G5803

1A Single Cell Li-Ion Battery Linear Charger

Features

- **No External Power MOSFET, Sense Resistor or Blocking Diode Required**
- **1% Regulation Voltage Accuracy**
- **Programmable Constant Charge Current Limit up to 1A**
- **Automatic Recharge**
- **Complete Pre-Charge, Constant Current, Constant Voltage and Charge Termination Charge Procedure**
- **Support for 5V Power Supply Voltage**
- **Internal Thermal Protection Circuit**
- **SOT-23-5 & SOP-8 (FD) Package**

General Description

The G5803 is a standalone linear Li-Ion battery charger with a complete pre-charge, constant-current and constant-voltage charge loop.

No external power MOSFET, sense resistor and blocking diode is required due to internal power MOSFET architecture. The charge voltage is regulated at 4.2V, and the charge current is programmable by an external resistor. After the final regulation voltage is reached and the charge current drops to 1/10th the programmed charge current, the open drain NMOS $\overline{\text{CHRG}}$ pin would be turn off automatically without terminating the charge loop.

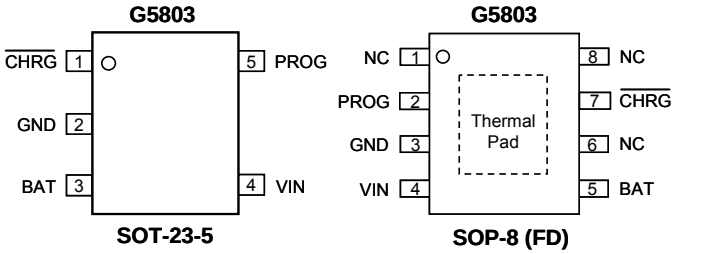
Other features include under voltage lockout, automatic recharge, over temperature protection and a charge status indication pin.

Ordering Information

ORDER NUMBER	MARKING	TEMP. RANGE	PACKAGE (Green)
G5803T11U	5803x	-40°C ~ +85°C	SOT-23-5
G5803F11U	G5803	-40°C ~ +85°C	SOP-8 (FD)

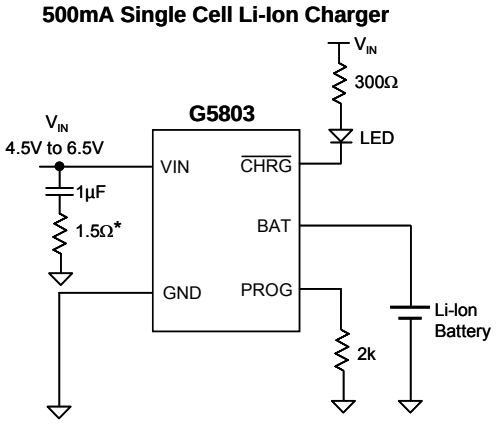
Note: T1: SOT-23-5 F1: SOP-8 (FD)
1: Bonding Code
U: Tape & Reel

Pin Configuration



Note: Recommend connecting the Thermal Pad to the Ground for excellent power dissipation.

Typical Application Circuit



*1.5Ω resistor in series with a ceramic capacitor will minimize the start-up voltage overshoot transients

Absolute Maximum Ratings

VIN to GND . . . . . -0.3V to +8V
BAT to GND . . . . . -0.3V to (VIN + 0.3V)
Thermal Resistance Junction to Ambient, (θ_{JA})
SOT-23-5 . . . . . 125°C/W(1)
SOP-8 (FD) . . . . . .108°C/W(2)
Continuous Power Dissipation (T_A = +25°C)
SOT-23-5 . . . . . 1W(1)
SOP-8 (FD) . . . . . 1.2W(2)
Thermal Resistance Junction to Case, (θ_{JC})
SOT-23-5 . . . . . .60°C/W
SOP-8 (FD) . . . . . 12°C/W
Operating Temperature Range . . . . . -40°C to +85°C
Junction Temperature . . . . . .+150°C
Storage Temperature Range . . . . . -65°C to +160°C
Reflow Temperature (soldering, 10sec) . . . . . 260°C

Note:
(1) Please refer to PCB size described in EV5805-10.
(2) Please refer to 1in^2 of 1oz PCB Layout Section.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Electrical Characteristics

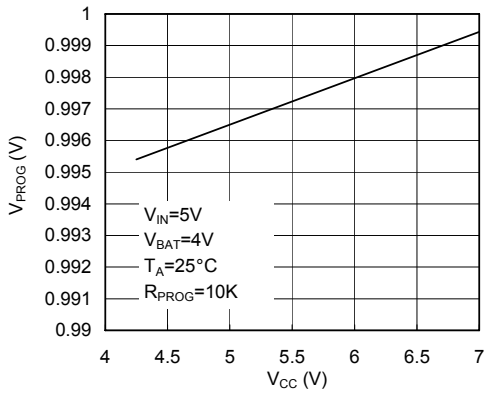
V_{IN}=5V; V_{SS}=0V; T_A=25°C, C_{IN}=1µF, C_{OUT}=1µF

