200mA, 6V, *Nanopower* I_Q 600nA, Low-Dropout Linear Regulator with Enable

DESCRIPTION

The TSL9A12 series are ultra-low quiescent current regulator features low dropout voltage and low current in the standby mode. With 600nA quiescent current at no load. The TSL9A12 series is ideally suited for standby micro-control-unit systems, especially for always-on applications like portable, and other battery-operated systems. The TSL9A12 series retains all the features that are common to low dropout regulators including a low dropout PMOS pass device, short circuit protection, and thermal shutdown.

FEATURES

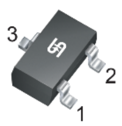
- Input voltage up to 6V
- Fixed output voltages 1.8V and 3.3V
- Ultra-low quiescent current 600nA (typ.)
- Output voltage accuracy ±2%
- Dropout voltage 400mV @ I_O: 200mA (V_{OUT}=3.3V)
- Stable with ceramic capacitors
- Current limit protection
- Over temperature protection
- RoHS Compliant
- Halogen-Free

APPLICATION

- Portable, Battery powered equipment
- Low power microcontrollers
- Wireless communication equipment

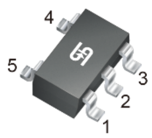
Pb-Free RoHS COMPLIANT HALOGEN FREE

SOT-23



Pin Definition:
1. Ground
2. Output
3. Input

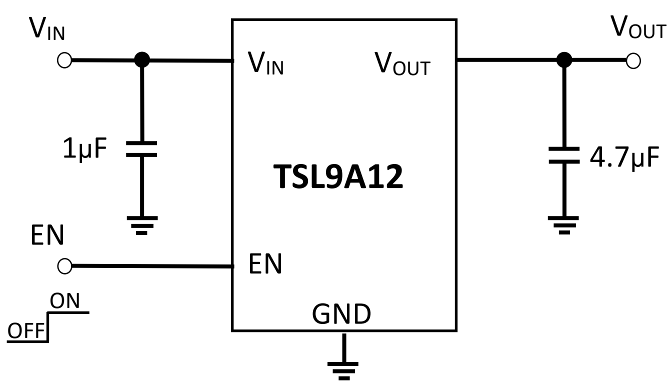
SOT-25



Pin Definition:
1. Input
2. Ground
3. Enable
4. NC
5. Output

Notes: MSL 1 (Moisture Sensitivity Level) per J-STD-020

TYPICAL APPLICATION CIRCUIT



ABSOLUTE MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)			
PARAMETER	**SYMBOL**	**LIMIT**	**UNIT**
Input voltage (V_{IN} to GND)	V_{IN}	-0.3 ~ 6	V
Recommended operating conditions	V_{IN}	~ 6	V
Junction temperature range	T_J	-40 ~ +125	°C
Operating temperature ambient range	T_A	-40 ~ +105	°C
Storage temperature range	T_{STG}	-55 ~ +150	°C
ESD	HBM	2	kV
	CDM	1	kV

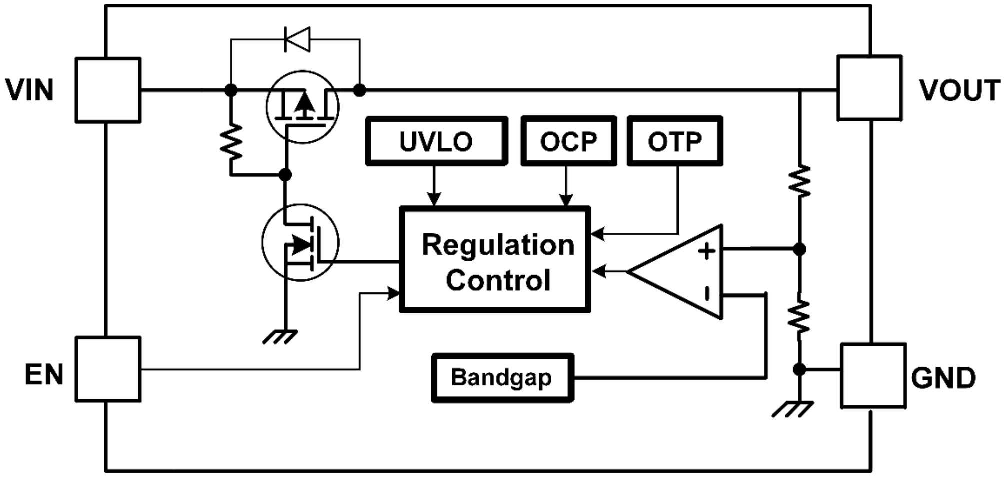
Notes: Stress above the listed absolute rating may cause permanent damage to the device.

