



Twin Tec

--TCFI Gen 7 & M8FI Racing EFI-- Tuning Manual

CAUTION: CAREFULLY READ INSTRUCTIONS BEFORE PROCEEDING. DESIGNED FOR RACING. NOT LEGAL FOR SALE OR USE IN CALIFORNIA OR ON POLLUTION CONTROLLED VEHICLES.

OVERVIEW – CONCEPT

Our Racing EFI system has been designed for **offroad racing use** in the “King of the Baggers” racing series. Each Racing ECU has been designed to plug directly into the factory HD harness.

- 17800 - TCFI7 → 2014-2016 Twin Cam Ultra/Touring - Natural Aspiration Engines (Utilizes OE 1 Bar)
- 17801 - TCFI7 → 2014-2016 Twin Cam Ultra/Touring - Turbo Engines (Utilizes Trask 2.5 Bar Sensor)
- 17802 - TCFI7 → 2014-2016 Twin Cam Ultra/Touring - Turbo Engines (Includes DTT 3 Bar Sensor)
- 17803 - TCFI7 → 2016-2017 Twin Cam Softail Models -NA Engines (Utilizes OE 1 Bar)
- 17804 - TCFI7 → 2016-2017 Twin Cam Softail Models - Turbo Engines (Utilizes Trask 2.5 Bar Sensor)
- 17805 - TCFI7 → 2016-2017 Twin Cam Softail Models - Turbo Engines (Includes DTT 3 Bar Sensor)
- 17808 – M8FI → 2017-2020 M8 Ultra/Touring - Natural Aspiration Engines (Utilizes OE 1 Bar)
- 17809 - M8FI → 2017-2020 M8 Ultra/Touring - Turbo Engines (Utilizes Trask 2.5 Bar Sensor)
- 17810 - M8FI → 2017-2020 M8 Ultra/Touring - Turbo Engines (Includes DTT 3 Bar Sensor)
- 17811 - M8FI → 2018-2020 M8 Softail Models - Natural Aspiration Engines (Utilizes OE 1 Bar)
- 17812 - M8FI → 2018-2020 M8 Softail Models - Turbo Engines (Utilizes Trask 2.5 Bar Sensor)
- 17813 - M8FI → 2018-2020 M8 Softail Models - Turbo Engines (Includes DTT 3 Bar Sensor)
- 2021-2023 M8 ECU – Coming Soon

→ M8FI and TFI7 require the use of version 20.0+ of the PC_LINK.exe tuning and TCFI_LOG.exe logging software. V20.0 has numerous updates including storing the options in the tune file and ECU.

AUTO-TUNE is included in all of our EFI systems.

To utilize **AUTO-TUNE**, the wideband O2 sensors must be installed in the exhaust AND closed loop must be enabled in the tune. After the engine is warm and close loop becomes active, AUTO-TUNE

learns fuel trim corrections. To apply the fuel corrections to the tune, the uploaded from the ECU and applied to the tune (corrections adjust the main and front fuel tables).

IMPORTANT NOTE: You must do some basic tuning before enabling the **AUTO-TUNE** feature. The tune on your motorcycle must be functioning at a basic level before using this feature. **It must start and run without popping and blowing black smoke.** Use the Real Time Data view and the build in data-logging to monitor and adjust the tune.

- **Data Logging is automatically enabled** – Anytime the engine is running, data is always recorded by the ECU in an endless loop, constantly overwriting the oldest data with the new data. Use the TCFI-M8 Data Logging software to read back the data that is automatically stored in the ECU.
- **Tuning, monitoring and data log playback** occurs via the USB Interface and the PC_LINK.exe tuning software or the TCFI_LOG.exe data log viewing software. The USB interface is the small black box; it connects between the USB port on your PC and the WEGO IIID (see the diagram labeled **TCFI7 & M8FI EFI SYSTEM DIAGRAM**).

Download Software and device Drivers

- PC_LINK_TCFI.exe -- PC Software that is used to tune the ECU. This software is also used to program the VIN, Odometer and Auto-Calibrate the ETC System. When using the Auto-Tune feature – this software is used to read the learning out of the ECU and apply it to the fuel tables.
- TCFI_LOG.exe is the PC Software is used to view/clear codes, view live data as the engine is running or read and view data log files out of the ECU.
- Find the latest software at: daytona-twintec.com/software
- Run the installer: https://jmschip.com/content/DTT/Software/TCFI_Software_Installer.exe
- Run the update: https://jmschip.com/content/DTT/Software/M8FI-TCFI7_SelfInstallUpdate_204-1991_041024.exe

A video tutorial for assisting with installing and using the software is available on YouTube:

<https://youtu.be/QOCByMf6wpk>

CAUTION: Tuning the TCFI requires competency in PC operation, using Microsoft Windows based programs, and basic engine tuning and fuel injection mapping concepts. The TCFI installer is assumed to be familiar with the Harley-Davidson® fuel injection system and to have access to basic test equipment and factory service manuals.

TUNING GUIDE



Important Note:

Before attempting to modify the current tune, we recommend reading entirely the document “**TCFI7_and-M8_installation_and_quick_setup.pdf**”, available for download on JMS-Daytona website. You **MUST** perform the initial setup and checks as outlined in the said document prior to start and run/ride the vehicle.

SOFTWARE INSTALL AND FIRST RUN

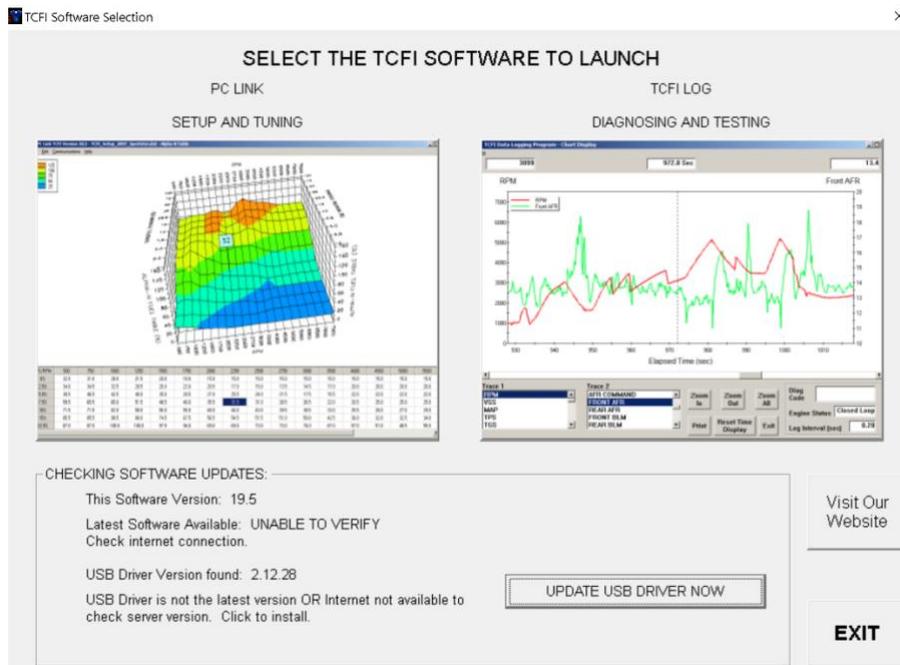
After successful software install, open the files location; typically they will be in the following location:

[Windows \(C:\) > Program Files \(x86\)>Daytona TwinTec>TCFI_Software](#)



Locate in folder the TCFI Launcher.exe icon  and place a shortcut on desktop. Double click on newly created shortcut.

A window will open listing the two programs available to run:



For tuning click the image to the left – PC LINK. For data logging and some special features, click the image on the right – TCFI LOG.

THE PC LINK APPLICATION *parameters, tables, functions and basic tuning procedure*

EDITING, CREATING and SAVING TUNE FILES

After initial setup, the tuning process may require multiple edits of the engine tables and parameters using **PC_Link** software. Unless you want to start with a blank slate, editing involves downloading the current tune from TCFI, performing the required edits, saving table edits to buffer memory, saving the revised setup file to disk, and then uploading it to the TCFI. You should always print out any affected tables and parameters and save each revised file with a unique filename. Use a filename that incorporates the customer’s name and a date code, such as JMS_20240410_a.dat. We suggest that you create a separate folder for all tuning files. Keep detailed written notes on the changes you make and the associated filenames. Make frequent backup copies onto removable media such as a USB Flash drive.

Customers with limited PC experience often become confused and have problems with simple Windows file management functions including the use of the Windows Explorer. We regret that we cannot provide tech support for Windows related issues. We suggest that you spend some time practicing with the

PC_Link_TCFI and TCFI_Log software, including the Copy, Paste, and Modify commands on the right mouse button popup menu.

ACRONYMS USED IN THIS DOCUMENT

ACR – automatic compression release
AFR – air fuel ratio
BCM – body control module
BLM – block learn multiplier
BTDC – before TDC
CL – closed loop
DTC – diagnostic trouble code
ECM – electronic control module, also called ECU, PCM
ET – engine temperature
ETC – engine coolant temperature
IAC – idle air control valve
IAT – intake air temperature
MAP – manifold absolute pressure
USB – universal serial bus (mechanism to connect peripheral devices to computer)
PCM – power control module
PW – pulse width (injectors)
PWM – pulse width modulation
TB – throttle body
TCFI – TwinCam Fuel Injection
TDC – top dead center
TPS – throttle position sensor
TGS – twist-grip sensor, sometimes called TGA – twist grip actuator
VSS – vehicle speed sensor
WOT – wide open throttle

DOWNLOADING and UPLOADING DATA

The USB interface, P/N 102004, is used for communication with the TCFI module. No additional hardware is required. The USB interface connects to the four terminal Deutsch data link connector that is part of the WEGO harness, not the OE diagnostic port. The USB Interface has a switch that selects the operating mode. For communication with the TCFI, you must use the TC88A And All Others switch position.

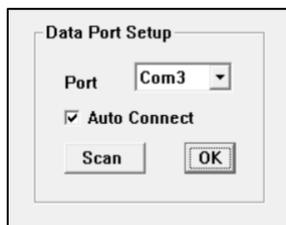
Turn the ignition key and engine run/stop switches on to provide power to the TCFI unit properly (some newer HD models do not have an ignition key, only engine run/stop switch, controlled by the security module). Do not start the engine.

The PC Link TCFI program has auto-connect capability and a COM port scan function to aid in initial setup of the communications link. You can use the Port Setup command from the Communications menu to display the dialog box shown below and select the correct COM port. If you are not sure what COM

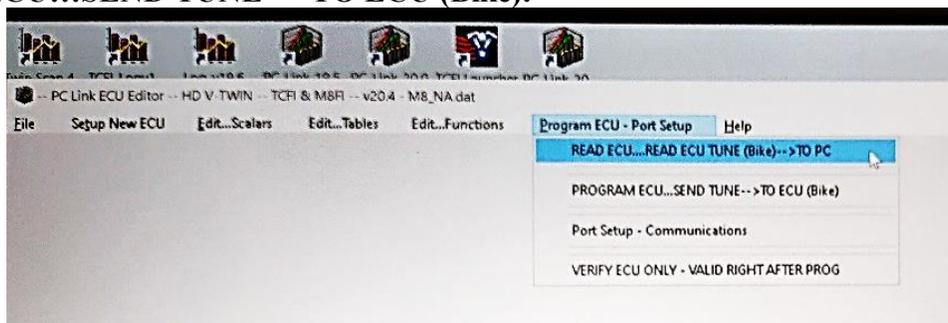
port the USB interface has been assigned to, you can click on the Scan button to automatically detect and select the correct port. Before you do so, make sure that the USB interface has been connected to your PC and the TCFI module. Both the ignition key and engine run/stop switches must be turned on. Once the correct COM port has been selected, the program will remember this setting.

If you enable the Auto Connect check box, the program will try to connect to the TCFI every time the program is started. Please note that you must have the correct COM port selected and the USB interface connected to your PC and the TCFI module. Both the ignition key and engine run/stop switches must be turned on in order for auto-connect to work.

Figure 6 – Data Port Setup



Download data by using the **READ ECU... READ ECU TUNE (Bike) → to PC** command on the **Program ECU – Port Setup** menu. The program will display the module's firmware ID. Save the tune on PC before start editing. You can upload (flash) the ECU your modified tune with the command **PROGRAM ECU...SEND TUNE → TO ECU (Bike)**.



In the following sections we will show you how to tune your bike for more power and fun.

Before you tune Make sure that:

- your engine is in good condition (no advanced wear) and has no mechanical or electrical issues
- the ignition system works well; if not, fix it: replace spark plugs, wires, coils, controller, if necessary
- the OEM ECU, OBDII diagnostic port are functional and no DTCs are present
- you have performed the TCFI system installation and initial setup as described in the **TCFI7_and-M8_installation_and_quick_setup.pdf** guide, available for download on Daytona-JMS website.
- you watched the instructional video on YouTube: <https://youtu.be/QQCByMf6wpk>
- you have read the current document entirely and gained a basic understanding of how the tuning/logging software works

BASIC CONCEPTS

The main tuning window contains the tuning parameters. They consist of scalar values, tables and functions.



