



YOUSHANG SEMICONDUCTOR

设计研发新型功率器件

各类小信号开关

中低压及高压大电流等场效应管

0755-83047638

ysbdt@szyoushang.cn

www.szyoushang.cn



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Description

The NK-AP7315 is a low dropout regulator with high output voltage accuracy, low $R_{DS(ON)}$, high PSRR, low output noise, and low quiescent current. This regulator is based on a CMOS process.

The NK-AP7315 includes a voltage reference, error amplifier, current limit circuit, and an enable input to turn it on and off. With the integrated resistor network fixed output voltage versions can be delivered.

With its low power consumption and line and load transient response, the NK-AP7315 is well suited for low power handheld communication equipment.

The AP7315 is packaged in X2-DFN1010-4, SOT23, and SOT25 packages and allows for the smallest footprint and a dense PCB layout.

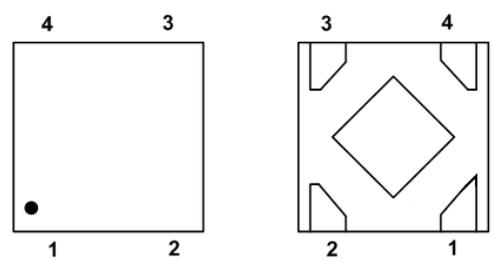
Features

- Low V_{IN} and Wide V_{IN} Range: 1.7V to 5.25V
- Guarantee Output Current, 150mA
- V_{OUT} Accuracy $\pm 1\%$
- Ripple Rejection 75dB at 1kHz
- Low Output Noise, 60 μ Vrms from 10Hz to 100kHz
- Quiescent Current as Low as 35 μ A
- V_{OUT} Fixed 1.1V to 3.3V

Applications

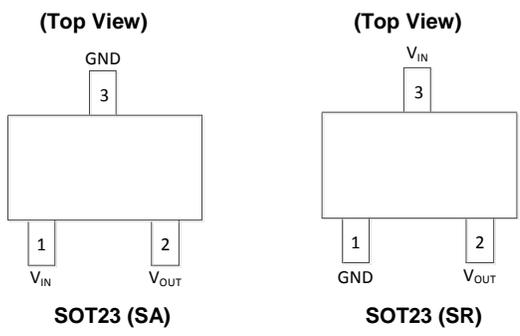
- Smart Phone/PAD
- RF Supply
- Cameras
- Portable Videos
- Portable Media Players
- Wireless Adapters
- Wireless Communication

Pin Assignments

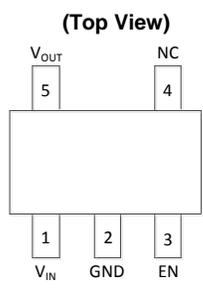


Top View X2-DFN1010-4 Bottom View

Pin 1 – V_{OUT} , Pin 2 – GND, Pin 3 – EN, Pin 4 – V_{IN}

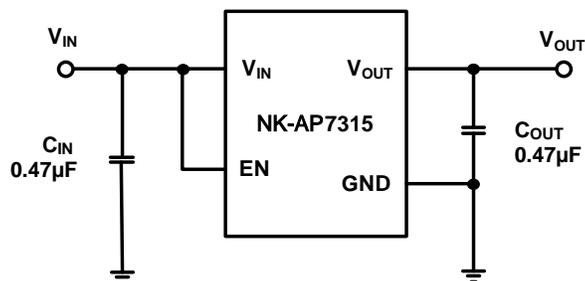


SOT23 (SA) SOT23 (SR)



SOT25

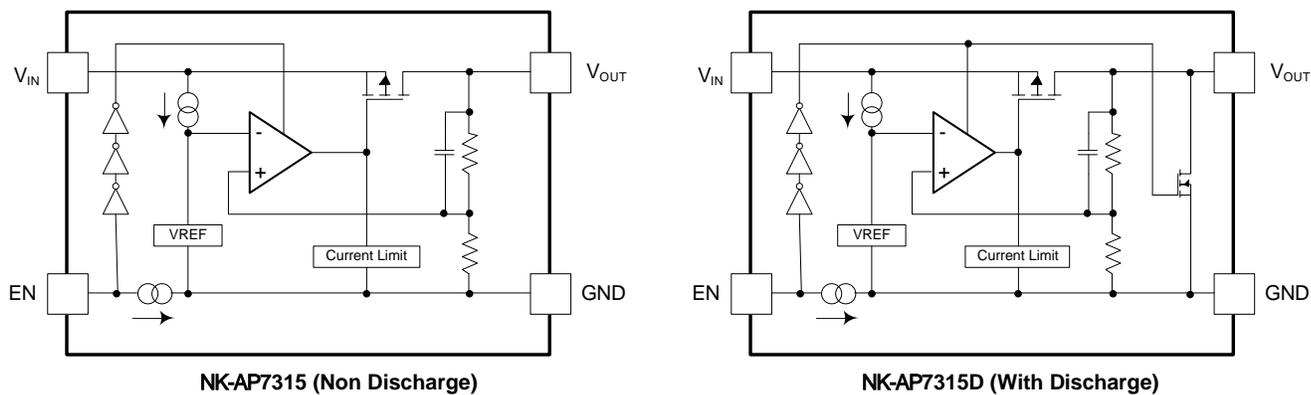
Typical Applications Circuit



Pin Descriptions

Pin Name	Pin Number				Function
	X2-DFN1010-4	SOT25	SOT23 (SA)	SOT23 (SR)	
V _{OUT}	1	5	2	2	Power output pin
GND	2	2	3	1	Ground
EN	3	3	—	—	Enable Pin This pin should be driven either high or low and must not be floating. Driving this pin high enables the regulator, while pulling it low puts the regulator into shutdown mode
V _{IN}	4	1	1	3	Power input pin
—	Thermal PAD	—	—	—	In PCB layout, prefer to use large copper area to cover this pad for better thermal dissipation, then connect this area to GND or leave it open. However, do not use it as GND electrode function alone.
NC	—	4	—	—	Not Connected internally. Recommend connection to GND to maximize PCB copper for thermal dissipation.

Functional Block Diagram



Absolute Maximum Ratings (Note 4) (@ $T_A = +25^\circ\text{C}$, unless otherwise specified.)

Symbol	Parameter	Ratings	Unit
V_{IN}	Input Voltage	6.0	V
V_{EN}	Input Voltage EN	6.0	V
V_{OUT}	Output Voltage	-0.3 to $V_{IN} + 0.3$	V
I_{OUT}	Output Current	300	mA
P_D	Power Dissipation	400	mW
T_A	Operating Ambient Temperature	-40 to +85	$^\circ\text{C}$
T_{STG}	Storage Temperature	-55 to +125	$^\circ\text{C}$

- Note:
4. a). 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 conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
 - b). Ratings apply to ambient temperature at +25 $^\circ\text{C}$. The JEDEC High-K board design used to derive this data is a 2in. x 2in. multi-layer board with 1oz. internal power and ground planes and 2oz. copper traces on the top and bottom of the board.

Recommended Operating Conditions (@ $T_A = +25^\circ\text{C}$, unless otherwise specified.)

Symbol	Parameter	Min	Max	Unit
V_{IN}	Input Voltage	1.7	5.25	V
I_{OUT}	Output Current	0	150	mA
T_A	Operating Ambient Temperature	-40	+85	$^\circ\text{C}$

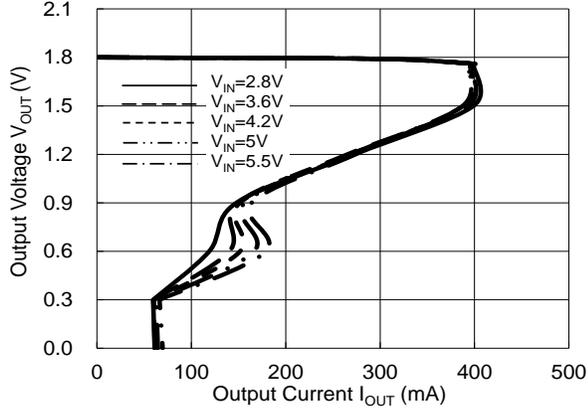
Electrical Characteristics ($V_{EN} = V_{IN} = V_{OUT} + 1.0V$, $C_{IN} = C_{OUT} = 0.47\mu F$, $I_{OUT} = 1.0mA$ @ $T_A = +25^\circ C$, unless otherwise specified.)

