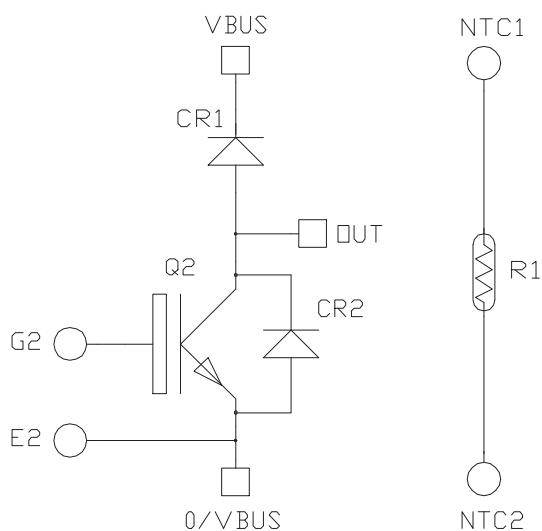


## Product Overview

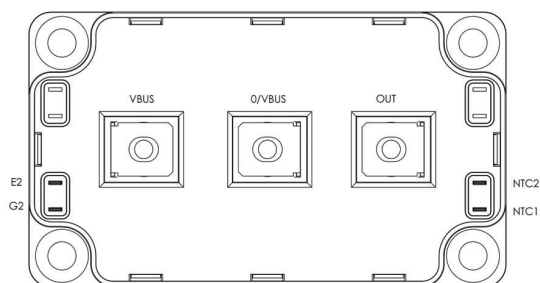
The APTGX600DA120T6G device is a boost chopper 1200V, 600A Insulated-Gate Bipolar Transistor (IGBT) 7 power module.

The following figures show the electrical diagram and pinout location of the device.

**Figure 1.** Electrical Diagram



**Figure 2.** Pinout Location



### Note:

- All ratings are at  $T_j = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified.



These devices are sensitive to electrostatic discharge. Proper handling procedures must be followed.

## Features

The APTGX600DA120T6G device has the following key features:

- IGBT 7
  - Low-voltage drop
  - Low-leakage current
- Very low-stray inductance
- Kelvin emitter for easy drive
- M5 power connectors
- Internal thermistor for temperature monitoring
- Al<sub>2</sub>O<sub>3</sub> substrate and copper base plate

## Benefits

The APTGX600DA120T6G device has the following benefits:

- High efficiency converter
- Direct mounting to heatsink (isolated package)
- Low junction-to-case thermal resistance
- Low profile
- RoHS compliant

## Potential Applications

The APTGX600DA120T6G device has the following potential applications:

- AC and DC motor control
- Switched-mode power supplies
- Power factor correction

# 1. Electrical Specifications

The following sections show the electrical specifications of the APTGX600DA120T6G device.

## 1.1 IGBT Characteristics (Per IGBT)

The following table lists the absolute maximum ratings (per IGBT) of the APTGX600DA120T6G device.

**Table 1-1.** Absolute Maximum Ratings

| Symbol    | Parameter                                               | Maximum Ratings                            | Unit |
|-----------|---------------------------------------------------------|--------------------------------------------|------|
| $V_{CES}$ | Collector-emitter voltage                               | 1200                                       | V    |
| $I_C$     | Continuous collector current                            | $T_C = 25\text{ }^{\circ}\text{C}$<br>805  | A    |
|           |                                                         | $T_C = 80\text{ }^{\circ}\text{C}$<br>600  |      |
| $I_{CM}$  | Pulsed collector current, $t_p$ limited by $T_{J(max)}$ | 1200                                       |      |
| $V_{GE}$  | Gate-emitter voltage                                    | $\pm 20$                                   | V    |
|           | Transient gate-emitter voltage                          | $\pm 25$                                   |      |
| $P_D$     | Power dissipation                                       | $T_C = 25\text{ }^{\circ}\text{C}$<br>1923 | W    |

The following table lists the electrical characteristics (per IGBT) of the APTGX600DA120T6G device.

**Table 1-2.** Electrical Characteristics

| Symbol        | Characteristic                       | Test Conditions                          | Min.                                | Typ. | Max. | Unit    |
|---------------|--------------------------------------|------------------------------------------|-------------------------------------|------|------|---------|
| $I_{CES}$     | Zero gate voltage collector current  | $V_{GE} = 0V$ ; $V_{CE} = 1200V$         | —                                   | —    | 50   | $\mu A$ |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE} = 15V$<br>$I_C = 600A$           | $T_J = 25\text{ }^{\circ}\text{C}$  | —    | 1.55 | V       |
|               |                                      |                                          | $T_J = 125\text{ }^{\circ}\text{C}$ | —    | 1.7  |         |
|               |                                      |                                          | $T_J = 175\text{ }^{\circ}\text{C}$ | —    | 1.77 |         |
| $V_{GE(th)}$  | Gate threshold voltage               | $V_{GE} = V_{CE}$ ; $I_C = 14\text{ mA}$ | 5.15                                | 5.8  | 6.45 |         |
| $I_{GES}$     | Gate-emitter leakage current         | $V_{GE} = 20V$ ; $V_{CE} = 0V$           | —                                   | —    | 400  | nA      |

The following table lists the dynamic characteristics (per IGBT) of the APTGX600DA120T6G device.

