AUTOMOTIVE COMPLIANT 500mA HIGH PSRR LOW NOISE LDO WITH ENABLE

Description

The AP7347DQ is a low dropout regulator with high output voltage accuracy, low $R_{DS(on)}$, high PSRR, low output noise, and low quiescent current. This regulator is based on a CMOS process.

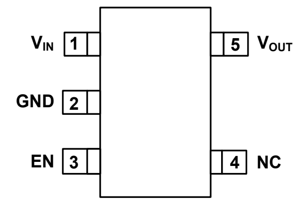
The AP7347DQ includes a voltage reference, error amplifier, current limit circuit, and an enable input to turn it on and off. With the integrated resistor network, fixed output voltage versions can be delivered.

With its low power consumption and line and load transient response, the AP7347DQ is well-suited for low power handheld automotive equipment.

The AP7347DQ is packaged in the SOT25 (Type A1) and WDFN2020-6 (wettable) packages, which allow for the smallest footprint and a dense PCB layout.

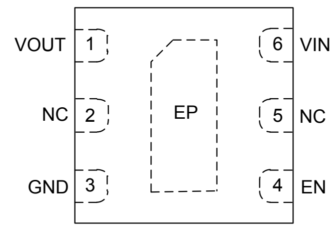
Pin Assignments

(Top View)



SOT25 (Type A1)

(Top View)



W-DFN2020-6 (SWP) (Type A1)

Features

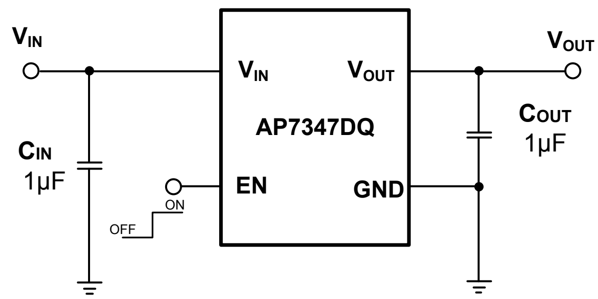
- Low V_{IN} and Wide V_{IN} Range: 1.7V to 5.5V
- Guarantee Output Current: 500mA
- V_{OUT} Accuracy ±1%
- Ripple Rejection 75dB at 1kHz
- Low Output Noise, 60μVrms from 10Hz to 100kHz
- Quiescent Current as Low as 60μA
- V_{OUT} Fixed 1.0V to 5.0V
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **The AP7347DQ 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/

Applications

- Infotainment Power Supplies
- Automotive RF Supplies
- Cameras
- Automotive POL in ADAS
- Automotive Wireless Communication Systems

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.

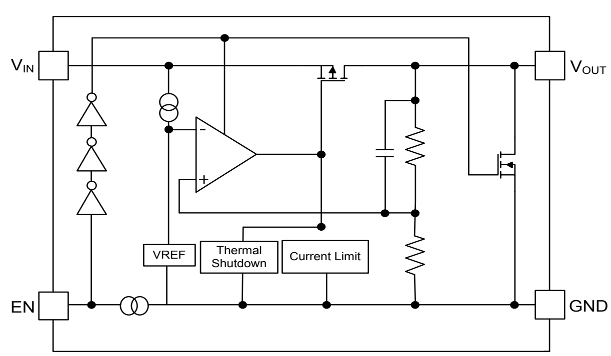
Typical Applications Circuit



Pin Descriptions

Pin Number		Pin Name	Function
SOT25 (Type A1)	DFN2020-6 (wettable)		
1	6	V_{IN}	Power Input Pin
2	3	GND	Ground
3	4	EN	Enable Pin This pin should be driven either high or low and must not be floating. Driving this pin high enables the regulator, while pulling it low puts the regulator into shutdown mode
4	2, 5	NC	No Connect Not connected internally; recommended to connect to GND to maximize PCB copper for thermal dissipation.
5	1	VOUT	Power Output Pin
-	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



AP7347DQ (With Discharge)

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

Symbol	Parameter		Ratings	Unit
ESD HBM	Human Body Mode ESD Protection		> 2	KV
ESD CDM	Charge Device Model		± 500	V
V_{IN}	Input Voltage		6.0	V
V_{EN}	Input Voltage for EN Pin		6.0	V
V_{OUT}	Output Voltage		-0.3 to V_{IN} + 0.3	V
I_{OUT}	Output Current		500	mA
P_D	Power Dissipation	SOT25 (Type A1)	0.89	mW
		WDFN2020-6 (wettable)	2.3	
T_A	Operating Ambient Temperature		-40 to +125	°C
T_j	Operating Junction Temperature		-40 to +150	°C
T_{STG}	Storage Temperature		-55 to +150	°C

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

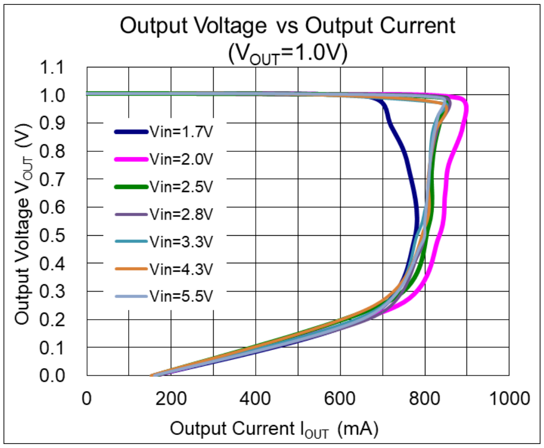
Symbol	Parameter	Min	Max	Unit
V_{IN}	Input Voltage	1.7	5.5	V
I_{OUT}	Output Current	0	500	mA
T_J	Operating Junction Temperature	-40	+125	°C

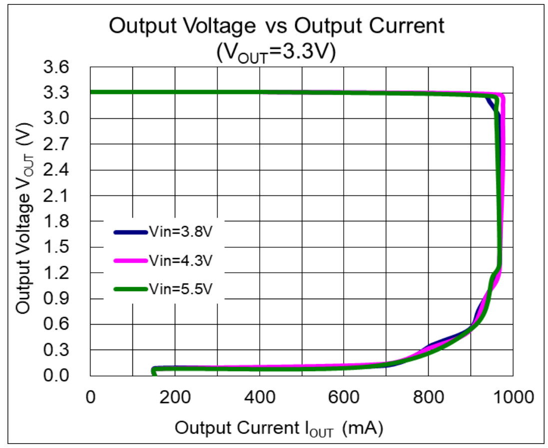
Electrical Characteristics (@ T_J = -40°C~+125°C, V_{IN} = V_{OUT} +1.0V or V_{IN} = V_{OUT} +0.5 (if V_{OUT} > 4.5V) C_{IN} = C_{OUT} = 1.0µF, I_{OUT} = 1.0mA, unless otherwise specified.)

