Description

The AP7375 series is a wide input voltage range (45V), low quiescent current (2.1μA), low-dropout linear regulator (LDO) able to provide 300mA load current. The AP7375 family LDO offers an EN pin that takes an input voltage of 45V to enable and disable the LDO output.

The device features very fast response times against line voltage transient and load current transient, and ensures no overshoot voltage during start-up and short-circuit recovery. It also features integrated short-circuit and thermal shutdown protection.

The AP7375 has 1.8V, 3.0V, 3.3V, 3.6V and 5.0V fixed output voltage versions, and is available in the SOT23, SOT25, SOT89 and U-DFN2020-6 (SWP) (Type UXC) packages.

Features

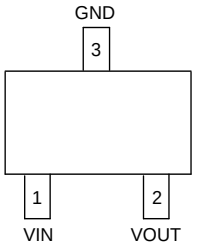
- Wide Input Voltage Range: 3V to 45V
- Maximum Output Current: 300mA
- Low Dropout Voltage:
  V_{DROP} = 35mV @ I_{OUT} = 10mA (typ.)
  V_{DROP} = 350mV @ I_{OUT} = 100mA (typ.)
- Low Quiescent Current: 2.1μA (typ.)
- Fixed Output Voltages: 1.8V, 3.0V, 3.3V, 3.6V and 5.0V
- High Output Voltage Accuracy: ±2%
- High PSRR: 85dB @ 1kHz
- Excellent Line/Load Regulation
- Thermal Shutdown Function
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **An automotive-compliant part is available under separate datasheet (AP7375Q)**

Applications

- Battery-powered equipments
- Smoke detectors and sensors
- Microcontroller applications
- Home appliances

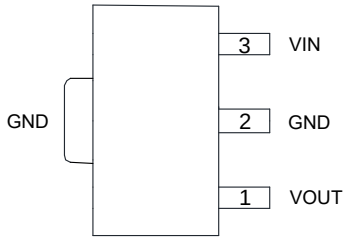
Pin Assignments

(Top View)



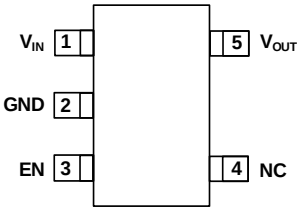
SOT23

(Top View)



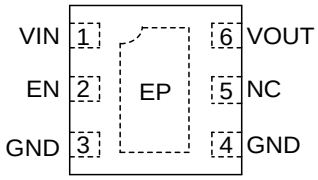
SOT89

(Top View)



SOT25

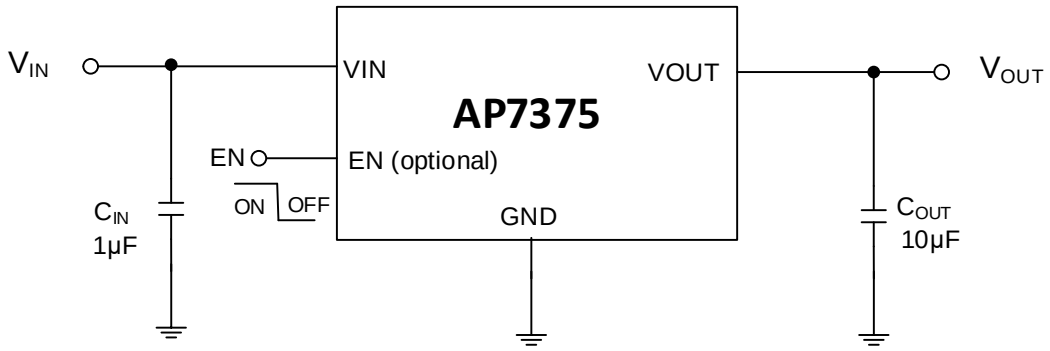
(Top View)



U-DFN2020-6 (SWP) (Type UXC)

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

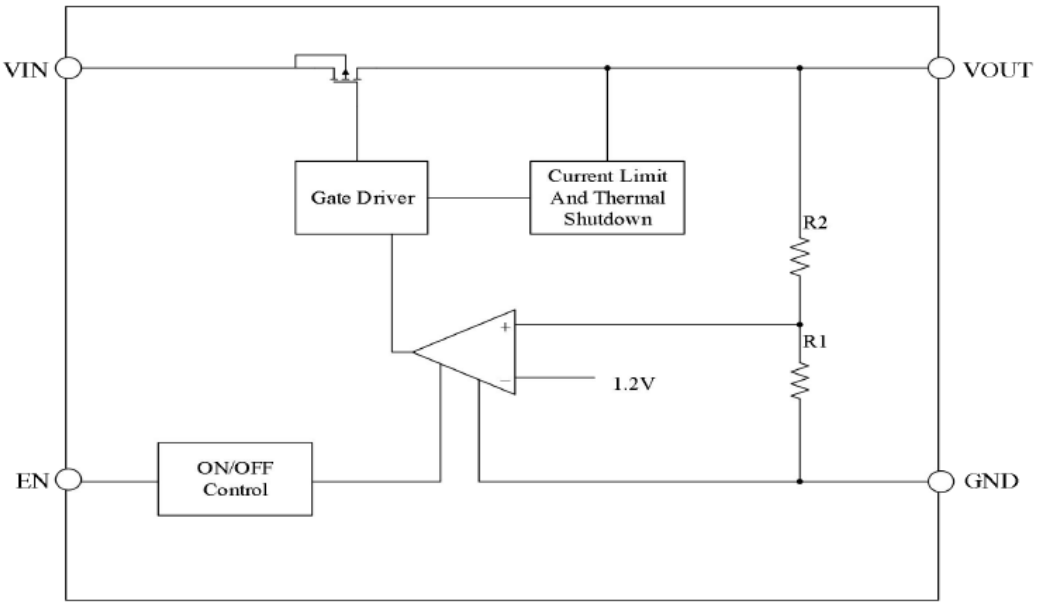
Typical Applications Circuit



Pin Descriptions

Pin Number				Pin Name	Function
SOT25	SOT23	SOT89	U-DFN2020-6 (SWP) (Type UXC)		
1	1	3	1	VIN	Input voltage
2	3	2	3, 4	GND	Ground
3	—	—	2	EN	Enable
5	2	1	6	VOUT	Regulated output voltage
4	—	—	5	NC	Not Connected internally, recommend connect to GND to maximize PCB copper for thermal dissipation.
—	—	—	EP	Expose 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

