SGM41030
Over-Voltage Protection for 2-Series to 3-Series Cell Li-Ion Batteries with Low Operating Consumption

GENERAL DESCRIPTION

The SGM41030 series can monitor over-voltage events and provide over-voltage protections for 2-series cell to 3-seires cell Li-Ion battery pack systems.

When the device detects an over-voltage event on any cell of the battery pack, an internal delay timer is initiated. Once the delay timer expires, the output of the device is triggered into active state. The topology of the output is optional for N-channel open-drain (active-low) or CMOS (active-high) output.

The SGM41030 is available in a Green SOT-23-6 package.

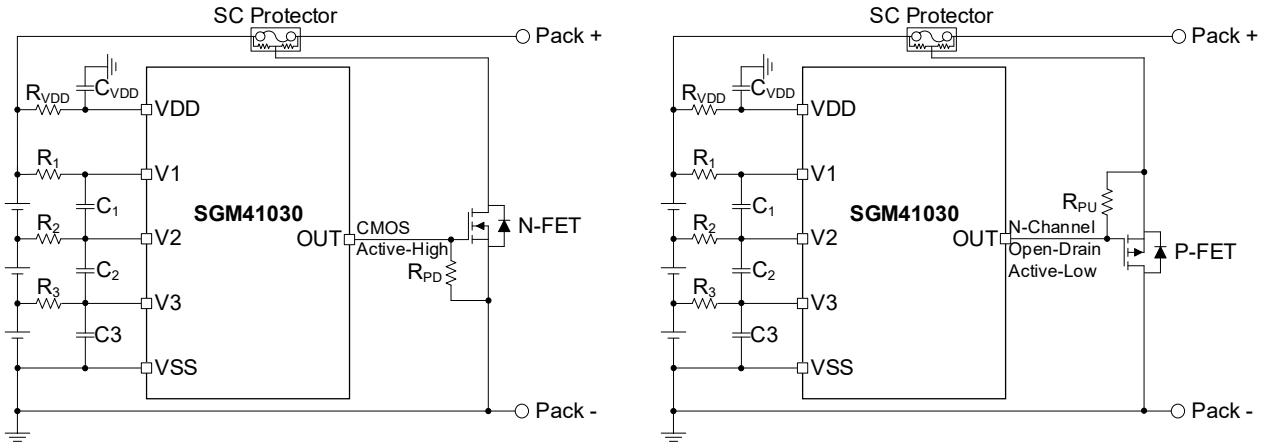
APPLICATIONS

Notebooks
Cordless Vacuum Cleaners
Handheld Power Tools
Handheld Garden Tools
Light Electric Vehicles
UPS Battery Backup

FEATURES

- **2- to 3-Series Cell Over-Voltage Protection (OVP)**
- **3.85V to 4.7V Optional OVP Threshold with 25mV per Step**
- **±20mV OVP Accuracy**
- **Optional OVP Hysteresis:**
  - **One Time Latch Option**
  - **100mV/200mV/300mV/400mV Options**
- **Optional Output Topology:**
  - **N-Channel Open-Drain Output, Active-Low**
  - **CMOS Output, Active-High**
- **2s/4s/6s/8s Optional Output Delay Timer**
- **700nA Operating Consumption**
- **Internal Delay Timer**
- **Customer Test Mode (CTM) to Reduce the Delay Time**
- **Available in a Green SOT-23-6 Package**

