

### Product Summary

$V_{(BR)CES}$	$V_{CE(SAT)MAX}$	$I_c$
650V	1.7V@15V	50A

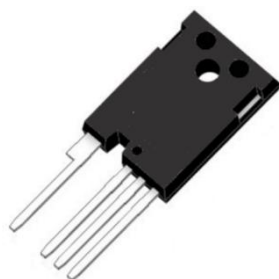
### Feature

- High speed smooth switching device for hard and soft switching
- Positive temperature coefficient
- High ruggedness, temperature stable

### Application

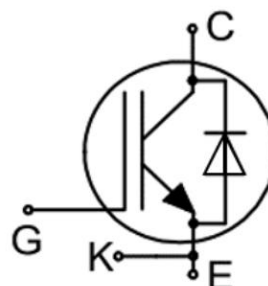
- Solar converters
- Uninterruptible power supplies
- Welding converters
- Mid to high range switching frequency converters

### Package



TO-247-4L

### Circuit diagram



### Marking



### Absolute maximum ratings (Tc=25°C unless otherwise noted)

Parameter	Symbol	Value	Unit
Collector-Emitter Voltage	V <sub>CES</sub>	650	V
Continuous Gate- Emitter Voltage	V <sub>GES</sub>	±20	V
Collector Current	I <sub>C</sub>	80	A
Collector Current(T <sub>C</sub> =100°C)	I <sub>C</sub> (100°C)	60	A
Pulsed Collector Current, tp limited by T <sub>Jmax</sub> ,V <sub>GE</sub> =15V	I <sub>CM</sub>	200	A
Diode Continuous Forward Current	I <sub>F</sub>	80	A
Diode Continuous Forward Current(T <sub>C</sub> =100°C)	I <sub>F</sub> (100°C)	60	A
Diode Forward Current, tp limited by T <sub>Jmax</sub>	I <sub>Fpuls</sub>	200	A
Turn off Safe Operating Area V <sub>CE</sub> ≤ 650V,T <sub>J</sub> ≤150°C	-	200	A
Power Dissipation(T <sub>J</sub> =175°C)	P <sub>D</sub>	283	W
Thermal Resistance, Junction to case for Diode	R <sub>θJC</sub>	1.05	°C/W
Thermal Resistance, Junction to case for IGBT	R <sub>θJC</sub>	0.53	°C/W
Soldering Temperature,wave soldering 1.6mm(0.063in.) from case for 10s	T <sub>L</sub>	260	°C
Junction Temperature Range	T <sub>J</sub>	-40 ~ +175	°C
Storage Temperature Range	T <sub>STG</sub>	-55 ~ +150	°C

