

Product Overview

The APTX600U170D4G device is a single switch 1700V, 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

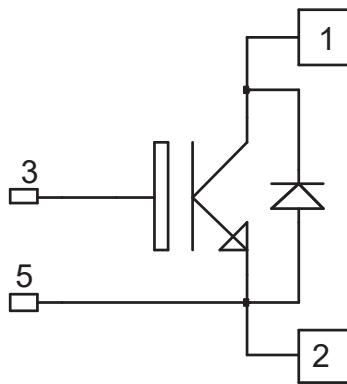
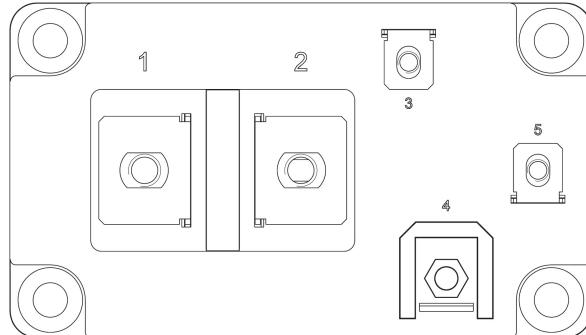


Figure 2. Pinout Location



Note:

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

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

Features

The APTGX600SK170T6G device has the following key features:

- IGBT 7
 - Low-voltage drop
 - Low-leakage current
- Very low-stray inductance
- Kelvin emitter for easy drive
- M6 power connectors
- M4 connectors for signal
- Al_2O_3 substrate and copper base plate

Benefits

The APTGX600SK170T6G 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 APTGX600SK170T6G 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 APTX600SK170T6G device.

1.1 IGBT Characteristics (Per IGBT)

The following table lists the absolute maximum ratings (per IGBT) of the APTX600SK170T6G device.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter	Maximum Ratings	Unit
V_{CES}	Collector-emitter voltage	1700	V
I_C	Continuous collector current	$T_C = 25^\circ\text{C}$	750
		$T_C = 65^\circ\text{C}$	600
I_{CM}	Pulsed collector current, t_p limited by $T_{J(\text{max})}$	1200	
V_{GE}	Gate-emitter voltage	± 20	V
P_D	Power dissipation	$T_C = 25^\circ\text{C}$	1948

The following table lists the electrical characteristics (per IGBT) of the APTX600SK170T6G device.

Table 1-2. Electrical Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
I_{CES}	Zero gate voltage collector current	$V_{GE} = 0\text{V}$; $V_{CE} = 1700\text{V}$	—	—	50	μA
$V_{CE(\text{sat})}$	Collector-emitter saturation voltage	$V_{GE} = 15\text{V}$ $I_C = 600\text{A}$	$T_J = 25^\circ\text{C}$	—	1.7	2
			$T_J = 125^\circ\text{C}$	—	1.95	—
			$T_J = 175^\circ\text{C}$	—	2.1	—
$V_{GE(\text{th})}$	Gate threshold voltage	$V_{GE} = V_{CE}$; $I_C = 12.6\text{ mA}$	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 APTGX600SK170T6G 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	—	62.5	—	nF
C_{oes}	Output capacitance		—	1	—	
C_{res}	Reverse transfer capacitance		—	0.22	—	
Q_G	Gate charge	$V_{GE} = \pm 15V$ $V_{CE} = 900V$ $I_C = 600A$	—	5.6	—	μC
$T_{d(on)}$	Turn-on delay time	$V_{GE} = \pm 15V$ $V_{Bus} = 900V$ $I_C = 600A$ $R_G = 1.1\Omega$	$T_J = 25$ °C	172	—	ns
			$T_J = 125$ °C	186	—	
			$T_J = 175$ °C	192	—	
			$T_J = 25$ °C	41	—	
T_r	Rise time	$V_{GE} = \pm 15V$ $V_{Bus} = 900V$ $I_C = 600A$ $R_G = 1.1\Omega$	$T_J = 125$ °C	67	—	
			$T_J = 175$ °C	73	—	
$T_{d(off)}$	Turn-off delay time	$V_{GE} = \pm 15V$ $V_{Bus} = 900V$ $I_C = 600A$ $R_G = 1.1\Omega$	$T_J = 25$ °C	441	—	
			$T_J = 125$ °C	538	—	
			$T_J = 175$ °C	583	—	
			$T_J = 25$ °C	270	—	
T_f	Fall time	$V_{GE} = \pm 15V$ $V_{Bus} = 900V$ $I_C = 600A$ $R_G = 1.1\Omega$	$T_J = 125$ °C	429	—	
			$T_J = 175$ °C	556	—	
E_{on}	Turn-on energy	$V_{GE} = \pm 15V$ $V_{Bus} = 900V$ $I_C = 600A$ $R_G = 1.1\Omega$	$T_J = 25$ °C	70.8	—	mJ
			$T_J = 125$ °C	110	—	
			$T_J = 175$ °C	136.4	—	
E_{off}	Turn-off energy	$di/dt = 12.8$ kA/μs $dv/dt = 6.1$ kV/μs	$T_J = 25$ °C	94.4	—	
			$T_J = 125$ °C	133.6	—	
			$T_J = 175$ °C	160.8	—	
R_{Gint}	Internal gate resistance		—	0.33	—	Ω
I_{sc}	Short circuit data	$V_{GE} \leq 15V$ $V_{Bus} = 1000V$ $t_p \leq 8$ μs	$T_J = 150$ °C	2100	—	A
		$V_{GE} \leq 15V$ $V_{Bus} = 1000V$ $t_p \leq 7$ μs	$T_J = 175$ °C	2000	—	
R_{thJC}	Junction-to-case thermal resistance		—	—	0.077	°C/W

