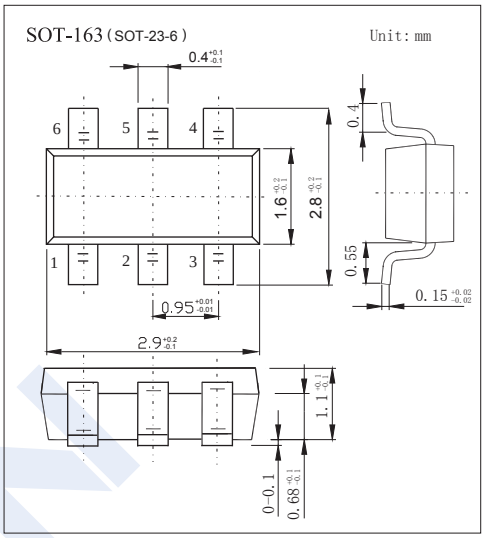
Lithium-ion/Polymer Battery Protection IC

KP00Q02



General Description

The KP00Q02 battery protection IC is designed to protect lithium-ion/polymer battery from damage or degrading the lifetime due to overcharge, overdischarge, and/or overcurrent for one-cell lithium-ion/polymer battery powered systems, such as cellular phones.

Theultra-small package and less required external components make it ideal to integrate the KP00Q01 into the limited space of battery pack. The accurate ±50mV overcharging detection voltage ensures safe and full utilization charging. The very low standby current drains little current from the cell while in storage.

Features

- Reduction in Board Size due to Miniature Package SOT-23-6.
- Ultra-Low Quiescent Current at 3 μA (Vcc=3.9V).
- Ultra-Low Power-Down Current at 0.1μA (Vcc=2.0V).
- Precision Overcharge Protection Voltage 4.3V ± 50mV for the KP00Q02
- Load Detection Function during Overcharge Mode.
- Two Detection Levels for Overcurrent Protection.
- Delay times are generated by internal circuits. No external cap acitors required.

Applications

- Protection IC for One-Cell Lithium-Ion / Lithium-Poly mer Battery Pack

Ordering Information

KP00Q02

PACKAGE TYPE
SOT-23-6

TEMPERATURE RANGE
-40°C~+85°C

OVERCHARGE PROTECTION
4.3V± 50mV

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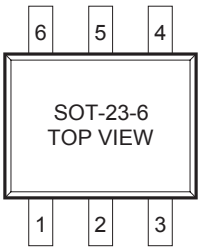
KP00Q02

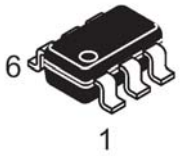
Product NameList

Model	Package	Overcharge detection voltage [V_{OCP}] (V)	Overcharge release voltage [V_{OCR}] (V)	Overdischarge detection voltage [V_{ODP}] (V)	Overdischarge release voltage [V_{ODR}] (V)	Overcurrent detection voltage [V_{OI1}] (mV)
	SOT-23-6					
KP00Q02	DW01B	4.300±0.050	4.100±0.050	2.40±0.100	3.0±0.100	150±30

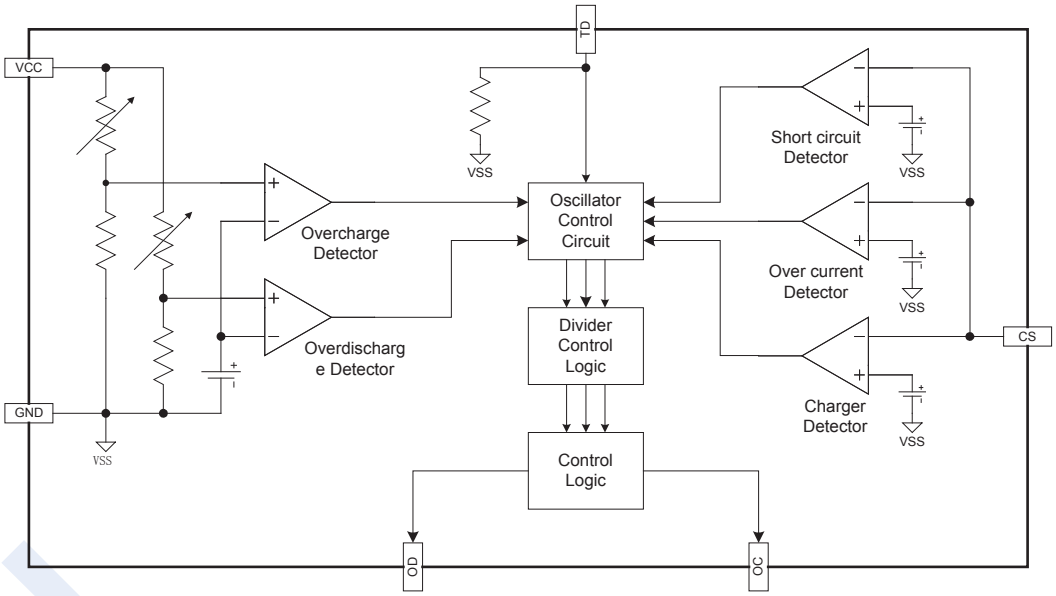
Pin Configuration

Pin No.	Symbol	Description
1	OD	MOSFET gate connection pin for discharge control
2	CS	Input pin for current sense, charger detect
3	OC	MOSFET gate connection pin for charge control
4	TD	Test pin for reduce delay time
5	VCC	Power supply, through a resistor (R1)
6	GND	Ground pin





