

### General Description

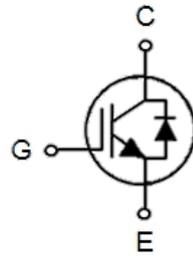
This IGBT is produced using advanced Magnachip's Field Stop Trench IGBT Technology, which provides low  $V_{CE(sat)}$ , high speed switching and high ruggedness performance and excellent quality.

### Applications

- PV inverter
- Motor driver
- UPS, ESS

### Features

- High Speed Switching & Low Power Loss
- $V_{CE(sat)} = 1.60V @ I_C = 40A$
- High Input Impedance
- $t_{sc} = 10\mu s$
- Ultra-soft, fast recovery anti-parallel diode
- Ultra-narrowed  $V_F$  distribution control
- Positive Temperature Coefficient for easy paralleling



Package outline and symbol

- G : Gate
- C : Collector
- E : Emitter

### Absolute Maximum Ratings

Characteristics		Symbol	Rating	Unit
Collector-emitter voltage		$V_{CES}$	1200	V
Gate-emitter voltage		$V_{GE}$	±25	V
DC collector current, limited by $T_{vjmax}$	$T_C=25^\circ C$	$I_C$	80	A
	$T_C=100^\circ C$		40	A
Pulsed collector current, $t_p$ limited by $T_{vjmax}$		$I_{Cpuls}$	160	A
Diode forward current, limited by $T_{vjmax}$	$T_C=25^\circ C$	$I_F$	80	A
	$T_C=100^\circ C$		40	A
Diode pulsed current, Pulse time limited by $T_{vjmax}$		$I_{Fpuls}$	160	A
Power dissipation	$T_C=25^\circ C$	$P_D$	484	W
	$T_C=100^\circ C$		242	W
Short circuit withstand time $V_{CE} = 600V, V_{GE} = 15V, T_C = 150^\circ C$		$t_{sc}$	10	$\mu s$
Operating Junction temperature range		$T_{vj}$	-40~175	$^\circ C$
Storage temperature range		$T_{stg}$	-55~150	$^\circ C$

### Thermal Characteristics

Characteristics	Symbol	Rating	Unit
Thermal resistance junction-to-ambient	$R_{th(j-a)}$	40	$^\circ C/W$
Thermal resistance junction-to-case for IGBT	$R_{th(j-c)}$	0.31	
Thermal resistance junction-to-case for Diode	$R_{th(j-c)}$	0.60	

**Ordering Information**

Part Number	Marking	Temp. Range	Package	Packing	RoHS Status
MBQ40T120RFRA	40T120RFRA	-55~150°C	TO-247	Tube	Compliant

**Electrical Characteristics ( $T_{vj} = 25^{\circ}\text{C}$  unless otherwise specified)**

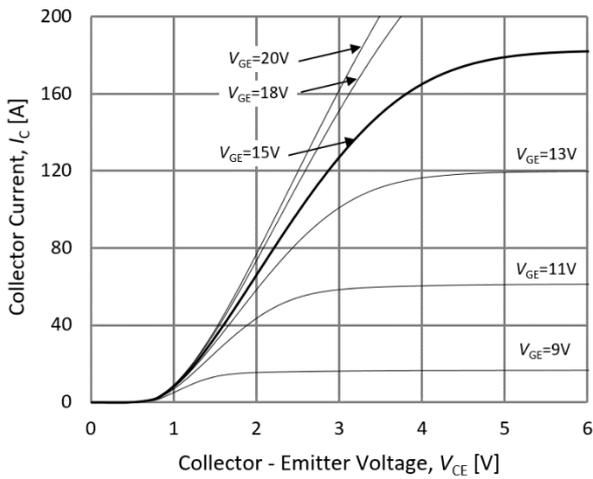
Characteristics	Symbol	Conditions	Min	Typ	Max	Unit	
<b>Static Characteristics</b>							
Collector-emitter breakdown voltage	$BV_{CES}$	$I_C = 1\text{mA}, V_{GE} = 0\text{V}$	1200	-	-	V	
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C = 40\text{A}, V_{GE} = 15\text{V}$	$T_{vj} = 25^{\circ}\text{C}$	-	1.60	2.1	V
			$T_{vj} = 175^{\circ}\text{C}$	-	2.10	-	
Diode forward voltage	$V_F$	$V_{GE} = 0\text{V}, I_F = 40\text{A}$	$T_{vj} = 25^{\circ}\text{C}$	-	2.00	2.5	V
			$T_{vj} = 175^{\circ}\text{C}$	-	2.10	-	
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 1\text{mA}$	5.0	6.0	7.0	V	
Zero gate voltage collector current	$I_{CES}$	$V_{CE} = 1200\text{V}, V_{GE} = 0\text{V}$	-	-	1	mA	
Gate-emitter leakage current	$I_{GES}$	$V_{GE} = 25\text{V}, V_{CE} = 0\text{V}$	-	-	±250	nA	