SIMPLIFIED SCHEMATIC



(a) SGM41030 CMOS Active-High Option

(b) SGM41030 N-Channel Open-Drain Active-Low Option

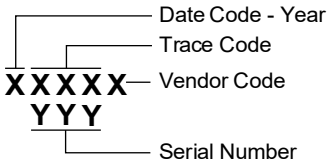
Figure 1. Simplified Schematic

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM41030-85C63	SOT-23-6	-40℃ to +110℃	SGM41030-85C63GN6G/TR	XXXXX 2S2	Tape and Reel, 3000
SGM41030-95D41	SOT-23-6	-40℃ to +110℃	SGM41030-95D41GN6G/TR	XXXXX 2S3	Tape and Reel, 3000
SGM41030-20D21	SOT-23-6	-40℃ to +110℃	SGM41030-20D21GN6G/TR	XXXXX 2RW	Tape and Reel, 3000
SGM41030-20C21	SOT-23-6	-40℃ to +110℃	SGM41030-20C21GN6G/TR	XXXXX 2RX	Tape and Reel, 3000
SGM41030-22D23	SOT-23-6	-40℃ to +110℃	SGM41030-22D23GN6G/TR	XXXXX 2RS	Tape and Reel, 3000
SGM41030-22D21	SOT-23-6	-40℃ to +110℃	SGM41030-22D21GN6G/TR	XXXXX 2RZ	Tape and Reel, 3000
SGM41030-22C21	SOT-23-6	-40℃ to +110℃	SGM41030-22C21GN6G/TR	XXXXX 2RY	Tape and Reel, 3000
SGM41030-27D21	SOT-23-6	-40℃ to +110℃	SGM41030-27D21GN6G/TR	XXXXX 2RT	Tape and Reel, 3000
SGM41030-27D43	SOT-23-6	-40℃ to +110℃	SGM41030-27D43GN6G/TR	XXXXX 2S1	Tape and Reel, 3000
SGM41030-27C21	SOT-23-6	-40℃ to +110℃	SGM41030-27C21GN6G/TR	XXXXX 2S0	Tape and Reel, 3000
SGM41030-30C63	SOT-23-6	-40℃ to +110℃	SGM41030-30C63GN6G/TR	XXXXX 2RR	Tape and Reel, 3000
SGM41030-30C23	SOT-23-6	-40℃ to +110℃	SGM41030-30C23GN6G/TR	XXXXX 2DS	Tape and Reel, 3000
SGM41030-35C63	SOT-23-6	-40℃ to +110℃	SGM41030-35C63GN6G/TR	XXXXX 2RU	Tape and Reel, 3000
SGM41030-45C63	SOT-23-6	-40℃ to +110℃	SGM41030-45C63GN6G/TR	XXXXX 2RV	Tape and Reel, 3000

MARKING INFORMATION

NOTE: XXXXX = Date Code, Trace Code and Vendor Code.



Green (RoHS & HSF): SG Micro Corp defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your SGMICRO representative directly.

DEVICE DESCRIPTION

Table 1. Key Parameters and Options/Part Numbering

Model: SGM41030-AABCD								
Over-Voltage Detection Threshold Options								
Option Code "**AA**"	**85**	**87**	**90**	**92**	**95**	**97**	**00**	**02**
OVP Threshold V_{OV} (V)	3.850	3.875	3.900	3.925	3.950	3.975	4.000	4.025
Option Code "**AA**"	**05**	**07**	**10**	**12**	**15**	**17**	**20**	**22**
OVP Threshold V_{OV} (V)	4.050	4.075	4.100	4.125	4.150	4.175	4.200	4.225
Option Code "**AA**"	**25**	**27**	**30**	**32**	**35**	**37**	**40**	**42**
OVP Threshold V_{OV} (V)	4.250	4.275	4.300	4.325	4.350	4.375	4.400	4.425
Option Code "**AA**"	**45**	**47**	**50**	**52**	**55**	**57**	**60**	**62**
OVP Threshold V_{OV} (V)	4.450	4.475	4.500	4.525	4.550	4.575	4.600	4.625
Option Code "**AA**"	**65**	**67**	**70**					
OVP Threshold V_{OV} (V)	4.650	4.675	4.700					
Output Form Options								
Option Code "**B**"	**C**				**D**			
Output Forms	CMOS (Active-High) Output				N-Channel Open-Drain (Active-Low) Output			
Over-Voltage Delay Time Options								
Option Code "**C**"	**2**		**4**		**6**		**8**	
Output Delay Timer t_{DELAY} (s)	2		4		6		8	
Over-Voltage Detection Hysteresis Options								
Option Code "**D**"	**0**		**1**	**2**		**3**		**4**
OVP Hysteresis V_{HYS} (mV)	One Time Latch		100	200		300		400

NOTE: Samples are only available for some part numbers. Contact SGMICRO for sample availability.

DEVICE COMPARISON TABLE

MODEL	OVP Threshold (V)	OVP Hysteresis (mV)	Output Delay Timer (s)	Output Forms
SGM41030-85C63	3.850	300	6	CMOS, Active-High
SGM41030-95D41	3.950	100	4	N-Channel Open-Drain, Active-Low
SGM41030-20D21	4.200	100	2	N-Channel Open-Drain, Active-Low
SGM41030-20C21	4.200	100	2	CMOS, Active-High
SGM41030-22D23	4.225	300	2	N-Channel Open-Drain, Active-Low
SGM41030-22D21	4.225	100	2	N-Channel Open-Drain, Active-Low
SGM41030-22C21	4.225	100	2	CMOS, Active-High
SGM41030-27D21	4.275	100	2	N-Channel Open-Drain, Active-Low
SGM41030-27D43	4.275	300	4	N-Channel Open-Drain, Active-Low
SGM41030-27C21	4.275	100	2	CMOS, Active-High
SGM41030-30C63	4.300	300	6	CMOS, Active-High
SGM41030-30C23	4.300	300	2	CMOS, Active-High
SGM41030-35C63	4.350	300	6	CMOS, Active-High
SGM41030-45C63	4.450	300	6	CMOS, Active-High
SGM41030-AABCD	3.85V to 4.7V	Latch/100mV/200mV/ 300mV/400mV	2s/4s/6s/8s	N-Channel Open-Drain, Active-Low/ CMOS, Active-High
NOTE: SGM41030-AABCD family products can be customized for other options, please contact with SG MICRO for more information.				

