



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

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Description

The NK-AP7354 is a low dropout regulator with high output voltage accuracy. The NK-AP7354 includes a voltage reference, error amplifier, current limit circuit, and an enable input to turn it on/off. With the integrated resistor network, fixed output voltage versions can be delivered.

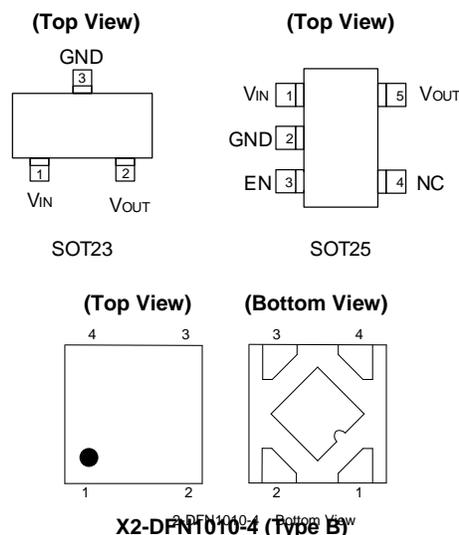
With its ultra-low quiescent current, the NK-AP7354 is well-suited for low-power handheld, wearable devices, and other battery-operated devices requiring an extended time period until new battery replacement.

The NK-AP7354 is available in SOT23, SOT25, and X2-DFN1010-4 (Type B) packages.

Features

- Wide V_{IN} Range: 2.0V to 5.5V
- Guarantee Output Current: 150mA
- Output Voltage Range: 1.1V to 4.5V
- V_{OUT} Accuracy: $\pm 1\%$
- Quiescent Current as Low as 0.25 μ A
- Output Discharge Available for Devices in SOT25 or X2-DFN1010-4 (Type B)
- Typical Standby Current: 0.02 μ A
- ESD Protection Exceeds JESD 22
 - Exceeds 4000V Human Body Model (A114)
 - Exceeds 400V Machine Model (A115)
- Latch-Up Exceeds 400mA per JESD 78, Class I
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals:
 - SOT23/SOT25: Finish - Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208^(e3)
 - X2-DFN1010-4 (Type B): Finish - NiPdAu over Copper Leads, Solderable per MIL-STD-202, Method 208^(e4)
- Weight:
 - SOT23: 0.009 grams (Approximate)
 - SOT25: 0.016 grams (Approximate)
 - X2-DFN1010-4 (Type B): 0.001 grams (Approximate)

Pin Assignments

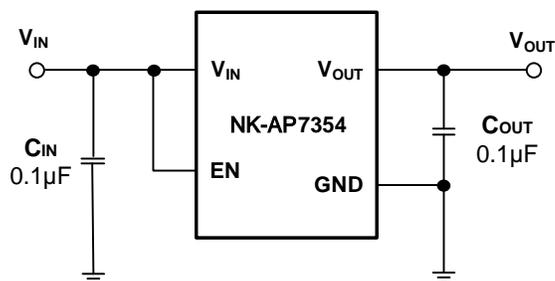


Pin 1 – V_{OUT} , Pin 2 – GND, Pin 3 – EN, Pin 4 – V_{IN}

Applications

- Wearable Electronics
- Sensor Module for Internet-of-Things (IoT)
- Wireless Communication Module
- Battery-Operated Device
- Camera
- Image Sensor

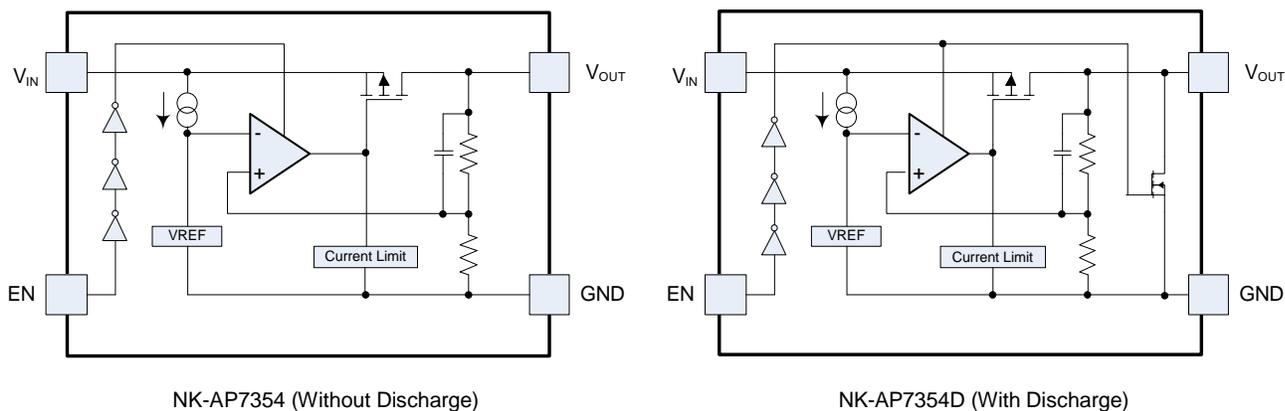
Typical Applications Circuit (Note 4)



Pin Description

Pin Number			Pin Name	Function
SOT25	SOT23	X2-DFN1010-4 (Type B)		
3	—	3	EN	Chip Enable — This should be driven either high or low and must not be floating. Driving EN high enables regulator output, while pulling it low places regulator into shutdown mode.
2	3	2	GND	Ground
5	2	1	V _{OUT}	Output Voltage
1	1	4	V _{IN}	Power Input
—	—	Center Pad	—	No connection or ground. Note: Chip Ground must be through GND pin.

