

MSP430 for Battery Management of Portable Devices

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Agenda

- Introduction
- Issues of Battery Management
- Architecture of Battery Management
- Peripheral Control of Potable Device
- Interface to Host System
- Advantages of using MSP430
- Conclusion

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Introduction

- Batteries are power sources of portable devices
- Management of the battery to achieve maximum power usage and system reliability
- Reasonable user battery information
- Integration of Peripheral Control
- Share the system operation loading

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Issues of Battery Management

- Synchronizing of Charger and Gas Gauge
- USB charging current select
- Charging status LEDs control
- Battery management in system suspension
- Interface to host system
- Battery low alarm
- Second layer protection of battery

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Synchronizing of Charger and Gas Gauge

- Tapper current is the parameter to determine the charging condition to be “full”
- The tapper current setting on charger and gas gauge are different
- Tapper current setting of gas gauge should be larger than charger
- There should be a controller to read the data of gas gauge to terminate the charging of charger

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USB charging current select

- USB charging current has 100 mA and 500 mA to be selected
- When system is off, it does not allow the use of the USB power as the power source

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Charging Status LEDs Control

- Due to the synchronization issue, the charging LEDs can not be controlled by the charger independently
- LED display pattern is determined by customer
- There may be other LED status needs to integrate

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Battery Management During System Suspended

- As the host system is suspension, there should be another controller to monitor the battery charging and discharging status
- As system is in low battery condition, it should inhibit the system from being activated

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Interface to Host System

- HDQ is the interface of gas gauge.
- HDQ is time dependent interface. It is not efficient to be read by the host CPU.
- A bridge is needed to transfer the HDQ interface to I2C.

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Battery Low Alarm

- In portable devices, single celled Li-Ion battery is used most commonly
- The 0% capacity reported by gas gauge is about 3 Volts
- 3 Volts can not be used by the system
- There should be an algorithm to do the translation of real capacity to display capacity

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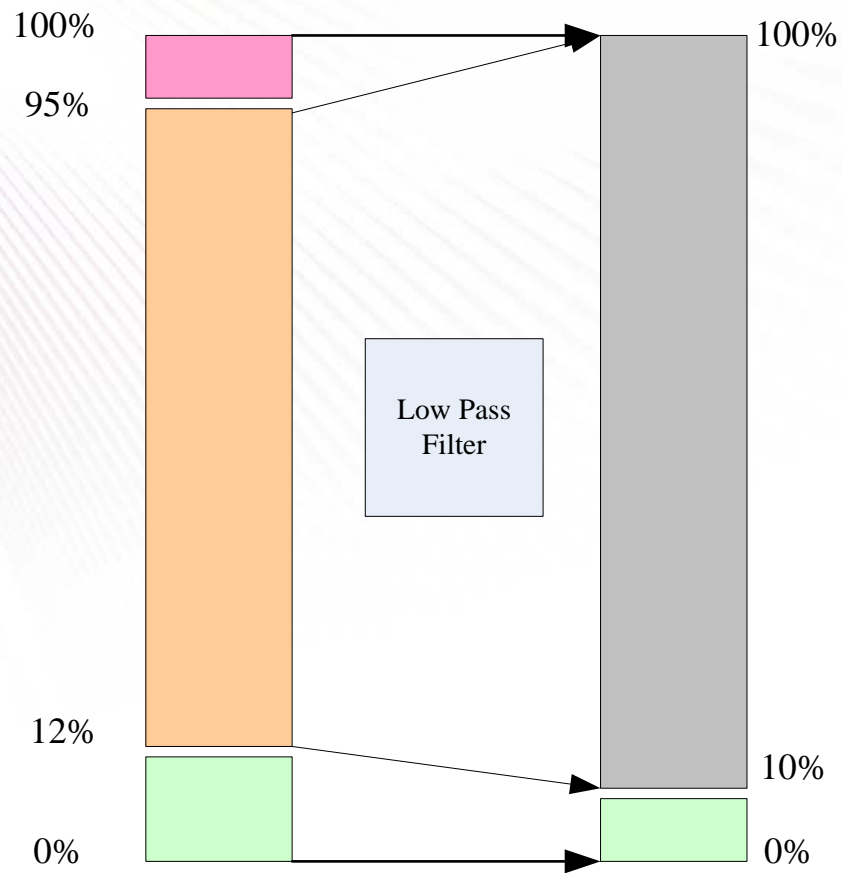
Second Layer Protection of Battery

