DESCRIPTION

The A4056B is a complete constant-current /constant-voltage linear charger for single cell lithium-ion batteries. Its SOT package and low external component count make the A4056B ideally suited for portable applications especially in USB power specifications.
Internal MOSFET architecture makes A4056B no external sense resistor needed, and no blocking diode is required. Thermal feedback regulates the charge current to limit the die temperature during high power operation or high ambient temperature. The charge voltage is fixed at 4.2V, and the charge current can be programmed externally with a single resistor. The A4056B automatically terminates the charge cycle when the charge current drops to 1/10th the programmed value after the final float voltage is reached.
When the input supply (wall adapter or USB supply) is removed, the A4056B automatically enters a low current state, dropping the battery drain current to less than 2μA. The A4056B can be put into shutdown mode, reducing the supply current to 25μA.
When battery reversed, the internal protected the BAT pin throughout about 0.7mA current from GND. Also, The BAT pin has a 7KV ESD (HBM) capability.
Other features include charge current monitor, under-voltage lockout, automatic recharge and a status pin to indicate charge termination and the presence of an input voltage.

The A4056B is available in SOT-25 and SOT89-5 packages.

ORDERING INFORMATION

Package Type	Part Number	
SOT-25 SPQ: 3,000pcs/Reel	E5	A4056BE5R
		A4056BE5VR
SOT89-5 SPQ: 1,000pcs/Reel	K5	A4056BK5R
		A4056BK5VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

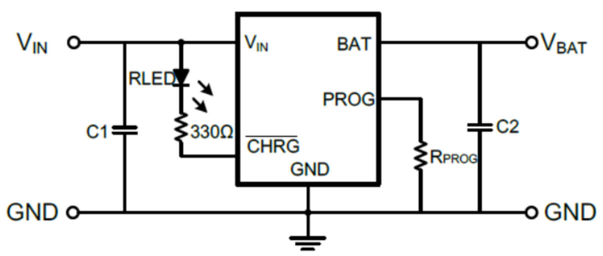
FEATURES

- Programmable Charge Current Up to 500mA
- No MOSFET, Sense Resistor or Blocking Diode Required
- Complete Linear Charger in SOT Package for single Cell Lithium-Ion Batteries
- Constant-Current/Constant-Voltage Operation with Thermal Regulation to Maximize Charge Rate Without Risk of Overheating
- Charges Single Cell Li-Ion Batteries Directly from USB Port
- Preset 4.2V Charge Voltage with ±1% Accuracy
- Charge Current Monitor Output for Gas Gauging
- Automatic Recharge
- Charge Status Output Pin
- C/10 Charge Termination
- 25μA Supply Current in Shutdown
- 2.9V Trickle Charge Threshold
- Soft-Start Limits Inrush Current
- Battery reversed protection
- 7KV ESD(HBM) capability
- Available in SOT-25 and SOT89-5 packages

APPLICATION

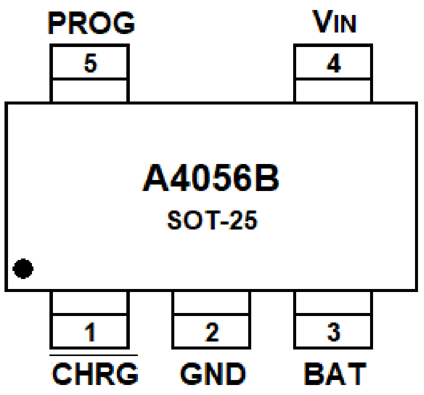
- Cellular Telephones, PDAs, MP3 Players
- Charging Docks and Cradles
- Bluetooth Applications

