A Brief Introduction About Battery Charger ICs

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Abstract- Battery charger ICs and other energy storage devices are becoming increasingly popular. Batteries demonstrate owing performance while maintaining cheap cost, multifunctionality, adaptability, and flexibility due to their inherent characteristics. Battery charger ICs and their applications are discussed in this overview.

I. INTRODUCTION

ICs for battery chargers come in a variety of shapes and sizes. They are utilized to ensure that each battery cell in your application receives the right charge current and voltage. The vast majority of battery chargers are designed to work with lithium-ion batteries, which are commonly used in hand-held devices. The battery charger will keep track of the battery's charging current and voltage and manage the device MOSFET to ensure that pre-conditioning - constant current - constant voltage - cut-off current are the required battery charge operation modes, and the charge current follows them. An external resistor can be used to programmed the maximum charge current, and an NTC connected to the battery will give information about the temperature of the battery to the charger. The charge condition will be indicated by the charge status pins. A 5V supply powers the majority of linear chargers for single cell Li-Ion batteries and are built to handle up to 1A charge currents, making them appropriate for batteries with capacities of up to 1Ah.

Let us consider a Torex charger ICs. They're linear charger ICs that use constant-voltage (CV) and constant-current (CC) charging methods for 1-cell Li-ion and Li-polymer batteries. The following is the order in which their charging cycles are completed: trickle charging, main charging, trickle charging, main charging….

II. BATTERY CHARGER ICs, TYPES AND MANUFACTURING COMPANIES

Integrated circuits (ICs), which have all charging and protection and other circuits together on a chip, that can be used to develop a simplified solution in terms of cost, space, design time for charging batteries are known as battery charger ICs.

2.1 TYPES OF CHARGER ICs

2.1.1 Linear chargers

A linear charger is the only way to reduce the size and complexity of a charger. Using a pass transistor, the linear charger converts the AC adapter voltage to battery voltage (usually a MOSFET, however a bipolar transistor can also be used). In linear chargers, there are far fewer external components: input and output bypass capacitors, an external pass transistor, and voltage and current limit resistors. A voltage-controlled source is used in linear chargers to compel a set voltage to appear at the output terminal. The basic disadvantage of this charger is degradation of power. The charger merely reduces the AC adaptor's voltage to that of the battery, the charging current multiplied by the voltage converter minus the battery voltage equals the pass element power dissipation [1]. For example, the power dissipation of a 1A charger with a 5v±10% regulated AC adapter voltage and a battery voltage ranging from 4.2V to 2.5V might range from 0.3W to 3.0W.

2.1.2 Switch mode Chargers

In terms of power dissipation over a wide range of input and battery voltage changes, switch-mode chargers offer a major advantage over linear chargers. Switch-mode chargers also have the advantage of being able to tolerate a larger range of input voltage than pulse chargers, allowing them to use a smaller and less expensive AC wall adapter. Main drawback of this type of charger are its size and complexity. Because of its external switches and LC filter, the controller uses considerably more board space than other types of chargers. Other drawbacks include EMI and electrical

noise created by the charger's switching motion, as well as radiation from the output filter inductor.
Switching chargers send energy in discrete packets from the input to the batteries using an inductor, transformer, or capacitor. Electrical noise can be easily filtered because to the controller's set switching frequency. However, to avoid interference difficulties, caution must be exercised in circuit design and component selection [1].

2.1.3 Pulse Charger
The pulse charger shares some of the benefits of both switch-mode and linear chargers. A pulse charger, like a switch-mode charger, works effectively. When the battery it's charging has a low voltage, the pass transistor remains active and directs the current from the battery's input source. As the battery voltage approaches the battery regulation voltage, the charger pulses the input current to get the appropriate charging current, hence regulating the battery voltage at the specified voltage limit. The quantity of power dissipated is far lower than with a linear charger since the transistor does not work in this linear area during this part of the charge cycle, but rather acts as a switch.

The variety of IC package types are available for battery charger ICs.

They are
- DUAL IN- LINE PACKAGES (DIPs)

i. ceramic (CDIP) or PLASTIC (PDIP)

- GRID ARRAY PACKAGES INCLUDE BALL-GRID ARRAY (BGA)
- FLIP CHIP BALL GRID ARRAY (FCBGA)
- PLASTIC BALL GRID ARRAY (PBGA)
- MULTI-CHIP MODULE PLASTIC BALL GRID ARRAY (MCM-PBGA)
- TAPE BALL GRID ARRAY
- FINE-PITCH LAND GRID ARRAY (FLGA)
- PIN GRID ARRAY (PGA)
- INTERSTITIAL PACKAGE GRID ARRAY (IPGA)
- CHIP SCALE PACKAGES or CHIP SIZE PACKAGES (CSPs)

i. FLIP CHIP CSP (FCCSP)
ii. wafer-LEVEL CHIP SCALE PACKAGE (WLCSP).

