30V, 100 mA Low-Dropout Linear Regulator

Features

- Input voltage range: 7V to 30V
- Available in fixed voltage: 5V
- Output voltage tolerances of ±5% over the temperature range
- Rated output current: 100mA
- Quiescent current: typical 300μA
- Typical 750mV dropout voltage (I_{OUT}=40mA, 5V output)
- Output transistor safe area protection
- Internal short-circuit current limit
- Internal thermal overload protection
- SOT89-3L package

Applications

Battery Chargers

Portable Instrumentation

LED Lighting

Low Wattage Power Supplies

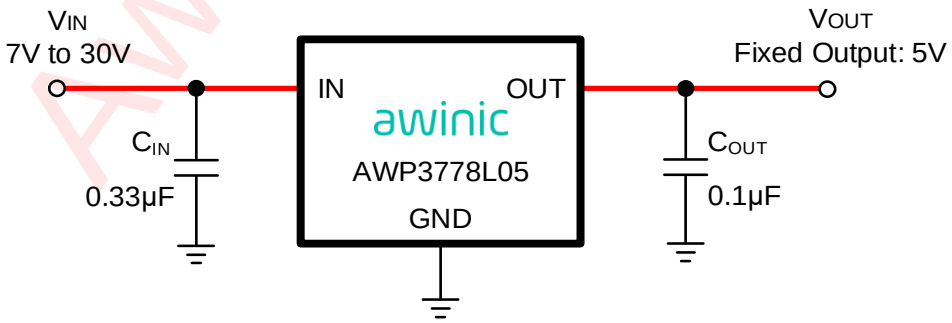
General Description

AWP3778L05 is a low dropout voltage regulator available with 5V fixed output voltage, making it useful in a wide range of applications. Used as a Zener-diode and resistor combination replacement, the AWP3778L05 usually provides an effective output impedance improvement of two orders of magnitude and lower quiescent current. The regulator can provide local, on-card regulation, eliminating distribution problems associated with single-point regulation. The AWP3778L05 can be used in logic systems, instrumentation, HiFi, and other solid-state electronic equipment.

With adequate heat sinking, the AWP3778L05 can deliver 100mA output current. Current limiting is included to limit the peak output current to a safe value. Safe area protection for the output transistors is provided to limit internal power dissipation. If internal power dissipation is too high for the heat sinking provided, the thermal shutdown circuit prevents the IC from overheating.

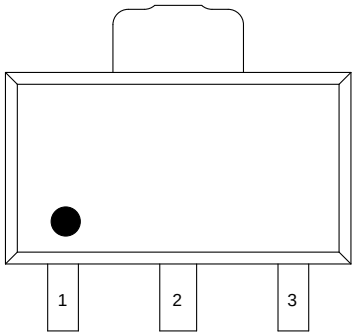
The AWP3778L05 is available in SOT89-3L package.