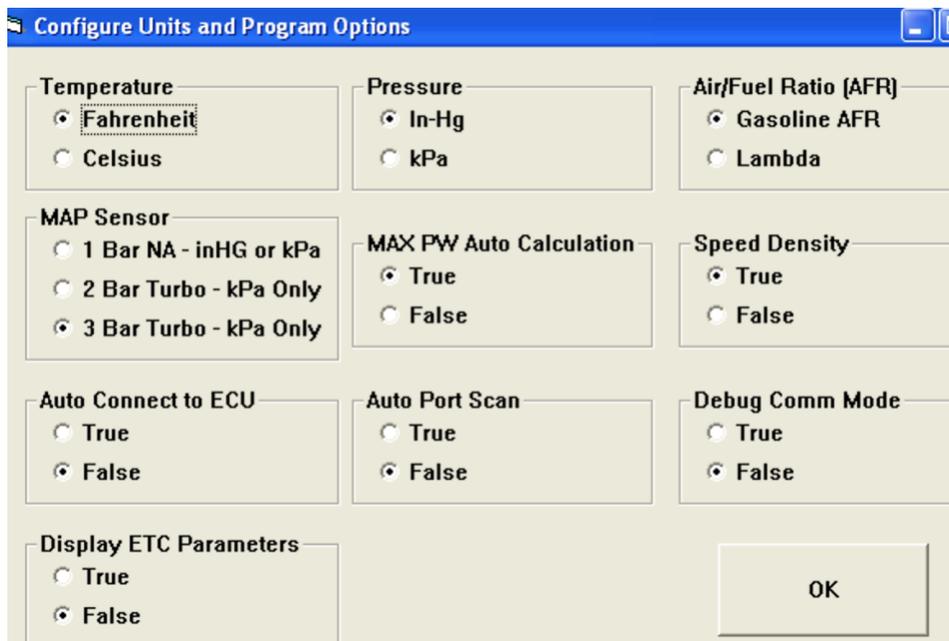
MAIN MENU GROUPS

File

You can: **Open** files, **Save** files, **Edit Config file**, **Print** various items of interest, open recent files.

Setup New ECU

First you need to open the tab **Configure – Units and Program Options** under **Setup New ECU** header and choose the preferred units. Your choice of units and options will be programmed into the ECU and the program; this way you don't need to remember these settings.



The new ECU setup routine is explained in detail in the **TCFI7_and-M8_installation_and_quick_setup.pdf** guide. You need to follow instructions closely, or you will have an engine running erratically or not running at all.

Scalars

Scalars are single value numbers, switches, injector size, rev limits, etc. When you click on **Edit...Scalars** in the main window, a sub-menu opens and revealing 4 groups:

Edit Basic Parameters

Edit Basic Module Parameters

Basic Parameters

- Closed Loop AFR Control Mode
- Dual Independent Runner Intake
- Continuous Barometric Pressure Update
- Enable Low Fuel Warning
- Automatic Nominal Idle IAC Update Mode
- Anti-Stall IAC Mode
- Brake Override (TBW only)
- Enable TwinCool Parameters

Rear Cyl Timing Offset [-5 to +5]

VSS Frequency [Hz] at 100 KPH

6th Gear Ratio [RPM/KPH]

WEGO Warmup Time [0-60 sec]

Idle TGS [1.0-2.5%]

Nominal Idle IAC Steps [15-50]

Cranking Revs [0-3]

MAX RPM Limit [100 RPM steps]

Base Injector Pulse Width [msec]

BASE INJ PW - AUTO CALC ENABLE

Commanded Fuel PW is calculated by multiplying the BASE INJECTOR PULSE WIDTH and the Main Fuel Table (working cell). Main Fuel Table is a percentage of the Main Injector Pulse Width value. MAX PW AUTO CALC is recommended and auto sets the MAX PW to 125% of the calculated MAX available PW at the RPM Limit. This value is set to 125% of the MAX INJ Value so enough fuel is available for the accelerator pump function to work properly. Be sure to match your datalog to determine if you need to add a set of larger matched GDT injectors (85% PW is the maximum controlled PW at MAX RPM LIMIT).

SAVE CHANGES Cancel Restore Defaults

Values below the line are not directly used by the ECU or Tune Software. If a tune-up works well with an injector size - utilize the Calc Base PW - Injector Change feature to make a quick Base Injector PW Change for the new INJ - If the results are good re-open the orig tune and make the same percentage change to the entire Main Fuel Table (leave the orig Base PW).

User Data Saved With Tune File
2017 107 M8 str 07 oct - 01twlp

Orig Tune Inj Size [gm/Sec]

New Inj Size [gm/Sec]

Re-Calculate Base PW - Apply for New Injector Change

Base PW Factor

NOT USED BY SW - CALC - MAX INJ PW at MAX RPM LIMIT [msec]

Note: Be sure to monitor the Inj PW via the included Datalog Software -> If PW is greater than the CALC MAX INJ PW @ MAX RPM increase Inj size.

Edit Advanced parameters

Edit Advanced Module Parameters

Advanced Parameters

Warm Eng Temp [100-257 deg F]

Min Injector Pulse Width [msec] Do NOT Change

Engine Warmup Time [70-260 sec]

Idle Integrator Gain [1-63]

Hot Soak Temp [122-257 deg F]

AFR Integrator Gain [0-127]

Hot Soak Timeout [30-260 sec]

AFR Deadband [0.00-0.068]

Delta TPS Gain [1-25] Accelerator Pump - Lower Value if Idle PW Oscillates

Min AFR BLM [50-100%]

Enlean Decay Rate [2-50]

Max AFR BLM [100-150%]

Enrich Decay Rate [2-50] Accelerator Pump

Fuel Adder per PSI K Factor [0-1 Extra Fuel= PW*(PSI * 1.015 * K)]

Asynchronous Fuel Gain [0-255] Affects Accelerator Pump < 2kRPM

MAX Allowed Spark Retard [deg]

IAT Spark Retard K Factor [0-8] IAT Range = 120-200F

ET Spark Retard K LOW [0-8] ET Range = 180-220F - Linear

ET Spark Retard K HIGH [0-8] Retard = MAX Low + Calc High

OK Cancel Restore Defaults

Edit User Functions

User Functions

User Input

- Data Log Only [Default]
- Ignition Retard
- Ignition Kill
- Stage RPM Limit

Stage RPM Limit [100 RPM]

User Retard

User Retard [0-10 deg]

OK Cancel Restore Defaults

User Output

- Off [Default]
- RPM And TPS Based Switch
- NOS Trigger

RPM On [100 RPM steps]

RPM Off [100 RPM]

TPS On [%]

TPS Off [%]

Minimum VSS [MPH]

Edit ETC Parameters

Edit ETC and Cruise Control Parameters

ETC Parameters

- PID Proportional Gain [Kp]
- PID Integral Gain [Ki]
- PID Derivative Gain [Kd]
- PID Integral Error Limit [KIL]
- Limpback Position Estimate [LPE]
- Spring Preload Compensation 1 [SPC1]
- Spring Preload Compensation 2 [SPC2]
- Friction Negative Compensation [FNC]
- Friction Positive Compensation [FPC]
- Friction Deadband [FDB]

Cruise Control Parameters

- PID Proportional Gain [Kp]
- PID Integral Gain [Ki]
- PID Derivative Gain [Kd]
- PID Integral Error Limit [KIL]
- PID Proportional Error Limit [KPL]
- Throttle Positive Ramp Rate [TPR]

TPS/TGS Scale Factors

- TPS Offset
- TGS Fullscale
- TGS Offset
- TGS Fullscale

Upload Exit

You need to set the scalars in **Basic Parameters** only once, when you perform the initial setup and/if need to enter injector size, base PW, VSS, etc. **Read detailed parameters description and instructions** - pages 14 - 17 in **TCFI7_and-M8_installation_and_quick_setup.pdf** guide. Do not make changes to **ETC Parameters** unless you know what are you doing and why - for example you replaced the TB or TGA.

Note: under **Setup New ECU** menu there are 2 options: **Basic Mode** and **Advanced Mode**. We recommend checking the **Advanced Mode** option. This will reveal all parameters available for editing, which otherwise some will be hidden if **Basic Mode** is selected.

Tables

Tables are multi-row, column data, where two inputs X (columns) and Y (rows) give one output cell (table cell). These are often called 3D Maps.

Tip: You can rotate the 3D chart display for a better view of a particular region by dragging the mouse while holding both mouse buttons down. Chart property pages and normalizers can be edited by right clicking on the chart. Almost any chart property can be changed. Click on the Help button for more information. If you corrupt the chart, exit and restart PC Link TCFI.

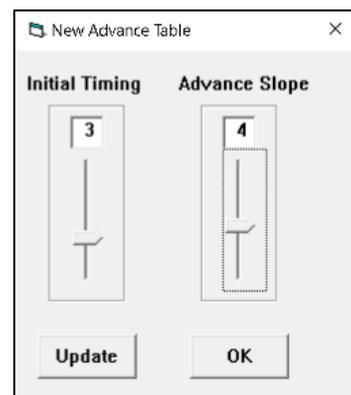
Available tables are:

- 1) **Ignition Advance Table**, with the option of **Creating New Advance Table**

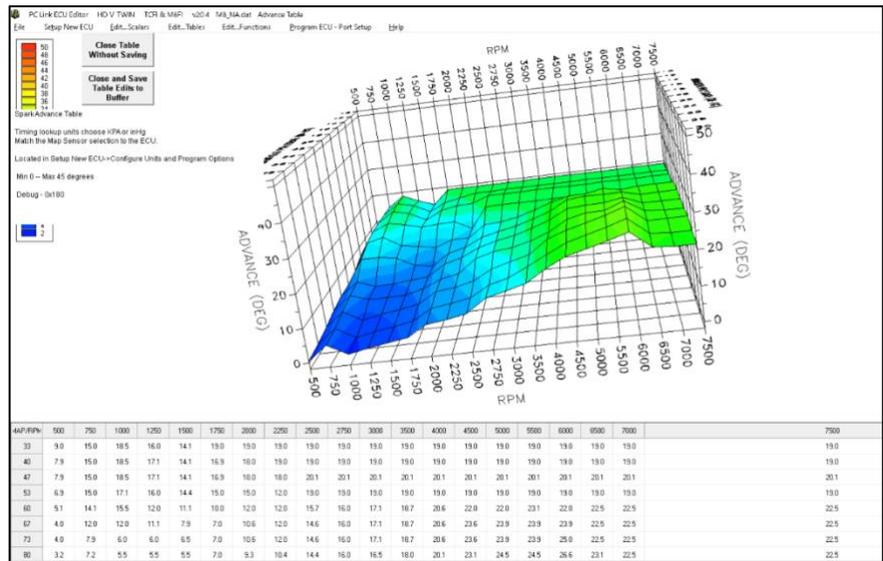
Use the **Create New Advance Table** command on the **Edit...Tables > Create New Advance Table**. A dialog box appears and allows you to enter initial timing and advance slope settings. Settings close to 5 result in an advance table suitable for stock engines. Use lower values for high compression engines. Each time you click on Update, the corresponding advance table is displayed.

You will find the **Create New Advance Table** command useful for generating an advance table that will serve as a starting point for further edits. When you are ready to proceed with editing, click on OK. After you have edited the table, you must use the Save Table Edits to Buffer command from the Edit menu to save your edits to buffer memory. If you use the Close Table command from the Edit menu, all your edits are lost.

Once you have **Ignition Advance Table** data (by opening an existing data file, downloading data from a TCFI unit or creating a new table as explained previously), you can edit the data by clicking on and dragging individual points on the 3D chart display or you can directly edit numeric data on the spreadsheet grid.



The table consists of 20 columns from zero to 7,500 RPM and 11 manifold pressure (MAP) rows from 10 to 30 In-Hg. The 7,500 RPM advance value is used at all higher RPM levels and the 10 In-Hg MAP advance value is used at all lower MAP levels. Note that 10 In-Hg corresponds to a high vacuum deceleration or idle condition and that 30 In-Hg corresponds to wide open throttle (WOT). Advance values must be between zero and 45 degrees. You can shift the entire advance table up or down by holding the Shift key down while dragging any point. The chart label box shows the shift in degrees.

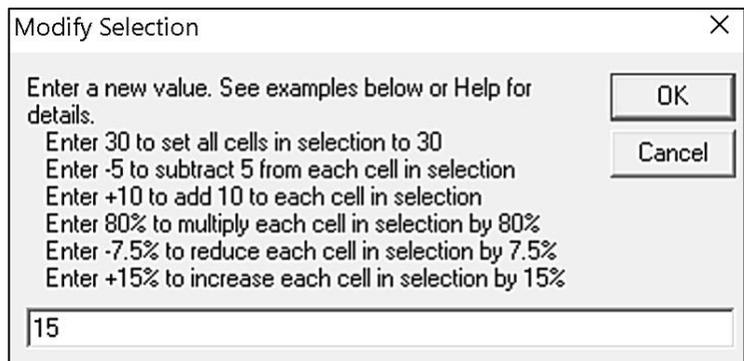


When you release the mouse button, the chart and spreadsheet grid values will be updated. Response of the chart label box may be sluggish on slower systems due to the amount of data being updated.

After you have edited the table, you must use the **Save Table Edits To Buffer** command from the Edit menu to save your edits to buffer memory. If you use the **Close Table** command from the Edit menu, all your edits are lost.

Editing Tables Data – Same procedure for all 3D tables and Functions

You can edit table data using standard Windows copy and paste operations by selecting cells and then clicking the right mouse button to pop-up the edit menu. You can select cells by dragging the mouse with left button down. You can also use the Modify command on the pop-up menu. When you enter a value, the presence of optional sign (+ or -) or percent (%) characters affects the outcome of the Modify command as shown in fig below.



You can also use the Modify command on the pop-up menu. When you enter a value, the presence of optional sign (+ or -) or percent (%) characters affects the outcome of the Modify command.