- QUAD FLAT PACKAGES (QFPs)

i. LINEAR QUAD FLAT PACKAGES(LQFP)
ii. THIN QUAD FLAT PACKAGES (TQFP) and
iii. QUAD FLAT NON- LEADED PACKAGES (QFM).

- SMALL OUTLINE PACKAGES (SOP)
- MINI SMALL OUTLINE PACKAGES (MSOP)
- SMALL OUTLINE INTEGRATED CIRCUIT (SOIC)
- SMALL OUTLINE J-LEAD (SOJ)
- SHRINK SMALL OUTLINE PACKAGES (SSOP)
- THIN SHRINK SMALL OUTLINE L-LEADED PACKAGES (TSSOP [1].

2.2 NEED FOR BATTERY CHARGER ICs:
Analog Devices offers a wide range of battery charger IC devices for both wired and wireless applications, including Li-Ion, LiFePO4, lead acid, and nickel-based rechargeable battery chemistry. These high-capacity battery chargers are available in both linear and switching topologies and are totally self-contained. The battery charger ICs we manufacture offer functions like on-chip preconditioning of the battery, current limitation, temperature-controlled charging, monitoring and protection, telemetry with SMBus or I2C interface, and support for high voltage, multiple-cell, and multiple-chemistry batteries. ADI's battery chargers can aid with lithium-ion battery monitoring, PV cell energy harvesting, industrial monitoring, wearable gadgets, and other portable equipment, to name a few.

2.3 MANUFACTURING COMPANIES OF BATTERY CHARGER ICs:
Manufacturers of Battery Control ICs are listed below.
- Battery Chargers from Analog Devices Inc.
- Battery management IC from Atmel - SPI control interface, SIM interface
- Battery Charger Regulator ICs from Champion Microelectronic Corp.
- Battery Charger for Notebook Computers by intersil.
- Battery Management ICs from Maxim - Battery Switch Over
- LiIon Battery Charger IC from Micrel Semiconductor.
- Battery Management ICs with SMbus Interface from Microchip.
- Mitsumi Integrated Circuits for Lithium-Ion Battery Protection and Control.

- MEGHA TRADERS {Trader & Distributor Of DVD Rome & Secondary Battery}
- MAYUKA POWER PRODUCTS PRIVATE LIMITED
- Battery Monitoring ICs - Switching Converter Devices by National Semiconductor.
- Charge Controllers - Protection ICs from ON Semiconductor.
- Battery Control ICs from Texas Instruments "TI" provide charger protection, lithium-ion protection, and battery charge gauge.

2.4 LATEST RELEASES, SPECIFICATIONS, AND APPLICATIONS

2.4.1 LATEST RELEASES FOR BATTERY CHARGER ICs

1BQ25306: A single cell and dual cell battery charger with a voltage of 17V and a current of 3A.

Description of BQ25306

The BQ25306 is a single-mode battery charger for 1- and 2-cell lithium ion, Li polymer, and LiFePO4 batteries. It has a 4.1-V to 17-V input voltage range and a 3-A rapid current draw. The device's integrated current sensing architecture allows for great charge efficiency and a cheap BOM cost. The device's best-in-class 200-nA low quiescent current saves battery. It saves energy and extends the shelf life of portable electronics. The BQ25306 comes in a 3x3 WQFN format for convenient 2-layer configuration and little space applications.

Features of BQ25306:

- It is a standalone charger and easy to configure.
- It is having High efficiency and frequency of 1.2-MHz, synchronous switch mode buck charger.
- High integration.
- Single input to support USB input and high voltage adaptors.
- Charge accuracy.
- ±0.5% charge voltage regulation.
- ±10% charge current regulation.
- It is available in WQFN 3x3-16 package.

Applications:

- Wireless speaker
- Gaming
- Cradle charger
- Medical

Specifications	BQ25302	BQ25306
Battery cells in series	1 cell	1-2 cell
Input voltage	4.1V to 6.2V	4.1V to 17V
Charge voltage	4.1V, 4.35V, 4.4V, 4.2V	Programmable from 3.4V to 9.0 V
Maximum fast charge current	20A	3.0 A
Battery temperature protection (JEITA or Cold/Hot)	Cold/Hot	Cold/Hot

I2C-Controlled, 1-4 Cell, 5-A Buck-Boost Battery Charger with Dual-Input Selector and USB PD 3.0 OTG Output (BQ25790).

