

Product Overview

The APTGX600A120TDP3EG 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

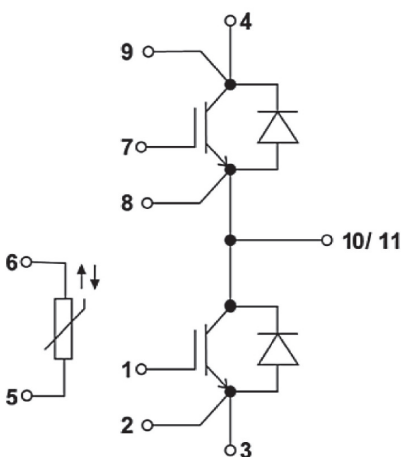
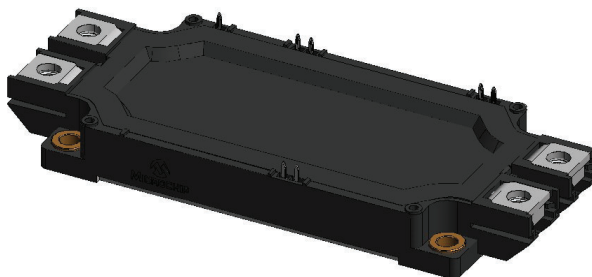
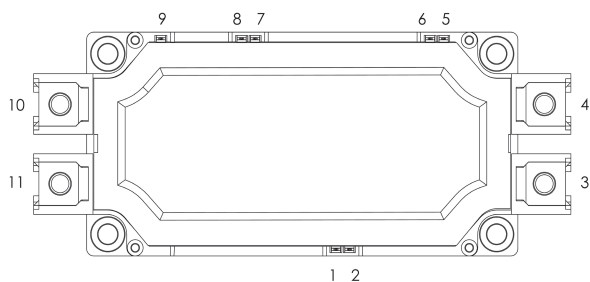


Figure 2. Pinout Location



Notes:

- Pins 10/11 must be shorted together.
- All ratings are at $T_J = 25^\circ\text{C}$, unless otherwise specified.



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

Features

The APTGX600A120TDP3EG device has the following key features:

- IGBT 7
 - Low-voltage drop
 - Low-leakage current
- Kelvin emitter for easy drive
- M6 power connectors
- Internal thermistor for temperature monitoring
- Al₂O₃ substrate and copper base plate
- Press-fit terminals for easy assembly
- V_{CEsat} with positive temperature coefficient

Benefits

The APTGX600A120TDP3EG 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 APTGX600A120TDP3EG 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 APTGX600A120TDP3EG device.

1.1. IGBT Characteristics (Per IGBT)

The following table lists the absolute maximum ratings (per IGBT) of the APTGX600A120TDP3EG device.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter	Maximum Ratings	Unit
V_{CES}	Collector-emitter voltage	1200	V
I_C	Continuous collector current	$T_C = 90\text{ }^{\circ}\text{C}$	600
I_{RMS}	RMS 3 & 4 DC power terminals current	$T_{\text{terminal}} = 90\text{ }^{\circ}\text{C}; T_C = 90\text{ }^{\circ}\text{C}$	580
I_{CM}	Pulsed collector current, t_p limited by $T_{J(\text{max})}$	1200	A
V_{GE}	Gate-emitter voltage	± 20	V
P_D	Power dissipation	$T_C = 25\text{ }^{\circ}\text{C}$	2272
			W

The following table lists the electrical characteristics (per IGBT) of the APTGX600A120TDP3EG device.

Table 1-2. Electrical Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Zero gate voltage collector current	$V_{GE} = 0\text{V}; V_{CE} = 1200\text{V}$	—	—	200	μA
$V_{CE(\text{sat})}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{V}$ $I_C = 600\text{A}$ $T_J = 25\text{ }^{\circ}\text{C}$	—	1.6	1.8	V
		$T_J = 125\text{ }^{\circ}\text{C}$	—	1.65	—	
		$T_J = 175\text{ }^{\circ}\text{C}$	—	1.75	—	
$V_{GE(\text{th})}$	Gate threshold voltage	$V_{GE} = V_{CE}; I_C = 12\text{ mA}$	5.15	5.8	6.45	
I_{GES}	Gate-emitter leakage current	$V_{GE} = 20\text{V}; V_{CE} = 0\text{V}$	—	—	200	nA

The following table lists the dynamic characteristics (per IGBT) of the APTGX600A120TDP3EG device.