**Table 1-3.** Dynamic Characteristics

| Symbol              | Characteristic                      | Test Conditions                                                                                     |                         | Min. | Typ. | Max.  | Unit |
|---------------------|-------------------------------------|-----------------------------------------------------------------------------------------------------|-------------------------|------|------|-------|------|
| C <sub>ies</sub>    | Input capacitance                   | V <sub>GE</sub> = 0V<br>V <sub>CE</sub> = 25V<br>f = 100 kHz                                        |                         | —    | 120  | —     | nF   |
| C <sub>oes</sub>    | Output capacitance                  |                                                                                                     |                         | —    | 1.5  | —     |      |
| C <sub>res</sub>    | Reverse transfer capacitance        |                                                                                                     |                         | —    | 0.44 | —     |      |
| Q <sub>G</sub>      | Gate charge                         | V <sub>GE</sub> = ±15V<br>V <sub>CE</sub> = 600V<br>I <sub>C</sub> = 600A                           |                         | —    | 10   | —     | μC   |
| T <sub>d(on)</sub>  | Turn-on delay time                  | V <sub>GE</sub> = ±15V<br>V <sub>Bus</sub> = 600V<br>I <sub>C</sub> = 600A<br>R <sub>G</sub> = 0.5Ω | T <sub>J</sub> = 25 °C  | —    | 151  | —     | ns   |
|                     |                                     |                                                                                                     | T <sub>J</sub> = 125 °C | —    | 155  | —     |      |
|                     |                                     |                                                                                                     | T <sub>J</sub> = 175 °C | —    | 157  | —     |      |
| T <sub>r</sub>      | Rise time                           |                                                                                                     | T <sub>J</sub> = 25 °C  | —    | 55   | —     |      |
|                     |                                     |                                                                                                     | T <sub>J</sub> = 125 °C | —    | 70   | —     |      |
|                     |                                     |                                                                                                     | T <sub>J</sub> = 175 °C | —    | 60   | —     |      |
| T <sub>d(off)</sub> | Turn-off delay time                 |                                                                                                     | T <sub>J</sub> = 25 °C  | —    | 342  | —     |      |
|                     |                                     |                                                                                                     | T <sub>J</sub> = 125 °C | —    | 420  | —     |      |
|                     |                                     |                                                                                                     | T <sub>J</sub> = 175 °C | —    | 453  | —     |      |
| T <sub>f</sub>      | Fall time                           |                                                                                                     | T <sub>J</sub> = 25 °C  | —    | 102  | —     |      |
|                     |                                     |                                                                                                     | T <sub>J</sub> = 125 °C | —    | 200  | —     |      |
|                     |                                     |                                                                                                     | T <sub>J</sub> = 175 °C | —    | 263  | —     |      |
| E <sub>on</sub>     | Turn-on energy                      | V <sub>GE</sub> = ±15V<br>V <sub>Bus</sub> = 600V<br>I <sub>C</sub> = 600A                          | T <sub>J</sub> = 25 °C  | —    | 34   | —     | mJ   |
|                     |                                     | R <sub>G</sub> = 0.5Ω<br>di/dt = 9000 A/μs<br>dv/dt = 4000 V/μs                                     | T <sub>J</sub> = 125 °C | —    | 42   | —     |      |
|                     |                                     |                                                                                                     | T <sub>J</sub> = 175 °C | —    | 50.2 | —     |      |
| E <sub>off</sub>    | Turn-off energy                     |                                                                                                     | T <sub>J</sub> = 25 °C  | —    | 38   | —     |      |
|                     |                                     | T <sub>J</sub> = 125 °C                                                                             | —                       | 57.5 | —    |       |      |
|                     |                                     | T <sub>J</sub> = 175 °C                                                                             | —                       | 72.5 | —    |       |      |
| R <sub>Gint</sub>   | Internal gate resistance            |                                                                                                     |                         | —    | 0.25 | —     | Ω    |
| I <sub>sc</sub>     | Short circuit data                  | V <sub>GE</sub> ≤ 15V<br>V <sub>Bus</sub> = 800V<br>t <sub>p</sub> ≤ 8 μs                           | T <sub>J</sub> = 150 °C | —    | 2080 | —     | A    |
|                     |                                     | V <sub>GE</sub> ≤ 15V<br>V <sub>Bus</sub> = 800V<br>t <sub>p</sub> ≤ 7 μs                           | T <sub>J</sub> = 175 °C | —    | 1960 | —     |      |
| R <sub>thJC</sub>   | Junction-to-case thermal resistance |                                                                                                     |                         | —    | —    | 0.078 | °C/W |

## 1.2 Diode Characteristics (Per Diode)

The following table lists the diode characteristics (per diode) of the APTGX600DA120T6G device.

