

### General Description

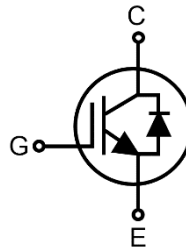
This IGBT is produced using advanced Magnachip's Field Stop Trench IGBT Technology, which provides low  $V_{CE(sat)}$ , high ruggedness performance and excellent quality.

### Applications

- Automotive PTC Heater
- General Inverter

### Features

- High ruggedness
- $V_{CE(sat)} = 1.61V @ I_C = 40A$
- Ultra-Soft, fast recovery anti-parallel diode
- Ultra-narrowed  $V_F$  distribution control
- Positive Temperature coefficient for easy paralleling
- AEC-Q101 qualified



Package outline and symbol

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

### Absolute Maximum Ratings

Characteristics		Symbol	Rating	Unit
Collector-emitter voltage		$V_{CES}$	650	V
Gate-emitter voltage		$V_{GE}$	±25	V
DC collector current <sup>1)</sup>	$T_C=25^\circ C$	$I_C$	80	A
	$T_C=100^\circ C$		40	A
Pulsed collector current, $t_p$ limited by $T_{vjmax}$		$I_{Cpuls}$	120	A
Diode forward current <sup>1)</sup>	$T_C=25^\circ C$	$I_F$	80	A
	$T_C=100^\circ C$		40	A
Diode pulsed current, $t_p$ limited by $T_{vjmax}$		$I_{Fpuls}$	120	A
Total power dissipation	$T_C=25^\circ C$	$P_{total}$	307	W
	$T_C=100^\circ C$		153	W
Short circuit withstand time $V_{CE} = 400V, V_{GE} = 15V, T_{vj} = 175^\circ C$		$t_{SC}$	10	µs
Operating Junction temperature range		$T_{vj}$	-40~175	°C
Storage temperature range		$T_{stg}$	-55~150	°C

Note 1) Current is limited by junction temperature.

### Thermal Characteristics

Characteristics	Symbol	Rating	Unit
Thermal resistance junction-to-ambient	$R_{th(j-a)}$	40	°C/W
Thermal resistance junction-to-case for IGBT	$R_{th(j-c)}$	0.49	
Thermal resistance junction-to-case for Diode	$R_{th(j-c)}$	0.9	

**Ordering Information**

Part Number	Marking	Temp. Range	Package	Packing	RoHS Status
AMBQ40T65PHRTH	40T65PHR	-55~150°C	TO-247	Tube	Compliant

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

Parameter	Symbol	Conditions	Min	Typ	Max	Unit	
<b>Static Characteristics</b>							
Collector-emitter breakdown voltage	$BV_{CES}$	$I_C = 2\text{mA}, V_{GE} = 0\text{V}$	650	-	-	V	
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C = 40\text{A}, V_{GE} = 15\text{V}$	$T_{vj} = 25^\circ\text{C}$	-	1.61	2.1	V
			$T_{vj} = 175^\circ\text{C}$	-	2.06	-	
Diode forward voltage	$V_F$	$V_{GE} = 0\text{V}, I_F = 40\text{A}$	$T_{vj} = 25^\circ\text{C}$	-	1.51	2.1	V
			$T_{vj} = 175^\circ\text{C}$	-	2.05	-	
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 2\text{mA}$	4.3	5.3	6.3	V	
Zero gate voltage collector current	$I_{CES}$	$V_{CE} = 650\text{V}, V_{GE} = 0\text{V}$	-	-	1	mA	
Gate-emitter leakage current	$I_{GES}$	$V_{GE} = 25\text{V}, V_{CE} = 0\text{V}$	-	-	±300	nA	

**Dynamic Characteristics**

Total gate charge	$Q_G$	$V_{CE} = 520\text{V}, I_C = 40\text{A}, V_{GE} = 15\text{V}$	-	167	-	nC
Gate-emitter charge	$Q_{GE}$		-	30	-	
Gate-collector charge	$Q_{GC}$		-	78	-	
Input capacitance	$C_{ies}$	$V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$	-	3897	-	pF
Output capacitance	$C_{oes}$		-	147	-	
Reverse transfer capacitance	$C_{res}$		-	81	-	

