

NSD79XX Series Three Terminal Voltage Regulator

1 Introduction

The NSD79XX series is a group of three terminal negative voltage linear regulators with multiple fixed output voltages. Under the condition of good heat dissipation, it can provide output current up to 1.5A, and has the functions of internal current limit, short circuit protection, thermal shutdown protection and output transistor SOA protection, which make it relatively difficult to damage. Although designed as fixed voltage regulators without external components, these devices can be used with external components to obtain adjustable voltage and current. Therefore, the NSD79XX series is widely used as fixed voltage regulators, including local (on card) regulators, to eliminate noise and power distribution problems associated with single point regulation.

2 Available Packages

PART NUMBER	PACKAGE
NSD79XX Series	TO-220-3L
	TO-220F
	TO-263-2L

Note: For all available packages, please refer to the part *Orderable Information*.

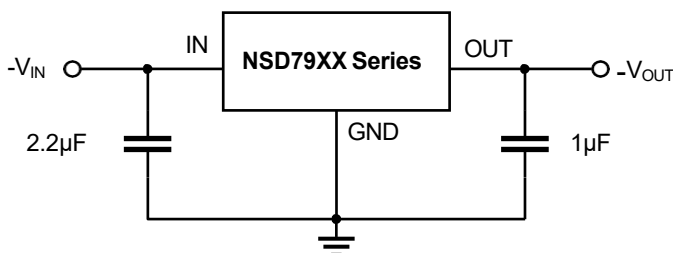


Figure 2-1. Typical Application Circuit

3 Features

- Available Fixed Output Voltage:
 - 5.0V: NSD7905
 - 6.0V: NSD7906
 - 8.0V: NSD7908
 - 9.0V: NSD7909
 - 12V : NSD7912
 - 15V : NSD7915
 - 24V : NSD7924
- Output Current:
 - up to 1.5A at $T_J = 25^\circ\text{C}$
- Output Voltage Tolerance at $T_J = 25^\circ\text{C}$:
 - $\pm 2\%$ for Conventional Device
 - $\pm 1\%$ can be Customized
- Operating Junction Temperature:
 - $-40 \sim 125^\circ\text{C}$
- Output Voltage Tolerances of $\pm 4\%$ over the Temperature Range
- Dropout Voltage: 1.2V@1A
- Power Supply Rejection Ratio:
 - 75dB@120Hz ($V_{OUT} = -5.0\text{V}$)
- Output Transistor SOA Protection
- Internal Current Limit
- Short Circuit Protection
- Thermal Shutdown Protection

4 Applications

- AC Inventors
- DC Motor Drivers
- Household Electric Appliances
- HVAC Systems
- Industrial Power Supplies
- SMPS Post Regulation
- Solar Energy String Inventors
- Test and Measurement Equipment

5 Pin Configuration and Marking Information

5.1 Pin Configuration

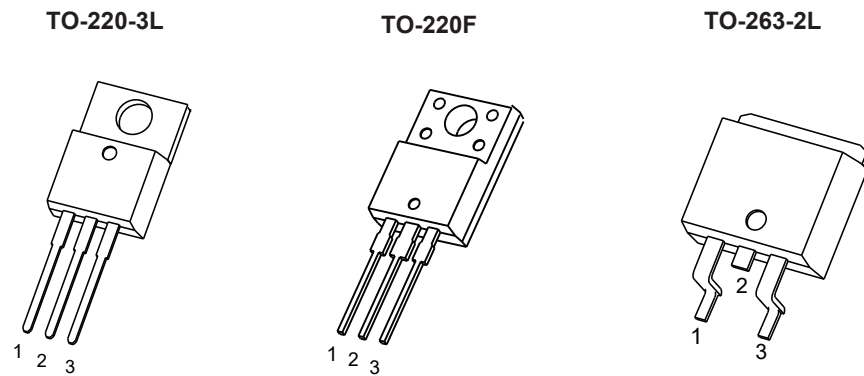


Figure 5-1. Pin Configuration

PIN NAME	NSD79XX Series Pin Configuration			DESCRIPTION
	TO-220-3L	TO-220F	TO-263-2L	
	(TBN)	(TCN)	(TGN)	
IN	1	1	1	Input of the device.
GND	2	2	2	Regulator ground.
OUT	3	3	3	Output of the device.

6 Specifications

6.1 Absolute Maximum Ratings

(over operating free-air temperature range, unless otherwise specified)⁽¹⁾

CHARACTERISTIC		SYMBOL	VALUE	UNIT
Maximum input voltage range ⁽²⁾		$V_{IN\ MAX}$	-36	V
Maximum output current		$I_{OUT\ MAX}$	1.5	A
Maximum power dissipation	NSD79XX Series	TO-220-3L	Internally Limited ⁽³⁾	W
		TO-220F		
		TO-263-2L		
Maximum junction temperature		$T_{J\ Max}$	150	°C
Storage temperature		T_{stg}	-65 ~ 150	°C
Soldering temperature & time		T_{solder}	260°C, 10s	-

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum rated conditions for extended periods may affect device reliability.

(2) All voltages are with respect to network ground terminal.

(3) Refer to *Thermal Information* for details.

6.2 Recommend Operating Conditions

PARAMETER		SYMBOL	MIN.	NOM.	MAX.	UNIT
Input voltage range	NSD7905	V_{IN}	-	-	-30	V
	NSD7906		-	-	-30	
	NSD7908		-	-	-30	
	NSD7909		-	-	-32	
	NSD7912		-	-	-35	
	NSD7915		-	-	-35	
	NSD7924		-	-	-35	
Operating junction temperature		T_J	-40	-	125	°C
Operating ambient temperature		T_A	-	-(4)	-	°C

(4) It is necessary to ensure that the operating junction temperature of the device does not exceed the rated value of the recommended operating conditions when using the device for design.

6 Specifications

6.3 ESD Ratings

ESD RATINGS		SYMBOL	VALUE	UNIT
Electrostatic discharge ⁽⁵⁾	Human body model	$V_{ESD-HBM}$	6000	V

(5) ESD testing is conducted in accordance with the relevant specifications formulated by the Joint Electronic Equipment Engineering Commission (JEDEC). The human body model (HBM) electrostatic discharge test is based on the JESD22-114D test standard, using a 100pF capacitor and discharging to each pin of the device through a resistance of 1.5k Ω . The electrostatic discharge test in mechanical model (MM) is based on the JESD22-115-A test standard and uses a 200pF capacitor to discharge directly to each pin of the device.

6.4 Thermal Information

THERMAL METRIC ⁽⁶⁾	SYMBOL	NSD79XX Series		UNIT
Junction-to-ambient thermal resistance	$R_{\theta JA}$	TO-220-3L	TO-220F	$^{\circ}\text{C}/\text{W}$
		65.1	66.4	
			TO-263-2L	
			62.3	
Junction-to-case thermal resistance	$R_{\theta JC}$	TO-220-3L	TO-220F	$^{\circ}\text{C}/\text{W}$
		5.4	6.2	
			TO-263-2L	
			5.3	
Reference maximum power dissipation for continuous operation	$P_{D Ref}$	TO-220-3L	TO-220F	W
		1.53	1.51	
			TO-263-2L	
			1.60	

(6) $T_A = 25^{\circ}\text{C}$, all numbers are typical, and apply for packages soldered directly onto a PCB board in still air without extra heat dissipation pads.

6 Specifications

6.5 Electrical Characteristics

NSD7905 ($V_{IN} = -10V$, $I_{OUT} = 500mA$, $C_{IN} = 2.2\mu F$, $C_{OUT} = 1\mu F$, $T_J = 25^\circ C$, unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS ⁽⁷⁾	MIN.	TYP.	MAX.	UNIT
Output voltage	V_{OUT}	$T_J = 25^\circ C$	$\pm 2\%$ grade ⁽⁸⁾	-4.90	-5.10	V
			$\pm 1\%$ grade ⁽⁸⁾	-4.95	-5.05	
		$I_{OUT} = 5mA$ to $1A$, $V_{IN} = -6.5$ to $-20V$, $T_J = -40$ to $125^\circ C$, $P_D \leq 15W$	-4.80	-5.00	-5.20	
Line regulation	ΔV_{RLINE}	$V_{IN} = -7$ to $-25V$, $T_J = 25^\circ C$	-	15	50	mV
		$V_{IN} = -8$ to $-12V$, $T_J = 25^\circ C$	-	1	25	
Load regulation	ΔV_{RLOAD}	$I_{OUT} = 5mA$ to $1.5A$, $T_J = 25^\circ C$	-	10	100	mV
		$I_{OUT} = 250mA$ to $750mA$, $T_J = 25^\circ C$	-	5	25	
Quiescent current	I_Q	$T_J = 25^\circ C$, $I_{OUT} = 0mA$	-	2.5	4.0	mA
Quiescent current change	ΔI_Q	$I_{OUT} = 5mA$ to $1A$	-	-	0.5	mA
		$V_{IN} = -7$ to $-25V$	-	-	0.5	
Output voltage temperature coefficient	$\Delta V_{OUT} / \Delta T$	-	-	0.4	-	mV/ $^\circ C$
	$\Delta V_{OUT} / (V_{OUT} \times \Delta T)$	-	-	60	-	ppm/ $^\circ C$
Output noise voltage	V_N	$f = 10$ to $100k$ Hz, $T_A = 25^\circ C$	-	40	-	μV
Ripple rejection	RR	$f = 120Hz$, $I_{OUT} = 20mA$	-	75	-	dB
Dropout voltage ⁽⁹⁾	V_D	$I_{OUT} = 1A$	-	1.2	-	V
Peak current	I_{PK}	-	-	2.2	-	A

Note:

(7) Pulse test technology is used to make T_J as close to T_A as possible. Thermal effects must be considered separately.

