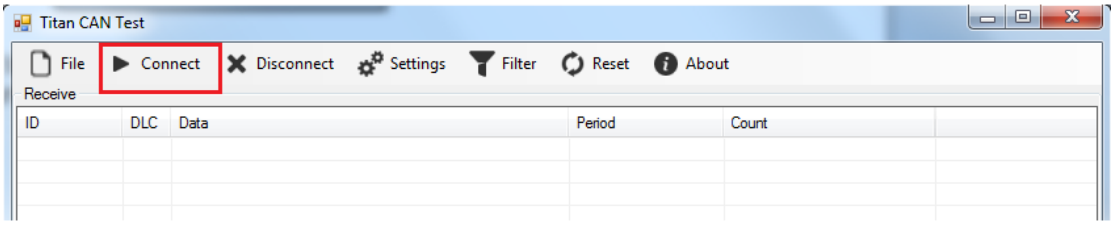
CANBaudRate 1000 Kbit/s

□ LoopBack

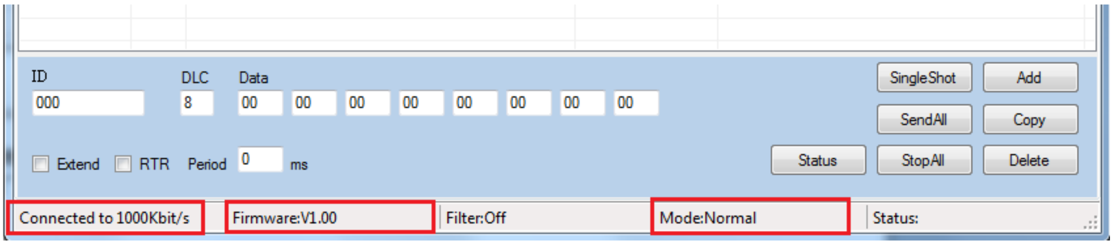
□ ListenOnly

☑ Timestamp

You may connect the SER-CAN-M adapter after configuration. Click “**Connect**”, as shown in the figure, to start the Titan CAN test program operation.



When SER-CAN-M adapter successfully connects, you will find the message “Connected to XXX kbits/s”, firmware version VXXXX and operation mode at the bottom of the main panel.



ID: 000

DLC: 8

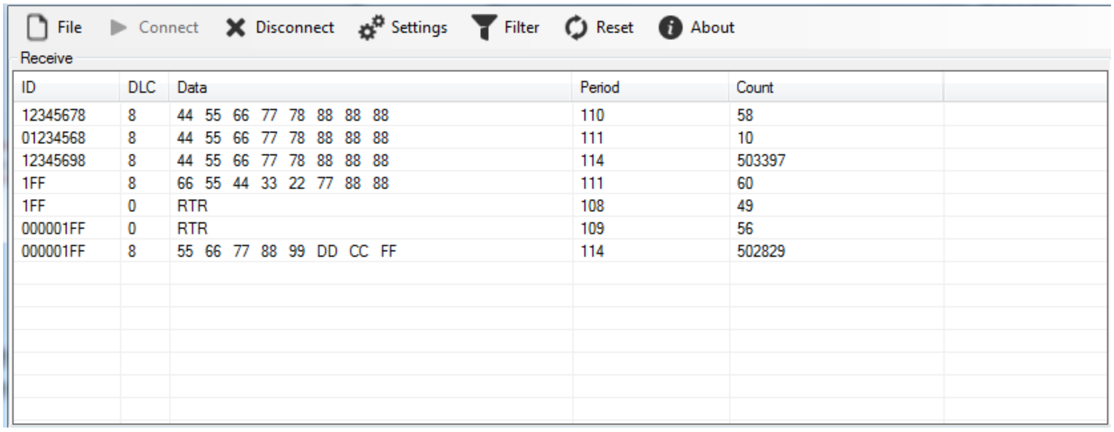
Data: 00 00 00 00 00 00 00 00

□ Extend □ RTR Period 0 ms

Connected to 1000Kbit/s | Firmware:V1.00 | Filter:Off | Mode:Normal | Status:

Receiving CAN frames

When Titan CAN test program receives CAN frames from another CAN node, it will show all CAN frame messages in middle of main panel. The CAN frame messages includes ID, DLC, Data, Period, Count.

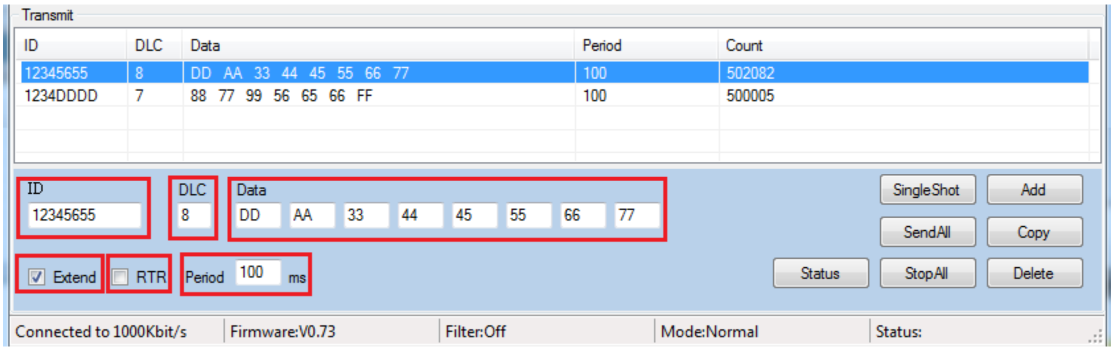


Receive

ID	DLC	Data	Period	Count
12345678	8	44 55 66 77 78 88 88 88	110	58
01234568	8	44 55 66 77 78 88 88 88	111	10
12345698	8	44 55 66 77 78 88 88 88	114	503397
1FF	8	66 55 44 33 22 77 88 88	111	60
1FF	0	RTR	108	49
000001FF	0	RTR	109	56
000001FF	8	55 66 77 88 99 DD CC FF	114	502829

Sending CAN frames

Titan CAN test program provides many parameters for sending CAN frames to another CAN node, you can set the following parameters on the bottom of the main panel for CAN data transmission:



Transmit

ID	DLC	Data	Period	Count
12345655	8	DD AA 33 44 45 55 66 77	100	502082
1234DDDD	7	88 77 99 56 65 66 FF	100	500005

ID 12345655 DLC 8 Data DD AA 33 44 45 55 66 77

☑ Extend □ RTR Period 100 ms

Connected to 1000Kbit/s | Firmware:V0.73 | Filter:Off | Mode:Normal | Status:

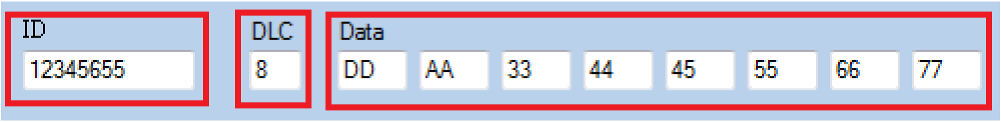
Select transmit an extended CAN frame (29 bits ID) or a standard CAN frame (11 bits ID).

Check "Extend" ☑ Extend to transmit an extended CAN Frame (29 bits ID) and uncheck "Extend" □ Extend to transmit a standard CAN frame (11 bits ID).

Select remote request frame mode or transmit CAN frame mode.

Check "RTR" ☑ RTR for a remote request frame mode or uncheck "RTR" □ RTR for transmit CAN frame mode.

Enter CAN frame messages in the respective fields, including ID, DLC, Data.

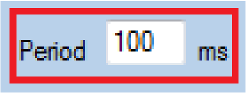


ID 12345655

DLC 8

Data DD AA 33 44 45 55 66 77

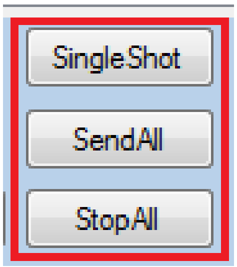
When “Periodic” mode is selected, you can enter “Period(ms)” to send CAN frames message repeatedly (enter “100” to send CAN messages every 100ms).



