



立達電通科技股份有限公司
IC Leader Technology Corp.

EzFi Rev. B Programmable Fuel Injection Computer for Scooters with EFI Engines

User's Manual

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1 Introduction

With the gradually increasing trend of fuel injection engine scooters, the EzFi programmable fuel injection computer developed by IC Leader Technology Corporation is announced for cooperating with the factory ECU (Electronic Control Unit) to adjust fuel injection amounts, fuel injection parameters and modes of various scooter engines. Suitable models for each brand of scooters are listed in [Section 1.4](#).

1.1 EzFi Rev. B Product Package List

Thank you for purchasing the EzFi programmable fuel injection computer designed by our company. When you open the product package, all contained accessories are listed below. If any accessory misses, please exchange another full set with the corresponding dealer.

- 1 × EzFi programmable fuel injection computer
- 1 × EzYMT-CygnusX 18-pin converter (for YAMAHA (New) Cygnus X (without O₂ sensor) / GTR models only)
- 1 × EzYMT-CygnusX5 34-pin converter (for YAMAHA RS-Z / Cygnus X (with O₂ sensor) / BW'S models only)
- 1 × SYM/KYMCO 22-pin wiring harness (for SYM/KYMCO brands only)
- 1 × EzYMT-CygnusX wiring harness (for YAMAHA (New) Cygnus X (without O₂ sensor) / GTR models only)
- 1 × EzYMT-CygnusX5 conversion wiring harness (for YAMAHA RS-Z / Cygnus X (with O₂ sensor) / BW'S models only)
- 1 × EzYMT-CygnusX5 extension wiring harness (for YAMAHA RS-Z / Cygnus X (with O₂ sensor) / BW'S models only)



1. Introduction

1.2 Product Features

EzFi programmable fuel injection computer is a high-technology after-market product for fuel injection scooters with features listed as follows:

- Relief fuel-cut restriction of the factory ECU at high RPM range
- Supports programmable updating via USB and PC application software
- Supports up to 18,000 RPM basic fuel map with 100/200/500/1,000 RPM resolutions
- Supports 11-step TPS resolution (0%, 5%, 10%, 15%, 20%, 30%, 40%, 50%, 60%, 80%, 100%)
- Supports programmable TPS only/MAP only/TPS+MAP acceleration sensor configurations
- Supports programmable MAP sensor to TPS sensor mapping
- Supports programmable 11/23 teeth pulser configurations
- Supports programmable single/double injections within one 4-stroke cycle
- Supports programmable 32-step engine temperature compensation for the basic fuel map
- Supports programmable 16-step battery voltage compensation for the basic fuel map
- Supports programmable 16-step engine cold/warm start compensation for the basic fuel map
- Supports programmable 0% ~ 95% duty cycle upper bound of the fuel injector with 1% resolution
- Supports semi-auto detection for 0% and 100% TPS sensor voltages
- Supports programmable tilt sensor enable/disable with active-high and active-low voltages
- Supports run-time engine status monitoring
- Adopts high-performance dual microprocessor units
- Adopts five 16-level rotary switches to independently fine-tune fuel supply amount from -6% through +9% with 1% step for 0 ~ 1,999 RPM, 2,000 ~ 3,999 RPM, 4,000 ~ 5,999 RPM, 6,000 ~ 7,999 RPM, and 8,000 RPM ~ 18,000 RPM
- Supports 22 RPM indication LEDs in five colors with RPM indication range from 1,500 RPM through 12,500 RPM
- Provides dedicated wiring harness and/or converter for SYM/KYMCO/YAMAHA to achieve plug-and-play and easy installation without cutting wires to ensure factory ECU warranty



1.3 Product Specifications

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

- Sensor inputs
 - Factory MAP (Manifold Absolute Pressure) sensor signal with an analog voltage ranging from 0 to 5VDC (partial of SYM/KYMCO/YAMAHA models)
 - Factory TPS (Throttle Position Sensor) signal with an analog voltage ranging from 0 to 5VDC (partial of SYM/KYMCO/YAMAHA models)
 - Factory CPS (Crankshaft Position Sensor) signal with an analog voltage ranging from 0 to ± 120 VAC and either 11 pulses per revolution (YAMAHA models) or 23 pulses per revolution (SYM/KYMCO models)
 - Factory tilt sensor signal with a digital voltage ranging from 0 to 12VDC
 - Factory engine temperature 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
 - Pulse width modulation voltage ranging from 0 to 12VDC
 - Suitable fuel injector resistance ranging from 10 to 16 Ω

- User adjustable inputs
 - Five 16-level rotary switches

- Fuel injection signal output
 - Direct drive of fuel injector
 - Pulse width modulation voltage ranging from 0 to 12VDC
 - Suitable fuel injector resistance ranging from 10 to 16 Ω
 - Supports up to 95% duty cycle of the fuel injector
 - Supports high flow-rate fuel injectors
 - Supports either single injection or double injections per 4-stroke cycle



1. Introduction

- Display interface
 - 22 RPM indication LEDs from 1,500 RPM through 12,500 RPM with one LED per 500 RPM in a total of five colors
 - Blinking LED if engine RPM exceeds 12,500 RPM
 - 1 × blue LED for power on indication
 - 1 × blue LED for compensation indication
 - 1 × red LED for fuel injection short/open error indication

- EzFi size
 - Length: 80 mm
 - Width: 116 mm
 - Height: 23 mm
 - Net weight (without including wiring harness): 160 g
 - SYM/KYMCO wiring harness length (for SYM/KYMCO only): 120 cm
 - YAMAHA-CygnusX wiring harness length (for YAMAHA (New) Cygnus X (without O₂ sensor) / GTR models only): 200 cm
 - YAMAHA-CygnusX5 conversion wiring harness length (for YAMAHA RS-Z / Cygnus X (with O₂ sensor) / BW'S models only): 20 cm
 - YAMAHA-CygnusX5 extension wiring harness length (for YAMAHA RS-Z / Cygnus X (with O₂ sensor) / BW'S models only): 200 cm

- YMT-CygnusX converter size (for YAMAHA (New) Cygnus X (without O₂ sensor)/ GTR models only)
 - Length: 44 mm
 - Width: 77 mm
 - Height: 20 mm
 - Net weight (without including wiring harness): 55 g

- YMT-CygnusX5 converter size (for YAMAHA RS-Z / Cygnus X (with O₂ sensor) / BW'S models only)
 - Length: 44 mm
 - Width: 110 mm
 - Height: 20 mm
 - Net weight (without including wiring harness): 92 g



1.4 Supported Scooter Brands and Models

EzFi supports every single-cylinder engine with high-impedance fuel injectors. For easier installation, our company provides dedicated wiring harnesses and converters for the following scooter brands and models as listed in Table 1-1. If your scooter is not listed in, you must have a professional technician to evaluate whether your scooter is suitable for installing the EzFi and to help you cut and solder wires manually. If you are not familiar with how to cut and solder wires manually, our company strongly recommends that **DO NOT** install our products, or our company is not responsible for warranty and caused damage.