Data Export and Import

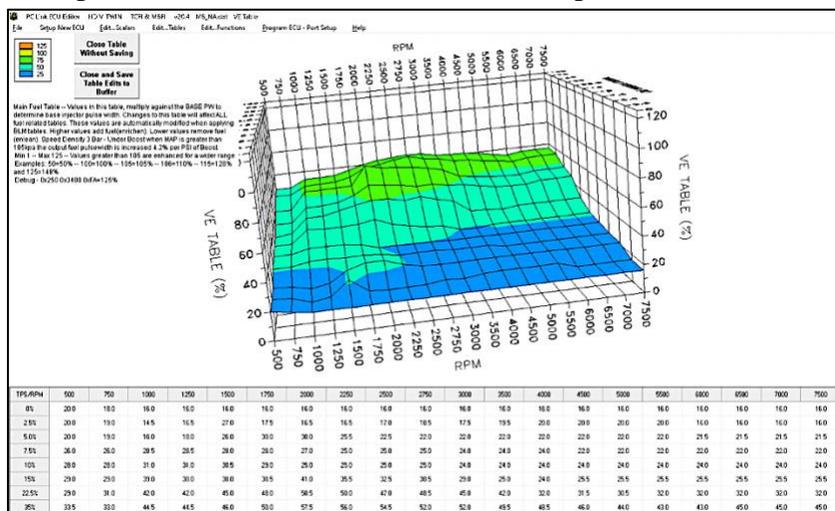
You might want to export or import 3D table data to or from another application such as Microsoft Excel. Arrange the program windows so that both the source and destination are visible (one on the left side of the screen and the other on the right side seems to work best). You must be able to see the information

you want to drag as well as the location where you want to drop it. To export from PC Link TCFI to Excel, use the left mouse button to select a range of data on the spreadsheet grid. Then move the mouse cursor to an edge around the selection. Hold the left mouse button down and drag the selection into Excel. Release the left mouse button on the top left cell in Excel. When importing into PC Link TCFI from Excel, use the same procedure, except that Excel requires dragging and dropping with the right mouse button.

2) Main Fuel Table (also named Alpha-N Table)

The Alpha-N table is the main fuel table (Alpha-N is the technical term for throttle position and RPM).

The Alpha-N table values are in percent units. The calculated base injector pulse width (determined by horsepower and injector size settings on the module parameters screen) is multiplied by the Alpha-N table value to determine the theoretical injector pulse width for a 14.7 air fuel ratio. This value is then corrected for the desired air/fuel ratio (as set on the AFR table) and BLM (block learn multiplier) to arrive at the actual rear injector pulse width. A feedback correction is applied based on the oxygen sensor signal and the stored closed loop correction values in the block learn multiplier (BLM) table. AFR reported by the WEGO is compared to the desired set point value in the AFR 3D table.

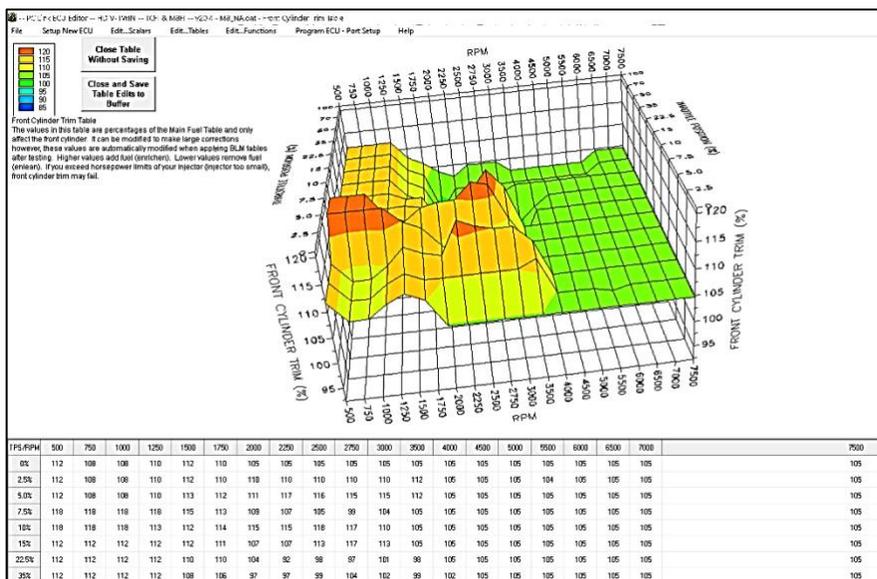


From a practical standpoint, the Alpha-N table must be within about $\pm 20\%$ of the required values for the TCFI system to successfully correct the injector pulse width based on closed loop feedback from an exhaust gas oxygen sensor.

3) Front Cylinder Trim Table

The front cylinder trim table values are in percent units. The calculated injector pulse width is multiplied by the front cylinder trim value to arrive at the front injector pulse width. Required front cylinder trim values are dependent on engine gas flow dynamics.

The front cylinder trim table is automatically corrected when the **Apply Front BLM Table**



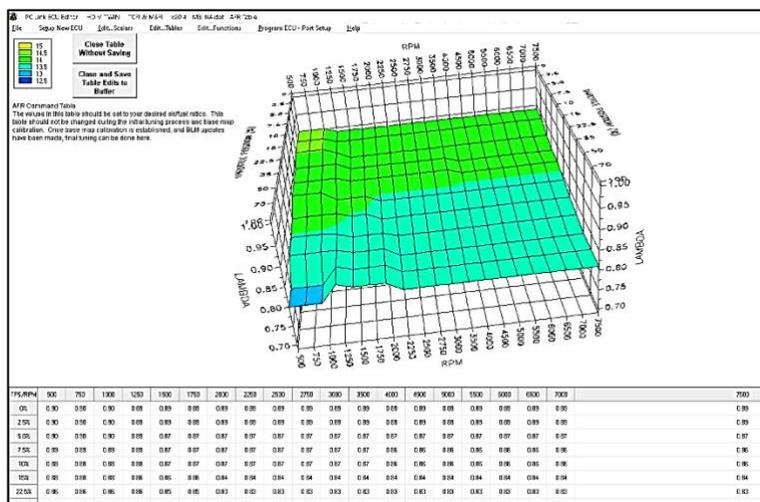
command is executed. **If you exceed the horsepower limits listed in table Recommended Horsepower Limits, front cylinder trim may fail.**

Recommended Horsepower Limits

Injector Size	Horsepower Limit
4.34 gm/sec (stock)	100 HP
4.89 gm/sec (Screamin Eagle® P/N 27654-06)	110 HP

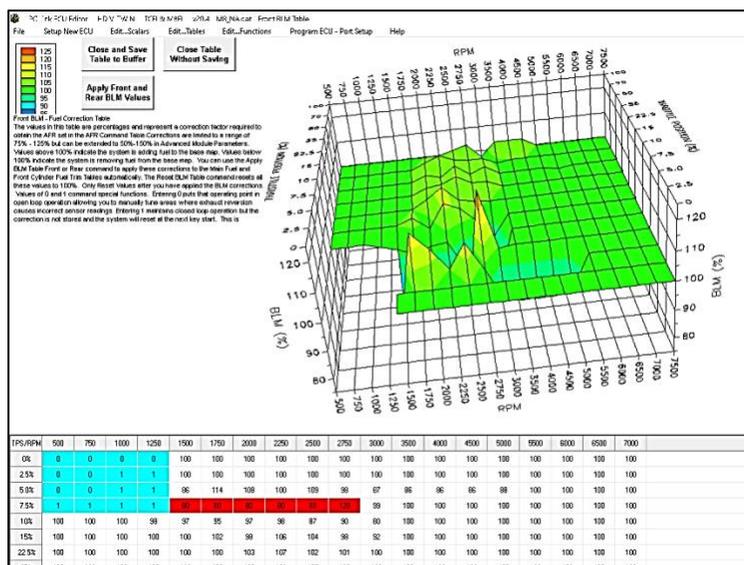
4) AFR Command Table – Closed Loop (CL)

The AFR (air/fuel ratio) table sets the desired air/fuel ratio under various operating conditions. The air/fuel ratio value is used in the rear injector pulse width calculation as explained above. Typical air/fuel ratios are 13.0 for idle, 13.8 for cruise, and 12.8 for wide open throttle. To prevent engine overheating, avoid lean air/fuel ratios exceeding 14.5 under cruise conditions.



5) Front/Rear BLM Correction Tables (CL)

The front BLM (block learn multiplier) table is shown in the graphic above. BLM values are in percent units and represent a correction factor required to maintain the air/fuel ratio set on the AFR table. BLM values are updated based on closed loop feedback from the exhaust gas oxygen sensors.



6) Maximum BLM fuel Adjustment Table (CL)

The values are in percentages. They represent the maximum allowed BLM learning in a given cell. AFR-BLM are limited to the values dialed in the table. Corrections can be made both ways + or - (lean or enrich).

Some special considerations apply to the BLM tables. BLM values are limited in range from 75% to 125%. The range limits are set on the module parameters screen. When a BLM cell nears the range limit, the cell color changes to red to alert the user that the system has just about run out of correction range and that the corresponding cell in the Alpha-N fuel table must be changed.

BLM cell values 0 and 1 command special functions and these cells are highlighted in blue. Closed loop feedback is disabled in any BLM cells

with value 0. This is useful in operating areas where exhaust reversion effects may cause incorrect sensor readings. Note that most BLM tables will have the value 0 in cells corresponding to decel (RPM above idle and closed throttle) where reversion effects are most pronounced.

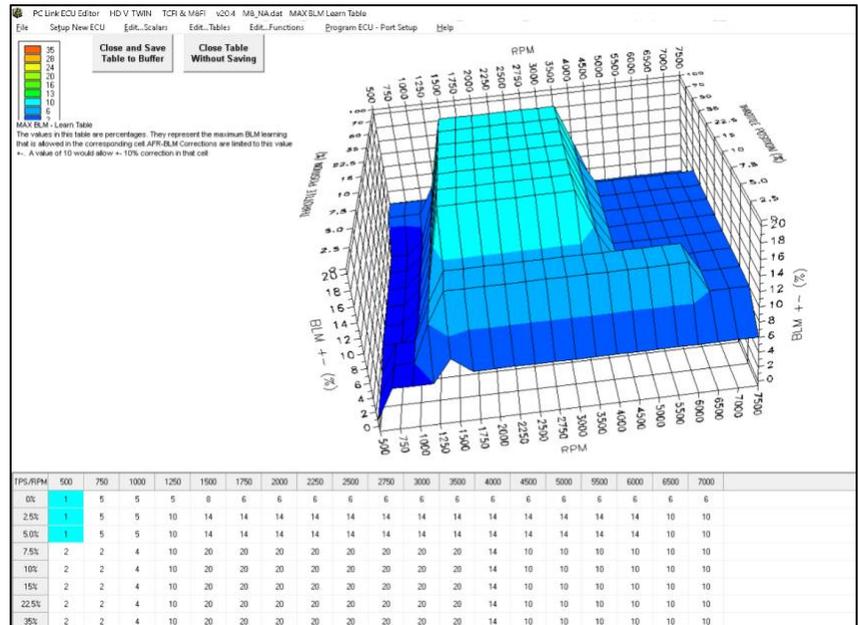
BLM update, but not closed loop feedback, is disabled in any BLM cells with value 1. Some BLM tables may have the value 1 in cells corresponding to idle (1,000-1,250 RPM and closed throttle).

After several hours of engine operation, read the ECU and examine the BLM tables. If you see red cells on a BLM table, you can use the corresponding (Front or Rear) **Apply BLM Table** command (on the submenu) to automatically correct the **Main Fuel Table** and **Front Cylinder Trim Table (CL)**. You can choose to apply either front, rear, or both learnt values – **Apply Front/Rear BLM Corrections – Recommended (CL)**. After running the **Apply BLM Table** command, the BLM table cells will return to 100% and the learning process will start again.

- 7) The **Reset BLM Correction Tables (CL)** command on the BLM Table submenu resets all BLM cells to 100%.

FUNCTIONS

Functions are two column tabular data, 2D maps. An input value (top row) gives an output value (bottom row). There are fourteen (in this version PC Link 20.4) 2D tables that you can edit. Before you can edit one of these tables you must either open a data file or download data from a TCFI unit. Each table consists of 17 columns with the upper row corresponding to the independent variable (throttle position, engine temperature, elapsed time, or IAC position). You can edit the numeric data corresponding to the



dependent variable on the lower row of the spreadsheet grid. A typical 2D table is shown below. Some of the engine temperature cells are highlighted in red. These red cells correspond to invalid sensor readings. After you have edited the table, you must use the **Close and Save Table to Buffer** command from the Edit menu to save your edits to buffer memory.

There is a **Complete Function List** under **Edit...Functions** section, which at the time of writing cannot be edited. You can skip it.

Function table example

IAT (deg F)	3	32	61	90	118	147	176	205	234	262	291	320	349	378	406	435	464
Fuel Mult%	111	111	105	102	100	102	104	104	104	104	104	104	106	106	109	109	109

Accel/Decel - Fuel Multiplier

This table consists of a fuel multiplier (percent units) that is a function of delta throttle position. Delta throttle position means change in throttle position. Fuel multipliers greater than 100% for positive delta throttle position correspond to an acceleration enrichment which has a similar effect to an accelerator pump on a carburetor. Fuel multipliers less than 100% for a negative delta throttle position correspond to a deceleration enleanment (useful for reducing exhaust back fire).

Delta TPS%	-100	-88	-75	-62	-50	-38	-25	-12	0	12	25	38	50	62	75	88	100
Fuel Mult%	96	96	96	96	96	97	99	100	100	116	118	118	118	118	118	118	118

ET Based - Priming Fuel

ET (deg F)	3	32	61	90	118	147	176	205	234	262	291	320	349	378	406	435	464
PW (msec)	65	56	26	23	18	14	12	10	11	11	11	11	11	11	11	11	11

This table consists of an injector pulse width that is a function of engine temperature. The priming pulse occurs once on the initial ignition switch on event. Some of the engine temperature cells are highlighted in red. These red cells correspond to invalid sensor readings.