**Table 1-4.** Diode Characteristics

| Symbol            | Characteristic                                                            | Test Conditions                                                                               |                         | Min. | Typ. | Max.  | Unit             |
|-------------------|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|-------------------------|------|------|-------|------------------|
| V <sub>RRM</sub>  | Peak repetitive reverse voltage                                           |                                                                                               |                         | —    | —    | 1200  | V                |
| I <sub>RM</sub>   | Reverse leakage current                                                   | V <sub>R</sub> = 1200V                                                                        |                         | —    | —    | 32    | μA               |
| I <sub>FRM</sub>  | Repetitive forward current, t <sub>p</sub> limited by T <sub>J(max)</sub> |                                                                                               |                         | —    | —    | 1200  | A                |
| I <sup>2</sup> t  | I <sup>2</sup> t value                                                    | t <sub>p</sub> = 10 ms<br>V <sub>R</sub> = 0V                                                 | T <sub>J</sub> = 125 °C | —    | —    | 29900 | A <sup>2</sup> s |
|                   |                                                                           |                                                                                               | T <sub>J</sub> = 175 °C | —    | —    | 23200 |                  |
| I <sub>F</sub>    | DC forward current                                                        | T <sub>C</sub> = 35 °C                                                                        | T <sub>J</sub> = 175 °C | —    | 600  | —     | A                |
| V <sub>F</sub>    | Diode forward voltage                                                     | I <sub>F</sub> = 600A<br>V <sub>GE</sub> = 0V                                                 | T <sub>J</sub> = 25 °C  | —    | 1.75 | 2     | V                |
|                   |                                                                           |                                                                                               | T <sub>J</sub> = 125 °C | —    | 1.6  | —     |                  |
|                   |                                                                           |                                                                                               | T <sub>J</sub> = 175 °C | —    | 1.52 | —     |                  |
| I <sub>RRM</sub>  | Reverse recovery current                                                  | V <sub>GE</sub> = -15V<br>I <sub>F</sub> = 600A<br>V <sub>R</sub> = 600V<br>di/dt = 9000 A/μs | T <sub>J</sub> = 25 °C  | —    | 400  | —     | A                |
|                   |                                                                           |                                                                                               | T <sub>J</sub> = 125 °C | —    | 550  | —     |                  |
|                   |                                                                           |                                                                                               | T <sub>J</sub> = 175 °C | —    | 625  | —     |                  |
| Q <sub>rr</sub>   | Reverse recovery charge                                                   |                                                                                               | T <sub>J</sub> = 25 °C  | —    | 41.2 | —     | μC               |
|                   |                                                                           |                                                                                               | T <sub>J</sub> = 125 °C | —    | 86.8 | —     |                  |
|                   |                                                                           |                                                                                               | T <sub>J</sub> = 175 °C | —    | 114  | —     |                  |
| E <sub>rr</sub>   | Reverse recovery energy                                                   |                                                                                               | T <sub>J</sub> = 25 °C  | —    | 20   | —     | mJ               |
|                   |                                                                           |                                                                                               | T <sub>J</sub> = 125 °C | —    | 40.5 | —     |                  |
|                   |                                                                           |                                                                                               | T <sub>J</sub> = 175 °C | —    | 55   | —     |                  |
| R <sub>thJC</sub> | Junction-to-case thermal resistance                                       |                                                                                               |                         |      | —    | —     | 0.128            |

