



# MP2793

## 4-Cell to 16-Cell, High-Accuracy Battery Monitor and Protector with Coulomb Counting

**PRELIMINARY SPECIFICATIONS SUBJECT TO CHANGE**

### DESCRIPTION

The MP2793 is a robust battery management device, providing a complete analog front-end (AFE) monitoring and protection solution. It is designed for multiple-cell series battery management systems (BMS). The device can support I<sup>2</sup>C or SPI communication. It supports connections for 4-cell to 16-cell series battery packs, with an absolute voltage exceeding 80V on particular pins.

The MP2793 integrates two separate analog-to-digital converters (ADCs). The first ADC measures each channel's differential cell voltages (up to 16 channels), die temperature, and 4-channel temperatures via external NTC thermistors. The second ADC measures the current via an external current-sense resistor. The dual ADC architecture enables synchronous voltage and current measurements for cell and pack impedance monitoring.

When paired with an MPF4279x fuel gauge, the MP2793 can achieve state-of-charge (SOC) error to within 2%.

The MP2793 includes high-side MOSFET (HS-FET) drivers for charge and discharge independent control. The discharge (DSG) MOSFET driver includes a configurable soft start (SS) that provides a controlled turn-on, eliminating the need for an external pre-charge circuit. The DSG MOSFET driver incorporate the protection with discharging over-current (DOC), short-circuit (SC), battery under-voltage (UV), over-temperature (OT), and under-temperature (UT). The CHG MOSFET driver incorporate the protection with charging over-current (COC), short-circuit (SC), battery over-voltage (OV), UT, and OT. All of these protections have configurable thresholds.

Internal passive balancing MOSFETs can be used to equalize mismatched cells, supporting up to 58mA. There is also the option to drive external balancing transistors (MOSFET or BJT).

The MP2793 is available in a TQFP-48 (7mmx7mm) package.

### FEATURES

- Incorporates Dual ADC Architecture:
  - $\leq \pm 2\%$  State-of-Charge (SOC) Error with MPF4279x Fuel Gauge
  - Cell Voltage Measurement Error  $< 5\text{mV}$
  - Current/Coulomb Counter Error  $\leq \pm 0.5\%$
  - Strictly Synchronized Current/Voltage Measurement for Impedance Sensing
- Includes High-Side N-Channel MOSFET Drivers for Charge and Discharge Control:
  - Supports FET Soft-Start Discharge Control to Eliminate Pre-Charge Circuit
  - Drives Up to 100A DC with Parallel N-Channel MOSFETs
- Hardware Configurable Protections with Recovery Option:
  - Charge/Discharge OC and SC
  - Cell UV and OV
  - Pack UV and OV
  - Cell UT and OT
  - Die High-Temperature Protection
- Passive Cell Balancing up to 58mA per Cell:
  - Can Drive External Balancing Transistors
  - Automatic or Manual Control
- Additional Features:
  - Integrated 3.3V and 5V LDOs
  - Load and Charge Plug-In Detection
  - High-Voltage and Low-Voltage GPIOs
  - Dedicated Thermistor Inputs
  - Open Wire Detection
  - Persistent Dead Battery Flag
  - Lockable MTP for Key Thresholds
- I<sup>2</sup>C or SPI Interface with 8-Bit CRC
- Random Cell Connection Tolerant
- Available in a TQFP-48 (7mmx7mm) Package