ET Based Cranking Fuel

ET (deg F)	3	32	61	90	118	147	176	205	234	262	291	320	349	378	406	435	464
PW (msec)	35	30	22	18	14	11	8	8	9	9	9	9	9	9	9	9	9

This table consists of an injector pulse width that is a function of engine temperature. The cranking pulse width is used during engine start. Some of the engine temperature cells are highlighted in red. These red cells correspond to invalid sensor readings.

Time Based Cold Start Enrichment Multiplier

Time (sec)	0	8	16	33	50	67	83	100	117	134	150	167	184	201	217	234	251
Fuel Mult%	100	80	68	64	62	60	60	60	60	60	60	60	60	60	60	60	60

This table consists of a fuel cold start multiplier (percent units) that is a function of elapsed time since engine start. The overall fuel cold start enrichment is determined as follows: calculated injector pulse width for each cylinder is multiplied by the time-based fuel cold start enrichment and by the appropriate ET based front or rear cylinder cold start enrichment. The overall fuel cold start enrichment is then added to the injector pulse width. For example, assume that the calculated injector pulse width is 4 msec and that the time and ET based fuel cold start enrichment values are 50% and 25% respectively. The total injector pulse width is then 4.5 msec ($0.5 \times 0.25 \times 4.0 + 4.0$). The time-based fuel cold start enrichment should always taper off from 100% at zero elapsed time and must reach 0% at the maximum value of elapsed time (251 seconds).

ET Based AFR Cold Start Enrichment Table

ET (deg F)	3	32	61	90	118	147	176	205	234	262	291	320	349	378	406	435	464
Fuel Add%	60	55	45	38	20	4	0	0	22	24	26	26	30	30	30	30	30

This table consists of an AFR cold start multiplier (percent units) that is a function of engine temperature. This table does double duty for hot soak enrichment. Some of the engine temperature cells are highlighted in red. These red cells correspond to invalid sensor readings. In general, the values in this table will be correct for most applications and should not be changed without consulting tech support.

Time Based – Individual Cylinder Cold Start Enrichment

Time (sec)	0	8	16	33	50	67	83	100	117	134	150	167	184	201	217	234	251
Fuel Mult%	100	80	68	64	62	60	60	60	60	60	60	60	60	60	60	60	60

This table consists of a fuel cold start multiplier (percent units) that is a function of elapsed time since engine start. The overall fuel cold start enrichment is determined as follows: calculated injector pulse width for each cylinder is multiplied by the time-based fuel cold start enrichment and by the appropriate ET based front or rear cylinder cold start enrichment. The overall fuel cold start enrichment is then added to the injector pulse width. For example, assume that the calculated injector pulse width is 4 msec and that the time and ET based fuel cold start enrichment values are 50% and 25% respectively. The total injector pulse width is then 4.5 msec ($0.5 \times 0.25 \times 4.0 + 4.0$). The time-based fuel cold start enrichment should always taper off from 100% at zero elapsed time and must reach 0% at the maximum value of elapsed time (251 seconds).

ET Based Front and Rear Cylinder Cold Start Enrichment Table

ET (deg F)	3	32	61	90	118	147	176	205	234	262	291	320	349	378	406	435	464
Fuel Add%	100	100	96	55	50	35	20	0	3	4	5	5	5	4	4	4	4

ET (deg F)	3	32	61	90	118	147	176	205	234	262	291	320	349	378	406	435	464
Fuel Add%	100	100	96	55	50	35	20	0	3	4	5	5	4	4	4	4	4

These tables consist of a fuel cold start fuel multiplier (percent units) that is a function of engine temperature. Individual tables are used because most engines exhibit significant differences in the characteristics of the front and rear cylinders. These tables also do double duty for hot soak enrichment. Note that a significant enrichment is required at high temperatures due to reduced injector flow. Some of the engine temperature cells are highlighted in red. These red cells correspond to invalid sensor readings. You may need to edit these two tables for optimum cold start and restart after hot soak. **Please refer to the TCFI Idle Tuning Tech Note. for more information on this subject.**

Global Fuel Enrichment vs IAT Multiplier

IAT (deg F)	3	32	61	90	118	147	176	205	234	262	291	320	349	378	406	435	464
Fuel Mult%	111	111	105	102	100	102	104	104	104	104	104	104	106	106	109	109	109

This table will add or remove fuel based in air intake temperature. Values above 100% add fuel, values below 100% subtract fuel. The table output is applied on top of other corrections. The valid range is 85 – 125.

Global Fuel Enrichment vs Baro

kPa	0	21	42	63	84	105	126	147	168	189	210	231	252	273	294	315	336
Fuel Mult%	97	97	97	97	97	97	97	97	97	97	97	97	98	99	100	101	102

This table adds or remove fuel based on barometric pressure. Values above 100% add fuel, values below 100% subtract fuel. The table output is applied on top of other corrections. The valid range is 85 – 125. It works as intended, with one adverse effect on datalog screen.

Note: do not modify it unless you have good reason.

Fuel Injector Compensation vs Battery Voltage

Volts (DC)	0	1	2	4	5	6	7	8	10	11	12	13	14	16	17	18	19
PW (usec)	400	400	400	400	400	400	400	400	400	320	240	160	80	0	0	0	0

This table will add to the final calculated PW as the system voltage drops following charging system fault. Units are in microsecond, not millisecond (400µsec = 0.4 msec)

ET Based Idle RPM Table

ET (deg F)	3	32	61	90	118	147	176	205	234	262	291	320	349	378	406	435	464
Idle RPM	1398	1320	1250	1250	1250	1102	988	969	969	969	1102	1176	1168	1168	1168	1168	1168

This table consists of desired idle RPM as a function of engine temperature. The ET based IAC position (see table description below) is adjusted to maintain the desired idle RPM. Some of the engine temperature cells are highlighted in red. These red cells correspond to invalid sensor readings.

ET Based IAC Table

ET (deg F)	3	32	61	90	118	147	176	205	234	262	291	320	349	378	406	435	464
IAC	67	57	40	30	22	14	12	6	5	5	8	10	10	40	40	40	40

This table consists of IAC (idle air control) value as a function of engine temperature. The IAC value is the minimum throttle position during idle in 0.1% units (i.e. an IAC value of 50 corresponds to 5% throttle). Greater IAC values result in more idle air and higher idle speed. IAC is continuously reduced as the engine warms up, even if the engine is not idling. Some of the engine temperature cells are highlighted in red. These red cells correspond to invalid sensor readings.

ET Based IAC Start Adder Table

ET (deg F)	3	32	61	90	118	147	176	205	234	262	291	320	349	378	406	435	464
IAC	40	40	34	26	18	14	14	13	15	18	23	23	28	33	33	33	33

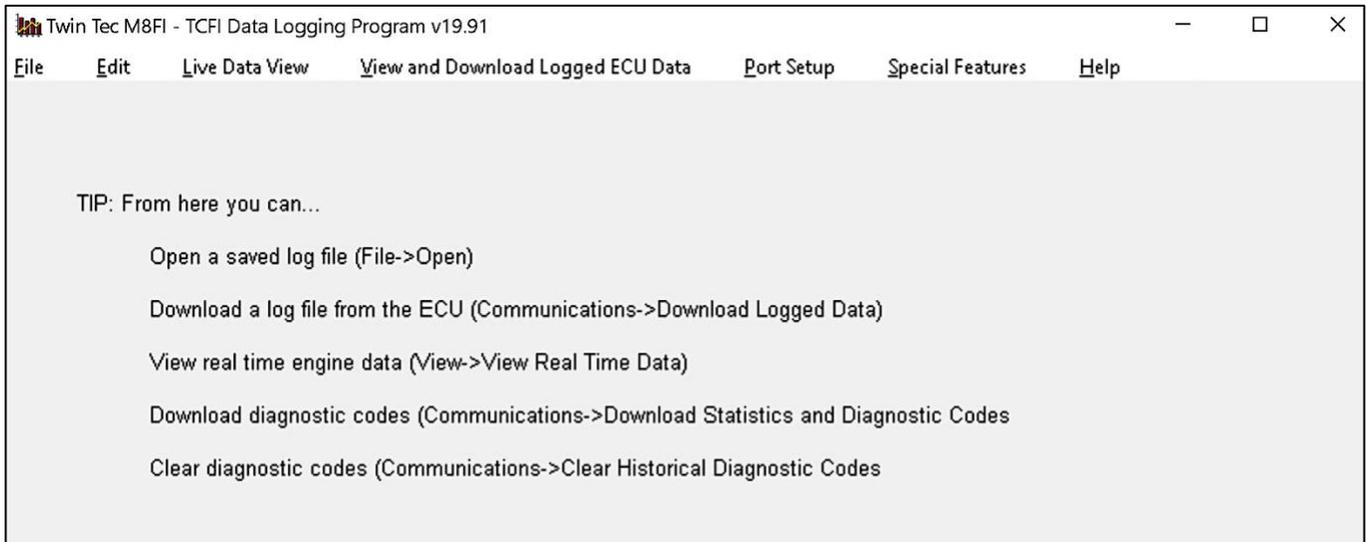
This table consists of IAC (idle air control) value as a function of engine temperature. The values represent additional air flow through the idle system during engine starting. Generally, more air is required for a hot start, especially after a hot soak. Some of the engine temperature cells are highlighted in red. These red cells correspond to invalid sensor readings.

Note: the bikes running TCFI7 and M8FI do not have an IAC per se; it is a virtual software device – it opens/closes the throttle blade in real time to adjust the airflow at idle based on the changing environment.

THE TCFI LOG APPLICATION

Overview, real time data view and logging

After TCFI Log is launched, the main screen appears blank. You have multiple display options.



You can display real time engine data on an instrument panel type screen by using the View Real Time Data command on the View menu. You can display and print data logged by the TCFI unit on a chart recorder type screen. Data logged by the TCFI unit must be downloaded before it can be displayed, by using the Download Logged Data from TCFI command on the Communications menu. Once data has been downloaded, it is automatically displayed on a chart recorder type screen. You can save this data by using the Save File command from the File menu. You can display a previously saved data file by first using the Open File command on the File menu and then using the View Chart command on the View menu.

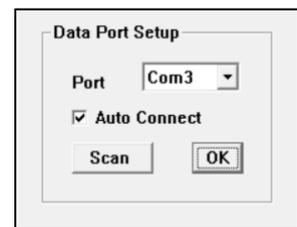
You can also download, view, and print engine operating statistics and historical diagnostic codes by using the Download Statistics and Diagnostic Codes command from the Communications menu. Please note that this data is not saved.

The USB interface, P/N 102004, is used for communication with the TCFI module. No additional hardware is required. The USB interface connects to the four terminal Deutsch data link connector that is part of the WEGO harness (refer to Figure 26 for details). The USB Interface has a switch that selects the operating mode. For communication with the TCFI, you must use the **TC88A And All Others** switch position.



Turn the ignition key and engine run/stop switches ON to provide power to the TCFI unit. Do not start the engine.

The TCFI Log program has auto-connect capability and a COM port scan function to aid in initial setup of the communications link. You can use the Port Setup command from the Communications menu to display the dialog box shown below and select the correct COM port.

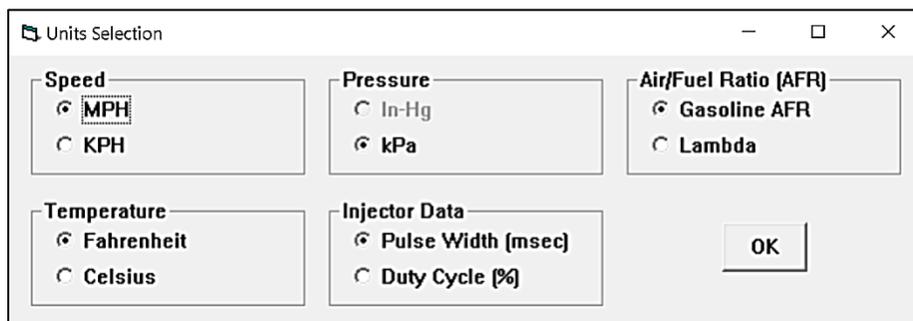


If you are not sure what COM port the USB interface has been assigned to, you can click on the Scan button to automatically detect and select the correct port. Before you do so, make sure that the USB interface has been connected to your PC and the TCFI module. Both the ignition key and engine run/stop switches must be turned on. Once the correct COM port has been selected, the program will remember this setting.

If you enable the Auto Connect check box, the program will try to connect to the TCFI every time the program is started. Please note that you must have the correct COM port selected and the USB interface connected to your PC and the TCFI module. Both the ignition key and engine run/stop switches must be turned on in order for auto-connect to work properly.

Units Selections and Configuration File

Use the **Units Selection** command on the **Edit** menu. A dialog box will appear as shown below. You can select miles per hour (MPH) or kilometers per hour (KPH) vehicle speed units, Fahrenheit (F) or Celsius (C) temperature units, inches of mercury (In-Hg) or kilopascals (kPa) manifold pressure units, pulse width in milliseconds or duty cycle in percent for injector data, and air/fuel ratio in gasoline AFR or Lambda units. The program remembers the selections you have made.

