

**EZECU® - City Fi ECU
Piggyback 3D Programmable
Fuel Injection Computer
for
BOSCH Compliant EFI
Systems**

User's Manual

January, 2012

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Printed in Taiwan 2012.

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1 Introduction

With the gradually increasing trend of electronic fuel injection engines, the EZECU® series – City Fi ECU (Engine Control Unit) developed by IC Leader Technology Corporation is announced for cooperating with the factory ECU to tune fuel injection amounts from -100% to +100%. Unlike other piggyback products that generate a faked signal (MAP, TPS, or MAF sensor) to cheat the factory ECU, City Fi ECU drives the fuel injector directly according to a base fuel injection width by the factory ECU.

1.1 Product Package List of City Fi ECU

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

- 1 × City 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. Introduction

1.2 Product Features

City 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 BOSCH compliant fuel injection systems
- Support up to 15,000 RPM
- Programmable -100% ~ +100% fuel tuning percentages with 1% resolution
- Fuel tuning 3D table with 59×10 cells and 250/500/1,000 RPM resolutions
- 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 cell 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 City 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 City Fi ECU. One is a 6-pin main connector and another one is a B-type USB connector. City Fi 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.

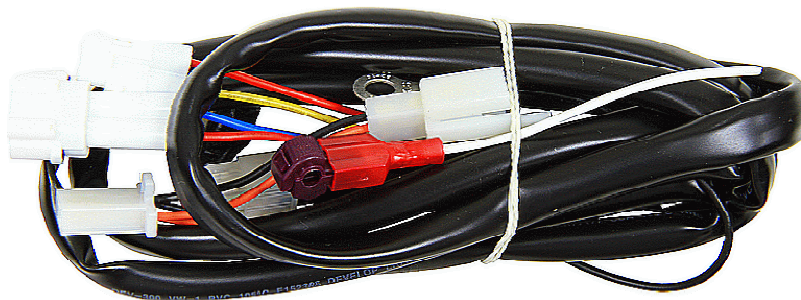


Figure 2-1 Wiring Harness of City Fi ECU for YAMAHA

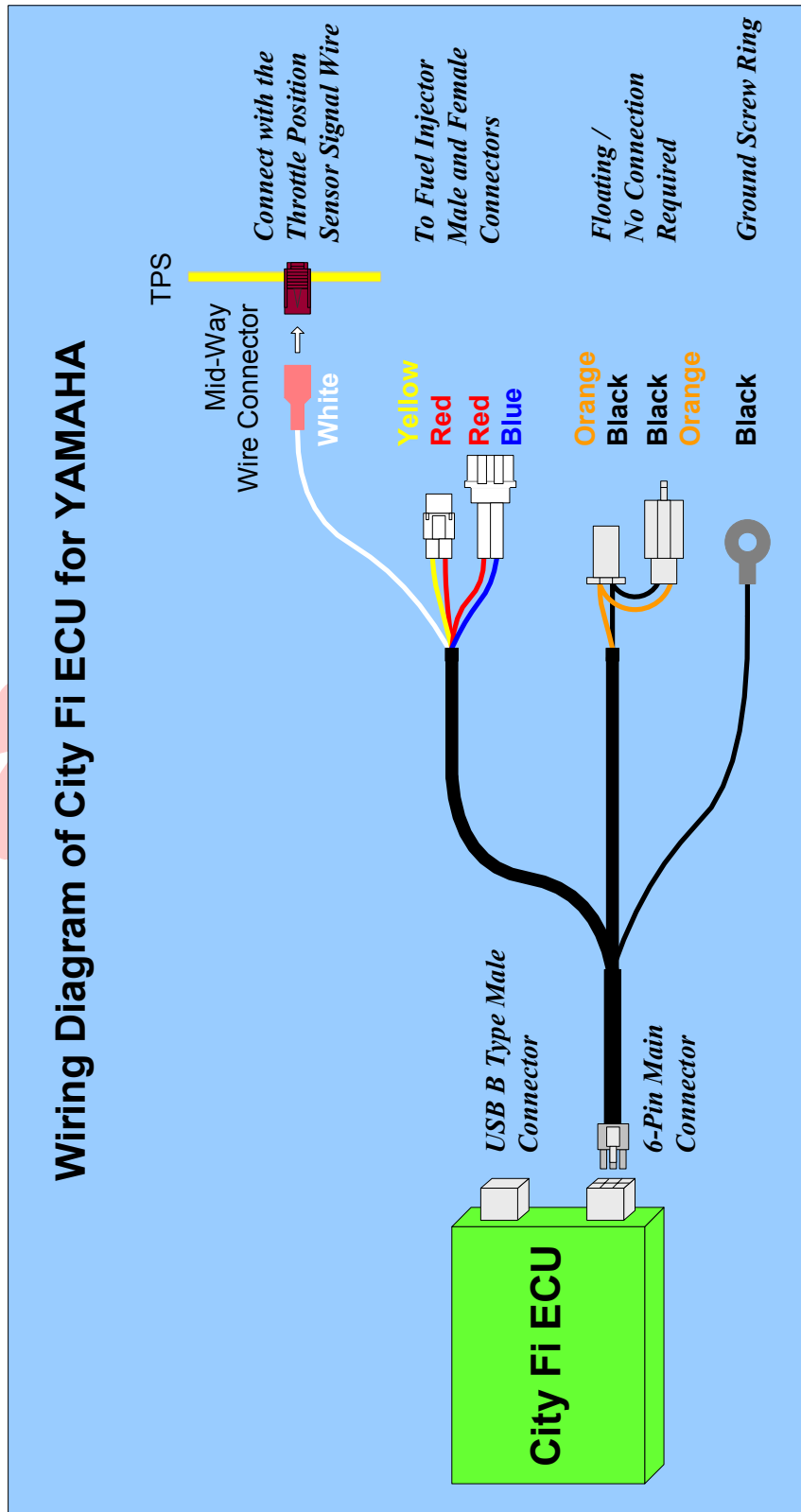


Figure 2-2 Wiring Diagram of City Fi ECU for YAMAHA

2. Wiring Diagrams

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 signals are connected directly by the wiring harness. However, since the wiring definitions for the fuel injector are different for various scooter/bike models, users have to confirm the correct wiring definition by the following steps:

1. Disconnect the fuel injector connector from the fuel injector;
2. Turn on the power;
3. Switch the multi-meter to 20VDC and connect the black probe to battery ground;
4. Use the red probe of the multi-meter to test both terminals of the female fuel injector connector and find out the female terminal with +12V battery voltage;
5. Connect the male fuel injector connector provided by the City Fi ECU to the female fuel injector and insert the red wire male terminal to the corresponding position of the female terminal with +12V battery voltage; and
6. Insert the blue wire male terminal to the remaining position of the male fuel injector connector.

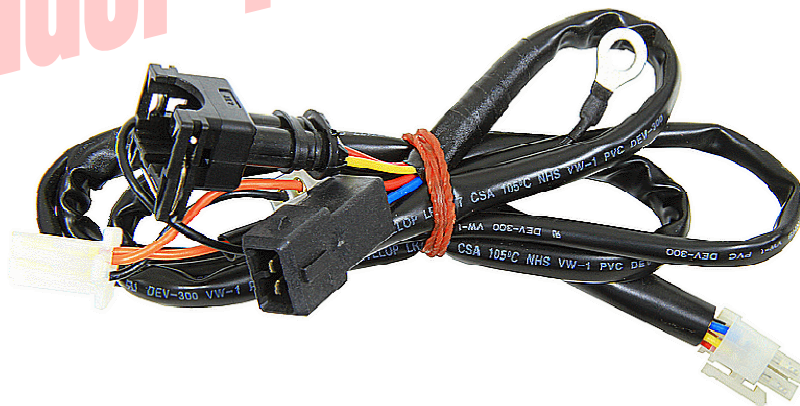


Figure 2-3 Wiring Harness of City Fi ECU for KYMCO/SYM

Furthermore, 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.