Functional Block Diagram



EN Pin Not Available on SOT23

Absolute Maximum Ratings (Note 5)

Symbol	Parameter	Rating	Unit
ESD HBM	Human Body Model ESD Protection	4	kV
ESD MM	Machine Model ESD Protection	400	V
V _{IN}	Input Voltage	6.0	V
V _{EN}	Input Voltage at EN Pin	6.0	V
V _{OUT}	Output Voltage to GND	-0.3 to V _{IN} +0.3	V
T _A	Operating Ambient Temperature	-40 to +85	°C
T _J	Maximum Junction Temperature	+125	°C
T _{STG}	Storage Temperature	-55 to +125	°C
P _D	Power Dissipation (Note 6)	315	mW

Notes: 5. Stresses beyond those listed under *Absolute Maximum Ratings* can 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 can affect device reliability.
 6. This is based on an application temperature of +40°C. Derate 3.75mW per °C for each degree above +40°C.

Recommended Operating Conditions

Symbol	Parameter	Min	Max	Unit
V _{IN}	Input Voltage	2.0	5.5	V
I _{OUT}	Output Current	0	150	mA
T _A	Operating Ambient Temperature	-40	+85	°C

Electrical Characteristics (@ $T_A = +25^\circ\text{C}$, $V_{EN} = V_{IN} = V_{OUT} + 1\text{V}$ ($1.5\text{V} < V_{OUT} \leq 4.5\text{V}$), $V_{EN} = V_{IN} = 2.5\text{V}$ ($V_{OUT} \leq 1.5\text{V}$), $I_{OUT} = 1\text{mA}$, $C_{IN} = C_{OUT} = 0.1\mu\text{F}$, unless otherwise specified.)

Parameter	Conditions		Min	Typ	Max	Unit
Input Voltage	$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$		2.0	—	5.5	V
Output Voltage Accuracy	$V_{OUT} > 2.0\text{V}$ $I_{OUT} = 1\text{mA}$	$T_A = +25^\circ\text{C}$	-1	—	+1	%
		$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$	-2	—	+2	
	$V_{OUT} \leq 2.0\text{V}$ $I_{OUT} = 1\text{mA}$	$T_A = +25^\circ\text{C}$	-40	—	40	mV
		$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$	-80	—	80	
Line Regulation ($\Delta V_{OUT}/\Delta V_{IN}/V_{OUT}$)	MAX ($V_{OUT} + 1.0\text{V}$, 2.5V) $\leq V_{IN} \leq 5.5\text{V}$ (All Versions Except 4.5V)		—	0.02	0.1	%/V
Load Regulation (ΔV_{OUT})	$1\text{mA} \leq I_{OUT} \leq 150\text{mA}$ (All Versions Except 4.5V)		-40	—	40	mV
	$1\text{mA} \leq I_{OUT} \leq 150\text{mA}$ (Applicable to 4.5V Version)		-55	—	55	mV
Short Circuit Current Limit (Note 7)	$V_{OUT} = 0\text{V}$		—	60	—	mA
Quiescent Current (Note 8)	$I_{OUT} = 0\text{mA}$		—	0.25	0.6	μA
$I_{STANDBY}$	Set EN Low, No Load		—	0.02	0.2	μA
Output Current	—		150	—	—	mA
Dropout Voltage (Note 9)	$I_{OUT} = 150\text{mA}$	$V_{OUT} = 1.1\text{V}$	—	0.70	1.00	V
		$V_{OUT} = 1.2\text{V}$	—	0.60	0.90	
		$V_{OUT} = 1.5\text{V}$	—	0.43	0.75	
		$V_{OUT} = 1.8\text{V}$	—	0.33	0.60	
		$V_{OUT} = 1.85\text{V}$	—	0.32	0.58	
		$V_{OUT} = 2.2\text{V}$	—	0.27	0.52	
		$V_{OUT} = 2.5\text{V}$	—	0.22	0.48	
		$V_{OUT} = 2.8\text{V}$	—	0.19	0.40	
		$V_{OUT} = 3.0\text{V}$	—	0.18	0.35	
		$V_{OUT} = 3.3\text{V}$	—	0.16	0.35	
$V_{OUT} = 4.5\text{V}$	—	0.14	0.35			
EN Input Low Voltage	—		—	—	0.4	V
EN Input High Voltage	—		1.0	—	5.5	V
Active Output Discharge Resistance (Note 10)	$V_{IN} = 4.0\text{V}$, $V_{EN} = 0\text{V}$		—	35	—	Ω
Θ_{JA} Thermal Resistance Junction-to-Ambient	(Note 11)	SOT23	—	170	—	$^\circ\text{C}/\text{W}$
		SOT25	—	162	—	
		X2-DFN1010-4 (Type B)	—	295	—	
Θ_{JC} Thermal Resistance Junction-to-Case	(Note 11)	SOT23	—	43	—	$^\circ\text{C}/\text{W}$
		SOT25	—	38	—	
		X2-DFN1010-4 (Type B)	—	120	—	

Notes: 7. Short-circuit current is measured with V_{OUT} pulled to GND.

