





OWNER'S MANUAL

1. Index

2.	Presentation
3.	Warranty terms
4.	Characteristics84.1 Harness connections A connector - FT450 / FT550 and LITE
5.	First steps with FuelTech read before installation
6.	Getting to know the ECU.206.1 Dashboard206.2 Main menu206.3 FTManager shortcuts216.4 Warning sounds in FT550LITE226.5 Dashboard screen226.6 Diagnostic panel226.7 Test time based features236.8 Compression test246.9 Internet Remote Tuning246.10 FTManager exclusive features246.11 FTManager - Datalogger25
7.	Engine settings. 26 7.1 Engine setup. 27 7.2 RPM signal. 29 7.3 Cam sync sensor. 30 7.4 Ignition. 31 7.5 Fuel injection 32 7.6 Pedal/Throttle 33 7.7 Idle actuators 35 7.8 FueITech base map 35 7.9 Fuel injectors deadtime. 36 7.10 Ignition Dwell 36 7.11 Ignition energy 36 7.12 Map options 37 7.13 Advanced map options. 37
8.	Electrical installation
9.	Wiring PowerFT ECUs to harnesses from previous ECUs

	9.2 Connector diagram - Harness FT400 to FT550/LITE	. 41
	9.3 Connector Diagram - Harness FT400 to FT550/LITE	. 41
	9.4 A - Connector Diagram - Harness FT500 to FT550/LITE	. 42
	9.5 B - Connector Diagram - Harness FT500 to FT550/LITE	. 42
	9.6 A - Connector diagram - Harness FT500 to FT600	. 43
	9.7 B - Connector diagram - Harness FT500 to FT600	.43
10.	Fuel injectors	.44
11.	Ignition	.44
12.	Sensors and actuators	. 47
	12.1 Intake air temperature sensor	. 47
	12.2 Engine temperature sensor	. 47
	12.3 Fuel and oil pressure	. 47
	12.4 Throttle position sensor (TPS)	. 47
	12.5 Crank trigger/RPM sensor	. 48
	12.6 Camshaft position sensor	. 50
	12.7 02 sensor	. 50
	12.8 Step motor – idle speed	.50
13.	Auxiliary outputs	. 52
	13.1 Cooling fan 1 and 2	.52
	13.2 Idle valve	.52
	13.3 Air conditioning	.52
	13.4 Shift Alert	52
	13.5 Fuel numn	52
	13.6 Variable campbaft control/Poweralide gearbox	52
	13.7 Prograesive nitrous control	52
	12.9 Roost Control N75	.00 52
	12.0 ReactController	. JJ
		. 04
14.	Electronic throttle control	.55
	14 1 Electronic throttle control (ET600)	55
	14.2 Connection – throttle bodies and nedals	55
	1/1.3 Electronic thrattle control (ET550 / LITE)	56
	14.0 Connection - throttle bodies and nedals	56
		. 00
15.	Sensors and Calibration	.57
	15.1 Ignition calibration	.57
	15.2 TPS calibration	.57
	15.3 Electronic throttle/nedal calibration	57
	15.4 Fuel/oil pressure sensors inputs	58
	15.5 Intake air and engine temperature sensors	58
	15.6 M2 sensor innuts	59.
	15.7 Speed inputs	60
	15.8 Driveshaft RPM	.00 60
	15.9 Innut shaft BPM	61
	15.0 μραι σται ττι τη π	61
	15.10 Minu Oction	61
	15.11 Utitue hottle process	.01
	15.12 Nill Ous DULLE PIESSULE	.UZ
	15.15 Oluton position	. 02
	15.14 Uluton pressure	. 62



	15.15 Ride Height	. 63
	15.16 Pitch Rate	. 63
	15.17 CAN communication	. 63
	15.18 EGT	. 63
	15.19 Wastegate Pressure	. 64
	15.20 Internal accelerometer (FT550 /LITE and FT600)	. 64
	15.21 Brake Pressure	. 65
	15.22 Front and rear shocks	65
	15.22 Floy Fuel	65
	15.24 Back Proseura	65
	15.24 Dath Hessure	. 05
	15.20 UII pari pressure	.00
	15.20 Transmission pressure	
	15.27 Iransmission temperature	. 66
	15.28 lorque converter pressure	. 66
	15.29 Intercooler temperature	. 66
	15.30 Front and rear tires temperature	. 66
	15.31 Track temperature	. 66
	15.32 Engine Coolant pressure	. 66
	15.33 Turning lights	. 67
	15.34 Low beam / High beam	. 67
	15.35 Turbocharger RPM	. 67
	15.36 Fuel flow	. 67
	15.37 Flywheel RPM (Clutch basket)	. 67
	15.38 Automatic transmission range selector	. 67
	15.39 Paddle Shift	. 68
	15.40 Brake	. 69
	15.41 Multifunction button	. 69
	15 42 Battery temperature	69
	15 43 Compressed air pressure	60
	15.44 Fuel Consumption Control	60
		.00
16.	Starting the engine for the first time	.71
	16.1 First engine start	.71
	16.2 Ignition calibration	.71
17.	Fuel tables adjust	.72
	17.1 Main fuel table	.72
	17.2 Overall fuel trim	.72
	17.3 RPM compensation	.72
	17.4 O2 Closed Loop	.73
	17.5 Idle speed by TPS table	.74
	17.6 Acceleration fuel enrichment and decay	.74
	17.7 Engine temperature compensation	.75
	17.8 Intake air temperature compensation	.75
	17.9 Battery voltage compensation	. 75
	17 10 MAP / TPS compensation	76
	17 11 Prime nulse	76
	17 12 Engine start	76
	17.12 Englito stat anrichment	76
	17.14 Individual avlindar time	. 1 U 77
	17.14 II UIVIOUAI CYIIITOET UTITT	
	I / . I > KUTOR COMPENSATION	. / /
	17.16 Gear based compensation	. 77
	1/.1/ Gear shift fuel enrichment	.77

17.18 Fuel injection phase angle table77
Ignition tables adjust
18.1 Main ignition table
18.2 Overall ignition trim
18.3 MAP/TPS compensation
18.4 Engine temperature compensation
18.5 Intake air temperature compensation
18.6 Rotary timing split79
18.7 Individual cylinder trim
18.8 Rotor compensation
18.9 Timing limits
18.10 Engine Start
18.11 Gear compensation
18.12 Gear shift compensation
Other functions 91
10.1 Internal datalonger 01
19.2 Accelerometer and avroscope (FT550 and FT600) 82
19.3 Idle speed control 83
10.4 Deceleration cut-off
19.5 Bayolution limiter 85
19.5 Nevolution limiter
19.7 Thermatic Fan #1 86
10.8 Thermatic Fan #2
10.0 Air conditioning
19.10 Fuel numn 88
19 11 Cold start auxiliary 88
19.12 Camshaft control 89
19 13 Progressive nitrous control #1 and #2
19.14 Generic duty cycle output
19 15 Boost activated output #1 and #2
19 16 Tachometer output 91
19 17 Wasterrate boost pressure control #1 and #2 91
19 18 Power shift (GearController FT550 / LITE and FT600) 96
19.19 Start Button
19.20 BPM activated output. 98
19.21 Pit limit
19.22 Active traction control
19.23 Generic Outputs
19.24 Flex Fuel
19.25 Blip / Heel and toe
19.26 Variable Camshaft (VVT)
19.27 Automatic Transmission Control
19.28 Lockup Control
19.29 Push to pass (P2P)
19.30 Anti-lag / Pops & Bangs / Engine brake
19.31 Compressed air control
19.32 Advanced gear shift manager
19.33 Electronic Wastegate Control
19.34 eGate Important Information
19.35 eGate #1 and #2 position calibration
19.36 eGate #1 and #2 temperature



18.

19.

19.37 Control by external reference	. 117
19.38 PWC Controls	. 118
19.39 Frequency control	. 118
19.40 Water pump	. 119
19.41 Vehicle lights control	. 119
19.42 Power brakes control	. 120
19.43 Timed main relay	. 120
19.44 Electronic Blow Off control	.121
19.45 External TCU control	.121
19.46 Water methanol injection (WMI)	. 123

20.	Drag race features
	20.1 Burnout mode
	20.2 3-step (boost spool)
	20.3 2-step rev limiter
	20.4 Linelock Brake Control
	20.5 Timing table for rev launch
	20.6 Gear shift output
	20.7 Time based fuel enrichment
	20.8 Pro-Nitrous
	20.9 Time based output
	20.10 Wheelie Control
	20.11 Davis Technologies
	20.12 Time based throttle opening
	20.13 Staging control
	20.14 Mechanical fuel injection controller
	20.15 Launch delay controls (delay box)
	20.16 Time based individual ignition trim
	20.17 Time based individual fuel trim
	20.18 DialBoard
	20.19 Throttle stop control
21	Alert settings 139
211	21.1 General alert settings 139
	21.2 Alerts 139
22.	Favorites
03	Interface settings 1/2
20,	23.1 Day/night mode selection 142
	22.2 LCD blocklight acttings (ET600 only) 142
	22.2 LOD blacklight Settings (F1000 011))
	20.0 LLD Wininguidulli (F1000 Unity)
	23.4 VITUal LEDS CONIUGUIATION (F1430 and F1550)

23.5 Alert sound settings14323.6 Dashboard setup14323.7 Startup screen selection14423.8 Splash Screen14423.9 Password Protection setup14423.10 Clear peaks14523.11 Measurement units14523.12 Demonstration mode14523.13 Touchscreen calibration14523.14 Serial number and software version146

FT450	/ FT550	/ FT550L	ITE / FT60	0
				_

	23.15 Odometer and Hourmeter 146 23.16 Practice Tree Game 146
24.	File manager14724.1 FuelTech base map generator14724.2 Edit map file name14724.3 Copy map to another file14724.4 Erase file14724.5 Selection by button147
25.	Electrification 148 25.1 Glossary 148 25.2 Power Train Settings 148 25.3 EV output configuration 149 25.4 Torque and Regen 149 25.5 Battery 150 25.6 DCDC Converter 151 25.7 Driveability 151 25.8 Charging Control 152
26.	Rotary engines setup15326.1 Crank angle sensor installation and alignment15326.2 Crank angle sensor wiring15326.3 ECU setup15426.4 Ignition coils wiring154
27.	Electrical diagram - example FT600155
28.	FT450 and FT550 mounting kit159
29.	Bracket dimensions
30.	FTCAN 2.0 protocol 163 30.1 Physical layer 163 30.2 IDENTIFICATION 163



2. Presentation

Congratulations, You're now part of the high performance world of FuelTech!

The equipment that you just acquired is the same being used in different vehicles all over the world, whether it be for a street car, motorcycle, jet ski, boat, ATV or professional series drag race combination...we have you covered!

From all of us at FuelTech, we wish you fun on your path and many victories, because winning is in our DNA!

Inspired by our passion of victories, be it on the track or a personal one like having a perfectly tuned car, and writing new chapters in our history between automobilism and technology, FuelTech created the PowerFT line of ECU's, with it you will enjoy features developed to extract the maximum performance and safety out of your project, street or drag car, off road vehicle, motorcycle or any other application that needs functionalities with ease of use and great results.

The PowerFT platform is capable of managing any type of Otto cycle engine(with cylinders) or Wankel (with rotors). It has sequential, semisequential and multipoint fuel injection as well as sequential, distributor or wasted spark ignition, both with either simple (2D) or advanced (3D tables), besides that , there are many other features made to improve functionality on a variety of applications, allowing for better drivability and comfort. All this versatility is also applied to the hardware, making it possible to customize its inputs to use factory sensors and assigning outputs to different roles, rendering it practically impossible not to suit to your project.

The PowerFT ECU's have no limitation in regards to features except when special hardware is needed, like with the powershift, internal accelerometer and drive by wire. The main integrated features of all ECU's are wastegate boost control (Boostcontroller), O2 closed loop corrections, idle control by timing and actuators, nitrous control, active traction control, as well as dedicated features to obtain the best results in drag racing.

All the ECU's feature a CAN bus to create a network with other products, making the installation of upgrades even simpler and easier, the USB port also allows a fast and robust communication with the FTManager software.

Another great feature is the 256 channel datalogger, with a resolution of up to 200hz for detailed analysis and fine adjustments that could make all the difference to attain victory. Through FTDatalogger software you can quickly and efficiently visualize every logged channel and easily make changes to the engine management as well as using the diagnostic feature (also accessible on the ECU screen and FTManager) to identify problems.

FuelTech is concerned with your engine safety and created an extensive range of alerts and safe modes to help protect your engine in dangerous and critical situations.

The FuelTech FT450 is the perfect choice for cost-effective builds. Featuring a robust and waterproof plastic housing, an automotive 26 pin connector, 7 inputs and 10 outputs that are totally configurable. Its 4.3" display, along with same dashboard as the FT600, makes the heads up of information to the driver much more clearer while enabling street cars to have an engine start button and virtual LEDs to use with warning lights such as high beam, turn signals and much more. The display also allows for complete access to all map adjustments, so its possible to edit tables and other settings without the need of a computer, the perfect integration between ECU and Dashboard.



The FT550 is ideal for projects that need more resources, it has integrated powershift, internal accelerometer (G force sensor) and gyroscope (inclination sensor), and drive by wire control.

Features a robust and waterproof plastic housing with 52 pins automotive connectors, 2 CAN ports, 14 inputs and 24 outputs that are totally configurable.



The FT600 is the most complete ECU and Dashboard available on the market.

It features an waterproof aluminum case with superseal automotive connectors with a total of 68 pins (21 inputs and 32 outputs), 2 CAN ports, internal accelerometer and gyroscope as well as integrated powershift feature. It also has 10 LEDS with RPM, activation and colors configurable, 4 side LEDs that can be used for alerts and a 4.3" anti-glare display.



3. Warranty terms

The use of this equipment implies the total accordance with the terms described in this manual and exempts the manufacturer from any responsibility regarding to product misuse

Read all the information in this manual before starting the product installation.



NOTE

This product must be installed and tuned by specialized auto shops and/or personnel with experience on engine tuning.

Before starting any electric installation, disconnect the battery.

The inobservance of any of the warnings or precautions described in this manual might cause engine damage and lead to the invalidation of this product warranty. The improper use of the product might cause engine damage.

This product does not have a certification for the use on aircraft or any flying devices, as it has not been designed for such use purpose.

In some countries where an annual inspection of vehicles is enforced, no modification in the OEM ECU is permitted. Be informed about local laws and regulations prior to the product installation.

Important warnings for proper installation of this product:

- Always cut the unused parts of cables off NEVER roll up the excess.
- The black wire of the harness MUST be connected directly to the battery's negative terminal, as well as each one of the sensors' ground wires.
- It is recommended to wire the **black/white** wire directly to the **battery negative** terminal, making sure that the ECU is well grounded. If the ECU wiring has not been made properly, it may cause irreparable problems to the ECU.



IMPORTANT

The all black and black/white ground wires must go SEPARATELY to the negative battery terminal.



WARNING

- It is a good practice to save your maps on the PC, as a security backup. In case of problems with your ECU, this will be the guarantee that your calibrations are saved. In some cases, when the ECU is upgraded by the factory, its memory may be erased also.
- It's not possible to change the interface language on the PowerFT platform.

IMPORTANT

PowerFT ECU's (FT450, FT550 and FT600) are water proof, however, some specific instructions must be followed:

- Do not point pressure washers directly to the ECU screen

- When removing wires from the ECU connector, be sure to use Super seal connector hole plugs, to completely seal the ECU (TE Connectivity PN 4-1437284-3)

Limited Warranty

This product warranty is limited to one year from the date of purchase and covers only manufacturing defects upon presentation of purchase invoice.

This ECU has a serial number that's linked to the purchase invoice and to the warranty. In case of product exchange, please contact FuelTech tech support.

Damages caused by misuse of the unit are not covered by the warranty. This analysis is done by FuelTech tech support team.

The violation of the warranty seal results in the invalidation of the Product Warranty.

All PowerFT ECUs are protected by US Patent 11,215,158

Manual version 2.8 – November/2024 ECU version – 5.3 FTManager version - 5.3



4. Characteristics

Specifications	FT450	FT550 / LITE	FT600
Otto cycle engine control	8	12	12
Wankel engines (rotary)	2	4	4
Sequential, semi sequential and multipoint fuel control		YES	
Distributor and crank trigger ignition control		YES	
Wasted spark and sequential ignition control		YES	
Electronic throttle body Control (Drive-By-Wire)	NO	YES	YES
Idle speed control by PWM valve		YES	
Idle speed control by electronic throttle, stepper motor and ignition timing	NO	YES	YES
Closed loop injection through oxygen sensor (wide band lambda sensor)		YES	
Real time programmable by the screen or PC through FTManager Software		YES	
Inputs			
Differential input for RPM signal		YES	
Differential input for cam sync signal	NO	NO	YES
Input channels totally configurable - digital and analogical	7	14	20
2 high sensibility inputs used preferably for gear shifter force sensor	NO	YES	YES
Editable sensors reading scale	YES	YES	YES
103psi internal MAP sensor (7 bar - absolute), 14.7psi of vacuum and 88psi of positive pressure (boost);		YES	
1 USB port for computer and FuelTech software connection;		YES	
CAN ports for FuelTech FTCAN 2.0 or FTCAN 1.0 communication with FuelTech WB-O2 Nano, FuelTech EGT-8 CAN, Racepak IQ3, VNET, AiM, etc).	1	2	2
Outputs			
Configurable outputs channels	10	24	32
Blue output ¹		12	16
Gray output ²		8	8
Yellow output ³	0	4	8
Injection control			
Sequential injection (Blue outputs)	6	12	16
Closed loop fuel control through O2 sensor (wide band sensor)	YES		
2 injector banks (staged injection banks A and B)	YES		
Main map to MAP or TPS to RPM	YES		
Main map 3D advanced until 32x32 points (completely adjustable map index and size)	YES		
Simplified 2D map with up to 1x32 cells per MAP or TPS and RPM compensation of up to 1x32 cells (completely adjustable map index and size)	YES		
Injection time resolution 0.001ms	YES		
Fuel enrichment and decay adjust	YES		
Individual cylinder trim setting by MAP or RPM	YES		
Starting engine map with the engine temperature	YES		
Ignition control			
Sequential ignition with individual coil	54	8	8
Main map to MAP or TPS to RPM	YES		
Main map 3D advanced until 32x32 points (completely adjustable map index and size)	YES		
Simplified 2D map with up to 1x32 cells per MAP or TPS and RPM compensation of up to 1x32 cells YES (completely adjustable map index and size)			
Ignition angle resolution 0.01° YES			
Timing compensation (air temperature, engine and gear) YES			



		1	
Dashboard screen / On board computer	FT450	FT550 / LITE	FT600
Screen dashboard which displays different sizes and styles to be used with any existing equipment or sensor		YES 6	
Upper tab with 10 LED lights, colored RGB and adjustable progressive shift light	NO	NO	YES
4 RGB LED side lights which can be triggered by 3 different combined settings	NO	NO	YES
4 Virtual LED	YES	YES 6	NO
Diagnosis dashboard with real-time information of all inputs outputs, CAN and Status Events		YES	
Internal datalogger			
Multiple logs recording (channels)		256	
Configurable sampling rate per channel	1, 5, 25	5, 50, 100 c	r 200Hz
Automatic activation by RPM, through the screen or by external button		YES	
Data storage for up to 5		2h50min	
FTManager Datalogger Software for viewing and comparing logs		YES	
Drag race features			
Burnout mode, 2-step, 3-step; Timing table for rev launch; 2-step by wheel speed or pressure/position of clutch; Time based RPM limiter by timing retard or ignition cut; Time based wheel speed or driveshaft RPM control with timing retard or ignition cut; Time-based ignition timing compensation; Pro-Nitrous setting for up to 6 stages, with activation control, fuel enrichment and ignition timing maps; Gear shift output; Time based output; Staging control; Wheelie control;		YES	
Other realizes			VEO
Integrated Gear Controller: Ignition out for clutchiess gear shifting using a strain gage sensor on the shifter;	NO	YES	YES
PWM valve or electronic throttle body; Deceleration fuel cut-off; Control of up to two cooling fans by coolant temperature; Air conditioning control; Fuel pump control – with 6s prime; VTEC control; Progressive nitrous control with fuel enrichment and timing retard; Automatic transmission control; Lockup control; Launch delay control (Delay Box);	YES		
Protection and Alerts			
RPM limiter by fuel or ignition cut; Shift light ⁶ with sound and dashboard alert and/or external shift light; Configurable safe mode options;		YES	
General characteristics			
Display brightness adjusts; Night and day mode selection by external switch and through the menu; Audible and visual alert, including external shift light control; 5 memory positions to save different adjusts and maps; User and tuner protection passwords; PC communication through USB cable and channel customization via FTManager Software;			
Working temperature:	-4 F until 158 F		
Maximum power supply		20V	
ECU Dimensions			
- ECU: width (in)	5.75	5.75	5.86
Height (in)	3.62	3.62	3.7
Depth (in)	2.13	2.13	2.42
- Box: width (in)		12.2	
Height (in)		8.86	
Depth (in) 3.34			
Weight			
- ECU (oz)	10	11	21
- Box with wire harness (oz)	92	134	117

1 - Recommended for high impedance injectors without the need of an external driver (up to 4 injectors per output)

2 - Recommended for ignition (open collector outputs with 5v power supply)

3 - Recommended for driving stepper motors, electronic throttle, ignition and 12v loads

4 - Use blue output number 6 as a 5th ignition output on FT450

5 - Data recording time depends on the sample rate and the number of channels that are being recorded.

6 - FT550LITE not support.



4.1 Harness connections A connector - FT450 / FT550 and LITE

Pin	Wire Color	Function	Information
1	Blue #1	Blue output #1	
2	Blue #2	Blue output #2	
3	Blue #3	Blue output #3	These outputs are usually used for injector control. When needed, they can be
4	Blue #4	Blue output #4	- Configured as adxillary outputs ****.
5	Blue #5	Blue output #5	
6	Blue #6	Blue output #6	
7	Black/white	Power ground input	Directly wired to the battery negative terminal with no seams. Do not tap any other grounds to this wire, it must run clean straight to the battery negative terminal.
8	Gray #1	Gray output #1	
9	Gray #2	Gray output #2	These outputs are usually used for ignition control.
10	Gray #3	Gray output #3	When needed, they can be set up as injector outputs or auxiliary outputs ¹⁴ .
11	Gray #4	Gray output #4	
12	Black	Battery negative input	Connected directly to the battery negative with no seams. Do not connect this wire to the chassis, engine block or head.
13	Red	12V input from relay	Connected to the pin 87 of the Main Relay
14	Green/Red	5V outputs for sensors	5V voltage output for TPS, electronic throttle and pedal sensors
15	Yellow/Blue	CAN A (-)	CAN A (-)
16	White/Red	CAN A (+)	CAN A (+)
17	Shielded Cable (white)	CAM sync signal input	Connected to the cam sync sensor (hall or magnetic)
18	Black Shielded Cable (White)	Magnetic RPM sensor reference	Connected to the negative wire of the magnetic sensor. When OEM ECU is reading the sensor in parallel, split this wire with OEM sensor negative - Do not connect when using hall effect sensor.
19	Black Shielded Cable (Red)	RPM signal input	Connected to the crank trigger sensor (hall or magnetic) or to the distributor. To VR sensors, use the shield wire the sensor shield. To Hall sensor, do not use the shield as negative
20	White #1	Input #1	
21	White #2	Input #2	
22	White #3	Input #3	
23	White #4	Input #4	Sensors input
24	White #5	Input #5	
25	White #6	Input #6	
26	White #7	Input #7	

1 - Outputs that can be used as "Tach output": Blue #3, blue #6, gray #4 (FT450)

2 - The blue output #6 can be used as the fifth ignition output (FT450)

3 - In order to avoid backfeeding when using the blue outputs or gray output #4 to power relays or actuators, make sure the switched 12V that powers them is the same that powers the ECU.

4 - When using as an injector output a Peak and Hold driver must be used

5 - The blue output #5 Can be used with PWM idle valve or WT Controller (FT450);



A-connector diagram - FT450 / FT550 and LITE





4.2 Harness connections B-connector (FT550 / LITE Only)

Pin	Wire Color	Function	Information
1	Black/White	Power ground inputs	Directly wired to the battery negative terminal with no seams. Do not tap any
2	Black/White	Power ground inputs	other grounds to this wire, it must run clean straight to the battery negative terminal.
3	Yellow/Blue	CAN B (-)	CAN B (-)
4	White/Red	CAN B (+)	CAN B (+)
5	White #8	Input #8	
6	White #9	Input #9	Sensors input
7	White #10	Input #10	
8	Blue #7	Blue output #7	These outputs are usually used for injector control. When needed, they can be
9	Blue #8	Blue output #8	configured as auxiliary outputs.
10	Gray #5	Gray output #5	These outputs are usually used for ignition control.
11	Gray #6	Gray output #6	When needed, they can be set up as injector outputs or auxiliary outputs.
12	White #11	Input #11	
13	White #12	Input #12	- Serisors input
14	Blue #9	Blue output #9	These outputs are usually used for injector control. When needed, they can be
15	Blue #10	Blue output #10	configured as auxiliary outputs.
16	Gray #7	Gray output #7	These outputs are usually used for ignition control.
17	Gray #8	Gray output #8	When needed, they can be set up as injector outputs or auxiliary outputs ² . By standard, Gray output #8 is used as a tachometer output ¹ . (FT550)
18	White #13	Input #13	Sensors input or Power Shift Input - Blue wire Strain gage sensor (positive)
19	White #14	Input #14	Sensors input or Power Shift Input - Orange wire Strain gage sensor (negative)
20	Blue #11	Blue output #11	These outputs are usually used for injector control. When needed, they can be
21	Blue #12	Blue output #12	configured as auxiliary outputs.
22	Yellow #1	Yellow output #1	
23	Yellow #2	Yellow output #2	Electronic throttle and step motor outputs. Also used as injection or auxiliary
24	Yellow #3	Yellow output #°3	outputs (cooling fan, fuel pump, etc.)
25	Yellow #4	Yellow output #4	
26	Green/Black	Ground for sensors	Connected the sensors ground

1 - In order to avoid backfeeding when using the blue outputs or gray output #4 to power relays or actuators, make sure the switched 12V that powers them is the same that powers the ECU.

2 - When using as an injector output a Peak and Hold driver must be used



B-connector diagram - FT550 / LITE





Pin	Wire Color	Function	Information	
1	Blue#1	Blue output #1		
2	Blue#2	Blue output #2		
3	Blue#3	Blue output #3		
4	Blue#4	Blue output #4		
5	Blue#5	Blue output #5		
6	Blue#6	Blue output #6		
7	Blue#7	Blue output #7		
8	Blue#8	Blue output #8	These outputs are usually used for injector control. When needed,	
9	Blue#9	Blue output #9	they can be configured as auxiliary outputs.	
10	Blue#10	Blue output #10		
11	Blue#11	Blue output #11		
12	Blue#12	Blue output #12		
13	Blue#13	Blue output #13		
14	Blue#14	Blue output #14		
15	Blue#15	Blue output #15		
16	Blue#16	Blue output #16		
17	Black/White	Power ground input	Directly wired to the battery negative terminal with no seams. Do not tap any other grounds to this wire, it must run clean straight to the battery negative terminal.	
18	Gray#1	Gray output#1		
19	Gray#2	Gray output#2		
20	Gray#3	Gray output#3	These outputs are usually used for ignition control.	
21	Gray#4	Gray output#4	When needed, they can be set up as injector outputs or auxiliary	
22	Gray#5	Gray output#5	outputs.	
23	Gray#6	Gray output#6	By standard, Gray output #8 is used as a tachometer output ¹ .	
24	Gray#7	Gray output#7		
25	Gray#8	Gray output#8		
26	Yellow#1	Yellow output#1		
27	Yellow#2	Yellow output#2		
28	Yellow#3	Yellow output#3		
29	Yellow#4	Yellow output#4	Electronic throttle and step motor outputs. Also used as injection or	
30	Yellow#5	Yellow output#5	auxiliary outputs (cooling fan, fuel pump, etc.)	
31	Yellow#6	Yellow output#6		
32	Yellow#7	Yellow output#7		
33	Yellow#8	Yellow output#8		
34	Red	12V input from relay	Connected to the pin 87 of the Main Relay.	

1 - The switched 12v on loads like relays and solenoids, must be the same as the ECU when being triggered by the gray output 8, to avoid backfeeding that will keep the ECU powered on (FT600)



A-connector diagram





4.4 Harness connections B-connector (FT600)

Pin	Wire Color	Function	Information	
1	Red	RPM signal input	Connected to the crank trigger sensor (hall or magnetic) or to the distributor. To VR sensors, use the shield wire the sensor shield. To Hall sensor, do not use the shield as negative	
2	White	Magnetic RPM sensor reference	Connected to the negative wire of the magnetic sensor. When OEM ECU is reading the sensor in parallel, split this wire with OEM sensor negative - Do not connect when using hall effect sensor.	
3	Red	Cam sync signal input	Connected to the cam sync sensor (hall or magnetic)	
4	White	Cam sync reference input	Connected to the cam sync sensor (hall or magnetic) - Use the shield as negative to the sensor	
5	White#1	White input#1	Default: O2 sensor input	
6	White#2	White input#2	Default: two-step input	
7	White#3	White input#3	Default: Air conditioning button	
8	White#4	White input#4	Default: Oil pressure	
9	White#5	White input#5	Default: Coolant temperature	
10	Black	Battery negative input	Connected directly to the battery negative with no seams. Do not connect this wire to the chassis, engine block or head.	
11	Yellow/Blue	CAN A LOW		
12	White/Red	CAN A HIGH	- CAN A	
13	White#6	White input#6	Default: fuel pressure	
14	White#7	White input#7	Default: Air temperature	
15	White#8	White input#8	Default: pedal#2 signal input	
16	White#9	White input#9	Default: pedal#1 signal input	
17	White#10	White input#10	Default: MAP signal output, electronic throttle 1B input signal	
18	Black/White		Directly wired to the battery negative terminal with no seams. Do not tap any	
19	Black/White	Power ground inputs	other grounds to this wire, it must run clean straight to the battery negative terminal.	
20	White/Red	CAN B HIGH	CAN B HIGH	
21	White#11	White input#11	Default: TPS sensor	
22	White#12	White input#12		
23	White#13	White input#13	Sonsore input	
24	White#14	White input#14		
25	White#15	White input#15		
26	Red	12V input from relay	Connected to the pin 87 of the Main Relay	
27	Green/Red	5V outputs for sensors	5V voltage output for TPS, electronic throttle and pedal sensors	
28	Yellow/Blue	CAN B LOW	CAN B LOW	
29	Green/Black	Ground for sensors	Connected the sensors ground	
30	White#16	White input#16		
31	White#17	White input#17	Sensors input	
32	White#18	White input#18		
33	White#19	White input#19	Power Shift Input - Blue wire Strain gage sensor (positive signal)	
34	White#20	White input#20	Power Shift Input - Orange wire Strain gage sensor (negative signal)	



NOTE

When using the GearController function connect the White wire from the shifter to ground for sensors Green/Black (pin #29).

IMPORTANT

Fuel only: When using this option, the RPM signal input cannot be connected to a coil high voltage signal because the input has no protection and will damage the trigger input on the ecu. Please use a tach output, another rpm source or an ignition coil to tach adapter module to avoid damage to the unit.

<u>FuelTech</u>

B-connector diagram



4.5 Output table of FT

Wire color	Output type	Nominal current for negative activation (0V) for each output	Nominal current for positive activation for each output	Application	Notes
Blue	Open collector (Lo side)	5A* ***	Can't activate by positive	Fuel injectors, relays, solenoid valves	Triggers loads always by negative
Gray	Open collector with current source in 5V (Lo side)	1A* ***	30mA in 5V	Inductive ignition control, fuel injectors, relays, solenoid valves	Triggers loads always by negative
Yellow	PUSH-PULL or HALF BRIDGE	5A* ***	5A** in 12V	Electronic throttle, step motor, MSD/ M&W and other ignitions activated by 12V	When used to control relays, valves or any other load by negative , there is a risk of 12V return to the ECU. This will keep the ECU always powered on. In this case, an external diode or a relay with built-in diode is required for protection.
Green/ Red	5V output	-	150mA in 5V	5V output sensors	Supplies 5v for sensors such as TPS, driveshaft, PS150, PS300 and etc

* Total max current combined with all outputs triggering loads by negative: (30A - FT550 / LITE and FT600) (10A - FT450) continuous

** Total max current combined with all outputs triggering loads by positive: (20A - FT600) (10A - FT550) continuous

*** Outputs can be automatically disabled for safety when currents above 20% of the rated current are detected



NOTE

Blue outputs cannot control ignition because they do not have a pullup resistor.

IMPORTANT

The ECU has the ability to support the connection of up to two relays at each output. If it is necessary to install additional relays, it is recommended to perform this installation in cascade, starting from the main relay.



4.6 PowerShift Connector (FT550 / LITE and FT600)

The FT600 wiring harness comes with the gear strain gauge sensor connector. In case the vehicle isn't equipped with a gear strain gauge, this connector can be removed and it's white inputs can be used for other functions.



4.7 Auxiliary outputs

Outputs can be set up in many different ways, they have different capacities according to the function. Bellow is some important information about them:

Blue outputs: by default, used as injector outputs. Each one of them can control up to:

Impedance higher than 10 Ohms: 24 injectors for the FT550 and FT600/ 8 injectors for FT450 (amongst all blue outputs)

Impedance between 7 and 10 Ohms: 16 injectors for the FT550 and FT600/ 6 injectors for FT450 (amongst all blue outputs)

The use of a **Peak and Hold** driver is mandatory when the number of injectors is higher than the maximum quoted above or when using low impedance injectors (impedance below 7 Ohms).

During the Engine Setup configuration, blue outputs will be selected automatically.

When more than 16 injector outputs are needed, the ECU will use Gray outputs or Yellow output. In this case, the use of a Peak and Hold driver is mandatory on Gray and Yellow outputs (for saturated and low impedance injectors).

Blue outputs not used to control fuel injectors may be used as auxiliary outputs (controlling fuel pump, cooling fan, etc.). In this case, the use of a relay is mandatory.

Gray outputs: by default, used as ignition outputs. According to the engine setup, they can be set up as injectors or auxiliary outputs. During the Engine Setup configuration, ignition outputs will be selected automatically from Gray #1 to Gray #8 and from Yellow #1 to Yellow #4 (FT550) or Yellow #8 (FT600).

Gray outputs not used for ignition control can be set up as injectors outputs (the use of a Peak and Hold driver is mandatory) or as auxiliary outputs (the use of a relay is mandatory).

Yellow outputs (FT550/LITE and FT600 only): by default, they're used as electronic throttle control (Yellow #1 and #2) or stepper motor control (Yellow #1 to #4).

The yellow outputs that will not be used for electronic throttle control can be used as auxiliary outputs or for injectors. When using injectors for the integrated BoostController, the output can be connected directly to the injector, but when using injectors for fuel, the use of a Peak and Hold driver is mandatory for both high and low impedance injectors. This is because this output may present minimal differences in the injection time when controlling fuel injectors without Peak and Hold.

Tach output: There are some pre-defined outputs for this function, but in case the output for that is already assigned to something, use one of the following:

FT450: Gray 4 (Default) or Blue 3 or Blue 6

FT550/LITE/FT600: Gray 8 (Default) or any of the yellow outputs

4.8 Internal MAP sensor

This ECU is equipped with an internal MAP sensor. Use a **6mm pneumatic hose (4mm internal diameter)** to connect the sensor to the intake manifold. Pneumatic hoses are flexible, durable and highly resistant. Usually found in black or blue colors.

Silicon hoses are not recommended because they can be easily bent, blocking vacuum/boost readings on the ECU MAP sensor.

Use a hose exclusively for FT MAP sensor, avoiding splitting it with valves, gauges, etc. Connect it to any spot between the throttle and the engine head. Its length must be as short as possible to avoid lags and errors on the sensor readings. When using individual throttle bodies, it is a good idea to connect all intake runners into a single point and then connect to the FT MAP sensor; otherwise, MAP readings may be erratic or inaccurate.

4.9 USB port

The USB cable is used to update the ECU firmware version, setup maps and adjusts trough a computer and FTManager software and download data recorded by the internal datalogger.

4.10 FuelTech CAN network

FuelTech CAN port is a 4 way connector placed on the wiring harness of the ECU and is responsible for ECUs communication with other FT modules (GearController) and Racepak dashboards. A FuelTech CAN-CAN cable is used to establish a connection between them.



WARNING

For the correct operation of the CAN Network, its mandatory to use the CAN resistor as shown in the following image.



4.11 Connector disassembly

The connectors are built in a way that it's terminals can be easily taken out of the housing. To do so follow these instructions:

- a Remove the connector from the ECU
- b Push down the white lock (1)
- c Pull the wire (2) out of the connector
- d On the other side of the connector, push down the 2 small white locks (3)









IMPORTANT

To ensure IP67 sealing of the module and electrical connector, do not remove any wires from the harness. The module seal is not affected, however the connector seal depends on the presence of wire and terminal inserted in its position. If you need to remove any wires, you must use a seal not supplied by FuelTech, part number 4-1437284-3

Using the connector with a vacant and unsealed terminal may allow water to enter and cause oxidation on the ECU terminals and electrical connector.

5. First steps with FuelTech read before installation

This chapter is a step-by-step guide that must be followed to start FT basic setup before electric installation, as the function of each wire may vary according to engine setup (number of cylinders, injectors control mode, ignition coils and auxiliary outputs).

- Connect the flash drive in the PC USB port and install the FTManager software. Remember to check if the software and the ECU are in the latest version at www.fueltech.net.
- 2. Connect FT to the computer using the USB cable included on the package. The ECU will be powered up;
- 3. With the ECU in hands go through chapter 6, that introduces all basic information about menu navigation and operation;
- 4. Chapter 7 guides the user through all the menus where data regarding the engine must be setup (crank trigger signal, injectors and ignition control modes, etc.);

- 5. The last step before the electric installation is to check harness connections. Go to the "Engine Setting" menu then click the last option "Wiring harness diagram". Check and write down the connections and use it as guide to know how functions were allocated to the pins.
- Chapters 8 to 14 guide through details related to the electrical installation of injectors, coils, 12V inputs, grounds, sensors, etc. Chapter 25 shows full wiring diagrams as example for your installation;
- 7. Chapter 15 gathers information on sensors settings for temperature, pressure, RPM, speed, etc.
- 8. With the electric installation finished, proceed to chapter 15.14 and check all the information needed for the first start of the engine, ignition calibration, sensors checking, etc.
- 9. Lastly, chapters 17 to 24 show detailed descriptions about all functions of the ECU. It is very important and informative to read these sections, as they also outline every function and operation that the FT can perform.



6. Getting to know the ECU

6.1 Dashboard

The ECU has a whole new dashboard, completely redesigned and customizable to improve visualization in any kind of vehicle.

- 1- **Top LED bar (shift lights only FT600):** configurable shift light by gear
- 2- Side LEDs (alerts only FT600): many different options of activation and alerts
- 3- **Dashboard**: fully customizable and redesigned with new gauges (3x2 size), besides a G meter



IOTE

For more info check chapter 23.11.



9 - Interface Settings: LCD backlight and alert sounds, dashboard configs, measurement units, touchscreen calibration serial number and version

- **10 File Manager:** Used to generate FuelTech Base Map, copy, delete and manager map files
- **11 Sensors and Calibration:** Setup and calibrate sensors, electronic throttle, O2 sensor, etc
- 12 Other Functions: Internal datalogger, RPM limiter, fuel cut-off, thermatic fans, progressive nitrous, boost control idle speed, etc.
- **13 Drag Race Features:** Burnout mode 3-step, 2-step, spool assist table, Gear shift output, time based enrichment and timing Pro-Nitrous
- 14 Favorites: Shortcuts to the most used menus and functions.
- 15 Diagnostic Panel: Check inputs and outputs status and all information of what the ECU is reading and doing is real time



You can navigate through all menus with FTManager (available in the flash drive) and mini USB cable. The software initial screen is shown below:

- 16 Quick access
- 17 Function table
- **18 -** Help
- 19 Function or map graph
- 20 Real time dashboard



When entering a map or setting up a function, there are some buttons on the screen that act as described below:

- 21 Red area shows the point selected for editing
- Yellow area is shown only when the engine is running and shows the actual condition of MAP, temperature, TPS, etc

6.2 Main menu

Navigation through touchscreen is intuitive, because the ECU display makes the access to information very easy, eliminating physical buttons. So, all changes on maps, setups and functions are done by light touches on the screen.

To enter menus, press the screen twice, just like a double click. This is a feature that prevents the user from entering the wrong menu when managing the ECU inside the car.

- **Dashboard:** Shows real time engine information (RPM, Temperature, pressure, timing, injection time, etc.)
- 5 Fuel Tables Adjust: Main fuel map, overall fuel trim, RPM compensation, TPS idle fuel table accel fuel enrich and decay, engine and intake temp, compensation battery voltage, compensation, post start enrich, etc
- 6 Ignition Tables Adjust: Main ignition map, overall ignition trim, MAP / TPS compensation, air and engine temperature compensations, individual cylinder trim, timing split, etc
- 7 Alert Settings: Access to shift alert settings, safe mode RPM limiter, alerts by fuel and oil pressure, TPS, etc
- 8 Engine Settings: Engine basics info as ignition mode, RPM signal, pedal/throttle settings, idle actuator, injectors deadtime, ignition dwell, wiring harness diagram

- 23 Button +: increases the value of the selected parameter
- 24 Button >: Selects next parameter on the map
- 25 Save/Select Button: Saves any changes done to the map or configuration and returns to the main menu
- 26 Home Button: Returns to the home screen. If any maps or configurations were changed, it ask for confirmation
- 27 Cancel/Back Button: Cancels all changes done to the maps or configuration and returns to previous menu
- 28 Button -: Reduces the value of the selected parameter
- 29 Button <: Selects previous parameter on the map
- 30 Button <>: Change the screen (if available on the menu)





In the FTManager all commands are accessible through mouse and keyboard. The advance (3D) fuel table is shown below:

Advanced edition mode

In the advanced mode, both fuel and timing tables will be in a 3D table format. Some functions will also be presented in a 3D table only. The navigation is very simple, in the left bottom corner you can see the current position in the table. Green marker is for bank A and purple for bank B. A yellow marker will show the current engine table position. If you click this icon, you will taken to the current load/tps and rpm position.

To scroll through the vacuum/pressure or TPS, click in the horizontal direction of the table, to RPM ranges, click in the vertical direction.

- 31 Injector Bank
- 32 Engine RPM
- **33 -** MAP / TPS
- 34 Use button + and to increase or decrease injection time
- **35** Injection time and percentage. The above value corresponds to bank A value below to bank B

36 - Table position mini map:

Yellow: click this icon to go directly to the point of the map where the engine is working at the moment

Purple: That's the position of the table that's being shown by the screen



6.3 FTManager shortcuts

- F1 Show and hide help panel
- F2 Show and hide quick access panel
- **F3** Show and hide graph
- **F4** Show and hide real time (FTManager real time dashboard)
- **F5** display main table and hide every other function
- F6 change the main fuel table measurement unit: milliseconds (ms), volumetric efficiency (%VE), duty cycle (%DC), fuel flow (lb/ hr or customized unit)
- F7 Datalogger REC
- F8 Datalogger Stop
- **F9** no shortcut
- F10 datalog overlay vertical split screen
- **F11** datalog overlay horizontal split screen
- F12 Dashboard popup
- (Ctrl) + (C) copy
- (Ctrl) + (V) paste
- (Ctrl) + (+) fast value increment. Increases 0,100ms in the fuel table. On VE and DC the change is related to milliseconds
- (Ctrl) + (-) slow value decrement. Decreases 0,100ms in the fuel table. On VE and DC the change is related to milliseconds
- (+) Increment in 0,010ms steps. On VE and DC the change is related to milliseconds

(-) – Decrement in 0,010ms steps. On VE and DC the change is related to milliseconds

- (Shift) + (+) slow value increment in 0,001ms steps. On VE and DC the change is related to milliseconds
- (Shift) + (-) slow value decrement in 0,001ms steps. On VE and DC the change is related to milliseconds
- **(A)** sum
- (M) multiply
- (Space bar) pops up a box to fill a value
- (I) interpolate the selected cells
- (V) interpolate vertically the selected cells
- (H) interpolate horizontally the selected values
 - (S) Smooths the fields selected in the main tables
- (G) site function. Moves the cursor to actual engine position



- (Home) moves the cursor to the leftmost cell
- (End) moves the cursor to the rightmost cell
- (Page Up) moves the cursor to the topmost cell
- (Page Down) moves the cursor to the bottommost

6.4 Warning sounds in FT550LITE

The FT550LITE has several warning sounds that indicate error conditions, safety alerts or gear shifting rpm. Check out the meaning of these alerts:

Short duration alert at short intervals (40 ms with sound, 10 ms without sound)

• Shift alert: the alert turns on at a programmed rpm.

Average duration alert at short intervals (400 ms with sound, 100 ms without sound)

This warning refers to any safety configuration inserted in the Alerts Settings menu

It can refer to:

 Over rev / Injector duty cycle / Overboost / High oil pressure / Low oil pressure / Minimum oil pressure @ RPM / High engine temperature / Low fuel pressure / Base fuel pressure /

The alert will only sound if the function is enabled at the Alert Settings menu.

Long duration alert with average intervals (800 ms with sound, 400 ms without sound)

This alert may correspond to different situations in ECU:

ECU firmware error: (need to update the module via the FTUpdater); Missing cam sync sensor: a setting was sent to the module which requires the use of cam sync sensor (12 teeth crank trigger and sequential ignition). In this case, go to the RPM Signal menu and enable the cam sync sensor;

Ignition must be configured as a distributor: a configuration has been sent to the module that only works in distributor mode. In this case, connect the module to the PC and go to Ignition menu and select the "Distributor" option;

Disabled outputs: connect the FT550LITE to the PC, go to the Engine Setup menu and select the check box "Enable Outputs pins";

TPS not calibrated: connect the module in USB and calibrate the TPS before starting the engine;

These alerts will be played continuously and will only stop when the error condition ceases to exist.



IMPORTANT

When connecting FT550LITE to the USB, it is normal that the warning sound is weak. It is a strategy to save the battery when connecting the ECU to notebooks.

6.5 Dashboard screen

When the engine is running, the dashboard screen shows real-time information of sensors that are being read by the ECU.

Chapter 23.3 has more information on how to change the instruments on this screen.

To access the dashboard screen, touch the icon of the main menu.

- 1 Real time readings;
- 2 Internal datalogger status;
- 3 Touch this whole area to access the main menu;
- 4 Accelerometer graphic;



The dashboard is also shown in real time in FTManager: To add or remove gauges, click with mouse right button in a free space and select the gauge type you want to (radial, bar or digital).





6.6 Diagnostic panel

The diagnostic panel is a function which shows all ECU inputs and outputs parameters and is very helpful to detect anomalies in tune, sensors and actuators. To access it through FTManager, click on Diagnostic Panel tab at quick access panel.

The Diagnostic Panel is a tool used to detect anomalies on inputs, outputs, sensors and actuators. In order to access it, touch its icon , at the main menu.

<	Diagr	nostic	>
Crank	General	CAN	Time based functions
Minimum and Maximum	Compression test	Alert events	
White inputs	Blue outputs	Gray outputs	Yellow outputs
×			\checkmark



The diagnostics panel is separated in the following screens:

0				0	
	Crank	General	CAN Time functions		
	Minimum and maximum	Compression test	Alert event		
	White inputs	Blue outputs	Gray outputs	Yellow outputs	

In this screen a small red circle with a number inside is shown in the corner of the icon when there's a problem on that function.

Crank

Displays crank and cam RPM as well as cam sync angle, very useful for diagnosing problems in cam and crank trigger sensors.



General

Displays real time information of all the sensors and engine conditions.

Inputs, outputs and CAN

White inputs: in the left, the function assigned to the input is displayed, in the center is the voltage being received by the wire and in the right the value corresponding to that reading.

CAN bus: In the left the name of the sensor is displayed and in the right, the reading of said sensor.

Blue, Gray and Yellow outputs: In the left is the name of the function assigned to the output, in the center is the applied value, and in the right, data relevant to the performing of the function.

Minimum and maximum

Displays the peak maximum and minimum values recorded by the ECU during it's usage. These values can be erased by touching the red X icon lower right corner of the screen or in "Interface Settings/ Erase Peaks".

On page 10 are information regarding the engine RPM signal readings. Below are some common errors and possible causes:

Crank trigger error: gap detected at the wrong spot - it detected the gap (missing teeth) in the wrong place; it can also happen with a trigger wheel without missing tooth when there is a cam sync signal in the wrong place. Also occurs in engines with a very light flywheel that accelerates and decelerates quickly during compression strokes at engine startup and running.

Crank trigger error: wrong number of teeth - number of teeth is different on the crank trigger wheel than what is set at ECU. Electrical noise can cause a reading of a "ghost" tooth, for example.

Crank trigger error: missed tooth reading - the ECU detected less teeth then it should have. Also happens in engines with a very light flywheel that accelerate and decelerate very fast during compression strokes at engine startup and running.

Crank trigger error: abnormal acceleration - tooth error detection. Usually caused by signal noise.

Cam sync sensor: signal noise - cam sync signal detected in the wrong spot. Typically this error is caused when the ECU detects noise in the cam sync sensor signal or when the cam trigger wheel has more than one tooth.



WARNING

When the 2-step and 3-step are set to activate by speed, its operation can be checked through the page 1 of the Diagnostic Panel, not through page 2, since you are not using an analog input (white wire) to switch.

)iagnostic Panel					
Diagnostic		White wires: Inputs		Blue wires: outputs	
Engine mode		🔺 #1: None		#1: None	
RPM	RPM	A #2: None		#2: None	
MAP		🔺 #3: None		#3: None	
Engine temp.		A #4: None		#4: None	
 Air temperature 		#5: None		#5: None	
Battery voltage		🔺 #6: None		#6: None	
Fuel pressure	psi	A #7: None		#7: None	
Oil pressure		🔺 #8: None		#8: None	
🔵 TPS		🔺 #9: None		C	
Ignition divel		🔺 #10: None		Grey wires: outputs	
 Ignition timing 		🔺 #11: None		#1: None	
Primary injection time		Alexan		#2: None	
Secondary injection time	ms	Alerts		🔮 #3: None	
Duty bank A				#4: None	
Duty bank B	%			#5: None	
O2 ≠1	AFR			#6: None	

Diagnostic panel labels



Input or output is configured, enabled and working properly.
Input or output is configured and disabled.
Input or output has not been set up.
Input or output is set up, but there is an abnormal behavior.

6.7 Test time based features

This menu allows you to run the output test controlled by time. To start this test the engine must be turned off and the ignition switch on (12V). The test starts when the 2-step button is pressed and lasts as long as the button is pressed.

While the test is performed the RPM values, MAP, TPS and temperatures can be changed in real time.

Test time based features		
-	Diagnostic	
Enable	Engine mode	
	RPM	RPM
Hold the 2-step button for the test	🔵 мар	psi
	Engine temp.	
	Air temperature	°F
	Des TPS	%
	Ignition timing	°
	Primary injection time	ms
	Secondary injection time	ms
Time	Duty bank A	%
0.00	Duty bank B	%
0.00s	Blue wires: outputs	
	#1: None	
	#2: None	
C Test	t time based features	

Test time based features							
Desat. Ativ.	RPM - 1000	╉					
Hold the 2-step button for the test	MAP - 0,00 ·	╋					
Tempo (s): 0,00	TPS - 90,0	╋					
	T.air - 70,0	╉					
T.e	engine – 70,0 ·	+					



6.8 Compression test

The compression test monitors the current during the engine cranking to estimate the relative compression in each cylinder.

The battery current increases during each cylinder compression stroke, reducing the battery voltage.

The test is performed through the ECU screen, at the "*Diagnostic Panel/Compression Test*"

The test is performed during the engine cranking, injectors and coils will be disable during the test. The ECU screen will show the relative compression in each cylinder.

Compression test 1/2		\rightarrow	<	Coi	mpressio	on test 1/2	2	\rightarrow
Crank the engine and check the relative compression of each cylinder	Cil. 1	Cil. 2	Cra relativ	nk the eng re compres in re	ine and cl sion of ea eal time	neck the ch cylinder		Start
Start	Cil. 3	Cil. 4	Cil. 1	Cil. 2	Cil. 3	Cil. 4	Cil. 5	Cil. 6
			Cil. 7	Cil. 8	Cil. 9	Cil. 10	Cil. 11	Cil. 12

4 Cylinder test

5 to 12 Cylinder test

6.9 Internet Remote Tuning

Since update 3.3, FTManager has a new feature wich will make it easier to connect 2 computers that have FTManager installed. To Start a connection go to the "Internet Remote Tuning" tab on FTManager.

Allow remote tuner: This option allows for another remote computer to connect to your FTManager. Click on "Allow" to generate a 6 digit password wich must be informed to the tuner that's going to connect to your computer.

Tune remote client: This option allows you to connect to another remote computer using the 6 digit password generated on the clients FTManager.

File	Home	Мар	Security	View	Tools	Internet remote tuning
		Γ				
	Allow		Connect			
Allow	remote tun	er	Tune remote di	ent		

6.10 FTManager exclusive features

This section will explain some features that can only be found in the FTManager, they make it easy to create new map files based on existing ones.

1 - **Import settings:** settings from another map can be imported to the currently opened map.

File Home Map Security View Too	is Internet remote tuning		
Datalogger Open Conse Map FIT Files	Write EOU ECU ECU SC Rename map ECU Confirm Map ECU ECU ECU ECU ECU ECU ECU	TPS / Pedal Ignition Calibration Calibration	Mep name Padrão FuelTech Start Engine
	/ Import to	ables	×
File: C:\Fueltech\FT500\Maps\1 0 26\T map base.ftm	(1)		
Pertable Mentable Mentable Mentable:-Scordary M	Perturbation Memory status hashes Memory status hashes	Intervalue I	Lend spice table Thing table for which Lock environment table Sender to inverte table Sender to inverte table Menna raispec failable Menna raispec failabl

2 - Import from ECU Manager: Use this option to import settings from maps from FT200, FT250, FT300, FT350 and FT400 into a map in FTManager.



3 - Export sensors: export sensors from this map into another



- 4 ECU factory reset: Performs a factory reset and completely erases maps and settings on the ECU.
- 5 Project CARS Interface: Use this option to send data from the Project CARS game to the ECU and use it as a dashboard.
- 6 **Refresh Throttle database:** Update the compatible electronic throttle database on the software.
- 7 Check Updates: Checks if a newer version of the software is available.



8 - Oscilloscope mode: Used to diagnose RPM and Cam Sync signals.

Oscilloscope mode

This tool allows the RPM and Cam sync signals received by the ECU to be drawn on screen and analyzed by the user to find any issues that can make engine start difficult as well as RPM signal losses.

By analyzing the signals, it's possible to identify damages in the trigger wheel, as well as the pattern (number of teeth), problems with the sensor itself, and the best working trigger voltages.

To access this function, go to "Tools" and then "Oscilloscope Mode".

There are several signal display configurations.

Frequency (Hz): adjusts the frequency that the signal is shown in a range from 1KHz to 500 KHz.



Axis Y: adjusts the voltage limits shown in the graphic from 2.5V to 25V.

Export to: This log file can be exported as text format, Excel spreadsheet or as an image.



