



# M1 GPRP ROTARY PACKAGE (PADDLE SHIFT)



**MoTeC's GPRP Rotary Package maintains all the functionality of the GPR Rotary Package with the inclusion of paddle shift gearbox control using switched actuators.**

**This single product can be configured over a huge range of rotary engine configurations, from controlling a simple, naturally aspirated 13B to a multi-throttle, boosted quad rotor with three injectors per rotor.**

**This Package also includes vehicle integration for modern rotaries such as the Mazda RX7 and RX8.**

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

The product 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 available on request.

## ► LICENSING

To load the Package onto an M1 ECU, MoTeC's **M1 GPRP ROTARY PACKAGE** (part number 23347) is required.

## ► ECU VARIANTS

The Package is available for use with MoTeC's M130, M150, M170 and M190 ECUs. A pin-out example for the M130 follows.

## ► VEHICLE COMPATIBILITY

This product also includes CAN messaging for OE vehicle integration with the Mazda RX8. This enables OE vehicle systems such as power steering, ABS, TPMS, transmission and instrument cluster information.

## ► ROTARY SPECIFIC FEATURES

The GPRP Rotary Package is based on MoTeC's GPRP Package with the addition of the following rotary engine-specific features:

- Operates port injected rotary engines from 1 to 4 rotors.
- Configurable engine synchronisation modes for common rotary engines. Refer to the Engine Speed Modes section for details.
- Configurable leading and trailing ignition outputs for each rotor. The trailing ignition timing can be defined as either an angle relative to the leading ignition (i.e. split angle) or TDC.
- Configurable on-board knock detection for each rotor with up to two assignable knock sensors and 4 selectable centre frequencies.
- Control of up to three injectors per rotor with user definable tables to control the fuel contribution of each injector.
- Coolant and engine oil temperature compensations for engine speed limiting, ignition timing, fuel volume and boost limiting.
- Supports control of a Sequential Shutter Valve with fuel injector integration as found on the Mazda RX8.
- Supports control of VFAD, VDI and APV inlet manifold valves found on Mazda rotaries.

- Diagnostic checking of SSV, VFAD, VDI and APV valves via feedback position sensors.
- User configurable engine efficiency table with adjustments based on the state of the SSV, VFAD, VDI and APV valves.
- Supports control of a stepper motor-based Metering Oil Pump. This includes diagnostics and a warning system to detect if there is a failure of the components.
- Supports dual speed cooling fans via three relay outputs, as found on Mazda rotaries.
- Cruise Control for DBW equipped vehicles.
- CAN Integration, for the Mazda RX8, to enable the operation of the power steering, transmission and ABS. Wheel speeds, steering angle, fuel tank level, tyre pressure monitoring and park brake data are also received from the CAN bus for use in the ECU.

## ► GPRP FEATURES

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

- Closed loop lambda control support; requires optional LTC with Bosch LSU4.9 sensor or LTCN with NTK sensor.
- Paddle shift gearbox control for sequential gearboxes with switched actuators and air pump support.
- Physical settings for engine displacement, fuel properties, and injector characteristics allow for simplified engine start-up prior to tuning.
- Fast and easy engine tuning using engine efficiency map.
- Engine load modelling based on inlet manifold pressure and inlet manifold temperature. Alternatively, for example, when using individual throttle bodies, throttle position can be used.
- Fuel volume calculation considers delay effects resulting from the secondary (high) injector installation position.
- 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.
- Transient fuelling compensation using physical modelling of fuel film.
- Nitrous system with two activation stages and additional fuel pumps, bottle heater control and pressure sensor.
- Transmission brake control ('bump') functionality for perfect positioning of cars.
- Support of MoTeC devices: ADR, E8XX, PDM, SLM, VCS.
- Test settings for most outputs, including injection and ignition outputs, to allow for easier setup.
- Turbocharger wastegate pressure control with pressure sensor and two PWM outputs.
- Configurable boost control with a single wastegate actuator. Single and dual solenoids supported.
- Configurable turbocharger bypass (blow off) control.
- Configurable anti-lag for single turbo with ignition timing limit, fuel volume trim, ignition cut, engine speed limit, boost aim and throttle aim tables.
- 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.
- Coolant temperature compensations for engine speed limit, ignition timing, fuel volume, fuel mixture, 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 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.
- Paddle shift input hard wired or via CAN, optional linear sensor.
- Optional gearbox shift request via Up shift Switch / Down Shift Switch or Gear Lever Force sensor.
- Gearbox shift support with ignition cut, fuel cut, throttle blip and engine speed matching in forward gears.
- Up/Down actuator control, with preload times preceding the shifts and hold time to safely engage gears.
- Minimum/Maximum blip time on downshifts configurable.
- Different gear shift modes: manual, automatic, fault modes, switch selection only, disabled.
- GPS acquisition and logging via CAN or RS232.
- 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 ignition timing trim, fuel mixture aim, boost limit and throttle limit.
- Engine idle closed loop control system using ignition, drive by wire actuation or idle solenoid.
- Idle bypass control with stepper motor supported.