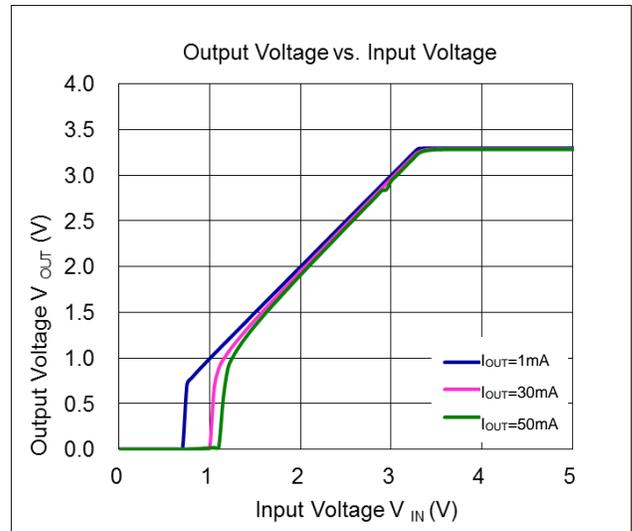
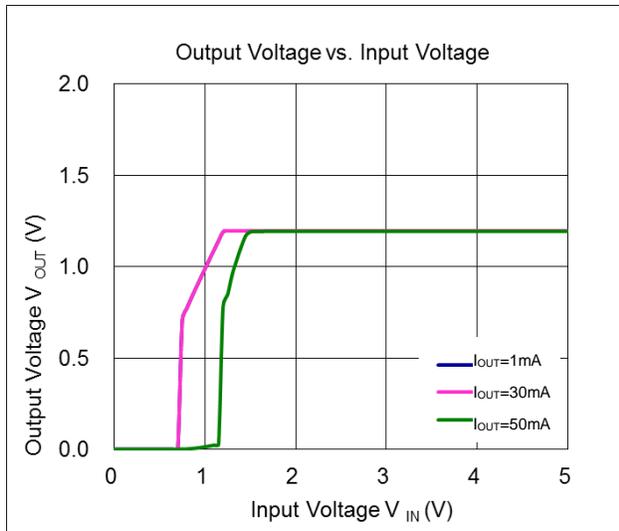
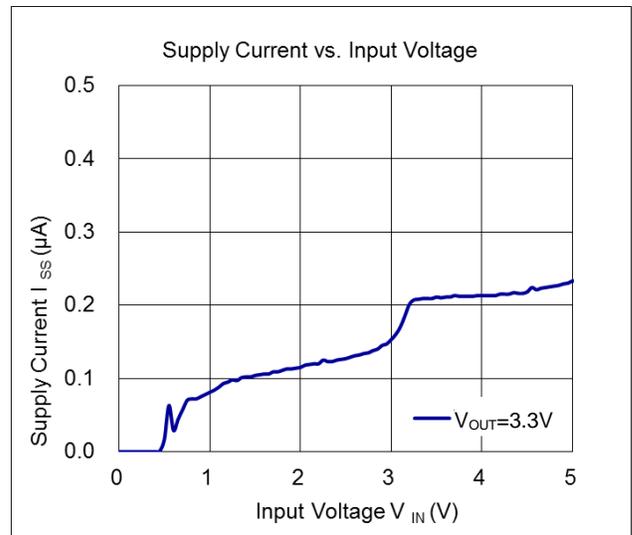
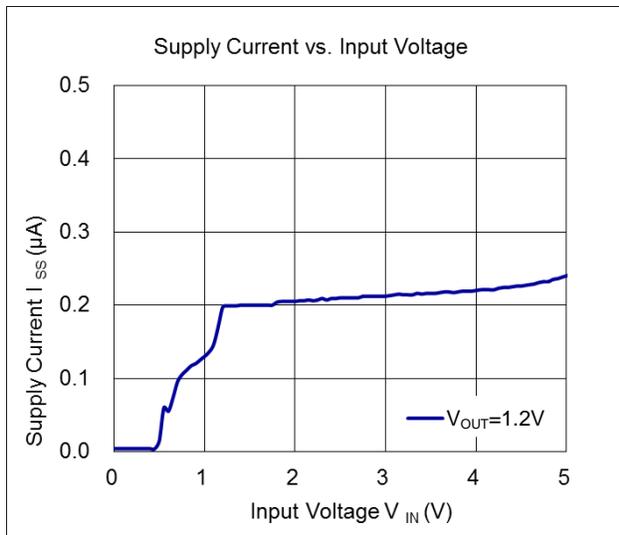
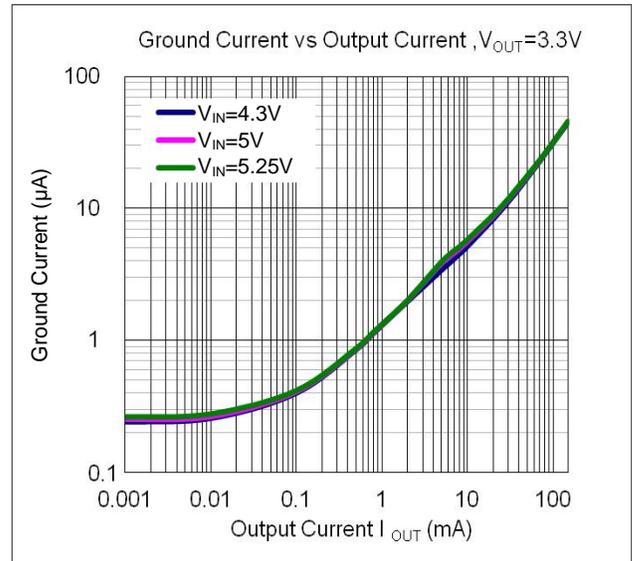
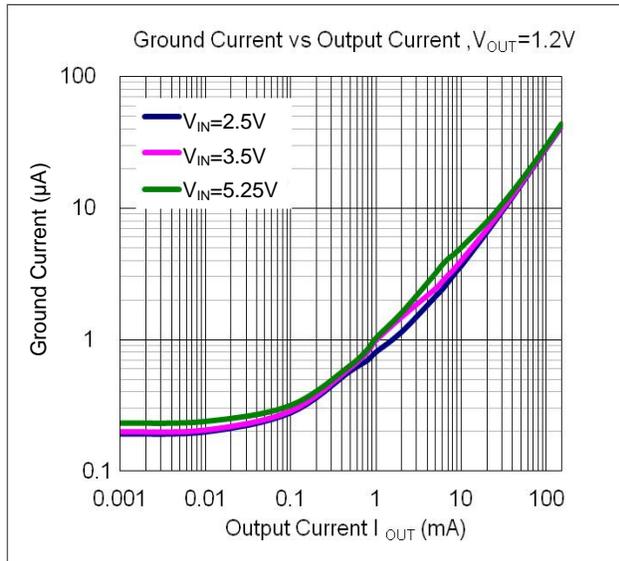
8. Quiescent current defined as the difference in current between the input and the output.

9. Dropout voltage is the voltage difference between the input and the output at which the output voltage drops 2% below its nominal value.

