EMERALD
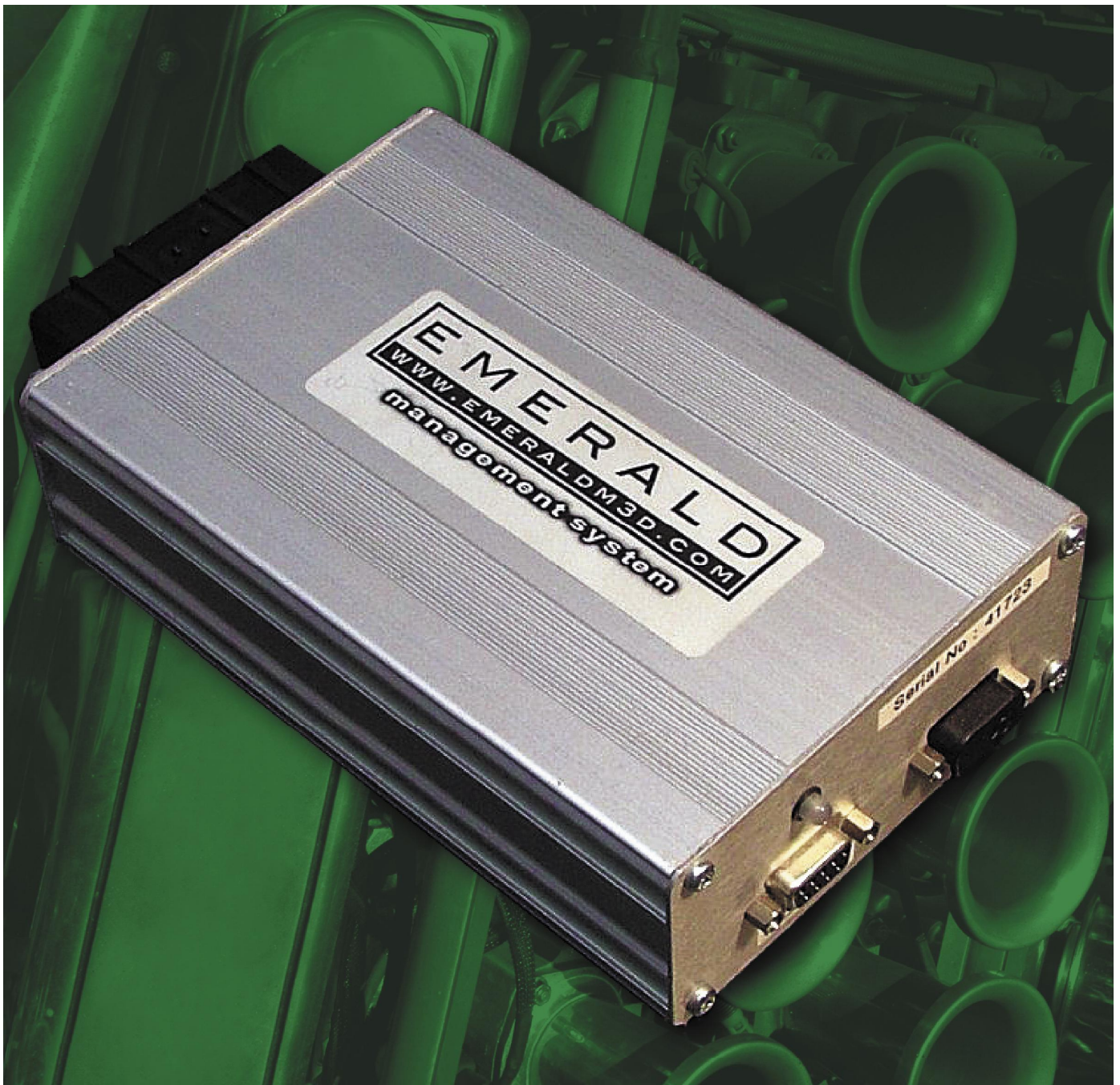
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EMERALD K3

Calibration • Innovation • Performance

The new K3 ECU is the most significant step forward for Emerald in over a decade of ECU design, development and manufacture. The new firmware and software packages take Emerald into a realm where it can stand comparison with systems costing up to three times as much. For example the K3 has a CAN bus (controller area network) and now links direct to the AIM dashboard.

When you check out the new features that come as standard with the Emerald K3 ECU I think you will agree that you cannot find better value for money anywhere in the ECU market place. Considering the ability to upgrade our previous 32 bit M3Dk to the latest specification, it makes the decision to purchase an Emerald ECU a true performance investment: Emerald - here today and here tomorrow.

