# EZECU® - Rich Fi ECU Piggyback 3D Programmable Fuel Injection Computer for DCP Compliant EFI Systems



## User's Manual

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# Revision History

| Date | Revision | Description |
|---|---|---|
| 15, July 2011 | 1.00 | Initial draft |
| 24, October 2011 | 1.10 | Add for SUZUKI Music125 model |
| 02, January 2012 | 2.00 | Update for Rich Fi ECU Rev.B |
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# 1 Introduction

With the gradually increasing trend of electronic fuel injection engines, the EZECU® series – Rich Fi ECU (Engine Control Unit) developed by IC Leader Technology Corporation is announced dedicated for SUZUKI DCP (Discharge Pump) compliant fuel injection systems to provide a fuel tuning 3D table with 59×10 cells and up to 250 fuel-tuning levels for each cell. Unlike other piggyback products that generate a faked signal (MAP, TPS, or MAF sensor) to cheat the factory ECU, Rich Fi ECU drives the DCP directly according to a base fuel injection width by the factory ECU. Furthermore, Rich Fi ECU can detect various crankshaft flywheel types automatically by our built-in intelligent algorithm.

## 1.1 Product Package List of Rich Fi ECU

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

- 1 × Rich Fi 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

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

- Piggyback fuel injection ECU dedicated for SUZUKI Address/Tekken/Music V125/V125G/V125Z/V125S with DCP (Discharge Pump) fuel injection systems
- Support up to 15,000 RPM
- Fuel tuning 3D table with 59×10 cells and 250/500/1,000 RPM resolutions
- Programmable 0 ~ 250 fuel tuning levels for each cell in the fuel tuning 3D table
- Supports 12-1/18-1/24-1/12-2/18-2/24-2/12-3/18-3/24-3/1/12/18/24 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 tuning 3D table
- Graphical 2D curve for displaying fuel tuning percentages
- Graphical gauges for real-time engine status monitoring via standard USB interface
- Fast table uploading within 1 second
- 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

- Fuel injection signal input
  - Connects to the fuel driver output of the factory ECU
  - Supports either single-injection or double-injection per 4-stroke cycle
  - Pulse width modulation 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 Rich Fi 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 Rich Fi ECU. One is a 6-pin main connector and another one is a B-type USB connector. Rich Fi ECU also provides one power good indication LED.

## 2.2 Wiring Diagram for SUZUKI Address Without $O_2$ Sensor

For SUZUKI Address without O2 sensor, the wiring diagram is shown in Figure 2-1. Most signals are connected directly by unplug-and-plug of the wiring harness except two signals. The first signal to be connected via the mid-way wire connector is the TPS (Throttle Position Sensor) signal. Please connect the *pink* wire of Rich Fi ECU's wiring harness to the *pink* TPS wire of the scooter. The second signal to be connected via the mid-way wire connector is the CPS (Crankshaft Position Sensor) signal. Please connect the *brown* wire of Rich Fi ECU's wiring harness to the *brown* CPS wire of the scooter.

The white wire terminal and the *blue* wire terminal should be inserted manually into the attached male connector according to the wiring diagram. The white male and female connectors with the *green* wire can be left unconnected.

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.