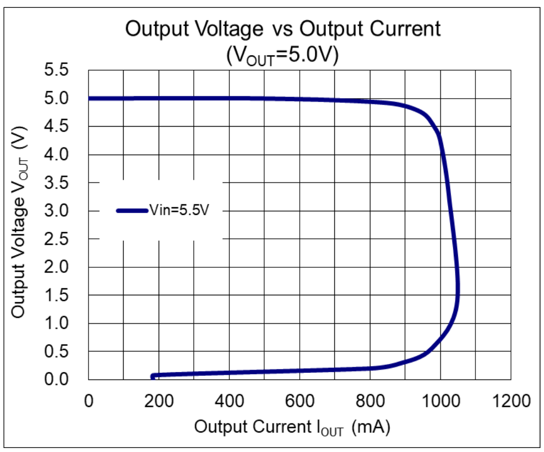
Parameter	Condition		Min	Typ	Max	Units
Input Voltage	T_J = -40°C to +125°C		1.7	—	5.5	V
Output Voltage Accuracy (Note 10)	V_{OUT}(T) ≥ 2.0V, V_{IN} = V_{OUT}(T)+1V or V_{IN} = V_{OUT} +0.5 (if V_{OUT} > 4.5V)		V_{OUT}(T)* 0.99	V_{OUT}(T)	V_{OUT}(T)* 1.01	V
	V_{OUT}(T) < 2.0V, V_{IN} = V_{OUT}(T)+1V		V_{OUT}(T)- 20mV	V_{OUT}(T)	V_{OUT}(T)+ 20mV	
Line Regulation ($dV_{OUT}/dV_{IN}/V_{OUT}$)	V_{IN} = ($V_{OUT-Nom}$ +1.0V) to 5.5V, I_{OUT} = 1.0mA, V_{IN} = 5.3 to 5.5V (if V_{OUT} = 5.5V)		—	0.02	0.1	%/V
Load Regulation	V_{IN} = $V_{OUT-Nom}$ +1.0V, I_{OUT} = 1mA to 500mA		—	22.5	45	mV
Quiescent Current (Note 6)	I_{OUT} = 0mA		—	60	125	µA
$I_{STANDBY}$	V_{EN} = 0V (Disabled)		—	0.01	1.0	µA
Output Current	V_{IN} > V_{OUT} + max Dropout, and V_{IN} >2.0V		500	—	—	mA
Fold-back Short Current (Note 7)	V_{OUT} Short to Ground		—	180	—	mA
PSRR (Note 8)	V_{IN} = (V_{OUT}+1V) V_{DC} + 0.2Vp-pAC, V_{OUT} = 1.0V, I_{OUT} = 50mA	f = 1kHz	—	75	—	dB
Output Noise Voltage (Note 8) (Note 9)	BW = 10Hz to 100kHz, V_{OUT} = 1.0V, I_{OUT} = 50mA		—	60	—	µVrms
Dropout Voltage (Note 5)	I_{OUT} = 500mA	1.0V ≤ V_{OUT} < 1.2V	—	0.75	0.95	V
		1.2V ≤ V_{OUT} < 1.4V	—	0.65	0.80	
		1.4V ≤ V_{OUT} < 1.7V	—	0.55	0.66	
		1.7V ≤ V_{OUT} < 2.1V	—	0.45	0.55	
		2.1V ≤ V_{OUT} < 2.5V	—	0.36	0.42	
		2.5V ≤ V_{OUT} < 3.0V	—	0.31	0.36	
		3.0V ≤ V_{OUT} < 4.0V	—	0.27	0.32	
		4.0V ≤ V_{OUT} < 5.0V	—	0.14	0.32	
Output Voltage Temperature Coefficient	I_{OUT} = 50mA, T_J = -40°C to +125°C		—	±30	—	ppm/°C
Thermal Shutdown Threshold (TSHDN)	—		—	+170	—	°C
Thermal Shutdown Hysteresis (THYS)	—		—	+20	—	°C
EN Input Low Voltage	—		0	—	0.5	V
EN Input High Voltage	—		1.25	—	5.5	V
EN Input Leakage	V_{EN} = 0, V_{IN} = 5.0V or V_{EN} = 5.0V, V_{IN} = 0V		-1	—	+1	µA
On Resistance of N-Channel for Auto-Discharge (Note 10)	V_{IN} = 4.0V, V_{EN} = 0V (Disabled)		—	30	—	Ω
Thermal Resistance Junction to Ambient (θ_{JA})	SOT25 (Type A1)		—	140	—	°C/W
	WDFN2020-6 (Wettable)		—	54	—	
Thermal Resistance Junction to Case (θ_{JC})	SOT25 (Type A1)		—	57	—	°C/W
	WDFN2020-6 (Wettable)		—	20	—	

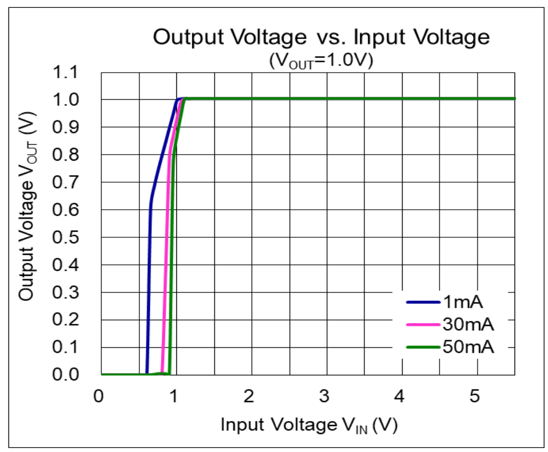
Notes:
5. Dropout voltage is the voltage difference between the input and the output at which the output voltage drops 2% below its nominal value.
6. Quiescent current is defined here is the difference in current between the input and the output.
7. Short-circuit current is measured with V_{OUT} pulled to GND.
8. This specification is guaranteed by design.
9. To make sure lowest environment noise minimizes the influence on noise measurement.
10. Potential multiple grades based on following output voltage accuracy.

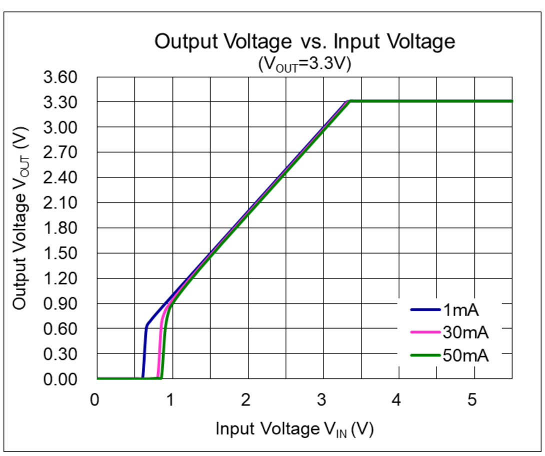
Typical Characteristics (CIN = COUT = 1μF)