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 to 55		V
V_{OUT}	Regulated Output Voltage	-0.3 to 6		V
—	V_{OUT} to V_{IN}	-55 to 0.3		V
V_{EN}	EN to GND	-0.3 to 55		V
I_{OUT}	Output Current	Internally limited		mA
T_{LEAD}	Lead Temperature (Soldering, 10sec)	+260		ºC
T_J	Operating Junction Temperature	+150		ºC
T_A	Operating Ambient Temperature	-40 to +85		ºC
θ_{JA}	Thermal Resistance (Junction to Ambient)	SOT25	153	°C/W
		SOT23	164	
		SOT89	95	
		U-DFN2020-6 (SWP) (Type UXC)	99.5	
T_{STG}	Storage Temperature Range	-40 to +150		ºC
CDM	ESD (Change Device Model)	1.5V		kV
HBM	ESD (Human Body Model)	4V		kV

Note: 4. a). Stresses greater than 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 or any other conditions beyond those indicated under *"Recommended Operating Conditions"* is not implied. Exposure to *"Absolute Maximum Ratings"* for extended periods can 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	3.0	—	45	V
V_{OUT}	Output Voltage	—	—	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.)

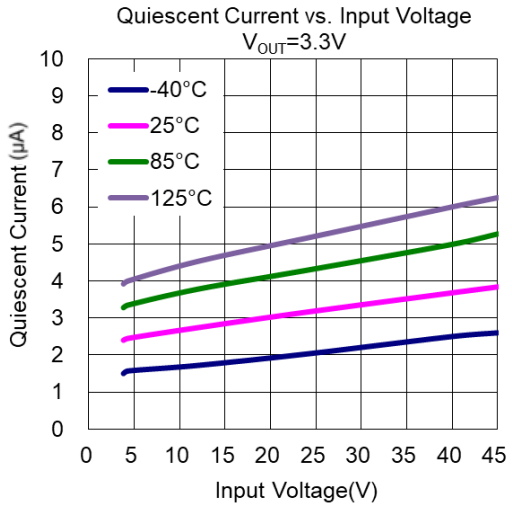
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Input Voltage	—	3	—	45	V
I_{GND}	Quiescent Current	V_{IN} = 12V, No Load	—	2.1	5	µA
V_{OUT}	Output Voltage	V_{IN} = 12V, I_{OUT} = 10mA	V_{OUT}x98%	—	V_{OUT}x102%	V
I_{OUT_MAX}	Output Current	—	300	350	—	mA
V_{DROP}	Dropout Voltage	I_{OUT} = 10mA, V_{IN} = V_{OUTNOM} – 0.1V	—	35	50	mV
		I_{OUT} = 100mA, V_{IN} = V_{OUTNOM} – 0.1V	—	350	360	mV
$\triangle V_{OUT}(\triangle I_{OUT})$	Load Regulation (Note 5)	V_{IN} = 12V, 1mA ≤ I_{OUT} ≤ 100mA	—	0.02	0.025	%/mA
$\triangle V_{OUT}(\Delta V_{IN})$	Line Regulation	V_{OUTNOM} + 0.5 V ≤ V_{IN} ≤ 45V, I_{OUT} = 1mA	—	0.01	0.02	%/V
I_{LIMIT}	Current Limit	—	—	500	—	mA
T_{OTSD}	Thermal Shutdown Temperature	—	—	+150	—	°C
T_{HYOTSD}	Thermal Shutdown Hysteresis	—	—	+20	—	°C
PSRR	Power Supply Rejection Ratio	V_{IN} = 12V, I_{OUT} = 10mA, V_{OUT} = 3.3V @ 1kHz	—	85	—	dB
VENH	EN High Level	Enabled	1	—	—	V
VENL	EN Low Level	Disabled	—	—	0.4	V
θ_{JC}	Thermal Resistance Junction to Case (Note 4)	SOT25	—	54	—	°C/W
		SOT23	—	85	—	
		SOT89	—	44	—	
		U-DFN2020-6 (SWP) (Type UXC)	—	15.8	—	

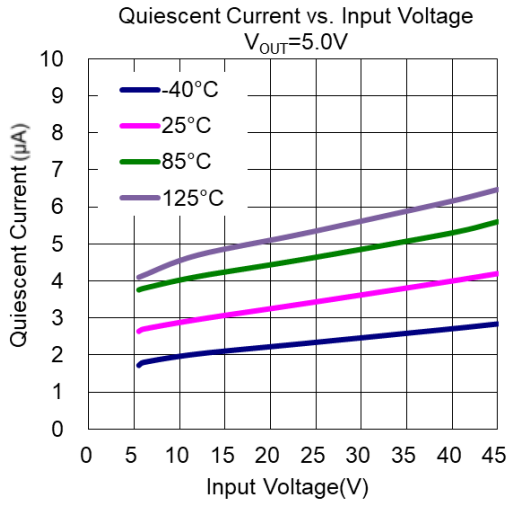
Notes: 4. a). Stresses greater than those listed under *"Absolute Maximum Ratings"* can cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *"Recommended Operating Conditions"* is not implied. Exposure to *"Absolute Maximum Ratings"* for extended periods can affect device reliability.

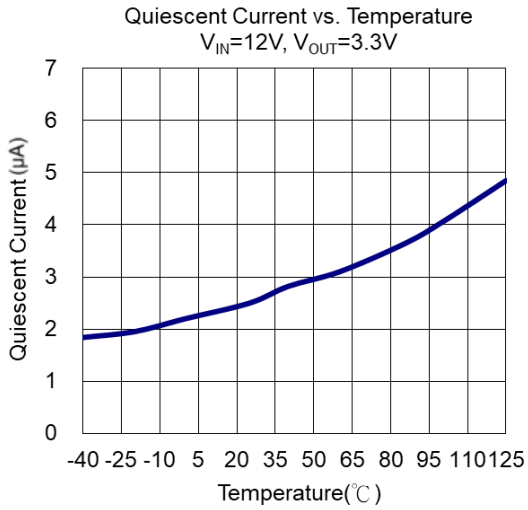
b). Ratings apply to ambient temperature at +25°C. The JEDEC STD.51 High-K board design used to derive this data was a 3 inch x 3 inch multilayer board with 1oz. internal power and ground planes and 2oz. copper traces on the top and bottom of the board.

