

1200 V, 140 A Fast Field-Stop IGBT 7 with DQ Diode

APT140GH120JD100



Product Overview

1200 V, 140 A Fast Field-Stop IGBT, SOT-227

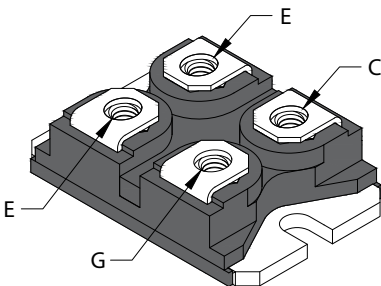
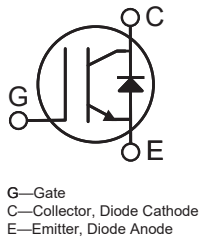


Table 1. Ordering Information

Catalog Part Number (CPN)	Package	Packing Media	Qualification
APT140GH120JD100	SOT-227	Tube	Industrial

Features

- Low conduction loss and saturation voltage
- Fast switching
- Low gate charge
- Ultrafast tail current shutoff
- Soft recovery
- Reverse-bias safe operating area (RBSOA) rated
- Easy to parallel
- RoHS compliant
- Isolated voltage to 2500 V, UL certified file E145592 

1. Device Specifications

This section shows the specifications of this device.

1.1. Absolute Maximum Ratings

The following table shows the absolute maximum ratings of this device. $T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Table 1-1. Absolute Maximum Ratings

Symbol	Parameter	Ratings	Unit
V_{CES}	Collector-emitter voltage	1200	V
V_{GE}	Gate-emitter voltage	± 20	
I_{C1}	Continuous collector current ($T_C = 25\text{ }^{\circ}\text{C}$)	190	A
I_{C2}	Continuous collector current ($T_C = 100\text{ }^{\circ}\text{C}$)	115	
I_{CM}	Pulsed collector current ¹ ($T_C = 175\text{ }^{\circ}\text{C}$)	560	
RBSOA	Reverse-bias safe operating area ($T_J = 175\text{ }^{\circ}\text{C}$)	560	A
P_D	Total power dissipation	536	W

Note:

1. Repetitive rating: Pulse width and case temperature are limited by the maximum junction temperature.

1.2. Thermal and Mechanical Characteristics

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

Table 1-2. Thermal and Mechanical Characteristics

Symbol	Characteristic	Min.	Typ.	Max.	Unit
$R_{\theta JC}$	Junction-to-case thermal resistance (IGBT)			0.28	$^{\circ}\text{C/W}$
$R_{\theta JC}$	Junction-to-case thermal resistance (diode)			0.41	
T_J, T_{STG}	Operating and storage junction temperature	-40		175	$^{\circ}\text{C}$
$V_{ISOLATION}$	RMS voltage (50 Hz–60 Hz sinusoidal waveform from terminals to mounting base for 1 minute)	2500			V
τ_M	Mounting torque, M3 screw for heat sink attachment (requires 2, not included)		0.8		N·m
τ_T	Terminal screw torque, M4 screw (4 included)			1.1	
Wt	Package weight		29.2		g

1.3. Electrical Performance

The following table shows the static characteristics of this device. $T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Table 1-3. Static Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
$V_{GE(th)}$	Gate threshold voltage	$V_{CE} = V_{GE}, I_C = 2.24\text{ mA}$	4.7	5.5	6.2	V
$V_{CE(on)}$	Collector-emitter on voltage	$V_{GE} = 15\text{ V}, I_C = 140\text{ A}$		1.7	2.15	
		$V_{GE} = 15\text{ V}, I_C = 140\text{ A}, T_J = 175\text{ }^{\circ}\text{C}$		2.0		
I_{CES}	Collector cut-off current ¹	$V_{CE} = 1200\text{ V}, V_{GE} = 0\text{ V}$			140	μA
		$V_{CE} = 1200\text{ V}, V_{GE} = 0\text{ V}, T_J = 175\text{ }^{\circ}\text{C}$		18000		
I_{GES}	Gate-emitter leakage current	$V_{GE} = \pm 20\text{ V}$			± 100	nA

Note:

1. I_{CES} includes both IGBT and diode leakages.

The following table shows the dynamic characteristics of this device. $T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Table 1-4. Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
C_{ies}	Input capacitance	$V_{GE} = 0\text{ V}, V_{CE} = 25\text{ V}, f = 200\text{ kHz}$		18460		pF
C_{res}	Reverse transfer capacitance			110		
C_{oes}	Output capacitance			251		
V_{GEP}	Gate-to-emitter plateau voltage	$V_{GE} = 15\text{ V}, V_{CE} = 600\text{ V}, I_C = 140\text{ A}$		7.5		V
Q_G	Total gate charge ¹			1005		nC
Q_{GE}	Gate-emitter charge			129		
Q_{GC}	Gate-collector ("Miller") charge			361		
RBSOA	Reverse-bias safe operating area	$T_J = 175\text{ }^{\circ}\text{C}, R_G = 23\text{ }\Omega, V_{GE} = 15\text{ V}, V_{CE} = 800\text{ V}, L = 100\text{ }\mu\text{H}$	560			A
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 800\text{ V}, V_{GE} = 15\text{ V}, I_C = 140\text{ A}, R_G = 5\text{ }\Omega, T_J = 25\text{ }^{\circ}\text{C}$		58		ns
t_r	Current rise time			100		
$t_{d(off)}$	Turn-off delay time			540		
t_f	Current fall time			82		
E_{on1}	Turn-on switching energy ²			13030		μJ
E_{on2}	Turn-on switching energy with diode ³			17010		
E_{off}	Turn-off switching energy ⁴			6940		
$t_{d(on)}$	Turn-on delay time	$V_{CC} = 800\text{ V}, V_{GE} = 15\text{ V}, I_C = 140\text{ A}, R_G = 5\text{ }\Omega, T_J = 125\text{ }^{\circ}\text{C}$		58		ns
t_r	Current rise time			100		
$t_{d(off)}$	Turn-off delay time			587		
t_f	Current fall time			81		
E_{on1}	Turn-on switching energy ²			12570		μJ
E_{on2}	Turn-on switching energy with diode ³			22890		
E_{off}	Turn-off switching energy ⁴			8257		