THERMAL PERFORMANCE (Note 2)				
PARAMETER	**SYMBOL**	**TYP**		**UNIT**
		SOT-23	**SOT-25**	
Thermal resistance junction to ambient	$R_{\theta JA}$	260	220	°C/W
Thermal resistance junction to case	$R_{\theta JC}$	120	95	°C/W

ELECTRICAL SPECIFICATIONS (V_{IN} = V_{OUT} +1V, I_O=1mA, T_A = 25°C unless otherwise noted)							
PARAMETER		**CONDITIONS**	**SYMBOL**	**MIN**	**TYP**	**MAX**	**UNIT**
Output voltage	V_{OUT} 1.8V	V_{IN} = V_{OUT}+1V, I_O = 1mA	V_{OUT}	1.764	--	1.836	V
	V_{OUT} 3.3V			3.234		3.366	
Line regulation		V_{IN} = V_{OUT}+1V ~ 5.5V,	$\Delta V_{OUT,li}$	--	--	2	%
Load regulation	V_{OUT} 1.8V	1mA < I_{LOAD} ≤ 200mA	$\Delta V_{OUT,lo}$	--	--	2.5	%
	V_{OUT} 3.3V			--	--	2	
Quiescent current		V_{IN} = V_{EN}, Io = 0mA	I_Q	--	0.6	1.2	μA
Current limit			I_{CL}	350	--	--	mA
Dropout voltage	V_{OUT} = 1.8V	Io = 100mA	$V_{DROPOUT}$	--	215	304	mV
		Io = 150mA		--	320	456	
		Io = 200mA		--	425	607	
	V_{OUT} = 3.3V	Io = 100mA		--	160	280	mV
		Io = 150mA		--	300	430	
		Io = 200mA		--	400	575	
Enable threshold voltage		Enable high	V_{EN_HI}	1	--	--	V
		Enable low	V_{EN_LO}	--	--	0.2	
Thermal shutdown			T_{SD}	--	150	--	°C
Power supply rejection ratio		Io = 5mA, f = 100Hz	PSRR	--	60	--	dB

Note:
1. Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. 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 remain possibility to affect device reliability.
2. Devices are ESD sensitive. Handing precaution recommended.
3. The device is not guaranteed to function outside its operating conditions.

BLOCK DIAGRAM



ORDERING INFORMATION

OUTPUT VOLTAGE	ORDERING CODE	PACKAGE	PACKING
1.8V	TSL9A12V18CX RFG	SOT-23	3,000pcs / 7" Reel
3.3V	TSL9A12V33CX RFG	SOT-23	3,000pcs / 7" Reel
1.8V	TSL9A12V18CX5 RFG	SOT-25	3,000pcs / 7" Reel
3.3V	TSL9A12V33CX5 RFG	SOT-25	3,000pcs / 7" Reel

APPLICATION INFORMATION

Input-Output capacitor requirements

The external input and output capacitors of TSL9A12 series must be properly selected for stability and performance. Use a 1μF or larger input capacitor and place it close to the IC's V_{IN} and GND pins. Any output capacitor meeting the minimum 1mΩ ESR (Equivalent Series Resistance) and effective capacitance between 1μF and 22μF requirement may be used. Place the output capacitor close to the IC's V_{OUT} and GND pins. Increasing capacitance and decreasing ESR can improve the circuit's PSRR and line transient response.

