Intelligent Power Supply Design Solutions

Today, power supply designers must create power conversion products that offer greater efficiency, higher power density, higher reliability, advanced communications and sophisticated control features. And, as always, these products need to be developed and marketed quickly and at lower costs. Microchip offers a comprehensive set of Intelligent Power Supply solutions enabling you to meet these challenges.

What is an Intelligent Power Supply?

Traditional power supply designs use analog ICs with fixed functionality to provide regulated power. The intelligent power supply integrates a microcontroller (MCU) or Digital Signal Controller (DSC) for a fully programmable and flexible solution. Below are some examples of intelligent power supply functions:

- Digital on/off control for low standby power
- Power supply sequencing and hot-swap control
- Programmable soft-start profile
- Power supply history logging and fault management
- Output voltage margining
- Current fold back control
- Load sharing and balancing
- Regulation reference adjustment
- Compensation network control and adjustment
- Full digital control of power control loop
- Communications
- AC RMS voltage measurement
- Power factor correction

Typical intelligent power supply applications include the following:

- AC-to-DC converters
- DC-to-DC converters
- DC-to-AC inverters
- Wireless power transmitters/receivers
- Uninterruptible Power Supply (UPS)
- Renewable power/pure sine wave inverters
- Battery chargers
- HID, LED and fluorescent light ballasts
- Networked Power Distribution Units (PDUs)

Why Intelligent Power Conversion?

Implementing power conversion functions with digital control offers many benefits to your designs and applications. These functions are enabled by performing power conversion control via reprograming software in conjunction with the performance and features offered by our Digitally Enhanced Power Analog (DEPA) technology as well as our PIC® MCUs, dsPIC® DSCs and microprocessors (MPUs).

With intelligent power conversion, you can experience the following benefits of digital control when developing your design:

1. **Lower system component count and lower raw material costs.** Valuable board space can be allotted for magnetics and power components. You can incorporate power supply control, regulation and protection functions into one device and easily integrate auxiliary functions, including fan control and data logging. Since many analog controller blocks can be integrated into our dsPIC DSCs, your Bill of Materials (BOM) costs and system's complexity will be reduced.
2. **Increased system efficiency.** Our dsPIC DSCs have on-board, high-performance peripherals, such as Pulse-Width Modulation (PWM) generators, Analog-to-Digital Converters (ADCs) and comparators, and high-performance Digital Signal Processing (DSP) engines. The combination of these features allows you to implement many digital algorithms into a single device. As a result, your project's system performance is enhanced with higher power efficiency.
3. **Absolute compatibility with advanced conversion topologies.** Digital power fully supports complex power conversion topologies, such as resonant and quasi-resonant converters. Digital control can also be used to achieve high power efficiency and high power density with new topologies, including phase-shifted full-bridge and LLC-resonant converters.
4. **Highly flexible control parameters.** The sophisticated control algorithms of digital power let you dynamically change the control parameters and adapt the system behavior of your design to input and load changes.

How Can Microchip Help?

In addition to its local and global non-commissioned sales force, Microchip provides these products and resources for power conversion applications:

- 8-, 16- and 32-bit microcontrollers and microprocessors and 16-bit digital signal controllers
- High-side, low-side and synchronous MOSFET gate drivers
- Temperature sensors, fan controllers, digital potentiometers and op amps
- Analog PWM controllers including external control inputs
- High-voltage linear regulators and high-voltage interface products
- Serial EEPROM memory products
- Power conversion development tools, reference designs, algorithms and software
- Power conversion training and technical support

Scalable Solutions for Power Conversion Applications

Microchip delivers everything a power conversion design engineer needs: low-risk product development, lower total system cost, faster time to market, outstanding technical support and dependable delivery and quality.

An intelligent power supply does not need to be complex or expensive. Offering MCUs and DSCs ranging from 6- to 144-pins, Microchip has an appropriate device solution for every application. Many simple tasks can be implemented with a low-cost MCU that contains basic peripherals. For more demanding applications, many of our MCUs and DSCs have innovative on-chip peripherals designed specifically for power conversion. These peripherals include fast PWM modules with special operating modes and high-speed Analog-to-Digital Converters (ADCs) for fast acquisition of power supply feedback signals.

Microchip Power Conversion Solutions	Technical Functions	Recommended Devices	Applications
Full Digital Power	• Dynamic control loop adjustment • Predictive control loop algorithms • Operational flexibility for different power levels	dsPIC33E DSCs dsPIC33C DSCs	• AC-DC or DC-DC conversions • Renewable energy • Telecom servers and networking • Automotive on-board charger, fast charger and bus balancer • Wireless power
Digitally Enhanced Power Analog (DEPA) Hybrid Controllers	• High input voltage capability • Integrated high current drive pins • Increased configuration capability • Programmable fault response	MCP19110 Buck Controller MCP19111 Buck Controller MCP19114 Current Controller MCP19125 Current and Voltage Controller MCP19214 Dual-Channel DEPA Current Controller MCP19215 Dual-Channel DEPA Current Controller	• Battery charging • Dimmable single- or multi-string LED lighting • Automotive power applications
Core Independent Peripheral (CIP) Hybrid Power Controllers	• Flexibility to assemble multiple control topologies managed by a single CPU	PIC16F1764 MCU PIC16F1769 MCU PIC16F1777 MCU PIC16F753 MCU	• Management of solid-state lighting solutions • Advanced dimming solutions for automotive and building automation • Battery charging • Multistage power sequencing • Smart power applications for the Internet of Things (IoT)
Silicon Carbide (SiC) Devices and Power Modules	• Improved system efficiency • High-power density • High temperature stability • Reliable and rugged	SiC Schottky Barrier Diodes (SBDs) SiC 700V–1200V MOSFETs SiC Power Modules SiC Digital Programmable Gate Drivers	• External charging, on-board charging, DC-DC conversion, motor drive in electric vehicles • High-power industrial power supplies and motor control • Renewable energy • Servers and computer networking
DC-DC Linear Voltage Regulators	• Low-power standby • Programmable soft start • Power up sequencing	PIC10F MCUs PIC12F MCUs MIC45408 Integrated Power Module MIC28304 Integrated Power Module MCP16xxx Integrated Switching Regulators	• Battery management • Lighting • Energy harvesting • Embedded power conversion

