

Li Battery Charger Demo Board – Using the HT46R46

D/N: HA0083E

Introduction

The miniaturization of electronics and its resulting major expansion in the use of hand held battery powered products, such as digital cameras, PDAs, mobile phones, etc., has brought with it increasing demands for high capacity rechargeable batteries. Among the various types of rechargeable batteries available today, one of the most popular is the Lithium type, a battery technology which offers the advantage of higher capacity when compared to other battery technologies such as Nickel Cadmium or Nickel Metal Hydride types.

The charging process for all rechargeable batteries requires some special considerations and is rarely just a matter of supplying a charge for a fixed period of time. Determining what charging current to use and detecting when the battery is fully charged requires that the battery voltage and charging current is monitored continuously so that correct charging decisions can be made by the charger to allow the battery to be charged safely to its maximum capacity. However, to do so most chargers will normally require the services of a suitable microcontroller and analog to digital converters. Holtek provides a range of A/D microcontroller devices, which are suitable for battery charging applications, one of these is the HT46R46. To assist customers in their development of battery charger applications, Holtek has produced a Li Battery Charger Demo Board, which includes an HT46R46 microcontroller device and all necessary peripheral hardware.

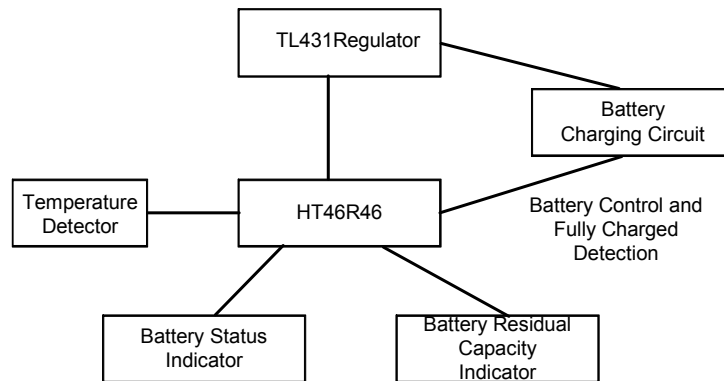
There are two versions available, one has a residual capacity display and out of temperature range protection, while the other version does not have these features.

Demo Board Features

The Li Battery Charger Demo Board contains all the hardware to form a complete Li battery charger system and incorporates a range of features to ensure that Lithium batteries are charged safely to their full capacity. Some of these features are listed below:

- The Li Battery voltage is charged to $4.2 \pm 0.01V$.
- The maximum charging current is 250 mA.
- Battery polarity inverse warning.
- Battery short circuit warning.
- The charging time is set to be about 6 hours after which the charging process will automatically stop.
- Battery leakage current is less than 10uA during power failure.
- Two indicator LEDs are provided to indicate the charging status.
- Four indicator LEDs are provided to indicate the charging percentage.
- The charging process will automatically stop if a temperature abnormality is detected.

Demo Board Block Diagram



Maximum Ratings

- Input Voltage: DC 6V
- Input Power: 1.5W
- Maximum Charging Voltage: DC 4.2V
- Maximum Charging Current: 250mA

DC/AC Characteristics

- Maximum Charging Current: 250mA \pm 50mA
- Charging Voltage: 4.20 \pm 0.01V
- Charging Time: 6 hours
- Battery Leakage Current during power failure: less than 10 μ A

Functional Description

Charging Procedure

- A power LED indicates the board power status
- Green LED on when powered and awaiting battery insertion
- When battery inserted, charging begins and LED colour turns to yellow
- When battery is fully charged, LED color turns to orange
- After removing the battery, the LED turns to green and awaits other battery insertion
- Charging percentage will be displayed during charging

