

**APT60DQ60SG**  
**Datasheet**  
**Ultra-Fast Soft Recovery Rectifier Diode**

Final  
October 2017



## Contents

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<b>1</b>	<b>Revision History</b> .....	<b>1</b>
1.1	Revision A .....	1
<b>2</b>	<b>Product Overview</b> .....	<b>2</b>
2.1	Features .....	2
2.2	Benefits .....	2
2.3	Applications .....	2
<b>3</b>	<b>Electrical Specifications</b> .....	<b>3</b>
3.1	Absolute Maximum Ratings .....	3
3.2	Electrical Performance .....	3
3.3	Dynamic Characteristics .....	4
3.4	Typical Performance Curves .....	4
<b>4</b>	<b>Package Specification</b> .....	<b>8</b>
4.1	Chip Outline Drawing .....	8

# 1 Revision History

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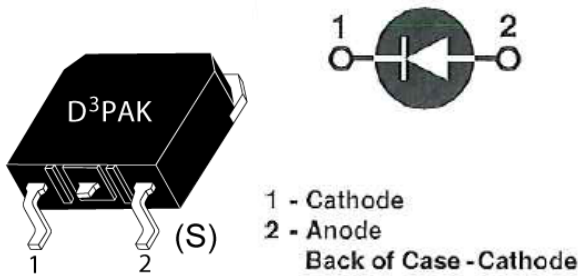
The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

## 1.1 Revision A

Revision A was published in October 2017. It is the first publication of this document.

## 2 Product Overview

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### 2.1 Features

The following are key features of the APT60DQ60SG device:

- Ultra-fast recovery times
- Soft recovery characteristics
- Low forward voltage
- Low leakage current
- Avalanche energy rated
- Popular D<sup>3</sup>PAK package
- RoHS compliant
- AEC-Q101 qualified

### 2.2 Benefits

The following are benefits of the APT60DQ60SG device:

- Higher switching frequency
- Low switching losses
- Low noise (EMI) switching
- Easy to parallel
- Improved system reliability

### 2.3 Applications

The APT60DQ60SG device is designed for the following applications:

- PFC
  - Continuous conduction mode
- Freewheeling diode
  - Inverters
  - Hard- or soft-switched high-frequency SMPS
- Clamp diode
  - Single- and two-switch forward
  - Bridge circuits
- Fast output rectifier
  - High-output voltage SMPS

### 3 Electrical Specifications

This section details the electrical specifications for the APT60DQ60SG device.

#### 3.1 Absolute Maximum Ratings

The following table shows the absolute maximum ratings for the APT60DQ60SG device.

All Ratings:  $T_c = 25\text{ }^\circ\text{C}$  unless otherwise specified.

**Table 1 • Absolute Maximum Ratings**

Symbol	Parameter	Ratings	Unit
$V_R$	Maximum DC reverse voltage	600	V
$V_{RRM}$	Maximum peak repetitive reverse voltage		
$V_{RWM}$	Maximum working peak reverse voltage		
$I_{F(AV)}$	Maximum average forward current ( $T_c = 110\text{ }^\circ\text{C}$ , duty cycle = 0.5)	60	A
$I_{F(RMS)}$	RMS forward current (square wave, 50% duty)	94	
$I_{FSM}$	Non-repetitive forward surge current ( $T_J = 45\text{ }^\circ\text{C}$ , 8.3 ms)	600	
$E_{AVL}$	Avalanche energy (1 A, 40 mH)	20	mJ
$T_J, T_{STG}$	Operating and storage temperature range	-55 to 175	$^\circ\text{C}$
$T_L$	Lead temperature for 10 seconds	300	

The following table shows the thermal and mechanical characteristics of the APT60DQ60SG device.

**Table 2 • Thermal and Mechanical Characteristics**

Symbol	Characteristic	Min	Typ	Max	Unit
$R_{\theta JC}$	Junction-to-case thermal resistance			0.44	$^\circ\text{C}/\text{W}$
$W_T$	Package weight		0.14		oz
			4.0		g

#### 3.2 Electrical Performance

The following table shows the static characteristics of the APT60DQ60SG device.