Notes:

1. See MIL-STD-750 Method 3471.
2. E_{on1} is the clamped inductive turn-on-energy of the IGBT only, without the effect of a commutating diode reverse recovery current adding to the IGBT turn-on loss. (See [Figure 1-19](#), [Figure 1-20](#).)
3. E_{on2} is the clamped inductive turn-on energy that includes a commutating diode reverse recovery current in the IGBT turn-on switching loss. (See [Figure 1-19](#), [Figure 1-20](#).)
4. E_{off} is the clamped inductive turn-off energy measured in accordance with JEDEC standard JESD24-1. (See [Figure 1-19](#), [Figure 1-21](#).)

1.4. Typical Performance Curves

Data for performance curves are characterized, not 100% tested.

Figure 1-1. Output Characteristics

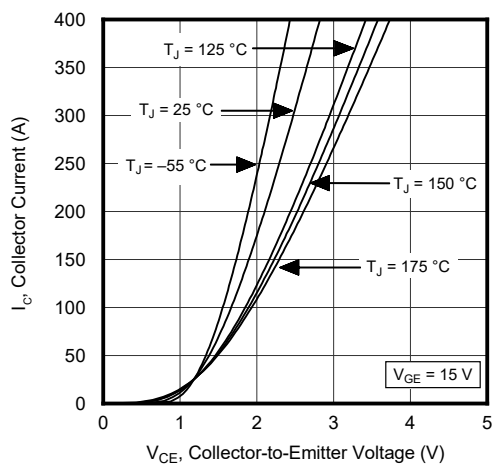


Figure 1-2. Transfer Characteristics

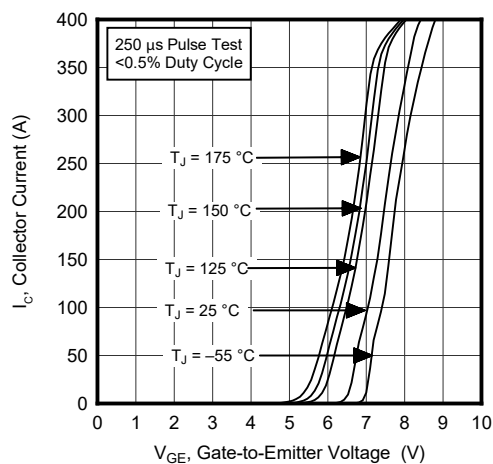


Figure 1-3. Gate Charge

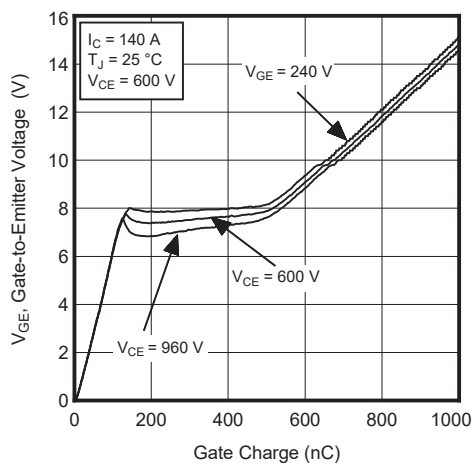


Figure 1-4. On-State Voltage vs. Gate-to-Emitter Voltage

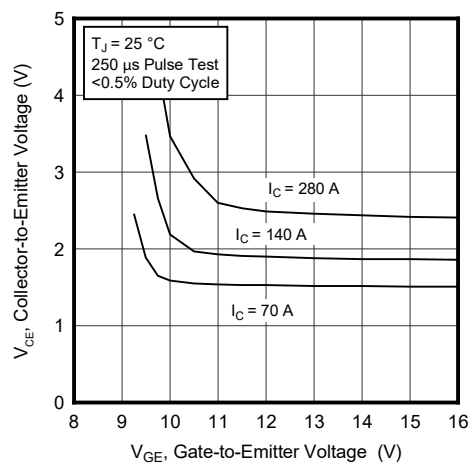


Figure 1-5. On-State Voltage vs. Junction Temperature

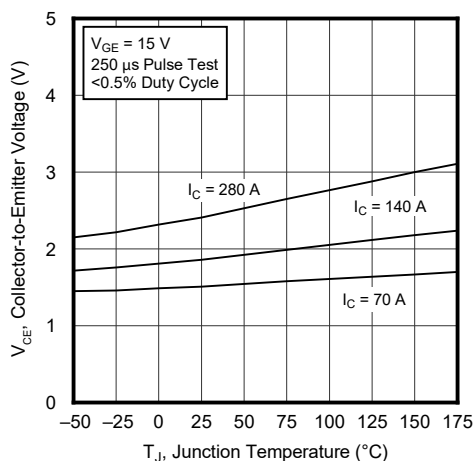


Figure 1-6. DC Collector Current vs. Case Temperature

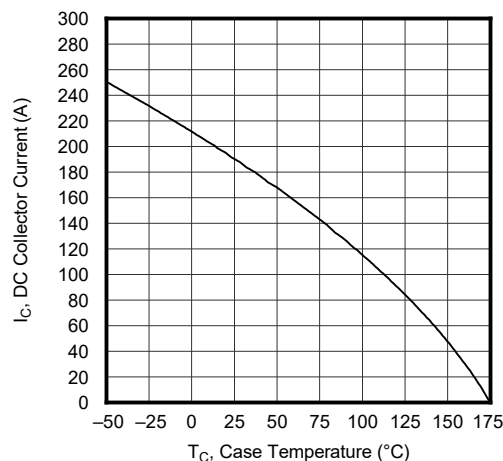


