EZECU® - EzFi® Starter ECU Standalone 3D Programmable Fuel Injection Computer for BOSCH Compliant EFI Systems

User's Manual

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Version 2.00

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Revision History

Date	Revision	Description
15, July 2011	1.00	Initial draft
02, January 2012	2.00	Update for EzFi® Starter ECU Rev.B

1   Introduction

   With the gradually increasing trend of electronic fuel injection engines, the EZECU® series – EzFi® Starter ECU (Engine Control Unit) developed by IC Leader Technology Corporation is announced as an easy entry-level ECU for racing purposes. Without considering about intake air temperature, engine temperature, and air pressure, EzFi® Starter ECU only focuses on engine RPM and TPS (Throttle Position Sensor) input to control fuel injection operations. This simplifies the engine fine-tune process for racing environments. For general purpose usage, we suggest users to buy our piggyback fuel injection products like City Fi ECU and Sport Fi ECU.

1.1   Product Package List of EzFi® Starter ECU

   Thank you for purchasing the EzFi® Starter ECU originally designed and manufactured by our company in Taiwan. When you open the product package, all contained accessories are listed below.

- 1 × EzFi® Starter ECU
- 1 × wiring harness
- 1 × USB A-type male to B-type male cable
- 1 × CD-ROM containing the USB driver and the application software

1.2　　Product Features

EzFi® Starter ECU is a high-technology after-market product for electronic fuel injection engines with features as listed below:

- Simplified for racing environments without intake-air and engine temperature compensations
- Standalone fuel injection ECU dedicated for BOSCH compliant fuel injection systems
- Support up to 15,000 RPM
- Programmable 0.00ms ~ 12.75ms fuel injection widths with 0.05ms resolution
- Fuel injection width 3D table with 59×10 cells and 250/500/1,000 RPM resolutions
- Supports 12-1/18-1/24-1/12-2/18-2/24-2/12-3/18-3/24-3 teeth crankshaft flywheel types
- Up to 10 customizable throttle position voltage levels
- Semi-auto detection for both fully-closed and fully-opened TPS calibration voltages
- Table uploading while engine is running
- Dynamic tracking of referenced cells within fuel injection width 3D table
- Graphical 2D curve for displaying fuel injection widths
- Graphical gauges for real-time engine status monitoring via standard USB interface
- Fast table uploading within 1 second
- Programmable -100% ~ +100% engine start fuel compensation with 1% resolution
- Programmable 0s ~ 255s engine start fuel compensation period with 1s resolution
- Adopt water-proof metal case sealed by epoxy/silicon or equivalent
- Support languages: Traditional Chinese and English
- Support Microsoft Windows 2000/XP/Server 2003/Vista/7 32-/64-bit Operating Systems

1.3   Product Specifications

- **Power supply input**
  - ➢ 8 ~ 20VDC
  - ➢ 40VDC Max. reverse protection

- **Sensor inputs**
  - ➢ TPS (Throttle Position Sensor) signal with an analog voltage ranging from 0 to 5VDC
  - ➢ CPS (Crankshaft Position Sensor) signal with an analog voltage ranging from ±3 to ±120VAC with 12-1/18-1/24-1/12-2/18-2/24-2/12-3/18-3/24-3/1/18/24 teeth per revolution

- **External switch input**
  - ➢ Connects to the an optional external switch to enable/disable forced engine start fuel compensation
  - ➢ Max. input voltage ranging from 0 to 12VDC

- **Fuel injection signal output**
  - ➢ Direct drive of the BOSCH compliant fuel injector with resistance greater than 10Ω
  - ➢ Pulse width modulation voltage ranging from 0 to 12VDC
  - ➢ Supports high flow-rate fuel injectors
  - ➢ Supports either single injection or double injections per 4-stroke cycle

- **Indication LED**
  - ➢ 1 × blue LED for power good indication

- **USB interface**
  - ➢ Standard USB B type male connector

- **Form factor of EzFi® Starter ECU**
  - ➢ Length: 79 mm (without including the connectors)
  - ➢ Width: 69 mm
  - ➢ Height: 22 mm
  - ➢ Net weight (without including wiring harness): 225±10 gram

2　Wiring Diagrams

2.1　Connectors and LED

There are two connectors on EzFi® Starter ECU. One is a 6-pin main connector and another one is a B-type USB connector. EzFi® Starter ECU also provides one power good indication LED.

2.2　Wiring Harness and Wiring Diagram for YAMAHA

For YAMAHA scooters, the wiring harness is shown in Figure 2-1 and the wiring diagram is shown in Figure 2-2. Most signals are connected directly by the wiring harness. The only signal to be connected via the mid-way wire connector is the TPS (Throttle Position Sensor) signal. It is strongly recommended that using soldering and covered with the heat-shrink pipe can extend the life for the wiring of TPS. Please connect the wire with CARE AND PATIENCE. Any fault can cause either the product or any parts of the bike/scooter to be damaged permanently. If you are not familiar with this procedure, you should ask expert EFI engine technicians for wiring these signals.

