

Model EVAL-01 Cymbet™ EnerChip™ Thin-Film Battery Evaluation Kit

A Versatile Charging Module for Solid State Thin Film Rechargeable Batteries

Introduction

Model EVAL-01 is a small (1.36 x 0.60 inch) circuit board to help users evaluate Cymbet™ EnerChip™ solid state batteries. It includes a flexible charging circuit and two jumper-selectable batteries: a CBC012-L5C (12 μ Ah) and a CBC050-Q8C (50 μ Ah). The connection diagram is shown in *Figure 1*.

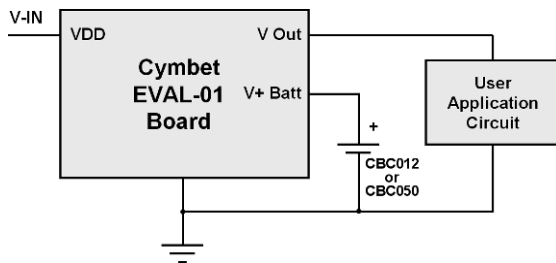


Figure 1. Typical EVAL-01 connection diagram.

The charging circuit used in EVAL-01 provides exceptional design flexibility by operating over a wide range of input voltages. It can be integrated directly into a product, whether it is a semiconductor chip, smart card, cell phone, sensor, or other application. Please see AN-1002 for more details. Table 1 provides the electrical specifications of the circuit.

Circuit Description

The charge control circuit delivers a constant voltage to the battery. As the battery is charged, the current input to the battery drops until the battery is fully charged. This design uses a simple but effective technique to isolate itself from the power supply during power outages. Isolation prevents any discharging of the battery through the charging circuit or the power supply input. The design also prevents deep discharge of the battery by cutting off the battery from load when the battery voltage is too low.

Figure 2 shows a typical charging profile of current versus time for a Cymbet battery. To calculate the maximum current draw, multiply the battery capacity by the peak value in this graph. For the Cymbet CBC050-Q8C, the peak current would be $3.8\mu\text{A} \times 50 = 190\mu\text{A}$.

Figure 3 shows the typical battery charge versus charge time. After only 20 minutes, the Cymbet battery is 80% charged.

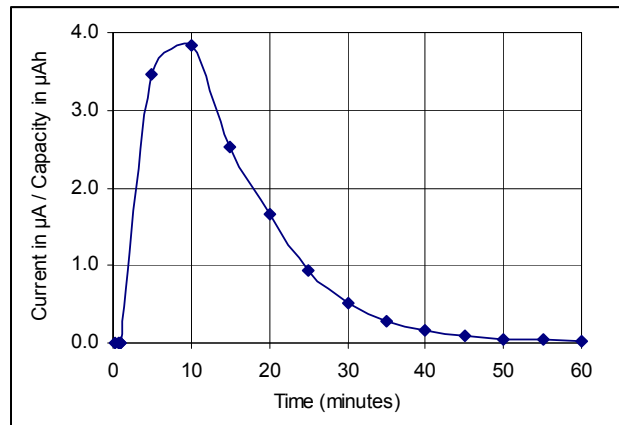


Figure 2. Charging current profile; $V_c = 4.1\text{V}$.

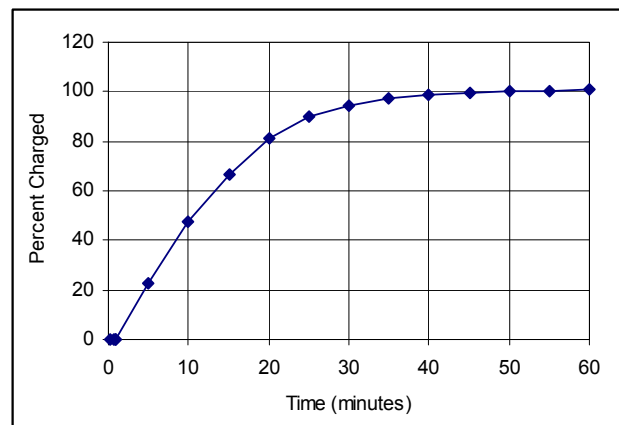


Figure 3. Typical charge vs. charging time.

Parameter	Min	Typ	Max	Units
Input Voltage	4.7	5	15	Volts
Input Current, Battery Charging	---	150	500	μA
Charger Quiescent Current, Battery Charged	---	125	---	μA @V _{cc} =5.0
VOUT1, 2μA Load	2.3	3.1	3.4	V
VBAT	3.0	3.8	4.1	V
Battery Cutoff Voltage	3.0	3.3	3.6	V
Charging Voltage	---	4.1	---	V
Output Current, Continuous	---	25	---	μA
Output Current, Pulsed	---	1	---	mA
Operating Temperature	0	25	70	°C

Table 1. Electrical specifications.

