

Descriptions

The CTCL3140ZN series product is a high integration solution for lithium-ion/polymer battery protection. CTCL3140ZN contains advanced power MOSFET, high-accuracy voltage detection circuits and delay circuits. CTCL3140ZN is put into an ultra-small DFN1 × 1-4L package and only one external component makes it an ideal solution in limited space of battery pack. CTCL3140ZN has all the protection functions required in the battery application including overcharging, overdischarging, overcurrent and load short circuiting protection etc. The accurate overcharging detection voltage ensures safe and full utilization charging. The low standby current drains little current from the cell while in storage. It also has CTL shipping mode setting function.

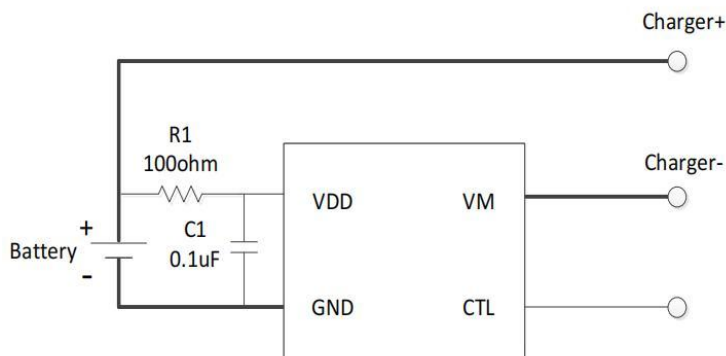
Features

- Integrate advanced power MOSFET with Equivalent of 52mΩ RDS(ON)
- Support CTL shipping mode
- Ultra-small DFN1 × 1-4L package
- Over-temperature Protection. Overcharge Current Protection. Overdischarge Current Protection. Load Short Circuiting Protection
- Charger detection function. 0V battery charging function. delay times are generated inside. High-accuracy voltage detection
- Low Current Consumption. Operation Mode: 2.2μA typ; Power-down Mode: <10nA typ
- Over discharge non self recovery function
- Halogen-free Product

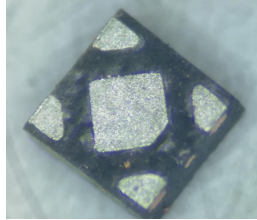
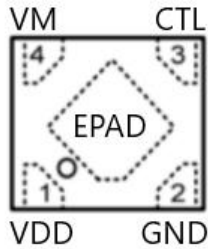
Applications

Portable wireless wearable device

Typical Application



Pinning



Pin Number	引脚名称 Pin Name	引脚说明 Pin Description
1	VDD	电源输入
2	GND	电芯负极
3	CTL	船运模式设置脚，当不用CTL脚时，悬空或者短接到VM都可以
4	VM	充电器或者负载的负极，通过内部的开关管连接到GND
EPAD	NC	无电特性，实际应用建议与GND(BAT-)连接，增强散热能力

Marking

See Marking Instructions.

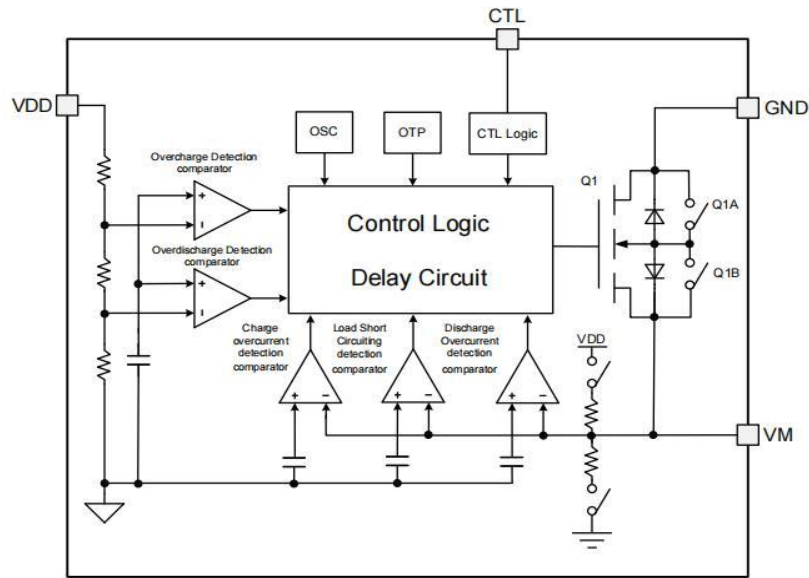
Absolute Maximum Ratings(Ta=25°C)