(8) $\pm 2\%$ for conventional device, $\pm 1\%$ can be customized.

(9) The difference of output voltage and input voltage when input voltage is decreased gradually till output voltage equals to 95% of V_{OUT} .

6 Specifications

6.5 Electrical Characteristics (continued)

NSD7906 ($V_{IN} = -11V$, $I_{OUT} = 500mA$, $C_{IN} = 2.2\mu F$, $C_{OUT} = 1\mu F$, $T_J = 25^\circ C$, unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS ⁽⁷⁾	MIN.	TYP.	MAX.	UNIT
Output voltage	V_{OUT}	$T_J = 25^\circ C$	$\pm 2\%$ grade ⁽⁸⁾	-5.88	-6.12	V
			$\pm 1\%$ grade ⁽⁸⁾	-5.94	-6.06	
		$I_{OUT} = 5mA$ to $1A$, $V_{IN} = -7.5$ to $-21V$, $T_J = -40$ to $125^\circ C$, $P_D \leq 15W$	-5.76	-6.00	-6.24	
Line regulation	ΔV_{RLINE}	$V_{IN} = -7$ to $-25V$, $T_J = 25^\circ C$	-	15	60	mV
		$V_{IN} = -8$ to $-12V$, $T_J = 25^\circ C$	-	1	36	
Load regulation	ΔV_{RLOAD}	$I_{OUT} = 5mA$ to $1.5A$, $T_J = 25^\circ C$	-	10	120	mV
		$I_{OUT} = 250mA$ to $750mA$, $T_J = 25^\circ C$	-	5	36	
Quiescent current	I_Q	$T_J = 25^\circ C$, $I_{OUT} = 0mA$	-	2.5	4.0	mA
Quiescent current change	ΔI_Q	$I_{OUT} = 5mA$ to $1A$	-	-	0.5	mA
		$V_{IN} = -7$ to $-25V$	-	-	0.5	
Output voltage temperature coefficient	$\Delta V_{OUT} / \Delta T$	-	-	0.48	-	mV/ $^\circ C$
	$\Delta V_{OUT} / (V_{OUT} \times \Delta T)$	-	-	60	-	ppm/ $^\circ C$
Output noise voltage	V_N	$f = 10$ to $100k$ Hz, $T_A = 25^\circ C$	-	40	-	μV
Ripple rejection	RR	$f = 120Hz$, $I_{OUT} = 20mA$	-	75	-	dB
Dropout voltage ⁽⁹⁾	V_D	$I_{OUT} = 1A$	-	1.2	-	V
Peak current	I_{PK}	-	-	2.2	-	A

Note:

(7) Pulse test technology is used to make T_J as close to T_A as possible. Thermal effects must be considered separately.

(8) $\pm 2\%$ for conventional device, $\pm 1\%$ can be customized.

(9) The difference of output voltage and input voltage when input voltage is decreased gradually till output voltage equals to 95% of V_{OUT} .

6 Specifications

6.5 Electrical Characteristics (continued)

NSD7908 ($V_{IN} = -14V$, $I_{OUT} = 500mA$, $C_{IN} = 2.2\mu F$, $C_{OUT} = 1\mu F$, $T_J = 25^\circ C$, unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS ⁽⁷⁾	MIN.	TYP.	MAX.	UNIT
Output voltage	V_{OUT}	$T_J = 25^\circ C$	$\pm 2\%$ grade ⁽⁸⁾	-7.84	-8.16	V
			$\pm 1\%$ grade ⁽⁸⁾	-7.92	-8.08	
		$I_{OUT} = 5mA$ to $1A$, $V_{IN} = -9.5$ to $-23V$, $T_J = -40$ to $125^\circ C$, $P_D \leq 15W$	-7.68	-8.00	-8.32	
Line regulation	ΔV_{RLINE}	$V_{IN} = -10.5$ to $-25V$, $T_J = 25^\circ C$	-	24	80	mV
		$V_{IN} = -11$ to $-17V$, $T_J = 25^\circ C$	-	2	40	
Load regulation	ΔV_{RLOAD}	$I_{OUT} = 5mA$ to $1.5A$, $T_J = 25^\circ C$	-	16	160	mV
		$I_{OUT} = 250mA$ to $750mA$, $T_J = 25^\circ C$	-	8	40	
Quiescent current	I_Q	$T_J = 25^\circ C$, $I_{OUT} = 0mA$	-	2.5	4.0	mA
Quiescent current change	ΔI_Q	$I_{OUT} = 5mA$ to $1A$	-	-	0.5	mA
		$V_{IN} = -10.5$ to $-25V$	-	-	0.5	
Output voltage temperature coefficient	$\Delta V_{OUT} / \Delta T$	-	-	0.64	-	mV/ $^\circ C$
	$\Delta V_{OUT} / (V_{OUT} \times \Delta T)$	-	-	60	-	ppm/ $^\circ C$
Output noise voltage	V_N	$f = 10$ to $100k$ Hz, $T_A = 25^\circ C$	-	40	-	μV
Ripple rejection	RR	$f = 120Hz$, $I_{OUT} = 20mA$	-	75	-	dB
Dropout voltage ⁽⁹⁾	V_D	$I_{OUT} = 1A$	-	1.2	-	V
Peak current	I_{PK}	-	-	2.2	-	A

Note:

(7) Pulse test technology is used to make T_J as close to T_A as possible. Thermal effects must be considered separately.

(8) $\pm 2\%$ for conventional device, $\pm 1\%$ can be customized.

(9) The difference of output voltage and input voltage when input voltage is decreased gradually till output voltage equals to 95% of V_{OUT} .

6 Specifications

6.5 Electrical Characteristics (continued)

NSD7909 ($V_{IN} = -15V$, $I_{OUT} = 500mA$, $C_{IN} = 2.2\mu F$, $C_{OUT} = 1.0\mu F$, $T_J = 25^\circ C$, unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS ⁽⁷⁾	MIN.	TYP.	MAX.	UNIT	
Output voltage	V_{OUT}	$T_J = 25^\circ C$	$\pm 2\%$ grade ⁽⁸⁾	-8.82	-9.00	-9.18	V
			$\pm 1\%$ grade ⁽⁸⁾	-8.91	-9.00	-9.09	
		$I_{OUT} = 5mA$ to $1A$, $V_{IN} = -10.5$ to $-25V$, $T_J = -40$ to $125^\circ C$, $P_D \leq 15W$	-8.64	-9.00	-9.36		
Line regulation	ΔV_{RLINE}	$V_{IN} = -11.5$ to $-25V$, $T_J = 25^\circ C$	-	27	90	mV	
		$V_{IN} = -12$ to $-18V$, $T_J = 25^\circ C$	-	2	45		
Load regulation	ΔV_{RLOAD}	$I_{OUT} = 5mA$ to $1.5A$, $T_J = 25^\circ C$	-	18	180	mV	
		$I_{OUT} = 250mA$ to $750mA$, $T_J = 25^\circ C$	-	9	45		
Quiescent current	I_Q	$T_J = 25^\circ C$, $I_{OUT} = 0mA$	-	2.5	4.0	mA	
Quiescent current change	ΔI_Q	$I_{OUT} = 5mA$ to $1A$	-	-	0.5	mA	
		$V_{IN} = -11.5$ to $-25V$	-	-	0.5		
Output voltage temperature coefficient	$\Delta V_{OUT} / \Delta T$	-	-	0.72	-	mV/ $^\circ C$	
	$\Delta V_{OUT} / (V_{OUT} \times \Delta T)$	-	-	60	-	ppm/ $^\circ C$	
Output noise voltage	V_N	$f = 10$ to $100k$ Hz, $T_A = 25^\circ C$	-	40	-	μV	
Ripple rejection	RR	$f = 120Hz$, $I_{OUT} = 20mA$	-	75	-	dB	
Dropout voltage ⁽⁹⁾	V_D	$I_{OUT} = 1A$	-	1.2	-	V	
Peak current	I_{PK}	-	-	2.2	-	A	

Note:

(7) Pulse test technology is used to make T_J as close to T_A as possible. Thermal effects must be considered separately.

(8) $\pm 2\%$ for conventional device, $\pm 1\%$ can be customized.

(9) The difference of output voltage and input voltage when input voltage is decreased gradually till output voltage equals to 95% of V_{OUT} .

