M1 GPR DIESEL PACKAGE

MoTeC's M1 GPR Diesel Package is a versatile and adaptable platform for the operation of diesel fuelled engines.

This Package has been designed for direct injection, common rail, turbo diesel engines, but can also be used for naturally aspirated diesel applications. Many features from MoTeC's petrol GPR Packages have been reproduced in this Package, providing a familiar feel for current GPR users.

Included are many ancillary features commonly found on race cars, such as launch control, traction control, driver switches (e.g. pit switch, launch enable, boost trim), gearbox control, intercooler sprays, transmission pump, differential pump and coolant pump. Also accommodated are many systems found on modified road vehicles, such as air conditioning.

The Package fully integrates with other MoTeC products, and provides pre-defined CAN messaging for all current Display Loggers, Loggers, E888, VCS, GPS, ADR, BR2, PDM, and SLM. A Vector database (.dbc) file is also available upon request.

LICENSING

To load the Package onto an M1 ECU, MoTeC's **M1 GPR Diesel Licence** (part number 23189) is required.

ECU VARIANTS

This Package is available for use with MoTeC's direct injection ECUs: M141 and M142. A Package variant for M130 and M150 ECUs is also available and is used in conjunction with an injector drive box fitted to some vehicles (e.g. Toyota Hilux).

The key difference between MoTeC's M141 and M142 ECUs is the maximum available Boost Voltage and Peak/Hold Currents for direct injector operation. Accordingly, the injector supply requirements of any engine must be considered when choosing an M1 ECU.

ECU	Max Boost Voltage	Max Peak Current	Max Hold Current
M141	188V	20A	10A
M142	80V	20A	15A

Refer to the **Engine Compatibility** section of this datasheet to determine the correct ECU for the application. A pinout example for the M142 follows.

VEHICLE COMPATIBILITY

Adaptor kits for common diesel vehicles will be available soon. These adaptor kits connect the vehicle's original engine harness directly to the M1 without needing to modify the existing OE wiring.

The following sensors are required to run a diesel engine with this GPR Diesel Package:

- Coolant Temperature Sensor
- Fuel Pressure Direct Sensor (Common Rail)
- Mass Airflow Sensor or Inlet Manifold Pressure Sensor and Inlet Air Temperature Sensor (all 3 preferred)
- Throttle Pedal Sensor
- Engine Speed Reference Sensor
- Engine Synchronisation Sensor (Camshaft Position)

For optimal performance the following sensors are recommended for use with the GPR Diesel Package:

- Exhaust Temperature Sensor
- Boost Pressure Sensor
- Fuel Temperature Sensor
- Ambient Pressure Sensor

DIESEL SPECIFIC FEATURES

The following features in GPR Diesel have been specifically designed to run diesel engines:

- Operates diesel direct injected engines from 1 to 8 cylinders with inductive or piezo injectors and synchronous direct injection fuel pumps. Refer to the **Engine Compatibility** section for known applicable engines.
- Turbocharger boost pressure control of either a PWM solenoid or servo motor for use with a Variable Nozzle Turbo (VNT), wastegate, bypass etc. The boost control can be fully configured via a PID control system that gives the user full control over the response and stability of the system. The Boost Aim can be varied based on Fuel Mass, Engine Speed and Ambient Pressure.

  To ensure safe operation, a number of overriding Boost Limits can also be set. These limits may be based on Coolant Temperature, Engine Load, Exhaust Temperature, Inlet Air Temperature, Race Time, Gear, Vehicle Speed and Turbocharger Speed.
- Control of a throttle valve is also supported. This throttle valve can be used to assist engine shutdown or reduce power during Engine Overrun.
- Exhaust Gas Recirculation control via a servo motor, solenoid or stepper motor actuator. The EGR amount applied can be varied with Engine Speed and Fuel Mass. Compensations for Air Temperature, Coolant Temperature and Ambient Pressure can also be applied.

  A Start Off EGR Compensation can be used to avoid soot formation when the vehicle takes off. Separate EGR aims can be used for Overrun and Gear Shifts. The Throttle Servo or a Flap Actuator (EGR Cooler) can also be controlled during EGR requests.
- The Glow Plug Control system includes independent strategies to control the glow plugs pre-cranking, during cranking and post cranking. Each phase has tuneable compensations for Coolant Temperature and Battery Voltage.
- Ignition outputs are available for each cylinder to check the timing of the fuel injection.
- Advanced LTC Enable functionality ensures safe operation of Lambda sensors.