Parameter	Conditions	Min	Typ	Max	Units		
Input Voltage	$T_A = -40^\circ C$ to $+85^\circ C$	1.7	—	5.25	V		
Output Voltage Accuracy (Note 11)	$V_{OUT} \geq 2.0V$, $V_{IN} = V_{OUT} + 1V$, $T_A = +25^\circ C$	$V_{OUT} * 0.99$	V_{OUT}	$V_{OUT} * 1.01$	V		
	$V_{OUT} < 2.0V$, $V_{IN} = V_{OUT} + 1V$, $T_A = +25^\circ C$	$V_{OUT} - 20mV$	V_{OUT}	$V_{OUT} + 20mV$	V		
Line Regulation ($dV_{OUT}/dV_{IN}/V_{OUT}$)	$V_{IN} = (V_{OUT} - Nom + 1.0V)$ to $5.25V$, $I_{OUT} = 1.0mA$	—	0.02	0.1	%/V		
Load Regulation ($dV_{OUT}/V_{OUT}/dI_{OUT}$)	$V_{IN} = V_{OUT} - Nom + 1.0V$, $I_{OUT} = 1mA$ to $150mA$	—	0.5	1.0	%/A		
Quiescent Current (Note 6)	$I_{OUT} = 0mA$	20	35	60	μA		
	$I_{OUT} = 150mA$	30	60	100			
$I_{STANDBY}$	$V_{EN} = 0V$ (Disabled)	—	0.01	1.0	μA		
Output Current	—	150	—	—	mA		
Fold-back Short Current (Note 7)	V_{OUT} Short to Ground	—	55	—	mA		
PSRR (Note 8)	$V_{IN} = (V_{OUT} + 1V)V_{DC} + 0.2Vp-pAC$, $V_{OUT} \geq 1.8V$, $I_{OUT} = 30mA$		$f = 1kHz$	—	75	—	dB
Output Noise Voltage (Notes 8, 9)	$BW = 10Hz$ to $100kHz$, $I_{OUT} = 30mA$	—	60	—	μV_{rms}		
Dropout Voltage (Note 5)	$I_{OUT} = 150mA$	$1.1V \leq V_{OUT} < 1.5V$	—	0.50	0.64	V	
		$1.5V \leq V_{OUT} < 1.7V$	—	0.38	0.49		
		$1.7V \leq V_{OUT} < 2.0V$	—	0.34	0.44		
		$2.0V \leq V_{OUT} < 2.5V$	—	0.28	0.38		
		$2.5V \leq V_{OUT} < 2.8V$	—	0.22	0.32		
		$2.8V \leq V_{OUT} \leq 3.3V$	—	0.21	0.29		
Output Voltage Temperature Coefficient	$I_{OUT} = 30mA$, $T_A = -40^\circ C$ to $+85^\circ C$	—	± 30	—	ppm/ $^\circ C$		
EN Input Low Voltage	—	0	—	0.5	V		
EN Input High Voltage	—	1.3	—	5.25	V		
EN Input Leakage	$V_{EN} = 0$, $V_{IN} = 5.0V$ or $V_{EN} = 5.0V$, $V_{IN} = 0V$	-1.0	—	+1.0	μA		
On Resistance of N-channel for Auto-Discharge (Note 10)	$V_{IN} = 4.0V$ $V_{EN} = 0V$ (Disabled)	—	30	—	Ω		

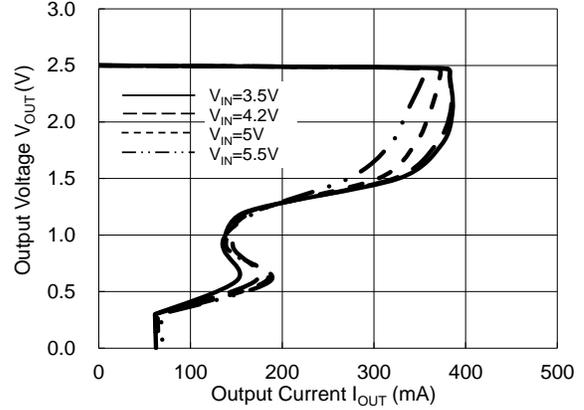
- Notes:
- Dropout voltage is the voltage difference between the input and the output at which the output voltage drops 2% below its nominal value.
 - Quiescent current is defined here is the difference in current between the input and the output.
 - Short circuit current is measured with V_{OUT} pulled to GND.
 - This specification is guaranteed by design.
 - To make sure lowest environment noise minimizes the influence on noise measurement.
 - NK-AP7315 has 2 options for output, built-in discharge and non-discharge.
 - Potential multiple grades based on following output voltage accuracy.

Typical Characteristics

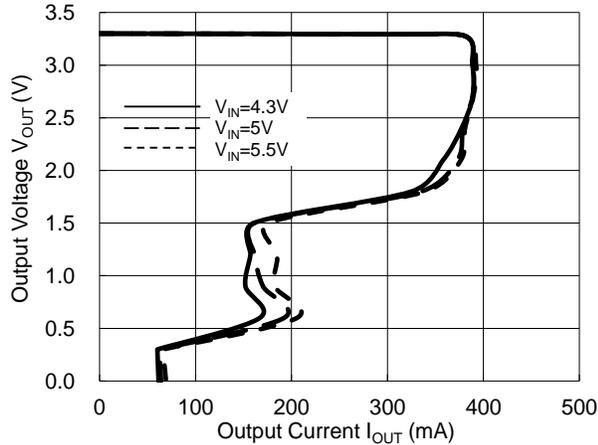
Output Voltage vs. Output Current
NK-AP7315-18



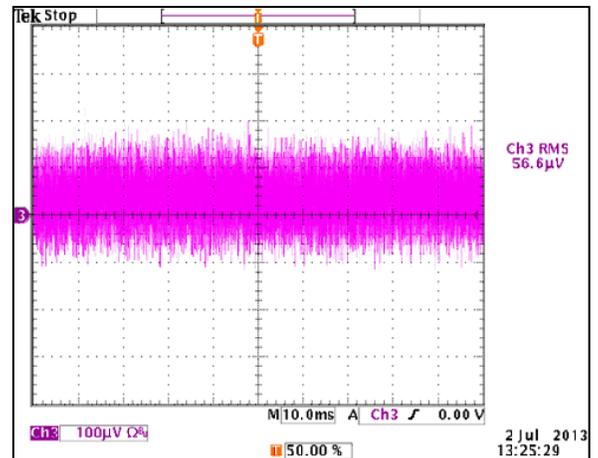
Output Voltage vs. Output Current
NK-AP7315-25



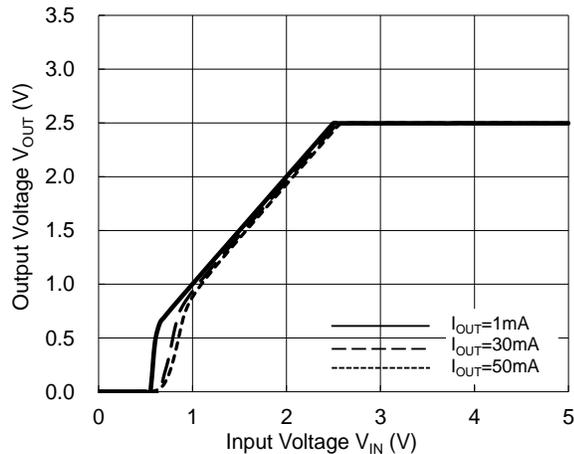
Output Voltage vs. Output Current
NK-AP7315-33



