

$V_{CE} = 650\text{ V}$, $I_C = 30\text{ A}$
Trench Field Stop IGBTs with Fast Recovery Diode
KGF65A3H, MGF65A3H, FGF65A3H

Description

KGF65A3H, MGF65A3H, and FGF65A3H are 650 V Field Stop IGBTs. Sanken original trench structure decreases gate capacitance, and achieves high speed switching and switching loss reduction. Thus, Field Stop IGBTs can improve the efficiency of your circuit.

Features

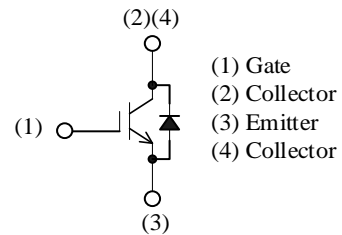
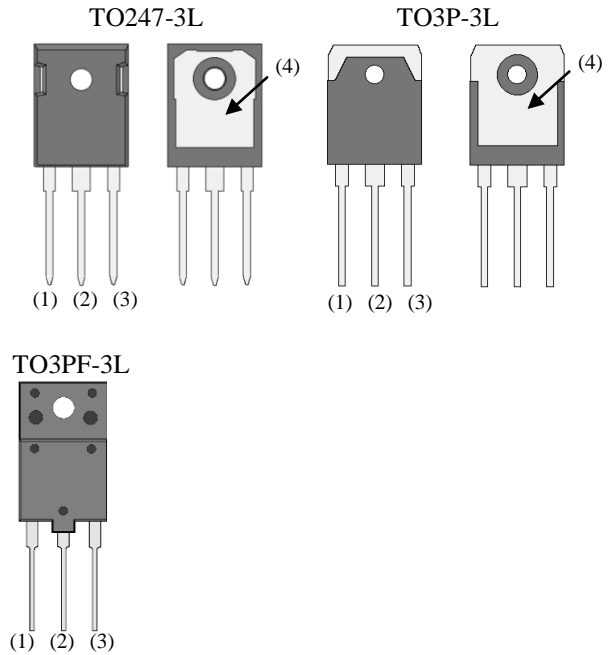
- Low Saturation Voltage
- High Speed Switching
- With Integrated Fast Recovery Diode
- RoHS Compliant

- V_{CE} ----- 650 V
- I_C ($T_C = 100\text{ }^\circ\text{C}$)----- 30 A
- Short Circuit Withstand Time ----- 10 μs
- $V_{CE(sat)}$ ----- 1.9 V typ.
- t_f ($T_J = 175\text{ }^\circ\text{C}$) ----- 60 ns typ.
- V_F ----- 1.8 V typ.

Applications

- Welding Converters
- PFC Circuit

Package



Not to scale

Selection Guide

Part Number	Package
KGF65A3H	TO247-3L
MGF65A3H	TO3P-3L
FGF65A3H	TO3PF-3L

KGF65A3H, MGF65A3H, FGF65A3H

Absolute Maximum Ratings

Unless otherwise specified, $T_A = 25\text{ }^\circ\text{C}$

Parameter	Symbol	Conditions	Rating	Unit	Remarks
Collector to Emitter Voltage	V_{CE}		650	V	
Gate to Emitter Voltage	V_{GE}		± 30	V	
Continuous Collector Current ⁽¹⁾	I_C	$T_C = 25\text{ }^\circ\text{C}$	50	A	
		$T_C = 100\text{ }^\circ\text{C}$	30	A	
Pulsed Collector Current	$I_{C(PULSE)}$	$PW \leq 1\text{ ms}$, duty cycle $\leq 1\%$	90	A	
Diode Continuous Forward Current ⁽¹⁾	I_F	$T_C = 25\text{ }^\circ\text{C}$	40 ⁽²⁾	A	
		$T_C = 100\text{ }^\circ\text{C}$	30	A	
Diode Pulsed Forward Current	$I_{F(PULSE)}$	$PW \leq 1\text{ ms}$, duty cycle $\leq 1\%$	90	A	
Short Circuit Withstand Time	t_{SC}	$V_{GE} = 15\text{ V}$, $V_{CE} = 400\text{ V}$ $T_J = 175\text{ }^\circ\text{C}$	10	μs	
Power Dissipation	P_D	$T_C = 25\text{ }^\circ\text{C}$	217	W	MGF65A3H KGF65A3H
			72		FGF65A3H
Operating Junction Temperature	T_J		175	$^\circ\text{C}$	
Storage Temperature Range	T_{STG}		-55 to 150	$^\circ\text{C}$	

Thermal Characteristics

Unless otherwise specified, $T_A = 25\text{ }^\circ\text{C}$

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	Remarks
Thermal Resistance of IGBT (Junction to Case)	$R_{\theta JC}$ (IGBT)		—	—	0.69	$^\circ\text{C/W}$	MGF65A3H KGF65A3H
			—	—	2.08		FGF65A3H
Thermal Resistance of Diode (Junction to Case)	$R_{\theta JC}$ (Di)		—	—	1.15	$^\circ\text{C/W}$	MGF65A3H KGF65A3H
			—	—	2.28		FGF65A3H

⁽¹⁾ I_C and I_F are determined by the maximum junction temperature for TO3P-3L package.

⁽²⁾ Determined by bonding wires capability.

KGF65A3H, MGF65A3H, FGF65A3H

Electrical Characteristics

Unless otherwise specified, $T_A = 25\text{ }^\circ\text{C}$

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Collector to Emitter Breakdown Voltage	$V_{(BR)CES}$	$I_C = 100\text{ }\mu\text{A}$, $V_{GE} = 0\text{ V}$	650	—	—	V
Collector to Emitter Leakage Current	I_{CES}	$V_{CE} = 650\text{ V}$, $V_{GE} = 0\text{ V}$	—	—	100	μA
Gate to Emitter Leakage Current	I_{GES}	$V_{GE} = \pm 30\text{ V}$	—	—	± 500	nA
Gate Threshold Voltage	$V_{GE(TH)}$	$V_{CE} = 10\text{ V}$, $I_C = 1\text{ mA}$	4.0	5.5	7.0	V
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE} = 15\text{ V}$, $I_C = 30\text{ A}$	—	1.9	2.37	V
Input Capacitance	C_{ies}	$V_{CE} = 20\text{ V}$, $V_{GE} = 0\text{ V}$, $f = 1.0\text{ MHz}$,	—	1800	—	pF
Output Capacitance	C_{oes}		—	200	—	
Reverse Transfer Capacitance	C_{res}		—	80	—	
Gate Charge	Q_g	$V_{CE} = 520\text{ V}$, $I_C = 30\text{ A}$, $V_{GE} = 15\text{ V}$	—	60	—	nC
Turn-on Delay Time	$t_{d(on)}$	$T_J = 25\text{ }^\circ\text{C}$, see Figure 1.	—	30	—	ns
Rise Time	t_r		—	30	—	
Turn-off Delay Time	$t_{d(off)}$		—	90	—	
Fall Time	t_f		—	30	—	
Turn-on Energy ⁽³⁾	E_{on}		—	0.5	—	
Turn-off Energy	E_{off}	—	0.4	—		
Turn-on Delay Time	$t_{d(on)}$	$T_J = 175\text{ }^\circ\text{C}$, see Figure 1.	—	30	—	ns
Rise Time	t_r		—	30	—	
Turn-off Delay Time	$t_{d(off)}$		—	120	—	
Fall Time	t_f		—	60	—	
Turn-on Energy ⁽³⁾	E_{on}		—	1.0	—	
Turn-off Energy	E_{off}	—	0.7	—		
Emitter to Collector Diode Forward Voltage	V_F	$I_F = 30\text{ A}$	—	1.8	—	V
Emitter to Collector Diode Reverse Recovery Time	t_{rr}	$I_F = 30\text{ A}$, $di/dt = 700\text{ A}/\mu\text{s}$	—	50	—	ns

⁽³⁾ Energy losses include the reverse recovery of diode.

