ECU MASTER

PMU-16

POWER MANAGEMENT UNIT

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Decades ago, the critical electronic components in a race car were the ignition coil and points. Race cars are now sophisticated machines equipped with advanced engine management systems, and often antilock brake systems and paddle shifters. Add to that the requisite dataloggers, radios, electric pumps, fans, and lights, and you end up with a lot of electrical equipment. All components need to be powered ON and turned OFF at the correct moments, and all components require circuit protection to prevent damage or fire in case of accident or component malfunction.

Switches, fuses, and relays have historically met these needs, but they have many shortcomings. First and foremost, each component must have its own switch, fuse, and relay, requiring wiring looms to run from the switch to each relay or component, adding complexity and weight. Fuses and relays are also susceptible to damage from vibration and high temperatures, both of which are commonplace in racing environments. Fuse failure is also difficult to diagnose during competition, and a driver is unlikely to be able to replace a fuse while racing. Partial solutions for this are automatic circuit breakers, but high ambient temperatures can cause breakers to trip well below their rated current (ratings can drop as much as 40% at 50 degC). Also, relays are mechanical devices that are subject to wear.

All of these problems can be solved by using intelligent power management units (PMUs). The newly developed ECUMaster PMU unit is at the forefront of power management technology. The PMU features 16 output channels that can be grouped for high-current devices. If more than 16 outputs are required, multiple PMUs can be connected via CAN BUS. The PMU is a modern device that packages the functionality of fuses, relays and more in one sleek and small package.

One of the main advantages of intelligent power management is self-resetting functionality. If the current output for a given channel exceeds a limit defined by the user, the PMU will disable the channel and attempt to restart it after a user-defined waiting period. If the channel continues to malfunction, the reconnection count will reach a user defined level and the output will be permanently turned OFF until a master reset or power cycle is performed. All output states (ON, OFF, Tripped, Retry, Fail) are logged internally and sent over CAN bus to a main logger or dash display to inform the driver of potential problems.

An additional advantage of a power management system is the capability to define logic for controlling outputs. Using data received over CAN-bus or via analogue inputs, the PMU can perform countless math operations to control output channels. The PMU features 16 analog inputs (10-bit resolution) with software selectable pullups that can be used for external switches or additional sensors. All of these inputs, along with output states, voltages and currents, can be logged and/or transmitted over one of two inbuilt independent CAN-bus connections.

PMU is also equipped with visible LED indicators, each one of them assigned to an output to indicate the status of the channel. These indicators allow for immediate checking of all output statuses without the need to offload data or reference a dash display.

CAN bus switch panels mounted either on the dash or the steering wheel allow for vastly simplified wiring and reduced weight.

Two unique features of the PMU are the inbuilt accelerometer and gyroscope. Both signals can be logged and transmitted via CAN for engineering purposes, and can be used to program functionality for an "inertia switch" which would disable the engine and other electrical systems in the event of an accident.

We are confident that our PMU will meet and exceed the expectations of all of our current and future customers.

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PMU-16 Specification

TECHNOLOGY

PMU is assembled according to IPC-S-815A standards to ensure product reliability. The device is manufactured on an automated assembly line with optical inspection, and automated testing (including burn-in). The PCB material and design, special surface coating and IP65 enclosure ensure reliability even in the harshest environments. Carefully selected components allow for continuous and reliable operation across a very wide temperature range (AECQ-100 GRADE 1 (-40 to +125˚C).

