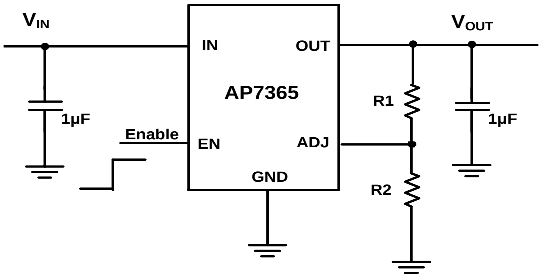
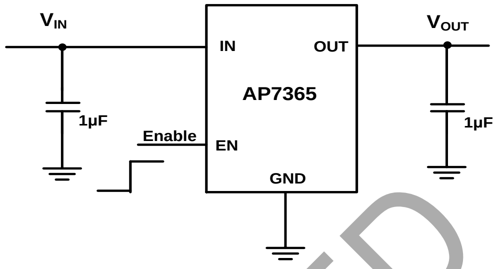
Typical Applications Circuit



Adjustable Output



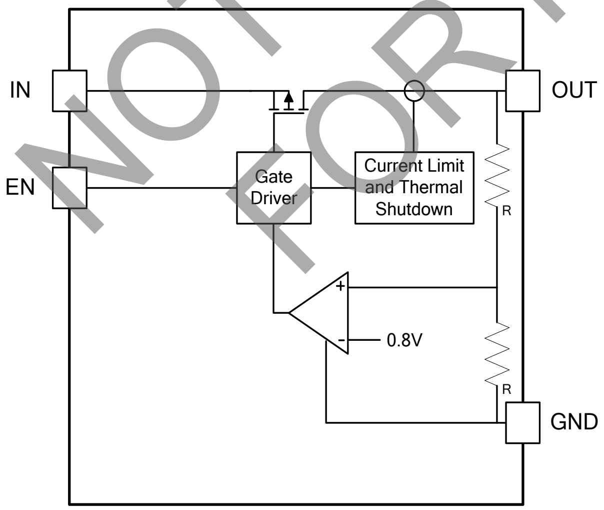
Fixed Output

$$V_{OUT} = V_{REF}\left(1+\frac{R_1}{R_2}\right) \text{ where } R_2 \le 80K\Omega$$

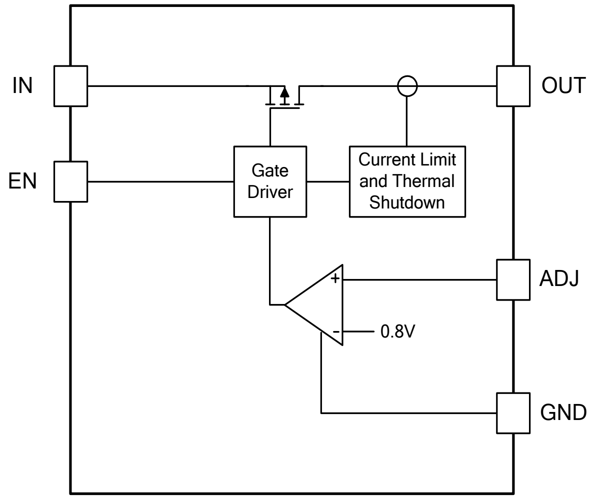
Pin Descriptions

Pin Name	Pin Number							Functions
	SOT25 (Fixed)	SOT25 (ADJ)	U-DFN2020-6 (Fixed)	U-DFN2020-6 (ADJ)	SOT89 (Y Package) SOT223 (E Package)	SOT89 (YR Package) SOT223 (ER Package)	SOT223 (EV Package)	
IN	1	1	3	3	3	2	3	Voltage Input Pin. Bypass to ground through at least 1µF MLCC capacitor
GND	2	2	2	2	2	1	1	Ground
EN	3	3	1	1	—	—	—	Enable Input, Active High
ADJ	—	4	—	6	—	—	—	Output Feedback Pin
NC	4	—	5, 6	5	—	—	—	No Connection
OUT	5	5	4	4	1	3	2	Voltage Output Pin. Bypass to ground through 1µF MLCC capacitor

Functional Block Diagram



Fixed Version



Adjustable Version

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

Symbol	Parameter	Ratings	Unit
ESD HBM	Human Body Model ESD Protection	2000	V
ESD MM	Machine Model ESD Protection	200	V
V_{IN}	Input Voltage	6.5	V
—	OUT, EN Voltage	V_{IN} +0.3	V
—	Continuous Load Current per Channel	Internal Limited	—
T_{ST}	Storage Temperature Range	-65 to +150	°C
T_J	Maximum Junction Temperature	+150	°C

Recommended Operating Conditions (@T_A = +25°C, unless otherwise specified.)

Symbol	Parameter	Min	Max	Unit
V_{IN}	Input Voltage	2	6	V
I_{OUT}	Output Current (Note 4)	0	600	mA
T_A	Operating Ambient Temperature	-40	+85	°C

Note: 4. The device maintains a stable, regulated output voltage without a load current.

Electrical Characteristics (@T_A = +25°C, V_{IN} = V_{OUT} +1V, C_{OUT} = 1µF, C_{IN} = 1µF, V_{EN} = 2V, unless otherwise specified.)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{REF}	ADJ Reference Voltage (Adjustable Version)	I_{OUT} = 0mA	—	0.8	—	V
I_{ADJ}	ADJ Leakage (Adjustable Version)	—	—	0.1	1.0	µA
V_{OUT}	Output Voltage Accuracy	T_A = -40°C to +85°C, I_{OUT} = 10% of $I_{OUT\text{-}Max}$	-2	—	+2	%
ΔV_{OUT} /ΔV_{IN}/V	Line Regulation	V_{IN} = (V_{OUT} +1V) to $V_{IN\text{-}Max}$, V_{EN} = V_{IN}, I_{OUT} = 1mA	—	0.02	0.20	%/V
$\Delta V_{OUT}/V_{OUT}$	Load Regulation	V_{IN} = (V_{OUT} +1V) to $V_{IN\text{-}Max}$, I_{OUT} = 1mA to 600mA	-1.0	—	+1.0	%
$V_{DROPOUT}$	Dropout Voltage (Note 5)	V_{OUT} < 2.5V, I_{OUT} = 600mA	—	370	600	mV
		V_{OUT} ≥ 2.5V, I_{OUT} = 600mA	—	300	400	
I_Q	Input Quiescent Current	V_{EN} = V_{IN}, I_{OUT} = 0mA	—	35	80	µA
I_{SHDN}	Input Shutdown Current	V_{EN} = 0V, I_{OUT} = 0mA	—	0.1	1.0	µA
I_{LEAK}	Input Leakage Current	V_{EN} = 0V, OUT grounded	—	0.1	1.0	µA
t_{ST}	Start-Up Time	V_{EN} = 0V to 2.0V in 1µs, I_{OUT} = 600mA	—	200	—	µs
PSRR	PSRR (Note 6)	V_{IN} = [V_{OUT} +1V] V_{DC} + 0.5V_{ppAC}, f = 1kHz, I_{OUT} = 50mA	—	65	—	dB
I_{SHORT}	Short-Circuit Current	V_{IN} = $V_{IN\text{-}Min}$ to $V_{IN\text{-}Max}$, V_{OUT} < 0.2V (fixed version) or 25% of V_{OUT} (ADJ version)	—	240	—	mA
I_{LIMIT}	Current limit	V_{IN} = $V_{IN\text{-}Min}$ to $V_{IN\text{-}Max}$, V_{OUT}/R_{OUT} = 2.5A	0.8	1.4	—	A
V_{IL}	EN Input Logic Low Voltage	V_{IN} = $V_{IN\text{-}Min}$ to $V_{IN\text{-}Max}$	—	—	0.4	V
V_{IH}	EN Input Logic High Voltage	V_{IN} = $V_{IN\text{-}Min}$ to $V_{IN\text{-}Max}$	1.4	—	—	V
I_{EN}	EN Input Current	V_{IN} = 0V or $V_{IN\text{-}Max}$	-1	—	+1	µA
T_{SHDN}	Thermal Shutdown Threshold	—	—	+145	—	°C
T_{HYS}	Thermal Shutdown Hysteresis	—	—	+15	—	°C

