

$V_{CE} = 650\text{ V}$, $I_C = 60\text{ A}$
Trench Field Stop IGBTs with Fast Recovery Diode
KGF65A6L, MGF65A6L

Description

KGF65A6L and MGF65A6L are 650 V Field Stop IGBTs. Sanken original trench structure decreases gate capacitance, and achieves low saturation voltage and switching losses reduction. Thus, Field Stop IGBTs can improve the efficiency of your circuit.

Features

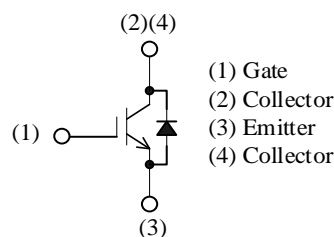
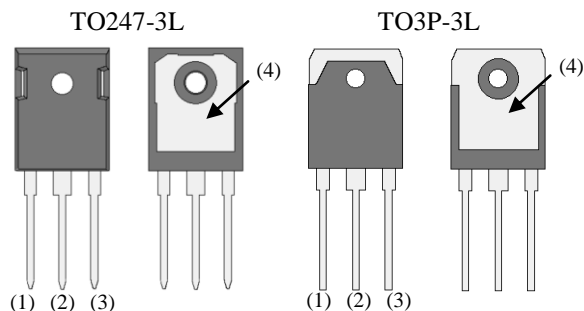
- Low Saturation Voltage
- High Speed Switching
- With Integrated Fast Recovery Diode
- RoHS Compliant

- V_{CE} ----- 650 V
- I_C ($T_C = 100\text{ }^\circ\text{C}$)----- 60 A
- Short Circuit Withstand Time ----- 5 μs
- $V_{CE(sat)}$ ----- 1.6 V typ.
- t_f ($T_J = 175\text{ }^\circ\text{C}$) ----- 150 ns typ.
- V_F ----- 1.7 V typ.

Applications

- Uninterruptible Power Supply (UPS)
- Inverter Circuit
- Bridge Circuit

Package



Not to scale

Selection Guide

Part Number	Package
KGF65A6L	TO247-3L
MGF65A6L	TO3P-3L

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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	$T_C = 25\text{ }^\circ\text{C}$	80 ⁽²⁾	A	
		$T_C = 100\text{ }^\circ\text{C}$	60	A	
Pulsed Collector Current	$I_{C(PULSE)}$	$PW \leq 1\text{ ms}$, duty cycle $\leq 1\%$	180	A	
Diode Continuous Forward Current ⁽¹⁾	I_F	$T_C = 25\text{ }^\circ\text{C}$	80 ⁽²⁾	A	
		$T_C = 100\text{ }^\circ\text{C}$	60	A	
Diode Pulsed Forward Current	$I_{F(PULSE)}$	$PW \leq 1\text{ ms}$, duty cycle $\leq 1\%$	180	A	
Maximum Collector–Emitter dv/dt	dv/dt	$T_J \leq 175\text{ }^\circ\text{C}$, see Figure 1.	10	V/ns	
Short Circuit Withstand Time	t_{SC}	$V_{GE} = 15\text{ V}$, $V_{CE} = 400\text{ V}$ $T_J = 175\text{ }^\circ\text{C}$	5	μs	
Power Dissipation	P_D	$T_C = 25\text{ }^\circ\text{C}$	405	W	
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)		—	—	0.37	$^\circ\text{C/W}$	
Thermal Resistance of Diode (Junction to Case)	$R_{\theta JC}$ (Di)		—	—	0.93	$^\circ\text{C/W}$	

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

⁽²⁾ Determined by bonding wires capability.

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Electrical Characteristics

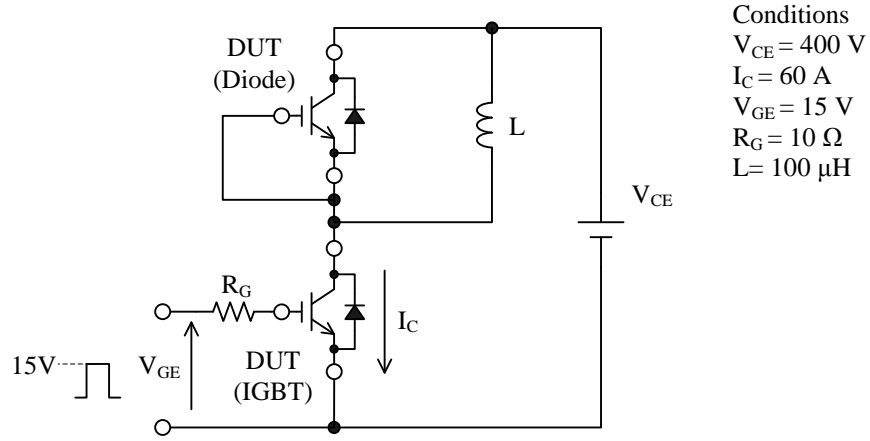
Unless otherwise specified, $T_A = 25\text{ }^\circ\text{C}$