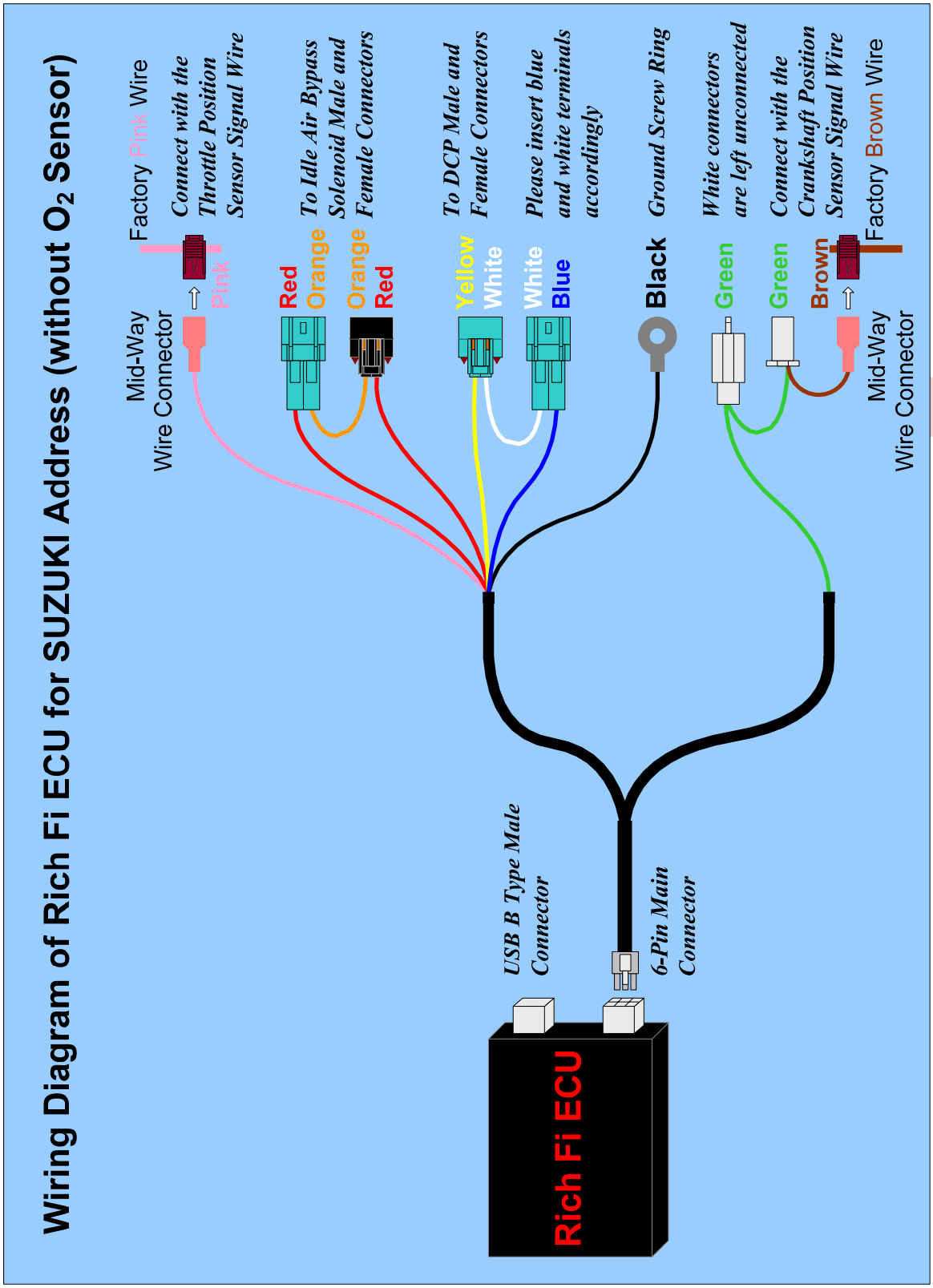


Figure 2-1 Wiring Diagram of Rich Fi ECU for SUZUKI Address Without $O_2$ Sensor

## 2.3 Wiring Diagram for SUZUKI Address / Music with $O_2$ Sensor

For SUZUKI Address/Music with O2 sensor, the wiring diagram is shown in Figure 2-2. Most signals are connected directly by unplug-and-plug of the wiring harness except the TPS (Throttle Position Sensor) signal. The TPS signal should be connected via the mid-way wire connector. Please connect the *pink* wire of Rich Fi ECU's wiring harness to the *pink* TPS wire of the scooter.

The white wire terminal and the *blue* wire terminal should be inserted manually into the attached male connector according to the wiring diagram. The mid-way wire connector of the *brown* wire can be left unconnected.

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.

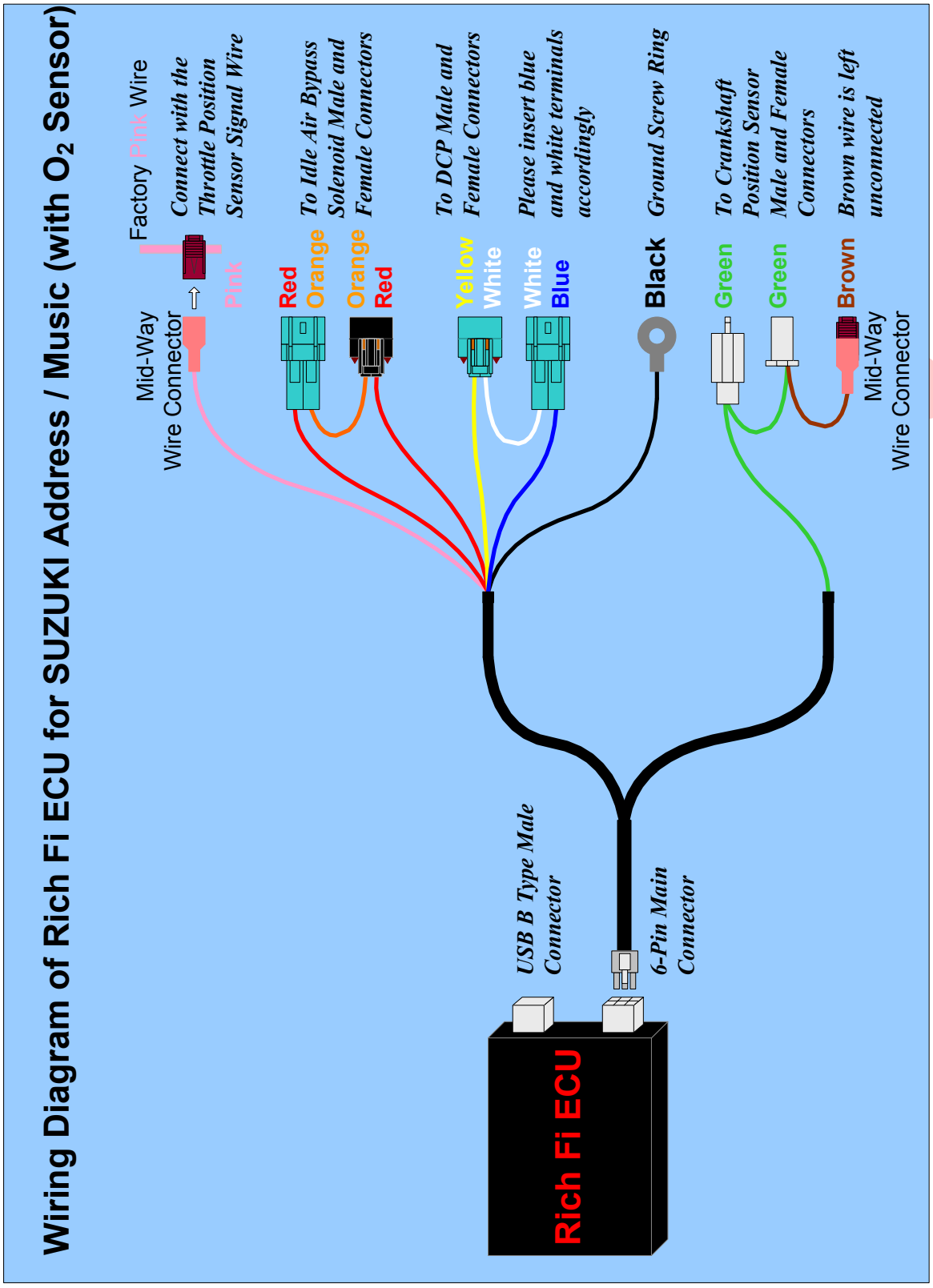


Figure 2-2 Wiring Diagram of Rich Fi ECU for SUZUKI Address / Music with $O_2$ Sensor

## 2.4 Wiring Diagram for SUZUKI Tekken / V125S

For SUZUKI Tekken / V125S, the wiring diagram is shown in Figure 2-3. Most signals are connected directly by unplug-and-plug of the wiring harness except the TPS (Throttle Position Sensor) signal. The TPS signal should be connected via the mid-way wire connector. Please connect the *pink* wire of Rich Fi ECU's wiring harness to the *pink* TPS wire of the scooter.