Table 1-3. Dynamic Characteristics

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
C _{ies}	Input capacitance	V _{GE} = 0V		—	80	—	nF
C _{oes}	Output capacitance	V _{CE} = 25V		—	1.2	—	
C _{res}	Reverse transfer capacitance	f = 100 kHz		—	0.48	—	
Q _G	Gate charge	V _{GE} = ±15V V _{CE} = 600V I _C = 600A		—	9.6	—	μC
T _{d(on)}	Turn-on delay time	V _{GE} = -5/15V V _{Bus} = 600V I _C = 600A R _G = 0.33Ω	T _J = 25 °C	—	218	—	ns
			T _J = 125 °C	—	233	—	
			T _J = 175 °C	—	235	—	
T _r	Rise time		T _J = 25 °C	—	54	—	
			T _J = 125 °C	—	61	—	
			T _J = 175 °C	—	65	—	
T _{d(off)}	Turn-off delay time		T _J = 25 °C	—	513	—	
			T _J = 125 °C	—	613	—	
			T _J = 175 °C	—	657	—	
T _f	Fall time		T _J = 25 °C	—	129	—	
			T _J = 125 °C	—	263	—	
			T _J = 175 °C	—	344	—	
E _{on}	Turn-on energy	V _{GE} = -5/15V V _{Bus} = 600V I _C = 600A	T _J = 25 °C	—	23.3	—	mJ
		R _G = 0.33Ω di/dt = 9000 A/μs dv/dt = 5900 V/μs	T _J = 125 °C	—	35.1	—	
			T _J = 175 °C	—	42.3	—	
E _{off}	Turn-off energy		T _J = 25 °C	—	45.5	—	
		T _J = 125 °C	—	71.5	—		
		T _J = 175 °C	—	85.4	—		
R _{Gint}	Internal gate resistance			—	0.75	—	Ω
I _{sc}	Short circuit data	V _{GE} = 15V V _{Bus} = 800V t _p ≤ 8 μs	T _J = 150 °C	—	2500	—	A
		V _{GE} = 15V V _{Bus} = 800V t _p ≤ 6 μs	T _J = 175 °C	—	2400	—	
R _{thJC}	Junction-to-case thermal resistance			—	—	0.066	°C/W
R _{thCH}	Case-to-heatsink thermal resistance		λ = 1 W/mK	—	0.029	—	

1.2. Diode Characteristics (Per Diode)

The following table lists the diode characteristics (per diode) of the APTGX600A120TDP3EG 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		—	—	150	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	T _J = 125 °C	—	28300	—	A ² s
		V _R = 0V	T _J = 175 °C	—	26000	—	
I _F	DC forward current			—	600	—	A
V _F	Diode forward voltage	I _F = 600A V _{GE} = 0V	T _J = 25 °C	—	1.8	2.05	V
			T _J = 125 °C	—	1.7	—	
			T _J = 175 °C	—	1.6	—	
I _{RRM}	Reverse recovery current	V _{GE} = -5V I _F = 600A V _R = 600V di/dt = 9000 A/μs	T _J = 25 °C	—	405	—	A
			T _J = 125 °C	—	580	—	
			T _J = 175 °C	—	605	—	
Q _{rr}	Reverse recovery charge		T _J = 25 °C	—	58.7	—	μC
			T _J = 125 °C	—	86	—	
			T _J = 175 °C	—	99.5	—	
E _{rr}	Reverse recovery energy		T _J = 25 °C	—	18.9	—	mJ
			T _J = 125 °C	—	37.4	—	
			T _J = 175 °C	—	47.5	—	
R _{thJC}	Junction-to-case thermal resistance			—	—	0.116	°C/W
R _{thCH}	Case-to-heatsink thermal resistance		λ = 1W/mK	—	0.045	—	

