

# rCube2: Solenoid injectors 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.

## Solenoid injectors I/O Module

Ricardo supplies the Solenoid injectors specific Input/Output Module (SIOM) as an expansion unit to the MicroController Module (MCM) to cover the requirements of advanced gasoline or diesel engine control. The Solenoid 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 limited processing capacity. All inputs and simple outputs are directly interfaced to the MCM control signals. High power injector drives combine an internal intelligent current/time waveform generator with an MCM driven trigger and output pulse duration. The key functions of the Solenoid injectors I/O Module are as follows:

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- 8 high power injector drivers
- 8 configurable push-pull drive outputs
- 2 VR/Hall position sensor inputs
- 8 low-side general purpose drives (usable as digital inputs)
- 8 analogue 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 and to limit stand-by power consumption, 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.

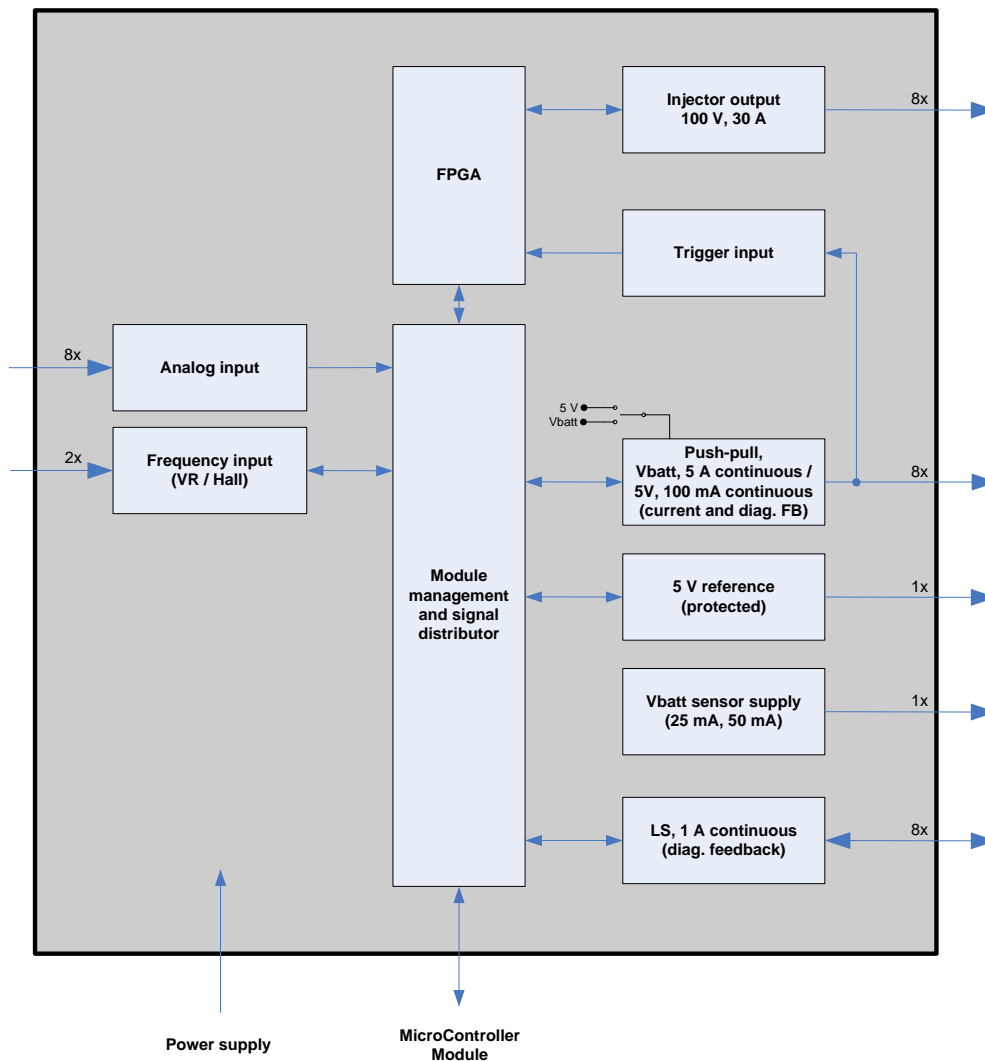


Figure 1: Internal block diagram

## Electrical interface/input-output set

### Power supply specifications

Supply voltage	6.0...36 V	Compliant with 24 V systems to ISO7637 part 2
Reverse battery protection	None	Responsibility of the MCM to protect the I/O module
Operating current	< 600 mA	Excluding external loads
Power handling	40 A	Maximum total current passed through the module