Period 100 ms

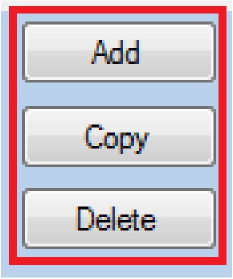
To send a single CAN frame message, click “Single Shot”. Click “Send All” to send CAN frames message repeatedly.

To stop sending CAN frame messages, click “Stop All”.



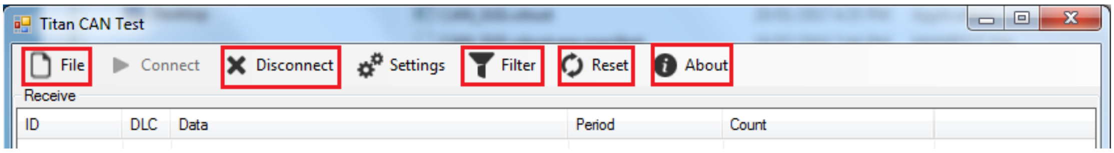
To add a new send CAN frame message, click “Add” to add new send CAN frame message and click “Copy” to copy a send CAN frame message repeatedly.

To delete a send CAN frame message, click “Delete” to delete send CAN frame message.

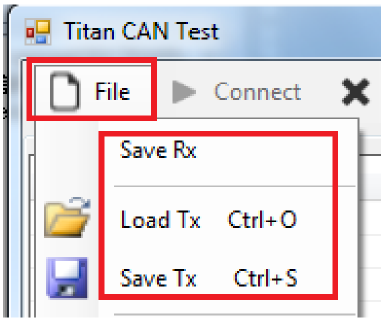


Assistant features

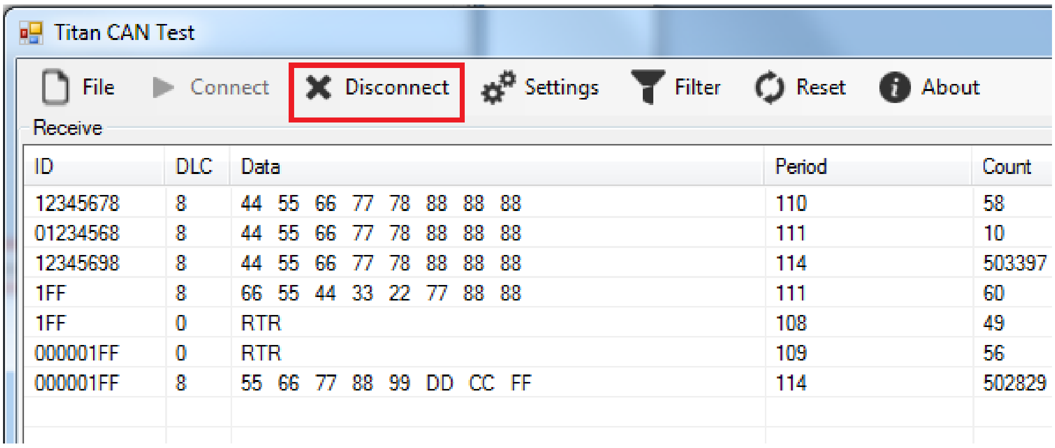
There are many assistant features included in Titan CAN test program, as shown in the figure below:



Select “**File**” option to save Rx List, Tx List and Load Tx List.

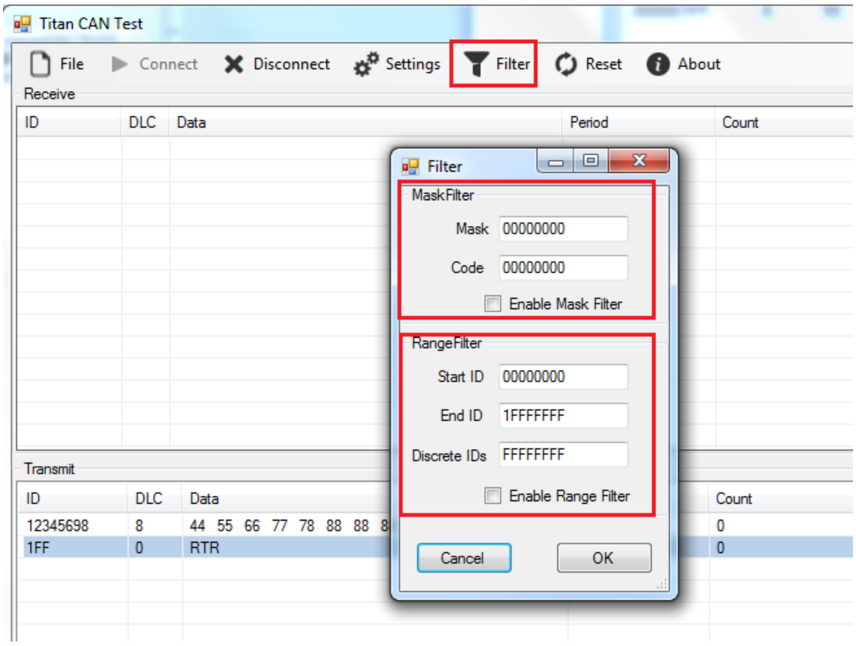


Click “**Disconnect**” to stop Titan CAN test program.



ID	DLC	Data	Period	Count
12345678	8	44 55 66 77 78 88 88 88	110	58
01234568	8	44 55 66 77 78 88 88 88	111	10
12345698	8	44 55 66 77 78 88 88 88	114	503397
1FF	8	66 55 44 33 22 77 88 88	111	60
1FF	0	RTR	108	49
000001FF	0	RTR	109	56
000001FF	8	55 66 77 88 99 DD CC FF	114	502829

Select “**Filter**” to set mask filter and range filter.



ID	DLC	Data	Period	Count

Mask Filter

Mask 00000000

Code 00000000

☐ Enable Mask Filter

Range Filter

Start ID 00000000

End ID 1FFFFFFF

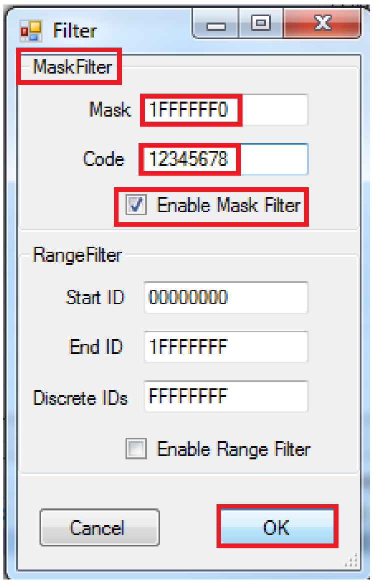
Discrete IDs FFFFFFFF

☐ Enable Range Filter

ID	DLC	Data	Count
12345698	8	44 55 66 77 78 88 88 8	0
1FF	0	RTR	0

Mask Filter: Set “Acceptance Code Register” and “Acceptance Mask Register” for CAN bus controller to specify the CAN IDs that are passed or blocked; after setting “Mask” and “Code”, check “Enable Mask Filter” then click “OK” to finish the Mask Filter settings and return to the main panel.

Note: Before you set the “Mask Filter” function, you need to disconnect the SER-CAN-M adapter. After setting the value of “Mask” + “Code”, connect the SER-CAN-M adapter again to enable the “Mask Filter” function, because the “Mask Filter” function is only available if the CAN adapter is initiated and not opened.



Mask Filter

Mask 1FFFFFF0

Code 12345678

☑ Enable Mask Filter

Range Filter

Start ID 00000000

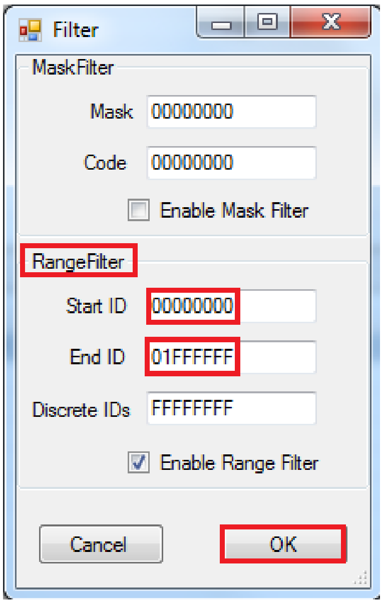
End ID 1FFFFFFF

Discrete IDs FFFFFFFF

☐ Enable Range Filter

Mask Filter example: After setting “Mask” to 1FFFFFF0 and “Code” to 12345678, CAN message frames of the range 0x12345670 through 0x1234567F will be passed and all other CAN IDs will be blocked.