ABSOLUTE MAXIMUM RATINGS

Voltage Range (with Respect to VSS)
- VDD ..... -0.3V to 30V
- V1, V2, V3 ..... -0.3V to 30V
- OUT ..... -0.3V to 30V
- V1 - V2, V2 - V3, V3 - VSS ..... -0.3V to 6V

Package Thermal Resistance
- SOT-23-6, θ_{JA} ..... 161.8℃/W
- SOT-23-6, θ_{JB} ..... 48.2℃/W
- SOT-23-6, θ_{JC} ..... 97.8℃/W

Junction Temperature ..... +150℃
Storage Temperature Range ..... -65℃ to +150℃
Lead Temperature (Soldering, 10s) ..... +260℃
ESD Susceptibility (1) (2)
HBM ..... ±3000V
CDM ..... ±1000V

NOTES:

1. For human body model (HBM), all pins comply with ANSI/ESDA/JEDEC JS-001 specifications.

2. For charged device model (CDM), all pins comply with ANSI/ESDA/JEDEC JS-002 specifications.

RECOMMENDED OPERATING CONDITIONS

Voltage Range (with Respect to VSS)
- VDD ..... 3V to 25V
- V1 - V2, V2 - V3, V3 - VSS ..... 0V to 5V

Operating Ambient Temperature Range ..... -40℃ to +110℃

OVERSTRESS CAUTION

Stresses beyond those listed in Absolute Maximum Ratings may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect reliability. Functional operation of the device at any conditions beyond those indicated in the Recommended Operating Conditions section is not implied.

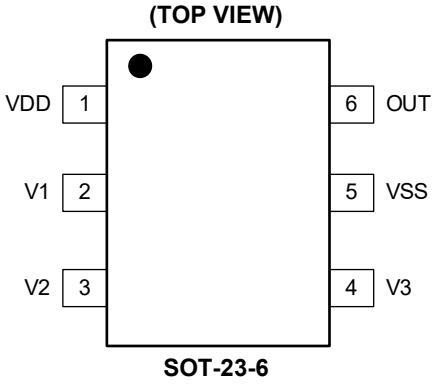
ESD SENSITIVITY CAUTION

This integrated circuit can be damaged if ESD protections are not considered carefully. SGMICRO recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because even small parametric changes could cause the device not to meet the published specifications.

DISCLAIMER

SG Micro Corp reserves the right to make any change in circuit design, or specifications without prior notice.

PIN CONFIGURATION



PIN DESCRIPTION

PIN	NAME	TYPE	DESCRIPTION
1	VDD	P	Power Supply Pin.
2	V1	I	Sense Positive Cell Voltage Input Pin. It is used to sense the third cell voltage from the bottom of the stack.
3	V2	I	Sense Positive Cell Voltage Input Pin. It is used to sense the second cell voltage from the bottom of the stack.
4	V3	I	Sense Positive Cell Voltage Input Pin. It is used to sense the lowest cell voltage from the bottom of the stack.
5	VSS	P	It is connected to IC ground and negative terminal of the bottom cell.
6	OUT	O	Output Drive Pin for Over-Voltage Fault Signal.

NOTE: I = input, O = output, P = power.

ELECTRICAL CHARACTERISTICS

(V_{VDD} = 10.8V, T_A = -40℃ to +110℃, typical values are measured at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Voltage Protection Threshold						
Over-Voltage Detection Threshold (Rising)	V_{OV}	SGM41030-85C63		3.850		V
		SGM41030-95D41		3.950		
		SGM41030-20D21/SGM41030-20C21		4.200		
		SGM41030-22D23/SGM41030-22D21/ SGM41030-22C21		4.225		
		SGM41030-27D21/SGM41030-27D43/ SGM41030-27C21		4.275		
		SGM41030-30C63/SGM41030-30C23		4.300		
		SGM41030-35C63		4.350		
		SGM41030-45C63		4.450		
		SGM41030-AABCD	3.85	25mV/Step	4.7	
Over-Voltage Detection Hysteresis (Falling)	V_{HYS}	SGM41030-85C63/SGM41030-22D23/ SGM41030-27D43/SGM41030-30C63/ SGM41030-30C23/SGM41030-35C63/ SGM41030-45C63	250	300	400	mV
		SGM41030-95D41/SGM41030-20D21/ SGM41030-20C21/SGM41030-22D21/ SGM41030-22C21/SGM41030-27D21/ SGM41030-27C21	50	100	150	
		SGM41030-AABCD	100	Latch/ 100/200/ 300/400	400	
Over-Voltage Detection Accuracy across Ambient Temperature	V_{OA}	T_A = +25℃	-15		15	mV
		T_A = -40℃ to +110℃	-20		20	
Power Supply and Leakage Current						
Supply Current	I_{CC}	$(V_1 - V_2) = (V_2 - V_3) = (V_3 - V_{VSS}) = 4V$, see Figure 6		0.7	2	μA
Input Current at Vn Pins	I_{IN}	$(V_1 - V_2) = (V_2 - V_3) = (V_3 - V_{VSS}) = 4V$, see Figure 6	-0.1		0.1	μA