1.2 Diode Characteristics (Per Diode)

The following table lists the diode characteristics (per diode) of the APTGX600SK170T6G device.

Table 1-4. Diode Characteristics

Symbol	Characteristic	Test Conditions		Min.	Typ.	Max.	Unit
V_{RRM}	Peak repetitive reverse voltage			—	—	1700	V
I_{RM}	Reverse leakage current	$V_R = 1700V$		—	—	50	μA
I_{FRM}	Repetitive forward current, t_p limited by $T_{J(max)}$			—	1200	—	A
I^2t	I^2t value	$t_p = 10$ ms	$T_J = 125$ °C	—	17800	—	A^2s
		$V_R = 0V$	$T_J = 175$ °C	—	15300	—	
I_F	DC forward current			—	600	—	A
V_F	Diode forward voltage	$I_F = 600A$ $V_{GE} = 0V$	$T_J = 25$ °C $T_J = 125$ °C $T_J = 175$ °C	— — —	2.35 2.25 2.1	2.7	V
I_{RRM}	Reverse recovery current	$V_{GE} = -15V$ $I_F = 600A$ $V_R = 900V$ $di/dt = 12.8$ kA/ μs	$T_J = 25$ °C $T_J = 125$ °C $T_J = 175$ °C	— — —	640 740 782	—	A
Q_{rr}	Reverse recovery charge		$T_J = 25$ °C $T_J = 125$ °C $T_J = 175$ °C	— — —	62 140 174	—	μC
E_{rr}	Reverse recovery energy		$T_J = 25$ °C $T_J = 125$ °C $T_J = 175$ °C	— — —	38 79.4 116.6	—	mJ
R_{thJC}	Junction-to-case thermal resistance				—	0.14	°C/W

1.3 Thermal and Package Characteristics

The following table lists the thermal and package characteristics of the APTGX600SK170T6G 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	—	19.9	—	mm
	Creepage distance terminal-to-heatsink	—	28.7	—	
d_{clear}	Clearance distance terminal-to-terminal	—	12.2	—	mm
	Clearance distance terminal-to-heatsink	—	28.6	—	
R_{CE}	Lead resistance terminal-to-chip	$T_C = 25$ °C, per switch		0.5	—
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	M6	3	—	N.m
		M4	1	—	
Wt	Package weight	—	335	—	g

1.4 Typical IGBT Performance Curve

The following figures show the IGBT performance curves of the APTGX600SK170T6G device.