- Over and under temperature charging control
- Charging time out control
- Charging status report
 - Battery full
 - Battery low alarm
 - Over temperature
 - Charging
 - Battery fault

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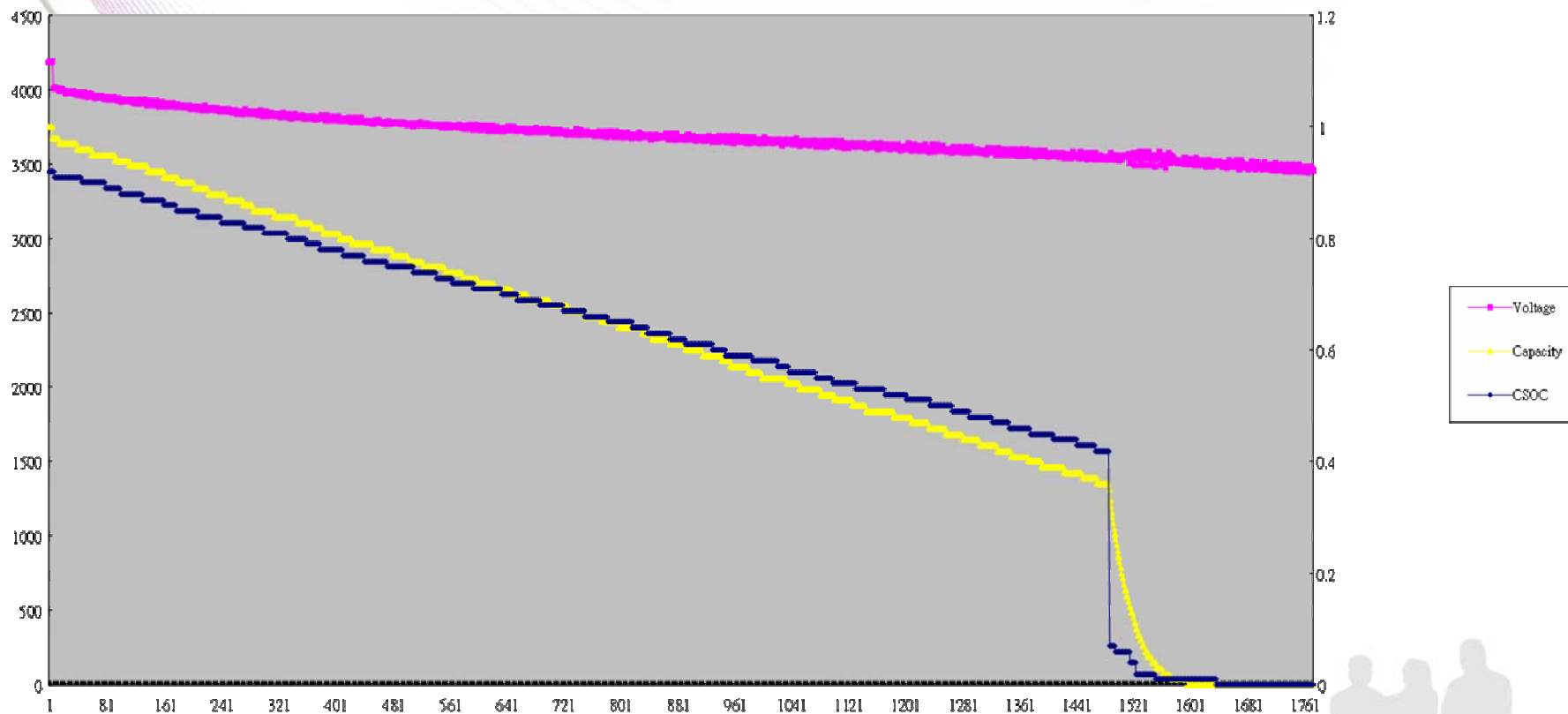
Battery Capacity Translation



