PSC1534 Lithium-Ion Linear Battery Charger

Features

- Low external component count and small footprint
- Charge termination indication and manual shutdown using PROG pin
- Programmable charge current: 200 mA to 800 mA
- 4.1 V or 4.2 V preset voltages
- Automatic trickle charging at IPROG/10 for heavily discharged batteries requires no additional external components
- Very low quiescent battery current during shutdown and standby (charger removed)
- Charger undervoltage lockout and battery overvoltage lockout
- Overcurrent/overtemperature protection
- Low-profile (1 mm) SOT-23 package

Description

The PSC1534 is a constant-current/constant-voltage Li-Ion battery charger controller that is functionally equivalent and performance equivalent to the *LTC*®1734. As an enhancement, the PSC1534 also includes automatic detection and trickle charging of deeply discharged batteries (VBAT <2.42 V).

The PSC1534 allows charge current programming using a single external resistor, RPROG. The voltage on the PROG pin is proportional to the charging current at the ISENSE pin, allowing the user to use an external A/D to monitor charging progress. A low battery drain (BAT pin) manual shutdown state can be forced by floating the PROG pin. When the input supply (VIN) is removed, the PSC1534 enters a very low-current sleep mode, during which BAT input supply current is <1 µA.

Applications

- Any application that requires a compact, low-cost solution for Li-Ion battery charging

