

Product Summary

$V_{(BR)CES}$	$V_{CE(SAT)TYP}$	$I_C(100^{\circ}C)$
650V	1.60V@15V	20A

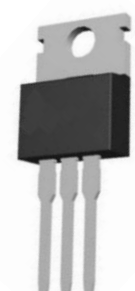
Feature

- High speed smooth switching device for hard & soft switching
- Maximum junction temperature 175°C
- Positive temperature coefficient
- High short circuit capability(5us)
- High ruggedness, temperature stable

Application

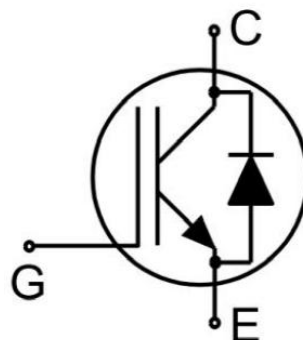
- Inverter for motor drive
- Air conditioning
- Uninterruptible power supply

Package



TO-220AB

Circuit diagram



Marking



Absolute maximum ratings ($T_C=25^{\circ}\text{C}$ unless otherwise noted)

Parameter	Symbol	Value	Unit
Collector-Emitter Voltage	V_{CES}	650	V
Continuous Gate- Emitter Voltage	V_{GE}	± 20	V
Transient Gate-Emitter Voltage ($t_p \leq 10\mu\text{s}, D < 0.01$)	V_{GE}	± 30	V
Collector Current, limited by T_{jmax}	I_C	40	A
Collector Current, limited by T_{jmax} ($T_C = 100^{\circ}\text{C}$)	$I_C(100^{\circ}\text{C})$	20	A
Pulsed Collector Current, t_p limited by T_{jmax} ($V_{GE} = 15\text{V}$)	I_{CM}	60	A
Diode Continuous Forward Current, limited by T_{jmax}	I_F	40	A
Diode Continuous Forward Current, limited by T_{jmax} ($T_C = 100^{\circ}\text{C}$)	$I_F(100^{\circ}\text{C})$	20	A
Diode Pulsed Current, t_p limited by T_{jmax}	I_{Fpuls}	60	A
Turn off Safe Operating Area ($V_{CE} \leq 650\text{V}, T_J \leq 150^{\circ}\text{C}$)	-	60	A
Short Circuit Withstand Time ($V_{GE} = 15\text{V}, V_{CC} = 400\text{V}, V_{CEM} \leq 650\text{V}$)	T_{sc}	5	μs
Power Dissipation ($T_J = 175^{\circ}\text{C}$)	P_D	187	W
Thermal Resistance, Junction to case for Diode	$R_{\theta JC}$	1.5	$^{\circ}\text{C}/\text{W}$
Thermal Resistance, Junction to case for IGBT	$R_{\theta JC}$	0.8	$^{\circ}\text{C}/\text{W}$
Operating junction temperature range	T_J	$-40 \sim +175$	$^{\circ}\text{C}$
Storage Temperature Range	T_{STG}	$-55 \sim +150$	$^{\circ}\text{C}$

Electrical characteristics of the IGBT ($T_J=25^{\circ}\text{C}$ unless otherwise noted)