Test Circuits and Waveforms

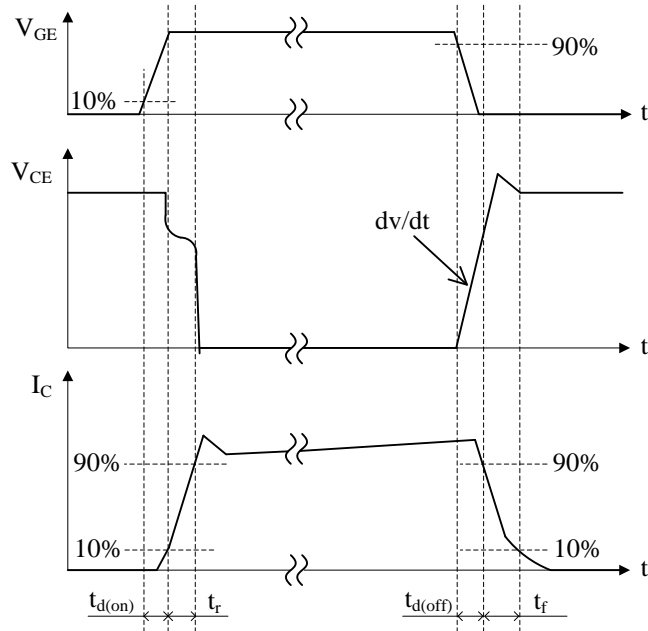
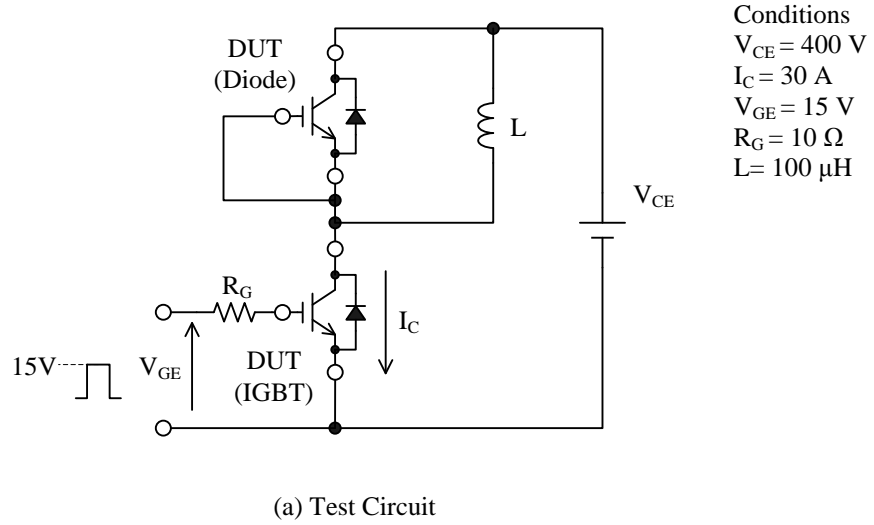