- Engine Load Average channel with tables for engine speed limit, ignition timing trim, fuel mixture aim, boost limit and throttle limit.
- Inlet Manifold Flap support (actuator with position).
- Inlet Manifold Runner support (actuator with position feedback).
- Assisted engine start control with dedicated fuel volume 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.
- Calculation of clutch slip.
- 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) with each of 10 positions simultaneously mappable to Launch Control, Pit Switch, Anti-Lag, Traction, Race Time Reset, Engine Speed Limit Maximum, Throttle Pedal Translation, Ignition Timing, Fuel Mixture Aim, Boost Limit, Traction Aim and Traction Control Range.
- 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 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 (DBW throttle-based), which can also be used for pit speed limiting.
- Configurable warning system with light and CAN output.
- Auxiliary time system with tables for ignition timing compensation, fuel volume trim and fuel mixture aim.
- 4 auxiliary outputs for PWM control of added actuators:
  - Duty cycle tables using Engine Speed and Throttle or Manifold Pressure Axes.
  - Activation based on Inlet Manifold Pressure or Throttle Position.
  - Auxiliary Output 1 includes tables for Ignition Timing Compensation, Fuel Volume Trim and Mixture Aim.
- Optional channels for additional sensors via input pin and/or CAN message, including:
  - Airbox Mass Flow, Pressure and Temperature
  - Ambient Pressure and Temperature
  - Boost Pressure
  - Brake Pressure Front and Rear
  - Brake Switch
  - 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 Rotors 1 to 4.
  - Exhaust Lambda via LTC, LTCN, or PLM for a single Collector, Bank 1 and 2 Collectors, and Rotors 1 to 4.
  - Fuel Pressure and Temperature
  - Fuel Tank Level
  - Gear Position
  - Gear Lever Force
  - Gear Neutral Switch
  - Gear Shift Request (Lever or Paddles)
  - 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
  - G-Force (acceleration) – Longitudinal, Lateral, Vertical
  - Wheel Speed sensors front/rear left/right, wired or CAN input

## ▶ ENGINE COMPATIBILITY

This product is suitable for one, two, three or four rotor engines with port injectors.

### Known OE engines that are suitable:

Engine Family	Engine Designation	Year	Vehicle Platform	Comment
Mazda 12A	10A			See Note 1
Mazda 12A	10B			See Note 1
Mazda 12A	12A			See Note 1
Mazda 12A	12A Turbo	1984-1985 1982-1989 1982-1985	RX7 Cosmo Luce	See Note 1
Mazda 12A	13A			See Note 1
Mazda 13B	13B			See Note 1
Mazda 13B	13B-RESI	1984-1985 1984-1985 1984-1985	RX7 FB Cosmo HB Luce HB	See Note 1
Mazda 13B	13B-DEI	1986-1988 1989-1991	RX7 FC3S S4 RX7 FC3S S5	See Note 1
Mazda 13B	13B-T	1986-1988 1989-1991 1986-1991	RX7 FC3S S4 RX7 FC3S S5 Luce HC	See Note 1
Mazda 13B	13B-MSP Rensis (Standard)	2003-2007	RX8 Gen 1	4-Port Intake System
Mazda 13B	13B-MSP Rensis (High Power)	2003-2007	RX8 Gen 1	6-Port Intake System
Mazda 20B	20B			See Note 1

**Note 1:** All variants of this engine can be run provided they meet the following criteria (from factory or modified):

- Fitted with an engine speed reference sensor that matches one of the Engine Speed Modes listed.
- Individual coil for each spark plug.
- Is not fitted with a twin sequential turbocharger.

### Known OE engines that are not suitable:

Engine Family	Engine Designation	Year	Vehicle Platform	Not Applicable Because
Mazda 13B	13B-RE	1990-1995	Eunos Cosmo	Sequential Turbocharger*
Mazda 13B	13B-REW	1992-2002	RX7 FD	Sequential Turbocharger*
Mazda 13B	13B-MSP Rensis	2008-2012	RX8 Gen 2	Metering Oil Pump**

\*The GPR Rotary Package can be used to run this engine if a single turbocharger is fitted.

\*\*The GPR Rotary Package can be used to run this engine if control of the metering oil pump is not required.

