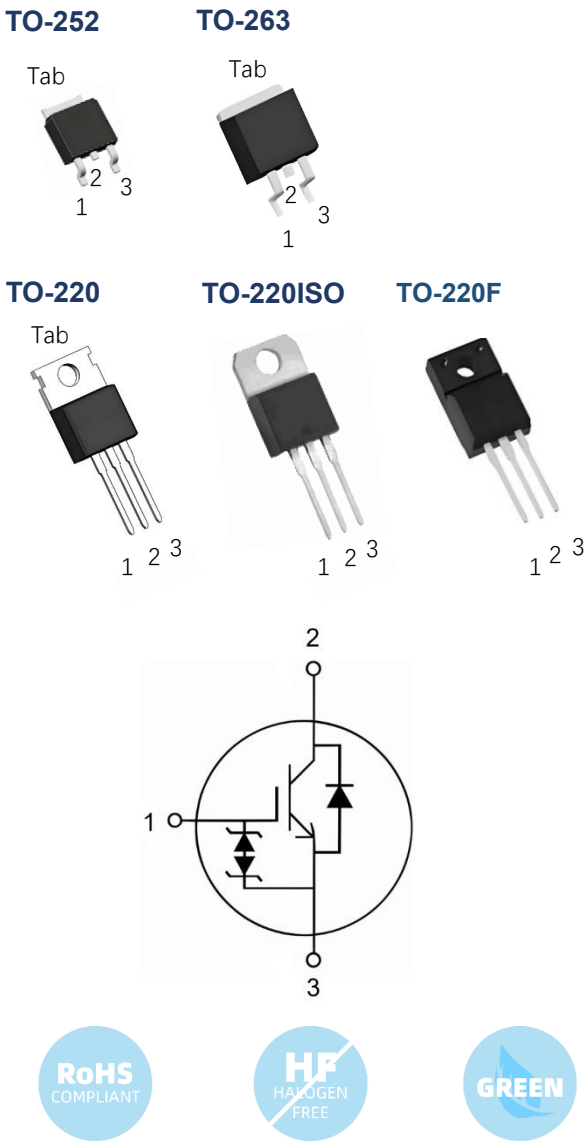
IGBT with Trench and Field-Stop technology, Built-in gate ESD protection

WGD10x65STSB3P



Features

- V_{CES}=650V
- I_C=10A@T_C=100℃
- High efficient turn-on di/dt controllability
- Low $V_{CE(sat)}$ enable high efficiencies
- Low Turn-off switching loss
- Very Good EMI and High Short-Circuit Ruggedness
- RoSH Compliant
- ESD-HBM Class 2

Applications

- Motor Drives
- Home Appliance Applications
- Fan, Pumps, Vacuum Cleaner
- Other Hard Switching Applications

Package pin definition	1	2/Tab	3
	Gate	Collector	Emitter

Part	Package	Marking	Packing method	MPQ
WGD10D65STSB3P	TO-252	10D65STSB3P	Tape and reel	2.5K/Reel
WGD10M65STSB3P	TO-263	10M65STSB3P	Tape and reel	800/Reel
WGD10K65STSB3P	TO-220	10K65STSB3P	Tube	50/Tube
WGD10A65STSB3P	TO-220ISO	10A65STSB3P	Tube	50/Tube
WGD10L65STSB3P	TO-220F	10L65STSB3P	Tube	50/Tube

Maximum Ratings

Table 1 Maximum rated Values(T_C=25℃ unless otherwise specified)

Parameter	Symbol	Condition	TO-252	TO-263/ TO-220	TO-220 ISO	TO-220F	Unit
Collector to Emitter Voltage	V_{CES}		650				V
Gate to Emitter Voltage	V_{GES}		±20				V
Continuous Collector Current [1]	I_C	T_C=25℃	20				A
		T_C =100℃	10				A
Pulsed Collector Current [1]	I_{CM}		40				A
Diode Continuous Forward Current [1]	I_F	T_C=25℃	20				A
		T_C =100℃	10				A
Diode Maximum Forward Current [1]	I_{FM}		40				A
Maximum Power Dissipation	P_D	T_C=25℃	100	136	83	42	W
		T_C =100℃	50	68	42	21	W
Operating Junction Temperature Range	T_J		-55~+175				℃
Storage Temperature Range	T_{STG}		-55~+150				℃
Thermal Resistance, Junction to case for IGBT	$R_{th(J-C)}$		1.5	1.1	1.8	3.5	K/W
Thermal Resistance, Junction to case for Diode	$R_{th(J-C)}$		2.0	2.0	3.0	5.0	K/W

Notes:

1. Pulse width limited by maximum junction temperature.

Electrical Characteristics, IGBT

Table 2 Characteristics Values(T_C=25℃ unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Collector to Emitter Breakdown Voltage	BV_{CES}	I_C=250μA, V_{GE}=0V	650	-	-	V
Collector to Emitter Saturation Voltage	$V_{CE(sat)}$	I_C=10A , V_{GE}=15V	-	1.65	2.2	V
		I_C=10A, V_{GE}=15V, T_J=150℃	-	2.0	-	V
Gate Threshold Voltage	$V_{GE(th)}$	I_C=250μA, V_{GE}=V_{CE}	4.5	5.5	6.5	V
Zero Gate Voltage Collector current	I_{CES}	V_{CE}=650V, V_{GE}=0V	-	-	50	μA
Gate to Emitter Leakage Current	I_{GES}	V_{GE}=±20V, V_{CE}=0V	-	-	±10	μA
Input Capacitance	C_{ies}	f=1MHz, V_{CE}=30V, V_{GE}=0V	-	484	-	pF
Output Capacitance	C_{oes}		-	30	-	pF
Reverse Transfer Capacitance	C_{res}		-	6	-	pF
Total Gate charge	Q_G	V_{CC}=520V, I_C=10A , V_{GE}=15V	-	28	-	nc
Gate to Emiter charge	Q_{GE}		-	2	-	nc
Gate to Collector charge	Q_{GC}		-	18	-	nc
Short Circuit Withstand Time	t_{SC}	V_{CC}=400V, V_{GE}=15V	-	5	-	μs
Turn-on Delay Time	$t_{d(on)}$	V_{CC}=400V, I_C=10A V_{GE}=0/15V, R_G=10Ω, T_J=25℃ Inductive load	-	26	-	ns
Rising Time	t_r		-	26	-	ns
Turn-off Delay Time	$t_{d(off)}$		-	78	-	ns
Falling Time	t_f		-	96	-	ns
Turn-on Switching Loss Energy	E_{on}		-	0.18	-	mJ
Turn-off Switching Loss Energy	E_{off}		-	0.20	-	mJ
Turn-on Delay Time	$t_{d(on)}$	V_{CC}=400V, I_C=10A V_{GE}=0/15V, R_G=10Ω, T_J=150℃ Inductive load	-	26	-	ns
Rising Time	t_r		-	30	-	ns
Turn-off Delay Time	$t_{d(off)}$		-	96	-	ns
Falling Time	t_f		-	134	-	ns
Turn-on Switching Loss Energy	E_{on}		-	0.36	-	mJ
Turn-off Switching Loss Energy	E_{off}		-	0.28	-	mJ