TYPICAL APPLICATION

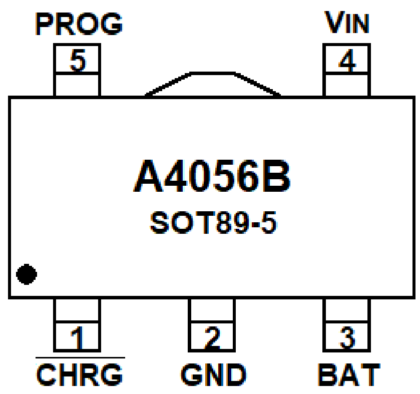


NOTE: C1=4.7uF, C2=10uF, $I_{BAT}=(V_{PROG}/R_{PROG})*1000$

PIN DESCRIPTION



Top View



Top View

Pin #	Symbol	Function
1	$\overline{CHRG}$	Open-Drain Charge Status Output. When the battery is charging, the CHRG pin is pulled low by an internal N-channel MOSFET. When the charge cycle is completed, a weak pull-down of approximately 20μA is connected to the CHRG pin, indicating an "AC present" condition. When the A4056B detects an undervoltage lockout condition, CHRG is forced high impedance.
2	GND	Ground.
3	BAT	Charge Current Output. Provides charge current to the battery and regulates the final float voltage to 4.2V. An internal precision resistor divider from this pin sets the float voltage which is disconnected in shutdown mode. When the battery reversed, Internal protection circuitry to protect the chip will not be burned. And about 0.7mA current flows from GND to BAT.
4	V_{IN}	Positive Input Supply Voltage. Provides power to the charger. V_{IN} can range from 4.25V to 6.5V and should be bypassed with at least a 1μF capacitor. When V_{IN} drops to within 30mV of the BAT pin voltage, the A4056B enters shutdown mode, dropping I_{BAT} to less than 2μA.
5	PROG	Charge Current Program, Charge Current Monitor and Shutdown Pin. The charge current is programmed by connecting a 1% resistor, R_{PROG}, to ground. When charging in constant-current mode, this pin servos to 1V. In all modes, the voltage on this pin can be used to measure the charge current using the following formula: $I_{BAT} = (V_{PROG}/R_{PROG}) \times 1000$ The PROG pin can also be used to shut down the charger. Disconnecting the program resistor from ground allows a 3μA current to pull the PROG pin high. When it reaches the 1.21V shutdown threshold voltage, the charger enters shutdown mode, charging stops and the input supply current drops to 25μA. This pin is also clamped to approximately 2.4V. Driving this pin to voltages beyond the clamp voltage will draw currents as high as 1.5mA. Reconnecting R_{PROG} to ground will return the charger to normal operation.

ABSOLUTE MAXIMUM RATINGS

V_{IN}, Input Supply Voltage		V_{SS}-0.3V ~ V_{SS}+7V
V_{PROG}, PROG pin Voltage		V_{SS}-0.3V ~ V_{IN}+0.3V
V_{BAT}, BAT pin Voltage		Vss-0.3V ~ 7V
V_{CHRG}, CHRG pin Voltage		V_{SS}-0.3V ~ V_{SS}+7V
P_D, Power Dissipation	SOT-25	250mW
	SOT89-5	500mW
I_{BAT}, BAT pin Current		500mA
I_{PROG}, PROG pin Current		800μA
T_{OPA}, Operating Ambient Temperature		-40°C ~ +85°C
T_{STR}, Storage Temperature		-65°C ~ +125°C

Stress beyond above listed "Absolute Maximum Ratings" may lead permanent damage to the device. These are stress ratings only and operations of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