Figure 2-1　Wiring Harness of EzFi® Starter ECU for YAMAHA

Wiring Diagram of EzFi® Starter ECU for YAMAHA

TPS

Mid-Way Wire Connector

White

Yellow
Red
Red

Orange
Black
Black
Orange

Black

Connect with the Throttle Position Sensor Signal Wire

To Fuel Injector

To +12V

To an External Switch for Engine Startup Compensation

To Crankshaft Position Sensor Male and Female Connectors

Ground Screw Ring

6-Pin Main Connector

USB B Type Male Connector

EzFi® Starter ECU

Figure 2-2   Wiring Diagram of EzFi® Starter ECU for YAMAHA

2.3   Wiring Harness and Wiring Diagram for KYMCO/SYM

For KYMCO/SYM scooters, the wiring harness is shown in Figure 2-3 and the wiring diagram is shown in Figure 2-4. Most KYMCO/SYM ECUs are integrated with the throttle body so that it is almost impossible to connect with the TPS signal inside. User may buy an additional TPS (contact with us if required) to be installed on the opposite axis of the throttle and take the white wire out from the PVC cable to solder with the added TPS signal. It is strongly recommended that using soldering and covered with the heat-shrink pipe can extend the life for the wiring of TPS. Please connect the wire with CARE AND PATIENCE. Any fault can cause either the product or any parts of the bike/scooter to be damaged permanently. If you are not familiar with this procedure, you should ask expert EFI engine technicians for wiring these signals.
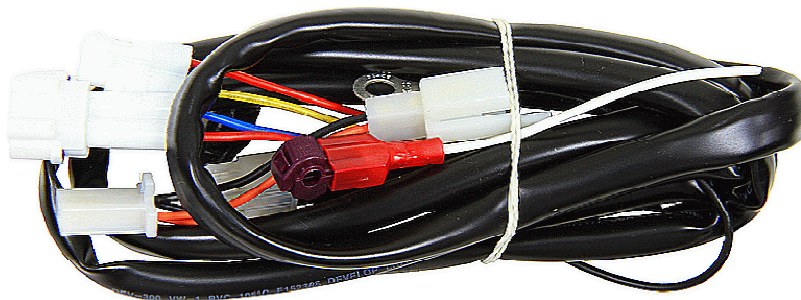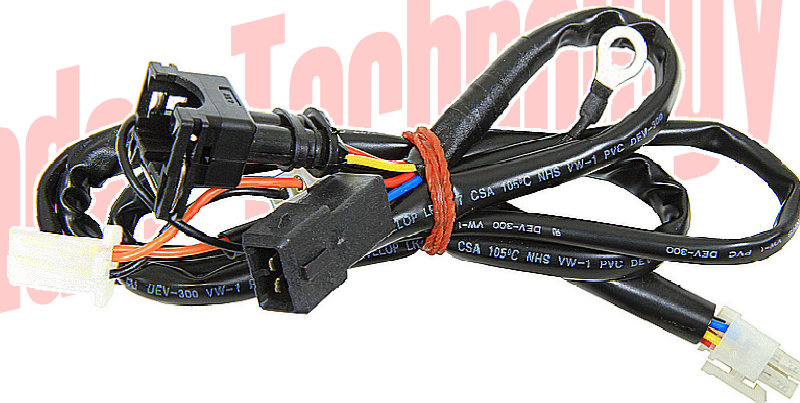

Figure 2-3   Wiring Harness of EzFi® Starter ECU for KYMCO/SYM

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Wiring Diagram of EzFi® Starter ECU for KYMCO/SYM

Label	Description
TPS Throttle Position Sensor	
White	*Connect with the Throttle Position Sensor Signal Wire*
Yellow	
Red	*To Fuel Injector*
Red	*To +12V*
Blue	*To an External Switch for Engine Startup Compensation*
Brown	
Orange	
Orange	*To Crankshaft Position Sensor Male and Female Connectors*
Brown	
Black	*Ground Screw Ring*

USB B Type Male Connector

6-Pin Main Connector

EzFi® Starter ECU

Figure 2-4   Wiring Diagram of EzFi® Starter ECU for KYMCO/SYM

3　Application Software

The application software can be installed on Intel 80x86 compatible computers with Microsoft Windows 2000/XP/Server 2003/Vista/7 operating systems. At least one USB 1.1/2.0 compatible interface port is required to communicate with EzFi® Starter ECU. The screen resolution requirement is at least 1024×768 and the memory requirement is at least 1,024 MB.

3.1　Overview

The first screen of the application software is shown in Figure 3-1. Buttons on the left top corner are responsible of semi-detection of TPS (Throttle Position Sensor) voltages. Buttons on the middle-bottom are responsible for fuel map and firmware file open, save, save as, and upload operations. On the right top corner, three buttons are used for setting revolution limit, engine start fuel compensation percentage and time. The fuel map and the graphical fuel injection time curve display are resided below.
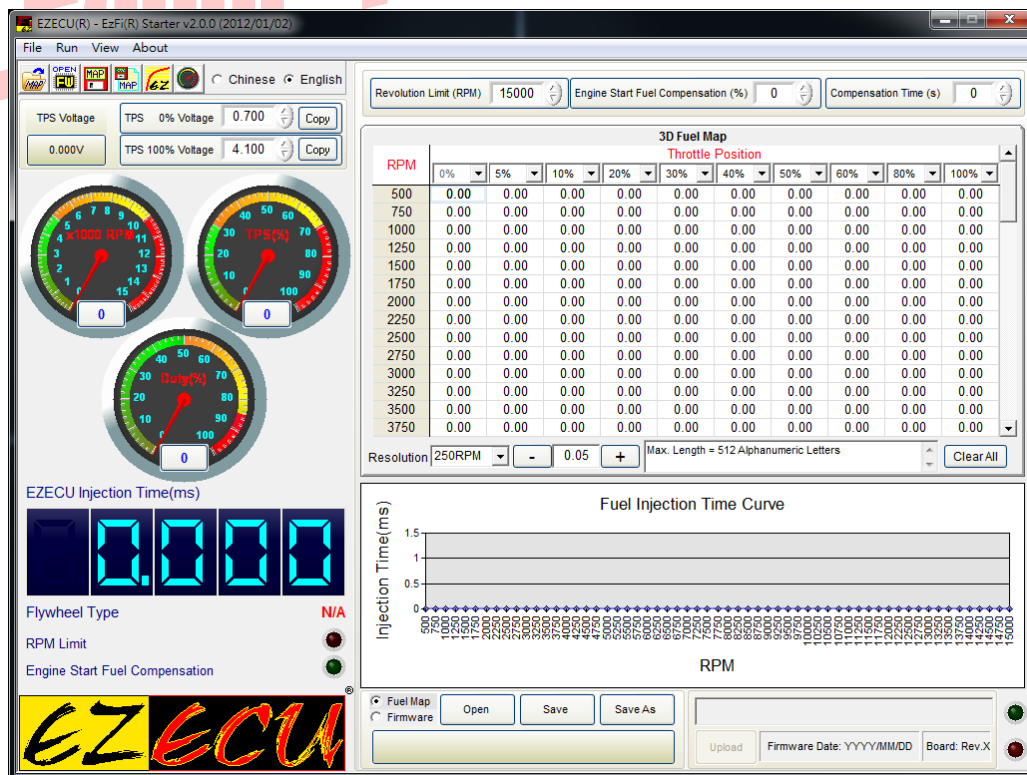
Figure 3-1　Overview of EzFi® Starter ECU Application Software (Unconnected)

