

# MoTeC

## M1 LICENCE - GPRP PRO



**GPRP Pro is a sophisticated engine control Package centred around calculating and controlling engine torque via throttle opening and ignition control.**

Built with race functionality and Paddle Shift Gearbox Control, this Package includes all the key characteristics of MoTeC's GPRP Package, plus Torque Control, Dual Plenum Fuelling and much more.

Cutting edge features that improve engine performance, driver consistency and tuning simplicity are combined to make a Package suitable for the highest levels of professional motorsport.

A GPRP Pro ECU fully integrates with other MoTeC products and provides pre-defined CAN messaging for current Displays, Loggers, E888, Video Capture Systems, GPS, ADRs, BR2, PDMs, SLMs and Keypads.

### ► ECU VARIANTS

The GPRP Pro Package is available for use with MoTeC's M150 and M190 ECUs. A pinout example for the M150 follows.

A separate Package, GPRP-DI Pro (Part# 23667), supports MoTeC's M142 and M182 Direct Injection ECUs.

### ► PRO SPECIFIC FEATURES

The GPRP Pro Package is based on MoTeC's GPRP Package with the addition of the following features:

- Torque Based Throttle Control used throughout the Package:
  - Ignition Retard and Cut are also used for torque reductions. These are blended with the Throttle Based Control for fast response and seamless transitions;
  - Torque is relevant to vehicle acceleration for improved Traction Control;
  - Much faster control response and more accurate than Boost Control;
  - Improved drivability with a torque based throttle pedal and seamless transition between Throttle, Overrun and Idle Control;
- Torque Limits based on Engine Speed, Vehicle Speed, Gear, Wheel Torque, Race Time, Fuel Composition and many more.
- Traction Control:
  - Controls front to rear wheel slip, closed loop to an aim value;
  - Torque reduction by Throttle Control, Ignition Timing or Cut for fast response;
  - Tuneable and dynamically adjustable aim slip;
  - Option to limit slip to the fastest driven wheel.
- Traction Model system:
  - Controls the maximum wheel torque via Throttle Control;
  - Dynamically adjustable for downforce, G force (lateral and vertical) and weight transfer.
  - This open loop system works in conjunction with the closed loop slip based control.
- Torque Limit Response system, to help improve throttle based torque limiting (e.g. for Traction Control).
- Paddle Shift Gearbox Control for sequential gearboxes:
  - Supply pump support with soft start;
  - Rev matching using retard or cut;
  - Shift error detection and automatic retry;
  - Automatic gear shifting, tuneable for road, race and drag;
  - Auto gear shift at rev limiter.
- Flex Fuel and Dual Fuel Control:
  - Model based fuel type selection, reduces tuning time;
  - Comprehensive tuneability improvements;
  - Ethanol sensor support;
  - Dual Fuel - change contribution with a driver switch;
  - Flex Fuel - vary secondary injector contribution based on fuel composition;
  - Alternative Fuel Engine Load Average - allows higher limits and different trims on E85.

