MICROCHIP

Automotive Solutions

Driving the Freedom to Innovate

Ethernet lin LOCAL INTERCONNECT NETWORK MOST CAN CERTIFIED USB

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Optimal Solutions for Innovation in the Car of the Future

Microchip's Automotive Solutions

The automotive industry continues to be a challenging environment. Intense competition drives automotive OEMs to seek innovative solutions to differentiate their vehicles, which in today's market are not only required to provide safe and reliable transportation, but must also offer the functionality to entertain, inform and connect to the outside world. Advanced technology is required to enable the delivery of these new features without compromising cost and weight.
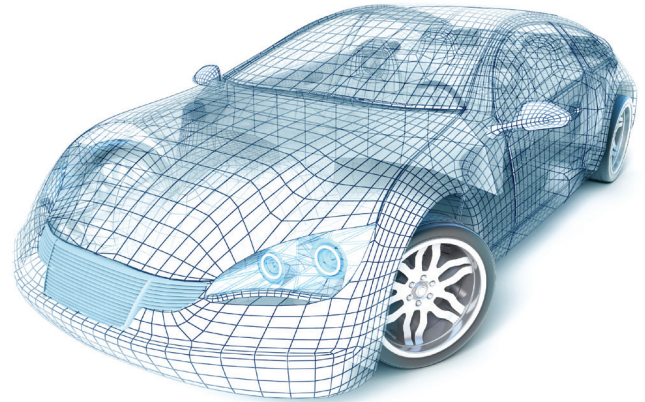
As automotive system suppliers race to address the rigorous and constantly changing requirements of automotive OEMs, the evolution of alternatives for the electrical/electronic architecture also continues. The demands of global automotive customers create many new challenges and opportunities for innovation.

With many years of experience in delivering embedded solutions to global automotive customers, Microchip Technology has a proven track record in the automotive market. Our broad portfolio of products, development tools and design support enable creative and advanced solutions which allow automotive OEMs to deliver vehicles that offer reduced fuel consumption and lower emissions, as well as a safer, more comfortable experience on the road for the vehicle occupants.

Automotive Grade Support

Microchip Technology has an understanding of automotive requirements from concept through production support. Automotive support is provided to our customers who specifically order devices listed in the Automotive Product Selector Guide as capable of meeting AEC requirements. Devices not listed in Microchip's Automotive Product Selector Guide as AEC-Q100 "compliant" or "capable" are not recommended for automotive applications. If you desire support of the stringent automotive requirements for quality, reliability, failure analysis and change control, you should not purchase standard part number devices.

As Microchip Technology supplies devices listed in the Automotive Product Selector Guide for both automotive and non-automotive applications, it is your responsibility to work with the local sales team to create and order custom part numbers to satisfy your automotive customer's quality requirements and support. Ordering standard versions of devices listed in the Microchip Automotive Product Selector Guide, Microchip Corporate Focus Product Selector Guide, microchipDIRECT or Microchip's website will not ensure the delivery of automotive-compliant devices and subsequent support. In the event that you order a non AEC-Q100 compliant device or a standard version of a device, Microchip Technology will only warrant commercial level support.

Commitment to the Relentless Quest for Perfection

Microchip Technology has been an ISO/TS-16949-certified supplier since 2003. "Quality Comes First' is at the top of the list of our Guiding Values, which provide the core principles that define our culture and the way we do business. Microchip's Aggregate System uniquely supports our commitment to exceptional quality, demonstrating an enterprise-wide dedication to continuous improvement and fostering an environment where every employee is responsible for quality.

Microchip supports various automotive quality initiatives:

- Zero defect
- Advanced Product/Process Quality Planning (APQP)
- AEC-Q100 stress testing
- Production Part Approval Process (PPAP)
- 8D reporting
- Product change notification

With two decades of experience in serving the demanding requirements of the automotive market, Microchip Technology has a proven track record of successfully delivering cost-effective and reliable total product solutions to our valued customers.

www.microchip.com/quality

Microchip: A Partner in Your Automotive Success

Functional Safety and ISO 26262

With their ever-increasing use in automotive designs, electronics play an essential role in vehicle operation, user convenience and the protection of human life. Given the widespread use of electronic systems in automotive applications, it can be difficult to understand how essential their correct operation is to the control of the vehicle. As long as these electronic systems work properly, the safety of the people in and around the vehicle depends primarily on the driver's skill and driving practices. But what happens when the electronics malfunction and prevent the driver from maintaining proper control? For example, an airbag may suddenly deploy while the vehicle is in motion, without being triggered by a crash. What if the driver doesn't even know that the electronics are malfunctioning, as might be the case when the image is frozen on a rear view camera? All electronics are susceptible to random failures. Although the failure rate may be quite low for individual components, the incremental use of electronics in a vehicle significantly increases the potential for failures to occur. Most software engineers will also agree that eliminating bugs is becoming more difficult as software grows in size and complexity. Functional safety is the ability of an electronic system to detect when there is a fault, make the driver aware of the fault and put the vehicle in a mode that allows the driver to maintain safe control. Returning to the example of the airbag, the diagnostics should identify the fault, disable deployment and turn on a warning light to inform the driver that the system is not working properly.

Recognizing the need to focus on the functional safety of electronic systems, the automotive industry has adopted ISO 26262, which is a derivative of IEC 61508. This automotive-specific standard applies not only to the design and test of electrical and electronic systems, but to the entire life cycle of the product, from concept to eventual disposal and recycling of the vehicle. The implementation of ISO 26262 supports the ability of component suppliers, system suppliers and automotive OEMs to discuss, evaluate, design, measure and ensure an appropriate level of functional safety for electrical and electronic control systems.

Ensuring a functionally safe system requires a comprehensive analysis of the hazards and risks. A robust system design, development and validation process is also required, with proper selection and usage of both hardware and software components. ISO-26262 defines a series of steps to assign an acceptable level of risk for a system, to minimize errors during the product development process and to determine if the end product achieves the required level of functional safety. The utilization of this common standard also enables a team of people working together on a project who are distributed around the world to more easily discuss complex functional safety topics.

Microchip enables functional safety in automotive embedded designs—from electronic door handles to electronic steering systems—by providing you with the right building blocks to create a system that meets the most stringent requirements. Our extensive experience in creating robust applications helps us develop semiconductor components that offer the right combination of hardware and software features, plus development tools, suitable for your most demanding automotive applications.