Figure 1-7. Turn-On Delay Time vs. Collector Current

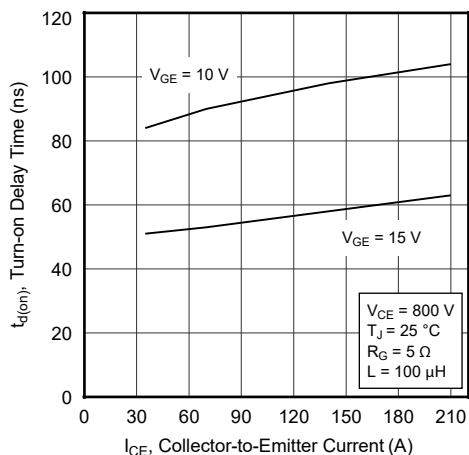


Figure 1-8. Turn-Off Delay Time vs. Collector Current

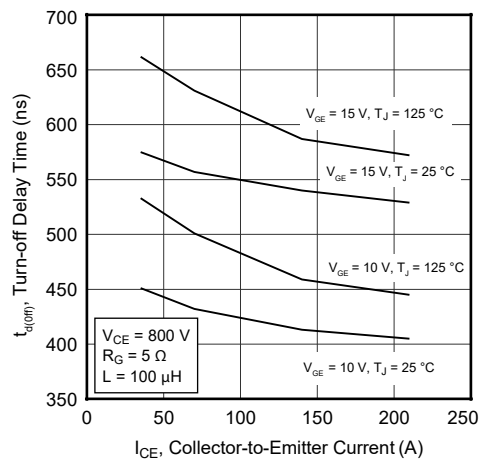


Figure 1-9. Current Rise Time vs. Collector Current

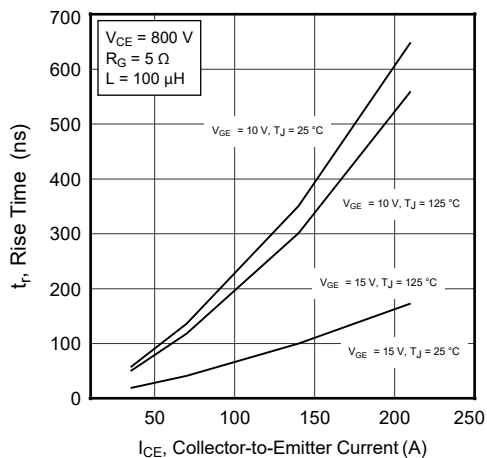


Figure 1-10. Current Fall Time vs. Collector Current

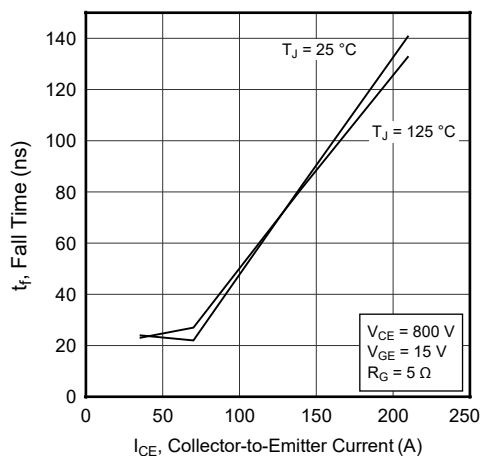


Figure 1-11. Turn-On Energy Loss vs. Collector Current

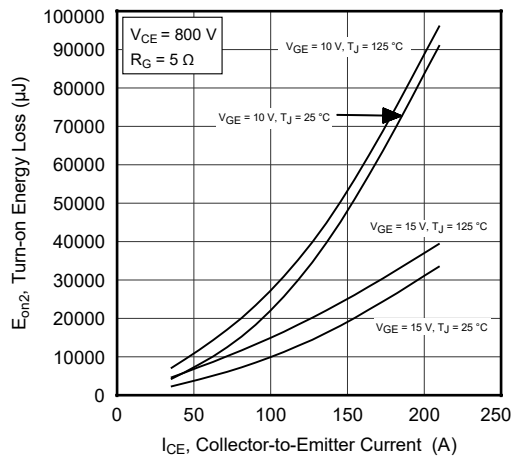


Figure 1-12. Turn-Off Energy Loss vs. Collector Current

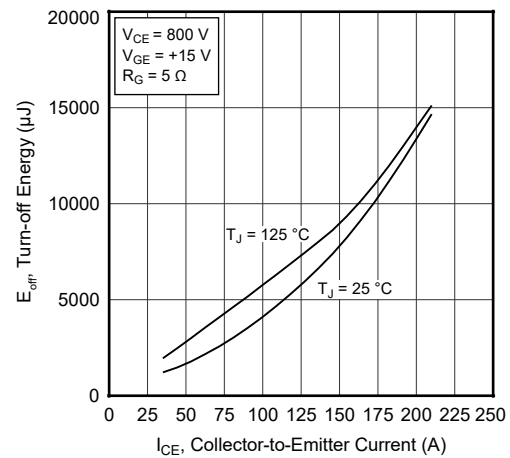


Figure 1-13. Switching Energy Losses vs. Gate Resistance

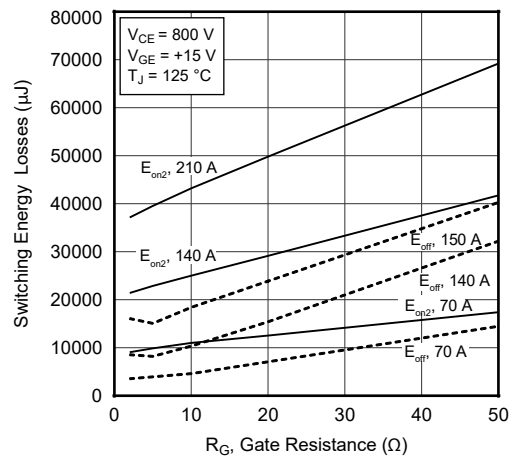


Figure 1-14. Switching Energy Losses vs. Junction Temperature

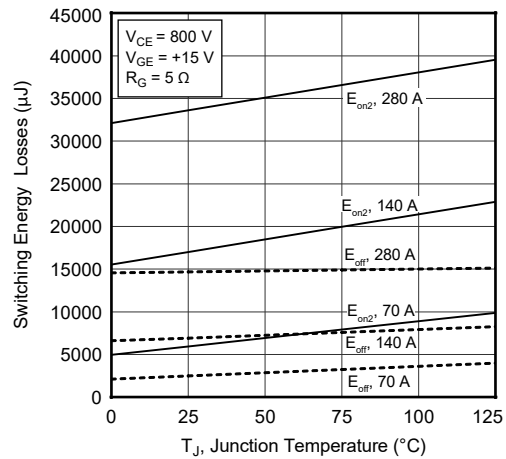


Figure 1-15. Capacitance vs. Collector-To-Emitter Voltage

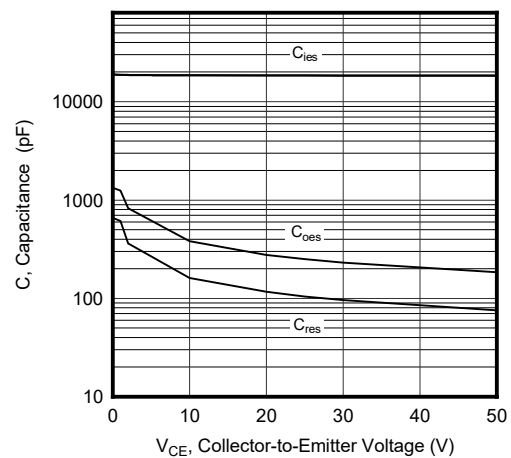


Figure 1-16. Reverse-bias Safe Operating Area

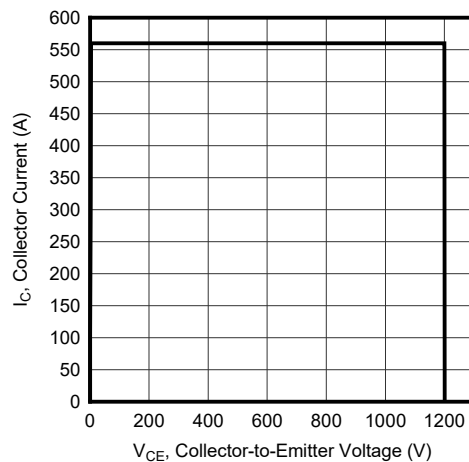


Figure 1-17. Maximum Transient Thermal Impedance

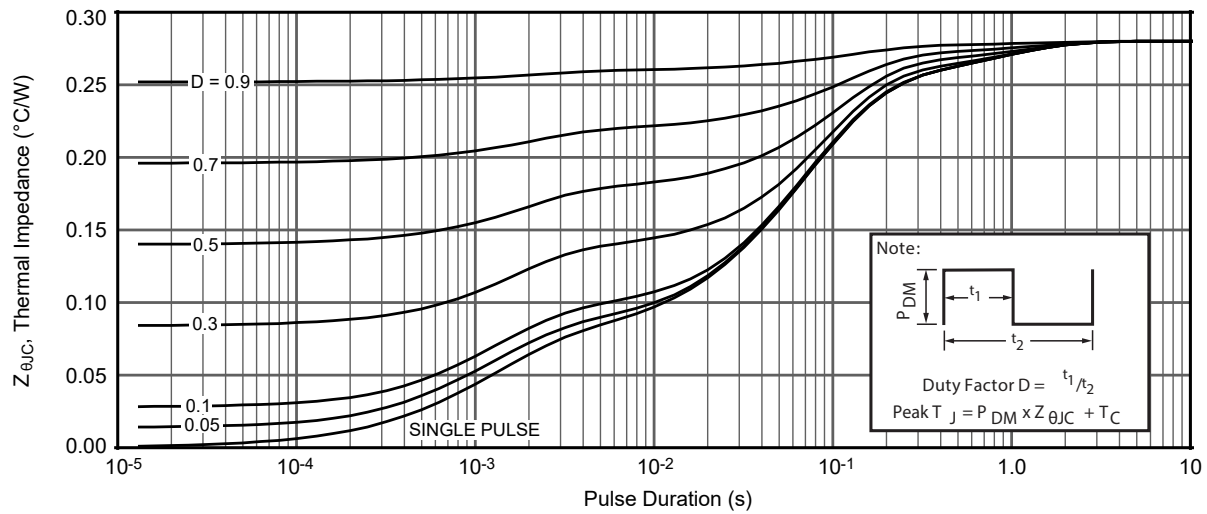


Figure 1-18. Transient Thermal Impedance Model

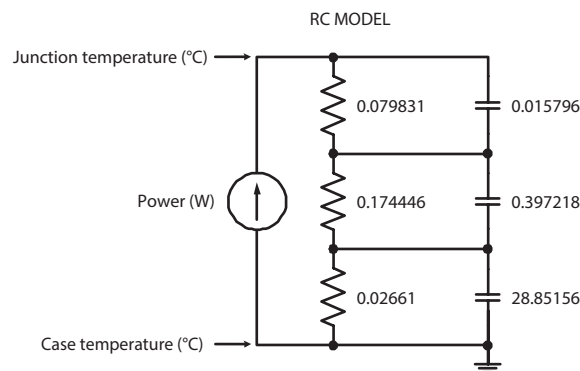


Figure 1-19. Inductive Switching Test Circuit