ELECTRICAL CHARACTERISTICS (continued)

(V_{VDD} = 10.8V, T_A = -40℃ to +110℃, typical values are measured at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Drive OUT, CMOS Active-High Option						
Output Drive Voltage (Active-High)	V_{OUT1}	(V_1 - V_2) or (V_2 - V_3) or (V_3 - V_{VSS}) > V_{OV}, V_{VDD} = 10.8V, I_{OH} = 100μA	4.5	5.3	6.5	V
		If two cells are short circuited and only one cell remains powered and the voltage > V_{OV}, V_{VDD} = V_n (cell voltage), I_{OH} = 100μA		V_{VDD} - 0.4		V
		(V_1 - V_2) and (V_2 - V_3) and (V_3 - V_{VSS}) < V_{OV}, V_{VDD} = 10.8V, I_{OL} = 100μA, measured into OUT pin		280	550	mV
OUT Source Current (during OV)	I_{OUTH1}	(V_1 - V_2) or (V_2 - V_3) or (V_3 - V_{VSS}) > V_{OV}, V_{VDD} = 10.8V, V_{OUT} = 0V, measured out of OUT pin			5	mA
OUT Sink Current (no OV)	I_{OUTL1}	(V_1 - V_2) and (V_2 - V_3) and (V_3 - V_{VSS}) < V_{OV}, V_{VDD} = 10.8V, V_{OUT} = V_{VDD}, measured into OUT pin	0.5		8.5	mA
Output Drive OUT, N-Channel Open-Drain Active-Low Option						
Output Drive Voltage (Active-Low)	V_{OUT2}	(V_1 - V_2) or (V_2 - V_3) or (V_3 - V_{VSS}) > V_{OV}, V_{VDD} = 10.8V, I_{OL} = 100μA, measured into OUT pin		280	550	mV
OUT Sink Current (during OV)	I_{OUTH2}	(V_1 - V_2) or (V_2 - V_3) or (V_3 - V_{VSS}) > V_{OV}, V_{VDD} = 10.8V, V_{OUT} = V_{VDD}, measured into OUT pin	0.5		8.5	mA
OUT Source Current (no OV)	I_{OUTL2}	(V_1 - V_2) and (V_2 - V_3) and (V_3 - V_{VSS}) < V_{OV}, V_{VDD} = 10.8V, V_{OUT} = V_{VDD}, measured into OUT pin			100	nA

TIMING REQUIREMENTS

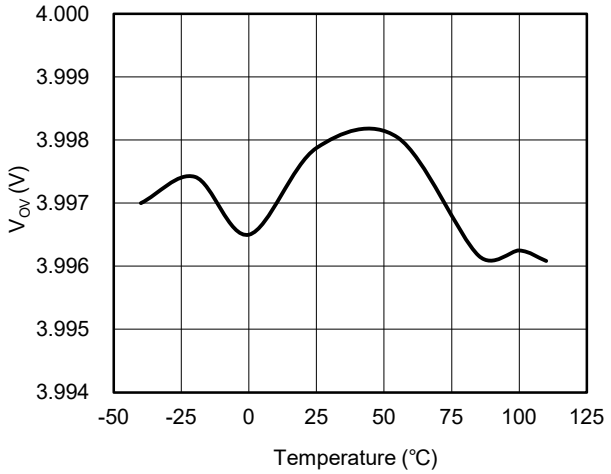
(T_A = -40℃ to +110℃, typical values are measured at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Delay Timer						
Over-Voltage Delay Time	t_{DELAY}	SGM41030-85C63/SGM41030-30C63/SGM41030-35C63/ SGM41030-45C63	2	6	10	s
		SGM41030-95D41/SGM41030-27D43	1.5	4	6.5	
		SGM41030-20D21/SGM41030-20C21/SGM41030-22D23/ SGM41030-22D21/SGM41030-22C21/SGM41030-27D21/ SGM41030-27C21/SGM41030-30C23	0.5	2	3.5	
		Preview option only, contact with SGMICRO	3	8	13	
Customer Test Mode Over-Voltage Detection Delay Time	$t_{CTMDELAY}$	See Customer Test Mode section	5	15	25	ms

