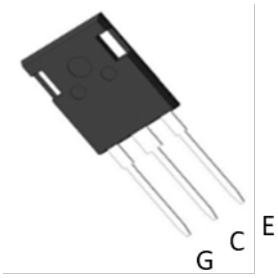
650V 60A Advanced Technology IGBT

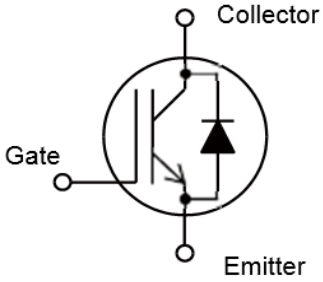
Features:

- Low switching power loss
- Low switching surge and noise
- Advanced Fieldstop technology
- Low EMI
- Maximum junction temperature 175°C
- Qualified according to JEDEC for target applications
- Pb-free lead plating, halogen-free mold compound, RoHS compliant



Applications:

- Industrial UPS
- Welding machine
- Solar converters
- Energy Storage
- Mid to high range switching frequency converters



Key Performance and Package Parameters

Type	V_{CE}	I_C	V_{CEsat}, T_{vj}=25°C	T_{vjmax}	Marking	Package
EX60N65HMF	650V	60A	1.6V	175°C	60N65HMF	TO247

Maximum Ratings and Characteristics

Absolute Maximum Ratings at T_{vj}= 25°C (unless otherwise specified)

Items	Symbols	Value	Units
Collector-Emitter voltage	V_{CES}	650	V
Gate-Emitter voltage	V_{GES}	±20	V
DC Collector Current, limited by Tvjmax Tc= 25°C Tc= 100°C	I_C	 85 60	A
Pulsed Collector Current, tp limited by Tvjmax	I_{CP}	240	A
Turn-Off Safe Operating Area Vce≤ 1200V, Tj≤ 175°C, tp=1μs	-		A
Diode Forward Current, limited by Tvjmax Tc= 25°C Tc= 100°C	I_F	 85 60	A
Turn-Off Safe Operating Area Vce≤ 1200V, Tj≤ 175°C, tp=1μs	-		A
IGBT Max. Power Dissipation	P_{D_IGBT}	375	W
FWD Max. Power Dissipation	P_{D_FWD}		W
Operating Junction Temperature	T_{vj}	-55 ~ +175	°C
Storage Temperature	T_{stg}	-55 ~ +175	°C

Electrical characteristics at T_{vj}= 25°C (unless otherwise specified)

Description	Symbols	Conditions	Characteristics			Unit
			Min	Typ	Max	
Collector-emitter breakdown voltage	$V_{(BR)CES}$	V_{GE}= 0V, I_C= 0.50mA	650	-	-	V
Zero Gate Voltage Collector Current	I_{CES}	V_{CE}= 650V, V_{GE}= 0V	-	-	10	μA
Gate-Emitter Leakage Current	I_{GES}	V_{CE}= 0V, V_{GE}= 20V	-	-	100	nA
Gate-Emitter Threshold Voltage	$V_{GE(th)}$	V_{CE}= V_{GE}, I_C= 0.5mA	3.5	4.5	5.5	V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	V_{GE}= 15V, I_C= 60A,Tvj= 25°C V_{GE}= 15V, I_C= 60A,Tvj= 125°C V_{GE}= 15V, I_C= 60A,Tvj= 175°C	 - -	1.6 1.8 1.9	2.0	V
Input Capacitance	C_{ies}	V_{CE}= 25V, V_{GE}= 0V f= 100kHz	-	5782	-	pF
Output Capacitance	C_{oes}		-	185	-	pF
Reverse Transfer Capacitance	C_{res}		-	4.9	-	pF
Gate Charge	Q_G	V_{CC}= 520V, I_C= 60A, V_{GE}= 15V	-	104	-	nC
Forward Voltage Drop	V_F	V_{GE}=0 V, I_F=60 A ,Tvj= 25°C V_{GE}=0 V, I_F=60 A ,Tvj= 125°C V_{GE}=0 V, I_F=60 A ,Tvj= 175°C	 - -	1.5 1.4 1.3	1.8	V