6 Specifications

6.5 Electrical Characteristics (continued)

NSD7912 ($V_{IN} = -19V$, $I_{OUT} = 500mA$, $C_{IN} = 2.2\mu F$, $C_{OUT} = 1.0\mu F$, $T_J = 25^\circ C$, unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS ⁽⁷⁾	MIN.	TYP.	MAX.	UNIT	
Output voltage	V_{OUT}	$T_J = 25^\circ C$	$\pm 2\%$ grade ⁽⁸⁾	-11.76	-12.00	-12.24	V
			$\pm 1\%$ grade ⁽⁸⁾	-11.88	-12.00	-12.12	
		$I_{OUT} = 5mA$ to $1A$, $V_{IN} = -13.5$ to $-27V$, $T_J = -40$ to $125^\circ C$, $P_D \leq 15W$	-11.52	-12.00	-12.48		
Line regulation	ΔV_{RLINE}	$V_{IN} = -14.5$ to $-30V$, $T_J = 25^\circ C$	-	36	120	mV	
		$V_{IN} = -16$ to $-22V$, $T_J = 25^\circ C$	-	3	60		
Load regulation	ΔV_{RLOAD}	$I_{OUT} = 5mA$ to $1.5A$, $T_J = 25^\circ C$	-	24	240	mV	
		$I_{OUT} = 250mA$ to $750mA$, $T_J = 25^\circ C$	-	12	60		
Quiescent current	I_Q	$T_J = 25^\circ C$, $I_{OUT} = 0mA$	-	2.5	4.0	mA	
Quiescent current change	ΔI_Q	$I_{OUT} = 5mA$ to $1A$	-	-	0.5	mA	
		$V_{IN} = -15$ to $-30V$	-	-	0.5		
Output voltage temperature coefficient	$\Delta V_{OUT} / \Delta T$	-	-	0.96	-	mV/ $^\circ C$	
	$\Delta V_{OUT} / (V_{OUT} \times \Delta T)$	-	-	60	-	ppm/ $^\circ C$	
Output noise voltage	V_N	$f = 10$ to $100k$ Hz, $T_A = 25^\circ C$	-	40	-	μV	
Ripple rejection	RR	$f = 120Hz$, $I_{OUT} = 20mA$	-	75	-	dB	
Dropout voltage ⁽⁹⁾	V_D	$I_{OUT} = 1A$	-	1.2	-	V	
Peak current	I_{PK}	-	-	2.2	-	A	

Note:

(7) Pulse test technology is used to make T_J as close to T_A as possible. Thermal effects must be considered separately.

(8) $\pm 2\%$ for conventional device, $\pm 1\%$ can be customized.

(9) The difference of output voltage and input voltage when input voltage is decreased gradually till output voltage equals to 95% of V_{OUT} .

6 Specifications

6.5 Electrical Characteristics (continued)

NSD7915($V_{IN} = -23V$, $I_{OUT} = 500mA$, $C_{IN} = 2.2\mu F$, $C_{OUT} = 1.0\mu F$, $T_J = 25^\circ C$, unless otherwise specified)

CHARACTERISTIC	SYMBOL	TEST CONDITIONS ⁽⁷⁾	MIN.	TYP.	MAX.	UNIT	
Output voltage	V_{OUT}	$T_J = 25^\circ C$	$\pm 2\%$ grade ⁽⁸⁾	-14.70	-15.00	-15.30	V
			$\pm 1\%$ grade ⁽⁸⁾	-14.85		-15.15	
		$I_{OUT} = 5mA$ to $1A$, $V_{IN} = -16.5$ to $-30V$, $T_J = -40$ to $125^\circ C$, $P_D \leq 15W$	-14.40	-15.00	-15.60		
Line regulation	ΔV_{RLINE}	$V_{IN} = -17.5$ to $-30V$, $T_J = 25^\circ C$	-	45	150	mV	
		$V_{IN} = -20$ to $-26V$, $T_J = 25^\circ C$	-	3	75		
Load regulation	ΔV_{RLOAD}	$I_{OUT} = 5mA$ to $1.5A$, $T_J = 25^\circ C$	-	30	300	mV	
		$I_{OUT} = 250mA$ to $750mA$, $T_J = 25^\circ C$	-	15	75		
Quiescent current	I_Q	$T_J = 25^\circ C$, $I_{OUT} = 0mA$	-	2.5	4.0	mA	
Quiescent current change	ΔI_Q	$I_{OUT} = 5mA$ to $1A$	-	-	0.5	mA	
		$V_{IN} = -18.5$ to $-30V$	-	-	0.5		
Output voltage temperature coefficient	$\Delta V_{OUT} / \Delta T$	-	-	1.2	-	mV/ $^\circ C$	
	$\Delta V_{OUT} / (V_{OUT} \times \Delta T)$	-	-	60	-	ppm/ $^\circ C$	
Output noise voltage	V_N	$f = 10$ to $100k$ Hz, $T_A = 25^\circ C$	-	40	-	μV	
Ripple rejection	RR	$f = 120Hz$, $I_{OUT} = 20mA$	-	75	-	dB	
Dropout voltage ⁽⁹⁾	V_D	$I_{OUT} = 1A$	-	1.2	-	V	
Peak current	I_{PK}	-	-	2.2	-	A	

Note:

(7) Pulse test technology is used to make T_J as close to T_A as possible. Thermal effects must be considered separately.