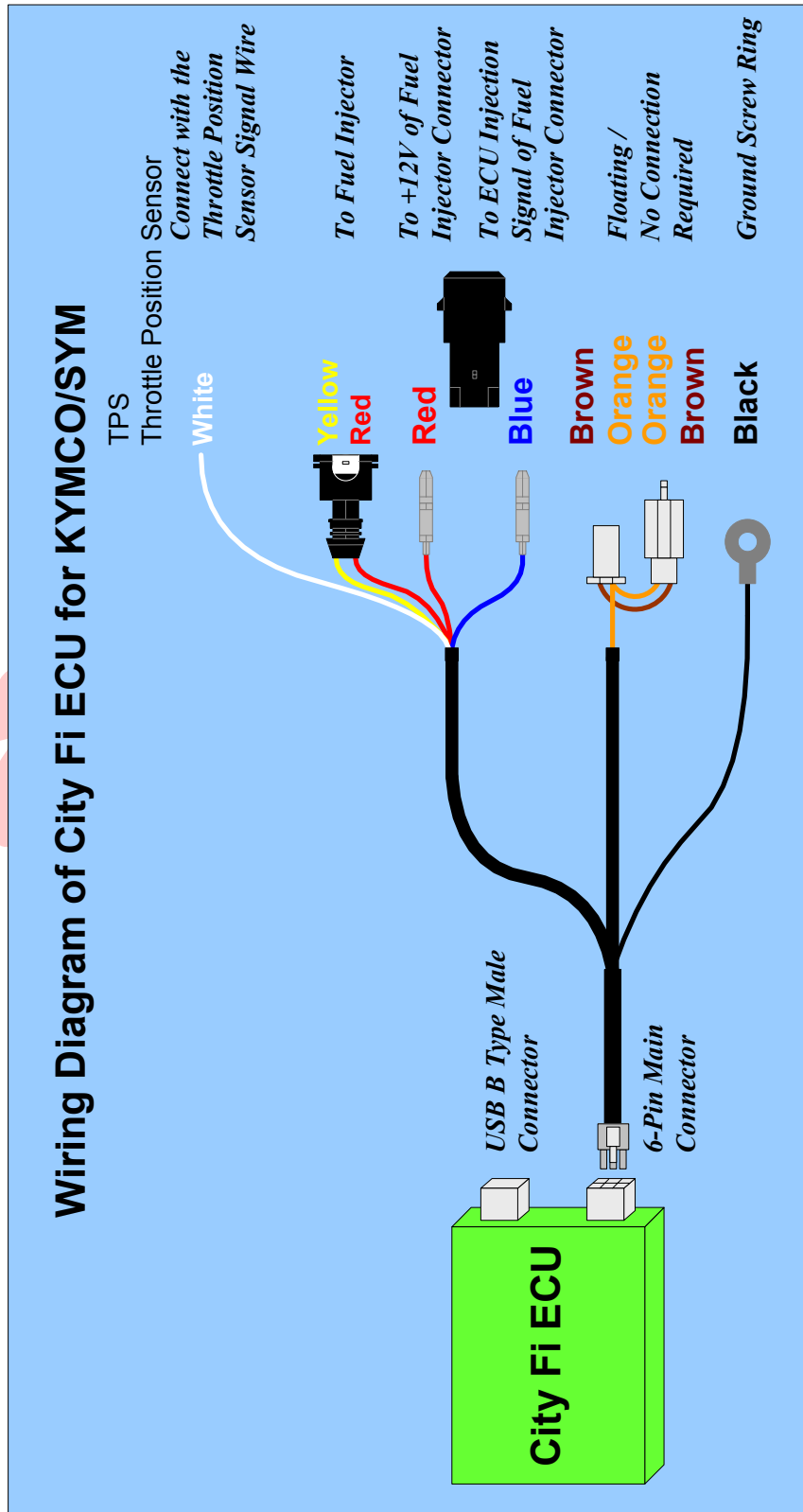


Figure 2-4 Wiring Diagram of City Fi ECU for KYMCO/SYM



3. Application Software

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 City 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.

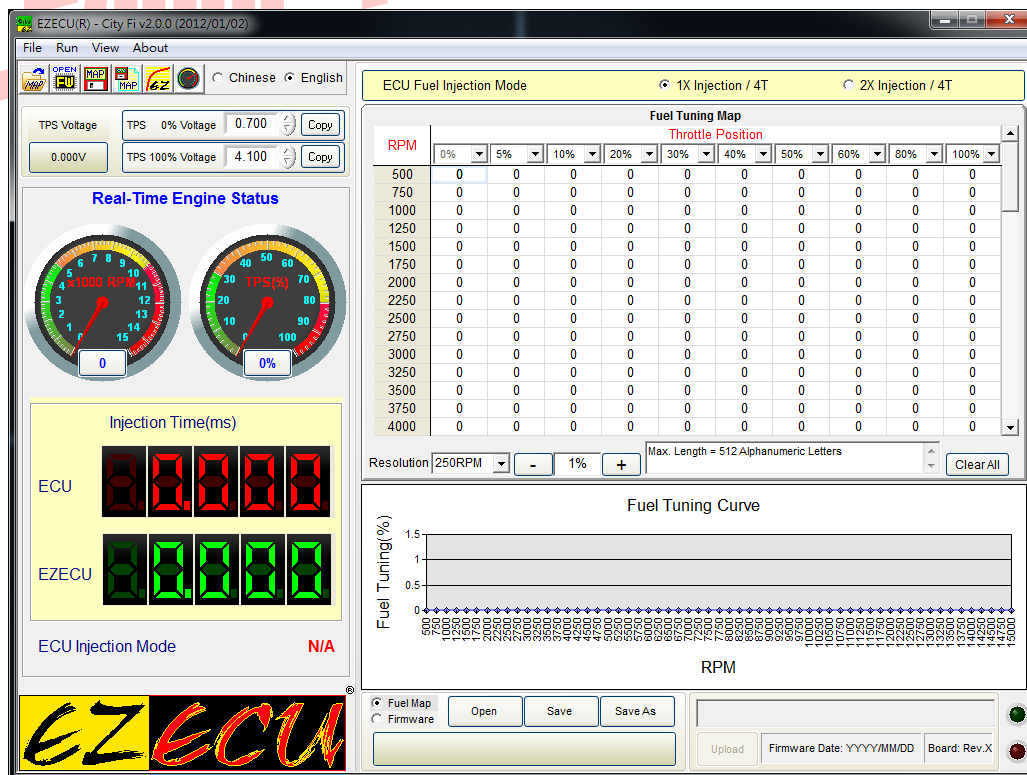


Figure 3-1 Overview of City Fi ECU Application Software (Unconnected)

If City 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 City Fi ECU will be shown also.

