

GENERAL DESCRIPTION

The SGM41050 series can monitor over-voltage events and provide over-voltage protections for 2-series cell to 5-series cell Li-Ion battery pack systems.

When the device detects an over-voltage event on any cell of the battery packs, 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 SGM41050 is available in Green TDFN-3×4-8L and MSOP-8 packages.

APPLICATIONS

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

FEATURES

- 2- to 5-Series Cell Over-Voltage Protection (OVP)
- 3.85V to 4.6V Optional OVP Threshold
- $\pm 20\text{mV}$ OVP Accuracy
- Optional OVP Hysteresis:
 - ◆ One Time Latch Option
 - ◆ 50mV/100mV/200mV/250mV/300mV/400mV/500mV Options
- Optional Output Topology:
 - ◆ N-Channel Open-Drain Output, Active-Low
 - ◆ CMOS Output, Active-High
- 1s/3s/4s/5.5s Optional Output Delay Timer
- 700nA Operating Consumption
- Internal Delay Timer
- Customer Test Mode (CTM) to Reduce the Delay Time
- Available in Green TDFN-3×4-8L and MSOP-8 Packages

SIMPLIFIED SCHEMATIC

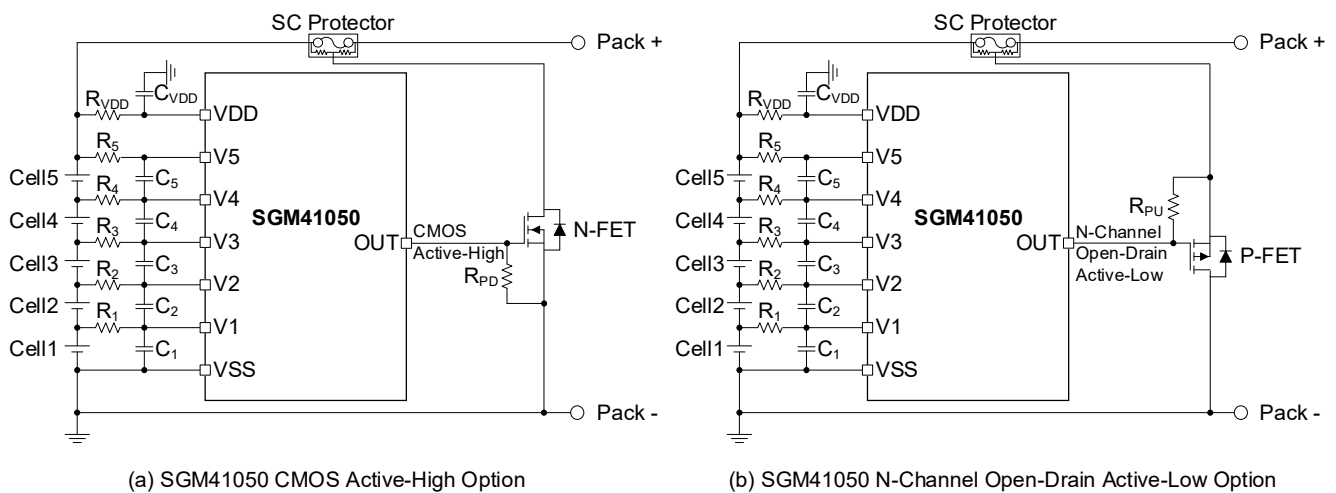


Figure 1. Simplified Schematic

Over-Voltage Protection for 2-Series to 5-Series SGM41050 Cell Li-Ion Batteries with Low Operating Consumption

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM41050-00	TDFN-3×4-8L	-40°C to +110°C	SGM41050-00GTIB8G/TR	SGM1JO GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-00GMS8G/TR	SGM1K3 GMS8 XXXXX	Tape and Reel, 4000
SGM41050-01	TDFN-3×4-8L	-40°C to +110°C	SGM41050-01GTIB8G/TR	SGM1JP GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-01GMS8G/TR	SGM1K4 GMS8 XXXXX	Tape and Reel, 4000
SGM41050-02	TDFN-3×4-8L	-40°C to +110°C	SGM41050-02GTIB8G/TR	SGM1JQ GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-02GMS8G/TR	SGM1K5 GMS8 XXXXX	Tape and Reel, 4000
SGM41050-03	TDFN-3×4-8L	-40°C to +110°C	SGM41050-03GTIB8G/TR	SGM1JR GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-03GMS8G/TR	SGM1K6 GMS8 XXXXX	Tape and Reel, 4000
SGM41050-04	TDFN-3×4-8L	-40°C to +110°C	SGM41050-04GTIB8G/TR	SGM2PT GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-04GMS8G/TR	SGM2Q6 GMS8 XXXXX	Tape and Reel, 4000
SGM41050-05	TDFN-3×4-8L	-40°C to +110°C	SGM41050-05GTIB8G/TR	SGM2PU GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-05GMS8G/TR	SGM2Q7 GMS8 XXXXX	Tape and Reel, 4000
SGM41050-06	TDFN-3×4-8L	-40°C to +110°C	SGM41050-06GTIB8G/TR	SGM1JS GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-06GMS8G/TR	SGM1K7 GMS8 XXXXX	Tape and Reel, 4000
SGM41050-07	TDFN-3×4-8L	-40°C to +110°C	SGM41050-07GTIB8G/TR	SGM1JT GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-07GMS8G/TR	SGM1K8 GMS8 XXXXX	Tape and Reel, 4000
SGM41050-08	TDFN-3×4-8L	-40°C to +110°C	SGM41050-08GTIB8G/TR	SGM1JU GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-08GMS8G/TR	SGM1K9 GMS8 XXXXX	Tape and Reel, 4000

Over-Voltage Protection for 2-Series to 5-Series SGM41050 Cell Li-Ion Batteries with Low Operating Consumption

PACKAGE/ORDERING INFORMATION (continued)

