

### Product Summary

$V_{(BR)CES}$	$V_{CE(SAT)MAX}$	$I_c(100^\circ C)$
650V	2.2V@15V	15A

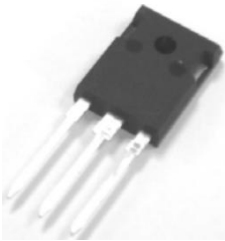
### Feature

- High speed smooth switching device for hard & soft switching
- Positive temperature coefficient
- High ruggedness, temperature stable
- High short circuit capability

### Application

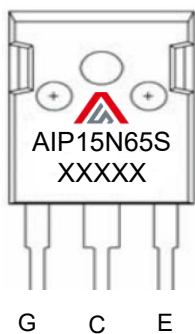
- Inverter for motor drive
- Air conditioning
- Uninterruptible power supply

### Package

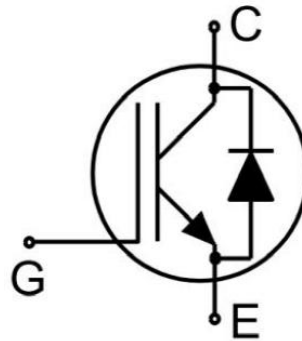


TO-247AB

### Marking



### Circuit diagram



### 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>	30	A
Collector Current(T <sub>C</sub> =100°C)	I <sub>C</sub> (100°C)	15	A
Pulsed Collector Current, tp limited by T <sub>jmax</sub> ,V <sub>GE</sub> =15V	I <sub>CM</sub>	45	A
Diode Continuous Forward Current	I <sub>F</sub>	30	A
Diode Continuous Forward Current(T <sub>C</sub> =100°C)	I <sub>F</sub> (100°C)	15	A
Diode Forward Pulsed Current, tp limited by T <sub>jmax</sub>	I <sub>Fpuls</sub>	45	A
Turn off Safe Operating Area V <sub>CE</sub> ≤650V,T <sub>J</sub> ≤150°C	-	45	A
Power Dissipation(T <sub>J</sub> =175°C)	P <sub>D</sub>	150	W
Thermal Resistance, Junction to case for Diode	R <sub>θJC</sub>	1.5	°C/W
Thermal Resistance, Junction to case for IGBT	R <sub>θJC</sub>	1.0	°C/W
Short Circuit Withstand Time V <sub>GE</sub> =15V, V <sub>CC</sub> =400V, V <sub>CEM</sub> ≤650V	t <sub>sc</sub>	5	us
Maximum Temperature for Soldering,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>CE</sub> =1mA	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			5		
Gate to Emitter Leakage Current	I <sub>GES</sub>	V <sub>GE</sub> =±20V, V <sub>CE</sub> = 0V			200	nA	
Collector-Emitter Saturation Voltage	V <sub>CE(sat)</sub>	V <sub>GE</sub> =15V, I <sub>C</sub> =15A		1.7	2.2	V	
		V <sub>GE</sub> =15V, I <sub>C</sub> =15A, T <sub>J</sub> =125°C		2.1			
		V <sub>GE</sub> =15V, I <sub>C</sub> =15A, T <sub>J</sub> =150°C		2.2			
Gate Threshold Voltage	V <sub>GE(th)</sub>	V <sub>CE</sub> =V <sub>GE</sub> , I <sub>C</sub> =250uA	4.6	5.6	6.2	V	
<b>Dynamic characteristics</b>							
Input Capacitance	C <sub>ies</sub>	V <sub>CE</sub> =25V, V <sub>GE</sub> =0V, f =1MHz		0.99		nF	
Reverse Transfer Capacitance	C <sub>res</sub>			0.03			
Total Gate Charge	Q <sub>g</sub>	V <sub>CC</sub> =480V, V <sub>GE</sub> =15V, I <sub>C</sub> =15A		0.09		uC	
Turn-on delay time	t <sub>d(on)</sub>	V <sub>CC</sub> =300V, V <sub>GE</sub> = -5V~15V, I <sub>C</sub> =15A, R <sub>G</sub> =20Ω,		12		nS	
Turn-on rise time	t <sub>r</sub>			16			
Turn-off delay time	t <sub>d(off)</sub>			41			
Turn-off fall time	t <sub>f</sub>			78			
Turn-on Switching Energy	E <sub>on</sub>			0.29			mJ
Turn-off Switching Energy	E <sub>off</sub>			0.10			
Turn-on delay time	t <sub>d(on)</sub>	V <sub>CC</sub> =300V, V <sub>GE</sub> = -5V~15V, I <sub>C</sub> =15A, R <sub>G</sub> =20Ω, T <sub>J</sub> =125°C		14		nS	
Turn-on rise time	t <sub>r</sub>			18			
Turn-off delay time	t <sub>d(off)</sub>			43			
Turn-off fall time	t <sub>f</sub>			95			
Turn-on Switching Energy	E <sub>on</sub>			0.37			mJ
Turn-off Switching Energy	E <sub>off</sub>			0.14			
Turn-on delay time	t <sub>d(on)</sub>	V <sub>CC</sub> =300V, V <sub>GE</sub> = -5V~15V, I <sub>C</sub> =15A, R <sub>G</sub> =20Ω, T <sub>J</sub> =150°C		15		nS	
Turn-on rise time	t <sub>r</sub>			19			
Turn-off delay time	t <sub>d(off)</sub>			44			
Turn-off fall time	t <sub>f</sub>			102			
Turn-on Switching Energy	E <sub>on</sub>			0.41			mJ
Turn-off Switching Energy	E <sub>off</sub>			0.16			

