



# SGM42402Q

## Automotive Low-side Driver with Dual Self-Protection Featuring Current and Temperature Limits

### GENERAL DESCRIPTION

SGM42402Q is a dual self-protected, low-side driver, which provides several protection features, including over-current, over-temperature, and ESD, as well as integrated drain-to-gate clamping for over-voltage protection. With its safeguarding capabilities, this device is an ideal option for usage in harsh automotive environments.

The SGM42402Q is AEC-Q100 qualified (Automotive Electronics Council (AEC) standard Q100 Grade 1) and it is suitable for automotive applications.

The SGM42402Q is available in Green SOIC-8 and SOIC-8 (Exposed Pad) packages.

### APPLICATIONS

Can Switch Resistance, Inductance and Capacitance Loads

Can Substitute Discrete Circuits and Electromechanical Relays

Automotive/Industrial

### FEATURES

- **AEC-Q100 Qualified for Automotive Applications Device Temperature Grade 1**  
 $T_A = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$
- **Full Set of Protections**
  - ♦ Short-Circuit Protection
  - ♦ Over-Voltage Protection
  - ♦ ESD Protection
  - ♦ Thermal Shutdown with Automatic Restart
- **Clamp Integrated for Switching of Inductive Loads**
- **dV/dt Robustness**
- **42V Drain-to-Source Breakdown Voltage**
- **Output Clamp Voltage: 42V**
- **Static Drain-to-Source On-Resistance: 110m $\Omega$ /Channel (TYP) at 10V**
- **Continuous Drain Current:**  
**SOIC-8:**
  - ♦ 3.2A, 1-Channel On
  - ♦ 2.2A/CH, 2-Channel On**SOIC-8 (Exposed Pad):**
  - ♦ 4.2A, 1-Channel On
  - ♦ 3.1A/CH, 2-Channel On**Output Peak Current (Thermal Limited): 8.8A**
- **Logic Level Input Capable of Analog Driving**
- **Available in Green SOIC-8 and SOIC-8 (Exposed Pad) Packages**

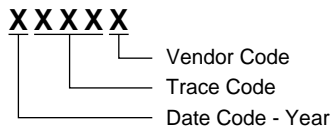
# Automotive Low-side Driver with Dual Self-Protection SGM42402Q Featuring Current and Temperature Limits

## PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM42402Q	SOIC-8	-40°C to +125°C	SGM42402QS8G/TR	0J4S8 XXXXX	Tape and Reel, 4000
	SOIC-8 (Exposed Pad)	-40°C to +125°C	SGM42402QPS8G/TR	0F3PS8 XXXXX	Tape and Reel, 4000

### 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.

### ABSOLUTE MAXIMUM RATINGS

Internally Clamped Drain-to-Source Voltage	
V <sub>DSS</sub> .....	42V
V <sub>DSS</sub> (T <sub>J</sub> = -40°C).....	38V
Internally Clamped Drain-to-Gate Voltage	
V <sub>DGR</sub> .....	42V
V <sub>DGR</sub> (T <sub>J</sub> = -40°C).....	38V
Gate-to-Source Voltage, V <sub>GS</sub> .....	±14V
Continuous Drain Current, I <sub>DS</sub> .....	Internally Limited
Maximum Continuous Drain Current, I <sub>DS</sub> (T <sub>J</sub> = +25°C)	
SOIC-8, 1-Channel On.....	3.2A
SOIC-8, 2-Channel On.....	2.2A/CH
SOIC-8 (Exposed Pad), 1-Channel On.....	4.2A
SOIC-8 (Exposed Pad), 2-Channel On.....	3.1A/CH
Single Pulse Drain-to-Source Avalanche Energy (V <sub>DD</sub> = 32V, V <sub>G</sub> = 5.0V, I <sub>PK</sub> = 1.0A, L = 300mH, R <sub>G_EXT</sub> = 25Ω), E <sub>AS</sub> <sup>(1)</sup> .....	430mJ
Load Dump Voltage (V <sub>GS</sub> = 0V and 10V, R <sub>I</sub> = 2.0Ω, R <sub>L</sub> = 9.0Ω, t <sub>d</sub> = 400ms), V <sub>LD</sub> .....	40V
Package Thermal Resistance	
SOIC-8, θ <sub>JA</sub> .....	98°C/W
SOIC-8, θ <sub>JB</sub> .....	46.6°C/W
SOIC-8, θ <sub>JC</sub> .....	46.2°C/W
SOIC-8 (Exposed Pad), θ <sub>JA</sub> .....	33.9°C/W
SOIC-8 (Exposed Pad), θ <sub>JB</sub> .....	9.8°C/W
SOIC-8 (Exposed Pad), θ <sub>JC (TOP)</sub> .....	45.5°C/W
SOIC-8 (Exposed Pad), θ <sub>JC (BOT)</sub> .....	1.5°C/W
Junction Temperature.....	+150°C
Storage Temperature Range.....	-65°C to +150°C
Lead Temperature (Soldering, 10s).....	+260°C
ESD Susceptibility	
HBM.....	8000V
CDM.....	2000V

NOTE:

$$1. E_{AS} = \frac{1}{2} \times L \times I_{PK}^2 \times \left( 1 - \frac{V_{BAT}}{V_{BAT} - V_{CLAMP}} \right)$$

### RECOMMENDED OPERATING CONDITIONS

Operating Ambient Temperature Range.....	-40°C to +125°C
Operating Junction Temperature Range.....	-40°C to +150°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.

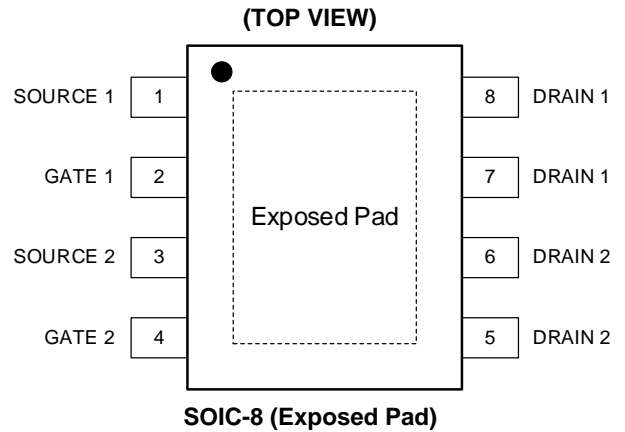
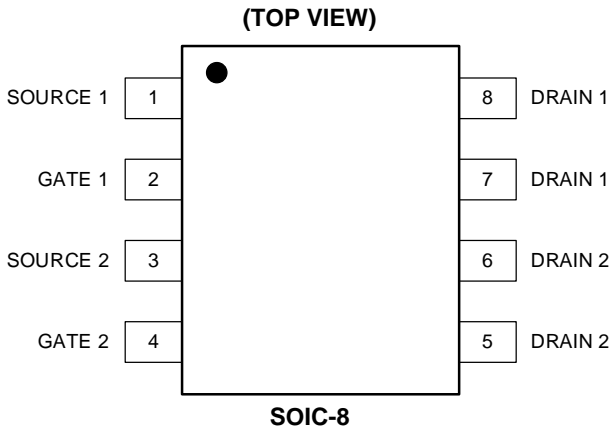
### ESD SENSITIVITY CAUTION

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.

**PIN CONFIGURATIONS**



**PIN DESCRIPTION**

PIN		SYMBOL	NAME
SOIC-8	SOIC-8 (Exposed Pad)		
1	1	S	SOURCE 1
2	2	G	GATE 1
3	3	S	SOURCE 2
4	4	G	GATE 2
5, 6	5, 6	D	DRAIN 2
7, 8	7, 8	D	DRAIN 1
—	Exposed Pad	—	GND or SOURCE

# Automotive Low-side Driver with Dual Self-Protection SGM42402Q Featuring Current and Temperature Limits

## ELECTRICAL CHARACTERISTICS

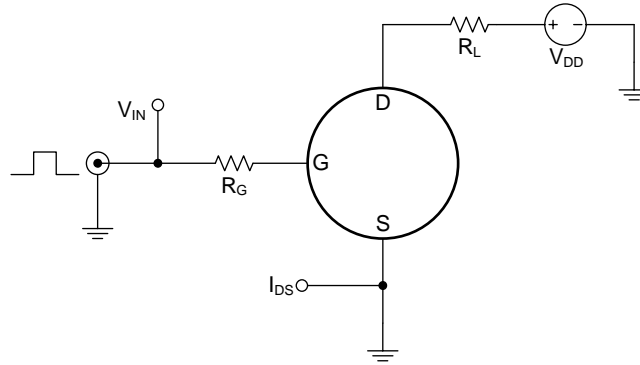
(T<sub>J</sub> = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	
<b>Off Characteristics</b>							
Drain-to-Source Breakdown Voltage <sup>(1)</sup>	V <sub>BR_DSS</sub>	V <sub>GS</sub> = 0V, I <sub>DS</sub> = 10mA, T <sub>J</sub> = +25°C	38 <sup>(4)</sup>	42	44	V	
		V <sub>GS</sub> = 0V, I <sub>DS</sub> = 10mA, T <sub>J</sub> = +125°C <sup>(3)</sup>	40	43	45		
Drain Current at Zero Gate Voltage	I <sub>DSS</sub>	V <sub>GS</sub> = 0V, V <sub>DS</sub> = 32V, T <sub>J</sub> = +25°C		0.025	0.4	μA	
		V <sub>GS</sub> = 0V, V <sub>DS</sub> = 32V, T <sub>J</sub> = +125°C <sup>(3)</sup>		0.2	1		
Gate Input Current	I <sub>GSSF</sub>	V <sub>DS</sub> = 0V, V <sub>GS</sub> = 5V		225	300	μA	
<b>On Characteristics</b> <sup>(1)</sup>							
Gate Threshold Voltage	V <sub>GS_TH</sub>	V <sub>GS</sub> = V <sub>DS</sub> , I <sub>DS</sub> = 150μA	1.3	1.75	2.2	V	
Gate Threshold Temperature Coefficient	V <sub>GS_TH</sub> /T <sub>J</sub>			3.0		-mV/°C	
Static Drain-to-Source On-Resistance/Channel	R <sub>DSON</sub>	V <sub>GS</sub> = 10V, I <sub>DS</sub> = 1.7A, T <sub>J</sub> = +25°C		110	135	mΩ	
		V <sub>GS</sub> = 10V, I <sub>DS</sub> = 1.7A, T <sub>J</sub> = +125°C <sup>(3)</sup>		150	175		
Source-Drain Forward On Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0V, I <sub>S</sub> = 7A		1.23		V	
<b>Switching Characteristics</b> <sup>(3)</sup>							
Turn-On Time	t <sub>ON</sub>	V <sub>GS</sub> = 10V, V <sub>DD</sub> = 12V, I <sub>DS</sub> = 2.5A, R <sub>L</sub> = 4.7Ω	10% V <sub>IN</sub> to 90% I <sub>DS</sub>		34	45	μs
Turn-Off Time	t <sub>OFF</sub>		90% V <sub>IN</sub> to 10% I <sub>DS</sub>		86	110	μs
Turn-On Rise Time	t <sub>RISE</sub>		10% I <sub>DS</sub> to 90% I <sub>DS</sub>		21	30	μs
Turn-Off Fall Time	t <sub>FALL</sub>		90% I <sub>DS</sub> to 10% I <sub>DS</sub>		42	60	μs
Slew-Rate On	-dV <sub>DS</sub> /dt <sub>ON</sub>		70% to 50% V <sub>DD</sub>		0.67	1.0	V/μs
Slew-Rate Off	dV <sub>DS</sub> /dt <sub>OFF</sub>		50% to 70% V <sub>DD</sub>		0.29	0.4	V/μs
<b>Self-Protection Characteristics</b> <sup>(2)</sup>							
Current Limit	I <sub>LIM</sub>	V <sub>DS</sub> = 10V, V <sub>GS</sub> = 5V, T <sub>J</sub> = +25°C	7.8	8.8	9.8	A	
		V <sub>DS</sub> = 10V, V <sub>GS</sub> = 5V, T <sub>J</sub> = +125°C <sup>(3)</sup>	5.3	6.8	8.6		
		V <sub>DS</sub> = 10V, V <sub>GS</sub> = 10V, T <sub>J</sub> = +25°C	8	9	10		
		V <sub>DS</sub> = 10V, V <sub>GS</sub> = 10V, T <sub>J</sub> = +125°C <sup>(3)</sup>	5.5	7	8.8		
Temperature Limit (Turn-Off)	T <sub>LIM_OFF</sub>	V <sub>GS</sub> = 5V <sup>(3)</sup>		155		°C	
Thermal Hysteresis	ΔT <sub>LIM_ON</sub>	V <sub>GS</sub> = 5V		20			
Temperature Limit (Turn-Off)	T <sub>LIM_OFF</sub>	V <sub>GS</sub> = 10V <sup>(3)</sup>		155			
Thermal Hysteresis	ΔT <sub>LIM_ON</sub>	V <sub>GS</sub> = 10V		20			
<b>Gate Input Characteristics</b> <sup>(3)</sup>							
Gate Input Current in Device On State	I <sub>GON</sub>	V <sub>GS</sub> = 5V, I <sub>DS</sub> = 1A		225		μA	
		V <sub>GS</sub> = 10V, I <sub>DS</sub> = 1A		225			
Gate Input Current in Current Limit State	I <sub>GCL</sub>	V <sub>GS</sub> = 5V, V <sub>DS</sub> = 10V		0.24		mA	
		V <sub>GS</sub> = 10V, V <sub>DS</sub> = 10V		0.24			
Gate Input Current in Thermal Limit Fault State	I <sub>GTL</sub>	V <sub>GS</sub> = 5V, V <sub>DS</sub> = 10V		0.08		mA	
		V <sub>GS</sub> = 10V, V <sub>DS</sub> = 10V		0.08			

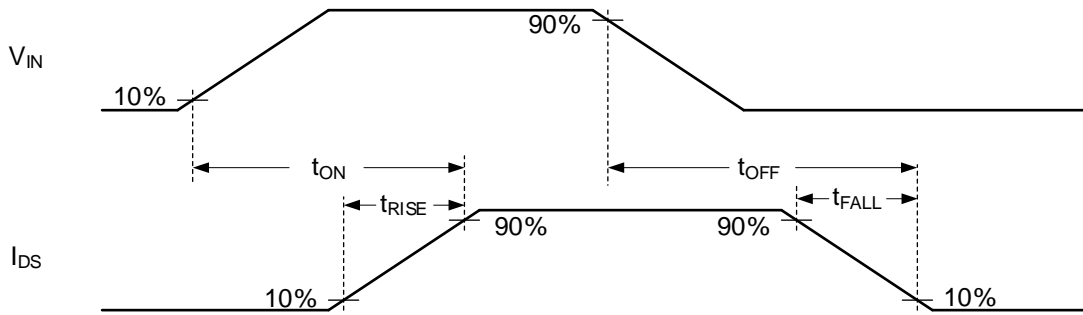
**NOTES:**

1. Pulse test: pulse width ≤ 300μs, duty cycle ≤ 2%.
2. Fault conditions are considered to be outside the normal operating range of the component.
3. Not included in the production testing.
4. MIN value including -40°C.

**TEST CIRCUITS AND WAVEFORMS**

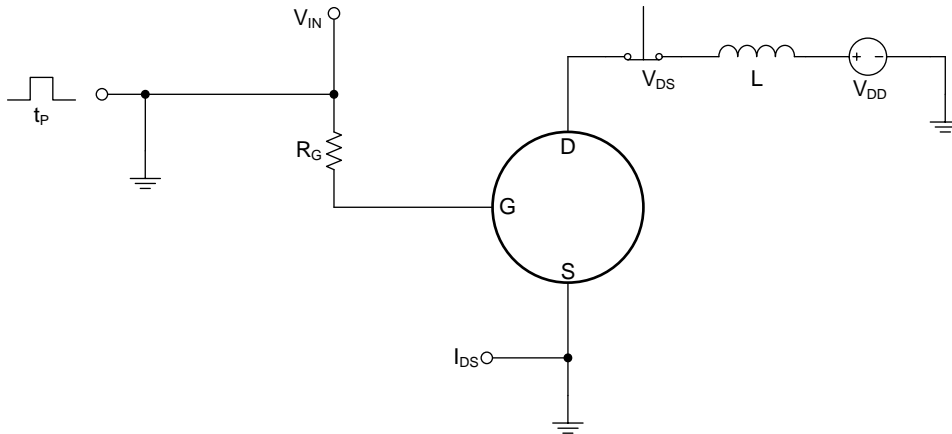


**Figure 1. Test Circuit for Switching Resistive Loads**

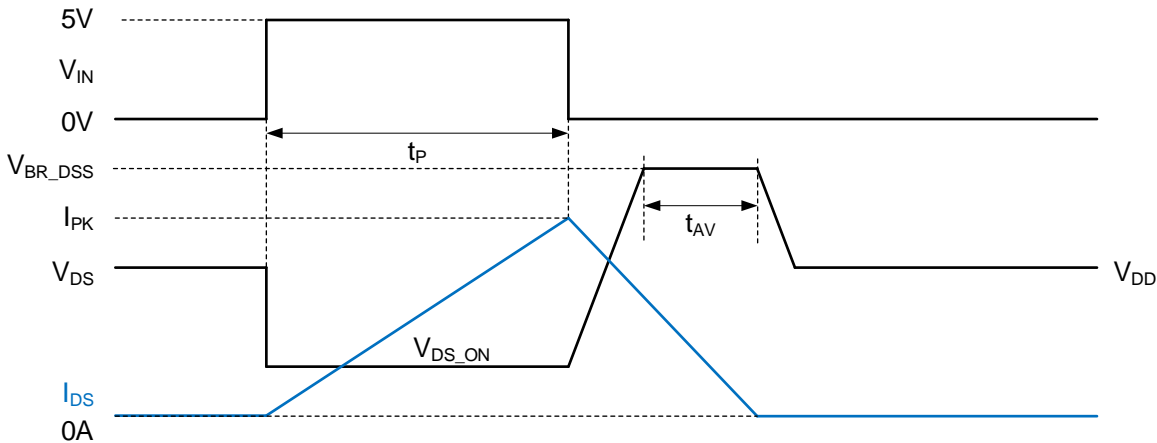


**Figure 2. Waveforms for Switching Resistive Loads**

**TEST CIRCUITS AND WAVEFORMS (continued)**



**Figure 3. Test Circuit for Switching Inductive Loads**

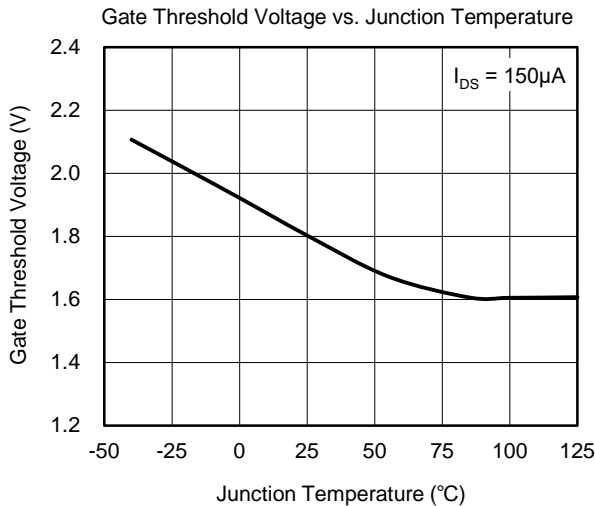
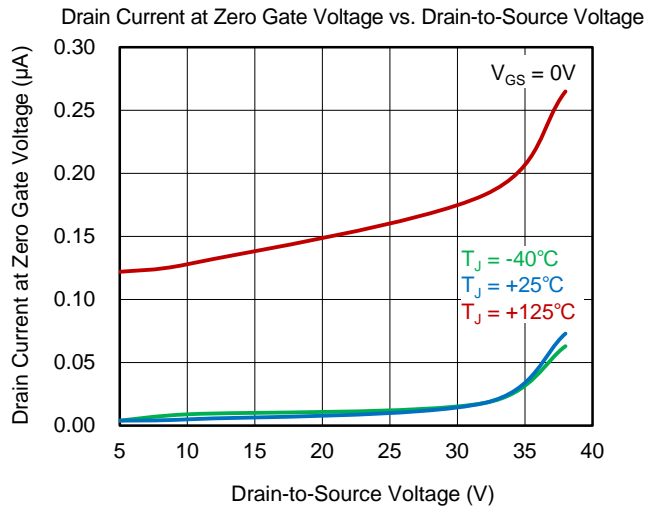
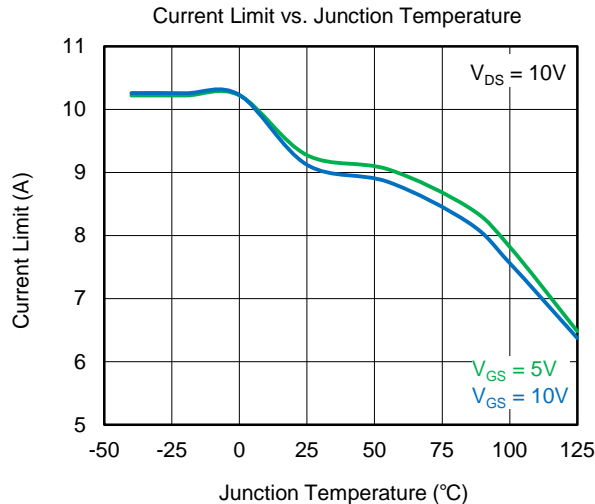
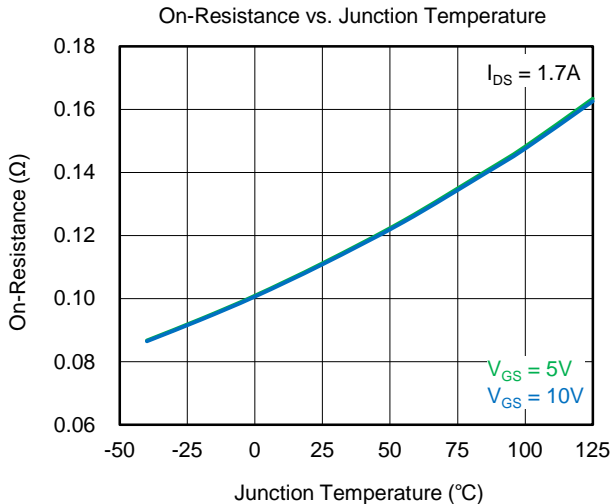


**Figure 4. Waveforms for Switching Inductive Loads**

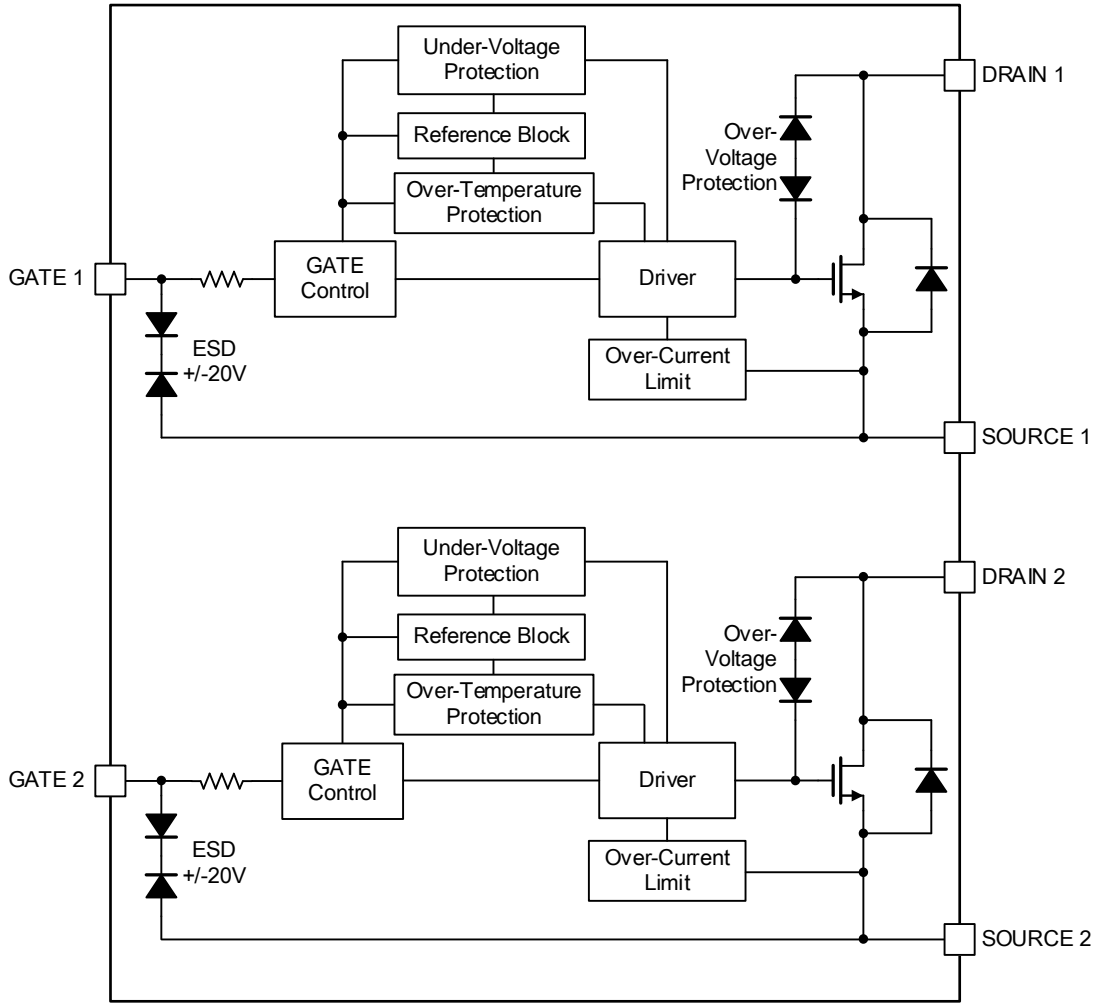
# Automotive Low-side Driver with Dual Self-Protection Featuring Current and Temperature Limits

## SGM42402Q

### TYPICAL PERFORMANCE CHARACTERISTICS



**FUNCTIONAL BLOCK DIAGRAM**



**REVISION HISTORY**

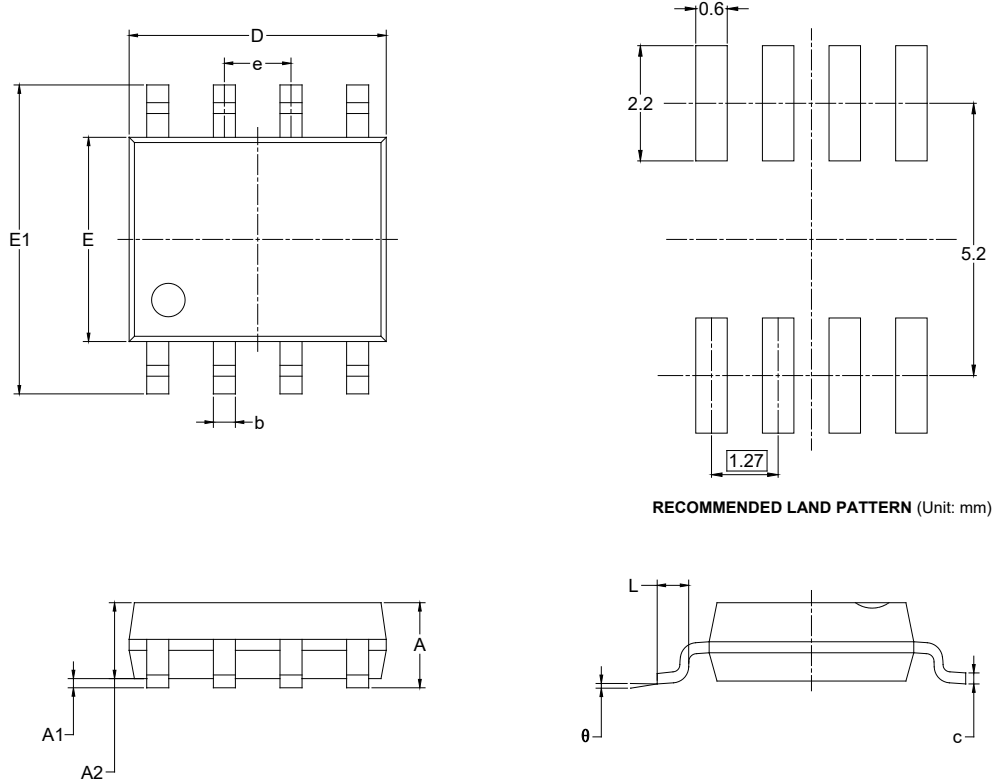
NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (AUGUST 2024) to REV.A	Page
Changed from product preview to production data.....	All



PACKAGE OUTLINE DIMENSIONS

SOIC-8



RECOMMENDED LAND PATTERN (Unit: mm)

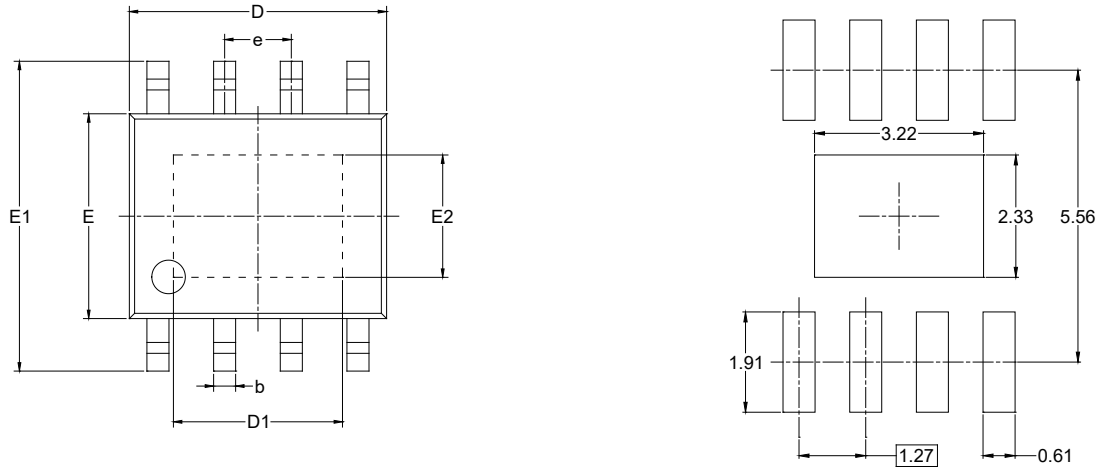
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.27 BSC		0.050 BSC	
L	0.400	1.270	0.016	0.050
$\theta$	0°	8°	0°	8°

- NOTES:  
 1. Body dimensions do not include mode flash or protrusion.  
 2. This drawing is subject to change without notice.

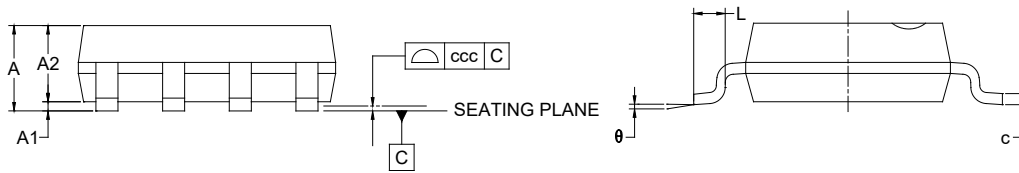
# PACKAGE INFORMATION

## PACKAGE OUTLINE DIMENSIONS

### SOIC-8 (Exposed Pad)



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A			1.700
A1	0.000	-	0.150
A2	1.250	-	1.650
b	0.330	-	0.510
c	0.170	-	0.250
D	4.700	-	5.100
D1	3.020	-	3.420
E	3.800	-	4.000
E1	5.800	-	6.200
E2	2.130	-	2.530
e	1.27 BSC		
L	0.400	-	1.270
$\theta$	0°	-	8°
ccc	0.100		

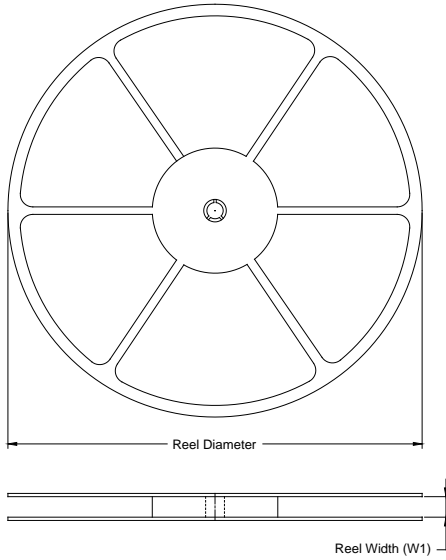
NOTES:

1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MS-012.

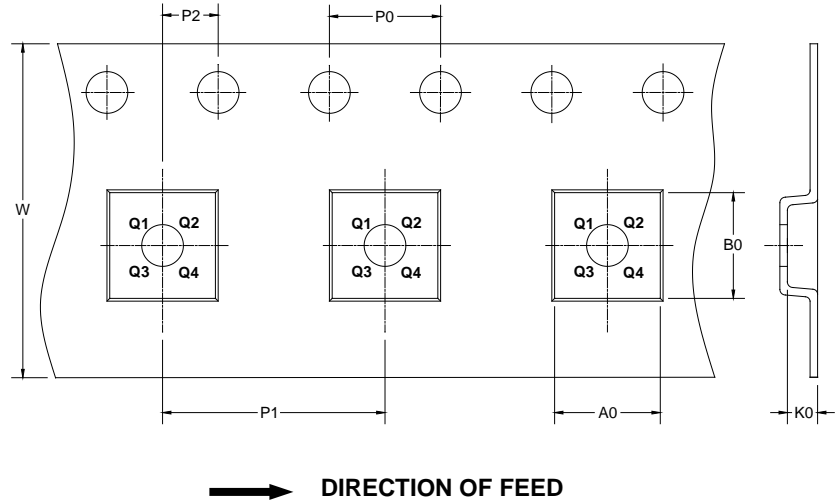
# PACKAGE INFORMATION

## TAPE AND REEL INFORMATION

### REEL DIMENSIONS



### TAPE DIMENSIONS



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

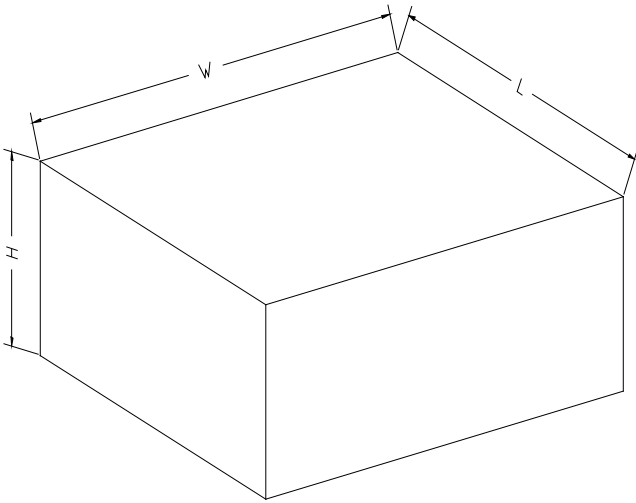
### KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOIC-8	13"	12.4	6.40	5.40	2.10	4.0	8.0	2.0	12.0	Q1
SOIC-8 (Exposed Pad)	13"	12.4	6.40	5.40	2.10	4.0	8.0	2.0	12.0	Q1

D200001

# 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