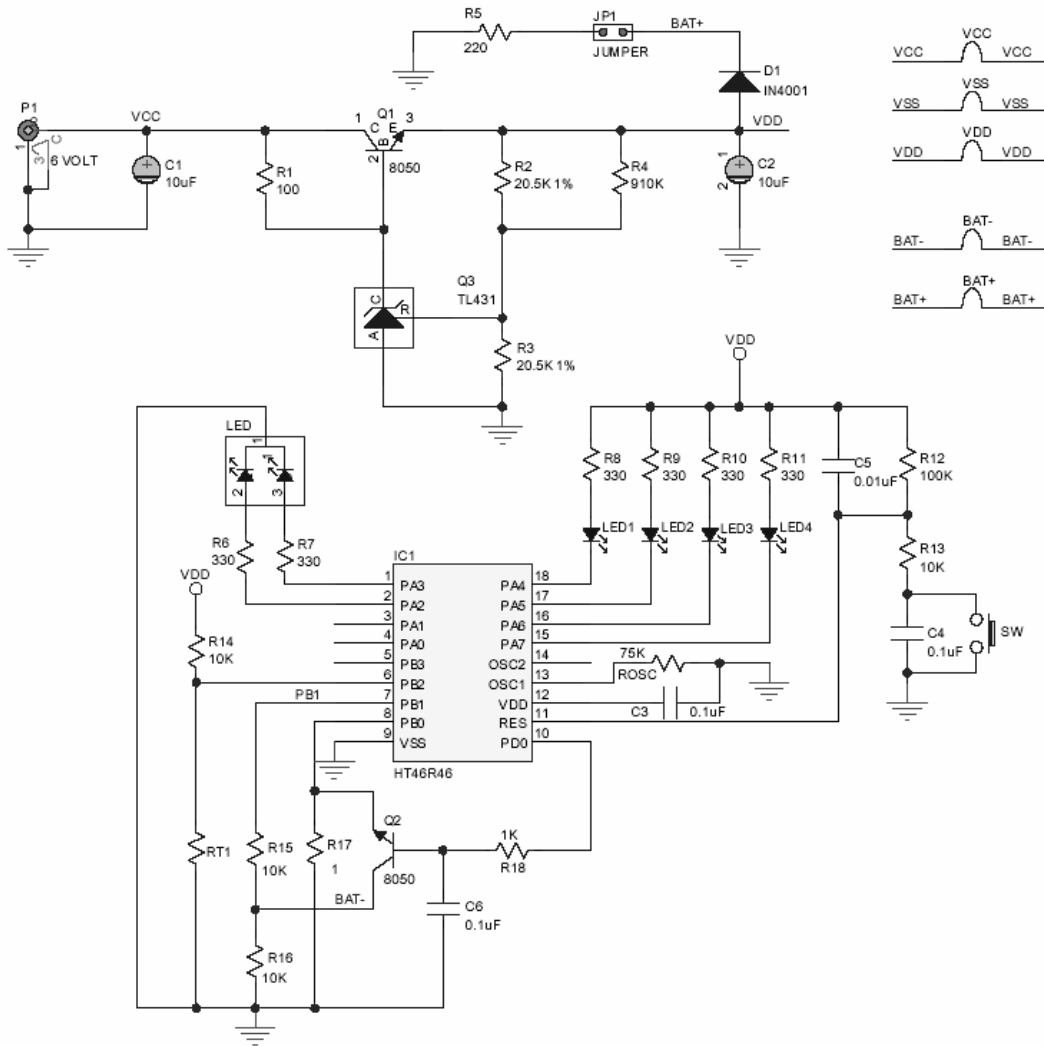
Bi-color LED Charging and Warning

- Constant Green: awaiting battery insertion
- Constant Yellow: charging in process
- Constant Orange: battery is fully charged or charged over 6 hours
- Flashing Orange: warning due to short circuit, polarity inversion or temperature abnormality

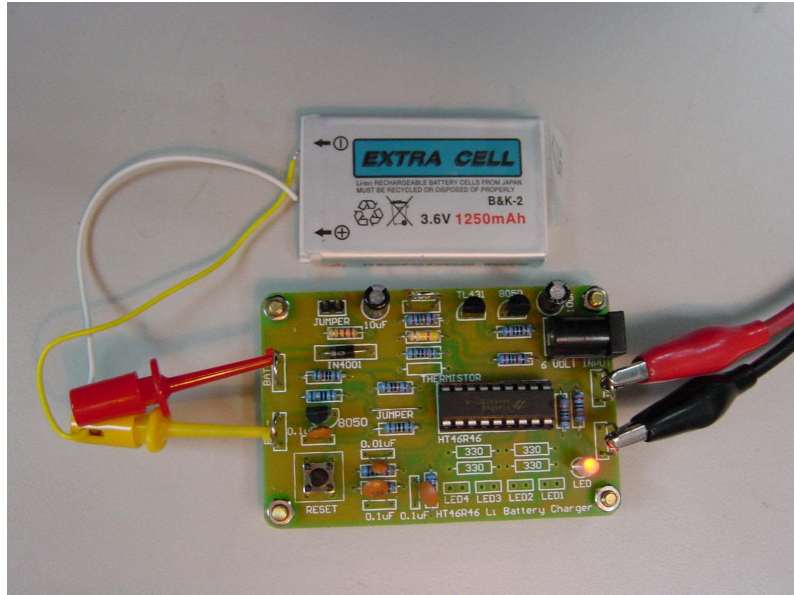
Charging Status and Temperature Protection

