优尚

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

企业微信二维码

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Description

The NK-AP7387 is a wide input voltage range (60V), low quiescent current, high-PSRR, linear regulator able to drive 150mA output current.

The device features a very fast line/load transient response against rapid input-voltage and load-current changes. The IC consists of a voltage reference, an error amplifier, a current-limit circuit for current-protection, short-circuit, and thermal-shutdown protection.

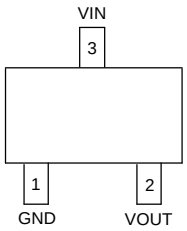
The NK-AP7387 has 3.0V, 3.3V, 3.6V, and 5V fixed output voltage versions, and is available in the SOT23, SOT25, SOT89, SOT89R,and U-DFN2020-6 (Type C) packages.

Features

- Wide Input Voltage Range: 5V to 60V
- Maximum Output Current: 150mA
- Dropout Voltage:
  V_{DROP} = 700mV@I_{OUT} = 100mA (Typ.)
  V_{DROP} = 1100mV@ I_{OUT} = 150mA (Typ.)
- Low Quiescent Current: 2μA (Typ.)
- High Output Voltage Accuracy: ±2%
- High PSRR: 70dB@1kHz
- Excellent Line/Load Regulation
- Thermal Shutdown Function
- Short-Current Protection Function
- Output Current Limit
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

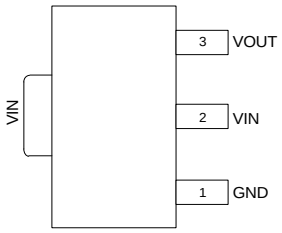
Pin Assignments

(Top View)



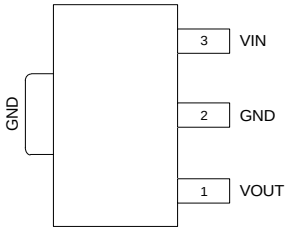
SOT23

(Top View)



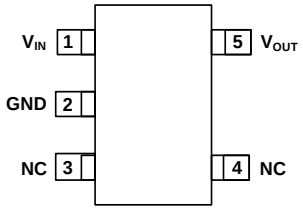
SOT89

(Top View)



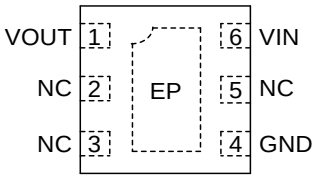
SOT89R

(Top View)



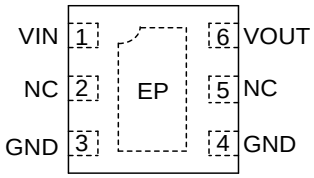
SOT25

(Top View)



U-DFN2020-6 (Type C)

(Top View)

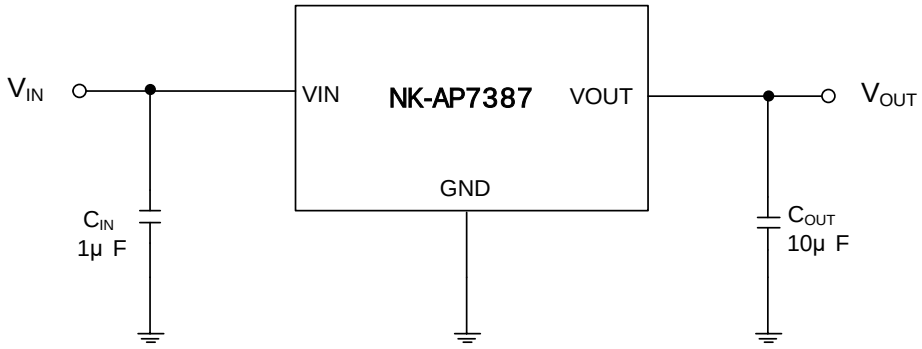


U-DFN2020-6R (Type C)

Applications

- Battery-powered equipment
- Smoke detector and sensors
- EV and HEV battery management systems
- Micro-controller applications
- Home appliances

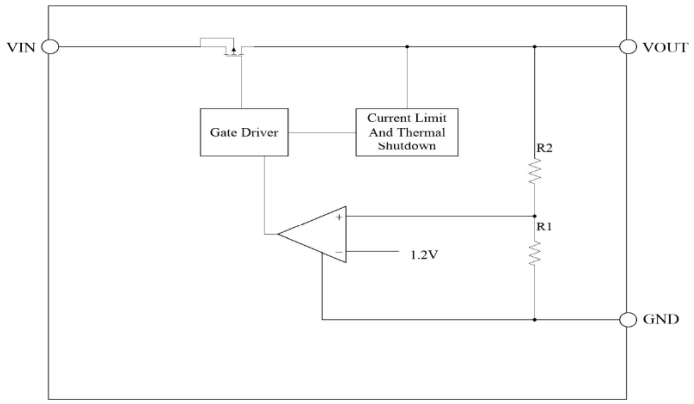
Typical Applications Circuit



Pin Descriptions

Pin Number						Pin Name	Function
SOT25	SOT23	SOT89	SOT89R	U-DFN2020-6 (Type C)	U-DFN2020-6R (Type C)		
1	3	2	3	6	1	VIN	Input voltage
2	1	1	2	4	3, 4	GND	Ground
3,4	-	-	-	2, 3, 5	2, 5	NC	Not connected internally, recommend connection to GND to maximize PCB copper for thermal dissipation
5	2	3	1	1	6	VOUT	Regulated output voltage
-	-	-	-	EP	EP	Exposed Pad	In PCB layout, prefer to use large copper area to cover this pad for better thermal dissipation, then connect this area to GND. This pad is connected with GND internally.

Functional Block Diagram



Absolute Maximum Ratings (Note 4) (@ T_A = +25°C, unless otherwise specified.)

