



**Drive-By-Wire Platform**

**Safety Systems**

**Power Distribution**

**Navigation & Autonomy**

**Operator Control Unit**

■ **Flexible Vehicle Interface**

Relays, serial, CAN, analog/digital I/O, and expansion slots for custom electronics adapts to a wide variety of vehicle interfaces.

■ **Closed-loop Steering & Speed Control**

A feed forward closed-loop controller ensures precision vehicle steering and speed control.

■ **Auxillary Controls**

In addition to steering and speed control, auxiliary functions such as engine start, stop, turn signals and headlights can be controlled.

■ **Real-Time Vehicle Monitoring**

Vehicle system information such as battery voltages, CAN error messages, and oil and fuel warning are continuously monitored.

■ **J AUS Interoperable**

The ByWire is J AUS-interoperable for integration with other J AUS compatible devices.

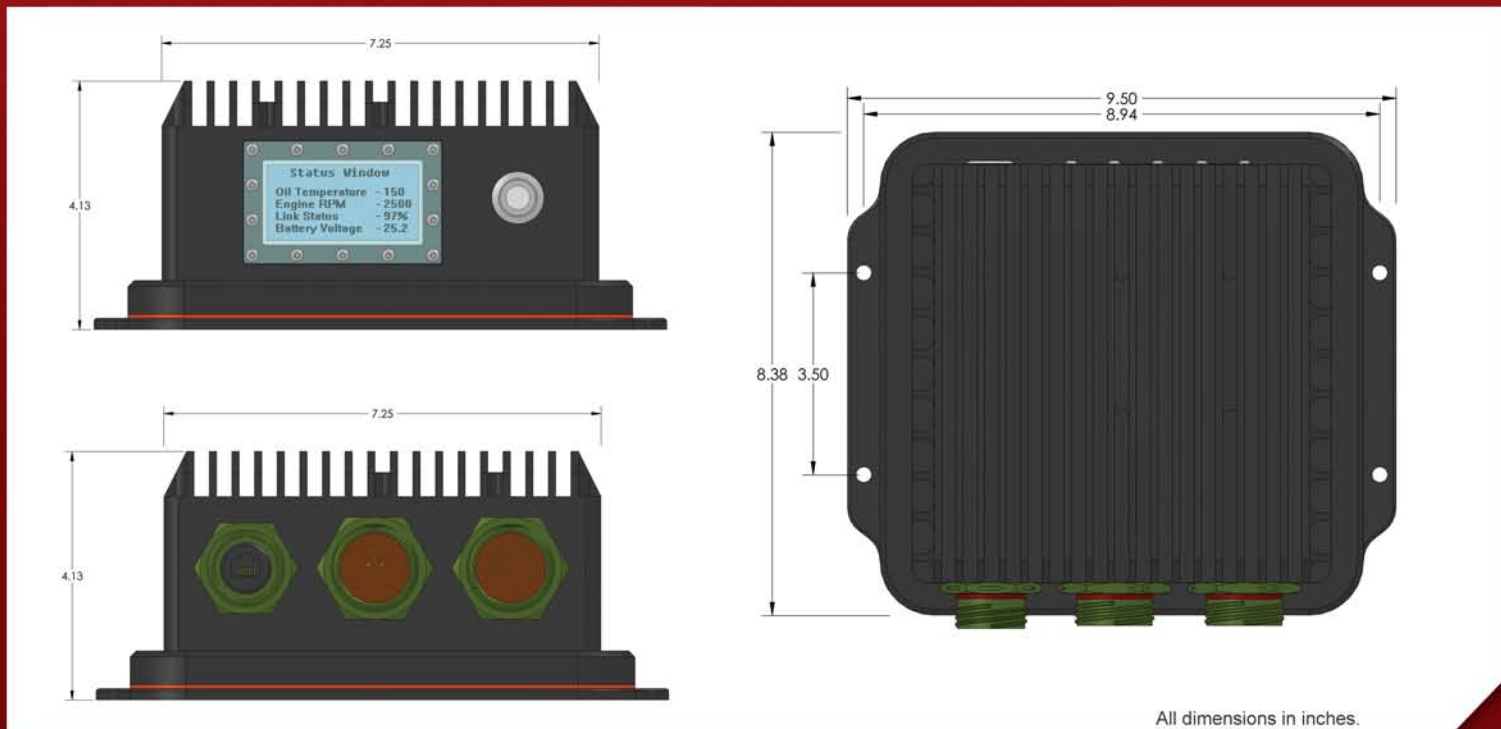
To maximize platform flexibility TORC offers the ByWire. The ByWire houses a real-time embedded controller and presents a single, unified interface to any base vehicle. Utilizing a simple Ethernet port, communication with the ByWire follows an industry standard protocol known as the Joint Architecture for Unmanned Systems (J AUS). For interfacing with stock vehicles systems as well as external actuators, the ByWire features analog/digital I/O, CAN, USB, and serial connectivity options.

The ByWire can provide electronic control of steering, throttle, braking, gearing, and engine startup/shutdown. Auxiliary controls such as turn signals and head lights are also accessible. Available vehicle feedback includes vehicle speed, individual wheel speeds, steering angle, battery voltages, oil and fuel warnings, and CAN error messages. The embedded controller provides both open-loop and closed-loop speed and steering control. In open-loop mode, the vehicle systems are directly manipulated. This is the lowest level of control and is most commonly used for teleoperation. In closed-loop mode, vehicle speed, curvature, and accelerations are commanded allowing for higher-level path control. This mode of control is most useful for the implementation of autonomous driving algorithms.

# ROBOTIC BUILDING BLOCKS

For Unmanned & Autonomous Systems

## ByWire™ Specifications



All dimensions in inches.

### Vehicle Interface

- Relay ..... (16) 5A SPST (optional)
- Digital IO ..... 24 Channel  
3.3V and 5V Compatible
- Analog Input ..... 32 single-ended / 16 differential  
16-Bit Resolution  
+/- 10V Input Range  
250 KHz Max Sample Rate
- Analog Outputs ..... (4) 12-Bit Resolution  
+/- 10V Range
- Timer / Counter ..... Variable Reluctance Speed Sensor
- Serial ..... (2) RS-232  
(2) RS-232/422/485 (2 optional)
- Ethernet ..... (1) Gigabit
- USB ..... (2) Version 2.0
- CAN ..... (2) Version 2.0B (optional)

### Environmental

- Dust / Water Resistance ..... IP65
- Operating Temperature ..... -20°C to +70°C
- Operational Shock Rating ..... 20g

### Electrical

- Power Consumption ..... 25 Watts
- BW-100 Input Voltage ..... 10-32 VDC

### LCD Visual Indicator

- 128x64 Graphical Display
- User Configurable Indicators

### Optional Accessories

- BW-100-GPS GPS Receiver Module
- BW-100-VBI Vibration Isolators
- BW-100-41P 41-pin Cable Harness
- BW-100-79P 79-pin Cable Harness
- BW-100-ETC Ethernet Cable Harness