

ΕN

(Top View)

### AUTOMOTIVE COMPLIANT WIDE INPUT VOLTAGE RANGE 300mA ULDO REGULATOR

**Pin Assignments** 

(Top View)

GND

VIN 1

GND 2

EN 3

### Description

The AP7375Q 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 AP7375Q family of LDOs offers an EN pin to enable and disable the LDO output. The EN pin can take an input voltage of 45V.

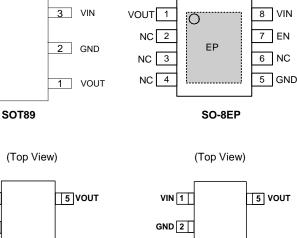
The device provides a very fast response against line voltage transient and load current transient, and ensures no overshoot voltage occurs during startup and short-circuit recovery. It also features integrated short-circuit and thermal-shutdown protection.

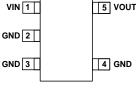
The AP7375Q has 1.8V, 3.0V, 3.3V, and 5.0V fixed output voltage versions, and is available in the SOT89, SO-8EP, SOT25 and U-DFN2020-6 (SWP) (Type UXC) packages.

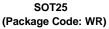
### Features

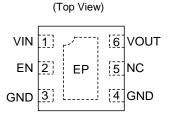
- Wide Input Voltage Range: 3V to 45V
- Maximum Output Current: 300mA
- Low Dropout Voltage:
  - $V_{DROP} = 35mV @I_{OUT} = 10mA (typ)$
  - VDROP = 350mV @IOUT = 100mA (typ) .
- Low Quiescent Current: 2.1µA (typ)
- Fixed Output Voltages: 1.8V, 3.0V, 3.3V and 5.0V
- High Output Voltage Accuracy: ±2%
- High PSRR: 85dB@1kHz
- Excellent Line/Load Regulation
- Thermal Shutdown Function
- Short-Current Protection Function
- Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)
- Halogen and Antimony Free. "Green" Device (Note 3)
- The AP7375Q is suitable for automotive applications requiring specific change control; this part is AEC-Q100 qualified, PPAP capable, and manufactured in IATF 16949 certified facilities.

https://www.diodes.com/quality/product-definitions/









SOT25

(Package Code: W5)

4 NC

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

### Applications

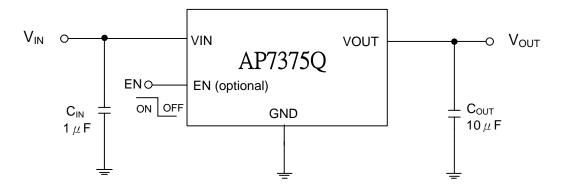
- Powering MCUs and CAN/LIN transceivers
- Automotive head units
- EV and HEV battery management systems
- Body control modules
- Transmission control units (TCUs)

1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant. Notes:

- 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**

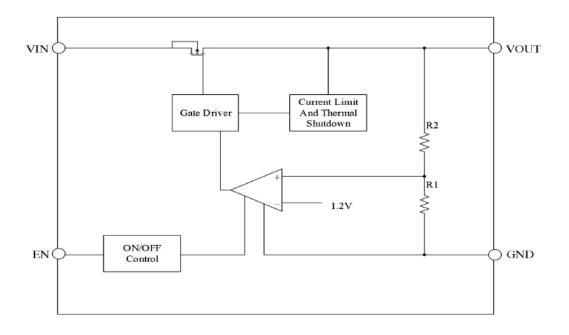


# **Pin Descriptions**

	Pin Number					
SOT89	SO-8EP	SOT25 (Package Code: W5)	SOT25 (Package Code: WR)	U-DFN2020-6 (SWP) (Type UXC)	Pin Name	Function
3	8	1	1	1	VIN	Input voltage
2	5	2	2, 3, 4	3, 4	GND	Ground
_	7	3	—	2	EN	Enable
1	1	5	5	6	VOUT	Regulated output voltage
	2, 3, 4, 6	4	_	5	NC	Not connected internally, recommend connect to GND to maximize PCB copper for thermal dissipation.
_	EP	_	_	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)