Range Filter: Set "Start ID" and "Stop ID" for SER-CAN-M adapter to specify a range of CAN IDs that are to be passed; after setting "Start ID" and "Stop ID", check "Enable Range Filter" then click "OK" to finish the Ranger Filter settings and return to the main panel.



MaskFilter

Mask 00000000

Code 00000000

□ Enable Mask Filter

RangeFilter

Start ID 00000000

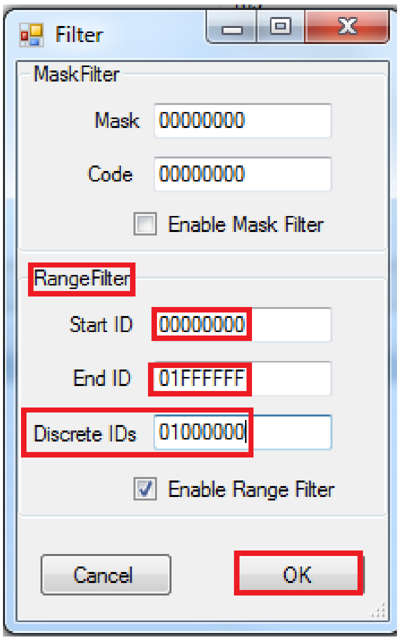
End ID 01FFFFFF

Discrete IDs FFFFFFFF

☑ Enable Range Filter

Range Filter example: After setting "Start ID" to 00000000 and "End ID" to 01FFFFFF, The CAN message frames of the range 0x00000000 through 0x01FFFFFF will be passed and all other CAN IDs will be blocked.

The Range Filter can also set "Discrete IDs" to block a unique CAN ID.



MaskFilter

Mask 00000000

Code 00000000

□ Enable Mask Filter

RangeFilter

Start ID 00000000

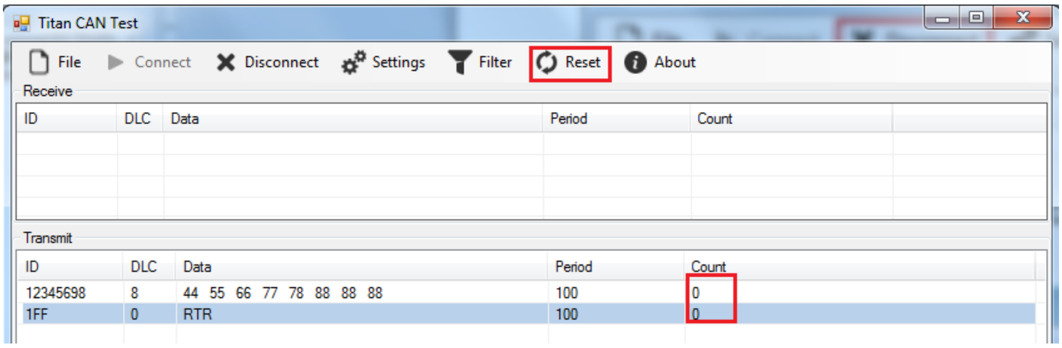
End ID 01FFFFFF

Discrete IDs 01000000

☑ Enable Range Filter

Discrete IDs Filter example: After setting "Start ID" to 00000000, "End ID" to 01FFFFFF and setting "Discrete IDs" to 01000000; The CAN ID range 0x00000000 through 0x01FFFFFF will be passed but only CAN ID 0x01000000 will be blocked.

Click “**Reset**” option to renew the received CAN frame message and reset the transmitted (received) count.



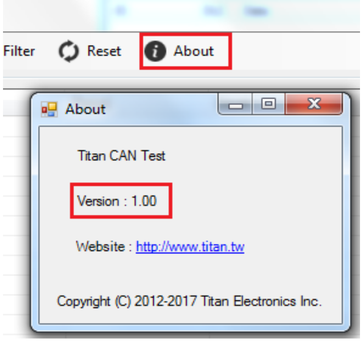
Receive

ID	DLC	Data	Period	Count

Transmit

ID	DLC	Data	Period	Count
12345698	8	44 55 66 77 78 88 88 88	100	0
1FF	0	RTR	100	0

Click “**About**” option to show the version information of Titan CAN test program.



Titan CAN Test

Version : 1.00

Website : http://www.titan.tw

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CANopen

CANopen is a CAN-based communication system. It comprises higher-layer protocols and profile specifications. CANopen has been developed as a standardized embedded network with highly flexible configuration capabilities. It was designed originally for motion-oriented machine control systems, such as handling systems. Today it is used in various application fields, such as medical equipment, off-road vehicles, maritime electronics, railway applications, or building automation.

CanFestival project is an open source CANopen multi-platform framework. (http://www.canfestival.org/) CanFestival focuses on providing an ANSI-C platform independent CANopen stack that can be implemented as master or slave nodes on PCs, Real-time IPCs, and Microcontrollers.

For detailed information about using CanFestival in your project see the "The CanFestival CANopen stack manual".

How to get CanFestival

You can get the CanFestival source code from repository. Then get TITAN CAN driver for CanFestival. Or you can download the code with TITAN driver from TITAN web site.

Linux Compilation and installation

Linux target is default configure target.
Call./configure -help to see all available compile time options.
After invoking ./configure with your platform specific switches, just type make.

```
./configure –can=titan
make
make install
```

Windows Compilation

CanFestival can be compiled and run on Windows platform. It is possible to use both Cygwin and win32 native runtime environment.

Minimal Cygwin installation is required at configuration time in order to create specific header files (config.h and cancfg.h). Once these files created, Cygwin is not necessary anymore. Project and solution files have been created and tested with Visual Studio Express 2005. Be sure to have installed Microsoft Platform SDK, as recommended at the end of Visual Studio installation.

Cygwin must be installed with those packages:

1. gcc
2. unzip
3. wget
4. make

Extract CanFestival source code into your Cygwin home. Then configure CanFestival.

```
cd CanFestival
./configure --can=titan
make
```

Compilation with Visual Studio

You can either load independent "*.vcproj" project' files along your own pro jects in your own solution or load the provided "CanFestival-3.vc8.sln" solution files directly. Build CanFestival-3 project first.

The "examples" directory contains some test program you can use as example you're your own developments.

You'll find an example on the supplied CD showing the communication between master and slave nodes. Following baudrates are supported: 20K, 50K, 100K, 125K, 250K, 500K and 1M.

