DV2031S2

Lead-Acid Charger Development System

Control of On-Board P-FET Switch-Mode Regulator

Features

- bq2031 fast-charge control evaluation and development
- Onboard configuration for fast charge of 2, 3, 4 or 6 lead-acid cells; user-defined option allows other configurations
- Selectable charge algorithms: Two-Step Voltage, Two-Step Current, or Pulsed Current
- Constant current (up to 2.2A) and constant voltage (up to 15V) provided by on-board switch-mode regulator
- Charge termination by maximum voltage, second difference of cell voltage, minimum current, or maximum time-out
- Direct connections for battery, thermistor, and power supply
- MTO is set for 3.1 hours
- Jumper-configurable 3-LED display

General Description

The DV2031S2 Development System provides a development environment for the bq2031 Lead-Acid Fast-Charge IC. The DV2031S2 incorporates a bq2031 in a buck-type switch-mode regulation mode to provide fast-charge control for 2, 3, 4, or 6 lead-acid cells.

The DV2031S2 can be configured for three different charge algorithms with jumpers JP1 and JP3. The charge algorithms available are

Two-step voltage

Two-step current

Pulsed current

Each algorithm consists of pre-charge qualification, fast charge, and maintenance charge periods.

Fast charge termination occurs on

Maximum voltage

The second difference of cell voltage (Δ^2V)

Minimum current

Maximum time-out

The maintenance charge may be configured for either a regulated float voltage or a pulsed current.

The user provides a DC power supply and batteries and configures the board for the number of cells, the minimum current threshold, and the LED display mode. The board has direct connections for the battery and the provided thermistor.

Before using the DV2031S2 board, please review the bq2031 data sheet (SLUS156) and the application note entitled “Using the bq2031 to Charge Lead-Acid Batteries” (SLUA017).

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Connection Descriptions

TB1

DC+	Charger supply (DC) 30V MAX
DC–	Ground from charger supply and low side of system load

TB2

BAT+	Positive battery terminal
BAT–	Negative battery terminal
TEM–	Thermistor connection (negative)
TEM+	Thermistor connection (positive)

JP1	QSEL	Charge algorithm select
JP2	DSEL	Display mode select
JP3	TSEL	Charge algorithm select
JP4	IGSEL	Minimum current select
JP5		Number of cells

Fixed Configuration

The DV2031S2 board has the following fixed characteristics:

V_{CC} for the fast charge IC is regulated on-board from the supply at connector TB1. TB1 can accept a maximum of 30VDC. The minimum charging voltage for two cells is 10VDC, and the minimum charging voltage for six cells is 22VDC.

LED1 and LED2 indicate charge status.

LED3 indicates a charge-pending or fault condition.

Charge begins on the later application of

1. The battery
2. Supply voltage

The onboard regulator supplies a fast charge current I_{MAX} of 2.2A. The fast (bulk) charge voltage V_{BLK} is set at 2.45V per cell (±1%) and the float voltage V_{FLT} is set at 2.25V per cell (±1%)

The number of cells can be changed within board-defined parameters, as described below in "Jumper-Selectable Configuration."

The switching frequency of the PWM control is 100kHz.

The regulated current is controlled by the value of the sense resistor R_{SNS} according to the equation

$$I_{CHG} = \frac{0.25V}{R_{SNS}}$$

The value of R_{SNS} (R20 in the schematic) at shipment is 0.120Ω. This resistor can be changed depending on the application. The suggested maximum charging current I_{MAX} for the bq2031S1 board is 2.2A with an accuracy of ±10%.

The thermistor provided is the Philips 2322–640–63103. With this thermistor connected between TEM+ and TEM–, the temperature fault limits are V_{LTF} (low temperature fault) = 0°C, V_{HTF} (high temperature fault) = 45°C, and V_{TCO} (charge cutoff) = 47°C.

Jumper-Selectable Configuration

The DV2031S2 must be configured as follows:

DSEL (JP2) selects the LED display options as described in Table 1 on the following page.

TSEL (JP3) and QSEL (JP1) select the charge algorithm as shown in Table 2 on the following page.

IGSEL (JP4) sets I_{MIN} and the Two-Step Current maintenance charge as a ratio of I_{MAX}. I_{COND} = $I_{MAX}/5$, as shown below:

JP4	I_{MIN}	Fixed-Pulse Average Current
L	$I_{MAX}/10$	$I_{COND}/2 = I_{MAX}/10$
H	$I_{MAX}/20$	$I_{COND}/4 = I_{MAX}/20$
None	$I_{MAX}/30$	$I_{COND}/8 = I_{MAX}/30$

As indicated in the Jumper Configuration Diagram, JP5 configures the board for the number of lead-acid cells.

Table 1. bq2031 LED Display Output Summary

Mode	Charge Action State	LED_1	LED_2	LED_3
L	Battery absent or over-voltage fault	Low	Low	High
	Pre-charge qualification	Flash	Low	Low
	Fast charging	High	Low	Low
	Maintenance charging	Low	High	Low
	Charge pending (temperature out of range)	X	X	Flash
	Charging fault	X	X	High
H	Battery absent or over-voltage fault	Low	Low	High
	Pre-charge qualification	High	High	Low
	Fast charge	Low	High	Low
	Maintenance charging	High	Low	Low
	Charge pending (temperature out of range)	X	X	Flash
	Charging fault	X	X	High
None	Battery absent or over-voltage fault	Low	Low	High
	Pre-charge qualification	Flash	Flash	Low
	Fast charge: current regulation	Low	High	Low
	Fast charge: voltage regulation	High	High	Low
	Maintenance charging	High	Low	Low
	Charge pending (temperature out of range)	X	X	Flash
	Charging fault	X	X	High

Notes: 1 = V_{CC}; 0 = V_{SS}; X = LED state when fault occurred; Flash = ⅛ s low, ⅛ s high.
In the Pulsed Current algorithm, the bq2031 annunciates maintenance when charging current is off and fast charge whenever charging current is on.