Digital Control of Analog Regulators

Linear Low-Dropout (LDO) Regulators

Our linear LDO regulators feature ultra-low quiescent current, ultra-low dropout voltage, ultra-high ripple rejection, very accurate output, fast transient response, a wide selection of packages and a wide input voltage range.

Switching Regulators

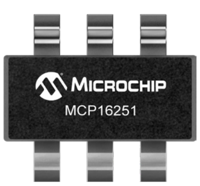
Our comprehensive portfolio supports buck, boost, buck-boost and SEPIC designs from 100 mA peak output current up to 12A as well as multi-output regulators to support multiple point-of-load applications such as microprocessors, FPGAs and ASICs.

DDR Termination Regulators

DDR termination regulators are essential for regulating power through DDR transmission lines. Our products provide reduced power dissipation and higher efficiency.

Charge Pumps

Charge pump ICs convert and regulate voltage using capacitive energy storage elements. They are efficient and easy to use for applications with low-current requirements.



MCP16311

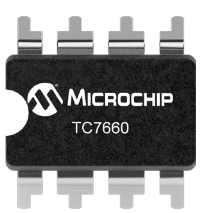
MIC24045

MCP16251

MCP1665

MIC28514

TC1044S



TC7660

TC7660H

TC7660S

TC7662B

Core Independent Peripheral (CIP) Hybrid Power Controllers

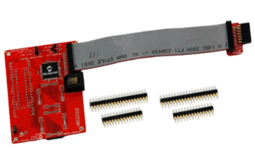
You can efficiently implement an analog control loop with a PIC® MCU that features the most recent set of CIP blocks that are optimized for power conversion applications. These MCUs implement a hybrid approach to power control by combining the flexibility of analog and digital peripherals that can be configured at runtime to enable the MCU to control a variety of topologies. To provide you with the maximum flexibility in selecting power and voltages, these CIP hybrid power controllers do not include integrated FET drivers.

Since CIPs are designed to operate independently from the core, they free up the Central Processing Unit (CPU) to perform communication and coordination tasks. A single controller can manage up to four independent power conversion stages. This solution is excellent for managing smart solid state lighting, advanced dimming for automotive and building automation, battery charging, multistage power sequencing and smart power applications for the Internet of Things.

Select 8-bit PIC10F, PIC12F and PIC16F Microcontrollers

Product	Pins	Flash Memory (B)	Self Read/Write	RAM (B)	EE Bytes	Timer 8-/16-bit	PRG/SC	Op Amp	ZCD	Comparator	PWM	ADC	DAC	DSM	EUSART	SPI/I2C
PIC16F18313	10	3.5 K	✓	256	256	3/1	–	–	–	1	1 × Half Bridge	5 × 10-bit	1 × 5-bit	1	1	1
PIC16F(HV)753	14	3.5 K	✓	128	HEF*	3/1	0/1	–	–	2	1 × Half Bridge	8 × 10-bit	1 × 9-bit	–	–	–
PIC16F1765	14	14 K	✓	1 K	HEF*	4/3	1/0	1	1	2 × High Speed	1 × Full Bridge	8 × 10-bit	1 × 5-bit 1 × 9-bit	1	1	1
PIC16F1769	20	14 K	✓	1 K	HEF*	4/3	1/0	2	1	4 × High Speed	2 × Full Bridge	12 × 10-bit	2 × 5-bit 2 × 9-bit	2	1	1
PIC16F1778	28	28 K	✓	2 K	HEF*	4/3	1/0	3	1	6 × High Speed	3 × Full Bridge	17 × 10-bit	3 × 5-bit 3 × 9-bit	3	1	1
PIC16F1779	40	28 K	✓	2 K	HEF*	4/3	1/0	4	1	8 × High Speed	4 × Full Bridge	28 × 10-bit	4 × 5-bit 4 × 9-bit	4	1	1

*High-Endurance Flash: 128B non-volatile data storage with high-endurance 100k E/W cycles



PIC16(L)F1719 Emulation Extension Pak

CIP Hybrid Power Starter Kit

Silicon Carbide (SiC) Devices and Power Modules

Silicon Carbide (SiC) semiconductors are innovative, new options for improving system efficiency, supporting higher operating temperatures and reducing costs in your power electronic designs. They can be used in broad range of high-voltage, high-power applications in industrial, automotive, medical, aerospace, defense, and communication market segments. Our next-generation SiC MOSFETs and SiC Schottky Barrier Diodes (SBDs) are designed with high-repetitive Unclamped Inductive Switching (UIS) capability and excellent gate oxide shielding and channel integrity for robust operation. Our SiC MOSFET and SiC SBD die can be paired for use in power modules with various topologies.