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM41050-09	TDFN-3×4-8L	-40°C to +110°C	SGM41050-09GTIB8G/TR	SGM1JV GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-09GMS8G/TR	SGM1KA GMS8 XXXXX	Tape and Reel, 4000
SGM41050-10	TDFN-3×4-8L	-40°C to +110°C	SGM41050-10GTIB8G/TR	SGM2PV GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-10GMS8G/TR	SGM2Q8 GMS8 XXXXX	Tape and Reel, 4000
SGM41050-11	TDFN-3×4-8L	-40°C to +110°C	SGM41050-11GTIB8G/TR	SGM1JW GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-11GMS8G/TR	SGM1KB GMS8 XXXXX	Tape and Reel, 4000
SGM41050-12	TDFN-3×4-8L	-40°C to +110°C	SGM41050-12GTIB8G/TR	SGM2PW GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-12GMS8G/TR	SGM2Q9 GMS8 XXXXX	Tape and Reel, 4000
SGM41050-13	TDFN-3×4-8L	-40°C to +110°C	SGM41050-13GTIB8G/TR	SGM2PX GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-13GMS8G/TR	SGM2QA GMS8 XXXXX	Tape and Reel, 4000
SGM41050-14	TDFN-3×4-8L	-40°C to +110°C	SGM41050-14GTIB8G/TR	SGM2PY GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-14GMS8G/TR	SGM2QB GMS8 XXXXX	Tape and Reel, 4000
SGM41050-15	TDFN-3×4-8L	-40°C to +110°C	SGM41050-15GTIB8G/TR	SGM1JX GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-15GMS8G/TR	SGM1KC GMS8 XXXXX	Tape and Reel, 4000
SGM41050-16	TDFN-3×4-8L	-40°C to +110°C	SGM41050-16GTIB8G/TR	SGM2PZ GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-16GMS8G/TR	SGM2QC GMS8 XXXXX	Tape and Reel, 4000
SGM41050-17	TDFN-3×4-8L	-40°C to +110°C	SGM41050-17GTIB8G/TR	SGM1JY GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-17GMS8G/TR	SGM1KD GMS8 XXXXX	Tape and Reel, 4000

Over-Voltage Protection for 2-Series to 5-Series SGM41050 Cell Li-Ion Batteries with Low Operating Consumption

PACKAGE/ORDERING INFORMATION (continued)

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM41050-18	TDFN-3×4-8L	-40°C to +110°C	SGM41050-18GTIB8G/TR	SGM1JZ GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-18GMS8G/TR	SGM1KE GMS8 XXXXX	Tape and Reel, 4000
SGM41050-19	TDFN-3×4-8L	-40°C to +110°C	SGM41050-19GTIB8G/TR	SGM2Q0 GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-19GMS8G/TR	SGM2QD GMS8 XXXXX	Tape and Reel, 4000
SGM41050-20	TDFN-3×4-8L	-40°C to +110°C	SGM41050-20GTIB8G/TR	SGM2Q1 GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-20GMS8G/TR	SGM2QE GMS8 XXXXX	Tape and Reel, 4000
SGM41050-21	TDFN-3×4-8L	-40°C to +110°C	SGM41050-21GTIB8G/TR	SGM2Q2 GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-21GMS8G/TR	SGM2QF GMS8 XXXXX	Tape and Reel, 4000
SGM41050-22	TDFN-3×4-8L	-40°C to +110°C	SGM41050-22GTIB8G/TR	SGM2Q3 GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-22GMS8G/TR	SGM2QG GMS8 XXXXX	Tape and Reel, 4000
SGM41050-23	TDFN-3×4-8L	-40°C to +110°C	SGM41050-23GTIB8G/TR	SGM1K0 GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-23GMS8G/TR	SGM1KF GMS8 XXXXX	Tape and Reel, 4000
SGM41050-24	TDFN-3×4-8L	-40°C to +110°C	SGM41050-24GTIB8G/TR	SGM1K1 GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-24GMS8G/TR	SGM1KG GMS8 XXXXX	Tape and Reel, 4000
SGM41050-25	TDFN-3×4-8L	-40°C to +110°C	SGM41050-25GTIB8G/TR	SGM1K2 GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-25GMS8G/TR	SGM1KH GMS8 XXXXX	Tape and Reel, 4000
SGM41050-26	TDFN-3×4-8L	-40°C to +110°C	SGM41050-26GTIB8G/TR	SGM2Q4 GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-26GMS8G/TR	SGM2QH GMS8 XXXXX	Tape and Reel, 4000

SGM41050 Over-Voltage Protection for 2-Series to 5-Series Cell Li-Ion Batteries with Low Operating Consumption

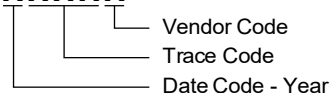
PACKAGE/ORDERING INFORMATION (continued)

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM41050-27	TDFN-3×4-8L	-40°C to +110°C	SGM41050-27GTIB8G/TR	SGM2Q5 GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-27GMS8G/TR	SGM2QI GMS8 XXXXX	Tape and Reel, 4000
SGM41050-28	TDFN-3×4-8L	-40°C to +110°C	SGM41050-28GTIB8G/TR	SGM26N GTIB8 XXXXX	Tape and Reel, 4000
	MSOP-8	-40°C to +110°C	SGM41050-28GMS8G/TR	SGM26O GMS8 XXXXX	Tape and Reel, 4000

MARKING INFORMATION

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

XXXXX



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.

ABSOLUTE MAXIMUM RATINGS

Voltage Range (with Respect to VSS)

VDD	-0.3V to 30V
V5, V4, V3, V2, V1	-0.3V to 30V
OUT	-0.3V to 30V
V5 - V4, V4 - V3, V3 - V2, V2 - V1, V1 - VSS	-0.3V to 6V

Package Thermal Resistance

TDFN-3×4-8L, θ_{JA}	47.5°C/W
TDFN-3×4-8L, θ_{JB}	23°C/W
TDFN-3×4-8L, $\theta_{JC (TOP)}$	43°C/W
TDFN-3×4-8L, $\theta_{JC (BOT)}$	10.2°C/W
MSOP-8, θ_{JA}	143.7°C/W
MSOP-8, θ_{JB}	87.6°C/W
MSOP-8, θ_{JC}	58.7°C/W

Junction Temperature +150°C

Storage Temperature Range -65°C to +150°C

Lead Temperature (Soldering, 10s) +260°C

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
V5 - V4, V4 - V3, V3 - V2, V2 - V1, V1 - VSS	0V to 5V
Operating Ambient Temperature Range	-40°C to +110°C

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.