1.3. Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the APTGX600A120TDP3EG 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				3400	—	—	V
CTI	Comparative tracking index				600	—	—	
L _{stray}	Stray inductance module				—	20	—	nH
d _{creep}	Creepage distance terminal-to-terminal				—	17.6	—	mm
	Creepage distance terminal-to-heatsink				—	20.1	—	
d _{clear}	Clearance distance terminal-to-terminal				—	10	—	
	Clearance distance terminal-to-heatsink				—	14.8	—	
R _{CE}	Lead resistance terminal to chip	T _C = 25 °C, per switch			—	0.8	—	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	M5		3	—	5	N.m
		To terminals	M6		3	—	5	
Wt	Package weight				—	350	—	g

Note: T_J exceeding 150 °C is permitted only under overload operating conditions.

The following table lists the temperature sensor NTC of the APTGX600A120TDP3EG device.

Table 1-6. Temperature Sensor NTC

Symbol	Characteristic	Min.	Typ.	Max.	Unit
R ₂₅	Resistance at 25 °C	—	5	—	kΩ
ΔR ₂₅ /R ₂₅	—	—	5	—	%
B _{25/50}	T ₂₅ = 298.15K	—	3380	—	K
ΔB/B	—	—	2	—	%

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

T: Thermistor temperature
R_T: Thermistor value at T

Note: For more information, see the latest document on using NTC temperature sensor integrated into power module, available on the Microchip website.

1.4. Typical IGBT Performance Curve

The following figures show the IGBT performance curves of the APTGX600A120TDP3EG device.