**Switching Characteristics**

Turn-on delay time	$t_{d(on)}$	$V_{GE} = 15\text{V}, V_{CC} = 400\text{V}, I_C = 40\text{A}, R_G = 10\Omega,$ Inductive Load, $T_{vj} = 25^\circ\text{C}$	-	27	-	ns	
Rise time	$t_r$		-	156	-		
Turn-off delay time	$t_{d(off)}$		-	102	-		
Fall time	$t_f$		-	115	-		
Turn-on switching energy	$E_{on}$		-	2.56	-		mJ
Turn-off switching energy	$E_{off}$		-	0.83	-		
Total switching energy	$E_{ts}$	-	3.39	-			
Turn-on delay time	$t_{d(on)}$	$V_{GE} = 15\text{V}, V_{CC} = 400\text{V}, I_C = 40\text{A}, R_G = 10\Omega,$ Inductive Load, $T_{vj} = 175^\circ\text{C}$	-	29	-	ns	
Rise time	$t_r$		-	161	-		
Turn-off delay time	$t_{d(off)}$		-	111	-		
Fall time	$t_f$		-	202	-		
Turn-on switching energy	$E_{on}$		-	3.35	-		mJ
Turn-off switching energy	$E_{off}$		-	1.18	-		
Total switching energy	$E_{ts}$	-	4.53	-			
Reverse recovery time	$t_{rr}$	$I_F = 40\text{A}, di_F/dt = 200\text{A}/\mu\text{s}, T_{vj} = 25^\circ\text{C}$	-	304	-	ns	
Reverse recovery current	$I_{rr}$		-	11	-	A	
Reverse recovery charge	$Q_{rr}$		-	1.42	-	$\mu\text{C}$	
Reverse recovery time	$t_{rr}$	$I_F = 40\text{A}, di_F/dt = 200\text{A}/\mu\text{s}, T_{vj} = 175^\circ\text{C}$	-	387	-	ns	
Reverse recovery current	$I_{rr}$		-	15	-	A	
Reverse recovery charge	$Q_{rr}$		-	3.23	-	$\mu\text{C}$	

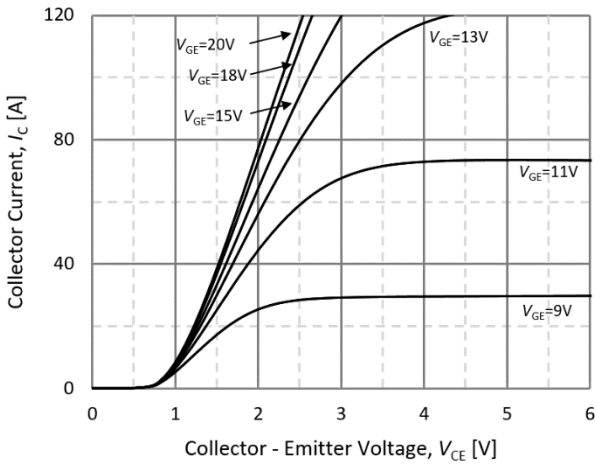


Fig.1. Typical output characteristics ( $T_{vj}=25^{\circ}\text{C}$ )

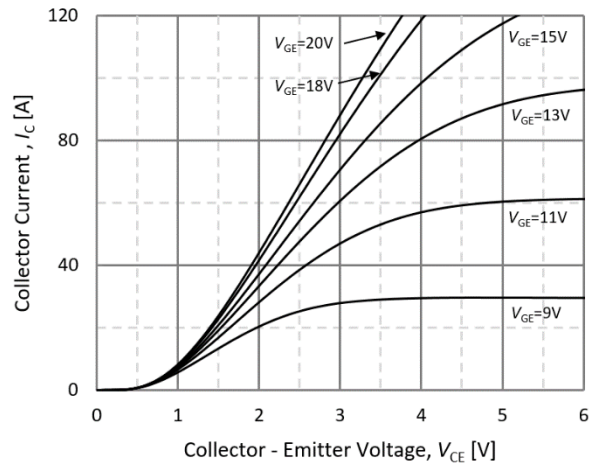


Fig.2. Typical output characteristics ( $T_{vj}=175^{\circ}\text{C}$ )