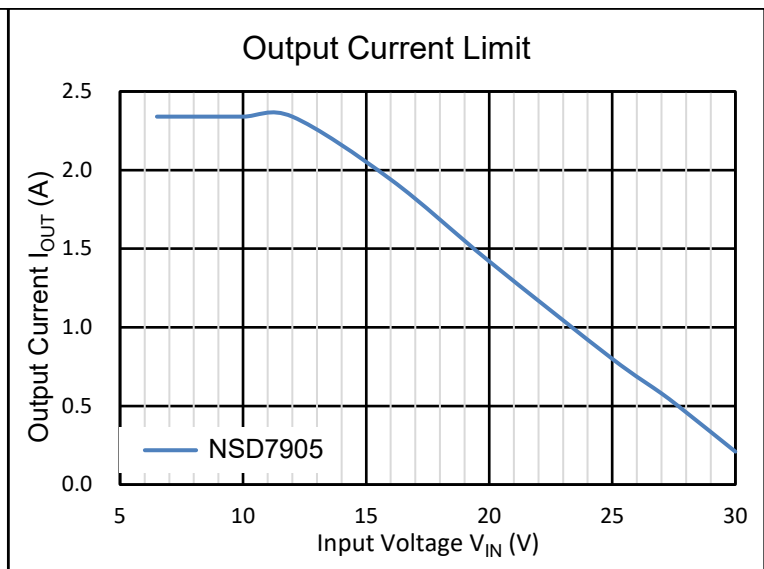
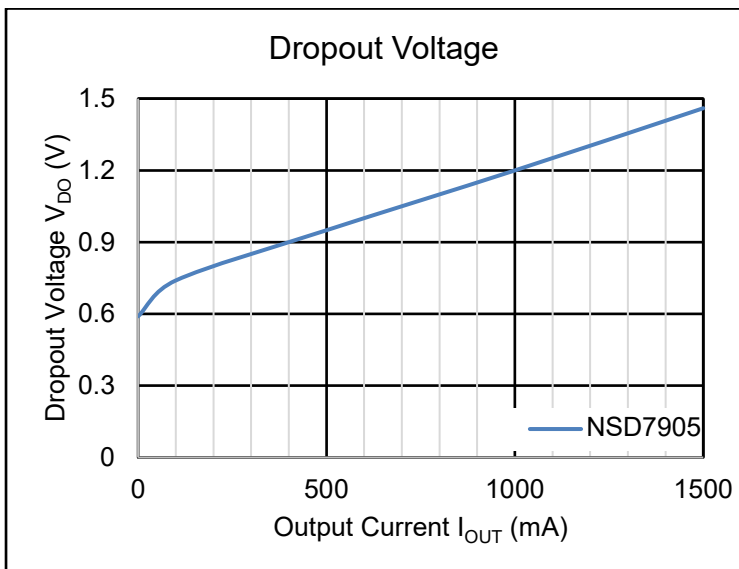
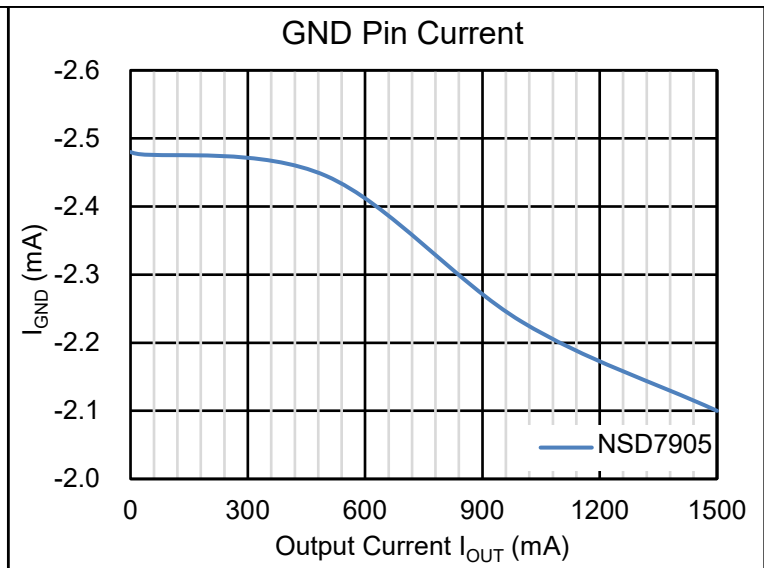
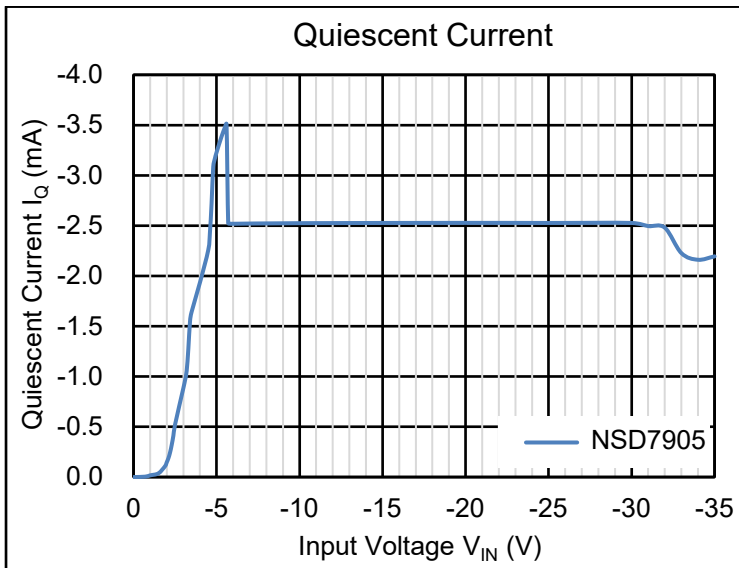
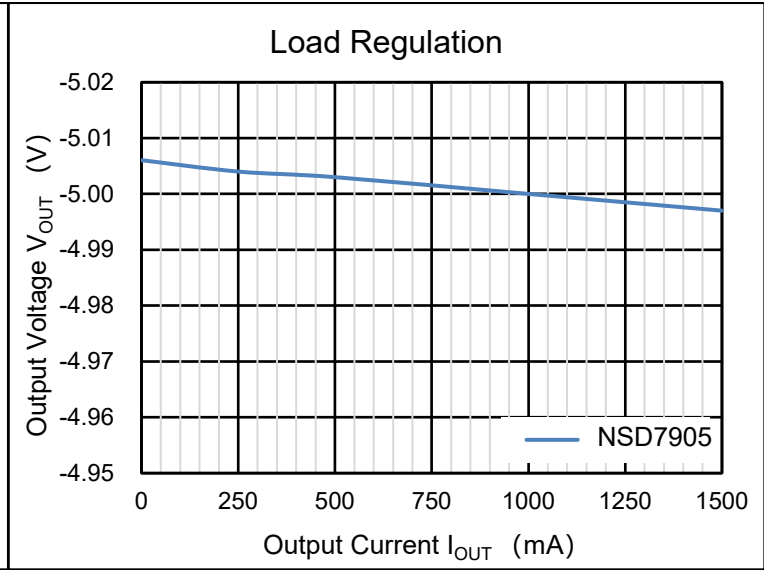
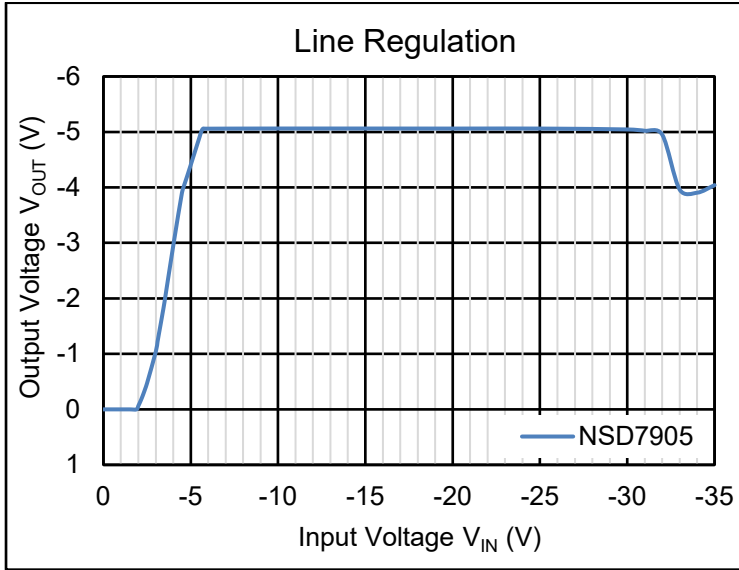
(8) $\pm 2\%$ for conventional device, $\pm 1\%$ can be customized.

(9) The difference of output voltage and input voltage when input voltage is decreased gradually till output voltage equals to 95% of V_{OUT} .

6 Specifications

6.6 Typical Characteristics

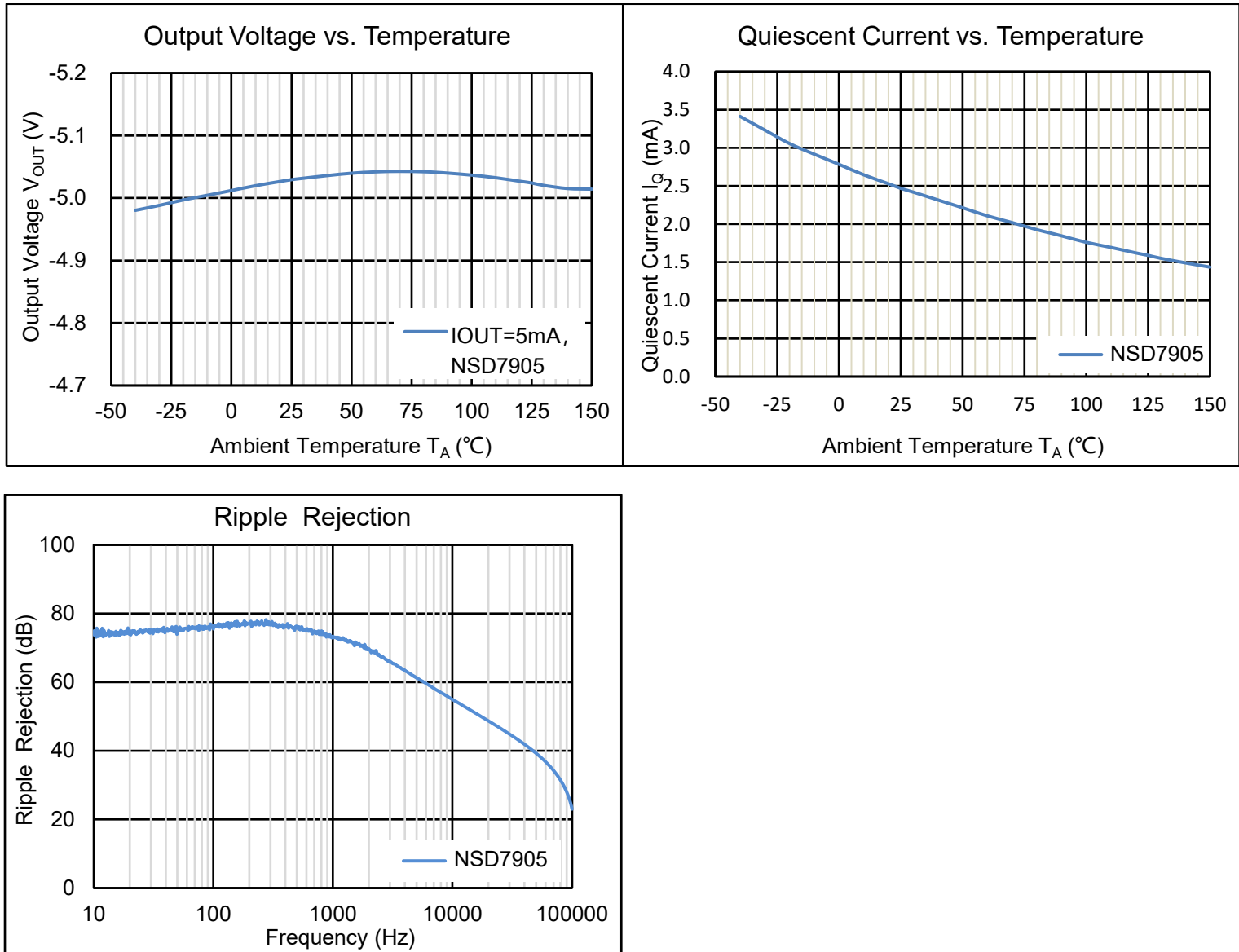
NSD7905 Series ($V_{IN} = -10V$, $I_{OUT} = 500mA$, $C_{IN} = 2.2\mu F$, $C_{OUT} = 1\mu F$, $T_A = 25^\circ C$, unless otherwise specified)



6 Specifications

6.6 Typical Characteristics (continued)

NSD7905 Series ($V_{IN} = -10V$, $I_{OUT} = 500mA$, $C_{IN} = 2.2\mu F$, $C_{OUT} = 1\mu F$, $T_A = 25^\circ C$, unless otherwise specified)



