Shenzhen Fuman Electronics Co., Ltd.
SHENZHEN FUMAN ELECTRONICS CO., LTD.

DW03D(File No:S&CIC0953) **2-in-1 lithium battery protectionIC**

I. Overview

DW03DThe product is a highly integrated solution for single-cell lithium-ion/lithium polymer rechargeable battery pack protection.DW03DIncludes advanced power MOSFET, high-precision voltage detection circuit and delay circuit.

DW03Dhave very smallTSS08-8packaging, making the device ideal for rechargeable battery pack applications where space is very limited. DW03DIt has all the required protection functions for batteries such as overcharge, over-discharge, over-current, short circuit, etc., and the power consumption is very low when working. This chip is not only designed for mobile phones, but also suitable for all kinds of information products that require long-term power supply from lithium-ion or lithium-polymer rechargeable batteries.

2. Characteristics

- Internal integrated equivalent45mΩ-60mΩThe advanced power MOSFET;
- 3Segment overcurrent protection: overdischarge current1, over-discharge current2 (optional), load short-circuit current;
- Charger detection function;
- Delay time is set internally;
- High-precision voltage detection;
- Low static current consumption: normal operating current3.8uA
- compatibleROHSand lead-free standards.
- useTSSOP-8Packaging form: Plastic sealing.

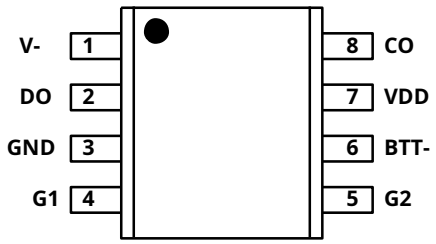
3. Application

- Single-cell lithium-ion battery pack;
- Lithium polymer battery pack.

4. Ordering information

model	encapsulation	Overcharge detection voltage [V_{CU}](V)	Overcharge release voltage [V_{CL}](V)	Over discharge detection voltage [$V_{D.L.}$](V)	Over-discharge release voltage [V_{DR}](V)	Overcurrent detection current [I_{OV1}](A)	Print mark
DW03D	TSSOP-8	4.3	4.1	2.4	3.0	2.5	DW03D

5. Pin appearance and description

Package form	Pin number	Pin name	Pin description
	1	V-	Current sensing input pin, charger detection.
	2	DO	Discharge controlFETThreshold connection pin.
	3	GND	Connect the negative pole of the battery cell
	4	G1	dischargeMOSTubeGpole, connectionOD, external connection.
	5	G2	ChargeMOSTubeGpole, connectionOC, external connection.
	6	BTT-	Charging negative electrode
	7	VDD	Positive power input pin.
	8	0C	Charge controlFELThreshold connection pin.

