

300mA, Low noise, High PSRR, High speed, CMOS LDO Regulators with fixed Voltage

Features

- VIN Voltage Range: 1.4V to 5.5V
- Fixed Output Voltage Version: 0.9V, 1.0V, 1.2V, 1.3V, 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.3V
- Output Current: 300mA
- Quiescent Current: 50μA Type
- Shut-down Current: <1μA
- Low Dropout Voltage:
170mV@I_{OUT}=0.3A, V_{OUT}=3.3V
- PSRR: 85dB@1kHz, V_{OUT}=2.8V
- Low Output Voltage Noise:
16μV_{RMS}@I_{OUT}=10mA, V_{OUT}=0.9V
50μV_{RMS}@I_{OUT}=10mA, V_{OUT}=2.8V
- Output Voltage Tolerance: ±1.5%
- Thermal-Overload and Short-Circuit Protection
- Package of TMI6036-XX: SOT23-5
- Package of TMI6036D-XX: DFN1x1-4

Description

The TMI6036D-XX and TMI6036-XX series are fixed output voltage, high accuracy, low noise, high speed, high PSRR, low dropout CMOS Linear regulator with high ripple rejection. The devices have input voltage range from 1.4V to 5.5V and can support low input voltage application. The current limit functions both as a short circuit protection and as an output current limiter. The device also has high PSRR and low output noise performances. The TMI6036D-XX is available in small DFN1x1-4 package and TMI6036-XX is SOT23-5 package. Standard products are Pb-free and Halogen-free.

Application

- MP3/MP4 players
- Cellphones, radiophone, digital cameras
- Bluetooth, wireless handsets

Typical Application

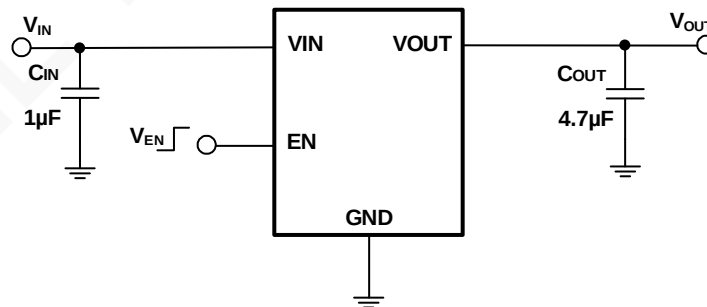
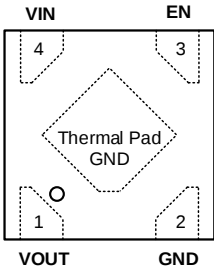
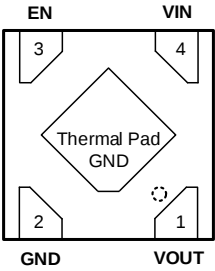
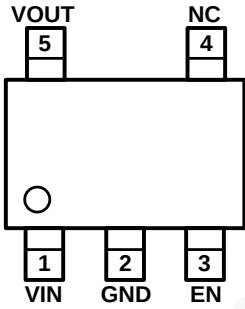


Figure 1. Basic Application Circuit

Package

(Top View)  (Bottom View) 	
TMI6036D-XX DFN1x1-4	TMI6036-XX SOT23-5

ORDER INFORMATION

Part Number	Output Voltage	Package	Top Marking	Quantity/Reel
TMI6036D-09	0.9V	DFN1X1-4	TZAxxx	10000
TMI6036D-10	1.0V	DFN1X1-4	TZBxxx	10000
TMI6036D-12	1.2V	DFN1X1-4	TZCxxx	10000
TMI6036D-13	1.3V	DFN1X1-4	TZDxxx	10000
TMI6036D-15	1.5V	DFN1X1-4	TZDxxx	10000
TMI6036D-18	1.8V	DFN1X1-4	TZExxx	10000
TMI6036D-25	2.5V	DFN1X1-4	TZFxxx	10000
TMI6036D-28	2.8V	DFN1X1-4	TZGxxx	10000
TMI6036D-30	3.0V	DFN1X1-4	TZHxxx	10000
TMI6036D-33	3.3V	DFN1X1-4	TZLxxx	10000
TMI6036-09	0.9V	SOT23-5	TSAxxx	3000
TMI6036-10	1.0V	SOT23-5	TSBxxx	3000
TMI6036-12	1.2V	SOT23-5	TSCxxx	3000
TMI6036-13	1.3V	SOT23-5	TSDxxx	3000
TMI6036-15	1.5V	SOT23-5	TSExxx	3000
TMI6036-18	1.8V	SOT23-5	TSFxxx	3000
TMI6036-25	2.5V	SOT23-5	TSJxxx	3000
TMI6036-28	2.8V	SOT23-5	TSKxxx	3000
TMI6036-30	3.0V	SOT23-5	TSLxxx	3000
TMI6036-33	3.3V	SOT23-5	TSMxxx	3000

TMI6036D-XX and TMI6036-XX devices are Pb-free and RoHS compliant.

Pin Functions

Pin		Name	Function
TMI6036D-XX	TMI6036-XX		
1	5	VOUT	Output pin of the device.
2	2	GND	Ground.
3	3	EN	Enable Pin. Connect this pin to logic low to disable the device, connect EN to logic high to enable the device. This pin should not be floated.
4	1	VIN	LDO power supply input pin.
5	/	Thermal Pad GND	Thermal Pad must be connected to a large-area ground plane to maximum the thermal performance.
/	4	NC	No Connection Internal of device.

Absolute Maximum Ratings (Note 1)

Parameter	Min	Max	Unit
V_{IN} Voltage	-0.3	6.5	V
V_{EN} Voltage	-0.3	$V_{IN}+0.3$	V
V_{OUT} Voltage	-0.3	$V_{IN}+0.3$	V
Power Dissipation (DFN1x1-4)	-	600	mW
Power Dissipation (SOT23-5)	-	500	mW
Lead Temperature Range	-	260	°C
Storage Temperature Range	-55	150	°C
Junction Temperature (Note2)	-40	150	°C

ESD Rating

Items	Description	Value	Unit
V_{ESD_HBM}	Human Body Model for all pins	±2000	V
V_{ESD_CDM}	Charged Device Model for all pins	±500	V

JEDEC specification JS-001

Recommended Operating Conditions

Items	Description	Min	Max	Unit
V_{IN}	Supply Voltage	1.4	5.5	V
T_A	Operating Ambient Temperature Range (Note2)	-40	85	°C

Thermal Resistance (Note3)

Items	Description	Value	Unit
θ_{JA}	Junction-to-ambient thermal resistance (DFN1x1-4)	210	°C/W
θ_{JA}	Junction-to-ambient thermal resistance (SOT23-5)	220	°C/W
ψ_{JT}	Junction-to-case(top) characterization parameter (DFN1x1-4)	5.5	°C/W
ψ_{JT}	Junction-to-case(top) characterization parameter (SOT23-5)	30.1	°C/W

Electrical Characteristics

$V_{IN}=V_{OUT}+1V$, $C_{IN}=1\mu F$, $C_{OUT}=4.7\mu F$, $T_A=25^{\circ}C$, $I_{OUT}=1mA$, and unless otherwise noted.