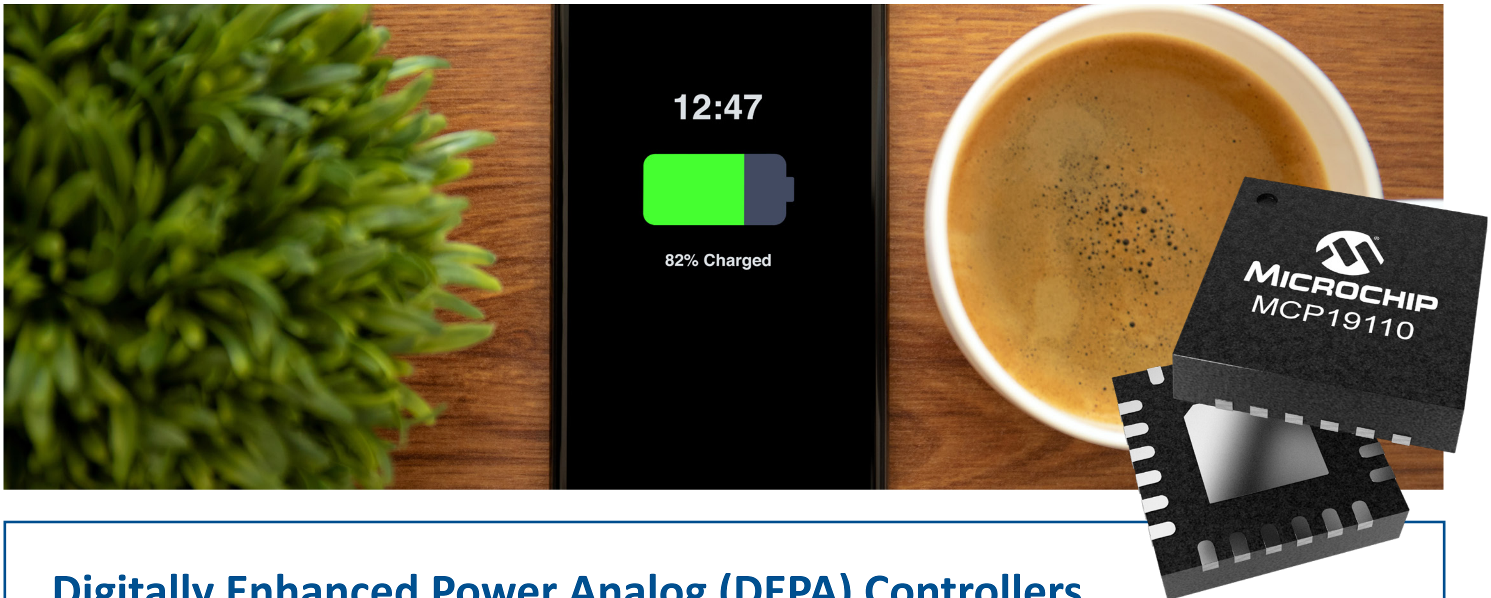
SiC Devices and Power Modules Offer:

- Improved system efficiency with lower switching losses
- Higher power density for similar power topologies
- Higher operating temperature
- Reduced cooling needs, smaller filters and passives
- Higher switching frequency
- Ten times lower Failure In Time (FIT) rate for neutron susceptibility than comparable Insulated Gate Bipolar Transistors (IGBTs) at rated voltages
- Extremely low parasitic (stray) inductance at < 2.9 nH in SiC modules

How Can Silicon Carbide Devices Solve Your Design Challenges?

- Wide range of 700V, 1200V and 1700V SiC products to support a variety of markets and applications
- Higher SiC power density vs. silicon enables smaller magnetics, transformers, filters and passives, resulting in a compact form factor
- SiC products can be combined with other Microchip devices, including 8-, 16- and 32-bit microcontrollers, power management devices, analog sensors, touch and gesture controllers and wireless connectivity solutions, to create a total system and lower overall system costs

Vienna 3-Phase Power Factor Correction (PFC) Reference Design



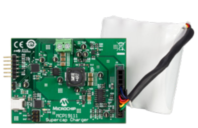
Digitally Enhanced Power Analog (DEPA) Controllers

Combine the Speed of an Analog Controller with the Flexibility of a Digital Microcontroller

Digitally Enhanced Power Analog (DEPA) controllers contain analog control loops with digital oversight using analog references, amplifiers and Pulse-Width Modulation (PWM) generators to regulate an output, while configuring, monitoring, measuring and dynamically adjusting that performance with an embedded Microcontroller (MCU).