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
Collector to Emitter Breakdown Voltage	$V_{(BR)CES}$	$I_C = 100\ \mu\text{A}$, $V_{GE} = 0\ \text{V}$	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	$V_{CE(sat)}$	$V_{GE} = 15\ \text{V}$, $I_C = 60\ \text{A}$	—	1.6	1.96	V	
Input Capacitance	C_{ies}	$V_{CE} = 20\ \text{V}$, $V_{GE} = 0\ \text{V}$, $f = 1.0\ \text{MHz}$,	—	3500	—	pF	
Output Capacitance	C_{oes}		—	330	—		
Reverse Transfer Capacitance	C_{res}		—	170	—		
Gate charge	Q_g	$V_{CE} = 520\ \text{V}$, $I_C = 60\ \text{A}$, $V_{GE} = 15\ \text{V}$	—	110	—	nC	
Turn-On Delay Time	$t_{d(on)}$	$T_J = 25\text{ }^\circ\text{C}$, see Figure 1.	—	50	—	ns	
Rise Time	t_r		—	70	—		
Turn-Off Delay Time	$t_{d(off)}$		—	130	—		
Fall Time	t_f		—	60	—		
Turn-on Energy ⁽³⁾	E_{on}		—	1.7	—		mJ
Turn-off Energy	E_{off}	—	1.4	—			
Turn-On Delay Time	$t_{d(on)}$	$T_J = 175\text{ }^\circ\text{C}$, see Figure 1.	—	50	—	ns	
Rise Time	t_r		—	70	—		
Turn-Off Delay Time	$t_{d(off)}$		—	160	—		
Fall Time	t_f		—	150	—		
Turn-on Energy ⁽³⁾	E_{on}		—	2.7	—		mJ
Turn-off Energy	E_{off}		—	2.5	—		
Emitter to Collector Diode Forward Voltage	V_F	$I_F = 60\ \text{A}$	—	1.7	—	V	
Emitter to Collector Diode Reverse Recovery Time	t_{rr}	$I_F = 60\ \text{A}$, $di/dt = 500\ \text{A}/\mu\text{s}$	—	65	—	ns	

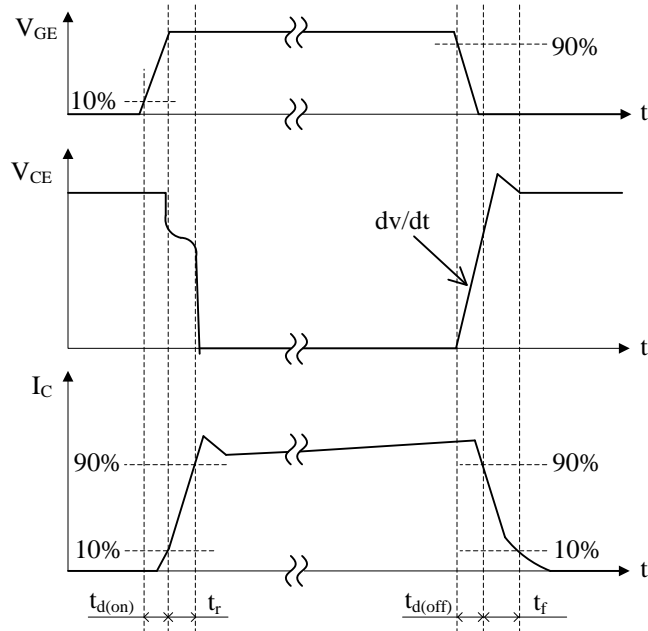
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⁽³⁾ Energy losses include the reverse recovery of diode.