Dave Walker

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Norwich Road Industrial Estate,
Watton, Norfolk IP25 6DR.**

K3 ECU: £580 plus VAT

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Map Switching
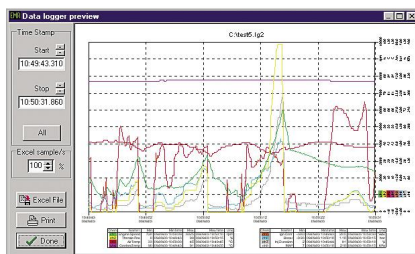
TRIPLE MAP FACILITY

Using a simple, user configurable, voltage input you can now switch between three completely different maps held inside the ECU's memory. This is not just a case of having different fuel or ignition maps. The Emerald K3 ECU holds the total map parameters in memory allowing you to conveniently switch between maps with different warm up values, rev limits, and boost control settings, etc, as well as fuel and ignition timing.

As an example you can set up one map for unleaded, another for high octane fuel and a third for the new E85 BioEthanol fuels. You can have different boost level settings on a turbo engine and switch between maps as you drive. You can even have different boost levels in different gears.

The ability to switch maps on the fly from the dashboard allows you to change fuel grades mid journey, lower the rev limit for a "guest" driver or run a slightly weaker mixture for motorway cruising – as opposed to a maximum attack track map where everything is set up for power and nothing else. Experience and imagination will undoubtedly find many other uses for this superb new triple map feature.
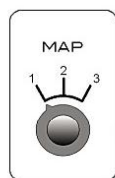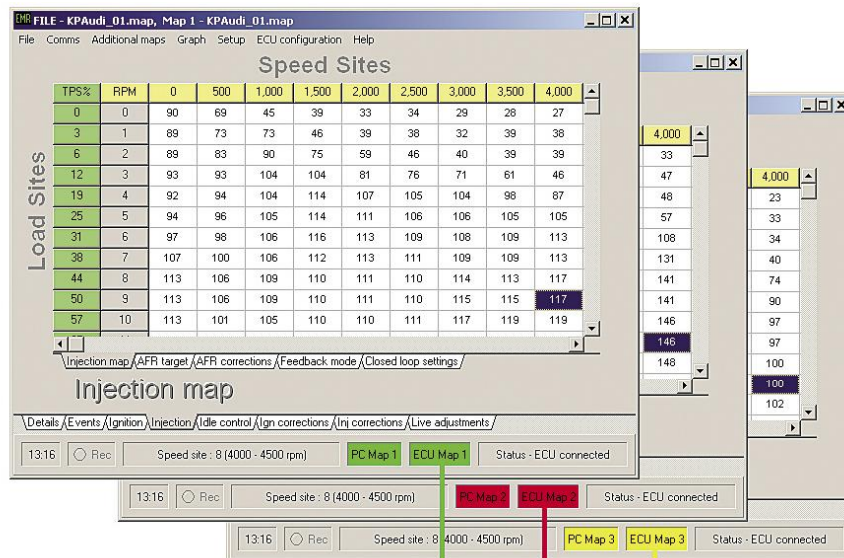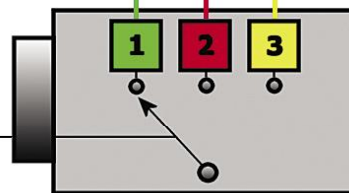
- The ECU can store up to three completely separate maps.
- If set to do so the ECU will allow you to freely switch between maps on-the-fly.
- The mapping software also holds three maps in memory and will switch maps in sync with the ECU.
- The mapping software uses a new file format that allows three maps be to stored within the one file.
- A 0-5 volt signal via an analogue input can be used to instruct the ECU which map to use. A simple two position on-off switch can be used to provide a high-low signal that will enable you to switch between two maps. To switch between three maps a rotary multi-position or potentiometer can be used.

Adaptive Mapping

Fuelling learns as you drive

Currently standard production ECUs have a self learning system for the fuelling which ensures that the air to fuel ratio remains where the car manufacturer meant it to be. This has only been possible with the development of the wide band lambda sensor. Consequent mass production of wide band sensors has now made these affordable to car builders and modifiers working on a budget.

The new K3 software and firmware package includes an adaptive mapping system but unlike the OE systems our target maps are fully adjustable by you, the end user. The adaptive learning map exactly overlays the base fuelling map so you can have exactly the air to fuel ratio that YOU want anywhere in the speed and load range.

