

Product Overview

The APTGX600A120T6G device is a phase leg 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

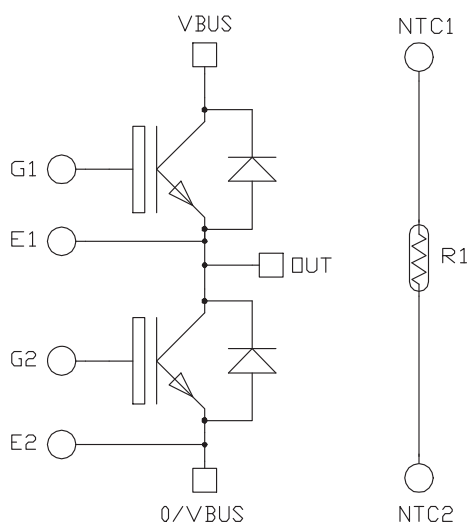
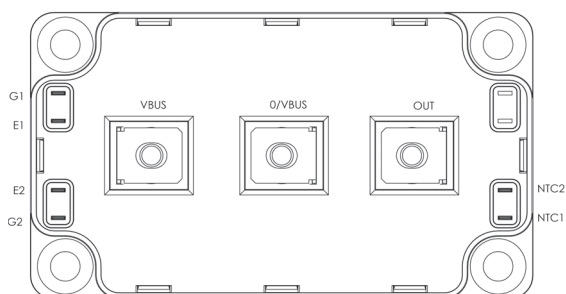


Figure 2. Pinout Location



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 APTGX600A120T6G 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
- Al₂O₃ substrate and copper base plate

Benefits

The APTGX600A120T6G 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 APTGX600A120T6G device has the following potential applications:

- Welding converters
- Switched-mode power supplies
- Uninterruptible power supplies
- Electric Vehicle (EV) motor and traction drive

1. Electrical Specifications

The following sections show the electrical specifications of the APTGX600A120T6G device.

1.1 IGBT Characteristics (Per IGBT)

The following table lists the absolute maximum ratings (per IGBT) of the APTGX600A120T6G device.

Table 1-1. Absolute Maximum Ratings

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

The following table lists the electrical characteristics (per IGBT) of the APTGX600A120T6G 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	μA
$V_{CE(sat)}$	Collector-emitter saturation voltage	$V_{GE} = 15V$ $I_C = 600A$	$T_J = 25\text{ }^{\circ}\text{C}$	—	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 APTGX600A120T6G device.

Table 1-3. Dynamic Characteristics

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
C _{ies}	Input capacitance	V _{GE} = 0V V _{CE} = 25V f = 100 kHz		—	120	—	nF
C _{oes}	Output capacitance			—	1.5	—	
C _{res}	Reverse transfer capacitance			—	0.44	—	
Q _G	Gate charge	V _{GE} = ±15V V _{CE} = 600V I _C = 600A		—	10	—	μC
T _{d(on)}	Turn-on delay time	V _{GE} = ±15V V _{Bus} = 600V I _C = 600A R _G = 0.5Ω	T _J = 25 °C	—	151	—	ns
			T _J = 125 °C	—	155	—	
			T _J = 175 °C	—	157	—	
T _r	Rise time		T _J = 25 °C	—	55	—	
			T _J = 125 °C	—	70	—	
			T _J = 175 °C	—	60	—	
T _{d(off)}	Turn-off delay time		T _J = 25 °C	—	342	—	
			T _J = 125 °C	—	420	—	
			T _J = 175 °C	—	453	—	
T _f	Fall time		T _J = 25 °C	—	102	—	
			T _J = 125 °C	—	200	—	
			T _J = 175 °C	—	263	—	
E _{on}	Turn-on energy	V _{GE} = ±15V V _{Bus} = 600V I _C = 600A	T _J = 25 °C	—	34	—	mJ
		R _G = 0.5Ω di/dt = 9000 A/μs dv/dt = 4000 V/μs	T _J = 125 °C	—	42	—	
			T _J = 175 °C	—	50.2	—	
E _{off}	Turn-off energy		T _J = 25 °C	—	38	—	
		T _J = 125 °C	—	57.5	—		
		T _J = 175 °C	—	72.5	—		
R _{Gint}	Internal gate resistance			—	0.25	—	Ω
I _{sc}	Short circuit data	V _{GE} ≤ 15V V _{Bus} = 800V t _p ≤ 8 μs	T _J = 150 °C	—	2080	—	A
		V _{GE} ≤ 15V V _{Bus} = 800V t _p ≤ 7 μs	T _J = 175 °C	—	1960	—	
R _{thJC}	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 APTGX600A120T6G device.