Typical Application

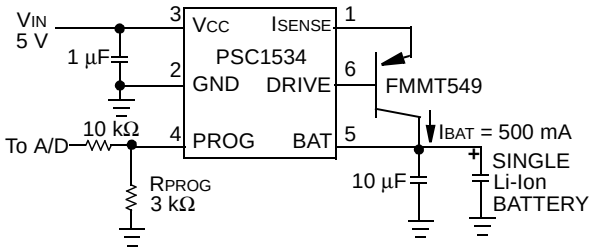


Figure 1. 500 mA Li-Ion Battery Charger

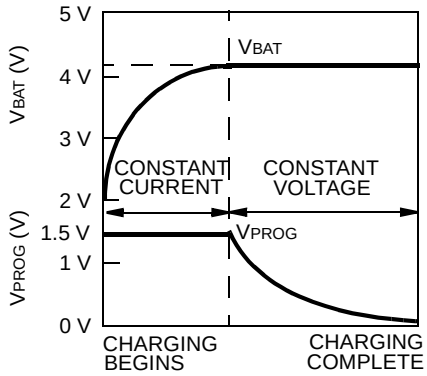


Figure 2. PROG Pin Indicates Charge Status

Block Diagram

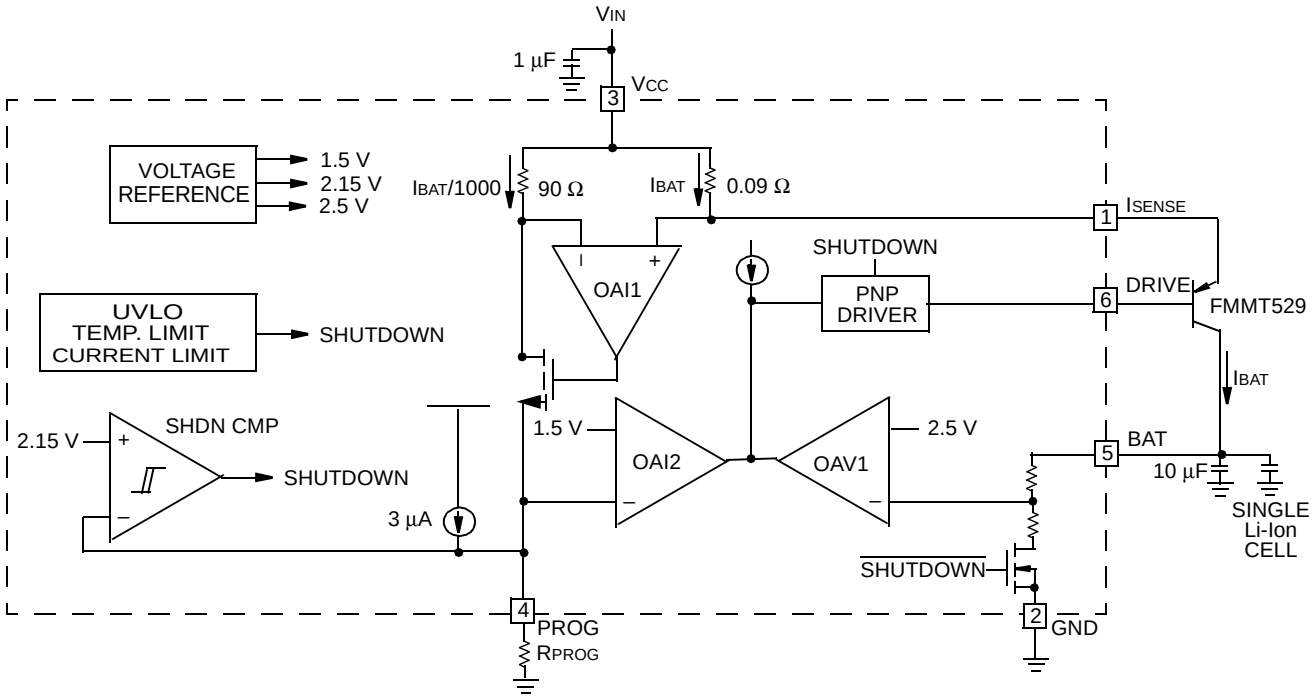


Figure 3. PSC1534 Block Diagram

Pin Information

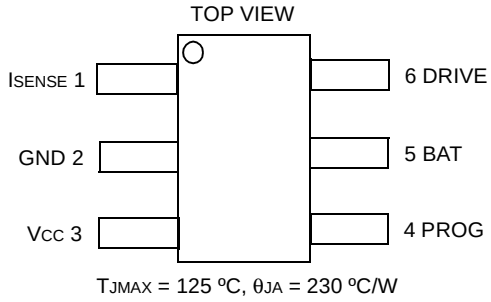


Figure 4. S6 Package, 6-Lead Plastic, 1 mm Thick, SOT-23

Table 1. Pin Descriptions

Pin Number	Signal Name	Type	Description
1	ISENSE	Output	Charging current sense node. Supplies a monitored and controlled current from VCC to the PNP emitter.
2	GND	GND	Ground reference for all internal circuits. Kelvin connects battery ground to GND to minimize battery top-off voltage error.
3	VCC	Supply	Positive input supply for all internal circuits and external charging current (PNP emitter). The internal charging current control loop monitors and controls the current flow between VCC and ISENSE. Bypass this pin to GND with a 1 µF to 10 µF tantalum capacitor.
4	PROG	I/O	Charge current programming pin. Use an external resistor, RPROG, to set current-mode charging current. ICHRG = 1.5 V/RPROG. If the voltage on PROG exceeds 2.15 V, the PSC1534 enters manual shutdown mode. This pin can be monitored by an external A/D converter.
5	BAT	I/O	Battery voltage sense input. Bypass this pin with a 10 µF tantalum capacitor close to BAT and GND.
6	DRIVE	Output	Output base driver for PNP transistor. This driver output is current limited and monitored by an internal thermal shutdown circuit that will disable the driver if high-current fault conditions occur.

Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute maximum ratings for extended periods can adversely affect device reliability.

Table 1. Absolute Maximum Ratings*

Parameter	Value	Unit
Supply Voltage (V_{CC})	–0.3 to +6.5	V
Input Voltage (BAT, PROG)	–0.3 to (V_{CC} + 0.3)	V
Output Voltage (DRIVE)	–0.3 to (V_{CC} + 0.3)	V
Output Current (I_{SENSE})	–900	mA
Short-circuit Duration (DRIVE)	Indefinite	—
Junction Temperature	125	°C
Operating Ambient Temperature Range†	–40 to +85	°C
Operating Junction Temperature†	100	°C
Storage Temperature Range	–65 to +150	°C
Lead Temperature (soldering, 10 s)	300	°C

* Absolute maximum ratings are those values beyond which the life of a device may be impaired.
† Some electrical characteristics are guaranteed by design and statistical process control.