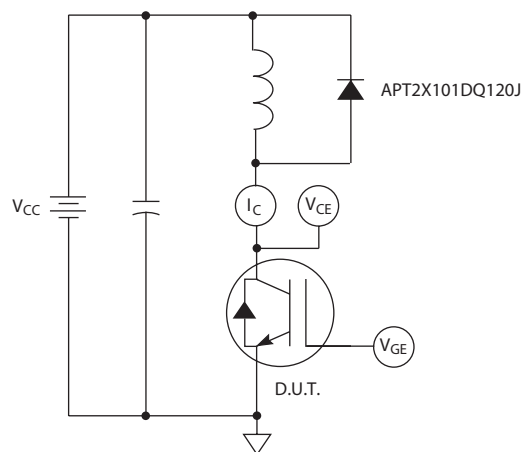


Figure 1-20. Turn-on Switching Waveform and Definitions

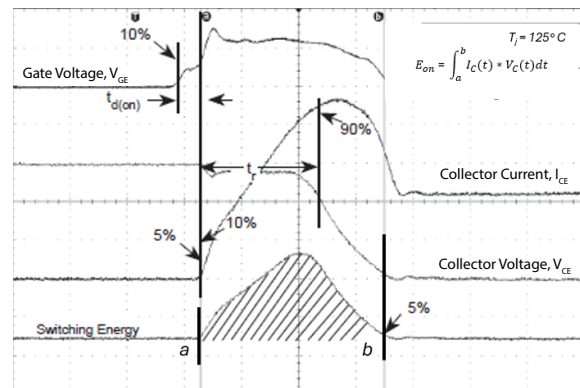
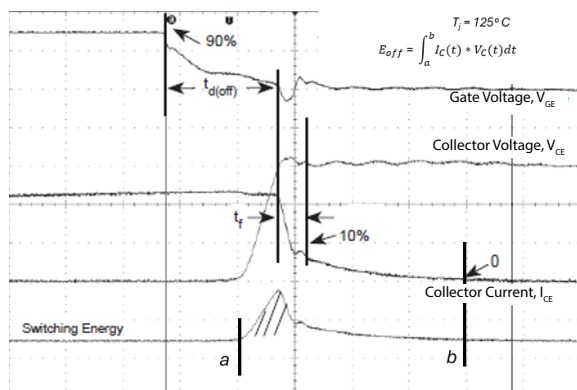


Figure 1-21. Turn-off Switching Waveform and Definitions



2. Device Specifications: Ultrafast Soft Recovery Anti-Parallel Diode

This section shows the specifications of the co-packaged, anti-parallel diode.

2.1. Absolute Maximum Ratings

The following table shows the absolute maximum ratings of the anti-parallel diode. $T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Table 2-1. Absolute Maximum Ratings

Symbol	Parameter	Ratings	Unit
$I_F(AV)$	Maximum average forward current ($T_C = 50\text{ }^{\circ}\text{C}$, duty cycle = 0.5)	100	A
$I_F(RMS)$	RMS forward current (square wave, duty cycle = 0.5)	127	
I_{FSM}	Non-repetitive forward surge current ($T_J = 45\text{ }^{\circ}\text{C}$, 8.3 ms)	1000	

2.2. Electrical Performance

The following table shows the static characteristics of the anti-parallel diode. $T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Table 2-2. Static Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
V_F	Forward voltage	$I_F = 100\text{ A}$		2.4	3.0	V
		$I_F = 150\text{ A}$		2.65		