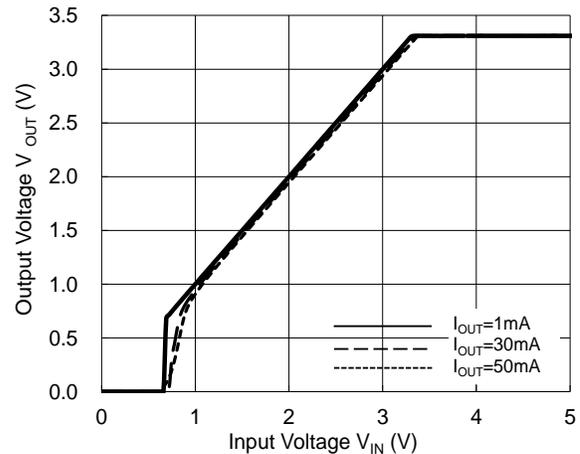
Output Noise (NK-AP7315-33)



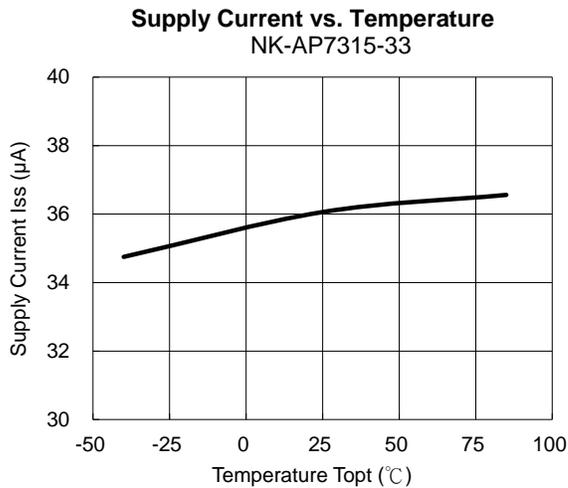
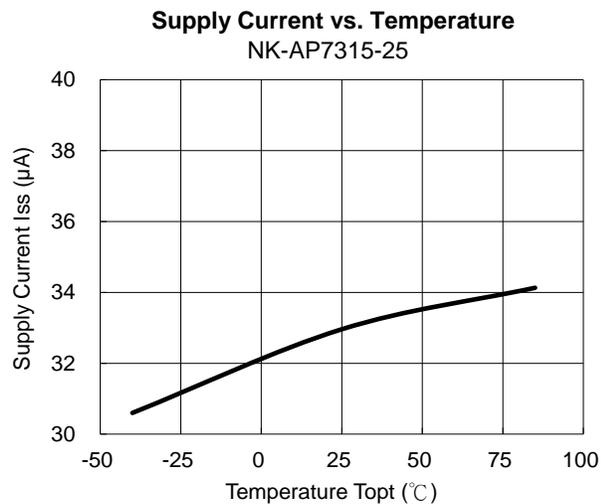
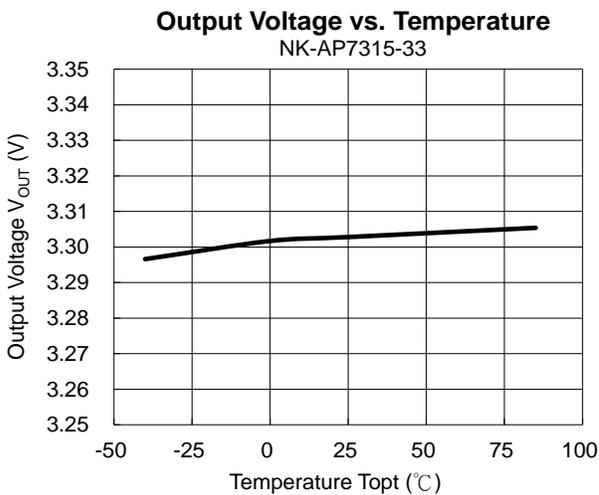
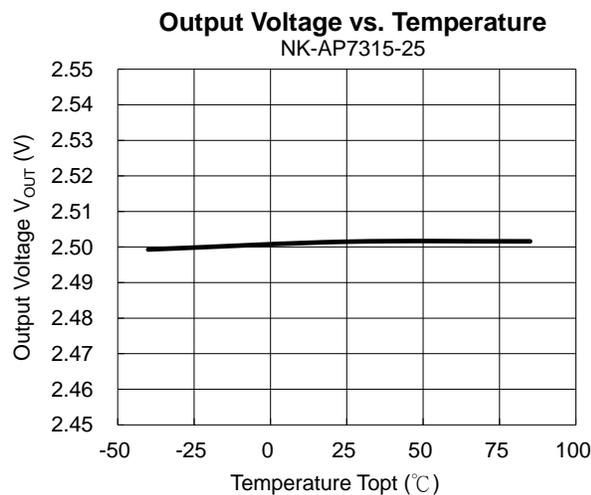
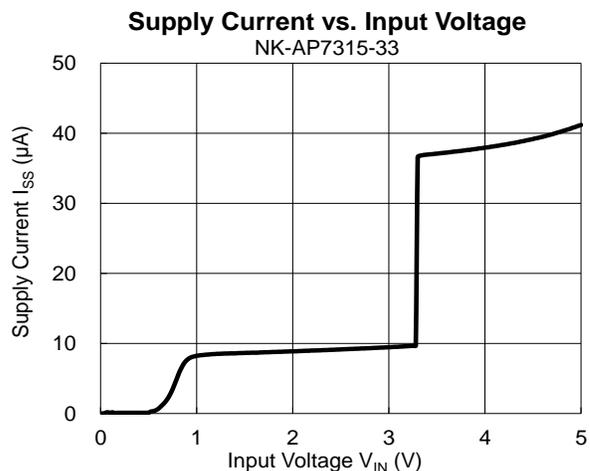
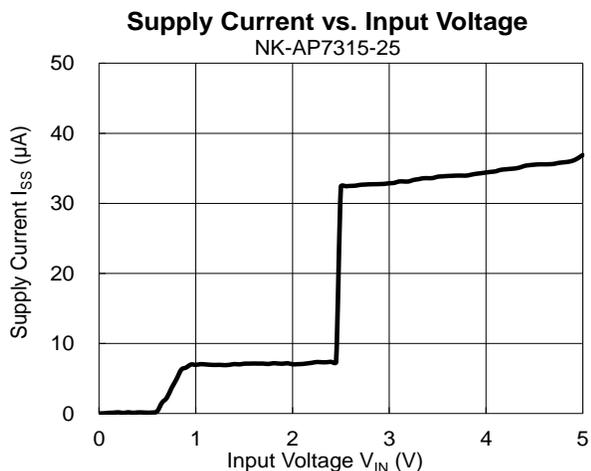
Output Voltage vs. Input Voltage
NK-AP7315-25



Output Voltage vs. Input Voltage
NK-AP7315-33

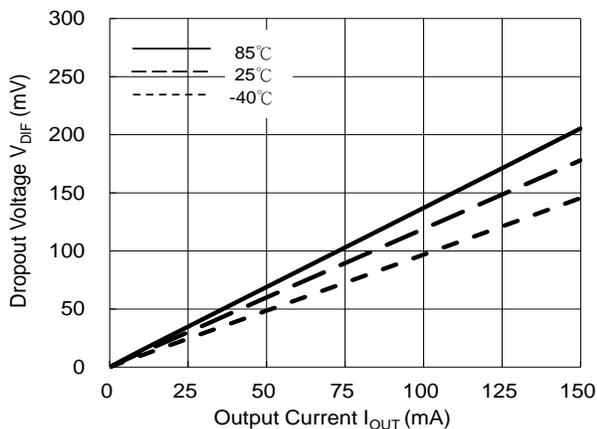


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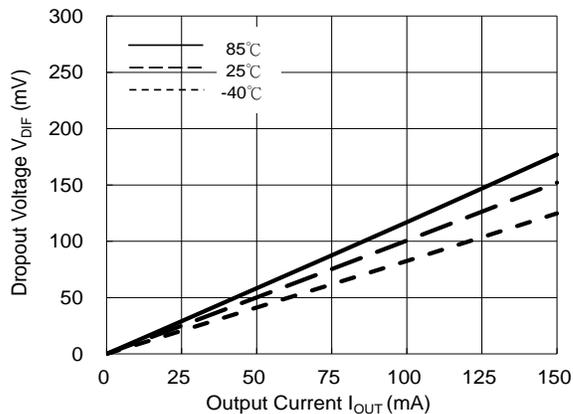


