

Robot charging management

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Agenda

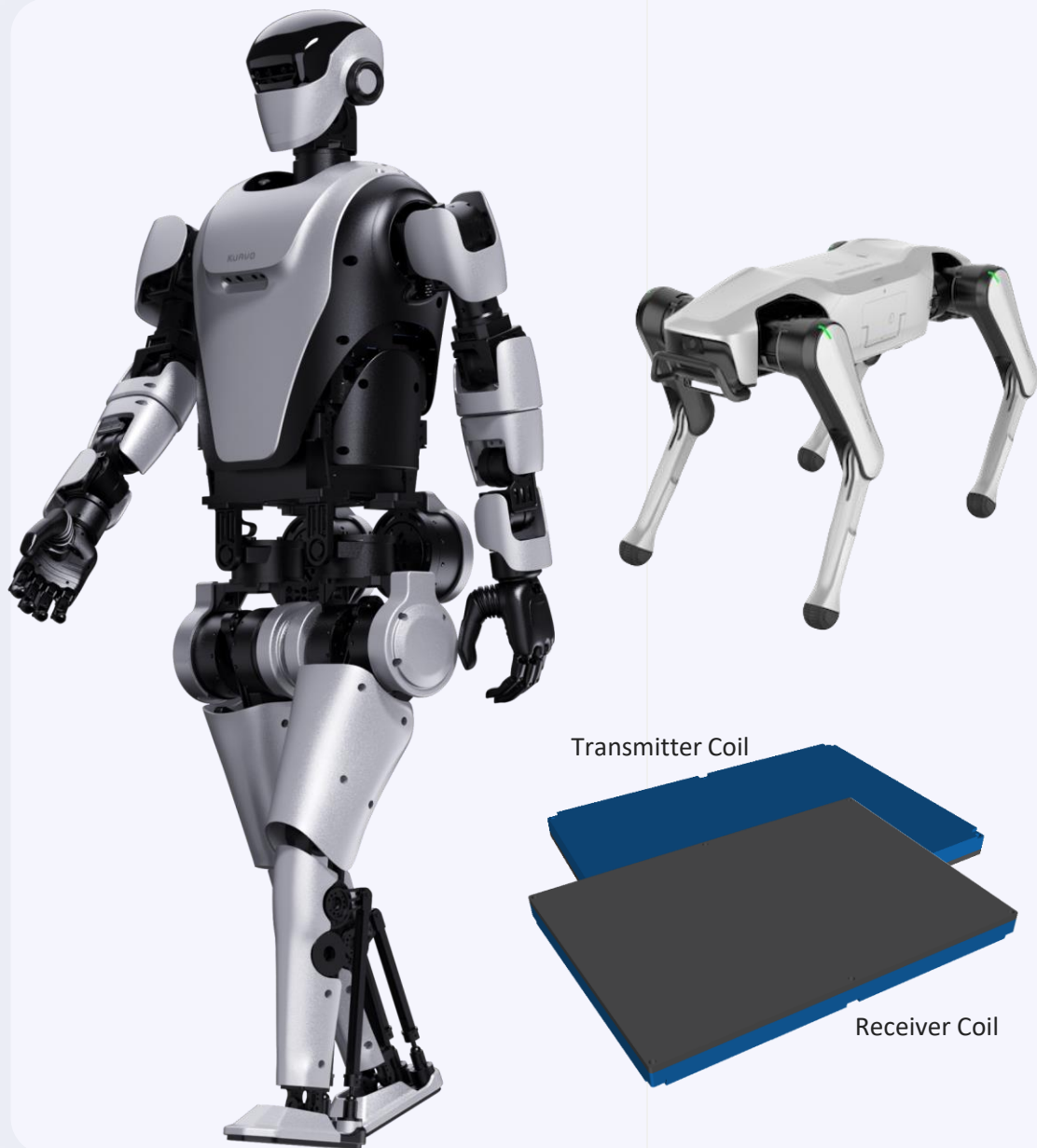


- Introduction to Robot Charging Modes.
- Convenient Charging Solutions for Various Household Robots
- Introduction to MPS Charging Solution.

