DV2031S1

Fast Charge Development System

Control of On-Board PNP Switch-Mode Regulator

Features

- ➤ bq2031 fast-charge control evaluation and development
- ➤ Accepts AC (21V RMS max.) or DC (30V max.) inputs
- ➤ Onboard configuration for fast charge of 3 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 2.5A) 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 reset signal
- ➤ Jumper-configurable three-LED display

General Description

The DV2031S1 Development System provides a development environment for the bq2031 Lead-Acid Fast-Charge IC. The DV2031S1 incorporates a bq2031 and a buck-type switch-mode regulator to provide fast charge control for 3 or 6 lead-acid cells.

The DV2031S1 can be configured for three different charge algorithms with jumpers JP2 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 bq2031 can be reset and a new charge cycle started with either the momentary on-board switch (SW1) or via the INH input on connector J2. The reset signal simulates a “Battery Absent” condition. Charging is inhibited as long as the reset signal is active; once it is released, the charge cycle re-starts at pre-charge qualification.

The user provides a power supply (AC or DC) and batteries and configures the board for the number of cells, the maximum time-out period, the minimum current threshold, and the LED display mode. The board has direct connections for the battery and the provided thermistor.

Before using the DV2031S1 board, please review the bq2031 data sheet and the application note entitled “Using the bq2031 to Charge Lead-Acid Batteries”.

Connection Descriptions

J1		Charger supply (AC): 21 RMS MAX
J2	INH	Charge inhibit signal
	BAT+	Positive battery terminal
	BAT–	Negative battery terminal
	TS+, TS–	Thermistor connections
	LOAD+	High side of system load
	DC_RTN	Ground from charger supply and low side of system load
	DC_IN	Charger supply (DC): 30V MAX
JP1	DSEL	Display mode select
JP2	TSEL	Termination select
JP3	QSEL	Charge algorithm select
JP4	IGSEL	Minimum current select
HD1	TMTO	Maximum time--out select
HD2	BAT	Number of cells select
S1		Charge inhibit switch

Fixed Configuration

The DV2031S1 board has the following fixed characteristics:

V_{CC} for the fast charge IC is regulated on--board from the supply at connector J1 or J2. J1 can accept a maximum of 21VAC RMS and J2 can accept a maximum of 30VDC. The minimum charging voltage for three cells is 9VAC or 13VDC, and the minimum charging voltage for six cells is 18VAC or 25VDC.

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 2.75A. The fast (bulk) charge voltage V_{BLK} and the float maintenance voltage V_{FLT} are set at 25°C as:

Number of Cells	V_{BLK}	V_{FLT}
3	2.45	2.28V
6	2.47	2.27V

The number of cells, V_{BLK}, and V_{FLT} can be adjusted as described in the next section.

The switching frequency of the PWM control loops is 100kHz.

The regulated current is controlled by the value of the sense resistor R_{SNS} by the relationship:

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

The value of R_{SNS} (R31 in the schematic) at shipment is 0.100Ω. This resistor can be changed depending on the application. The suggested maximum charging current I_{MAX} for the bq2031S1 board is 2.5A with an accuracy of ±10%.

The thermistor provided is the Philips 2322–640–63103. With this thermistor connected between TS+ and TS–, 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.

Charge Algorithms

JP2	JP3	Fast Charge	Termination	Maintenance
[1 2] 3 or 1 [2 3]	1 [2 3]	Two-Step Voltage	I_{MIN} or MTO	Constant voltage at V_{FLT}
[1 2] 3	[1 2] 3	Pulsed Current	V_{BLK} or MTO	Fast charge rate when $V_{BAT} < V_{FLT}$, until $V_{BAT} = V_{MAX}$
1 [2 3]	[1 2] 3	Two-Step Current	V_{BLK} or Δ^2V or MTO	Fixed-pulse current at I_{COND}

Jumper-Selectable Configuration

The DV2031S1 must be configured as follows:

DSEL (JP1): Selects the LED display options as described in the data sheet.

TSEL (JP2) and QSEL (JP3): Select the charge algorithm.

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

JP4	I_{MIN}	Fixed-Pulse Average Current
[1 2] 3	$I_{MAX}/20$	$I_{COND}/4 = I_{MAX}/20$
1 [2 3]	$I_{MAX}/10$	$I_{COND}/2 = I_{MAX}/10$
1 2 3	$I_{MAX}/30$	$I_{COND}/8 = I_{MAX}/40$

TMTO (HD1): Sets the maximum time-out period (MTO).

HD1	MTO
[1 2] 3 4 5 6	2.5 hours
1 2 [3 4] 5 6	5.5 hours
1 2 3 4 [5 6]	11 hours

BAT (HD2): Configures the board for the number of lead-acid cells.