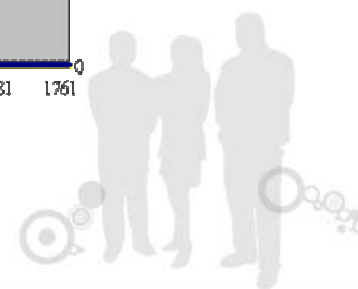
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Sample of Capacity Data



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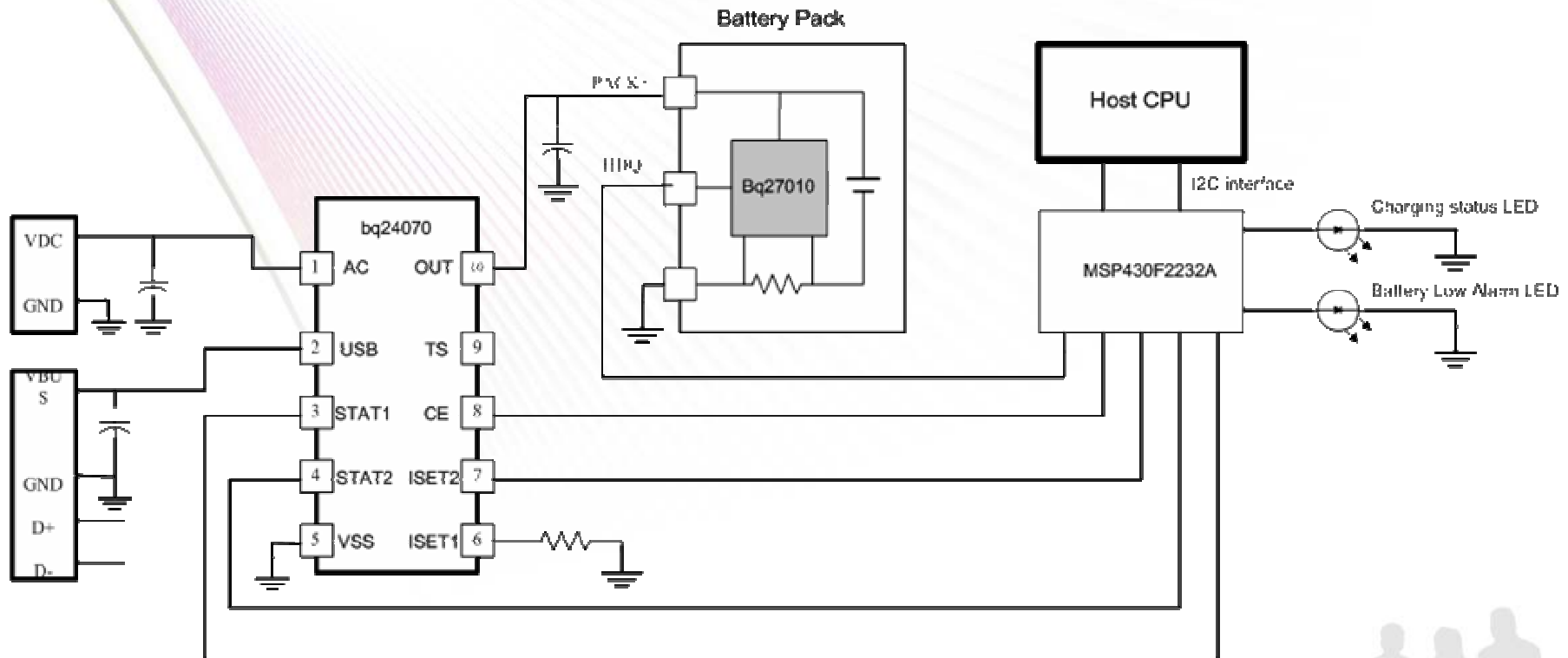
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Block Diagram of Battery Management