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Input Voltage	V_{IN}		4.25	---	6.5	V
Quiescent Current	I_Q	Sleep Mode V_{IN}=0V	---	1	---	µA
		Charge Mode, R_{prog}=10k	---	300	1000	
		Standby Mode (charge terminated)	---	200	500	
		UV Mode	30	70	100	
		Shutdown Mode	---	24	50	
BAT Pin Current	I_{BAT}	Sleep Mode	---	1	---	µA
		Charge Mode, R_{prog}=2k	465	500	535	mA
		Charge Mode, R_{prog}=10k	93	100	107	mA
		Standby Mode (charge terminated)	---	-7	-10	µA
		UV Mode	-2	0.1	2	µA
		Shutdown Mode	-2	0.1	2	µA
Pre-Charge Threshold Voltage	V_{PRE}		3.1	3.2	3.3	V
Pre-Charge Hysteresis Voltage	V_{PREHYS}		100	200	350	mV
Pre-Charge Current	I_{PRE}	V_{BAT}<V_{TRIKL}, R_{prog}=2k	20	50	70	mA
Regulated Output (Float) Voltage	V_{FLOAT}	0<T_A<85°C, I_{BAT}=40mA	4.158	4.2	4.242	V
V_{IN} Undervoltage Lockout Threshold	V_{UV}	From V_{IN} low to high	4.2	4.3	4.4	V
V_{IN} Undervoltage Lockout Hysteresis	V_{UVHYS}		0.15	0.25	0.35	V
Manual Shutdown Threshold Voltage	V_{MSD}		---	V_{IN}/2	---	V
C/10 End of Charge Threshold Current	I_{EOC}	Rprog=2k	0.085	0.1	0.115	mA/mA
Recharge Threshold Current	I_{RECHG}		0.170	0.2	0.230	mA/mA
PROG Voltage	V_{PROG}	R_{prog}=10k, CC Mode	0.93	1.0	1.07	V
PROG PIN Pull-Up Current	I_{PROG}		---	2	---	µA
Power MOSFET "ON" Resistance (Between V_{IN} and V_{BAT})	R_{ON}	V_{IN}=4.2V, I_{BAT}=100mA, R_{prog}=2k	---	580	---	mΩ
Thermal Shutdown Temperature	T_{SHDN}		---	152	---	°C
Thermal Shutdown Temperature Hysteresis	ΔT_{SHDN}		---	10	---	°C
Over Voltage Threshold Voltage	OV		4.25	4.35	4.45	V

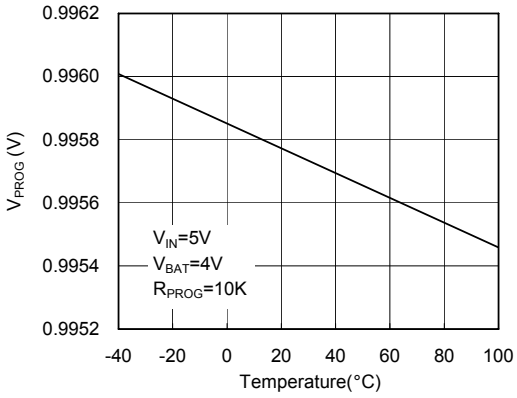
Typical Performance Characteristics

V_{IN}=5.0V, C_{VIN}=1μF, C_{VBAT}=1μF, T_A=25°C, unless otherwise noted.

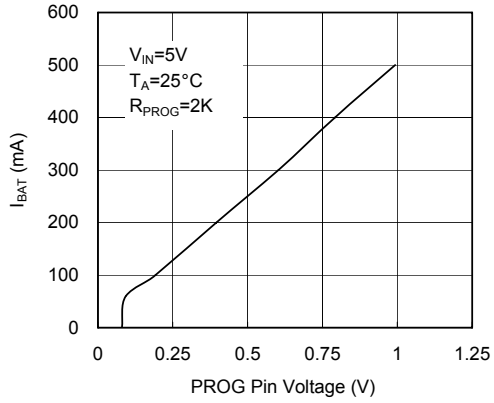
PROG Pin Voltage vs Supply Voltage (Constant Current Mode)



