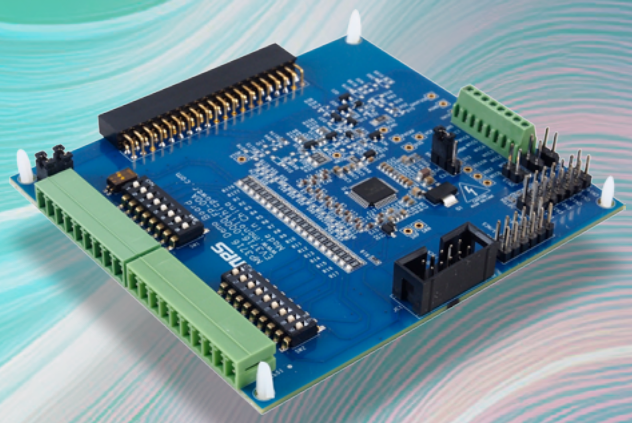
BATTERY MANAGEMENT SYSTEM SOLUTIONS

High-Performance Battery Management for:

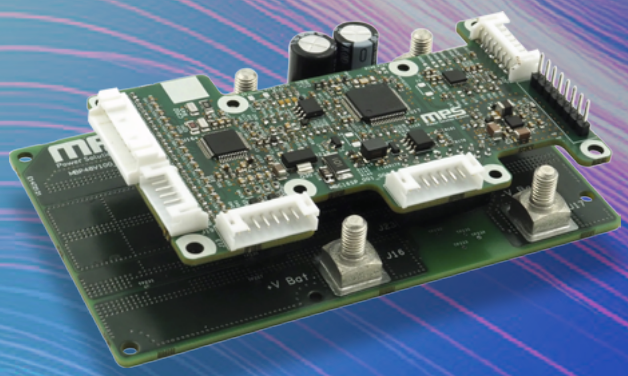
- POWER TOOLS
- E-MOBILITY
- BATTERY BACKUP
- ENERGY STORAGE
- ROBOTICS

BATTERY MONITORS & PROTECTORS

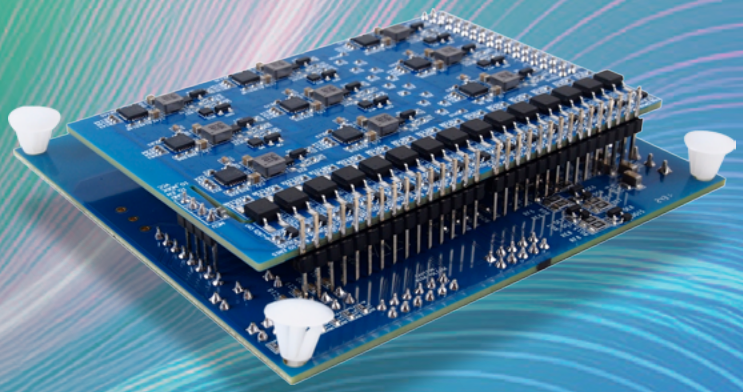


BATTERY FUEL GAUGES

COMPLETE BMS SOLUTION MODULES



ACTIVE BALANCERS



MPS

MonolithicPower.com

Quality Assurance & Reliability Commitment

Quality and Compliance Certificates:

- Quality Policy (MPS)
- ISO 9001 Certificate (MPS)
- ISO 14001 Certificate (MPS)
- ISO 45001 Certificate (Suppliers)
- ISO 27001 Certificate (MPS)
- RBA Certificate (MPS)

Product Quality:

- Automotive Products Qualified per AEC-Q100 Standard
- Standard Products Qualified per JEDEC and Military Standards
- Reliability Failure Rate < 10FIT
- Product Quality Level < 1.0ppm

Quality Control and Monitoring:

- On-Site Foundry and Assembly Teams for Real-Time Actions
- Quarterly Supplier Quality Review and Annual Supplier Audit
- Short-Term Reliability Monitor Test – Daily
- Long-Term Reliability Monitor Test – Monthly
- Real-Time Engineering Actions on Monitor Failure
- Quarterly Reliability Monitor Reports

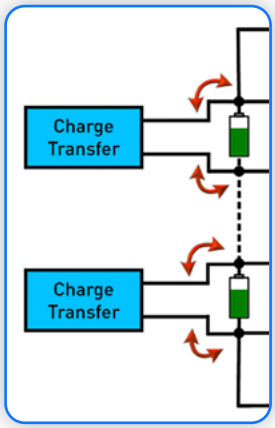
Environmental Compliances:

- EU RoHS/HF/REACH Compliant
- UL Compliant
- Sony Green Partner
- Samsung Eco-Partner
- MPS Conflict Minerals Policy