The white wire terminal and the *blue* wire terminal should be inserted manually into the attached male connector according to the wiring diagram. Please note that the insertion position of the white wire terminal and the blue wire terminal is different from the SUZUKI Address/Tekken with or without $O_2$ sensor. The mid-way wire connector of the *brown* wire can be left unconnected.

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.

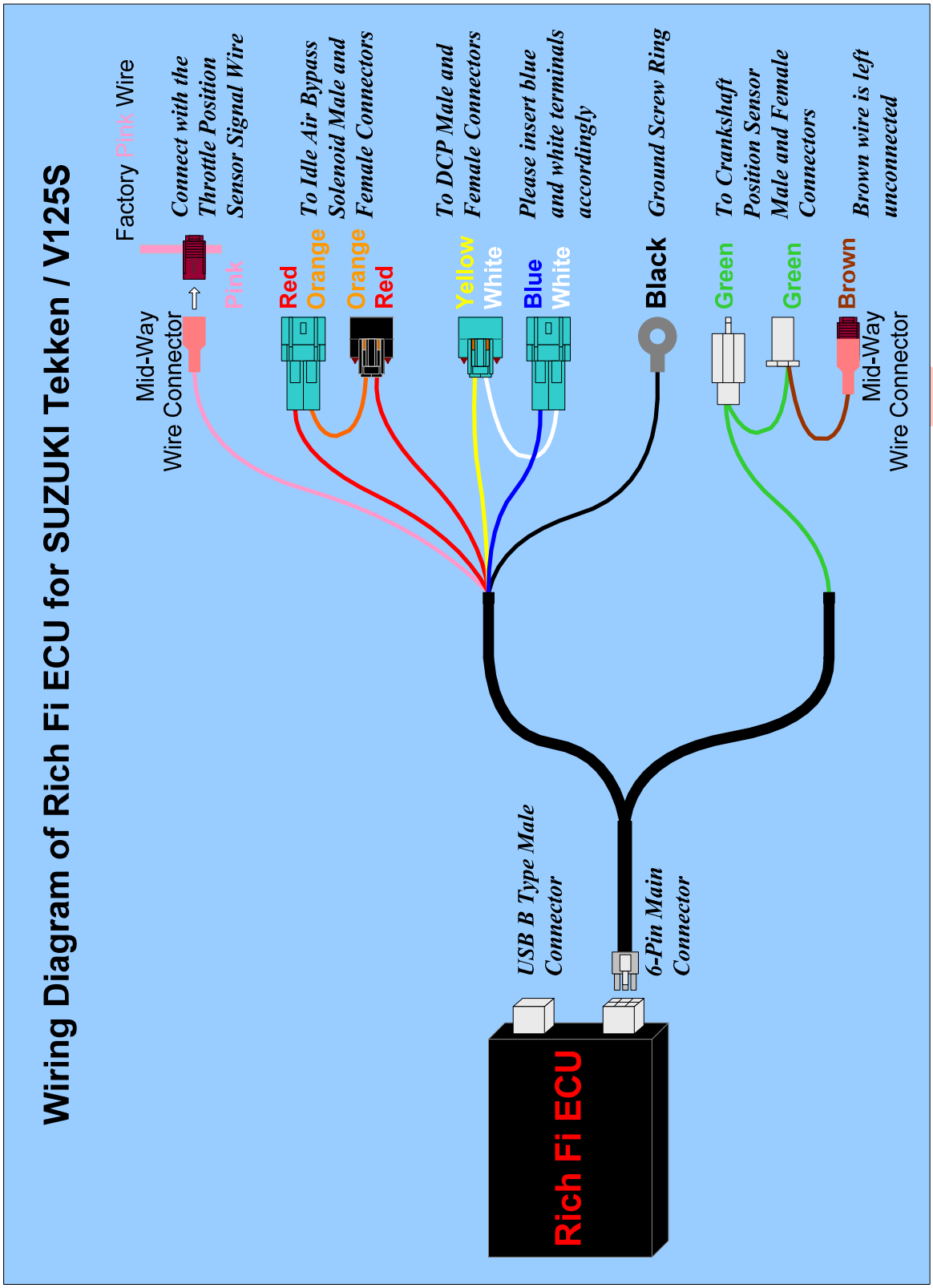


Figure 2-3 Wiring Diagram of Rich Fi ECU for SUZUKI Tekken / V125S

# 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 Rich Fi 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, two options are used for setting ECU fuel injection mode. The fuel tuning map and the graphical fuel tuning curve display are resided below.