- Battery Status Display: 4 LEDs indicates less than 25%, 25%~50%, 50%~75%, 75%~90% and greater than 90%.
 - Lower than 25%: LED1 on and LED2 ~ LED4 off
 - 25%~50%: LED1 on, LED2 flashes and LED3 ~ LED4 off
 - 50%~75%: LED1 and LED2 on, LED3 flashes and LED4 off
 - 75%~90%: LED1 ~ LED3 on and LED4 flashes
 - 90%以上: LED1 ~ LED4 on
- Temperature Protection: if temperature is higher than 45°C or lower than -5°C charging stops.

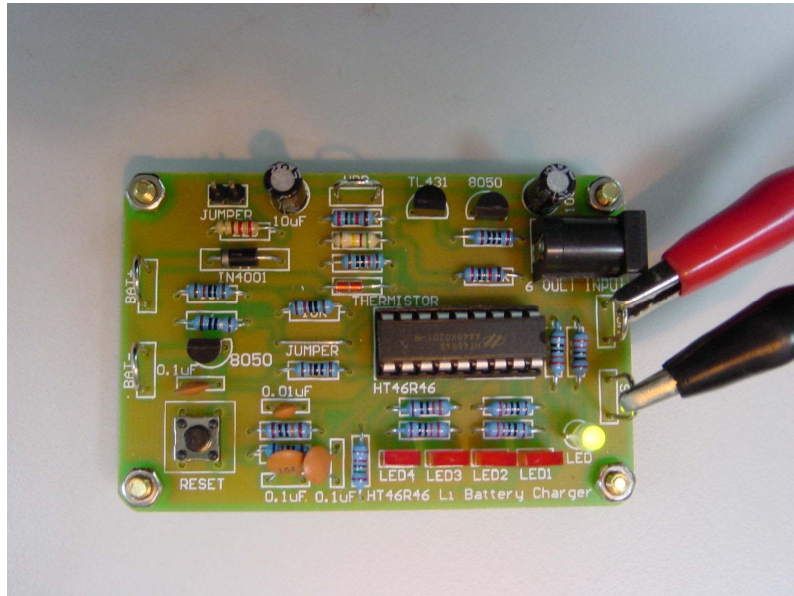
Charger Demo Board Circuit



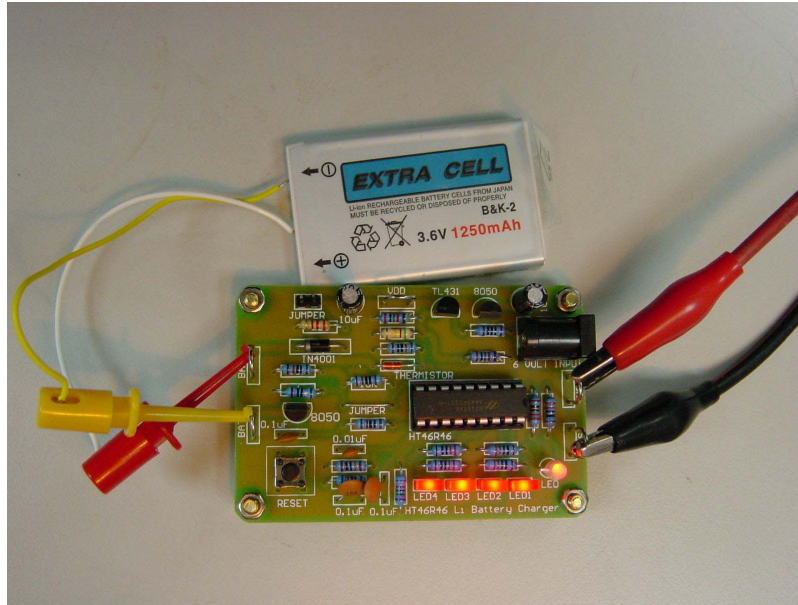
- Without residual capacity display: battery charge complete