		$I_F = 100\text{ A}$, $T_J = 125\text{ }^{\circ}\text{C}$		1.8		

The following table shows the dynamic characteristics of the anti-parallel diode. $T_C = 25\text{ }^{\circ}\text{C}$ unless otherwise specified.

Table 2-3. Dynamic Characteristics

Symbol	Characteristic	Test Conditions	Min.	Typ.	Max.	Unit
t_{rr}	Reverse recovery time	$I_F = 1\text{ A}$, $di_F/dt = -100\text{ A}/\mu\text{s}$, $V_R = 30\text{ V}$		45		ns
t_{rr}	Reverse recovery time	$I_F = 100\text{ A}$, $di_F/dt = -200\text{ A}/\mu\text{s}$, $V_R = 800\text{ V}$		385		
Q_{rr}	Reverse recovery charge			1055		
I_{RRM}	Maximum reverse recovery current			6		A
t_{rr}	Reverse recovery time	$I_F = 100\text{ A}$, $di_F/dt = -200\text{ A}/\mu\text{s}$, $V_R = 800\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}$		480		ns
Q_{rr}	Reverse recovery charge			5240		nC
I_{RRM}	Maximum reverse recovery current			19		A
t_{rr}	Reverse recovery time	$I_F = 100\text{ A}$, $di_F/dt = -1000\text{ A}/\mu\text{s}$, $V_R = 800\text{ V}$, $T_C = 125\text{ }^{\circ}\text{C}$		210		ns
Q_{rr}	Reverse recovery charge			9345		nC
I_{RRM}	Maximum reverse recovery current			70		A

2.3. Typical Performance Curves

Data for performance curves are characterized, not 100% tested.