**Dynamic Characteristics**

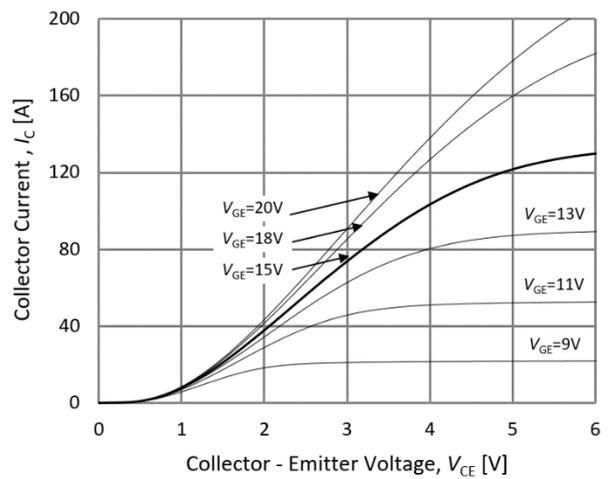
Total gate charge	$Q_G$	$V_{CE} = 960\text{V}, I_C = 40\text{A}, V_{GE} = 15\text{V}$	-	151.8	-	nC
Gate-emitter charge	$Q_{GE}$		-	39.0	-	
Gate-collector charge	$Q_{GC}$		-	70.7	-	
Input capacitance	$C_{ies}$	$V_{CE} = 30\text{V}, V_{GE} = 0\text{V}, f = 800\text{kHz}$	-	4110	-	pF
Output capacitance	$C_{oes}$		-	163	-	
Reverse transfer capacitance	$C_{res}$		-	29	-	

**Switching Characteristics**

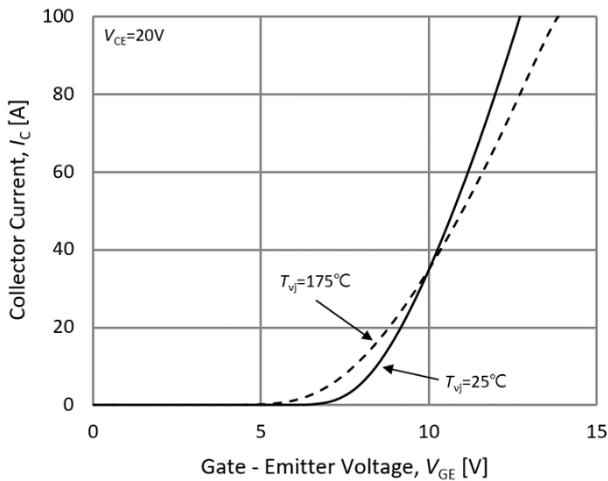
Turn-on delay time	$t_{d(on)}$	$V_{GE} = 0/15\text{V}, V_{CC} = 600\text{V}, I_C = 40\text{A}, R_G = 10\Omega,$ Inductive Load, $T_{vj} = 25^{\circ}\text{C}$	-	63.0	-	ns
Rise time	$t_r$		-	61.7	-	
Turn-off delay time	$t_{d(off)}$		-	169.7	-	
Fall time	$t_f$		-	171.0	-	
Turn-on switching energy	$E_{on}$	$T_{vj} = 25^{\circ}\text{C}$	-	3.2	-	mJ
Turn-off switching energy	$E_{off}$		-	1.9	-	
Total switching energy	$E_{ts}$		-	5.1	-	
Turn-on delay time	$t_{d(on)}$	$V_{GE} = 0/15\text{V}, V_{CC} = 600\text{V}, I_C = 40\text{A}, R_G = 10\Omega,$ Inductive Load, $T_{vj} = 175^{\circ}\text{C}$	-	57.0	-	ns
Rise time	$t_r$		-	74.3	-	
Turn-off delay time	$t_{d(off)}$		-	184.7	-	
Fall time	$t_f$		-	211.3	-	
Turn-on switching energy	$E_{on}$	$T_{vj} = 175^{\circ}\text{C}$	-	5.1	-	mJ
Turn-off switching energy	$E_{off}$		-	2.3	-	
Total switching energy	$E_{ts}$		-	7.4	-	
Reverse recovery time	$t_{rr}$	$I_F = 40\text{A}, di_F/dt = 400\text{A}/\mu\text{s}, T_{vj} = 25^{\circ}\text{C}$	-	174.0	-	ns
Reverse recovery current	$I_{rr}$		-	13.0	-	A
Reverse recovery charge	$Q_{rr}$		-	1.2	-	$\mu\text{C}$
Reverse recovery time	$t_{rr}$	$I_F = 40\text{A}, di_F/dt = 400\text{A}/\mu\text{s}, T_{vj} = 175^{\circ}\text{C}$	-	341.0	-	ns
Reverse recovery current	$I_{rr}$		-	19.0	-	A
Reverse recovery charge	$Q_{rr}$		-	3.8	-	$\mu\text{C}$