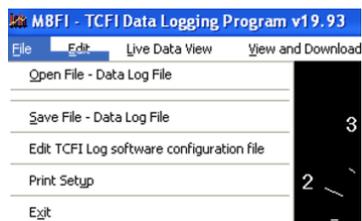
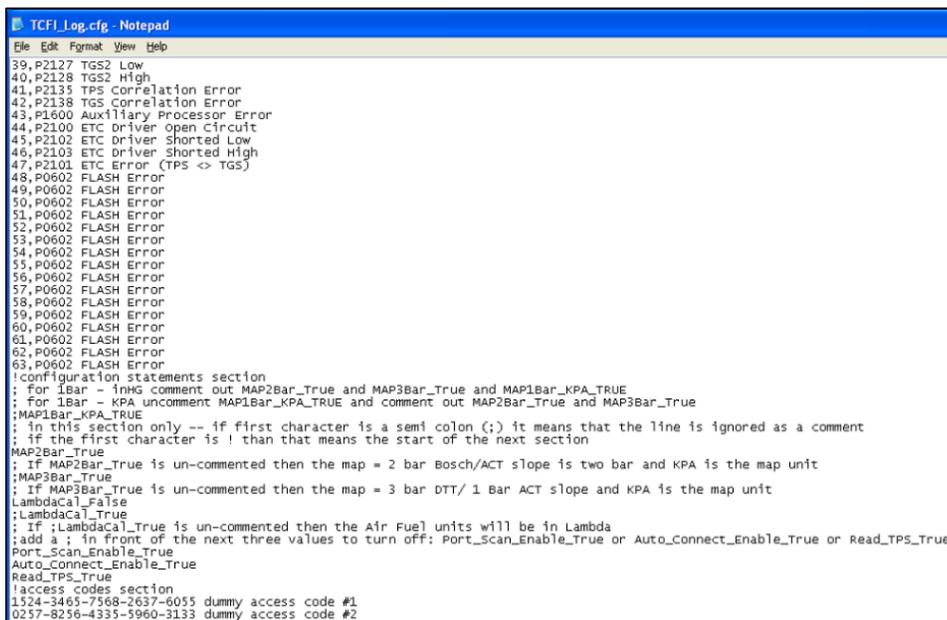


The most important item to setup/verify is the MAP Sensor configuration 1/2/3 bar. To verify: Open the Live Data View and look for the MAP value on the gauge. Confirm that the display matches the maximum range of your MAP sensor. Map sensor ranges are: 1 Bar in-HG 10-30, 1 Bar kPA = 105,

2 bar kPA = 220, 3bar kPA = 330. To modify, edit the **TCFI Log Software configuration file**. You can easily access and edit this file using under the menu **File→Edit TCFI Log Software configuration file**. To modify the TCFI Log Configuration file –

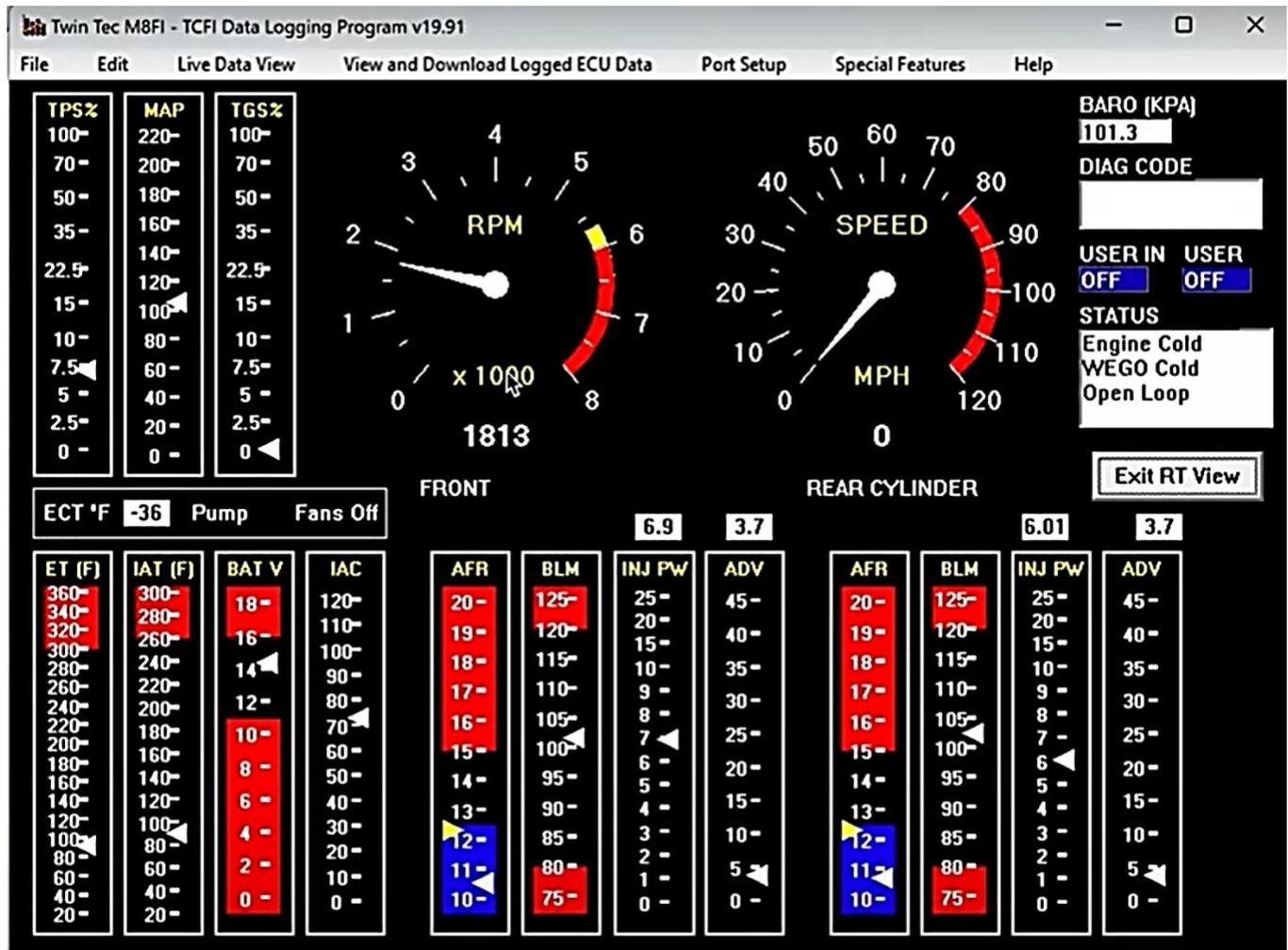
it will automatically open in Notepad. Scroll down towards the end of the file and remove the semi-colon in front of the sensor type that you

wis to log – in this example: “MAP2BAR_TRUE. Verify that a semi-colon is the first item on the other map sensor lines. Save the file, close and re-open the TCFI Log program to apply the changes.



LIVE DATA VIEW -- REAL TIME ENGINE DATA DISPLAY

When the engine is running, you can display real time engine data on an instrument panel type screen by using the View Real Time Data command on the View menu. Please note that real time engine data cannot be directly saved by means of the TCFI Log program. However, this data is constantly being logged by the TCFI unit and can be downloaded (for example at the end of series of dyno runs).



Real time engine data is displayed on an instrument panel type layout with round tach and speedometer gauges and bar graph type gauges for most other parameters. Barometric pressure, any diagnostic codes, status of the user input and output, and status messages are displayed in additional windows. If the engine is not running most values will appear as zero.

Displayed parameters include:

RPM – engine crankshaft RPM (numeric value displayed beneath gauge)

VSS – vehicle speed in MPH or KPH (numeric value displayed beneath gauge)

TPS – throttle position (0 to 100%)

TGS – twist grip position (0 to 100%)

MAP – manifold pressure in In-Hg (29.92 In-Hg or 101.3 kPa corresponds to atmospheric pressure)

ECT – engine coolant temperature (On TwinCooled™ models only). Coolant pump and cooling fans status also displayed.

ET – engine cylinder head temperature

IAT – intake air temperature

BAT – battery voltage

IAC – idle air control value in 0.1% throttle position units (higher number means more idle air)

AFR – the air/fuel ratio bar graph has dual pointers. The yellow pointer on the left side is the air/fuel ratio command (from AFR table). The white pointer on the right side is the actual air/fuel ratio based on the exhaust gas oxygen sensor reading. Note that the value will remain near 10 until the sensor has warmed up. Front and rear cylinder AFR values are displayed for all TCFI Gen 7 units when the WEGO IIID is installed.

BLM – block learn multiplier (main fuel table correction factor based on exhaust gas oxygen sensor feedback, shown as percent value from 75-125%). Separate front and rear cylinder BLM values are displayed.

FRONT INJ, REAR INJ – injector pulse width in milliseconds or duty cycle in percent

FRONT ADV, REAR ADV – ignition advance in degrees BTDC

You can also select the vehicle speed, temperature, pressure, and injector data units used for real time engine data display and data logging chart display. Use the Units Selection command on the Edit menu. A dialog box will appear as shown below. You can select miles per hour (MPH) or kilometers per hour (KPH) vehicle speed units, Fahrenheit (F) or Celsius (C) temperature units, inches of mercury (In-Hg) or kilopascals (kPa) manifold pressure units, pulse width in milliseconds or duty cycle in percent for injector data, and air/fuel ratio in gasoline AFR or Lambda units. The program remembers the selections you have made.

SPECIAL FEATURES

ETC TEST MODE

The ETC Test Mode command on the Communications menu has two options that allow you to test the electronic throttle control system without the engine running:

Manual test. Throttle control actuator (TCA) throttle position follows twist grip sensor (TGS) command. This option is useful for a quick check of TCA operation. Enter “1” to enable ETC manual test mode or “0” to disable. Then select View Real Time Data on the View menu to view TGS and TPS data.

Characteristic curve. The system plots out the characteristic curve of TCA throttle position versus TCA motor pulse-width modulated (PWM) drive. This option allows detection of defects such as excessive friction, incorrect or noisy TPS signals, and broken gear teeth. Refer to Appendix A for more details.

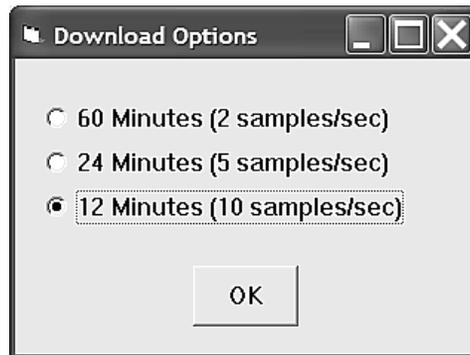
USER OUTPUT MANUAL OVERRIDE

The User Output Manual Override command on the Communications menu allows you to manually override the user output on TCFI units. This command can be used as a diagnostic aid to test accessory systems connected to the user output.

DATA LOGGING CHART DISPLAY

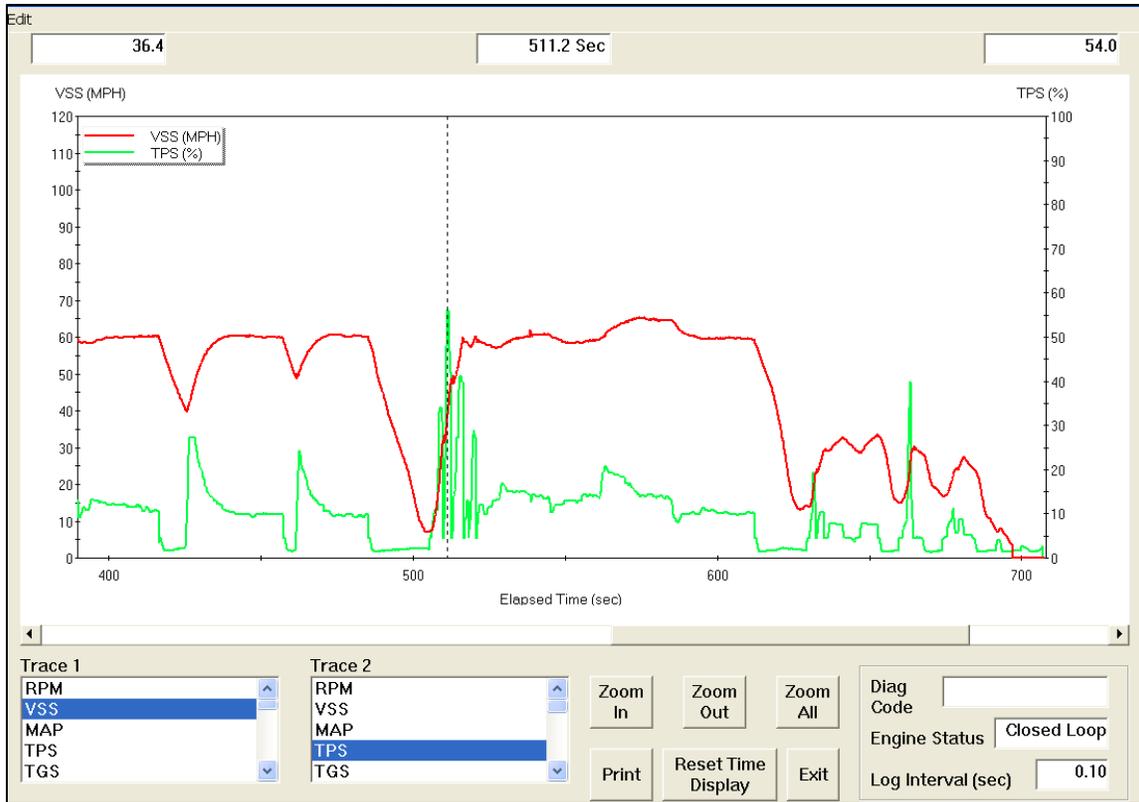
You can also display data logged by the TCFI unit on a chart recorder type screen. The data logging memory within the TCFI stores the last 36000 data points at 10 samples/second. This corresponds to 60 minutes of data. When you use the Download Logged Data from TCFI command on the Communications menu, the popup menu shown in Figure 19 will appear. You can select the length of the data set that will be downloaded. Once data has been downloaded, it is automatically displayed. **The last data logged will appear at the right end of the chart.** You can save the data by using the Save File command from the File menu after closing the chart display (data is not lost by closing the chart display). You can display a previously saved data file by first using the Open File command on the File menu and then using the View Chart command on the View menu.