Parameter	Symbol	Value	Unit
VDD input pin voltage	V_{IN}	-0.3 to +6	V
VM input pin voltage	V_{VM}	-6 to +9	V
CTL input pin voltage	V_{CTL}	-6 to +6	V
Maximum Junction Temperature	T_J	150	°C
Operating Junction Temperature	T_{opr}	-40 to +85	°C
Storage Temperature	T_{stg}	-55 to +150	°C
Package Thermal Resistance	$R_{\theta JA}$	250	°C/W
ESD (HBM)	ESD	6000	V

Electrical Characteristics(Ta=25°C)

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Overcharge Detection Voltage	V _{CU}		4.250	4.275	4.300	V
Overcharge Release Voltage	V _{CL}		4.025	4.075	4.125	V
Overdischarge Detection Voltage	V _{DL}		2.70	2.80	2.90	V
Overdischarge Release Voltage	V _{DR}		2.90	3.00	3.10	V
Overcharge Current Detection	I _{IOCC}	V _{dd} =3.6V	0.21	0.33	0.45	A
Overdischarge Current Detection	I _{IOV}	V _{dd} =3.6V	0.22	0.35	0.47	A
Load Short-Circuiting Detection	I _{SHORT}	V _{dd} =3.6V	0.80	1.15	2	A
Current Consumption in Normal Operation	I _{OPe}	V _{dd} =3.6V V _M =0V		2.2	4.0	μA
Current Consumption in power Down	I _{PDN}	V _{dd} =2V V _M floating			10	nA
Equivalent FET on Resistance	R _{Ds}	V _{dd} =3.6V I _{VM} =0.1A		52	70	mΩ
Over Temperature Protection	T _{SHD+}			135		°C
Over Temperature Recovery Degree	T _{SHD-}			105		°C
Overcharge Current Detection Delay Time	T _{OCC}	V _{dd} =3.6V	4.5	8	11.5	ms
Overcharge Voltage Detection Delay Time	T _{CU}	V _{dd} =3.6V~4.4V	75	125	175	ms
Overdischarge Voltage Detection Delay Time	T _{DL}	V _{dd} =3.6V~2.0V	115	190	265	ms
Overdischarge Current Detection Delay Time	T _{IOV}	V _{dd} =3.6V	4.5	8	11.5	ms
Load Short-Circuiting Detection Delay Time	T _{SHORT}	V _{dd} =3.6V		100	200	us
CTL high level voltage	V _{CTLH}		1.5		5	V
CTL low level voltage	V _{CTLL}				0.3	V
CTL pull-down resistance	R _{CTL}		20	35	55	kΩ
Shipping mode detection delay time	T _{CTL}		300			ms
Resistance between VM and VDD	R _{VMD}	V _{dd} =2V V _M =0V	150	350	500	kΩ
Resistance between VM and GND	R _{VMS}	V _{dd} =3.6V V _M =0.5V	10	25	40	kΩ

Functionl Block Diagram



Functional Description

The CTCL3140ZN monitors the voltage and current of a battery and protects it from being damaged due to overcharge voltage, overdischarge voltage, overdischarge current, and short circuit conditions by disconnecting the battery from the load or charger. The peripheral circuit is very simple. The MOSFET is integrated and its RDS(ON) is as low as 52mΩ typical.

● 正常工作模式

If no exception condition is detected, charging and discharging can be carried out freely. This condition is called the normal operating mode.

● 过充电压情况

When the battery voltage becomes higher than the overcharge detection voltage (VCU) during charging under normal condition and the state continues for the overcharge detection delay time (TCU) or longer, the CTCL3140ZN turns the charging control FET off to stop charging. This condition is called the overcharge condition.

The overcharge condition is released in the following two cases:

- (1) When the battery voltage drops below the overcharge release voltage (VCL), the CTCL3140ZN turns the charging control FET on and returns to the normal condition.