SGM41050 Over-Voltage Protection for 2-Series to 5-Series Cell Li-Ion Batteries with Low Operating Consumption

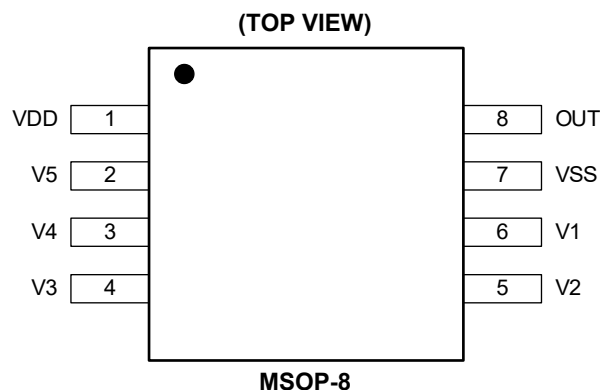
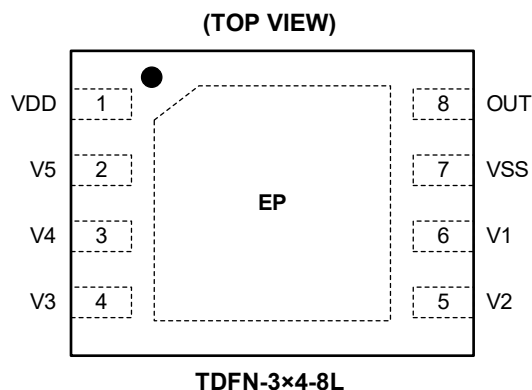
DEVICE COMPARISON TABLE

Model	OVP Threshold (V)	OVP Hysteresis (mV)	Output Delay Timer (s)	Output Forms
SGM41050-00	4.300	300	4	CMOS, Active-High
SGM41050-01	4.275	50	3	N-Channel Open-Drain, Active-Low
SGM41050-02	4.225	300	1	N-Channel Open-Drain, Active-Low
SGM41050-03	4.275	50	1	N-Channel Open-Drain, Active-Low
SGM41050-04	4.325	200	1	CMOS, Active-High
SGM41050-05	4.375	300	3	CMOS, Active-High
SGM41050-06	4.350	300	3	CMOS, Active-High
SGM41050-07	4.450	300	3	CMOS, Active-High
SGM41050-08	4.200	50	1	N-Channel Open-Drain, Active-Low
SGM41050-09	4.200	50	1	CMOS, Active-High
SGM41050-10	4.225	100	1	CMOS, Active-High
SGM41050-11	4.225	50	1	CMOS, Active-High
SGM41050-12	4.450	100	3	N-Channel Open-Drain, Active-Low
SGM41050-13	4.325	50	1	CMOS, Active-High
SGM41050-14	4.325	50	3	CMOS, Active-High
SGM41050-15	4.225	50	1	N-Channel Open-Drain, Active-Low
SGM41050-16	4.250	50	1	CMOS, Active-High
SGM41050-17	4.275	50	1	CMOS, Active-High
SGM41050-18	4.300	300	1	CMOS, Active-High
SGM41050-19	4.350	300	3	CMOS, Active-High
SGM41050-20	4.375	300	3	N-Channel Open-Drain, Active-Low
SGM41050-21	4.200	50	3	CMOS, Active-High
SGM41050-22	4.100	300	3	CMOS, Active-High
SGM41050-23	4.275	300	3	N-Channel Open-Drain, Active-Low
SGM41050-24	3.850	300	4	CMOS, Active-High
SGM41050-25	3.950	50	3	N-Channel Open-Drain, Active-Low
SGM41050-26	3.900	300	3	CMOS, Active-High
SGM41050-27	3.950	50	3	CMOS, Active-High
SGM41050-28	4.150	50	1	CMOS, Active-High
SGM41050-AB	3.85V to 4.6V	Latch/50mV/100mV/ 200mV/250mV/300mV/ 400mV/500mV	1s/3s/4s/5.5s	N-Channel Open-Drain, Active-Low/ CMOS, Active-High

NOTE: SGM41050-AB family products can be customized for other options, please contact with SGMICRO for more information.

SGM41050 Over-Voltage Protection for 2-Series to 5-Series Cell Li-Ion Batteries with Low Operating Consumption

PIN CONFIGURATIONS



PIN DESCRIPTION

PIN	NAME	TYPE	DESCRIPTION
1	VDD	P	Power Supply Pin.
2	V5	I	Sense Positive Cell Voltage Input Pin. It is used to sense the fifth cell voltage from the bottom of the stack.
3	V4	I	Sense Positive Cell Voltage Input Pin. It is used to sense the fourth cell voltage from the bottom of the stack.
4	V3	I	Sense Positive Cell Voltage Input Pin. It is used to sense the third cell voltage from the bottom of the stack.
5	V2	I	Sense Positive Cell Voltage Input Pin. It is used to sense the second cell voltage from the bottom of the stack.
6	V1	I	Sense Positive Cell Voltage Input Pin. It is used to sense the lowest cell voltage from the bottom of the stack.
7	VSS	P	It is connected to IC ground and negative terminal of the bottom cell.
8	OUT	O	Output Drive Pin for Over-Voltage Fault Signal.
Exposed Pad	EP	—	The exposed pad must be soldered to PCB for optimal thermal performance. TDFN-3×4-8L package only.