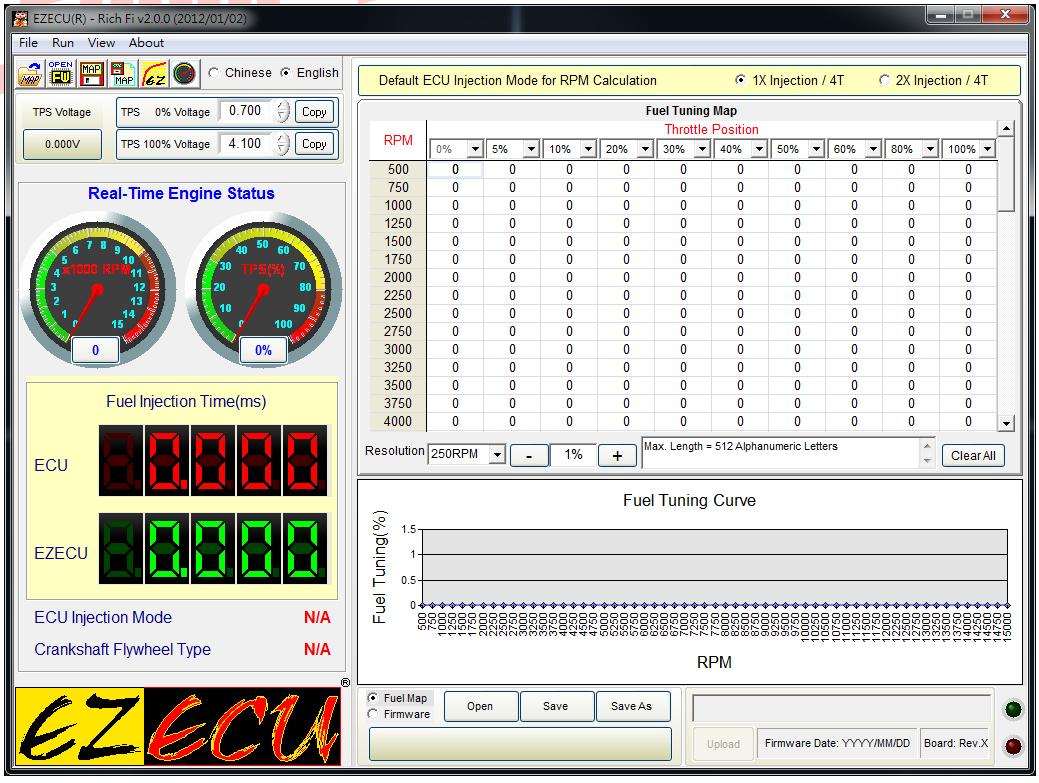


Figure 3-1 Overview of Rich Fi ECU Application Software (Unconnected)

If Rich Fi 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 Rich Fi ECU will be shown also.

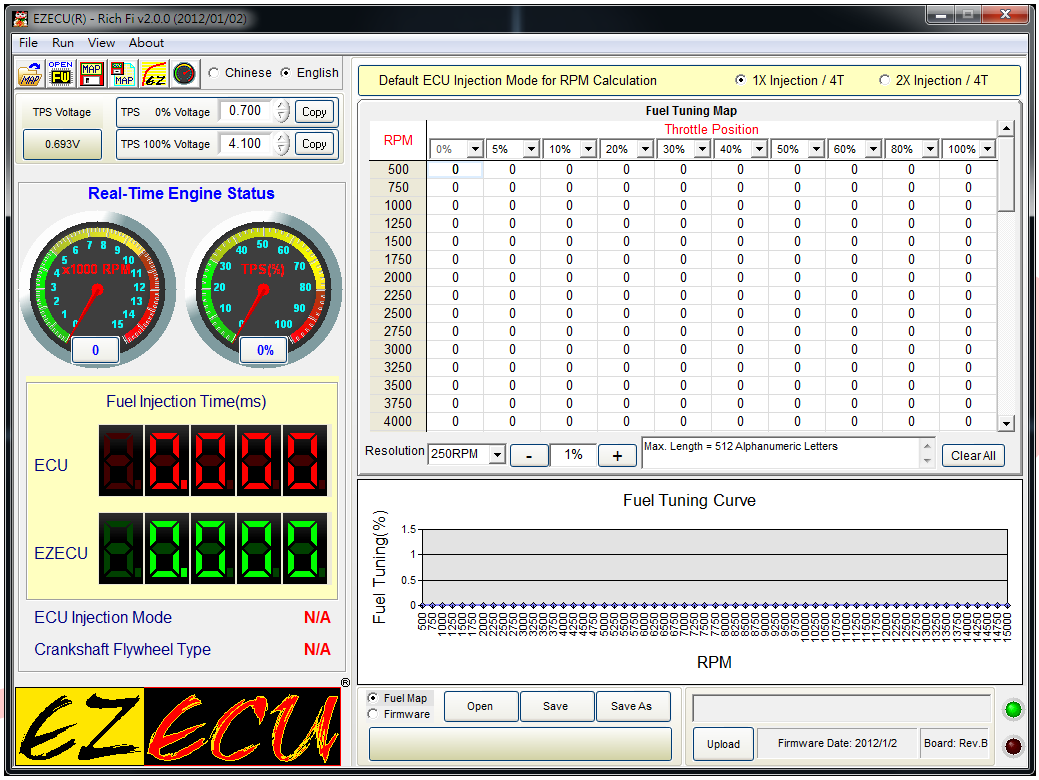


Figure 3-2 Overview of Rich Fi ECU Application Software (Connected)

## 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.

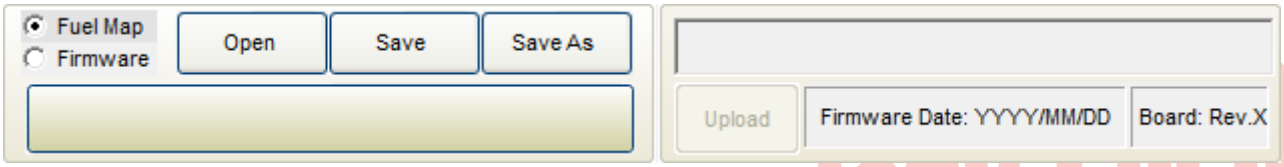


Figure 3-3 Fuel Map Operation Buttons

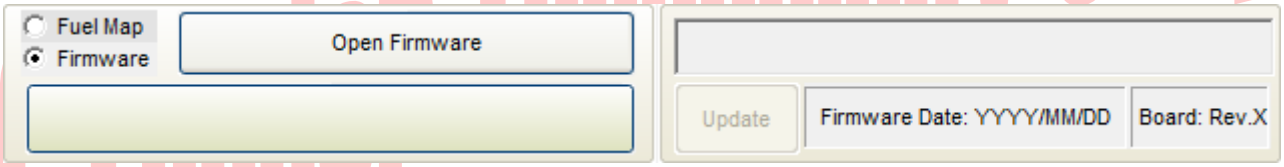


Figure 3-4 Firmware Operation Buttons

Before pressing the “Upload” button, please make sure that the USB cable is correctly connected between your computer and Rich Fi 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 shut down the engine before pressing the “Update” 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.