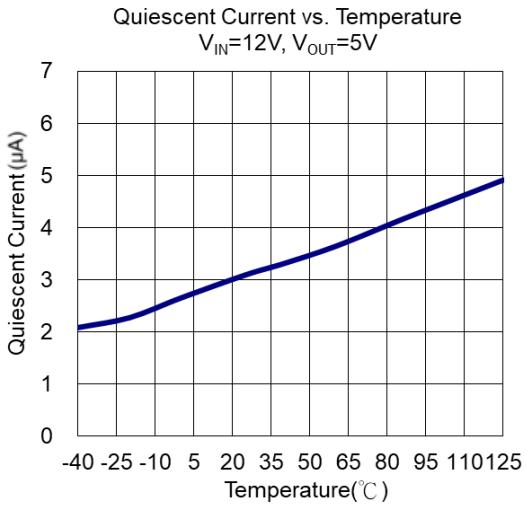
5. The AP7375 internal circuitry is not fully operation until V_{IN} is at least the greater of 3V or (V_{OUT} + $V_{DROPOUT(MAX)}$).

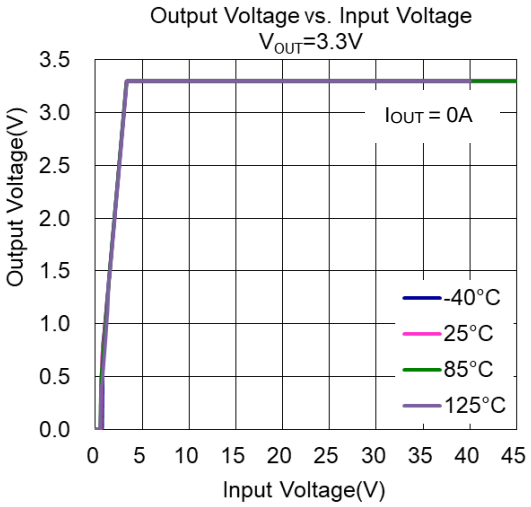
Performance Characteristics

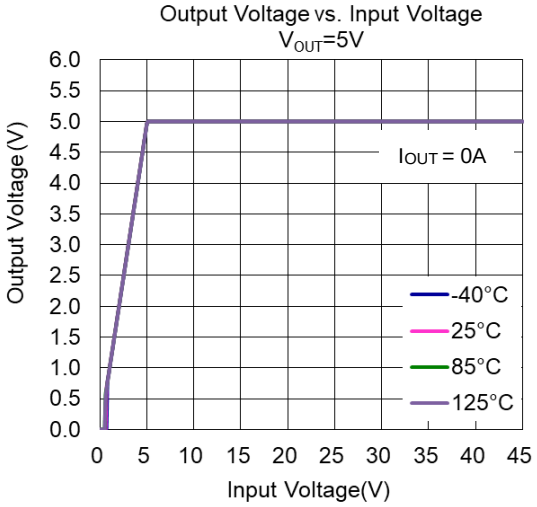




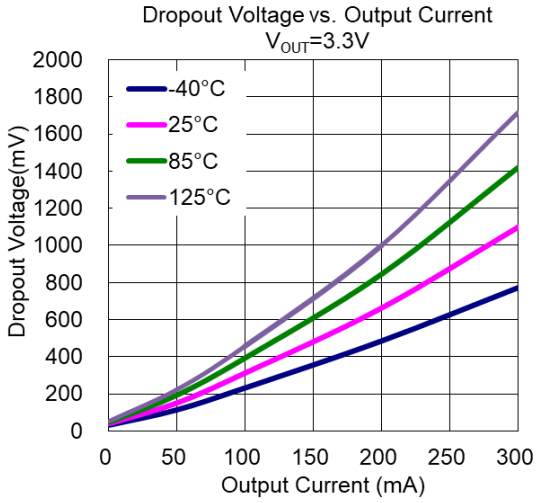


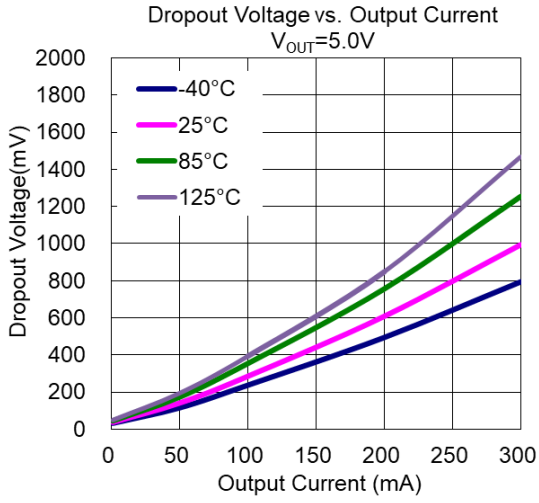


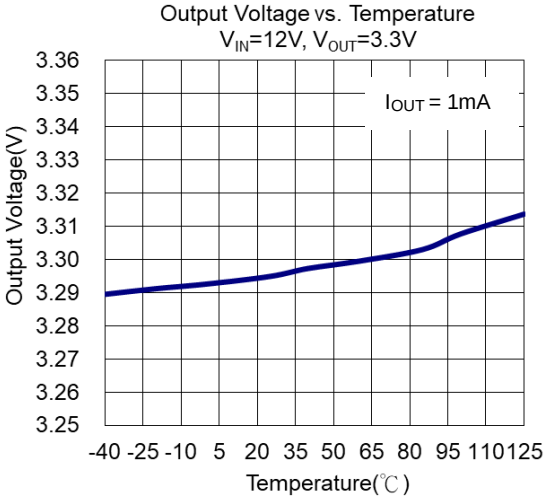


