



**Mazda MX-5 (1600-1800)
Installation Manual**

linkecu.com

G4X

Product Warranty Statement

LINK ENGINE MANAGEMENT LTD – LIMITED LIFETIME WARRANTY

All Engine Control Units (ECUs) manufactured or distributed by Link Engine Management Ltd are subject to the following LIMITED LIFETIME WARRANTIES, and no others.

Link Engine Management Ltd warrants only to the original purchaser of the ECU, for the lifetime of the ECU, (subject to the limitations set out below), that the ECU shall be free from defects of materials and workmanship in the manufacturing process. This warranty ceases to apply and does not apply to ECUs that have not been manufactured or distributed by Link Engine Management Ltd for a period of greater than one year.

An ECU claimed to be defective must be returned to the place of purchase. Link Engine Management Ltd, at its sole option, may replace the defective ECU with a comparable new ECU or repair the defective ECU.

This limited lifetime warranty is not transferable and does not apply to any ECU not properly installed or properly used by the purchaser or end user, or to any ECU damaged or impaired by external forces. The above warranties are the full extent of the warranties available on the ECU. Link Engine Management Ltd has no liability to the original purchaser or any other person for any loss, injury or damage to persons or property resulting from the use of the ECU or any failure of or defect in the ECU whether by general, special, direct, indirect, incidental, consequential, exemplary, punitive, or any other damages of any kind or nature whatsoever. Link Engine Management Ltd specifically disclaims and disavows all other warranties, express or implied, including, without limitation, all warranties of fitness for a particular purpose, warranties of description, warranties of merchantability, trade usage or warranties of trade usage.

For off-road use only, not intended for highway vehicles. This ECU contains a user-configurable software programme, which is updated by Link Engine Management Ltd from time to time. The user must ensure the current correct version of this programme is downloaded from the website of Link Engine Management Ltd and installed in the ECU prior to use. This limited lifetime warranty does not apply where the ECU has been installed with the incorrect version of the software programme. The user is solely responsible for the setup and testing of all user-configurable features.

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1 G4X Plug-In ECU Installation Manual

1.1 Introduction

Thank you for purchasing your Link Plug-In Engine Control Unit (ECU), an advanced, fully programmable microprocessor controlled Engine Management System.

G4X software employs high resolution fuel and ignition tables with configurable load and RPM centres. When coupled with up to six dimensional fuel and ignition mapping, barometric pressure compensation and intake air temperature correction this gives an unprecedented level of tuning accuracy. All Link G4X ECUs are in-field upgradeable, there is no need to return the unit for software updates.

All Link G4X Plug-In Engine Management Systems are designed with flexibility and ease of installation in mind. Link Plug-In systems are designed to replace the circuit board inside the factory ECU enclosure. This provides an invisible install that requires minimal modification to vehicle wiring and ECU mounting.

Installing and tuning any after market engine management system is not to be taken lightly. G4X ECUs give the tuner the control & flexibility that only top after-market engine management systems in the world can provide. While every effort has been made to keep G4X ECUs as user friendly as possible, it should be recognised that added features bring added complexity.

The complete setup of your ECU can be divided into two important tasks:

1. This manual covers the installation of your G4X ECU. While it is not strictly essential that this work is performed by an automotive electrician, the knowledge and tools available to these professionals makes it highly recommended. Regardless of who does the installation, it is of utmost importance that instructions provided in this manual are followed exactly throughout the installation.
2. Once the G4X ECU has been installed it will need to be tuned using a laptop computer with PCLink software. Information on the configuration and tuning of the G4X ECU is detailed in the help section of PCLink. G4X ECUs are shipped pre-loaded with a base configuration that should be close enough to get most engines running after a few application specific adjustments have been made. While hearing the engine running on the new ECU for the first time is always a satisfying feeling, it is important to realise that the job is not complete. The amount of tuning performed and the experience of the tuner are the two most important factors in determining how happy you will be with your engine management system.

1.1.1 Safety Notice

Your Link Plug-In ECU is designed to enhance the performance of your vehicle. However in all cases, your vehicle must be operated in a safe manner. Do not tune your vehicle while operating it on public roads.

WARNING!

Failure to follow all installation and operating instructions may result in damage to the Link ECU, personal injury, or harm to property.

1.1.2 Disclaimer

All care has been taken to ensure the pin outs and interconnections of the ECU to the vehicles wiring harness are correct. However due to variations between vehicle models it is the installers responsibility to check wiring connections BEFORE installing the ECU. Link will not be held responsible for any damage caused by the incorrect installation of this product.

1.1.3 Support Options

Should any issues arise during installation, the following options exist for technical support:

1. PCLink help, press F1 while running PCLink
2. Contact your nearest Link dealer. A Link dealer list is available on our website.
3. Link website: www.linkecu.com with Online Discussion Forum.
4. Technical Support Email: tech@linkecu.com

The majority of questions received by the technical support team are clearly answered in the manuals. Please consult the manuals to make sure that your question has not already been answered.

1.2 Pre-Installation

Before installing the Link G4X ECU into the vehicle some pre-installation checks must be performed.

1.2.1 Injector Impedance

Injector impedance is important and needs consideration before installing the ECU.

