Field Stop Trench IGBT with Soft Fast Recovery Diode

120 A, 650 V

AFGY120T65SPD

AFGY120T65SPD which is AEC Q101 qualified offers very low conduction and switch losses for a high efficiency operation in various applications, rugged transient reliability and low EMI.

Meanwhile, this part also offers an advantage of outstanding parallel operation performance with balance current sharing.

Features

- AEC−Q101 Qualified
- Very Low Saturation Voltage: $V_{CE(Sat)}$ = 1.6 V (Typ.) @ I_C = 120 A
- Maximum Junction Temperature: T_J = 175°C
- Positive Temperature Co−efficient for Easy Parallel Operating
- Tight Parameter Distribution
- High Input Impedance
- 100% of the Parts are Tested for I_{LM}
- Short Circuit Ruggedness
- Co−packed with Soft Fast Recovery Diode

Typical Applications

- Traction Inverter for HEV/EV
- Auxiliary DC/AC Converters
- Motor Drives
- Other Power−Train Applications Requiring High Power Switch

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Collector−to−Emitter Voltage	V_{CES}	650	V
Gate−to−Emitter Voltage Transient Gate−to−Emitter Voltage	V_{GES}	±20 ±30	V
Collector Current (Note 1) @ T_C = 25°C @ T_C = 100°C	I_C	160 120	A
Pulsed Collector Current	I_{LM}	360	A
Pulsed Collector Current	I_{CM}	360	A
Diode Forward Current (Note 1) @ T_C = 25°C @ T_C = 100°C	I_F	160 120	A
Maximum Power Dissipation @ T_C = 25°C @ T_C = 100°C	P_D	714 357	W
Short Circuit Withstand Time @ T_C = 25°C	SCWT	6	μs
Voltage Transient Ruggedness (Note 2)	dV/dt	10	V/ns
Operating Junction / Storage Temperature Range	T_J, T_{STG}	−55 to +175	°C
Maximum Lead Temp. for Soldering Purposes, 1/8″ from case for 5 seconds	T_L	265	°C

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Value limit by bond wire
2. V_{CC} = 400 V, V_{GE} = 15 V, I_C = 360 A, Inductive Load

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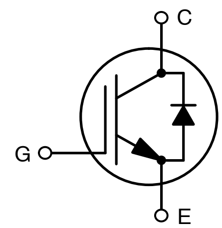
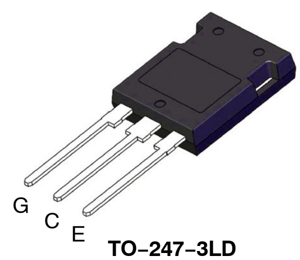
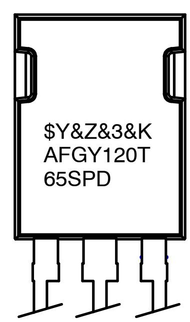
120 A, 650 V,
V_{CESat} = 1.6 V





TO−247−3LD
CASE 340CU

MARKING DIAGRAM



$Y	= ON Semiconductor Logo
&Z	= Assembly Plant Code
&3	= Date Code (Year & Week)
&K	= Lot Traceability Code
AFGY120T65SPD	= Specific Device Code

ORDERING INFORMATION

Device	Package	Shipping
AFGY120T65SPD	TO−247−3LD	30 Units / Tube

THERMAL CHARACTERISTICS

Rating	Symbol	Value	Unit
Thermal resistance junction−to−case, for IGBT	$R_{\theta JC}$	0.21	°C/W
Thermal resistance junction−to−case, for Diode	$R_{\theta JC}$	0.32	
Thermal resistance junction−to−ambient	$R_{\theta JA}$	40	

