

eMobility



# Connected vehicle solutions



**EATON**  
*Powering Business Worldwide*

Customizable solutions  
for harsh environments



# Why Multiplex?

On and off-highway OEMs are faced with significant challenges as more and more components move toward electrification. Trucks and construction/agricultural equipment that once had hundreds of electrical circuits now have thousands. Multiplexing offers a cost-effective solution for simplifying and improving these systems with:

- Connected products that all communicate on the same network (CAN)
- Real time diagnostics for optimized machine performance
- Software that can provide added safety features, configurability and flexibility



# Customizable solutions for harsh environments

Our team at Eaton brings together vast electrical and industrial experience to give you a robust portfolio of low-voltage products. These commercial vehicle solutions range from off-the-shelf catalog products to fully customized, next-generation systems that enable differentiation.

The engineering strength and proven track record of the Eaton Bussmann®, Sure Power and OMNEX product portfolios provide you with the capability to accelerate “smart system” and custom component development, resulting in innovative, industry-leading solutions.

We are experts on the effects of harsh environments relating to temperature extremes, vibration, high moisture, chemicals and transient power fluctuations. We know vehicle power and control systems from the smallest to largest platforms and are able to develop reliable products and system solutions that:

- Meet low and high-volume requirements, simple to complex
- Exceed OEM requirements for ruggedness, configurability and performance

## Markets served



Truck/bus



Construction



Agricultural



Military



Emergency vehicle



Specialty vehicle



Material handling

— High current  
 - - - CAN signal



Wireless Transmitter



Wireless Receiver

# Vehicle Controller



DC/DC Converter



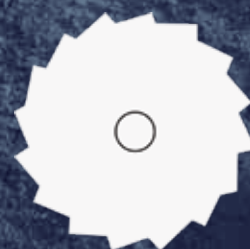
CAN Controlled Power Distribution Module



J1939 Keypads



Infotainment



Vehicle Implement

# Power distribution

## Flexible, rugged, custom solutions

Eaton's off-the-shelf and custom-designed power distribution products provide and protect vehicle power distribution, including vehicle electric centers, power distribution modules, fuse panels, fuse holders and junction blocks. Our product range offers multiplexing capabilities, high power ratings, ignition protection options and flexible configurations with rugged and serviceable, agency-compliant designs that include a range of sealing options up to IP6K9K.



### Series 31m - multiplexed vehicle electrical center

The multiplexed vehicle electrical center (mVEC) offers economical Controller Area Network (CAN) oversight for high power circuits in vehicle power distribution. The mVEC is rated at 200 Amps and is based on proven and patented technology that is suited for the most demanding transportation vehicle applications. The mVEC may be configured to provide various OEM circuit protection and switching functions, using industry standard fuses, relays and breakers, with the status and control of each circuit accessible through J1939 CAN open messages.

#### Key features

- The mVEC acts as a slave module on a J1939 network communicating via the vehicle data bus with the master controller
- Functionality as a node in existing vehicle networks is available today with plans for limited stand-alone capability planned for the future
- Capabilities include relay control as well as diagnostic reports for fuses, relays, and circuit breakers via the vehicle's CAN bus
- Both 12 & 24V functionality is available along with high-side and low-side control



### mRFRM

#### Series 154M -multiplexed rear-fed fuse and relay (mRFRM)

The multiplexed rear-fed fuse and relay module (mRFRM) is an enhanced version of the Eaton rear-fed fuse and relay module (RFRM) as it has a Controller Area Network (CAN) interface and rear fed sealed connectors. The mRFRM communicates with other devices on the vehicle's CAN bus using the SAE J1939 protocol and can be part of a multiplexing system that eliminates the need for individual connections between switches and loads. The mRFRM works by receiving messages to turn its relays "on" and "off," and by sending messages indicating the state of its monitored components.

#### Key features

- Accepts plug-in components common to power distribution such as fuses, relays, circuit breakers, diodes, etc. and is IP66 compliant
- Provides sockets for 14 relays (10 Form-A and 4 Form-C) and 28 two-bladed sockets for fuses or circuit breakers
- Each relay is protected by an associated fuse or circuit breakers
- 14 fuses or circuit breakers are for independent outputs
- All the output components are electronically interfaced with a CAN control board that monitors the state of components and controls relays that are plugged into the module

# Power conversion

## Conversion, conditioning, balancing and battery charging

Eaton's power conversion solutions provide standard and custom products for a wide range of DC-to-DC conversion, battery equalizer and DC-to-AC inverter requirements. Exceeding the most stringent performance requirements of military, commercial vehicle, agriculture and construction applications, we provide rugged products that maximize vehicle productivity and useful life.