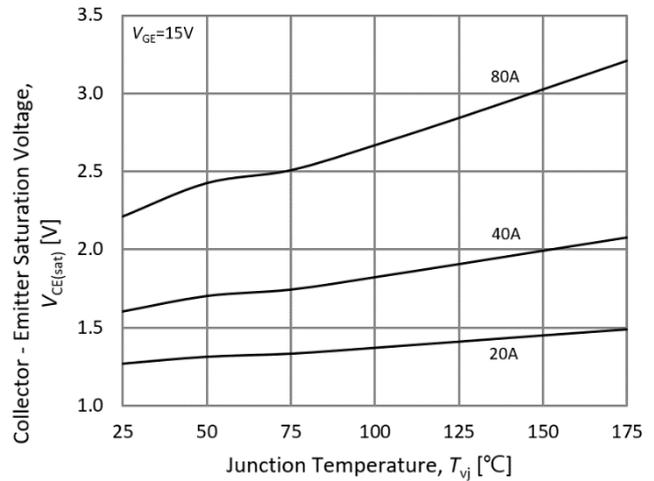
**Fig.1. Typical output characteristics ( $T_{vj}=25^{\circ}\text{C}$ )**



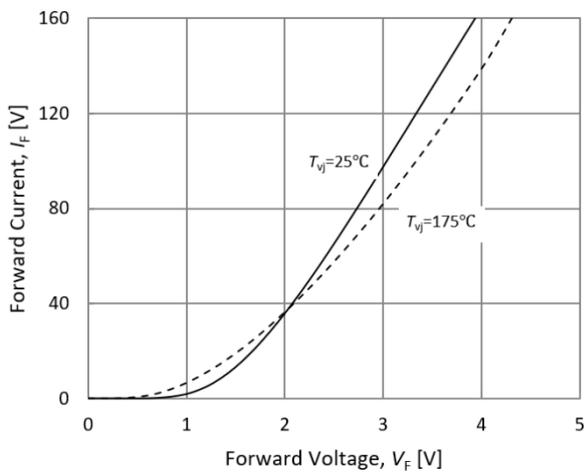
**Fig.2. Typical output characteristics ( $T_{vj}=175^{\circ}\text{C}$ )**



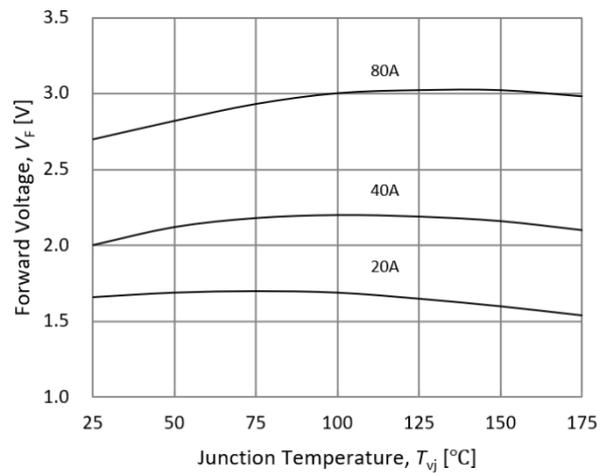
**Fig.3. Typical transfer characteristics**