### Electrical characteristics of the IGBT (T<sub>J</sub>=25°C unless otherwise noted)

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit	
<b>Static Characteristics</b>							
Collector-Emitter Breakdown Voltage	V <sub>(BR)CES</sub>	V <sub>GE</sub> = 0V, I <sub>C</sub> =250uA	650			V	
Collector-Emitter Leakage Current	I <sub>CES</sub>	V <sub>GE</sub> = 0V, V <sub>CE</sub> =650V			0.25	mA	
		V <sub>GE</sub> = 0V, V <sub>CE</sub> =650V, T <sub>J</sub> =150°C			3		
Gate to Emitter Leakage Current	I <sub>GES</sub>	V <sub>GE</sub> =±20V, V <sub>CE</sub> = 0V			100	nA	
Collector-Emitter Saturation Voltage	V <sub>CE(sat)</sub>	V <sub>GE</sub> =15V,I <sub>C</sub> =50A	1.1	1.4	1.7	V	
		V <sub>GE</sub> =15V,I <sub>C</sub> =50A,T <sub>J</sub> =125°C		1.6			
		V <sub>GE</sub> =15V,I <sub>C</sub> =50A,T <sub>J</sub> =150°C		1.7			
Gate Threshold Voltage	V <sub>GE(th)</sub>	V <sub>CE</sub> =V <sub>GE</sub> ,I <sub>C</sub> =500uA	3.8	4.8	5.8	V	
<b>Dynamic characteristics</b>							
Input Capacitance	C <sub>ies</sub>	V <sub>CE</sub> =25V,V <sub>GE</sub> =0V, f =1MHz		2.86		nF	
Reverse Transfer Capacitance	C <sub>res</sub>			0.02			
Total Gate Charge	Q <sub>g</sub>	V <sub>CC</sub> =520V,V <sub>GE</sub> =15V,I <sub>C</sub> =50A		0.14		uC	
Turn-on delay time	t <sub>d(on)</sub>	V <sub>CC</sub> =400V,V <sub>GE</sub> =-5V~15V, I <sub>C</sub> =50A,R <sub>G</sub> =10Ω, Inductive Load		24		nS	
Turn-on rise time	t <sub>r</sub>			25			
Turn-off delay time	t <sub>d(off)</sub>			82			
Turn-off fall time	t <sub>f</sub>			44			
Turn-on Switching Energy	E <sub>on</sub>				1.51		mJ
Turn-off Switching Energy	E <sub>off</sub>				0.49		
Total Switching Energy	E <sub>ts</sub>				2		
Turn-on delay time	t <sub>d(on)</sub>		V <sub>CC</sub> =400V,V <sub>GE</sub> =-5V~15V, I <sub>C</sub> =50A,R <sub>G</sub> =10Ω,T <sub>J</sub> =125°C, Inductive Load		25		nS
Turn-on rise time	t <sub>r</sub>				31		
Turn-off delay time	t <sub>d(off)</sub>				91		
Turn-off fall time	t <sub>f</sub>			56			
Turn-on Switching Energy	E <sub>on</sub>				1.56		mJ
Turn-off Switching Energy	E <sub>off</sub>				0.68		
Total Switching Loss	E <sub>ts</sub>				2.22		
Turn-on delay time	t <sub>d(on)</sub>	V <sub>CC</sub> =400V, V <sub>GE</sub> =-5V~15V, I <sub>C</sub> =50A, R <sub>G</sub> =10Ω, T <sub>J</sub> =150°C, Inductive Load			26		nS
Turn-on rise time	t <sub>r</sub>				34		
Turn-off delay time	t <sub>d(off)</sub>				96		
Turn-off fall time	t <sub>f</sub>			63			
Turn-on Switching Energy	E <sub>on</sub>				1.59		mJ
Turn-off Switching Energy	E <sub>off</sub>				0.73		
Total Switching Energy	E <sub>ts</sub>				2.32		

### Electrical characteristics of the Diode ( $T_j=25^\circ\text{C}$ unless otherwise noted)

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Diode Forward Voltage	$V_F$	$I_F=50\text{A}$		1.6	2	V
		$I_F=50\text{A}, T_j=125^\circ\text{C}$		1.5		
		$I_F=50\text{A}, T_j=150^\circ\text{C}$		1.4		
Reverse Recovery Current	$I_{rr}$	$I_F=50\text{A}, V_R=400\text{V},$ $-di/dt=450\text{A}/\mu\text{s}$		15		A
Reverse Recovery Charge	$Q_{rr}$			1.58		$\mu\text{C}$
Diode Reverse Recovery Time	$t_{rr}$			148		ns
Reverse Recovery Energy	$E_{rec}$			0.29		mJ
Reverse Recovery Current	$I_{rr}$	$I_F=50\text{A}, V_R=400\text{V},$ $-di/dt=450\text{A}/\mu\text{s}, T_j=125^\circ\text{C}$		21		A
Reverse Recovery Charge	$Q_{rr}$			2.54		$\mu\text{C}$
Diode Reverse Recovery Time	$t_{rr}$			183		ns
Reverse Recovery Energy	$E_{rec}$			0.65		mJ
Reverse Recovery Current	$I_{rr}$	$I_F=50\text{A}, V_R=400\text{V},$ $-di/dt=450\text{A}/\mu\text{s}, T_j=150^\circ\text{C}$		24		A
Reverse Recovery Charge	$Q_{rr}$			3.59		$\mu\text{C}$
Diode Reverse Recovery Time	$t_{rr}$			218		ns
Reverse Recovery Energy	$E_{rec}$			0.79		mJ