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Static Characteristics						
Collector-Emitter Breakdown Voltage	$V_{(BR)CES}$	$V_{GE}=0V, I_C=1mA$	650			V
Collector-Emitter Leakage Current	I_{CES}	$V_{GE}=0V, V_{CE}=650V$			1	mA
		$V_{GE}=0V, V_{CE}=650V, T_J=150^{\circ}C$			5	
Gate to Emitter Leakage Current	I_{GES}	$V_{GE}=\pm 20V, V_{CE}=0V$			± 200	nA
Gate Threshold Voltage	$V_{GE(th)}$	$V_{GE}=V_{CE}, I_C=250\mu A$	4	5	6.5	V
Collector-Emitter Saturation Voltage	$V_{CE(sat)}$	$V_{GE}=15V, I_C=20A$		1.6	1.9	V
		$V_{GE}=15V, I_C=20A, T_J=125^{\circ}C$		1.8		
		$V_{GE}=15V, I_C=20A, T_J=150^{\circ}C$		1.9		
Dynamic characteristics						
Input Capacitance	C_{ies}	$V_{CE}=25V, V_{GE}=0V, f=1MHz$		1.05		nF
Reverse Transfer Capacitance	C_{res}			0.02		
Total Gate Charge	Q_g	$V_{CC}=300V, V_{GE}=15V, I_C=20A$		0.09		μC
Turn-on delay time	$t_{d(on)}$	$V_{CC}=300V, V_{GE}=-5V\sim 15V$ $I_C=20A, R_G=20\Omega$		46		nS
Turn-on rise time	t_r			47		
Turn-off delay time	$t_{d(off)}$			80		
Turn-off fall time	t_f			74		
Turn-On Switching Loss	E_{on}			0.36		mJ
Turn-Off Switching Loss	E_{off}			0.25		

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Dynamic characteristics						
Turn-on delay time	$t_{d(on)}$	$V_{CC}=300V, V_{GE}=-5V\sim15V$ $I_C=20A, R_G=20\Omega$ $T_J=125^\circ C$		39		nS
Turn-on rise time	t_r			53		
Turn-off delay time	$t_{d(off)}$			95		
Turn-off fall time	t_f			131		
Turn-On Switching Loss	E_{on}	$V_{CC}=300V, V_{GE}=-5V\sim15V$ $I_C=20A, R_G=20\Omega$ $T_J=150^\circ C$		0.39		mJ
Turn-Off Switching Loss	E_{off}			0.37		
Turn-on delay time	$t_{d(on)}$			40		nS
Turn-on rise time	t_r			55		
Turn-off delay time	$t_{d(off)}$			95		
Turn-off fall time	t_f			138		
Turn-On Switching Loss	E_{on}			0.41		mJ
Turn-Off Switching Loss	E_{off}			0.40		

Electrical characteristics of the Diode ($T_J=25^\circ C$ unless otherwise noted)

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Diode Forward Voltage	V_F	$I_F=20A$		1.75	2.3	V
		$I_F=20A, T_J=125^\circ C$		1.65		
		$I_F=20A, T_J=150^\circ C$		1.6		
Reverse Recovery Current	I_{rrm}	$V_R=300V, I_F=20A$ $di/dt=-360A/\mu s$		6		A
Reverse Recovery Charge	Q_{rr}			0.25		μC
Reverse Recovery Time	T_{rr}			200		nS
Reverse Recovery Energy	E_{rec}			0.07		mJ
Reverse Recovery Current	I_{rrm}	$V_R=300V, I_F=20A$ $di/dt=-360A/\mu s$ $T_J=125^\circ C$		8		A
Reverse Recovery Charge	Q_{rr}			0.59		μC
Reverse Recovery Time	T_{rr}			218		nS
Reverse Recovery Energy	E_{rec}			0.13		mJ
Reverse Recovery Current	I_{rrm}	$V_R=300V, I_F=20A$ $di/dt=-360A/\mu s$ $T_J=150^\circ C$		9		A
Reverse Recovery Charge	Q_{rr}			0.78		μC
Reverse Recovery Time	T_{rr}			227		nS
Reverse Recovery Energy	E_{rec}			0.16		mJ

Typical Characteristics

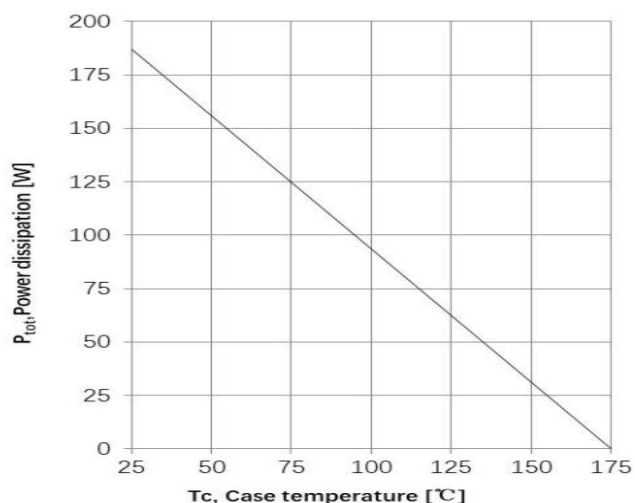


Fig1. Power dissipation as a function of case temperature ($T_j \leq 175^\circ\text{C}$)