Test Circuits and Waveforms



(a) Test Circuit



(b) Waveform

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

Rating and Characteristic Curves

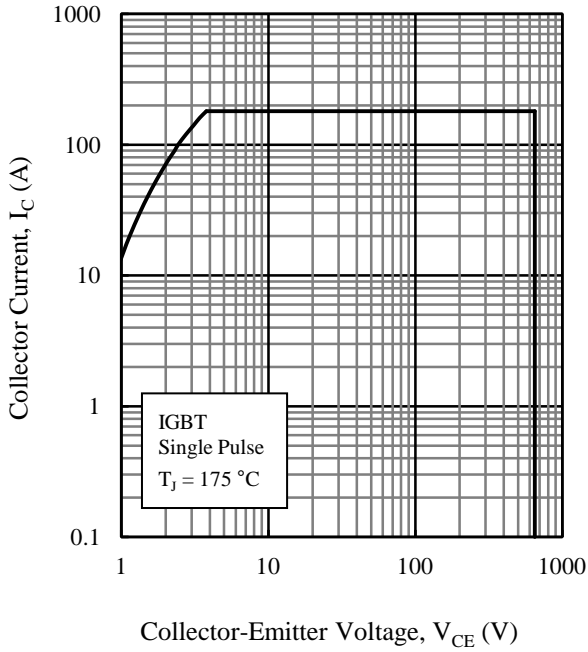


Figure 2. IGBT Reverse Bias Safe Operating Area

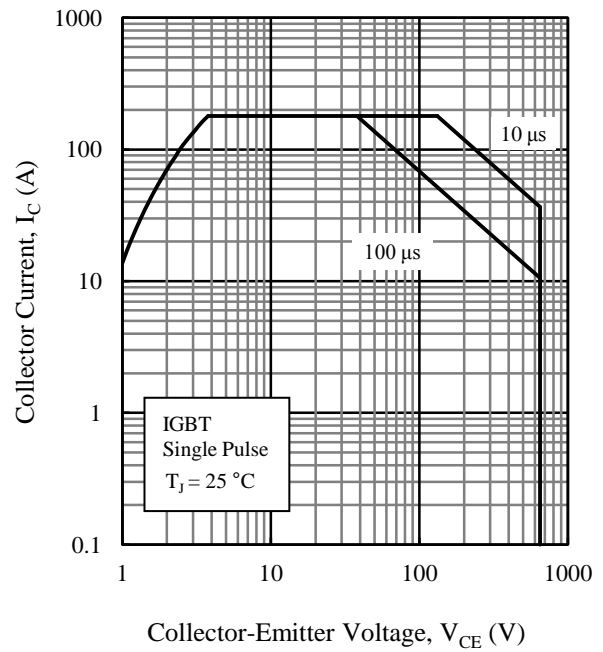


Figure 3. IGBT Safe Operating Area

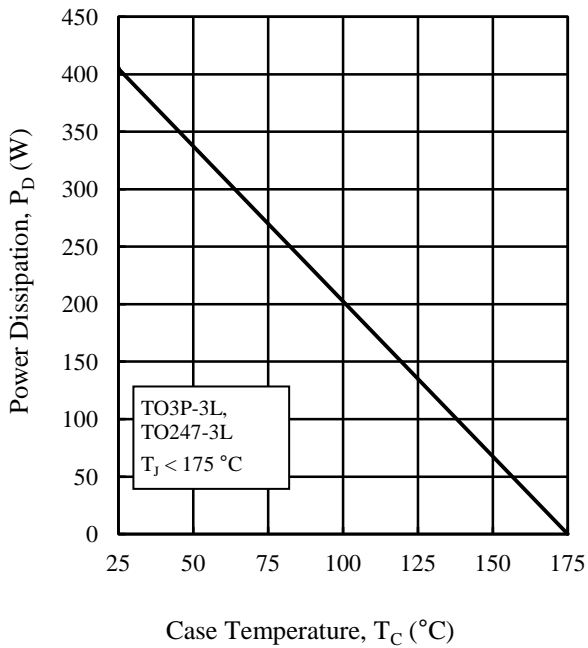


Figure 4. Power Dissipation vs. Case Temperature

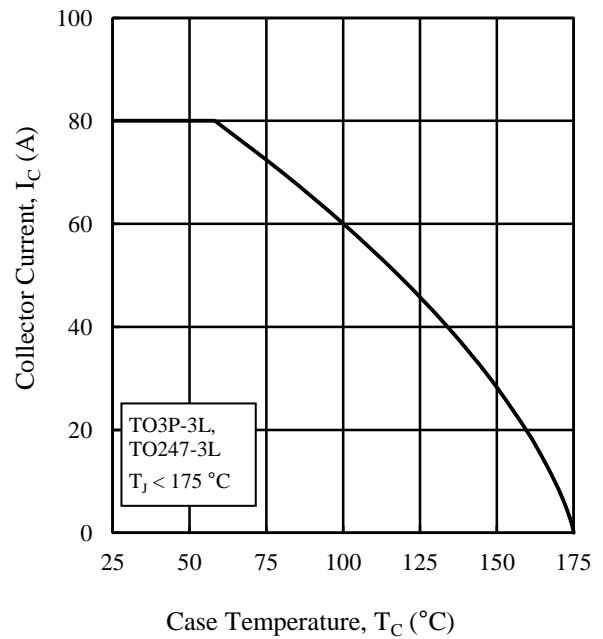


Figure 5. Collector Current vs. Case Temperature

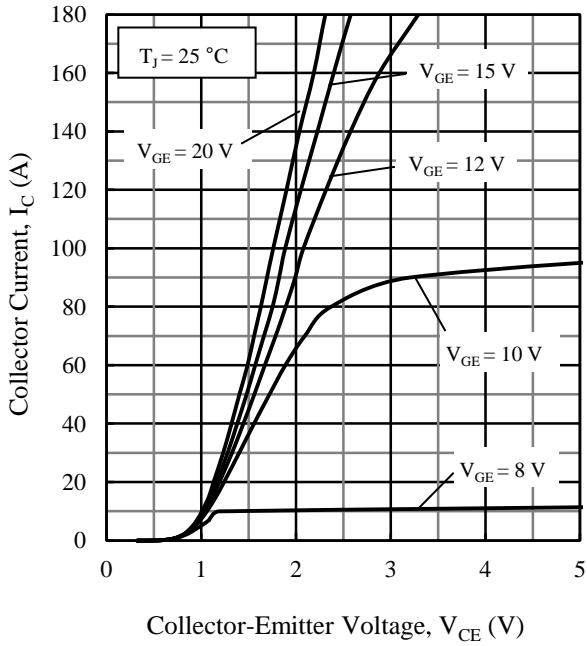


Figure 6. Output Characteristics ($T_J = 25\text{ }^\circ\text{C}$)

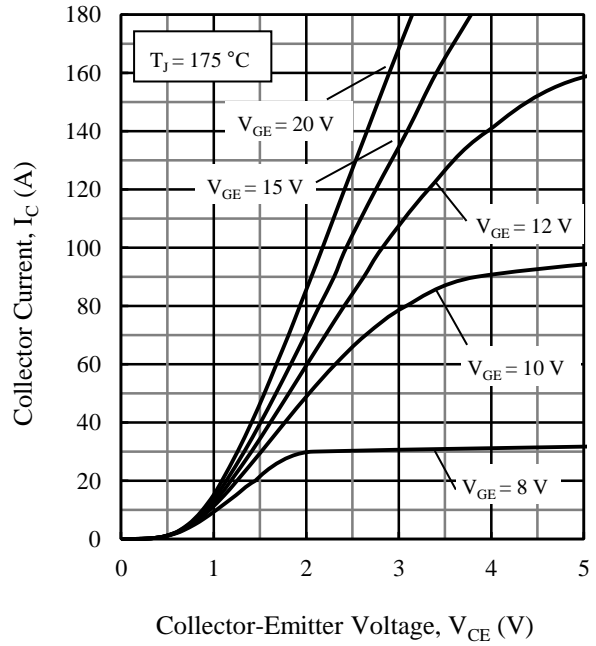


Figure 7. Output Characteristics ($T_J = 175\text{ }^\circ\text{C}$)