- CanFestival_example_win_x86.zip For Windows 32 bit
- CanFestival_example_win_x64.zip For Windows 64 bit
- CanFestival_example_linux_x86.tar.gz For Linux 32 bit
- CanFestival_example_linux_x64.tar.gz For Linux 64 bit

Under Windows connect two CAN devices, installed as COM3 and COM4. Open two command windows and change to the directory where examples were extracted to and execute

```
TestMasterSlave -s COM3 -S 125K -M none -l canfestival_titan.dll
```

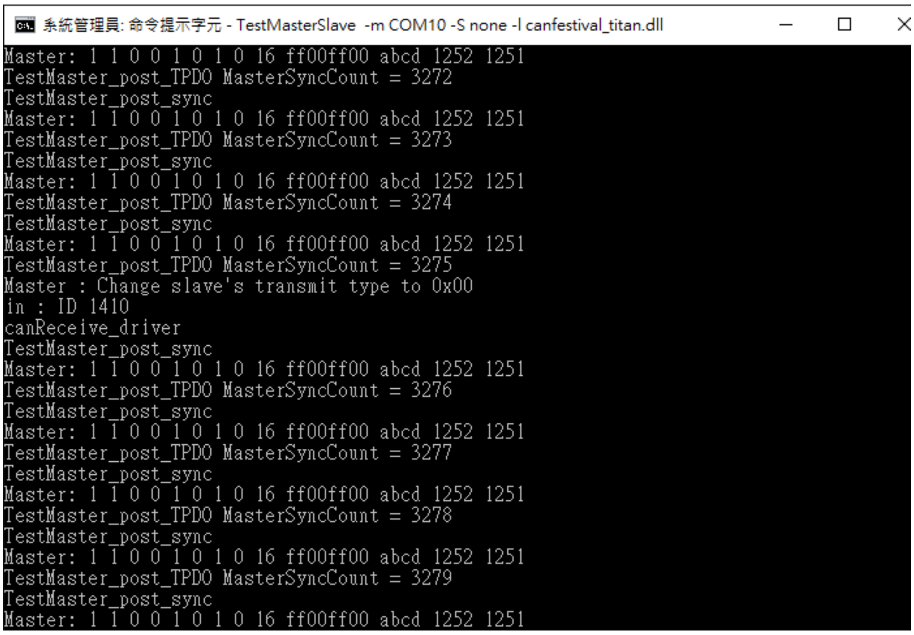
in the first command window and

```
TestMasterSlave -m COM4 -M 125K -S none -l canfestival_titan.dll
```

in the second.

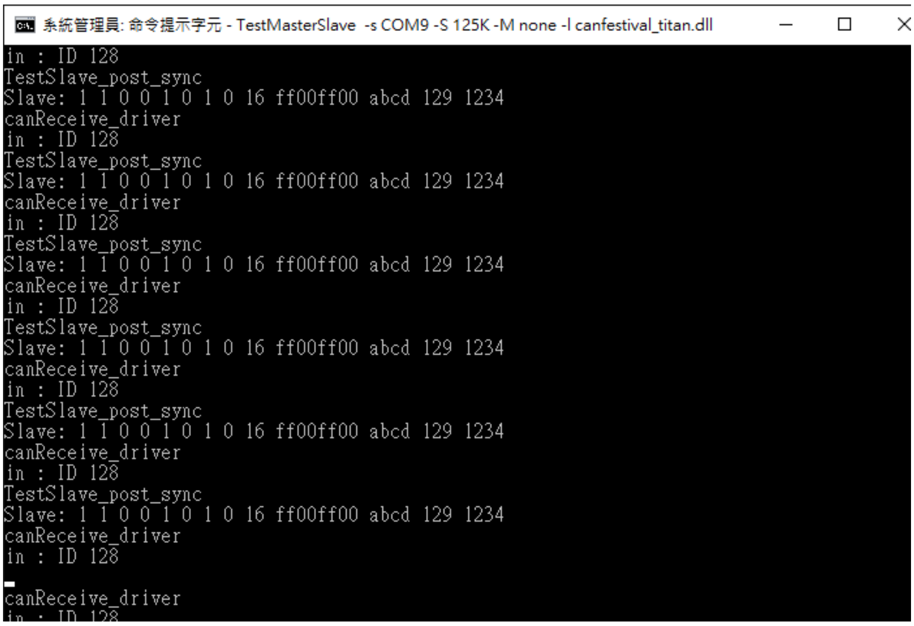
Following pictures shows the output messages of both nodes.

Master:


系統管理員: 命令提示字元 - TestMasterSlave -m COM10 -S none -l canfestival_titan.dll

```
Master: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 1252 1251
TestMaster_post_TPDO MasterSyncCount = 3272
TestMaster_post_sync
Master: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 1252 1251
TestMaster_post_TPDO MasterSyncCount = 3273
TestMaster_post_sync
Master: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 1252 1251
TestMaster_post_TPDO MasterSyncCount = 3274
TestMaster_post_sync
Master: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 1252 1251
TestMaster_post_TPDO MasterSyncCount = 3275
Master : Change slave's transmit type to 0x00
in : ID 1410
canReceive_driver
TestMaster_post_sync
Master: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 1252 1251
TestMaster_post_TPDO MasterSyncCount = 3276
TestMaster_post_sync
Master: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 1252 1251
TestMaster_post_TPDO MasterSyncCount = 3277
TestMaster_post_sync
Master: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 1252 1251
TestMaster_post_TPDO MasterSyncCount = 3278
TestMaster_post_sync
Master: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 1252 1251
TestMaster_post_TPDO MasterSyncCount = 3279
TestMaster_post_sync
Master: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 1252 1251
```

Slave:


系統管理員: 命令提示字元 - TestMasterSlave -s COM9 -S 125K -M none -l canfestival_titan.dll

```
in : ID 128
TestSlave_post_sync
Slave: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 129 1234
canReceive_driver
in : ID 128
TestSlave_post_sync
Slave: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 129 1234
canReceive_driver
in : ID 128
TestSlave_post_sync
Slave: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 129 1234
canReceive_driver
in : ID 128
TestSlave_post_sync
Slave: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 129 1234
canReceive_driver
in : ID 128
TestSlave_post_sync
Slave: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 129 1234
canReceive_driver
in : ID 128
TestSlave_post_sync
Slave: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 129 1234
canReceive_driver
in : ID 128

canReceive_driver
in : ID 128
```

Under Linux connect two CAN devices, installed as /dev/ttyUSB0 and /dev/ttyUSB1. Open two terminal windows and change to the directory where examples were extracted to and execute

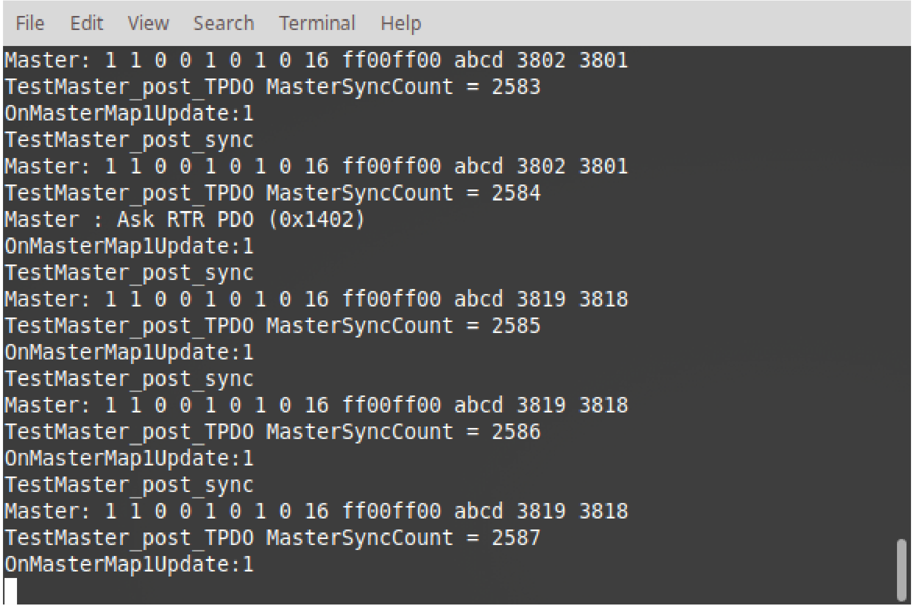
```
export LD_LIBRARY_PATH=.
./TestMasterSlave -s “/dev/ttyUSB0” -S 125K -M none -l ./libcanfestival_can_titan.so
```

in the first terminal window and

```
export LD_LIBRARY_PATH=.
./TestMasterSlave -m “/dev/ttyUSB1” -M 125K -S none- ./libcanfestival_can_titan.so
```