Table 1-4. Diode Characteristics

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

1.3 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the APTGX600A120T6G device.

Table 1-5. Thermal and Package Characteristics

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

The following table lists the temperature sensor NTC of the APTGX600A120T6G device.

Table 1-6. Temperature Sensor NTC

Symbol	Characteristic	Min.	Typ.	Max.	Unit
R ₂₅	Resistance at 25 °C	—	50	—	kΩ
ΔR ₂₅ /R ₂₅	—	—	5	—	%
B _{25/85}	T ₂₅ = 298.15K	—	3952	—	K
ΔB/B	—	T _C = 100 °C		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_T: 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 APTGX600A120T6G device.

Figure 1-1. Maximum Thermal Impedance

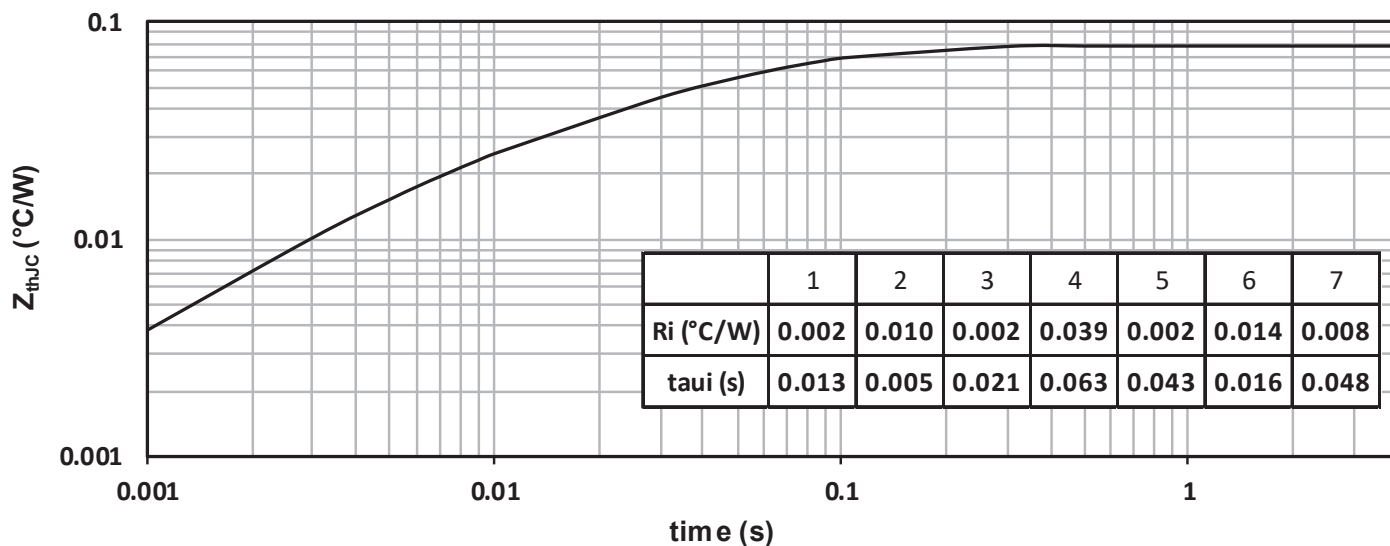


Figure 1-2. Output Characteristics, $V_{GE} = 15\text{V}$

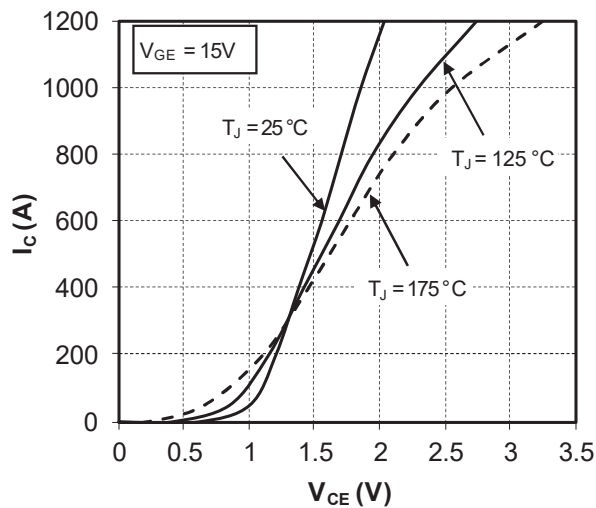


Figure 1-3. Output Characteristics, $T_J = 175^{\circ}\text{C}$

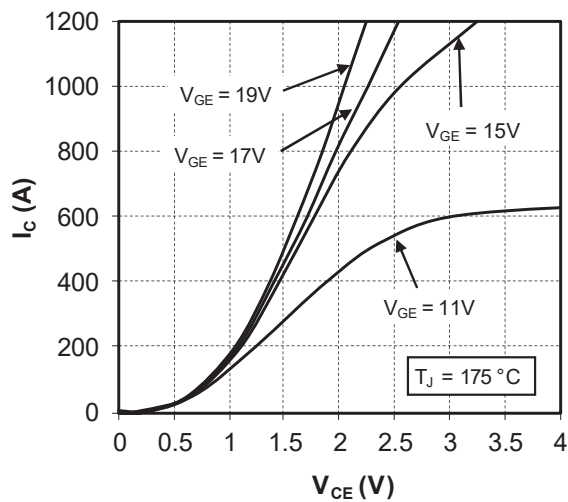


Figure 1-4. Switching Losses vs. Gate Resistance

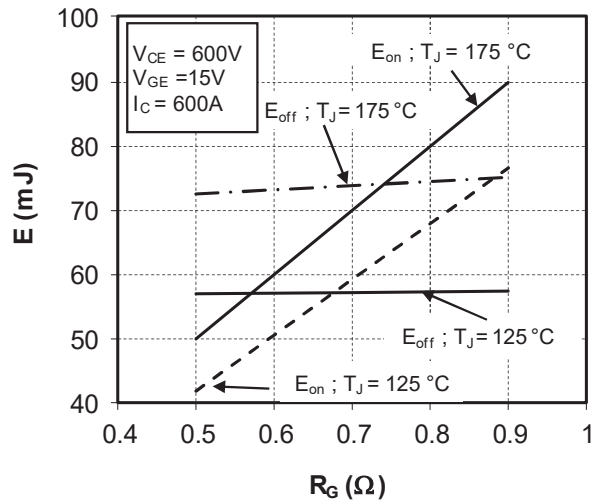


Figure 1-5. Switching Losses vs. Collector Current

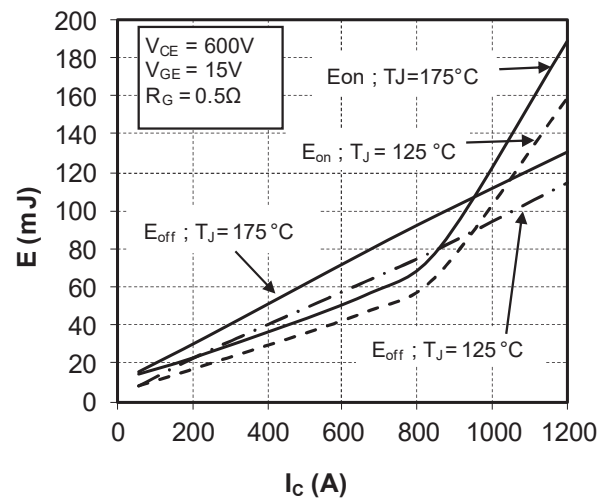


