

Product Summary

$V_{(BR)CES}$	$V_{CE(SAT)TYP}$	$I_C(100^{\circ}C)$
650V	1.65V@15V	10A

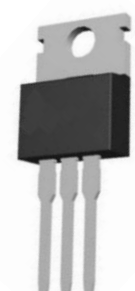
Feature

- 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

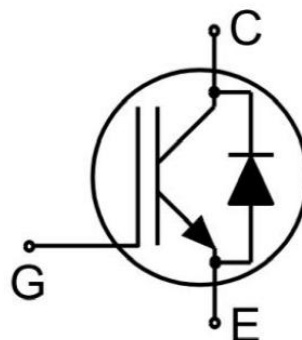
- Inverter for motor drive
- Air conditioning
- Uninterruptible power supply

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	20	A
Collector Current, limited by T_{jmax} ($T_C = 100^{\circ}\text{C}$)	$I_C(100^{\circ}\text{C})$	10	A
Pulsed Collector Current, t_p limited by T_{jmax} ($V_{GE} = 15\text{V}$)	I_{CM}	30	A
Diode Continuous Forward Current, limited by T_{jmax}	I_F	20	A
Diode Continuous Forward Current, limited by T_{jmax} ($T_C = 100^{\circ}\text{C}$)	$I_F(100^{\circ}\text{C})$	10	A
Diode Pulsed Current, t_p limited by T_{jmax}	I_{Fpuls}	30	A
Turn off Safe Operating Area ($V_{CE} \leq 650\text{V}, T_J \leq 150^{\circ}\text{C}$)	-	30	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	115	W
Thermal Resistance, Junction to case for Diode	$R_{\theta JC}$	1.5	$^{\circ}\text{C/W}$
Thermal Resistance, Junction to case for IGBT	$R_{\theta JC}$	1.3	$^{\circ}\text{C/W}$
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			0.25	mA
		V _{GE} =0V, V _{CE} =650V, T _J =150°C			5	
Gate to Emitter Leakage Current	I _{GES}	V _{GE} =±20V, V _{CE} =0V			±200	nA
Gate Threshold Voltage	V _{GE(th)}	V _{GE} =V _{CE} , I _C =250μA	4	5.5	6.5	V
Collector-Emitter Saturation Voltage	V _{CE(sat)}	V _{GE} =15V, I _C =10A		1.65	2.15	V
		V _{GE} =15V, I _C =10A, T _J =125°C		1.8		
		V _{GE} =15V, I _C =10A, T _J =150°C		1.85		
Dynamic characteristics						
Input Capacitance	C _{ies}	V _{CE} =25V, V _{GE} =0V, f =1MHz		0.56		nF
Reverse Transfer Capacitance	C _{res}			0.01		
Total Gate Charge	Q _g	V _{CC} =400V, V _{GE} =15V, I _C =10A		0.06		μC
Turn-on delay time	t _{d(on)}	V _{CC} =400V, V _{GE} =-5V~15V I _C =10A, R _G =10Ω		7		nS
Turn-on rise time	t _r			17		
Turn-off delay time	t _{d(off)}			23		
Turn-off fall time	t _f			106		
Turn-On Switching Loss	E _{on}			0.19		mJ
Turn-Off Switching Loss	E _{off}			0.17		

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Dynamic characteristics						
Turn-on delay time	$t_{d(on)}$	$V_{CC}=400V, V_{GE}=-5V\sim 15V$ $I_C=10A, R_G=10\Omega$ $T_J=125^\circ C$		6		nS
Turn-on rise time	t_r			18		
Turn-off delay time	$t_{d(off)}$			28		
Turn-off fall time	t_f			161		
Turn-On Switching Loss	E_{on}			0.21		mJ
Turn-Off Switching Loss	E_{off}			0.25		
Turn-on delay time	$t_{d(on)}$	$V_{CC}=400V, V_{GE}=-5V\sim 15V$ $I_C=10A, R_G=10\Omega$ $T_J=150^\circ C$		6		nS
Turn-on rise time	t_r			18		
Turn-off delay time	$t_{d(off)}$			31		
Turn-off fall time	t_f			189		
Turn-On Switching Loss	E_{on}			0.23		mJ
Turn-Off Switching Loss	E_{off}			0.3		