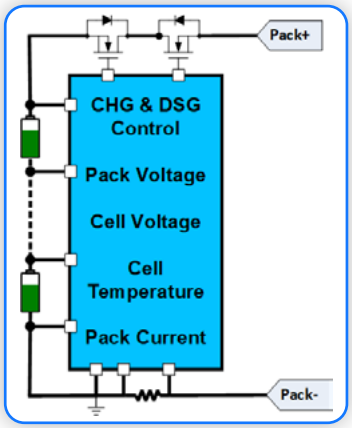
In This Guide

MPS Battery Management Solutions

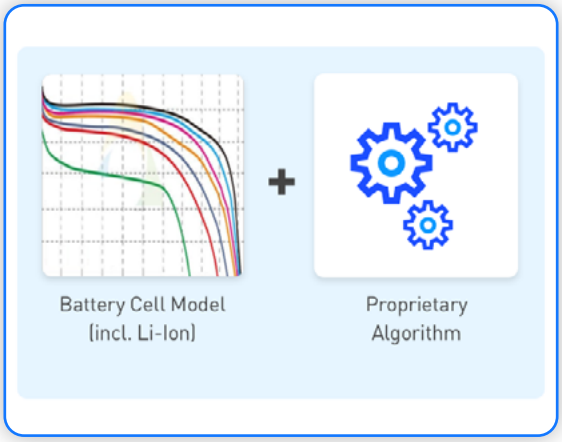
Active Balancers



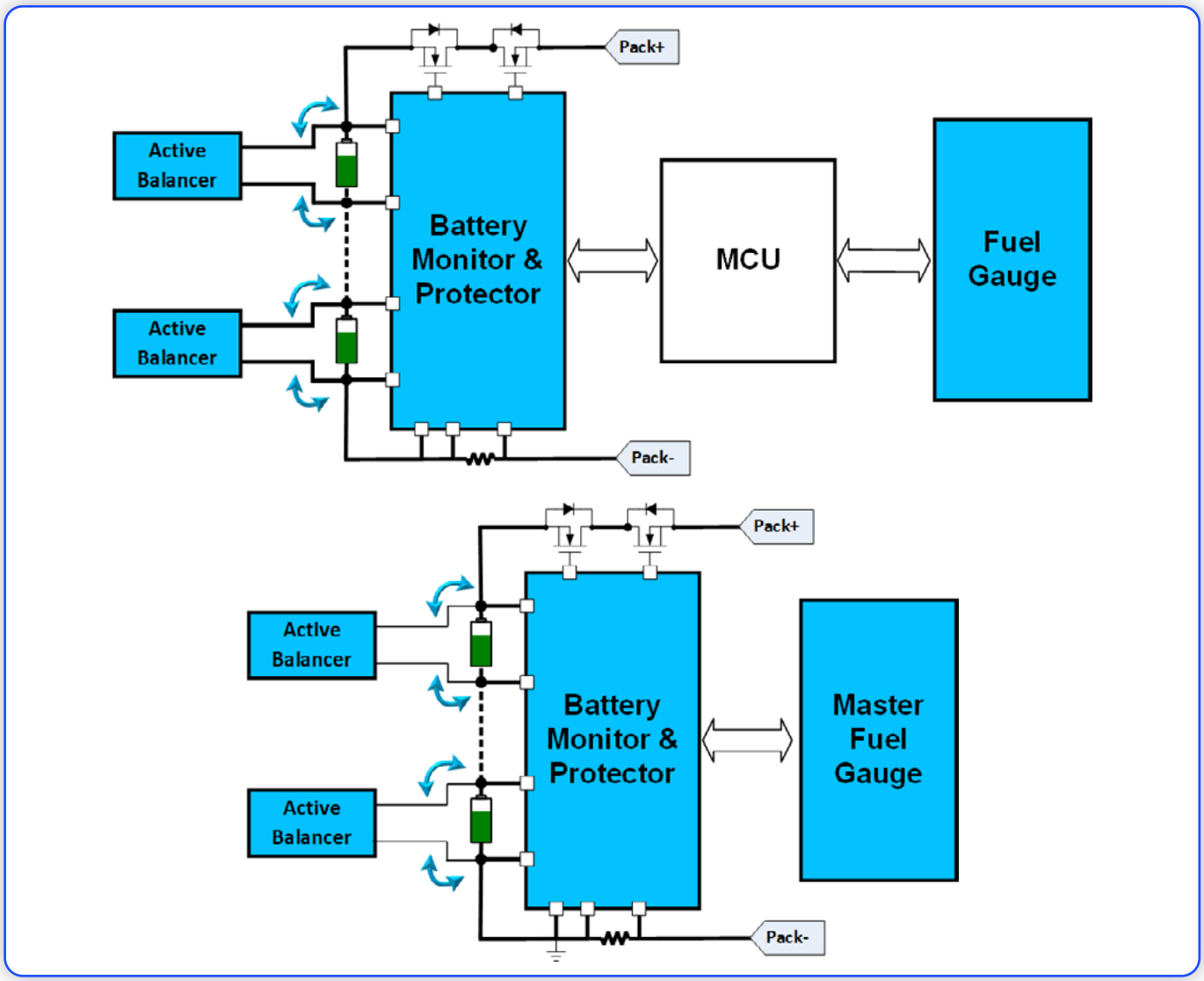
Battery Monitors



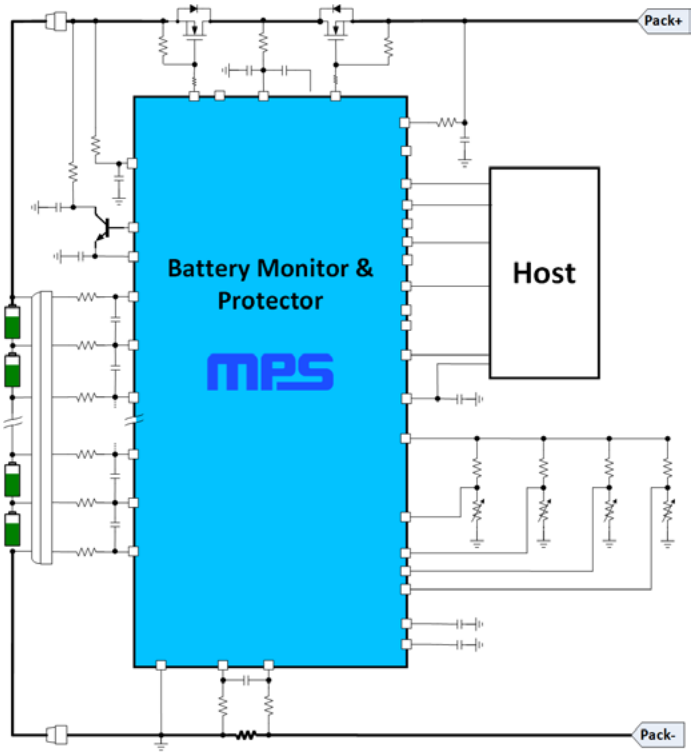
Fuel Gauges



BMS Complete Solutions



Battery Stack Monitors & Protectors

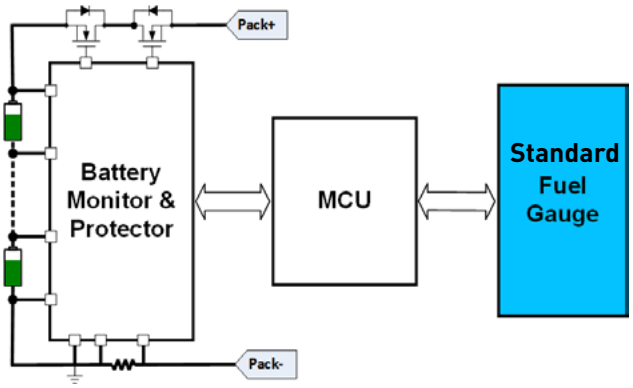


Battery Monitors & Protectors

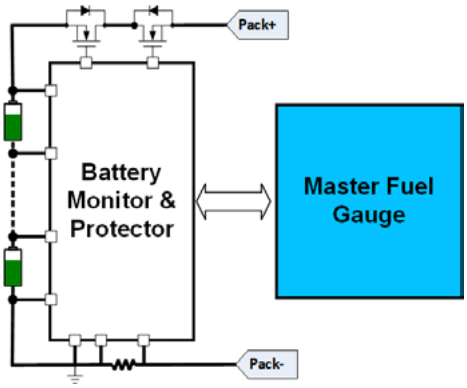
These highly integrated devices are designed for monitoring and protecting Li-ion battery strings from 3 to 18 cells in series. These devices include charge and discharge control, current sensing, Coulomb counting, passive balancing, and an industry-standard serial communication interface.