Typical Application Circuit

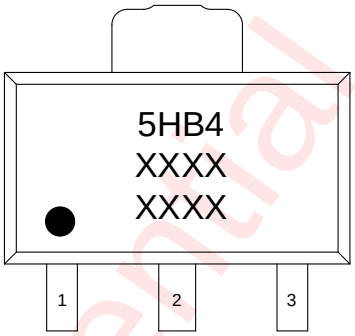


Pin Configuration And Top Mark

AWP3778L05STR
Top View



AWP3778L05STR Marking
Top View

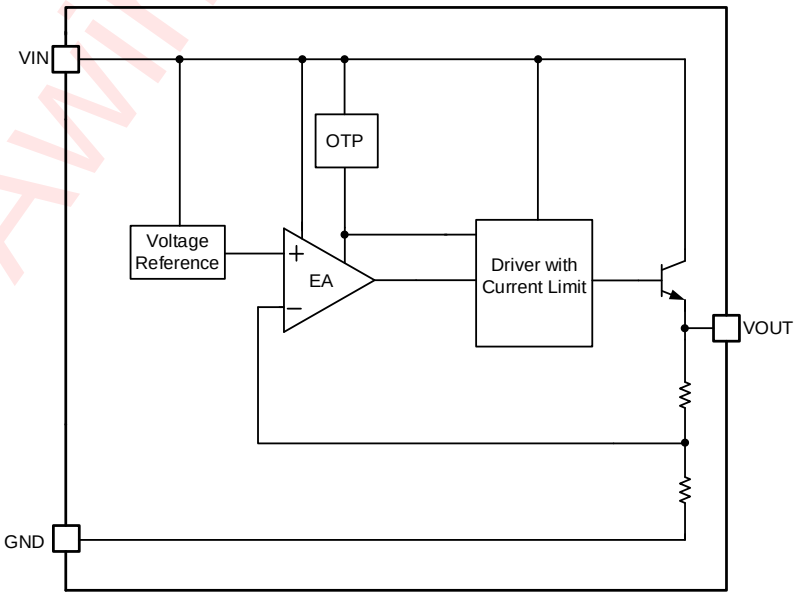


5HB4 - AWP3778L05STR
XXXX/XXXX - Production Tracing Code

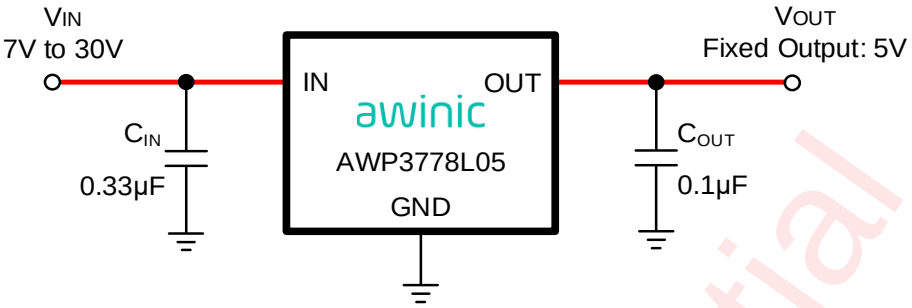
Pin Definition

No.	NAME	DESCRIPTION
1	OUT	Regulated output voltage pin. Put a 0.1μF or more ceramic capacitor at the output pin.
2	GND	Ground.
3	IN	Input supply pin. Put a 0.33μF or more bypass capacitor at the power supply.

Functional Block Diagram



Typical Application Circuit



AWP3778L05 Application Circuit

Notice for typical application circuits:

Capacitance of C_{IN} should be 0.33μF or more and C_{OUT} should be 0.1μF or more. The rated voltage of C_{IN} and C_{OUT} should be higher than V_{IN} and V_{OUT} voltage.

Ordering Information

Part Number	Temperature	Package	Marking	Moisture Sensitivity Level	Environmental Information	Delivery Form
AWP3778L05STR	-40°C～105°C	SOT89-3L	5HB4	MSL3	ROHS+HF	1000 units/ Tape and Reel

Absolute Maximum Ratings(NOTE1)

PARAMETERS		RANGE
Input voltage range		-0.3V to 35V
Maximum operating junction temperature T_{J_MAX}		125°C
Recommended operating temperature T_A		-40°C to 105°C
Storage temperature T_{STG}		-65°C to 150°C
Lead temperature (soldering 10 seconds)		260°C
ESD	HBM (Human body model)(NOTE2)	±2kV
	CDM(Charged device model) (NOTE3)	±1.5kV

NOTE1: Conditions out of those ranges listed in "absolute maximum ratings" may cause permanent damages to the device. In spite of the limits above, functional operation conditions of the device should within the ranges listed in "recommended operating conditions". Exposure to absolute-maximum-rated conditions for prolonged periods may affect device reliability.

NOTE2: All pins. Test Condition: ESDA/JEDEC JS-001-2023.

NOTE3: All pins. Test Condition: ESDA/JEDEC JS-002-2022.

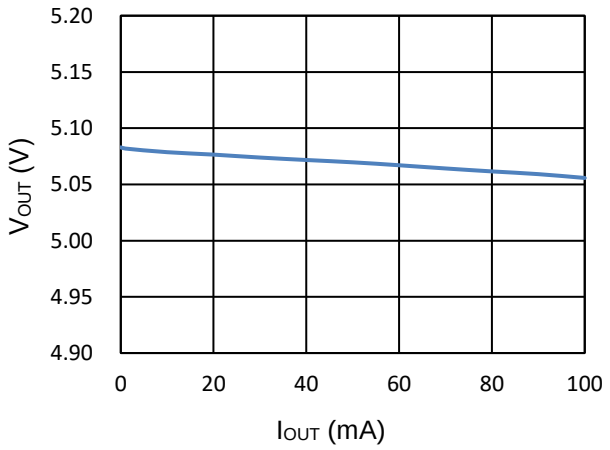
Electrical Characteristics

V_{IN}=10V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF, T_J=25°C (unless otherwise noted)