The target and correction maps are now colour coded so you can instantly identify rich or weak areas (red is rich and blue is weak). This is yet another example of Emerald's hands-on approach to ECU software design; practical as well as pleasing to the eye.

More flexible?

Need more flexibility? You have a fourth adaptive mapping screen that allows you to switch from closed loop to open loop to adaptive mapping from one load cell to another (feed-back mode) – giving you total control at all times.

Taking a voltage input from 0 to 5 volts you can define the signal from any of the currently available aftermarket wide band readers. You can tell the ECU what to learn, when to learn it, by how much and how quickly. You get total control of the self mapping system and you can have different AFR values for all three different maps in the ECU. That's real flexibility.

Boost control

Boost control against engine rpm is an essential part of turbo control but the better systems have always had boost control against throttle position as well as rpm. This gives you the ability to back off the boost as you lift the throttle – giving much more control than the all-or-nothing approach of some systems.

Emerald has now added boost control functions input from the gear ratio. With input from a road wheel sensor the ECU calculates which gear you are in and therefore you can run different boost levels in different gears. There is also the facility to have the boost control over-ridden from a control knob on the dash giving the driver total control over the engine boost parameters. By adding this to the triple map switching facility we believe there has never been a more flexible system on the market at this price.
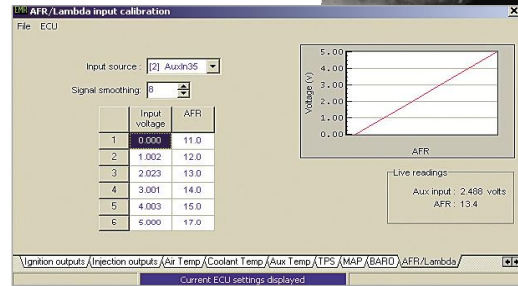

- **Fuelling adjustments made by the closed-loop function will be recorded in a corrections table. The actual fuelling will be determined by the injection map and the corrections table.**
- **Connect to any aftermarket wide band lambda controller that provides a 0-5v AFR signal.**

- **The 16 x 32 cell AFR target table allows you to set the desired AFR that you wish the ECU to target for any given speed or load site.**
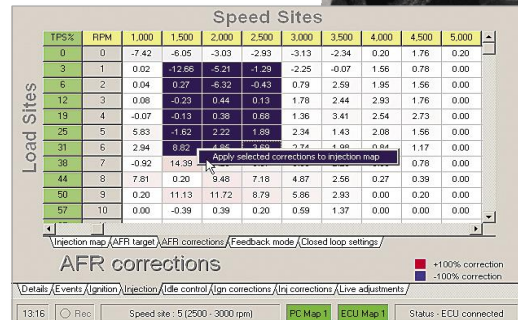

- **The 16 x 32 cell AFR corrections table allows you to view / edit / apply the fuelling corrections built up by the ECU while in adaptive mode.**
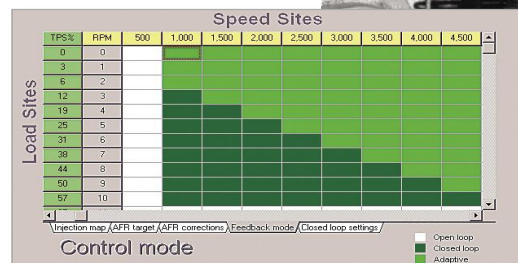
- **The 16 x 32 cell Feedback mode table allows you to set the mode of operation (open loop, closed loop, adaptive) for any given speed or load site.**

Individual cylinder trims

The K3 ECU can now trim cylinders on an individual basis allowing simple calibration of unmatched injectors or fuel and ignition trims to suit individual cylinder efficiencies. Each cylinder can be trimmed with positive or negative gains.
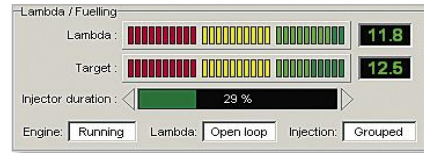

● *Clear and concise fuelling information is provided on the live adjustments screen. View the ECU's target and measured AFR as well as important information such as injector duration.*