### 1.3 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the APTGX600DA120T6G device.

**Table 1-5.** Thermal and Package Characteristics

| Symbol             | Characteristic                                                  |                                    |    | Min. | Typ. | Max. | Unit |
|--------------------|-----------------------------------------------------------------|------------------------------------|----|------|------|------|------|
| V <sub>ISOL</sub>  | RMS isolation voltage, any terminal-to-case t = 1 min, 50/60 Hz |                                    |    | 4000 | —    | —    | V    |
| L <sub>stray</sub> | Stray inductance module                                         |                                    |    | —    | 15   | —    | nH   |
| d <sub>creep</sub> | Creepage distance terminal-to-terminal                          |                                    |    | —    | 14.5 | —    | mm   |
|                    | Creepage distance terminal-to-heatsink                          |                                    |    | —    | 15.9 | —    |      |
| d <sub>clear</sub> | Clearance distance terminal-to-terminal                         |                                    |    | —    | 11.4 | —    |      |
|                    | Clearance distance terminal-to-heatsink                         |                                    |    | —    | 12.1 | —    |      |
| R <sub>CE</sub>    | Lead resistance terminal-to-chip                                | T <sub>C</sub> = 25 °C, per switch |    | —    | 0.5  | —    | mΩ   |
| T <sub>J</sub>     | Operating junction temperature range                            |                                    |    | –40  | —    | 175  | °C   |
| T <sub>STG</sub>   | Storage temperature range                                       |                                    |    | –40  | —    | 125  |      |
| T <sub>C</sub>     | Operating case temperature                                      |                                    |    | –40  | —    | 125  |      |
| τ <sub>M</sub>     | Mounting torque                                                 | To heatsink                        | M6 | 3    | —    | 5    | N.m  |
|                    |                                                                 | For terminals                      | M5 | 2    | —    | 3.5  |      |
| Wt                 | Package weight                                                  |                                    |    | —    | 282  | —    | g    |

The following table lists the temperature sensor NTC of the APTGX600DA120T6G device.

**Table 1-6.** Temperature Sensor NTC

| Symbol                            | Characteristic            |  |  | Min. | Typ. | Max. | Unit |
|-----------------------------------|---------------------------|--|--|------|------|------|------|
| R <sub>25</sub>                   | Resistance at 25 °C       |  |  | —    | 50   | —    | kΩ   |
| ΔR <sub>25</sub> /R <sub>25</sub> | —                         |  |  | —    | 5    | —    | %    |
| B <sub>25/85</sub>                | T <sub>25</sub> = 298.15K |  |  | —    | 3952 | —    | K    |
| ΔB/B                              | —                         |  |  | —    | 4    | —    | %    |

$$R_T = \frac{R_{25}}{\exp\left[B_{25/85}\left(\frac{1}{T_{25}} - \frac{1}{T}\right)\right]}$$

T: Thermistor temperature  
R<sub>T</sub>: Thermistor value at T

**Note:** For more information, see [APT0406—Using NTC Temperature Sensor Integrated into Power Module](#).

## 1.4 Typical IGBT Performance Curve

The following figures show the IGBT performance curves of the APTGX600DA120T6G device.