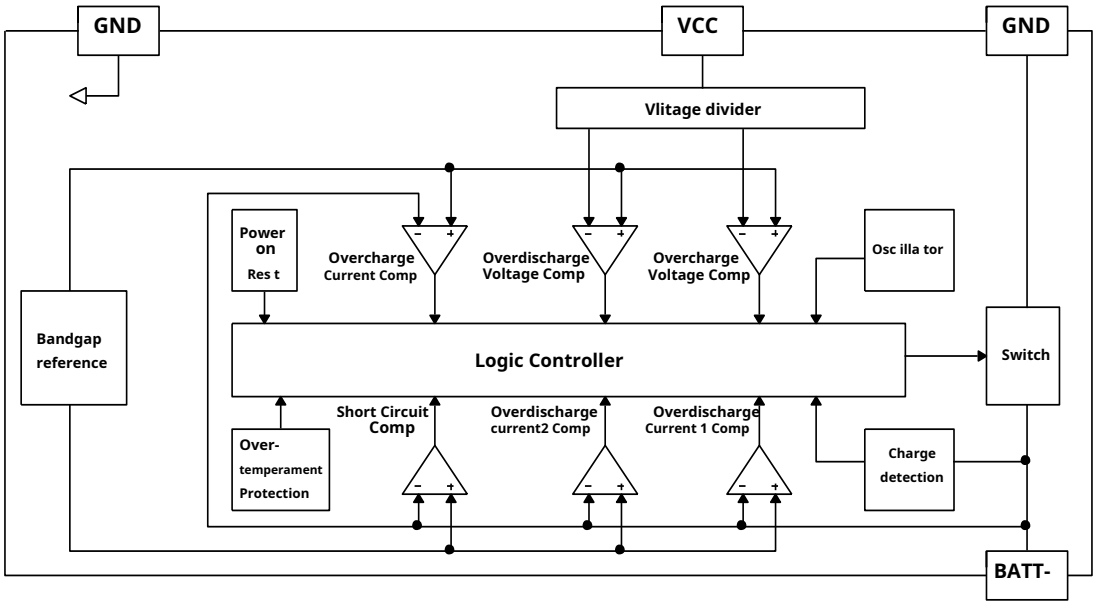
6. Limit parameters

parameter	symbol	Parameter range	unit
voltage	VDD	VSS-0.3~VSS+12	V
OCOutput pin voltage	VOC	VDD-15~VDD+0.3	V
ODOutput pin voltage	VOD	VSS-0.3~VDD+0.3	V
CSIInput pin voltage	VCSI	VDD+15~VDD+0.3	V
Operating temperature	Topr	- 40~+85	℃
storage temperature	Txt	- 40~+125	℃

7. Electrical Characteristics Parameters

parameter	symbol	Test Conditions	minimum value	Typical value	maximum value	unit
Operating Voltage						
Operating Voltage	VDD	- -	1.5	- -	10	V
Current consumption						
Working current	IDD	VDD=3.9V	- -	4.0	6.0	uA
Detection voltage						
Overcharge detection voltage	VOCD	- -	4.25	4.30	4.35	V
Overcharge release voltage	VOCR	- -	4.05	4.10	4.15	V
Overdischarge detection voltage	VODL	- -	2.30	2.40	2.50	V
Overdischarge release voltage	VODR	- -	2.90	3.00	3.10	V
Overcurrent1Detection voltage	VOI1	- -	0.12	0.15	0.18	V
Overcurrent2(Short circuit current) detection voltage	VOI2	VDD=3.6V	0.80	1.00	1.20	V
Overcurrent reset resistor	Rshort	VDD=3.6V	50	100	150	KΩ
Overcurrent detection voltage	VCH	- -	- 0.8	- 0.5	- 0.2	V
Delay time						
Overcharge detection delay time	TOC	VDD=3.6V~4.4V	- -	110	200	ms
Overdischarge detection delay time	TOD	VDD=3.6V~2.0V	- -	80	140	ms
Overcurrent1Detection delay time	TOI1	VDD=3.6V	5	13	20	ms
Overcurrent2(Short circuit current) detection delay time between	TOI2	VDD=3.6V	- -	5	50	us
other						
OCThe pin outputs a high level voltage	Voh1	- -	VDD-0.1	VDD-0.02	- -	V
OCThe pin outputs a low level voltage	Vol1	- -	- -	0.01	0.1	V
ODThe pin outputs a high level voltage	Voh2	- -	VDD-0.1	VDD-0.02	- -	V
ODThe pin outputs a low level voltage	Vol2	- -	- -	0.01	0.1	
singleMOSOn-resistance from drain to source of tube anti-	R_{DS}(on)	V_{GS}= 2.5V,I_D= 3.3A	- -	22.0	30.0	mΩ
	R_{DS}(on)	V_{GS}= 4.5V,I_D= 8.2A	- -	16.0	20.0	

8. Functional block diagram



picture1.functional block diagram

Nine, Function description

DW03DMonitor the voltage and current of the battery, and protect single-cell rechargeable lithium batteries from damage due to overcharge voltage, over-discharge voltage, over-discharge current, short circuit, etc. by disconnecting the charger or load. These functions enable the rechargeable battery to operate within the specified range.