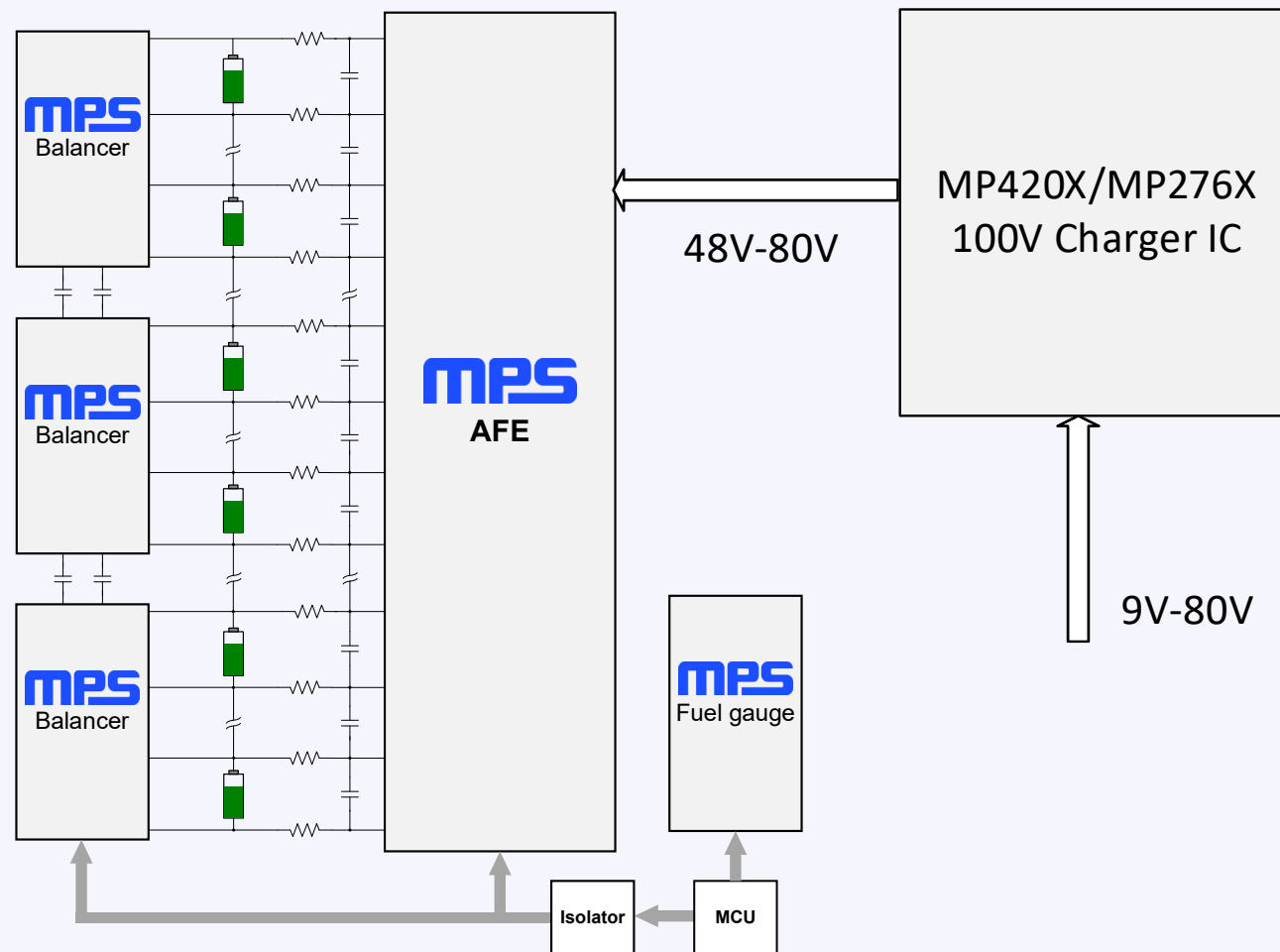
Charging Methods For Robots

Contact / Contactless Charging

Robot Battery System



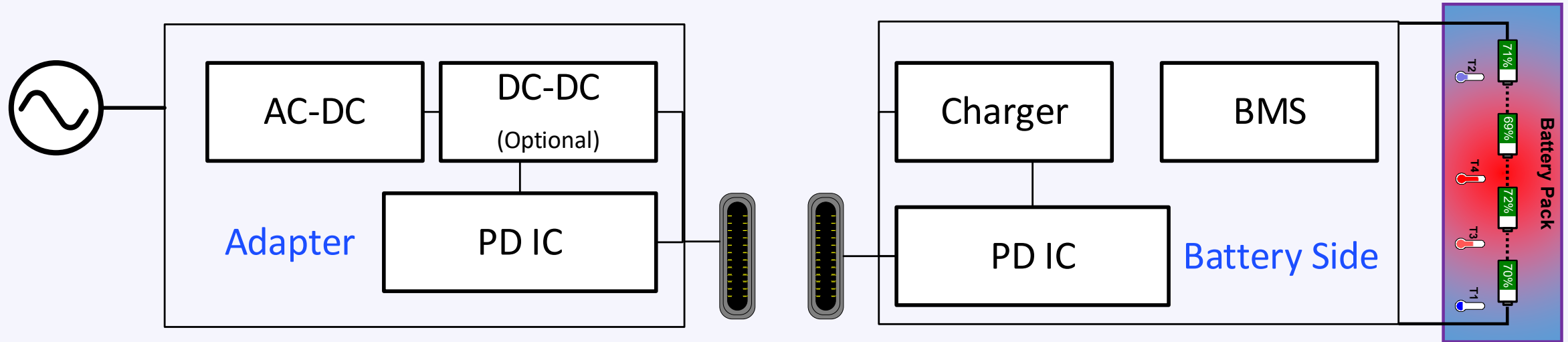
Battery Pack



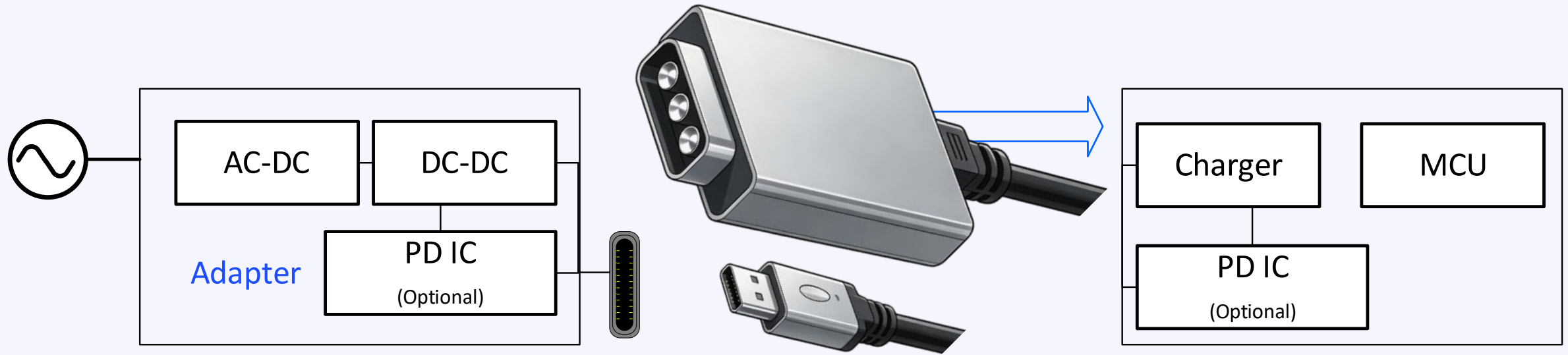
Battery Swapping / Wired charging

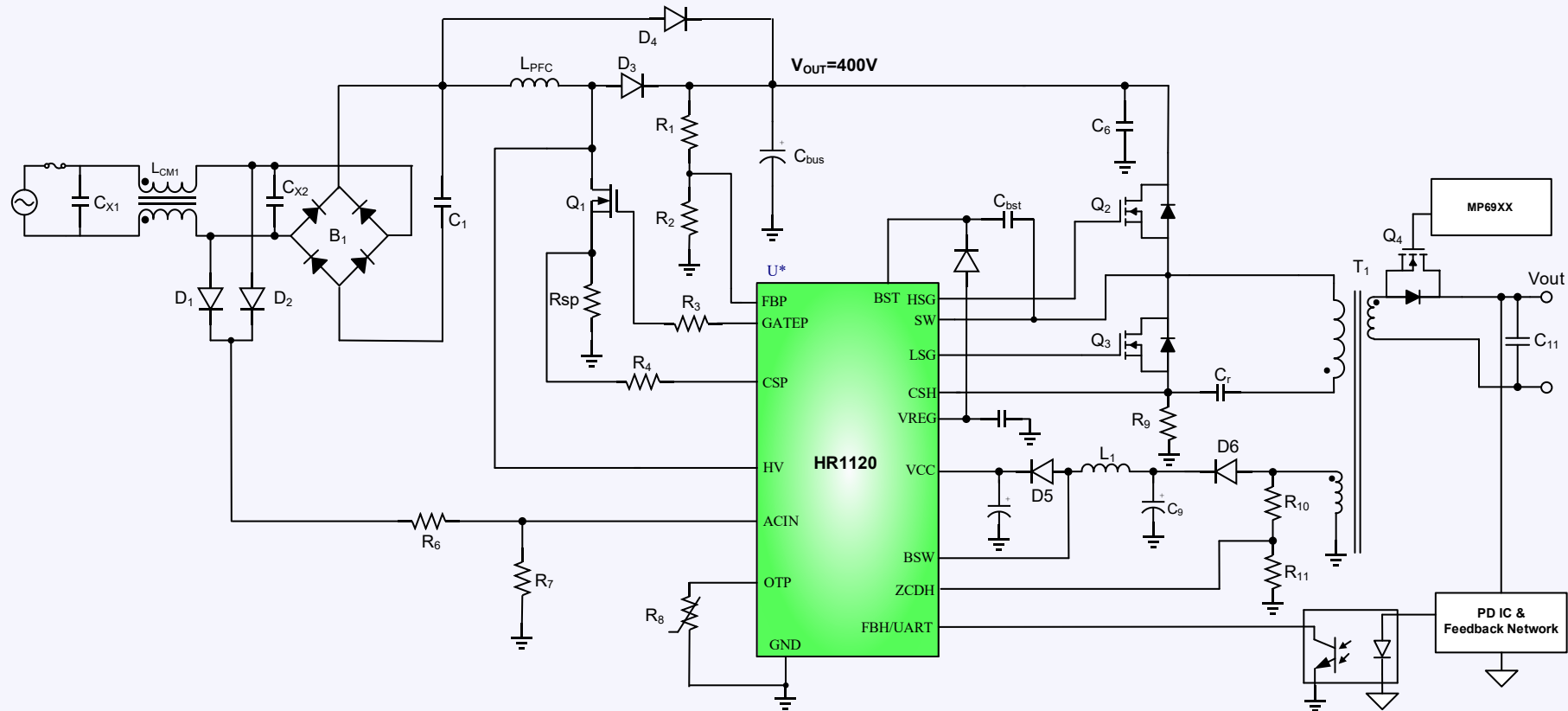
Contact Charging

Wired charging | A charging method based on the PD protocol



Digital CRM PFC+ AHB Flyback Combo

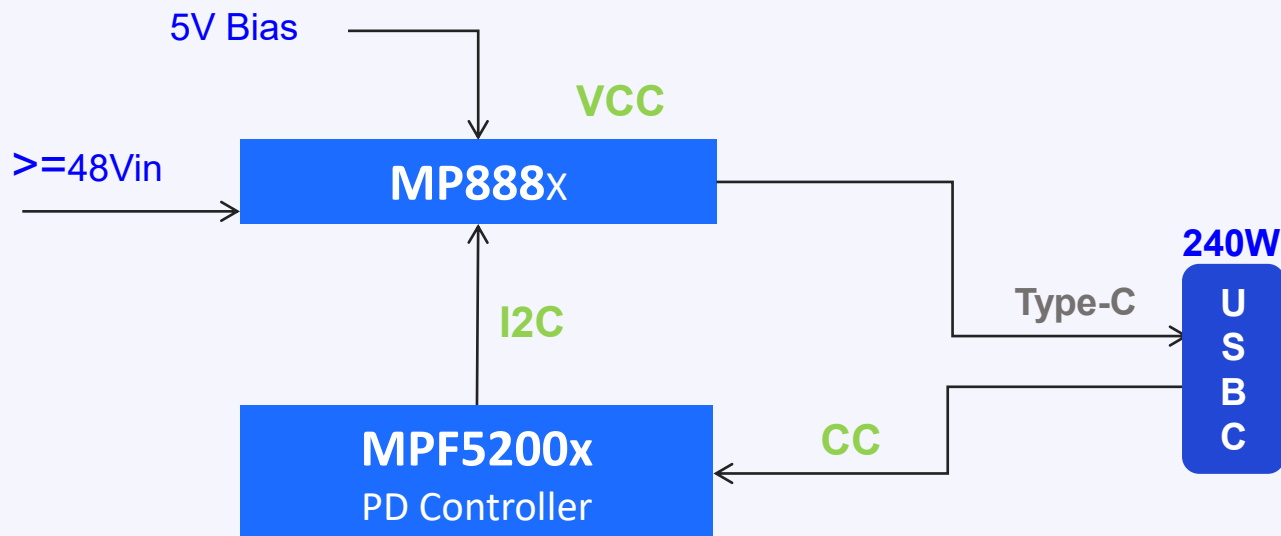




240W PD3.1 EPR Adaptor

Key Features

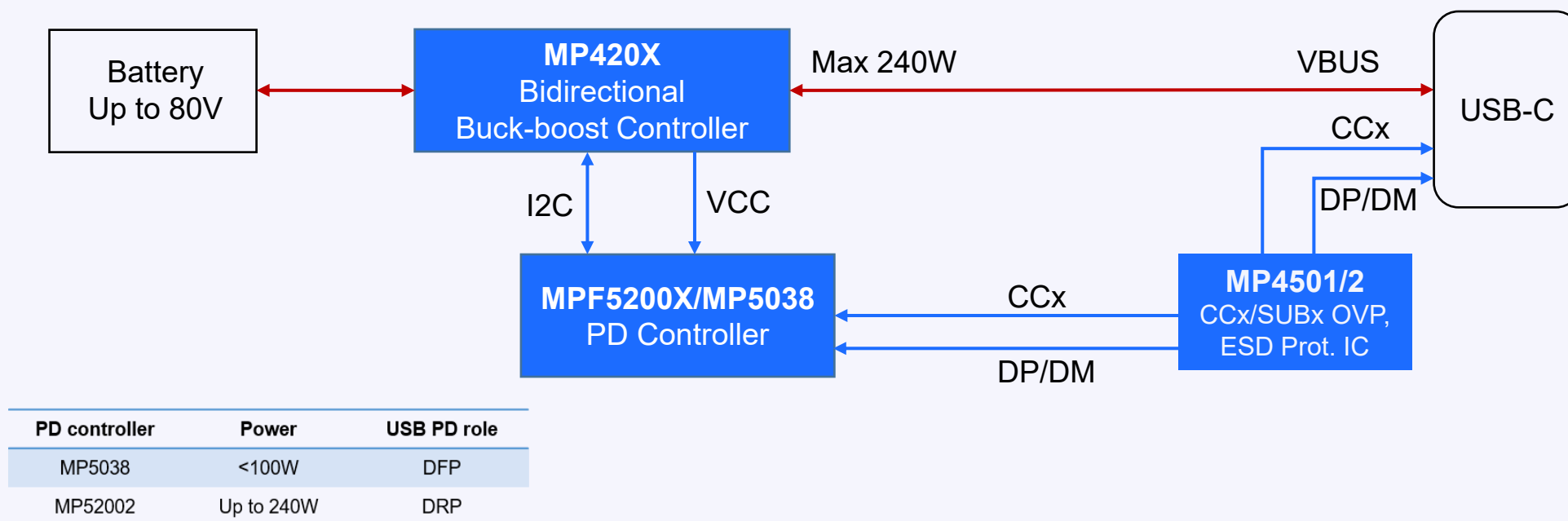
- Wide 4.5V to 65V Input Voltage (VIN) Range. 70V Absolute Maximum Voltage
- Feedback Reference Voltage Range is 0V to 2.047V, 0.5mV/Step
- 6A Continuous Output Current
- 100μA Low IQ at I2C Operation Off
- Support 100% Duty Cycle Operation.
- ±5% Output CC Current Limit Accuracy.
- Programmable 200kHz to 1MHz Switching Frequency with Clock Synchronization
- Programmable Line Drop Compensation



High Voltage Battery Pack PD DRP

Key Features

- 240W high-power bidirectional DRP charging & discharging architecture, compatible with multi-series lithium batteries
- Full compliance with PD3.2 EPR/SPR specifications, supporting wide voltage regulation via PPS and AVS
- Integrated intelligent battery temperature control and multi-stage power derating protection
- Visual parameter configuration over I2C plus non-volatile MTP storage for parameter retention
- Highly integrated and streamlined hardware with full-link safety protection, delivering high efficiency and low thermal rise