1.2.1.1 Mazda ECUs

The G4X Mazda Plug-In ECUs are NOT designed to be used directly with low impedance injectors. All models this ECU is designed for are fitted with high impedance injectors from factory. This means that the ECU is plug-in compatible with factory fitted injector combinations on all models. If low impedance injectors are to be fitted then a ballast resistor pack will be required. Contact your Link dealer for further information.

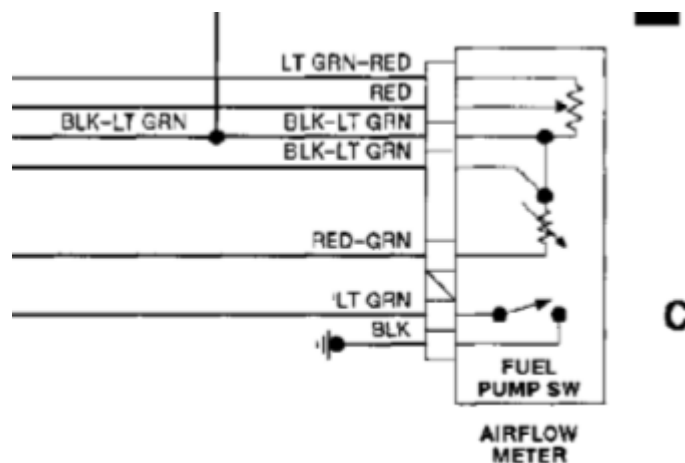
1.2.2 Required Modifications

Modifications may be required on some vehicles to make the Link G4X Plug-In ECU function fully.

1.2.2.1 MX5Link

Some models supported by the G4X MX5Link Plug-In ECU require additional installation modifications. The following modifications may be required:

- Fuel Pump Control – Some models have a switch fitted inside the AFM that disables the fuel pump when the engine is drawing no air. Depending on the way the AFM is wired it may be necessary to either bypass the AFM switch or wire a separate ECU controlled Fuel Pump Relay. Bridging the BLK and LT-GRN will allow the AFM to be removed:



MX5 AFM Wiring

- Throttle Position Sensor (TPS) – Miata/MX5 1600cc models do not have a factory fitted TPS. A TPS should be installed and wired to the ECUs expansion connector. This is required for functions such as acceleration enrichment, idle speed control and motor sport features.
- The Mazda GTX has four injectors, but they are operated in group fire mode. In PCLink connect to the ECU, go to the Fuel Setup section, change the Injection Mode to Multi-Point Group and set the Active Drives to INJ1-2. Store the configuration (F4) and switch the ignition off and back on again.

1.3 Installation

This guide provides information on correctly and safely installing your new Link G4X Plug-In ECU.

1.3.1 ECU Handling Procedures

WARNING!!!

The following installation process will require handling of both the Link ECU and factory ECU. Both of these are highly sensitive to electrostatic discharge and are easily damaged. Follow the anti-static precautions given in this manual carefully to avoid damaging electronic components. Warranty claims for ECUs damaged by electrostatic discharge will NOT be accepted.

ANTI-STATIC HANDLING GUIDELINES



Your body builds up an electrical charge as you move around. This charge can reach very high voltages. Whenever given the opportunity this energy will attempt to discharge (usually through your finger tips!). This can be fatal to most electronic components. Most people have experienced an electrostatic discharge when they step out of their car or touch a metal bench top.

The following guidelines describe precautions that can be taken to reduce the possibility of damaging your ECU:

1. Work only on a conductive surface. A clean steel bench is suitable.
2. Always wear a wrist strap that is electrically connected to the conductive working surface. An Anti-static wrist strap is included for use during install
3. Touch the working surface regularly.
4. Do NOT touch components on the circuit board.
5. Where possible, only handle the ECU by its plastic header.
6. Do NOT carry the ECU around without anti-static packaging.
7. Do NOT touch the bare terminals in the ECU header.

Observing the above procedures will minimise the chance of damaging the ECU. Note that failure due to static damage often does not appear until well after it was caused.

1.3.2 Fitting the ECU

Information is provided to assist in fitting the ECU into the vehicle.

1.3.2.1 MX5Link, MX5 NB1 and MX5 NB2

The following steps outline the installation procedure:

1. Ensure the key is in the OFF position and remove the ECU from the vehicle. The factory ECU is located in either of the following places: GT-X - behind the centre console, MX-5/Miata - under the passengers foot well carpet for RHD cars or behind the pedals on the drivers side for LHD cars. Unplug the wiring harness from the factory ECU. Remove the 6mm bolts (10mm socket) that retain the ECU and remove the ECU from the vehicle. DO NOT touch the exposed pins in the factory ECU connector.
2. Remove the factory ECU's circuit board from its enclosure: Ensure you are following the given anti-static guidelines and ARE WEARING A CONDUCTIVE WRIST STRAP connected to a conductive working surface. Remove the top cover by removing the side retaining screws. Remove the circuit board by removing the corner screws. Hold it only by the plastic header and place it aside.
3. Connect the ECU USB tuning cable and the expansion loom to the Link Plug-In ECU if required.
4. Fit the Link Plug-In ECU: Place the Link ECU on the base plate and carefully fit the four corner screws. Place the factory ECU in the packaging your Link ECU came in for its protection.
5. Refit the top cover: It may be necessary to widen the slot around the main header to allow cables to exit. Ensure that any modifications are de-burred to prevent cutting into cable insulation.
6. Reassemble the enclosure and fit the ECU back to the vehicle.
7. Connect the ECU to the factory wiring loom.
8. Do NOT attempt to start the vehicle. Proceed to read through the remaining sections of this manual first.