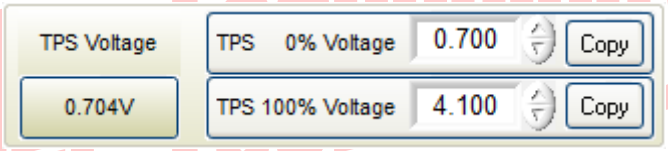


Figure 3-5 TPS Calibration Buttons



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

Step 1 Connect Rich Fi ECU and your bike/scooter;
Step 2 Connect the USB cable between Rich Fi 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 Rich Fi 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, an ECU fuel injection time, a Rich Fi ECU fuel injection time, an ECU injection mode, and a crankshaft flywheel type.

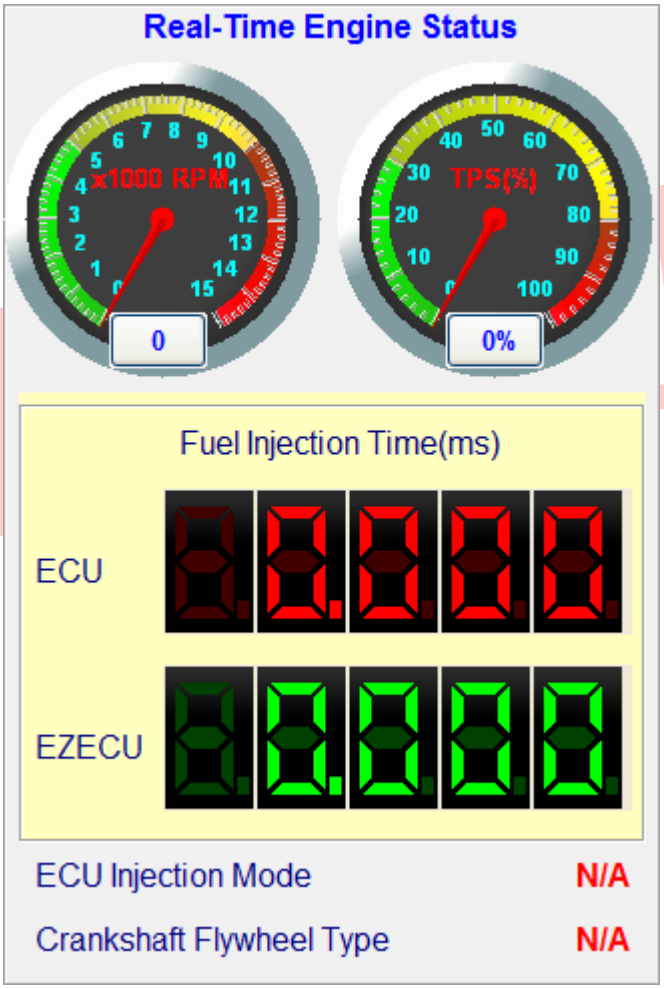


Figure 3-6 Real-Time Engine Status

The ECU injection mode shows the number of fuel injection times within the 4-stroke cycles. This is set by user while uploading the fuel tuning map. For SUZUKI Address without $O_2$ sensor, the crankshaft flywheel type shows "1" to indicate that there is only one tooth on the flywheel. For SUZUKI Address/Music with $O_2$ sensor and Tekken / V125S, the crankshaft flywheel type shows "12-2" to indicate that there are 12 teeth on the flywheel with 2 missing teeth.