Send files... From: Image: To: Message: Image: File: Image: Image:</td

Input expander (11)

Input expander to PowerFT ECUs see owner manual for more information

Engine Simulator (9)

Now it's possible to change reading values from sensors and activate buttons from certain features to simulate engine operation and test actuators and solenoid response while the engine is OFF. Recommended to test the overall behavior of electronics in the engine and car;



Send Map (10)

This option allows you to send the map directly via FTManager, click on the "send map by e-mail" button.

From: enter your email or your name;

To: enter the email to whom you want to send the map;

Message: Write your message, describing the subject of the email;File: the map that is currently open will be attached.To send it is necessary agree to the terms and conditions of use of

the service.



NOTE

The computer must have access to the web, to send the map by e-mail,





6.11 FTManager - Datalogger

Used for a complete analysis of datalogs recorded in the ECU, refer to chapter 19 for instructions on how to set up which channels are going to be recorded.

- Options: Here the channels of the opened log can be edited without changing the settings of the map file.
- 2 Set zero time: Use this to set the 0 mark of the timer, can be assigned right at the launch so the run gets properly timed in the log.
- 3 Clear all graphs: hides all channels.



- 4 Compare graphs: Compare graphs between 2 or more logs.
- 5 **Min/Max values:** List all the minimum and maximum values registered for each channel.
- 6 Status events: Displays an alert and error report along with the time at which they occurred.
- 7 Log info: This form should be filled by the tuner with information regarding track times, weather, driver and many others that pertain the opened log file.



- 8 Fuel table Overlay: making it possible to see which cells were in use as you drag the cursor through the log file.
- 9 Ignition table Overlay: making it possible to see which cells were in use as you drag the cursor through the log file.



10 - O2 correction overlay: This features works similarly to the regular fuel table overlay but, besides showing all the corrections performed by the O2 closed loop, it makes it possible to apply changes permanently to the fuel tables by clicking "send to FTManager".

To apply the O2 closed loop corrections follow these steps:

- a) Open the datalog file to be analyzed
- b) Click on O2 corrections overlay (10)
- c) A screen will pop up showing corrections made to the fuel table of the currently opened map(not the one from the datalog, so make sure the log file being analyzed was made using the same map file that is currently opened in the software)
- d) Analyze the colored cells and select the values to be sent to the map and click "send to FTManager"

For better results, it is recommended that the log files are recorded with similar conditions of temperature, RPM, boost, weather, etc. As this feature does not change temperature compensation tables (IAT and ECT), the O2 closed loop compensation will be directly affected by them and may apply corrections that are not necessarily the best for your fuel table. **NOTE**

This feature will only work on 3D maps

- The correction can be applied as many times as desired, the more it is used, the better the fuel table will get.



7. Engine settings

FuelTech ECUs leave the factory without maps or adjustments, so you need to create the injection maps, ignition and the inputs and outputs settings before running the engine.

The FuelTech Default is an automatic calculation of the basic injection and ignition maps for your engine based on the information provided in the "Engine Settings". Performing this automatic adjustment every injection and ignition maps, including temperature compensation, etc. Will be filled based on your engine characteristics.

The information provided must be correct and consistent, maximum RPM and boost values should be according to the engine capacity and the injectors should be properly sized to the estimated engine power.

The use of an instrument, such as oxygen sensor (wideband recommended) and/or an analyzer of exhaust gases, to make the analysis of the air/fuel mixture is extremely important.

Caution, especially during start-up, is needed, since it is an initial tune that will start most engines, there are no guarantees for any situation. Be extremely cautious when tuning your engine. Engine should not be operated at maximum load until the air fuel ratio has been confirmed.

Start tuning with a rich map and a conservative timing, because starting with a lean map and advanced timing can severely damage the engine. To create a default map by FTManager, click the "File" menu and then "New" to start the wizard. The menu "Engine Settings" will be passed in sequence.

Check in later chapters the descriptions of all these options required to complete the step by step and create the default map.



Vehicle mode

There are three modes, combustion, electric and hybrid

Combustion: Enable this function for conventional combustion engine control, powered by Ethanol, Methanol, Gasoline and derivatives.

Electric: Enable this function to use only the electric motor control, all other functions for combustion engines will be hidden to facilitate the use of the equipment.

Hybrid: Enables all functions for electric and combustion control.



To generate a new map through the touchscreen, just get in a setting that is empty and a message appears telling you that the setting is empty and asking if you want to create a new tune.



In the first screens of the wizard are the settings for measurement units used by the ECU. Select the temperature, O2 sensor, pressure and speed units.

The following screens are part of the engine configuration menus and are described in the following chapters. Follow the wizard by reading the next pages.



7.1 Engine setup

Engine setup			
Engine type	Firing order		
Piston ~	Predefined		
Number of cylinders / rotors	1-3-4-2 (VW AP, VW Golf, Chevrolet, Ford, Flat, Honda, etc) 1-2-3-4 (FT200, FT250, FT300, FT350 and FT400 standard) 1-3-2-4 (Subaru)		
Maximum boost 29.00 - psi	1-4-3-2 (Aircooled VW)		
Maximum engine speed	O Custom		
RPM for engine start 400 - RPM	1 2 3 4 1 3 4 2		
Main fuel table by			
MAP ~	Enable Outputs pins		
TPS idle fuel injection table Disabled	This setting enables or disables all outputs, it works as a master switch.		
Acceleration fuel enrichment by TPS ~			

Enable outputs

Basically prevents the outputs from turning on (injection, ignition and auxiliary outputs).



Engine type and number of cylinders

Select the type of engine, piston or rotary and the number of cylinders or rotors.



Engine limits

Setup the maximum RPM and maximum boost.

Maximum engine speed: setup the engine maximum RPM. All fuel and timing maps will be created with its last point on this RPM. This parameter is also used to calculate fuel injector's percentage of use.

Maximum boost: maximum boost for fuel and ignition maps. For naturally aspirated engines, set this option as 0.0psi. For turbocharged engines, use 10psi above the maximum boost the engine will effectively be using. In case of an overboost, the ECU will apply the last injection timing set on the map. This option doesn't control boost pressure, is just a limit for fuel and ignition maps.





Firing Order

Select the firing order according to your engine.

4 cylinder engines

- 1-3-4-2: majority of engines, VW AP, VW Golf, Chevrolet, Ford, Fiat, Honda, etc.;
- 1-3-2-4: Subaru;
- 1-4-3-2: air-cooled VW;
- 1-2-4-3: Motorcycles (majority)

5 cylinder engines

• 1-2-4-5-3: Audi 5 cylinders, Fiat Marea 20V and VW Jetta 2.5;

6 cylinder engines:

- 1-5-3-6-2-4: GM in line (Opala and Omega), VW VR6 and BMW in line;
- 1-6-5-4-3-2: GM V6 (S10/Blazer 4.3);
- 1-4-2-5-3-6: Ford Ranger V6;

8 cylinder engines:

- 1-8-4-3-6-5-7-2: Chevrolet V8 (majority);
- 1-8-7-2-6-2-4-3: Chevrolet LS
- 1-5-4-2-6-3-7-8: Ford 272, 292, 302, 355, 390, 429, 460;
- 1-3-7-2-6-5-4-8: Ford 351, 400 and Porsche 928;
- 1-5-4-8-6-3-7-2: Mercedes-Benz;

10 cylinder engines

- 1-10-9-4-3-6-5-8-7-2: Dodge V10;
- 1-6-5-10-2-7-3-8-4-9: BMW S85, Ford V10, Audi, Lamborghini V10;

12 cylinder engines

- 1-12-5-8-3-10-6-7-2-11-4-9: Jaguar V12, Audi, VW, Bentley Spyker W12;
- 1-7-5-11-3-9-6-12-2-8-4-10: 2001 Ferrari 456M GT V12;
- 1-7-4-10-2-8-6-12-3-9-5-11: 1997 Lamborghini Diablo VT;

Customized

 In case the firing order of your engine is not listed on the ECU, there's a mode that allows full customization of the firing order.

<	Engine setup 3/6	>
Firing order:	FT200, FT250, FT300, FT350 and FT400 def	fault
0 1-3-4-		\sim
1-2-3-		
1-3-2-		
1-4-3-	-2	
Custor	m	>
×		~

Main fuel table

MAP: this mode is indicated for turbo or naturally aspirated engines. That's the mode that better represents engine load, because engine vacuum varies under different loads, even with the throttle on the same position. **TPS:** this option is mostly used on naturally aspirated engines with aggressive camshafts, when this causes the vacuum on idle and under low load conditions to be unstable. When this option is selected, MAP compensation is available for fuel and timing maps.

TPS idle fuel injection table: This is the mode the fuel injection on idle speed will be controlled. When enabled, a table that relates injection time versus engine RPM is activated whenever TPS is equal to 0%. Enable this feature an engines with high profile camshafts and unstable vacuum on idle.

For street cars with stable vacuum on idle, it is recommended to keep this feature disabled. In this case, injection time for idle will be set up directly on the vacuum ranges on the main fuel MAP.

Accel fuel enrichment: use this parameter set up as TPS whenever possible, as this sensor reacts faster than the MAP sensor to indicate a quick change of position in the throttle.



RPM for engine start: set up a RPM limit above which the start-up routines are disabled. Below this RPM, all the injection, ignition and actuator positions set up for engine start are used.



BSFC: ESTIMATED number of engine efficiency to be used in ESTIMATED crankshaft torque and power. Total injector flow information, BSFC or incorrect AFR will result in inconsistent estimated power and torque values.

<	Engine se	etup 8/8	>
	BFS	C	
0.50	< >	ESTIMATE efficien in the l crank Total flow the injecto mix will res values of	D value of engine cy to be used STIMATED of shaft power. information of s, BSCF or wrong ult in inconsistent estimated power
×			\checkmark



7.2 RPM signal

RPM signal is the most important information to run the engine properly. This menu is where the RPM input will be set up.

RPM signal			
Sensor type Hall/VR with pull-up VR mitcrnal reference VR differential Cank tricear nation	5ensor edge O Rising ම Falling		Advanced vature
Crank trigger pattern	Custom crank trigger settin	as	Advanced setup
Crank index position (degrees)	GAP Number of T missing n teeth n	eeth to GAP ext GAP threshold	Sensor conditioning mode
Crank trigger type			Magnetic trigger levels
Crank trigger number of teeth			0 to 2000rpm over 2000rpm 0.00 • v 0.00 • v
Number of missing teeth			
Additional tooth angle			
Gap duration time 0.00 🔹			
	RPM sign	al 1/4	



Engines with crank trigger: select the crank trigger pattern.

Select the crank trigger or distributor pattern. In case of a crank trigger without missing tooth and multi-coils, a cam sync sensor is required. When using a single coil, the cam sync sensor is not mandatory. A several options of standard patterns are available for using with multi-coils or distributor based systems.

RPM Sensor

Select the RPM sensor used on the vehicle, VR or Hall Effect.

VR internal ref: Only use this option when told by our tech support. This is used for compatibility with older units only.

VR Differential: Select this for VR sensors; it's less susceptible to electromagnetic interference. When the crank trigger signal is split with the OEM ECU this option is mandatory.

Hall/VR with pull-up: Select when using Hall effect RPM sensor or when experiencing problems with electromagnetic interference.

RPM Signal Edge: this option changes the way the ECU reads the RPM signal. As there's no simple way of telling which one is the correct option (without an oscilloscope), select the option Standard (Falling Edge). If the ECU sees no RPM signal during initial startup, change this parameter to Inverted (Rising Edge)

First tooth alignment: set here the crank trigger alignment related to the TDC. This alignment can be checked by turning the engine to the cylinder #1 TDC and counting, counterclockwise, angle distance, from the crank trigger gap to the RPM sensor. If there crank trigger has no gap, the angle distance is from the previous teeth to the RPM sensor. For engines with distributor and Crank trigger, check our Technical Support for information about the alignment in use.

Below is a table with known alignment values and configurations for most of the cases:





WARNING

Ignition calibration values on this table are just a start point. ALWAYS perform the ignition calibration according to chapter 16. When the ignition is not correctly calibrated, the timing shown on the ECU screen is different from the one that is being applied to the engine. This may cause serious damage to the engine.

Crank trigger - pattern	Engine/ brand	Recommended Index position	Cam sync sensor
60-2	BMW, Fiat, Ford (inj. Marelli), Renault, VW, GM	324° (BMW) 123° (GM) 90° (others)	Not mandatory
48-2			Not mandatory
36-1	Ford (ECU FIC)	90°	Not mandatory
36-2-2-2	Subaru	55°	Not mandatory
36-2	Toyota	102°	Not mandatory
30-1			Not mandatory
30-2			Not mandatory
24-1	Hayabusa	110°	Not mandatory
24-2	Suzuki Srad 1000		Not mandatory
24 (crank) or 48 (cam)		60°	Falling edge
12-3	Bikes Honda CB300R		Not mandatory
12+1	Honda Civic Si	210° or 330°	Not mandatory
12-1	Bikes Honda/ Suzuki/ Yamaha		Not mandatory
12-2			Not mandatory
12 (crank) or 24 (cam)	Motorcycles/ AEM EPM/ Honda distributors 92/95-96/00		Falling edge
8 (crank) or 16 (cam)			Falling edge
4+1 (crank)			Not mandatory
4 (crank) or 8 (cam)	8 cylinders	70°	Falling edge



3 (crank) or 6 (cam)	6 cylinders	60°	Falling edge
2 (crank) or 4 (cam)	4 cylinders	90°	Falling edge

Smart cranking RPM sync: option to allow faster RPM detection during cranking, specially for high compression ratio and light weight rotating setup, such as motorcycle engines.

7.3 Cam sync sensor

This option indicates if a cam sync sensor will be used and if it uses a hall effect or magnetic variable reluctance (VR) sensor. This sensor is mandatory when controlling fuel or timing in sequential mode. Without cam sync sensor the injection mode will be only semi-sequential or multipoint. Ignition will be always wasted spark.

Random cam sync sensor option is a test mode that automatically assumes a position for the cam sync signal. Use this only for testing purposes, as this may cause misfires in some applications. Use this option only for tests, because with individual coils and sequential ignition the firing order can be lagged (inverted) in 360°, so the engine won't start.

Cam sync sensor edge: this option changes the way the ECU reads the cam sync signal. As there's no simple way of telling which one is the correct option (without an oscilloscope), select the option Falling edge. If the engine starts with misfires, change this parameter to Rising edge.





Cam sync sensor for synchronization

Cam sync signal will be used only for 10 revolutions after engine start and after that will be disconsidered for engine synchronization but it will still be recorded on the datalogger.

<		Cam sync sensor 6/8	>
		ibled Enabl	ed
	Cam sync	sensor for synchroniza	ation only.
	Cam sync sensor will be used only after engine starts for 10 revolutions of the engine And then disconsidered for engine synchronization, but will recontinue to be recorded in the datalogger.		
	×		\checkmark

Cam sync position angle

The adjustment is degrees before top dead center (°BTDC) of cylinder 1 combustion.

This angle is not mandatory and won't affect the ignition calibration.

If you don't know the position angle, set the same alignment as crank index position or select the cam sync sensor as random.

With the random mode enabled, the position angle in the log and diagnostic panel.



Cam sync reading mode

Select if there's a single tooth or multi-teeth used for cam sync, and in case there are multiple teeth, a tolerance between them must be set next, this value is in percentage and it's based on a table that must be set through FTManager.

<	Cam sync sensor 3/	7	<	Cam sync sensor 4/7	>
	cam sync reading mor Single tooth	de		Tolerance between teeth	
>		\checkmark	×		\checkmark

Cam sync wheel decoder

This feature must be used with the ignition on, it'll automatically read all the teeth in the cam sync, then a signal edge used for cam sync can be selected.





Cam sync position

Cam sync position is used to create a range within wich a Cam sync signal is read and all others out of it are discarded, allowing the use of a single reference on multi-toothed Cam sync pulleys.



7.4 Ignition

This menu sets everything related to the ignition control mode and there is a "Default" mode (configurable through the ECU or PC) and a "Custom" mode (configurable only through the PC). When the ignition is set as "Disabled", timing maps are unavailable and only the fuel control is enabled. Gray outputs are free to be set up as injectors or auxiliary outputs.

Default: this mode makes the options available the options that are commonly used for the majority of engines, with standard firing order tables and configurations.

Custom: this mode enables all the options related to the ignition control, as customizable firing orders and angles, etc. When using this mode, ignition configuration can only be done through a PC with FTManager Software.

Ignition mode	Ignition delay
O Sequential - individual coils / COP	45 🐳 u:
\bigcirc Wasted spark - individual coils / COP	MSD legacy Cut
O Wasted spark - double coil	
Oistributor - single coil	MSD 6/7/8
FTSPARK	O Pro Mag
Outputs	Ignition cut
Multiple Outputs	Maximum level 90 🗭 %
O FT Ignition BUS (One multiplexed output)	Above limiter RPM progression range
In this mode FTSPARK is connected to the ECU through multiple ignition outputs (gray wires). On ignition output	200 - RPM
settings, the 'Falling edge' and fixed 3ms dwell are automatically selected.	Maximum level is the limit percentage ignition cu level to be applied when RPM goes over the
Ignition output	Example: if limiter is set to 8000rpm and RPM
Falling edge (SparkPRO)	progression range to 200rpm, it means that the ignition will start to progressively cut from
○ Rising edge (MSD - duty 25%)	90% of ignition cut level, what means that



Ignition Mode

Select if the ignition will be controlled in sequential (cam sync sensor needed) or wasted spark modes or if a distributor will be used for that control. There is also the wasted spark mode, where the coils work in pairs.

The option "distributor" means that the spark distribution will actually be done by a distributor, with a single coil, regardless of the number of cylinders. Only the ignition output #1 (gray #1) will be used to control the ignition coil, the others are disabled.



FTSPARK

Select the FTSPARK check box when using the fueltech FTSPARK module and select the connection mode with it:

Multiple outputs: this is the conventional way of connecting FT to any ignition module, using an ignition output to trigger each coil (double or single). In this case one or more ignition outputs will be connected to the FTSPARK.

FTIgnition BUS (one multiplex output): Select this option to enable only one ignition output to send all the ignition trigger signals to the FTSPARK via the FT Ignition BUS. In this way the other outputs that would be used for ignition can be reallocated to other functions.

<	Ignitio	Ignition 3/7	
	sabled	Enable	d
FTSP/	ARK	In this mo connecte	de FTSPARK is d to the ECU
O Multiple	outputs	through m outputs	ultiple ignition (gray wires).
FT igniti multiple	on bus xed output.	On ignition the 'Falling 3m	output settings, edge' and fixed s dwell.
×			\checkmark

Output Test

When the multiplexed output is selected, its possible to test the FTSPARK outputs using a "test function" on the FTManager. To do so, go to 'Sensors and Calibration' then 'Outputs' and select FTSPARK - Output test.

Quick access panel	FTSpark - Output test	
Advanced map options		
Sensors and Calibration	Output #1	Output #5
-Inputs		
-Speed inputs		
-Drive shaft and Input shaft RPM	Output #2	Output #6
Gear change detection		
-Internal accelerometer	Output #3	Output #7
-CAN communication	oucput #5	oucput #/
-Outputs		
FTSPARK - Output test	Output #4	Output #8
Interface Settings		

Ignition output

Select the ignition output edge/mode.

Falling edge (SparkPRO): Select this option when using FuelTech SparkPRO, M&W ignition, smart coils (integrated igniter, such as GM LS coils). This mode has dwell control enabled. It's important to know the dwell requirements or "charge time" of your particular ignition coil(s).



• **Rising edge (MSD duty 50%):** select this option when using MSD, Crane, Mallory or other capacitive discharge ignitions (CDI). This mode has a fixed 50% duty cycle signal.

• **Rising edge (Honda Distributor):** this option must only be selected when using Honda distributor with stock igniter (the one that's integrated to the distributor). This mode has dwell control enabled. Select this option only when using Honda OEM igniter and distributor.



Ignition cut

The ignition cut maximum level is the percentage of ignition events that will be cut to limit the engine RPM.

The RPM progression range acts like a smoothing for the ignition cut. Example: rev limiter at 8000rpm, RPM progression range at 200rpm. From 8000rpm the ignition cut level will gradually increase until it reaches 90% cut at 8200rpm.

Percentages less than 90% may not keep the engine under the rev limiter. Bigger RPM progression range tend to stabilize more smoothly the rev limiter, but allows the RPM to pass the RPM set as rev limiter. These numbers are valid to all kinds of ignition cut, with the exception of time based compensations (time based RPM and driveshaft RPM/ wheel speed) and 2-step. These features have their own parameters. For inductive ignition systems it is recommended to use 90% maximum level and 200 RPM progression range. For capacitive system, like MSD, it is recommended to use 100% maximum level and 1 RPM progression range.



External cut

This mode is only available when using a distributor and a MSD ignition module. Enabling this option means the ignition cuts will be performed by the MSD using the Legacy input they have.

To use MSD Legacy cut a FT600 white wire has to be connected to the MSD Legacy right pin. By standard, White#10 is setup as ignition cut.

When experiencing problems with the cut through MSD like no cut at all or RPM limit always 500 RPM above what was setup, use the other MSD pin.





Ignition Delay time

That's the delay time the ignition module has between receiving a signal to spark and effectively spark at the plugs. Time is given in microseconds (uS).



7.5 Fuel injection

In this menu, all the options related to fuel settings must be configured.

Basic: This mode makes available the options that are commonly used for the majority of engines, with standard injection angles and configurations.

Advanced: This mode enables all the options related to the fuel control, as customizable injection angles, etc. When using this mode, fuel injection configuration can only be done through a PC with FTManager Software. It is also possible to customize all the fuel tables and RPM positions, adding RPM, TPS or MAP points according to the engine needs





Fuel Banks: select primary and secondary (if used) banks control mode.

Multipoint: All the injector's outputs will fire at the same time, as batch fire.





Semi-sequential: in this mode, injectors are fired once per engine revolution, at 0° and 360°, in pairs, according to the twin cylinders. In a 4 cylinder engine, cylinders 1 and 4 will be fired at the same time, then cylinders 2 and 3 at the same time.



Sequential: in this mode, each injector output fires only a single time per engine cycle (720° on a 4 stroke). This mode is only available when a cam sync sensor is properly set up.



Injector's total flow

That's the total flow of all injectors on the bank (primary or secondary). This data is used to allow addition of some fuel tables in lb/hr l.e. four 80 lb/hr injectors on primary bank have a total flow of 320 lb/hr (80×4).



Fuel type

Select the fuel used on the motor. This information is used to create a better base map

K Fuel in	jection 6/6
Fuel type Pump gas Race gas E85	Fuel injector phase reference: Fuel injector opening Fuel injector
Alcohol	
×	\checkmark

Fuel injection phase reference

Select if the Fuel injection phase angle table will be based on the injectors opening or closing. The angular distance is the measure between the ignition TDC of each cylinder and the moment the injector should open or close

Fuel injector opening: in this option it is only possible to know the angle the injector will open, but, its closure will vary according to injection time and RPM, this means that, depending on these factors, the fuel injection may still be occurring even after the intake valve has closed

Fuel injector closing (default): This is the most commonly used option as the fuel injection always occurs before the end of the intake cycle, no matter the injection time or RPM.

7.6 Pedal/Throttle

Select the option "TPS" when using a mechanical throttle, driven by cable.

Quick access panel	Pedal / Throttle		
Fuel Tables	De del 17h-entre	Paters by other sector street	
Ignition Tables	None	Enabled	
式 Other Functions	O TPS	Disable the idle actuator	
Drag Race Features	Single electronic throttle	when the engine is off.	
Engine Settings	O Dual electronic throttles		
– Engine setup – RPH signal – Can sync signal – Dankicin – Fuel injection	Electronic throttle O Predefined Brand Model	Custom Throttle 1 signal type Double reference ✓	ETC Throttle speed Normal ~ Pedal mode Linear ~
- Pedal/Throttle	rioder	Switch throttle 1 wires	Pedal type
Idle actuator Ignition coil diviel Joniton coil diviel Diviel table by MAP and Yokage Wring harness diagram	Description	Throttle 1 KP 0 😄	Double reference (pedal 1 and ~ Throttle opening limit 100 + %
Map options Advanced map options	Code 000000000000000000000000000000000000	Throttle 1 KD	Analog SENT protocol
Sensors and Calibration			ETC - Throttle 2
Inputs MAP			Analog SENT protocol

Κ Ε	edal / Throttle 1/13				
None		Código da borboleta			
		0500	02001000	2001	
TPS	TPS				
Single e	electronic				
throttle Dual ele	ectropic				
throttle	throttle			×	
×				/	

TPS

When using a throttle drives by cable with a potentiometer on the throttle shaft select the TPS option.

Standard input for TPS sensor signal is #11(FT600) and #3 (FT450 / FT550), but it is possible to set this input on any available input. Pedal/Throttle calibration must be performed as shown in chapter 12.4

<				>
TPS	input selection	: default white #11 on F	T400	
	White 7: Air	temperature		<
	White 8: Ava	aliable		
	White 9: Ava	aliable		
	White 10: Av	valiable		
0	White 11: Av	valiable		>
	×		\sim	

Electronic throttle control ETC

First data to be inserted on the ECU when using electronic Throttle is its code (not the throttle part number). This code is found on the FTManager Software. If your throttle is not on the list, please, contact our tech support to check compatibility first.

Throttle position sensor input

If the map is generated in the FTManager software the ETC inputs will be automatically allocated and can be checked in "Sensors and Calibration" menu, then "Inputs".

Inputs				
Inputs (White wires)	Input enabled			
#1: O2 General	Import sensor		Calibrate sensor	
#2: None	impore sensor		Cullor dec School	
3: A/C button	Channel name		Input sensor	
4: Oil pressure	Default name		Default	
5: Engine temp.	O2 General	~	Wide band (0.59 - 1.10)	~
6: Fuel pressure	Custom name		O Custom	
7: None	O2 General			
8: Input shaft	Dash name	Unit	Signal type	
9: None	O2 General	AFR	Analog	\sim
10: Wheel speed front right	Decimal places		Enable pullup	
11: TPS	3 (Min: -32,000 Max: 32,000)) ~ ~	Average points	
12: None			Averagepoints	7 🌲
13: None	Offset			1.000
14: None	Offset type			
15: None	Add offset before conversion	~		
16: None	Offset value		Digital sensor setup	
17: None		-0.065 🜩	Higher level	\sim



After inserting the Throttle code, set the input that will be connected to the throttle position sensor, usually there are two signals on the throttle. Standard inputs are wires white #11 (Throttle signal #1A) and white #10 (Throttle signal #1B).

<	Pedal / Throttle 2/9	>	Pedal / Throttle 3/9	>
Throttle #	1A input selection: default white #11 on FT4	00	Throttle #1B input selection: default white #10 on FT400	
White	e 7: Air temperature	<	White 7: Air temperature	\sim
White	e 8: Available		White 8: Available	
White	9: Available		White 9: Available	
White	e 10: Available		White 10: Available	
🔵 White	e 11: Available	>	White 11: Throttle #1A	~
×		/	× ×	
	Input for Throttle signal #1A		Input for Throttle signal #1B	

Now, setup the inputs that will be connected pedal #1 and pedal #2 position sensors. The standard inputs are wires white #9 (pedal #1) and white #8 (pedal #2).



Electronic throttle control motor outputs (FT550/LITE and FT600 only)

When generating the map in the FTManager the Yellow #3 and #4 will be selected to ECT motor control.

	Gray output #1	Yellow output #1
✓ Test	Cylinder #01 ignition \vee Test	None V Test
	Gray output #2	Yellow output #2
✓ Test	Cylinder #02 ignition \checkmark Test	None ~ Test
	Gray output #3	Yellow output #3
✓ Test	Cylinder #03 ignition \checkmark Test	None V Test
	Gray output #4	Yellow output #4
 ✓ Test 	Cylinder #04 ignition 🗸 Test	None ~ Test
	Gray output #5	Yellow output #5
✓ Test	None V Test	None V Test
	Gray output #6	Yellow output #6
 ✓ Test 	None ~ Test	None ~ Test
	Gray output #7	Yellow output #7
 ✓ Test 	None ~ Test	None ~ Test
	Gray output #8	Yellow output #8
✓ Test	Tach output V Test	None V Test

Select the outputs that will control the two wires from the throttle motor. By standard they are yellow #3 (motor 1A) and yellow #4 (motor 1B). In case these outputs are already being used by another kind of control, use outputs yellow #1 and yellow #2

<	Pedal / Throttl	e 6/9		>	<	Pedal / Throttl	e 7/9		>
	Test output:	Test				Test output:	Test		
	ETC motor #1A output selectio	n: default	yellow #	13	ETC motor	#1B output selection	n: default	yellow #	4
	Yellow 1: Available				Yellow 1: A	vailable			
	Yellow 2: Available				Yellow 2: A	vailable			
0	Yellow 3: Available				Yellow 3: ETC motor 1A				
	Yellow 4: Available			>	🔵 Yellow 4: A	vailable			>
	×		~	/	×			\checkmark	1
	Input for throttle motor 1A control			Input for throttle motor 1B control					

The next parameter to be setup is the Throttle speed.

O TPS	Disable the idle actuator	
 Single electronic throttle 	when the engine is off.	
O Dual electronic throttles		
Electronic throttle		ETC
O Predefined	Custom	Throttle speed
	71 111 4 1 11	Normal 🗸 🗸
Brand	Dauble astrong as	
· · · · · · · · · · · · · · · · · · ·	Double reference	✓ Pedal mode
Model	_	Linear 🗸 🗸
~	Switch throttle 1 wires	Pedal type
Description	Throttle 1 KP	Double reference (pedal 1 and $ \smallsetminus $
		0 🗭 Throttle opening limit
	Throttle 1 KI	100 🜩 %
		ETC - Throttle 1
Code	Throttle 1 KD	 Analog
000000000000000000000000000000000000000		0
March 1		III 1 (a) Annia

There are five control modes:

Normal: normal throttle response little bit faster than the stock ECU. **Fast:** fast throttle response.

Smooth: smoother control mode, used on street cars and automatic transmissions.

Smooth when cold and normal when hot: changes the control mode according to the engine temperature, starts with smooth mode, and then changes to normal mode automatically.

Smooth when cold and fast when hot: changes the control mode according to the engine temperature, starts with smooth mode, and then changes to fast mode automatically

Custom: Option to configure throttle opening curve according to gear and engine RPM.



It is possible to turn off the Throttle when the ignition on, being activated only when the ECU detects RPM. This option is very useful where you want to test the system and you don't want the throttle to stay on for a long period.

Operation mode: this parameter changes the ratio between the pedal and the throttle.

Linear: this mode has a 1:1 ratio between pedal and throttle.

Progressive: recommended for street cars.

Aggressive: throttle/pedal ratio is 2:1. When pressing 50% pedal, throttle is already on 100%.

The last parameter to be configured is an opening limiter, very useful to limit the engine power by the throttle.

Use 100% when no safety limit is wanted.

Custom: enables a table where the pedal x throttle ratio can be freely customized. Very useful when using big throttle bodies, allows you to build your own throttle progression.

Custom Pedal pos. and RPM: Relation between throttle and RPM through a pedal x throttle x RPM percentage table, very useful for motorcycle throttles where there is a very fast opening variation.





Throttle opening limit: allows you to define a limit for the opening of the throttle. This option is very useful where you want to control the maximum throttle opening, thus limiting engine power.

7.7 Idle actuators

This menu allows you to select the idle actuator used on the engine and the outputs that will control it. After this quick setup, the idle speed parameters must be done according to chapter 19.2.

An important tip is that, when selecting "No Actuator", it is still possible to control idle speed by ignition timing as configured in the "Other Functions" then "Idle Speed" menus. If any kind of actuator is selected, the idle speed by timing control is automatically enabled. This happens because the idle speed control was specially developed for this FT, integrating the timing control with the actuator reactions

Electronic throttle

Select this option, then go to "Idle speed control settings", under "Other Functions" menu.

Check Chapter 19.2 of this manual for more details.



PWM Valve

After selecting this option, it will be necessary to set up the output connected to the valve and the control frequency. Small valves usually use up to 2000Hz. For big valves use around 100Hz. If your valve becomes noisy, that means the control frequency is lower than what the valve requires. In this case, increase the control frequency.

Be aware that the only outputs that can control these kinds of valves are the yellow ones.



Stepper motor

In this option, the four yellow outputs are used. It is necessary to inform which output controls which step motor output and the step motor type. There are predefined actuators for VW and GM models (number of steps) and a "Custom" mode that allows the configuration of steps. As there are many variables in the manufacturing process, if you're experiencing difficulties at idle tuning, check the "Custom" mode and change the number of steps. In some GM step motors, 190 is the correct number. For some VW step motors, 210 works better. The option "Fully open for TPS over 90%" fully opens the idle valve when TPS is above 90%, increasing the air admitted.



7.8 FuelTech base map

With the "Engine Setup" menu fully set up, the next step is to generate the FuelTech base map, a function that generates fuel and ignition maps to be used as a start point for the engine tuning.

The window below is displayed at the end of configuration assistant in the FTManager:

	Generate FuelTech base map	\$
Generate FuelTech base i	nap	-
Select other engine characterist	ics, needed to generate the FuelTech base map.	FT
Compression ratio	Initial boost secondary injectors	
O Low compression	0.0 🌩 psi	
O Medium compression	Camshaft profile	
High compression	Low profile	
Fuel type	O High profile	
Alcohol	▼	

When generating a base map in the touchscreen interface, the information will be displayed similar to the images below:







Compression ratio: used to correctly estimate the timing tables. A low, medium or high compression ratio is defined according to the fuel used on the engine and if it is turbocharged or naturally aspirated. I.e., a 10:1 compression ratio for a naturally aspirated engine using ethanol is considered a "low compression ratio". The same ratio for a turbocharged engine running gasoline will be "high".

Primary and secondary injector's total flow: select the flow of the injectors responsible for the naturally aspirated/low load range of the engine.

Initial boost for secondary injectors: Here is where you will set the pressure you want the secondary bank to start opening, usually under boost. This option is only shown when using two banks of injectors

Camshaft: select the characteristic of the engine camshaft. When selecting high profile camshaft, all injection tables from absolute vacuum until -4.3psi are equal, as this type of camshaft does not have steady vacuum at idle speed. When selecting low profile camshaft, the injection times at vacuum phase are filled up in a linear manner.

Now, click the button "Generate FuelTech base map". The ECU will show a warning that the current map will be overwritten by the FuelTech base map.



A notice about throttle/pedal calibration will be displayed. Click Yes and you will be redirected to the calibration screen.

The Chapter 15.1 has detailed information about the calibration. The next chapters explain other functions contained in the Engine Settings menu.

7.9 Fuel injectors deadtime

All fuel injectors, as they are electromechanical valves, have an opening inertia, which means that there is a "dead time", a moment in which the injector has already received an opening signal, but still has not started to inject fuel. This parameter considers, as a standard value, 1.00ms for high impedance fuel injectors. For low impedance injectors using Peak and Hold driver, set the deadtime to 0.60ms. These are

general values; check this parameter with the injector manufacturer. In the FTManager, this parameter is in the Injection menu in "Engine Settings".



7.10 Ignition Dwell

This option sets the ignition coil charging time. There is a dwell table because the charging time varies according to the battery voltage, especially in vehicles that do not have alternator.

Usually, the lower the voltage, the higher the dwell time has to be set.

Smart coils (coils with internal igniter) demand lower charging times. These are general values; check this parameter with the coil manufacturer.



WARNING

When using MSD ignition modules, it's not possible to control the Dwell time. In this case, the coils charging time is calculated by th MSD module.





7.11 Ignition energy

This menu allows the user to program the ignition energy of the FuelTech FTSPARK ignition module.

This 3D table relates engine RPM, MAP (boost/vacuum) and the desired mJ (millijoules) value.

The ignition energy control is done by connecting both equipments (FT ECU and FTSPARK) by their CAN network.


Quick access panel	Ign	Ignition energy (m3)							
Config time based componention		MAP (psi)							
Wheelie control		mJ	-14.50	-10.15	-4.35	0.00	14.50	29.00	
Engine Settings	(ud	9000	400	400	400	600	600	600	
Engine setup RPM signal IIIIgnition	RPM (7000	400	400	400	600	600	600	
Pedal/Throttle		5000	400	400	400	600	600	600	
Ignition energy Wining harness diagram		3000	400	400	400	600	600	600	
Advanced map options		1000	400	400	400	600	600	600	

7.12 Map options

Select the ECU model that is connected to the PC and which features will remain visible on the active map.

This makes navigation through the software much easier by hiding unused menus.

In case you need to make an option visible again, just go to Engine Settings and then Map Options.

Vehicle mode

There are three modes, combustion, electric and hybrid

Combustion: Enable this function for conventional combustion engine control, powered by Ethanol, Methanol, Gasoline and derivatives.

Electric: Enable this function to use only the electric motor control, all other functions for combustion engines will be hidden to facilitate the use of the equipment.

Hybrid: Enables all functions for electric and combustion control.

	Map options 2							
Map options Set enabled func	tions to the default map							
ECU model FT450 FT500 FT550 FT550 FT600 Eucl Tablac	Vehicle mode Combustion Electric Hybrid	Changing	"Vehicle Hode" will only take effect after	CCU reset.	Evalue Settinge			
C 22 does does does does does does does does	mpensation mpensation s mpensation mpensation spool / roll start for control start stat sta	4FI)	Home datasegue Home dat	Bet battom Bet battom Bet battom Bet battom battom Bet battom battom Bet battom control Bet battom contre Bet battom control Bet battom control	Interface Index			

7.13 Advanced map options

There are some options that are only available through FTManager. To access them, go to "Engine Settings" Menu:



FT450 / FT550 / FT550LITE / FT600

Injection

Fuel maps

- Basic fuel maps are in a 2D table that relates MAP x injection time or TPS x injection time.
- Advanced 3D MAP x RPM or TPS x RPM fuel table with 32x32 cells.

Fuel injection pins assignment mode

- Automatic fuel injector's pins are automatically assigned by the ECU.
- Manual fuel injector's pins are manually assigned by the user through "Sensors and Calibration Outputs" menu.

O2 closed loop mode

- Basic Predefined options for the O2 closed loop.
- Advanced Enables advanced options for the O2 closed loop.

Ignition

Ignition maps

- Basic ignition maps are in a 2D table that relates MAP x timing or TPS x timing.
- Advanced 3D MAP x RPM or TPS x RPM timing table with 32x32 cells.

Ignition pins assignment mode

- Automatic ignition pins are automatically assigned by the ECU.
- Manual ignition pins are manually assigned by the user through "Sensors and Calibration - Outputs" menu.

RPM settings

- Basic Pre-defined voltage detection levels for VR crank and cam sensors.
- Advanced The adjustment of voltage levels for detection of VR sensors in advanced mode allows the conditioning of non standard crank/cam signals, especially when they're spliced with the stock ECU.

Other Function

Internal Datalogger

- Basic fixed sampling rates.
- Advanced configured sampling rates per channel.

Idle speed control

- Basic predefined options for controlling idle. Meet 99% of the vehicles.
- Advanced releases advanced options such as PID control, target approach RPM, deadband, approach RPM, etc.

Wastegate boost pressure control

- Basic predefined options for the wastegate boost pressure control.
- Advanced enables advanced options for the wastegate boost pressure control.



8. Electrical installation

As FT wires are fully configurable according to the installation needs, it is very important that the step by step guide shown on chapter 5 is followed before starting the electrical installation. This way the wiring harness connection table is automatically filled as shows the example below:

In the FTManager, to check all the inputs and outputs, go to "Sensors and Calibration" menu, then "Inputs" or "Wiring harness diagram".

Outputs			
Blue output #1	Blue output #9	Gray output #1	Yellow output #1
Fuel injection cyl. #01 - Primary 🛛 🕹 Test	None V Test	Cylinder #01 ignition V Test	None V Test
Blue output #2	Blue output #10	Gray output #2	Yellow output #2
Fuel injection cyl. #02 - Primary 🛛 🗸 Test	None V Test	Cylinder #02 ignition V Test	None V Test
Blue output #3	Blue output #11	Gray output #3	Yellow output #3
Fuel injection cyl. #03 - Primary 🛛 🗸 Test	None V Test	Cylinder #03 ignition V Test	None V Test
Blue output #4	Blue output #12	Gray output #4	Yellow output #4
Fuel injection cyl. #04 - Primary 🛛 🗸 Test	None v Test	Cylinder #04 ignition V Test	None v Test
Blue output #5	Blue output #13	Gray output #5	Yellow output #5
None v Test	None v Test	None ~ Test	None v Test
Blue output #6	Blue output #14	Gray output #6	Yellow output #6
None V Test	None v Test	None v Test	None V Test
Blue output #7	Blue output #15	Gray output #7	Yellow output #7
Thermatic fan #1 V Test	None V Test	None V Test	None V Test
Blue output #8	Blue output #16	Gray output #8	Yellow output #8
Fuel pump V Test	None V Test	Tach output \checkmark Test	None V Test

Through the touchscreen interface, you can access this function in the "Engine Settings", then "Wiring harness diagram".



Based on this information, you can start the electrical installation that must be done with the ECU disconnected from the harness and the battery disconnected from the vehicle. It is very important that the cable length as short as possible and that unused parts of wires are cut off.

Choose an appropriate location to affix the module inside the car, and avoid passing the cable wires close to the ignition wires and cables, ignition coils and other sources of electric noise.

DON'T EVER, under any circumstance, install the ECU near ignition modules in order to avoid the risk of interferences.

Electric cables must be protected from contact with sharp edges on the vehicle's body that might damage the wires and cause short circuit. Be particularly attentive to wires passing through holes, and use rubber grommets/protectors or any other kind of protective material to prevent any damage to the wires. At the engine compartment, pass the wires through places where they will not be subject to excessive heat and will not obstruct any mobile parts in the engine.

Red wire - 12V input

The 12V input to FuelTech ECU, this wire must be connected to 12V from a relay (Main Relay) and cannot be shared with the positive wire that powers coils, fuel injectors or other actuators.

• **12V for sensors:** use a 24 AWG wire from the same 12V wire that feeds the ECU (Main Relay). Example: Hall Effect sensors, pressure sensors, speed/RPM sensors, etc. This wire cannot be shared with the positive wire that powers coils, fuel injectors or other actuators.

• **12V for fuel injectors:** use a 14 AWG wire connected to a 40A relay. Protection fuse must be chosen according to the peak current of the fuel injectors plus a 40% safety coefficient.

Example: for up to 4 injectors that draw 1A of current per injector on primary bank, and 4 injectors that draw 4A of current per injector on secondary bank: (4x1A)+(4x4A)=20A + 40% = 28A. Use a 30A fuse.

• **12V for coils, fuel pump and other high power actuators:** use a wire with at least 14 AWG connected to a relay and a fuse correctly dimensioned according to the actuator current draw. When using individual coils (COP), it is recommended a 70A or 80A relay.

NEVER share the 12V that feeds injectors, coils or other accessories, because, after shutting the engine off, there is a risk of reverse current that may damage a sensor or the ECU.

Black wire - Battery's negative

This wire is responsible for signal ground to the ECU so, it must be connected **straight to the battery's negative terminal**, with no seams. **Under no circumstances, should this wire be connected to the vehicle chassis** or split with the ECU black/white wire (power ground). This will cause electromagnetic interference and other problems hard to diagnose and solve.

The black wire must have permanent contact with the battery's negative terminal, never being connected to switches, car alarms or others. To turn a FuelTech ECU off, the red wire should be switched on and off.

- Attach the negative wires to the battery terminal use ring terminals and avoid soldering them. A well crimped terminal has better resistance than a soldered one. Besides that, solder makes the joint stiffer, and less resistant to vibration, typically found in automotive applications.
- Use a crimping tool and insulate the wire with insulating tape or heat shrink tubing.
- If there's a need to solder the wire to the terminal, check it's resistance after the solder, it should be lower than 0.2 Ohms.

NOTE: If corrosion is found (green/White powder) on the battery terminals, clean it with a wire brush and baking soda or contact cleaner spray. Double check the terminal holder and replace it if necessary. Check resistance after the cleaning, it should be lower than 0.2 Ohms.

Green/Black wire - Negative for sensors

(TPS, air temp., Pressure, rpm, distributor, etc.): It is vital to use sensors ground straight to the battery's negative terminal. Connecting them to chassis may cause electromagnetic interference, wrong readings or even damage to the sensors.



FT450 / FT550 / FT550LITE / FT600

Black/White wire - power ground

These are the ECU power ground wires. They MUST be wired to the battery's negative terminal. The **power ground (black/white wire) can not** be joined to the **signal ground (black wire)** before reaching the battery's negative terminal.

The three power grounds must have permanent contact with the engine block/head, never being connected to switches, car alarms or others. To turn a FuelTech ECU off, the red wire should be switched on and off.

Power ground to ignition modules (SparkPRO, etc.), Peak and Hold drivers, relays and other accessories, must be connected to the same point, at the engine block/head.

A good test to check if the power grounds are with good connection is, using a tester, to measure the resistance between the battery's negative terminal and the chassis ground. Connect the red probe on the chassis point that the shield is connected and the black probe on the battery's negative. With the tester on the 200ohms range, the resistance measured must be below 0.2 Ohms. Remember to touch both probes to check its resistance. This reading must be subtracted from the first reading to found the correct value.

OBS: it is very important to check the shield that connects the engine block to the chassis and to the battery. If this shield is defective, replace it by a new one, as it may cause serious damage to the ECU and its sensors. For this reason, we recommend the use of two these shields two of these shields.

Main switch installation (optional) - important tips

Main switches have been used for a long time in competition vehicles for safety purposes in case of an accident. Just like any other electric accessory, there's a correct way to install it:

The main switch cannot be connected to ground or power ground, under any circumstances!! This is the most common error by installers and, usually costs hours of work to fix all the problems that it cause. All of this without counting the huge possibility of damaging all the electronic accessories on the vehicle.

The main switch must $\underline{\text{ALWAYS}}$ control the battery's positive (12V).



- 1 Shield connecting battery negative to chassis and engine
- 2 The ECU's black and black/white wires must go straight to the battery's negative terminal without being joined together along the way
- 3 Positive wire to alternator
- 4 Main switch
- 5 Ignition Switch
- 6 Switched 12V



9. Wiring PowerFT ECUs to harnesses from previous ECUs

The ECUs can be installed on vehicles which already use FT250, FT300, FT350, FT400 and FT500/FT500LITE, with no need to rewire everything. However, a few points must be checked or modified.

The best option is to make a new installation, using the FT harness, according to the recommendations here brought.

However, if to rewire is not possible, there is another alternative: to cut the old FT connectors and wiring them as shown below.

In order to do so a FT450, FT550/LITE or FT600 connector kit is needed (sold separately).



NOTE

In order to avoid any kind of damage to your installation, cut one wire at a time, crimp it and install it in the proper position.



IMPORTANT

The wire positions are sequentially numbered in back rear of both connectors. The following diagrams show the connectors from a back view, where the pins must be inserted.



WARNING

Check carefully and identify each connector: A-Connector: 3 reference notches B-Connector: 4 reference notches.

9.1 Connector diagram - Harness FT250, FT300, FT350 to FT450



Colors of the wires in the FT250,FT300 and FT350 main harness after crimped and inserted in the FT450/FT550 A connector



NOTES

-If a 5th ignition output is needed, use gray wire E of the old harness in the

-For the FT450, use blue output number 5 for PWM idle actuators

-The Tach output feature must used on either blue 3, 6 or gray 4



9.2 Connector diagram - Harness FT400 to FT550/LITE



Colors of the wires in the FT400 main and auxiliary harness after crimped and inserted in the FT450/FT550 A connector

9.3 Connector Diagram - Harness FT400 to FT550/LITE



Colors of the wires in the FT400 main and auxiliary harness after crimped and inserted in the FT450/FT550 B connector



NOTE

- In order to use electronic throttle body, it is necessary to cut pins 13 and 14 from the FT400 harness



9.4 A - Connector Diagram - Harness FT500 to FT550/LITE



Colors of the wires in the FT500 harness after crimped and inserted in the FT550 A connector

9.5 B - Connector Diagram - Harness FT500 to FT550/LITE



Colors of the wires in the FT500 harness after crimped and inserted in the FT550 B connector



9.6 A - Connector diagram - Harness FT500 to FT600



Colors of the wires in the FT500 harness after crimped and inserted in the FT600 A connector

9.7 B - Connector diagram - Harness FT500 to FT600



Colors of the wires in the FT500 harness after crimped and inserted in the FT600 B connector



10. Fuel injectors

The FT outputs to control fuel injectors (blue wires). Each one of them can control up to 6 injectors with internal resistance above 10 Ohms (saturated injectors) or up to 4 injectors with internal resistance above 7 Ohms. Using a Peak and Hold driver, this capacity varies according to the output and the Peak and Hold current control (2A/0,5A, 4A/1A or 8A/2A).

In situations where more than 16 outputs are needed, the gray or yellow outputs can be set as injector outputs. In this case, the use of a Peak and Hold driver for these outputs is mandatory.

Injectors can be triggered in multipoint, semi sequential or sequential modes.

Examples of 4-cyl engines running high impedance injectors

• **Individual triggering:** each blue output controls a cylinder. This is the most recommended connection cause is the only one that allows individual per cylinder fuel compensations, amongst other functions.



Two injectors per channel: blue output #1 controls injector of cylinders 1 and 4. Blue output #2 controls injectors of cylinders 2 and 3



Four injectors per channel: use this connection only for compatibility with previous generation FT ECUs.



Even with each output controlling only one injector it is possible to change the triggering mode to multipoint (batch fire), semi sequential (outputs triggered in pairs) or sequential.

11. Ignition

The ECU has ignition outputs that can be used according to the needs of the project, controlling a distributor or a crank trigger.

Ignition with distributor

When using this ECU with a distributor, the only active ignition output is gray #1. This wire must trigger an ignition module or a coil with integrated igniter. When MSD configured it's utilized Yellow#1.

Coil with integrated igniter (smart coil)

They are coils with at least 3 pins and only one spark plug wire output. This kind of coil (inductive) must be set as "Falling dwell" in the "Ignition output" menu. In case of selecting the wrong output type, coil will be damaged.

FuelTech SparkPRO-1 with coil without integrated igniter (dumb coil)

The FuelTech Spark PRO-1 module is an high energy inductive igniter which has an excellent cost/benefit and can be used with any 2-wire dumb coil (without internal igniter). Coils with primary least possible resistance are recommended for maximum SparkPRO-1 potential. The minimum resistance of the coil primary should be 0.3 ohms, below this the SparkPRO will be damaged.

Try to place SparkPRO-1 as close as possible to the coil.

Warning about the SparkPRO-1:

An excessive charging time (Dwell) can damage the SparkPRO and the coil. It is recommended to use a Dwell map with 6ms at 8V, 4ms at 10V, 3.60ms at 12V and 3.00ms at 15V and check coils temperature at the beginning.





IMPORTANT

In the "Ignition" menu, select the ignition output as "Falling dwell". In case of selecting the wrong output type, coil will be damaged.

Capacitive discharge ignition module (MSD 6A, MSD 7AL, Crane, Mallory)

FuelTech's ignition output must be connected to the MSD ignition module, (usually, the white wire is the points input). When using a MSD ignition box, the yellow #1 is automatically set up as ignition output.

The installation of ignition modules must always follow what is indicated by its manufacturer in the instructions manual. This ignition module will receive a Points signal from FuelTech. Ignition coil must follow the ignition module manufacturer recommendations as well.

Important Notes:

- The module must be placed as close as possible to the ignition coil, and never inside the car, in order to avoid the risk of interference with electronic devices.
- The length of the wires that connects the ignition module to the ignition coil must be as short as possible.
- In "Ignition Setup," select the output "Rise (CDI)".
- It is not possible to control the ignition Dwell when using this type of module.
- To use the ignition cut through MSD, check Chapter 7.3



• When using MSD ignition modules with a distributor, it is necessary to connect a FuelTech white wire to the MSD Legacy input. Doing so improves the response of timing control, which is especially necessary when using Drag Race Features.

• When experiencing problems with the cut through MSD like no cut at all or RPM limit always 500 RPM above what was setup, use the other MSD pin.

Ignition with crank trigger

When controlling the ignition in distributor less systems, wasted spark or individual coils per cylinder are needed. In this case, coils are triggered by different outputs, according to the number of cylinders. Ignition outputs (gray wires) are triggered according to the firing order set up on the ECU

Example: 4 cylinder engine with individual coils:

Gray outputs are selected automatically, according to the number of cylinders.

Gray wires that will not be used for ignition control can be set up as injectors outputs (Peak and Hold driver is mandatory) or auxiliary outputs (relay needed).

Individual coils - electrical connections

These connections must be done by matching the output number with the cylinder number:

- Ignition output #1 controls cylinder #1 coil;
- Ignition output #2 controls cylinder #2 coil;
- Ignition output #3 controls cylinder #3 coil.

When working with dumb coils, an external ignition module must be used (as the FuelTech SparkPRO). In this case, ignition outputs from FT600 are connected to the ignition module inputs.

۷ ۷	Viring harness diagram		>
Blue 8: Shift Al	ert		<
Grey 1: Ignition	n - cylinder 1		
Grey 2: Ignition	n - cylinder 2		
Grey 3: Ignition	n - cylinder 3		
Grey 4: Ignition	n - cylinder 4		>
×		 ✓ 	*





Wasted spark coils - electrical connections

In this case, ignition output #1 controls cylinder #1 and its twin, ignition output #2 controls cylinder #2 and its twin, etc.

When using dumb coils, an external igniter must be used, such as FuelTech SparkPRO. The FT ignition outputs (gray wires) will be connected to the igniter inputs and the igniter outputs will be connected to the coil.



Resistor Installation gray outputs

When coils with integrated ignition module are used in your vehicle with FuelTech it's recommended to install a 100 ohms resistor (100R) in series with each gray output used in installation.

This procedure is used as a protection to the ECU against current discharges in adverse situations.



After installing the resistor, you must insulate the area with electrical tape or heat shrink.



12. Sensors and actuators

The ECUs has some pre-defined sensors available as standard, but, it's possible to setup any kind of analog sensor on its inputs or even to connect it and read a sensor in parallel with the OEM ECU. This configuration is done on the custom mode through software FTManager and USB cable on a PC.

12.1 Intake air temperature sensor

With this sensor, the ECU can monitor the intake air temperature and perform real time compensations.



Models:

- Fiat: Delphi / NTK (3,3kΩ a 20°C);
- GM (American): ACDelco: 213-190 / GM n°25036751.

One of its pins is connected to the battery negative. The other to the white #7 wire (standard – can be changed).

12.2 Engine temperature sensor

This sensor is very important for a good running engine, as varying engine temperatures dramatically affect an engine's fuel and timing requirements.

On water cooled engines, place this sensor near the engine head, reading the water temperature. On air cooled engines, install this sensor reading the engine oil temperature.



Models:

- Fiat: Delphi / NTK (3,3kΩ a 20°C);
- GM (American): ACDelco: 213-928 / GM: 12146312 (or 15326386).

One of its pins is connected to the battery negative. The other to the white #5 wire (standard – can be changed).

12.3 Fuel and oil pressure

FuelTech PS-150/300/1500 is a high precision sensor responsible for general pressure readings (fuel, oil, boost, exhaust back pressure, etc.) It can be purchased Online at www.fueltech.net or from an authorized FuelTech dealer (check the website to locate the dealer nearest to you).

FuelTech PS-150/300/1500 sensor below:

- Connection: 1/8" 27NPT
- Pressure Range: 0 to 150/300/1500psi
- Power Voltage: 5V
- Output Scale: 0.5-4.5V
- Electric Connector: 3-way Metri Pack 150

Pin A: Battery's Negative Pin B: 5V supply Pin C: Output signal FuelTech part numbers: 5005100020 - 0-150 psi sensor 5005100021 - 0-300 psi sensor 5005100022 - 0-1500 psi sensor





As FT600 is fully configurable, practically any automotive pressure sensor can be used – if the voltage x pressure table is known, you can setup through FTManager software.

