Cymbet EnerChip™ Smart Solid State Batteries Product Overview and User Guide

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Version 8.0

CYMBET™
CORPORATION

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Cymbet Corporation
18326 Joplin St. NW
Elk River, MN 55330
Phone 763-633-1780
www.cymbet.com

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EnerChip Product Family Overview

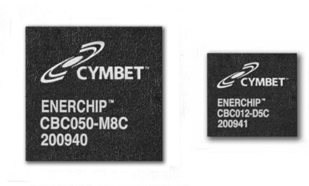


Figure 1: EnerChip CBC050 and CBC012 Front

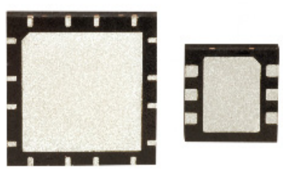


Figure 2: EnerChip CBC050 and CBC012 Back

ENERCHIP THIN FILM BATTERIES

Cymbet EnerChip™ smart solid state rechargeable batteries having unique characteristics relative to conventional rechargeable batteries. EnerChips have a high charge/discharge cycle life; low self-discharge; simple voltage controlled charging requirement; flat voltage profile; have no flammable solvents to leak or catch fire; are solder reflow tolerant; and are offered in low profile surface mount packages.

EnerChips are used in applications requiring backup, bridging, or transition power to maintain real-time clock operation or SRAM data retention in the event of main power interruption; wireless sensing as the main power source when energy can be harvested from the ambient power and used to constantly trickle charge the EnerChip; and as a power source used to perform housekeeping for microcontrollers and peripherals when main power is interrupted, to ensure an orderly shutdown or transition to low power modes.

This User Guide provides the system designer, manufacturing engineer, and end user with important information on operating characteristics, design guidelines, handling, storage, assembly, and testing of the EnerChip Smart Solid State Batteries.

To ensure specification integrity across Cymbet EnerChip documentation, detailed product specifications for each EnerChip or Evaluation kit are contained in the products associated Data Sheet. The Data Sheets are either on www.cymbet.com or available directly from Cymbet. Using EnerChips in various applications in conjunction with other vendor's devices can be found on the Application Notes page http://www.cymbet.com/design-center/application-notes.php

EnerChips are offered in a variety of sizes and packages ranging from 1uAh to 50uAh with features and options available to serve a range of applications. Standard products include:

CBC012

EnerChip 12µAh Battery

The EnerChip CBC012 is a solid state thin film rechargeable battery. It is designed to be surface mounted (SMT) and is reflow tolerant. The EnerChip provides thousands of recharge cycles and has a fast recharge time. The CBC012 is Eco-friendly and has no harmful gasses, liquids or special handling procedures. It is packaged in a 5 x 5 mm 6-pin DFN package. Operating temperature is -20°C to +70°C.

Data Sheet: DS-72-02

CBC050

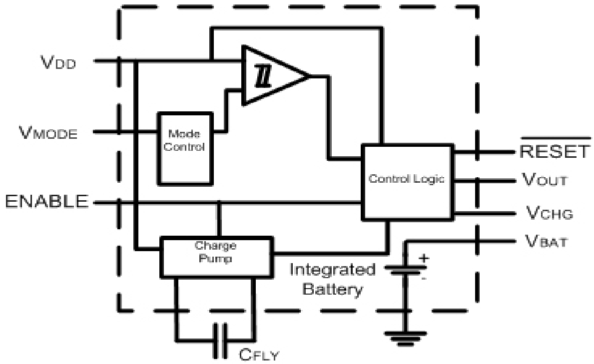
EnerChip 50µAh Battery

The EnerChip CBC050 is a solid state thin film rechargeable battery. It is designed to be surface mounted (SMT) and is reflow tolerant. The EnerChip provides thousands of recharge cycles and has a fast recharge time. The CBC050 is Eco-friendly and has no harmful gasses, liquids or special handling procedures. It is packaged in an 8 x 8 mm 16-pin QFN package. Operating temperature is -20°C to +70°C.

Data Sheet: DS-72-01

ENERCHIP CC WITH INTEGRATED BATTERY MANAGEMENT

The EnerChip CC is the world's first Intelligent Solid State Battery. It is an integrated solution that provides battery backup and power management for systems requiring power bridging and/or secondary power. A single EnerChip CC can charge up to 10 additional EnerChips connected in parallel. The EnerChip CC block diagram:



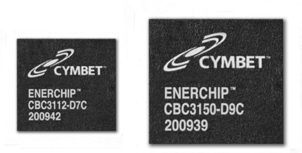


Figure 3: EnerChip CBC3112 and CBC3150

CBC3112

EnerChip CC 12µAh with Integrated Battery Management

The EnerChip CC is the world's first Intelligent Thin Film Battery. It is an integrated solution that provides battery backup and power management in systems requiring power bridging and/or secondary power. A single EnerChip CC CBC3112 can charge up to 10 additional EnerChips connected in parallel. It is packaged in a 20-pin 7 x 7 mm DFN package for SMT and is reflow tolerant.

Data Sheet: DS-72-04

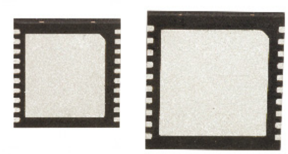


Figure 4: EnerChip CBC3112 and CBC3150 Back

CBC3150

EnerChip CC 50µAh with Integrated Battery Management

The EnerChip CC is the world's first Intelligent Thin Film Battery. It is an integrated solution that provides battery backup and power management in systems requiring power bridging and/or secondary power. A single EnerChip CC CBC3150 can charge up to 10 additional EnerChips connected in parallel. It is packaged in a 20-pin 9 x 9 mm DFN package for SMT and is reflow tolerant.