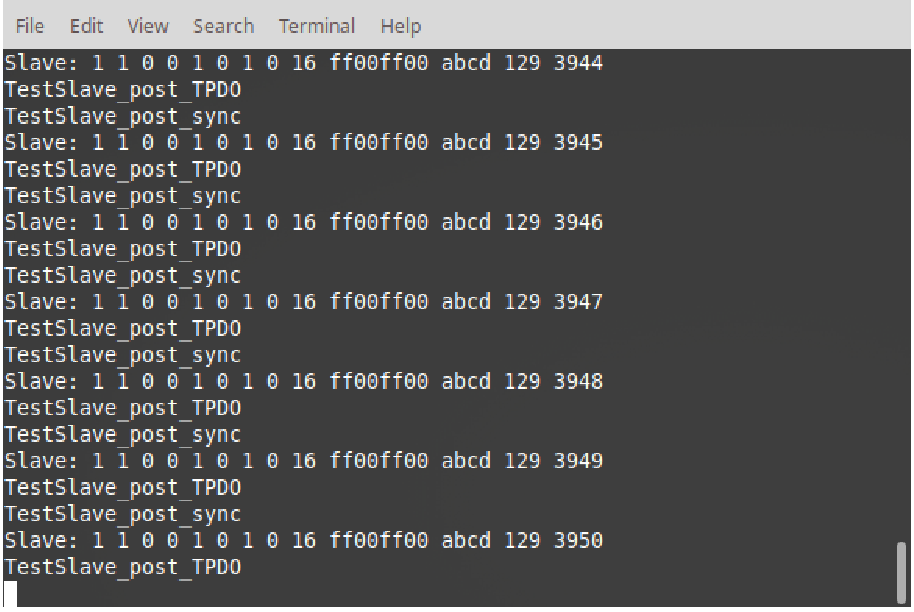
in the second.

Following pictures shows the output messages of both nodes.
Master:



```
Master: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 3802 3801
TestMaster_post_TPDO MasterSyncCount = 2583
OnMasterMap1Update:1
TestMaster_post_sync
Master: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 3802 3801
TestMaster_post_TPDO MasterSyncCount = 2584
Master : Ask RTR PDO (0x1402)
OnMasterMap1Update:1
TestMaster_post_sync
Master: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 3819 3818
TestMaster_post_TPDO MasterSyncCount = 2585
OnMasterMap1Update:1
TestMaster_post_sync
Master: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 3819 3818
TestMaster_post_TPDO MasterSyncCount = 2586
OnMasterMap1Update:1
TestMaster_post_sync
Master: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 3819 3818
TestMaster_post_TPDO MasterSyncCount = 2587
OnMasterMap1Update:1
```

Slave:



```
Slave: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 129 3944
TestSlave_post_TPDO
TestSlave_post_sync
Slave: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 129 3945
TestSlave_post_TPDO
TestSlave_post_sync
Slave: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 129 3946
TestSlave_post_TPDO
TestSlave_post_sync
Slave: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 129 3947
TestSlave_post_TPDO
TestSlave_post_sync
Slave: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 129 3948
TestSlave_post_TPDO
TestSlave_post_sync
Slave: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 129 3949
TestSlave_post_TPDO
TestSlave_post_sync
Slave: 1 1 0 0 1 0 1 0 16 ff00ff00 abcd 129 3950
TestSlave_post_TPDO
```

APPLICATION PROGRAMMING INTERFACE

The Application Programming Interface (API) gives the user tools to use all of the functions that the CAN adapter provides. It will make it much easier for users to build their own CAN controlling software with these functions, than to implement their application command by command on the ASCII protocol.

Users can use Windows-based API for use with high-level languages. Please refer to the following website for our GUI, sample codes and updates:

https://www.titan.tw/drivers/can-api.html

CAN_Open

CAN_Open(ComPort, szBitrate, acceptance_code, acceptance_mask, flags, Mode)

Function:
Opens a channel to the device.

Parameters:

- ComPort
  - Type: String
  - The COM port to be opened.
  - Format: “COMXXX”
  - Example: “COM1, “COM57”, “COM118”

- szBitrate
  - Type: String
  - The bitrate to operate at. Can be one of the standard bitrates or a user-defined non-standard bitrate.
  - Format:
    - 10 = 10Kbps
    - 20 = 20Kbps
    - 50 = 50Kbps
    - 100 = 100Kbps
    - 125 = 125Kbps
    - 250 = 250Kbps
    - 500 = 500Kbps
    - 800 = 800Kbps
    - 1000 = 1000Kbps
    - XXXXXXXXX, non-standard bitrate
  - Example: “50”, “1000”, “000000150”

- acceptance_code
  - Type: String
  - Used in conjunction with the acceptance mask to filter CAN messages. Set to “00000000” for NULL to allow all messages. Also referred to as acceptance filter in other parts of the manual.
  - Format: “XXXXXXXX”
  - Example: “00000700”

- acceptance_mask
  - Type: String
  - Used in conjunction with the acceptance code to filter CAN messages. Set to “00000000” for NULL to allow all messages.
  - Format: “XXXXXXXX”
  - Example: “000001FF”

- flags
    - Type: IntPtr
    - Determines whether or not the timestamp function should be enabled.
    - Format:
        - 1 = Timestamp will be enabled
        - 0 = Timestamp will be disabled
    - Example: 1

- Mode
    - Type: Integer
    - Determines the mode the USB CAN should operate at.
    - Format:
        - 0 = Normal, the device will operate under normal circumstances
        - 1 = Listen only, the device will passively receive CAN messages
        - 2 = Loopback, the device will also receive messages it transmits
    - Example: 2

- Return value:
    - Type: Integer
    - Handle to the device.
    - Result:
        - > 0, CAN_Open is successful
        - -1, error communicating with COM port
        - -2, error in opening channel, COM port may be already in use
        - -3, error in parameter settings
    - Example: 2508

Sample Command:
CAN_Open(“COM3”, “50”, “00000000”, “00000000”, 1, 2)
Opens a channel to COM3 at 50kbps, with all messages allowed, timestamp enabled and operating in loopback mode.

CAN_Close

CAN_Close(Handle)

Function:
Closes the channel with the specified handle.

Parameters:

- Handle
    - Type: Integer
    - The handle of the CAN channel to be closed.
    - Format: A numeric value provided by the return value of CAN_Open
    - Example: 2508

- Return value:
    - Type: Integer
    - Code indicating result of CAN_Close.
    - Result:
        - 1, CAN_Close is successful
        - -1, error communicating with COM port
        - -4, error: CAN channel is not open

Sample Command:
CAN_Close(2508)
Closes device connected to channel with the handle 2508.

CAN_Write

CAN_Write(Handle, Buf)

Function:
Writes a message to the channel with the specified handle.

Parameters:

- Handle
  - Type: Integer
  - The handle of the CAN channel to write to.
  - Format: A numeric value provided by the return value of CAN_Open
  - Example: 2508

- Buf[1]
  - Type: CAN_MSG structure
  - The standard structure of CAN frame messages.
  - Format: Name of an instance of the CAN_MSG structure
  - Example: myCANMsg

- Return value:
  - Type: Integer
  - Code indicating result of CAN_Write.
  - Result:
    - 1, CAN_Write is successful
    - -1, error communicating with COM port
    - -4, error: CAN channel is not open

Sample Command:
CAN_Write(2508, myCANMsg)
Writes the message contained in myCANMsg to device connected to channel with the handle 2508.

[1] Refer to the "CAN_MSG Structure" section for more information

CAN_Read

CAN_Read(Handle, Buf)

Function:
Reads a message from the channel with the specified handle.

Parameters:

- Handle
    - Type: Integer
    - The handle of the CAN channel to read from.
    - Format: A numeric value provided by the return value of CAN_Open
    - Example: 2508

- Buf[2]
    - Type: CAN_MSG structure
    - The standard structure of CAN frame messages.
    - Format: Name of an instance of the CAN_MSG structure
    - Example: myCANMsg

- Return value:
    - Type: Integer
    - Code indicating result of CAN_Read.
    - Result:
        - 1, CAN_Read is successful
        - -1, error communicating with COM port
        - -4, error: CAN channel is not open
        - -5, error: there are no messages

Sample Command:
CAN_Read(2508, myCANMsg)
Reads the message from device connected to channel with the handle 2508 and stores it into myCANMsg.

[2] Refer to the "CAN_MSG Structure" section for more information

CAN_Flush

CAN_Flush(Handle)

Function:
Clears the buffers of the channel with the specified handle.