Functional Description

(2) When a load is connected and discharging starts, the CTCL3140ZN turns the charging control FET on and returns to the normal condition. The release mechanism is as follows: the discharging current flows through an internal parasitic diode of the charging FET immediately after a load is connected and discharging starts, and the VM pin voltage increases about 0.7 V (forward voltage of the diode) from the GND pin voltage momentarily. The CTCL3140ZN detects this voltage and releases the overcharge condition. Consequently, in the case that the battery voltage is equal to or lower than the overcharge detection voltage (VCU), the CTCL3140ZN returns to the normal condition immediately, but in the case the battery voltage is higher than the overcharge detection voltage (VCU), the chip does not return to the normal condition until the battery voltage drops below the overcharge detection voltage (VCU) even if the load is connected. In addition, if the VM pin voltage is equal to or lower than the overcurrent detection voltage when a load is connected and discharging starts, the chip does not return to the normal condition.

Note: If the battery is charged to a voltage higher than the overcharge detection voltage (VCU) and the battery voltage does not drop below the overcharge detection voltage (VCU) even when a heavy load, which causes an overcurrent, is connected, the overcurrent does not work until the battery voltage drops below the overcharge detection voltage (VCU). Since an actual battery has, however, an internal impedance of several dozens of m Ω , and the battery voltage drops immediately after a heavy load which causes an overcurrent is connected, the overcurrent works. Detection of load shortcircuiting works regardless of the battery voltage.

- 过放电压情况

When the battery voltage drops below the overdischarge detection voltage (VDL) during discharging under normal condition and it continues for the overdischarge detection delay time (tDL) or longer, the CTCL3140ZN turns the discharging control FET off and stops discharging. This condition is called overdischarge condition. After the discharging control FET is turned off, the VM pin is pulled up by the RVMD resistor between VM and VDD in CTCL3140ZN, the current of the chip is reduced to the power-down current (IPDN). This condition is called power-down condition. The VM and VDD pins are shorted by the RVMD resistor.

Note: If the VM pin voltage is no less than the charger detection voltage (VCHA), when the battery under overdischarge condition is connected to a charger, the overdischarge condition is released (the discharging control FET is turned on) as usual, provided that the battery voltage reaches the overdischarge release voltage (VDR) or higher.

- 过放电流情况

When the discharging current becomes equal to or higher than a specified value (the VM pin voltage is equal to or higher than the overcurrent detection voltage) during discharging under normal condition and the state continues for the overcurrent detection delay time or longer, the CTCL3140ZN turns off the discharging control FET to stop discharging. This condition is called overcurrent condition. (The overcurrent includes overcurrent, or load shortcircuiting.) The VM and GND pins are shorted internally by the RVMS resistor under the overcurrent condition. When a load is connected, the VM pin voltage equals the VDD voltage due to the load.

Functional Description

Because of the connection between the VM and the GND by the RVMS resistor , when the load is removed, the VM pin goes back to the GND potential since the VM pin is shorted the GND pin with the RVMS resistor. Detecting that the VM pin potential is lower than the overcurrent detection voltage (VIOV), the IC returns to the normal condition.

- 异常充电电流检测

If the VM pin voltage drops below the Overcharge Current Detection during charging under the normal condition and it continues for the overcharge detection delay time or longer, the CTCL3140ZN turns the charging control FET off and stops charging. This action is called abnormal charge current detection. Abnormal charge current detection is released when the voltage difference between VM pin and GND pin becomes higher than the charger detection voltage (VCHA) by separating the charger. Since the 0 V battery charging function has higher priority than the abnormal charge current detection function, abnormal charge current may not be detected by the product with the 0 V battery charging function while the battery voltage is low.

- 负载短路情况

If voltage of VM pin is higher short circuiting protection voltage (VSHORT) and it continues for the tSHORT or longer, the CTCL3140ZN will stop discharging and battery is disconnected from load. This status is released when voltage of VM pin is higher than short protection voltage (VSHORT), such as when disconnecting the load.

- 0V电池充电功能

This function enables the charging of a connected battery whose voltage is 0V by self-discharge. When connects to a charger , the discharging control FET is off and the charging current flows through the internal parasitic diode in the discharging control FET. If the battery voltage becomes equal to or higher than the overdischarge release voltage (VDL), the normal condition returns.

