Application Note AN 4110

Charger Control IC for Off-Line Lithium-Ion Battery Charger

1. Charger characteristics of Lithium-Ion Battery

Required characteristics for charging Lithium-ion battery are constant voltage and constant current control. Curves in Fig 1 show the basic charging characteristics for Li-ion battery in terms of time variation.

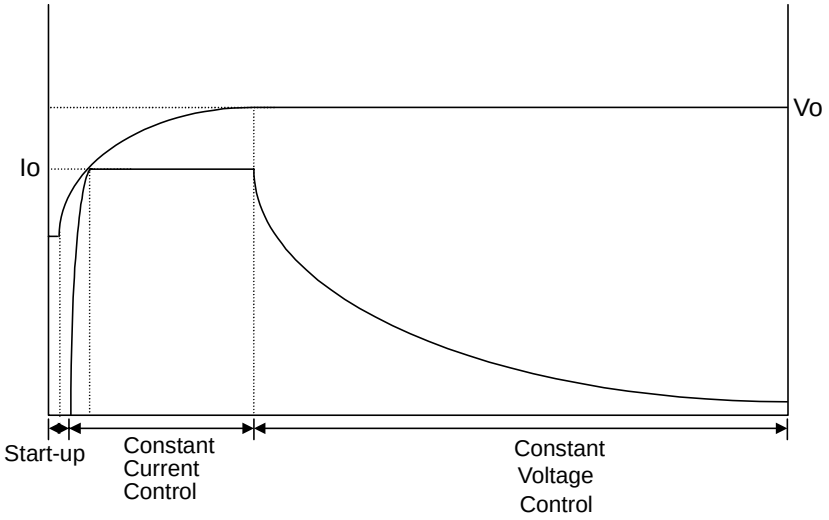

Figure 1. Lithium - Ion Charger

2. Functions of FAN7563/4

FAN7563 (FAN7564) was carefully designed to achieve the required characteristics as follows. FAN7563 has basically three functions, which are voltage sensing for constant voltage, peak charging(load) current sensing for constant current and a charging current monitoring function for the charging state. In addition to these functions of FAN7563, FAN7564 has a LDO driving circuitry with an output sensing terminal and a detection function to guarantee the proper voltage level for an external micro controller.

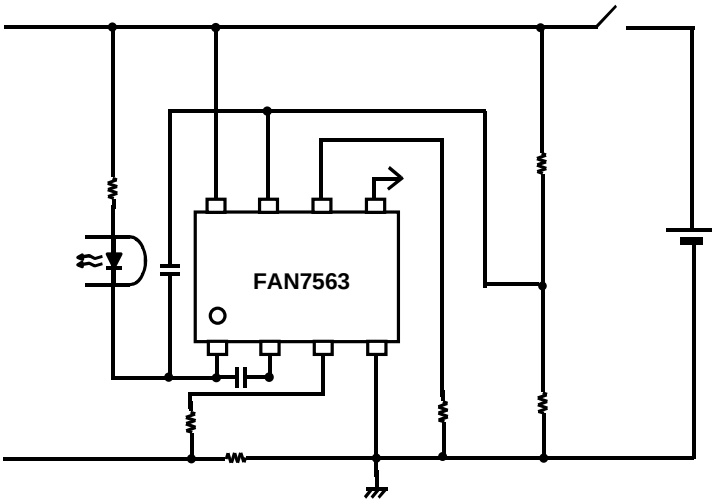

Figure 2. Typical application circuit of FAN7563

Rev. 1.0.2

3. Design method of maximum charging current: limit of max. current

We can easily obtain the constant voltage and current control by applying the very simple external circuit. Fig. 2 shows a typical application circuit for constant voltage and current control, and more details are presented in Fig. 3.
In Fig. 3, we can determine the maximum charging

