



MT / LT Series

Electronic Engine Management System

**Installation and
Programming Manual**

Version 2.0

MicroTech is a proudly Australian company with one very simple policy: to provide the customer with the best and latest technology, in an easy to use way, and at an affordable price.

The MicroTech MT-Series Electronic Control Unit is a microprocessor-based computer, which the user can program to meet the specific running demands of an engine.

Your MicroTech ECU comes fitted with a computer chip which was factory set with a basic program to suit your engine. This should enable you to start the engine as soon as you plug the ECU in. However this is only a basic program and as every engine is different, fine-tuning will be necessary to achieve best results.

The new LT-Series Laptop interface Software now allows for tuning to be done with either a laptop computer or by the MicroTech Handset. This instruction manual explains all the functions of the LT software, and how to use the Laptop Interface to adjust each of these functions and optimise the performance of your engine.

NOTE: This manual contains simple examples to assist novice users in the tuning process, but please note that it IS NOT designed to teach you how to tune an engine; rather it is assumed that if you are going to make adjustments to your ECU, then you already have a good working knowledge of electronic engine management principles. It is very easy to make a mistake which could cause serious engine damage, so if you are not sure of what you are doing please refer back to the dealer from whom you purchased your ECU. You have been warned!

The MicroTech LT Series software requires a Pentium 133 system or better to run correctly.

LIMITED WARRANTY

MicroTech Automotive Systems warrants this product to be free from any fault due to materials or workmanship for a period of one year from the date of purchase. If the MicroTech MT ECU is found to be faulty due to materials or workmanship, it shall be repaired or replaced upon return to MicroTech. MicroTech Automotive Systems accepts no responsibility for any damage or injury resulting from improper use of this product. This product is intended for racing and high performance engines used in non-highway applications. This product is not intended for aircraft use. Compliance with your local statutory regulations cannot be guaranteed.

MicroTech MT / LT Series Engine Management Computer Installation / Programming manual VERSION 2.0 - NOVEMBER 2001

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INSTALLATION GUIDE

The MicroTech MT Series of engine management computers are designed to suit a wide range of vehicles. This section provides an overview of the installation procedure however as the actual wiring requirements will vary from application to application, refer to the System Wiring Diagram supplied with the computer for the correct connections to the MT ECU.

For the MT ECU to function correctly, the engine must be fitted with a coolant sensor (to control warm-up enrichment) and a throttle position sensor (to detect idle and off-idle transition). Determine that these items are fitted to your engine and in working order before proceeding any further.

All connections should be soldered and sealed with electrical tape or heat shrink tubing. The MT ECU should NOT be plugged in until all connections have been soldered, checked, insulated, checked, and then checked again. The warranty will not cover you for damage due to incorrect installation procedures.

Before commencing the installation, disconnect the vehicle battery. The battery should not be

1 INJECTORS

**red + yellow ; red + orange ; red + yellow/black ; red + orange/black
(OPTIONAL: red + yellow/red ; red + orange/red)**

- If the engine is fitted with an O.E.M. (factory) loom, splice the injector wires from the MicroTech harness directly onto the original injection loom. The injector wires are the thinner RED wires and the YELLOW, ORANGE, YELLOW/BLACK, ORANGE/BLACK and optionally YELLOW/RED and ORANGE/RED.
- If the engine is not fitted with an OEM loom, you will need to purchase the appropriate connectors for the sensors, injectors etc. on your engine. In most cases these are all standard connectors, and are available from your MicroTech dealer or at most auto accessories shops.
- Injectors are fired by earth switching (i.e. the negative terminal is grounded to fire the injector). As such, the injectors are tolerant of being wired either way, i.e.: they are not polarity dependent. As a general rule, the MicroTech loom is supplied with four pairs of injector wires and should be coupled up to a maximum of two (2) injectors per wire pair. **Please refer to the System Wiring Diagram for the correct connection of the injectors in your system.**
- In throttle body type or other two-injector set-ups, the harness will only include 2 pairs of injector wires (RED + YELLOW, RED + ORANGE). Hook up one pair of injector wires to each injector.
NOTE: in these cases, a maximum of one low impedance (1.5 - 2.5 ohms) injector per pair must be used.
- In set-ups where the injectors are to be staged, the RED + YELLOW pair should be wired to the primary injectors, and RED + ORANGE pair wired to the secondary injectors.
- If high resistance injectors are used (12-16 ohms), then hook up 4 injectors per bank. Please contact your dealer immediately if you have any doubt about what type of injectors you have.

Ensure that injectors are wired in parallel, not in series; refer to the supplied System Wiring Diagram for the correct connection of injectors in your system.

2 COOLANT TEMPERATURE SENSOR

violet + brown

The coolant sensor (or engine head temperature sensor on air-cooled motors) is used to tell the MT ECU the operating temperature of the engine, allowing it to modify the fuel flow as the engine temperature changes, and to assist with warm-up. The sensor has two terminals, and is non-polarity dependent (can be wired either way). One terminal is connected to the BROWN wire (earth), and the other terminal is connected to the VIOLET wire (signal).

3 INLET AIR TEMPERATURE SENSOR

thin black + brown

The air temperature sensor measures the temperature of the air at the inlet to the engine and modifies the fuel flow to suit the ambient air temperature. The sensor has two terminals, and is non-polarity dependent (can be wired either way). One terminal is connected to the BROWN wire (earth), and the other terminal is connected to the BLACK wire (signal). If there is no air temperature sensor connected to the MT ECU, the air temperature function will default to "OFF"; this will not affect any of the other functions if it is not used. However many late model engines are coming out with air temperature sensors fitted as a standard feature, so it may be well worthwhile just checking to see whether you have one...

4 THROTTLE POSITION SENSOR

blue + grey + brown

Before going any further, it is necessary to identify the type of TPS sensor your engine is fitted with. There are two different types of TPS, switched or variable.

SWITCH TYPE (Early model Bosch / Toyota / Nissan etc.)

The switch type TPS is normally closed (the output is switched to earth) at idle. As the throttle is opened, the switch goes open circuit (the contact with earth is broken). Use a multimeter, test light or continuity tester to check which two terminals are common at idle (throttle fully closed). Hook the BROWN wire to one of these contacts and the GREY wire to the other contact. This type of TPS does not use the BLUE wire.

VARIABLE RESISTOR TYPE (Late type GMH / Ford / Mazda / Mitsubishi etc.)

This type of sensor sends a continuous variable signal to the MT ECU, telling the computer how far the throttle is being opened. The BLUE wire supplies +5v from the MT ECU voltage supply, and the GREY wire sends the return signal to the computer via a variable resistor inside the throttle position sensor. For the sensor to work, it must be earthed through the BROWN wire.

The Accessories Diagrams Supplement contains wiring diagrams for the more commonly used TPS units.

5 OXYGEN SENSOR

black/red

Most modern cars have an oxygen sensor fitted as standard equipment; connect the black/red wire to the oxygen sensor in the exhaust system if there is one fitted to your vehicle. If your oxygen sensor has more than one wire or terminal, refer to the Accessories Diagrams Supplement for correct wiring connections. The oxygen sensor function will not affect any of the other functions if there is no oxygen sensor connected to the MT ECU.

6 COILS AND IGNITION SYSTEM

IMPORTANT NOTES ON IGNITION CONNECTION:

If Coils have external resistors, make sure the PINK wire from the MT ECU is hooked up on the +12v (IGN) side of the resistors and NOT on the coil side of the resistors. If two coils are used (e.g. Mazda Rotary), connect the MT ECU wiring to the LEADING coil.

Digital EFI systems suffer from electrical noise problems with various ignition wires available on the market, such as spiral wound or solid wire unsuppressed leads. The use of such wires may interfere with the operation of the MT ECU.

Please ensure that you only use leads that are clearly marked "SILICON SUPPRESSED".

6(a) FUEL AND IGNITION

CRANK ANGLE SENSOR or ELECTRONIC DISTRIBUTOR

pink + shielded multi-core cable

Connect the PINK wire to the positive (+) terminal of the coil; this wire senses +12v from the coil when the ignition is switched on. The harness for fuel and ignition systems includes a shielded multi-core cable for ignition signal pick-up. Refer to the System Wiring Diagram for the correct connection of these wires to your crank angle sensor or electronic distributor.

IGNITION SIGNAL OUTPUT

grey/blue + grey/black + grey/red + grey/white + grey/green

These five wires provide the output signals for the ignitors to fire the spark plugs and tachometer (NOTE: not all five wires are used in all applications). Refer to the System Wiring Diagram for the correct connection of these wires to your ignition modules.

6(b) FUEL ONLY

pink + white

Connect the PINK wire to the positive (+) terminal of the coil; this wire senses +12v from the coil when the ignition is switched on.

Connect the WHITE wire to the negative (-) terminal of the coil.

In multiple coil applications (e.g.: Mazda rotary), the white wire should be connected to the leading coil.

If you are using an after-market ignition enhancer box (e.g. MSD or Accel), connect the WHITE wire to the tachometer output of the ignition unit instead of the negative side of the coil.

7 AUXILIARY

Fuel Only systems: blue/red

Fuel + Ignition systems: white

The function of the auxiliary wire varies from system to system. Refer to the System Wiring Diagram for the correct connection of the auxiliary wire in your set-up.

8 FUEL SUPPLY

pink + green

Fuel supply is critical to any EFI system. An EFI pump must be capable of delivering a steady fuel supply of at least 40-60 psi and at a flow rate of at least 25% greater than the total flow rate of all the injectors fitted to the motor. If these parameters are not adhered to, then fuel starvation will occur. This can be disastrous with a piston engine, and doubly so with a turbo engine.

For example, an engine with four injectors which are rated at 600 cc per minute should have a pump capable of supplying a minimum of $4 \times 600 = 2400 \times 1.25 = 3000\text{cc}$ or 3 litres per minute, which is about 180 litres per hour. This is an important rule to remember, especially with turbo engines that have had the boost raised well above standard levels. Too much fuel is always preferable to not enough, especially with turbo engines.

The MT ECU switches the fuel pump on and off and must be connected via a 30 amp automotive relay as it is not designed to switch the high current of an EFI pump.

Wire the relay as follows:

- Connect the GREEN wire to pin 85.
- Connect the PINK wire to pin 86.
- Connect pin 87 via a fuse to a constant +12v power source via a 15 amp fuse.
- Connect pin 30 to the +12v switch-on wire or terminal on the fuel pump.

Make sure the pump is connected with the correct electrical polarity, and the fuel supply is connected correctly; the Accessories Diagrams Supplement contains a diagram for the correct set-up of the fuel system. The ground for the fuel pump can be any clean, paint free point on the chassis. Route and secure the wiring from the pump into the engine bay so that it does not hang below the vehicle, interfere with rotating parts or become exposed to excessive heat. The MT ECU system is designed so that if the engine stops firing, the pump will turn off; this is a safety precaution in case of accident or the ignition being inadvertently left on.

9 FLUID CONNECTIONS

If the existing fuel supply line cannot sustain 40-60 psi pressure, then it must be replaced with high-pressure fuel line/tubing. Remember that carburettor systems operate at about 6 psi, but EFI systems operate at pressures from 40 to 60 psi. Never take any chances. If in doubt, replace the hose: it's cheap insurance. A high-pressure fuel filter must be mounted at the outlet of the fuel pump or in the engine bay before the fuel rail. It is also recommended to place a low-pressure filter between the tank outlet and the pump inlet to protect the pump if the pickup tube in the fuel tank does not have a filter.

10 POWER SUPPLY

thick red + thick black

Connect the thick (4mm) RED wire to the positive (+) battery terminal via a 15 amp fuse and the thick (4mm) BLACK wire directly to the negative (-) terminal of the battery. If the battery is located in the boot, hook the +12v positive RED wire to the main starter motor feed from the battery and the BLACK wire to a clean, rust and paint free connection on the chassis. It is essential that all connections are clean and tight for correct operation of the MT ECU. A little grease or anti-corrosion compound such as "Neverseeze" applied to connections exposed to the air will ensure long-term resistance to oxidation and corrosion.

11 VACUUM AND FINAL CHECKS

The last connection left is the MAP (manifold absolute pressure) vacuum signal. The vacuum line MUST be hooked up to a CONSTANT VACUUM SOURCE BELOW THE BUTTERFLIES on the plenum chamber to ensure the correct operation of the MT ECU. Use a cable tie to secure the vacuum line on the MAP sensor nipple to ensure a clean vacuum signal (especially in turbo systems). Most injected motors have multiple connections on the plenum chamber, so check after starting the engine that you have connected the vacuum line to a constant vacuum source and not a ported vacuum source (such as the ignition vacuum advance port).

Check all wiring connections to ensure that they are away from hot engine parts, and double check for any fuel leaks.