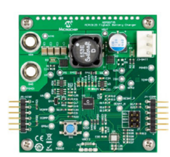
DEPA Technology Lets You Easily:

- **Measure the environment:** Including input voltage, output voltage, current, temperature, external reference or control signals
- **Respond to the environment:** Dynamically adjust output voltages, currents, limit conditions; or signaling other devices
- **Intelligently handle problems:** Customize fault, brownout, over- and under-voltage responses to create predictable system behavior
- **Manage system power:** Sequence start and shutdown throughout a board for robust operation across all operating conditions
- **Communicate:** Using dedicated output pins or digital interfaces, with standard or proprietary messaging schemes

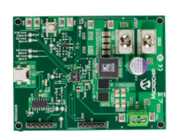


MCP19111 Battery Charger Evaluation Board

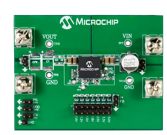
19114 Flyback



19125 Battery Charger



MCP19111 PMBus Enabled Point of Load (POL) Demonstration Board (ARD00609)



MIC45208-1YMPL Evaluation Board

Full Digital Power

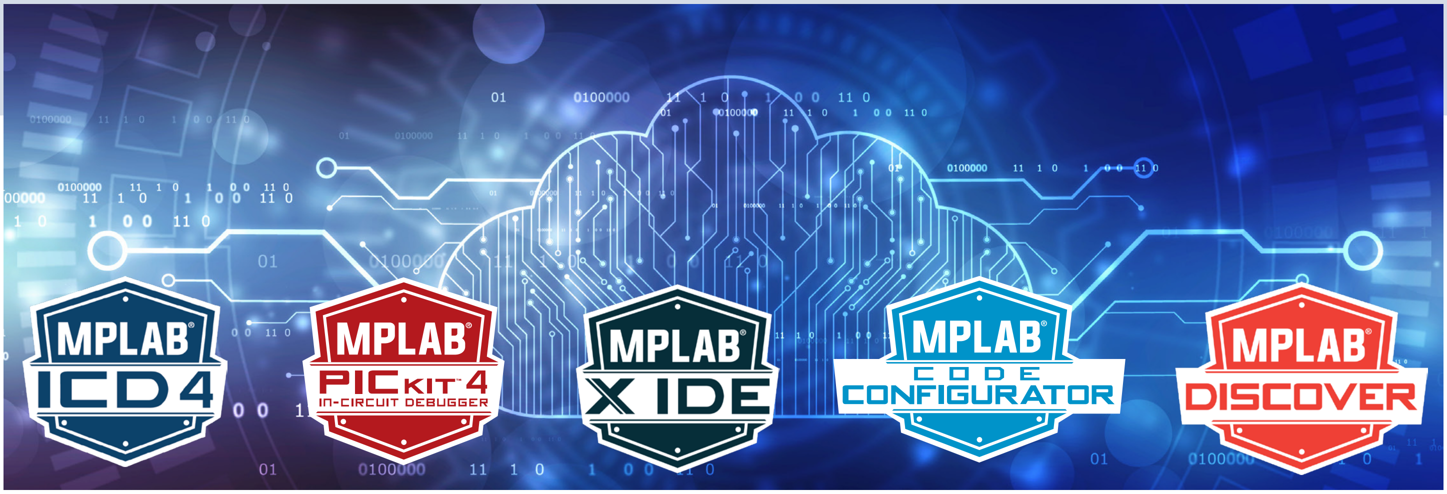
Implementing advanced software digital control loops for power applications requires a high-performance DSP engine along with specialized peripherals. The high-performance CPU and rich peripherals of dsPIC DSCs enable solutions with minimal external support requirements. In addition to their space and cost-saving benefits, dsPIC DSCs solutions offer special features that enable advanced power conversion designs. The DSP engine can perform single-cycle MAC with up to 40 bits of resolution, data saturation, zero overhead looping and barrel shifting to support fast control loop execution. These devices contain peripherals specifically designed for power conversion. Peripherals such as high-speed PWM generators, ADCs and analog comparators can be tied together using an internal configurable control fabric that enables them to interact directly with one another, resulting in stunning performance gains in digital power applications.

- Large family of code- and pin-compatible Flash devices
- Up to 100 MIPS 16-bit CPU with compiler-efficient architecture
- Built-in DSP engine enables high-speed, high-precision digital power control loops
- 40-bit accumulators
- Precision high-speed internal oscillators do not require external crystal oscillator components
- Comprehensive system integration features
- Advanced On-chip Intelligent Power Peripherals Microchip's 16-bit dsPIC DSCs provide on-chip peripherals specifically designed for high-performance, intelligent power supplies:
  - Power Supply PWM Module (High-speed PWM Module) Up to 250 pico-second resolution
  - Highly configurable supporting all common topologies
  - High resolution at high PWM frequencies
  - Trigger events from PWM to ADC
  - High-speed ADC with up to 12 bit resolution and up to 3.5 Msps
  - Sophisticated triggering capabilities
  - High-speed analog comparator Up to four analog comparators
  - Up to four integrated 12-bit DAC references
  - Outputs can directly trigger PWM and ADC events
  - Additional channels of 16-bit timers, input capture, circuits, output comparators and PWM generators
  - Communications include UART, SPI, I²C, PMBus™ and CAN/CAN-FD interfaces

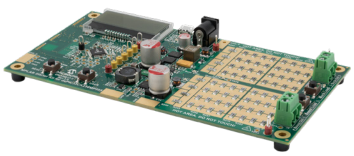
Select dsPIC33 SMPS and Digital Power Conversion Family