Monitors Up to 18 Cells in Series	Supports Large Battery Packs
Accurate, Synchronous Voltage & Current	Improves Runtime
High-Side MOSFETs for Fault Protection	Supports Safety & Separate Charge/Discharge
Soft-Start Control	Eliminates the Need for a Pre-Charge Circuit
Integrated Passive Balancing, 2x Regulators	Minimizes External Circuitry

Battery Stack Fuel Gauges



MCU Connection Type



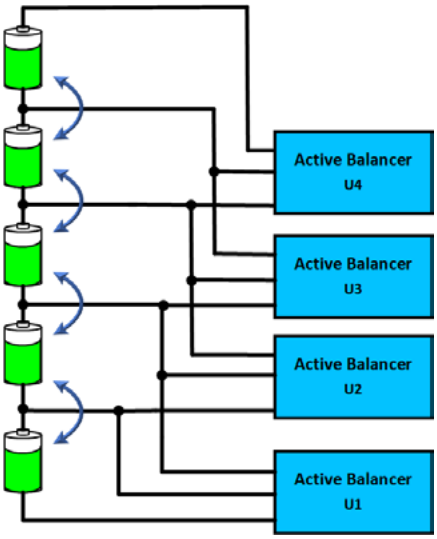
Direct Connection Type

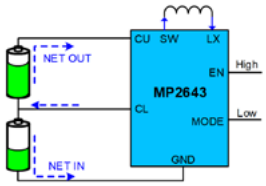
Fuel Gauges

These standalone ICs use a proprietary algorithm and cell battery model to estimate state-of-charge (SOC) for cell and pack, state-of-health (SOH) for cell and pack, as well as time-to-full, time-to-empty, and available energy.

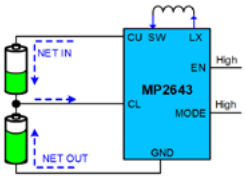
Accurate Pack & Cell State-of-Charge	Improves Runtime, Safety & Reliability
Runtime & Charge Time	Maximizes Runtime and Efficiency
Power Limits	Extract Peak Performance
Accurate Pack & Cell State-of-Health	Diagnostics for Better Runtime & Reliability
Cell-Level Impedance	Diagnostics for Better Safety & Reliability

Battery Stack Active Balancers





Buck Mode



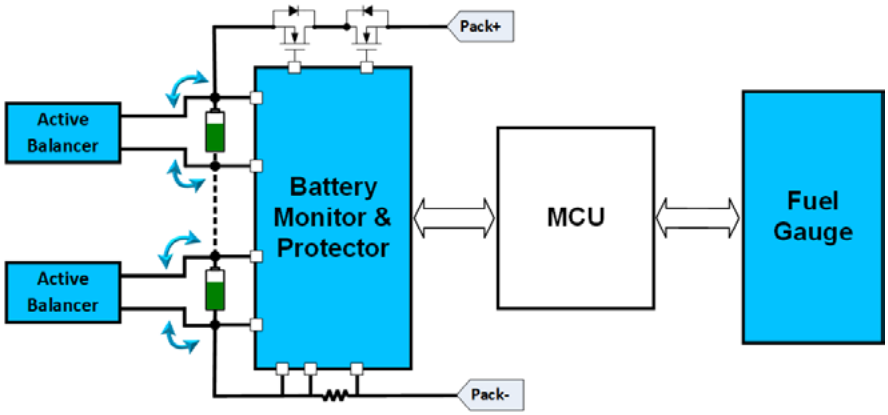
Boost Mode

MPS Buck-Boost Active Balancers

As an alternative to passive balancing, active balancers efficiently move charge between 2 cells using a simple buck or boost power conversion operation. Interleaving multiple devices allows scaling to any number of series cells to redistribute charge to and from any cells within a pack.

Moves Charge between Cells	Reduces Balancing & Charge Time
92.8% Energy Transfer Efficiency	Reduces Wasted Energy & Heat
Up to 2A of Net Current	Reduces Charge Time & Increases Runtime
Can Be Interleaved across Cells	Scales to Support Any Pack Size
Simple 2-Pin Operation	Easy to Implement

BMS Complete Solution

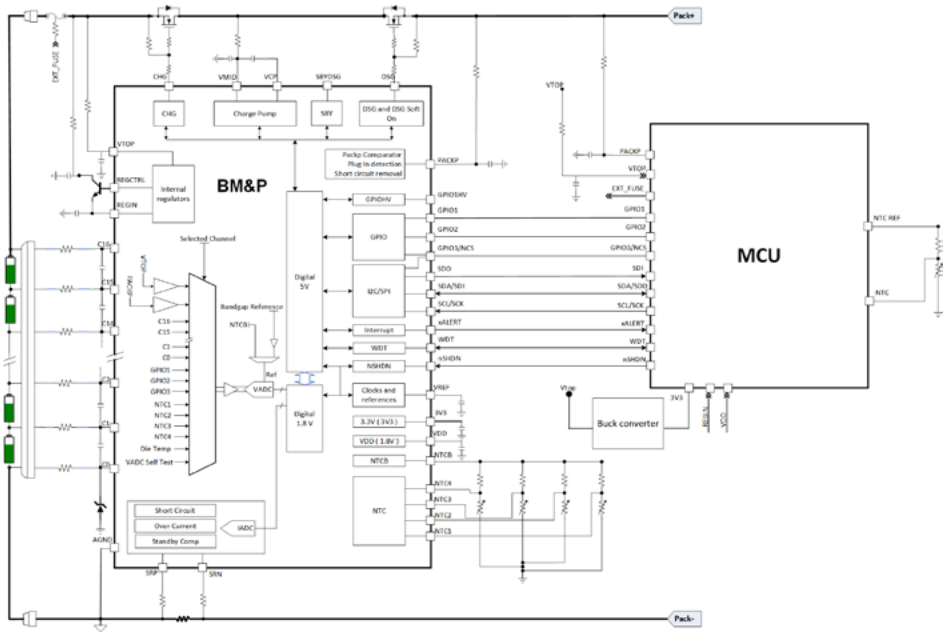


3 to 18 Series Cell Battery Management System

- ±5mV Cell Measurement Error
- ±0.5% Current Measurement Error
- ±1% Temperature Measurement Error
- ±2.5% State-of-Charge (SOC) Error
- ±1% State-of-Health (SOH) Error
- MPS Offers a Production-Ready, Fully Validated Solution