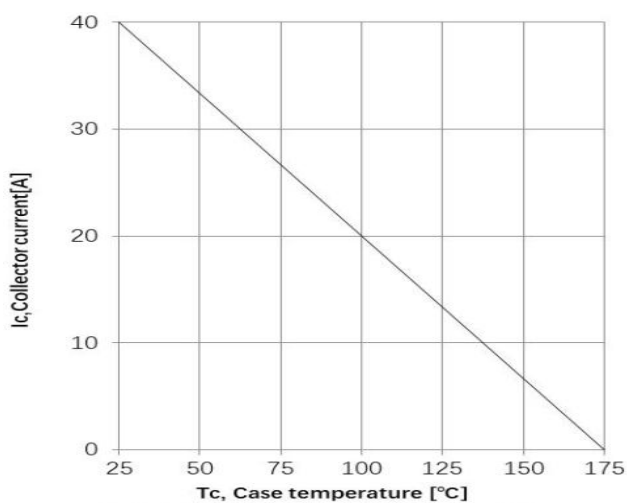


Fig2. Collector current as a function of case temperature ($V_{ge} \geq 15\text{V}$, $T_j \leq 175^\circ\text{C}$)

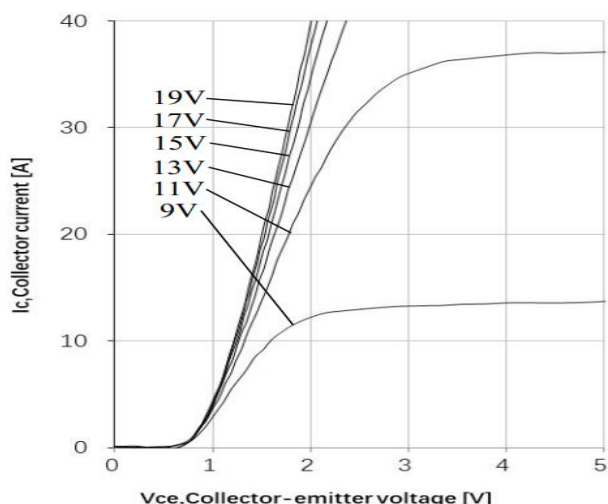


Fig3. Typical output characteristic ($T_j = 25^\circ\text{C}$)

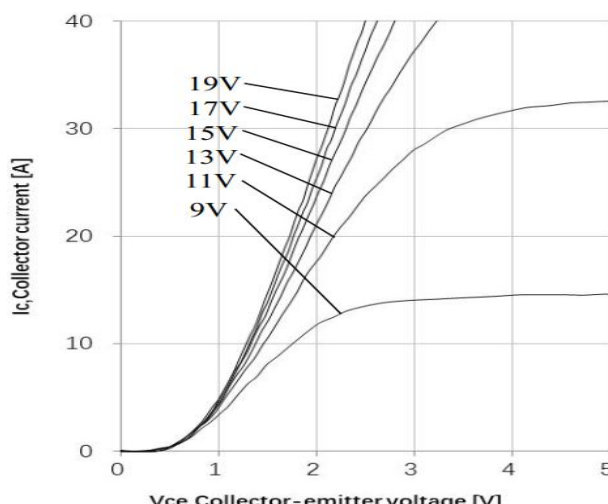


Fig4. Typical output characteristic ($T_j = 150^\circ\text{C}$)