## Typical Characteristics

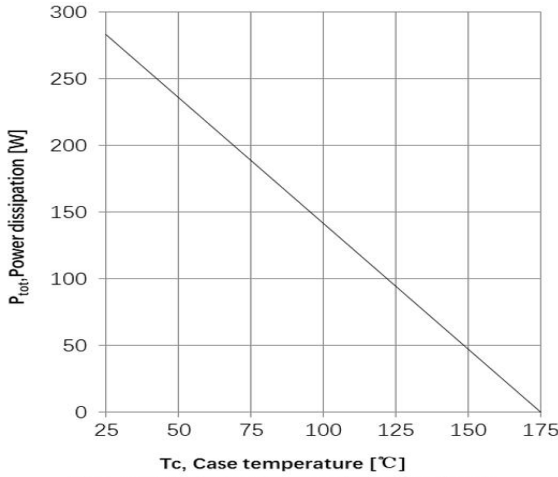


Fig1. Power dissipation as a function of case temperature ( $T_j \leq 175^\circ\text{C}$ )

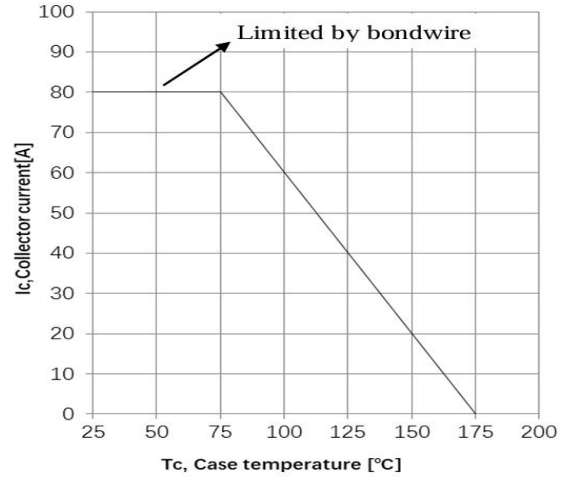


Fig2. Collector current as a function of case temperature ( $V_{ge} \geq 15\text{V}$ ,  $T_j \leq 175^\circ\text{C}$ )

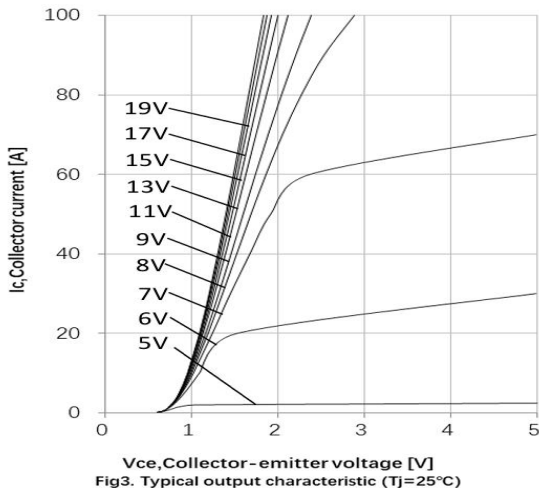


Fig3. Typical output characteristic ( $T_j = 25^\circ\text{C}$ )

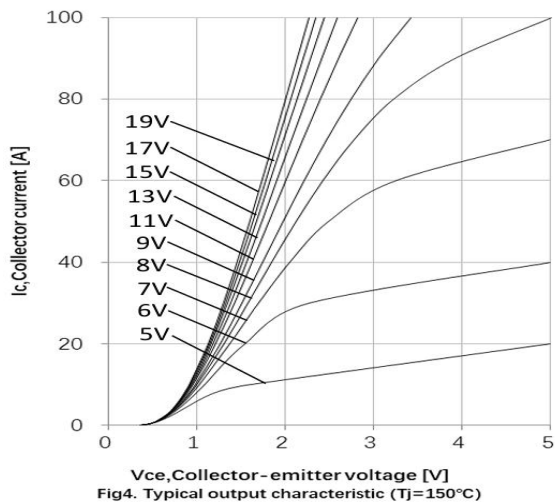


Fig4. Typical output characteristic ( $T_j = 150^\circ\text{C}$ )

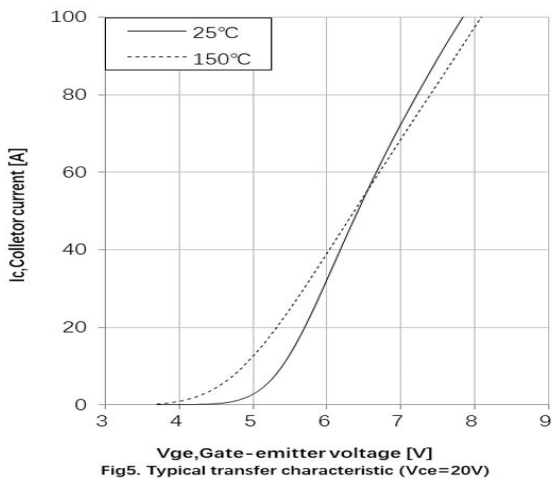


Fig5. Typical transfer characteristic ( $V_{ce} = 20\text{V}$ )