COMMON GPR FEATURES

The following features from MoTeC's GPR Package are maintained in the GPR Diesel Package:

- Configurable engine synchronisation mode for many common engine types. Refer to the **Engine Synchronisation Modes** section for current details.
- Configurable top dead centre for each cylinder allows for odd-fire engines.
- Configurable camshaft control from 1 to 4 cams, plus 1 switched camshaft.
- Physical settings for engine displacement, fuel properties, and injector characteristics allow for simplified engine start-up prior to tuning.
- Sensor calibrations available for many common automotive sensors. Sensors calibrations can also be manually defined.
- Support for analogue and digital (frequency or duty cycle) sensors.
- Support for single wire digital (SENT) sensors.
- Diagnostics on all sensors to check for high and low shorts. When the diagnostic detects a fault, the Package either deactivates any functions using the faulting sensor or uses the pre-defined sensor estimates. The Airbox Mass Flow Sensor has extra plausibility diagnostics to check for offset and gain faults.
- Support for MoTeC devices: ADR, E8XX, PDM, SLM, Video Systems
- Supports CAN messaging for BOSCH ABS M4 unit.
- Test settings for most outputs, including injection and ignition outputs, for easier setup.
- Configurable turbocharger bypass (blow off) control.
- Supports two coolant fan outputs (PWM controlled).
- Configurable closed loop alternator control system for PWM field winding control.
- Air conditioner support with switched output control and optional refrigerant pressure sensor.
- Coolant pump output with PWM control.
- Coolant pump after-run functionality, optionally with additional pump output.
- Engine speed limiting via fuel cut.
- Fuel pump switched output.
- Fuel Flow Supply Sensor and Fuel Flow Return Sensor.
- Gearbox position detection via optional dual sensor or engine speed/wheel speed estimate.
- Gearbox shift request via Up Shift Switch/Down Shift Switch or Gear Lever Force sensor.
- GPS acquisition and logging via CAN or RS232.
- GLONASS messaging support on GPS devices.

- Intercooler temperature and spray control.
- Differential temperature control with dedicated temperature sensor and switched pump output.
- Engine charge temperature calculation allows for correction of inlet air temperature (compensation of heat soak effect etc.).
- Lap distance, time and number via BR2, GPS or switched input, with split and sector options.
- Configurable launch control with tables for engine speed, throttle limit, boost aim and fuel volume trim.
- Race time system with tables for fuel mass, fuel timing, boost limit and throttle limit.
- Engine Load Average channel with tables for engine speed limit and boost limit.
- Inlet Manifold Flap support (actuator with position).
- Inlet Manifold Runner support (actuator with position feedback).
- Assisted engine start control with dedicated fuel mass and idle compensations during crank and post start.
- Engine run time total for engine hour logging.
- Configurable security for multiple users with differing access options.
- Configuration of brake state using a switch or pressure sensor.
- Configuration of clutch state using a switch, a position sensor or a pressure sensor.
- Transmission brake control ('bump') functionality for perfect positioning of cars, with 'creep' feature.
- Calculation of clutch slip ratio.
- ECU-internal G-force (acceleration) – longitudinal, lateral, vertical.
- ECU CAN receive from a defined CAN ID for data reception from MoTeC devices.
- Support of up to three separate CAN buses.
- Most common ECU channels transmitted on CAN using standard MoTeC CAN templates.
- 8 configurable switches and 8 rotary switches (wired or CAN input) each with 10 positions. These can be simultaneously mapped to Launch Control, Pit Switch, Traction, Race Time Reset, Engine Speed Limit Maximum, Throttle Pedal Translation, Boost Limit, Traction Aim and Traction Control Range, Transmission Brake Bump, Wheel Circumference and Wheel Speed Limit Maximum Switch.
- Pulsed tachometer output with configurable output pin and scaling.
- Dual bank Drive by Wire throttle servo control.
- Configurable throttle sensor input, with 2 channel analogue or single wire digital (SENT) protocol.
- Throttle Pedal sensor with translation table. Hybrid OE pedals (for example Ford) are supported - one analogue and one digital channel.
- Use of a Throttle Pedal sensor or a Throttle Position sensor in case of a cable throttle.
- Differential pump output with user definable differential temperature control.
- Transmission cooler pump output with user definable transmission temperature control.
- Traction control with tables for Aim Main, Aim Compensation and Control Range.
- Vehicle speed measurement using wheel speed sensors, estimation or GPS.
- Vehicle Speed Limit Control system, which can also be used for pit speed limiting.
- Configurable warning system with light and CAN output.
- 5 auxiliary output functions for PWM control of added actuators. Control of the output duty cycle can be varied based on:
  - Engine Speed and Engine Load (Output 1)
  - Engine Speed and Throttle Pedal (Output 2)
  - Engine Speed and Fuel Mass (Output 3 & 4)
  - Engine Speed and Aux Input (Output 5)
- Optional channels for additional sensors via input pin and/or CAN message, including:
  - Airbox Mass Flow, Mass Flow Reference, Pressure and Temperature
  - Ambient Pressure and Temperature
  - Boost Pressure
  - Brake Pressure Front and Rear
  - Brake Switch
  - Brake Vacuum Pressure
  - Clutch Pressure and Position
  - Clutch Switch
  - Coolant Pressure and Temperature
  - Differential Temperature
  - Engine Oil Pressure and Temperature
  - Engine Crankcase Pressure
  - Exhaust Pressure Bank 1 and Bank 2
  - Exhaust Temperature (EGT) via TCA Thermocouple Amplifier, Generic CAN, or E888 for a single Collector, Bank 1 and 2 Collectors, and Cylinders 1 to 8.
  - Exhaust Lambda via LTC, LTCN, or PLM for a single Collector, Bank 1 and 2 Collectors, and Cylinders 1 to 8.
  - Fuel Pressure and Temperature
  - Fuel Tank Level
  - Gear Position
  - Gear Lever Force

- Gear Neutral Switch
- Gear Shift Request
- G-Force (acceleration) – Longitudinal, Lateral, Vertical
- Inlet Air Temperature
- Inlet Manifold Pressure and Temperature
- Inlet Manifold Flap Position x 2, Inlet Manifold Runner Position
- Intercooler Temperature
- Steering Angle and Pressure
- Transmission Pressure and Temperature
- Turbocharger Speed
- Turbocharger Inlet/Outlet Temperature
- Turbocharger Wastegate Position
- Wheel Speed sensors front/rear left/right, directly wired or CAN input.