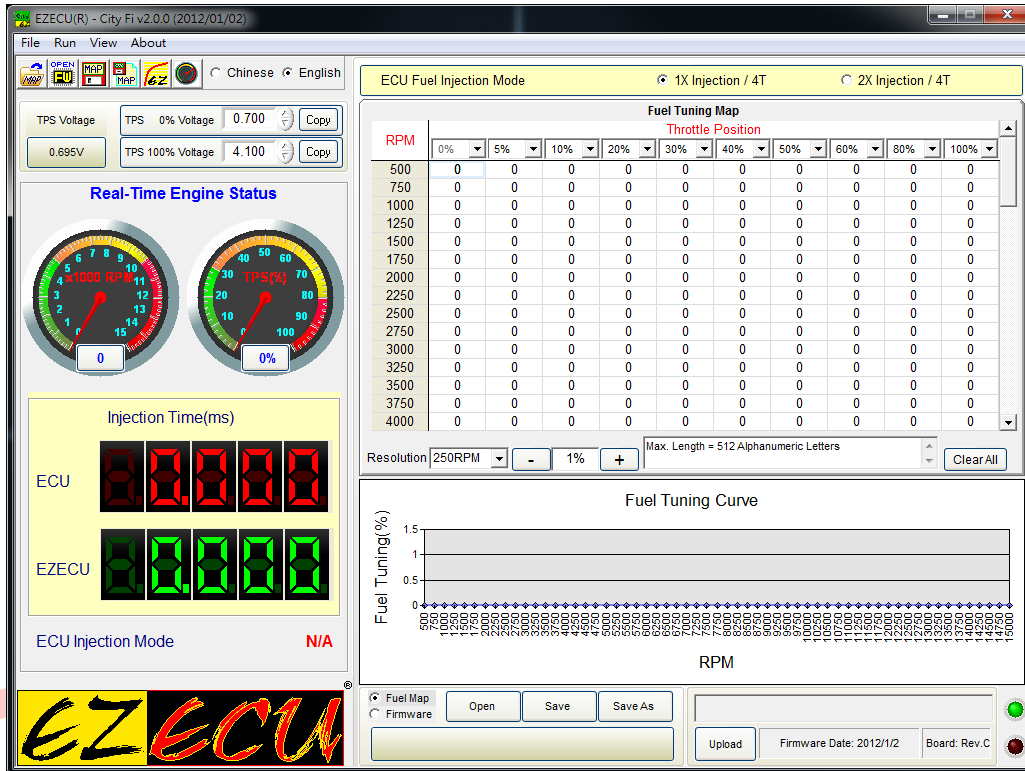


Figure 3-2 Overview of City Fi ECU Application Software (Connected)



3. Application Software

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.

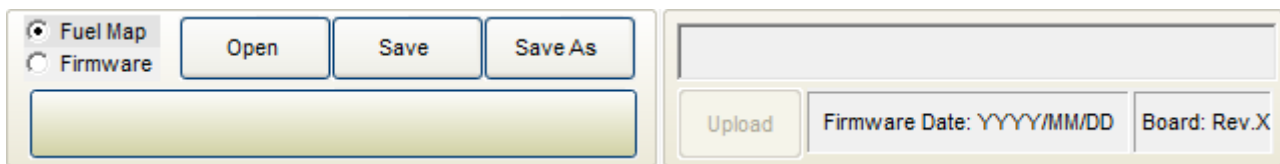


Figure 3-3 Fuel Map Operation Buttons

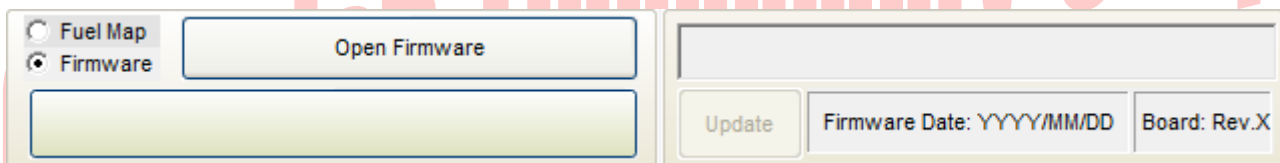


Figure 3-4 Firmware Operation Buttons

Before pressing the “Upload” button, please make sure that the USB cable is correctly connected between your computer and City 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.

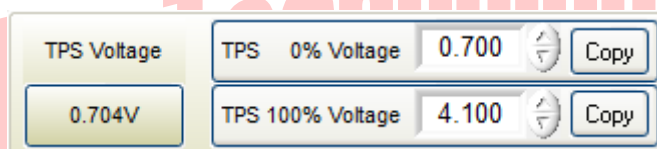


Figure 3-5 TPS Calibration Buttons

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

- Step 1 Connect City Fi ECU and your bike/scooter;
- Step 2 Connect the USB cable between City Fi ECU and your computer;
- Step 3 Execute the application software;
- Step 4 Turn on the bike/scooter power but do not start the engine and confirm the blue power LED on City 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

3. Application Software

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.