### 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	$V_{FM}$	$I_F=15\text{A}$		1.60	2.10	V
		$I_F=15\text{A}, T_j=125^\circ\text{C}$		1.50		
		$I_F=15\text{A}, T_j=150^\circ\text{C}$		1.45		
Reverse Recovery Current	$I_{rr}$	$I_F=15\text{A}, V_R=300\text{V},$ $-di/dt=380\text{A}/\mu\text{s}$		6		A
Diode Reverse Recovery Time	$t_{rr}$			197		ns
Reverse Recovery Charge	$Q_{rr}$			0.24		$\mu\text{C}$
Reverse Recovery Energy	$E_{rec}$			0.06		mJ
Reverse Recovery Current	$I_{rr}$	$I_F=15\text{A}, V_R=300\text{V},$ $-di/dt=380\text{A}/\mu\text{s}, T_j=125^\circ\text{C}$		7		A
Diode Reverse Recovery Time	$t_{rr}$			213		ns
Reverse Recovery Charge	$Q_{rr}$			0.58		$\mu\text{C}$
Reverse Recovery Energy	$E_{rec}$			0.11		mJ
Reverse Recovery Current	$I_{rr}$	$I_F=15\text{A}, V_R=300\text{V},$ $-di/dt=380\text{A}/\mu\text{s}, T_j=150^\circ\text{C}$		8		A
Diode Reverse Recovery Time	$t_{rr}$			221		ns
Reverse Recovery Charge	$Q_{rr}$			0.71		$\mu\text{C}$
Reverse Recovery Energy	$E_{rec}$			0.14		mJ

## Typical Characteristics

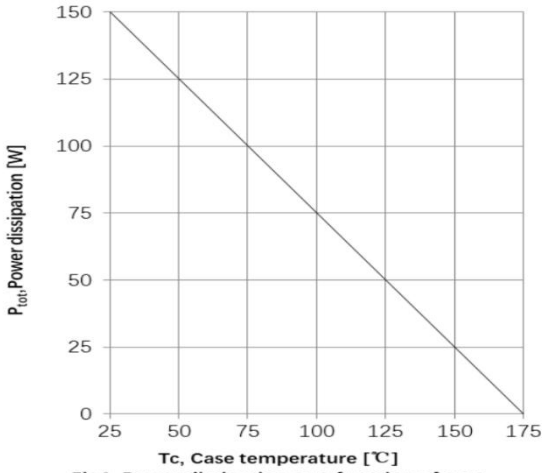


Fig1. Power dissipation as a function of case temperature ( $T_j \leq 175^\circ\text{C}$ )

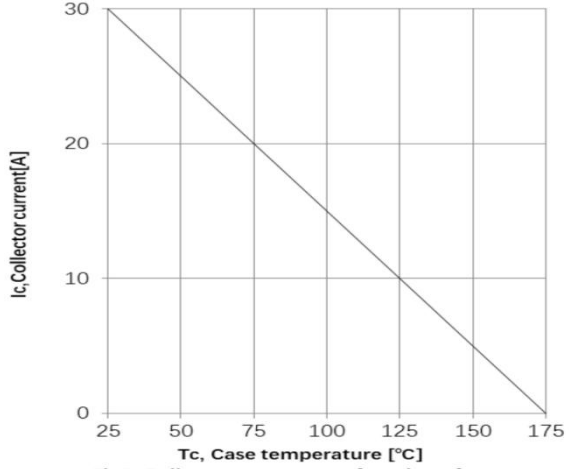


Fig2. Collector current as a function of case temperature ( $V_{ge} \geq 15\text{V}$ ,  $T_j \leq 175^\circ\text{C}$ )