Table 1-1 Dedicated Wiring Harness and Converter by EzFi Programmable Fuel Injection Computer

Brand	Fuel Injection Scooter Models	Wiring Harness / Converter
YAMAHA	Cygnus X 125	Yes (EzYMT-CygnusX converter)
	New Cygnus X 125	Yes (EzYMT-CygnusX converter)
	GTR 125	Yes (EzYMT-CygnusX converter)
	RS-Z 100	Yes (EzYMT-CygnusX5 converter)
	Cygnus X (with O ₂ Sensor) 125	Yes (EzYMT-CygnusX5 converter)
	BW'S 125	Yes (EzYMT-CygnusX5 converter)
	Majesty 125/250	No, manually cutting and soldering wires is required
SYM	Fighter 4V Fighter 125	Yes
	Fighter 4V VIP Fighter 125/150	Yes
	R1 125	Yes
	Attila RS21 150	Yes
	RV 180	Yes
KYMCO	JR100	Yes
	TECHNO 125	Yes
	GP 125	Yes
	G3 Jockey 125	Yes
	G4 Jockey 125	Yes
	G5 Jockey 125/150	No, manually cutting and soldering wires is required and either a secondary TPS should be added or
	Racing 125/150	



1. Introduction

Brand	Fuel Injection Scooter Models	Wiring Harness / Converter
		the TPS should be hardwired from the ECU body
	DINK 180FI	Yes
SUZUKI	Address V125G	Yes, DCP should be replaced by a fuel injector and a fuel pump
	Address Z125	

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2 EzFi Appearance

2.1 Top View

The top view of the EzFi is shown in [Figure 2-1](#). With a transparent glass as an indication LEDs window, user can see all 22 RPM indication 5-color LEDs and power, compensation, fuel injection error LEDs. The EzFi case is constructed by a rustproof aluminum box. The red print circuit board is also coated by transparent waterproof material. Both sides of the box have semicircle holes for fixing screw installation.



Figure 2-1 Top View of EzFi Programmable Fuel Injection Computer

2. EzFi Appearance

2.2 Side View

The side view of EzFi is shown in [Figure 2-2](#). There are five rotary switches on the left side and there is a wiring harness connector and a programmable connector on the bottom side.



Figure 2-2 Side View of EzFi Programmable Fuel Injection Computer



2.3 Rotary Switches

Five rotary switches of the EzFi fuel injection computer are shown in [Figure 2-3](#). From right to left, five rotary switches represents for I (Idle), L (Low), M (Medium), H (High) and S (Super) RPM ranges, respectively to independently fine-tune fuel supply amount for corresponding RPM range, wherein the detailed descriptions for adjusting fuel supply amount are illustrated in [Section 3](#).



Figure 2-3 Rotary Switches of EzFi Programmable Fuel Injection Computer

2. EzFi Appearance

2.4 Indication LEDs

The EzFi programmable fuel injection computer provides 22 RPM indication LEDs and 3 status indication LEDs as shown in Figure 2-4. A mapping table between each LED and RPM range is shown in Table 2-1.

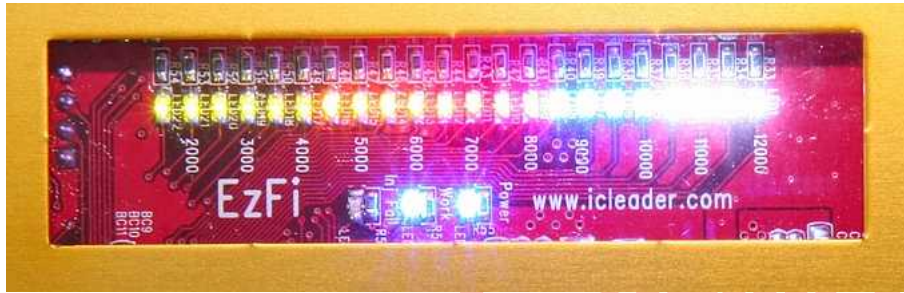


Figure 2-4 RPM and Status Indication LEDs of EzFi Programmable Fuel Injection Computer

Table 2-1 Mapping Between Each RPM LED and RPM Range

RPM Ranges	LED Colors
1,500 RPM ~ 1,999 RPM	Yellow Green
2,000 RPM ~ 2,499 RPM	Yellow Green
2,500 RPM ~ 2,999 RPM	Yellow Green
3,000 RPM ~ 3,499 RPM	Yellow Green
3,500 RPM ~ 3,999 RPM	Yellow Green
4,000 RPM ~ 4,499 RPM	Yellow Green
4,500 RPM ~ 4,999 RPM	Orange
5,000 RPM ~ 5,499 RPM	Orange
5,500 RPM ~ 5,999 RPM	Orange
6,000 RPM ~ 6,499 RPM	Orange
6,500 RPM ~ 6,999 RPM	Red
7,000 RPM ~ 7,499 RPM	Red
7,500 RPM ~ 7,999 RPM	Red
8,000 RPM ~ 8,499 RPM	Red
8,500 RPM ~ 8,999 RPM	Blue
9,000 RPM ~ 9,499 RPM	Blue
9,500 RPM ~ 9,999 RPM	Blue
10,000 RPM ~ 10,499 RPM	Blue
10,500 RPM ~ 10,999 RPM	White
11,000 RPM ~ 11,499 RPM	White
11,500 RPM ~ 11,999 RPM	White
12,000 RPM ~ 18,000 RPM	White (Blink if exceeding 12,500 RPM)



Three status indication LEDs located at middle-bottom side of Figure 2-4 are listed in Table 2-2.

Table 2-2 Status Indication LEDs of EzFi Programmable Fuel Injection Computer

LED Color	LED Position	Functionality
Red	Left	Light: fuel injector fail Dark: fuel injector ok
Blue	Middle	Light: Fuel injection compensation completes Dark: Fuel injection compensation is in progress
Blue	Right	Light: power supply is normal Dark: power supply is abnormal

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2. EzFi Appearance

2.5 EzFi Connectors and USB Programmer

There are two connectors supported by EzFi programmable fuel injection computer. One is a 10-pin main connector and another one is a 10-pin USB programmer connector as shown in Figure 2-5. The USB programmer is shown in Figure 2-6. For the interconnection between a USB programmer and the EzFi, an illustration is shown in Figure 2-7.



Figure 2-5 Connectors of EzFi Programmable Fuel Injection Computer



Figure 2-6 USB Programmer



Figure 2-7 Interconnection Between USB Programmer and EzFi Programmable Fuel Injection Computer



2.6 SYM/KYMCO Wiring Harness (22-Pin ECU Connector)

The 22-pin wiring harness for SYM/KYMCO is shown in [Figure 2-8](#). There are three connectors in the SYM/KYMCO wiring harness. Two of them are of 22-pin connectors interconnected with the factory ECU and factory wiring harness. The remaining 10-pin connector is used for interconnecting with EzFi programmable fuel injection computer.



Figure 2-8 SYM/KYMCO Wiring Harness

2. EzFi Appearance

2.7 YAMAHA Wiring Harnesses and Converters (18- / 34-Pin ECU Connectors)

EzFi programmable fuel injection computer supports two types of converters for YAMAHA scooters. The first type converter supports the 18-pin ECU connector as shown in Section 2.7.1. The second type converter supports the 34-pin ECU connector as shown in Section 2.7.2.

