



rCube2: Powertrain I/O Module

Overview

rCube2 is a rapid prototyping ECU based on AUTOSAR that enables fast and efficient development of control systems from initial concept to production. The system has been successfully used on a number of projects including Diesel/gasoline/CNG engines, transmission, hybrid powertrain control, as well as real-time 1-D gas dynamics engine model (WAVE-RT) integration into an engine control strategy.

Powertrain I/O Module

Ricardo supplies the Powertrain specific Input/Output Module (PIOM) as an expansion unit to the MicroController Module (MCM) to cover the requirements of advanced gasoline or diesel engine control as well as transmission and other powertrain related systems control. The powertrain I/O module occupies one I/O module slot in the rCube2 system and fits in either VARIANT II or VARIANT III configurations.

Key features

The I/O module is attached to the system as an expansion unit with no specific processing capacity. All the inputs and outputs are under direct control of the MCM. Its key functionality is to provide input signal pre-conditioning and to provide appropriate power output signals for direct control of external actuators.

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- 6 peak-hold current outputs (e.g. for smaller injectors)
- 6 coil drive outputs
- 2 wideband lambda interfaces
- 2 VR/Hall position sensor inputs
- 2 knock sensor inputs with signal processing
- 6 high-side and 8 low-side general purpose drives
- 2 full H-bridge drives
- 8 analog and 4 thermistor inputs



All signals are carefully distributed across MCM's microcontroller peripherals (mainly ADCs and timers) to enable precise synchronization between various channels.

System management

The I/O module is designed to work closely with the base MCM including start-up and shut-down procedures. The system features:

- Glitch-free start up and shutdown procedures
- External and internal power supply voltage monitoring
- Internal temperature sensing
- Module plug-and-play start-up identification

The management functions are integrated with the MCM's system controls to allow for seamless operation without any specific requirements for the user application.

Power supply consideration

To prevent potential damage of the board due to reverse polarity, it is highly recommended to install a power relay to the battery power supply of the module. The relay shall be controlled by an MCM relay output.

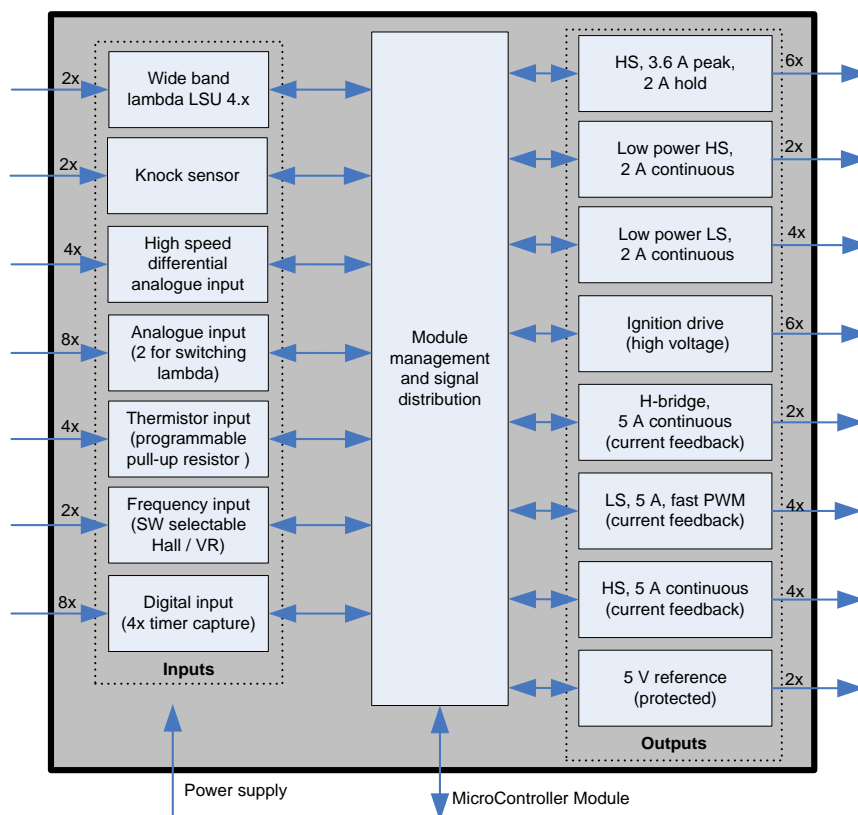


Figure 1: Internal block diagram

Electrical interface/input-output set

Power supply specifications

Supply voltage	6.0...32 V	Compliant with 24 V systems to ISO7637 part 2 (power supplies, the board internals, LS and HS drives and coil drives)
	6.0...18 V	Compliant with 12 V systems to ISO7637 part 2 (supplies lambda, peak & holds, low power LS and HS drives)
Reverse battery protection	None	Responsibility of the MCM to protect the I/O module
Operating current	< 300 mA	Excluding external loads
Power handling	30 A	Maximum total current passed through the I/O module

The Powertrain I/O Module supports the following signal interfaces:

Low power input signal specifications

Analogue inputs	12	4 fast differential and 8 standard single-ended inputs attached directly to the MCU internal ADC, 0...5 V input range, 12-bit resolution, 30 kΩ input impedance, 530 Hz bandwidth
NTC thermistor inputs	4	Analog inputs equipped with pull-up resistor. Intended mainly for thermistor and variable resistance sensors.
Digital inputs	8	General purpose digital inputs suitable also for PWM measurement or Hall input. Configurable as pull-up, pull-down or high impedance.
Sensor supply	2	5 V, 300 mA each, short circuit protected