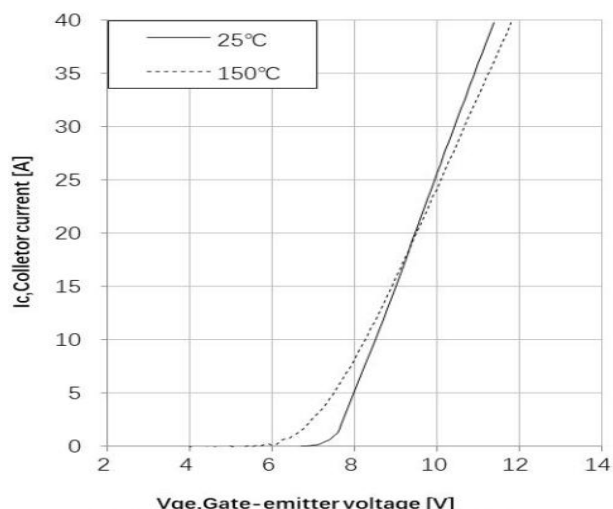


Fig5. Typical transfer characteristic ($V_{ce} = 20\text{V}$)

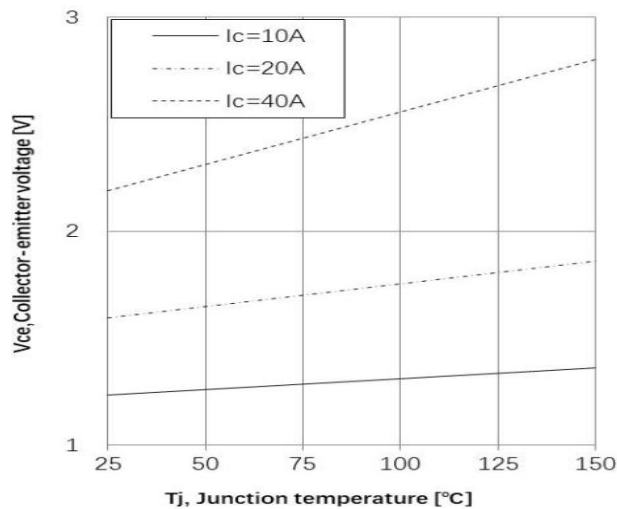


Fig6. Typical collector-emitter saturation voltage as a function of junction temperature ($V_{ge} = 15\text{V}$)

Typical Characteristics

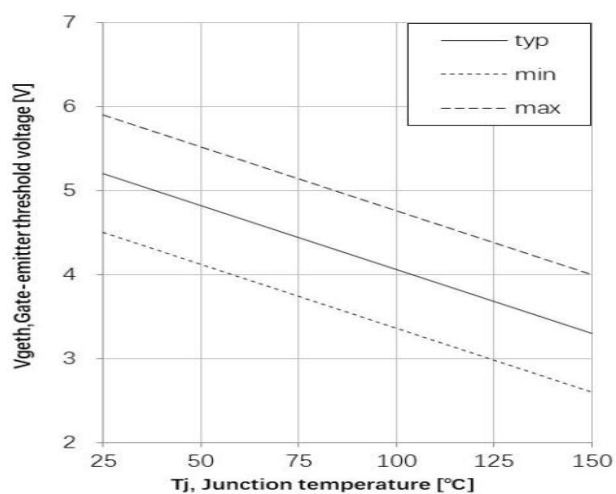


Fig7. Gate-emitter threshold voltage as a function of junction temperature ($I_c=0.60mA$)