MP420X | Synchronous Bi-directional Buck-Boost Controller



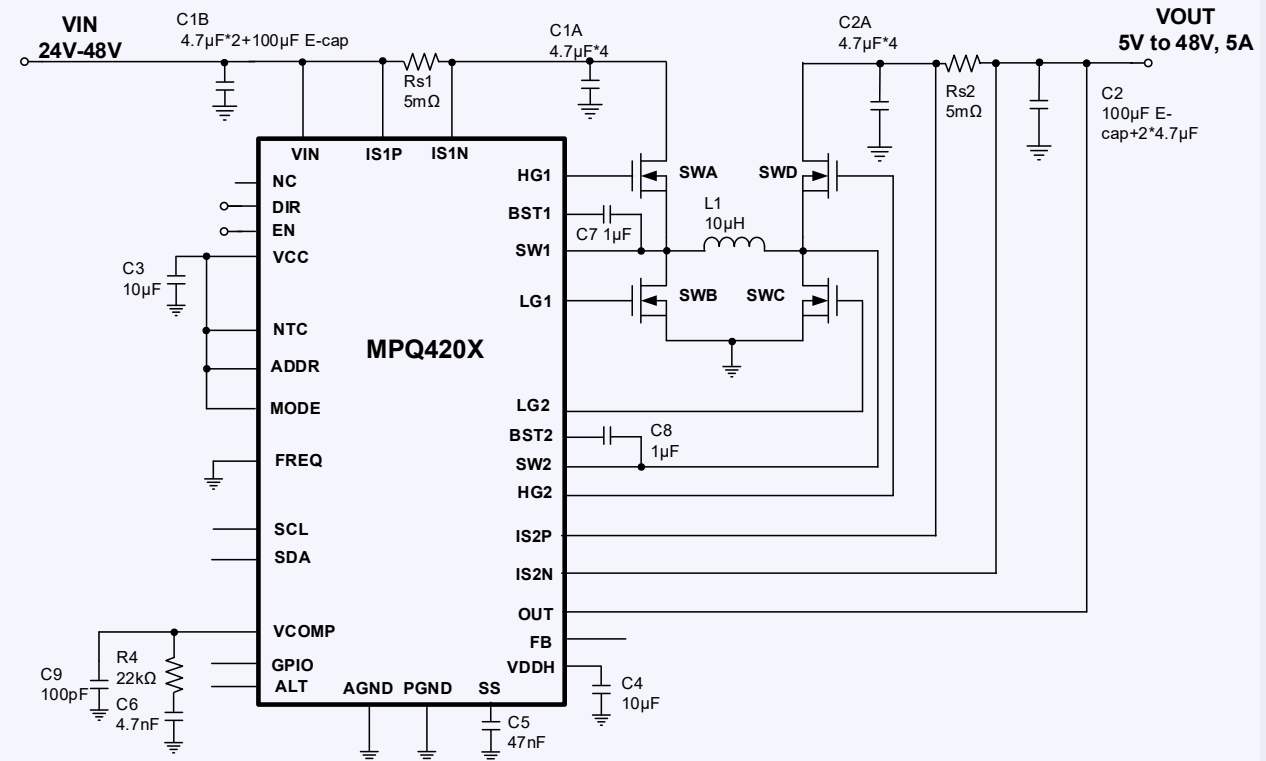
FEATURES

- 4-switch Bi-directional Buck-boost Controller
- 4.75V to 100V Operation Input Voltage Range.
- External feedback can support 100V output; Internal feedback supports 3.2V-85.12V Output Voltage Range, 20mV/step.
- 1 μ A EN Shutdown IQ
- 100 μ A IQ when I2C operation OFF
- Programmable Input / Output Continuous Current limit (CC), 0.5A-25A with 50mA/step.
- Support 1m Ω Sensing Resistor for 25A Current
- Support USB PD SPR PPS and EPR AVS
- 200kHz/400kHz/600kHz/1MHz Switching Frequency with frequency spread spectrum and frequency SYNC input
- PFM and FCCM mode selection
- 1.75A Peak Source Current and 4.5A Peak Sink Current Capability for Driver
- Programmable VIN UVLO Voltage via OTP
- Programmable VOUT OVP
- Programmable Input Regulation Threshold for MPPT

System

- Battery Charge Cycle Control with Status Indication
- I2C Interface with interrupt function
- OCP, OVP, PG, NTC and thermal shutdown Interrupt
- 10-bit ADC Readout Function for VIN, IIN, VOUT, IOUT and Temperature

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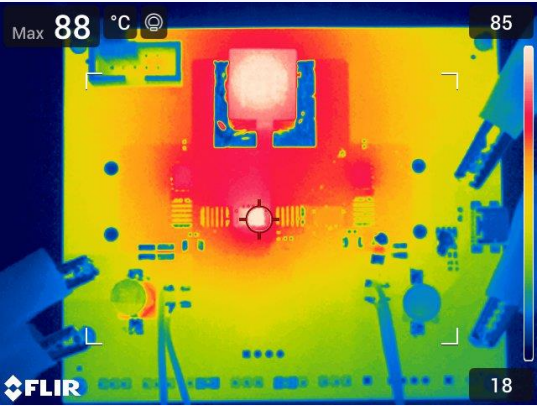
MP420X | Efficiency and Thermal



$V_{in}=20V$. $V_o=20-48V@5A$, $f_s=200kHz$, $L=4.7\mu H$ (XAL1510-472, $R_{dc}=3.35m\Omega$). 10cmx8.5cm 6-layer, top/bottom 2Oz, inner 1Oz. Input $R_{sens}=2m\Omega$, Output $R_{sens}=5m\Omega$.

Efficiency- GaN

V_{in}	I_{in}	V_{out}	I_{out}	eff(%)
20.006	5.1564	20.195	5.0053	97.98669
20.0432	7.1831	28.1955	5.0053	98.02367
20.0154	9.3111	36.2062	5.0044	97.22315
20.068	12.4667	48.2315	5.0044	96.47775

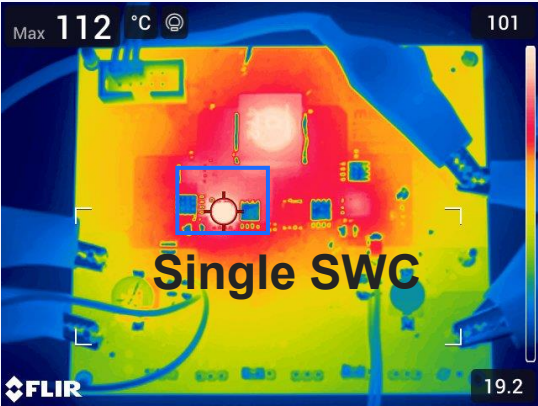


20Vin->48V/5A

GaN FET: MPD21108G0GQW-15032 (3.9mΩ, 20nC)