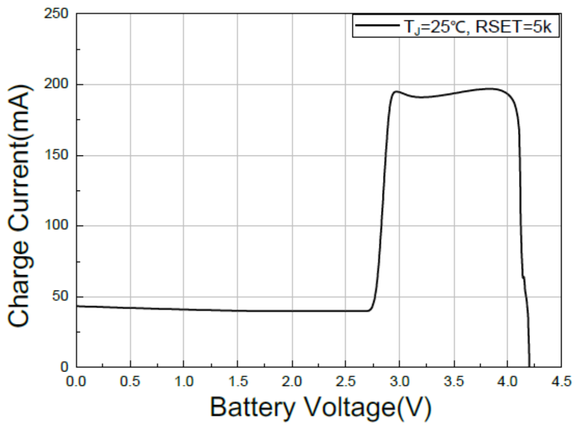
ELECTRICAL CHARACTERISTICS

T_A=25℃, unless otherwise noted

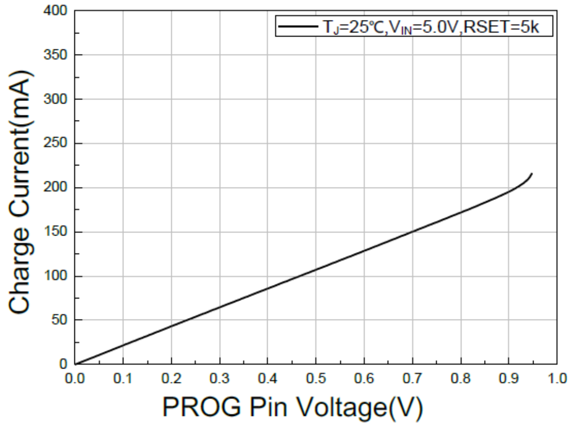
Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input Supply Voltage	V_{IN}		4.25	-	6.5	V
Input Supply Current	I_{IN}	Charge mode, R_{PROG}=10k	-	300	2000	μA
		Standby mode	-	200	500	
		Shutdown mode (R_{PROG} not connected, V_{IN}<V_{BAT} or V_{IN}<V_{UV})	-	25	50	
Regulated Output Voltage	V_{FLOAT}	0℃≤T_A≤85℃, I_{BAT}=40mA	4.16	4.2	4.25	V
BAT pin Current	I_{BAT}	R_{PROG} =10k,Current mode	93	100	107	mA
		R_{PROG} =2k,Current mode	465	500	535	mA
		Standby mode, V_{BAT}=4.2V	0	-2.5	-6	μA
		Shutdown mode	-	1	2	μA
		Battery reverse mode, V_{BAT}=-4V	-	0.7	-	mA
		Sleep mode, V_{IN}=0V	-	1	2	μA
Trickle Charge Current	I_{TRIKL}	V_{BAT}<V_{TRIKL}, R_{PROG}=5k	30	40	50	mA
Trickle charge Threshold Voltage	V_{TRIKL}	R_{PROG}=10k，V_{BAT} Rising	2.8	2.9	3.0	V
Trickle Voltage Hysteresis Voltage	V_{TRHYS}	R_{PROG}=10k	60	80	110	mV
V_{IN} Undervoltage Lockout Threshold	V_{UV}	From V_{IN} low to high	3.7	3.8	3.93	V
V_{IN} Undervoltage Lockout Hysteresis	V_{UVHYS}		150	200	300	mV
Manual Shutdown Threshold Voltage	Vmsd	PROG pin rising	1.15	1.21	1.30	V
		PROG pin falling	0.9	1.0	1.1	
V_{IN}-V_{BAT} Lockout Threshold Voltage	Vasd	V_{IN} from low to high	70	100	140	mV
		V_{IN} from high to low	5	30	50	
C/10 Termination Current Threshold	Iterm	R_{PROG}=10k	0.085	0.10	0.115	mA/mA
		R_{PROG}=2k	0.085	0.10	0.115	
PROG pin Voltage	V_{PROG}	R_{PROG}=10k, Current mode	0.93	1.0	1.07	V
CHRG pin Weak Pull-Down Current	I_{CHRG}	V_{CHRG}=5V	8	20	35	μA
CHRG pin Output Low Voltage	V_{CHRG}	I_{CHRG}=5mA	-	0.35	0.6	V
Recharge Battery Threshold Voltage	ΔV_{RECG}	VFLOAT - VRECHRG	-	100	200	mV