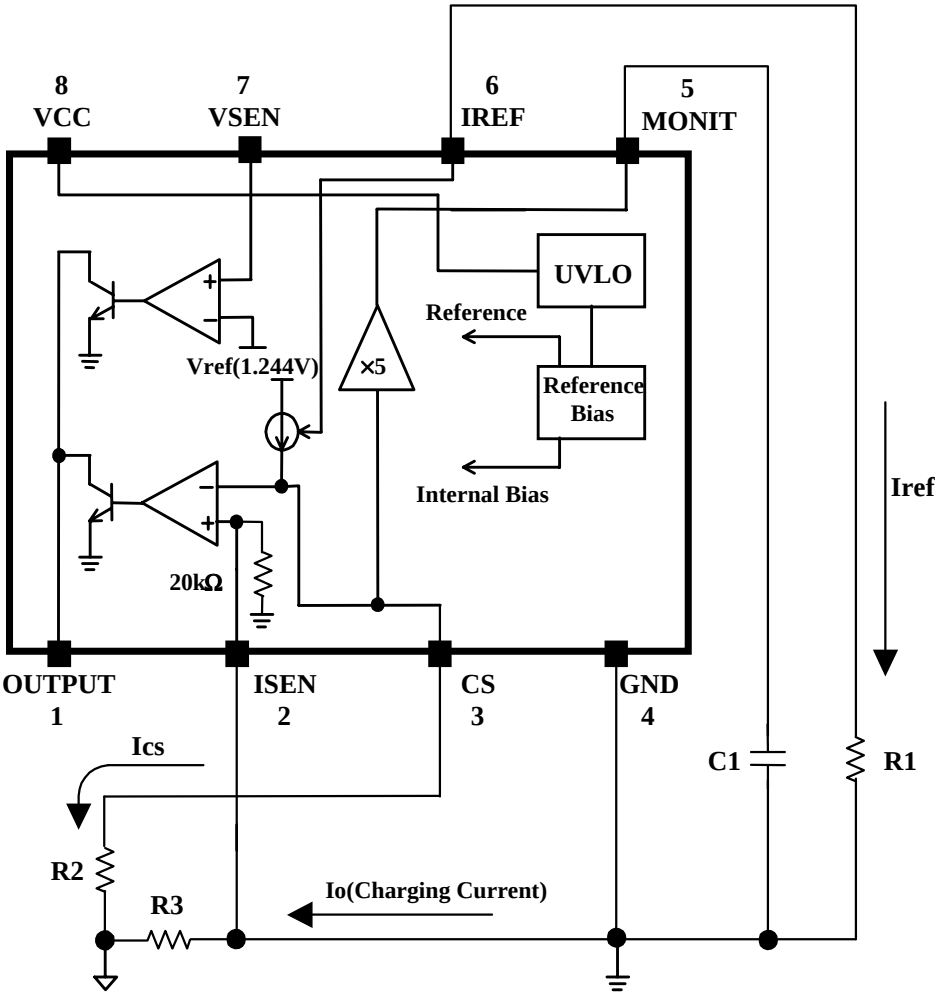

Figure 3. Application circuit for constant current

current from the relationship of the voltage drops on R2 and R3. First, in order to determine the voltage drop on R2, we need to consider the proper value of resistor (R1) to obtain the Iref. The voltage drop on R2 is the multiple of Iref and R2, and this voltage drop is the reference voltage in determining the maximum charging current. If the charging current is increased, the voltage drop on R3 will increase until this voltage is the same as the voltage drop on R2. If the voltage on R3 is slightly higher than the voltage drop on R2, it activates the lower side comparator in Fig. 3, and finally the output terminal will sink the current through an opto-coupler. Followings are equations for determining each value of resistors:

$$Iref = \frac{Vref}{R1}$$

$$Ics = Iref$$

$$Io \cdot R3 = Ics \cdot R2$$

$$So, Io = \frac{Ics \cdot R2}{R3}$$

(Io=Battery charging current, R3=sensing register)

3.1 Additional functions of FAN7564

FAN7564 has more functions as shown below in

addition to the functions of FAN7563.