Functional Safety Relevant Feature	PIC10FXXX	PIC12FXXX PIC16FXXX	PIC12F1XX PIC16F1XXX	PIC18FXXXX
Self-Readable Output Pins	●	●	●	●
Watchdog Timer (WDT) + Internal RC Osc.	●	●	●	●
Windowed Watchdog Timer (WWDT)	–	–	○	–
Asynchronous Master Clear Reset (MCLR)	●	●	●	●
Under Voltage Detection (BOR, PLVD, HLVD)	○	●	●	●
Over Voltage Detection (HLVD)	–	–	–	○
Self-Readable Flash Memory	○	○	●	●
Fail-Safe Clock Mode (FSCM)	–	○	○	○
Hardware CRC Engine (RAM/Flash/Data Comm)	–	–	●	–
CAN Port Loopback Mode	–	–	–	○
Hardware Limit Timer (HLT)	–	–	○	–
C-Compiler ASIL-D Qualified per ISO-26262	●	●	●	●
LDRA Compliance Management Tool Suite	●	●	●	●

Functional Safety Relevant Feature	PIC24XXXX	dsPIC33XXXX
Self-Readable Output Pins	●	●
Watchdog Timer (WDT) + Internal RC Osc.	●	●
Windowed Watchdog Timer (WWDT)	○	○
Asynchronous Master Clear Reset (MCLR)	●	●
Under Voltage Detection (BOR, PLVD, HLVD)	●	●
Over Voltage Detection (HLVD)	○	○
Self-Readable Flash Memory	●	●
Fail-Safe Clock Mode (FSCM)	●	●
Hardware CRC Engine (RAM/Flash/Data Comm)	●	●
Flash Memory Hardware ECC	○	○
CAN Port Loopback Mode	○	○
Codeguard Memory Protection	○	○
High Precision Deadman Timer	○	○
MCAL Drivers for Autosar	●	●
C-Compiler ASIL-D Qualified per ISO-26262	●	●
LDRA Compliance Management Tool Suite	●	●

Legend

● Available in all devices
○ Available in some devices

Our support for functional safety doesn't stop at the component level. We can provide system designers with detailed information on any specific feature in a given device including advice about the proper usage of a feature, its relevant statistical reliability data, its signature when something goes wrong, methods for detecting malfunctions and possible safe modes when problems arise.

In addition, we have partnered with Liverpool Data Research Associates (LDRA) to provide a seamless integration between our MPLAB® X Integrated Development Environment and MPLAB XC compilers and LDRA's tool suite for functional safety compliance management, software verification, source code analysis and test tools. Contact your local Microchip representative for assistance in achieving the required level of functional safety for your next electronic system.

Advanced Driver Assistance Systems

Driver Assistance with MOST® Technology: Powerful Network Infrastructure for ADAS Solutions

Cameras are the key to many modern automotive applications like surround-view and lane departure warning. Depending on the application and the number of cameras, one or more video signals need to be transported to a control unit for display and/or signal processing. Digital video transmission with low latency is essential to match the application requirements.
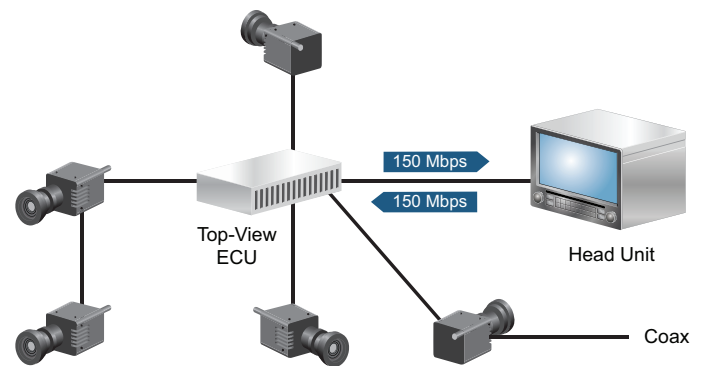
The MOST network has been designed from the beginning as time-division-multiplex network to provide data transmission with minimum latency and premium quality of service. In a multi-camera application, the cameras are synchronized via the MOST network to sample the video frames at exactly the same time with low jitter. The MOST network transports streaming data—like high definition video—as well as control data and packet data over the same cable. The MOST network controls each camera, and a camera back channel is implicitly supported by the nature of MOST technology. Additional data—such as parameter lists, camera settings and/or accompanying image information—can be sent to the control unit as packet data.

In addition to cameras, various sensors within the car can be networked with MOST technology to allow for central and/or de-central sensor data fusion. MOST technology can be used with an electrical and/or optical physical layer and with a variety of topology options including ring, star, daisy-chain, double ring or even with a mixture of topologies. This flexibility and the ability to easily create seamlessly connected clusters support the implementation of redundancy systems.

MOST technology delivers a functional system model to enable a scalable, modular and expandable driver assistance system design based on interchangeable and common sensors and control units.

Technical Key Benefits

- Real-time data transfer: digital high-definition video transmission with ultra-low latency
- Highest quality of service
- Flexible topologies: star, daisy chain, ring and any combination
- Automotive proven coax physical layer: full duplex and power over cable supported
- Synchronized devices
- Wide range of data types: streaming, control, packet and IP over one cable
- Remote control
- Single-chip solution for lean camera nodes

Figure: Top-view diagram

Application Example: Top-View (Surround-View)

The example below shows a Top-View Electronic Control Unit (ECU) connected to four high-resolution cameras. Both the camera links and the link to the head unit are capable of running compressed video of typically 50 Mbps up to 150 Mbps.
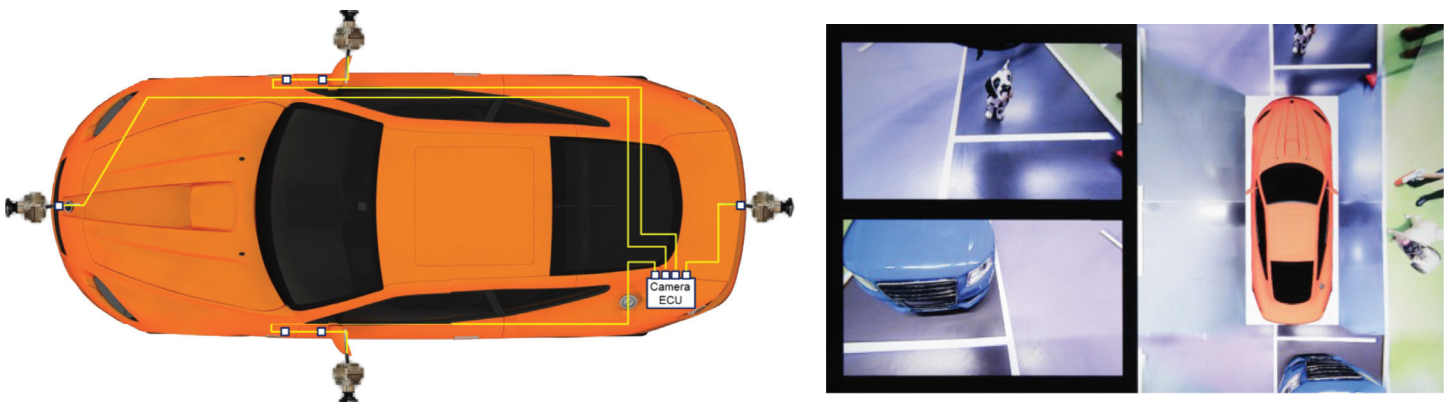

Figure: Top-view application with flexible views—top-view image, dewarped single camera pictures with minimal delay from camera to display