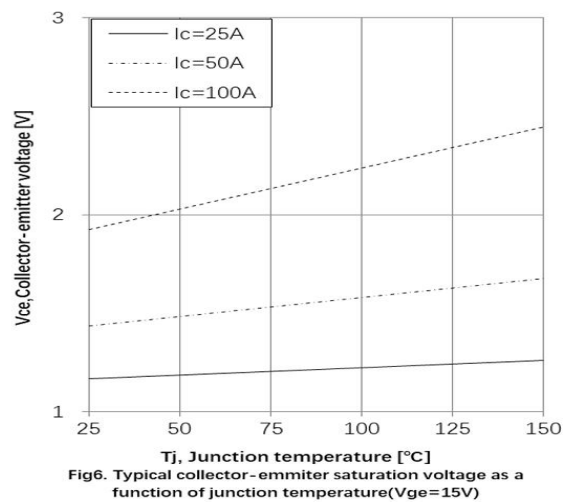
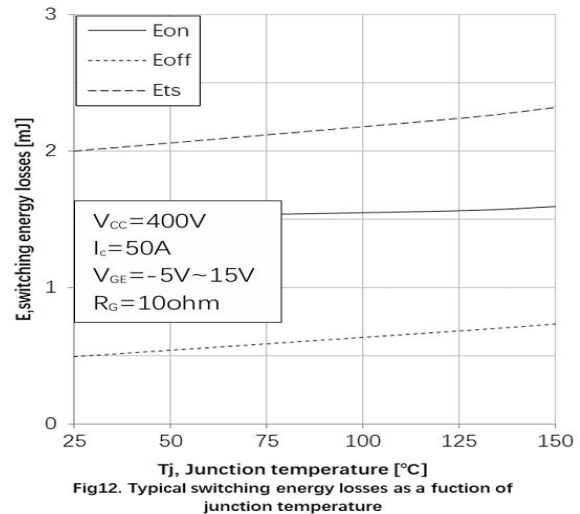
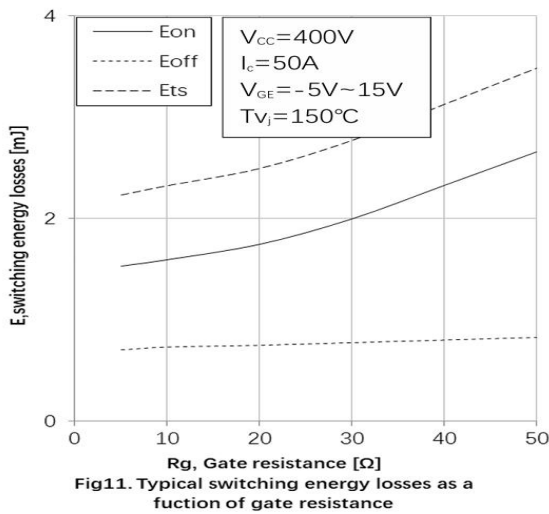
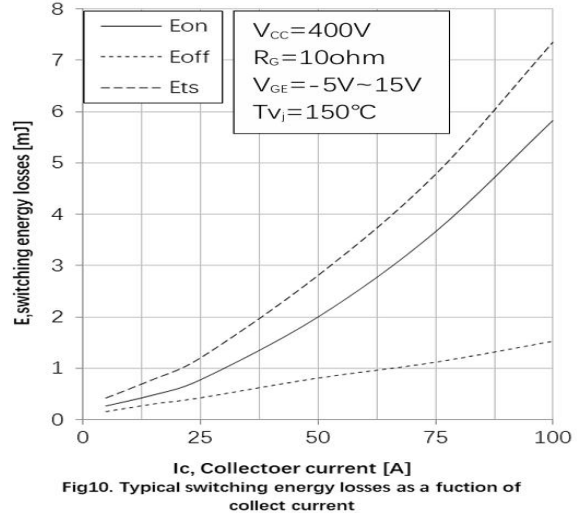