If EzFi® Starter ECU is powered on and connected to PC, the green LED on the right bottom corner will be turned on as shown in Figure 3-2. Furthermore, the corresponding firmware date and board version of the EzFi® Starter ECU will be shown also.
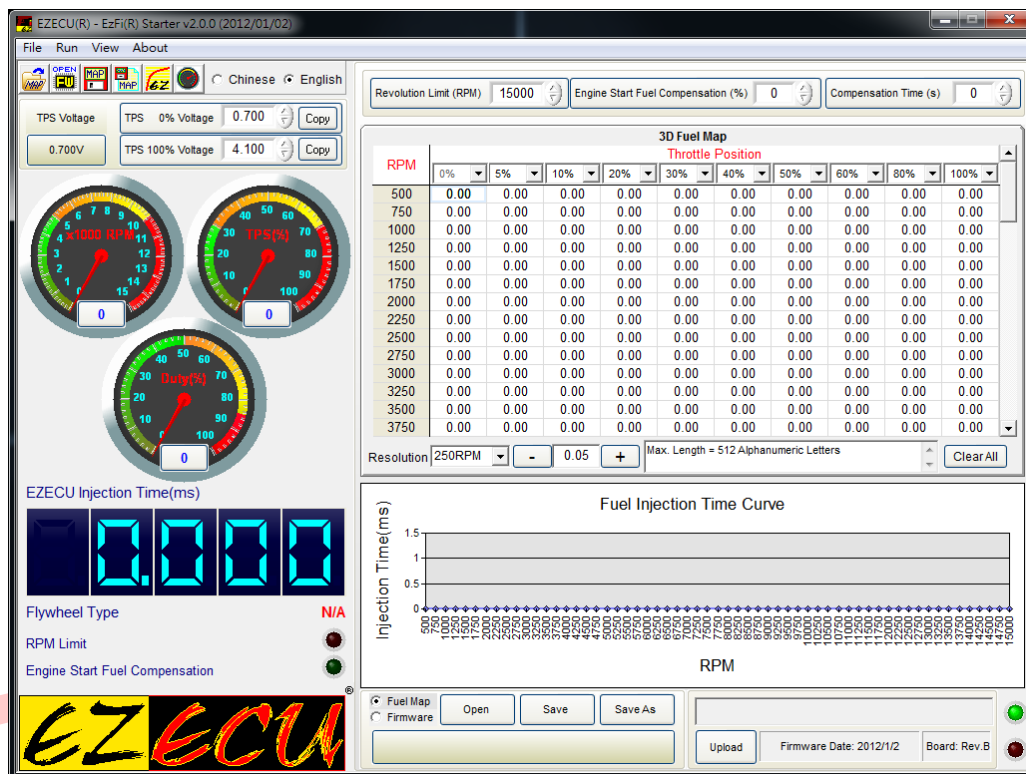
Figure 3-2   Overview of EzFi® Starter ECU Application Software (Connected)

3.2   Fuel Map and Firmware Operations

As shown in Figure 3-3 and Figure 3-4, file operations for the fuel map and the firmware are slightly different. The fuel map file can be opened, saved, and saved as another file name. However, the firmware file can be opened only.
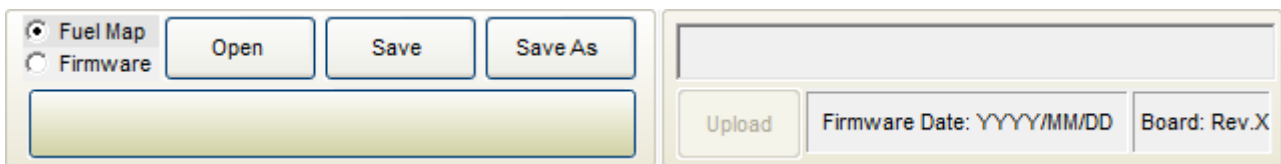
Figure 3-3   Fuel Map Operation Buttons
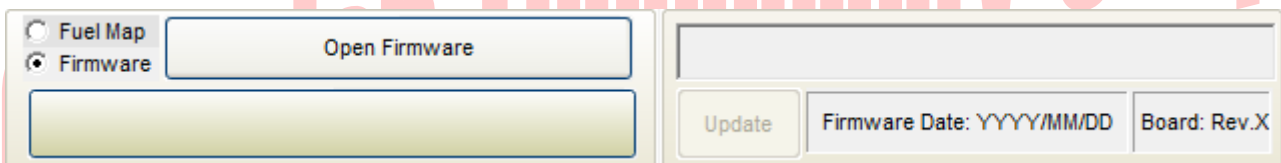
Figure 3-4   Firmware Operation Buttons

Before pressing the "Upload" button, please make sure that the USB cable is correctly connected between your computer and EzFi® Starter ECU. Finally, please confirm the power good LED is lighted on. You can press the "Upload" button even if the engine is running still. However, you must stop engine before pressing the "Update Firmware" button. When programming is in progress, the application software will show current programming progress. After uploading or updating, the application software will have a pop up window to indicate that the operation is completed.