Description:

The BQ25790 is a fully integrated switch-mode buck-boost charger for 1-4 cell Li-ion battery and Li-polymer battery. The integration includes 4 switching MOSFETs (Q1, Q2, Q3, Q4), input and charging current sensing circuits, the battery FET (QBAT) and all the loop compensation of the buck-boost converter. It provides high power density and design flexibility to charge batteries across the full input voltage range for USB Type-C™ and USB power delivery (USB-PD) applications.

Features:

- Highly efficient synchronous Switch Mode buck-boost charger for 1-4 cell battery.
- Support a wide range of input sources.
- Dual-input power mux controller for source selection.
- High level integration.
- Voltage, current, and temperature are all monitored using an integrated 16-bit ADC.
- High accuracy.
- Low battery quiescent current.
- *Applications*:

- Smartphone, Tablet, Drone.
- Mobile printer.
- Electronic point of sales (EPOS).
- Wireless speaker, Digital Camera [3].

2.4.2 SPECIFICATIONS OF BATTERY CHARGER ICs:

Battery charger ICs must meet a variety of performance parameters, including the maximum number of cells, supply voltage, quiescent current (IQ), maximum charge current, voltage accuracy, and operating temperature. Battery charger ICs with high supply voltages and quiescent currents are well-suited for batteries with a large number of cells. For both low and high charge devices, the maximum charge current is generally specified in amperes (M). Voltage accuracy is expressed as a percentage variation from a nominal value. The temperature is within the safe operating range. Number of cells-The greatest number of cells that a gadget may charge is this. A cell is a single vessel containing electrodes and an electrolyte for current generation. Two or more cells make up a battery.

Supply Voltage-This is the required input voltage for the charger to work.

Quiescent Current-The quiescent current (IQ) or running current is the amount of current required for the charger to function properly.

Maximum Charge Current-The maximum current that chargers can output is this.

Voltage Accuracy-The accuracy of the voltage is represented as a percentage of the nominal value

Temperature of Operation-This is the whole Region of ambient operating temperature that is necessary.

2.4.3 APPLICATIONS OF BATTERY CHARGER ICs:

The MP2639A is a battery charge management IC that uses a 5V power source to charge two cells in parallel. USB ports are widely used by portable devices due to its universal interoperability and lower e-waste of in-box power sources. Due to its functional diversity, control flexibility, and high dependability, the MP2639A charging IC from Monolithic Power Systems (MPS) is ideal for a variety of applications, including electrical point-of-sale (POS) machines, Bluetooth speakers, electronic cigarettes, power banks, and so on.

The MP2639A charger ic has a number of complex characteristics, including:

Charging or discharging in both directions is possible.
For two-series cell charging, cell balance and protection escorting are required.
For discharge mode, light-load sensing is used.
Monitoring the current in the battery
Control of the input current and voltage loop
Four LED drivers are used to provide an integrated voltage-based fuel gauge.

2.4.3.1 Bluetooth Speaker

For better music quality and longer battery life, many Bluetooth speakers employ a two-cell battery in series. To charge the 2-cell battery and conform with the 5V USB input, a boost charger, such as the MP2639A, is required. The MP2639A charger ic has configurable input current and voltage restrictions, making it compatible with a variety of power sources.

2.4.3.2 POS Machine

On most point-of-sale (POS) machines, a stepping motor is necessary to print receipts. The stepping motor's driver is powered by two-cell batteries, resulting in a high voltage. As a result, in order to charge the 2-cell battery to 5V USB input compliance, a boost charger is required. By calibrating the voltage drop across the internal resistance of the battery, the MP2639A charger IC can provide a 4-LED capacity indicator or a battery current monitoring output to the microcontroller (MCU) for a more accurate state of charge (SOC).

2.4.3.3 Power Bank:

Because of its bidirectional operation mode, the MP2639A charger ic can also be employed in power applications. The MP2639A can produce a 5V/5A output when set to buck-discharge mode. Simple voltage-based SOC data can be obtained using the 4-LED indicator and IB pin for battery current monitoring.

CONCLUSION

The preceding discussion focuses on the various varieties of Battery Charger ICs, their requirements, the firms that manufacture them, and their applications. Despite the fact that we have a variety of battery kinds, each has its own set of benefits. When we compare the characteristics and specifications of one group of chargers, we find that there are a lot of differences. Each of the battery charger ICs has its own set of benefits.

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