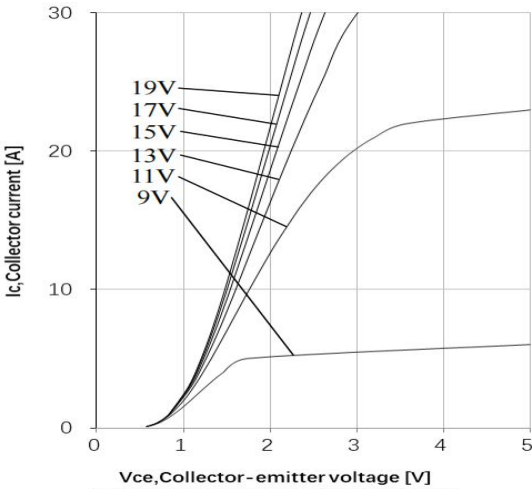


Fig3. Typical output characteristic ( $T_j = 25^\circ\text{C}$ )

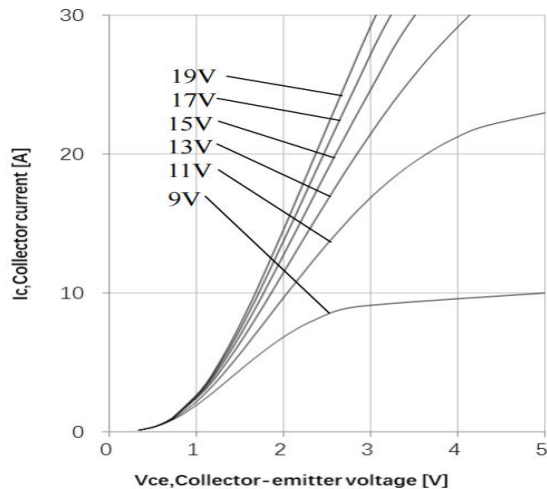


Fig4. Typical output characteristic ( $T_j = 150^\circ\text{C}$ )

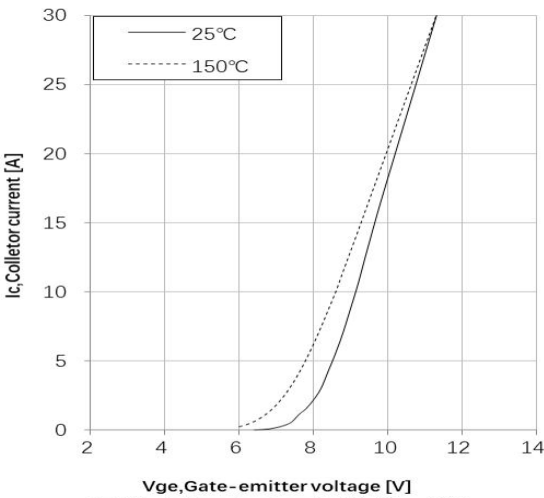


Fig5. Typical transfer characteristic ( $V_{ce} = 20\text{V}$ )

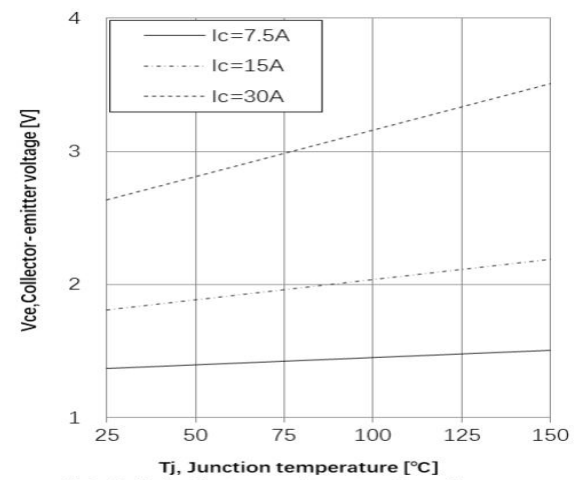


Fig6. Typical collector-emitter saturation voltage as a function of junction temperature ( $V_{ge} = 15\text{V}$ )