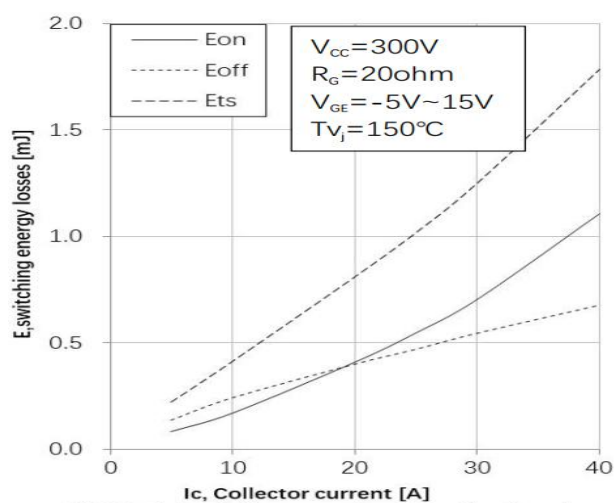


Fig8. Typical switching energy losses as a function of collector current

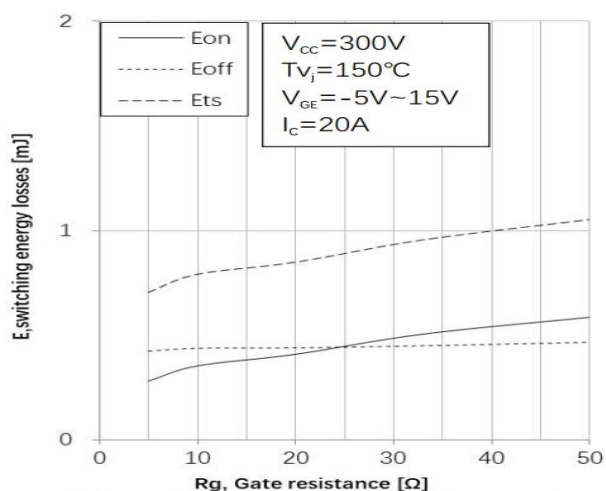


Fig9. Typical switching energy losses as a function of gate resistance

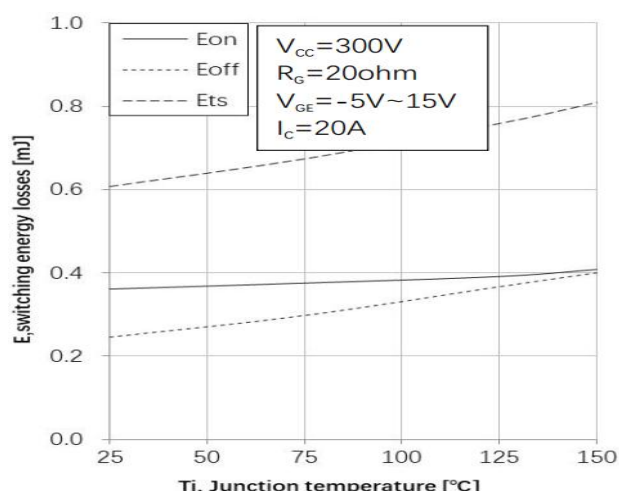


Fig10. Typical switching energy losses as a function of junction temperature

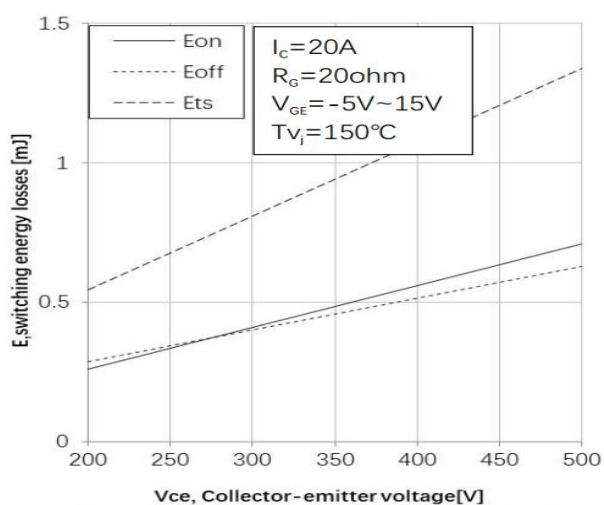


Fig11. Typical switching energy losses as a function of collector-emitter voltage