Figure 1-1. Maximum Thermal Impedance

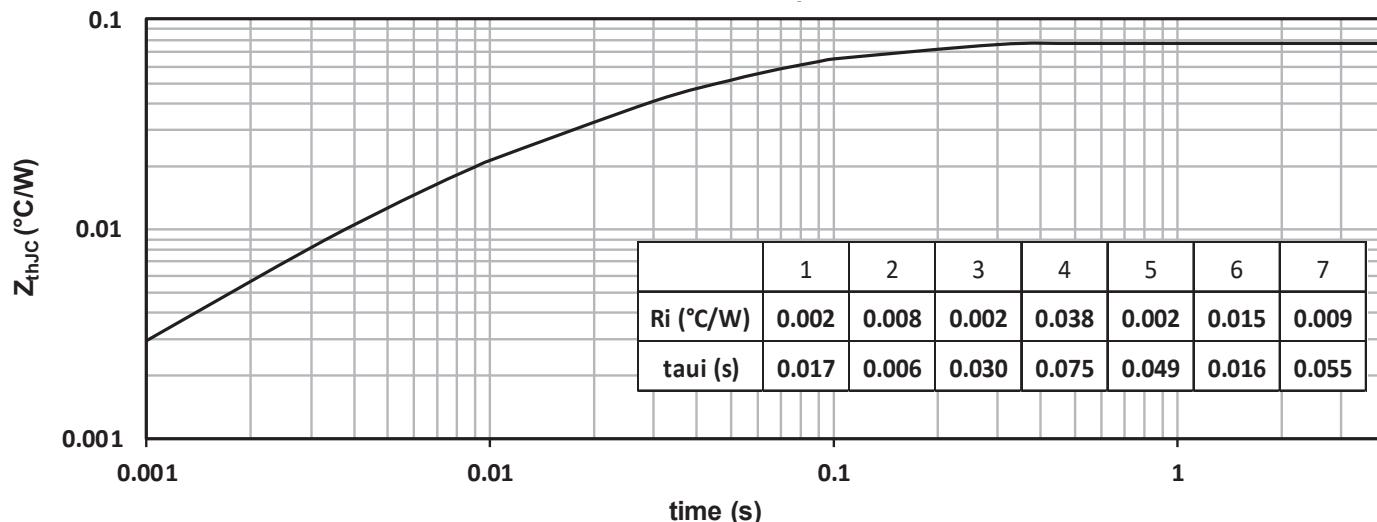


Figure 1-2. Output Characteristics, $V_{GE} = 15V$

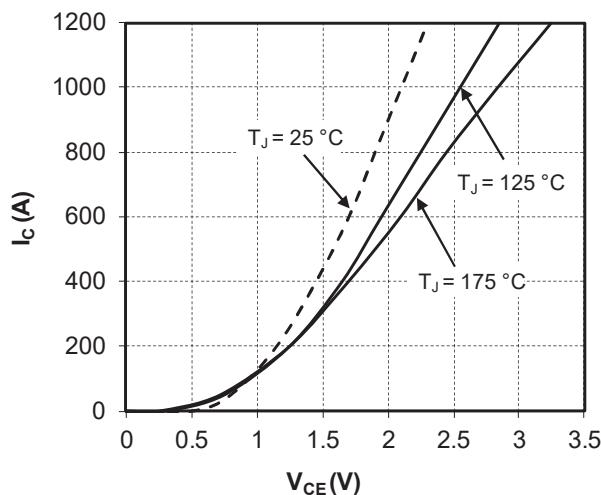


Figure 1-3. Output Characteristics, $T_j = 175$ °C

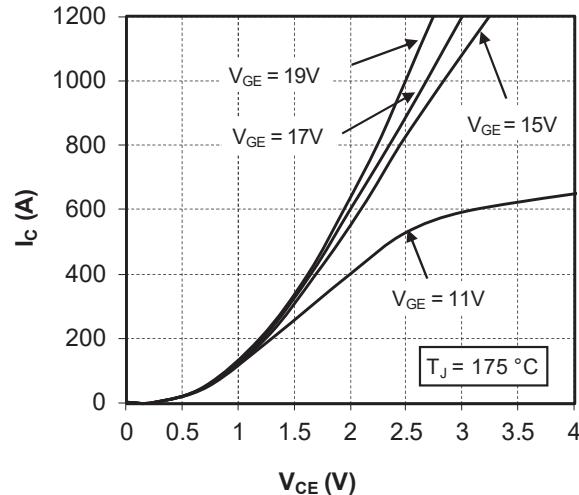


Figure 1-4. Switching Losses vs. Gate Resistance