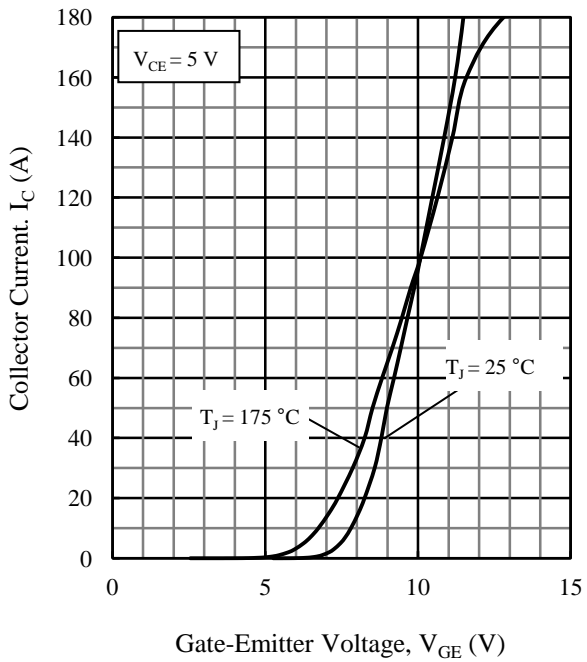


Figure 8. Transfer Characteristics

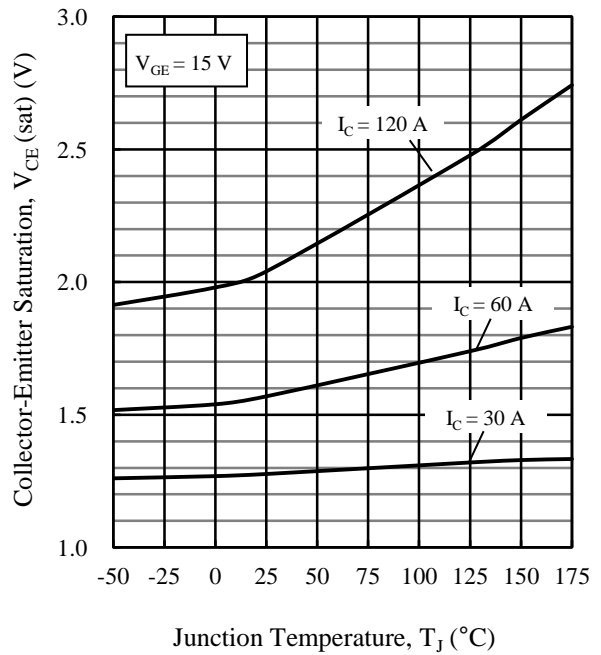


Figure 9. Saturation Voltage vs. Junction Temperature

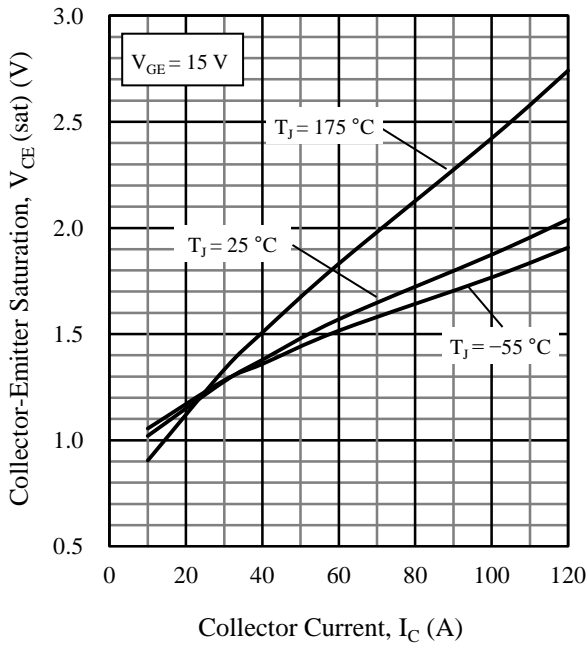


Figure 10. Saturation Voltage vs. Collector Current

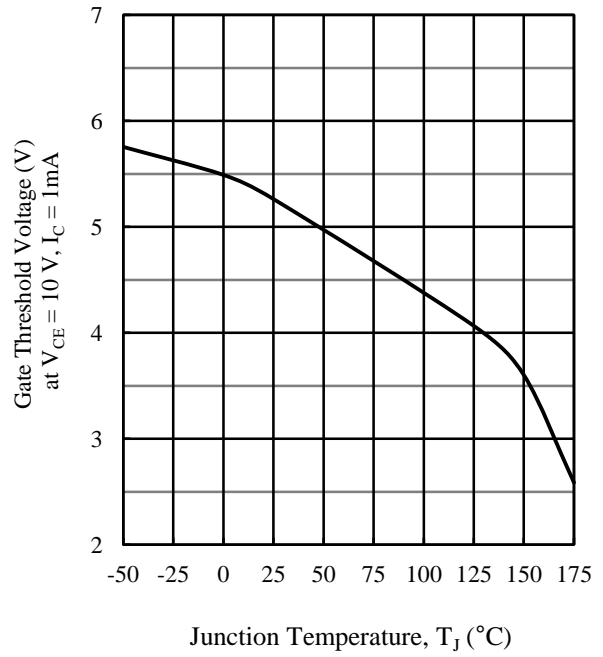


Figure 11. Gate Threshold Voltage vs. Junction Temperature

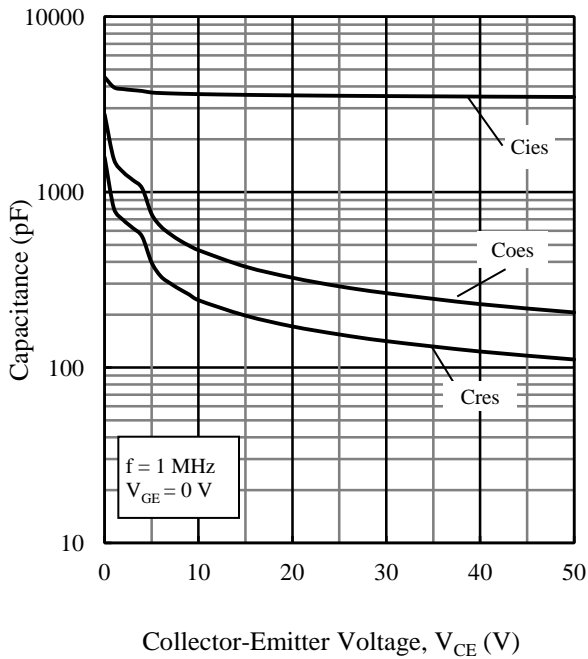


Figure 12. Capacitance Characteristics

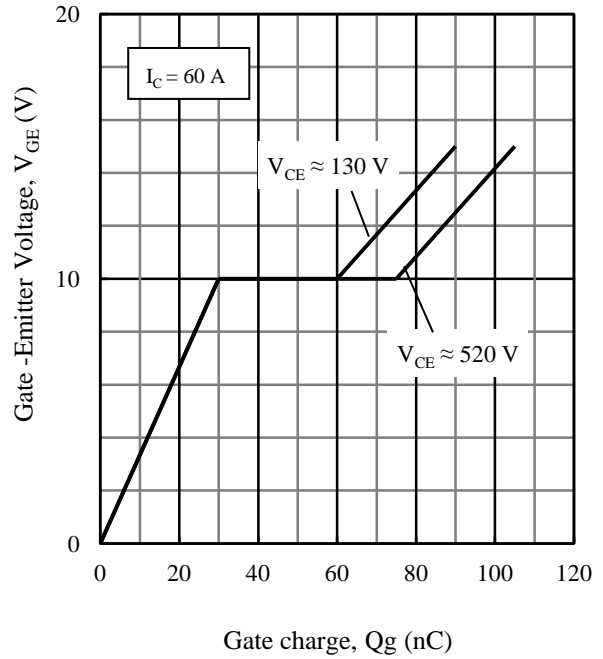