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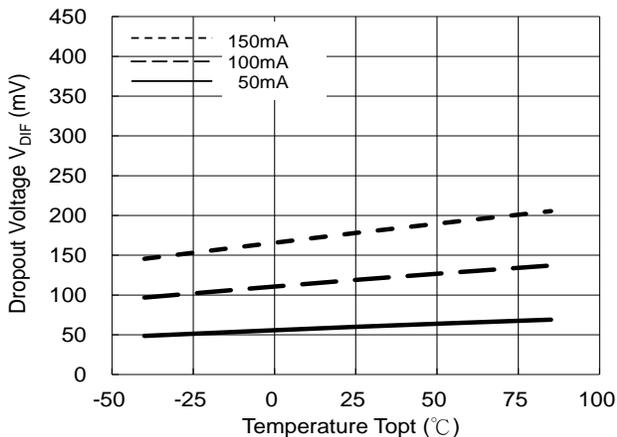
Dropout Voltage vs. Output Current
NK-AP7315-25



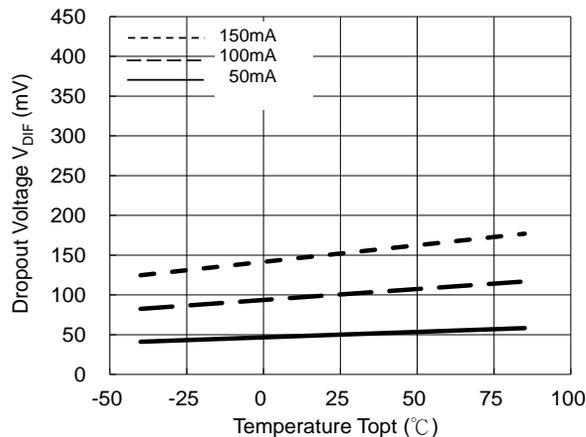
Dropout Voltage vs. Output Current
NK-AP7315-33



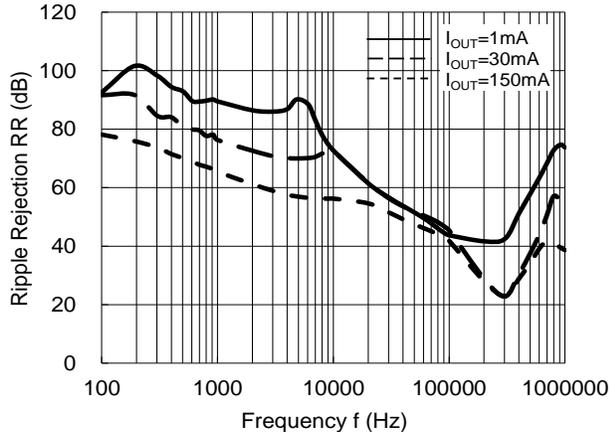
Dropout Voltage vs. Temperature
NK-AP7315-25



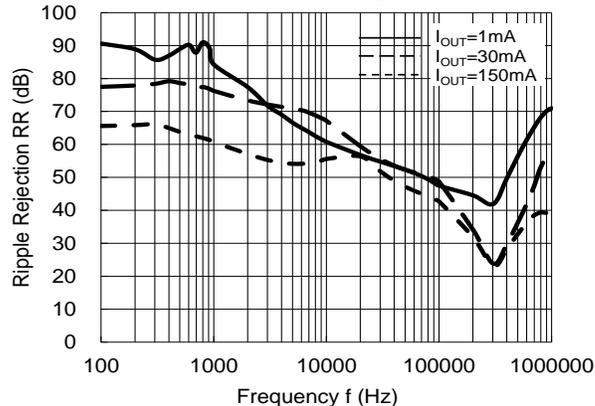
Dropout Voltage vs. Temperature
NK-AP7315-33



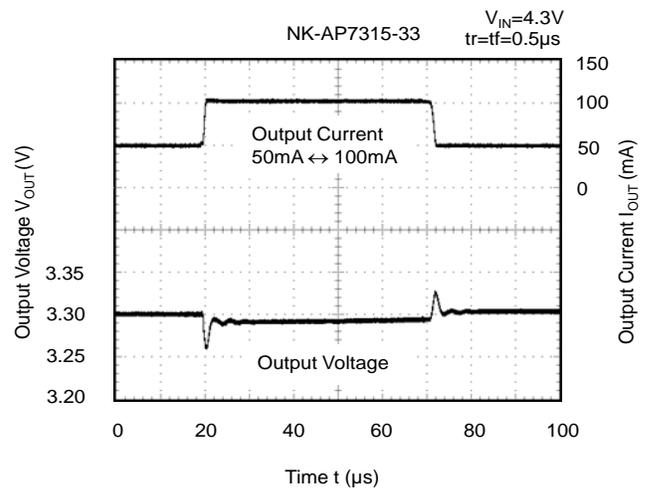
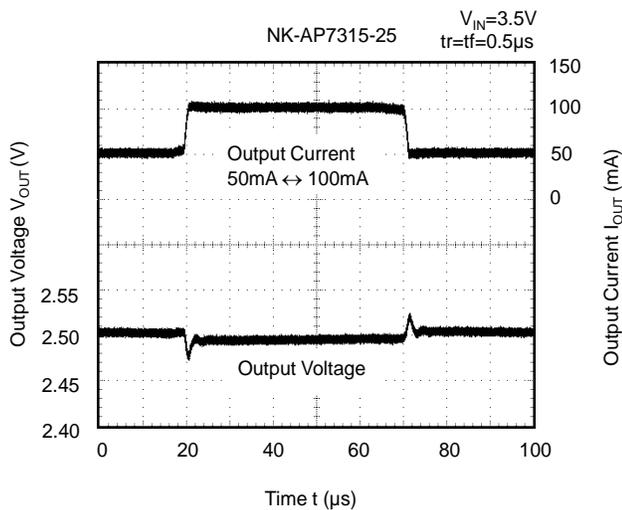
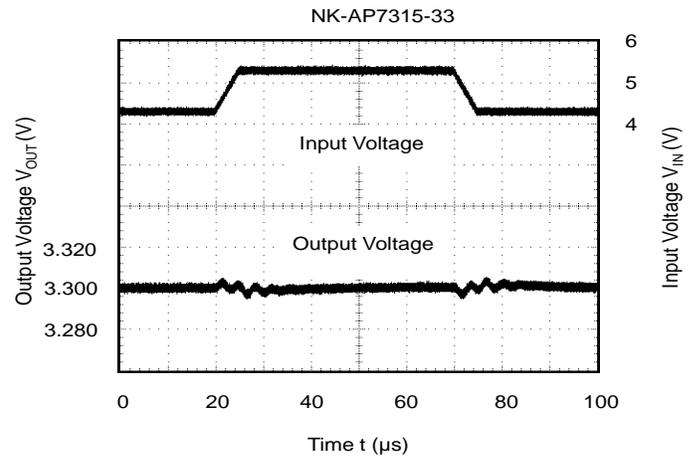
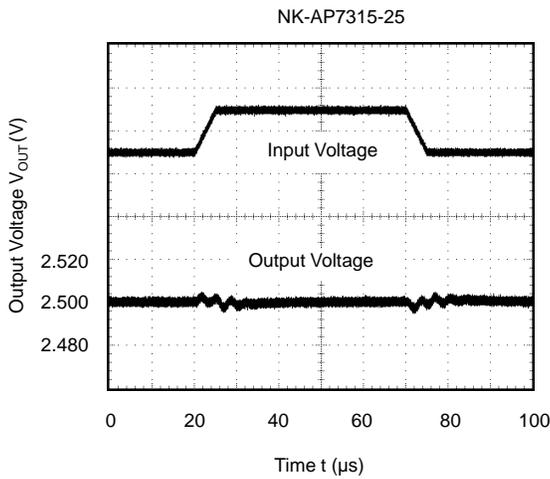
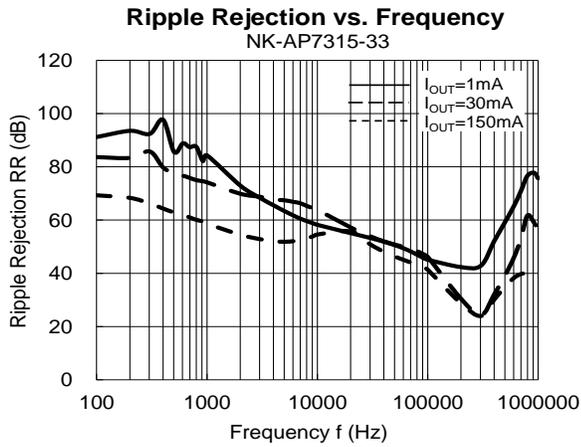
Ripple Rejection vs. Frequency
NK-AP7315-18