Efficiency- Si FET Single SWC FET

V_{in}	I_{in}	V_{out}	I_{out}	eff(%)
20.01	5.1923	20.2845	5.0025	97.66626
20.0155	7.2702	28.35	5.0016	97.44268
20.0685	9.4139	36.4155	5.0016	96.40748
20.015	12.7276	48.5029	4.9997	95.19399

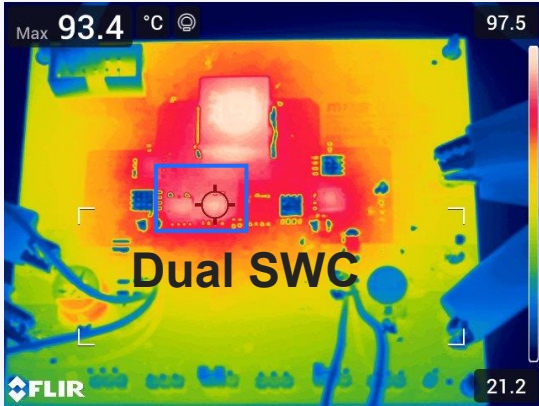


20Vin->48V/5AThermal is Not Good

Si FET: MPD51108K0GZK-08090 (10.4mΩ, 22nC Qg)

Efficiency- Si FET Dual SWC FETs

V_{in}	I_{in}	V_{out}	I_{out}	eff(%)
20.0338	5.1502	20.2896	4.9688	97.70968
20.0276	7.2778	28.3411	5.0156	97.52379
20.013	9.4418	36.3999	5.0147	96.60023
20.0278	12.6922	48.4844	5.0147	95.64821



20Vin->48V/5A

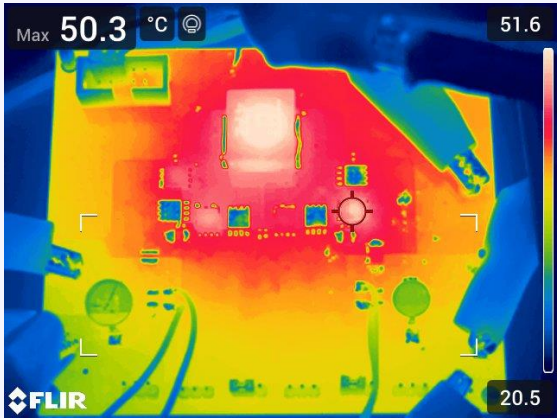
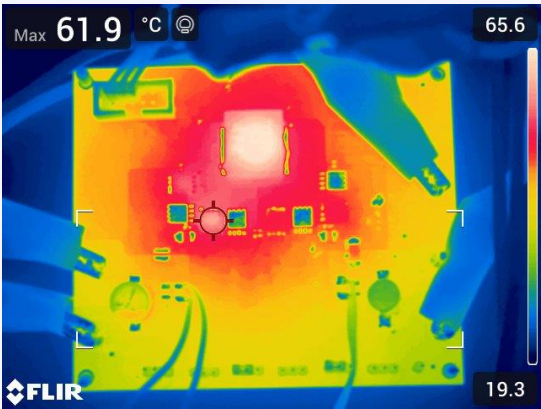
Vin=36V-48V. Vo=20-48V@5A, fs=200kHz, L=4.7uH (XAL1510-472,Rdc=3.35mΩ). 10cmx8.5cm 6-layer, top/bottom 2Oz, inner 1Oz. Input Rsens=2mΩ, Output Rsens=5mΩ

Efficiency- Si FET

Vin	Iin	Vout	Iout	eff(%)
36.0212	2.915	20.259	4.9988	96.44662
36.0331	4.003	28.3265	4.9988	98.16834
36.0312	5.1551	36.4413	4.9988	98.07172
36.01	6.888	48.5126	4.9997	97.78725

Efficiency- Si FET

Vin	Iin	Vout	Iout	eff(%)
48.0692	2.2313	20.2458	5.013	94.62541
48.0186	3.074	28.311	5.0109	96.10757
48.0375	3.8688	36.36	4.9997	97.81628
48.0284	5.144	48.5215	4.9969	98.13768

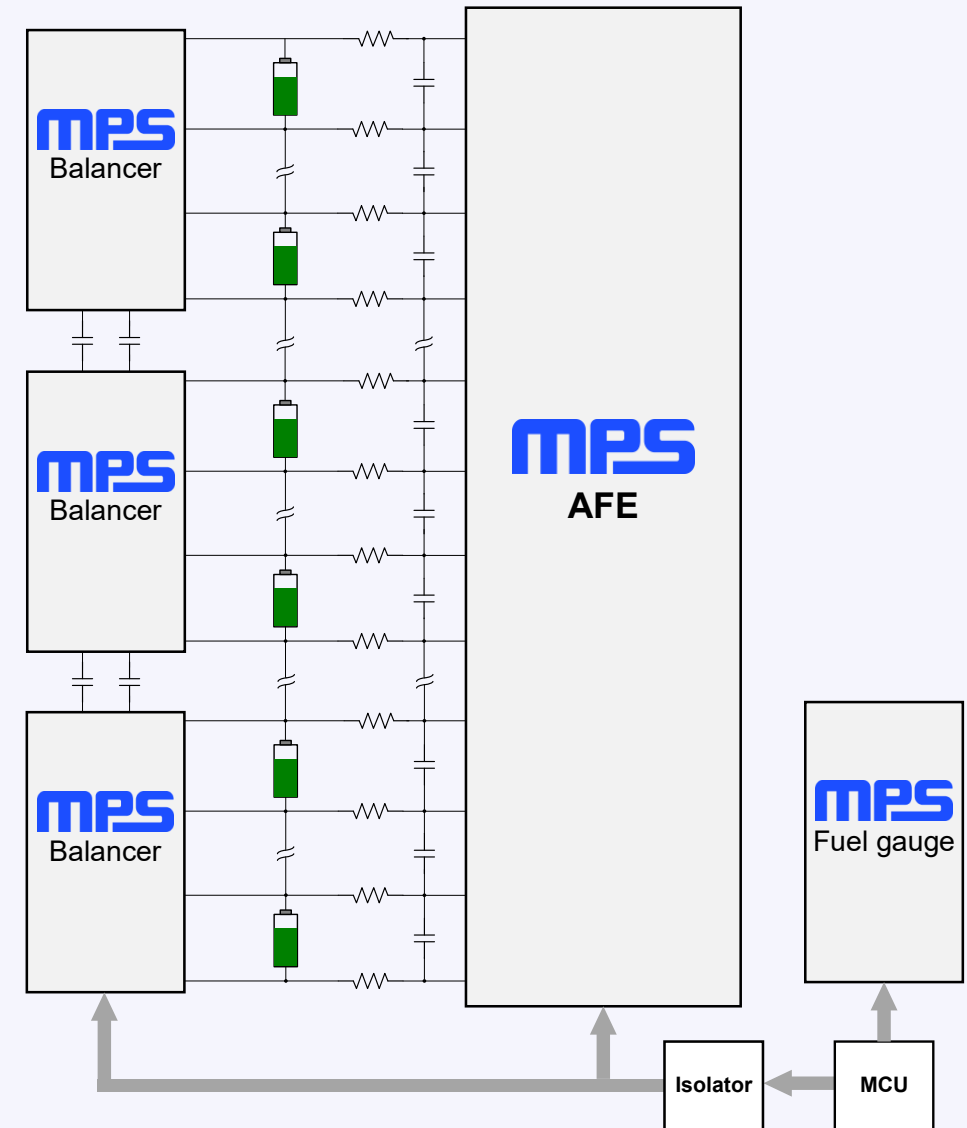


Si FET: MPD51108K0GZK-08090 (10.4mΩ, 22nC Qg)