Notes: 5. Dropout voltage is the voltage difference between the input and the output at which the output voltage drops 2% below its nominal value. This parameter only applies to input voltages above minimum V_{IN} = 2.0V.

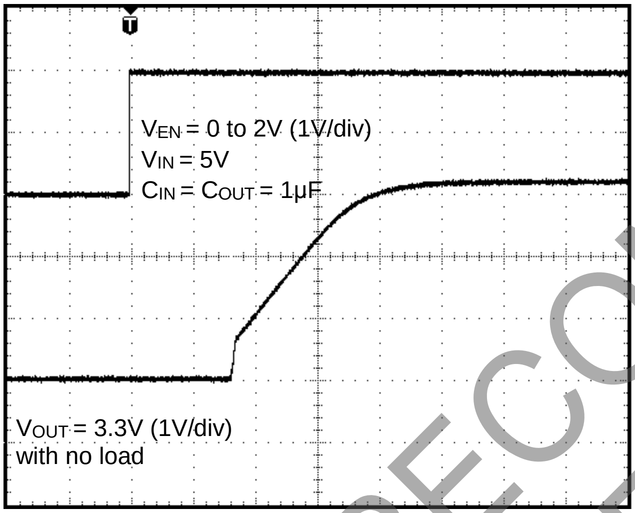
6. At V_{IN} < 2.3V, the PSRR performance may be reduced.

Electrical Characteristics (continued) (@T_A = +25°C, V_{IN} = V_{OUT} +1V, C_{OUT} = 1µF, C_{IN} = 1µF, V_{EN} = 2V, unless otherwise specified.)

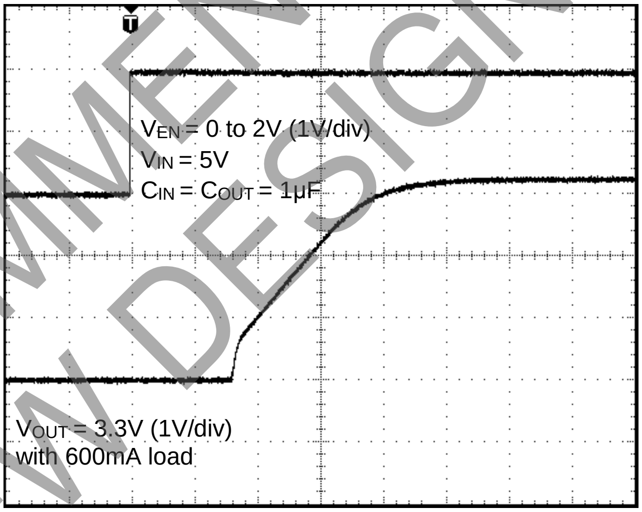
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
θ_{JA}	Thermal Resistance Junction-to-Ambient	SOT25 (Note 7)	—	169	—	°C/W
		U-DFN2020-6 (Note 7)	—	132	—	
		SOT89 (Note 7)	—	133	—	
		SOT223 (Note 7)	—	142	—	
θ_{JC}	Thermal Resistance Junction-to-Case	SOT25 (Note 7)	—	31	—	°C/W
		U-DFN2020-6 (Note 7)	—	48	—	
		SOT89 (Note 7)	—	30	—	
		SOT223 (Note 7)	—	39	—	

Note: 7. Test condition for all packages: Device mounted on FR-4 substrate PC board, 1oz copper, with minimum recommended pad layout.