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	$I_F=10A$		1.5	2	V
		$I_F=10A, T_J=125^\circ C$		1.4		
		$I_F=10A, T_J=150^\circ C$		1.35		
Reverse Recovery Current	I_{rrm}	$V_R=400V, I_F=10A$ $di/dt=-320A/\mu s$		9		A
Reverse Recovery Charge	Q_{rr}			0.33		uC
Reverse Recovery Time	T_{rr}			81		nS
Reverse Recovery Energy	E_{rec}			0.06		mJ
Reverse Recovery Current	I_{rrm}	$V_R=400V, I_F=10A$ $di/dt=-320A/\mu s$ $T_J=125^\circ C$		11		A
Reverse Recovery Charge	Q_{rr}			0.52		uC
Reverse Recovery Time	T_{rr}			99		nS
Reverse Recovery Energy	E_{rec}			0.14		mJ
Reverse Recovery Current	I_{rrm}	$V_R=400V, I_F=10A$ $di/dt=-320A/\mu s$ $T_J=150^\circ C$		12		A
Reverse Recovery Charge	Q_{rr}			0.77		uC
Reverse Recovery Time	T_{rr}			106		nS
Reverse Recovery Energy	E_{rec}			0.17		mJ

Typical Characteristics

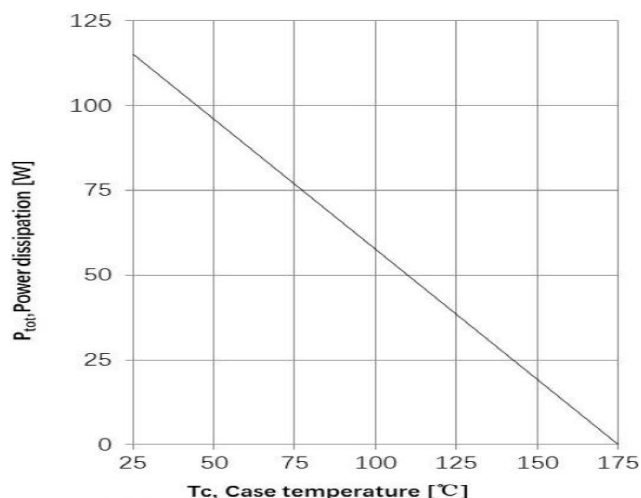


Fig1. Power dissipation as a function of case temperature ($T_j \leq 175^\circ\text{C}$)

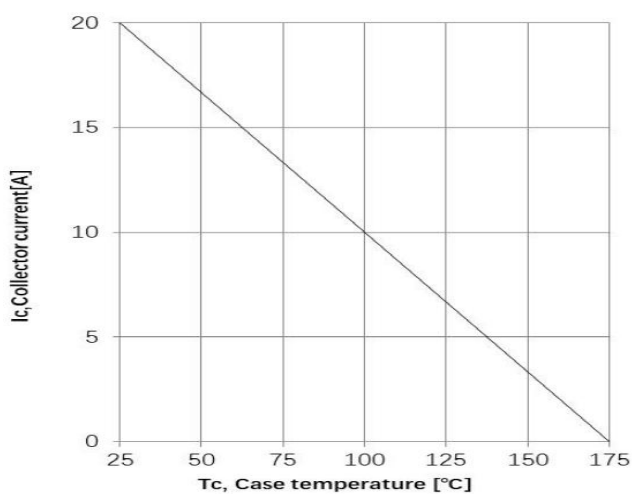


Fig2. Collector current as a function of case temperature ($V_{ge} \geq 15\text{V}$, $T_j \leq 175^\circ\text{C}$)

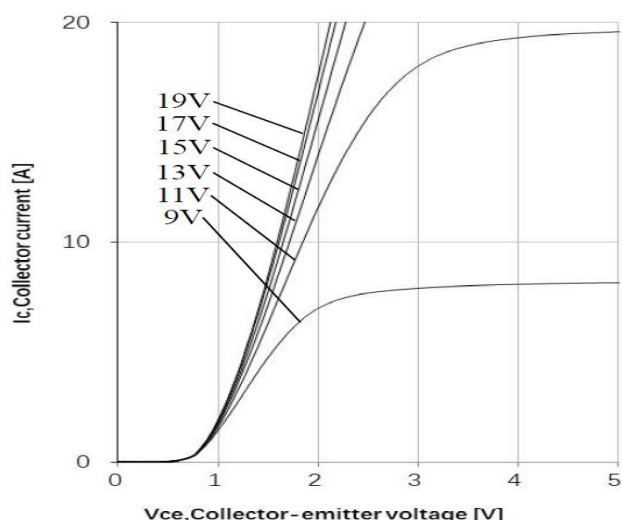


Fig3. Typical output characteristic ($T_j = 25^\circ\text{C}$)