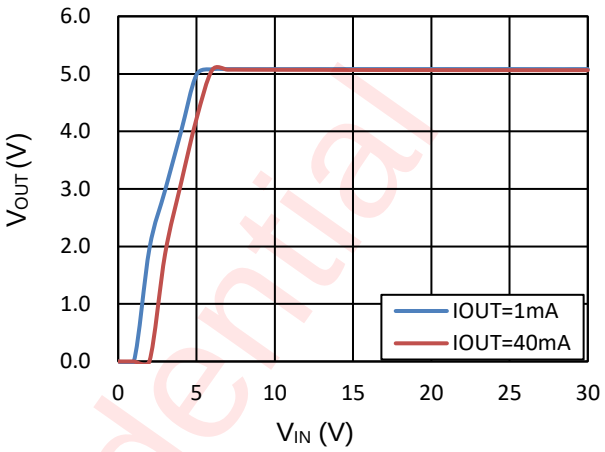
PARAMETER		TEST CONDITION		MIN	TYP	MAX	UNIT
V_{IN}	Input Voltage Range			7		30	V
V_{OUT}	Output Voltage	T_J=25°C		4.8	5	5.2	V
		V_{IN}=7V to 20V, I_{OUT}=1mA to 40mA		4.75		5.25	
		I_O=1mA to 70mA		4.75		5.25	
$LINE_{Reg}$	Line Regulation	V_{IN}=7V to 20V			12		mV
		V_{IN}=8V to 20V			10		
$LOAD_{Reg}$	Load Regulation	I_{OUT}=1mA to 100mA			20		mV
		I_{OUT}=1mA to 40mA			10		
$V_{dropout}$	Dropout Voltage	I_{OUT}=40mA, When V_{OUT} falls 100mV			750		mV
I_Q	Quiescent Current	T_J=25°C			0.3		mA
		T_J=125°C				1	
ΔI_Q	Quiescent Current Change	V_{IN}=8V to 20V, T_J=0°C~125°C			0.17		mA
		I_{OUT}=1mA to 40mA, T_J=0°C~125°C			0.1		
PSRR	Power Supply Ripple Rejection	I_{OUT}=30mA	f=1kHz		67		dB
			f=10kHz		72		
$\Delta V_{OUT}/\Delta T$	Average output voltage temperature coefficient	I_{OUT}=5mA, -40°C ≤ T_J ≤ 125°C			40		ppm/°C
I_{CL}	Output Current Limit	V_{OUT}=90%*$V_{OUT(SET)}$			170		mA
T_{SDH}	Thermal Shutdown Threshold	Temperature Rising			165		°C
T_{SDL}	Thermal Shutdown Reset Threshold	Temperature Falling			145		°C

Typical Characteristics

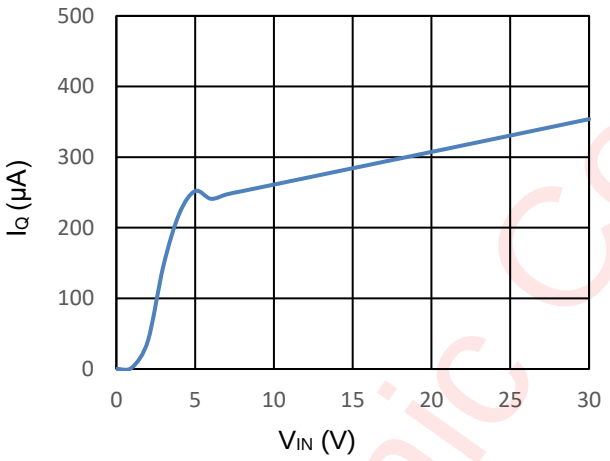
V_{IN}=10V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF, T_J=25°C. In Typical Application Circuit, unless otherwise noted.