Data Sheet: DS-72-03

CBC-EVAL-05

EnerChip CC Evaluation Kit

The EnerChip CC EVAL-05 evaluation kit contains both an EnerChip CC CBC3112 and an EnerChip CC CBC3150. Either Enerchip CC can be tested standalone, either internal Enerchip battery may be tested alone, or either EnerChip CC can control itself and the thin film battery in the other EnerChip CC. The EVAL-05 is packaged as a 24-pin DIP that can be socketed on a test board.

Data Sheet: DS-72-09

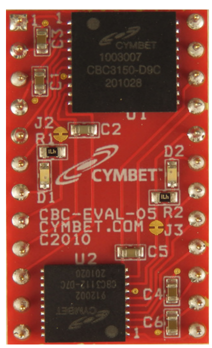


Figure 5: CBC-EVAL-05 Evaluation Kit

Chapter Two

Designing with EnerChips

CIRCUIT DESIGN TECHNIQUES

EnerChips are used much in the same way as legacy storage devices such as capacitors and coin cells. The EnerChip CBC012 and CBC050 have a Positive Terminal and Negative Terminal (normally tied to a Ground Potential) similar to these other devices.

DESIGNING ENERCHIP CHARGING CIRCUITS

EnerChip thin film rechargeable batteries are conducive to a variety of charge control circuits. The recommended charging voltage is a constant 4.1V. The range from 4.1V to 4.3V is acceptable, but the number of life charge cycles will be reduced toward the top of the range. The range from 4.0V to 4.1V is also acceptable, but the full charge will be reduced toward the bottom of the range. The range of acceptable charging voltages is illustrated in Figure 14.

Circuits consisting of one or more diodes and a fixed power supply may be used; however, fluctuations in the power supply voltage and part-to-part variability in the diode voltage drop will affect the voltage across the battery terminals.

CIRCUIT SCHEMATIC EXAMPLES

The following three figures present examples of how the EnerChip CC is used in conjunction with microcontrollers and real-time clocks. These designs are fairly straight forward due to the highly integrated capabilities of the EnerChip CC. For applications requiring high pulse current outputs, please refer to Application Note AN-72-1025. For applications using the "brown-out" feature of several microcontrollers, please refer to Application Note AN-72-1027.