Leverages Combined Accuracy of MPS Devices	Best SOC Accuracy (including for LFP)
Plug-and-Play Complete Solution	Fast Time-to-Market, Reduced Cost & Risk
MCU with Source Code	Ready to Customize for Any Application
Connects to MPS Active Balancers	Option for Efficiency & Performance
Architecture Supports ISO 13849	Addresses FuSa, Supports UL Standards

MPS Functional Safety Concept



ISO 13849 PL-C Architecture Certified

MPS BM&P + MCU redundancy architecture

MPS Proprietary Architecture	Leverages Existing BMS Components
Pre-Certified Architecture	Fast Time-to-Market, Reduced Cost & Risk
Functional Safety SW Available	MPS Shares the Dedicated FuSa SW
HW Schematics	Fully Validated Reference Designs
Reference Designs & Complete Solutions	MPS Offers FuSa-Ready Devices for Testing

Power & Gardening Tools

Application Characteristics

» Battery pack performance is key to success
  - Competition is motivating suppliers to offer more power, energy, and runtime

» Each OEM seeks to sell a full suite of tools
  - A single battery design must support many tools with diverse requirements

» Cost-sensitive as the battery pack is a large percentage of tool cost

MPS Advantages

» Battery Monitors
  - Cost-effective, small footprint with advanced integrated features to minimize external components
  - Support for 3- to 18-cell stacks to cover a wide range of pack sizes
  - Onboard FET control up to 200A with separate discharge/charge and fast protection response
  - Low standby current for maximum battery storage time

» Fuel Gauges
  - Compact solution when directly connected to MPS battery monitors without a microprocessor
  - Advanced fuel gauging provides competitive features such as time-to-full and time-to-empty

Market Trends for Power & Gardening Tool BMS					
Gov. Regulation	Industry Standards	Evolving Batteries	Cost Differentiation	End-Product Differentiation	Manufacturing Localization
	√		√	√	

PRODUCTS FOR POWER & GARDENING TOOLS

Battery Monitor & Protectors

Part Number	# of Series Cells	Pack Voltage (V)	Charge/Discharge MOSFET Driver	Separate Charge/Discharge Control	Cell-Balancing	Coulomb Counting	Discharge Soft Start	Load/Charger Detection	Sync Voltage & Current Measurement	OT Cell Voltage Accuracy (-20°C to +60°C)	MPS Advantages for Power & Gardening Tools
MP2790	4 to 10	10 to 75	High-Side	✓	✓	✓	✓	✓	✓	±7.5mV	Supports 4- to 10-cell battery packs, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes soft start to eliminate pre-charge circuit
N **MP2793**	4 to 16	10 to 86	High-Side	✓	✓	✓	✓	✓	✓	±7.5mV	Supports 4- to 16-cell battery packs, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes soft start to eliminate pre-charge circuit
S **MP3710**	3 to 18	7.5 to 85	High-Side	✓	✓	-	✓	✓	-	±7.5mV	Standalone protection device for 3- to 18-cell packs, supports broad range of pack sizes, no communication required for operation, can directly control protection MOSFETs, fuses, and generate interrupts or alarms
S **MP3712**	3 to 7	7.5 to 85	High-Side	✓	✓	✓	✓	✓	✓	±7.5mV	Supports low-voltage 3- to 7-cell battery packs, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes advanced soft start to eliminate pre-charge circuit
S **MP3713**	3 to 10	7.5 to 85	High-Side	✓	✓	✓	✓	✓	✓	±7.5mV	Supports 3- to 10-cell battery packs, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes advanced soft start to eliminate pre-charge circuit
S **MP3716**	3 to 18	7.5 to 86	High-Side	✓	✓	✓	✓	✓	✓	±7.5mV	Supports 3- to 18-cell battery packs, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes advanced soft start to eliminate pre-charge circuit

Battery Pack Fuel Gauges

Part Number	# of Series Cells	Chemistry	Communication Interface	External SOC Indication	Pack SOC Accuracy	Cell Impedance Monitoring	Thermal Model	Recommended Battery Monitor	Battery Monitor I/F	MPS Advantages for Power & Gardening Tools
MPF42791	2 to 16	Li-Ion, Li-Polymer	I²C	LED	±3%	✓	✓	MP2793	via MCU	Supports battery packs up to 16 cells, standard Li-ion chemistries, high-accuracy SOC including LiPo cells, provides max available power, charge and runtime, lifetime logging
MPF42792	2 to 16	Li-Ion, Li-Polymer	I²C	-	±3%	-	-	MP2793	via MCU	Streamlined feature set for lowest cost, supports battery packs up to 16 cells for standard Li-ion chemistries, provides high-accuracy cell and pack battery metrics with logging
MPF42795	2 to 10	Li-Ion, Li-Polymer	I²C	LED	±3%	-	-	MP2790	via MCU	Supports battery packs up to 16 cells for standard Li-ion chemistries, provides high-accuracy cell and pack battery metrics with logging including SOC max available power, charge and runtime, lifetime logging
MPF42797	2 to 10	Li-Ion, Li-Polymer	I²C	-	±3%	-	-	MP2790	via MCU	Streamlined feature set for lowest cost, supports battery packs up to 10 cells for standard Li-ion chemistries, provides high-accuracy cell and pack battery metrics with lifetime logging
S **MPF42780**	2 to 10	Li-Ion, Li-Polymer, LiFePO4	I²C	LED	±3%	✓	✓	MP3713	Direct	Supports battery packs up to 10 cells for all Li-ion chemistries including LiFePO4, streamlined architecture eliminates need for MCU between battery monitor and fuel gauge
S **MPF42781**	2 to 18	Li-Ion, Li-Polymer, LiFePO4	I²C	LED	±3%	✓	✓	MP3716	Direct	Supports battery packs up to 18 cells for all Li-ion chemistries including LiFePO4, streamlined architecture eliminates need for MCU between battery monitor and fuel gauge

N - New Product S - Sampling Product

E-Mobility

Application Characteristics

» Growing regulations for e-mobility battery safety (worldwide)

» Increasing functional safety requirements, such as ISO 13849 (worldwide)

» Highly competitive market with many OEMs
- End-user access to extensive, precision battery fuel gauging enables OEM product differentiation
- OEMs driven to lower-cost, more integrated solutions