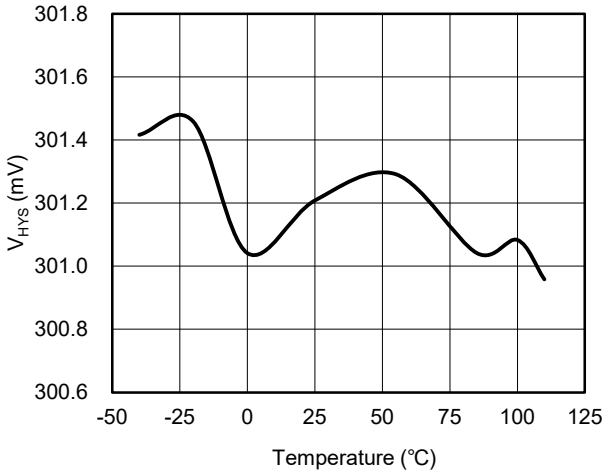
TYPICAL PERFORMANCE CHARACTERISTICS

T_A = -40℃ to +110℃, unless otherwise noted.

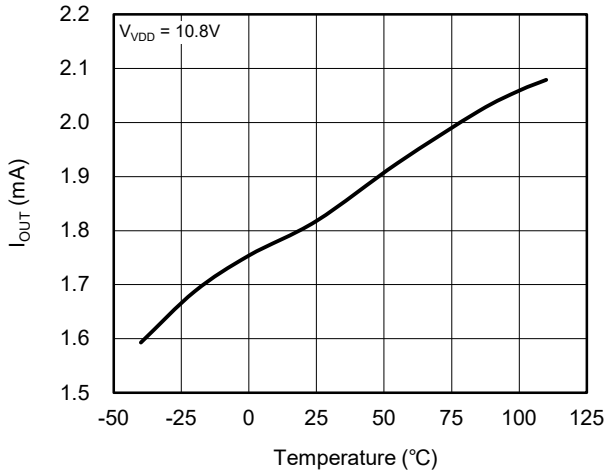
Over-Voltage Detection Threshold vs. Temperature



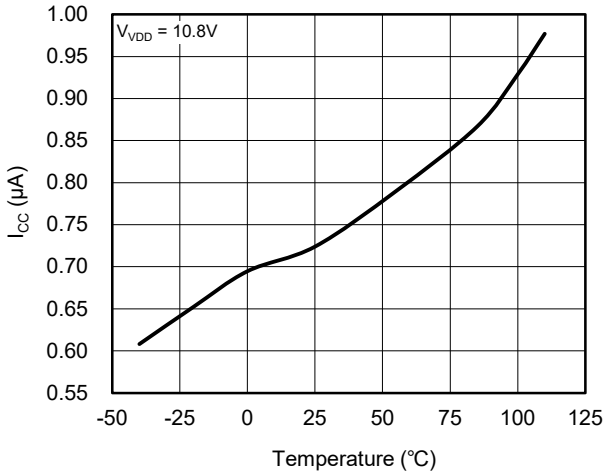
Over-Voltage Detection Hysteresis vs. Temperature