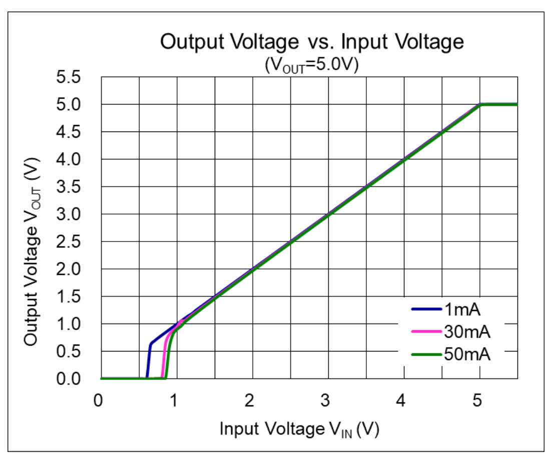




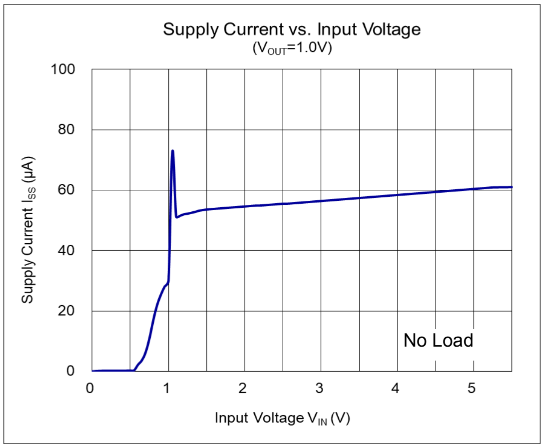


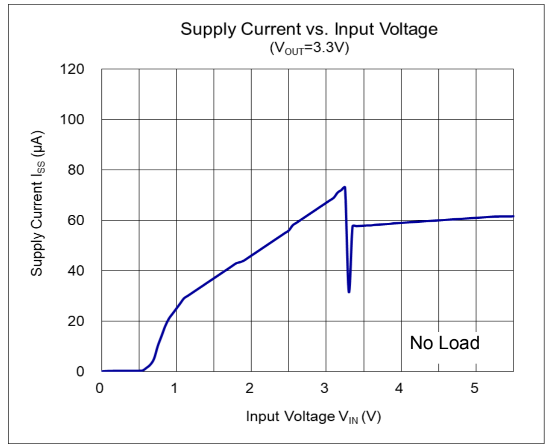


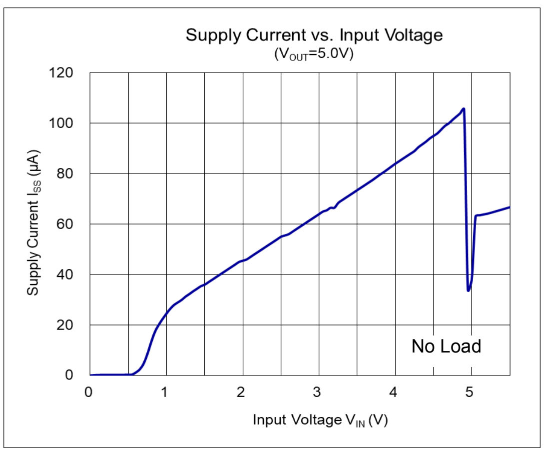


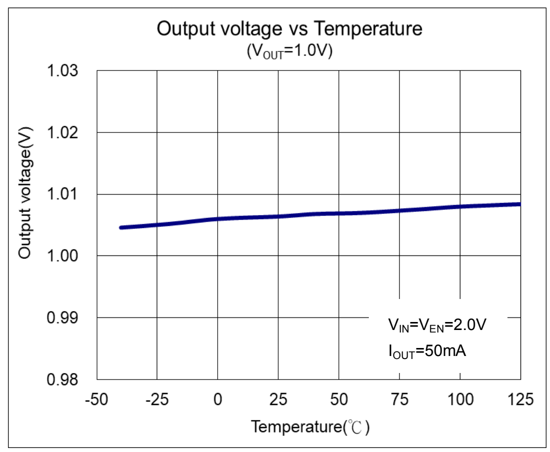


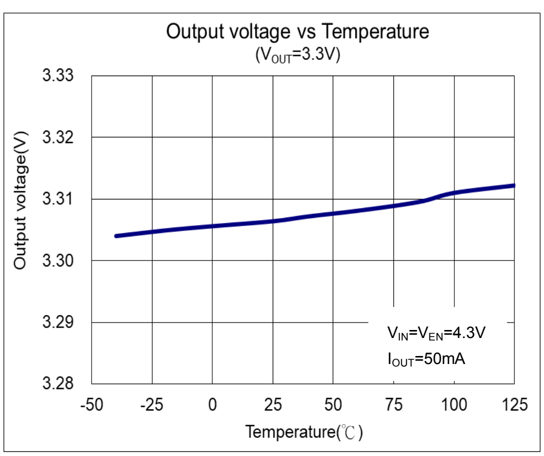
Typical Characteristics (C_{IN} = C_{OUT} = 1µF) (continued)