Switching Characteristics at Tvj=25°C

Description	Symbols	Conditions	Characteristics			Unit
			Min	Typ	Max	
IGBT Characteristics						
Turn-On Delay Time	$t_{d(on)}$	V_{CC}= 400V I_C= 60A V_{GE}= 15V R_G= 10Ω	-	51	-	ns
Rise Time	t_r		-	74	-	ns
Turn-Off Delay Time	$t_{d(off)}$		-	137	-	ns
Fall Time	t_f		-	62	-	ns
Turn-On Energy	E_{on}		-	1.87	-	mJ
Turn-Off Energy	E_{off}		-	0.68	-	mJ
Turn-On Delay Time	$t_{d(on)}$	V_{CC}= 400V I_C= 30A V_{GE}= 15V R_G= 10Ω	-	50	-	ns
Rise Time	t_r		-	41	-	ns
Turn-Off Delay Time	$t_{d(off)}$		-	160	-	ns
Fall Time	t_f		-	47	-	ns
Turn-On Energy	E_{on}		-	0.76	-	mJ
Turn-Off Energy	E_{off}		-	0.32	-	mJ
Diode Characteristics						
Diode Reverse Recovery Time	t_{rr}	V_R= 400V I_F= 60A di_F/dt= 500A/μs	-	109	-	ns
Diode Reverse Recovery Charge	Q_{rr}		-	1.21	-	μC
Diode peak reverse recovery current	Irrm		-	19.8	-	A

Thermal resistance

Items	Symbols	Characteristics			Unit
		Min	Typ	Max	
Thermal Resistance, Junction-Ambient	$R_{th(j-a)}$	-	-	40	°C /W
Thermal Resistance, IGBT Junction to Case	$R_{th(j-c)}$	-	-	0.4	
Thermal Resistance, Diodes Junction to Case	$R_{th(j-c)}$	-	-	0.38	

Electrical Characteristics Diagrams

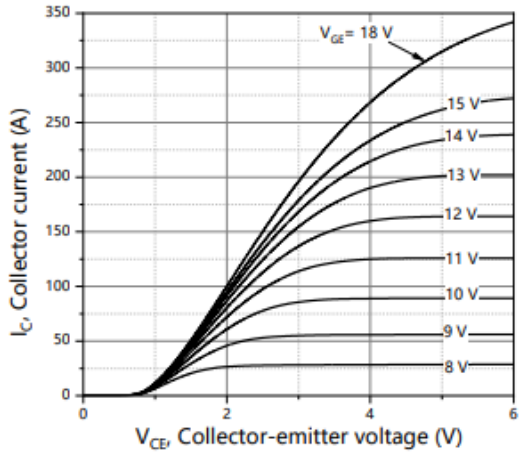


Figure 1. Typical output characteristics
(T_{vj}=25 ℃)

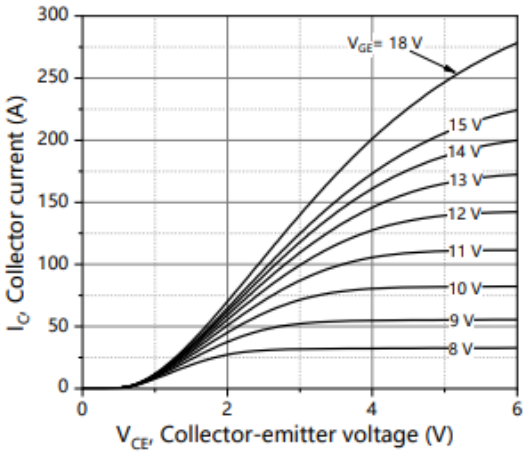


Figure 2. Typical output characteristics
(T_{vj}=150 ℃)

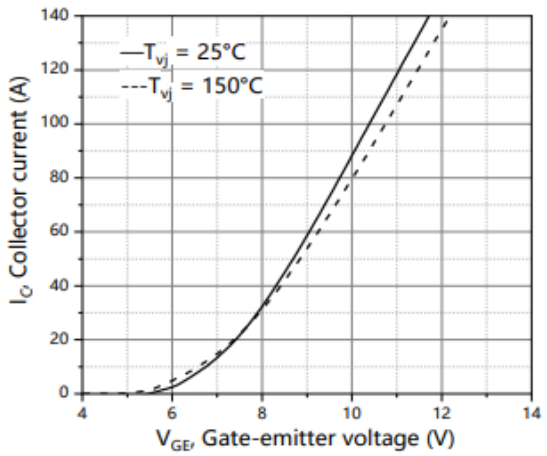


Figure 3. Typical transfer characteristics
(V_{CE}=20 V)