Symbol	Parameter	Rating		Unit	
Vin	Supply Input Voltage	-0.3 to 55		V	
Vout	Regulated Output Voltage	-0.3 to 6		V	
V <sub>EN</sub>	EN to GND	-0.3 to 55		V	
IOUT	Output Current	Internally limited		mA	
TLEAD	Lead Temperature (Soldering, 10sec)	+260		°C	
TJ	Operating Junction Temperature	+150		°C	
TA	Operating Ambient Temperature	-40 to +125		°C	
		SOT89	94.5		
0	Thermal Resistance	SO-8EP	47.7	°C/W	
θја	(Junction to Ambient)	SOT25	135.5	-C/W	
		U-DFN2020-6 (SWP) (Type UXC)	99.5		
T <sub>STG</sub>	Storage Temperature Range	-40 to +150		°C	
CDM	ESD (Charge Device Model)	±1.5		kV	
HBM	ESD (Human Body Model)	3		kV	

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. Note:



### **Recommended Operating Conditions**

Symbol	Parameter	Min	Тур	Max	Unit
VIN	Supply Input Voltage	3.0	—	45	V
Vout	Output Voltage	—	—	5	V
TJ	Operating Junction Temperature	-40	—	+125	°C
CIN	Input Capacitor		1	—	μF
COUT	Output Capacitor	1	10	—	μF

### Electrical Characteristics (T<sub>A</sub> = -40°C to +125°C, Iout = 1mA, C<sub>IN</sub> = 1µF, Cout = 10µF ceramic capacitor, V<sub>IN</sub> = Voutnom +2.0V)

Symbol	Parameter	Test Conditions	Min	Тур	Мах	Unit	
Vin	Input Voltage		3	_	45	V	
I <sub>GND</sub>	Quiescent Current	V <sub>IN</sub> = 12V, No load	—	2.1	8	μA	
Vout	Output Voltage	V <sub>IN</sub> = 12V, I <sub>OUT</sub> = 10mA	Vout x 98%	_	Vout x 102%	V	
IOUT_MAX	Output Current	_	300	350	_	mA	
		$I_{OUT} = 10 \text{mA}, V_{IN} = V_{OUTNOM} - 0.1 \text{V}$	—	35	80	mV	
Vdrop	Dropout Voltage (Note 5)	$I_{OUT} = 100 \text{mA}, V_{IN} = V_{OUTNOM} - 0.1 \text{V}$	—	350	580	mV	
VDROP	Diopour voltage (Note 3)	IOUT = 300mA, $V_{IN} = V_{OUTNOM} - 0.1V$ T <sub>A</sub> = +25°C	—	1200	1400	mV	
∆Vou <u>⊤</u> (∆Iouт <b>)</b>	Load Regulation (Note 6)	$V_{IN} = 12V, 1mA \le I_{OUT} \le 100mA$	_	0.02	0.025	%/mA	
$\triangle VOUT(\Delta VIN)$	Line Regulation	$V_{OUTNOM} + 2V \le V_{IN} \le 45V$ $I_{OUT} = 1mA$	—	0.01	0.02	%/V	
Ilimit	Current Limit		_	500	_	mA	
Totsd	Thermal Shutdown Temperature	_	_	+150	—	°C	
THYOTSD	Thermal Shutdown Hysteresis	—		+10	_	°C	
PSRR	Power Supply Rejection Ratio	V <sub>IN</sub> = 12V, I <sub>OUT</sub> = 10mA V <sub>OUT</sub> = 3.3V@1kHz	_	85	—	dB	
Vn	Output Noise Voltage	BW = 10Hz to 100kHz, Iout = 30mA	—	120	—	µVrms	
VENH	EN High Level	Enabled	1	—	—	V	
VENL	EN Low Level	Disabled	—	_	0.4	V	
		SOT89	—	43.7	—		
0	Thermal Resistance Junction	SO-8EP	—	17.4	—		
θJC	to Case (Note 4)	SOT25	—	36.7	—	°C/W	
		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.