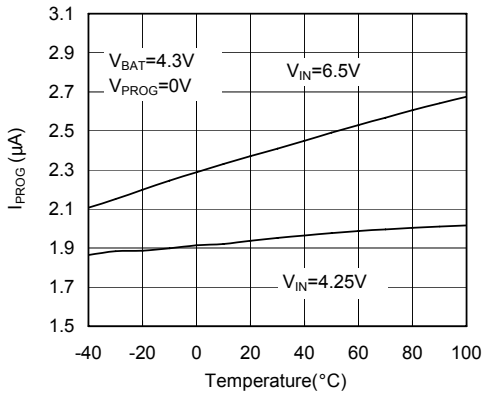
PROG Pin Voltage vs Temperature



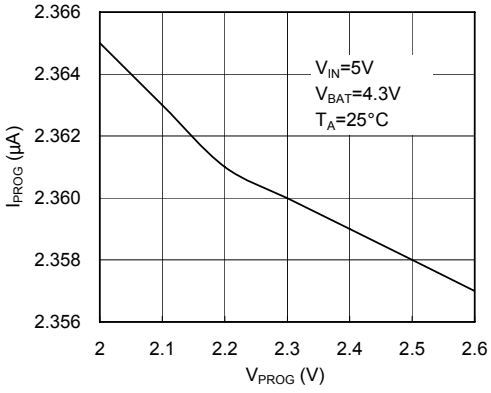
Charge Current vs PROG Pin



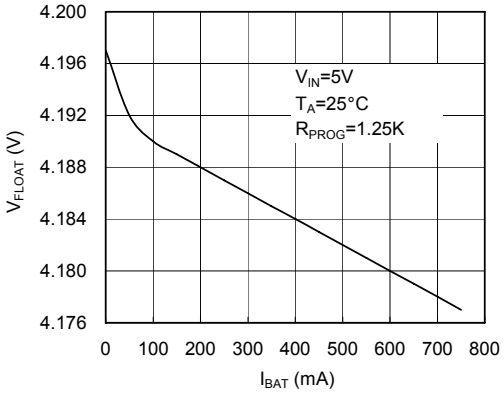
PROG Pin Pull-Up Current vs Temperature and Supply Voltage



IPROG(μA) vs VPROG(V)

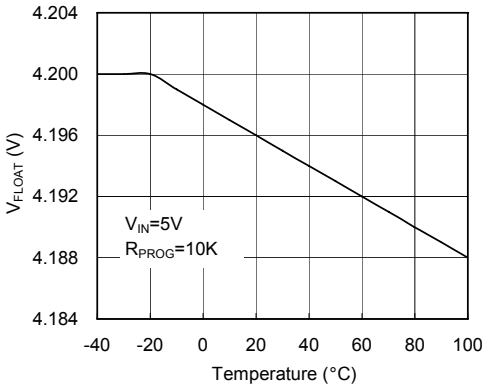


Regulated Output (Float) voltage vs Charge Current

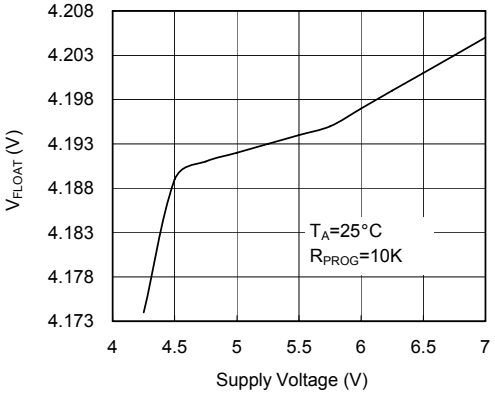


Typical Performance Characteristics (continued)

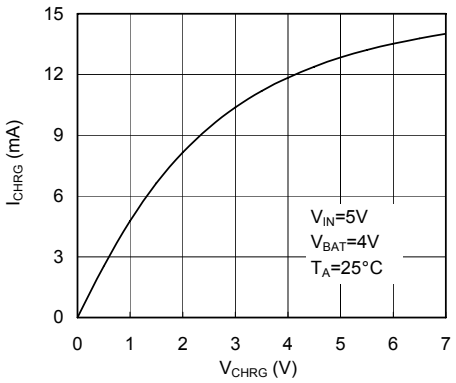
Regulated Output (Float) voltage vs Temperature



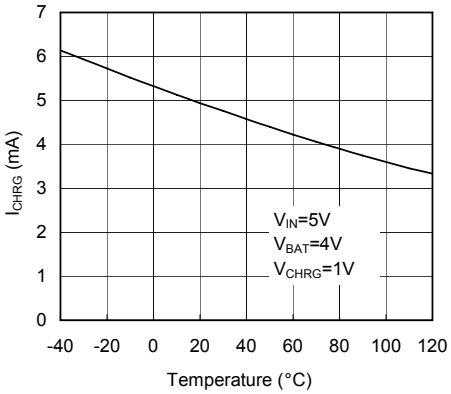
Regulated Output (Float) voltage vs Supply voltage



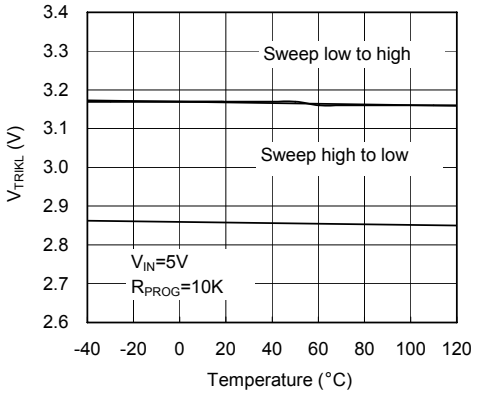
$\overline{CHRG}$ Pin I-V Curve (Strong Pull-Down State)



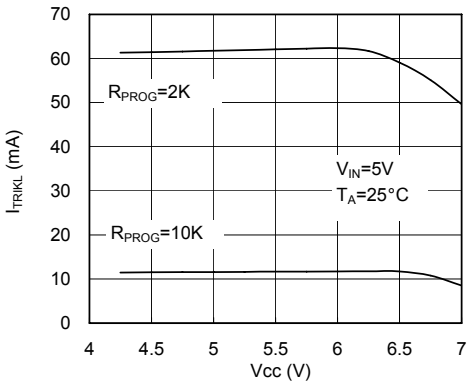
$\overline{CHRG}$ Pin I-V Curve vs Temperature (Strong Pull-Down State)