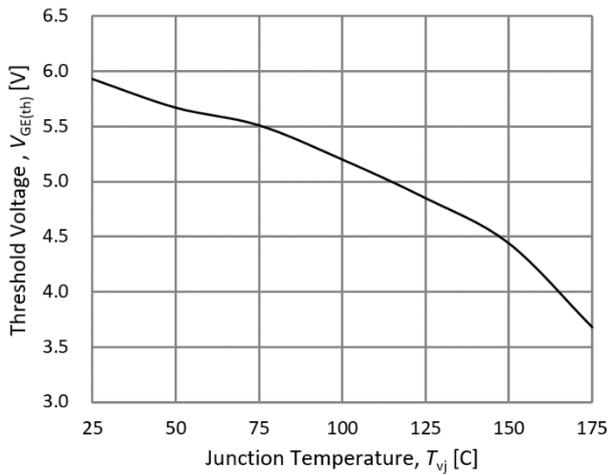
**Fig.4. Typical collector emitter saturation voltage-junction temperature**



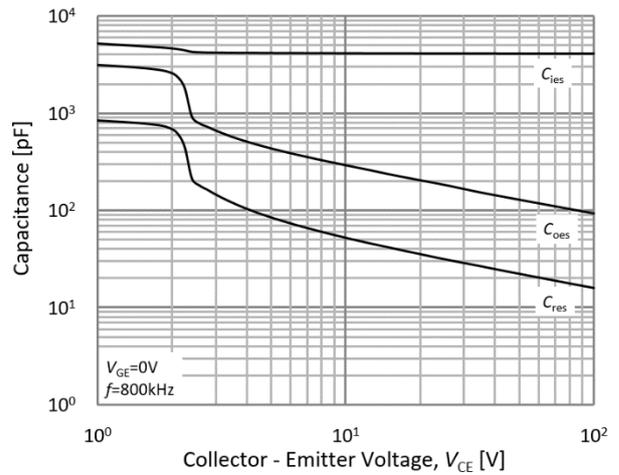
**Fig.5. Diode Forward Characteristics**



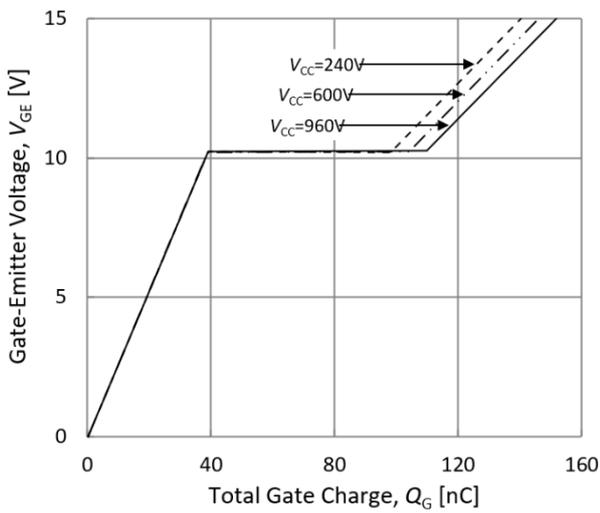
**Fig.6. Diode Forward-Junction Temperature**



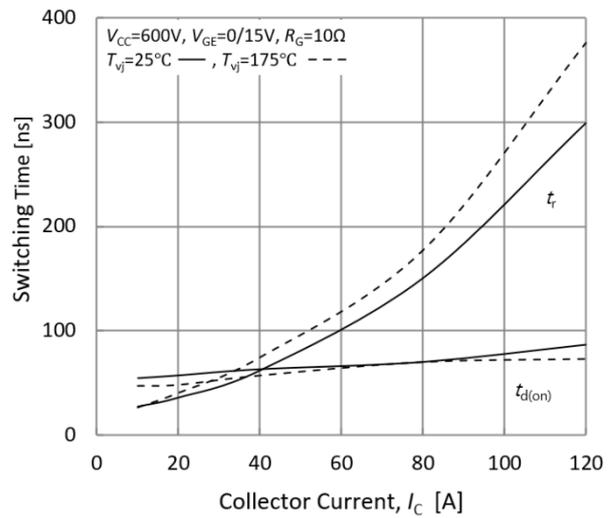
**Fig.7. Threshold voltage-junction temperature**