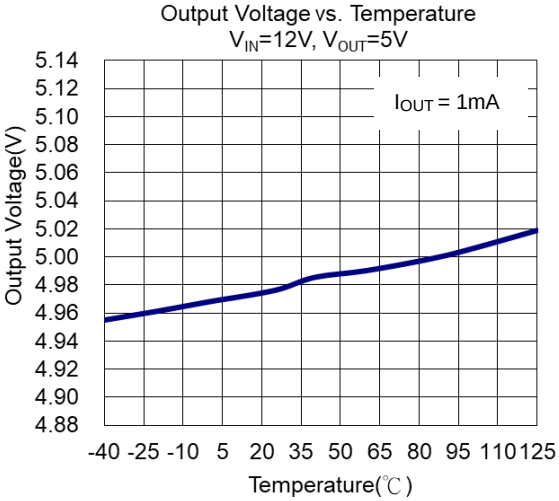


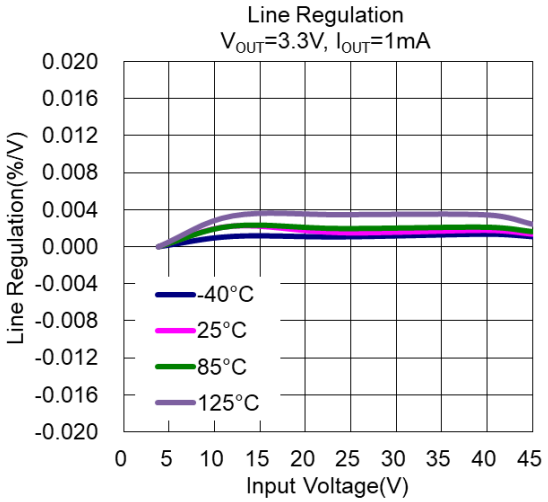
Typical Characteristics (continued)

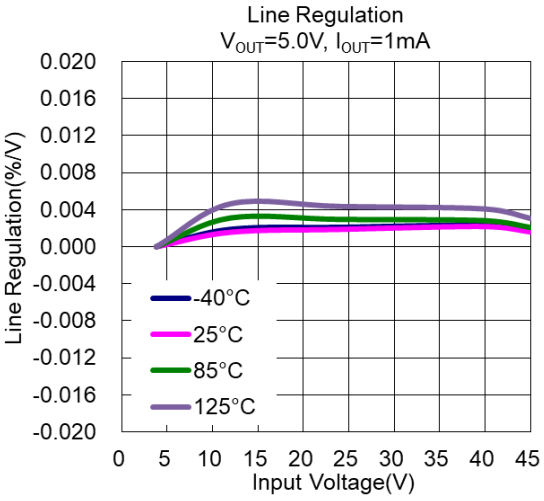




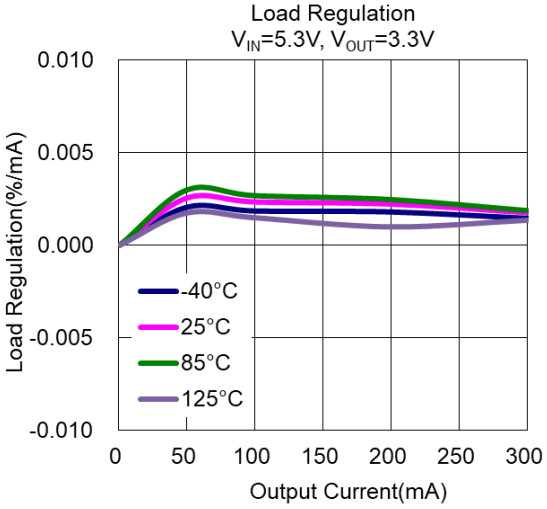


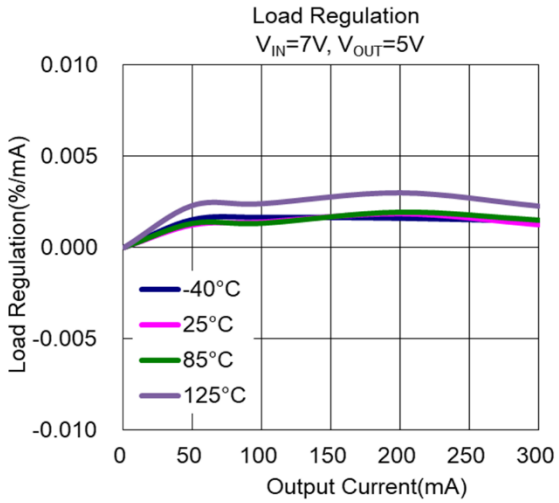


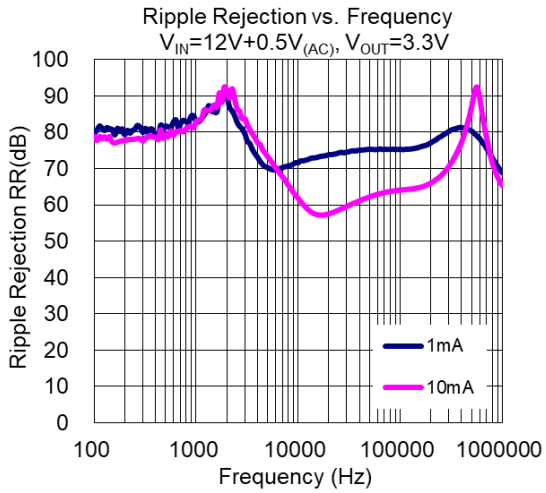


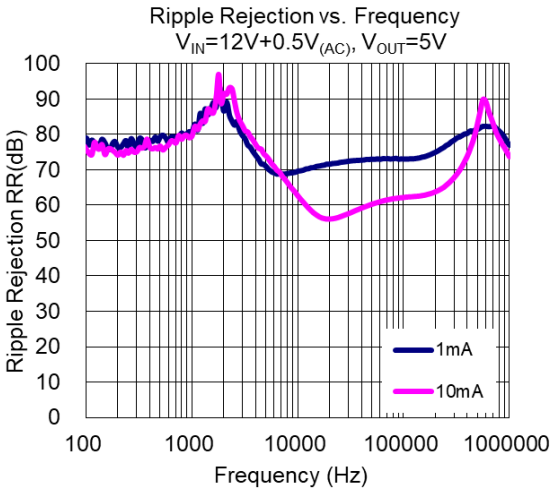


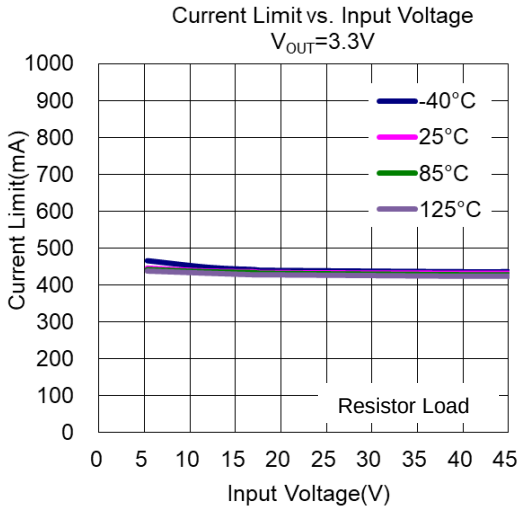
Typical Characteristics (continued)

