Accelerometer User Manual

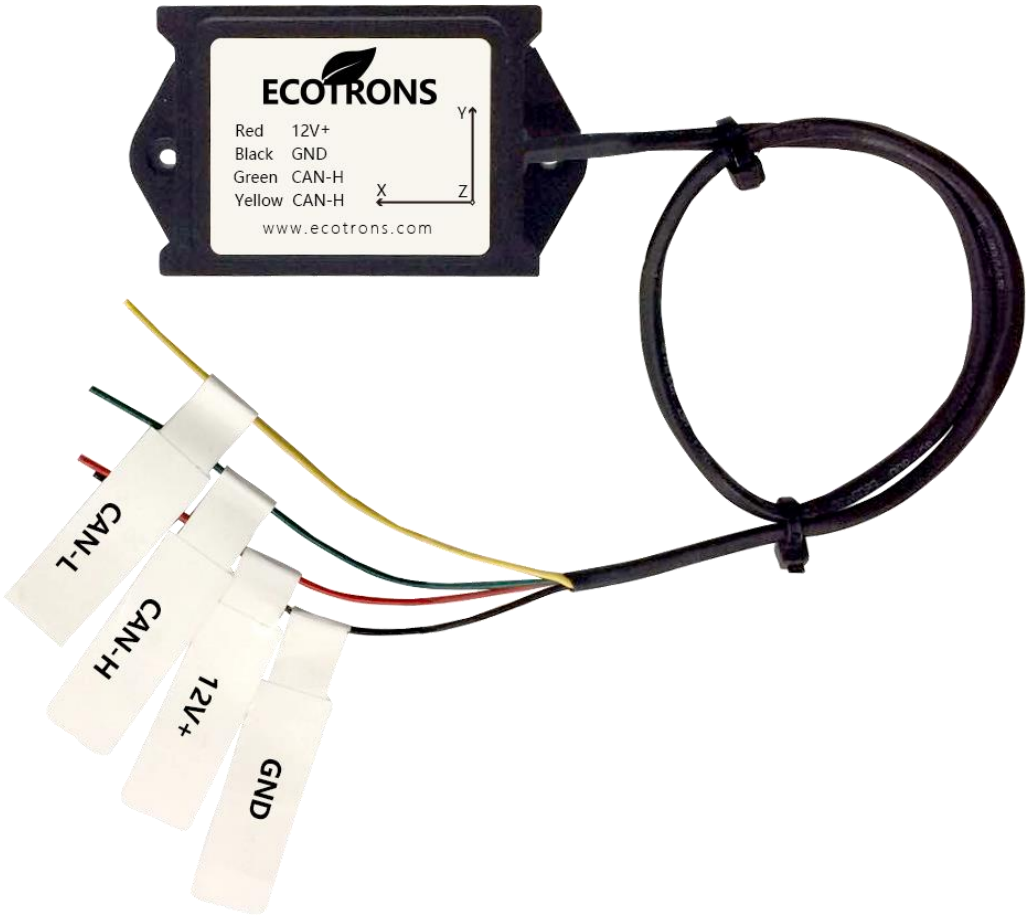
V1.6.3

Note: If you are not sure about any specific details, please contact us at support@ecotrons.com.

Index	Version	Date
1	V1.3	1.18.2018
2	V1.4	9.27.2018
3	V1.5	12.05.2018
4	V1.6	2.13.2019
5	V1.6.3	4.7.2020

Content

1. Introduction



ECOTRONS accelerometer is an advanced triaxial accelerometer. It can measure the triaxial acceleration, and calculate roll angle and pitch angle. ECOTRONS accelerometer is based on the modern LSM303D and MPU6050 solutions. The LSM303D can provide accurate forward direction, high-accuracy sensing, extended magnetic range and the smallest measurement noise. The MPU6050 can also accurately output acceleration and angular velocity. ECOTRONS accelerometer can accurately output -4g to +4g linear acceleration. It can also output the accurate triaxial attitude data after the complex kinetic calculation and dynamic Kalman Data Fusion Filter Algorithm.