Symbol	Parameter	Rating		Unit
V_{IN}	Supply Input Voltage	-0.3 ~ 80		V
V_{OUT}	Regulated Output Voltage	-0.3 ~ 6		V
I_{OUT}	Output Current	Internally limited		mA
T_{LEAD}	Lead Temperature (Soldering, 10sec)	+260		°C
T_J	Operating Junction Temperature	+150		°C
T_A	Operating Ambient Temperature	-40 to +85		°C
θ_{JA}	Thermal Resistance	SOT25	150	°C/W
		SOT23	248.5	
		SOT89	165	
		SOT89R	79	
		U-DFN2020-6 (Type C)	48	
T_{STG}	Storage Temperature Range	-40 to +150		°C
CDM	ESD (Change Device Model)	2KV		V
HBM	ESD (Human Body Model)	4KV		V

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 period may affect device reliability.
b). Ratings apply to ambient temperature at +25°C. The JEDEC STD.51 High-K board design used to derive this data was a 3 inch x 3 inch multilayer board with 1oz. internal power and ground planes and 2oz. copper traces on the top and bottom of the board.

Recommended Operating Conditions

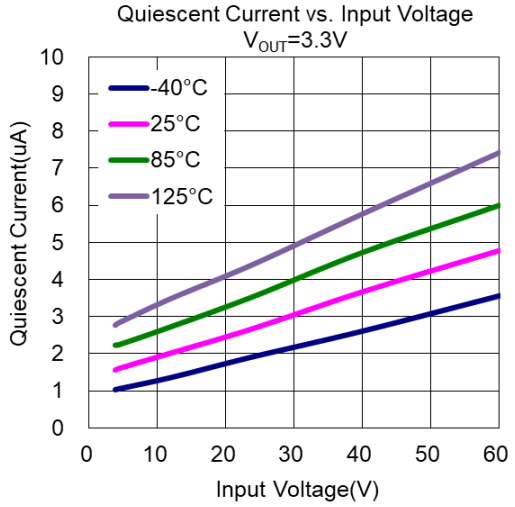
Symbol	Parameter	Min	Typ	Max	Unit
V_{IN}	Supply Input Voltage	5.0		60	V
V_{OUT}	Supply Output Voltage	3.0		5	V
T_J	Operating Junction Temperature	-40		+125	°C
C_{IN}	Input Capacitor	—	1	—	μF
C_{OUT}	Output Capacitor	1	10	—	μF

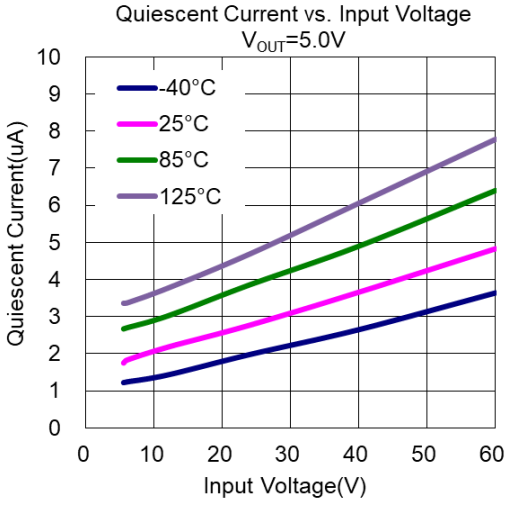
Electrical Characteristics (T_A = 25°C, I_{OUT} = 1mA, C_{IN}=1μF, C_{OUT} =10μF ceramic capacitor, V_{IN} = V_{OUTNOM} +2.0V)

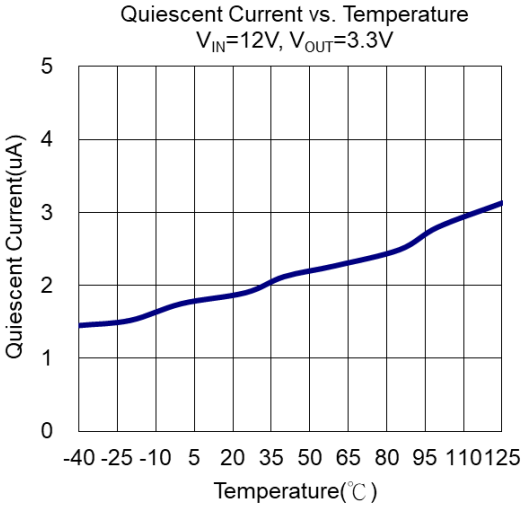
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage	—	5.0	—	60	V
I_{GND}	Quiescent Current	V_{IN} = 12V, No load	—	2	4	μA
V_{OUT}	Output Voltage	V_{IN} = 12V, I_{OUT} = 10 mA	V_{OUT}x98%	—	V_{OUT}x102%	V
I_{OUT_MAX}	Output Current		—	150	—	mA
V_{DROP}	Dropout Voltage	I_{OUT} = 100mA, V_{OUT} = V_{OUTNOM} – 0.1V	—	700	850	mV
		I_{OUT} = 150mA, V_{OUT} = V_{OUTNOM} – 0.1V	—	1100	1350	mV
$\Delta V_{OUT}/(\Delta I_{OUT})$	Load Regulation (Note 5)	V_{IN} = 12V, 1mA ≤ I_{OUT} ≤ 100mA	—	0.02	0.025	%/mA
		V_{IN} = V_{OUT}+2V, 1mA ≤ I_{OUT} ≤ 150mA	—	0.015	0.02	
$\Delta V_{OUT}/\Delta V_{IN}$	Line Regulation	V_{OUTNOM} + 0.5 V≤ V_{IN} ≤ 60 V, I_{OUT} = 1 mA	—	0.01	0.02	%/V
I_{LIMIT}	Current Limit		—	250	—	mA
T_{OTSD}	Thermal Shutdown Temperature	—	—	+150	—	°C
T_{HYOTSD}	Thermal Shutdown Hysteresis	—	—	+30	—	°C
PSRR	Power Supply Rejection Ratio	V_{IN} = 12V,I_{OUT} = 1mA, V_{OUT} = 3.3V@1kHz	—	70	—	dB
θ_{JC}	Thermal Resistance Junction to Case (Note 5)	SOT25	—	59.5	—	°C/W
		SOT23	—	140.5	—	
		SOT89	—	97	—	
		SOT89R	—	25	—	
		U-DFN2020-6 (Type C)	—	15.5	—	