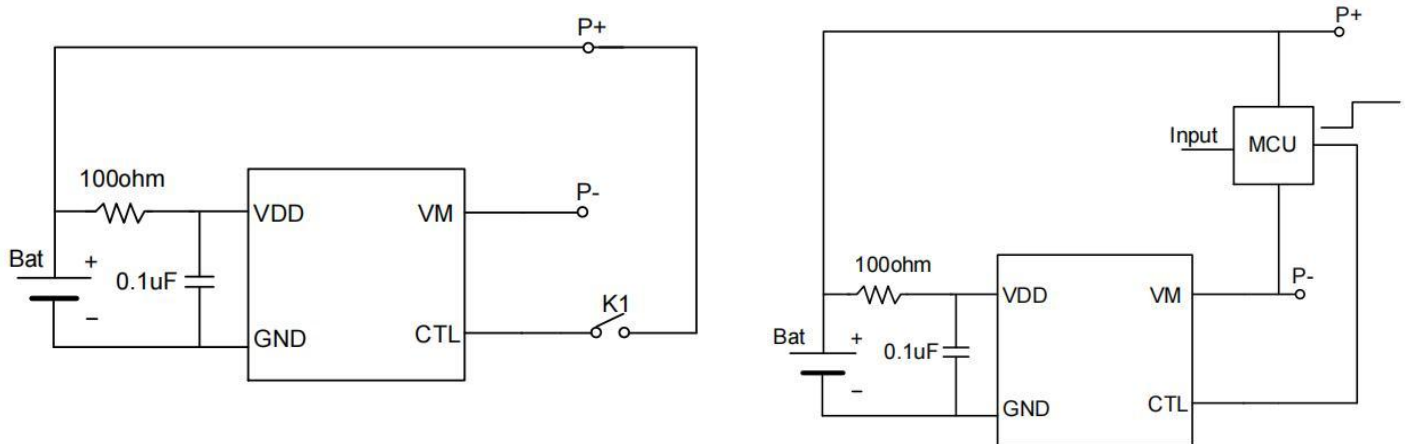
Notes :

- (1) Some battery providers do not recommend charging of completely discharged batteries. Please refer to battery providers before the selection of 0 V battery charging function.
- (2) The 0V battery charging function has higher priority than the abnormal charge current detection function. Consequently, a product with the 0 V battery charging function charges a battery and abnormal charge current cannot be detected during the battery voltage is low.
- (3) When a battery is connected to the IC for the first time, the IC may not enter the normal condition in which discharging is possible. In this case, set the VM pin voltage equal to the GND voltage (short the VM and GND pins or connect a charger) to enter the normal condition.