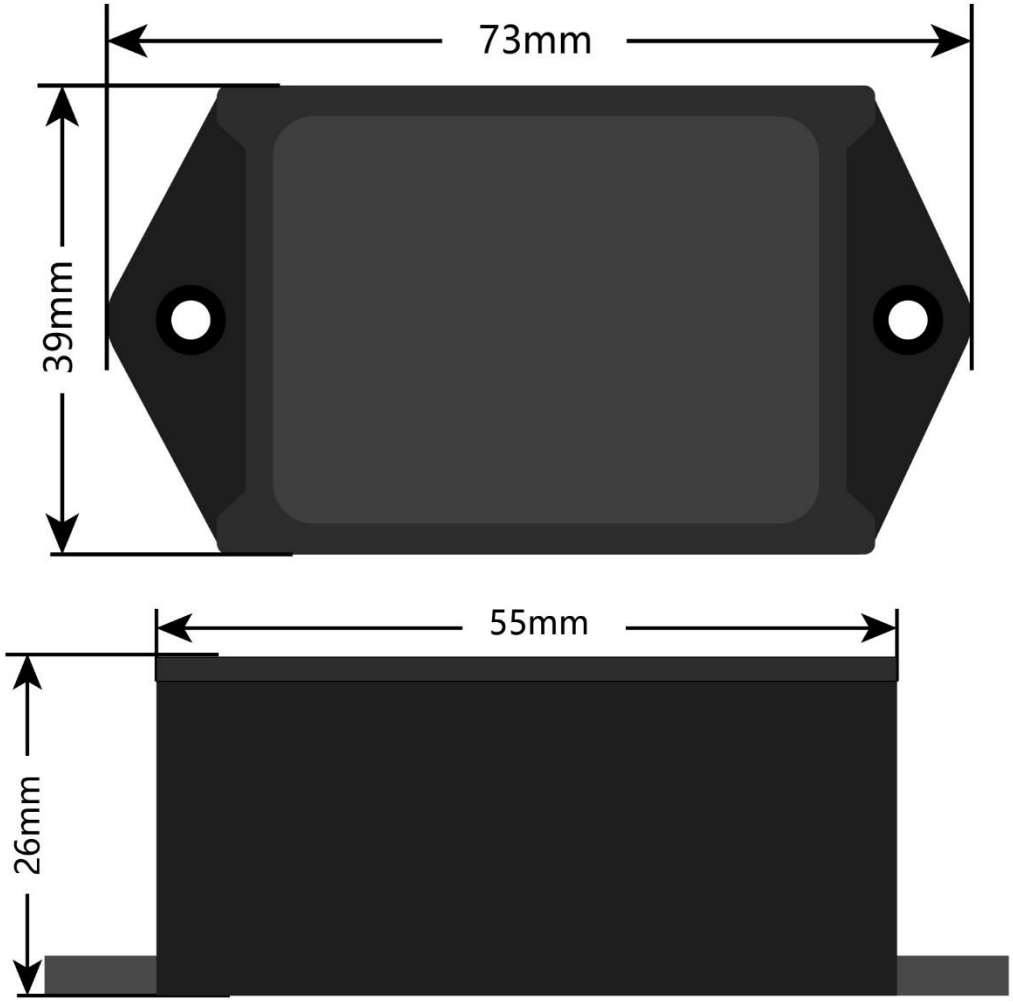
2. Electrical Connection

ECOTRONS accelerometer has four wires shown as follows:

Color		Signal	Description
	Red	+12V	+12V Power supply (9~16V)
	Black	GND	Ground
	Green	CAN-H	CAN bus high
	Yellow	CAN-L	CAN bus low

3. Dimensions

The size of the device is as follows:



4. Specifications

Detailed specifications	Value	Unit
Size	73 x 39 x 26	mm
Weight	70	gram
Range	±4	g
Resolution	0.001	g
Axial measurement	X, Y, Z	
Data output frequency	100	Hz
Power supply	9 ~ 16	V
Operating temperature	-40 ~ 85	℃

Note:

Y direction: the direction of the vehicle forward.

X direction: the direction on the vehicle running plane, perpendicular to the Y-axis.

Pitch angle: the angle between the Y axis and horizontal.

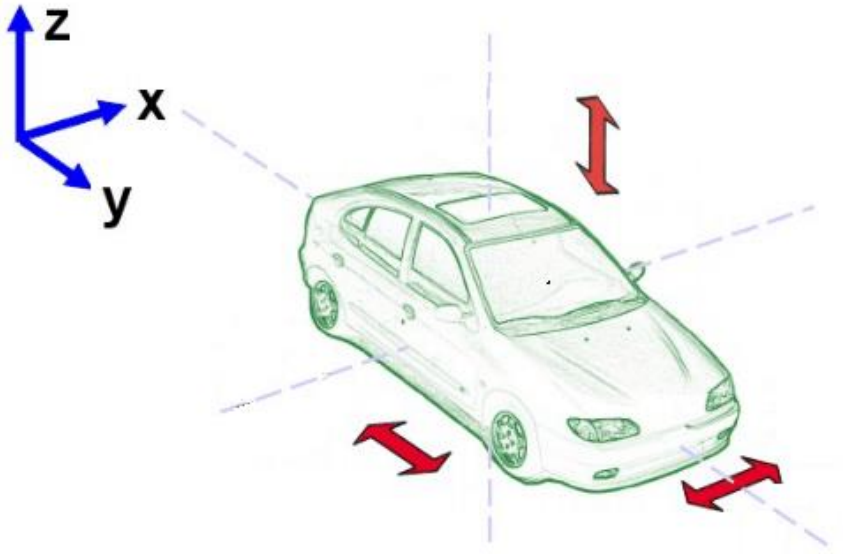
Roll angle: the angle between the X axis and horizontal.

Accelerometer does not include a 120Ω termination resistor on the CAN bus.

5. Accelerometer Installation

The accelerometer should be installed as close to the vehicle's centerline as possible, and fixed on the vehicle with two screws. Please make sure the vehicle is on a flat and horizontal ground when installing the accelerometer.

Make sure the Y-axis points to the forward direction of the vehicle, the X-axis is perpendicular to the driving direction and the Z-axis is perpendicular to the horizontal direction, as shown below:



When the vehicle is stationary, the acceleration of the X axis and Y axis value is 0g, the Z axis is -1g.