Figure 1-1. Maximum Thermal Impedance

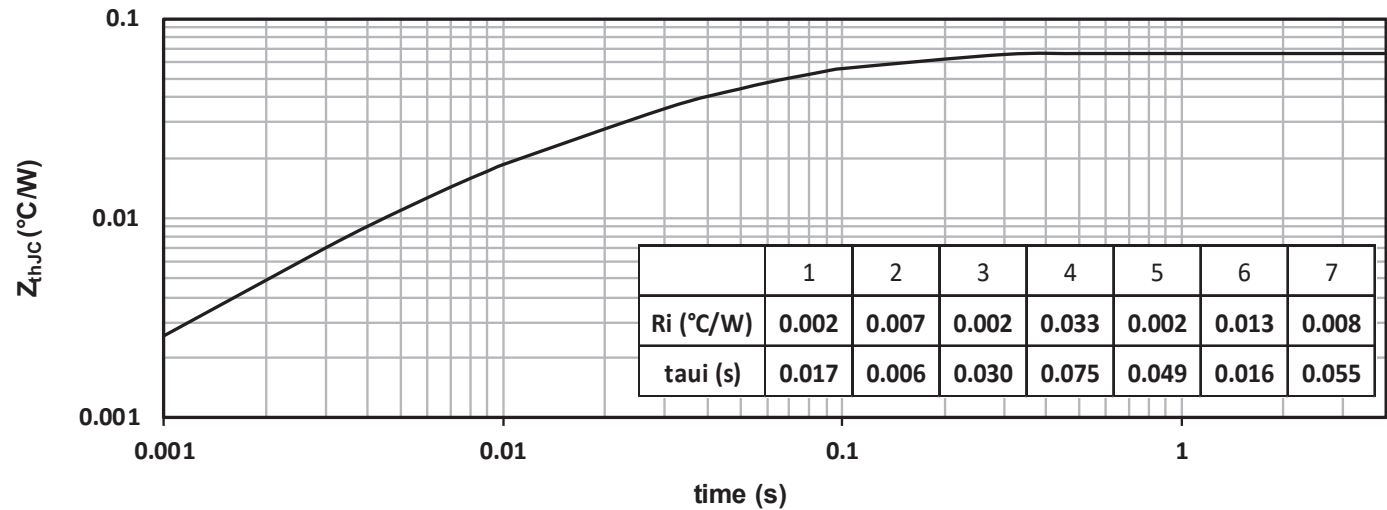


Figure 1-2. Output Characteristics, $V_{GE} = 15V$

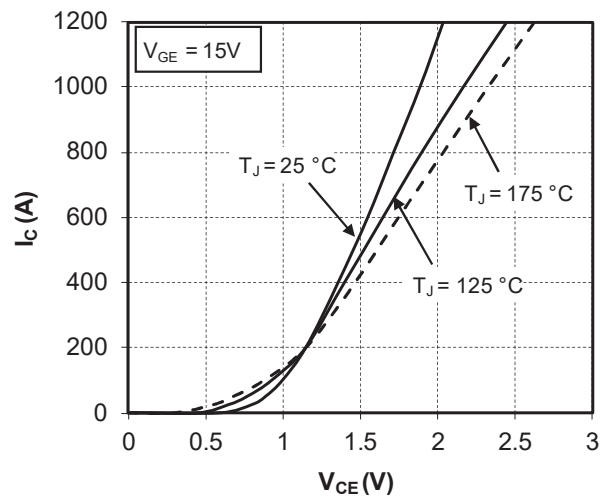


Figure 1-3. Output Characteristics, $T_J = 175\text{ }^{\circ}\text{C}$

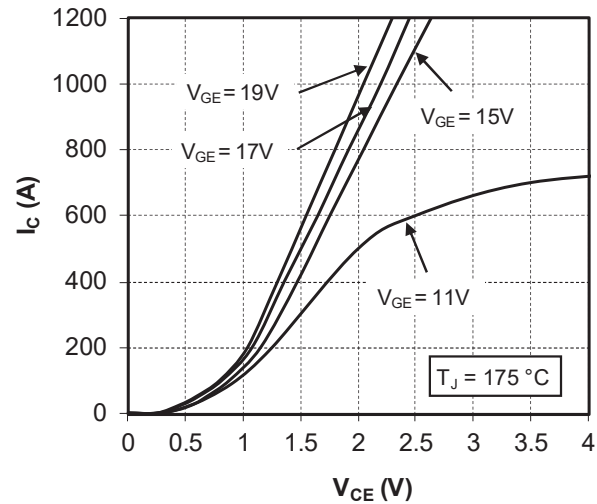


Figure 1-4. Switching Losses vs. Gate Resistance

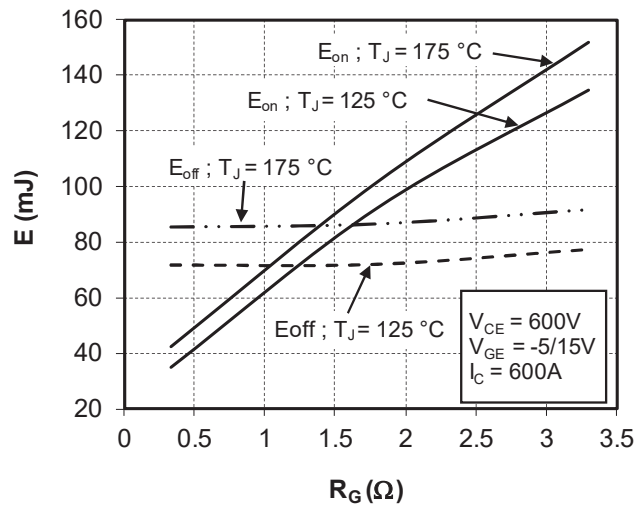