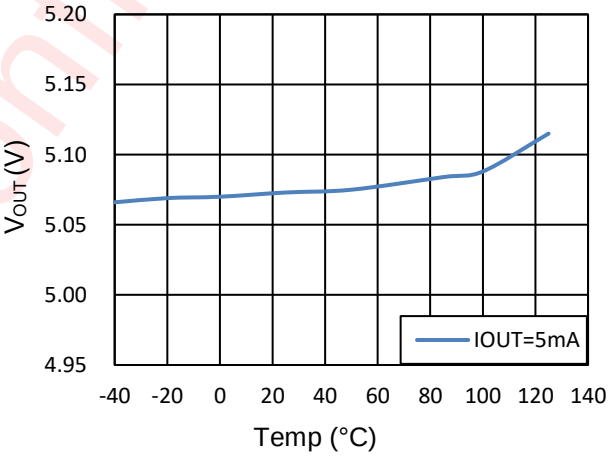
Output Voltage vs Output Current



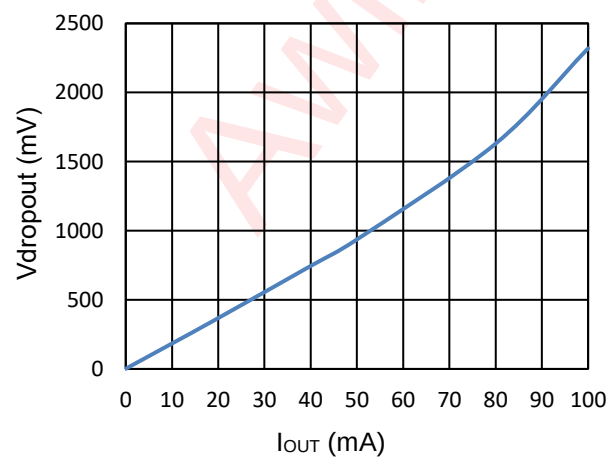
Output Voltage vs Input Voltage



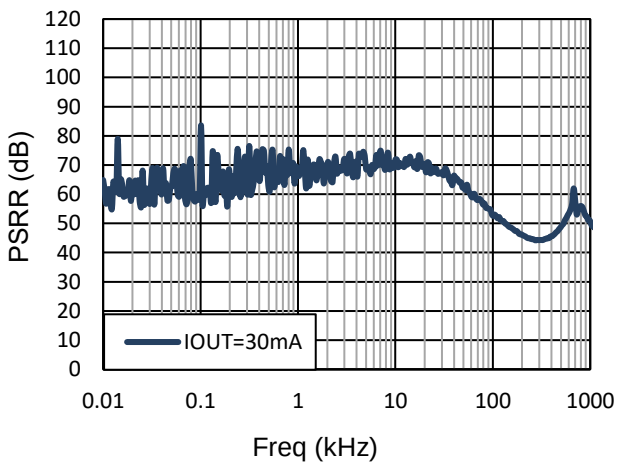
Quiescent Current vs Input Voltage



Output Voltage vs Temperature



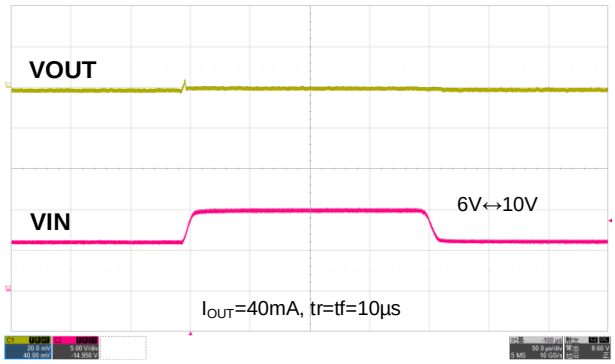
Dropout Voltage vs Output Current



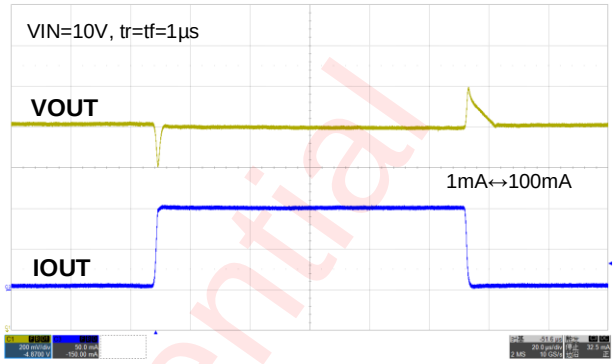
PSRR vs Frequency

Typical Characteristics (Continued)

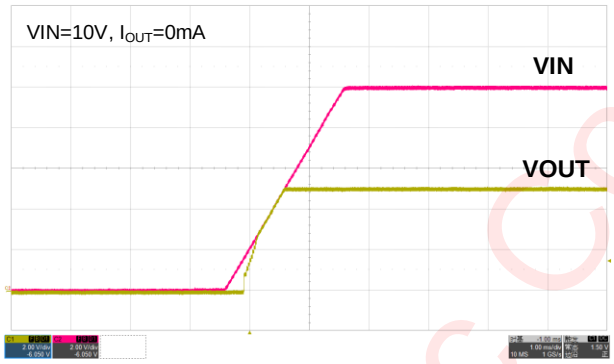
V_{IN}=10V, I_{OUT}=40mA, C_{IN}=0.33μF, C_{OUT}=0.1μF, T_J=25°C. In Typical Application Circuit, unless otherwise noted.