**Table 3 • Static Characteristics**

Symbol	Characteristic/Test Conditions	Min	Typ	Max	Unit	
$V_F$	Forward Voltage		$I_F = 60\text{ A}$	2.0	2.4	V
			$I_F = 120\text{ A}$	2.44		
			$I_F = 60\text{ A}, T_J = 125\text{ }^\circ\text{C}$	1.7		
$I_{RM}$	Maximum reverse leakage current		$V_R = 600\text{ V}$		25	$\mu\text{A}$
			$V_R = 600\text{ V}, T_J = 125\text{ }^\circ\text{C}$		500	
$C_J$	Junction capacitance, $V_R = 200\text{ V}$		75		pF	

### 3.3 Dynamic Characteristics

The following table shows the dynamic characteristics of the APT60DQ60SG device.

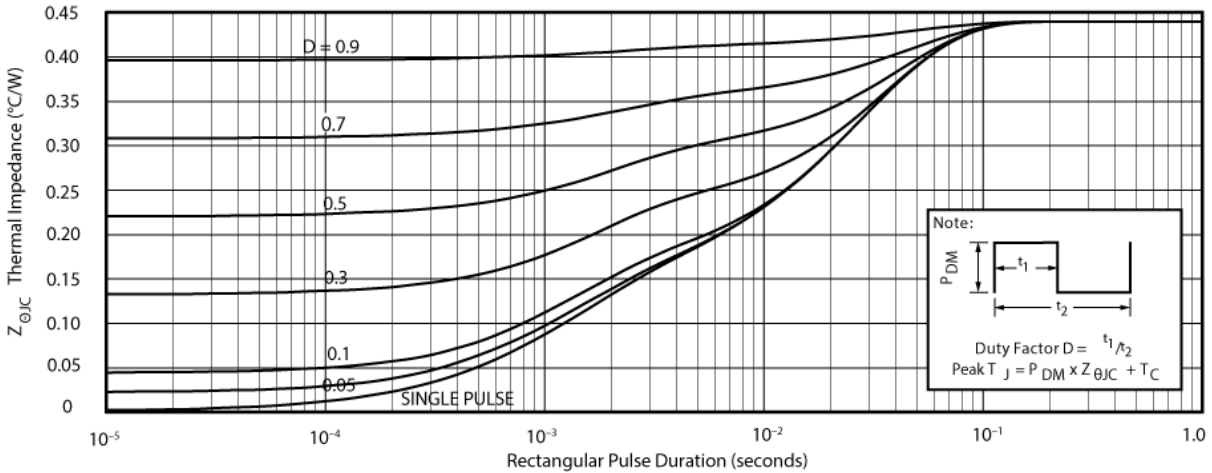
**Table 4 • Dynamic Characteristics**

Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$t_{rr}$	Reverse recovery time	$I_F = 1\text{ A}$ , $di_F/dt = -100\text{ A}/\mu\text{s}$ $V_R = 30\text{ V}$ , $T_J = 25\text{ }^\circ\text{C}$		26		ns
$t_{rr}$	Reverse recovery time	$I_F = 60\text{ A}$ , $di_F/dt = -200\text{ A}/\mu\text{s}$ $V_R = 400\text{ V}$ , $T_C = 25\text{ }^\circ\text{C}$		35		
$Q_{rr}$	Reverse recovery charge			45		nC
$I_{RRM}$	Maximum reverse recovery current			4		A
$t_{rr}$	Reverse recovery time	$I_F = 60\text{ A}$ , $di_F/dt = -200\text{ A}/\mu\text{s}$ $V_R = 400\text{ V}$ , $T_C = 125\text{ }^\circ\text{C}$		175		ns
$Q_{rr}$	Reverse recovery charge			680		nC
$I_{RRM}$	Maximum reverse recovery current			8		A
$t_{rr}$	Reverse recovery time	$I_F = 60\text{ A}$ , $di_F/dt = -1000\text{ A}/\mu\text{s}$ $V_R = 400\text{ V}$ , $T_C = 125\text{ }^\circ\text{C}$		100		ns
$Q_{rr}$	Reverse recovery charge			1380		nC
$I_{RRM}$	Maximum reverse recovery current			26		A