- With residual capacity display: battery not inserted

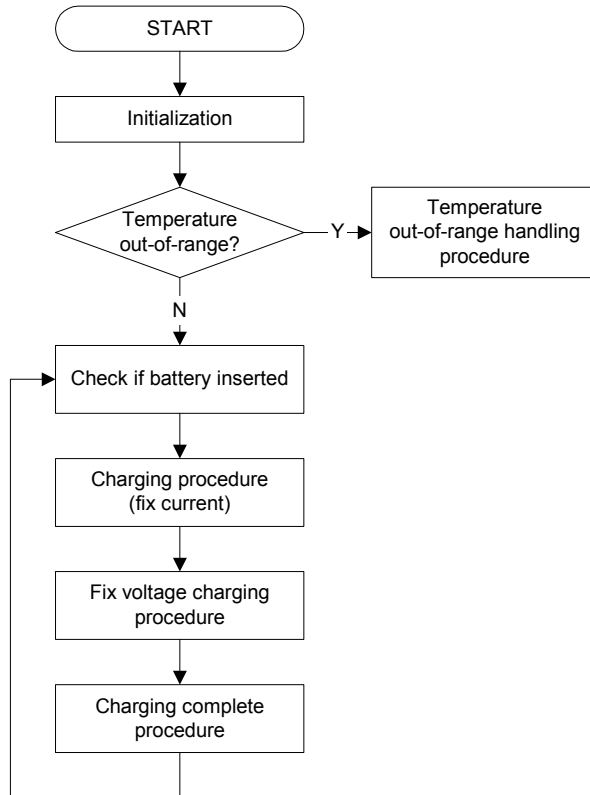


- With residual capacity display: battery charge complete

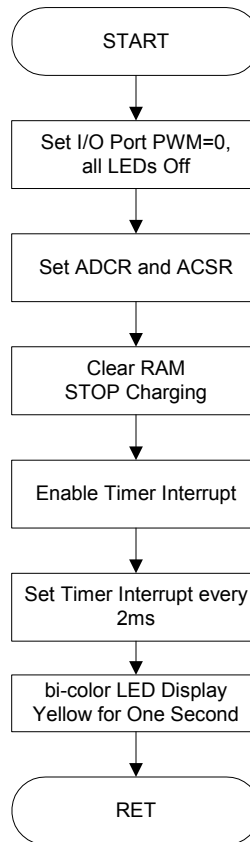


Flowcharts

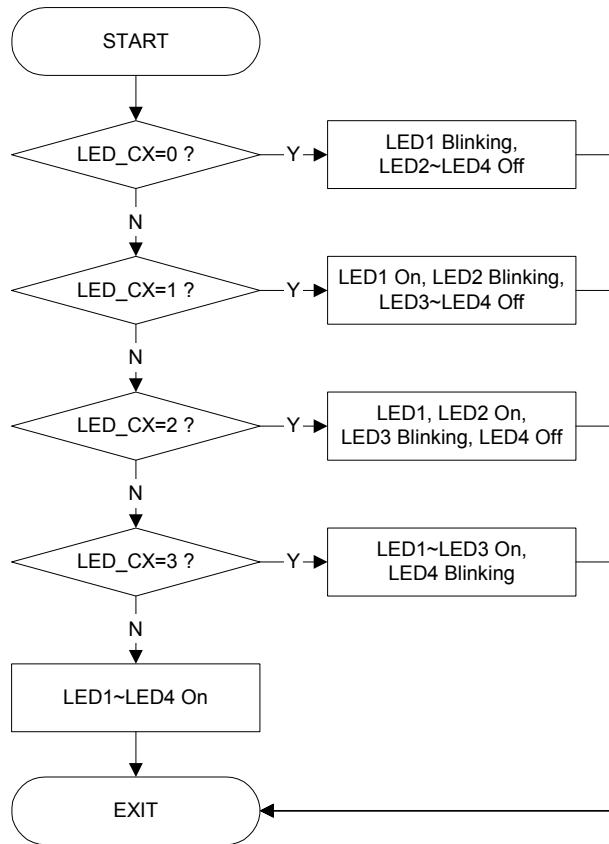