Symbol	Parameter	Conditions	Min	Type	Max	Units
V_{IN}	Input Voltage		1.4		5.5	V
V_{IN_UVLO}	Input Under Voltage Lock	Input voltage rising		1.25	1.4	V
$V_{IN_UVLO_HYS}$	Input Under Voltage Lock Hysteresis			0.12		V
V_{OUT_ACC}	Output Voltage Accuracy ^(Note4)	$V_{OUT}<2V$	-20		+20	mV
		$V_{OUT}>2V$	-1.5%		1.5%	V
I_{LIM}	Current Limit	$V_{EN}=V_{IN}$	300	600		mA
V_{DROP}	Dropout Voltage ^(Note5)	$V_{OUT}=3.3V$, $I_{OUT}=300mA$		170	190	mV
		$V_{OUT}=2.8V$, $I_{OUT}=300mA$		180	200	
		$V_{OUT}=1.2V$, $I_{OUT}=300mA$		420	450	
		$V_{OUT}=0.9V$, $I_{OUT}=300mA$		600	630	
ΔV_{LINE}	Line Regulation	$V_{IN}=V_{OUT}+0.5V$ to $5.5V$		1	5	mV
ΔV_{LOAD}	Load Regulation	$I_{OUT}=1mA$ to $300mA$, $V_{IN}=V_{OUT}+1V$		15	28	
I_Q	Quiescent Current	$V_{EN}=V_{IN}$, No load		50	90	μA
I_{SD}	Shut-down Current	$V_{EN}=0V$			1	μA
I_{SHORT}	Short Current	$V_{EN}=V_{IN}$, V_{OUT} Short to GND		120		mA
PSRR	Power supply Rejection Rate	$V_{IN}=(V_{OUT}+1V)_{DC}+0.5V_{PP}$ $I_{OUT}=10mA$, $V_{OUT}=2.8V$	$f=100Hz$	80		dB
			$f=1kHz$	85		
			$f=10kHz$	70		
			$f=100kHz$	60		
			$f=1MHz$	35		
V_{ENH}	EN logic high voltage	$V_{IN}=5.5V$, $I_{OUT}=1mA$	1.2			V
V_{ENL}	EN logic low voltage	$V_{IN}=5.5V$, $V_{OUT}=0V$	0		0.4	
I_{EN}	EN Input Current	$V_{EN}=0V$ to $5.5V$		120		nA
V_{NOISE}	Output Noise Voltage	$V_{IN}=V_{OUT}+1V$ 10Hz to 90kHz, $C_{OUT}=1\mu F$, $I_{OUT}=10mA$	$V_{OUT}=0.9V$	16		μV_{RMS}
			$V_{OUT}=1.2V$	28		
			$V_{OUT}=2.8V$	55		
			$V_{OUT}=3.3V$	57		
R_{DIS}	Auto-discharge Resistance	$V_{IN}=5.5V$, $V_{EN}=0V$, $V_{OUT}=2V$		120		Ω
T_{SD}	Thermal shutdown threshold ^(Note6)	Shutdown temperature		160		$^{\circ}C$
		Hysteresis		20		

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

Note 2: T_J is calculated from the ambient temperature T_A and power dissipation P_D according to the following formula: $T_J = T_A + P_D \times \theta_{JA}$.

Note 3: Measured on JESD51-7, 4-layer PCB.

Note 4: The load condition and dropout voltage should be considered in low input voltage application to ensure input voltage have enough headroom for expected load current.

Note 5: The dropout voltage is defined as $V_{IN}-V_{OUT}$, when V_{OUT} is 98% of the normal value of V_{OUT} .

Note 6: Guaranteed by design.

Operation Description

Overview

The TMI6036-XX and TMI6036D-XX are low input voltage, low noise and low dropout LDO with fixed output voltage and provides 300mA output current. The devices have voltage range from 1.4V to 5.5V. These features make the device a reliable solution to solve many challenging problems in the generation of clean and accurate power supply. The high performance also makes the TMI6036-XX and TMI6036D-XX useful in a variety of applications. The TMI6036-XX and TMI6036D-XX provides the protection functions for output overload, output short-circuit condition and overheating. It is designed to work with low-ESR ceramic capacitor, reducing the amount of the PCB area. Only a 4.7 μ F ceramic output capacitor can make the device stable over the whole load range.

Enable/Shutdown

The TMI6036-XX and TMI6036D-XX are disabled when the EN pin is connected to logic low level voltage. Connect EN pin to logic high level voltage to enable the device. This EN pin cannot be floated.

Output Auto Discharge

When the regulator is disabled, an internal 120 Ω resistor is connected between V_{OUT} and GND to discharge output capacitor C_{OUT} .

Current Limit

The TMI6036-XX and TMI6036D-XX contain an independent current limiter, which monitors and controls the pass transistor's gate voltage, limiting the output current to 0.6A (type). When the load current is higher than the over-current limit, the current limit circuit will clamp the gate voltage of the pass transistor to limit the output current.

Thermal Shutdown

The TMI6036-XX and TMI6036D-XX monitor junction temperature. If the device junction temperature exceeds the threshold value (typically 160°C), the inner OTP circuits turns off the device until the device is cooled down by OTP hysteresis temperature 20°C.