SYSTEM OUTLINE

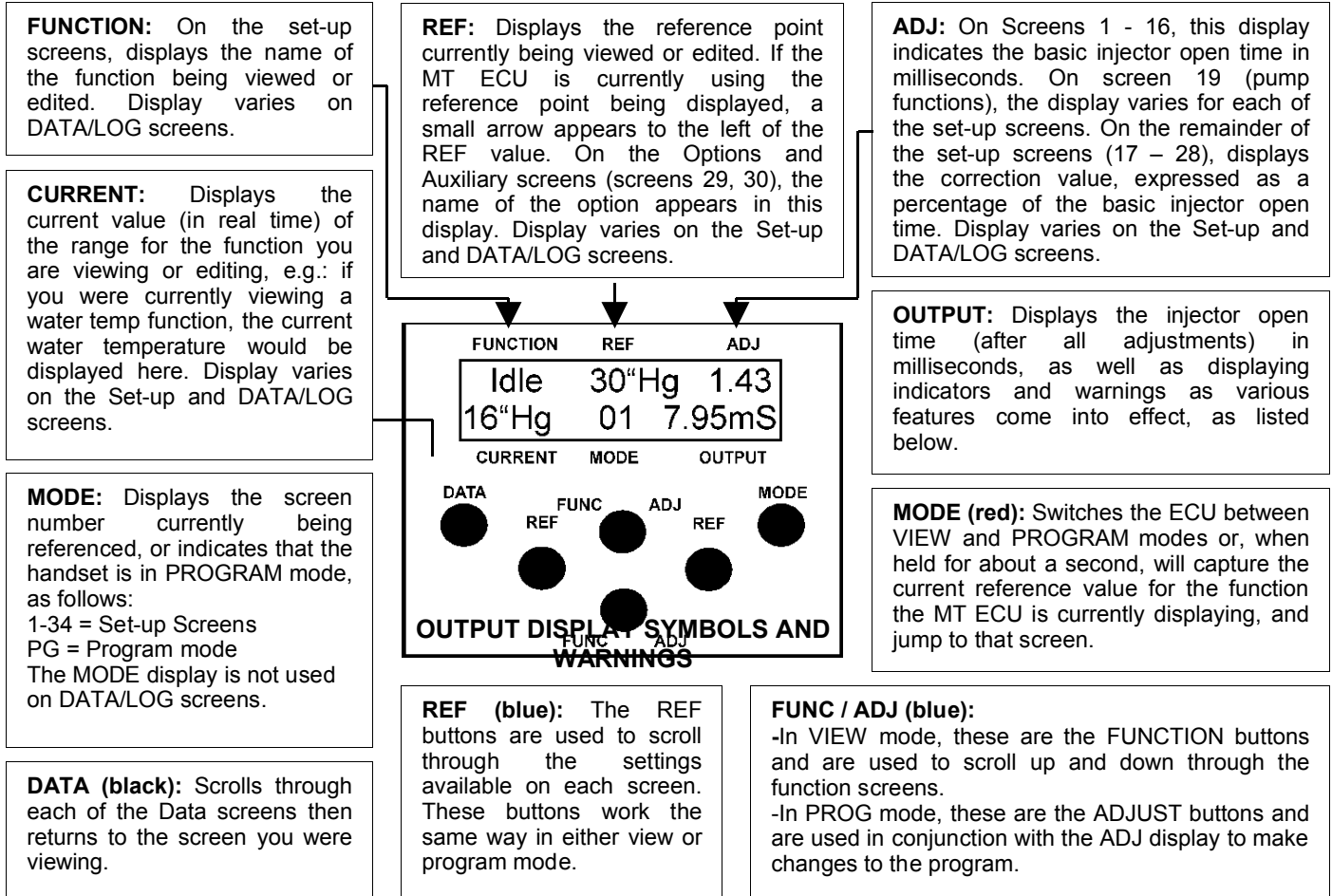
INDICATOR LAMPS

There are 2 indicator lamps on the side of the MT-4 ECU and 3 lamps on all other models:

- GREEN** = Power
ON (All models except MT-4)
- YELLOW** = Ignition Pulse indicator (when engine is running)
= TPS Calibration check (with ignition on, engine not running).
- RED** = Power
ON (MT-4 only)
= (Flashing) Master Warning light - refer to **ERROR LOG SCREENS** (Screen 33).

A GUIDE TO THE PROGRAMMING HANDSET

DISPLAY and BUTTONS



SYMBOLS:

- mS =milliseconds injector open time
- mL =ECU data logging active
- Decel =deceleration fuel cut active
- aS =after-start enrichment active
- sT =staged injection active (primary currently on)
- Pump1M =Pump 1 triggered in MAP mode
- Pump1T =Pump 1 triggered in TPS mode
- Pump2M =Pump 2 triggered in MAP mode
- Pump2T =Pump 2 triggered in TPS mode

WARNINGS:

- Max Duty Cycle =injectors are open for the maximum possible time.

- Water Temp =Temp over 100c
- Revlm =rev limiter operating
- Revcut =over-rev engine cut operating
- Bstcut =over-boost engine cut operating
- Battery =voltage low or alternator charging too high
- Shift =shift light activated (Dash only)
- Boost =activate over-boost warning (Dash only)

NOTE: the above information also describes the top two lines of the display for the large-view (4-line) MicroTech handset, while the bottom two lines contain a continual scrolling view of the current values for all sensors connected to the ECU.

USING THE MT SOFTWARE (with the Programming Handset)

OVERVIEW

The chip supplied with your MT ECU has been factory programmed with a basic data map to suit your engine. A data map is simply a set of instructions for the computer to execute under certain conditions. As the operating conditions of the engine change, the various sensors on the MT ECU detect the changing requirements and adjust the fuel supply and/or timing advance to maintain optimum running conditions. The MicroTech MT ECU has 17 main set-up functions, 8 for fuel functions, 6 for ignition functions and 3 options screens containing numerous set-up and optional features. Fine-tuning the MT ECU is a process of adjusting these functions relative to each other to establish the ideal running conditions for your engine. The MicroTech Handset allows you to view and edit the factory set maps in the MT ECU to optimise the running of your engine. The FUNC buttons scroll through the functions, and the REF buttons scroll through the reference points for each function. Switching to PROG mode by pressing the MODE button allows the adjustment value to be set with the ADJ buttons. The lead provided with the MicroTech Handset plugs into the 9-pin accessory port on the right hand side of the MT ECU.

MODES, FUNCTIONS and SCREENS

MODES

The MT ECU works in two modes; VIEW and PROGRAM. In VIEW mode, the up / down FUNC buttons and left /right REF buttons can be used to display any screen. Any time the MT ECU is switched on, it starts up in VIEW mode; no alterations can be made to the maps in this mode. Pressing the red MODE button switches the MT ECU to PROGRAM mode. In PROG mode the left /right REF buttons still work the same way, but the up / down have now become ADJ buttons, and are used to adjust the correction values in the screen being displayed. To look at a different function it is necessary to switch back to VIEW mode, then use the up / down FUNC buttons. The MODE display indicates the mode the MT ECU is in by displaying the function number while in VIEW mode and displaying PG instead of the function number when in PROG mode.

FUNCTIONS

The function pages represent the various inputs used by the computer to control the fuel curve. There are 17 different function pages (8 for fuel functions, 6 for ignition functions and 3 for options), as well as an ID page, a DATA/LOG page and a security features page. The up / down FUNC buttons are used while in VIEW mode to move between the function, ID, data and security pages. NOTE: pressing the up / down buttons in PROG mode will edit the data - make sure you are in VIEW mode!

SCREENS

Each function area has numerous screens attached to it; use the left / right REF buttons to move between screens. Fuel and ignition functions (Screens 1 – 28) each have 16 screens attached. Each of these represents an adjustable map point for that function. The interaction of these maps forms the basic fuel and ignition curve for the engine. The Screens 29 – 34 have numerous screens allowing various options to be set up, or switched on or off.

TYPICAL SET-UP PROCEDURES

To obtain optimum performance from your engine we recommend that an experienced MicroTech dealer on a dynamometer do the final set-up and tuning of the MT ECU. It is possible however to achieve good results by tuning on the road with the help of a timing light and an air-fuel ratio sensor.

*This is only an overview of the set-up procedure, and does not go into great detail about the functions. For more detailed information on the functions of the MT ECU, refer to the **CONTROL FUNCTIONS** and **OPTIONS** sections of this manual.*

<p>Opt TPScal +10% +00% 30 8.33mS</p>

After completing the installation, check all wiring and fluid connections carefully before reconnecting the vehicle battery. Turn the ignition on to power the MT ECU up, but DO NOT start the engine yet; first the TPS sensor must be calibrated. Scroll to the TPScal screen in the OPTIONS function (Screen 30).

If your system is fitted with a switch type TPS, you will need to loosen the screws mounting the TPS onto the throttle body, and physically turn the TPS until the TPScal display reads 0%. Retighten the TPS in this position and check the calibration by softly touching the accelerator pedal - as soon as you touch the throttle, the TPScal value should change from 0% to 99%.

If your system is fitted with a variable resistor type TPS, switch the Handset into PROG mode and with the throttle closed (foot off the pedal), use the up/down ADJ buttons to make the CURRENT display in the TPScal screen read 0%.

NOTE: With the ignition switched on but the motor not running, the yellow lamp on the side of the MT ECU acts as a TPS calibration indicator and will be lit while the throttle is closed (0%TPS).

Now start the engine and while it warms up to operating temperature, check over all the fuel and vacuum connections again (remembering that they are now pressurised) and scroll through the DATA screens (Screen 33) to check the values for the input sensors (RPM, water, battery, etc.). Make sure all the sensors are reading correctly.

<p>Timing LOCK ON Setup 31 2.90sT</p>

(Fuel + Ignition set-ups only) Once the engine has reached operating temperature, scroll to the Timing screen in the Set-up function (Screen 31) and set this to read "Timing locked ON". This locks the timing (all timing correction values are ignored) so there is no timing advance. **DO NOT rev the motor while the timing is locked!**

Check the timing with a timing light and adjust to 10°BTDC for piston motors, or 5°ATDC for rotaries (the first mark that you see on the pulley). Switch the Timing function off again (display reads "Timing check OFF"), rev the motor and check the timing again with the timing light. Make sure the timing advances as the revs increase.

Idle 30"Hg 1.43
14psi 01 7.71mS

Set the engine idle speed by adjusting the setting screw on the throttle body. Use the Idle function (Screen 1) if necessary to adjust the fuel curve to achieve a smooth idle with clean exhaust emissions. If the car blows black smoke, the mixture is too rich; if it "hunts" at idle, mixture is too lean.

Load minMS 1.81
15psi 08 8.00mS

Next we need to set "off-idle" for smooth transition from idle when the throttle is opened. With no load on the motor, use light pressure on the throttle to free-rev to about 2000RPM. Scroll to the Load function (Screen 8) and adjust the 25"Hg, 20"Hg and 15"Hg screens as necessary to ensure a smooth transition from idle and that the engine revs cleanly as you open the throttle. This should result in an air/fuel ratio of about 14.7 - 13.5.

Now it's time to set up the main power maps: load the engine using a dynamometer or find a deserted spot where you can drive the car. Run the motor under load at about 3000RPM and adjust the 10"Hg, 5"Hg and 0"Hg Load screens. This should result in an air/fuel ratio of about 13.5 - 12.5.

If you have a turbo or supercharger, set up the boost Load maps (2psi - max. boost) while running the engine under load at about 3000 - 4000RPM.

NOTE: check air/fuel ratio with caution when setting up boost screens to avoid a lean out. This should result in an air/fuel ratio of about 12.5 - 11.5

This completes the coarse tuning of the system; now the other functions of the MT ECU can be used to fine-tune the system. All of these functions should be set up with the engine under load i.e.: on a dyno or while driving.

RPMwot 2000 +00%
OFF 17 8.43mS

Scroll to Screen 17: **RPMwot**. This function must be set up under full load, so if you are road tuning you will need to find a big hill... Load the motor and check conditions every 500RPM from 500 - 8000RPM. If necessary, adjust the mixtures to maintain conditions through the rev range.

RPMcrs 8000 +24%
OFF 18 9.57mS

Next, set up Screen 18: **RPMcrs**. Under light load (cruise), check conditions every 500RPM from 500 - 8000RPM. If necessary adjust the mixtures to maintain air/fuel ratios at light throttle openings all the way through the rev range.

Pump1 Amt +10%
15psi 19 8.52mS

Now adjust for throttle response and to remove any flat spots using the **Pump** functions (Screen 19). Remember that the MT ECU has two accelerator pump functions: **Pump1** for below 2000RPM and **Pump2** for above 2000RPM.

(Fuel + Ignition set-ups only)

t_rpm 6000 +25
+26 23 3.43sT

Now it is time to fine-tune the ignition functions. Firstly, scroll to Screen 23: **T°rpm**. This function sets the basic timing advance curve for the engine. If necessary, adjust the timing values every 500RPM in these screens so that there is no detonation (pinging) at any rev range under full load. **DO NOT** take turbo engines into boost at this stage; this function should be set up at about 10"Hg - 0"Hg.

t_map 04psi +00
+25 24*10.33mS

The **T°map** function (Screen 24) is the equivalent of a vacuum advance on a distributor. Use **T°map** to adjust timing advance under light load conditions (25"Hg - 15"Hg) for smooth cruise . If you are setting up a turbo motor, also adjust the boost screens (2psi - max. boost). In turbo systems, you may find that you have to retard the timing as boost rises in order to avoid detonation.

Water> 82 C +02%
82_C 20 8.33mS

t_wat 82 C +00
+25 28 7.19mS

This concludes the primary set-up of the MT ECU. There are still a few functions that need to be set once the engine has cooled down again (e.g. next morning):

The **Water** and **T°wat** functions (Screens 20, 28) should be set up if necessary to adjust the fuel and ignition to maintain

t_air 38 C +00
+25 25 9.24mS

the air/fuel ratio as the engine temperature changes.

The **Crank** function (Screen 22) should be set up as temperatures rise - as the temperature rises, crank the motor and adjust the **Crank** correction value to assist the motor to start more easily at that temperature.

