

rCube2: Transmission control 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.

Transmission control I/O Module

Ricardo supplies the Transmission control specific Input/Output Module (TIOM) as an expansion unit to the MicroController Module (MCM) to cover the requirements of modern transmission systems. The Transmission control 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 minimal processing capability. The MCM controls most of the inputs and outputs directly. Its main purpose is to provide input pre-processing and electrical amplification for the outputs straight to the user application. Solenoid drives feature an interval configurable controller.

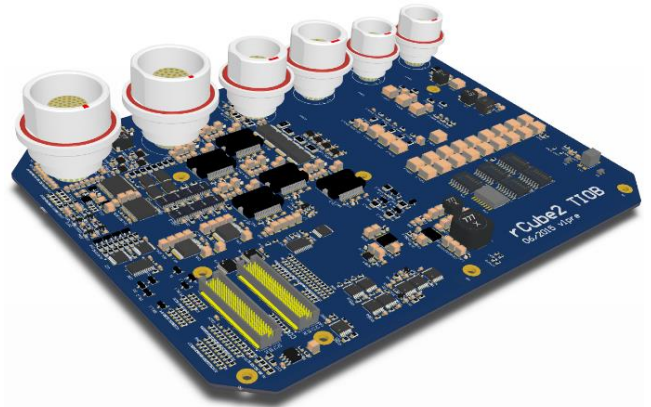
rCube2: Transmission control I/O Module (TIOM10)

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- 15 current controlled HS/LS power outputs for inductive loads (e.g. solenoids), 1.5 A each
- 8 Low Side drives, 2 A each
- 4 high current High Side drives, 6 A each
- 2 low power pulse outputs
- 6 current mode (two wire) Hall sensor inputs
- 2 VR sensors inputs
- 16 switch inputs, pull-up/down configurable
- 6 voltage mode (3 wire) Hall sensor inputs
- 4 general purpose analog inputs
- 3 thermocouple inputs
- 2 sensor 5 V supply outputs, 200 mA each
- 2 sensor 9 V supply outputs, 100 mA each
- 2 three-phase bridges for electric motor drive, 15 A RMS each



All signals are carefully distributed across the MCM's micro-controller peripherals (mainly ADCs and timers) so that precise synchronization between various channels is achievable.

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 are:

- 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 to 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.