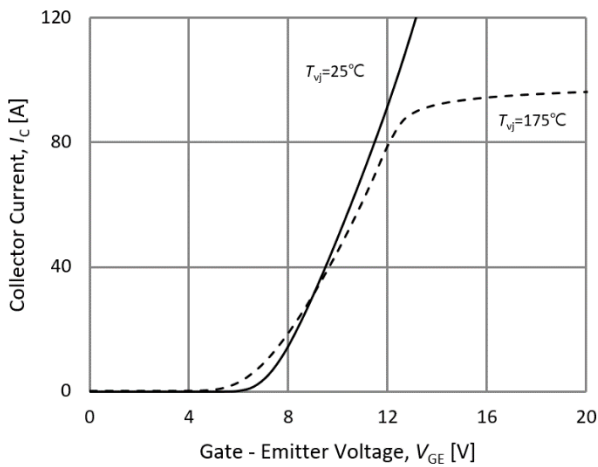


Fig.3. Typical transfer characteristics

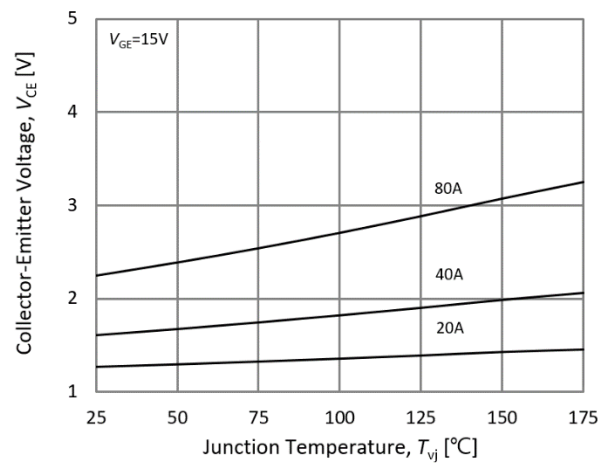


Fig.4. Typical collector-emitter saturation voltage-junction temperature

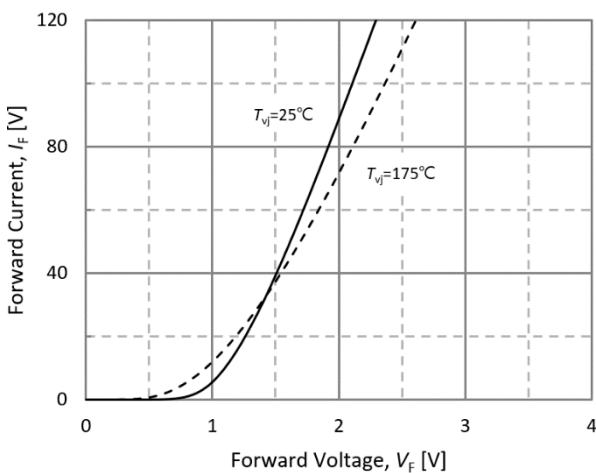


Fig.5. Diode forward characteristics

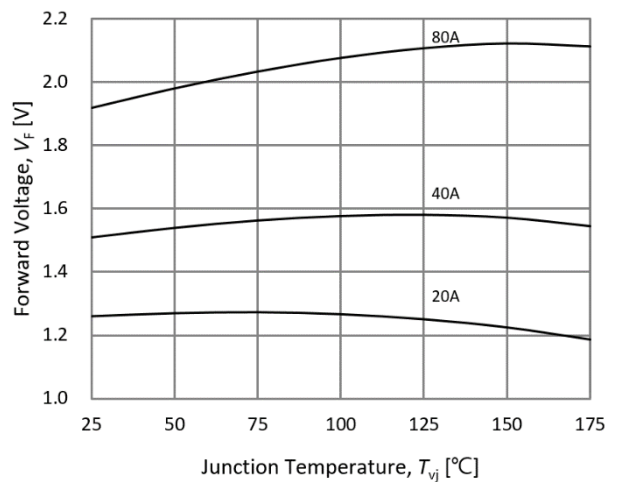


Fig.6. Diode forward-junction temperature

