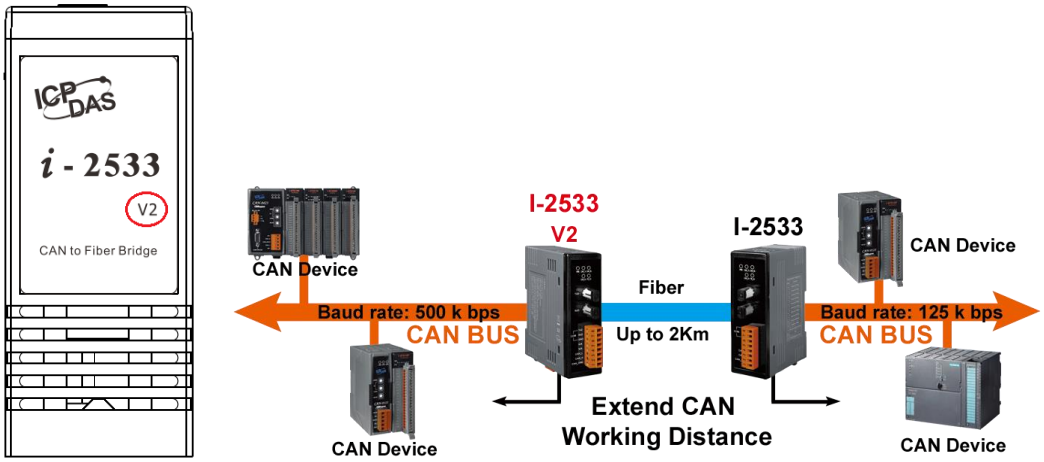
I-2533 [V2] User Manual

◎◎ Notice ◎◎

This manul is for the I-2533 module with [V2] mark on the case. Here shows the picture below. The I-2533 [V2] can works with original I-2533 module as below.



If the users do not use the PC utility for some configuration, they do not need to care about the difference. The main difference between I-2533 [V2] and I-2533 is configuration of the PC utility. Here shows the list of the compatibility.

Function Items	I-2533 with V2 mark
Rotary Definition	Compatible with I-2533
Pin Definition	Compatible with I-2533
LED Definition	Compatible with I-2533
120Ω Resister Switch	Compatible with I-2533
Fiber Communication	Compatible with I-2533
CAN Communication	Compatible with I-2533
PC Utility	Supported but incompatible with I-2533
CAN Filter Configuration	Supported but incompatible with I-2533
Firmware Upgrade	Supported but incompatible with I-2533
CAN User-defined Baud Rate Configuration	Supported but incompatible with I-2533

Warranty

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

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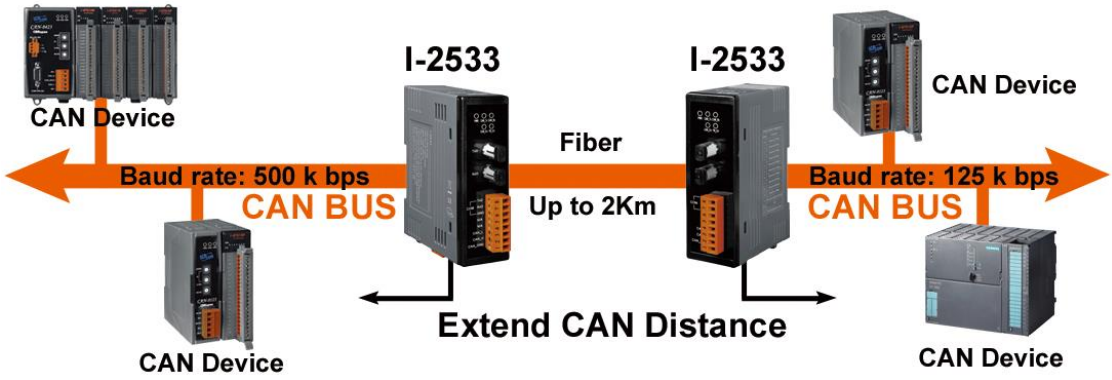
Tables of Content

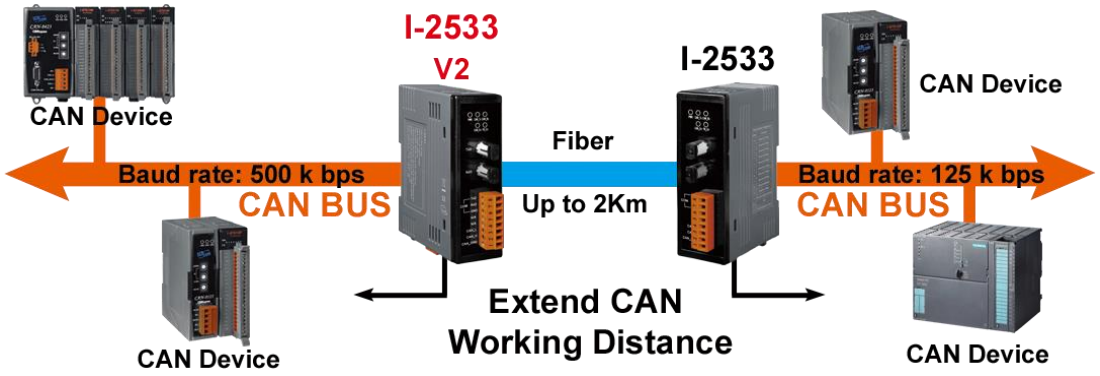
Tables of Content 3
1 Introduction 4
1.1 Specifications 5
1.2 Features 6
2 Technical data 7
2.1 Block Diagram 7
2.2 Appearance 8
2.3 Pin Assignment 9
2.4 Rotary Switch 10
2.5 LED Indicator 11
2.6 Terminator Resistor Setup 13
2.7 Wire Connection 15
3 Network Deployment 16
3.1 Driving Capability 16
3.2 Fiber Selection & Fiber Length 17
3.3 Filter & User's Baud Rate Configuration 18
3.4 CAN Message Filter Configuration 23
3.5 Update Firmware 25
4 Dimension 26

1 Introduction

I-2533 is a local CAN bridge used to establish a connection between two CAN bus system via fiber optic transmission medium. In order to solve the problem between CAN and fiber transmission medium, I-2533 is specially designed for converting the electrical CAN bus signal to fiber optic cables. Not just like I-2533, I-2533 has three more important features.

First, the transmission distance limitation of the CAN bus system will not reduced because of CAN baud rate. It means that the total network distance can be extended. Second, the bus error on one CAN network will not affect the operation of another CAN network. Finally, the two CAN network can communication with each other by using different CAN baud rate for highly flexibility. Besides, I-2533 provides the utility tool for user-defined baud rate and filter configuration. By using this tool, it is allowed to have user-defined baud rate and message filter. When users use the I-2533 on two CAN network with different CAN baud rate, it may be useful to reduce the bus loading on the network which has low baud rate.