Schematic

Figure 4 shows the charge control circuit.

When power is applied to VDD, voltage reference diode D1 is at 4.1V. Transistor Q1 is forward biased, which in turn pulls the gate of FET Q2A to VDD. With FET Q2A turned on, the gate of FET Q2B is at ground, turning on the FET. Diode D3 is forward biased, which turns on FET Q3B allowing the battery voltage at VOUT1 and VBAT. FET Q3B is shut off when the battery voltage goes below about 3.5 volts. The resistor divider R18/R17 sets the turn-off voltage. When Q3A turns off, the battery will charge the gate of Q3B to the battery voltage. This prevents any possible damage to the battery by discharging it too deeply.

When power is removed from VDD, the power rail collapses, causing transistor Q1 to shut off when its base-emitter is no longer forward biased. This causes FET Q2B to shut off. This allows the gates of FET Q2B to be pulled up to VBAT through resistor R5. The battery is now isolated by Q2B from any leakage path back into the charging circuit or the power supply.

VOUT1 and VBAT provide alternative voltage outputs as desired.

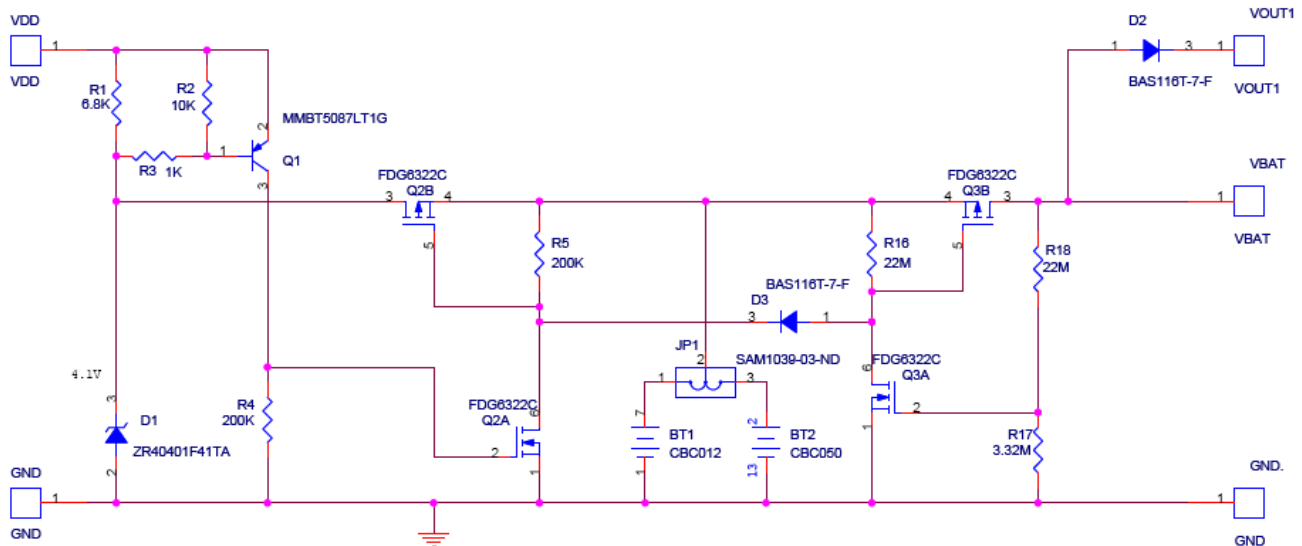


Figure 4. EVAL-01 charge control circuit.

Charging Board Description

The EVAL-01 Thin-Film Battery Evaluation Kit is prefabricated on a 1.36 x 0.60 inch board, which can be mounted on another board with through-hole posts.

Connection Instructions (refer to Figure 5)

- Connect positive (+) supply (range 4.7V to 15V) to **VDD**.
- Connect supply ground or negative (-) to **GND**.
- If EVAL-01 is configured with both CBC012 & CBC050, select battery with Jumper on **JP1**. If only one battery is present, jumper **JP1** must be set properly.
- Connect **VOUT1** to the positive (+) supply connection of the test system (i.e., the load).
- **VBAT** is the positive (+) terminal of the battery.
- Connect **GND** to ground or negative (-) of test system.