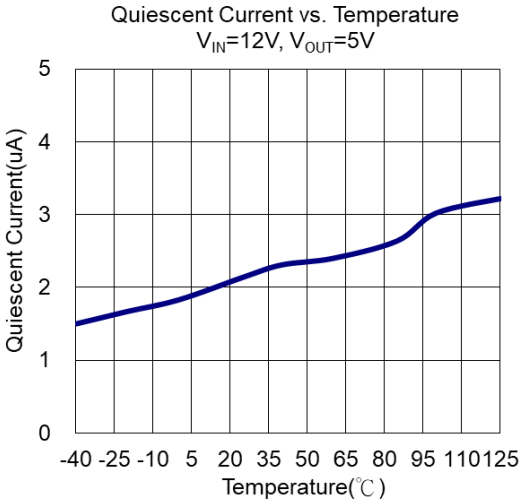
Note: 5. The load regulation SPEC is depended on the package and operating temperature, be careful the operating junction temperature not over OTP threshold.

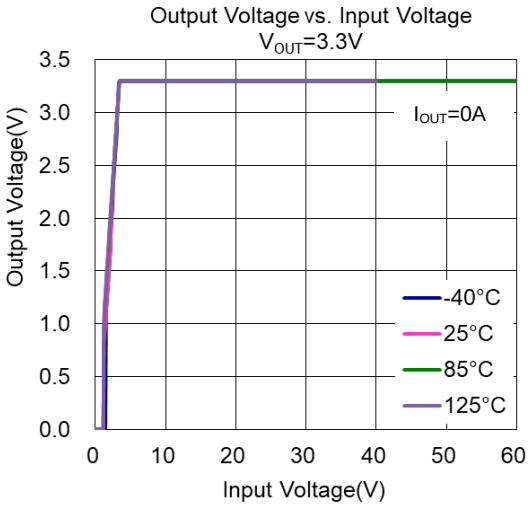
Performance Characteristics

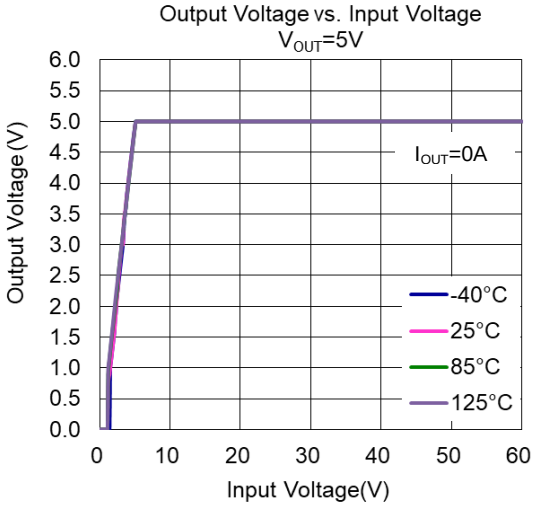




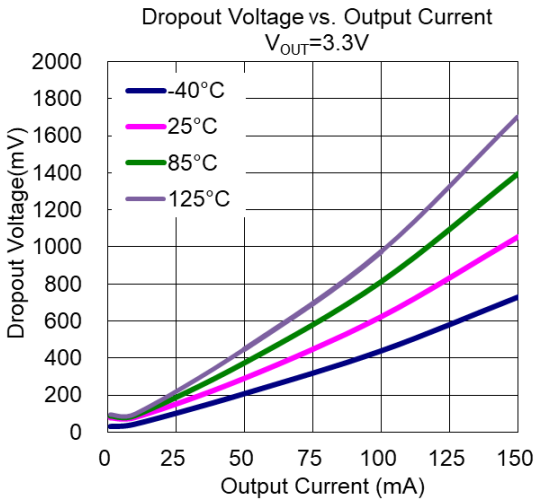


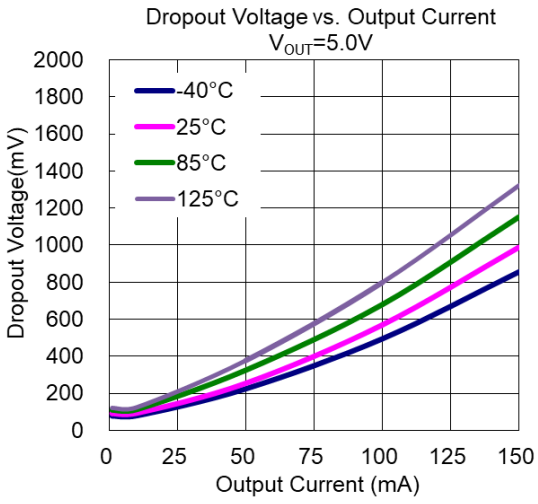


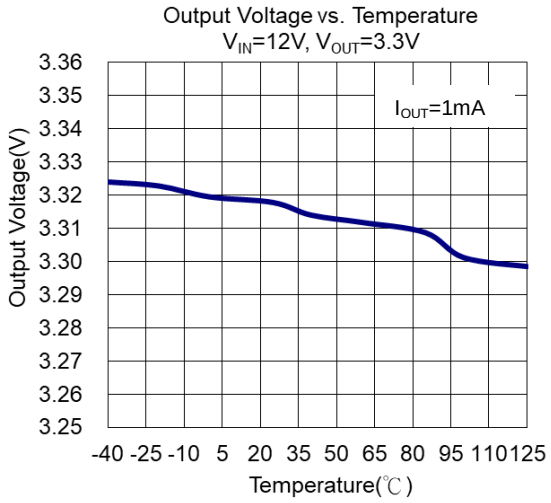


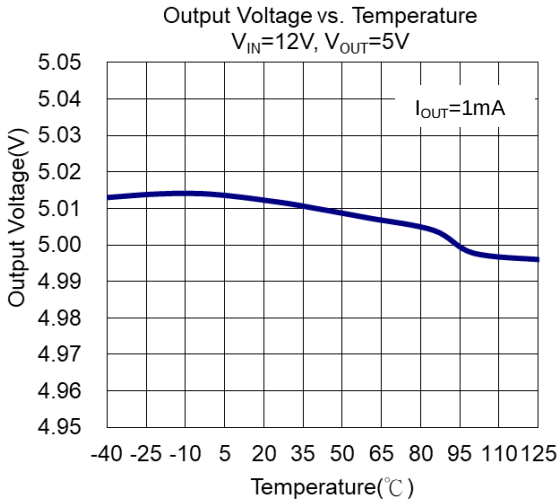


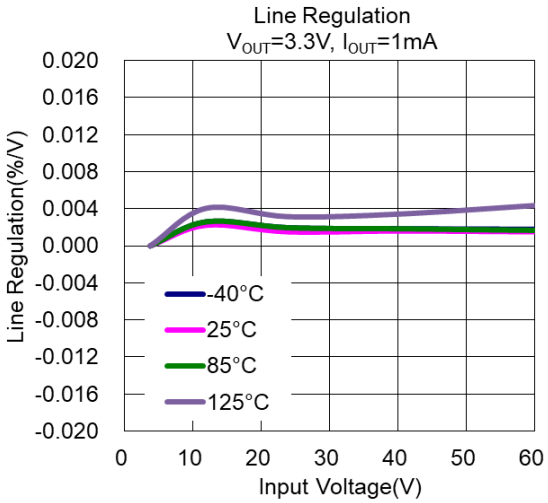
Typical Characteristics (continued)