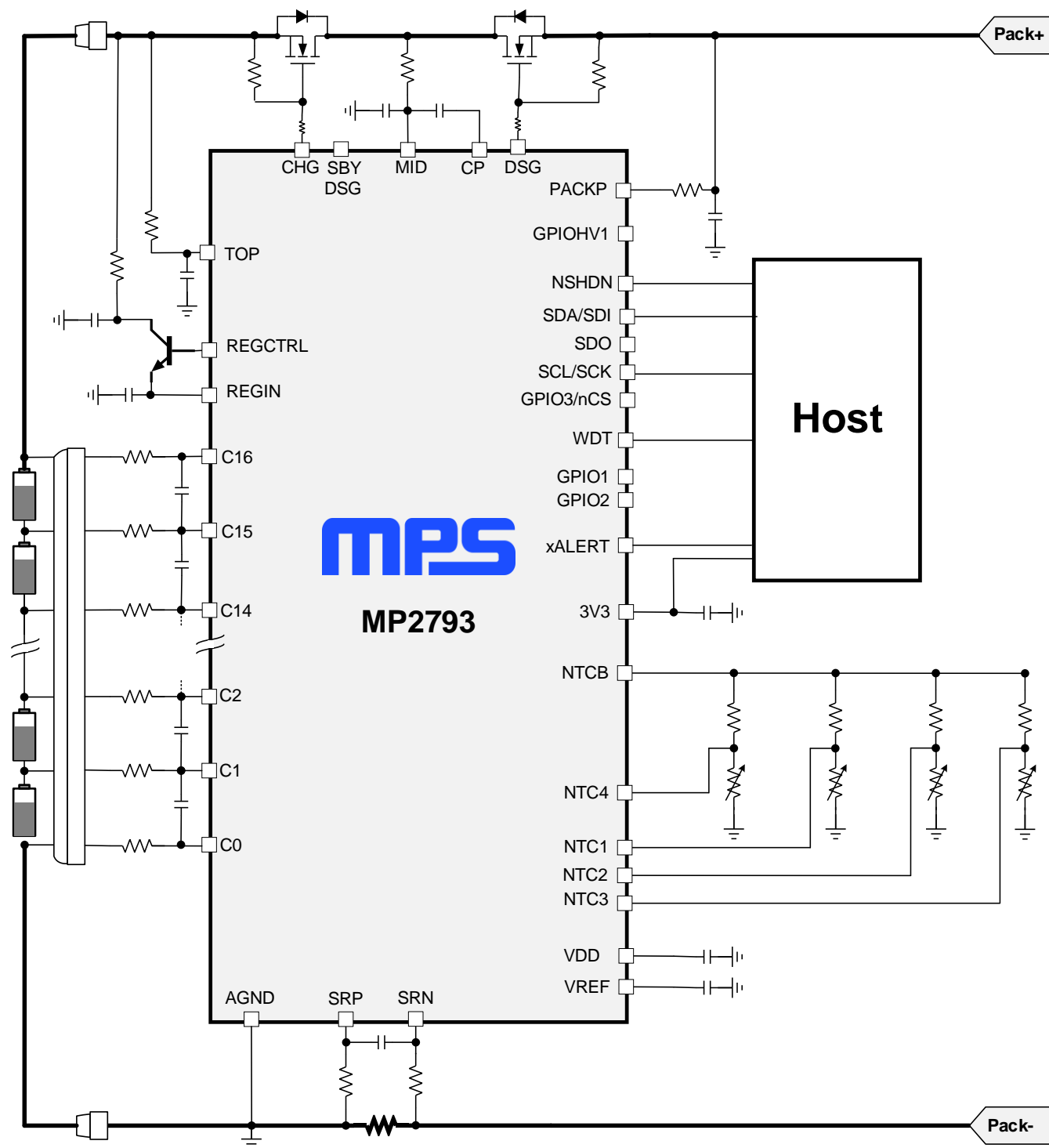
### APPLICATIONS

- Energy Storage System (ESS)
- E-Bikes, E-Scooters
- Light Electric Vehicles (LEVs)
- Power and Gardening Tools
- Battery Backups and UPS

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## TYPICAL APPLICATION



**ORDERING INFORMATION**

Part Number*	Package	Top Marking	MSL Rating	Communication
MP2793DFP-xxxx**	TQFP-48 (7mmx7mm)	See Below	3	-
MP2793DFP-0000	TQFP-48 (7mmx7mm)	See Below	3	I <sup>2</sup> C,
MP2793DFP-0002	TQFP-48 (7mmx7mm)	See Below	3	SPI
EVKT-MP2793-0000	Evaluation kit	N/A	N/A	N/A
EVKT-MP2793-0002	Evaluation kit	N/A	N/A	N/A

\* For Tray, add suffix -T (e.g. MP2793DFP-xxxx-T).

\*\* “xxxx” is the configuration code identifier for the register settings. Each “x” can be a hexadecimal value between 0 and F. Contact an MPS FAE to create this unique number.