Crank> 82 C +00%
72_C 22 7.62mS

The **Air_t** and **T°air** functions (Screens 21, 25) can be set up over time as required, as air temperature conditions change.

USING THE LT SERIES SOFTWARE (Laptop Interface)

The LT-Series Software is an interface package allowing for the MicroTech MT-Series ECU to connect to a Laptop computer or PC. This interface allows for full 3-D tuning and data logging, while offering all the running data in an easy to view format.

Requirements:

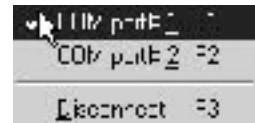
- Min. Pentium 133MHz PC
- Windows 95, 98, ME, 2000
- MicroTech MT-Series ECU - LT Version
NOTE: a label is attached to the bottom of the MT ECU when the LT software is installed. If your ECU does not have this identifying label, you will need to return it to MicroTech to have the upgraded software installed.
- MicroTech Laptop Interface Adaptor
- 9-pin serial port connecting cable

Connection

The 9-pin connector on the MT-Series ECU is used to connect to either the standard programming handset or to the serial communications port on the rear panel of your laptop via the Laptop Adaptor supplied with the LT Software upgrade. The adaptor is necessary for the connection, and also contains any stored programs you may have saved. Make sure you keep it in a safe place, as you will not be able to connect to the ECU without it.

If your laptop has a 25-pin communications port, or does not have a communications port, you will need to obtain a 25 – 9 pin serial adapter or a USB – serial adapter; these are available at most computer or electronics stores.

When the ECU has been connected to the laptop correctly and the ECU switched on (ignition on), establish the connection by pressing F1 (com port #1) or F2 (com port #2), or select the com port from the **Connect System** drop down menu.



Display



In the top left corner of the LT program screen is a representation of the MT-Series handset. If you are familiar with tuning the MicroTech system using the Handset, you may find it helpful to refer to the display here while you are learning your way around the new software.

This handset is the key interface to the ECU. By clicking on the buttons on this diagram, or using the appropriate keyboard shortcut keys, you navigate the MT function screens the same as you would with a real handset. The cursor keys on your keyboard become the navigation buttons: Left / Right = Ref Buttons, Up / Down = Func / ADJ Buttons. Press either the "P" or the "M" key to change between View and Prog mode (See the Hotkeys section for a full list of the keyboard shortcuts used in the LT software).

Directly beneath the handset is an air/fuel ratio display, allowing constant monitoring of engine emissions while tuning.

The top centre and right hand sections of the display contain a set of gauges showing all the current values from the ECU as the engine runs. If any value for the input sensors exceeds the safe limit set for that function, the face of the gauge for that function will turn red as a warning.

When viewing the fuel map screens (Screens 1 – 16), the top centre portion of the screen changes to a graph display for the fuel maps, and can be viewed in two different ways; either as a series of graphs defining the maps for each function, or as a table showing the values of all the fuel maps in matrix mode. View mode is selected from the Functions drop down menu or by pressing [L] for Load Maps view, and [T] for Matrix Table view.

At the bottom of the screen the Data Outputs frame continuously displays the current values of all inputs to the ECU. The Rx and Tx indicators show the connection to the ECU: Rx = receiving data from the ECU, Tx = sending data to the ECU.

The Ref Points frame in the middle of the screen shows all of the reference points for the function currently being viewed. An arrow indicates which point is currently being referenced.

Menus

This is a list of the in the MicroTech LT Series Laptop Interface Program, and their functions:

- **File**
 - **Tuning Time** – displays the time elapsed since connecting to the ECU.
 - **Exit** – close the LT Interface program.
- **Connect System**
 - **COM Port #1, COM Port #2** – connect to the ECU on serial port 1 or 2.
 - **Disconnect** – stop the connection to the ECU without closing the LT Interface program.
- **Functions**
 - **Load Maps, Matrix Tables, Graph 3D** – selects display mode.

- **Ignition Maps, Fuel Maps, Accel Pump, Temp Maps, Aux Outputs, Options, Set-up, ECU Set-up, DATA Screens, Start Screen** – selects the function to be displayed.
- **3D Chart** – opens the 3D Chart window.
- **DATA Gauges** – opens the data gauges window.
- **Data LOGGER** – opens the data logger window.
- **ECU Logger**
 - **Load ECU Log** – download a data log from ECU Logger.
 - **View ECU Log** – convert and view ECU log.

NOTE: the ECU Logger function is optional in the LT-Series software. If this option is not fitted in your ECU, the “ECU Logger” menu options will be disabled, and you will need to have your laptop connected to the ECU in order to log data. Please ask your MicroTech dealer for information if you wish to upgrade your system for ECU logging capability.

- **Help**
 - **Quick Keys** – display a list of hot-keys.
 - **Help** – display the on-line help file.
 - **About** – display version and user information for the LT software.

Hotkeys

This is a list of all the shortcut keys used in the MicroTech LT Series Laptop Interface Program:

- **Programmer Navigation Keys**

[ARROW KEYS]		Scroll
between FUNC / REF points		
[P] or [M]		
Switch between VIEW / PROG modes		
[PgUp] & [PgDn]		Scroll
between pages while in PROG mode		
[R]	Record data to logger (on / off)	
[CAPS LOCK]		Switch
AFR display on / off		
- **Program Shortcut Keys**

[SHIFT]		Clear Capture points
Clear Program cell		[DEL]
[+], [-]	Fast program increment / decrement	[INS]
[C]	Insert Current Data point for copying	Copy data
to current Ref point		
[HOME]	Main Startup screen	
[F]		Show Fuel
Maps		[I]
Show Ignition Maps		ECU
[E]		
Setup page		[L]
Load Map view		3D Graph
[G]		
view		[T]
Matrix Table view		Options
[O]		
page		[X]
Auxiliary page		Data page
[D]		
	Accelerator Pumps	[A]
[S]		Setup
page		
- **Function Keys**

[F1]		Connect to MT ECU via COM#1 port
Connect to MT ECU via COM#2 port		[F2]
[F3]		Disconnect from MT ECU
		[F4] Exit

program

3D Chart Display

The new Matrix Tuning mode of the MicroTech LT software uses a series of "rpmLoad" maps to build a basic fuel requirement matrix for the engine: each of these rpmLoad maps becomes active in turn as the engine revs change. Adjusting each of the rpmLoad maps allows you to ensure that your engine is receiving precisely what it requires at all times.

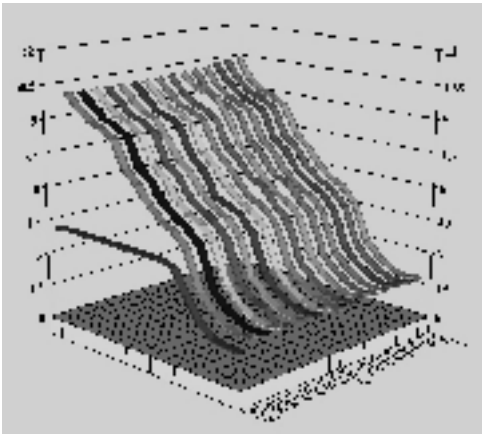
By displaying the full range of rpmLoad maps in sequence, the 3D Chart display creates a full 3D graph of the fuel matrix.

Displaying the 3D Chart

The 3D chart can be viewed either in the main programming screen for quick reference while tuning by selecting "Graph 3D" from the "Functions" menu, or pressing "G".

To open the 3D Chart in its' own full size window for a larger view, click on the "3D Chart" option in the menu bar or press [Alt]-3.

To close the 3D Chart window and return to the main programming screen, click the "Exit 3D Chart" button or the close gadget in the top right corner of the window, or press [Alt]-X.



Reading the 3D Chart

The base axes of the chart are the current engine Load values (X-axis) and Injector open time values (Y-axis) that make up the fuel map for each rpmLoad point. The Z-axis refers to the full range of rpmLoad points.

Each rpmLoad map is displayed in a different colour to differentiate between its neighbours. The legend on the right-hand side of the screen shows the colours used by each map.

In full-screen mode, there are 4 choices for the way you wish to view the 3D chart:

- Line (default) – displays a smooth curved line for each map. This is the default view; 3D Chart will always open with this view.
- Bar – displays each map as a series of solid bars.
- Area – same as line, but the area below the lines is filled with solid colour.
- Step – same as bar, except the gap between the columns is filled.

Clicking on any of the rpmLoad curves will display the individual setting points for that curve. Please note however, that it is not possible to use the chart to make changes to the settings. If using the chart view in the standard programming screen, you will need to press “G” to refresh the graph display after you make any changes.

Rotating the 3D Chart

The 3D chart may be rotated a full 360° in any direction to allow you to fine-tune its' position for the best view of the entire fuel matrix. To rotate the chart, place the mouse cursor anywhere on the chart display, then press and hold the [Ctrl] key. Now click and hold the left mouse button; move the mouse to rotate the chart to the position you prefer and release the mouse button.

The full window chart display also has several control buttons to control chart rotation:

- Rotate Chart – each time this button is pressed, the chart rotates 15° to the right.
- Elevate Chart – each time this button is pressed, the chart rotates 15° down.
- Reset Chart – returns the chart rotation to the default settings (45° right, 15° down).

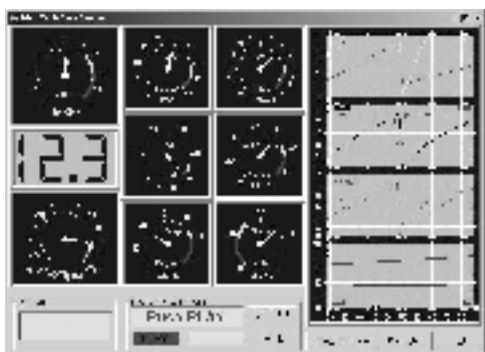
Data Gauges Window

The Data Gauges window displays a set of realistic automotive style gauges for real-time monitoring of the running condition of an engine, as well as a series of log graphs, which retain a history log of the values from the sensor inputs.

Opening the Data Gauges Window

To open the Data Gauges window, click on the “DATA Gauges” option in the menu bar or press [Alt]-D.

To close the Data Gauges window and return to the main programming screen, click the “Exit” button or the close gadget in the top right corner of the window, or press [Alt]-X.



Data Gauges Display

The main gauges in this window are:

- RPM – tachometer display showing current engine speed
- Map – manifold pressure gauge (30”Hg – 30psi)
- Air/Fuel Ratio – digital readout of air / fuel ratio
- Timing – shows ignition timing advance / retard
- Output – the amount of time the injector stays open when fired

These main gauges are always visible in the Data Gauges window. The centre portion of the screen contains a further 4 gauges:

- T.P.S. – shows the current amount of throttle opening (in %)
- Water Temp – current water temperature
- Air Temp – current inlet air temperature
- Charge – battery voltage

Clicking on the “Show E.C.U. Status” button will hide these four additional gauges and replace them with:

- E.C.U. Status checklist – displays the set-up configuration of the ECU as well as status of auxiliary functions
- ERROR Check checklist – indicates the status of the input sensors connected to the ECU
- Rich / lean exhaust indicator – shows air / fuel ratio in a bar graph display

Click the “Show E.C.U. Status” button again to return to the full gauge display.

The “Status” box in the bottom left corner of the window displays ECU alerts as various functions are switched on or off by the ECU.

These are the same alerts as displayed on the programming handset; see “A Guide to the Programming Handset” for a full list of these alerts.

Sensor Log Display

The right hand side of the Data Gauges Window is a set of four log graphs, which continually display the inputs being read from the sensors connected to the ECU: RPM and TPS are shown on graph 1, Load and Ignition timing on graph 2, Injector open time on graph 3, Water and Air temperatures on graph 4. These four graphs are simply a breakdown of the full Data logging graph display (see “Data Logger Window” section).

On the left margin of each graph is a set of sliders, which can be adjusted to set the vertical scale of each graph; another set is found on the bottom margin of the fourth graph which are used to set the horizontal scale of all four graphs together. To quickly scroll back and forth through the graph data, place the mouse cursor over the top of the graph you wish to check then press and hold the right mouse button. The graph will lock onto the mouse, and move with it until the mouse button is released.

The “Pause Chart” button below the graphs display will stop the graphs at their current point; press the button again to resume the real-time display. NOTE: when you resume display, the graphs will restart scrolling from the present time, i.e.: the section of graph between the time the graph is paused and the time it is resumed may not be displayed. To see this section of the graph you will need to scroll back through the data after resuming.

Data Log Player

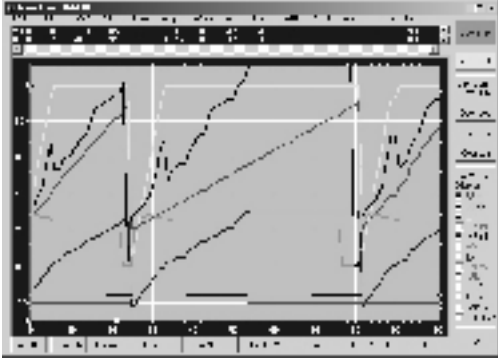
The Data Log player controls located at the bottom centre of the Data Gauge window enable you to view a stored data log in Data Gauges view. This feature is disabled unless a data log has been recorded or loaded from disk (see “Data Logger Window” for

information on saving and loading data logs). If there is a log file open, the display in the Data Log Player screen will read “Push PLAY”, and the PLAY button will flash red.