Figure 1-5. Switching Losses vs. Collector Current

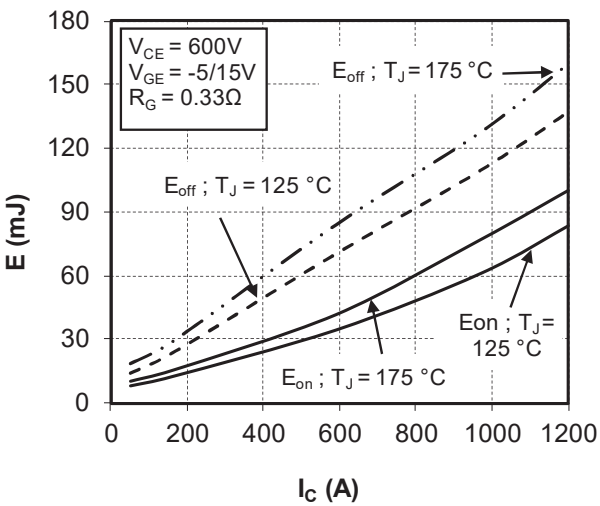


Figure 1-6. Switching Time vs. Collector Current

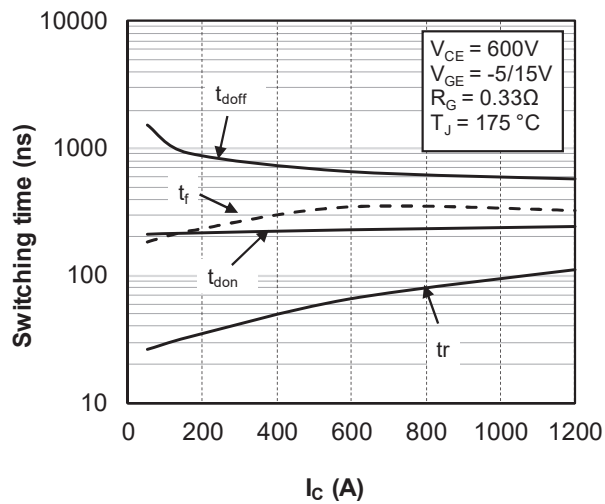


Figure 1-7. Switching Time vs. Gate Resistance

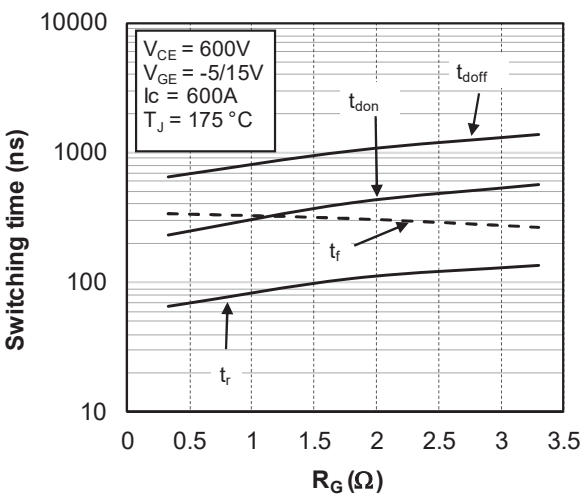


Figure 1-8. Operating Frequency vs. Collector Current

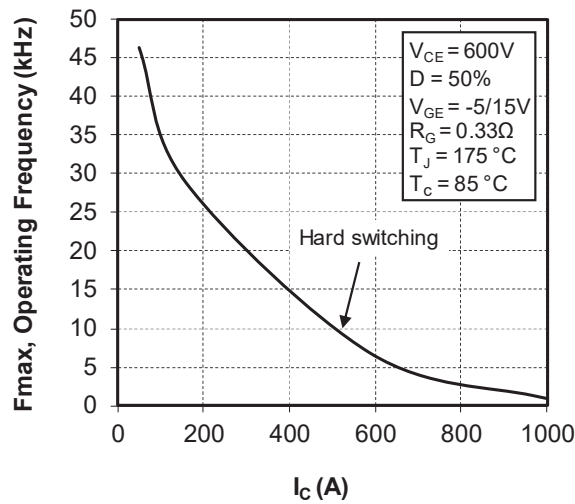


Figure 1-9. Gate Charge Characteristics