Infotainment Connectivity Solutions

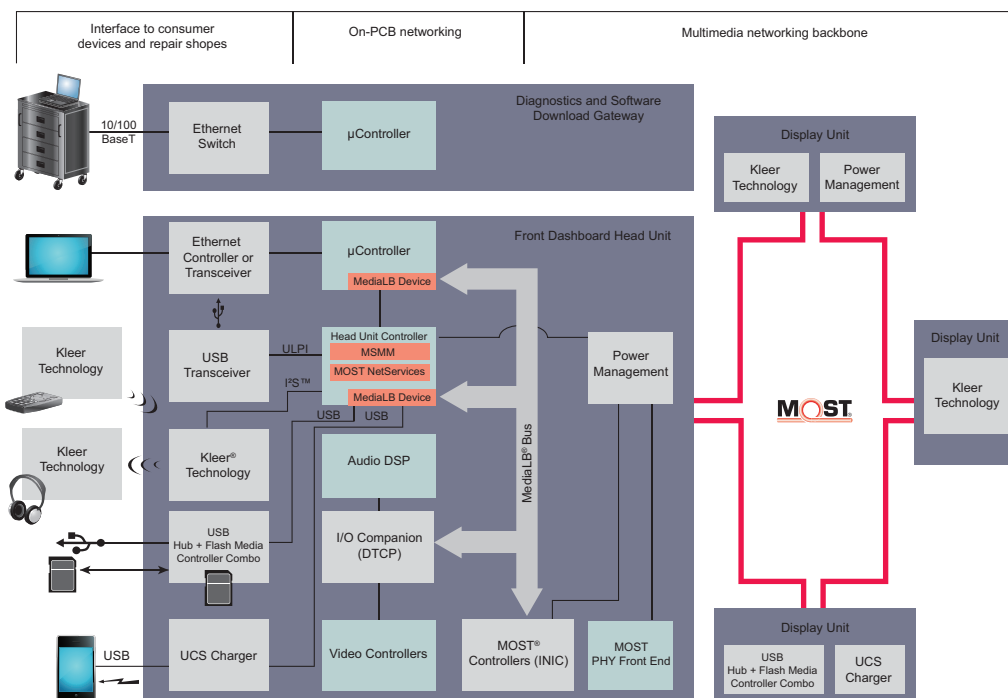## MOST Technology: Infotainment and Driver Assist Backbone

Media-Oriented Systems Transport (MOST) is the accepted standard for high-bandwidth automotive multimedia networking. This synchronous network provides excellent quality of service and seamless connectivity for audio/video streaming through a variety of multimedia interfaces. MOST technology:

- Uses a single interconnection to transport audio, video data and control information
- Supports fiber-optic, shielded or unshielded twisted pair wires and coax as its physical layers
- Supports 25, 50 and 150 Mbps speed grades
- Provides an automotive-proven physical layer for Ethernet
- Supports a variety and combination of topologies: star, daisy chain, ring

Kleer® Technology: Wireless Audio

Kleer technology provides a low-power, lossless wireless audio interface. Operating on the 2.4 GHz ISM band, it has been designed to coexist with other technologies such as Wi-Fi® and Bluetooth®. Microchip's automotive Kleer technology solutions:

- Provide CD-quality, lossless audio transmission
- Consume very low power compared to other consumer RF technologies
- Coexist with Wi-Fi/WLAN and other technologies operating in the ISM band

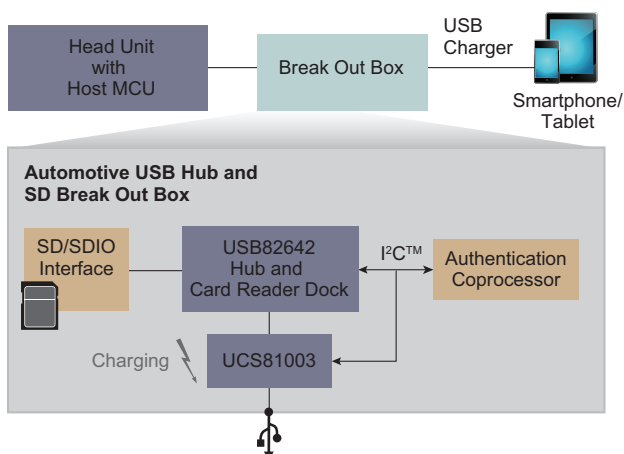| Microchip Solution	Suggested Products	Description
Intelligent Network Interface Controller (INIC)	OS81118	Fully encapsulated, single-chip, embedded network management Supports MOST technology embedded Ethernet channel and isochronous channels (MOST150) Supports USB 2.0 and coax physical layer
	OS81110	Fully encapsulated, single-chip, embedded network management Supports MOST® technology embedded Ethernet channel and isochronous channels (MOST150)
	OS81082	Fully-encapsulated, single-chip, embedded network management (MOST50)
	OS81092	ROM version of OS81082 INIC (MOST50)
	OS81050	Fully-encapsulated, single-chip with embedded network management (MOST25)
	OS81060	ROM version of OS81050 INIC (MOST25)
Multimedia I/O Companion	OS85650	Low-cost multimedia I/O port expander DTCP co-processor
	OS85652	Low-cost multimedia I/O port expander
	OS85656	Low-cost multimedia I/O port expander Well-suited for streaming applications
Power Management Companion	MPM85000	Power management companion for diagnostics, status monitoring and power supply
Kleer® Technology Wireless Audio	KLR83012	System-on-chip (SoC) solution for high-quality digital stereo audio over a robust RF link at very low power

USB Connectivity Solutions

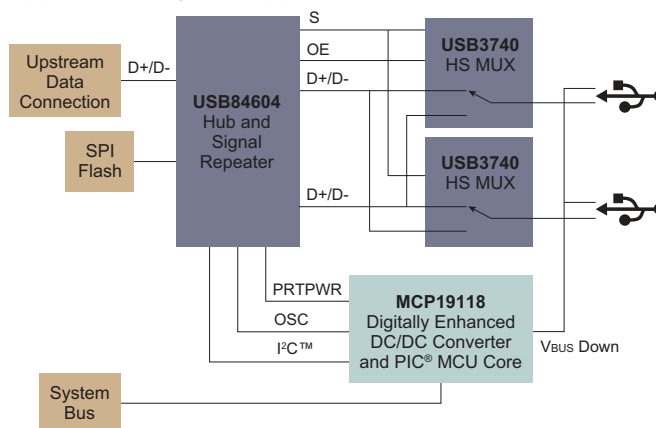## USB Break Out Box: Consumer Ports and Battery Charging

USB has become a ubiquitous interface used to transfer data, charge and control the operation of portable consumer devices. Microchip is a leading supplier of USB solutions for consumer, industrial and automotive applications which:

- Connect a growing number of portable consumer devices with the vehicle
- Provide an interface to a wide range of industrial devices such as Wi-Fi/WLAN and GPS components
- Enable charging of USB devices
- Offer RapidCharge Anywhere for high-current delivery to USB devices
- Include active current limiting and monitoring
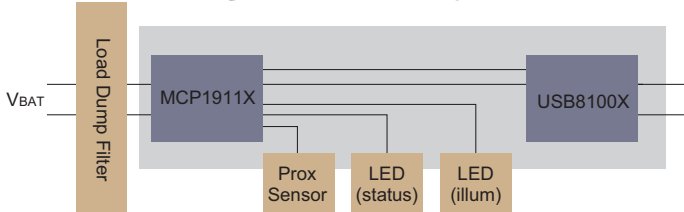- Provide programmable charging profile