NOTE:

1. I = input, O = output, P = power.

SGM41050 Over-Voltage Protection for 2-Series to 5-Series Cell Li-Ion Batteries with Low Operating Consumption

ELECTRICAL CHARACTERISTICS

($V_{DD} = 18V$, $T_A = -40^{\circ}C$ to $+110^{\circ}C$, typical values are measured at $T_A = +25^{\circ}C$, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Voltage Protection Threshold						
Over-Voltage Detection Threshold (Rising)	V _{OV}	SGM41050-24		3.850		V
		SGM41050-26		3.900		
		SGM41050-25/27		3.950		
		SGM41050-22		4.100		
		SGM41050-28		4.150		
		SGM41050-08/09/21		4.200		
		SGM41050-02/10/11/15		4.225		
		SGM41050-16		4.250		
		SGM41050-01/03/17/23		4.275		
		SGM41050-00/18		4.300		
		SGM41050-04/13/14		4.325		
		SGM41050-06/19		4.350		
		SGM41050-05/20		4.375		
		SGM41050-07/12		4.450		
		SGM41050-AB		3.85 ~ 4.6		
Over-Voltage Detection Hysteresis (Falling)	V _{HYS}	SGM41050-00/02/05/06/07/18/19/20/22/23/24/26		300		mV
		SGM41050-04		200		
		SGM41050-10/12		100		
		SGM41050-01/03/08/09/11/13/14/15/16/17/21/25/27/28		50		
		SGM41050-AB		Latch/50/100/200/250/300/400/500		
Over-Voltage Detection Accuracy across Ambient Temperature	V _{OA}	T _A = +25°C	-20		20	mV
		T _A = -40°C to +110°C	-25		25	
Power Supply and Leakage Current						
Supply Current	I _{CC}	(V ₅ - V ₄) = (V ₄ - V ₃) = (V ₃ - V ₂) = (V ₂ - V ₁) = (V ₁ - V _{VSS}) = 4V, see Figure 6		0.7	1.5	μA
Input Current at Vx Pins	I _{IN}	(V ₅ - V ₄) = (V ₄ - V ₃) = (V ₃ - V ₂) = (V ₂ - V ₁) = (V ₁ - V _{VSS}) = 4V, see Figure 6	-0.1		0.1	μA

SGM41050 Over-Voltage Protection for 2-Series to 5-Series Cell Li-Ion Batteries with Low Operating Consumption

ELECTRICAL CHARACTERISTICS (continued)

($V_{DD} = 18V$, $T_A = -40^{\circ}C$ to $+110^{\circ}C$, typical values are measured at $T_A = +25^{\circ}C$, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Output Drive OUT, CMOS Active-High Option						
Output Drive Voltage (Active-High)	V_{OUT1}	$(V_5 - V_4)$ or $(V_4 - V_3)$ or $(V_3 - V_2)$ or $(V_2 - V_1)$ or $(V_1 - V_{SS}) > V_{OV}$, $V_{DD} = 18V$, $I_{OH} = 100\mu A$	6			V
		If three of four cells are short-circuited, only one cell remains powered and the voltage $> V_{OV}$, $V_{DD} = V_x$ (cell voltage), $I_{OH} = 100\mu A$		$V_{DD} - 0.45$		V
		$(V_5 - V_4)$ and $(V_4 - V_3)$ and $(V_3 - V_2)$ and $(V_2 - V_1)$ and $(V_1 - V_{SS}) < V_{OV}$, $V_{DD} = 18V$, $I_{OL} = 100\mu A$, measured into OUT pin		325	550	mV
OUT Source Current (during OV)	I_{OUTH1}	$(V_5 - V_4)$ or $(V_4 - V_3)$ or $(V_3 - V_2)$ or $(V_2 - V_1)$ or $(V_1 - V_{SS}) > V_{OV}$, $V_{DD} = 18V$, $V_{OUT} = 0V$, measured out of OUT pin			5	mA
OUT Sink Current (no OV)	I_{OUTL1}	$(V_5 - V_4)$ and $(V_4 - V_3)$ and $(V_3 - V_2)$ and $(V_2 - V_1)$ and $(V_1 - V_{SS}) < V_{OV}$, $V_{DD} = 18V$, $V_{OUT} = V_{DD}$, measured into OUT pin	0.5		6.5	mA
Output Drive OUT, N-Channel Open-Drain Active-Low Option						
Output Drive Voltage (Active-Low)	V_{OUT2}	$(V_5 - V_4)$ or $(V_4 - V_3)$ or $(V_3 - V_2)$ or $(V_2 - V_1)$ or $(V_1 - V_{SS}) > V_{OV}$, $V_{DD} = 18V$, $I_{OL} = 100\mu A$, measured into OUT pin		325	550	mV
OUT Sink Current (during OV)	I_{OUTH2}	$(V_5 - V_4)$ or $(V_4 - V_3)$ or $(V_3 - V_2)$ or $(V_2 - V_1)$ or $(V_1 - V_{SS}) > V_{OV}$, $V_{DD} = 18V$, $V_{OUT} = V_{DD}$, measured into OUT pin	0.5		6.5	mA
OUT Source Current (no OV)	I_{OUTL2}	$(V_5 - V_4)$ and $(V_4 - V_3)$ and $(V_3 - V_2)$ and $(V_2 - V_1)$ and $(V_1 - V_{SS}) < V_{OV}$, $V_{DD} = 18V$, $V_{OUT} = V_{DD}$, measured into OUT pin			100	nA