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS						
Collector−emitter breakdown voltage, gate−emitter short−circuited	V_{GE} = 0 V, I_C = 1 mA	BV_{CES}	650	–	–	V
Temperature Coefficient of Breakdown Voltage	V_{GE} = 0 V, I_C = 1 mA	$\frac{\Delta BV_{CES}}{\Delta T_J}$	–	0.6	–	V/°C
Collector−emitter cut−off current, gate−emitter short−circuited	V_{GE} = 0 V, V_{CE} = 650 V	I_{CES}	–	–	40	μA
Gate leakage current, collector−emitter short−circuited	V_{GE} = 20 V, V_{CE} = 0 V	I_{GES}	–	–	±250	nA
ON CHARACTERISTICS						
Gate−emitter threshold voltage	V_{GE} = V_{CE}, I_C = 120 mA	$V_{GE(th)}$	4.3	5.3	6.3	V
Collector−emitter saturation voltage	V_{GE} = 15 V, I_C = 120 A V_{GE} = 15 V, I_C = 120 A, T_J = 175°C	$V_{CE(sat)}$	– –	1.6 2.15	2.05 –	V
DYNAMIC CHARACTERISTICS						
Input capacitance	V_{CE} = 30 V, V_{GE} = 0 V, f = 1 MHz	C_{ies}	–	4930	–	pF
Output capacitance		C_{oes}	–	375	–	
Reverse transfer capacitance		C_{res}	–	42	–	
Internal Gate Resistance	f = 1 MHz	R_G	–	3	–	Ω
Gate charge total	V_{CE} = 400 V, I_C = 120 A, V_{GE} = 15 V	Q_g	–	125	187	nC
Gate−to−emitter charge		Q_{ge}	–	38	–	
Gate−to−collector charge		Q_{gc}	–	40	–	
SWITCHING CHARACTERISTICS, INDUCTIVE LOAD						
Turn−on delay time	T_J = 25°C, V_{CC} = 400 V, I_C = 120 A, R_G = 5.0 Ω, V_{GE} = 15 V, Inductive Load	$t_{d(on)}$	–	40	–	ns
Rise time		t_r	–	104	–	
Turn−off delay time		$t_{d(off)}$	–	80	–	
Fall time		t_f	–	116	–	
Turn−on switching loss		E_{on}	–	6.6	–	mJ
Turn−off switching loss		E_{off}	–	3.8	–	
Total switching loss		E_{ts}	–	10.4	–	
Turn−on delay time	T_J = 175°C, V_{CC} = 400 V, I_C = 120 A, R_G = 5.0 Ω, V_{GE} = 15 V, Inductive Load	$t_{d(on)}$	–	36	–	ns
Rise time		t_r	–	112	–	
Turn−off delay time		$t_{d(off)}$	–	92	–	
Fall time		t_f	–	160	–	
Turn−on switching loss		E_{on}	–	10.5	–	mJ
Turn−off switching loss		E_{off}	–	4.9	–	
Total switching loss		E_{ts}	–	15.4	–	

ELECTRICAL CHARACTERISTICS (T_J = 25°C unless otherwise noted) (Continued)

Parameter	Test Conditions	Symbol	Min	Typ	Max	Unit
DIODE CHARACTERISTIC						
Diode Forward Voltage	I_F = 120 A, T_J = 25°C	V_{FM}	–	1.4	1.7	V
	I_F = 120 A, T_J = 175°C		–	1.35	–	
Reverse Recovery Energy	I_F = 120 A, dI_F/dt = 1000 A/μs, V_{CE} = 400 V, T_J = 25°C	E_{rec}	–	428	–	μJ
	I_F = 120 A, dI_F/dt = 1000 A/μs, V_{CE} = 400 V, T_J = 175°C		–	2026	–	
Diode Reverse Recovery Time	I_F = 120 A, dI_F/dt = 1000 A/μs, V_{CE} = 400 V, T_J = 25°C	T_{rr}	–	107	–	ns
	I_F = 120 A, dI_F/dt = 1000 A/μs, V_{CE} = 400 V, T_J = 175°C		–	203	–	
Diode Reverse Recovery Charge	I_F = 120 A, dI_F/dt = 1000 A/μs, V_{CE} = 400 V, T_J = 25°C	Q_{rr}	–	2237	–	nC
	I_F = 120 A, dI_F/dt = 1000 A/μs, V_{CE} = 400 V, T_J = 175°C		–	8155	–	