Main Program



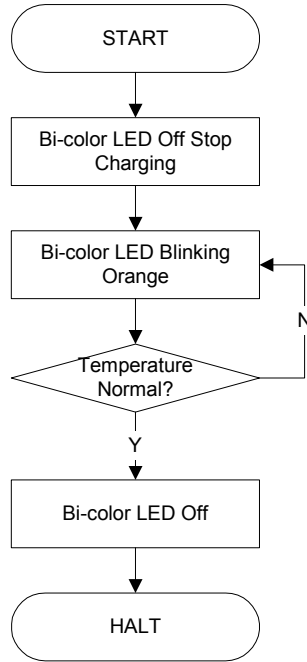
Initialization Procedure



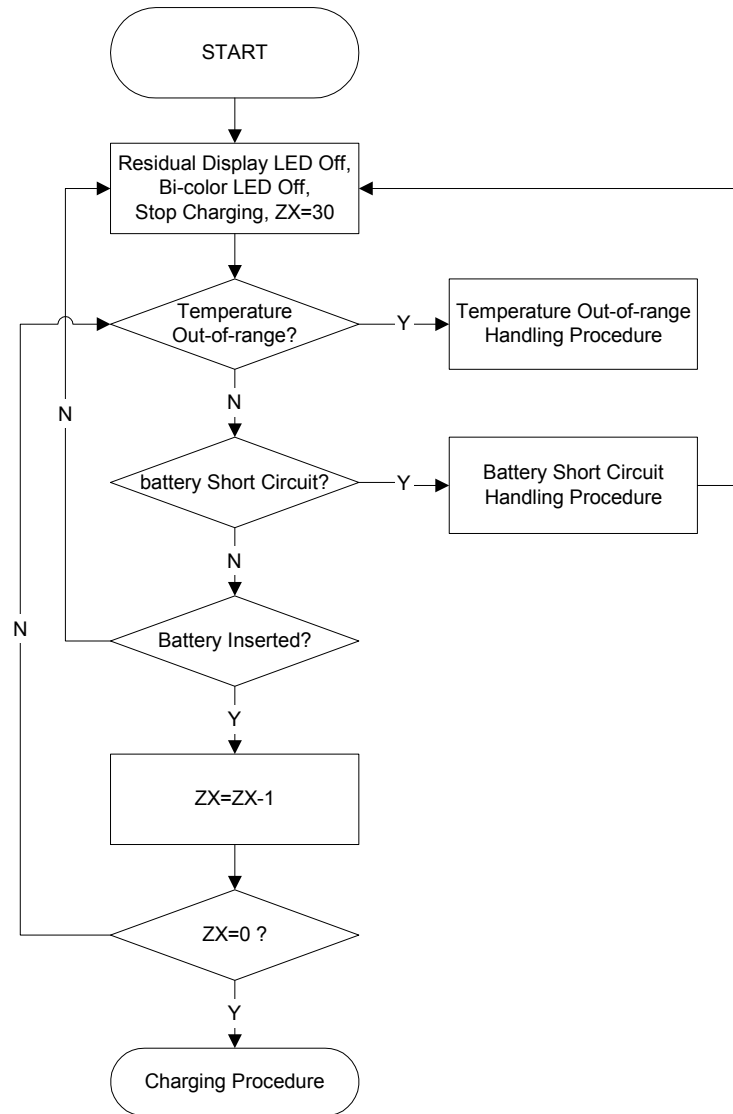
Residual Capacity LED Display Procedure



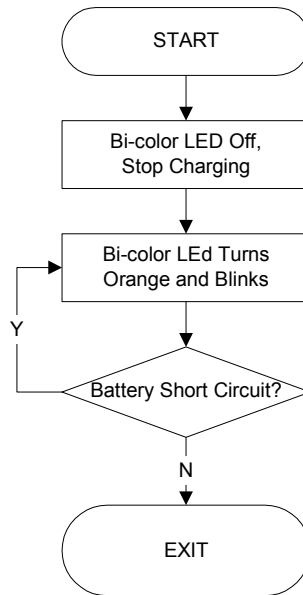
Temperature Out-of-Range Handling Procedure