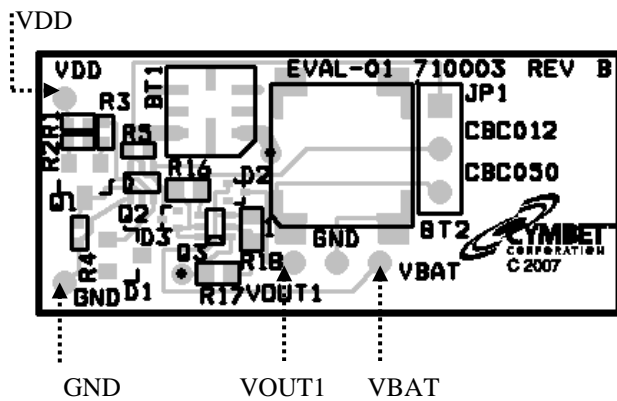


Figure 5. EVAL-01 board layout.

Figure 5 shows the board layout. Gerber files for the layout and the BoM are available from Cymbet.

Figure 6 shows mechanical dimensions in inches. A Cymbet thin film battery can be mounted on the backside of the board.

Table 2 contains the Bill of Materials (BoM).

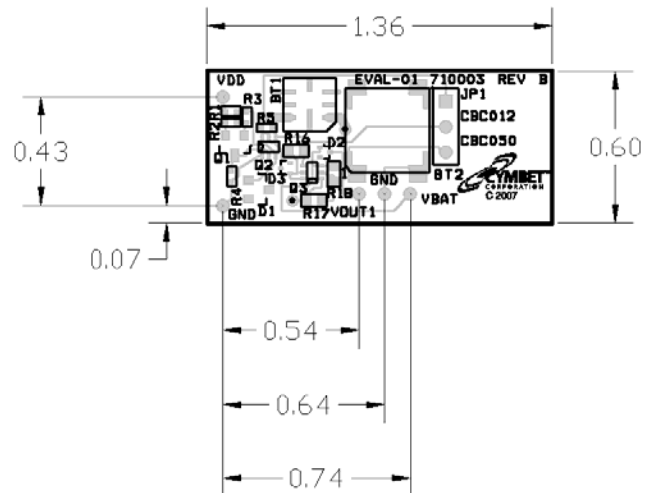


Figure 6. EVAL-01 through-hole and board dimensions in inches.

AN-1003: Model EVAL-01 Thin-Film Battery Evaluation Kit

Qty	Ref	Part Mfr	Mfr Part #	Description	Digikey Part #
1	Q1	ON Semiconductor	MMBT5087LT1G	PNP Transistor SOT-23	MMBT5087LT1GOSCT-ND
1	Q2	FAIRCHILD SEMICONDUCTOR	FDG6322C	FET DGTL P-CHAN DUAL SC70-6	FDG6322CTR-ND or FDG6322CCT-ND
1	Q3	FAIRCHILD SEMICONDUCTOR	FDG6322C	FET DGTL N-CHAN DUAL SC70-6	FDG6301NCT-ND
1	D1	ZETEX INC	ZR40401F41TA	IC REFERENCE VOLTAGE 4.1V SOT-23	ZR40401F41TR-ND
1	D2	Diodes Inc	BAS116T-7-F	DIODE SWITCH 85V 150MW SOT523	BAS116T-FDICT-ND
1	D3	Diodes Inc	BAS116T-7-F	DIODE SWITCH 85V 150MW SOT523	BAS116T-FDICT-ND
1	R1	VISHAY/DALE	CRCW04026K80JNED	RES CHIP 0402 THK FILM 6.8K OHM 1/18W 5%	541-6.8KJTR-ND
1	R2	VISHAY/DALE	CRCW040210K0JNED	RES 10K OHM 1/16W 5% 0402 SMD	541-10KJTR-ND
1	R3	VISHAY/DALE	CRCW04021K00JNED	RES 1.0K OHM 1/16W 5% 0402 SMD	541-1.0KJTR-ND
2	R4, R5	VISHAY/DALE	CRCW0402200KJNED	RES 200K OHM 1/16W 5% 0402 SMD	541-200KJTR-ND
2	R16, R18	STACKPOLE ELECTRONICS INC	RMCF 1/16 22M 5% R	RES 22M OHM 1/10W 5% 0603 SMD	RMCF1/1622M5%R-ND
1	R17	VISHAY/DALE	CRCW060322KOJNEH	RES 3.32M OHM 1/10W 1% 0603 SMD	541-3.32MHCT-ND
1	JP1	Samtec Inc	TSW-103-08-G-S-RA	CONN HEADER 3POS .100 SGL R/A AU	SAM1039-03-ND
1	J1	3M	929955-06	SHORTING JUMPER GLD/NICKEL BLUE	929955-06-ND
1		TwinStar	710003	Bare Board	NA
1	BT1	Cymbet Corporation	CBC012-L5C-ES	Lithium Cell 12µAH 5X5mm 8 pin LLP	NA
1	BT2	Cymbet Corporation	CBC050-M8C-ES	Lithium Cell 50µAH 8X8mm	NA

Table 2. EVAL-01 Bill of Materials (BoM).