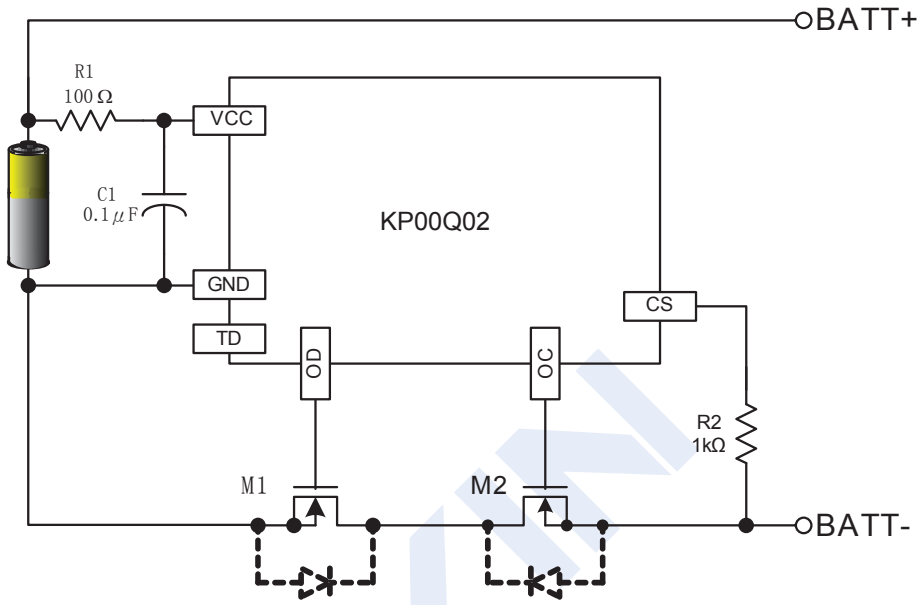
Functional Block Diagram



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Typical Application Circuit



Absolute Maximum Ratings

(VSS=0V, Ta=25°C unless otherwise specified)

Item	Symbol	Rating	Unit
Input voltage between VDD and VSS *	V_{DD}	VSS-0.3 to VSS+10	V
OC output pin voltage	V_{OC}	VDD-26 to VDD+0.3	V
OD output pin voltage	V_{OD}	VSS-0.3 to VDD+0.3	V
CS input pin voltage	V_{CS}	VDD-26 to VDD+0.3	V
Operating Temperature Range	T_{OP}	-40 to +85	°C
Storage Temperature Range	T_{ST}	-40 to +125	°C

Note: KP00Q01 contains a circuit that will protect it from static discharge; but please take special care that no excessive static electricity or voltage which exceeds the limit of the protection circuit will be applied to it.

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Eletrical Characteristics

(Ta=25°C unless otherwise specified)

PARAMETER	TEST CONDITIONS	SYMBOL	Min	Typ	Max	UNIT
Supply Current	VCC=3.9V	ICC		3.0	6.0	μA
Power-Down Current	VCC=2.0V	IPD			0.1	μA
Overcharge Protection Voltage	KP00Q02	VOCP	4.25	4.30	4.35	V
Overcharge Release Voltage		VOCR	4.05	4.10	4.15	V
Overdischarge Protection Voltage		VODP	2.30	2.40	2.50	V
Overdischarge Release Voltage		VODR	2.90	3.00	3.10	V
Overcurrent Protection Voltage		VOIP（VOI1）	120	150	180	mV
Short Current Protection Voltage	VCC=3.6V	VSIP（VOI2）	1.25	1.35	1.45	V
Overcharge Delay Time		TOC		80	200	ms
Overdischarge Delay Time	VCC=3.6V to 2.0V	TOD		20	60	ms
Overcurrent Delay Time (1)	VCC=3.6V	TOI1		10	20	ms
Overcurrent Delay Time (2)	VCC=3.6V	TOI2		5	50	μs
Charger Detection Threshold Voltage		VCH	-1.2	-0.7	-0.2	V
OD Pin Output “H” Voltage		VDH	VCC-0.1	VCC-0.02		V
OD Pin Output “L” Voltage		VDL		0. 1	0.5	V
OC Pin Output “H” Voltage		VCH	VCC-0.1	VCC-0.02		V
OC Pin Output “L” Voltage		VCL		0.1	0.5	V

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Description of Operation

1. Overcharge Protection

When the voltage of the battery cell exceeds the overcharge protection voltage (V_{OCP}) beyond the overcharge delay time (T_{OC}) period, charging is inhibited by turning off of the charge control MOSFET. The overcharge condition is released in two cases:

1) The voltage of the battery cell becomes lower than the overcharge release voltage (V_{OCR}) through self-discharge.
2) The voltage of the battery cell falls below the overcharge protection voltage (V_{OCP}) and a load is connected.