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

TYPICAL CHARACTERISTICS

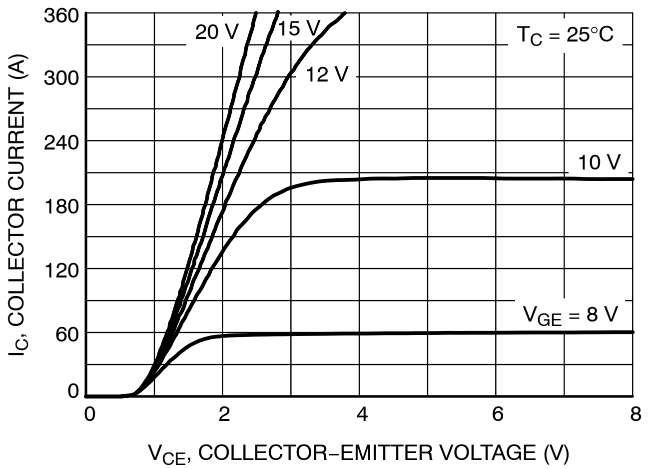


Figure 1. Typical Output Characteristics

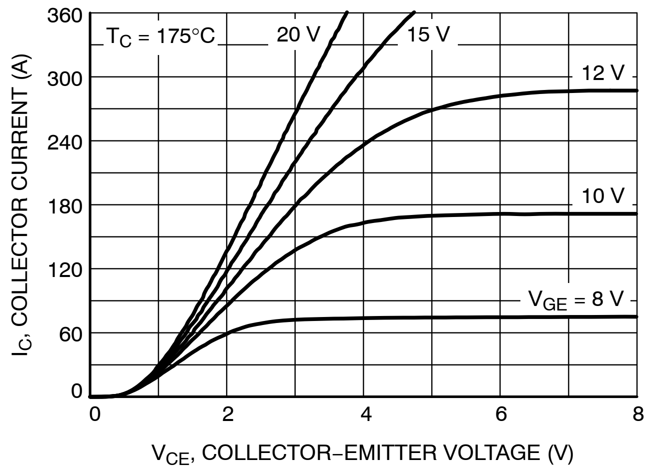


Figure 2. Typical Output Characteristics

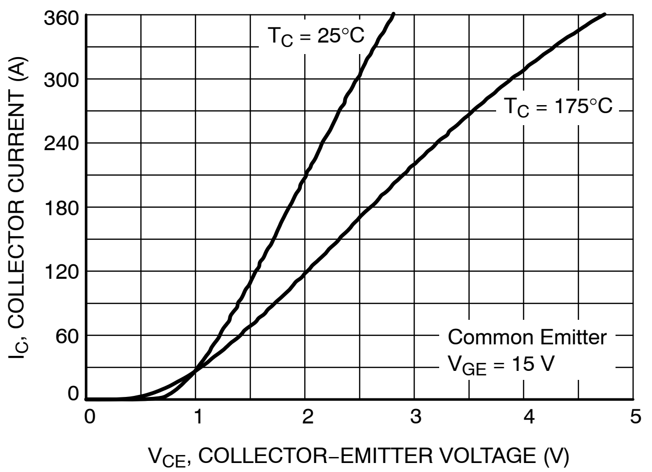


Figure 3. Typical Saturation Voltage

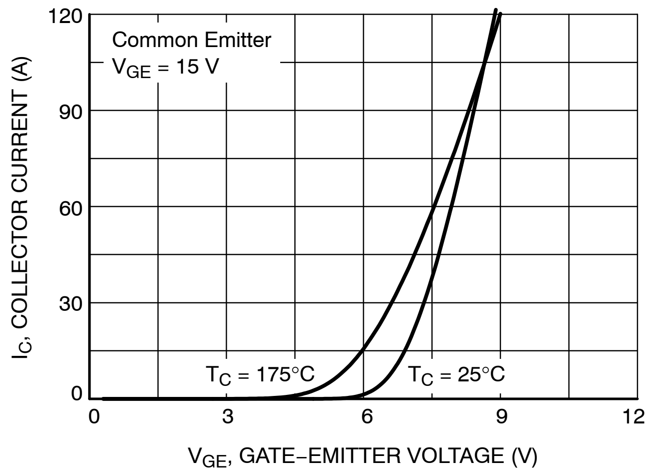


Figure 4. Transfer Characteristics

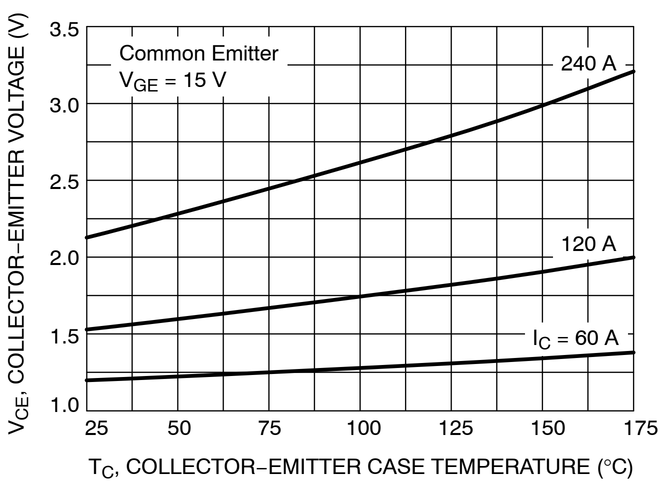


Figure 5. Saturation Voltage vs. Case Temperature