As this is just a very basic log player, the controls are simple:

- Play – starts playback of the currently loaded data log
- Stop Log – stops playback of the current data log
- Pause / Resume – pause or resume playback

During playback, the background colour of the gauges changes to light blue to indicate that the current display is from stored data, not in real time.



Data Logger Window

The new MicroTech LT laptop interface software now incorporates a full range Data Log facility that records samples of the inputs and outputs of the ECU. This makes trouble-shooting easy as any anomaly, which may happen too quickly to be caught in real time, can be tracked down and corrected by careful examination of the data log.

You may save your data logs as files (either on the hard drive of your laptop or on any other type of disk you like), allowing you to recall and review them at any time in the future. MicroTech Log files are assigned an .MTL extension.

Opening the Data Logger Window

To open the Data Logger window, click on the “Data LOGGER” option in the menu bar or press [Alt]-L.

To close the Data Logger window and return to the main programming screen, click the “Exit” button or the close gadget in the top right corner of the window, or press [Alt]-X.

Text and Chart Views

The main display of the data logger window is made up of the data screen, which can be viewed either as text or as a chart.

- **Text View** displays all incoming data as a table of values. This view represents the basic form of a data log; it is simply a record of the set of samples that have been recorded. If you save your data log to disk, it is this text version of the log that is retained. (See “Text View Commands” below for information on inserting additional information into your data logs when saving to disk).
- **Chart View** plots a series of graphs from the data in the text view.

Data Logger Controls

The main control buttons are set down the right hand side of the window, along with a legend of the colours used to graph each function in the chart view. The main control buttons are:

- LOG Start / LOG OFF – starts and stops the data logger. Hotkey is [Alt]-L.
- View Text / View Chart – changes between text view and chart view. Hotkey is [Ctrl] or [Alt]-V.
- Quick Help – displays a list of hotkeys for the Data Logger Window. Hotkey is [Alt]-Q.
- Open Log – opens a stored data log file from disk. Hotkey is [Alt]-O.
- Save Log – saves current data to disk as a data log file. Hotkey is [Alt]-S.
- Clear Log – clears current data. Hotkey is [Alt]-C.
- Print Log – prints the text version of the data log currently being viewed (if a printer is connected to your laptop). Hotkey is [Alt]-P.

Directly below these control buttons is a list of the functions that can be displayed in the chart view, as well as the colour each function will be drawn with. Click in the checkboxes to place a check mark next to each function you wish to view on the chart, or to remove the check mark if you do not wish that function to be shown. The “Colours” and “Thin Lines” options allow you to change the background and line weight in the chart for easier viewing with certain types of laptop display. Try these options if you have difficulty reading the chart display.

Along the bottom of the data logger window is a second set of control buttons, which are used to show additional information and control the chart display as well as add identifying information to logs in text view. These controls are as follows:

Chart View Control buttons

- Log MAX – displays the maximum values for all functions at the bottom of the chart.
- Log MIN – displays the minimum values for all functions at the bottom of the chart.
- Log AVG – displays the average values for all functions at the bottom of the chart.
- ReDraw Log – redraws the chart from the text data and resets the chart view to 50 samples wide (default setting).
- Max View – displays the full chart in a single screen (shrinks chart to fit).
- Display Mode – select the preferred display mode:
 - Wrap Display – the chart is plotted from left to right of screen, then returns to the left and over-draws the existing chart.
 - Display Norm – the chart starts plotting from the right, continually scrolls to the left and off the screen (default setting).
- Orientation – choose from:
 - Vertical – chart reads from top to bottom of screen.
 - Horizontal – chart reads from left to right (default setting).

Text View Control buttons

- Insert Statistics – inserts the maximum, minimum and average values for each function at the top of the text version of the data log.
- Insert Notes – allows you to add notes to the top of the text version of the data log to help identify the log or to keep comments about the data in the log file.

Besides these main control buttons, several additional hotkeys are available for navigating when in chart view:

- [Home] – returns to the start of the log and resets the chart view to 50 samples wide (default setting).
- [End] – jumps to the end of the log and resets the chart view to 50 samples wide (default setting).
- [PgUp], [PgDn] / [U-Arrow], [D-Arrow] – move forward or back by 50 sample steps through the log and resets the chart view to 50 samples wide (default setting).
- [L-Arrow], [R-Arrow] – move one sample forward or back through the log.
- [Ctrl] – toggle between text view and chart view.

ECU Logger

The ECU logger is an optional feature in the LT-Series software that allows you to record a data log into memory on board the ECU and download it to the laptop later, meaning you can record a full run without the need to actually have an expensive laptop in the car with you.

If this option is not fitted in your ECU, the “ECU Logger” menu options will be disabled, and you will need to have your laptop connected to the ECU in order to log data. Please ask your MicroTech dealer for information if you wish to upgrade your system for ECU logging capability.

Starting the ECU Logger

The only thing you need to do to set up the ECU logger is tell it when to start recording. This is done using the Rpm_ON and Map_ON functions (Screen 31: Set-up) to set the trigger points. The ECU logger function will be switched on any time both of these values are exceeded.

Rpm_ON 3000 Log
Setup 31 7.33mS

Example 1: if you were to set the Rpm_ON value at 3000rpm and the Map_ON value at 1psi, the ECU logger function will switch on just as the MAP sensor begins to read boost pressure (and engine revs > 3000rpm), and switch off again as revs and boost fall back below these values after the run.

The ECU logger stops recording if the values go back below the trigger points; if the trigger values are exceeded again, the ECU logger will recommence recording from that point. I.e. all information for running conditions above the trigger points is saved, and no information for below them.

Example 2: if you were to set the Rpm_ON value at 60rpm and the Map_ON value to OFF, the ECU logger would be turned on continuously while ever the engine was running, as idle speed will be higher than the Rpm trigger and the Map trigger is disabled. The ECU logger remains active while ever the ignition remains on. This means that the ECU Logger will continuously record “blocks” of data into a log as the engine conditions change above and below the trigger points. When the ignition is turned off, the ECU Logger is reset; next time it is activated, the existing data will be erased and a new log will be started.

Map_ON 05psi Log
Setup 31 6.10mS

NOTE: if you wish to view or save the ECU log, you must do so before you restart the ECU Logger function. YOU CANNOT GET BACK DATA THAT HAS BEEN ERASED!

Downloading an ECU Log

After recording an ECU log that you wish to retain, plug the ECU into your laptop and turn the car ignition on. It is wise not to run the engine at this stage, as if the trigger values are exceeded the ECU Logger function will start up and erase the current log – you will lose the data you are trying to download. Start the LT Interface software on the laptop and press [F1] or [F2] to connect to the ECU.

Click on “Load ECU Log” in the “ECU Logger” menu, and the log will be downloaded from the ECU to the memory in the laptop. The handset display will read “Loading DataLOG” while this is happening.

Next, click on “View ECU Log” in the “ECU Logger” menu. This converts the raw data from the ECU log into the standard MicroTech Log format (.MTL), then opens the Data Logger window and loads the converted data ready for review. See the Data Logger Window section above for information on using the Data Logger window.

PROGRAMMING GUIDE

FUEL CONTROL FUNCTIONS

The LT software allows two different methods of setting up the fuel control functions: Normal view or Matrix view.

Normal view will be familiar to anyone who has tuned a MicroTech ECU using the handset – it involves creating master Load and Idle curves and making adjustments according to rpm (RPMcrs, RPMwot) to vary these maps as engine conditions change.

Matrix view is slightly different. Instead of using a single Load curve, a series of load curves are generated for the full range of rpm values. This generates a full 3D map of values rather than relying on the more general correction values supplied by the RPMcrs and RPMwot features. This allows you to achieve a much finer resolution in the final tune.

Screens 1 – 18: Idle / Aux, Load, RPMcrs, RPMwot

1. Fuel Control Functions: Normal Mode

Screen 1: Idle / Aux (Normal Mode)

This is a two-part function; the vacuum screens (30"Hg – 0"Hg) are used to set up the Idle function, which makes fine adjustments to the fuel supply when the throttle is closed to maintain a smooth idle as vacuum fluctuates, or to keep the engine running efficiently on over-run. The 10 boost screens (2psi – 28psi) are used to set up the microfueller function, which is available as an option on the latest range of ECU's. If your ECU does not have the microfueller option fitted, the Aux screens will be disabled.

1. Idle

There are 6 set-up screens for the Idle function, from 30"Hg to 0"Hg.

- NOTE: the Idle function should be set up at the engines normal operating temperature, and before any corrections are made using the Water function. Make sure that the engine is properly warmed up before setting these values.
- While the engine is at idle, observe the vacuum reading on the MicroTech Handset. This will establish which screens you will use to set for idle and which screens you will use for over-run.
- Use the Idle screens below the actual idle vacuum level to make any necessary corrections for variation in idle condition due to fluctuating vacuum, e.g.; if the engine idles at 20"Hg, you may need to make corrections in the 20"Hg, 15"Hg and 10"Hg screens.
- As the engine will always pull more vacuum on over-run, use the Idle screens above the actual idle value to make any necessary corrections for over-run, i.e.; in the above example, 25"Hg and 30"Hg.
- The MicroTech Handset indicates when an Idle screen is active by displaying a small "block" between the MODE and OUTPUT displays.

Idle 24"Hg 1.48
14"Hg 01 3.33sT

It is vital that your TPS is properly calibrated for the Idle feature to work correctly – refer to the TPScal function in the Options screens (Screen 30) for instructions on calibrating the TPS.

2. Aux (Optional)

There are 10 set-up screens for the Aux function, from 2psi to 28 psi. These screens are used to create a fuel map for the microfueller injector, if fitted. Whenever the MAP sensor senses boost, the ECU will fire the auxiliary injector for the time set in the current Aux screen.

Aux 16psi 4.19
4.19 01 9.95mS

Screen 8 - Load (Normal Mode)

The Load function senses engine vacuum/boost and sets the injector open time to the value in the active Load screen (the map point closest to the current value).

- Load is the most significant setting in the MT ECU system, as it is the values set in the Load screens that determine the basic fuel map for the engine.
- When you purchase an MT ECU, it comes pre-programmed with a load curve suited to your particular engine type. Fine-tuning is a process of using the other functions of the MT ECU to add or subtract fuel from this basic curve to maintain ideal running conditions as engine requirements change.
- The MicroTech Handset indicates when a Load screen is active by displaying a small "block" between the MODE and OUTPUT displays.

Load minMS 1.81
15psi 08 8.00mS

Load sensing may be configured in one of three ways; using a manifold pressure sensor (most common), throttle position sensor or a combination of both.

Low or irregular vacuum applications such as ported rotary engines, motorcycles, or performance engines with large cam overlaps and radical inlet manifold designs may have wide vacuum fluctuations at idle and low revs, which will give false readings proportional to load. The T.P.S. function overcomes this problem by sensing engine load using the throttle position sensor rather than vacuum as the primary load source. To configure the MT ECU to operate in T.P.S. mode, go to the configuration set-up screens (Screen31) and move to the LOAD= screen. The default setting is "LOAD= MAP", i.e.: the MT ECU is configured to work in MAP mode. Switch to program mode and press one of the ADJ buttons, and the screen will change to read "LOAD= TPS". Switch out of program mode again; the MT ECU is now configured to operate in T.P.S. mode.

Set up TPS mode the same way as for MAP mode, except the settings refer to the percentage of throttle opening rather than manifold vacuum. Boost pressure screens remain the same in either MAP or TPS mode.

NOTE: Before continuing, make sure that your TPS switch has been properly calibrated using the TPScal function in the Options screens (Screen 30). The TPS must be properly calibrated for this function to operate correctly.

The factory-supplied program contains a set of Load maps tailored to suit your engine type. This factory map should allow you to start the engine as soon as you have installed the MT ECU. The only time this map should require adjustment is if a major change
MT / LT Series ECU

is made to the running conditions, e.g.; fitting a different exhaust system, changing injector size, etc. The factory map set in the Load screens should be close enough to the actual requirements of the motor that no adjustment is necessary to the Load maps. DO NOT change the Load maps unless the problem cannot be fixed by making corrections with the other functions of the MT ECU. Remember that the Load function is only setting the basic fuel map; the other functions of the MT ECU will still need to be adjusted for smooth performance.

EXAMPLE:

Let's say that an engine is not running cleanly on the factory-supplied map while engine load is between 15"Hg and 5"Hg. Using the MicroTech Handset, make the required adjustment at each map point through the problem area. This can be quite easily done by trial and error; when the engine is at normal operating temperature, drive the vehicle and observe what adjustments are required at the various vacuum or boost points. Now pull up, switch to PROG mode, and make some coarse adjustments to the Load screens. Drive the vehicle again, note the conditions, stop and adjust. Continue this routine until you are satisfied that you have achieved the optimal basic map for your engine (i.e.: adjusting any of the Load screens up or down deteriorates performance). With a little practice, this is a very quick and easy process. Set up the Load maps so that the engine is not running too rich or too lean, then use the other features to fine-tune.