Dropout voltage

The TSL9A12 series use a PMOS pass transistor to achieve low dropout. When (V_{IN} – V_{OUT}) is less than the dropout voltage (V_{DROP}), the PMOS pass device is in the linear region of operation and the input-to-output resistance is the $R_{DS(ON)}$ of the PMOS pass element. V_{DROP} scales approximately with the output current because the PMOS device behaves as a resistor in dropout condition. As any linear regulator, PSRR and transient response are degraded as (V_{IN} – V_{OUT}) approaches dropout condition.

Over Temperature Protection

The over temperature protection function of TSL9A12 series will turn off the P-MOSFET when the junction temperature exceeds 150°C (typ.). Once the junction temperature cools down by approximately 15°C, the regulator will automatically resume operation

Thermal Application

For continuous operation, do not exceed the absolute maximum junction temperature. The maximum power dissipation depends on the thermal resistance of the IC package, PCB layout, rate of surrounding airflow, and difference between junction and ambient temperature. The maximum power dissipation can be calculated as below: $P_{D(MAX)} = (T_{J(MAX)} - T_A) / (R_{\theta JA})$ where $T_{J(MAX)}$ is the maximum allowable junction temperature, and T_A is the ambient temperature suitable in application. Power dissipation (P_D) is equal to the product of the output current and the voltage drop across the output pass element, as shown in the equation below: $P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$.