2.7.1 (New) Cygnus X (without O₂ Sensor) / GTR (18-Pin ECU Connector)

For YAMAHA scooters with the 18-pin ECU connector, EzFi programmable fuel injection computer provides a dedicated converter box and a wiring harness as shown in Figure 2-9 and Figure 2-10, respectively.



Figure 2-9 EzYMT-Cygnus Converter for YAMAHA (18-Pin ECU Connector)



Figure 2-10 EzYMT-Cygnus Wiring Harness for YAMAHA (18-Pin ECU Connector)



2.7.2 Cygnus X (with O₂ Sensor) / RS-Z / BW'S (34-Pin ECU Connector)

For YAMAHA scooters with the 34-pin ECU connector, EzFi programmable fuel injection computer provides a dedicated converter box, a conversion wiring harness, and an extension wiring harness as shown in Figure 2-11, Figure 2-12, and Figure 2-13, respectively.



Figure 2-11 EzYMT-CygnusX5 Converter for YAMAHA (34-Pin ECU Connector)



Figure 2-12 EzYMT-CygnusX5 Conversion Wiring Harness for YAMAHA (34-Pin ECU Connector)



Figure 2-13 EzYMT-CygnusX5 Extension Wiring Harness for YAMAHA (34-Pin ECU Connector)

3 EzFi Application Software

The EzFi application software can be installed on x86 machines with Microsoft Windows 2000/XP operating systems. The Windows Vista is NOT supported. The screen resolution requirement is at least 1024 × 768 and the memory requirement is at least 1,024 MB. The EzFi application software is used for achieving full programmability like other programmable ECUs for racing cars.

3.1 Real-Time Engine Status Monitoring

The first screen of the EzFi application software is used for real-time engine status monitoring as shown in Figure 3-1. The default language is of Traditional Chinese. On the right top corner, there are several buttons. An engine information display area is below these buttons, comprising several 7-segment displays, four gauges, one meter, three LEDs, one LCD panel and five rotary switches.



Figure 3-1 Real-Time Engine Status Monitoring of EzFi Application Software (Traditional Chinese)



At first, we introduce the buttons reside on right top corner of the screen. From left to right, the first option button as shown in Figure 3-2 is used for selecting display language. Currently, two languages are supported by the EzFi application software – Traditional Chinese and English. If the language option button is selected for displaying English, the screen will be changed as shown in Figure 3-3.



Figure 3-2 Language Option of EzFi Application Software



Figure 3-3 Real-Time Engine Status Monitoring of EzFi Application Software (English)

The second button as shown in Figure 3-4 is used for switching display screen to the real-time engine status monitoring screen from other display screens.

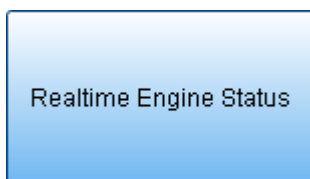
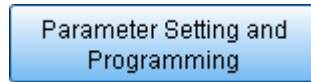


Figure 3-4 Real-Time Engine Status Button of EzFi Application Software

3. EzFi Application Software

The third button as shown in [Figure 3-5](#) is used for switching display screen to the parameter setting and programming screen from other display screens.



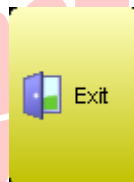
[Figure 3-5](#) Parameter Setting and Programming Button of EzFi Application Software

The fourth button as shown in [Figure 3-6](#) is used for switching display screen to the basic fuel map editing screen from other display screens.



[Figure 3-6](#) Basic Fuel Map Editing Button of EzFi Application Software

The fifth button as shown in [Figure 3-7](#) is used for closing the EzFi application software.



[Figure 3-7](#) Exit Button of EzFi Application Software

[Figure 3-8](#) shows six 7-segment displays on the left portion of [Figure 3-3](#). The first display shows a five-digit RPM value ranging from 0 RPM through 18,000 RPM. The second display shows a four-digit fuel injection time ranging from 0.00ms through 12.75ms. The third display shows a three-digit TPS percentage value ranging from 0% through 100%. If the TPS is not available on your scooter, the display value is 0. The fourth display shows a three-digit fuel injector duty cycle value ranging from 0% through 100%. The fifth display shows a three-digit MAP sensor voltage value ranging from 0.00V through 5.00V. The sixth display shows a three-digit battery voltage value ranging from 0.0V through 18.0V.

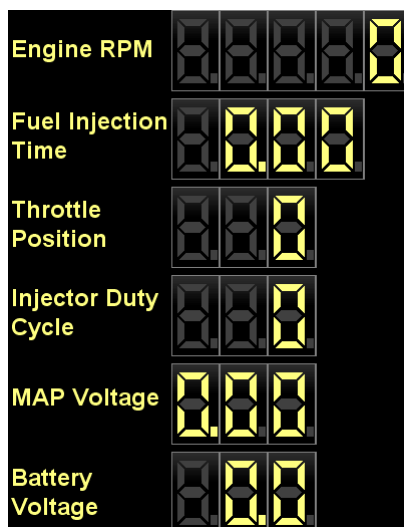


Figure 3-8 7-Segment Displays of EzFi Application Software

Figure 3-9 shows four gauges on the middle portion of Figure 3-3. The large one is a RPM gauge with the display range from 0 RPM through 18,000 RPM. The leftmost small gauge is responsible for displaying fuel injector duty cycle value ranging from 0% through 100%. The middle small gauge is responsible for displaying battery voltage value ranging from 6V through 18V. Finally, the rightmost small gauge is responsible for displaying MAP sensor voltage value ranging from 0V through 5V.



Figure 3-9 Gauges of EzFi Application Software

3. EzFi Application Software

Figure 3-10 shows the only meter on the screen of Figure 3-3. The meter is displayed in a vertical orientation and the throttle level is represented by the high/low level of the yellow liquid ranging from 0% through 100%. If the TPS is not available on your scooter, the display value is 0.

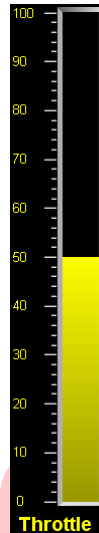


Figure 3-10 TPS Meter of EzFi Application Software

Figure 3-11 shows three LEDs on the left bottom portion of Figure 3-3. The first LED will be turned on when fuel compensation due to engine temperature is still in progress. In other words, since current engine temperature is too low (possibly when altitude is high or the engine is cold), the EzFi programmable fuel injection computer will perform fuel compensation according to user's setting. If the fuel compensation is completed (engine temperature is high enough), this LED will be turned off.

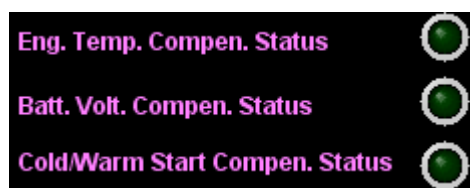


Figure 3-11 LEDs of EzFi Application Software

The second LED will be turned on when fuel compensation due to battery voltage is still in progress. In other words, since current battery voltage is too low (possibly due to aging of battery or lower energy), it requires more time to turn on the fuel injector. Consequently, the EzFi programmable fuel injection computer will perform fuel compensation according to user's setting. If user replaces a new battery or the battery voltage returns to a normal value (13 Volts), this LED will be turned off.



