

IMA Boost Device

Insight IMA power control boost & reduction system

Owners manual. Version 211116V01

Introduction

If you have had your Insight a while, you may have heard of the IMA boost device. It's an Insight-specific, 12F683 PIC-based simple IMA assist & regeneration boost or reduction device.

The IMA boost device is designed and built by me, Peter Perkins, a multi Insight owner and electronics enthusiast from the UK. You can find me at www.thehybridexpert.co.uk



The IMA boost device ready for installation.

In normal use, the Insight uses the OEM computers and parameters to control how the IMA system operates. It balances assist and regeneration levels with throttle requests, engine load, available battery power and road conditions to give the average owner consistent IMA system operation for normal use.

This, however, can be quite restrictive and is by no means optimal in every situation. It means that the hypermiler or performance enthusiast cannot get the best out of the car.

However, with the IMA boost device, the skilled and enthusiastic driver gains benefit by modifying how the IMA operates. This can give better acceleration and deceleration performance by boosting assist and regeneration or by reducing them.

The IMA boost device is based on pioneering earlier work done by enthusiasts and owners of these impressive cars worldwide. Mike Dabrowski, a key American early developer, produced a system called MIMA (Manual Integrated Motor Assist) which gave full

manual control functionality to the IMA system. He developed a clever and intricate system which sold well but is sadly now out of production. The IMA boost device is a simple device (only requiring four connections to the vehicle harness) which makes partial control of the IMA system possible.



The neat IMA boost device in its case mounted with self adhesive Velcro near the cup holder.

How it works

The basics of the IMA boost device rely on the fact that the Insight OEM computer modules are divided into separate units and communicate with each other via the car's wiring loom.

The internal combustion engine is controlled by the ECM (Engine Control Module) which resides under the carpet in the passenger foot well.

The IMA motor is controlled by the MCM (Motor Control Module) which is located in the IMA compartment under the rear luggage area.

During normal use, the ECM sends requests for IMA assist or regeneration to the MCM and the MCM responds accordingly, providing assist or regeneration as requested. This occurs as long as the IMA battery is within its normal operating range for SOC (State of Charge) and temperature.

The IMA boost device works by intercepting the signals from the ECM to the MCM on the 2khz PWM CmdPwr (Command Power) line, and modifying them. These modified requests are then acted on by the MCM as if they had come from the ECM. They are carried out without question, but comfortingly the system retains its safety systems and the battery protection provided by the MCM and BCM (Battery Control Module) software. So you cannot exceed the battery safe operating zone, even if you request higher levels of assist for extended periods.

The IMA boost device has some limitations, the main one being it cannot override a request for assist and replace it with one for regeneration, or vice versa. However you can reduce requests for assist or regeneration to zero if desired in most situations.

If you want total IMA control (including the ability to override assist with regeneration or vice versa) you need the full Imac&c p&p system (also designed and built by myself) which is more complicated and expensive. But even with the above limitation IMA boost gives a large amount of flexibility and control possibilities.

In use, we can modify requests for assist or regeneration by increasing or decreasing the effect the requests have.

The IMA boost device has two rotary linear 10k potentiometer controls, (Assist & Regeneration), a single push to make non locking boost button, and a colour indicator led which can display red, green, and simulated yellow.

With the potentiometers in the central (neutral) position, requests for assist and regeneration pass thru the device unchanged. If we turn the assist knob up, then requests for assist are boosted to a higher level. Conversely if we turn the assist knob down requests for assist are reduced. This also applies to requests for regeneration, turning the regeneration knob up boosts the amount of regeneration and turning it down reduces it. The knobs can be adjusted to your desired levels and then left or used whilst on the move if you wish. The 10k potentiometers can be mounted on either side of the circuit board so as to provide internal or external adjustment capability. They can also be replaced and mounted remotely on the dashboard for example, using bigger more robust fumbling finger friendly controls suitable for daily use.



The IMA boost device in its case. Note the reverse mounted external access assist and regeneration level potentiometers in this example.

The non locking boost button is the maximum assist or maximum regeneration switch. If the car is requesting assist (indicated by some yellow bars on the OEM assist/regen display) then pushing this button boosts assist to the maximum. It's like the Kers button in formula 1. As soon as you release the button assist returns to the normal level. Exactly the same happens

when the car is requesting regeneration (indicated by green bars on the assist/regen display) pushing the button boosts regeneration to the maximum. When released it falls again to the normal level. If the car is not requesting either assist or regeneration then pushing the button has no effect.

The boost button can also be remotely mounted, and a simple low current push to make non locking switch can be connected between pins 4 and 5 on the IMA boost device screw terminal connector. This parallels the one built onto the circuit board, so pressing either will activate the boost mode.

The indicator led turns red to indicate assist mode and green to indicate regeneration mode. If it is off the car is not requesting either assist or regeneration.