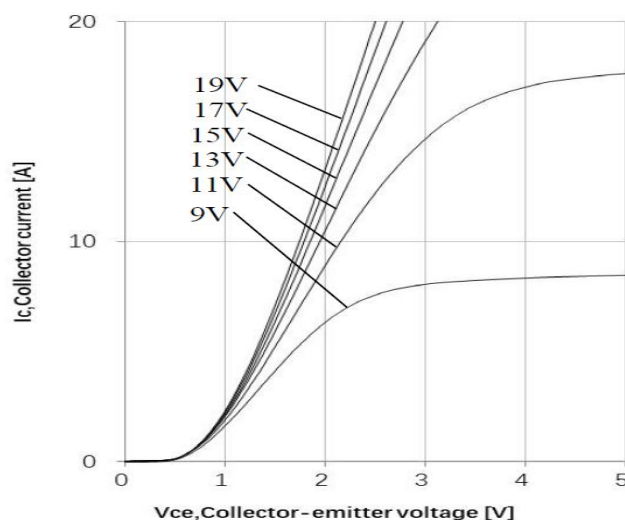


Fig4. Typical output characteristic ($T_j = 150^\circ\text{C}$)

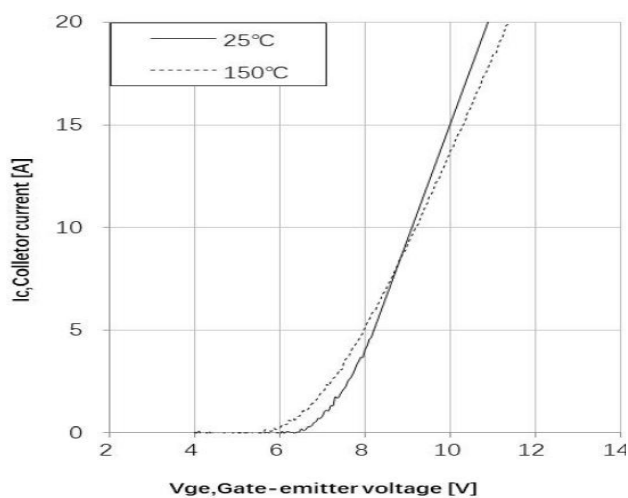


Fig5. Typical transfer characteristic ($V_{ce} = 20\text{V}$)

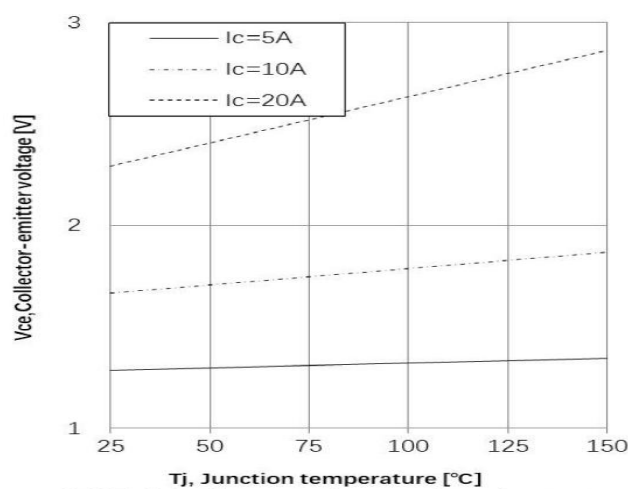


Fig6. Typical collector-emitter saturation voltage as a function of junction temperature ($V_{ge} = 15\text{V}$)