Switch the Handset back to VIEW mode, and use the REF buttons to scroll back and forth through the Load screens and check your correction values; these values should follow a fairly steady progression. If a value in one screen is dramatically higher or lower than the values on either side of it, the engine will run roughly as the MT ECU switches between these screens, e.g.:

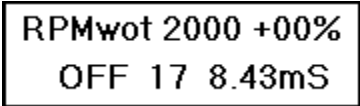
LOAD	30"Hg	25"Hg	20"Hg	15"Hg	10"Hg	5"Hg	0"Hg	2psi	4psi	6psi
ADJ	2.00mS	2.15mS	2.25mS	2.40mS	3.00mS	4.00mS	5.00mS	5.50mS	6.00mS	7.00mS

NOTE: these values are examples only. DO NOT use these values when programming your MT ECU.

These figures show a fairly smooth curve as you step between them. If you find that one value is way out of line with the values on either side of it, adjusting that screen and the screens on either side of it to smooth the curve out. If you have a high point in the fuel curve, it is better to bring the surrounding (lower) values up to the high point rather than bringing the high values down. This prevents the chance of an accidental lean-out.

Screen 17: RPMwot (Normal Mode)

The RPMwot function varies the fuel supply when the throttle is opened wide to provide the additional fuel required under acceleration. When the MT ECU senses the drop in vacuum which occurs at wide open throttle it checks the engine speed and changes the injector open time by the amount set in the RPMwot screen closest to this speed. This value is expressed as a percentage of the total injector open time.



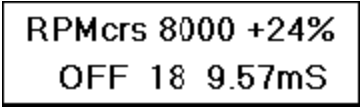
NOTE: the RPMwot function is used to normalise running conditions when running under full throttle; the Pump function is used to provide an additional "squirt" of fuel for crisp acceleration when the throttle is opened quickly. See Screen 19: Pump for information on using the Pump function.

The switch on point of the RPMwot function is factory set at 5"Hg (i.e.: when the MT ECU detects the vacuum rapidly decrease to below 5"Hg, it will switch on the RPMwot function). This setting should suit most engines; DO NOT adjust this value unless necessary. Please refer to the Options Set-up (s1) section if you need to reset the RPMwot or RPMcrs switch-on points.

The MicroTech Handset indicates when an RPMwot screen is active by displaying a small "block" between the MODE and OUTPUT displays.

Screen 18: RPMcrs (Normal Mode)

The RPMcrs function varies the fuel supply when cruising at speed. When the MT ECU senses the continuous high vacuum that occurs while cruising it checks the engine speed and changes the injector open time by the amount set in the RPMcrs screen closest to this speed. This value is expressed as a percentage of the total injector open time.



The switch on point of the RPMcrs function is factory set at 15"Hg (i.e.: when the MT ECU detects constant vacuum above 15"Hg, it will switch on the RPMcrs function). This setting should suit most engines; DO NOT adjust this value unless necessary. Please refer to the Options Set-up (s1) section if you need to reset the RPMwot or RPMcrs switch-on points.

2. Fuel Control Functions: Matrix Mode

To switch to Matrix mode, set the "Maps =" option to "Matrix" (Screen 31).

This generates a series of Load maps, which the ECU references according to engine rpm, i.e. there is a Load map at 1000 rpm, another at 1500, then 2000 etc. As the engine revs change, the ECU switches Load maps according to the changing rev range. This 3D mapping system allows for much higher resolution tuning, as you can compensate for any requirement of the engine under special conditions without affecting its' running under other conditions.

Screen 1: Idle / Aux (Matrix Mode)

This is a two-part function; the vacuum screens (30"Hg – 0"Hg) are used to set up the Idle function, which makes fine adjustments to the fuel supply when the throttle is closed to maintain a smooth idle as vacuum fluctuates, or to keep the engine running efficiently on over-run. The 10 boost screens (2psi – 28psi) are used to set up the microfueller function, which is available as an option on the latest range of ECU's. If your ECU does not have the microfueller option fitted, the Aux screens will be disabled.

1. Idle

There are 6 set-up screens for the Idle function, from 30"Hg to 0"Hg, or 0% - 80% TPS

- NOTE: the Idle function should be set up at the engines normal operating temperature, and before any corrections are made using the Water function. Make sure that the engine is properly warmed up before setting these values.
- While the engine is at idle, observe the vacuum reading on the Load gauge on the right of the screen. This will establish which of the Idle screens you will set for idle and which screens you will use for over-run.
- Use the Idle screens below the actual idle vacuum level to make any necessary corrections for variation in idle condition due to fluctuating vacuum, e.g.; if the engine idles at 20"Hg, you may need to make corrections in the 20"Hg, 15"Hg and 10"Hg screens.
- As the engine will always pull more vacuum on over-run, use the Idle screens above the actual idle value to make any necessary corrections for over-run, i.e.; in the above example, 25"Hg and 30"Hg.

Idle 24"Hg 1.48
14"Hg 01 3.33sT

It is vital that your TPS is properly calibrated for the Idle feature to work correctly – refer to the TPScal function in the Options screen (Screen 30) for instructions on calibrating the TPS.

2. Aux (Optional)

There are 10 set-up screens for the Aux function, from 2psi to 28 psi. These screens are used to create a fuel map for the microfueller injector, if fitted.

Whenever the MAP sensor senses boost, the ECU will fire the auxiliary injector for the time set in the current Aux screen.

Aux 16psi 4.19
4.19 01 9.95mS

Screens 2 - 16: RPMLoad (Matrix Mode)

The Load function sets up the main 3D fuel map. The ECU senses either engine vacuum/boost or TPS% and sets the injector open time to the value in the active Load map (the map for the current rev range).

These screens set the Load maps the ECU refers to as the engine revs change. Each map defines a series of values, which determine the injector open time according to engine revs and Load. The factory-supplied program contains basic Idle and Load maps tailored to suit your engine type. These factory maps should allow you to start the engine as soon as you have installed the MT ECU. The tuning process involves setting the RPMLoad screens to compensate for the varying requirements of the engine as the revs change.

5500 16psi= 8.48
10psi 11 7.14mS

The 4000rpm RPMLoad screen (Screen 8) represents the main load curve for the set-up. When starting from scratch, set this curve up first, i.e. get the engine running reasonably at 4000rpm. Once you are satisfied with this basic map, scroll to the "ALL MAPS the SAME" option in the ID Screens (Screen 34). Press and hold the mode button for two seconds, and the basic map you have created in the LOAD screen will be copied into all the other RPMLoad screens, setting up a full 3D spectrum which can be adjusted through the RPMLoad screens. Use the 3D Chart view to ensure that your values make up a smooth matrix (no huge peaks or troughs).

Low or irregular vacuum applications such as ported rotary engines, motorcycles, or performance engines with large cam overlaps and radical inlet manifold designs may have wide vacuum fluctuations at idle and low revs, which will give false readings proportional to load. The T.P.S. function overcomes this problem by sensing engine load using the throttle position sensor rather than vacuum as the primary load source. To configure the MT ECU to operate in T.P.S. mode, go to the configuration set-up screens (Screen31) and move to the LOAD= screen. The default setting is "LOAD= MAP", i.e.: the MT ECU is configured to work in MAP mode. Switch to program mode and press one of the ADJ buttons, and the screen will change to read "LOAD= TPS". Switch out of program mode again; the MT ECU is now configured to operate in T.P.S. mode.

Set up TPS mode the same way as for MAP mode, except the settings refer to the percentage of throttle opening rather than manifold vacuum. Boost pressure screens remain the same in either MAP or TPS mode.

NOTE: Before continuing, make sure that your TPS switch has been properly calibrated using the TPScal function in the Options screens (Screen 30). The TPS must be properly calibrated for this function to operate correctly.

Remember that the Load function is only setting the basic fuel map; the other functions of the MT ECU will still need to be adjusted for smooth performance.

EXAMPLE:

Let's say that an engine is not running cleanly at 5,500 rpm while engine load is between 15"Hg and 5"Hg. Select the 5500 Load screen (Screen 11), switch to program mode and make the required adjustment at each map point through the problem area (15", 10", 5"). Switch back to view mode, then test your changes. Set up the Load maps so that the engine is not running too rich or too lean, and there is a smooth progression from point to point in all directions. Use the 3D Chart display from the drop down menus to check that your map is smooth.

Screens 17, 18: RPMwot, RPMcrs (matrix Mode)

These functions are disabled in Matrix mode.

Screen 19: Pump

The MT ECU has two different Pump functions, which are used to supply additional fuel under hard acceleration:

- **Pump1** adds fuel "asynchronously" at low engine speeds. Asynchronous firing means that while the injectors continue their regular timed firing, the additional fuel is supplied using a random firing pattern. The total injector open time per ignition pulse remains the same, but this form of "asynchronous spattering" of the fuel creates a blanket of fuel vapour at the inlet, giving improved fuel economy and crisper accelerator response at low engine speeds.
- **Pump2** operates at higher engine speeds, and adds to the fuel curve with normal timed pulses.

Pump1 Amt +10%
15psi 19 8.52mS

The accelerator pump function can be set to trigger in either MAP or TPS mode; default is MAP mode (i.e. will work in MAP mode unless set to TPS mode).

To configure either the Pump 1 or Pump2 function to work in TPS mode, you must turn either Pump1Stop or Pump2Stop to OFF. The Pump function will then work according to the rate of change of throttle position instead of vacuum/boost. The Pump function comprises 16 set-up screens that allow you to set the operating parameters, i.e. when the Pump functions will switch on or off and how much fuel should be added:

Pump2Start | As mentioned above, Pump1 is used at low engine speed, and Pump2 for higher speeds. The Pump2Start function sets the RPM changeover value for Pump1 and Pump2, i.e.: if this value is set at 3000RPM, Pump1 will be active from 0 to 3000 RPM and Pump2 will be active from 3000 RPM upwards.

PUMP1 FUNCTIONS (low engine RPM)

Pump1Amt | Sets the amount of additional fuel to be delivered when Pump1 is activated. This value is expressed as a percentage of the injector open time, i.e.: if this value is set at +30, there will be 30% additional fuel supplied when Pump1 is switched on.

Pump1Pulse | Sets the minimum amount of additional fuel to be supplied by Pump1. This value is expressed as the minimum number of asynchronous pulses the injectors must fire before PUMP1 can be switched off, e.g.; if this value is set to +04, the MT ECU will send a minimum of 4 additional pulses to the injectors before allowing the PUMP1 function to switch off. This feature prevents the PUMP function from "bouncing" on and off at the trigger point.

Pump1Trig | Sets the amount of change (in MAP or TPS) required before triggering the Pump1 function. By default, this function works in MAP mode, but can be configured to work in TPS mode by setting the Pump1Stop function to "OFF".

- In MAP mode, this value sets the vacuum trigger point at which Pump1 will switch on, e.g.; if this value is set to 15"Hg, the MT ECU will Pump1 function on when vacuum rapidly increases to above 15"Hg.
- In TPS mode, this value sets the amount of change in TPS required to trigger Pump1. This is expressed as a percentage of throttle opening, e.g.; if this value is set to +20, the Pump1 function will switch on if the MT ECU detects a rapid increase of more than 20% in throttle opening.

Pump1Stop | Sets the vacuum trigger point at which Pump1 turns off, e.g.; if this value is set to 5"Hg the MT ECU will switch the Pump1 function off when vacuum falls below 5"Hg.(Note: Pump1 will also be prevented from switching on while ever vacuum is below this value). If you wish to run the Pump1 function in TPS mode, set this value to "OFF". Pump1 will now be switched off after firing the number of pulses set in the Pump1Pulse screen.

Pump1Adv
(Fuel + Ignition systems only) | Allows you to add ignition timing advance while Pump1 is active to improve throttle response under acceleration. This value is expressed as the amount of additional advance required, e.g.; if this value was set at +10, the MT ECU will automatically add 10° to the ignition timing advance while Pump1 is switched on.

PUMP2 FUNCTIONS (high engine RPM)

Pump2Time | Sets the minimum amount of additional fuel to be supplied by Pump2. This value is expressed as the minimum number of timed pulses the injectors must fire before Pump2 can be switched off, e.g.; if this value is set to +10, the MT ECU will send a minimum of 10 additional pulses to the injectors before allowing the Pump2 function to switch off. This feature prevents the Pump2 function from "bouncing" on and off at the trigger point.

Pump2Amt | Sets the amount of additional fuel to be delivered when Pump2 is activated. This value is expressed as a percentage of the injector open time, i.e.: if this value is set at +30, there will be 30% additional fuel supplied when Pump2 is switched on.

Pump2Trig | Sets the amount of change (in MAP or TPS) required before triggering the Pump2 function. By default, this function works in MAP mode, but can be configured to work in TPS mode by setting the Pump2Stop function to "OFF"

- In MAP mode, this value sets the vacuum trigger point at which Pump2 will switch on, e.g.; if this value is set to 15"Hg, the MT ECU will switch the Pump2 function on when vacuum rapidly increases to above 15"Hg.
- In TPS mode, this value sets the amount of change in TPS required to trigger Pump2. This is expressed as a percentage of throttle opening, e.g.; if this value is set to +20, the Pump2 function will switch on if the MT ECU detects a rapid increase of more than 20% in throttle opening.

Pump2Stop

Sets the vacuum trigger point at which Pump2 turns off, e.g.; if this value is set to 5"Hg the MT ECU will switch the Pump2 function off when vacuum falls below 5"Hg. (Note: Pump2 will also be prevented from switching on while ever vacuum is below this value). If you wish to run the Pump2 function in TPS mode, set this value to "OFF". Pump2 will now be switched off after firing the number of pulses set in the Pump2Time screen.