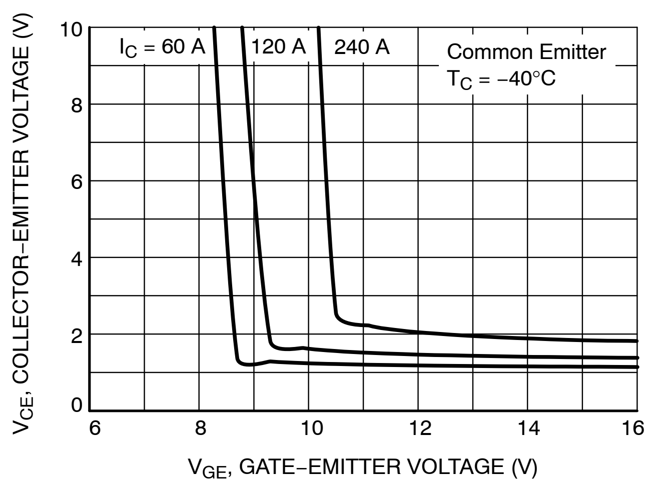


Figure 6. Saturation Voltage vs. V_{GE}

TYPICAL CHARACTERISTICS

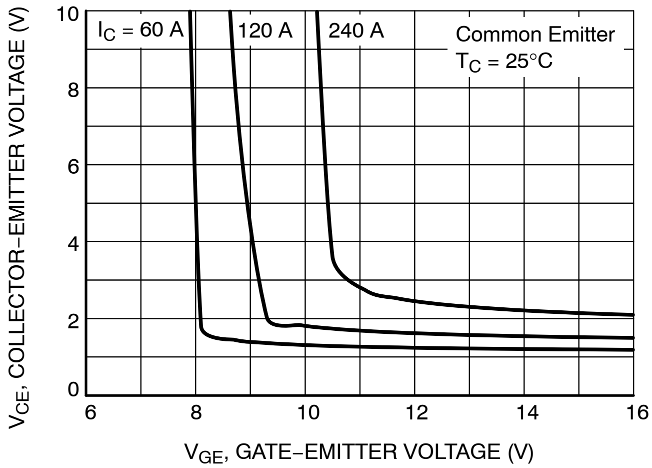


Figure 7. Saturation Voltage vs. V_{CE}

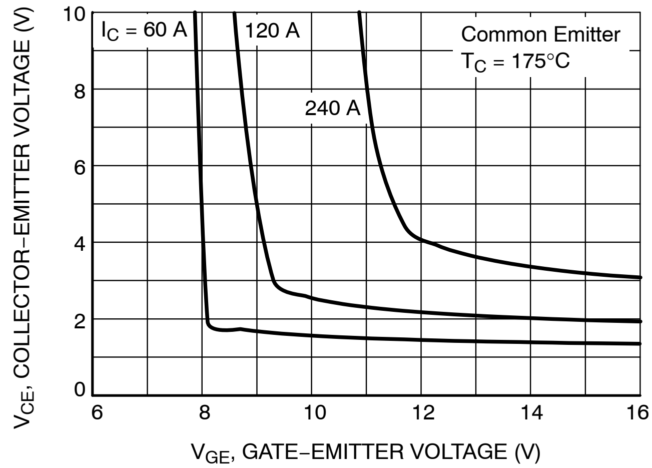


Figure 8. Saturation Voltage vs. V_{CE}

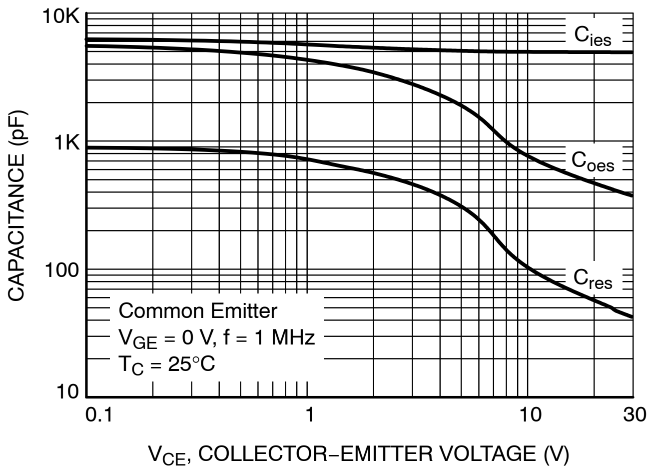


Figure 9. Capacitance Characteristics

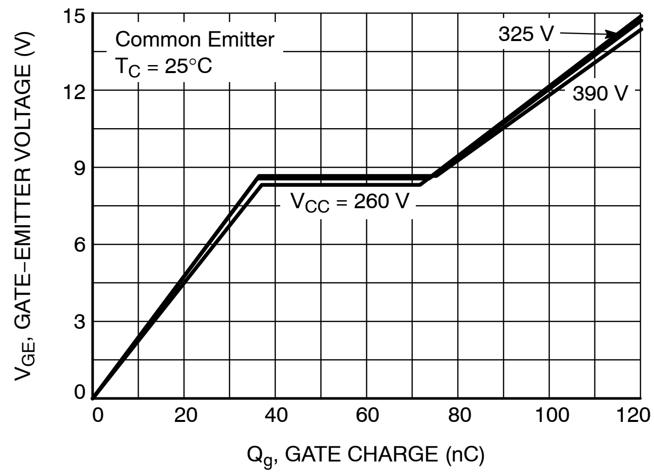


Figure 10. Gate Charge Characteristics

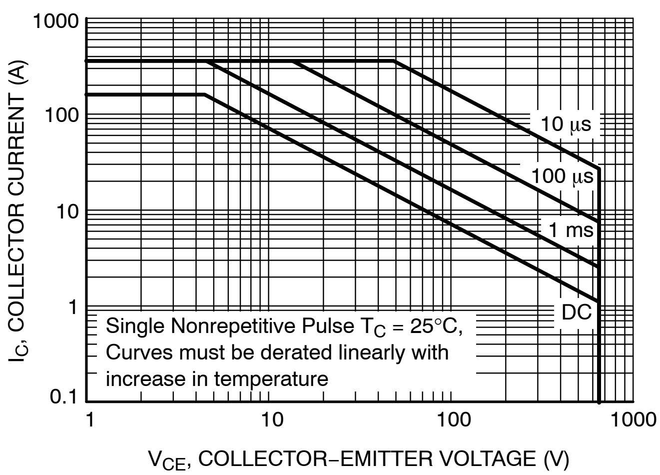