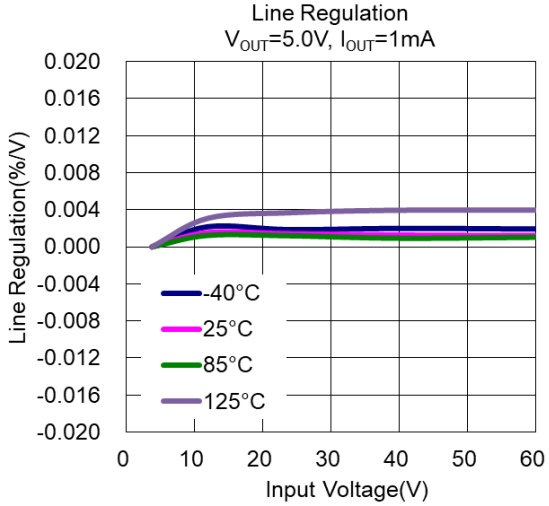




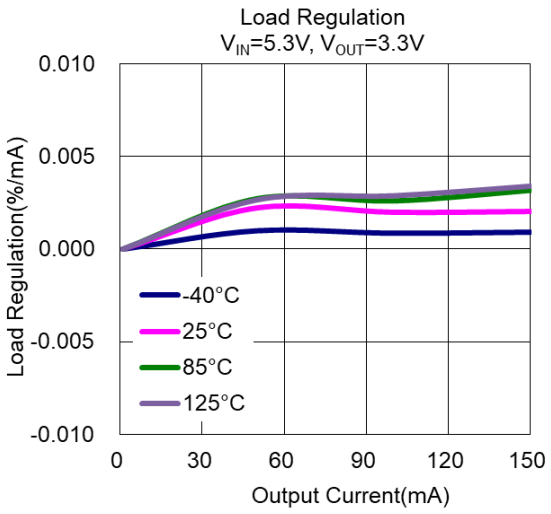


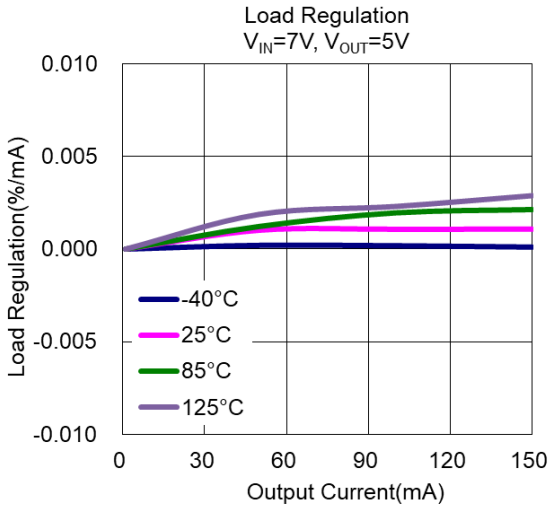


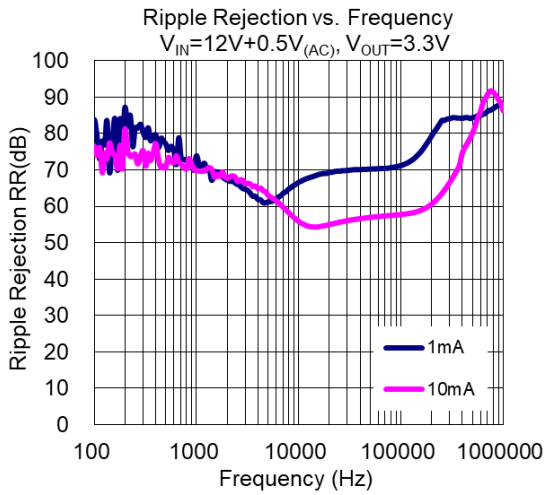


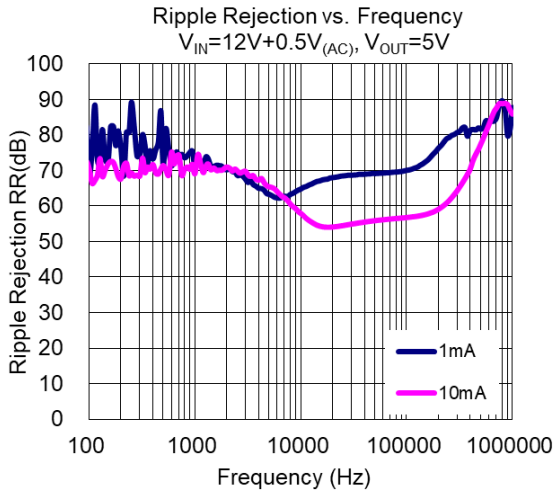


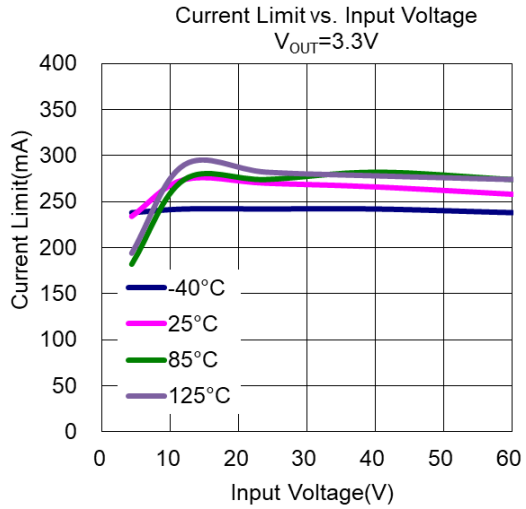
Typical Characteristics (continued)