Electrical Characteristics, Diode

Table 3 Characteristics Values(T_C=25℃ unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Forward Voltage	V_F	I_F=10A, T_J=25℃	-	1.50	2.0	V
		I_F=10A, T_J=150℃	-	1.3	-	V
Peak Reverse Recovery Current	I_{rr}	I_F=10A di/dt=-250 A/μs V_{CC}=400V T_J=25℃	-	7	-	A
Reverse Recovery Time	t_{rr}		-	120	-	ns
Reverse Recovery Charge	Q_{rr}		-	459	-	nC
Reverse Recovery Energy	E_{rec}			131	-	μJ
Peak Reverse Recovery Current	I_{rr}	I_F=10A di/dt=-250A/μs V_{CC}=400V T_J=150℃	-	9	-	A
Reverse Recovery Time	t_{rr}		-	194	-	ns
Reverse Recovery Charge	Q_{rr}		-	756	-	nC
Reverse Recovery Energy	E_{rec}			317	-	μJ

Typical Characteristics diagrams

Fig.1 Typical output characteristic
$I_C=f(V_{CE})$, $T_{vj}=25℃$

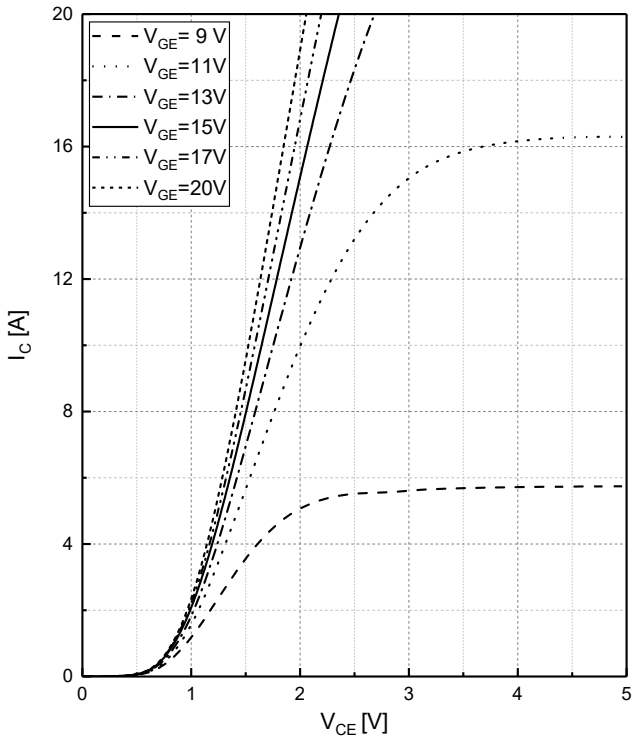


Fig.2 Typical output characteristic
$I_C=f(V_{CE})$, $T_{vj}=150℃$

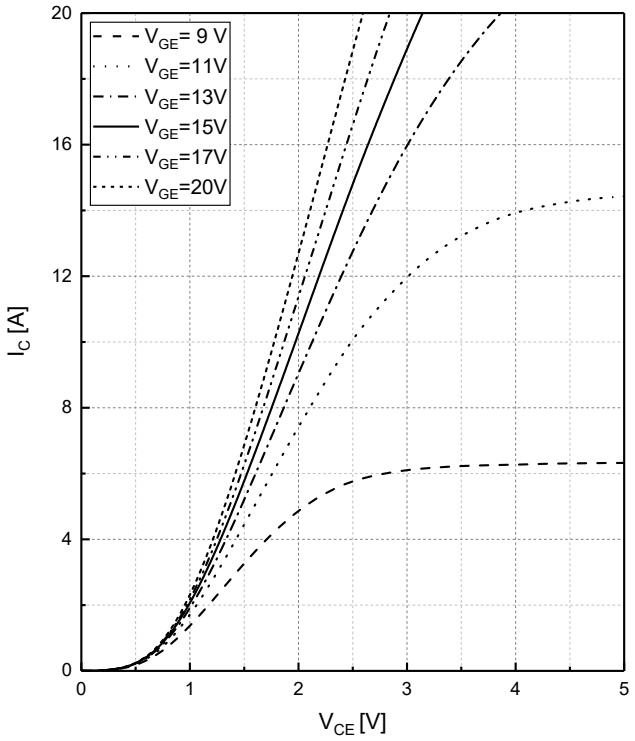


Fig.3 Typical transfer characteristic
$I_C=f(V_{GE})$, $V_{CE}=20V$

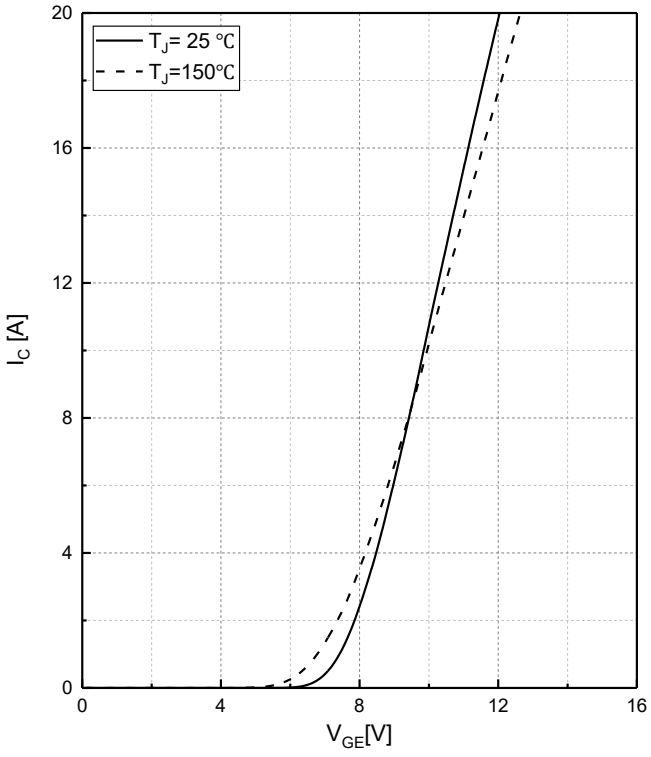


Fig.4 Typical I_F as a function of V_F
$I_F=f(V_F)$

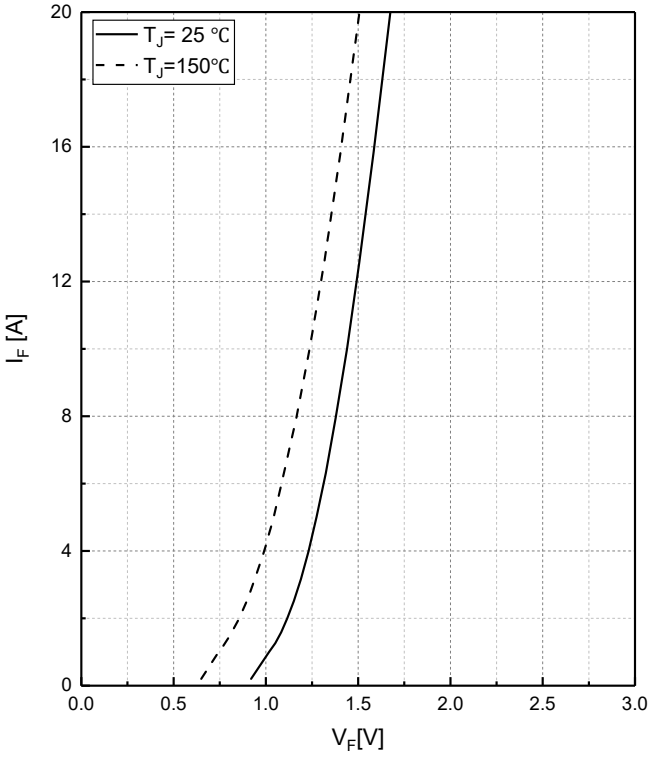


Fig.5 Typical $V_{GE(th)}$ as a function of T_{vj}
$V_{GEth}=f(T_{vj})$, $I_C=250\mu A$

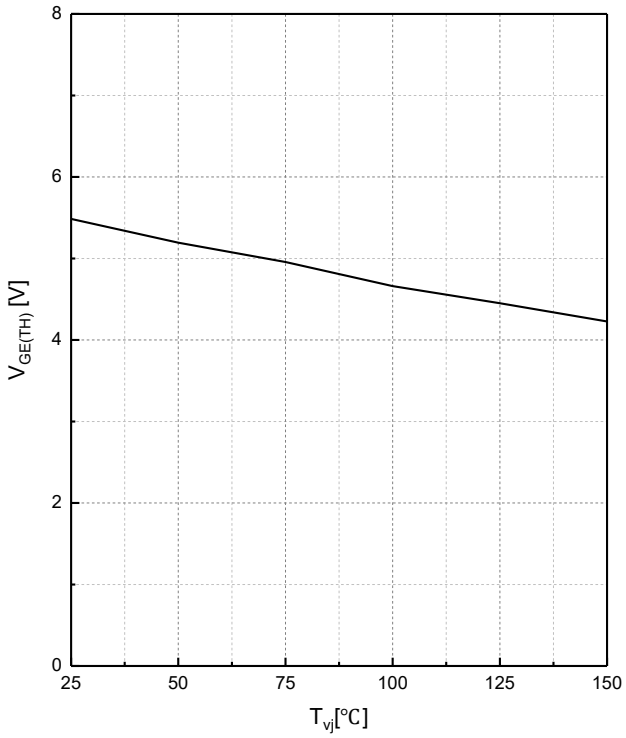


Fig.6 Typical V_{CEsat} as a function of T_{vj}
$V_{CEsat}=f(T_{vj})$, $V_{GE}=15V$