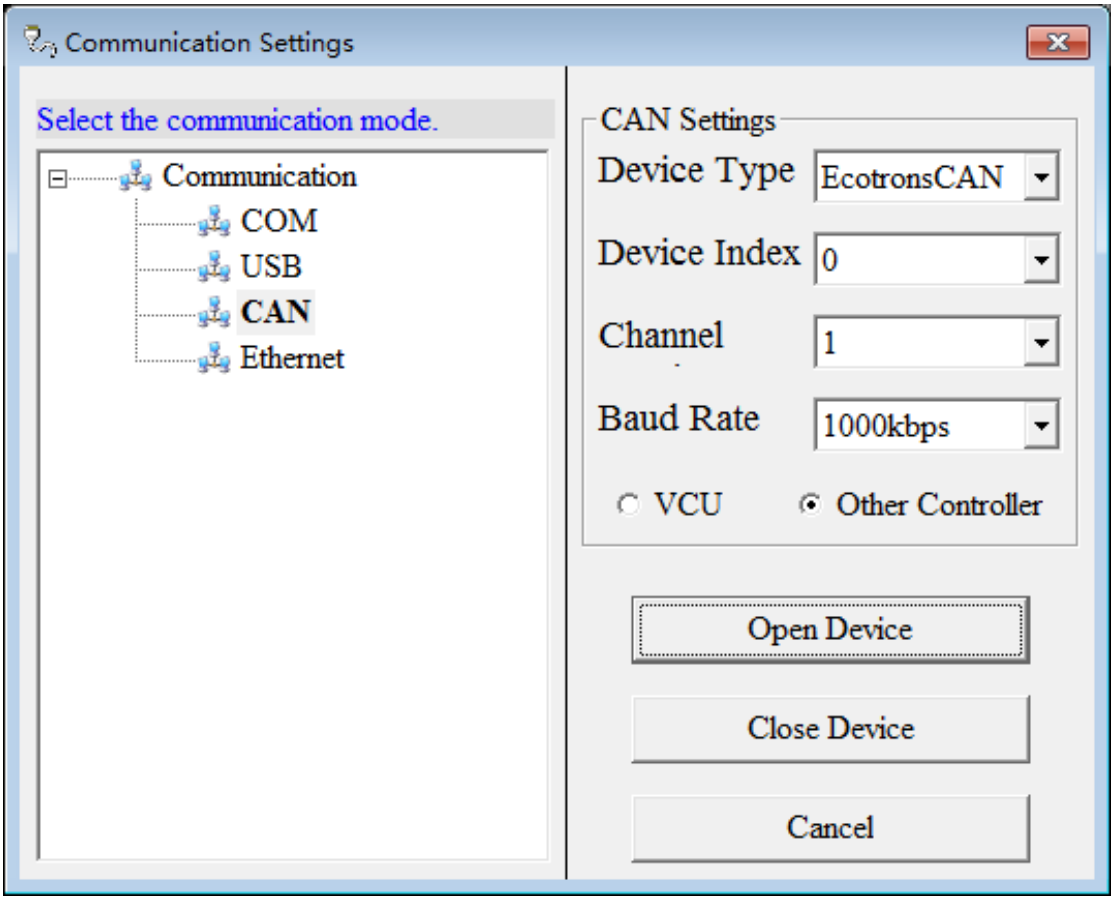
6. How to Use EcoCAL

6.1 EcoCAL Installation and Communication

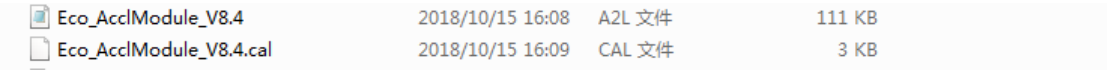
The accelerometer calibration can be achieved by EcoCAL software. EcoCAL can measure variables and record data. It also supports playing back the recorded data. The EcoCAL user manual and software can be downloaded: http://www.ecotrons.com/support/

6.2 Establish Connection

(1) when establishing connection, please select the **CAN channel** and the corresponding **CAN device**. The initial baud rate is set to **1000kbps** by default. Select **Other Controller** and click **Open Device**.



(2)Click the Open button to and load the correct A2L and CAL files

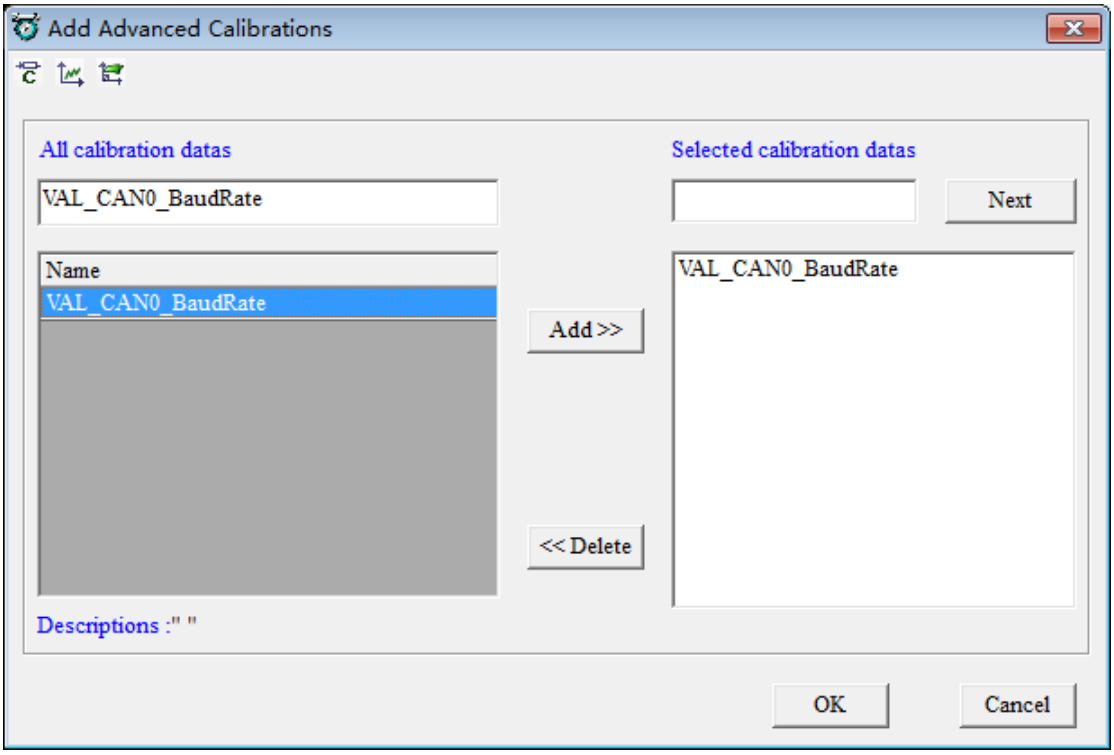


(3) click the connect button to connect to the accelerometer.

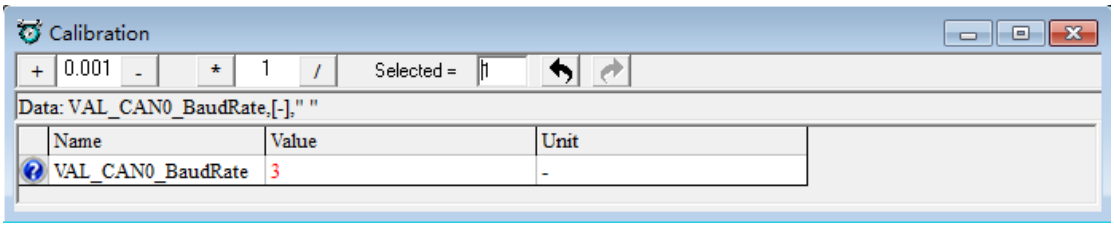
(4) click the measurement button to start measurement.