## ▶ ENGINE SPEED MODES

This Package currently supports the following engine speed reference modes:

- Crankshaft One Missing Tooth
- Crankshaft Two Missing Teeth
- Multi Tooth
- Mazda RX8 - Mazda Rensis 13B-MSP

## ▶ EXAMPLE M130 PINOUT

**PINOUT - M130 CONNECTOR A - 34 WAY**

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

Pin	Designation	Full Name	OE Pin	Description
A01	OUT_HB2	Half Bridge Output 2		Fuel Pump
A02	SEN_5V0_A	Sensor 5.0V A		Sensor 5V Analogue Signals
A03	IGN_LS1	Low Side Ignition 1		Ignition Rotor 1 Leading Output
A04	IGN_LS2	Low Side Ignition 2		Ignition Rotor 2 Leading Output
A05	IGN_LS3	Low Side Ignition 3		Ignition Rotor 1 Trailing Output
A06	IGN_LS4	Low Side Ignition 4		Ignition Rotor 2 Trailing Output
A07	IGN_LS5	Low Side Ignition 5		
A08	IGN_LS6	Low Side Ignition 6		
A09	SEN_5V0_B1	Sensor 5.0V B		Sensor 5V Analogue Signals
A10	BAT_NEG1	Battery Negative		Ground
A11	BAT_NEG2	Battery Negative		Ground
A12	IGN_LS7	Low Side Ignition 7		
A13	IGN_LS8	Low Side Ignition 8		
A14	AV1	Analogue Voltage Input 1		Throttle Position Sensor
A15	AV2	Analogue Voltage Input 2		Airbox Pressure Sensor
A16	AV3	Analogue Voltage Input 3		Fuel Pressure Sensor
A17	AV4	Analogue Voltage Input 4		Engine Oil Pressure
A18	OUT_HB1	Half Bridge Output 1		
A19	INJ_PH1	Peak Hold Injector 1		Fuel Rotor 1 Primary
A20	INJ_PH2	Peak Hold Injector 2		Fuel Rotor 2 Primary
A21	INJ_PH3	Peak Hold Injector 3		Fuel Rotor 1 Secondary
A22	INJ_PH4	Peak Hold Injector 4		Fuel Rotor 2 Secondary
A23	INJ_LS1	Low Side Injector 1		
A24	INJ_LS2	Low Side Injector 2		
A25	AV5	Analogue Voltage Input 5		
A26	BAT_POS1	Battery Positive		ECU Battery Voltage
A27	INJ_PH5	Peak Hold Injector 5		
A28	INJ_PH6	Peak Hold Injector 6		
A29	INJ_PH7	Peak Hold Injector 7		
A30	INJ_PH8	Peak Hold Injector 8		
A31	OUT_HB3	Half Bridge Output 3		Gear Shift Actuator Up
A32	OUT_HB4	Half Bridge Output 4		Gear Shift Actuator Down
A33	OUT_HB5	Half Bridge Output 5		
A34	OUT_HB6	Half Bridge Output 6		

**PINOUT - M130 CONNECTOR B - 26 WAY**

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

Pin	Designation	Full Name	OE Pin	Function
B01	UDIG1	Universal Digital Input 1		Engine Speed Sensor
B02	UDIG2	Universal Digital Input 2		Engine Synchronisation Sensor
B03	AT1	Analogue Temperature Input 1		Inlet Air Temperature Sensor
B04	AT2	Analogue Temperature Input 2		Coolant Temperature Sensor
B05	AT3	Analogue Temperature Input 3		
B06	AT4	Analogue Temperature Input 4		
B07	KNOCK1	Knock Input 1		
B08	UDIG3	Universal Digital Input 3		
B09	UDIG4	Universal Digital Input 4		
B10	UDIG5	Universal Digital Input 5		
B11	UDIG6	Universal Digital Input 6		Paddle Up*
B12	BAT_BAK	Battery Backup		
B13	KNOCK2	Knock Input 2		
B14	UDIG7	Universal Digital Input 7		Paddle Down*
B15	SEN_0V_A2	Sensor 0V A		Sensor 0V for Digital Signals
B16	SEN_0V_B2	Sensor 0V B		Sensor 0V for Digital Signals
B17	CAN1_HI	CAN Bus 1 High		MoTeC 1 Mbit/sec CAN
B18	CAN1_LO	CAN Bus 1 Low		MoTeC 1 Mbit/sec CAN
B19	SEN_6V3	Sensor 6.3V		
B20	AV6	Analogue Voltage Input 6		
B21	AV7	Analogue Voltage Input 7		
B22	AV8	Analogue Voltage Input 8		
B23	ETH_TX+	Ethernet Transmit +	Ethernet Green/White	Ethernet Cable
B24	ETH_TX-	Ethernet Transmit-	Ethernet Green	Ethernet Cable
B25	ETH_RX+	Ethernet Receive +	Ethernet Orange/White	Ethernet Cable
B26	ETH_RX-	Ethernet Receive-	Ethernet Orange	Ethernet Cable

\*Assign to Driver Switch, then Gear Paddle Up/Down.