12.4 Throttle position sensor (TPS)

This sensor is a potentiometer installed on the throttle to inform the ECU about its position. If needed, it is possible to run the engine without this sensor, but, it is very important for a fine tuning. When possible, use the OEM TPS. This ECU is calibrate to any kind 0-5V TPS sensor. Anyway, FuelTech products are compatible with any 0-5V TPS sensor, since they have calibration function.

Finding connections for TPS sensors

Using a multimeter, select the 20k Ohms range, unplug the ECU harness and leave the ignition off. Put the test probes on 2 different pins of the TPS sensor and then open the throttle. You must find 2 pins that will not make any change to the measure when opening and closing the throttle body. One of these two pins must be connected to a 5V output from the ECU and the other one to the signal ground. The third pin is the TPS signal to the ECU.

The TPS signal voltage should vary according to the throttle opening, with voltage differences higher than 3V between fully closed and wide open throttle.





12.5 Crank trigger/RPM sensor

To control fuel and ignition, this ECU is able to read magnetic and Hall Effect sensors.

Distributor

To read RPM signal from a Hall Effect distributor, it should have a sensor with at least 3 pin and have the same number of reading windows (or "triggers") than the engine has number of cylinders.

VW Hall Effect distributor connections



Crank trigger

The crankshaft trigger wheel is responsible for informing the exact position of the crankshaft to the electronic ignition management system, in such a way that this system is able to determine the ignition timing in the engine. The trigger wheel is installed on the crankshaft, outside or inside the engine block, with a specific alignment. Usually, the Crankshaft Trigger Wheels placed on the outside of the block are put in front of the engine, by the front crankshaft pulley, or in the rear of the engine, by the flywheel. There are many types of Trigger Wheels, but the compatible ones are mentioned below

60-2: this is, in general, the most used type of trigger wheel. It is a wheel with 58 teeth and a gap (fault point) equivalent to two missing teeth, therefore called "60-2". This trigger wheel is found in most Chevrolet (Corsa, Vectra, Omega, etc.), VW (Golf, AP TotalFlex, etc.), Fiat (Marea, Uno, Palio, etc.), Audi (A3, A4, etc.) and Renault (Clio, Soènic, etc.) Models, among other car makers. Ford Flex models with Marelli ECU use this type of trigger wheel also.

36-2: standard in Toyota engines, being 34 teeth and a gap equivalent to two missing teeth.

36-1: 35 teeth and a gap equivalent to one missing tooth. It can be found in all Ford vehicle lines, with 4 or 6 cylinders (except the Flex models with Marelli injection, which use the 60-2 trigger wheel).

12 teeth: this type is used by AEM's Engine Position Module (EPM) distributor. In this case, the CAM sensor from the EPM must be used. This distributor has 24 teeth, but as it rotates half-way for each full engine RPM, there will only be 12 teeth per RPM. Setup the Ignition with 12 teeth at crank (24 at CAM) and the 1st tooth alignment with 60°.

Setup ECU as 12 teeth (at crank) 24 (at cam) and use 60° for 1st tooth alignment.

Mitsubishi 1G CAS: due to the fact the CAM signal has two slots on this CAS, it's only possible to control the ignition on wasted spark mode and the fuel injection on multipoint or semi-sequential. No sequential fuel or ignition will work on this CAS with 2 slots on the CAM.

- **Pin 1** white CAM signal: connect to white wire from FT (connector A pin #17 to FT450 and FT550) and (connector B pin #4 to FT600).
- Pin 2 yellow CRANK signal: connect to red wire from FT600 black shielded cable (Connector B - pin #1), from FT450/FT550 (connector A - pin #19)
- Pin 3 red sensor feed: connect to a switched +12V
- Pin 4 black sensor ground: connect directly to battery's negative.

FT setup: RPM signal "2 (crank) or 4 (CAM)" (4G63) or "3 (crank) or 6 (CAM)" (6G72), Hall Effect crank and CAM sensors, rising edge on both. Wasted spark ignition. 1st tooth alignment: 67.*

Mitsubishi 2G CAS: uses the same settings that 1G CAS, but has a sensor on the crankshaft (reading a 2 tooth trigger) and a CAM sync sensor.*



NOTE

This crank trigger will only work with a single tooth cam sync. On stock engines it is needed to remove the smaller tooth from the cam trigger wheel.

Crank trigger sensor:

- Pin 1: switched 12V
- Pin 2: CRANK signal: connect to red wire from FT450/FT550 (connector A - pin #19), from FT600 (connector B - pin #1)
- Pin 3: connect directly to battery's negative

CAM sync sensor:

- Pin 1: switched 12V
- Pin 2: CAM signal: connect to white wire from FT450 / FT550 (connector A pin #17), from FT600 (connector pin #4)
- Pin 3: connect directly to battery's negative

Ignition settings:

- Stock Honda coil and igniter: setup ignition as "Distributor single coil" and select option "Rising edge (Honda distributor)". In this option, only the ignition output #1 will be active.
- Multi coils and/or external igniter: in this case, ignition can be controlled in wasted spark or sequential modes. Ignition output must be setup as "Honda distributor", but as Falling edge or Rising edge, according to the external igniter used.
- **1, 2, 3, 4, 5, 8, 10 and 24 teeth:** options available according to the number of engine cylinders. When having these trigger wheels, the use of a camshaft position sensor is mandatory, in order to maintain the synchronization of the parts. Also, the teeth must be equidistant. They can be found in models such as Subaru, Mitsubishi Lancer and 3000GT, GM S10 Vortec V6, etc.



Sensors and actuators

FT450 / FT550 / FT550LITE / FT600



Distributor Pin	Honda 92/95 (Wire color)	Honda 96/00 (Wire color)	FT600 connection	Configuration
1	Yellow/green	Yellow/green	With OEM coil and igniter, connect gray #1 wire	With stock Honda coil and igniter: connect to gray wire #1 and setup as " Honda Distributor ". With multi-coils, and external igniter: do not connect
2	Blue/Green	White	Do not connect	
3	Orange/Blue	Red	Connect red wire from black shielded cable	Reference - 2 (crank) 4 (cam)
4	Orange	Black	Do not connect	
5	Blue/Yellow	Blue	Do not connect	
6	White/Blue	Green	Connect white wire from black shielded cable	Signal - 2 (crank) 4 (cam)
7	White	Yellow	Do not connect	
8	Blue	Blue	Do not connect	
9	Black/Yellow	Black/Yellow	12V input	12V input for OEM coil and igniter (inside the distributor) With external coil, do not connect

MSD distributor and crank trigger:

The distributors are equipped with VR/magnetic sensors e must be wired as the following:

- Orange/black: connected to the red wire of black shielded cable
- Purple/black: connected to the white wire of black shielded cable

Any mechanical or centrifugal advance must be locked. The crank trigger kits have different wire colors and the wiring must be as following:

- Purple: connected to the red wire of black shielded cable of FT600;
- Green: connected to the white wire of black shielded cable of FT600

The RPM signal settings must be:

- 4 cylinders: 2 (at crank) or 4 (at cam);
- 6 cylinders: 3 (at crank) or 6 (at cam);
- 8 cylinders: 4 (at crank) or 8 (at cam);

RPM sensor:

VR differential, rising edge, crank index position 45° (need to calibrate ignition with timing light)

Cam sync sensor:

Not utilized, unless you are running crank trigger and distributor (or a dedicated cam sync sensor) with a single tooth.

48-2, 30-2, 30-1, 24-2, 24-1, 15-2, 12-3, 12-2, 12-1, 12+1 and 4+1 teeth: These are less common types, but they are perfectly compatible. These trigger wheels can operate without a camshaft position sensor, as they have a gap that indicates the TDC on cylinder 1.

In order to correctly inform the engine position to the injection module, it is necessary that the injection has the right information about the alignment of the trigger wheel in relation to the TDC on cylinder 1. The image below shows a 60-2 trigger wheel with the sensor aligned on the 15th tooth after gap. In this image, for example, the engine is on the TDC on cylinder 1. Notice that the RPM is clockwise, and therefore, the TDC on cylinder 1 is set 15 teeth after the sensor passes the gap. That is exactly the number of teeth that must be informed to the injection upon its configuration.



60-2 Trigger Wheel Aligned on the 15th tooth after the gap



Of the space in between them. The minimum diameter for the fabrication of a 60-2 trigger wheel is 125mm (5").

For 36-1 trigger wheels, the minimum diameter recommended is 100mm (4"). Trigger wheels with smaller diameters can be fabricated, but reading errors may occur and the engine may not work.

Crankshaft trigger sensor

When controlling the ignition with a trigger wheel, it is necessary to have a sensor that reads the signal from its teeth and informs the engine position to the injection. There are two types of crankshaft trigger sensors:

VR sensor: this is the type that is most commonly used in cars nowadays, especially with 60-2 and 36-1 trigger wheels. One of its main characteristics is that it does not receive 12V or 5V; it only generates an electromagnetic signal based on induction. It might have 2 or 3 wires (the third wire is an electromagnetic shield).

Hall Effect sensor: it is usually found on 2, 3 and 4-tooth trigger wheels and some 36-1 and 60-2 types. It receives a 5V or 12V feed and emits a square wave signal. It invariably has 3 pins: voltage, negative and signal.



The crank Wheel should be aligned with the sensor



NOTE

If a VR sensor doesn't pick up RPM signal, try to swap the sensor wires (red and white wires). Or install resistor of 560ohms between red and white wires.

A very simple test using a tester can identify if a Crankshaft Trigger Sensor is an inductive or a Hall Effect sensor. Turn the tester on the resistance measurement mode at a 2000Ω scale and connect its probes to the sensor's pins. Test pin 1 with the other two. If a resistance of $600-1200\Omega$ is found, the sensor tested is of inductive type.

If no resistance is found among any of the pins, or if the resistance found is much higher than 1200Ω , it is either a Hall Effect sensor, or an inductive sensor with a broken coil. Notice that, when finding the resistance between pins 2 and 3, for example, pin 1 must be connected to the battery's negative terminal and the other 2 to FT shielded cable. If the module does not capture the signal, invert the white and red wires connections.

12.6 Camshaft position sensor

This sensor tells the ECU when the cylinder #1 is reaching its TDC on the compression stroke. With this information it is possible to control ignition and fuel injection in sequential mode.

Installation and alignment of this sensor are pretty simple. The only

requirement is that this sensor is triggered before the crank trigger sensor goes through the gap on the crank trigger wheel.

12.7 O2 sensor

Wideband O2 sensor

The use of wideband lambda sensors on ECUs input requires an external conditioner (WB-O2 Slim or WB-O2 Datalogger). It is important to verify the measurement range of conditioner analog output, as this will be informed during the configuration of ECUs O2 input (0,65-1,30, 0,65-4,00 or 0,65 to 9,99)

Narrowband O2 sensors

Although less precise than the wideband lambda sensor, narrowband O2 sensors can be connected to the ECU input for the display of values (in Volts) at the Dashboard and at the Diagnostic Panel. Narrowband O2 sensors usually follow a standard set of colors, facilitating the wiring. The table below shows the wiring instructions based on the color scheme generally used for O2 sensor wires:

Wire Color	4-wire O2 sensor	3-wire O2 sensor	1-wire
Black	Signal Output	Signal Output	Signal
White (2 wires)	Switched 12\ one wire onto t ground –	Not featured	
Gray	Battery's negative terminal	Not featured	Not featured

As a general rule, if there are two wires with the same color, one is the switched 12V and the other is the ground. After connecting the O2 sensor to the ECU, the O2 sensor input must be set up as guides chapter 15.5.

12.8 Step motor - idle speed

Its control is done through the four yellow outputs of the connector A, also used for electronic throttle control. After selecting the idle speed control as step motor the four yellow outputs are automatically set up as "step motor" on the harness connection table. Below are some known step motor connections.

WW stepper motor - Magneti Marelli



GM stepper motor - Delphi



IMPORTANT

Step motor is calibrated every time the ECU is turned on, so, before cranking the engine, it is recommended to wait about 2s after turning the ignition switch on. If this procedure is not respected, the engine may be revved up unwittingly during the step motor calibration, coming back to normal within seconds.

If your step motor is different from the ones listed here, do what follows:

- 1. Put a tester on the 200 Ohms range;
- 2. Measure the step motor actuators until you find a resistance of approximately 50 Ohms. That's one pair of coils;
- Connect yellow #1 and yellow #3 to a pair of coils and yellow #2 and yellow #4 to the other pair.;
- 4. If the step motor remains fully opened after the calibration, change yellow #1 by yellow #3 position.

FT600 step motor control is compatible with the great majority of actuators nowadays.

Usually, with this simple test you're able to make the step motor work normally.



13. Auxiliary outputs

The installation of a fuse equivalent to the charge is recommended. The auxiliary outputs have an overload protection system, with automatic current cut-off. They trigger the charges (lamps, relays, etc.) With a negative signal. Thus, the positive terminal must be connected to a switched 12V.



Battery 12V

The auxiliary outputs must be set manually according to the desired function in the outputs (blue, gray or yellow wires) that are not being used as injector or ignition outputs.

In case of having back current and keeping relays switched on with ECU powered off, use a 1N4004 diode.

Each output must be configured in accordance to its function.

For more information about the outputs programming, see chapter 19.

13.1 Cooling fan 1 and 2

This output is responsible for switching an electric fan according to the module's settings. The relay used must be adequate to the electric fan's current (50A, for example). The relay is switched by negative (sourced by the output), and the positive a switched 12V.

Important Note: the electric fan must not be connected directly to the auxiliary output without the use of a relay; otherwise, the output will be damaged.

13.2 Idle valve

This function opens a valve which increases the air flow in the intake, helping the engine to idle.

We recommend normally closed values, such as boost or purge (EVAP) solenoids.

An appropriate relay must be used according to current and voltage. The FT output switches ground and the 12V must be a switched 12V.

13.3 Air conditioning

This auxiliary output option allows for a much more intelligent control of the vehicle's air conditioning compressor, as the FT controls its activation only when the engine is already on and the idle speed has stabilized and turns off the air conditioning when the valve exceeds a predetermined value (a resource commonly used in low-powered engines).

A/C button

In order to have the air conditioning control, the A/C button on the dashboard must be connected to a white input of FT. The two connection options are:



A/C button negative when ON



The air conditioning will remain turned on as long as the A/C Signal Input receives signal from the button. The signal polarity can be chosen and it varies depending on the installation.

A/C Compressor

A/C compressor must be controlled with a relay, triggered by an auxiliary output (sends negative when activated).

The auxiliary output that was setup as A/C will activate the A/C compressor relay and the A/C fan. For more information on how to setup this output, check chapter 13.

13.4 Shift Alert

This function activates an external shift light and works by sending negative when turned on. Any of the options below can be used:

- 12V light: switched 12V directly connected to the light bulb and the negative connected to the blue or yellow outputs.
- LED working as a Shift Light, which must be connected with a serial resistance (if used in 12V, resistance from 390Ω to 1kΩ) to the switched 12V.
- Any "Pen" Shift Light working in the same way as a light bulb.

13.5 Fuel pump

The fuel pump control must be done through a relay sized in accordance to the pump's working current. The output sends out negative to activate the relay, which stays activated for 6 seconds and turns itself off if the ECU does not receive any RPM signal. When the ECU reads RPM signal, it activates the fuel pump once again.

13.6 Variable camshaft control/Powerglide gearbox

The camshaft control systems that use solenoid valve type NO/NC such as Honda's VTEC can be controlled through this output. The user only needs to inform the solenoid's turn on RPM.

It is important to notice that the impedance of the variable control system's solenoid must respect the auxiliary output limits, which



requires a minimum impedance of 25Ω , or the use of a relay. For valve timing control systems switched by PWM (such as Toyota's WTi), it is possible to manage it through the Boost Control function, as long as its characteristics (power, current, etc.) are within the auxiliary output limits.

This resource can also be used to switch the control solenoid from the 2-speed automatic gear control, Powerglide type. Configure the RPM to turn on the solenoid responsible for engaging the second gear, only for drag racing applications.

13.7 Progressive nitrous control

This function drives the solenoids used for the injection of nitrous oxide in the engine.

As these solenoids have high power (90W) and low impedance (~1.6 Ω), they cannot be connected directly to the auxiliary output. A solid state relay with appropriate max current and voltage must be used to power the nitro and fuel solenoids.

Set the output as progressive nitrous output.



In the second option, the fogger only injects nitrous (dry nitrous). Fuel enrichment is managed by the injection, increasing injection times based on what has been programmed. The dry nitrous system has reached better results in tests, giving the engine a more linear power than the first option. It is important to clarify that in order to use the dry nitrous system, the fuel injectors must be correctly sized for the power maximum with the nitrous system operating.

There is a difference in the operation of solenoids that control nitrous injection and the ones that control fuel injection: nitrous solenoid starts pulsing after 5%; fuel solenoid only pulses after 20%. Variations may occur among solenoids from different brands/manufacturers.

When applying the conventional nitrous control, one must start with a minimum injection time of 20%, but when using dry nitrous, it is possible to start with 5%, as the injectors – and not the solenoid – will control fuel injection.

13.8 Boost Control - N75

This auxiliary output configuration allows the driving of a boost pressure control solenoid. FuelTech recommends using a 3-way N75 solenoid, found in the original 4 and 5-cylinder

VW/Audi Turbo models, which can be directly switched through the auxiliary output. Such solenoid valve controls the pressure on the top and bottom parts of the wastegate valve, changing the engine manifold pressure with which the latter opens.



N75 Solenoid Valve VW 058-906-283F

Wastegate at the exhaust manifold

This type of valve is used on most cars with adapted turbo, in competitions, etc.

Example 1: the first way to install a boost valve is connecting it to the bottom of wastegate valve, similar to the OEM installing in the VW 1.8T. Select the output signal as activated at OV and frequency at 20Hz.

This way the boost valve will decrease the pressure under the wastegate to increase boost pressure.



Example 2: the second way is to connect the boost solenoid to the top of wastegate.

Select the output signal as activated at 12V and frequency at 20Hz. This way, the boost valve will increase the pressure at the top of wastegate to increase boost





Wastegate integrated to the turbine

This valve has a different operation system, as it relieves the boost pressure when pressure is put on its top part, which is the opposite of what happens to the wastegate installed at the exhaust manifold.

Select the output signal as activated at OV and frequency at 20Hz With this kind of wastegate, the boost valve relieves the pressure in top of wastegate to increase boost pressure



13.9 BoostController

The BoostController is used for more precise control of the turbo pressure in street cars, circuit and drag races. The control can be performed by time after 2-step, RPM and gear, gear and time after change, unique value and engine RPM, as well as the control with specific targets for drag race (2-step, 3-step and burnout). See more information in chapter 19.15 BoostController diagrams.



14. Electronic throttle control

14.1 Electronic throttle control (FT600)

Electrical installation of an electronic throttle on FT600 is pretty simple. Check the example diagram below:



•

- Yellow wire #3 (pin 28 of the connector A) must be connected to the throttle input corresponding to the Motor 1 input.
- Yellow wire #4 (pin 29 of the connector A) must be connected to the throttle input corresponding to the Motor 1 input.
- **Green/red wire** (connector B) is and 5V output used to feed throttle and pedal position sensors. It must be spliced and connected to both of them.
- Sensors negative can also be spliced between pedal and throttle position sensors. Connect it directly to the battery's negative terminal.
- White numbered wires are sensors signal inputs, connect them to the signal outputs of the pedal (Pedal 1 and Pedal 2) and throttle (TPS1 and TPS2). After connecting these inputs, it is necessary to calibrate throttle and pedal as guides chapter 15.1.

Pins 28 and 29 (connector A), yellow wires, will not be used for electronic throttle control, they can be set up as auxiliary outputs.

14.2 Connection - throttle bodies and pedals

Check the throttle and pedal wiring before disconnect it from the OEM ECU. If you need, contact our tech support to get more information about throttles and pedals.

With the electrical connections ready, go back to chapter 7.5 and insert the throttle code (FT) that you found on the throttle table connection

If your throttle is not listed in our table, it might be necessary to send it to our tech team to have them check compatibility and research its control parameters. In this case please contact our tech support.



14.3 Electronic throttle control (FT550 / LITE)



FT550

- Yellow wire #3 (pin 24 of the connector B) must be connected to the throttle input corresponding to the Motor 1 input..
- Yellow wire #4 (pin 25 of the connector B) must be connected to the throttle input corresponding to the Motor 1 input.
- **Green/red wire** (pin 14 of the connector A) is and 5V output used to feed throttle and pedal position sensors. It must be spliced and connected to both of them.
- **Green/Black** (pin 26 the connector B) Sensors negative can also be spliced between pedal and throttle position sensors. Connect it directly to the battery's negative terminal.
- White numbered wires are sensors signal inputs, connect them to the signal outputs of the pedal (Pedal 1 and Pedal 2) and throttle (TPS1 and TPS2). After connecting these inputs, it is necessary to calibrate throttle and pedal as guides chapter 15.2.

Pins 24 and 25 (connector A), yellow wires, will not be used for electronic throttle control, they can be set up as auxiliary outputs.

14.4 Connection - throttle bodies and pedals

Check the throttle and pedal wiring before disconnect it from the OEM ECU. If you need, contact our tech support to get more information about throttles and pedals.

With the electrical connections ready, go back to chapter 7.5 and insert the throttle code (FT) that you found on the throttle table connection

If your throttle is not listed in our table, it might be necessary to send it to our tech team to have them check compatibility and research its control parameters. In this case please contact our tech support.



15. Sensors and Calibration

This chapter has the final steps before the first engine start. It basically guides the user through checking sensor readings and calibrating engine actuators.

15.1 Ignition calibration

The ignition calibration screen on FT has the same parameters that previous FT ECUs, the difference is that they are in the same screen. After calibrating the ignition, the 1st tooth index position is automatically changed on the "Engine setup" menu.

When using distributor, the ignition must be calibrated on this screen, instead of turning the distributor.

Ignition calibration screen: FTManager in FT

Ignition calibration × Adjust calibration until match 0° at timing light. Ignition calibration Image: Calibration in the second sec

15.2 TPS calibration

Through FTManager, click in the TPS/Pedal button





IMPORTANT

To perform this calibration, it is very important that the engine is not running, because the throttle is fully opened and closed

Go to "Sensors and calibrations" and then "Calibrate throttle/pedal".

- 1. With the pedal on idle position, click button "calibrate" beside the field "Idle: 0%
- 2. Push throttle to the maximum and click "calibrate" button beside the field "WOT: 100%".
- 3. Press "Save". Message "Calibration done!" is shown if the process is OK.
- 4. In case an error message is shown, check TPS connections.

TPS calibration errors may be:

Inverted and calibrated: means the TPS is connected the wrong way, but is working normally. Double check connections, but, know that it will work normally connected this way.

Possibly disconnected: check TPS connections. Maybe there is a broken wire or one of the connectors does not reach the TPS pins.

Check with a tester to see if the voltage on the orange wire varies according to the throttle position.



TPS sensor must be calibrated on the first time the ECU is turned on only, and should be recalibrate only when it has to be replaced or the throttle opening on idle was changed. TPS calibrations are individual by map file.

TPS signal voltage must go up, as the pedal is pressed, and must have at least a 3V difference between the idle and WOT positions

TPS errors and diagnostics

Error message	Diagnostic
TPS range must be higher than 1.5 Volts	The TPS value from 0% to 100% has a smaller difference than 1,5V
TPS signal may be shorted to ground	Ground short circuit for TPS input
TPS signal may be disconnected	TPS input disconnected or short circuited to 5V
TPS calibration is required only when activated	No input configured as TPS.

15.3 Electronic throttle/pedal calibration

This calibration procedure is exactly the same as the mechanical throttle calibration. The only difference is that the calibration screen shows voltage value on both TPSs of the electronic pedal.

With this done, it is necessary to adjust idle speed control parameters as guides chapter 19.2



IMPORTANT

Every time the pedal calibration is done the throttle automatically calibrates its opening limits. It is very important that during this calibration the engine is turned off because the throttle is fully opened and closed.

<	TPS/pedal calibration						
I	Pedal #1		Pedal #2				
	4.05V		2.01V				
		Idle	0%				
	4.99V		4.99V	Calibrate			
		Full 1	.00%				
	4.99V		4.99V	Calibrate			
	×			\checkmark			



Error Message	Diagnostic
Throttle #1 channels not found	There is no input configured as throttle input
ETC motor #1 signals may be disconnected	ECU Failed to actuate the throttle motor
Throttle #1A signal may be shorted to ground	Throttle Input A short circuited to GND
Throttle #1A signal may be disconnected	Throttle input A disconnected or short circuited to 5V
Throttle #1B signal may be shorted to ground	Throttle Input A short circuited to GND
Throttle #1B signal may be disconnected	Throttle input A disconnected or short circuited to 5V
ETC 1 code error	Throttle code error

Electronic Throttle security behaviors

Correlation error between throttle and pedal signals

- Happens when the difference between pedal and throttle is higher than 20% for more than 200ms

- The electronic throttle is turned off and returns 500ms after the difference between the signals is below 20%.

ETC position tracking error

Happens when the difference between the desired position and the throttle position is higher than 10% for more than 1 second
The electronic throttle control is turned off and only returns 0,5s after the difference between the desired position and the throttle position is lower than 10%

15.4 Fuel/oil pressure sensors inputs

In this menu are the settings for fuel and pressure sensors. There is a predefined configuration for PS-150/300/1500 pressure sensors, but any kind of analog sensor with 0-5V signal can be used. This configuration is done through the PC and software FTManager.

In case there is a reading error between the FT screen and the real value of the sensor (comparing to an external gauge), this compensation is easily done by adjusting the sensor offset. It is possible to edit this compensation in mV or in pressure offset. Just change the button on the top part of the screen between "Input value" (mV adjust) and "Output value" (pressure offset). The field "Read value" shows readings in real time.

Make sure your external gauge is correctly calibrated and that the correct sensor is selected, as incorrect use of this function can cause significant error in pressures reported.

Inputs		
Inputs (White wires)	✓ Input enabled	
#1: None #2: Pitch rate #3: Davis Profiler - Input signal	Import sensor	Calibrate ser
#4: Oil pressure	Channel name	Input sensor
#5: Engine temp.	Default name	O Default
#6: Clutch Position #7: Air temperature	None 🗸	
#8: Pedal #2	None	^
#9: Pedal #1 #10: Throttle 1B	Air temperature	
#11: Throttle 1A	Engine temp.	
	Oil pressure	
	Fuel pressure	
	02 Conorol	



The FT has fully customizable inputs, which allows to read any 0-5V analog pressure sensor, since its pressure vs voltage table is known. In this case, just select the custom option and fill the interpolation table through FTManager.

15.5 Intake air and engine temperature sensors

In this menu are the settings for intake air and engine temperature sensors. There is a predefined configuration for GM and Fiat sensors.

In case there is a reading error between the FT and the real value of the sensor (comparing to an external gauge or to the dashboard), this compensation is easily done by adjusting the sensor offset. It is possible to edit this compensation in mV or in degrees. Just change the button on the top part of the screen between "Input value" (mV adjust) and "Output value" (temperature offset). The field "Read value" shows readings in real time.

Make sure your external gauge or dashboard is correctly calibrated and that the correct sensor is selected, as incorrect use of this option can cause significant error in reported temperatures and possible engine damage



The FT has fully customizable inputs, which allows to read any 0-5V analog temperature sensor, since its temperature vs voltage table is known. In this case, just select the custom option and fill the interpolation table through FTManager.



15.6 O2 sensor inputs

O2 sensor signal input can be setup on any sensors input of this FT it is even possible to read fifteen O2 sensors simultaneously and show them on the screen. For wide band O2 sensors, it is necessary to use a wide band conditioner, for narrow band O2 sensors, direct connection is allowed.

Be sure to connect the O2 conditioner to FT according to the Chapter 12.7 of this manual.

Inputs		
Inputs (White wires)	✓ Input enabled	
#1: None #2: Pitch rate #2: Davis Brofilor - Input signal	Import sensor	Calibrate ser
#4: Oil pressure	Channel name	Input sensor
#5: Engine temp.	Default name	🔿 Default
#6: Clutch Position #7: Air temperature	None 🗸	
#8: Pedal #2	None	^
#9: Pedal #1 #10: Throttle 1P	MAP	
#10: Throttle 18	Engine temp	
"III Inocce In	Oil pressure	
	Fuel pressure	
	Engine coolant pressure	
	102 General	llup

CAN network reading

Through CAN network the reading is sent directly to FT, the only configuration necessary is to indicate what is the position of each sensor, this procedure is called "association".

The association procedure is executed by disconnecting from the conditioner a single sensor at time, this way the FT identifies and associates that sensor to the position of the engine (cylinder 1, general O2 sensor).

Follow the steps and repeat for each O2 sensor:

- Keep the conditioner connected and turned on and disconnect the O2 sensor;
- 2. Press the Associate button on FT or on the "CAN communication of FTManager" window;
- Reconnect the O2 sensor and repeat the process for all other O2 sensors;



Sensors and Calibration	Wideband O2				
Fuel pressure	^		Ger	neral	
Air temperature		Left	bank	Righ	t bank
Engine temperature		Cylinder 1	Cylinder 2	Cylinder 3	Cylinder 4
NarrowBand O2	_	Cylinder 5	Cylinder 6	Cylinder 7	Cylinder 8
WideBand O2	\sim	Cylinder 9	Cylinder 10	Cylinder 11	Cylinder 12
×	\checkmark	×			\checkmark

FT450 / FT550 / FT550LITE / FT600



Analog input reading

The O2 sensor reading through an analog input is used either to narrow band or wide band with conditioners that have analog output (FuelTech WB-O2 Slim WB-O2 Nano WB-O2 Datalogger and Alcohol O2), Simply set the sensor in any input of FT (white wires).

It's necessary to set the input scale according to the analog output of conditioner used. If it's a FuelTech conditioner select one of the preset scales. For other manufacturers use the custom table. The narrow band sensor reading is displayed directly in Volts.

Analog scales compatible with the FT are:

Scale	Output voltage
0,35 - 1,20	0,35 = 0,2V - 1,20 = 4,8V
0,59 - 1,10	0,59 = 0,2V - 1,10 = 4,8V
0,65 – 1,30	0,65 = 0,2V - 1,30 = 4,8V
0,65 - 4,00	0,65 = 0,2V - 4,00 = 4,8V
0,65 – 9,99	0,65 = 0,2V - 9,99 = 4,8V

WB-O2 Nano, Slim or Datalogger calibration

Offset calibration is needed to compensate analog signal loss. With O2 sensor connected and configured go to "Calibrate O2 sensor" (through display) or click in "Calibrate sensor" in FTManager software.

To calibrate O2 sensor, proceed as follows:

- 1. Check the scale of FT with external conditioner, they must be equal.
- 2. With the engine running, stabilize the O2 reading.
- 3. Adjust the offset until the reading in the conditioner matches the reading in the ECU.



4. If the calibration and configuration are correct, there will be no reading difference.







FT450 / FT550 / FT550LITE / FT600

Sensor offset					
Sensor offset					
Offset type	Value				
Input value	16.170 AFR				
O Output value	Sensor offset				
X Cancel	Save 🗸				

Alcohol-O2 Calibration

Also called free air calibration, this calibration is necessary when using FuelTech Alcohol O2 conditioner to compensate for differences in each sensor. When replacing a sensor it's necessary to repeat this calibration.

- 1. Remove the sensor from the exhaust pipe and let it ventilate for at least 20 seconds;
- 2. Press the calibrate button;
- 3. Calibration is OK;



15.7 Speed inputs

In the FTManager, there is a menu with all the settings related to wheel speed reading. In the touchscreen, the settings are divided in a few sub menus and will be presented in the next chapters.



Select Origin

Select on the first screen if wheel speed information will be read using ECU analog inputs (white wires), using GearController information over CAN bus (FTCAN 2.0), or using OEM CAN and FTCAN 2.0 (FT Input Expander).



If the chosen option is "White wire", the configuration screens will be shown to set the sensor input to left and right wheels, and number of teeth. The next screens will not be displayed when the CAN option is chosen.



The last setting is related to tire type and size. Slick/Drag Race tires only require the wheel rim diameter. Radial tires require wheel rim diameter, tire width and height.

Re	ear wheel spee	ed 5/6	K R	ear whee	l speed 6,	/6
Tire type	w	heel rim diameter	Tire wic	lth	Tir	e height
C Radial	agRace	17,0 <u>^</u>	225 mm	\sim	45 %	~
×		\checkmark	×	:		\checkmark

15.8 Driveshaft RPM

In the FTManager, there is a menu with all the settings related to driveshaft RPM and input shaft RPM reading. In the touchscreen, the settings are divided in a few sub menus and will be presented in the next chapters.

Quick access panel	Drive shaft RPM	
C Sensors and Calibration		
Inputs	Select origin White wire	Signal Filter
MAP	O FTCAN 2.0	Noise rejection filtering
Traction type Front wheel sneed	Number of teeth	Legacy high average points:
- Rear wheel speed	Calculate wheel speed	default filtering method on 4.11 update and older.
Drive shaft RPM	Enabled	Noise rejection filtering:
Input shaft RPM	Differential ratio	Quicker response, more detailed signal.
Turbo speed RPM	4.10	
Fuel flow sensor	Tire type	
Paddle shift	 Slick / DragRace Tire cire 	
Durles .	THE SIZE	

This menu is used to setup the driveshaft RPM reading. Select the FT600 sensor input to be used and insert the trigger wheel number of teeth

Driveshaft RPM 1/5		ζ [Driveshaft RPM 2/5	· · · · · · · · · · · · · · · · · · ·
ction				
e	\sim			
1: O2 sensor #1			Number of teeth	
2: 2-step				
3: Air Conditioning			teeth	
4: Oil pressure	$\left.\right>$			
	\sim	×		\checkmark
	Driveshaft RPM 1/5	Driveshaft RPM 1/5	Driveshaft RPM 1/5	Driveshaft RPM 1/5 Driveshaft RPM 2/5 ettion Nee 1: 02 sensor #1 2: 2: 2:step 3: Air Conditioning 4: 0il pressure

With the driveshaft speed and the tire dimensions, it is possible to calculate the traction wheel speed. If you want to use a driveshaft RPM sensor instead of a wheel speed sensor, check the box "Calculate wheel speed" in the next screen.





To calculate wheel speed, insert the differential ratio and tire dimensions.

The last setting is related to tire type and size. Slick/Drag Race tires only require the wheel rim diameter. Radial tires require wheel rim diameter, tire width and height.

15.9 Input shaft RPM

This feature allows the gearbox input shaft RPM Reading. The reading is very useful to analyze the clutch/torque converter slip. Just insert the sensor input and the number of teeth

Gearbox RPM 1/2	>	<	Gearbox RPM 2/2	>
Input selection				
None	\sim			
White 1: O2 sensor #1			Number of teeth	
White 2: 2-step			, ^	
White 3: Air Conditioning			Teeth	
White 4: Oil pressure	>			
×	\checkmark	×		\checkmark

15.10 MAP Sensor

This menu allows to setup the internal MAP or an external one.

Internal MAP: Can read up to 87 PSI and it's average points and Q factor can be changed for smoother readings on engines with high cam profiles.

External MAP: Can usually read pressures higher than 87 PSI, a white input must be used to setup an external MAP sensor for more than 87 psi.



15.11 Gear detection

In this menu there are the settings related to gear detection change (display and log). There are 10 different ways to detect it: by RPM drop (drag race only), by gear position sensor (requires a sensor in the transmission), by interpolating the current wheel speed versus engine RPM, by pulse and by gear shift output.

To view the currently engaged gear in the FT dashboard, go to "Interface Settings" and then "Dashboard Settings". Once in, click in the cell where you want to display the gear and select "Gear".

The first mode, by RPM drop, must be used only in drag race cars, since it can only detect upshifts and not down shifts. The third screen is for safety configurations, used to prevent false gear detection due to traction loss. Default values are good to most cases.

The fourth screen is for the RPM drop programming to each gear. The fifth screen is to enable and program the timeout for gear shift detection that is another safety feature to prevent false detection.





The second mode reads an analog gear position sensor, which is a potentiometer that indicates the engaged gear in transmissions already equipped with this sensor. Select the input that will read the sensor signal and then configure each gear voltage

To find the gear voltage, use a multimeter, in 20VDC scale, connected to the output of the gear position sensor and engage a gear at a time. **Intermediate voltage:** uses the voltage reading between the levels configured to detect gear shift.

Adjustable window: set a voltage window for the gear shift detection to happen.





The third mode crosses the wheel speed and RPM to calculate the engaged gear.

To configure, set the number of gears, gearbox ratio and differential ratio.

This detection mode will only show the engaged gear if the vehicle is moving and there is wheel speed reading.

When the clutch is pressed or the gear is disengaged (neutral) your FT may display an incorrect gear momentarily.



The fourth mode increases the gear counting by each pulse received on a white input. Set in which edge the count should be increased (default: falling edge). Configure an input as "Gear Detection" and connect the device that will send the pulse to increase the counting. This mode cannot detect down shifts and requires the 2-step to be used to reset the counter; therefore it is best suited for drag race cars.



The fifth mode enables an internal counter that is increased by each pulse sent out by the Gear shift output (Drag Race Features menu). This mode cannot detect down shifts and requires the 2-step to be used to reset the counter; therefore it is best suited for drag race cars.



The sixth mode of gear detection uses the "Gear shift output (Liberty gearbox)" and is specially designed for drag racing vehicles using Liberty Gearboxes. Set inputs for detection of Reverse and Drive switches and if necessary, set gear increment delays.

Gear detection 2/9		<	Gear detection 3/9		
Detection type		Reverse switch in	out		
By wheel speed	<	🔵 None			<
By input signal		White 1: O2 0	General		
Gear shift based output		White 2: Aval	able		
By gear shift output (liberty gearbox)		White 3: Air C	onditioning		
By integrated power shift (GearController)	>	White 4: Oil P	ressure		<
× v	/	×		\checkmark	•
0 1 1 50					
Gear detection 5/9	>	X	Gear detection 9/9		
Drive switch input		<	Gear detection 9/9		<u>></u>
Drive switch input		< <u> </u>	Gear detection 9/9 Gear increment delay after detection (ms)		>
Cear detection 5/9 Drive switch input O None White 1: 02 General	>	Gea	Gear detection 9/9 Gear increment delay after detection (ms)		>
Gear detection 5/9 Drive switch input None White 1: 02 General White 2: Available	>	Gea	Gear detection 9/9 Gear increment delay after detection (ms) r Shift 9 - 10		<u>></u>
Orive switch input Orive switch input None White 1: 02 General White 2: Available White 3: Air Conditioning		Gea	Gear detection 9/9 Gear increment delay after detection (ms) r Shift 9 - 10 Delay - 200) +	>
Operation of the set of the		Gez	Gear detection 9/9 Gear increment delay after detection (ms) r Shift 9 - 10 Delay - 200) +	>

The seventh option is FTCAN 2.0 and it must be selected whenever an external GearController is used. There is also an option to setup gear increment delays for each gear, to make gear compensation tables match and start at the exact same time as the actual gear is engaged.

Gear detection 2/9		<	Gear detection 9/9	>
Detection type By input signal	<	C	Gear increment delay after detection (ms)	
Gear shift based output By gear shift output (Liberty gearbox)		Gear	Shift 🗸 9 - 10	>
By integrated power shift (GearController)			Delay — 200	+
FTCAN 2.0	\sim			
× · · · · · · · · · · · · · · · · · · ·		×		\checkmark

15.12 Nitrous bottle pressure

This menu gathers the settings to read nitrous bottle pressure. This way is possible do compensate fuel according to the bottle pressure. To read the bottle pressure you must use a PS1500 sensor or a similar one.

15.13 Clutch position

In this menu are the settings to read the clutch position. A potentiometer must be used, similar to a TPS. After the wiring done, the calibration is required.

Clutch position 1/2	>	<	Clutch position 2/2	>
Input selection			Reading	
White 7: Air temperature	^		4.99V	
White 8: Avaliable			Position at 0%	<u>.</u>
White 9: Avaliable			4.99V	Calibrate
White 10: MAP signal			Position at 100%	
White 11: TPS	\sim		4.99V	Calibrate
X	/	×	:::	<u> </u>

15.14 Clutch pressure

This function allows to measure the pressure of the liquid on hydraulic assisted clutches. To read the pressure, use a PS1500 sensor or a similar one.

<	Clutch pressure 1/3			Clutch pressure 2/3			
Input selection				Pressure sensor type			
White 6: Fuel	pressure		\sim	-			
White 7: Air t	temperature			1450	PSI / PS100 (1,0 a 5,	.0V)	
O White 8:	Avaliable			1500 PSI (0,5 a 4,5V)			
White 9: clut	tch						
White 10: MA	P signal		~	Custo			
×		\sim	•	×		\checkmark	



15.15 Ride Height

This function allows to read the front end height from the ground. The wheelie control is based on this input and you can find more on this at Chapter 20.9. Normally, a laser height sensor is used.

<	Ride height 1/2		>	<	Ride	height 2/2	>
Input selection							
None			<u> </u>	Inpi	ut value	Outp	ut value
White 1: O2 s	ensor #1			Read	lina	Sen	isor offset
White 2: J	Avaliable						
White 3: 2-ste				3,	5	+0,	,3
White 4: Oil p	ressure		~				
×		\checkmark		×			\checkmark

15.16 Pitch Rate

This function reads the rate at the front end pitches and is given by degrees per second.

Pitch rate 1/2	>	K F	Pitch rate 2/2	
Input selection				
None None	\sim	Input valu	Sensor valu	ıe
White 1: O2 Sensor		Reading	Sensor of	fset
White 2: Pitch rate				
White 3: 2-step		0,0	+0,6	$\overline{\bigcirc}$
white 4: Oil pressure	\sim		/5	
×	\checkmark	×		\checkmark

Through FTManager, all the sensors above can be configured in the "Sensors and Calibration" menu, then "Inputs".



15.17 CAN communication

In this menu is possible to configure all the equipment connected to the CAN network. There are 2 different CAN protocols. Below is the compatibility of each protocol:

- FTCAN 1.0: GearController (until V2.17), BoostController, Racepak IQ3 and AiM Dashes;
- FTCAN 2.0: GearController (after V2.20) EGT-8 CAN; WB-O2 Nano and WB-O2 Slim;

CAN network supports up to 32 sensors of each product.

- This option allows stock ECU data to be received through CAN network.





Realtime Broadcast: sends all data to a CAN network in real-time.

Fixed data packet: Creates data packages and makes it available on network, this option is used by equipment from other brands in the same CAN network.

- CAN OEM: This CAN port is intended for reading sensors vehicles that already have original CAN network from the factory.



SwitchPanel Configuration

This is an external panel with 8 buttons that are totally configurable through FTManager via CAN Communication. Go to "Sensors and Calibration / CAN Communication / SwitchPanel and select a 4, 5or 8 version" click on the button you want to configure and select one of the many preset functions from the list.



15.18 EGT

This menu allows to setup the EGT conditioners (ETM-1 or EGT CAN) and to perform the cylinder attribution. To do it, simply select the cylinder where the EGT is placed and what is the conditioner.

The attribution can be done using the CAN network with EGT CAN or using the white wires inputs with $\ensuremath{\mathsf{ETM-1}}$.

To use EGT CAN, FTCAN 2.0 must be selected, then which model is being used (EGT A or B - for EGT-8, and the channel) or (EGT A, B, C and D - for EGT-4, and the channel).



NOTE

To configure the EGT-4, check the procedure in manual that came with the product.

EGT Settings

To configure EGT, access the menu "Sensors and Calibration / CAN communication/ EGT" an EGT image appears, click on the channels you want to configure and select from the list which will be sensor associated with this channel.



FT450 / FT550 / FT550LITE / FT600





Setup the wastegate pressure sensor for use with the integrated BoostController. For more information check chapter 19.16 BoostController.

15.20 Internal accelerometer (FT550 /LITE and FT600)

After the FT installation, the accelerometer calibration is needed to avoid errors. It can be performed directly through the FT screen or through the PC Software FTManager.

FTManager 4.50 or newer Software versions allow the ECU to be positioned in any orientation in the car, this way it is necessary to configure the accelerometer axes.

ECU position: choose between vertical or horizontal.

Acceleration direction: choose between Side of the ECU or perpendicular to the screen.

Acceleration signal: choose between normal or inverted.

Internal accelerometer	
Internal Accelerometer mode	Calibrate accelerometer
Software filtering (Legacy mode)	Frontal G: -0.299 G
Advanced hardware filtering	
ECU position	Lateral G: -0.034 G
 Vertical 	Calibrata
O Horizontal	Calibrate
Acceleration direction	Disable calibration
Perpendicular to the screen	
O Side of the ECU	Filter frequency (Bandwith)
Acceleration signal	31.25Hz ~
Normal	Accelerometer multiplier factor
○ Inverted	1.00 🜩













Accelerometer multiplier factor: it is typically 1.00, meaning that no multiplier factor will be used and that readings will be the original ones, from the accelerometer. If you notice that the calculated "Accel speed" from accelerometer is not matching a known vehicle speed reading (i.e. time slip showing 220mph on 1/4 mile but your datalogger Accel speed by accelerometer says 200mph) and you have already performed the accelerometer calibration and adjusted the filter frequency, then the multiplier factor must be changed from 1.00 to 1.10 in order to make Accel G readings increase by 10%, consequently increasing the calculated Accel speed also by 10%. This is very helpful when the active traction control is using the Accel speed as Reference speed and traction wheel speed (calculated by the driveshaft rpm) to calculate the wheel slip %, or when you have another external accelerometer device you are used to and want to make both match.

Calibration: The first step is to calibrate the accelerometer to compensate a tilted installation of the ECU, it must show OG when vehicle is stopped and leveled.

Filter frequency: The filter is used to remove unwanted vibration so, if you have the ECU mounted on an OEM dash that is very isolated from chassis vibration you can probably use a higher filter frequency (62Hz or 125Hz) so it will improve reading of the small accelerometer changes. If you experience vehicle chassis vibration transferring and affecting the accelerometer readings, then a lower filter frequency (example as 15hz) is recommended.

IMPORTANT A greater filter frequency will result in signal

reading delay.



15.21 Brake Pressure

This function configures a sensor input for brake pressure control, helping the line lock function.

Brake Presusre 1/3	>	<	Brake pressure 2/3	>
Input selection		Se	elect the sensor type	
None	\sim	_		
White 1: Avaliable		1450 F	PSI / PS100 (1,0 a 5,0	DV)
White 2: Two Step		🔵 1500 F	PSI (0,5 a 4,5V)	
White 3: Air temperature		Custor	n	
White 4: Avaliable	>			
×	\checkmark	×		\checkmark

FT450 / FT550 / FT550LITE / FT600

Brake pre	essure 3/3
Input value	Output value
Reading 1350,0 PSI	Sensor offset
×	✓

15.22 Front and rear shocks

This function allows to set the range for the sensor used on each wheel to measure suspension travel.

Front left shock 1/6		Front left shock 2/6	>
Input selection		Select the sensor type	
O None		Suspension travel 100mm/4 pol (0 a 5V)	
White 1: O2 General		Suspension travel 150mm/6 pol (0 a 5V)	
White 2: 2-Step		Suspension travel 250mm/8 pol (0 a 5V)	
White 3: Air conditioning		Customizado	
White 4: Oil Pressure	~		~
×	/	×	

15.23 Flex Fuel

This function allows the use of a GM Flex Fuel sensor to measure the ethanol density that the gasoline has on the fuel line.

Discard reading during engine start: (where the drop on battery voltage may affect the sensors 12v power supply) and use values read before cranking.

Discard reading under high load: (where the high flow of fuel may affect the sensor readings) and use only below 2500rpm.



15.24 Back Pressure

This function allows to set up a pressure sensor to be used on the exhaust to measure back pressure.

〈 (Counterpressure 1/3			<	CounterPressure 2/3		>
Input selection			Select the sensor type				
None		~		VDO (8bar/11	5psi - 0 a 5V)		<
🔵 White 1: /	Avaliable			PS10A (10bar,	'145psi - 1 a 5V)		
White 2: 2-St	ер			PS10B (10bar,	'145psi - 1 a 5V)		
White 3: Air C	Conditioning			Ps20 (20bar/2	90psi - 1 a 5V)		
White 4: Oil p	ressure	~	< C) PS150 (10,2ba	ar/150psi - 0,5 a 4,5V)		\langle
×		\checkmark		×		 ✓ 	·



<u>FuelTech</u>

15.25 Oil pan pressure

Used to measure pressure inside the oil pan.

<	Oil pan pressure 1/3		• 🖌	Pre	essão carter 2/3	>
Input selection			Selecione c	tipo de sens	or	
None		~	🔪 🔵 -15 a	15 PSI (0,5 a	a 4,5V)	<
🔵 White 1	.: Avaliable		Custo	mizado		
White 2: 2	-Step					
White 3: A	ir Conditioning					
White 4: 0)il pressure	~	-			>
×		>	X			•

15.26 Transmission pressure





15.27 Transmission temperature

Allows to set a sensor to measure the oil temperature

<	Transmission temperature	e 2/3		Tran	smission te	emperature	e 3/3
Select the s	ensor type						
🔵 FIAT		//			value	Outpu	ut value
🔵 дм				Peading	.	Sen	sor offset
🔵 ЕТМ-1					ש ר		
Custo	n			56,0		+10	,7
		~	/				
×		~		×			\checkmark

15.28 Torque converter pressure

This function allows to set up a pressure sensor to be used to measure torque converter pressure.

<	Torque converter pressu	ire 2/3	ד 🖌	orque conve	ter pressure	2 3/3
Select the sen	sor type					
VDO (8b)	ar/116psi - 0 a 5V)	\sim	In	put value	Outpu	ut value
PS10A (1	0bar/145psi - 1 a 5V)		Rea	dina	Sen	sor offset
PS10B (1	0bar/145psi - 1 a 5V)					
Ps20 (20	bar/290psi - 1 a 5V)		3,	.50	+0,3	36
O PS150 (1	0,2bar/150psi - 0,5 a 4,5V)	$\mathbf{>}$				
X		\checkmark	×			\checkmark

15.29 Intercooler temperature

Used to monitor intercooler temperature.

Inte	ercooler temperature 1	/3	>	<	Interco	ooler tempera	ture 2/3		>
Input selection				Select the se	ensor typ	e			
None			\sim	● FIAT					
•				🔵 бм					
🔵 White 7: /	Avaliable			ЕТМ-1					
White 8: 2-St	ep			Custom					
White 9: Oil p	pressure		<						<
×		 		×				\checkmark	·

Inte	rcooler ter	mperature 3/3	\rightarrow
	/alue	Output value	
Reading 56,0	•	Sensor offset +10,7	et
×			/

15.30 Front and rear tires temperature

Allows to monitor tire temperature using a laser sensor with either an ETM-1 wired into a white input or an EGT-8 via CAN.

Front left tire temp. 1/6	\rightarrow	Fron	t left tire temp. 2	/6
Input selection			Select the sensor ty	ре
None None	<			
White 1: O2 General			~	
White 2: 2-Step	_			
White 3: Air Conditioning			Custom	
🔵 White 4: Avaliable	>			
×	/	×		\sim
Front left tire temp. 1/6		Fro	ont left tire temp.	2/6
Front left tire temp. 1/6		K Fro	ont left tire temp. Channel association	2/6 >
Front left tire temp, 1/6 Input Selection White 5: Available		Frc	ont left tire temp. Channel association	2/6
Front left tire temp, 1/6 Input Selection White 5: Available White 6: Available	<u> ^</u>	Equipme	ont left tire temp. Channel association ent	2/6
Front left tire temp, 1/6 Input Selection White 5: Available White 6: Available White 6: Available White 7: Available	\sim	Equipme	ont left tire temp. Channel association ent A	2/6
Front left tire temp, 1/6 Input Selection White 5: Available White 6: Available White 6: Available White 7: Available White 7: Available White 8: Available	\sim	Equipme EGT-8	ont left tire temp. Channel association ent A	2/6
Front left tire temp. 1/6 Input Selection White 5: Available White 6: Available White 6: Available White 8: Available C CAN 2.0	\sim	Equipme EGT-8 EGT-8	ont left tire temp. Channel association ent A B	2/6

15.31 Track temperature

Allows to monitor track surface temperature using a laser sensor with either an ETM-1 wired into a white input or an EGT-8 via CAN.

Track temperature 1/3	>	Tra	ck temperature 2/	3
Input selection			Select the sensor typ	e
None	\sim			
White 1: Avaliable			▲ ETM-1	
White 2: 2-Step				
White 3: Air Conditioning			Custom	
🔵 White 4: Avaliable	<			
×	\checkmark	×		\checkmark
Track temperature 1/3	>	Tra Tra	ick temperature 2	/3
Input selection			Channel association	
White C. Auglights				
White 5: Available				
White 6: Avaliable	\sim	Equipme	ent (Channel
White 5: Available White 6: Available White 7: Available		Equipme EGT A	ent (Channel
White 5: Available White 6: Available White 7: Available White 8: Available		Equipme EGT A	ent d	Channel
White 5: Available White 7: Available White 8: Available CAN 2.0		Equipme EGT A	ent o	Channel

15.32 Engine Coolant pressure

This function it is possible to configure a sensor for monitor of the pressure to the engine cooling system. Set the sensor used if necessary, to adjust the offset.

<	Engine coolant pressure	e 💙	Engine coolant pressure 3/4				
Select sen	sor						
🔵 vdo	(8bar/116psi - 0 a 5V)	\sim	Input	: value Outp	u value		
PS10	A (10bar/145psi - 1 a 5V)		Readir	ng Off	set sensor		
PS10	B (10bar/145psi - 1 a 5V)						
Ps20	(20bar/290psi - 1 a 5V)		3,50) +0,	36		
PS15	0 (10,2bar/150psi - 0,5 a 4,5V)	\sim	bar	ba			
>		\checkmark	×		\checkmark		



15.33 Turning lights

Set an input for each turn signal (left and right) and whether it'll be activated at OV or 12V.

Go to "Interface settings" and then "Side LEDs" to set up LEDs for each one of them, for more information refer to chapter 23.

Left turn signal :	1/4	<	Right turn	signal 3/4	
Select Input		Select Inpu	t		
None	\sim	None			\sim
White 1: Avaliable		White	1: Avaliable		
White 2: Two Step		White	2: Two Step		
White 3: Air temperature		White	3: Air temperature		
White 4: Avaliable	>	O Whit	te 4: Avaliable		\sim
×	\checkmark	×			/

15.34 Low beam / High beam

Set one input for the low beacon and one for the high beacon, set whether the drive will be OV or 12V.

Access the "Interface Configuration" menu then "LED Configuration" to adjust the high and low headlight drive indication LED. For more information, see chapter 23.



15.35 Turbocharger RPM

This feature reads the turbocharger compressor wheel speed. In order to use it a white wire input must be set as Turbocharger RPM. Set the internal divisor (provided by the manufacturer) and the number of blades of the compressor.

RPM Turbo 1 2/2							
Internal divis	or	Compressor blades					
8		40 ~					
×							

15.36 Fuel flow

Any sensor configured will be shown in the unit display and/or recorded in the datalog, to display fuel consumption, at least 1 sensor in the pressure line and 1 in the return line is needed. In the event of having 2 separated fuel feeds, like blower hat and intake runners, it is required to have 4 individual sensors to be able to measure fuel delivery per line.



NOTE

This feature requires a Hall effect fuel flow sensor, if a VR sensor is used, a signal converter to Hall effect is mandatory.