Trickle Charge Threshold vs Temperature

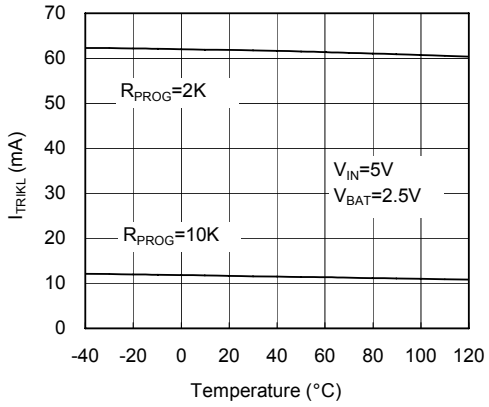


Trickle Charge Current vs Supply Voltage

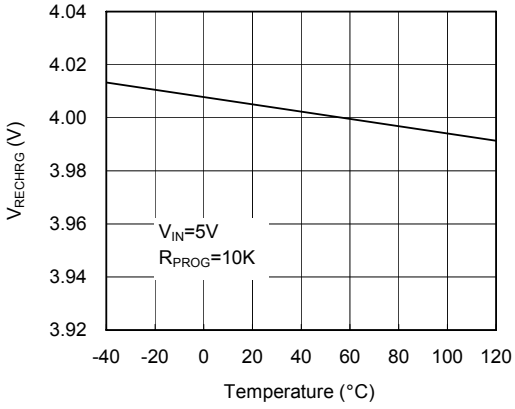


Typical Performance Characteristics (continued)