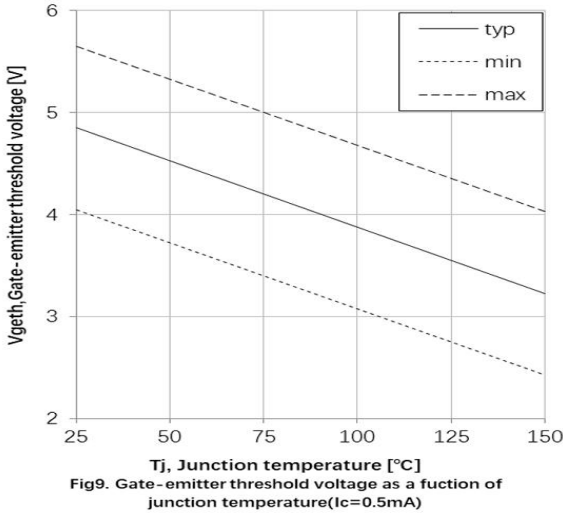
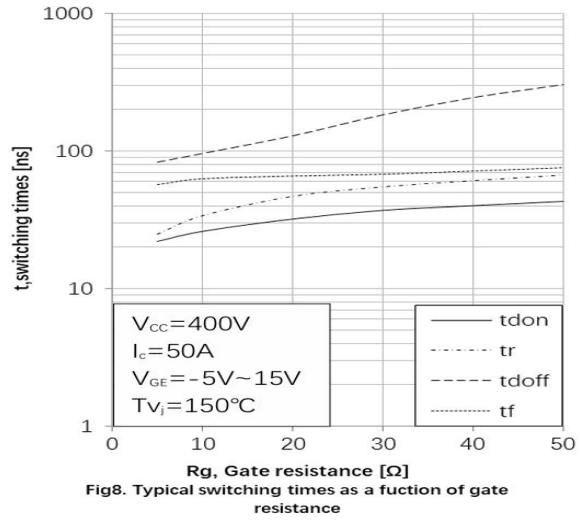
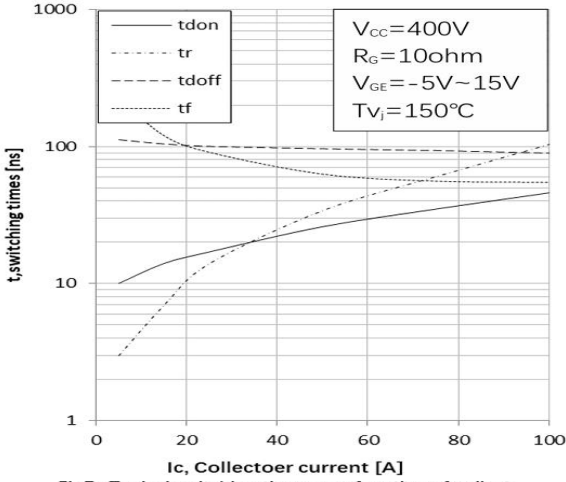


