# DV2005S3

## Nickel/Li-Ion Development System

### Control of On-Board PNP Switch-Mode Regulator

## Features

- bq2005 fast charge control evaluation and development for NiMH, NiCd and Li-Ion
- Charge current (up to 2.0A) sourced from an on-board switch mode regulator to 100kHz
- Sequential fast charge control for one or two battery packs containing five NiCd or NiMH cells or two Li-Ion cells
- Fast charge termination by $\Delta T/\Delta t$, PVP maximum time, temperature, and voltage, and minimum current (for voltage regulated Li-Ion charging)
- Charging status displayed on one dual color LED per battery pack
- Jumper configurable for charge time, hold-off period, top-off rate, and pulse trickle rate and frequency
- Discharge-before-charge control with push-button switch or auto discharge-before-charge with jumper


## General Description

The DV2005S3 Development System provides a dual-chemistry development environment for the bq2005 Dual-Battery Fast Charge IC. The DV2005S3 incorporates a bq2005 and a buck-type switch-mode regulator to provide fast charge control for two battery packs containing five NiCd or NiMH cells or two Li-Ion cells.

Fast charge for Nickel chemistry batteries is terminated by any of the following: $\Delta T/\Delta t$, PVP, maximum charge time, maximum temperature, and maximum voltage. Li-Ion fast charging is accomplished by a current limited phase followed by a voltage regulated (within 1%) phase, and terminated by a minimum current criterion backed up by maximum voltage and maximum time.

The user supplies a power supply and batteries. Please review the bq2005 data sheet before using the DV2005S3 board. The user configures the DV2005S3 for maximum time, hold-off period, top-off rate, pulse trickle rate and frequency, and manual (push button switch) or auto discharge-before-charge.

## Contents

1 DV2005S3 printed circuit board containing:

a) bq2005 PDIP IC
b) Switch-mode current regulator
c) All programming jumpers
d) 4 NTC thermistors

1 bq Charge Configuration diskette

1 Documentation kit including user's manual, schematics and datasheets

## Connection Descriptions

J1

| | |
|---|---|
| DC+ | DC power supply high side input |
| DC- | DC power supply low side input |

J2

| | |
|---|---|
| SELCA | Pack A chemistry select |
| THERMA | Pack A high side thermistor connection |
| SNSA | Pack A negative battery terminal and thermistor connections |
| BATA+ | Pack A positive battery terminal and high side discharge load connection |
| LOADA- | Pack A low side discharge load connection |
| INHA | Pack A logic level inhibit input |

J3

| | |
|---|---|
| SELCB | Pack B chemistry select |
| THERMB | Pack B high side thermistor connection |
| SNSB | Pack B negative battery terminal and thermistor connections |
| BATB+ | Pack B positive battery terminal and high side discharge load connection |
| LOADB- | Pack B low side discharge load connection |
| INHB | Pack B logic level inhibit input |

## Fixed Configuration

The DV2005S3 board has the following fixed characteristics:

- $V_{CC}$ (4.75-5.25V) is regulated on-board from the supply at connector J1 DC+.
- $LED1_{A/B}$ and $LED2_{A/B}$ indicate charge status per battery pack (A/B).

Charge begins on the later application of the battery or DC, which provides $V_{CC}$ to the bq2005. Charging of the two battery packs is sequential. See the bq2005 datasheet for details.

As shipped from Benchmarq, the DV2005S3 buck-type switch-mode regulator is configured to a charging current of 2.0A. This current level is controlled by the value of sense resistor $R_{SNS}$ by the relationship:

$$I_{CHG} = \frac{0.225V}{R_{SNS}}$$

The inductor is configured for a maximum of 2.0 Amps and should not be adjusted without consulting Benchmarq.

With the provided NTC thermistor connected between $THERM_{A/B}$ and $SNS_{A/B}$, the thermal threshold values are: LTF = 0°C, HTF = 40°C, TCO = 60°C. The $\Delta T/\Delta t$ setting at 30°C ($T_{\Delta T}$) is: minimum = 0.82°C/minute, typical = 1.10°C/ minute.

## Jumper-Selectable Configuration

**Inhibit (JP1):** Enables/disables fast charge inhibit. Set across pins 1 and 2 to enable fast charging. Set across pins 2 and 3 to disable fast charge. Board is shipped with inhibit disabled.

**Number of Cells (JP2-4):** A resistor-divider network is provided to select 3, 6, or 9 Nickel cells or 1, 2, or 3 Li-Ion cells. The resulting resistor value equals (N/2 - 1) cells. Board is shipped configured for 3 NiCd/NiMH or 1 Li-Ion cell (jumper on JP4).

| Closed Jumper | NiCd/NiMH | Li-Ion |
|---|---|---|
| JP2 | 9 | 3 |
| JP3 | 6 | 2 |
| JP4 | 3 | 1 |

**Maximum Time Out (JP5-6):** These jumpers configure the pins $TM_1$ and $TM_2$ (respectively) on the bq2005 to set Maximum Time Out (MTO) limit, Hold-Off Time, Top-Off enable/disable, and Pulse Trickle rate and period. See Table 3 in the bq2005 datasheet for the configuration of these pins for various values. Set the jumper across pins 1 and 2 to pull the line high, 2 and 3 to pull the line low, and remove the jumper to float the input. Boards are shipped with both lines set high.