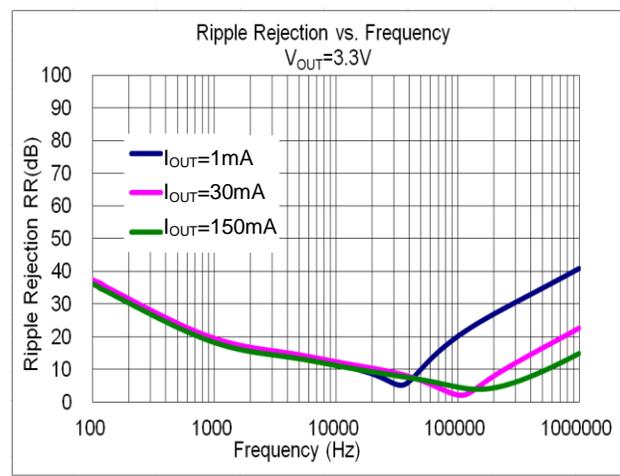
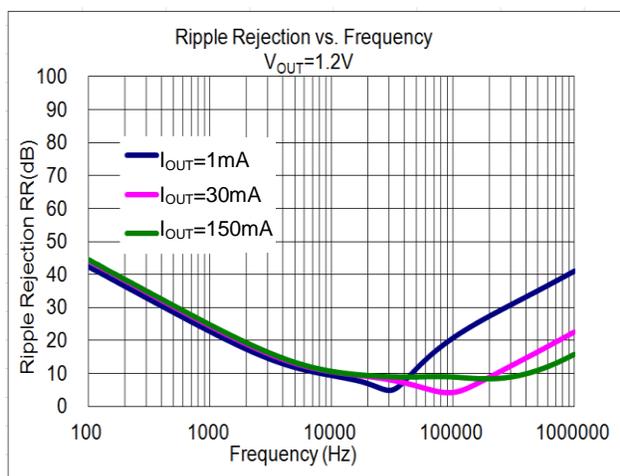
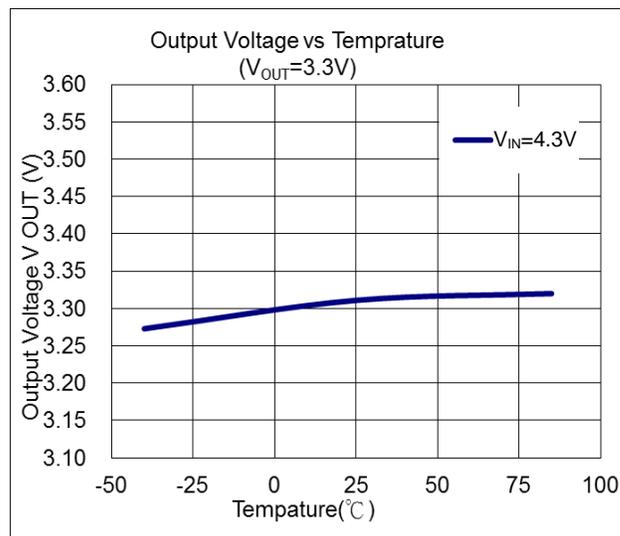
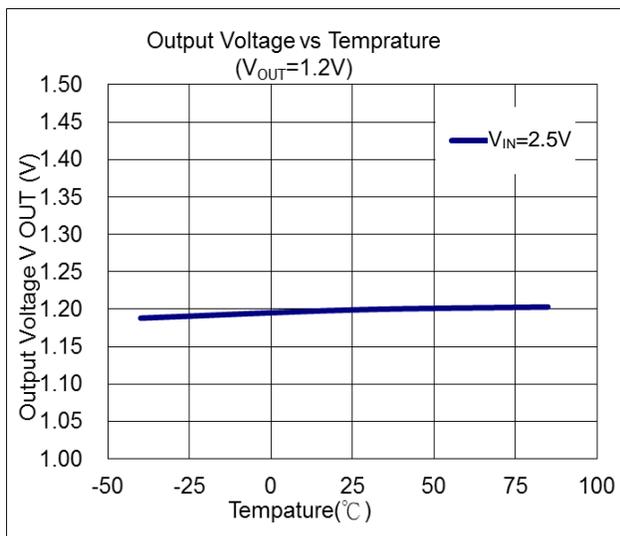
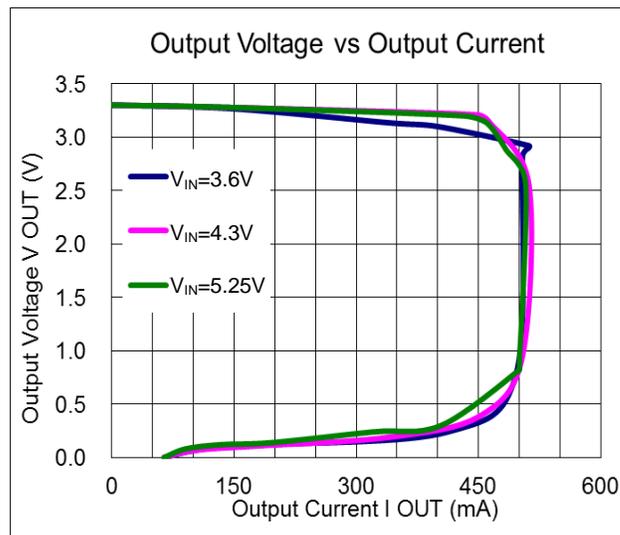
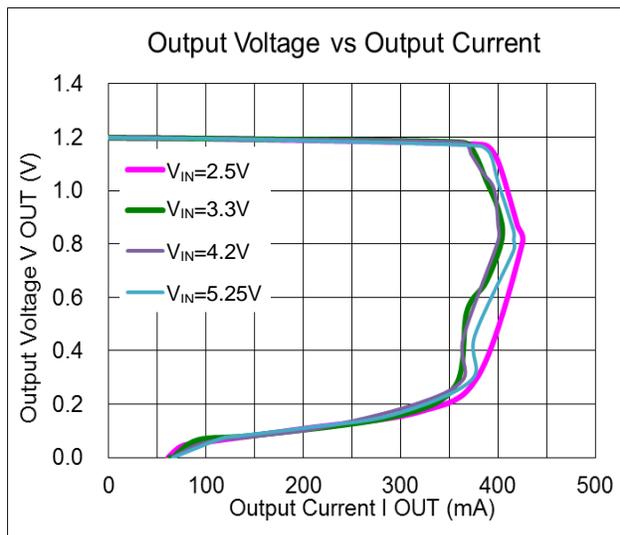
10. NK-AP7354 is available with two options: built-in discharge (NK-AP7354D) and non-discharge (NK-AP7354).