Table 2. Charge Algorithms

JP1	JP3	Fast Charge	Termination	Maintenance
L	H or L	Two-Step Voltage	I_{MIN} or MTO	Constant voltage at V_{FLT}
H	L	Two-Step Current	V_{BLK} or Δ^2V or MTO	Fixed-pulse current at I_{COND}
H	H	Pulsed Current	V_{BLK} (see Note)	Fast-charge rate when $V_{BLK} \le V_{FLT}$

Note: Fast-charge termination by MTO is a fault.

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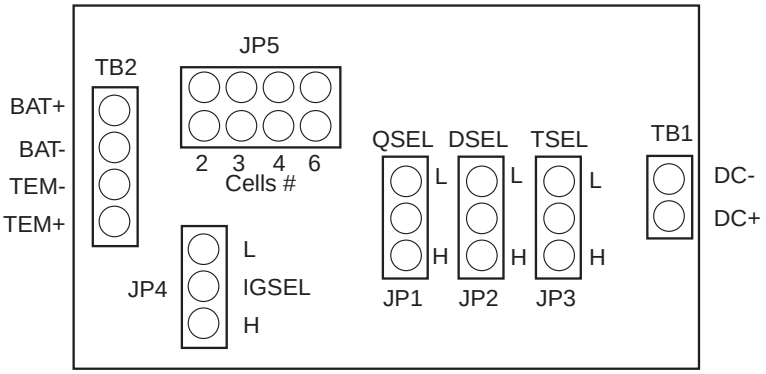
Jumper Configuration Diagram



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Setup Procedure

1. Configure DSEL, TSEL, QSEL, maximum time-out, and the number of cells.
2. Connect the thermistor to TEM+ and TEM–.
3. Attach the battery pack to BAT+ and BAT–.
4. Connect the charging supply to TB1 (DC+, DC-).

The combined charging and system load should not exceed the I_{MAX} limit of 2.2A.

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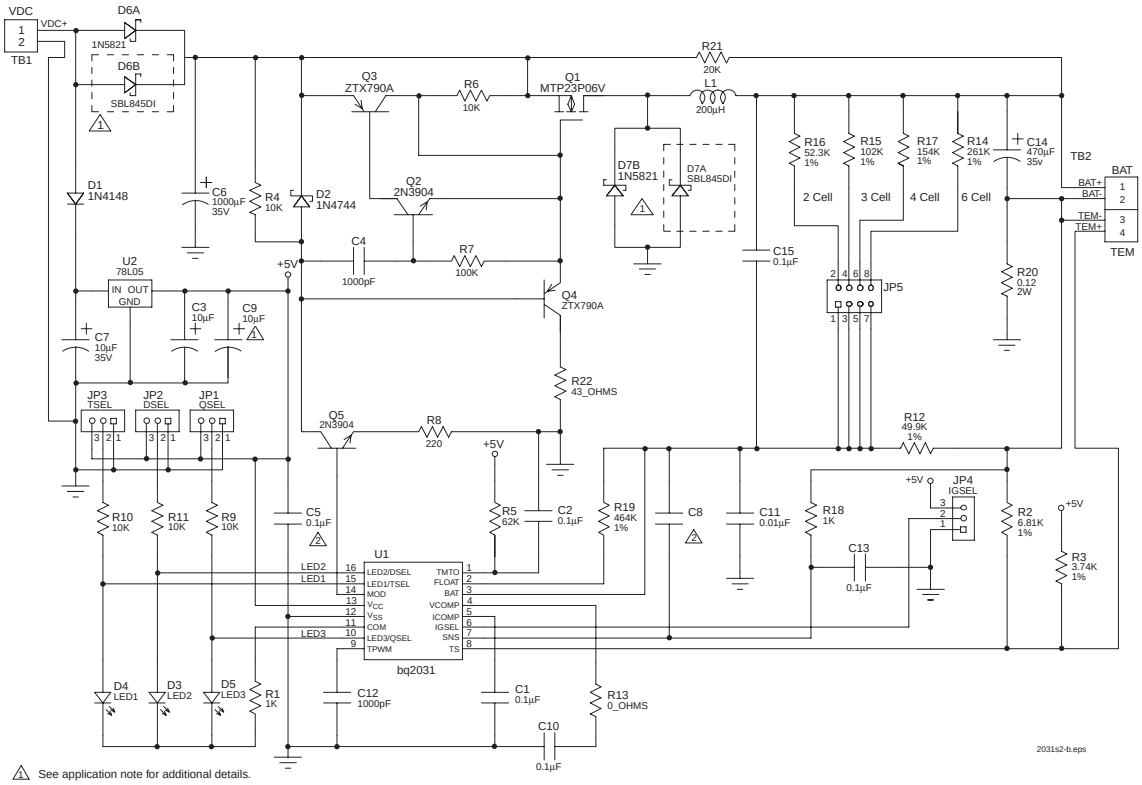
DV2031S2 Board Schematic



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It is important to operate this EVM within the input voltage range of 30 V and the output voltage range of 21 V and 4.6 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

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