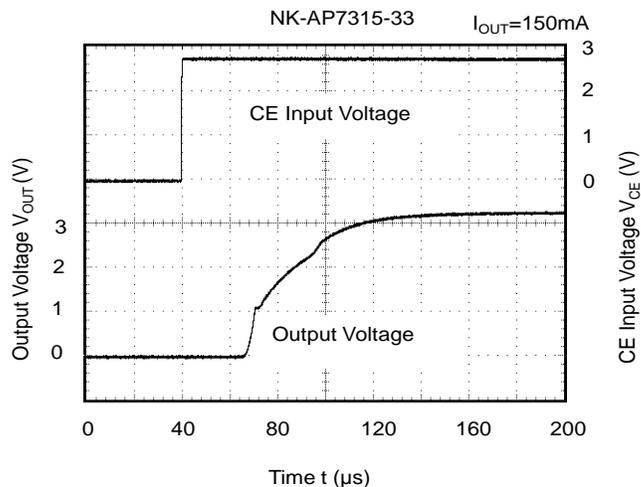
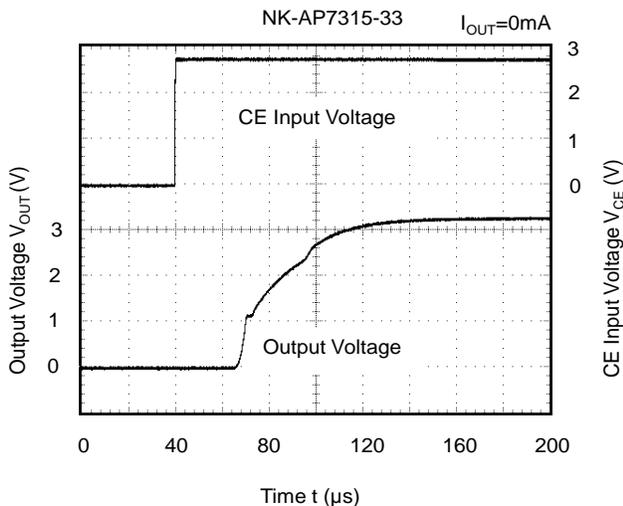
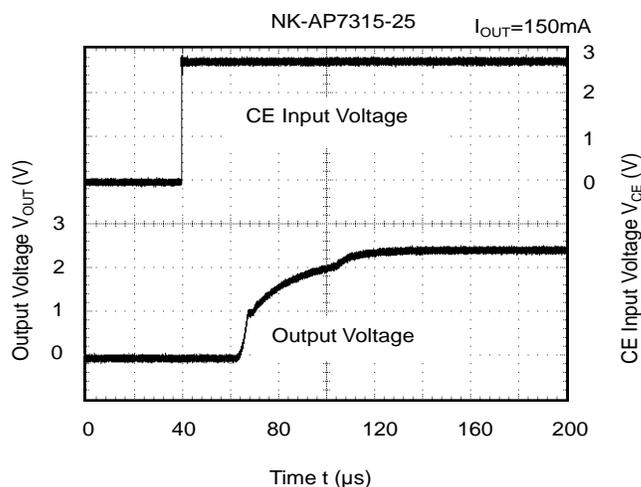
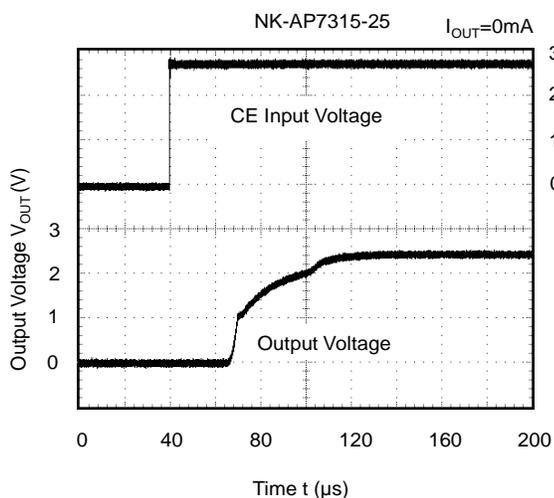
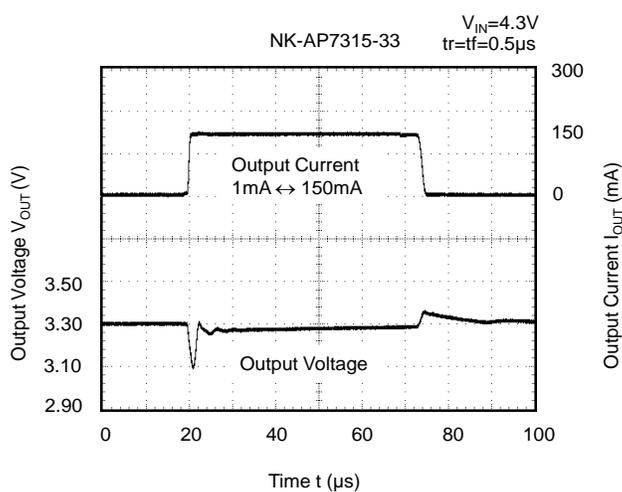
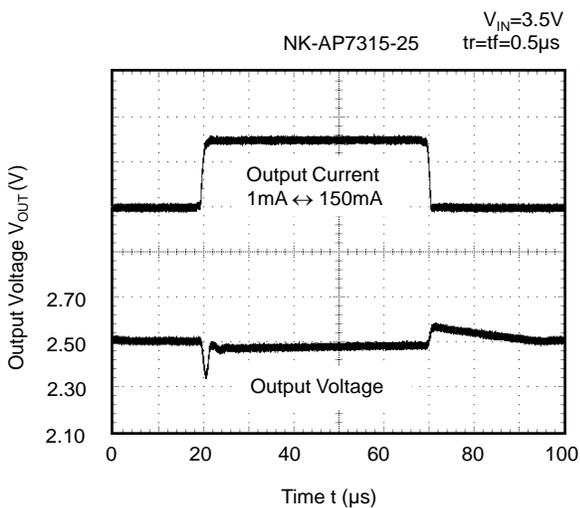
Ripple Rejection vs. Frequency
NK-AP7315-25