Figure 1. Test Circuits and Waveforms of dv/dt and Switching Time

Rating and Characteristic Curves

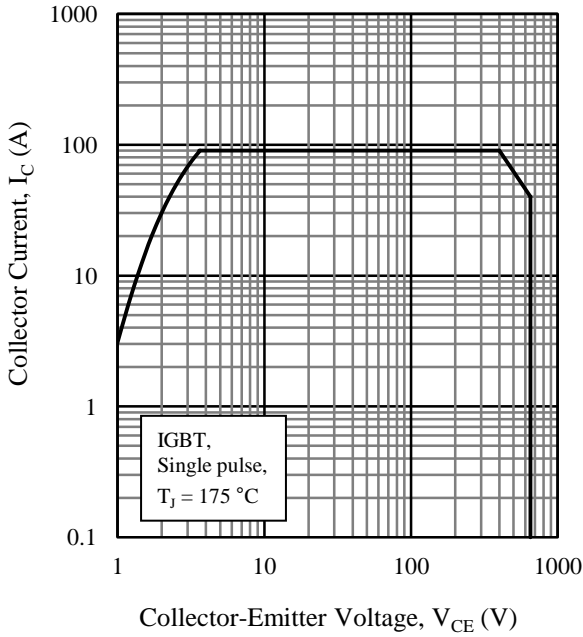


Figure 2. IGBT Reverse Bias Safe Operating Area

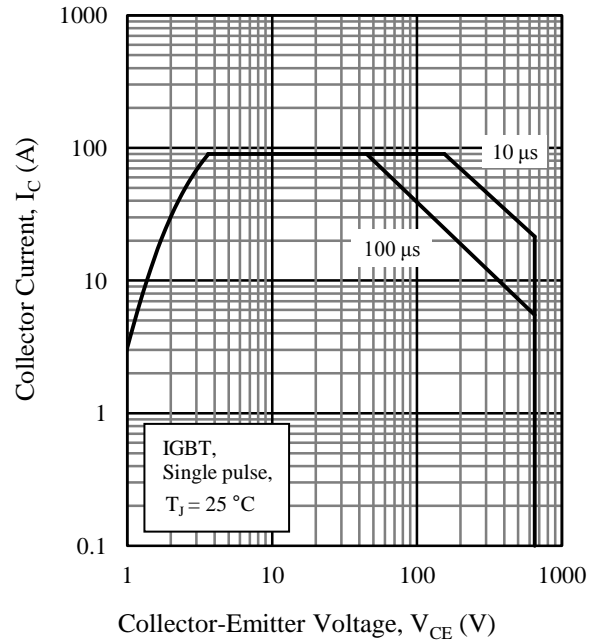


Figure 3. IGBT Safe Operating Area

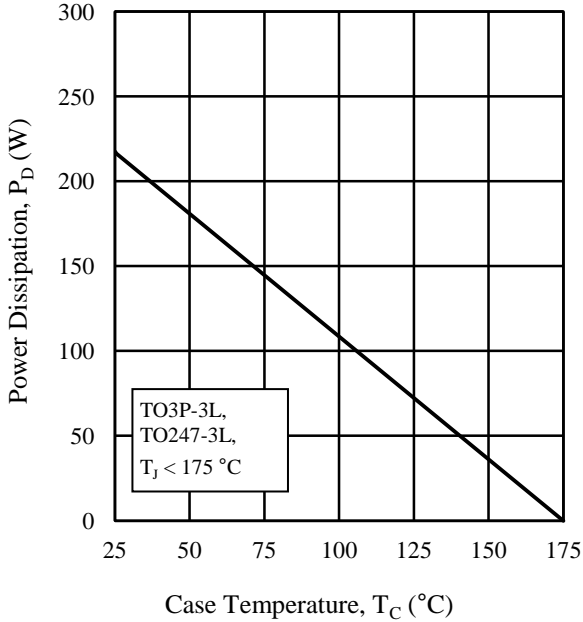


Figure 4. Power Dissipation vs. TO3P-3L and TO247-3L Case Temperature

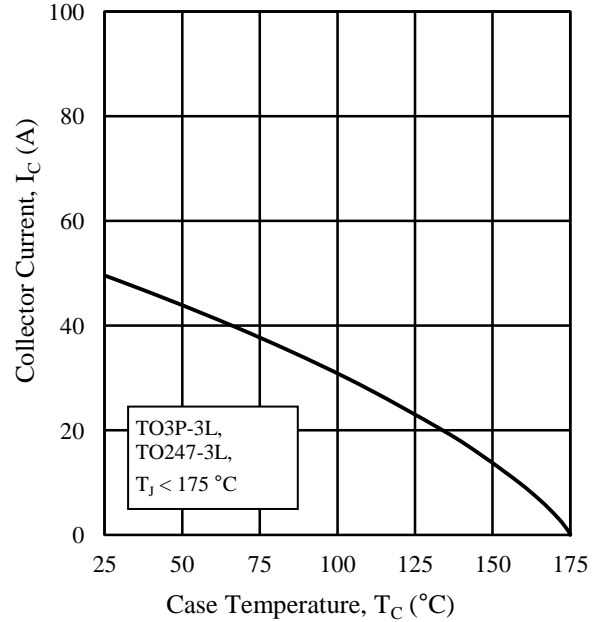


Figure 5. Collector Current vs. TO3P-3L and TO247-3L Case Temperature

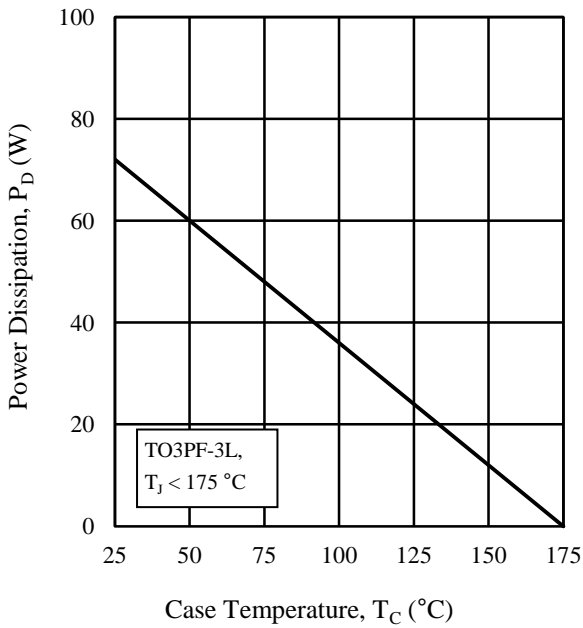


Figure 6. Power Dissipation vs. TO3PF-3L Case Temperature

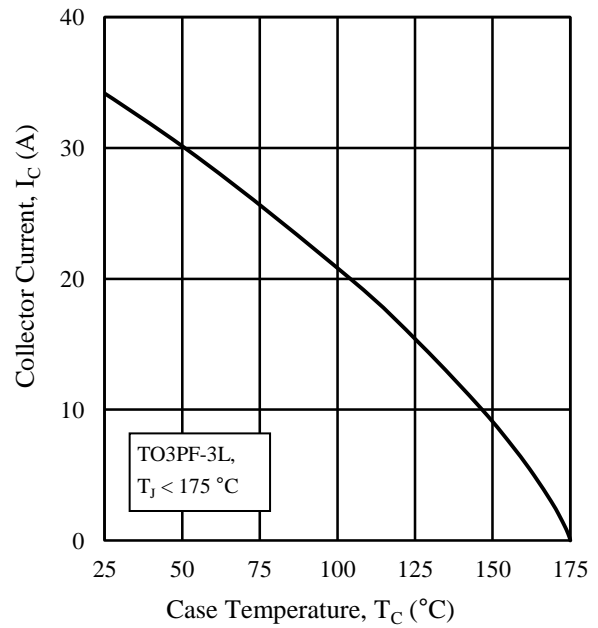


Figure 7. Collector Current vs. TO3PF-3L Case Temperature

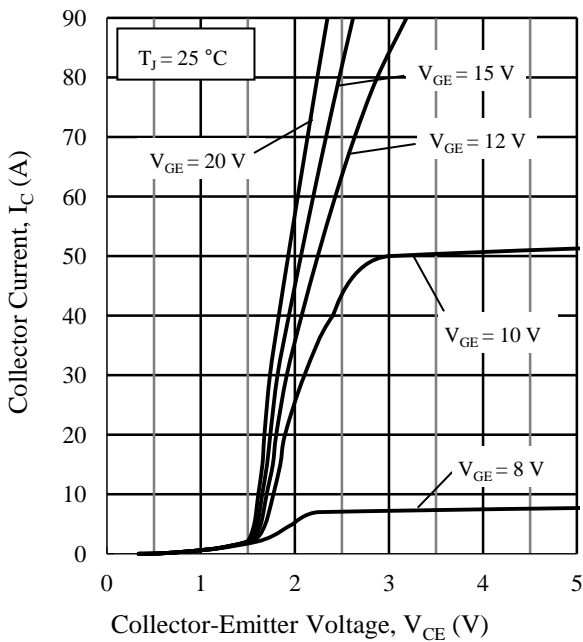


Figure 8. Output Characteristics ($T_J = 25\text{ }^\circ\text{C}$)

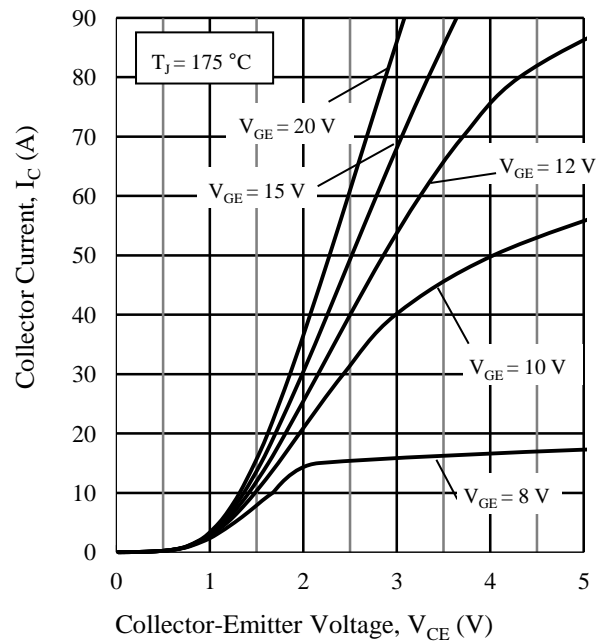


Figure 9. Output Characteristics ($T_J = 175\text{ }^\circ\text{C}$)