Electrical Characteristics

In Table 2, specifications are at T_A = 25 °C. V_{CC} = 5 V, GND = 0 V, and V_{BAT} = V_{FLOAT} unless otherwise noted. **Bold** text highlights the specifications that apply over the –40 °C to +85 °C operating temperature range.

Table 2. Electrical Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Vcc Supply					
Operating Supply Range*	—	**4.55**	**—**	**6.0**	V
Quiescent V_{CC} Pin Supply Current	V_{BAT} = 5 V, (forces I_{DRIVE} = I_{BAT} = 0), I_{PROG} = 200 µA, (7500 Ω from PROG to GND)	—	**550**	**1150**	µA
V_{CC} Pin Supply Current in Manual Shutdown	PROG pin open	—	**350**	**900**	µA
Battery Drain Current in Manual Shutdown†	PROG pin open	**–2**	**0.2**	**2**	µA
Battery Drain Current in Sleep Mode‡	V_{CC} = 0 V	**–2**	**0.2**	**2**	µA
Undervoltage Lockout Exit Threshold	V_{CC} increasing	**4.45**	**4.56**	**4.68**	V
Undervoltage Lockout Entry Threshold	V_{CC} decreasing	**4.30**	**4.41**	**4.53**	V
Undervoltage Lockout Hysteresis	V_{CC} decreasing	—	150	—	mV
Charging Performance					
Output Float Voltage in Constant Voltage Mode	4.1 V version, I_{BAT} = 10 mA, 4.55 V ≤ V_{CC} ≤ 5.5 V, 4.2 V version, I_{BAT} = 10 mA, 4.55 V ≤ V_{CC} ≤ 5.5 V	**4.059** **4.158**	**4.10** **4.20**	**4.141** **4.242**	V V
Output Full-scale Current When Programmed for 200 mA in Constant Current Mode	R_{PROG} = 7500 Ω, 4.55 V ≤ V_{CC} ≤ 5.5 V, pass PNP beta > 50	**155**	**200**	**240**	mA
Output Full-scale Current When Programmed for 700 mA in Constant Current Mode	R_{PROG} = 2143 Ω, 4.55 V ≤ V_{CC} ≤ 5.5 V, pass PNP beta > 50	**620**	**700**	**770**	mA
Current Monitor Voltage on PROG Pin	I_{BAT} = 10% of I_{BAT1}, R_{PROG} = 7500 Ω 4.55 V ≤ V_{CC} ≤ 5.5 V, pass PNP beta > 50, 0 °C ≤ T_A ≤ 85 °C	0.025	0.15	0.30	V
Current Monitor Voltage on PROG Pin	I_{BAT} = 10% of I_{BAT2}, R_{PROG} = 2143 Ω, 4.55 V ≤ V_{CC} ≤ 5.5 V, pass PNP beta > 50, 0 °C ≤ T_A ≤ 85 °C	0.08	0.15	0.22	V
Drive Output Current	V_{DRIVE} = 3.5 V	**30**	—	—	mA

* When operating near minimum V_{CC}, a low $V_{ce\text{-}sat}$ PNP transistor is required.
† External PNP pass transistor has negligible $I_{b\text{-}c}$ when the $V_{b\text{-}c}$ = 0.8 V (V_{CC} – V_{BAT} = 5.0—4.2 = 0.8 V).
‡ External PNP pass transistor has negligible $I_{b\text{-}e}$ when the $V_{b\text{-}e}$ = 4.2 V (V_{BAT} – V_{CC} = 4.2—0 = 4.2 V).