DIESEL ENGINE OPERATION ON M1

Multi Pulse Injection System

Fuel is delivered by up to four pulses: two pilots, one main and one post pulse. Fuel Mass is calculated as described in the following section, where the total fuel mass may be divided between the pilot and main pulses.

Post pulses are calculated separately from the other pulses. They are not considered in terms of torque delivery into an engine, rather as exhaust treatment or turbo control strategies which have limited effect on overall engine torque.

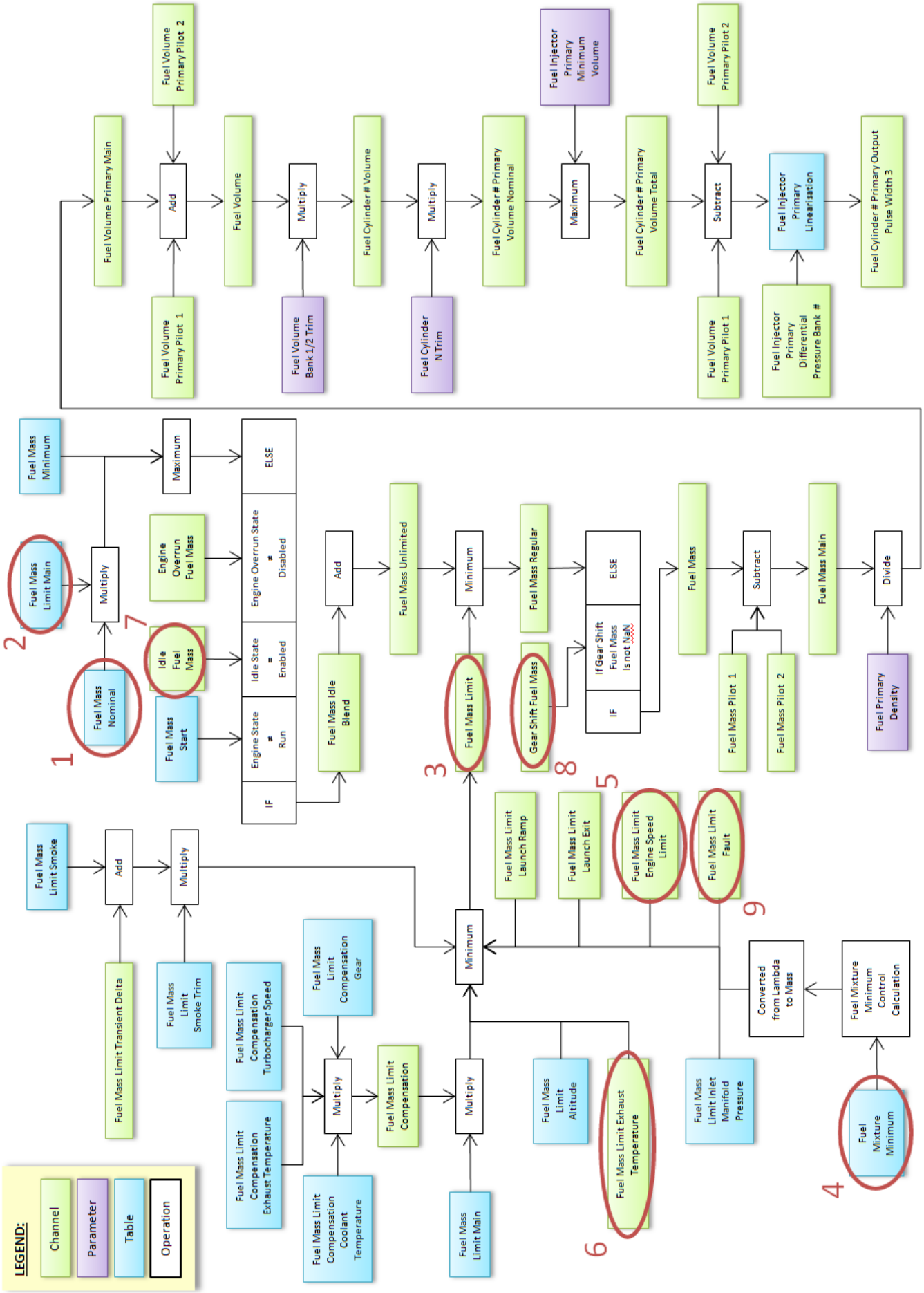
Main Pulse System

Note: *This section refers to the Main Injection Pulse Flow Chart on the following page (Fig 1).*