Typical Characteristics

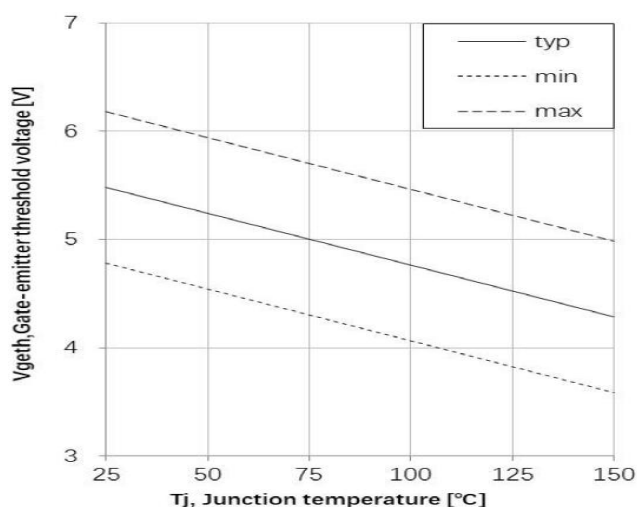


Fig7. Gate-emitter threshold voltage as a function of junction temperature ($I_c=0.25mA$)

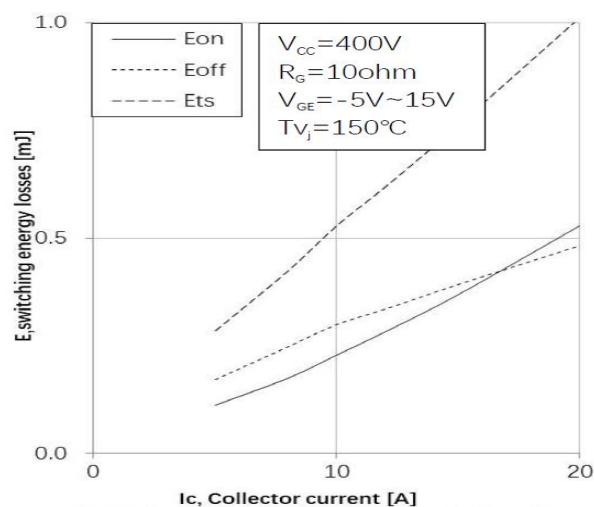


Fig8. Typical switching energy losses as a function of collector current

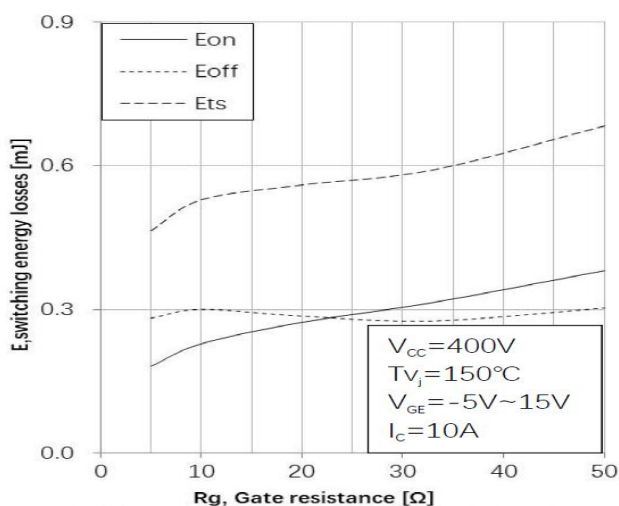


Fig9. Typical switching energy losses as a function of gate resistance

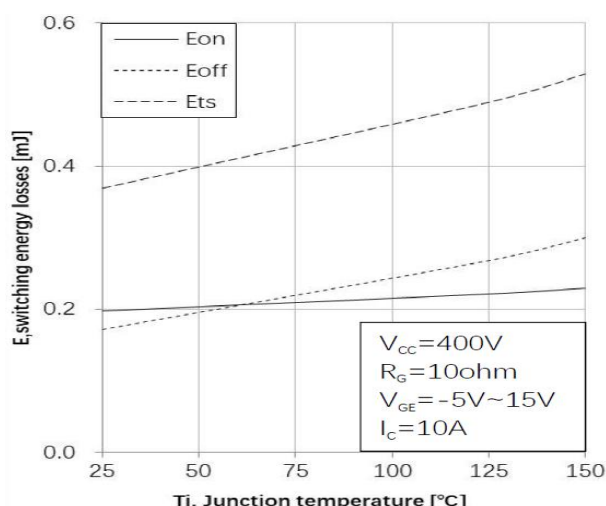


Fig10. Typical switching energy losses as a function of junction temperature

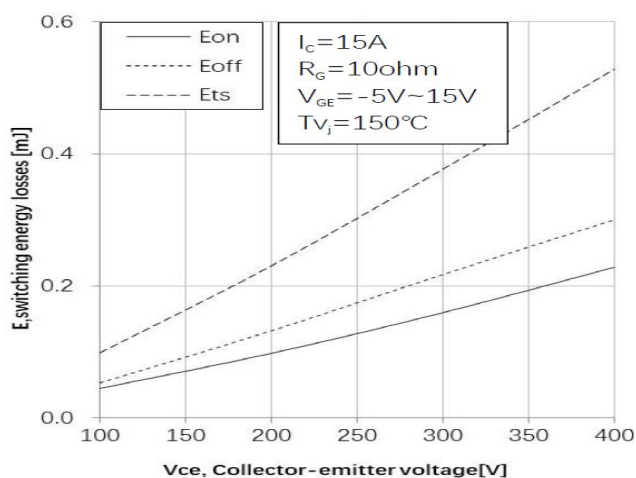


Fig11. Typical switching energy losses as a function of collector-emitter voltage