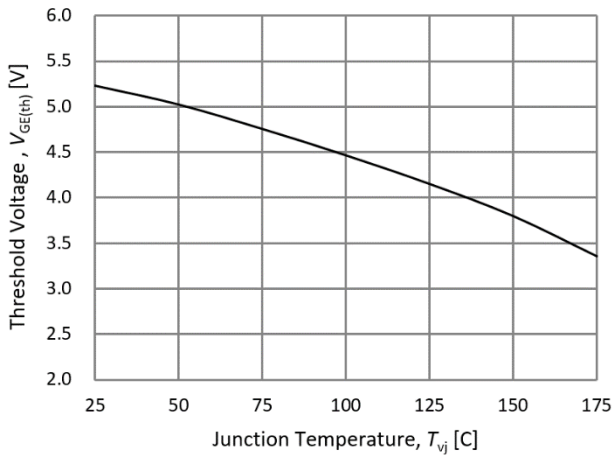


Fig.7. Threshold voltage-junction temperature

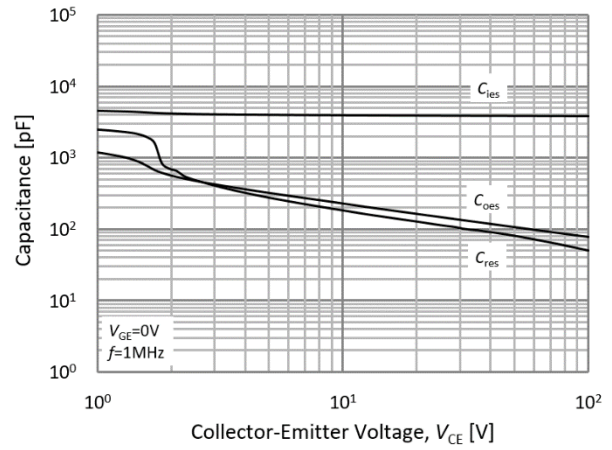


Fig.8. Typical capacitance

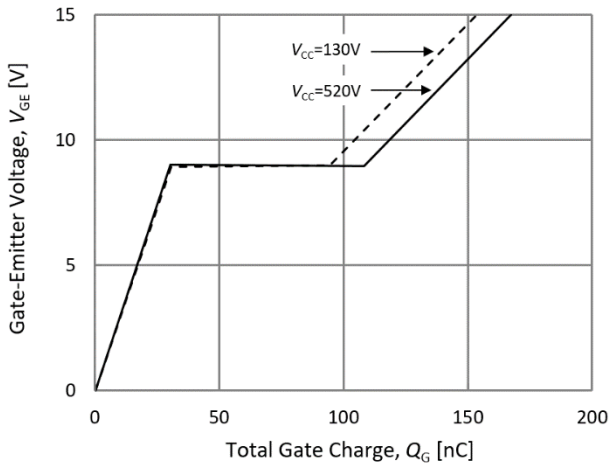


Fig.9. Typical gate charge

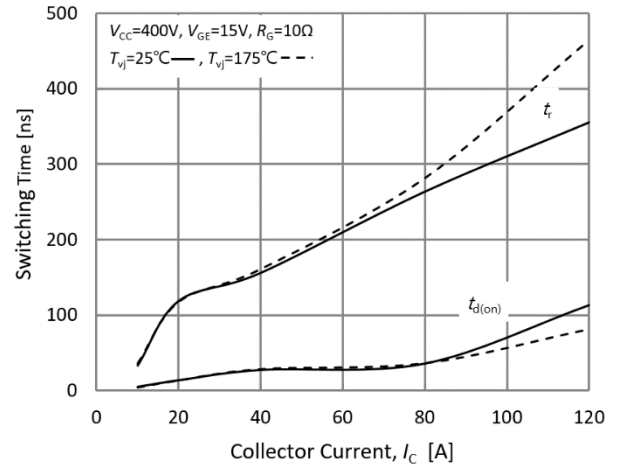


Fig.10. Typical turn on-collector current

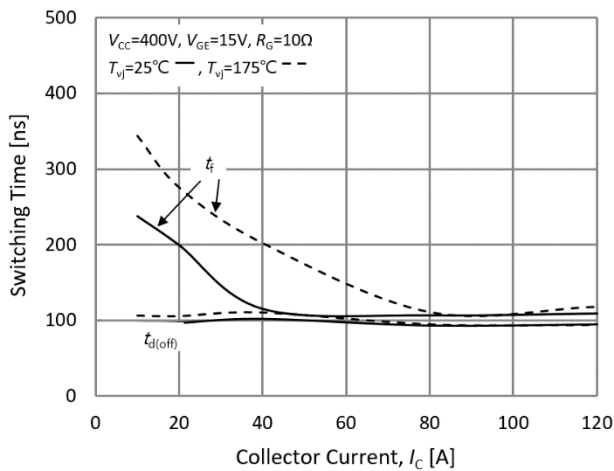