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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 City Fi ECU fuel injection time, and an ECU injection mode.

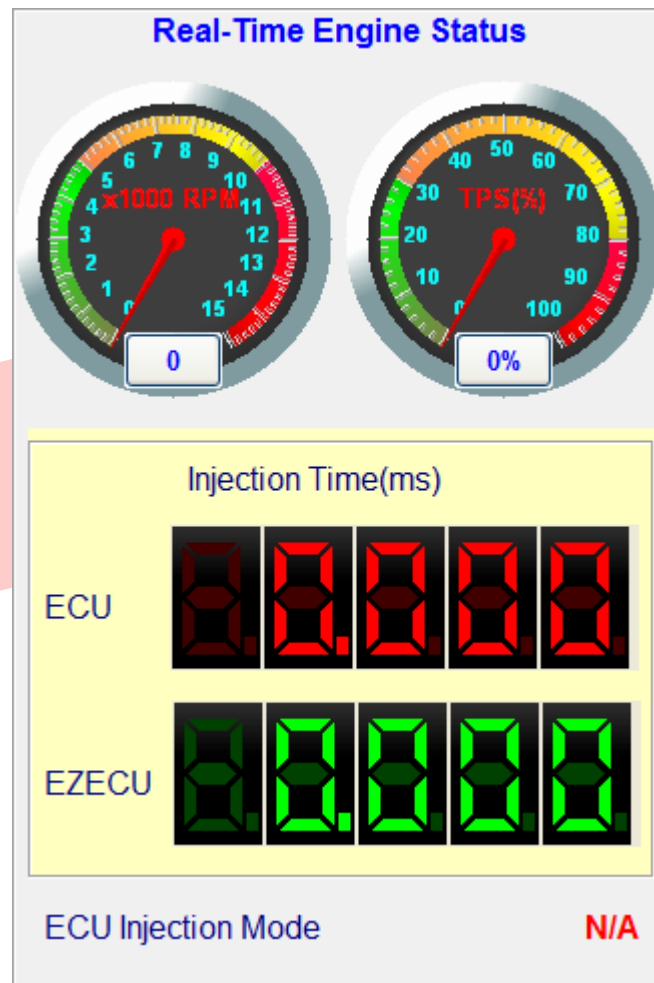


Figure 3-6 Real-Time Engine Status

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 table.