MPS Advantages

» Battery Monitors
- Support for 3- to 18-cell designs with minimal BOM
- Include cell-balancing, onboard LDOs, and soft start to eliminate pre-charge circuitry
- Offer very low standby current to minimize charge depletion in storage
- Include onboard FET drivers with separate discharge/charge control and fast protection response

» Fuel Gauges
- Include advanced estimates to enhance end-user experience
- Provide more accurate, more detailed results than competitors with fewer complications
- MPS e-bike reference design available

Market Trends for E-Mobility BMS					
Gov. Regulation	Industry Standards	Evolving Batteries	Cost Differentiation	End-Product Differentiation	Manufacturing Localization
√	√		√	√	

PRODUCTS FOR E-MOBILITY

Battery Monitor & Protectors

Part Number	# of Series Cells	Pack Voltage (V)	CCharge/Discharge MOSFET Driver	Separate Charge/Discharge Control	Cell-Balancing	Coulomb Counting	Discharge Soft Start	Load/Charger Detection	Sync Voltage & Current Measurement	OT Cell Voltage Accuracy (-20°C to +60°C)	MPS Advantages for E-Mobility
MP2790	4 to 10	10 to 75	High-Side	✓	✓	✓	✓	✓	✓	±7.5mV	Supports 4- to 10-cell battery packs, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes soft start to eliminate pre-charge circuit
N **MP2793**	4 to 16	10 to 86	High-Side	✓	✓	✓	✓	✓	✓	±7.5mV	Supports 4- to 16-cell battery packs, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes soft start to eliminate pre-charge circuit
S **MP3710**	3 to 18	7.5 to 85	High-Side	✓	✓	-	✓	✓	-	±7.5mV	Standalone protection device for 3- to 18-cell packs, supports broad range of pack sizes, no communication required for operation, can directly control protection MOSFETs, fuses, and generate interrupts or alarms
S **MP3712**	3 to 7	7.5 to 85	High-Side	✓	✓	✓	✓	✓	✓	±7.5mV	Supports low-voltage 3- to 7-cell battery packs, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes advanced soft start to eliminate pre-charge circuit
S **MP3713**	3 to 10	7.5 to 85	High-Side	✓	✓	✓	✓	✓	✓	±7.5mV	Supports 3- to 10-cell battery packs, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes advanced soft start to eliminate pre-charge circuit
S **MP3716**	3 to 18	7.5 to 86	High-Side	✓	✓	✓	✓	✓	✓	±7.5mV	Supports 3- to 18-cell battery packs, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes advanced soft start to eliminate pre-charge circuit

Battery Pack Fuel Gauges

Part Number	# of Series Cells	Chemistry	Communication Interface	External SOC Indication	Pack SOC Accuracy	Cell Impedance Monitoring	Thermal Model	Recommended Battery Monitor	Battery Monitor I/F	MPS Advantages for E-Mobility
MPF42791	2 to 16	Li-Ion, Li-Polymer	I²C	LED	±3%	✓	✓	MP2793	via MCU	Supports battery packs up to 16 cells, standard Li-ion chemistries, high-accuracy SOC including LiPo cells, provides max available power, charge and runtime, lifetime logging
MPF42792	2 to 16	Li-Ion, Li-Polymer	I²C	-	±3%	-	-	MP2793	via MCU	Streamlined feature set for lowest cost, supports battery packs up to 16 cells for standard Li-ion chemistries, provides high-accuracy cell and pack battery metrics with logging
MPF42795	2 to 10	Li-Ion, Li-Polymer	I²C	LED	±3%	-	-	MP2790	via MCU	Supports battery packs up to 16 cells for standard Li-ion chemistries, provides high-accuracy cell and pack battery metrics with logging including SOC max available power, charge and runtime, lifetime logging
MPF42797	2 to 10	Li-Ion, Li-Polymer	I²C	-	±3%	-	-	MP2790	via MCU	Streamlined feature set for lowest cost, supports battery packs up to 10 cells for standard Li-ion chemistries, provides high-accuracy cell and pack battery metrics with lifetime logging
S **MPF42780**	2 to 10	Li-Ion, Li-Polymer, LiFePO4	I²C	LED	±3%	✓	✓	MP3713	Direct	Supports battery packs up to 10 cells for all Li-ion chemistries including LiFePO4, streamlined architecture eliminates need for MCU between battery monitor and fuel gauge
S **MPF42781**	2 to 18	Li-Ion, Li-Polymer, LiFePO4	I²C	LED	±3%	✓	✓	MP3716	Direct	Supports battery packs up to 18 cells for all Li-ion chemistries including LiFePO4, streamlined architecture eliminates need for MCU between battery monitor and fuel gauge

N - New Product S - Sampling Product

Battery Backup Units

Application Characteristics

- Typically uses 24V to 75V battery packs, from 6 to 18 cells
- Battery reliability is critical to product success
  - Systems subject to "rarely used pack" condition
  - State-of-health (SOH) must be periodically assessed to guarantee uptime
  - System must always know the available energy and power with high accuracy
- Battery cells
  - Growing dominance of LiFePO4 with lower cost
  - No premium for space (lower energy density is OK)
- Commonly requires high discharge rates (15C+)
  - Accurate fuel gauging becomes increasingly important and difficult
  - MOSFET-based current control requires parallel devices with very strong charge/discharge drive capability

MPS Advantages

- Battery Monitors
  - Enable outstanding product reliability and lifetime via high-accuracy, I/V synchronized measurements
  - Very strong drive capacity, up to 10x the leading competitor, which is particularly important for short-circuit protection
  - Support LiFePO4, Li-ion, and LiPo chemistries
- Fuel Gauges
  - Provide accurate pack and cell SOC for challenging LiFePO4 cells, particularly for the high C-rate requirements of battery backup units (BBUs)
  - Provide accurate pack and cell SOH estimations for guaranteed performance at all times
- Active Balancers
  - Extend reliability and lifetime by maintaining continuously balanced cells

Market Trends for Battery Backup Unit BMS					
Gov. Regulation	Industry Standards	Evolving Batteries	Cost Differentiation	End-Product Differentiation	Manufacturing Localization
	√	√	√	√	√