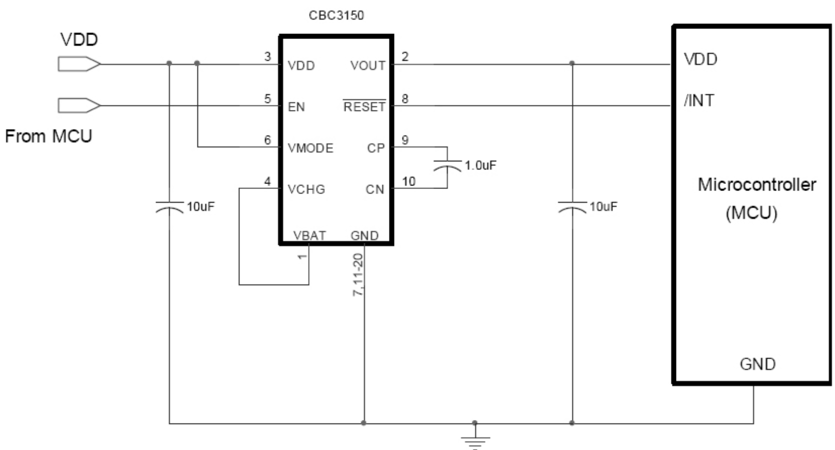


Figure 6: Typical EnerChip CC Microcontroller Backup

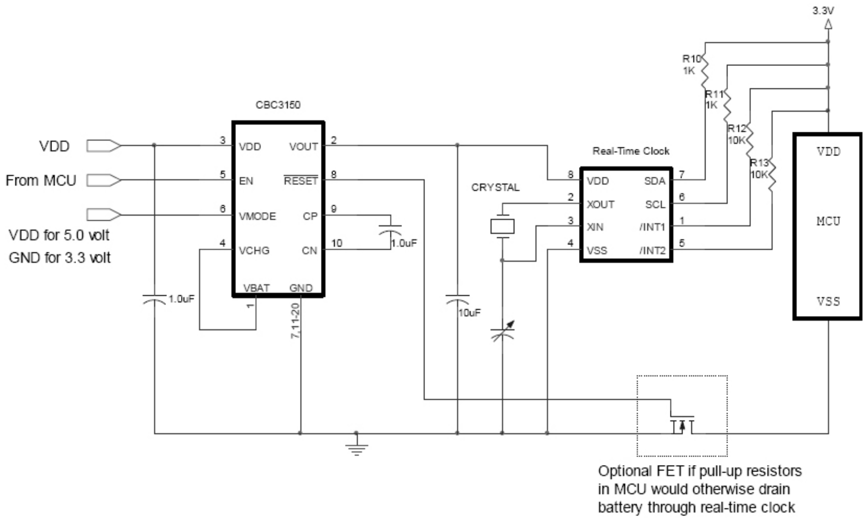


Figure 7: EnerChip CC Providing Real-Time Clock Power Backup

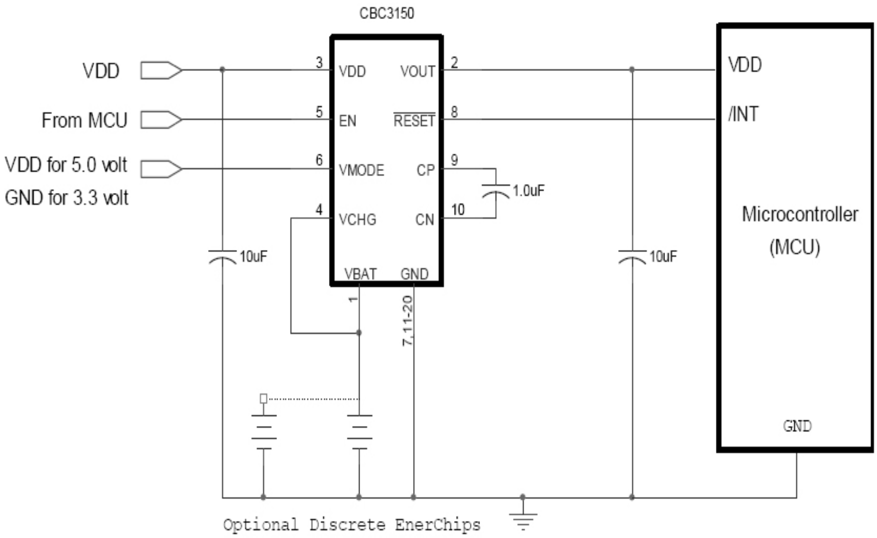


Figure 8: EnerChip CC Providing Power Management for Multiple EnerChips

ENERCHIP PCB LAYOUT RULES

There are several PCB layout considerations that must be taken into account when using the EnerChip:

1. All capacitors should be placed as close as possible to the EnerChip.
2. Power connections should be routed on the layer the EnerChip is placed.
3. The flying capacitor connections must be as short as possible and routed on the same layer the EnerChip is placed.
4. A ground (GND) plane in the PCB should be used for optimal performance of the EnerChip.
5. Very low parasitic leakage currents from the VBAT pin to power, signal, and ground connections, can result in unexpected drain of charge form the integrated power source. Maintain sufficient spacing of traces and vias from the VBAT pin and any traces connected to the VBAT pin in order to eliminate parasitic leakage currents that can arise from solder flux or contaminants on the PCB.
6. On the EnerChip CC, Pin 1 VBAT and Pin 4 VCHG must be tied together for proper operation.

PCB LAYOUT & BOARD CONTAMINATION

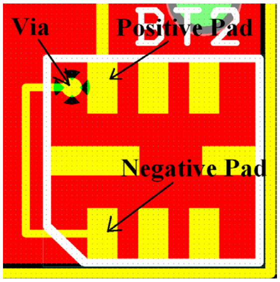


Figure 9: CBC012 PCB traces resulting in a low resistance leakage path.

- Electrical resistance of solder flux residue can be low enough to discharge the cell at a much higher rate than in the normal backup mode. Therefore, solder flux must be thoroughly washed from the board following soldering.
- The PCB layout can make this problem worse if the cell's positive and negative terminals are routed near each other and under the package, where it is difficult to wash the flux residue away.
- In the example in Figure 9, the negative connection is routed from the negative pad to a via placed under the package near the positive pad. In this scenario, solder flux residue can wick from the positive solder pad, covering both the positive pad and the via, resulting in a high resistance current path. This current path will make the cell appear to be defective or make the application circuit appear to be drawing too much current. Avoid placing vias beneath the EnerChip package.
- Make sure positive and negative traces are routed outside of the package footprint to ensure that flux residue will not cause a discharge path between the positive and negative pads.
- See the section on assembly repair techniques for additional information on board layout guidelines.

ENERCHIP PCB PACKAGE LAYOUTS

Each EnerChip data sheet shows the details of each chip package. Refer to the data sheet for the EnerChip you are using for PCB layout guidelines specific to that device and package. Note that although some of the EnerChip packages have an exposed center die pad on the bottom of the package, it is strongly recommended that the PCB NOT have a corresponding solder pad to align with the center pad on the package. Again, this is to reduce the number and severity of leakage paths between the battery terminals.

PROTOTYPING WITH THE EVAL-05

The first step in using the CBC-EVAL-05 evaluation kit is to read the data sheet DS-72-09 for all the technical specifications and interface descriptions.

To connect the EVAL-05 to a power source and a target load, insert the 24-pin DIP EVAL-05 as shown in Figure 10 into a socket or proto-board. Connect the other devices as shown in the EVAL-05 data sheet.

The EVAL-05 can be used in 7 different modes. Please refer to the EVAL-05 data sheet for the connections for the other 6 modes.

The EVAL-05 EnerChip CC CBC3112 and CBC3150 devices are charged at the factory, so there should be about a 50% state of charge on both devices. Any charging time required to enable the application should be minimal.

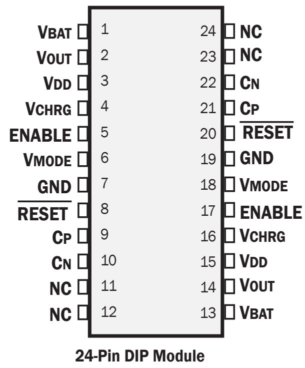


Figure 10: Pin configuration of EVAL-05 24-pin DIP Board.