Fig.11. Typical turn off-collector current

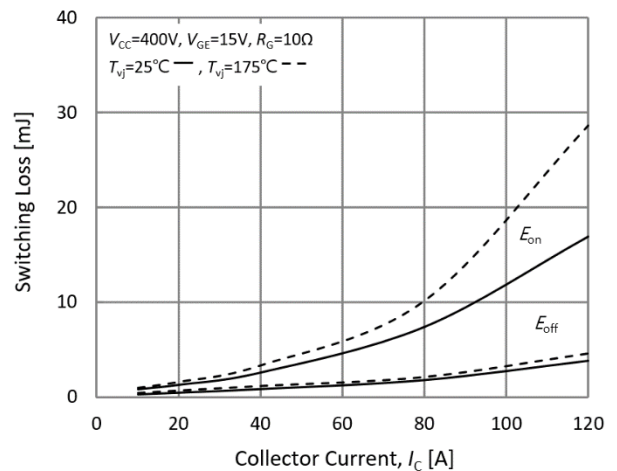


Fig.12. Switching loss-collector current

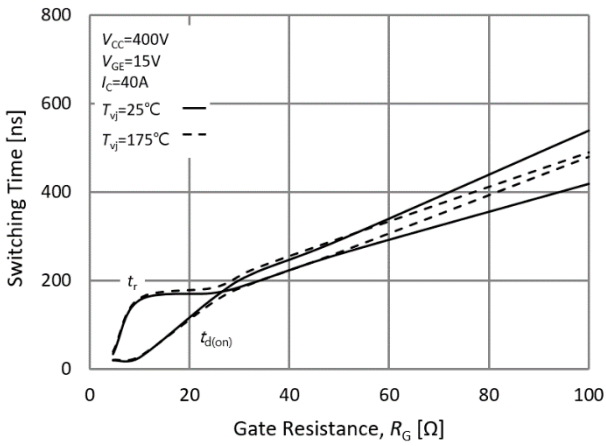


Fig.13. Turn on characteristics-gate resistance

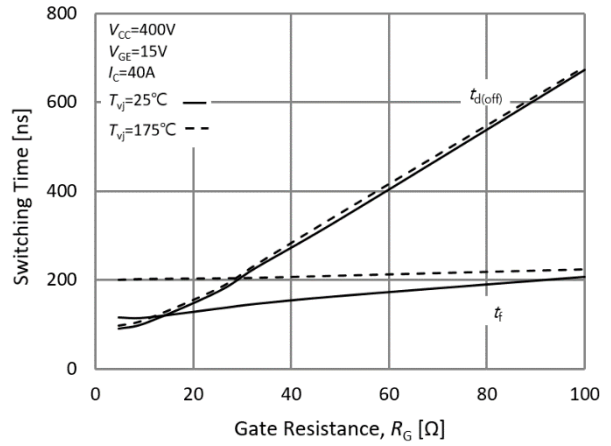


Fig.14. Turn off characteristics-gate resistance

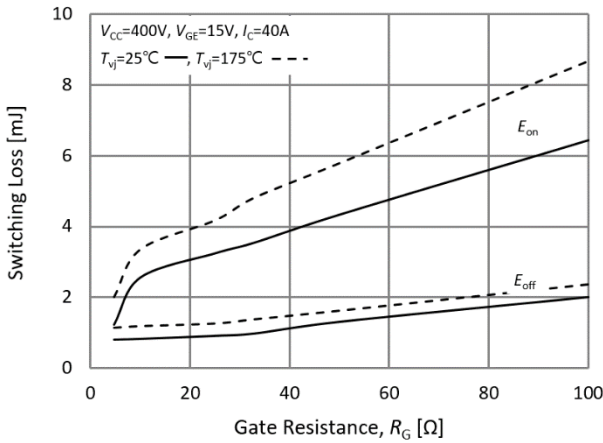