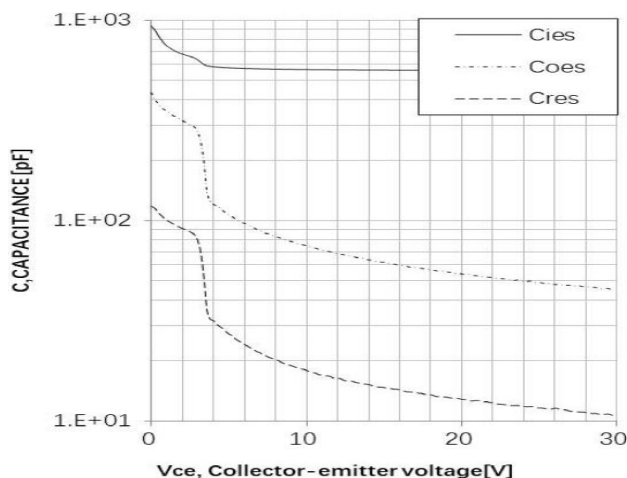


Fig12. Typical capacitance as a function of collector-emitter voltage

Typical Characteristics

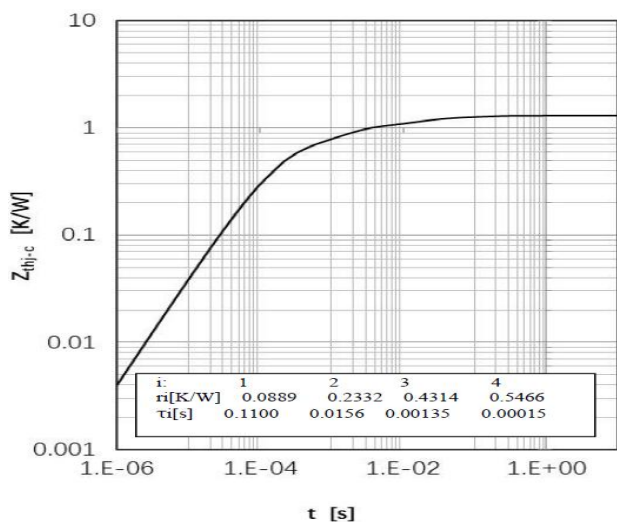


Fig 13. IGBT Transient Thermal Impedance

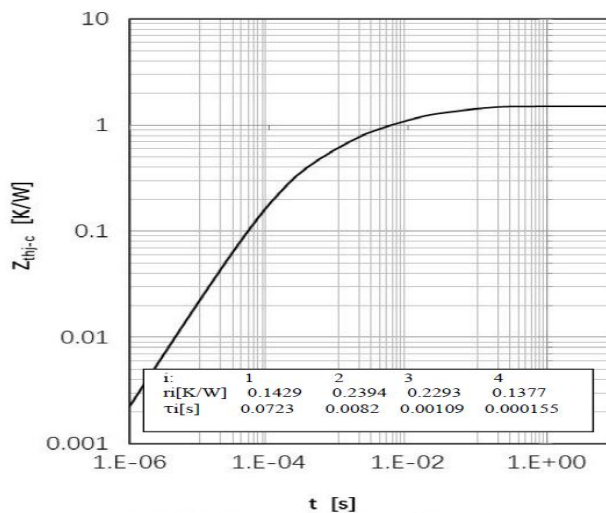


Fig 14. Diode Transient Thermal Impedance

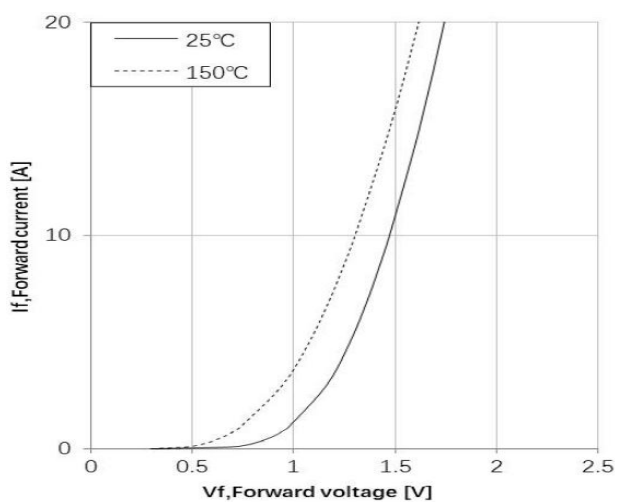