FUNCTIONAL BLOCK DIAGRAM

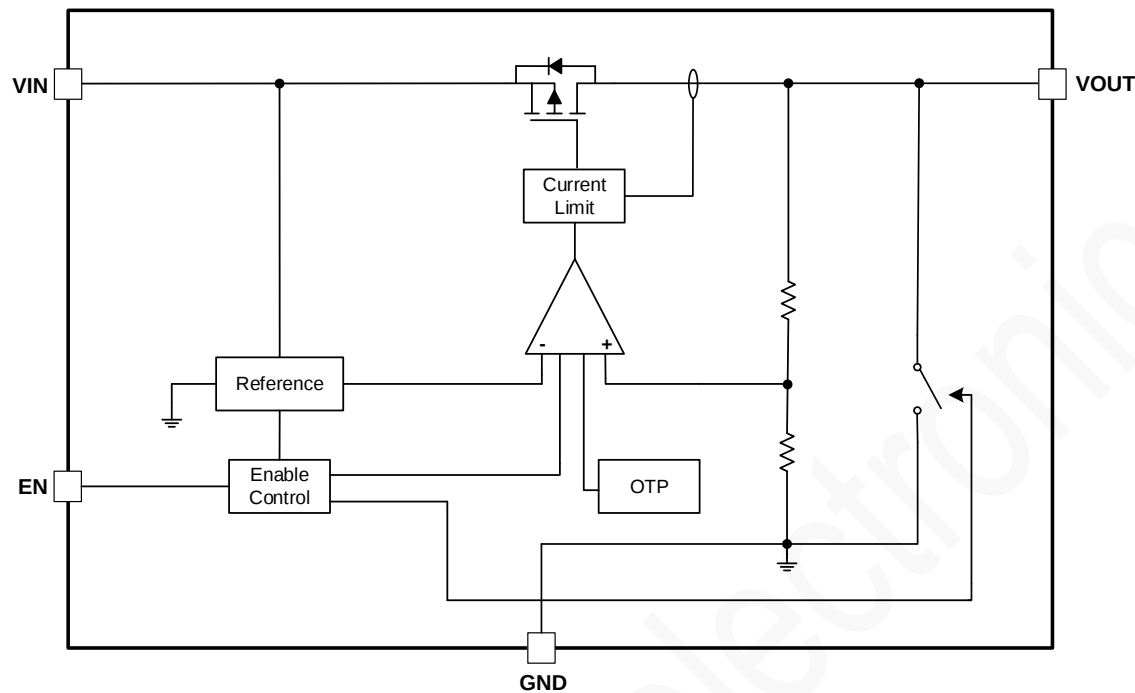


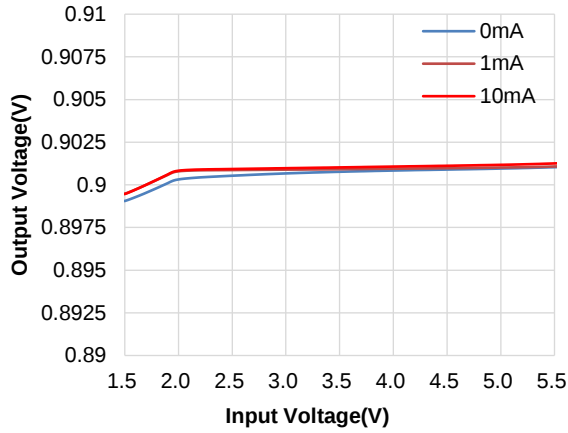
Figure 2. TMI6036-XX and TMI6036D-XX Block Diagram

TYPICAL CHARACTERISTICS

$V_{IN}=V_{OUT}+1V$, $C_{IN}=1\mu F$, $C_{OUT}=4.7\mu F$, $T_A=25^{\circ}C$.

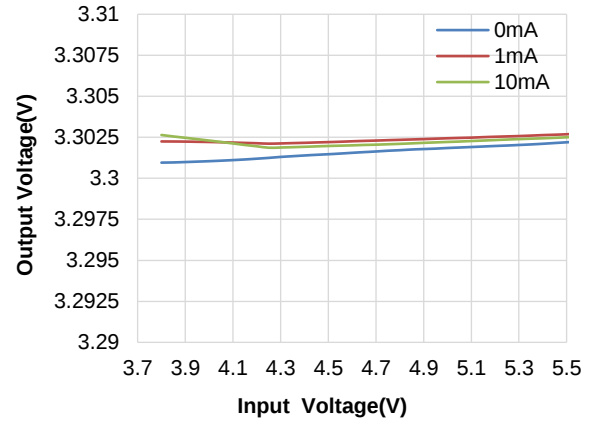
Line Regulation

$V_{IN}=1.9V$, $V_{OUT}=0.9V$



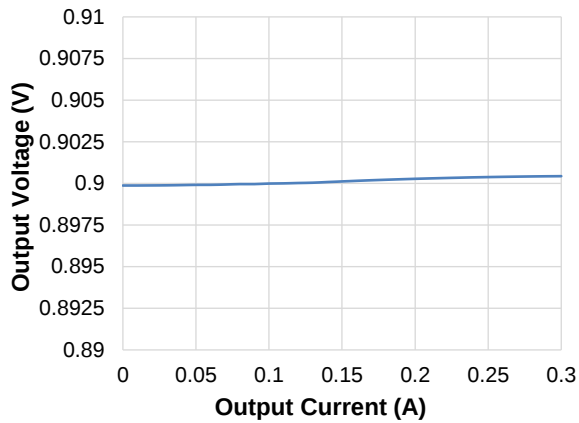
Line Regulation

$V_{IN}=4.3V$, $V_{OUT}=3.3V$



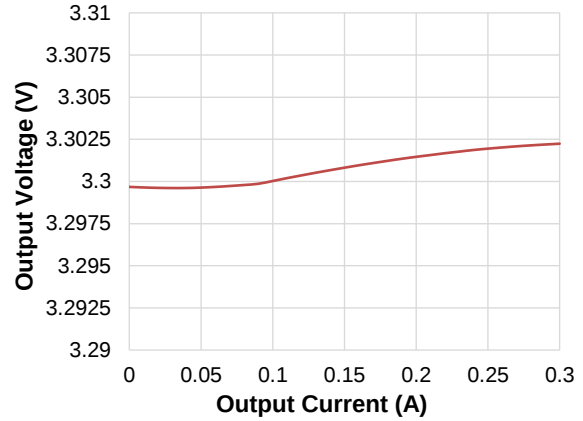
Load Regulation

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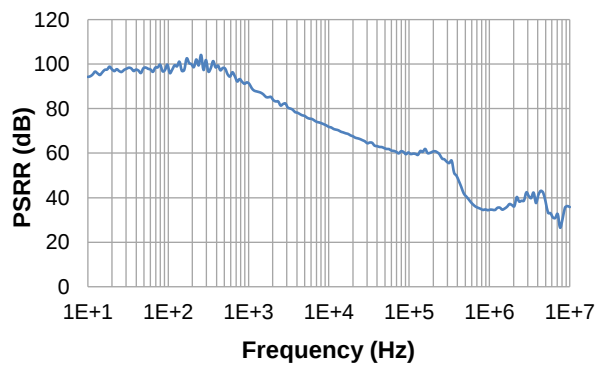
Load Regulation

