Application Brief

How Does MSPM0H321x Fit into Battery Power Adapters?

Introduction

Battery power adapters are essential components in various applications, including power banks, portable chargers, and smart wall adapters. These devices require not only efficient power management but also intelligent control and monitoring capabilities. The MSPM0H321x family of microcontrollers (MCUs), based on the Arm® Cortex® -M0+ core, is preferred for such applications. This article explores how the MSPM0H321x can be integrated into battery power adapter designs and outlines typical application scenarios.

MSPM0H321x Introduction

The MSPM0H321x operates within a supply voltage range of 4.5V to 5.5V, allowing for direct compatibility with standard 5V adapter rails. The extended temperature range of –40°C to +125°C verifies reliable operation in diverse environments, making the device preferred for both consumer and industrial applications.

The device family provides up to 64KB embedded flash program memory with 8KB SRAM, which can cover most memory requirement in power adapters. These MCUs incorporate a high-speed on-chip oscillator with an accuracy up to ±1.5%, eliminating the need for an external crystal.

The MCU also includes a high-performance ADC capable of handling up to 27 external channels. With sampling rates of 1.7Msps at 10 bits or 1.5Msps at 12 bits, the MCU provides precise measurements for battery voltage and current, and ambient temperatures.

With up to 18 PWM outputs distributed across advanced and general-purpose timers, the MSPM0H321x is capable of efficiently driving synchronous buck and boost converters. This feature is crucial for maintaining stable power output in variable load conditions, verifying performance.

The MSPM0H321x offers robust communication options, including three UART, two I²Cs, and one SPI. These interfaces allow the MCU to communicate effectively with external components, such as PD controllers, battery fuel gauges, and flyback controllers, enhancing the overall functionality of the power adapter.

Power Adapter Category

Commonly, there are two kinds power adapters from the high level side, as shown in Figure 1. All of the power adapters translate energy from AC to DC. The difference lies on that whether the adapter directly charges the battery, or charge the battery through a typical charger IC.

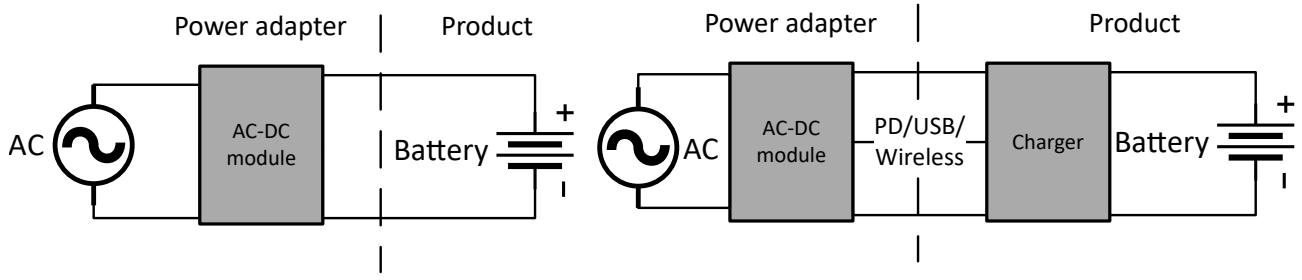

Figure 1. Power Adapter Type

If the adapter directly charges the battery, the output voltage changes to meet the battery requirements, as shown in Figure 2. The adapter performs a trickle charge to check whether the battery is shorted. The adapter performs a pre-charge before the fast charge to avoid causing Lithium ion precipitation, when the battery has performed a deep discharge. After that, the adapter performs a fast charge, which is called the constant current charge (CC phase). When the battery reaches the regulation voltage, the charge current starts to decrease. This part is also called the constant voltage charge (CV phase).