## 3.5 Fuel Tuning Map

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

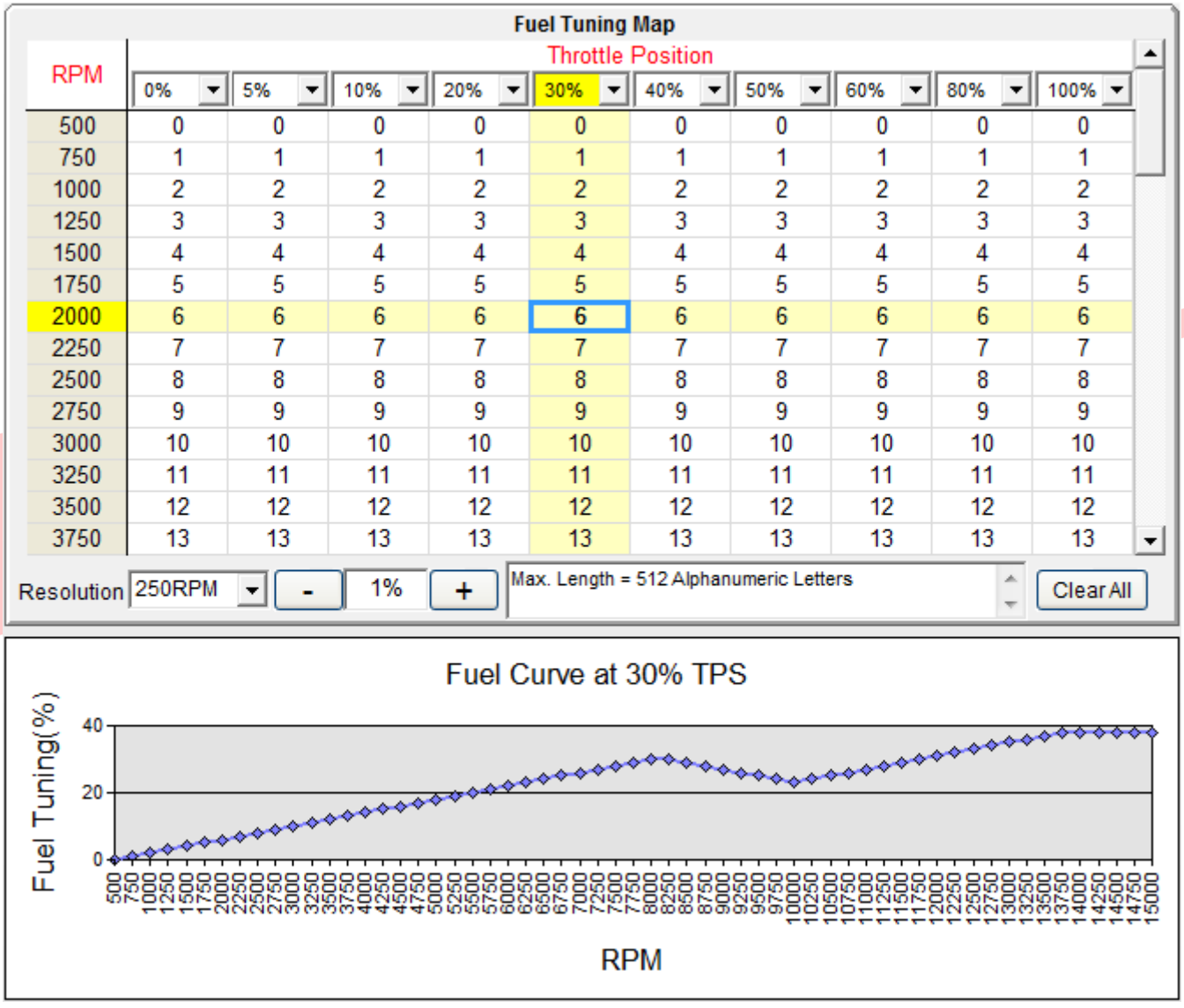


Figure 3-7 Fuel Tuning Map with 250 RPM Resolution

Rich Fi ECU provides a fuel tuning 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 tuning maps with 500 RPM and 1,000 RPM resolutions are shown in Figure 3-8 and Figure 3-9, respectively.