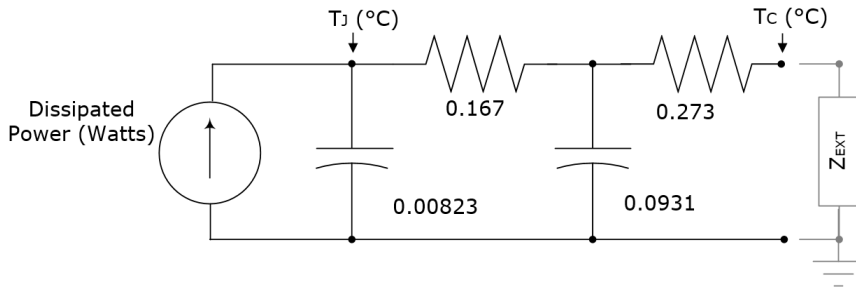
### 3.4 Typical Performance Curves

This section shows the typical performance curves for the APT60DQ60SG device.

**Figure 1 • Maximum Transient Thermal Impedance**

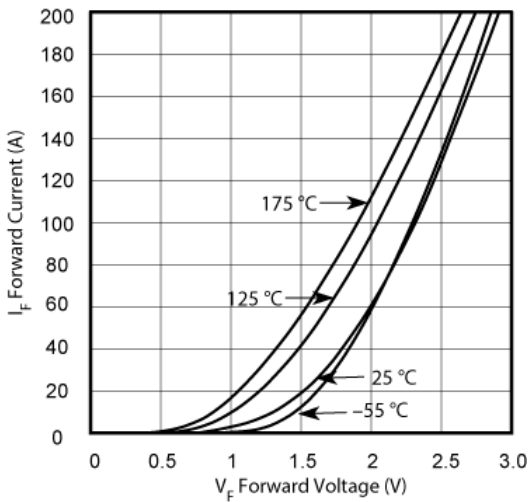


**Figure 2 • Transient Thermal Impedance Model**

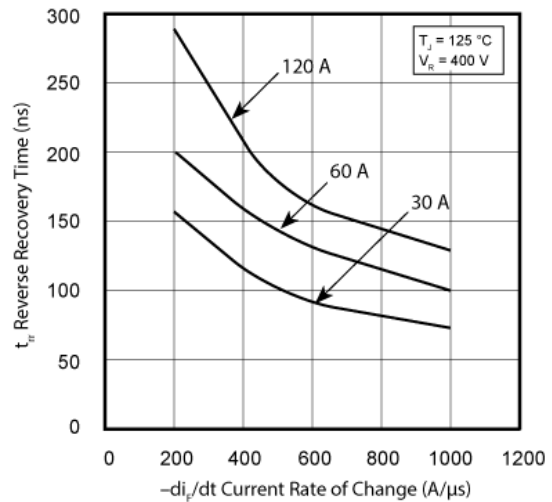


**Note:**  $Z_{EXT}$  are the external thermal impedances (case to sink, sink to ambient, etc.). Set to zero when modeling only the case to junction.

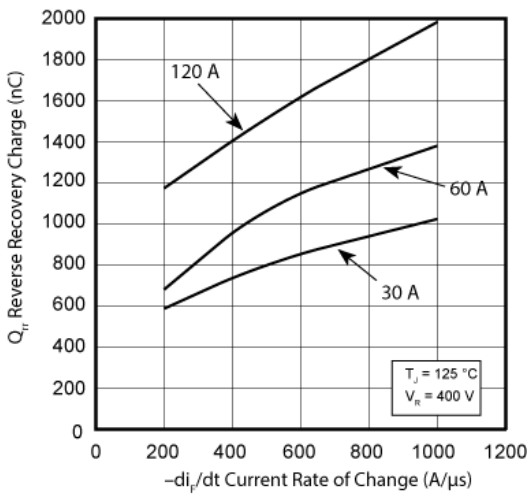
**Figure 3 • Forward Current vs. Forward Voltage**