Simple Charging and Data Transfer to Entertainment Devices

CDP1.2 Break Out Box with Dual Apple CarPlay™ Support

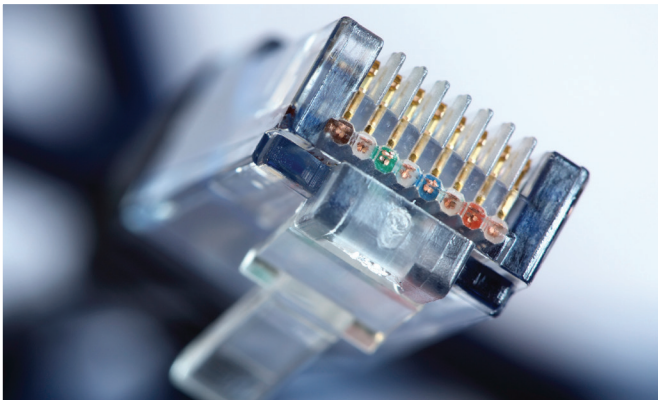### USB Smart Charger and Accessory Power Outlet

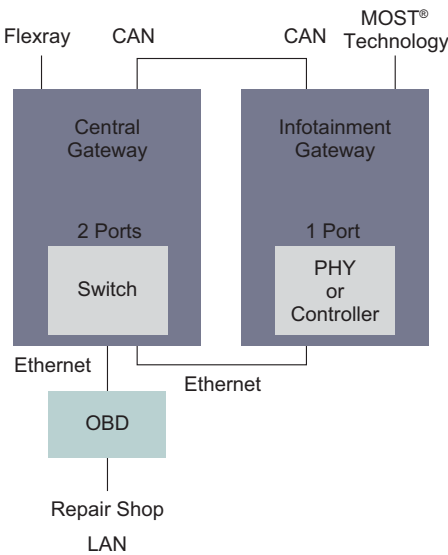| Microchip Solution	Suggested Products	Description
High-Speed USB 2.0 Hub	USB84604	Hub controller IC with 4 downstream ports, upstream port selectable between HSIC or USB 2.0, USB-IF BCS 1.2 on up and downstream ports (DCP, CDP, SDP), battery charging support for Apple® devices
		FlexConnect: Downstream port 1 able to swap with upstream port, USB to I²C™/SPI, GPIO, UART bridge endpoint support, configuration OTP Flash
	USB82512 USB82513 USB82514	Versatile, cost-effective, energy-efficient, incorporating Microchip's MultiTRAK™ technology, PortMap, PortSwap and PHYBoost technologies
	USB82640	Hub and Flash Media Card Controller Features Microchip's PortMap, PortSwap and PHYBoost technologies
	USB82642	Hub and Flash Media Card Controller USB bridge/card reader combo with USB to SDIO and USB to I²C bridging functionality and Microchip's PortMap, PortSwap and PHYBoost technologies
Hi-Speed USB 2.0 Transceiver	USB83340	Multi-frequency reference clock
USB 2.0 Hi-Speed Switch	USB3740	1 GHz of bandwidth allowing for the passage of robust 2.0 signals, very low-current consumption in an extremely small package, automotive qualified
Hi-Speed USB 2.0 Battery Charging	UCS81001 UCS81002	USB battery charger supporting BC1.2, China charging, Apple and RIM® charging profiles as well as programmable charging profiles for unforeseen peripherals
	USC81003	USB battery charging support BC1.2 DCP, 12W charging Apple, Samsung® profile, free programmable changing profiles, extended current limit provide flexibility for future charging profile changes
Buck Converter	MCP19XXX	Buck converter, proximity sensing, LED lighting, programmable integrated 8-bit MCU supports flexible designs
Diagnosis, Light Control, LIN Communication	PIC16F1XXX	Connection to body control network, diagnosis, LED color and dimming control

Ethernet Connectivity Solutions

Diagnostics, Software Download and Seamless Integration of Ethernet-Based Devices with MOST Technology

Ethernet is the most widely used networking technology in a repair shop's IT infrastructure. Microchip is a leading provider of embedded Ethernet products for a wide variety of consumer and industrial applications. Microchip's automotive Ethernet solutions:

■ Connect the vehicle to the repair shop service bay for diagnostics

■ Support a high-speed interface to download large amounts of data for software updates

Two Gateways Connected via an Ethernet Branch

■ Different physical layers and topology options applicable with the MOST technology hub
■ Integrated Ethernet-based applications:
  · Ethernet gateway
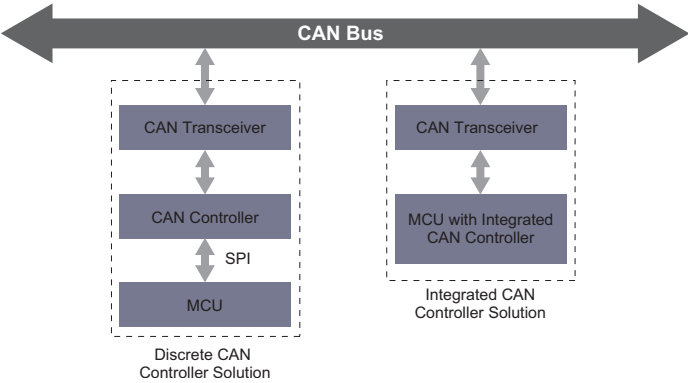 · Web server
  · Network Attached Server (NAS)
  · UPnP server

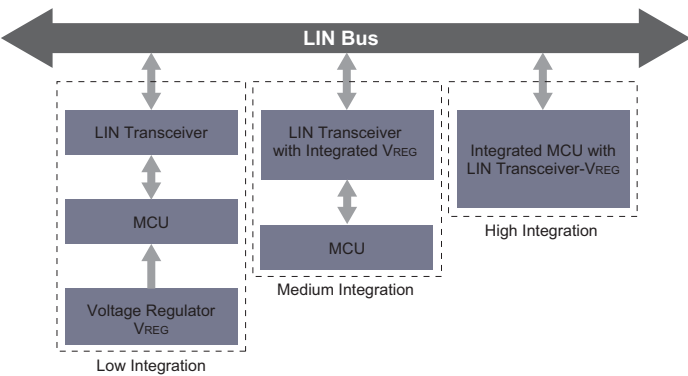| Microchip Solution	Suggested Products	Description
Controllers	LAN89218	High-performance, single-chip controller with HP Auto-MDIX support
	LAN89530	Hi-speed USB 2.0 to 10/100 Ethernet controller
	LAN89730	Hi-speed HSIC to 10/100 Ethernet controller
Switch	LAN89303	10/100 managed Ethernet switch with HP Auto-MDIX support
		High-performance, small-footprint, full-featured, single MII/RMII/Turbo MII support
Transceiver	LAN88730	10/100 Ethernet transceiver with HP Auto-MDIX support, featuring flexPWR® technology
		Small-footprint, low-power consumption, full-featured

CAN and LIN Connectivity Solutions

CAN

Microchip offers a complete line of products to meet the needs of high-performance CAN embedded applications, including standalone CAN controllers, CAN transceivers, and microcontrollers and digital signal controllers with integrated CAN controllers.