FT450 / FT550 / FT550LITE / FT600

uick access panel	Inputs				
V Diagnostic Panel	Inputs (White wires)	Input enabled			
Fuel Tables	#1: None				
Ignition Tables	#2: 2-step	Import ser	nsor	Calibrate sen	
Other Functions	#3: A/C button	Channel name		Input sensor	
Drag Race Features	#4: Oil pressure	Default name		Default	
Engine Settings	#5: Engine temp.	Fuel flow return A	~	Frequency falling w	
Sensors and Calibration	#6: Fuel pressure	Custom name		O Custom	
- Inputs	#7: Air temperature	Fuel flow return A			
Mop	#8: Flex Fuel	Dash name	Unit	Signal type	
Tool in the second s	#9: Fuel flow pump A	Fuel flow return A	L/m	Digital	
- Traction type	#10: Fuel flow return A	Decimal places		🗹 Enable pullup	
Pront wheel speed	#11: TPS	0 (Min: -32000 Max: 320	00) 🗸 🗸	Averagepoints	
- Drive shaft RPM		Offset			
- Input shaft RPM		Offset type			
Turbo speed RPM		Disabled	\sim		
Eval Bow cancer		Offset value		Digital sensor setup	
- I GRITION BRIDGE			0.*	Digital options	

Fuel flow pump A: Pulses from the sensor to measure 10 US Gallon, so its possible to evaluate pump A fuel flow in the log.
Fuel flow pump B: Pulses from the sensor to measure 10 US Gallon, so its possible to evaluate pump B fuel flow in the log.
Fuel flow return A: Pulses from the sensor to measure 10 US Gallon, so its possible to evaluate fuel flow return A in the log.
Fuel flow return B: Pulses from the sensor to measure 10 US Gallon, so its possible to evaluate fuel flow return A in the log.

Fuel flow	
Flow pump A	Flow return A
K factor (pulses per 10 galon)	K factor (pulses per 10 galon)
15000	15000
Flow pump B	Flow return B
K factor (pulses per 10 galon)	K factor (pulses per 10 galon)
15000	15000



15.37 Flywheel RPM (Clutch basket)

Used primarily on motorcycles that have a gear ratio between the crankshaft and the input shaft/clutch basket.

To use this feature in a car, a 1:1 ratio must be used.

Flywheel RPM (clutch basket)							
Disabled Enabled							
Engine main drive sprocket teeth 6	Flywheel main drive sprocked teeth 6						
×							

15.38 Automatic transmission range selector

This setting is required so the ECU can associate the inputs to the shifter position. The automatic transmission controller applies the parameters set in this tab to control the transmission.

There are four different settings: Digital, Analogic voltage level, CAN 2.0 Network and Duty cycle (PWM).



uick access panel	Automatic transmission range selector				
Diagnostic Panel	Shifter portifier				
Fuel Tables					
Ignition Tables					
Other Functions	Diaital (Multiple inputs)	Analogic voltage level (finale input)			
Drag Race Features	Rate Features				
Engine Settings	Input A Input B Input C Input D	P R N D M D1 D2 D3 D4			
Sensors and Calibration		1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0			
- Inputs - MAP		Detection window for next position 0.05 🖨 v			
- Traction type		O Duty Cycle (PWM)			
- Front wheel speed		Duty cycle per position (%)			
- Rear wheel speed		P R N D M D1 D2 D3 D4			
- Drive shaft RPM		1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0			
- Input shaft RPM		Detection window for next position			
- Hywheel RPM (Clutch basket)		PWH signal mode			
Turbo speed RPM	Shifter switch A activation mode Shifter switch C activation mode	Normal			
 Fuel flow sensor 	Advanded by 01 Advanded by 11 Advanded by 11	O Inverted			
 Gear change detection 		O CAN 3 00			
 Automatic transmission range selector 	Shifter switch B activation mode Shifter switch D activation mode				
- Padde shift	Activated by 0V OV Activated by 0V				
- Brake	Activated by 12V Activated by 12V				

Digital

This option is the most complex to set up and requires some attention. The first step is to select which inputs correspond to each shifter position.

TA A	range selector	1/19	<	AT	range selector 2,	/19	>
			Input sele	ction			
	Operation mode		None				<
	tal	CAN	🔵 Whit	e 1: Avali	able		
			White	e 2: Two :	Step		
Anal	logic	Duty cycle	White	e 3: Air C	onditioning		
			White	e 4: Avali	able		<
×		\checkmark	>	(\checkmark	

Shifter input settings: Select all available positions at the shifter, normally located at the dashboard or even at the shift lever itself.



Input activation: This is directly related to the previous settings and assumes that if "activated at Ov" is selected, then all the options with a checked box will be activated at Ov. If "activated as 12v" is selected, then all checked boxes will be activated at 12v

Inputs position configuration: After checking the boxes to all shifter positions, select which inputs will be assigned to each position.

For example: For "P" position, A and C inputs will be activated. For "D" position, only input D will be activated and so on.



There is also a "*Capture current reading*" button that is very helpful during the setup. This process must be executed for all shifter positions.

For example: While the shifter is in position "P", click in "Capture current reading" and the FT will automatically identify and set up the active input.

Analogic

This option must be used when there is only one input (white wire) dedicated for the ECU to identify the shifter position. The shifter sensor must be a potentiometer that will vary the voltage and therefore send different values for the ECU according to each position. Each voltage must be set up in the ECU, as well as each detection window between the positions.



CAN 2.0 Network

This option allows the use of a SwitchPanel to select gears. After the positions are selected, you must set a SwitchPanel button to activate each one.

AT range	AT range selector 10/19			AT range selector 11/19		
Automatic trans	smission range	selectors	Sel	lection of position inp	out P	
P R	N S		Equipm	nent 🗸 Switch	Panel-4M	
	2 3	4	Button	<	3	
×		✓	×		✓	

Duty cycle

This option can be used when there is only one input (white wire) identifying the shifter positions through a PWM percentage. To set this up, it's necessary to set up the input, define the shifter positions, adjust the Duty cycle percentage for each position and set the detection window around each percent.



15.39 Paddle Shift

This option allows the driver to perform gear shifts by paddle shifters. You must set up an input for upshifts and another for downshifts.



Quick access panel		Paddle shift	
Wiring harness diagram Map options Advanced map options Sensors and Calibration Inputs MAP Traction type Sensors by balanced	^	Upshift button activation mode Activated by 0V Activated by 12V Downshift button activation mode Activated by 0V Activated by 12V	
Upshift 1/4		Upshift 3/4	>
Input selection for upshift button	Inp	ut selection for downshift button	
None		None	\sim
White 1: Avaliable		White 1: Avaliable	
White 2: Two Step		White 2: Two Step	
White 3: Air Conditioning	0	White 3: Avaliable	
White 4: Avaliable	C	White 4: Avaliable	~
× · · · · · · · · · · · · · · · · · · ·		×	1

For vehicles that doesn't have paddle shifters, the gear shifts can be operated through a SwitchPanel. Just select the "CAN 2.0" option and assign which buttons will be responsible for up shifting and downshifting.

15.40 Brake

This function is related to the Lockup system. A sensor can be used to read the line pressure and adjust a ON and OFF range or just a brake switch to activate/deactivate the Lockup.

Quick access panel		Brake
 Wiring harness diagram Map options Advanced map options 	^	Brake switch activation mode Activated by 0V Activated by 12V
Sensors and Calibration Inputs MAP Traction type Front wheel speed		Brake pressure Set brake off below 0 - psi Set brake on above 3 - psi
Rear wheel speed Brake detection 1/2	>	Brake detection 2/2
Input selection None	<u>^</u>	Input activation
White 1: Available White 2: Two Step White 3: Air Conditioning		Activated at 0V
White 4: Avaliable	~ ~	×

15.41 Multifunction button

Allows the use of a single input to act as staging control, boost+ (scramble) and line lock button, according to set conditions:

1st condition: When on 2-step/Transbrake it acts as Staging Control(bump box)

2nd condition: After a validated launch it becomes the Boost+ (scramble) button

3rd condition: When the speed and driveshaft reading is 0, it turns into a Line Lock button



15.42 Battery temperature

This function configures a sensor to monitor the temperature of the battery.

Battery temperature 1/3		Battery temperature 2/3				
Input selection		Equipme	nt			
White 5: Avaliable	\sim			Ch	annel	
White 6: Avaliable		EGT-8	A			
White 7: Avaliable		🔵 EGT-8	в	1		
White 8: Avaliable			AN			
CAN 2.0	$\mathbf{>}$		AN			
× · · · · · · · · · · · · · · · · · · ·	1	×			\checkmark	

15.43 Compressed air pressure

This function monitors the pressure in a compressed air tank, very useful for vehicles equipped with pneumatic gearboxes.

15.44 Fuel Consumption Control

This function, allows you to calculate the vehicle's fuel consumption. The flow calculated here is used to define the car's range and consumption during use.

Quick access panel	Fuel consumption control						
🝸 Diagnostic Panel 🔷	Fuel consumption calculation	Fuel tank level calculation					
Fuel Tables	Enabled	O By fuel consumption calculation					
Ignition Tables	By fuel flow and injection time	O By fuel tank level sensor					
🔨 Other Functions	O By fuel flow sensor	Tank Capacity					
Drag Race Features	Calibration factor	50.0 😴 gal					
📺 Engine Settings	1.000 ÷	When selecting tank level calculation method by tank					
Sensors and Calibration	Block fuel reset while vehicle is moving	for the level sensor in the <u>Inputs</u> menu					
Inputs	Enabled						
MAP							
Traction type	Custom fuel specific gravity						
Front wheel speed	0.750 * (b/b)						
Rear wheel speed							
Drive shaft RPM	The density used for consumption calculations follows the fuel type selected in the Injection menu. In case of using						
Input shaft RPM	the Flex Fuel sensor, the density will be calculated based on the percentage of each fuel used according to the						
Flywheel RPM (Clutch basket)	sensor reading. To edit the density value, enable the custom density						
Turbo speed RPM	option.						
Fuel flow sensor	The fuel consumption calculation is related to the injector						
Gear change detection	flow configuration. Make sure the total flow is correctly						
Automatic transmission range selector	seciri byn under <u>anjectori</u> mend.						
Paddle shift	The Total consumption, Average consumption, Instant						
Brake	consumption and Fuel range can be displayed in the log and on the dashboard, accessing the Dashboard settings						
GAN communication	menu.						
Internal accelerometer							

Configure the vehicle's fuel tank volume.



Then select what will be the method of calculating consumption.

By fuel flow and injection time: in this option the calculation will be based on the injection time and flow of the injectors.

For a more accurate calculation it is necessary that the flow of the injectors is correctly configured in the map.

To check this, in FTManager software, go to "Engine Settings/Fuel Injection" and "Primary total flow".

By fuel flow sensor: this can be used when the vehicle is equipped with a specific sensor for reading the fuel flow.





FT450 / FT550 / FT550LITE / FT600

Fuel Density: The density varies depending on the type of fuel in the tank. This value is automatically set when you choose the type of fuel in the map. When using a Flex Fuel sensor this setting is changed automatically depending on its reading.

Correction Factor: this factor adjusts possible differences between the read value and the actual value.



Select the method of calculating the tank level.

By fuel tank level sensor: when the car has equipped with a fuel level sender unit.

By fuel consumption calculation: uses the volume of the tank and calculates consumption through injection time and injector flow.



When the vehicle is equipped with a fuel level sensor, it's necessary to define an input to read it. Also define the type of sensor used and if there is any reading offset, it can be adjusted.



The last step is to set up an input for a fuel consumption reset button. This button has the same function as a factory car that can reset the dashboard values to obtain a new average fuel consumption.





16. Starting the engine for the first time

This chapter shows final steps before the engine first start and guides the user through checking and calibrating all the sensors and actuators of the motor.

16.1 First engine start

Try not to stress the starter motor by cranking too long on the make the first start. Check if the fuel pump is turned on and if there is fuel pressure on the line. Check if the FT reads the correct RPM in its dashboard and make sure there's spark on the spark plugs (unplug the spark plug wires and install a spark plug on it to check for spark).

On engines fueled with ethanol or methanol, use a squirt of gasoline into the throttle body to make the first start smooth.

When the engine starts, keep it at a fast idle and double check oil pressure and the coil and igniter temperature.

Check if the RPM is being correctly shown on the ECU display (if possible, compare to an external tachometer) and if throttle variations coincide with TPS and vacuum readings.

16.2 Ignition calibration

Once the engine has started, before any kind of test or tune, the ignition calibration must be performed. This calibration is very important to make sure the timing the ECU reads is really correct with the engine. This function locks the timing to 20° (or 0°) on any RPM, this means, if the engine starts but has no idle, you can rev it up and keep it in something around 2000rpm to perform the calibration. Avoid RPM variations as this causes variations on the timing light readings.



The access to this function is given by the "Ignition" button in the main FTManager menu or the "Calibrate ignition" in the touchscreen "Sensors and Calibration" menu

Ignition calibration with distributor: On the engines originally equipped with distributor, there's a TDC mark for cylinder #1. Point the timing light and turn the distributor until the timing light reads 20°. Lock the distributor then press "OK" button on the ECU. Ignition calibration is finished



FT450 / FT550 / FT550LITE / FT600



Ignition calibration with crank trigger: Cars originally equipped with crank triggers, usually do not have the TDC mark. This mark then should be done by stopping the engine on cylinder #1 TDC of compression using a dial-comparator. It is very important to be precise when making this timing mark; the slightest error will ultimately affect ignition timing on the engine

In these systems, usually the ignition is controlled on wasted spark, with one spark on the combustion stroke and one on the exhaust stroke. As the timing light reads both sparks, it usually shows 40° BTDC of timing, but the actual timing is 20° BTDC.

As it is not possible to turn the crank trigger as we do on distributor systems, the ignition calibration screen has a compensation that must be changed until the timing light shows 20° BTDC (or 40°, according to the timing light). Let's say you read a timing of 24°BTDC, a compensation of -4° is needed to read 20° BTDC on the crankshaft TDC mark. When the timing light is reading double the real timing (wasted spark), if the timing on the timing light is 46°, the compensation that must be set is -3°, instead of -6°.

To check if your timing light is reading twice the real timing, advance 5° and check the timing on the engine again. If the timing has advanced 10°, the timing light is reading double the real timing.



17. Fuel tables adjust

17.1 Main fuel table

Editing mode for main fuel table is set as 2D basic mode by default, but it is possible to switch to advanced 3D mode. To change parameter, in the FTManager, go to "Advanced map options" in the "Engine settings" menu.

On FTManager, it is possible to edit the map cell ranges of MAP/TPS, RPM, etc., making it possible to increase the detail level on the maps where a fine tuning is needed. To do it, simply click on "Edit axis" on FTManager tool bar.

Datalogger Open Close Map	🔉 TPS / Pedal 🏹 Ignition	 ✓ Confirm ❑ Undo 	Edit
---------------------------	--------------------------	---	------

Basic Mode - 2D table

In the basic mode, the engine is tuned according to the MAP sensor or TPS. By default, the main fuel table by MAP is from -14.5psi up to the desired pressure.

When the main fuel table is by TPS, the table is from 0 to 100% in 10% steps.

Through FTManager, it is possible to use up to 32 cells, which will allow to have a better map and a fine tuning.

Quick access panel		Main fuel injection table (basic) (ms)						
🔣 Fuel Tables			TP	s (%)				
Main fuel injection table (basic)	_	≥[%	0.00	10.00	20.00	30.00	
Overall fuel trim		Ē	ms <mark>3.</mark> (579	4.795	5.464	7.696	
		a						
-O2 closed loop								
-O2 closed loop target table								
O2 closed loop control limits								
Acceleration fuel enrichment and decay								



Advanced Mode - 3D table

In the advanced mode, the main fuel table is a 3D table, where the injection time is calculated according to the MAP sensor (or TPS) and engine RPM. As well as the basic mode, the MAP range is from -14.5psi up to the desired pressure. When the main fuel table is by TPS, the table is from 0 to 100% in 10% steps.

The default RPM steps are 200rpm until 3000rpm, and above this rpm the steps are in 500rpm. The MAP, TPS or RPM steps can be edited via FTManager.

Quick access panel	МА	P x RP	M fue	l tabl	e - Pr	imary	(adv	ance	d) (I	ns)										
Fuel Tables			MAP	(psi	i)															
MAP × RPM fuel table - Primary (advanced)		ms	-11.60	-10.15	-8.70	-7.25	-5.80	-4.35	-2.90	-1.45	0.00	2.90	5.80	8.70	11.6					
- Overall fuel trim	1 P	8000	1.249	1.293	1.377	1.446	1.673	1.730	2.249	2.354	2.667	3.447	4.281	4.898	5.503					
-O2 closed loop	현	7600	1.223	1.302	1.387	1.459	1.678	1.755	2.277	2.386	2.705	3.501	4.355	4.985	5.602					
Acceleration fuel enrichment and decay	Σ	7200	1.282	1.386	1.474	1.528	1.733	1.830	2.400	2.549	2.889	3.742	4.661	5.337	5.998					
- Engine temperature compensation - Intake air temperature compensation	R	1 a	1 az	1 a	1 a	~	6800	1.336	1.410	1.500	1.554	1.757	1.875	2.433	2.585	2.928	3.789	4.716	5.400	6.068
-Battery voltage compensation - Primary			6400	1.300	1.394	1.486	1.547	1.722	1.860	2.464	2.626	2.984	3.887	4.741	5.455	6.155				
- TPS auxiliary compensation		6000	1.294	1.387	1.483	1.551	1.697	1.855	2.505	2.676	3.048	3.992	4.893	5.640	6.371					
Prime pulse																				

Main Fuel Injection Table								
			bar -0,90	-0,80				
А					+			
в	20000 RPM		0,000 (000%) 0,000 (000%)	0,000	ms			
	19375		0,000	0,000				
	X			\sim	•			

17.2 Overall fuel trim

The overall fuel trim recalculates and replaces all values of the main fuel table according to the percentage configured. This functions can be accessed through "Fuel tables" menu.

When using individual banks, the trim will be available to each bank.

This compensation applies a percentage that can add or remove fuel from the main table (basic or advanced mode). For example, if in a certain cell the injection time is 2.000ms, representing 50% of injector opening at maximum rpm, and you apply 10% compensation, the result will be 2.100ms, representing 55% of injector opening, if the dead time is 1.000ms.

In all compensations the dead time must be discounted, so the value can be related to amount of fuel, instead of pulse width purely.

Quick access panel	Overall fuel trim				
🔛 Fuel Tables	Primary fuel trim				
—Main fuel injection table (basic)	0.0 🜩 %				
—MAP × RPM fuel table - Primary (advanced)					
—MAP × RPM fuel table - Secondary (advanced)	Secondary fuel trim				
— TPS × RPM fuel table - Primary (advanced)	0.0 🖨 %				
— TPS × RPM fuel table - Secondary (advanced)					
Overall fuel trim					



17.3 RPM compensation

This option is exclusive to the basic mode. The RPM compensation is a percentage compensation applied to the main fuel table. The calculation is automatically done considering the engine RPM and all the other compensations. This way, a 3D table is not necessary, which despite being more accurate, is harder then the basic mode and very often doesn't show a better result.

With the RPM compensation is possible to have a good tune in any engine type, either a stock engine, race engine or with a variable camshaft (Honda VTEC, Toyota WT-i, BMW Vanos, etc).

Every engine has a specific fuel consumption peak around the maximum torque rpm, so in the region additive compensation between 5 and 15% must be applied. In a stock engine the maximum torque


is normally between 2000rpm and 4500rpm, but to know exactly the rpm a dynamometer is required. Anyway, this compensation will be performed, because, to keep a constant AFR, more fuel will be needed at the maximum torque rpm.

With the main fuel table and the RPM compensation, the ECU generates internally a injection time vs load vs RPM table.



It is very important to check data continuity, avoiding incoherent values that may produce abrupt changes on the RPM graphic.

17.4 O2 Closed Loop

O2 closed loop reads O2 sensor and adds or removes fuel from the main fuel table in order to reach the O2 target set up.

Quick access panel	O2 closed loop config		
Diagnostic Panel fuel Tables	Minimum engine temperature	Behavior during acceleration fuel enrichment	Malha fechada durante Anti-lag / Pops&Bangs / Freio Notor
Main fuel injection table Overall fuel trim RPM compensation	68 🛊 🤫 Smoothing for low load	C Freeze closed loop Behavior duration 0.150 S	Desativado Ativado e valor único Valor único
02 dosed loop 02 closed loop target table 02 closed loop carget table 02 closed loop control lines Lide spend by TP5 table Acceleration fuel errichment and decay bright encember compensation Intake air temperature compensation	Off below ☐ Enabled 100 € RPM Off above ☐ Enabled 100 € RPM 100 € RPM 100 € RPM 100 € RPM 100 € RPM 100 € RPM	Comportamento durante a troca de marcha Atadoa © Desigar a maha fechada © Congeir a maha fechada Duração do comportamento 0.150 © s 02 desed loon on burnout. 3-stre a d2-sten	Arado pelo mapa de alvos Average valae protection Grabiled Wern enabled, fins feature oil momentarily spore Juli lender / 86.1 AFR gas (7.6 AFR accord
Bettervistage cooperation - Prenzy The survive programma - Prenzy Preparation - Preparation - Degrad and the survive - Press - Dedrad of option this (PHI (Prenzy) - Dedrad of option this (PHI (PHI)) - Dedrad of option this (PHI) - Dedrad of option	20 sensors for average value ▲ 02 general <	Duabled Attre, single value Burnowl, 2-step and 3-step target. Autre, target map Active, target map Actue, target map Duabled Time based O RM based Pro-Ntrous	

Low load smoothness is the speed control for low load situations like idle speed, where the O2 closed loop must reduce the compensation for O2 variations.

Engine temperature for control start is a temperature limit below which the O2 closed loop stays disabled and assumes the open loop fuel tables.

Sets RPM limits for the control to be automatically enabled or disabled. In vehicles where the O2 sensor is installed at the end of the exhaust usually a stable reading is only obtained after a certain RPM, in this case , it is recommended to disable the closed loop when RPM is lower than the optimal point.

The higher RPM limit is used to disable the control above a certain RPM. Forcing the ECU to go back into open loop operation.



During acceleration fuel enrichment it is possible to choose to turn off the closed loop or to freeze closed loop compensation during some time. The closed loop will return to its target between 300 and 500ms after the acceleration fuel enrichment is over.

〈 02 cl	O2 closed loop 4/15									
Behavior during acceleration fuel enrichment										
Turn off closed Freeze closed le	loop Behar oop 10 ms	o o o o o o o o o o o o o o o o o o o								
×		\checkmark								

Adjust the closed loop strategy during and after a power reduction cut used for gear shifting. It allows to disable the closed loop or freeze the closed loop target for a period of time after the cut starts.

C2 closed	O2 closed loop 5/15								
Gear shifting during protection									
Turn off closed loop	Behavior duration:								
Freeze closed loop	ms								
×	\checkmark								

Select the O2 sensors that will be used to calculate the AFR average value for closed loop control.

This is a safety feature for O2 reading. When the protection is enabled, if the reading of one O2 sensor is above 16.1AFR gas or 7.0AFR alcohol, the value is excluded of the O2 closed loop control average calculation to prevent a misreading of a damaged sensor.

O2 closed loop 6/15	>	O2 closed loop 7/15					
Sensor selection for average value		Dis	abled Enalb	ed			
General	\sim						
✓ Left bank		Average value protection					
Right bank		When enabled, this feature will momentarily					
Cylinder 1		ignore O2 sensors with reading walues above:					
Cylinder 2	\langle						
X	\checkmark	×		\checkmark			

This is the lambda target map that the Closed loop control will use as a base to tune your map.

This table has up to 256 points (up to 16 columns and 16 rows) and relates engine speed (RPM) with throttle position (TPS) or engine speed with manifold absolute pressure (MAP).

It is also possible to block the O2 closed loop under or above some RPM limits. The "Lock below" parameter is used, i.e., on engines where the O2 sensor is installed too close to the end of the exhaust, reading free air below a certain RPM. The "Lock above" parameter is a limit to disable the O2 closed loop and return to the open loop maps.



Next, is a 3D table of O2 closed loop targets versus RPM and MAP. It has up to 16x16 cells that can be edited through the PC Software.



When the option of a single target for 2-step, 3-step, burnout mode, Anti-lag, Pops & Bangs, Engine brake is activated, the closed loop will follow only that number, despite of RPM, boost or TPS reading.



The next screen is only shown when the idle is TPS based. Set a target for idle condition (TPS=0%).



O2 closed loop control limits is a 16 points (8 columns and 2 lines) table, totally editable, by TPS or MAP, which defines the actuation limits of O2 closed loop, avoiding the control to remove or add too much fuel in certain situations.



Auxiliary O2 closed loop:

Aux by time (2-step):

This feature allows the creation of a 16 points time based O2 target table after the 2-step deactivation, which will overwrite the main O2 target table during the time setup on this auxiliary table. To trigger the 2-step, TPS must be above 50% or RPM must hit the 2-step rev limiter.



Aux Pro-Nitrous by RPM:

This feature allows the creation of a 16 points RPM based O2 target table to each Pro-Nitrous stage, which will overwrite the main O2 target table while the auxiliary control is on. This feature is only enabled when all Pro-Nitrous requirements are fulfilled.

〈 (O2 closed loop 13/15					O2 closed loop 14/15			
Disa	abled	Enalb	ed		_	1	Stages 2	3	
Time base	ed (2-step)	Auxiliar	y closed loop		1000	0,82	0,82	0,82	+
RPM base	d Pro-N.	Set tim targe	Set time based lambda			0,82	0,82	0,82	λ
Time based Pro-N.				•	3000	0,82	0,82	0,82	
×			\checkmark		×			\checkmark	•

Aux Pro-Nitrous by time:

This feature is a 16 points time based O2 target table to each Pro-Nitrous stage, which will overwrite the main O2 target table while the auxiliary control is on. This feature is only enabled when all Pro-Nitrous requirements are fulfilled.

〈 0	O2 closed loop 13/15					O2 closed loop 14/15			>
Disa	bled	Enalb	ed			1	Stages 2	3	
Time base	d (2-step)	Auxiliar	y closed loop		0,00	0,82	0,82	0,82	+
RPM based	d Pro-N.	Set tim targe	e based lambda t after 2-step		0,50 s	0,82	0,82	0,82	λ
🔵 Time base	d Pro-N.		release		1,50	0,82	0,82	0,82	
×			\checkmark		×				_

17.5 Idle speed by TPS table

This menu is only available when the idle speed is set up by TPS. The injection time is adjusted according to the engine RPM.



17.6 Acceleration fuel enrichment and decay

Acceleration enrichment is a fuel increase when the throttle is suddenly opened.

Max fuel on pump: value added to the actual injection time when a quick throttle variation is detected. There are two RPM and injection time parameters to be set. With them, the FT creates an acceleration fuel table that interpolates the values between these two positions. TPS/MAP variation for maximum fuel pump shot: This configures the MAP or TPS variation for which the max fuel pump will be used. Engines equipped with small throttles usually need a higher TPS



variation to need max fuel pump. In this case, use higher TPS values on this parameter (70-90%). For big diameter throttle bodies, a small TPS variation is enough to demand max fuel pump (around 15%). The TPS or MAP selection is done in the Engine Setup menu. If the TPS is not present, MAP must be selected.

Accel fuel pump reduction above TPS 50%: due to reduced need of fuel when the acceleration fuel pump occurs with the throttle already opened above 50%, this parameter reduces the max fuel pump on this condition. By standard, the ECU reduces 50% of the max pump when it occurs above 50% of TPS.

Cold engine fuel pump enrichment: this is a simple increase on the max fuel pump value when the engine is cold, especially necessary on the first few minutes of engine operation.

Fuel decay on max pump: this is the injection time that will be subtracted from the actual injection time during a sudden throttle closure. With this, in a fast throttle closing, is possible to remove fuel and have a more stable AFR during deceleration.

Minimum variation of TPS/MAP for pump shot: A minimum percentage of variation can be set so the pump shot only starts to be applied above it.

Minimum variation of TPS/MAP for decay: A minimum percentage of variation can be set so the decay only starts to be applied above it.

Decay max pulse: that's the injection time to be subtracted from the actual injection time in the event of a sudden throttle closure.





17.7 Engine temperature compensation

Engine temperature greatly influences the amount of fuel requested by engine, especially in cars run with ethanol and methanol, when it is possible to operate a cold engine as if it had already reached normal temperatures. This compensation is applied based on the engine temperature sensor, which, in water-cooled cars, must be at the cylinder head reading the water temperature, and in air-cooled engines, must be reading the oil temperature.

Compensations based on engine temperature are only available when the sensor is connected to the injection system.



17.8 Intake air temperature compensation

This compensation is applied based on the air temperature sensor placed in the intake manifold, and it is only available when the sensor is connected to the injection system.

This compensation mode is used to automatically adapt the injection to different temperatures of the air taken by the engine. In turbocharged engines, it is of great importance, because when the system is pressurized, the temperature rises immediately to very high numbers.





17.9 Battery voltage compensation

With lower battery voltages the injectors take a longer time to open and to close. This table is used to compensate this variation.

Fuel injectors with a high flow rate usually operate with minimum injection time at idle speed and are the ones most affected by a battery voltage drop.







17.10 MAP / TPS compensation

This table changes according to the main map configuration (MAP or TPS). When the main fuel table is setup by MAP, this table is a compensation by TPS. When the main fuel table is setup by TPS, this compensation is by MAP.



17.11 Prime pulse

This feature improves the engine start by injecting fuel when any crank trigger tooth is detected, just like OEM ECUs. Usually this table uses injection times higher than the "engine start" parameter injection times.

Select which fuel bank you want to use for prime pulse and setup its table by engine temperature.

The injection time is related to engine temperature. The colder the engine, the bigger the injection time.





17.12 Engine start

This function is essential when starting the engine, as it needs a greater injection pulse to initiate its operation, especially if the vehicle runs on ethanol or methanol.

Whenever the RPM drops below 400rpm, the ECU applies start injection pulses in addition to the idle speed value. This excess of fuel prevents the engine from failing involuntarily, making it return to idle speed. Be careful not to exaggerate on injection time, as it may cause the engine to stall/flood easily.

The engine must always be turned off through the injection system. Otherwise, if RPM drops below 400rpm and injection is turned on, the system injects fuel that will not be burned and, therefore, will be accumulated on the cylinder.

If the engine temperature sensor has not been installed, only the value from start injection with cold engine is considered.

The bank B option will be only available if enabled on "Injection" menu on "Engine Settings"



17.13 Post-start enrichment

This configuration is a table that relates engine temperature with time in seconds. This parameter helps stabilizing engine RPM just after start, improving the idle control especially under low temperature conditions.



<	Post-Start enrichment							
		1,00	s 3,50	6,00				
	10,0	+99	+83	+35	+			
	30,0 °C	+70	+35	+15	%			
•	60,0	+45	+15	0				
	×			\checkmark				



17.14 Individual cylinder trim

Set a compensation to each injectors output on a table that relates engine RPM with individual cylinder trim compensation.

To use this compensation as a cylinder trim, the injectors have to be wired with one output per injector.

This compensation usually brings minor power gains when correctly used, so, the use of one O2 sensor per cylinder is highly recommended



17.15 Rotor compensation

Available only when controlling rotary engines, this is an individual rotor fuel trim. This compensation usually brings minor power gains when correctly used, so, the use of one O2 sensor per rotor is highly recommended.



17.16 Gear based compensation

This option allows having a RPM based fuel compensation for each gear.

To enable this option, gear change detection must be enabled. It is possible to set up to 6 compensation tables (6 gears).



FT450 / FT550 / FT550LITE / FT600



17.17 Gear shift fuel enrichment

This function enables fuel compensation when a gear shift is detected, that allows building a time based enrichment table.



17.18 Fuel injection phase angle table

This table changes the moment, during the engine cycle, where the injectors open or close and is only available when the fuel injection is being controlled in sequential mode. The injection phase angle is the distance, in degrees BTDC from the ignition TDC (0°) until the moment the injector opens or closes (according to what is selected).







18. Ignition tables adjust

All timing tables can advance or retard timing. When a base map is generated, all tables are filled with standard values, so, if you want to use just the main timing table, you must zero fill all compensations manually.

18.1 Main ignition table

The editing mode of this table is, by default, this table is displayed in a 2D format. It is possible to change to a 3D table using the FTManager software.

Through the software is also possible to edit the range interval of MAP, TPS and engine RPM on the maps. This makes possible to increase the detail level on specific ranges where a fine tuning is needed.

FT Datalogger	Open	Read Write ECU ECU	TPS / Pedal	✓ Confirm つ Undo	Edit axis
	FTM Files	ECU	Calibration	Edit	

Basic mode 2D table

In this mode, the main ignition table is a 2D map that relates RPM and timing from 400rpm to the max RPM.

Using an analogy, if you want an initial timing of 15° and final of 32° (as you do on a distributor), you must enter 15° at 600rpm and 32° at the maximum rpm, 8600rpm for example. The timing between maximum and minimum RPM are interpolation of initial and final timing . If you want to run a fixed timing, all cells must be filled with the same timing.

Remember that the timing applied will only be the same as the main table if all the compensations are zero.

The rpm breakpoints can be changed up to 32 cells, allowing a fine tuning.





Advanced mode 3D table

In this mode, the main ignition table is a 3D map that relates RPM x MAP x ignition timing. As well as the basic mode, the MAP range is from -14.5psi up to desired pressure. When the main timing table is by TPS, the table is from 0 to 100% in 10% steps.

The default RPM steps are 200rpm until 3000rpm, and above this rpm the steps are in 500rpm. The MAP, TPS or RPM steps can be edited via FTManager

Quick access panel	МА	P x RP	M ignitio	n table (advance	ed) (° B	TDC)		
Fuel Tables			MAP (psi)					
Ignition Tables		° BTDC	-11.60	-10.15	-8.70	-7.25	-5.80	-4.35	-2.9
MAP × RPM ignition table (advanced)	Ē	8000	44.0	41.6	40.4	39.1	38.2	37.6	37.3
-Overall ignition trim	15	7600	42.7	40.4	39.3	38.2	37.7	37.0	36.6
 TPS auxiliary compensation 	M	6800	40.1	38.2	37.2	36.2	36.8	35.8	35.4
 Engine temperature compensation 	<u>~</u>		10.1	50.2	57.2	50.2	50.0	55.0	55.1
 Intake air temperature compensation 		6000	37.6	35.9	35.1	34.3	35.9	34.7	34.0
-Individual cylinder trim		5200	37.2	36.3	35.8	35.4	35.0	33.5	32.8
Ignition limits		4400	26.7	26.6	26.5	26.4	25.0	24.4	22.6
Gear based compensation		4400	30.7	30.0	30.5	30.4	35.9	34.4	33.0
-Ignician ching shirt compensation		3600	36.3	36.9	37.2	37.5	36.8	35.2	34.4
<									
			bar	-0	80				
			-0,90	-0,	.00				
						•			
20000 RPM			+31,9	+5	0,0	•			
19375			+31,1	-30),0	-			
X					~				

18.2 Overall ignition trim

To apply a quick compensation to the entire ignition map, the Overall Ignition Trim function may be used. It is only necessary to inform the correction, negative or positive, and confirm by pressing the right button. This correction will be added to or subtracted from the entire ignition table based on RPM

Quick access panel	Overall ignition trim
Fuel Tables	Advance or retard entire map
Ignition Tables	0.0 🔹 °
—MAP × RPM ignition table (advanced)	
Overall ignition trim	
—TPS auxiliary compensation	



18.3 MAP/TPS compensation

This table changes according to the main map configuration (MAP or TPS). When the main ignition table is setup by MAP, this table is a compensation by TPS. When the main ignition table is setup by TPS, this compensation is by MAP.





18.4 Engine temperature compensation

This map represents a compensation on the advance or retard angle applied to the main RPM map based on engine temperature variation. It is a very important feature and it brings significant improvement on drivability, especially while operating cold engines, when advanced ignition timing is necessary in order to have a correct response from the engine. It is also essential for engine protection, as it retards the ignition timing when the engine reaches high temperatures.



18.5 Intake air temperature compensation

This map represents a timing compensation applied to the main RPM timing map based on intake air temperature variation.

It is beneficial, because the colder the air entering the combustion chamber, the denser it is, and the greater the possible ignition advance is.

But when temperatures are very high (especially on turbocharged engines), the ignition timing must be retarded to protect the engine.



18.6 Rotary timing split

This menu is only shown when controlling Rotary engines, the axis will be set dependent on fueling method (TPSxRPM or MAPxRPM). This is the timing split between Leading and Trailing spark plugs. It is a 3D table of negative timing split values and has 8x8 cells that can be edited through the FTManager software.

The main ignition table will get all the corrections and timing controls applied to the leading spark plugs. The timing split to the trailing spark plugs will be based on the leading final timing values with an applied compensation based on the values listed in the Rotary Timing Split table.

FT450 / FT550 / FT550LITE / FT600





18.7 Individual cylinder trim

Set a timing compensation to each ignition output on a table that relates engine RPM with individual cylinder trim compensation. The timing compensation is done individually to each cylinder according to the engine RPM and it comes from the flow differences, heating dissipation capacity or even cylinder position.

Quick access panel	Ind	ividual	cylinder trim (° B	TDC)			
Fuel Tables	RPM (rpm)						
Ignition Tables		° BTDC	1000		2000	3	
-MAP × RPM ignition table (advanced)	cyl	1	0.0	0.0		0.0	
-Overall ignition trim	$\left \right $	1	.0.0	0.0	0.0	0.0	
- TPS auxiliary compensation	l B						
-Engine temperature compensation	15						
-Intake air temperature compensation		2	20.0		0.0	0.0	
Individual cylinder trim							
-Ignition limits							
-Gear based compensation		3	0.0	0.0		0.0	
Ignition timing shift compensation							

<		Individual cylinder trim									
			Cylinders 1 2 3								
	4250	-30,0	-15,5	+0,1	+						
	4000 RPM	-29,9		+29,9	•						
•	3000	-0,1	+15,5	+30,0							
	×			\checkmark							

18.8 Rotor compensation

Available only when controlling Rotary engines, this is an individual rotor ignition trim.

Quick access panel	Ind	lividual	roto	· trim (° BTDC)	
Fuel Tables			RPM	(rpm)	
Ignition Tables		° BTDC		2000	4000
Main ignition table (basic) Overall ignition trim	or (rot)	1	0.0		0.0
MAR compensation (dask.) — Engine temperature compensation — Intake air temperature compensation — MAP x RPM rotery timing solit	Rot	2	0.0		0.0
Individual rotor trim					

<		Rotary timing split				
		-0,70	bar -0,30	0,00		
	4250	-30,0	-15,5	+0,1	+	
	4000 RPM	-29,9	0,0	+29,9	•	
•	3000	-0,1	+15,5	+30,0		
	X					



18.9 Timing limits

This menu is used to configure the maximum and minimum ignition timing limits, so the engine won't run in any situation with too much retard or advanced ignition timing. No other function will be able to apply timing beyond these limits. This is a safety feature to prevent an inappropriate timing, considering all the functions that may enable a timing compensation (mainly drag race time based features).



18.10 Engine Start

This is an ignition advance vs engine temperature table. Calibrate the ignition advance for each temperature site.



18.11 Gear compensation

This compensation allows advancing or retarding the ignition timing according to the engaged gear. This table applies the compensation in the main ignition table according to engaged gear and RPM.

To enable this option, gear change detection must be enabled. It is possible to set up to 9 compensation tables (10 gears).



Quick access panel	Gea			(° BTD	C)	
🛃 Fuel Tables		Enabled				
Ignition Tables		RPM	(rpm)		-	
Main ignition table (basic)		° BTDC	1000			2000
—Overall ignition trim	a.	10.0			0.0	
-MAP compensation (basic)	ge					
-Engine temperature compensation	Ĩ	20.0			0.0	
-Intake air temperature compensation	l is	20.0			0.0	
—MAP × RPM rotary timing split						
—Individual rotor trim		30.0			0.0	
-Ignition limits						
Gear based compensation		40.0			0.0	
-Ignition timing shift compensation						

18.12 Gear shift compensation

This function allows advancing or retarding the timing after a gear shift (upshift).

You can enable a TPS condition so the retard can happen.

In the example, there will be a 5° timing retard. The ramp return time is the retard total time, which will be gradually re-established. In other words, after shift gear, timing will be retarded 5°, 0,25s the retard will be 2.5° and 0,50s after the shift there will be no gear shift compensation. To enable this option, gear change detection must be enabled. It is possible to set up to 5 compensation tables (6 gears).





19. Other functions

This menu allows the adjustment of all functions that modify the operation of auxiliary outputs and compensations of idle speed, etc.

19.1 Internal datalogger

This function is used to log all the engine data read by FueITech ECU. The Internal Datalogger can record up to 256 channels like: injection time (banks A and B), injectors duty cycle (banks A and B), timing, engine rpm, auxiliary output status, TPS, coolant and air temperature, oil and fuel pressure, O2 sensor, two-step button, MAP sensor, camshaft position sensor and battery voltage.

Log download and data analysis are done through the computer and FTManager Software.





Datalogger enabled

Select if the datalogger is enabled or not and set the start/finish mode. Through dashboard a touchscreen button will start or stop the recording. Through external switch an white input must be wired to an on/off switch to enable the recording. While the input is grounded the datalogger will be recording.

It is possible to choose two modes for the Internal Datalogger:

Basic: All channels are logged with the same sampling rate. **Advanced:** allows the user to select the channels that will be logged and their sampling rate. Functions and sensors added after setting the internal datalogger on advanced mode will be automatically logged with the default sampling rate, but this can be changed if desired.

Log start and stop

The internal datalogger start and stop trigger can be set up by RPM signal or by a button on the ECU dashboard.

When selecting "RPM Signal", the log will be started only when the programmed RPM is reached. If a button on the dashboard is preferred, select it on the internal datalogger. After that, go to "Interface settings" menu and set up the datalogger button on a spot under "Dashboard setup.

Log is automatically stopped when memory is full, ECU is turned off or the button is pressed.

Via FTManager software, the log can be started or finished through the "Start log" and "Stop log" in the tool bar. The "Erase memory" will clear all the logs in the FT memory.

Sampling rate

The sample rate defines the log quality. Higher sample rates create more detailed logs, however, the logging time available will be shortened. For competition vehicles, especially drag racing, it is recommended to use a high sample rate to have high detail level on the log.

The **lower** the sample rate, the more "square" will be the graph and less detailed. On the other, the **higher the sample rate**, the more detailed the log.

Automatically erase memory at 100% usage

If this option is checked, the memory will be erased when it reaches 100% capacity, this means older logs will be permanently erased and the recording of new logs will be possible.



Advanced diagnostics:

Enables the logging of many different advanced RPM signal diagnostic channels such as signal reading noise, pulse timeout, incorrect pulse edge, the count of teeth and others. This is very helpful to diagnose issues with engine synchronization when using Cam sync or RPM signal losses.

Individual channel options

In this menu it is possible to setup each channel individually about line color, if it will be visible or not, its scale and, when in the advanced mode, its sampling rate.

Data	ogger - Individual channel options				
Reco	1 Color Otionnel	Sample rate	. Ve	ale .	Rived scale
Gru					
		942		Ø	
		912		2	
		912		Ø	
		942		Ø	
	RPM	942			
		512		2	
	TP5	912			
		942		Ø	
	Eattery voltage	912		2	
		512		Ø	
	- Duty cade Prinery	942			



Internal datalogger status

At the Dashboard Screen of the ECU, a round icon is shown besides engine RPM. This icon indicates the Internal Datalogger status.

- Internal datalogger stopped: Grey "Data" button
- Recording: green "Data" button, blinking light red icon with the word REC
- Memory full: red "Data" button with the word FULL



NOTE

When memory is full, connect the ECU to the PC and download the data thought FTManager Software.



Log download

The log download must be through FTManager. Connect the FT to the computer with the USB cable



Open the FTManager, and click on the Datalogger icon. The FTManager Datalogger will open. To download, click on the Download icon and a window will pop up showing all logs saved on the ECU. Select the files and click OK.

The datalog software will open. Use the mouse to browse the graph and check the values on the left panel.





19.2 Accelerometer and gyroscope (FT550 and FT600)

FT has an internal 9-axis accelerometer which provides the following data:



See section 15:19 for the accelerometer calibration.



WARNING

In order for the accelerometer and gyroscope to work properly and have correct readings, a calibration of the sensor is required. The FT should be installed as vertical as possible.



G-Force acceleration: records the vehicle's acceleration force. G-Force braking: records the vehicle's braking force. Pitch angle: records the vehicle's pitch angle. Pitch rate: records the vehicle's pitch rate.





Lateral G-Force: registers the vehicle's lateral force. Roll: registers the vehicle's roll angle.



Speed under acceleration: calculates the speed based on the vehicle's acceleration.



Distance under acceleration: measures the traveled distance based on the vehicle's acceleration.



Direction: records the calculated position in degrees based on the moment the vehicle launched.



NOTE

The features: speed under acceleration, distance under acceleration, roll angle and pitch angle are calculated only after a valid launch (when with the 2-step activated the engine hits TPS higher than 50% or the 2-step rev limiter).

19.3 Idle speed control

This FT can control idle speed through electronic throttle, step motor, PWM valve and by timing.

To enable the idle speed control by electronic throttle, it is needed to setup the menu "Electronic throttle" under "Engine setup" menu. After that, you can follow this menu to setup idle parameters.

Actuator reaction level: this parameter is the aggressiveness that the timing and the actuator will be changed of position in order to control a RPM fall. The higher this number, the more aggressive is the reaction of the control.

High reaction levels may lead the idle speed to be unstable.





Position on idle

Automatic: in this mode, idle actuator is automatically opened and closed by the ECU in order to make the engine idle near the target RPM.

Fixed: in this option, idle actuator assumes a fixed position, set up later according to engine temperature.

ETC reference position: this parameter is the actuator position when the engine is turned off or cranking. It is also used as a stable reference during the automatic idle speed control. Setup a value that's enough for a cold start of the engine. Start with a value around 4% for electronic throttle and 30% for step motor.

Idle speed cont	Idle speed control settings 2/9					
Automatic Fixed						
Standard reference openning (cold)	Standard reference openning (hot)					
3,0 ~	6,0 ×					
×						

Idle speed by timing

This control uses a target RPM for idle speed and works by advancing and retarding the engine timing to keep the engine running near the specified RPM.

As the FT idle speed control has an advanced integration with the idle speed by timing control, this one stays always enabled when any other kind of idle speed control is selected. By doing this, the idle speed actuator is always kept in a position where the idle speed by timing control can set the timing away from the maximum and minimum timing positions.

Maximum and minimum timing limits: these values are the limits for advance and retard when ECU is controlling the idle by timing.



Actuator position

This parameter will be only available when the position on idle is set as fixed. This table relates the actuator position in function of the engine temperature.





Post-start position

This parameter will be only available when the position on idle is set as fixed. The table controls the actuator opening after the engine start. The table is an actuator position vs time. After the time slip, the position is defined by the actuator position table based on engine temperature.



RPM for idle speed

This table tells the ECU the target RPM the idle control will assume, according to engine temperature. On intermediate temperature ranges, target RPM is automatically interpolated.

When "Position on idle" is set to "fixed" this table represents the actuator position X engine temperature.

Quick access panel	Target RPM (RPM)	
Fuel Tables	Temperature (°F)	
Ignition Tables	of 50 RPM 1250 1	68
Other Functions		200
—Internal datalogger		
Idle speed control		
-Actuator position		
-Post-start position		
Target RPM		
Post-start RPM		



Post-Start position

This parameter is a RPM increase (or % of increase in the actuator position for fixed idle position). The table shows the actuator position according to time post engine start.





Compensation by load: used to compensate actuator position when suddenly loads (like AC or fan) are added to engine and can affect idle. It is possible to set an target RPM compensation when the AC is on and fuel/actuator opening compensation for AC and fans.

		Air conditioning load compensation
		✓ Enabled
Idle speed cont	rol settings 9/9	RPM Opening 100 ♀ RPM 5.0 ♀ %
Disab. Enab.	Disab. Enab.	Thermatic fan #1 load compensation
Thermatic Fan 1 compensation	Thermatic Fan 2 compensation	 Enabled
		Opening 5.0 ▲ %
×		Thermatic fan #2 load compensation
		Enabled
		Opening 5.0 + %

Idle speed control on movement: when this option is checked the idle speed control will turn on when the TPS percentage is 0% and the engine RPM is 700 rpm above the set target.

<	Idle speed control settings 10/10					
	Dis	abled	Enabled			
	Active idle speed control when the vehicle is moving.					
	When this option is selected, the idle speed control will still be active even if the vehicle speed is higher than 2 km/h (1.2 mph)					
	×			 Image: A second s		

Return ramp: When enabled, it generates a return ramp for the ignition timing. If this function is disabled, when the idle control is operating the ignition timing will be set as the minimum defined for the condition. When the idle control is off, the ignition timing will return for the value set at the ramp.

<	Idle s	Idle speed control settings 11/12					
	Dis	abled	Enabl	ed			
	Enables a t cutoff. Wh speed o ramp to sr Othe to y	ining return rar ien this option i control will use noothen the de erwise timing g our main timing lecel cutopp is o	mp for s enab a tinin celerat oes str g table disable	deceleration led the idle g return ion cutopp. aight after d.			
	×			\checkmark			

Compensation by automatic transmission: If the vehicle is equipped with an automatic transmission it may be necessary to set a compensation for adding a certain amount of air flow in idle control, once the automatic transmission applies an additional load at the engine.

<	Idle speed control cettings 12/12				
	Disabled	Ena	abled		
	Compensation by	,0 ,0	ransmission		
)	×		\checkmark		

Advanced configuration

For advanced idle speed control options go to Engine settings menu, Advanced map options and select Idle speed control as Custom.

Timing compensation: it is used when a load is detected (electric fan or AC). Timing is immediately applied when load is detected, after that the control acts advancing or retarding timing if needed (default 7°).

<u>Fuel Tech</u>

Target approach rate: used to reach RPM target, also responsible for control reaction speed (default 6RPM/s).

Deadband: dead zone the control considers as on target. Example: target 800RPM, deadband 50RPM. From 750RPM up to 850rpm the control will be stable (default 50RPM).

Approach RPM: added to the target RPM where the control starts to act (this makes the control smoothier). When RPM reaches this number the control uses the target approach until it reaches the RPM target within it's deadband.

Boundary RPM to enable: indicates the minimum RPM to the ECU consider Idle, added to the Idle target, for example idle target at 1000RPM, plus 700RPM boundary RPM equals to 1700RPM for idle control strategy.

Proportional gain (KP): responsible to identify if the RPM is close or too far from the target, acting according to the number, high numbers can make it instable.

Integral gain (KI): responsible for RPM trend, to identify and make changes to reach the target.

Derivative gain (KD): evaluates the RPM back in a recent period of time and has been done to be in the actual engine RPM, will provide data to the next sequences of control.



19.4 Deceleration cut-off

The purpose of Deceleration cut-off is to improve fuel economy when the engine is at 0% throttle situations.

This aids in the deceleration of the vehicle by making use of engine braking while driving in traffic. This function is valuable to the reduction of fuel consumption

On a circuit racing or auto cross vehicle is utilizing heavy braking going into a turn, it is necessary that it has a quick and clean response from the engine upon re-opening the throttle.

Deceleration cut-off will aid in dynamic braking from the engine as well as overall fuel economy.

A standard RPM of 2000rpm is recommended. Setting a very low RPM may cause the engine to turn off involuntarily during deceleration

The "Cut-off Delay for TPS=0%" parameter is the time (in seconds) delay before fuel is actually cut-off after releasing the throttle. Such delay exists to prevent the engine from instantly becoming lean when the throttle is released. It also rapidly cools the combustion chamber without being excessive, and avoids situations in which the cut-off might oscillate, especially when the throttle is lightly pressed. A standard delay of 0.5s is suggested.

Such delay exists to prevent the engine from instantly becoming lean when the throttle is released.

In order to have the Deceleration cutoff working along with Anti-lag / Pops & Bangs / Engine brake is necessary to enable it according to the following image.



19.5 Revolution limiter

This function is very important for engine protection, limiting the RPM with two different options of cut-off:

Fuel Injection: the fuel injection is cut-off instantly, as the ignition is still operating. It is a very smooth and clean cut-off. Recommended only for naturally aspirated engines, it is the standard setting in vehicles with original injection systems.

Ignition: the engine ignition is cut-off when the configured RPM is reached. It is recommended for high-power engines, especially turbocharged ones, being the most efficient and safe option.

Quick access panel	Revolution limiter
🚺 Other Functions 🔷 🔨	Cut huns
🖶 - Internal datalogger	Institute
Idle speed control	
Deceleration fuel cut-off	
Rev limiter	Revolution limiter
Thermatic fan #1	Single value
Thermatic fan #2	8000 🖨 RPM
Air conditioning	 Engine temperature table
Fuel pump	O Gear based table
Boost activated output #1	Rev limiter RPM signal
- Wastegate Boost Control	 Automatic (Legacy)
Power shift (gear change ignition cut)	O Normal RPM
Start button	O High-resolution RPM
RPM activated output	Ignition timing on Rev. limiter
Map selection by button	Enable
Active traction control	Fixed timing
Generic outputs	0.0÷ °





Rev limiter by engine temperature

When the option "table by engine temperature" is selected, it's possible to set different rev limiters according to engine temperature



RPM Signal for Limiter: There are three selection modes. Automatic, Normal RPM, or High-resolution RPM.

Ignition timing on Rev. limiter: Set the ignition timing target for the RPM limiter.



19.6 Shift Light

When the engine reaches the RPM set in this parameter, the screen will display a blinking message ("SHIFT") indicating that gear must be shifted.

To switch an external shift light, it is necessary to configure an auxiliary output at the "Input and Output Setup" menu. If no auxiliary output has been configured as Shift Light, the message "Output not configured!" will be displayed. Even so, it is possible to set the Shift Light RPM on the screen



19.7 Thermatic Fan #1

There are to two ways to set up the control of the thermatic fan #1, either by an on/off command or a PWM proportional control.

ON/OFF: The thermatic fan will switch on/off depending on the temperatures that are set. There's also the option to turn on the thermatic fan when the A/C is on, to do so select "turn on with A/C"

Quick access panel	Thermatic fan #1	
Quick access panel	Temperature source reference Engine temperature Ar temperature Operation mode Ov/OF control PWM proportional control Ar conditioning Ture on with A/C	Image: Turn on by temperature
Fuel pump Boost activated output #1 Wastegate Boost Control Power shift (geer change ignition cut) Trick htm	PWH with A/C on 95 \$ %	Temperature [ºF] -4 32 68 122 PWH [%] 0 0 0 0 PWH [%] 0 0 0 0
Adve values Adve values	Output signal Activated at 0V Activated at 12V (Only w/ Yellow outputs) Activated only after engine running Enabled	

There's an option that allows one of the fans to be activated when A/C is turned on. As these fans may draw considerable load, a fuel compensation is also available.

To test the fan output, just click on the "Test output" button. If it doesn't work, check the install or test another output.

Through FTManager, the output configuration is done in the "Sensors and calibration" menu - Outputs.



PWM proportional control: The thermatic fan will be controlled by a solid state relay via PWM control, this creates a very linear and progressive control of the engine temperature.



<u>FuelTech</u>

Both modes of operation can be set according to the air or engine temperatures.

Engine temperature: The most commonly used, the control is made by the temperature in the cooling system.

Air temperature: This option may be used for cooling the air of a turbocharged engine equipped with a watercooler or water pump, or even to drag race diesel engine tractors where water is injected inside the combustion chamber for cooling.