TIMING REQUIREMENTS

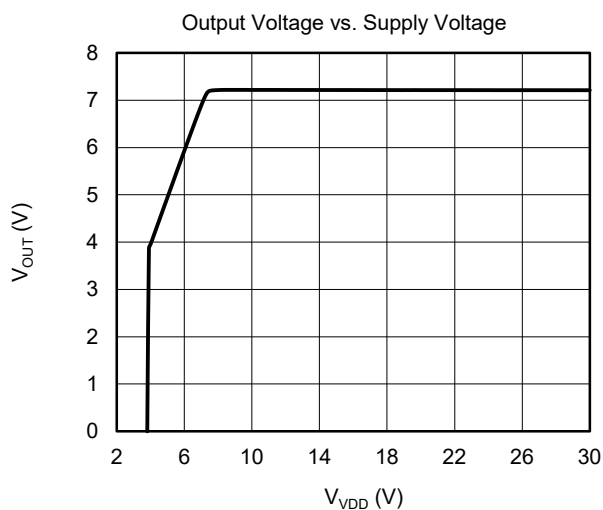
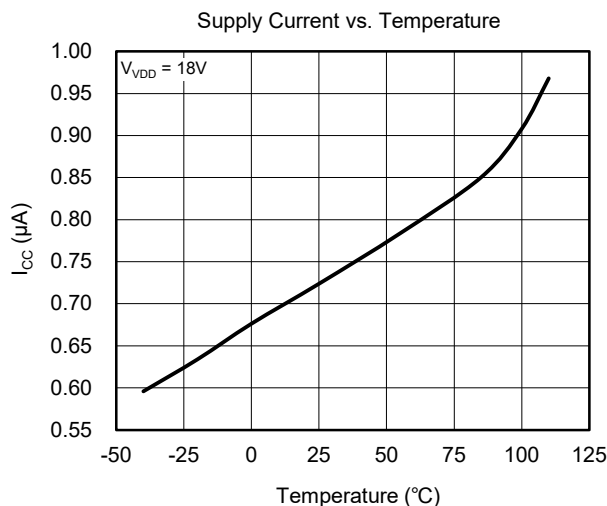
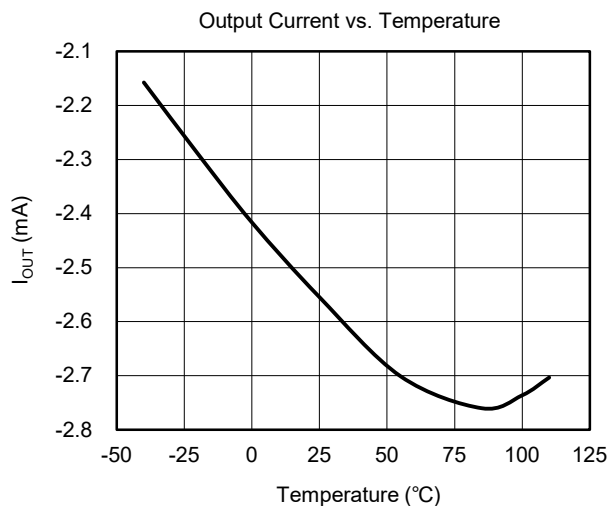
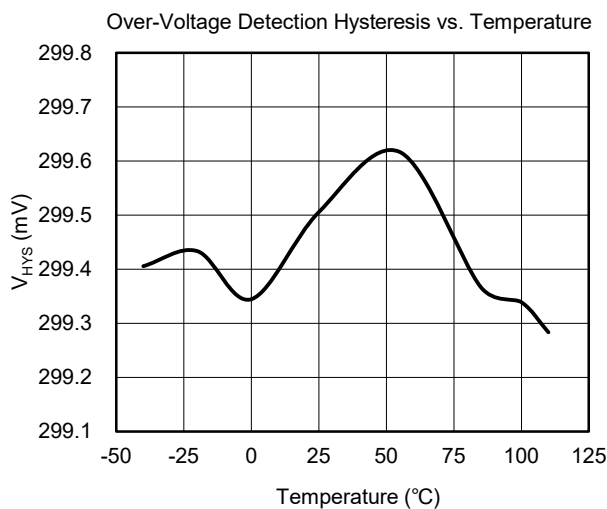
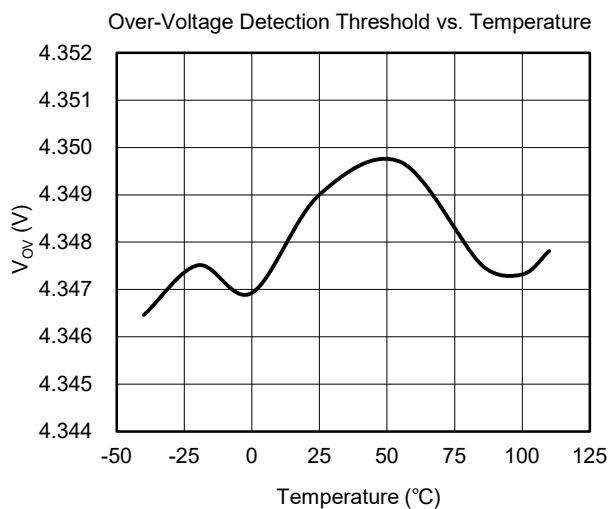
($T_A = -40^{\circ}C$ to $+110^{\circ}C$, typical values are measured at $T_A = +25^{\circ}C$, unless otherwise noted.)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Delay Timer						
Over-Voltage Delay Time	t_{DELAY}	SGM41050-00/24	2.5	4	5.5	s
		SGM41050-01/05/06/07/12/14/19/20/21/22/23/25/26/27	2.0	3	4	
		SGM41050-02/03/04/08/09/10/11/13/15/16/17/18/28	0.5	1	1.5	
		Preview option only, contact with SGMICRO	3.5	5.5	7.5	
Customer Test Mode Over-Voltage Detection Delay Time	$t_{CTMDELAY}$	See Customer Test Mode section	10	15	20	ms

SGM41050 Over-Voltage Protection for 2-Series to 5-Series Cell Li-Ion Batteries with Low Operating Consumption

TYPICAL PERFORMANCE CHARACTERISTICS

$T_A = -40^\circ\text{C}$ to $+110^\circ\text{C}$, unless otherwise noted.