MOSFETBuilt-in, the typical equivalent resistance value is50mΩ

Normal working mode

If no abnormalities are detected, both charging and discharging processes will switch freely. This situation is called normal operating mode. **Overcharge voltage situation**

During the charging process under normal conditions, when the battery voltage is higher than the overcharge detection voltage (VCU), and the duration reaches the overcharge voltage detection delay time (tCU) or longer,DW03Dwill controlMOSFETto stop charging. This situation is called an overcharge voltage condition. The overcharge voltage condition will be released under the following two conditions:

1, when the battery voltage is lower than the overcharge release voltage (VCL), DW03Dcontrol chargingFETTurn on and return to normal working mode.

2, when connecting a load and starting to discharge,DW03Dcontrol chargingFETTurn on to return to normal operating mode. The release mechanism is as follows: After connecting the load, the discharge current immediately flows through the chargingFETThe internal parasitic diode begins to discharge,BATT-The voltage rises to0.7V,DW03DAfter detecting this voltage, when the battery voltage is equal to or lower than the overcharge detection voltage (VCU), DW03DImmediately return to the normal working mode. In addition, when the load is connected and discharged, if BATT-voltage is at or below the overcurrent1Detection voltage, the chip will not return to normal state.

Note: When the battery is charged to exceed the overcharge detection voltage (VCU)and the battery voltage has not dropped to the overcharge detection voltage (VCU)Below, even if a heavy load is added that can cause overcurrent, overcurrent1and overcurrent2will not work unless the battery voltage drops to the overcharge detection voltage (VCU)the following. But actually the battery There is internal resistance. When the battery is connected A heavy load causes the battery voltage to drop immediately, causing overcurrent1and overcurrent2Will take action. Short circuit protection and battery voltage independent close.

Over discharge voltage situation

During normal discharge, When the battery voltage drops to the over-discharge detection voltage (VDL)When the following conditions occur, and the duration reaches the over-discharge voltage (tDL)or longer,DW03D detection delay time, the connection between the battery and the load will be cut off, and discharging will stop. This situation is called an over-discharge voltage condition. is turned off,BATT-through within When controlling dischargeFET departmentBATT-andVDDbetweenRBATT-Dresistor is pulled high. whenBATT-Voltage higher than load short circuit detection

voltage, the current consumption of the chip will drop to the sleep current (IPDN). This situation is called a dormant situation. In over-discharge and sleep conditionsBATT-andVDD betweenRBATT-DResistor connection. When a charger is connected andBATT-andVDDThe potential difference between1.3V(Typical value) or higher (load short-circuit detection voltage), the sleep state is released. Discharge at this timeFETStill disconnected. When the battery voltage becomes the over-discharge detection voltage (VDL)or higher (see remarks), DW03D makeFETTurn on to return to normal operating mode. .

Note: When the battery is over-discharged and connected to the charger, ifBATT-The terminal voltage is not lower than the charger detection voltage (VCHA),and the battery voltage reaches the over-discharge release voltage or higher (VDR)Over-discharge condition is released (control dischargeFETconduction). **Over-discharge current situation**

In normal operating mode, when the discharge current is equal to or higher than the set value (BATT-When the voltage is equal to or higher than the overcurrent detection voltage) and the time continues to exceed the overcurrent detection delay time,DW03DOff dischargeFETStop discharging. This is called an over-discharge current condition (including over-discharge current1, over-discharge current2 and load short-circuit current). In case of overcurrentBATT-andGNDconnected internallyRBATT-Sresistance. When a load is connected,BATT-The voltage is equal toVDDThe voltage flowing through the load resistor.

According to actions such as cutting off the load,B+andB-When the impedance between them increases to greater than or equal to the impedance that can automatically return to the normal state, the over-discharge current state will be released and return to the normal state. becauseBATT-andGNDconnection betweenRBATT-Sresistor, when the load is disconnected,BATT-The voltage is pulled to ground potential. when detectedBATT-The potential is lower than the overcurrent1Detection voltage (VIOV1), the chip returns to normal state. **Abnormal charging current situation**

During normal charging, ifBATT-The voltage drops below the charge detection voltage (VCHA), the duration exceeds the overcharge voltage detection delay time (tCU), DW03DTurn off chargingFET Stop charging. This is called abnormal charging current detection. when dischargingFETconductive andBATT-The voltage will reach the charge detection voltage (VCHA)The charging current detection does not work normally when the following conditions occur. In the case of over-discharge voltage, when abnormal charging current flows into the battery, the battery voltage changes to the over-discharge detection voltage and the duration reaches the over-charge detection voltage delay time (tCU),DW03DTurn off chargingFETStop charging.