3.3 TPS Voltage Calibration

The voltage values of TPS for each bike/scooter should be calibrated before operating correctly because the 0% and 100% throttle may be mapped to different voltages for different TPS models. For example, some TPS outputs 0V through 3.1V corresponding to 0% through 100%, while some TPS outputs 0.7V through 4.1V corresponding to 0% through 100%. Consequently, the application software provides semi-auto detection and manual input for the TPS calibration values.

As shown in Figure 3-5, there are two "Copy" buttons and two fields for inputting the voltage values corresponding to 0% and 100% throttle, wherein two "Copy" buttons are responsible for the semi-auto input function and two fields are responsible for the manual input function.
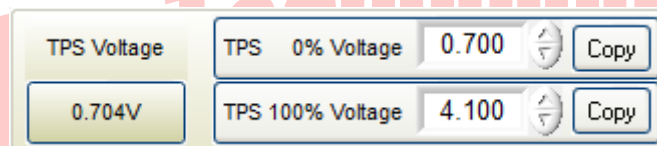
Figure 3-5   TPS Voltage Calibration Buttons

At first, the semi-auto input function is introduced as the following steps:

Step 1   Connect EzFi® Starter ECU and your bike/scooter;

Step 2   Connect the USB cable between EzFi® Starter ECU and your computer;

Step 3   Execute the application software;

Step 4   Turn one the bike/scooter power but do not start the engine and confirm the blue power LED on EzFi® Starter ECU is lighted;

Step 5   Press the upper "Copy" button to copy TPS voltage of 0% throttle;

Step 6   Rotate the bike/scooter's throttle to 100% and hold, press the lower "Copy" button to copy TPS voltage of 100% throttle; and

Step 7   Release the bike/scooter's throttle.

Since the TPS is made of resistor, the voltage output may vary according to different working temperatures. Consequently, we suggest to increase the fully-closed TPS voltage by 0.1V and to decrease the fully-opened TPS voltage by 0.1V.

In this manner, the TPS mapping range for your bike/scooter can be detected. Both TPS setting

values can be saved into the fuel map file. If user wants to update the fuel map again, the TPS calibration process can be skipped by reloading the saved TPS setting values.

Finally, user may use a precise voltage meter to measure TPS voltage values corresponding to 0% and 100% throttle and then fill the measured voltage values into the TPS calibration fields.

3.4　Real-Time Engine Status

As shown in Figure 3-6, real-time engine status includes a RPM gauge, a TPS % gauge, a fuel injector duty % gauge, an EzFi® Starter ECU fuel injection time, a flywheel type, a RPM limit indication LED, and an engine start fuel compensation indication LED.
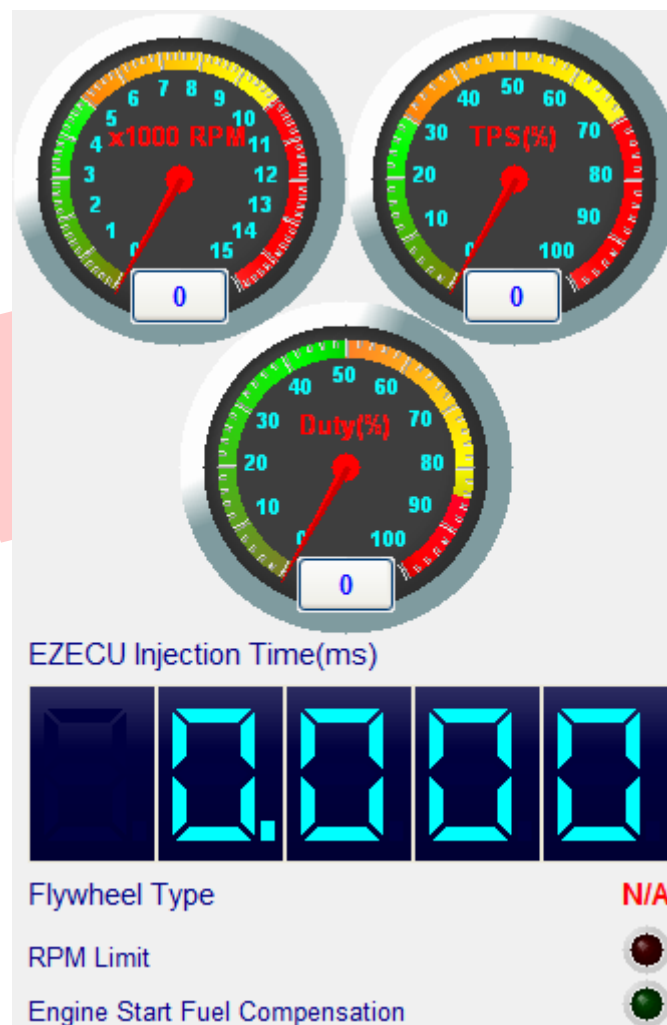
Figure 3-6　　Real-Time Engine Status

The crankshaft flywheel type shows one of 12-1/18-1/24-1/12-2/18-2/24-2/12-3/18-3/24-3/1/18/24 teeth. The "RPM Limit" indication LED will be lighted when the engine RPM exceeds the maximum RPM setting inputted by the user. The "Engine Start Fuel Compensation" indication LED will be lighted if the EzFi® Starter is performing fuel compensation.

3.5   Fuel Map

The fuel map with 250 RPM resolution is shown in Figure 3-7.