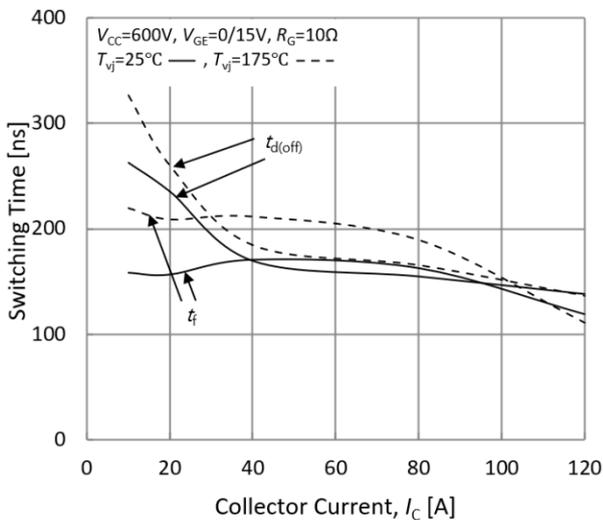
**Fig.8. Typical capacitance**



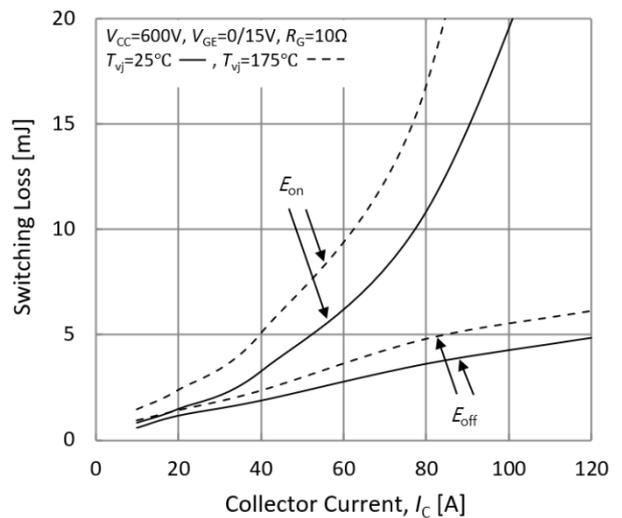
**Fig.9. Typical gate charge**



**Fig.10. Typical turn on times-collector current**



**Fig.11. Typical turn off times-collector current**



**Fig.12. Switching losses-collector current**

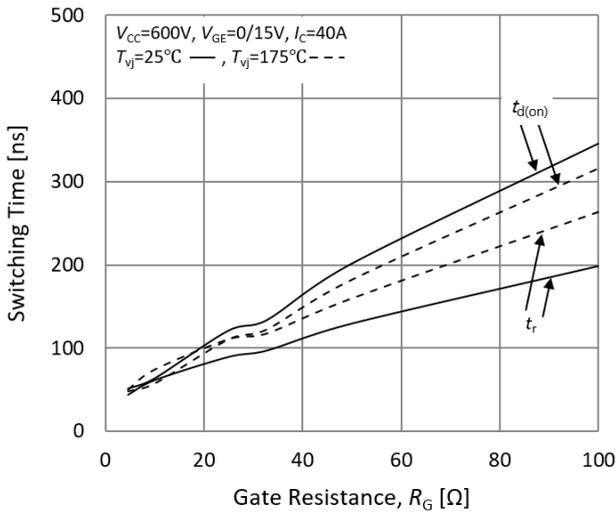


Fig.13. Typical turn on times-gate resistance

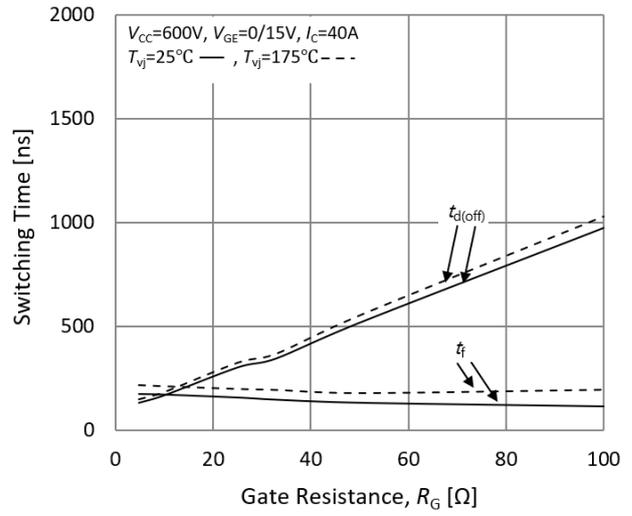


Fig.14. Typical turn off times-gate resistance

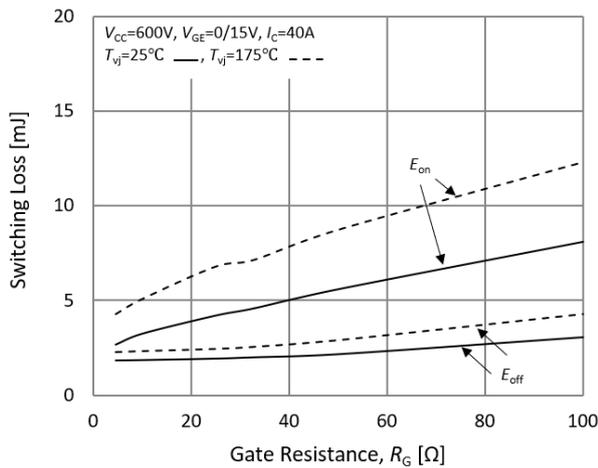


Fig.15. Switching losses-gate resistance

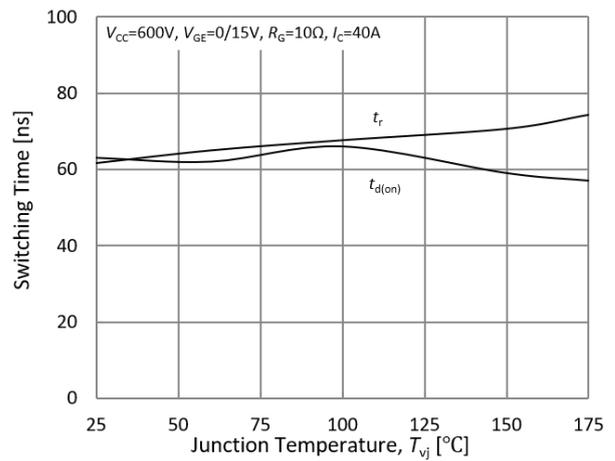