Figure 1-1. Maximum Thermal Impedance

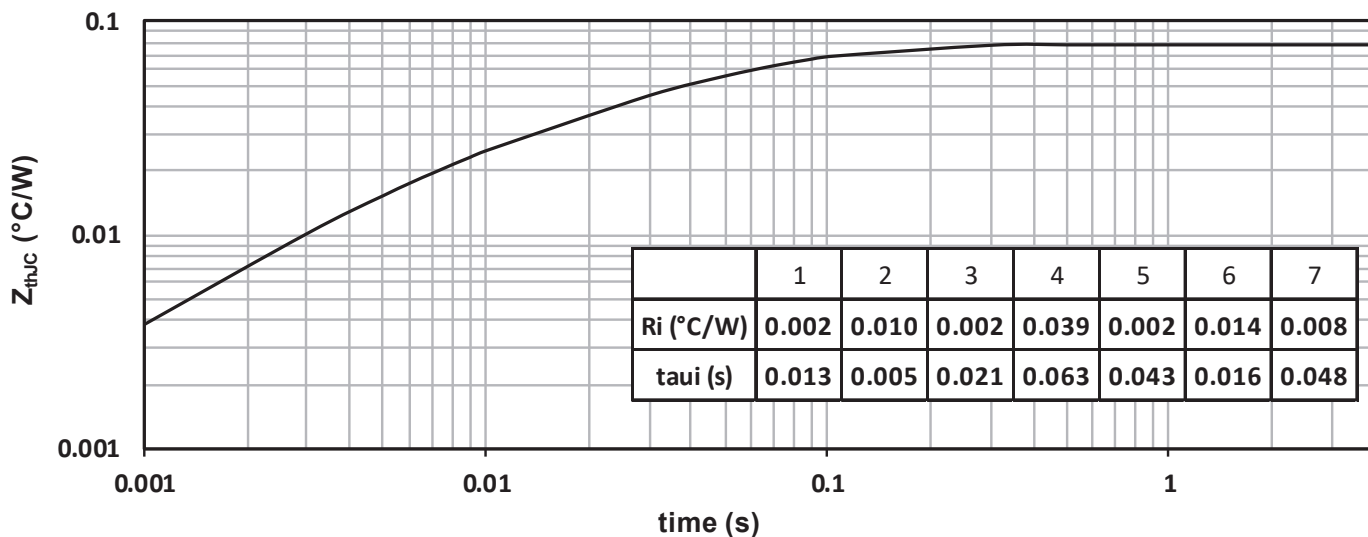


Figure 1-2. Output Characteristics,  $V_{GE} = 15V$

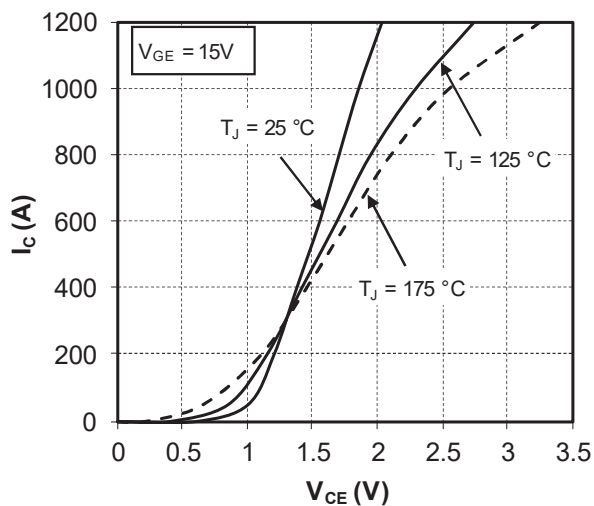


Figure 1-3. Output Characteristics,  $T_J = 175^\circ C$

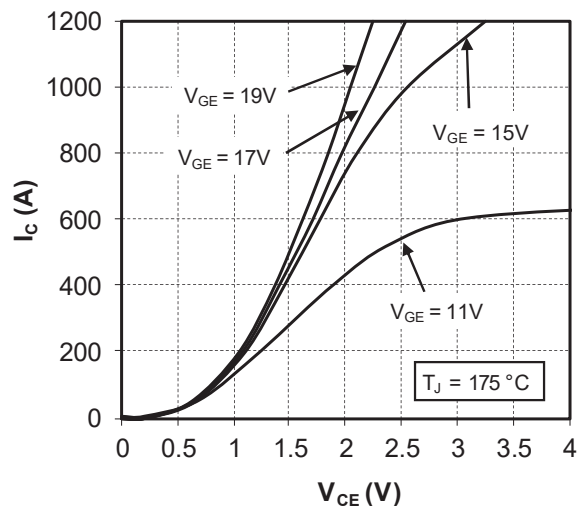


Figure 1-4. Switching Losses vs. Gate Resistance

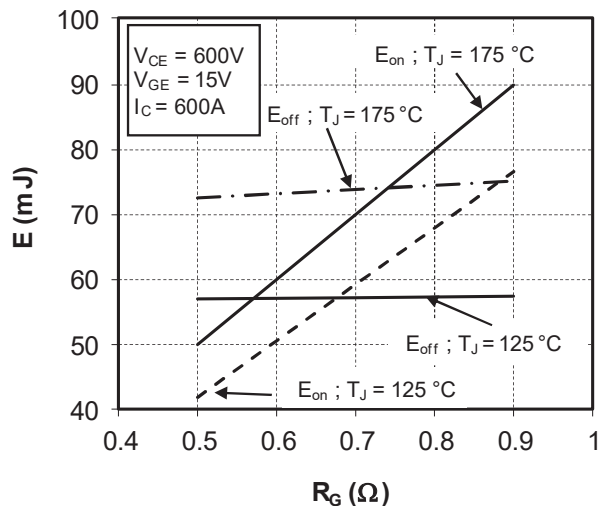


Figure 1-5. Switching Losses vs. Collector Current

