BQ25730 Driver Development Log

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Project
Universal Battery Management System (BMS) Controller

Component
BQ25730 Buck-Boost Battery Charger Controller

Date Range
Ongoing (Latest Update: April 19, 2025)

1. Introduction
This document summarizes the design, implementation, testing, and ongoing development of a custom driver written in Arduino C++ for the BQ25730 battery charger IC. This driver is part of a broader Universal BMS Controller project, which aims to provide flexible and programmable charging logic for a wide range of battery chemistries and form factors.

The BQ25730 is a highly integrated buck-boost battery charge controller from Texas Instruments. It supports 1- to 5-cell battery configurations, input voltages from 3.5V to 26V, and charge/discharge currents up to 10A. The IC supports I2C/SMBus communication, allowing full configuration and monitoring by a host microcontroller.

2. Project Goals
- Establish reliable communication with BQ25730 using I2C

- Implement a modular and testable driver to manage battery charge parameters

- Enable charging across a wide range of conditions with system-level safety

- Ensure reusability for different cell configurations and battery types

3. Hardware Setup
- I2C Interface: Verified BQ25730 at 7-bit address 0x6B

-EVM: BMS5051 REV A

- MCU: STM32F103C8T6 ARM STM32

- Power Source: Bench power supply (12V–24V range)

- Battery: Sodium Ion 18650 3.0V 1.3Ah 3.90Wh 10C Rechargeable Battery 4S pack (used for test configuration)

4. Functional Overview

The firmware performs the following:

1. I2C Bus Initialization

2. Device Presence Check using Device ID register

3. Charger Configuration:

   - Charge Voltage

   - Charge Current

   - Input Voltage Limit (VINDPM)

   - Input Current Limit

   - Minimum System Voltage (VSYS_MIN)

4. ADC Activation

5. Charging Enable/Disable Control

6. Fault Detection and I2C Auto-Recovery

7. Debug Printouts of Register Values

5. Code Design Decisions

- Modular function design for each configuration register

- I2C reliability enhancement via polling and auto-reset

- Delays added to prevent register write collisions

- ADC activated with one-shot mode

- Periodic re-write of charge settings to maintain charger state

- Serial printout of all registers for debugging

6. Charging Logic Summary

Battery Charging Phases:

Pre-Charge: Battery < 3V, limits current to 384 mA

Fast Charge (LDO): 3.0V < Battery < 3.6V, limited to 2 A

Full Fast Charge: Battery > 3.6V, full speed charging

7. Register Programming Examples

- Charge Voltage (0x04): (voltage / 0.008) << 3 → 16V = 0x3F00

- Charge Current (0x02): (current / 0.128) << 6 → 1A = 0x0200

- Input Voltage (0x0A): ((Vin - 3.2) / 0.064) << 6 → 12V = 0x1E00

- Input Current (0x0E): (mA / 50) << 8 → 2.1A = 0x2A00

- VSYS_MIN (0x0C): (voltage * 10) << 8 → 13.3V = 0x5300

8. Observations and Issues

- ADC values stop updating after charging ends

- VIN behavior during OTG not confirmed

9. Conclusion

This log captures the iterative development of the BQ25730 driver for a flexible BMS platform. The driver has reached a stable stage for configuring key charging parameters and monitoring battery behavior. Future development will focus on diagnostics, energy efficiency, and broader battery compatibility.