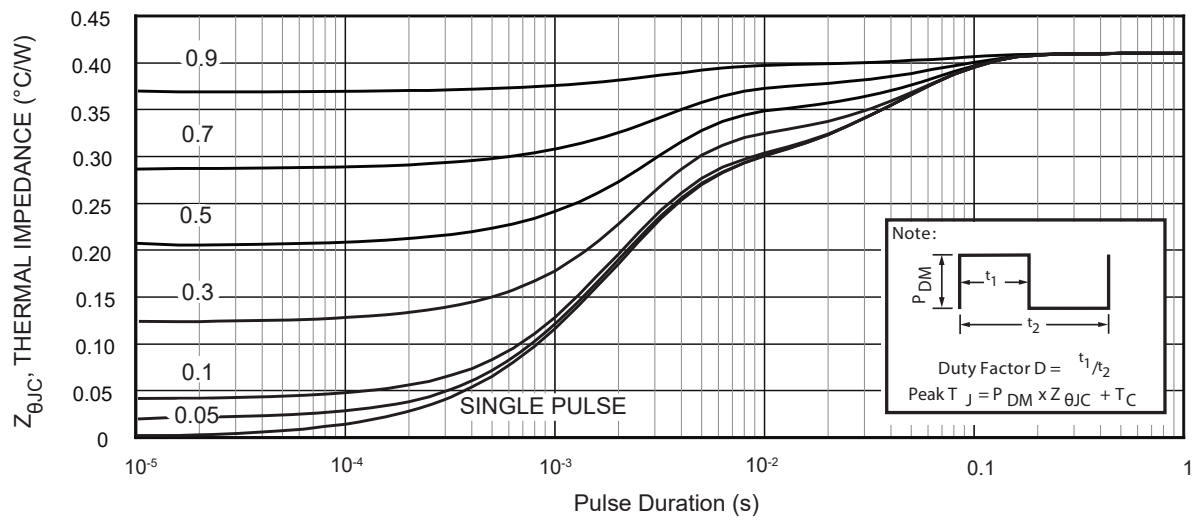
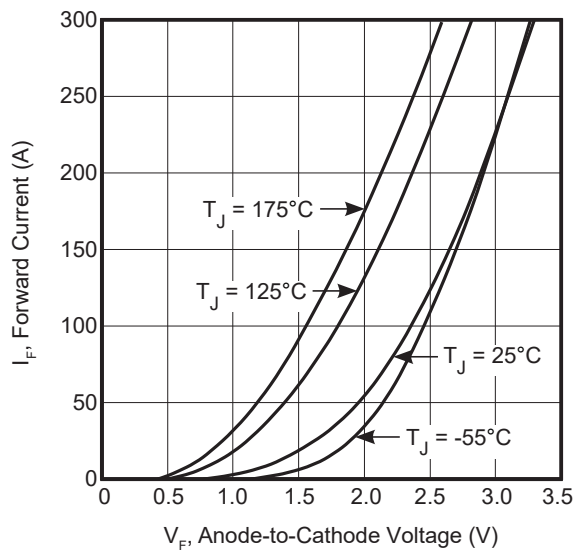
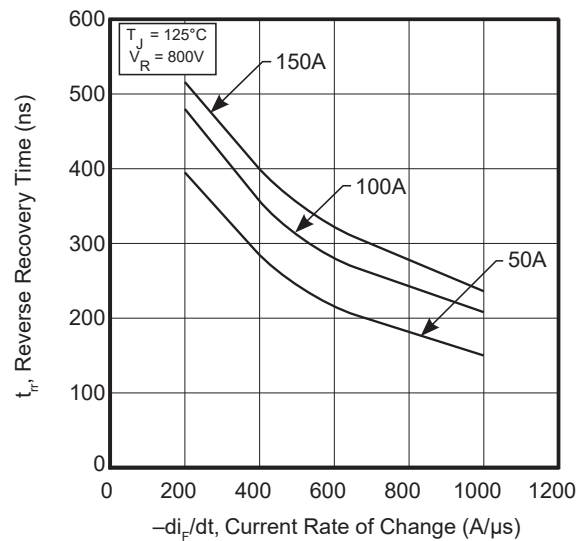
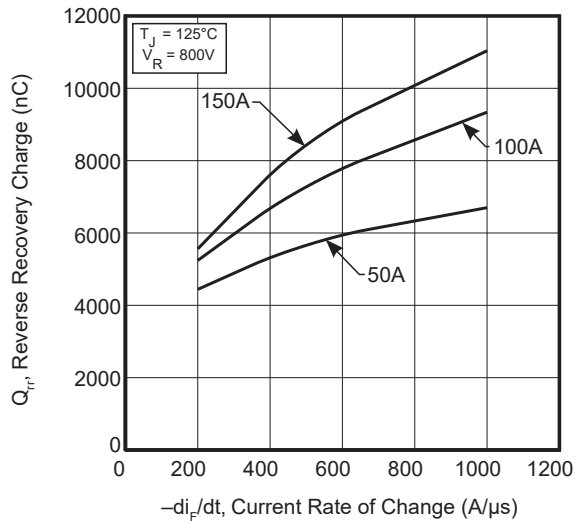
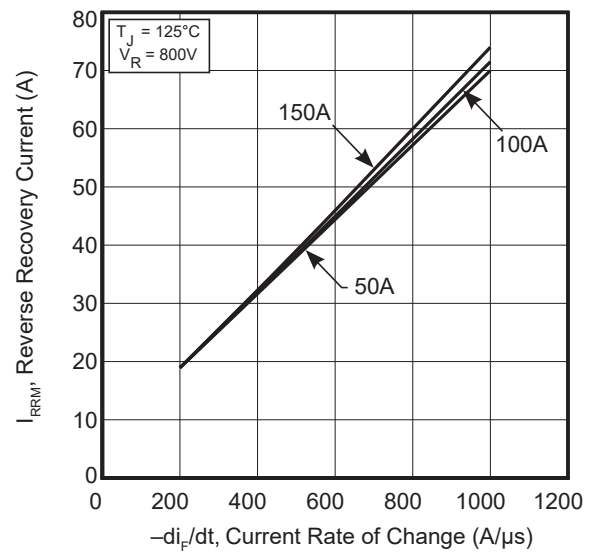
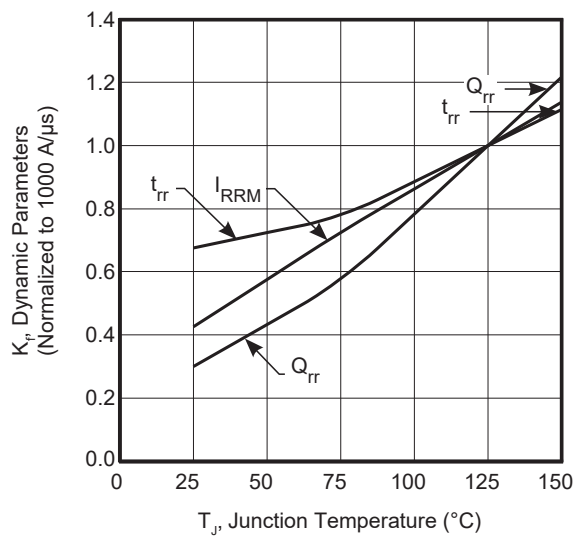
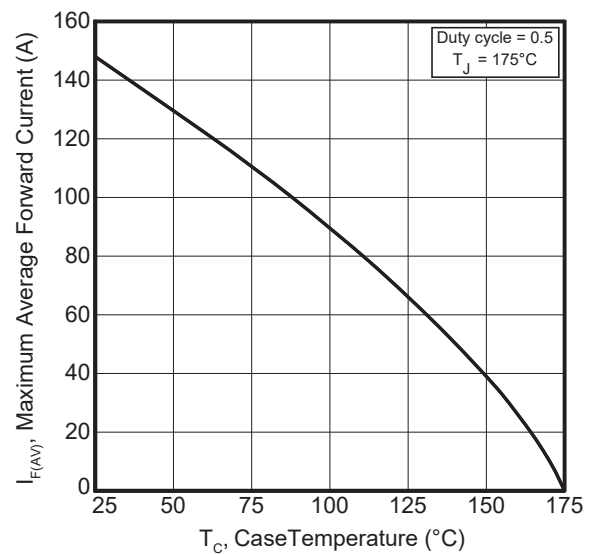
Figure 2-1. Maximum Transient Thermal Impedance**Figure 2-2.** Forward Current vs. Forward Voltage**Figure 2-3.** Reverse Recovery Time vs. Current Rate of Change