$V_{IN}=4.3V$, $V_{OUT}=3.3V$



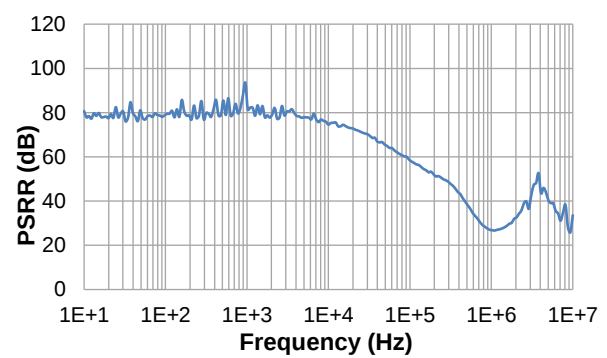
PSRR

$V_{IN}=2.5V$, $V_{OUT}=0.9V$, $I_{OUT}=10mA$



PSRR

$V_{IN}=4.3V$, $V_{OUT}=3.3V$, $I_{OUT}=10mA$

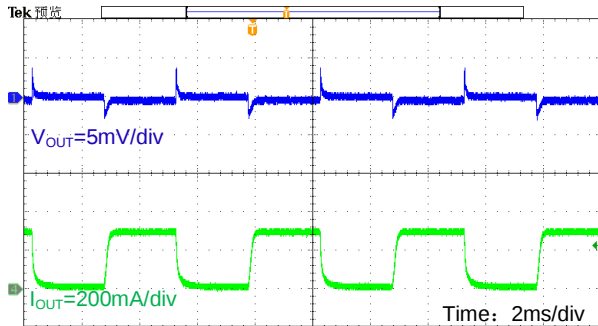


TYPICAL CHARACTERISTICS (continued)

$V_{IN}=V_{OUT}+1V$ or $V_{IN}=2.5V$, $C_{IN}=1\mu F$, $C_{OUT}=4.7\mu F$, $T_A=25^{\circ}C$.

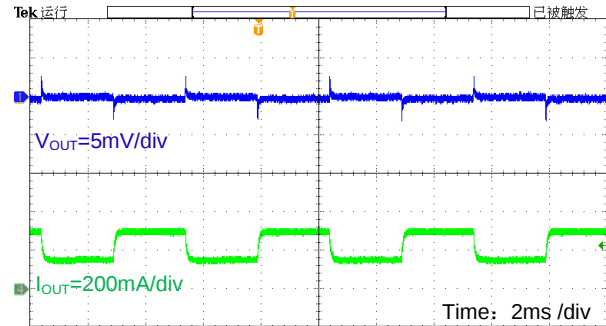
Load Transient

$V_{IN}=2.5V$, $V_{OUT}=0.9V$, $I_{OUT}=1mA$ to $300mA$



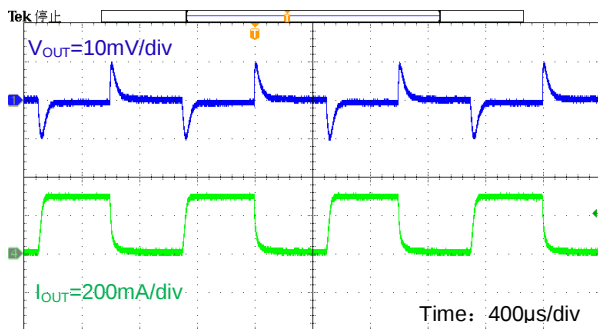
Load Transient

$V_{IN}=2.5V$, $V_{OUT}=0.9V$, $I_{OUT}=150mA$ to $300mA$



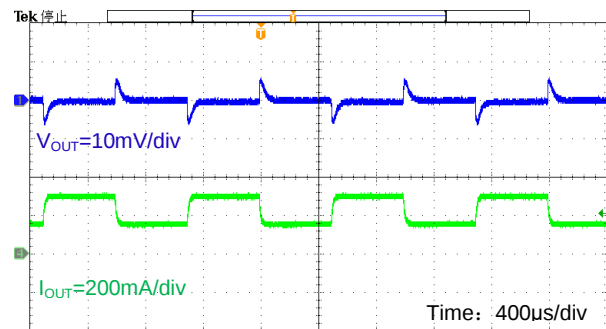
Load Transient

$V_{IN}=4.3V$, $V_{OUT}=3.3V$, $I_{OUT}=1mA$ to $300mA$



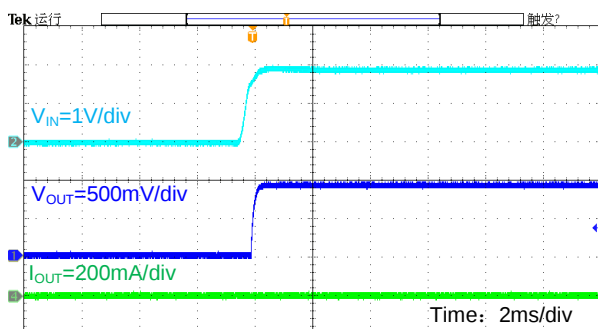
Load Transient

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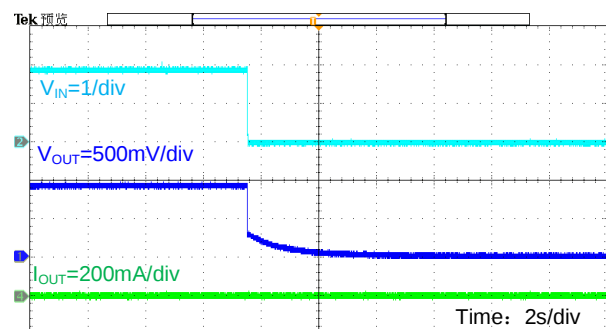
Input Power On

$V_{IN}=1.9V$, $V_{OUT}=0.9V$, $I_{OUT}=0mA$



Input Power Down

$V_{IN}=1.9V$, $V_{OUT}=0.9V$, $I_{OUT}=0mA$

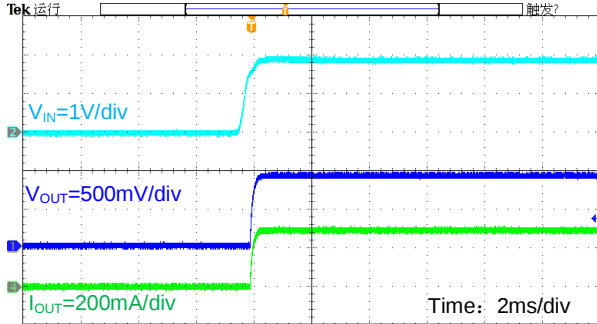


TYPICAL CHARACTERISTICS (continued)

$V_{IN}=V_{OUT}+1V$ or $V_{IN}=2.5V$, $C_{IN}=1\mu F$, $C_{OUT}=4.7\mu F$, $T_A=25^\circ C$.