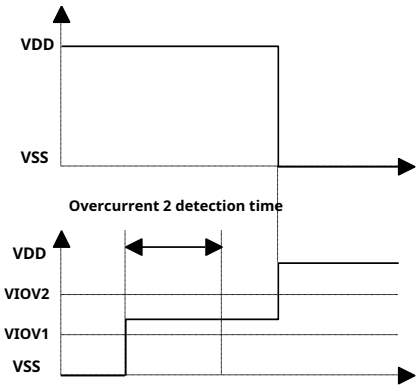
Disconnect the charger,BATT-andGNDThe voltage between is lower than the charger detection voltage (VCHA), the abnormal charging current mode is released. because0VThe battery charging function has a higher priority than abnormal current charging detection, and the battery with very low battery voltage is in progress.0VWhen charging, abnormal charging current detection will not work.

Load short circuit condition

ifBATT-The voltage is higher than the short-circuit protection voltage (VSHORT),DW03DWill be disconnected from the load to stop discharging. The delay time does not exceedtSHORT. when BATT-The voltage is higher than the short-circuit protection voltage (VSHORT)When, for example, the load is removed, the load short circuit condition will be resolved. **Delay circuit**

When over-discharge current1is detected, the over-discharge current2The detection delay time of short circuit with load starts to calculate. Once the over-discharge current is measured2Or the load short-circuit time exceeds the over-discharge current2or load short circuit delay time,DW03DDischarge will stop.

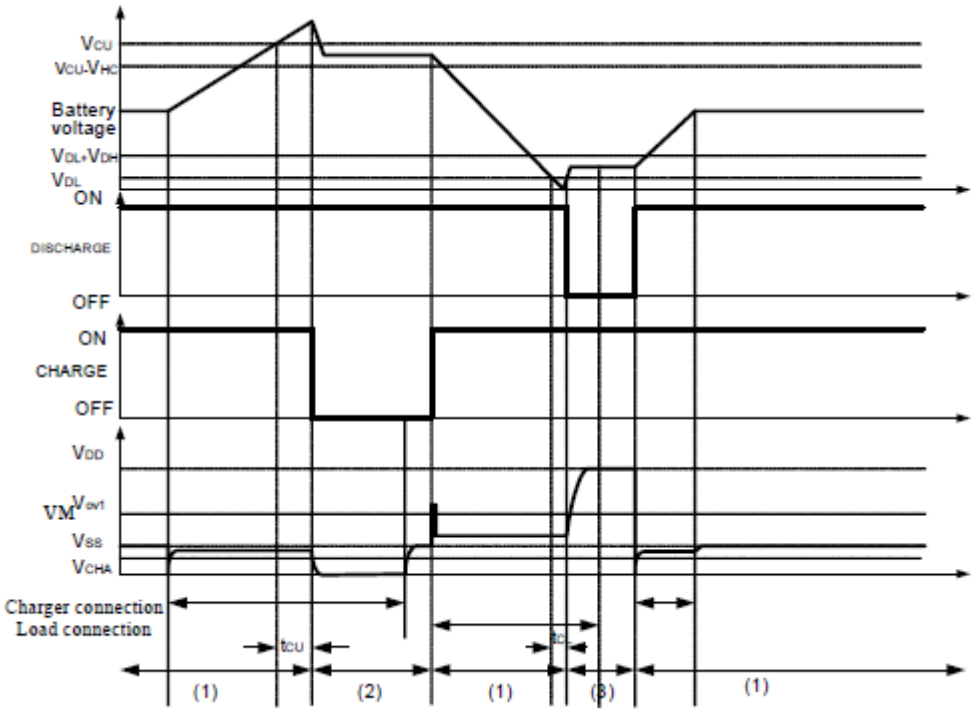
When an over-discharge current is detected and exceeds the over-discharge detection delay time, if the battery voltage is lower than the over-discharge detection voltage, the system will enter the sleep state. If the over-discharge voltage drops to the over-discharge detection voltage due to over-discharge current,DW03DDischarge will be stopped by overdischarge current detection. In this case, the battery voltage recovers very slowly. If after the over-discharge voltage detection delay time, the battery voltage is still lower than the over-discharge detection,DW03DWill go to hibernation state.