The third LED will be turned on when fuel compensation due to cold/warm engine start is in progress. In other words, since the engine is just started, the EzFi programmable fuel injection computer can perform fuel compensation according to user's setting. When compensation is completed (when engine rotates for more than 850 revolutions, it takes about 30 seconds corresponding to 1,700 RPM), this LED will be turned off.

Figure 3-12 shows the LCD panel on the bottom of Figure 3-3. The LCD panel is used for displaying miscellaneous information including number of teeth of the crankshaft position sensor, fuel injection modes (single-injection or double-injection per 4-stroke cycle), fuel injection compensation statuses, tilt sensor status and settings, etc.



Figure 3-12 LCD of EzFi Application Software

Figure 3-13 shows five rotary switches on the bottom of Figure 3-3. The EzFi application software can show the real-time status for each rotary switch on the EzFi programmable fuel injection computer (refer to Figure 2-3) via the USB programmer. On the screen, the leftmost rotary switch is corresponding to the Idle RPM range and the rightmost rotary switch is corresponding to the Super RPM range.



Figure 3-13 Rotary Switches of EzFi Application Software

3. EzFi Application Software

Figure 3-14 shows the firmware version 7-segment display on the right bottom portion of Figure 3-3. The four-digit 7-segment display shows current firmware version number of the EzFi programmable fuel injection computer.



Figure 3-14 Firmware Version 7-Segment Display of EzFi Application Software

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3.2 Parameter Setting and Programming

Whenever the parameter setting and programming button on the top right of the EzFi application software is pressed, a parameter setting and programming screen will be activated as shown in Figure 3-15.



Figure 3-15 Parameter Setting and Programming of EzFi Application Software

3. EzFi Application Software

3.2.1 Firmware File Open and Programm

Figure 3-16 and Figure 3-17 show the top portion with green background of Figure 3-15. The button on left side is used for opening a firmware file (*.ROM) for the EzFi programmable fuel injection computer. After installing the EzFi application software, the firmware file can be located at the C:\Program Files\EzFi\ directory. After the firmware file is selected as shown in Figure 3-17, the program button on right side will be enabled. User can program firmware, parameter settings, and fuel map into the EzFi fuel injection computer by pressing the program button.

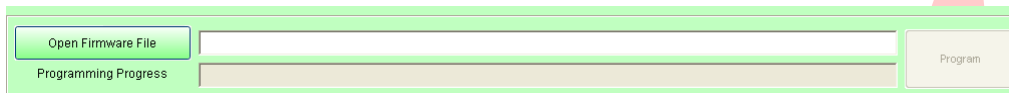


Figure 3-16 Open Firmware File and Program Buttons of EzFi Application Software (Before Opening the Firmware File)

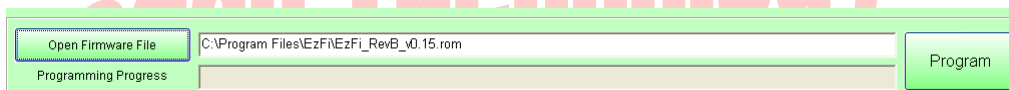


Figure 3-17 Open Firmware File and Program Buttons of EzFi Application Software (After Opening the Firmware File)

Before pressing the program button, please make sure that the USB programmer is correctly connected with your computer and the rainbow bus of the USB programmer is plugged into the EzFi programmable fuel injection computer. Finally, please confirm the main switch of the scooter should be turned on and the power indication LED on the EzFi is turned on also. You can press the program button only when the engine is not started. If connections and power supply are well, the EzFi application software will show current programming progress. It takes about 10+ seconds for completing the whole programming process. Software will have a pop up window to indicate that the programming is completed.



3.2.2 Fuel Map File Open and Save

Figure 3-18 shows the fuel map/parameter file open and save buttons. All parameter settings and the basic fuel map are saved as an EzFi fuel map file (*.map). After installing the EzFi application software, three sample EzFi fuel map files can be located at the C:\Program Files\EzFi\ directory as shown in Figure 3-19. When pressing the save fuel map/parameter file button, the saved file name is automatically assigned by the EzFi application software according to current year, month, day, hour, minute and second of user's computer. Users can rename the saved fuel map file as required.

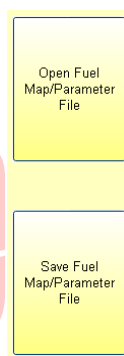


Figure 3-18 Fuel Map/Parameter File Open and Save Buttons of EzFi Application Software

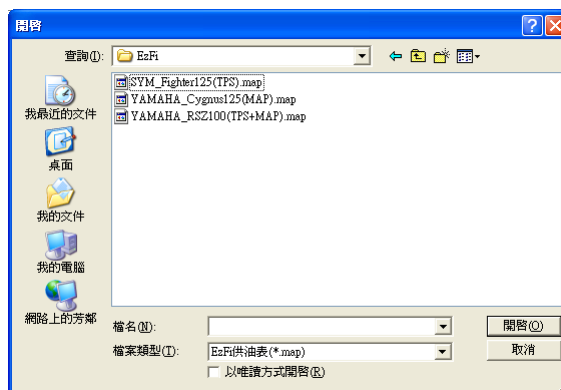


Figure 3-19 Sample Fuel Map Files of EzFi Application Software

3. EzFi Application Software

3.2.3 Parameter Setting – Pulser Type

The following subsections will introduce each parameter setting provided by the EzFi programmable fuel injection computer. The first one is the pulser type. As shown in [Figure 3-20](#), there are three options as described below:

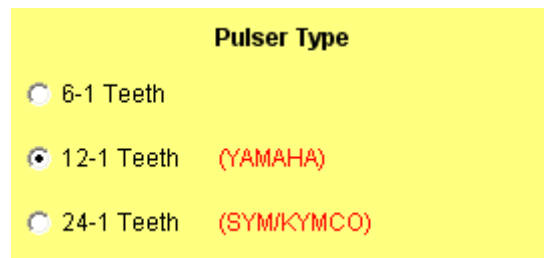


Figure 3-20 Pulser Type Setting of EzFi Application Software

- 6-1 Teeth – Selecting the WOLF crankshaft position sensor (CPS) as the source of engine revolution signal. In each revolution, five AC pulses are generated with a 60° interval between each tooth and a 120° interval for the missing tooth.
- 12-1 Teeth – Selecting the YAMAHA crankshaft position sensor (CPS) as the source of engine revolution signal. In each revolution, eleven AC pulses are generated with a 30° interval between each tooth and a 60° interval for the missing tooth.
- 24-1 Teeth – Selecting the SYM/KYMCO crankshaft position sensor (CPS) as the source of engine revolution signal. In each revolution, twenty-three AC pulses are generated with a 15° interval between each tooth and a 30° interval for the missing tooth.

If other pulse types are required for flexibility, please feel free to contact us.



3.2.4 Parameter Setting – Fuel Injection Mode

As shown in [Figure 3-21](#), there are two options for selecting the fuel injection modes.