CAN Bus

CAN Transceiver → CAN Controller → SPI → MCU

Discrete CAN Controller Solution

CAN Transceiver → MCU with Integrated CAN Controller

Integrated CAN Controller Solution

Microchip Solution	Suggested Products	Description
CAN Transceiver	MCP256X Family	High-speed CAN transceiver
CAN Controller	MCP2515	Stand-alone CAN controller supports CAN V2.0B specification
Microcontroller (MCU) and Digital Signal Controller (DSC)	PIC18FXXK80 Family	8-bit MCU family with ECAN™ technology
	dsPIC33FJ Family	16-bit 40 MIPS DSC family with ECAN technology
	dsPIC33EP Family	16-bit 70 MIPS DSC family with ECAN technology
	PIC24H/E Family	16-bit MCU family with up to 70 MIPS performance with ECAN technology
	PIC32 Family	32-bit MCU family with up to 80 MIPS performance and ECAN technology

LIN

LIN can be implemented on any PIC® microcontroller with a USART or a EUSART interface. Microchip offers LIN transceivers, LIN-compliant drivers and a variety of development aids.

LIN Bus

LIN Transceiver → MCU → Voltage Regulator V_{REG}

Low Integration

LIN Transceiver with Integrated V_{REG} → MCU

Medium Integration

Integrated MCU with LIN Transceiver-V_{REG}

High Integration

Microchip Solution	Level of Integration	Suggested Products	Description
LIN Transceiver	Low	MCP200X Family	Stand-alone LIN transceiver family
	Medium	MCP202XA Family	LIN transceiver family with integrated voltage regulator
		MCP2050	LIN transceiver with integrated voltage regulator and windowed watchdog timer
LIN SIP	High	PIC16F1829LIN	Integrated, single-package 8-bit MCU, LIN transceiver and voltage regulator
Voltage Regulator	Low	MCP179X Family	70 mA, high-voltage linear regulator family

Actuator and Motor Control Solutions

Smart Actuators

Smart actuators use microcontrollers to perform intelligent tasks which enable better control, precision, torque and speed. They are being utilized more and more in the vehicles' high temperature zones to enhance performance, improve fuel efficiency, improve reliability, reduce cost and support compliance with exhaust emission standards.
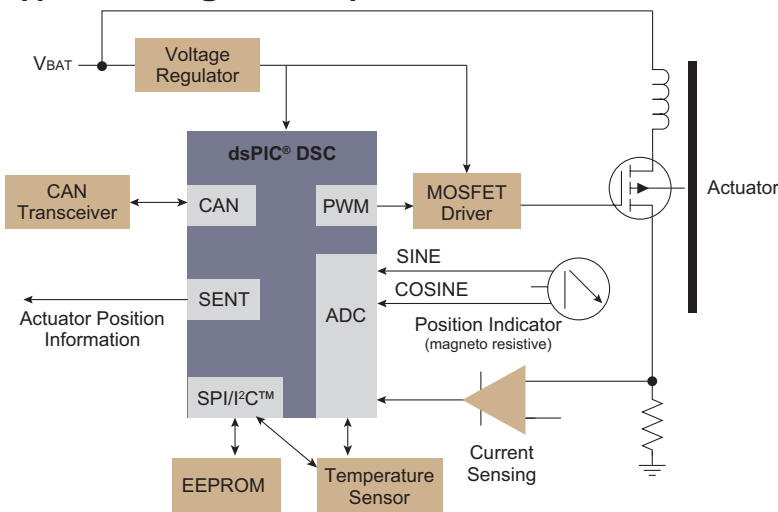
Simple linear actuators can be controlled by many of the 8-bit PIC microcontrollers. Rotary actuators such as BLDC motors demand the high-performance 16-bit dsPIC® digital signal controllers. The dsPIC digital signal controllers support advanced motor control algorithms such as Field Oriented Control (FOC), which delivers smooth control at low speed as well as efficient control at high speed. In applications requiring variable speed with constant torque and FOC for greater efficiency, the high-performance, scalable dsPIC DSC core includes DSP instructions for more precise control.

Typical Applications

- Exhaust flap control
- Exhaust Gas Recirculation (EGR) valves
- Throttle control valve
- Urea sensor control
- High-temperature sensor
- Turbo wastegate control
- Engine cooling fan
- Window lift control
- Fuel pump control
- Water pump control
- Mass air flow sensor control
- Gearshift control
- Clutch actuator
- Transmission actuator

Application Diagram Example: Smart Actuator

Microchip Solution	Suggested Products	Description
Digital Signal Controller	dsPIC33FJXXXMC Family	16-bit 40 MIPS Digital Signal Controller family with motor control peripherals
	dsPIC33EPXXXMC Family	16-bit 70 MIPS Digital Signal Controller family with motor control peripherals
CAN Transceiver	MCP256X Family	High-speed CAN transceiver family
LIN Transceiver	MCP200X Family	Stand-alone LIN transceiver family
EEPROM	24LCXXX Family	I²C™ serial EEPROM family
	25LCXXX Family	SPI Bus serial EEPROM family
Voltage Regulator	MCP179X Family	70 mA, high-voltage linear regulator family
MOSFET Driver	MCP14XX Family	Inverting/non-inverting single and dual power MOSFET driver family
	TC443X Family	High-voltage single MOSFET driver family
Temperature Sensor	MCP970X Family	Low-power linear active thermistor family
	MCP980X Family	Digital temperature sensor with 2-wire I²C/SMBus interface family
Gate Driver	MCP8024	3-Phase Brushless DC power module

