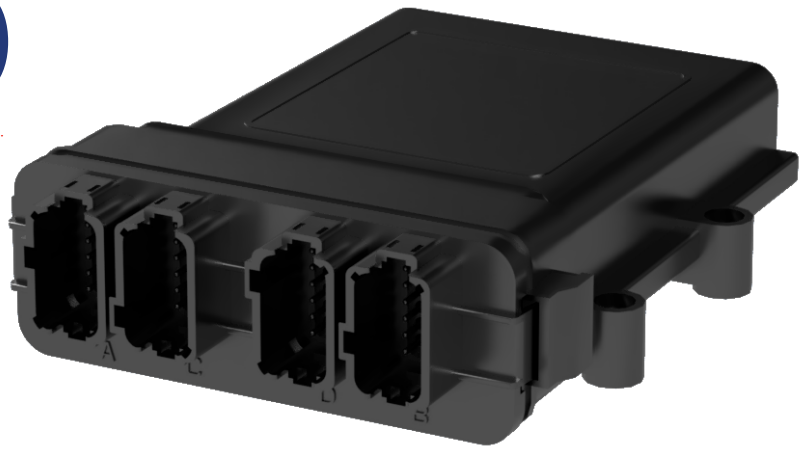
MBW Technologies, LLC

EM4000

Rugged I/O for Harsh Environments



Overview

The EM4000 I/O Module is a rugged, sealed expansion unit designed to extend the input/output capability of electronic or mechanical engine control systems. Built for use in demanding environments, the EM4000 integrates seamlessly with MBW and other controllers capable of reading J1939 messages, offering flexible control and monitoring options for industrial, mobile, and off-highway applications.

Key Features:

- **8x Analog Inputs**
  - 1x 100/1000K RTD / 3K Thermistor
  - 2x Resistive (10–1000 Ohms)
  - 2x 4–20mA Current Loop
  - 3x Voltage (0–10VDC)
- **7x Digital Inputs**
  - 3x Active High
  - 4x Active Low
- **2x CAN Inputs**
  - 1x Standard CAN
  - 1x NMEA Isolated CAN
- **1x Tachometer Input**
- **1x Motor Driver / PWM Output**
- **4x Relay Driver Outputs**
- **2x 2A Discrete Outputs**
- **2x 20A Discrete Outputs**
- **Bluetooth Connectivity**
- **Real time Clock**
  - Start / Stop up to 30 days
- **CAN Gateway**
  - Analog data translation to J1939 / NMEA 2K
- **Low Power Sleep mode**
- **Field Updateable**
- **Custom configurations via PC based app**

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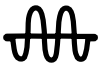
Detailed overview of features

The EM4000 is built for performance and versatility in harsh, demanding environments. Engineered to extend the I/O capabilities of both mechanical and electronic engine systems, the EM4000 offers an advanced suite of features designed for seamless integration, precise sensor monitoring, and robust output control.

From flexible analog and digital inputs to high-current discrete outputs, CAN gateway translation, and field-updatable configuration, each feature of the EM4000 is purpose-built to simplify system design and improve reliability in industrial, mobile, and off-highway applications.

The following section provides an in-depth look at the capabilities that make the EM4000 a powerful addition to any engine control or monitoring solution.

Inputs:



8 Analog Inputs – Multi-Sensor Compatibility: The EM4000 offers eight dedicated analog input channels supporting a broad range of industrial sensors:

- 1x RTD/Thermistor Input – Supports 100Ω, 1000Ω RTDs or 3K NTC thermistors for precise coolant or oil temperature readings.
- 2x Resistive Inputs – Ideal for fuel level, oil pressure, or other resistive-type senders in the 10–1000 Ohm range.
- 2x 4–20mA Current Loop Inputs – Designed for industrial sensors with current-based signaling over long cable runs.
- 3x 0–10V Voltage Inputs – Supports pressure, temperature, or other sensors with voltage output, user-scalable via PC app.

7 Digital Inputs – Flexible Logic Triggering The EM4000 includes seven digital inputs with mixed logic levels:

- 3x Active High Inputs – Triggered by high-side voltage sources (e.g. +Battery).
- 4x Active Low Inputs – Triggered by ground or low-side switches. This allows connection of float switches, key switches, low-pressure alarms, and more.

2 CAN Inputs – Primary and Isolated Bus Support

- 1 Standard CAN Interface – For system-level integration with controllers or other CAN - capable devices.

Tachometer Input – RPM Monitoring Accepts frequency input from magnetic pickups, alternator taps, or ignition signals. Supports scalable RPM reading to interface with display units or generate overspeed alarms.

4 Relay Low side Driver Outputs – General Purpose Switching Each relay is capable of driving moderate loads (fan control, starter relay, solenoids). Relays are onboard, eliminating the need for external switching for many applications.

2 2A Discrete Outputs Switched +VBatt outputs rated to 2 Amps for low-power loads such as indicators, relays, or signal lights.

2x 20A Discrete Outputs Heavy-duty switched +VBatt outputs rated up to 20 Amps, ideal for driving larger actuators, preheat elements, or pumps directly.