- This Package delivers fuel proportionally to Throttle Pedal Position (see 1 & 2 on Fig 1, over page). The fuel mass can then be limited (see 3 on Fig 1) by a number of tables and calculations including:
  - Fuel Mass Limit Smoke
  - Fuel Mass Limit Smoke Trim
  - Fuel Mass Limit Compensation Coolant Temperature
  - Fuel Mass Limit Compensation Exhaust Temperature
  - Fuel Mass Limit Compensation Turbocharger Speed
  - Fuel Mass Limit Compensation Gear
  - Fuel Mass Limit Altitude
  - Fuel Mass Limit Exhaust Temperature
  - Fuel Mass Limit Fault
  - Fuel Mass Limit Inlet Manifold Pressure
  - Fuel Mixture Minimum
- Fuel Mixture Minimum Control system applies a trim to the Fuel Mass Limit to ensure that the Exhaust Lambda is not richer than the user defined limit, which is set in the Fuel Mixture Minimum table (see 4 on Fig 1).
- Engine Speed Limiting Control system varies Fuel Mass to keep the engine speed within the user defined limits (see 5 on Fig 1).
- Exhaust Temperature Protection Control system that limits Fuel Mass (see 6 on Fig 1) based on exhaust temperature can be used to prevent the overheating of exhaust components (i.e. turbocharger).
- Idle Control with Closed Loop Control of the Fuel Mass (see 7 on Fig 1) to ensure a smooth, stable Idle Engine Speed. Ramp Down functionality can also be used to provide a smooth transition into idle.
- Assisted gearshifts with independent Fuel Mass control (see 8 on Fig 1). Up and down gear shifts can be tuned independently via separate tables.
- Configurable control of up to 2 proportional and 1 synchronous direct injection fuel pump/s.
- Fuel Mass limits (see 9 on Fig 1) can be set for each of the 61 individual warnings that can be monitored with the warning system. The warning system determines if a measurement is outside normal operating conditions or if a sensor, input or output is at fault.

  Warnings are included for:
  - Engine Oil Pressure
  - Engine Crankcase Pressure
  - Fuel Primary Pressure Direct Bank 1 & 2
  - Fuel Primary Pressure
  - Coolant Temperature
  - Inlet Air Temperature
  - Engine Oil Temperature
  - Exhaust Lambda
  - Exhaust Temperature
  - Exhaust Pressure
  - Engine Speed

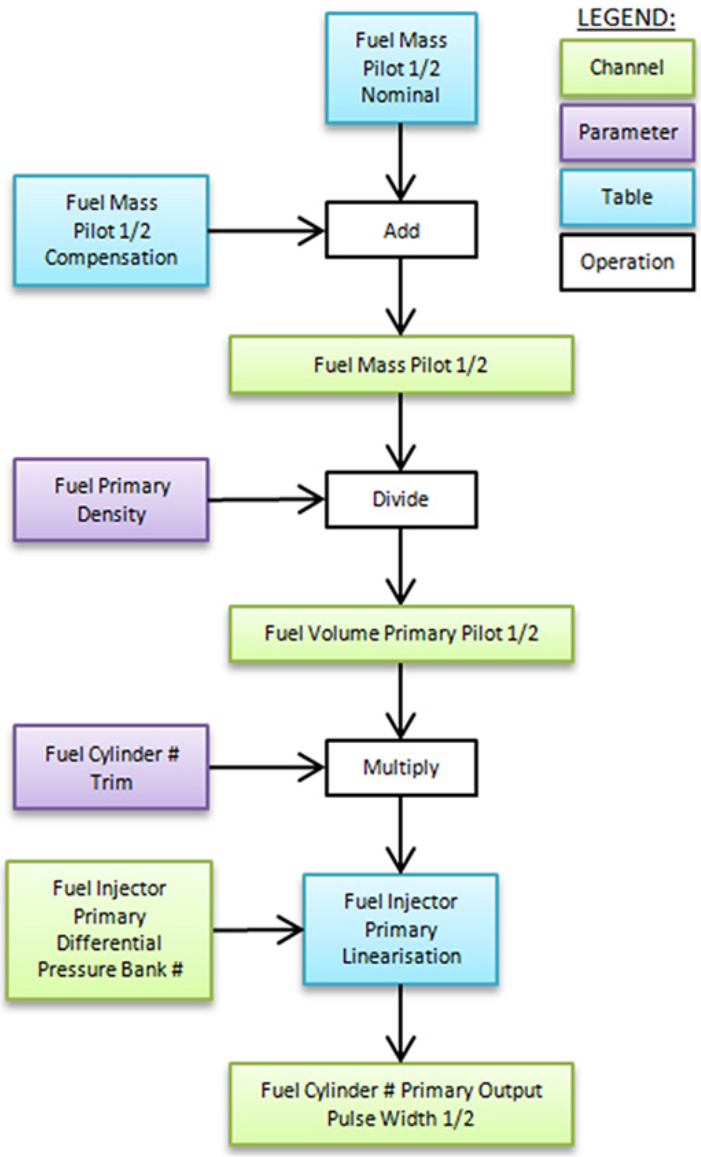
Fig 1: Main Injection Pulse Flow Chart



Pilot Pulse System

Support for up to two pilot pulses prior to the main pulse to allow for smoother running and reduced noise. Each pilot pulse's fuel mass can be varied with engine speed and the total mass of fuel that is being delivered. The pilot fuel mass can also be compensated by coolant temperature. The timing of the pilot pulse can either be relative to TDC, the main pulse or calculated. The timing can also be varied with engine speed and total fuel mass and can be compensated by coolant and engine charge temperature.