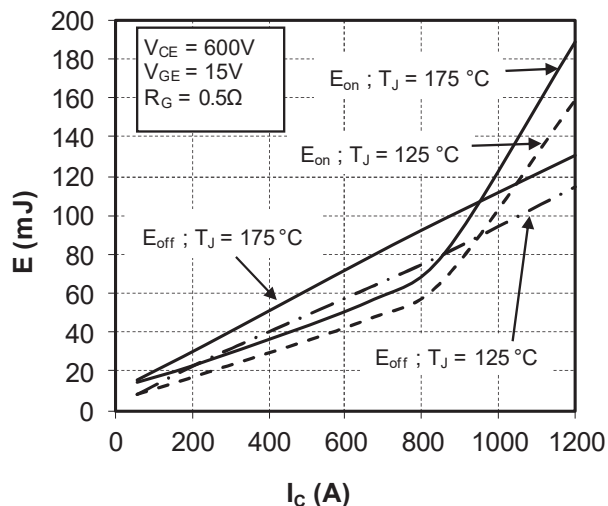


Figure 1-6. Operating Frequency vs. Collector Current

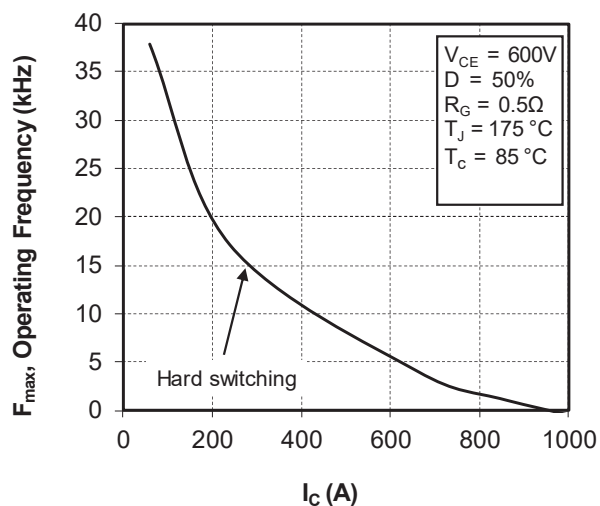


Figure 1-7. Gate Charge Characteristics

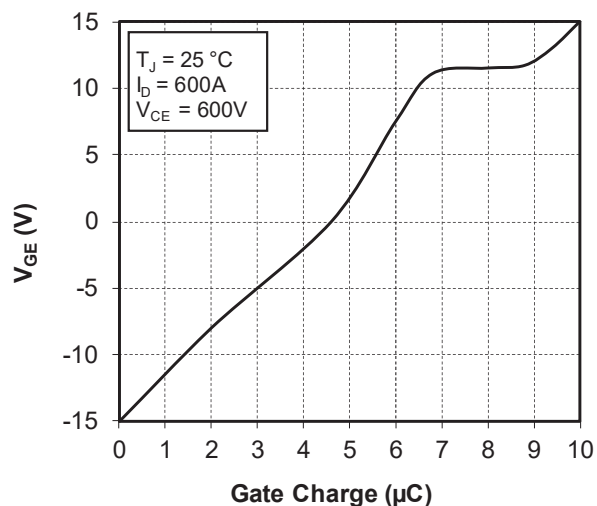




Figure 1-8. Transfer Characteristics

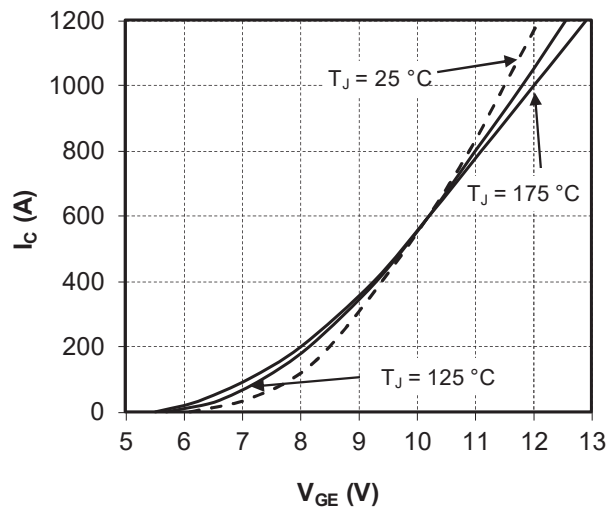


Figure 1-9. Capacity Characteristics

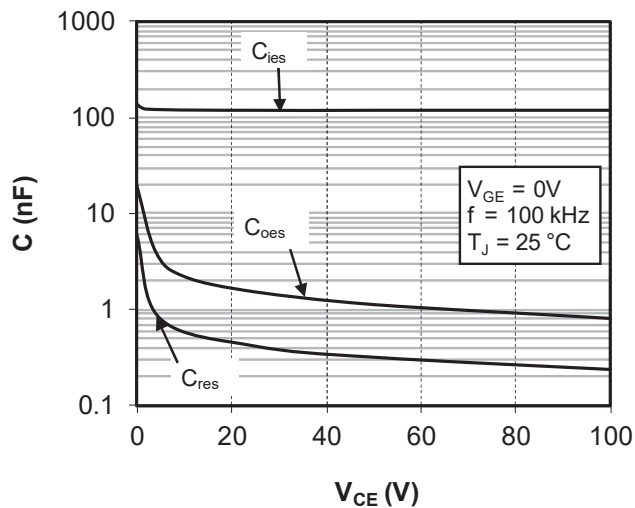
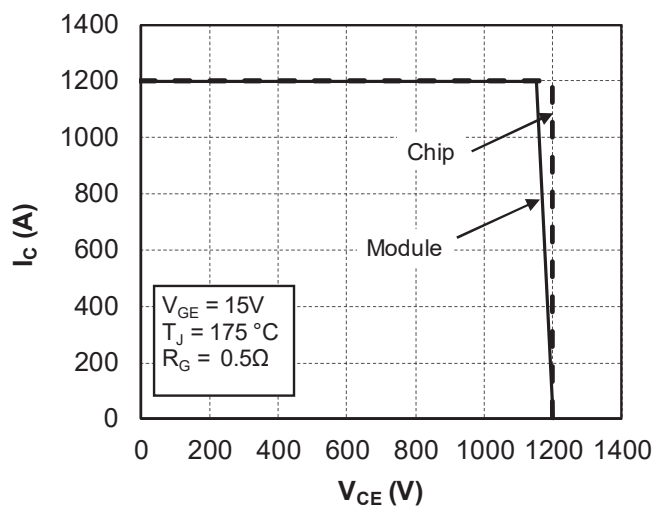