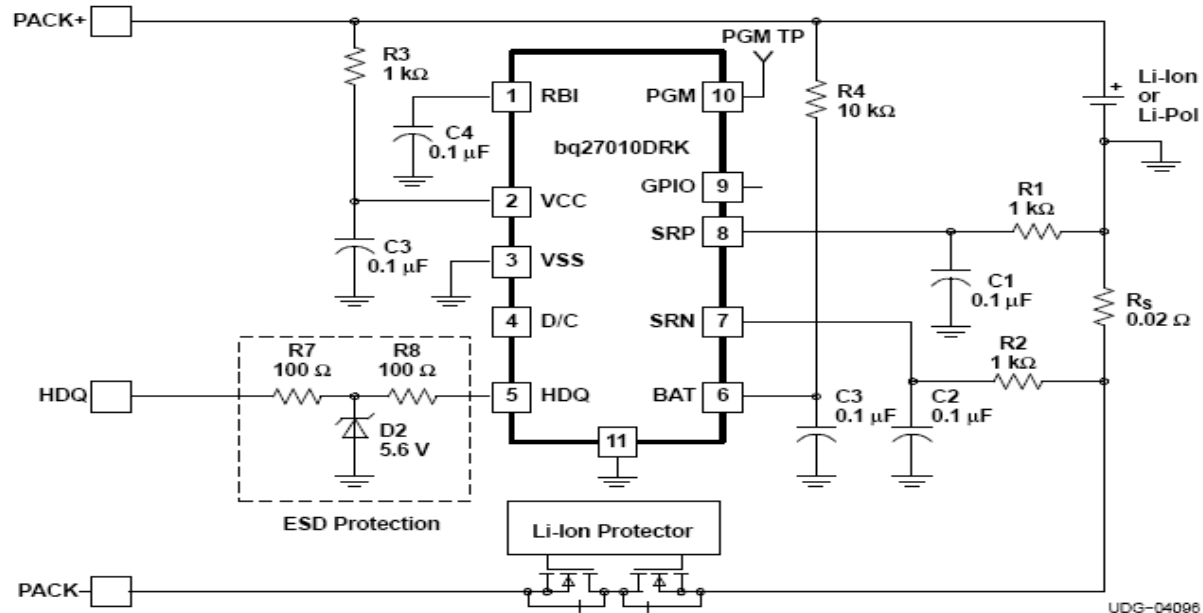


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bq27010

- Bq27010 is highly accurate stand-alone single-cell Li-Ion and Li-Pol battery capacity monitoring and reporting device targeted for portable application