11. Test condition: Device mounted on 1" x 1" FR-4 MRP substrate PCB, 2oz copper, with minimum recommended pad layout.

Performance Characteristics

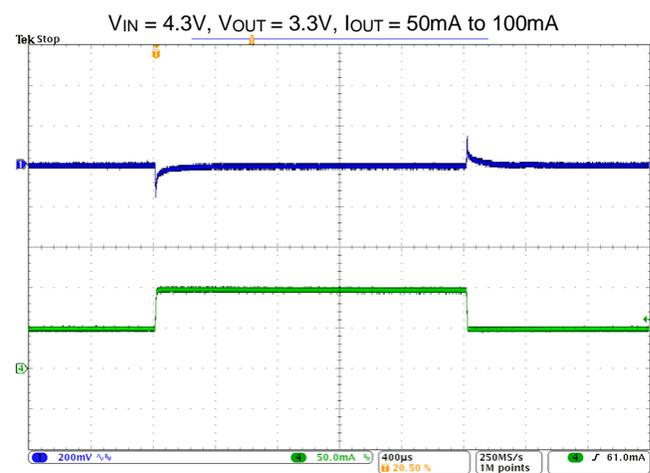
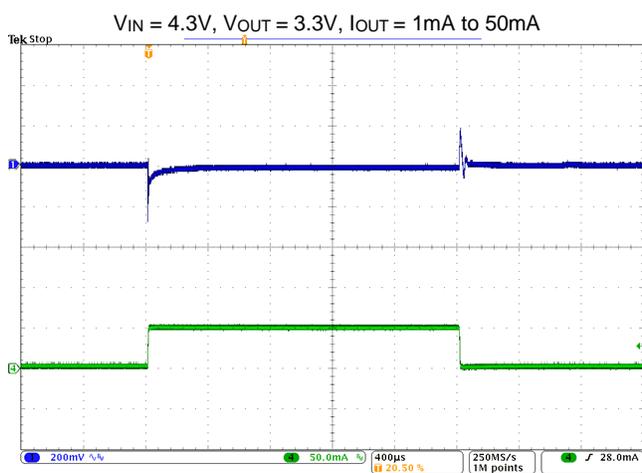
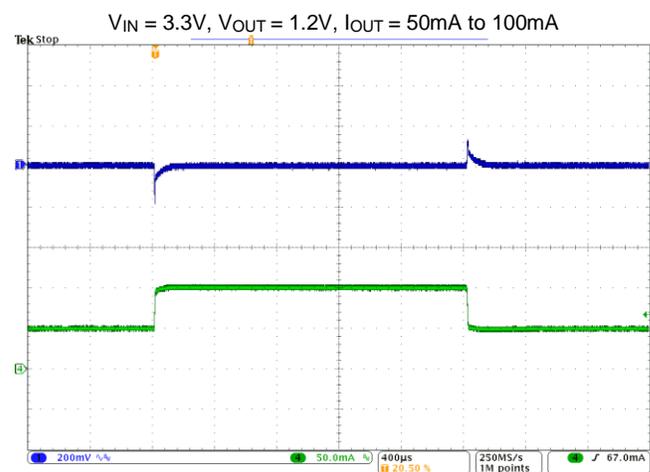
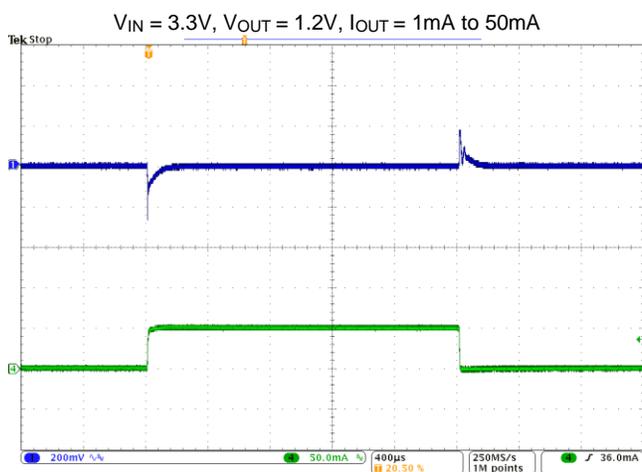


Performance Characteristics (continued)



Performance Characteristics (continued)

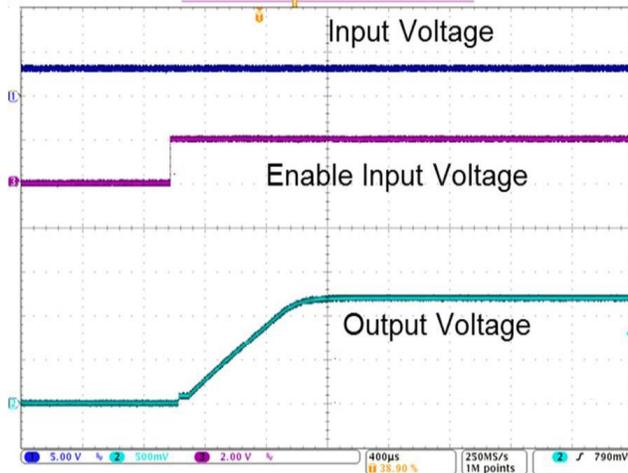
Load Transient Response ($C_{IN} = C_{OUT} = 0.1\mu F$, $t_r = t_f = 5.0\mu s$, unless otherwise specified.)