Pump2Adv (Fuel + Ignition systems only)

Allows you to add ignition timing advance while Pump2 is active to improve throttle response under acceleration. This value is expressed as the amount of additional advance required, e.g.; if this value was set at +10, the MT ECU will automatically add 10° to the ignition timing advance while Pump2 is switched on.

**PumpDwell
PumpTimers
Pump1Sync
PumpSpare**

**THESE ARE FACTORY PRESET FEATURES,
AND SHOULD NOT BE ALTERED.**

PumpCold

Increases the amount of additional fuel supplied by the Pump function when the engine is cold. This value is set as a percentage of the injector open time: +50 means 50% more fuel. If the water temperature is below 11°, the full amount of this adjustment value is added to the Pump value; as temperature increases, PumpCold adds less and less until it is deactivated at 60°. E.g.: if this value were set to +50, the PumpCold function would add 50% to the Pump function value when water temperature was 10°; at 35° it would add about 25%, and at 60° there would be no extra at all.

Screen 20: Water

The Water function varies the fuel supply dependent upon engine temperature to assist with warm-up and maintain ideal running conditions as the engines requirements change. The MT ECU senses the engine coolant temperature (or engine head temp on air-cooled motors) and applies the correction factor set in the Water function screen closest to the actual temperature. The MT ECU will increase or decrease the injector open time by the amount set in the Water function screens.

Water> 82 C +02%
82_C 20 8.33mS

- For optimum results, the Water function should not be set up until after the other main functions of the MT ECU.
- If the coolant temperature sensor is faulty, the engine will not run properly. The Master Warning light on the ECU and an error message in the display of the Handset will indicate a faulty sensor.

EXAMPLE:

Say that our engine runs perfectly at normal operating temperature of 82°, but is not running cleanly while warming up; the colder it is, the worse it runs. Start the engine when cold and set the amount of correction required at this temperature range; in the case of our example, lets say 65% extra fuel is required to make the engine run well below 11°. As the water temperature rises above 11°, the MT ECU will switch to the 18° screen. Make adjustments to each of the Water reference screens in turn as the temperature rises and that screen becomes active. When all the maps have been set up satisfactorily, scroll through the screens you have just edited, and check your correction values; these should follow a fairly steady progression. If a value in one screen is dramatically different to the values on either side of it, the engine will not run smoothly as the MT ECU switches between these screens. For example, if the Water function values were as follows, the engine may not run well when the coolant temperature is between 31° and 46°.

Water (°C)	99°	82°	68°	60°	46°	38°	31°	24°	18°	11°	5°
ADJ	10%	0%	5%	0%	15%	35%	30%	40%	50%	60%	65%

NOTE: these values are examples only. DO NOT use these values when programming your MT ECU.

Screen 21: Air_t

The Air_t function varies the fuel supply dependent upon air temperature at the inlet manifold. As the air temperature increases, the air becomes less dense and consequently less fuel is required to maintain an ideal air/fuel mixture. The Air_t function allows the MT ECU to make fine adjustments to the fuel curve as the air temperature changes, thus maintaining an ideal air/fuel ratio. This function has been preset in the factory software, and should not be adjusted unless necessary.

Air_t 46 C +00%
37_C 21 10.62mS

The Air_t function is optional, and requires an air temperature probe to be fitted to the engine. (The Air_t function will not affect the operation of the MT ECU if not connected).

For example, let's say that the engine runs perfectly at an ambient temperature of 15° at the inlet. At 20°, the drop in performance is noticeable, becoming even worse at 35°, and by the time the air temp rises over 50° at the inlet the car has become undriveable. Let's say that the inlet air temperature is currently 22°; the MT ECU will display the 25c screen, as this is currently the active Air_t screen. Set the amount of correction required at this temperature range; lets say 5% less fuel is required to make the engine run well. Now we need to wait until the air temperature rises before we can set the next map; however, it is possible to make an educated guess: use the REF buttons to scroll back and forth through the Air_t screens and check your correction values. These should follow a fairly steady progression, as in the above example for the Water function.

Screen 22: Crank

The Crank function varies fuel supply while cranking the engine to assist with starting. When the MT ECU detects the engine being cranked, it adds the amount of fuel set in the Crank screen for the current temperature.

Crank> 82 C +00%
72_C 22 7.62mS

IGNITION CONTROL FUNCTIONS

This section covers the ignition control features of the MicroTech MT ECU. **If you have an MT4 (fuel only) ECU, these features will be disabled.**
NOTE: Ignition timing can never be retarded beyond the value set by the **Static** function (see Static function in Options, **Screen 30**).

Screen 23: t°rpm

The t°rpm function is the most significant of the ignition timing functions as it sets the basic ignition curve for the engine, in much the same way that the Load function sets the basic fuel curve. The ECU senses engine speed and sets the ignition timing to the value in the active t°rpm screen (the rpm point closest to the current value). There are 16 set-up screens for the t°rpm function;

t_rpm 6000 +25
+26 23 3.43sT

- 15 screens represent engine speeds between 1000rpm and 8000rpm. The values represent the amount of advance or retard required in the ignition timing at that engine speed.
- To help maintain constant timing at idle, the 500rpm screen has been replaced by the t°rpmidle function. When the throttle is fully closed (TPS = 0%) the basic timing will be set at this value, regardless of engine speed.

When you purchase an MT ECU, it comes pre-programmed with a timing curve suited to your engine type. The factory map set in the t°rpm screens should be close enough to the actual requirements of the engine that no adjustment is necessary to the t°rpm values. Fine-tuning is a process of using the other main ignition control functions (t°map, t°wat and t°air) to make adjustments to this curve as engine requirements change. **DO NOT ADJUST THE t°rpm VALUES UNLESS NECESSARY.**

Screen 24: t°map

The t°map function senses the engine load and applies the correction value set in the active t°map screen to the basic ignition curve set by the t°rpm function. The value is expressed as the number of degrees of advance or retard you wish to add to the ignition curve at that vacuum or boost point. There are 16 set-up screens for the t°map function;

t_map 04psi +00
+25 24*10.33mS

- 15 screens represent engine loads between 25"Hg and 20psi. The values in these screens represent the amount of advance required in the ignition timing at that engine load. For example; if you were to set a value of +5 in the 10"Hg t°map screen, the ignition timing will advance by 5° over the basic ignition map whenever the engine is pulling 10" of vacuum.
- The 30"Hg screen has been replaced by the t°mapidle function. When the throttle is fully closed (TPS = 0%) and engine speed is above 1750rpm, this value will be added to the t°rpmidle value to maintain smooth running on over-run.

Screen 25: t°air

The t°air function senses the intake air temperature and advances or retards the ignition timing by the value set in the active t°air screen. This allows you to make slight changes to the ignition curve to compensate for varying ambient temperatures. There are 16 t°air set-up screens, representing inlet air temperatures from -25°C to 124°C. The correction value is expressed as the number of degrees of advance or retard you wish to apply to the ignition curve at that ambient temperature.

t_air 38 C +00
+25 25 9.24mS

For example; if you were to set a value of -6 in the 24° t°air screen, the ignition timing will be retarded by 6° over the basic map while the temperature of the incoming air is around 24°. If there is no inlet air temperature sensor fitted, the t°air function will not be active. This will not affect the operation of any of the other functions.

Screen 26: t°gap (Mazda Rotary only)

The t°gap function allows you to alter the timing gap between firing leading and trailing coils as revs change. For example, if the 5000rpm value for this function were set at +10, the trailing coils would be fired 10° after the leading coils when engine speed is around 5000rpm.

This feature is used for Mazda Rotary set-ups only and allows settings within the range of 0 - 15°.

t_gap 3500 +10
+10 26 6.24mS

Screen 27: t°inj

The t°inj function sets a delay time before the injectors are fired, allowing the user to fine tune the precise timing of the injectors as revs change. For example, if the 3500rpm screen in this function were set to 160, the injectors will be delayed from firing until the crankshaft has turned through a further 160°.

This feature affects all injectors and allows settings within the range of 0 - 360°.

t_inj 5000 210
180 27 5.62mS

Screen 28: t°wat

The t°wat function senses the coolant temperature and advances or retards the ignition timing by the value set in the active t°wat screen to assist with engine warm-up, and to maintain smooth engine performance as running conditions change. There are 16 t°wat set-up screens, representing coolant temperatures from -25°C to 124°C. The correction value is expressed as the number of degrees of advance or retard you wish to apply to the ignition curve at that temperature. For example; if you were to set a value of +7 in the 11° t°wat screen, the ignition timing will be advanced by 7° over the basic map whenever the engine coolant temperature is around 11°.

t_wat 82 C +00
+25 28 7.19mS

Screen 29: Auxiliary Functions

The Auxiliary functions are used to set up the Auxiliary Input and Output on the MT ECU.

1. Auxiliary Output Functions

AuxRPM_ON	To switch a device on at a set engine speed, scroll to the AuxRPM_ON screen and enter the RPM trigger value at which you want the device to switch on. If you set a value in both the AuxRPM_ON and AuxMAP_ON screens, the device will only be switched on when BOTH values are reached. If the AuxMAP_ON screen is set to "OFF", the device will be switched on every time engine speed goes above this trigger point. (NOTE: this value should be set to 60RPM or greater to prevent the Auxiliary Output switching on with the ignition key).
AuxMAP_ON	The AuxMAP_ON function is the same, but works on manifold pressure instead of engine speed. Enter the pressure value above which you want the device to be switched on. If the AuxRPM_ON screen is set to "OFF", the device will be switched on every time engine load goes above this trigger point. If you set a value in both the AuxRPM_ON and AuxMAP_ON screens, the device will only be switched on when BOTH values are reached.
AuxFAN_ON	This function allows the MT ECU to use the auxiliary output to switch an electronic fan on and off dependant upon water temperature. Set the AuxRPM_ON and AuxMAP_ON functions to "OFF", then set the AuxFAN_ON function to the temperature at which you wish the fan to switch on. The MT ECU will switch the fan on when the coolant temperature reaches this value; the switch-off point is automatically set 5° lower than the switch-on value.
AuxFANadd	If the Auxiliary output is being used to operate the thermo fan, this feature allows you to add extra fuel when the fan is switched on. The figure in this screen represents the number of milliseconds to add to the injector open time. Using this feature in combination with AuxFANair creates an "idle-up", allowing you to compensate for temperature change and the extra alternator load generated by electric fans.
AuxFANair	If the Auxiliary output is being used to operate the thermo fan, this feature allows you to open the cold air bypass valve (if fitted) when the fan is switched on. The figure in this screen represents the amount you wish the valve to be opened. Using this feature in combination with AuxFANadd creates an "idle-up", allowing you to compensate for temperature change and the extra alternator load generated by electric fans.
AuxAIRmin AuxAIRmax	These functions are not currently used.
AuxAIRwat	If you have a cold air bypass valve connected to the ECU, use this feature to set the size of its' opening when the engine is cold. When the water temperature is below 11°, the valve is opened by the full amount set here; as the temperature increases, the opening will be slowly reduced until it is completely closed at 60°.
AuxAIRafs	Adds to the size of the opening for the cold air bypass (if fitted) for a short period after starting, to allow the engine to normalise.
AuxRPMset Auxpwm_LOW Auxpwm_HI	Used to set up boost control valve on the Aux output: further details are not available at time of printing. NOTE: the Auxiliary output can only control one device; it is not possible to run both the cold air bypass and boost control at the same time.

2. Auxiliary Input Functions

The four Auxiliary Input functions are used to create an "idle-up" which will be activated whenever the device connected to the Aux input is activated, as demonstrated in the examples below.

InpRPMlim	This function is a Rev limiter that works only when a device connected to the Aux Input is activated.
InpAIRadd	Opens the cold air bypass valve (if fitted) by the amount specified in this screen whenever a device connected to the Aux Input is activated.
InpEnrich	Specifies the amount of additional fuel you wish to add to the mixture when a device connected to the Aux Input is activated.
InpTiming	Allows for an adjustment to the timing curve when a device connected to the Aux Input is activated.

Example 1: If your vehicle has air conditioning fitted, you can connect the idle-up trigger wire from the compressor to the Aux Input on the MT ECU. By setting up the InpAIRadd and InpEnrich functions, the engine can be made to idle higher whenever the air conditioning is switched on. You may also wish to use the InpTiming function in this set-up, but InpRPMlim would need to be set to "OFF".

Example 2: Connect a (earth) switch to the Aux Input, and set a limit figure in the InpRPMlim screen and use the InpTiming screen to retard the timing slightly: when the button is pressed, the engine will be limited to this rpm figure, and the timing retarded (to prevent detonation). Releasing the button will deactivate the rev limiter and return the timing to its' normal value, allowing the engine to instantly produce full power. This way you can very easily use the Aux Input to set up a basic "two-step".