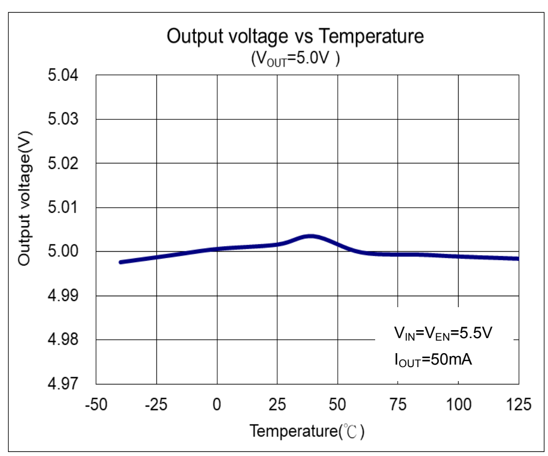




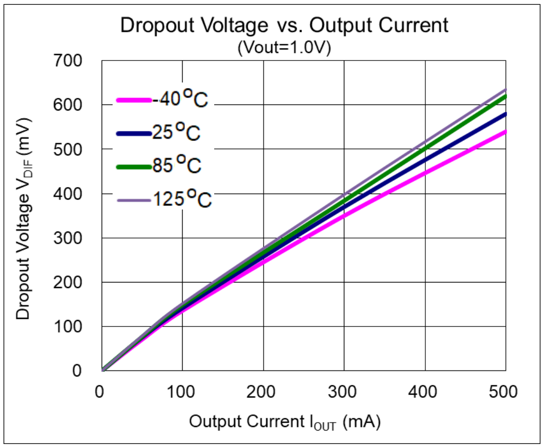


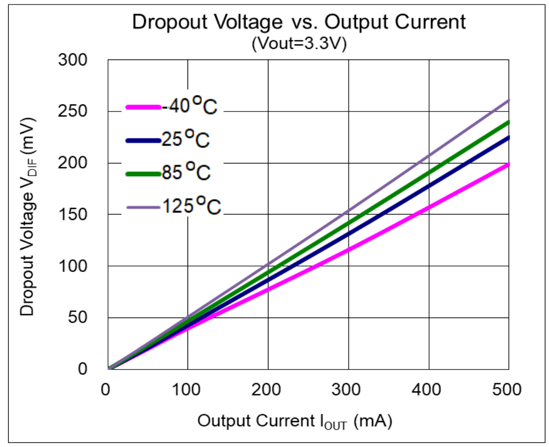


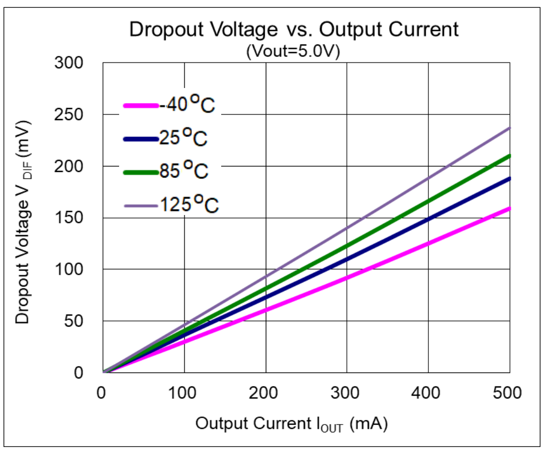


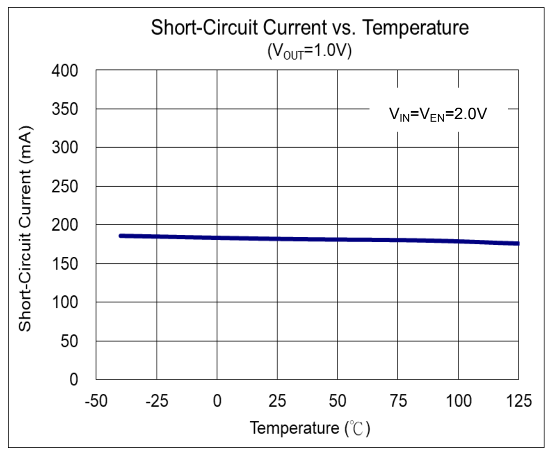


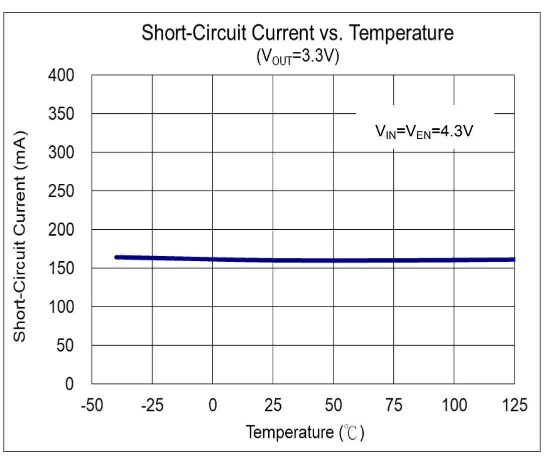
Typical Characteristics ($C_{IN} = C_{OUT} = 1\mu F$) (continued)

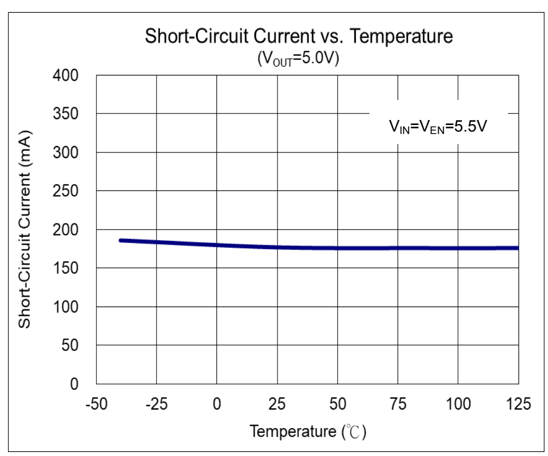




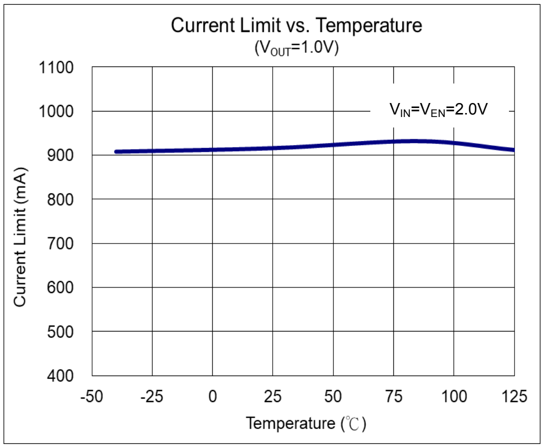


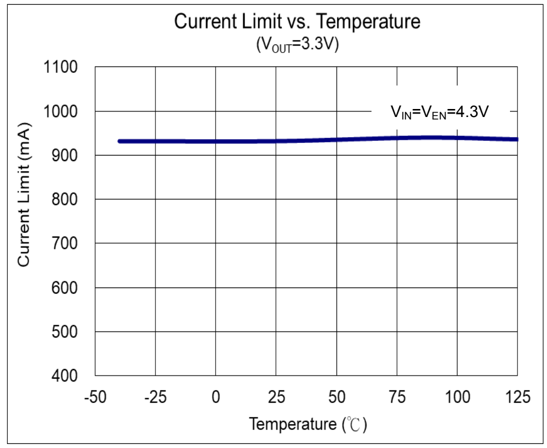


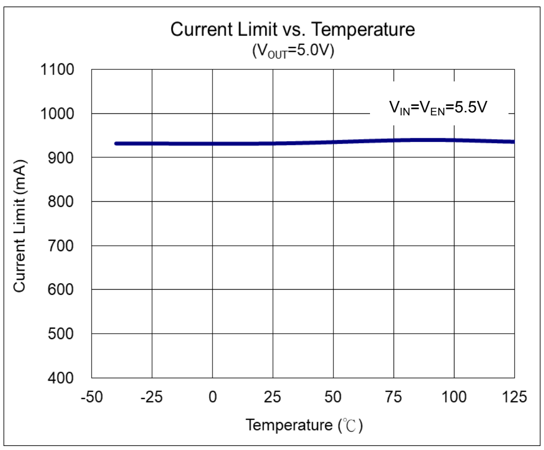


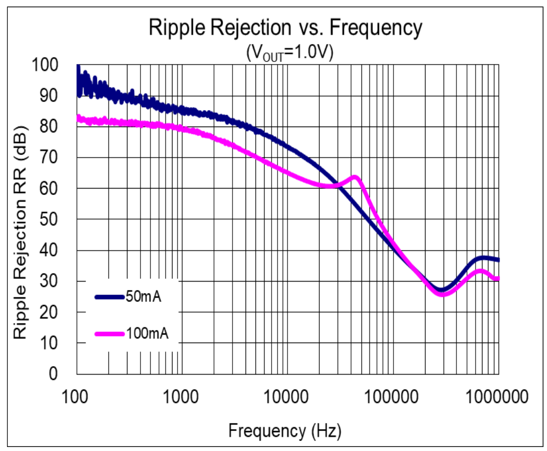


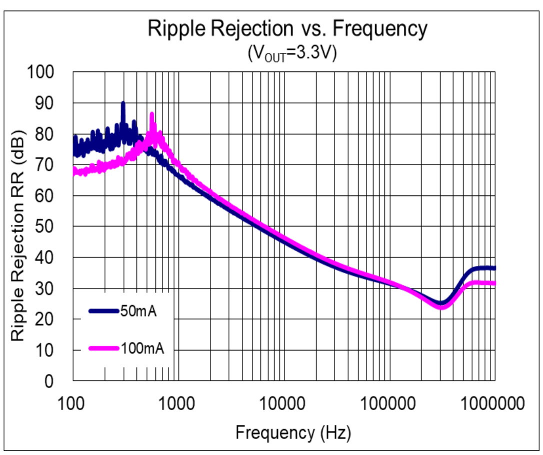
Typical Characteristics ($C_{IN} = C_{OUT} = 1\mu F$) (continued)