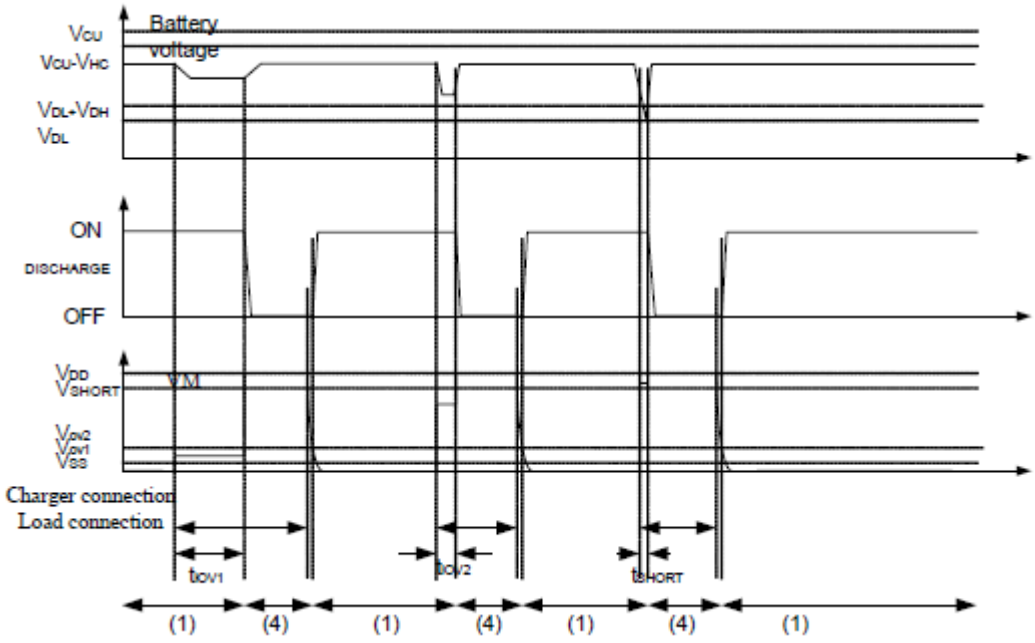
picture2.Pass Current delay time

10. Timing diagram

1, Overcharge and over-discharge voltage detection

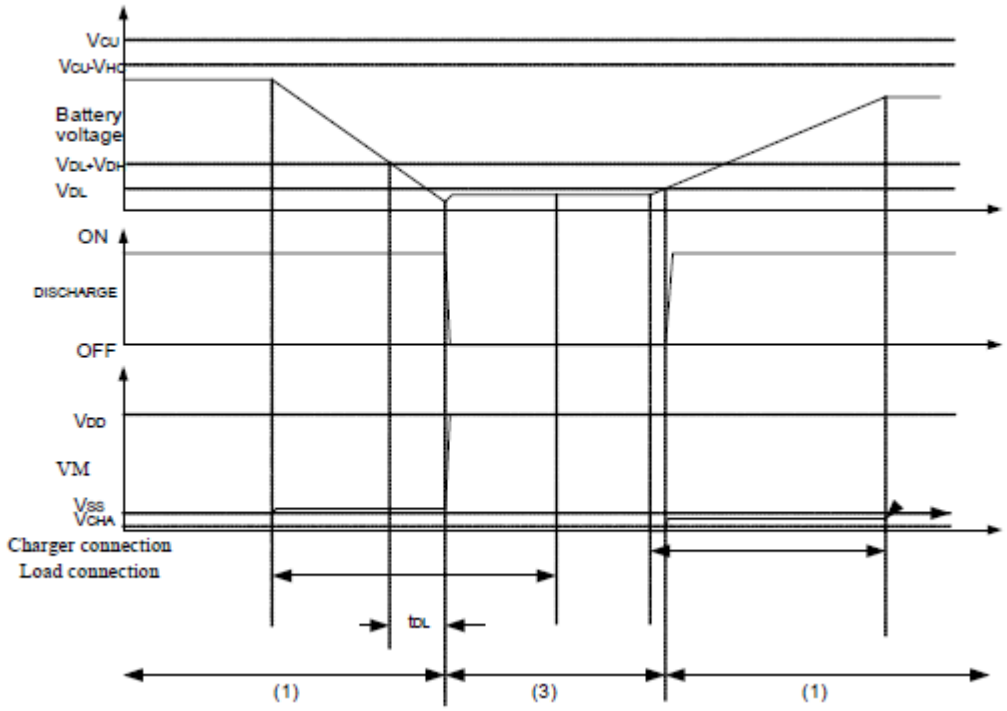