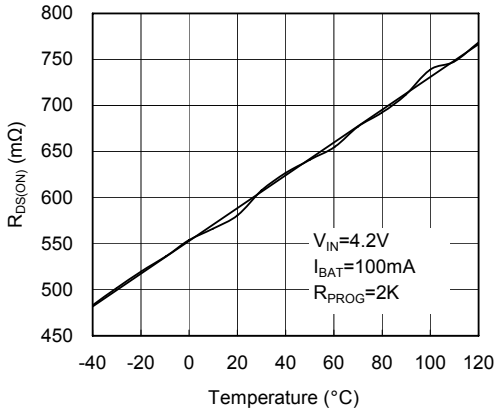
Trickle Charge Current vs Temperature



Recharge Voltage Threshold vs Temperature

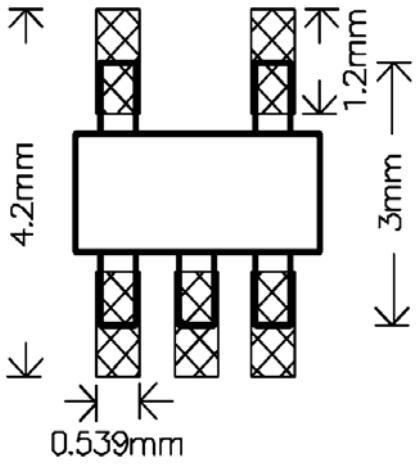


Power FET "ON" Resistance vs Temperature



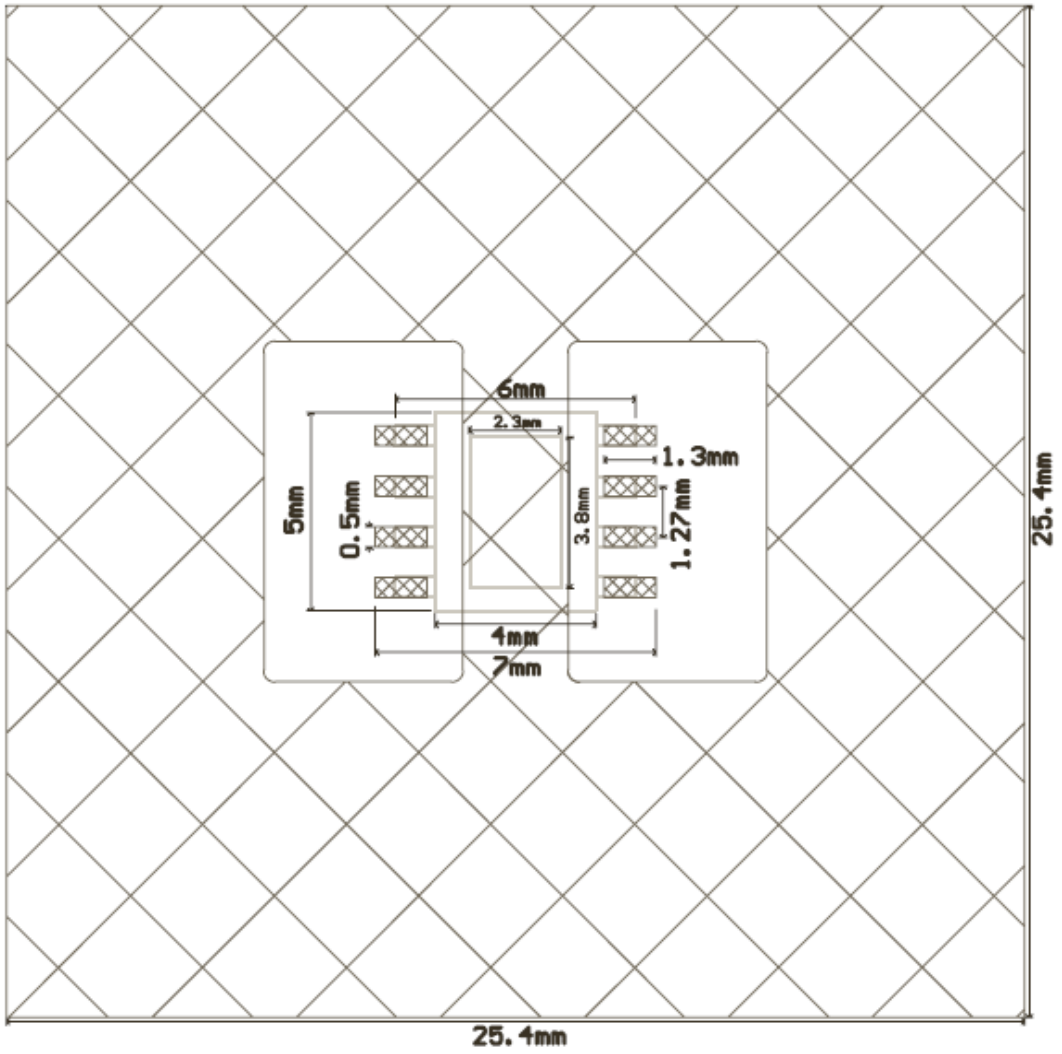
Minimum Footprint PCB Layout Section

SOT-23-5

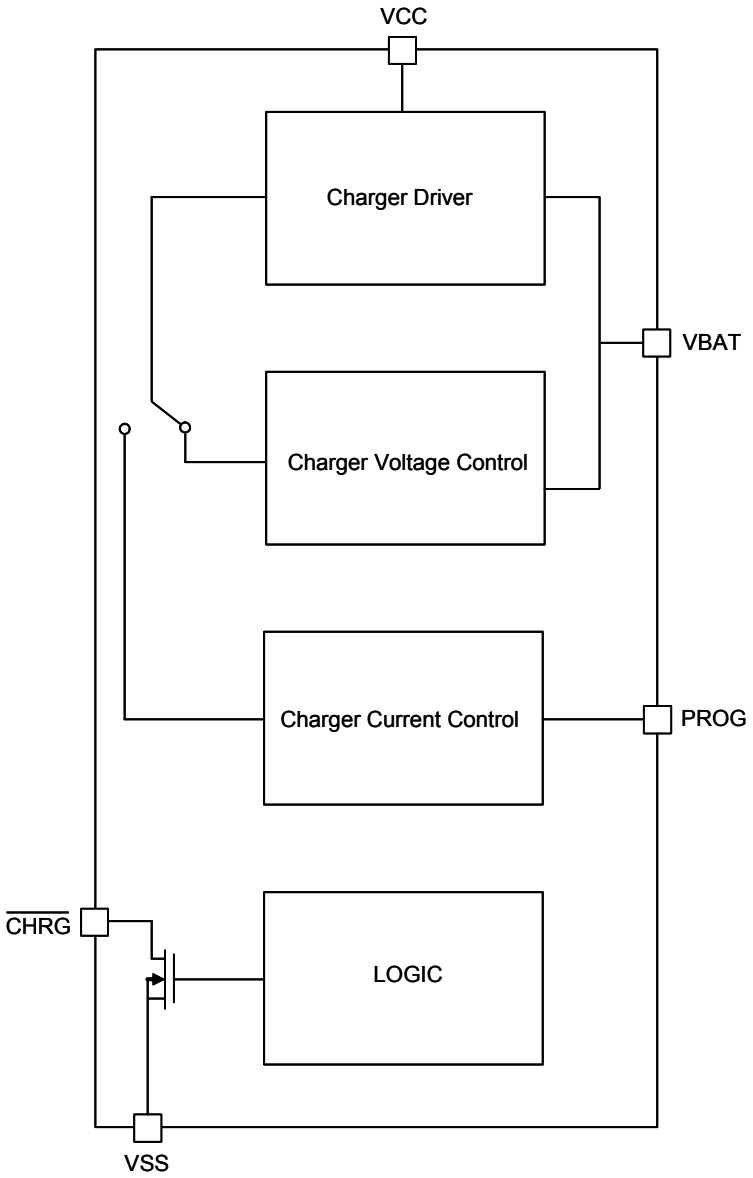


1in^2 of 1oz PCB Layout Section

SOP-8 (FD)



Block Diagram



Pin Description

PIN		NAME	FUNCTION
SOT-23-5	SOP-8 (FD)		
1	7	$\overline{CHRG}$	Open drain out, charge status output pin
2	3	GND	IC ground
3	5	BAT	Charge current output pin
4	4	VIN	Power supply input
5	2	PROG	Constant charge current program pin, $I_{BAT}= (V_{PROG}/R_{PROG})*1000$
	1,6,8	NC	No Connection

Detailed Description

Undervoltage Lockout (UVLO)

An internal undervoltage lockout circuit monitors the input voltage and keeps the charger in shutdown mode until VIN rise above 4.3V. The UVLO circuit has a built-in hysteresis of 0.4V.