Activated only after the engine is running: the option enables the fan output only after the engine is running, above configured RPM for engine start.



19.8 Thermatic Fan #2

This FT can control up to two cooling fans on different temperatures. There's an option that allows one of the fans to be activated when A/C is turned on. As these fans may draw considerable load, a fuel compensation is also available.

To test the fan output, just click on the "Test output" button. If it doesn't work, check the install or test another output.

Through FTManager, the output configuration is done in the "Sensors and calibration" menu - Outputs.

Activate only after engine running: the option enables the fan output only after the engine is running, above configured RPM for engine start.



Both modes of operation can be set according to the air, engine temperatures or follow water pump.

Engine temperature: The most commonly used, the control is made by the temperature in the cooling system.

Air temperature: This option may be used for cooling the air of a turbocharged engine equipped with a watercooler or water pump, or even to drag race diesel engine tractors where water is injected inside the combustion chamber for cooling.

Transmission temperature: with this option it's possible to use electric fan #2 for transmission oil coolers.

Inverter temperature: used for electrified vehicles that require inverter temperature control.



19.9 Air conditioning

To control air conditioning through FT, first you have to setup an output to control the A/C relay. Then, setup the input that will receive signal from the A/C button on the car dashboard. Check chapter 13 for more information.

Adjust the percentage of *"Fuel enrichment"* for the air conditioner activation, this prevents the engine from having a drop in rpm when turning ON the A/C compressor.

The turn on delay will happen in 3 different situations:

- When starting the engine with the AC button turned on, the turn on delay will start to count after the RPM for engine start is overcome. In this case, the reference is engine start, not the moment when the AC button is switched on.

- When turning off and then turning on the AC button, the turn on delay will count from the moment the AC button is turned off. If the time between turning off and then turning on is bigger the turn on delay set, the AC will be immediately activated.

- When the engine RPM is below the minimum RPM the turn off is immediate. The delay will count from the moment the RPM is below the minimum RPM. To turn on again, the delay will start to count when the engine RPM is 50RPM higher then the minimum.





Air condit	tioning 1/8	<	Air conditioning 2/8	>
Disabled	Enabled		Enabled function by	
Fuel enrichment +10	Turn on delay		External button Dashboard button	
×		X		\checkmark

When selecting *"External button"*, it is necessary to select which input will be responsible for activating the air conditioning. It is also possible to select an input via the CAN network.

Configure the output to activate the A/C compressor, choose if the activation will either be by OV (blue or gray outputs) or 12V (yellow outputs).

You can also configure the A/C shutdown conditions to make better use of the engine's power.

RPM Source: this option allows you to choose where the RPM signal will come from to activate the function. There are two options, combustion engines or electric motors.



19.10 Fuel pump

This output activates the fuel pump relay through lowside (OV) or highside (12V).

You can choose from the following options:

Always enabled (the output is permanently activated while the ignition switch is on)

Timed (when the ignition switch is turned on, the output is activated for a defined activation time, afterwards the output is deactivated. When engine speed signal is received, the ECU reactivates the output.). **During start** (when the output is activated while it's below the starting engine speed).

It's required to use a relay that supports the necessary current for the fuel pump. Through the FTManager software, the output configuration is done through the menu "Sensors and calibration" and then "Outputs"



19.11 Cold start auxiliary

This feature is very useful for cold starts on methanol and alcohol engines using a gasoline injection auxiliary kit. The table shows the auxiliary injector time versus temperatures.

The ECU will activate the output according to the time set on the table once it detects the first tooth from engine RPM on every engine start. The cold start auxiliary is disabled when cranking the engine with the accelerator pressed with TPS above the value set in the parameter "Disable injection on engine start with TPS above" in the "Injection" menu, under "Engine settings".

Output signal: Activation through OV in the blue or gray outputs. The yellow outputs have the possibility to activate the outputs through 12V.

Time versus temperature curve: This table is composed of a pulse in seconds of the cold start injector depending on engine temperature.





19.12 Camshaft control

This function allows the control of a variable valve timing control system (or a drag racing 2-gear automatic system). Select the output used to control the camshaft solenoid, and then, inform the RPM that the solenoid must be turned on. Only on/off camshaft systems can be controlled.



19.13 Progressive nitrous control #1 and #2

This auxiliary output configuration gives access to setting the ratio for the fuel-nitrous mixture (or nitrous only) through pulse-width modulation (PWM) sent to the solenoids.

Progressive nitrous setup		
Control type Disabled	PWM frequency	NOS fuel compensations ON delay
 by RPM by Speed 	Output signal Activated at OV V	0.00 ÷ s
O by Time	Disable when engine temperature under	0.10 + s
Always enabled External switch	167 🖕 아F	0.10 ÷ s
Dashboard switch Graduation durity Day Wheney	0 🗘 %	ON delay
Progressive output by TP5	0.0 * %DC 0.0 b/h	OFF delay
Enabled TP5 for 0% of nitrous	Mining receiver of a setup	OFF ramp
10 🤤 %	2500 RPM	0.10 y 5
90 ‡ % Turn on with TP5 over	8000 RPM	
90 🗘 %	Total time to return PWM control Time	

Select an auxiliary output as "Progressive nitrous output" and how the control will be performed: by time (after 2-step), by rpm or by wheel speed.

Also, select the enable mode:

Always enabled;

External switch: select a white input. When the input is grounded the progressive nitrous will be enabled;

Dashboard switch: a touchscreen button must be configured to enable or disabled the progressive nitrous;

Synchronized with Pro-Nitrous: the progressive nitrous control will activate when the Pro-Nitrous (Drag race features menu) conditions are met;

FT450 / FT550 / FT550LITE / FT600



The first parameter to be configured is the TPS opening percentage, above which the injection of nitrous will be activated.

The next parameter is the percentage of fuel enrichment for 100% nitrous.

After this, set the PWM output frequency and the output signal. To regular solenoids, use between 25 and 30Hz, big shot solenoids use 50Hz. The next screen will show the engine temp protection, where you can define a minimum engine temperature for progressive nitrous.



The fuel enrichment for 2-step is a fuel compensation when the 2-step is enabled. The timing retard for 2-step is a compensation applied to the timing configured in the 2-step function. The minimum and maximum RPM is a RPM window and work as a safety feature, so the progressive nitrous will only active if the engine rpm is inside the window. The total time to return PWM control is a delay ramp to reactivate the progressive nitrous when it is disabled by any safety features or switch. This ramp avoids the progressive nitrous to return in a big shot, helping the traction on pedaling.



Next is the nitrous injection map based on RPM. The higher the percentage configured in this map, the higher the amount of nitrous (or nitrous + fuel) injected

The maximum RPM is the same chosen on "Fuel Injection Setup. With the FTManager you can edit axis and add or remove cells. When using 2 injector banks the fuel enrichment will happen on both.





The ON delay for NOS fuel compensation avoids the extra fuel to get earlier than the NOS in the cylinder, very common when the fogger is far from the injectors.

The Progressive fuel table by nitrous duty cycle and the Auxiliary fuel enrichment table compensation are related to the percentage of fuel added according to %DC of nitrous or engine load/rpm.



After the end of nitrous shot, normally is necessary to keep the compensations on for a few tenths of seconds, since the intake is full of nitrous that will be consumed by the engine. The OFF ramp makes the compensation ends smoothly.

The delay to start the timing compensation has the same purpose of fuel compensation, the time nitrous takes to reach the cylinder.

The Progressive timing table by nitrous duty cycle and Auxiliary timing retard compensation are related to the timing retard (always negative values) according to the %DC of nitrous and engine load/rpm.



In the end, there are the OFF delay and the OFF ramp and are used to keep the engine safe, avoiding an immediate timing advance that could damage the engine.

19.14 Generic duty cycle output

This feature allows the control, through PWM, of a solenoid valve that manages the wastegate valve, therefore regulating the boost pressure. Through an external button, you can activate the Boost+function (optional use), which is an instant increase in the boost %DC while the Burton is turned on.

FuelTech recommends using a 3-way button N75 solenoid.

For more information about its installation, see chapter 13.8 in this manual.

uick access panel	Generic duty cycle control
	Generic duty cycle control Control type
Sensors and Calibration	Programmed value when TPS is over 90.0 🛓 % Enable when MAP is above Enabled 0.00 🗧 ps

The first parameter is the output which will drive the boost solenoid. Select among the available outputs. After this, select the Boost+input, if necessary.

In the FTManager, this setting is done in the "Sensors and calibration", then "Inputs" and "Outputs".

<	Generic duty cycle output 1/21				
		Test output:	Test		
		Output selection	on		
	None				
Yellow 2: Progressive nitrous					
Yellow 3: Avaliable					
Yellow 4: Avaliable					>
	×			~	1

The next screens allow to quickly enable or disable the control, and choose the control mode: by RPM, by time, by speed, by MAP, by gear and Engine RPM and gear elapse time. Time control starts after 2-step is deactivated.

<	Generic duty cycle output	2/21	〈 G	eneric duty o	ycle output 3	3/21
	Disabled Enabl	ed	O Cont	rol by RPM	Cont	trol by MAP
	Generic duty cycle outp	ut	Cont	rol by time	Gea Engi	r and ne RPM
			Cont	rol by speed	Gea	r elapsed
×		\checkmark	×			\checkmark

When selecting the option "Gear elapsed time", it is necessary to define whether the function will always be activated or only after a valid start (after the 2-step validation).

<	Generic duty cycle output 4/21	\rightarrow
	Activation of timers	
	Always activate	
	Enable after validated launch	
×		/



"Programmed boost when TPS is over" is the minimum TPS value to activate the boost solenoid. When the progressive output is selected, boost output is progressive to boost table, starting at 10% to the "Programmed boost when TPS is over" value.

- The recommended frequency for most PWM 3-way valve is 20Hz. The output signal depends on the solenoid installation. Check Chapter 13.8 for further information.
- Select if you want to use the Boost+ button.

The boost duty cycle for 2-step is the boost level when the 2-step is on, which overrides any other boost table.



Once your parameters are setup in there will be boost duty cycle table by rpm, speed or time. The boost by time starts after the 2-step release.



19.15 Boost activated output #1 and #2

This function is used to activate an auxiliary output according to MAP readings.

Quick access panel	Boost activated output
Fuel Tables	✓ Enabled
Ignition Tables	Turn on above
Other Functions	0.00 🔹 psi
—Internal datalogger	Turn off below
Idle speed control	0.00 🌩 psi
-Deceleration cutoff	Activation mode
Rev limiter	Activation mode
—Shift light	Always active
— Thermatic fan	 Active only on 2-step
—Air conditioning	O Not active only on 2-step
-Fuel pump	
—Camshaft control	Finabled
Progressive nitrous control	1500 A PPM
Boost control	1300 ¥ KPM
RPM based boost duty cycle table	Minimum TPS to trigger
Boost activated output	Enabled



Select an available output to trigger a relay or any other external device. In the FTManager, this setup is at "Sensors and calibration" - "Outputs"



Select the output signal sent when it is activated. The only outputs capable of switching 12V are the yellow.

Define the vaccum/boost range to trigger the output.



There are 3 different activation modes: "always active", "active only on 2-step" or "Not active only on 2-step". This means that even if the vacuum/boost conditions are met, the activation mode condition must be respected.

As safety features, minimum TPS and RPM values can be set, so the output will not activate if one or more conditions are not met.

19.16 Tachometer output

By default, the tach output is configured on the gray #8 wire (FT550 and FT600) and gray #4, blue #3 and blue #6 (FT450), but can be set on one of the yellow wires also.

If one of these outputs is not available, the blue and gray can also be used, but an external 12V pull-up with a 1K resistor.

In the FTManager, this setup is at "Sensors and calibration" - "Outputs"

Trigger mode

Synced: Uses same RPM reading

Unsynchronized: Used to adjust RPM through pulses around the engine.

19.17 Wastegate boost pressure control #1 and #2

The active control function of the wastegate valve pressure is used for a more precise control of turbo pressure in street, circuit and, mostly, drag race cars. The control can be performed by time after 2-step, by gear and engine RPM, by gear elapsed time, by a single target or by engine RPM, besides specific targets for 2-step, 3-step and burnout mode.





IMPORTANT

- The pressure controlled by BoostController is the pressure at the top of the wastegate valve.
- You can set the maximum MAP pressure and maximum MAP pressure on 2-step.
- When the BoostController is off the target is zero, and each time the read pressure, for any reason, exceeds 1.45psi the decrease solenoid is activated.

Installation diagram

- 1 Decrease solenoid/injector trigger connected to the yellow output
- 2 Decrease solenoid
- 3 Increase solenoid/injector trigger connected to the yellow output
- 4 Increase solenoid
- 5 Negative
- 6 Intake or CO2 bottle
- 7 Pressure sensor
- 8 Pressure sensor hose
- 9 Intake;
- 10 Free air
- 11 Injectors block
- 12 3 way Valve or N75
- 13 Actuation of 3 way valve or N75
- 14 Control pressure Wastegate
- 15 FT dual valve block
- 16 Connection to second Wastegate or must be blocked

Diagram with regular solenoids



Diagram with injectors block



Diagram with 3 way Valve



Diagram with N75 Valve





Diagram with FT dual valve block



IMPORTANT

Use a PS150 pressure sensor connected to any white input. Setup as "Wastegate pressure".





NOTE

The pressure sensor (7) must be connected to the top of the wastegate with a hose (8) with a maximum length of 1ft. It prevents damage to the pressure sensor caused by vibration.



IMPORTANT

- The pressure sensor must be installed on an exclusive line, and not shared with any other connection, to avoid reading errors.
- For the correct operation of the system, use only FuelTech PS sensors line: PS-150, PS-300, etc.



WARNING

The boostcontroller test (when set as time based after 2-step) will only work with the engine turned off.

To test this feature with the engine running, a valid launch is required (when with the 2-step activated the engine hits TPS higher than 50% or the 2-step rev limiter).

FTManager setting

Through FTManager you can make all settings required for the operation the BoostController.

Wastegate boost pressure control		
Enabled		
Control type	Settings	
Time based after 2-step	Pressure source	Maximum MAP boost
Gear and engine RPM	 Intake manifold pressure 	
Gear elapsed time	○ CO2 bottle	0.00 - P
Single target value Wastegate	Valve type	2-step maximum MAP boost Enabled
1.00 🌻 psi	 Dual 2 way valve (CO2 compatible) 	0.00 📥 a
O Engine RPM	 Single 3 way valve (CO2 not compatible) 	Proportional output
aunch targets	CO2 bottle pressure	 Enabled
2-step target	10.00 ÷ psi	Boost output will be proportional to the TPS over 10% until to the defined max boost TPS beside.
2.50 - psi	Valve model	
3-step target	 High flow injector (>80lb/h) 	Achieve boost target when TPS is
1.00 🌩 psi	 Low flow injector (<80lb/h) 	80 🌩 %
Burnout target	O FT dual valve block	Deactivation delay
1.00 🌩 psi	BoostController2 valve	0.8 ÷ s
oost+ scramble button increase	Activate control when TPS is over	Output activation
_ Enabled	0 * %	Activated at 0V
0100 ¥ pa	Activate control when MAR is over	 Activated at 12V (Yellow outputs)
ontrol gain	Enabled	Boost + button activation mode
U Ţ	0.00 Å psi	Activated at 0V

Set the input for the pressure sensor as PS-10B, PS-20B, PS-150 and PS-300 or BoostController2 MAP. In FTManager access the menu "sensors and calibration/inputs".

Inputs					
Inputs (White wires)	✓ Input enabled				
11:02.64netal 22:24:ep 23:24:ep 24:ep 25:ep 26:ep 27:A1:epperture 27:A1:epperture 26:ep 27:A1:epperture 27:A1:epperture 27:A1:epperture 21:D:NAP 21:None	Import sensor	Calibrate sensor	_		
	Definiel name Default name Wastegate Pressure Custom name Wastenate Pressure	Input sensor © Default PS-10B (10bar / 145psi ~ 1 to 5V) ~ Custom			
	Dash name Unit Wastegate pressure psi Decimal places 3 (Min: -32,000 Max: 32,000) >	Signal type Analog V Cable Delug Analog V Cable Delug Average points	Voltage 1.000 5.000	Value 0.000 145.000	^

Set the outputs of the increase and decrease solenoid valves.

Blue output #1	Gray output #1		Yellow output #1	
Fuel injection cyl. #01 - Primary V	Cylinder #01 ignition	 ✓ Test 	Step motor 1A	✓ Te:
Blue output #2	Gray output #2		Yellow output #2	
Fuel injection cyl. #02 - Primary V	lest None	✓ Test	Step motor 2A	✓ Tes
Blue output #3	Gray output #3		Yellow output #3	
Fuel injection cyl. #03 - Primary V	Test None	✓ Test	Step motor 1B	∨ Te
Blue output #4	Gray output #4		Yellow output #4	
Fuel injection cyl. #04 - Primary V	est None	✓ Test	Step motor 2B	∨ Te
Blue output #5	Gray output #5			
Boost activated output 🗸 🗸	'est None	✓ Test		
Blue output #6	Gray output #6]	
None v 1	lest None	✓ Test		
Blue output #7	Gray output #7]	
Thermatic fan #1 V	'est None	✓ Test		
Blue output #8	Gray output #8]	



It is recommended to use the yellow or blue outputs for connecting the solenoids.



IMPORTANT

Avoid using different color outputs for solenoids. Use two yellow outputs or two blue outputs.



In datalogger you can configure the channels for monitoring BoostController pressure.



FT Input setting

In the "Sensors and calibration" menu select the "Wastegate pressure", after this set the associated input and the sensor type used.



FT setting

In this menu, you can setup the BoostController basic functions.



Basic: You can access all control settings through the FT screen. **Control gain:** Adjust the control gain according to the valve response. If it is taking to achieve the target it is necessary to increase the gain, if it overshoots the target it is necessary to reduce this value. **Advanced (PC):** Some settings are available only in FTManager software.



Pressure source: When configuring your boost controller, it is necessary to inform the ECU where your pressure will be sourced from; intake manifold, or CO2 bottle.

When using a bottle, an industrial pressure regulator is required, limiting the line pressure according to the desired configuration. Two manometers must be used, one before the regulator indicating the pressure in the bottle and the other after the regulator showing pressure in the line.

General c	onfig 3/13	< (General config 4/13	
Pressure source Intake manifold pressure Co2 bottle	Valve mode Dual 2 way valve (Co2 compatible) Single 3 way valve (Co2 not compatible)		Co2 bottle pressure	
×	✓	×		\checkmark

Valve model: You can choose which valve type will be used, high or low flow injectors, FuelTech 2 valve block or BoostController2 solenoid. You can set a minimum value for BoostController activation by TPS and MAP.



Proportional output: from 10% TPS the output is proportional to the map. The programmed pressure is reached when the TPS reaches the value set.



MAP maximum pressure and MAP maximum pressure on

2-step: Allow to set a MAP maximum pressure during 2-step and out of the 2-step. This function will not adjust the MAP pressure according to a target and will make the pressure bounces around the target. This maximum pressure must be used only as a safety feature to prevent overboost.

Output activation: the output can be triggered at OV or 12V

General c	onfig 8/13	< (General config 9/13	>
Disab. Enab.	Disab. Enab.		Output activation	
Maximum MAP pressure 3,00 psi	2-Step maximum MAP pressure 3,00 pol		Activated at 0V	
×	\checkmark	×		\checkmark

Boost+ button: Increases boost pressure while is switched on.

General co	nfig 12/13	〈 G	eneral config 13/13	• >
Disab Enab		None	Boost+ button input selecti	on
Boost+ Scramble	Button mode	O White 1:	Avaliable	
Button increase:	Activated at 12V	White 2: Aval	iable	
12.0 Activated at 0V		White 3: Aval	iable	
×	✓	×		✓



Launch targets

Defines the target pressure at the top of the valve in 2-step, 3-step and burnout mode.



2-step target: Set the target pressure during 2-step.

3-step target: Set the target pressure during 3-step.

Burnout target: Set the target pressure during burnout mode.

Anti-lag / Pops & Bangs / Engine Brake target: Configure the boostcontroller target when under these conditions.



Boost maps

In this function you can set modes of boost maps by time after 2-step (single-stage), by gear and engine RPM (a stage for each gear), by gear elapsed time (a stage by each gear) and single value target.

<	Wasteg	ate boost pressure	e control
		General config	
		Lauch targets	
		Main targets	
		Overall trim	
	×		\checkmark

By time after 2-step: Allows a detailed ramp up to 32 time points. The intermediate values are interpolated.



By gear and engine RPM: set up a stage for each gear, with up to 8 points per engine RPM. It is necessary that the gear change detection function is enabled. It does not depend on 2-step.



By gear elapsed time: Set up a stage for each gear, with up to 8 time points after the shift.



Single target value: Sets a fixed pressure for BoostController. The wastegate valve will always work this pressure.

This mode is recommended for dynamometer tests.



By engine RPM: Adjust the wastegate pressure according to the engine RPM only.



By reference speed: Adjust the wastegate pressure according to reference speed.





Overall Trim:

It is possible to do a target pressure overall trim.

Target pressure overall trim is available to any kind of boost control type.



When boost control type is selected by gear, the overall trim can be individually applied.



Is mandatory to have gear change detection activated to use any kind of gear control.)



19.18 Power shift (GearController FT550 / LITE and FT600)

This feature allows gear shifting in manual transmission gearboxes (sequential or not) without the use of the clutch (flat shifts).



NOTE

VOTE

This feature can only be used on dog engagement equipped gearboxes. Synchronized gearboxes may be severely damaged when trying to shift gears without using the clutch, even if used with the power shift feature.

When this function is activated, the white inputs number 19 and 20 will be automatically setup as gear shifter force sensor.

It is possible to setup the ignition timing during the cut in two different ways: using the main timing table or using a fixed timing.

Main table: timing on gear shifts will use the values set in the main timing table.

Fixed timing: adjust the ignition timing according to the selected gear.

Power	r shift (GearController) 1/13	Y Pow	ver shift (Gea	rController) 2/13
Dis	abled Enab	e	Shifter ty	sensor pe	Igni during	tion timing gear change
	This feature allows flatshifts (gear shifts without using the clutch or lifting the throttle) on dog engagement equipped gearboxes (Liberty Pro-Shift,	:	Load (Strai	cell in gauge) ified	Ma	in table
	Liberty Face plate, etc) Shifter sensor uses white wires #19 and #20		(0 to	5V)	F D	ied timing
×		\checkmark	×			 Image: A set of the set of the

Cut duration: the cut duration configuration is adjusted in ms and the values are configurable by gear.

The cut duration is used to disengage the current gear, therefore, the next gear engagement is done by the mechanical system of the gearbox.



Fixed timing: this setting fixes the ignition timing during the gear shifts. It is configurable by gear.

Set the % of the ignition cut for each gear.

Powe	r shift (GearControlle	er) 5/13	ζ Ρ	Power shift (Ge	arController) 6/13
Fixe	d ignition timing (BT at gear change	DC)		Ignition at gear ch	cut level ange (in %)	
G	ear shift 🖌 9 - 10))		Gear shift	〈 9 - 10	\rangle
Fixe	d timing — -39.8	3 +		Cut	20	+
×		\checkmark	×			\checkmark

When the gearbox has an analog gear position sensor, the powershift feature has the option to interrupt the cut as soon as the new gear is detected. This helps to save the gear engagements and ensures that the power is only released after the full engagement of the next gear.

P	ower shift (Ge	arControll	ler) 7/13
	Disabled	En:	abled
	Activate clo reduction dura next ge	sed-loop ation acco ar detecte	power rding to ed
×			\checkmark

Set the minimum TPS for the gear cut and lock time between gears after launch.

Select which cut will be used, choosing between ignition only or ignition and injection.



Shifter type: select the shifter type - H/Inline pattern or sequential shifter. Also select if your shifter is normal or inverted.

When forcing the shifter, check the voltage reading in the FT diagnostic panel or in the log, while shifting gears.

- If the voltage goes from 2.5V towards 5V, select the Normal shifter type.
- If the voltage goes from 2.5V towards OV, select Inverted as shifter type.



The shifter voltage cut level is used to disengage the current gear, therefore, the force to the back means the voltage to disengage odd gears (1st, 3rd, 5th) and force to the front refers to the cut to disengage even gears (2nd, 4th).



With the car stopped, push the shifter to the front and check the voltage read in the FT diagnostic panel. The recommended value is between 4 and 4.5V (or 0.5 and 1V - inverted transmission).

If the lever signal reaches 0V or 5V easily, lower the sensitivity gain in order to keep it below 5V and above 0V, the shifter voltages must never hit these limits.



Power shift lever connection diagram (FT600)

- Connect the blue wire from the shifter to the input #19 white wire (pin 33 - FT600's B connector);
- Connect the orange wire from the shifter to the input #20 white wire (pin 34 FT600's B connector);
- 3- Connect the two white wires from the shifter to the green/ black wire from the ECU - sensors ground (pin29 FT600's B connector);



Power shift lever connection diagram (FT550 / LITE)

- Connect the blue wire from the shifter to the input #13 White wire (pin 18 FT550's B connector);
- 2 Connect the orange wire from the shifter to the input #14 White wire (pin 19 FT550's B connector);
- 3 Connect the two whites from the shifter to the green/black from the ECU sensors ground (pin 26 FT550's B connector);



GearController reset for sequential change

The reset logic is based on the user set value.

Sequential / Normal shifter (5V forward)

The gear shift reset will occur when the lever voltage is greater than the voltage calculated by the equation below.

Reset voltage (V) = 2,5 - ((2,5 - tensile strength back) x 0,3)

Sequential / inverted shifter (0V forward)

The gear shift reset will occur when the lever voltage is less than the voltage calculated by the equation below.

Reset voltage (V) = $2,5 + ((tensile strength back - 2,5) \times 0,3)$

19.19 Start Button

This function allows the control of the vehicle's starter motor through an output (blue, gray or yellow wires) and an input (white wire) or through the FT screen.





Select whether you want to start the engine through the FT LCD screen (must setup the "Start Button" item on the FT dashboard" or through an external switch

If Dashboard is chosen the starter motor remains engaged while the button is being pressed and until the engine RPM goes above the "RPM for engine start" (set in the Engine Setup menu". As soon as the engine is running, the function of the button on the dashboard is now changed to turn the engine off when pressed (by cutting fuel and spark).

When external switch is selected.

Select whether the input is activated when it receives OV (ground) 12V. The output that actives the starter relay can be programmed whether to send OV or 12V when activated.

Automatic Start: When this option is selected, you no longer need to hold down on the start button, just one touch and the ECU will keep activating the starter automatically, however some precautions need taken, such as those described below.

- Set the Maximum RPM for cranking: when detecting an RPM above the configured value, the button is turned off.
- Maximum cranking time: Adjust the time limit within which the starter will start engine.
- Check that the car is not in gear.



Select all the safety protections for the engine start button, they will prevent the engine from cranking if the conditions are not met.

Define whether there will be a startup lock during the startup screen. This lock is necessary for use on watercraft, as the button that turns on the ECU is the same one that starts it.



Starter button for PWC

For PWC it is necessary to configure three inputs for the start button, one to start the pwc, one to start the engine and one to stop.

Select an output to activate the engine starter relay. Select the input to the start button.

Define which is the activation signal to the input button and to the output if 12V or 0V.



19.20 RPM activated output

This function allows enable output when the RPM is above a determined value.

Quick access panel	RPM activated output
🌠 Diagnostic Panel	Enable with RPM above
Fuel Tables	20 - RPM
Ignition Tables	Output signal
Other Functions	Activated at 0V
🗐 - Internal datalogger	O Activated at 12V (Only w/ Yellow outputs)
RPM activated output 1/3	RPM activated output 2/3
Test output: Test	Disabled Enabled
Output selection	Enabled with PDM above:
Yellow 1: Avaliable	
Yellow 2: Avaliable	RPM V
	X

19.21 Pit limit

This feature limits the speed to a set value, it can be activated through a dashboard button, an external button or an external switch.

External button: will keep the function activated for as long as it's pressed, deactivating when the button is released.

External switch: When pressed, it'll keep the function activated until it's pressed again, the same applies for the dashboard button. Both can be set up using a white wire or via CAN 2.0.





19.22 Active traction control

NOTE

This function actively controls the vehicle traction by changing ignition timing and the electronic throttle to try to obtain the best possible traction on various track conditions.



To use this feature, the vehicle must have at least 2 wheel speed sensors with speed differences between them.



Settings

On this menu it's possible to set up all the options regarding the traction control.

Always active: The control is always active and will function whenever the parameters defined in the settings are met.

Only with validated launch: the control will only function after a valid launch (when the settings for 2step are reached before launch) **Dashboard:** Activates the control through a button on the dashboard.

External switch: Activates the control though an external on/off switch.

External button: Activates the control while the button is pressed, deactivates when released.



If External button or External switch is selected, a white wire or CAN (Switchpanel-8 or OEM) must be set up.

<	Settings 2/9	>	<	Settings 3	/9 💙
Input selection					
None None		\sim	Equipment		
🔵 White 1: Av	/aliable			,	AN DUTTON CHANNEL
White 2: Avaliat	le		Switchpan	el-8	
White 3: Air temperature			OEM CAN		
White 4: Oil pre	ssure	\sim			
×		\checkmark	×		\checkmark

After one of the activation options are selected, it's possible to choose whether the control will be enabled or disabled when the ECU starts. Next the minimum RPM must be set, this is the lowest RPM the control will allow the engine to drop to, and below this RPM the control will not actuate.

The same principle is applied to the settings of minimum and maximum speed (of the reference wheel), the control will not actuate below the minimum speed or above the maximum speed.

There's also the possibility to deactivate the control right after a gear change is detected, allowing for some wheel slip during this set amount of time.

If necessary, configure an event status output to show when traction control is active.



Table selection mode

Here it's possible to set the quantity of tables and how to select them.

Dashboard: When selected, a button must be set up at "dashboard setup" menu, this button will switch between tables.

By gear: When selected, the tables will be assigned according to the current gear. That being: first gear > table-1, second gear> table-2, and so on.

External analog selector: When selected, it's possible to use an external multi-position selector by setting the voltage level for each table.





Target tables

The tables can be set up three different ways.

Time based after validated launch: creates a 6x16 TPS% by Time after validated launch, target slip table.

Engine RPM based: creates a 4x8 TPS% by engine RPM target slip table.

Vehicle speed based: creates a 6x16 TPS% by wheel speed target slip table.



Control actuation

In this menu it's possible to set up how the traction control will actuate on the vehicle.

The reaction level can be set between 1(less aggressive) and 10(very aggressive), and it dictates how the traction control will actuate.

Initial slip is the minimum wheel slip allowed, this is needed when the vehicle launches to get the car moving easily.

The strategy of the traction control to maintain the slip target is to retard the timing first, and if the slip is still increasing it will start to cut the ignition too.

<	Active traction contr	ol 💙	Control actuation 1/3			
	Settings					
	Table selection mod	le	React	ion level	Ini	tial slip
	Target tables		8	\sim	5	\sim
	Control actuation					
×		\checkmark	×			\checkmark
<	Control actuation 2,	/3 💙	<	Control act	tuation 3/3	3 💙
<	Control actuation 2, Power reduction strategy	/3 > /	<	Control act	tuation 3/3	3 >
< 	Control actuation 2, Power reduction strategy	/3 >	K Maximum	Control act	tuation 3/. Maximur	3 >
Ignition	Control actuation 2, Power reduction strategy retard	/3 >	Maximum	Control act	Maximur	3
✓ Ignition ✓ Ignition	Control actuation 2, Power reduction strategy retard cut	/3 >	K Maximum -30,0	Control act	Maximur	3) m ignition cut
Ignition	Control actuation 2, Power reduction strategy retard cut	/3 >	Maximum	Control act	tuation 3/: Maximur 90	m ignition cut

Configure what Egate's mode of operation will be and also the pressure and target for the slip.

〈 c	ontrol actuation 4/	5 >	🖌 с	5 >		
1	Boost control actuation		Additional	boost um slin	Boost re	duction when
	ntroller 1 🗸 eGa	te	0.80		0.0	
✓ BoostCor	itroller 2		bar	\checkmark		
×		\checkmark	×			\checkmark

19.23 Generic Outputs

In this menu it's possible to set up to 8 different outputs for various uses like activating exhaust diverts, turn off alternators during drag races, and many others that require datalogging. These outputs must be activated by either an white input or via CAN with the SwitchPanel-8.



19.24 Flex Fuel

General Settings

This feature allows the ECU to apply compensations on fuel, ignition timing and BoostController, based on ethanol content reading by using a Flex Fuel Sensor on the fuel lines.



Quick access panel	Flex fuel
🏹 Diagnostic Panel	Default blend in case of amon on flow fuel
Fuel Tables	sensor
Ignition Tables	75 🌩 %eth
Other Functions	Safe reading of the ethanol blend
🗐 - Internal datalogger	Discard reading during engine start
Idle speed control	with fuel pump on)
Deceleration cutoff	Discard reading with high load
Rev limiter	(use values below 2500 RPM)
Thermatic fan #1	
Fuel pump	Flex fuel setup wizard

If the sensor is disconnected or there's a malfunction, the ECU will use the compensations based on this blend.



Main fuel injection compensation

The main fuel injection table works real time over the main fuel map, compensating the fuel need according to the ethanol percentage in the tank.

One of the axis on the table is ethanol percentage, the other is MAP or TPS (depend of main fuel table setting) and the amount of fuel to be added or subtracted must be placed in the table cells.

For a 100% ethanol mapped engine, as ethanol percentage decrease, less amount of fuel is required, so the values in the table will normally be negative.

For a 100% gasoline mapped engine, as the ethanol percentage increases, more amount of fuel is needed, so the values in the table will be positive.





Prime pulse and engine start: Fuel percentage compensation table for prime pulse and engine start according to the percentage of ethanol used.

Based on a ethanol tune, ethanol percentage decrease requires negative compensation to start the engine.

For gasoline based map, raising the ethanol level requires positive compensation to start the engine.



Acceleration fuel enrichment: Usually, ethanol engines require more acceleration fuel enrichment than gasoline tuned engines.



O2 closed loop target: Based on ethanol percentage and MAP or TPS (depending of main fuel table settings). All the values set on the table will be added or subtracted to the main closed loop table and interpolated according to engine RPM.

<	Fuel compensations 4/4					
		Ethanol 0	10			
				+		
-5 PSI		+0.06	+0.05	λ		
0		+0.06	+0.05			
×			 			

Ignition compensation

It is possible to apply ignition compensations depending on ethanol percentage, the table is also related to MAP or TPS reading. The values set in the table are in °BTDC and are added to the ignition map, interpolating MAP or TPS with engine rpm to obtain the final value.

<	Flex fuel	>	<	ons	>	
	Settings			Ethanol 0	10	_
	- uel compensation	5				+
Timing compensations			-5 PSI	-6	-5	•
C	ther compensatior	ıs	G	-6	-5	
X		\checkmark	×		 ✓ 	

Other compensations

When the BoostController feature is enabled, it is possible to change pressure targets in the wastegate according to ethanol percentage, adjusting engine power to the fuel used. The values in the table are added or removed in BoostController function maps, even in cases

of different pressures per gear, 2-step, 3-step, Burnout or Pre-Start target pressures.

When turbo pressure is controlled by generic duty cycle output, ethanol percentage can also change the pulse frequency that opens / closes the wastegate, adjusting the engine power to the fuel used. The value entered in the table is added to the original PWM curve of the map.





19.25 Blip / Heel and toe

The blip/heel and toe feature quickly opens or closes the throttle when shifting gears.

The feature adds a percentage of opening in the throttle channel, so if you have the TPS at 20% and blip configured to add 60%, the final opening will be 80%. And, even if some function is limiting the opening of the throttle (custom pedal/throttle curves or maximum electronic butterfly opening), the blip function will still achieve its target, even if it exceeds the maximum value configured in these functions.

Quick access panel		Blip / Heel and toe	
 Bip / Heel and toe 	~	Activation method	Output for markening theattle
- Throttle closing for upshift		Evternal button	
Throttle opening for downshift		Power shift function	C Enabled
Automatic Transmission Control		Gear Control Management (GCM)	Output signal
Gear change table		Automatic Transmission Control	• Activated at 0V
- Lockup control		Addoniado Hairishission control	Activated at 12V (Only with yellow outputs)
- Lockup table		Brake + Cucch (Manual Cansmission only)	
- Push to pass (P2P)		Button activation mode	
Anti-lag / Door & Bange / Engine brake		 Activated at 0V 	
Gear Control Management	1	 Activated at 12V 	

Activation method

External button: Uses a white input to receive a blip signal;

Power Shift: Applies blip with the Power Shift function;

FTCAN 2.0: Receives blip signal from any FuelTech equipment connected to the CAN network;

Gear Control Management - GCM function: Applies blip when with GCM function;

Automatic transmission control: Applies blip when shifting through the automatic transmission control;

Brake + Clutch: Applies the blip when the brake and clutch pedal inputs are activated simultaneously. It is suitable for cars with standard manual transmissions;

Button activation mode: Choose whether the function will be activated by OV (ground) or positive (12V)

Output for mechanical throttle: Enables a pulse output to open a mechanical throttle through an actuator/solenoid that pulls the throttle cable.

Output Signal: Choose whether the function will be activated by OV (ground) or positive (12V).





WARNING

This function was developed to work in conjunction with an external sequential gearbox control module with electrical or pneumatic drive that has a specific output for controlling the "blip".

The Throttle opening and closing tables are only available in the FTManager software.

Configure the opening and closing time and percentage for each throttle position and gear.

Quick access panel	Throttle cl	osing	for up	shift					
Blip / Heel and toe	TPS %	0.0		25	.0	70.0		100	.0
- Throttle closing for upshift		s	%	5	%	5	%	5	%
Throttle opening for downshift	1->2	0.2	15.0	0.2	15.0	0.2	15.0	0.2	15.0
- Automatic Transmission Control	2->3	0.2	15.0	0.2	15.0	0.2	15.0	0.2	15.0
- Gear change table	3->4	0.2	15.0	0.2	15.0	0.2	15.0	0.2	15.0
- Lockup control	4->5	0.2	15.0	0.2	15.0	0.2	15.0	0.2	15.0
Lockup table									

Quick access panel		Throttle opening for downshift										
E Bip / Heel and toe	RPM	10	00	30	00	500)	800	0			
Throttle closing for upshift		s	%	s	%	s	%	s	%			
- Throttle opening for downshift	1 <- 2	0.2	15.0	0.2	15.0	0.2	15.0	0.2	15.0			
Automatic Transmission Control	2 <- 3	0.2	15.0	0.2	15.0	0.2	15.0	0.2	15.0			
Gear change table	3 <- 4	0.2	15.0	0.2	15.0	0.2	15.0	0.2	15.0			
E- Lockup control	4 <- 5	0.2	15.0	0.2	15.0	0.2	15.0	0.2	15.0			
- Lockup table												

19.26 Variable Camshaft (VVT)

This feature allows independent intake and exhaust camshaft angle control according to separate target tables for both of them.

Post start activation time:	÷ ;	Disable VVT with engine temp below:		
Intake #1		Intake #2	Exhaust #1	Exhaust #2
Enabled		Enabled	Enabled	Enabled
Sensor type		Sensor type	Sensor type	Sensor type
 Cam sync sensor 		 Cam sync sensor 	 Cam sync sensor 	 Cam sync sensor
④ Analog input (hall sensor)		Analog input (hall sensor)	Analog input (hall sensor)	Analog input (hall sensor)
Output signal		Output signal	Output signal	Output signal
Activated at 0V		Activated at 0V	Activated at 0V	Activated at 0V
 Activated at 12V (Only w/ Yellow out 	puts)	 Activated at 12V (Only w/ Yellow outputs) 	 Activated at 12V (Only w/ Yellow outputs) 	 Activated at 12V (Only w/ Yellow outputs)
PWM frequency		PWM frequency	PWH frequency	PWH frequency
200 💠	Hz	200 🌩 Hz	200 🌩 Hz	200 🌣 Hz
Ninimum duty cycle		Ninimum duty cycle	Minimum duty cycle	Minimum duty cycle
0 👙	55	0 🗘 🐝	0 🗘 🐝	0 🔅 💊
Naximum duty cycle		Haximum duty cycle	Maximum duty cycle	Havimum duty cycle
100 0	56	100 0 %	100 0 %	100 0 %
Base duty cycle		Base duty cycle	Base duty cycle	Base duty cycle
75 🛊	55	75 🔹 %	75 🖕 %	75 🛟 %
Solenoid direction		Solenoid direction	Solenoid direction	Solanoid direction
Normal (Advance)		Normal (Advance)	 Normal (Advance) 	 Normal (Advance)
Inverted (Retard)		Inverted (Retard)	Inverted (Retard)	Inverted (Retard)
Proportional gain		Proportional gain	Proportional gain	Proportional gain
1.1	500 🗘	1.500 💠	1.500 🔹	1.500 🗘
Integral gain		Integral gain	Integral gain	Integral gain
0.	\$00 🛊	0.500 ‡	0.500 🛟	0.500 ‡
Derivative gain		Derivative gain	Derivative gain	Derivative gain
0.1	020 🔅	0.020 🛫	0.020 🛫	0.020 🛊



IMPORTANT

Check the physical limitations of your variable camshaft. In case this feature is improperly used, it may cause irreversible damage to the engine (valves hitting each other or the piston, specially when using aftermarket cams).



WARNING

We recommend using yellow outputs for VVT (FT500, FT550 and FT600). These outputs do not need any modifications or add-ons (protection diodes) on the harness.

For FT450, blue output #5 has this protection diode built-in. Other blue outputs require adding a protection diode according to the diagram.

<u>FuelTech</u>



NOTE

Recommended diode: 1N5400, 1N5401, 1N5402, 1N5404, 1N5406, 1N5407 or 1N5408.



IMPORTANT

Gray outputs are NOT recommended for the VVT control.



General configurations

Select how many variable camshafts are going to be used, it's possible to use up to four, 2 intake and 2 exhaust.

Variable car	mshaft (VVT)	Gen	eral configurations	1/3
general cor	nfigurations	Disa	abled Enab	led
Intake 1	Exhaust 1	🗸 Intake 1	Exha	ust 1
Intake 2	Exhaust 2	V Intake 2	Exha	iust 2
×	\checkmark	×		\checkmark

Time after engine start for VVT activation: configures a blocking time to activate the VVT, this time aims to facilitate the engine start. Block VVT with motor temp below: limits VVT performance for a minimum activation temperature.



Fill out the target tables for intake or/and exhaust. The values are shown in degrees, in relation to cam sync position sensor

Example: If the sensor is at 45°, and there's a value of 10° in the table, the camshaft will be mode to 55°.

Quick access panel	Inte	аке са	rget (°)										-
🖄 Other Functions 🔷			RPM (rpr	n)									
Enternal datalogger		0	2000	4000	5500	6000	6500	7000	7500	8000	8500	9000	Τ
Idle speed control	G I												
- Deceleration cutoff	1					0.4		0.5	0.6	0.6	0.7	0.7	1
- Rev Imber	\$	67.02		U.Z	0.4	0.4	0.5	0.5	0.0	0.0	0.7	0.7	ľ
- Shift light													
- Thermatic fan #1													
- Air conditioning													
- Fuel pump		72.52	2.1	2.1	2.2	2.2	2.2	2.2	2.2	2.2	2.2	2.2	12
Cold start auxiliary													
Wastegate Boost Control													۲
- Pit limit													
- Generic outputs		58.02	4.3	4.2	4.0	4.0	4.0	3.9	3.9	3.9	3.8	3.8	3
Variable canshaft (VVT)													
- Intake target													
- Exaust target													1





Camshaft sensors

NOTE

Here the parameters for all the camshaft sensors to be controlled are input.

E

The screens shown here are for intake 1. The procedure is the same for all other camshafts.

Intake #2	Exhaust #1
Sensor position angle	Sensor position angle
9° 🖨 0.0	°BTDC 0.0
Cam wheel type	Cam wheel type
○ Single tooth	O Single tooth
Sensor edge	Sensor edge
Window filter detection angle	o 0 ≜ o
Multiple teath	Multiple teath
Teeth tolerance	Teeth tolerance
10.0 -	% 10.0 ÷ %
Teeth table	Teeth table
Tooth Start angle End angl	gle Tooth Start angle End angle
Wheel decoder	Wheel decoder
Varial	ble camshaft (VVT)
Gene	eral configurations
Intake 1	Exhaust 1
Intake 2	Exhaust 2
×	

Sensor position angle: There are two options to get the signal: using a cam sync sensor on it's dedicated input or a hall effect sensor on one of the Analog inputs.





Select an output that is going to drive the actuator solenoid for the camshaft and how it's going To activate, then select it's PWM frequency.



Insert the minimum and maximum duty cycles.

Adjust the base duty cycle percentage and it's direction of actuation.



In the last screen the Proportional, Integral and Derivative values are set.

Proportional gain: How fast the control tries to reach the target.

Integral gain: Is the accumulated error over time, that should have been corrected, from the proportional gain in trying to reach the target. **Derivative gain:** Smoothes out the approach and overshoot control

around the target.



Analog input (Intake 1): Uses another cam sync sensor to manage camshaft position.



NOTE

The screens shown here are for intake 1. The procedure is the same for all other camshafts.



Cam wheel type

Single tooth: This option should be selected when there's only one tooth for reference.

Multiple teeth: This option should be selected when there are multiple teeth for reference.

It's very important to inform the sensor position as this will be the reference for the target tables.

Example: If the sensor is installed at 100° and there's a 10° increment in the target table, the final angle will be 110°.

The detection window creates a range in degrees in which the ECU expects the signal, ignoring signals found outside of it.



Wheel decoder

The decoder can be used either by just cranking or running the engine, it will automatically detect all teeth in cam sync wheel and draw the signal pattern, then one of the angles must be chosen as the sync reference.





Default configuration for 2JZ WTi - Single tooth

Intake #	1
Sensor type	Cam sync sensor
Output signal	OV
PWM Freq	200 Hz
Minimum duty cycle	0%
Maximum duty cycle	100%
Base duty cycle	75%
Solenoid direction	Advance
Proportional gain	1.500
Integral gain	0.50000
Derivative gain	0.020
Camshaft se	nsors
Sensor position angle	70.0 °BTDC
Sensor edge	Rising
Window filter detection angle	120°
Cam sync w	rheel
Sensor edge	Rising
Window filter detection angle	120°



Default configuration for 2JZ VVTi - Multiple teeth

Intake #1	
Sensor type	Cam sync sensor
Output signal	OV
PWM Freq	200 Hz
Minimum duty cycle	0%
Maximum duty cycle	100%
Base duty cycle	75%
Solenoid direction	Advance
Proportional gain	1.500
Integral gain	0.50000
Derivative gain	0.020
Camshaft sens	ors
Sensor position angle	70.0 °BTDC
Sensor edge	Rising
Window filter detection angle	120°
Cam sync who	eel
Cam sync teeth tolerance	30%
Window filter detection angle	120°
Cam sync teeth table	Use Cam sync wheel decoder button

19.27 Automatic Transmission Control

This function enables the ECU to control automatic transmissions up to 10-speed gearboxes.

Based on speed maps and function settings, the ECU will automatically select the desired gear and it is able to interpret temperature, pressure and speed data from the original transmission sensors.



IMPORTANT

To use this feature and set it up properly, you need the electrical diagram of the transmission you want to control

dear change compensation	minimum time	Maxim	um RPM at	each gea	ir 👘						
	0.00 🜩	s 1	2	3	4	5	6	7	8	9	
Range selector 1, 2, 3 & 4 m	ode	11000	11000	11000	11000	11000	11000	11000	11000	11000	R
 Limit gear up to the leve 	r position	Minimu	ım speed a	t each ge	ar						
O Hold gear to the lever po	sition	2	3	4	5	6	7	8	9	10	Γ
2-Step line pressure control		12	25	37	50	62	75	87	99	112	M
Enabled	Maxim	Maximum speed to downshift at each gear									
	80.0 ‡	% 1	2	3	4	5	6	7	8	9	Γ
Lock time after gear change		25	37	50	62	75	87	99	112	124	M
Gear change delay during th	0.50 🛊	s Autom	atic transn abled sbrake	nission tra	ansbrake	and stagi	ing contro	bl			

General configurations

For a proper automatic transmission control it is necessary to set up which solenoids will be active for each gear and also the sensors that will feed the ECU with transmission oil pressure data.

<	Automatic transmission control
	General configuration
	Triggering map
	Target tables
)	× … · ·

The first step is to select which strategy will be adopted to control the transmission when the vehicle is running.

Limit the number of gears: In this configuration, the transmission will shift gears only until the last gear selected.

For example: When "3" is selected in the shifter, the transmission will only perform gear shifts among 1st, 2nd and 3rd gears.

Hold actual gear: Holds the transmission at the gear selected in the shifter.

For example: When "3" is selected in the shifter, the transmission will only run in 3rd gear, not performing any gear shift.



Configuration for the total oil line pressure during 2-step/Transbrake.



Sets the locking time between gear changes.



Sets the delay and the percentage of TPS when pedaling the accelerator, this prevents the transmission from shifting several gears when the accelerator is pedaled.

It is possible to activate the solenoids between gear changes, this configuration is necessary for the correct control of some gears.





The next screen is dedicated to set up which solenoids will be activated.

These solenoids are responsible for engaging or disengaging the sets of each gear.



NOTE

This manual describes the configuration of solenoid 1. The emails must be configured following the same procedure.

Transmission pressure: Main solenoid that controls the transmission line pressure, responsible for maintaining or increasing the oil pressure when necessary.

Accumulator solenoid: Solenoid that controls the amount of oil sent to the accumulator, smoothing the gear changes.



The first step is to enable the solenoid and set up the output for the control.

<	Solenoid A 4/7	>	<		>			
	Disabled Enab	led						
			None				^	
	Solenoid A		Blue 5: Avaliable					
	Colenoid /		Blue 6: Avaliable					
			Blue 7: Avaliable					
×		\checkmark	×			\checkmark	•	

This configuration must be made for all gears available in the transmission, for both upshifts or for downshifts.

<	Solenoi	d A 6/7	>	<	Solenoid A 7/7	\rangle
	PWM frequency	Output	Signal ivated at 0V ivated at 12V		Activation ramp duratio	'n
	×		\checkmark	×		 ✓

Triggering map (Gear)

This is where the automatic transmission programming is made. It is necessary to define which solenoids will be activated for each gear, for upshifts and downshifts.

Depending on the transmission model, it may be necessary to activate several solenoids simultaneously for certain gears. The number of solenoids may vary depending on transmission model.



IMPORTANT

This configuration is for gear changes and not Shifter position.

Quick access panel	Gear cha	nge trigger	table						
Internal datalogger ^	Upshift								
- Idle speed control		Solenoid A	Solenoid B	Solenoid C	Solenoid D	Solenoid E	Solenoid F	Solenoid G	Solenoid H
- Deceleration cutoff	P								
Rev limiter	R								
- Thermatic fan #1	N								
Fuel pump	1								
- Generic outputs	2								
Automatic gearbox control	3								
Solenoids	4								
Gear change trigger table	5								
- Gear change table	6								
Cardan be announ table	7								
Gearbox line pressure cable	8								
- Line pressure by temperature comprensation	9								
Gear change line pressure compensation	10								
Accumulator pressure table									
Lockup control	Downshift								
Drag Race Features		Solenoid A	Solenoid B	Solenoid C	Solenoid D	Solenoid E	Solenoid F	Solenoid G	Solenoid H
- 2-Step rev limiter	P								
- Timing table for rev launch	R								
Time based compensations	N								
- Wheele control	1								
- Launch delay controls (delay box)	2		Ľ		Ľ		0	0	
- Engine Settings	3								
- Engine seture	4								
PDM cimal	5								
Company	6								
- Cam sync signal	7								<u> </u>
- Igntion	8								

For example: To set up the 2nd gear, it is necessary to define which solenoids will be activated for up-shifting from 1st and for downshifting from 3rd.



NOTE

This configuration must be made for all gears available in the transmission, for both upshifts or for downshifts.



IMPORTANT

These triggering informations can usually be found on the electric and hydraulic diagrams of the transmission

NOTE

On the majority of transmissions, both tables can be the same.



Triggering map (Transbrake / Staging)

This configuration creates a map for the vehicle when it's in Transbrake/ Staging mode, commonly used in drag racing. To activate this map, it is necessary to set up the table directly in the automatic transmission control function.

Quick access panel	Automatic Transmission Control											
🜠 Diagnostic Panel	Gear change compensation minimum time	Maximum RPM at each gear										
Fuel Tables	0.00 ÷ s	1	2	3	4	5	6	7	8	9		
Ignition Tables	Ranne selector 1.2.38 4 mode	11000	11000	11000	11000	11000	11000	11000	11000	11000	RPM	
Other Functions	 Limit gear up to the lever position 	Minimu	n speed a	t each ge	ar							
Internal datalogger	O Hold gear to the lever position	2	3	4	5	6	7	8	9	10		
- Idle speed control	2-Step line pressure control	12	25	37	50	62	75	87	99	112	Mph	
- Rev Imiter	Enabled	Haximum speed to downshift at each gear										
- Shift light	80.0 🌩 %	1	2	3	4	5	6	7	8	9		
 Thermatic fan #1 	Lock time after gear change	25	37	50	62	75	87	99	112	124	Mph	
- Thermatic fan #2	0.50 🔹 s	Automatic transmission transbrake and staging control										
- Start button	Gear change delay during throttle pedalling Enabled	Transl	rake									
Variable canshaft (VVT)	Delay during throttle pedalling	st	aging									
Automatic Transmission Control	AND A MARKED AND A COMPANY											
Drag Race Features	Add delay when TPS reduces from											
Engine Settings												

The setup procedure is the same as the one described for the gears. You just have to check the solenoids that will be activated for each condition.



Tables

These tables will define the behavior in each gear and the changes between them. The main table is based on throttle position and the desired speed for each gear shift.

Maximum RPM in each gear: The maximum value allowed in each gear before shifting.



Minimum speed in each gear: Minimum speed that the ECU will hold the current engaged gear or deny a upshift.



Deny downshifts above speed: Maximum speed that the ECU will deny a downshift, avoiding drive-train and mechanical failures.

<	Target tables 3/9											
Deny downshifts above speed:												
Gear			1	2	3	+						
Speed [kmh]			10	20	35	kmh						
	×				~							

This is the main table for the gear shift operation. You must set the speed according to throttle position for all gear shifts and the ramps built for each shift schedule will define the values for each upshift and downshift. It is recommended to always set the downshift values lower than the upshifts.





Gearbox line pressure: The transmission oil pressure will be given according to the percentage set up in this table. The pressure won't necessarily increase as the percentage increases, depending on the transmission electrical system.

Quick access panel	Ge	arbox E	ne pressure table				
Other Functions			TPS (%)				
Internal datalogger		%	0.00	10.00	20.00	30.00	40.00
- Idle speed control	1 î			ſ		ſ	ſ
- Deceleration cutoff	B	R	20.0	21.5	23.0	24.5	26.0
- Rev limiter	10						
- Thermatic fan #1	8			50.0	22.0	22.5	24.0
- Fuel pump		N	19.1	20.6	22.0	23.5	24.9
- Generic outputs				-		-	
Automatic gearbox control	1.		18.2	19.6	21.0	22.4	23.8
Solenoids		1	10.2	15.0	21.0	22.7	2.5.0
Gear change trigger table				*	-	-	
Gear change table		2	17.3	18.7	20.0	21.4	22.7
Gearbox line pressure table							
Line pressure by temperature comprensation				r		ř.	
Gear change line pressure compensation		3	16.4	17.7	19.0	20.3	21.6
Accumulator pressure table							
Lockup control							
A	14	1	45.5	46.0	40.0	40.2	D0.6



Line pressure compensation: This table allows the easy percent addition or reduction of oil pressure over the main table.