GENERAL

Temperature range	AECQ100 GRADE1 (-40 to +125˚C)
CPU	32 bits automotive, 90MIPS
Reverse polarity protection	Yes, internal
Operating voltage	6-22V, immunity to transients according to ISO 7637
Enclosure	IP 65, bespoke CNC machined aluminum
Size (mm) and weight(g)	131x112x32.5, 345g
Connectors	1 x 39 Automotive connector, 1 x M6 stud for battery connection
PC communication	CAN (PCAN, ECUMASTER USBCAN)

OUTPUTS

High current outputs	10 x 25A(cont.), 6 x 15A(cont.) with Overcurrent and overheating protection. Outputs may be paired to increase continuous current capability. Current and voltage is measured for each output
ITotal current output	150A continuous
Output current control step	100mA
Wipers output	dedicated output with wiper braking feature
+5V	monitored 5V, 500mA output for powering external sensors

INPUTS

Analog inputs	16 inputs, 10 Bit resolution, 0-5V (protected), with software selectable 10K Ohm pullup and pulldowns
CAN Keypads	2 x Ecumaster keypads (4, 8, 12 keys)

OTHER

Output state indication	16 bicolor LEDs
Accelerometer/Gyroscope	3D accelerometer with 3D gyroscope for logging and crash detection
Real time clock	Yes, super capacitor for backup power (up to 3 days)

CAN BUS

CAN interface	2 x CAN2B
CAN standard	2.0B 125, 250, 500, 1000 kBps
Input/output stream	User defined with bit masking up to 48 input messages

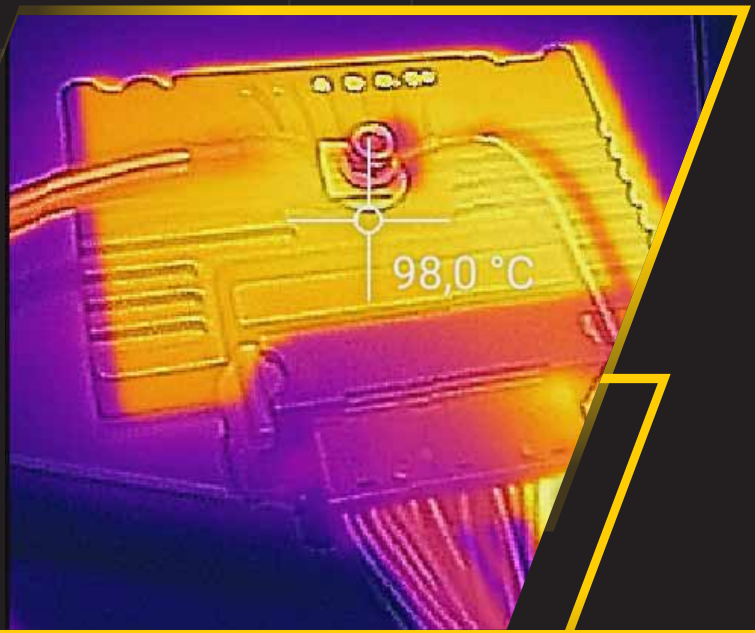
LOGGING[1]

Logging memory	256 Mbytes
Logging speed	Variable, defined per channel, up to 500Hz

1) Version PMU-16DL

FUNCTIONS

Logical operators	AND, OR, NOT, XOR, >, <, =, >=, <=, !=, isTrue, isFalse, Toggle, Flash, Pulse
Number of functions	100
Number of operations	250
Update frequency	500Hz
Special functions	Wipers, momentary switch



SOFTWARE

The powerful and user friendly PMU software suite is used for managing the device configuration. The intuitive graphical help menu offers support for the user by presenting contextual help for each window. To meet users demands, most keyboard shortcuts can be user-defined.

PC REQUIREMENTS

Windows XP, VISTA, 7, 8, 10, 32 and 64 bits
Minimum screen resolution 1024x768
Open GL compatible video card
CAN interface (PEAK system or ECUMASTER)