Parameters:

- Handle
    - Type: Integer
    - The handle of the CAN channel whose buffers are to be cleared.
    - Format: A numeric value provided by the return value of CAN_Open
    - Example: 2508

- Return value:
    - Type: Integer
    - Code indicating result of CAN_Flush.
    - Result:
        - 1, CAN_Flush is successful
        - -1, error communicating with COM port
        - -4, error: CAN channel is not open

Sample Command:
CAN_Flush(2508)
Clears the buffers of device connected to channel with the handle 2508.

CAN_Status

CAN_Status(Handle)

Function:
Checks the status bits for more specific details when an error occurs.

Parameters:

- Handle
    - Type: Integer
    - The handle of the CAN channel whose status bits are to be inquired.
    - Format: A numeric value provided by the return value of CAN_Open
    - Example: 2508

- Return value:
    - Type: Integer
    - Code indicating result of CAN_Status.
    - Result:
        - Bit [2, 1, 0]
            - 0, 0, 0: no error
            - 0, 0, 1: stuff error
            - 0, 1, 0: form error
            - 0, 1, 1: ACK error
            - 1, 0, 0: Bit1Error
            - 1, 0, 1: Bit0Error
            - 1, 1, 0: CRCError
            - 1, 1, 1: unused
        - Bit [3]
            - 1: message successfully transmitted
            - 0: no message has been transmitted
        - Bit [4]
            - 1: message successfully received
            - 0: no message has been received
        - Bit [5]
            - 1: CAN core is in error passive state
            - 0: CAN core is in error active state
        - Bit [6]
            - 1: at least one error counter in EML has reached the warning limit of 96
            - 0: both error counters are below the warning limit of 96
        - Bit [7]
            - 1: CAN module is in bus-off state
            - 0: CAN module is not in bus-off state
        - <BELL> = ERROR

Sample Command:

CAN_Status(2508)

Checks the status bits of device connected to channel with the handle 2508.

CAN_Version

CAN_Version(Handle, buf)

Function:
Retrieves the firmware version of the device connected to channel with the specified handle.

Parameters:

- Handle
  - Type: Integer
  - The handle of the CAN channel whose version information is to be inquired.
  - Format: A numeric value provided by the return value of CAN_Open
  - Example: 2508

- buf
  - Type: Character array/string
  - Information about the firmware version will be stored into this array.
  - Format: Name of a character array
  - Example: myVersion

- Return value:
  - Type: Integer
  - Code indicating result of CAN_Version.
  - Result:
    - 1, CAN_Version is successful
    - -1, error communicating with COM port
    - -4, error: CAN channel is not open

Sample Command:
CAN_Version(2508)
Retrieves the firmware version of device connected to channel with the handle 2508.

CAN_MSG Structure

- Members:
  - Id
    - Type: Unsigned Integer
    - Message ID.
    - Format: XXX (standard), XXXXXXXX (extended)
    - Example: 1FF
  - Size
    - Type: Byte
    - Message size.
    - Format: A numeric value from 0~8
    - Example: 8
  - Data
    - Type: Byte array with 8 elements
    - Content of the data to be sent/received.
    - Format: XX
    - Example: 11
  - Flags
    - Type: Byte
    - Determines the message ID type and timestamp settings.
    - Format:
      - 1, timestamp off, standard
      - 2, timestamp off, extended
      - 9, timestamp on, standard
      - 10, timestamp on, extended
    - Example: 9
  - Timestamp
    - Type: Unsigned Short
    - Value of the timestamp.
    - Format: No input from the user is required
    - Example: 0

- Sample Message:
  - With a CAN_MSG structure instance declared as myCANMSG:
    - myCANMsg.ID = 1FF
    - myCANMsg.Size = 3
    - myCANMsg.Data(0) = 11
    - myCANMsg.Data(1) = 22
    - myCANMsg.Data(2) = 33
    - myCANMsg.Flags = 10

Example Code for C

```
#include <stdio.h>
#include <stdlib.h>
#include "CAN_API.h"

int main() {
    TCAN_HANDLE Handle;
    TCAN_STATUS Status;
    CHAR *ComPort = "COM23";
    CHAR *szBitrate = "800";
    CHAR *acceptance_code = "1FFFFFFF";
    CHAR *acceptance_mask = "00000000";
    VOID *flags = CAN_TIMESTAMP_OFF;
    DWORD Mode = LoopBack;

    char version[10];
    CAN_MSG SendMSG;
    CAN_MSG RecvMSG;
    Handle = -1;
    Status = 0;

    SendMSG.Flags = CAN_FLAGS_EXTENDED;
    SendMSG.Id = 0x12345678;
    SendMSG.Size = 8;
    SendMSG.Data[0] = 0x11;
    SendMSG.Data[1] = 0x22;
    SendMSG.Data[2] = 0x33;
    SendMSG.Data[3] = 0x44;
    SendMSG.Data[4] = 0x55;
    SendMSG.Data[5] = 0x66;
    SendMSG.Data[6] = 0x77;
    SendMSG.Data[7] = 0x88;

    Handle = CAN_Open ( ComPort, szBitrate, acceptance_code, acceptance_mask, flags,
Mode );

    printf ( "handle= %d\n", Handle );
    if ( Handle < 0 ) {
        return 0;
    }

    memset ( version, 0, sizeof ( char ) * 10 );
    Status = CAN_Flush ( Handle );
    Status = CAN_Version ( Handle, version );

    if ( Status == CAN_ERR_OK ) {
        printf ( "Version : %s\n", version );
    }

    Status = CAN_Write ( Handle, &SendMSG );
    if ( Status == CAN_ERR_OK ) {
        printf ( "Write Success\n" );
    }

    while ( 1 ) {
        Status = CAN_Read ( Handle, &RecvMSG );
        if ( Status == CAN_ERR_OK ) {
            printf ( "Read ID=0x%X, Type=%s, DLC=%d, FrameType=%s, Data=",
            RecvMSG.Id,( RecvMSG.Flags & CAN_FLAGS_STANDARD ) ? "STD" : "EXT",
            RecvMSG.Size,( RecvMSG.Flags & CAN_FLAGS_REMOTE ) ? "REMOTE" :
"DATA"  );

                for ( int i = 0; i < RecvMSG.Size; i++ ) {
                printf ( "%X,", RecvMSG.Data[i] );
            }
            break;
        }
    }

    Status = CAN_Close ( Handle );
    printf ( "Test finish\n" );
    return 0;
}
```

Using the API in C#

1. Ensure that the DLL file is placed in the same folder as your application executable.

2. Import the functions you need from the DLL into your source code with the Declare statement:

```
[DllImport("can_api.dll", EntryPoint = "CAN_Open",
CallingConvention = CallingConvention.Cdecl)]
        static extern Int32 CAN_Open(string
SerialNrORComPortORNet, string szBitrate, string acceptance_code,
string acceptance_mask, Int32 flags, UInt32 Mode);
```

3. Create a definition of the CAN_MSG structure for the CAN_Write and CAN_Read functions, if needed.

```
public struct CAN_MSG
{
   public UInt32 Id;
   public byte Size;
   [MarshalAs(UnmanagedType.ByValArray, SizeConst = 8)]
   public byte[] Data;
   public byte Flags;
   public UInt16 TimeStamp;
}
```

   The keyword MarshalAs is used for all structure members to ensure that the structure size corresponds to what the DLL expects.

4. In order to communicate with the channel with other functions after opening it with CAN_Open, you need to create a variable to store the handle value.

```
Int myHandle;
myHandle = CAN_Open(("COM3", "50", "00000000", "00000000", 1, 2);
```

5. This concludes the basic setup process of using the DLL in C#. Imported functions can then be easily called from the DLL with the parameters created above.