6.3 How to Change Baud Rate

(1) Finish section **6.2** first. Add a calibration variable: VAL_CAN0_BaudRate: Variables →Add Calibrations → find VAL_CAN0_BaudRate on the left and Add it to the right as shown below, then click OK to confirm.



(2) Change the default value from 1 to 3, press enter to confirm, and save CAL file. (the baud rate is 1000kbps when the value is 1, and 500kbps when the value is 3)



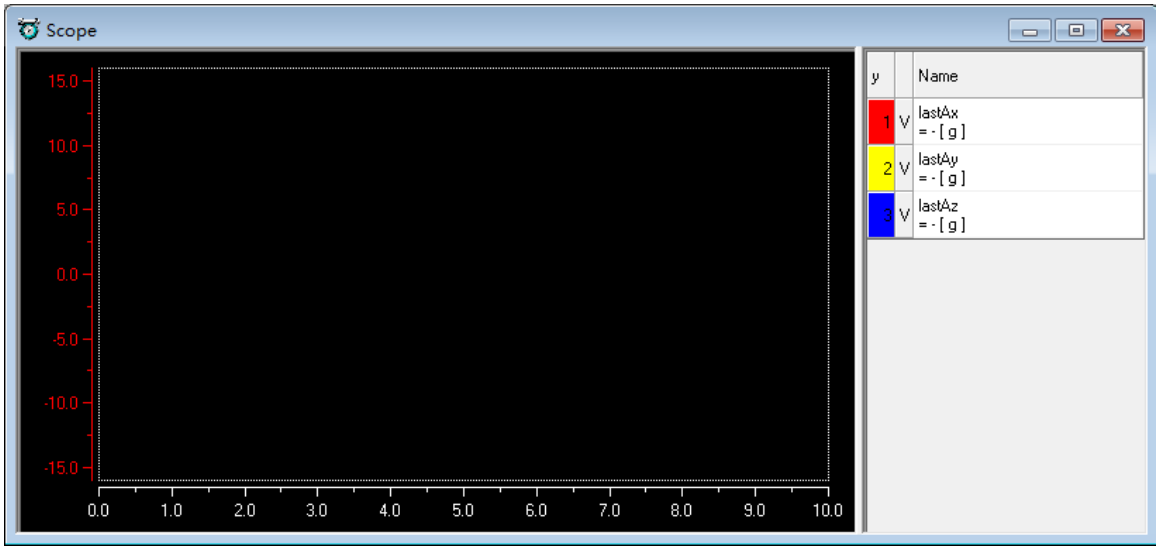
(3) Disconnect the measurement, click Run→Burn to ECU to flash the data into

the accelerometer, and EcoCAL will show that the communication is down. Now, the baud rate is changed from 1000kbps to 500kbps.

(4) Establish the connection again following section **6.2**, but make sure you choose 500kbps for the Baud Rate this time.

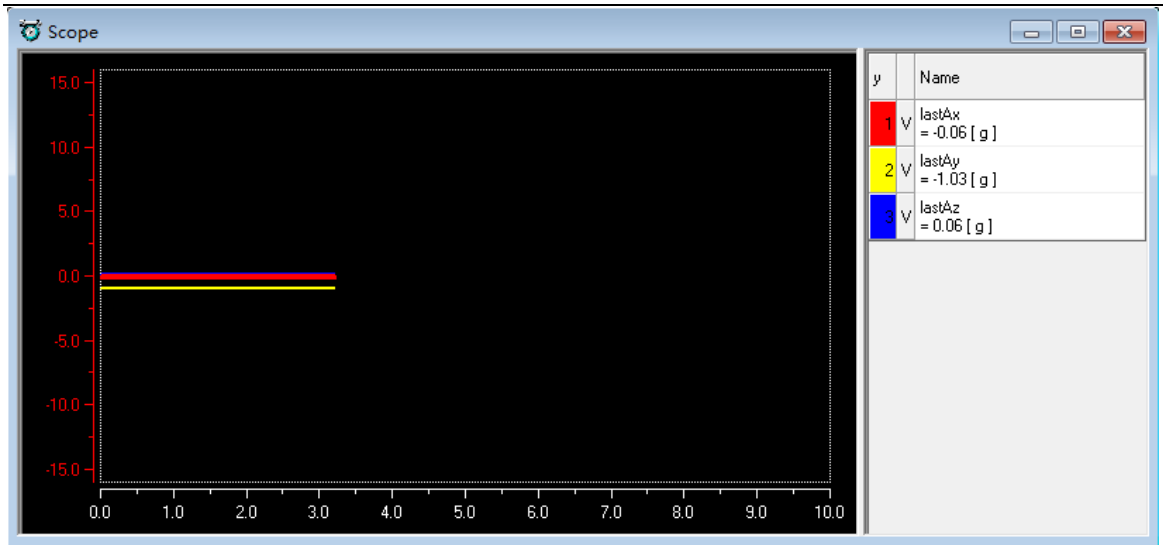
6.4 Add Axis Acceleration Variables

Right-click on the gray background area then select “Add measurements” -> “New Oscilloscope window”, then add “lastAx”, “lastAy”, and “lastAz” variables to 20ms. These variables are 3-axis acceleration. (For how to add variables, please refer to EcoCAL user manual).



