PT6160

Multi-cell Battery Management Front End with I^{2}C Interface

GENERAL DESCRIPTION

The PT6160 is a highly integrated, digitally programmable, charging/discharging management IC for 3 to 7 serially connected Li-Ion or LiFePO$_4$, batteries used in portable electrical tools or other multi-cell battery powered systems. It contains a multi-channel 10-bit ADC digitizing battery voltages, environment temperature, and battery discharge current. The converted data is transferred to MCU via I^{2}C interface and is used for battery balancing and safety protections against battery over-voltage, under-voltage, discharging over current, and over temperature. The integrated battery balance circuitry could deliver a programmable shunt current as high as 200mA without the need of external transistors. The PT6160 buffers both DC and PWM (Pulse Width Modulation) MOSFET control signals generated from MCU to drive an electrical motor.

Key parameters in the PT6160 are programmable by a microprocessor through an I^{2}C interfacing port, which features customers to achieve flexible and optimal multi-cell Li-ion/LiFePO$_4$ battery charging/discharging progress control and safety protection. The package is QFN-24.
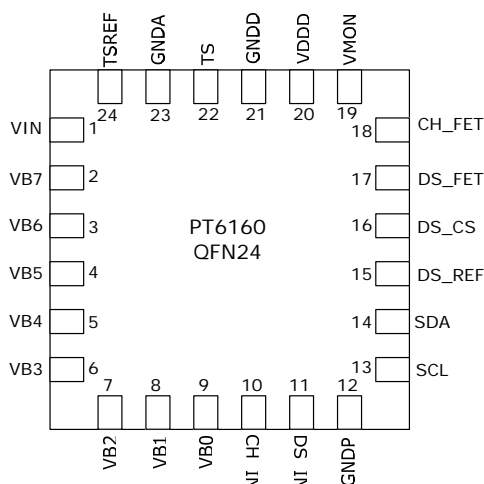
PIN ASSIGNMENT

Figure 1. Pin order in QFN-24 package

FEATURES

Charging Control

- 3~7 Li-ion or LiFePO$_4$ battery cells system
- Cell balancing with programmable shunt currents up to 200mA
- Accurately sensing battery cell voltages and temperature through a 10-bit ADC.
- MCU controlled protection cutoff voltages.

Discharging

- Programmable discharge over-current or short-circuit protection thresholds
- MCU controlled battery under-voltage protection thresholds
- 10~15V PWM or DC MOSFET gate driving voltages
- 200mA maximum MOSFET gate driving current
- Load protection to prevent discharging on short-circuit or light load between two terminals connected to the motor

MCU Interfacing

- A 10-bit ADC samples up to 7 individual cell voltages, environmental temperature, and discharge current.
- ADC sampling time <20ms through all channels
- ADC fail bit indicates overflow
- 100 kHz I^{2}C communication port
- 2 seconds watchdog function for MUC.
- 5~3.2V supply voltage to MCU

Other Protections

- 6V under voltage lockout voltage (UVLO)
- Protected from <1.0ms negation glitch toward ground generated from battery pack
- Internal over temperature shutdown (TSD)

PIN DESCRIPTION

Pin #	Function	Name	Description
1	Battery voltage input	VIN	Power supply
2		VB7	Battery cell 7 voltage input
3		VB6	Battery cell 6 voltage input
4		VB5	Battery cell 5 voltage input
5		VB4	Battery cell 4 voltage input
6		VB3	Battery cell 3 voltage input
7		VB2	Battery cell 2 voltage input
8		VB1	Battery cell 1 voltage input
9		VB0	This pin connects to the most negative terminal in the battery string
10	Charging/ discharging control	CH_IN	Charge control signal in
11		DS_IN	Discharge control signal in
12		GNDP	Connect to ground
15	Charging/ discharging control	DS_REF	Discharging current sense reference
16		DS_CS	Discharging current sense monitor
17		DS_FET	Discharge MOSFET gate drive
18		CH_FET	Charge MOSFET gate drive
19		VMON	Discharge load monitoring for short circuit protection
13	Interface with MCU	SCL	Serial clock
14		SDA	Serial date
20		VDDD	Regulated 5V supply voltage to MCU and E^{2}PROM
21		GNDD	Digital ground
22		TS	Temperature monitor input
23	Analog power supply	GNDA	Analog ground
24		TSREF	TS input reference voltage

TYPICAL APPLICATION EXAMPLE

Q1 and Q2 are MOSFET switches controlled by two gate driving voltages CH_FET and DS_FET. Their functions are described in Table 2.

CH_FET	DS_FET	Operation status
1 (or PWM)	1 (or PWM)	Battery charging or discharging
0	0	1) Battery charging/discharging safety protection 2) Battery standby

Table 2. The functions of charging/discharging control switched

Please note that Q1 and Q2 could be not only turned on by DC voltage, but also by a PWM sequence. D2 and R1 are added for short circuit loading protection during battery discharging. D3 limits the gate-source voltage of Q1 to be less than 15V. D4 and R2 are used to protect the CH_FET pin from being damaged by the

flyback voltage from the motor windings, when the CH_FET is opened suddenly for over current or short circuit shut-down.