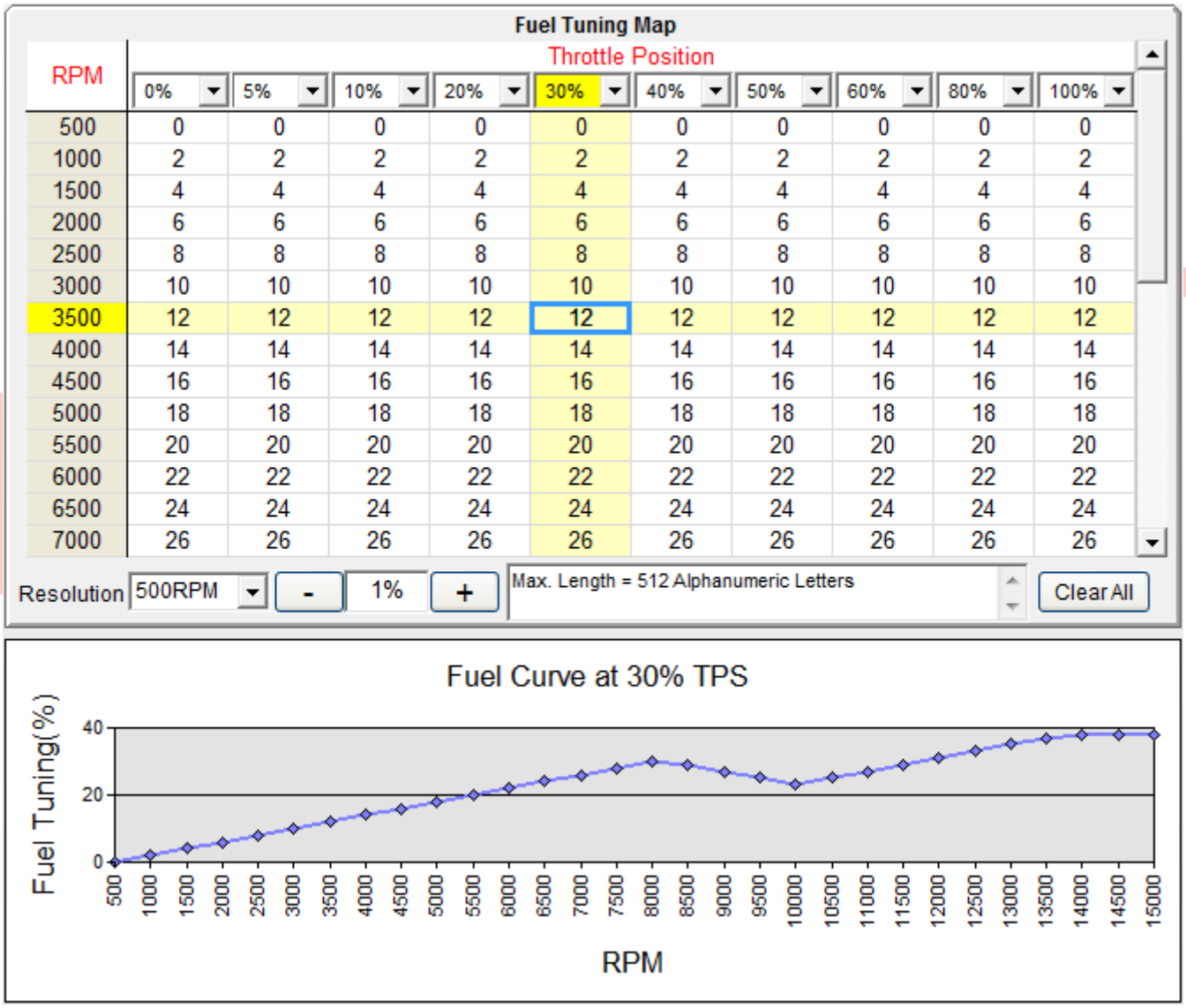


Figure 3-8 Fuel Tuning Map with 500 RPM Resolution

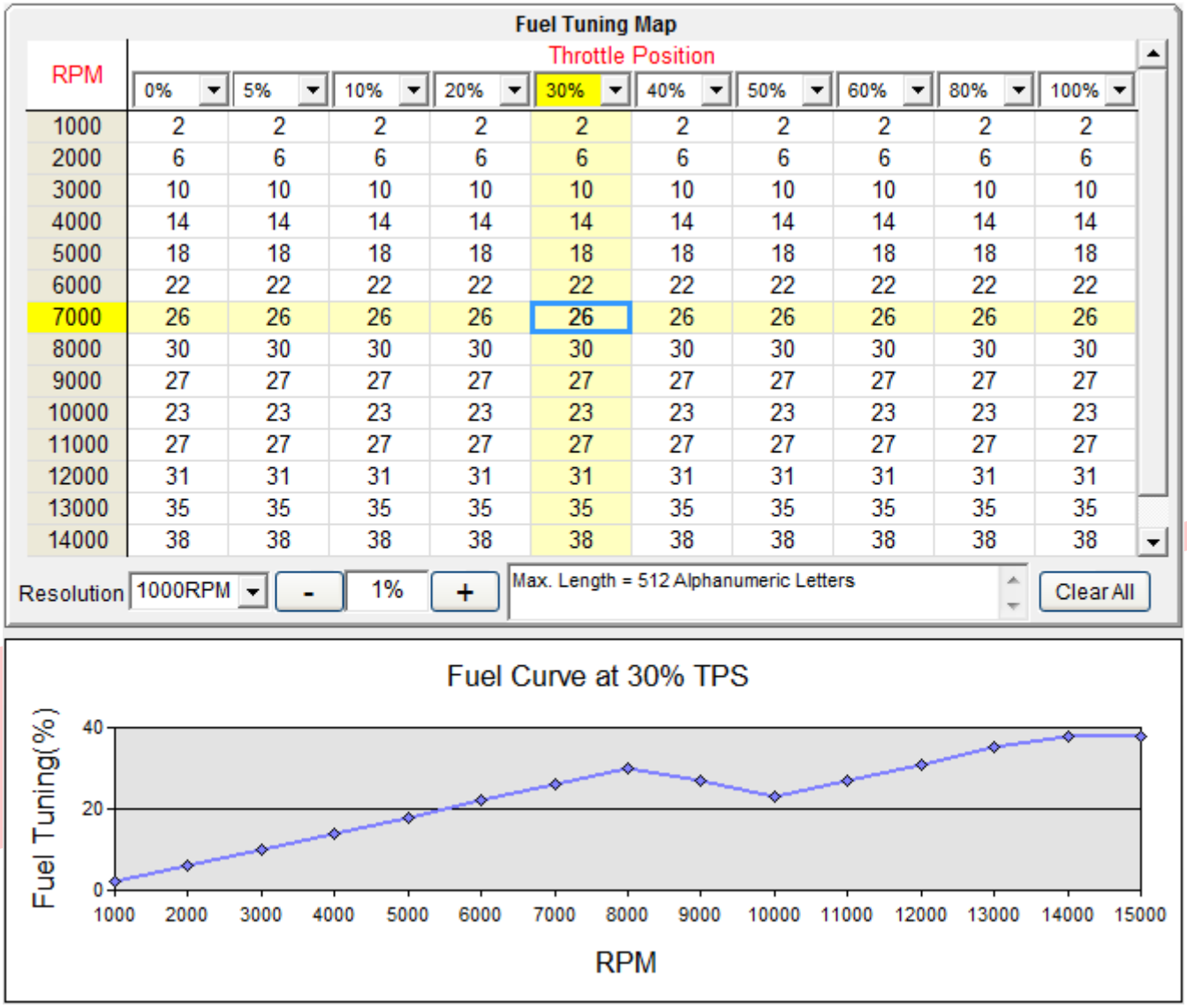


Figure 3-9 Fuel Tuning Map with 1,000 RPM Resolution

In general, the 1,000 RPM resolution is recommended as a startup basis. The fuel tuning map with 1,000 RPM resolution is formed as a 15 by 10 table. Since there are fewer cells, it is easier for roughly tuning the fuel map. The application software will average and interpolate the fuel tuning map values into each cell of the 250 RPM fuel tuning 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 tuning the fuel map, the 500 RPM resolution can be selected. The fuel tuning 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 tuning 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 tuning 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 tuning map, user may mark an area to perform addition/subtraction/clear all by pressing corresponding buttons below the fuel tuning 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 tuning map to 0.



The fuel injection time is calculated as follows:

$$Fuel\ Injection\ Time_{Rich\ Fi\ ECU} = (Fuel\ Injection\ Time_{Factory\ ECU} - DCP\ Turn\ On\ Time) \times (100\% \pm \frac{X\%}{2.5}) + DCP\ Turn\ On\ Time$$

, wherein the *X%* is the 32-bit bilinear interpolated percentage value by the Rich Fi ECU with the range of $0.00\% \le X \le +250.00\%$.

The initial values of the fuel tuning map are all 0s. That is, the fuel injection time of Rich Fi ECU is the same as the factory ECU. If user has an enlarged cylinder from 125CC to 164CC, the enlarged percentage is ((164−125)÷125)×100% ≈ 30%. If the fuel injector remains the same, the fuel tuning map may be all filled by 30% as a tuning basis. Use a wideband oxygen sensor data logger (contact us if required) and an optional dyno machine to fine-tune the engine and modify the cells in the fuel tuning map. Ride the bike/scooter with the data logger as the final feedback for tuning. You may get your best performance for your engine.