Download Options



Please note that real time engine data cannot be directly saved by means of the TCFI Log program. However, this data is constantly being logged by TCFI unit and can be downloaded (for example at the end of series of dyno runs).

Note that TCFI data files use a .log extension. You should create a separate folder to store these files.



You can select two parameters for display. Trace 1 is displayed in red with its Y axis legends on the left side of the chart. Trace 2 is displayed in green with its Y axis legends on the right side of the chart. The X axis is always elapsed time. You can zoom in, zoom out, or zoom all (displays entire data file). At the maximum zoom in level, approximately 100 data samples will be displayed on the chart. You can use the scroll bar to move the chart display window in terms of elapsed time. If you hold the left mouse button down within the chart area, a cursor line appears. The exact values of the parameters displayed on trace 1 and trace 2 and the elapsed time appear in windows above the chart. When you zoom in or zoom out, the displayed data will always be centered about the cursor line. This allows you to quickly select and closely examine an area of interest. If you want to analyze the elapsed time between two events (for example the time required to accelerate from 0 to 60 MPH), you can move the cursor to the first event and then click on the Reset Time Display button. You can print the displayed chart to any Windows printer by clicking on the Print button.

Data parameters include:

RPM – engine crankshaft RPM

VSS – vehicle speed in MPH or KPH

MAP – manifold pressure in In-Hg (29.92 In-Hg or 101.3 kPa corresponds to atmospheric pressure)

TPS – throttle position (0 to 100%)

TGS – twist grip position (0 to 100%)

AFR CMD – air/fuel ratio command (10:1 to 20:1). This is the AFR value the TCFI is attempting to maintain.

FRONT AFR, REAR AFR – air/fuel ratio based on the exhaust gas oxygen sensor reading (10:1 to 20:1). Front and rear cylinder AFR values are displayed for all TCFI Gen 7 units when the WEGO IID is installed.

FRONT BLM, REAR BLM – block learn multiplier (main fuel table correction factor based on exhaust gas oxygen sensor feedback, shown as percent value from 75-125%). Separate front and rear cylinder BLM values are displayed.

IAC – idle air control value in 0.1% throttle position units (higher number means more idle air)

IAT – intake air temperature

ET – engine cylinder head temperature

COOLANT TEMP – engine coolant temperature (on TwinCooled models only)

COOLING PUMP – On/Off pump operation (on TwinCooled models only)

COOLING FANS – On/Off fan operation (on TwinCooled models only)

FRONT INJ, REAR INJ – injector pulse width in milliseconds or duty cycle in percent

FRONT ADV, REAR ADV – ignition advance in degrees BTDC

BAT – battery voltage

USER IN – user input displayed as digital (on/off) signal. On means that the input is active (grounded).

USER OUT – user output displayed as digital (on/off) signal. On means that the output is grounded.

CLUTCH – On means that the clutch is pulled in

BRAKE – On means that a brake has been applied

NEUTRAL – On means that neutral light is illuminated (transmission in neutral)

TGS ROLLOFF – On means the twist grip is in the roll-off position

CRUISE ENABLE – On mean the cruise switch is on.

CRUISE ENGAGED – On means the cruise control system is controlling vehicle speed

CRUISE SET – On means the cruise set button is pressed

CRUISE RESUME – On means the cruise resume button is pressed

ETC PWM – ETC system pulse width modulation command to the TCA motor ($\pm 100\%$ range with negative values below limp back and positive values above)

Additional data is displayed at the lower right side of the screen. This data includes:

Diagnostic Code – normally blank unless a diagnostic code is set. Refer to page 12 for details.

Engine Status – based on engine temperature and open/closed loop AFR

Log Interval – the actual data logging interval in seconds

You can clear the data within the TCFI by using the Clear TCFI Data Buffer command from the Communications menu.

The following additional functions are available from the Edit menu:

Fuel Cell Display – shows the active cell in terms of RPM and TPS percent at the cursor position. TPS percent is compensated for idle air. This function is useful for determining what fuel table cell is active at any given point in time. The same RPM and TPS cell is active in all fuel tables.

Gear Ratio Display – shows the calculated gear ratio (RPM/KPH) at the cursor position. This function is useful for determining the 6th gear ratio required for Module Parameter setup in PC Link TCFI for the 6th gear indicator light.

Misc Data Display – shows the current barometric pressure and nominal IAC value (value learned by system when engine is completely warmed up and at stable idle condition).

IMPORTING DATA INTO EXCEL

Data files saved from TCFI Log are in comma delimited ASCII format. You can easily import a data file into other programs such as Microsoft Excel for further analysis. You can also view data files with a text editor such as Windows WordPad. To import a data file into Excel:

1. Start Excel. In the File Open dialog box, select Files of type: All Files (*.*). Then browse for the data file.
2. The Text Import Wizard appears. For step 1, select delimited file type. For step 2, select comma delimiter. For step 3, select general column data format. Then click on Finish.
3. You can then format the data and save the spreadsheet as an Excel file.

OPERATING STATISTICS

You can also display and download engine operating statistics logged by the TCFI unit. Data logged by the TCFI unit must be downloaded before it can be displayed, by using the **Download and View Statistics/Diagnostic Codes/ Diagnostic Codes** command on the **View and Download Logged ECU Data** menu. Once data has been downloaded, it will automatically be displayed. Please note that this data is not saved.

The data is fairly self-explanatory. Total hours represents the total time that the engine was running. ID represents the firmware identification. This field typically includes the manufacturer (Twin Tec), model number, program revision and author's initials, and date. Note that the date is not a manufacturing date code, just the date for the particular firmware release.

Elapsed time is displayed for 13 RPM bands from idle to 6999 RPM. Note that elapsed time data is rounded off during each engine run, so the sum of the elapsed time figures may not precisely match the total hours. The program also displays the maximum engine RPM, time at the RPM limit (in seconds for better resolution) and the number of engine starts.

Clicking on the Print Statistics button prints a report. When you click on this button, a small data entry screen pops up and allows you to add a serial number or comment that will appear on the printout. You can also use the Print command from the File menu.

TCFI Operating Data

Total Hours: 20.35 Maximum Engine RPM: 5760

ID: Twin Tec TCFI Gen 5 Program Rev 1.1 CFS 2012 Seconds at RPM Limit: 5.11

Engine Starts: 67

RPM Band	Idle	1000-1499	1500-1999	2000-2499	2500-2999	3000-3499	3500-3999
Hours	3.21	3.54	5.81	5.27	1.30	0.43	0.35

RPM Band	4000-4499	4500-4999	5000-5499	5500-5999	6000-6499	6500-6999	
Hours	0.21	0.10	0.07	0.01	0.00	0.00	

Historical Diagnostic Codes:

- P0107 MAP Rationality Fault Trips: 3
- P0563 High Battery Voltage Trips: 7

Buttons: Histogram, Print Statistics, Exit

Any historical diagnostic codes logged by the TCFI unit are listed along with the number of trips (engine start cycles) since the individual code was last logged. Codes are automatically cleared after 50 trips.

Customers are often confused about the meaning of the term “trips.” This is an industry standard terminology. If a code shows 40 trips, it means that the code was set 40 engine start cycles ago, not that the code has been set 40 times.

You can clear historical diagnostic codes by using the **Clear Historical Diagnostic Codes** command from the **Special Features** menu.

The elapsed time data in the various RPM bands can be displayed in the form of a histogram chart by clicking on the Histogram button. Color coding of the bars helps to interpret the data. The idle RPM band

is blue, normal operating RPM bands are green and high RPM bands are yellow and red. The chart is automatically scaled for best display. You can print the chart along with a complete statistics report by clicking on the Print Chart button.

BASIC TUNING RECOMMENDATIONS AND PROCEDURES

ENGINE STARTING PROCEDURE

With alpha-N fuel control, the proper engine starting procedure must be followed. When the run/stop switch is turned on, the ETC system runs an auto-calibration routine that establishes the zero (closed throttle) position. During this time, the check engine light is on and the fuel pump is energized for several seconds, making an audible buzz. Do not press the starter button until the check engine light goes out and the fuel pump stops buzzing.

We recommend that you let the engine idle for about 20-30 seconds before operating the motorcycle. This allows the closed loop idle air control system to stabilize idle RPM.

IDLE TUNING

Please note that during the initial period after engine start, fuel control is open loop (no feedback from the WEGO sensors) and relies entirely on correct values in the Alpha-N table. The TCFI will enter closed loop AFR control mode after the WEGO warm up time (nominal value of 30 seconds) has elapsed.

To allow viewing and logging AFR data immediately after engine start, turn the ignition switch on but leave the run/stop switch in the stop position. Wait at least 15 seconds for the WEGO sensors to warm up and then start the engine. Monitor engine data and status with TCFI Log software.

Allow the engine to idle until it reaches normal operating temperature of 110° C or 230° F. A fan should be used to direct cooling air on the engine to more realistically simulate actual warm up conditions and prevent the engine from overheating. If the engine does not start or stalls, please refer to the diagnostic tips at the end of this section.

Monitor front and rear cylinder AFR and BLM, engine temperature, and IAC values. Keep notes on your observations of these values. After 30 seconds, the system should be operating in closed loop and maintaining the desired idle AFR (nominal value of 13.5). The BLM values should remain within the range of 80-120%. The IAC value should slowly go down as the engine reaches operating temperature and requires less idle air.

BLM values below 100% indicate that the TCFI is removing fuel in closed loop to correct a rich condition. BLM values above 100% indicate that the TCFI is adding fuel in closed loop to correct a lean condition.

If the BLM values go below 80% or above 120% anytime during the warm up period, the system is running out of adjustment range and the idle cells in the Alpha-N fuel table should be edited before proceeding with further tuning.

Download the current setup with PC Link TCFI software and use the Edit 3D Table – Alpha-N Table command to edit the idle cells in the Alpha-N fuel table. Depending on engine temperature, IAC value and idle RPM, the TCFI will be using the cells in the 750, 1,000, 1,250, and 1,500 RPM columns and the

0%, 2.5% (IAC between 15-40), and 5% TPS (IAC above 40) rows. You can select all these cells, right click the mouse, and then use the Modify command on the pop-up menu. Add a percentage corresponding to the BLM error. For example, if the worst-case BLM value noted was 120%, add 20% fuel by entering +20% (not +20). Likewise, if the worst-case BLM value was 80%, subtract 20% fuel by entering -20%. Remember to use the Save Table Edits to Buffer command after editing the table. Then use the Edit 3D Table – BLM Tables – Reset BLM Tables command to reset all BLM values to 100%. Save the edited setup file to disk and upload it to the TCFI.

As mentioned above, the IAC value should slowly go down as the engine reaches operating temperature. The IAC value should drop to near the nominal value (15-30 as set under basic module parameters). If the IAC value stays above 40 or drops below 15, there may be an electromechanical problem with the TCA or a manifold vacuum leak (very low IAC).

After making any required edits repeat the start test and allow the engine to reach normal operating temperature. **Make sure the engine runs for at least 5 minutes and the status display shows warm closed loop operation – otherwise BLM values will not be saved.**

The idle tuning step is complete when BLM values stay within the range of 85-115% during the warm up phase and the IAC value is within the range of 15-30 once the engine reaches normal operating temperature. If these criteria cannot be met, please contact our tech support before proceeding.

Diagnostic tips if the engine does not start:

1. Verify that the TCFI is properly installed and set up, that the battery is fully charged, and that the engine is not flooded from excessive priming caused by repeatedly cycling the run/stop switch during setup. Disconnect the fuel pump relay and crank the engine to clear flooding.
2. Try the following starting procedure: set the run/stop switch to run, wait until the fuel pump stops running, slightly open the throttle, and then press the starter switch. If the engine starts, the problem may be insufficient air caused by an incorrect IAC value. Please contact our tech support before proceeding.
3. Ether starting spray can be used as a diagnostic aid. Try starting the engine after an application of ether spray. If the engine starts and runs at a normal idle RPM, the problem is insufficient fuel. Try increasing the priming and cranking fuel values by 10-20%. Download the current setup with PC Link TCFI software and use the Edit 2D Table – ET Based Priming Fuel Table and ET Based Cranking Fuel Table commands. Select all cells, right click the mouse, use the Modify command on the pop-up menu, and enter +10% (not +10). Remember to use the Save Table Edits to Buffer command after editing each table. Save the edited setup file to disk and upload it to the TCFI. Retest and repeat if additional fuel seems to be required.
4. If larger fuel injectors were installed, cranking and priming fuel values may need to be decreased. Try decreasing the priming and cranking fuel values by 20%. Download the current setup with PC Link TCFI software and use the Edit 2D Table – ET Based Priming Fuel Table and ET Based Cranking Fuel Table commands. Select all cells, right click the mouse, use the Modify command on the pop-up menu, and enter -20% (not -20). Remember to use the Save Table Edits to Buffer command after editing each table. Save the edited setup file to disk and upload it to the TCFI.
5. Try re-installing the stock ECM. If the engine does not start with the stock ECM, there may be an underlying problem that requires correction. If the engine starts with the stock ECM but not the TCFI, please contact our tech support for assistance.

6.