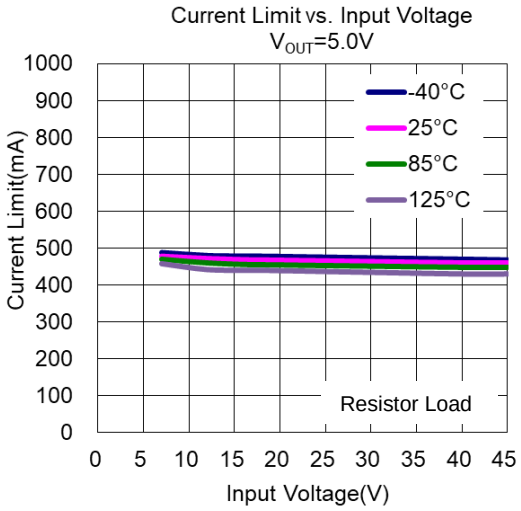






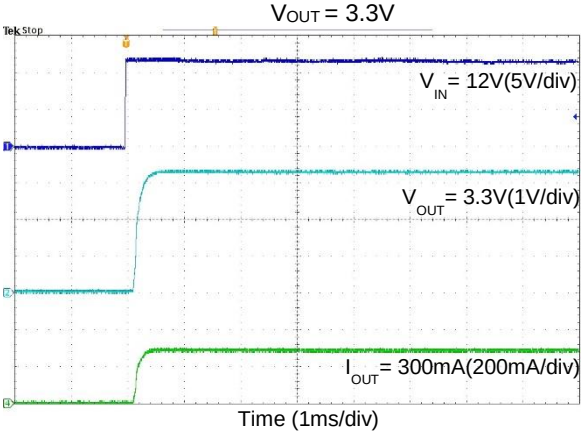






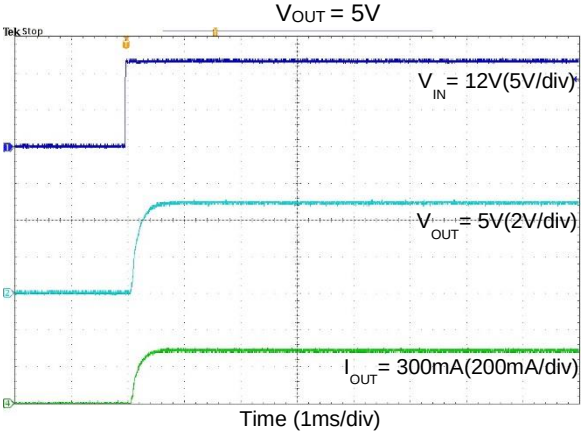
Typical Characteristics (continued)

Power On
V_{OUT} = 3.3V



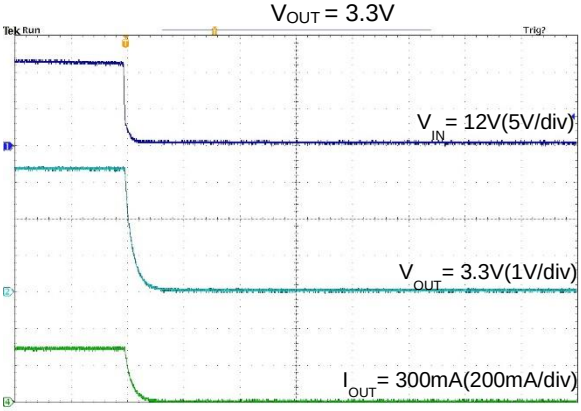
Time (1ms/div)

Power On
V_{OUT} = 5V



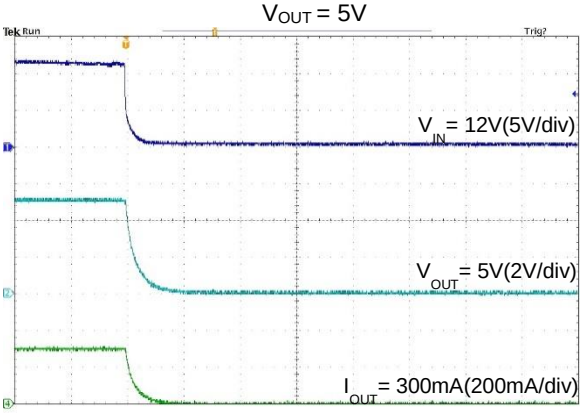
Time (1ms/div)

Power Off
V_{OUT} = 3.3V



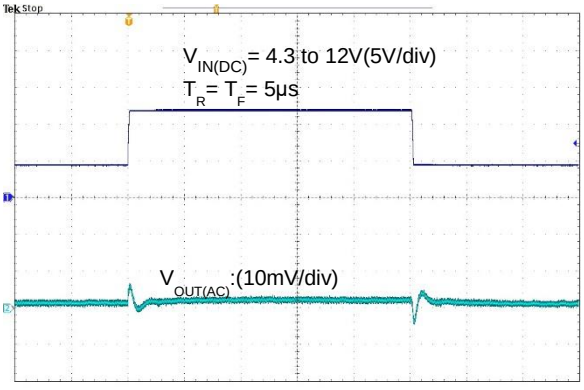
Time (1ms/div)

Power Off
V_{OUT} = 5V



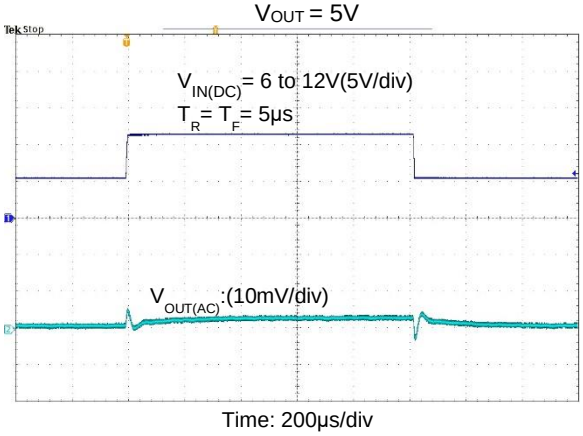
Time (1ms/div)