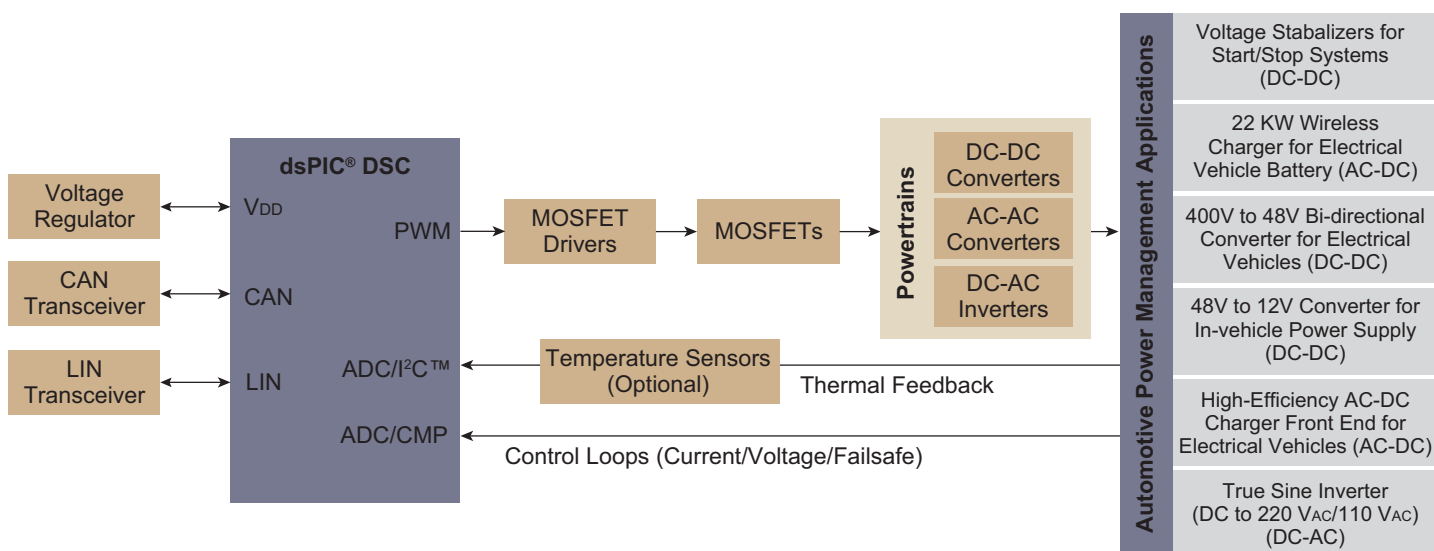# Power Management Solutions

Power Management

Automotive embedded systems designers are being challenged to reduce the quiescent current in an environment of an increasing number of electronic control modules (ECMs). Microchip provides a broad range of cost-effective solutions to help solve today's power management design challenges.

Typical Applications

- Voltage stabilizers for start/stop systems
- Wireless charger for electrical vehicle battery
- Bi-directional converter for electrical vehicles
- Converter for in-vehicle power supply

Application Diagram Example: Power Management

Microchip Solution	Suggested Products	Description
Digital Signal Controller	dsPIC33FJXXXGS Family	16-bit 40 MIPS Digital Signal Controller family with power conversion peripherals
	dsPIC33EPXXXGS Family	16-bit 70 MIPS Digital Signal Controller family with power conversion peripherals
MOSFET Driver	MCP14EX Family	Inverting/Non-inverting dual power MOSFET driver family
Temperature Sensor	MCP970X Family	Low-power linear active thermistor family
	MCP980X Family	Digital temperature sensor family with 2-wire I2C™/SMBus interface
Voltage Regulator	MCP16301	600 mA peak output current, DC-DC regulator
	MCP179X Family	70 mA, high-voltage linear regulator family
LIN Transceiver	MCP200X Family	Stand-alone LIN transceiver family
CAN Transceiver	MCP256X Family	High-speed CAN transceiver family

LED Interior Lighting Solutions
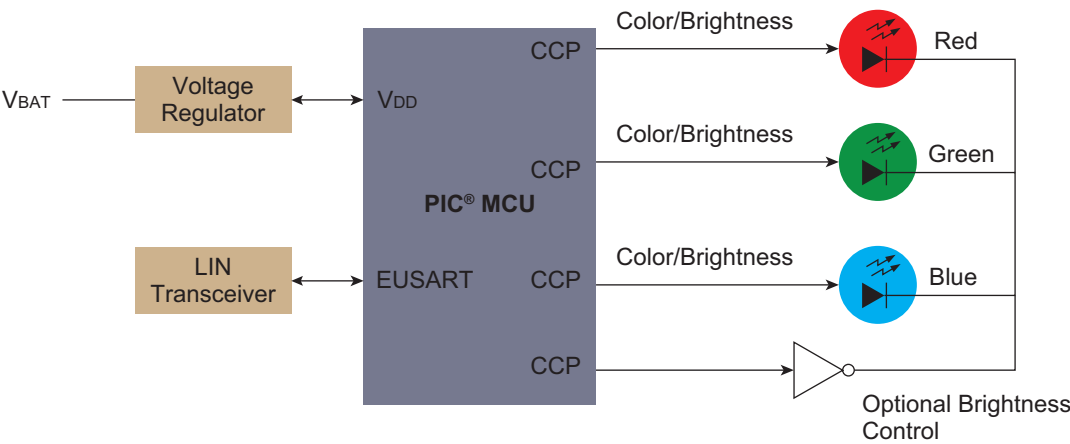
Automotive Ambient RGB LED

Red, Green and Blue (RGB) LEDs can be used in a variety of automotive lighting applications. The color and brightness of an RGB LED can be controlled by a PIC microcontroller with LED driver capability that offers at least three output channels. This allows the LEDs to be used to implement an interior color scheme to highlight the unique look and feel of a car model or to be dimmed for nighttime lighting that is not too bright or distracting to the driver. Each RGB LED node is connected to a LIN bus as slave. The LIN master node controls each slave's color profile. Each LIN bus contains one master and up to 15 slaves. More than one LIN bus should be used to control a large quantity of RGB LEDs.

Typical Applications

- Footwell lights
- Cup holder lights
- Tell-tale lights
- Cluster backlighting
- Capacitive touch backlighting
- LCD panel backlighting

Application Diagram Example: Interior Automotive RGB LED Ambient Lighting

Microchip Solution	Suggested Products	Description
Microcontroller	PIC16F Family	8-bit mid-range MCU family with on-chip EEPROM
	PIC18F Family	8-bit high-end MCU family with on-chip EEPROM
LIN Transceiver	MCP200X Family	Stand-alone LIN transceiver family
	MCP202XA Family	LIN transceiver family with integrated voltage regulator
	MCP2050	LIN transceiver with integrated voltage regulator and windowed watchdog timer
LIN SIP	PIC16F1829LIN	Integrated, single-package 8-bit MCU, LIN transceiver and voltage regulator
Voltage Regulator	MCP179X Family	70 mA, high-voltage linear regulator family

LED Exterior Lighting Solutions

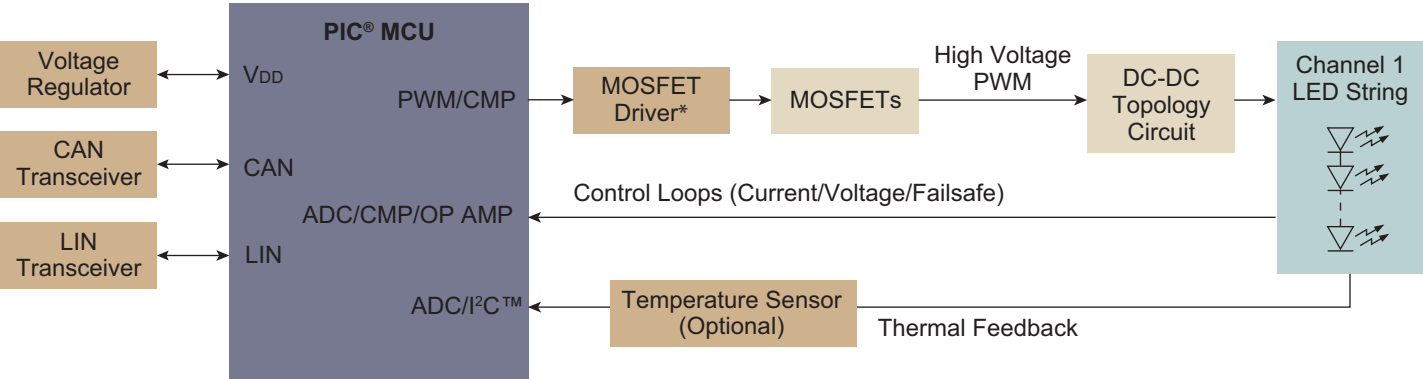## Low-End Exterior Automotive LED Control Module Solution

Microchip's broad portfolio of microcontrollers offers you cost-effective building blocks to enable a low-cost yet capable Switch Mode Power Supply (SMPS) control configuration for single LED string applications. A cost-effective 8-bit PIC microcontroller delivers closed-loop regulation for this type of application. The configuration below supports flexible DC/DC converter topologies with circuits such as boost, buck, buck-boost, Ćuk, flyback and SEPIC. As fog lights and turn indicator lights have more relaxed beam stability requirements than front headlamps, these are ideal applications for this low-end oriented configuration.