6 Specifications

6.6 Typical Characteristics (continued)

NSD7905 Series ($V_{IN} = -10V$, $I_{OUT} = 500mA$, $C_{IN} = 2.2\mu F$, $C_{OUT} = 1\mu F$, $T_A = 25^\circ C$, unless otherwise specified)

Load Transient

NSD7905, $V_{IN} = -10V$, CH1: V_{OUT} , CH4: I_{OUT}

$I_{OUT} = 10$ to $1000mA$



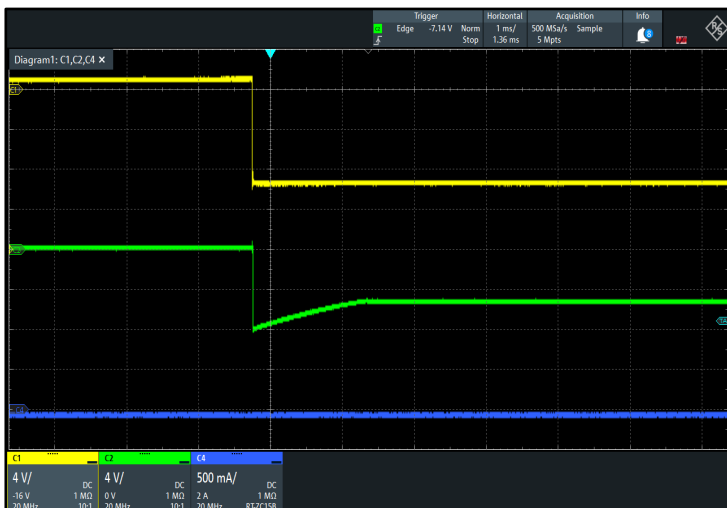
$I_{OUT} = 10$ to $1500mA$



Power-up Response

NSD7905, $V_{IN} = -10V$, CH1: V_{OUT} , CH2: I_{OUT}

$I_{OUT} = 0mA$

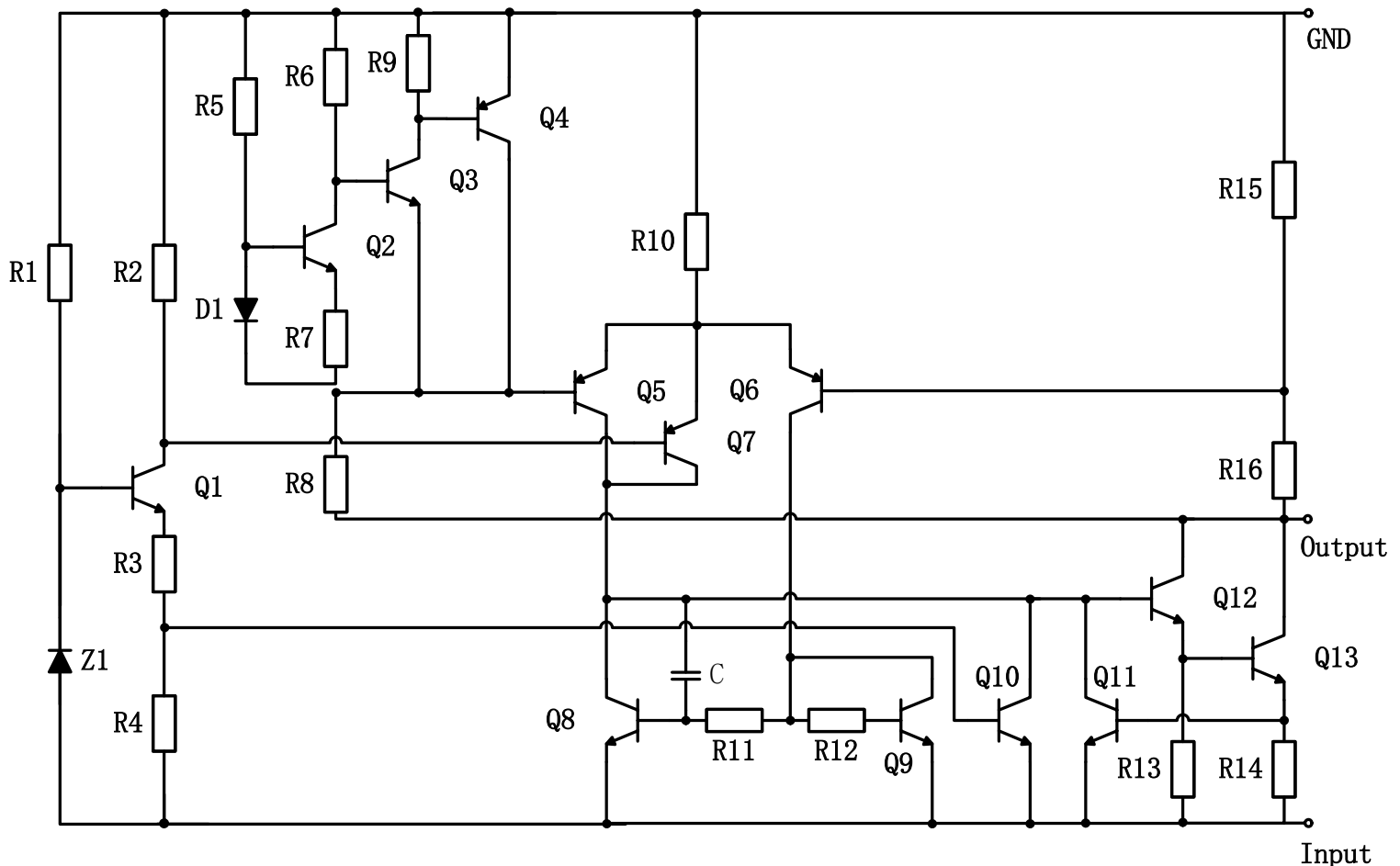


7 Detailed Description

7.1 Description

The NSD79XXseries is a group of fixed output negative voltage regulators. It integrates built-in current limit, short-circuit protection, thermal overload protection and safe operating area protection of output transistor, which makes it relatively difficult to be damaged. By setting the resistance value of peripheral resistance, the NSD79XX series can also be used as adjustable voltage output regulator.

7.2 Representative Schematic Diagram



7.3 Feature Description

Input Voltage

When the input voltage is lower than the rated range of the data sheet, the device will lose the regulation function of stabilizing the output voltage, that is, it is unable to maintain the output voltage within the rated range. When the input voltage is higher than the rated range of the data sheet, the device may cause irreversible damage or failure due to exceeding the maximum rated range of electrical stress.

Built-in Current Limit & Short Circuit Protection

The NSD79XXseries has built-in current limit and short circuit protection. When the output current of the device is too high, the output of the device will be shut down. When the output of the device is short circuited to ground, the output of the device will also be shut down and the output current will be maintained within a certain range.

The typical current limits for the NSD79XXseries is 2.2A.

7 Detailed Description

7.3 Feature Description (continued)

Thermal Shutdown Protection

The NSD79XX series has thermal shutdown protection. When the junction temperature exceeds the rated temperature range for normal operation in the data sheet, the device will enter the thermal shutdown state. At this time, the output voltage of the device will be reduced to prevent catastrophic damage to the chip due to accidental heat. When the junction temperature decreases and no longer remains too high, the device will release the thermal shutdown and output normally. To ensure reliable operation, please limit the junction temperature to the specified range of recommended operating conditions in the data sheet. Applications that exceed the recommended temperature range may cause the device to exceed its operating specifications.

Although the internal protection circuitry of the device is designed to protect against thermal overall conditions, this circuitry is not intended to replace proper heat sinking. Continuously running the device into thermal shutdown or above the maximum recommended junction temperature reduces long-term reliability.

Output Current

Due to the internal integration of thermal shutdown protection, in the case of large output current, the device may enter the thermal shutdown state because the junction temperature is higher than the rated value in the data sheet. Therefore, the appropriate package should be selected for circuit design according to the heat dissipation power consumption of the package and the effective connection thermal resistance with the environment, so as to make the device emit more heat energy, so as to ensure the maximum load current capacity of the device. If the circuit design is appropriate and the device has good heat dissipation conditions, the NSD79XX series can output a current of up to 1.5A.

8 Application and Implementation

8.1 Risk Alert and Precautions

The NSD79XXseries is designed with thermal protection, output short circuit protection and output transistor SOA protection. However, like any IC regulator, precautions are necessary to reduce the possibility of accidental damage to the regulator. The following describes the possible causes of unit damage or failure:

Electrostatic Discharge (ESD) and Instantaneous Electrical Surge

Electrostatic discharge (ESD) is a common near-field hazard source. It comes from many sources, such as human body, mechanical equipment and electronic components themselves. ESD can cause phenomena such as high voltage and instantaneous high current in a very short time, resulting in damage or failure of the device due to electric shock.

In some applications, a short duration but high energy spike may occur in the circuit, including peak voltage and surge current. They may cause unstable operation of the regulator, accelerated aging and potential hazards, and even damage or malfunction of the regulator. These peaks are usually more likely to occur in hot-plug, switch inductance, heavy-load, and other types of circuits.

Precautions for ESD and Electrical Surge

In the practical application of the circuit, adopting the following suggestions can reduce the possibility of device failure due to the above reasons to a certain extent.