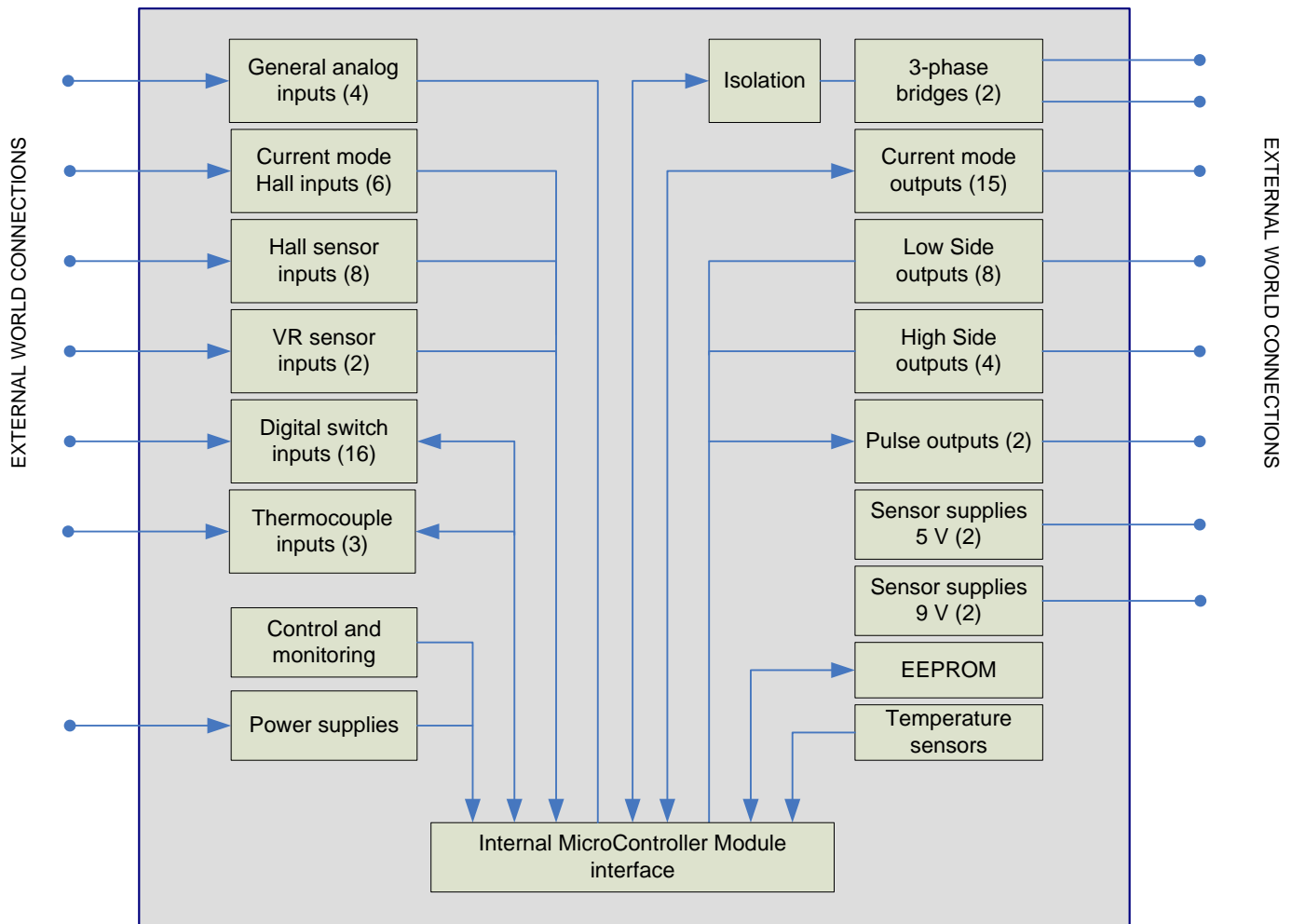


Figure 1: Internal block diagram

Electrical interface/input-output set

Power supply specifications

Supply voltage	6.0...28 V / 36 V	Operational up to 36 V, performance limitations may apply from 28 V
Reverse battery protection	None	Responsibility of the MCM to protect the I/O module
Operating current	< 500 mA	Excluding external loads
Power handling	33 A	Maximum total current through the module excluding 3-phase drives

The Transmission control I/O Module supports the following signal interfaces:

Low power input signal specifications

Analogue inputs	4	Standard single-ended inputs attached directly to the MCU internal ADC, 0...5 V input range
Switch inputs	16	Digital inputs optimized for switch interfacing, configurable close-to-battery or close-to-ground topology, programmable wetting current
Thermocouple analogue inputs	3	Differential analogue inputs dedicated for thermocouple application, also useable as low frequency high resolution differential analogue inputs
Sensor supply 5 V	2	5 V, 200 mA, short circuit protected
Sensor supply 9 V	2	9 V, 100 mA, short circuit protected

Pulse/speed inputs

VR sensor inputs	2	VR sensor inputs with appropriate impulse pre-processing attached directly to a timer input of the MCU. Designed for position sensing of rotational parts.
Two wire Hall inputs (current mode)	6	Current mode Hall inputs (two wire interface, 7/14 mA) attached directly to MCU timers, intended for speed and direction of motion sensing. Internal sensor supply limits the supply voltage to 9 V.
Three wire Hall inputs (voltage mode)	8	Voltage mode Hall inputs - three wire interface, 5 V or Vbatt signal voltage swing. Inputs attached to MCU timers to allow precise speed/position sensing and synchronization to other peripherals. Optimized for use with 3-phase motor drive.