## Typical Characteristics

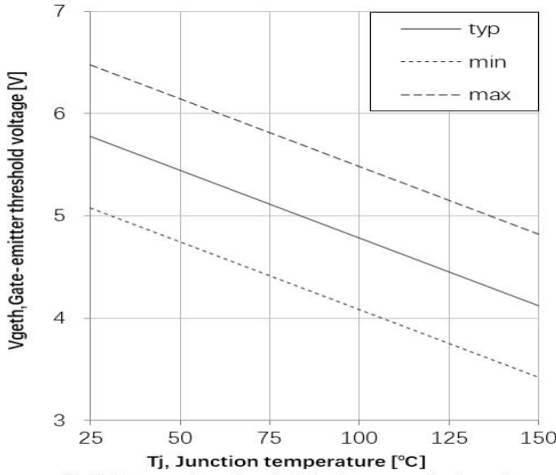


Fig7. Gate-emitter threshold voltage as a function of junction temperature( $I_c=0.60mA$ )

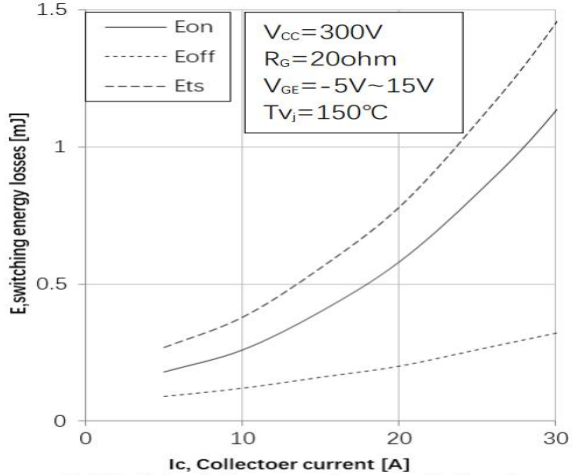


Fig8. Typical switching energy losses as a function of collector current

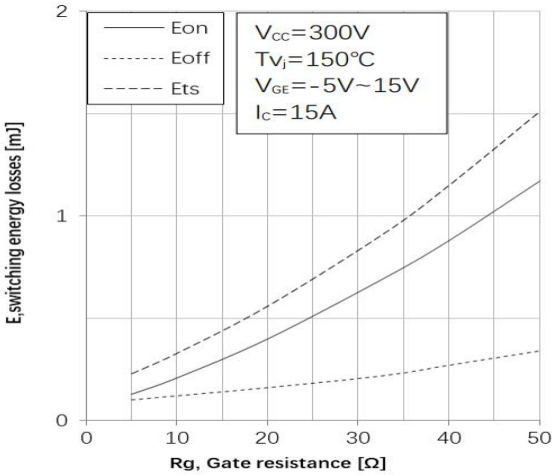


Fig9. Typical switching energy losses as a function of gate resistance

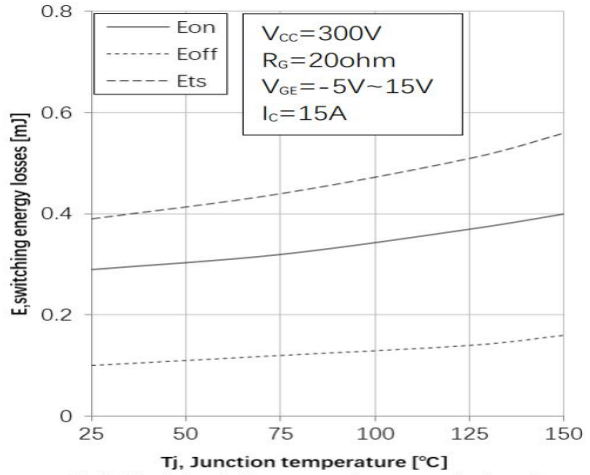


Fig10. Typical switching energy losses as a function of junction temperature

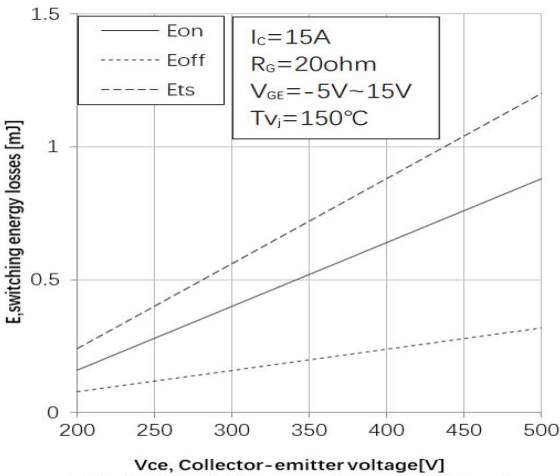


Fig11. Typical switching energy losses as a function of collector-emitter voltage