CAN COMMUNICATION

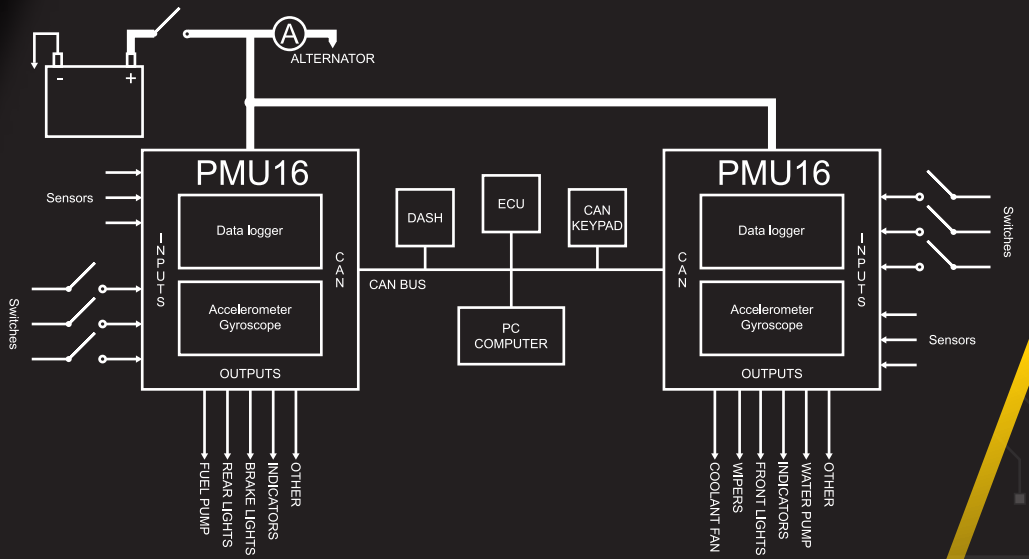
PMU device has 2 CAN interfaces used for configuration and communication with other devices.

For PC communication, CAN#1 interface is used with a 1Mbps baud rate. Currently supported interfaces are Peak CAN and Ecumaster CAN-USB interface.
CAN #1 interface may also be used for receiving and transferring messages to other devices.
CAN#2 interface could be used for any communication purpose.
To make installation easier, the CAN termination resistor can be software enabled.

PMU features a very flexible export / import CAN message system. Virtually any incoming and outgoing CAN stream can be user defined, which makes device very versatile and allows for communication with any CAN capable device.
Each CAN port can import up to 10 base message IDs, however using smart filtering up to 48 unique incoming IDs can be used. CAN stream configuration may be saved as a file and loaded to other devices.
For outgoing messages, all PMU parameters may be used, which allows for easy diagnosis as well as transferring PMU analog inputs or CAN keyboard states to the ECU.

MULTIPLE PMU

It is possible to use more than one unit (up to 4) in a vehicle, which can be useful when more than 16 outputs are required or for simplifying the harness (eg. front / rear). All devices need to be connected to one CAN network. Configuration is very easy and switching between devices is instant (< 1s) using a keyboard shortcut. All configuration data is automatically reloaded when the transition is made.



SWITCHES AND KEYPADS

Traditional switches may be connected to the PMU by connecting one wire from the switch to an input on the PMU. Thanks to software selectable internal pullups/pulldowns, each analog input may be used as a switch input.

In an effort to simplify electrical installations, CAN switches and CAN keypads may be used. The PMU supports up to 2 ECUMASTER keypads (4, 8 or 12 keys).

A flexible keypad configuration allows end users to define different behavior for each key. The simplest is non-latching key. When the key is pressed, the key led indicator will change color. For latching and momentary switches, the active states are indicated by user defined color. Another key option is a "radio buttons" group (only one key out of the group may be active).

The keys' state can be stored in the memory of the device, and after next power up the keys will be in the same state.

Due to a flexible CAN stream configuration, the keys' state can be sent out to another devices such as the ECU, datalogger, etc.

Another option, often used for steering wheel buttons, is the ECUMASTER CAN switch board that allows for the transmittal of 8 switch states and 2 rotary switch states over the CAN BUS. This information can be sent to the PMU as well as to the ECU.

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DATA LOGGING

PMU-16DL unit has 256MB of high performance, high temperature flash memory built in. Due to sophisticated logging capability, the PMU unit can be used as a data logger for both internal and external data (received over CAN).