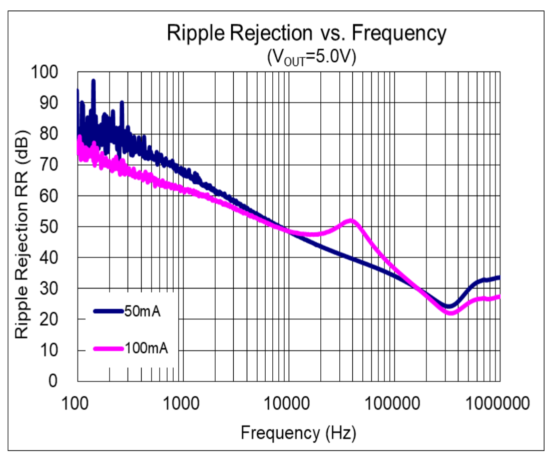






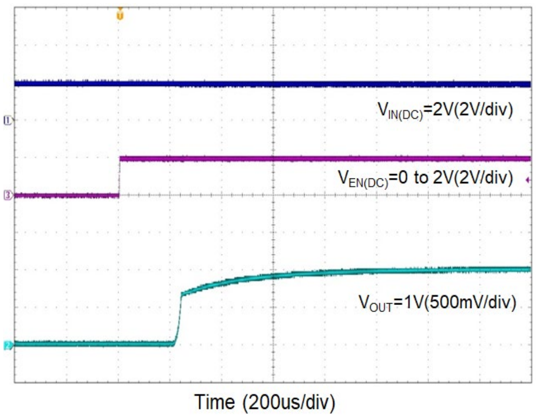




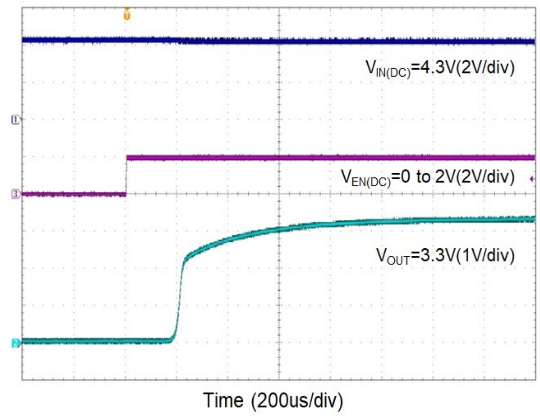


Typical Characteristics ($C_{IN} = C_{OUT} = 1\mu F$) (continued)

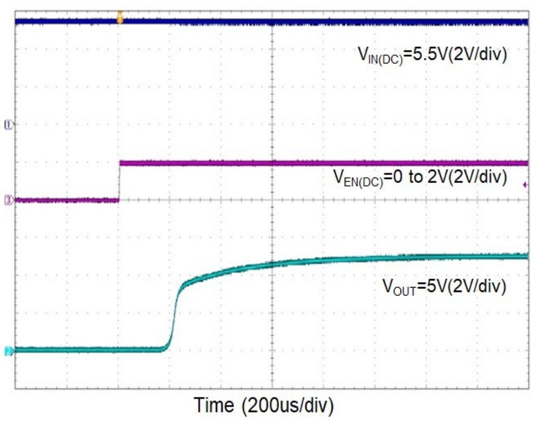
Enable Turn-On Response
(V_{OUT}=1.0V)



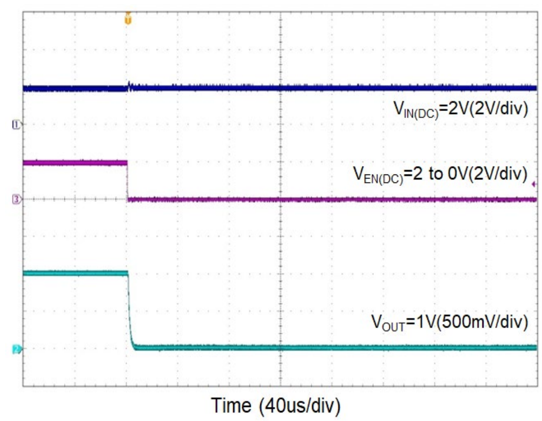
Enable Turn-On Response
(V_{OUT}=3.3V)



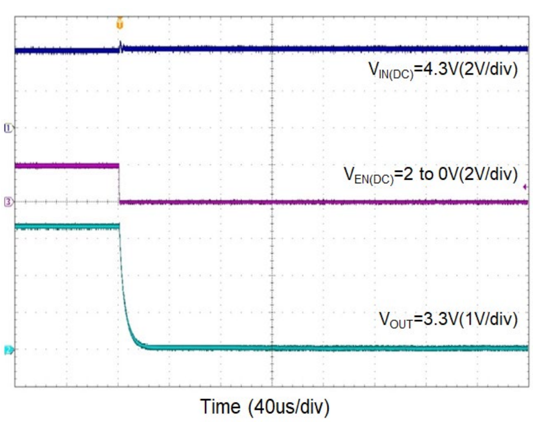
Enable Turn-On Response
(V_{OUT}=5.0V)



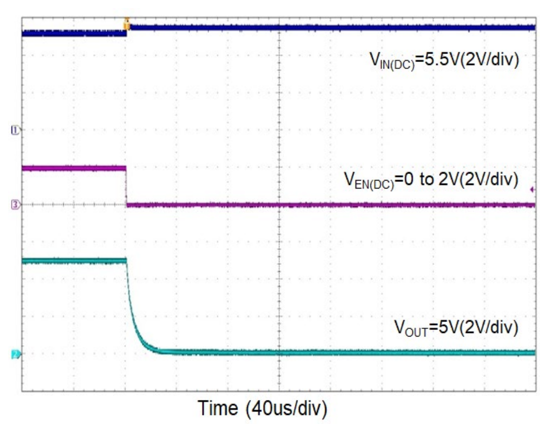
Enable Turn-Off Response
(V_{OUT}=1.0V)



Enable Turn-Off Response
(V_{OUT}=3.3V)

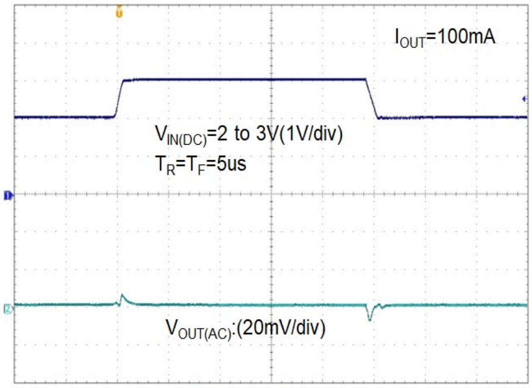


Enable Turn-Off Response
(V_{OUT}=5.0V)