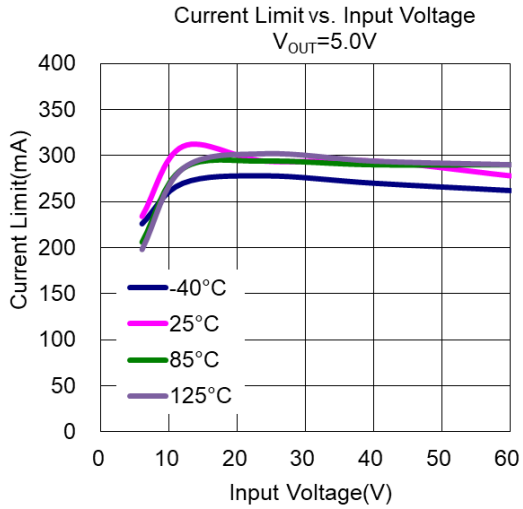






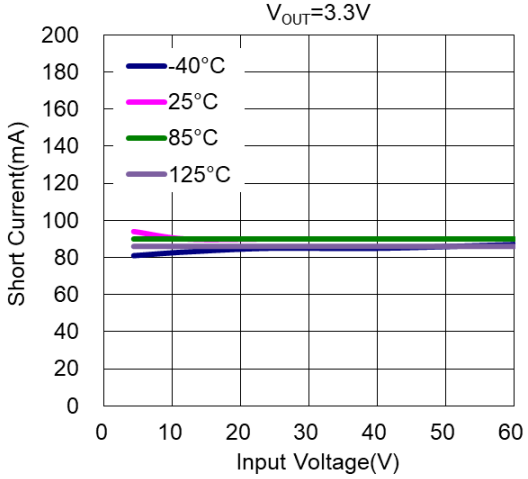




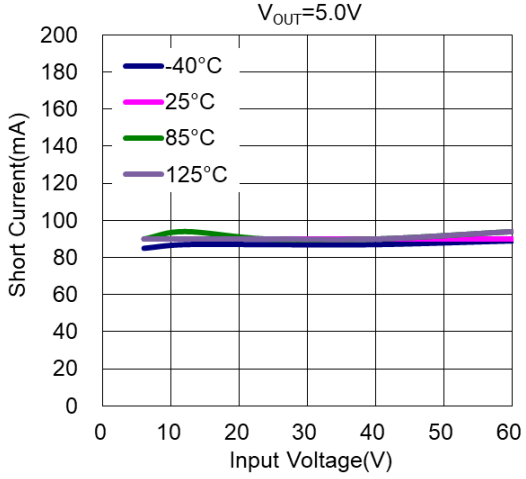


Typical Characteristics (continued)

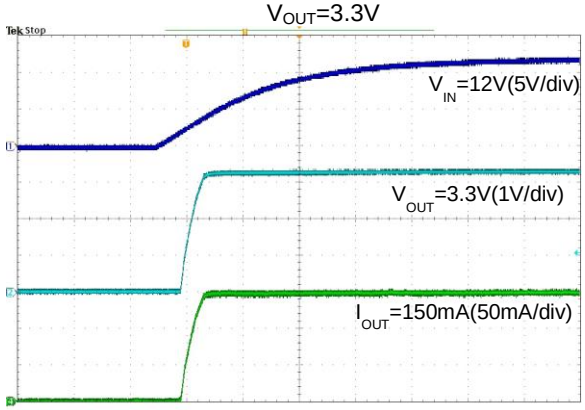
Short Current vs. Input Voltage
V_{OUT}=3.3V