Figure 2-4. Reverse Recovery Charge vs. Current Rate of Change**Figure 2-5.** Reverse Recovery Current vs. Current Rate of Change**Figure 2-6.** Dynamic Parameters vs. Junction Temperature**Figure 2-7.** Maximum Average Forward Current vs. Case Temperature

The following figure shows the diode test circuit of this device.

Figure 2-8. Diode Test Circuit

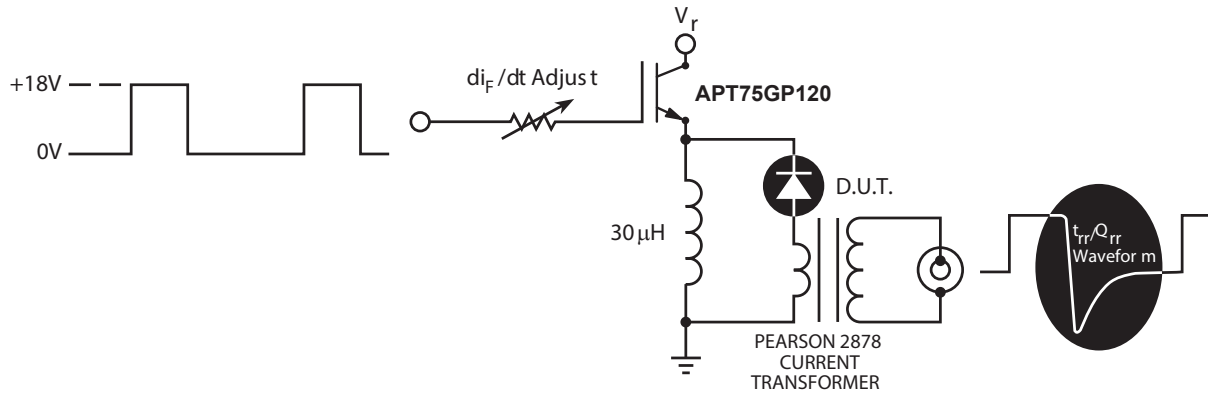
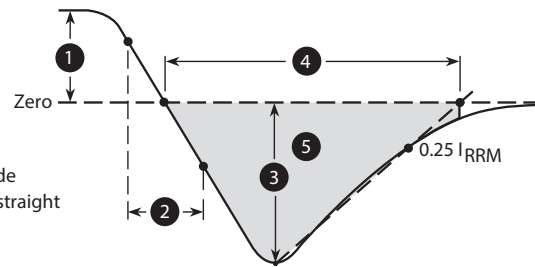


Figure 2-9. Diode Reverse Recovery Waveform and Definitions

- ① I_F — Forward conduction current
- ② di_F/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 $0.25 \cdot I_{RRM}$ passes through zero.
- ⑤ Q_{rr} — Area under the curve defined by I_{RRM} and t_{rr} .