The Solenoid injectors I/O Module supports the following signal interfaces:

**Low power input signal specifications**

Analogue inputs	8	Standard single-ended inputs attached directly to the MCU internal ADC, 0...5 V input range, 12-bit resolution, 47 kΩ input impedance, 16 kHz bandwidth
Digital inputs	8	Digital inputs for external triggering of injectors (shared with push-pull outputs)
Sensor supply 5 V	1	5 V, 100 mA, short circuit protected
Sensor supply Vbatt	1	Vbatt, 25 mA / 50 mA, short circuit protected

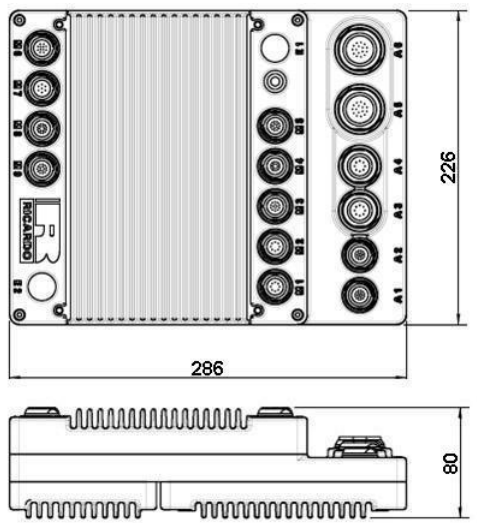
**Specific inputs**

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 position sensing of rotational parts.
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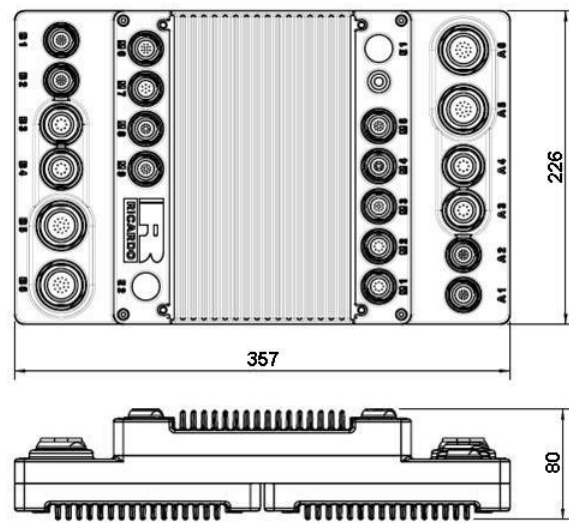
**Power output specifications**

Injector outputs	8	Programmable automatic peak & hold outputs 100 V / 30 A max intended for large direct injection injectors, up to 8 separate injection per cycle, 3 current levels, duration time HW limited to 2.5 ms / 42 ms (safety feature)
Low side outputs/digital inputs	8	Low side outputs attached to MCU timer outputs targeted as general purpose power outputs with pulse capabilities and synchronization (PWM etc.). Diagnostic feedback. 1 A continuous current, 3.5 A limiting. Can be used as digital inputs.
Push-pull outputs	8	Push-pull outputs up to 5 A continuous load each or digital inputs. Customisable to 5 V / 100 mA for IGBT coil drive (smart coils).

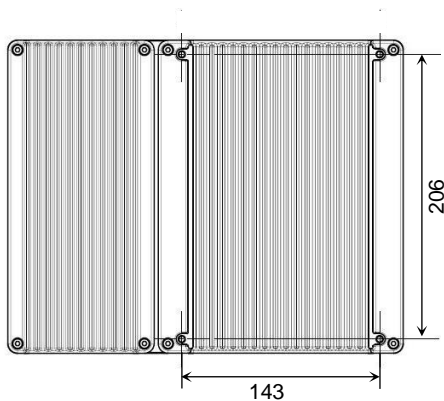
## Mechanical dimensions



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*
x2	Main power	FGA.2K.307.CYCC70Z
x3	Injector outputs 5...8	FGG.3K.308.CLAC11Z
x4	Injector outputs 1...4	FGA.3K.308.CLAC11Z
x5	LS outputs and Push-pull outputs	FGG.4K.316.CLAC15Z
x6	Analog inputs, VRS inputs and sensor supply	FGC.4K.316.CLAC15Z

\*Note: The suffix (CYCxxxZ and CLAxxxZ) 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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