PRODUCTS FOR BATTERY BACKUP UNITS

Battery Monitor & Protectors

Part Number	# of Series Cells	Pack Voltage (V)	Charge/Discharge MOSFET Driver	Separate Charge/Discharge Control	Cell-Balancing	Coulomb Counting	Discharge Soft Start	Sync Voltage & Current Measurement	OT Cell Voltage Accuracy (-20°C to +60°C)	MPS Advantages for Battery Backup Units
MP2787	7 to 16	18 to 86	-	-	✓	✓	-	✓	±7.5mV	Supports battery packs up to 16 cells, designed for systems with separate current control circuit (not including integrated high-side MOSFET drivers)
N **MP2793**	4 to 16	10 to 86	High-Side	✓	✓	✓	✓	✓	±7.5mV	Supports 4- to 16-cell battery packs, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes soft start to eliminate pre-charge circuit
S **MP2798**	3 to 18	18 to 86	-	-	✓	✓	-	✓	±7.5mV	Supports 3- to 18-cell battery packs, designed for systems with separate current-control circuit (not including integrated high-side MOSFET drivers)
S **MP3716**	3 to 18	18 to 86	High-Side	✓	✓	✓	✓	✓	±7.5mV	Supports 3- to 18-cell battery packs, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes advanced soft start to eliminate pre-charge circuit
S **MP3716A**	3 to 18	18 to 86	High-Side	✓	✓	✓	✓	✓	±4.5mV	High-accuracy measurements ideal for LiFePO4, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes advanced soft start to eliminate pre-charge circuit

Battery Pack Fuel Gauges

Part Number	# of Series Cells	Chemistry	Communication Interface	External SOC Indication	Pack SOC Accuracy	Cell Impedance Monitoring	Thermal Model	Recommended Battery Monitor	Battery Monitor I/F	MPS Advantages for Battery Backup Units
MPF42791	2 to 16	Li-Ion, Li-Polymer	I²C	LED	±3%	✓	✓	MP2793	via MCU	Supports battery packs up to 16 cells, standard Li-ion chemistries, high-accuracy SOC including LiPo cells, provides max available power, charge and runtime, lifetime logging
MPF42793	2 to 16	LiFePO4	I²C	LED	±5%	✓	✓	MP2793	via MCU	Supports battery packs up to 16 cells, specifically designed for LiFePO4, provides high-accuracy SOC including LiPo cells, provides max available power, charge and runtime, lifetime logging
S **MPF42781**	2 to 18	Li-Ion, Li-Polymer, LiFePO4	I²C	LED	±3%	✓	✓	MP3716 MP3716A	Direct	Supports battery packs up to 18 cells for all Li-ion chemistries including LiFePO4, streamlined architecture eliminates need for MCU between battery monitor and fuel gauge
S **MPF42786**	2 to 112	Li-Ion, Li-Polymer, LiFePO4	I²C	LED	±3%	✓	✓	Multiple MP3716	via MCU	Supports multiple battery monitors for high cell packs for all Li-ion chemistries including LiFePO4, provides accurate pack and cell SOC and SOH, max available power, charge and runtime, lifetime logging

Active Balancers

Part Number	Topology	Chemistry	# of Series Cells	Maximum Net Balance Current (A)	Minimum V_{IN} (V)	Maximum V_{IN} (V)	CU Quiescent Current (µA)	CL Quiescent Current (µA)	Efficiency @ V_{CELL} = 3.3V	OVP/UVP	Control Interface	MPS Advantages for Battery Backup Units
N **MP2642**	Bidirectional, Buck-Boost	Li-Ion, Li-Po, LiFePO4	2	1	3.8	16	12	0.1	92.8%	✓	2-Pin	Integrated FETs, requires single inductor/capacitor, tiny package, supports high cell-count strings
N **MP2643**	Bidirectional, Buck-Boost	Li-Ion, Li-Po, LiFePO4	2	2	3.8	16	12	0.1	92.8%	✓	2-Pin	Integrated FETs, requires single inductor/capacitor, tiny package, supports high cell-count strings

N - New Product S - Sampling Product

Robotics & Supply Chain

Application Characteristics

» Wide, diverse range of products among many small- to mid-sized OEMs

» Compact pack designs required for tight size constraints
- Typical 4- to 18-cell packs, with high level of design integration

» NMC and LiPo battery cells
- High energy density cells required due to size constraints
- High power density cells required due to large load variations

» Safety critical
- Products are designed for indoor usage within close proximity to humans

MPS Advantages

» Battery Monitors
- Support highly integrated BMS with FET control for up to 200A of current control, soft start to eliminate pre-charge circuitry

» Fuel Gauges
- Offer full suite of pack and cell estimations to maximize pack utilization and user experience

» Active Balancers
- Extend runtime and decrease charge time for high duty cycle applications such as forklifts

» Complete Battery Management System Solutions
- Provide fast time-to-market, minimal upfront investment, and support for industry and safety standards

Market Trends for Robotics & Supply-Chain Automation BMS					
Gov. Regulation	Industry Standards	Evolving Batteries	Cost Differentiation	End-Product Differentiation	Manufacturing Localization
√	√	√		√	√

PRODUCTS FOR ROBOTICS & SUPPLY CHAIN

Battery Monitor & Protectors

	Part Number	# of Series Cells	Pack Voltage (V)	Charge/Discharge MOSFET Driver	Separate Charge/Discharge Control	Cell-Balancing	Coulomb Counting	Discharge Soft Start	Sync Voltage & Current Measurement	OT Cell Voltage Accuracy (-20°C to +60°C)	MPS Advantages for Robotics & Supply Chain
N	**MP2793**	4 to 16	10 to 86	High-Side	✓	✓	✓	✓	✓	±7.5mV	Supports 4- to 16-cell battery packs, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes soft start to eliminate pre-charge circuit
S	**MP3712**	3 to 7	7.5 to 85	High-Side	✓	✓	✓	-	✓	±7.5mV	Supports low-voltage 3- to 7-cell battery packs, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes advanced soft start to eliminate pre-charge circuit
S	**MP3713**	3 to 10	3 to 85	High-Side	✓	✓	✓	✓	✓	±7.5mV	Supports 3- to 10-cell battery packs, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes advanced soft start to eliminate pre-charge circuit
S	**MP3716**	3 to 18	7.5 to 86	High-Side	✓	✓	✓	✓	✓	±7.5mV	Supports 3- to 18-cell battery packs, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes advanced soft start to eliminate pre-charge circuit