Performance Characteristics (continued)

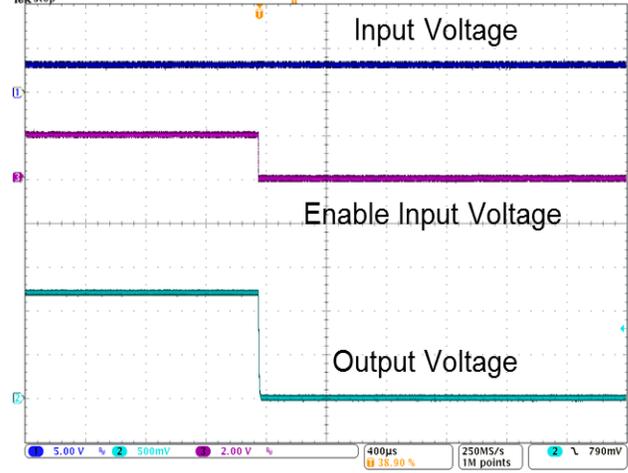
TURN ON

$V_{IN} = 3.3V, V_{OUT} = 1.2V, I_{OUT} = 0mA, C_{IN} = C_{OUT} = 0.1\mu F$

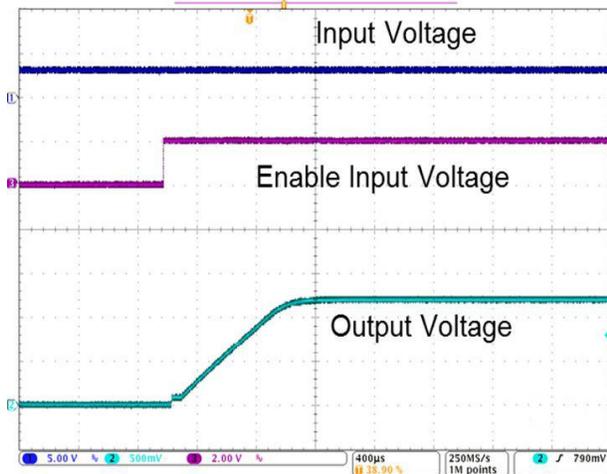


TURN OFF

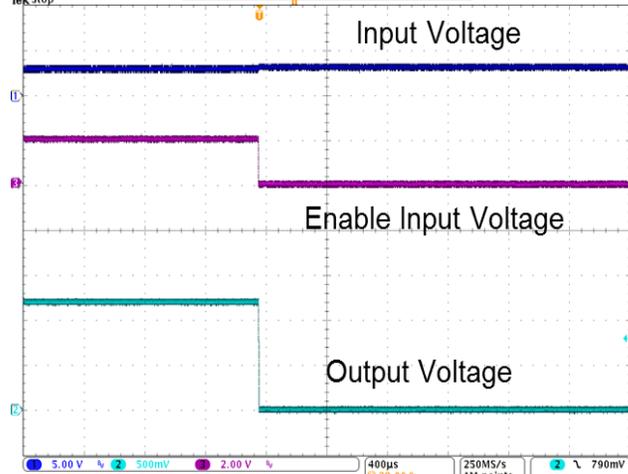
$V_{IN} = 3.3V, V_{OUT} = 1.2V, I_{OUT} = 0mA, C_{IN} = C_{OUT} = 0.1\mu F$



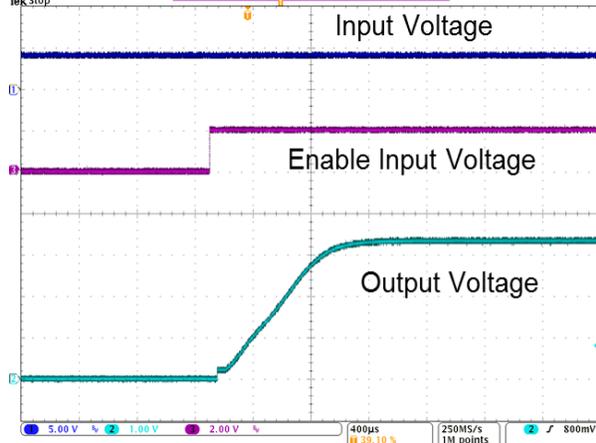
$V_{IN} = 3.3V, V_{OUT} = 1.2V, I_{OUT} = 150mA, C_{IN} = C_{OUT} = 0.1\mu F$



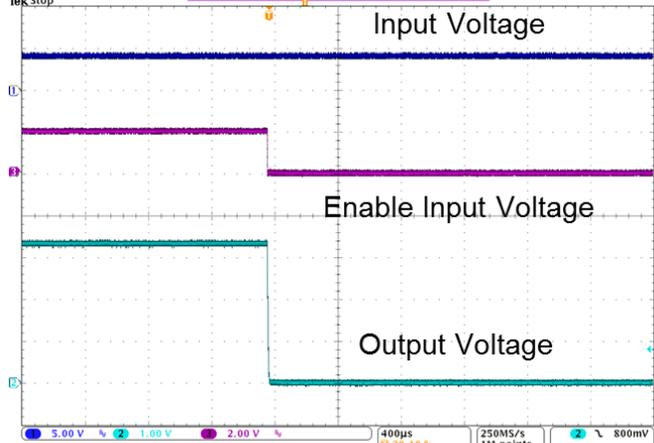
$V_{IN} = 3.3V, V_{OUT} = 1.2V, I_{OUT} = 150mA, C_{IN} = C_{OUT} = 0.1\mu F$