Fig6. Typical collector-emitter saturation voltage as a function of junction temperature ( $V_{ge} = 15\text{V}$ )

### Typical Characteristics



### Typical Characteristics

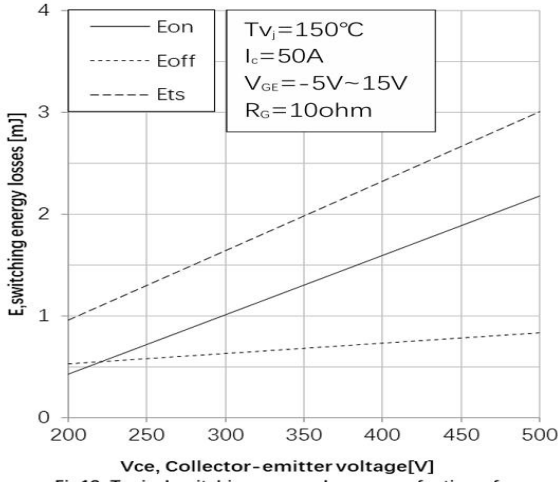


Fig13. Typical switching energy losses as a function of collector-emitter voltage

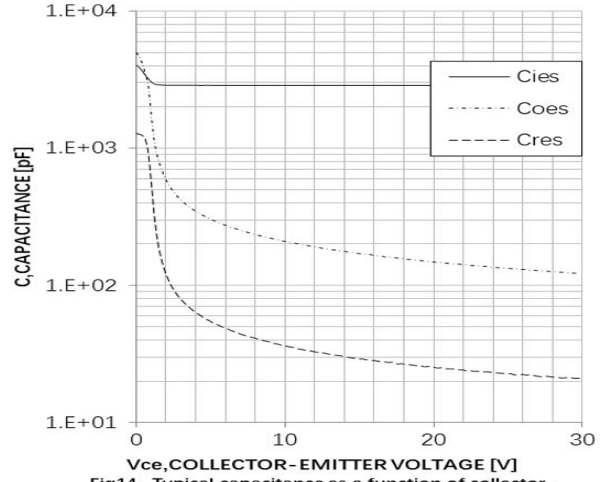


Fig14. Typical capacitance as a function of collector-emitter voltage

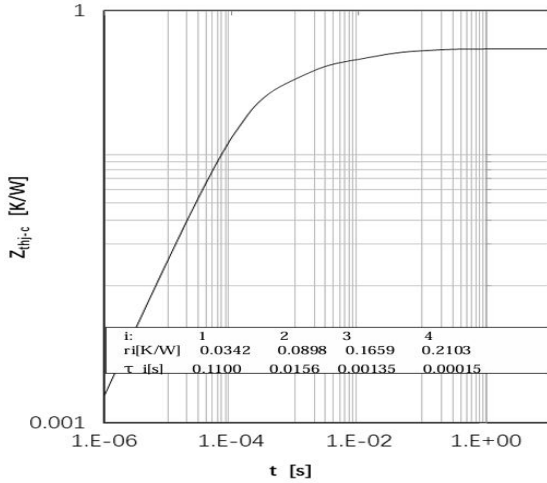


Fig 15. IGBT Transient Thermal Impedance

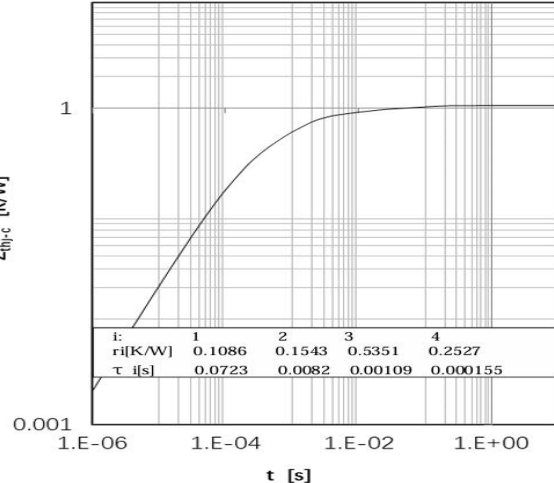


Fig 16. Diode Transient Thermal Impedance

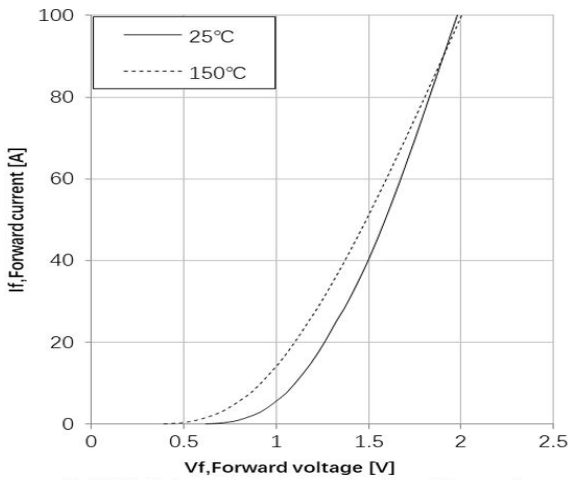


Fig17. Diode forward current as a function of forward voltage

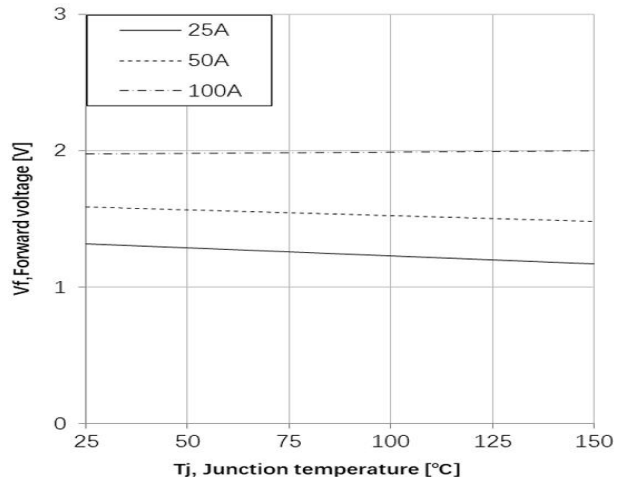
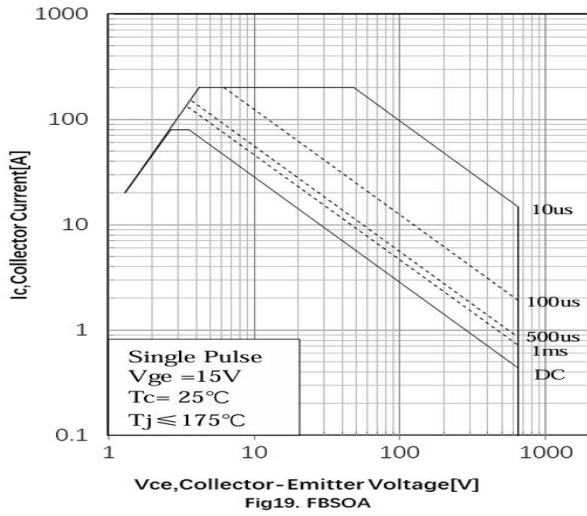
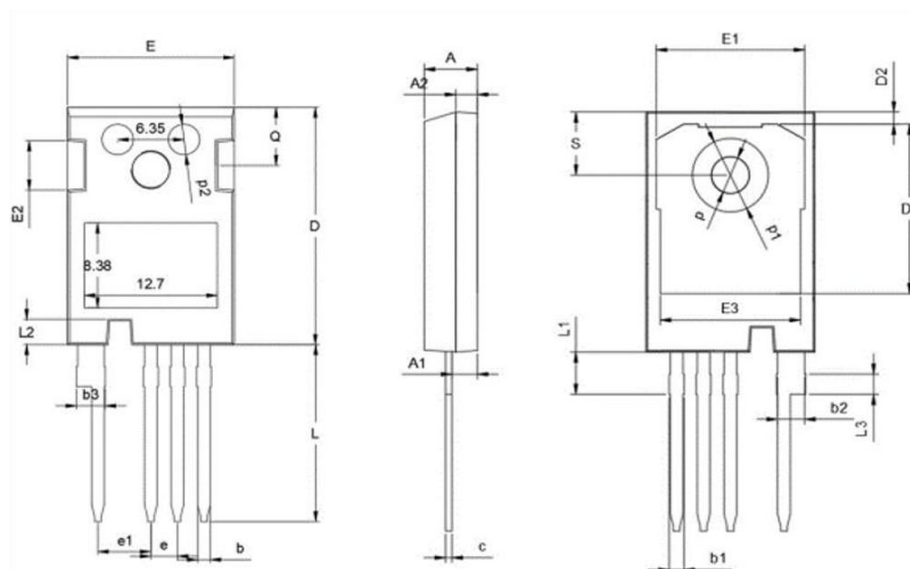