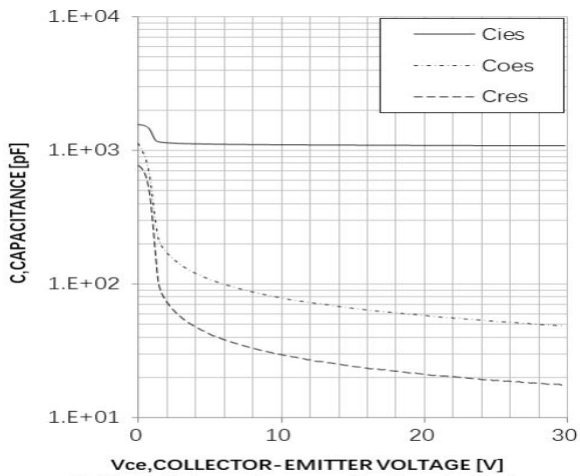


Fig12. Typical capacitance as a function of collector-emitter voltage

## Typical Characteristics

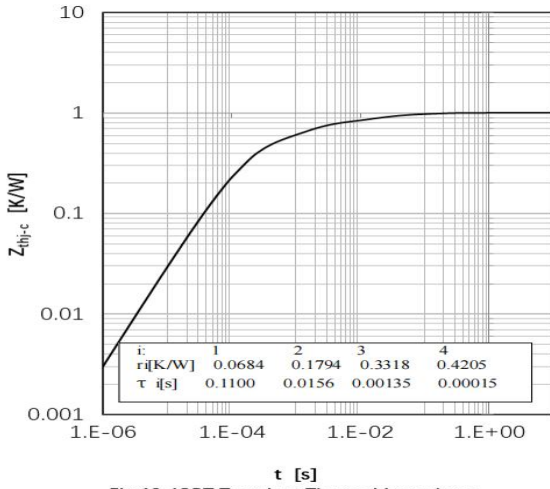


Fig 13. IGBT Transient Thermal Impedance

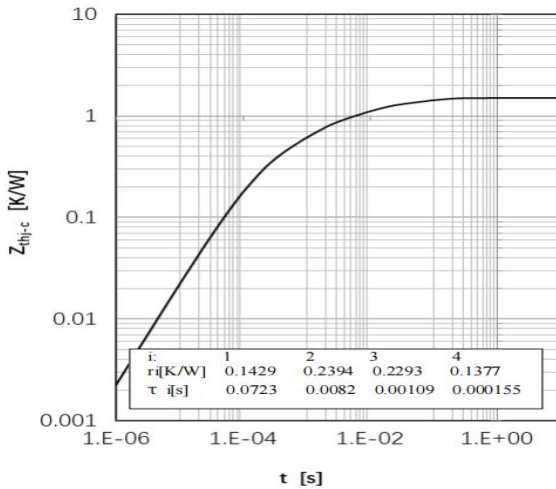


Fig 14. Diode Transient Thermal Impedance

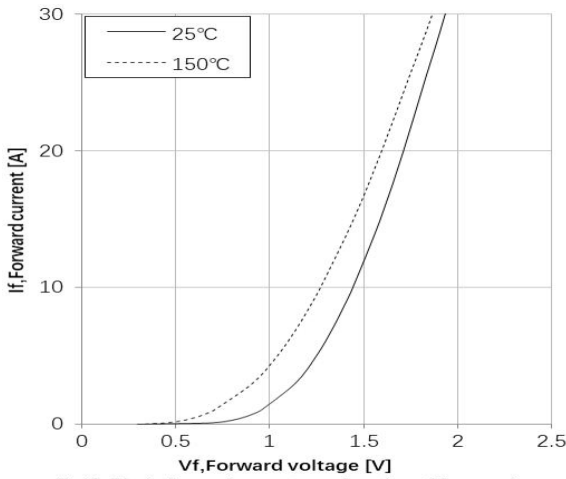


Fig15. Diode forward current as a function of forward voltage

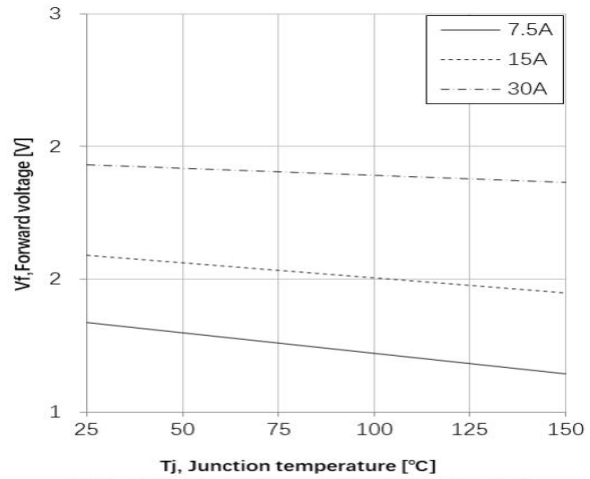
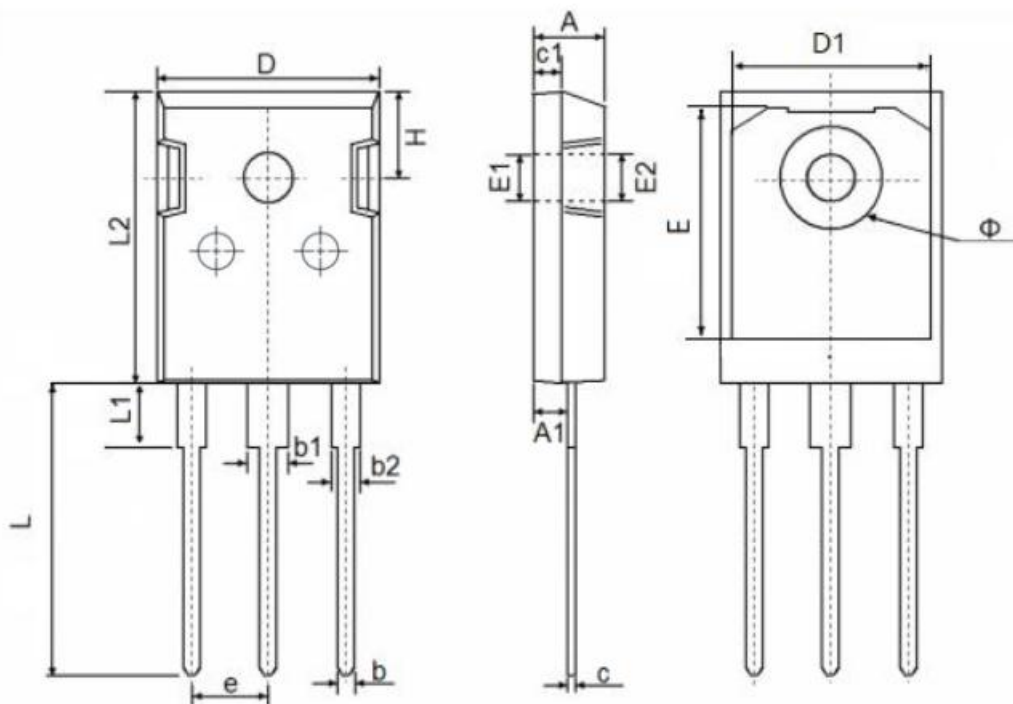


Fig16. Typical diode forward voltage as a function of junction temperature

### TO-247AB Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.800	5.250	0.189	0.207
A1	2.100	2.600	0.083	0.102
b	1.000	1.400	0.039	0.055
b1	2.800	3.400	0.110	0.134
b2	1.800	2.420	0.071	0.095
c	0.500	0.700	0.020	0.028
c1	1.500	2.500	0.059	0.098
D	15.500	16.200	0.610	0.638
D1	13.000	14.200	0.512	0.559
E	16.250	17.650	0.640	0.695
E1	3.650	5.500	0.144	0.220
E2	3.650	5.500	0.144	0.220
L	19.400	20.400	0.764	0.803
L1	3.900	4.500	0.154	0.177
L2	20.800	21.300	0.819	0.836
φ	7.190 REF.		0.283 REF.	
e	5.440 BSC		0.214 BSC	
H	5.300	6.300	0.209	0.248