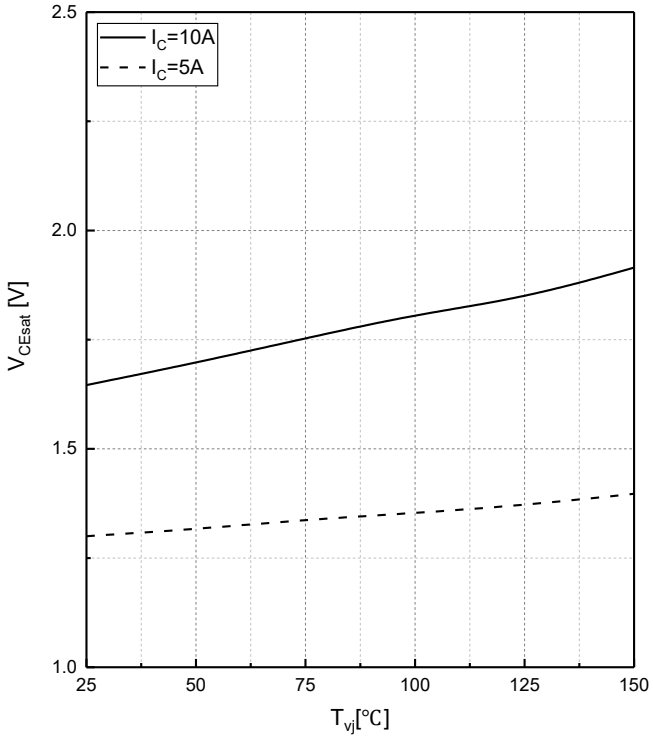


Fig.7 Typical V_F as a function of T_{vj}
$V_F=f(T_{vj})$

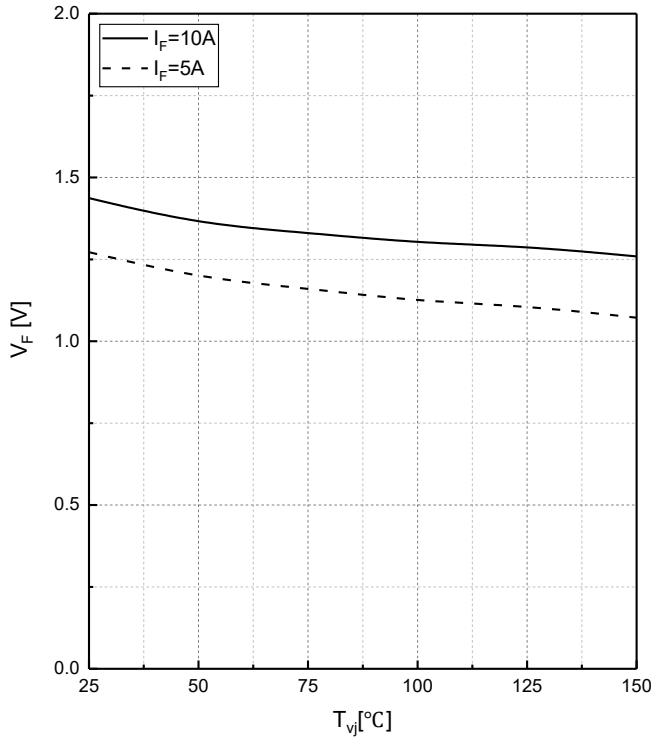


Fig.8 Typical Gate charge
$V_{GE}=f(Q_G)$, $I_C=10A$, Vcc=520V

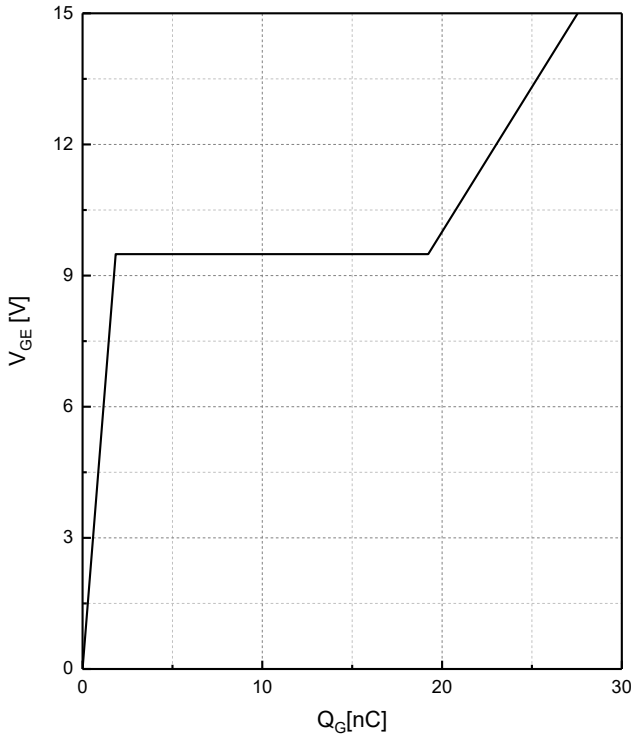


Fig.9 Typical switching loss energy as a function of R_G

$E=f(R_G)$, V_{CC}=400V, I_C=10A, V_{GE}=0/15V, T_J=150℃

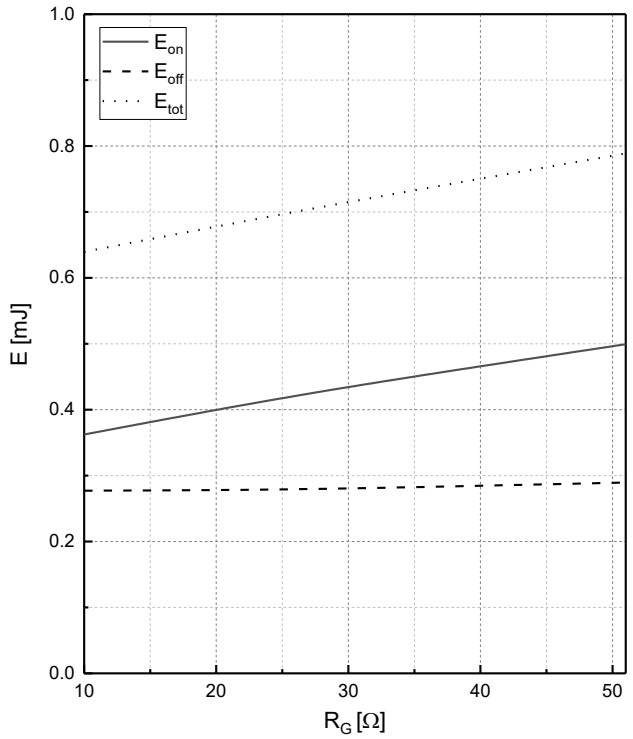


Fig.10 Typical switching loss energy as a function of I_C

$E=f(I_C)$, V_{CC}=400V, R_G=10Ω, V_{GE}=0/15V, T_J=150℃

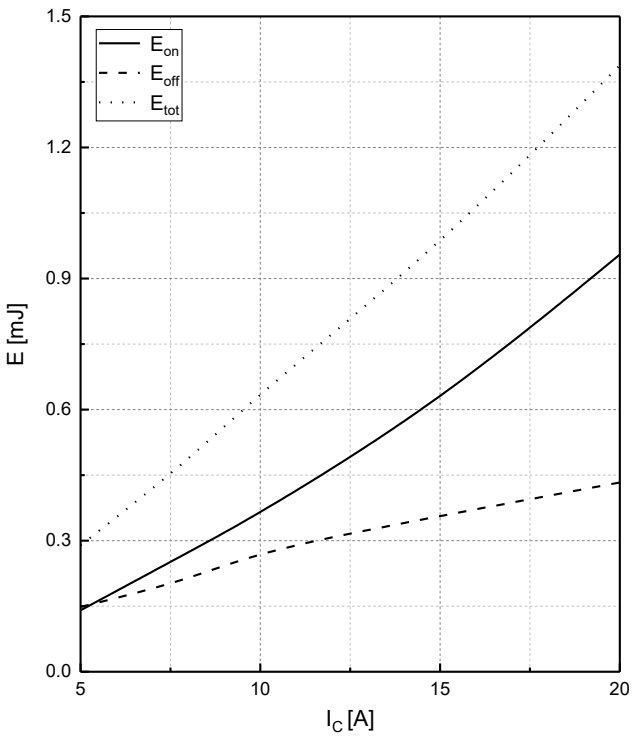