Figure 11. SOA Characteristics

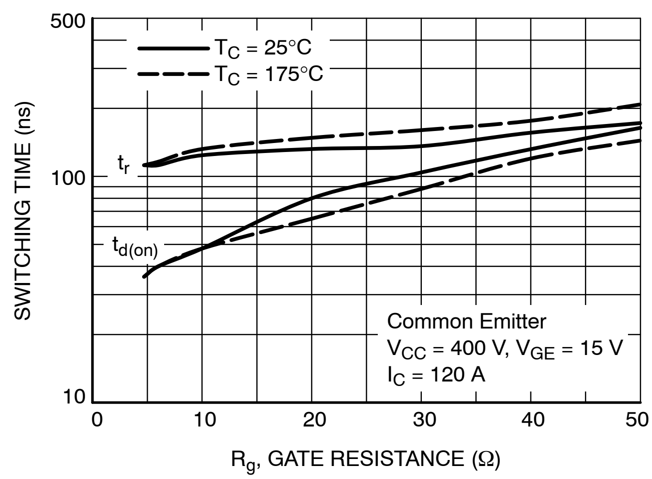


Figure 12. Turn−On Characteristics vs. Gate Resistance

TYPICAL CHARACTERISTICS

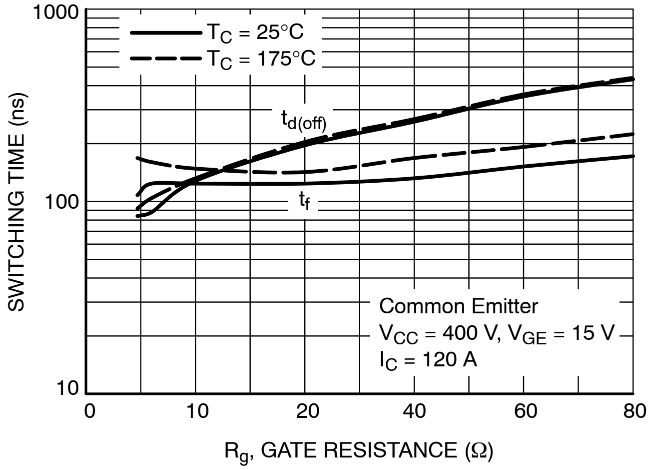


Figure 13. Turn−Off Characteristics vs. Gate Resistance

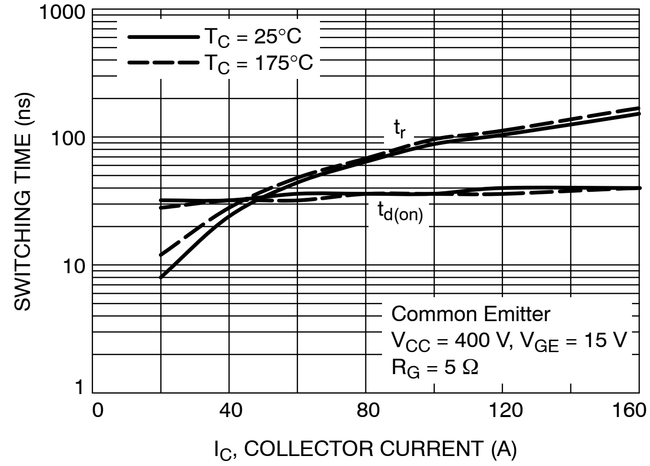


Figure 14. Turn−On Characteristics vs. Collector Current

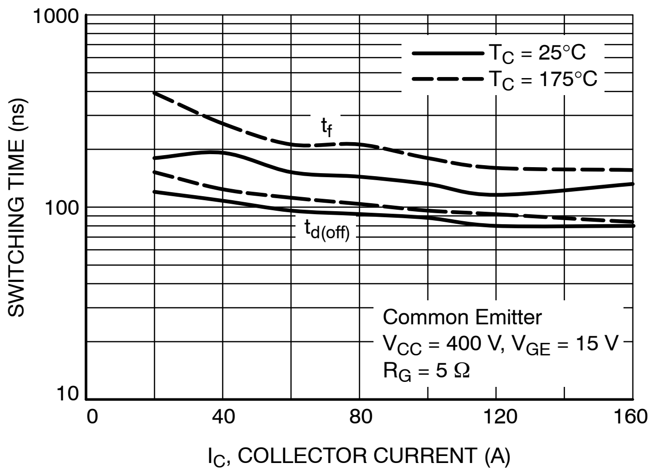


Figure 15. Turn−Off Characteristics vs. Collector Current

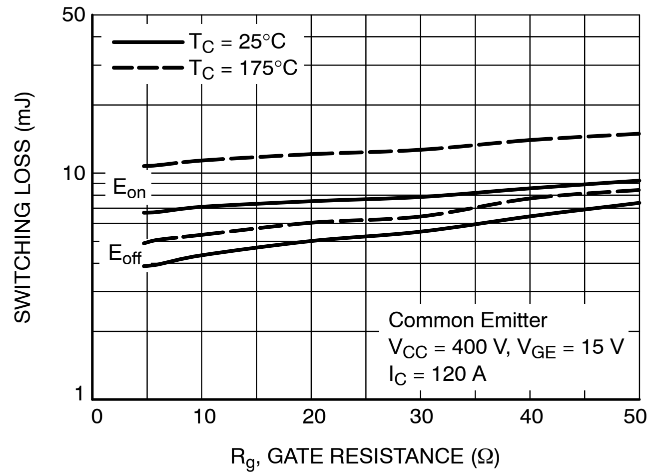