Fig.16. Typical turn on times-junction temperature

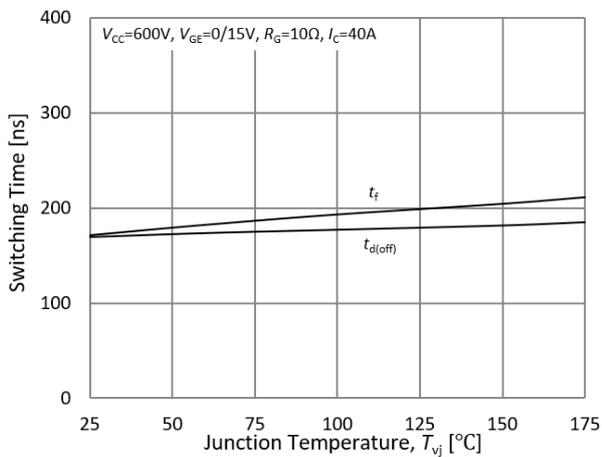


Fig.17. Typical turn off times-junction temperature

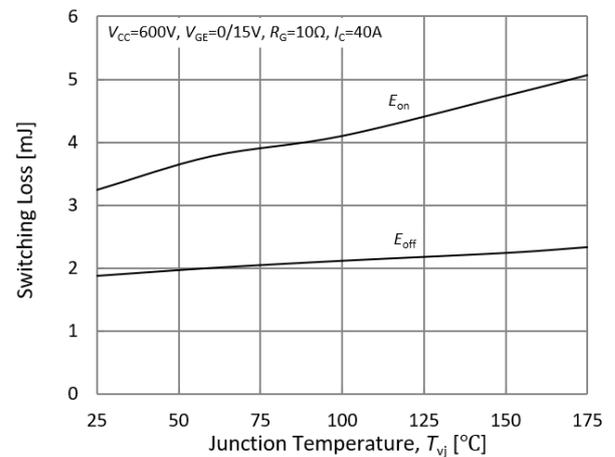


Fig.18. Switching losses-junction temperature

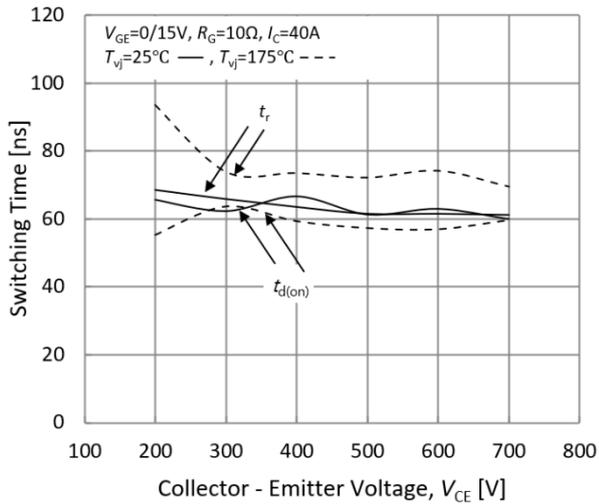


Fig.19. Typical turn on times-collector emitter voltage

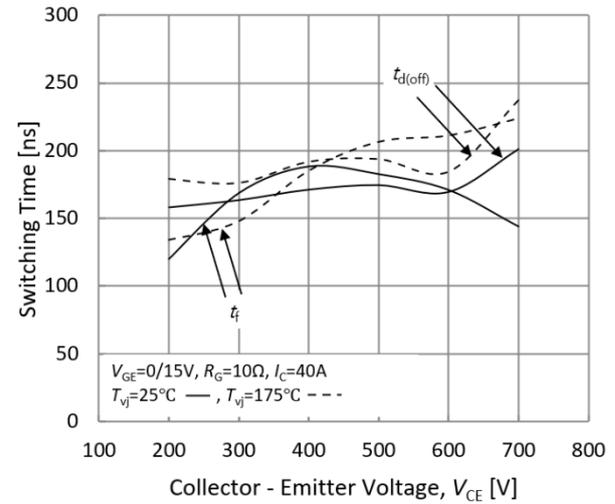


Fig.20. Typical turn off times-collector emitter voltage

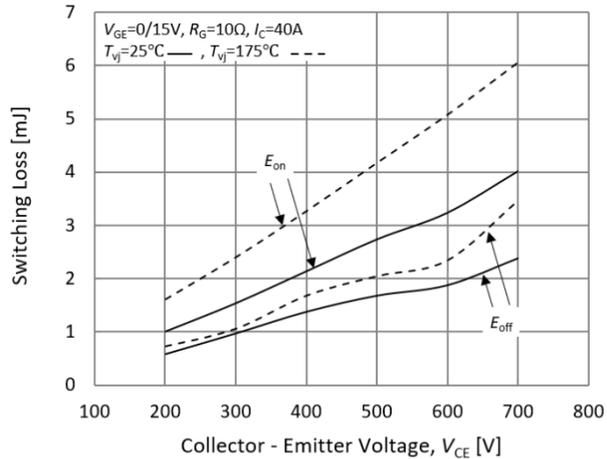


Fig.21. Switching losses-collector emitter voltage

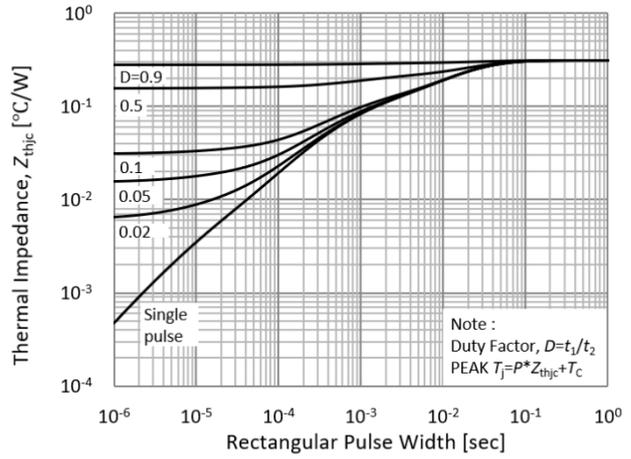