Chapter Three

Handling, Charging and Storing EnerChips

GUIDELINES FOR HANDLING ENERCHIPS

Cymbet™ EnerChip™ thin film, solid state batteries feature all solid state construction, are packaged in standard integrated circuit packages, and can be reflow soldered for high volume PCB assembly. They are ideal as rechargeable backup power sources for clocks, memories, microcontrollers and other low-power circuits where data or timing information must be retained in the absence of primary power.

This document provides general handling guidelines and precautions for the batteries. These include device handling and storage, protection against electrostatic discharge (ESD), reflow solder, and in-circuit use.

Device Handling & Storage

- EnerChip batteries are packaged and shipped in moisture barrier bags, and are sensitive to moisture absorption. They must be kept in the sealed bag until ready for board mounting and reflow soldering.
- If the batteries are removed from the sealed bag more than 168 hours prior to board mounting, they must be baked at 125°C for a minimum of 24 hours prior to board mounting and reflow soldering.
- Store the batteries in an environment where the temperature and humidity do not undergo large fluctuations. Store at 10°C to 30°C and at less than 60% relative humidity.

Electrostatic Discharge (ESD)

- Similar to integrated circuits, the batteries are sensitive to ESD damage prior to receiving a charge cycle. Therefore, adherence to ESD prevention guidelines is required.
- Remove devices from protective shipping and storage containers at approved ESD workstations only.
- All equipment used to process the devices must be configured to minimize the generation of static charges. This includes soldering and de-soldering equipment and tools, pick-and-place equipment, test equipment, and all other tools and equipment used to handle or process the devices.
- Failure to observe these precautions can lead to premature failure and shall void product warranty.

In-circuit Use Guidelines

- Do not connect these batteries to other types of batteries except through an approved charging circuit.
- To increase battery life, avoid installing near devices that would generate heat exceeding the 70°C operating limit.

ENERCHIP CHARGING OVERVIEW

Cymbet™ EnerChip™ thin film, solid state batteries feature all solid state construction, are packaged in standard integrated circuit packages, and can be reflow soldered for high volume PCB assembly. They are ideal as rechargeable backup power sources for clocks, memories, microcontrollers and other low-power circuits where data or timing information must be retained in the absence of primary power.

The charging time of EnerChip batteries is short compared to that of conventional rechargeable batteries.

Figure 11 shows the typical percentage of full charge vs. time during constant voltage charging. Figure 12 shows the EnerChip allowable charging voltage range.

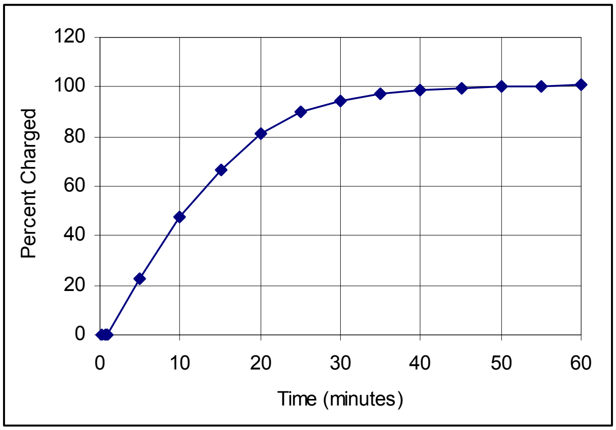


Figure 11: Typical Battery Charging Profile; Vc = 4.1V

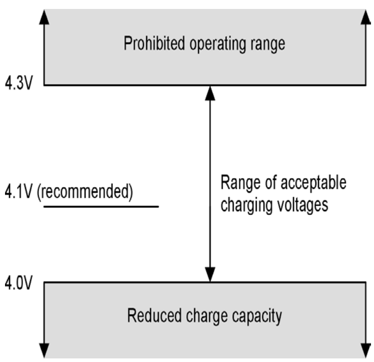


Figure 12: Allowable Charging Voltage Range

ENERCHIP CHARGING GUIDELINES

As with other rechargeable batteries, discharge capacity and cycle life are a function of charge voltage, discharge cutoff voltage, depth-of-discharge, temperature, and other factors. The system designer must understand the effect of these factors when designing the charge control circuit.

- Never apply more than 4.3V across the battery terminals. There is no need to externally limit the charging current of small surface-mount batteries. The intrinsic cell resistance is sufficient to limit the current to an acceptable level as long as the applied voltage does not exceed 4.3V.
- The charging voltage and charge time determine the amount of charge delivered to, and accessible from, the battery. A higher charging voltage will deliver more charge, but will also result in greater long-term capacity fade as a function of charge/discharge cycling. Figure 13 shows trade-offs between charging voltage, charge capacity and cycle fade.
- The batteries may be charged at a constant current (CC) followed by a constant voltage (CV). During the CC phase, the current may be set to any value that results in an acceptable charging time and does not cause the battery voltage to exceed 4.3V.
- CV charging will normally result in faster charging times than the combined CC-CV approach. The latter may become necessary with future, larger batteries with lower intrinsic cell resistance. Please refer to the data sheets of these batteries.