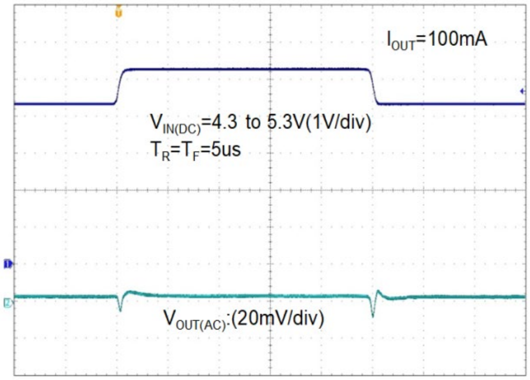
Typical Characteristics ($C_{IN} = C_{OUT} = 1\mu F$) (continued)

Line Transient Response
(V_{OUT}=1.2V)



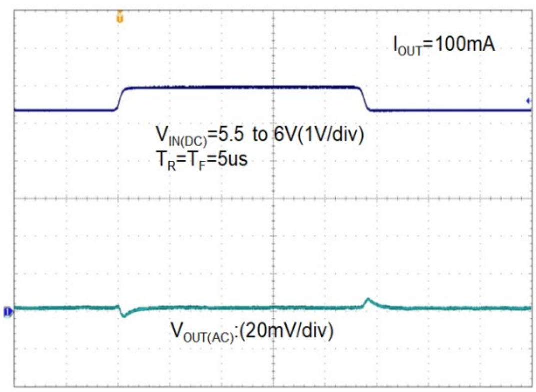
Time (40us/div)

Line Transient Response
(V_{OUT}=3.3V)



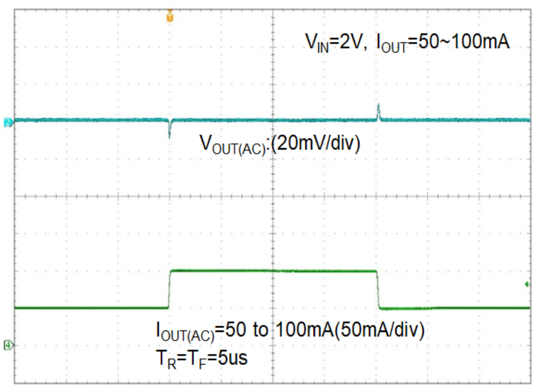
Time (40us/div)

Line Transient Response
(V_{OUT}=5.0V)



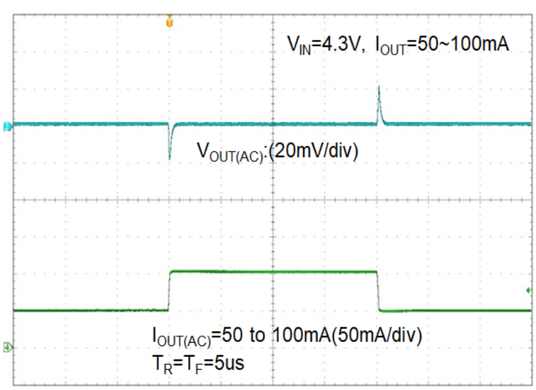
Time (40us/div)

Load Transient Response
(V_{OUT}=1.0V)



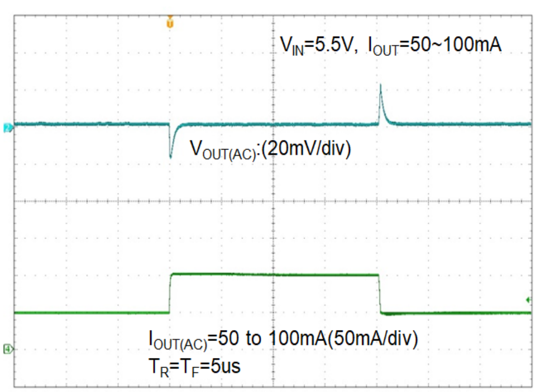
Time (200us/div)

Load Transient Response
(V_{OUT}=3.3V)



Time(200us/div)

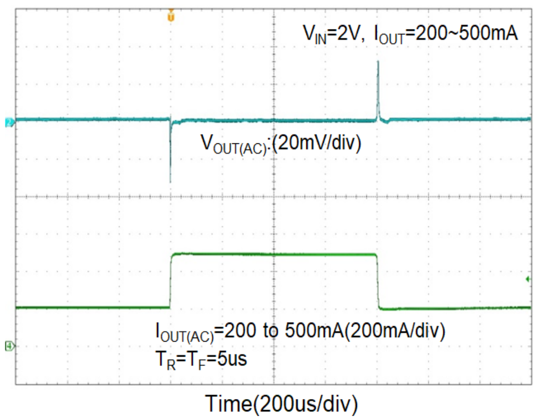
Load Transient Response
(V_{OUT}=5.0V)



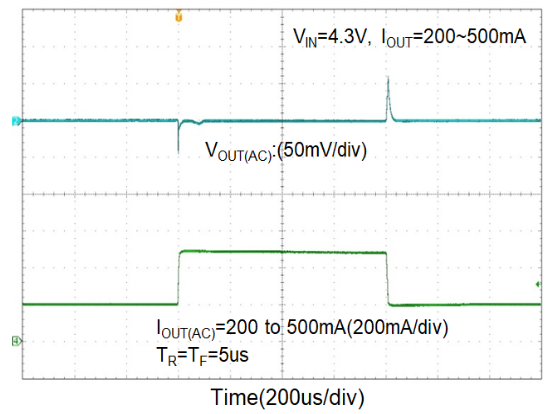
Time (200us/div)

Typical Characteristics ($C_{IN} = C_{OUT} = 1\mu F$) (continued)

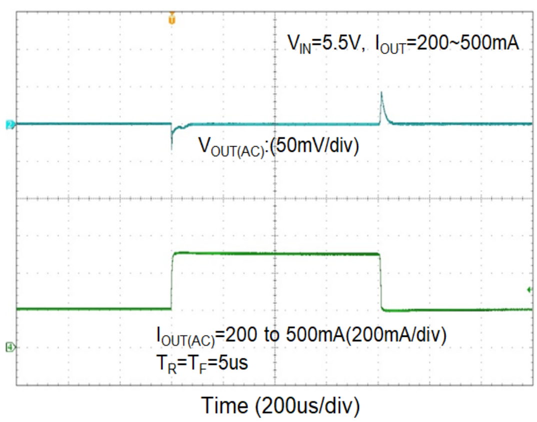
Load Transient Response
(V_{OUT}=1.0V)



Load Transient Response
(V_{OUT}=3.3V)



Load Transient Response
(V_{OUT}=3.3V)



Application Information

Output Capacitor

An output capacitor (C_{OUT}) is needed to improve transient response and maintain stability. The AP7347DQ is stable with very small ceramic output capacitors. The ESR (equivalent series resistance) and capacitance drives the selection. If the application has large load variations, it is recommended to utilize low-ESR bulk capacitors. It is also recommended to place ceramic capacitors as close as possible to the load and the ground pin. Care should be taken to reduce the impedance in the layout.