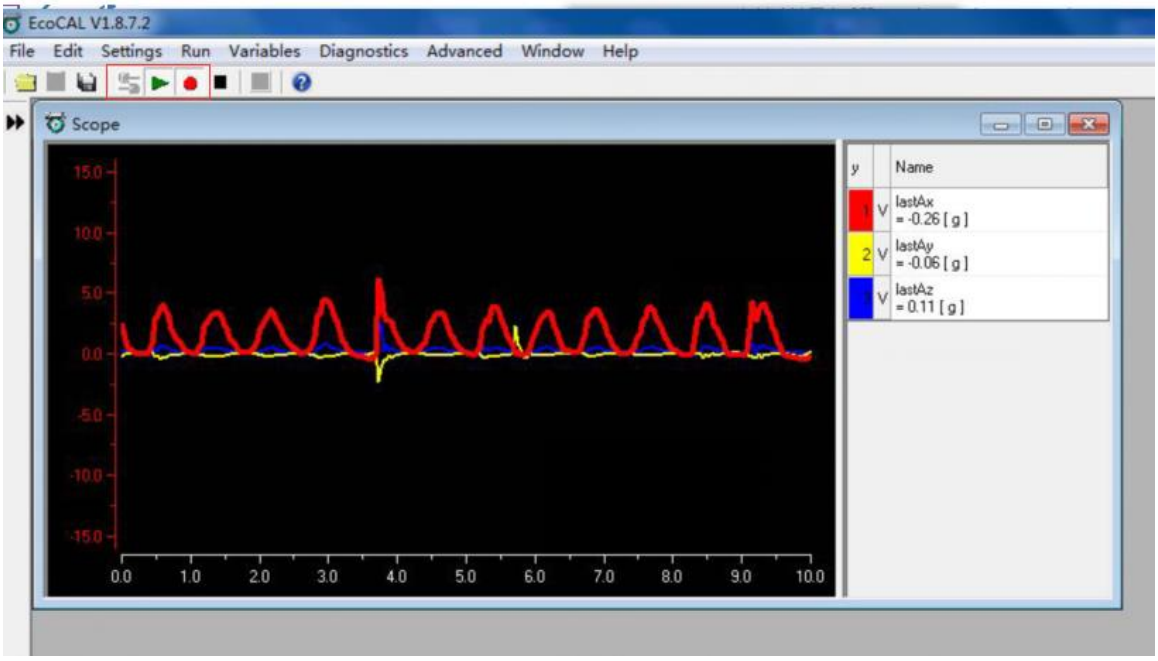
6.5 Measure the Variables

Click  and observe the waveforms of 3 variables:



6.6 Record the Data

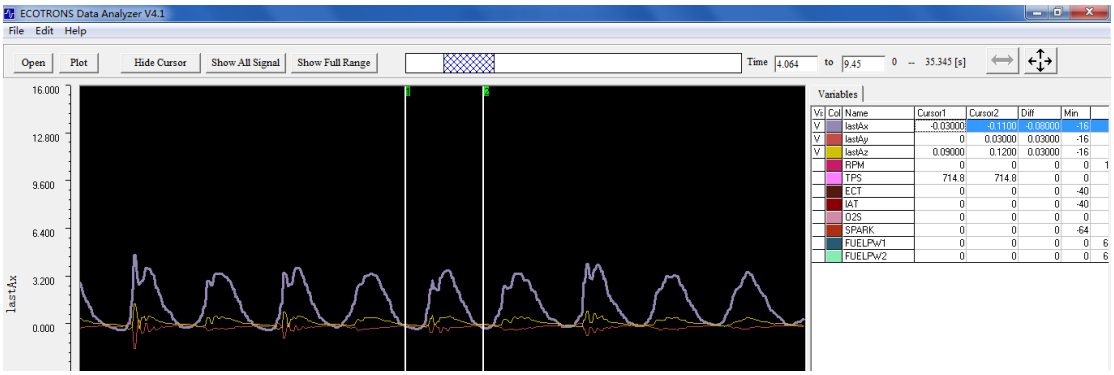
Click the button  , it will start recording the running data of the added measurement variables.



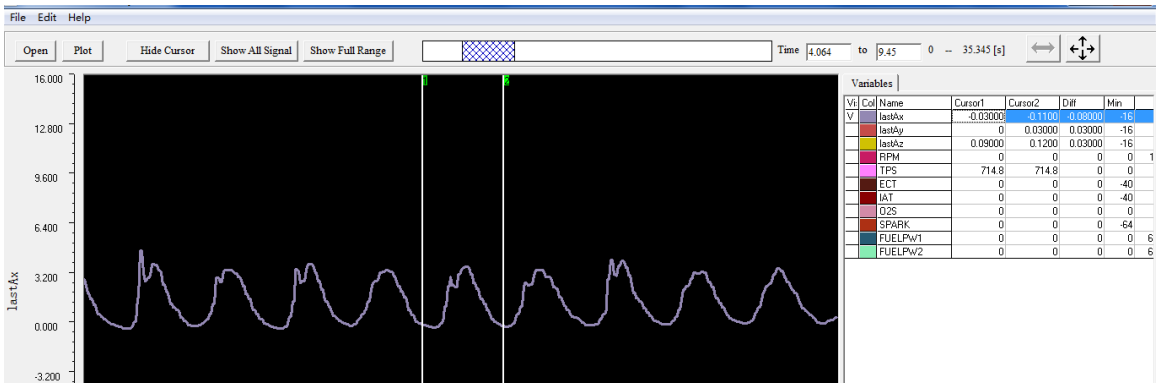
6.7 Measure Value and Calculate Offset

Click  to stop measuring. And click  button to open the recorded data.

Then, click “Open” button, and go to “C:\EcoCAL\record” file path. Then select the latest data file.