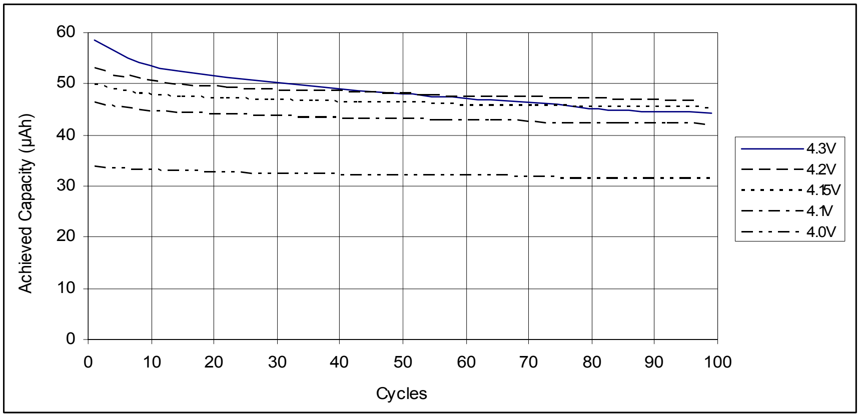


Figure 13: Effect of Charging Voltage on Battery Charge and Cycle Fade

CHARGING PROFILE

Figure 14 shows the charging current input in microamperes divided by the EnerChip capacity in microampere-hours. As indicated, the EnerChip is at 80% charge in about 30 minutes.

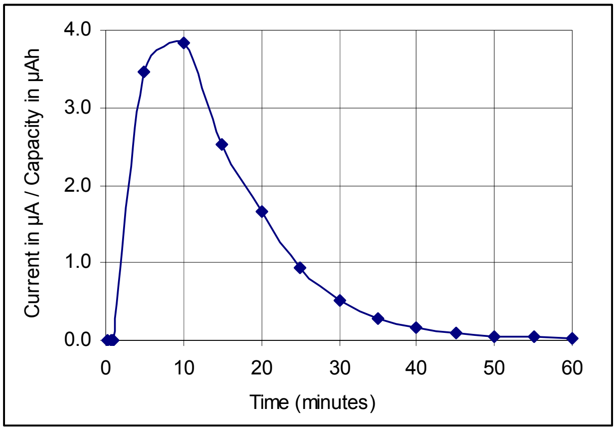


Figure 14: Charging Circuit with a Linear Regulator

DISCHARGE CUTOFF

In order to preserve the cycle life and other performance characteristics of the EnerChip, it is important to terminate the battery discharge when the battery voltage reaches 3V. This is particularly important when discharging at very low current – for example, below a few microAmperes. Although > 90% of the battery capacity will have been depleted when the battery voltage reaches 3V at low drain current, the battery will nevertheless continue to supply current below 3V. If discharged continuously below that voltage, the battery will be damaged.

Simple circuits utilizing a discrete or MCU-embedded reference voltage to control a series FET switch, for example, could be used to disconnect the load when the battery voltage reaches 3V.

Chapter Four

Packaged EnerChip Assembly Techniques

CHIP DELIVERY OPTIONS

EnerChips are delivered from the factory in one of three package types:

- **Tube** - EnerChips are packaged in anti-static tubes that are compatible with automated assembly equipment using surface mount technology.
- **Tape and Reel** - EnerChips are packaged in 1000 piece lots on a tape and reel for use with automated assembly equipment using surface mount technology.
- **Waffle Pack** - EnerChips are placed in individual chambers in a waffle pack tray for manual assembly or automated pick and place assembly.

SMT PROCESS

The EnerChips are packaged in standard surface mount packages. Refer to the solder paste material data sheets for attachment of the package to a PCB using solder reflow processes. Ensure that the solder reflow oven is programmed to the correct temperature profile prior to assembling the EnerChip on the PCB.

REFLOW SOLDERING

- The maximum number of times the battery may be reflow soldered is three times.
- The surface temperature of the battery must not exceed 260°C.
- The recommended solder reflow profile is shown in Figure 15 below; refer to Figure 16 for time and temperature requirements. Whenever possible, use lower temperature solder reflow profiles.

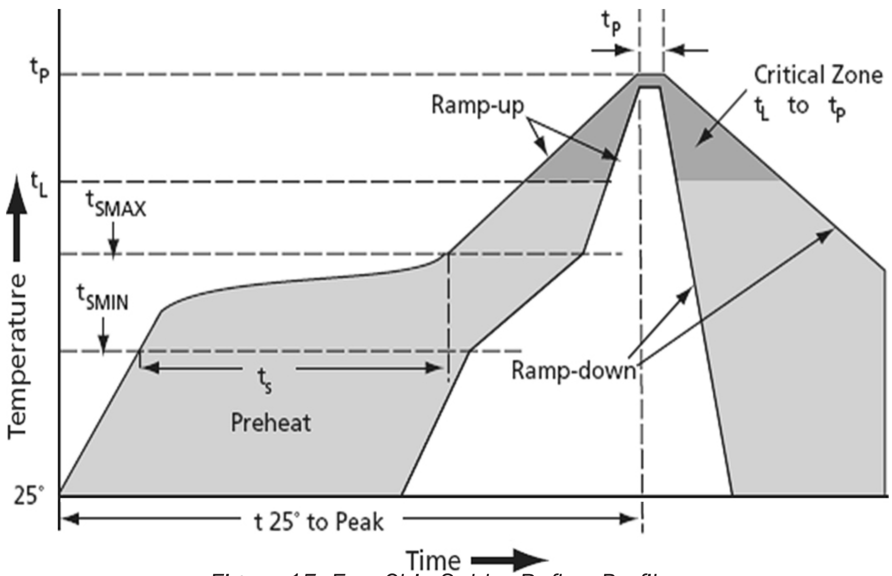


Figure 15: EnerChip Solder Reflow Profile

Parameter	Sn/Pb	Pb-free
Max ramp-up rate	6°C/sec	6°C/sec
Soak temperature, min, T_{SMIN}	135°C	150°C
Soak temperature, max, T_{SMAX}	155°C	200°C
Soak time, max, t_S	2 min	3 min
Liquid temperature, T_L	183°C	220°C
Max time above t_L	150 sec	150 sec
Max peak temperature, T_P	220°C	260°C
Max time at peak, t_P	225°C	260°C
Max ramp-down rate	10°C/sec	10°C/sec