Solution Details

- The Heart: AFE monitors voltage/current/temp, controls balancing and protection → best price vs. performance
- The Brain: Fuel gauge provides module SOC, SOH, and controls balancing → best accuracy in industry
- The Muscle: Active Balancer extends runtime → 20x smaller, 3x cheaper, and higher efficiency
- All chips work together to enable “sticky” solution to sell complete MPS solution

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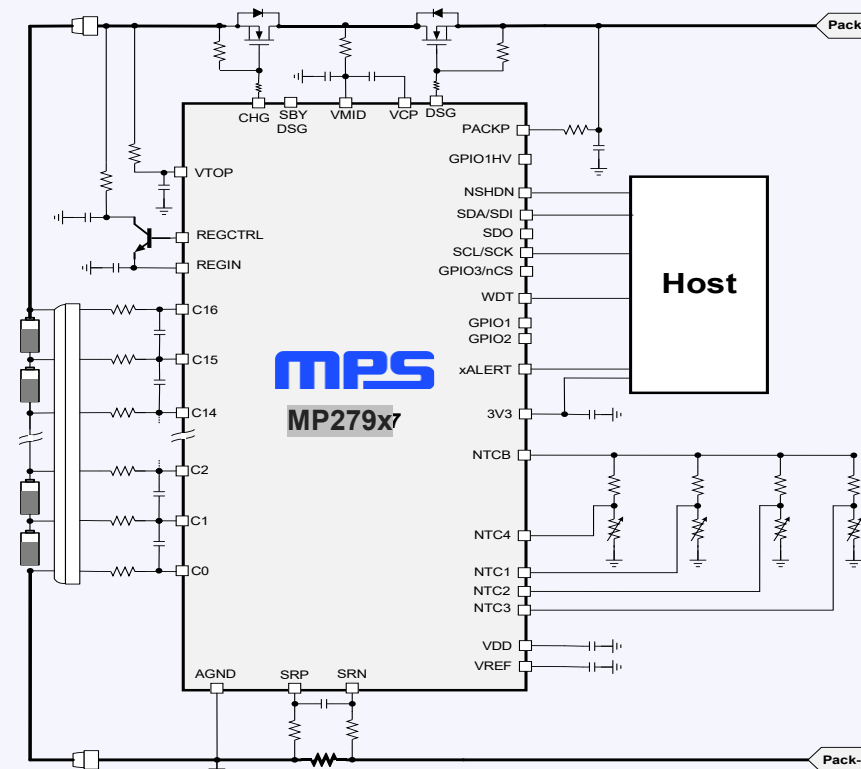


MP279x: 4 to 16-Cell High-Accuracy Battery Monitor and Protector with Coulomb Counting

FEATURES

- Voltage Measurements for 4 to 16 Series Cells
- Supports Battery Chemistries from 1V to 5V
- Accuracy: $\pm 2\text{mV}$ @ 25°C / $\pm 7.5\text{mV}$ @ -40° to 85°C with calibration $\pm 1\text{mV}$ @ 25°C
- Current Measurements
- Synchronized Current Measurement w/ Each Cell Voltage
- Accuracy: $\pm 1.5\%$ (-40° to 85°C , $\pm 100\text{mV}$ Sense Range)
- Includes Coulomb Counting Function
- 4 NTCs and die temperature measurements
- Integrated High Side N-FET driver
- Discharge Soft-start to eliminate pre-charge circuit
- Double path supported for CHG and DSG differentiation
- Internal balancing current up to 58mA
- External balancing with transistor or MOSFET can support higher current
- 3.3V Regulated output, up to 50mA
- $< 1\mu\text{A}$ in shutdown mode with 3.3V LDO disabled
- 1 x High Voltage and 2 x Low Voltage GPIOs
- Support Random Cell connection
- I2C or SPI communication with CRC option
- Package: TQFP 48 7mm x 7mm and QFN 6mm x 6mm option

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- Temperature monitoring: up to 4 NTC + IC Die
- Configurable Cell OV / UV, Pack OV, UV
- Configurable Over current / Short circuit
- Dead Cell and Cell Unbalance detection
- Inactive Host watchdog
- **Self Diagnosis**
- Open wire detection

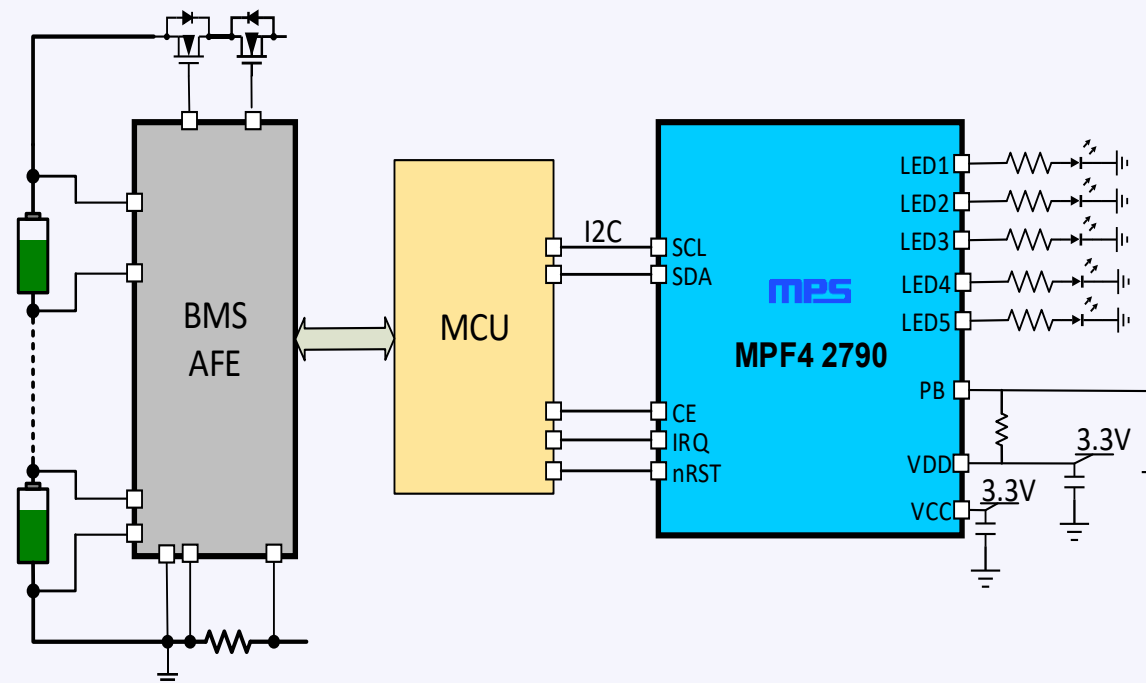
MPF4279X Battery Pack Fuel Gauge



FEATURES

- Compatible w/ Common Battery Monitors (up to 16 cells)
- $\pm 2.5\%$ State-of-Charge Accuracy when Paired with MP2797
- Provides Critical Battery Information:
- Pack and Cell State-of-Charge (SoC)
- Pack and Cell State-of-Health (SoH)
- Remaining Run Time and Charge Time
- Instantaneous Available Power
- Real-time Cell Resistance
- Adaptive Learning Capability:
- Refine Initial Charge Settings
- Refine Initial Discharge Settings
- Update Cell SoH to track degradation
- Update Cell ESR to track degradation
- Thermal Model to predict temperature
- Lifetime Logging of Key Parameters
- 5-Level LED SoC Indicator w/ Push-button Trigger
- 2.5V Minimum Supply Voltage
- 6 μ A Shutdown Current
- I2C Communication with CRC (up to 400kHz)