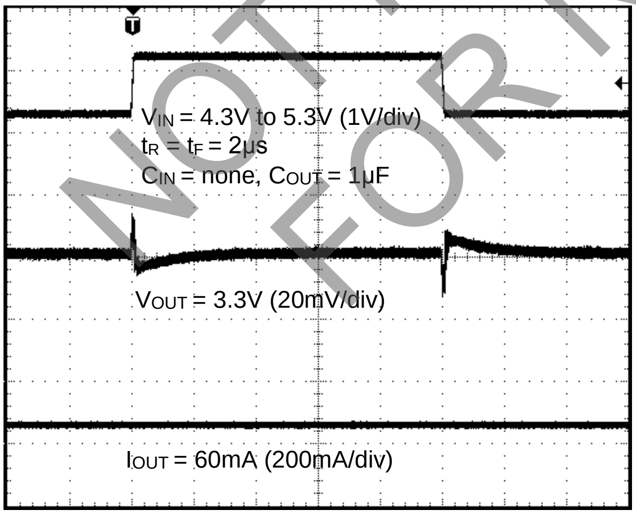
Typical Performance Characteristics



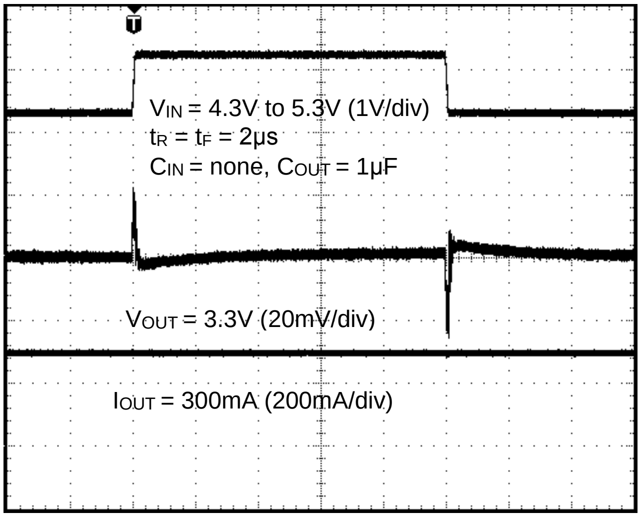
Start-Up Time



Start-Up Time

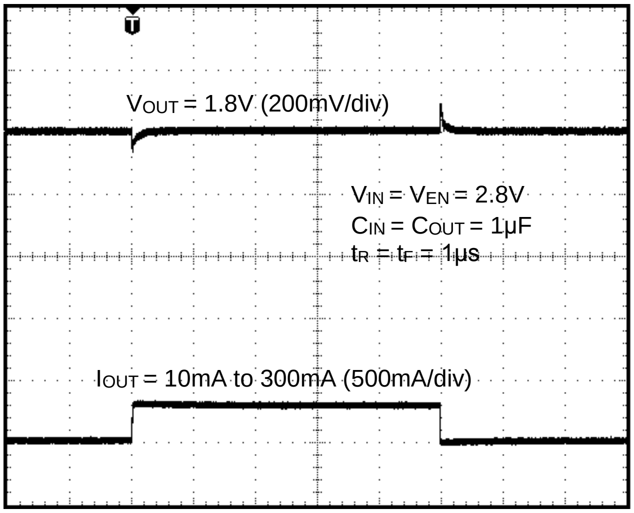


Line Transient Response

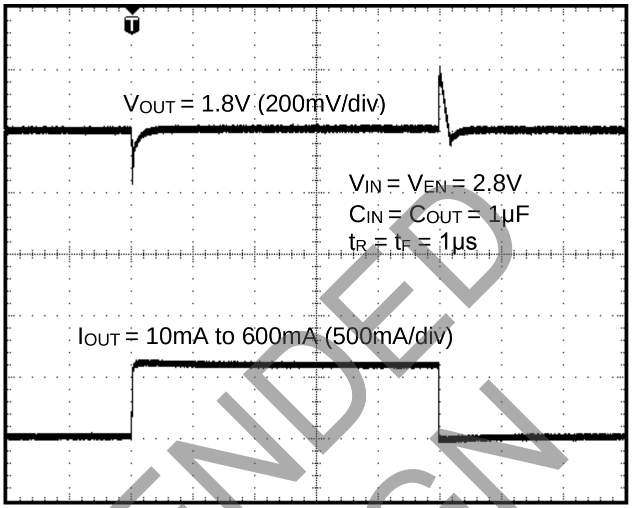


Line Transient Response

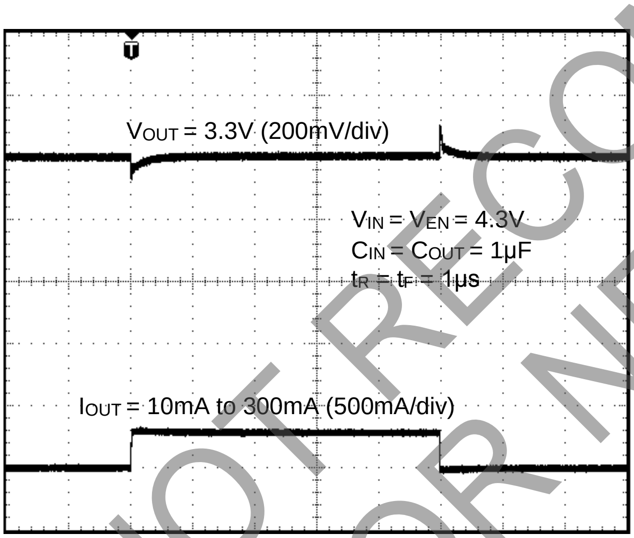
Typical Performance Characteristics (continued)



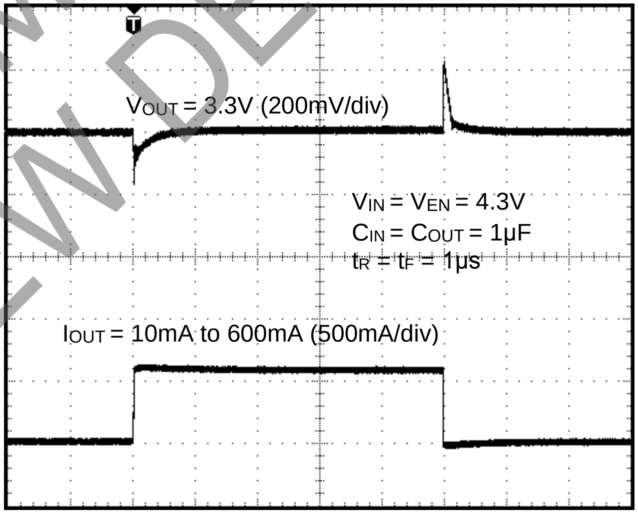
Load Transient Response
Time (100µs/div)



Load Transient Response
Time (100µs/div)

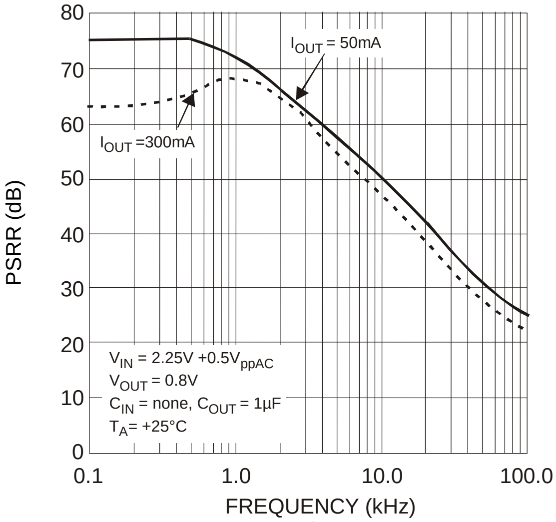


Load Transient Response
Time (100µs/div)

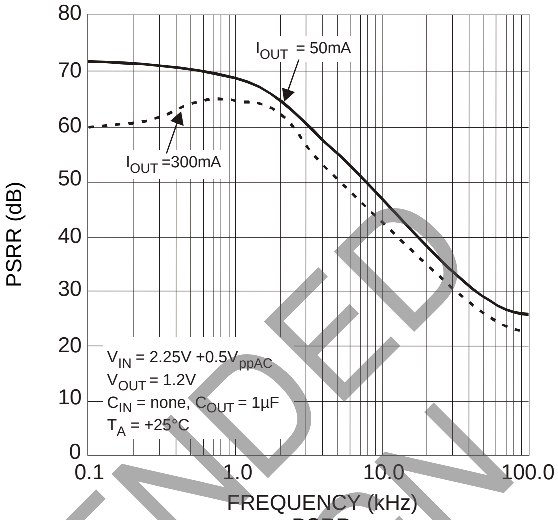


Load Transient Response
Time (100µs/div)

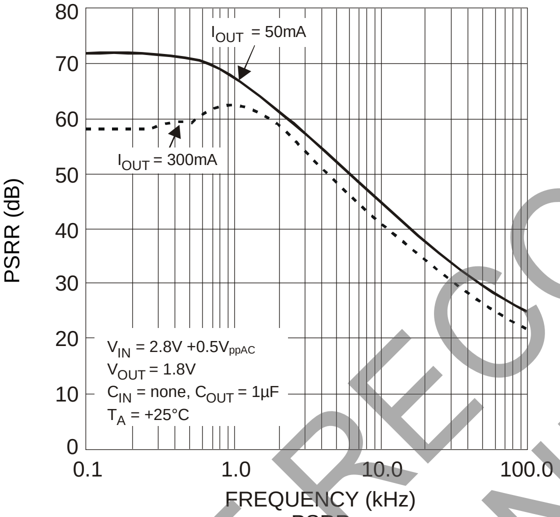
Typical Performance Characteristics (continued)