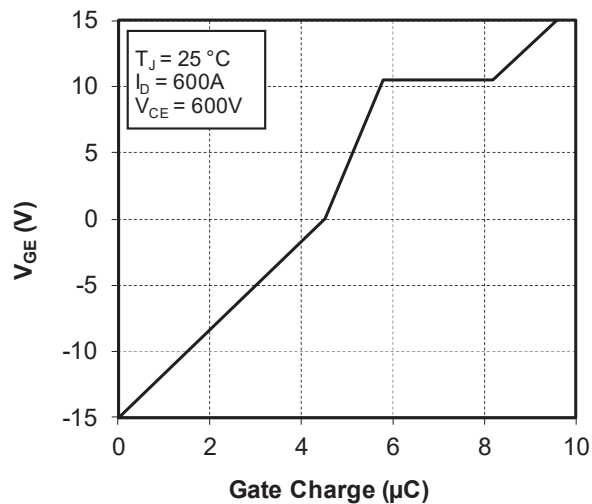


Figure 1-10. Transfer Characteristics

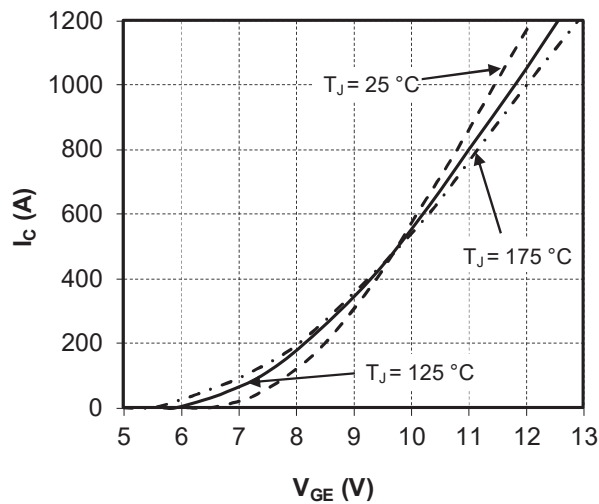


Figure 1-11. Capacity Characteristics

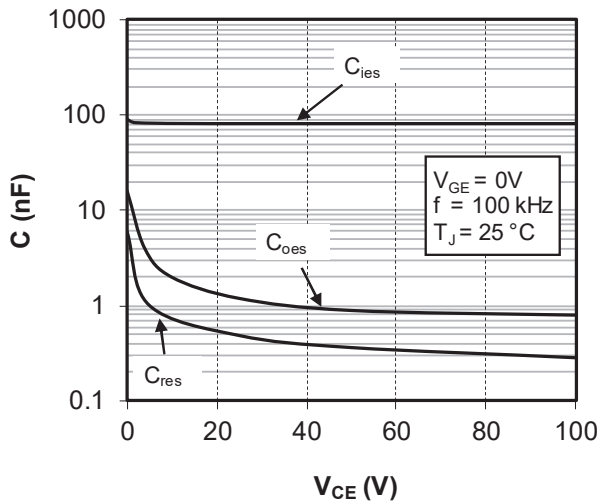
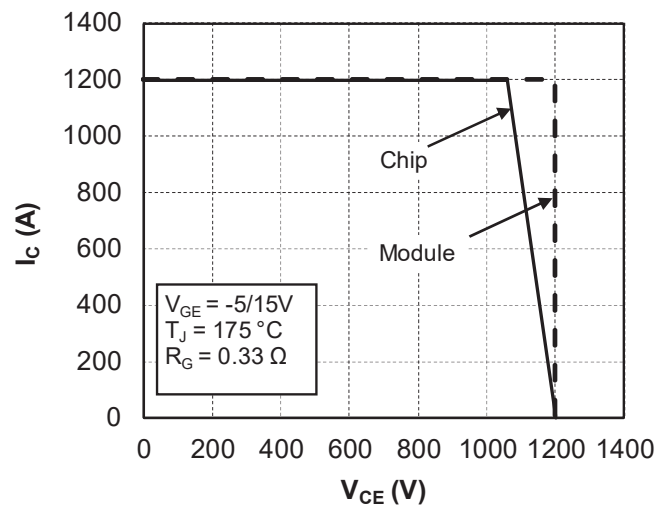


Figure 1-12. Reverse Bias Safe Operating Area



1.5. Typical Diode Performance Curve

The following figures show the diode performance curves of the APTGX600A120TDP3EG device.