TYPICAL PERFORMANCE CHARACTERISTICS

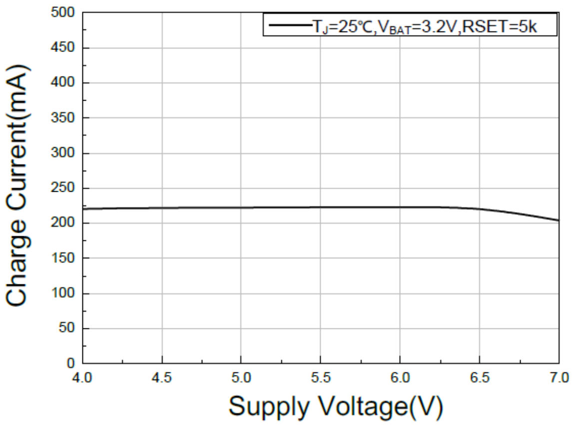
1. Charge Current vs. Battery Voltage



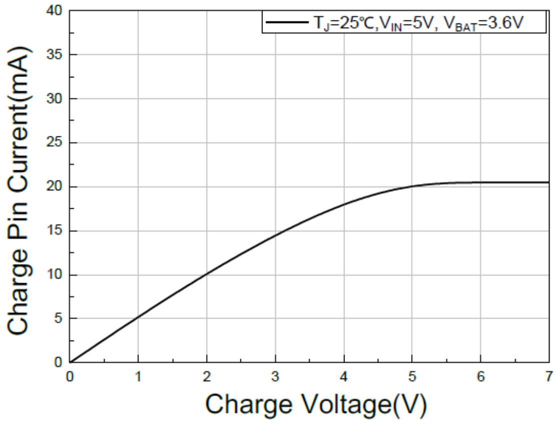
2. Charge Current vs. PROG Pin Voltage



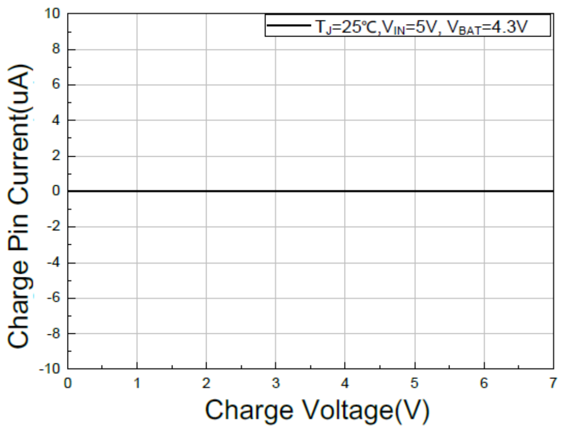
3. Charge Current vs. Supply Voltage



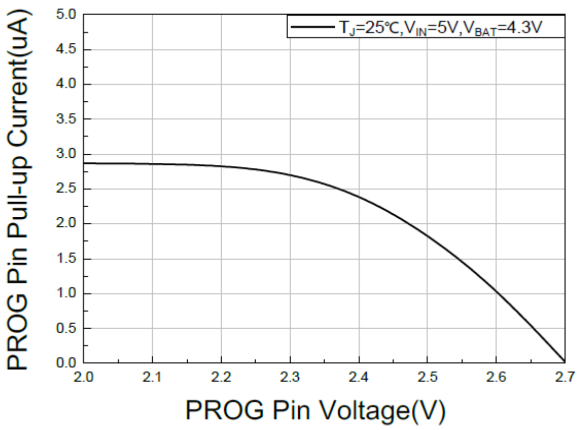
4. PROG Pin Pull-up Current vs. PROG Pin Voltage



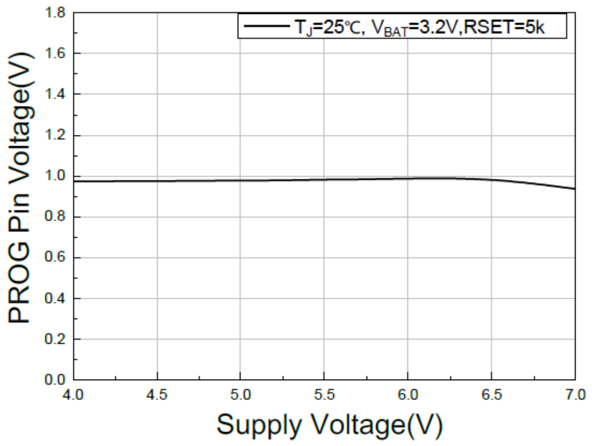
5. Charge Pin Current vs. Charge Voltage (Weak Pull-Down State)



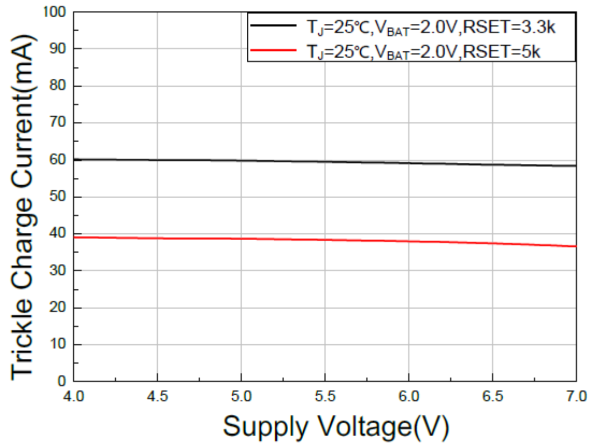
6. Charge Pin Current vs. Charge Voltage (Strong Pull-Down State)



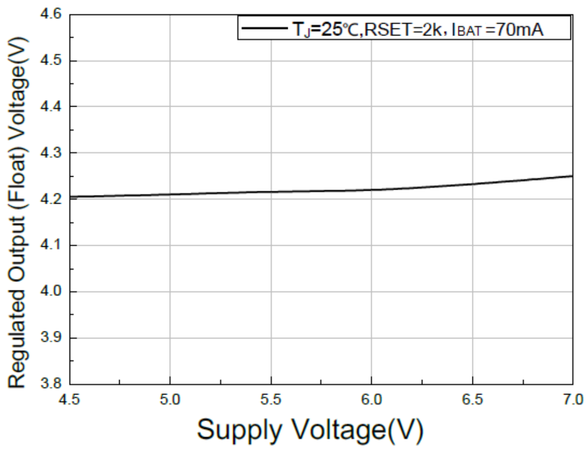
7. PROG Pin Voltage vs. Supply Voltage



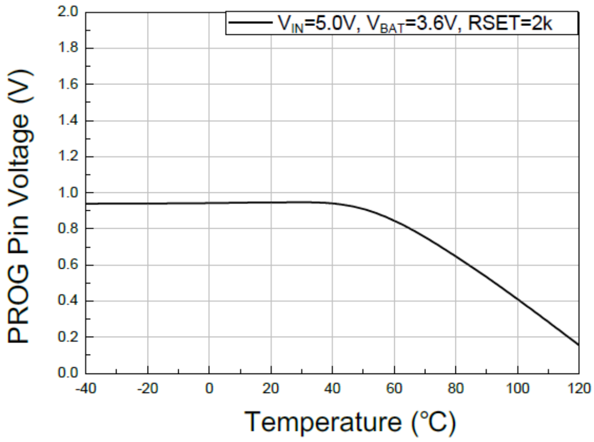
8. Trickle Charge Current vs. Supply Voltage