1.4 Additional Sensors/Functions

G4X Plug-In ECUs offer various options for the installation of additional sensors and devices. As a minimum it is recommended that all ECUs are installed with a Manifold Absolute Pressure (MAP) sensor and Intake Air

Temperature (IAT) sensor. These parts can be purchased if required from your nearest Link dealer.

1.4.1 MAP Sensor

It is important that the pressure source for a MAP sensor be taken from a stable pressure source after the throttle body. It is common to 'T' into the fuel pressure regulators pressure signal. Do NOT share this signal with other devices such as boost gauges or blow off valves.

Note: Internal MAP Sensors on new plug-in ECUs have changed from 4Bar to 7Bar. The 7Bar versions should be identifiable by a sticker on the bottom board and can also be confirmed by comparing MAP and BAP when the MAP vacuum line isn't connected to see if they match with the calibration being used.

1.4.1.1 MX5Link

The G4X MX5Link Plug-In ECU supports several options for fitting of a MAP sensor. Any one of the following options can be used:

1. Internal MAP Sensor – The G4X MX5Link Plug-In ECU has an on board MAP Sensor. This sensor is either rated to 4.0 Bar absolute pressure (3.0 bar boost) or 7.0 Bar absolute pressure (6.0 bar boost) depending on the age of the bottom board. Which sensor is fitted can be ascertained by looking at the sticker on the bottom board (should say 7 Bar for 7 Bar models and nothing for 4 Bar) or by looking at the MAP value when at atmospheric pressure and changing the calibration setting. The internal MAP sensor is wired to AN Volt 3.
2. MAP Through Expansion Connector - The expansion connector provides power, ground, and analog channels for the connection of a MAP sensor.
3. MAP Through AFM Wiring – A MAP sensor can be wired through the AFMs wiring if required. Connect the MAP sensor to the AFMs signal and sensor ground wires (consult factory wiring manuals). AN Volt 4 is wired to the AFMs sensor signal.

Make sure that the correct MAP sensor input has been selected in PCLink and a MAP calibration has been performed before attempting to start the vehicle.

1.4.2 IAT Sensor

It is highly recommended that an IAT sensor be fitted in all applications to provide an input for correction of fuel and ignition based on the engines air charge temperature.

An IAT sensor should be fitted in the intake system in a location that accurately represents intake temperature. The most common location is just prior to the throttle body. Installing in the manifold is not recommended due to heat soak issues. A fast response sensor must be used in all forced induction applications.

1.4.2.1 MX5Link

From factory, models supported by the G4X MX5Link Plug-In ECU are fitted with an IAT sensor in the AFM. This sensor is suitable for use in naturally aspirated applications. In forced induction application a suitable fast responding IAT sensor must be fitted just prior to the throttle plate. The G4X MX5Link Plug-In ECU supports the following options for IAT sensor installation:

1. AFM IAT – In naturally aspirated applications the AFMs IAT sensor can be used. The AFM IAT sensor is wired to An Temp 2.
2. IAT Through AFM Wiring – An IAT sensor can be wired through the AFMs wiring if required. Connect the IAT sensor to the AFMs IAT and sensor ground wires (consult factory wiring manuals). An Temp 2 is wired to the AFMs IAT sensor.
3. IAT Through Expansion Connector – An IAT sensor can be wired directly to the ECU through the ECUs Expansion Connector. Note spare An Volt channels can be used as temperature inputs when a pullup resistor (to +5V) is added.

1.4.3 E-Throttle Output

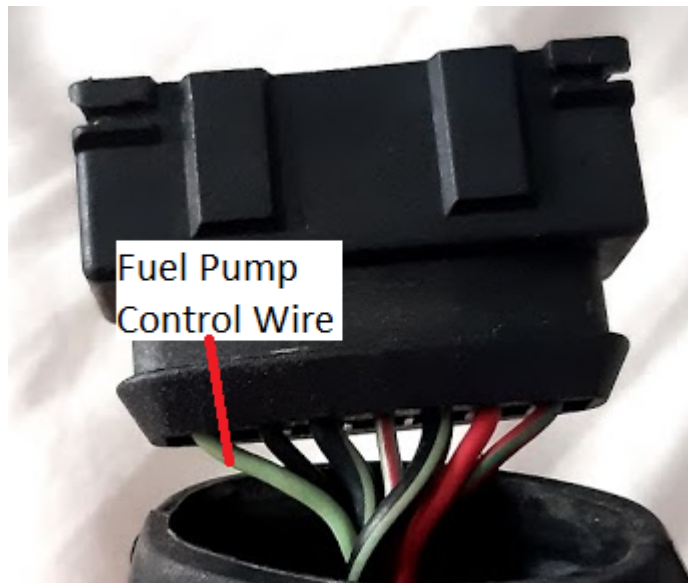
1.4.3.1 MX5Link

Aux 9 & 10 are not exposed on this plugin and so to use E-Throttle it is recommended to use Aux 1 & 2 (ISC Solenoid and nc/Fan/Overboost buzzer depending on vehicle) with an external E-Throttle controller.