Typical Applications
- Fog lights
- Turn lights

Application Diagram Example: Single LED String Control Using PIC MCU

* MOSFET driver is not needed if the selected MOSFET's gate voltage is compatible with the MCU's switching output voltage.

Microchip Solution	Suggested Products	Description
Microcontroller	PIC12F/PIC16F/ PIC18F Family	8-bit MCU family
Voltage Regulator	MCP16301	600 mA peak output current, DC-DC regulator
	MCP179X Family	70 mA, high-voltage linear regulator family
LIN Transceiver	MCP200X Family	Stand-alone LIN transceiver family
CAN Transceiver	MCP256X Family	High-speed CAN transceiver family
Temperature Sensor	MCP970X Family	Low-power linear active thermistor family
	MCP980X Family	Digital temperature sensor with 2-wire I²C™/SM Bus interface family
MOSFET Driver	MCP14XX Family	Inverting/non-inverting single and dual power MOSFET driver family
	TC443X Family	High-voltage single MOSFET driver family

LED Exterior Lighting Solutions

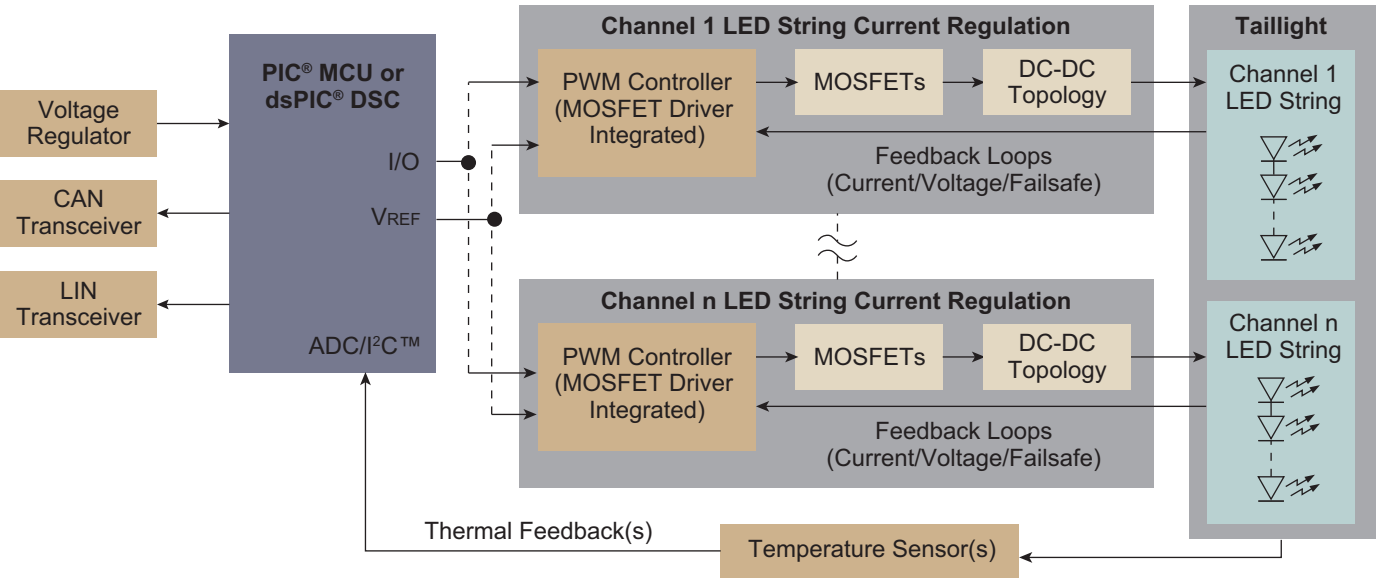## Mid-Range Exterior Automotive LED Control Module Solution

The mid-range LED control module solution enables you to expand the functional capability of a lighting system to support the safety of a vehicle's occupants while also reducing the vehicle's weight and improving its fuel efficiency. Utilizing a low-cost PIC microcontroller in conjunction with discrete PWM controllers to regulate one or more LED strings allows scalability of the LED control module. Microchip's solutions provide the flexibility to effectively address a range of system requirements.

Typical Applications

- Fog lights
- Tail lights
- Daytime running lights
- Position lights
- High/low beam headlamps
- Corner lights

Application Diagram Example: MCU in Conjunction with Multiple Discrete PWM Controllers

Microchip Solution	Suggested Products	Description
Microcontroller	PIC® MCU/dsPIC® DSC Family	8-bit/16-bit/32-bit MCU/DSC family
Voltage Regulator	MCP16301	600 mA peak output current, DC-DC regulator
	MCP179X Family	70 mA, high-voltage linear regulator family
LIN Transceiver	MCP200X Family	Stand-alone LIN transceiver family
CAN Transceiver	MCP256X Family	High-speed CAN transceiver family
Temperature Sensor	MCP970X Family	Low-power linear active thermistor family
	MCP980X Family	Digital temperature sensor with 2-wire I²C™/SM Bus interface family
PWM Controller	MCP163X Family	High-speed, microcontroller-adaptable, pulse width modulator family