1.1 Specifications

CAN Interface	
Connector	Screwed terminal block (CAN_GND, CAN_L, CAN_H)
Baud Rate (bps)	10 k ~ 1 M
Transmission Distance (m)	Depend on baud rate
Isolation	2500 Vrms
Terminator Resistor	Switch for 120Ω terminator resistor
Specification	ISO-11898-2, CAN 2.0A and CAN 2.0B
Fiber Interface	
Connector	ST (Multi-mode)
Wave Length	850 nm
Fiber Cable	50 / 125 μm , 62.5 / 125 μm, 100 / 140 μm (62.5 / 125μm is recommended)
Transmission Distance (m)	2 km max (in 62.5 / 125 μm fiber cable)
UART Interface	
COM 1	RS-232 (configuration only)
COM 1 Connector	Screwed terminal block (RxD, TxD, GND)
Baud Rate (bps)	115200
Data bit	8
Stop bit	1
Parity	None
LED	
Round LED	PWR LED, CAN_Tx LED, CAN_Rx LED, CAN_Err LED, FB_Err LED
Power	
Power supply	Unregulated +10 ~ +30 V_{DC}
Protection	Power reverse polarity protection, Over-voltage brown-out protection
Power Consumption	3 W
Mechanism	
Installation	DIN-Rail
Dimensions	32.3mm x 77.5mm x 99.0mm (W x L x H)
Environment	
Operating Temp.	-25 ~ 75 ℃
Storage Temp.	-40 ~ 80 ℃
Humidity	5 ~ 95% RH, non-condensing

1.2 Features

- Fiber Port: ST (Multi-mode)
- Maximum transmission distance up to 2 km at any CAN baud rate
- TCAN1042 CAN transceiver
- 2500 Vrms isolation on the CAN side
- Support both CAN 2.0A and CAN 2.0B
- Fully compatible with the ISO 11898-2 standard
- Rotary switch for CAN baud rate configuration
- Build-in switch for 120 Ω terminator resistor
- Up to 100 CAN nodes on each channel
- Removable terminal block, Mount easily on DIN-Rail
- Allow user-defined baud rate
- Fiber cable broken detection
- Utility tool for message filter configuration.
  (V2 version has different filter configuration from the original module).

2 Technical data

2.1 Block Diagram

The following figure is the block diagram illustrating the functions of the I-2533 module.

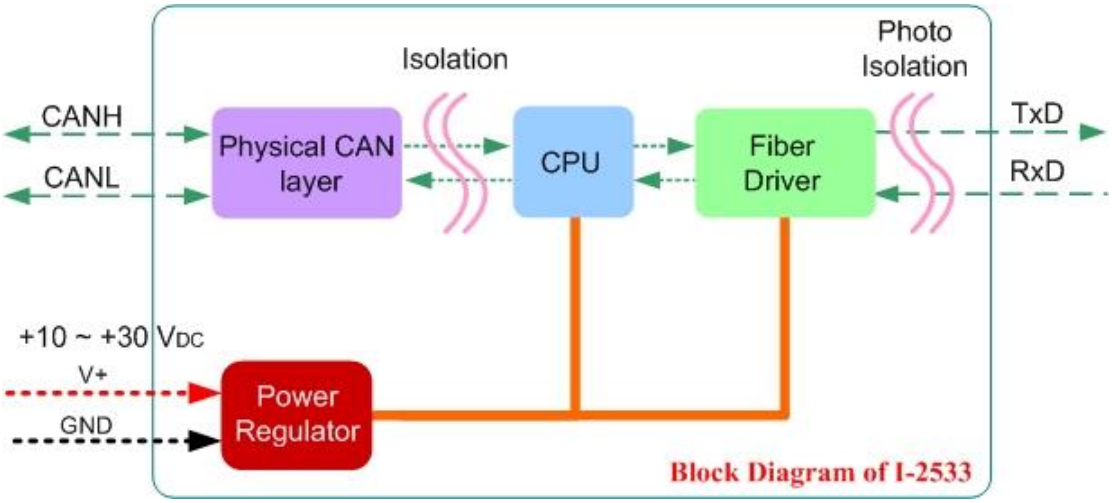


Figure 2-1 Block Diagram of I-2533

2.2 Appearance

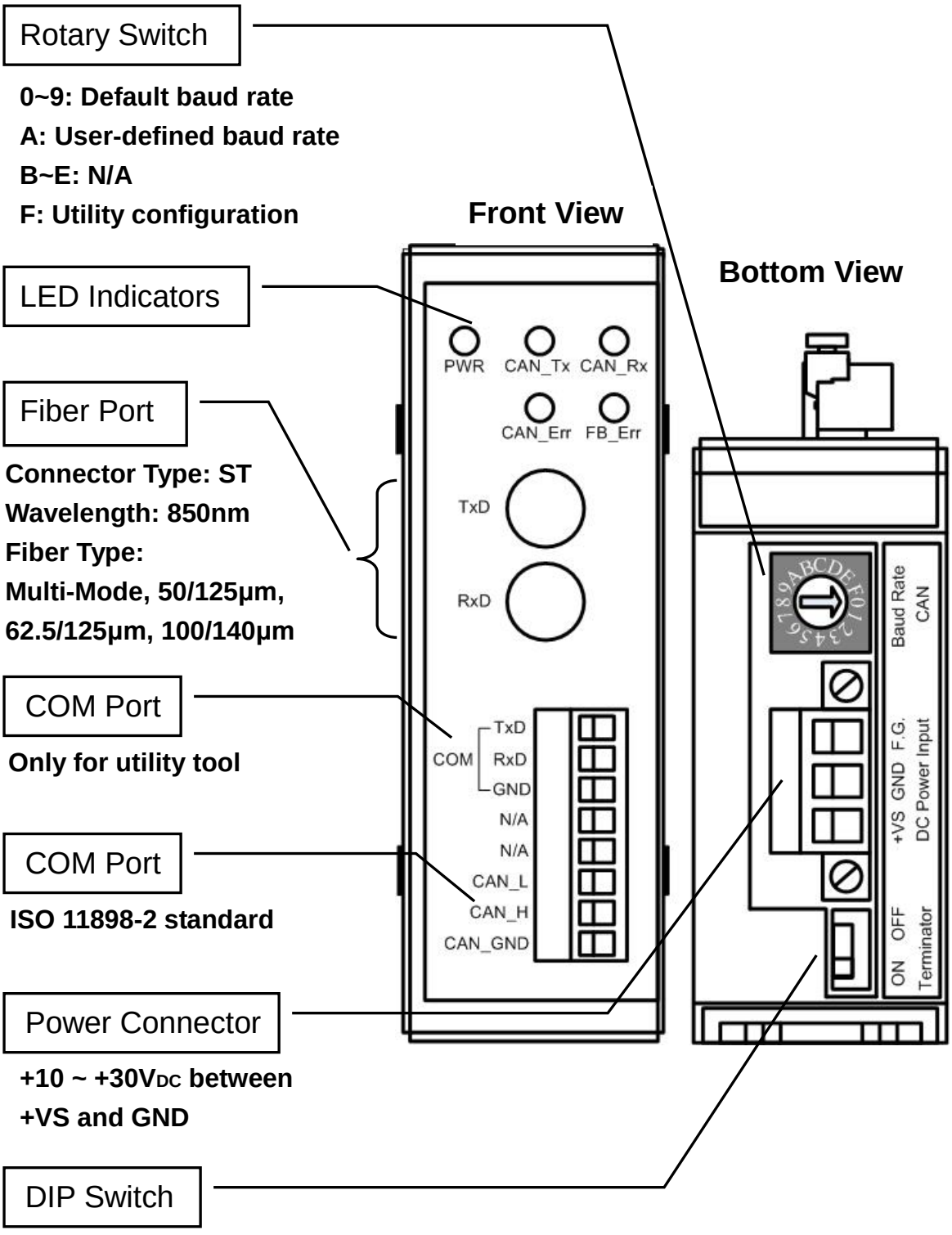


Figure 2-2 Appearance of I-2533

2.3 Pin Assignment

The pin assignments of COM port, CAN port, fiber port and power connector of I-2533 are shown in the following tables.

Table 2-1 Pin Assignment

Port	Name	Description
COM	TXD	TXD pin of RS-232 port.
	RXD	RXD pin of RS-232 port.
	GND	SG (or GND) pin of RS-232 port.
CAN	CAN_L	CAN_Low, signal line of CAN port.
	CAN_H	CAN_High, signal line of CAN port.
	CAN_GND	CAN_Ground, ground voltage level of CAN port.
Fiber	TXD	Transmit optic data.
	RXD	Receive optic data.
Power	+VS	Voltage Source Input. +10V_{DC} ~ +30V V_{DC}.
	GND	Power Ground.
	F.G.	Frame Ground.

