SGM4024xQ
Automotive, Low Drift, Low Power, Small-Package Voltage Reference

GENERAL DESCRIPTION

The SGM4024xQ is a low power, low drift and high precision CMOS voltage reference. The device features a low temperature drift of 10ppm/℃ (MAX) and a high initial accuracy of ±0.05% (MAX), while consuming only 72μA (TYP) quiescent current.

Additionally, the output noise of the device is as low as 6μV_{P-P}/V. This means the SGM4024xQ can keep the signal's high fidelity with high resolution data converters in systems that are sensitive to noise. The hysteresis and long-term drift of the output voltage are low as well, which enhance the stability and reliability of the system.

The SGM4024xQ fits in a small package and has a low quiescent current. These two advantages make it a good choice for portable devices and battery-powered equipment.

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

The SGM4024xQ is available in a Green SOT-23-5 package. It is specified over the extended industrial temperature range of -40℃ to +125℃.

FEATURES

- **AEC-Q100 Qualified for Automotive Applications**
  Device Temperature Grade 1
  T_A = -40℃ to +125℃
- **Input Voltage Range: 2.7V to 5.5V**
- **Fixed Output Voltage: 1.25V, 1.8V, 2.5V, 3V, 3.3V, 4.096V, 5V**
- **High Initial Accuracy: ±0.05% (MAX)**
- **Low Temperature Drift: 10ppm/℃ (MAX)**
- **Low Quiescent Current: 72μA (TYP)**
- **High Output Current: ±10mA**
- **Stable Output C_L Range: 0.1μF to 47μF**
- **Low Noise: 6μV_{P-P}/V at 0.1Hz to 10Hz**
- **Long-Term Stability: 50ppm at 1000h**
- **Available in a Green SOT-23-5 Package**

APPLICATIONS

Automotive Applications
Industrial Equipment
Medical Equipment
BMS

TYPICAL APPLICATION

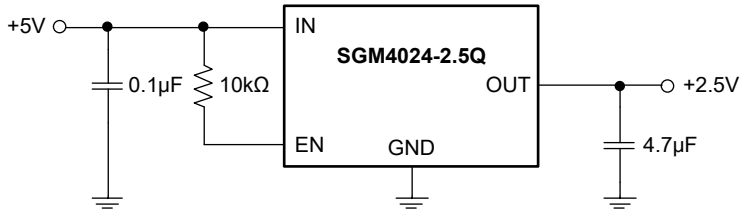


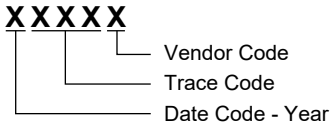
Figure 1. Typical Application Circuit

PACKAGE/ORDERING INFORMATION

MODEL	PACKAGE DESCRIPTION	SPECIFIED TEMPERATURE RANGE	ORDERING NUMBER	PACKAGE MARKING	PACKING OPTION
SGM4024-1.25Q	SOT-23-5	-40℃ to +125℃	SGM4024-1.25QN5G/TR	17H XXXXX	Tape and Reel, 3000
SGM4024-1.8Q	SOT-23-5	-40℃ to +125℃	SGM4024-1.8QN5G/TR	1O6 XXXXX	Tape and Reel, 3000
SGM4024-2.5Q	SOT-23-5	-40℃ to +125℃	SGM4024-2.5QN5G/TR	0XX XXXXX	Tape and Reel, 3000
SGM4024-3.0Q	SOT-23-5	-40℃ to +125℃	SGM4024-3.0QN5G/TR	17C XXXXX	Tape and Reel, 3000
SGM4024-3.3Q	SOT-23-5	-40℃ to +125℃	SGM4024-3.3QN5G/TR	17D XXXXX	Tape and Reel, 3000
SGM4024-4.096Q	SOT-23-5	-40℃ to +125℃	SGM4024-4.096QN5G/TR	17E XXXXX	Tape and Reel, 3000
SGM4024-5.0Q	SOT-23-5	-40℃ to +125℃	SGM4024-5.0QN5G/TR	17F XXXXX	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.

ABSOLUTE MAXIMUM RATINGS

Input Voltage Range, V_{IN} ..... -0.3V to 6V
Enable Voltage Range, V_{EN} .....-0.3V to V_{IN} + 0.3V
Output Voltage Range, V_{OUT} ..... -0.3V to 5.5V
Output Short-Circuit Current, I_{SC} 20mA
Package Thermal Resistance
SOT-23-5, θ_{JA}..... 170.4℃/W
SOT-23-5, θ_{JB}..... 32.5℃/W
Junction Temperature.....+150℃
Storage Temperature Range .....-65℃ to +150℃
Lead Temperature (Soldering, 10s).....+260℃
ESD Susceptibility (1) (2)
HBM.....±6000V
CDM .....±1000V

NOTES:

1. For human body model (HBM), all pins comply with AEC-Q100-002 specification.
2. For charged device model (CDM), all pins comply with AEC-Q100-011 specification.

RECOMMENDED OPERATING CONDITIONS

Input Voltage Range, V_{IN} ..... MAX(V_{OUT} + V_{DO}, 2.7V) to 5.5V
Enable Voltage Range, V_{EN} ..... 0V to V_{IN}
Output Current Range, I_L ..... -10mA to 10mA
Operating Temperature Range .....-40℃ to +125℃

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.

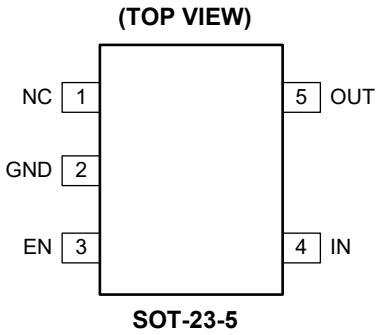
ESD SENSITIVITY CAUTION

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	FUNCTION
1	NC	—	Not Connected. Leave floating.
2	GND	G	Ground.
3	EN	I	Active High Enable Input. When EN = High, the device enters active status and the output voltage is established normally. When EN = Low, the device enters shutdown status and the output turns off.
4	IN	P	Power Supply.
5	OUT	O	Output of the Voltage Reference.

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

ELECTRICAL CHARACTERISTICS

(At V_{IN} = 5.5V, V_{EN} = V_{IN}, C_L = 10μF, C_{IN} = 0.1μF, I_L = 0mA, minimum and maximum values are at T_A = -40℃ to +125℃, typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
SGM4024-1.25Q							
Output Voltage	V_{OUT}				1.25		V
Initial Accuracy		T_A = +25℃		-0.05		0.05	%
Low Frequency Noise	e_{nP-P}	f = 0.1Hz to 10Hz			6		μV_{P-P}/V
Wide Band Noise	e_n	f = 10Hz to 10kHz			16		μV_{RMS}
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	V_{OUT} + V_{DO} ≤ V_{IN} ≤ 5.5V			2	30	ppm/V
Load Regulation	$\Delta V_{O(\Delta IL)}$	V_{IN} = V_{OUT} + V_{DO}	Source, I_{LOAD} = 0mA to 10mA		1.5	10	ppm/mA
			Sink, I_{LOAD} = -10mA to 0mA		75	105	
Turn-On Time	t_{ON}	0.1% of output voltage settling, C_L = 10μF			1.7		ms
SGM4024-1.8Q							
Output Voltage	V_{OUT}				1.8		V
Initial Accuracy		T_A = +25℃		-0.05		0.05	%
Low Frequency Noise	e_{nP-P}	f = 0.1Hz to 10Hz			6		μV_{P-P}/V
Wide Band Noise	e_n	f = 10Hz to 10kHz			19		μV_{RMS}
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	V_{OUT} + V_{DO} ≤ V_{IN} ≤ 5.5V			2	30	ppm/V
Load Regulation	$\Delta V_{O(\Delta IL)}$	V_{IN} = V_{OUT} + V_{DO}	Source, I_{LOAD} = 0mA to 10mA		1	10	ppm/mA
			Sink, I_{LOAD} = -10mA to 0mA		2	10	
Turn-On Time	t_{ON}	0.1% of output voltage settling, C_L = 10μF			1.7		ms
SGM4024-2.5Q							
Output Voltage	V_{OUT}				2.5		V
Initial Accuracy		T_A = +25℃		-0.05		0.05	%
Low Frequency Noise	e_{nP-P}	f = 0.1Hz to 10Hz			6		μV_{P-P}/V
Wide Band Noise	e_n	f = 10Hz to 10kHz			31		μV_{RMS}
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	V_{OUT} + V_{DO} ≤ V_{IN} ≤ 5.5V			2	30	ppm/V
Load Regulation	$\Delta V_{O(\Delta IL)}$	V_{IN} = V_{OUT} + V_{DO}	Source, I_{LOAD} = 0mA to 10mA		1	10	ppm/mA
			Sink, I_{LOAD} = -10mA to 0mA		38	60	
Turn-On Time	t_{ON}	0.1% of output voltage settling, C_L = 10μF			2.5		ms
SGM4024-3.0Q							
Output Voltage	V_{OUT}				3.0		V
Initial Accuracy		T_A = +25℃		-0.05		0.05	%
Low Frequency Noise	e_{nP-P}	f = 0.1Hz to 10Hz			6		μV_{P-P}/V
Wide Band Noise	e_n	f = 10Hz to 10kHz			35		μV_{RMS}
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	V_{OUT} + V_{DO} ≤ V_{IN} ≤ 5.5V			2	30	ppm/V
Load Regulation	$\Delta V_{O(\Delta IL)}$	V_{IN} = V_{OUT} + V_{DO}	Source, I_{LOAD} = 0mA to 10mA		1	10	ppm/mA
			Sink, I_{LOAD} = -10mA to 0mA		32	50	
Turn-On Time	t_{ON}	0.1% of output voltage settling, C_L = 10μF			2.5		ms
SGM4024-3.3Q							
Output Voltage	V_{OUT}				3.3		V
Initial Accuracy		T_A = +25℃		-0.05		0.05	%
Low Frequency Noise	e_{nP-P}	f = 0.1Hz to 10Hz			6		μV_{P-P}/V
Wide Band Noise	e_n	f = 10Hz to 10kHz			42		μV_{RMS}
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	V_{OUT} + V_{DO} ≤ V_{IN} ≤ 5.5V			2	30	ppm/V
Load Regulation	$\Delta V_{O(\Delta IL)}$	V_{IN} = V_{OUT} + V_{DO}	Source, I_{LOAD} = 0mA to 10mA		1	10	ppm/mA
			Sink, I_{LOAD} = -10mA to 0mA		30	50	
Turn-On Time	t_{ON}	0.1% of output voltage settling, C_L = 10μF			2.5		ms

ELECTRICAL CHARACTERISTICS (continued)

(At V_{IN} = 5.5V, V_{EN} = V_{IN}, C_L = 10μF, C_{IN} = 0.1μF, I_L = 0mA, minimum and maximum values are at T_A = -40℃ to +125℃, typical values are at T_A = +25℃, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
SGM4024-4.096Q							
Output Voltage	V_{OUT}				4.096		V
Initial Accuracy		T_A = +25℃		-0.05		0.05	%
Low Frequency Noise	e_{nP-P}	f = 0.1Hz to 10Hz			6		μV_{P-P}/V
Wide Band Noise	e_n	f = 10Hz to 10kHz			44		μV_{RMS}
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	V_{OUT} + V_{DO} ≤ V_{IN} ≤ 5.5V			3	45	ppm/V
Load Regulation	$\Delta V_{O(\Delta IL)}$	V_{IN} = V_{OUT} + V_{DO}	Source, I_{LOAD} = 0mA to 10mA		1	10	ppm/mA
			Sink, I_{LOAD} = -10mA to 0mA		25	45	
Turn-On Time	t_{ON}	0.1% of output voltage settling, C_L = 10μF			2.6		ms
SGM4024-5.0Q							
Output Voltage	V_{OUT}				5.0		V
Initial Accuracy		T_A = +25℃		-0.05		0.05	%
Low Frequency Noise	e_{nP-P}	f = 0.1Hz to 10Hz			6		μV_{P-P}/V
Wide Band Noise	e_n	f = 10Hz to 10kHz			47		μV_{RMS}
Line Regulation	$\Delta V_{OUT}/\Delta V_{IN}$	V_{OUT} + V_{DO} ≤ V_{IN} ≤ 5.5V			5	60	ppm/V
Load Regulation	$\Delta V_{O(\Delta IL)}$	V_{IN} = V_{OUT} + V_{DO}	Source, I_{LOAD} = 0mA to 10mA		1	10	ppm/mA
			Sink, I_{LOAD} = -10mA to 0mA		20	40	
Turn-On Time	t_{ON}	0.1% of output voltage settling, C_L = 10μF			3.6		ms
SGM4024xQ							
Output Voltage Temperature Drift (1)	$\Delta V_{OUT}/\Delta T$	T_A = -40℃ to +125℃			3	10	ppm/℃
Long-Term Stability		0h to 1000h at +25℃			50		ppm
		1000h to 2000h at +25℃			20		
Output Voltage Hysteresis	V_{HYST}	T_A = +25℃ to +125℃ to -40℃ to +25℃			170		ppm
Dropout Voltage	V_{DO}	I_{LOAD} = 0mA			50	100	mV
		I_{LOAD} = 10mA				500	
Short-Circuit Current (2)	I_{SINK}	V_{OUT} = 5.5V	SGM4024-1.25Q/1.8Q	7	21		mA
			SGM4024-2.5Q/3.0Q/3.3Q/4.096Q/5.0Q	13	27.5		
	I_{SOURCE}	V_{OUT} = 0V	SGM4024-1.25Q/1.8Q	12	28		
			SGM4024-2.5Q/3.0Q/3.3Q/4.096Q/5.0Q	18	26		
EN Pin							
Enable Pin Voltage	V_{EN}	Active mode (EN = 1)		1.7			V
		Shutdown mode (EN = 0)				0.5	
Enable Pin Current	I_{EN}	V_{EN} = 5.5V			0.05		μA
Power Supply							
Input Voltage Range	V_{IN}			V_{OUT} + V_{DO} (3)		5.5	V
Quiescent Current	I_Q	Active mode			72	110	μA
		Shutdown mode, V_{EN} = 0V			1.7	4	
Capacitive Load							
Stable Output Capacitor Range	C_L			0.1		47	μF

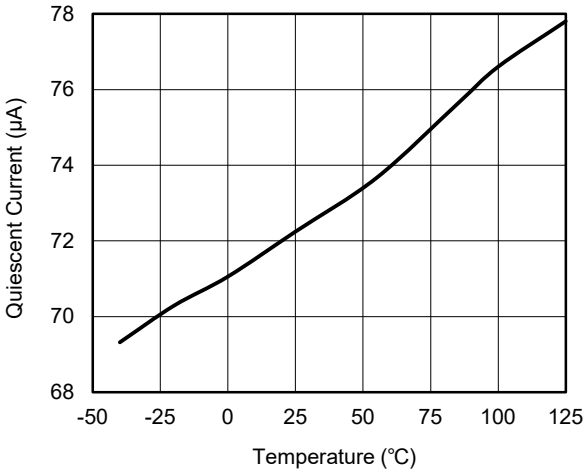
NOTES:

1. The way to determine temperature drift is using Box Method.
2. The maximum junction temperature restricts the short-circuit current capacity when the ambient temperature is high.
3. The minimum supply voltage for SGM4024-1.25Q, SGM4024-1.8Q and SGM4024-2.5Q is 2.7V.

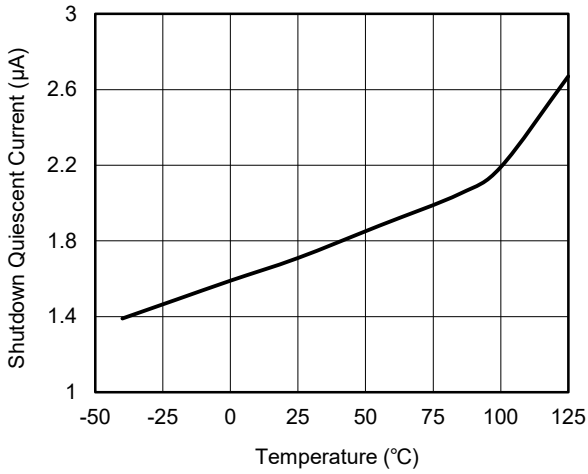
TYPICAL PERFORMANCE CHARACTERISTICS

At T_A = +25℃, V_{IN} = V_{EN} = 5.5V, V_{OUT} = 2.5V, I_{LOAD} = 0mA, C_L = 10μF, C_{IN} = 0.1μF, unless otherwise noted.

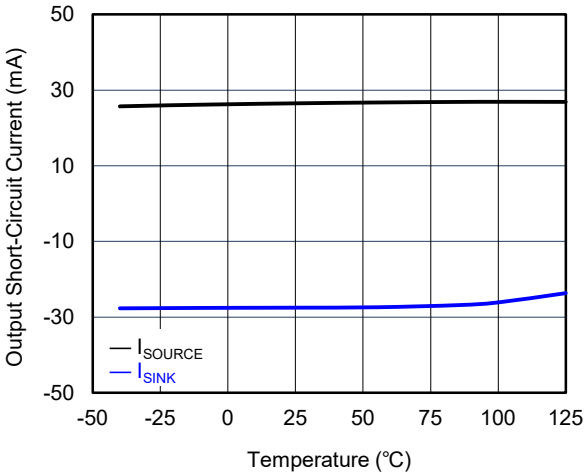
Quiescent Current vs. Temperature



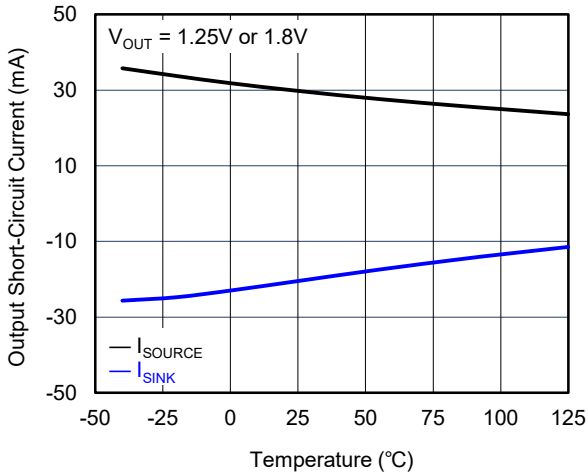
Shutdown Quiescent Current vs. Temperature



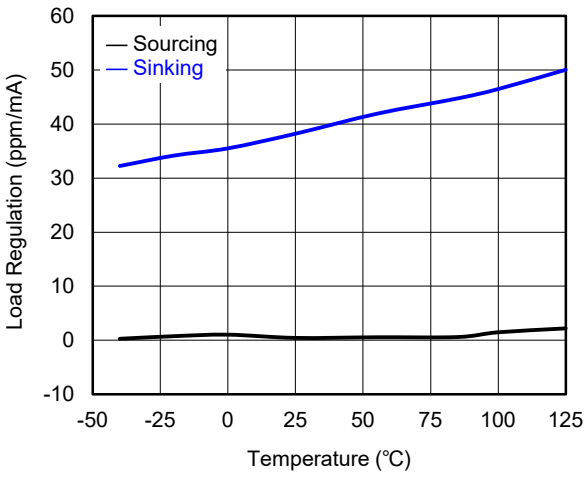
Output Short-Circuit Current vs. Temperature



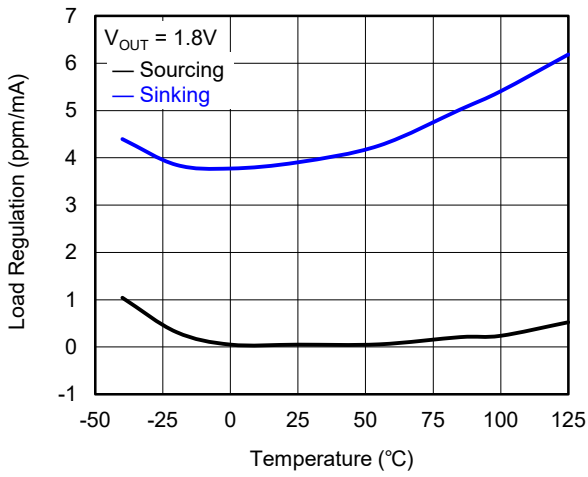
Output Short-Circuit Current vs. Temperature



Load Regulation vs. Temperature



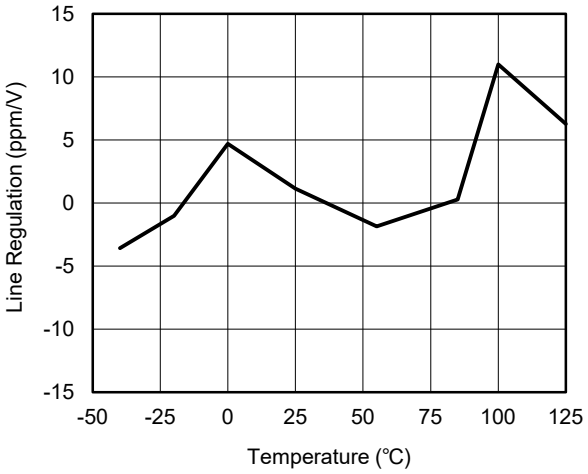
Load Regulation vs. Temperature



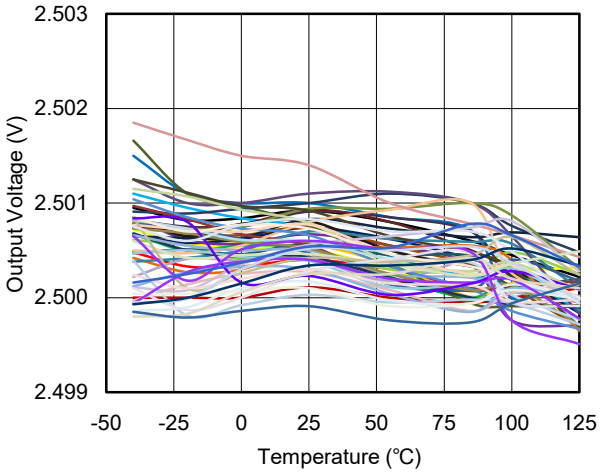
TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{IN} = V_{EN} = 5.5V, V_{OUT} = 2.5V, I_{LOAD} = 0mA, C_L = 10μF, C_{IN} = 0.1μF, unless otherwise noted.

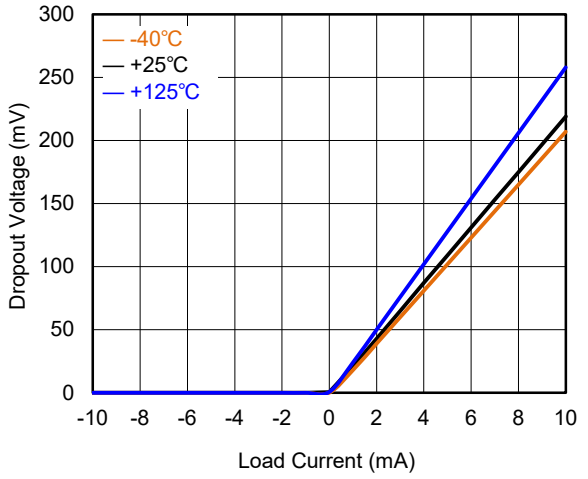
Line Regulation vs. Temperature



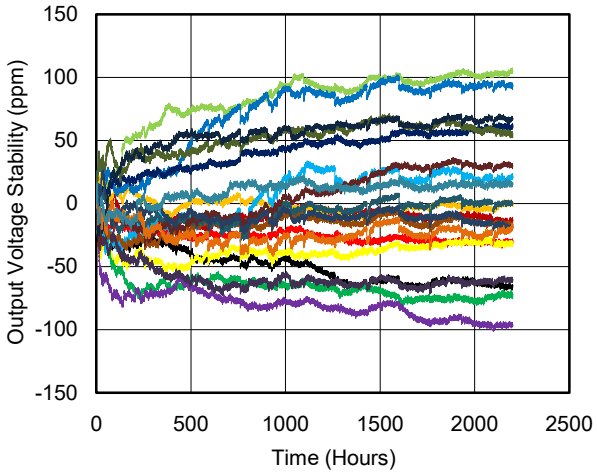
Output Voltage vs. Temperature



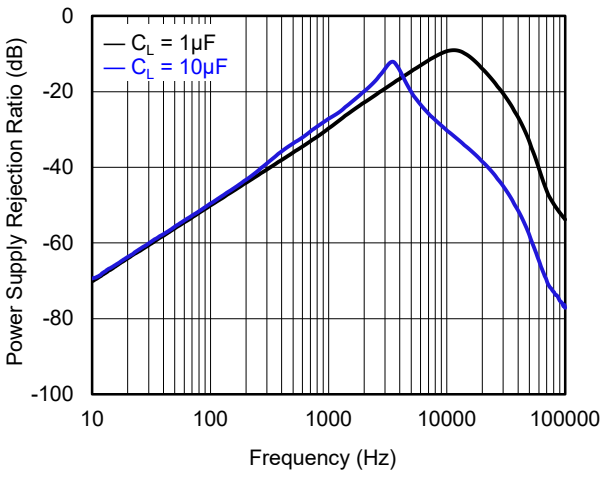
Dropout Voltage vs. Load Current



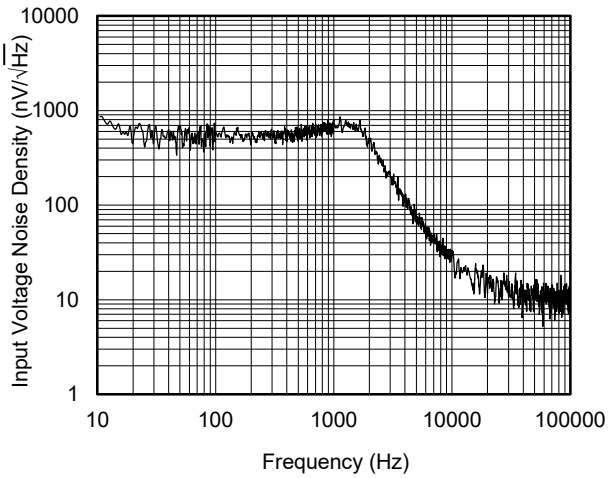
Long-Term Stability



PSRR vs. Frequency



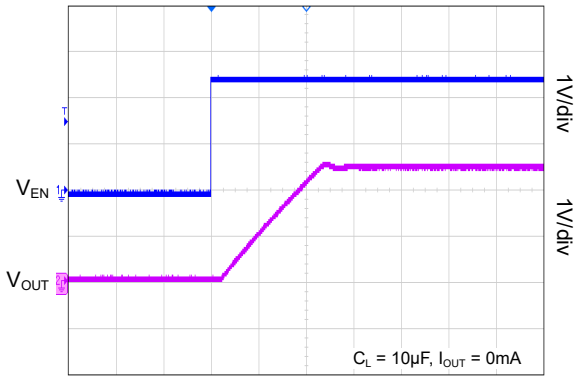
Input Voltage Noise Density vs. Frequency



TYPICAL PERFORMANCE CHARACTERISTICS (continued)

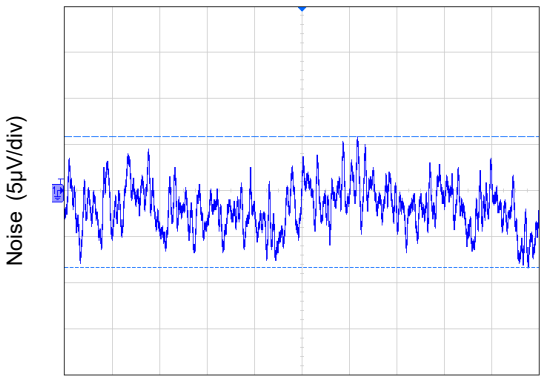
At T_A = +25℃, V_{IN} = V_{EN} = 5.5V, V_{OUT} = 2.5V, I_{LOAD} = 0mA, C_L = 10μF, C_{IN} = 0.1μF, unless otherwise noted.

Turn-On Time



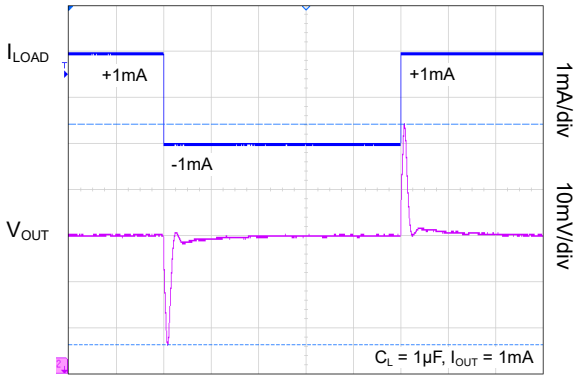
Time (500μs/div)

0.1Hz to 10Hz Noise



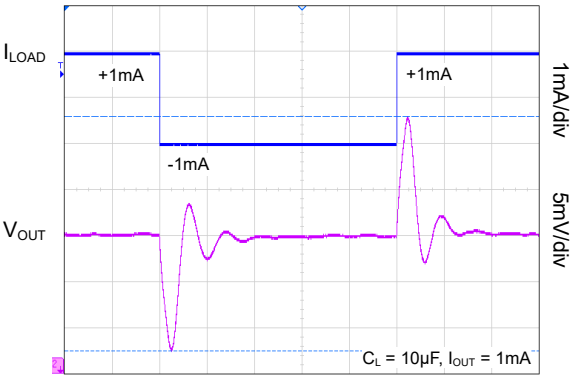
Time (1s/div)

Load Transient



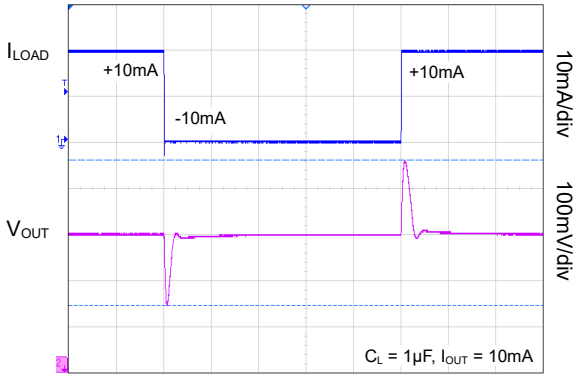
Time (250μs/div)

Load Transient



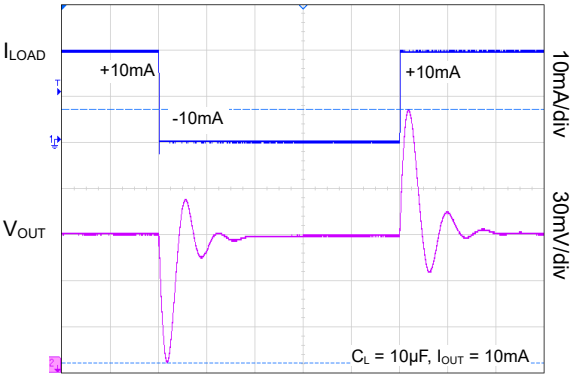
Time (250μs/div)

Load Transient



Time (250μs/div)

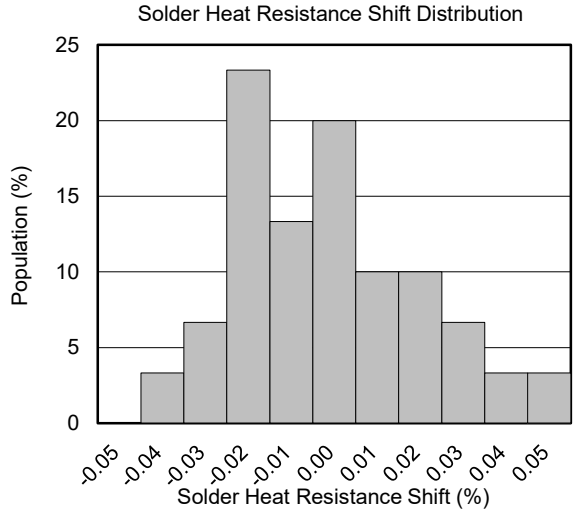
Load Transient



Time (250μs/div)

TYPICAL PERFORMANCE CHARACTERISTICS (continued)

At T_A = +25℃, V_{IN} = V_{EN} = 5.5V, V_{OUT} = 2.5V, I_{LOAD} = 0mA, C_L = 10μF, C_{IN} = 0.1μF, unless otherwise noted.



FUNCTIONAL BLOCK DIAGRAM

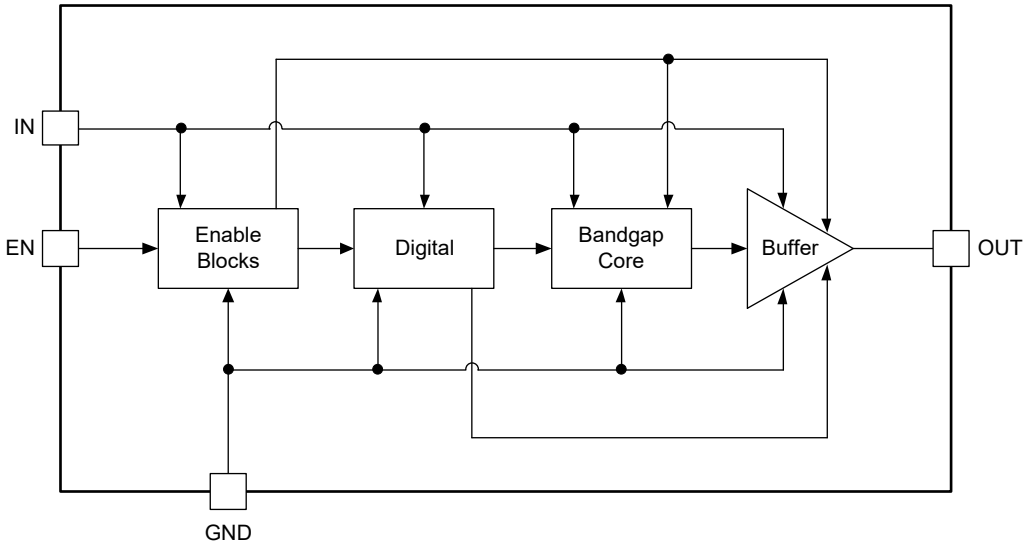


Figure 2. Block Diagram

PARAMETER MEASUREMENT INFORMATION

Solder Heat Shift

The internal structure of SGM4024xQ is made by different materials, which have different temperature coefficient, and the heat can cause stress of the die. Also, the output accuracy will be affected by the stress of temperature and pressure. Commonly, this kind of error is caused by reflow soldering.

Thermal Hysteresis

To measure thermal hysteresis, the SGM4024xQ is soldered to a printed circuit board, replicating an authentic application environment. Before the evaluation of thermal hysteresis, this board is subjected to a pre-heating stage at a temperature of +150℃ for a duration of 30 minutes. The V_{OUT} of the device should be measured at the temperature of +25℃. After finishing this, the SGM4024xQ will be cycled to the other temperatures, and then remove it back to +25℃ and measure the V_{OUT} again. In conclusion, this voltage difference is the hysteresis of temperature.

$$V_{HYST} = \frac{\left|V_{PRE} - V_{POST}\right|}{V_{NOM}} \times 10^6 (ppm) \quad (1)$$

where:

V_{HYST} is the thermal hysteresis.

V_{PRE} is the output voltage measured at +25℃ before the device is removed to the temperature range of -40℃ to +125℃.

V_{POST} is the output voltage measured at +25℃ after the device is removed to the temperature range of -40℃ to +125℃.

V_{NOM} is the output voltage which is specified.

Long-Term Stability

The long-term stability of a reference is very important in industrial and automotive applications. It can also be referred to as long-term drift (LTD). The long-term drift (LTD) is defined as a slow change in output voltage and is usually expressed in ppm/1000h. The equation is as follows:

$$LTD(ppm)|_{t=n} = \left(\frac{V_{OUT}|_{t=0} - V_{OUT}|_{t=n}}{V_{OUT}|_{t=0}} \right) \times 10^6 \quad (2)$$

where:

$LTD(ppm)|_{t=n}$ is long-term stability (in units of ppm).

$V_{OUT}|_{t=0}$ is the measured output voltage at the start of time period.

$V_{OUT}|_{t=n}$ is the measured output voltage at the end of time period.

The long-term drift (LTD) of the SGM4024xQ is 50ppm from 0 to 1000 hours and 20ppm from 1000 to 2000 hours. Users can evaluate the impact of this value on the system application.

Noise Performance

The voltage noise for the frequency from 0.1Hz to 10Hz is shown in the Typical Performance Characteristics section, and it will be increased for high output voltage or temperature. Using an RC filter can improve the noise level of SGM4024xQ; however, please make sure that the output impedance of the device is not affected.

DETAILED DESCRIPTION

The SGM4024xQ is a precision, low noise, low power, bandgap voltage reference with extremely low drift and high initial accuracy. The internal structure of SGM4024xQ is shown in the section of Functional Block Diagram.

Shutdown/Enable

The SGM4024xQ has an EN pin that can control whether the device is enabled or disabled. When the EN pin is pulled high and the EN pin input voltage is 1.7V or higher, the SGM4024xQ enters active mode and the output voltage is established normally. When the EN pin is pulled low and the EN pin input voltage is below 0.5V, the SGM4024xQ enters shutdown mode and the output turns off. In shutdown mode, the quiescent current of the SGM4024xQ reduces to 1.7μA, making it ideal for power-sensitive applications. To activate the SGM4024xQ, the EN pin input voltage must be higher than the EN high-level input voltage. Typically, the EN pin can be connected to the IN pin to enable the output. If the shutdown feature is not needed, the EN pin can be pulled to the IN pin, allowing the reference to keep continuously active.

Low Temperature Drift

The drift error for SGM4024xQ is significantly small, and the change of output voltage illustrates the drift of error. The Box Method is used to evaluate the temperature drift as shown in Equation 3.

$$\text{Drift} = \left(\frac{V_{OUTMAX} - V_{OUTMIN}}{V_{OUT} \times \text{Temp Range}} \right) \times 10^6 (\text{ppm}) \quad (3)$$

Output Current

Within the specification of the supply voltage range, the load current of SGM4024xQ is specified to ±10mA per output. The output of the device is designed with a protective mechanism that limits the short-circuit current to 26mA to prevent short-circuit conditions. The following equation illustrates how the temperature changes with the increasing of temperature.

$$T_J = T_A + P_D \times \theta_{JA} \quad (4)$$

where:

T_J is the junction temperature (℃).

T_A is the ambient temperature (℃).

P_D is the power dissipated (W).

θ_{JA} is the junction-to-ambient thermal resistance (℃/W).

The junction temperature of SGM4024xQ must be lower than +150℃, which is the maximum acceptable temperature of this voltage reference.

Supply Voltage

The input voltage range of the SGM4024xQ is from 2.7V to 5.5V, and it has an extremely low dropout voltage. The SGM4024xQ can operate with a supply of 50mV more than the output voltage in an unloaded condition. For other loaded conditions, the curve of Dropout Voltage vs. Load Current can be referenced. The SGM4024xQ has a low quiescent current and the quiescent current changes very little with both temperature and supply. As illustrated in the Electrical Characteristics, the quiescent current measured at +25℃ is 72μA, and the maximum over the temperature range is 110μA. Additionally, the quiescent current of the SGM4024xQ may be higher than the typical quiescent current if the input voltage is not within the specified range.

APPLICATION INFORMATION

Negative Reference Voltage

If users desire to use SGM4024xQ to guarantee positive and negative voltage, SGM4024xQ and SGM8253-2Q should be taken into account. In Figure 3, the output of SGM8253-2Q is equal to the negative value of SGM4024xQ. The following circuit can also guarantee the accuracy as the offset voltage and drift of SGM8253-2Q is also extreme low. In addition, the temperature coefficient of two resistors should be taken into account.

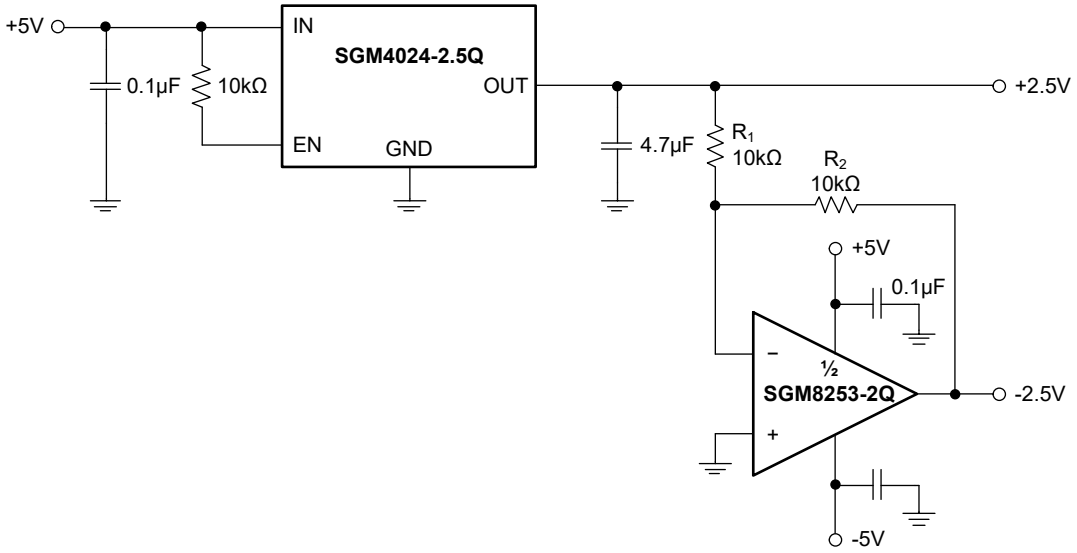


Figure 3. Positive and Negative Voltage Reference

16-Bit, 960SPS Data Acquisition System

Besides positive or negative voltage reference applications, data acquisition systems also require stable voltage references to maintain accuracy. The SGM4024xQ has low noise, very low drift and high initial accuracy. These features make it suitable for high-performance data converter applications. Figure 4 shows the SGM4024xQ in a basic data acquisition system.

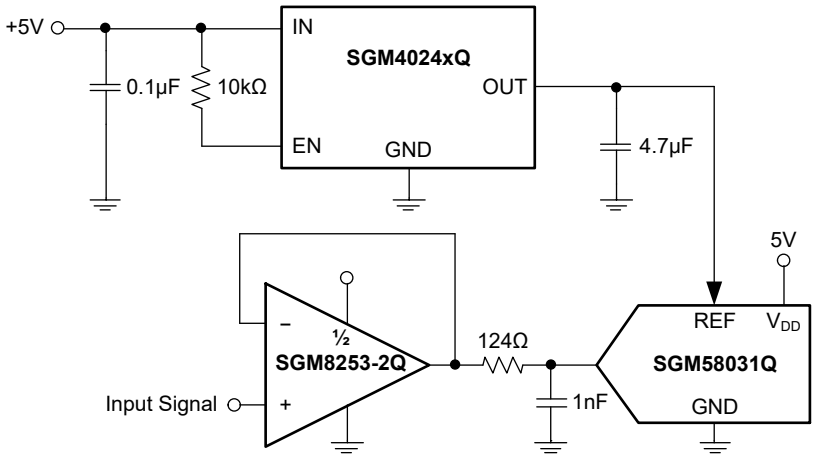


Figure 4. Data Acquisition System with SGM4024xQ

APPLICATION INFORMATION (continued)

Input Capacitors

The SGM4024xQ requires one or more input decoupling capacitors to reduce the input voltage noise in actual application. The input decoupling capacitor should be placed as close as possible to the IN pin to improve transient response. Usually, the optimal configuration of decoupling capacitors is a combination of 1μF and 0.1μF. The large 1μF capacitor can be used to stabilize input voltage and the small 0.1μF capacitor can filter out high-frequency noise.

Output Capacitors

The SGM4024xQ output effective capacitance range is 0.1μF to 47μF. A ceramic capacitor with a minimum value of 0.1μF must be added to ensure stability in application. The output capacitor should be placed as close as possible to the OUT pin. A 1μF or larger X7R or X5R ceramic capacitor is recommended to achieve good dynamic performance.

For ceramic capacitors, temperature, DC bias and package size will affect the effective capacitance, so sufficient margin for C_L must be considered in the design. Additionally, a C_L with larger capacitance and lower ESR will help increase high-frequency PSRR and improve load transient response.

Power Supply Recommendations

The input voltage range of the SGM4024XQ is from 2.7V to 5.5V, and it has an extremely low dropout voltage. The SGM4024XQ can operate with a supply of 50mV more than the output voltage in an unloaded condition. In applications, a bypass capacitor must be connected from the IN pin to the GND pin to reduce input noise, and the bypass capacitor should be at least 0.1μF.

Layout

Some key considerations of printed-circuit board (PCB) layout using the SGM4024xQ are:

- A low ESR bypass capacitor with 0.1μF should be added at the input of SGM4024xQ.
- A decouple capacitor should be also added for the device which is associated with SGM4024xQ.
- A solid ground plane should be taken into account to decrease EMI and distribute heat.
- The external passive devices should be added as close as possible to SGM4024xQ in order to reduce the error which is from the parasitic parameter.
- The analog trace should not be parallel with the digital trace to prevent the crosstalk. If the PCB is complicated and the crossing of these two traces cannot be avoid, then please make them in the different layer and keep perpendicular.

Power Dissipation

The SGM4024xQ voltage reference has the capability to both source and sink a load current of up to 10mA within the specification of the supply voltage range. However, in high temperature conditions, it is crucial to keep a close watch on both the input voltage and the load current to prevent exceeding the device's highest power dissipation capacity. The following equation illustrates how the temperature changes with the increasing of temperature.

$$T_J = T_A + P_D \times \theta_{JA} \quad (5)$$

where:
T_J is the junction temperature (℃).
T_A is the ambient temperature (℃).
P_D is the power dissipated (W).
θ_{JA} is the junction-to-ambient thermal resistance (℃/W).

Due to this correlation, the permissible load current under conditions of high temperature might not reach the device's ultimate capacity for sourcing current. It is critical to operate the device within its specified power limits, as exceeding these can lead to early malfunction or irreversible harm to the device.

REVISION HISTORY

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

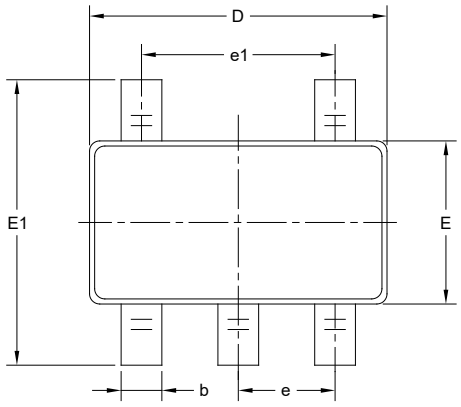
DECEMBER 2025 – REV.A.1 to REV.A.2	Page
Updated Electrical Characteristics section	5

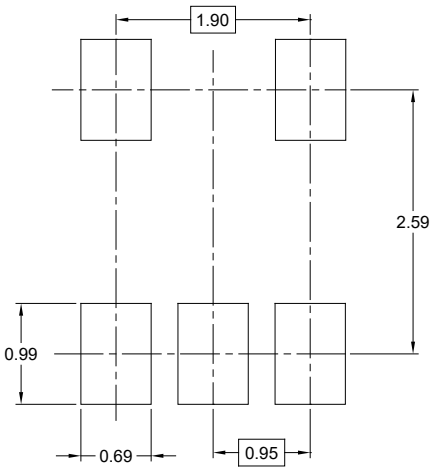
JUNE 2025 – REV.A to REV.A.1	Page
Updated Absolute Maximum Ratings section	2
Updated Typical Performance Characteristics section	8
Updated Detailed Description section	12

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

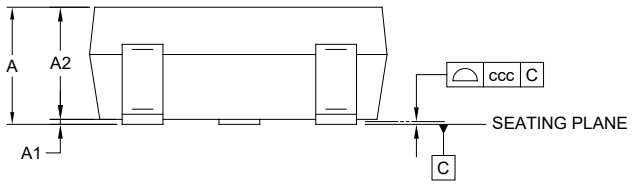
PACKAGE OUTLINE DIMENSIONS

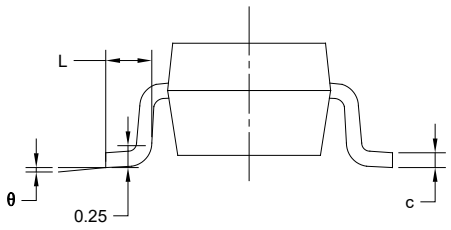
SOT-23-5





RECOMMENDED LAND PATTERN (Unit: mm)



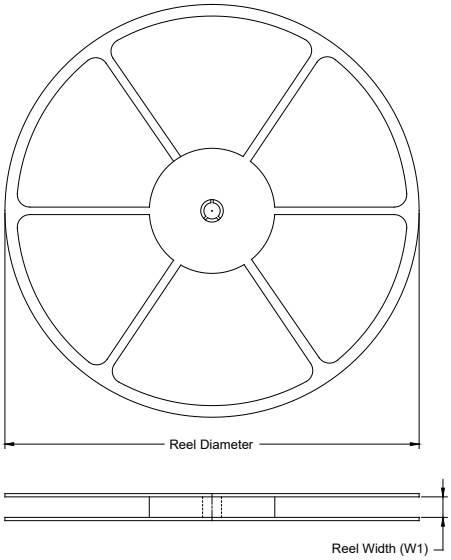


Symbol	Dimensions In Millimeters		
	MIN	NOM	MAX
A	-	-	1.450
A1	0.000	-	0.150
A2	0.900	-	1.300
b	0.300	-	0.500
c	0.080	-	0.220
D	2.750	-	3.050
E	1.450	-	1.750
E1	2.600	-	3.000
e	0.950 BSC		
e1	1.900 BSC		
L	0.300	-	0.600
θ	0°	-	8°
ccc	0.100		

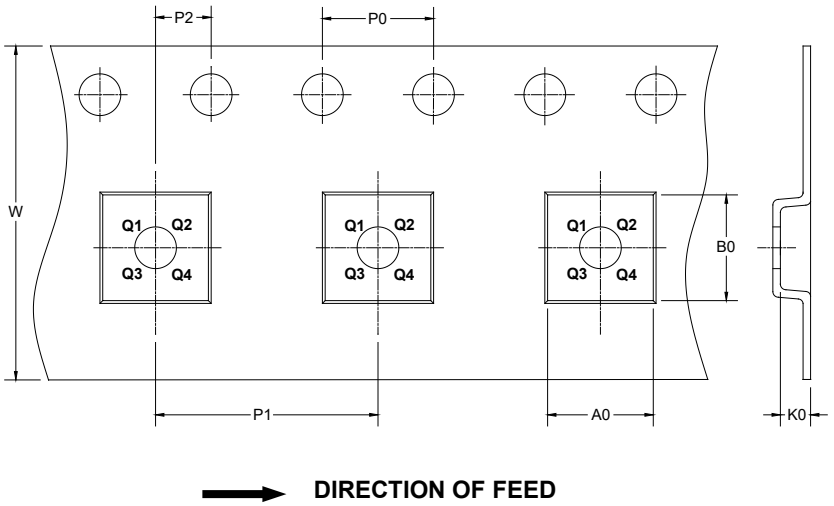
NOTES:
1. This drawing is subject to change without notice.
2. The dimensions do not include mold flashes, protrusions or gate burrs.
3. Reference JEDEC MO-178.

TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



DIRECTION OF FEED

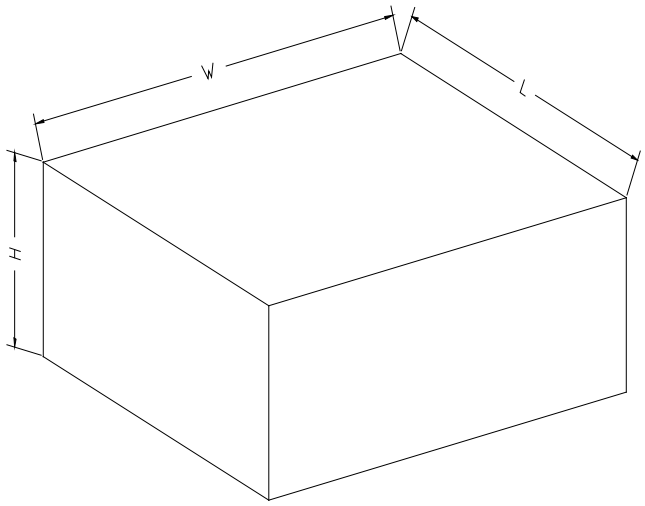
NOTE: The picture is only for reference. Please make the object as the standard.

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-23-5	7″	9.5	3.20	3.20	1.40	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