LED Exterior Lighting Solutions

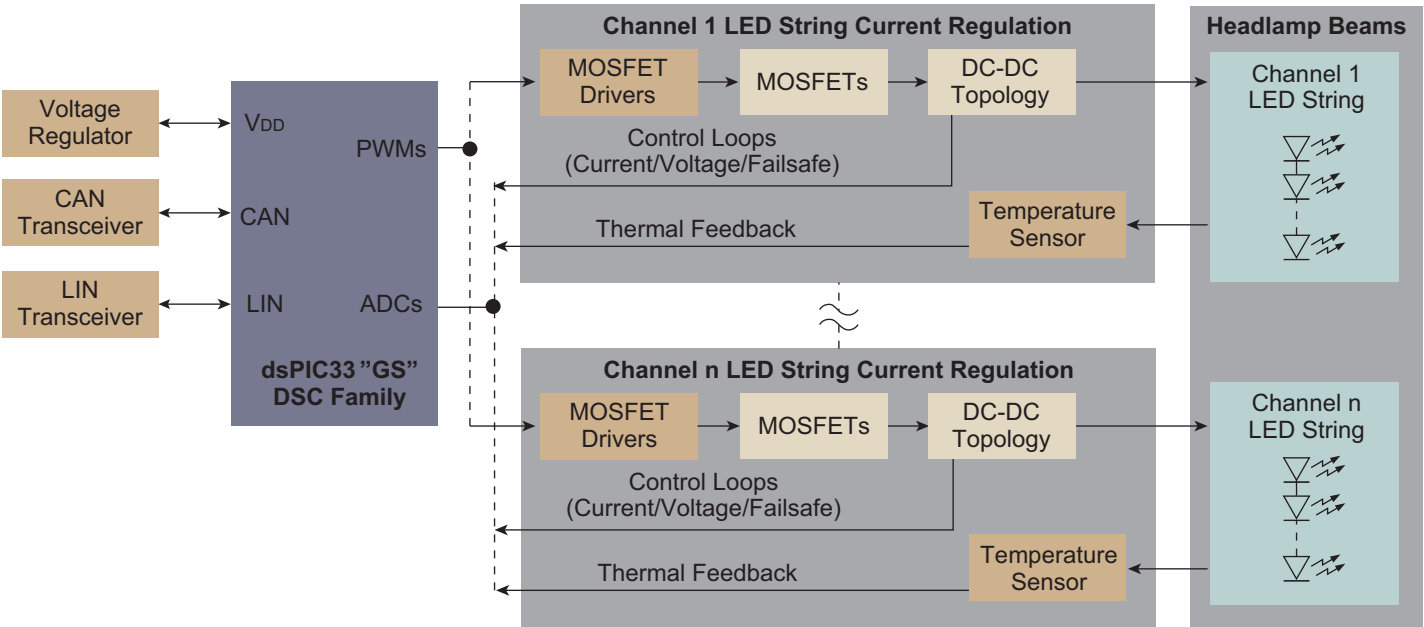## High-End Exterior Automotive LED Control Module Solution

Microchip's broad portfolio of dsPIC Digital Signal Controllers (DSCs) offers an excellent building block to support high-end solutions. The DSC utilizes switch mode power supply (SMPS) techniques to regulate a large number of LED strings or matrix LEDs. With its feature-rich, performance-oriented PWM peripherals and analog peripherals, the dsPIC33 "GS" Family offers a controller capable of regulating up to 18 high-brightness LED strings or 18 individual matrix LEDs independently from each other. The DSC has sufficient performance to control all head lamp beams, daytime running lights, turn indicator lights and thermal fans.

Typical Applications

- Headlamp
- High/low beam
- Corner lights

Application Diagram Example: Single Controller with Multiple LED Strings

Microchip Solution	Suggested Products	Description
Digital Signal Controller	dsPIC33FJXXXGS Family	16-bit 40 MIPS Digital Signal Controller family with power conversion peripherals
	dsPIC33EPXXXGS Family	16-bit 70 MIPS Digital Signal Controller family with power conversion peripherals
Voltage Regulator	MCP16301	600 mA peak output current, DC-DC regulator
	MCP179X Family	70 mA, high-voltage linear regulator family
LIN Transceiver	MCP200X Family	Stand-alone LIN transceiver family
CAN Transceiver	MCP256X Family	High-speed CAN transceiver family
Temperature Sensor	MCP970X Family	Low-power linear active thermistor family
	MCP980X Family	Digital temperature sensor with 2-wire I^2C™/SM Bus interface family
MOSFET Driver	MCP14XX Family	Inverting/non-inverting single and dual power MOSFET driver family

Human-Machine Interface Solutions

Touch and Free-Space Sensing Solutions

Microchip offers a broad portfolio of semiconductors for touch technologies that are capable of being integrated into a vehicle's Human-Machine Interface (HMI). Our solutions have expanded to include innovative, unique touch and free-space (3D) sensing techniques. Our turnkey solutions include devices, firmware and software tools to provide a comprehensive, flexible platform to solve your touch and input sensing challenges.

Microhip's mTouch® software libraries simplify software development and enable quicker time to market. Supported functions include:

- Momentary buttons
- Linear and rotary slider
- Metal Over Capacitance (MOC) buttons
- Proximity detection
- Touchpad
- Gesture control

Our patented GestIC® technology allows the fast detection and tracking of a driver's hand movements in 3D. It enables hand/finger position tracking and the use of intuitive free-space gestures in real time, which allows the driver to interact with devices while minimizing the distraction level.
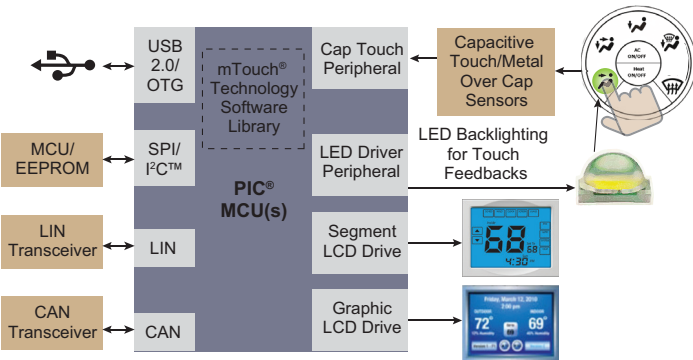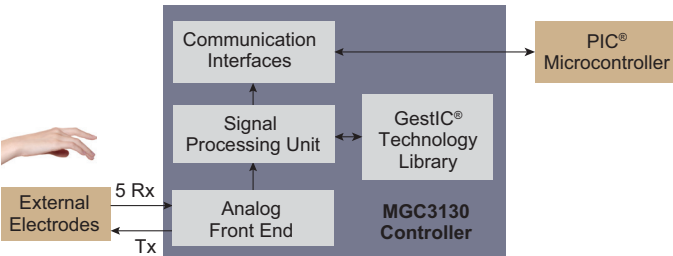

Typical Applications

Replace buttons, knobs and switches; support touchpads and gesture control in:

- HVAC controls
- Audio/navigation/telematics controls
- Window lift controls
- Overhead console controls
- Dome light controls
- Multi-function steering controls
- Door and trunk controls

Application Diagram Example: Automotive Center Console HMI

Application Diagram Example: GestIC Technology and USB Concept

Microchip Solution	Suggested Products	Description
Microcontroller	PIC12F Family	8-bit baseline MCU family
	PIC16F Family	8-bit mid-range MCU family with segmented LCD peripherals
	PIC18F Family	8-bit high-end MCU family with segmented LCD, USB and CAN peripherals
	PIC24F/H/E Families	16-bit MCU families with segmented LCD, graphics, USB and CAN peripherals
	dsPIC33F/E Families	16-bit Digital Signal Controller families with CAN peripherals
	PIC32 Family	32-bit MCU family with Ethernet, USB and CAN peripherals
Voltage Regulator	MCP16301	600 mA peak output current, DC-DC regulator
	MCP179X Family	70 mA, high-voltage linear regulator family
LIN Transceiver	MCP200X Family	Stand-alone LIN transceiver family
CAN Transceiver	MCP256X Family	High-speed CAN transceiver family
GestIC® Technology Controller	MGC3130	Electrical near field (E-field) 3D tracking and gesture controller

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Microchip Technology Inc.
2355 W. Chandler Blvd.
Chandler, AZ 85224-6199