Sometimes, the CAN_GND voltage level of different CAN devices on a CAN bus system are not equal. In this case, it could cause some problems and derogate the system stability. There is one way to relieve this situation; users can connect the CAN_GND of different CAN devices with each other to balance the voltage level of CAN_GND.

Electronic circuits are always influenced by different levels of Electro-Static Discharge (ESD), which become worse in a continental climate area. F.G. provides a path for conducting the ESD to the earth ground. Therefore, connecting the F.G correctly can enhance the capability of the ESD protection and improve the module's reliability.

Wiring of CAN_GND and F.G. is not necessary; users can modify the configuration of wiring according to real applications.

2.4 Rotary Switch

When users would like to set the CAN baud rate or message filter of I-2533, use the rotary swich on the upper of the power connector to archieve this purpose. Users can find it on the top of the power connector.

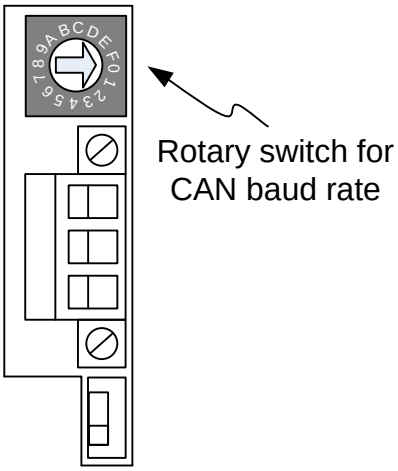


Figure 2-3 Location of Rotary Switch

There are 16 sections on the rotary switch. They are descripted on the following table.

Table 2-2 Description of Rotary Switch

Switch Value	Description
0	Set baud rate to 10 kbps
1	Set baud rate to 20 kbps
2	Set baud rate to 50 kbps
3	Set baud rate to 80 kbps
4	Set baud rate to 100 kbps
5	Set baud rate to 125 kbps
6	Set baud rate to 250 kbps
7	Set baud rate to 500 kbps
8	Set baud rate to 800 kbps
9	Set baud rate to 1 Mbps
A	Set baud rate to user-defined baud rate which is configured by I-2533 utility.
B~D	Not-available
E	Firmware update mode.
F	Set I-2533 into configuration mode.

2.5 LED Indicator

There are 5 LEDs on the I-2533. One for power indication, three for CAN bus indication and one for fiber indication. The LED assignment and description are shown as follows.

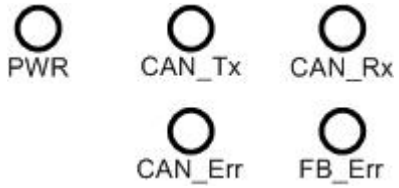


Figure 2-4 LED Assignment of I-2533

LED Name	Color	Description
PWR	Red	When power on the I-2533, this LED is turned on.
CAN_Tx	Green	When the I-2533 sends one CAN message to CAN bus, this LED flashes once. Therefore, if bus loading is heavy, the LED will be always on.
CAN_Rx	Green	When the I-2533 receives one CAN message from CAN bus, this LED flashes once. Therefore, if bus loading is heavy, the LED will be always on.
CAN Err	Red	1. If the I-2533 detects the bus-off status on the CAN bus, this LED is always on. At this moment, the I-2533 clear all CAN messages stored in the I-2533 transmission buffer. When the I-2533 can receive or transmit one CAN message successfully, the error status is clear and the LED is turned off if there is no error happened. 2. If the I-2533 can't send CAN messages successfully because the bus connector is off or some errors happen, this LED flashes five times per second. In this case, the I-2533 will keep all CAN messages in the transmission buffer until the buffer is overflow ◦ When the I-2533 can receive or transmit one CAN message successfully, the error status is clear and the LED is turned off if there is no error happened.

		3. If the CAN transmission buffer is overflow, this LED flashes once per second. If the I-2533 sents all the CAN messages sotred in the transmission buffer in to the CAN network, the LED is turned off if there is no error happened.
Fiber Err	Red	1. If the I-2533 detects the RXD line of the fiber is off, this LED is always on. 2. If the fiber data buffer is overflow, this LED flashes once per second. If the I-2533 sents all the data sotred in the fiber data buffer, the LED is turned off if there is no error happened.

Table 2-3 LED Description

2.6 Terminator Resistor Setup

In order to minimize the reflection effects on the CAN bus line, the CAN bus line has to be terminated at both ends by two terminator resistors as in the following figure. According to the ISO 11898-2 spec, each terminator resistor is 120Ω (or between 108Ω~132Ω). The bus topology and the positions of these terminator resistors are shown as following figure.

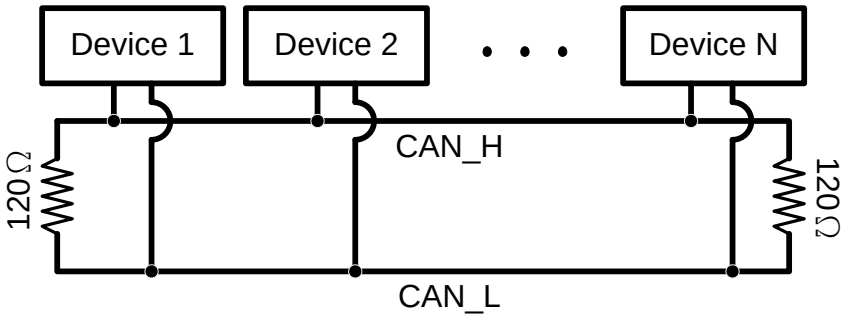


Figure 2.5 CAN bus network topology

Each I-2533 includes one build-in 120Ω termintor resistor, users can decide if it is enabled or not. The DIP switch for terminator resistor is under the power connector.

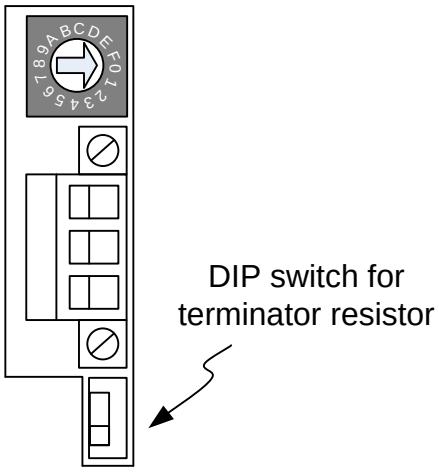


Figure 2-6 Location of Terminator Resistor DIP Switch

The following DIP switch statuses present the condition if the terminator resistor is active (default) or inactive.

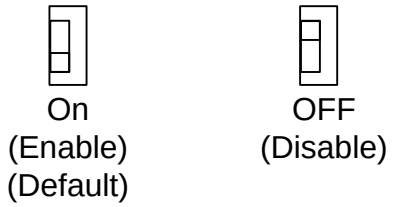


Figure 2-7 Adjustment of Terminal Resistance

Generally, if your application is as follows, we recommend you to enable the terminator resistor.

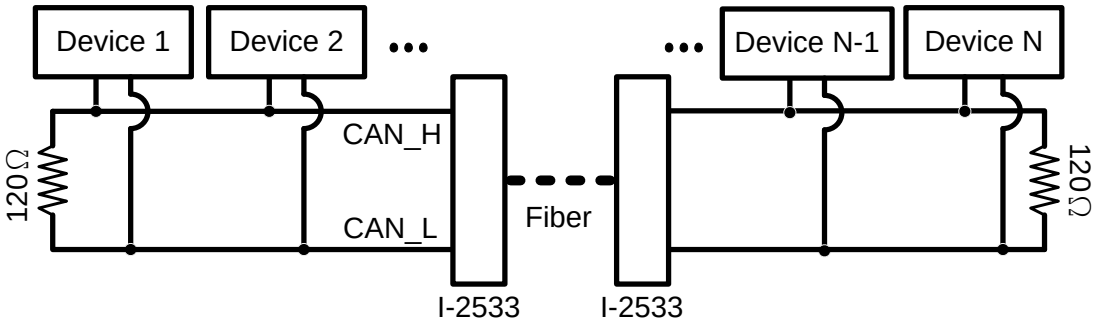


Figure 2-8 Application 1

If your application is like the structure as follows, the terminator resistor is not needed.

