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1 Revision History

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 D

Revision D was published in March 2018. The following is a summary of the changes in revision D of this document.

- The new Microsemi template and format was applied.
- The package outline drawing was updated. For more information, see Package Outline Drawing.

1.2 Revision C

Revision C was published in May 2011. The following is a summary of the changes in revision C of this document.

- The patent information was removed from the document.
- For TO-247 packages: the maximum lead thickness was changed from 0.70 in (0.031 mm) to 1.016 in (0.040 mm).

1.3 Revision B

Revision B was published in August 2005. The following is a summary of the changes in revision B of this document.

- The $I_{RM}$ in the static characteristics table was updated. For more information, see Electrical Performance.

1.4 Revision A

Revision A was published in May 2005. It is the first publication of this document.
2 Product Overview

This section outlines the product overview for the APT40DQ120BG device.

2.1 Features
The following are key features of the APT40DQ120BG device:

- Ultrafast recovery times
- Soft recovery characteristics
- Low forward voltage
- Low leakage current
- Avalanche energy rated
- RoHS compliant
- AEC-Q101 qualified

2.2 Benefits
The following are benefits of the APT40DQ120BG device:

- Higher switching frequency
- Low switching losses
- Low noise (EMI) switching
- Higher reliability systems
- Increased system power density

2.3 Applications
The APT40DQ120BG device is designed for the following applications:

- Power factor correction (PFC)
- Anti-parallel diode
  - Switch-mode power supply
  - Inverters/converters
  - Motor controllers
- Freewheeling diode
  - Switch-mode power supply
  - Inverters/converters
- Snubber/clamp diode
3 Electrical Specifications

This section shows the electrical specifications for the APT40DQ120BG device.

3.1 Absolute Maximum Ratings

The following table shows the absolute maximum ratings for the APT40DQ120BG device.

All ratings: \( T_c = 25 \, ^\circ\text{C} \) unless otherwise specified.

Table 1 • Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Ratings</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{R} )</td>
<td>Maximum DC reverse voltage</td>
<td>1200</td>
<td>V</td>
</tr>
<tr>
<td>( V_{RRM} )</td>
<td>Maximum peak repetitive reverse voltage</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>( V_{W} )</td>
<td>Maximum working peak reverse voltage</td>
<td>1200</td>
<td></td>
</tr>
<tr>
<td>( I_{F(AV)} )</td>
<td>Maximum average forward current ( \left( T_c = 112 , ^\circ\text{C}, \text{duty cycle} = 0.5 \right) )</td>
<td>40</td>
<td>A</td>
</tr>
<tr>
<td>( I_{F(RMS)} )</td>
<td>RMS forward current</td>
<td>63</td>
<td></td>
</tr>
<tr>
<td>( I_{FSM} )</td>
<td>Non-repetitive forward surge current ( \left( T_{L} = 45 , ^\circ\text{C}, 8.3 , \text{ms} \right) )</td>
<td>210</td>
<td></td>
</tr>
<tr>
<td>( E_{AVL} )</td>
<td>Avalanche energy ( \left( 1 , \text{A}, 40 , \text{mH} \right) )</td>
<td>20</td>
<td>mJ</td>
</tr>
<tr>
<td>( T_{J}, T_{STG} )</td>
<td>Operating and storage temperature range</td>
<td>–55 to 175</td>
<td>°C</td>
</tr>
<tr>
<td>( T_{L} )</td>
<td>Lead temperature for 10 seconds</td>
<td>300</td>
<td></td>
</tr>
</tbody>
</table>

The following table shows the thermal and mechanical characteristics of the APT40DQ120BG device.

Table 2 • Thermal and Mechanical Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Characteristic</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( R_{JC} )</td>
<td>Junction-to-case thermal resistance</td>
<td>0.61</td>
<td></td>
<td></td>
<td>°C/W</td>
</tr>
<tr>
<td>( W_{T} )</td>
<td>Package weight</td>
<td>0.22</td>
<td>0.22</td>
<td>5.9</td>
<td>oz</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>g</td>
</tr>
<tr>
<td>Torque</td>
<td>Maximum mounting torque</td>
<td>10</td>
<td></td>
<td>1.1</td>
<td>lb-in</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>N-m</td>
</tr>
</tbody>
</table>

3.2 Electrical Performance

The following table shows the static characteristics of the APT40DQ120BG device.