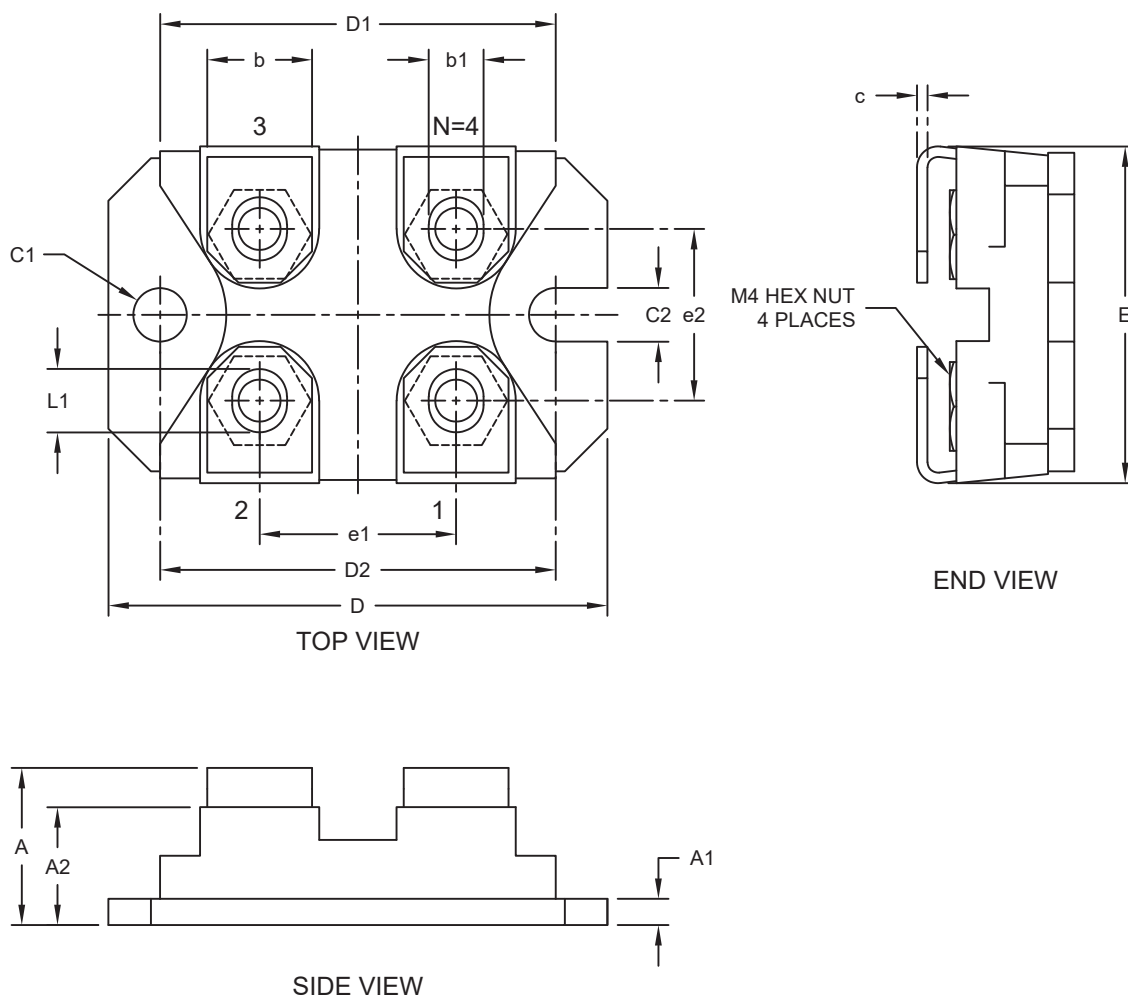
3. Package Specification

This section shows the package specification of this device.

3.1. Package Outline Drawing

The following figure illustrates the SOT-227 package outline of this device.

Figure 3-1. Package Outline Drawing



The following table shows the SOT-227 dimensions and should be used in conjunction with the package outline drawing.

Table 3-1. SOT-227 Dimensions

Dimension Limits		Dimensions (millimeters)	
		Min.	Max.
Number of terminals	N		4
Terminal pitch	e1	14.9	15.1
Terminal pitch	e2	12.6	12.8
Overall height	A	11.8	12.2
Base plate thickness	A1	1.95	2.14

Table 3-1. SOT-227 Dimensions (continued)

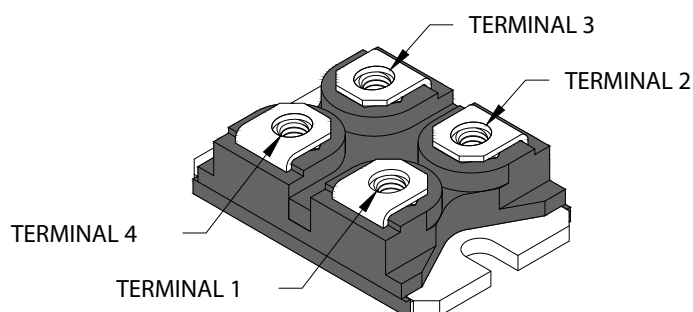
Dimension Limits		Dimensions (millimeters)	
		Min.	Max.
Molded package thickness	A2	8.9	9.6
Overall length	D	38.0	38.2
Molded package length	D1	31.5	31.7
Mounting centers	D2	30.1	30.3
Overall width	E	25.2	25.4
Terminal width	b	7.8	8.2
Terminal thickness	c	0.75	0.85
Terminal slot width	b1	4.1	4.3
Terminal slot length	L1	4.8	4.9
Mounting hole diameter	C1	4.0	4.2
Mounting slot width	C2	4.0	4.2

Note:

1. Dimensioning and tolerancing per ASME Y14.5M.

3.2. Terminal Pinout

The following figure illustrates the terminal pinout of this device.

Figure 3-2. Terminal Pinout

The following table shows the electrical signal terminal pinout of this device.

Table 3-2. Electrical Signal Terminal Pinout

Terminal	Definition
TERMINAL 1	Gate
TERMINAL 2	Collector, Diode Cathode
TERMINAL 3	Emitter, Diode Anode
TERMINAL 4	Emitter, Diode Anode

4. 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.

Table 4-1. Revision History

Revision	Date	Description
A	02/2026	Document created.

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