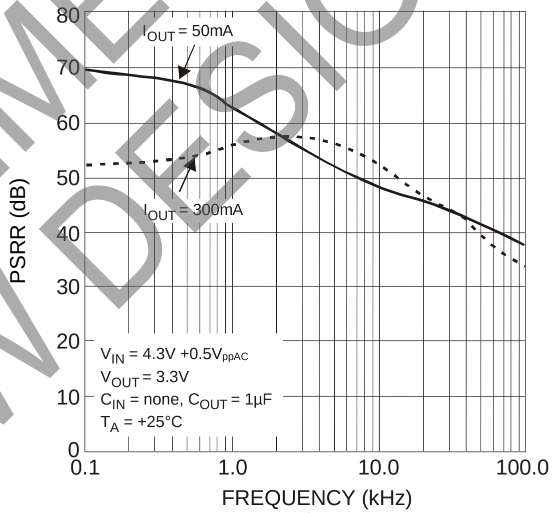
PSRR



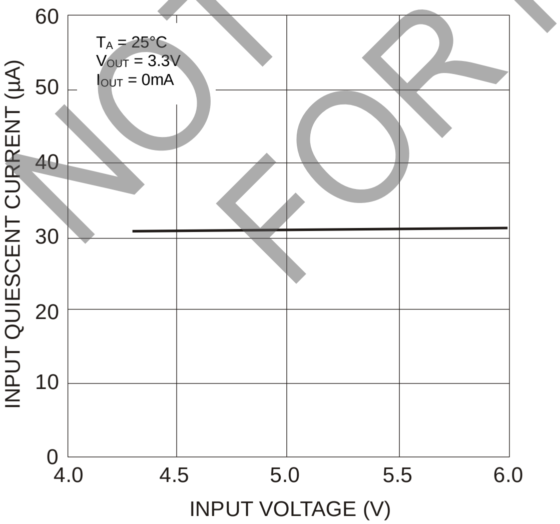
PSRR



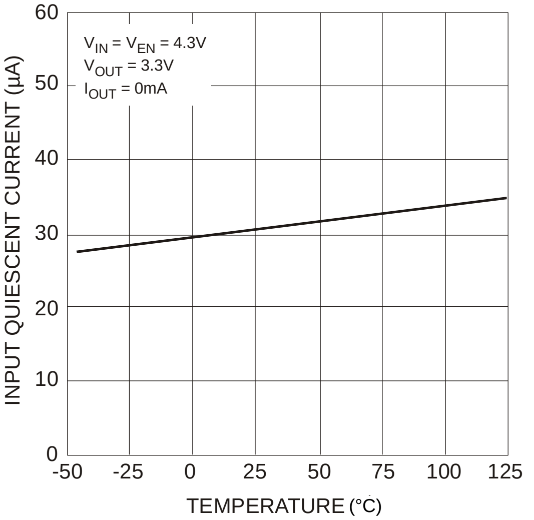
PSRR



PSRR

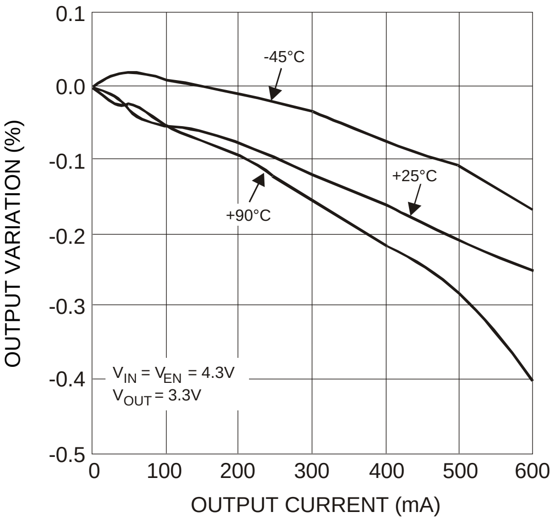


Input Quiescent Current vs. Input Voltage

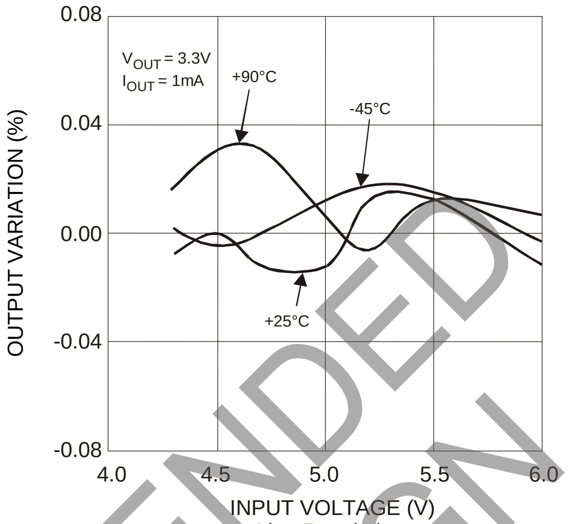


Input Quiescent Current vs. Temperature

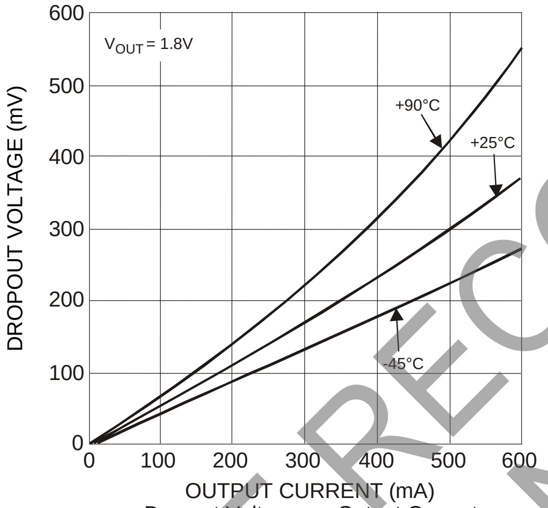
Typical Performance Characteristics (continued)