Fig 2: Pilot Injection Pulse Flow Chart

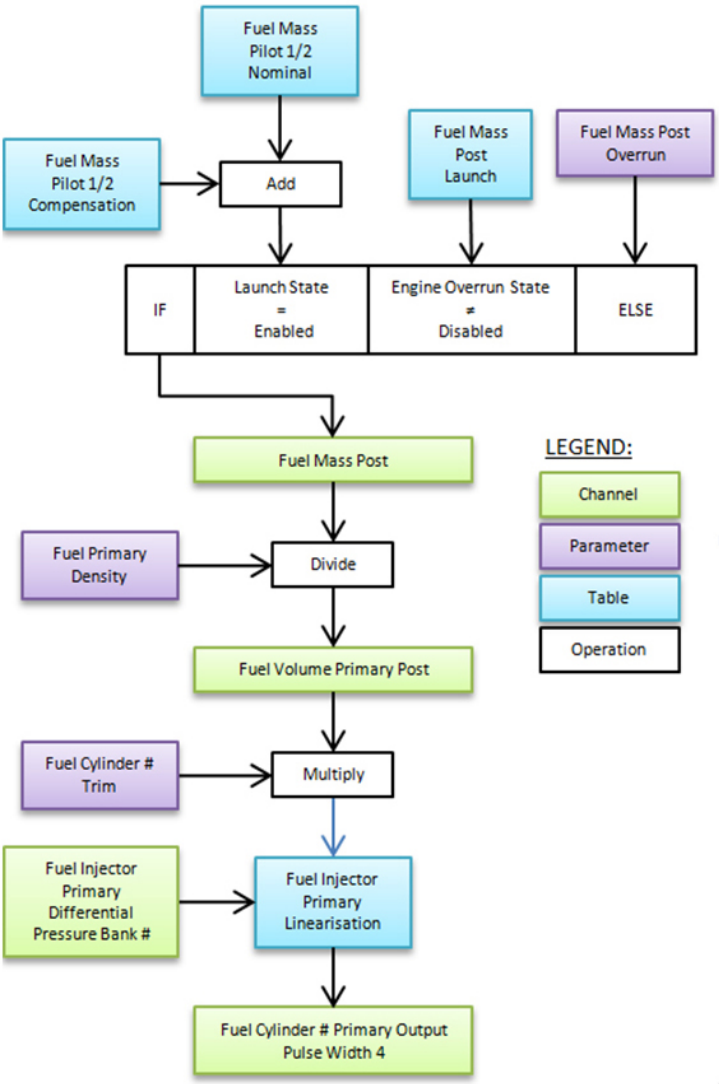


Post Pulse System

A single post pulse after the main pulse can be added to reduce emissions or build boost without affecting the engine's output. The post pulse's fuel mass can be varied with engine speed and the total mass of fuel that is being delivered. The pilot fuel mass can also be compensated by coolant temperature.

The timing of the post pulse can either be relative to TDC, the main pulse or calculated. The timing can also be varied with engine speed and total fuel mass and can be compensated by coolant temperature. The post pulse can be independently controlled in engine overrun and launch with options to disable/enable the post pulse during gear shifts and traction control.

Fig 3: Post Injection Pulse Flow Chart



VNT Turbo with Servo Motor

As the VNT Turbo operates at high temperatures, the open and closed position of the vanes may change over time. In some cases the vane mechanism may jam if the open and closed positions are not closely matched in the M1 Package settings.

It is advisable to **manually test** the open and closed positions of the VNT when installing a kit for the first time, and, if necessary, **manually reset** the open and closed positions.

Manual Test of VNT Open and Closed Positions

This test should be performed regularly to confirm that the VNT servo open and closed positions are closely matched in the M1 settings.

1. Turn on the ignition. Do not start the engine.
2. Connect to the ECU in M1 Tune and select the **1:Tuning | 6: Boost Servo** Worksheet.
3. Monitor the **Boost Servo Actuator Aim** and **Boost Servo Actuator Position**. These are visible on the Time Graph on the right side of the Worksheet.
4. Change the **Boost Servo Aim Test** mode from **Disabled** to **Enabled**.
5. Enter **Boost Servo Aim Test Position** values ranging from 0% to 100% and observe the **Boost Servo Actuator Position** to see how closely it matches the **Boost Servo Actuator Aim.**
6. Reset the **Boost Servo Aim Test** mode from **Enabled** to **Disabled**.

If this test indicates a mismatch between the physical open and closed positions and the M1 settings, perform the following test.

Manual Reset of VNT Open and Closed Position

This procedure manually resets the M1 settings to match the physical open and closed positions of the VNT. It need only be performed after the previous test indicates a mismatch between the physical open and closed positions and the M1 settings.