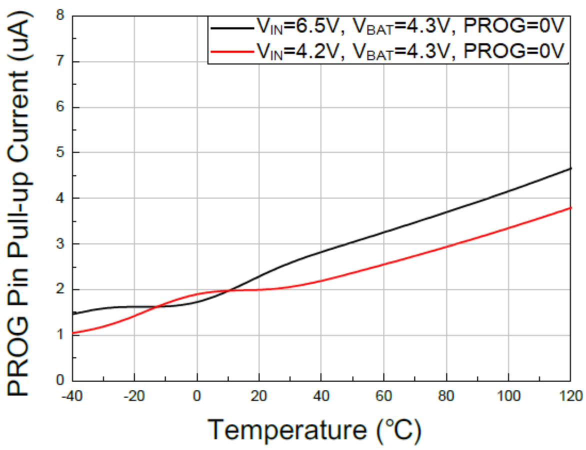
9. Regulated Output (Float) Voltage vs. Supply Voltage



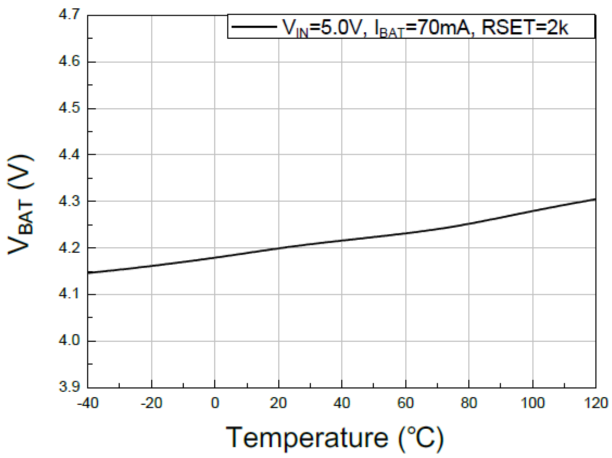
10. PROG Pin Voltage vs. Temperature



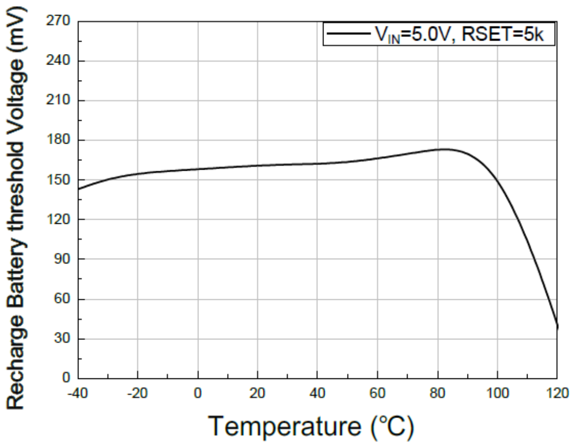
11. PROG Pin Pull-up Current vs. Temperature