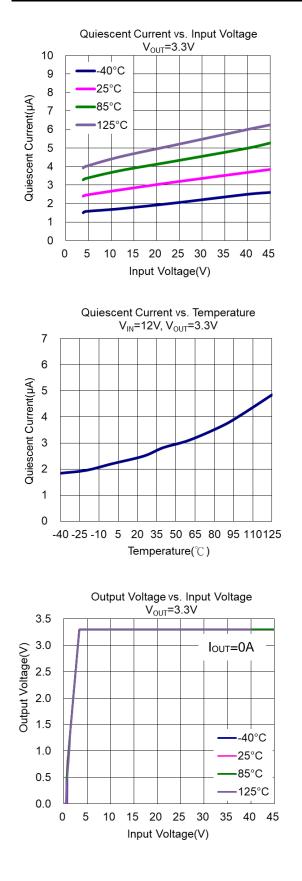
b). Ratings apply to ambient temperature at +25°C. The JEDEC STD.51 High-K board design used to derive this data was a 3 inch x 3 inch multilayer board with 1oz. internal power and ground planes and 2oz. copper traces on the top and bottom of the board. 5. Dropout voltage is the voltage difference between the input and output at which the output voltage drops 100mV below its nominal value. This parameter

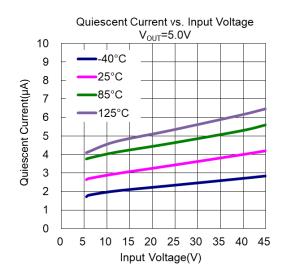
only applies to output voltages above 3.0V since minimum  $V_{IN}$  = 3.0V.

6. The AP7375Q internal circuitry is not fully operational until V<sub>IN</sub> is at least the greater of 3V or (V<sub>OUT</sub> + V<sub>DROPOUT(MAX)</sub>).

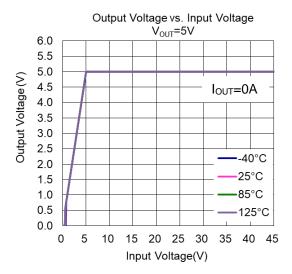


### **Performance Characteristics**



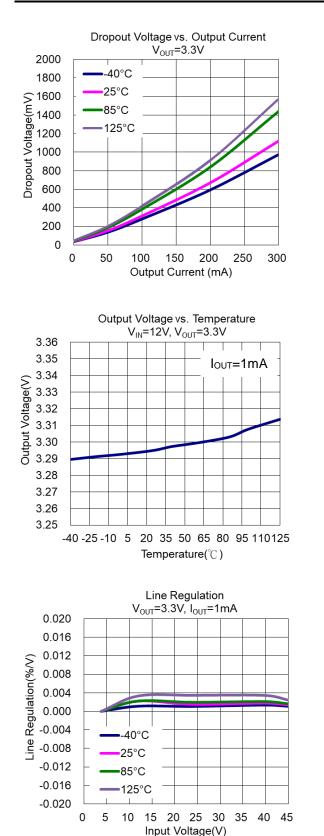


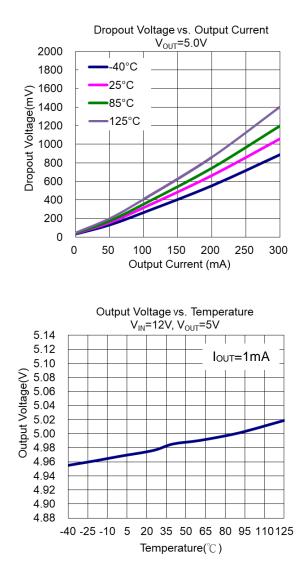
Quiescent Current vs. Temperature VIN=12V, V<sub>OUT</sub>=5V