$V_{IN} = 4.3V, V_{OUT} = 3.3V, I_{OUT} = 0mA, C_{IN} = C_{OUT} = 0.1\mu F$

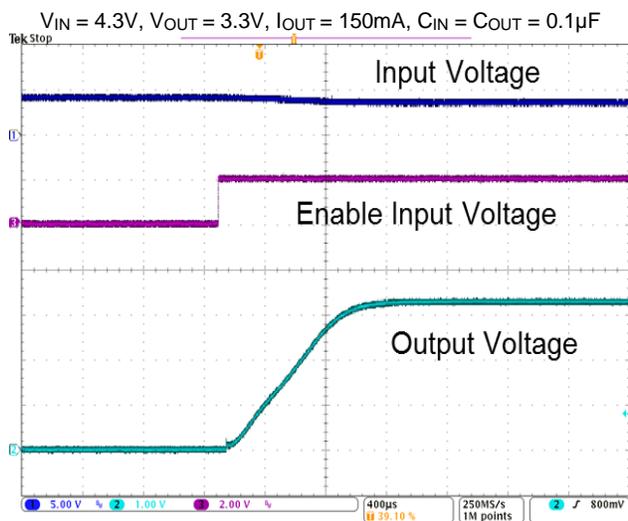


$V_{IN} = 4.3V, V_{OUT} = 3.3V, I_{OUT} = 0mA, C_{IN} = C_{OUT} = 0.1\mu F$

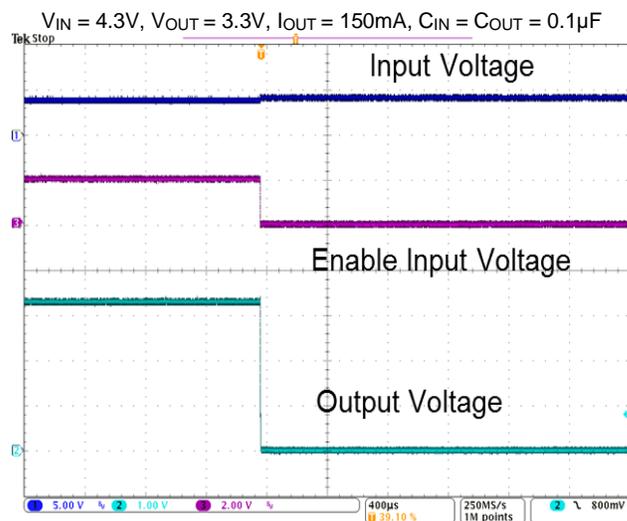


Performance Characteristics (continued)

TURN ON



TURN OFF



Application Information

Output Capacitor

An output capacitor (C_{OUT}) is required to improve transient response and maintain stability. The NK-AP7354 is stable with very small ceramic output capacitors. The equivalent series resistance (ESR) and capacitance drive 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 GND pin. Care must 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 $0.1\mu\text{F}$ ceramic capacitor is recommended between V_{IN} and GND pin 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 pin.

Enable Control

The NK-AP7354 is turned on by setting the EN pin high, and is turned off by pulling them 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.

Layout Considerations

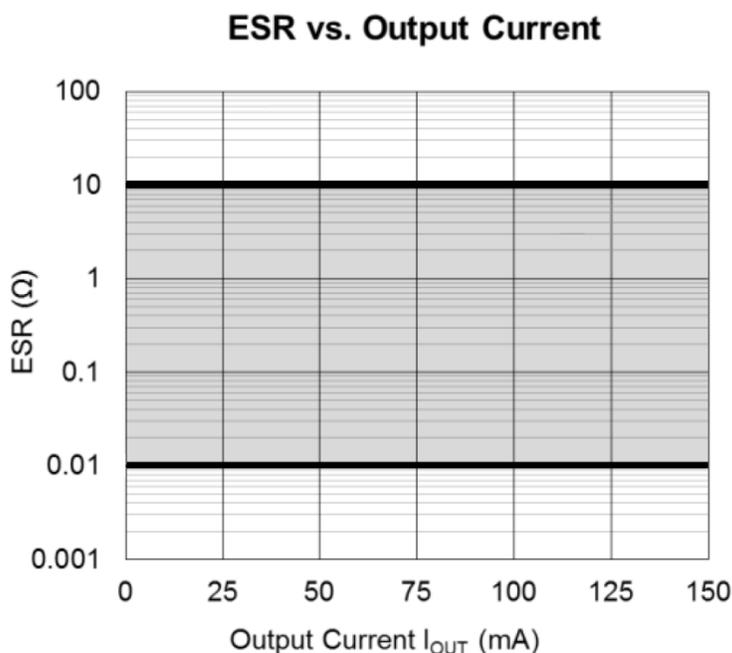
For good ground loop and stability, the input and output capacitors must be located close to the input, output, and GND pin of the device. The regulator GND pin must be connected to the external circuit ground to reduce voltage drop caused by trace impedance. Ground plane is generally used to reduce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

ESR vs. Output Current

A 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.

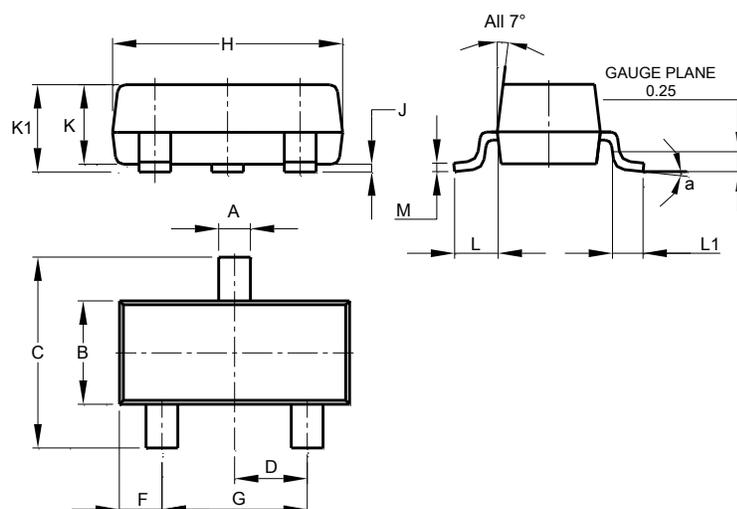
Measurement Conditions:

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



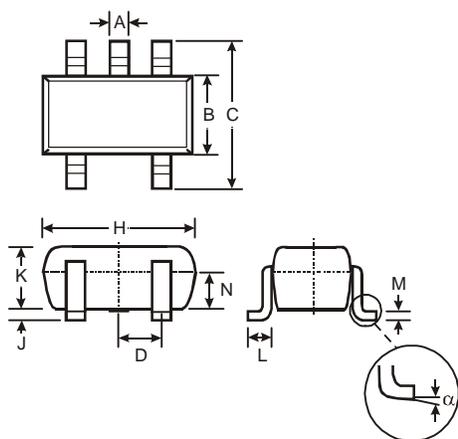
Package Outline Dimensions

(1) Package Type: SOT23



SOT23			
Dim	Min	Max	Typ
A	0.37	0.51	0.40
B	1.20	1.40	1.30
C	2.30	2.50	2.40
D	0.89	1.03	0.915
F	0.45	0.60	0.535
G	1.78	2.05	1.83
H	2.80	3.00	2.90
J	0.013	0.10	0.05
K	0.890	1.00	0.975
K1	0.903	1.10	1.025
L	0.45	0.61	0.55
L1	0.25	0.55	0.40
M	0.085	0.150	0.110
a	0°	8°	--
All Dimensions in mm			

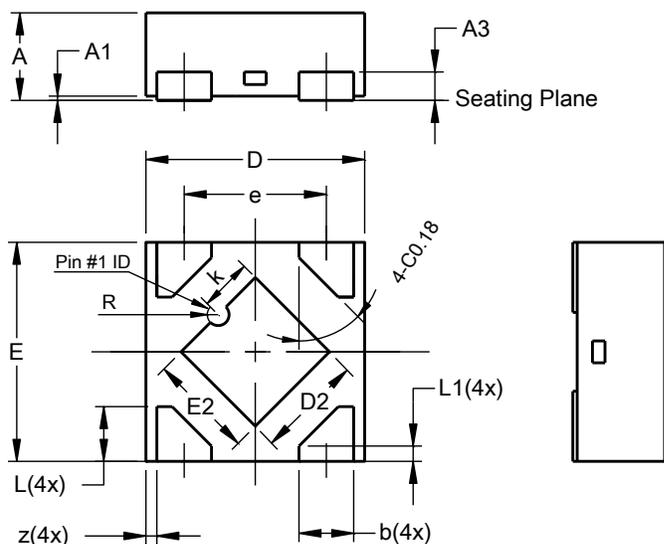
(2) Package Type: SOT25



SOT25			
Dim	Min	Max	Typ
A	0.35	0.50	0.38
B	1.50	1.70	1.60
C	2.70	3.00	2.80
D	-	-	0.95
H	2.90	3.10	3.00
J	0.013	0.10	0.05
K	1.00	1.30	1.10
L	0.35	0.55	0.40
M	0.10	0.20	0.15
N	0.70	0.80	0.75
α	0°	8°	-
All Dimensions in mm			

Package Outline Dimensions (continued)

(3) Package Type: X2-DFN1010-4 (Type B)

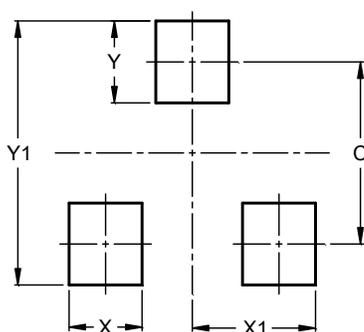


X2-DFN1010-4 (Type B)			
Dim	Min	Max	Typ
A	-	0.40	0.39
A1	0.00	0.05	0.02
A3	-	-	0.13
b	0.20	0.30	0.25
D	0.95	1.05	1.00
D2	0.43	0.53	0.48
E	0.95	1.05	1.00
E2	0.43	0.53	0.48
e	-	-	0.65
k	0.19	0.29	0.24
L	0.20	0.30	0.25
L1	0.02	0.12	0.07
R	0.02	0.08	0.05
z	-	-	0.050

All Dimensions in mm

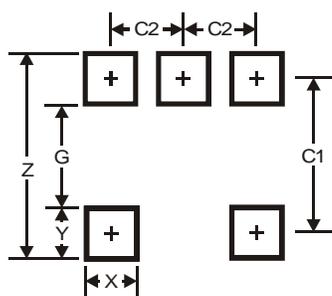
Suggested Pad Layout

(1) Package Type: SOT23



Dimensions	Value (in mm)
C	2.0
X	0.8
X1	1.35
Y	0.9
Y1	2.9

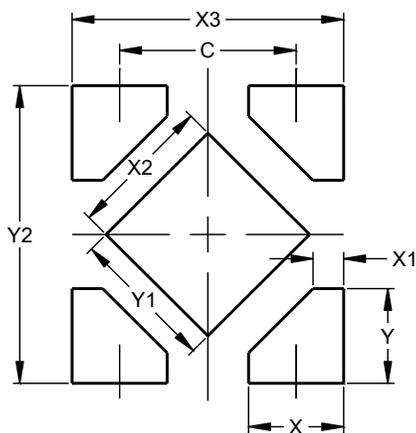
(2) Package Type: SOT25



Dimensions	Value
Z	3.20
G	1.60
X	0.55
Y	0.80
C1	2.40
C2	0.95

Suggested Pad Layout (continued)

(3) Package Type: X2-DFN1010-4 (Type B)



Dimensions	Value (in mm)
C	0.650
X	0.350
X1	0.112
X2	0.530
X3	1.00
Y	0.350
Y1	0.530
Y2	1.100