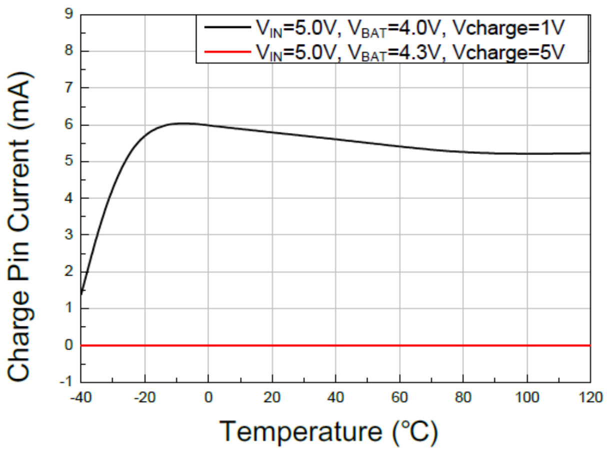
12. V_{BAT} vs. Temperature



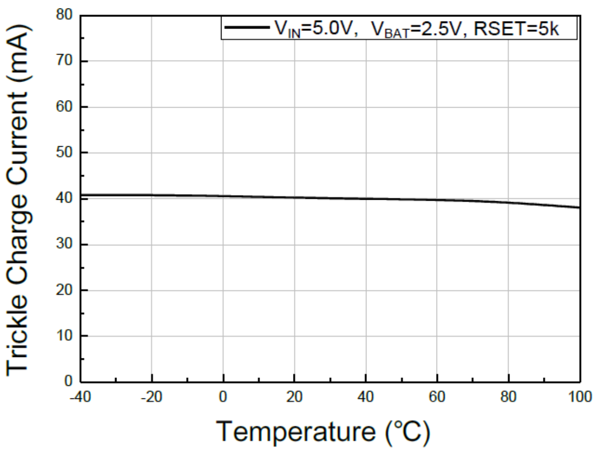
13. Recharge Battery Threshold Voltage vs. Temperature



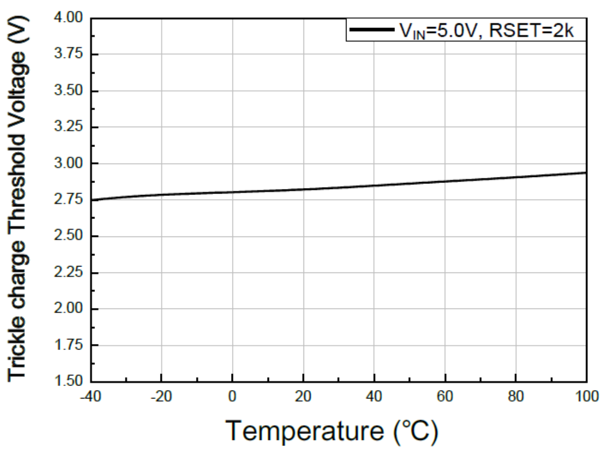
14. Charge Pin Current vs. Temperature



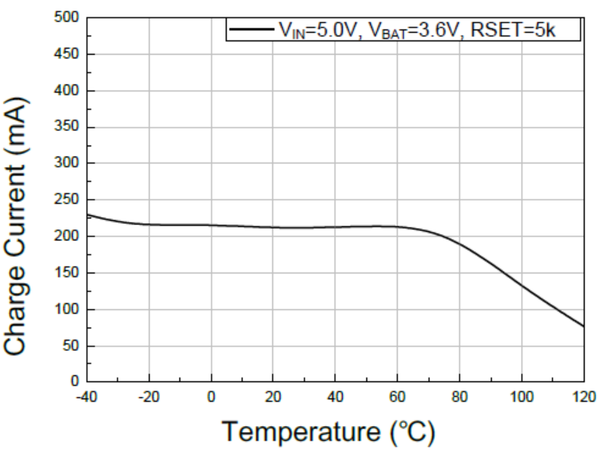
15. Trickle Charge Current vs. Temperature



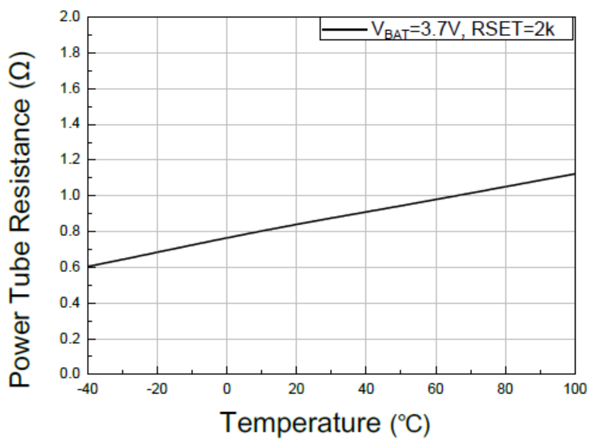
16. Trickle charge Threshold Voltage vs. Temperature