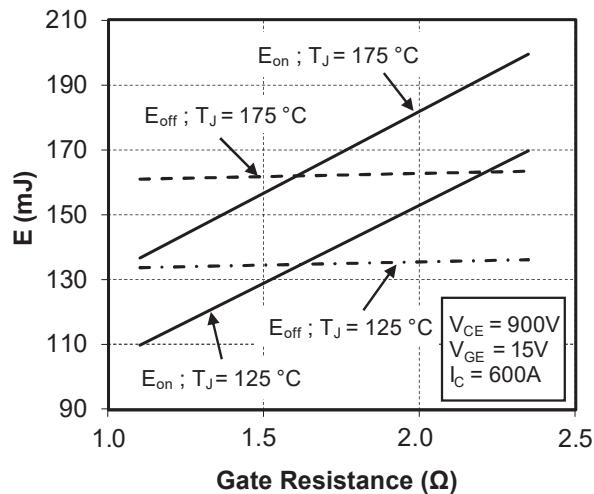


Figure 1-5. Switching Losses vs. Collector Current

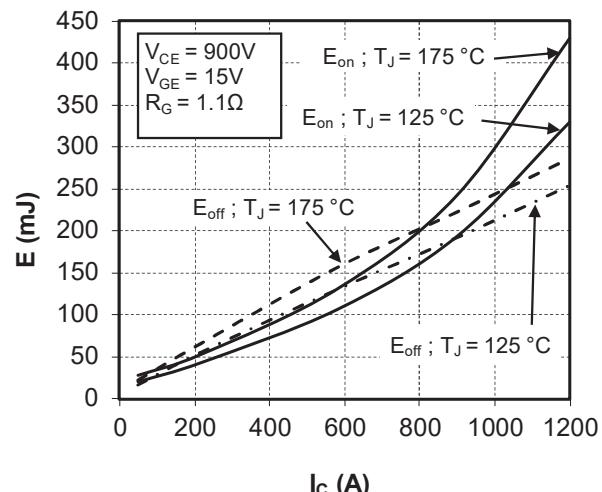


Figure 1-6. Operating Frequency vs. Collector Current

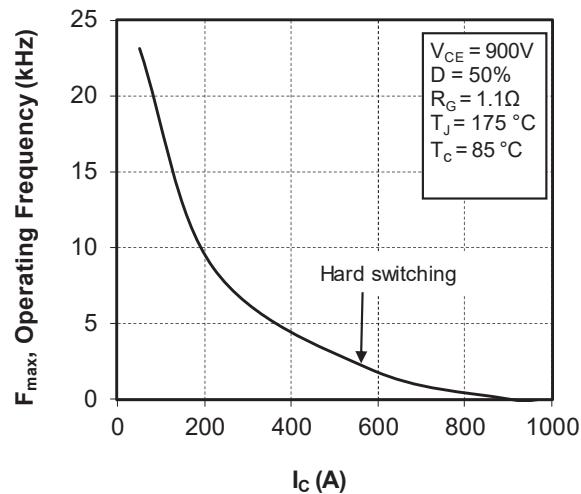


Figure 1-7. Gate Charge Characteristics

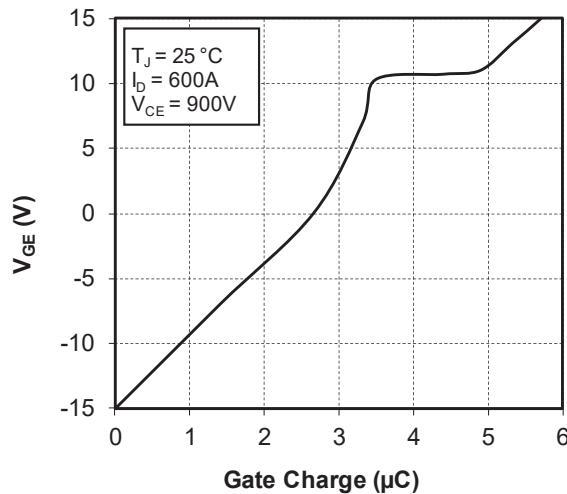


Figure 1-8. Transfer Characteristics