Diagnostic tips if the engine stalls:

1. If the engine momentarily starts, runs for several revolutions (less than 2 seconds), and then stalls, priming and cranking fuel values may be insufficient to build up the required fuel film in the intake manifold. Try using ether starting spray or cycling the run/stop switch several times to add additional priming fuel before starting the engine. If the engine starts normally, you have confirmed that more fuel is required. Try adding 10-20% more priming and cranking fuel as explained in Paragraph 2 in the preceding section.
2. If the engine stalls after running for several seconds, observe AFR values. To do this you must allow the WEGO sensors to warm up for at least 15 seconds before starting the engine. You can observe data in real time or download data logged using TCFI Log. For best results, select the 10 samples/sec download option. In most cases, the problem is caused by excessively lean AFR. Based on observed AFR values, make appropriate corrections to the idle cells in Alpha-N table. If the AFR is lean, try adding 10-20% fuel (use the procedure explained on page 6). If this does not solve the problem, please contact our tech support for assistance.
3. In some cases, changes to the cold start enrichment tables may be required. There are independent ET (engine temperature) based front and rear cylinder cold start enrichment tables. To allow viewing and logging AFR data immediately after engine start, turn the ignition switch on but leave the run/stop switch in the stop position. Wait at least 15 seconds for the WEGO sensors to warm up and then start the engine. Monitor engine data and status with TCFI Log. Download the logged data. Compare the front and rear AFR values after engine start to determine if adjustments are required. Refer to the TCFI Idle Tuning Tech Note for more details.

4.

AUTO-TUNING

The closed loop auto-tuning process consists of operating the motorcycle through a wide range of loads and speeds while periodically monitoring progress using the PC Link TCFI software. Long rides at constant speed and load are of no value. The best technique is to very slowly accelerate through the useable RPM range in every gear, allowing several seconds of operation in each RPM and throttle position-based cell. Also operate the motorcycle at various fixed speeds likely to be encountered during normal riding. For safety reasons, wide open throttle runs should be done on a closed course.

We recommend auto-tuning under actual riding conditions. If this is not possible, you can auto-tune on a load control dyno and use TCFI Log to monitor AFR and other engine parameters.

If AFR values appear very lean (above 14.5), we suggest that you edit the Alpha-N table to add 15-20% fuel to all cells except idle cells before proceeding. Auto-tuning works best if you start with a slightly rich Alpha-N table. Download the current setup with PC Link TCFI software and use the Edit 3D Table – Alpha-N Table command. You can select groups of cells, right click the mouse, use the Modify command on the pop-up menu, and enter +15% (not 15). Remember to use the Save Table Edits to Buffer command after editing each table. Save the edited setup file to disk and upload it to the TCFI.

After 1-2 hours of engine operation, download the current setup with PC Link TCFI software and use the Edit 3D Table – BLM Tables – Edit Front and Edit Rear BLM Table commands to examine the BLM tables. Cells that are shaded red indicate that the system has run out of correction range. Then use the

Apply Front and Apply Rear BLM Table commands to automatically correct the Alpha-N fuel table and front cylinder trim table. This also resets all the BLM values back to 100% and allows auto-tuning to continue. Save the edited setup file to disk and upload it to the TCFI.

Auto-tuning is a statistical process. The longer the operating time, the greater the probability that more cells will be covered. However, even a varied operating cycle can miss some cells. After you use the Apply BLM Table commands, take some time to examine the modified Alpha-N and front cylinder trim tables. Unless your engine has some unusual camshaft and exhaust interactions, the tables should appear smooth (with gently rising slopes). If you spot sharp spikes or dips, these cells have probably been missed during auto-tuning and will require some manual edits to smooth them into the surrounding terrain.

The Alpha-N table represents percent injector pulse width (fuel flow) before correction for BLM, front cylinder trim, barometric pressure, intake temperature, and cold start enrichment. You can use the following guidelines to smooth the Alpha-N table:

1. At part throttle (low TPS%), Alpha-N values in each row will tend to decrease as RPM increases (because the throttle is choking air flow).
2. At wide open throttle, Alpha-N values in each row will tend to follow the engine torque curve.
3. In any given RPM column, Alpha-N values must always increase with TPS.

The front cylinder trim table may appear more complex and irregular, with peaks and valleys corresponding to gas flow interactions within the intake and exhaust system. However, very sharp spikes and dips may require some smoothing.

If you edit the Alpha-N or front cylinder trim table to smooth out values, remember to use the Save Table Edits to Buffer command after editing each table. Save the edited setup file to disk and upload it to the TCFI.

Continue to operate the motorcycle under varying conditions for another 1-2 hours. Then repeat the process of downloading setup data, examining the BLM tables, using the Apply BLM Table commands, smoothing the Alpha-N and front cylinder trim tables, saving, and uploading back to the TCFI as previously described.

Continue this auto-tuning process until most of the BLM cells remain in the 90-110% range.

If spark knock is noted under wide open throttle or throttle roll-on, use PC Link TCFI software to edit the ignition advance table and reduce the ignition advance 3-5 degrees under the conditions that cause spark knock. Using the TCFI Log software to examine engine data may be very helpful for determining exactly what manifold pressure and RPM values were encountered. A common error is to assume spark knock only occurs at high MAP (manifold absolute pressure) values. Large displacement engines are prone to spark knock at relatively low MAP values during throttle roll-on. You may need to reduce the ignition advance throughout the entire MAP range.

FUEL INJECTOR SIZING

Accepted engineering practice is to use the smallest possible injectors (in terms of flow) for best control at idle and part throttle. The original equipment throttle body and similar aftermarket units with Siamese runners are subject to fuel imbalance problems between the front and rear cylinders. When the fuel

injector duty cycle exceeds 50%, fuel will start being inducted into the wrong cylinder (i.e. front injector spraying fuel while rear intake valve is still open). **The TCFI system cannot correct this problem.**

Table 1 lists conservative horsepower limits based on injector size. You can use TCFI Log software to check the injector duty cycle at wide open throttle.

Recommended Horsepower Limits

Injector Size	Horsepower Limit
4.34 gm/sec (stock)	100 HP
4.89 gm/sec (Screamin Eagle® P/N 27654-06)	110 HP

IDLE TUNING CONSIDERATIONS

Some large displacement engines with high overlap/long duration camshafts may not idle properly at the nominal 1,000 RPM and 13.5 AFR settings used in the standard setup files. You may have to increase the idle RPM to a higher value such as 1,100 RPM and enrich the idle to 12.5-12.8 AFR.

Download the current setup with PC Link TCFI software and use the Edit 2D Table – ET Based Idle RPM command to increase the idle RPM. Do not decrease values at the left of the table (corresponding to a cold start condition) that are already higher than your desired idle RPM. If you significantly increase idle RPM, you may also have to make corresponding edits to the ET Based IAC Position table. Then use the Edit 3D Table – AFR Table command and change the applicable idle cells (750 -1,500 RPM at 0-5% TPS) to the desired AFR value. Remember to use the Save Table Edits to Buffer command after editing each table. Save the edited setup file to disk and upload it to the TCFI.

DYNO TUNING CONSIDERATIONS

Auto-tuning using the procedures listed on page 7 will get you within a few horsepower of the maximum that the engine can deliver. If you decide to do dyno tuning for maximum power, you can experiment with wide open throttle (WOT) ignition timing and AFR. **Please pay careful attention to the following dyno tuning considerations:**

1. **Only edit the ignition advance and AFR tables.** Don't edit any other tables (never make any changes to the BLM or Alpha-N tables once auto-tuning is completed). The usual range for WOT ignition timing at 4,000-6,000 RPM is about 28-34 degrees BTDC. The usual range for WOT AFR is about 12.5-12.8. Some engines may require a richer mixture, possibly down to 11.5, to avoid detonation problems.
2. **The TCFI should be operated in closed loop.** Make sure that the engine is warmed up (oil temperature is in the 150-180° F range) before doing a run and that engine status in TCFI Log shows closed loop operation. If you have made any table edits, allow one run for auto-tuning before capturing data.

-
3. **Inadequate air flow for engine cooling is a major problem with many dyno systems.** Always let the engine cool off between dyno runs. The use of a separate heavy duty industrial grade fan capable of generating at least 50+ MPH air velocity at the front of the engine is recommended. You can measure the air velocity with a handheld anemometer such as Extech P/N 45118 available from Grainger.
 4. **Use the TCFI data logging capability.** Always download data with TCFI Log software at the end of every run and study the results (use the 10 samples/sec download option). Check engine and air temperatures, throttle position, manifold pressure, and AFR. TCFI Log is a very powerful tool that can help you identify potential problems that may be affecting engine performance. Inconsistent dyno test results are often the result of thermal problems (engine temperature variations or hot soak effects).
 5. **Dyno exhaust sniffer limitations.** Some of the older sniffers monitored CO and CO₂. These systems are so slow and inaccurate that they should be totally disregarded. Modern sniffers from Dynojet and Horiba use a wideband sensor similar to the WEGO sensor. These sniffers are still subject to erroneous lean readings caused by reversion of atmospheric oxygen if the probe cannot be inserted past the baffles in the exhaust. Sensor degradation caused by leaded racing gas is a common occurrence. Another problem is sampling delay due to the long hose between the sniffer tip and actual sensor. The bottom line is to trust your WEGO sensors and disregard any errant readings from an exhaust sniffer.

ENGINE TUNING GUIDELINES

Higher AFR values correspond to a leaner (less fuel) condition. The practical operating range for most engines using gasoline fuel is from approximately 11.5 to 14.7 AFR. Combustion of a stoichiometric mixture (exactly enough air to burn all the fuel) results in 14.7 AFR indication. Automotive engines with catalytic converters operate near 14.7 AFR during cruise and idle. Air-cooled motorcycle race engines usually require a richer mixture to limit cylinder head temperature and prevent detonation. Table 2 lists recommended AFR values for race engines without emission controls.

Recommended AFR Values

Operating Mode	Recommended AFR
Cold Start (first 30 sec)	11.5-12.5
Idle	12.8-13.5
Part Throttle Cruise	13.0-14.0
Wide Open Throttle	12.5-12.8 (values down to 11.5 may be used to reduce detonation)

EXHAUST CONSIDERATIONS

The use of a WEGO system for closed loop fuel control places constraints on the choice of exhaust system. The WEGO system may give inaccurate results in certain situations:

Exhaust reversion. Reversion is the term for a negative pressure wave that can suck ambient air back into the exhaust and cause an erroneous lean AFR indication. Reversion effects will be most noticeable at idle, part throttle low RPM cruise, and decel. Open drag pipes suffer from reversion effects. Please note that if you use drag pipes or other open pipes, auto-tuning may not be possible at idle or part throttle due to reversion effects. In this case, you have three options:

1. Modify the exhaust to allow auto-tuning at idle and part throttle by adding a restriction such as the washers shown in Figure 1 or some other type of baffling. For race applications, you can remove the restriction after auto-tuning the idle and part throttle cells and then lock out closed loop operation by using the special value 0 in the BLM tables for these cells.
2. Use a rubber hose to extend the exhaust length during auto tuning at idle and part throttle. For more information, please contact our tech support.
3. Manually tune the fuel tables for idle and part throttle cells. This involves trial and error and is not recommended. Closed loop operation in idle and part throttle cells must be locked out by using the special value 0 in the BLM tables for the affected cells.

You can reduce reversion effects in open drag pipes and mufflers without restrictive baffles with the modification shown in Figure 1. Use washers with an OD that is 2/3 to 3/4 the ID of the pipe (for example, 1-1/2" OD washers are suitable for pipes with an ID of 2" to 2.25"). Weld 1/4-20 socket head cap screws to the washers as shown. Drill holes at the bottom of the pipes about 2" from the end and use decorative acorn nuts to secure the washer assemblies. We suggest that you use stainless steel hardware.

The washers will reflect positive pressure waves that will cancel out the negative pressure waves reflecting from the end of the pipes. You can turn the washers just like throttle blades to provide more or less restriction. Dyno tests will show a significant increase in midrange torque and a small drop in top end horsepower as the restriction is increased.

HOT STARTING PROBLEMS

Some engines are prone to hot starting problems. When cranked after a short hot soak, the engine may "kick back." Over time, this will cause damage to the ring gear and starter pinion.

The TCFI module uses an improved starting algorithm that includes a programmable cranking delay. The TCFI module is shipped with a zero cranking delay: it fires on the first recognized compression stroke. This works best on stock and mildly modified engines.

High compression engines will generally require compression releases. When compression releases are installed, best starting results will be obtained by programming the TCFI module for a 1-2 revolution cranking delay. This can be done by means of the PC Link TCFI software.

SPARK KNOCK PROBLEMS WITH HIGH COMPRESSION ENGINES

Spark knock problems may be encountered with high compression engines. If engine parts were “mixed and matched” from different suppliers, the actual compression ratio may differ substantially from the expected value. You cannot estimate compression ratio with cranking compression tests, as camshaft timing usually causes an erroneous low reading.

To accurately calculate compression ratio, you must measure the combustion chamber volume and use the formula:

$$\text{Compression Ratio} = \frac{\text{Head cc} + \text{Deck cc} + \text{Cylinder Volume}}{\text{Head cc} + \text{Deck cc}}$$

The practical limit for compression ratio is about 10.5:1 to 11:1 when running 93 octane pump gas. Any higher compression ratio will require retarding the ignition timing to the point where more power is lost from the retarded timing than is gained from the higher compression.

If spark knock is encountered during operation, you can use the TCFI Log software to download data and examine the operating conditions (RPM and manifold pressure) where spark knock occurred. You can then make appropriate reductions to the ignition advance table. Large displacement, high compression engines are prone to spark knock at relatively low MAP values during throttle roll-on. You may need to reduce the ignition advance throughout the entire MAP range.

ACR SYSTEM

Engines on some models are equipped with an automatic compression release (ACR) system. The TCFI Gen 7 supports the ACR system. No modifications or other special considerations are required. The ACR output on pin 19 of the ECM connector is active during the cranking revolutions set under Module Parameters (refer to page 26) if this parameter is set to a non-zero value.