К Р	ressure o	essure compensation 6/9								
		TPS 0,00	0,10							
R		0	0	+						
N		0	0	%						
•		50	40							
×			\checkmark							



Line pressure by temperature compensation: This table allows the ECU to make percent compensations for oil pressure according to the oil temperature, helping the transmission to reach its operating temperature quickly.

Quick access panel	Line pre	ssure by tempera	ature comprensa	tion (%)			
Other Functions ^		Temperature (oF)				
🖶 Internal datalogger	٩F	14	32	50	68	86	104
- Idle speed control		⁶ 10.0	10.5	11.1	11.6	12.1	12.6
- Deceleration cutoff							
- Rev limiter							
- Thermatic fan #1							
- Fuel pump							
- Generic outputs							
Automatic gearbox control							
Solenoids							
Gear change trigger table							
Gear change table							
Gearbox line pressure table							
- Line pressure by temperature comprensation							
- Gear change line pressure compensation							

 Target tables 7/9
 Target tables 8/9

 Minimum shift compensation time
 Pressure compensation by temperature

 0,75
 -10
 0
 10

 *
 *
 *
 *

19.28 Lockup Control

This function allows the ECU to manage the slip percentage of the torque converter in automatic transmissions. To use this function it is necessary to set up the solenoid in a blue, gray or yellow output and adjust its frequency.

Quick access panel	Lockup control	
Other Functions	Output signal	Minimum engine temperature for lockup
Internal datalogger	Activated at 0V	32 - of
Idle speed control	Activated at 12V (Only w/ Yellow outputs)	Michael and a start and a start and a start and a start a star
- Deceleration cutoff		Plinimum gearbox temperature for lockup
Rev limiter	70 Hz	32 🔹 🕫
Thermatic fan #1	Minimum duty cycle	Force lockup when gearbox temperature
Fuel pump	0 ÷ %	32 + +
Generic outputs	Maximum duty cycle	Disable lockup during unshift
- Automatic gearbox control	0 * %	0.00 - s
Lockup control	Activation ramp duration	Disable lockup during downshift
Lockup table	0.00 ÷ s	0.00 ÷ s
Drag Race Features	Deactivation ramp duration	Disable lockup when brake pressed below
- 2-step rev Imiter	0.00 - 5	
Timing table for rev launch	Minimum gear for lockup	
Time based compensations	1÷	

Lockup control 2/10	>	Loc Loc	kup control 3/10	```
Test output: Test				
Output selection		PWM freq	uency Out	tput Signal
Blue 5: Avaliable		300	<u> </u>	ctivated at 0V
Blue 6: Avaliable		Hz		ctivated at 12V
Blue 7: Avaliable	\langle		Ŭ	
×	\checkmark	×		\checkmark

The next step is to adjust the solenoid operating range.



In this table you can set the speed and throttle position in which the Lockup will be activated/deactivated. The Lockup will be activated when the speed is higher than the value set and deactivated when the value is lower.

Quick access panel	Lo	ckup table					
🔨 Other Functions 🔗		TPS	(%)				
⊞- Internal datalogger		Mph	0.00	10.00	20.00	30.00	
Idle speed control	ar)	1 Lockup		1	2	3	4
Deceleration cutoff	g l			-	-	-	F
Rev limiter	- Ear	1 Unlock		1	2	3	4
Thermatic fan #1	0	D.L. and the			2		Ľ
Fuel pump		2 LOCKUP		1	2	3	4
Generic outputs		2 Unlock		1	2	3	4
Automatic gearbox control				-	-	-	ŀ
Lockup control		3 Lockup		1	2	3	4
Lockup table						_	Ì.



It is also necessary to setup the Lockup activation and deactivation ramps, so the system can operate smoothly.



After the table is set up, it is necessary to adjust some Lockup control parameters, such as:

Lower gear: That is the lowest gear in which the torque converter will operate.

Temperatures: This option defines the maximum and minimum engine temperatures that will allow the torque converter to operate.



This last setting is applied for Lockup deactivation in conditions as manual gear shifting(paddle shifter) or when the brakes are applied below a certain RPM value.



19.29 Push to pass (P2P)

This function allows to have 2 different maximum throttle opening in the same map, using a button or switch to change throttle maximum percentage.

To configure this function, go to menu "Engine settings / Pedal/ Throttle". If you want to use this feature, setup a maximum throttle opening lower than 100%.

Example: some road racing cars have a power limit that is controlled by the amount of throttle opening, and during some parts of the race the driver is allowed to use 100% of throttle.






Throttle percent added: Sets the percentage to be added over the throttle opening limit.

Timeout actuation: set the time in seconds the P2P will last.

Activation method: Select if the P2P will be activated by a White Input or by CAN (SwitchPanel or Input Expander)



19.30 Anti-lag / Pops & Bangs / Engine brake

These functions share the same basic settings, the definition of which one will be activated is based on the configurations and compensations.

Anti-lag: mostly applied for turbo engines to keep the boost up when throttle goes down, rally cars are the main application.

Pops & Bangs: commonly used in street cars to have flames and shots coming out from the exhaust.

Engine brake: used to keep the intake air valve or throttle blade with a different opening under engine deceleration, making it faster or slower.



NOTE

It's necessary TPS is correctly configured to the function to be activated.

Quick access panel	Anti-lag / Pops & Bangs / Engine b	rake	
PPM activated output Nap selection by button Pit limit	Enable function by	Brake switch activation	Ignition cut Intervention cut 28 0 % %
Active traction control Generic outruits	O External button O Dashboard button	Released	Idle actuator/electronic throttle position
B - Flex Fuel B - Variable canshaft (VVT) Canshaft sensors The United and the	External button Anti-lag button FTCAN 2.0 Equipment	Clutch switch activation Clutch switch activation Pressed Released	Gran based
Automatic Transmission Control Lodup control Pueh to pass (P2P) Anthia J Poes & Banas J Preso motor	SwitchPanel	Tgnition timing O Main ignition timing table Fixed timing Fixed timing at Fixed timing at	
Drag Race Features Engine Settings Sensors and Calibration	Turn on while pressed (button mode) Turn on or off when pressed (switch mode)	Activation delay 0.19 5	
- Inputs - MAP - Traction type	External button activation Activated at 0V Activated at 12V	Activation ramp duration 0.04 s	
- Front Wheel speed - Rear wheel speed - Drive shaft RPM - Input shaft RPM	Start ECU with Control deactivated Control activated	Minimum RPH to activate 2530 ± RPM Maximum TPS 0 ± %	
Flywheel RPM (Clutch basket) Turbo speed RPM Puel flow sensor	Output activation mode Output activated at 0V Activated at 12V	Fuel enrichment	

Configurations

There are 3 different options to enable this function:

- Always enabled
- Dashboard button
- External button



Select if the ECU will start with this function enabled or not.

🖌 Anti-lag /	Pops&Bangs / E. t	orake 1/17 🔪	🖌 Anti-lag /	Pops&Bangs / E. E	Brake 5/17
	abled Enabl	led		Start ECU with	
Alway Dash Exter	ys active board button nal button			Control desact	ivated ed
×		\checkmark	×		~

When an external button is defined, is necessary to configure if it's connected to an analog input or if it's over CAN bus using a Switch Panel.

There is an extra option to select whether it it's a switch or a momentary button





Brake activation: Select if the brake pedal is going to be used to turn the feature on and off. To use this option Brake switch input is required.

ch input is required. the amount of air going through the engine in this function. A fixed position can be used or a gear based table is presented.



Clutch activation: Select if the clutch pedal is going to be used to turn this feature on and off. To use this option clutch switch input is required.

🖌 Anti-lag / Pops&Bangs / E. Brake 7/17 🔪							
Disabled Enabled							
	Clutch switch activation						
	Pressed						
Released							
×		\checkmark					

Ignition timing: define if the ignition timing will follow the main ignition table or if it is a fixed timing.



Adjust the activation delay, maximum duration time minimum RPM, maximum TPS and fuel enrichment to have the function working as expected.



Ignition cut: adjust ignition cut % applied when the feature is active.





Idle actuator/electronic throttle position: it's possible to setup

Activation ramp duration configuration time





IMPORTANT

After the main configuration is done, auxiliary options are available under BoostController, Deceleration Cutoff and closed loop menus.

19.31 Compressed air control

This function controls the air compressor activation and regulates the pressure in the air reserve tank. Often used in automatic transmissions where the gear change is pneumatic.

Quick access panel	Compressed air control
 Solenoids Gear change trigger table Gear change table Gearbox line pressure table 	Operation mode Only with engine running Always enabled
Line pressure by temperature compensation Gear change line pressure compensation Lockup control	1.000 psi Turn OFF when reach 5.000 psi
 Lockup table Push to pass (P2P) Anti-lag / Pops & Bangs / Freio motor Gear Control Management 	Minimum time for compressor ON 10.00 + s Minimum time for compressor OFF 10.00 + s
Compressed air control Compressed air control Drag Race Features Burnout mode O the burn burnt and full data	Outuput activation mode



Operation mode: select if the compressor control will be enable only with running engine or always enable.



Select the reserve tank minimum and maximum pressure, the compressor will turn on and off by these limits.

Select the max duration for the compressor to stay on.



19.32 Advanced gear shift manager

This function is similar to the Power Shift (gear change ignition cut), yet with the possibility of gear change ignition cut and downshift enrichment.

This gear control is common in course race cars, when the gear change is made by steering wheel paddle shift, works combined with other functions for full control of an automatic transmission.

Quik	ck access panel	Gear Control Management											
	O2 dised loop target compensation Man ignition compensation Wastegate Boost Control compensation	Gear shift command Manual paddle shift and automatic by RPM To configure manual hadde Shift you need to	Upshift Downshift Automatic gear shift by engine RPM					Upshift solenoid output					
	- Generic duty cycle compensation	Recent to Concern						Output activation dare					
- 6	 Fariable canshaft (WT) 	 Automatic transmission control 	1-2	23	3	4-+5	5-+6	6→7	7→8	8 → 9	9 → 10		
- 4	8- Bip / Heel and toe	O FTCAN 2.0 (External TCU)	8000	8000	8000	8000	8000	8000	8000	8000	8000	0714	Output activation mod
1	Automatic Transmission Control	 Strain gauge 	Hinkneys	TPS for inco						-			O Activated at 0V
- 1	8- Lockup control	 Analog gear lever sensor 				10.0	a 18						Activated at 12V (r
	- Push to pass (P2P)	Gear lever direction											
	- Anti-log / Pops & Bangs / Engine brake	O Increase in voltage = Increase	Power reduction										
	- Gear Control Management	Increase in voltage = Reduction	Enabled										
	Compressed er control Dechanic wastegate control Mal farvat ressure namel him	Lock time between gear shift Drabled 0.00 © 5	Pweer reduction delay after Oct mode Ignition timing output activation 0.000 s • O Ignition O Ham system to 1.000 s • O Ford		ition table								
	The based after inten twart table	Neutral return only with Interlock button	Power red	luction due	ation								
	Bace opening table by RPM x MIP Target	With this option enabled, it's possible to	1-+2	2-+3	3-+4	4→5	5→6	6→7	7→8	8-+9	9 -+ 20		
	- Control by external reference	Activated R-on using only the Interlock button, not	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150		
	- Tach output	requiring Paddle Shift buttons.	Speition ti	insing durin	power rea	duction							
	- PWC Controls	Strain same configuration		2-+3	3-+4	4-+5	5→6	6→7	7→8	8-19	9 -+ 13		
	D. Frequency Control	Direction	0.0	0.0	0.0	0.0	0.0	-40.0	-40.0	-40.0	-40.0		
	Control to 900	O Regular (5V to the front)	Jgnition c	et during p	ower reduct	tion							
	Control by TRS	O Reverse (0V to the front)	1-2	2-+3	3-+4	4-+5	5→6	6→7	7→8	8→9	9 → 10		
	Control In 1990	Contraction and the local	53	53	55	55	55	20	20	20	20	5	
	- External TCU control	Gear sumer sensor tripper vokage ieveis	Activat after th	e cloosed-li re next ge	op power i r is detecte	reduction du rd	ration						
	- Dectronic BlowOff control	Beckwards shift 1.00 \cdot v	Upshift protections										

General configuration

There are 3 ways to control the gear change, through the automatic transmission control by paddle shift or by RPM, and also through an external TCU connected by CAN (FTCAN 2.0)

For Paddle shift / automatic transmission and external TCU, it is necessary to adjust the lock time for engaging the next gear (only for paddle shift), then select whether the gear will be placed in neutral when the Interlock button is activated and also the function will be activated when the blip/heel and toe function is active.

Advar	anced gear shift manager				Advance	ed gear sh	ift mana	ger 1/6 🏾 🔪
Ge	neral co	nfiguratio	ns			abed	Enable	ed
DownSh	ift	U	pShift		Manual pao & automatic Automatic transmissic FTCAN2.0	ddle shift ic by RPM on control (external TC	Straing Analog lever s	g gauge g gear sensor
X			\checkmark		×			\checkmark



DownShift

When set for Paddle Shift or Automatic by RPM is necessary to adjust the RPM for each gear change.

Advanced gear	r shift manager	🕻 Advanced	d gear shift manager 1/19))			
General cor	nfigurations	Disa	bled Enabled				
DownShift	UpShift	Automatic downshift by RPM					
×	\sim	×	···· V	/			
	Advanced gear s	hift manager 2	2/19				
	Downsl	nift RPM					
	Gear Shift	9 - 10					
	RPM	2500 +					
	×		\checkmark				

When set for External TCU or Automatic Transmission function, the downshift is configured at the third screenshot above.

Adjusting the delay for the power reduction to begin, this delay is the delay between the Paddle Shift pulling and the ECU to apply the downshift.

When "*power reduction*" box is selected, there will be more settings for downshift:

Cut mode: select if ignition cut or fuel and ignition cut.

Power reduction duration: adjust the power reduction duration for each gear change.

Ignition timing during power reduction: set the timing at each gear change.

Cut: adjust the cut percentage for each gear change.







Closed loop control: When this option is selected the function will control the cut duration, if the gear engages before the power reduction time is over this function will anticipate the engine power return.



Adjust the additional throttle opening percentage for each gear change, also the duration time in milliseconds, similar to the "blip / heel and toe" function.



Downshift protections: Allows adjusting the maximum RPM for Downshifting, cancel the downshift if TPS is above specific percentage, and allows setting a TPS percentage wich bellow it won't apply any power reduction.



Additional power reduction after gearshift: Before the downshift the blip is activated, increasing engine RPM, this function can be used to avoid a "push" feeling during downshift.



Stacked downshift: When activated this function will save the request for downshift if the request can't be applied at the time due to protections, up to the time limit applied and minimum TPS for the request stacking. Cancel the request when upshift is requested is also an option.

Example: The pilot pull downshift 3 times in a row, the ECU will schedule the request and apply when RPM is within the pre-set limits.



Downshift solenoid output: Set the output activation and duration.

Advanced gear shift manager 17/19		Advance	d gear shift m	hanager 1	18/19	9)
Disabled Enabled			Ttest output:	Test		
		🔵 Gray 7: Av	Ouptut selection Valiable	pn		>
Downshift output		Gray 8: Avalia	ble			
		Yellow 1: Avali	iable			
		Yellow 2: Avali	iable			\langle
× · · · · · · · · · · · · · · · · · · ·		×			\checkmark	•
Advanced ge	ear shi	ift manager 19	9/19 🔪			
Output activation activated at 0 activated at 1)V 12V	Output activ duration				
X			\checkmark			

Upshift

Additional power reduction after gearshift: Before the downshift the blip is activated, increasing engine RPM, this function can be used to avoid a "push" feeling during downshift.



When set for External TCU or Automatic Transmission function, the downshift is configured at the third screenshot above.

Adjusting the delay for the power reduction to begin, this delay is the delay between the Paddle Shift pulling and the ECU to apply the downshift.

When "*power reduction*" box is selected, there will be more settings for downshift:



Cut mode: select if ignition cut or fuel and ignition cut.

Power reduction duration: adjust the power reduction duration for each gear change.

Ignition timing during power reduction: set the timing at each gear change.

Cut: adjust the cut percentage for each gear change.

Advanced gear shift manager 3/19 Advanced gear shift manager 4/19 Cut Type Power reduction Power reduction delay after output activation Enabled Timing 0.020 Injection / Ignition × Advanced gear shift manager 6/19 Advanced gear shift manager 5/19 Power reduction duration Ignition timing during power reduction 9 - 10 🔪 Gear shift 9 - 10 Gear shift Time [s] Dearees × Advanced gear shift manager 7/19 Ignition cut during power reduction Gear shift 🔇 9 - 10 〉 Percentual [%]

Closed loop control: When this option is selected the function will control the cut duration, if the gear engages before the power reduction time is over this function will anticipate the engine power return.



Upshift solenoid output: Set the output activation and duration.



19.33 Electronic Wastegate Control

This function controls the electronic wastegate. When using this function, there's no need for BoostController function, and a lot of components can be removed if using a electronic wastegate, like hoses, O2 cylinder and pressure sensor.

uick access panel	Electronic wastegate control	
Diagnostic Panel	Actuator configuration	Settings
Fuel Tables	1 eGate	Enate rest position
Ignition Tables	O 3 aGatar	Equite read position
Other Functions	0 1 eGate integrated	EGate goes to rest position when TPS is
⊕- Internal datalogger	O 2 eGates integrated	20 * %
Idle speed control		
Deceleration cutoff	Control type	Mode
- Rev inter	Time based after validated launch	 Exed position
Thermatic fac. #1	Gear and engine RPM	Position x RPM table
- Hermocrarer	Gear elapsed time	Rest position (opening %)
- Huerpump	 Single target value Wastegate 	50 ‡ %
Generic outputs	7.25 👙 psi	
Anti-lag / Pops & Bangs / Engine brake	Engine RPM	
Gear Control Management	O Reference crossed	EGates offset Offset percente
Compressed air control	O Reference speed	Enabled eGate #1 is the
Electronic wastegate control		0
MAP target pressure overall trim	Launch targets	Boost+ scramble button increase
- Time based after 2step target table	2-step target	L Enabled
Flow percentage by opening position - Wastenate #1	0.00 🖶 psi	7.25 🔹 p
The second of the second	3-step target	Boost+ button activation mode
- How percentage by opening position - wastegate #2	7.25 🌩 psi	 Activated at 0V
Drag Race Features		O Activated at 12V
Engine Settings	Burnout target	
Sensors and Calibration	v Pr	Enabled
- Inputs	Pre-Launch target	14.50 ‡
MAP	0.00 🐳 psi	
NOTE		

This function is available to FT550 and FT600 only.

General configurations

Select the actuator configuration, if for 1 or 2 e-gates, if they are integrated.



E-gate setup

eGate offset: this is for when using two e-gates, compensating any backpressure offset between the two engine sides.

eGate config 4/16							
eGate off Offset percenta	fset ge		offset pe	ercentual			
eGate #1 is the reference			%				
×				\sim			

Rest position: set the minimum TPS for the eGate go to rest position. This percentage can be either fixed or by rpm.

Rest position opening: set a valve opening percentage for the rest position. This percentage can be either fixed or by rpm.







Boost+ button: Will increase or reduce the boost target when pressing the button.



Set the e-gate outputs.

	eGate config 14/16	5	>	eGate config 15/16				
	Test output: Test				Test outpu	t: Test		
Se	lect the output for eGate #1+	motor			Select the output	for eGate #2+	motor	
None		-		🔵 None				
Yellow 1: Ava	aliable			Yellow 1	: Avaliable			
Yellow 2: Ava	aliable		-	Yellow 2: Avaliable				
• Yellow 3: Ava	aliable			Yellow 3: Avaliable				$\boldsymbol{\boldsymbol{\boldsymbol{\boldsymbol{\boldsymbol{\boldsymbol{\boldsymbol{\boldsymbol{\boldsymbol{\boldsymbol{\boldsymbol{\boldsymbol{\boldsymbol{\boldsymbol{\boldsymbol{\boldsymbol{\boldsymbol{\boldsymbol{$
		<i>.</i>		~				•
X		\sim		- X			\sim	

Targets by function

Set a individual boost target for each function: Boost target for 2-step, 3-step, burnout, pre-launch and one boost target for anti-lag/ pops&Bangs/engine brake.

Targets by	function 1/3	Targets by	function 2/3
2-step target	3-step target	Burnout target	Pré-Launch
0.00 bar	0.50	1.00 ×	0.00 ×
×	· · · ·	×	·····
	Targets by	function 3/3	
	Anti-lag/Pops&Bangs/E	ngine brake boot target	
	1.00 bar	< >	
	×	\checkmark	

Main targets

The eGate control can operate with target by time after validated launch, gear and engine RPM, gear elapsed time, engine RPM, reference speed or just use a single target.

〈	Electronic wastegate co	ontrol	<	e	Gate Map	1/12		>
	General configuratio	ns		me based alidated la	l after unch		Single target	
	Targets by function	n	G	Engine RPM				
Main targets				Gear elapsed By reference				
	Overall trim	tii	ne .			speed		
×		\checkmark	×				\checkmark	

Overall trim

This adjustment is for quick decrease or increase the boost pressure. It changes according to the last screen.



19.34 eGate Important Information

The eGate is the evolution of boost control, with the electronic wastgate your project is simplified.

FuelTech sells two models, 45 and 60mm valve. To control the eGate a FT Dual Power Driver (FTDPD) is needed.



eGate wiring

Wire	Goes to
Large gauge Red	Motor A tending towards 0% (goes to FT DPD blue wire)
Large Gauge Black	Motor B tending towards 100% (goes to FT DPD white wire)
	Multi Core Wire
Red	5V
Black	Ground for sensors (green/black)
White	Position Signal 0-5V (goes to a FT white input)
Orange or yellow	Temperature Signal 0-5V (goes to a FT white input)
Blue	Not used



19.35 eGate #1 and #2 position calibration

Once the inputs are selected, the calibration is needed, adjusting the valve opening and closing limits.

There are 2 ways to calibrate:

Manually: Same steps as for TPS calibration

Automatic: At FTManager go to "Sensors and Calibration/Inputs" and select the position Input for eGate #1 and #2 (if using two)



Once the input is selected click on "Calibrate sensor" for eGate position sensor calibration. A calibration screen will pop up, just click "Calibrate auto" for the automatic calibration process.





<	Position eGate #1 1/4	<u>></u>	<	Position eGate #1 3	3/4			
	Manual Calibration		Sensor decreases voltage when opening the valve					
	Automatic Calibratior	ı	S v	ensor increases vo when opening the	oltage valve			
×		\checkmark	×		\checkmark			
		Position eG	ate #1 4/4					
		Rea 4.9	ding 9V					
		Positio	on 0%					
		0.0	00V					
		Positior	n 100%	Calibrate				
		0.0	00V					
	×			\checkmark				

19.36 eGate #1 and #2 temperature

This sensor gives the eGate internal temperature, to utilize this sensor a white FT input should be connected to the yellow or orange eGate wire.





eGate installation diagram

- 1 Input #1 Red wire from FT DPD (connected to a ODD yellow output (#1-3-5-7) of the PowerFT ECU **EGate Motor+**)
- 2 Input #2 White wire from FT DPD (connected to a EVEN yellow output (#2-4-6-8) of the PowerFT ECU **EGate Motor-**)
- 3 Blue output from FT DPD connected to the eGate red wire (Single core EGate Motor+)
- 4 White output from FT DPD connected to the eGate black wire (single core EGate Motor-)
- 5 Red from eGate multi core wire connected to the 5V output (green/red wire) of PowerFT ECU
- 6 Black from eGate multi core wire connected to the Ground for sensor (green/black)
- 7 **Position** White from eGate multi core wire connected to the white input of PowerFT ECU (Position signal)
- 8 **Temperature** Orange from eGate multi core wire connected to the white input of PowerFT ECU (Temperature signal)
- 9 Blue from eGate multi core wire Not Used
- 10 Connection for **gray outputs** it is necessary to use a 10K 1/4W resistor in each output
- 11 10K ¼W resistor



NOTE

If yellow outputs #1 or #2 are used it is necessary to use another pair of outputs.



IMPORTANT

To use a gray output to drive the FT DPD, it is necessary to install a 10K 1/4W resistor in this output.



Diagram yellow outputs



Diagram gray outputs





19.37 Control by external reference

This function allows ignition and ETC bypass, through reading from the stock ECU when it is working in parallel with FT ECU.

The FT white inputs will get the data from the stock ECU (ECM) and either replicate at the engine the same data it is reading, or apply the tune configured at FT ECU, by user's choice.

This function is usually configured to mirror the data from the stock ECU when idling and low load, so the stock ECU won't detect any anomalies.

ETC bypass requires:

- An electronic throttle body plugged to the stock harness, controlled by the stock ECM but not installed at the intake manifold (external throttle). This is only for FuelTech reading.
- Have a second Throttle body installed at the intake manifold and connected to the FuelTech ECU
- Set up the Throttle body controlled by the stock ECU as "*External Throttle*"

For ignition bypass just set up the white inputs as "*Ext. Ignition Timing* X". This wire must be connected to the ignition signal wire at the cylinder in the firing order. The stock ECU signal (not controlling the ignition timing at the engine anymore) is read by the FT ECU.





External throttle (SENT protocol) 1/2		External throttle (SENT protocol) 1/2						
Input selection			Reading					
None	^		4.99V					
White 1: Avaliable			Position at 0%	_				
White 2: Two Step			4.99V Ca					
White 3: Air Conditioning			Position at 100%					
White 4: oil pressure	>	4.99V Cal						
X	/	×		 				

FT450 / FT550 / FT550LITE / FT600



Operation

Select the operation method from the options below, defining when to replicate the stock Throttle position and ignition timing received from the stock ECU and when to switch to the FT control.

Settings:

Follow external reference under RPM: select the RPM witch FuelTech ECU will kick in, bellow this RPM FuelTech will replicate stock ECU behavior.

Follow external reference under MAP: select the MAP witch FuelTech ECU will kick in, bellow this MAP FuelTech will replicate stock ECU behavior.

Follow external reference under TPS: select the TPS witch FuelTech ECU will kick in, bellow this TPS FuelTech will replicate stock ECU behavior.

The timing and throttle control will only be made by FT ECU if **all parameters are validated**, otherwise the control will be made by the stock ECU (FT ECU mirroring)

Example: If RPM and MAP are above the determined value, just TPS is still below the determined value, the control will be made by the stock ECU.



19.38 PWC Controls

These features help with the handling of Yamaha and Seadoo watercraft. It is necessary to have the CAN network correctly configured according to the brand and model for these configurations to work.

Quick access panel	PWC Controls	
📉 Other Functions	^ No Wake mode	Speed and acceleration limiter
Internal datalogger	Enabled	Enabled
Idle speed control	Activated by 0V	Throttle opening limit
Rev limiter	O Activated by 12V	Mode 1
Air conditioning	Additional Throttle position at No Wake mode -	10 🔹 %
Start button	4.0 ‡ %	Mode 2
Generic outputs		20 🜩 %
 Variable camshaft (VVT) 	Throttle opening limit at reverse	Mode 3
- Automatic Transmission Control	15 🜲 %	30 🐳 %
- Lockup control	ATTENTIONI Carefully adjust this value to avoid	For correct operation, it is pecessary to enable
Gear Control Management	damaging the reverse/neutral system.	packet reception via CAN communication menu, by color-ting the PMC model in the CAN OEM
Compressed air control	Acceleration delay when leaving neutral	menu
- Electronic wastegate control	Enabled	
Control by external reference	Delevities	
Tach output	0.5 ÷ s	
PWC Controls	Feature only compatible with	
Frequency Control	Yamaha RiDE	

No Wake mode: The function is activated by the input of the No Wake button that can be activated by OV or 12V, when the input is activated the electronic throttle will open as set.

Maximum throttle opening in Reverse: This percentage will limit the throttle when in reverse gear. Gear detection must be selected by the PWC steering control. Be careful not to use too high values, as it can damage the reverse system.



19.39 Frequency control

This feature reads frequency through a white input and repeats its signal at an output. Using its tables, the output frequency can be modified as needed.

Using the auxiliary tables, it is even possible to limit the output frequency by RPM, MAP or TPS, which makes it act similarly to a clamper.

	Sensor input and outy Input (Hz) 3818 3570 3352 3222 3133 3028 22945 2849 2795 2849 2762	Input 0.8 1.1 1.5 2.1 2.5 2.9 3.4	Output 0.8 1.1 1.5 1.8 2.1 2.5 2.9	Output (Hz) 3818 3570 3352 3222 3133 3028	Filter 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Output % Diff 0.00 0.00 0.00 0.00 0.00	^		
Other Fanctions Default database Default database A control A control A control A control A control B cont active database Fan Japane Doots active database Fan Japane Waterpane Boots Control Fan Japane Pan J	Input (Hz) 3818 3570 3352 3332 3222 3133 3028 2945 2849 2762 2762	Input 0.8 1.1 1.5 1.8 2.1 2.5 2.9 3.4	Output 0.8 1.1 1.5 1.8 2.1 2.5 2.9	Output (Hz) 3818 3570 3352 3222 3133 3028	Filter 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Output % Diff 0.00 0.00 0.00 0.00 0.00	^		
bitment divelopge bits genet control	38 18 1570 3352 3222 3133 3028 2945 2849 2762	0.8 1.1 1.5 1.8 2.1 2.5 2.9 3.4	0.8 1.1 1.5 1.8 2.1 2.5 2.9	3818 3570 3352 3222 3133 3028	2 2 2 2 2 2 2	0.00 0.00 0.00 0.00 0.00 0.00			
Ide speed control Thematic fan #1 Aer conditioning Pool pump Boost activitied output #1 Wattegate Boost Control Sant button PM activitied output	3570 3352 3222 3133 3028 2945 2849 2752 2849	1.1 1.5 1.8 2.1 2.5 2.9 3.4	1.1 1.5 1.8 2.1 2.5 2.9	3570 3352 3222 3133 3028	2 2 2 2 2 2	0.00 0.00 0.00 0.00 0.00			
- Thematic for #1 - Ar conditioning - Pool pump - Boord activated output #1 - Wathyade Boot Control - Start button - RPM activated output	3352 3222 3133 3028 2945 2849 2762 2760	1.5 1.8 2.1 2.5 2.9 3.4	1.5 1.8 2.1 2.5 2.9	3352 3222 3133 3028	2 2 2 2	0.00 0.00 0.00			
- Air conditioning - Rull pump - Boost activated output: #1 - Watergate Boost Control - Start button - RPM activated output	3222 3133 3028 2945 2849 2762	1.8 2.1 2.5 2.9 3.4	1.8 2.1 2.5 2.9	3222 3133 3028	2 2 2	0.00			
- Fuel pump - Boost activated output #1 - Wastegate Boost Control - Start button - RPM activated output	3133 3028 2945 2849 2762	2.1 2.5 2.9 3.4	2.1 2.5 2.9	3133 3028	2	0.00			
- Boost activated output #1 B- Wastegate Boost Control - Start button - RPM activated output	3028 2945 2849 2762	2.5 2.9 3.4	2.5	3028	2				
Wastegate Boost Control Start button Revealed output	2945 2849 2762	2.9 3.4	2.9			0.00			
RPM activated output	2849 2762	3.4		2945	2	0.00			
RPM activated output	2762		3.4	2849	2	0.00			
 RPM activated output 	200	4.0	4.0	2762	2	0.00			
	2000	4.8	4.8	2660	2	0.00			
- Map selection by button	2584	5.5	5.5	2584	2	0.00			
- Generic outputs	2423	7.7	7.7	2423	2	0.00			
Automatic Transmission Control	2341	9.2	9.2	2341	2	0.00			
Electronic wastegate control	2272	10.7	10.7	2272	2	0.00			
- Control by external reference	2191	12.8	12.8	2191	2	0.00			
- Tach output	2125	14.8	14.8	2125	2	0.00			
- PWC Controls	2051	17.7	17.7	2051	2	0.00			
Energy Control	1991	20.4	20.4	1991	2	0.00			
Central In DDM	1918	24.6	24.6	1918	2	0.00			
Control by RPN	1857	28.7	28.7	1857	2	0.00			
- Control by IPS	1791	34.1	34.1	1791	2	0.00			
- Control by MAP	1738	39.6	39.6	1738	2	0.00			
Drag Race Features	1676	47.3	47.3	1676	2	0.00			
Engine Settings	1626	54.8	54.8	1626	2	0.00			
- Engine setup	1521	76.0	76.0	1521	2	0.00			
- RPM signal	1420	105.6	105.6	1420	2	0.00			
- Cam sync signal	1327	146.3	146.3	1327	2	0.00	~		
- Ignition	Number of rows in t	he table 33		Fill values					

Input (Hz): enter the values that will be read by the white input Input: enter the value corresponding to the reading you want (example MAF reading in g/s)

Output: fill in the values that you want to be sent in the output of the function. If you want to change the value, just fill in the desired value or fill in the same input value to just repeat what the function read from the sensor.

Output (Hz): is the frequency value, calculated by the software, which will be sent at the output of the function.

Filter: digital filter to improve the output signal and eliminate unwanted variations (Example of a MAF sensor that can have its signal affected and vary at idle and low load situations due to the addition of a turbocharger).

Difference % output: calculation made by the software to simplify the view of what has changed between input value vs output value.







19.40 Water pump

This function was developed to control an external water pump, necessary for electrified cars where there is no provision for a belt driven water pump



Reference temperature: Specifies the required temperature source to turn on the water pump; inverter temperature, electric motor temperature or traction battery temperature

Enable by temperature: Adjust the minimum and maximum range of temperature to turn on the water pump output.

Mode: Set the output trigger that will activate the control.

Force output: This option force activates the water pump as soon as the inverter is activated, regardless of the configured temperature.



19.41 Vehicle lights control

This function was developed for electric vehicles to activate the brake and reverse lights.

Brake light by pedal: when pressing the brake pedal on electrified vehicles, the battery pack regeneration system will enable.

Adjust the percentage values for the start and end of the battery pack regeneration system. Requires either a brake activation switch or a brake pressure sensor to enable the function.





Reverse light: Set the output that will activate the reverse light when enabling Reverse in the VCU.

<	Vehi	cle lights co	ontrol 6/8	· · · · ·		Vehicle lights control 7/8							
	Disabled Enabled						Test output: Test						
					Select reverse light output								
						Blue	7: Avalia	able			<		
Reverse light						Blue 8: Avaliable							
						🔘 Gray 5: Avaliable							
						Gray	6: Avalia	able			>		
>	۲.			\checkmark		>	〈			~	•		



32.00 ÷ s

Output signal

Activated at 0V

Activated at 12V

19.42 Power brakes control

Quick access panel

🗄 - Internal datalogger

This function was also developed for electrified vehicles, it is required to create a vacuum for the brake pedal as there is no mechanical production of vacuum. After the function is activated, it is necessary to configure the brake vacuum input, define the sensor type, adjust the sensor offset if necessary and configure when the brake vacuum booster will activate and deactivate.

> Servo Brake Servo Brake

Sensor type

Always enabled: the relay is activated after turning on the ignition key. In this case, it is MANDATORY that the option "Disable output when pressed - Start button - Shutdown" is checked. Otherwise the ECU will not turn off.

Timed: When turning on the module, the relay is activated for a defined activation time, after which the relay is deactivated and the ECU is turned off, returning to activation when it detects an RPM signal.

During starting: the relay remains activated while in cranking and the desired time after the engine is running.



Diagram for connecting a Jet Ski with 1 Start/Stop button



Configure, if necessary, a time in which the brake servo will be active after the brake pedal is released.



19.43 Timed main relay

This function activates a timed output when turning on the ECU to activate a main relay, normally controlled by the original ECU.

The function working: it is activated in parallel after as the ECU receives 12V power, in this case it is necessary to use a diode (1N4007) between the positive of the start button and the 12V of the ECU. (See diagram below).

19.44 Electronic Blow Off control

This function is dedicated for controlling 2-wire electronic blow-off valves. It is based on the TPS variation to be activated.

Activate with Delta TPS variation: Minimum TPS variation rate to activate the valve opening. This variation is negative because it is the closing of the throttle that activates the opening of the valve.

Deactivate with TPS variation: Minimum positive variation rate to close the valve again. This variation is positive because it happens with the opening of the throttle.

Minimum MAP: Minimum turbo pressure above which valve opening will occur.

Maximum activation time: Maximum time that the valve remains open. The valve closes instantly if the TPS reaches the deactivation range, regardless of time.

Always activate: This function keeps the valve open in the following conditions: Idle, 2-step and 3-step.

Output activation mode: By OV or 12V (yellow outputs)

Quick access panel **Electronic Blow Off Control** PWC Control Output activati - Frequency Control Activate with TPS variat Control by RPM (Negative Delta) faster than -20.0 ÷ %/s Control by TPS Control by MAP The valve is activated when TPS is closing, when the delta TPS (variation per second) is negative - External TCU contro - Electronic BlowOff contro Deactivate with TPS variation: (Positive delta) faster than: 20.0 - %/s Timed main relay - Water methanol injection (WMI) WMI PWM curve by MAP es of percentage change per When the TPS opens (positive values second) the value is deactivated. PWM Compensation by engine temp PWM Compensation by air temp Minimum MAP for activation PWM Compensation by EGT temp PWM Compensation by O2 targe 0.00 psi Fuel compensation by MAP Maximum activation time Fuel compensation by %PWM Ignition compensation by %PWM 5.0 ÷ s RPM ignition compensation



19.45 External TCU control

This function was developed to suit DSG gearboxes (DQ500 and DQ250).



IMPORTANT

- To use this function it is necessary to perform an gearbox remap!!!
- The function does not work with gearboxes that have an electronic park brake.

Pinout DQ250

- 1 K-LINE: diagnostic pin, pin available only on gearboxes with older mechatronics.
- 10 CAN HIGH
- 11 12V Battery (30A)
- 13 12V switched (15A)
- 15 CAN LOW
- 16 Ground
- 18 12V Battery (30A)
- 19 Ground

Pinout DQ500

- 2 12V Switched (15A)
- 6 CAN HIGH
- 7 CAN LOW
- 9 12V Battery (30A)
- 16 Ground





Functions necessary for the correct functioning of the DSG gearbox

It is necessary to activate several functions for the DSG to working correctly. Below is the list.

- External TCU control
- Advanced gear shift management
- Gait detection
- Fuel consumption control

Remap

To function works correctly, it is recommended to remap the gearbox, disabling any errors that occur.

The RPM, gear shifting speed, gear pressure and kickdown can only be changed directly in the gearbox TCU via Remap.

To carry out Remap, we recommend looking for specialized workshops.

Mandatory sensors

For the DSG to works correctly it is necessary to have some sensors connected to the FuelTech.

- Rotation
- Engine temperature
- TPS
- Brake Pedal
- Wheel speed

Optional:

- Paddle Shift (connected directly to the FT ECU)



Configuration in FTManager for FuelTech ECU

- 1. Enable the necessary functions in FTManager.
 - External TCU Control
 - Blip/Heel and toe
 - Gear control Management
 - Gear detection
 - Fuel consumption control



2. Access the "CAN Communication" function, select the CAN B port and set it to "OEM CAN".

Click on the menu in the sidebar "OEM CAN" and select the External TCU - DSG option from the list





3. Acess the menu "Other functions / External TCU Control" and configure the function.



Vehicle has ABS module installed: this option allows you to obtain the speed through the ABS sensor (only for Audi 8L/8P, Golf Gti Mk4/4.5).

Send simulated speed: This option must be selected when the vehicle does not have a wheel speed sensor installed in the gearbox. This option is recommended for drag cars with DSG.

Enable diagnostic messages: allows you to record DSG log channels such as: clutch pressure, oil temperature, among others.

Torque control

Fixed torque calculated by ECU: This option allows the FT to calculate torque. For this calculation to be correct it is necessary to have the following parameters configured correctly.

Injector flow in the "Engine Settings / Fuel injection " menu. Fuel flow in the "sensors and calibration/fuel consumption control" menu BSFC in the "engine settings/engine setup" menu.

With these parameters correctly configured, the ECU will estimate the torque and send it to the DSG to control clutch pressure and gear change.

Maximum gearbox torque: it is a torque limiter for the DSG, the value placed in this field will be the gearbox operating limit.

Torque table: This option uses a table that must be configured in percentage of torque, where 0% will be 0Nm and 100% will be the gearbox torque limit.

Gerar Model	Torque Limit
DQ250	630Nm
DQ500	800Nm



4. Access the "Sensors and Calibration/Gear change Detection" function and select the "External TCU" option





Others functions

5. In the "Automatic transmission range selector" function, select the "External TCU (OEM CAN)" option

uick access panel	Auto	omatic	transm	ission ran	ge selecto											
Sensors and Calibration																
- Inputs					1 D 2 D	1.04										
- MAP				. 0. 0												
- Traction type	Inpu	at signal	mode													
- Front wheel speed	0	Digital	Hultiple	inputs)				Analogic voltage level (Single input)								
- Rear wheel speed		Shifter i	nput setti	ngs				- 1	Shifter posit	ons analo	g level (Volt	0				H
Drive shaft EPM			Input A	Input B	Input C	Input D	Calibrate	11.1	P R	0.0	0.0 0.0	0.0		0.0	0.0	è
locut shaft DEM							Calibrate	-11 5								
8 - 1							Calibrate	0.00 C v								
TUPDO Speed Kitte							Calibrate	-								
- Fuel now sensor			0	0	0	0	Control	- 0	O Duty Cycle (PWM)							
- Gear change detection									Duty cycle p	er positor	1 (%)		1	1	-	ł
 Automatic transmission range selector 									PR	N	DM	1	2	3	4	
- Padde shift								11 1	0.0 0.0	0.0	0.0 0.0	0.0	0.0	0.0	0.0	1
- Drake									Detection	indow fo	r next positi	n				
- Fuel consumption control											4.0 -	15				
- CAN communication		Shifter s	witch A a	ctivation mod	le — Shi	lter switch Cad	tivation mode	- 1	PWH signa	Imode						
- GEM CAN		O Activ	ated by OV		0	Activated by OV			O Normal							
E-EST CAN		O Activ	ated by 12			Activated by 12V			O Inverte	1						
FGT-4 A		Shifter s	witch B a	ctivation mod	le Shi	ter switch D as	ctivation mode	_ 0	CAN 2.00							
07.48		O Activ	ated by OV		0	Activated by OV		0	External T	U (CAN	OEM)					
		O Activ	ated by 12			Activated by 12V										

6. Access the "Other functions / Blip/Heel and toe" function and configure the control to use Gear control Management (GCM).



7. The last step is to access the "Gear Control management" function and select the "FTCAN 2.0 (External TCU) option and check the check box "Activate Blip/Rev match function"

Quick access panel	Gear Control Management											
💥 Diagnostic Panel												
Fuel Tables	Gear shift command	Upshift Doe	nshift									
Imition Tables	C Hanua packe shitt and automatic by KPH	Automatic gear shift by engine RPM										
Calculation of the second seco	access the Padde SMt	Automatic upshift by RPM										
EX OUR FUTURE		Upshift R	91									
E- treenal oacaogger	 Automatic transmission control 	$1 \rightarrow 2$	$2 \rightarrow 3$		$4 \rightarrow 5$				$8 \rightarrow 9$	$9 \rightarrow 10$		
 Individual channel options 	FTCAN 2.0 (External TCU)	8000	8000	8000	8010	8000	8000	8000	8000	8000	RPM	
 Individual digital channel options 	 Strain gauge 	Minimum TPS for increment										
- Individual math channel options	 Analog gear lever sensor 	10.0 b m										
- Idle speed control	Gear lever direction					<u></u>						
- Deceleration fuel cut-off	O Increase in voltage – Increase	Power redu	ction									
- Rev limber	Increase in voltage = Reduction	Enabled										
- Shift light	Power re	duction del	ay after		Cut mode			Ignition timing				
- Generic outputa	Enabled	oother s	0.010				O Ignition O Nain				ignition table	
Electronic field and true	0.00 0					O Fo	al Ignition		Pixed			
Throuth a closing for concluit	Neutral return only with Interfork button	Power re	duction dur	ation								
We water and a first data with the	With this policy analysis if a possible to	1-2	2 -> 3	3→4	4→5	$5 \rightarrow 6$	6 → 7	7→8	8 9	9-+ 10		
- Infotoe opening for downshift	dorwshift from 1->N or upshift from	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	0.150	6	
- Gear Control Management	requiring Padde Shift buttors.	Tonition	Ignition timing during power reduction									
 External TCU control 		1-2	2 3	$3 \rightarrow 4$	4-+5	5-16	6 → 7	7→8	0 → 9	9-10		
 Torque by MAP 	Strain gauge configuration	0.0	0.0	0.0	0.0	0.0	-40.0	-40.0	-40.0	-40.0	0	
Drag Race Features	Direction	Vestilizer										
Engine Settings	O Regular (5V to the front)	Ignition cut during power reduction										
- Engine setup	 Reverse (0V to the front) 	55	55	55	55	55	20	20	20	20		
 RPM signal 	Gear shifter sensor trigger voltage levels						_					
- Can sync signal		after t	le next per	op power ir is detect	reduction d ed	uración						
- Fuel Intection	Backwards shift											
PedalThuttle	1.00 ¢ V					Upshi	ft protectic	45				
Ide actuality	Forward shift					Dea	ctivate por	ver reduct	on with TP	5 below		
C. Inside and shard	4.00 ¢ V									10.0 -	%	
E space ca cae	Genr shifter server cale	5				Dea	ctivate por	ver reduct	on with RP	11 below		
- Lives table by Pail- and Voltage	1500									2000 💠	R.511	
- Wiring harness diagram		-				Exter	eal TCU - A	chote por	and and a state	on shows		
- Map options	Activate the Blip/Rev match function					exter		comme por	ici icobeei		0.0	
- Advanced map options	Activated									60	(F)	
Sensors and Calibration	Activates both the upshift and downshift											

After following out these steps, the DSG control will be working. If you have any questions, please contact our technical support.

19.46 Water methanol injection (WMI)

The function controls a mechanical injection system of a mixture of water and methanol into the intake manifold.

The control works through a pump and solenoid, based on PWM curves and temperature conditions, and applies ignition and fuel corrections.

FT450 / FT550 / FT550LITE / FT600

Quick access panel	Water and methanol injection (WMI)		
🖤 Diagnostic Panel			1
Turi Tables	Enable WHI function	Pre launch actuation	WHI fuel compensations
Tractico Tables	C Always enabled	2-step	0.00
Other Lunching	O WHI switch	3-step	
di tanun di dadi nun	O Dashboard switch	Burnout	Off delay
 anema oscaogger 	U CAN 2.0	WHI PWH for pre launch	
 Idle speed control 	CAN	60 🗘 👒	Off ramp
 Deceleration fuel cut-off 	O NanoPRO	Fuel enrichment for pre launch	0.00 -
- Rev liniter	O SwitchPanel	0.0 - %	WHI Ignition compensations
- Shift light	Button channel via CAN	Timing retard for per launch	ON delay
- Generic outputs	SWILCIPATIE-6 · · · · ·	0.0 0	0.00 🚖 s
Bip / Heel and toe	Input activation mode		OFF delay
- Gear Control Management	 Activated at 0V 	Total time to return PWM control	0.00 + s
External TCU control	 Activated at 12V 	100 A	OFF ramp
Water methanol intection (NIMI)		1.00 - 5	0.00 + s
WW first and the WW	Control type	Base DC for PWM control return 60.5 st	
	O by air temperature		Pump output WHI (PWH)
- Pwith Compensation by engine temp.	O by Time	Progressive outred by TPS	PWH frequency 25 * un
 PWM Compensation by air temp. 	O by HAP	C Enabled	
 PWM Compensation by EGT temp. 		TPS for 0th of Whit	Output signal
 PWM Compensation by O2 target 	Safety conditions	10 0 %	 Activated at 0V
 Puel compensation by MVP 	Minimum air temperature to activate:	The fact there is what	 Activated at 12V (Only w/ Yellow outputs)
- Fuel compensation by %PWM	Enabled (Coltarian	60 C %	Solenoid output (ON/OFF)
- Jgnition compensation by %PWM	138 🔤 🕂		Output signal
RPM ignition compensation	Minimum engine temperature to activate:	form on with TPS over 60 * %	 Activated at 0V
Drag Race Features	132 4		C Activated at 12V (Only w/ Yellow outputs)
Toping Settings	122 y T		
Engline celture	Minimum EGT temperature to activate:		
2004 storage	602 A 16		
NYI SIDIA			
- Can sync signal	Disable output by fuel level sensor		
- Puel injection	Enabled		
- Pedal/Throttle			
- Idle actuator	Minimum RPH 2000 + som		
Ignition coll dwell	1000		
- Dwell table by NAP and Voltage	Maximum RPM		
- Wiring herness diagram	4000 🔶 RFM		

Enable WMI function: there are four options for activating the function, always enabled, WMI switch, Dashboard switch or CAN 2.0.

Control type: Select the type of WMI drive control, there are four options by air temperature, by EGT, by time or by MAP.

Safety conditions: Enable which conditions will be used for control, adjust the minimum and maximum RPM for the function to be activated.

When selecting the option "Disable output by fuel level sensor" it is necessary to configure an input as "WMI - Tank level".



Pre launch actuation: Determines whether the function will be activated in pre launch conditions, the enrichment in % of injection and the timming delay.





Total time to return PWM control: Adjusts the PWM activation ramp, through the ramp time and the PWM at which the ramp will start.



Progressive output by TPS: If enabled, determines a minimum and maximum TPS value for gradual TPS activation. If disabled, it follows a minimum TPS value for full activation of the function (On-Off).



Fuel compensations: adjusts the delays for starting and stopping the compensation, as well as the ramp time to reset the compensation.



Ignition compensations: Adjusts the delays for starting and stopping the compensation, and also the ramp time to reset the compensation.



Pump output WMI (PWM): Adjusts the PWM drive frequency for the WMI pump and the output voltage.

Solenoid Output: Determines the output voltage to the solenoid.

K Wate	er Methanol Injection 2	2/25	K Wa	ter Methanol Injection 25	5/25
PWM Frequ	Nency WMI pum	ip output (PWM) tivated at 0V ivated at 12V	Edi	ting of WMI tables avali nly in FTManager softwa	able are
×		\checkmark	×		\checkmark



20. Drag race features

This menu gathers all options normally used in drag race applications. All the time based features start after releasing the 2-step button which indicates the moment when the vehicle launched.

20.1 Burnout mode

The Burnout Mode is a function used to facilitate the processes of warming up the tires and using the two-step.

When pressing the two-step button, the two-step function is activated.



When Burnout mode is activated, it disables the standard RPM Limiter, instead the ECU uses this RPM limiter as the engine's RPM limit.



But when the two-step button is being pressed, the value considered is the one set for the two-step parameter. The values adopted for ignition timing retard and enrichment are the ones configured on the two-step function.

There are 3 different ways to enable the burnout mode:

• By dashboard button: a touchscreen button in the FT dashboard enables the function.

- By an external button* a white input is required. One click to enable and another to disable the burnout mode.
- By an external switch* similar to the button, but in this case the function is enabled while the input is grounded.

* In the FTManager, this setup is at "Sensors and calibration" - "Inputs" The burnout mode can be automatically disabled by RPM. When the engine RPM is below an editable value. This option is not available for "external switch" option.



20.2 3-step (boost spool)

The 3-step is quite similar to the 2-step function, however, with more aggressive strategies to assist in the boost spool.

3-step / boost spool / roll start	
Activation method 3-Step button Auto ON with 2-step (until reach boost)	Min TPS to active timing retard and fuel enric Enabled 60.0 %
Input activation Activated at 0V Activated at 12V Operation mode Fixed RPM Roll start	Timing ○ Timing table for rev launch ● Fixed Fixed timing 0.0 ♦ ° Fuel enrichment 20.0 ♦ %
3-step enabled until pressure 29.01 psi RPM for limiter 7000 RPM Start compensation X RPM before 1000 RPM	Lock above Lock above S000 RPM
3-step / boost spool / roll start 1/7 Disabled Disabled Automatic activation uses the same trigger as 2-step (button or speed) automatically which to 2-step particular such to 2-step particular such to 2-step particular which to 2-step particular such	3-step / boost spool / roll start 2/7
×	× · · · · · · · · · · · · · · · · · · ·

There are two ways to activate this function, one uses an external button (must use a white wire attached to a button, usually on the foot brake) and the other is through 2-step button.

In this case, you must press the 2-step button and the 3-step will be activated until the engine reaches a predefined boost pressure, at this point the 3-step will be deactivated and the 2-step will be activated. If using an external button to trigger the 3-step, when it is triggered simultaneously with 2-step button, the 2-step will prevail.



It is possible to start the 3-step mode before the RPM rev limiter and to set a minimum TPS value to activate it.



20.3 2-step rev limiter

The two-step active with a retarded ignition timing, and a mixture enrichment given in percentage (also programmable).



It is possible to set the ignition cut maximum level, that is the percentage of ignition events cut to keep the engine under the rev limiter.

The RPM progression range acts as a smoothing for ignition cut. Example: rev limiter at 8000rpm, RPM progression range at 200rpm.

From 8000rpm the ignition cut level will gradually increase until it reaches 90% cut at 8200rpm.

Percentages less than 90% may not keep the engine under the rev limiter. Bigger RPM progression range tend to stabilize more smoothly the rev limiter, but allows the RPM to pass the RPM set as rev limiter. These numbers are valid to all kinds of ignition cut, with the exception of time based compensations (time based RPM and driveshaft RPM/ wheel speed) and 2-step. These features have their own parameters. For inductive ignition systems it is recommended to use 90% maximum

level and 200 RPM progression range. For capacitive system, like MSD, it is recommended to use 100% maximum level and 1 RPM progression range.

The "Start compensation X RPM before" helps to spool the turbo and have a more stable rev limiter.

The minimum TPS to activate timing retard and fuel enrichment allows the driver to hold the engine in the rev limiter without any compensation when not needed.

The time based compensations will only work after the release of a valid 2-step. This means hold the 2-step button with more then 50% TPS or reach the rev limiter on time at least.

A maximum electronic throttle opening can be set, allowing the driver to launch with the pedal to the floor while the ECU controls the maximum position of the throttle to aid in getting standardized launches.

Another option for the 2-step activation is to use a signal directly from a sensor. In the case of an air temperature sensor (which we recommend), a button is wired in parallel to the sensor wire, and when the button is pushed the signal is grounded. Once the signal is grounded, the ECU will read the maximum sensor temperature, which can be configured as the value for activation of 2-step.

WARNING

When the 2-step is by wheel speed, its working can be checked through the first page of Diagnostic Panel, since it is not being used any 2-step button input.



To prevent the driver to activate the 2-step on a run, there are 2 safety parameters. Block 2-step by time or by RPM. This way, even if th driver press the 2-step button, it will not activate before the time slip or above the RPM.

When using the 2-step by an input sensor, you must indicate an above or below value which the 2-step must be considered active.