Using TVS:

Place a TVS between the IN and GND of the voltage regulator to absorb the peak voltage that may be generated due to ESD or other reasons. As shown in Figure 9-4;

Using Input Resistor:

Place a resistor with appropriate resistance in series before the IN of the voltage regulator, which can help the voltage regulator share part of the energy in case of surge. The resistance value of the resistance should not be too large. The specific resistance value depends on the application of the circuit. Generally, the resistance value of this resistance does not exceed 20Ω. As shown in Figure 9-5;

Using Electrolytic Capacitor:

For the application circuit using the low ESR multilayer ceramic capacitor (MLCC) type input capacitor, the LC resonant voltage spike caused by hot plugging or power transmission line inductance can be suppressed by using RC suppression circuit for parallel connection of the input capacitor. A very simple method is to parallel a suitable electrolytic capacitor to the input capacitor. As shown in Figure 9-6. For most 100μF/25V electrolytic capacitor has an ESR of about 0.2Ω at 100kHz. This can completely suppress the overshoot phenomenon of the input and minimize the possibility of IC damage due to input voltage spikes.

Figure 9-1 and Figure 9-2 show the impact of not using electrolytic capacitor [Test circuit is shown in Figure 9-3] and using 100μF/25V electrolytic capacitor parallel to the input capacitor [Test circuit is shown in Figure 9-6] on suppressing surge voltage. As shown in Figure 9-1., when the input is powered on from 0 to 10V, a peak voltage of up to 20V (shown in the RED part) is generated in front of the input terminal of the device. When the electrolytic capacitor is used, as shown in Figure 9-2., the peak voltage generated by power on is effectively suppressed (shown in the GREEN part).

8 Application and Implementation

8.1 Risk Alert and Precautions (continued)

Test Condition: NSD7905, $C_{IN} = 10\mu\text{F}$ (MLCC), $C_{OUT} = 100\mu\text{F}$, $V_{IN} = 0 \sim -10\text{V}$, $I_{OUT} = 100\text{mA}$, CH1: V_{IN} , CH2: V_{OUT} .

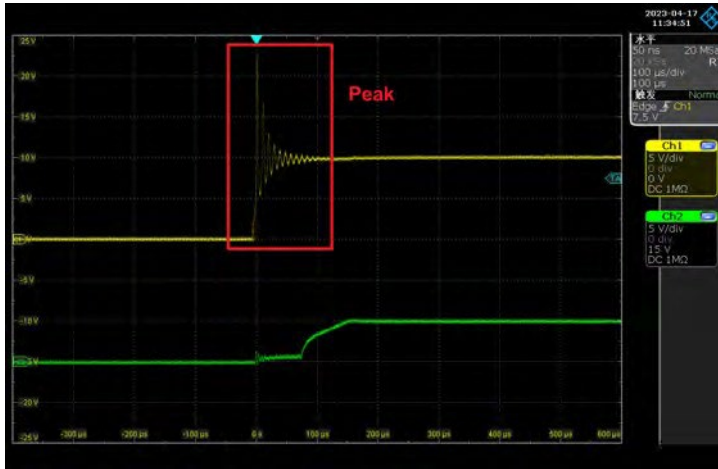


Figure 9-1. Test with the conventional circuit

[Test Circuit is shown in Figure 9-3]

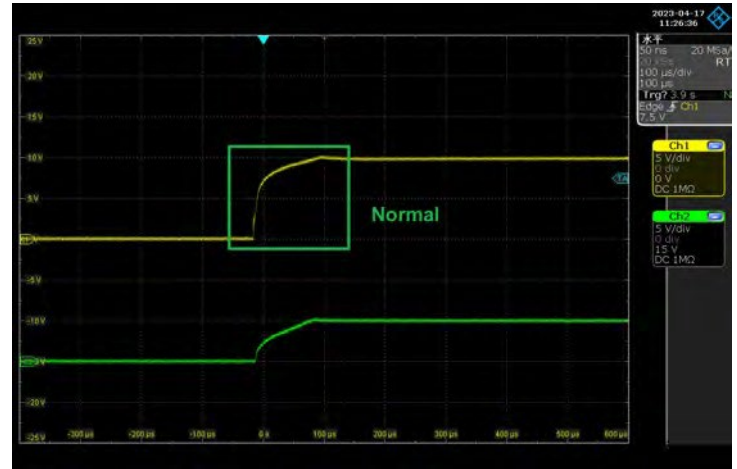


Figure 9-2. Test with the circuit that a $100\mu\text{F}/25\text{V}$ electrolytic capacitor parallel to the C_{IN} [Test Circuit is shown in Figure 9-6]

For the NSD79XX series, it is recommended that the input peak voltage should not exceed 36V. When the input voltage of the operating circuit may not meet the application conditions described above, it is recommended to adopt the circuit layout shown in Figure 9-5 in the circuit design.

Large Output Capacitance

The NSD79XX series can obtain better transient response with the help of output capacitance. However, if the output capacitor is relatively large, the surge current generated by the charging of the output capacitor will also be large at the moment of power on of the regulator, and the large surge current passing through the regulator may damage the internal circuit. When the output capacitance is large, adopting the circuit design shown in Figure 9-5 will reduce the possibility of damage to the device due to large surge current to a certain extent. It is recommended that the selection of output capacitor should not exceed $20\mu\text{F}$. If the selection of output capacitor exceeds $20\mu\text{F}$, it is recommended to adopt the circuit design in Figure 9-5 to reduce the possibility of accidental failure of the device due to large surge current during power on.

8.2 Typical Application Circuits

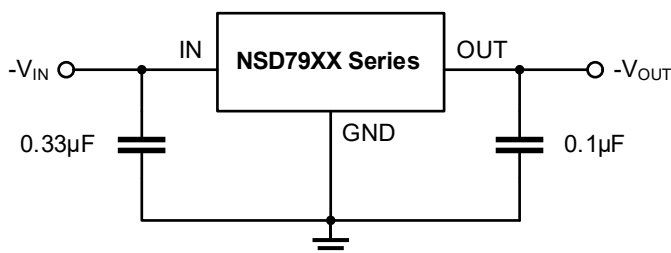


Figure 9-3. Conventional Circuit

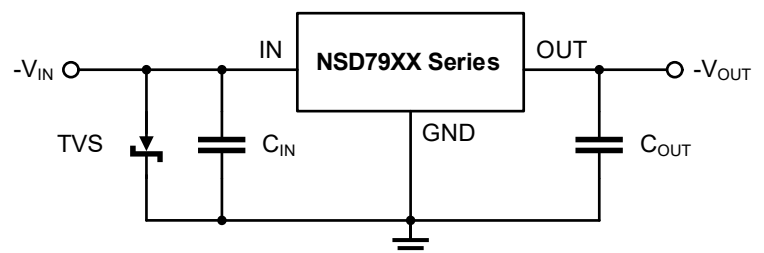


Figure 9-4. TVS is used at IN

8 Application and Implementation

8.2 Typical Application Circuits (continued)

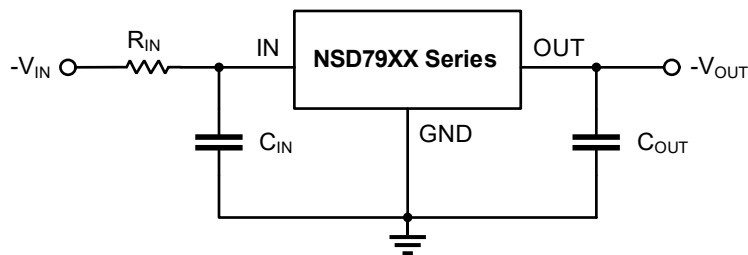


Figure 9-5. Resistance is used at IN

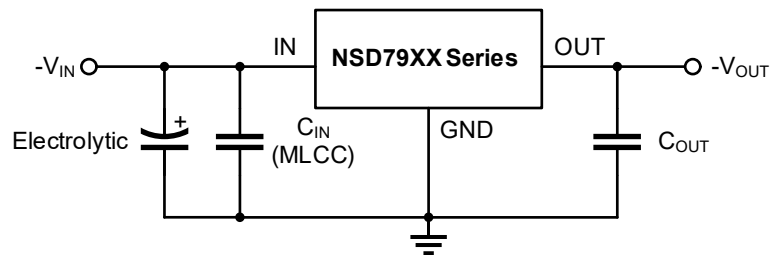


Figure 9-6. Electrolytic capacitor is used at IN

8.3 Bypass Capacitance Selection

A capacitance between IN and GND (C_{IN}) is required if the regulator is located far from the power supply filter. It is recommended to use a $2.2\mu\text{F}$ capacitor for C_{IN} , and the C_{IN} should be placed as close to the device IN pin and GND pin as possible.

It is recommended to use a $1.0\mu\text{F}$ capacitor between OUT and GND (C_{OUT}), and the C_{OUT} should be placed as close as possible between OUT and GND. The output capacitance can limit the high-frequency noise and help the device obtain the best stability and transient response.

The tolerance and temperature coefficient of the C_{IN} and C_{OUT} must be considered to ensure that the capacitor can work normally within the rated working ambient temperature and rated working conditions of the device.