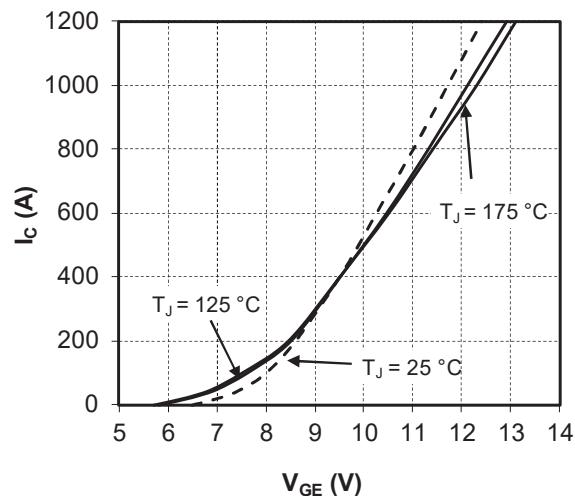


Figure 1-9. Capacity Characteristics

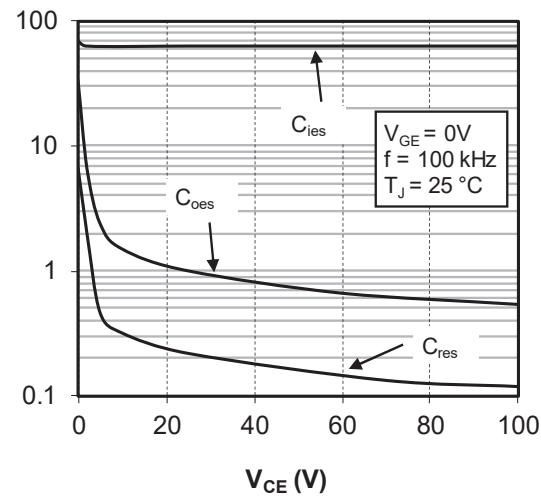
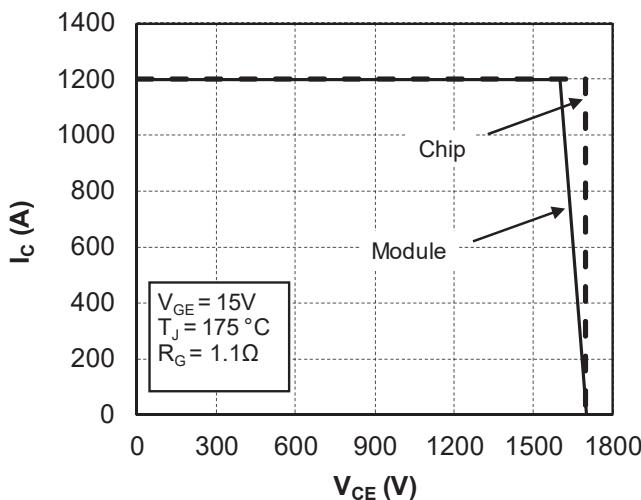


Figure 1-10. Reverse Bias Safe Operating Area



1.5 Typical Diode Performance Curve

The following figures show the diode performance curves of the APTX600SK170T6G device.