Using the API in Visual Basic .NET

6. Ensure that the DLL file is placed in the same folder as your application executable.

7. Import the functions you need from the DLL into your source code with the Declare statement:

```
Private Declare Function CAN_Open Lib "CANDLL_STDCALL.dll" (ByVal
ComPort As String, ByVal szBitrate As String, ByVal
acceptance_code As String, ByVal acceptance_mask As String, ByRef
Flags As IntPtr, ByVal Mode As Integer) As Integer
```

8. Create a definition of the CAN_MSG structure for the CAN_Write and CAN_Read functions, if needed.

```
Imports System.Runtime.InteropServices

Public Structure CAN_MSG
    <MarshalAs(UnmanagedType.U4)>
    Public Id As UInteger
    <MarshalAs(UnmanagedType.U1)>
    Public Size As Byte
    <MarshalAs(UnmanagedType.ByValArray, SizeConst:=8,
ArraySubType:=UnmanagedType.U1)>
    Public Data As Byte()
    <MarshalAs(UnmanagedType.U1)>
    Public Flags As Byte
    <MarshalAs(UnmanagedType.U2)>
    Public Timestamp As UShort
End Structure
```

The keyword MarshalAs is used for all structure members to ensure that the structure size corresponds to what the DLL expects.

To use the CAN_MSG structure, you will need to create an instance of the structure you just defined.

```
Private myCANMSG As CAN_MSG
```

Before accessing this instance you just created for the first time, set the size for the Data member to avoid “array out of bounds” error. This can be done in your program’s constructor.

```
ReDim myCANMSG(7)
```

9. In order to communicate with the channel with other functions after opening it with CAN_Open, you need to create a variable to store the handle value.

```
Private myHandle As Integer
myHandle = CAN_Open(("COM3", "50", "00000000", "00000000", 1, 2)
```

10. This concludes the basic setup process of using the DLL in Visual Basic .NET. Imported functions can then be easily called from the DLL with the parameters created above.

Using the API in Visual Basic 6.0

1. Ensure that the DLL file is placed in the same folder as your application executable.

2. Import the functions you need from the DLL into your source code with the Declare statement:

   ```
   Private Declare Function CAN_Open Lib "CANDLL_STDCALL.dll"  (ByVal
   ComPort As String, ByVal szBitrate As String, ByVal
   acceptance_code As String, ByVal acceptance_mask As String, ByRef
   Flags As Long, ByVal Mode As Long) As Long
   ```

3. Create a definition of the CAN_MSG structure for the CAN_Write and CAN_Read functions, if needed.

   ```
   Private Type CAN_MSG
       Id As Long
       Size As Byte
       Data(0 To 7) As Byte
       Flags As Byte
       Timestamp As Integer
   End Type
   ```

   To use the CAN_MSG structure, you will need to create an instance of the structure you just defined.

   ```
   Private myCANMSG As CAN_MSG
   ```

4. In order to communicate with the channel with other functions after opening it with CAN_Open, you need to create a variable to store the handle value.

   ```
   Private myHandle As Long
   myHandle = CAN_Open(("COM3", "50", "00000000", "00000000", 1, 2)
   ```

5. This concludes the basic setup process of using the DLL in Visual Basic 6.0. Imported functions can then be easily called form the DLL with the parameters created above.

Using the API in Python

1. Ensure that the DLL file is placed in the same folder as your application executable.

2. Import the DLL using the ctypes library function LoadLibrary.

```
from ctypes import windll

DLL = windll.LoadLibrary("CANDLL_STDCALL.dll")
```

3. Create a definition of the CAN_MSG structure for the CAN_Write and CAN_Read functions, if needed.

```
from ctypes import Structure, c_uint, c_ubyte, c_ushort

class CAN_MSG(Structure):
    _fields_ =  [("Id", c_uint),
                 ("Size", c_ubyte),
                 ("Data", c_ubyte * 8 ),
                 ("Flags", c_ubyte),
                 ("Timestamp", c_ushort)]
```

   To use the CAN_MSG structure, you will need to create an instance of the structure you just defined.

```
myCANMSG = CAN_MSG()
```

4. In order to communicate with the channel with other functions after opening it with CAN_Open, you need to create a variable to store the handle value.

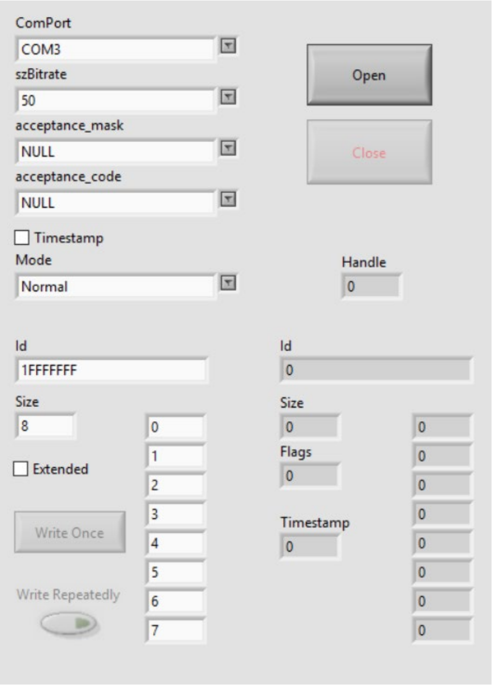
```
myHandle = DLL.CAN_Open(b"COM3", b"50", b"00000000", b"00000000",
1, 2)
```

5. This concludes the basic setup process of using the DLL in Python. Imported functions can then be easily called form the DLL with the parameters created above.

Using the API in LabVIEW

- CAN_Main.vi

The main panel is a simple, easy-to-use example program which contains most of the important functions available for use in the CAN API. Different functions can be tested by changing the settings on the leftmost side, which are restricted to legal parameters to prevent an error in operation. For example, the user can choose from Normal, Listen Only, or Loopback mode to suit their purposes.



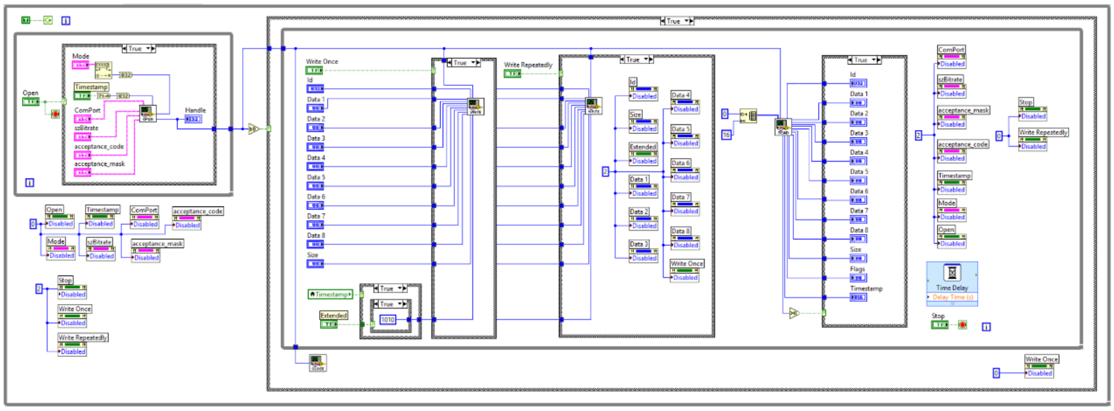
ComPort: COM3
szBitrate: 50
acceptance_mask: NULL
acceptance_code: NULL
□ Timestamp
Mode: Normal
Handle: 0

Id: 1FFFFFFF
Size: 8
0, 1, 2, 3, 4, 5, 6, 7
□ Extended

Id: 0
Size: 0
Flags: 0
Timestamp: 0
0, 0, 0, 0, 0, 0, 0, 0

Once the channel is opened, the user can use either "Write Once" or the "Write Repeatedly" button to send messages as configured in the fields. Messages received will appear on the fields on the rightmost side, if they are available.

All subVI icons have been customized, with the terminals wired to be user-friendly, increase readability and allow for cleanliness in larger projects, as seen in the block diagram for the main panel.