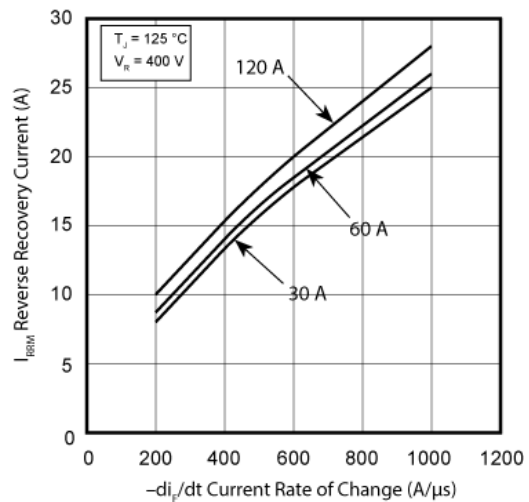
**Figure 4 •  $t_{rr}$  vs. Current Rate of Change**



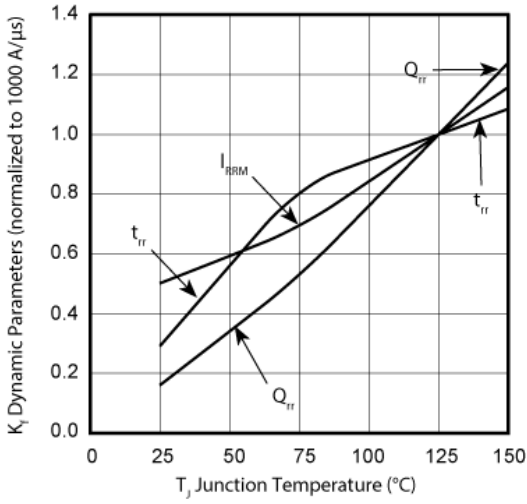
**Figure 5 •  $Q_{rr}$  vs. Current Rate of Change**



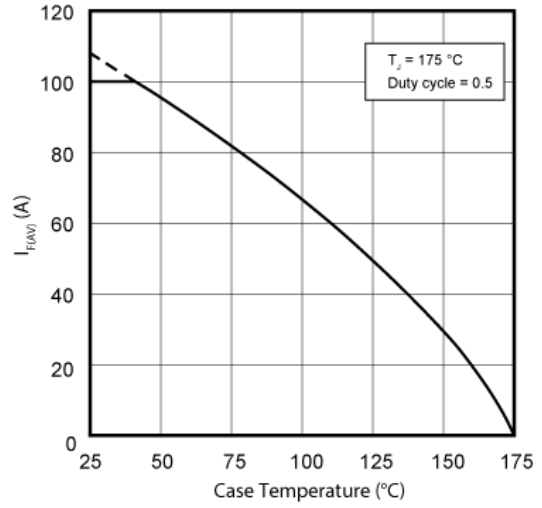
**Figure 6 • IRRM vs. Current Rate of Change**



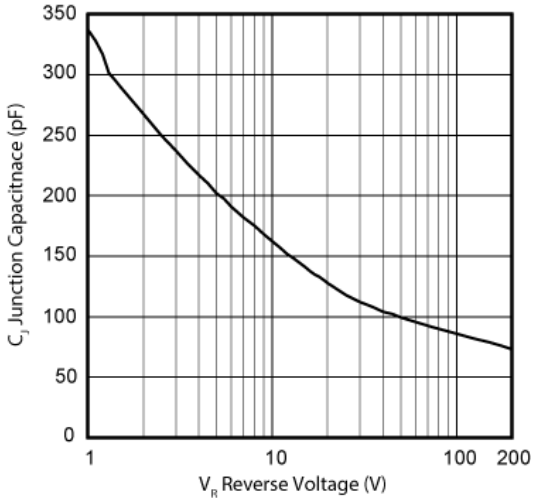
**Figure 7 • Dynamic Parameters vs. Junction Temperature**