Figure 16: Solder Reflow Parameters

HAND SOLDERING TECHNIQUES

When soldering the EnerChip using by hand at a soldering station, adhere to the following guidelines:

- Observe the ESD precautions outlined in this document.
- Never solder an EnerChip that has been partially or fully charged, even if the EnerChip is in a discharged state. This includes wave soldering and reflow soldering.
- Minimize the amount of time that heat is applied to the EnerChip. Using a tweezer-type soldering iron tip that applies heat to two opposite sides or the entire perimeter of the device simultaneously will result in more uniform heating of the package and for a shorter period of time than when soldering one pin or package edge at a time.
- If possible, apply solder paste to the solder pads on the PCB prior to placing the EnerChip on the board; this will promote wetting of the solder and reduce the amount of time the soldering iron is applied to the component and solder pads.
- Place the EnerChip onto the PCB by hand and solder in place rather than grabbing the EnerChip with a heated tweezer-type tip and placing the EnerChip on the board with the iron. This will minimize the amount of time the EnerChip is exposed to heat.
- Most surface mount packages have metal leadframe tie points that do not extend to the bottom surface of the package but are exposed on two more of the package sidewalls. When soldering, ensure that solder does not cover these tie points, as this situation could result in package pins being shorted to one another through the metal leadframe.

Chapter Five

EnerChip Bare Die Handling and Assembly

BARE DIE DELIVERY OPTIONS

EnerChip bare die applications often require custom procedures and significant variation exists among package vendors and assembly equipment, making specific guidelines difficult. Contact Cymbet Application Engineering to review handling, wirebonding, bumping, and assembly guidelines.

Bare die undergo the following screening procedures prior to leaving the manufacturing facility:

- Electrical test to ensure the cell is not shorted, open, and is within the specification limits of cell resistance.
- MIL-STD-883 optical inspection.

BARE DIE HANDLING GUIDELINES

- When unpacking, storing, inspecting, or handling bare die Enerchips, all operations should be performed in a Class-1,000 (or better) clean room - ISO 6 equivalent.
- When removing die from waffle packs, use the minimum downward force possible with the handling mechanism.
- Handling and insertion forces need to be kept to a minimum to reduce damage to the device materials.
- Tool recommendations: Use pick-and-place tool having a “soft” tip, e.g., rubber or other pliable material.
- EnerChips are sensitive to electrostatic discharge (ESD) and should always be handled in an ESD-controlled environment and in accordance with the ESD guidelines set forth in Chapter 3.
- EnerChips should be stored in a humidity-controlled environment to prevent excess moisture from penetrating the EnerChip.

DIE BUMPING AND WIREBONDING

EnerChip bare die have bond pads that are suitable for either wirebonding or bumping. The pad structure is typically designed for one or the other attachment methods, but not both. Pads are made of aluminum with a small amount of silicon and copper and therefore either gold or aluminum wires may be attached to the bond pad. Pads designed for bumping can be stud bumped or solder bumped.

Chapter Five

EnerChip Bare Die Handling and Assembly

Standard wirebond machine and process settings are generally applicable when wirebonding to EnerChip die. When placing EnerChip die onto the die attach material, use the minimum downward force possible. Ensure there is a uniform coating of die attach material on the substrate (i.e., no voids or gaps) and that the die attach material extends to the edge of the EnerChip die during die placement.

Recommended wirebond process time and temperatures are as follows:

Die Attach Epoxy Cure
190°C +/- 10°C for 1.5 hours

Wirebond

Pre-heat:	190°C
Wirebond:	200°C
Post-heat:	190°C

Package Epoxy Cure
175°C +/- 10°C

BARE DIE TEMPERATURE GUIDELINES

Temperature Guidelines:

- Operating temperature: -20°C to +70°C.
- Storage temperature (uncharged): -40°C to +125°C.
- Bare die assembly process temperatures: Do not exceed +200°C for duration consistent with die attach, wire bond & mold compound cure periods.

BARE DIE ENCAPSULATION AND UNDERFILL GUIDELINES

EnerChip die undergo a minute amount of expansion and contraction when being charged and discharged. Consequently, it is important to not encapsulate the die with overly compressive or rigid materials. Similarly, application of rigid epoxy underfill compounds between a flip-chipped die and printed circuit board material is discouraged.

Contact Cymbet to discuss any encapsulation or underfill requirements and a joint evaluation will be conducted.

Chapter Six

Factory Testing and Repair After Assembly

IN-CIRCUIT TESTING OF ENERCHIPS

Once the EnerChip has been soldered to a circuit board, it may be charged. If in-circuit testing is to be done for purposes of testing the EnerChip itself or other circuitry on the board, the following guidelines should be observed:

- Never apply a voltage outside the rated charge or discharge voltage range as specified in the respective EnerChip data sheet.
- As with all batteries, the EnerChip has an inherent internal resistance. Never force a current into or out of the EnerChip that would result in the battery voltage rising above or falling below a voltage outside the rated charge or discharge voltage range as specified in the data sheet.
- Once the EnerChip has been charged - partially or fully - do not store or operate the EnerChip outside of the operating temperature range as specified in the data sheet.