Fig.22. IGBT transient thermal impedance

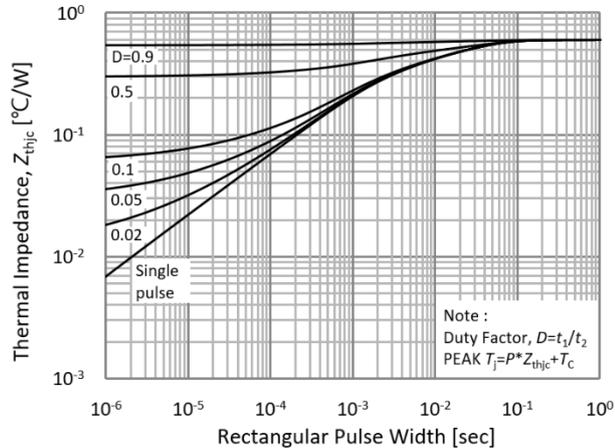


Fig.23. FRD transient thermal impedance

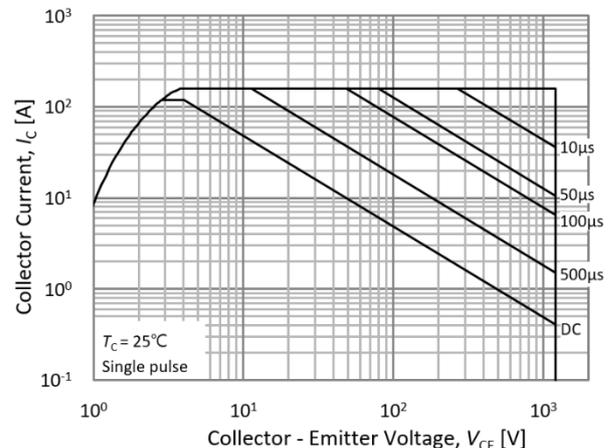


Fig.24. FBSOA

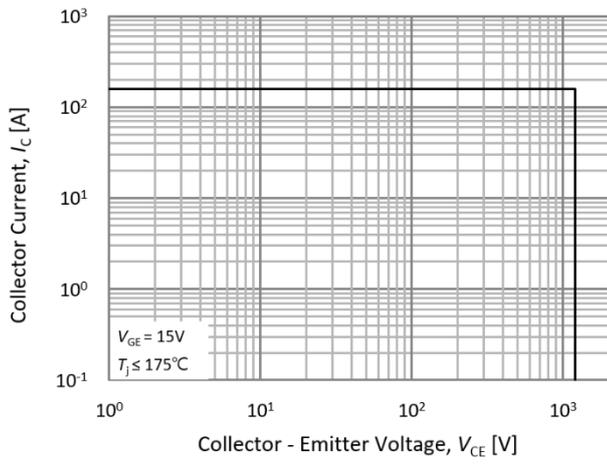
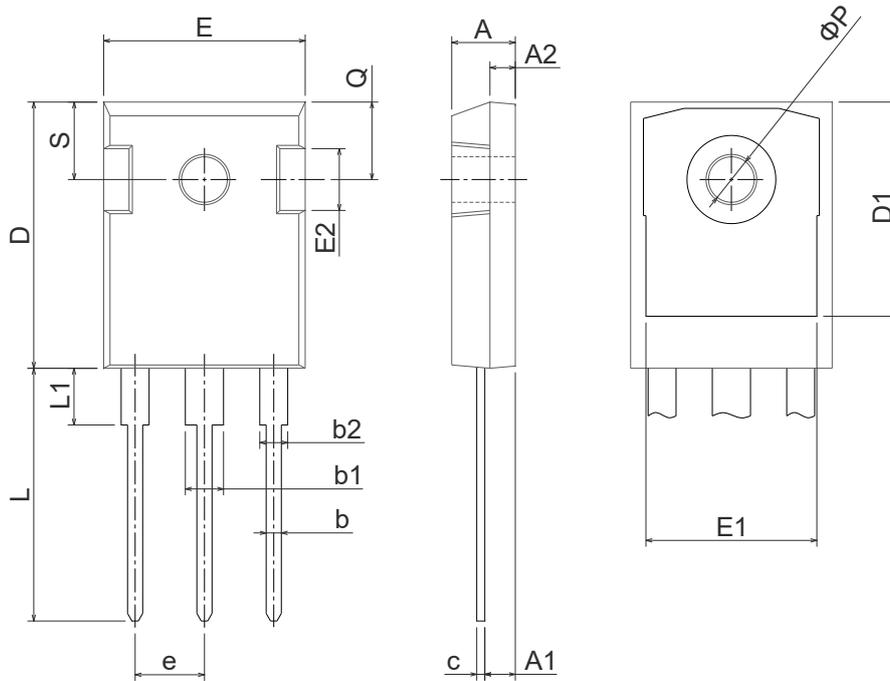


Fig.25. RBSOA

## Physical Dimension

### TO-247

Dimensions are in millimeters, unless otherwise specified



Dimension	Min(mm)	Max(mm)
A	4.70	5.31
A1	2.20	2.60
A2	1.50	2.49
b	0.99	1.40
b1	2.59	3.43
b2	1.65	2.39
c	0.38	0.89
D	20.30	21.46
D1	13.08	-
E	15.45	16.26
E1	13.06	14.02
E2	4.32	5.49
e	5.45BSC	
L	19.81	20.57
L1	-	4.50
ΦP	3.50	3.70
Q	5.38	6.20
S	6.15BSC	

Note: Package body size, length and width do not include mold flash, protrusions and gate burrs.



**DISCLAIMER:**

The Products are not designed for use in hostile environments, including, without limitation, aircraft, nuclear power generation, medical appliances, and devices or systems in which malfunction of any Product can reasonably be expected to result in a personal injury. Seller's customers using or selling Seller's products for use in such applications do so at their own risk and agree to fully defend and indemnify Seller.

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