Figure 1-6. Operating Frequency vs. Collector Current

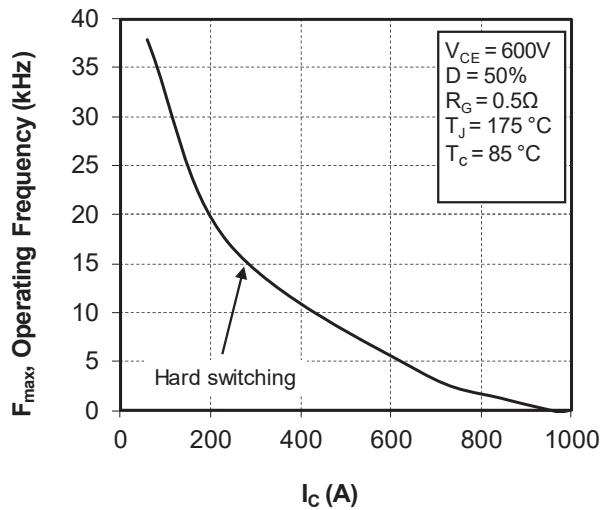


Figure 1-7. Gate Charge Characteristics

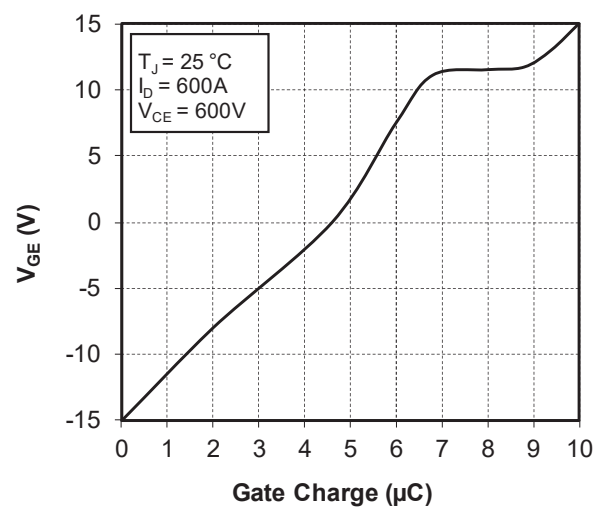


Figure 1-8. Transfer Characteristics

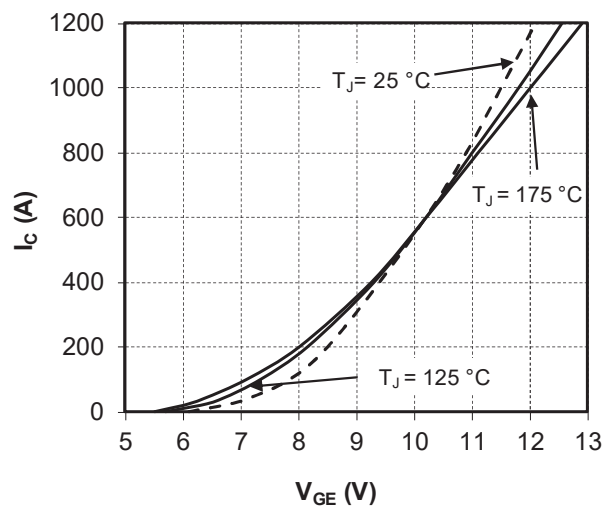


Figure 1-9. Capacity Characteristics

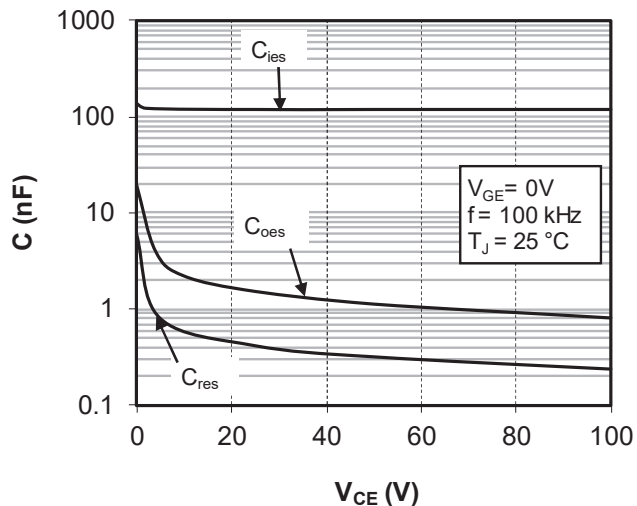
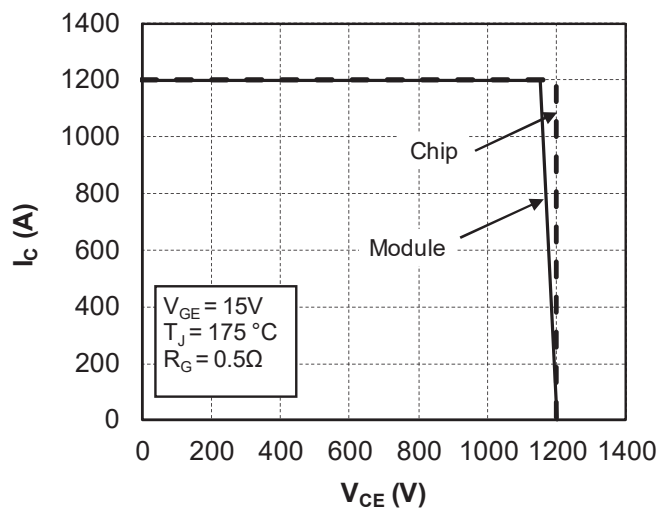


Figure 1-10. Reverse Bias Safe Operating Area



1.5 Typical Diode Performance Curve

The following figures show the diode performance curves of the APTGX600A120T6G device.