Exhaust Gas Temperature

Closed loop on EGT for boost and fuelling

Exhaust gas temperature is a critical measurement for high performance engines. The new K3 software allows you to read-in exhaust gas temperature from a suitable thermocouple via the CAN bus. You can then set port temperature limits in the software to reduce turbo boost and/or add fuelling to safeguard the engine. You also get the EGT reading on the live mapping screen allowing you to monitor the engine during mapping. The system already contains the calibration for the Audi/VW EGT sensor making the new K3 a must for anyone using the VW Audi 1.8 Turbo engine as a transplant.
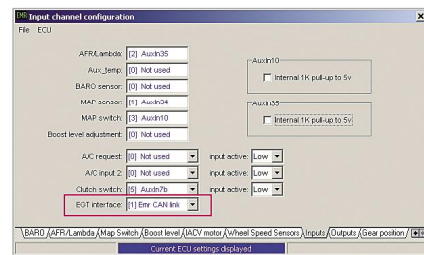

● *The ECU can be configured to read exhaust gas temperature via a signal conditioning unit. To ensure the best accuracy the exhaust gas temperature is transmitted digitally between the signal conditioning unit and the ECU. Either an Emerald or a VAG signal conditioning unit can be used.*

Movable Speed Sites

Emerald has always been proud of the speed capability of the system. Previously we had 32 speed sites at 500rpm intervals giving a total rpm span from Zero to 15,500rpm. The system has been bench tested on a simulated 36-1 trigger wheel to a staggering 44,000rpm - before it started to lose accuracy! We were confident that our 15,500rpm rev limit was no idle boast but to the best of our knowledge nobody has ever made use of it. Users were therefore asking for more speed sights over a lower speed range.
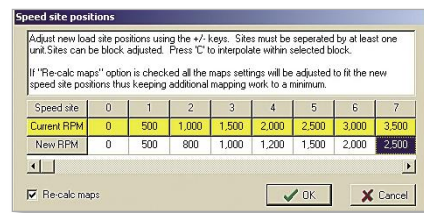
● *32 speed sites (rpm)*
● *Speed sites are adjustable to a resolution of 1 rpm.*

Consequently the K3 software package allows you to move the speed site position; which means you can shuffle the sites down the rpm range and have them anywhere you like. We wanted to give even the most demanding customer no cause for complaint so the resolution on site setting is one rpm (1 rpm). You can space them anywhere you like, even or uneven and all speed related events, like warm up tables, ignition sites, etc, move position to stay in alignment. This means you can move sites half way through mapping and carry on as if nothing had changed: practical as well as clever.

Flexible Settings

Movable Load Sites

It's the same story with load sites. Rather than having them fixed you can now move them to a resolution of one percent (1%) and with so many new throttle body designs coming onto the market this allows you to set up the maps for traditional butterfly bodies or roller barrels – whatever the design. Should you feel the need to experiment you can have different speed and load sites on each of the three available maps.

Load can also be read from a manifold air pressure sensor rather than throttle angle simply by changing the software configuration.

- Load sites can be set by
- Throttle position: adjustable to a resolution of 1%
- Pressure: adjustable to a resolution of 1 KPa.

Load site positions

Load site	Current pos (KPa)	New pos (KPa)
0	30	40
1	35	50
2	39	60
3	44	70
4	49	80
5	53	90
6	58	100
7	63	115
8	67	125
9	72	135
10	77	150
11	81	160
12	86	170
13	91	180
14	95	190
15	100	200

Adjust new load site positions using the +/- keys.

Sites must be seperated by at least one unit.

Sites can be block adjusted.

Press 'C' to interpolate within selected block

If "Re-calc maps" option is checked both the injection & ignition map settings will be adjusted to fit the new load site positions thus keeping additional mapping work to a minimum.

☐ Re-calc maps

✓ OK   ✗ Cancel

VVT Cam Control

K3 now features full control of the Rover cam duration (VVC) engine or variable cam timing systems with algorithm for oil temperature. No more dash mounted on/off switches!

- Cam on/off switching control.
- Switch according to rpm and load.
- Any spare output can be assigned to this function.

VTEC switch

Output ON condition
- RPM > 4000
- TPS > 34 %

Output OFF condition
- RPM < 3900
- TPS < 33 %

\Flat shift \IACV \Injection Scaling \Injector Timing \MAP Comp \PWM Control \RPM/Coolant enrich \VTEC Switch \

VVT control

Speed Sites

%	0	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500
0	235	235	235	235	250	255	260	265	268	269	270	288	288	288
25	235	235	235	235	250	253	258	260	268	268	270	288	288	288
50	235	235	235	235	250	252	255	255	264	267	270	288	288	288
75	235	235	235	235	250	251	252	253	262	266	270	288	288	288
100	235	235	235	235	250	250	250	250	260	265	270	288	288	288

Throttle

Control settings

-30	-20	-10	0	10	Aux temp (°C)
20	20	20	20	18	Control (mS)

MapOffset : 200

Delay count : 1

\IACV \Injection Scaling \Injector Timing \MAP Comp \PWM Control \RPM/Coolant enrich \VTEC Switch \VVT \

- Rover VVC control.
- Continuously variable cam duration.
- Control target duration according to load and speed table.
- Oil temperature correction to control algorithm.