3D Fuel Map

Throttle Position

RPM	0%	5%	10%	20%	30%	40%	50%	60%	80%	100%
500	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
750	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
1000	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
1250	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
1500	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
1750	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
2000	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
2250	2.00	2.00	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.25
2500	2.00	2.00	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.50
2750	2.00	2.00	2.35	2.35	2.35	2.35	2.35	2.35	2.35	2.75
3000	2.00	2.00	2.50	2.50	2.50	2.50	2.50	2.50	2.50	3.00
3250	2.00	2.00	2.50	2.50	2.50	2.60	2.60	2.60	2.60	3.10
3500	2.00	2.00	2.50	2.50	2.50	2.75	2.75	2.75	2.75	3.25
3750	2.00	2.00	2.50	2.50	2.50	2.85	2.85	2.85	2.85	3.35

Resolution 250RPM   -   0.05   +   Max. Length = 512 Alphanumeric Letters   Clear All

Figure 3-7   Fuel Map with 250 RPM Resolution

EzFi® Starter ECU provides a fuel map with 500 RPM through 15,000 RPM by programmable 10-level TPS resolutions with 1% step (the default TPS levels are 0%, 5%, 10%, 20%, 30%, 40%, 50%, 60%, 80%, and 100%). The 500 RPM through 15,000 RPM can be set by selecting the RPM resolution as one of 250 RPM, 500 RPM and 1,000 RPM. Fuel maps with 500 RPM and 1,000 RPM resolutions are shown in Figure 3-8 and Figure 3-9, respectively.
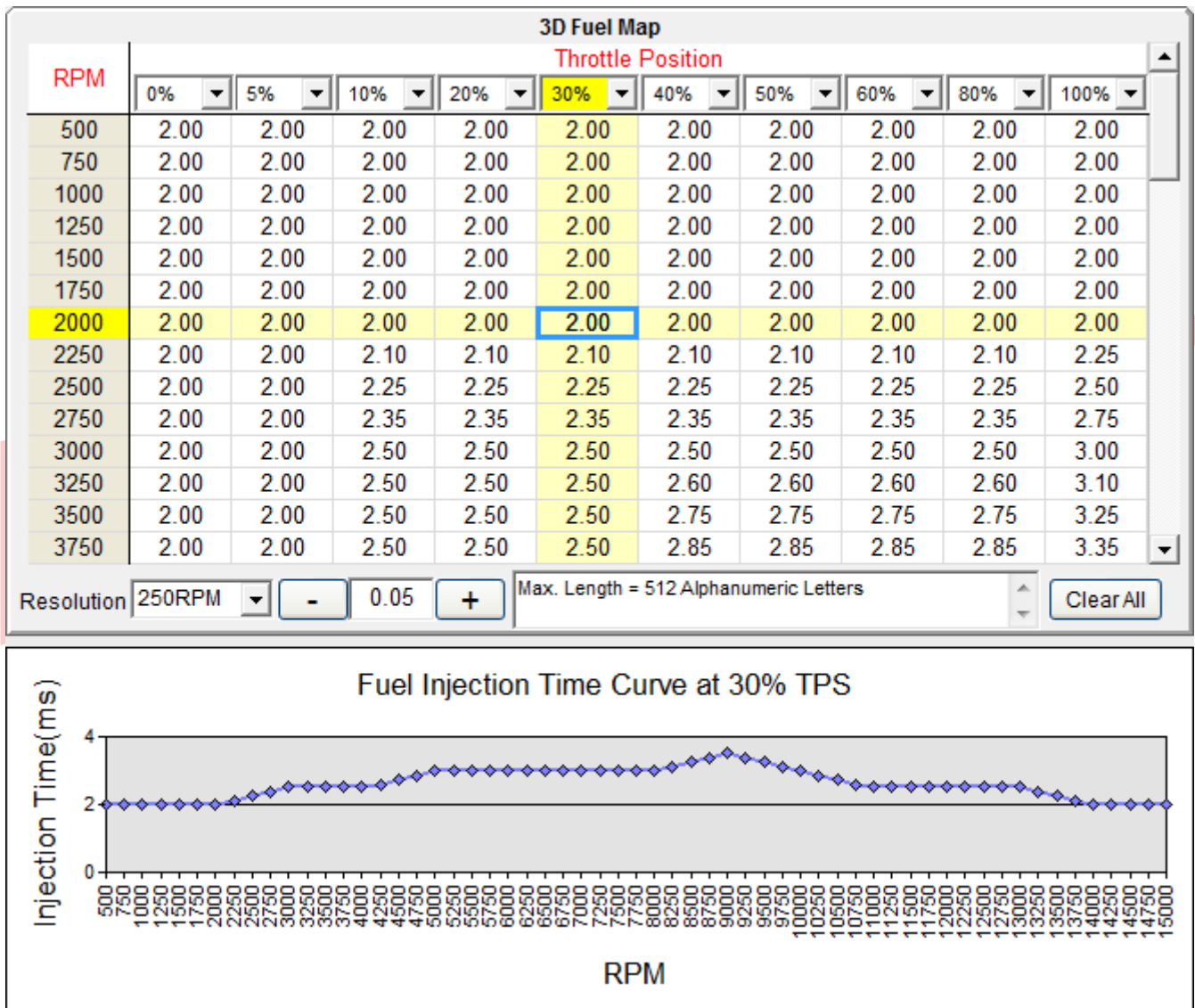
3D Fuel Map
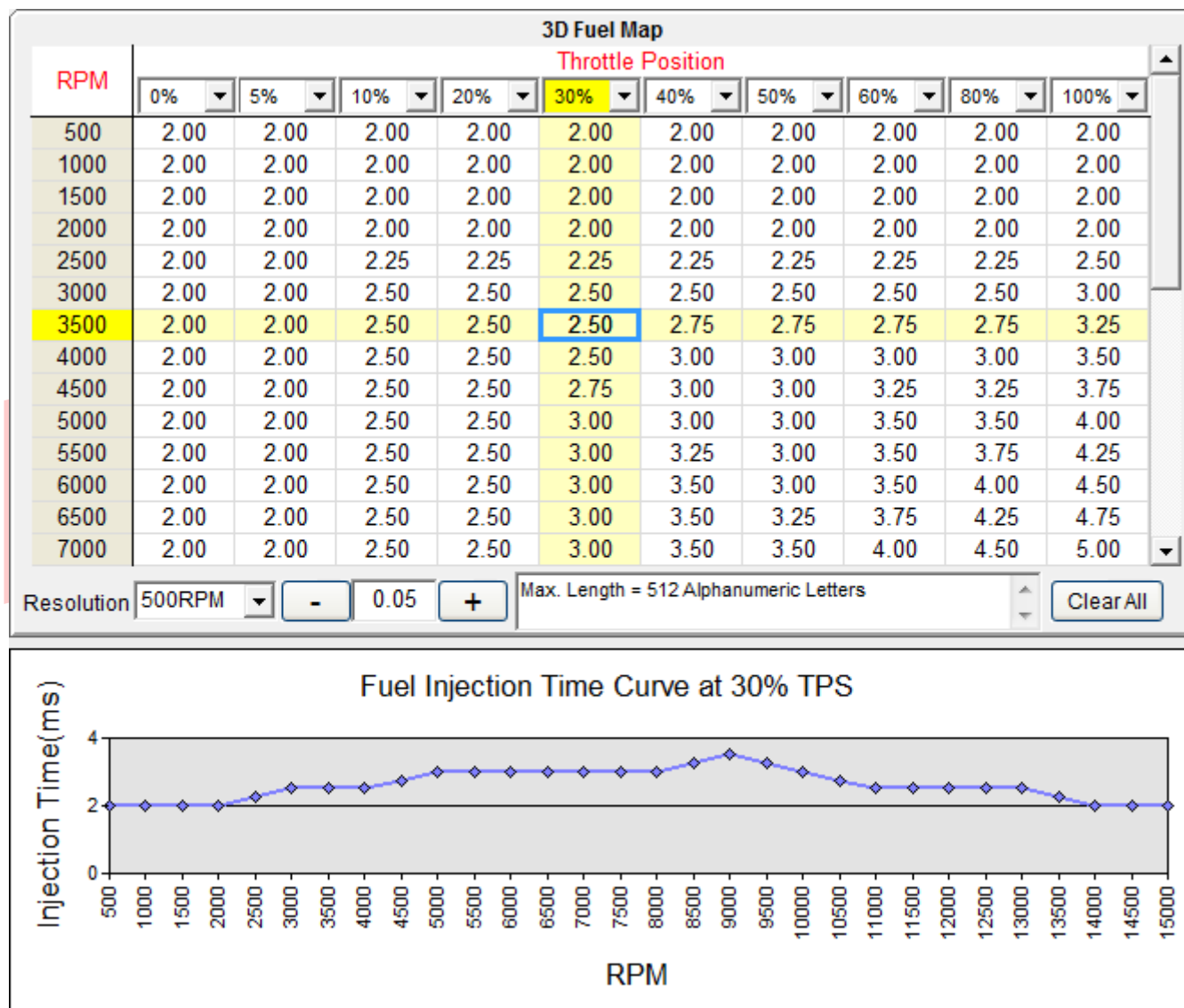
Throttle Position