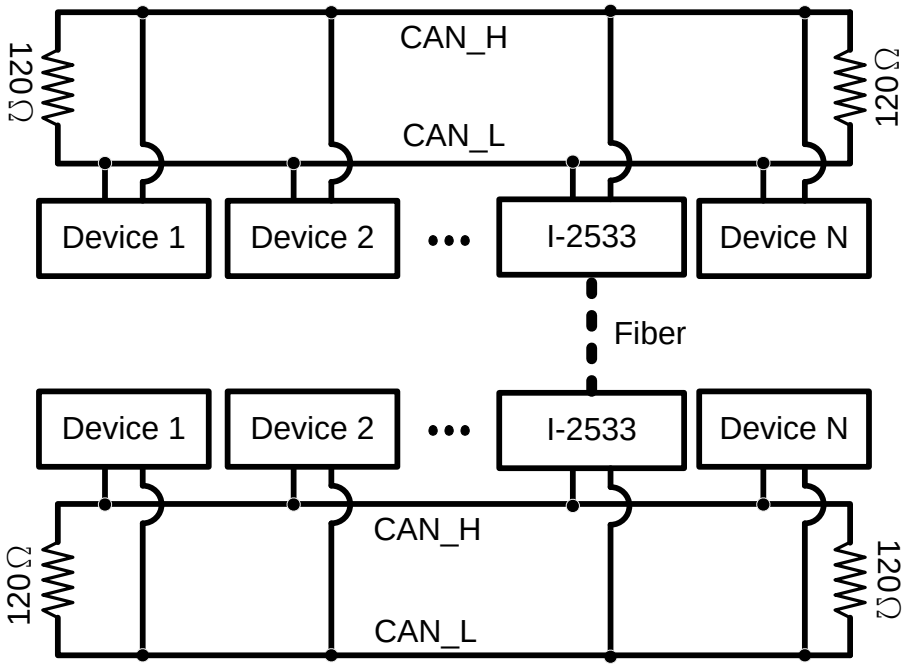


Figure 2-9 Application 2

2.7 Wire Connection

The wire connection of I-2533 is displayed below.

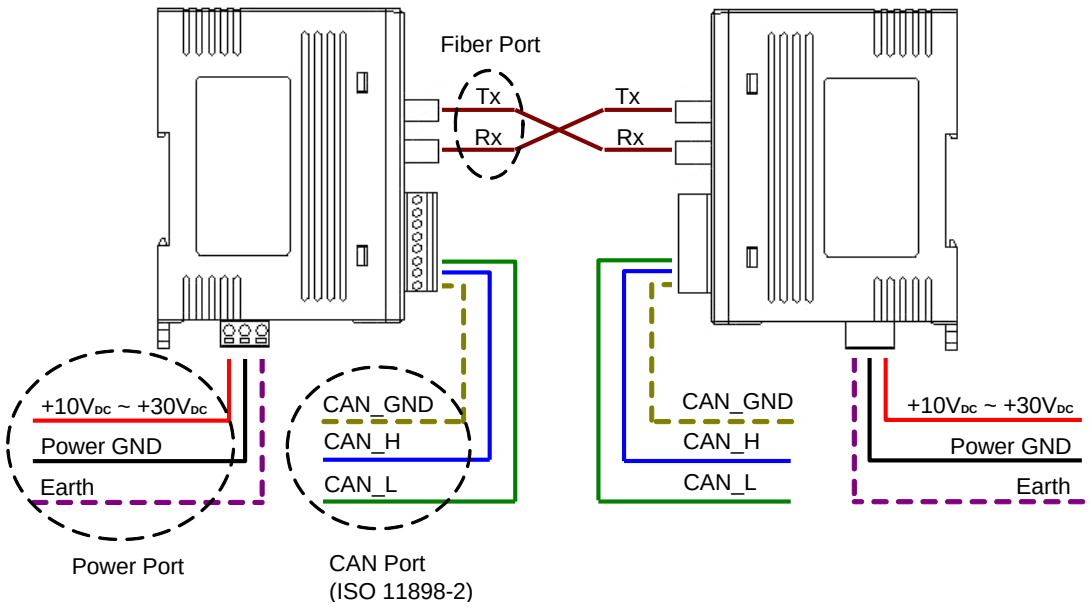


Figure 2-10 Wire Connection of I-2533

The I-2533 has a metallic board attached to the back of the plastic basket. This metallic board and the F.G. pin of power connector are interconnected inside the I-2533. When users mount the I-2533 onto a metal DIN-Rail, users can connect the DIN-Rail to Earth Ground to replace connecting the F.G. pin of power connector.

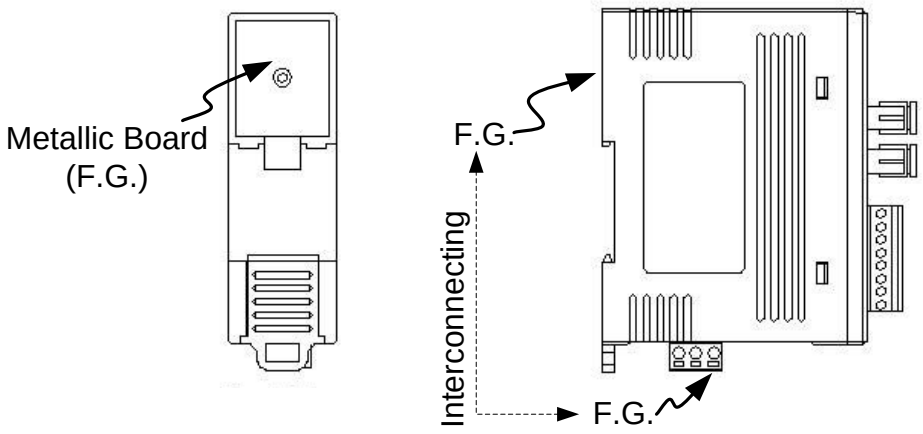


Figure 2-11 Metallic Board at Back of I-2533

3 Network Deployment

3.1 Driving Capability

Before introducing the driving capability of I-2533, some characteristics of copper cable must be assumed. The AC parameters are 120Ω impedance and 5 ns/m line delay, and the DC parameter follows the table shown below.

Table 3-1 Recommended DC parameters for CAN Bus Line

Wire Cross-Section [mm^2]	Resistance [Ω/km]
~0.25 (AWG23)	< 90
~0.5 (AWG20)	< 50
~0.8 (AWG18)	< 33
~1.3 (AWG16)	< 20

Under the conditions described above, users can refer to the following table to know the maximum node numbers in each segment following ISO 11898-2 and the maximum segment length when using different type of wire.

Table 3-2 Driving Capability

Wire Cross-Section [mm2]	The maximum segment length [m] under the case of specific node number in this segment			
	16 Nodes	32 Nodes	64 Nodes	100 Nodes
~0.25 (AWG23)	< 220	< 200	< 170	< 150
~0.5 (AWG20)	< 390	< 360	< 310	< 270
~0.8 (AWG18)	< 590	< 550	< 470	< 410
~1.3 (AWG16)	< 980	< 900	< 780	< 670

3.2 Fiber Selection & Fiber Length

The specification of fiber used to connect I-2533 is shown as following table.