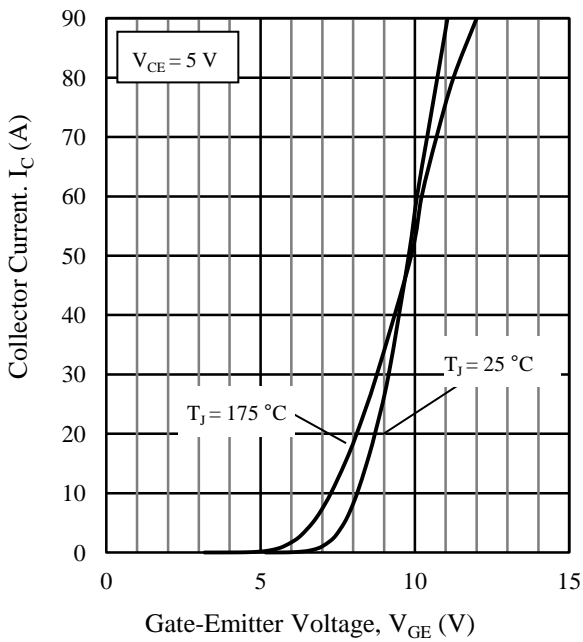


Figure 10. Transfer Characteristics

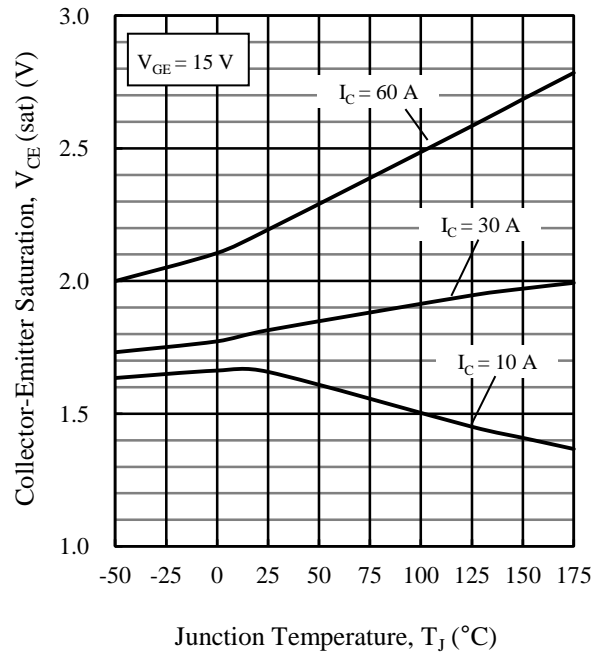


Figure 11. Saturation Voltage vs. Junction Temperature

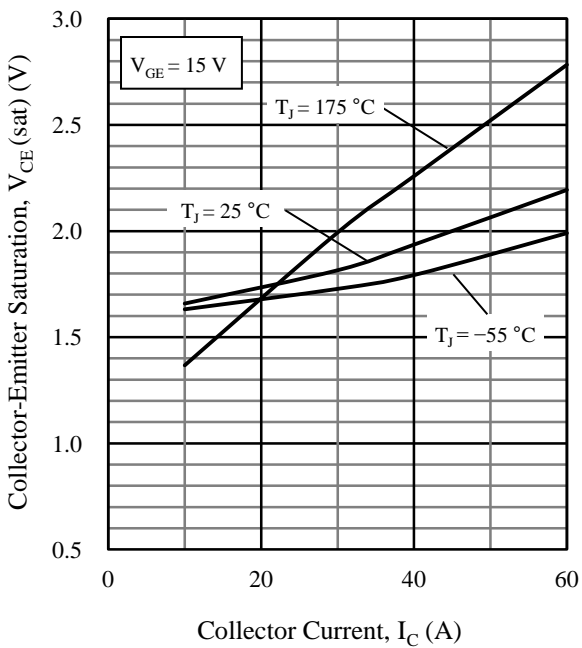


Figure 12. Saturation Voltage vs. Collector Current

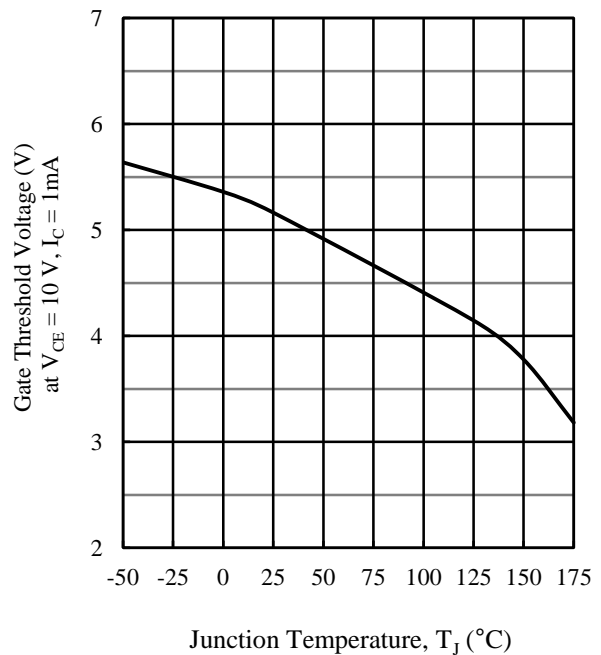


Figure 13. Gate Threshold Voltage vs. Junction Temperature

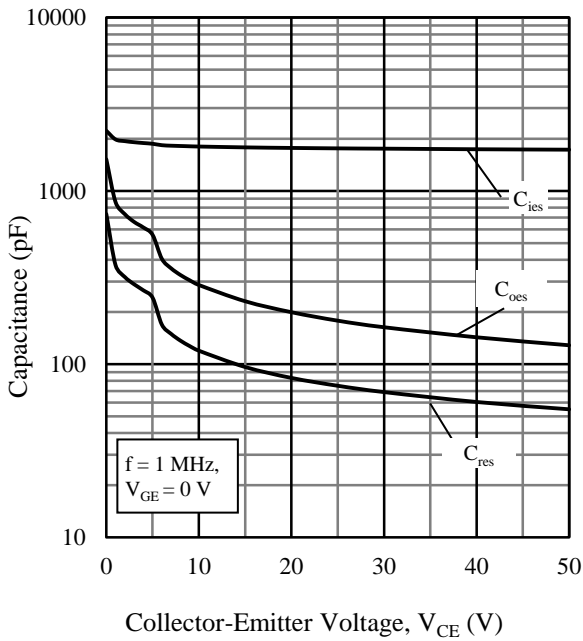


Figure 14. Capacitance Characteristics