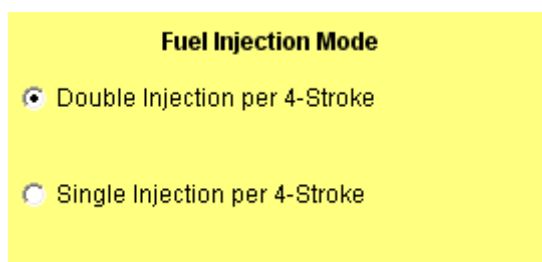


Figure 3-21 Fuel Injection Mode Setting of EzFi Application Software

- Double-Injection per 4-Stroke – the fuel is injected once in every single revolution of the 4-stroke engine. This mode is much more familiar to a carburetor. Every acceleration sensor type shown in [Subsection 3.2.5](#) is suitable for selecting this fuel injection mode. Since the engine can only intake the mixed air/fuel in the intake cycle, a portion of injected fuel will remain on the surface of the intake pipe and then evaporate or flow into the cylinder until the next intake cycle. Consequently, the fuel economy is possibly worse than single-injection per 4-stroke. However, this mode may be easier for achieving required performance of racing scooters.
- Single-Injection per 4-Stroke – the fuel is injected once in every two revolutions of the 4-stroke engine. This mode is a classic manner for electronic fuel injection engines. For acceleration sensor types shown in [Subsection 3.2.5](#), only the “MAP only” and the “MAP+TPS” types are suitable for selecting this fuel injection mode. Since the injection timing is set before the intake cycle, most of the mixed air/fuel will be directly drawn in the combustion chamber. Consequently, the fuel economy is possibly better than double-injection per 4-stroke. If precise air/fuel ratio tuning is well adopted, both racing performance and fuel economy can be achieved perfectly.

3.2.5 Parameter Setting – Acceleration Sensor Type

As shown in [Figure 3-22](#), there are three options for selecting the acceleration sensor type.

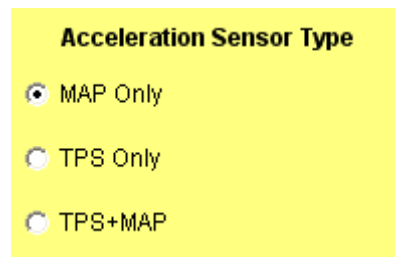


Figure 3-22 Acceleration Sensor Type Setting of EzFi Application Software

- **MAP Only** – For scooters like YAMAHA Cygnus X (without O₂ sensor), New Cygnus X (without O₂ sensor) and GTR, the Throttle Position Sensor (TPS) is unavailable in the factory design. Instead, a Manifold Absolute Pressure (MAP) sensor is responsible for both engine cycle identification and acceleration detection. The EzFi programmable fuel injection computer provides this MAP only type for these scooters. However, using the MAP sensor as acceleration detection is not sharper than using the TPS. It is recommended to install an extra TPS sensor provided by our authorized dealers. Besides the intake air efficiency is better, the acceleration sensor type can be set to TPS+MAP to achieve faster acceleration response time for your scooter. Furthermore, if you select the MAP only type, you need to set the MAP calibration table as described in [Subsection 3.2.12](#).
- **TPS Only** – For some older scooters of SYM and KYMCO, the MAP sensor is unavailable in the factory design. Instead, a TPS is responsible for acceleration detection. Without the MAP sensor, it is unable to identify the intake, compression, explosion, and exhaust cycle. The fuel injection mode as aforementioned in [Subsection 3.2.4](#) can select the “Double-Injection per 4-Stroke” only.
- **TPS+MAP** – Most electronic fuel injection scooters with O₂ sensor are equipped with both TPS and MAP sensor. Consequently, the acceleration detection and engine cycle identification can be achieved successfully. For older scooters lacking of any sensor, you may contact our authorized dealers to install the required sensor for your scooter.



3.2.6 Parameter Setting – Engine Temperature Fuel Injection Compensation

As shown in [Figure 3-23](#), the EzFi programmable fuel injection computer provides three options for selecting the fuel injection compensation as described in the following three subsections: engine temperature, battery voltage, and cold/warm start.

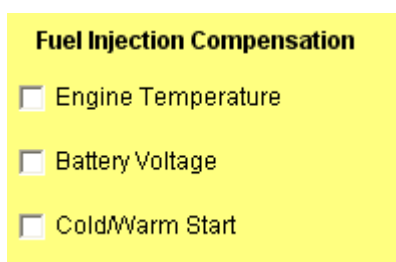


Figure 3-23 Fuel Injection Compensation Setting of EzFi Application Software

If you want to enable the fuel injection compensation according to engine temperature, you can mark the option of engine temperature. In contrast, you may disable the fuel injection compensation according to engine temperature by unmarking the option of engine temperature. As shown in [Figure 3-24](#), an engine temperature compensation table will be shown below after you mark the option of engine temperature. This one-dimension table contains 32 cells corresponding to voltage values of negative temperature coefficient sensor. Consequently, the voltage value is higher while engine temperature is lower and the voltage value is lower while engine temperature is higher. These hints are also shown on the EzFi application software.

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Figure 3-24 Fuel Injection Compensation According to Engine Temperature of EzFi Application Software

Usually, when the engine is cold (engine temperature sensor voltage is high), more rich fuel supply is required to maintain engine's operation since the bypass valve is usually open and air is richer. If the fuel injection amount is not increased adequately, the engine operation may be stopped without enough fuel supply. This compensation table can increase fuel injection amount for the whole basic fuel map. The increased percentage value is valid from 0% through 100% with 1% step. In general, 25% increase for low temperature is enough for most engines. The 32-level voltage values of the negative temperature coefficient sensor are 1.0V, 1.1V, 1.2V, 1.3V, 1.4V, 1.5V, 1.6V, 1.7V, 1.8V, 1.9V, 2.0V, 2.1V, 2.2V, 2.3V, 2.4V, 2.5V, 2.6V, 2.7V, 2.8V, 2.9V, 3.0V, 3.1V, 3.2V, 3.3V, 3.4V, 3.5V, 3.6V, 3.7V, 3.8V, 3.9V, 4.0V, and 5.0V. There are sample values in provided sample fuel map files.



3.2.7 Parameter Setting – Battery Voltage Fuel Injection Compensation

As shown in Figure 3-23, the EzFi programmable fuel injection computer provides three options for selecting the fuel injection compensation. The fuel injection compensation according to battery voltage is described in this subsection.

If you want to enable the fuel injection compensation according to battery voltage, you can mark the option of battery voltage. In contrast, you may disable the fuel injection compensation according to battery voltage by unmarking the option of battery voltage. As shown in Figure 3-25, a battery voltage compensation table will be shown below after you mark the option of battery voltage. This one-dimension table contains 16 cells corresponding to voltage values of the battery.



Figure 3-25 Fuel Injection Compensation According to Battery Voltage of EzFi Application Software

Usually, a normal healthy battery has a voltage value at around 13.8V. When the battery voltage is less than 12V, it indicates that the battery is decayed or possibly the stored energy is too low since charging current is not enough. With a lower battery voltage, it is harder to drive the fuel injector.