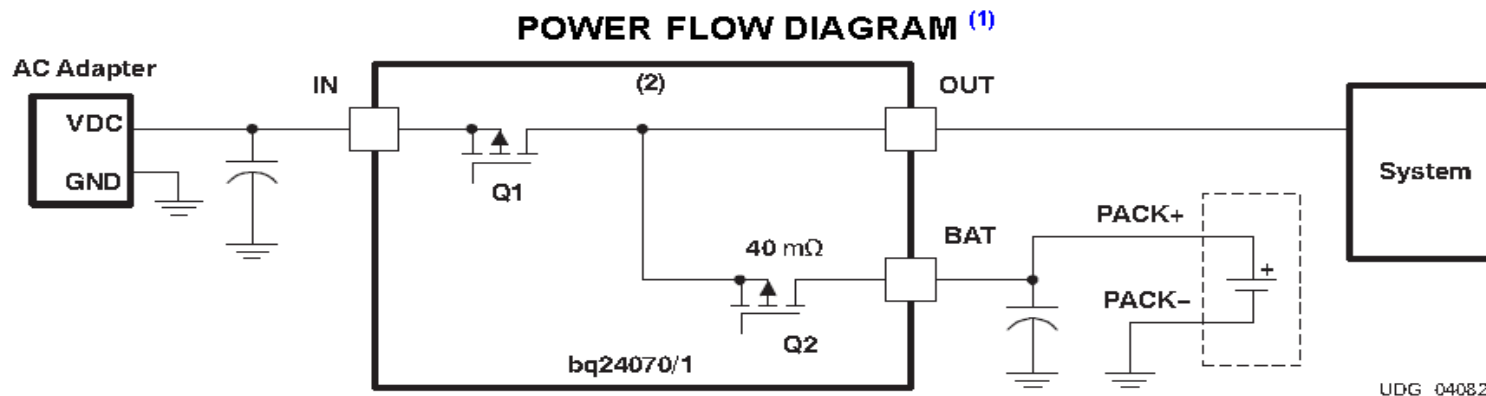


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bq24070

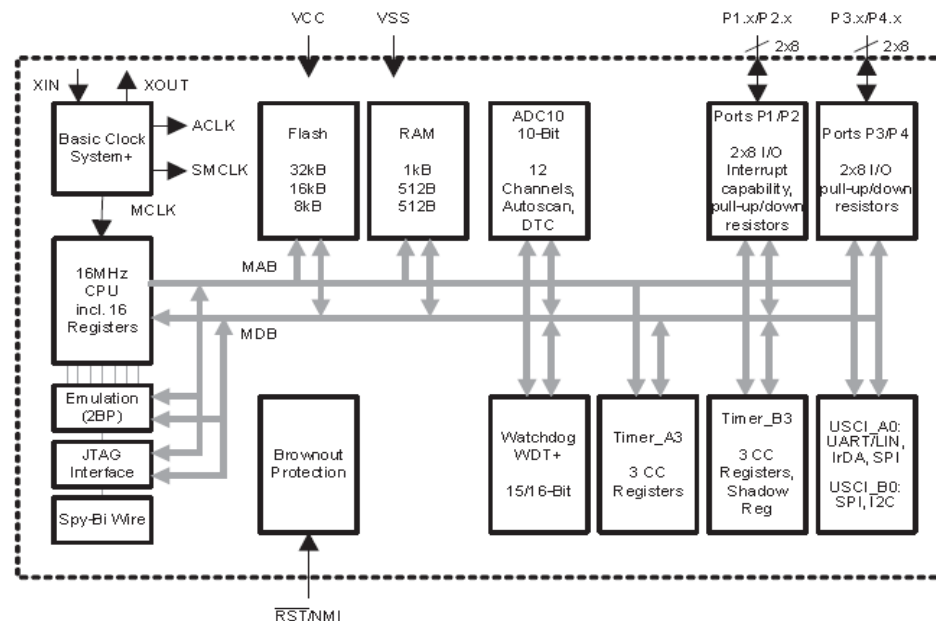
- Bq24070 is a linear charger which integrate the Dynamic Power-Path Management (DPPM) , current sensor, and FETs.



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MSP430F2232

- The MSP430x22xx series is an ultra low-power mixed signal microcontroller with two built-in 16-bit timers, a universal serial communication interface, hardware I2C, 10-bit A/D converter and 32 I/O pins.