Battery Pack Fuel Gauges

	Part Number	# of Series Cells	Chemistry	Communication Interface	External SOC Indication	Pack SOC Accuracy	Cell Impedance Monitoring	Thermal Model	Recommended Battery Monitor	Battery Monitor I/F	MPS Advantages for Robotics & Supply Chain
	MPF42791	2 to 16	Li-Ion, Li-Polymer	I²C	LED	±3%	✓	✓	MP2793	via MCU	Supports battery packs up to 16 cells, standard Li-ion chemistries, high-accuracy SOC including LiPo cells, provides max available power, charge and runtime, lifetime logging
N	**MPF42793**	2 to 16	LiFePO4	I²C	LED	±5%	✓	✓	MP2793	via MCU	Supports battery packs up to 16 cells, specifically designed for LiFePO4, provides high-accuracy SOC including LiPo cells, provides max available power, charge and runtime, lifetime logging
	MPF42795	2 to 10	Li-Ion, Li-Polymer	I²C	LED	±3%	✓	✓	MP3713	Direct	Supports battery packs up to 16 cells for standard Li-ion chemistries, provides high-accuracy cell and pack battery metrics with logging including SOC max available power, charge and runtime, lifetime logging
S	**MPF42780**	2 to 10	Li-Ion, Li-Polymer, LiFePO4	I²C	LED	±3%	✓	✓	MP3713	Direct	Supports battery packs up to 10 cells for all Li-ion chemistries including LiFePO4, streamlined architecture eliminates need for MCU between battery monitor and fuel gauge
S	**MPF42781**	2 to 18	Li-Ion, Li-Polymer, LiFePO4	I²C	LED	±3%	✓	✓	MP3716	Direct	Supports battery packs up to 18 cells for all Li-ion chemistries including LiFePO4, streamlined architecture eliminates need for MCU between battery monitor and fuel gauge

Active Balancers

	Part Number	Topology	Chemistry	# of Series Cells	Maximum Net Balance Current (A)	Minimum V_{IN} (V)	Maximum V_{IN} (V)	CU Quiescent Current (µA)	CL Quiescent Current (µA)	Efficiency @ V_{CELL} = 3.3V	OVP/UVP	Control Interface	MPS Advantages for Robotics & Supply Chain
N	**MP2642**	Bidirectional, Buck-Boost	Li-Ion, Li-Po, LiFePO4	2	1	3.8	16	12	0.1	92.8%	✓	2-Pin	Integrated FETs, requires single inductor/capacitor, tiny package, supports high cell-count strings
N	**MP2643**	Bidirectional, Buck-Boost	Li-Ion, Li-Po, LiFePO4	2	2	3.8	16	12	0.1	92.8%	✓	2-Pin	Integrated FETs, requires single inductor/capacitor, tiny package, supports high cell-count strings

N - New Product S - Sampling Product

Energy Storage Systems

Application Characteristics

» Modular designs
- Modularity allows energy storage systems (ESS) to be sized and expanded as needed
- 48V to 160V modules
- Current measurement may be separated into junction box to consolidate safety cutoff points (fuses, contactors, etc.)

» Battery cells
- Typical large format cells (such as 280Ah)
- Relatively lower space constraints allow for lower-cost, lower energy density LiFePO4 cells

» End-product differentiators
- Longer runtime to maximize value of energy arbitrage
- Faster cycle time to guarantee performance during grid variability

MPS Advantages

» Battery Monitors
- Support modules up to 18 cells in a single IC, with or without integrated FET control
- Stackable for multi-module systems

» Fuel Gauges
- Provide an extensive set of precision cell and pack estimations, critical for LiFePO4 cells
- Support up to 112 series cells across a stack of battery monitors

» Active Balancers
- >2A of balancing current enables short cycle operation, improved energy efficiency, and increased system runtime

Market Trends for Energy Storage Systems BMS					
Gov. Regulation	Industry Standards	Evolving Batteries	Cost Differentiation	End-Product Differentiation	Manufacturing Localization
√		√	√	√	√

PRODUCTS FOR ENERGY STORAGE SYSTEMS

Battery Monitor & Protectors

Part Number	# of Series Cells	Pack Voltage (V)	Charge/Discharge MOSFET Driver	Separate Charge/Discharge Control	Cell-Balancing	Coulomb Counting	Discharge Soft Start	Sync Voltage & Current Measurement	OT Cell Voltage Accuracy (-20°C to +60°C)	MPS Advantages for Energy Storage Systems
MP2797	7 to 16	18 to 86	High-Side	✓	✓	✓	✓	✓	±7.5mV	Supports battery packs up to 16 cells, designed for systems with separate current-control circuit, includes soft start to eliminate pre-charge circuit
S **MP2797A**	7 to 16	18 to 86	High-Side	✓	✓	✓	✓	✓	±4.5mV	High-accuracy measurements ideal for LiFePO4, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes soft start to eliminate pre-charge circuit
S **MP2798**	3 to 18	18 to 86	-	-	✓	✓	-	✓	±7.5mV	Supports 3- to 18-cell battery packs, designed for systems with separate current-control circuit (not including integrated high-side MOSFET drivers)
S **MP3716**	3 to 18	18 to 86	High-Side	✓	✓	✓	✓	✓	±7.5mV	Supports 3- to 18-cell battery packs, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes advanced soft start to eliminate pre-charge circuit
S **MP3716A**	3 to 18	18 to 86	High-Side	✓	✓	✓	✓	✓	±4.5mV	High-accuracy measurements ideal for LiFePO4, integrated drivers for independently controlled charge/discharge protection MOSFETs, includes advanced soft start to eliminate pre-charge circuit

Battery Pack Fuel Gauges

Part Number	# of Series Cells	Chemistry	Communication Interface	External SOC Indication	Pack SOC Accuracy	Cell Impedance Monitoring	Thermal Model	Recommended Battery Monitor	Battery Monitor I/F	MPS Advantages for Energy Storage Systems
MPF42791	2 to 16	Li-Ion, Li-Polymer	I²C	LED	±3%	✓	✓	MP2797	via MCU	Supports battery packs up to 16 cells, standard Li-ion chemistries, high-accuracy SOC including LiPo cells, provides max available power, charge and runtime, lifetime logging
N **MPF42793**	2 to 16	LiFePO4	I²C	LED	±5%	✓	✓	MP2797A	via MCU	Supports battery packs up to 16 cells, specifically designed for LiFePO4, provides high-accuracy SOC including LiPo cells, provides max available power, charge and runtime, lifetime logging
S **MPF42781**	2 to 18	Li-Ion, Li-Polymer, LiFePO4	I²C	LED	±3%	✓	✓	MP3716 MP3716A	Direct	upports battery packs up to 18 cells for all Li-ion chemistries including LiFePO4, streamlined architecture eliminates need for MCU between battery monitor and fuel gauge
S **MPF42786**	2 to 112	Li-Ion, Li-Polymer, LiFePO4	I²C	LED	±3%	✓	✓	Multiple MP3716	via MCU	Supports multiple battery monitors for high cell packs for all Li-ion chemistries including LiFePO4, provides accurate pack and cell SOC and SOH, max available power, charge and runtime, lifetime logging