**TOP MARKING (MP2793)**

**MPSYYWW**  
**MP2793**  
**LLLLLLLLLL**

MPS: MPS prefix  
YY: Year code  
WW: Week code  
MP2793: Part number  
LLLLLLLLLL: Lot number

**EVALUATION KIT EVKT-MP2793-0000**

EVKT-MP2793-0000 kit contents (items below can be ordered separately):

#	Part Number	Item	Quantity
1	EV2793-0000-FP-00A	MP2793DFP-0000 I <sup>2</sup> C evaluation board	1
2	EVKT-USBI2C-02	Includes one USB to I <sup>2</sup> C communication interface, one USB cable, and one ribbon cable	1
3	Online resources	Include datasheet, user guide, product brief, and GUI	1

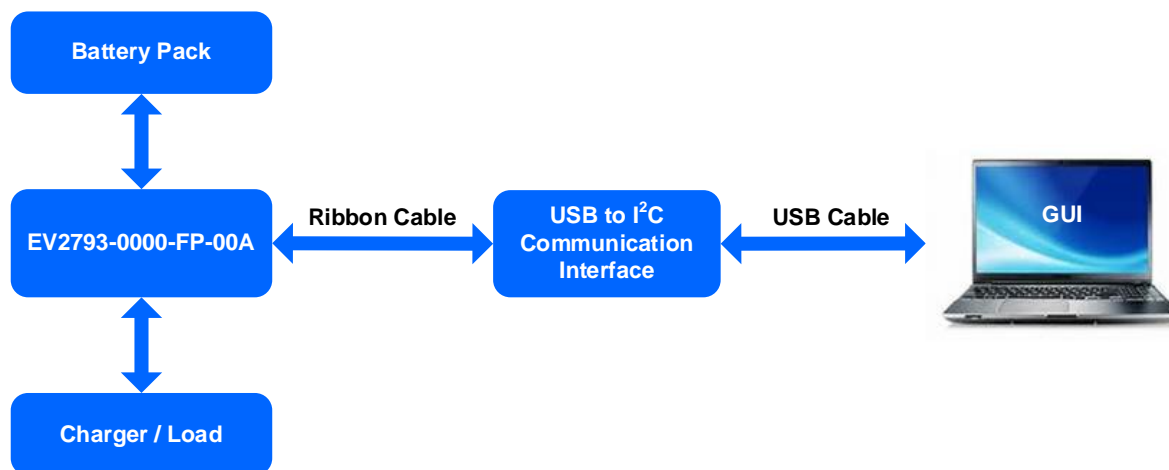
Order directly from [MonolithicPower.com](http://MonolithicPower.com) or our distributors.

Figure 1: EV2793-0000-FP-00A Evaluation Kit Set-Up

**EVALUATION KIT EVKT-MP2793-0002**

EVKT-MP2793-0002 kit contents (items below can be ordered separately):

#	Part Number	Item	Quantity
1	EV2793-0002-FP-00A	MP2793DFP-0002 SPI evaluation board	1
2	EVKT-USBSPI-00	Includes one USB to SPI communication interface, one USB cable, and one ribbon cable	1
3	Online resources	Include datasheet, user guide, product brief, and GUI	1

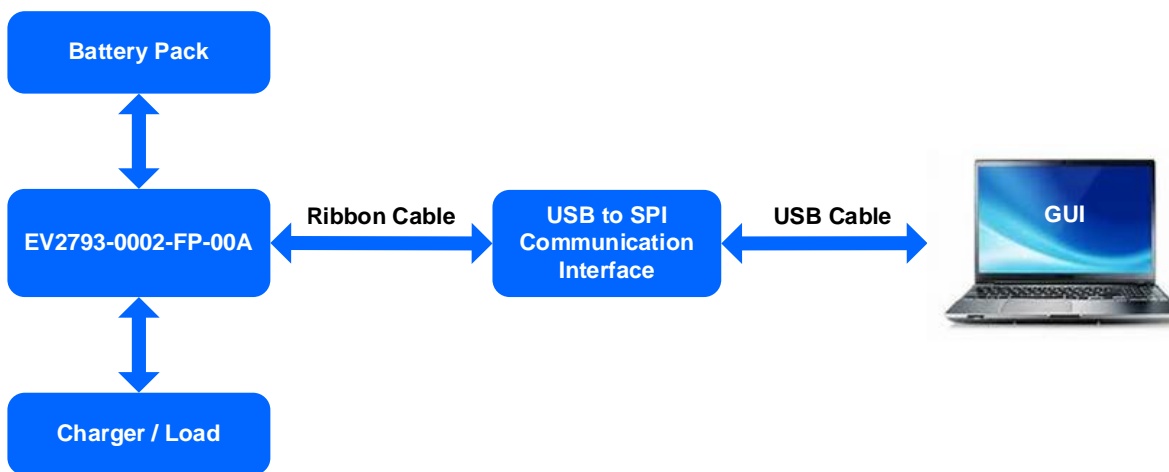
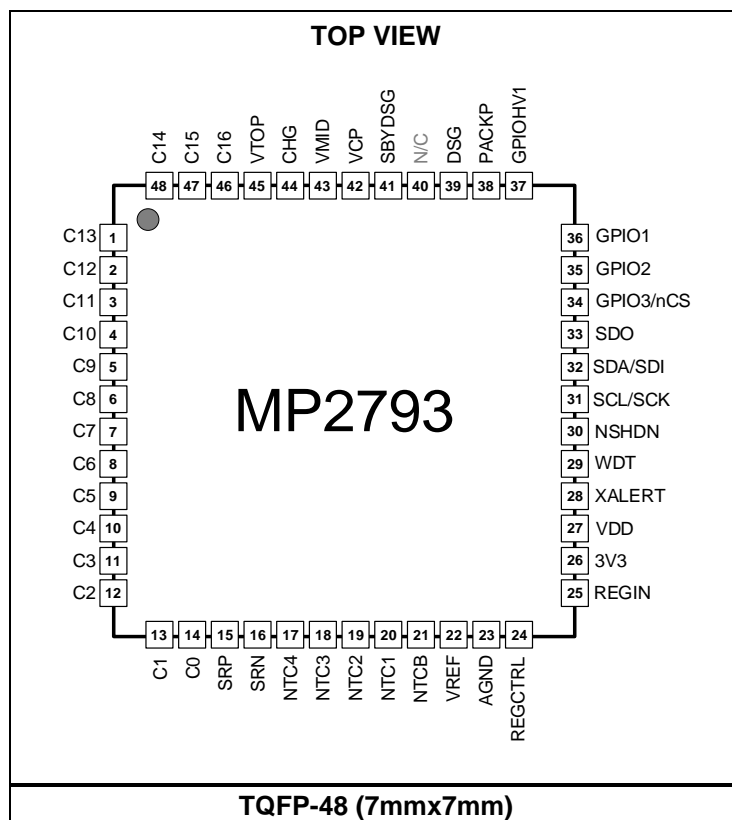
Order directly from [MonolithicPower.com](http://MonolithicPower.com) or our distributors.