Figure 1-11. Maximum Thermal Impedance

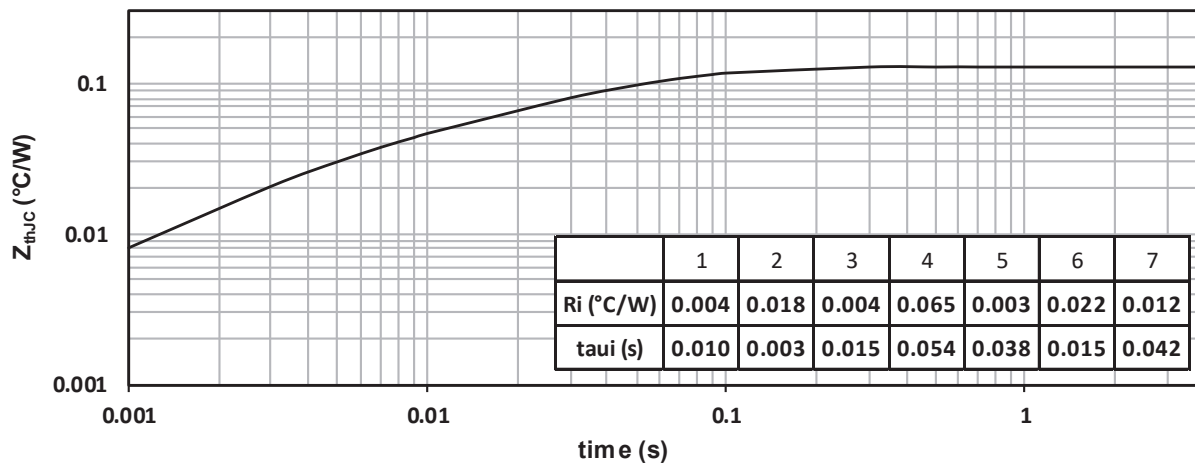


Figure 1-12. Forward Characteristics

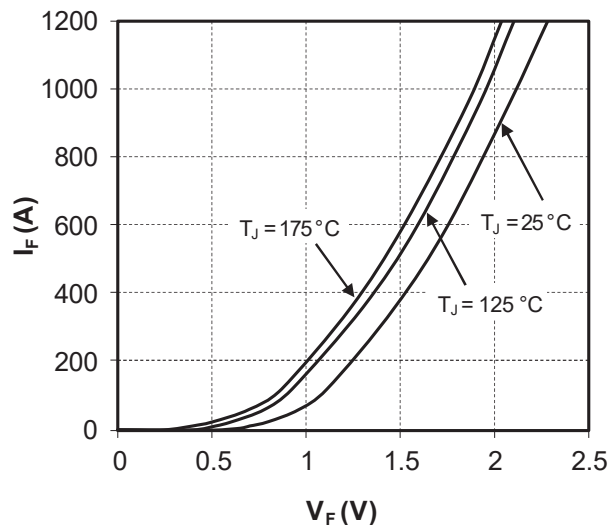


Figure 1-13. Switching Losses vs. Gate Resistance

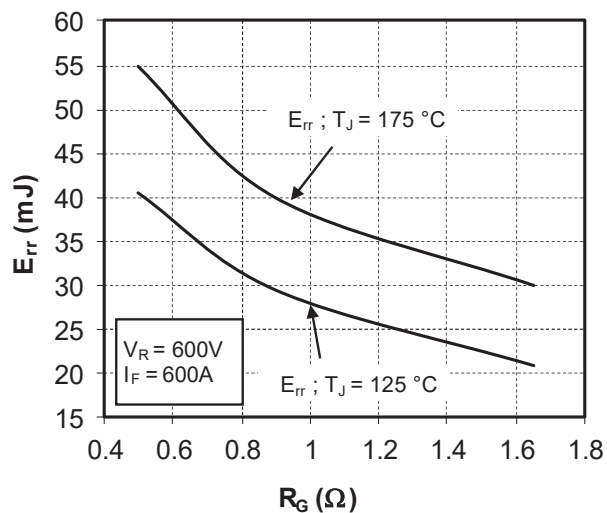
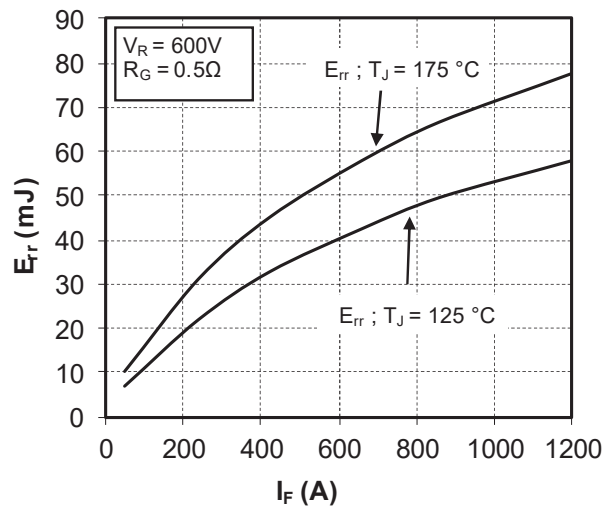