WARNING: This test should be momentary as the servo motor risks overheating if current (i.e. a positive or negative duty cycle that is not zero) is passed through the motor for more than 5 seconds.

1. Turn on the ignition. Do not start the engine.
2. Connect to the ECU in M1 Tune and select the **1:Tuning | 6: Boost Servo** Worksheet.
3. Change the **Boost Servo Actuator Test** mode from **Disabled** to **Enabled**.
4. Enter a **Boost Servo Actuator Test Duty Cycle** of -100%. This value should drive the motor to a fully closed position of 0%. Once the position has stabilised, enter a **Boost Servo Actuator Test Duty Cycle** of 0% to turn off the motor.
5. Use the 'Q' Calibrate function to set the **Boost Servo Actuator Position Sensor Main Offset**. Observe the Position value change from a non-zero value to 0%.
6. Enter a **Boost Servo Actuator Test Duty Cycle** of 60%. This value should drive the motor to a fully open position of 100%. Once the position has stabilised, enter a **Boost Servo Actuator Test Duty Cycle** of 0% to turn off the motor.
7. Use the 'Q' Calibrate function to set the **Boost Servo Actuator Position Sensor Main Scale**. Observe the position value change to 100%.
8. Reset the **Boost Servo Actuator Test** mode from Enabled to Disabled.
9. Perform the Manual Test of VNT Open and Closed Positions as detailed in the previous test procedure to confirm that the servo now operates correctly in the full range 0% to 100%.

Injector Types and Settings

Direct Injection M1 ECUs (M141, M142, M181, M182) can operate inductive or piezo injectors in this Package.

While the visible parameter settings are identical, piezo injector operation uses only a few of these settings. While the other settings are visible, they have no effect when used with piezo injectors.

Further, while inductive injector operation has comprehensive diagnostics available to protect both the injectors and the M1 ECUs, piezo injectors do not have diagnostics available in this Package release.

Package variants on MoTeC Online are configured to suit the injectors found on OE engines; injector settings should only be changed with extreme caution.

Inductive Injector Settings

All visible settings are required to correctly operate inductive injectors.

Piezo Injector Settings

Only the following settings are used for piezo injectors:

- **Fuel Output Supply Voltage** – normally above 110V for piezo injectors, so only an M141 is suitable.
- **Fuel Output Drive** – must be set to **Piezo.**
- **Fuel Injector Primary Off Time** – values may be as low as 150us. Note that even 150us may be short enough to allow 'pulse fusion' whereby two adjacent pulses (for example Pilot 1 and Pilot 2) are effectively joined together because the injector does not close in the available time. In this case larger fuel mass will be delivered and behaviour will be unpredictable.
- **Fuel Injector Primary Peak Maximum Current** – details follow
- **Fuel Injector Primary Peak Minimum Current** – details follow

- **Fuel Injector Primary Minimum Volume**
- **Fuel Injector Primary Reference Flow**
- **Fuel Injector Primary Reference Pressure**
- **Fuel Injector Primary Linearisation**

Piezo injector opening and closing is controlled using only three parameters: **Fuel Output Supply Voltage**, **Fuel Injector Primary Peak Maximum Current** and **Fuel Injector Primary Peak Minimum Current**. While other parameters are still visible, they have no part in the injector's operation.

MoTeC has provided base calibration files for numerous common engines. If the target engine is not on this list, assistance should be sought from an authorised MoTeC dealer for piezo injector settings.

ENGINE COMPATIBILITY

Known OE engines that are suitable:

Engine Family	Engine Designation	Year	Vehicle Platform	ECU	Comment
Toyota KD	1KD-FTV	2012-2015	Hilux KUN16R, KUN26R	M130 or M150*, M141 or M142	Medium voltage inductive injectors
Toyota GD	1GD-FTV	2015-2018	Hilux GUN126R	M141 or M142	Medium voltage inductive injectors
Toyota VD	1VD-FTV	2007-2017	Landcruiser 200	M130 or M150*, M141	High voltage inductive injectors
Duratorq 3.2	ZSD Puma (P5AT)	2011-2018	Ford Ranger T6	M141	Piezo injectors
Duratorq 3.2	MZ-CD 3.2	2011-2018	Mazda BT50	M141	Piezo injectors
Mitsubishi 4N1	4N15	2015-2018	Mitsubishi Triton L200MQ	M141	High voltage inductive injectors
Isuzu J	4JJ1-TCX	2012-2018	Isuzu D-Max	M141 or M142	Medium voltage inductive injectors
GM Duramax	LWN	2012-2018	Holden Colorado	M142	Medium voltage high current inductive injectors
VM Motori	R-4028DOHC	2010-2018	Jeep Wrangler	M142	Medium voltage high current inductive injectors

*M130 and M150 ECUs can only be used in conjunction with the OE injector drive box.

ENGINE SPEED MODES

As of M1 System 1.4.00.0056

This list refers only to engine modes that are relevant to known diesel engines.