**Figure 8 • Maximum Average Forward Current vs. Case Temperature**



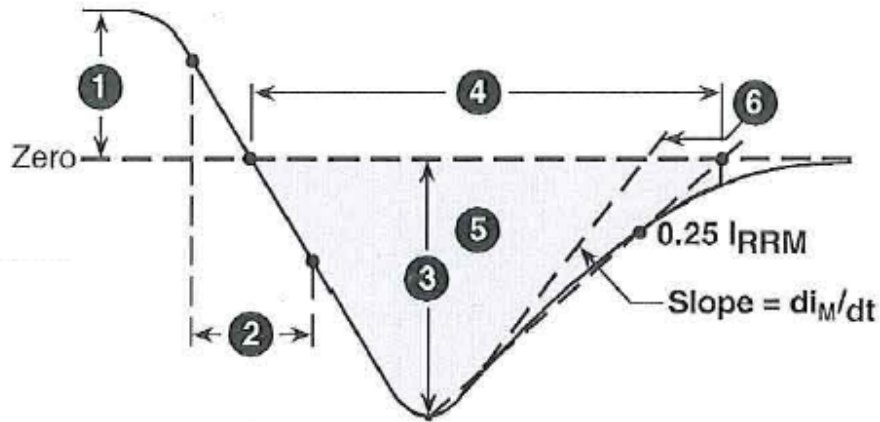
**Figure 9 • Junction Capacitance vs. Reverse Voltage**





The following illustration shows the diode reverse recovery waveform and definitions for the APT60DQ60SG device.

**Figure 10 • Diode Reverse Recovery Waveform and Definitions**



1.  $I_F$ —Forward conduction current.
2.  $di_F/dt$ —Rate of diode current change through zero crossing.
3.  $I_{RRM}$ —Maximum reverse recovery current.
4.  $t_{rr}$ —Reverse recovery time, measured from zero crossing where diode current goes from positive to negative, to the point at which the straight line through  $I_{RRM}$  and  $0.25 \times I_{RRM}$  passes through zero.
5.  $Q_{rr}$ —Area under the curve defined by  $I_{RRM}$  and  $t_{rr}$ .
6.  $di_M/dt$ —Maximum rate of current increase during the trailing portion of  $t_{rr}$ .

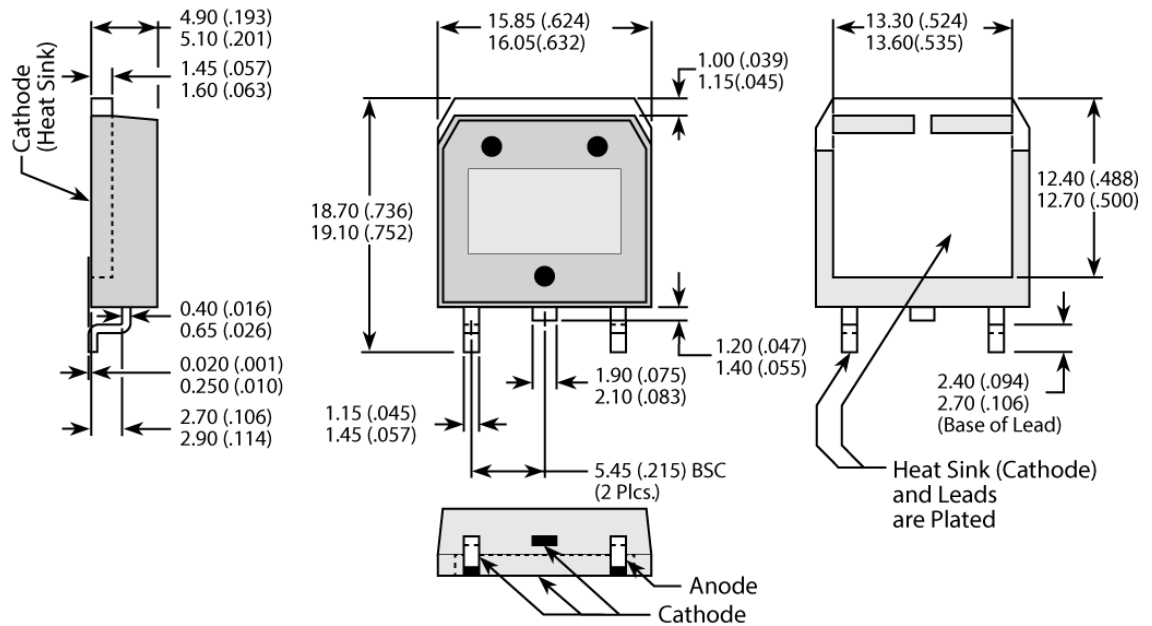
## 4 Package Specification

This section outlines the package specification for the APT60DQ60SG device.

### 4.1 Chip Outline Drawing

This section details the D<sup>3</sup>PAK package drawing of the APT60DQ60SG device. Dimensions are in millimeters and (inches).

Figure 11 • Package Outline Drawing



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