2-Step warning LEDs

2-step without valid launch condition: Yellow
2-step with valid launch condition (ign cut or TPS): Green Invalid launch: Red blinking for 5 seconds
Valid Launch: LED is turned off (it would be green until a valid launch)
2-step + staging control: Blue
Staging control button without 2-step: Purple
2-Step + 3-Step auto: White

Active function tables

The following tables show what will be the active function with the 2-step and 3-step combinations

		•
2-Step: Button	3-Step: Button	
Button 2-step	Button 3-step	Active function
Pressed	Pressed	3-step
Pressed	Released	2-step
Released	Pressed	3-step

2-Step: Button	3-Step: Auto	
Button 2-step	MAP pressure	Active function
Pressed	Lower than target	3-step
Pressed	Higher than target	2-step



2-Step: Speed	3-Step: Button	
Speed	Button 3-step	Active function
Lower than target	Released	2-step
Lower than target	Pressed	3-step
Higher than target	Pressed	3-step

2-Step: Speed	3-Step: Auto	
Speed	MAP pressure	Active function
Lower than target	Lower than target	3-step
Lower than target	Higher than target	2-step

2-Step: Sensor	3-Step: Button	
Sensor	Button 3-step	Active function
Active condition	Released	2-step
Active condition	Pressed	3-step
Not Active condition	Pressed	3-step

2-Step: Sensor	3-Step: Auto	
Sensor	Button 3-step	Active function
Active condition	Lower than target	3-step
Active condition	Higher than target	2-step

2-Step: CAN	3-Step: Button	
Button 2-step CAN	Button 3-step	Active function
Pressed	Pressed	3-step
Pressed	Released	2-step
Released	Pressed	3-step

2-Step: CAN	3-Step: Auto	
Button 2-step CAN	MAP pressure	Active function
Pressed	Lower than target	3-step
Pressed	Higher than target	2-step

When pressing the two-step button, usually installed on the steering wheel or driven by a launch control / transbrake switch, the system activates an ignition cut in a programmable RPM.

In the FTManager, this setup is at "Sensors and calibration" - "Inputs"



Clutch switch: for drag racing vehicles with manual transmission and clutch, this switch tells the ECU whenever the pedal is pressed. Connected to a white input.

This is an auxiliary feature to the 2-step and it helps releasing the 2-step at the same moment the clutch is being released.

If the clutch switch is pressed when the 2-step is deactivated, nothing happens, but, if the 2-step is active, then the clutch switch will hold the 2-step enabled until the clutch is released. The 2-step button

can be released after this that the 2-step feature will still be active. The 2-step button still works as usual. The clutch switch is fully optional.

Clutch switch electrical diagram

Connect the clutch switch to any white input and setup this input through the FTManager or through the screen. The other side of the clutch switch must be connected to the battery negative or chassis.



Line lock

Use a yellow output to control the line lock solenoid and setup this output as Line Lock through the FTManager or the screen. The other side of the solenoid must be connected to the battery negative or chassis.



20.4 Linelock Brake Control

This function allows the use of a line lock solenoid to keep the brake line of the trailing wheels pressurized and to facilitate the exit, avoiding that the pilot has to modulate the brake with the foot at the time of the exit. For correct use of this function press the brake pedal, operate the 2-step, release the brake pedal and the line lock will be activated. When you release the 2-step, the Line Lock solenoid is automatically disabled.

Select whether to activate the line lock on burnout, 3-step and / or 2-step modes.

An output must be configured as "Output line lock".

Brake pressure control: This function enables brake pressure control through a PWM curve. This is used to lower the brake line pressure to a desired value and standardize the launches.

It is necessary to have a white input must be setup as "Brake pressure" connected to a 1500psi pressure sensor.

Κ	Line lock br	ake cont	trol 1/5		>	نا 🖌	ne lock bral	ke control 2	/5	>
	Disabled Acior	namento	Enabled			Brake pre control	essure	PWM	frequenc	y
Burnoi	ut	~	2-step			Brake pressure Must be setup this function	sensor for	15 Hz		
×				 		×			\checkmark	•
<	Line lock br	ake con	trol 3/5		>	K Lir	ne lock brak	e control 4/	5	>
	PWM	table by p	ressure				Test outp	ut: Test		
							Select line	lock output		
Pressure		40	80	90		None				<
[, 54]					[%]	Blue 5: Avali	able			
PWM [%]			50	100		Blue 6: Avali	able			
_				1		O Blue 7: Avali	able			>
X				\checkmark		×			\sim	•







20.5 Timing table for rev launch

This timing table is only used for burnout mode, 2-step and 3-step. This is not a compensation table, but a table with absolute timing values, which ignores any other timing table or compensation.



20.6 Gear shift output

This feature allows switching on an external solenoid to shift the gears. The activation strategy can be either by a fixed RPM value for all the gears or different RPM for each gear just like the shift light feature.

Quick access panel	Gear shift output	
Other Functions		Vanna av
Drag Race Features	Automatic shift by RDM	Cinda valua
- Burnout mode	O Harrison and a state of the term	The stand of the s
- Timing table for rev launch	O Mandar opsnite input botton	7000 A RPM
- Gear shift output	O Automatic shift by KPM & Manual UpShift allowed	
Time based compensations	Upshift input button activation	Each gear
de Carlie Les Les des contractions	Active by 0V	Gear shift RPM
Conng one based compensations	 Active by 12V 	$1 \rightarrow 2$ $2 \rightarrow 3$ $3 \rightarrow 4$ $4 \rightarrow 5$ $5 \rightarrow 6$
- Wheele control	Look March Alexandron and Alexandron	2660 2900 3400 3900 4400 RPM
Engine Settings	Enabled	1→2 (Minimum gear time)
- Engine setup	0.60 5	Enabled
- RPM signal		2.00 🌲 s
- Ignition	Cutput mode	
- Fuel injection	O Single output	Power reduction during gear snitt
- Pedal/Throttle	O One output per gear	Descendanting defense from
- Idle actuator	Gear shift output duration	output activation
- Institute col charal	 Single pulse (Air Shift gearbox) 	0.00 ÷ s
Provell Adulta for MAR and Universit	Output pulse duration	Power reduction duration
- Divertable by INAP and Vokage	0.25 😴 s	$1 \rightarrow 2$ $2 \rightarrow 3$ $3 \rightarrow 4$ $4 \rightarrow 5$ $5 \rightarrow 6$
- wiring namess diagram	 Remain active (Lenco gearbox) 	150 150 150 150 150 ms
- Map options	 Each gear at a time (Liberty gearbox) 	Testites tisses during source adjustice
- Advanced map options	Last near activation time	$1 \rightarrow 2$ $2 \rightarrow 3$ $3 \rightarrow 4$ $4 \rightarrow 5$ $5 \rightarrow 6$
Sensors and Calibration	0.50 ÷ s	5.0 5.0 5.0 5.0 0
- Inputs	Output singal	
MAP	Activated at 0V	Ignition cut on power reduction
Traction type	Activated at 121/ (Only w/ Yellow outputs)	80 80 80 80 80 80 80
- Front wheel speed	Concounted at 124 (only w/ Tellow outputs)	
Rear wheel speed		Activate closed-loop power reduction duration according to part near detected
Drive shaft BPM		Text gear detected



Select the desired output, all the outputs will be displayed, except the ones used for injection and ignition. In the FTManager, this setup is at "Sensors and calibration" - "Inputs".

The gear shift by single value sends a signal every time the engine reaches the selected RPM. When using the each gear mode, each gear shift will be on its own RPM. To use this mode the gear detection must be activated.

The gear shift is enabled after the 2-step is released, so, after the last gear the 2-step must be activated again to perform the shifts again. When selecting this mode, the "First gear shift by time and RPM" will be available. It allows the gear shift to be performed not only by RPM, but also by time. This means that there are 2 conditions (time and RPM) to be met to gear shift. It is not possible to use this control with automatic transmissions with more than one solenoid.

These settings will define the lock time between shifts and the RPM in which they will happen. When the engine reaches the set RPM, the output will be activated and it will start counting the lock time. The shift into next gear will only happen after this time has passed and the engine reaches the defined RPM again.



It's possible to enable a power reduction during gear shifts, by setting it's duration, ignition timing and maximum ignition cut percentage.





This option enables a "variable duration" in the power reduction applied in the powershift feature, it will halt the power reduction as soon as it detects the shift into the next gear.



Select the outputs that will be used to activate the shifting solenoid, and the type of signal, single pulse (air shifter), remain active (Lenco) or one output at a time (Liberty).



Select the desired output, all the outputs will be displayed, except the ones used for injection and ignition. In the FTManager, this setup is at "Sensors and calibration" - "Outputs".

20.7 Time based fuel enrichment

Enables a time based fuel compensation that starts after the 2-step deactivation. This compensation is a time (seconds) versus compensation (%) feature. After you enter the table, a graph will be displayed.

I	Time based compensations																			
	Tura		16	Conclusion																
	Time based RPM (cut)		view	Enable																
	Time based RPM (cut) - Limit		~	\checkmark																
	Time based RPM (retard)																			
	Time based RPM (retard) - Tim	ina																		
	Time based advance/retard	2																		
	O Time based enrichment																			
	O Time based driveshaft (cut)																			
	O Time based driveshaft (cut) - L	imit																		
	O Time based driveshaft (retard)	- A																		
	O Time based driveshaft (retard)	- B																		
	 Time based driveshaft (retard) 	- Retard A																		
	O Time based driveshaft (retard)	- Retard B																		
	Load trace from log file																			
	Time	RF	M	51.40																
	0.00		5140 5025 4918 4918	5140	5140	5140	5140		5140	5140	5140	5140	5140	5140	5140	5140	5140	5140	5140	5140
	0.10							5025												
	0.30			4918																
	0.60				4918															
	0.90			4958																
	1.20			5077																
	1.50			5245																
	1.80			5572																
	2.10			6068																
	2.50			6821																
	3.00			8000																

Time based advanced/retard timing

Enables a time based timing compensation that starts after the 2-step deactivation. This compensation is a time (seconds) versus degrees BTDC (° BTDC) feature. After you enter the table, a graph will be displayed.





Time based revolution limiter

The RPM control is based on seven RPM and time points that can be determined as shown in the image above.

This function is frequently used in drag racing cars, because it makes it easier to control the vehicle, once it allows the traction to be recovered through an ignition cut ramp.



Time based speed (cut)

This feature is the same as the time based RPM (cut) but instead of using the engine RPM, it uses the wheel speed or the driveshaft RPM.



It will perform ignition cut to keep the wheel speed/driveshaft RPM under a predefined curve.

The "Time based RPM (cut) - Limit" is the maximum level, which means the percentage of ignition events that will be cut to keep the engine under the rev limiter.

The RPM progression range acts as a smoothing for ignition cut.



Example: rev limiter at 8000rpm, RPM progression range at 200rpm. From 8000rpm the ignition cut level will gradually increase until it reaches 90% cut at 8200rpm.

Values less than 90% may not keep the engine under the rev limiter. Bigger RPM progression ranges tend to stabilize more smoothly the rev limiter, but allows the RPM to pass the RPM set as your rev limit. For inductive ignition systems it is recommended to use 90% maximum level and 200 RPM progression range. For capacitive system, like MSD, it is recommended to use 100% maximum level and 1 RPM progression range.

The last screen will show the graph.



Time based RPM (retard)

This feature is very similar to the time base RPM (cut), instead of cutting the ignition, it will retard the timing, to have a smoother way to control power and torque to the wheels. The function starts after 2-step. It is recommended to use this function together with the Time based RPM (cut) to have a better control of the engine, this way the control itself will be smoother.



- 1 Green Speed curve;
- 2 Purple speed curve;
- 3 Buttons for chart selection that will be in the upper layer;
- 4 Check boxes to enable or disable graphic display.;

Time based speed (cut)

This feature is the same as the time based RPM (cut) but instead of using the engine RPM, it uses the wheel speed (with a wheel speed sensor or by calculating speed) or the driveshaft RPM. It will perform ignition cut to keep the wheel speed/driveshaft RPM under a predefined curve. Generally speaking, this speed/RPM control seeks to limit the wheel speed during the run.



The first screen will briefly explain how the feature works and it will ask what the speed reference is, if it is a wheel speed or drive shaft RPM. You must have a wheel speed sensor or a driveshaft RPM sensor enabled to use this feature.

The first parameter to be set is the speed/RPM progression range, which is the Speed/RPM range from start the ignition cut to its maximum level.

A 10 Mph speed progression range means that if your control starts at 80 Mph, the ignition cut maximum level will be at 90 Mph.

The next screen is the wheel speed/driveshaft RPM versus time table. After the 2-step, every time the speed/RPM goes above the curve, the ECU will perform ignition cuts.

Percentages less than 90% may not keep the engine under the rev limiter. Bigger RPM progression range tend to stabilize more smoothly the rev limiter, but allows the RPM to pass the RPM set as rev limiter.

For inductive ignition systems it is recommended to use 90% maximum level and 200 RPM progression range. For capacitive system, like MSD, it is recommended to use 100% maximum level and 1 RPM progression range.

<	Time based driveshaft (cut) 4/4									
10000	\sim									
9000										
8000						/				
7000					/					
6000				_	~					
5000										
4000		•								
0,	.00 0,	50 1,	00 1,	50 2,	00 2	,50 3,00				
	×					\checkmark				

Time based speed (retard)

This feature reads the wheel speed (or the driveshaft RPM) and applies ignition compensation, according to the two RPM curves (A and B) to control launch.

The basic idea is to retard the ignition timing, reducing power to the wheels. When the wheel speed reaches the programmed in the "speed curve A", the ECU starts the programmed retard in the "delay curve A point".

As the speed increases, and goes toward the curve "B" speed, the retard applied to the timing (that is interpolated between the two retard



curves) is incremented. Thus, if the initial retard made by curve A is not sufficient to hold the speed of the vehicle, the retard will increase as much as the RPM increase.

In cases where the speed/RPM exceeds the limits of the curve "B", the maximum retard (entered in curve B) will be applied.



The first screen allows to select the speed/RPM reference (wheel speed or driveshaft RPM). You must have a wheel speed sensor or a driveshaft RPM sensor enabled.

The next screens will show the speed/RPM curves A and B.



After this, the ignition retard curves A and B



- 1 Green speed curve A;
- 2 Purple speed curve B;
- 3 Pink timing retard curve A;
- 4 Blue timing retard curve B;
- 5 Buttons for chart selection that will be in the upper layer;
- 6 Check boxes to enable or disable graphic display;

In the end, a graph will be displayed with all the curves (speed/RPM A and B, retard A and B) $\,$

Note that the speed and retard curves shown on the graph form speed and retard zones. They have the following characteristics:

- When below the curve A, there is no retard applied to the engine;;
- When the speed/RPM is equal to the programmed curve A, the ignition retard is equal to the programmed in curve A;
- For speed/RPM between the two curves, the retard is interpolated, in other words, the more the speed/RPM exceeds the curve A towards to curve B, the more retarded the timing will be;

• If the speed/RPM programmed is overcoming the curve B, the ignition retard is equal to the value programmed in curve B.

20.8 Pro-Nitrous

This feature controls up to 6 time based nitrous stages, with individual settings for each stage.

Quick access panel	Pro-Nitrous Settings						
Fuel Tables	Enabled						
Ignition Tables	Enable function by						
Other Functions	O Dashboard switch						
Drag Race Features	External switch						
-Burnout mode	Number of stages						
	6						
—2-Step rev limiter	TPS to Pro-Nitrous activation						
— Timing table for rev launch	Turn on with TPS above						
—Gear shift output	0.0 🖨 %						
Time based compensations	Turp off with TPS below						
Config time based compensations	0.0 4 %						
E-Pro-Nitrous							
	Stages activation output						
Nitrous stages fuel table	 Activated at 0V 						
Nitrous bottle pressure compensation	 Activated at 12V (Yellow outputs) 						
Pro-Nicious							
Pro-Nitro	us settings						
Pro-Nitrou	s fuel table						
Pro-Nitrous fue	el compensation						
Pro-Nitrous	timing table						
×							

Pro-Nitrous settings

To active the Pro-Nitrous it is mandatory fulfill 3 requirements:

- 1. Active the Pro-Nitrous button (external switch in one of the white inputs or a dashboard button in FT display).
- 2. The elapsed time after 2-step cannot be more than 15s, otherwise Pro-Nitrous will not be turned on. In other words, the vehicle must launch in less than 15s after 2-step deactivation.
- 3. TPS must be above minimum percentage configured.

With these 3 requirements fulfilled, the Pro-Nitrous stages will start and follow the configured time. The fuel and timing compensations will also start at this point. If any condition fails, the Pro-Nitrous is deactivated and FT will use fuel, timing and O2 closed loop main tables.





The first parameter to be set is the enabling mode:

- **Dashboard button:** a touchscreen button in the LCD screen that can be found in the Dashboard settings menu.
- **External switch:** a white input must be used with an external switch. While the input is grounded, the Pro-Nitrous will be on.

FuelTech FT allows firing the solenoids by switching 12V or OV (ground), which must be setup in the grays or yellow outputs.

All the Pro-Nitrous inputs and outputs can be set both by touchscreen or FTManager, in the "Sensor and calibration" menu.

Pro-Nitrous has two different TPS limits. One limit is to turn on with a minimum TPS, the other is to turn off with a maximum TPS. The recommend is set the TPS to turn on at least 5% higher than the TPS to turn off. This way there will be a hysteresis that won't let Pro-Nitrous turn on and turn off several times when TPS is around activation TPS. Also, you will be able to pedal the throttle to get back traction.

The RPM activation window is necessary to protect the engine, not allowing having a nitrous shot in a low RPM or by deactivating nitrous before the rev limiter

The Pro-Nitrous timers and delays table gathers the on and off settings for stages and compensations. A pedaling delay can also be set, so, if the driver pedals in a run, the Pro-Nitrous can be reactivated progressively.

In the FTManager, this table is as shown below.

Pro-Nitrous Timers and	Pro-Nitrous Timers and Delays										
	Stage #1	Stage #2	Stage #3	Stage #4	Stage #5	Stage #6					
		NOS sta	ige timers								
ON after launch	0.00	0.00	0.00	0.00	0.00	0.00	5				
OFF after launch	0.00	0.00	0.00	0.00	0.00	0.00	s				
ON after pedaling	0.00	0.00	0.00	0.00	0.00	0.00	5				
NO5 fuel compensation											
ON delay	0.00	0.00	0.00	0.00	0.00	0.00	s				
OFF delay	0.00	0.00	0.00	0.00	0.00	0.00	5				
OFF ramp	0.00	0.00	0.00	0.00	0.00	0.00	s				
	NC	S ignition tim	ning compens	ation							
ON delay	0.00	0.00	0.00	0.00	0.00	0.00	s				
OFF delay	0.00	0.00	0.00	0.00	0.00	0.00	s				
055	0.00	0.00	0.00	0.00	0.00	0.00	_				



Pro-Nitrous fuel tables

Here all the fuel compensation for Pro-Nitrous can be configured according to each stage.

5500	6000	6500	7000	7500	8000	8	500	9000	9500	10	0000
0.000	0.000	0.000	0.000	0.000	0.000	0.00	0 0	.000	0.000	0.00	0
0.000	0.000	0.000	0.000	0.000	0.000	0.00	0 0	.000	0.000	0.00	0
0.000	0.000	0.000	0.000	0.000	0.000	0.00	0 0	.000	0.000	0.00	0
0.000	0.000	0.000	0.000	0.000	0.000	0.00	o c	.000	0.000	0.00	0
6000 7000	8000 9000	10000 11000	12000 13000	14000 1500	0 16000 17	000 180	00 19000	20000 2	1000 22000	23000	24000 2
\	Pro Nitro	us fuel tabl	e 1/7	>	<		Pro Nitro	ous fuel t	able 8/8		
D	elay to star (in	t fuel comp seconds)	ensation		Time to deactivate fuel compensations						
					_	1	2	3	4	5	1.11
	2 3	4	5	6	Delay (0,00	0,10	0,15	0,10	0,05	
0,30	0,25 0,2	0 0,15	0,10	0,10					1.00	4.00	[s]
					катр	1,00	1,00	1,00	1,00	1,00	
×				 Image: A start of the start of	×					~	
		<_	Fuel F	ro-Nitrous	s stage <u>1</u>	- 2/7		>			
 2400 RPM 1205 Ib/n 1000 SWE 1000 SWE 100,0 SWE 100,0 SWE 											
			×				\checkmark				

On the first screen is the configuration that allows setting a delay to start the fuel compensation, based on the time that the nitrous shot takes to get to the combustion chamber.

After the delay, there are the fuel tables to each stage. You can program the fuel compensation over RPM and it is calculated considering the main fuel table.

Since the injectors are closer to the combustion chamber than the nozzles/foggers, the purpose is that the fuel and nitrous get to the combustion chamber at the very same time.

In the FTManager software is possible to visualize the total calculated fuel table.

It is possible to set an OFF delay and OFF ramp after each stage. It helps because moments after shut down the nitrous solenoid, the intake still full of nitrous that will be consumed by the engine.

Nitrous stage cylinder trim and bottle pressure compensation

This is a fuel injection cylinder trim for the Pro-Nitrous feature.





<		Pro-Nitrous cyl trim 1/2							
		1							
		-11,0	-11,0	-17,0	+				
	2 Stag.	+1,0	+3,0	-3,0	%				
	3	+9,0	+7,0	0,0					
	×			\checkmark					

 Bottle pressure compensation: compensates the bottle pressure drop that happens in a run. The bigger the nitrous consumption, the bigger the pressure drops, and consequently the nitrous mass is smaller. With this, less fuel is necessary.



Nitrous stage timing tables: After the delay, there are the timing tables to each stage. You can program the timing compensation over RPM and it is calculated considering the main timing table. In the FTManager software is possible to visualize the total calculated ignition table.

Ni	trous s	stages t	iming t	table									
		RPM (r	pm)										
	° BTDC		2000				4000			53	500		
G	1	-10.0			-10.	0			-10.0				-10.0
(st	2	-6.0			-6.0				-6.0				-6.0
age	3	-2.0			-2.0				-2.0				-2.0
st	4	-2.0			-2.0				-2.0				-2.0
	-2.0 -3.0 -4.0 -5.0 -6.0 -7.0 -7.0 -8.0 -9.0 -10.0 2000	0 2200	2400	2600	2800	3000	3200	3400	3600	3800	4000	4200	4400
Nit			lated ig		able	(° BTD	C)						
		RPM (r	pm)										
	° BTDC		2000				4000			55	500		
-	1	10.0			11.8				12.8				13.3



20.9 Time based output

This feature allows activating an auxiliary output by time, which can be used to release the parachute, turn on the nitrous or even switch on the torque converter lockup solenoid.

FT450 / FT550 / FT550LITE / FT600



Also, there are conditions, besides time, to trigger the output. The conditions are: minimum RPM, minimum TPS, minimum driveshaft RPM and minimum wheel speed.



All these options can be enabled or disabled. The output signal can be an ON/OFF signal (remaining on while the conditions are valid) or a pulse (to release the parachute, for instance), which the duration is programmable

The available activation conditions are: minimum RPM, minimum TPS, minimum driveshaft RPM.

If the output trigger type is ON/OFF, when one of the conditions stops being met, the output is turned off.

When activated, the output switches to OV. In the FTManager, select the output in the "Sensors and calibration" menu, then "Outputs".

20.10 Wheelie Control

This function reads height and pitch sensors to help prevent the from leaving the track surface. It is recommended for rear wheel drive cars and bikes.



Wheelie control	
Mode O Always active O arg racing only	
Retard stage Enabled The Retard stage of wheelie control can be enabled based on laser height sensor installed on the front of the car and/or a Pitch rate sensor, that when reached will retard the ignition timing trying to reduce wheelie and activating an output if configured.	Cut stage Enabled The Cut stage of wheelie control will be activated if height and/or pitch rate keeps increasing by proceeding an ignition cut at a 90% level and activating an output.
Ride height for timing retard stage ✓ Enabled 11.0 ↓ in	Ride height for cut stage ✓ Enabled 15.0 ↔ in
Pitch rate for timing retard stage Enabled 0.0 's	Pitch rate for cut stage Enabled 0.0 + °/5
Timing retard -20.0 🔹	Minimum cut duration



Retard Stage

This feature retards the ignition timing when the front of the car reaches the limit height that has been programmed. The cut stage cuts the ignition to control the front height of the vehicle.

The retard stage is a first line of defense to keep the ride height under control, the cut stage is a more aggressive way to stop the height/or pitch rate from keep increasing.

Always active: As long as the engine is running this feature will be active, independent how or where the car is positioned, even when testing the car on a car lift. This function is highly recommended for motorcycles.



Drag racing only: This feature will be activated after releasing the 2 step button/switch, during the next 15s it will be operating. Set height (in) or pitch rate (%) to activate the retard control. It is possible to use both sensors at the same time.



Cut stage

As the retarding control, there are height and pitch rate configurations to the cut stage. The cut level can be configured, and it is possible to define a minimum time to the cut occurs. **Always active:** As long as the engine is running this feature will be active, independent how or where the car is positioned, even when testing the car on a car lift. This function is highly recommended for motorcycles.

K Wheelie o	control 5/9	Wheelie control 6/9				
Disab. Enab. Height for cut stage	Disab. Enab. Pitch rate for cut stage		Minimum cut duration			
X		×		\checkmark		

Drag racing only: This feature will be activated after releasing the 2 step button/switch, during the next 15s it will be operating.

Set height (in) or pitch rate (%) to activate the retard control. It is possible to use both sensors at the same time.

<		Cut by height 3/7				<		Cut by pitch rate 4/7			
		0,00	seconds 0,10	0,20				0,00	seconds 1.00	2.00	
	15,0	-0,80	-0,88	-0,75	+		250.0	-0.80	-0,88	-0,75	$\left + \right $
	16,0 in	-0,90	-1,00	-0,88	•		300.0 °/s	-0,90	-1,00	-0,88	•
•	17,0	-0,88	-1,00	-0,80		•	350.0	-0,88	-1,00	-0,80	
	×			\checkmark	•		×			 ✓ 	,

There is also the option to trigger an auxiliary output when the retard or cut is being performed. The output can be used to release the chute, shift gears, etc.

In the FTManager, select the output in the "Sensors and calibration" menu, then "Outputs".

To use this function, a height sensor or a pitch rate sensor must be installed and configured in the "Sensors and calibration" menu, then "Inputs".

20.11 Davis Technologies

The Davis Technologies Profiler is a traction control module, for rear wheel drive cars, which controls ignition timing and ignition cut by driveshaft RPM. This module allows direct communication with FT. In the FTManager, go to "Sensor and calibration" menu, then "Inputs" and select the white input wires that will do the communicate with the Davis Technologies Profiler.

<	Timing signal 1/2		>	Sma	rtDrop (TM) Signal 2/2	2	>		
Input selection									
None		-	~	None			<		
🔘 White 1:	Avaliable			🔵 White 1: A	Avaliable				
White 2: Ava	liable			White 2: Avali					
White 3: Air	temperature			White 3: Air te	emperature				
White 4: TPS		/	~	White 4: TPS					
×		 		×		~	•		

20.12 Time based throttle opening

This feature creates a curve for a time based progressive opening of the electronic throttle.

K Tir	ne based throttle openir	ng 1/3 🛛 🔪	Time based throttle opening 1/3							
D.	Attention!	da	Disabled Enabled							
m	Electronic throttle contro ust be activaded and corr tup in order to use this fea Ok	ol rectly ature.		Th of 1	is feature allows the cont the throttle opening by tii	rol me				
×		\checkmark	×			\checkmark				



You can create a curve based on time by maximum percentage of throttle opening.



20.13 Staging control

This function helps the car alignment when pre-staging after the burnout. When activated, it's possible to control the transbrake solenoid frequency to hold the car properly.



Now it is possible to select if the transbrake and the staging function will be active during 2-step and 3-step. This makes easier to stage the car and prevents the driver from trying to stage without meeting the launch conditions.



After configuring the inputs and outputs, its necessary to adjust the safety parameters, like the number of button presses to apply security, the additional intensity for security and the maximum time for output duration for solenoid protection.

<	Staging control 7/8	>	Staging control 8/8				
Di	sabled Enab	led	Dis	abled	Enab	led	
∿ dur	laximum time for outp ation (solenoid protect 20,0	ut iion)	Button pres apply sec	sses to urity	Additio	nal intensity	
×		>	×			>	

Staging control electrical diagram with Hella solid state relay

Use the diagram below to wire the staging control feature.

Any white wire can be used for the 2-step and staging buttons. The other side of the buttons must be connected to the battery negative or to a switched 12V when needed.



20.14 Mechanical fuel injection controller

The Mechanical Injection Fuel Controller is used to activate or deactivate solenoids that decrease the amount of fuel that goes to the engine (Lean out solenoids) in cars that use mechanical fuel injection (without fuel injectors).



NOTE

This manual shows the settings for one stage, but the

same can be applied to all other stages.

Settings:

The function can be enabled by a button on the ECU dashboard, by an external switch (requires an appropriately configured analog input or always active when the ECU is switched on.

Quick access panel	Mechanical Fuel Injection Controller (MFI)			
Quick access panel V Diagnostic Panel Luci Tables Cother Functions Trag Race Features	Mechanical Fuel Injection Controller Enable function by Dashboard switch Cetternal switch Anays enabled Input activation mode	(MIT)		
- Burnot mode - 3-step / boost spoil / roll start - 2-Step rov limiter - Stelle fine lock control - Trining table for rev launch	Activated at 0V Activated at 12V Timer #1 output activation Activated at 0V Activated at 0V Activated at 12V (Only w/ Yellow outputs)	Timer #5 output activation		
Geer shift output Time based compensations Pro-Nitrous Time based output	Timer #2 output activation Activated at 0V Activated at 12V (Only w/ Yellow outputs)	Timer #6 output activation Activated at 0V Activated at 12V (Only w/ Yellow outputs)		
Wheele control Staging control Hermical Fuel Injection Controller (MFI)	Timer #3 output activation 	Timer #7 output activation Activated at 0V Activated at 12V (Only w/ Yellow outputs)		
Timers and Delays Timers timing table	Timer #4 output activation O Activated at 0V Activated at 12V (Only w/ Yellow outputs)	Timer #8 output activation O Activated at 0V Activated at 12V (Only w/ Yellow outputs)		

switched relay 12V/16V





When using an external switch, a white input must be configured or a SwitchPanel-8 button when using CAN.



Stages

You can set up to 8 stages depending on what you need.

Quick access panel	MFI - Timers and Delays					
🏹 Diagnostic Panel						
Fuel Tables			Timer #1	Timer #2	✓ Timer #3	Timer #4
Ignition Tables		Minimum RPM:	1500	1500	1500	1500
Other Functions Drag Race Features		Maximum RPM:	8000	8000	8000	8000
- 2-Step rev limiter		Activated on:	2step/3step	2step/3step	2step/3step	2step/3step
Timing table for rev launch					Tim	ers ON/OFF
Time based compensations		ON after launch:	0.00	0.00	0.00	0.00
Config time based compensations		OFF after launch:	2.00	2.00	2.00	2.00
Wheelie control		ON after launch:	2.50	2.50	2.50	2.50
Mechanical Fuel Injection Controller (MFI)	12	OFF after launch:	4.00	4.00	4.00	4.00
- Imers and Delays		ON after launch:	4.50	4.50	4.50	4.50



Stages can be triggered within a RPM window and/or maintain the desired stages during the 2-step and 3-step by enabling them in the check boxes







The ignition compensations for each stage can be activated or deactivated with a delay time in relation to the fuel solenoid activation time, thus seeking to get the exact time that ignition timing needs to be changed to equal the fuel difference that is going to the engine. Next set up the ignition timing on the table, it's possible to set up to 16 points for each stage.



The last step is to select which output is responsible for each stage and how it activates (Ov or 12v).

After that it's possible to test to see if the output is working properly by clicking on "test".

Stage 1 6/	7	>	<	Stage 1 7/7	>
Test output:	Test			Output activation	
Output selection					
None				Activated at	0V
Blue 7: Avaliable					
Blue 8: Avaliable				Activated at	12V
🔘 Grey 5: Avaliable		\langle			
×		\checkmark	×		\checkmark

20.15 Launch delay controls (delay box)

This feature was developed for Bracket racing, in which two competitors launch at different times. There are several different delay times available for this function.

Quick access panel	Launch delay controls (delay box)		
V Diagnostic Panel	Launch delay 1	ET Dials	Pre staging output control
Ignition Tables Other Functions Drag Race Features 2:Seo rev limiter	Launch delay 2 Activated Launch delay 2 time 0.200 © s	Your Dial 4.00 5 Opponent Dial 4.00 5 5 5	Pre staging output modes FULL tree Pre staging output timer 0.800 f s
Timing table for rev launch Time based compensations Wheele control Launch delay controls (delay baix) Times existing	Delay 2 to override Delay 1 © OFF (Fist delay to expire will trigger launch) ON	Delay activation on 2-step release Requires validated bunch conditions Any 2-step release will trigger Note: in order for all the time based features that depend on a validated bunch to start after the brackst delay express, it is necessary to validate the	PRO tree FLLL tree mode: Deactivates with Pre Staging timer. PRO tree mode: Deativates when 2-step activated.
Interface Settings	(+) Bump up delay 0.005 5 5 (-) Bump down delay -0.005 5 5 (+/-) Super bump delay -0.010 5 5	Isonoh by https://www.isonohimatical.com/second-by-ittps://www.isonohimatical.	Pre staging enable function by: Bumo Uo Bumo Down Dashboard button External switch
	Pre Isunch cut Activated Pre Isunch RPH cut 2000	Bump Down button mode Activated by 0V Activated by 12V	Activated by 0V Activated by 12V
	Pre launch RPH cut time 0.800 \$	Super Bump button mode Activated by OV Activated by 12V	Pre staging output Activated at 0V Activated at 12V (Only w/ Yellow outputs)

Operation mode

There are two operation modes for this function.

Launch delay only: This option adjusts the delays only according to the set up value, regardless the opponent time.

With dial on dashboard: In this option, the delays will be calculated according to the time shown on the dial.

۱ ۲	aunch delay controls 1/	19 💙		
D	isabled Enable	ed		
Operation mode Caunch delay only With dial on dashboard				
×		\checkmark		

NOTE

It's necessary to configure the dials (bracket) in Interface Settings / Dashboard setup



In order for all the time based features that depend on a validated launch to start after the bracket delay expires, it's necessary to validate the launch by hitting the 2-step rev limiter or having TPS above 50% while bracket delay is active.



The next screens are dedicated to set up the launch delays 1 and 2. The values must be set in milliseconds.

Delay 1: Timer to launch the vehicle that begins counting down upon release of two step button.

Delay 2: Secondary delay option that allows the driver to get a second hit on the tree by pressing the two step button again after delay 1 timer has been triggered.

There are two options for this feature:

ON: Delay 2 overrides delay 1 and will launch the vehicle based on delay 2 timer once 2 step button is pressed and released for a second time.

OFF: Delay 2 DOES NOT override delay 1 and the vehicle will launch with the timer of whichever delay expires first.



Bump Up (+): Adds a USER defined time to delay 1 in order to calculate final delay timer. The numbers in this field can only have a positive value.

Triggering Bump up multiples times before delay 1 timer expires will result in each instance being added to final delay calculation.

Bump Down (-): Subtracts a USER defined time from delay 1 to calculate final delay. The numbers in this field can only have negative values.

Triggering bump down multiple times before delay 1 timer expires will result in each instance being subtracted from final delay calculation.



Pre launch RPM cut and Pre launch timer: This feature makes it possible to set a target RPM cut designed to "save" the engine during the staging procedure. The pre launch RPM target will be lower than the 2 step RPM target and will be active while the 2 step button is pressed. It will deactivate when a user defined pre launch timer is subtracted from an initiated delay 1 timer. (Example: 1.000 delay 1 and a 0.200 pre-launch timer will allow engine to climb to the 2-step target RPM cut at 0.800)



Pre staging output mode

This control modifies the behavior of launch delay, this setting is used to align the car before entering pre-staging.

There are two operating modes "FULL tree" and "PRO tree".

FULL tree mode: is activated for a configured time

PRO tree mode: is activated by a button and deactivates when the 2-step condition is met.

Select how the Pre staging will be activated. There are four options, "Bump up button", "Bump down button", "Dashboard switch" or "External button", in the latter it is necessary to configure one more input for activating the button in addition to the input for activating the function.

It is possible to reset the delays by pressing the button again before the set time is reached.



Inputs and Output

Inputs: There are 3 inputs that can be configured. *Bump up* button, *bump down* button and *super bump* button. These buttons can be connected to the analog inputs (white wires) or configured on a SwitchPanel via CAN network.

Launch delay controls 12/19	>	🕻 La	unch delay controls 14	/19 👌
Bump up button input selection		Select down bu	tton input selection	
None	\sim	O None		^
White 1: Avaliable		White 1: E	ump up button	
White 2: Avaliable		White 2: A	valiable	
White 3: Avaliable		White 3: A	valiable	
White 4: Avaliable	<	White 4: A	valiable	\langle
×	\checkmark	×		\checkmark

Output: This feature makes it possible to configure an output that will trigger a solenoid to limit the engine air intake opening. This output remains active while two step button is pressed and deactivates when the pre launch timer expires.

🖌 La	Launch delay controls 18/19					
	Test output: Test					
	Output selection					
None						
🔵 Blue 8: A	Blue 8: Avaliable					
Grey 5: Avali	Grey 5: Avaliable					
Grey 6: Avali	able			>		
×			~	•		



20.16 Time based individual ignition trim

Time based individual ignition trim table after validated launch, allowing better engine power management.



20.17 Time based individual fuel trim

Time based individual fuel trim table after validated launch, allowing better fuel management.



20.18 DialBoard

Adjusts the time to be displayed on the car's external panel (DialBoard).



20.19 Throttle stop control

This function allows blocking the throttle for a setup time. The total blocking time is "Timer 2 (OFF) - Timer 1 (ON)" .

It's also possible to configure buttons to increase or decrease this delay.





Choose how the throttle stop will be triggered within the function.



21. Alert settings

This is the menu where you can set all the alert warnings, including safety mode and engine shut down.

Quick access panel	Alerts Settings				
Diagnostic Panel	General Alert Settings				
Fuel Tables	and an element of the second s	Output activation mode	the second se	The Alerts will be validated after 0.2 second after 2 seconds of enone running to preven	of problem condition and they will be checked t fake trionering after start.
System Tables	Sale mode form anister	C Activated at ov	an output activates and next engine chark.		
Other Functions	- 280	O Activated at 12V (Only w/ Ye	low outputs)		
Drag Race Features	Over Rev	High oil pressure	EGT increase rate	Turbo overspeed	Pikit Pro Tajector Driver
Engine Kellings	Enabled Enable output	Enabled Enable output	Enabled Enable output	Enabled Enable output	Enabled Enable output
Sensors and Calibration	Acteo	Action	Action	Action	Action
Interface Settings	Warning only ~	Warning only ~	Warning only ~	Warning only ~	Warning only ~
Akrt Settings	8211 BCC0 () APH	Haximum of pressure 145.0 5 pt	CGT increase rate alert	Turbo overspeed RFM	Defines IDU action in case of PSM Pro Director Driver failure
	Injector duty cycle	Low oil pressure	Engine temperature	O2 closed loop: correction limits exceeded	
	Enabled Enable output	Enabled Enable evaport	Enabled Enable output	Enabled Enable output	
	Active	Action	Acting	Action	
	Warning only ~	Warning only 🗸 🗸	Warning only ~	Warning only	
	Duty cycle alert	Pixed value Hindmann of pressure	Temperature alert above 212 [5] +	Flex fael sensor error Enabled Enable output	
	Overboost Drabled Drable output	7.3 ¢ ps	tow fuel pressure	Artina Warning only	
	Active Warring only	Minimum time 0.2 (2) a	Action Warning only	Overboost by % ethanol	
	Overloost alert	Maximum of pressure 0 RPH	Hinknom fact pressure 21.8 2 pel	Action Warning only	
	High EGT		Base fuel pressure		
	Enabled Enable output	Warning only · · ·	Enabled Enable output	Englise BPH reading error Enabled Enable output	
	Warning only	Hinimum of pressure 43.5 (*) ps	Warning only	Artise Warring only	
	Unhaust gas temperature (LGT) 1472 +	RPH 3500 * 6PH	Base fuel pressure	LGate temperature	
	Pan Vacuum Rate	Low EGT	Allowed range	Enabled Pruble cutput	

21.1 General alert settings

Safe mode protects the engine whenever an alert is activated, limiting max engine RPM while the alert condition is still happening.

It is also possible to configure an *"alert"* output so that when an alert condition is met, the output will be triggered automatically. By checking the "Maintain output activated until next engine crank" the ECU will remain in safe mode until the engine is started again.



21.2 Alerts

The configuration of alerts allows the programming of sound and visual alerts whenever a dangerous situation to the engine is detected. It is possible to setup up to three different actions when any alert is displayed on the screen:

Alert only: alert is displayed on the screen, but the engine continues to work normally.

Safe mode: besides the alert displaying on the screen, engine has its max RPM limited to what was set up on the "Safe mode rev limiter" parameter

Engine shut off: besides the alert displayed on the screen, engine is immediately shut off by fuel and ignition cut.



NOTE

Keep in mind that the alerts programmed here can happen at any time, including during overtakes, turns, passes at the track and on the dynamometer. Be careful when selecting the "turn engine off" option and use it only for vital engine alerts.

Over rev

Setup the RPM for alert and the action the ECU must perform.

Disabled Enabled Over Rev Alert Safe Mode The alert will be enable and a safe the engine shutt off Alert and a safe the engine shutt off and a safe the engine shutt off and a safe the engine shutt off a safe the engine shutt o	>	tev 2/2	Over R	<	>	r Rev 1/2	Over	<
Over Rev Alert Safe Mode Enable output 8000 RPM Engine shutt off The alert will be applied of an arrow of the second of the seco	r only	The alert will appear o on the display.	ert	Only Alert	led	Enabl	abled	Disi
Enable output	itation	No engine cut or limita will be applied.	de	Safe Mode	er Rev Alert	Over		_
	led after Idition ne start.	The alert will be enabled 0,1s under alert condit and 2s after the engine :	hutt off	Engine shu		800 RPM	output	✓ Enable
	/			×	\checkmark	:::	:	×

Overboost

Setup an overboost value to activate the alert and the action the ECU must perform.



Engine temperature

Setup an engine temperature to activate the alert and the action the ECU must perform.

K E	ngine Temperature 1/2				
	abled		Enabled		
			Over o tempe	engine erature	
Enabled	d output		100 °℃	< >	
×				\checkmark	

Injector duty cycle

Setup a percentage value that indicates injector's saturation.

Injector duty cycle 1/2					
Disabled Enabled					
	Injector duty cycle alert				
✓ Enable output					
×	✓				

Oil Pressure

Enter a value that would be considered as excessive oil pressure excess and one that's considered for low oil pressure. Also, select how the ECU reacts when this alert is activated.

Coil Pressure 1/2					
Disabled Enabled					
C Enabled output	High oil pressure alert 10.00 bar				
×	✓				



Low oil pressure

It creates an alert for low oil pressure, which can be configured with a single value or through a pressure per RPM table.

Adjust the minimum condition time for the alert to trigger.



Minimum oil pressure

Setup a minimum oil pressure value above X RPM and how the ECU reacts.



Low fuel pressure

Setup a value to activate the alert and how the ECU reacts.



Base fuel pressure

Setup here a tolerance for the base fuel pressure.



The base fuel pressure is what the pressure regulator should keep with MAP = 0 psi, that, in most of cases is 45psi with the engine turned off and the fuel pump turned on.

When engine is turned on, the vacuum/boost makes the fuel pressure regulator to manage the fuel pressure in a 1:1 ratio.

Example: an engine idling with -8.7psi of map pressure must have 34.8psi of fuel pressure if differential pressure is set as 43.5psi. If the MAP sensor is reading 29psi, the fuel pressure must be 72.5psi. If the tolerance range is 5.8psi, the differential pressure can vary from 37.7 psi to 49.3psi.

High exhaust gas temperature alert (EGT)

Set the high exhaust gas temperature value for alert and the alert type as: "Alert only" "Safe mode" or "Engine shut off".



This function only works for EGT probes reading a single cylinder. EGTs for the entire bank or a single EGT for the motor are not considered for this alert.

K EGT - high	1 temp. 1/2
Disabled	Enabled
Enabled output	Exhaust temperature
X	

Low exhaust gas temperature alert (EGT)

Set the low exhaust gas temperature value for alert and the alert type as: "Alert only" "Safe mode" or "Engine shut off"



NOTE

This function only works for EGT probes reading a single cylinder. EGTs for the entire bank or a single EGT for the motor are not considered for this alert.

K EG	K EGT - low temp. 1/2				
Disabl	ed 📃	Enabled			
 Enabled o	utput	Exhaust temperature			
×		\checkmark			

O2 closed loop Correction limits exceeded

An alert will show when the O2 correction reaches upper or lower limits configured in the map.

Flex fuel sensor error

In cases where the sensor has read problems or is disconnected, alert will be displayed, the engine will enter safe mode or switch off.



Overboost by % ethanol

It is possible to enable overboost alert according to the amount of ethanol used. When you select this alert, a table is available in the alerts settings menu.

<	Boost	pressur	e by eth	anol % 2	:/3	>
		Boost	pressure l	imits		
	1	2	3	4	5	-
Ethanol [%]	0	10	40	75	85	
Pressure [PSI]	20	22	30	40	45	
(
	X				\checkmark	



Engine RPM reading error

This alert is activated when RPM reading shows an error, the ECU goes to safe mode, dashboard alert or engine shutoff.

Turbo overspeed

This alert is related to the turbo speed sensor, allowing configuration of dashboard warning, safe mode or engine shutoff.

Pan vacuum rate

This alert comes on when the rate of pan vacuum reading exceed the threshold configured, indicating an imminent problem in the engine.

EGT increase rate

Alert for EGT reading variation, indicating some of the cylinders can be under dangerous situation.

eGate Temperature

Setup an eGate temperature to activate the alert and the action the ECU must perform.

Peak and Hold PRO Injector Driver

This alert is activated when an error occurs in the P&H Pro Injector Driver

Alerts for electrified vehicles

There are a number of alerts that can be configured for electrified vehicles, to activate them, access the "Alerts Settings" menu. These alerts have the same actions as the alerts for combustion engines.

Inverter Alerts		tets Alerts		COC Alerts	General Alerts
High temperature in the invertee	Inserter communication error	High temperature in the HV Battery	HV Battery Isolation Fault	High temperature in the OBC	High pressure in the brak
Enabled Enable output	Frahled Frahle output	Enabled Enable output	Enabled Enable output	Enabled Enable output	C Enabled
Author	Adhe	Action	Action	Action	Action
Turn off the electric motor	Turn off the electric motor	Turn off the electric motor ~	Turn off the electric motor	Turn off the electric motor	Turn off the electric m
		Heb cell will see as 100 half any	High Resistance IV Batters	Hish will are at OW issue	Haximum pressure
tigh temperature in the Inverter Hotor	Inverter derate error	Carbon Contract Contract	C Fashind States	C Fashind Fashin adapt	
Enabled Enable output	Enabled Enable output	C mane C mane verpe.	C stabled C stable output	C saded C sade output	
Action	Action	Active Turn off the electric motor	Action Type off the elector meter	Action	Brake booster compress
Turn off the electric motor	Turn off the electric motor	Turn of the electric mount	Ten on the electric motor	Tell of the electric fields	L Enabled
Comparison in the Investor		Low cell voltage on HV battery	Interlock Connected Charger	OBC communication error	Action Turn off the electric me
		Frabled Frable output	Enabled Enable output	Enabled Enable autout	
Li Enabled Li Enable output		Artista	Action	Action	Pressure difference
Action		Turn off the electric motor	Turn off the electric motor	Turn off the electric motor	
Turn on the electric motor					Time difference
Undervoltage in the invertor		High CCL Current on HV battery		Hardware error in OBS	
Enabled Enable output		Enabled Enable output		Enabled Enable output	
dation .		Active		Action	
Turn off the electric motor		Turn off the electric motor 🧹 🗸		Turn off the electric motor	
		DC1 High Current on HV battery		Initial State Fault in OEC	
Overcarrent in the Inverter		Enabled Catholic autorst		Fnabled Fnable output	
Enabled Enable output		Linge ectpor		Children of States	
Action		Active Turn off the electric meter		Action Torre off the shado's makes	
Turn off the electric motor		Torri bil bie Becolc motor		Terri del del decor, mecor	
		8HS communication error	The Alerts will be voldated after 0.2		
		Enabled Enable output	be charked after 2 seconds of engine		
			running to prevent fake triggering after		

22. Favorites

In this menu it is possible to have access to the most used functions of the ECU. It gives quick access to functions as:

<		Favorites				
E	Main fuel injection t	able		Acce and	l fuel enricl decay	n
E.	Main ignit table	ion	M	Engi start		
Ň	Iddle spee control se	ed ttings	Ň	Two rev.	step limiter	
Ň	Internal datalogge	r		Over fuel	rall trim	
	X				\checkmark	



23. Interface settings

Here are the settings related to the interface like measure units, buzzer sound, LCD backlight, etc.

23.1 Day/night mode selection

There are 4 options to select.

Day mode: adjust brightness the display to value in LCD backlight settings menu.

Night mode: adjust brightness the display to value in LCD backlight settings menu.

Dashboard: Enable button on dash to control mode.

Day/night external switch: this option is necessary configure a white input with vehicle light switch.



23.2 LCD blacklight settings (FT600 only)

Adjust LCD brightness and select between night and day modes.



23.3 LED configuration (FT600 only)

This function allows you to configure all optional LED's

LED bar

Select here the options on how the shift light LEDs will work. It is possible to set the LEDs to turn on in a fixed RPM, progressively or with different values by gear.



Single value: select the LED you want to edit, choose its color and the RPM value to activate it .



By gear: select the LED to edit, choose its color, set the RPM you want it to turn on for each gear and which LEDs will be activated.



Side LEDs

It is possible to set side LEDs choosing from up to 52 alerts options.

10			\mathcal{D}
	Side Select the LFI	LEDS) to configure	
	None	None	•
	2-step	Battery voltage	•

Color: Select the LED color.

Warning mode: This menu has two options; always enabled or blinking;

Condition: Select the function will be associated to this LED.

Activation mode: set the maximum and minimum values to turn the LED on.

Operation 2 and 3: This option provides more activation conditions to the same LED.

	Side	LED		
	Side LED	settings		
☑ Enabled				
Color				
Red ~				
Alert mode	Operation #2		Operation #3	
Always ON V	None	~	None	
fest #1	Test #2		Test #3	
Select value to test	Select value to tes	t	Select value to test	
Battery voltage \sim	None	~	None	
Activation mode	Activation mode		Activation mode	
Turn on below \sim	Turn on upper V		Turn on upper	
Lower value Upper value 13.00 ♀ ∨ 0.00 ♀ ∨	Lower value	Upper value	Lower value	Upper value
Cancel				Save
Side LEDs 2/7	>	<	Side LEDs 3/7	
Disabled Ena	abled	1. Battery		
LED mode	Color		and	
_		2. RPM		
O Always enabled				
Blinking		3. Avaliable		
×		×	::::	\checkmark



LCD blacklight settings

Adjust LCD brightness side LED's and select between night and day modes.

LEDs Testing

This option verify if all LEDs are working properly. Selecting this function the LEDs must to turn on with the same color and at the same time, in case any LED do not turn on you must get in contact with FuelTech maintenance sector.

23.4 Virtual LEDs configuration (FT450 and FT550)

Virtual LEDs are configured the same way as in the FT600, through the ECU or the software.



23.5 Alert sound settings

This parameter allows for setting the volume of sounds generated by touching the display. When the mute option is selected, the ECU is silent when the screen is touched.



23.6 Dashboard setup

There are 96 configurable positions on the dashboard, with minimal size of 1×1 . It's possible to select sizes as 1×2 , 2×1 , 2×2 , 3×2 and 3×1 , and full screen (only for Dials).

First, select the position where you want the information to be, then the reading that will be displayed and the reading size.

Dashboard setup is very simple, first select the number of dashboards you want (1 to 4), after that set the space will be used, and then, choose the information you want and select right to define the gauge size.

The option "Goto screen 1 on 2-Step" was developed for using with the dial function.



After version 3.10 of FTManager is possible to set 4 different dashboards directly in the software clicking over the free gauges and editing the informations.



Clicking in the upper corners of the touchscreen the other configured dashboards will appear, as illustrated below, or it is also possible to set a white input as a button/switch key to change the dashboards.

, 73	325	9864 RPM E	kit		
1' 2	?' 8'	4'5'	6' 7'	8, 8,	10'

Exhibition limits and alerts

On some sensors, maximum and minimum values may be set up to activate alerts on the dashboard. In this case, the sensor changes it's color to indicate something is wrong. The sensors readings with these options are: MAP, air temperature, engine temperature, battery voltage, fuel pressure, oil pressure, TPS, dwell, ignition timing, primary injection time, secondary injection time, O2 sensor 1, O2 sensor 2 and delta TPS





RPM bar

When clicking the RPM bar parameter, it is possible to setup the RPM where the red zone starts.



Dials - Bracket

This parameter will define your dial as well as your opponent's dial to allow the ECU to calculate the crosstalk timer when the opponent is dialed slower than you. This data can be viewed and changed via the instrument panel or on FT Manager.



23.7 Startup screen selection

Select the screen shown right after the ECU is turned on. In case the option "Open the main menu after startup" is selected and the ECU is set up with a user password, the ECU will ask for the user password.



23.8 Splash Screen

This feature allows you to customize any image for the splash/start up screen. These settings can only be accessed through the FTManager software through the "Tools / Splash Screen " menus

- 1 Buttons for writing to the ECU and importing an image.
- 2 Preview screen.
- 3 Options for positioning, alignment and sizing of the FuelTech's watermark (cannot be disabled).
- 4 Options for zoom and alignment of image on the ECU's screen..



Through the touchscreen it is possible to select if the splash screen will be the default or a custom one.



23.9 Password Protection setup

It is possible to set 2 different kinds of password:

ECU Password

Activating the ECU password allows three types of blocking protection:

- FTManager: choose this option to activate an FTManager access password, but keep all touchscreen menus accessible. Do this to avoid that a password being activated without your consent.
- Menus: This option protects all the ECU menus, only giving access to information displayed on the on board computer and engine status.
- Engine Start: Engine start blocking. All menus will be available for viewing and editing, but the ECU system will be blocked until the password is inserted.

Quick access panel	Passwords & Access permissions			
\chi Diagnostic Panel	Map password			
🛃 Fuel Tables	Disabled Map protected by serial number			
Ignition Tables	Enabled			
Tother Functions	Change password 002814 . 0048863 . 013			
DragRace Features	Menu access permission			
Engine Settings	Injection menu			
Encore and Calibration	Main fuel injection table			
	Overall fuel trim			
Interface Settings	RPM compensation			
Lighting Settings	Acceleration fuel enrichment and decay			
Alert Sound settings	Engine temperature compensation			
Dashboard setup	Intake air temperature compensation			
Startup screen selection	Battery voltage compensation			
Password protection setup	MAP/TPS auviliary compensation			
Measurement Units	Drime and an			
Alert Settings	m Prime puse			
	Engine start			


	Yeass	word prot	ection set	up 〉			
		EC	CU				
		м	AP				
	×			\checkmark			
Password prote	ection setup 1/2		<	Password prote		2/2 >	
Disabled	Enabled						
ECU pa	assword		Menu	IS	FTM:	anager	
Change p	password		Engir Start	ne			
×			×				

Map Password

This password blocks all the map menus of the fuel and ignition table adjustments, engine settings, aux function and file manager. Alert settings, shift alert, display and initial screen are left unprotected. When this password is enabled, it's not possible to change any ignition or fuel maps. The FTManager software access is also blocked by the Map password.



WARNING

Passwords come disabled by default, when you enable a password you will be blocking access to people using the ECU, even yourself. When you choose a password, be sure you will remember it, as for safety reasons this password will only be removed through the total reset of the ECU (all maps and data are erased).