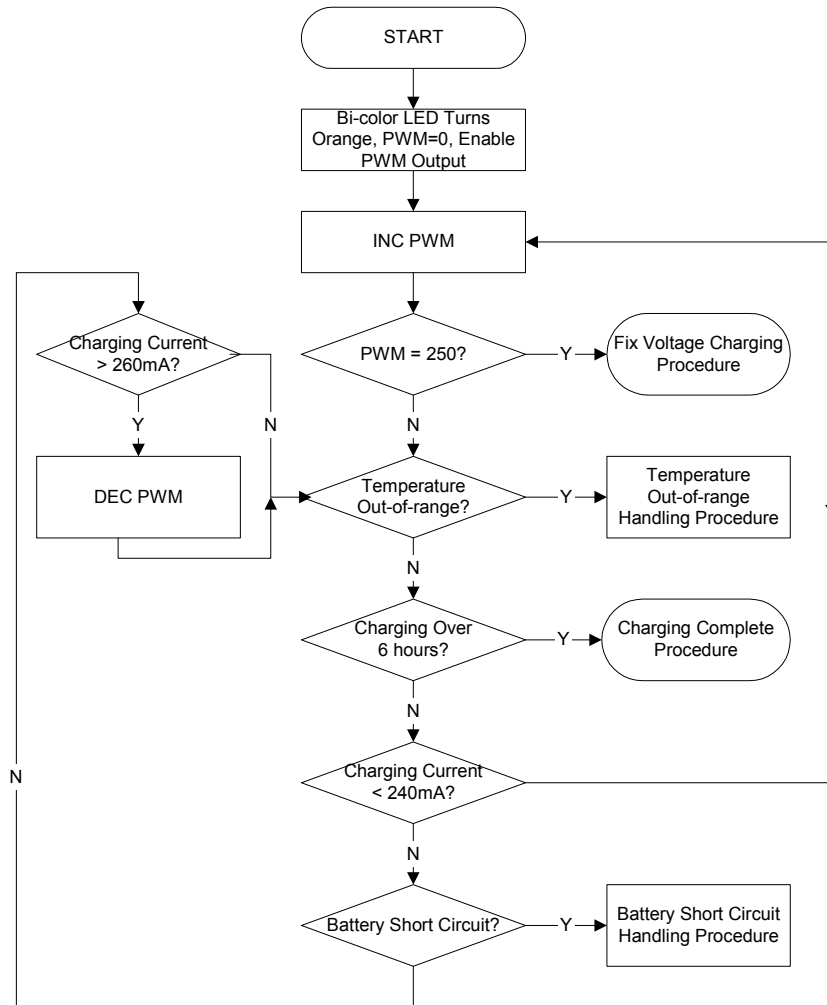
Check Li Battery Insertion Procedure



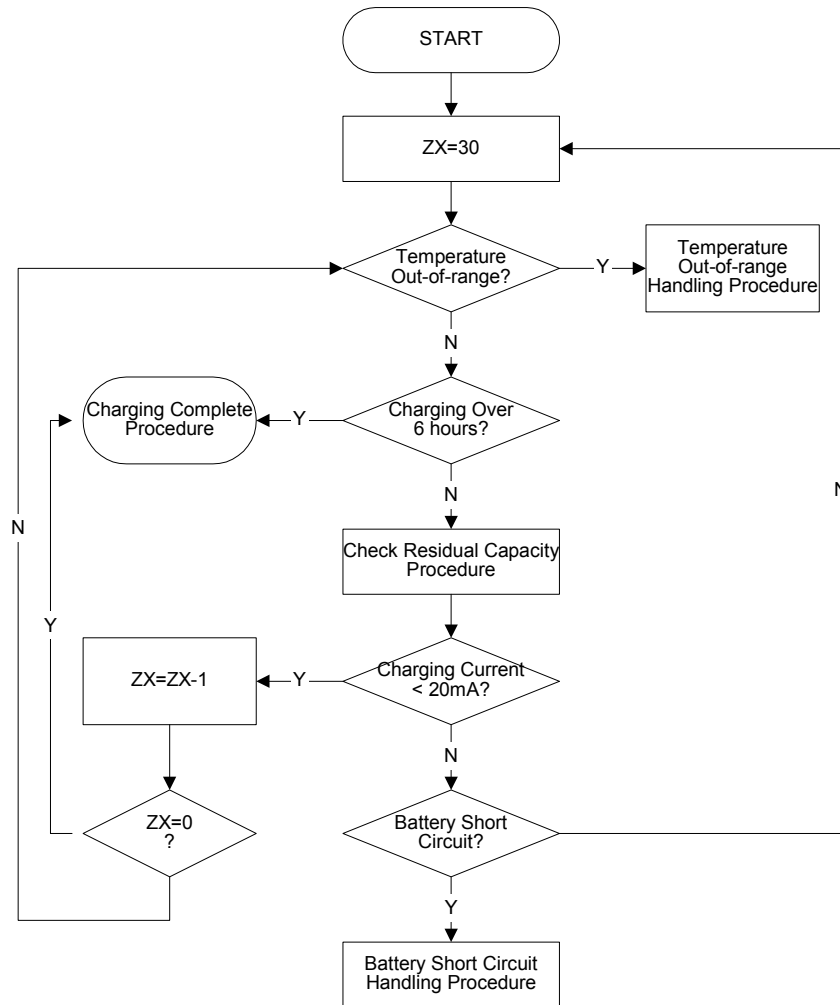
Battery Short Circuit Handling Procedure