Figure 2: EV2793-0002-FP-00A Evaluation Kit Set-Up



## PACKAGE REFERENCE





## PIN FUNCTIONS

Pin #	Name	Type	Description
26	3V3	P	<b>3.3V voltage output to drive external peripherals.</b> Bypass 3V3 with an external 1 $\mu$ F capacitor.
23	AGND	P	<b>Ground.</b> Connect AGND near the positive connection (SRP) of the low-side sense resistor.
45	VTOP	P	<b>Battery-side pack-sensing voltage and low-current positive supply pin.</b> VTOP must be connected to the top of the battery stack, which is the highest positive voltage in the battery pack.
46	C16	I	<b>Connect to the positive pin of cell 16.</b>
47	C15	I	<b>Connect to the positive pin of cell 15.</b>
48	C14	I	<b>Connect to the positive pin of cell 14.</b>
1	C13	I	<b>Connect to the positive pin of cell 13.</b>
2	C12	I	<b>Connect to the positive pin of cell 12.</b>
3	C11	I	<b>Connect to the positive pin of cell 11.</b>
4	C10	I	<b>Connect to the positive pin of cell 10.</b>
5	C9	I	<b>Connect to the positive pin of cell 9.</b>
6	C8	I	<b>Connect to the positive pin of cell 8.</b>
7	C7	I	<b>Connect to the positive pin of cell 7.</b>
8	C6	I	<b>Connect to the positive pin of cell 6.</b>
9	C5	I	<b>Connect to the positive pin of cell 5.</b>
10	C4	I	<b>Connect to the positive pin of cell 4.</b>
11	C3	I	<b>Connect to the positive pin of cell 3.</b>
12	C2	I	<b>Connect to the positive pin of cell 2.</b>
13	C1	I	<b>Connect to the positive pin of cell 1.</b>
14	C0	I	<b>Connect to the negative pin of cell 1.</b>
44	CHG	O	<b>Charge MOSFET driver.</b>
39	DSG	O	<b>Discharge MOSFET driver.</b>
36	GPIO1	I/O	<b>General-purpose pin 1.</b>
35	GPIO2	I/O	<b>General-purpose pin 2.</b>
37	GPIOHV1	I/O	<b>General-purpose, high-voltage pin 1.</b>
30	NSHDN	I	<b>Active-low shutdown input signal.</b>
20	NTC1	I	<b>Thermistor 1 terminal.</b>
19	NTC2	I	<b>Thermistor 2 terminal.</b>
18	NTC3	I	<b>Thermistor 3 terminal.</b>
17	NTC4	I	<b>Thermistor 4 terminal.</b>
21	NTCB	O	<b>NTC bias.</b>
40	N/C		<b>Not connected.</b>
38	PACKP	I/O	<b>Pack-sensing voltage (load-side).</b>
24	REGCTRL	P	<b>Turn-on control for the external BJT low-dropout (LDO) regulator.</b>
25	REGIN	P	<b>Internal regulator input.</b> Connect an external 3.3 $\mu$ F bypass capacitor from REGIN to AGND.
41	SBYDSG	O	<b>Discharge bypass P-channel MOSFET driver.</b>
29	WDT	I/O	<b>Watchdog timer pin.</b>
28	xALERT	O	<b>Interrupt alert output.</b>
16	SRN	I	<b>Negative sense pin.</b>
15	SRP	I	<b>Positive sense pin.</b>
42	VCP	P	<b>Charge pump regulated voltage.</b> Connect a 47nF capacitor from VCP to VMID, then adjust the value based on the number of parallel DSG and CHG MOSFETs.
27	VDD	P	<b>1.8V rail for internal use.</b> Connect a 1 $\mu$ F bypass capacitor from VDD to AGND.
43	VMID	P	<b>Protection MOSFET middle point.</b>