Fig.15. Switching loss-gate resistance

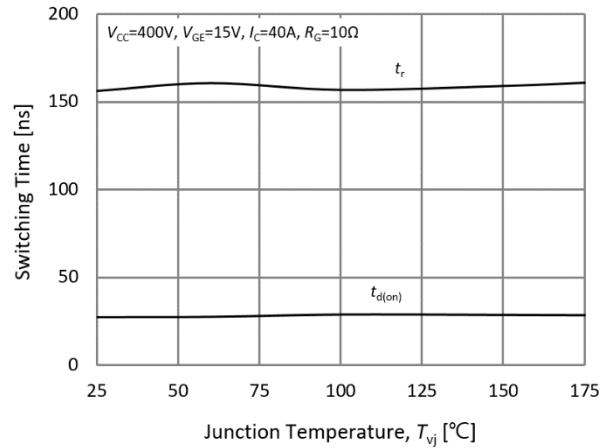


Fig.16. Turn on characteristics-junction temperature

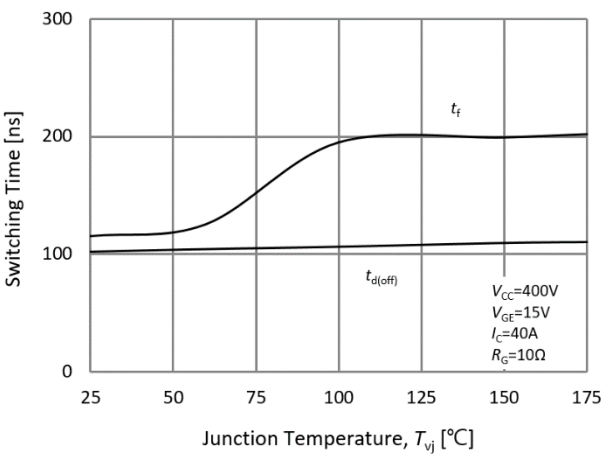


Fig.17. Turn off characteristics-junction temperature

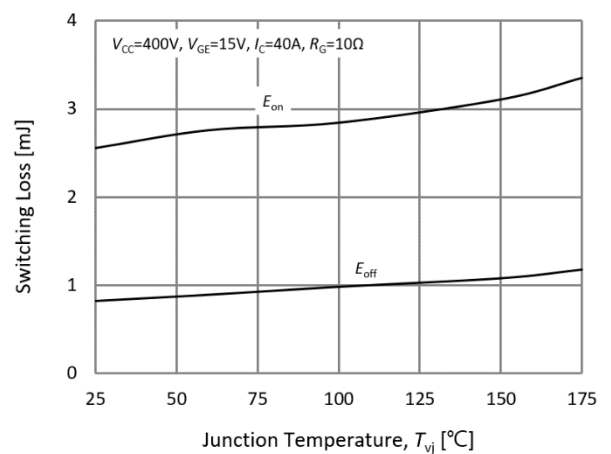


Fig.18. Switching loss-junction temperature

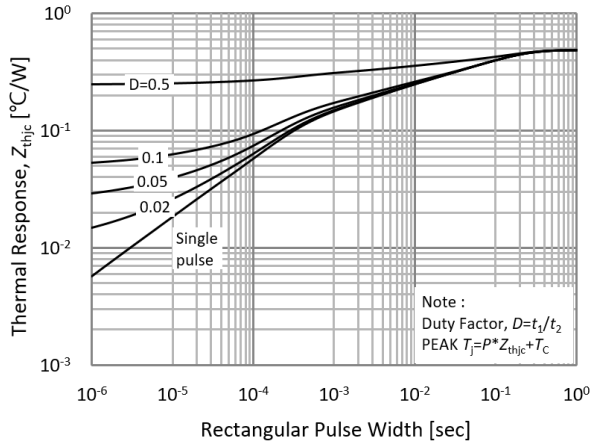