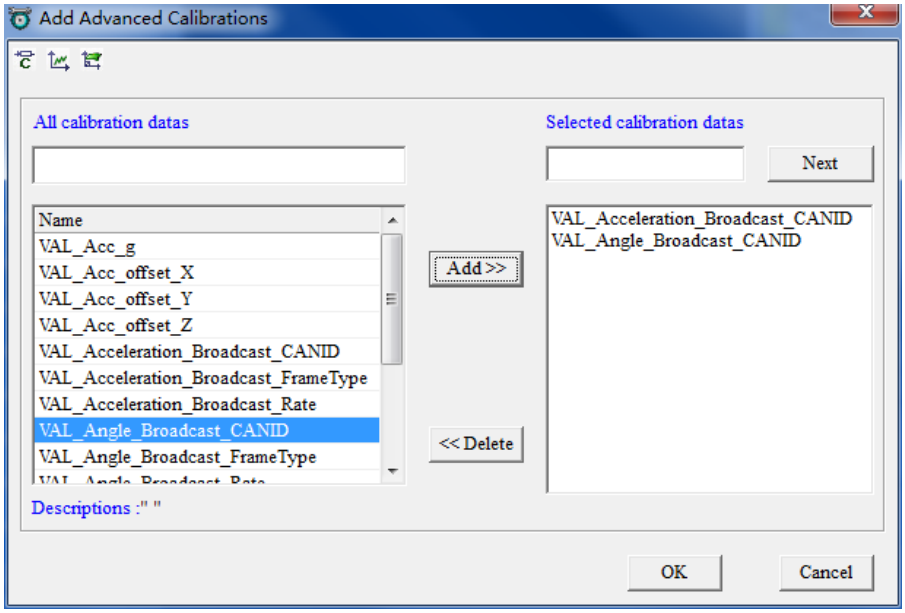
The oscilloscope only shows “X” waveform, click “show cursor/hide cursor”, and toggle the cursors. There are 2 cursors in the scope window. The values of all signals at the 2 cursor locations will be displayed in the variable list window. The cursor can be moved by mouse to other places.

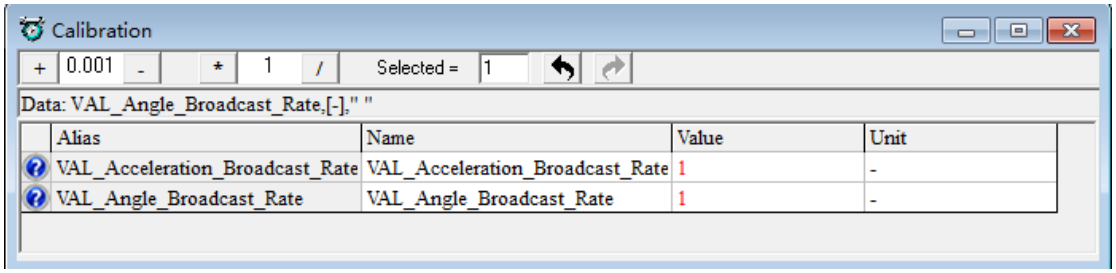


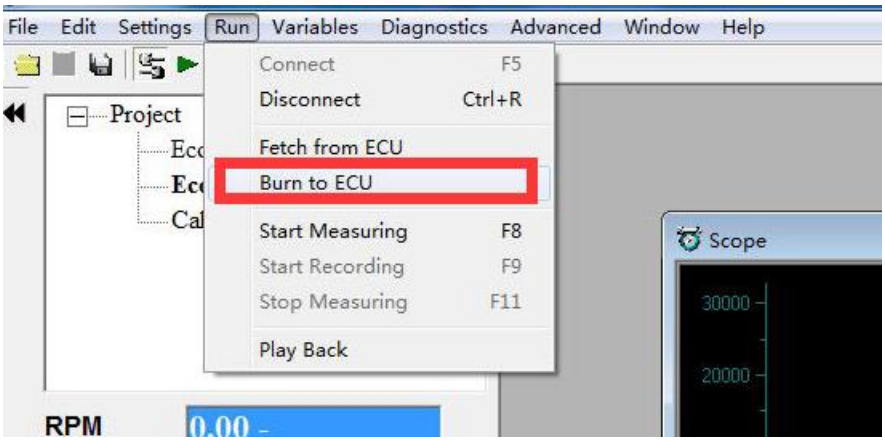
6.8 Modify Calibration Variables

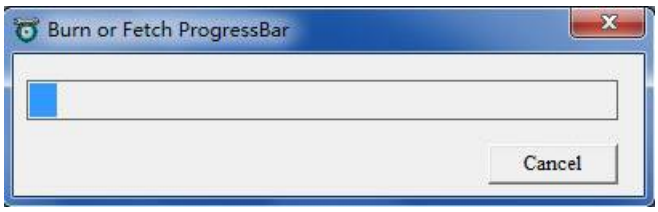
First Click ■ to stop measuring, go to "Variables -> Add calibrations" and choose the calibrations you need. Then click “OK” and a new table will be shown. Double click the cell of the variable value and modify the value. After modifying the value, please press “Enter” to save your changes. Open “Run” button from the

menu bar and choose “Burn to ECU”.







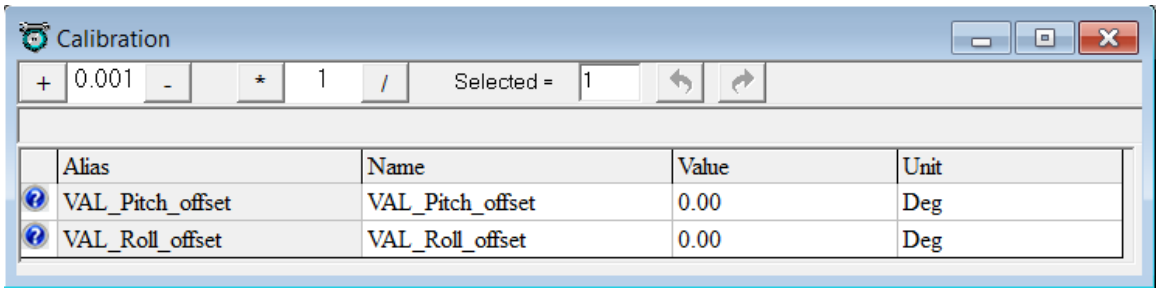


7. Angle Calibration

Add “Roll_Angle_Output” and “Pitch_Angle_Output” variables to the 20ms measurement list. These two variables are the measurement of roll angle and pitch angle. After the installation of the accelerometer, these two variables should be 0. If these two variables are not 0 after the installation, calibration is needed.