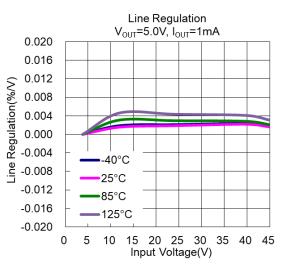




# **Typical Characteristics**

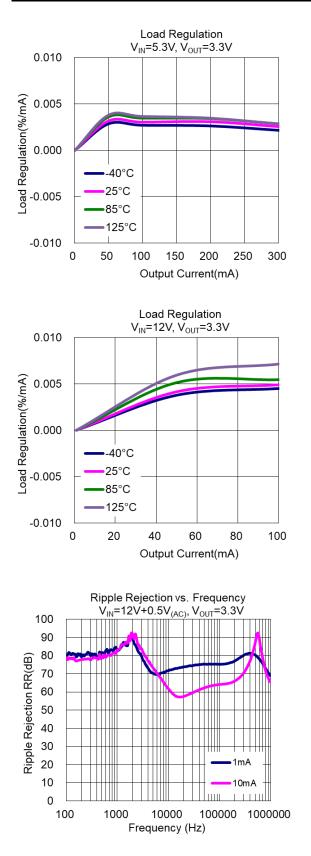


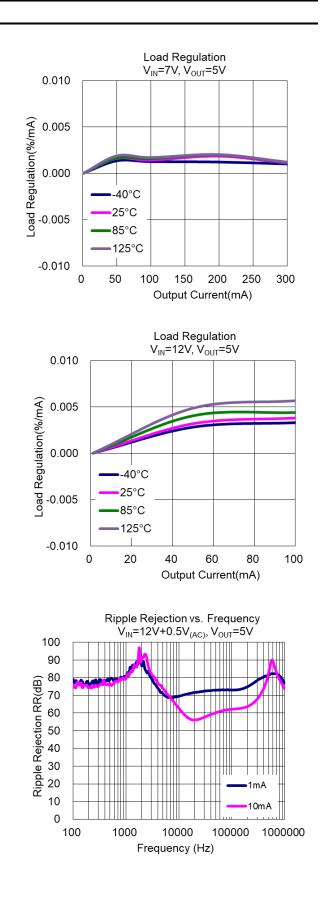






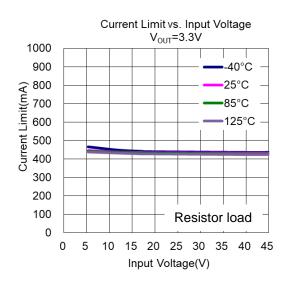
# Typical Characteristics (continued)

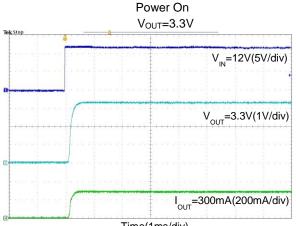




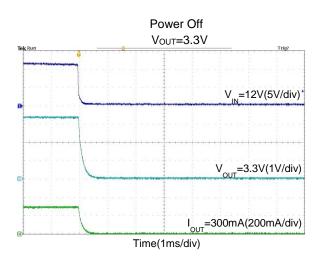


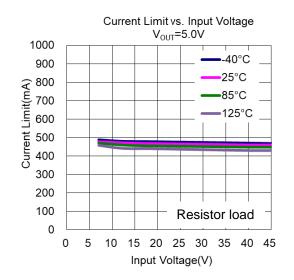
# Typical Characteristics (continued)