Figure 1-13. Maximum Thermal Impedance

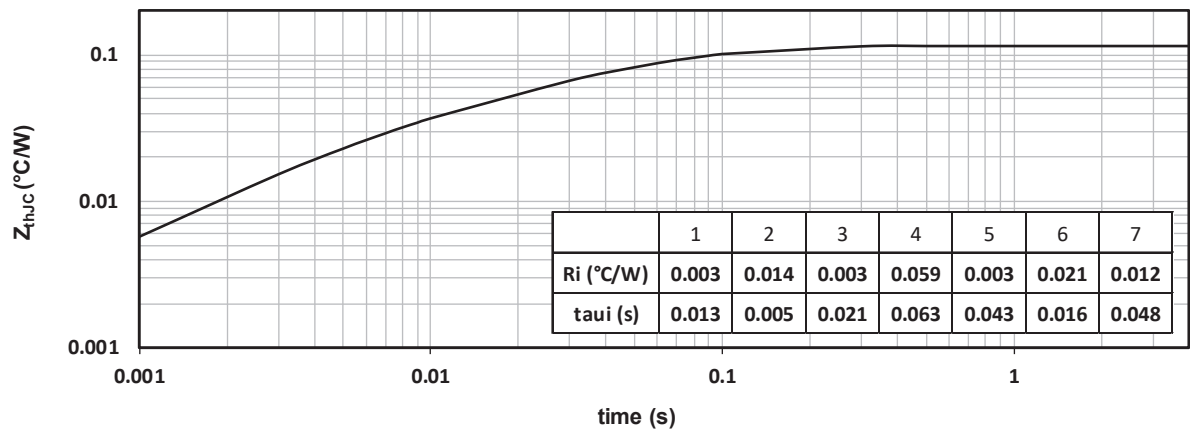


Figure 1-14. Forward Characteristics

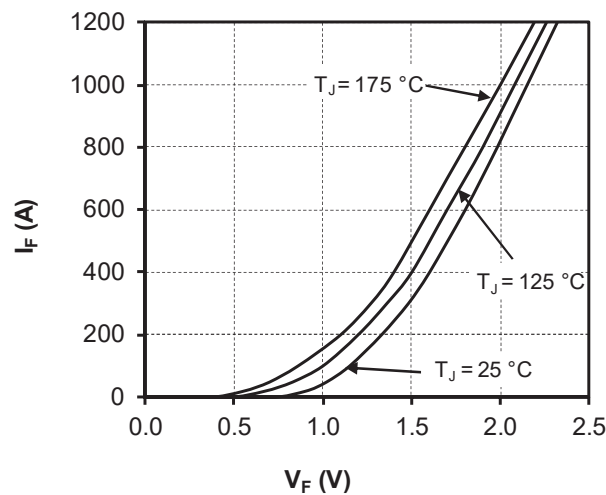


Figure 1-15. Switching Losses vs. Gate Resistance

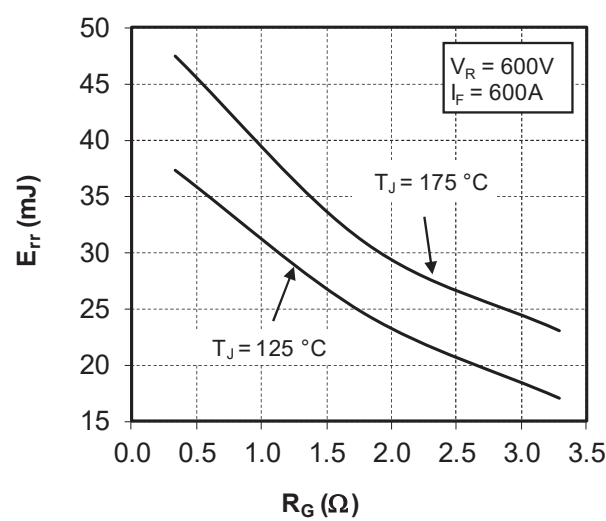
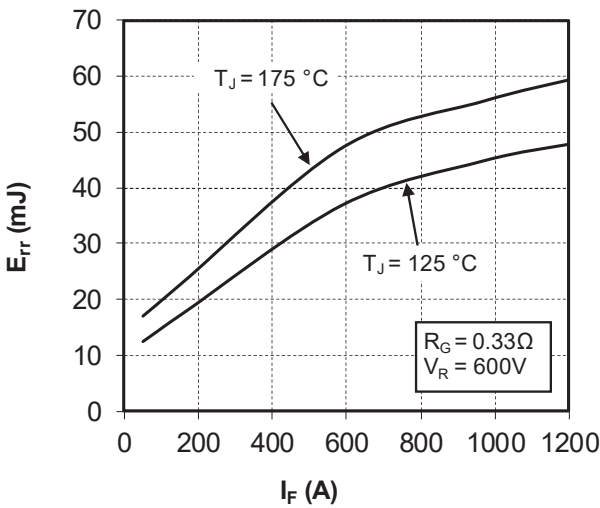