The only positive power supply voltage terminal of the chip is VIN. D1, C1, and C2 are added to stabilize the chip power supply in case of a positive or negative voltage surge coming from the battery or motor. GNDA and GNDD are internally generated supplies. "VB0" is connected to ground but is only used for the measurements of VB1 and external temperature.

Rt is a thermal resistor to sense the battery pack temperature. R5 and R6 are used for linearization. R4 and C4 filter noise added on the sensed discharge current and provide a certain time delay for over current protection., R8 and D5 are used for the protection of chip DS_CS input from the transient high voltage impulse when the system begins discharging operation.

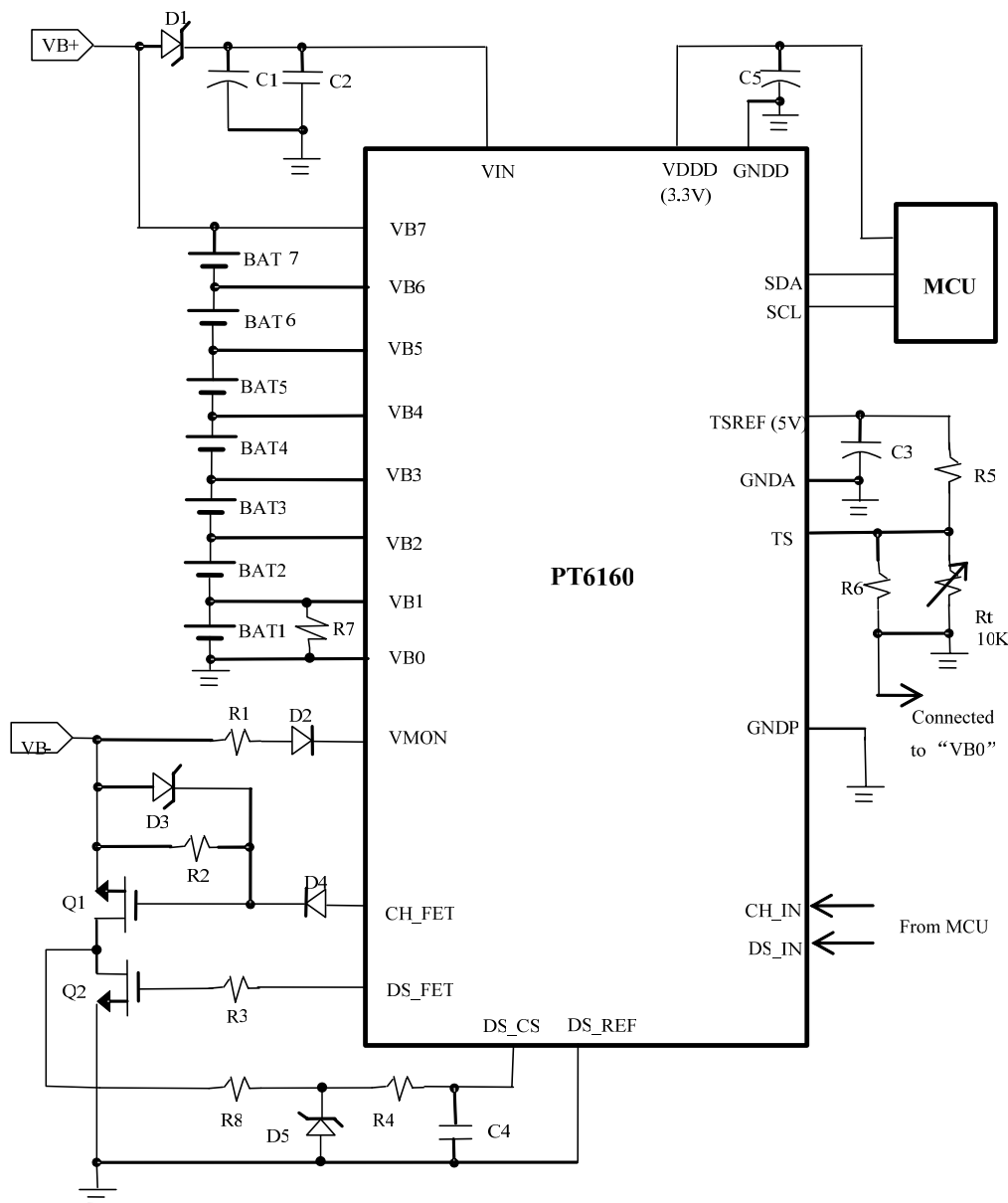D1 is suggested to be removed if there are only three batteries.

Figure 2. Typical application of PT6160 for 7 Li-ion battery cells