More than three Analog inputs are available on the expansion connector which can be used to add TPS (Sub) and the APS inputs.

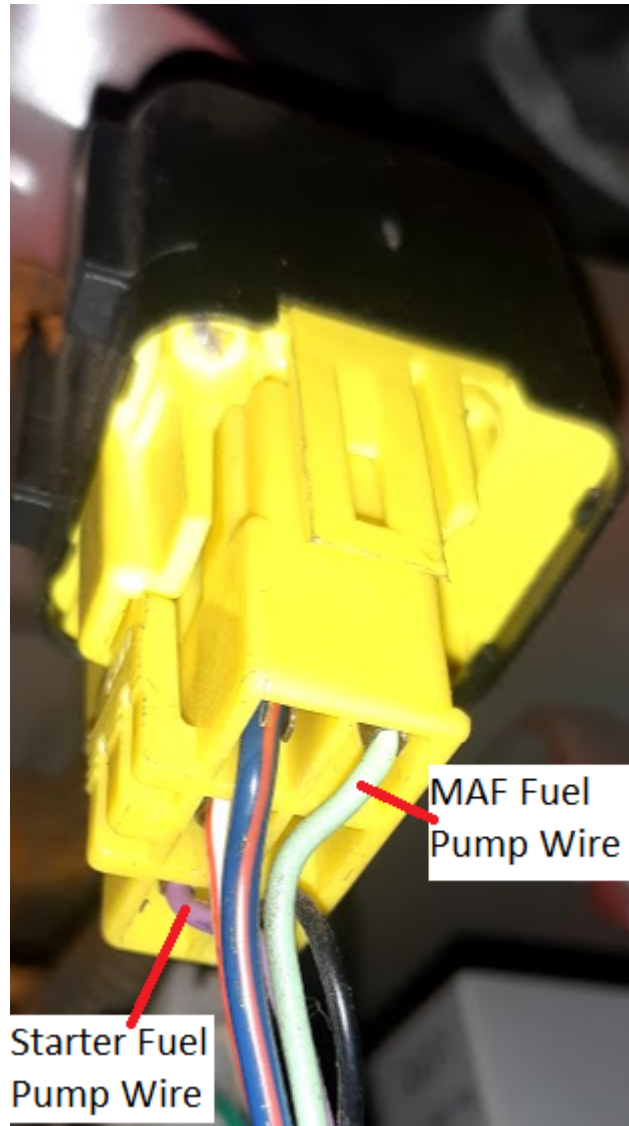
1.4.4 MX5Link Fuel Pump Control

NA MX5s with the 1.6 motor don't have an ECU controlled fuel pump from factory. The fuel pump relay is instead triggered initially by the starter solenoid signal and then once the engine is turning over by a switch in the AFM which is on when the flap is open. If you are deleting the factory AFM then you will want to connect a spare aux to the wire that triggers the fuel pump either at the AFM plug or, for a tidier installation, by tapping into the same wire in the body loom near the ECU.



NA6 MX5 AFM Plug

The Fuel Pump relay is referred to as the 'Circuit Opening Relay' by Mazda and it is located under the dash near the steering column (Left hand side for a LHD car or RHS for a RHD car) and has a yellow plug with a yellow and black housing.



NA MX5 Circuit Opening Relay

Either the Violet starter wire (connected to starter solenoid wiring) being 12V (i.e. starter being activated) or the Light Green wire (connected to one of the MAF plug pins and the Diagnostic connector F/P pin) being Ground will activate the relay and allow power to flow from the thick White/Red wire out through the thick Blue/Red wire to the fuel pump turning it on. The recommended method of control is to connect an Aux from the ECU to the Light Green wire either at the relay, the MAF plug, the diagnostic connector or anywhere in between and set that Aux up as the Fuel Pump Output.

1.4.5 Expansion Connector

Expansion connectors are provided to allow easy connection of additional ECU inputs. An “expansion cable” can be purchased from your Link dealer.

Important points when wiring to the expansion connector:

- Do not overload the +5V Out pin. Although this is protected against ECU damage the +5V out signal also provides power for other sensors.
- Do not connect the ground pin to chassis ground. This could cause ground loops and introduce unnecessary interference. Use this pin only to ground external sensors that are isolated from chassis ground.

The Expansion connectors available for each ECU can be found under the Pinouts Section.

1.5 PC Tuning

G4X ECUs require PC/laptop tuning using the PCLink Tuning Software application running on a Windows based computer. PCLink may be downloaded from www.linkecu.com. Note that when new versions of PCLink are released they are posted on the website and may be downloaded at no cost. Also note that G4X ECUs must be used with the correct version of PCLink.

IMPORTANT!

The G4X ECU has on board USB.

BEFORE connecting the ECU to your laptop, the USB drivers must be installed. Failure to install the drivers on your laptop first may result in windows assigning incorrect drivers. These drivers will not work with the G4X ECU and are difficult to uninstall. The correct USB drivers are installed as part of PCLink installation, as described in the following section. Should internet download not be practical, a copy of the drivers on CD can be obtained from your nearest Link dealer.