Product	Pins	Flash (KB)	RAM (Bytes)	PS PWM	ADC	PGAs*	Analog Comparator	UART/I^{2}C/SPI	CAN**
dsPIC33CH128MPX0X	28–80	64–128 (Main)/ 24 (Secondary)	16K (Main)/ 4K (Secondary)	4 × 2 Main 8 × 2 Secondary	(23–34) × 12-bit, 4 S/H	3	4	3/3/3	0–1
dsPIC33CH512MPX0X	48–80	256–512 (Main)/ 72 (Secondary)	32–48K (Main)/ 16K (Secondary)	4 × 2 Main 8 × 2 Secondary	(31–34) × 12-bit, 4 S/H	3	4	3/3/3	0–2
dsPIC33CK256MPX0X	28–80	32–256	8K–24K	(4-8) ×2	(12–24) × 12-bit, 3 S/H	2–3	3	3/3/3	0–1
dsPIC33CK64MP10X	28–48	32–64	8K	4 × 2	(12–19) × 12-bit, 3 S/H	2–3	3	3/2/3	0
dsPIC33EPXXXGS70X/80X	28–80	64–128	8K	8 × 2	(17–22) × 12-bit, 5 S/H	2	4	2/2/3	0–2
dsPIC33EPXXGS50X	28–64	16–64	2K–8K	5 × 2	(12–22) × 12-bit, 5 S/H	2	4	2/2/2	0
dsPIC33EPXXGS202	28	16–32	2K	3 × 2	12 × 12-bit, 3 S/H	2	2	1/1/1	0

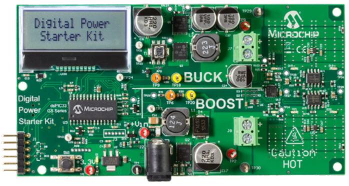
*PGAs: Programmable Gain Amplifiers. The CH family of devices have PGAs, whereas the CK family of devices have OpAmps
**C Family devices have CAN-FD



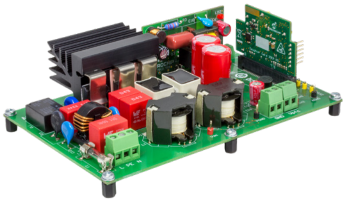
Development Boards



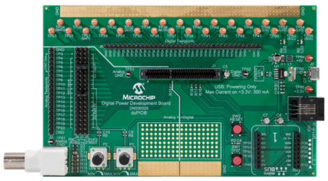
dsPIC33C Digital Power Starter Kit (DM330017-3)



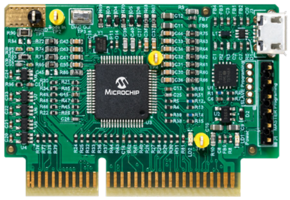
MPLAB® Starter Kit for Digital Power (DM330017-2)



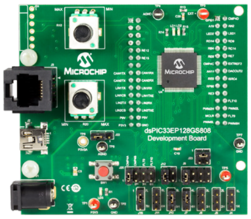
Low Voltage PFC Development Kit (DV330101)



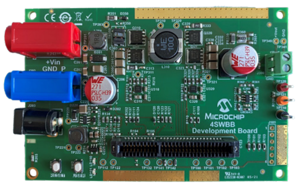
Digital Power Development Board (DM330029)



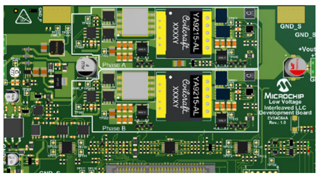
Digital Power Plug-In Modules (DP PIMs)



dsPIC33EP128GS808 Development Board (DM330026)



4-Switch Buck-Boost Development Board (EV44M28A)



Low-Voltage Interleaved LLC Development Board (EV84C64A)

Full Digital Power Applications

For the highest performance, dsPIC Digital Signal Controllers (DSCs) are designed to run powerful algorithms to maximize efficiency across widely varying load and environmental conditions. They have the performance to enable implementation of control loop with various algorithms in firmware. Fully digital power supplies are a competitive necessity in applications where efficiency requirements are stringent, transient response is critical and monitoring/reporting are mandatory for maximum uptime. This approach is ideal for server, networking and telecom infrastructure equipment, renewable energy hardware and wireless power applications.

AC to DC Power Supplies

AC-DC switch mode power supplies are designed to provide DC power from AC line voltages. The reference designs below include information on Power Factor Correction (PFC), high-voltage-compatible bias generation and primary/secondary isolation. Our dsPIC® Digital Signal Controllers (DSCs) are designed to support power flow control of advanced topologies and the implementation of adaptive nonlinear algorithms for front-end power factor control converters and isolated DC-DC converters.

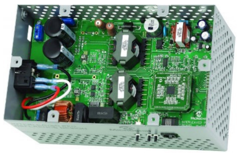
750W AC/DC Reference Design

Vienna 3-Phase Power Factor Correction (PFC) Reference Design

Low Voltage PFC Development Kit (DV330101)

PFC GAN Evaluation Board – Transphorm (TDTTP4000W066C-KIT)

Platinum-Rated 720W AC/DC Reference Design



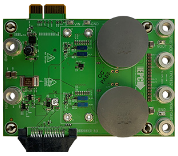
Digital Power Interleaved PFC Reference Design

dsPIC SMPS AC-DC Reference Design

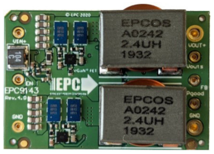
DC-to-DC Converters and Power Supplies

Digital power supplies are becoming more common as system designers and developers look for ways to simplify their power-supply design, increase overall efficiency, modify the design easily to meet power-quality standards and regulatory requirements. Digital Switch-Mode Power Supplies (SMPS) meet these complex design requirements and enable system miniaturization in telecom, networking, server, automotive Electric Vehicle (EV) and a variety of other applications.