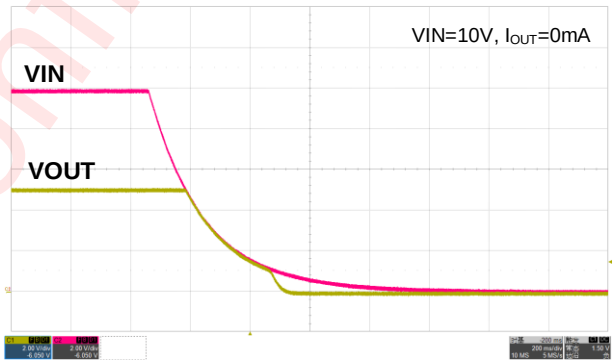
V_{OUT}: 20mV/div V_{IN}: 5V/div
Time(50μs/div)
Input Transient Response



V_{OUT}: 200mV/div I_{OUT}: 50mA/div
Time(20μs/div)
Load Transient Response



V_{OUT}: 2V/div V_{IN}: 2V/div
Time(1ms/div)
Turn On with V_{IN}



V_{OUT}: 2V/div V_{IN}: 2V/div
Time(200ms/div)
Turn Off with V_{IN}

V_{OUT}: 2V/div V_{IN}: 10V/div I_{OUT}: 200mA/div
Time(32ms/div)
V_{OUT} Short to GND

V_{OUT}: 2V/div V_{IN}: 10V/div I_{OUT}: 200mA/div
Time(32ms/div)
V_{OUT} Short and Release

Detailed Functional Description

The AWP3778L05 is available in fixed output voltage 5V. The linear regulator input supply must be well regulated and kept at a voltage level to not exceed the maximum input to output voltage differential allowed by the device. The minimum dropout voltage (V_{IN} – V_{OUT}) must be met with extra headroom when possible to keep the output well regulated. A 0.33μF or higher capacitor must be placed at the input to bypass noise. The output voltage tolerance is ±5% over temperature.

Output Current Limit

AWP3778L05 integrates output current limit function, protecting IC from excessive current.

When the load is excessively heavy, AWP3778L05 limits the current flowing through the IC to a typical 170mA current. This value is specially designed, so that IC is protected properly and the output capability of 100mA is not influenced either.

There is also internal short-circuit current limit and output transistor safe area protection that shuts down the device if the output current becomes too high.

Thermal Shutdown

AWP3778L05 integrates thermal shutdown function, protect IC from excessively high temperature.

When the chip temperature exceeds 165°C, AWP3778L05 detects it as an over-temperature event, triggering thermal shutdown, which will turn off the main function module. This inhibits increase of chip's temperature. IC would keep the protection-state on until the chip's temperature falls below to 145°C. At this moment, the over-temperature protection-state is released, IC resumes to work again. The hysteresis avoids IC's turning off and on frequently around the thermal shutdown threshold.

Application Information

Power Dissipation and Device Operation

The permissible power dissipation is dependent on the ambient temperature T_A and the junction-to-ambient thermal resistance $R_{\theta JA}$.

The absolute maximum allowable power dissipation for the device in a given package can be calculated using Equation below, where T_{J_MAX} = 125°C :

$$PD_{MAX\_ABS} = (T_{J\_MAX} – T_A) / R_{\theta JA}$$

The recommended maximum allowable power dissipation for the device in a given package can be calculated using Equation below, where T_{J_REC} = 125°C :

$$PD_{MAX\_REC} = (T_{J\_REC} – T_A) / R_{\theta JA}$$

The actual power being dissipated in the device can be represented by Equation below:

$$PD_{ACT} = (V_{IN} – V_{OUT}) \times I_{OUT}$$

These equations above establish the relationship between the maximum power dissipation allowed due to thermal consideration, the voltage drop across the device, and the continuous current capability of the device.

Capacitors Selection

IN pin: Input Capacitor C_{IN}

AWP3778L05 advises to use a 0.33μF or more X5R or X7R ceramic capacitor at IN pin as shown in Typical Application Circuit.

OUT pin: Output Capacitor C_{OUT}

AWP3778L05 advises to use a 0.1μF or more X5R or X7R ceramic capacitor at OUT pin as shown in Typical Application Circuit.