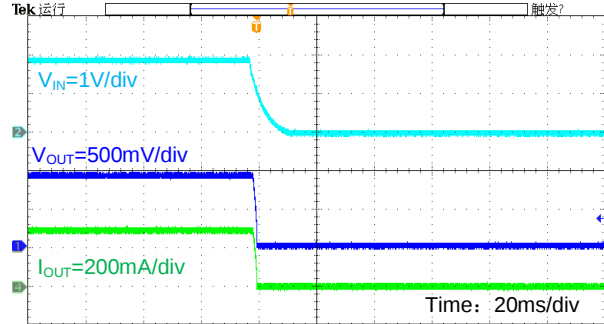
Input Power On

$V_{IN}=1.9V$, $V_{OUT}=0.9V$, $I_{OUT}=300mA$



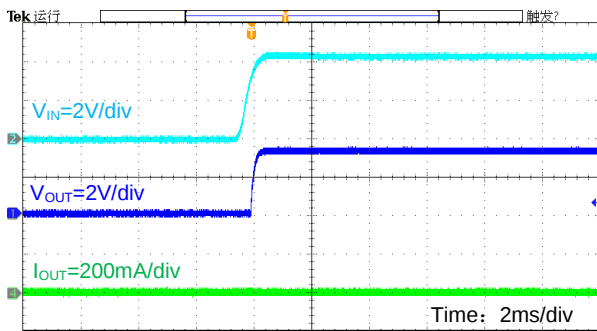
Input Power Down

$V_{IN}=1.9V$, $V_{OUT}=0.9V$, $I_{OUT}=300mA$



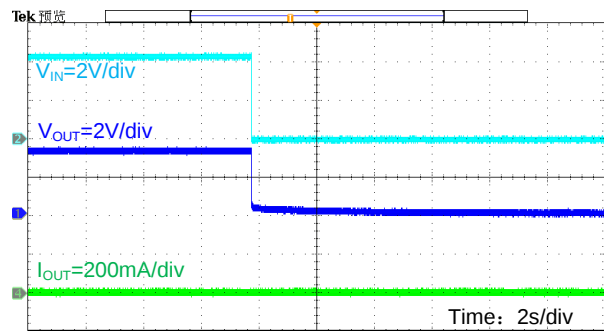
Input Power On

$V_{IN}=4.3V$, $V_{OUT}=3.3V$, $I_{OUT}=0mA$



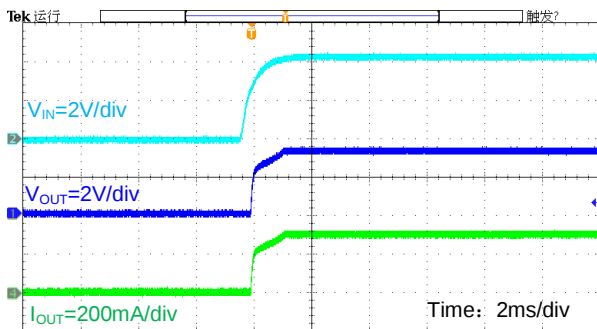
Input Power Down

$V_{IN}=4.3V$, $V_{OUT}=3.3V$, $I_{OUT}=0mA$



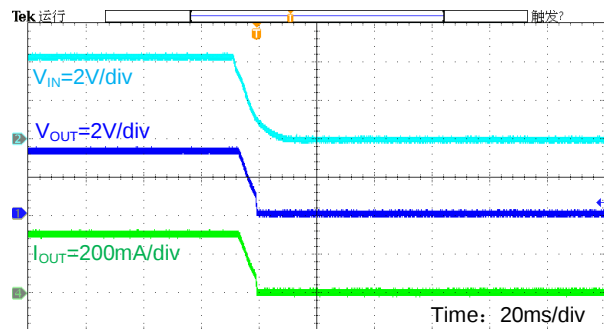
Input Power On

$V_{IN}=4.3V$, $V_{OUT}=3.3V$, $I_{OUT}=300mA$



Input Power Down

$V_{IN}=4.3V$, $V_{OUT}=3.3V$, $I_{OUT}=300mA$

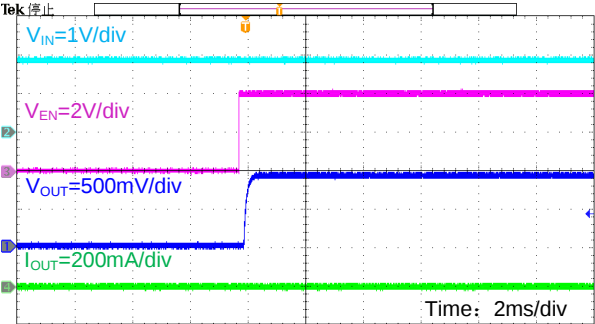


TYPICAL CHARACTERISTICS (continued)

$V_{IN}=V_{OUT}+1V$ or $V_{IN}=2.5V$, $C_{IN}=1\mu F$, $C_{OUT}=4.7\mu F$, $T_A=25^{\circ}C$.