- Bosch 140 40 - General Motors LLT, Audi BXA/Lamborghini LP560, Mazda L3-VDT
- Camshaft One Missing Four Stroke
- Camshaft Two Missing Four Stroke
- Crankshaft One Missing Four Stroke
- Crankshaft One Missing Two Stroke
- Crankshaft Two Missing Four Stroke
- Crankshaft Two Missing Two Stroke
- General Motors DMAX LMM - General Motors 6.6L Duramax LMM diesel engines (late 2007 - early 2011) when the eighth digit of the VIN number is 6.
- Isuzu 4JK1
- Mitsubishi Fuso 4P10 (also Agco Sisu Power 49G)
- Mitsubishi Fuso 6M60 - 2015 Fuso TKG-FK61F
- Multi Tooth Four Stroke
- Multi Tooth Two Stroke
- Nissan YS23DDT – Diesel Navara
- Scania DC16
- Scania SGL12A
- Toyota 1GD FTV - 2.8L common rail diesel (2015 -)
- Toyota 1KD FTV - 3.0L common rail diesel (2000 -)
- Volvo D11C - D11C truck engine (FM450 Platform)

EXAMPLE M142 PINOUT

M142 Connector A – 34 Way

Mating Connector: Tyco Superseal 34 Position Keying 2 – MoTeC #65067

Pin	Designation	Full Name	OE Pin	Function
A01	AT5	Analogue Temperature Input 5		Exhaust Temperature Sensor
A02	AT6	Analogue Temperature Input 6		Coolant Temperature Sensor
A03	AV15	Analogue Voltage Input 15		
A04	AV16	Analogue Voltage Input 16		
A05	AV17	Analogue Voltage Input 17		
A06	INJ_D1A_NEG	Direct Injector 1A -		Fuel Cylinder 1 Primary Output -
A07	INJ_D1A_POS	Direct Injector 1A +		Fuel Cylinder 1 Primary Output +
A08	INJ_D1B_POS	Direct Injector 1B +		Fuel Cylinder 4 Primary Output +
A09	INJ_D1B_NEG	Direct Injector 1B -		Fuel Cylinder 4 Primary Output -
A10	SEN_5V0_C1	Sensor 5.0V C		
A11	LA_NB1	Lambda Narrow Input 1		
A12	LA_NB2	Lambda Narrow Input 2		
A13	KNOCK3	Knock Input 3		
A14	KNOCK4	Knock Input 4		
A15	DIG2	Digital Input 2		
A16	DIG3	Digital Input 3		
A17	DIG4	Digital Input 4		
A18	SEN_5V0_C2	Sensor 5.0V C		
A19	SEN_5V0_B2	Sensor 5.0V B		Sensor 5V Analogue Signals
A20	LIN	LIN Bus		
A21	RS232_RX	RS232 Receive		
A22	RS232_TX	RS232 Transmit		
A23	DIG1	Digital Input 1		
A24	BAT_NEG3	Battery Negative		Ground
A25	BAT_NEG4	Battery Negative		Ground
A26	SEN_0V_C1	Sensor 0V C		
A27	SEN_0V_C2	Sensor 0V C		
A28	CAN3_HI	CAN Bus 3 High		
A29	CAN3_LO	CAN Bus 3 Low		
A30	CAN2_HI	CAN Bus 2 High		
A31	CAN2_LO	CAN Bus 2 Low		
A32	BAT_NEG5	Battery Negative		Ground
A33	SEN_0V_B1	Sensor 0V B		
A34	SEN_0V_A1	Sensor 0V A		

M142 Connector B – 26 Way

Mating Connector: Tyco Superseal 26 Position Keying 3 – MoTeC #65068

Pin	Designation	Full Name	OE Pin	Function
B01	OUT_HB9	Half Bridge Output 9		EGR Actuator Servo Motor -
B02	OUT_HB10	Half Bridge Output 10		EGR Actuator Servo Motor +
B03	UDIG8	Universal Digital Input 8		
B04	UDIG9	Universal Digital Input 9		
B05	UDIG10	Universal Digital Input 10		Engine Run Switch
B06	UDIG11	Universal Digital Input 11		Airbox Mass Flow Sensor
B07	UDIG12	Universal Digital Input 12		Boost Servo Actuator Position Sensor
B08	INJ_LS5	Low Side Injector 5		
B09	INJ_LS3	Low Side Injector 3		
B10	AV9	Analogue Voltage Input 9		Fuel Primary Pressure Direct Bank 1
B11	AV10	Analogue Voltage Input 10		
B12	AV11	Analogue Voltage Input 11		Engine Oil Pressure Sensor
B13	BAT_POS2	Battery Positive		ECU Battery Voltage
B14	INJ_LS6	Low Side Injector 6		
B15	INJ_LS4	Low Side Injector 4		ECU Power Relay
B16	AV12	Analogue Voltage Input 12		
B17	AV13	Analogue Voltage Input 13		
B18	AV14	Analogue Voltage Input 14		
B19	BAT_POS3	Battery Positive		ECU Battery Voltage
B20	OUT_HB7	Half Bridge Output 7		Throttle Servo Bank 1 Motor -
B21	OUT_HB8	Half Bridge Output 8		Throttle Servo Bank 1 Motor +
B22	INJ_D2A_NEG	Direct Injector 2A -		Fuel Cylinder 2 Primary Output -
B23	INJ_D2A_POS	Direct Injector 2A +		Fuel Cylinder 2 Primary Output +
B24	INJ_D2B_POS	Direct Injector 2B +		
B25	INJ_D2B_NEG	Direct Injector 2B -		
B26	SEN_5V0_A2	Sensor 5.0V A		