2, Over-discharge current detection

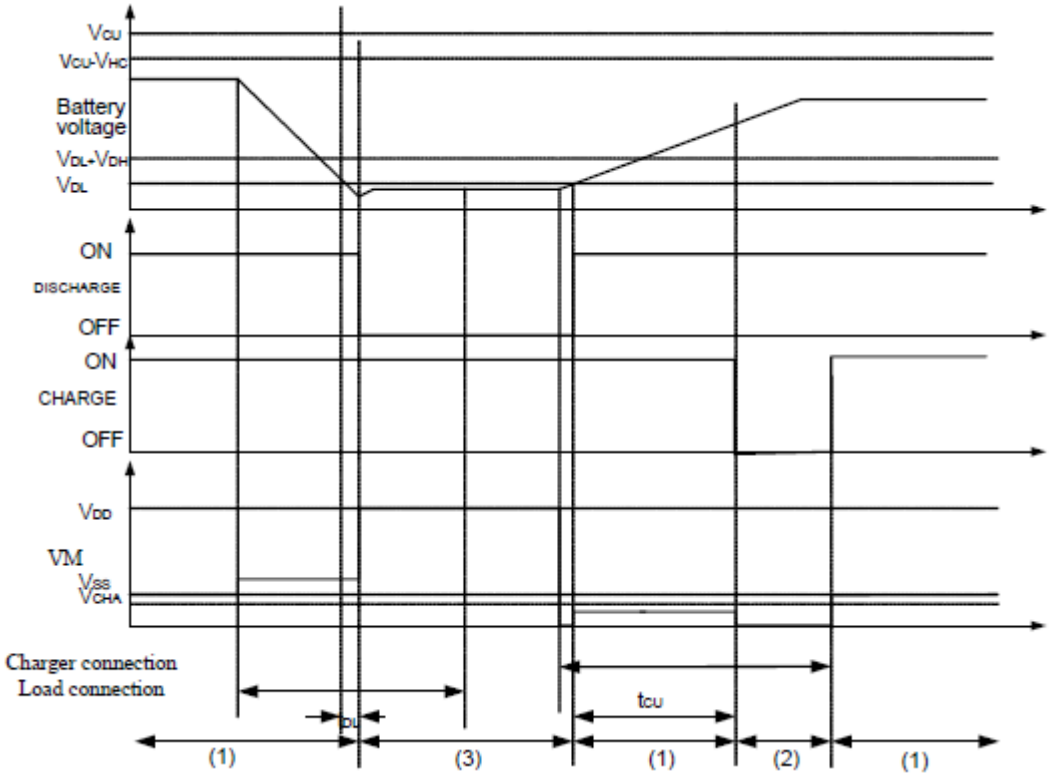


Remark:(1)Normal working status (2) overcharge voltage status (3) over-discharge voltage status (4) overcurrent status