TYPICAL PERFORMANCE CURVE

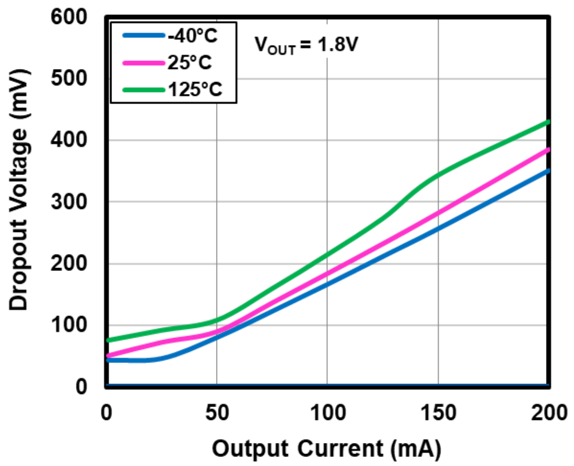


Figure 1. Dropout Voltage vs. Output Current

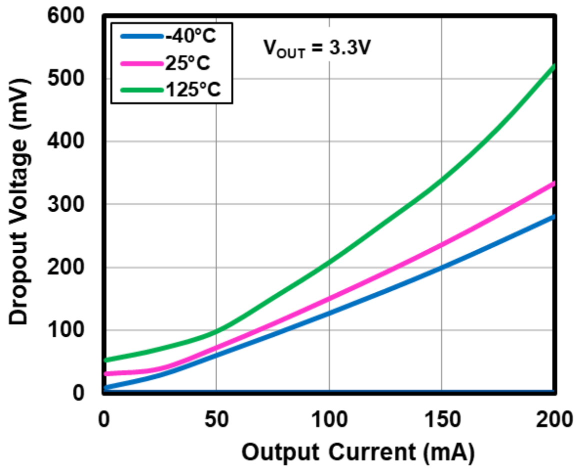


Figure 2. Dropout Voltage vs. Output Current

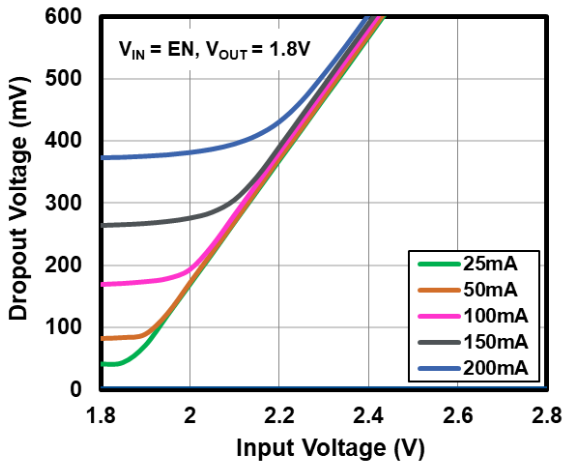


Figure 3. Dropout Voltage vs Input Voltage

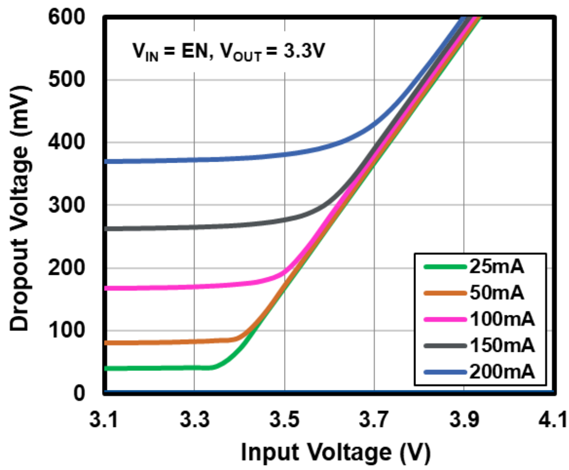


Figure 4. Dropout Voltage vs Input Voltage

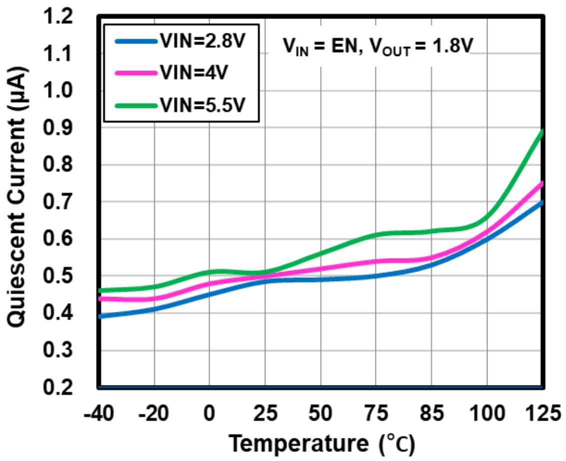


Figure 5. Quiescent Current vs Ambient Temperature

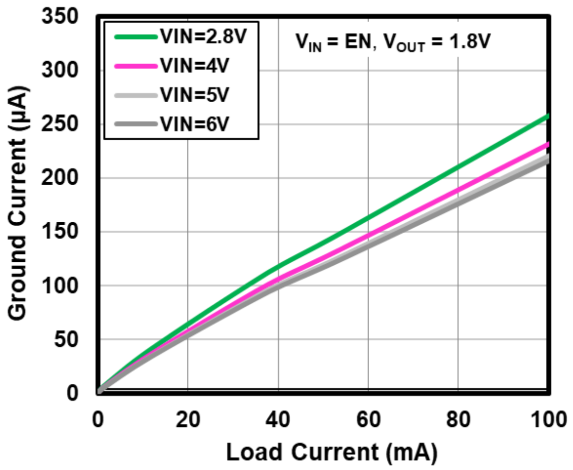


Figure 6. Ground Current vs Load Current

TYPICAL PERFORMANCE CURVE (CONTINUED)