Input Capacitor

To prevent the input voltage from dropping during load steps, it is recommended to utilize an input capacitor (C_{IN}). A minimum 1µF ceramic capacitor is recommended between the V_{IN} and GND pins to decouple input power supply glitch. This input capacitor must be located as close as possible to the device to assure input stability and reduce noise. For PCB layout, a wide copper trace is required for both V_{IN} and GND pins.

Enable Control

The AP7347DQ 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 V_{IN} pin to keep the regulator output on at all times. 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.

Short-Circuit Protection

When the V_{OUT} pin short-circuits to GND, short-circuit protection will be triggered and clamp the output current to approximately 55mA. This feature protects the regulator from overcurrent and damage due to overheating.

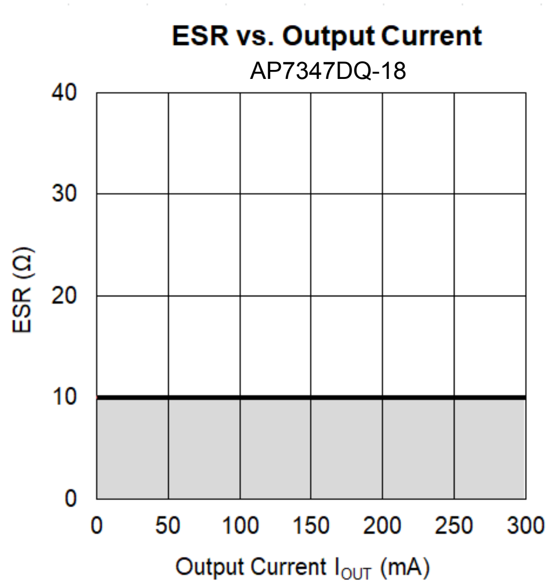
Layout Considerations

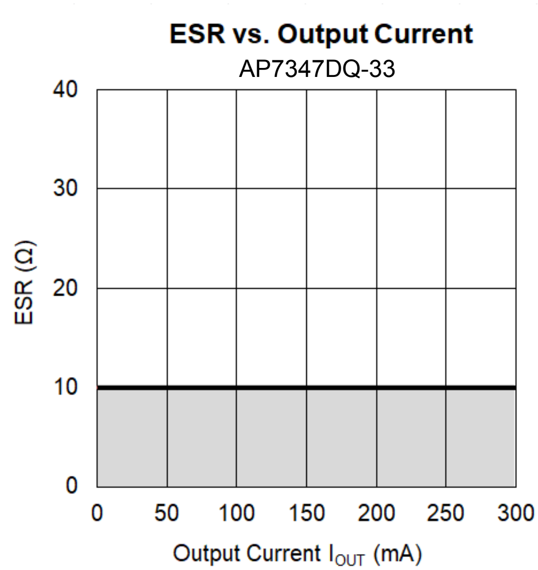
For good ground loop and stability, the input and output capacitors should be located close to the input, output, and ground pins of the device. The regulator ground pin should be connected to the external circuit ground to reduce voltage drop caused by trace impedance. Ground plane is generally used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

ESR vs. Output Current

A ceramic type output capacitor is recommended for this series; however, other output capacitors with low ESR can also be used. The relationship between the I_{OUT} (output current) and the ESR of an output capacitor are shown below. The stable region for the safe operating temperature (-40°C ~ +85°C) is marked as the gray area in the graph.

Measurement conditions: Frequency Band: 10Hz to 2MHz, Temperature: -40°C to +85°C.





Ordering Information (Note 11)

AP7347D Q - XXX XXX - X

Output Discharge	Compliance	Output Voltage	Package	Packing
D : Output Discharge	Q: Automotive Compliant	10 : 1.0V 105 : 1.05V 11 : 1.1V 12 : 1.2V 15 : 1.5V 18 : 1.8V 22 : 2.2V 25 : 2.5V 28 : 2.8V 29 : 2.9V 33 : 3.3V 50 : 5.0V	W5: SOT25 (Type A1) FDZW: W-DFN2020-6 (SWP) (Type A1)	7 : Tape & Reel

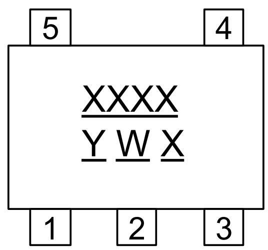
Part Number	Package Code	Packaging	7" Tape and Reel	
			Quantity	Part Number Suffix
AP7347DQ-XXXW5-7	W5	SOT25 (Type A1)	3000/Tape & Reel	-7
AP7347DQ-XXXFDZW-7	FDZW	W-DFN2020-6 (SWP) (Type A1)	3000/Tape & Reel	-7

Note: 11. For packaging details, go to our website at http://www.diodes.com/products/packages.html.

Marking Information

(1) SOT25 (Type A1)

(Top View)



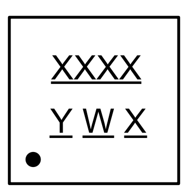
XXXX : Identification Code
Y : Year 0 to 9
W : Week : A to Z : 1 to 26 week;
a to z : 27 to 52 week; z represents
52 and 53 week
X : Internal Code

Part Number	Package	Identification Code
AP7347DQ-10W5-7	SOT25	J7AQ
AP7347DQ-105W5-7	SOT25	J7BQ
AP7347DQ-11W5-7 (*)	SOT25	J7CQ
AP7347DQ-12W5-7	SOT25	J7DQ
AP7347DQ-15W5-7 (*)	SOT25	J7EQ
AP7347DQ-18W5-7	SOT25	J7FQ
AP7347DQ-22W5-7 (*)	SOT25	J7GQ
AP7347DQ-25W5-7	SOT25	J7HQ
AP7347DQ-28W5-7	SOT25	J7JQ
AP7347DQ-29W5-7 (*)	SOT25	J7KQ
AP7347DQ-33W5-7	SOT25	J7MQ
AP7347DQ-50W5-7	SOT25	J7NQ

* This voltage is supported upon request.