Fig18. Diode forward voltage as a function of junction temperature

**Typical Characteristics**



### TO-247-4L Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.800	5.200	0.189	0.205
A1	2.300	2.500	0.091	0.098
A2	1.880	2.080	0.074	0.082
b	1.100	1.300	0.043	0.051
b1	1.200	1.500	0.047	0.059
b2	2.350	2.750	0.093	0.108
b3	2.450	2.850	0.096	0.112
c	0.550	0.650	0.022	0.026
D	23.300	23.600	0.917	0.929
D1	16.250	16.850	0.640	0.663
D2	1.000	1.300	0.039	0.051
e	2.540 TYP		0.100 YP	
e1	5.060 TYP		0.199 TYP	
E	15.750	16.050	0.620	0.632
E1	13.800	14.200	0.543	0.559
E2	4.400	5.100	0.173	0.201
E3	13.000	13.450	0.512	0.530
L	17.340	17.640	0.683	0.694
L1	4.000	4.300	0.157	0.169
L2	2.350	2.650	0.093	0.104
L3	1.980 TYP		0.078 TYP	
Q	5.600	6.000	0.220	0.236
S	6.050	6.300	0.238	0.248
p	3.580 TYP		0.141 TYP	
p1	7.180 TYP		0.283 TYP	
p2	3.000 TYP		0.118 TYP	