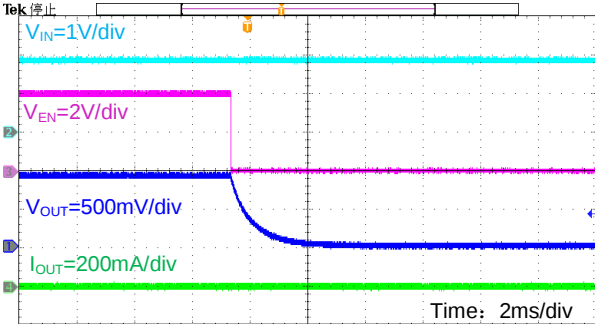
EN Enable

$V_{IN}=1.9V$, $V_{OUT}=0.9V$, $I_{OUT}=0mA$



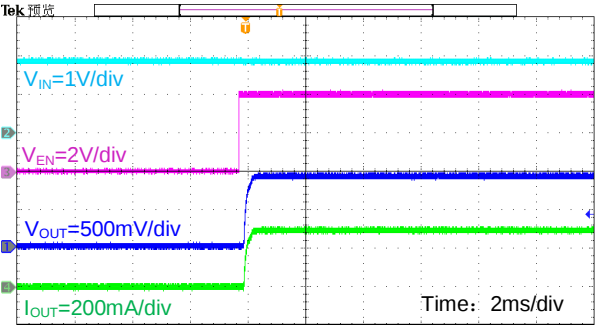
EN Disable

$V_{IN}=1.9V$, $V_{OUT}=0.9V$, $I_{OUT}=0mA$



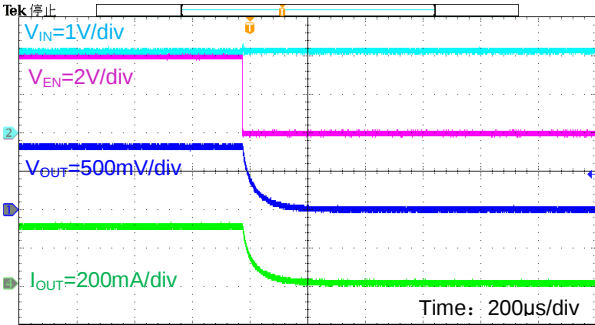
EN Enable

$V_{IN}=1.9V$, $V_{OUT}=0.9V$, $I_{OUT}=300mA$



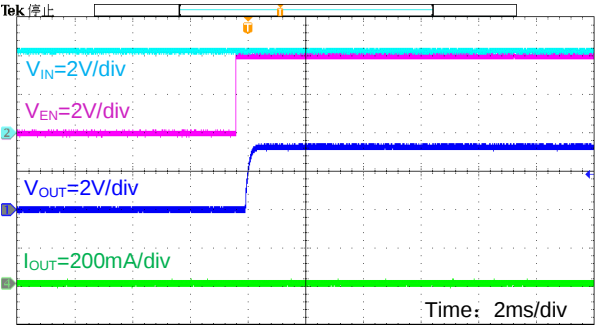
EN Disable

$V_{IN}=1.9V$, $V_{OUT}=0.9V$, $I_{OUT}=300mA$



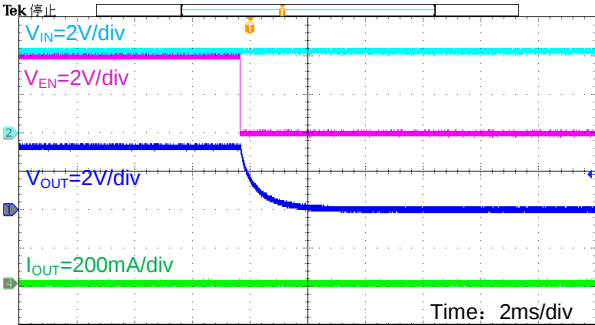
EN Enable

$V_{IN}=4.3V$, $V_{OUT}=3.3V$, $I_{OUT}=0mA$



EN Disable

$V_{IN}=4.3V$, $V_{OUT}=3.3V$, $I_{OUT}=0mA$

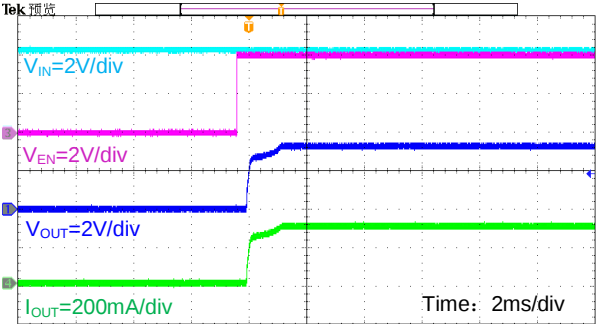


TYPICAL CHARACTERISTICS (continued)

$V_{IN}=V_{OUT}+1V$ or $V_{IN}=2.5V$, $C_{IN}=1\mu F$, $C_{OUT}=4.7\mu F$, $T_A=25^{\circ}C$.

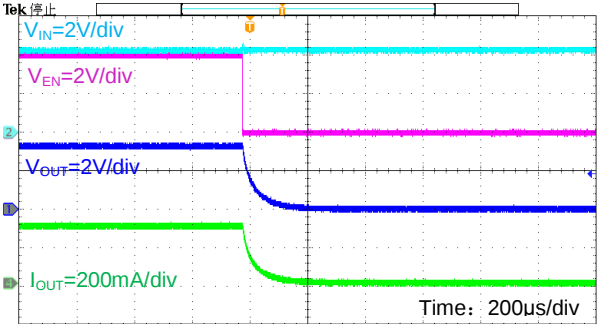
EN Enable

$V_{IN}=4.3V$, $V_{OUT}=3.3V$, $I_{OUT}=300mA$

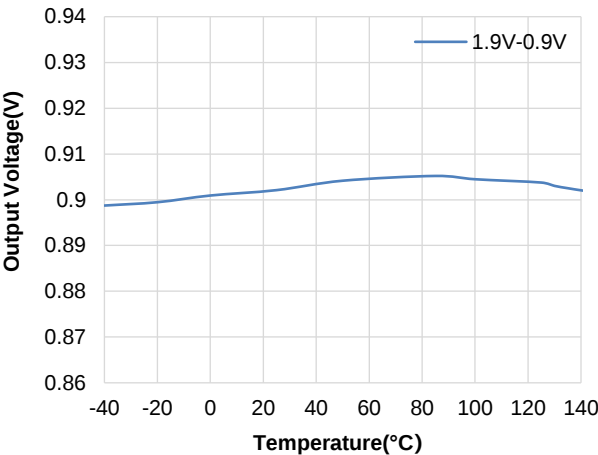


EN Disable

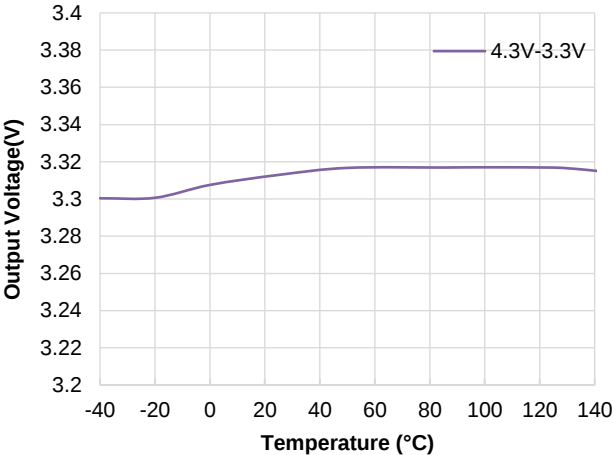
$V_{IN}=4.3V$, $V_{OUT}=3.3V$, $I_{OUT}=300mA$



Output Voltage Temperature Curve



Output Voltage Temperature Curve



Application Information

Input capacitor

A 1 μ F or higher capacitance value ceramic capacitor is required between the V_{IN} pin and the GND pin. Place it as close as possible to the device. There are no requirements for the ESR on the input capacitor, but the tolerance and temperature coefficient must be considered. The ceramic capacitor with 1 μ F or larger rating capacitance, X5R or X7R type dielectrics and 0603 or larger size is recommended as input capacitor.

Output capacitor

An output capacitor (C_{OUT}) is needed to improve transient response and maintain stability. The TMI6036-XX and TMI6036D-XX are stable with very small ceramic output capacitors. A 4.7 μ F to 10 μ F capacitor is suitable for the most TMI6036-XX and TMI6036D-XX applications. For typical application, the ceramic capacitor with 4.7 μ F or larger rating capacitance, X5R or X7R type dielectrics and 0603 or larger size is recommended as output capacitor.