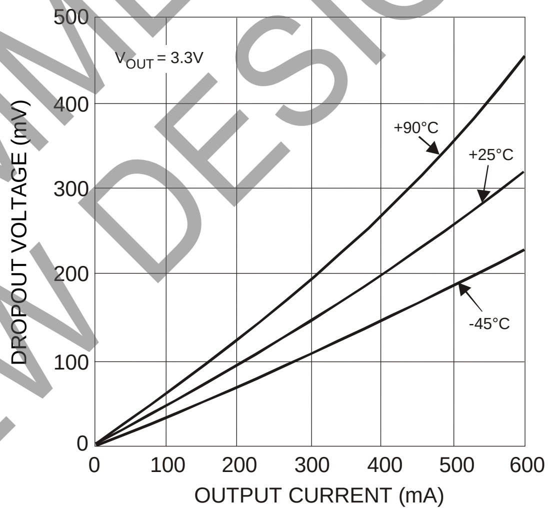
Load Regulation



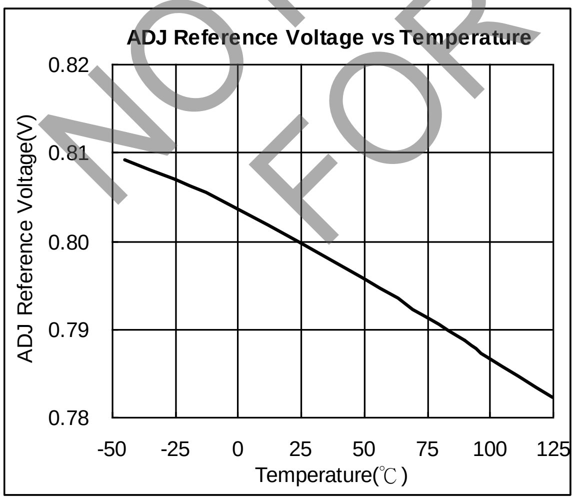
Line Regulation

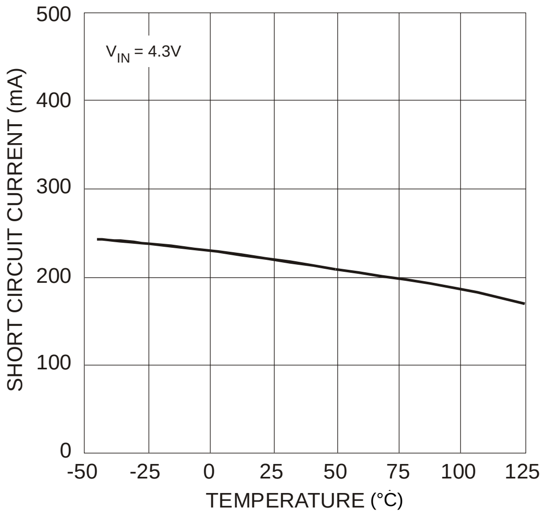


Dropout Voltage vs. Output Current



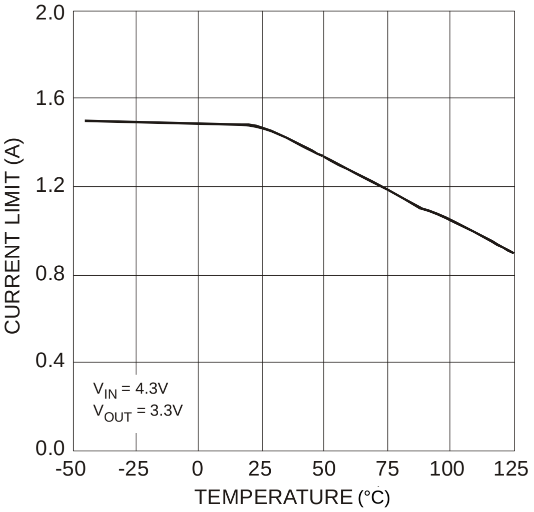
Dropout Voltage vs. Output Current





Short Circuit Current vs. Temperature

Typical Performance Characteristics (continued)



Current Limit vs. Temperature

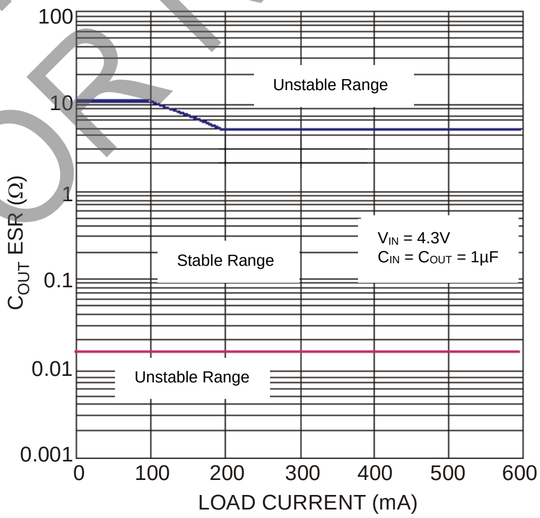
Application Information

Input Capacitor

A 1µF ceramic capacitor is recommended between IN 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 reduce noise. For PCB layout, a wide copper trace is required for both IN and GND pins. A lower ESR capacitor type allows the use of less capacitance, while higher ESR type requires more capacitance.

Output Capacitor

The output capacitor is required to stabilize and improve the transient response of the LDO. The AP7365 is stable with very small ceramic output capacitors. Using a ceramic capacitor value that is at least 1µF with ESR > 15mΩ on the output ensures stability. Higher capacitance values help to improve line and load transient response. The output capacitance may be increased to keep low undershoot and overshoot. Output capacitor must be placed as close as possible to OUT and GND pins.

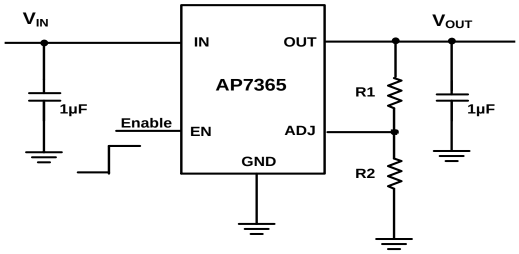


Region of Stable C_{OUT} ESR vs. Load Current

Application Information (continued)

Adjustable Operation

The AP7365 provides output voltage from 0.8V to 5.0V through external resistor divider as shown below.



The output voltage is calculated by:

$$V_{OUT} = V_{REF}\left(1+\frac{R_1}{R_2}\right)$$

Where V_{REF} = 0.8V (the internal reference voltage)

Rearranging the equation will give the following that is used for adjusting the output to a particular voltage:

$$R_1 = R_2\left(\frac{V_{OUT}}{V_{REF}}-1\right)$$

To maintain the stability of the internal reference voltage, R_2 needs to be kept smaller than 80kΩ.

No Load Stability

Other than external resistor divider, no minimum load is required to keep the device stable. The device will remain stable and regulated in no load condition.

ON/OFF Input Operation

The AP7365 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 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 under V_{IL} and V_{IH}.

Current Limit Protection

When output current at OUT pin is higher than current limit threshold, the current limit protection will be triggered and clamp the output current to approximately 1.4A to prevent overcurrent and to protect the regulator from damage due to overheating.

Short Circuit Protection

When OUT pin is short-circuit to GND, short circuit protection will be triggered and clamp the output current to approximately 240mA. This feature protects the regulator from overcurrent and damage due to overheating.

Thermal Shutdown Protection

Thermal protection disables the output when the junction temperature rises to approximately +145°C, allowing the device to cool down. When the junction temperature reduces to approximately +130°C, the output circuitry is enabled again. Depending on power dissipation, thermal resistance and ambient temperature, the thermal protection circuit may cycle on and off. This cycling limits the heat dissipation of the regulator, protecting it from damage due to overheating.

Ultra Fast Start-Up

After enabled, the AP7365 is able to provide full power in as little as hundreds of microseconds, typically 200µs, without sacrificing low ground current. This feature will help load circuitry move in and out of standby mode in real time, eventually extend battery life for mobile phones and other portable devices.