Figure 1-10. Reverse Bias Safe Operating Area



## 1.5 Typical Diode Performance Curve

The following figures show the diode performance curves of the APTGX600DA120T6G device.

Figure 1-11. Maximum Thermal Impedance

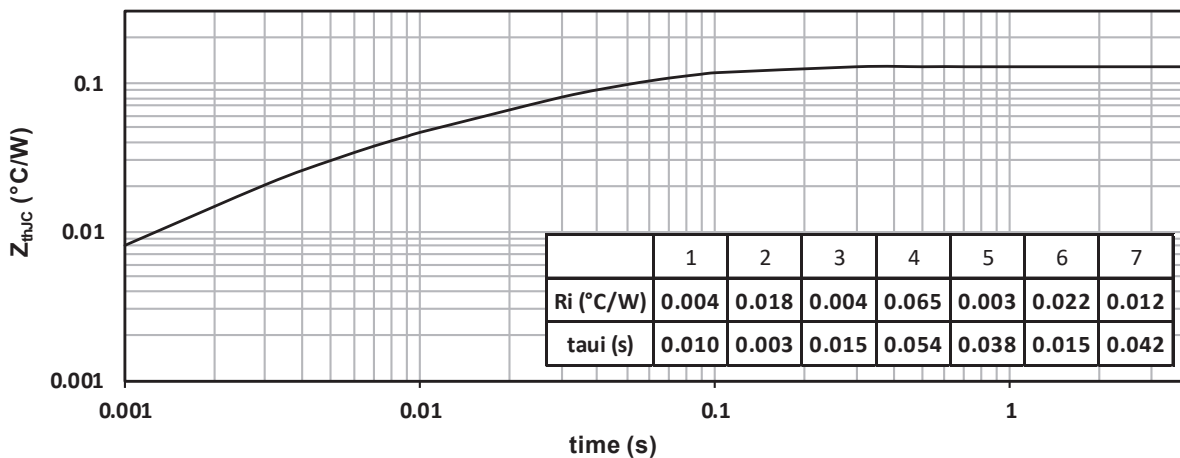


Figure 1-12. Forward Characteristics

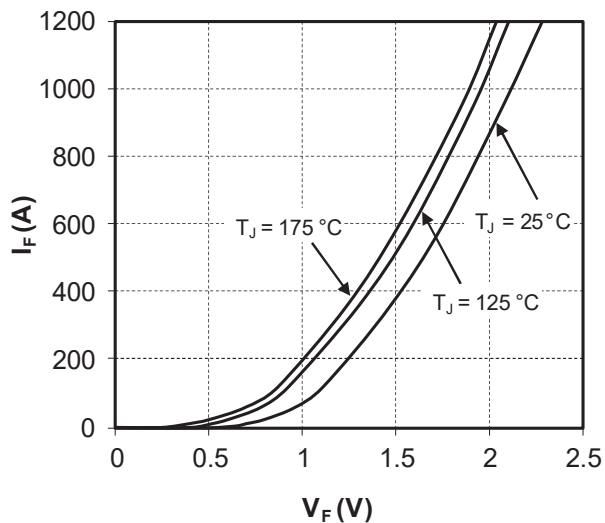


Figure 1-13. Switching Losses vs. Gate Resistance

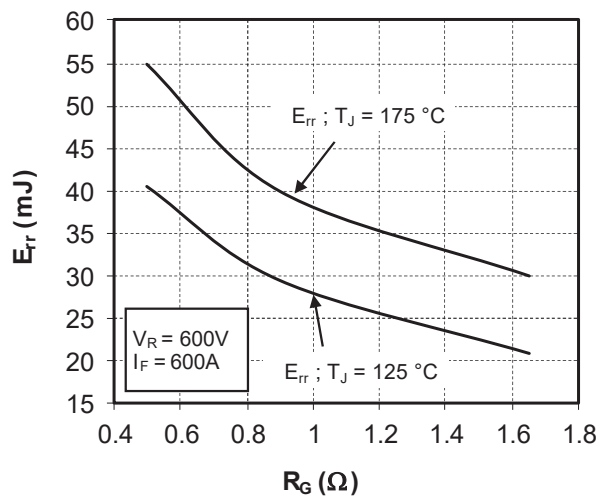
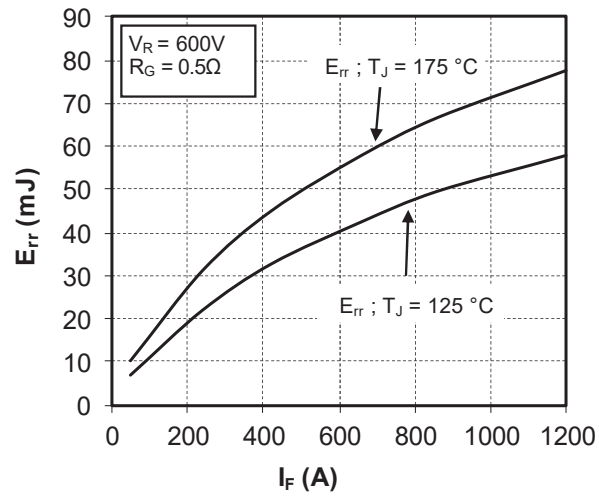


Figure 1-14. Switching Losses vs. Forward Current



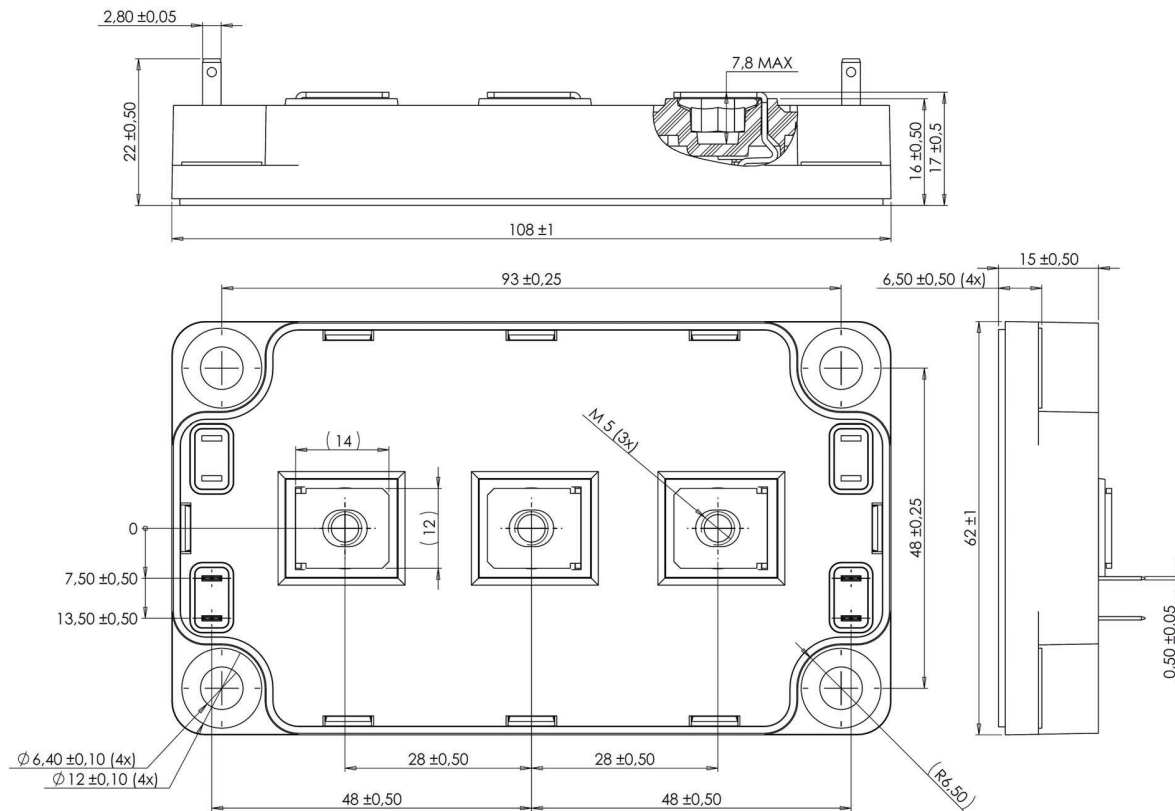
## 2. Package Specifications

The following section shows the package specification of the APTGX600DA120T6G device.

## 2.1 Package Outline

The following figure shows the package outline drawing of the APTGX600DA120T6G device. The dimensions in the following figure are in millimeters.

### Figure 2-1. Package Outline Drawing



**Note:** For more information, see [APT0601 - Mounting Instructions for SP6 Power Modules](#).

### 3. 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.

| Revision | Date    | Description      |
|----------|---------|------------------|
| A        | 09/2024 | Initial revision |

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