RPM	0%	5%	10%	20%	30%	40%	50%	60%	80%	100%
500	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
1000	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
1500	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
2000	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
2500	2.00	2.00	2.25	2.25	2.25	2.25	2.25	2.25	2.25	2.50
3000	2.00	2.00	2.50	2.50	2.50	2.50	2.50	2.50	2.50	3.00
3500	2.00	2.00	2.50	2.50	2.50	2.75	2.75	2.75	2.75	3.25
4000	2.00	2.00	2.50	2.50	2.50	3.00	3.00	3.00	3.00	3.50
4500	2.00	2.00	2.50	2.50	2.75	3.00	3.00	3.25	3.25	3.75
5000	2.00	2.00	2.50	2.50	3.00	3.00	3.00	3.50	3.50	4.00
5500	2.00	2.00	2.50	2.50	3.00	3.25	3.00	3.50	3.75	4.25
6000	2.00	2.00	2.50	2.50	3.00	3.50	3.00	3.50	4.00	4.50
6500	2.00	2.00	2.50	2.50	3.00	3.50	3.25	3.75	4.25	4.75
7000	2.00	2.00	2.50	2.50	3.00	3.50	3.50	4.00	4.50	5.00

Resolution 500RPM | − | 0.05 | + | Max. Length = 512 Alphanumeric Letters | Clear All