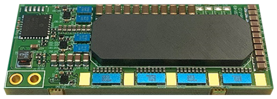
dsPIC Digital Signal Controllers (DSCs) are designed to support power flow control of advanced topologies and implementation of adaptive nonlinear algorithms for front-end power factor control converters and isolated DC-DC converters. You can use the same dsPIC DSC to implement power management, system monitoring and protection, and communication functions.



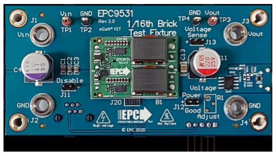
EPC9137 1.5 KW 48V/12V Bi-Directional Power Module Evaluation Board



EPC9143 300W 1/16 Brick Power Module Reference Design

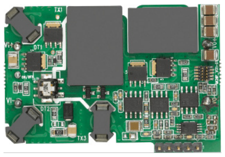


EPC9149
1 KW LLC 1/8 Brick Size Module



EPC9151 300W Bi-Directional 1/16 Brick Power Module Reference Design

Microchip's 200W DC-DC Resonant Converter Reference Design



Quarter Brick DC-DC Converter Reference Design

DC-to-AC Power Inverter Solutions

A DC-to-AC power inverter converts Direct Current (DC) to Alternating Current (AC). The input voltage, output voltage, frequency and overall power handling depend on the design of the specific device or circuitry. An Uninterruptible Power Supply (UPS) is a typical example of an DC to AC inverter. It provides an alternate electric power supply for connected electronic equipment when the primary power source is not available. There are three types of UPS systems, depending on how the electric power is being stored and relayed to the electronic device connected to them:

- Offline UPS, often called standby UPS
- Line-interactive UPS, also known as continuous UPS
- Online UPS, frequently called double conversion UPS

A typical UPS for computers protects against four types of power events:

- Power surges
- Voltage shortages
- Complete power failures
- Wide variations in the electric current frequency

Digital Pure Sine Wave
Uninterruptible Power Supply (UPS)
Reference Design

Renewable/Solar Power

Renewable resources, especially solar power and Photovoltaic (PV) systems, have gained great visibility during the past few years as convenient and promising renewable energy sources. Solar power systems offer several benefits, such as:

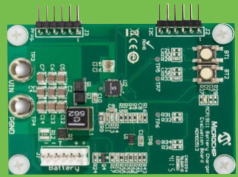
- Clean and renewable energy that replaces power produced by coal, oil and nuclear power
- Reduction/elimination of electric bills
- Ample resources since silicon for manufacturing PV panels is the second most abundant element on Earth
- The ability to provide power to remote locations

Our grid-connected solar microinverter reference design, featuring a dsPIC® Digital Signal Controller (DSC), has a maximum power output of 215W and provides a high efficiency of ~94% at nominal conditions (230V AC). We also offer a portable solar charging reference design based on an 8-bit PIC16F microcontroller (MCU) that can charge a 24V battery system from a 130W/12V solar panel. This design can provide 1.3 kWh of energy in 10 hours of charging time.

Battery Management and Charging

Every battery type has its own unique charging requirements. Managing these diverse requirements, while cell-balancing, fuel gauging and managing power paths, can become very complex. Flyback, buck and boost topology design examples using PIC® microcontrollers (MCUs) and dsPIC® Digital Signal Controllers (DSCs) demonstrate how to handle these functions with compact, easy-to-implement circuits. These design examples include temperature, voltage, current and time monitoring. In addition, the charge profiles can be customized in firmware to match the exact requirements of a battery manufacturer and to allow any desired customization to improve battery capacity, charge time or system lifetime.

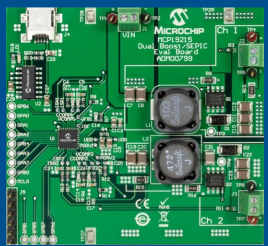
Grid-Connected Solar Microinverter Reference Design



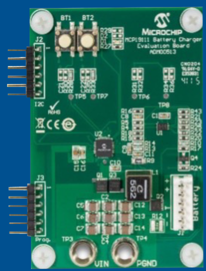
MCP19111 Battery Charger Evaluation Board