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Consequently, user may add extra fuel injector driving times with respect to different battery voltages. The added fuel injector driving time is valid from 0.0ms through 2.0ms with 0.1ms step. The 16-level battery voltage values are 6.0V, 6.5V, 7.0V, 7.5V, 8.0V, 8.5V, 9.0V, 9.5V, 10.0V, 10.5V, 11.0V, 11.5V, 12.0V, 12.5V, 13.0V, and 13.5V. There are sample values in provided sample fuel map files.

It should be noted that a general lead-acid battery with voltage value less than 10V ~ 11V can be treated as a damaged one. Please check the battery voltage and charge the battery frequently to keep voltage stability for smooth operation of electronic fuel injection systems.

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3.2.8 Parameter Setting – Cold/Warm Start Fuel Injection Compensation

As shown in Figure 3-23, the EzFi programmable fuel injection computer provides three options for selecting the fuel injection compensation. The fuel injection compensation according to cold/warm start is described in this subsection.

If you want to enable the fuel injection compensation according to cold/warm start, you can mark the option of cold/warm start. In contrast, you may disable the fuel injection compensation according to cold/warm start by unmarking the option of cold/warm start. As shown in Figure 3-26, a cold/warm start compensation table will be shown below after you mark the option of cold/warm start. This one-dimension table contains 16 cells corresponding to engine revolution counts.



Figure 3-26 Fuel Injection Compensation According to Cold/Warm Start of EzFi Application Software

The cold/warm start compensation table supports extra fuel injection compensation percentage within 850 revolutions from engine start. The valid percentage value is ranging from 0% through 100% with 1% step. The 16-level revolution counts are 0~99, 100~149, 150~199, 200~249, 250~299, 300~349,



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350~399, 400~449, 450~499, 500~549, 550~599, 600~649, 650~699, 700~749, 750~799, and 800~849. There are sample values in provided sample fuel map files.

If the revolution count after engine start exceeds 850 (note that 850 engine revolution count instead of RPM), the cold/warm start compensation table is no longer been used for fuel injection compensation. For example, if the RPM is 1,700 when engine is idle, this means that this engine will rotate 1,700 times within one minute. Consequently, the 850 engine revolution count means the engine takes about half minute to walk through this cold/warm start compensation table and get 16 compensation percentage values out of the table. After the engine rotates over 850 revolutions, the table will not be referenced again except the engine is stopped and started again.

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3.2.9 Parameter Setting – TPS Calibration Parameter

For scooters equipped with TPS, the voltage values of TPS should be calibrated before operating correctly because the 0% and 100% throttle may be mapped to different voltages for different TPS products. For example, some TPS outputs 0V through 3.1V corresponding to 0% through 100%, while some TPS outputs 0.8V through 4.2V corresponding to 0% through 100%. Consequently, the EzFi application software and the EzFi fuel injection computer design semi-auto detection and manual input for the TPS calibration values.

As shown in [Figure 3-27](#), there are two detection buttons and two fields for inputting the voltage values corresponding to 0% and 100% throttle, wherein two detection buttons are responsible for the semi-auto input function and two fields are responsible for the manual input function.

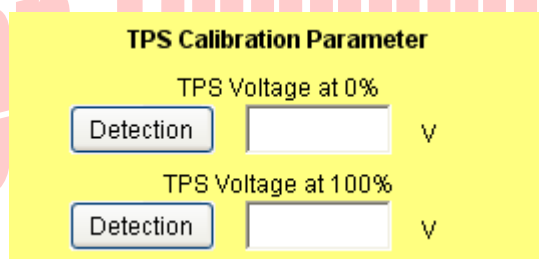


Figure 3-27 TPS Calibration Parameter Setting of EzFi Application Software

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

- Step 1 Connect the EzFi programmable fuel injection computer with your scooter;
- Step 2 Connect the USB programmer to both the EzFi and your computer;
- Step 3 Execute the EzFi application software and switch the display screen to parameter setting and programming;
- Step 4 Turn on the scooter power but do not start the engine and confirm the blue power LED on the EzFi is lighted;
- Step 5 Press the upper detection button at the TPS calibration parameter to detect TPS voltage of 0% throttle;
- Step 6 Rotate the scooter's throttle to 100% and hold, after 2 seconds press the lower detection button at the TPS calibration parameter to detect TPS voltage of 100% throttle; and
- Step 7 Release the scooter's throttle.



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In this manner, the TPS mapping range for each scooter can be detected. Both TPS setting values can be saved to 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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3.2.10 Parameter Setting – TPS Calibration Parameter

As shown in Figure 3-28, the upper bound of the fuel injector duty cycle can be set from 0% through 95% with 1% step. The fuel injector duty cycle indicates the ratio that the fuel injector is injecting corresponding to the 4-stroke cycle. For example, if single-injection per 4-stroke mode is adopted and the engine rotation speed is 6,000 RPM, the required time for each revolution is $1/(6,000/60) = 0.01$ second = 10ms. The 4-stroke (two revolutions) time is 20ms. If the EzFi calculated fuel injection time is 5ms. The duty cycle is $5\text{ms}/20\text{ms} = 25\%$. Furthermore, if double-injection per 4-stroke mode is adopted, there are two injections within 4-stroke. The duty cycle will become $5\text{ms} * 2 / 20\text{ms} = 50\%$. It is recommended to set the maximum duty cycle of not exceeding 80% for longer fuel injector life. If EzFi calculated fuel injection time exceeds the user defined maximum duty cycle, the final fuel injection time will be limited to the allowed maximum duty cycle.

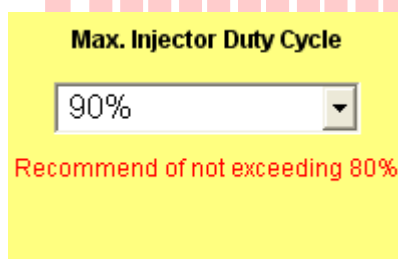


Figure 3-28 Max. Injector Duty Cycle Setting of EzFi Application Software

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3.2.11 Parameter Setting – TPS Calibration Parameter

This function is used for determining whether the fuel injection is cut while the scooter falls over. In general, the factory ECU will enable the fuel cut feature for safety considerations. Since the EzFi is independent from the factory ECU to drive the fuel injector, there is no relationship between EzFi fuel injection operation and the factory ECU’s fuel cut operation. Consequently, user may select to enable or disable this function. It should be noted that if this function is disabled, when the scooter falls over and the throttle is locked at 100%, the engine may be very dangerous since the engine still has rich air and fuel supply. This may increase opportunity of causing extra danger. Our company strongly recommended that all users should enable this option. If user decides to disable this option, our company does not responsible for any damage and indemnification.

Figure 3-29 and Figure 3-30 show the fuel cut by tilt sensor settings. If this function is enabled, the fuel cut sensor polarity should be selected further. Some scooters use high-level polarity and others use low-level polarity. If you do not know which polarity is used for your scooter, you may try any one and program into the EzFi to see if your scooter engine can be started while the scooter does not fall over. If your scooter engine can be started normally, it means that the polarity setting is correct. Otherwise, another polarity setting should be selected.