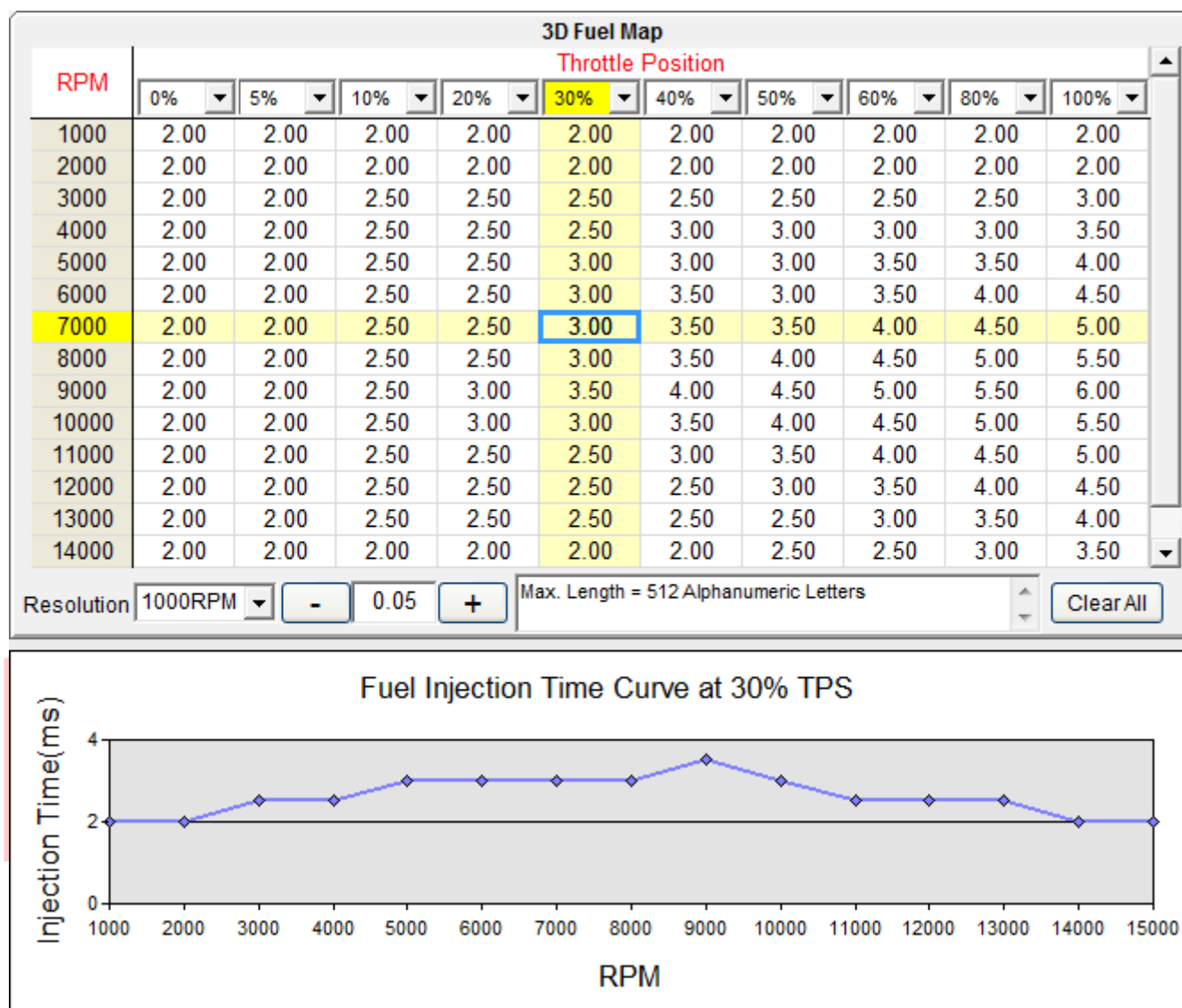Figure 3-8   Fuel Map with 500 RPM Resolution

Figure 3-9   Fuel Map with 1,000 RPM Resolution

In general, the 1,000 RPM resolution is recommended as a startup basis. The fuel map with 1,000 RPM resolution is formed as a 15 by 10 table. Since there are fewer cells, it is easier for roughly writing the fuel map. The application software will average and interpolate the fuel map values into each cell of the 250 RPM fuel map. User does not need to worry about losing control precision due to selecting the 1,000 RPM resolution.

If user wants to increase resolution for writing the fuel map, the 500 RPM resolution can be selected. The fuel map with 500 RPM resolution is formed as a 30 by 10 table. Since there are double cells as compared to the 1,000 RPM resolution, user may tune the fuel injection amount in a more detailed order. The application software will average and interpolate the fuel map values into each cell of the 250 RPM fuel map. User does not need to worry about losing control precision due to selecting the 500 RPM resolution.

The maximum resolution is to set as the 250 RPM resolution. The fuel map with 250 RPM resolution is formed as one 59 by 10 table. Since there are almost double cells as compared to the 500 RPM resolution, user may tune the fuel injection amount in a most detailed order.

When editing the fuel map, user may mark an area to perform addition/subtraction/clear all by pressing corresponding buttons below the fuel map. The addition/subtraction button will add/subtract each cell inside the marked area by the value of the addition/subtraction value field. The clear all button will reset each cell of the fuel map to 0.

While engine is running, EzFi® Starter ECU will perform the 32-bit bilinear interpolation in a real-time manner to calculate accurate fuel injection time according to current RPM and TPS. The resolution of calculated fuel injection time is 1us.

3.6   Programmable Revolution Limit

As shown in Figure 3-10, the RPM limit can be set from 9,000 RPM through 15,000 RPM with a 250 RPM step. Please ask professional technicians to confirm the maximum allowable working RPM for your engine! Our company is not responsible for any damage and loses.
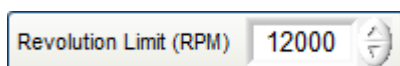

Figure 3-10   Programmable Revolution Limit

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3.7   Programmable Engine Start Fuel Compensation

It usually requires more fuel while starting the engine. EzFi® Starter ECU provides two programmable fields for users to set fuel compensation while starting the engine. As shown in Figure 3-11, the fuel compensation percentage is ranging from -100% through +100% with 1% step. This means that fuel can be either increased or decreased according the setting value after the engine is started. In general, any value in between 30% and 60% is a good startup basis.