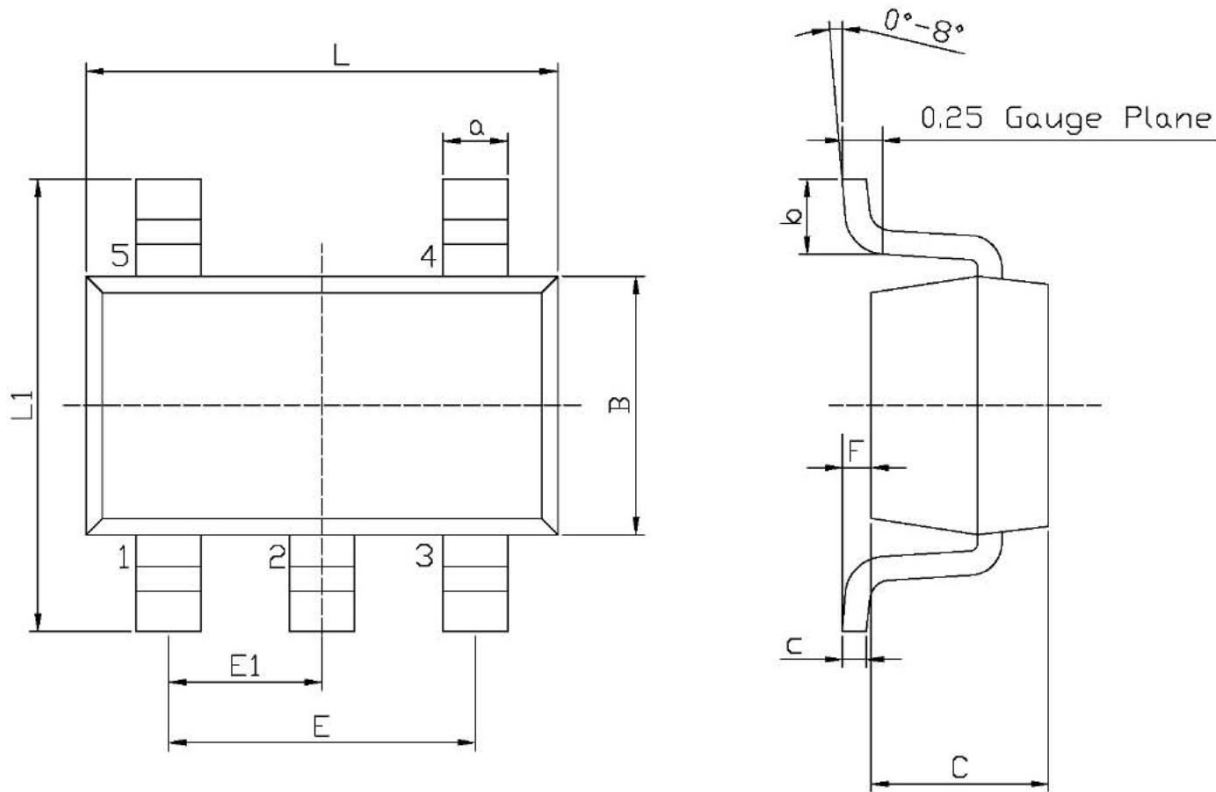
Layout Consideration

PCB layout is very important to achieve good regulation, ripple rejection, transient response and thermal performance. It is highly recommended to duplicate PCB layout for optimum performance. If change is necessary, please follow these guidelines and take PCB for reference.

- 1) Input and output bypass ceramic capacitors are suggested to be put close to the V_{IN} pin and V_{OUT} pin respectively.
- 2) Connect V_{IN} pin, V_{OUT} pin and especially GND respectively to a large copper area to cool the chip to improve thermal performance and long-term reliability.

Package Information

SOT23-5



Unit: mm

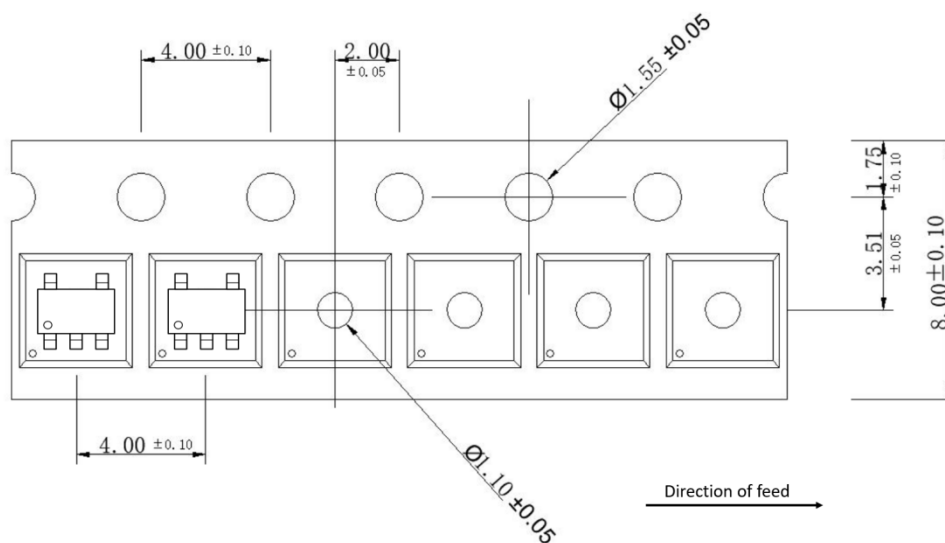
Symbol	Dimensions In Millimeters		Symbol	Dimensions In Millimeters	
	Min	Max		Min	Max
L	2.82	3.02	E1	0.85	1.05
B	1.50	1.70	a	0.35	0.50
C	0.90	1.30	c	0.10	0.20
L1	2.60	3.00	b	0.35	0.55
E	1.80	2.00	F	0	0.15

Note:

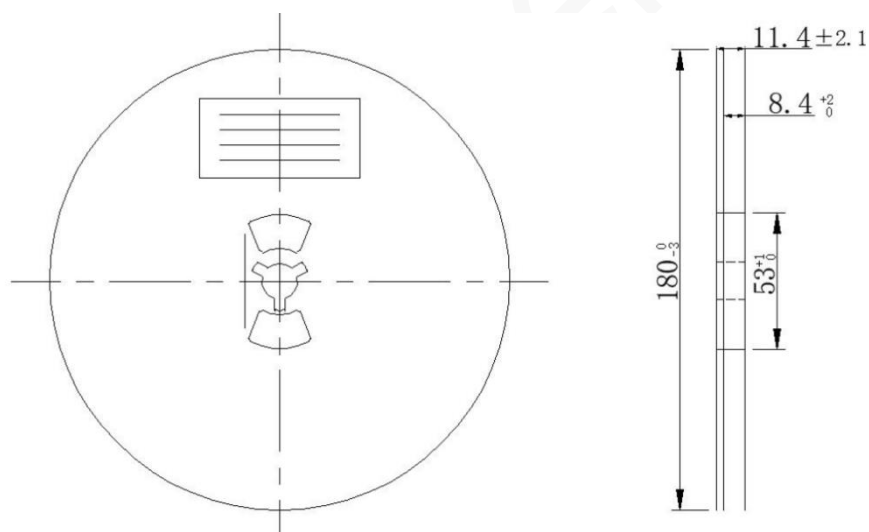
- 1) All dimensions are in millimeters.
- 2) Package length does not include mold flash, protrusion or gate burr.
- 3) Package width does not include inter lead flash or protrusion.
- 4) Lead popularity (bottom of leads after forming) shall be 0.10 millimeters max.
- 5) Pin 1 is lower left pin when reading top mark from left to right.