Application Information (continued)

Fast Transient Response

Fast transient response LDO can extend battery life. TDMA-based cell phone protocols such as Global System for Mobile Communications (GSM) have a transmit/receive duty factor of only 12.5%, enabling power savings by putting much of the baseband circuitry into standby mode in between transmit cycles. In baseband circuits, the load often transitions virtually instantaneously from 100µA to 100mA. To meet this load requirement, the LDO must react very quickly without a large voltage drop or overshoot — a requirement that cannot be met with conventional, general-purpose LDO.

The AP7365's fast transient response from 0 to 600mA provides stable voltage supply for fast DSP and GSM chipset with fast changing load.

Low Quiescent Current

The AP7365, consuming only around 35µA for all input ranges, provides great power saving in portable and low power applications.

Wide Output Range

The AP7365, with a wide output range of 0.8V to 5.0V, provides a versatile LDO solution for many portable applications.

Power Dissipation

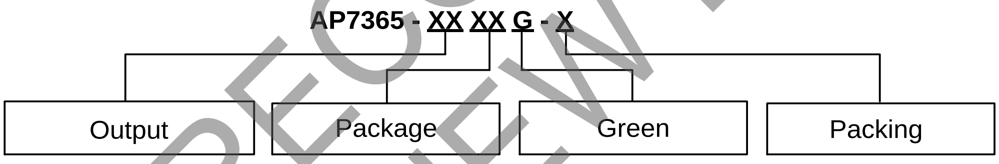
The device power dissipation and proper sizing of the thermal plane connected to the thermal pad is critical to avoid thermal shutdown and ensure reliable operation. Power dissipation of the device depends on input voltage and load conditions and can be calculated by:

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$$

The maximum power dissipation, handled by the device, depends on the maximum junction to ambient thermal resistance, maximum ambient temperature, and maximum device junction temperature, which can be calculated by the equation in the following:

$$P_D(MAX@T_A) = \frac{(+145°C - T_A)}{R_{\theta JA}}$$

Ordering Information



Blank : ADJ (Note 8)
08 : 0.8V
10 : 1.0V
12 : 1.2V
15 : 1.5V
18 : 1.8V
20 : 2.0V
25 : 2.5V
28 : 2.8V
30 : 3.0V
33 : 3.3V
39 : 3.9V

W : SOT25
SN : U-DFN2020-6
Y/YR : SOT89
E/ER/EV : SOT223

G : Green

7/13 : Tape & Reel

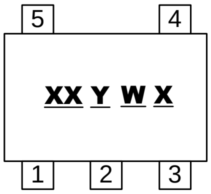
Part Number	Package Code	Packaging	7"/13" Tape and Reel	
			Quantity	Part Number Suffix
AP7365-XXWG-7	W	SOT25	3,000/Tape & Reel	-7
AP7365-XXSNG-7	SN	U-DFN2020-6	3,000/Tape & Reel	-7
AP7365-XXYG-13	Y	SOT89	2,500/Tape & Reel	-13
AP7365-XXYRG-13	YR	SOT89	2,500/Tape & Reel	-13
AP7365-XXEG-13	E	SOT223	2,500/Tape & Reel	-13
AP7365-XXERG-13	ER	SOT223	2,500/Tape & Reel	-13
AP7365-XXEVG-13	EV	SOT223	2,500/Tape & Reel	-13

Note: 8. Adjustable version is only available in SOT25 and U-DFN2020-6 packages.

Marking Information

(1) SOT25

(Top View)

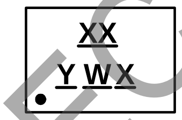


XX : Identification code
Y : Year 0~9
W : Week : A~Z : 1~26 week;
a~z : 27~52 week; z represents
52 and 53 week
X : A~Z : Green

Part Number	Package	Identification Code
AP7365-WG-7	SOT25	VA
AP7365-08WG-7	SOT25	VB
AP7365-10WG-7	SOT25	VC
AP7365-12WG-7	SOT25	VD
AP7365-15WG-7	SOT25	VE
AP7365-18WG-7	SOT25	VF
AP7365-20WG-7	SOT25	VG
AP7365-25WG-7	SOT25	VH
AP7365-28WG-7	SOT25	VJ
AP7365-30WG-7	SOT25	VK
AP7365-33WG-7	SOT25	VM
AP7365-39WG-7	SOT25	VN

(2) U-DFN2020-6

(Top View)



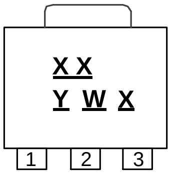
XX : Identification Code
Y : Year : 0~9
W : Week : A~Z : 1~26 week;
a~z : 27~52 week; z represents
52 and 53 week
X : A~Z : Green

Part Number	Package	Identification Code
AP7365-SNG-7	U-DFN2020-6	VA
AP7365-08SNG-7	U-DFN2020-6	VB
AP7365-10SNG-7	U-DFN2020-6	VC
AP7365-12SNG-7	U-DFN2020-6	VD
AP7365-15SNG-7	U-DFN2020-6	VE
AP7365-18SNG-7	U-DFN2020-6	VF
AP7365-20SNG-7	U-DFN2020-6	VG
AP7365-25SNG-7	U-DFN2020-6	VH
AP7365-28SNG-7	U-DFN2020-6	VJ
AP7365-30SNG-7	U-DFN2020-6	VK
AP7365-33SNG-7	U-DFN2020-6	VM
AP7365-39SNG-7	U-DFN2020-6	VN

Marking Information (continued)

(3) SOT89

(Top View)

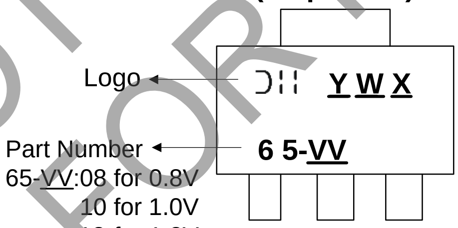


XX : Identification code
Y : Year : 0~9
W : Week : A~Z : 1~26 week;
a~z : 27~52 week;
z represents 52 and 53 week
X : Internal code
A~Z : Green

Part Number	Package	Identification Code
AP7365-08YG-13	SOT89	VB
AP7365-10YG-13	SOT89	VC
AP7365-12YG-13	SOT89	VD
AP7365-15YG-13	SOT89	VE
AP7365-18YG-13	SOT89	VF
AP7365-20YG-13	SOT89	VG
AP7365-25YG-13	SOT89	VH
AP7365-28YG-13	SOT89	VJ
AP7365-30YG-13	SOT89	VK
AP7365-33YG-13	SOT89	VM
AP7365-39YG-13	SOT89	VN
AP7365-08YRG-13	SOT89	TB
AP7365-10YRG-13	SOT89	TC
AP7365-12YRG-13	SOT89	TD
AP7365-15YRG-13	SOT89	TE
AP7365-18YRG-13	SOT89	TF
AP7365-20YRG-13	SOT89	TG
AP7365-25YRG-13	SOT89	TH
AP7365-28YRG-13	SOT89	TJ
AP7365-30YRG-13	SOT89	TK
AP7365-33YRG-13	SOT89	TM
AP7365-39YRG-13	SOT89	TN

(4) SOT223 (E Package)

(Top View)