Fig.11 Typical capacitance as a function of V_{CE}

$C=f(V_{CE})$, f=1MHz, V_{GE}=0V

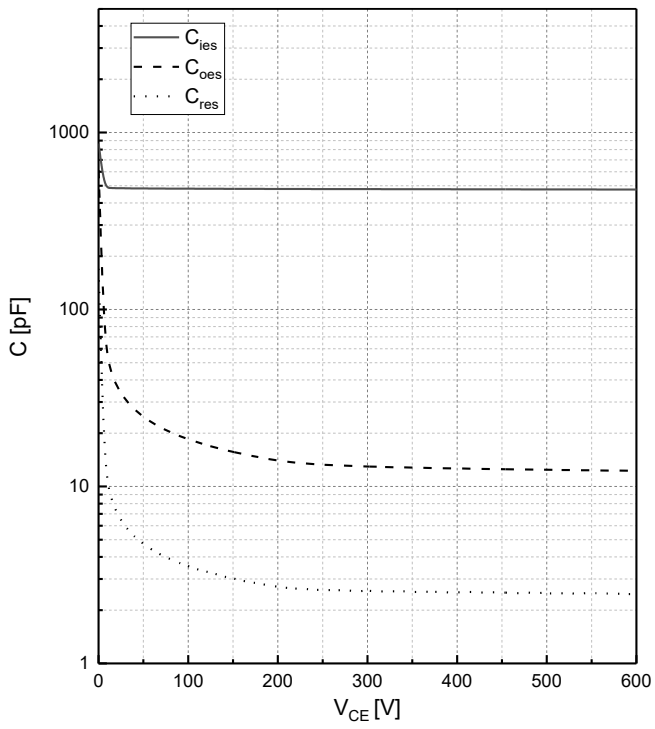


Fig.12 Collector current as a function of case temperature

$I_C=f(T_{vj})$

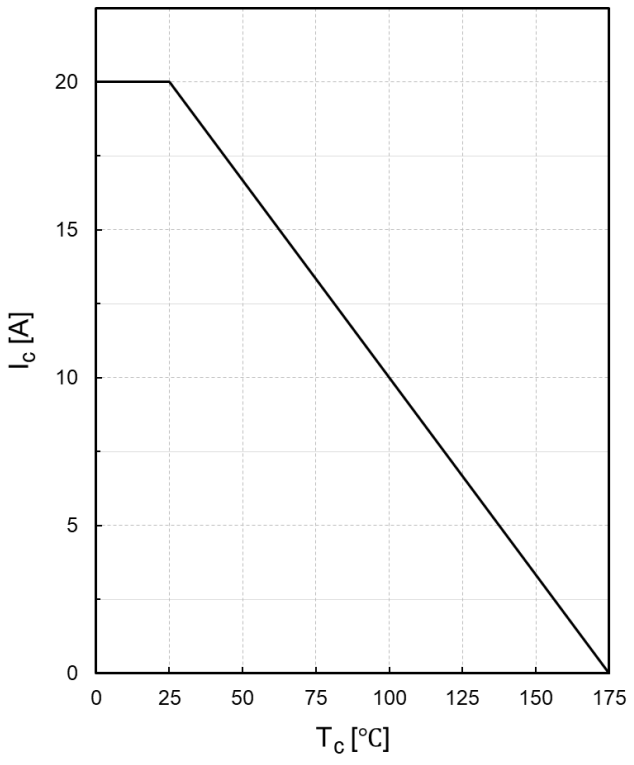


Fig.13 Forward bias safe operating area of IGBT
T_c=25℃, T_{vj}≤175℃, V_{GE}=15V, TO-252

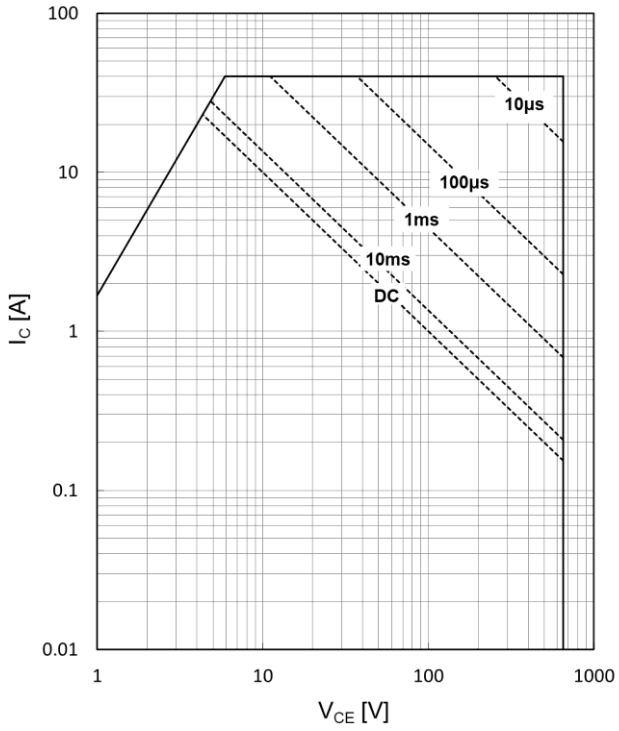


Fig.14 Transient thermal impedance of IGBT
$Z_{th(j-c)}=f(t_p)$, $D=t_p/T$, TO-252

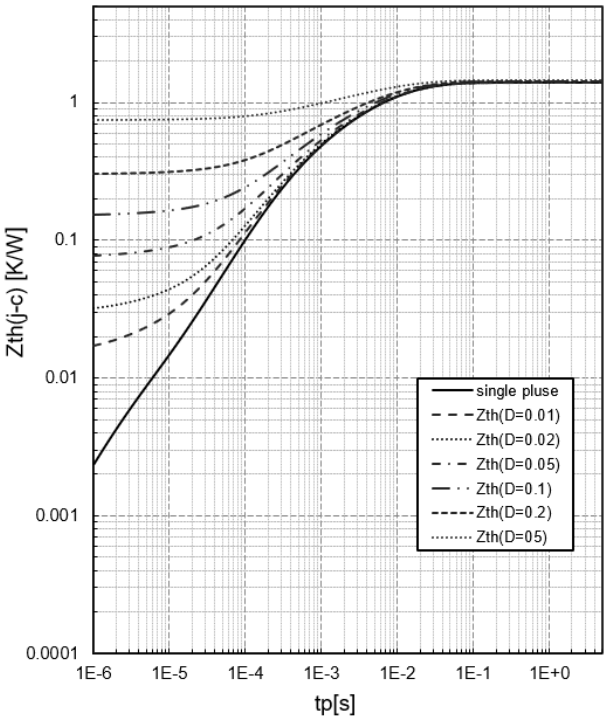


Fig.15 Forward bias safe operating area of IGBT
T_c=25℃, T_{vj}≤175℃, V_{GE}=15V, TO-263/TO-220