3, charger detection



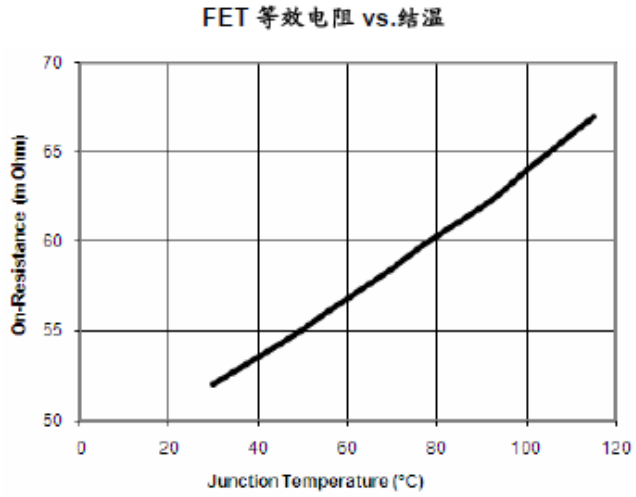
4,Abnormal charging current detection

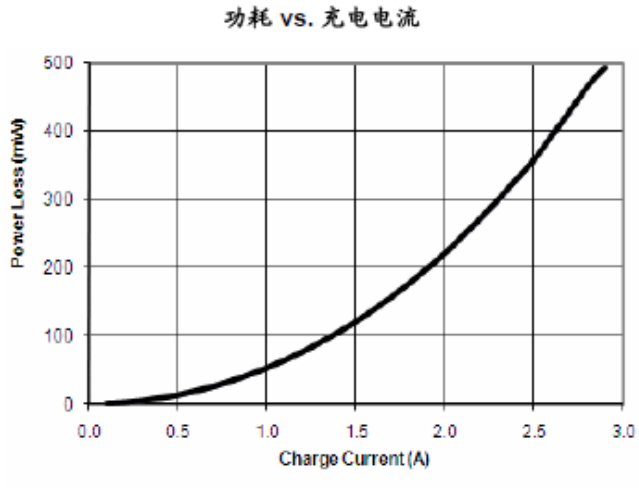


Remark:(1)Normal working status (2) overcharge voltage status (3) over-discharge voltage status (4) overcurrent status

eleven, Typical characteristics

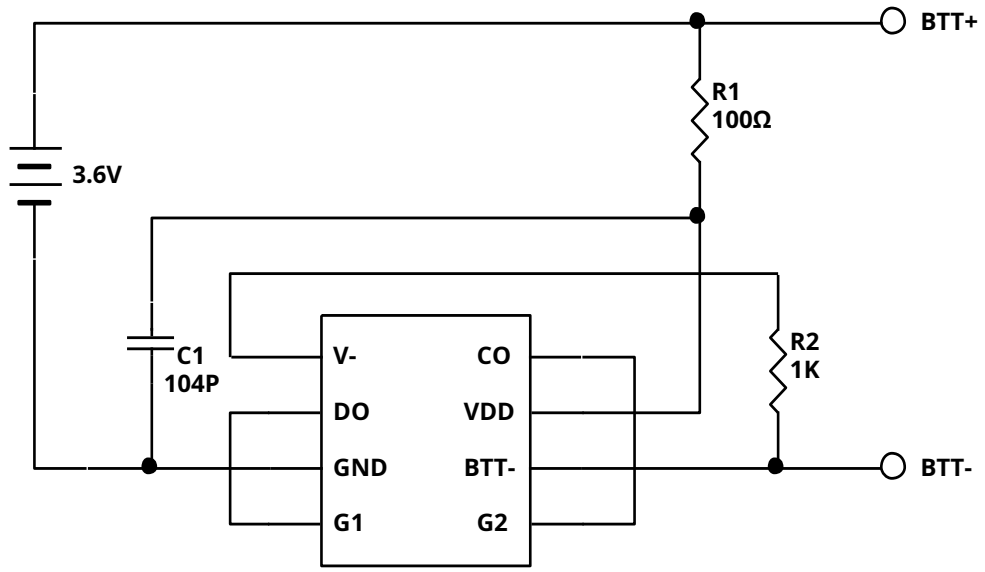
(Unless otherwise notedV_{BAT}=3.6V,T_A=25℃)