〈 Pa:	ssword protection setup	1/9	<	Password protection setu	p 2/9 👌
	isabled Enab	led	🔒 All	Injection menu	
			🔒 Main fue	el injection table	\sim
Map password			🔒 Overall fuel trim		
	Change password		RPM cor	npensation	
			📍 O2 close	ed loop	
×		\checkmark	X		\checkmark

Maintenance Password

This password only used to block editing Odometer and Hourmeter.



23.10 Clear peaks

At the Dashboard, values read by the sensors connected to the module are displayed in real time. On the bottom of each box on the display, the minimum (on the left) and maximum (on the right) values read by the sensor are shown.

It is possible to clear this data by accessing the option "Clear Peaks", under the "Interface Settings" menu.



FT450 / FT550 / FT550LITE / FT600

23.11 Measurement units

In this menu it is possible to change the measurement unit for some parameters as pressure, temperature, speed and O2 readings.

Pressure Units: bar, PSI or kPa

Temperature units: °C or °F

O2 sensor units: Lambda, AFR Gasoline or AFR Methanol Speed units: km/h or mph

Fuel flow unit: I/min, I/h, GPM, GPH, cc/min or Ib/h

Volume: L or gal

 $\textbf{Power:} \ \text{kW, CV or HP}$





23.12 Demonstration mode

The demonstration mode can be enabled to show the main features of FuelTech FT and its working. You can set the waiting time to get in the demo mode. To exit, just touch the screen.

23.13 Touchscreen calibration

This function allows the touchscreen re calibration, use it whenever you notice the screen is unresponsive. Calibrate the screen with you finger or with a pen.





23.14 Serial number and software version

In this menu, it is possible to verify the software version and the equipment's serial number.

Make sure you have these numbers in hand whenever the FuelTech Technical Support is contacted to facilitate and optimize the assistance.

<	Serial number	and version 1/2	>	🕻 Se	erial number	and version	n 2/2	>
	Softwar General version 1.00	e Version Compatibility version 1.00		Gene versiv 1.00	Softward ral on)	e Version Com ve	patibility ersion 1.00	
	Serial	number		ECU:	2.00	Bootloader	: 1.00	
	002814.0	023041.035		Interface:	1.00	Bootloader	: 1.00	
	×	··· 🗸		×			\checkmark	

23.15 Odometer and Hourmeter

This function was specially designed for engines that require a mileage or timing control.

- Odometer: Insert the mileage of the vehicle in the "total" field, this value can be edited only through the FTManager with the specific password, there is a "Partial" odometer that is possible to zero the value anytime.
- 2 **Hourmeter:** Follows the same principle of the Odometer, registering the engine hours in the "Total" field, having another field for "Partial" hours.



NOTE

These values are saved in the FuelTech memory, independently of the map that is active. The values can only be changed through the FTManager and through a province safeward



23.16 Practice Tree Game

The idea of this feature is to simulate the staging and launch of a drag racing car; allowing the driver to practice and achieve better reaction times.



_

This feature requires 2-step to be set up and activated using an external button.

There are four different settings for how the drag tree is going to light up:

Full: One light after the other

NOTE

- Pro: All three lights together
- Rollout: The time it takes for the car to start moving after releasing the button.
- 3 Drag tree simulator.
- 4 Staging simulator, the upper and bottom lines represent pre-staging and staging (only shows up if a staging button is configured).



NOTE

This feature is only available in the following ECUs: FT450, FT550 and FT600.

5 - Reaction time.



24. File manager

With the file manager it is possible to alternate between the 3 memory positions stored in the ECU. With this, you can have up to 3 totally different calibrations for different fuels or engines. Another option is to use the same ECU for up to 3 different engines with their own maps.

In the FTManager, the functions of File Manager are available in the tool bar.



24.1 FuelTech base map generator

This function generates a base map that can be used to start engine tuning. It is very helpful because it gathers information from the "Engine setup" menu to create a base map to start engine.

Before using this function, make sure you have followed chapter 5 in this guide.

Further information about the assistant manager can be found in the Chapter 7.7 of this manual

24.2 Edit map file name

Edit the file map name after generating the FuelTech base map.



24.3 Copy map to another file

This option copies a map that is already setup, to an empty position or to overwrite a previous map. First, select the map that will be copied, click right, then select the option "Copy map to another file". On the next screen, map that will be copied is not shown, only the positions available to be overwritten.

In the example below, the Adjust 4 was copied to Adjust 1, which was empty:



24.4 Erase file

Map files that will no longer be used can be easily erased with this option. To erase a file, simply enter on in by clicking right, then select option "Erase file". After the confirmation, every parameter that was previously changed will be erased to factory default.

24.5 Selection by button

In this option it's possible to quickly change the map through a button wired by an analogic input or a SwitchPanel button via CAN Network. You can set a single button to switch between maps or one button dedicated for each map.



You must set which maps will be available to be switched and also whether it will be switched by analogic inputs or CAN Network.



If switched by analogic input, it is necessary to set the activation voltage (OV or 12V). If switched by CAN Network, you just have to define the dedicated buttons in "Sensors and calibration/CAN communication/SwitchPanel" or directly from the FT screen.



25. Electrification

This section is dedicated to controlling electric and hybrid vehicles. The control and monitoring functions of the system for electrified vehicles will be explained.

Important notes

- FuelTech VCU will always send a torque request to the electrification system regardless of which Power Train is installed on the vehicle.
- The 12V battery is required to power the vehicle's original systems.
- The VCU post-switch will be done by a white input, that is, the VCU will always be "on" in standby mode and monitoring the 12V battery charge level and the Battery Pack charging.
- In standby condition, the VCU screen can be turned off to save the 12V battery. FuelTech VCU will draw 0.06A per hour in this standby mode.
- All communication between the VCU and the control modules of the electrification system is done through the CAN protocol. For more information, contact our technical support.

25.1 Glossary

BMS - Battery Management System: responsible for monitoring the battery pack cells. Informs the VCU in real time various information such as: cell voltage, current, temperatures, status and faults, etc. This equipment is only used when the battery pack is Li-Ion. For lead batteries the BMS is not required.

OBC - On-Board Charge: Battery pack charger. Connected together with the BMS to charge the battery pack when the vehicle is connected to a charging station.

DC/DC Converter: Responsible for charging the vehicle's 12V battery (the electric vehicle's alternator). This equipment keeps the 12V battery charged using the charge from the battery pack.

PDU - Power Distribution Unit: Power control unit for the battery pack. The system operates when the starter key is off or in an emergency, cutting the positive and negative of the battery pack.

Frequency Inverter: Responsible for effectively controlling the electric motor through torque and regeneration commands received from the VCU.

SOC - State of Charge: Informs the percentage of discharge and charge level of the battery pack.

Creeping: Function that works in conjunction with the brake pedal. When releasing the brake pedal, the vehicle will start to move without the need to press the accelerator.

Power Train: Pack of inverter and electric motor.

DCL - Discharge current limit: The discharge current limit of the battery pack.

25.2 Power Train Settings

This function configures the type of Inverter/Motor and also the control mode including which outputs will be controlled for each system.

Inverter model

There are 5 configurable models available (WEG CVW300 and CVW500, Gtake KTZ34, Kelly KAC8080 and SME A-X144) when selecting a model, different configuration options are enabled.



WEG CVW500 inverter: For this model, it is necessary to define the power reduction strategy; the speed to activate the regeneration mode, the minimum pedal position, the maximum and nominal current and the clockwise and counterclockwise torque.



WEG CVW300 Inverter: For this model, configure the minimum percentage of the pedal to allow torque, the maximum and nominal current of the motor and also the clockwise and counterclockwise torque.





Gtake KTZ34 / Kelly KAC8080 / SME A-X144 Inverter: For this model, configure the minimum percentage of the pedal to allow torque, the maximum and nominal current of the motor and also the clockwise and counterclockwise torque.



PWM digital output by % Torque

Some inverters have an analogue or PWM control input, it is possible to configure a PWM table by % of torque. In this case, it is necessary to define how the EV % of torque output is activated (OV inverted or 12V Normal), and adjust the frequency of this PWM.

Power relay control

Relay control activated by the VCU.

EV positive power relay output: Output to the vehicle's positive power relay.

EV Negative Power Relay output: Output for the vehicle's negative power relay.

Powertrain Control

Brake output: Output responsible for activating the regeneration function. It is necessary to configure the "Brake Light" function in the "Other Functions/Signalling" section, so that the regeneration control is activated.

Forward output: Output responsible for activating the relay connected to the inverter input that allows the vehicle to move forward.

Reverse output: Output responsible for activating the relay connected to the inverter input that allows the vehicle to move backwards.

Parking brake output: Output responsible for activating the relay connected to the vehicle's parking brake.

25.3 EV output configuration

This function is responsible for the operation mode of the car's EV system. The following outputs can be enabled, and whether they will be activated at OV or 12V.

Quick access panel	Vehicle state control
ne Electrification	Outputs configuration
Torque and Regeneration	EV Inverter ON/OFF output signal
- EV Other outputs	Active at 0V
Power Train	 Active at 12V (Only with yellow outputs)
Battery control	EV Enable All output signal
DCDC converter	Active at 0V
Driving assistances	O Active at 12V (Only with yellow outputs)
Charging Control	EV charge enable output signal
The Functions	• Active at 0V
- Internal datalogger	O Active at 12V (Only with yellow outputs)

EV Inverter ON/OFF output signal: Output for initializing the vehicle's inverter.

EV Enable all output signal: Output for enabling the vehicle's inverter. Mainly used after pre-charging inverters.

EV charge enable output signal: Output for enabling the load that the inverter will release on the vehicle.

25.4 Torque and Regen

In this function it is possible to configure the torque and regeneration tables for different vehicle conditions. The percentages within each table will be multiplied between all tables to build the required values of torque and/or regeneration.

Tables available for torque % by:

Pedal Position, RPM, Speed, Battery Voltage, Cell Voltage, Battery SOC, Inverter Temperature, Motor Temperature, Battery Temperature.

Tables available for regeneration % by:

Brake Pressure, Pedal Position, Battery Voltage, Cell Voltage, Speed, Battery Temperature, Battery SOC, RPM, Motor Temperature, Inverter Temperature.

For example: In the pedal position table, the user informs the VCU that with 10% of TPS the torque request is 100% while in the torque by speed table it is informed that at 1km/h, the motor operates with a torque of 20%. When the user is pressing 100% of the acceleration pedal, but the vehicle is at 1km/h or less, only 20% of torque will be released to the engine, due to the multiplication of the tables. The same works for regeneration tables, if they are configured accordingly.

Torque and Regeneration		
Torque Tables Torque % by pedal position	Regeneration Tables	Moving average settings for torque and regen control
Torque % by RPM	Regeneration % by RPM	Number of samples
Torque % by speed	Regeneration % by speed	2.
Torque % by battery voltage (open circuit)	Regeneration % by battery voltage (open circuit)	
Torque % by battery SOC	Regeneration % by battery SOC	Sampling time
Torque % by cell voltage (open circuit)	Regeneration % by cell voltage (open circuit)	20 🏚 ms
Torque % by battery temperature	Regeneration % by battery temperature	
Torque % by motor temperature	Regeneration % by motor temperature	
Torque % by inverter temperature	Regeneration % by inverter temperature	
	Regeneration % by brake pressure	





Moving average setting for torque and regen control

Number of samples: The number of samples to calculate the average torque and regen value.

Torque moving average period: Adjusts the time between each sample capture for the average calculation. The recommended value is 20ms.



25.5 Battery

This function manages the charge of the battery pack. The parameters configured here will serve as the basis for controlling the battery pack charge.

There are four BMS (charge controllers) options to choose from:

Without BMS: used when the battery pack is built with conventional lead cell batteries. It is necessary to adjust the DCL and CCL parameters. It is recommended to use a current sensor in the battery pack and connect it to a white "HV Battery Current" input on the VCU.

ORION / LITHIUM and WEG: for these BMSs it is necessary to configure the minimum and maximum SOC to allow torque and regeneration, in addition to configuring the detraction limit and speed to turn off these controls.

Inverter pre-charge time: this is the time the inverter takes to perform the pre-charge, during this configured time the VCU will not send torque requests to the inverter.

Battery energy: in this field it is necessary to inform the energy in kWh of the battery pack. This value will be used to calculate the efficiency metrics.

Efficiency metrics

It is possible to activate information about autonomy and battery consumption as the vehicle travels. These values are updated every 100 meters driven by the vehicle.

Last trip: Calculation of how much power was used (W), and how much distance was travelled (km). This distance is counted after every 100 meters traveled until the moment it is turned off.

Last charge: Calculation of how much power was used (W), and how much distance was travelled (km). This distance is counted since the last time the vehicle was recharged.

Total: Metric accounting for the power used (W), and how much distance traveled (km). This distance is total until the metric is reset to zero.



Quick access panel	Battery control	
TO Electrification	Battery Hanagement	Efficiency metrics
In Torque and Regeneration	BMS Model	Enable efficiency metrics calculation
 EV Other outputs 	ORION BMS	×
- Power Train	Fixed DCL - Application without BMS Fixed CCL - Applicat	ation without BMS— Last trip Last charge Total
- Battery control	500 ‡ A	250 ÷ A 0 0 0
- DCDC converter	Inverter Pre-Charge Time Battery energy	0 0 0
 Driving assistances 	2000 🗘 ms	25 kwh W/km W/km W/km
- Charging Control	Minimum SOC to allow torque regeneration	burn orr the Reset Reset Reset
Other Functions	1 🔹 %	100 * %
🖶 Internal datalogger	Maximum SOC to allow recentration	Male
- Individual channel options	95 - %	10 - Mph
 Individual digital channel options 		
Individual math channel options	Minimum HV battery voltage HV Battery Nominal	al Voltage
- Thermatic fan #2	100.0	125.0
- Water pump	Maximum HV battery voltage	
- Signaling	150.0 🌩 v	
Canada autorita		



25.6 DCDC Converter

This function is responsible for communicating with the vehicle's DC/ DC charger, and informs the essential parameters for operation





Allow DC/DC with SOC above: In this setting, create a charge limit so that the battery pack can start charging the vehicle's 12V battery.

Force use while battery charging & vehicle ready: Allows you to release the 12V battery charge while the vehicle is running or plugged into the charging socket.

Charge battery below and above: Create limits in Volts for 12V battery charge.

EV Output Signal Enabled DC/DC: configures the output signal for activating the relay for DC/DC operation.

25.7 Driveability

This function contains general vehicle driving settings such as: Creeping, reverse gear limiter, vehicle direction control and GearController.

Creeping

When activating this function, the vehicle will start to move as soon as the pressure on the brake pedal is being reduced by the driver. This function is very similar to a vehicle with an automatic transmission when the brake pedal is released.

Adjust the parameters so that the creeping function works as best serves the driver.

Creeping target by: defines whether the target will be based on vehicle speed or electric motor RPM.

Maximum torque at which the control will saturate: The percentage of torque at which the creeping function will deactivate.

Initial ramp of creeping torque: Creates a ramp from 0% to the value configured in "Maximum torque at which the control will saturate".

There are two ways to control time and pressure:

By time: When the brake is detected as inactive, the function will wait the configured time to reach the maximum torque value.

By brake pressure: When releasing pressure on the brake pedal, an interpolation will be made between the brake detection points and the maximum torque target. "Brake Servo" must be configured in the "Other functions" menu.

Driving Assistances	
Creeping	
Activate Creeping	
It starts moving the vehicle on released, after the end of the r to keep the vehicle or	n ramp when the brake pedal is ramp the PID control is activated n the selected target.
Creeping target by:	
Vehicle Speed	Electric motor RPM
Reference speed	Referce RPM
Maximum torque at which the c	control will saturate
By time Ramp time 500 ms	O By brake pressure
Time to reach maximum brake signal is dete	creeping torque after the cted as not pressed.
Drivability 4/17	C Drivability 5/17
eeping - Torque Limit	Creeping function
	Speed Reference
30.0	RRPM Reference





Reverse Limiter: Activates the reverse speed limit control. This control is very important as electric cars can reach the same speed in forward and reverse, it is mandatory to adjust these limits.

There are the same configurable parameters as the creeping function, minus the ramp.

Forward / reverse reversal: For electric vehicles, direction reversal is performed using a button not only through the gearbox (when equipped), it is necessary to define the maximum speed at which the change of direction will be performed. It is possible to press the direction change button at any time, but it will only act when the speed is below the maximum configured speed.



Activate control	
Limited by:	
Vehicle Speed	Electric motor RPM
Reference speed 10 ÷ km/h	Refence RPM 850 - RPM
imit torque in reverse	70.0
	70.0 - 70
ehicle direction swap For Forward	ward->Reverse Reverse-
ehicle direction swap For Forward Activate control	ward->Reverse Reverse-
chicle direction swap For Forward Activate control Maximum speed to allow ch	ward->Reverse Reverse-
ehicle direction swap For Forward Activate control Maximum speed to allow ch	nward->Reverse Reverse- ange of direction
chicle direction swap For Forward Activate control Aaximum speed to allow ch	nward->Reverse Reverse- ange of direction 8 - Implementation
chicle direction swap For Forward Activate control Aadmum speed to allow ch If the direction is chan speed higher than the s-	ange of direction B limit may have been been been been been been been be

GearController EV: Torque control for each gear change controlled by a button, when pressed, cuts engine torque electrically, in order to change gears without using the clutch. (Only for vehicles equipped with a gearbox).

Advanced settings: These settings act directly on the function's PID, in 99% of cases it is not necessary to adjust these parameters. If you are going to change any of these values, contact our technical support to seek guidance on how to proceed.

<	Crivability 17/17				
	Disabled Enabled				
	PowerShift Function				
×		·			

25.8 Charging Control

This function allows you to configure which On Board Charger will be used in the vehicle. Select the OBC Model and the VCU will be set with the parameters necessary for correct functioning of the charger.

Quick access panel	Chargi	ing control			
Comparison Comparison	On-Boar OBC Mo Thunde	ref Charger Control lodel derstruck TSM2500			
 Power Train Battery control DCDC converter Driving assistances 	Input for turning off the On-Board Charger DashBoard Button External button Release Charge				
Charging Control Other Functions Tothern I datalogoper Individual datal channel options Individual digital channel options Individual digital channel options Individual match channel options Thermatic fan #2 Water pump Signaling	Activation of the input button Turn off Charge Active at 0V Active at 12V Charge lock output Active at 0V Active at 12V Active a				
Charging control 2/7	>	Charging control 3/7			
On-Board Charger Control None Elcon H TSM 2500 Dilong DA3K3M WEG C	нк-J 3K3 DB66W	Input for turning off the On-board chager Dashboard button external button release charge			
×	$\overline{}$	×			



26. Rotary engines setup

FuelTech ECU will control the ignition timing using the reference of the 24 tooth wheel to calculate timing values based on the main timing table and corrections. All ignition timing programmed in the tables is referenced to the leading coil.

The trailing coil will be fired using the final calculated value from main timing table, including all corrections and timing controls, with an applied correction from the rotary timing split table. This means that if the ignition timing in the main table is 0° with no corrections and timing controls and the timing split is set as -10° in the rotary timing split table specific cell, the ECU will fire the leading coil at 0° and the trailing coil 10° after leading coil was fired.

If the rotary timing split values are different when the engine is operating with multiple cells, the ECU will interpolate the value between the cells and apply that value.



26.1 Crank angle sensor installation and alignment

The Crank Angle Sensor needs to be installed in the engine at 0° (top dead center position). To align it, follow this quick step by step

1. Use your ignition timing marks in the damper to align the eccentric to TDC. The ignition timing mark to be used is shown below.



2. Align the Crank Angle Sensor to 0° using the mark in the shaft.



3. Install and tighten the Crank Angle Sensor in the engine. After the steps above are correctly followed, the Crank Angle Sensor should be aligned at TDC with the eccentric shaft.

26.2 Crank angle sensor wiring

The stock distributor will be read by FT as a Crank Angle Sensor and Camshaft Position Sensor. Here's how to connect the FT to your stock Mazda distributor:



Function	Distributor wire	FuelTech wire	FuelTech pin
24 teeth signal (crank signal)	Red	Red from black shielded cable	1
24 teeth sensor negative	White	White from black shielded cable	2
2 teeth signal (home)	Green	Red from gray shielded cable	3
2 teeth sensor negative	White/Black	White from gray shielded cable	4

For engines using trigger wheel instead of distributor, here are the connections:



Function	FuelTech wire	FuelTech pin
12 teeth sensor (crank signal)	Red from black shielded cable	1
12 teeth sensor negative	White from black shielded cable	2
1 tooth sensor (home signal)	Red from gray shielded cable	3
1 tooth sensor negative	White from gray shielded cable	4

- A White from black shielded cable (crank trigger white wire)
- B Red from black shielded cable (crank trigger red wire)
- C White from gray shielded cable (Cam sync white wire)
- D Red from gray shielded cable (Cam sync red wire)





26.3 ECU setup

First, go to Fuel Injection Setup and enter the following:

- Max RPM: setup according to your engine;
- Injection mode: setup according to your engine;
- Idle by: TPS (fixed injection time on idle), MAP (injection time by MAP readings);
- Engine type: Rotary;
- Max boost pressure: setup according to your engine;
- Injectors banks: FT has two banks, setup how you want to use them (both as primary or A as primary and B as secondary);
- Acceleration fuel enrich: use by TPS, it's more accurate;

- Number of cylinders/rotors: setup according to your engine;
- Fuel injectors deadtime: if you don't have this info about your injectors, use 1,00ms;

Now, go to Ignition Setup and select:

- Ignition: Crank/Cam Ref. w/ Multi Coils;
- Crank Trigger Pattern: select option "12 (at crank) 24 (at cam)";
- First Tooth Alignment: 0 teeth or 5° BTDC;
- Crank Ref Sensor: VR differential;
- Crank Ref Edge: Falling edge;
- Cam sync position angle: 23° BTDC;
- Cam Sync Sensor: VR differential (FT600);
- Cam Sync Polarity: Falling edge;

Ignition output edge

Ignition system	ECU ignition output edge
Spark Pro	Falling dwell (Inductive / SparkPRO)
MSD DIS-2(1)	Rising duty (CDI)
MW Pro-14/R(2)	Falling dwell (Inductive / SparkPRO)
MW-Pro Drag 4/R(3)	Falling dwell (Inductive / SparkPRO)

Notes:

1. Use two (2) ignition units

2. Considering that MW PRO-14/R trigger edge need to be configured as Falling Dwell leaving pins 9 to 10 unconnected. See page 9 of MW Ignition manual for more details

3. There is no set up the trigger edge of Pro-Drag 4/R. Trigger edge is Falling Dwell by default.

After setting up Fuel Injection Setup and Ignition Setup menus, make sure you go through chapter 11.3 to generate a fuel and timing base map for your engine.

26.4 Ignition coils wiring

After setting everything up, the ignition outputs of the ECU are ready to be connected to your coils or ignition modules. FT ECU ignition outputs cannot be connected directly to dumb coils, only to smart coils (coils with integrated ignition module) or ignition modules.

For 2 rotor engines, the gray wires are connected as the table below shows:

ECU ignition output	Function	Recommended SparkPRO-4 channel
Gray wire #1	Leading rotor #1 – Coil L1	Channel 1
Gray wire #2	Leading rotor #2 – Coil L2	Channel 2
Gray wire #3	Trailing rotor #1 – Coil T1	Channel 3
Gray wire #4	Trailing rotor #2 – Coil T2	Channel 4

For 3 rotor engines, the gray wires are connected as the table below shows:

ECU ignition output	Function	Recommended SparkPRO-6 channel
Gray wire #1	Leading rotor #1 – Coil L1	Channel 1
Gray wire #2	Leading rotor #2 – Coil L2	Channel 2
Gray wire #3	Leading rotor #3 – Coil L3	Channel 3
Gray wire #4	Trailing rotor #1 – Coil T1	Channel 4
Gray wire #5	Trailing rotor #2 – Coil T2	Channel 5
Gray wire #6	Trailing rotor #3 – Coil T3	Channel 6



27. Electrical diagram - example FT600



Fuel Tech

FT450







Electrical diagram

FT550

<u>FuelTech</u>

157

FT550





28. FT450 and FT550 mounting kit

- 1-1/4" thread hex head screw
- 2-Mounting washer
- 3-Smart clip
- 4-Nut
- 5-Rubber mounts



NOTE

To use the internal accelerometer available in the FT550, the nuts and rubber mounts must be used to absorb vibration, otherwise the readings will be incorrect.





FT450 / FT550



FT600

Bracket





<u>Fuel Tech</u>

Smart Clip Dimensions FT450 / FT550





30. FTCAN 2.0 protocol

30.1 Physical layer

CAN 2.0B extended mode Rate: 1Mbps

Features

In this document we will approach the implementation of a custom protocol (FTCAN) running on top of a CAN 2.0B physical layer. One rain feature of the FTCAN protocol is to provide a means to segment a large stream of data into many smaller CAN packets. We will consider a CAN FRAME as indicated below:

CAN FRAME				
29 bits	0 to 8 bytes			
IDENTIFICATION	DATA FIELD			

30.2 IDENTIFICATION

The FTCAN will use the 29 bits of the IDENTIFICATION header to identify the device that originated the message. The 29 bits will be divided in order to provide information about: the unique product identifier, type of data and the type of message that is being sent. The bit division was planned in order to have multiple message priorities for the same type of product, and to have multiple priorities for the many different products inside the same CAN physical layer.

IDENTIFICATION (29 bits)						
Bits 28 to	Bits 13 to	Bits 10 to 0				
14 (15 bits)	11 (3 bits)	(11 bits)				
ProductID	DataFieldID	MessagelD				

ProductID

Identifies the product that has sent the message. The lower the ProductID the higher is the priority in the CAN bus. In the network two devices that are the same type of product (two O2 sensors for example) cannot have the same ProductID. In order to differentiate two products of the same type the ProductID bits are divided as show below.

ProductID (15 bits)					
Bit 14 to 5 (10 bits)	Bits 4 to 0 (5 bits)				
ProductTypeID	Unique identifier				

Each product that wants to send data to the CAN bus must have a unique identifier. Devices that will only receive data from the CAN bus doesn't need to have a unique ID.

The ProductIDs are divided in priority ranges:

•	Critical	priority:	0x0000	to	0x1FFF
---	----------	-----------	--------	----	--------

- High priority: 0x2000 to 0x3FFF
- Medium priority: 0x4000 to 0x5FFF
- Low priority: 0x6000 to 0x7FFF

A list with all the possible ProductTypeIDs is presented later in this document.

DataFieldID

Identifies the type of data structure that is being sent in the CAN FRAME -> DATA FIELD. There are 4 possible data layouts:

- 0x00: Standard CAN data field
- 0x01: Standard CAN data field coming from/going to a bus converter.
- 0x02: FTCAN 2.0 data field
- 0x03: FTCAN 2.0 data field coming from/going to a bus converter.

MessagelD

Identifies the data in the DATA FIELD. Example: commands, configuration data, real time readings, etc. The lower the MessageID the higher is the priority. The MessageID's most significant bit is reserved in order to identify a response from a command:

MessageID (11 bits)				
Bit 10 Bits 9 to 0 (10 bits)				
Response (value 1)	Message code			

The priorities ranges are:

- High priority: 0x100 a 0x1FF
- Medium priority: 0x200 a 0x2FF
- Low priority: 0x300 a 0x3FF

A list with all the possible MessageIDs is presented later in this document.

30.3 DATA FIELD

The DATA FIELD can have up to 8 data layouts accordingly to the DataFieldID's value. All values in the DATA FIELD are transmitted as big-endian.

DataFieldID 0x00: Standard CAN

In this data layout all 8 bytes of the DATA FIELD are used as valid data (PAYLOAD). All data are transmitted in one shot since this mode doesn't implement data segmentation.

DATA FIELD (1 to 8 bytes)							
0	1	2	3	4	5	6	7
PAYLOAD							

DataFieldID 0x01: Standard CAN Bridge (bridge, gateway or converter)

In this data layout all 8 bytes of the DATA FIELD will be forwarded by the bus converter. The DataFieldID (0x01) is also used to identify packets that are originated outside the CAN bus. Bridge examples are: Standalone USB-CAN converter, FT500's USB-CAN bridge, etc.



DATA FIELD (1 to 8 bytes)								
0 1 2 3 4 5 6 7								
PAYLOAD								

DataFieldID 0x02: FTCAN 2.0

This is the DataFieldID that all FuelTech's devices will use to communicated with each other in the CAN bus. The data segmentation feature is implemented in this type of data layout. As can be seen in the diagrams below the segmentation feature uses the first byte of the DATA FIELD to indicate which segment of the following bytes is. There can be 2 types of packets:

- Single packet (all data is transmitted in one CAN packet)
- Segmented packet (data is transmitted in multiples CAN packets)

Single packet

The first byte of the DATA FIELD will have the value of 0xFF. The following 7 bytes will have the message data (PAYLOAD).

DATA FIELD (1 to 8 bytes)							
0	1	2	3	4	5	6	7
OxFF			PA	YLO/	٩D		

Segmented packet

In the first byte of the DATA FIELD there will be values ranging from 0x00 to 0xFE. The first segment will have the 0x00 value and the following packets will contain 0x01, 0x02 and so on. In the first segment the 2 bytes following the 0x00 value contain the segmentation data.

DATA FIELD (8 bytes)											
0 1 2 3 4 5 6 7											
0x00	SEGME D/	NTATION ATA		PA	YLC	AD					

The segmentation data contains the following information:

				SEC	MEN	TATI	ON [DATA	(2 b	ytes)					
Bytes	Bytes 1 2															
Bits	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	RFU RFU RFU RFU RFU PAYLOAD total length (in bytes)															

RFU: Reserved for Future Use

DataFieldID 0x03: FTCAN 2.0 Bridge (bridge, gateway or converter)

This DataFieldID uses the same data layout from DataFieldID's 0x02 when the data is going to or coming from a BUS converter.

First segment

DATA FIELD (1 to 8 bytes)									
0	1	2	3	4	5	6	7		
0x00	0x00 PAYLOAD								

Second segment

DATA FIELD (1 to 8 bytes)											
0	1	2	3	4	5	6	7				
Ox01 PAYLOAD											

Third segment (if present)

DATA FIELD (1 to 8 bytes)											
0	1	2	3	4	5	6	7				
0x02			PA	YLO/	AD						

Last segment (if present)

NOTE

DATA FIELD (1 to 8 bytes)											
0	1	2	3	4	5	6	7				
OxFE			PA	YLOA	AD						

Ć

The maximum PAYLOAD length will be: 5 + (0xFD * 7) = 1776 bytes.



30.4 Attachments

ProductID's list

Since the 5 least significant bits of the ProductID are used for the unique value the FTCAN protocol can have up to 32 devices of the same product type at the same time. The unique value will range from 0x00 to 0x1F. The limit for different products types will be 1024.

		ProductID		
Priority	DreductTurcelD	Ra	nge	Product Type
	ProductTypeID	Start	Finish	
Critical		OxOFFF	OxOFFF	Device searching a ProductID (unique value undefined)
High	0x0140	0x2800	0x281F	Gear Controller
High	0x0141	0x2820	0x283F	Knock Meter
High	0x0142	0x2840	0x285F	Boost Controller 2
High	0x0150	0x2A00	0X2A1F	Reserved for Future Use
Medium	0x0240	0x4800	0x481F	WBO2 Nano
Medium	0x0241	0x4820	0x483F	WBO2 Slim
Medium	0x0242	0x4840	0x485F	Alcohol O2
Medium	0x0243	0x4860	0x4861	FTSPARK
Medium	0x0244	0x4880	0x4881	Switchpanel-8
Medium	0x0244	0x4882	0x4883	Switchpanel-4
Medium	0x0244	0x4884	0x4885	Switchpanel-5
Medium	0x0244	0x4886	0x4887	Switchpanel-8 mini
Medium	0x0245	0x48A0	0x48BF	Reserved for Future Use
Medium	0x0246	0x48C0	0x48DF	Reserved for Future Use
Medium	0x0280	0x5000	0x501F	FT500 ECU
Medium	0x0281	0x5020	0x503F	FT600 ECU
Medium	0x0282	0x5040	0x505F	First reserved range for future ECUs
Medium				
Medium	0x02E4	0x5C80	0x5C9F	Last reserved range for future ECUs
Low	0x0340	0x6800	0x681F	Reserved for Future Use
Reserved		0x0800	0x0800	FuelTech EGT-8 CAN (model A)
Reserved		0x0880	0x0880	FuelTech EGT-8 CAN (model B)

Example: A FT500 device with the unique value of 3 will have the following ProductID:

(0x0280 << 5) + 3 = 0x5003

Where 0x0280 is the ProductTypeID for FT500 and 3 is the unique value. The "<<" is the C language command rotate bit left, 0x0280 <<< 5 is the same as multiply 0x0280 with 0x0020.

MessagelD's list

- 0x0FF, 0x1FF, 0x2FF e 0x3FF Real time reading broadcast 0x0FF – Critical priority
 - 0x1FF High priority
 - 0x2FF Medium priority
 - 0x3FF Low priority

on the type of data, critical data will be broadcasted more often. Examples of critical data: Ignition Cut, Two Step signal, emergency signals, etc. Examples of high priority data: RPM, ignition timing, actual injection flow, MAP, TPS, etc.

Values are always transmitted as signed 16 bits in big-endian byte order.

Statuses are transmitted as big-endian unsigned 16 bits. Each real time data will be composed of 4 bytes:

REAL TIME DATA							
O-1	2-3						
Data identifier	Value or status						
(MeasureID)	(big endian)						

If a device needs to broadcast more than one reading at the same time it can do so using a segmented packet:

Those are the MessageIDs that the FuelTech's device will use to transmit its real time readings. The rate for each broadcast will depend



Segmented packet PAYLOAD							
MEASURE 1							
O-1	2-3						
MeasurelD	Value/Stat						

MEASURE 2						
4-5	6-7					
MeasurelD	Value/Stat					

MEASURE 3						
8-9	10-11					
MeasurelD	Value/Stat					

NOTE

The maximum number of measures that can be transmitted on segmented packages are: 1776/4 = 444

Another possibility is to use a CAN standard data frame to transmit 2 measures at a time, all the devices in the CAN bus must be capable of receiving data using all the data layouts.

Segmented packet PAYLOAD										
MEASU	IRE 1	MEASURE 2								
0-1	2-3	4-5 6-7								
MeasurelD	Value	MeasurelD	Value							

A list with the available MeasureIDs is presented further in this document.

• 0x600, 0x601, e 0x602 – Real time simple broadcast

Those are the MessageIDs that the FueITech's device will use to transmit its real time readings using a fixed set of MeasureIDs. Each measure value is prefixed in a specific position in payload. The rate for each broadcast is 100Hz.

Values are always transmitted as signed 16 bits in big-endian byte order.

The data is transmitted **always** using a CAN standard data frame (DataFieldID 0x00) to transmit 4 measures at a time as shown in the following image:

Segmented packet PAYLOAD								
MEASURE 1	MEASURE 2	MEASURE 3	MEASURE 4					
0-1 2-3		4-5	6-7					
Value Value		Value	Value					

The MeasureIDs transmitted in each message are:

Massam	Measure 1		Measure 2		Meas	sure 3	Measure 4	
MCSSageid	MeasureID	Description	MeasurelD	Description	MeasurelD	Description	MeasureID	Description
0x600	0x0002	TPS	0x0004	MAP	0x0006	Air temp	0x0008	Engine temp
0x601	A000x0	Oil pressure	0x000C	Fuel pressure	0x000E	Water pressure	0x0022	Gear
0x602	0x004E 0x004F	Exhaust O2	0x0084	ECU RPM	0x0118	Oil temp	0x011A	PitLimit Switch

MeasurelDs

The least significant bit of the MeasurelD is used to indicate if the following value is the actual value or the reading status. Considering that the MeasurelD have 16 bits in total we will use 15 bits to identify the data that is being transmitted.

MeasureID							
Bits 15 to 1	Bit 0						
Data identifier	0: Data value						
(DatalD)	1: Data status						



MeasureID	DatalD	Description	Unity	Multiplier	Broadcast source (rate*)
0x0000	0x0000	Unknown	-	-	-
0x0002	0x0001	TPS	%	0.1	
0x0004	0x0002	MAP	Bar	0.001	POWEIFT ECU TUUHZ
0x0006	0x0003	Air temperature		0.1	
0x0008	0x0004	Engine temperature		0.1	FOWEIFT EGU TUMZ
0x000A	0x0005	Oil pressure			
0x000C	0x0006	Fuel pressure	Bar	0.001	PowerFT ECU 100Hz
0x000E	0x0007	Water pressure			
0x0010	0x0008	ECU Launch Mode (2-Step, 3-Step, Burnout, Burnout + Spool)	-	Note 1	PowerFT ECU 100Hz
0x0012	0x0009	ECU Battery voltage	Volts	0.01	PowerFT ECU 100Hz
0x0014	0x000A	Traction speed	Km/h	1	PowerFT ECU 100Hz
0x0016	0x000B	Drag speed			Gear Controller 100Hz
0x0018	0x000C	Left front wheel speed	-		
0x001A	0x000D	Right front wheel speed	Km/h	1	PowerFT ECU 100Hz
0x001C	0x000E	Left rear wheel speed	1		
0x001E	0x000F	Right rear wheel speed			
0x0020	0x0010	Driveshaft RPM	RPM	1	PowerFT ECU 100Hz
0x0022	0x0011	Gear	-	Note 2	PowerFT ECU 100Hz
					WBO2 Nano 100Hz
0x0024	0x0012	Disabled O2		0.001	WBO2 Slim 100Hz
ONOOL 1	0/10012			0.001	Alcohol O2 100Hz
0x0026	0.0010	O l'actor 1 00			
0x0027	0x0013	Cylinder 1 Oz			
0x0028	0x0014	Cylinder 2 O2			
0x0029		- ,	-		
0x002A	0x0015	Cylinder 3 O2			
0x002D			-		
0x002D	0x0016	Cylinder 4 O2			
0x002E	0x0017	Ω uinder 5 Ω 2]		
0x002F	0,00017		-		
0x0030	0x0018	Cylinder 6 O2			
0x0031					
0x0033	0x0019	Cylinder 7 O2			
0x0034	0.0014	O l'aster 0.00			PowerFT ECU 100Hz
0x0035	UXUUTA	Cylinder 8 Oz	λ	0.001	WBO2 Nano 100Hz
0x0036	0x001B	Cylinder 9 02		0.001	WBO2 Slim 100Hz
0x0037			-		Alcohol O2 100Hz
0x0038	0x001C	Cylinder 10 O2			
0x003A			-		
0x003B	0x001D	Cylinder 11 O2			
0x003C	0×001E	Winder 12 O2	1		
0x003D			-		
0x003E	0x001F	Cylinder 13 O2			
0x003F			-		
0x0040	0x0020	Cylinder 14 O2			
0x0042	0.0001		-		
0x0043	UXUU21	Cylinder 15 02			
0x0044	0x0022	Cylinder 16 O2			
0x0045		Oymiddi i O OE			



MeasureID	DatalD	Description	Unity	Multiplier	Broadcast source (rate*)		
0x0046	0×0023	Winder 17 02					
0x0047	0x0023						
0x0048	0x0024	Cylinder 18 O2					
0x0049					PowerFT ECU 100Hz		
0x004A	0x0025	Left bank O2	λ	0.001	WBO2 Nano 100Hz		
0x004B					WBO2 Slim 100Hz		
0x004C	0x0026	Right bank O2			Alcohol O2 100Hz		
0x004D							
0x004E	0x0027	Exhaust O2					
0x004F	0,0000	Dischlad ECT	°C	0.1			
0x0050	0x0020		0	0.1			
0x0052	0x0029		-				
0x0054			-				
0x0056	0x002B						
0x0058	0x002C						
0x005A	0x002D	Cylinder 5 EGT					
0x005C	0x002E	Cylinder 6 EG I	-				
0x005E	0x002F	Cylinder 7 EGT	-				
0x0060	0x0030	Cylinder 8 EGT	-				
0x0062	0x0031	Cylinder 9 EG I	1				
0x0064	0x0032	Cylinder 10 EGT					
0x0066	0x0033	Cylinder 11 EGT	°C	0.1	PowerFT ECU 100Hz		
0x0068	0x0034	Cylinder 12 EGT	-				
0x006A	0x0035	Cylinder 13 EGT	-				
0x006C	0x0036	Cylinder 14 EGT	-				
0x006E	0x0037	Cylinder 15 EGT					
0x0070	0x0038	Cylinder 16 EGT					
0x0072	0x0039	Cylinder 17 EGT					
0x0074	0x003A	Cylinder 18 EGT					
0x0076	0x003B	Left bank EGT					
0x0078	0x003C	Right bank EGT					
0x007A	0x003D	Exhaust EGT					
0x007C	0x003E	ECU O2 Sensor Unit	-	Note 3			
0x007E	0x003F	ECU Speed Sensor Unit	-	Note 4			
0x0080	0x0040	ECU Pressure Sensor Unit	-	Note 5	FOWEIT FLOO 0.0112		
0x0082	0x0041	ECU Temperature Sensor Unit	-	Note 6			
0x0084	0x0042	ECU RPM	RPM	1	PowerFT ECU 1KHz		
0x0086	0x0043	ECU Injection Bank A Time		0.01			
0x0088	0x0044	ECU Injection Bank B Time		0.01			
0x008A	0x0045	ECU Injection Bank A Duty Cycle	0/	0.1	PowerFT ECU TUUHZ		
0x008C	0x0046	ECU Injection Bank B Duty Cycle	70	0.1			
0x008E	0x0047	ECU Ignition Advance/Retard	0	0.1	PowerFT ECU 1KHz		
0,0000	0,0040	O Ohan Cianal		Nicto 7	PowerFT ECU 1KHz		
0x0090	UXUU48	2-Step Signal	-	INOTE /	Gear Controller 1KHz		
0x0092	0x0049	3-Step Signal		Nicto 7			
0x0094	0x004A	Burnout Signal] -	INOLE /	FOWEIFT EGU TUUHZ		
0x0096	0x004B	ECU Cut	%	1	PowerFT ECU 100Hz		
0x0098	0x004C	ECU Air Conditioning		Nicto 7			
0x009A	0x004D	ECU Electro Fan	1 -	INOTE /	POWERT EGU TUUHZ		
0x009C	0x004E	GEAR Cut	%	1			
0x009E	0x004F	GEAR Retard	0	0.1	Gear Controller SUUHZ		



MeasurelD	DatalD	Description	Unity	Multiplier	Broadcast source (rate*)	
0x00A0	0x0050	GEAR Sensor Voltage	Volts	0.001	Gear Controller 100Hz	
0x00A2	0x0051	ECU Average O2	λ	0.001	PowerFT ECU 100Hz	
0x00A4	0x0052	External Ignition output 1 discharge time				
0x00A6	0x0053	External Ignition output 2 discharge time	1			
0x00A8	0x0054	External Ignition output 3 discharge time	1			
0x00AA	0x0055	External Ignition output 4 discharge time	1			
0x00AC	0x0056	External Ignition output 5 discharge time	1			
0x00AE	0x0057	External Ignition output 6 discharge time	1			
0x00B0	0x0058	External Ignition output 7 discharge time	1			
0x00B2	0x0059	External Ignition output 8 discharge time				
0x00B4	0x005A	External Ignition output 9 discharge time	- uS	1		
0x00B6	0x005B	External Ignition output 10 discharge time	1			
0x00B8	0x005C	External Ignition output 11 discharge time	1		FTSPARK 50Hz	
0x00BA	0x005D	External Ignition output 12 discharge time				
0x00BC	0x005E	External Ignition output 13 discharge time	1			
0x00BE	0x005F	External Ignition output 14 discharge time	1			
0x00C0	0x0060	External Ignition output 15 discharge time	1			
0x00C2	0x0061	External Ignition output 16 discharge time	1			
0x00C4	0x0062	External Ignition Power Supply				
0x00C6	0x0063	External Ignition Power Supply Drop		.001		
0x00C8	0x0064	External Ignition Power Level	mJ	1		
0x00CA	0x0065	External Ignition Temperature	°C	0.1		
0x00CC	0x0066	External Ignition Capacitor 1 charge		0.1		
0x00CE	0x0067	External Ignition Capacitor 2 charge				
0x00D0	0x0068	External Ignition Capacitor 3 charge	- V			
0x00D2	0x0069	External Ignition Capacitor 4 charge	1			
0x00D4	0x006A	External Ignition Capacitor 1 charge time		1	FTSPARK 50Hz	
0x00D6	0x006B	External Ignition Capacitor 2 charge time				
0x00D8	0x006C	External Ignition Capacitor 3 charge time	- uS			
0x00DA	0x006D	External Ignition Capacitor 4 charge time	1			
0x00DC	0x006E	External Ignition Error code	-	Note 8		
0x00DE	0x006F	External Ignition no load outputs	-			
0x00E0	0x0070	External Ignition partial discharge outputs	-	Note 9	FISPARK 25Hz	
0x00E2	0x0071	External Ignition damaged outputs	-	1		
0x00E4	0x0072	External Ignition disabled outputs	-	Note 9		
0x00E6	0x0073	External Ignition operation status	-	Note 10	FISPARK 25Hz	
0x00E8	0x0074	Power level config for external ignition	mJ	1	PowerFT ECU 10Hz	
0x00EA	0x0075	Air conditioning button state				
0x00EC	0x0076	Two step button state	1 -	Note 7	Internal use only	
OxOOEE	0x0077	Three step button state	1			
0x00F0	0x0078	Transbreak button state				
0x00F2	0x0079	Burnout button state	1			
0x00F4	0x007A	ProNitrous button state	1			
0x00F6	0x007B	Progressive Nitrous #1 button state	1			
0x00F8	0x007C	Datalogger button state	1			
0x00FA	0x007D	Day/Night button state		Note 7	Internal use only	
0x00FC	0x007E	Dashboard button state	1			
0x00FE	0x007F	Engine start button state	1			
0x0100	0x0080	Generic PWM output increase button state	1			
0x0102	0x0081	Gear upshift button state	1			



MeasurelD	DatalD	Description	Unity	Multiplier	Broadcast source (rate*)		
0x0104	0x0082	Boost controller increase button state					
0x0106	0x0083	Gear reset button state					
0x0108	0x0084	Adjust change button					
0x010A	0x0085	Adjust 1 button					
0x010C	0x0086	Adjust 2 button		Note 7	Internal use only		
0x010E	0x0087	Adjust 3 button	-				
0x0110	0x0088	Adjust 4 button	-				
0x0112	0x0089	Adjust 5 button	-				
0x0114	0x008A	Transmission temperature					
0x0116	0x008B	Intercooler temperature	- °C	0.1	Internal use only		
0x0118	0x008C	Oil temperature					
0x011A	0x008D	PitLimit Switch/Button					
0x011C	0x008E	Active Traction Control: enable switch	-				
0x011E	0x008E	Active Traction Control: table 1 button	-				
0x0120	0x0000	Active Traction Control: table 2 button	-				
0x0120		Active Traction Control: table 3 button	_				
0x0122	0x00001	Active Traction Control: table 4 button		Note 7	Internal use only		
0x0124	0x00032	Active Traction Centrel: table 5 button	-				
0x0120	0x0093	Active Traction Control: table 5 button	-				
0x0120	0x0094		_				
0x012A	0x0095	Active Traction Control: next table button	_				
0x0120	0x0096	Active fraction Control: previous table button					
0x012E	0x0097	Tire temperature: Front Leit	_				
0x0130	0x0098	lire temperature: Front Right		0.1			
0x0132	0x0099	lire temperature: Rear Lett		0.1	internal use only		
0x0134	0x009A	lire temperature: Rear Right	_				
0x0136	0X009B	Irack temperature					
0x0138	0x009C	Generic Input: button 1	_				
0x013A	0x009D	Generic Input: button 2	_				
0x013C	0x009E	Generic Input: button 3	_				
0x013E	0x009F	Generic Input: button 4	_				
0x0140	0x00A0	Generic Input: button 5	_				
0x0142	0x00A1	Generic Input: button 6		Note 7	Internal use only		
0x0144	0x00A2	Generic Input: button 7					
0x0146	0x00A3	Generic Input: button 8					
0x0224	0x0112	Left turn signal					
0x0226	0x0113	Right turn signal					
0x0228	0x0114	Low beam					
0x022A	0x0115	High beam					
0x022C	0x0116	External Ignition Switch voltage		0.001			
0x022E	0x0117	External Ignition CPU supply voltage	v	0.001	FTSPARK 25Hz		
0x0230	0x0118	External Ignition CPU temperature	°C	0.1			
0x0232	0x0119	External Ignition operation time	S	0.1	FTSPARK 10Hz		
0x0234	0x011A	MFI external switch					
0x0236	0x011B	Progressive Nitrous #2 button state					
0x0238	0x011C	Gear Reverse button	-	Note 7	Internal use only		
0x023A	0x011D	Gear Drive button					
0x023C	0x011E	Blip signal	1				
0x023E	0x011F	Bank A Injector 1 Duty cycle					
0x0240	0x0120	Bank A Injector 2 Duty cycle	%	0.1	PowerFT ECU 10Hz		
0x0242	0x0121	Bank A Injector 3 Duty cycle					



MeasurelD	DatalD	Description	Unity	Multiplier	Broadcast source (rate*)		
0x0244	0x0122	Bank A Injector 4 Duty cycle					
0x0246	0x0123	Bank A Injector 5 Duty cycle]				
0x0248	0x0124	Bank A Injector 6 Duty cycle]				
0x024A	0x0125	Bank A Injector 7 Duty cycle]				
0x024C	0x0126	Bank A Injector 8 Duty cycle					
0x024E	0x0127	Bank A Injector 9 Duty cycle					
0x0250	0x0128	Bank A Injector 10 Duty cycle					
0x0252	0x0129	Bank A Injector 11 Duty cycle					
0x0254	0x012A	Bank A Injector 12 Duty cycle					
0x0256	0x012B	Bank B Injector 1 Duty cycle					
0x0258	0x012C	Bank B Injector 2 Duty cycle	%	0.1	PowerFT ECU 10Hz		
0x025A	0x012D	Bank B Injector 3 Duty cycle					
0x025C	0x012E	Bank B Injector 4 Duty cycle					
0x025E	0x012F	Bank B Injector 5 Duty cycle					
0x0260	0x0130	Bank B Injector 6 Duty cycle					
0x0262	0x0131	Bank B Injector 7 Duty cycle					
0x0264	0x0132	Bank B Injector 8 Duty cycle					
0x0268	0x0133	Bank B Injector 9 Duty cycle					
0x026A	0x0134	Bank B Injector 10 Duty cycle					
0x026C	0x0135	Bank B Injector 11 Duty cycle					
0x026E	0x0136	Bank B Injector 12 Duty cycle					
0x0270	0x0137	Gear downshift button state	-	Note 7	Internal use only		
0x0274	0x0138	Battery temperature	°C	0.1	PowerFT ECU 10Hz		
0x0276	0x0139	Available					

Only one of the possible sources is allowed to broadcast a specific DatalD on the network. If one or more sources are broadcasting the same DatalD a network conflict state is raised.

*The broadcast transmission rate may vary when the ECU is under high RPM.

Note 1	Value 0xFF: Undefined	hi	igh voltage bu	s. (extern	nal ignition disabled until next power
Value 0: None (running) Value 1: Burnout Value 2: Burnout Spool (Burnout and 2-Step) Value 3: 3-Step Value 4: 2-Step	Note 4 Value 0: Km/h Value 1: Mph Note 5 Value 0: bar Value 1: PSI	ci - B - B - B - B	icle). it 3: Under volt (nition disabled it 4: Charge ci it 5: Power sup it 6: 12V switc	age in the while cor rcuit unab oply unde h under v	e output drivers power supply. (external ndition exists). ble to charge capacitors. er voltage. roltage.
Note 2 Value -1: Reverse Value 0: Neutral	Value 2: KPa Note 6 Value 0: °C	Note 9 Bit 0: Bit 1:	9 Output 1 Output 2	Bit 14: Bit 15:	Output 15 Output 16
Value 1: First gear Value 2: Second gear Value 3: Third gear Value 4: Fourth gear Value 5: Fifth gear Value 6: Sixth gear	'alue 1: °F Jote 7 'alue 0: Off 'alue 1: On	Bit 2: Bit 3: Bit 4: Bit 5: Bit 6:	Output 3 Output 4 Output 5 Output 6 Output 7	Note 1 Bit 0: Bit 1: Bit 2:	O Internal use Internal use High power mode enabled
Note 3 Value 0: Undefined Value 1: Lambda Value 2: AFR ethanol Value 3: AFR methanol Value 4: AFR gasoline	 Bit 0: Unknown pulse width received by the FT Ignition Bus. Bit 1: Incorrect ignition order in semi-sequential operation. Bit 2: Over voltage in the 	Bit 7: Bit 8: Bit 9: Bit 10: Bit 11: Bit 12: Bit 13:	Output 8 Output 9 Output 10 Output 11 Output 12 Output 13 Output 14	Note 1 Increme cylinder	1 Intal counter of errors in the respective



Simplified packets

In addition to the standard packets the FTCAN 2.0 can also be used in conjunction with simplified broadcast packets. This simplified broadcast packets have a fixed and defined data structure and are only broadcasted by the ECUs. The following table shows the simplified packets:

		Bytes									
ID (FT500)	ID (FT600/550/450)	1	2	3	4	5	6	7	8		
0x14000600	0x14080600	TPS		MAP		Air temp		Engine Temp			
0x14000601	0x14080601	Oil Pressure Fuel Pressure		Water Pressure		Gear					
0x14000602	0x14080602	Exhaust O2 RF		PM	Oil T	ēmp	Pit Limit				
0x14000603	0x14080603	Wheel S	peed FR	Wheel Speed FL		Wheel Speed RR		Wheel Speed RL			
0x14000604	0x14080604	Traction (Ctrl - Slip	Traction Ctrl - Retard		Traction	Ctrl - Cut	Hea	ding		
0x14000605	0x14080605	Shock se	ensor FR	Shock sensor FL		Shock sensor FL		Shock se	ensor RR	Shock s	ensor RL
0x14000606	0x14080606	G-forge	e (accel)	G-force (lateral)		Yaw-rate	e (frontal)	Yaw-rate	e (lateral)		
0x14000607	0x14080607	Lambda (Correction	Fuel Flo	w Total						

30.5 Connector Pinout

PowerFT ECUs

Frontal view of the connector on the back of the ECU

CAN A





CAN B

Examples

Example 1: Standard CAN layout - Single packet with RPM value





Example 2: Standard CAN layout - Single packet with RPM and TPS values



Example 3: FTCAN layout - Single packet with RPM value

	CAY	FRAME					
	IDENTIFICATION	DATA FIELD					
	140011FF	FF00 84 07 D0					
->	ProductID (0x140011FF / 0x4000) = 0x5000	Single packet					
	ProductTypeID 0x5000 / 0x20 = 0x280 (FT500) UniqueID 0x5000 &0x1F = 0x0	MesureID: 0x0084 DataID: 0x0084 (Vox = 0x42 (ECU RPM) Value or Status: 0x0084 & 0x1 = 0x0 (value)					
	DataFieldID (0x140011FF / 0x800) & 0x7 = 0x2	Value: 0x007D0 ECU RPM: 2000 RPM					
	FTCAN 2.0 data field						
L	MessageID 0x140011FF & 0x7FF = 0x1FF						
	Is Response 0x1FF/0x400 = 0x0 (Not) Message Code 0x1FF & 80x3FF = 0x1FF (Real time reading transdata, high priority)						

Example 4: FTCAN layout - Multiple packets with 5 different values







 \odot



455 Wilbanks Dr. Ball Ground, GA, 30107, USA

Phone: +1 678-493-3835

E-mail: info@FuelTech.net www.FuelTech.net



POWER FT