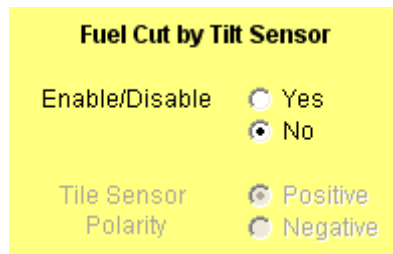


Figure 3-29 Fuel Cut by Tilt Sensor Setting of EzFi Application Software (Disabled)

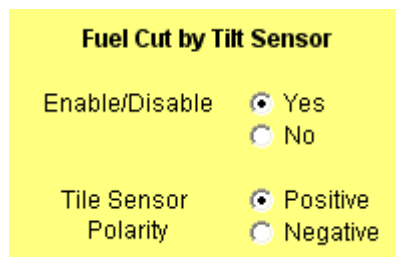


Figure 3-30 Fuel Cut by Tilt Sensor Setting of EzFi Application Software (Enabled)



3.2.12 Parameter Setting – MAP Calibration Table

On the bottom of the parameter setting and programming screen, the MAP calibration table as shown in **Figure 3-31** is used for the “MAP only” acceleration type scooters (refer to **Subsection 3.2.5**) to map the average MAP sensor voltage to TPS throttle. There are 11 levels for the TPS – 0%, 5%, 10%, 15%, 20%, 30%, 40%, 50%, 60%, 80%, and 100%. Since the “MAP only” scooters are not equipped with the TPS. The MAP sensor voltages have to be mapped into TPS percentages to index the basic fuel map as described in **Section 3.3**. The filled MAP average voltage is valid from 0.0V through 5.0V with 0.1V step. There are sample values in provided sample fuel map files.

MAP Calibration Table											
	Mapped Throttle Position %										
	0%	5%	10%	15%	20%	30%	40%	50%	60%	80%	100%
Avg. MAP Volt.											
Maximum MAP sensor voltage: 5.0V											

Figure 3-31 MAP Calibration Table of EzFi Application Software

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3.3 Basic Fuel Map Editing

3.3.1 Basic Fuel Map and RPM Resolution Setting

Whenever the basic fuel map button on the top right of the EzFi application software is pressed, a basic fuel map editing screen will be activated as shown in Figure 3-32.



Figure 3-32 Basic Fuel Map Editing of EzFi Application Software (100 RPM Resolution)



The EzFi programmable fuel injection computer provides a basic fuel map with 100 RPM through 18,000 RPM by 11-level TPS resolutions comprising 0%, 5%, 10%, 15%, 20%, 30%, 40%, 50%, 60%, 80%, and 100%. The 100 RPM through 18,000 RPM can be set by selecting the RPM resolution as one of 100 RPM, 200 RPM, 500 RPM and 1,000 RPM. In general, the 1,000 RPM resolution is recommended as a startup basis. As shown in Figure 3-33, the basic fuel map with 1,000 RPM resolution is formed as an 18 by 11 table. Since there are fewer cells, it is easier for roughly tuning the engine fuel map. The EzFi application software will average and interpolate the fuel map values into each cell of the 100 RPM fuel map. User does not need to worry about losing control precision due to selecting the 1,000 RPM resolution.



Figure 3-33 Basic Fuel Map Editing of EzFi Application Software (1,000 RPM Resolution)

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If user wants to increase resolution for tuning the fuel map, the 500 RPM resolution can be selected. As shown in Figure 3-34, the basic fuel map with 500 RPM resolution is formed as a 36 by 11 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 EzFi application software will average and interpolate the fuel map values into each cell of the 100 RPM fuel map. User does not need to worry about losing control precision due to selecting the 500 RPM resolution.



Figure 3-34 Basic Fuel Map Editing of EzFi Application Software (500 RPM Resolution)



If user wants to further increase resolution for tuning the fuel map, the 200 RPM resolution can be selected. As shown in Figure 3-35, the basic fuel map with 200 RPM resolution is formed as a 90 by 11 table. Since there are 2.5 times cells as compared to the 500 RPM resolution, user may tune the fuel injection amount in a more detailed order. The EzFi application software will average and interpolate the fuel map values into each cell of the 100 RPM fuel map. User does not need to worry about losing control precision due to selecting the 200 RPM resolution.



Figure 3-35 Basic Fuel Map Editing of EzFi Application Software (200 RPM Resolution)

The maximum resolution is to set as the 100 RPM resolution. As previous shown in Figure 3-32, the basic fuel map with 100 RPM resolution is formed as one 180 by 11 table. Since there are double cells as compared to the 200 RPM resolution, user may tune the fuel injection amount in a most detailed order.

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3.3.2 Basic Fuel Map Editing

As shown in Figure 3-36, there some buttons provided for editing the basic fuel map comprising a clear button, a average button, a subtraction button, an addition/subtraction value field, an addition button, a division button, a division/multiplication value field, a multiplication button, a RPM resolution menu, and messages for duty cycle and fuel injection time.



Figure 3-36 Basic Fuel Map Editing Buttons of EzFi Application Software

The clear button can be used for clearing the selected cell or area of the basic fuel map table. For the average button, we use the fuel map with 1,000 RPM resolution as an example. As shown in Figure 3-37, there are four cells marked by blue rectangles. User may input fuel injection times into these four cells ranging from 0.0ms through 12.75ms with a 0.05ms step. In the figure, the cell with 3,000 RPM and 10% TPS is 3.00ms; the cell with 3,000 RPM and 50% TPS is 4.00ms; the cell with 9,000 RPM and 10% TPS is 3.50ms; and the cell with 9,000 RPM and 50% TPS is 6.00ms. At this moment, user can use the mouse by clicking and holding the left key to mark the area with these four cells as four corners. The marked area is shown in Figure 3-28.



Figure 3-37 Basic Fuel Map Input Value Example of EzFi Application Software



Figure 3-38 Basic Fuel Map Mark Area Example of EzFi Application Software

After marking the area, user may press the average button to perform an averaging operation. The operated averaging result is shown in Figure 3-39.



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Figure 3-39 Basic Fuel Map Averaged Area Example of EzFi Application Software

Similarly, user may mark an area to perform addition/subtraction/multiplication/division by pressing corresponding buttons. The addition/subtraction button will add/subtract each cell inside the marked area by the value of the addition/subtraction value field. The division/multiplication button will divide/multiply each cell inside the marked area by the value of the division/multiplication value field.

It should be noted that the fuel injection time written inside the basic fuel map includes the operation time to open the fuel injector. In general, the fuel injector requires 0.8ms to 1.1ms to be fully turned on. Consequently, the fuel injection time below this value can possibly be treated as ineffective injection because the fuel injector does not have enough time to be turned on.



4 EzFi Rotary Switches

In this section, we will introduce the corresponding RPM ranges and fine-tuned fuel amount for each rotary switch of the EzFi programmable fuel injection computer.

4.1 Corresponding Engine RPM Ranges for Each Rotary Switch

There are five rotary switches provided by the EzFi programmable fuel injection computer. The corresponding symbols for these five rotary switches are I (Idle), L (Low), M (Medium), H (High), and S (Super), respectively. The corresponding engine RPM ranges for each rotary switch are shown in Table 4-1.