Short Current vs. Input Voltage
V_{OUT}=5.0V

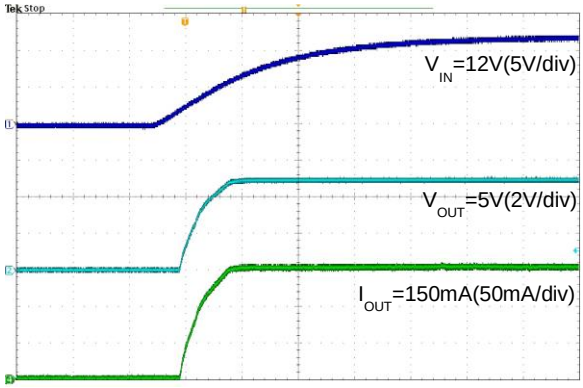


Power on
V_{OUT}=3.3V



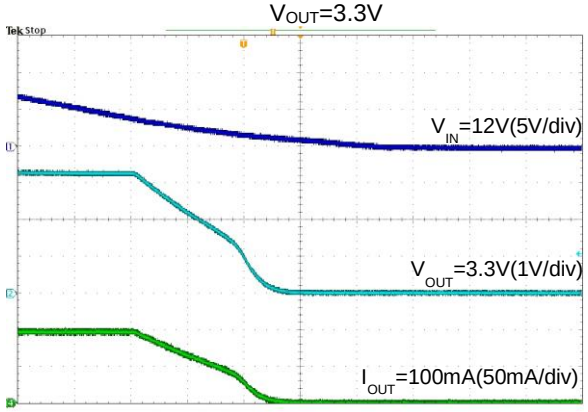
Time(2ms/div)

Power on
V_{OUT}=5V



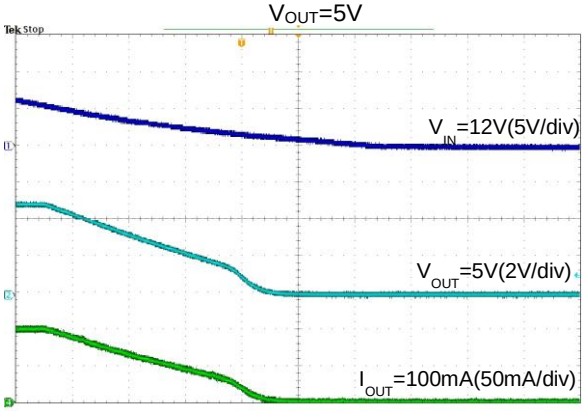
Time(2ms/div)

Power off
V_{OUT}=3.3V



Time(4ms/div)

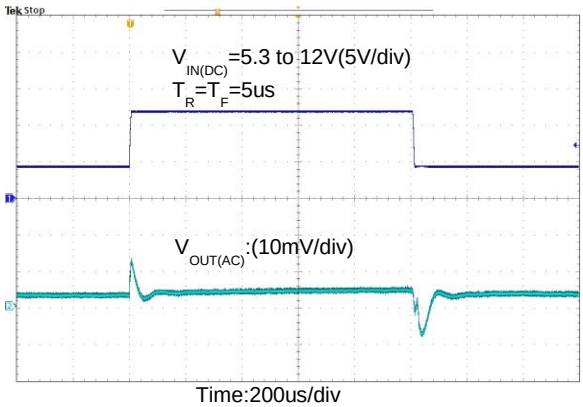
Power off
V_{OUT}=5V



Time(4ms/div)

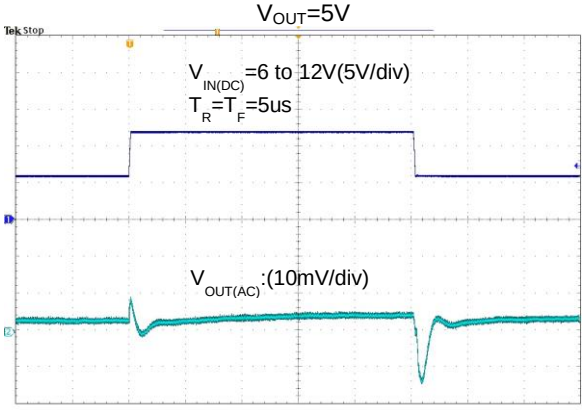
Typical Characteristics (continued)

Line Transient Response
V_{OUT}=3.3V



Time:200us/div

Line Transient Response
V_{OUT}=5V



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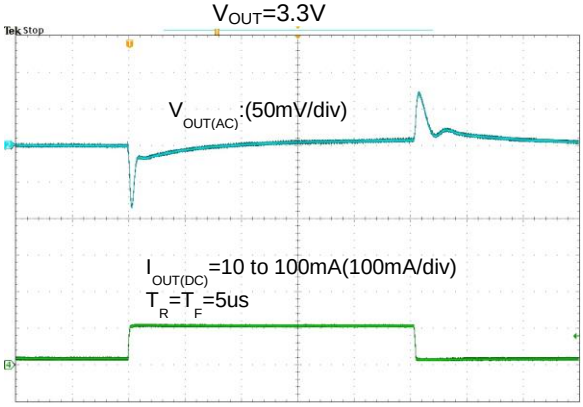
Load Transient Response
V_{OUT}=3.3V