- Boost Control for Dual Banks:
  - Two separate closed loop control systems with respective Boost Control solenoid outputs and boost pressure sensors.
  - Comprehensive tuning including influences for barometric pressure and gear;
  - Allows for multiple intercooler configurations including water-to-air with pump and fan control;
  - Integrates with the Torque Control system.
- Boost Servo Control
  - Controls dual servo operated wastegates or blow-off valves;
  - Multiple sources for aim position;
  - Use for Boost Control, blow-off valve or turbo surge prevention.
- Dual Bank Fuelling:
  - Dual plenum with or without balance pipe (calculates cross flow);
  - Each bank can be fuelled from its respective set of sensors: MAF, Boost, MAP, TP, AT.
- Improved Tuning Tools:
  - Set an Inlet Manifold Pressure limit for fine tuning Engine Efficiency;
  - Set a Throttle servo aim limit for tuning Throttle Area;
  - Boost Control bank copy Q functions. Tune one bank and copy to the other for convenience.
- Fallback and Limp Home Strategies:
  - Redundant sensor support; if one sensor fails (e.g. MAP) the other bank's sensor is automatically substituted;
  - Redundant crank position sensor;
  - Most critical sensors have a fallback strategy.
- Vehicle Speed measurement using a combination of wheel speed sensors, engine speed and gear, acceleration limits and GPS.
- Throttle Pedal:
  - Translation table to change pedal feel, linked to driver switch;
  - Commanding engine torque for improved consistency;
  - Absolute or relative torque modes;
  - Pedal damper for improved control at light loads.
- Vehicle Pitch Control to prevent wheel stands on drag cars.
- Bank crossing exhaust manifolds supported (for dual bank closed loop lambda).
- Multi level warning system.
- Clutch Slip Control for protection, or maximising clutch performance.
- Custom CAN Transmit (4 messages).
- Cruise Control with speed limiter and preset speed functions.
- Wheel circumference driver setting with 10 positions.
- Water to air intercooler controls, pump, fan and sensors.
- Camshaft Aim Position overrides for fast boost building (Launch and Anti Lag).
- Fuel Pump Control for multiple PWM pumps.
- Anti Lag System:
  - Controls Ignition Timing, Fuel Volume, Ignition Cut, Engine Speed Limit, Boost Aim and Torque (opens throttle);
  - Setup for Circuit, Rally or Roll Racing (rolling launch);
  - Basic 'Flames' feature.
- Engine Oil Level sensor with warning.
- Improvements to CPU usage.
- Vehicle Roll Rate, Vehicle Pitch Rate and Vehicle Pitch Angle sensor inputs.
- Driver Switch improvements including Combine and Counter Switches.
- Overrun Fuel Cut Integrated with Torque Control:
  - Sets a minimum throttle opening;
  - Controls torque via Ignition Timing once at the minimum throttle opening;
  - Tuneable amount of fuel cut and/or ignition cut.
- BOV activation for overboost.
- Oil Pressure closed loop control.
- Standardise PWM Outputs:
  - A table is used to set the final output duty cycle. This replaces Drive, Polarity and Min/Max settings.
  - Increases flexibility and enables actuator non-linearity correction.
- Exhaust Lambda Unavailable Fuel Volume Trim.
- Piston cooling/squirter control.
- Muffler Flap Control.
- Fuel Purge (charcoal canister) Control.
- Idle Control blends Ignition Timing and Throttle Control.
- Knock Control:
  - Single knock event rejection;
  - Ignition Retard, Fuel Addition and Ignition Cut based Control;
  - Ignition retard limit mapped to Engine Speed and Load.
- Takeoff Assistant for high response engines and light or button clutch:
  - Controls engine speed based on throttle pedal position;
  - Can be used as a mild Launch Control.
- Transfer Clutch Control (AWD):
  - Closed loop current or hydraulic pressure control;
  - Accumulator pressure and pump control;
  - Accelerating, braking and wheel slip based control.
- Coolant thermostat servo.
- Dual Boost Servo Control with zero tracking and fault handling.

## ► GPRP FEATURES

The following features from MoTeC's GPRP Package are maintained in the GPRP Pro Package:

- Operates Port Injected engines from 1 to 12 cylinders.
- Throttle Servo Control for dual banks.
- Auxiliary Inputs 1 to 4 - unitless sensor inputs for logging only.
- Brake Vacuum Pressure and Pump Control.
- Nitrous Control:
  - For wet or dry nitrous oxide systems;
  - Two stage with multiple trigger conditions and time limits;
  - Nitrous transport delay for dry systems;
  - Fuel pump triggers.
- Lambda Sensor Control with additional LTC module/s, banks and cylinders.
- Fuel Closed Loop Mixture Control for dual banks.
- Communications for External Devices:
  - MoTeC - ADRs, E8XXs, PDMs, SLMs, Video Capture Systems, Keypads, C1xx and D1xx Displays/Loggers.
  - Other - GPS (RS232 or CAN), Bosch M4/M5 ABS, Bosch MM5.10 G/yaw sensor, ID fuel pump controller.
- Thermocouple inputs via TCA Thermocouple Amplifier or up to 8 via E888 module.
- Injector outputs for 2 injectors per cylinder. Up to 24 individual injectors (hardware dependant).
- Tuneable balance table, injection timing.
- Comprehensive blending and transport delay compensations for secondary injectors.
- Ignition output pin for each cylinder (coil on plug).
- Engine physical settings for fast setup and minor re-tuning for many modifications.
- Engine pumping efficiency, air flow and load modelling based on inlet manifold pressure.
- Sensor calibrations available for many common automotive sensors.
- Transient fuelling compensation using physical modelling of fuel film remaining in the inlet manifold.
- Test settings for most outputs, including injection and ignition outputs, for easier setup.
- Wastegate Pressure Closed Loop Control, e.g. for CO2 systems.
- Turbocharger Bypass Valve Control (electric blow-off valve).
- Air Conditioner Control:
  - Conditional clutch activation;
  - Fan control.
- Coolant Temperature compensations for Engine Speed Limit, Ignition Timing, Fuel Mixture and Boost Limit.
- Coolant Pump output with PWM Control.
- Coolant Pump After Run functionality, optionally with additional pump output.
- Engine Speed Limiting with ignition cut and/or fuel cut.
- Fuel Flow Supply and Fuel Flow Return sensor inputs.
- Intercooler Temperature and Spray Control.
- Differential Oil Temperature Control with dedicated temperature sensor and pump output.
- Engine Charge air 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.
- Race Time System:
  - Trim tables for Ignition Timing, Fuel Mixture, Boost Limit and Torque Limit;
  - Integrates with Launch and Traction Control.
- Engine Load Average, allows trims to be applied with persistent high engine load.
- Dedicated Fuel, Ignition and Throttle setting for cranking and post start.
- Alternator Closed Loop Control.
- Engine Hours, Odometer and Trip Meter.
- Configurable security for multiple users.
- Brake State configuration using a switch or a pressure sensor.
- ECU CAN receive from a defined CAN ID for data reception from MoTeC devices. Support of 3 CAN buses.
- ECU CAN transmit of the most common channels using standard MoTeC CAN templates, ideal for MoTeC Displays.
- Auxiliary Time system with tables for Ignition Timing Compensation, Fuel Volume Trim and Fuel Mixture Aim.
- Auxiliary Outputs x 5, for PWM control of added actuators:
  - Duty cycle tables using Engine Speed and Throttle or Manifold Pressure axis;
  - Activation based on inlet manifold pressure or throttle position;
  - Auxiliary Output 1 and 5 include tables for Ignition Timing Compensation, Fuel Volume Trim and Fuel Mixture Aim;
  - Auxiliary Output 5 includes external sensor input.
- Turbo Speed limiting.
- Transmission Pump output with Transmission Temperature threshold and Hysteresis Control.
- Optional channels for additional sensors via input pin and/or CAN message, including:
  - Auxiliary Fuel Pressure;
  - Airbox Mass Flow, Pressure and Temperature;
  - Ambient Temperature;
  - Brake Pressure Front and Rear;
  - Brake Switch;
  - Coolant Pressure and Temperature;

- Engine Oil Pressure and Temperature;
- Engine Crankcase Pressure;
- Exhaust Pressure Bank 1 and Bank 2;
- Exhaust Temperature (EGT) Bank 1 and 2 Collector, and Cylinders 1 to 12;
- Exhaust Lambda via LTC, LTCN or PLM for Bank 1 and 2 Collector, and Cylinders 1 to 12;
- Fuel Pressure and Temperature;
- Fuel Tank Level;
- Gear Neutral Switch;
- Gear Shift Request;
- Intercooler Temperature;
- Steering Angle and Pressure;
- Transmission Pressure and Temperature;
- Turbocharger Speed;
- Turbocharger Inlet/Outlet Temperature;
- Turbocharger Wastegate Position;
- Vehicle Acceleration (G-Force) – Longitudinal, Lateral, Vertical;
- Vehicle Yaw, Pitch and Roll rate;
- Wheel Speed sensors front/rear left/right.

## ► ENGINE COMPATIBILITY

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Engines with the following features are **not** supported;

- Cable actuated throttle. Since the Torque Control requires control of the throttle, all throttles must be electronically controlled by the M1 (Drive By Wire).
- Throttle based fuel tuning. While the Package can be configured to be throttle based, a MAP or MAF sensor is required for initial tuning.
- Rotary Engines.
- Variable Valve Lift. Variable Valve Timing is supported.
- Direct Injection. Direct Injected engines are supported by GPRP-DI Pro (Part# 23667).

## Sensor Requirements

The following engine sensors are required to run this Package:

- Engine Speed Reference Sensor
- Camshaft Position Sensor
- Inlet Air Temperature Sensor
- Inlet Manifold Pressure Sensor
- Throttle Pedal Sensor
- Throttle Servo Position Sensors
- Boost Pressure Sensor (Boosted engines only)
- Gear Position Sensor (if Gear Shift system is used)

For optimal performance the following sensors are also recommended:

- Coolant Temperature Sensor
- Fuel Pressure Sensor
- Fuel Temperature Sensor
- Clutch Switch, Pressure or Position (if Gear Shift system is used)
- Wheel Speed Sensors (if Traction or Launch systems are used)

## ► ENGINE SPEED MODES

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See M1 Tune Help for the current list of selectable Engine Speed Modes.