It is recommended that the C_{OUT} should not exceed $20\mu\text{F}$. When the C_{OUT} exceeds $20\mu\text{F}$, it is recommended to use the circuit layout shown in Figure 9-2. See *Large Output Capacitance* for more details.

8.4 Design Requirements and Procedure

The NSD79XX series is mainly used to provide fixed output voltage regulation, the output voltage is selected based on the device variant, which is available in 5.0V, 6.0V, 8.0V, 9.0V, 12V and 15V regulator options, and it requires a very small number of device components. If the regulator is far from the power filter, the input capacitor C_{IN} is required. The bypass capacitor C_{OUT} is used at the output to obtain the best stability and transient response. These capacitors must be as close to the regulator as possible.

8.5 Power Supply Recommendation

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_{DO}) must be met with extra headroom when possible to keep the output well regulated.

For the best overall performance, some layout guidelines may be disregarded. Place all circuit components on the same side of the circuit board and as near as practical to the respective linear regulator pins. Traces must be kept short and wide to reduce the amount of parasitic elements in the system. The actual width and thickness of traces depends on the current carrying capability and heat dissipation required by the end system.

Orderable Information

MODEL	DEVICE	PACKAGE	OP T _J	ECO PLAN	MSL	PACKING OPTION	SORT
Conventional Device							
NSD79-5.0	NSD7905	TO-220-3L	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tube 50 Units / Rail	Active
NSD79-6.0	NSD7906	TO-220-3L	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tube 50 Units / Rail	Active
NSD79-8.0	NSD7908	TO-220-3L	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tube 50 Units / Rail	Active
NSD79-9.0	NSD7909	TO-220-3L	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tube 50 Units / Rail	Active
NSD79-12.0	NSD7912	TO-220-3L	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tube 50 Units / Rail	Active
NSD79-15.0	NSD7915	TO-220-3L	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tube 50 Units / Rail	Active
NSD79-24.0	NSD7924	TO-220-3L	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tube 50 Units / Rail	Active
NSD79-5.0	NSD7905	TO-220F	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tube 50 Units / Rail	Active
NSD79-6.0	NSD7906	TO-220F	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tube 50 Units / Rail	Active
NSD79-8.0	NSD7908	TO-220F	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tube 50 Units / Rail	Active
NSD79-9.0	NSD7909	TO-220F	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tube 50 Units / Rail	Active
NSD79-12.0	NSD7912	TO-220F	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tube 50 Units / Rail	Active
NSD79-15.0	NSD7915	TO-220F	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tube 50 Units / Rail	Active
NSD79-24.0	NSD7924	TO-220F	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tube 50 Units / Rail	Active

Orderable Information

MODEL	DEVICE	PACKAGE	OP T _J	ECO PLAN	MSL	PACKING OPTION	SORT
NSD79XX Conventional Device (continued)							
NSD79-5.0	NSD7905	TO-263-2L	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tape and Reel 800 Units / Reel	Active
NSD79-6.0	NSD7906	TO-263-2L	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tape and Reel 800 Units / Reel	Active
NSD79-8.0	NSD7908	TO-263-2L	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tape and Reel 800 Units / Reel	Active
NSD79-9.0	NSD7909	TO-263-2L	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tape and Reel 800 Units / Reel	Active
NSD79-12.0	NSD7912	TO-263-2L	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tape and Reel 800 Units / Reel	Active
NSD79-15.0	NSD7915	TO-263-2L	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tape and Reel 800 Units / Reel	Active
NSD79-24.0	NSD7924	TO-263-2L	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tape and Reel 800 Units / Reel	Active
Customized Device							
NSD79XX ±1% grade	NSD79XX	TO-220-3L	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tube 50 Units / Rail	Customized
	NSD79XX	TO-220F	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tube 50 Units / Rail	Customized
	NSD79XX	TO-263-2L	-40 ~ 125°C	RoHS & Green	Level 3 168 HR	Tape and Reel 800 Units / Reel	Customized
Others	-	-	-	-	-	-	Customized

Note:

ECO PLAN: For the RoHS and Green certification standards of this product, please refer to the official report provided by NSD.

MSL: Moisture Sensitivity Level. Determined according to JEDEC industry standard classification.

SORT: Specifically defined as follows:

Active: Recommended for new products;

Customized: Products manufactured to meet the specific needs of customers;

Preview: The device has been released and has not been fully mass produced. The sample may or may not be available;

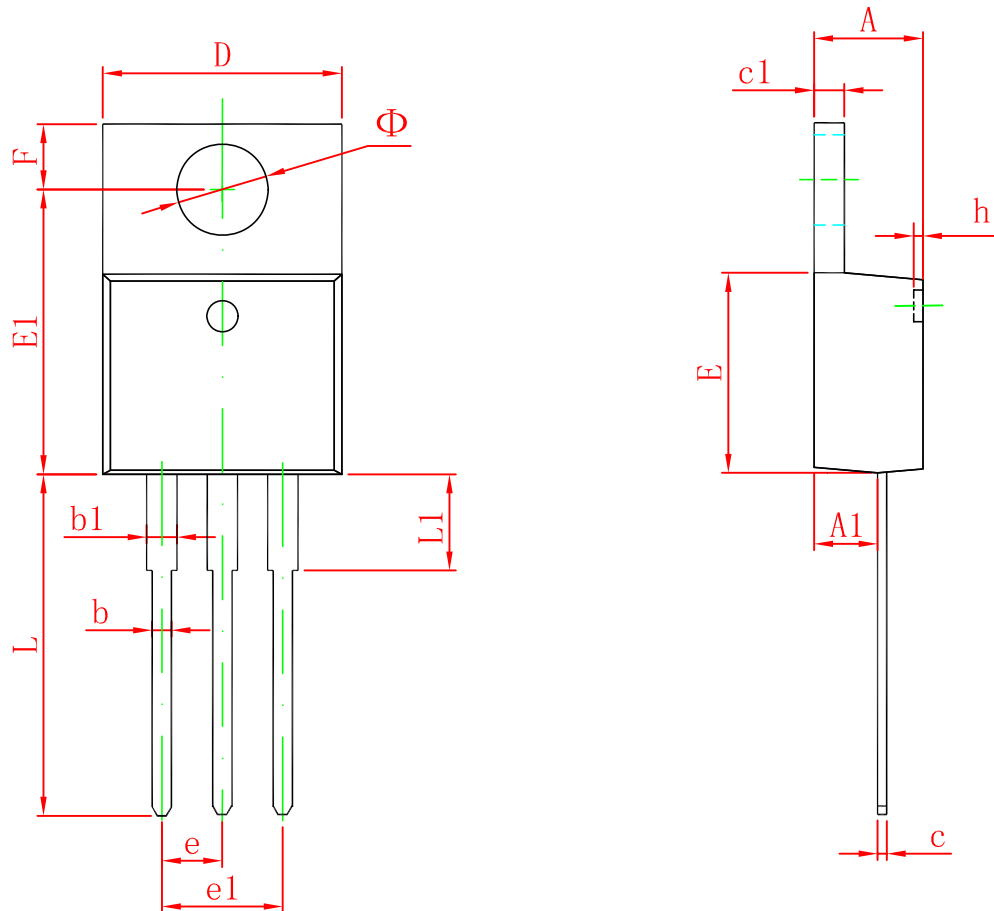
NoRD: It is not recommended to use the device for new design. The device is only produced for the needs of existing customers;