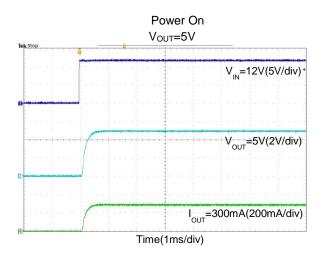


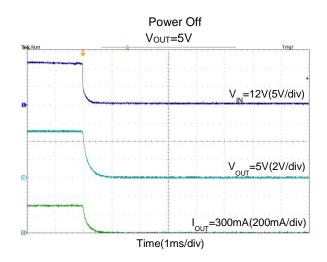






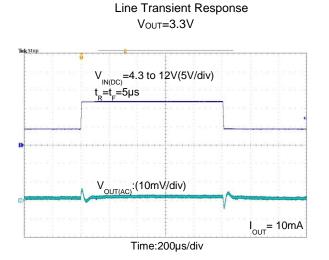




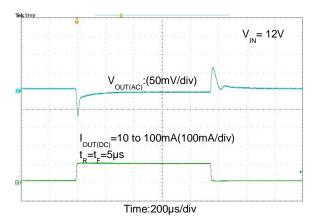


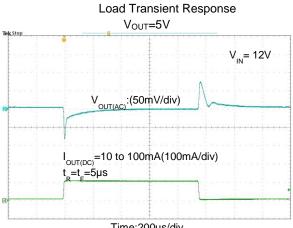


# Typical Characteristics (continued)

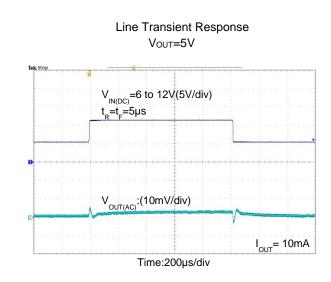


### Load Transient Response Vout=3.3V

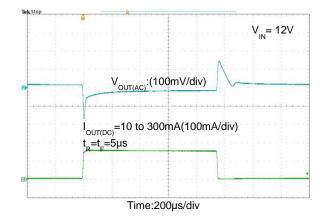


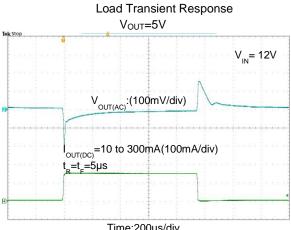


Time:200µs/div



Load Transient Response Vout=3.3V





Time:200µs/div



### **Application Information**

#### **Output Capacitor**

An output capacitor is required for the stability of the LDO. The recommended minimum output capacitance is 1µF. 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 the 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 ensure 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 the current-limit threshold or the VOUT pin directly shorts to GND, current-limit protection will be triggered and clamp the output current at a pre-designed level to prevent overcurrent and thermal damage.

#### **Thermal Protection**

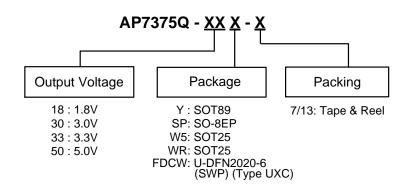
The AP7375Q has internal thermal sense and protection circuits. When excessive power dissipation happens on the device, such as short circuit at the output pin or very heavy load current with a large voltage drop across the device, the internal thermal protection circuit will be triggered, shutting down the power MOSFET to prevent the LDO from damage. As soon as the excessive thermal condition is removed and the temperature of the device drops down, the thermal protection circuit will release the control of the power MOSFET, and the LDO device returns 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<sub>IN</sub> to V<sub>OUT</sub>, and load circuit.



# **Ordering Information**

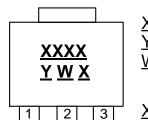


Part Number	Part Number	Daakara Cada	Backage	Pa	cking
	Suffix	Package Code	Package	Qty.	Carrier
AP7375Q-XXY-13	-13	Y	SOT89	2,500	13" Tape & Reel
AP7375Q-XXSP-13	-13	SP	SO-8EP	2,500	13" Tape & Reel
AP7375Q-XXW5-7	-7	W5	SOT25	3,000	7" Tape & Reel
AP7375Q-XXWR-7	-7	WR	SOT25	3,000	7" Tape & Reel
AP7375Q-XXFDCW-7	-7	FDCW	U-DFN2020-6 (SWP) (Type UXC)	3,000	7" Tape & Reel

# **Marking Information**

(1) SOT89

(Top View)

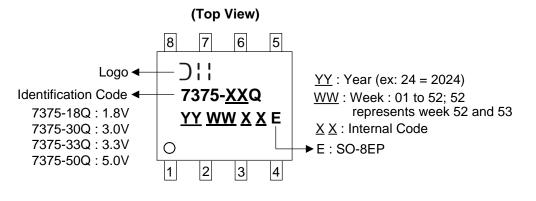


 $\frac{XXXX}{Y} : \text{Identification Code}$   $\frac{Y}{Y} : \text{Year} : 0 \text{ to } 9 \text{ (ex: } 4 = 2024\text{)}$   $\frac{W}{Y} : \text{Week} : A \text{ to } Z : \text{week } 1 \text{ to } 26\text{;}$  a to z : week 27 to 52; z represents week 52 and 53  $\underline{X} : \text{Internal Code}$ 