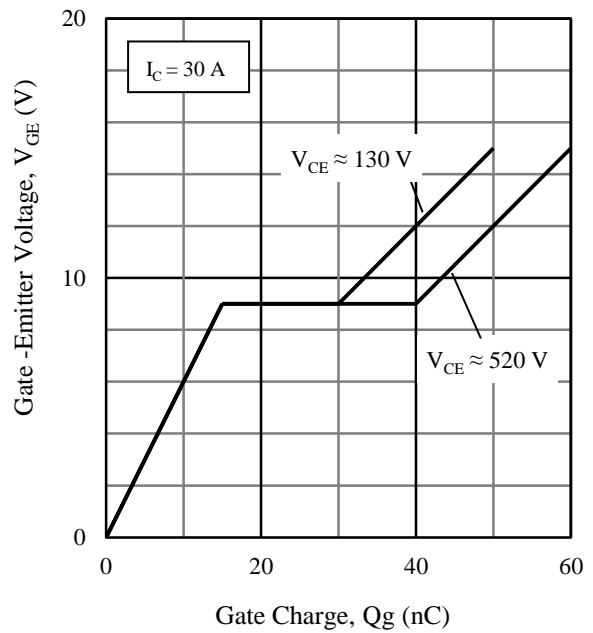


Figure 15. Typical Gate Charge

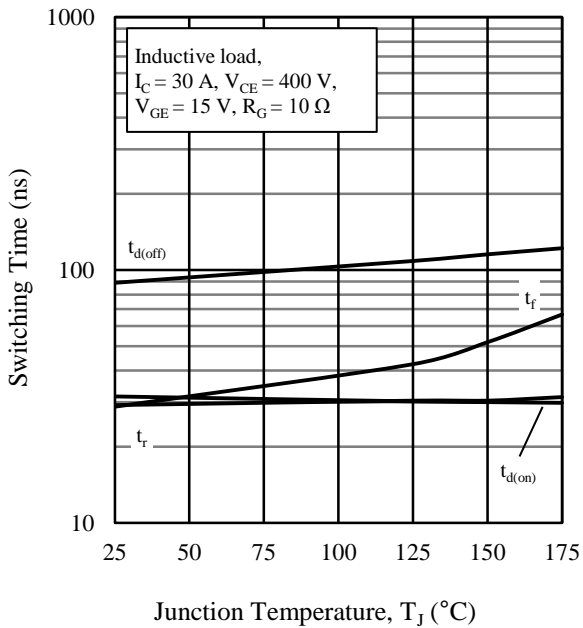


Figure 16. Switching Time vs. Junction Temperature

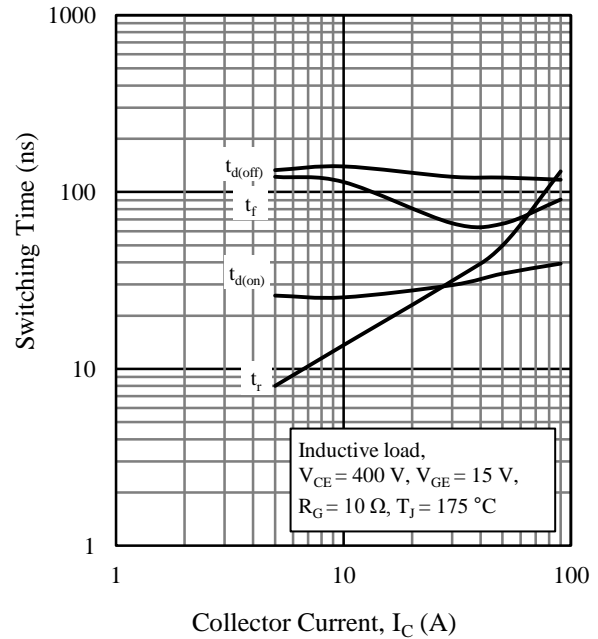


Figure 17. Switching Time vs. Collector Current

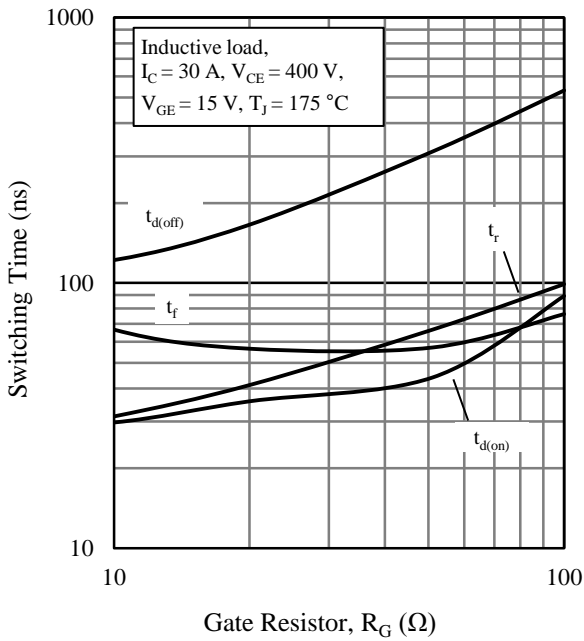


Figure 18. Switching Time vs. Gate Resistor

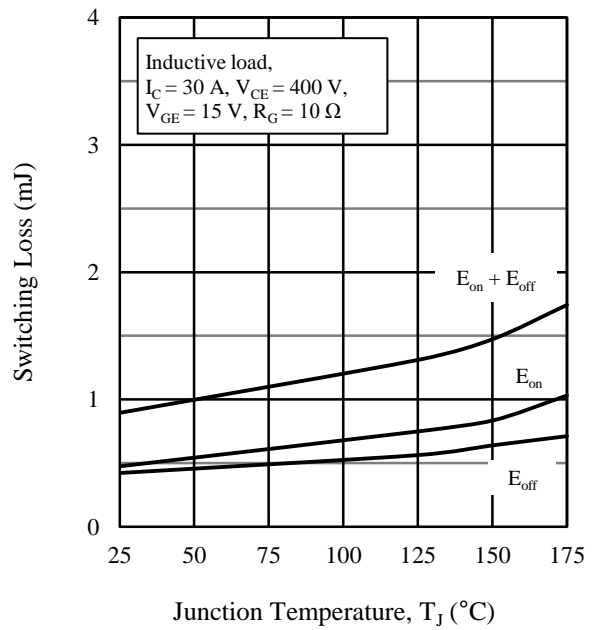


Figure 19. Switching Loss vs. Junction Temperature