Download M1 Tune here:

<https://www.motec.com.au/software/latestreleases/>

## ▶ EXAMPLE PINOUT

**M150 Connector A - 34 Way**

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

Pin	Designation	Full Name	Description
A01	AT5	Analogue Temperature Input 5	Fuel Temperature Sensor
A02	AT6	Analogue Temperature Input 6	
A03	AV15	Analogue Voltage Input 15	Gear Position Sensor Main
A04	AV16	Analogue Voltage Input 16	Driver Rotary Switch 2
A05	AV17	Analogue Voltage Input 17	Driver Rotary Switch 3
A06	IGN_LS9	Low Side Ignition 9	
A07	IGN_LS10	Low Side Ignition 10	
A08	IGN_LS11	Low Side Ignition 11	
A09	IGN_LS12	Low Side Ignition 12	
A10	SEN_5V0_C1	Sensor 5.0V C	Sensor 5V Supply
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	Sensor 5V Supply
A19	SEN_5V0_B2	Sensor 5.0V B	Sensor 5V Supply
A20	LIN	LIN Bus	
A21	RS232_RX	RS232 Receive	
A22	RS232_TX	RS232 Transmit	
A23	DIG1	Digital Input 1	Clutch Switch
A24	BAT_NEG3	Battery Negative	Chassis Ground
A25	BAT_NEG4	Battery Negative	Chassis Ground
A26	SEN_0V_C1	Sensor 0V C	Sensor 0V Supply
A27	SEN_0V_C2	Sensor 0V C	Sensor 0V Supply
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	Chassis Ground
A33	SEN_0V_B1	Sensor 0V B	Sensor 0V Supply
A34	SEN_0V_A1	Sensor 0V A	Sensor 0V Supply

**M150 Connector B - 26 Way**

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

Pin	Designation	Full Name	Description
B01	OUT_HB9	Half Bridge Output 9	Gear Shift Actuator Up
B02	OUT_HB10	Half Bridge Output 10	Gear Shift Actuator Down
B03	UDIG8	Universal Digital Input 8	Driver Switch 3
B04	UDIG9	Universal Digital Input 9	Driver Switch 2
B05	UDIG10	Universal Digital Input 10	
B06	UDIG11	Universal Digital Input 11	
B07	UDIG12	Universal Digital Input 12	
B08	INJ_LS5	Low Side Injector 5	
B09	INJ_LS3	Low Side Injector 3	
B10	AV9	Analogue Voltage Input 9	Fuel Pressure Sensor
B11	AV10	Analogue Voltage Input 10	
B12	AV11	Analogue Voltage Input 11	Ambient Pressure Sensor
B13	BAT_POS	Battery Positive	Ignition Power
B14	INJ_LS6	Low Side Injector 6	
B15	INJ_LS4	Low Side Injector 4	
B16	AV12	Analogue Voltage Input 12	Gear Shift Actuator Pressure Sensor
B17	AV13	Analogue Voltage Input 13	Driver Rotary Switch 1
B18	AV14	Analogue Voltage Input 14	Boost Pressure Bank 1 Sensor
B19	BAT_POS	Battery Positive	Ignition Power
B20	OUT_HB7	Half Bridge Output 7	Throttle Servo Bank 1 Motor Output
B21	OUT_HB8	Half Bridge Output 8	Throttle Servo Bank 1 Motor Output
B22	INJ_PH9	Peak Hold Injector 9	
B23	INJ_PH10	Peak Hold Injector 10	
B24	INJ_PH11	Peak Hold Injector 11	
B25	INJ_PH12	Peak Hold Injector 12	
B26	SEN_5V0_A	Sensor 5.0V A	Sensor 5V Supply