GUIDELINES FOR IN-CIRCUIT TESTING OF ENERCHIPS

Objective: Verify EnerChip device connectivity after reflow solder process. It is important to read and understand the proper test flow for the EnerChip devices. Following the proper test method will ensure reworkability of boards.

Due to the chemistry and construction of the EnerChip products, reflow soldering of EnerChip components must only be done prior to an initial charge. After the EnerChip device has been charged – even if subsequently discharged – care must be given to not expose the device to temperatures in excess of the rated operating temperature, such as temperatures reached during reflow solder assembly. Often, components and their connections to the printed circuit board must be tested before the product is shipped. Moreover, accommodation must be made for post-assembly rework of components on the board. Localized heating during removal of nearby components - such as can occur from solder pencils and localized SMT reflow tools and techniques - can destroy the EnerChip. Rework processes usually include one or more additional passes through the reflow solder process. Consequently, an in-circuit test method for the EnerChip must meet the following criteria:

1. Must be performed relatively quickly so as not to impede product assembly throughput.
2. Must be testable with standard automated test equipment and instruments.
3. Must provide results indicating that the EnerChip device is functional and properly connected to the circuit.
4. Must permit the EnerChip device to meet the rated electrical specifications after being subjected to additional reflow solder processes such as might be required when other components on the board are being reworked.

EnerChip devices are tested at the factory using proprietary test to ensure a very low field failure rate. However, as with any energy storage or semiconductor device, failures do occur as a result of any number of causes, including improper handling, electrostatic discharge (ESD), operating beyond rated specifications, etc.

If the board under test is to be reworked and reflowed due to a failure of any device on this board other than the EnerChip device it is important to follow the test flow exactly. The EnerChip device may be reflowed up to three times as with most semiconductor devices. However, once the EnerChip device is charged, the user may not reflow the part again without replacing it.

EnerChips fall into one of two general categories:

1. Those with integrated power management – typically designated as CBC31xx products (e.g., CBC3112, CBC3150).
2. Those without integrated power management – typically designated CBCxxx products (e.g., CBC012, CBC050).

The procedures shown in Figure 18 address all products in both categories and are intended to provide the test engineer with sufficient responses to declare that the EnerChip is connected to the circuit and that it is behaving as an energy storage device. The test procedures described herein do not include the test characterization necessary to ensure that the EnerChip device conforms to the electrical specifications as described in the respective data sheets.

The EnerChip test methods described herein are designed to provide the test engineer with flexibility with respect to charge time, discharge time, and selection of test limits in order to accommodate various types of test equipment, resolution of measuring instruments, and the allowable test time. The following graph depicts the time-dependent and temperature-dependent voltage of the EnerChip after applying a 4.1VDC charging voltage for approximately one second, followed by a brief discharge at a specific load resistance. Using this graph as a guide, the test engineer can develop a simple test that is feasible with the available test equipment and fixtures and meets the production throughput needs.

The chart in Figure 17 should be referenced to determine the voltage on the VCHG/VBAT pin to be expected after driving the ENABLE pin high for one second. The decay curves in the chart represent specific load impedances as might be encountered with Automated Test Equipment (ATE). Additionally, the decay curves represent the span of EnerChip cell impedances as specified in the respective data sheets. The test engineer has the freedom to choose a point on the discharge curve that falls within the parameters of test throughput and equipment measurement capability. In order for the EnerChip to be considered as meeting the gross functional test specification, the voltage on the VCHG/VBAT pin must be above the value indicated by whichever line is chosen as the reference line. Data at two temperatures is shown in order to encompass the anticipated factory test floors. Note the influence of temperature on the EnerChip test discharge voltage when setting the test specification pass/fail limits.

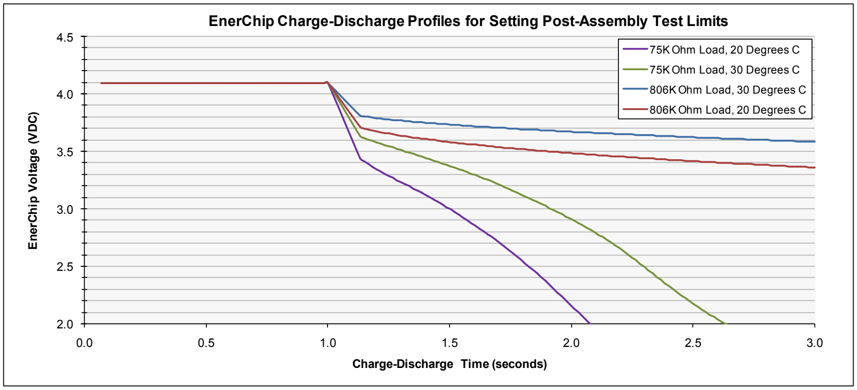


Figure 17: Voltage Determination on the VCHG/VBAT Pin

Figure 18: Factory In-circuit EnerChip Post Assembly Test Steps

1.0 Precautions

1.1 Follow ESD safe handling protocol.

2.0 CBC31xx In-Circuit Test Procedure

2.1. Apply 4.1VDC to the positive EnerChip terminal, with respect to the negative terminal (i.e., ground), for one second.