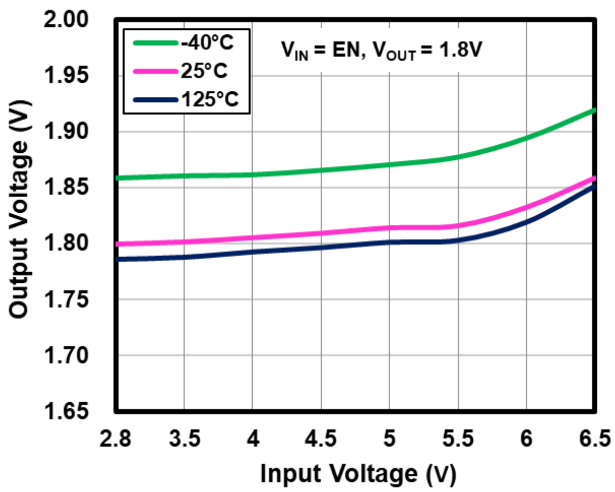


Figure 7. Output Voltage vs Input Voltage and Ambient Temperature

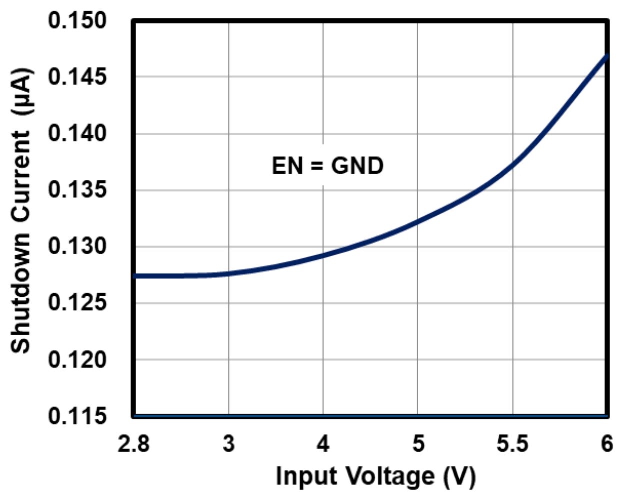


Figure 8. Shutdown Current vs Ambient Temperature

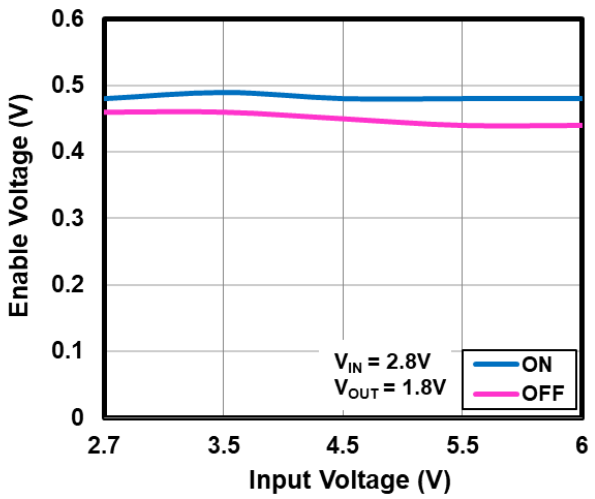


Figure 9. Enable Voltage vs Input Voltage

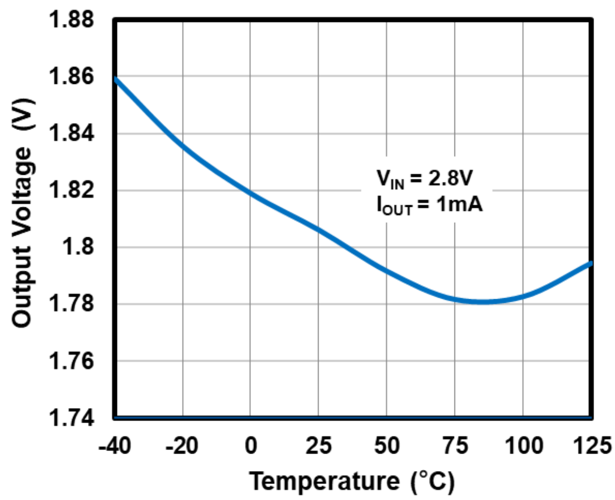


Figure 10. Output Voltage vs Ambient Temperature

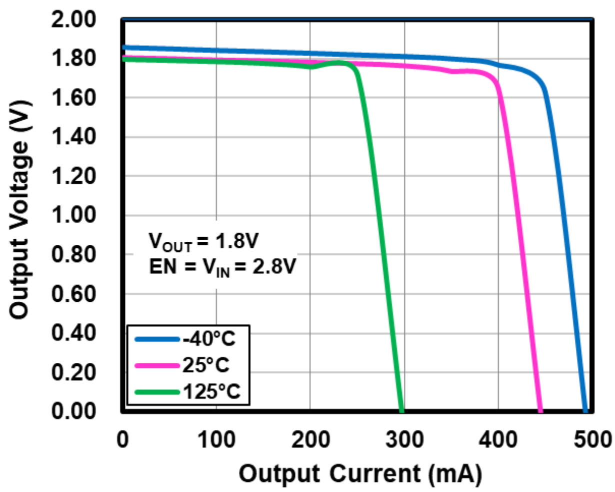


Figure 11. Output Voltage vs Output Current

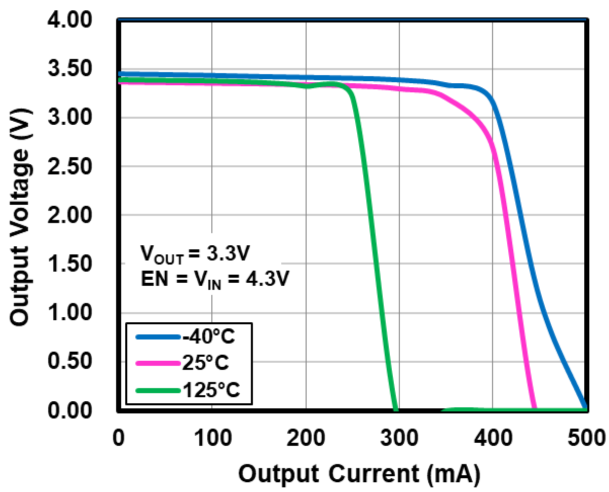


Figure 12. Output Voltage vs Output Current

TYPICAL PERFORMANCE CURVE (CONTINUED)