TAPE AND REEL INFORMATION

TAPE DIMENSIONS: SOT23-5



REEL DIMENSIONS: SOT23-5

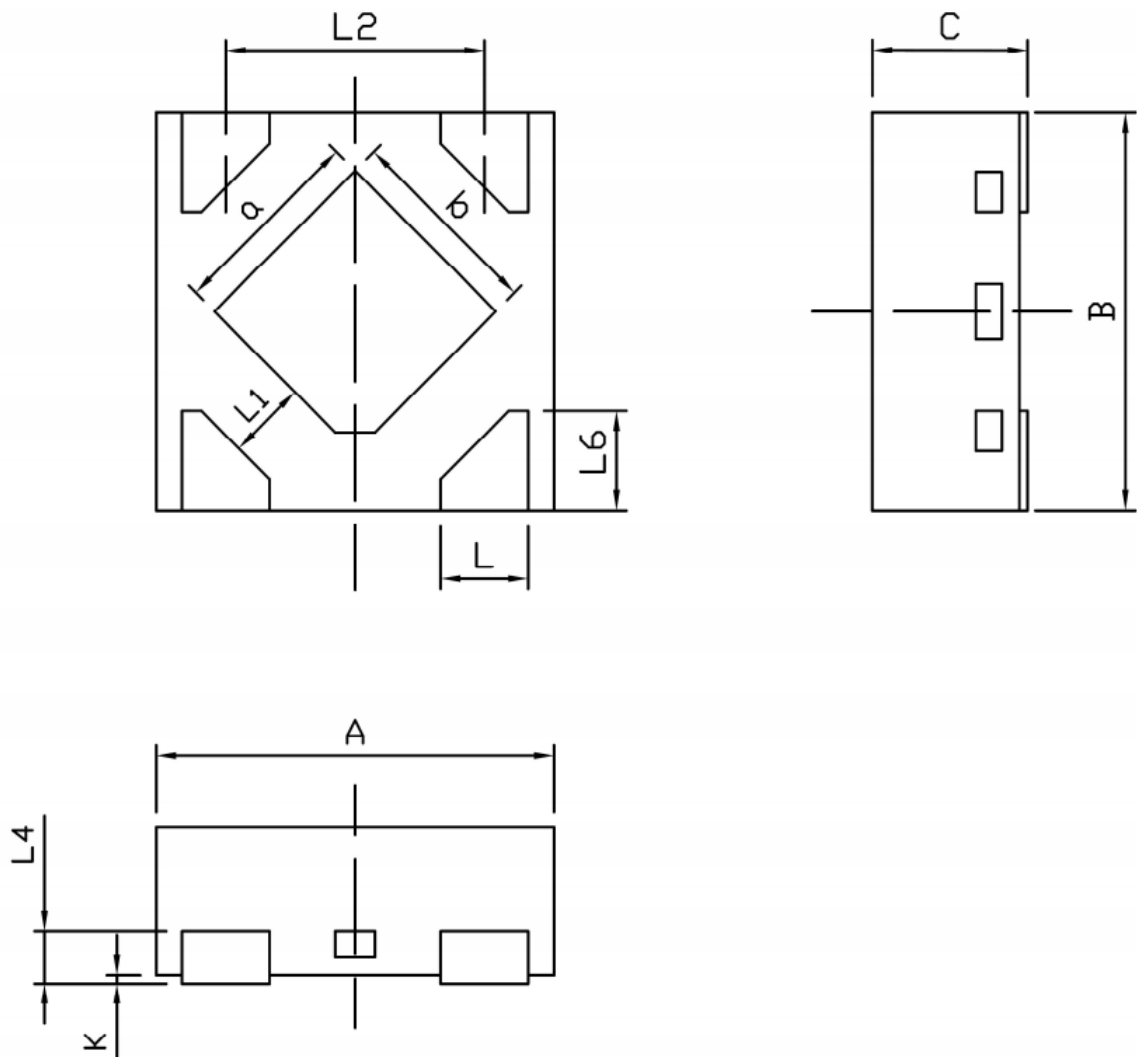


Note:

- 1) All Dimensions are in Millimeter
- 2) Quantity of Units per Reel is 3000
- 3) MSL level is level 3.

Package Information

DFN1×1-4



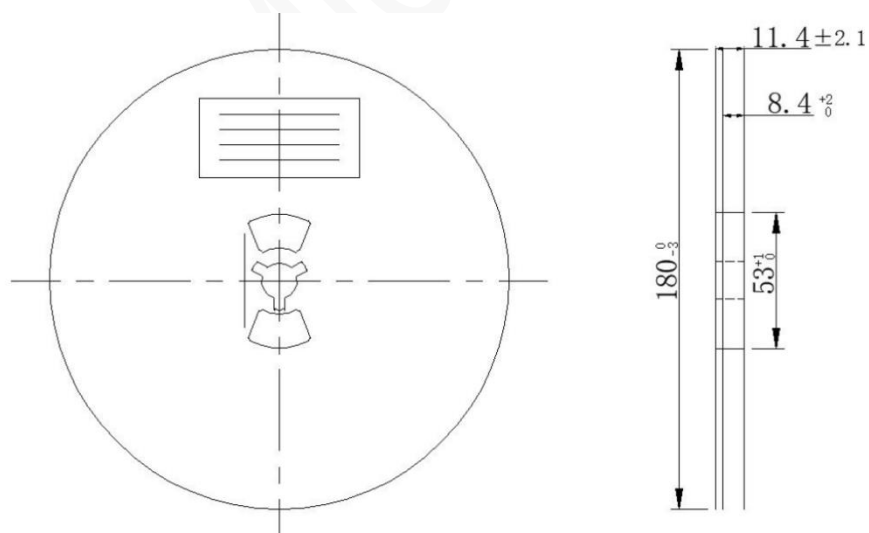
Unit: mm

Symbol	Dimensions In Millimeters			Symbol	Dimensions In Millimeters		
	Min	Nom	Max		Min	Nom	Max
A	0.95	1.00	1.05	L4		0.10	
B	0.95	1.00	1.05	L6	0.20	0.25	0.30
C	0.34	0.37	0.40	K	0.00	0.02	0.05
L	0.17	0.22	0.27	a	0.43	0.48	0.53
L1	0.15			b	0.43	0.48	0.53
L2		0.65					

Note:

1) All dimensions are in millimeters.

TAPE DIMENSIONS: DFN1x1-4



- 4) All Dimensions are in Millimeter
- 5) Quantity of Units per Reel is 10000
- 6) MSL level is level 3.

Important Notification

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