In use example

If our IMA battery is well charged, then by simply using more assist to crest a hill, we may be able to avoid depressing the throttle as far. We gain that few extra mpg, and as we use engine braking down the other side of the hill, we can boost the regeneration level to replace that energy used more quickly.

Sometimes the car will annoyingly start force-charging as we ascend a hill because we have depleted the battery. This is a double whammy as the extra load on the engine can force us to change down and use much more throttle than normal, so killing fuel economy. What the car does not know of course is that over the hill is a descent where we can probably use regeneration to replenish our battery while at the same time, controlling our speed without resorting to the brakes. In this scenario, we look ahead and become the computer; with the IMA boost device we can turn down the regeneration to reduce the charging during our climb and re-engage it during our descent.

Battery protection

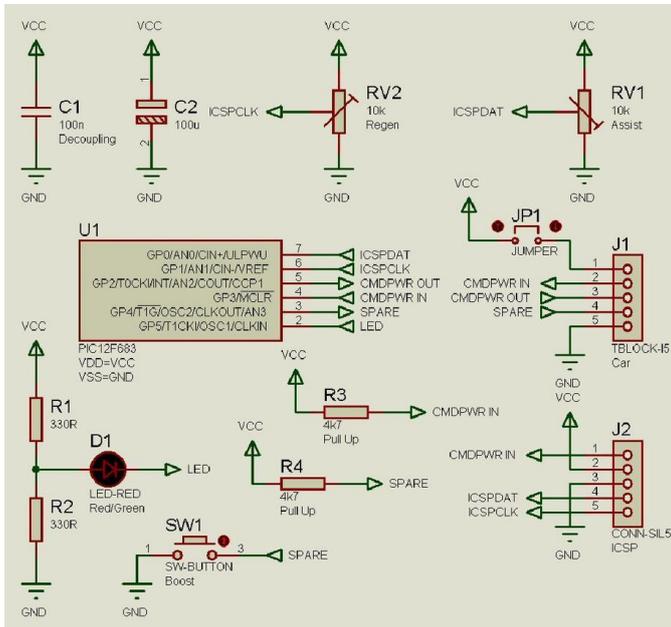
This is an important use of the device, and it can help ailing packs that throw error codes under load to have an easier life, thereby extending the time until replacement is necessary. Users can simply turn assist and/or regeneration down to much lower levels or even zero if they wish. Requests by the car will be ignored or reduced according to your settings, and the high current or voltage spikes that caused the battery to fail are avoided. Note turning down assist or regeneration does not affect the IMA start or autostop functions.

So how is the IMA boost device installed?

The IMA boost circuit board requires four connections to the vehicle wiring harness at the ECM located in the passenger foot well. Fitting is simply a matter of:

1. Disconnecting the 12v battery under the bonnet.

- Uncovering the ECM in the passenger foot well and unplugging the required connectors.
- Making the four connections to the wiring loom.
- Re-plugging the ECM connectors
- Reconnecting the 12v battery



IMA boost device circuit schematic.

Fitting the IMA boost device itself depends a lot on where you are going to mount it. Some people like it mounted on the gear knob, centre console or dashboard. It's small enough to fit almost anywhere, and once you have it fitted in your chosen position, you can route the 4 core wire back to the ECM connections.

The four wires that connect to the ECM need to be routed so that you can attach them to ECM connector C (blue) two wires, +5v power and ground, and connector D (grey) two wires, CmdPwr in/out.

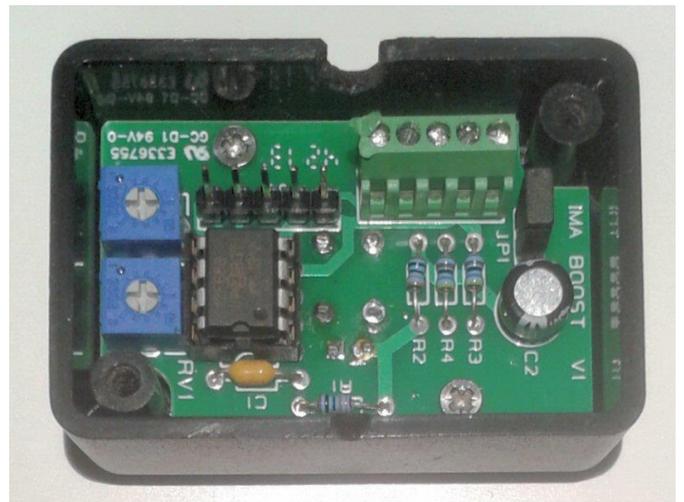
- The +5V power supply connection is on connector C pin 28 (yellow/blue wire) you need to splice into this. It connects to pin 1 (J1) on the IMA boost device PCB screw terminal connector. I suggest you use a red wire for this connection.
- The ground power supply connection is on connector C pin 18 (green/black wire) you need to splice into this. It connects to pin 5 (J1) on the IMA boost device PCB screw terminal connector. I suggest you use a black wire for this.
- The CmdPwr wire is on connector D pin 8 (blue/black wire) you need to cut this, not splice into it. The cut end nearest the ECM connector attaches to pin 2 (input) (J1) on the IMA boost device PCB screw terminal connector. I suggest you use a green wire for this.
- The other end of the cut CmdPwr wire connects to pin 3 (output) (J1) on the IMA boost device PCB screw

terminal connector. I suggest you use a white wire for this.