(2) W-DFN2020-6 (SWP) (Type A1)

(Top View)



XXXX : 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

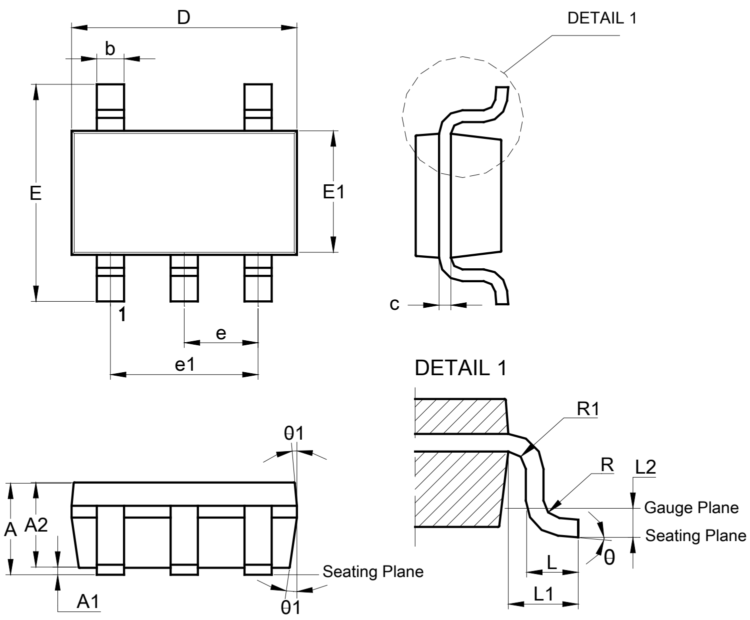
Part Number	Package	Identification Code
AP7347DQ-10FDZW-7	W-DFN2020-6 (SWP) (Type A1)	J7AQ
AP7347DQ-105FDZW-7	W-DFN2020-6 (SWP) (Type A1)	J7BQ
AP7347DQ-11FDZW-7 (*)	W-DFN2020-6 (SWP) (Type A1)	J7CQ
AP7347DQ-12FDZW-7	W-DFN2020-6 (SWP) (Type A1)	J7DQ
AP7347DQ-15FDZW-7 (*)	W-DFN2020-6 (SWP) (Type A1)	J7EQ
AP7347DQ-18FDZW-7	W-DFN2020-6 (SWP) (Type A1)	J7FQ
AP7347DQ-22FDZW-7 (*)	W-DFN2020-6 (SWP) (Type A1)	J7GQ
AP7347DQ-25FDZW-7	W-DFN2020-6 (SWP) (Type A1)	J7HQ
AP7347DQ-28FDZW-7	W-DFN2020-6 (SWP) (Type A1)	J7JQ
AP7347DQ-29FDZW-7 (*)	W-DFN2020-6 (SWP) (Type A1)	J7KQ
AP7347DQ-33FDZW-7	W-DFN2020-6 (SWP) (Type A1)	J7MQ
AP7347DQ-50FDZW-7	W-DFN2020-6 (SWP) (Type A1)	J7NQ

* This voltage is supported upon request.

Package Outline Dimensions

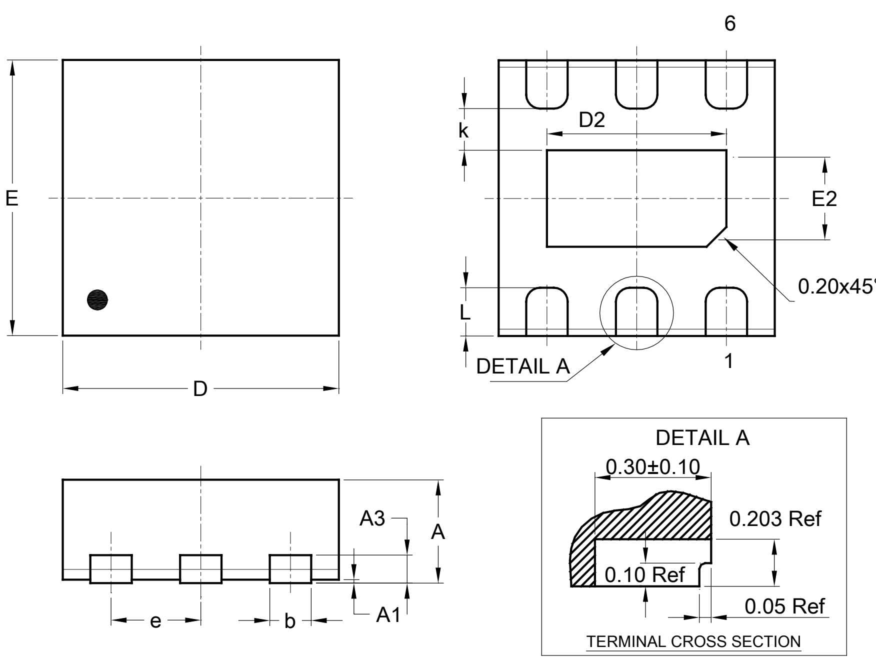
Please see http://www.diodes.com/package-outlines.html for the latest version.

(1) SOT25 (Type A1)



SOT25 (Type A1)			
Dim	**Min**	**Max**	**Typ**
A	--	1.45	--
A1	0.00	0.15	--
A2	0.90	1.30	1.15
b	0.30	0.50	--
c	0.08	0.22	--
D	2.90 BSC		
E	2.80 BSC		
E1	1.60 BSC		
e	0.95 BSC		
e1	1.90 BSC		
L	0.30	0.60	0.45
L1	0.60 REF		
L2	0.25 BSC		
R	0.10	--	--
R1	0.10	0.25	--
θ	0°	8°	4°
θ1	5°	15°	10°
All Dimensions in mm			

(2) W-DFN2020-6 (SWP) (Type A1)

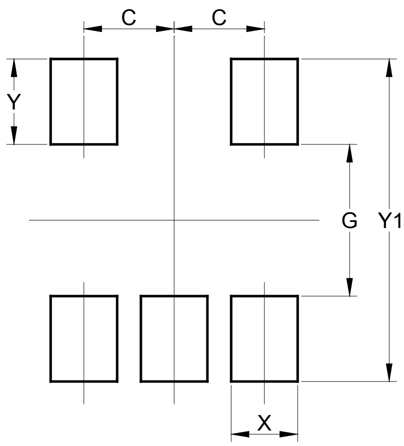


W-DFN2020-6 (SWP) (Type A1)			
Dim	**Min**	**Max**	**Typ**
A	0.70	0.80	0.75
A1	0.00	0.05	0.02
A3	0.203 REF		
b	0.25	0.35	0.30
D	2.00 BSC		
D2	1.35	1.45	1.40
E	2.00 BSC		
E2	0.55	0.65	0.60
e	0.65 BSC		
k	0.20	—	—
L	0.20	0.40	0.30
All Dimensions in mm			

Suggested Pad Layout

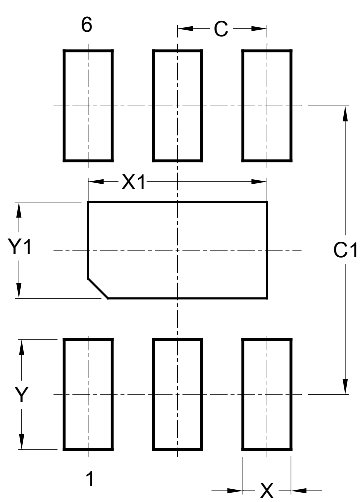
Please see http://www.diodes.com/package-outlines.html for the latest version.

(1) SOT25 (Type A1)



Dimensions	Value (in mm)
C	0.950
G	1.600
X	0.700
Y	0.900
Y1	3.400

(2) W-DFN2020-6 (SWP) (Type A1)



Dimensions	Value (in mm)
C	0.650
C1	2.100
X	0.350
X1	1.400
Y	0.800
Y1	0.600

Mechanical Data

- Moisture Sensitivity: Level 1 Per J-STD-020
- Terminals: Finish - Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 (e3)
- Weight:
  - SOT25: 0.016 grams (Approximate)
  - W-DFN2020-6: 0.010 grams (Approximate)

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