3. Application Software

3.5 Fuel Tuning Map

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

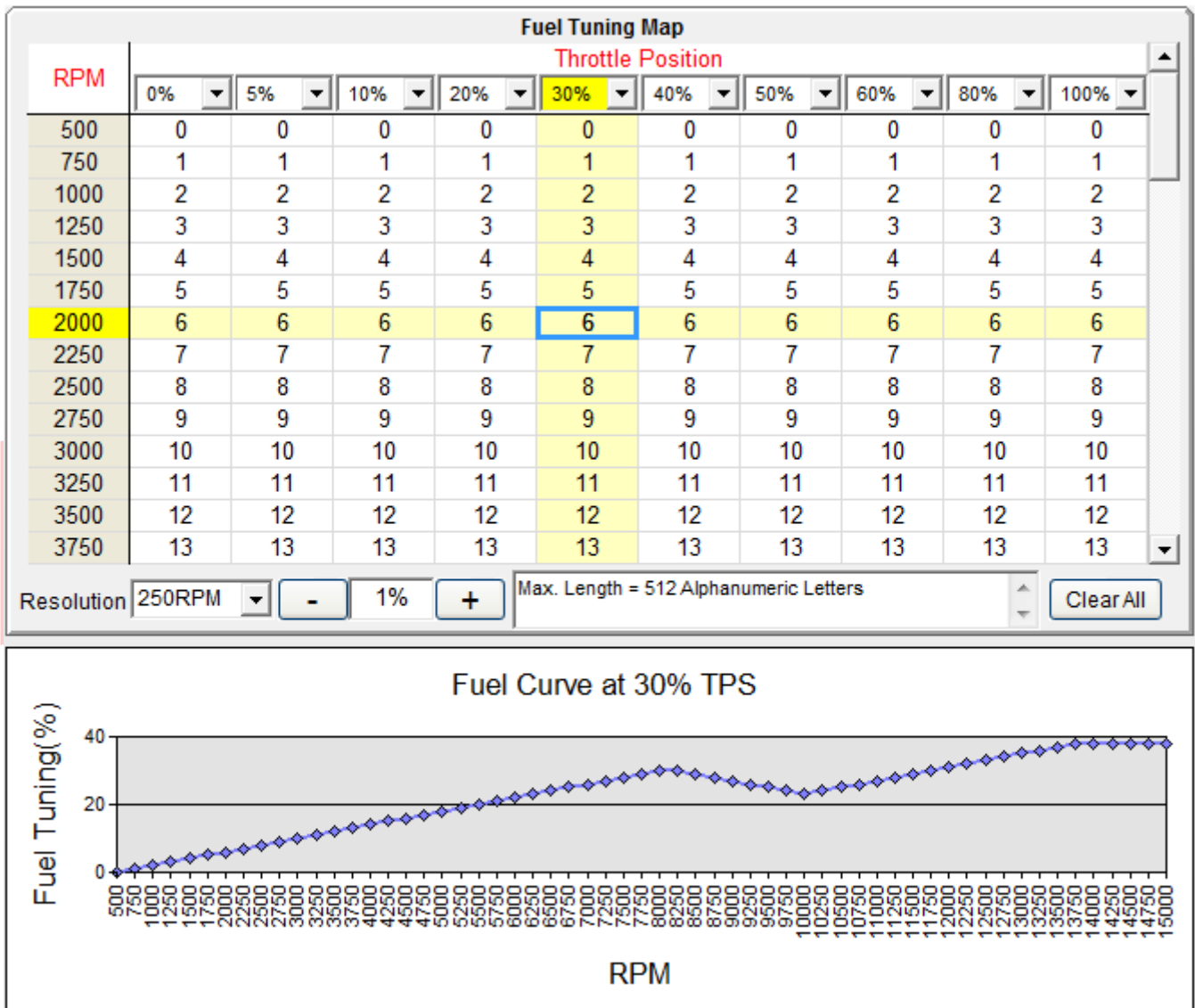


Figure 3-7 Fuel Tuning Map with 250 RPM Resolution

City 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.