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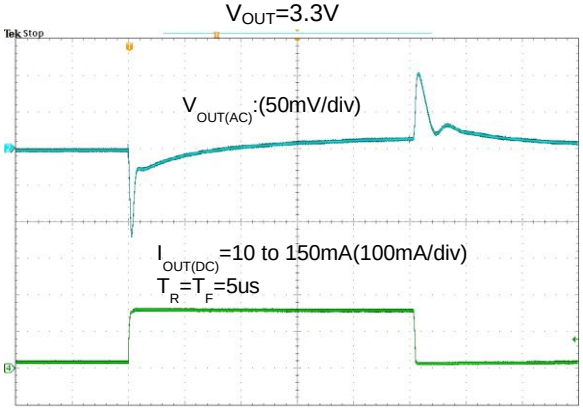
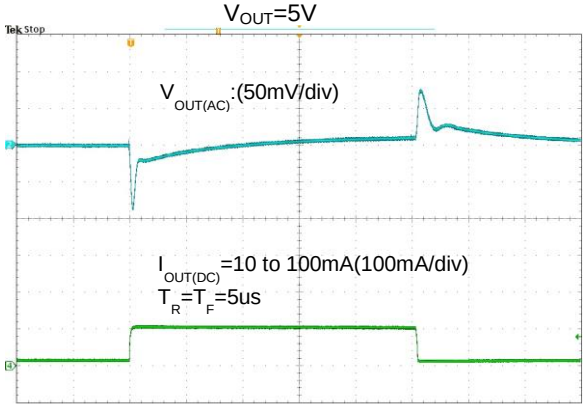
Load Transient Response
V_{OUT}=3.3V



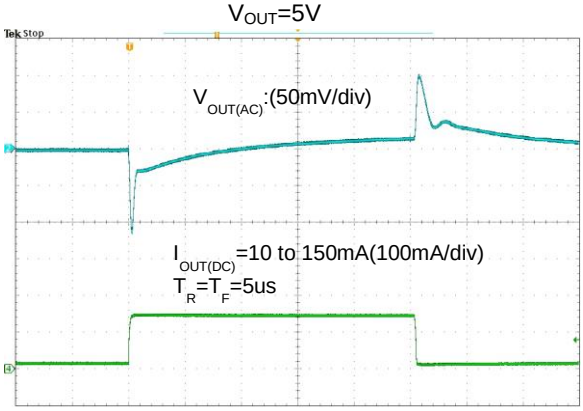
Time:200us/div

Load Transient Response
V_{OUT}=5V



Time:200us/div

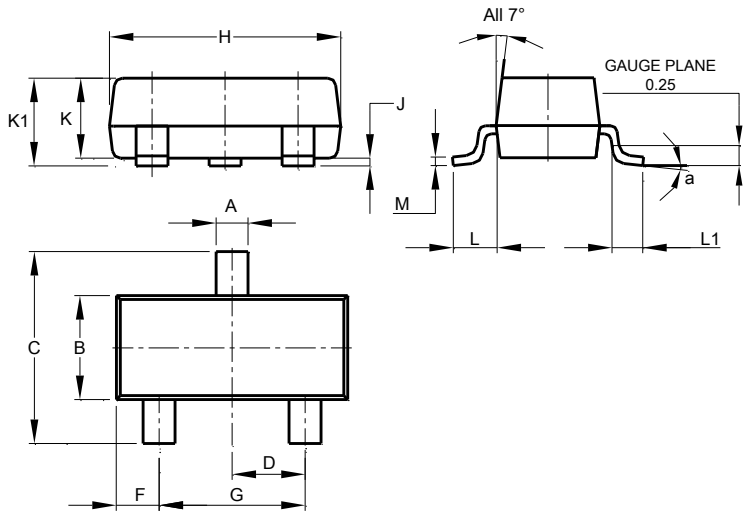
Load Transient Response
V_{OUT}=5V



Time:200us/div

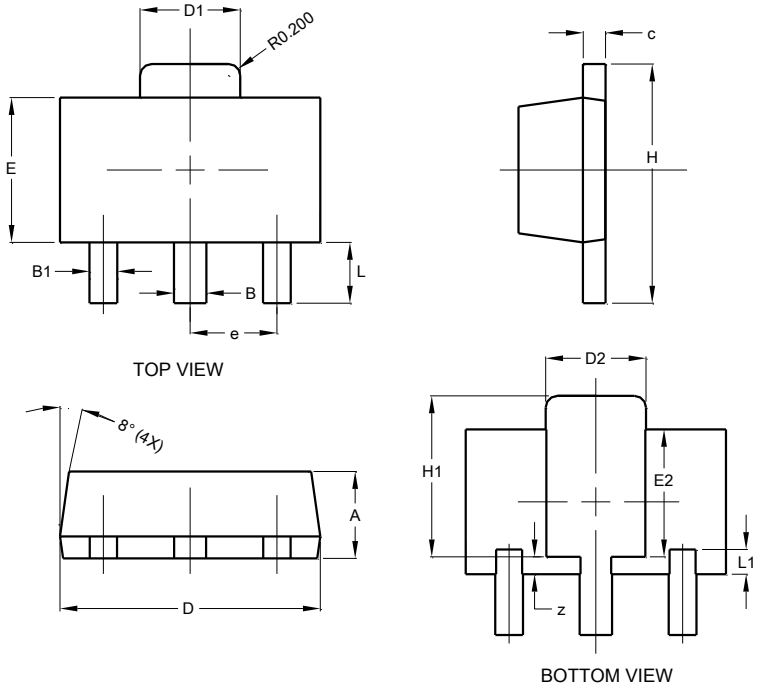
Package Outline Dimensions (All dimensions in mm.)