The ECM exposed and the two plugs removed to allow the four connections to be made.

I release new software for the IMA boost device periodically, and owners can update their devices to get extra functionality and features using a laptop and simple USB/serial pic programmer. The software source code has been published on the forum and is modifiable by owners wanting to customise it for their own circumstances and requirements.



The IMA boost device circuit board in the case. Note the blue internal access assist and regeneration level potentiometers in this example.

If you want a hand-built IMA boost device for your car, contact Peter at 150mpg@gmail.com

The price depends on the options selected:

- Fully built tested and cased IMA boost device including 2m of cable. \$299 Inc p&p & paypal fees.
- IMA boost device bare printed circuit board. \$49 Inc p&p and paypal fees.

Built units come ready programmed with the latest firmware.

To see some videos of the system and its installation check my You Tube channel videos and associated links below.

[IMA boost device forum thread link.](#)

[Video bench technical demo of the IMA boost software.](#)

[Video IMA boost device PCB build notes.](#)

[Video IMA boost device ECM connector notes.](#)

[Video ECM connector C notes.](#)

[Video ECM connector D notes.](#)

My channel also contains many other videos detailing my devices and installation instructions.

[UK CVT Insight Rally car in action.](#)

Safety

When trying out the IMA boost device functions whilst stationary, ensure the car is in neutral and the parking brake is on.

Firmware updates

The IMA boost device can be updated with new firmware quickly and simply by the user. The process requires a usb pic programmer and suitable computer running the PICKit 2 programming software.

The programmer recommended is the (icp01). It can be ordered, and the software required downloaded from this webpage link.

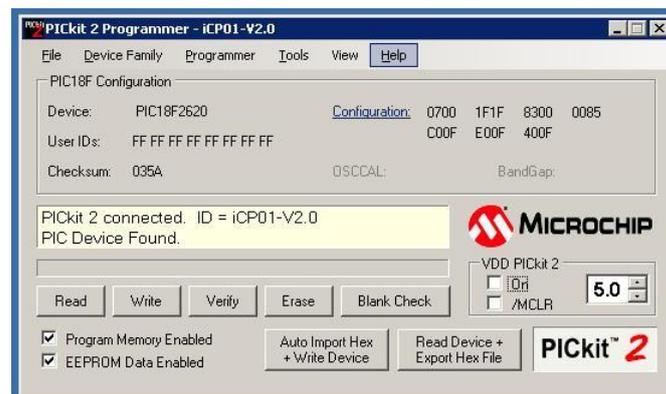
[Pic icp01 programmer](#)

The firmware update process should be carried out with the car off, and preferably the IMA boost device unplugged or disconnected from the car. The jumper on the PCB should be removed during programming. On the IMA boost device PCB is a sil 0.1" 5 pin connector (or holes), labelled "ICSP". The pic programmer plugs into a usb port on your computer, and connects to the 5 pin connector or holes on the IMA boost device. The red stripe of the programmer cable connects to pin "1" or the square marked pin on the PCB.

If pins are not fitted to your PCB then insert some sil 0.1" pins into the programmer connector and then push the pins into the holes on the PCB. Hold it at a slight angle under light pressure to maintain contact with the pads during the programming process. The potentiometers should be at the center neutral position during firmware update operations

Once the programmer is connected to the IMA boost device, and the software is running on your computer

check communication with the pic on the PCB by using the programming software Tools menu, and the option "Check Communication". The programmer should flash and the device type PIC12F683 should appear.



PICKit 2 software screenshot.

Make sure the options "Program Memory Enabled" and "EEPROM Data Enabled" are ticked.

Now open the File menu and select "Import Hex". Find the new IMA boost device firmware hex file you have downloaded and select it. You should see the message "Hex file successfully imported". Now press the Write button and the new firmware will be uploaded to the IMA boost device. If all goes well you should get a green "Programming Successful" message.

If you wish to back up your current software and data before upgrading, use the Read and Export options in the PICKit 2 software to save it

If the firmware update fails check your connections and try re-downloading the hex file. Check the www.insightcentral.net forum for further advice.

Finally

I hope you enjoy using the IMA boost device as much as I do. It took hours to research, design and build. It is a product specifically built for our fascinating cars, and I hope it helps you get the best out of yours.

Comments and feedback on it, these instructions, or any of my devices are always welcome. Please use the www.insightcentral.net forum IMA boost device thread for all general questions, feature requests or problems.

There are lots of users of my devices in the Insight community, and they are always willing to help on the forum with their experience and knowledge. Several forum members including the UK Gen 1 CVT rally car team use the device to boost performance for competition work.

Peter Perkins 21/11/2016