SGM41050 Over-Voltage Protection for 2-Series to 5-Series Cell Li-Ion Batteries with Low Operating Consumption

FUNCTIONAL BLOCK DIAGRAM

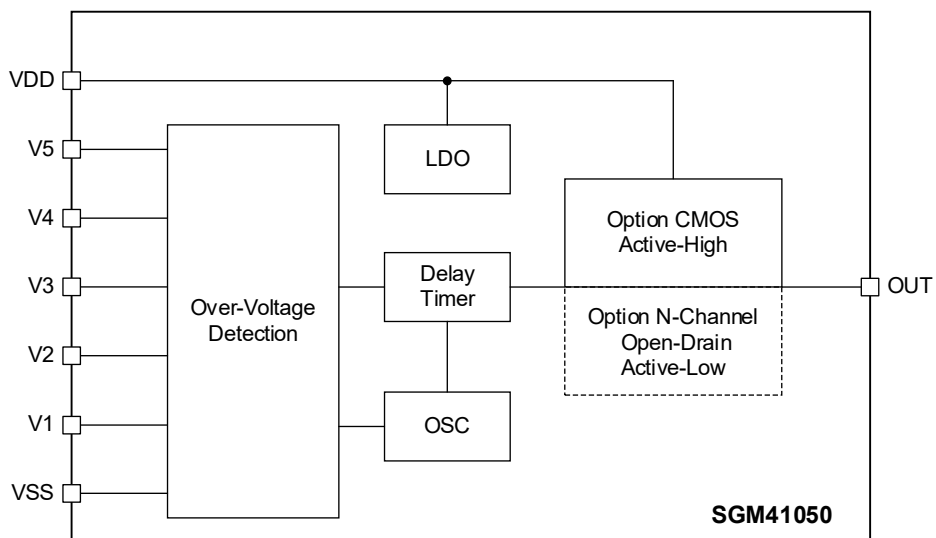


Figure 2. Block Diagram

TIMING DIAGRAM

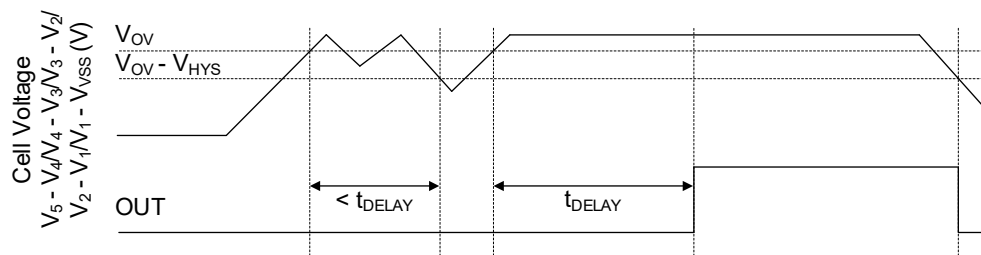
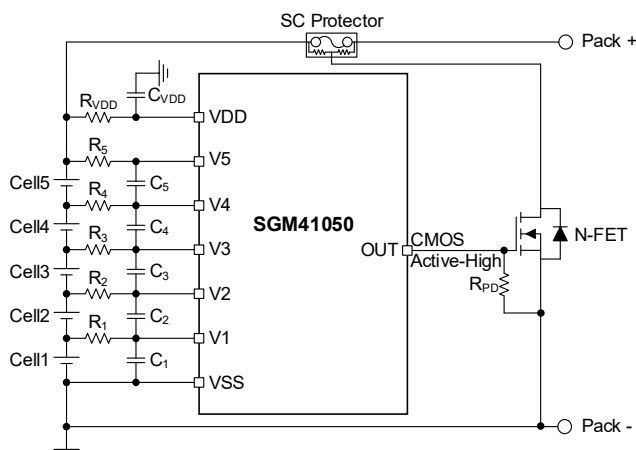


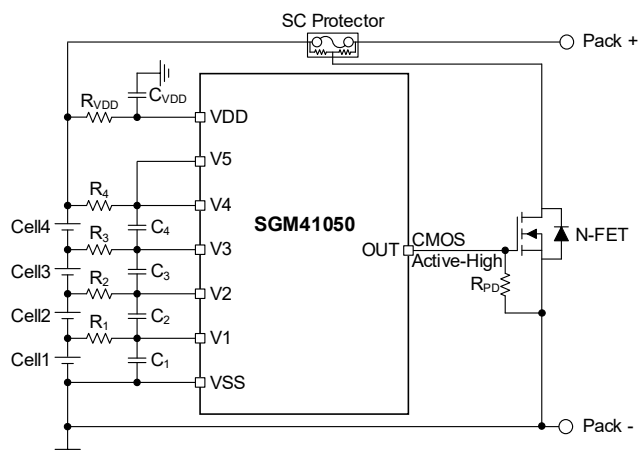
Figure 3. SGM41050 CMOS Active-High Option Over-Voltage Detection Timing

Over-Voltage Protection for 2-Series to 5-Series SGM41050 Cell Li-Ion Batteries with Low Operating Consumption

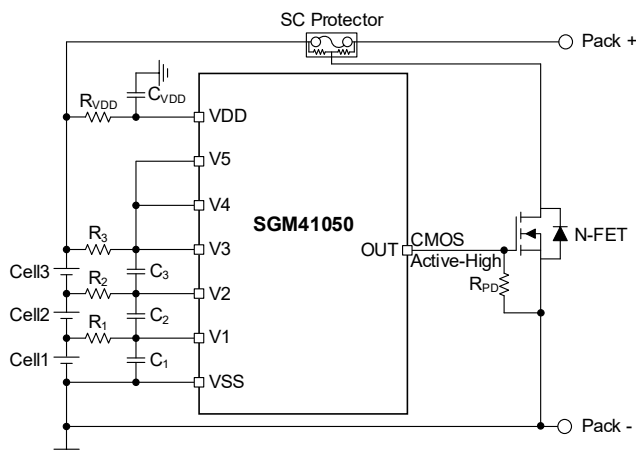
TYPICAL APPLICATION CIRCUITS



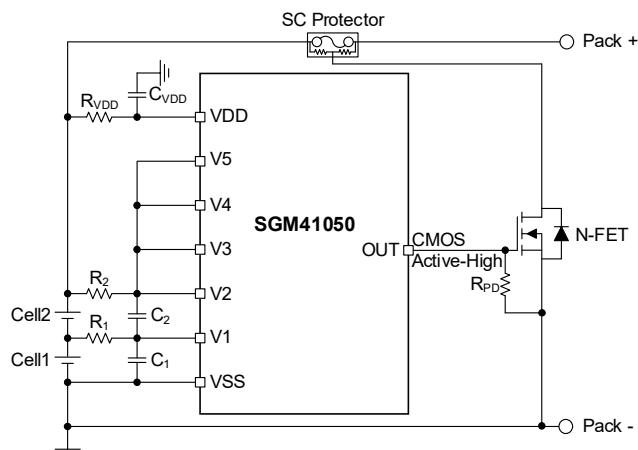
(a) SGM41050 5-Cell CMOS Active-High Option Typical Application Circuit