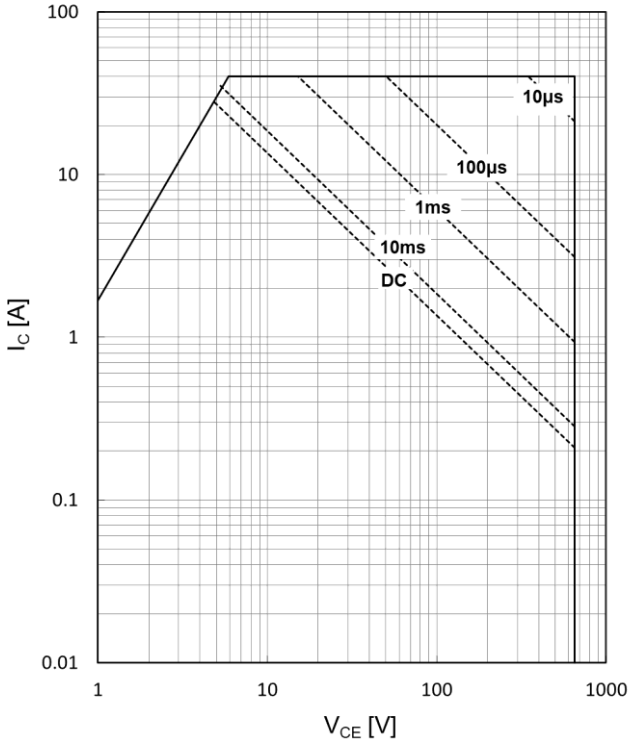


Fig.16 Transient thermal impedance of IGBT
$Z_{th(j-c)}=f(t_p)$, $D=t_p/T$, TO-263/TO-220

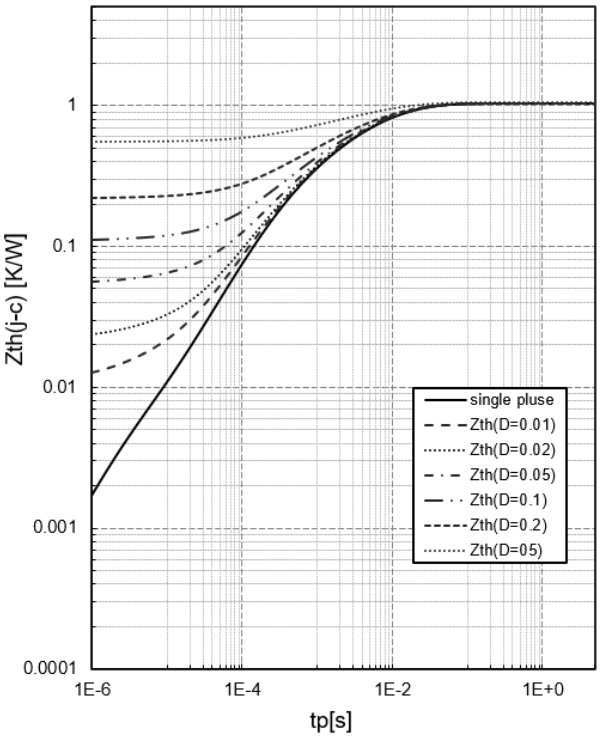


Fig.17 Forward bias safe operating area of IGBT
T_c=25℃, T_{vj}≤175℃, V_{GE}=15V, TO-220ISO

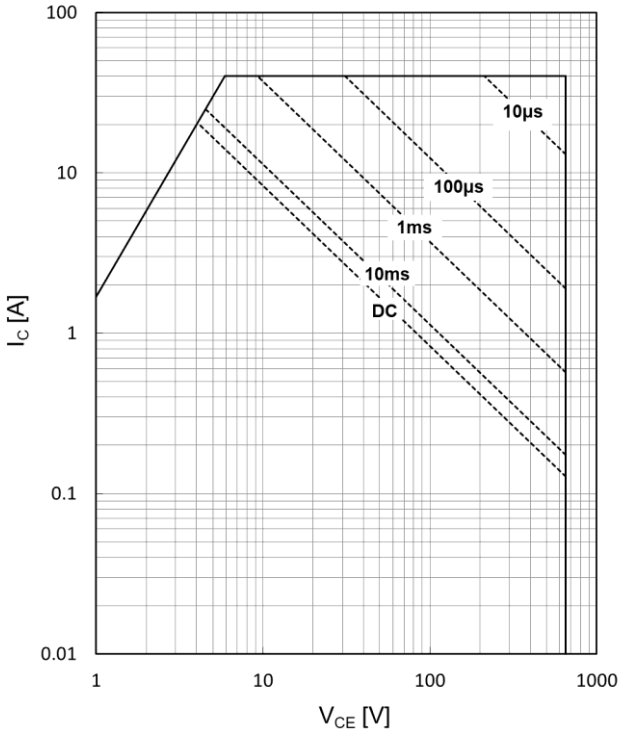


Fig.18 Transient thermal impedance of IGBT
$Z_{th(j-c)}=f(t_p)$, $D=t_p/T$, TO-220ISO

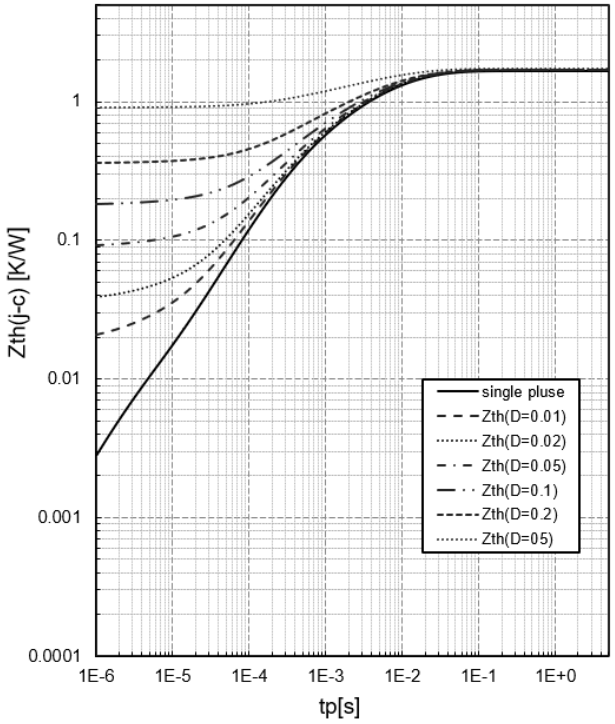


Fig.19 Forward bias safe operating area of IGBT
T_c=25℃, T_{vj}≤175℃, V_{GE}=15V, TO-220F