Fig15. Diode forward current as a function of forward voltage

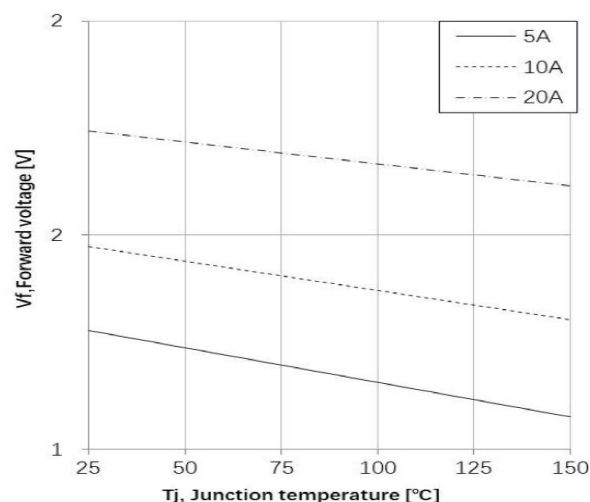
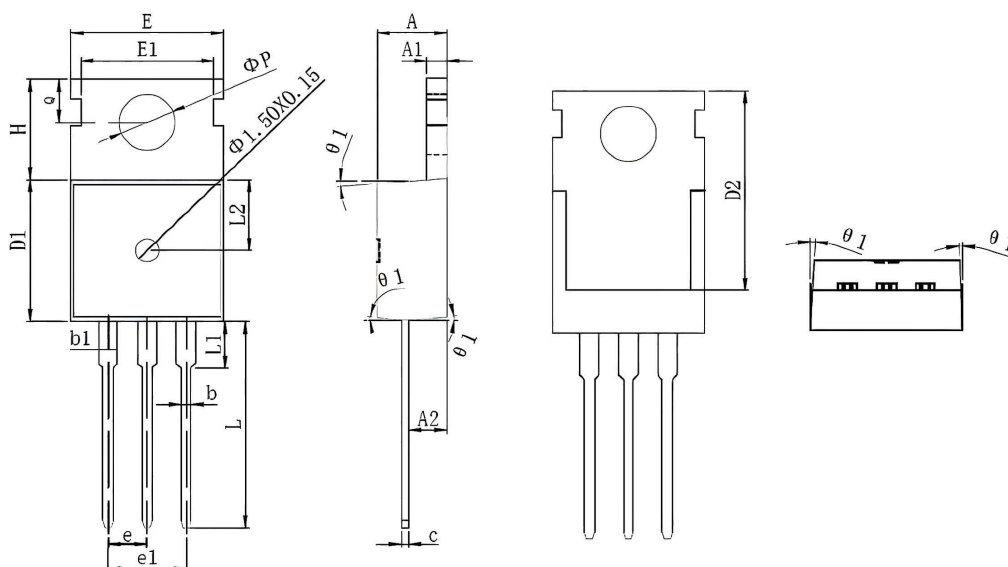


Fig16. Typical diode forward voltage as a function of junction temperature

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
φ P	3.600	3.750	0.142	0.148
Q	2.700	2.900	0.106	0.114
θ1	2°	7°	2°	7°