Figure 13. Typical Gate Charge

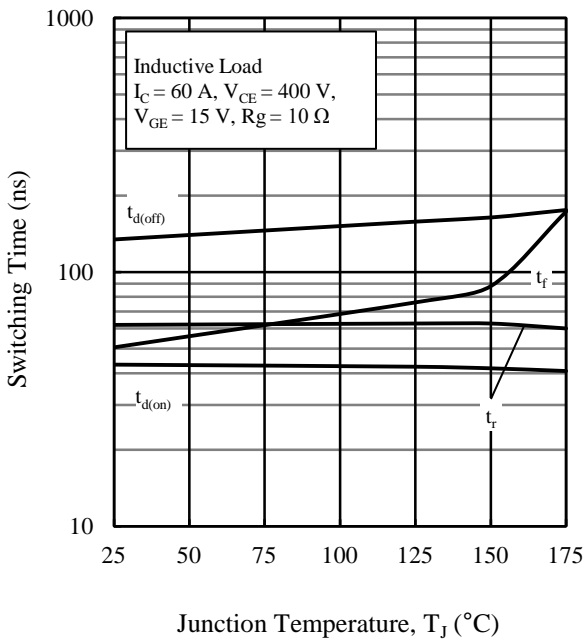


Figure 14. Switching Time vs. Junction Temperature

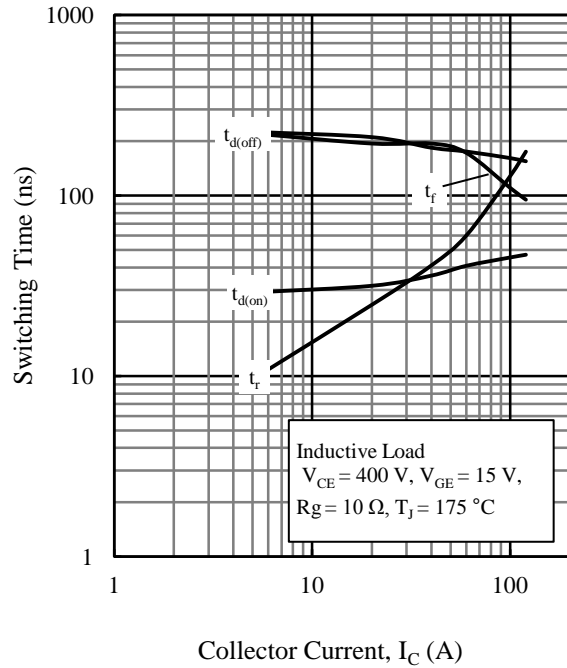


Figure 15. Switching Time vs. Collector Current

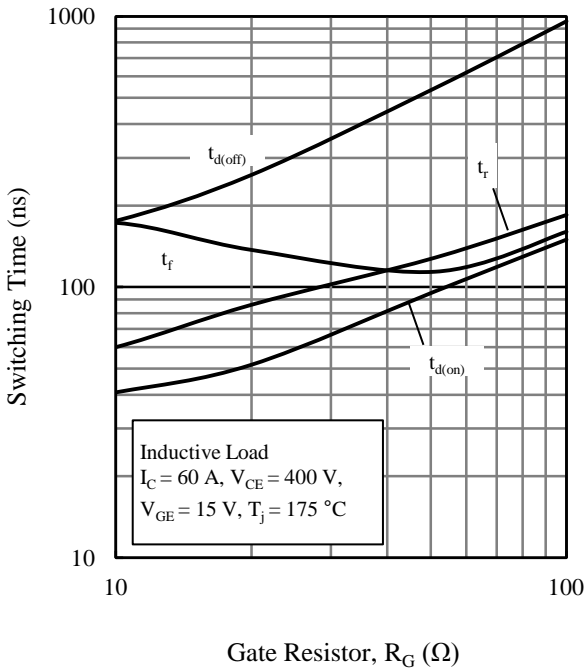


Figure 16. Switching Time vs. Gate Resistor

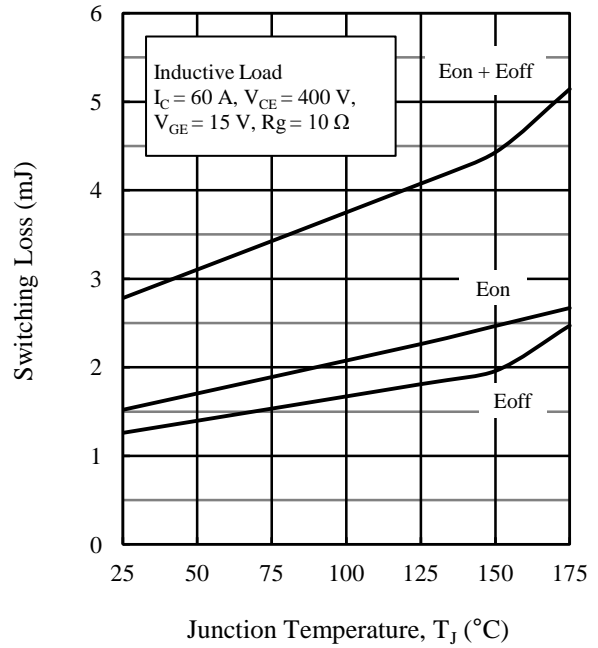


Figure 17. Switching Loss vs. Junction Temperature

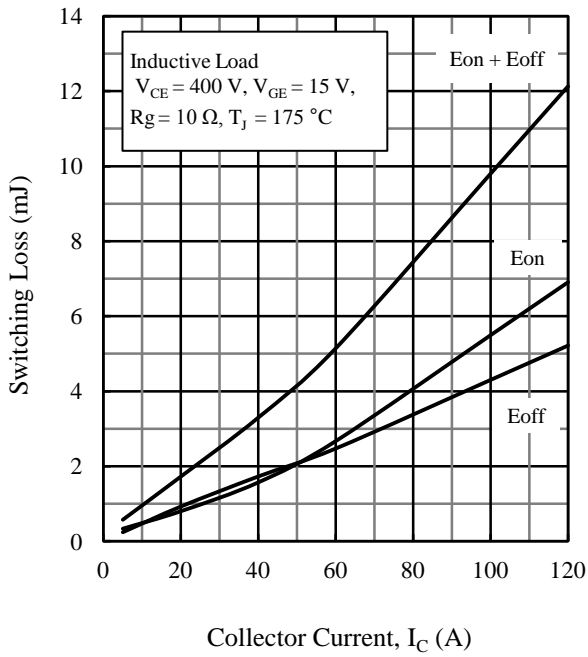


Figure 18. Switching Loss vs. Collector Current