Line Transient Response
V_{OUT} = 3.3V



Time: 200µs/div

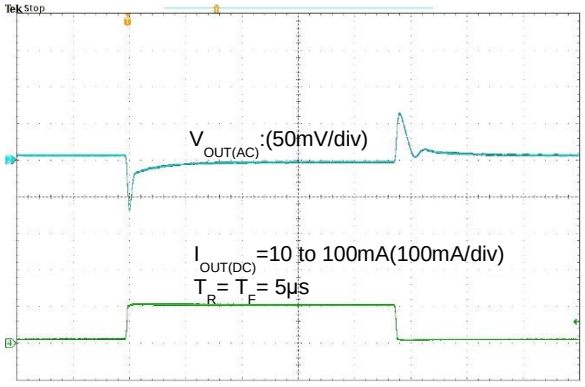
Line Transient Response
V_{OUT} = 5V



Time: 200µs/div

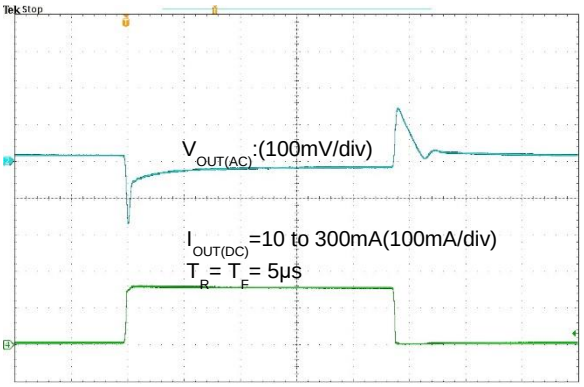
Typical Characteristics (continued)

Load Transient Response
V_{OUT} = 3.3V



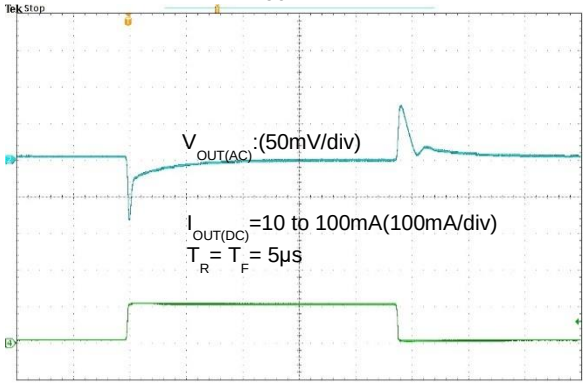
Time: 200μs/div

Load Transient Response
V_{OUT} = 3.3V



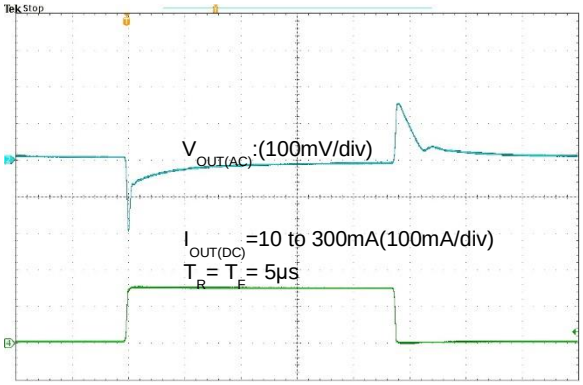
Time: 200μs/div

Load Transient Response
V_{OUT} = 5V



Time: 200μs/div

Load Transient Response
V_{OUT} = 5V



Time: 200μs/div

Application Information

Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended minimum output capacitance is 10μF. A ceramic capacitor is recommended, and temperature characteristics are X7R or X5R. Higher capacitance values help to improve load/line transient response. The output capacitance may be increased to keep low undershoot/overshoot. Place output capacitor as close as possible to VOUT and GND pins.

Input Capacitor

A 1μF ceramic capacitor is recommended to connect between VIN and GND pins to decouple input power supply glitch and noise. The amount of the capacitance may be increased without limit. This input capacitor must be located as close as possible to the device to assure input stability and less noise. For PCB layout, a wide copper trace is required for both VIN and GND.

Current Limit and Short Circuit Protection

When output current at VOUT pin is higher than current-limit threshold or the VOUT pin is direct short to GND, the current-limit protection will be triggered and clamp the output current at a pre-designed level to prevent overcurrent and thermal damage.

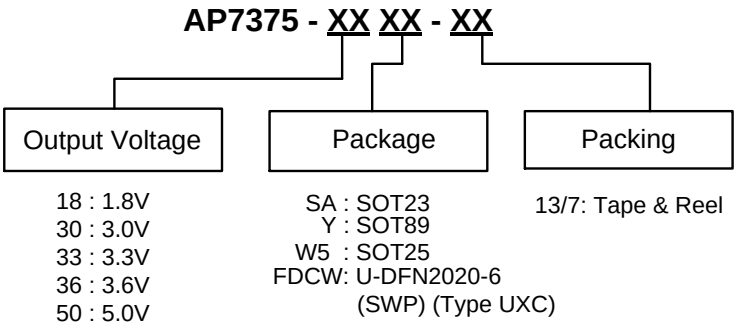
Thermal Protection

The AP7375 has internal thermal sense and protection circuits. When excessive power dissipation happens on the device, such as short circuit at the output pin or very heavy load current with a large voltage drop across the device, the internal thermal protection circuit will be triggered, and it will shut down the power MOSFET to prevent the LDO from damage. As soon as excessive thermal condition is removed and the temperature of the device drops down, the thermal protection circuit will lease the control of the power MOSFET, and the LDO device goes to normal operation.

Layout Considerations

For good ground loop and stability, the input and output capacitors should be located close to the input, output, and ground pins of the device. The regulator ground 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.