Functional Description

● CTL 船运模式设置

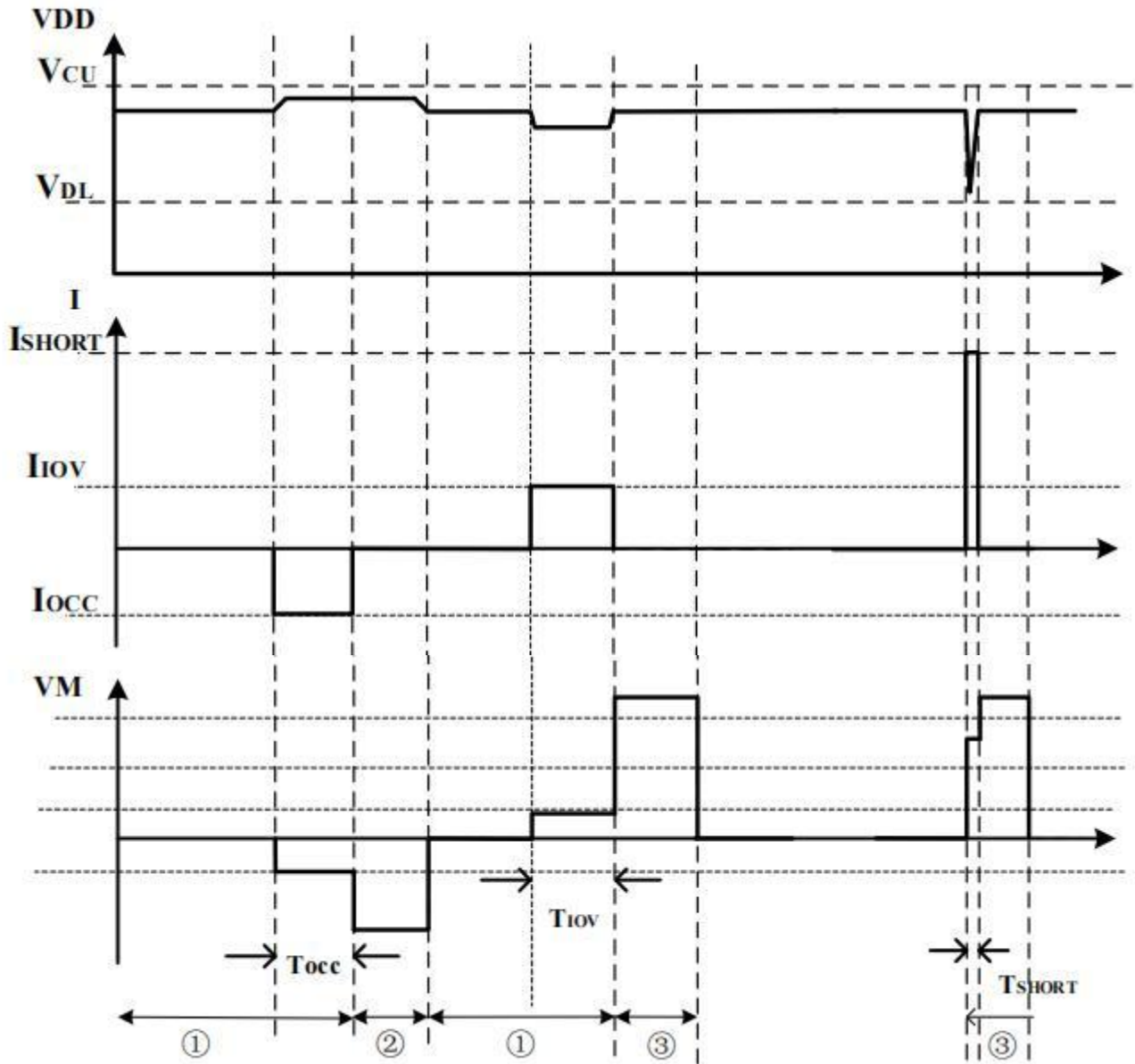
In normal working mode, CTL is suspended or connected to VM. When a high-level voltage is applied to the CTL pin and the duration reaches the shipping mode detection delay (TCTL) or longer, CTCL3140ZN enters the shipping mode, cuts off the connection between the battery and the load and stops discharging. When the FET controlling the discharge is turned off, the VM is pulled to the high level through the rvmid resistance between the internal VM and VDD, and the power consumption current of the chip will drop to the sleep current (IPDN). Connect the charger. If the VM terminal voltage is lower than the charging detection voltage and the battery voltage reaches the over discharge protection voltage (VDL) or higher, the shipping mode is released.



If you want to use shipping mode, you can enter it through a switch or MCU input a high level. The duration is greater than TCTL, and then CTCL3140ZN enters the shipping mode. After entering the shipping mode, the standby current is less than 50nA. Connect the charger, release the shipping mode and enter the normal mode.