1.5.1 Installing USB Drivers

Before connecting the ECU to your laptop or PC, the ECU USB drivers must be installed. These drivers are installed as part of PCLink installation as described in the following section.

1.5.2 Installing PCLink Tuning Software

Due to the frequent updates PCLink is no longer shipped with each ECU. You will be required to download the latest version of PCLink from: linkecu.com

Should access to an Internet connection be impractical, download the latest version of PCLink elsewhere to a USB drive, and then install on your laptop.

Installing from the web

1. Go to the above website and navigate to the downloads and software updates section.
2. Download the latest version of PCLink. When prompted to run or save the file, select save. It is recommended to save this file on the desktop.
3. Double click the saved file and follow on screen instructions.
4. When prompted to install USB drivers, select yes. This may take some time.
5. When installed, open PCLink by double clicking on the icon that has been placed on the desktop.

1.5.3 Communicating With Your ECU

After PCLink installation, you will be able to connect the G4X ECU to the laptop to perform set-up and tuning work.

1. Connect the ECU to your laptop using a Link G4X ECU USB Cable. If not supplied with the ECU, these can be purchased from a Link dealer. No other adapter or cabling is required. Connect the cable to the connector labelled USB.
2. If this is the first time you have connected a G4X USB ECU to your laptop follow the driver installation instructions that appear. When prompted if you want to install drivers select 'Continue Anyway'.
3. Start PCLink by double clicking on the PCLink icon on the windows desktop.
4. Switch the key to the ON position. This will provide power to the ECU.
5. In PCLink, under the 'Options' menu, select 'Connection'. The connection options dialogue will open. Select the correct COM Port number from the drop down list or select auto for automatic com port detection.
6. PCLink offers both mouse and keyboard control. To establish a connection between the PC and ECU press the F3 key. The same process can be used to disconnect. If a successful connection is established, PCLink will download settings from the ECU, otherwise you will be warned that an error has occurred.
7. Make sure the connection shows "ONLINE" in the top right corner of PCLink.
8. To permanently STORE any changes made to the ECU press F4. If this is not done before turning the ECUs power off all changes made will be lost.

1.6 Pre-Start Configuration

Before starting the vehicle, important pre-start configurations need to be made.

1.6.1 Firmware Version

It is recommended to ensure that the Link G4X ECU is running the most up to date firmware. Firmware version information can be obtained by connecting to the ECU with PCLink and selecting 'ECU Information' under the Help menu.

The latest firmware can be downloaded from our website with PCLink.

It is recommended that this is performed by an experienced Link dealer as new features may need to be properly configured.

The firmware can be updated by selecting 'Update Firmware' under the 'ECU Controls' menu in PCLink, follow the on screen instructions to complete the firmware update process.

1.6.2 Base Configuration

All G4X Plug-In ECUs are shipped with base configuration settings. Note that these are provided to reduce initial setup and tuning times. They are NOT recommended tuning values. PCLink includes base configurations for various models. Download the appropriate base configuration into your ECU with PCLink by connecting to the ECU (described in the Connecting To PCLink section of this manual), then selecting 'Open' under the 'File' menu. Select the appropriate .pclx file and then select 'Open'. Downloading large configuration files can take up to a few minutes. Be patient and acknowledge any messages PCLink shows.

1.6.3 MAP Sensor Calibration

At key on and engine not running the Manifold Absolute Pressure (MAP) Sensor should always match the Barometric Absolute Pressure (BAP) Sensor. As well as providing altitude correction, the BAP sensor also allows the MAP sensor to be calibrated prior to tuning.

Link G4X ECUs use an on-board barometric sensor that is calibrated prior to dispatch. This ensures that all PCLink Tuning Software programs (pclx Files) give a consistent state of tune throughout the ECU range. This allows a pclx file to be transferred between G4X based ECUs giving an equivalent state of tune providing all factors affecting volumetric efficiency are equal.

Without the ability to calibrate all the available types of MAP Sensors to the BAP Sensor there would be significant affects on the accuracy of the resulting tune, especially when tuning with Manifold Gauge Pressure (MGP) as a load index.

To calibrate the MAP sensor:

1. Connect a laptop/notebook PC to the ECU and connect to the ECU using PCLink.
2. Under the Analog Channels menu, select the An Volt channel that has been wired to the MAP sensor. Select the correct MAP Sensor Type.
3. Under the 'Options' menu, select 'MAP sensor calibration'.
4. Follow the on screen instructions.
5. Select the 'Analog Inputs' tab in the runtime values section of PCLink (lower part of the screen).
6. Compare the MAP and BAP values and ensure they have a similar reading (within 1 kPa).
7. Perform a 'Store' by pressing F4.

A more in depth explanation is provided in the PCLink help Manual under PCLink G4X Users Manual -> Tuning Operating Procedures -> ECU Controls -> MAP Sensor Calibration.