Figure 1-11. Maximum Thermal Impedance

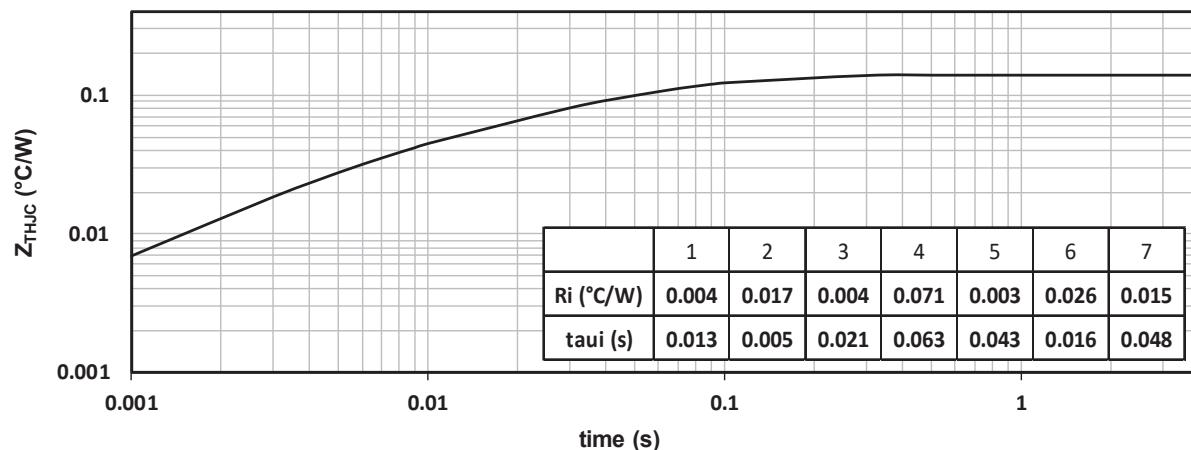


Figure 1-12. Forward Characteristics

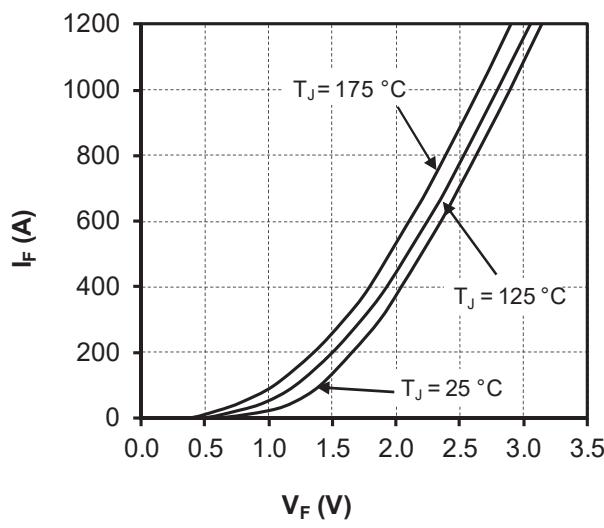


Figure 1-13. Switching Losses vs. Gate Resistance

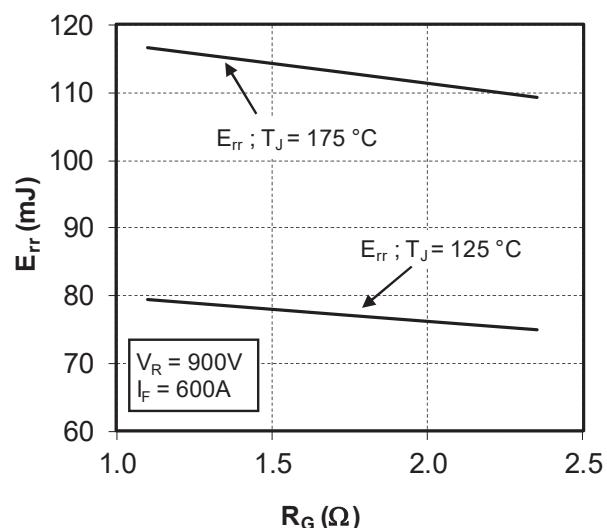
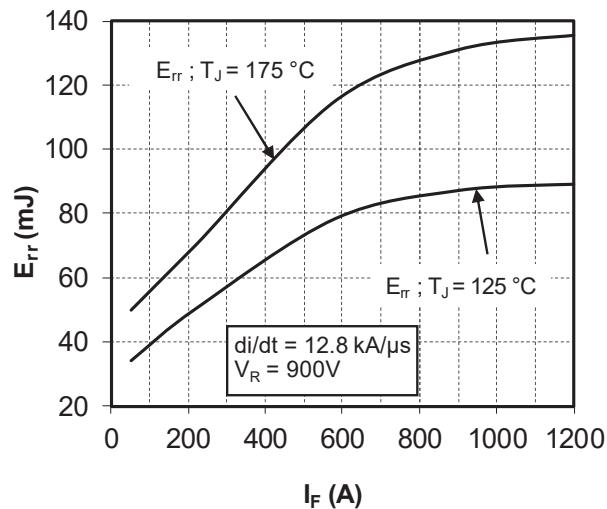