Obsolete: The device has been discontinued

Mechanical Information

TO-220-3L Mechanical Information

TO-220-3L Outline Dimensions

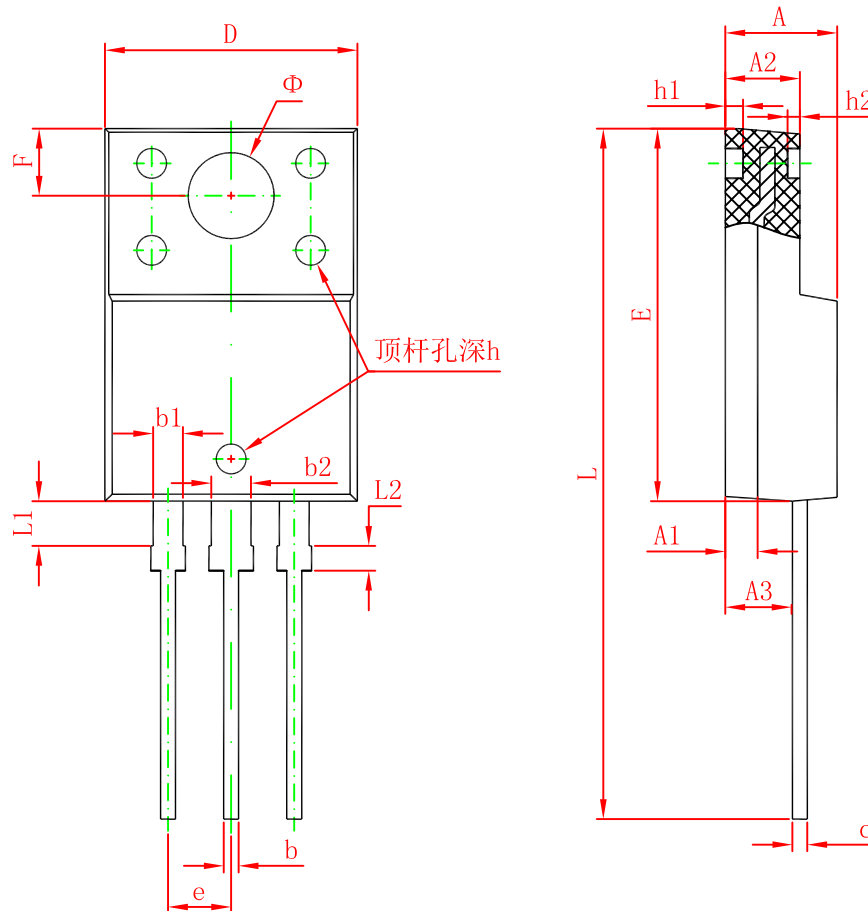


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	4.470	4.670	0.176	0.184
A1	2.520	2.820	0.099	0.111
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.310	0.530	0.012	0.021
c1	1.170	1.370	0.046	0.054
D	10.010	10.310	0.394	0.406
E	8.500	8.900	0.335	0.350
E1	12.060	12.460	0.475	0.491
e	2.540 TYP		0.100 TYP	
e1	4.980	5.180	0.196	0.204
F	2.590	2.890	0.102	0.114
h	0.000	0.300	0.000	0.012
L	13.400	13.800	0.528	0.543
L1	3.560	3.960	0.140	0.156
Φ	3.735	3.935	0.147	0.155

Mechanical Information

TO-220F Mechanical Information

TO-220F Outline Dimensions

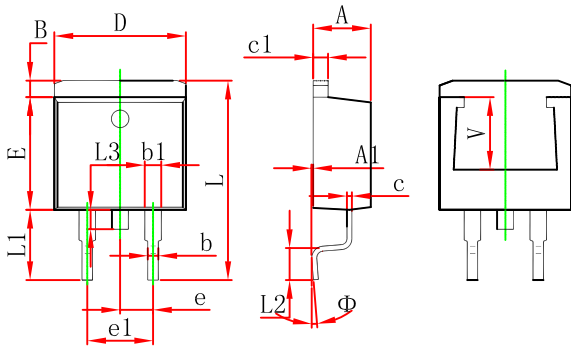


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.300	4.700	0.169	0.185
A1	1.300 REF.		0.051 REF.	
A2	2.800	3.200	0.110	0.126
A3	2.500	2.900	0.098	0.114
b	0.500	0.750	0.020	0.030
b1	1.100	1.350	0.043	0.053
b2	1.500	1.750	0.059	0.069
c	0.500	0.750	0.020	0.030
D	9.960	10.360	0.392	0.408
E	14.800	15.200	0.583	0.598
e	2.540 TYP.		0.100 TYP.	
F	2.700 REF.		0.106 REF.	
Φ	3.500 REF.		0.138 REF.	
h	0.000	0.300	0.000	0.012
h1	0.800 REF.		0.031 REF.	
h2	0.500 REF.		0.020 REF.	
L	28.000	28.400	1.102	1.118
L1	1.700	1.900	0.067	0.075
L2	0.900	1.100	0.035	0.043

Mechanical Information

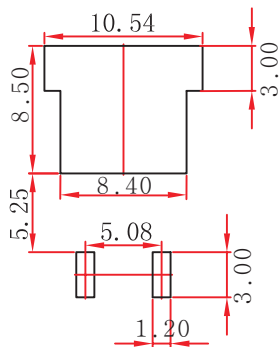
TO-263-2L Mechanical Information

TO-263-2L Outline Dimensions



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.470	4.670	0.176	0.184
A1	0.000	0.150	0.000	0.006
B	1.120	1.420	0.044	0.056
b	0.710	0.910	0.028	0.036
b1	1.170	1.370	0.046	0.054
c	0.310	0.530	0.012	0.021
c1	1.170	1.370	0.046	0.054
D	10.010	10.310	0.394	0.406
E	8.500	8.900	0.335	0.350
e	2.540 TYP.		0.100 TYP.	
e1	4.980	5.180	0.196	0.204
L	14.940	15.500	0.588	0.610
L1	4.950	5.450	0.195	0.215
L2	2.340	2.740	0.092	0.108
L3	1.300	1.700	0.051	0.067
Φ	0°	8°	0°	8°
V	5.600 REF.		0.220 REF.	

TO-263-2L Suggest Pad Layout



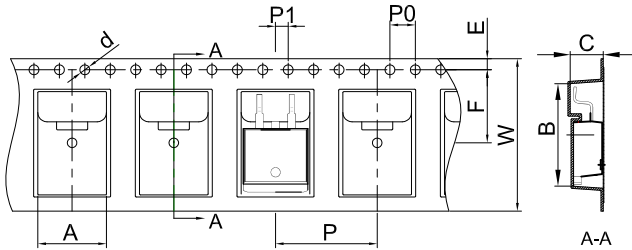
NOTE:

1. Controlling dimension: in millimeters.
2. General tolerance: $\pm 0.05\text{mm}$.
3. The pad layout is for reference purposes only.

Packaging Information

TO-263-2L Tape and Reel Information

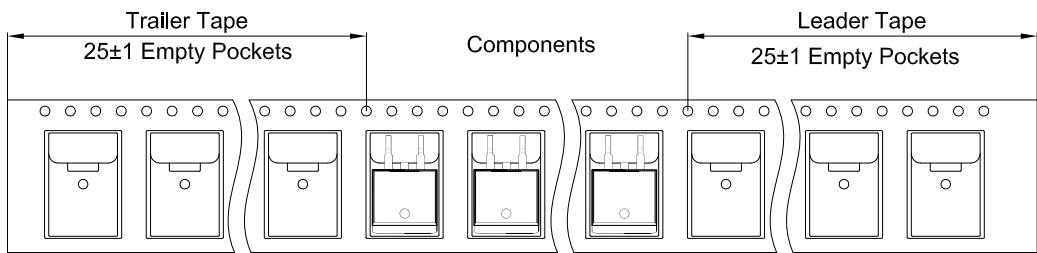
TO-263-2L Embossed Carrier Tape



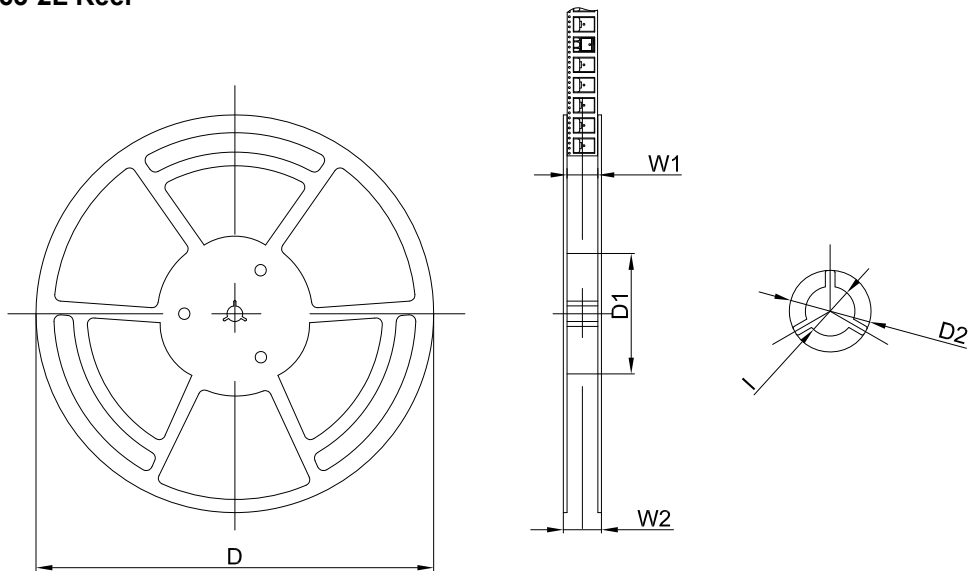
Packaging Description:
 TO-263-2L parts are shipped in tape. The carrier tape is made from a dissipative (carbon filled) polycarbonate resin. The cover tape is a multilayer film (Heat Activated Adhesive in nature) primarily composed of polyester film, adhesive layer, sealant, and anti-static sprayed agent. These reeled parts in standard option are shipped with 800 units per 13" or 33.0 cm diameter reel. The reels are clear in color and is made of polystyrene plastic (anti-static coated).

Dimensions are in millimeter										
Pkg type	A	B	C	d	E	F	P0	P	P1	W
TO-263-2L	10.80	16.13	5.21	Ø1.55	1.75	11.50	4.00	16.00	2.00	24.00

TO-263-2L Tape Leader and Trailer



TO-263-2L Reel



Dimensions are in millimeter						
Reel Option	D	D1	D2	W1	W2	I
13"Dia	Ø330.00	100.00	Ø21.00	24.4	30.4	Ø13.00

REEL	Reel Size	Box	Box Size(mm)	Carton	Carton Size(mm)	G.W.(kg)
800 pcs	13 inch	800 pcs	340×336×36	8,000 pcs	400×353×365	