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Peripheral Control

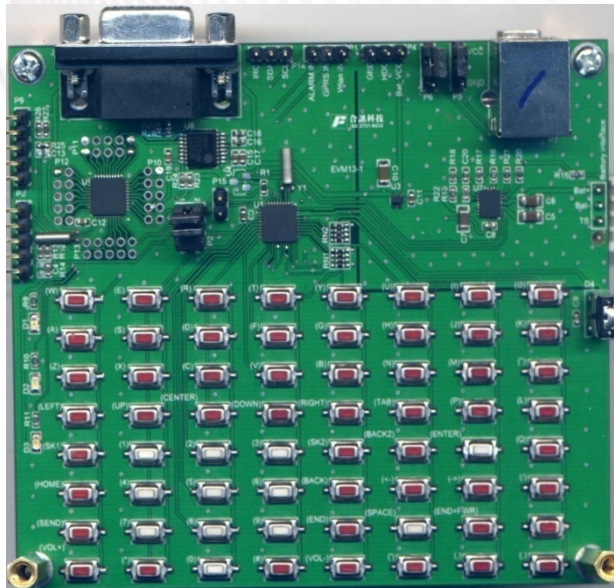
- Additional function
 - QWERTY key function
 - CIR function
 - Backlight LED control
 - Status LEDs control
 - RTC function
 - I/O extension
 - Power sequence control
 - Cap sense touch key function

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Evaluation Board

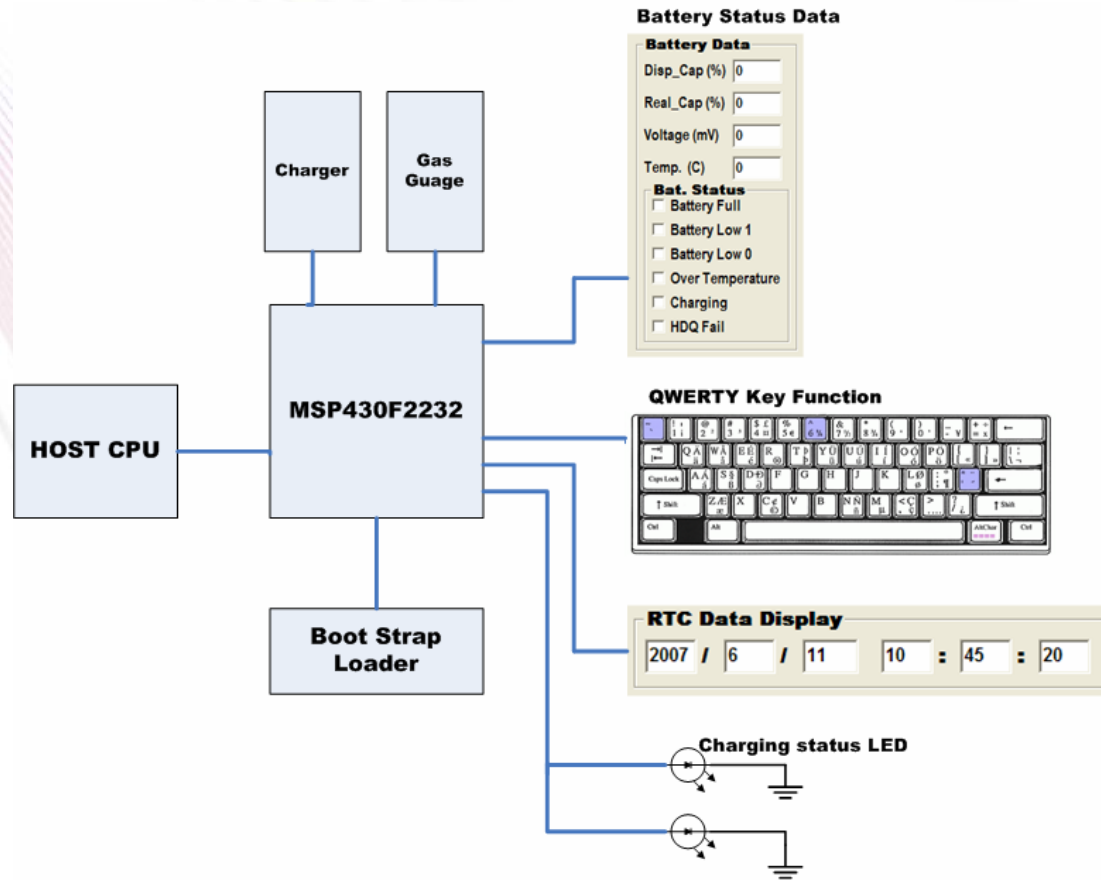
- Host system simulated
- I2C interface to host
- Bq24070 charger, CIR, RTC, QWERTY key, status LEDs functions on board