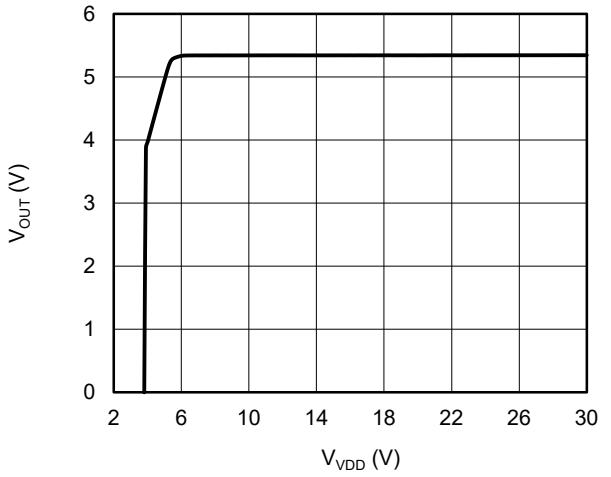
Output Current vs. Temperature



Supply Current vs. Temperature



Output Drive Voltage vs. Supply Voltage



FUNCTIONAL BLOCK DIAGRAM

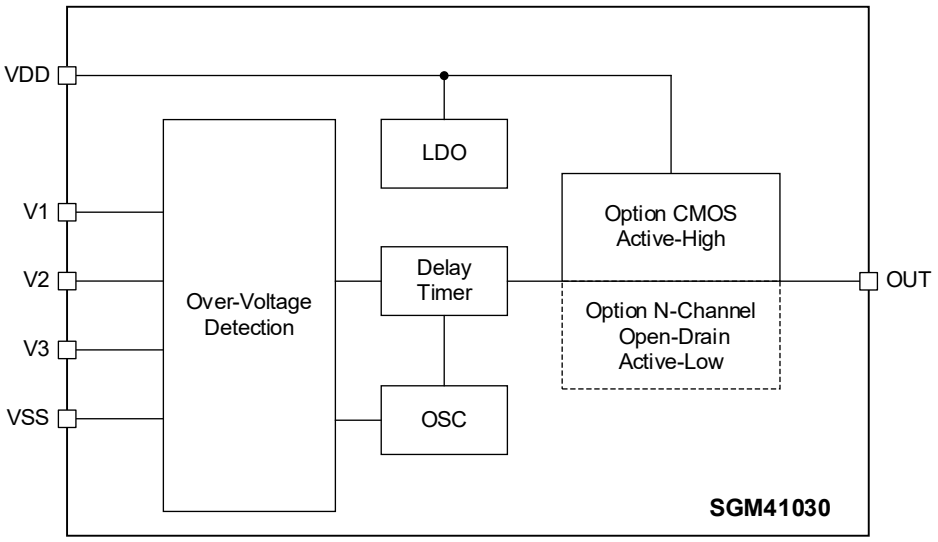


Figure 2. Block Diagram

TIMING DIAGRAM

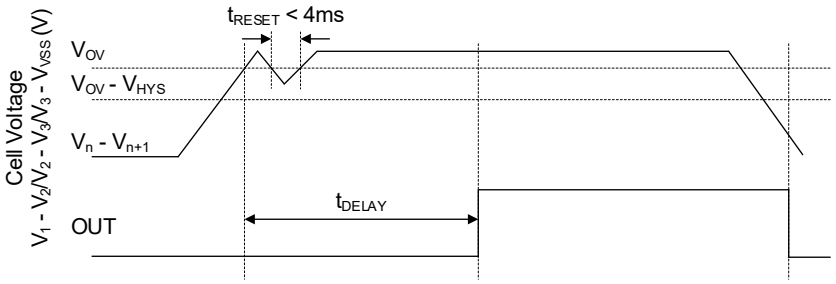
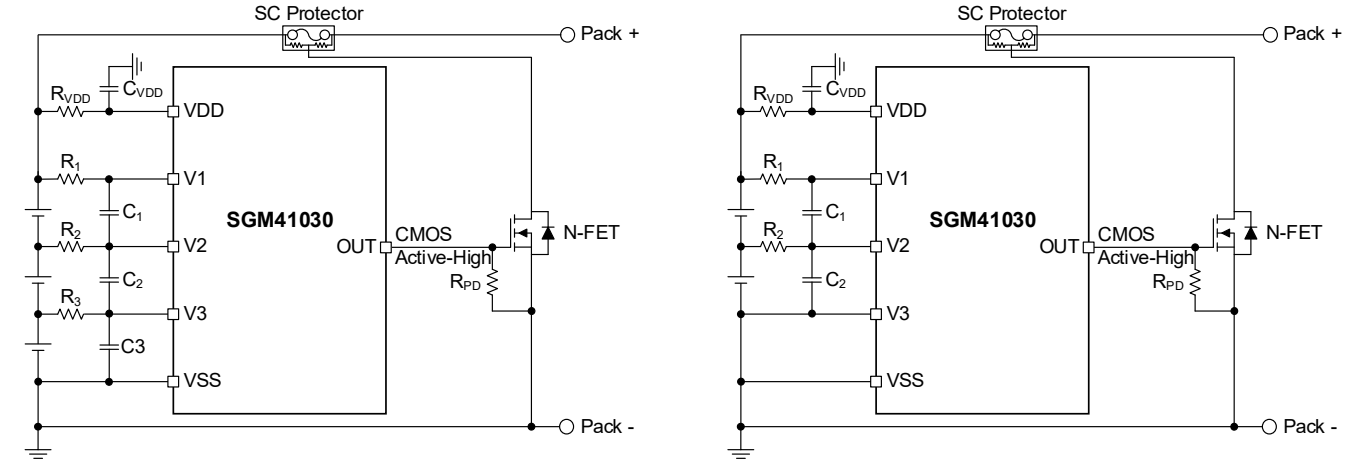


Figure 3. SGM41030 CMOS Active-High Option Over-Voltage Detection Timing

TYPICAL APPLICATION CIRCUITS



(a) SGM41030 3-Cell CMOS Active-High Option Typical Application Circuit

(b) SGM41030 2-Cell CMOS Active-High Option Typical Application Circuit

Figure 4. SGM41030 CMOS Active-High Option Typical Application Circuits for 2-/3-Cell Batteries Pack

RECOMMENDED BOM

COMPONENT	MIN	TYP	MAX	UNITS
R_{VDD}	100		1000	Ω
R_1, R_2, R_3	900	1000	1100	Ω
C_{VDD}		0.1		μF
C_1, C_2, C_3	0.01		0.1	μF
R_{PD} (CMOS Active-High Option, External Pull-Down Resistor)		100		kΩ
R_{PU} (N-Channel Open-Drain Active-Low Option, External Pull-Up Resistor)		100		kΩ

DETAILED DESCRIPTION

Operation

The SGM41030 monitors voltage of each cell independently, and it operates in normal status when all the monitored voltages are lower than the over-voltage threshold V_{OV}. Once any cell voltage rises above the threshold V_{OV}, an internal delay timer starts. When the timer expires, the OUT pin is active. Please refer to Figure 3 for details of over-voltage detection timing sequence.