Programmable Charge Current

The charge current is programmed by an external resistor from the PROG pin to ground. The charge current is 1000 times the current out of the PROG pin. In the pre-charge mode, the program resistor and the charge current can be calculated by the following equations:

R_{PROG} = 1000 * 0.1V / I_{CHG}, I_{CHG}=1000 * 0.1V / R_{PROG};

In the constant-current mode, the program resistor and the charge current can be calculated by the following equations:

R_{PROG} = 1000 * 1V / I_{CHG}, I_{CHG} = 1000 * 1V / R_{PROG}.

The charge current out of the VBAT pin can be determined by probing the PROG pin voltage by the following equation: I_{BAT} = 1000 * V_{PROG} / R_{PROG}

Normal Charge Cycle

When the voltage at the VIN pin is over the UVLO threshold and the program resistor is connected from the PROG pin to ground, the charge cycle would start to charge. If the BAT pin voltage is less than 3.2V, the charge cycle starts from pre-charge mode. If the BAT pin voltage is greater than 3.2V, the charge cycle would start from constant-charge mode.

In the pre-charge mode, the charge current is about $1/10^{th}$ programmed charging current. In the constant-current mode, the G5803 would supply fully programmed charge current. When the BAT pin approaches the final regulation voltage (4.2V), the G5803 enters to the constant-voltage mode and the charge current starts to decrease from programmed current. When the charge current drops below to $1/10^{th}$ programmed current, the open drain NMOS $\overline{CHRG}$ pin would be turn off without turning off the charge loop. When the charge current is raised to $1/5^{th}$ programmed current, the $\overline{CHRG}$ pin would be turn on.