Timing Chart

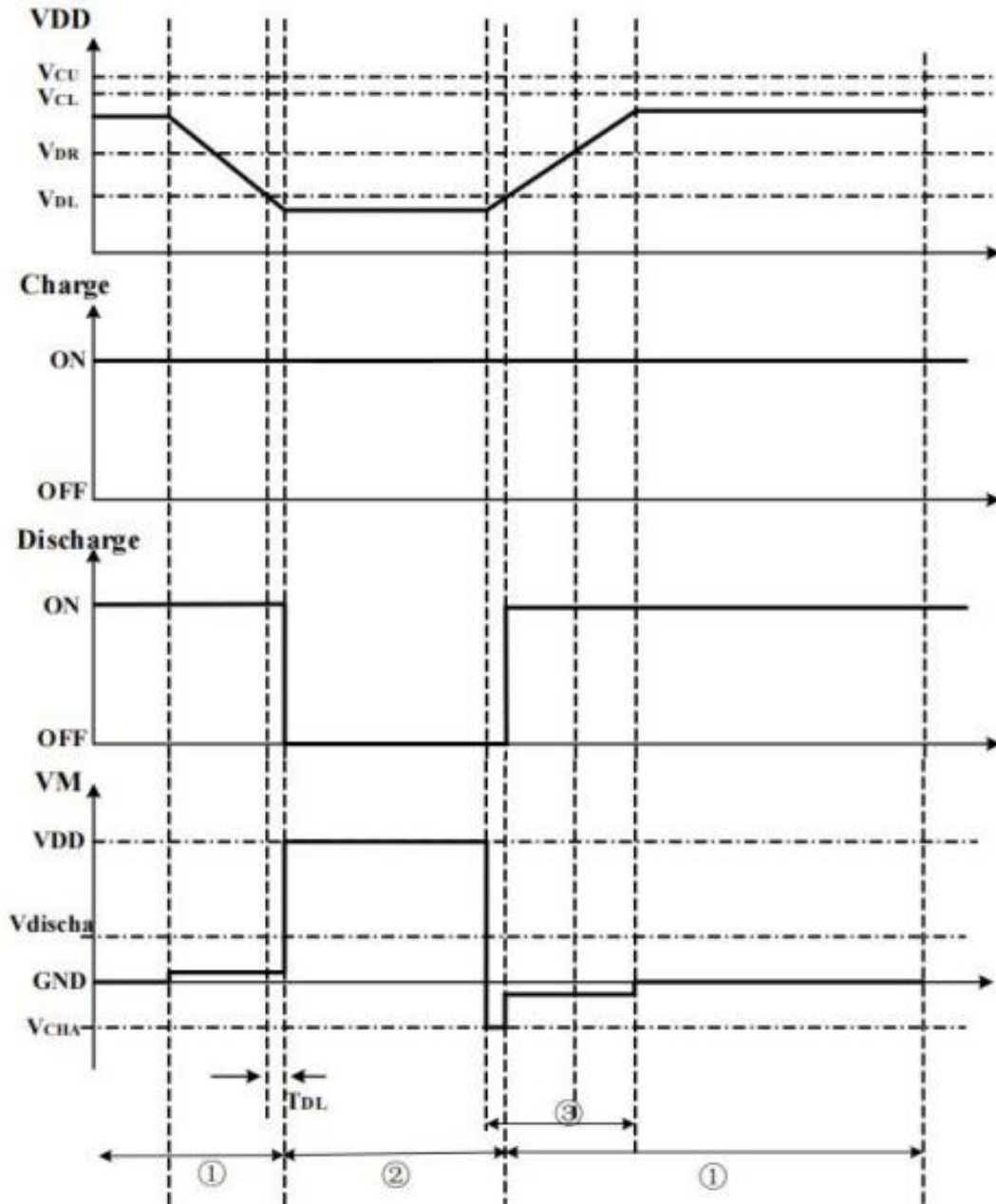
过充和过放电压检测



注: ①正常情况 ②过充电压情况 ③过放电压情况

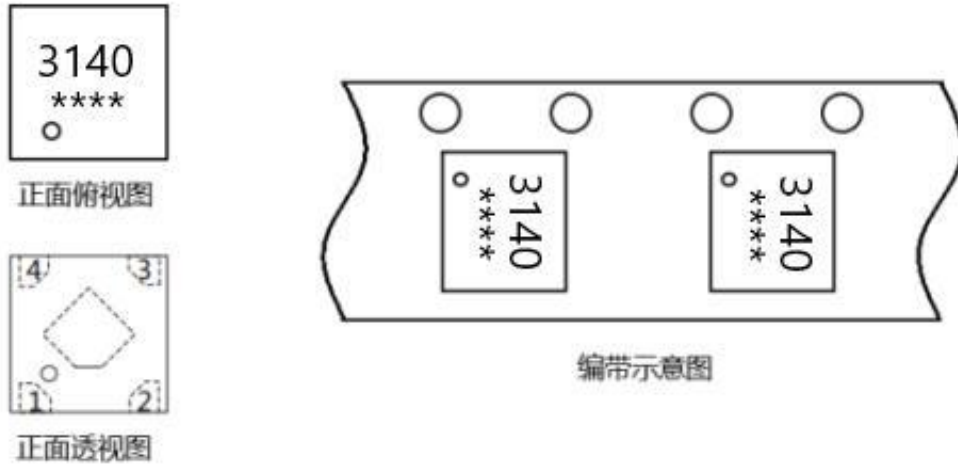
Timing Chart

充电器检测



注：①正常情况 ②过放电压状态 ③充电器接入状态

Marking Instructions



Note:
3140: Product Type.
****: Lot No. Code, code change with Lot No.