1.6.4 TPS Calibration

Non E-Throttle Vehicles:

The Throttle Position Sensor (TPS) is used by the ECU to calculate various engine management parameters used by functions such as idle speed control, acceleration enrichment and motor sport features. It is important that the ECU knows when the throttle is open and closed (or part way in between). The following procedure calibrates the ECU to match the TPS and is for engines using a cable driven throttle:

1. Connect a laptop/notebook PC to the ECU and connect to the ECU using PCLink.
2. Open Analog Inputs -> Throttle Position Sensor and ensure that the TPS (Main) Source is set to the correct input. Refer to the Pinouts section of this manual for details.
3. Under the 'Options' menu, select 'TPS calibration'.
4. Follow the on screen instructions.
5. Select the 'General' tab in the runtime values section of PCLink (lower part of the screen).
6. Ensure the Throttle Position value reads 0% when the throttle is closed and 100% when fully open.
7. Perform a 'Store' by pressing F4.

1.6.5 IAT Sensor Selection

This section only applies when an Intake Air Temperature (IAT) sensor has been wired and fitted to the intake system. It is important that the ECU is calibrated to match the sensor installed in the engine. This procedure is as simple as selecting the correct sensor type as follows:

1. Connect a laptop/notebook PC to the ECU and connect to the ECU using PCLink.
2. Click on 'Analog Channel' in the configuration tree.
3. Select the An Temp channel the sensor has been wired to.
4. Ensure that channel (and only that channel) is set to 'Inlet Air Temperature'.
5. Select the correct 'Temp Sensor Type'.
6. Select the 'Analog Inputs' tab in the runtime values section of PCLink (lower part of the screen).
7. Ensure that IAT reads the correct temperature.
8. Perform a 'Store' by pressing F4.

1.6.6 Input and Output Setup

As the Link G4X Plug-In ECUs are designed to run several models there are a few items that must be set-up to make the ECU specific to your model.

The Pinouts section of this manual gives a list of the functions of each channel based on the target vehicle. It is the tuners responsibility to make sure that the following channels are set-up correctly for the vehicle model the ECU is fitted to:

All Auxiliary Output Channels

Use the 'Test On' or 'Test PWM' (at 10 Hz) functions to test the wiring of channels.

All Digital Inputs

Look at the Digital Inputs runtime values (lower section of the PCLink screen) to confirm each channels operation.

All Analog Volt and Temperature Inputs

Look at the Analog Inputs runtime values (lower section of the PCLink screen) to confirm each channels operation.

1.6.7 Trigger Calibration

The following instructions assume that all pre-start set-up instructions given in previous sections have been completed. Only after all pre-start checks have been made should an attempt be made to crank the engine. The following steps must be performed before an attempt is made to start the engine to ensure the G4X ECU is calibrated to precisely measure engine position.

1. Connect the ECU to PCLink.
2. Select 'Fuel', then 'Fuel Set-up':
 - a. Set 'Injection Mode' to OFF. This will prevent the engine from trying to start while the triggers are calibrated.
 - b. Perform a Store (press F4) to make sure fuelling is not re-enabled if power to the ECU is lost.
3. Click on 'Triggers' then 'Calibrate Triggers'.
4. Perform the correct trigger calibration procedure specific to your vehicle as described in the PCLink help (Press F1).

Note that trigger calibration must be performed again once the engine is running. Due to the acceleration and deceleration of the crankshaft at low speeds, an inaccurate measurement of engine timing is usually made. Also it is often harder to see timing marks with a timing light at slow engine speeds. Trigger calibration should be checked again at between 2000-4000 RPM where engine speed is stable and a more consistent timing reading can be obtained.

A more in depth explanation is provided in the PCLink help Manual under G4X ECU Tuning Functions -> Triggers -> Calibration.

1.7 First Time Startup

For further help on any of the settings discussed below, consult the Help in PCLink Tuning Software. Help can be invoked by pressing F1, or right clicking any item and selecting 'What's this?'.

Pre-set-up Checks

Before attempting to configure the ECU, ensure the following tasks have been completed:

1. Ensure the ECU and all associated components are connected and correctly wired/installed.
2. Fully charge the vehicle's battery, as the engine will be required to be cranked during the set-up procedure.
3. Check all oil and water levels are correct.

Connecting to PCLink Tuning Software

Use the following procedure to establish a connection between your Link ECU and PCLink Tuning Software tuning software.

1. Make sure your laptop battery is fully charged or plugged in to mains power.
2. Connect the ECU to your laptop and connect to PCLink as described in the 'Communicating with your ECU' section of this manual.

First Time Startup

After performing all set-up instructions given in previous sections, including trigger calibration, the engine is now ready to be started. The following procedure should be used for first time start-up.