(b) SGM41050 4-Cell CMOS Active-High Option Typical Application Circuit



(c) SGM41050 3-Cell CMOS Active-High Option Typical Application Circuit



(d) SGM41050 2-Cell CMOS Active-High Option Typical Application Circuit

Figure 4. SGM41050 CMOS Active-High Option Typical Application Circuits for 2-/3-/4-/5-Cell Batteries Pack

RECOMMENDED BOM

COMPONENT	MIN	TYP	MAX	UNITS
R _{VDD}	100		1000	Ω
R ₁ , R ₂ , R ₃ , R ₄ , R ₅	900	1000	1100	Ω
C _{VDD}		0.1		μF
C ₁ , C ₂ , C ₃ , C ₄ , C ₅	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

SGM41050 Over-Voltage Protection for 2-Series to 5-Series Cell Li-Ion Batteries with Low Operating Consumption

DETAILED DESCRIPTION

Operation

The SGM41050 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 before the cell voltage falling lower than $V_{OV} - V_{HYS}$, the OUT pin activates. Please refer to Figure 3 for details of over-voltage detection timing sequence.

Options of OUT

The SGM41050 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 SGM41050 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, $V_{VDD} - V_5$ needs to be set to at least 10V. In CTM, the over-voltage detection delay timer changes is longer than 10ms, typical 15ms. To exit CTM, the $V_{VDD} - V_5$ voltage needs to be reduced.

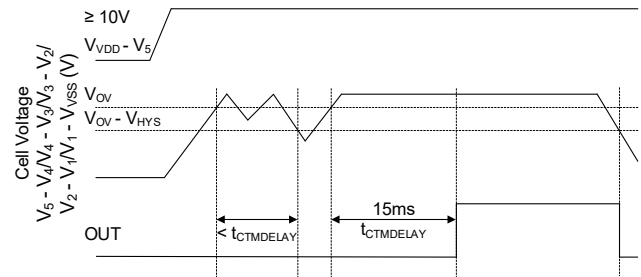


Figure 5. SGM41050 CMOS Active-High Option CTM Over-Voltage Detection Timing

Current Consumption Test

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

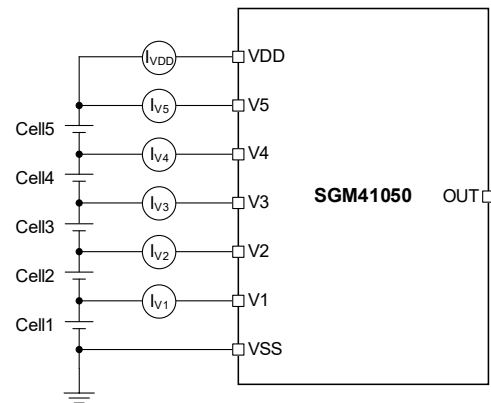


Figure 6. Current Consumption Test Circuit

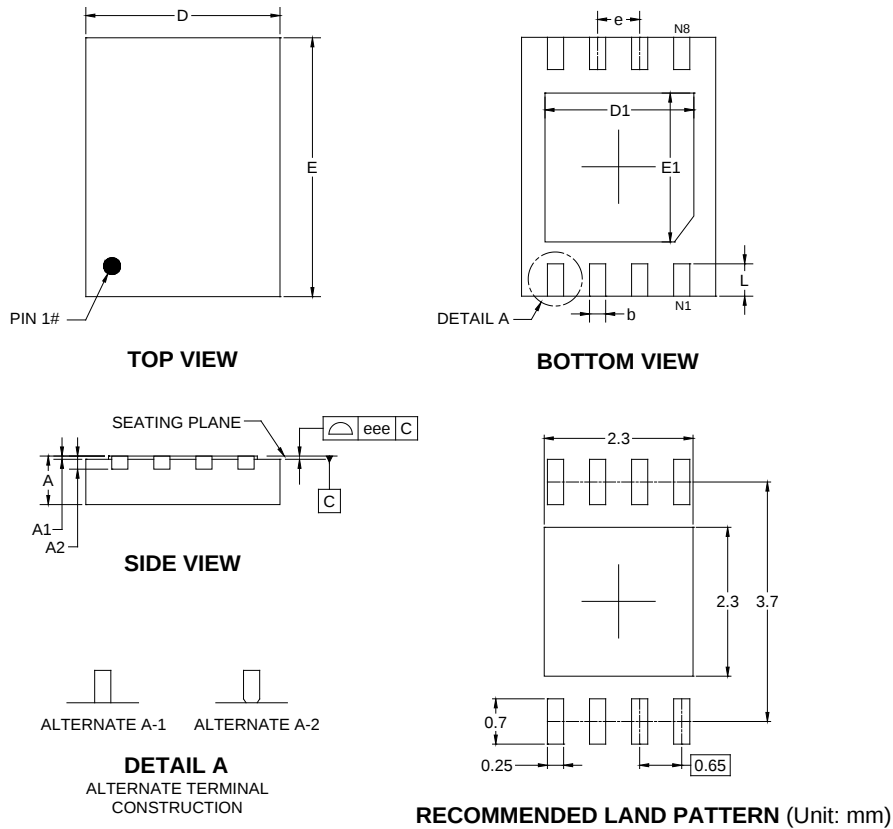
REVISION HISTORY

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

Changes from Original to REV.A (NOVEMBER 2025)	Page
Changed from product preview to production data.....	All