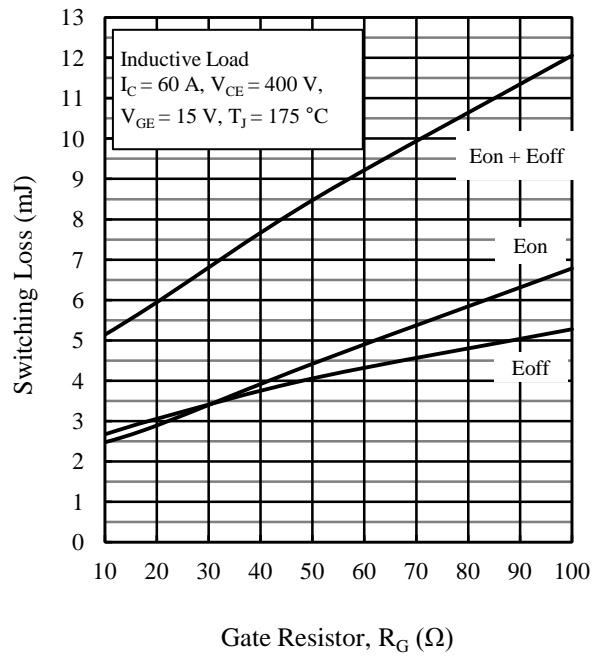


Figure 19. Switching Loss vs. Gate Resistor

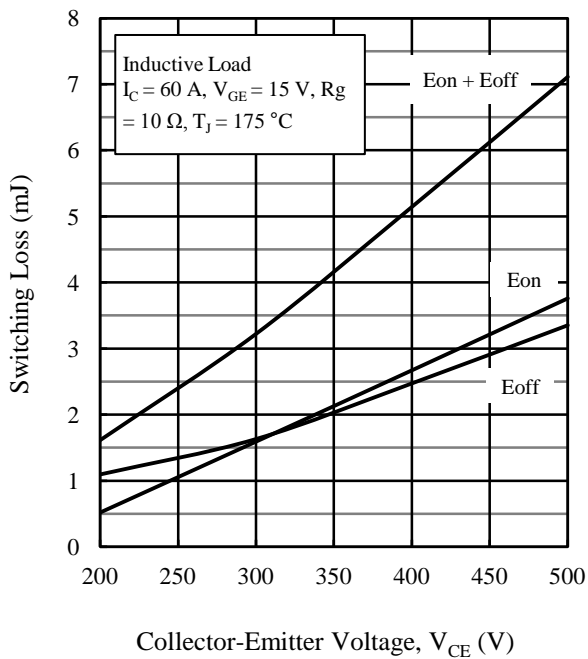


Figure 20. Switching Loss vs. Collector-Emitter Voltage

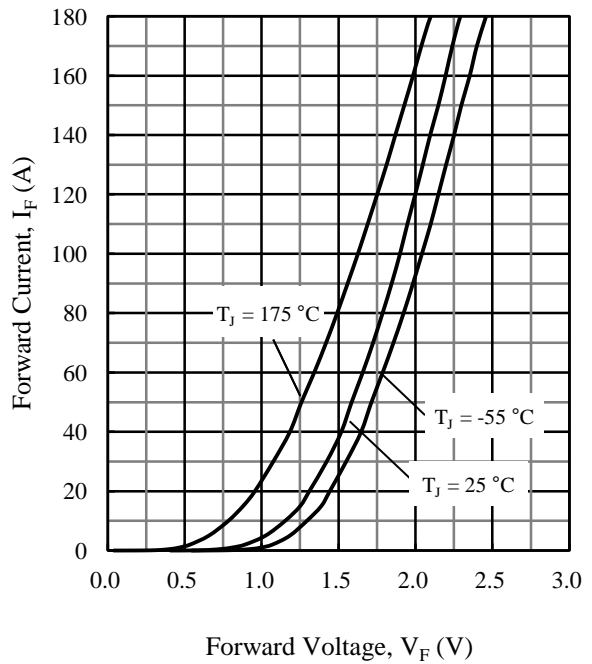


Figure 21. Diode Forward Characteristics

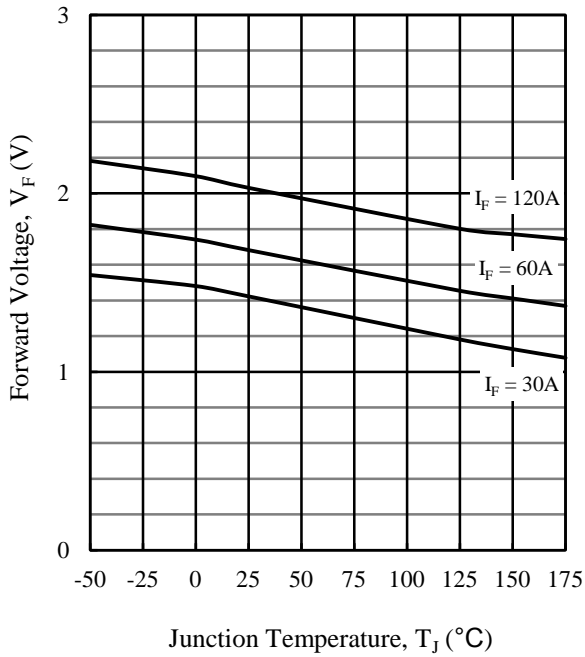


Figure 22. Diode Forward Voltage vs. Junction Temperature

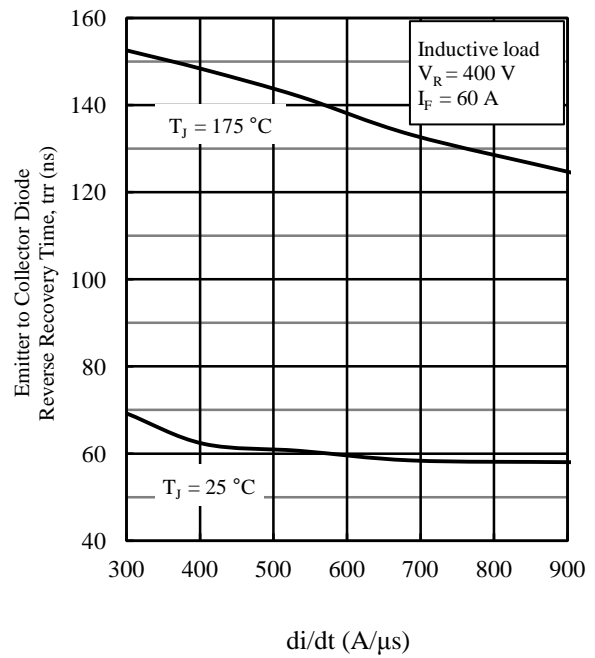


Figure 23. Diode Reverse Recovery Time vs. di/dt

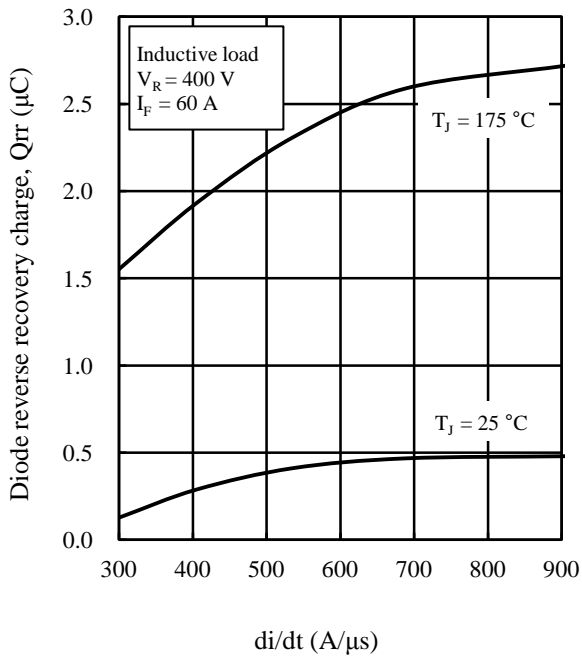