Specifications:

The key functional features include:

- Autonomous engine control with real-time clock and auto-start/stop scheduling capabilities (up to max 30-day interval)
- Low current sleep mode (<5mA draw); supports wake-up via digital inputs, 4–20 mA analog inputs, and battery voltage monitor
- CANbus data output: Translates analog / digital sensor data into standard SAE J1939 PGNs
- Fully compatible with J1939 CANbus displays
- Field-updatable:
  - Via USB flash drive (no PC required
  - PC-based configuration utility for advanced parameter mapping and I/O setup
  - Optional Bluetooth interface for wireless configuration and live data access via mobile app (future feature)

Software and Configuration:

- PC-Based Configuration App for I/O setup, CAN mapping and Start stop scheduling
- Field configuration via USB flash drive, USB PC connection, or Bluetooth
- Standard J1939 PGN output for sensor data, compatible with any CANbus display

Bluetooth Monitoring (optional):

- Wireless engine data visibility (RPM, fuel rate, coolant temp, DTCs)
- Edit parameters and perform diagnostics using mobile app
- Enables full control without requiring a physical display panel

Hardware:	
Microcontroller	STM32F413VGT6 (ARM Cortex-M4 @ 100 MHz)
Flash Memory	1 MB
SRAM	320 KB
RTC	Real-time clock with battery backup
Bluetooth	Optional BLE 5.x interface module
Brightness	1000 NIT (cd/m²) Full sunlight readable

Digital Interface	
CAN 1	SAE J1939 CAN (2.0B)
CAN 2	Isolated CAN (NMEA 2000-compatible)
Communication	RS-485 (Modbus RTU)
Connections	Bluetooth 5.x USB Port (Host and Device Capable)

Environmental	
Operating Temperature	-40°C to +80°C (-40°F to 176°F)
Storage Temperature	-55°C to +100°C
Vibration/Shock:	SAE J1455 / MIL-STD-202
EMC Compliance:	ISO 7637, CISPR 25 Class 3
Ingress Protection	IP67

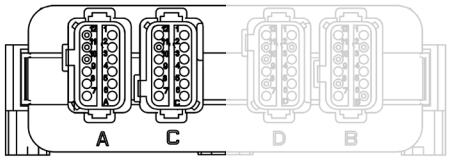
Mechanical	
Enclosure	Rugged, sealed (IP67) for engine-mount applications
Connectors	Sealed Deutsch-style (preferred) 12 pin connectors (keyed A, B, C and D)
Mounting	4-hole surface mount

Electrical	
Operating Voltage	7–32 VDC (12V/24V compatible)
Sleep Current	<5 mA
Reverse Polarity	Protected
Over-voltage	Protected
Reference Voltage	+5V @ 45 mA

Inputs	
Analogue Inputs (x8)	2x Resistive (10–450 Ohms) 3x Selectable (0–10V or Resistive) 2x 4–20 mA Current Loop 1x RTD (100Ω, 1000Ω or 3K Thermistor)
Digital Inputs (x7)	4x Discrete (active low) 3x Battery-sensing (active high)
Frequency Input (x1)	Magnetic pickup or alternator W-terminal (jumper selectable)
Battery Voltage Monitor	1x Battery Voltage Monitor - 6–32 VDC range

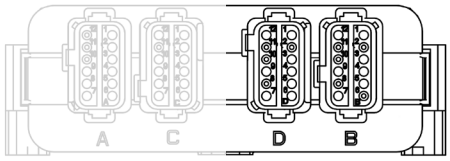
Outputs	
Relay Outputs (x4)	Low-side drivers (200 mA)
Switched Outputs (x4)	4 Discrete switched grounds, including 2 PWM-capable outputs
Drive Output (x1)	1 DC motor drive output – 5A bi-directional with current sense
Power Output (x1)	1 Sensor power output – +5V @ 45 mA

Connectors: Signals and Descriptions



PIN	**Connector A:** Signals / Descriptions
1	DI4: Digital Input, Active Low
2	DI5: Digital Input, Active Low
3	DI6: Digital Input, Active Low
4	No connection
5	AI8: Analog Input, Voltage, 0 - 10VDC
6	AI7: Analog Input, Voltage, 0 - 10VDC
7	AI1: Analog Input, 100/1K RTD, 3K Thermistor
8	AI5: Analog Input, 4 - 20mA
9	AI4: Analog Input, 4 - 20mA
10	AI3: Analog Input, 2 wire resistive (0 - 1000)
11	AI2: Analog Input, 2 wire resistive (0 - 1000)
12	AI6: Analog Input, Voltage, 0 - 10VDC

PIN	**Connector C:** Signals / Descriptions
1	CAN1 H: Primary CAN DATA High
2	CAN1 L: Primary CAN DATA Low
3	CAN2 H: Isolated CAN DATA High
4	CAN2 L: Isolated CAN DATA Low
5	CAN GND: Isolated CAN Ground
6	CAN PWR: Isolated CAN Supply
7	DI3: Digital Input, Active Low
8	DI2: Digital Input, Active High
9	DI1: Digital Input, Active High
10	DI7: Digital Input, Active High
11	PWM1: PWM Motor Driver (1/2 H-bridge)
12	PWM2: PWM Motor Driver (1/2 H-bridge)



PIN	**Connector D:** Signals / Descriptions
1	GND: Sender Ground
2	GND: Sender Ground
3	PWR -: Battery Negative
4	
5	+5V: +5VDC (100mA) Reference
6	No connection
7	DO2: Digital Out, switched Vbatt, 2A
8	DO1: Digital Out, switched Vbatt, 2A
9	DO4: Digital Out, switched Vbatt, 20A
10	
11	DO3: Digital Out, switched Vbatt, 20A
12	

PIN	**Connector B:** Signals / Descriptions
1	GND: Sender Ground
2	GND: Sender Ground
3	TACH: Tachometer Input
4	Serial Data: RS485 -
5	Serial Data: RS485 +
6	RLA4: Relay Output, Low 4A
7	RLA3: Relay Output, Low 4A
8	RLA2: Relay Output, Low 4A
9	RLA1: Relay Output, Low 4A
10	PWR -: Battery Negative
11	PWR +: Battery Positive, +8 - 32VDC
12	

Dimensions: