GS2019
300mA, Low Dropout,Linear Regulators

GENERAL DESCRIPTION

The GS2019 series low-power, low-noise, low-dropout, CMOS linear voltage regulators operate from a 2.5V to 5.5V input voltage. They are the perfect choice for low voltage, low power applications. A low ground current makes this part attractive for battery operated power systems. The GS2019 series also offer ultra-low dropout voltage to prolong battery life in portable electronics. Systems requiring a quiet voltage sources, such as RF applications, will benefit from the GS2019 series ultra-low output noise ($30uV_{RMS}$) and high PSRR. An external noise bypass capacitor connected to the device's BP pin can further reduce the noise level.

The output voltage is preset to voltages in the range of 1.2V to 5.0V. Other features include a 10nA logic-controlled shutdown mode, foldback current limit and thermal shutdown protection.

The GS2019 is available in Green SOT-23-5 and SC70-5 packages. It operates over an ambient temperature range of -40°C to +85°C.

FEATURES

- Low Output Noise
- Low Dropout Voltage

Thermal-Overload Protection

- Output Current Limit
- High PSRR(74dB at 1kHz)
- 10nA Logic-Controlled Shutdown
- Available in Multiple output Voltage Versions
- Fixed Outputs of 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 2.85V, 3.0V and 3.3V
- Adjustable Output from 1.2V to 5.0V
- -40°C to 85°C Operating Temperature Range
- Available in Green SC70-5 and SOT-23-5 Packages

APPLICATIONS

Cellular Telephones
Cordless Telephones
PCMCIA Cards
Modems
MP3 Player
Hand-Held Instruments
Portable/Battery-Powered Equipment

ORDERING INFORMATION

Order Number	Package Type	Temperature Range	Marking	QTY/Reel
GS2019-TR	SOT-23-5	-40°C to +85°C	LKXX[1]	3000
GS2019-CR	SC70-5	-40°C to +85°C	LKXX[1]	3000

NOTE 1:XX: voltage version (12:1.2V, 15:1.5V, 18:1.8V, 25:2.5V, 28:2.8V, 285:2.85V, 30:3.0V, 33:3.3V, AJ:Adjustable)

ABSOLUTE MAXIMUM RATINGS

IN to GND.....-0.3V to 6V
EN to GND…….....-0.3V to V_{IN}
OUT, BP/FB to GND.....-0.3V to (V_{IN}+0.3V)
Output Short-Circuit Duration.....Infinite
Power Dissipation, P_D@T_A=25℃
SOT-23-5.....0.4W
SC70-5.....0.3W
Package Thermal Resistance
SOT-23-5, θ_{JA}.....260℃/W
SC70-5, θ_{JA}.....330℃/W
Junction Temperature.....150℃
Operating Temperature Range.....-40℃ to +85℃
Storage Temperature Range.....-65℃ to 150℃
Lead Temperature (Soldering, 10 sec).....260℃
ESD Susceptibility
HBM.....2000V
MM.....200V

NOTE:

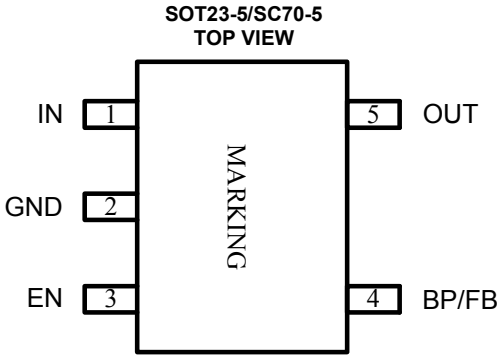
Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

CAUTION

This integrated circuit can be damaged by ESD if you don’t pay attention to ESD protection. Broadchip 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 very small parametric changes could cause the device not to meet its published specifications.

Broadchip reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact Broadchip sales office to get the latest datasheet.

PIN CONFIGURATION



PIN DESCRIPTION

PIN	NAME	FUNCTION
1	IN	Regulator Input. Supply voltage can range from 2.5V to 5.5V. Bypass with a 1uF capacitor to GND.
2	GND	Ground.
3	EN	Shutdown Input. A logic low reduces the supply current to 10nA. Connect to IN for normal operation.
4	BP	Reference-Noise Bypass (fixed voltage version only). Bypass with a low-leakage 0.01uF ceramic capacitor for reduced noise at the output.
	FB	Adjustable Voltage Version Only. This is used to set the output voltage of the device.
5	OUT	Regulator Output.

ELECTRICAL CHARACTERISTICS

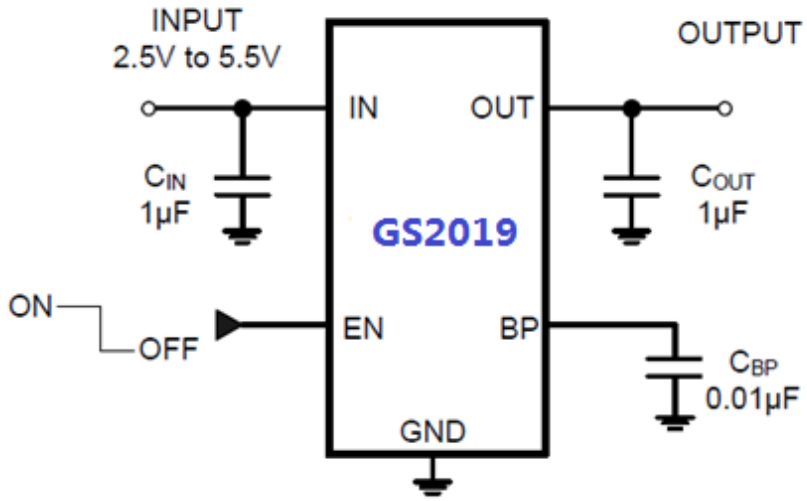
(V_{IN}= $V_{OUT(NOMINAL)}$+0.5V[1], Full = -40℃ to +85℃, unless otherwise specified.)

PARAMETER	SYM	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage	V_{IN}		2.5		5.5	V
Output Voltage Accuracy[1]		I_{OUT}=0.1mA	-2.5		2.5	%
Maximum Output Current		SOT-23-5		300		mA
		V_{OUT}=1.2V,1.5V,1.8V, SC70-5		150		
		V_{OUT}>2V, SC70-5		250		
Current Limit	I_{LIM}			800		mA
Ground Pin Current	I_Q	No load, EN=2V		100	200	uA
Dropout Voltage[2]		I_{OUT}=1mA		0.9		mV
		I_{OUT}=300mA		270	400	
Line Regulation	ΔV_{LNR}	V_{IN}=2.5V or (V_{OUT}+0.5V) to 5.5V, I_{OUT}=1mA		0.02	0.05	%/V
Load Regulation	ΔV_{LDR}	I_{OUT}=0.1mA to 300mA, C_{OUT}=1uF, V_{OUT}>2V		0.002	0.005	%/mA
		I_{OUT}=0.1mA to 300mA, C_{OUT}=1uF, V_{OUT}≤2V		0.004	0.008	
Output Voltage Noise	e_n	f=10Hz to 100kHz, C_{BP}=0.01uF, C_{OUT}=10uF		30		uV_{RMS}
Power Supply Rejection Ratio	PSRR	C_{BP}=0.1uF, I_{LOAD}=50mA, C_{OUT}=1uF, V_{IN}=V_{OUT}+1V, f=217Hz		77		dB
		f=1kHz		74		
SHUTDWON[3]						
EN Input Threshold	V_{IH}	V_{IN}=2.5V to 5.5V, V_{EN}=-0.3V to V_{IN}	1.5			V
	V_{IL}				0.3	
EN Input Bias Current	$I_{B(SHDN)}$	EN=0V or EN=5.5V		0.01	1	uA
Shutdown Supply Current	$I_{Q(SHDN)}$	EN=0.4V		0.01		uA
Shutdown Exit Delay[4]		C_{BP}=0.01uF, C_{OUT}=1uF, No Load		30		us
THERMAL PROTECTION						
Thermal Shutdown Temperature	T_{SHDN}			150		°C
Thermal Shutdown Hysteresis	ΔT_{SHDN}			15		°C

NOTES:

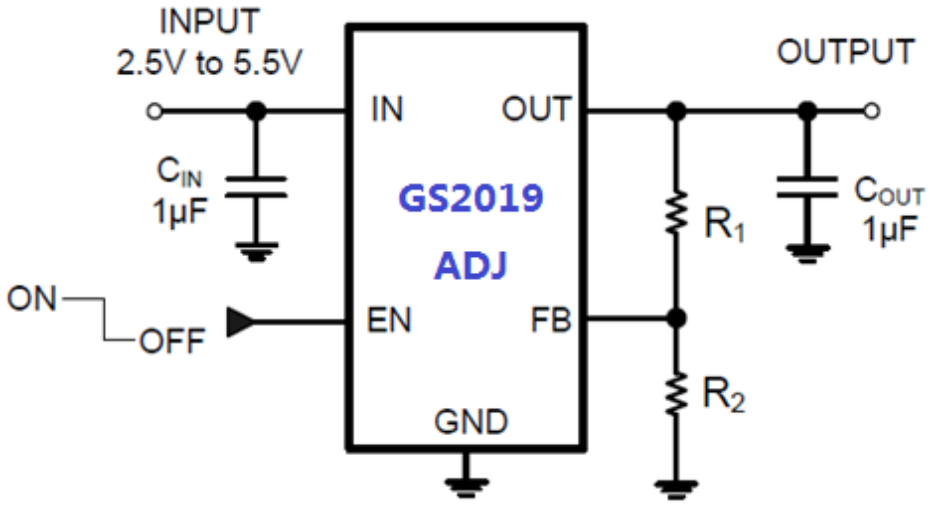
1. V_{IN} = $V_{OUT\ (NOMINAL)}$ + 0.5V or 2.5V, whichever is greater.
2. The dropout voltage is defined as VIN - VOUT, when VOUT is 100mV below the value of V_{OUT} for V_{IN} = V_{OUT} + 0.5V.
   (Only applicable for V_{OUT} = +2.5V to +5.0V.)
3. V_{EN} = -0.3V to V_{IN}
4. Time needed for V_{OUT} to reach 90% of final value.

TYPICAL APPLICATION CIRCUIT



C_{BP}(nF)	Shutdown Exit Delay(us) V_{OUT}=2.8V, V_{IN}=3.3V, EN=0V to 2V			PSRR(dB) at 217Hz V_{OUT}=2.8V, V_{IN}=V_{OUT}+1V		
	I_{LOAD}=50mA	I_{LOAD}=150mA	I_{LOAD}=300mA	I_{LOAD}=50mA	I_{LOAD}=150mA	I_{LOAD}=300mA
None	21.5	21.5	21	71.1	64.4	55
0.001	21.5	21.5	22	71.1	64.6	55.1
0.01	22	22.5	22.5	71.6	64.7	55.2
0.1	22.5	23	23	71.7	64.8	55.4
1	25	27	28.5	72.1	65.2	55.9
10	30	35	39	74.3	68.8	59.6
100	265	280	300	77	73.7	63.1

TYPICAL APPLICATION CIRCUIT



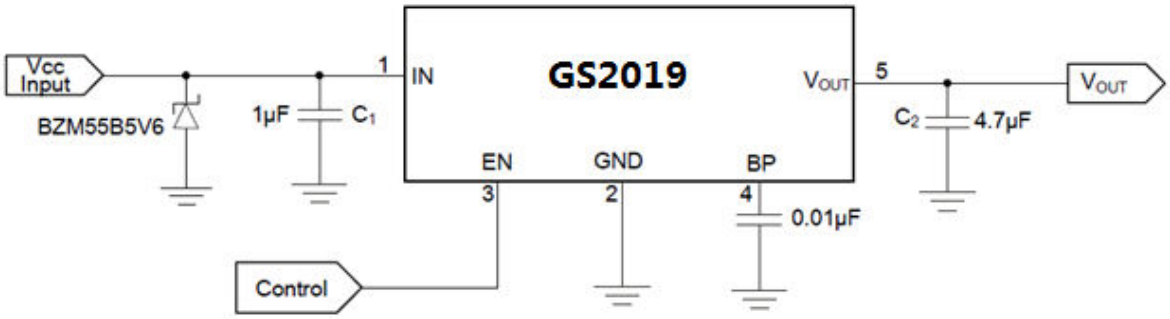
Standard 1% Resistor Values for Common Output Voltages of Adjustable Voltage Version

VOUT (V)	R1 (kΩ)	R2 (kΩ)
1.2	0	63.4
1.5	10.5	42.2
1.8	34	63.4
2.8	84.5	63.4
3.0	63.4	42.2
3.3	73.2	42.2
3.6	84.5	42.2
4.2	105	42.2

NOTE: VOUT = (R1 + R2)/ R2 × 1.207

APPLICATION NOTE

When LDO is used in handheld products, attention must be paid to voltage spikes which could damage GS2019. In such applications, voltage spikes will be generated at charger interface and VBUS pin of USB interface when charger adapters and USB equipments are hot-plugged. Besides this, handheld products will be tested on the production line without battery. Test engineer will apply power from the connector pin which connects with positive pole of the battery. When external power supply is turned on suddenly, the voltage spikes will be generated at the battery connector. The voltage spikes will be very high, and it always exceeds the absolute maximum input voltage (6.0V) of LDO. In order to get robust design, design engineer needs to clear up this voltage spike. Zener diode is a cheap and effective solution to eliminate such voltage spike. For example, BZM55B5V6 is a 5.6V small package Zener diode which can be used to remove voltage spikes in cell phone designs. The schematic is shown below.



Bypass Capacitor and Low Noise

Connecting a 22nF between the BP pin and GND pin significantly reduces noise on the regulator output, it is critical that the capacitor connection between the BP pin and GND pin be direct and PCB traces should be as short as possible. There is a relationship between the bypass capacitor value and the LDO regulator turn on time. DC leakage on this pin can affect the LDO regulator output noise and voltage regulation performance.

Enable Function

The GS2019 features an LDO regulator en-able/disable function. To assure the LDO regulator will switch on; the EN turn on control level must be greater than 1.2 volts. The LDO regulator will go into the shutdown mode when the voltage on the EN pin falls below 0.4 volts. For to protect the system, the GS2019 have a quick discharge function. If the enable function is not needed in a specific application, it may be tied to VIN to keep the LDO regulator in a continuously on state.

Programming the GS2019 Adjustable LDO regulator

The output voltage of the GS2019 adjustable regulator is programmed using an external resistor divider as show in Figure as below. The output voltage is calculated using equation as below:

$$V_{OUT} = V_{REF} \times \left(1 + \frac{R1}{R2}\right)$$

Where:

V_{REF}=1.207V typ (the internal reference voltage)

Resistors R1 and R2 should be chosen for approximately 50uA divider current. Lower value resistors can be used for improved noise performance, but the solution consumes more power. Higher resistor values should be avoided as leakage current into/out of FB across R1/R2 creates an offset voltage that artificially increases/decreases the feedback voltage and thus erroneously decrease/increases V_{OUT}.

Thermal Considerations

Thermal protection limits power dissipation in GS2019. When the operation junction temperature exceeds 150°C, the OTP circuit starts the thermal shutdown function turn the pass element off. The pass element turns on again after the junction temperature cools by 15°C.

For continue operation, do not exceed absolute maximum operation junction temperature 125°C. The power dissipation definition in device is:

$P_D = (V_{IN}-V_{OUT}) \times I_{OUT} + V_{IN} \times I_Q$

The maximum power dissipation depends on the thermal resistance of IC package, PCB layout, the rate of surroundings airflow and temperature difference between junction to ambient. The maximum power dissipation can be calculated by following formula：

$P_D(MAX) = (T_J(MAX) - T_A) / \theta_{JA}$

Where $T_J(MAX)$ is the maximum operation junction temperature 125°C, T_A is the ambient temperature and the θ_{JA} is the junction to ambient thermal resistance. For recommended operating conditions specification of GS2019, where $T_J(MAX)$ is the maximum junction temperature of the die (125°C) and T_A is the maximum ambient temperature. The junction to ambient thermal resistance (θ_{JA} is layout dependent) for SOT-23-5 package is 250°C/W, SC-70-5 package is 333°C/W, on standard JEDEC 51-3 thermal test board. The maximum power dissipation at T_A= 25°C can be calculated by following formula:

$P_D(MAX) = (125°C-25°C)/333 = 300mW$ (SC-70-5)

$P_D(MAX) = (125°C-25°C)/250 = 400mW$ (SOT-23-5)

The maximum power dissipation depends on operating ambient temperature for fixed T_J(MAX) and thermal resistance θ_{JA}. It is also useful to calculate the junction of temperature of the GS2019 under a set of specific conditions. In this example let the Input voltage V_{IN}=3.3V, the output current Io=300mA and the case temperature T_A=40°C measured by a thermal couple during operation. The power dissipation for the Vo=2.8V version of the GS2019 can be calculated as:

P_D = (3.3V−2.8V) ×300mA+3.6V×100uA
=150mW

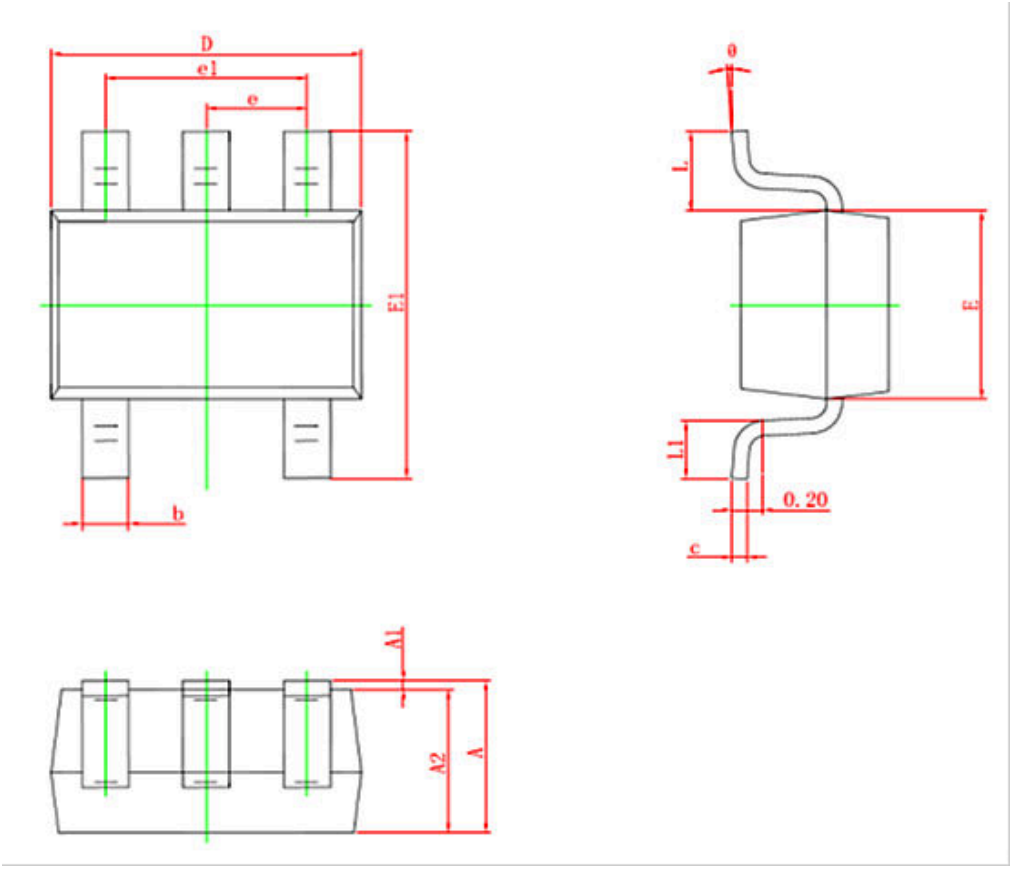
And the junction temperature, T_J, can be calculated as follows:

$T_J=T_A+P_D\times\theta_{JA}$=40°C+0.15W×250°C/W
=40°C+37.5°C=77.5°C<T_J(MAX) =125°C

For this operating condition, T_J is lower than the absolute maximum operating junction temperature,125°C, so it is safe to use the GS2019 in this configuration.