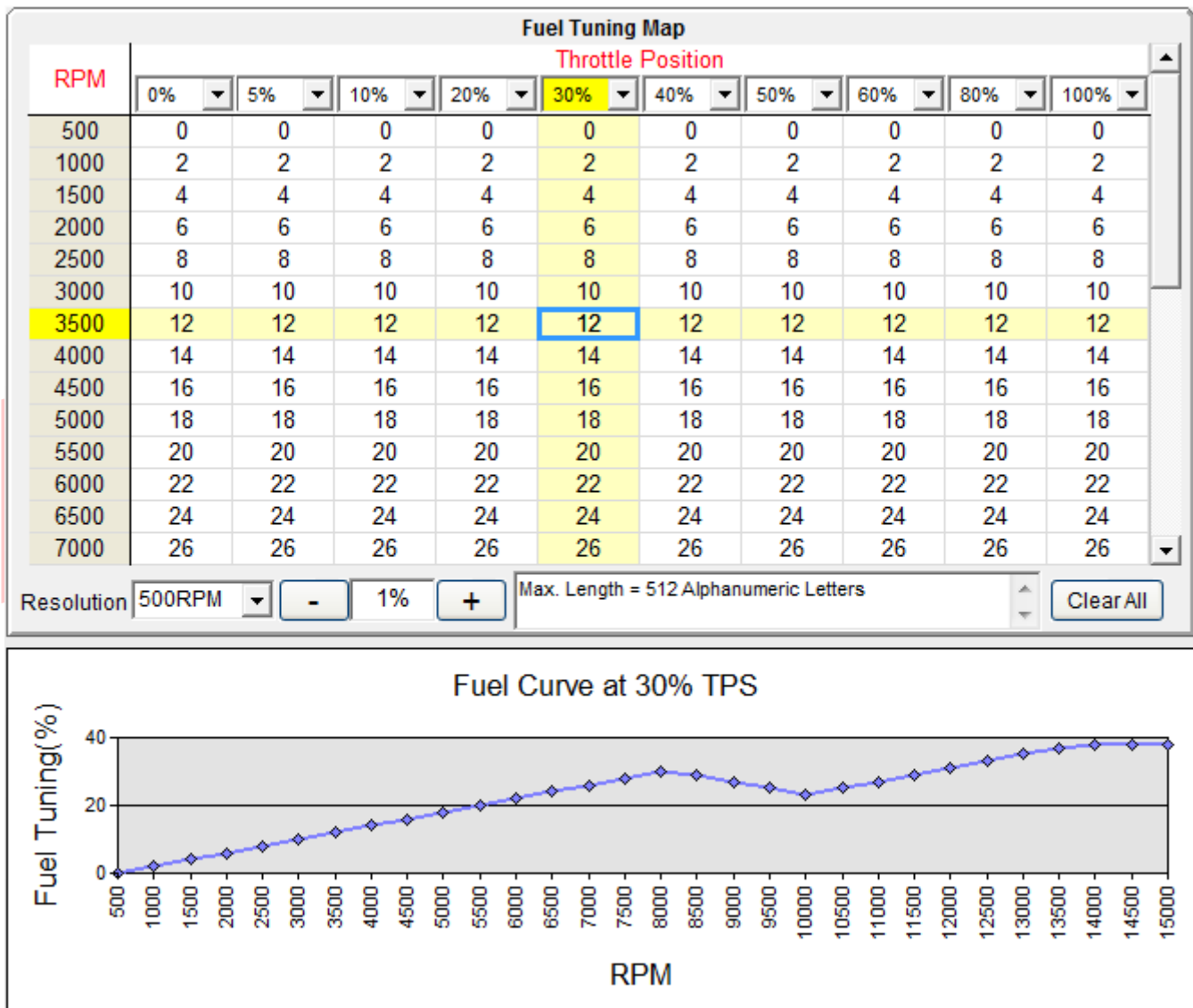


Figure 3-8 Fuel Tuning Map with 500 RPM Resolution



3. Application Software

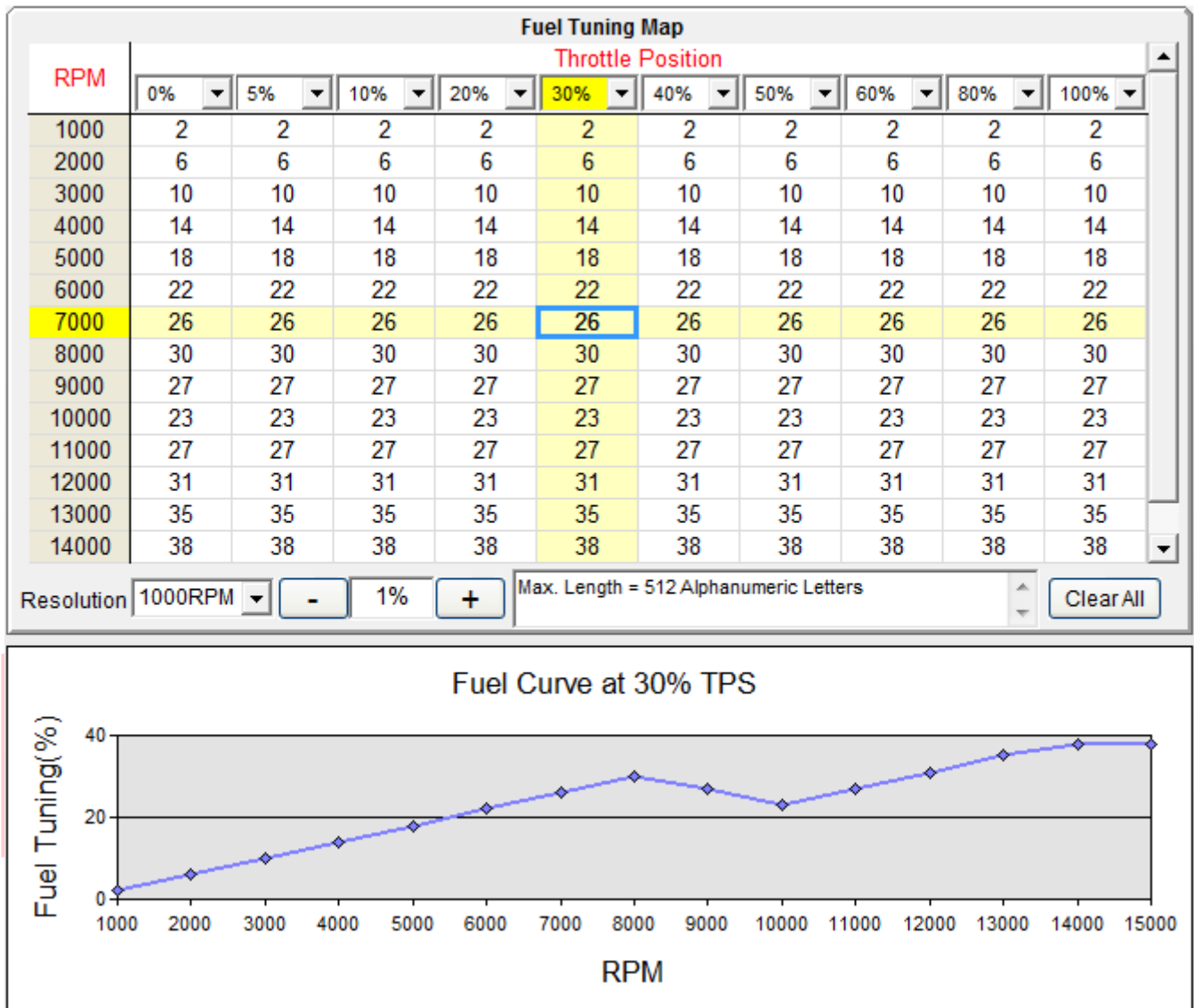


Figure 3-9 Fuel Tuning Map with 1,000 RPM Resolution

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:

$$\text{Fuel Injection Time}_{\text{City Fi ECU}} = (\text{Fuel Injection Time}_{\text{Factory ECU}} - \text{Fuel Inejctor Turn On Time}) \times (100\% \pm X\%) + \text{Fuel Inejctor Turn On Time}$$

, wherein the $X\%$ is the 32-bit bilinear interpolated percentage value by the City Fi ECU with the range of $-100.00\% \leq X \leq +100.00\%$.