Digital Lighting Control and Drivers

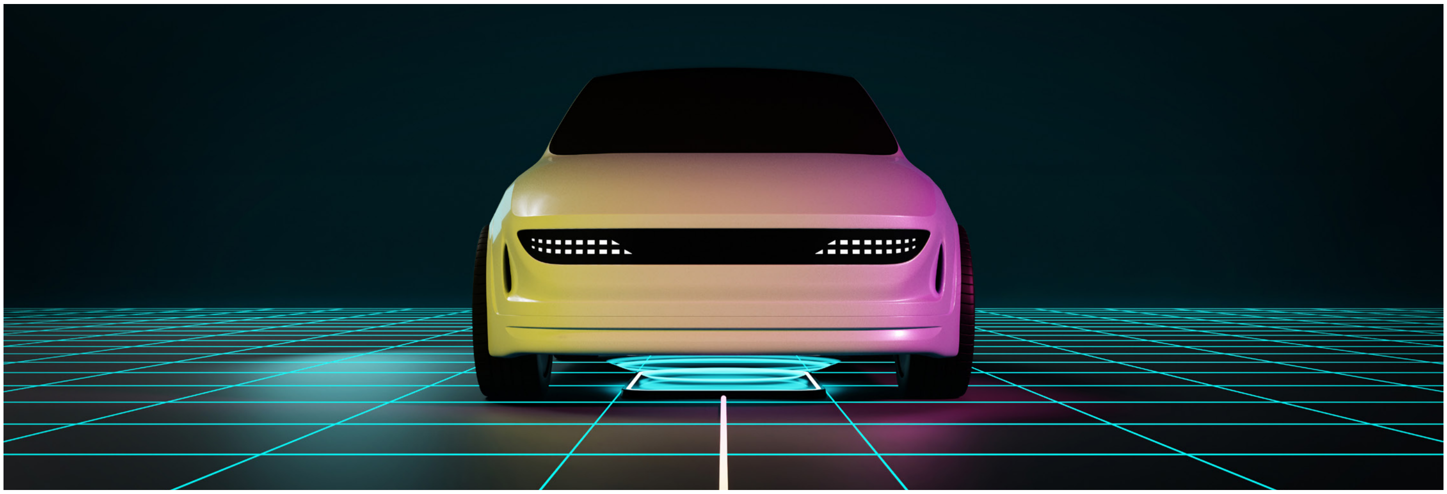
Binning, temperature, component aging, dimming and constant-current drive needs influence light quality and affect the customer experience. In addition to efficiency benefits or lifetime monetary savings, consumers are looking for better interior designs, brighter headlights, more beautiful colors and finer dimming control. “To implement proper color, temperature and chromaticity and make better LED and traditional lighting circuits in your application, start with a Microchip evaluation board or reference design. These designs can be implemented as stand-alone systems using a traditional dimmer and AC input, or as connected systems supporting standard or custom communication protocols to offer new control options.



MCP19215 Dual Boost/SEPIC Evaluation Board



MCP19114 Flyback Standalone Evaluation Board

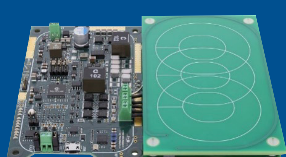


Wireless Power

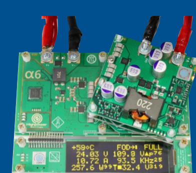
Wireless power solutions can energize applications with varying power requirements, from just a few hundred milliwatts to a few kilowatts. We offer expertise to fully support Qi® 1.3 with authentication.

Typical power requirements for common applications include:

- A few hundred milliwatts over a large Z distance for applications such as hearing aids and sensors
- 1–5W of charging power for portable applications such as game controllers and portable lighting
- 5–15W for smartphone charging, a major adopter of Qi wireless charging
- 45–60W for charging laptops, power tools and drones in acceptable amounts of time
- 100–300W for underwater drones, pool lighting and other automotive applications
- Several KW of power for electric vehicles looking to implement wireless power transfer

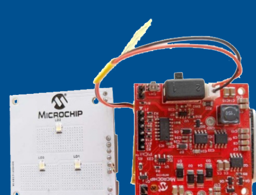


15W Multi-Coil Wireless Power Transmitter



300W Wireless Power Reference Design

Qi® Wireless 15W Receiver Reference Design



Qi Wireless Charging LED Lantern Reference Design

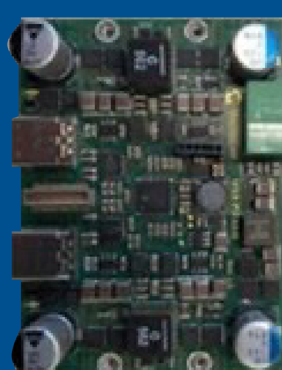
Qi Wireless Power Micro-Receiver Reference Design

USB Power Delivery

The USB Type-C™ and USB-PD have already become mainstream in mobile and laptop applications. Higher voltages and power levels are now required to address the needs for faster charging and more power-hungry devices.

The USB-PD 3.0 adds support for 9V, 15V and 20V with ability to transfer up to 100W. The USB Power Delivery 3.0 also extends the communication protocol to support features like battery condition, enhanced security, and fast role swapping.

USB PD Power Range	Fixed Voltage	Current Range	Example devices
0.5–15W	5V	0.1–3.0A	Headphones, small USB accessories
15–27W	9V	1.67–3.0A	Smartphones, cameras, drones
27–45W	15V	1.8–3.0A	Tablets, small laptops
45–100W	20V	3.0–5.0A only with rated cable	Large laptops, displays



USB Type-C PD Reference Design

Digital Power Design Suite

Our Digital Power Design Suite includes the Digital Compensation Design Tool (DCDT), MPLAB Code Configurator (MCC), SMPS compensator libraries and design examples that will simplify the development of your next digital power design.