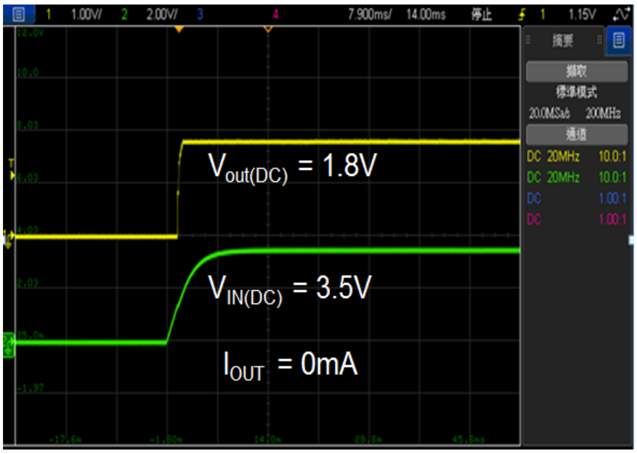


Figure 13. Start-up with $V_{EN} = V_{IN}$

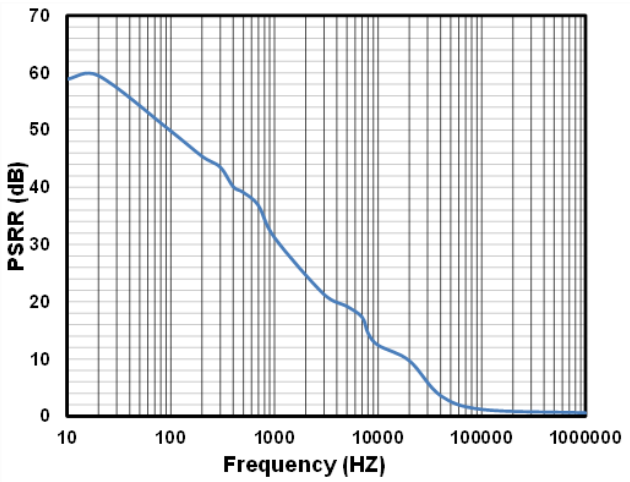


Figure 14. Output Noise vs. Frequency

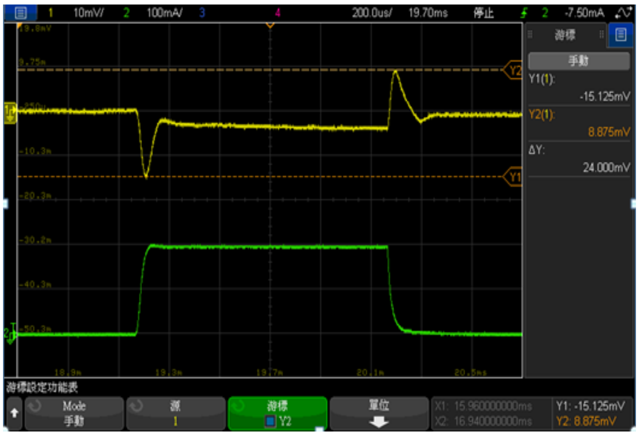
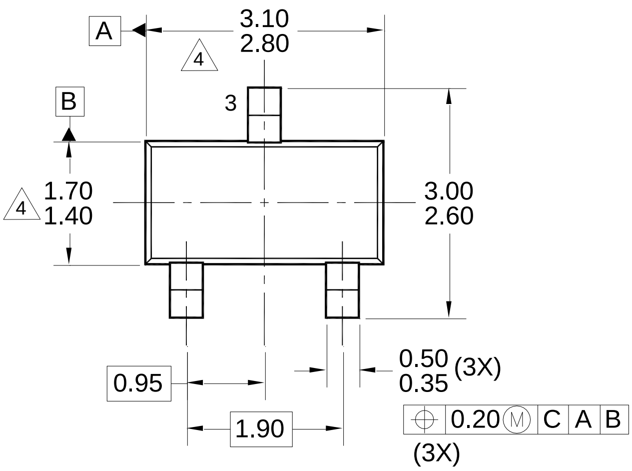
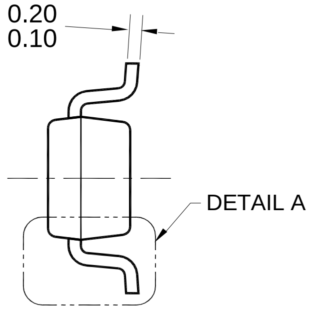


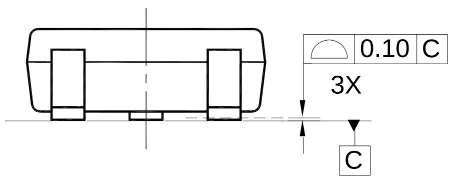
Figure 15. IOUT Transient 0mA to 200mA

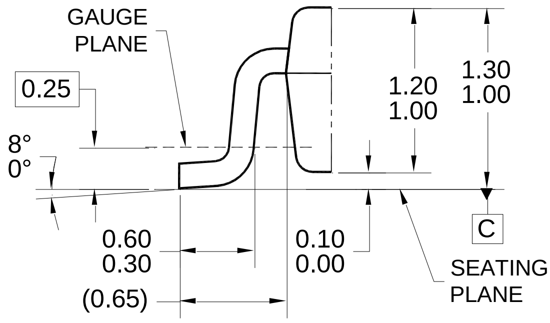
PACKAGE OUTLINE DIMENSIONS

SOT-23

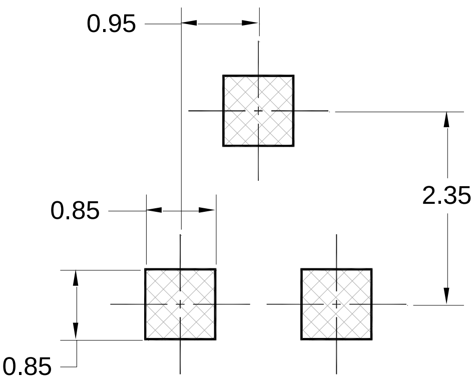




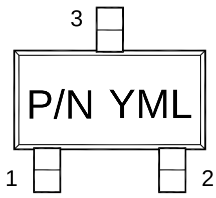




DETAIL A, ROTATED -90°
(SCALE 2:1)



SUGGESTED PAD LAYOUT



MARKING DIAGRAM

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
3. PACKAGE OUTLINE REFERENCE: EIAJ ED-7500A, SC-59.
4. (4) MOLDED PLASTIC BODY DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
5. DWG NO. REF: HQ2SD07-SOT23IC-104 REV A.