- CAN_Open.vi

Description

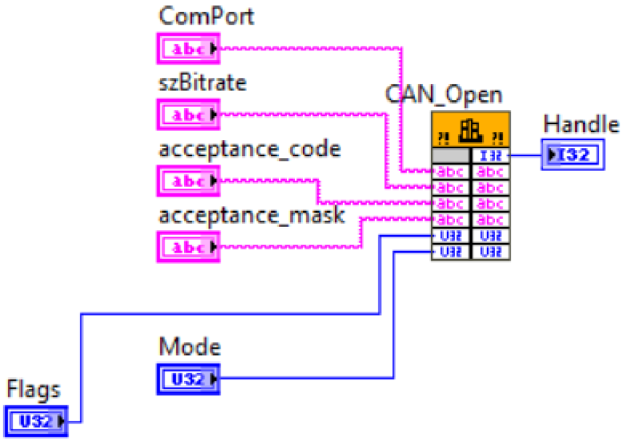
Opens a channel to the device.

Input

- ComPort: The COM port to establish a connection with.
- szBitrate: The speed at which the connection is to be made, with preset values of 10, 20, 50, 100, 125, 250, 500, 800, 100
- acceptance_code: Used for filtering CAN messages. To be used with the acceptance mask.
- acceptance_mask: Used for filtering CAN messages. To be used with the acceptance code.
- Flags: Whether or not the timestamp function should be enabled.
- Mode: The mode at which the device should operate at, with choices being Normal, Listen Only and Loopback

Output

- Return: Handle to the device. A positive value indicates success in opening the channel, while -2 represents error when opening channel and -3 represents error in input parameters

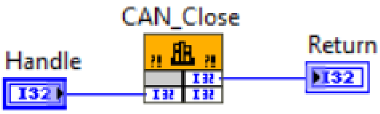


- CAN_Close.vi

  Description
  Closes the CAN channel with the specified handle.

  Input
- Handle: The handle of the CAN channel which is to be closed

  Output
- Return: A positive value indicates success in closing the channel, whereas a negative value indicates an error in closing the channel.



- CAN_Write.vi

Description

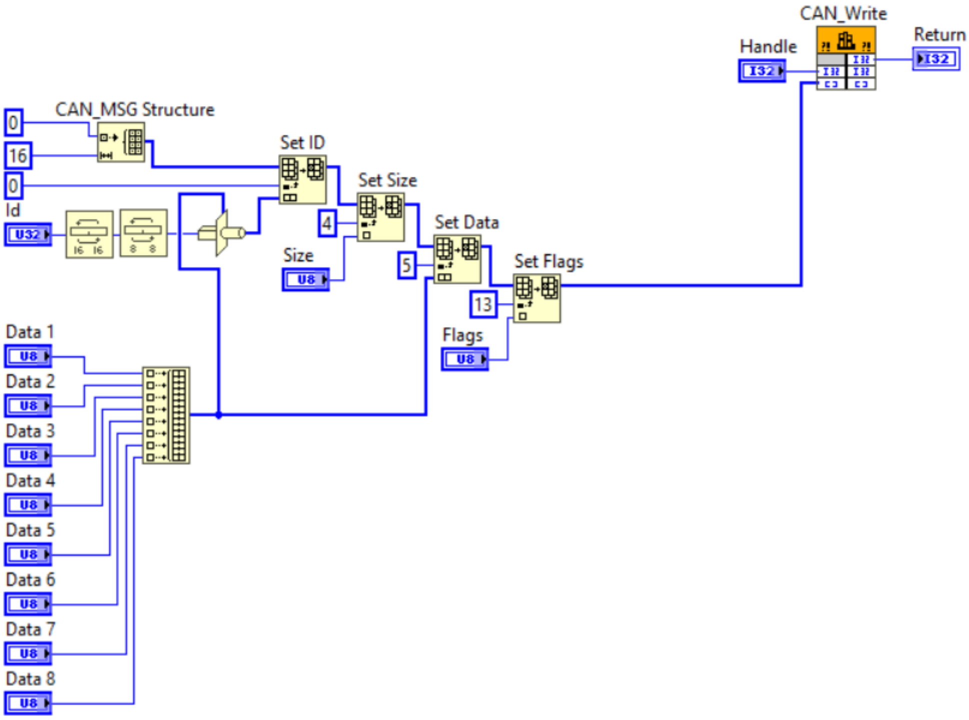
Writes a message to the CAN channel with the specified handle.

Input

- Handle: The handle of the CAN channel which the message is to be sent to.
- Id: Message ID.
- Size: Frame size (0~8).
- Data[8]: Data bytes 0~7.
- Flags: 1 (standard), 2 (extended), 9 (standard + timestamp), 10 (extended + timestamp)
- Timestamp: Timestamp (ms)

Output

- Return: A positive value indicates success in sending the message, whereas a negative value indicates an error in sending the message, with -4 representing that the channel is not open.



- CAN_Read.vi

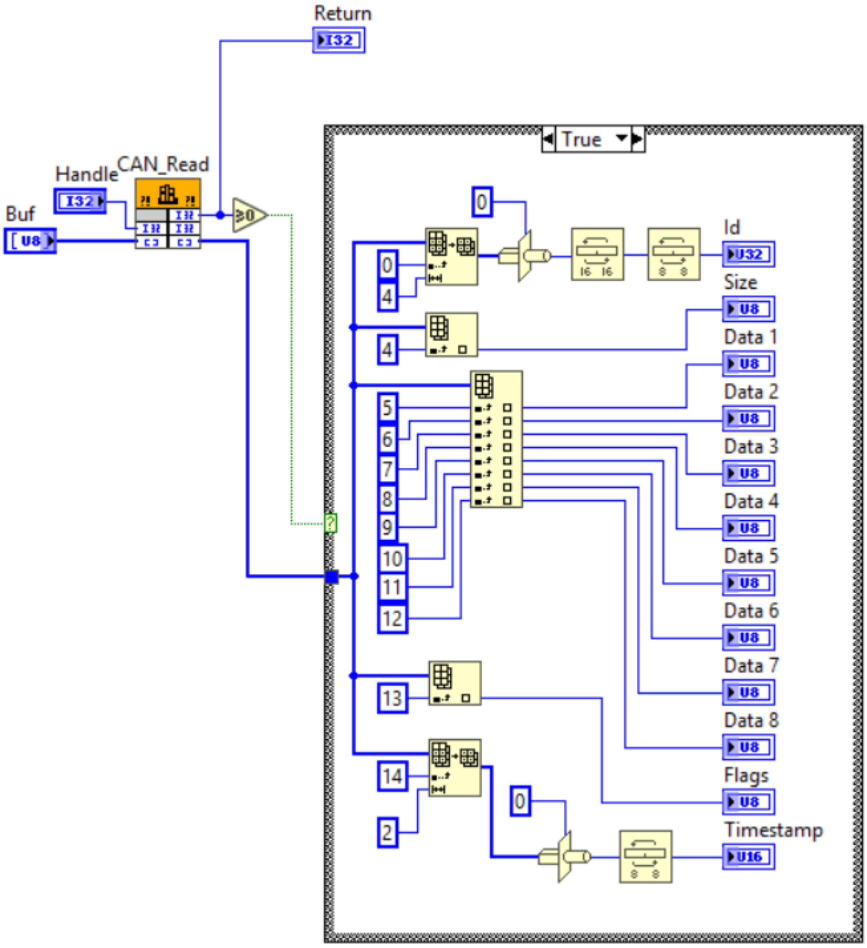
Description
Read a message from the CAN channel with the specified handle.

Input

- Handle: The handle of the CAN channel which the message is to be read from.

Output

- Return: A positive value indicates success in reading the message, whereas a negative value indicates an error in reading the message, with -4 representing that the channel is not open and -5 representing that there is no message to be read.
- Id: Message ID.
- Size: Frame size (0~8).
- Data[8]: Data bytes 0~7.
- Flags: 1 (standard), 2 (extended), 9 (standard + timestamp), 10 (extended + timestamp)
- Timestamp: Timestamp (ms).



Return
I32
Handle
CAN_Read
I32
Buf
U8
≥0
True
0
0
4
4
5
6
7
8
9
10
11
12
13
14
2
0
Id
U32
Size
U8
Data 1
U8
Data 2
U8
Data 3
U8
Data 4
U8
Data 5
U8
Data 6
U8
Data 7
U8
Data 8
U8
Flags
U8
Timestamp
U16