## PIN FUNCTIONS (continued)

Pin #	Name	Type	Description
22	VREF	P	ADC reference voltage.
34	GPIO3/nCS	I/O	Multi-function pin. This pin can be set as GPIO3, or it can be set for SPI cable selection.
31	SCL/SCK	I	Multi-function pin. This pin can be set as the I <sup>2</sup> C interface clock or the SPI interface clock.
32	SDA/SDI	I/O	Multi-function pin. This pin can be set as the I <sup>2</sup> C interface data or the SPI serial data input.
33	SDO	O	SPI serial data output.

ABSOLUTE MAXIMUM RATINGS <sup>(1)</sup>

CHG, DSG, VCP to AGND ..... -0.3V to +100V  
 SBYDSG to AGND ..... -0.3V to +86V  
 GPIOHV1 to AGND ..... -0.3V to +86V  
 GPIOHV1 to VTOP ..... 0.3V  
 VTOP to AGND ..... -0.3V to +86V  
 PACKP to AGND ..... -0.5V to +86V  
 VMID to AGND ..... -0.3V to +86V  
 Cn - C (n - 1) (n: 1 to 16) ..... -0.3V to +10V  
 Cn to AGND (n: 13 to 16) ..... -0.3V to +86V  
 Cn to AGND (n: 1 to 12) ..... - 0.3V to n x 7V  
 C0 to AGND ..... -0.5V to +5.7V  
 SRP, SRN to AGND ..... -0.5V to +6V  
 VDD to AGND ..... -0.5V to +2V  
 VCP to VMID ..... -0.3V to +20V  
 REGCTRL to AGND ..... -0.3V to +15V  
 NSHDN to AGND ..... -0.3V to +9V  
 All other pins to AGND ..... -0.3V to +6V  
 Junction temperature ..... 150°C  
 Lead temperature ..... 260°C  
 Storage temperature ..... - 65°C to +150°C

## ESD Ratings

Human body model (HBM) <sup>(2)</sup> ..... 1.5kV  
 Charged device model (CDM) <sup>(3)</sup> ..... 500V

Recommended Operating Conditions <sup>(4)</sup>

VTOP voltage ..... 10V to 75.2V  
 Cx - C (x - 1) (x: 1 to 16) <sup>(5)</sup> ..... 1V to 5V  
 C0 to AGND ..... -0.25V to +0.3V  
 Operating temperature (T<sub>J</sub>) ..... -40°C to +85°C  
 SRP to SRN ..... -100mV to +100mV

Thermal Metrics <sup>(6)</sup>

Junction-to-ambient (R<sub>θJA</sub>) ..... 46.6°C/W  
 Junction-to-case (top) (R<sub>θJC(TOP)</sub>) ..... 14.5°C/W  
 Junction-to-board (top) (R<sub>θJB(TOP)</sub>) ..... 27.1°C/W

## Notes:

- 1) Exceeding these ratings may damage the device.
- 2) Tested per ANSI/ESDA/JEDEC JS-001.
- 3) Tested per ANSI/ESDA/JEDEC JS-002.
- 4) The device is not guaranteed to function outside of its operating conditions.
- 5) The stack voltage should exceed 10V.
- 6) Metrics provided using set-up conditions compliant with EIA/JESD51-2, 7, and 8.

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