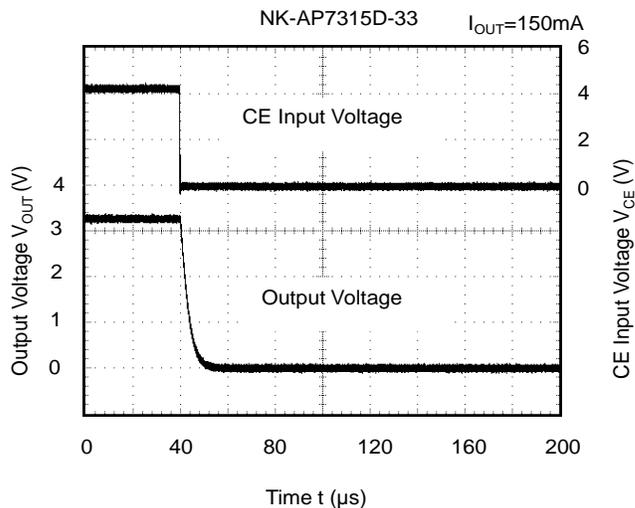
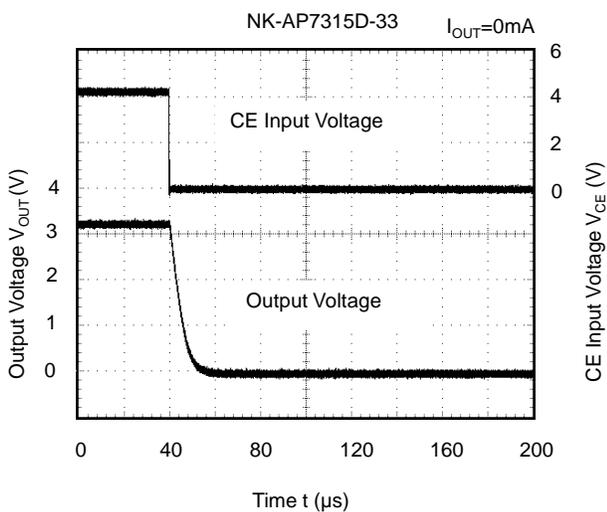
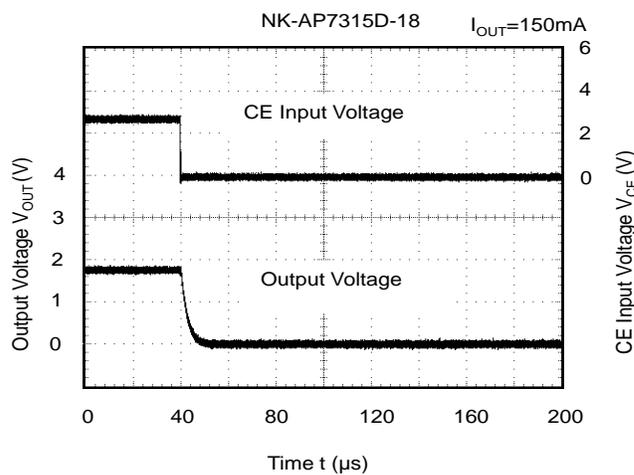
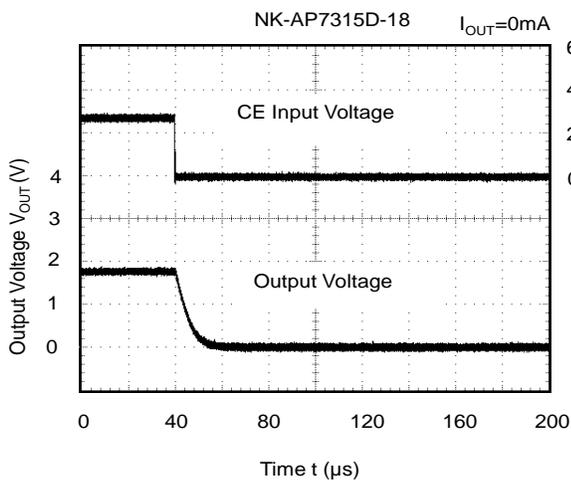
Typical Characteristics (Continued)



Typical Characteristics (Continued)



Typical Characteristics (Continued)



Application Information

Output Capacitor

An output capacitor (C_{OUT}) is needed to improve transient response and maintain stability. The NK-AP7315 is stable with very small ceramic output capacitors. The ESR (equivalent series resistance) and capacitance drives the selection. If the application has large load variations, it is recommended to utilize low-ESR bulk capacitors. It is recommended to place ceramic capacitors as close as possible to the load and the ground pin and care should be taken to reduce the impedance in the layout.

Input Capacitor

To prevent the input voltage from dropping during load steps, it is recommended to utilize an input capacitor (C_{IN}). A minimum $0.47\mu\text{F}$ ceramic capacitor is recommended between V_{IN} and GND pins to decouple input power supply glitch. This input capacitor must be located as close as possible to the device to assure input stability and reduce noise. For PCB layout, a wide copper trace is required for both V_{IN} and GND pins.

Enable Control

The NK-AP7315 is turned on by setting the EN pin high, and is turned off by pulling it low. If this feature is not used, the EN pin should be tied to V_{IN} pin to keep the regulator output on at all time. To ensure proper operation, the signal source used to drive the EN pin must be able to swing above and below the specified turn-on/off voltage thresholds listed in the Electrical Characteristics section.

Short Circuit Protection

When V_{OUT} pin is short-circuit to GND, short circuit protection will be triggered and clamp the output current to approximately 60mA. This feature protects the regulator from overcurrent and damage due to overheating.

Layout Considerations

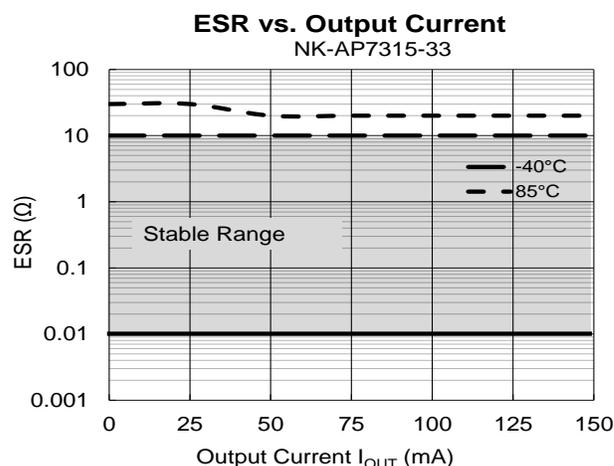
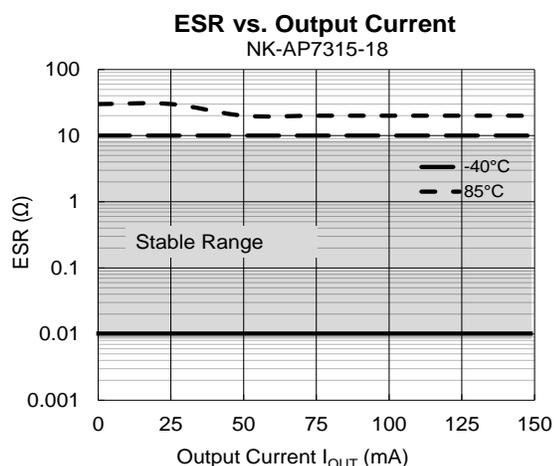
For good ground loop and stability, the input and output capacitors should be located close to the V_{IN} , V_{OUT} , and GND pins of the device. The regulator GND pin should be connected to the external circuit ground to reduce voltage drop caused by trace impedance. Ground plane is generally used to reduce trace impedance. Wide trace should be used for large current paths from V_{IN} to V_{OUT} , and load circuit.

ESR vs. Output Current

Ceramic type output capacitor is recommended for this series; however, the other output capacitors with low ESR also can be used. The relations between I_{OUT} (Output Current) and ESR of an output capacitor are shown below. The stable region is marked as the hatched area in the graph.