Sensor calibration

Traditionally, with an eye on simplicity, we at Emerald have stayed with one fixed air and one water temperature sensor calibration file. Due to the wide diversity of applications now available we have subsequently included the ability to user define the sensor calibration. Since we doubted that many of our customers would have access to climate chambers we have adopted a clever software strategy for sensor calibration.

You enter the sensor value at ambient (room) temperature. Next you place the sensor in ice and record the value at zero degrees C. Follow this up with boiling water (100 degrees C) and the software does the rest. A true parabolic curve is drawn through all three points allowing you to calibrate almost any sensor to the system with little more than domestic equipment available around the house (most people have a fridge and a kettle). Wherever we can we like to make the complicated as simple as possible.
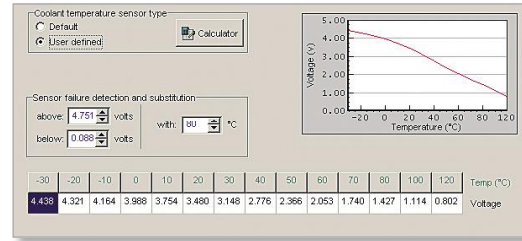
- *The ECU's air, coolant and auxiliary temperature sensor inputs can be calibrated to read from many different sensor types.*
- *Out of range sensor readings and/or a failed sensor can be detected. Once this has been detected the ECU will replace the reading with a user settable value and flag up an error.*
- *Adjust the ECU's calibration table directly or use the built in calibration calculator to built a new table from 3 simple measurements.*

Injectors can now be calibrated for changing supply voltage with the "user defined" option. Over the last ten years we have seen power outputs in the tuning industry climb ever higher. Ten years ago 200bhp was an outstanding engine; currently it is not an uncommon output for a fast road conversion. This has meant that a wide range of larger injectors are now being used and many have wildly different requirements on voltage correction. We are currently working on building up a library of correction curves for the most common injectors.

These are just a few of the new features of the Emerald K3 ECU. What isn't so obvious is the support you get from Emerald via the air conditioned 4WD rolling road cell and the Superflow 901 engine dyno facility. Full technical support via Email gives first time users the back-up they need. Clever as the new system is we will continue with our policy of NEVER sending out an ECU without a suitable base map. Even experienced operators appreciate having a starting point for engine tuning while for the beginner it is absolutely essential. You can download the software for free from: **www.emeraldM3D.com** and explore the system more fully for yourself.

There's never been a better reason for joining the ever growing family of satisfied Emerald ECU users.
Emerald M3D Ltd. 2006

EMERALD K3
TECHNICAL SPECIFICATION

Specification		
Physical	Dimensions	110mm x 190mm x 44mm (W x L x H)
	Weight	491g
	Power supply	6.5v - 18v
Input	Distributor trigger	Yes. Inductive or Digital Sensors
	Crank trigger	Yes. Inductive or Digital Sensor, selectable trigger patterns
	Air temperature	Yes, standard Bosch or user programmable characteristic
	Coolant temperature	Yes, standard Bosch or user programmable characteristic
	Engine load	Throttle pot and/or MAP 0-5v signals
	Oxygen sensor	0-1v narrow band lambda or 0-5v wideband AFR signals
	Road speed	Yes
	Other	Coded immobiliser input, exhaust gas temperature, oil/aux temperature. Spare inputs can be assigned to air conditioning request, boost level adjustment, clutch switch, map selection, launch enable, and others...
Output	Ignition coil drivers	3 internal
	Injector drivers	6 internal
	Other	Air conditioning clutch, fuel pump relay control, supply relay control, two stage cooling fan control, programmable tacho driver, oxygen sensor heater control, shift-light, boost control valve, variable cam control, cam switching, stepper motor and solenoid idle control valves, CAN data-link to digital dashboards, user programmable outputs, 5v and 8v sensor supplies
PC link	RS232 serial communications	

36-way Automotive connector

Aux input port

Status LED

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management system

Lightweight aluminium case

Communications port