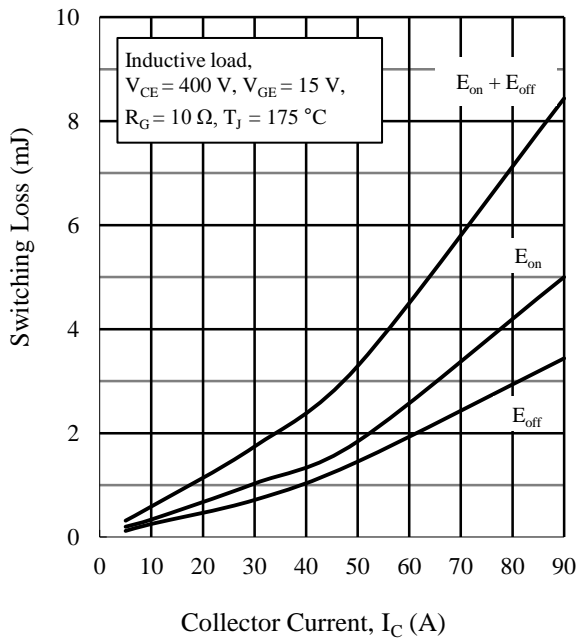


Figure 20. Switching Loss vs. Collector Current

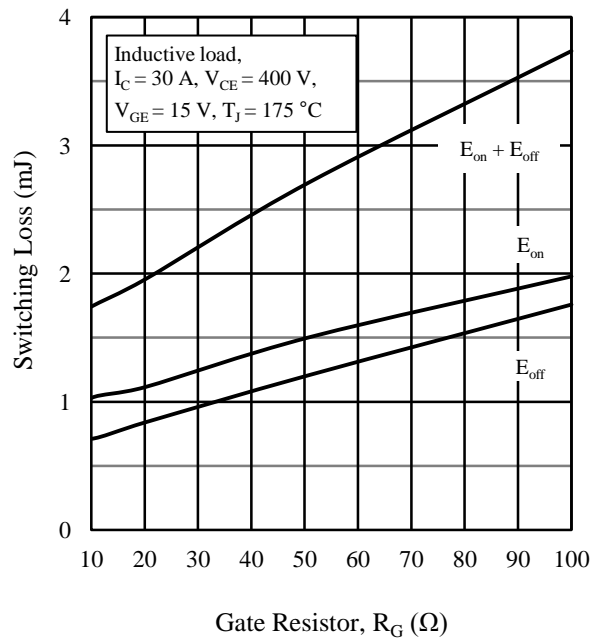


Figure 21. Switching Loss vs. Gate Resistor

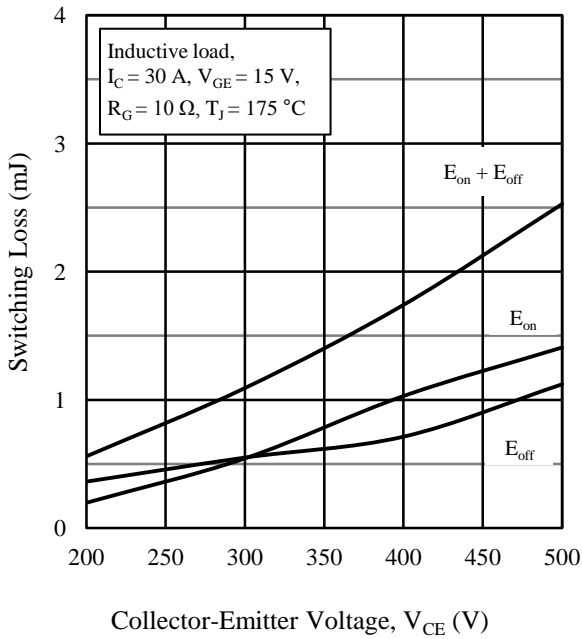


Figure 22. Switching Loss vs. Collector-Emitter Voltage

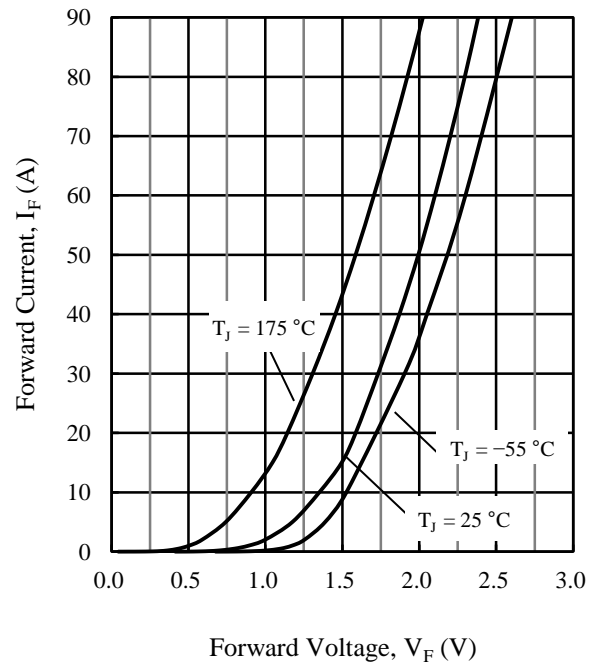


Figure 23. Diode Forward Characteristics

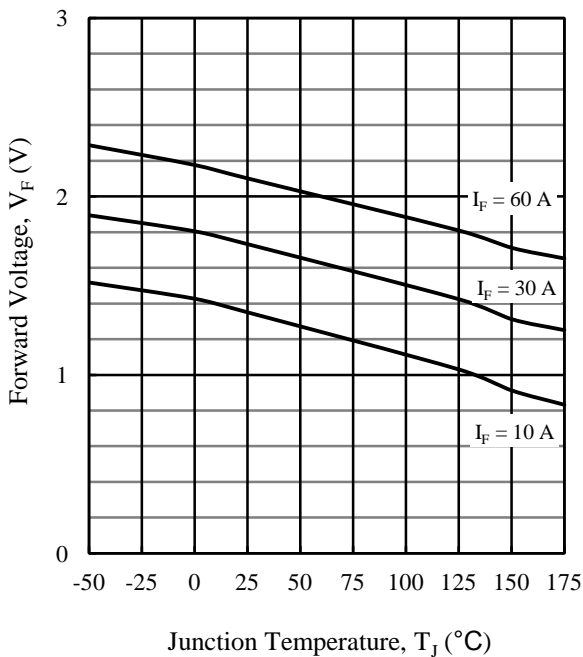


Figure 24. Diode Forward Voltage vs. Junction Temperature