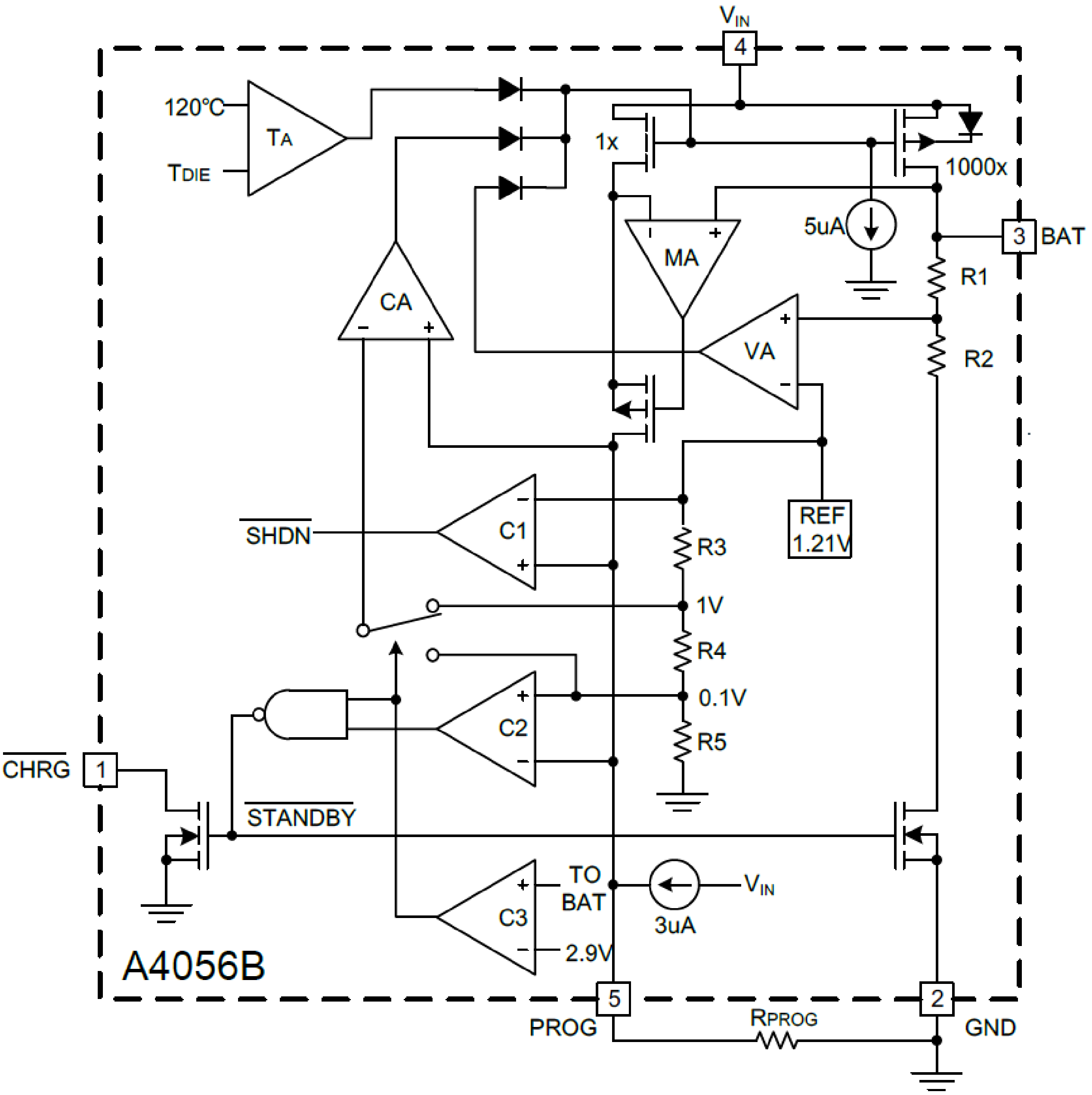
17. Charge Current vs. Temperature



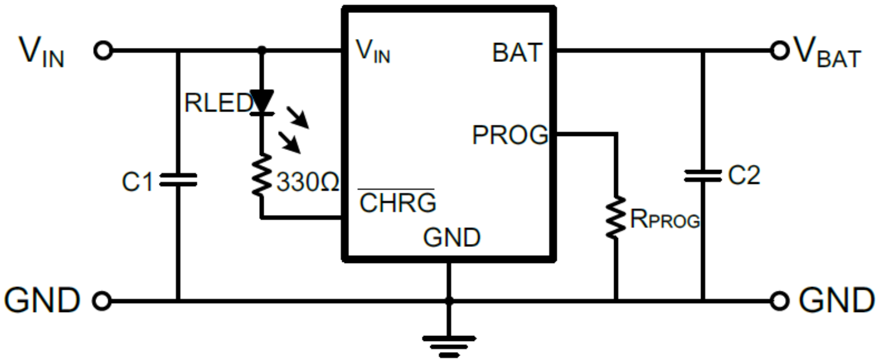
18. Power Tube Resistance vs. Temperature



BLOCK DIAGRAM



APPLICATION INFORMATION



Setting Charging Current

In constant current mode, the formula for calculating charging current is ICH = 1000 / R_{PROG}. ICH represents the charging current in amperes, R_{PROG} represents the resistance of the PROG pin to the ground in ohms. For example, if a charge current of 500mA is required, the following formula can be used: RISET = 1000/0.5 = 2kΩ