Screen 30: Options

MicroTech MT /LT Series Engine Management System

The Options screen allows for the setting up of the various optional features of the MicroTech ECU. There are 16 Options screens:

Mixtrm	The Mixture Trim function is used to make adjustments over the whole of the fuel curve. If the engine runs too rich or too lean all the time, use the Mixtrm function to make a "blanket" correction to the fuel curve. The range of adjustment is from -99% to +99%.
TPScal	Used to calibrate the TPS sensor by setting the closed throttle position. Scroll to the TPScal screen and switch to PROG mode. VARIABLE TPS: Keeping the throttle closed (foot off the pedal), press the up / down ADJ buttons until the CURRENT display reads 0%. SWITCH TPS: Loosen the mounting screws and physically rotate the TPS switch until the CURRENT display reads 0%. Re-tighten the TPS in position. The yellow lamp on the side of the MT ECU also acts as an indicator light for TPS calibration; with the ignition turned on and the engine not running, the yellow indicator lamp will glow when the TPS switch is properly calibrated.
TIMtrm	The Timing Trim function advances or retards ignition timing over the whole range of values, e.g.: if you set the TIMtrm value to +5, the MT ECU will advance the timing by 5° at all times. Note: the timing value will never retard beyond the Static value.
Static	Sets the minimum permissible timing value, i.e.: the position at which your distributor has been "locked". For example, if your distributor has been locked at 10°, set the Static value to +10. The ignition timing can now never be retarded beyond 10°.
TIMmax	Sets the maximum permissible timing value. For example, if you set this value to +30, the ignition timing can now never advance beyond 30°.
RPMwot (Normal only)	mode This screen sets the switch-on point for the RPM wide open throttle function (see Screen 17, RPMwot). This function is disabled in Matrix mode. NOTE: the factory setting for this screen is 5"Hg (supplying additional fuel while vacuum is between 0" and 5"). This setting will suit most engine set-ups.
RPMcrs (Normal only)	mode Sets the switch-on point for the RPM cruise function (see Screen 18, RPMcrs). This function is disabled in Matrix mode. NOTE: the factory setting for this screen is 15"Hg (supplying additional fuel while vacuum is above 15"Hg). This setting will suit most engine set-ups. DO NOT adjust these values unless necessary.
Af_Ste	The After Start Enrichment function supplies additional fuel for a short period after starting the engine to assist with initial engine warm-up and to prevent leaning out as engine conditions normalise. This option allows you to set the amount of additional fuel to be supplied while this function is active. This value is expressed as a percentage of the total injector open time.
REVlim	This is a "soft cut" rev limiter. The MT ECU will cut half of the injector banks out when the engine reaches the speed you set in the REVlim screen, halving the fuel supply to the engine. Halving the fuel flow rather than cutting it off completely causes less stress to the engine. DO NOT use this option on staged injector set-ups , since in this case it is only the primary injector bank which is cut; the secondary bank will continue to fire, allowing the engine to run on in a dangerous lean-out condition; use the REVcut option instead. If you do not wish to use the REVlim option, set this value above the maximum possible speed of the engine.
REVcut	This is a "hard cut" rev limiter. The MT ECU will cut off all fuel supply when the engine reaches the speed set in the REVcut option, effectively shutting the engine down. If you do not wish to use the REVcut option, set this value above the maximum possible speed of the engine. NOTE: using REVcut together with the REVlim option allows you to set up a very effective two stage rev limiter system, e.g.; if you set REVlim at 5500rpm and REVcut at 6000rpm, you eliminate the coarse action usually attributed to rev limiters. As the limiters come into effect more "softly", high speed gear shifting becomes easier, and the engine loses less power because it is not "bouncing" between on and off.
BstCUT	This feature prevents turbo engines from overboosting by cutting all fuel supply when boost pressure exceeds the limit set in the BSTcut screen, i.e.; if you set this value to 10psi, all fuel supply will be immediately shut off when boost is 11psi or higher.
Decel	The Decel function allows you to totally cut all fuel supply under deceleration. This function will only work when the engine speed is above 2000rpm and the water temperature is above 60°. This screen sets the switch-on point for the Decel function; if the engine has a load of 25"Hg under deceleration, set the switch-on point to 24"Hg. Now any time the engine pulls more than 24"Hg with the throttle fully closed, all fuel supply will be cut off. NOTE: this option should not be enabled until all other set-ups are complete.
Dwell	The Dwell feature has been factory set, and should not be adjusted unless otherwise specified.

Staged Injector Set-ups

Some engine applications (such as Mazda rotaries) require the injectors to be "staged", i.e.: a secondary set of injectors is switched on when the engine is running above a set RPM and vacuum/boost. The secondary injector bank uses the REVstg and MAPstg functions to set up the switch-on point of the secondary injectors, while the % stage function determines the amount of fuel that will be supplied.

REVstg	The REVstg feature "arms" the secondary injector bank when engine revs go above the value you set in this screen. Once armed, the MAPstg option takes over to switch the secondary injector bank on or off. If this value is set to 3500rpm, any time engine speed is higher than this the secondary injector bank is armed, and the MAPstg option can switch it on and off.
MAPstg	Once armed by the REVstg feature, the secondary injector bank will be switched on whenever vacuum goes below the value set in the MAPstg screen. For example, if the REVstg value is set to 3000rpm and MAPstg value is set to 5"Hg, the secondary injector bank will become active any time the engine is revving above 3000rpm and vacuum goes below 5"Hg (or to boost).
%Stage	The %Stage controls the amount of additional fuel the secondary injector bank should add to the fuel curve. This figure is expressed as a percentage of the total injector open time of the primary injector bank. For example, if you set this value to 50%, the injector open time for the secondary injector bank will be half that of the primary bank. If the primary and secondary injectors are the same size, the total fuel flow whenever the secondary bank is on will be 150% of the fuel curve. The MicroTech Handset indicates when the secondary injector bank is active by displaying the letters "sT" instead of "mS" in the OUTPUT display.

Screen 31: Setup

The Setup screen allows for the setting of the user-definable functions of the MicroTech ECU, such as the preferred programming mode and the switch-on points for the optional features. There are 16 Setup screens, as follows:

Maps =	The LT Version PC Interface software now allows the user to select a preferred method for setting the main fuel maps for the MT ECU - "Normal" or "Matrix". Maps = Normal sets the ECU to be tuned in the traditional way, i.e. one Load curve using the RPMwot and RPMcrs functions to compensate for changing conditions. Maps = Matrix switches the ECU to Matrix mode, enabling the new 3D Load curve software. In this mode, a series of RPMLoad curves are used in order to give a higher resolution to the tuning process. See "Fuel Control Functions", Screens 1 – 18 for information on tuning in Normal or Matrix mode.
Config	The Config screen is used to select the configuration of the engine; use the ADJ buttons to display the number of cylinders, 1 to 8.10A, 12A or 13B Mazda rotary engines are set up as 4 cylinder, 20B rotary engines are set up as 6 cylinder. The MT ECU now incorporates a diagnostic self-checker. If the value in the Config screen is set to 0, the computer will shut off the fuel pump and simulate the engine running at 1800rpm. The injectors (and the spark plugs in ignition control set-ups) will be pulsed, allowing you to easily check whether the MT ECU is functioning correctly. While in self-check mode, the MicroTech Handset will display the message Check TEST ON.
Firing	The MT ECU can be configured to either BANK fire the injectors (all injectors fire at the same time - this is used in throttle body style set-ups) or GROUP fire the injectors (injector banks fire independently of each other - used in multipoint type set-ups). To set the MT ECU up for BANK firing, set this screen to Throttle; for GROUP firing, set this screen to read INJ Multi.
LOAD=	This function sets the source the MT ECU will use to set the basic fuel map. By default, engine load is sensed via a pressure sensor connected to the inlet manifold. In some applications however manifold pressure can fluctuate at idle and low revs, making it an unreliable load source; in these cases it is best to use the TPS (throttle position switch) to sense engine load. Set this screen to read LOAD= MAP for MAP load sensing or LOAD= TPS for TPS load sensing.
DWELL=	The DWELL set-up screen is used to set the Dwell function (see Screen 30: Options) to work in either DUTY CYCLE mode or TIME BASE mode. Duty Cycle mode means that the coils are given a certain percentage of the time between firings to develop the charge for the next spark; Time Base sets a constant charging time (in mS). NOTE: The Dwell feature has been factory preset to suit your application, and should not be adjusted unless otherwise specified.

InputTrig / IDref	Sets the MT ECU to trigger on either the positive (rising) edge or the negative (falling) edge of the input signal; default is positive. Set this screen to read Input Trig= +POS for positive triggering, or Input Trig = -NEG for negative triggering. The Input Trig feature has been factory preset to suit your application, and should not be adjusted unless otherwise specified. NOTE: on NISSAN set-ups the IDref screen replaces this screen. The IDref screen is factory preset to suit the application, and should not be altered.
SparkTrig / TDCref	Sets the MT ECU to fire the spark plugs on either the positive (rising) edge or the negative (falling) edge of the output signal; default is positive. Set this screen to read Output Trig= +POS for positive triggering, or Output Trig = -NEG for negative triggering. The Output Trig feature has been factory preset to suit your application, and should not be adjusted unless otherwise specified. NOTE: on NISSAN set-ups the TDCref screen replaces this screen. The TDCref screen is factory preset to suit the application, and should not be altered.
TimingCheck	The Timing function allows for the timing to be locked at static for engine set-up and diagnostic purposes. During normal operation this screen should read "Timing check OFF"; to lock the timing and force the MT ECU to ignore all timing correction values, set this screen to read "Timing locked ON".
Rpm_ON	This function is used in conjunction with the Map_ON function to set the start point for the data logger. The values set in these two screens must be exceeded before data logging begins, i.e. if the value in this screen is set to 2500, data logging would not commence until engine revs exceeded 2500rpm (and manifold pressure exceeded the Map_ON value). See Data Logging, Screen 33 for detailed instructions on using the data log feature.
Map_ON	This function is used in conjunction with the Rpm_ON function to set the start point for the data logger. The values set in these two screens must be exceeded before data logging begins, i.e. if the value in this screen is set to 2psi, data logging would not commence until boost pressure exceeded 2psi (and engine revs exceeded the Rpm_ON value). See Data Logging, Screen 33 for detailed instructions on using the data log feature.
Sample Spare	These features are for factory use only, and should not be altered.
SHIFT Water AIR_T BOOST	These four functions set the limits for the warning lights when using the MicroTech Dash Display; simply set the value at which you wish the warning light to be shown. For example, if the Water value was set to 86, a warning light will illuminate on the Dash any time the water temperature exceeds 86°.

Screen 32: ECUid

The LT software contains new security features, allowing the ECU to be "locked" with a PIN number. The ECUid screens are used to:

- set the program ID name.
- set the security PIN number.
- turn the security locks on or off.

PROG = / E.C.U = screens

Both of these functions have 2 settings: "LOCK ON" or "ENABLED".

The **PROG =** function allows you to lock the ECU so that the settings cannot be seen and no changes can be made to the program until the PIN has been entered. When set to "LOCK ON", the computer will function but only the ID and DATA screens will be visible, and the PROG button is disabled. This function is used to avoid accidental changes to the program that can result from bumping the handset, etc., or to prevent your program settings from being viewed – the DATA screens are visible, but not the settings.

The **E.C.U =** function is a full system lock, i.e. when this feature is set to "LOCK ON", the ECU will not function until the PIN has been entered: it will not be possible to start the engine.

To set the system locks, scroll to the appropriate screen, i.e. "Prog =" or "E.C.U =". Press the mode button to change into Prog mode and use the up or down button to select the setting; "LOCK ON" means that the lock feature is active, "ENABLED" means the system is unlocked. If you set either value to "LOCK ON", you will need to enter the PIN number with either the laptop interface or a handset the next time the ECU is switched on. If the ECU is locked, the engine will not start until the PIN has been entered.

MAKE SURE YOU DO NOT FORGET THE PIN!

Char(1–8) screens

These screens allow you to give an 8-character name to your program; this is the name that appears in the ID screen when the ECU is turned on. Naming a program makes identifying your different set-ups simple.

To edit your program name, scroll to the characters you wish to alter and use the ADJ buttons / up or down arrows to set the desired character. For example, to name a program "4cyl_tur", scroll to the Char1 screen, switch to program mode and use the up / down buttons to set the first character i.e.: "4". Now scroll right to the Char2 screen and set the second character, "c". Set the rest

of the characters in the same way (screens Char3 to Char8), then switch back to view mode. The name you have entered will now appear as the program description in the ID screen.

Pin#(1–6) screens

These screens allow you to set the 6-digit security number for the ECU, and are set in the same way as the Char screens (above). If all six of these screens are set to "0" (i.e. the PIN number = "000000"), the security lock features of the ECU will be switched off. See SCREEN 34: ID AND PROGRAM SELECTION for instructions on entering the PIN to unlock the ECU.

Screen 33: Max / Min Data Logging and Display

The data section of the MT ECU contains 15 screens dedicated to the display and logging of data. Data/Log screens are single mode (do not have a program mode), and have a slightly different display layout from the function screens. The OUTPUT display continues to display the total injector open time and monitor the options; other data is displayed on the top line. The screen name now appears at bottom left. This section is a guide for each of these Data/Log screens.

NOTE: all data screens display ignition timing and injector open time in real time.

DATA screens

Data1: Displays engine speed and vacuum / boost in real time.

Data2: Displays water and air temperatures in real time. If the water temperature display reads -00c, the water temp sensor is faulty, and should be replaced or serious damage may occur. If you do not have an air temperature sensor fitted, or if your sensor is faulty, the air temp display will read -00c and the Air_t function will be disabled.

Data3: Displays TPS% and DC volts in real time.

Data4: Displays air/fuel ratio and auxiliary port status in real time. The auxiliary value is for factory use only, and relates to the 3.5mm auxiliary socket located near the harness on the ECU. If nothing is connected to the aux. socket, this value should be 15.

Data5: Displays the pulse width being supplied to the Idle Up valve and Boost Control valve. These values are displayed in milliseconds, and indicate the amount of opening for the cold air bypass valve and waste-gate valve respectively.