### Power converters

Both standard product and custom developed DC-DC converters provide regulated power directly to accessory or main loads. The DC-DC converters produce 24V power from a 12V source and 12V power from a 24V, 48V and 72V sources.

#### Key features

- Operating with a typical efficiency of 94%, DC-DC converters are optimally ruggedized for transportation applications including state-of-the-art vibration, emissions and abnormal use features, such as reverse polarity protection
- Designed to meet specific customer requirements including, SAE, ISO, E mark, CE and military standards, as well as application specific environmental requirements



### Trail charger series

The trail charger DC/DC battery chargers allow operators to charge a remote battery bank at a temperature compensated voltage. This technology eliminates voltage loss due to long wire lengths and automatically adjusts for temperature extremes. The trail charger charges lift gate and other batteries at the voltage needed, working to keep batteries charged and ready for your next lift. The smart reduce mode also eliminates the need for additional cables.

#### Key features

- Compensates for voltage drop optimizing battery charge
- Temperature compensation provides optimal charge voltage
- Low standby current reduces drain on the vehicle
- Smart reduce mode circuitry ensures no interference with vehicle ABS systems



### Battery equalizers

Both standard product and custom developed battery equalizers maintain battery balance in vehicle applications with multiple voltages and high peak load demand. Eaton battery equalizers produce 10A to 100A outputs to equalize 12V and 24V systems.

#### Key features

- Operating with a typical efficiency of 94%, the battery equalizers are optimally ruggedized for transportation applications including state-of-the-art vibration, emissions and abnormal use features, such as reverse polarity protection
- Provide robust fail-safe operation for dual voltage systems



### True sine wave inverter

The true sine wave inverter provides clean, reliable AC power. With a true sine wave output, the inverter is able to power all electrical loads up to 1,800W, including sleep apnea machines, tools, motors and other demanding electrical devices. When shore power is available, a built-in 20A relay automatically transfers to incoming AC utility power, minimizing battery discharge and eliminating the need for an external transfer switch.

#### Key features

- True sine wave output
- Remote mounted user interface control panel
- Integrated AC transfer switch
- Optional battery charger
- Surge current of twice the rated output
- UL Listed / CSA Approved
- Battery over voltage and under-voltage protection
- Over temperature shutdown
- Automatic overload protection
- Short circuit and ground Fault protection

# Vehicle Controls

## Total flexible solutions for all your commercial vehicle switching needs

The vehicle controls portfolio at Eaton offers a broad range of solutions not only for on- and off-road vehicles, but also for commercial machine applications that require rugged, dependable switches. These products are at the heart of many systems, including heavy-duty trucks, construction and agriculture.



### Keypad multiplexed switch modules

The E31 Keypad modules are sealed to IP68 from the front and rear. This allows them to meet requirements in severe environment applications with exceptional tactile and visual operator feedback with up to four independent indicator LEDs.

#### Key advantages

- Reduced assembly labor due to ease of installation, allowing for mounting and connection of 8 switch modules at one time versus individually
- Master-expansion connectivity allows for using one harness to accommodate up to 8 keypads on a single controller I/O pair
- Reduced wire harness complexity offers reduction in weight, significantly reduced failure points and lower overall cost
- Increase in switch lifecycle over traditional electromechanical switches (1M cycles compared to 250,000)
- Customizable graphics on each switch provides for application specific requirements
- Up to four daylight visible indicator LEDs per switch for status, mode, and scaling
- Sleep mode available to reduce current draw on the battery
- CAN J1939 2.0B communication protocol



### Electronic switch modules

Designed to support harsh environmental applications, the E33 electronic multiplex switch module offers sealing to IP68 and additional features including guarded and locking rockers. The E33 also provides flexibility of up to eight switch modules (24 switches total) per CAN node and exceptional visual feedback via Eaton's extensive library of icons and multi-color indicator bar.