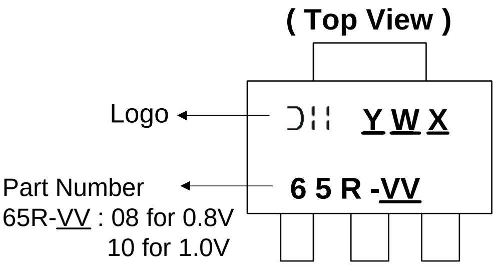


Y : Year : 0~9
W : Week : A~Z : 1~26 week;
a~z : 27~52 week;
z repersents 52 and 53 week
X : Internal code
A~Z : Green

65-VV:08 for 0.8V
10 for 1.0V
12 for 1.2V
15 for 1.5V
18 for 1.8V
20 for 2.0V
25 for 2.5V
28 for 2.8V
30 for 3.0V
33 for 3.3V
39 for 3.9V

Marking Information (continued)

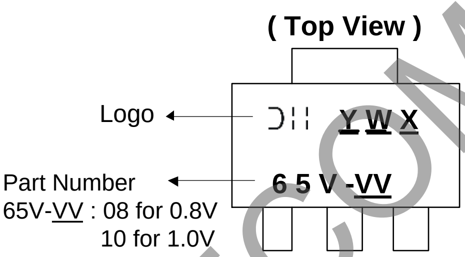
(5) SOT223 (ER Package)



Y : Year : 0~9
W : Week : A~Z : 1~26 week;
a~z : 27~52 week;
z repersents 52 and 53 week
X : Internal code
A~Z : Green

65R-VV : 08 for 0.8V
10 for 1.0V
12 for 1.2V
15 for 1.5V
18 for 1.8V
20 for 2.0V
25 for 2.5V
28 for 2.8V
30 for 3.0V
33 for 3.3V
39 for 3.9V

(6) SOT223 (EV Package)



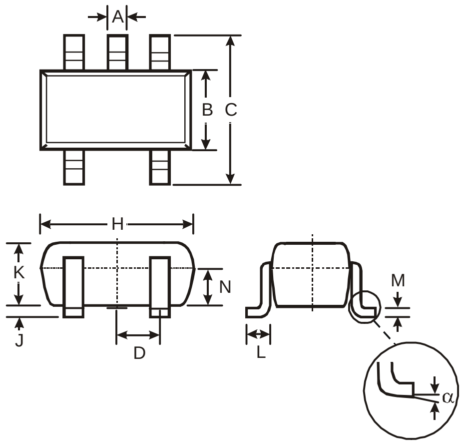
Y : Year : 0~9
W : Week : A~Z : 1~26 week;
a~z : 27~52 week;
z repersents 52 and 53 week
X : Internal code
A~Z : Green

65V-VV : 08 for 0.8V
10 for 1.0V
12 for 1.2V
15 for 1.5V
18 for 1.8V
20 for 2.0V
25 for 2.5V
28 for 2.8V
30 for 3.0V
33 for 3.3V
39 for 3.9V

Package Outline Dimensions

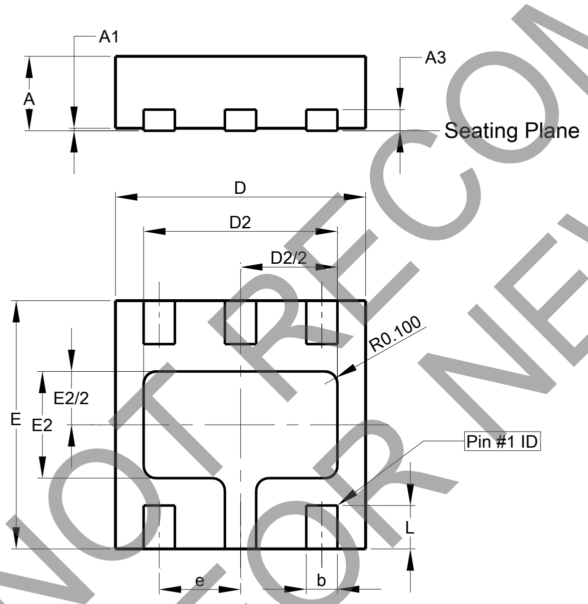
Please see http://www.diodes.com/package-outlines.html for the latest version.

(1) 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			

(2) Package Type: U-DFN2020-6

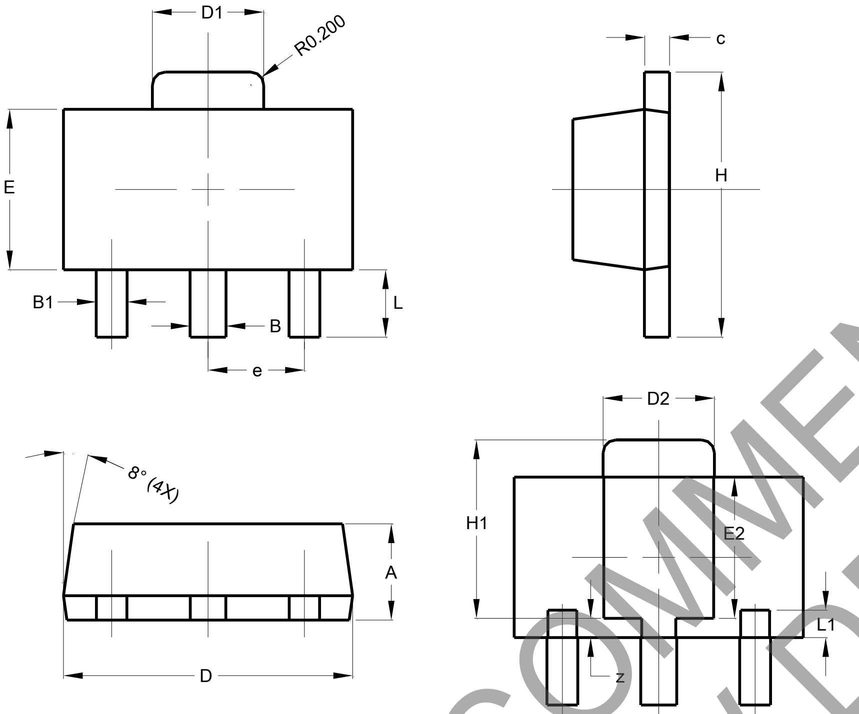


U-DFN2020-6			
Dim	**Min**	**Max**	**Typ**
A	0.57	0.63	0.60
A1	0	0.05	0.03
A3	-	-	0.15
b	0.20	0.30	0.25
D	1.95	2.075	2.00
D2	1.45	1.65	1.55
e	-	-	0.65
E	1.95	2.075	2.00
E2	0.76	0.96	0.86
L	0.30	0.40	0.35
All Dimensions in mm			

Package Outline Dimensions (continued)

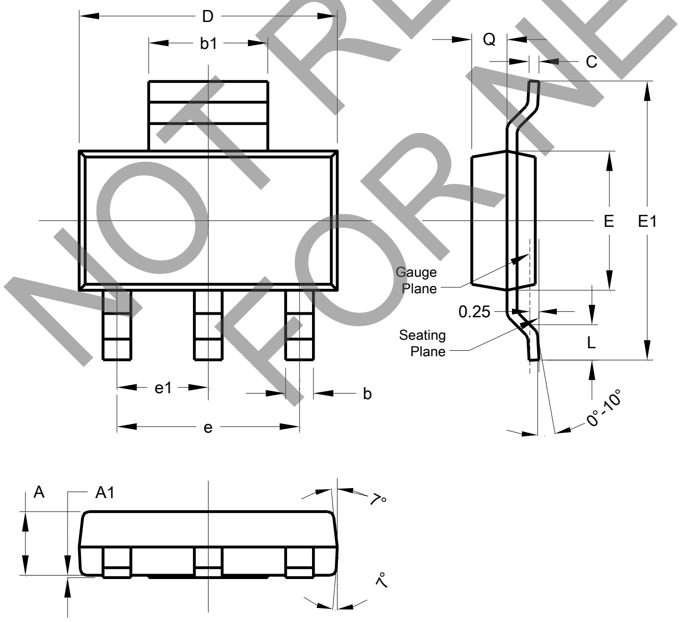
Please see http://www.diodes.com/package-outlines.html for the latest version.