Packaging SPEC.

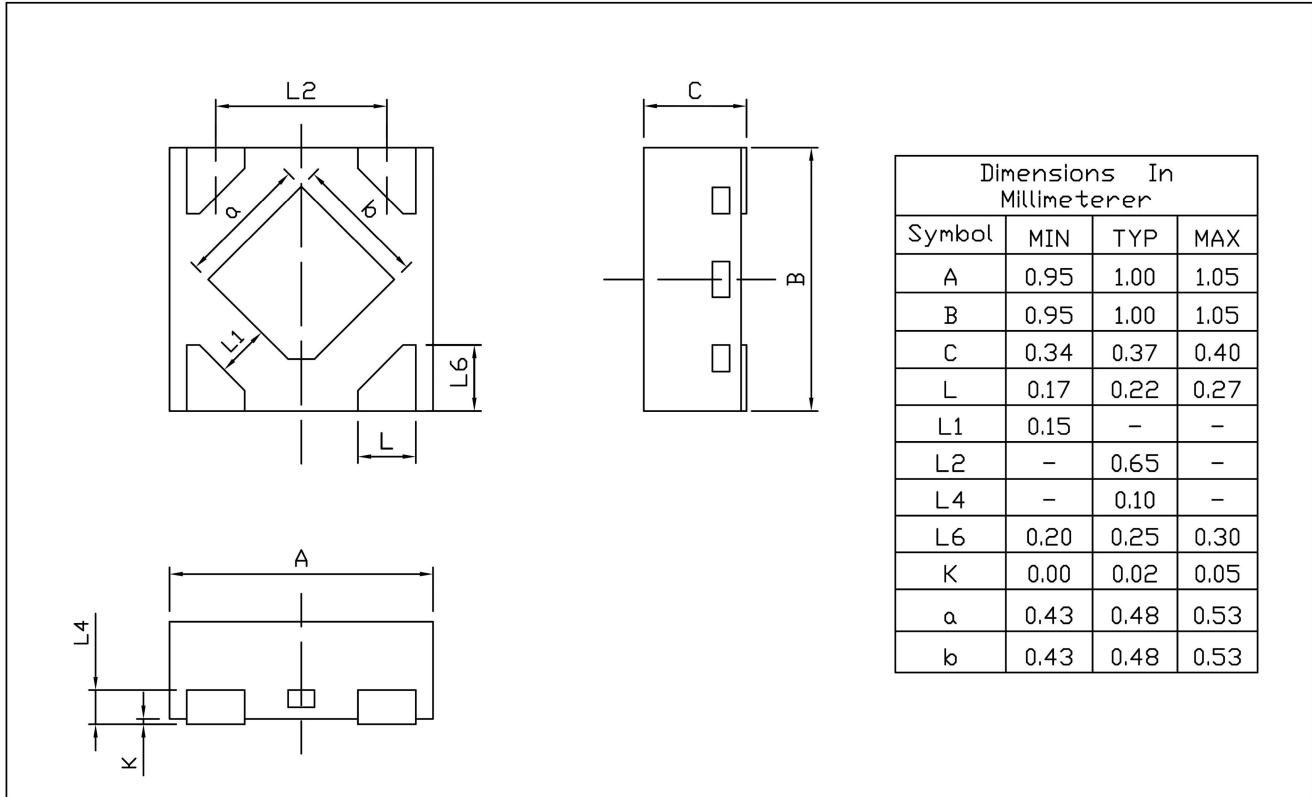
REEL

Package Type	Units					Dimension (unit : mm ³)		
	Units/Reel	Reels/Inner Box	Units/Inner Box	Inner Boxes/Outer Box	Units/Outer Box	Reel	Inner Box	Outer Box
DFN1×1-4L/6L	10,000	10	100,000	4	400,000	7×8	210×205×205	445×230×435

Package Dimensions

DFN1X1-4L-A

Unit:mm



Rev.00 201910