Figure 16. Switching Loss vs. Gate Resistance

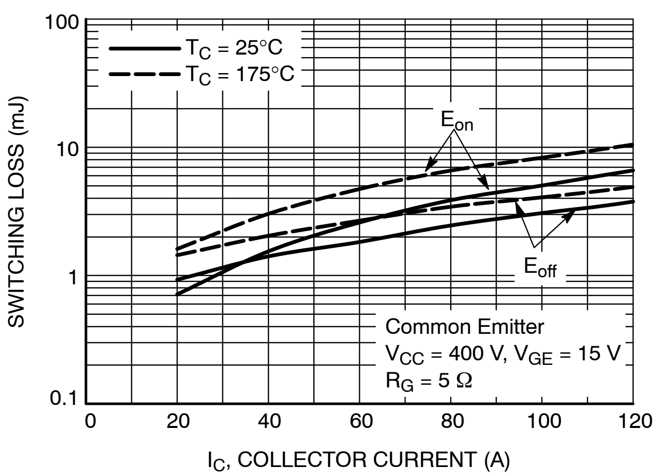


Figure 17. Switching Loss vs. Collector Current

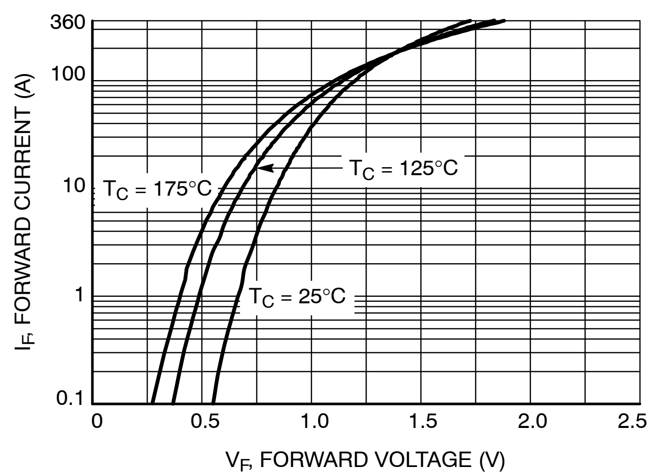


Figure 18. Forward Characteristics

TYPICAL CHARACTERISTICS

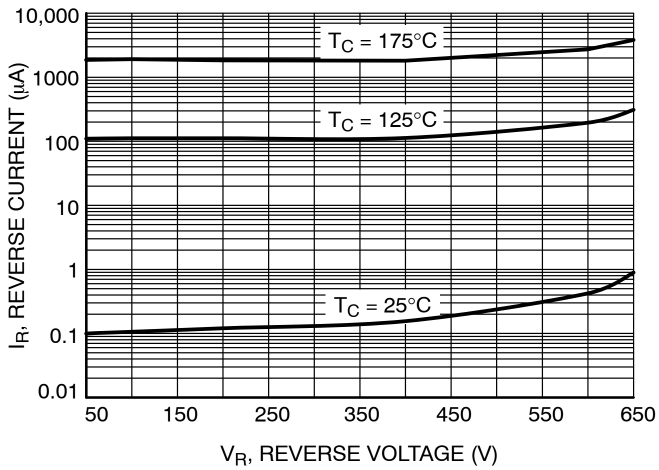


Figure 19. Reverse Current

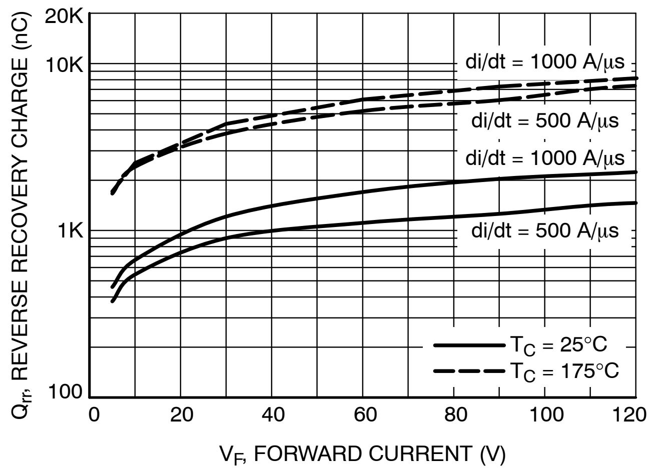


Figure 20. Stored Charge

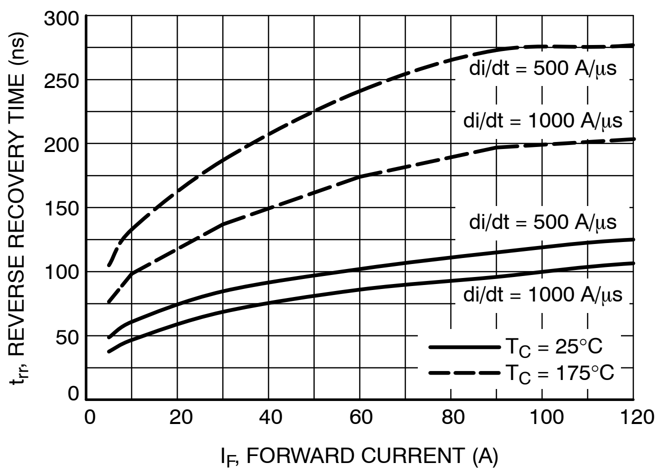


Figure 21. Reverse Recovery Time

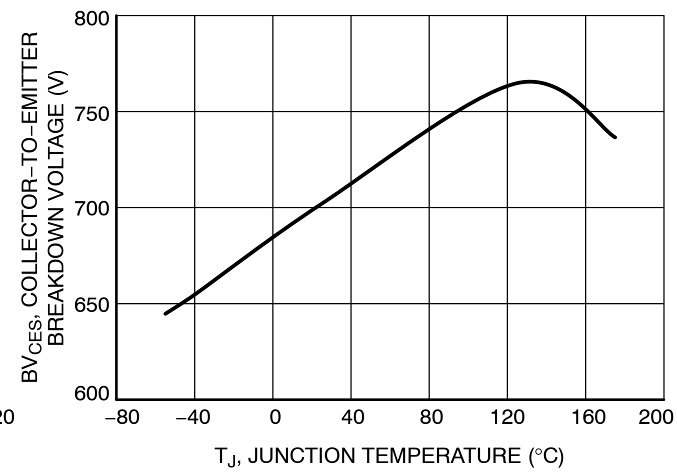