The initial values of the fuel tuning map are all 0s. That is, the fuel injection time of City Fi ECU is the same as the factory ECU. If user has an enlarged cylinder from 125CC to 164CC, the enlarged percentage is $((164-125) \div 125) \times 100\% \approx 30\%$. 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

Since City Fi ECU tunes fuel according to factory ECU's fuel injection signal and TPS, users must tell City 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.

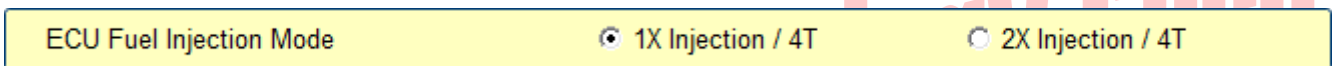


Figure 3-10 Setting for ECU Fuel Injection Mode

If the setting is wrong, City 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 City 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. Application Software

3.8 Dynamic Track Mode

When the “Dynamic Track Mode” button on the mini bar is pressed as shown in Figure 3-12, City 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 City 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 City 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.

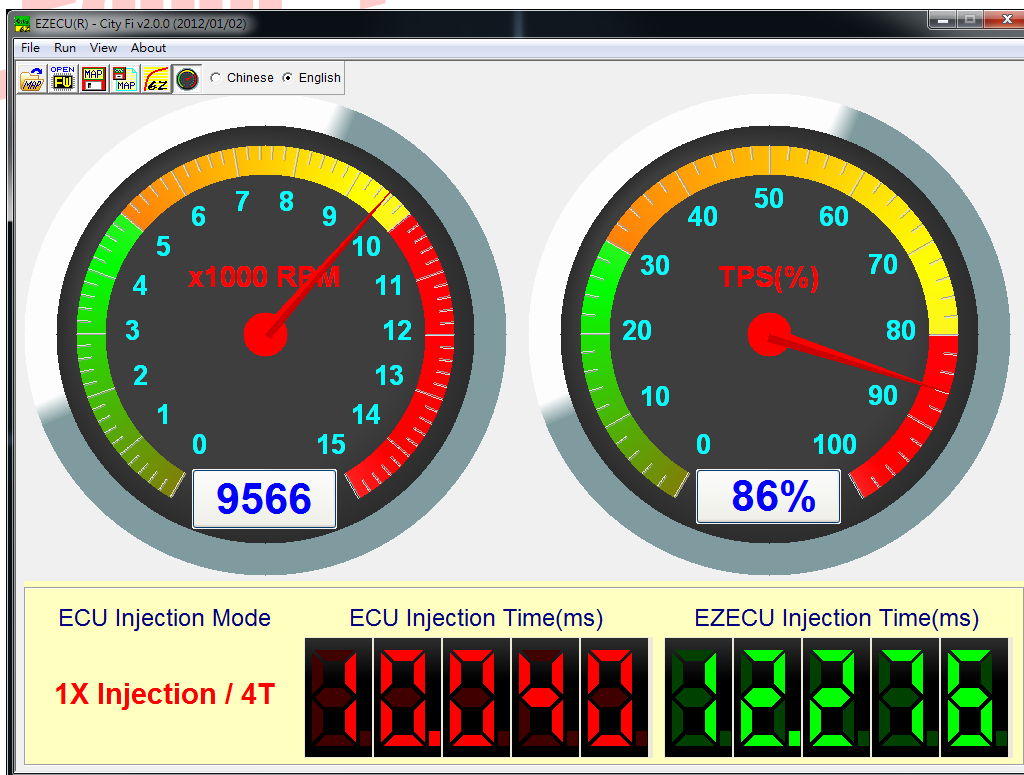


Figure 3-13 Full-Screen Engine Status of City Fi ECU Application Software

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

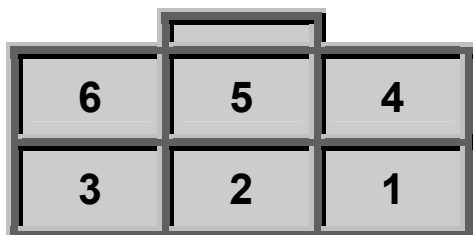


Table A-2 Main Connector Signals

Pin No.	Signal Description	Wire Color
1	TPS (Throttle Position Sensor) Input	White
2	Power Ground	Black
3	Fuel Injection Input (from Factory ECU)	Blue
4	No Connection	Orange
5	+12V Power	Red
6	Fuel Injection Output (to Injector)	Yellow