Table 3 • Static Characteristics

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Characteristic</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{F} )</td>
<td>Forward voltage</td>
<td>( I_r = 30 , \text{A} )</td>
<td>2.8</td>
<td>3.3</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( I_r = 60 , \text{A} )</td>
<td></td>
<td>3.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>( I_r = 30 , \text{A}, T_l = 125 , ^\circ\text{C} )</td>
<td></td>
<td>2.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( I_{RM} )</td>
<td>Maximum reverse leakage current</td>
<td>( V_b = 1200 , \text{V} )</td>
<td></td>
<td>100</td>
<td>500</td>
<td>µA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( V_b = 1200 , \text{V}, T_l = 125 , ^\circ\text{C} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( C_{J} )</td>
<td>Junction capacitance</td>
<td>( V_b = 200 , \text{V} )</td>
<td></td>
<td>36</td>
<td></td>
<td>pF</td>
</tr>
</tbody>
</table>
### 3.3 Dynamic Characteristics
The following table shows the dynamic characteristics of the APT40DQ120BG device.

**Table 4 • Dynamic Characteristics**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Characteristic</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
</table>
| $t_{rr}$ | Reverse recovery time                   | $I_r = 1 \text{ A}$  
                                   | $\frac{di}{dt} = -100 \text{ A/µs}$  
                                   | $V_s = 30 \text{ V}$  
                                   | $T_s = 25 \text{ °C}$                     | 26  |     |     | ns   |
| $t_{rr}$ | Reverse recovery time                   | $I_r = 40 \text{ A}$  
                                   | $\frac{di}{dt} = -200 \text{ A/µs}$  
                                   | $V_s = 800 \text{ V}$  
                                   | $T_s = 25 \text{ °C}$                     | 350 |     |     | nC   |
| $Q_{rr}$ | Reverse recovery charge                | $I_r = 40 \text{ A}$  
                                   | $\frac{di}{dt} = -200 \text{ A/µs}$  
                                   | $V_s = 800 \text{ V}$  
                                   | $T_s = 125 \text{ °C}$                     | 430 |     |     | ns   |
| $Q_{rr}$ | Maximum reverse recovery current       | $I_r = 40 \text{ A}$  
                                   | $\frac{di}{dt} = -1000 \text{ A/µs}$  
                                   | $V_s = 800 \text{ V}$  
                                   | $T_s = 125 \text{ °C}$                     | 210 |     |     | nC   |
| $Q_{rr}$ | Maximum reverse recovery current       | $I_r = 40 \text{ A}$  
                                   | $\frac{di}{dt} = -1000 \text{ A/µs}$  
                                   | $V_s = 800 \text{ V}$  
                                   | $T_s = 125 \text{ °C}$                     | 3400|     |     | nC   |
| $I_{RRM}$ | Maximum reverse recovery current       | $I_r = 40 \text{ A}$  
                                   | $\frac{di}{dt} = -1000 \text{ A/µs}$  
                                   | $V_s = 800 \text{ V}$  
                                   | $T_s = 125 \text{ °C}$                     | 29  |     |     | A    |
3.4 Typical Performance Curves

This section shows the typical performance curves for the APT40DQ120BG device.

Figure 1 • Maximum Transient Thermal Impedance

Figure 2 • Forward Current vs. Forward Voltage

Figure 3 • trr vs. Current Rate of Change
Figure 4 • Qrr vs. Current Rate of Change

Figure 5 • IRRM vs. Current Rate of Change

Figure 6 • Kf vs. Junction Temperature

Figure 7 • IF(AV) vs. Case Temperature

Figure 8 • Junction Capacitance vs. Reverse Voltage
3.5 Reverse Recovery Overview
The following illustration shows the diode test circuit for the APT40DQ120BG device.

Figure 9 • Diode Test Circuit

![Diode Test Circuit Diagram]

The following illustration shows the diode reverse recovery waveform and definitions for the APT40DQ120BG device.

Figure 10 • Diode Reverse Recovery Waveform and Definitions

1. \(I_r\) — Forward conduction current.
2. \(di/dt\) — 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 \(I_{RRM}\) passes through zero.
5. \(Q_r\) — Area under the curve defined by \(I_{RRM}\) and \(t_{rr}\).
4  Package Specification

This section shows the package specification for the APT40DQ120BG device.

4.1  Package Outline Drawing

This section shows the TO-247 package drawing of the APT40DQ120BG device. Dimensions are in millimeters and (inches).

Figure 11 • Package Outline Drawing