(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			

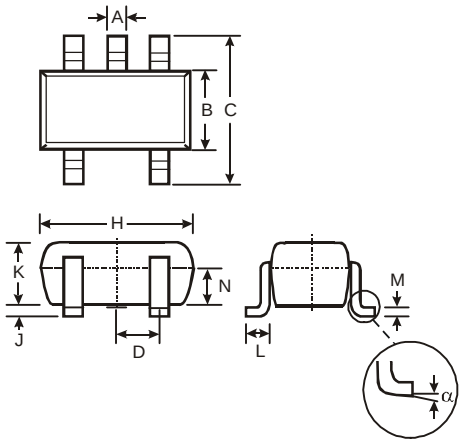
(2) SOT89



SOT89			
Dim	Min	Max	Typ
A	1.40	1.60	1.50
B	0.50	0.62	0.56
B1	0.42	0.54	0.48
c	0.35	0.43	0.38
D	4.40	4.60	4.50
D1	1.62	1.83	1.733
D2	1.61	1.81	1.71
E	2.40	2.60	2.50
E2	2.05	2.35	2.20
e	-	-	1.50
H	3.95	4.25	4.10
H1	2.63	2.93	2.78
L	0.90	1.20	1.05
L1	0.327	0.527	0.427
z	0.20	0.40	0.30
All Dimensions in mm			

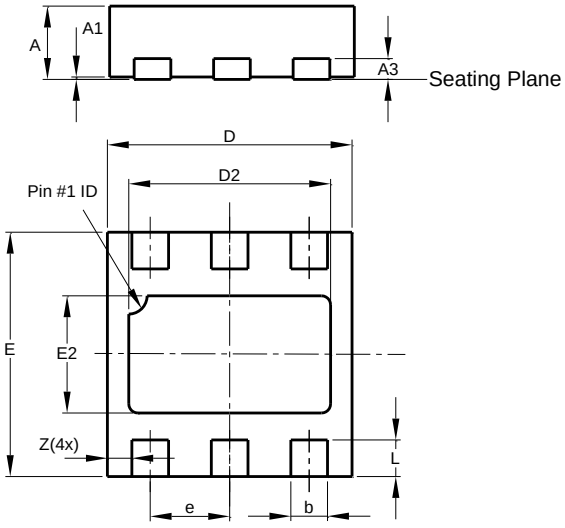
Package Outline Dimensions (All dimensions in mm.) (continued)

(3) 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			

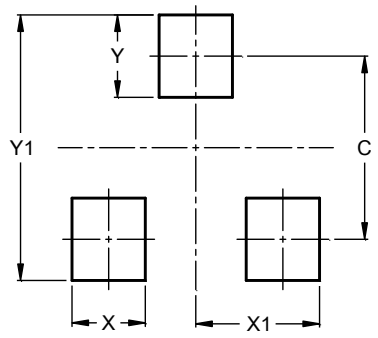
(4) U-DFN2020-6 (Type C)



U-DFN2020-6 Type C			
Dim	**Min**	**Max**	**Typ**
A	0.57	0.63	0.60
A1	0.00	0.05	0.02
A3	—	—	0.15
b	0.25	0.35	0.30
D	1.95	2.075	2.00
D2	1.55	1.75	1.65
E	1.95	2.075	2.00
E2	0.86	1.06	0.96
e	—	—	0.65
L	0.25	0.35	0.30
Z	—	—	0.20
All Dimensions in mm			

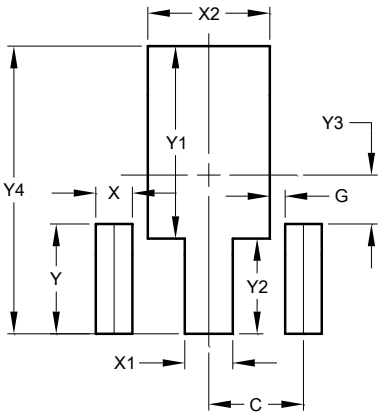
Suggested Pad Layout

(1) SOT23



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

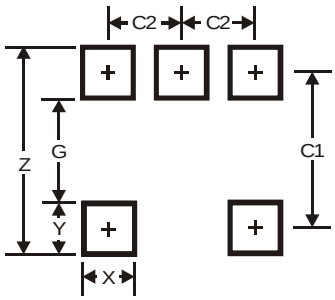
(2) SOT89



Dimensions	Value (in mm)
C	1.500
G	0.244
X	0.580
X1	0.760
X2	1.933
Y	1.730
Y1	3.030
Y2	1.500
Y3	0.770
Y4	4.530

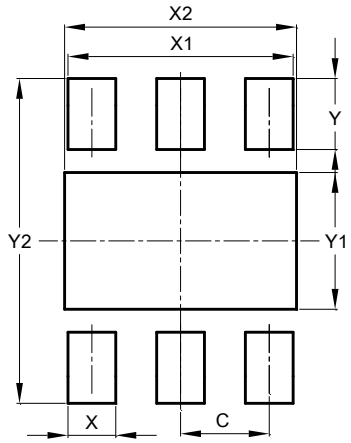
Suggested Pad Layout (continued)

(3) SOT25



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

(4) U-DFN2020-6 (Type C)



Dimensions	Value (in mm)
C	0.650
X	0.350
X1	1.650
X2	1.700
Y	0.525
Y1	1.010
Y2	2.400

Mechanical Data

- Moisture Sensitivity:
  - SOT23/SOT25/U-DFN2020-6 (Type C): Level 1 Per J-STD-020
  - SOT89: Level 3 Per J-STD-020
- Terminals:
  - SOT89/ SOT23/ SOT25: Finish - Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 e3
  - U-DFN2020-6 (Type C): Finish - NiPdAu over Copper Leads, Solderable per MIL-STD-202, Method 208 e4
- Weight:
  - SOT89: 0.054 grams (Approximate)
  - SOT23: 0.009 grams (Approximate)
  - SOT25: 0.018 grams (Approximate)
  - U-DFN2020-6 (Type C): 0.007 grams (Approximate)