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- Variety of Lithium-based Cell Models Supported
- Basic Configuration Allows for Quick Setup
- High Degree of Configurability - Advanced Configuration Allows for Fine-tuning
- Simple GUI: Check, Set, Record, Plot
- Evaluation Boards Available

Wireless charging

Contactless Charging

MPW320xA | 1kW/3kW Wireless Charging Module



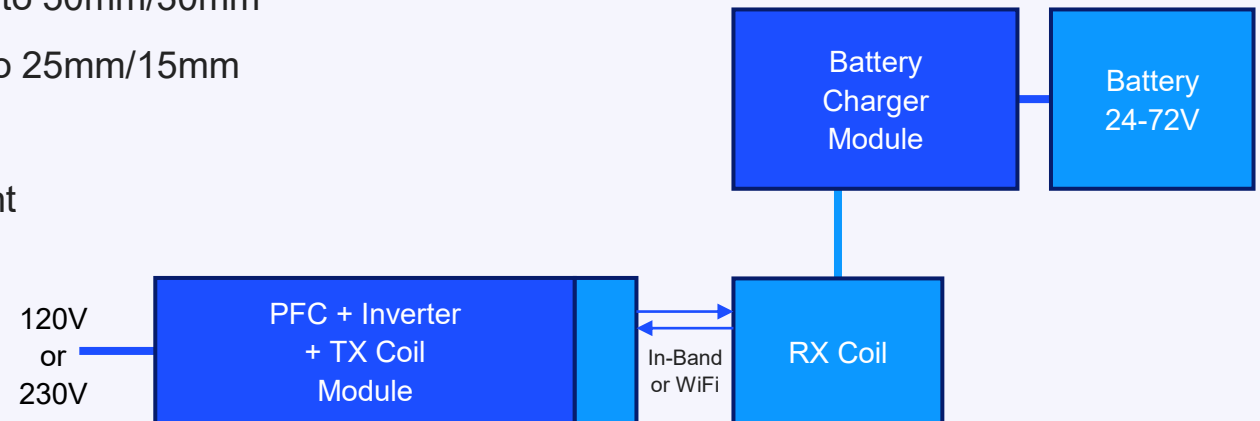
FEATURES

- 1kW (MPW3201AX) or 3kW (MPW3203AX) rated power at 230VAC
- Peak Efficiency above 96%
- Guaranteed Minimum Efficiency of 92%
- Takes advantage of best-in-class MPS GaN and SiC devices
- Optimized for passive cooling and IP67 applications
- Wireless power software pre-programmed into the MPS controllers
 - Software functions can be configured via GUI
 - Automatic system-level calibration and self-test
- Z Distance supported 5mm to 80mm
- For 300mm coils: Z Distance 10~80mm, X/Y misalignment up to 50mm/30mm
- For 150mm coils: Z Distance 5~40mm, X/Y misalignment up to 25mm/15mm
- Foreign Object Detection
- Relative position measurement and reporting for self-alignment
- Ethernet, CAN and RS-485
- WiFi or In-Band communication between TX and RX
- Battery types: Li-Ion, LiFePO4, Lead Acid
- Supports custom coils

ADVANTAGES

- Turnkey solution with minimal design needed
- High efficiency even in misaligned conditions
- Thermal solution can be designed that's guaranteed to work for worst case conditions
- IP67 ratings can be achieved easily
- Great user experience

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Dimensions for 3kW

Device	Length	Width	Height
PFC Module	150 mm	70 mm	40 mm
Inverter Module	150 mm	70 mm	26 mm
Battery Charger Module	150 mm	105 mm	40 mm

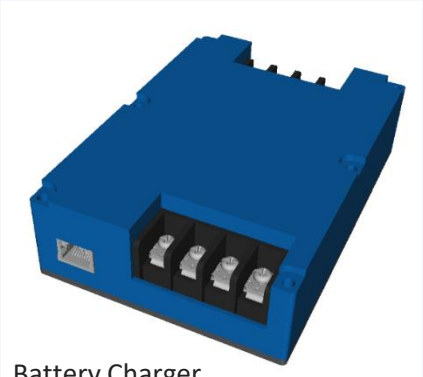
Dimensions for 1kW

Device	Length	Width	Height
PFC + Inverter Module (Integrated)	150 mm	70 mm	40 mm
Battery Charger Module	120 mm	105 mm	40 mm

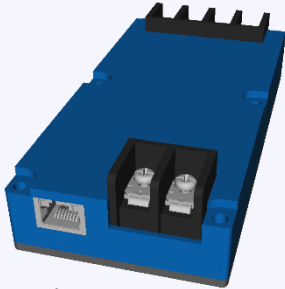
Dimensions for Coils*

Device	Length	Width	Height
High distance coil: Z distance 10mm~80mm	300 mm	210 mm	20 mm
Medium distance coil: Z distance 5mm~40mm	150 mm	110 mm	10 mm
Low distance coil: Z distance 5mm~15mm	100 mm	100 mm	10 mm

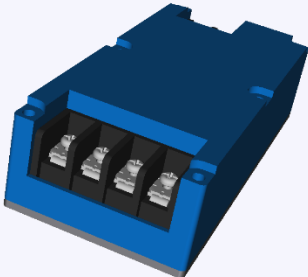
*Note: Supports custom coils



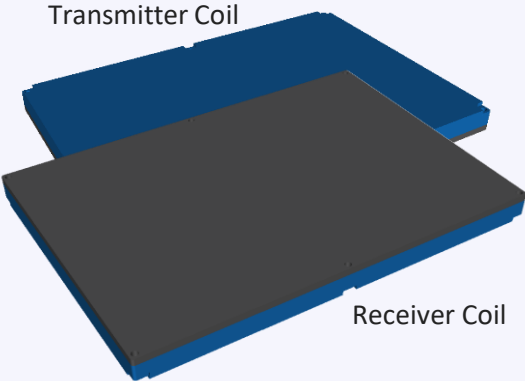
Battery Charger



Inverter



PFC

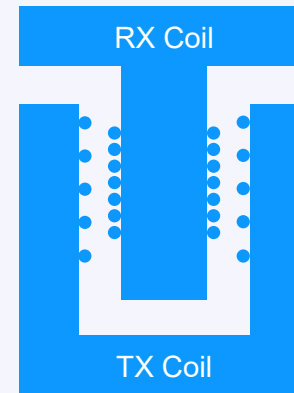
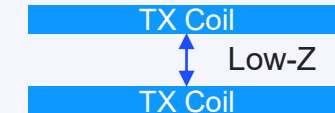
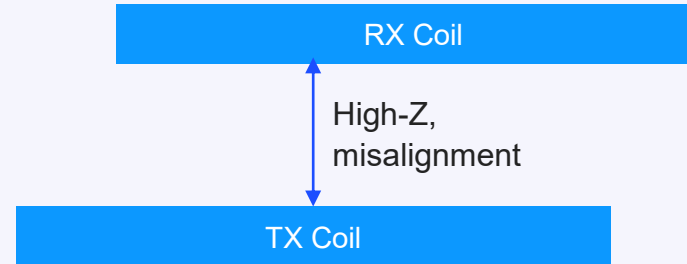