PACKAGE OUTLINE DIMENSIONS

TDFN-3×4-8L

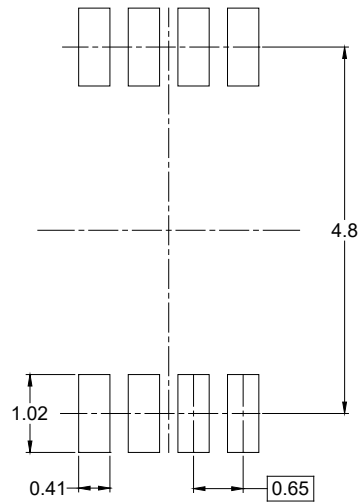
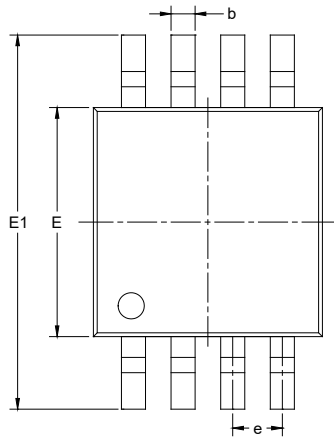


Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	0.700	-	0.800
A1	0.000	-	0.050
A2	0.203 REF		
D	2.900	-	3.100
E	3.900	-	4.100
D1	2.200	-	2.400
E1	2.200	-	2.400
b	0.200	-	0.300
L	0.400	-	0.600
e	0.650 BSC		
eee	0.080		

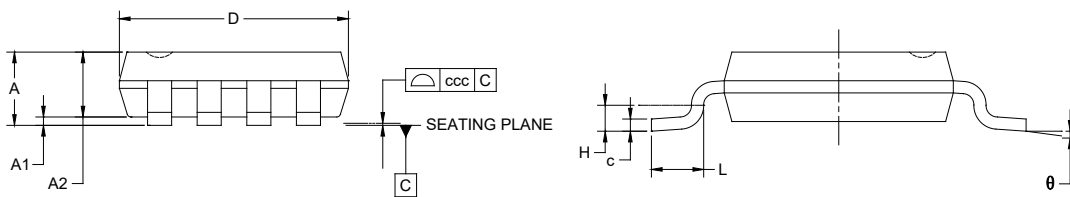
NOTE: This drawing is subject to change without notice.

PACKAGE OUTLINE DIMENSIONS

MSOP-8



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	-	-	1.100
A1	0.000	-	0.150
A2	0.750	-	0.950
b	0.220	-	0.380
c	0.080	-	0.230
D	2.800	-	3.200
E	2.800	-	3.200
E1	4.650	-	5.150
e	0.650 BSC		
L	0.400	-	0.800
H	0.250 TYP		
θ	0°	-	8°
ccc	0.100		

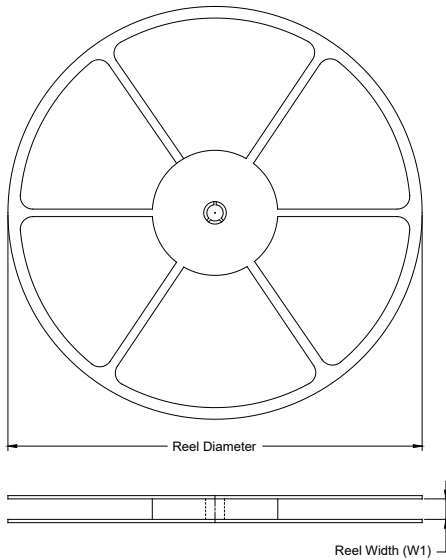
NOTES:

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-187.

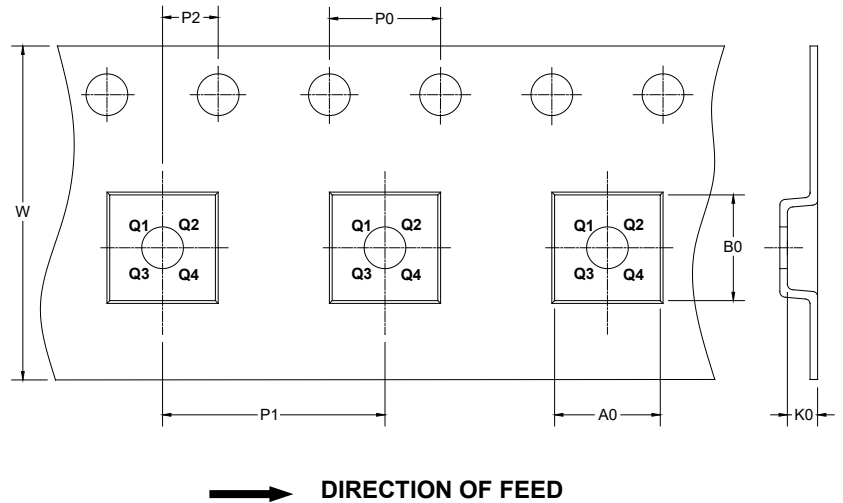
PACKAGE INFORMATION

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



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

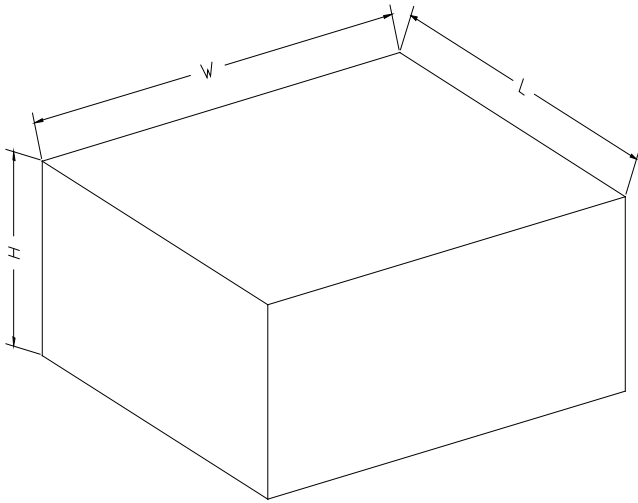
KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
TDFN-3×4-8L	13"	9.5	3.30	4.30	1.10	4.0	8.0	2.0	12.0	Q2
MSOP-8	13"	9.5	5.20	3.30	1.50	4.0	8.0	2.0	12.0	Q1

DD00001

PACKAGE INFORMATION

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
13"	386	280	370	5

DD0002