Table 4-1 Corresponding Engine RPM Ranges and Each Rotary Switch

Rotary Switch Symbol	Corresponding Engine RPM Range
I (Idle)	0 RPM ~ 1,999 RPM
L (Low)	2,000 RPM ~ 3,999 RPM
M (Medium)	4,000 RPM ~ 5,999 RPM
H (High)	6,000 RPM ~ 7,999 RPM
S (Super)	8,000 RPM ~ 18,000 RPM

It should be noted that the mechanical operation of each engine has its limitation. Although EzFi can support up to 18,000 RPM fuel map, the highest reachable engine RPM will be affected also by any combination of intake air system, exhaust system, engine compression ratio, engine displacement, and selected oil. This should be well configured and tuned by professional engine technicians instead of simply installation of the EzFi to achieve super high performance engine operation. Furthermore, operating engines in super high RPM ranges will accelerate engine lifecycle decaying. Users must ask professional engine technicians to sufficiently know the safety operation range of each engine and should ride the engine within the safety engine operation range.

4.2 Digital 16-Level Rotary Switches

As shown in Figure 2-3 and Figure 4-1, each rotary switch is of digital 16-level design. In the center of the rotary switch, there is an arrow shaped concave to select one of 16 levels (0 through 9 and A through F). Users may use a small screw driver for rotating the arrow shaped concave to point toward the intended alphanumeric.

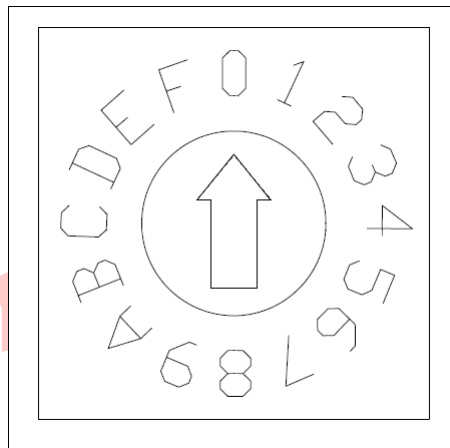


Figure 4-1 Digital 16-Level Rotary Switch

It should be noted that since the material of the rotary switch is of plastic, users should turn the rotary switch softly to prevent the plastic material of the arrow shaped concave and related material from being damaged.



4.3 Fine-Tune Fuel Amount of Rotary Switches

All five rotary switches have the same fine-tune fuel amount for corresponding engine RPM ranges as shown in Table 4-2.

Table 4-2 Fine-Tune Fuel Amount of Rotary Switches

Level of Rotary Switch	Fine-Tune Percentage
0	0% (Factory Default)
1	1%
2	2%
3	3%
4	4%
5	5%
6	6%
7	7%
8	8%
9	9%
A	-6%
B	-5%
C	-4%
D	-3%
E	-2%
F	-1%

When engine RPM is within 0 RPM through 1,999 RPM, EzFi programmable fuel injection computer will fine-tune the fuel amount of basic fuel map by the setting value of the I (Idle) rotary switch to output more or less fuel amount.

When engine RPM is within 2,000 RPM through 3,999 RPM, EzFi programmable fuel injection computer will fine-tune the fuel amount of basic fuel map by the setting value of the L (Low) rotary switch to output more or less fuel amount.

When engine RPM is within 4,000 RPM through 5,999 RPM, EzFi programmable fuel injection computer will fine-tune the fuel amount of basic fuel map by the setting value of the M (Medium) rotary switch to output more or less fuel amount.



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switch to output more or less fuel amount.

When engine RPM is within 6,000 RPM through 7,999 RPM, EzFi programmable fuel injection computer will fine-tune the fuel amount of basic fuel map by the setting value of the H (High) rotary switch to output more or less fuel amount.

When engine RPM is within 8,000 RPM through 18,000 RPM, EzFi programmable fuel injection computer will fine-tune the fuel amount of basic fuel map by the setting value of the S (Super) rotary switch to output more or less fuel amount.

It should be noted that if A through F is selected, a leaner fuel amount will be injected for the basic fuel map. If the fuel map is of fuel efficiency oriented already, to further reduce the fuel injection amount may cause that the engine may stop due to insufficient fuel supply. On the other hand, if the fuel map is of performance oriented already, to increase the fuel amount by selecting 1 through 9 may cause that the engine may loss power due to insufficient air supply.

Furthermore, the EzFi programmable fuel injection computer provides the interpolation compensation of neighboring rotary switches to fix the gap between neighboring rotary switch settings. For example, if M (Medium) rotary switch is set to 1 and H (High) rotary switch is set to richest 9, a sudden increase of fuel amount may possibly cause the engine stops when engine revolution is increased from M (Medium) range to H (High) range without adopting the interpolation compensation. Consequently, the EzFi programmable fuel injection computer has the built-in interpolation compensation between neighboring rotary switches to highly smooth engine operations across each RPM ranges.



Appendix A EzFi Connector Signals

Table A-1 EzFi Connector Signals

Pin No.	Signal Description	Wire Color
1	TPS Input	White
2	MAP Input	Grey
3	Tilt Input	Purple
4	Sensor Ground	Green
5	Power Ground	Black
6	Fuel Injection Output (To Injector)	Yellow
7	CPS Input	Orange
8	Fuel Injection Input (From ECU)	Blue
9	Engine Temperature Input	Pink
10	+12V Power	Red



Appendix B Authorized Dealers by IC Leader Technology Corporation

Authorized Dealers	Features
<p>HPM HIGH PERFORMANCE MAKER</p> <p>High Performance Maker Mr. Yu-Jing, Jhao No. 6-8, Sec. 1, Xin 5th Rd., Xinzhung City, Taipei County 24342, Taiwan TEL: +886-2-8521-5900 FAX: +886-2-8521-5919 Mobile: +886-936-074-001 E-Mail: yasu267@yahoo.com.tw</p>	<p>Famous racing bikes technician of Taiwan, Hong Kong, Macao and China Professional installation with dyno</p>
<p>Mr. Jhih-Jia, Gu 5F, No. 5, Alley 33, Lane 128, Sec. 3, Xiulang Rd., Zhonghe City, Taipei County 23580, Taiwan Mobile: +886-922-678-748 / +886-968-522-597 E-Mail: morelove2000@mail2000.com.tw</p>	<p>House call service at north of Hsinchu with air/fuel ratio instrument Taipei/Taoyuan area with dyno</p>
<p>FCS Motor Racing Co. Inc. Mr. Fang-Ruei, Ye No. 136, Sec. 3, Zhongshan Rd., Changhua City, Changhua County 50075, Taiwan TEL: +886-4-723-2127 / +886-4-722-1330 FAX: +886-4-723-9461 Moblie: +886-932-573-018 E-Mail: Nebfcs123@yahoo.com.tw</p>	<p>Distributor</p>
<p>Shun Zhan Motor Mr. Yu-Lin, Liang No. 1420-1, Jiuru 4th Rd., Gushan District, Kaohsiung City 80448, Taiwan</p>	<p>Frequent winner of scooter racings Professional installation with dyno</p>



Authorized Dealers	Features
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