When the battery voltage is above V_{OCP}, the overcharge condition will not release even a load is connected to the pack.

2. Overdischarge Protection

When the voltage of the battery cell goes below the overdischarge protection voltage (V_{ODP}) beyond the overdischarge delay time (T_{OD}) period, discharging is inhibited by turning off the discharge control MOSFET. The default of overdischarge delay time is 10ms. Inhibition of discharging is immediately released when the voltage of the battery cell becomes higher than overdischarge release voltage (V_{ODR}) through charging.

3. Overcurrent Protection

In normal mode, the KP00Q02 continuously monitors the discharge current by sensing the voltage of CS pin. If the voltage of CS pin exceeds the overcurrent protection voltage (V_{OIP}) beyond the overcurrent delay time (T_{OI1}) period, the overcurrent protection circuit operates and discharging is inhibited by turning off the discharge control MOSFET. The overcurrent condition returns to the normal mode when the load is released or the impedance between BATT+ and BATT- is larger than 500kΩ. The KP00Q02 provides two overcurrent detection levels (0.15V and 1.35V) with two overcurrent delay time (T_{OI1} and T_{OI2}) corresponding to each overcurrent detection level.

4. Charge Detection after Overdischarge

When overdischarge occurs, the discharge control MOSFET turns off and discharging is inhibited. However, charging is still permitted through the parasitic diode of MOSFET. Once the charger is connected to the battery pack, the KP00Q02 immediately turns on all the timing generation and detection circuitry. Charging progress is sensed if the voltage between CS and GND is below charge detection threshold voltage (V_{CH}).

5. Power-Down after Overdischarge

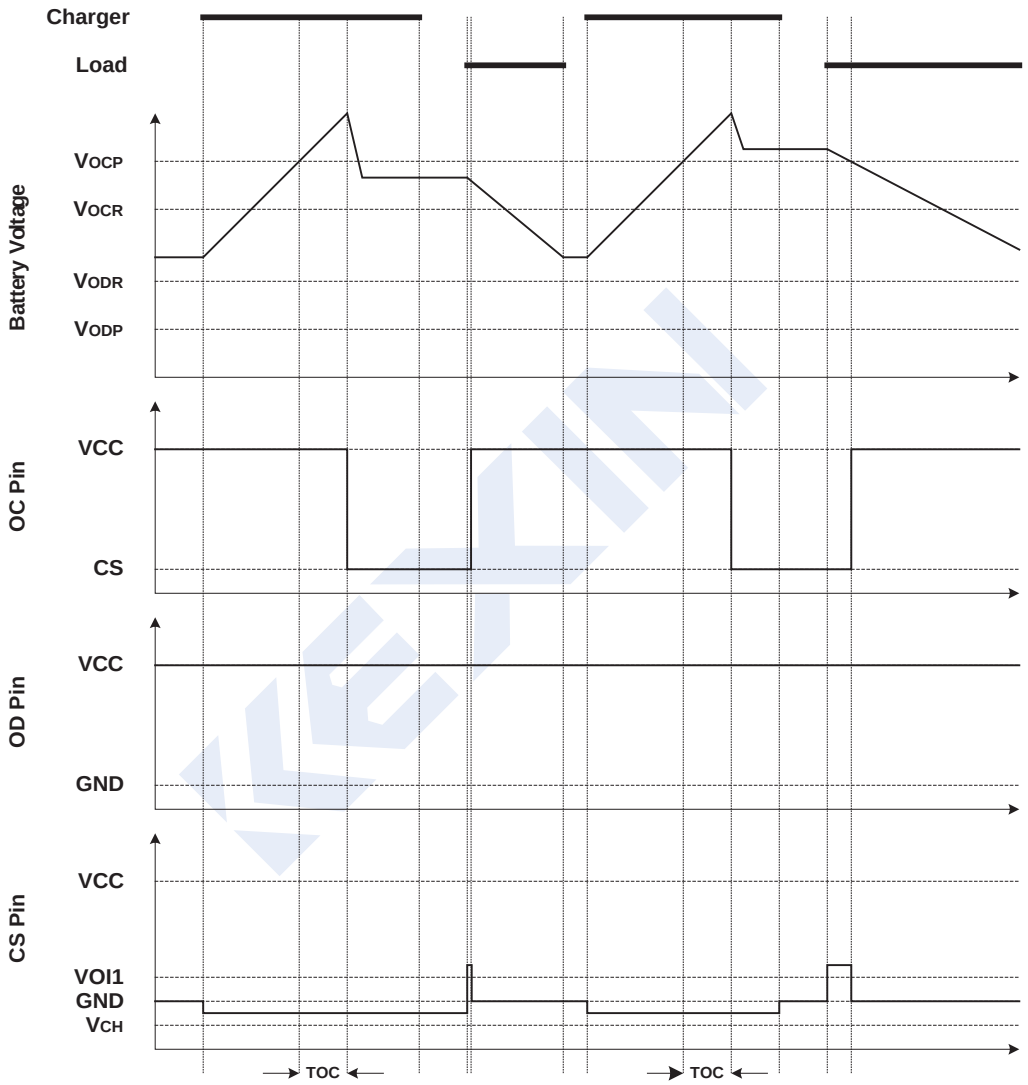
When overdischarge occurs, the KP00Q01 will enter into power-down mode, turning off all the timing generation and detection circuitry to reduce the quiescent current to 0.1μ A (VCC=2.0V). At the same time, the CS pin is pull-up to V_{CC} through an internal resistor.