Table 3-3 Specification of Fiber

Type	Diameter [μm] (Core/Cladding)	Operating Wavelength [nm]
Multi-Mode	50/125 62.5/125 100/140	850

I-2533 allows maximum 2 km fiber length for each kind of CAN baud. Alought the maximum fiber length has no relationship with the CAN baud rate, but the some attributions of fiber still influence it. Higher attenuation of fiber will reduce the transmission distance. Users can use following table to know the relationship between those two.

Table 3-4 The relationship between CAN baud rate and ideal fiber length

CAN Baud Rate [bit/sec]	Ideal Fiber Length [m]
1 M ~ 10 k	2000

Table 3-5 Attenuation & Fiber Length

Attenuation [dB/km]	Fiber Length [m]
2.8	< 2000
4	< 1500

By the way, when users use I-2533 in their application, they need to use one pair of I-2533 for communication. The general application architecture may look like as follows.

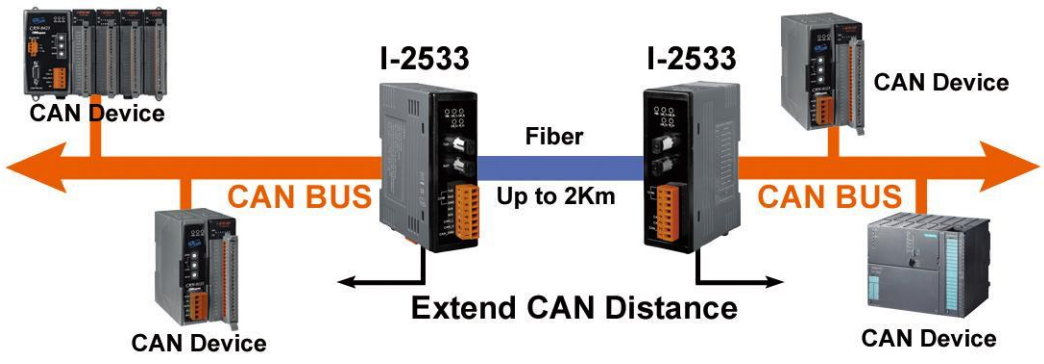


Figure 3-1 I-2533 general application architecture

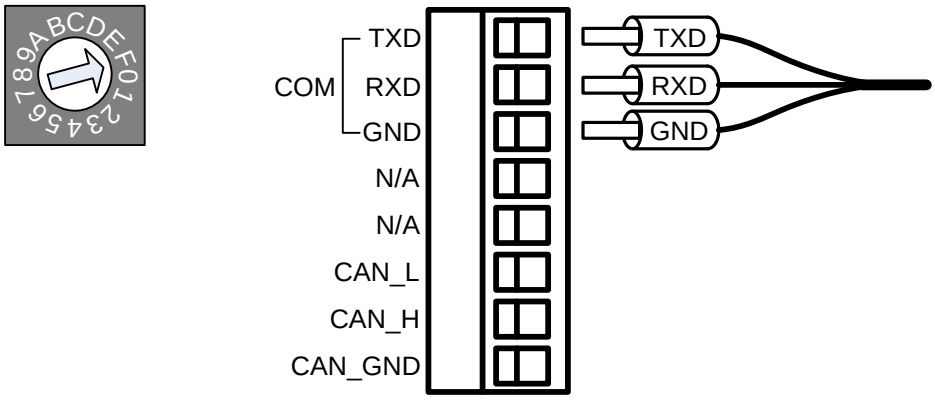
3.3 Filter & User's Baud Rate Configuration

When users want to use user's baud rate or set the message filter, I-2533 utility tool may be needed. It can be free downloaded from the following web site or get it in the product CD (path: CAN/Converter/I-2533 /Software):

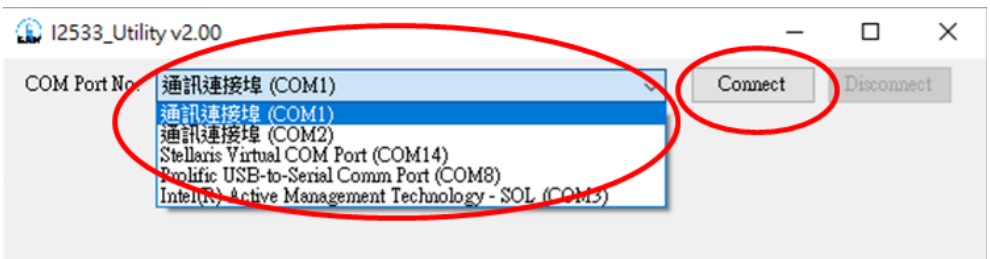
https://www.icpdas.com/en/product/I-2533

After getting the utility tool, please follow the following steps to set the baud rate and message filter.

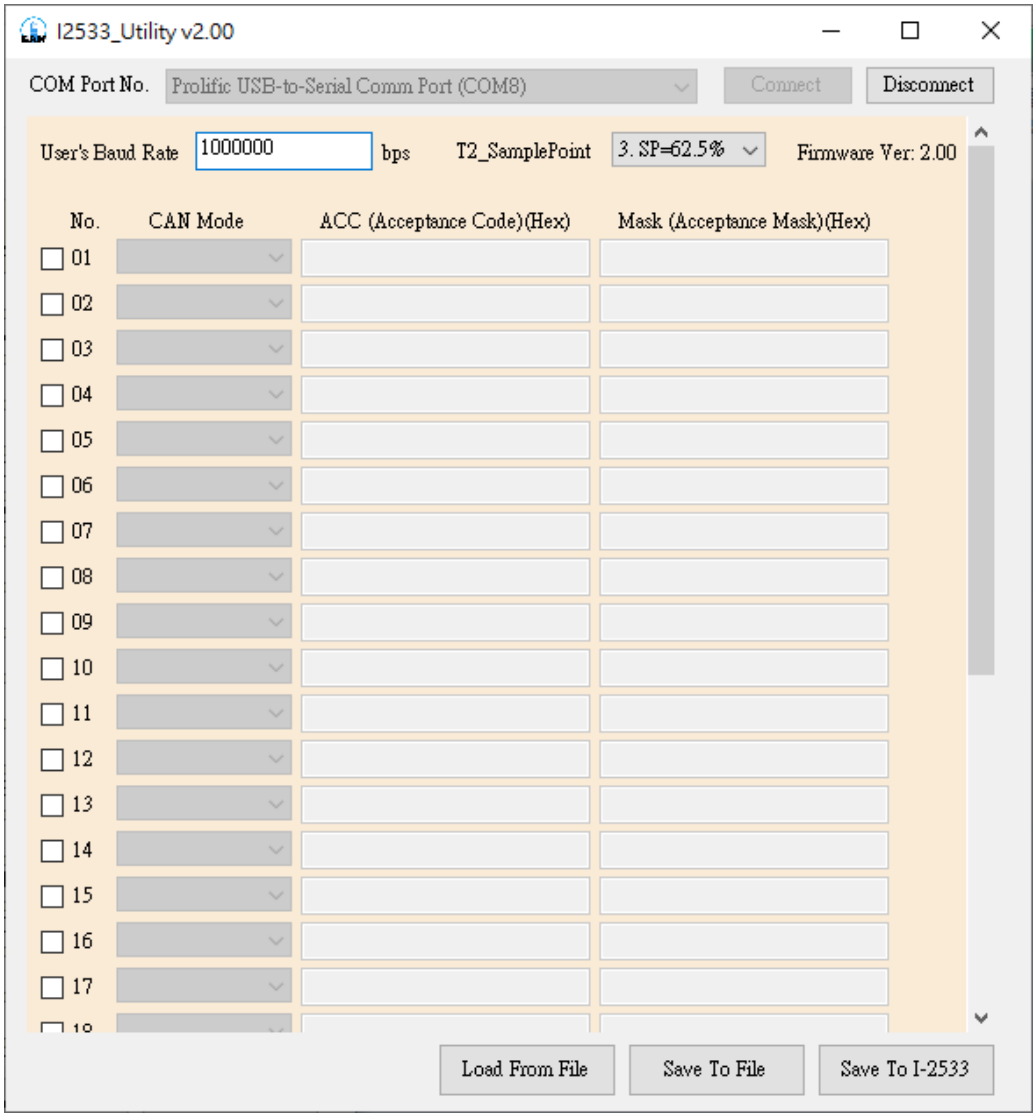
Step0: Power off the I-2533. Set the rotary switch to "F", and connect the PC available COM port with the COM port of the I-2533. Users can find the communication cable in the product box. When connecting to the COM port of I-2533, the TxD pin of the cable is connected to the TXD pin of the COM port, RXD pin of the cable is connected to the RXD pin of the COM port, and GND pin of the cable is connected to the GND pin of the COM port. Then, power on the I-2533.