HD2	Number of Cells
[1 2] 3 4 5 6	3
1 2 [3 4] 5 6	6
1 2 3 4 [5 6]	User selectable

The user selectable option can be used for series configurations of 2 to 6 cells or to change V_{FLT} or V_{BLK}. Jumper setting HD2[5 6] requires the appropriate sizing of R22 depending on the following equations:

Equation 1

$$\frac{R_A}{R19} = \left(\frac{N * V_{FLT}}{2.2}\right) - 1$$

Equation 2

$$\frac{R_A}{R19} + \frac{R_A}{R34} = \left(\frac{N * V_{BLK}}{2.2}\right) - 1$$

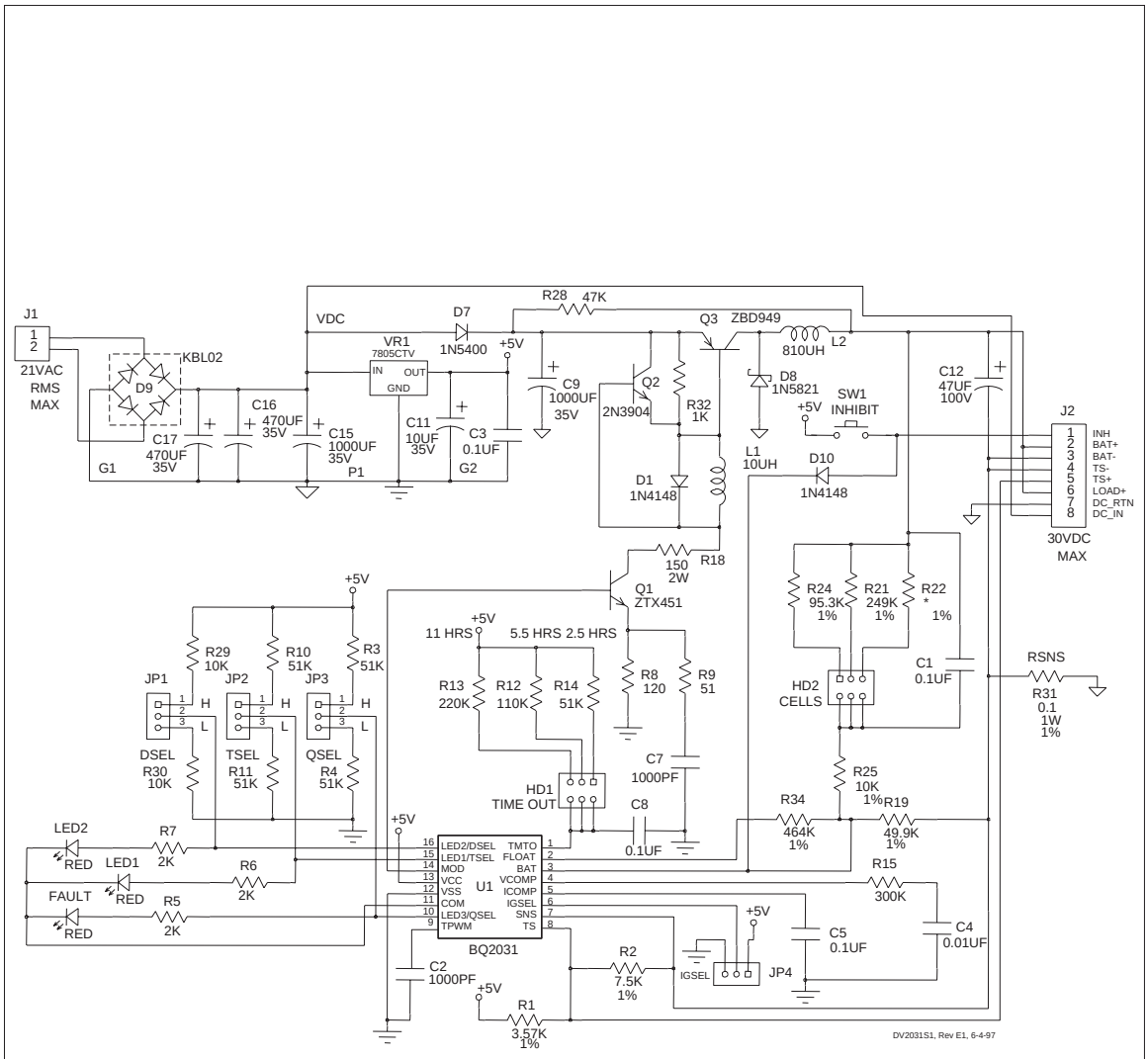
where N = number of cells and R_A = R22 + R25. The DV2031S1 board comes with R19 = 49.9K, R25 = 10K, and R34 = 464K.

Setup Procedure

1. Configure DSEL, TSEL, QSEL, maximum time--out, and the number of cells.
2. Connect the thermistor to TS+ and TS–.
3. Attach the battery pack to BAT+ and BAT–.
4. Connect the charging supply to J1 (AC) or J2 (DC).

The combined charging and system load should not exceed the I_{MAX} limit of 2.5A.

DV2031S1 Board Schematic



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