Take Roll Angle as an example:

To make variable “Roll_Angle_Output” be 0, you need to add whatever value “Roll_Angle_Output” is, to the variable “VAL_Roll_offset”. For example, after the installation of the accelerometer, Roll_Angle_Output = 1, VAL_Roll_offset = 2, you need to set VAL_Roll_offset = 3. After doing this, Roll_Angle_Output should be 0. Same with Pitch Angle.



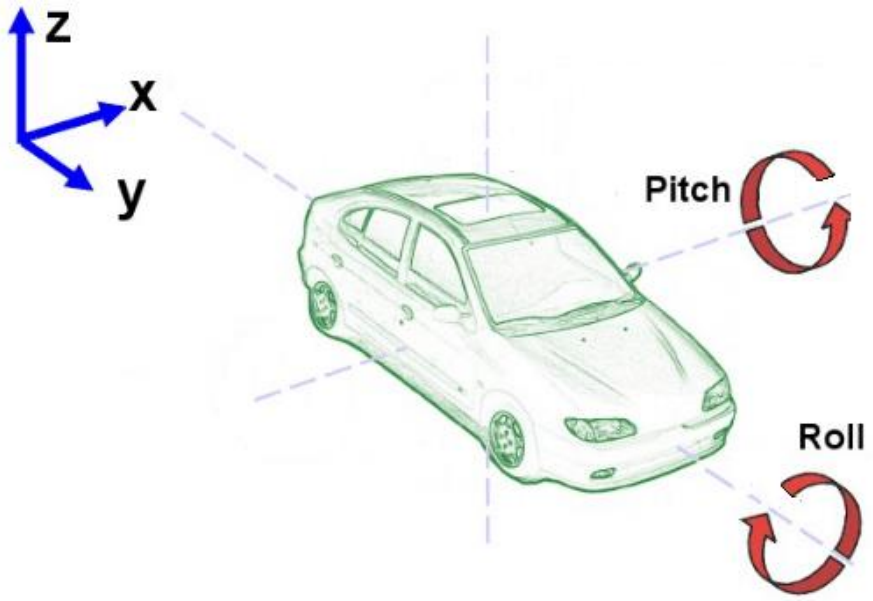
Click “Burn to ECU”, the data will be burned to ECU.

Note:

1) The range of effective value of pitch angle and roll angle is -64~64 deg.

2) The roll angle is the deflection in the X-axis direction (As shown in the figure below, the arrow is the positive direction of rotation.).

3) The pitch angle is the deflection in the Y-axis direction (As shown in the figure below, the arrow is the positive direction of rotation.)


z
x
y
Pitch
Roll

8. CAN Broadcast

8.1 CAN ID

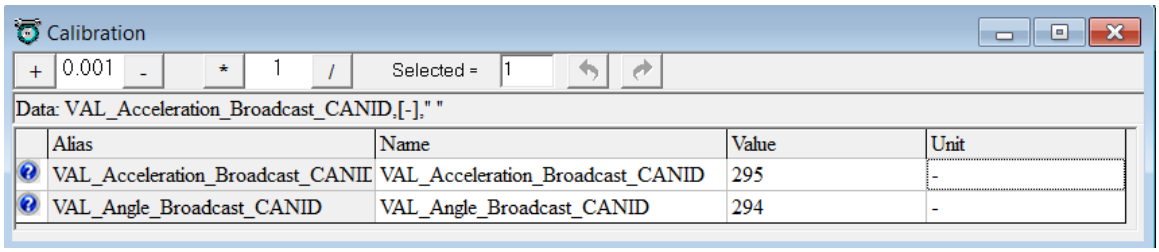
1. You can modify these calibrations to set the CAN ID and frame type. (The content of protocol is in appendix B)

Set the CAN ID:

VAL_Angle _Broadcast_CANID

VAL_Acceleration_Broadcast_CANID

These two values need to be different.



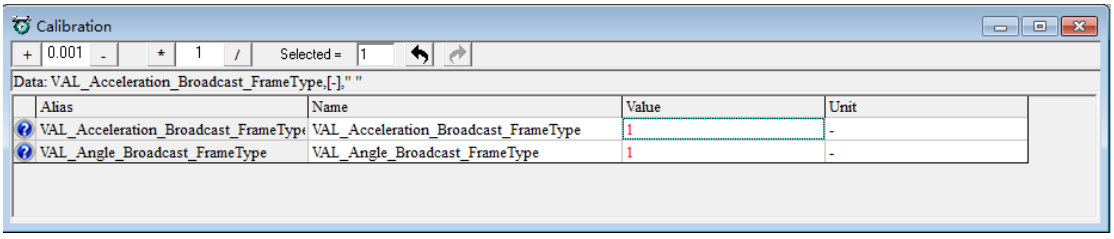
2. Set the frame type:

VAL_Acceleration_Broadcast_FrameType

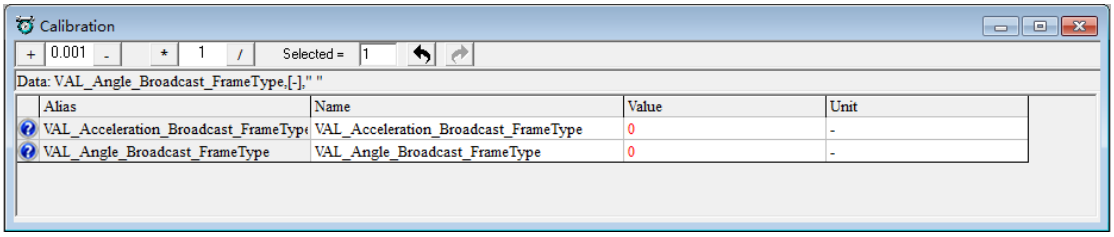
VAL_Angle_Broadcast_FrameType

These two values need to be the same. If CANID is extended frame, these two calibration variables need to be modified to 1. If CANID is standard frame, these two calibration variables need to be modified to 0.