twelve, typical application

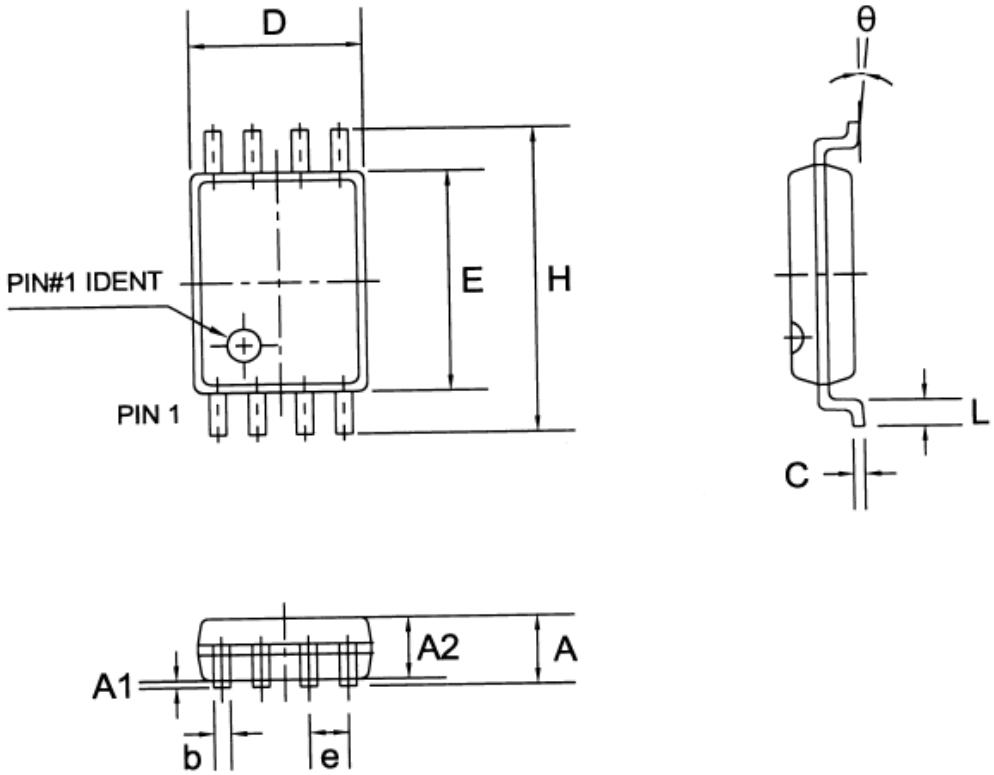
As shown in the picture: The thick wire part is an excessive current wire and must be as short as possible. Decoupling capacitorCto leaveDW03DAs close as possible.



Notice:1. Pay attention to the input and output voltage and load current conditions to ensure that the chip power consumption does not exceed the maximum power consumption that the package can withstand.

2. This product has anti-static protection function, but do not exceed the product's maximum ability to withstand static electricity.

Thirteen, **Package appearance**



symbol	mm			inch		
	smallest	typical	maximum	smallest	typical	maximum
A	1.05	1.10	1.20	0.041	0.043	0.047
A1	0.05	0.10	0.15	0.002	0.004	0.006
A2	0.90	1.00	1.10	0.035	0.039	0.043
b	—	0.27	—	—	0.011	—
C	—	0.127	—	—	0.005	—
D	2.90	3.05	3.10	0.114	0.120	0.122
E	4.30	4.40	4.50	0.169	0.173	0.177
e	—	0.65	—	—	0.026	—
H	6.20	6.40	6.60	0.244	0.252	0.260
L	0.50	0.60	0.70	0.020	0.024	0.028
θ	0°	—	8°	0°	—	8°