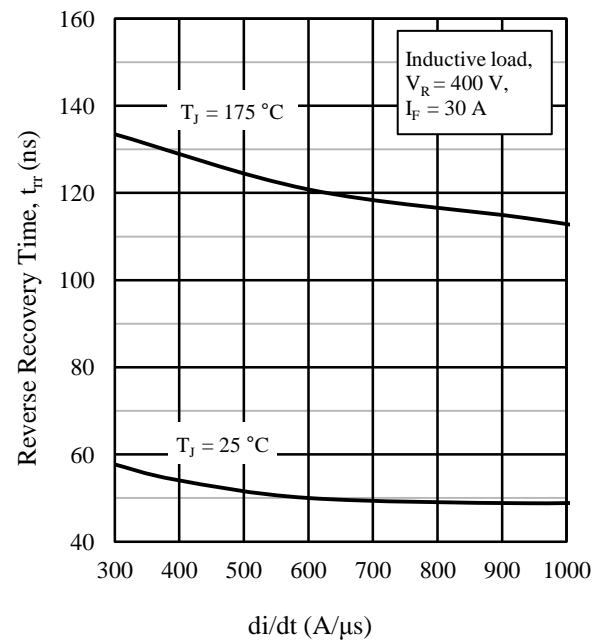


Figure 25. Diode Reverse Recovery Time vs. di/dt

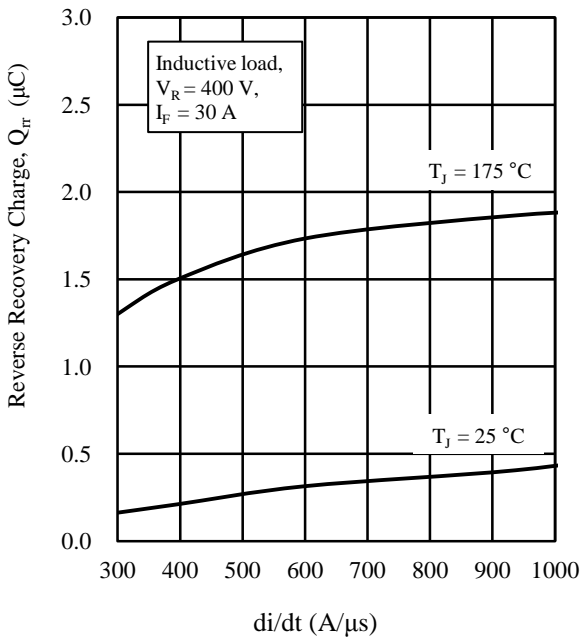


Figure 26. Diode Reverse Recovery Charge vs. di/dt

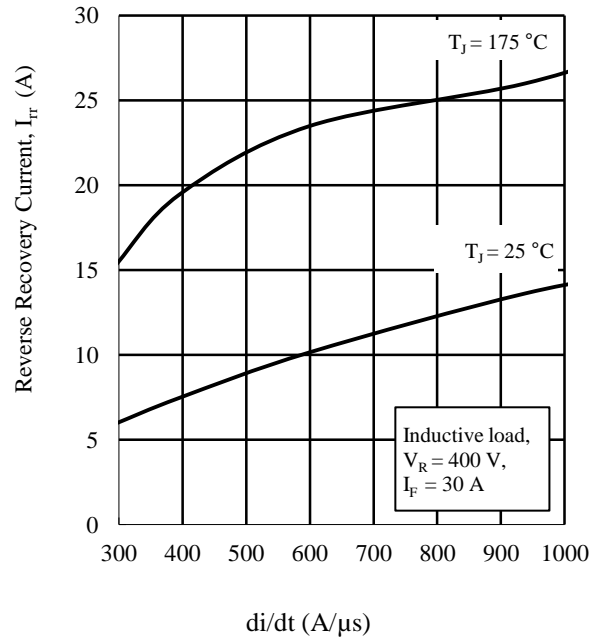


Figure 27. Diode Reverse Recovery Current vs. di/dt

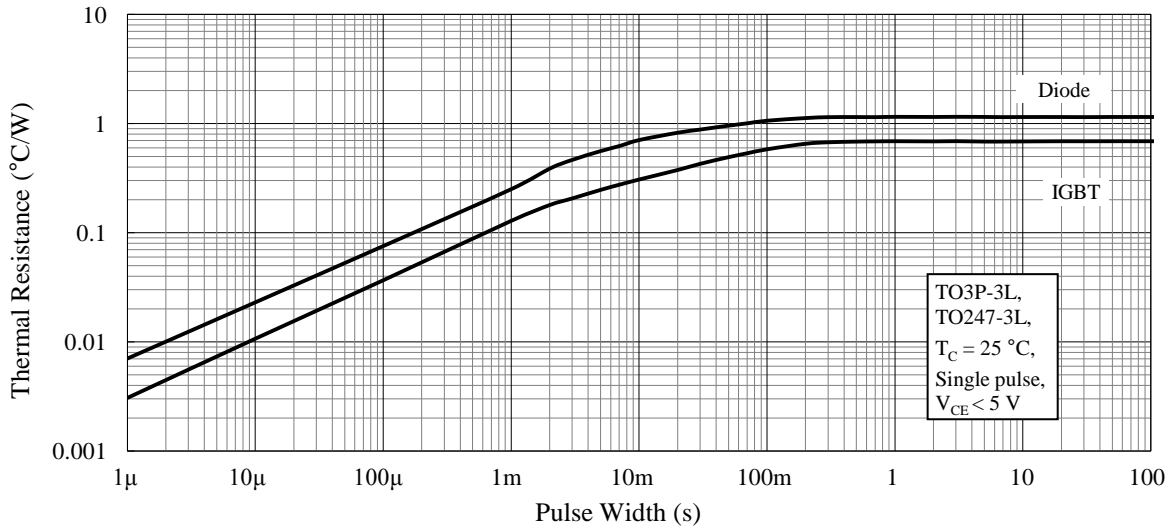


Figure 28. Transient Thermal Resistance (TO3P-3L and TO247-3L)

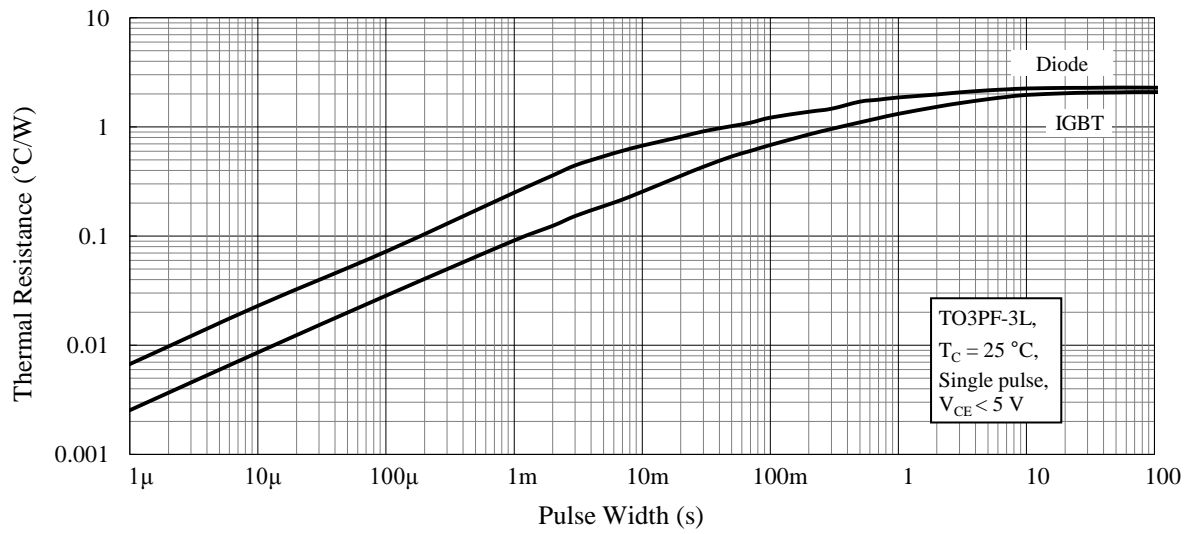
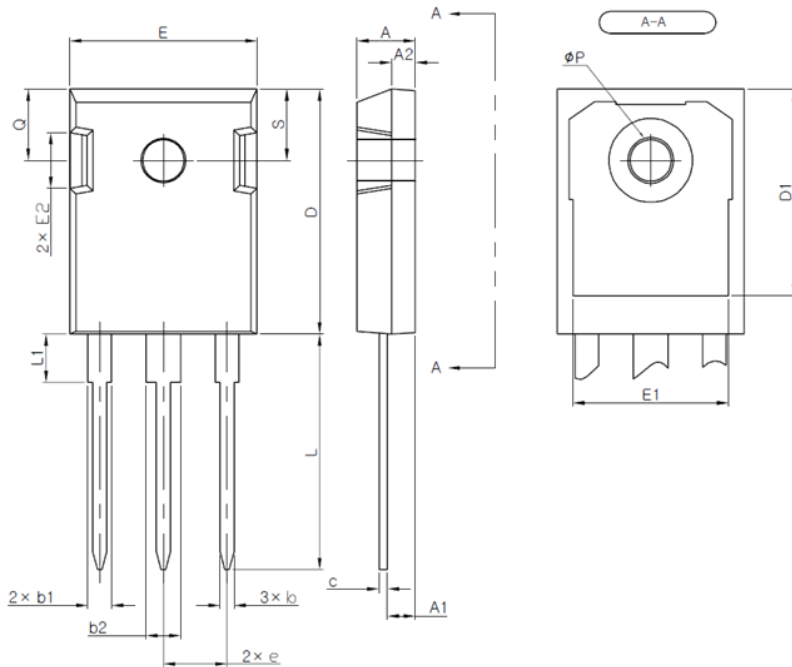