1. Turn the ignition key OFF then ON. The fuel pump should prime momentarily upon power up.
2. Connect the ECU to PCLink.
3. Access the runtimes values by pressing the F12 Key, click the 'Analog' tab:
 - a. TPS – spans from 0 to 100% when throttle is pressed. If not, perform a TPS Calibration. If the vehicle has an E-Throttle confirm that APS (Sub), APS (Main), TPS (Sub), TPS (Main) all operate correctly and that the throttle blade tracks the target correctly.
 - b. MAP – should read approx 101 kPa (at sea level) with the engine not running. If not, check the MAP Sensor Type setting and perform a MAP Calibration.
 - c. ECT – should read current engine temperature.
 - d. IAT – should read current intake air temperature.
 - e. Digital Inputs (click the 'Digital' tab) – Operate switches connected to any digital inputs while watching the runtime value to ensure they operate as expected.
4. Rectify any faults found in Step 3.
5. Ensure the basic Fuelling setup is correct.
 - a. If using Traditional Fuel Equation Mode then locate the 'Master Fuel' setting in the ECU Settings Menu under: *Fuel > Fuel Setup > Fuel Main*. This will need to be adjusted during or just after start-up.
 - b. If using one of the Modelled Fuel Equation Modes then navigate to *Fuel > Fuel Setup > Fuel main* and enter the correct engine capacity, correct base fuel pressure, and correct fuel properties. Navigate to *>Fuel>Fuel Setup>Injector Setup*, enter correct injector flow rate and rated pressure.
6. Crank the engine until it starts. Some throttle may be required for first time start-up due to imperfect tuning.
 - a. If using Traditional Fuel Equation Mode the Master Fuel setting can be used to enrich/lean the engine (increase to enrich).
 - b. If using one of the Modelled Fuel Equation Modes the Injector Flow Rate can be decreased to add more fuel, this will need to be changed back to the correct value later but works well for first start purposes.
7. If the engine fails to start after several attempts, do not crank it endlessly. Stop and determine the problem before continuing.
8. Check the Trigger Error Counter (found under the Triggers runtime values tab). If this value increases during cranking/running then there is a trigger setup fault. It is not unusual for this number to count one or two on the first engine revolution.
9. Once the engine starts:
 - a. If using Traditional Fuel Equation Mode adjust the Master Fuel setting to achieve best possible running
 - b. If using one of the Modelled Fuel Equation Modes adjust the Injector Flow Rate setting to achieve best possible running, this will need to be changed back to the correct value later but works well for first start purposes.
10. The engine should now be allowed to fully warm up. It may be necessary to readjust 'Master' several times to maintain smooth running. Don't forget to keep an eye on engine temperature.
11. Once the engine is warmed up and running well, perform another trigger calibration (known "as setting the base timing").
12. Perform a Store by pressing F4.

Essential Tuning Adjustments

It is assumed that at this stage all set-up procedures described in previous sections have been completed and the engine is running. The following steps detail correct set-up procedures for some of the more critical ECU parameters (note that MAP Sensor Calibration should have already been completed by now):

Injector Voltage (Dead-time) Correction

There is always a delay between the injector being energised and the injector actually opening. Likewise, there is a small delay between the injector being de-energised and the injector closing. The opening time is considerably longer than the closing time, however the overall result is that less fuel will flow for a given pulse width than would be expected with an 'ideal injector'. To compensate for this the injector pulse widths are increased to compensate for this 'dead-time'. The dead-time for a given injector is a function of the battery voltage, differential fuel pressure and the type of injector driver (saturated or peak and hold). A typical dead-time at 3 Bar differential fuel pressure and 14 volts is just under 1ms (ms = millisecond = 1 thousandth of a second).

In applications with a linear 1:1 fuel pressure regulator (i.e. not a rising rate regulator), the differential fuel pressure (difference between manifold pressure and fuel pressure) will be constant. Therefore the only variable that is changing will be the battery voltage (this changes with electrical load and sometimes engine speed). Without correction, the changes in dead-time will cause the engine to run lean when the voltage drops. If the Injector Voltage Correction is properly set-up then changes in the battery voltage will not affect the air/fuel ratio.

The injector dead-time table allows the dead-time for different battery voltages to be entered. The values represent the dead-time in milliseconds. These should increase with falling system voltage.

Injector dead-time for a particular set of injectors can be determined using a flow bench or on a running engine.

To determine the injector dead-time using a flow bench, the injectors need to be operated at the intended operating pressure (normally three bar) and at a constant duty cycle as well as a set voltage. Vary the supply voltage to the injector and measure minimum pulse width at which the injectors will flow for a particular voltage. This is the required dead-time for that injector at that tested voltage.

To determine injector dead-time on a running engine, with the engine fully warmed and operating at stable air/fuel ratios (a very precise AFR meter is required – a narrow band O2 sensor will not suffice), electrical drain needs to be applied to the system; the preferred method is disconnecting the alternator main fuse. Battery load testers are also useful here too.

Watching the air fuel ratios change while the battery voltage drops, the dead-time table can be trimmed to maintain the same stable air/fuel ratio. Injector dead-time can be viewed as a row graph. A smooth curve needs to be maintained at all times.

NOTE: any change to the fuel pressure or injectors will require a recalibration of the injector dead-times.

Traditional Fuel Equation Mode Master Fuel Setting

If using Traditional Fuel Equation mode the Master Fuel setting should be set so that the numbers in the middle of the fuel table end up around a value of 50. This is to allow sufficient span of the numbers in the main fuel table.

1.8 Pinouts

Pin information is provided to assist when troubleshooting. All pinouts are looking into the ECU (wire side).