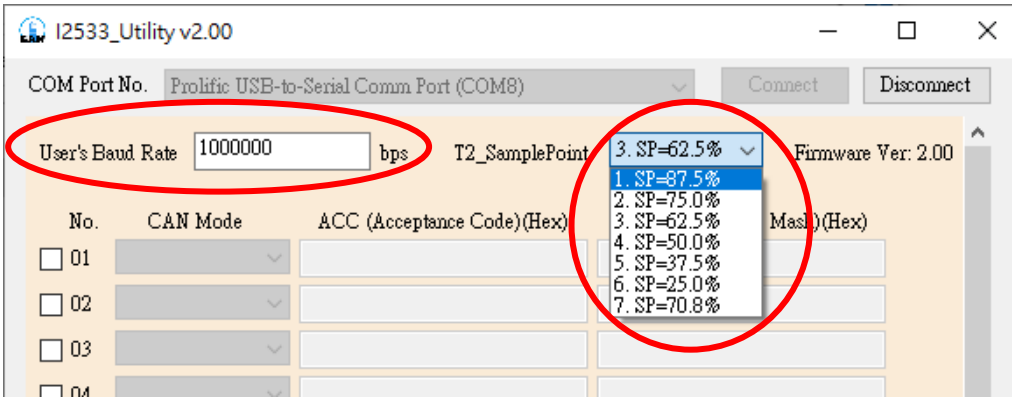
Step1: Execute the I2533_Utility.exe(v2.00), the dialog of the I-2533 utility(v2.00) will be poped up. Select the PC COM port which is connected with the COM port of the I-2533. Then, click "Connect" button.



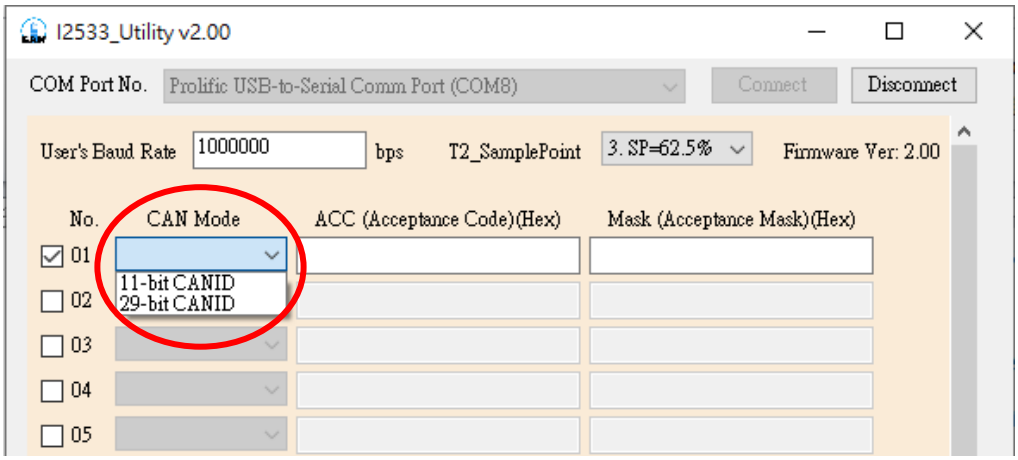
Step2: After connecting the I-2533 successfully, the parameters stored in the I-2533 will be shown on the dialog.



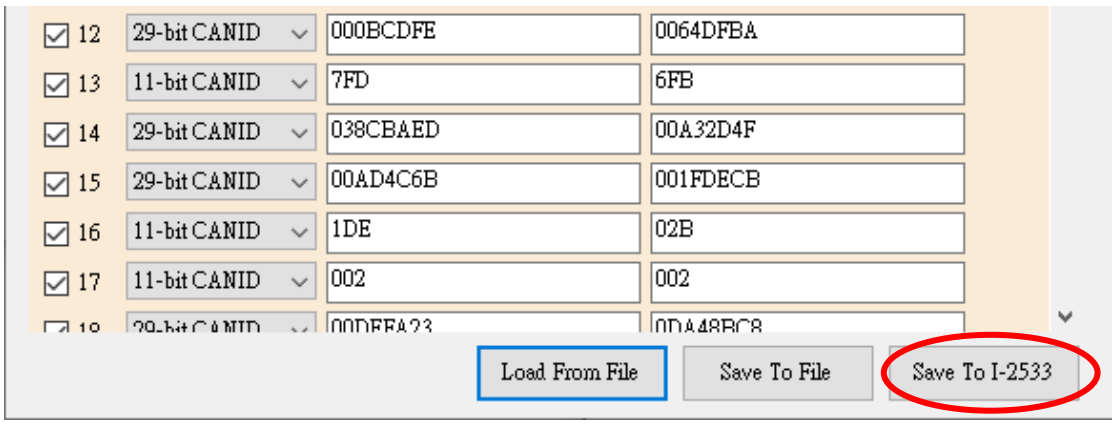
Step3: Users can set the baud rate on the “User’s Baud Rate” field. Here, fill “250000” for 250 kbps or “83333” for 83.333kbps. The I-2533 supports the sample-point configuration. This is useful for users to adjust the sampling point of the CAN signal waveform. The “T2_SamplePoint” provides 7 items which are 25%~87.5%.



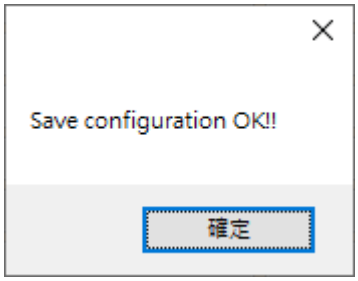
Step4: The default CAN filters are all disable. It means that I-2533 will receive all CAN messages and those CAN messages will be transfer to the fiber port. The filter configuration is uesed to block certain CAN messages which would not be transfered to the fiber. The filter configuration including the “CAN Mode”, “ACC” field and “Mask” field. The “CAN Mode” has “11-bit CAN ID” and “29-bit CAN ID”. The “11-bit CAN ID” means CAN 2.0A specification. And The “29-bit CAN ID” means CAN 2.0B specification. Refer to the CH 3.4 for how to set “ACC” and “Mask” filed.



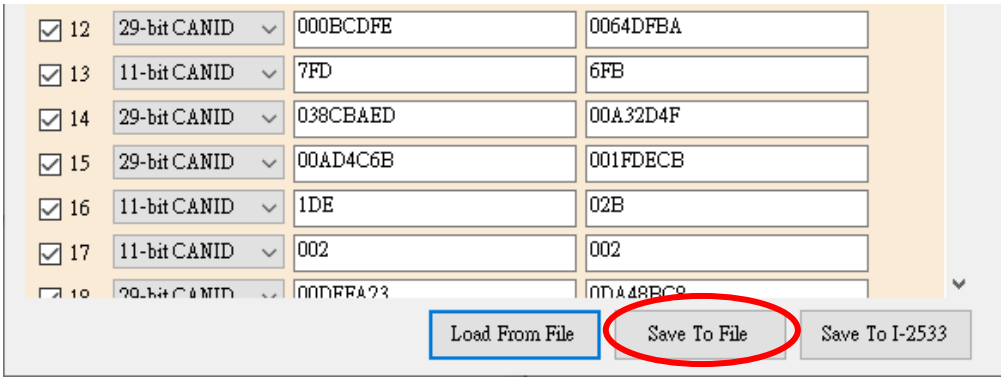
Step5:After finishing all of the configurations, click “Save To I-2533” to store the configuration into the I-2533.