Part Number	Package	Identification Code
AP7375Q-18Y-13	SOT89	H5AQ
AP7375Q-30Y-13	SOT89	H5BQ
AP7375Q-33Y-13	SOT89	H5CQ
AP7375Q-50Y-13	SOT89	H5DQ

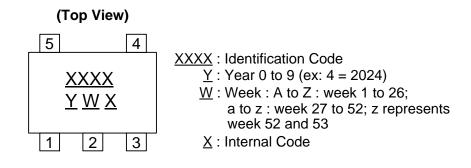


### (2) SO-8EP



Part Number	Package	Identification Code
AP7375Q-18SP-13	SO-8EP	7375-18Q
AP7375Q-30SP-13	SO-8EP	7375-30Q
AP7375Q-33SP-13	SO-8EP	7375-33Q
AP7375Q-50SP-13	SO-8EP	7375-50Q

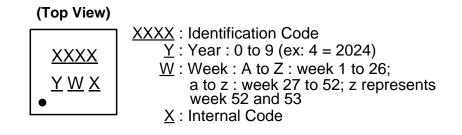
(3) SOT25



Part Number	Package	Identification Code
AP7375Q-18W5-7	SOT25	H5EQ
AP7375Q-30W5-7	SOT25	H5FQ
AP7375Q-33W5-7	SOT25	H5GQ
AP7375Q-50W5-7	SOT25	H5HQ
AP7375Q-18WR-7	SOT25	H5AQ
AP7375Q-30WR-7	SOT25	H5BQ
AP7375Q-33WR-7	SOT25	H5CQ
AP7375Q-50WR-7	SOT25	H5DQ



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



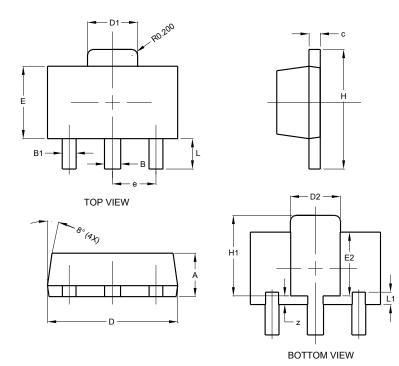
Part Number	Package	Identification Code
AP7375Q-18FDCW-7	U-DFN2020-6 (SWP) (Type UXC)	H5EQ
AP7375Q-30FDCW-7	U-DFN2020-6 (SWP) (Type UXC)	H5FQ
AP7375Q-33FDCW-7	U-DFN2020-6 (SWP) (Type UXC)	H5GQ
AP7375Q-50FDCW-7	U-DFN2020-6 (SWP) (Type UXC)	H5HQ



# **Package Outline Dimensions**

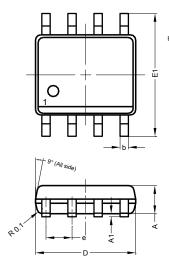
Please see http://www.diodes.com/package-outlines.html for the latest version.

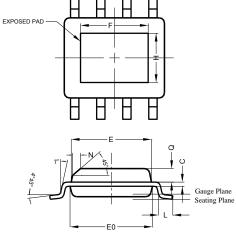
### (1) SOT89



	SOT89						
Dim	Min Max Typ						
Α	1.40	1.60	1.50				
В	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				
Е	2.40	2.60	2.50				
E2	2.05	2.35	2.20				
е	-	-	1.50				
Н	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	Dimen	sions	in mm				

### (2) Package Type: SO-8EP





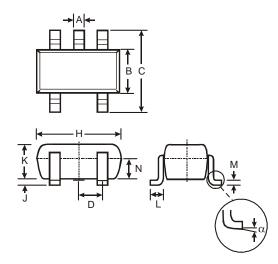
	SO-8	BEP	
Dim	Min	Max	Тур
Α	1.40	1.50	1.45
A1	0.00	0.13	-
b	0.30	0.50	0.40
с	0.15	0.25	0.20
D	4.85	4.95	4.90
ш	3.80	3.90	3.85
E0	3.85	3.95	3.90
E1	5.90	6.10	6.00
e	-	-	1.27
F	2.75	3.35	3.05
Н	2.11	2.71	2.41
L	0.62	0.82	0.72
N	-	-	0.35
q	0.60	0.70	0.65
All Di	mensi	ons in	mm