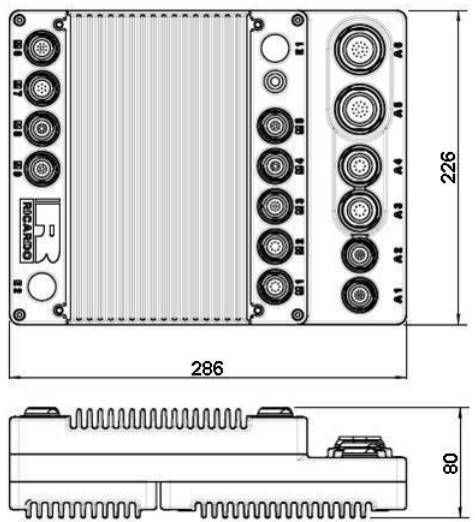
Specific inputs

VR/Hall sensor inputs	2	Programmable VR/Hall sensor inputs with appropriate impulse pre-processing attached directly to a timer input of the MCU. Designed for speed and position sensing of rotational parts.
Wideband lambda interfaces	2	Complete wideband lambda interfaces with feedback and signal processing. Bosch LSU 4.2 and 4.9 are supported.
Knock sensor inputs	2	Acoustic knock sensor inputs with signal processing and knock detection. Delivers “knock detected” digital information to the MCU.

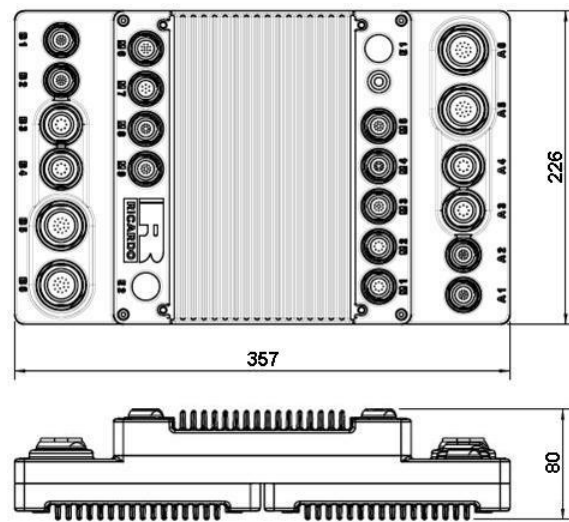
Power output specifications

Peak & hold current outputs	6	Programmable automatic peak & hold outputs 3.6 A / 2 A max intended for small injectors or current driven solenoids
Low side outputs	8	Low side outputs attached to MCU timer outputs. Targeted as general purpose power outputs with pulse capabilities and synchronization (PWM, PFM, etc.). 4 channels are capable of 2 A and 4 channels deliver up to 5 A of continuous current.
High side outputs	6	High side outputs attached to MCU timer outputs. Targeted as general purpose power outputs with pulse capabilities and synchronization (PWM, PFM, etc.). 2 channels are capable of 2 A and 4 channels deliver up to 5 A of continuous current.
Coil drive outputs	6	High voltage (up to 300 V) current monitored low side drives intended for ignition coil drive. Also usable as general purpose low side drives with high voltage capability and current monitoring.
H-bridge outputs	2	Complete H-bridge interfaces up to 5 A continuous load each

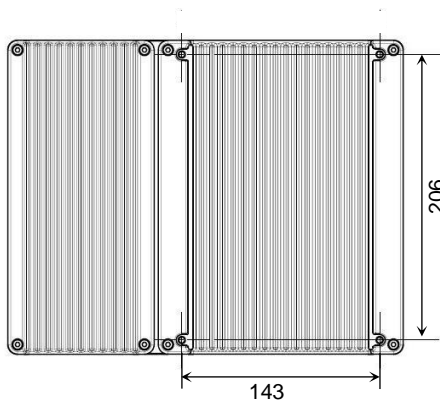
Mechanical dimensions



VARIANT II



VARIANT III



All dimensions are in [mm]

Mounting specification

Product mounting is by M4 screws. There are four threaded holes on the top surface of the MicroController Module (MCM is a common part of VARIANT I, II and III). Additionally, VARIANT II has four threaded holes on the bottom surface while VARIANT III has eight.



Connector information

The rCube2 connector system is based on the rugged sealed Lemo™ 'K' Series parts. See rCube2 connector information datasheet for further specifications and suitable cables.

Ref #	Connector function	Lemo order code*
x1	Main power	FGA.2K.307.CYCC70Z
x2	HS, LS and H-bridge outputs	FGA.2K.312.CYCC70Z
x3	Ignition outputs	FGG.3K.307.CYCC95Z
x4	Low power HS/LS outputs, peak & hold outputs and digital inputs	FGG.3K.324.CYCC10Z
x5	Analog inputs, lambda, knock and sensor supply	FGG.4K.348.CYCC13Z

*Note: The suffix (CYCxxxZ) determines the collet size for the cable and is dependent upon user application.

Full details of connectors and tooling are provided in the hardware user manual. These tools are not supplied by Ricardo.

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