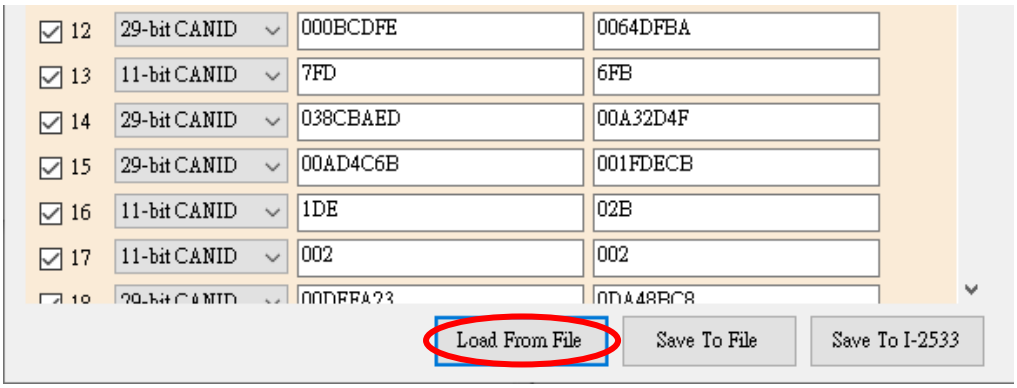
Step6: When the procedure is successful, the following message will be shown.



Step7: Then, Users can save the configurations into .xml file. Click “Save to File” to archieve this purpose.



Step8: Of course, users can load the configurations from .xml file, and “Save To I-2533” to store them into the I-2533.



Step9. After finishing the configuration, set the rotary switch value to “0” ~ “A” and reboot the I-2533. The CAN message filter will be applied automatically in the value “0” ~ “A” of the rotary switch. The CAN baud rate set by utility is only appled when the rotary switch is set to “A”.

3.4 CAN Message Filter Configuration

The I-2533 supports the CAN message filter configuration. By using the filter, the I-2533 will not receive unwanted CAN messages. The filter configuration has “Acceptance Code” and “Acceptance Mask” filed. It can filter useless CAN messages by combining these two setting.

Acceptance Code: The CAN ID bits that you want to get.

Acceptance Mask: The CAN ID bits that will be checked and need to the same with the Acceptance Code bits.

In the “Acceptance Mask”, the bit value ‘1‘ means that the received CAN ID bit must the same with the corresponding CAN ID bit of the “Acceptance Code”. If the two CAN ID bit are not the same, the incoming CAN message will be droped. If the bit value is ‘0’ in the “Acceptance Mask”, it means that the received CAN ID bit will not be check.

For Examples:

(1) If users want to receive all the incoming messages on the CAN bus, the setting must be as follow:

In CAN 2.0A(11-bit CAN-ID): Acceptance Code: Don’t care
Acceptance Mask: 000(Hex).

In CAN 2.0B(29-bit CAN-ID): Acceptance Code: Don’t care
Acceptance Mask: 00000000(Hex).

(2) If users want to only receive the message of CAN ID “123” (Hex) and drop all the other CAN message, the setting must be as follow:

In CAN 2.0A(11-bit CAN-ID):
Acceptance Code: 123 (001 0010 0011 bit)
Acceptance Mask: 7FF (111 1111 1111 bit)

In CAN 2.0B(29-bit CAN-ID):
Acceptance Code: 000000123 (0 0000 0000 0000 0000 0001 0010 0011 bit)
Acceptance Mask: 1FFFFFFF (1 1111 1111 1111 1111 1111 1111 1111 bit)

(3) If users want to receive the message of CAN ID from “300” to “33F” (Hex) and drop all the other CAN message, the setting must be as follow:

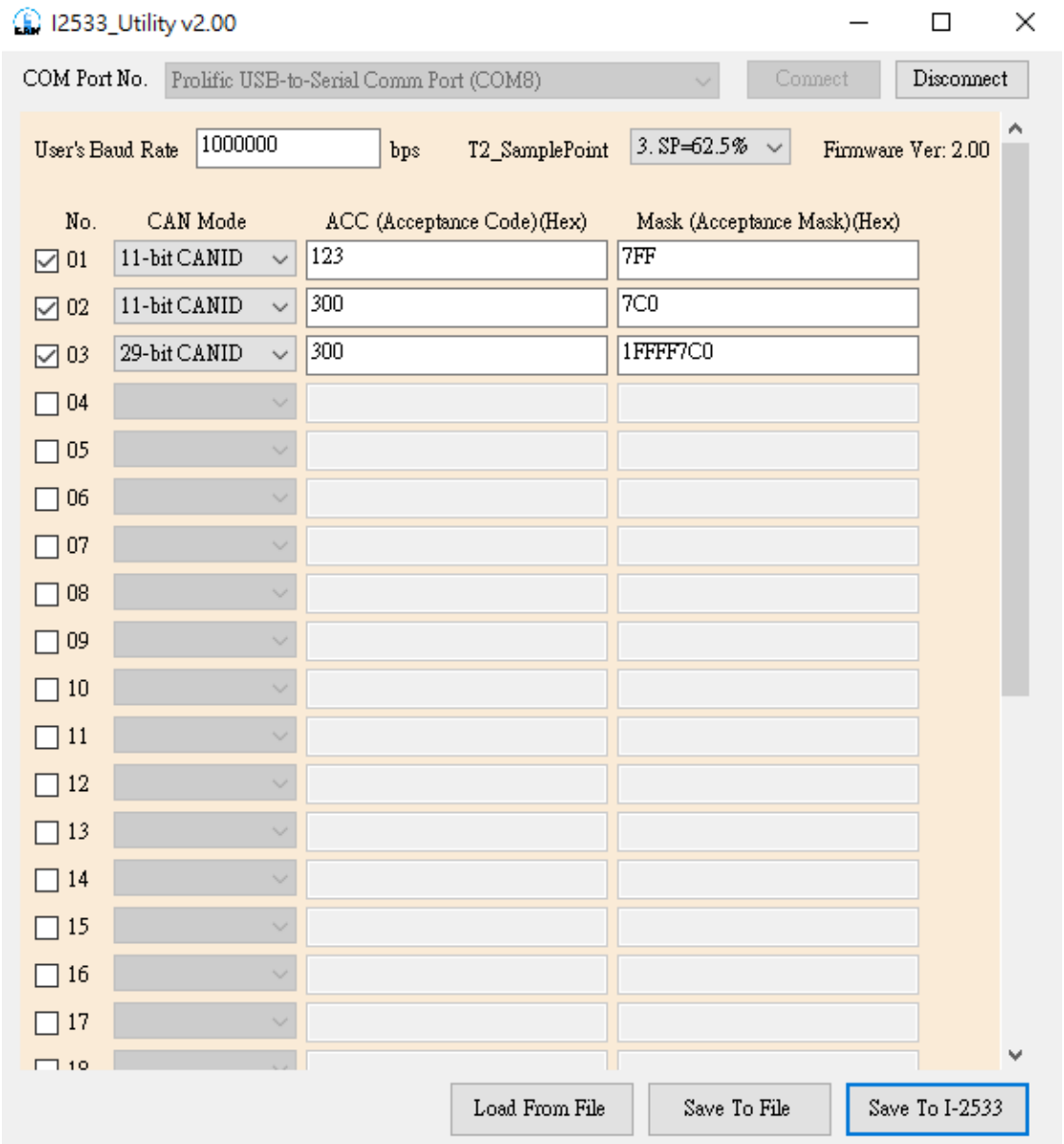
In CAN 2.0A(11-bit CAN-ID):
Acceptance Code: 30X (011 00XX XXXX bit) (X: don’t care)
Acceptance Mask: 7C0 (111 1100 0000 bit)

In CAN 2.0B(29-bit CAN-ID):

Acceptance Code: 00000030X (0 0000 0000 0000 0000 0011 00xx xxxx bit)

Acceptance Mask: 1FFFFFFF (1 1111 1111 1111 1111 1111 1111 1111 bit)

There are 30 filter settings. The incoming CAN message pass one of the filtering rule. The I-2533 will receive this message. Here shows the example (2) and (3) above.