(3) Package Type: 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			

(4) Package Type: SOT223

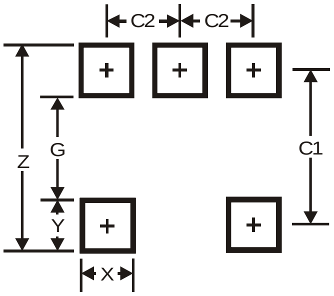


SOT223			
Dim	**Min**	**Max**	**Typ**
A	1.55	1.65	1.60
A1	0.010	0.15	0.05
b	0.60	0.80	0.70
b1	2.90	3.10	3.00
C	0.20	0.30	0.25
D	6.45	6.55	6.50
E	3.45	3.55	3.50
E1	6.90	7.10	7.00
e	-	-	4.60
e1	-	-	2.30
L	0.85	1.05	0.95
Q	0.84	0.94	0.89
All Dimensions in mm			

Suggested Pad Layout

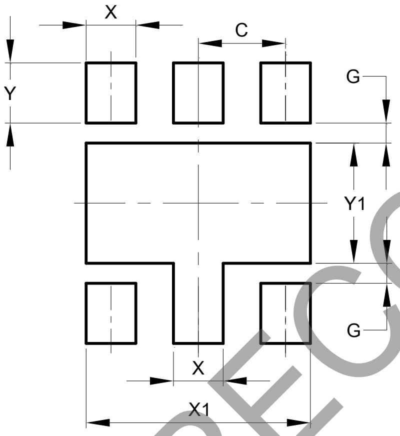
Please see http://www.diodes.com/package-outlines.html for the latest version.

(1) Package Type: SOT25



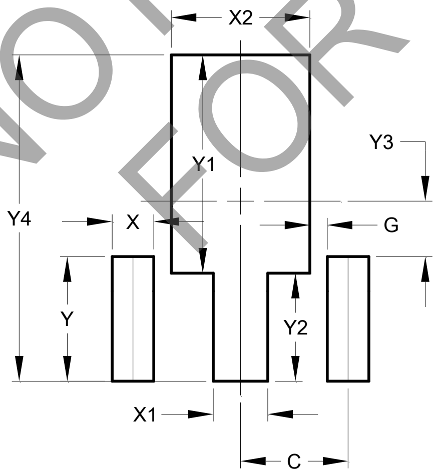
Dimensions	Value (in mm)
Z	3.20
G	1.60
X	0.55
Y	0.80
C1	2.40
C2	0.95

(2) Package Type: U-DFN2020-6



Dimensions	Value (in mm)
C	0.65
G	0.15
X	0.37
X1	1.67
Y	0.45
Y1	0.90

(3) Package Type: SOT89

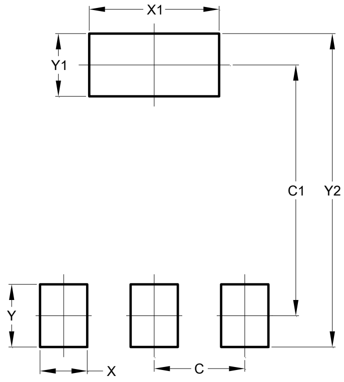


Dimensions	Value (in mm)
C	1.500
G	0.244
X	0.580
X1	0.760
X2	1.933
Y	1.730
Y1	3.030
Y2	1.500
Y3	0.770
Y4	4.530

Suggested Pad Layout (continued)

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

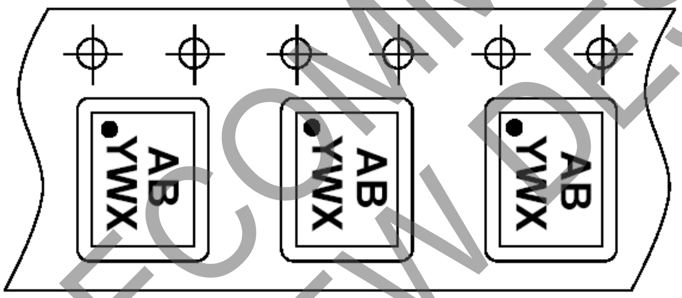
(4) Package Type: SOT223

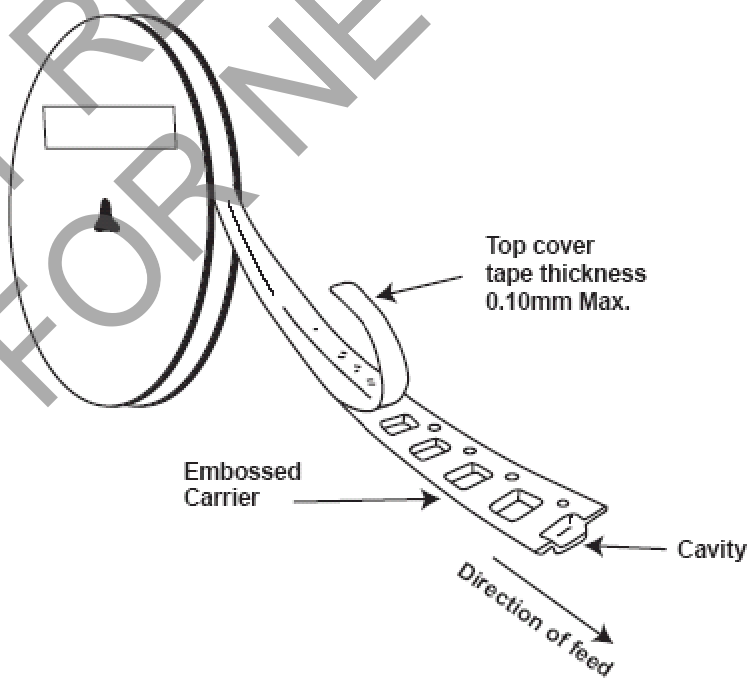


Dimensions	Value (in mm)
C	2.30
C1	6.40
X	1.20
X1	3.30
Y	1.60
Y1	1.60
Y2	8.00

Tape Orientation (Note 9)

For U-DFN2020-6





Note: 9. The taping orientation of the other package type can be found on our website at https://www.diodes.com/assets/Packaging-Support-Docs/ap02007.pdf

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