## 3.6 Setting for ECU Fuel Injection Mode

Rich Fi ECU has built-in an intelligent algorithm to detect the crankshaft flywheel type automatically. Usually, most crankshaft flywheel types can be detected correctly. However, if one factory announces a new bike/scooter model with a whole new flywheel that Rich Fi ECU can not recognize, Rich Fi ECU will simply use the factory ECU's fuel injection signal to calculate RPM. Consequently, users must tell Rich Fi ECU which injection mode is adopted by the factory ECU. In general, most fuel injection bikes/scooters adopt the single-injection within 4-stroke cycle mode, i.e., fuel is injected once every two engine revolutions (one 4-stroke cycle). Few bikes/scooters adopt the double-injection within 4-stroke cycle mode (one injection per engine revolution). User can set the ECU fuel injection mode as shown in Figure 3-10.


Figure 3-10 Setting for ECU Fuel Injection Mode

If the setting is wrong, Rich Fi ECU will read wrong engine revolution. If user cannot make sure what is adopted by his/her bike's/scooter's ECU, just upload the fuel map with the default "1X Injection / 4T" and start the engine to see whether the idle RPM reading is correct or not. If the idle RPM reading is wrong (usually you may see either half or double RPM reading), you just choose another option and upload the fuel map again.

## 3.7 Mini Bar

On the left-top corner of the application software, there is a mini bar shown in Figure 3-11 to provide quick accesses to functions.


Figure 3-11 Mini Bar of Rich Fi 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 3.8. The full screen engine status is described in Section 3.9. The display language options are also shown on the mini bar.

## 3.8 Dynamic Track Mode

When the "Dynamic Track Mode" button on the mini bar is pressed as shown in Figure 3-12, Rich Fi ECU will report which cell inside the fuel tuning 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 3-12 Dynamic Track Mode on the Mini Bar of Rich Fi ECU Application Software

## 3.9 Full-Screen Engine Status

When the "Full-Screen Engine Status" button on the mini bar is pressed, the application software of Rich Fi ECU will switch to a full-screen as shown in Figure 3-13. This may be helpful for longer distance observing. Press the same button on the mini bar again will switch back to the original screen.

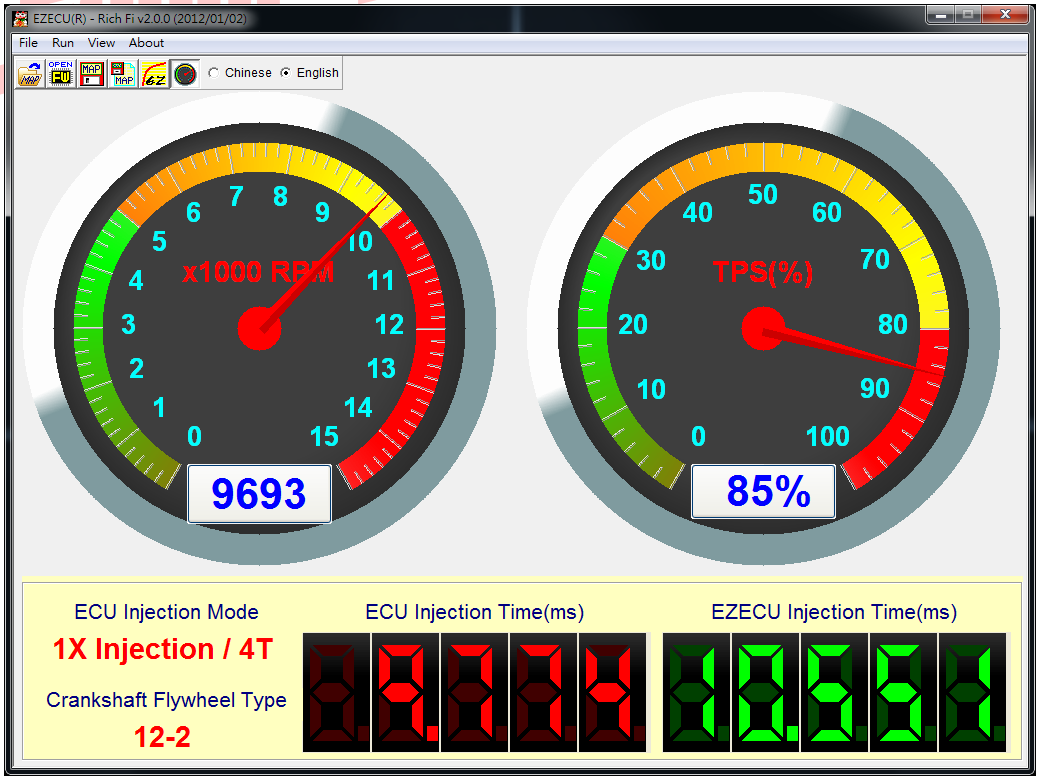


Figure 3-13 Full-Screen Engine Status of Rich Fi ECU Application Software

## 3.10 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 3-14 EZECU® Product Information Window

# Appendix Main Connector Signals

Table A-1 Main Connector Pin Numbers

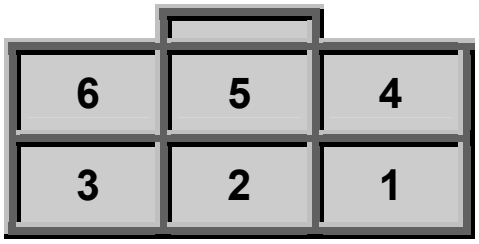


Table A-2 Main Connector Signals

| Pin No. | Signal Description | Wire Color |
|---|---|---|
| 1 | TPS (Throttle Position Sensor) Input | White |
| 2 | Power Ground | Black |
| 3 | DCP Drive Input (from Factory ECU) | Blue |
| 4 | CPS (Crankshaft Position Sensor) Input | Orange |
| 5 | +12V Power | Red |
| 6 | DCP Drive Output (to DCP) | Yellow |