SUPPORT FOR TWINCOOLED™ ENGINES

2014+ engines that have factory liquid cooling systems can have full compatibility and adjustability with the use of version 1.80 firmware and PC Link 18.1 and TCFI Log 18.1. No hardware changes are necessary; however, you must have TCFI7 firmware version 1.80 to utilize the coolant pump and cooling fans (see TCFI Gen 7 Rev 1.80 Firmware Update Tech Note).

The coolant pump will run when the engine is running, or when the conditions below exist:

Fans are turned on based on coolant temperature and vehicle speed. These are the stock settings:

Fan On Temp Below VSS : 105°C. This is the temperature setting that fans will turn from zero vehicle speed up to the programmed vehicle speed.

Fan On Temp Above VSS: 118°C. This is the temperature setting at which the fans will remain on above the programmed vehicle speed.

Speed for above Fan Settings 24 KPH. This is the vehicle speed breakpoint that the fan logic will follow to turn on the fans.

Fan Off Hysteresis: 8°, any scale. This is a temperature hysteresis value so the cooling system doesn't constantly turn itself on/off.

When the engine is switched off and the cooling system needs to continue running(ex: Turbo Timer), the following can be adjusted:

Engine Off Fan Timer: 180 seconds

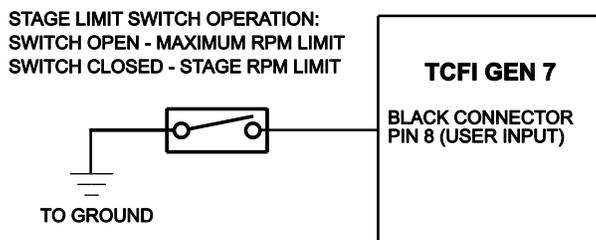
Engine Off Cooldown Temp: 95°C

Finally, the coolant temperature, coolant pump operation, and fans operation are logged in version 18.1+ of the TCFI Log software.

USER FUNCTIONS

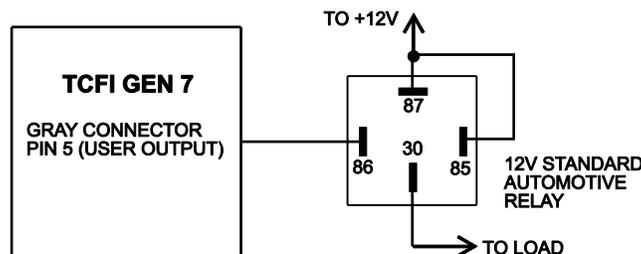
The TCFI user input on pin 56 of the ECM connector can be connected for a stage RPM limit function as shown in Figure 2. The stage limit switch must be normally open. You can use a microswitch attached to the clutch lever. When the clutch lever is pulled in, the switch contacts should close to activate the stage RPM limit. Refer to the User Functions section on page 28 for details on programming the stage RPM limit.

Figure 2 – Stage Limit Switch Wiring Diagram



The TCFI user output on pin 20 of the ECM connector can drive a standard automotive relay connected as shown in Figure 3. When the user output is active, +12V power is applied to the load. Refer to the User Functions section on page 28 for details on programming the user output.

Figure 3 – User Output Relay Wiring Diagram



CUSTOM BIKE AND AFTERMARKET ACCESSORY CONSIDERATIONS

Tight integration exists between the engine control module (ECM) and body control module (BCM) on Harley-Davidson® models with CAN data bus. It is not possible to run one of these models without a BCM.

The original equipment ECM has no connector terminal assignment for a tach signal. Engine RPM data is only available on the CAN data bus. Any aftermarket accessories that require engine RPM data will require an appropriate CAN data bus interface.

TECH SUPPORT

If you require tech support for tuning issues, we will ask you to email us both the current setup file (downloaded by means of PC Link TCFI) and a data logging file (downloaded by means of TCFI Log) that shows the problem. The data logging files are large and tend to be corrupted when attached to an email. **You suggest that you use an archiving program such as PKZIP or WinZip to compress the files prior to attaching them to an email.** You can send email to techsupport@daytona-twintec.com. Please make sure that you include your full name, phone number, complete information about the engine setup, and a detailed description of the problem. We suggest that you call us first to discuss the situation.

ENGINE DIAGNOSTICS

The TCFI Gen 7 version has extensive diagnostics. When the ignition switch is first turned on, the check engine LED illuminates. The LED goes out when the system initialization is complete.

If a diagnostic fault is detected while the engine is running, the LED will illuminate. Diagnostic codes can be read and cleared by means of the speedometer (same as with the OE ECM) or TCFI Log software. Most of the diagnostic codes are the same as those used by H-D® and the H-D® Electrical Diagnostic Manual for your model should be employed as a primary troubleshooting reference. Certain diagnostic codes that are unique to the TCFI or require special consideration are listed below:

P0373 CKP Signal Lost. This code will appear if the engine stalls. Customers are often confused about the meaning of the term “trips” associated with codes, especially P0373. This is an industry standard terminology. If code P0373 shows 40 trips, it means that the code was set 40 engine start cycles ago, not that the code has been set 40 times and that the crankshaft position sensor is defective.

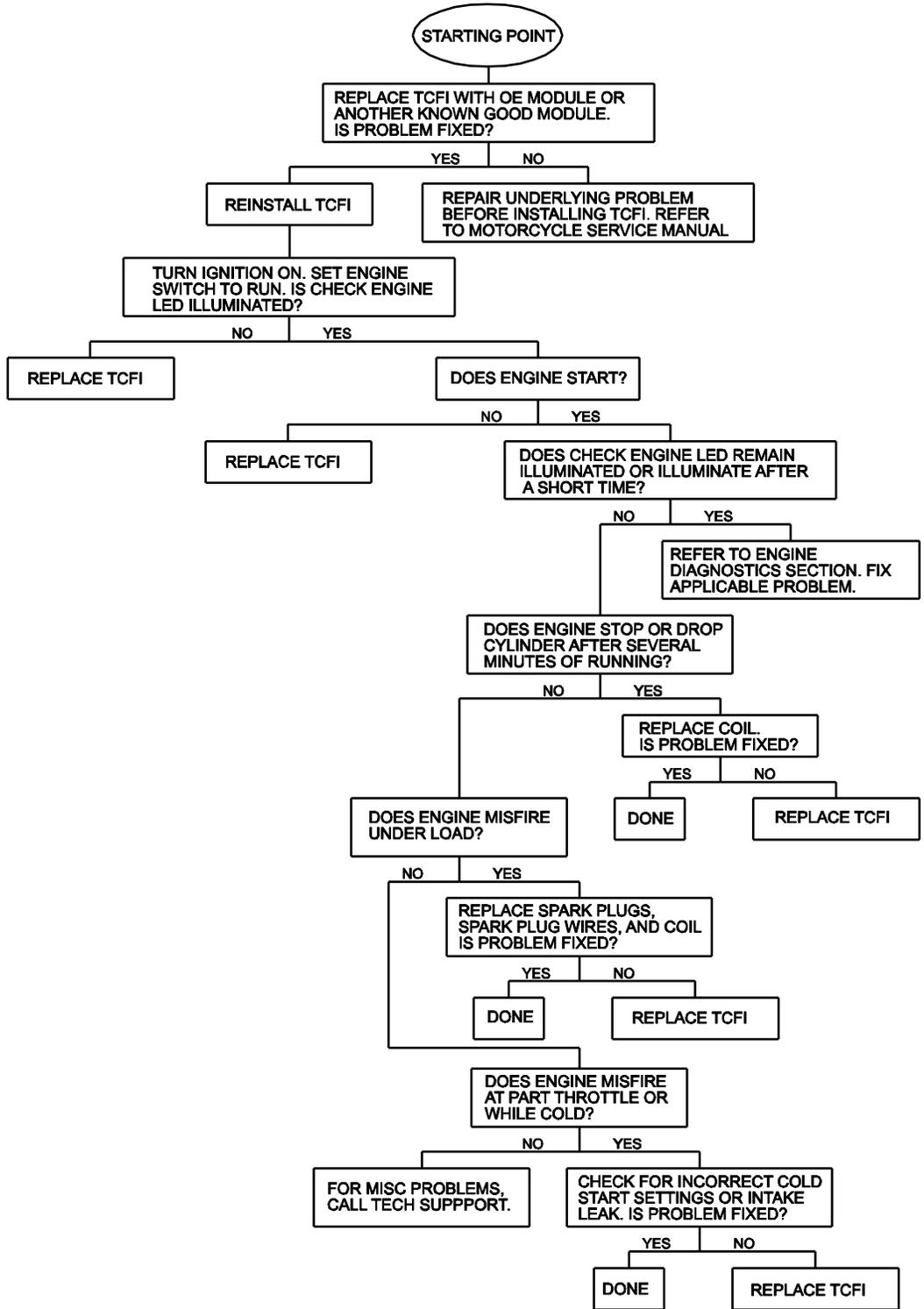
P0132 Rear Oxygen Sensor High, P0134 Rear Oxygen Sensor Low/Open, P0152 Front Oxygen Sensor High, or P0154 Front Oxygen Sensor Low/Open. These codes indicate a problem with the WEGO IIID unit. P0134 and/or P0154 will be set if the WEGO signal connection (white and blue wires) or WEGO power is lost. These codes may also be set if a Bosch sensor fails or becomes contaminated by leaded gasoline.

REINSTALLING THE ORIGINAL EQUIPMENT ECM

Removal of the WEGO system is not required for simple operational tests such as verifying that the engine will start and run.

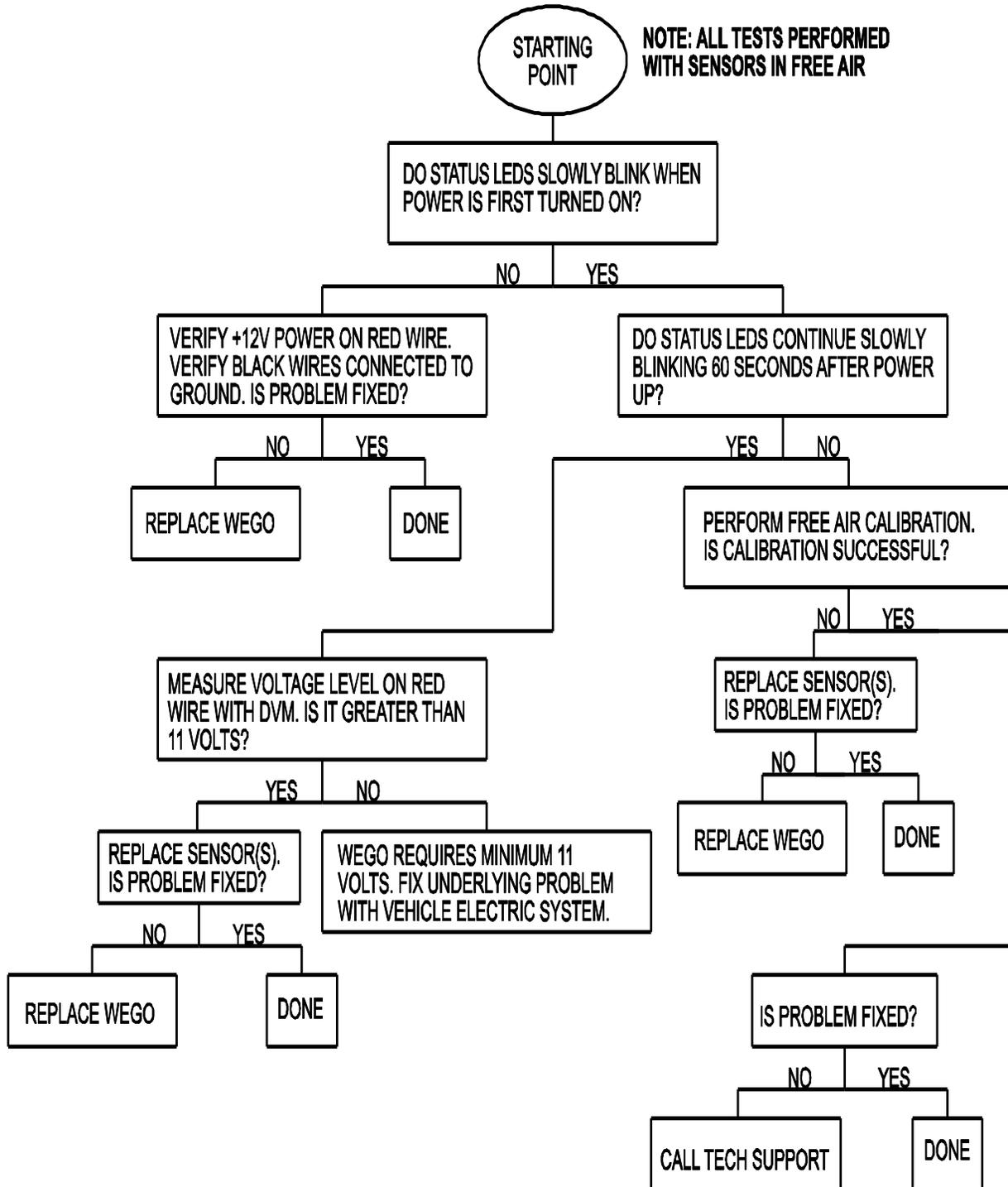
FAIL to START TROUBLESHOOTING FLOWCHART

Experience has shown that most units returned for warranty are OK and another problem, such as user error including improper setup or tuning, an intermittent wire harness connection, or defective coil, fuel injector, or sensor is later identified.



WEGO TROUBLESHOOTING FLOWCHART

Follow the troubleshooting flowchart shown below. Experience has shown that most units returned for warranty are OK and another problem, such as user error, a degraded sensor, or bad power connections is later identified.



COMMUNICATIIONS TROUBLESHOOTING FLOWCHART

Follow the troubleshooting flowchart shown below. Experience has shown that most communication problems are user error or PC compatibility issues.