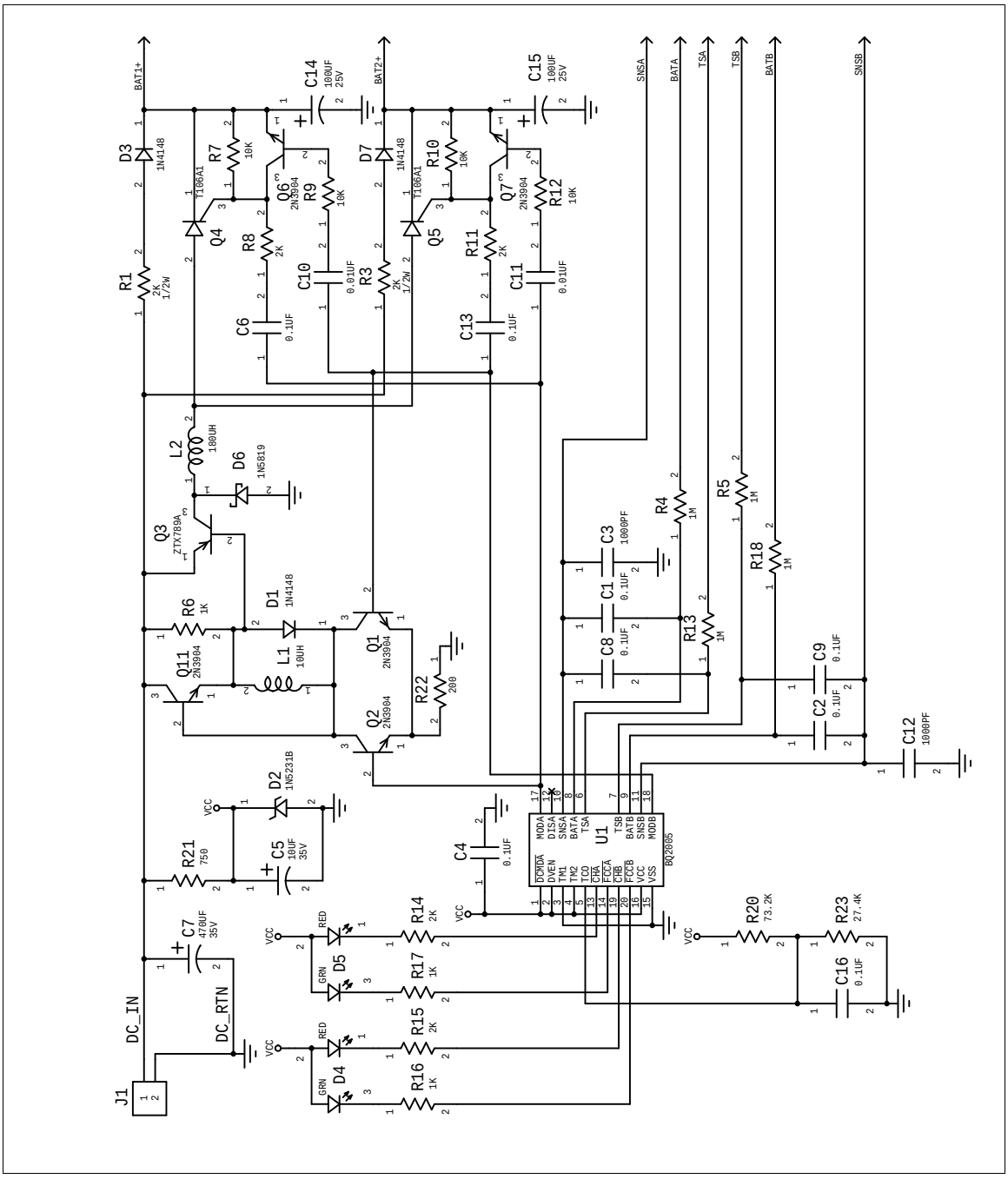
**Auto Discharge-Before-Charge (JP7):** Enables/disables automatic discharge-before-charge. Set across pins 1 and 2 to enable auto discharge; set across pins 2 and 3 to disable. If disabled, discharge before charge is activated only by the manual push button. Boards are shipped with auto discharge disabled.

**Temperature Disable:** Connecting a 10kΩ resistor between $TS_{A/B}$ and $SNS_{A/B}$ disables temperature sensing for pack A or pack B respectively.

## Setup Procedure

1. Configure all jumpers to their desired settings prior to applying batteries or power to the DV2005S3.
2. Connect the provided thermistors or 10kΩ resistors between $TS_A$ and $SNS_A$ and $TS_B$ and $SNS_B$.
3. Connect the discharge loads between $BAT_{A/B}$ + and $LOAD_{A/B}$ - for packs A and B, respectively.
4. Attach the battery packs between $BAT_{A/B}$ + and $SNS_{A/B}$ for packs A and B, respectively. For Nickel packs, SELC should float. For Li-Ion packs, SELC must be connected to $BAT_{A/B}$ + to operate properly.
5. Attach an appropriate DC current source to DC+ and DC- on connector J1.

## DV2005S3 Board Schematic

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