Fig.19 IGBT Transient Thermal Impedance

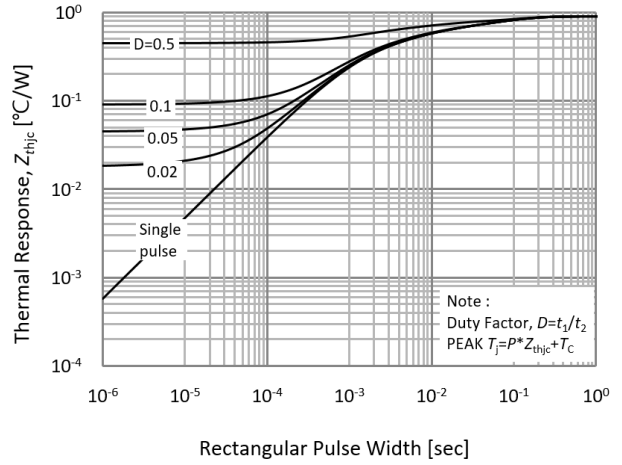


Fig.20 FRD Transient Thermal Impedance

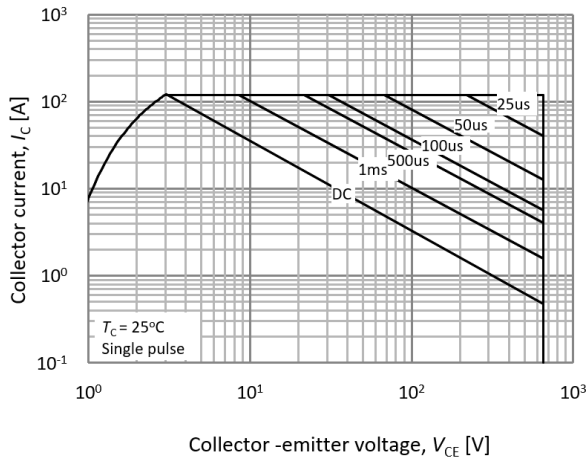


Fig.21 FBSOA

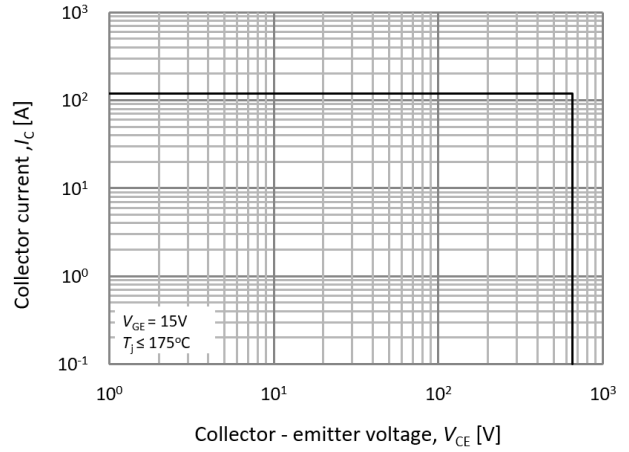
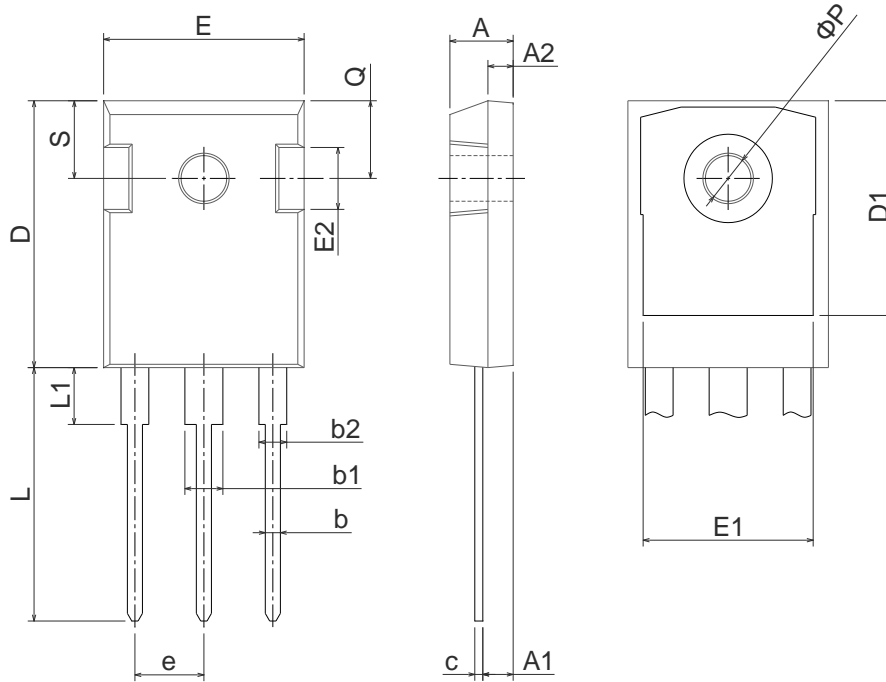


Fig.22 RBSOA

## 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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