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Timing Diagram

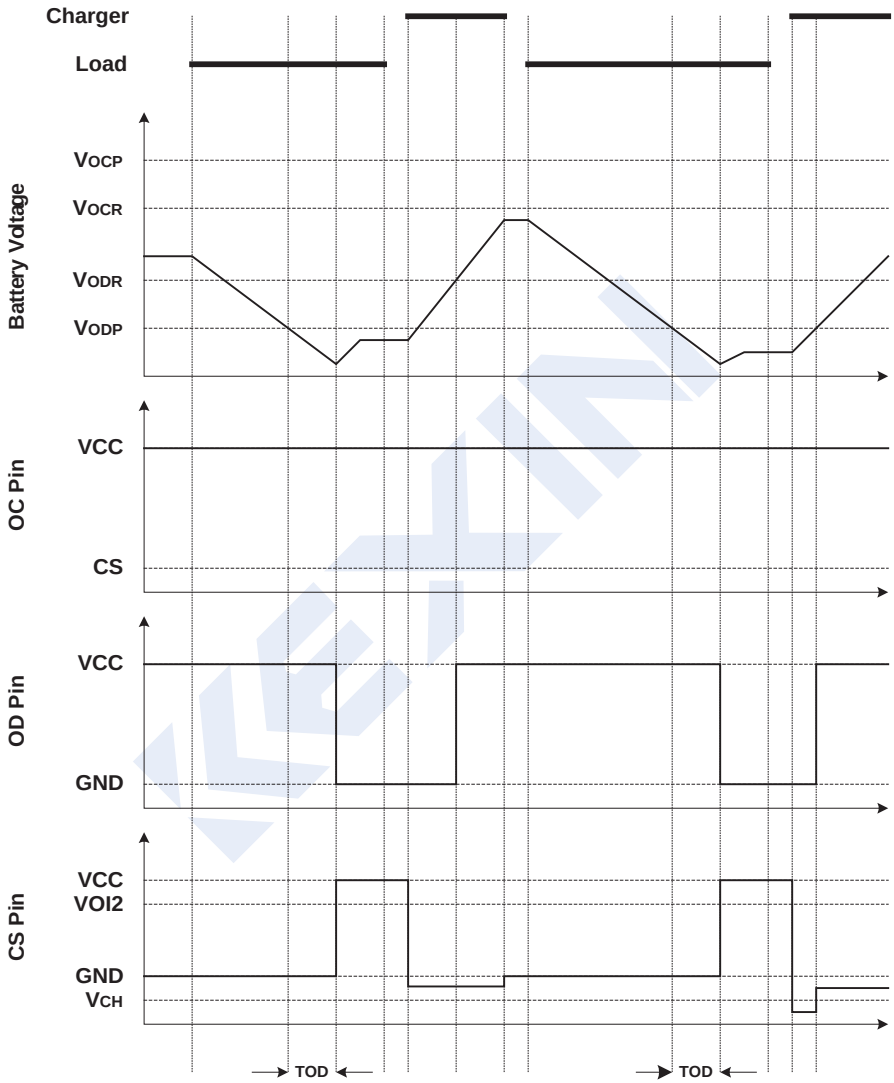
1. Overcharge Condition →Load Discharging → Normal Condition



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2. Overdischarge Condition → Charging by a Charger →Normal Condition



Lithium-ion/Polymer Battery Protection IC

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3. Over Current Condition → Normal Condition