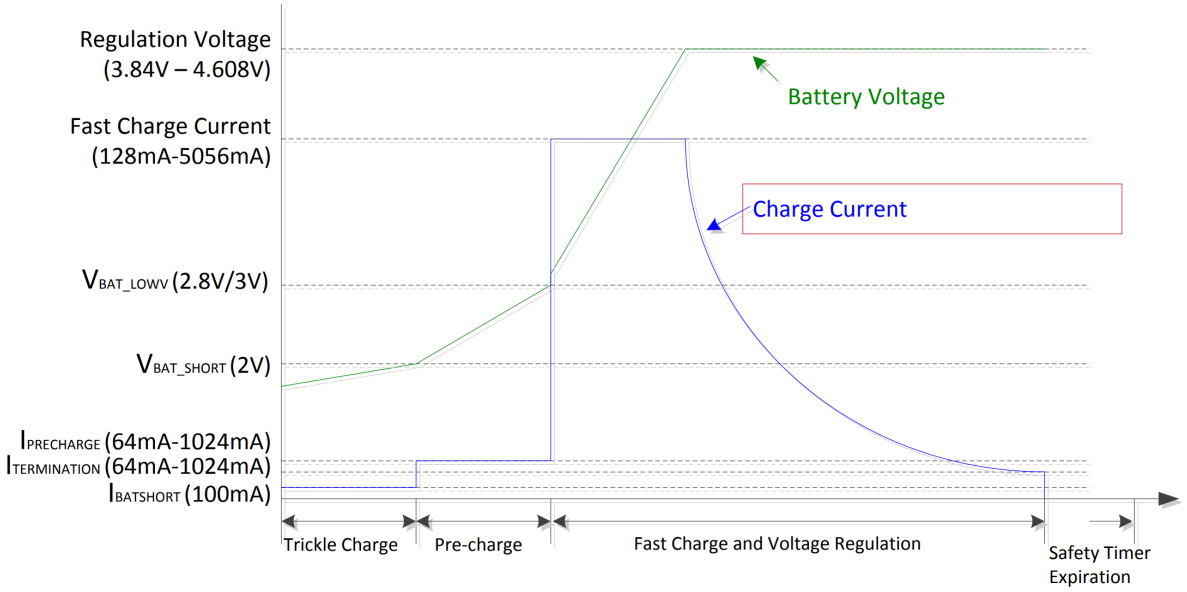

Figure 2. Charge Wave

In another category, this battery charging part is finished by a standalone charger device, with the linear, buck or buck-boost topology. The power adapter only acts as a constant voltage supply. The root cause is that these power adapter must meet the requirements from the standard communication protocols or connectors, such as USB, USB Type C ® and wireless.

In the following sections of this application brief, these two categories and how MSPM0 is implemented is discussed.