LOGmax screens

LOGmax1: Records the maximum engine speed and vacuum / boost used since the Log screens were last reset. To reset the Log screens, press the MODE button. The LOGmax1 screen will now display and hold the maximum engine speed and vacuum / boost values as they are reached. If a higher value is reached, the display will change to reflect this value, e.g.; start the engine, and press FUNC up once to display the DATA page, then use the REF buttons to display the LOGmax1 screen. Press MODE to reset the Log screens, and look at the rpm value. Slowly rev the engine then let it return to idle. The rpm value will rise as engine revs increase, and retain the highest value it reaches when the engine slows down again. This value will be remembered until a higher value is reached, or the Log screens are reset. NOTE: pressing the MODE button resets ALL Log screens.

LOGmax2: Records the maximum water and air temperatures since the Log screens were last reset. To reset the Log screens, press the MODE button. The LOGmax2 screen will now display and hold the maximum water and air temperatures as they are reached. If a higher value is reached, the display will change to reflect this value, e.g.; start the engine cold, and press FUNC up once to display the DATA page, then use the REF buttons to display the LOGmax2 screen. Press MODE to reset the Log screens, and look at the Wat value. This value will rise as the water temperature increases, and retain the highest value it reaches when the engine cools down again. This value will be remembered until a higher value is reached, or the Log screens are reset.

LogMax3: Records the maximum air/fuel ratio and DC volts values since the Log screens were last reset. To reset the Log screens, press the MODE button. The LOGmax3 screen will now display and hold the maximum air/fuel ratio and DC volts values as they are reached. If a higher value is reached, the display will change to reflect this value, e.g.; start the engine cold, and press FUNC up once to display the DATA page, then use the REF buttons to display the LOGmax3 screen. Press MODE to reset the Log screens, and look at the Volts value. This value will rise as the battery voltage increases while charging, and retain the highest value it reaches when the alternator slows down again. This value will be remembered until a higher value is reached, or the Log screens are reset.

LOGmin screens

LOGmin1: Records the minimum engine speed and vacuum used since the Log screens were last reset. To reset the Log screens, press the MODE button. The LOGmin1 screen will now display and hold the minimum engine speed and vacuum / boost values as they are reached. If a lower value is reached, the display will change to reflect this value, e.g.; start the engine, and press FUNC up once to display the DATA page, then use the REF buttons to display the LOGmin1 screen. Press MODE to reset the Log screens, and look at the Load value. Run the engine at constant revs for a couple of seconds, then let it return to idle. The Load value will fall as engine load drops, and retain the lowest value it reaches when the engine slows down again. This value will be remembered until a lower value is reached, or the Log screens are reset.

LOGmin2: Records the minimum water and air temperatures since the Log screens were last reset. To reset the Log screens, press the MODE button. The LOGmin2 screen will now display and hold the minimum water and air temperatures as they are reached. If a higher value is reached, the display will change to reflect this value, e.g.; start the engine, and press FUNC up once to display the DATA page, then use the REF buttons to display the LOGmin2 screen. When the engine is hot, press MODE to reset the Log screens, and look at the Wat value. This value will fall as the water temperature decreases after the engine is turned off, and retain the lowest value it reaches when the engine cools down again. This value will be remembered until a lower value is reached, or the Log screens are reset.

LogMin3: Records the minimum air/fuel ratio and DC volts values since the Log screens were last reset. To reset the Log screens, press the MODE button. The LOGmin3 screen will now display and hold the minimum air/fuel ratio and DC volts values as they are reached. If a higher value is reached, the display will change to reflect this value, e.g.; start the engine, and press FUNC up once to display the DATA page, then use the REF buttons to display the LOGmin3 screen. Press MODE to reset the Log screens, and look at the Volts value. This value will change as the draw on the electrical system changes and retain the lowest value it reaches. This value will be remembered until a lower value is reached, or the Log screens are reset.

Injector output screens

Logpw_mS: Records the maximum and minimum injector pulse widths used since the Log screens were last reset. These values will be remembered until a lower or higher value is reached, or the Log screens are reset.

To reset the Log screens, press the MODE button.

Log_time: Records the maximum and minimum ignition timing values used since the Log screens were last reset. These values will be remembered until a lower or higher value is reached, or the Log screens are reset.

To reset the Log screens, press the MODE button.

Error log screens

The last 2 Log screens are dedicated to the logging of errors. If one of the inputs to the MT ECU should become faulty for some reason, the RED master warning light will begin to flash and the error will be recorded in the **ErrorChk** screens. **ErrorChk1** records the water and air temp sensors, as well as the crank angle sensor functions, Home and Ref. **ErrorChk2** records MAP, RPM, TPS and DC voltage. In these screens, the function names appear across the top line of the display and the status of each of the sensors is toggled once every second or so, indicated by the words "OK" or "ERR". An error will remain logged until the screens are reset; after repairing the fault that caused the error, press and hold the MODE button for two seconds to reset the ErrorLog screens.

Screen 34: ID and Program Selection

ID screen

Each time the MT ECU is switched on, the handset will display the Program ID Screen for the computer. This screen displays the description of the currently selected program and the version number of the MicroTech software installed in the computer.

If the ECU has been locked (see "Prog =" and "ECU =" functions – ECUid, screen 32), only the ID and DATA screens will be displayed. To unlock the ECU, use the right REF button (or right arrow on the keyboard) to scroll through the pin number, and use the up / down PROG buttons / arrows to enter each number in the PIN. As soon as the PIN has been entered correctly the display will return to the ID screen and all other screens will now be available.

memCAL screens

When the ECU is unlocked, the left / right arrows scroll through the program selection options. The LT software has four memories called memCALs, which allow for the storage and retrieval of different set-ups. These memories are kept on the Laptop Adapter that plugs into the cable connecting the ECU to the laptop. Note that these memories cannot be accessed with the standard handset; ask your dealer about a Handset memCAL unit if you wish to use the memCAL feature with a handset.

The memCALs are accessed by using the left / right arrows to scroll to the required function, then pressing "P" or "M" on the keyboard and holding the button down for two seconds, e.g. holding the button down for two seconds when the display reads "Save to memCAL#3" would store the current settings in memCAL 3. While a program is being saved or loaded, the display will read "Saving Program.."; once finished, the display will read "ProgrammingPASSED", then return to the main ID screen.

The memCALs can also be most useful for temporarily storing data while working on programs; if you want to try an adjustment but don't want to lose the data you already have, save your settings in one of the memCAL areas and it can be retrieved later if your adjustments don't work.

NOTE: when you save to a memCAL, any data in that memory will be overwritten; it is wise to keep a record of what is stored in the memCALs to avoid losing data you wish to retain.

ALL MAPS the SAME

This function sets all Matrix maps to the values in the Load map. To activate, press and hold the Prog button (P or M) for two seconds.

DASH FEATURES

Overview

The MicroTech Dash features a large easy to read high temperature resistant LCD bar graph rev display with digital tachometer and boost gauge, Water/ Air/ Battery measurements and warning function and a programmable ultra-bright 4 LED rev and gear shift indicator. The upgraded software that has been installed in your MicroTech computer still looks the same as the old system, however the Log set-up screens (s2) have been replaced by the Dash configuration screens (NOTE: these functions are not lost; Max/Min data logging is a standard feature of the Dash).

Display

At the top of the Dash is 4 high intensity LED's, which act as an "eyes up", rev and shift display. Although the Dash is not designed to be used in the same way as a Handset, it can be used in an emergency. While viewing standard functions the display is exactly the same as the standard Handset display. In Dash mode the LCD display offers 4 screens of data in that may be viewed:

- The MAIN display consists of a bar graph tachometer across the top line and a digital rev counter and water temp / boost pressure display on the second line. The water temp display is automatically replaced by the boost display the moment positive pressure is detected. The rev counter is replaced by the message "CRK-rpm" whilst cranking the engine.
- Data1 displays engine revs and vacuum / boost on the top line and timing advance / injector open time on the second line.
- Data2 displays water and air temperatures on the top line and timing advance / injector open time on the second line.
- Data3 displays TPS (throttle opening) and battery voltage on the top line and timing advance / injector open time on the second line. The Dash will also display warning messages if it detects oil pressure, water or air temperature, battery voltage or boost exceed pre-set thresholds (see SET-UP below for information on setting thresholds). If an error is detected by the Dash, the high intensity master warning light (left hand amber lamp) will switch on and a warning message will appear in place of the water temp / boost display on the MAIN screen or in place of the injector open time on the Data screens. The error codes are; Water_T, Air_T, Battery, Boost and Oil_P (requires the fitting of a standard oil pressure switch to the Blue/Red AUX Input wire of the MT ECU. Refer to the wiring diagram supplied with your MT series computer). Contrast of the LCD display may be adjusted via a trimpot on the right hand side of the unit.
-

Controls

There are 3 toggle switches on the upper body of the Dash, which allow you to navigate through the display screens for the Dash as well as all the standard program screens for the MT ECU. While the Dash is not designed to be an everyday handset, it is possible to use it to make adjustments to your computer if necessary.

- The left-hand switch is the MODE and DATA controls.
- Pressing the button down (DATA) will advance the display of the Data screens. The screens are viewed in a loop; - MAIN - Data1 - Data2 - Data3 - Last Function - MAIN. The Last Function screen will show the last program screen that was viewed, e.g.; say you are making an adjustment to the 15"Hg Load screen. Pressing the DATA button will advance through the MAIN and Data screens, then automatically return to the 15"Hg Load screen. The remote pushbutton has the same function - it is merely an extension of the DATA button allowing you to navigate through the Data screens without taking your hands off the wheel.
- Pressing the button up (MODE) toggles the ECU between VIEW and PROG modes when using the standard functions of your MT ECU, the same as the red button on the MicroTech handset. The two switches on the right are the same as the REF and FUNC/ADJ buttons on the MicroTech handset, allowing you full access to the software should it be necessary to make any alterations to your program. Using the middle button while viewing the MAIN or Data screens will scroll the display left or right through all the Data screens, including the Max/Min log screens and Error log screens.

Set-up

In order to customise the Dash to your application, 4 set-up screens have been included in the upgraded software that was installed in your MT ECU when you purchased your Dash. These screens can be found in Screen 29: Aux. The set-up screens are:

Dash SHIFT: This value sets the rev range the tachometer will cover and the switch on point for the shift light, e.g.; if the redline of your engine is 5500rpm, enter 5500 as the value in this screen. Now the bar graph tachometer will be completely filled at 5500rpm and the high intensity shift lamp will come on just before redline is reached.

Dash WATER: Sets the maximum safe water temperature. If this figure is exceeded the Water_T warning will appear on the screen and the master warning lamp will come on.

Dash BOOST: Sets the maximum safe boost level. If the engine is over-boosting, the Boost warning will appear on the screen and the master warning lamp will come on.

Dash AIR_T: Sets the threshold at which the Air_T warning will come on. This function can be especially handy with turbocharged engines.

TROUBLE SHOOTING GUIDE

ENGINE WILL NOT CRANK	<ul style="list-style-type: none"> • starter motor or solenoid not getting power • battery connections poor or battery dead
FUEL PUMP DOESN'T PRIME	<ul style="list-style-type: none"> • fuel pump relay wired incorrectly • poor connections or blown fuse • faulty fuel pump or filter • fuel tank blocked, return line blocked or fuel reg faulty
ENGINE WILL NOT START WHEN CRANKING	<ul style="list-style-type: none"> • no fuel pressure or injectors not firing (blown fuse) • no ignition pulse signal (no spark) • engine flooded (too much fuel) • engine compression down • injector wiring bad
ENGINE DIFFICULT TO START	<ul style="list-style-type: none"> • battery voltage too low while cranking • ignition pulse intermittent • spark plugs fouled or timing wrong • engine temp sensor not connected or faulty • bad cold start (Water) settings (too rich or too lean) • bad Crank settings (too rich or too lean)
ENGINE RUNS ROUGH	<ul style="list-style-type: none"> • engine getting to much fuel or mis-timed • fuel pressure too high or too low • engine has non-suppressed ignition leads • ignition firing order wrong • vacuum line for MAP sensor not connected • injector wiring bad or open circuit • fuel injectors are poorly positioned in manifold
IDLING PROBLEMS	<ul style="list-style-type: none"> • Idle mixture values too rich or too lean • ignition timing wrong or fouled plugs • ECU losing manifold vacuum
CRUISE PROBLEMS	<ul style="list-style-type: none"> • Load mixture values too rich or too lean • RPMcrs mixture values too rich or too lean • TPScal not calibrated or Decel set too low • ignition timing retarded on cruise (t°map)
POWER PROBLEMS	<ul style="list-style-type: none"> • full Load mixture values too rich or too lean • RPMwot mixture values too rich or too lean • vacuum line for map sensor in wrong position • fuel pressure dropping off or not stable • fuel pump is not large enough for amount of flow • engine timing is too advanced (detonates) • engine timing is too retarded (runs HOT) • engine compression down
THROTTLE RESPONSE PROBLEMS	<ul style="list-style-type: none"> • incorrect acceleration Pump values • TPScal not calibrated correctly or • Decel set too low • Load mixture values too rich or too lean • ignition timing too retarded • throttle body is too large or injector too small • fuel injectors are poorly positioned in manifold
FUEL CONSUMPTION POOR	<ul style="list-style-type: none"> • Load mixture values or cold start values too rich • Pump values too rich • engine ignition timing values incorrect • fuel system leaking or fuel injectors leaking