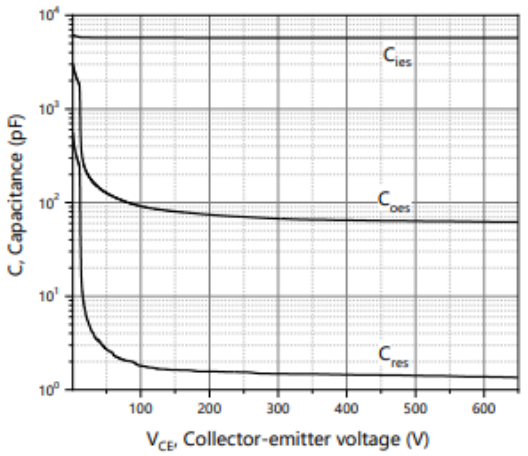


Figure 4. Typical capacitance
(V_{GE}=0V, f=100 kHz)

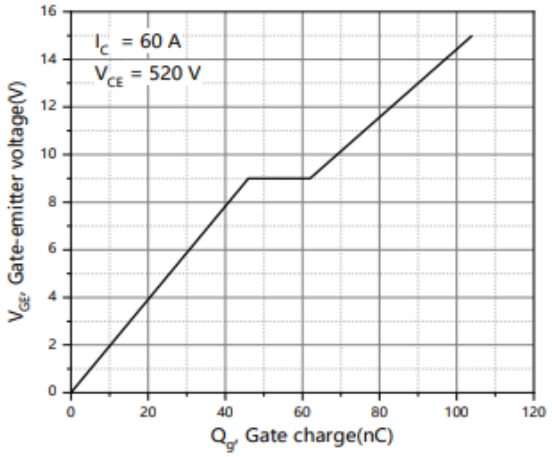


Figure 5. Typical gate charge

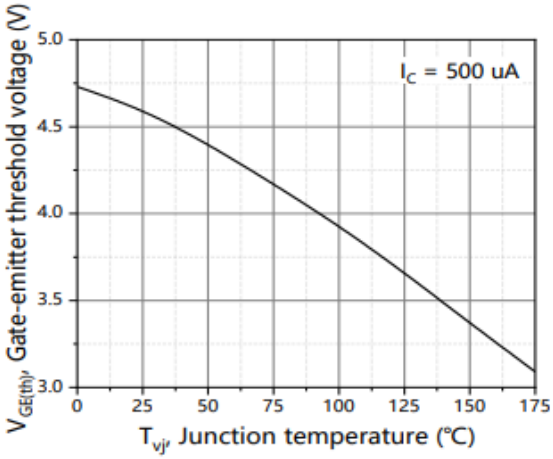


Figure 6. Gate-emitter threshold voltage

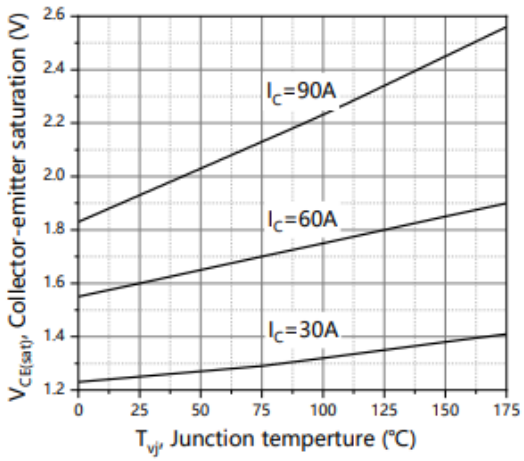


Figure 7. Typical collector-emitter voltage

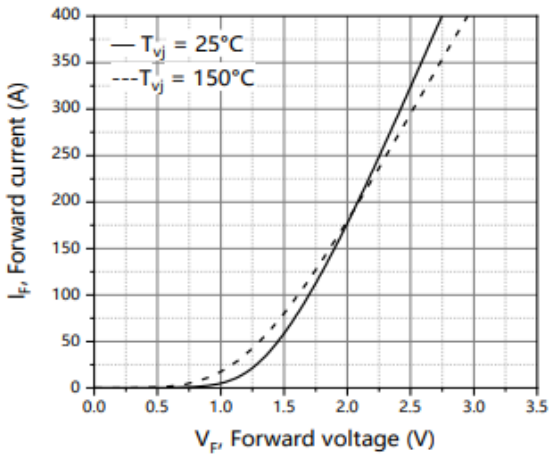


Figure 8. Forward characteristic of diode

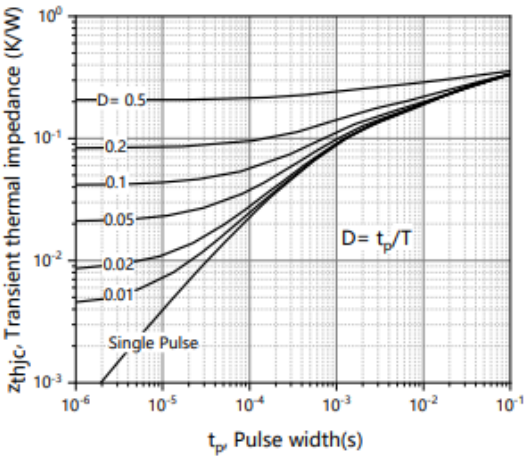


Figure 9. IGBT transient thermal impedance

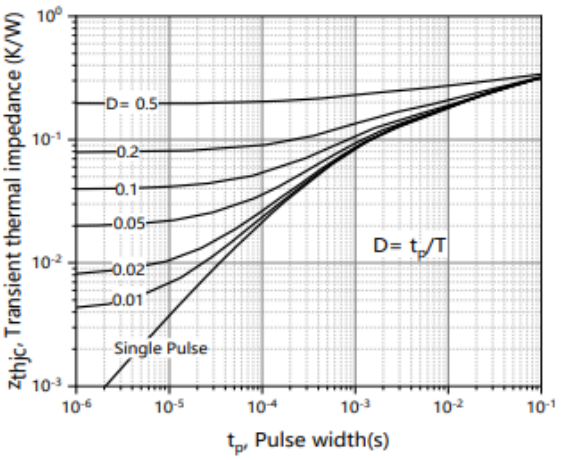
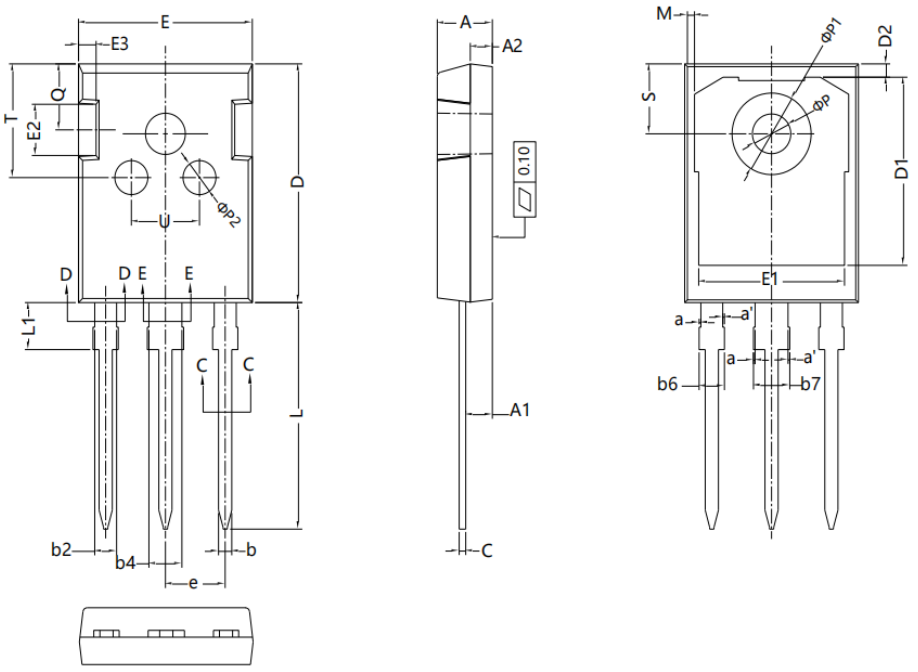


Figure 10. Diode transient thermal impedance

TO247 Package Outline



Symbol	mm		
	Min	Nom	Max
A	4.90	5.00	5.10
A1	2.31	2.41	2.51
A2	1.90	2.00	2.10
a	0.00	-	0.15
a'	0.00	-	0.15
b	1.16	-	1.26
b2	1.96	-	2.06
b4	2.96	-	3.06
b6	-	-	2.25
b7	-	-	3.25
c	0.59	-	0.66
c1	0.58	0.60	0.62
D	20.90	21.00	21.10
D1	16.25	16.55	16.85
D2	1.05	1.17	1.35
E	15.70	15.80	15.90
E1	13.10	13.30	13.50
E2	4.40	4.50	4.60
E3	1.50	1.60	1.70
e	5.436 BSC		
L	19.80	19.92	20.10
L1	-	-	4.30
M	0.35	-	0.95
P	3.40	3.50	3.60
P1	7.00	-	7.40
P2	2.40	2.5	2.6
Q	5.60	-	6.0
S	6.05	6.15	6.25
T	9.8	-	10.20
U	6.00	-	6.40

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