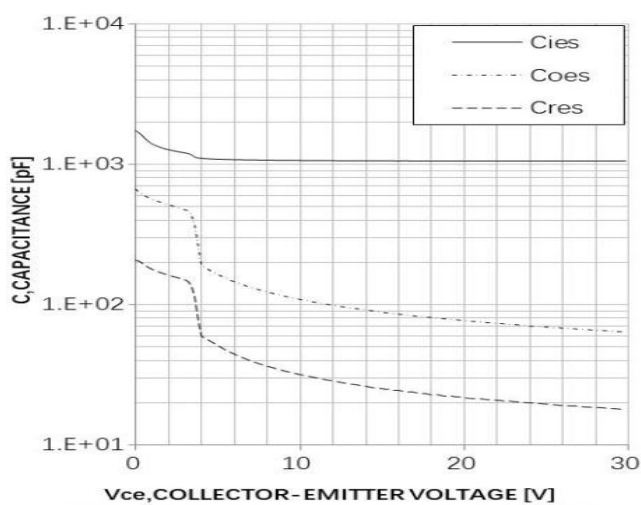


Fig12. Typical capacitance as a function of collector-emitter voltage

Typical Characteristics

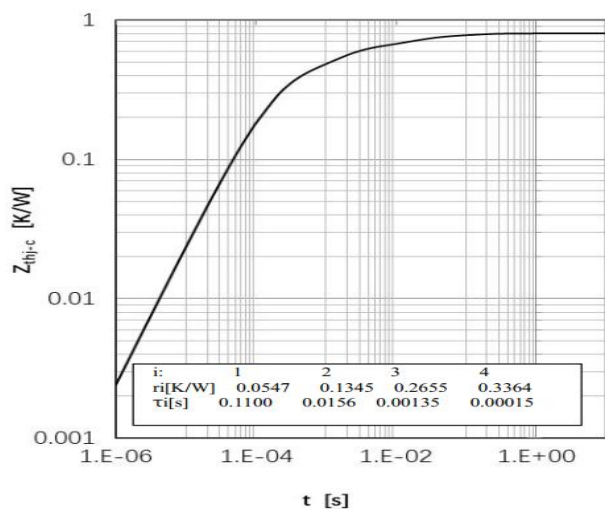


Fig 13. IGBT Transient Thermal Impedance

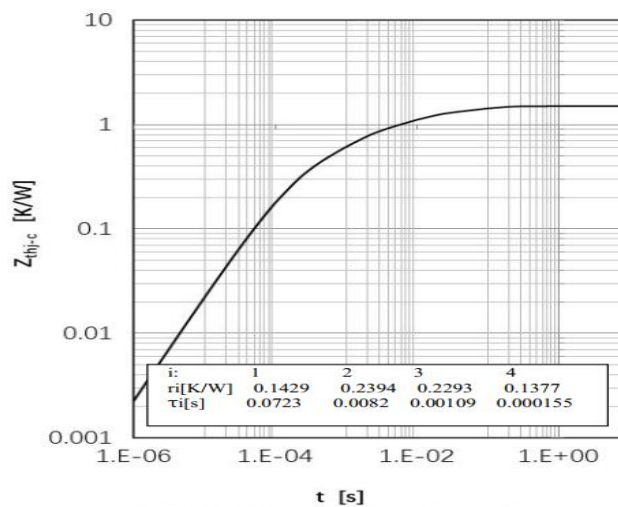


Fig 14. Diode Transient Thermal Impedance

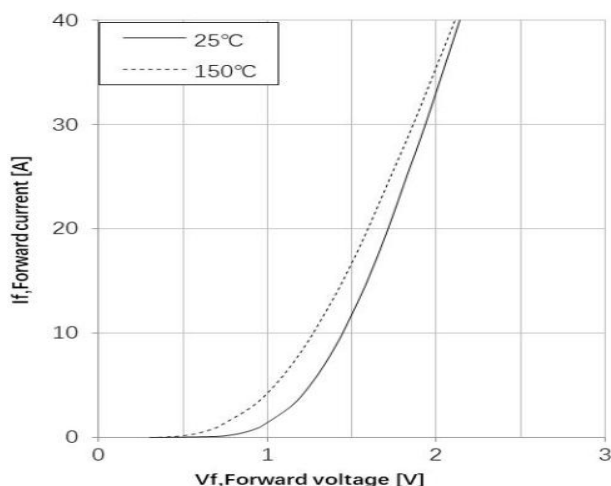


Fig15. Diode forward current as a function of forward voltage

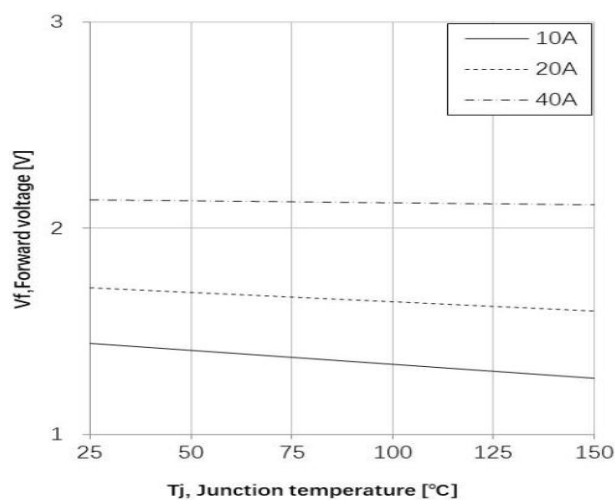
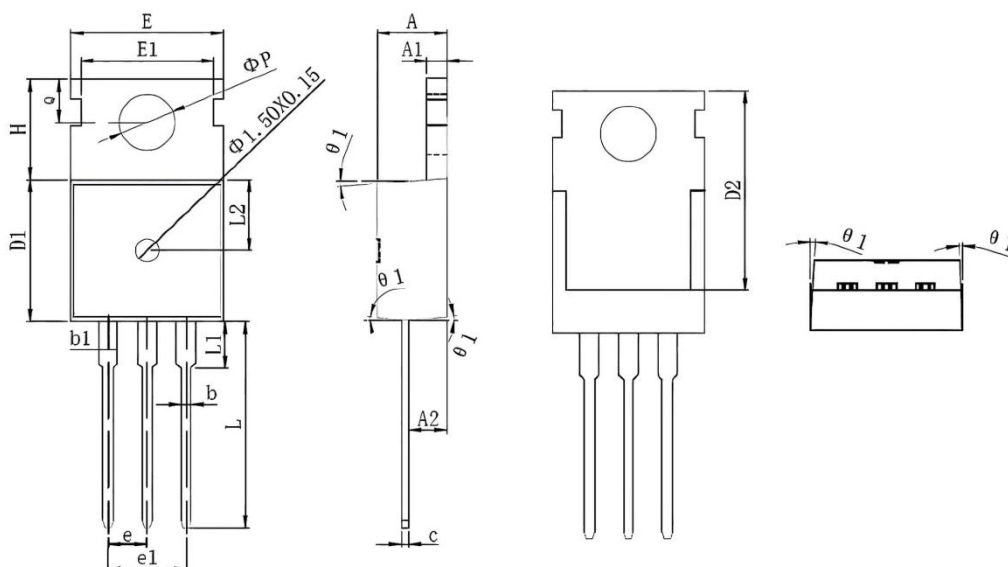


Fig16. Typical diode forward voltage as a function of junction temperature

TO-220AB Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	4.400	4.600	0.173	0.181
A1	1.250	1.350	0.049	0.053
A2	2.300	2.500	0.091	0.098
b	0.750	0.850	0.030	0.033
b1	1.250	1.420	0.049	0.056
C	0.450	0.550	0.018	0.022
D1	9.100	9.300	0.358	0.366
D2	12.900	13.300	0.508	0.524
E	9.800	10.150	0.386	0.400
E1	8.550	8.850	0.337	0.348
e	2.500	2.580	0.098	0.102
e1	5.080 BSC.		0.200 BSC.	
H	6.400	6.600	0.252	0.260
L	13.000	13.450	0.512	0.530
L1	-	3.400	-	0.134
L2	4.550	4.750	0.179	0.187
ϕP	3.600	3.750	0.142	0.148
Q	2.700	2.900	0.106	0.114
$\theta 1$	2°	7°	2°	7°