(1) Extended frame:



(2) Standard frame:

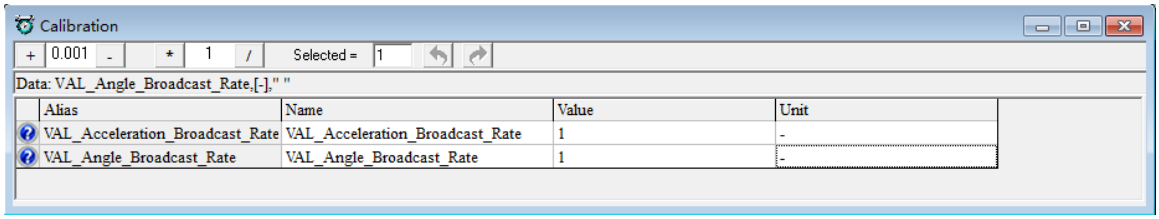


8.2 Broadcast Rate of CAN

CAN broadcast rate by default is 10ms (detailed protocol content is in Appendix B). And broadcast rate can be modified. Unit is 10ms, which means if value is 1, the rate is 10ms, if the value is 2, the rate is 20ms, etc.

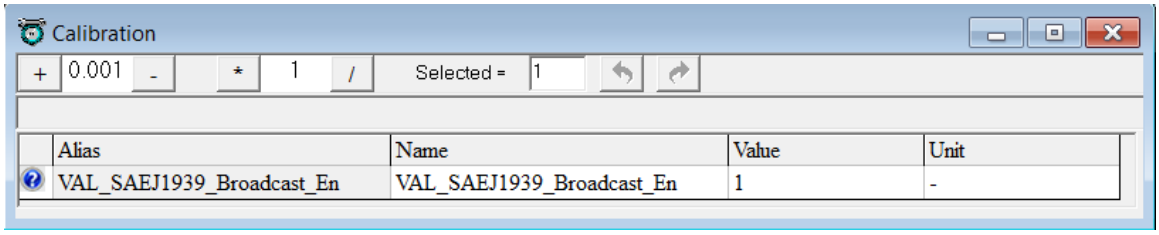
VAL_Acceleration_Broadcast_Rate variable is the broadcast rate of acceleration.

VAL_Angle_Broadcast_Rate variable is the broadcast rate of angle.



8.3 CAN Broadcast Enable

VAL_SAEJ1939_Broadcast_En is the enable flag of CAN broadcast, “0” means disabled and “1” means enabled.



Appendix A: Calibration and Measurement Variables

Calibration Variables

Name	Description
VAL_Pitch_offset	the offset value of the pitch angle.
VAL_Roll_offset	the offset value of the roll angle.
VAL_Acceleration_Broadcast_CANID	ID of acceleration broadcast, it can be modified, 0x127 by default.
VAL_Angle _Broadcast_CANID	ID of angle broadcast, it can be modified, 0x126 by default.
VAL_Acceleration_Broadcast_FrameType	frame type of acceleration broadcast. “1”: extended frame, “0”: standard frame.
VAL_Angle_Broadcast_ FrameType	frame type of angle broadcast. “1”: extended frame, “0”: standard frame.
VAL_Acceleration_Broadcast_Rate	the rate of acceleration broadcast, it can be modified, 1 (means 10ms) by default. Unit: 10ms
VAL_Angle_Broadcast_ Rate	the rate of angle broadcast, it can be modified,1 (means 10ms) by default. Unit: 10ms
VAL_CAN0_BaudRate	the baud rate of CAN bus. 1: 1000Kbps, 3: 500K bps, 4: 250Kbps.
VAL_SAEJ1939_Broadcast_En	broadcast enable flag, “1”: enabled and “0”: disabled.

Measurement Variables

Name	Description
lastAx, lastAy, lastAz	the measurement value of X, Y, Z accelerations.

X_acc	the measurement value of the acceleration of the vehicle. Positive value: the direction of acceleration is same with vehicle driving direction. Negative value: the acceleration direction is opposite to the direction of the car.
Roll_Angle_Output	the measurement value of the roll angle. The positive direction of the angle is the clockwise direction along the X axis.
Pitch_Angle_Output	the measurement value of the pitch angle. The positive direction of the angle is the clockwise direction along the Y axis.

Appendix B: CAN communication protocol

Name	J1939_PitchAng_output	J1939_RollAng_output
Msg ID(Hex)	0x126	0x126
Rate (ms)	10	10
Start Byte	3	1
Start Bit	24	8
Length (Bit)	16	16
Byte Order	Motorola	Motorola
Value Type	UWORD	UWORD
Initial(Hex)	0	0
Factor(g)	0.002	0.002
Offset(g)	-64	-64
Signal Min Value (Phys)	-64	-64
Signal Max Value (Phys)	64	64
Signal Min Value (Hex)	0	0
Signal Max Value (Hex)	0xFFFF	0xFFFF

Name	xacc	yacc	zacc
Msg ID(Hex)	0x127	0x127	0x127
Rate (ms)	10	10	10
Start Byte	1	3	5
Start Bit	8	24	40
Length (Bit)	16	16	16
Byte Order	Motorola	Motorola	Motorola
Value Type	UWORD	UWORD	UWORD
Initial(Hex)	0	0	0
Factor(g)	0.01	0.01	0.01
Offset(g)	-4	-4	-4
Signal Min Value (Phys)	-4	-4	-4
Signal Max Value (Phys)	4	4	4
Signal Min Value (Hex)	0	0	0
Signal Max Value (Hex)	0xFFFF	0xFFFF	0xFFFF