Electrical Characteristics (continued)

Table 2. Electrical Characteristics (continued)

Parameter	Conditions	Min	Typ	Max	Unit
Automatic Trickle Charging					
Trickle Charge Battery Voltage Entry Threshold	V_{BAT} decreasing	**2.32**	**2.42**	**2.52**	V
Trickle Charge Battery Voltage Exit Threshold	V_{BAT} increasing	**2.42**	**2.52**	**2.62**	V
Trickle Charge Battery Voltage Hysteresis	—	—	100	—	mV
Trickle Charge—Charge Current	R_{PROG} = 3000 Ω, 4.55 V ≤ V_{CC} ≤ 5.5 V, pass PNP beta > 50	10	50	90	mA
Charger Manual Control					
Manual Shutdown Threshold	V_{PROG} increasing	**2.05**	**2.15**	**2.25**	V
Manual Shutdown Hysteresis	V_{PROG} decreasing from V_{MSDT}	—	90	—	mV
Programming Pin Pull-up Current	V_{PROG} = 2.5 V	–6	–3	–1.5	µA
Protection					
Drive Output Short-circuit Current Limit	V_{DRIVE} = V_{CC}	**35**	**65**	**130**	mA

† When operating near minimum V_{CC}, a low $V_{ce\text{-}sat}$ PNP transistor is required.
‡ External PNP pass transistor has negligible $I_{b\text{-}c}$ when the $V_{b\text{-}c}$ = 0.8 V (V_{CC} – V_{BAT} = 5.0—4.2 = 0.8 V).
§ External PNP pass transistor has negligible $I_{b\text{-}e}$ when the $V_{b\text{-}e}$ = 4.2 V (V_{BAT} – V_{CC} = 4.2—0 = 4.2 V).

Typical Performance Characteristics

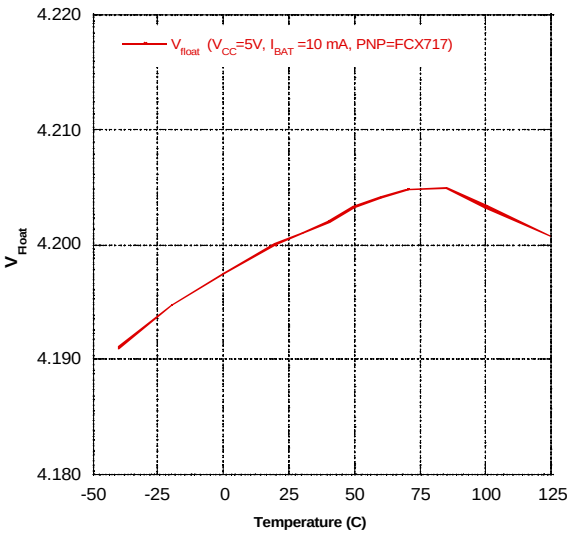


Figure 5. Float Voltage vs. Temperature

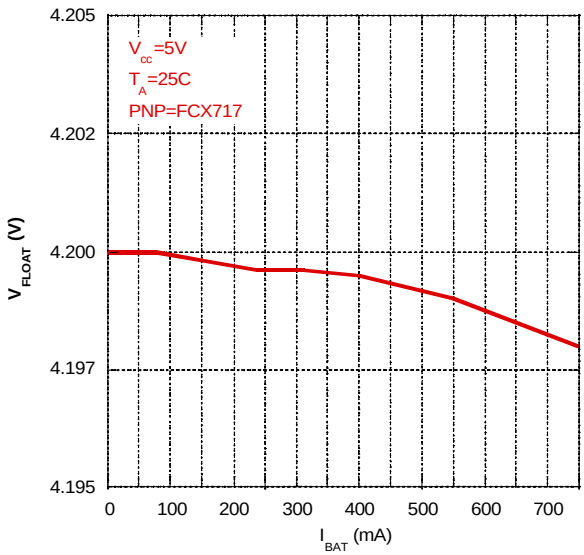


Figure 6. V_{FLOAT} vs. I_{BAT} (R_{PROG} = 2 kΩ)

Typical Performance Characteristics (continued)