M142 Connector C – 34 Way

Mating Connector C: Tyco Superseal 34 Position Keying 1 – MoTeC #65044

Pin	Designation	Full Name	OE Pin	Function
C01	OUT_HB2	Half Bridge Output 2		Fuel Primary Pressure Direct Bank 1 Pump +
C02	SEN_5V0_A1	Sensor 5.0V A		
C03	IGN_LS1	Low Side Ignition 1		
C04	IGN_LS2	Low Side Ignition 2		
C05	IGN_LS3	Low Side Ignition 3		
C06	IGN_LS4	Low Side Ignition 4		
C07	IGN_LS5	Low Side Ignition 5		Ignition Cylinder 1 (Timing Light Output)
C08	IGN_LS6	Low Side Ignition 6		
C09	SEN_5V0_B1	Sensor 5.0V B		Sensor 5V Analogue Signals
C10	BAT_NEG1	Battery Negative		Ground
C11	BAT_NEG2	Battery Negative		Ground
C12	IGN_LS7	Low Side Ignition 7		
C13	IGN_LS8	Low Side Ignition 8		
C14	AV1	Analogue Voltage Input 1		Throttle Pedal Sensor Main
C15	AV2	Analogue Voltage Input 2		Throttle Pedal Sensor Tracking
C16	AV3	Analogue Voltage Input 3		
C17	AV4	Analogue Voltage Input 4		
C18	OUT_HB1	Half Bridge Output 1		Fuel Primary Pressure Direct Bank 1 Pump -
C19	INJ_D3A_POS	Direct Injector 3A +		Fuel Cylinder 3 Primary Output +
C20	INJ_D3B_POS	Direct Injector 3B +		
C21	INJ_D4A_POS	Direct Injector 4A +		
C22	INJ_D4B_POS	Direct Injector 4B +		
C23	INJ_LS1	Low Side Injector 1		
C24	INJ_LS2	Low Side Injector 2		
C25	AV5	Analogue Voltage Input 5		
C26	BAT_POS1	Battery Positive		ECU Battery Voltage
C27	INJ_D3A_NEG	Direct Injector 3A -		Fuel Cylinder 3 Primary Output -
C28	INJ_D3B_NEG	Direct Injector 3B -		
C29	INJ_D4A_NEG	Direct Injector 4A -		
C30	INJ_D4B_NEG	Direct Injector 4B -		
C31	OUT_HB3	Half Bridge Output 3		Fuel Pump Primary
C32	OUT_HB4	Half Bridge Output 4		
C33	OUT_HB5	Half Bridge Output 5		Boost Servo Actuator Motor -
C34	OUT_HB6	Half Bridge Output 6		Boost Servo Actuator Motor +

M142 Connector D – 26 Way

Mating Connector D: Tyco Superseal 26 Position Keying 1 – MoTeC #65045

Pin	Designation	Full Name	OE Pin	Function
D01	UDIG1	Universal Digital Input 1		Engine Speed Sensor
D02	UDIG2	Universal Digital Input 2		Inlet Camshaft Position Sensor
D03	AT1	Analogue Temperature Input 1		
D04	AT2	Analogue Temperature Input 2		Inlet Air Temperature Sensor
D05	AT3	Analogue Temperature Input 3		Fuel Primary Temperature Sensor
D06	AT4	Analogue Temperature Input 4		
D07	KNOCK1	Knock Input 1		
D08	UDIG3	Universal Digital Input 3		
D09	UDIG4	Universal Digital Input 4		
D10	UDIG5	Universal Digital Input 5		
D11	UDIG6	Universal Digital Input 6		Throttle Servo Bank 1 Position Sensor
D12	BAT_BAK	Battery Backup		
D13	KNOCK2	Knock Input 2		
D14	UDIG7	Universal Digital Input 7		
D15	SEN_0V_A2	Sensor 0V A		Sensor 0V for digital signals
D16	SEN_0V_B2	Sensor 0V B		Sensor 0V for digital signals
D17	CAN1_HI	CAN Bus 1 High		MoTeC 1 Mbit/sec CAN
D18	CAN1_LO	CAN Bus 1 Low		MoTeC 1 Mbit/sec CAN
D19	SEN_6V3	Sensor 6.3V		
D20	AV6	Analogue Voltage Input 6		EGR Actuator Servo Position Sensor
D21	AV7	Analogue Voltage Input 7		
D22	AV8	Analogue Voltage Input 8		Inlet Manifold Pressure Sensor
D23	ETH_TX+	Ethernet Transmit +	Ethernet Green/White	
D24	ETH_TX-	Ethernet Transmit -	Ethernet Green	
D25	ETH_RX+	Ethernet Receive +	Ethernet Orange/White	
D26	ETH_RX-	Ethernet Receive -	Ethernet Orange	