2.2. To ensure that the battery cell inside the CBC31xx is not charged during test it is important that the user force the EN pin on the CBC3150 to a logic low before performing board level testing. WARNING: If the enable pin is asserted for more than 1 second with the VDD > 2.5 volts the CBC3150 cannot be reflowed again. Therefore all other components should be tested and reworked prior to testing the CBC3150.

2.3. Perform test at room temperature.

2.4. Force EN pin of CBC31xx to GND.

2.5. Enable power domains under test.

2.6. Run all vectors to ensure proper functionality of all semiconductor devices.

2.7. The device powered by the CBC31xx can be tested at this time.

2.8. Force the VMODE pin to GND in 3.3V systems; force VMODE pin to VDD in 5V systems.

2.9. Force VBAT to be electrically tied to VCHG. Typically this is already done on the board, as VBAT must be tied to VCHG in order for the internal battery to be connected to the power management circuit.

2.10. Apply voltage to VIN that is in the range of 2.5V to 5.5V. (Note: VIN = VDD.)

2.11. Verify that the VBAT/VCHG net is 4.1 volts +/- 0.025 volts.

2.12. Allow one second for the battery to charge a very small amount by leaving the device in the above noted configuration.

2.13. Remove VDD and begin tracking elapsed time.

2.14. Verify that the VBAT/VCHG not is greater than the value as shown in the fore going discharge curves.

3.0 CBC31xx Battery Backup Verification: Optional Board/System Level Test. [(1)]

3.1. Power up board or system.

3.2 Ensure that CBC31xx EN pin is asserted and VDD is > 2.5 volts.

3.3 Allow battery to charge for several minutes.

3.4 Program device to be battery-backed.

3.5 Remove power for at least several seconds to one minute.

3.6 Power up board or system.

3.7 Read device formerly under battery backed mode.

3.8 Verify device contents.

Notes:

[(1)] This test does not verify the actual battery capacity. In order to verify actual capacity the device must be charged for at least one hour and discharged into the battery-backed device.

ENERCHIP ASSEMBLY REPAIR TECHNIQUES

Should the need arise to replace an EnerChip that has already been soldered to a circuit board, due to battery failure, improper package placement, or other circumstances, it is recommended that the EnerChip being replaced be discarded and replaced with a new EnerChip. When removing the EnerChip from the board, use a tweezer-type soldering iron tip that heats opposite sides of the package simultaneously and lift the package from the board. When applying the new EnerChip to the board, follow the hand soldering guidelines in the previous section.

For QFN-style packages, use a hot air rework station to remove a defective or misplaced EnerChip package. If there are other EnerChips in the vicinity of the EnerChip being replaced, use proper heat shielding to protect the adjacent EnerChip package from the heat source and turn off any heat source that would otherwise be used to heat the bottom of the board during removal of the EnerChip. This will prevent the adjacent EnerChip(s) from being damaged during the rework procedure.

If it is not possible to replace the EnerChip with a new EnerChip, use extreme care when removing the EnerChip from the board to minimize the amount of time heat is applied to the package during removal and re-soldering. Follow the guidelines in the previous section pertaining to hand soldering. Under no circumstances should an EnerChip that has been partially or fully charged - even if subsequently discharged - be subjected to reflow, wave, or hand soldering.

Conductive epoxy may also be used as an attachment method. If the cure temperature is above 70°C, then a new (i.e., never charged) EnerChip must be used.

Chapter Seven
EnerChip Performance Considerations

BATTERY PERFORMANCE CONSIDERATIONS

There are several considerations that must be taken into account that determine EnerChip performance over time and with use. These are:

1. Temperature
   - Battery aging accelerates with increasing temperature.
   - Note that storage temperatures and operating temperatures are specified for the EnerChip in the device data sheet. The operating temperature range is narrower than the storage temperature range; moreover, the storage temperature range for an EnerChip that has never been charged is different from that of an EnerChip that has been charged one or more times - partially or fully.
   - Battery impedance increases with decreasing temperature - by a factor of approximately 1.5 to 2 for every 10°C reduction in operating temperature.

2. Depth-of-Discharge
   - As the depth -of-discharge on the cell increases (i.e. lower state-of-charge), the charge/discharge cycle life decreases. See the respective data sheet for charge/discharge cycle life under various operating conditions.

3. Number of Charge/Discharge cycles
   - The charge/discharge cycle life of the EnerChip is dependent on a number of variables, including temperature, depth-of-discharge, charging voltage, and discharge cutoff voltage. Consult the EnerChip data sheet for specific details.

4. Input Charging Conditions
   - It is important to regulate the charging voltage applied to the EnerChip in order to ensure a long service life and delivery of the rated capacity.

5. Discharge Cutoff Conditions
   - During discharge of the EnerChip, the minimum discharge cutoff voltage as specified in the data sheet must be enforced. If the discharge voltage is allowed to drop below the rated value, particularly at low discharge currents, The performance of the EnerChip will be degraded, and under certain conditions, the device will ultimately fail to operate according to specifications.

6. In regards to resistance to Humidity, Chemical exposure, and G-Forces, the EnerChip product family is designed to meet JEDEC standards.

Contact Info

Documentation: www.cymbet.com

Design Center
Application Notes
Data Sheets
White Papers
Sales Offices
Request for Quotations

Applications Support: +1 763-633-1780

Email Support: http://www.cymbet.com/design-center/support.php

The Support form is an easy way to document your information request and have this tracked in the Cymbet case management system.