1.8.1 MX5Link

1	2	3	4	5	6	7	8	9	10	11	12	13	31	32	33	34	35	36	37	38	39	40	41
14	15	16	17	18	19	20	21	22	23	24	25	26	42	43	44	45	46	47	48	49	50	51	52

Pin	ECU Pin	MX5 1600	MX5 1800	GTX/GTR	Pin	ECU Pin
1 (2Y)	Injector 3	nc	Injection	Circuit Opening Relay	Expansion 1	Ground (Signal)

2 (2W)	Aux 1	ISC			Expansion 2	+5V Out
3 (2U)	Injector 1	Injection			Expansion 3	DI 7
4 (2S)	Aux 2	nc	Condenser Fan Relay	Over Boost Buzzer	Expansion 4	DI 6
5 (2Q)	An Temp 1	ECT			Expansion 5	An Volt 5
6 (2O)	An Volt 4	MAF			Expansion 6	An Volt 6
7 (2M)	An Volt 1	nc	TPS Signal		Expansion 7	An Temp 4
8 (2K)	+5V Out				Expansion 8	An Temp 3
9 (2I)	Tacho Pullup	Igniter F/B	Tacho in	nc	Expansion 9	Ground (Signal)
10 (2G)	Trig 2	Trig 2			Expansion 10	+5V Out
11 (2E)	Trig 1	Trig 1			Expansion 11	Ignition 7 (Aux)
12 (2C)	Ground (Signal)				Expansion 12	Ignition 8 (Aux)
13 (2A)	Ground				Expansion 13	DI 8
14 (2Z)	Injector 4	nc	Injection	nc	Expansion 14	DI 9
15 (2X)	Aux 7	Purge			Expansion 15	An Volt 10
16 (2V)	Injector 2	Injection			Expansion 16	An Volt 11
17 (2T)	Aux 5	nc	Fuel Pump Relay	Fuel Pres Reg Solenoid		
18 (2R)	Aux 6	nc	Fuel Pres Reg Solenoid	Turbo Light	Built in MAP	An Volt 3
19 (2P)	An Temp 2	IAT (MAF)				
20 (2N)	An Volt 2	NB O2 Sensor				
21 (2L)	nc					
22 (2J)	nc					
23 (2H)	nc					
24 (2F)	Ground	nc	Ground (MAF)	nc		
25 (2D)	Ground (Signal)					
26 (2B)	Ground					

31 (1U)	nc			
32 (1S)	nc			
33 (1Q)	DI 1	A/C Request		
34 (1O)	nc			
35 (1M)	DI 3	nc	Vehicle Speed	Ground
36 (1K)	nc			
37 (1I)	Aux 3	nc		FP Speed Relay
38 (1G)	Ignition 1	Ignition1/4		Ignition
39 (1E)	Aux 4	CE Light		nc
40 (1C)	DI 4	Start Signal		
41 (1A)	nc (Constant +12V)			
42 (1V)	DI 5	Neutral/Clutch Switch		
43 (1T)	nc			
44 (1R)	Aux 8	nc		Engine Fan Relay
45 (1P)	DI 2	PS Switch		
46 (1N)	nc			
47 (1L)	Ignition 4 (Aux)	nc	Engine Fan Relay	nc
48 (1J)	Ignition 3 (Aux)	A/C Relay		
49 (1H)	Ignition 2	Ignition 2/3		Boost Solenoid
50 (1F)	nc			
51 (1D)	nc			
52 (1B)	+14V Main Relay	ECU Power		

Note: Injector Drives 7 and 8 aren't exposed and don't have the hardware required to drive Injectors.

Note: Manual 1.6 NA chassis MX5s do not have a TPS sensor from factory, they only have idle and full throttle switches.

Note: The 1.6 NA chassis MX5s Fuel pump is turned on by a switch in the MAF and the starter signal, the factory wiring requires modification if you want to control the fuel pump from the ECU.

1.9 CAN Information

The following CAN (Controller Area Network) information is provided:

1.9.1 MX5Link

The G4X MX5Link Plug-in ECU has two CAN buses. These CAN buses exist to support aftermarket CAN devices.

CAN bus 1 uses a 5 pin connector and is labeled on the ECU as 'CAN 1/RS232'.

If using this connector for CAN ensure the cable being used doesn't have Serial wires connected as this can act as an aerial and prevent USB communications from working.

CAN 1/RS232 Connector		
Pin	Function	Colour
1	Comms GND	Brown
2	CAN1 L	Green
3	CAN1 H	White
4	RS232-RX	Grey
5	RS232-TX	Yellow

CAN bus 2 uses a 5 pin connector and is labeled on the ECU as 'CAN 2/OBD'.

CAN 2/OBD Connector		
Pin	Function	Colour
1	GND	Brown
2	CAN2 L	Green
3	CAN2 H	White
4	NC	Grey
5	+14V	Yellow

To learn more about CAN see PCLink help.

1.10 Known Issues

All plug-in ECUs are fully tested on a range of relevant vehicles, although there are often variations that have not been tested. For this reason issues can arise.

WARNING: Always download the latest Installation Manual from linkecu.com and check the latest status of known issues before installing the ECU.

Please contact your nearest Link dealer when suspecting a compatibility issue.

1.10.1 MX5Link

An Volt 10 & 11 are incorrectly labeled as An Volt 9 & 10 on the expansion plugs on bottom boards V1.4 and earlier.