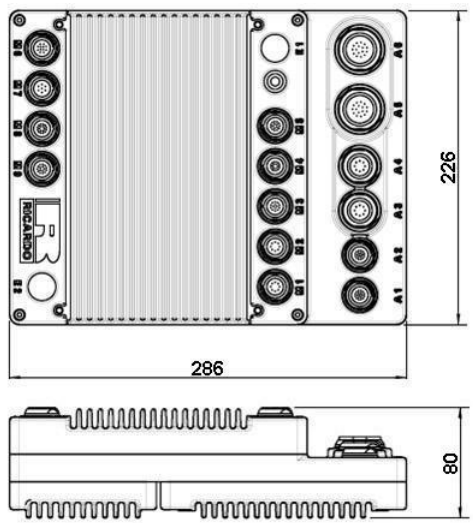
Specific outputs

Pulse/speed output	2	Low current (100 mA) LS drive with high bandwidth and low phase shift (up to 20 kHz). Signals attached to MCU timers to provide PWM, PFM and pulse generation capabilities.
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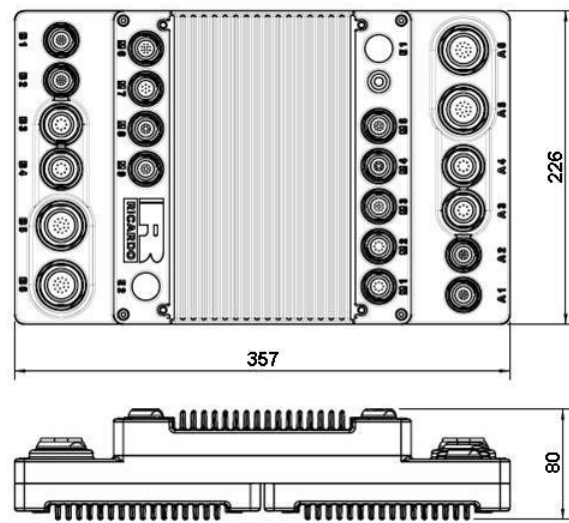
Power output specifications

Solenoid drive current mode outputs	15	Programmable PWM operated current mode outputs for inductive loads. Current control loop (PI regulator) closed in hardware, capability includes variable dither, extensive status monitoring and instantaneous current feedback. Output topology configurable to HS or LS. 0...1.5 A output range, 0.73 mA resolution, 1 % accuracy.
Low Side outputs	8	Low Side outputs targeted as general purpose power outputs with pulse capabilities and precision current feedback. Control signals interfaced to MCU timer banks to produce PWM, PFM, etc. Up to 2 A continuous current.
High Side outputs	4	High Side outputs attached to MCU timer outputs targeted as general purpose power outputs with precision current feedback. Up to 6 A continuous current.
3-phase bridges	2	Three-phase bridge for motor drive up to 15 A RMS current. Separate power supply including isolated ground to avoid high current ground loops, full six-switch drive and six-signal control for maximum control flexibility. Two phase current feedback, phase voltage zero crossing feedback and integrated overcurrent and short circuit protection. Bridges can be ganged for higher power.

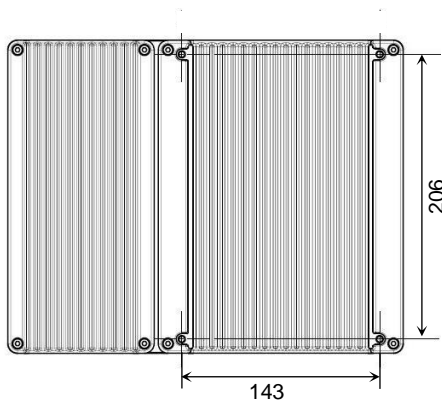
Mechanical dimensions



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 supply	FGA.2K.307.CYCC70Z
x2	Motor bridge power supply	FGG.2K.306.CYCC70Z
x3	Motor bridge outputs	FGA.3K.307.CYCC10Z
x4	Thermocouple inputs and Pulse outputs	FGG.3K.316.CYBC10Z
x5	LS, HS outputs and solenoid current mode outputs	FGG.4K.330.CYCC13Z
x6	Analog inputs, digital inputs and sensor supplies	FGA.4K.348.CYCC13Z

*Note: The suffix (CYCxxxZ and CYBxxxZ) 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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