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MSP430 as Keyboard Controller



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Interface to Host System

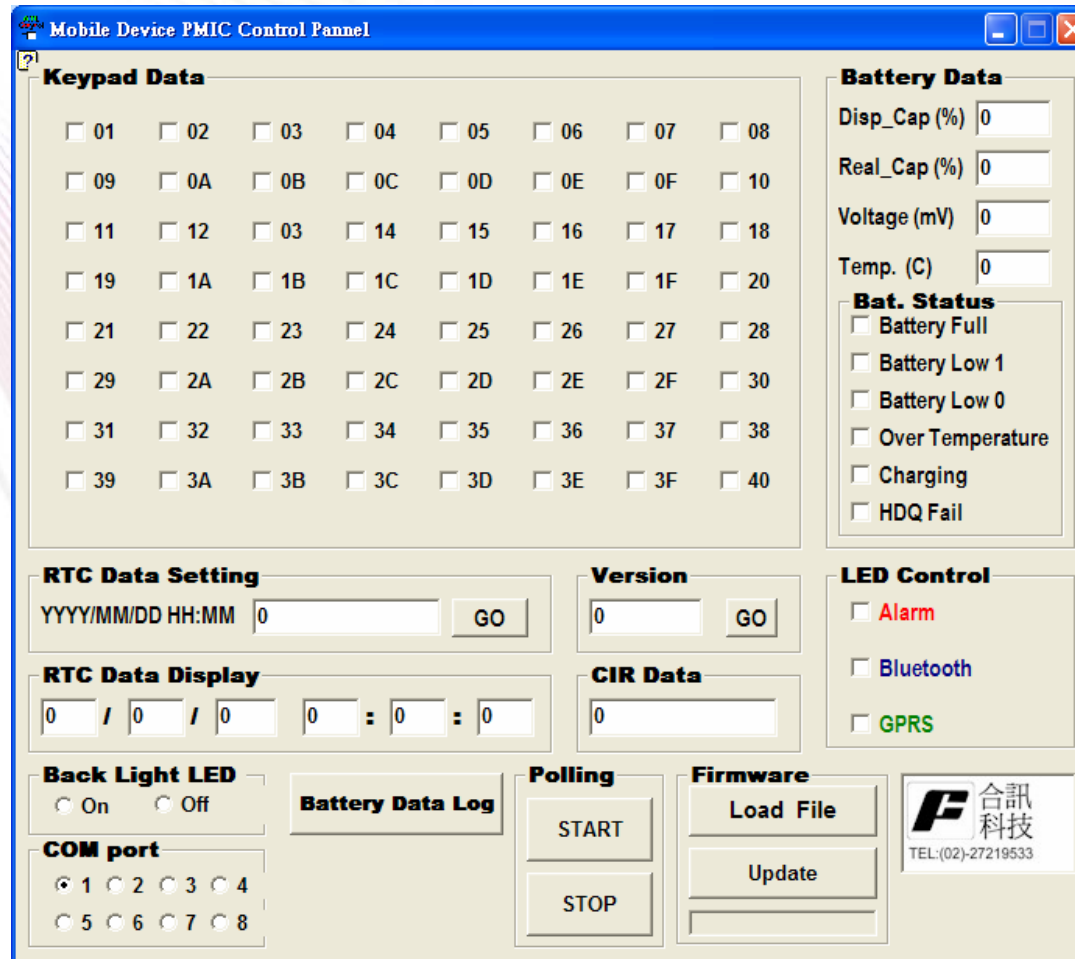
- Via I2C interface to Host system
- Update the firmware code via I2C
- I2C's command list