**M150 Connector C - 34 Way**

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

Pin	Designation	Full Name	Description
C01	OUT_HB2	Half Bridge Output 2	
C02	SEN_5V0_A	Sensor 5.0V A	Sensor 5V Supply
C03	IGN_LS1	Low Side Ignition 1	Ignition Cylinder 1 Output
C04	IGN_LS2	Low Side Ignition 2	Ignition Cylinder 2 Output
C05	IGN_LS3	Low Side Ignition 3	Ignition Cylinder 3 Output
C06	IGN_LS4	Low Side Ignition 4	Ignition Cylinder 4 Output
C07	IGN_LS5	Low Side Ignition 5	Ignition Cylinder 5 Output
C08	IGN_LS6	Low Side Ignition 6	Ignition Cylinder 6 Output
C09	SEN_5V0_B	Sensor 5.0V B	Sensor 5V Supply
C10	BAT_NEG1	Battery Negative	Chassis Ground
C11	BAT_NEG2	Battery Negative	Chassis Ground
C12	IGN_LS7	Low Side Ignition 7	
C13	IGN_LS8	Low Side Ignition 8	
C14	AV1	Analogue Voltage Input 1	Throttle Servo Bank 1 Position Sensor Tracking
C15	AV2	Analogue Voltage Input 2	Inlet Manifold Pressure Bank 1 Sensor
C16	AV3	Analogue Voltage Input 3	Throttle Pedal Sensor Tracking
C17	AV4	Analogue Voltage Input 4	Throttle Pedal Sensor Main
C18	OUT_HB1	Half Bridge Output 1	
C19	INJ_PH1	Peak Hold Injector 1	Fuel Cylinder 1 Primary Output
C20	INJ_PH2	Peak Hold Injector 2	Fuel Cylinder 2 Primary Output
C21	INJ_PH3	Peak Hold Injector 3	Fuel Cylinder 3 Primary Output
C22	INJ_PH4	Peak Hold Injector 4	Fuel Cylinder 4 Primary Output
C23	INJ_LS1	Low Side Injector 1	Boost Actuator Bank 1 Output
C24	INJ_LS2	Low Side Injector 2	Boost Actuator Bank 2 Output
C25	AV5	Analogue Voltage Input 5	Throttle Servo Bank 1 Position Sensor Main
C26	BAT_POS	Battery Positive	Ignition Power
C27	INJ_PH5	Peak Hold Injector 5	Fuel Cylinder 5 Primary Output
C28	INJ_PH6	Peak Hold Injector 6	Fuel Cylinder 6 Primary Output
C29	INJ_PH7	Peak Hold Injector 7	
C30	INJ_PH8	Peak Hold Injector 8	
C31	OUT_HB3	Half Bridge Output 3	Inlet Camshaft Bank 1 Actuator Output
C32	OUT_HB4	Half Bridge Output 4	Inlet Camshaft Bank 2 Actuator Output
C33	OUT_HB5	Half Bridge Output 5	Exhaust Camshaft Bank 1 Actuator Output
C34	OUT_HB6	Half Bridge Output 6	Exhaust Camshaft Bank 2 Actuator Output

**M150 Connector D — 26 way**

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

Pin	Designation	Full Name	Description
D01	UDIG1	Universal Digital Input 1	Engine Speed Reference
D02	UDIG2	Universal Digital Input 2	
D03	AT1	Analogue Temperature Input 1	Coolant Temperature Sensor
D04	AT2	Analogue Temperature Input 2	Engine Oil Temperature Sensor
D05	AT3	Analogue Temperature Input 3	Inlet Air Temperature Bank 1 Sensor
D06	AT4	Analogue Temperature Input 4	Differential Temperature Sensor
D07	KNOCK1	Knock Input 1	Knock Cylinder 1, 2, 3
D08	UDIG3	Universal Digital Input 3	Inlet Camshaft Bank 1 Position
D09	UDIG4	Universal Digital Input 4	Exhaust Camshaft Bank 1 Position
D10	UDIG5	Universal Digital Input 5	Inlet Camshaft Bank 2 Position
D11	UDIG6	Universal Digital Input 6	Exhaust Camshaft Bank 2 Position
D12	BAT_BAK	Battery Backup	Permanent Power
D13	KNOCK2	Knock Input 2	Knock Cylinder 4, 5, 6
D14	UDIG7	Universal Digital Input 7	
D15	SEN_0V_A	Sensor 0V A	Sensor 0V Supply
D16	SEN_0V_B	Sensor 0V B	Sensor 0V Supply
D17	CAN1_HI	CAN Bus 1 High	
D18	CAN1_LO	CAN Bus 1 Low	
D19	SEN_6V3	Sensor 6.3V	
D20	AV6	Analogue Voltage Input 6	Gear Position Sensor Tracking
D21	AV7	Analogue Voltage Input 7	Engine Oil Pressure Sensor
D22	AV8	Analogue Voltage Input 8	Transmission Temperature 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