Figure 24. Diode Reverse Recovery Charge vs. di/dt

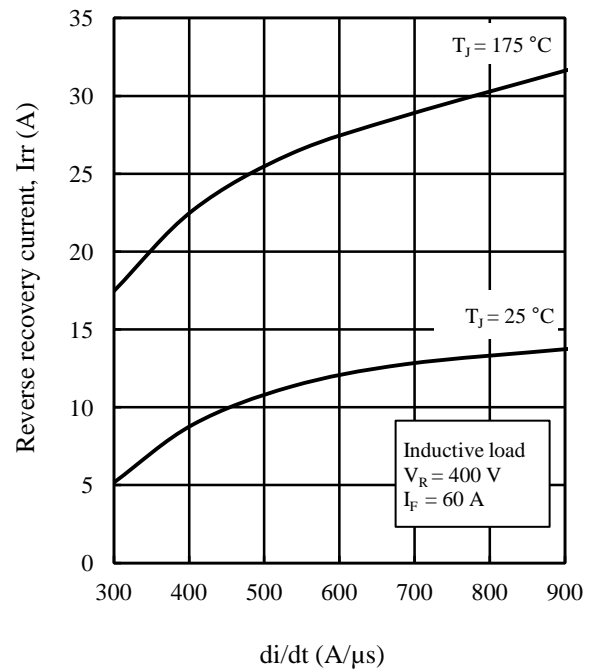


Figure 25. Diode Reverse Recovery Current vs. di/dt

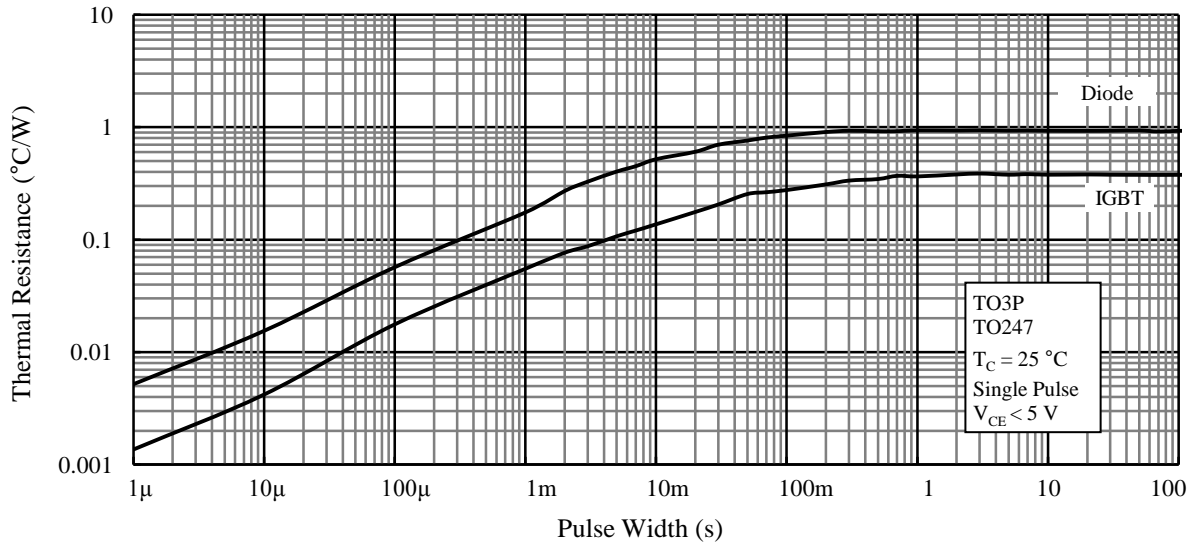
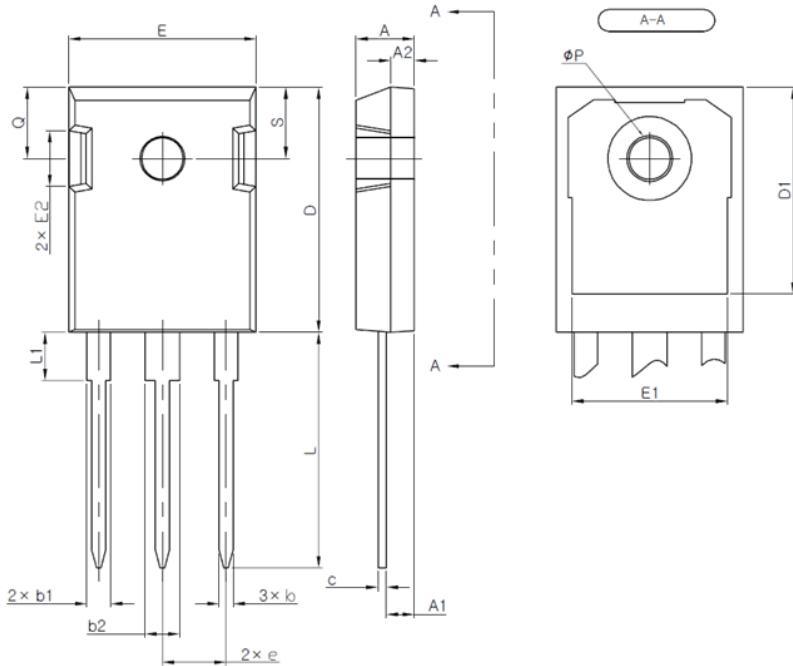


Figure 26. Transient Thermal Resistance

KGF65A6L, MGF65A6L

Physical Dimensions

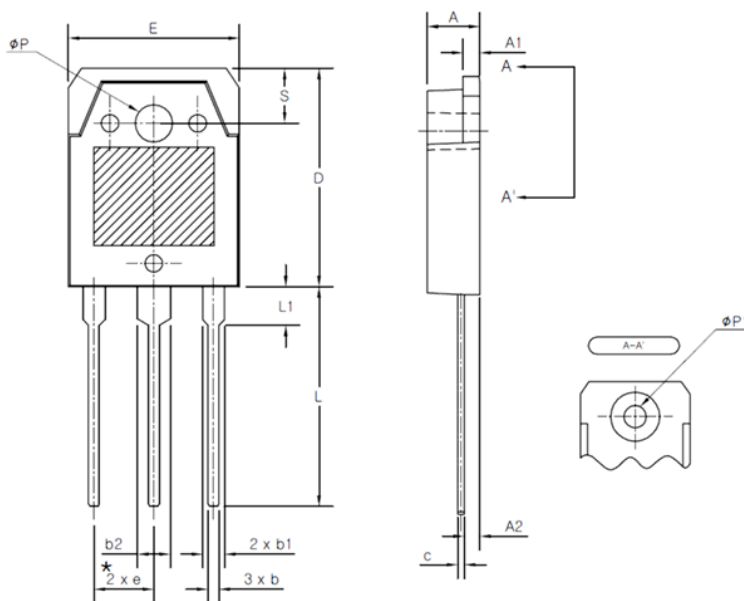
● TO247-3L



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

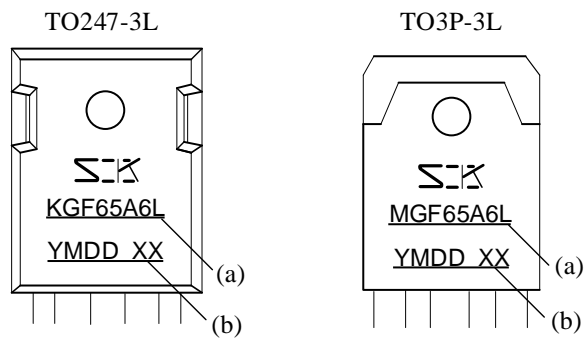
NOTE
1. THESE DIMENSIONS DO NOT INCLUDE PROTRUSIONS OF THE MOLD.
2. THE (*) MARK IS THE REFERENCE

NOTES:

- All dimensions in millimeters
- Pin treatment for TO247 and TO3P: Pb-free (RoHS compliant)
- When soldering the products, make sure to minimize the working time within the following limits:

260 ± 5 °C	10 ± 1 s, 2 times (flow)
380 ± 10 °C	3.5 ± 0.5 s, 1 time (soldering iron)
- 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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DSGN-AEZ-16002