Digital Compensator Design Tool (DCDT)

DCDT simplifies calculating compensator coefficients and analyzing performance. This topology-independent Graphical User Interface (GUI) offers these key benefits:

- Analysis of plant and feedback transfer functions
- Controller design (PID, 2P2Z, 3P3Z, etc.)
- Migration of analog Type II, Type III to digital control
- Analysis of loop gain and tuning controller
- Generation of coefficients to be exported to MPLAB X Integrated Development Environment (IDE)

SMPS Compensator Library

The SMPS compensator library includes optimized functions for dsPIC33 DSCs to help you implement common compensator algorithms and create an efficient SMPS application design. The library supports:

- Algorithms such as PID, 2P2Z and 3P3Z
- Fixed point and trigger update
- Context registers on “GS” and “MP” family devices

Microchip Power Board Visualizer Supporting dsPIC33 DSCs

Microchip’s Power Board Visualizer is a configurable tool running on Windows for visualizing data and controlling individual functions of a connected dsPIC33 Digital Signal Controller (DSC) through a USB/UART port.

The demo source code for the embedded device contains a ready to use communication layer to make it easy to integrate it in different applications. The Power Board Visualizer works seamlessly with Microchip’s various development boards including digital power development boards and dsPIC33 DSC Digital Power PIMs.

MPLAB Code Configurator (MCC)

MCC is a graphical programming environment that generates seamless, easy-to-understand device configuration code. It offers these key benefits:

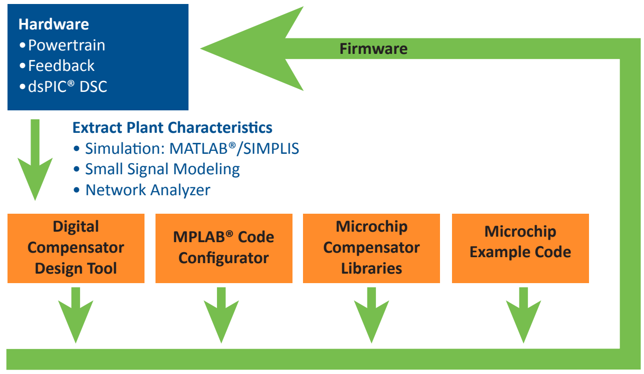
- Intuitive interface for quick start development
- Automated configuration of peripherals and functions to minimize the need to refer to the product data sheet and reduce overall design effort and time

Design Examples and Reference Designs

We also support your development with application-specific hardware and software

- Starter kits/development boards and evaluation boards
- Reference designs and application notes

Simplified SMPS Design Flow



Software and Application Notes

Application Solution	AN #	Description
Online Firmware Updates in Timing-Critical Applications	AN2601	Many applications require a live firmware update feature with no down time. This application note discusses how the Live Update feature can be implemented with 16-bit dsPIC33 and PIC24F controllers, the MPLAB® XC Compiler and the Easy Bootloader library.
Power Factor Correction in Power Conversion Applications Using the dsPIC® DSC	AN1106	This application note focuses on the implementation of Power Factor Correction (PFC) using a Digital Signal Controller (DSC).
Switch Mode Power Supply (SMPS) Topologies (Part I)	AN1114	This application note explains the basics of different types of SMPS topologies, their pros and cons, and their applications. It also guides you in selecting an appropriate topology for your application.
Switch Mode Power Supply (SMPS) Topologies (Part II)	AN1207	This application note is the second of a two-part series on Switch Mode Power Supply (SMPS) topologies. This series expands on the previous material in Part I, and presents the basic tools needed to design a power converter.
Offline UPS Reference Design	AN1279	This application note describes the design of an offline Uninterruptible Power Supply (UPS) using a dsPIC DSC.
Digital Power Interleaved PFC	AN1278	This application note describes the design of a Digital Power Interleaved PFC (IPFC).
Quarter Brick DC-DC Reference Design	AN1335	This application note describes our a Quarter Brick DC-DC Reference Design.
DC-DC LLC Resonant Converter	AN1336	This application note describes our DC-DC LLC Resonant Converter using dsPIC DSC.
Grid Connected Solar Microinverter	AN1338	This application note describes our Grid Connected Solar Microinverter Reference Design.
Platinum-Rated AC/DC Reference Design	AN1421	This application note describes a fully digital-controlled 720W AC-to-DC (AC/DC) power supply, which meets all CSCI Platinum Specifications, and provides a variety of, application-specific features and functions.
Getting Started with Dual Core	AN2721	This application note explains how to develop and debug an application using dsPIC33CH dual-core DSCs.
Peak Current Controlled ZVS Full-Bridge Converter with Digital Slope Compensation	AN2388	This application note features a detailed discussion on plant modeling, control system design and firmware implementation of a 750W Peak Current Controlled Zero-Voltage Switching Full-Bridge (ZVS FB) Converter reference design with digital slope compensation.
Online Firmware Updates in Timing-Critical Applications	AN2601	This application note discusses the compiler tools that help facilitate LiveUpdate, as well as details regarding how to set up the MPLAB X IDE project and implement firmware for the LiveUpdate event.

Getting Started

The Microchip website (www.microchip.com) provides a wealth of information that can help you get started with your intelligent power design.

Development Tools

Visit www.microchip.com/tools to learn more about all of Microchip's software and hardware development tools.

Intelligent Power Supply Design Center

If you would like more information about any of the solutions presented here, please visit the Microchip Intelligent Power Supply Design Center (www.microchip.com/power) for further details. The Design Center contains links to application notes, web seminars, user manuals and software referenced in this brochure.

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