#### Key advantages

- Reduced assembly labor due to ease of installation, allowing for mounting and connection of 8 switch modules at one time versus individually
- Master-expansion connectivity allows for using one harness to accommodate up to 8 keypads on a single controller I/O pair
- Reduced wire harness complexity offers reduction in weight, significantly reduced failure points and lower overall cost
- Increase in switch lifecycle over traditional electromechanical switches (500,000 cycles compared to 250,000)
- Customizable graphics on each switch provides for application specific requirements
- IP68 sealed from the front and rear with optional panel sealing available
- Late point definition of circuit and rockers reduces inventory and provides flexibility for high mix, low volume applications
- Locking rocker and palm guard features available
- Sleep mode available to reduce current draw on the battery
- CAN J1939 2.0B communication protocol

# Wireless Controls

## Trusted wireless technology for high-value mobile machinery

For more than 25 years, Eaton's OMNEX Trusted Wireless™ remote control products have been used to wirelessly control high value machinery in harsh environments with utmost reliability, precision and durability. Our team of engineering experts develop customized solutions for applications that require high degrees of operator flexibility and safety when operating and manipulating vehicle-mounted equipment and mobile machinery.

### Two-way transmitters

Eaton's OMNEX Trusted Wireless™ robust, easy-to-use one-way and two-way remote control transmitters are designed to perform on a large variety of mobile industrial machines. OMNEX industrially hardened Trusted Wireless FHSS radio technology and impact-resistant packaging are your assurance of dependable operation and precise control.

#### Handhelds



##### TD110 remote control

- Two-way communication for real-time and precise machine feedback
- Robust construction with superior ingress protection, purposefully built for the harshest environments (IP65 and IP67 ratings)
- 1650 ft. range at 900 MHz (900 ft. @ 2.4 GHz)
- Multi-color indicator LEDs on control buttons give operator real time status and information
- Built-in rechargeable long-life lithium battery pack
- Contactless charging



##### TD1140 remote control

- 1650 ft. range at 900 MHz (900 ft. @ 2.4 GHz)
- OMNEX Trusted Wireless FHSS technology
- 1.8-inch backlit monochrome LCD display with graphics capability
- Proportional button capability with user-customized sensitivity
- Multiple battery options: rechargeable long-life lithium battery pack or off-the-shelf alkaline batteries
- Contactless charging and external battery charger available
- Bluetooth connectivity to Eaton wireless accessory
- Tether as alternate to wireless connectivity and for fast and simple user configurability
- E-stop option (twist to release)



##### TD2100 remote control

- 1650 ft. range at 900 MHz (900 ft. @ 2.4 GHz)
- 2-inch backlit FSTN monochrome LCD display with graphics capability
- Compact design with user-customized configuration control options of paddles, 2-axis joysticks, buttons, standard and specialized toggle switches and potentiometers
- Multiple battery options: rechargeable long-life lithium battery pack or off-the-shelf alkaline batteries, external battery charger available
- Bluetooth connectivity to Eaton wireless accessory
- Tether as alternate to wireless connectivity and for user configurability
- E-stop function with twist to release
- Available accessories including tether cable and external battery pack charger



## Belly-packs



### TD3100 remote control

- 1650 ft. range at 900 MHz (900 ft. @ 2.4 GHz)
- 3-inch backlit FSTN monochrome LCD display with graphics capability
- Compact design with user-customized configuration control options of paddles, 2-axis joysticks, 3-axis joysticks, buttons, standard and specialized toggle switches, and potentiometers
- Multiple battery options: rechargeable long-life lithium battery pack or off-the-shelf alkaline batteries
- Contactless charging and external battery charger available
- Bluetooth connectivity to Eaton wireless accessory
- Tether as alternate to wireless connectivity and for user configurability
- E-stop function with twist to release



### TD3200 remote control

- State-of-the-art ergonomic design: lightweight
- Customizable multi-function controller with extensive controls capability
- Superior 2-way communication
- Graphical display provides direct feedback from the machine
- 3.5" transfective color LCD display
- 20-hour battery life
- Waist belt, 4 point and shoulder harness options

## Receivers

Eaton's factory-configurable receivers are designed to work with our transmitters to provide complete mobile control solutions that stand up under the most demanding industrial conditions. Receivers directly connect to machine hydraulic valves and/or CAN bus for complete control. Our industrially hardened Trusted Wireless FHSS radio technology and impact resistant packaging are your assurance of dependable operation and precise control.



### R260 programmable 20-function CAN controller

- Designed with the latest in mobile control network technology
- Robust, license-free, wireless I/O module and valve driver
- 2-way wireless communication
- 20 I/O combinations
- CAN Bus Network Integration
- IEC 61131-3 compliant PLC programmability R160 19-function remote control receiver
- 19 I/O combinations
- E-Stop output for safe emergency shutdown to outputs and external circuits
- Powered from a 12 VDC or a 24 VDC system
- Capable of operating 4 proportional outputs and up to 19 digital outputs

Learn more at  
[www.eaton.com/low-voltageCVsolutions](http://www.eaton.com/low-voltageCVsolutions)

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