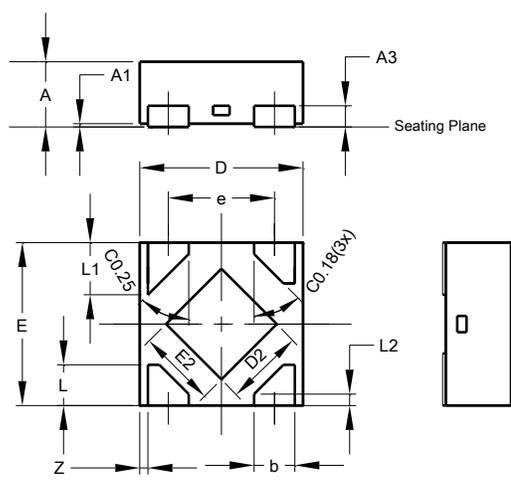
Measurement conditions:

Frequency Band: 10Hz to 2MHz, Temperature: -40°C to $+85^{\circ}\text{C}$



Package Outline Dimensions

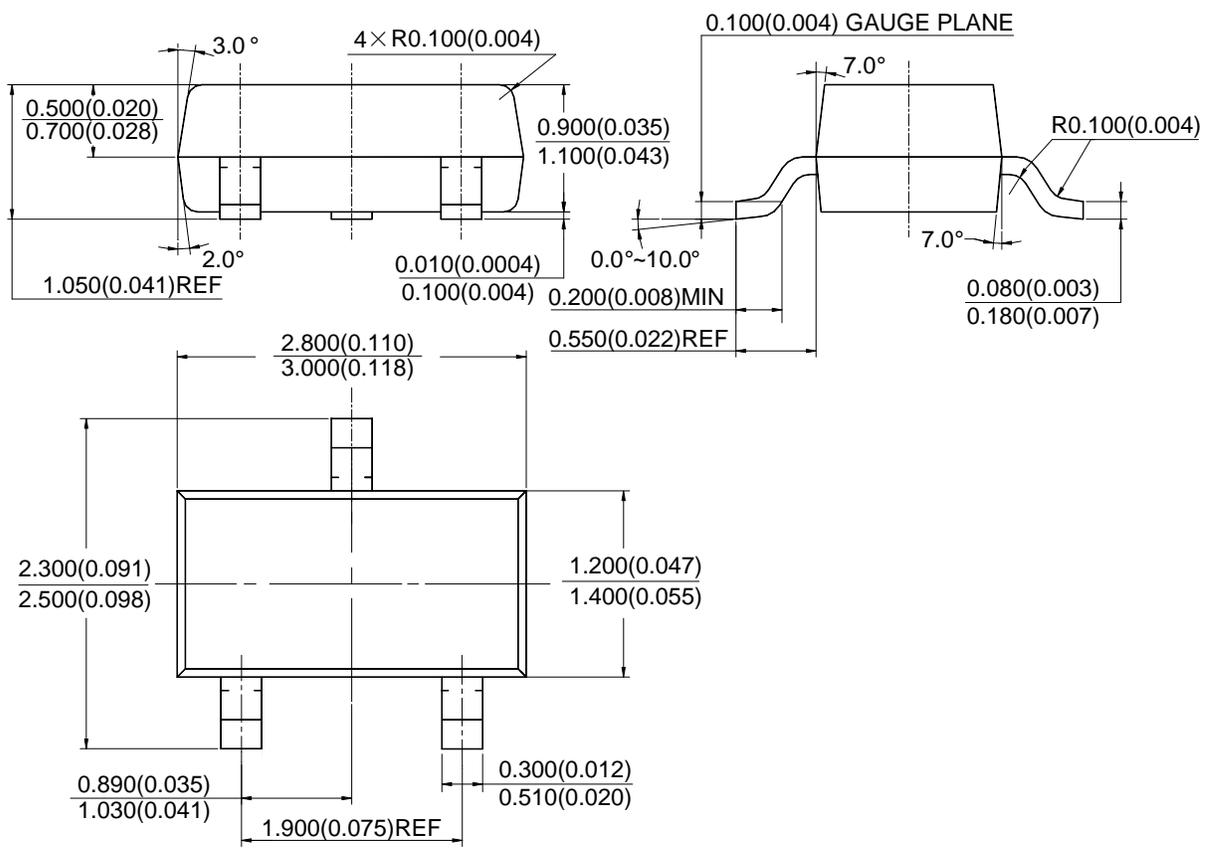
(1) Package Type: X2-DFN1010-4



X2-DFN1010-4			
Dim	Min	Max	Typ
A	-	0.40	0.39
A1	0.00	0.05	0.02
A3	-	-	0.13
b	0.20	0.30	0.25
D	0.95	1.05	1.00
D2	0.38	0.58	0.48
E	0.95	1.05	1.00
E2	0.38	0.58	0.48
e	-	-	0.65
L	0.20	0.30	0.25
L1	0.27	0.37	0.32
L2	0.02	0.12	0.07
Z	-	-	0.050
All Dimensions in mm			

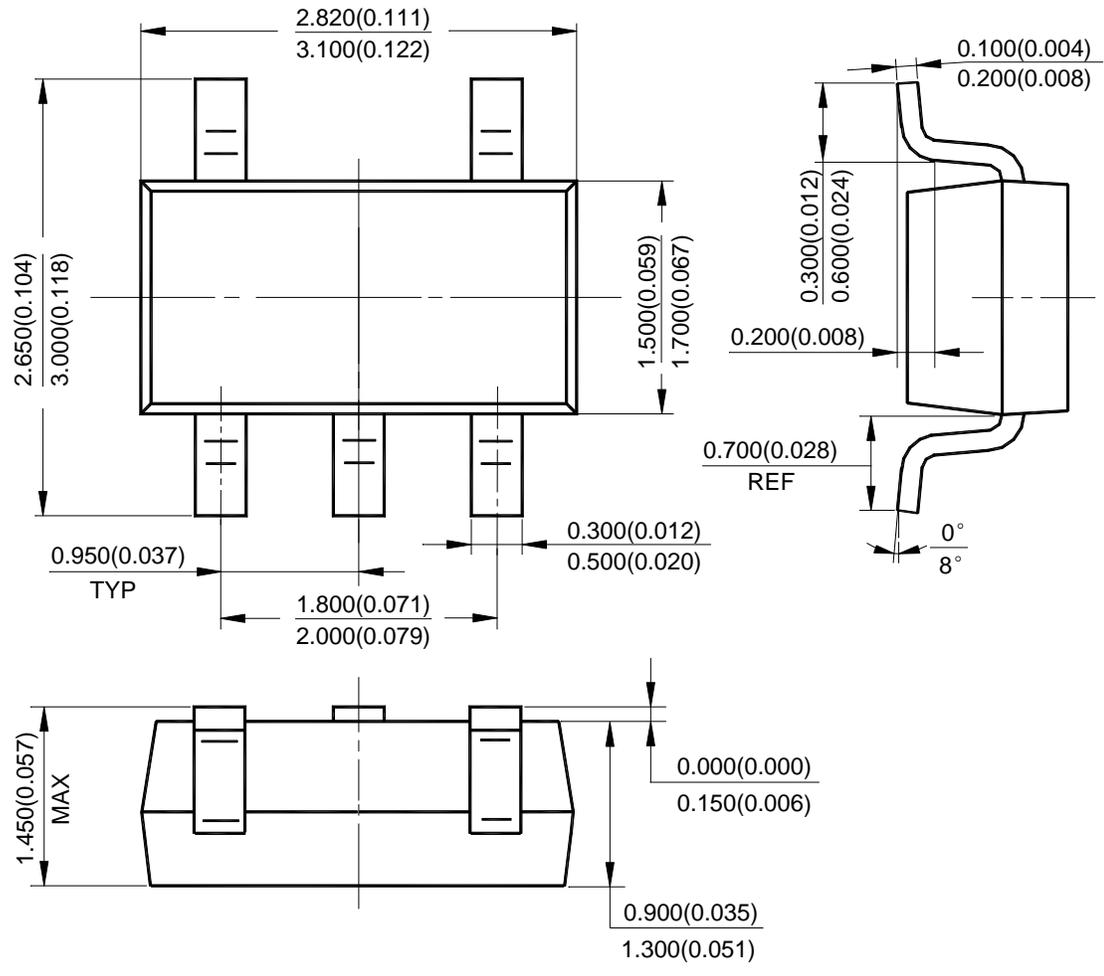
Package Outline Dimensions (All dimensions in mm.)