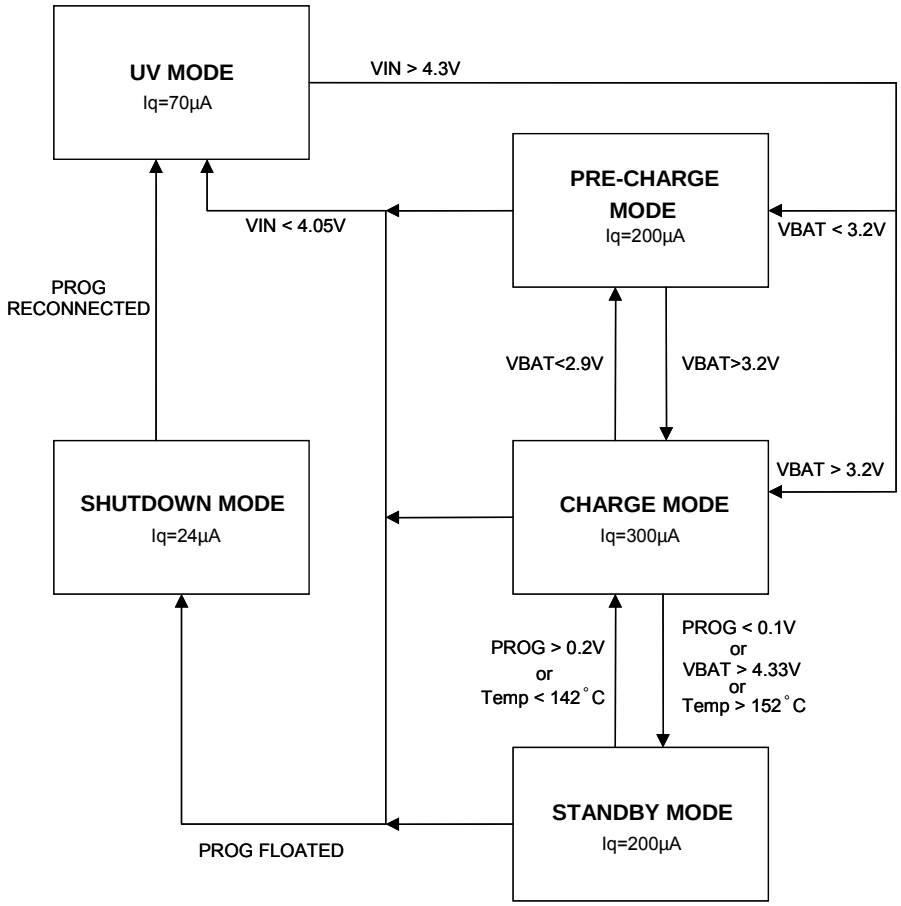


Fig. 1 State Diagram

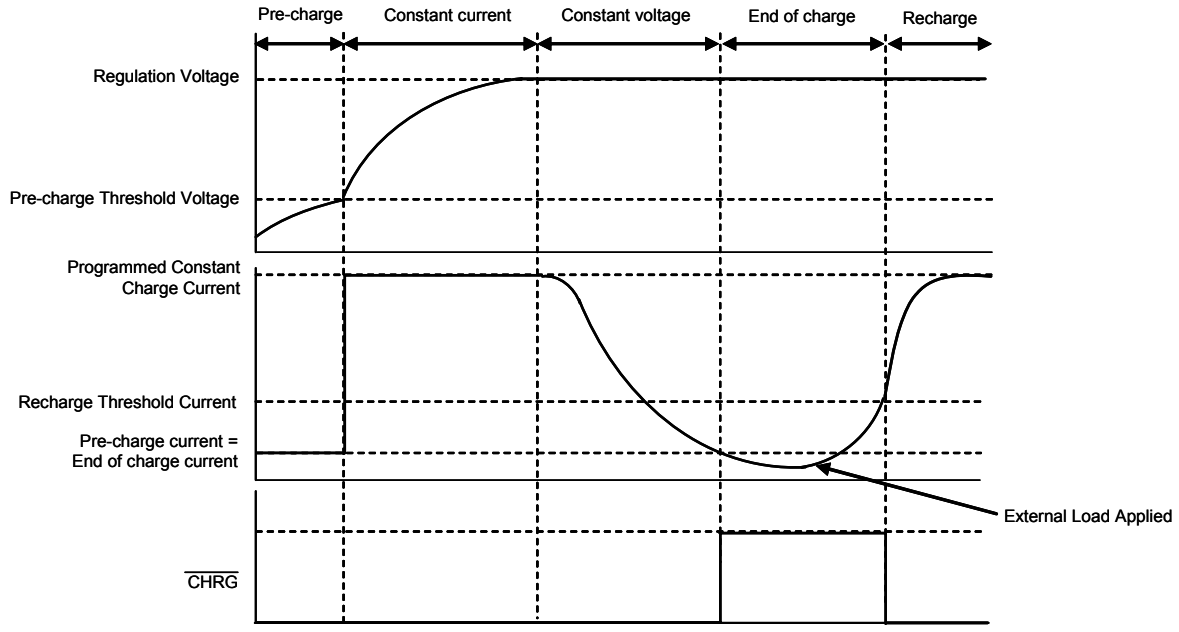


Fig.2 Complete Charge Cycle

Charge Status Indicator ($\overline{CHRG}$)

The charge status output has two different states: strong pull-down (~10mA) and high impedance. The strong pull-down indicates that G5803 is charging. High impedance indicates charge termination, manual shutdown, UVLO or over temperature conditions.

Over Temperature Protection

To prevent abnormal temperature from occurring, the G5803 has a built-in temperature monitoring circuit. When it detects the temperature is above 150°C, the output MOS is turned off. When the IC is cooled down to below 140°C, the output is turned on again. In this way, the G5803 will be protected against abnormal junction temperature during operation.

Manual Shutdown

The G5803 can be put into shutdown mode by removing RPROG thus floating the PROG pin. This reduces the battery drain current to less than 1μA and the quiescent current to less than 30μA. The G5803 would be restarted by reconnecting the program resistor.

Application Information

Power Dissipation

The die attachment area of the G5803's lead frame is connected to pin 2, which is the GND pin. Therefore, the GND pin of G5803 can carry away the heat of the G5803 die very effectively. To improve the power dissipation, connect the GND pin to ground using a large ground plane near the GND pin.

VIN Bypass Capacitor

Several types of capacitors can be used for input bypassing. Because of the self-resonant and high Q characteristics of some types of ceramic capacitors, it could generate high voltage transients under some start-up conditions, such as connecting the charger input to a live power source. Adding a 1.5Ω resistor in series with a ceramic capacitor will minimize the start-up voltage overshoot transients.

USB and Wall Adapter Power

The power source of G5803 can be both a wall adapter and a USB port. Fig 3 shows an example of how to combine wall adapter and USB power inputs.

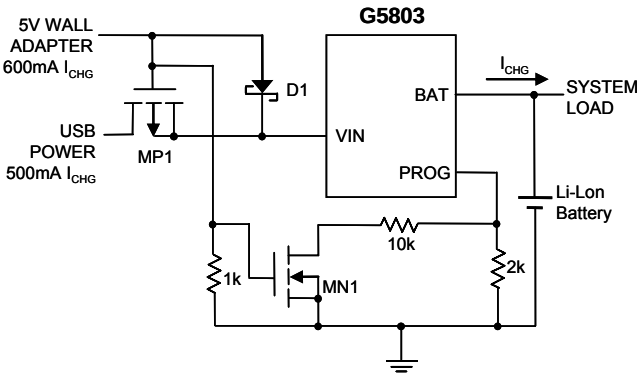
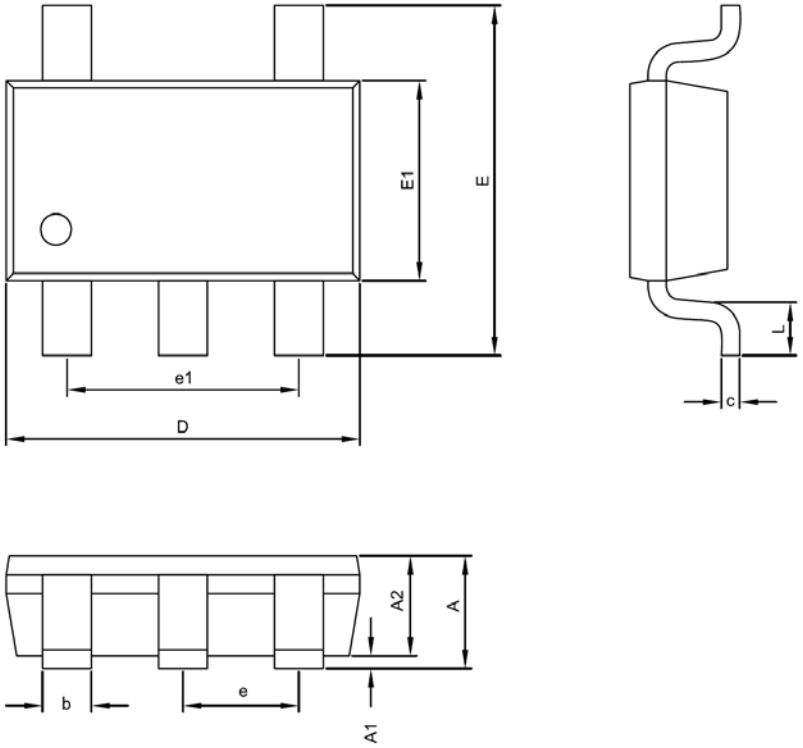