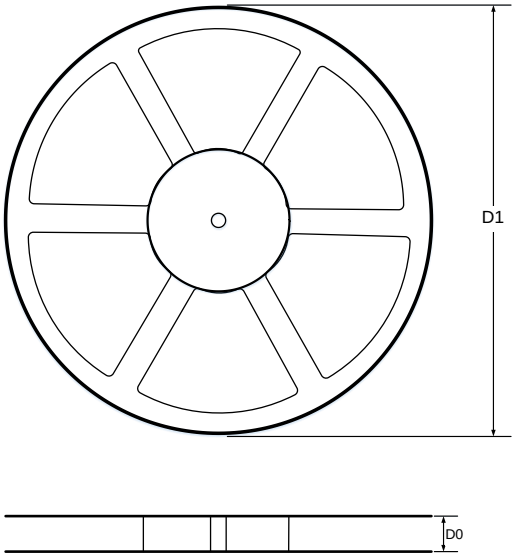
PCB Layout Consideration

The performance of a power source circuit using this device is highly dependent on a peripheral circuit. To obtain the optimal performance, a peripheral component or the device mounted on PCB should not exceed its rated voltage, rated current or rated power. When designing a peripheral circuit, guidelines below for PCB layout of AWP3778L05 should be obeyed:

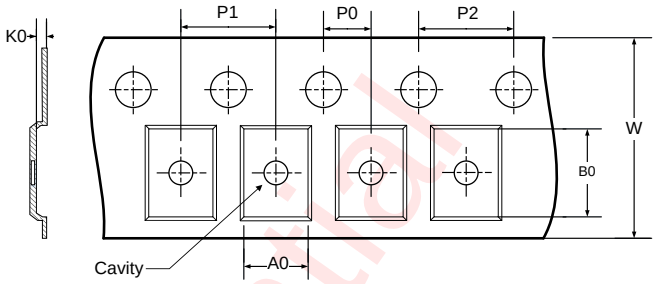
1. All peripheral components should be placed as close to the chip as possible. C_{IN} and C_{OUT} should be close to IN and OUT pins respectively. Avoid connecting device and chip pins with two different layers of copper, use the same layer of copper instead.
2. IN and OUT pin are the large current input and output of the chip, make IN, OUT, and meanwhile GND lines sufficient.
3. The connection lines between the planes of C_{IN} or C_{OUT} and respective chip pin should be as short and wide as possible, to reduce noise and EMI interference, or it may cause noise pickup or unstable operation.
4. The exposed plane of chip and GND pins must be connected to the large-area ground layer of PCB directly, meanwhile place sufficient vias below the exposed plane. Thus we can decrease the thermal resistor on the board to optimize heat-diffusion performance.

Tape And Reel Information

REEL DIMENSIONS

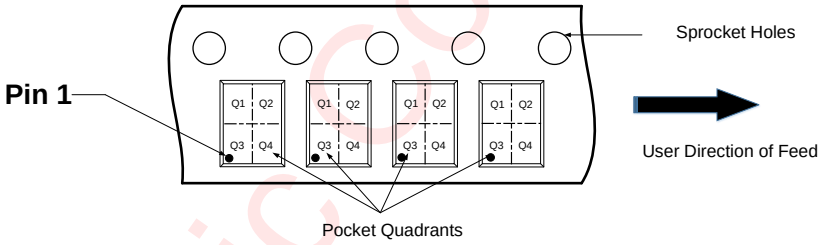


TAPE DIMENSIONS



A0：Dimension designed to accommodate the component width
B0：Dimension designed to accommodate the component length
K0：Dimension designed to accommodate the component thickness
W：Overall width of the carrier tape
P0：Pitch between successive cavity centers and sprocket hole
P1：Pitch between successive cavity centers
P2：Pitch between sprocket hole
D1：Reel Diameter
D0：Reel Width

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



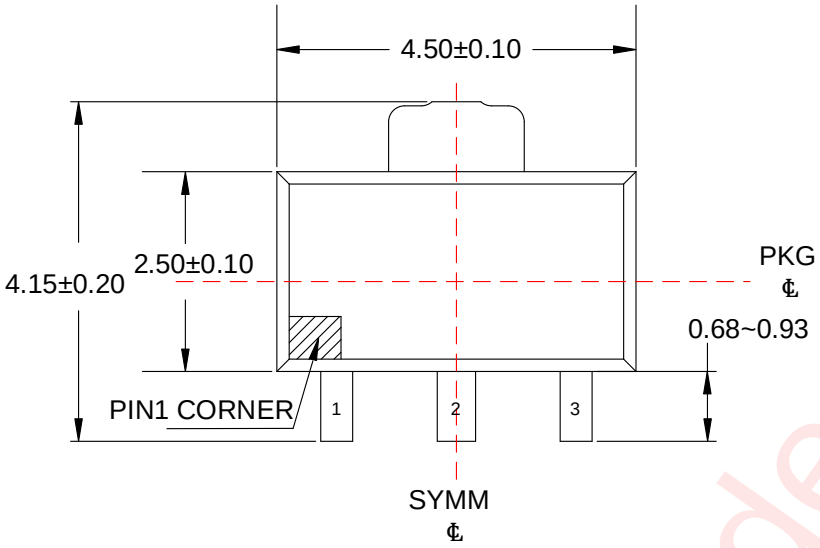
Note：The above picture is for reference only. Please refer to the value in the table below for the actual size