Power Adapter with Charging Requirements

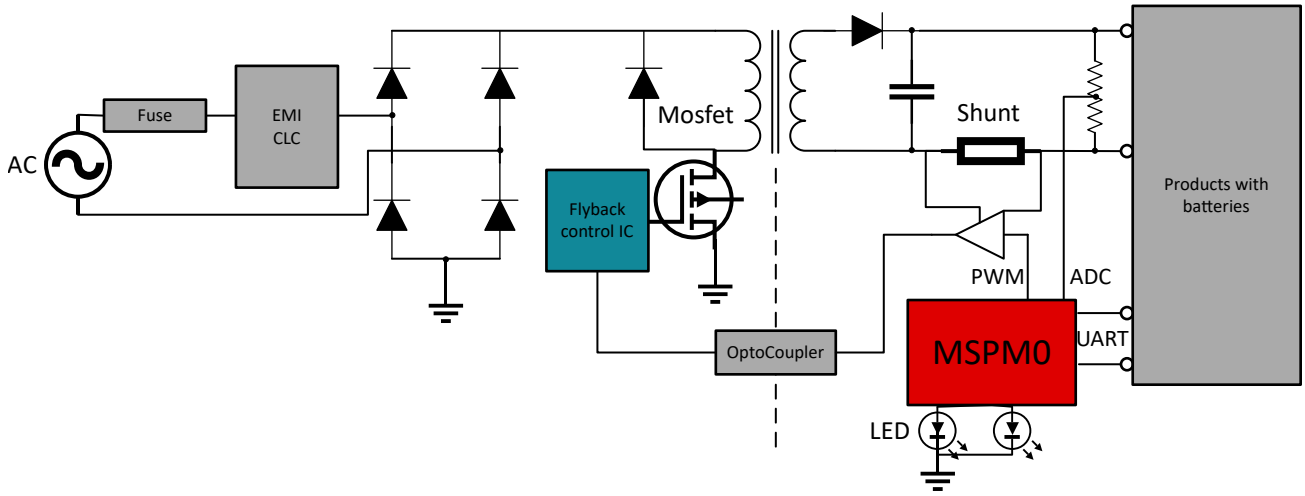

Figure 3. Power Adapter with Charging Requirements

The block diagram is shown in Power Adapter with Charging Requirements, which is commonly seen in some customize charging cases, such as power tools and garden tools. Due to the low power output requirements, such as 100-250W, mostly the adapter uses the flyback topology to realize the power transmission. A flyback control IC is used, paired with a current sensing amplifier. In this design, the main function of MSPM0 is to control the charging loop when the battery turns to CV mode, as shown in Figure 2, through PWM output to reducing the discharge current. In some conditions, the voltage signal is obtained from ADC measurement. In some conditions, if the charging line has large voltage drop, the voltage information is obtained through UART, which is sent by the products with batteries. With this method, the battery can be charged to full power. In addition to these functions, the MSPM0 device can also show the charging status through the LEDs.

Power Adapter without Charging Requirements

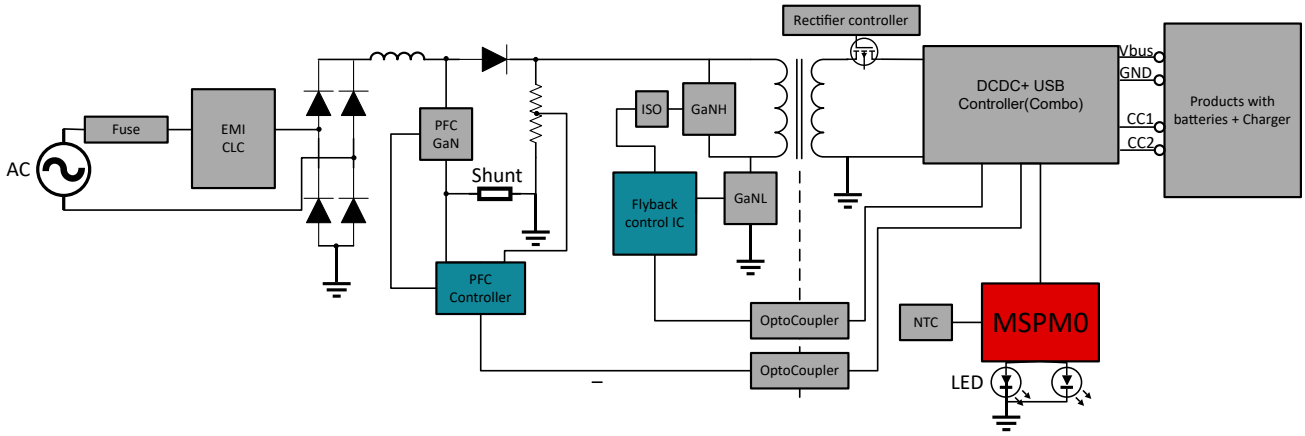

Figure 4. PD Adapter

In power adapters without charging requirements, the most common application is PD adapters for phones or notebooks. The block diagram is shown in Figure 4. If the output power is above 70W, to reduce the harmonic influence on the AC, an PFC is required. To meet the requirement of PD control, the USB PD source controllers are used to control the DC/DC Buck Circuit and PD communication to output the required voltage by the PD source. The number of PD controllers lies on the requirement on the output power and type C ports. To increase product efficiency, GaN is used in PFC and flyback circuit to replace the MOSFET and reverse diode on the primary side of the transformer, and a MOSFET with the rectifier controller is used to replace the diode on the secondary side. In this type of power adapter, MSPM0 is mostly used to perform the NTC, current detection, LED control and controllers' configuration.

Conclusion

The MSPM0H321x microcontroller family offers a compelling combination of performance, power efficiency, and rich peripheral support, making the family preferable for intelligent battery power adapter designs. The PMBus-capable I²C interface, with abundant timers, ADC channels, and low-power modes, enable robust monitoring, control, and communication. Whether developing a smart charger for consumer electronics or a rugged industrial backup supply, the MSPM0H321x provides the building blocks for creating safe, reliable, and feature-rich power designs.

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