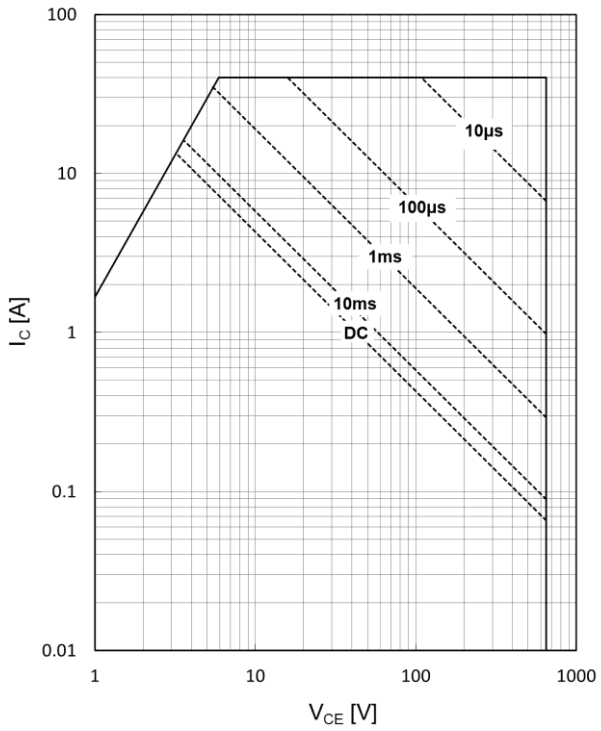
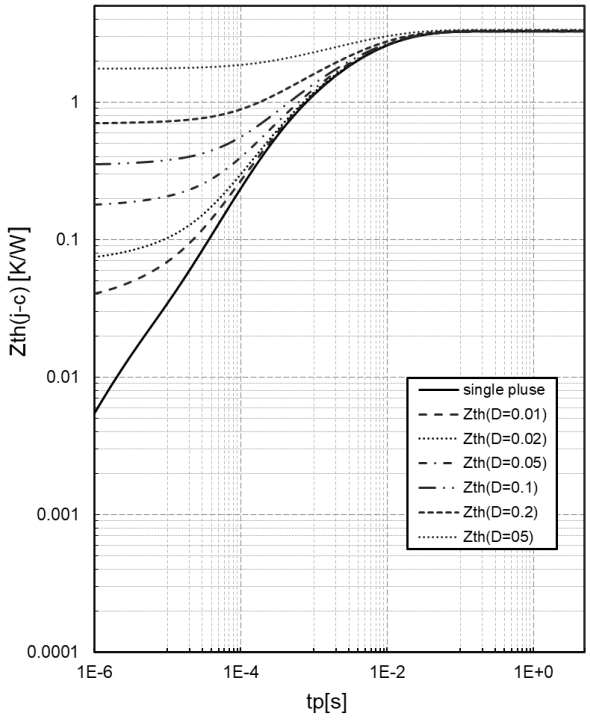
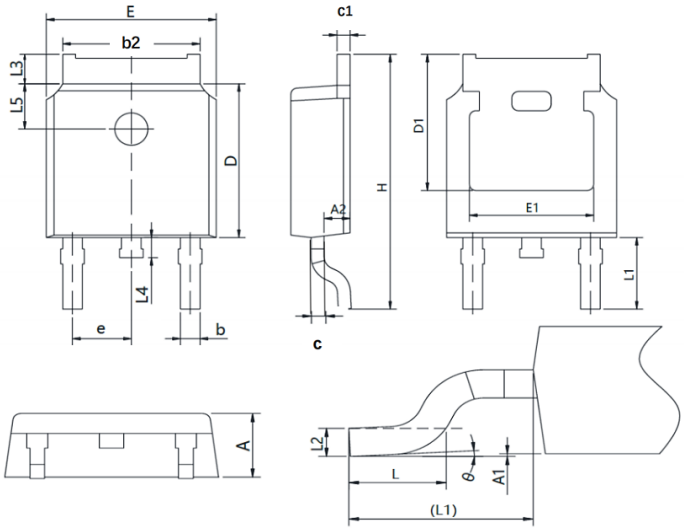


Fig.20 Transient thermal impedance of IGBT
$Z_{th(j-c)}=f(t_p)$, $D=t_p/T$, TO-220F



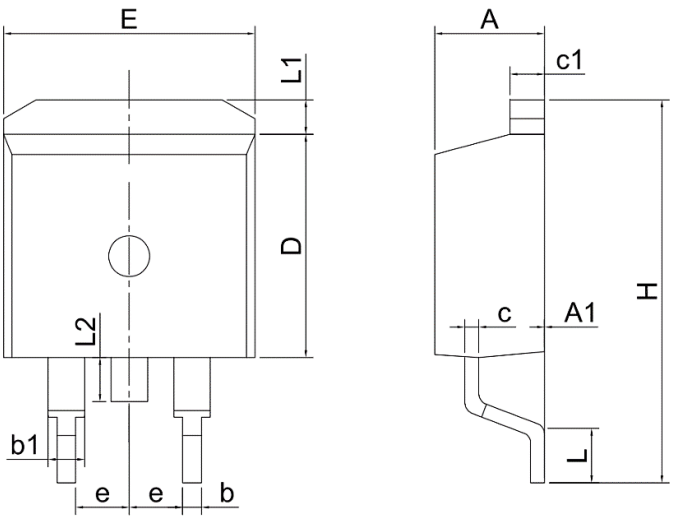
Package Outlines

Mechanical Dimensions for TO-252



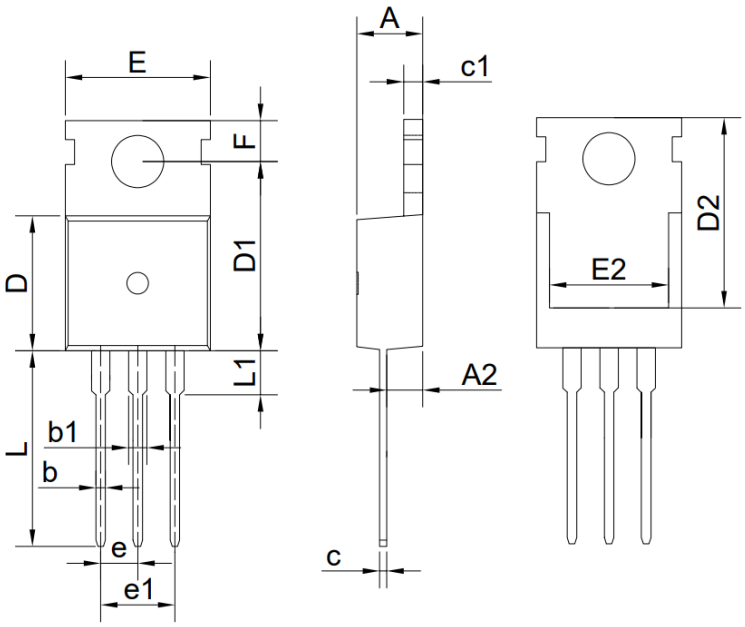
SYMBOL	MM		
	MIN	NOM	MAX
A	2.10	2.30	2.50
A1	0	-	0.15
b	0.7	0.76	0.9
b2	5.13	5.36	5.54
c	0.44	-	0.65
c2	0.45	-	0.65
D	6.00	6.10	6.20
D2	5.37	5.40	5.78
E	6.30	6.60	6.90
E1	4.83 REF		
e	2.23	2.29	2.33
H	9.7	10.10	10.5
L	1.38	1.50	1.73
L1	2.58	2.90	3.00
L2	0.50	-	0.52
L3	0.60	-	1.00
L4	0.40	0.80	1.00