Ordering Information

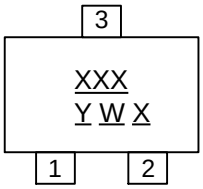


Part Number	Package Code	Package	Packing	
			Qty.	Carrier
AP7375-XXSA-7	SA	SOT23	3000	7” Tape & Reel
AP7375-XXY-13	Y	SOT89	2500	13” Tape & Reel
AP7375-XXW5-7	W5	SOT25	3000	7” Tape & Reel
AP7375-XXFDCW-7	FDCW	U-DFN2020-6 (SWP) (Type UXC)	3000	7” Tape & Reel

Marking Information

(1) SOT23

(Top View)

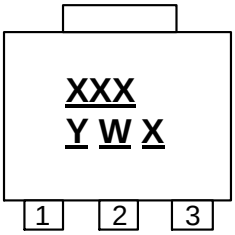


XXX : Identification Code
Y : Year 0 to 9
W : Week : A to Z : 1 to 26 Week;
a to z : 27 to 52 Week; z Represents 52 and 53 Week
X : Internal Code

Part Number	Package	Identification Code
AP7375-18SA-7	SOT23	H5A
AP7375-30SA-7	SOT23	H5B
AP7375-33SA-7	SOT23	H5C
AP7375-50SA-7	SOT23	H5D

(2) SOT89

(Top View)



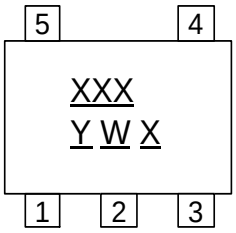
XXX : Identification Code
Y : Year : 0 to 9
W : Week : A to Z : 1 to 26 Week;
a to z : 27 to 52 Week;
z Represents 52 and 53 Week
X : Internal Code

Part Number	Package	Identification Code
AP7375-18Y-13	SOT89	H5A
AP7375-30Y-13	SOT89	H5B
AP7375-33Y-13	SOT89	H5C
AP7375-50Y-13	SOT89	H5D

Marking Information (continued)

(3) SOT25

(Top View)

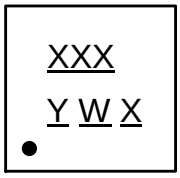


XXX : Identification Code
Y : Year 0 to 9
W : Week A to Z: 1 to 26 Week;
a to z : 27 to 52 Week; z Represents 52 and 53 Week
X : Internal Code

Part Number	Package	Identification Code
AP7375-18W5-7	SOT25	H5A
AP7375-30W5-7	SOT25	H5B
AP7375-33W5-7	SOT25	H5C
AP7375-36W5-7	SOT25	H5J
AP7375-50W5-7	SOT25	H5D

(4) U-DFN2020-6 (SWP) (Type UXC)

(Top View)



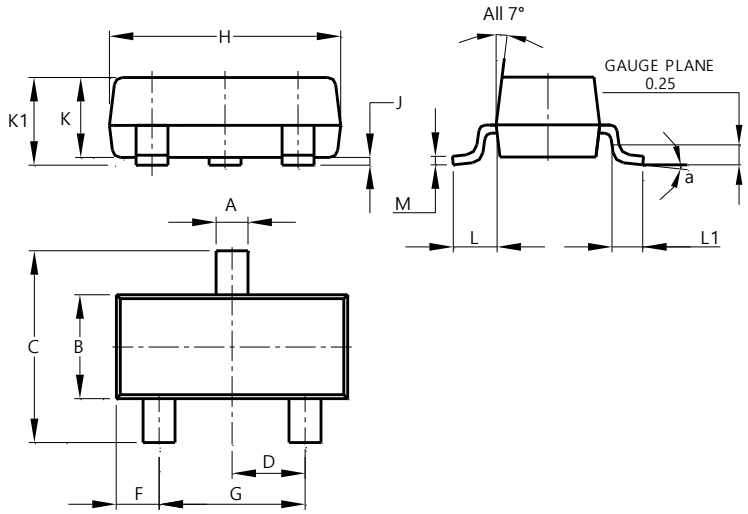
XXX : Identification Code
Y : Year : 0 to 9
W : Week : A to Z : 1 to 26 Week;
a to z : 27 to 52 Week; z Represents 52 and 53 Week
X : Internal Code

Part Number	Package	Identification Code
AP7375-18FDCW-7	U-DFN2020-6 (SWP) (Type UXC)	H5A
AP7375-30FDCW-7	U-DFN2020-6 (SWP) (Type UXC)	H5B
AP7375-33FDCW-7	U-DFN2020-6 (SWP) (Type UXC)	H5C
AP7375-36FDCW-7	U-DFN2020-6 (SWP) (Type UXC)	H5J
AP7375-50FDCW-7	U-DFN2020-6 (SWP) (Type UXC)	H5D

Package Outline Dimensions

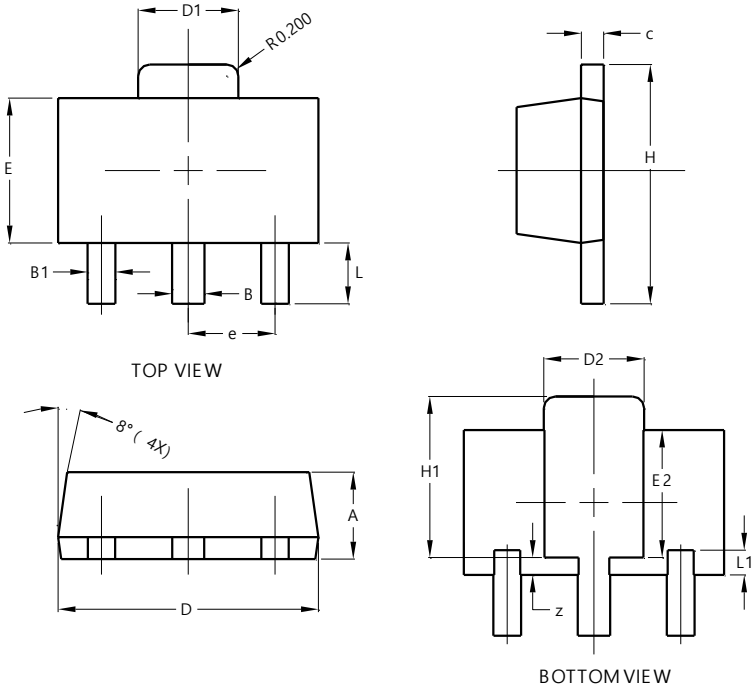
Please see http://www.diodes.com/package-outlines.html for the latest version.