Options of OUT

The SGM41030 has two kinds of topologies of OUT, which can be factory programmed. One option is that CMOS (active-high) output, and the other is that N-channel open-drain (active-low) output. Please refer to Figure 1.

For CMOS (active-high) output option, the OUT pin is pulled high when active, and is pulled low when inactive.

For N-channel open-drain (active-low) output option, the OUT pin is pulled low when active, and is high-impedance state when inactive.

Customer Test Mode

The SGM41030 has a Customer Test Mode (CTM) which can greatly reduce the test time of over-voltage delay time to improve production efficiency. To enter CTM, V_{VDD} - V_1 needs to be set to at least 8.5V. In CTM, the over-voltage detection delay timer is $t_{CTMDELAY}$, typical 15ms. If the V_{VDD} - V_1 voltage drops below 8.5V, the SGM41030 maintains the CTM mode. The SGM41030 will only exit CTM if OV (over-voltage) condition occurs. Please refer to Figure 5 for details of CTM over-voltage detection timing sequence.

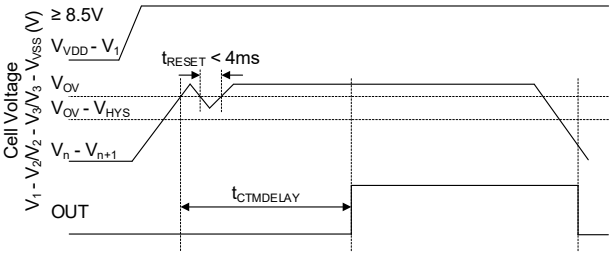


Figure 5. SGM41030 CMOS Active-High Option CTM Over-Voltage Detection Timing

Current Consumption Test

Figure 6 refers to the measured current values of VDD and Vn pins, where I_{CC} only indicates I_{VDD}, and the remaining measurement values are I_{IN}.

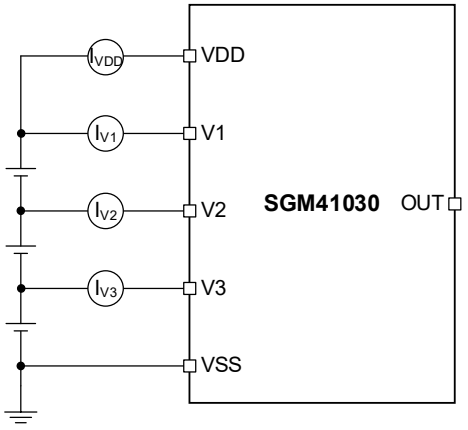


Figure 6. Current Consumption Test Circuit

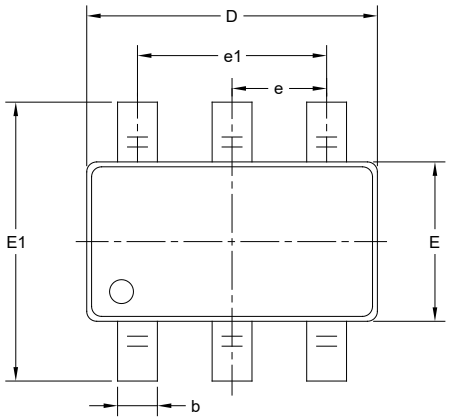
REVISION HISTORY

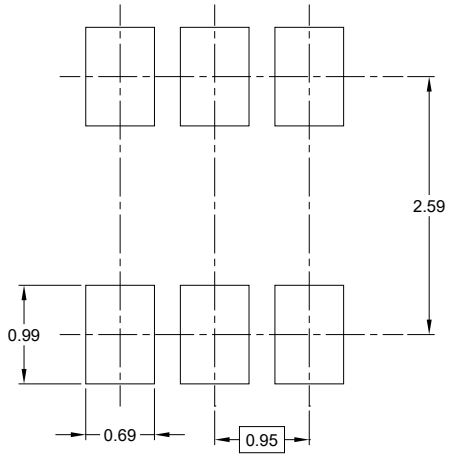
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original to REV.A (MARCH 2026)	Page
Changed from product preview to production data	All