Active Balancers

Part Number	Topology	Chemistry	# of Series Cells	Maximum Net Balance Current (A)	Minimum V_{IN} (V)	Maximum V_{IN} (V)	CU Quiescent Current (µA)	CL Quiescent Current (µA)	Efficiency @ V_{CELL} = 3.3V	OVP/UVP	Control Interface	MPS Advantages for Energy Storage Systems
N **MP2642**	Bidirectional, Buck-Boost	Li-Ion, Li-Po, LiFePO4	2	1	3.8	16	12	0.1	92.8%	✓	2-Pin	Integrated FETs, requires single inductor/capacitor, tiny package, supports high cell-count strings
N **MP2643**	Bidirectional, Buck-Boost	Li-Ion, Li-Po, LiFePO4	2	2	3.8	16	12	0.1	92.8%	✓	2-Pin	Integrated FETs, requires single inductor/capacitor, tiny package, supports high cell-count strings

N - New Product S - Sampling Product

ABOUT MONOLITHIC POWER SYSTEMS

Who we are

We are creative thinkers. We break boundaries. We take technology to new levels. As a leading international semiconductor company, Monolithic Power Systems (MPS) creates cutting-edge solutions to improve the quality of life with green, easy-to-use products.

What we do

We make power design fun! With our innovative proprietary technology processes, we thrive on reimagining and redefining the possibilities of high-performance power solutions in industrial applications, telecom infrastructures, cloud computing, automotive, and consumer applications.

Where we come from

It started with a vision. Michael Hsing, pioneering engineer and CEO, founded Monolithic Power Systems, Inc. in 1997 with the belief that an entire power system could be integrated onto a single chip. Under his leadership, MPS has succeeded not only in developing a monolithic power module that truly integrates an entire power system in a single package, but also it continues to defy industry expectations with its patented groundbreaking technologies.

Our values

We cultivate creativity
As a company, we believe in creating an environment that encourages and challenges our employees to collaborate and think outside the box to excel beyond their preconceived capabilities.

We do not accept the status quo
We do not believe in limitations. It is not about what is, but what can be. Possibilities are endless at MPS.

We are passionate about sustainability
It's about the future. From materials to finances, we are committed to conservation. We will not tolerate waste in an effort to improve and preserve the quality of life.

We are committed to providing innovative products to our customers
Let us do the heavy lifting. We relentlessly strive to make system design versatile and effortless to meet our customers' specific needs. We'll do the work, so our customers can have the fun!

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NOTES :

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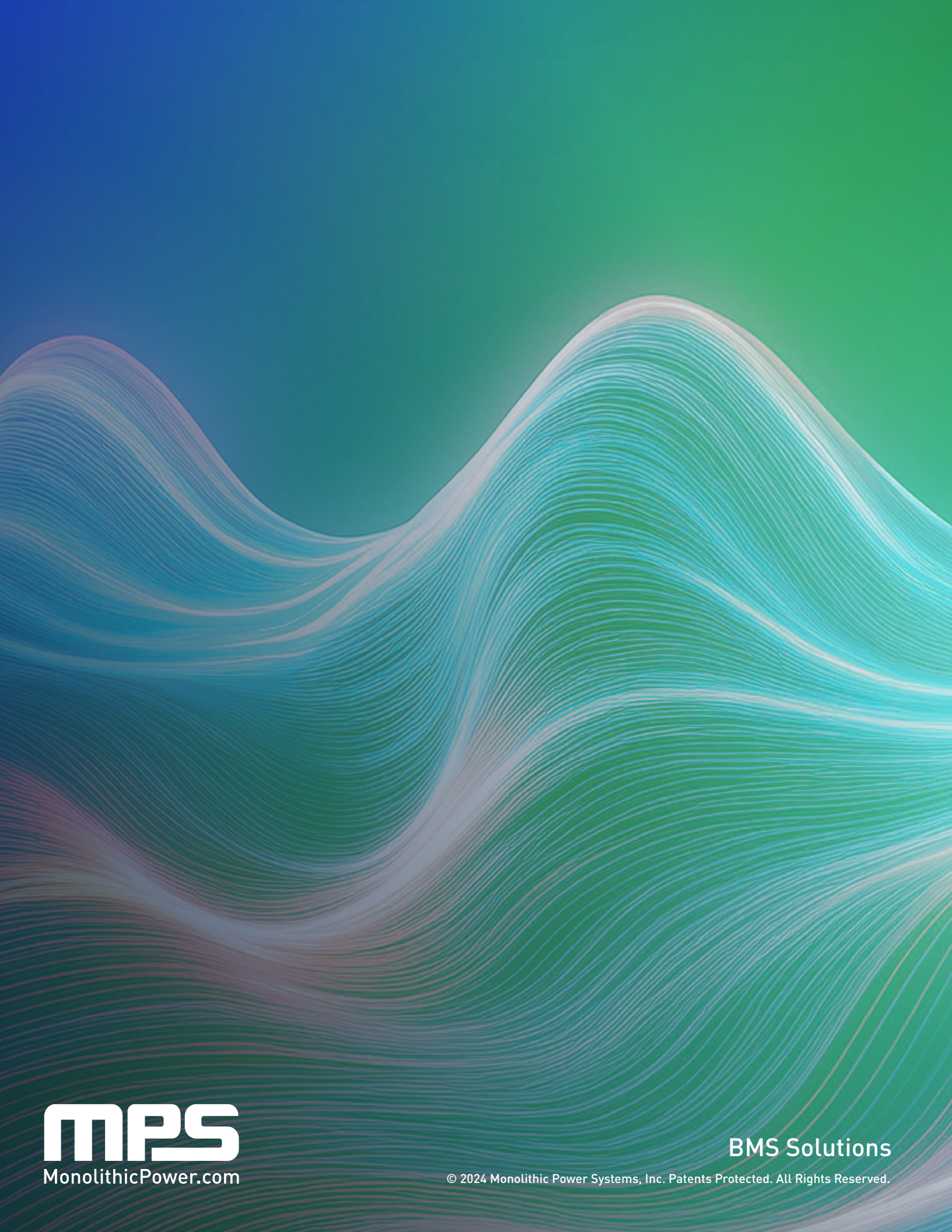

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