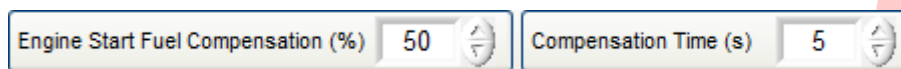| Engine Start Fuel Compensation (%) | 50 | | Compensation Time (s) | 5 | |

Figure 3-11   Programmable Engine Start Fuel Compensation

Furthermore, the compensation period can be set by entering number of seconds in another field. The valid input range is from 0s through 255s with the resolution of 1 second. In general, any value in between 20s and 60s is a good startup basis.

Engine start fuel compensation can be enabled also by connecting the blue wire of EzFi® Starter ECU to an optional external switch. The other pin of the external switch is connected to battery ground. Once the external switch is conducted, EzFi® Starter ECU will be forced to activate the engine start fuel compensation even if the compensation time is over. If you want to disable the function of the blue wire, you may use tape to seal the blue wire.

3.8   Mini Bar

On the left-top corner of the application software, there is a mini bar shown in Figure 3-12 to provide quick accesses to functions.

Figure 3-12   Mini Bar of EzFi® Starter ECU Application Software

Functions for buttons on the mini-bar from left to right are listed below:
1. Open Fuel Map
2. Open Firmware
3. Save Fuel Map
4. Save As Fuel Map
5. Dynamic Track Mode
6. Full Screen Engine Status

The first four buttons have same functions as aforementioned in Section 3.2. The dynamic track mode is described in Section 3.9. The full screen engine status is described in Section 3.10. The display language options are also shown on the mini bar.

3.9   Dynamic Track Mode

When the "Dynamic Track Mode" button on the mini bar is pressed as shown in Figure 3-13, EzFi® Starter ECU will report which cell inside the fuel map has been referenced. This may be helpful for technicians who are tuning engines. Press the same button on the mini bar again will exit the track mode.

Figure 3-13   Dynamic Track Mode on the Mini Bar of EzFi® Starter ECU Application Software

3.10   Full-Screen Engine Status

When the "Full-Screen Engine Status" button on the mini bar is pressed, the application software of EzFi® Starter ECU will switch to a full-screen as shown in Figure 3-14. This may be helpful for longer distance observing. Press the same button on the mini bar again will switch back to the original screen.
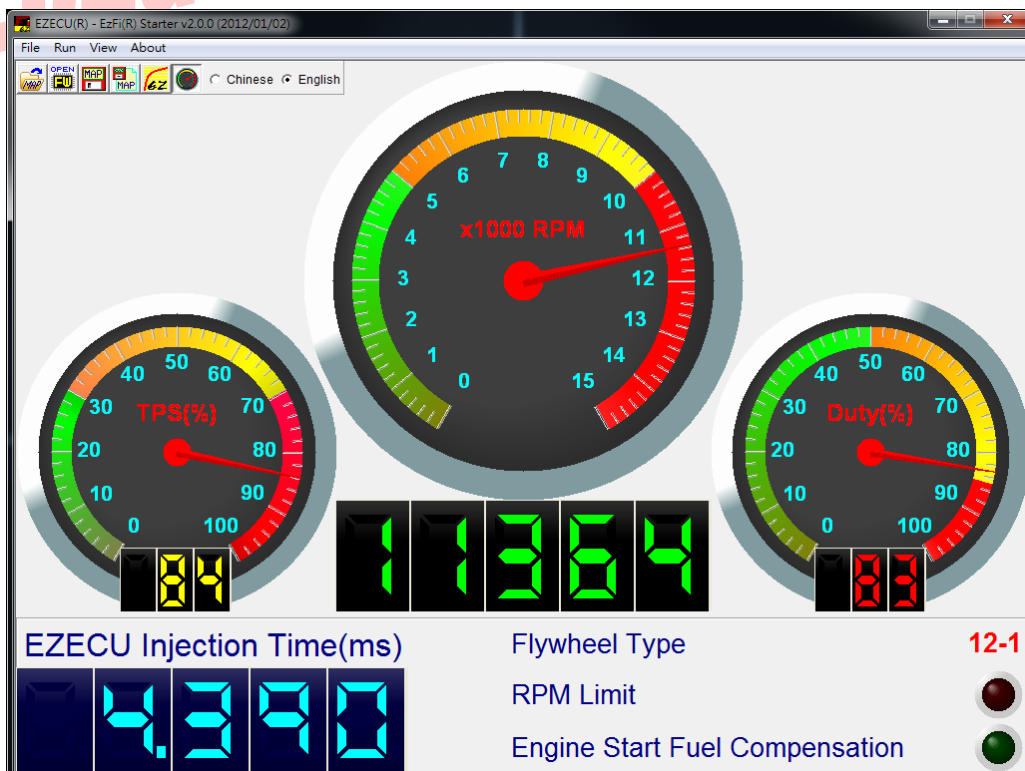

Figure 3-14   Full-Screen Engine Status of EzFi® Starter ECU Application Software

3.11 About EZECU®

The information about EZECU® series products and our company can be found by clicking the "About" menu. The following window with trademarks and URL will appear.

Figure 3-15   EZECU® Product Information Window

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IC Leader Technology Corporation

Appendix   Main Connector Signals

Table A-1   Main Connector Pin Numbers

6	5	4
3	2	1
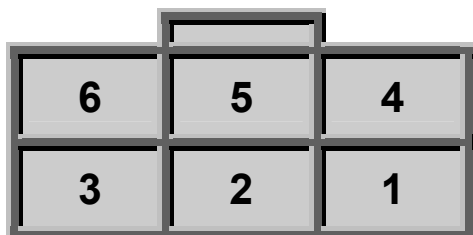
Table A-2   Main Connector Signals

Pin No.	Signal Description	Wire Color
1	TPS (Throttle Position Sensor) Input	White
2	Power Ground	Black
3	External switch to force engine start fuel compensation	Blue
4	CPS (Crankshaft Position Sensor) Input	Orange
5	+12V Power	Red
6	Fuel Injection Output (to Injector)	Yellow