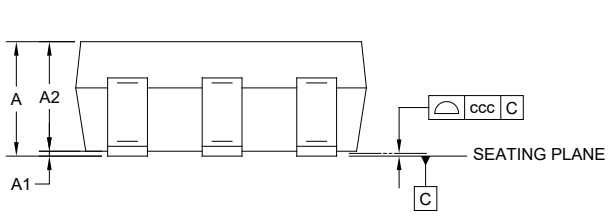
PACKAGE OUTLINE DIMENSIONS

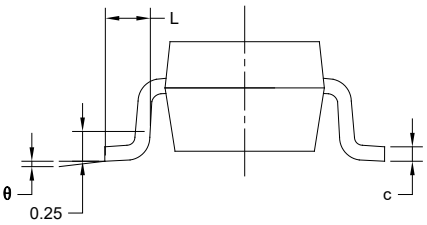
SOT-23-6





RECOMMENDED LAND PATTERN (Unit: mm)



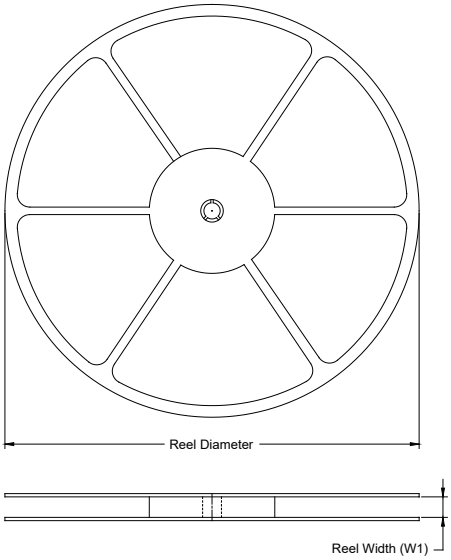


Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	-	-	1.450
A1	0.000	-	0.150
A2	0.900	-	1.300
b	0.300	-	0.500
c	0.080	-	0.220
D	2.750	-	3.050
E	1.450	-	1.750
E1	2.600	-	3.000
e	0.950 BSC		
e1	1.900 BSC		
L	0.300	-	0.600
θ	0°	-	8°
ccc	0.100		

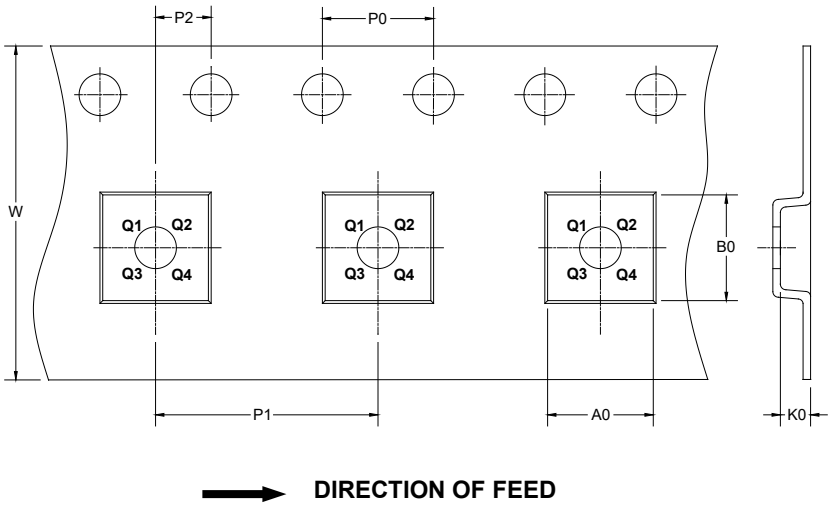
NOTES:
1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MO-178.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



DIRECTION OF FEED

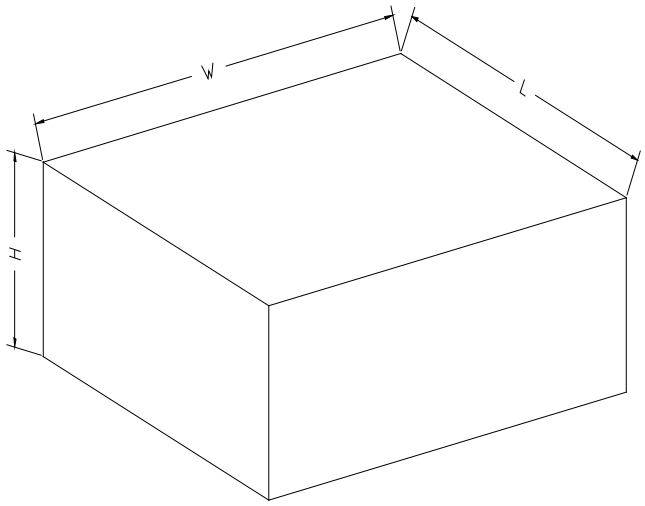
NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOT-23-6	7″	9.5	3.23	3.17	1.37	4.0	4.0	2.0	8.0	Q3

DD0001

CARTON BOX DIMENSIONS



NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF CARTON BOX

Reel Type	Length (mm)	Width (mm)	Height (mm)	Pizza/Carton
7″ (Option)	368	227	224	8
7″	442	410	224	18

DD0002