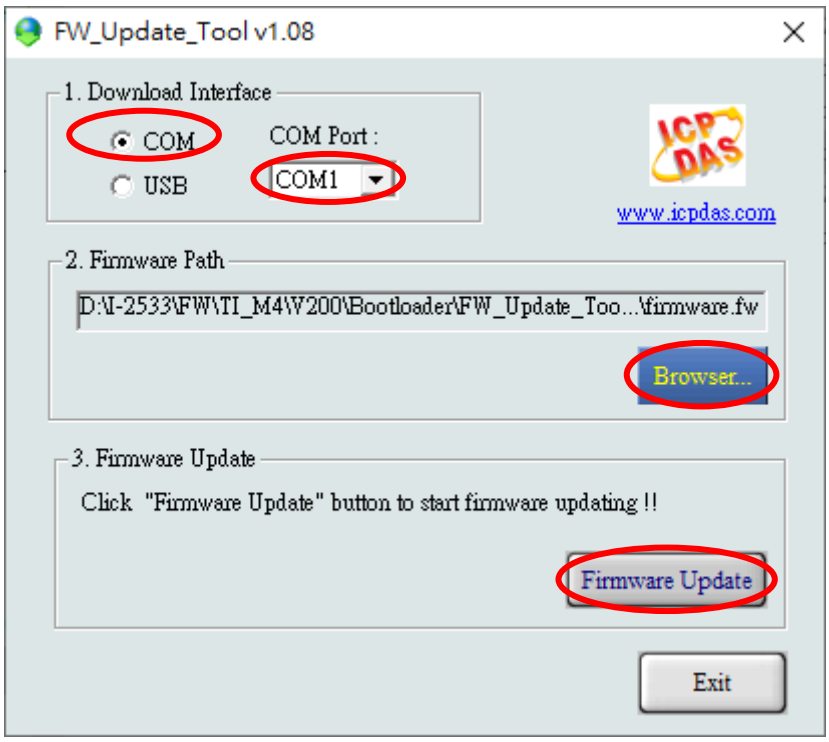
3.5 Update Firmware

When users would like to update the I-2533 firmeware, please prepare the tool FW_Update_Tool.exe, and the firmware .fw file which would be downloaded into the I-2533. You can get these files from the following website

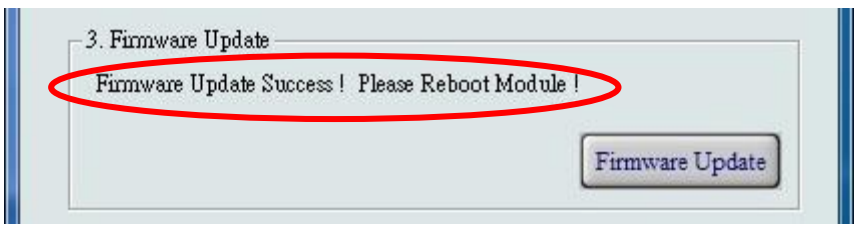
https://www.icpdas.com/en/download/index.php?model=I-2533

Step 1: Power off the I-2533, set the rotary switch to 'E', and power on the I-2533. If the I-2533 is in the firmware update mode, the CAN_Tx, CAN_Rx, CAN_Err, FB_Err will flash once per second simulationously.

Step 2: Download the FirmwareUpdateTool.zip and extract the compressed file. Then execute the FW_Updatae_Tool.exe. Select the PC COM port which is connected to the I-2533 COM port, and find the firmware by using Browser button. Then click the Firmware Update button.



Step 3: When finishing the firmware update, you can see the information as follows.



4 Dimension

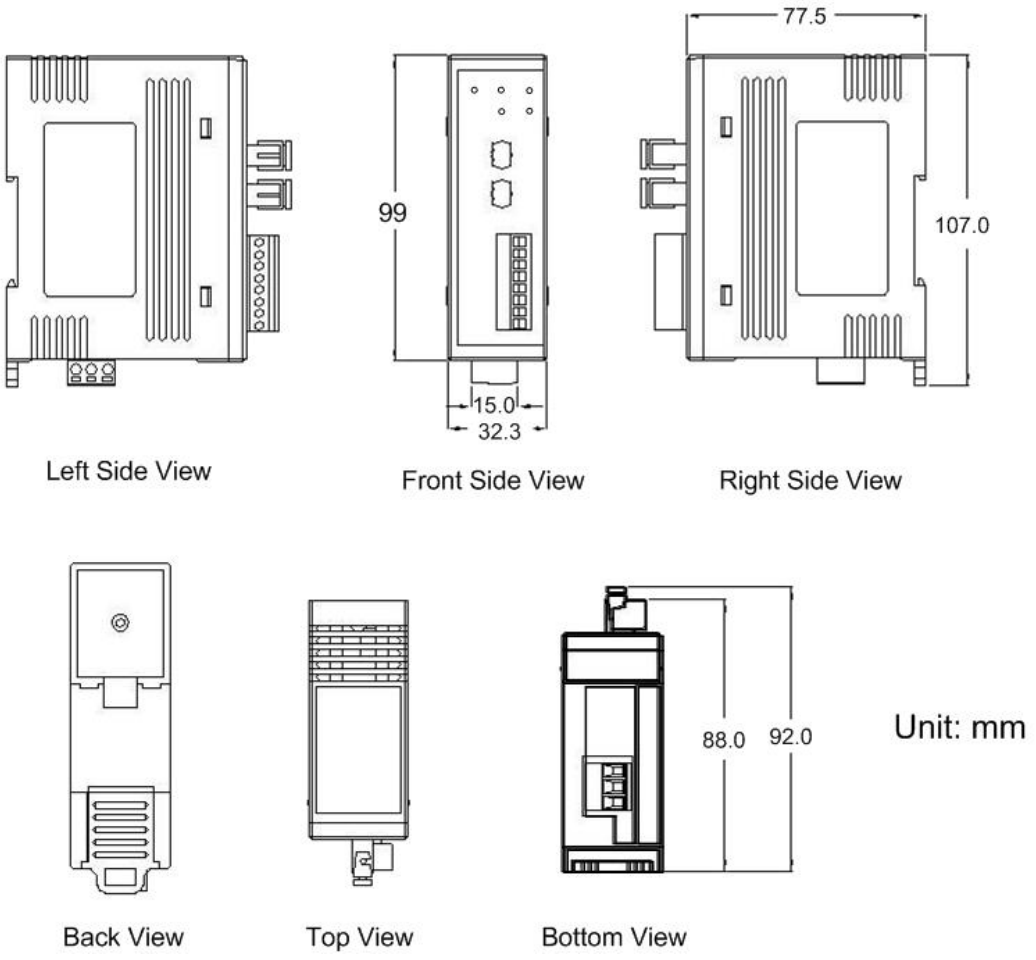


Figure 4-1 Dimension of I-2533