P/N = PRODUCT DEVICE CODE
Y = YEAR CODE
M = MONTH CODE FOR HALOGEN FREE PRODUCT

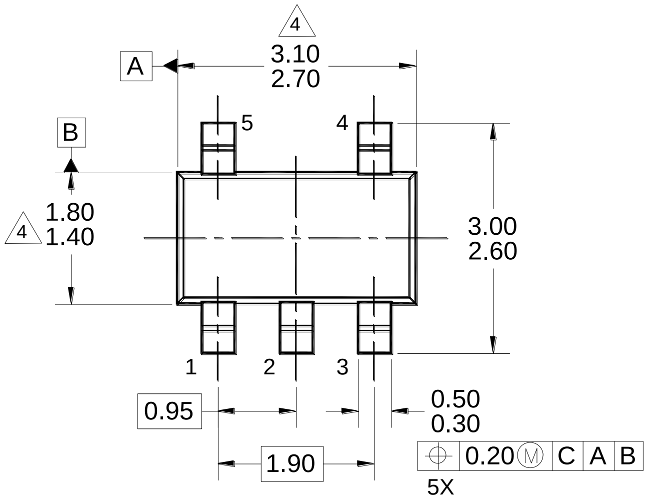
O =JAN	P =FEB	Q=MAR	R = APR
S =MAY	T =JUN	U=JUL	V = AUG
W =SEP	X =OCT	Y=NOV	Z = DEC

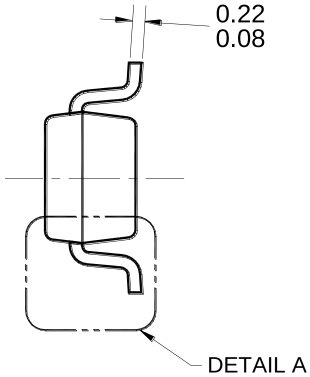
L = LOT CODE

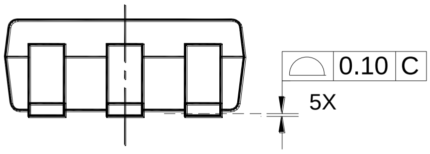
Device code: C
Voltage code: D (1.8V), S (3.3V)

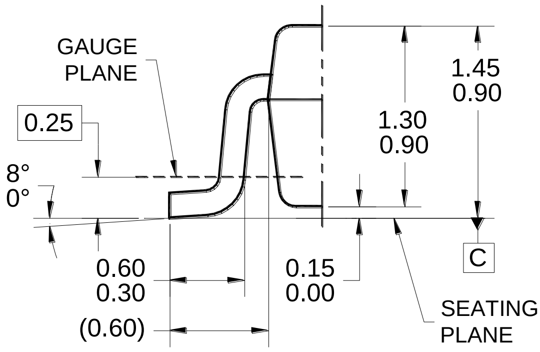
PACKAGE OUTLINE DIMENSIONS

SOT-25

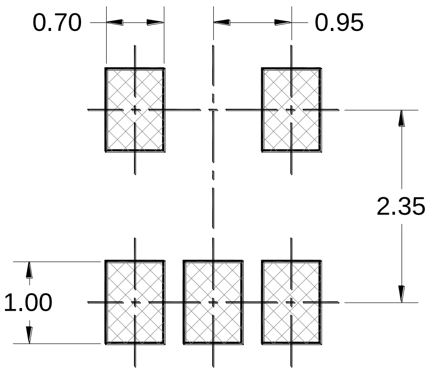




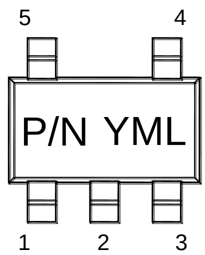




DETAIL A, ROTATED -90°
(SCALE 2:1)



SUGGESTED PAD LAYOUT



MARKING DIAGRAM

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
3. PACKAGE OUTLINE REFERENCE: JEDEC MO-178, VARIATION AA.
4. (△) MOLDED PLASTIC BODY DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
5. DWG NO. REF: HQ2SD07-SOT25-026 REV A.

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L = LOT CODE

Device code: C
Voltage code: D (1.8V), S (3.3V)

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