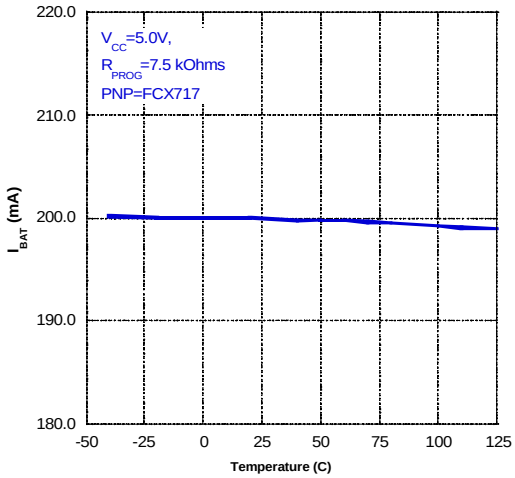


Figure 7. IBAT1 vs. Temperature, RPROG = 7.5 kΩ

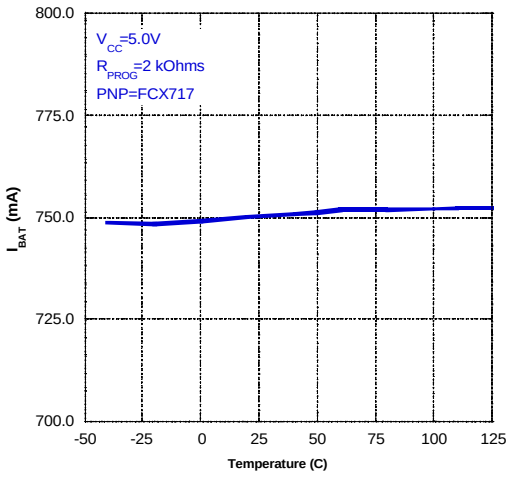


Figure 10. IBAT1 vs. Temperature, RPROG = 2 kΩ

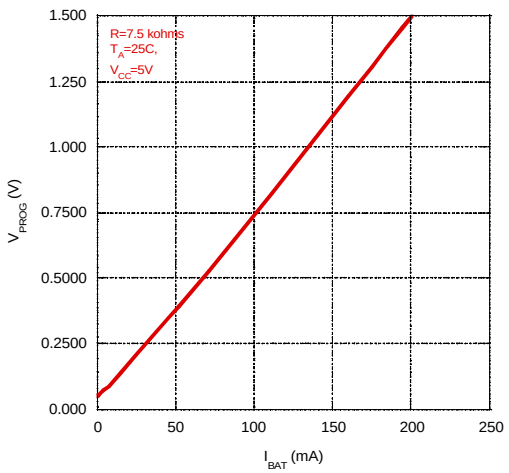


Figure 8. VPROG vs. IBAT1 (RPROG = 7.5 kΩ)

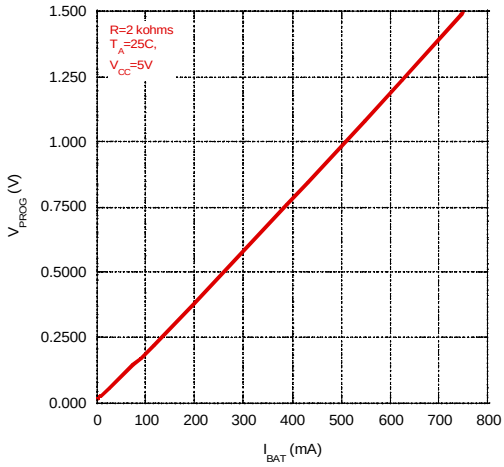


Figure 11. VPROG vs. IBAT (RPROG = 2 kΩ)