Figure 1-16. Switching Losses vs. Forward Current



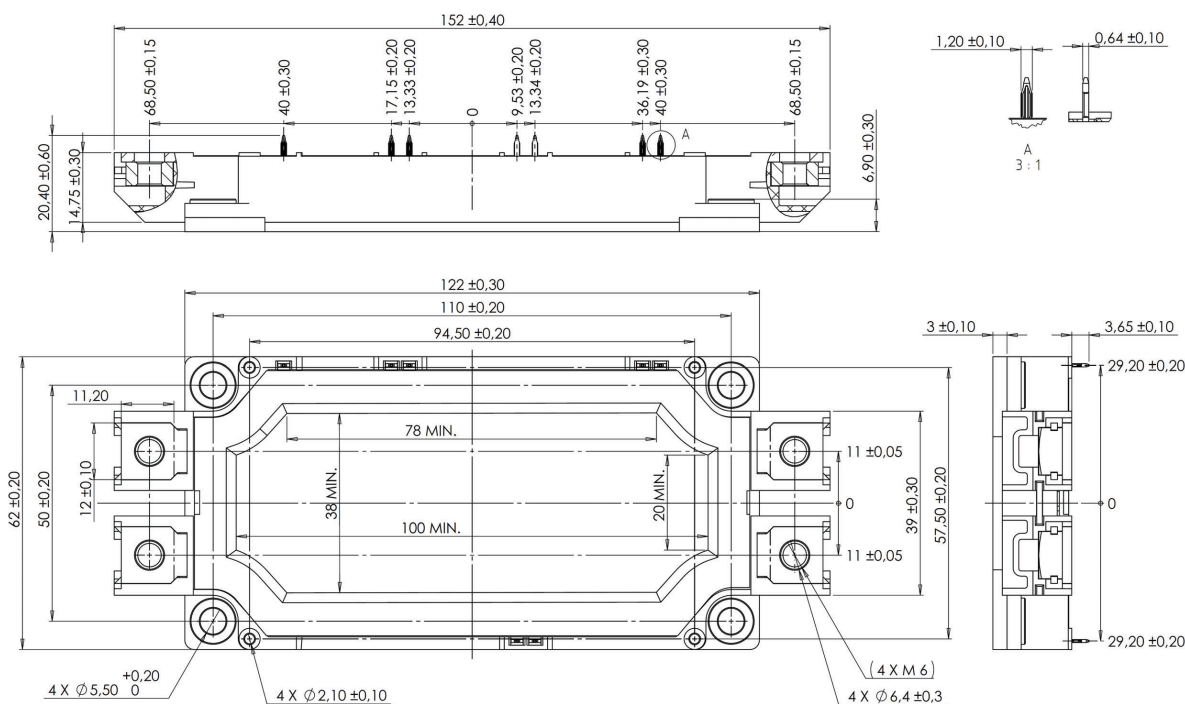
2. Package Specifications

The following section shows the package specification of the APTGX600A120TDP3EG device.

2.1. Package Outline

The following figure shows the package outline drawing of the APTGX600A120TDP3EG device. The dimensions in the following figure are in millimeters.

Figure 2-1. Package Outline Drawing



Note: For more information, see the latest application note on mounting instruction for DP3 power module, available on the Microchip website.

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	09/2025	Initial revision

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