Figure 22. Collector−to−Emitter Breakdown Voltage vs. Junction Temperature

TYPICAL CHARACTERISTICS

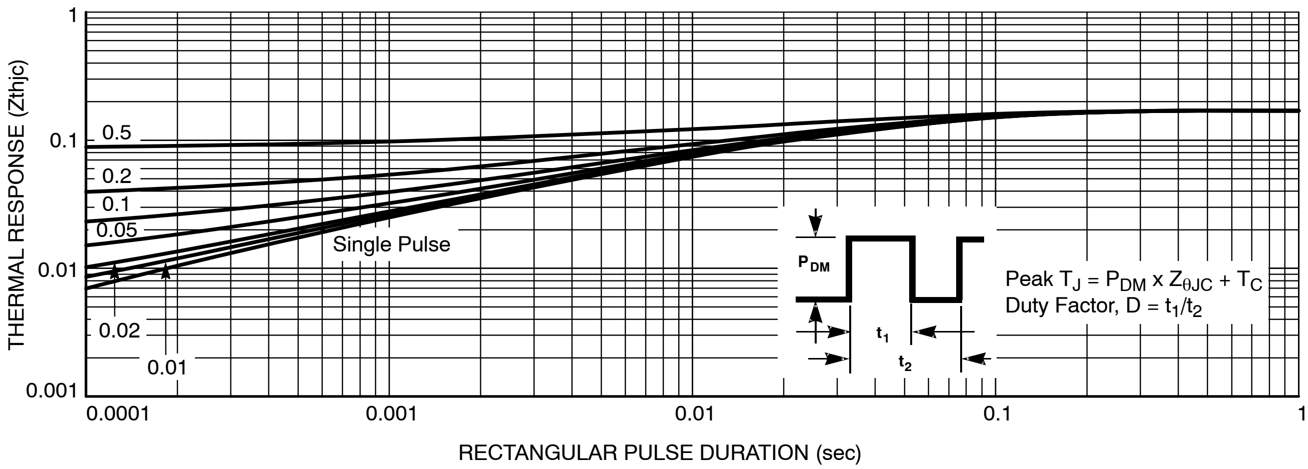


Figure 23. Transient Thermal Impedance of IGBT

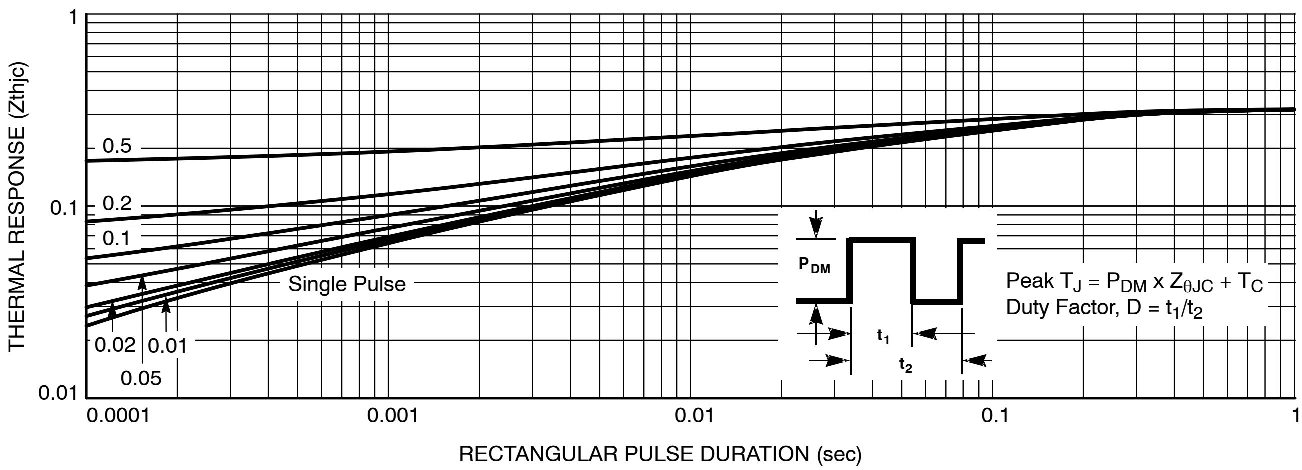


Figure 24. Transient Thermal Impedance of Diode

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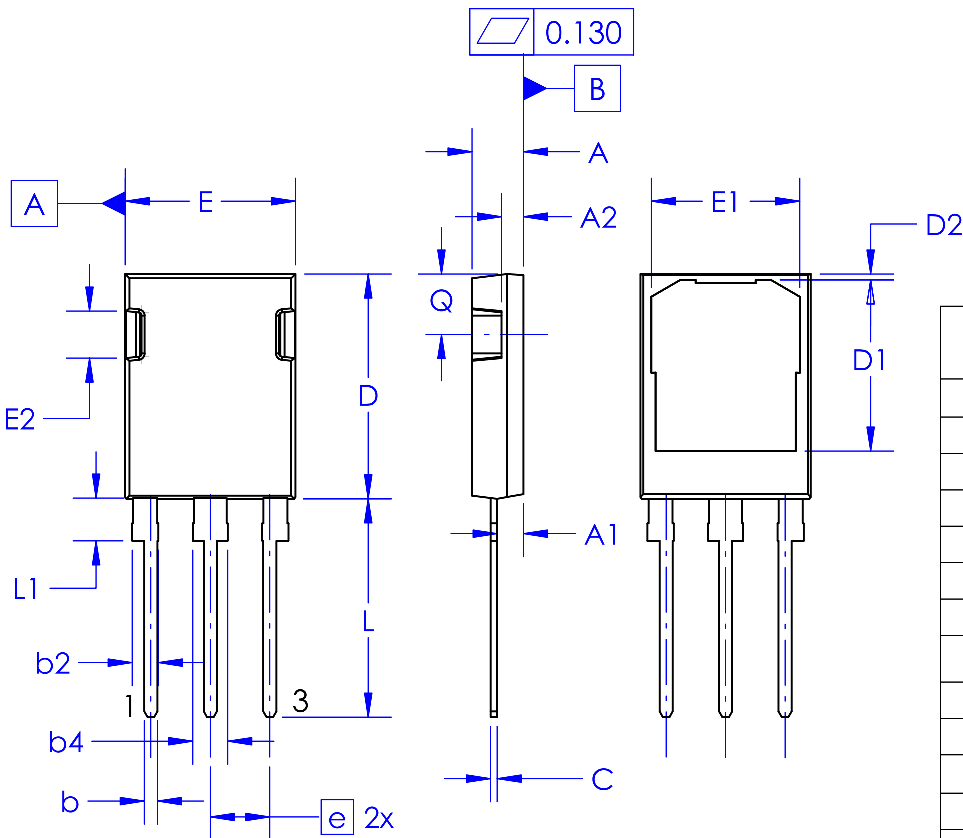

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	4.50	4.70	4.90
A1	2.10	2.40	2.70
A2	1.70	2.00	2.30
b	1.00	1.20	1.400
b2	2.20	2.40	2.60
b4	3.00	3.20	3.40
c	0.40	0.60	0.80
D	20.40	20.60	20.80
D1	15.47	15.67	15.87
D2	0.25	0.55	0.85
e	5.45 BSC		
E	15.40	15.60	15.80
E1	13.40	13.60	13.80
E2	4.12	4.30	4.52
L	19.70	20.00	20.30
L1	3.65	3.85	4.05
Q	5.35	5.55	5.75

NOTES:

A. NO INDUSTRY STANDARDS APPLIES TO THIS PACKAGE.
B. ALL DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH AND TIE BAR PROTRUSIONS.
D. DRAWING CONFORMS TO ASME Y14.5-2009.

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