PACKAGE OUTLINE DIMENSIONS

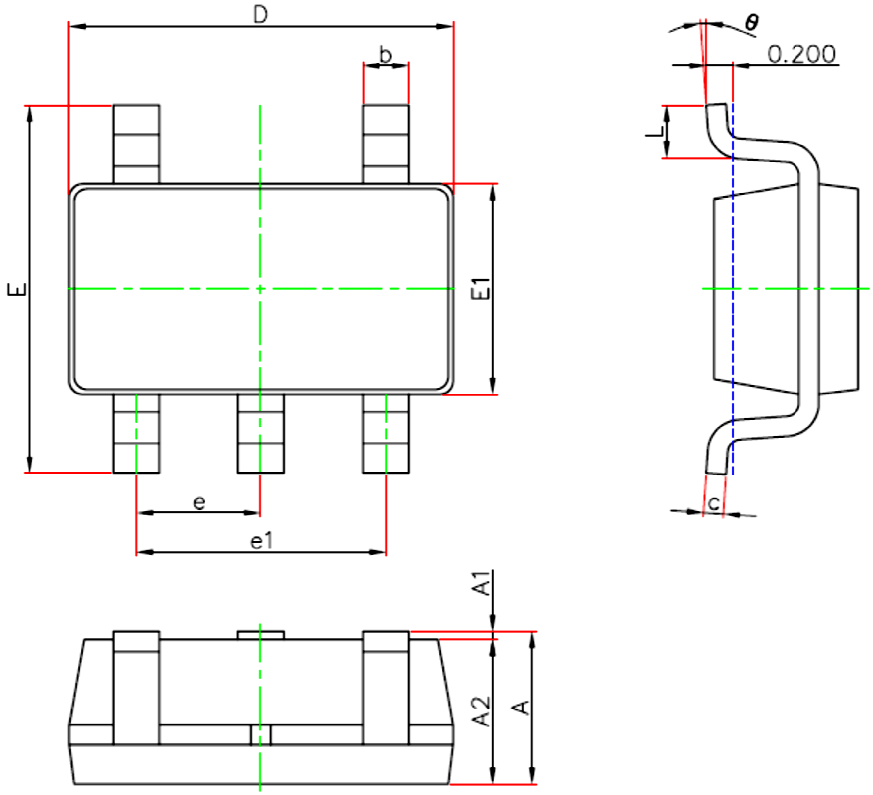
Packaging Mechanical: SC70 (C)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.900	1.100	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.000	0.035	0.039
b	0.150	0.350	0.006	0.014
c	0.110	0.175	0.004	0.007
D	2.000	2.200	0.079	0.087
E	1.150	1.350	0.045	0.053
E1	2.150	2.450	0.085	0.096
e	0.650 TYP.		0.026 TYP.	
e1	1.200	1.400	0.047	0.055
L	0.525 REF.		0.021 REF.	
L1	0.260	0.460	0.010	0.018
θ	0°	8°	0°	8°

PACKAGE OUTLINE DIMENSIONS

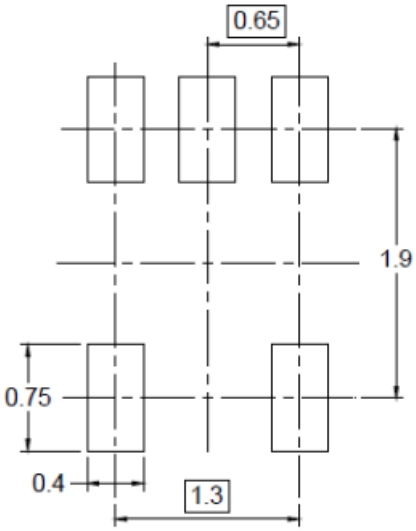
SOT23-5



Symbol	Dimensions In Millimeters	
	Min	Max
A	1.05	1.3
A1	0	0.15
A2	1.05	1.15
b	0.28	0.5
c	0.1	0.23
D	2.82	3.02
E1	1.5	1.7
E	2.65	3.05
e	0.95(BSC)	
e1	1.8	2
L	0.3	0.6
θ	0	8°

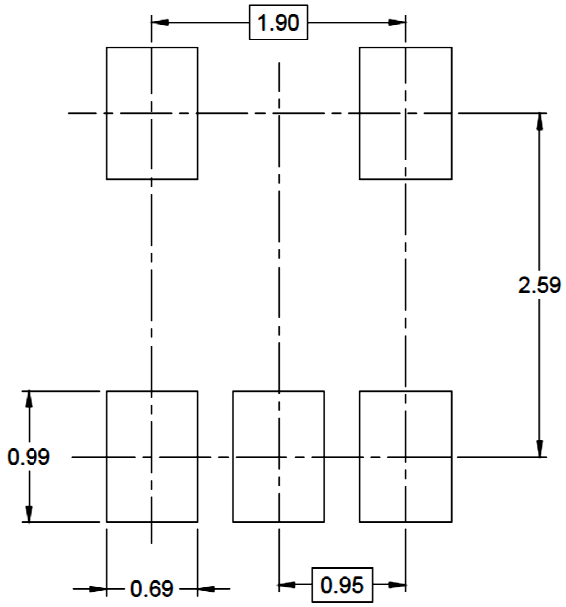
SOT-23-5 Surface Mount Package

PCB Layout Pattern: SC70 (C)



RECOMMENDED PCB LAYOUT PATTERN (Unit: mm)

PCB Layout Pattern: SOT23-5



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