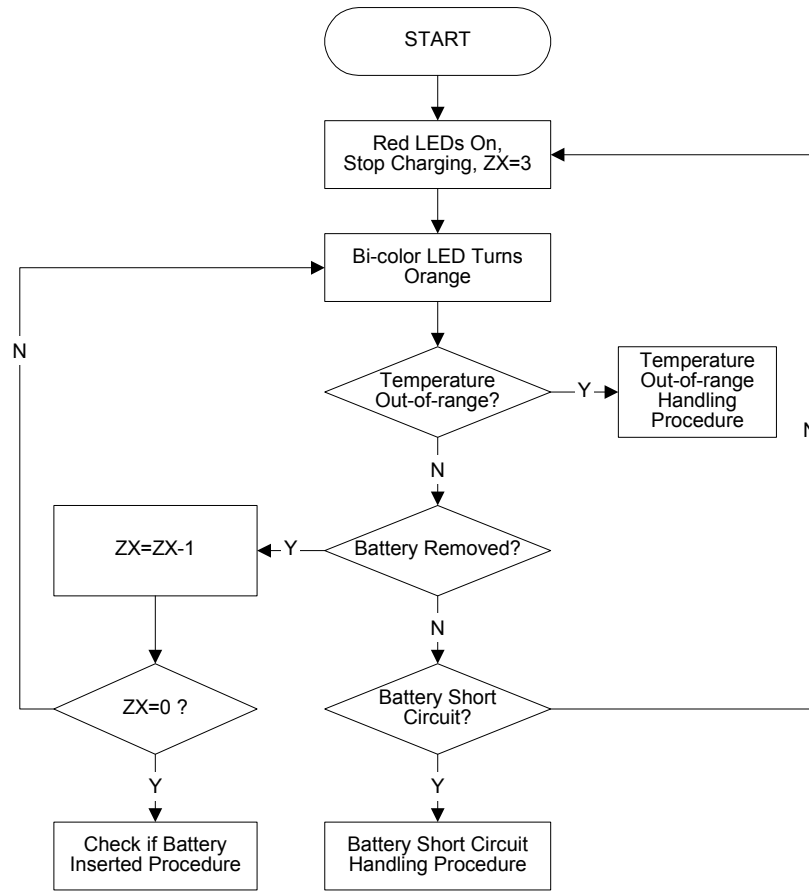
Charging Procedure - With Fixed Current



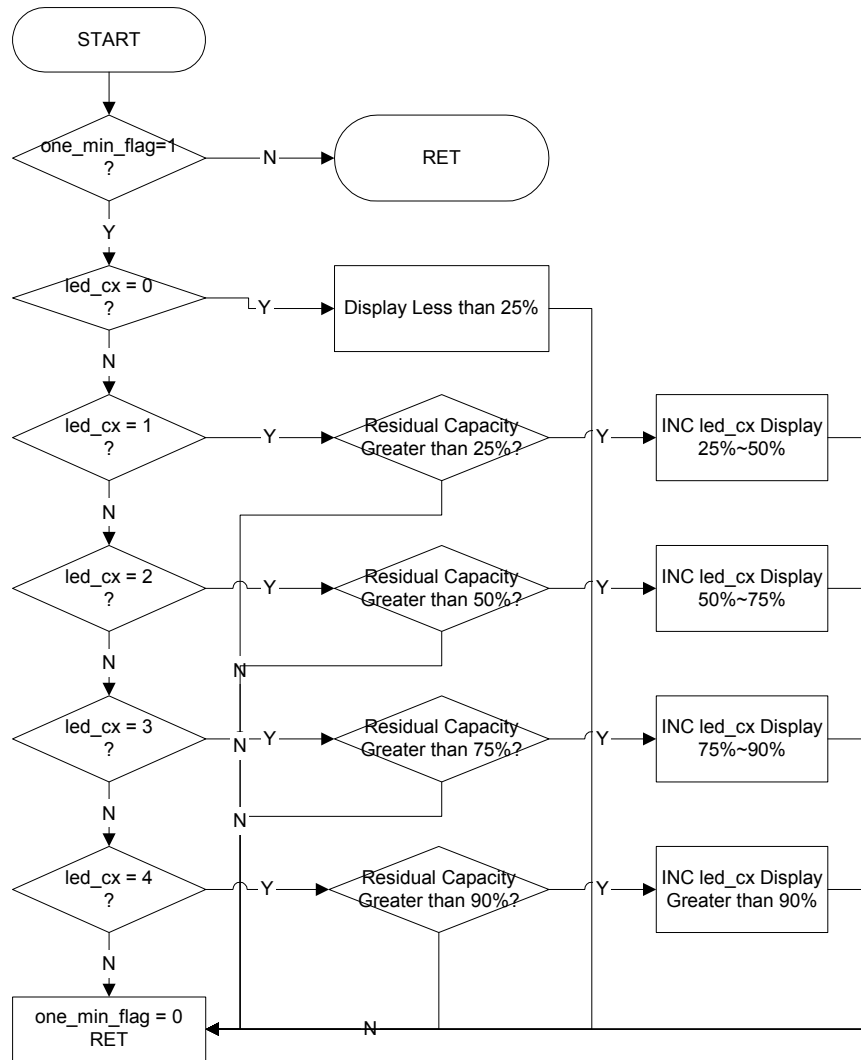
Fixed Voltage Charging Procedure



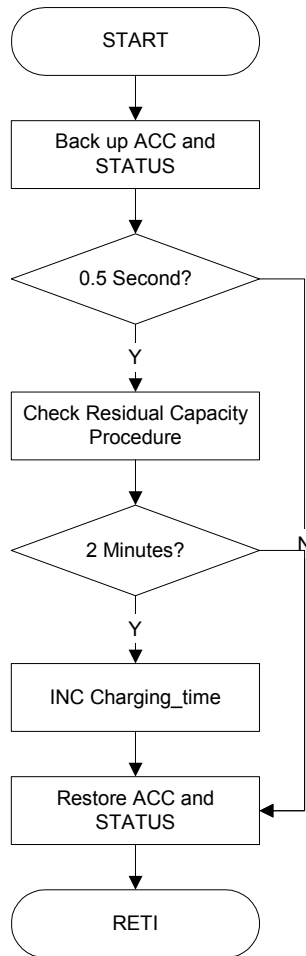
Charging Complete Procedure



Check Residual Capacity Procedure



Timer ISR Procedure



Program Description

The HT46R46 Li Battery Charger demo program consists of a charging_current.asm main program and 2 include files. The ch0_main.asm program is the main procedure for charging and sub.asm is a subroutine.

The compressed file should be expanded and the latest version of the HT-IDE3000 program executed, which will support the HT46R46 device. The T1.PRJ project file should then be opened. When this has been done the program modification, compile, simulate, print options etc. can be implemented to program OTP devices.