Transmitter Coil

Receiver Coil

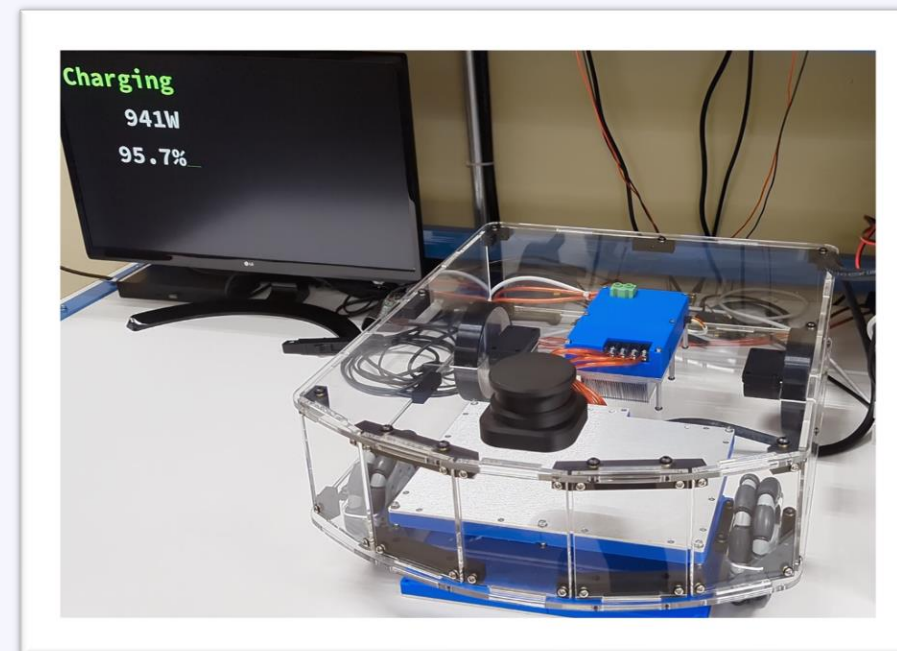
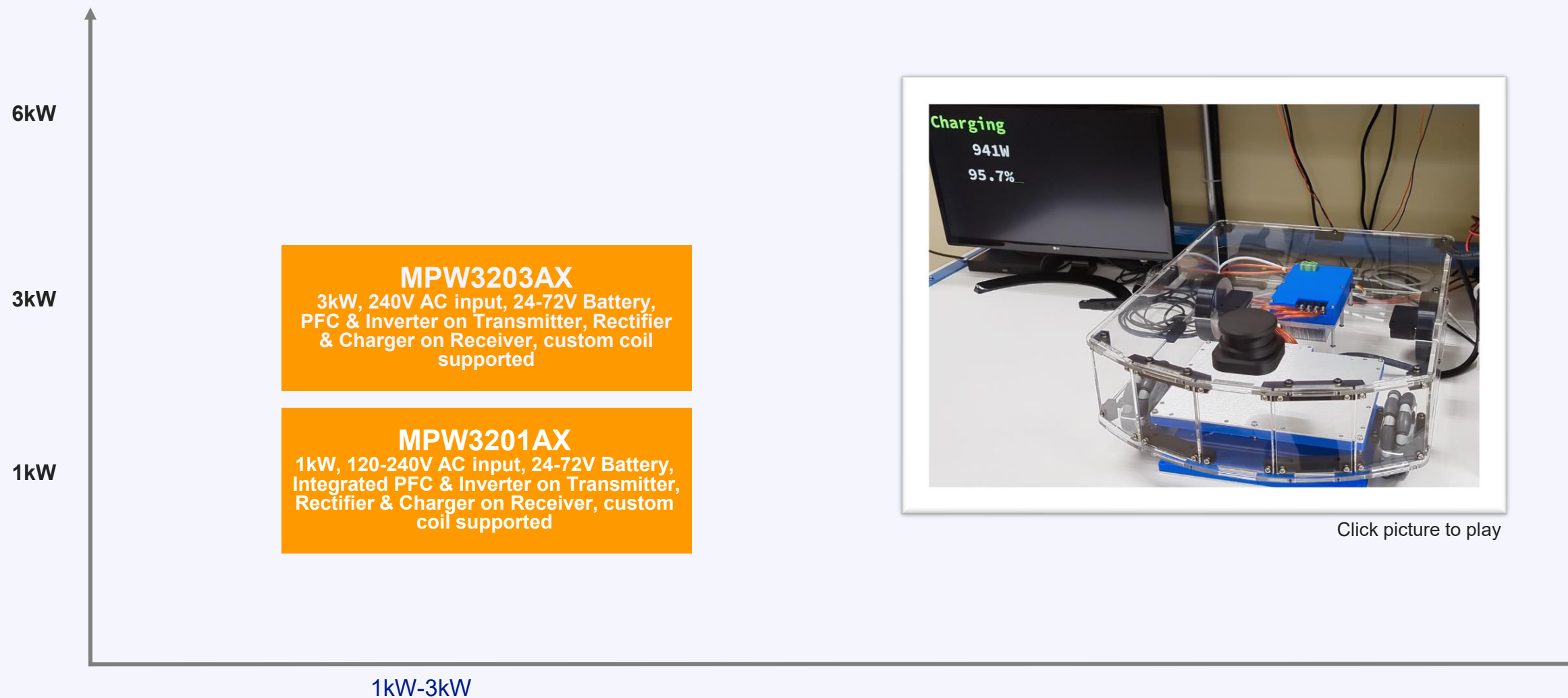
Coils are application-specific

- Larger coils for high-Z applications
 - Coils run high currents and need heavy wire
 - Coils generate a larger amount of heat
- Smaller coils when good coupling and alignment are guaranteed
 - Coil currents are low
 - Significant cost reductions can be achieved at the system level
- Non-standard coil form factors are supported
 - Some applications can't use flat coils
 - The electronic system expects a certain range of inductance and coupling
 - The coil geometry is not important



Example cylindrical coils
(section view)

High Power Wireless Charging Products Roadmap



Click picture to play

Newly Released

Released

Sampling

In Development

Thank you