Figure 1-14. Switching Losses vs. Forward Current



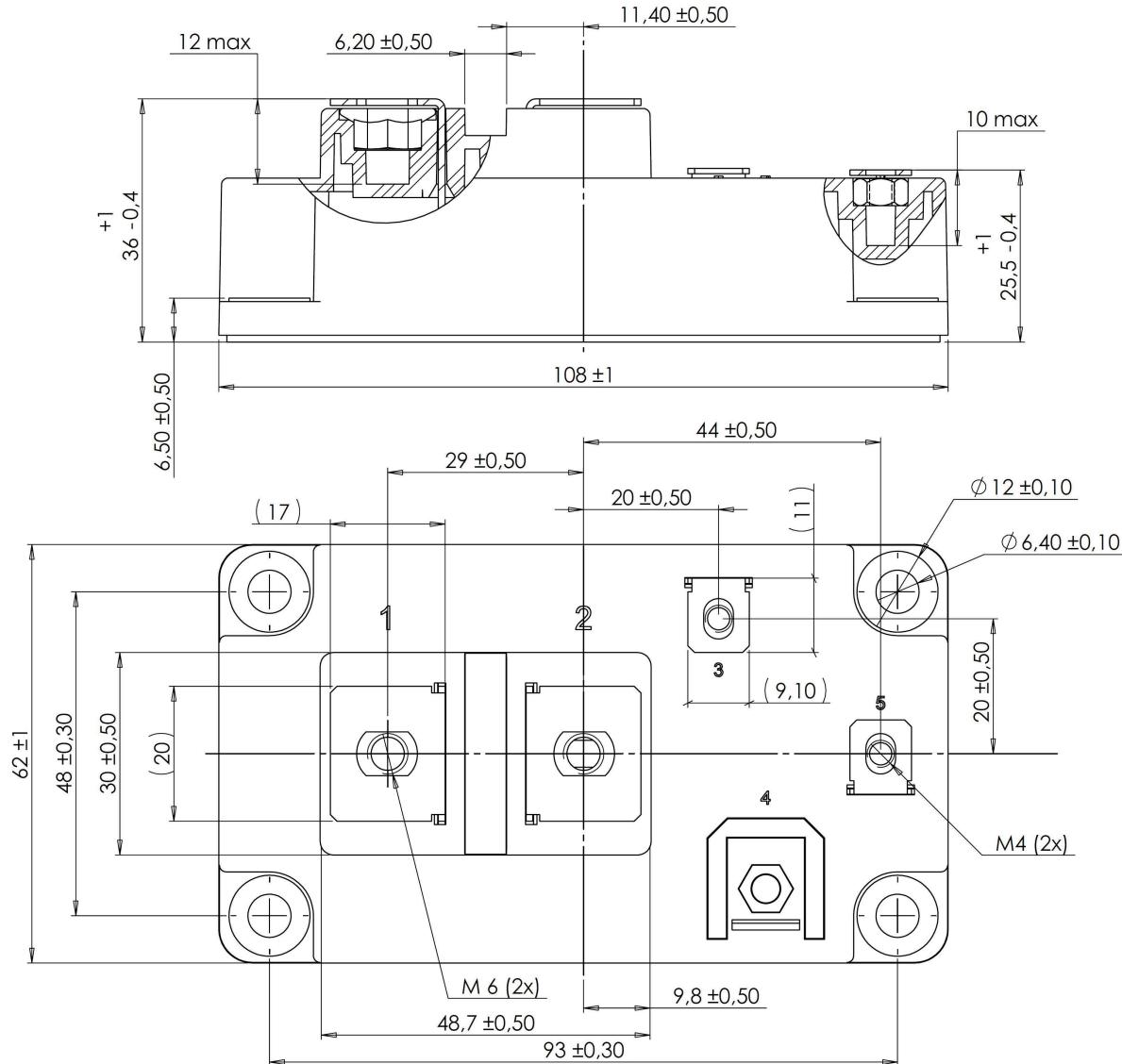
2. Package Specifications

The following section shows the package specification of the APTGX600SK170T6G device.

2.1 Package Outline

The following figure shows the package outline drawing of the APTGX600SK170T6G device. The dimensions in the following figure are in millimeters.

Figure 2-1. Package Outline Drawing



Note: For more information, see [AN1908-Mounting Instructions for D3 & D4 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	11/2024	Initial revision

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