1. It has a LDO driving circuitry for supply voltage to micro controller.
2. It senses the charging state of battery with external resistors.
3. It senses the supply voltage level of the micro controller.

pin #8 (LDO driving output) provides the supply voltage to the micro-controller with an external PNP transistor, an electrolytic capacitor and three resistors. Pin #9 (ERR) is to sense the condition of supply voltage of micro controller to avoid malfunctioning of the micro controller caused by getting out the range of the supply voltage of the micro controller, which means that, with this function, the micro controller can operate within the adequate supply voltage range. Fig. 4. shows the internal blocks of FAN7564 except the same function blocks of FAN7563.

Vr

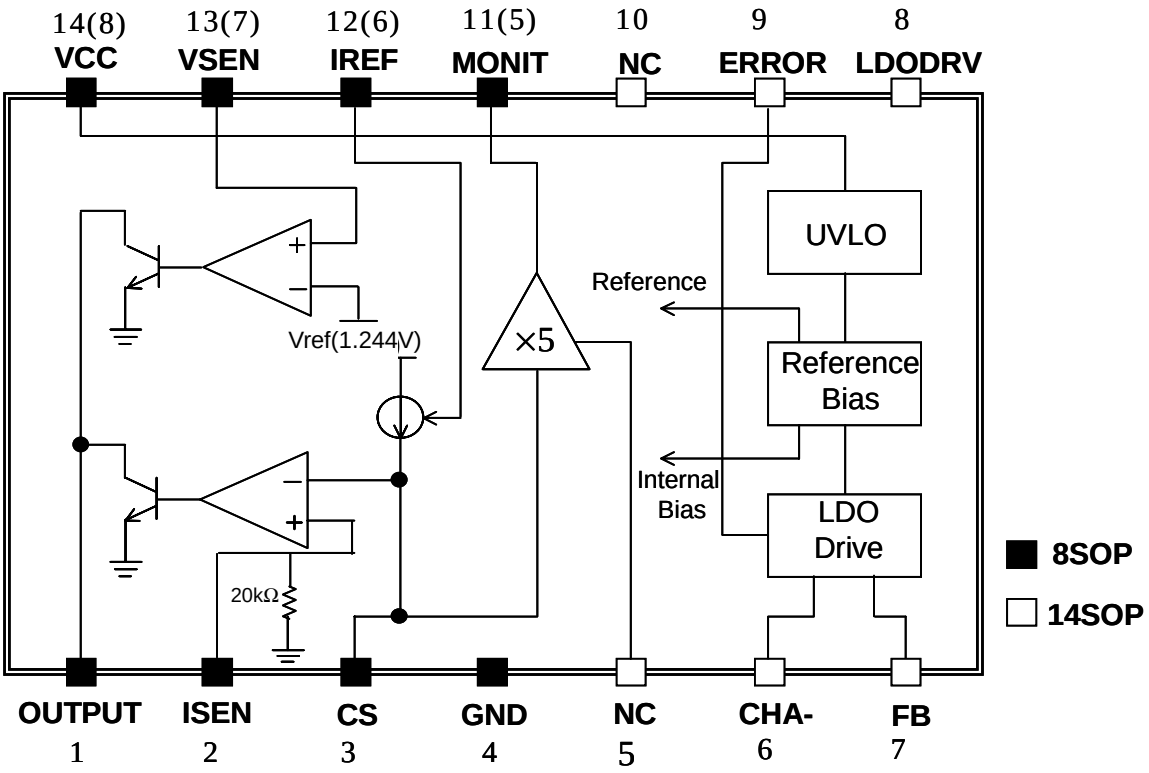

Figure 4. FAN7564 block diagram

Pin # 11 (Moni) has an amplified voltage level, which is five times in comparison with CS voltage level, derived from pin # 3 (CS) of FAN7563, and this voltage level will be used to sense the charging state in the micro controller. Additionally, we can obtain a suitable amplifying ratio in the internal multiplier (×5) if R1 and R2 are properly set.