DIMENSIONS AND PIN1 ORIENTATION

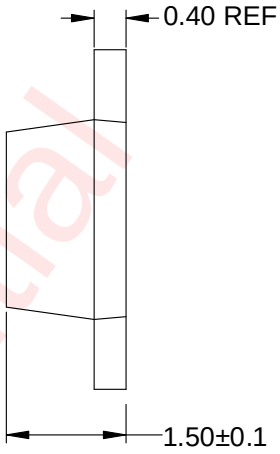
D1 (mm)	D0 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
178	12	4.9	4.5	1.85	2	8	4	12	Q3

All dimensions are nominal

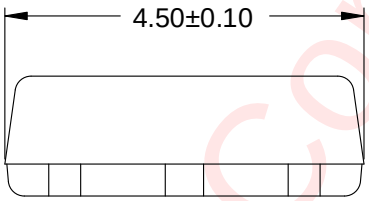
Package Description



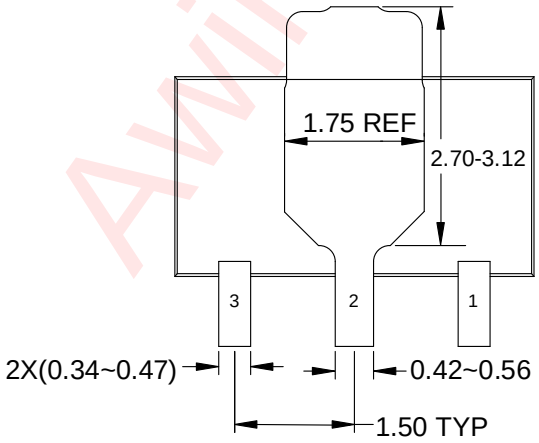
Top View



Side View



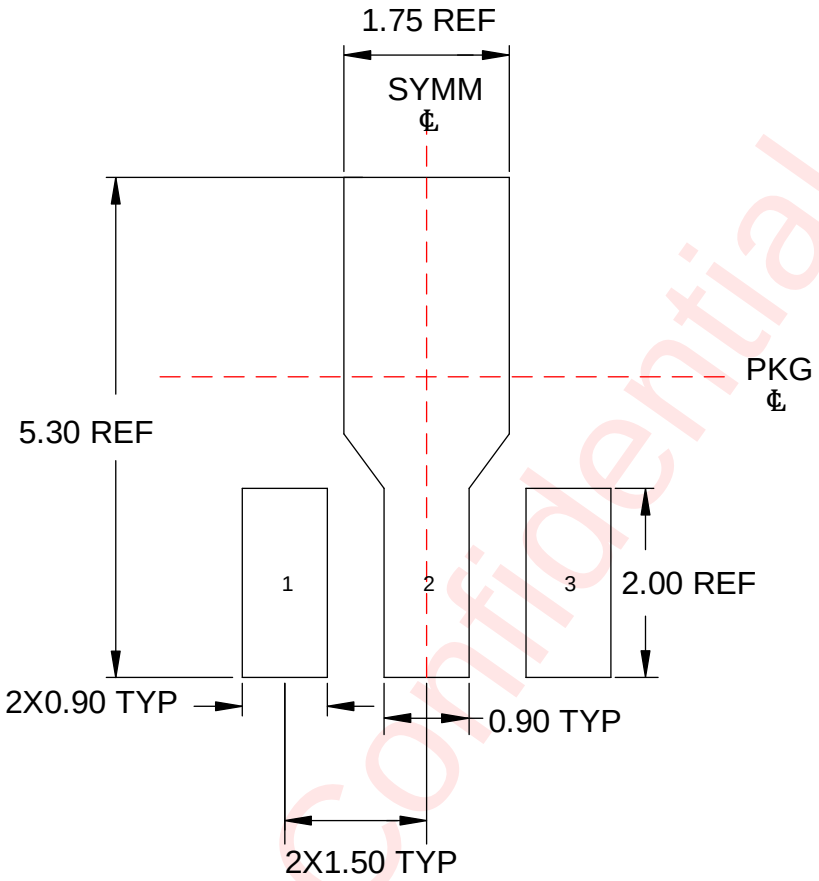
Side View

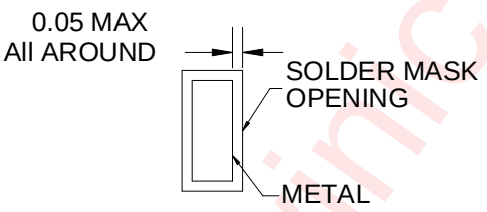


Bottom View

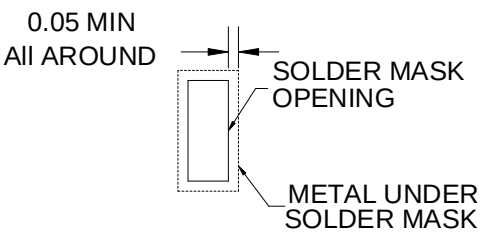
Unit: mm

Land Pattern Data





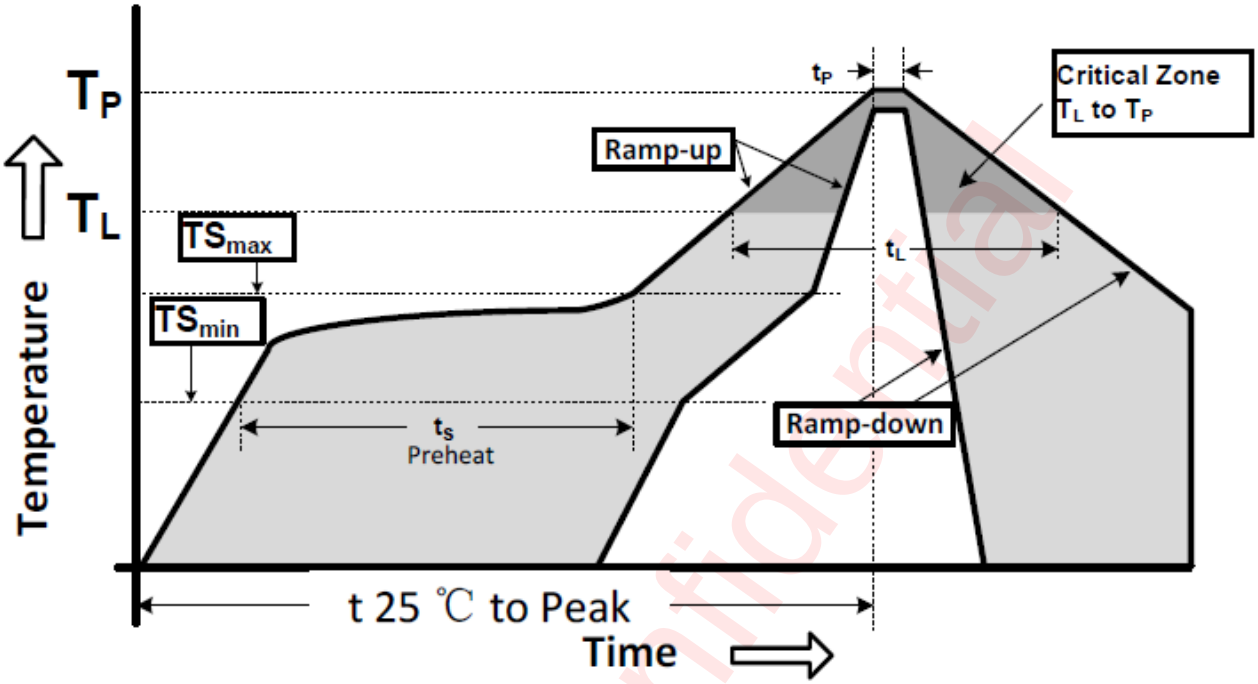
NON SOLDER MASK DEFINED



SOLDER MASK DEFINED

Unit：mm

Reflow



Reflow Note	Spec
Ramp-up rate（TSmax to T_P）	3°C/second max.
Preheat temperature（TSmin to TSmax）	150°C to 200°C
Preheat time（t_s）	60 - 180 seconds
Time above T_L , 217°C（t_L）	60 - 150 seconds
Peak temperature（T_P）	260°C
Time within 5°C of peak temperature(t_P)	20 - 40 seconds
Ramp-down rate	6°C/second max.
Time 25°C to peak temperature	8 minutes max.

Revision History

Version	Date	Change Record
V1.0	Aug. 2024	Officially released
V1.1	Dec. 2024	1. Update the “Pin Configuration And Top Mark”.(P2) 2. Update the dropout curve.(P6)

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