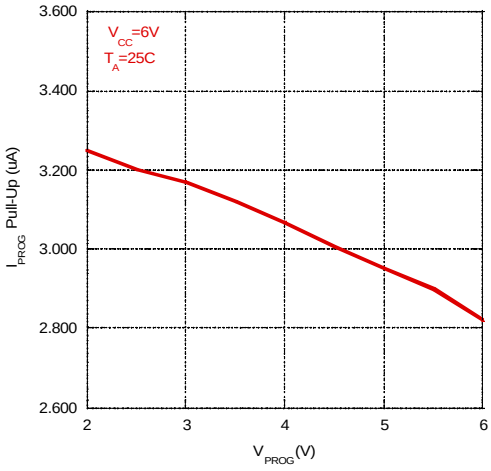


Figure 9. IPROG_PU vs. VCC

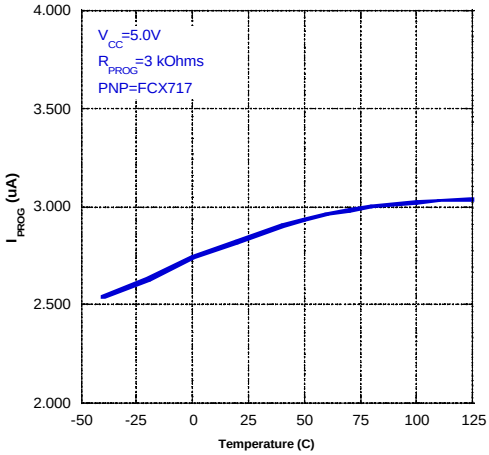
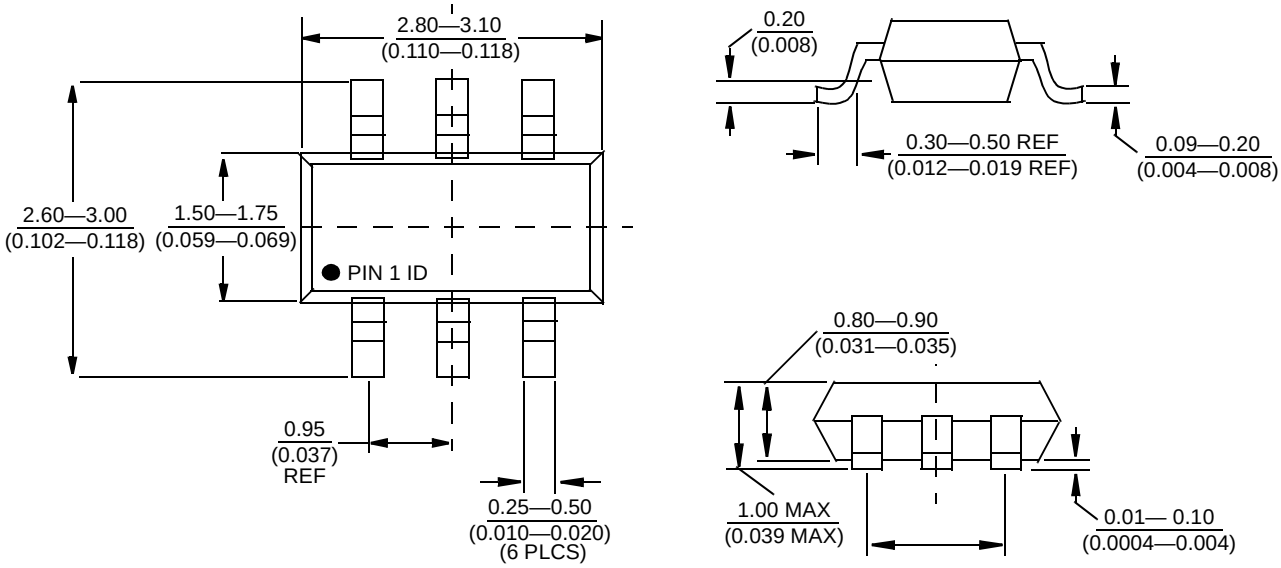


Figure 12. IPROG_PU vs. Temperature

Package Description

S6 Package, 6-Lead Plastic SOT-23

All dimensions are in millimeters.



Ordering Information

Table 3. Ordering Information

Device Version	Part Order Number	SOT-23-6 Package Marking
PSC1534-4.1	700045365	Axxx
PSC1534-4.2	700045383	Lxxx

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