Figure 29. Transient Thermal Resistance (TO3PF-3L)

KGF65A3H, MGF65A3H, FGF65A3H

Physical Dimensions

● TO247-3L

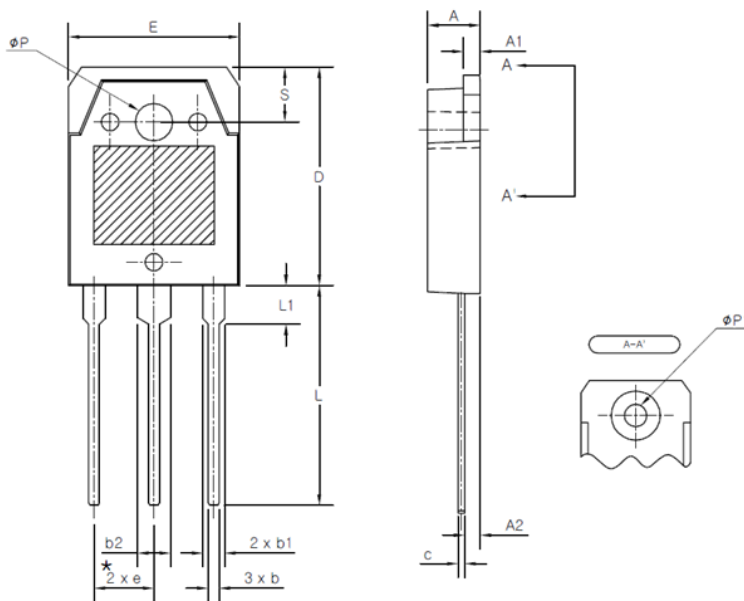


SYMBOL	MIN	NOM	MAX
A	4.83	5.02	5.21
A1	2.29	2.41	2.54
A2	1.91	2.04	2.16
b	1.14	1.27	1.40
b1	1.91	2.10	2.20
b2	2.92	3.10	3.20
c	0.61	0.71	0.80
D	20.80	21.07	21.34
D1	17.43	17.63	17.83
E	15.75	15.94	16.13
E1	13.06	13.26	13.46
E2	4.32	4.58	4.83
e	5.25	5.45	5.65
L	19.81	20.19	20.57
L1	3.81	4.07	4.32
φP	3.55	3.60	3.65
Q	5.59	5.90	6.20
S	6.15 BSC		

NOTE

1. THESE DIMENSION DO NOT INCLUDE MOLD PROTRUSION

● TO3P-3L



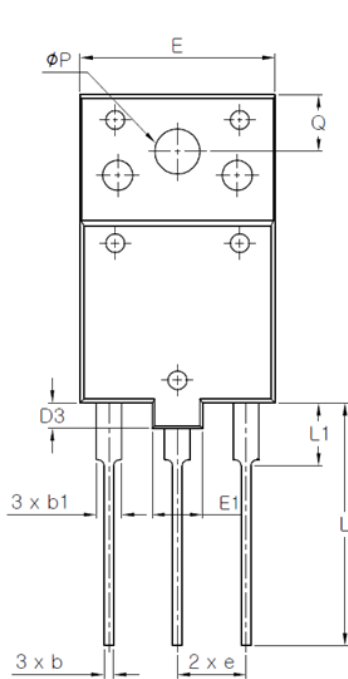
SYMBOL	MIN	NOM	MAX
A	4.60	4.80	5.00
A1	1.45	1.50	1.65
A2	1.20	1.40	1.60
b	0.80	1.00	1.20
b1	1.80	2.00	2.20
b2	2.80	3.00	3.20
c	0.55	0.60	0.75
D	19.70	19.90	20.10
E	15.40	15.60	15.80
*e	5.25	5.45	5.65
L	19.80	20.00	20.20
L1	3.30	3.50	3.70
φP	3.30	3.40	3.50
φP1	3.10	3.20	3.30
S	4.80	5.00	5.20

NOTE

1. THESE DIMENSIONS DO NOT INCLUDE PROTRUSIONS OF THE MOLD.
2. THE "(*)" MARK IS THE REFERENCE

KGF65A3H, MGF65A3H, FGF65A3H

• TO3PF-3L

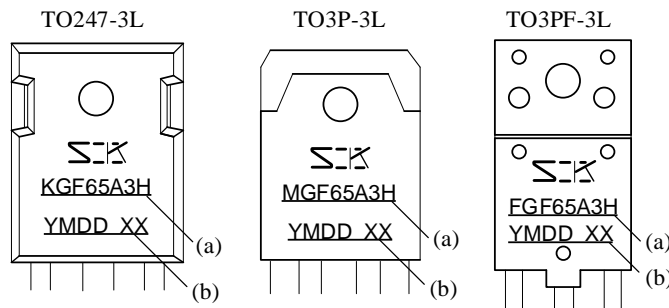


SYMBOL	MIN	NOM	MAX
A	5.30	5.50	5.70
A1	3.10	3.30	3.50
b	0.65	0.75	0.95
b1	1.80	2.00	2.20
c	0.80	0.90	1.10
D	26.30	26.50	26.70
D1	22.80	23.00	23.20
D2	9.80	10.00	10.20
D3	1.80	2.00	2.20
E	15.30	15.50	15.70
E1	3.80	4.00	4.20
e	5.25	5.45	5.65
F	2.80	3.00	3.20
F1	1.80	2.00	2.20
L	19.10	19.30	19.50
L1	4.80	5.00	5.20
Q	4.30	4.50	4.70
φP	3.40	3.60	3.80

NOTES:

- All dimensions in millimeters
- Pin treatment for TO247, TO3P and TO3PF: Pb-free (RoHS compliant)
- When soldering the products, make sure to minimize the working time within the following limits:
Flow: $260 \pm 5 \text{ }^\circ\text{C} / 10 \pm 1 \text{ s}$, 2 times
Soldering Iron: $380 \pm 10 \text{ }^\circ\text{C} / 3.5 \pm 0.5 \text{ s}$, 1 time (Soldering should be at a distance of at least 1.5 mm from the body of the products.)
- Soldering should be at a distance of at least 1.5 mm from the body of the products.
- The recommended screw torque for TO247, TO3P and TO3PF: 0.686 to 0.882 N·m (7 to 9 kgf·cm)

Marking Diagram



(a) Part Number

(b) Lot Number

Y is the last digit of the year of manufacture (0 to 9).

M is the month of the year (1 to 9, O, N or D).

DD is the day of the month (01 to 31).

XX is the control number.

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