Each log channel can be recorded at frequencies up to 500Hz, at a total bandwidth of 25KB/s. The logged channels and the logging frequency can change on the fly, depending on user defined conditions.

Thanks to a built-in real-time clock, all logged data is time stamped.

To improve data download, LZ77 compression is used (up to10 times faster transfer)

DIAGNOSTIC

PMU unit is able to provide wide range of diagnostic information. The first group of diagnostic information is related to the hardware itself. During start up, a quick self-test is performed to detect potential hardware failure (eg. flash memory, real time clock, etc.). During operation, device parameters such as PCB board temperatures, flash memory temperature, CAN bus, internal voltage level and external +5V voltage are monitored.

The second group of diagnostics are tied to the device outputs. Actual current, peak current and output voltage are processed. Based on this information and user configuration, fault states like under or over current can be detected for each output.

All of the above data can then be exported to the CAN stream to be used by a dashboard or other CAN based devices.

In addition to the CAN stream output, the state of each output is indicated by an LED (green for proper operation, red for over current and orange for undercurrent).

FUNCTIONS

The “intelligence” of the device is based on logic operators. PMU supports many flexible and advance logic capabilities, from simple functions like enabling an output when an input is enabled to conditional functions where inputs are created from a combination of other input functions. CAN stream data and output states can also be used to define output states. Such an approach allows for intelligent control of all components on a race car, from lights, blinkers, turbo timers to redundant fuel pump control with automatic switching when a fault is detected. PMU offers 100 functions and 250 operators, and with such a high sampling rate (500Hz) these features make it one of the best on the market.

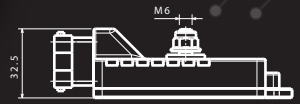
OTHER

To increase driver safety the PMU is equipped with a 3D accelerometer and gyroscope that could be used for vehicle crash detection. In the event of a collision, all outputs can be immediately shut down to prevent fire due to an electrical short circuit or fluid leak. Also, the information from the accelerometer and gyroscope can be logged or send to another device.

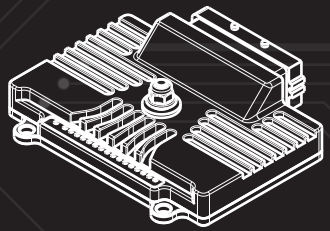
Another important feature of the PMU is windshield wiper support (using dedicated output) with electronic brake control.

Visual output statuses- we are the first in the market to offer quick and simply output state indication. LEDs assigned to each output give a quick indication of output states. They can provide the following status information: OFF- output not active, GREEN – output working correctly, ORANGE- Open circuit (under-current), RED – (over-current)

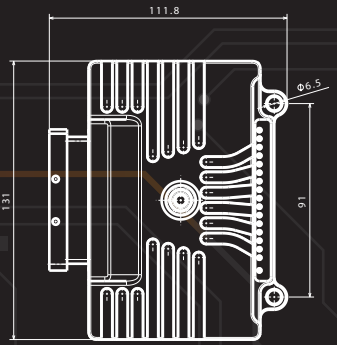
TECHNICAL DRAWINGS



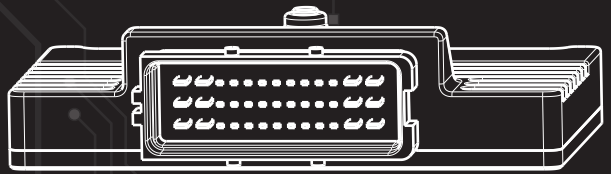
Front view
Scale: 1:1



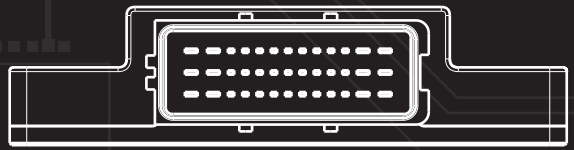
Isometric view
Scale: 1:1



Top view
Scale: 1:1



Isometric view
Scale: 2:1



Front view
Scale: 2:1

- **all dimensions are in mm**