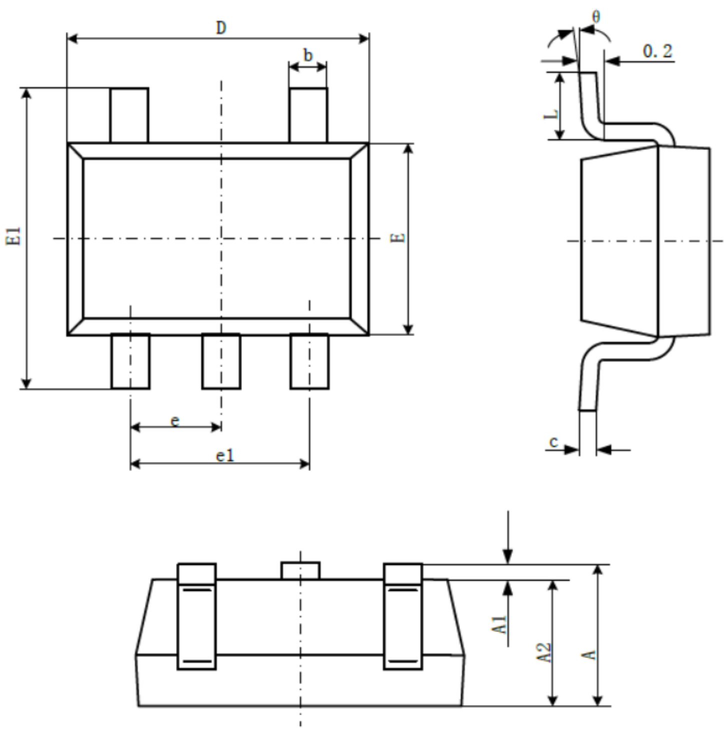
In order to ensure good stability and temperature characteristics, RISET recommends the use of metal film resistors with accuracy of 1%. Charging current can be detected by measuring the voltage of ISET. Charging current can be calculated by the following formula: ICH = (V_{PROG} / R_{PROG}) *1000

Setting Charging Current

Suggested capacitance values: C1 = 4.7uF, C2 = 10uF, and PCB board requires that the connected capacitor be as close as possible to the chip.

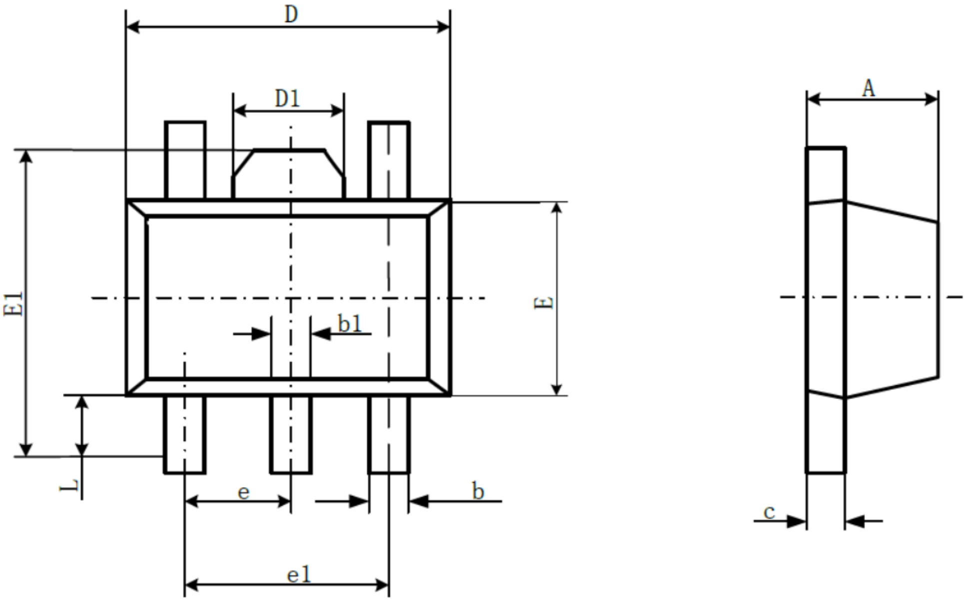
PACKAGE INFORMATION

Dimension in SOT-25 Package (Unit: mm)



Symbol	Millimeters		Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

Dimension in SOT89-5 Package (Unit: mm)



Symbol	Millimeters		Inches	
	Min	Max	Min	Max
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.360	0.560	0.014	0.022
c	0.350	0.400	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.400	1.800	0.055	0.071
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP		0.060 TYP	
e1	2.900	3.100	0.114	0.122
L	0.900	1.100	0.035	0.043

IMPORTANT NOTICE

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