(2) Package Type: SOT23



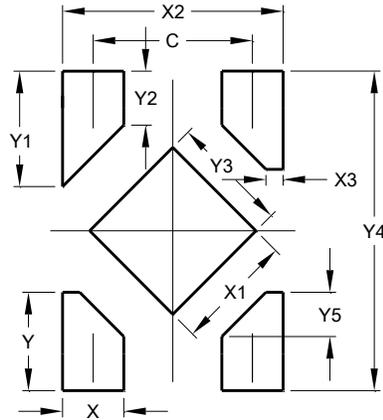
Package Outline Dimensions (All dimensions in mm.)

(3) Package Type: SOT25



Suggested Pad Layout

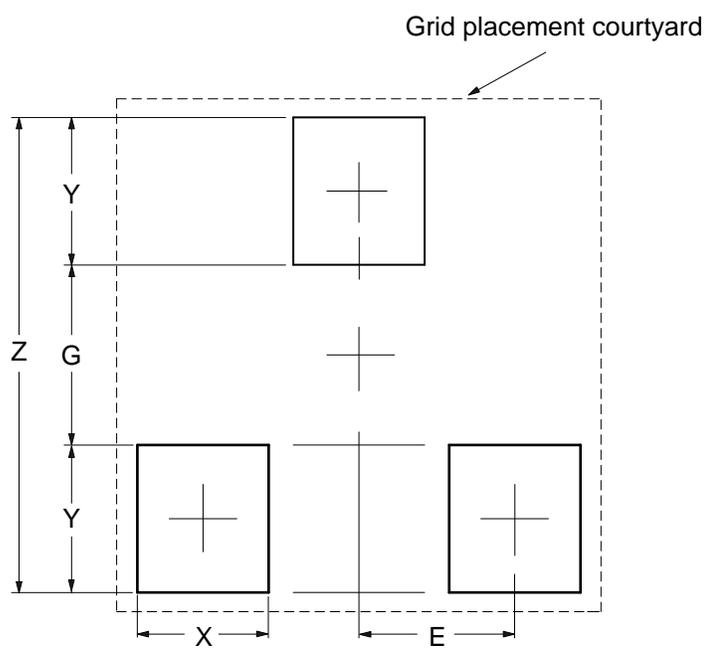
(1) Package Type: X2-DFN1010-4



Dimensions	Value (in mm)
C	0.650
X	0.250
X1	0.480
X2	0.900
X3	0.070
Y	0.400
Y1	0.470
Y2	0.220
Y3	0.480
Y4	1.300
Y5	0.180

Suggested Pad Layout (Continued)

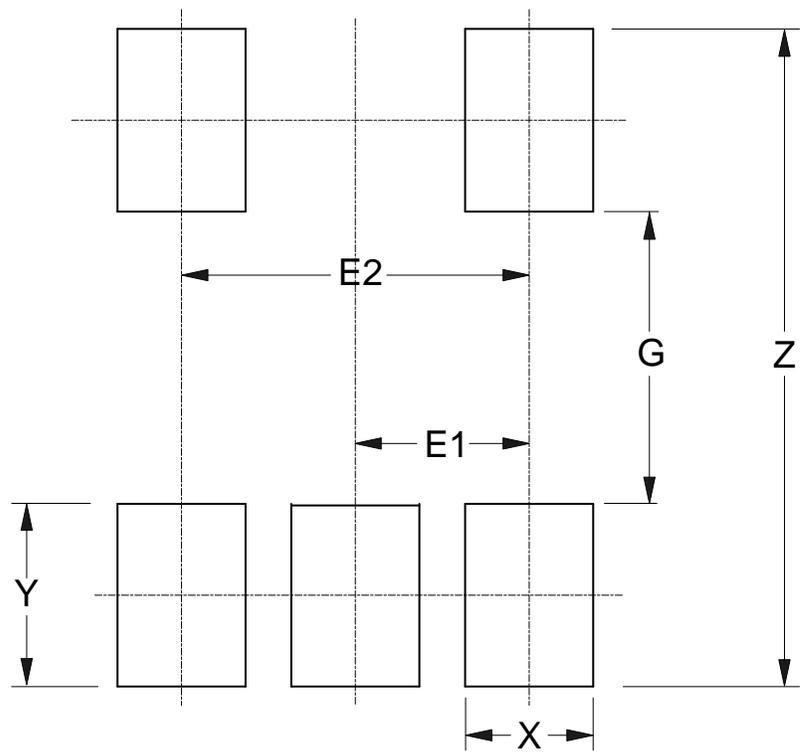
(2) Package Type: SOT23



Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E (mm)/(inch)
Value	2.900/0.114	1.100/0.043	0.800/0.031	0.900/0.035	0.950/0.037

Suggested Pad Layout (Continued)

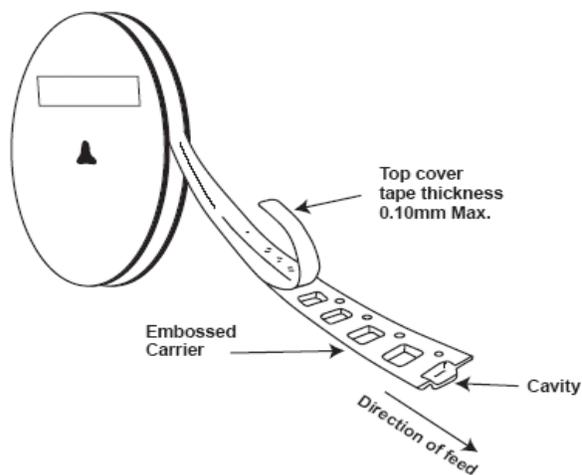
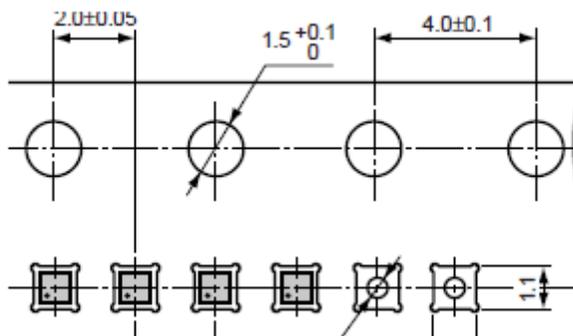
(3) Package Type: SOT25



Dimensions	Z (mm)/(inch)	G (mm)/(inch)	X (mm)/(inch)	Y (mm)/(inch)	E1 (mm)/(inch)	E2 (mm)/(inch)
Value	3.600/0.142	1.600/0.063	0.700/0.028	1.000/0.039	0.950/0.037	1.900/0.075

Tape Orientation

For NK-AP7315-XXXFS4-7B & NK-AP7315D-XXXFS4-7B



Mechanical Data

- Moisture Sensitivity: Level 1 Per J-STD-020
- Terminals:
 - SOT23, SOT25: Finish - Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 [Ⓔ]
 - X2-DFN1010-4: Finish - NiPdAu over Copper Leads, Solderable per MIL-STD-202, Method 208 [Ⓔ]
- Weight:
 - SOT23: 0.009 grams (Approximate)
 - SOT25: 0.016 grams (Approximate)
 - X2-DFN1010-4 (Type B): 0.001 grams (Approximate)