# Package Outline Dimensions (continued)

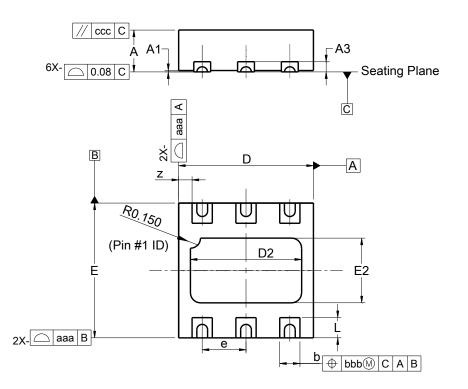
Please see http://www.diodes.com/package-outlines.html for the latest version.

### (3) Package Type: SOT25



	SOT	[25	
Dim	Min	Max	Тур
Α	0.35	0.50	0.38
В	1.50	1.70	1.60
С	2.70	3.00	2.80
D	-	-	0.95
Н	2.90	3.10	3.00
J	0.013	0.10	0.05
К	1.00	1.30	1.10
L	0.35	0.55	0.40
М	0.10	0.20	0.15
Ν	0.70	0.80	0.75
α	0°	8°	-
All D	imensi	ons in	mm

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



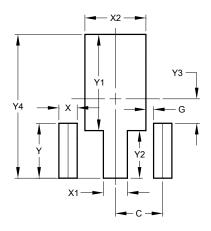
U-DFN2020-6 (SWP)					
(Type UXC)					
Dim	Min	Max	Тур		
Α	0.57	0.63	0.60		
A1	0.00	0.05	0.02		
A3			0.13		
b	0.25	0.35	0.30		
D	1.95	2.075	2.00		
D2	1.55	1.75	1.65		
Е	1.95	2.075	2.00		
E2	0.86	1.06	0.96		
е		-	0.65		
L	0.25	0.35	0.30		
z			0.20		
aaa	0.25				
bbb	0.10				
CCC	0.10				
All Dimensions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



# **Suggested Pad Layout**

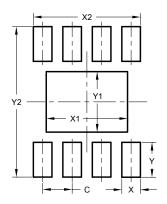
Please see http://www.diodes.com/package-outlines.html for the latest version.

#### (1) SOT89



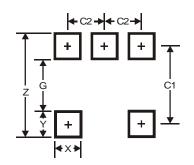
Dimensions	Value (in mm)
С	1.500
G	0.244
Х	0.580
X1	0.760
X2	1.933
Y	1.730
Y1	3.030
Y2	1.500
Y3	0.770
Y4	4.530

#### (2) Package Type: SO-8EP



Value Dimensions (in mm) С 1.270 Х 0.802 X1 X2 3.502 4.612 Y 1.505 Y1 2.613 Y2 6.500

(3) SOT25



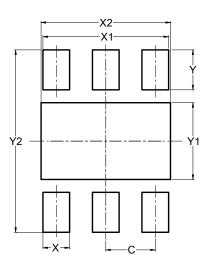
Dimensions	Value (in mm)
Z	3.20
G	1.60
Х	0.55
Y	0.80
C1	2.40
C2	0.95



# Suggested Pad Layout (continued)

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

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



Dimensions	Value
Dimensions	(in mm)
С	0.650
Х	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:
  - SOT89/ SO-8EP/ SOT25: Finish Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 (3)
  - U-DFN2020-6 (SWP) (Type UXC): Finish NiPdAu over Copper Leads, Solderable per MIL-STD-202, Method 208 @
- Weight:
  - SOT89: 0.054 grams (Approximate)
  - SO-8EP: 0.075 grams (Approximate)
  - SOT25: 0.018 grams (Approximate)
  - U-DFN2020-6 (SWP) (Type UXC): 0.007 grams (Approximate)



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