(1) 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

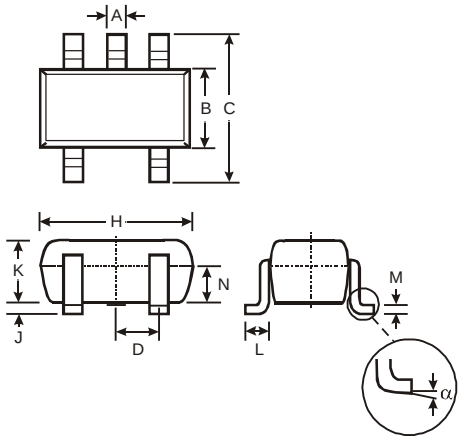


SOT89			
Dim	**Min**	**Max**	**Typ**
A	1.40	1.60	1.50
B	0.50	0.62	0.56
B1	0.42	0.54	0.48
c	0.35	0.43	0.38
D	4.40	4.60	4.50
D1	1.62	1.83	1.733
D2	1.61	1.81	1.71
E	2.40	2.60	2.50
E2	2.05	2.35	2.20
e	-	-	1.50
H	3.95	4.25	4.10
H1	2.63	2.93	2.78
L	0.90	1.20	1.05
L1	0.327	0.527	0.427
z	0.20	0.40	0.30
All Dimensions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

Package Outline Dimensions (continued)

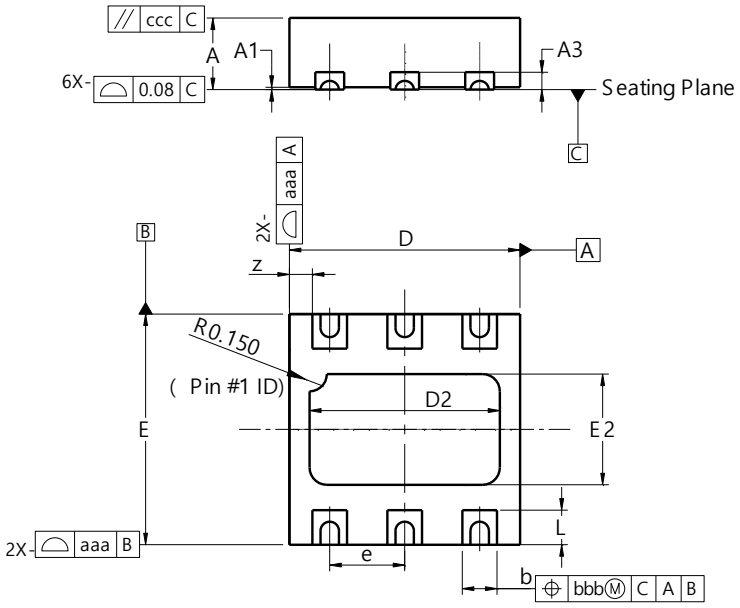
Please see http://www.diodes.com/package-outlines.html for the latest version.

(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 (SWP) (Type UXC)

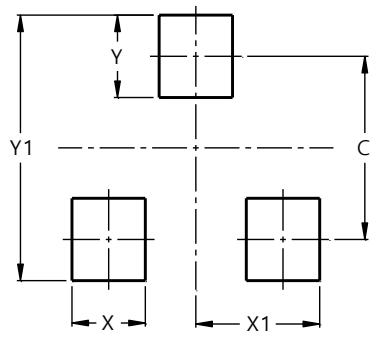


U-DFN2020-6 (SWP) (Type UXC)			
Dim	**Min**	**Max**	**Typ**
A	0.57	0.63	0.60
A1	0.00	0.05	0.02
A3	—	—	0.13
b	0.25	0.35	0.30
D	1.95	2.075	2.00
D2	1.55	1.75	1.65
E	1.95	2.075	2.00
E2	0.86	1.06	0.96
e	—	—	0.65
L	0.25	0.35	0.30
z	—	—	0.20
aaa	0.25		
bbb	0.10		
ccc	0.10		
All Dimensions in mm			

Suggested Pad Layout

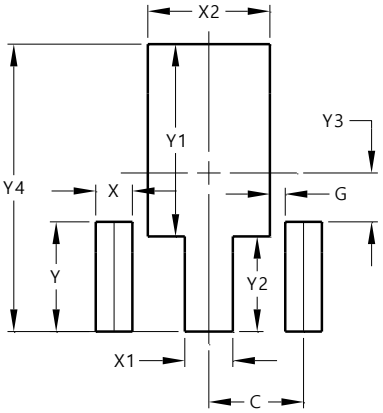
Please see http://www.diodes.com/package-outlines.html for the latest version.

(1) SOT23



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

(2) SOT89

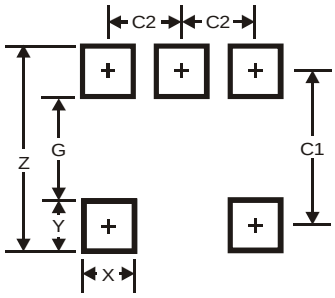


Dimensions	Value (in mm)
C	1.500
G	0.244
X	0.580
X1	0.760
X2	1.933
Y	1.730
Y1	3.030
Y2	1.500
Y3	0.770
Y4	4.530

Suggested Pad Layout (continued)

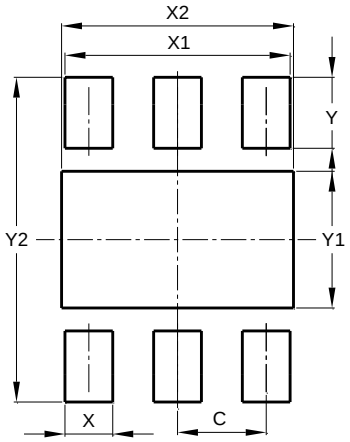
Please see http://www.diodes.com/package-outlines.html for the latest version.

(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 (SWP) (Type UXC)



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: Level 1 Per J-STD-020
- Terminals:
  - SOT23/SOT25/SOT89: Finish - Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 e3
  - U-DFN2020-6 (SWP) (Type UXC): 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 (SWP) (Type UXC): 0.007 grams (Approximate)

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