Fig. 3 Combining Wall Adapter and USB Power

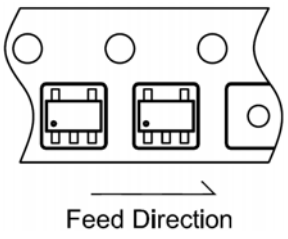
Package Information



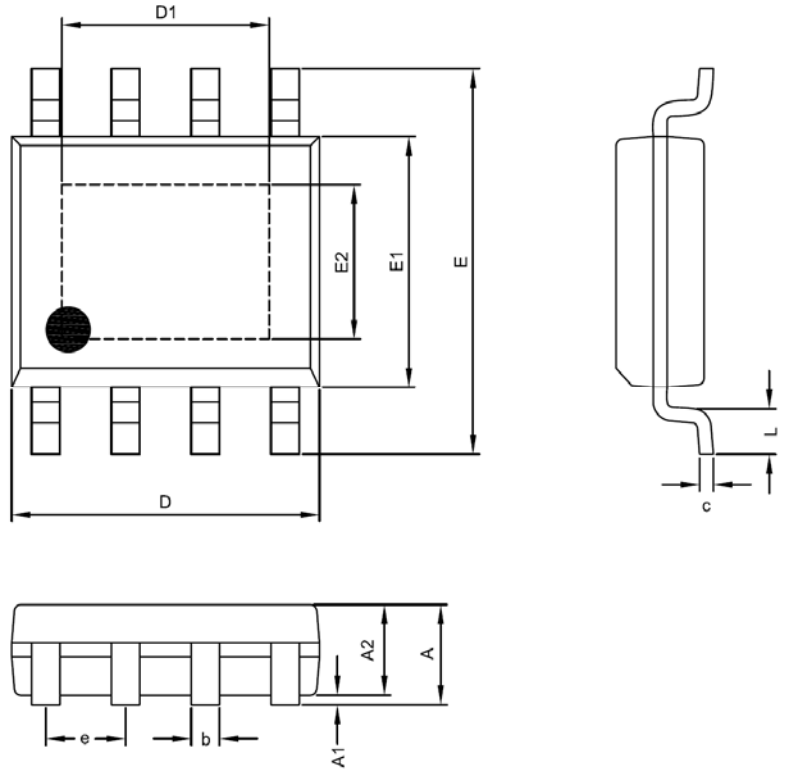
SOT-23-5 Package

Symble	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.00	1.10	1.45	0.039	0.043	0.057
A1	0.00	---	0.10	0.000	---	0.004
A2	1.00	1.10	1.30	0.039	0.043	0.051
D	2.70	2.90	3.10	0.106	0.114	0.122
E	2.60	2.80	3.00	0.102	0.110	0.118
E1	1.50	1.60	1.70	0.059	0.063	0.067
c	0.08	0.15	0.25	0.003	0.006	0.010
b	0.30	0.40	0.50	0.012	0.016	0.020
e	0.95 BSC			0.037 BSC		
e1	1.90 BSC			0.075 BSC		
L	0.30	0.45	0.60	0.012	0.018	0.024

Taping Specification



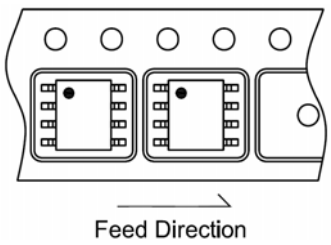
PACKAGE	Q'TY/REEL
SOT-23-5	3,000 ea



SOP-8 (FD) Package

Symble	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.35	1.55	1.65	0.053	0.061	0.065
A1	0.00	---	0.15	0.000	---	0.006
A2	1.15	1.35	1.50	0.045	0.053	0.059
D	4.80	4.90	5.00	0.189	0.192	0.197
D1	2.29	---	3.71	0.090	---	0.146
E	5.80	6.00	6.20	0.228	0.236	0.244
E1	3.80	3.90	4.00	0.150	0.153	0.157
E2	2.29	---	2.64	0.090	---	0.104
c	0.19	0.23	0.27	0.007	0.009	0.011
b	0.33	0.43	0.53	0.013	0.017	0.021
e	1.27 BSC			0.050 BSC		
L	0.40	0.70	1.00	0.016	0.028	0.039

Taping Specification



PACKAGE	Q'TY/REEL
SOP-8 (FD)	2,500 ea