Command	Address	*R/W	Command	Data
<i>Status Command</i>				
Status Read command	0x16	WO	0x01	Dummy Data (2) Bytes
Status data read	0x16	RO	0x01	Status (2) Bytes
<i>Display Battery Capacity Command</i>				
Display Capacity Read Cmd.	0x16	WO	0x02	Dummy Data (2) Bytes
Display Capacity Data Read	0x16	RO	0x02	DispCap (1) Byte + Dummy Data (1) Byte

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PC GUI of Evaluation S/W



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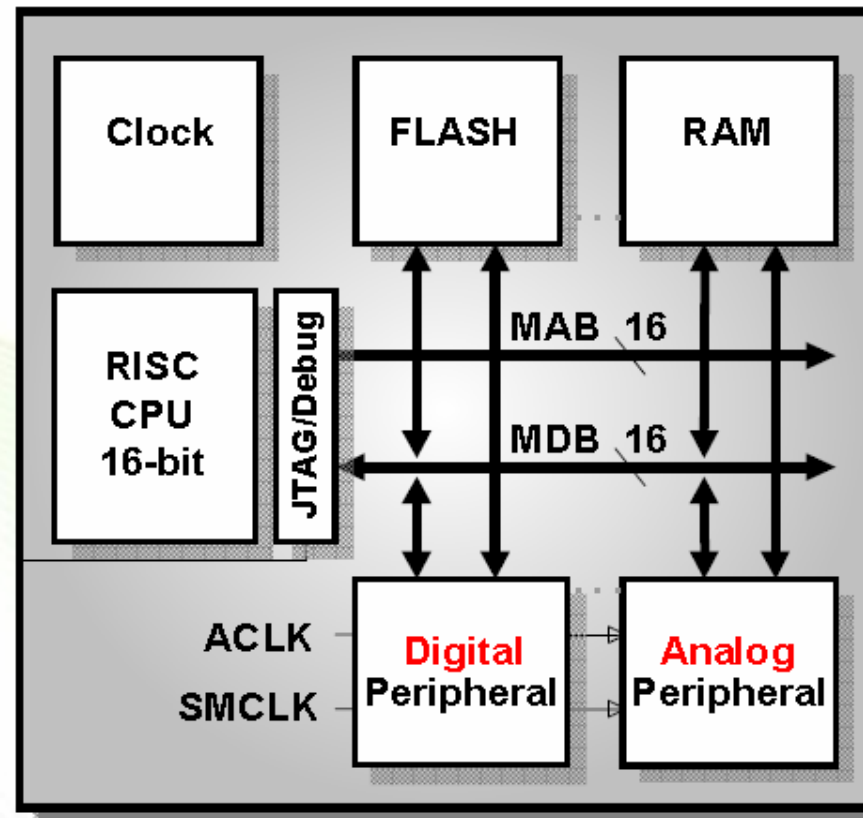
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Advantage of Using MSP430

- MSP430 is Ultra-low Power
 - 0.1uA power down
 - 0.8uA standby mode
 - 250uA / 1MIPS
 - <1us clock start-up
 - <50nA port leakage
 - Zero-power BORs very low
- Ultra-Flexible
 - 1k-128kB ISP Flash
 - 14-100 pin options
 - USART, I2C, Timers
 - 10/12/16-bit ADC
 - DAC, OP Amp, LCD driver
 - Embedded emulation



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Conclusion

- MSP430 is an ultra low power and ultra flexible MCU and is suitable for the battery management application of portable devices
- Battery management and peripheral control function that are integrated are like a keyboard controller of NB
- MSP430 share the host CPU loading and power to extend the battery life and enhance system performance
- Specific battery management algorithm is to optimize battery performance

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Thanks!

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