Figure 1-14. Switching Losses vs. Forward Current



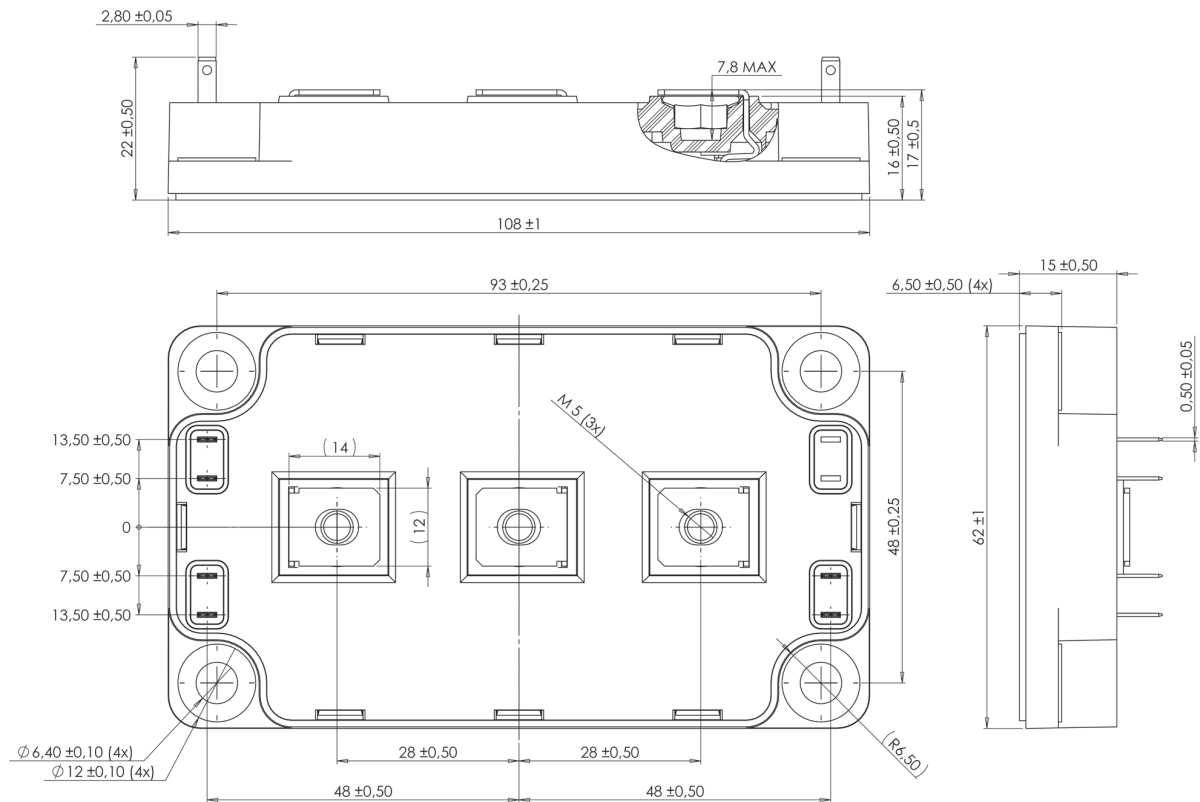
2. Package Specifications

The following section shows the package specification of the APTGX600A120T6G device.

2.1 Package Outline

The following figure shows the package outline drawing of the APTGX600A120T6G 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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