Mechanical Dimensions for TO-263



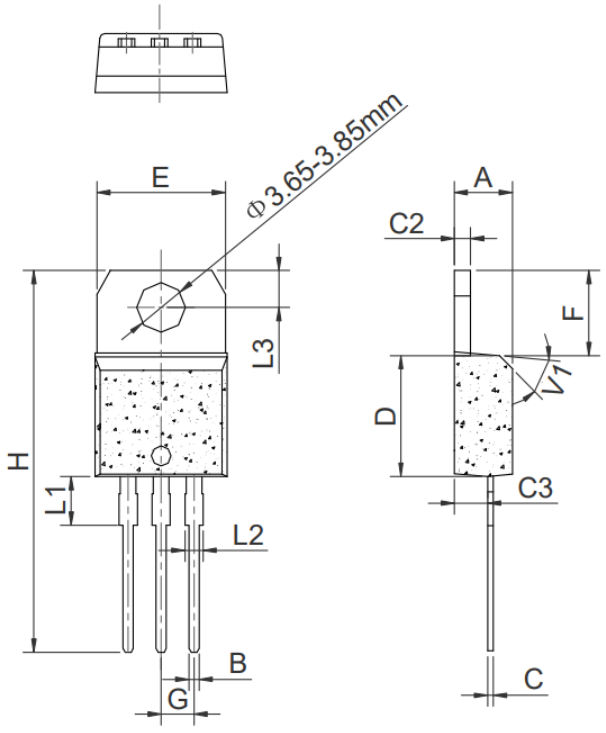
SYMBOL	MM		
	MIN	NOM	MAX
A	4.30	4.50	4.70
A1	0.00	0.13	0.25
b	0.70	0.80	0.90
b1	1.21	1.27	1.40
c	0.30	-	0.60
c1	1.20	1.30	1.40
D	9.10	9.20	9.30
E	9.70	9.90	10.20
e	2.54BSC		
H	14.80	15.10	15.40
L	2.10	2.30	2.50
L1	1.00	1.20	1.40
L2	1.10	1.30	1.50

Mechanical Dimensions for TO-220



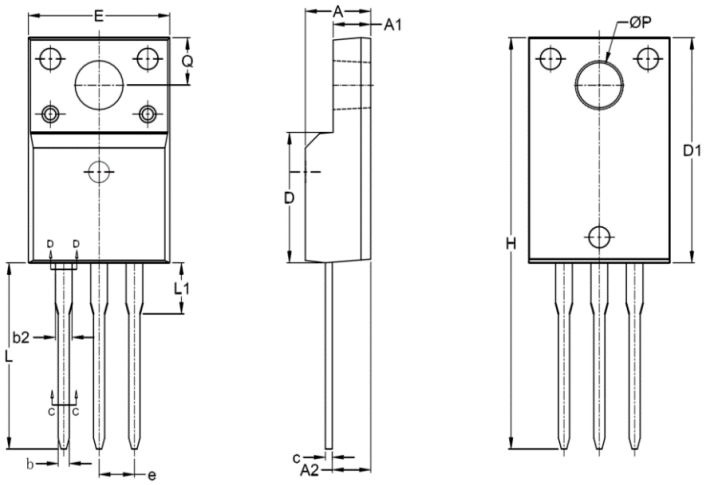
SYMBOL	MM	
	MIN	MAX
A	4.40	4.80
A2	2.30	2.50
b	0.70	0.90
b1	1.15	1.40
c	0.40	0.60
c1	1.20	1.40
D	9.10	9.30
D1	12.70	13.10
D2	12.90	13.30
E	9.80	10.20
E2	7.80	8.20
e	2.50	2.60
e1	5.08 REF	
F	2.70	2.90
L	13.00	13.50
L1	-	3.40

Mechanical Dimensions for TO-220ISO



SYMBOL	MM	
	MIN	MAX
A	4.40	4.60
B	0.61	0.88
C	0.46	0.70
C2	1.21	1.32
C3	2.40	2.72
D	8.60	9.70
E	9.80	10.40
F	6.55	6.95
G	2.40	2.70
H	28.0	29.8
L1	3.75 REF	
L2	1.14	1.70
L3	2.65	2.95
V1	45° REF	

Mechanical Dimensions for TO-220F



SYMBOL	MM	
	MIN	MAX
A	4.30	4.70
A1	2.30	2.82
b	0.70	0.94
b1	1.17	1.41
c	0.30	0.64
c1	1.17	1.44
D	9.70	10.20
E	8.50	9.30
E1	12.00	12.50
e	2.44	2.64
e1	4.88	5.26
F	2.60	2.94
L	13.00	14.00
L1	3.385	4.20
ØP	3.74	3.95

Contact Information

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WAYON website: **http://www.way-on.com**

For additional information, please contact your local Sales Representative.

Product Specification Statement

1.The product specification aims to provide users with a reference regarding various product parameters, performance, and usage. It presents certain aspects of the product's performance in graphical form and is intended solely for users to select product and make product comparisons, enabling users to better understand and evaluate the characteristics and advantages of the product. It does not constitute any commitment, warranty, or guarantee.

2.The product parameters described in the product specification are numerical values, characteristics, and functions obtained through actual testing or theoretical calculations of the product in an independent or ideal state. Due to the complexity of product applications and variations in test conditions and equipment, there may be slight fluctuations in parameter test values. WAYON shall not guarantee that the actual performance of the product when installed in the customer's system or equipment will be entirely consistent with the product specification, especially concerning dynamic parameters. It is recommended that users consult with professionals for product selection and system design. Users should also thoroughly validate and assess whether the actual parameters and performance when installed in their respective systems or equipment meet their requirements or expectations. Additionally, users should exercise caution in verifying product compatibility issues, and WAYON assumes no responsibility for the application of the product.

3.WAYON strives to provide accurate and up-to-date information to the best of our ability. However, due to technical, human, or other reasons, WAYON cannot guarantee that the information provided in the product specification is entirely accurate and error-free. WAYON shall not be held responsible for any losses or damages resulting from the use or reliance on any information in these product specifications. WAYON reserves the right to revise or update the product specification and the products at any time without prior notice, and the user's continued use of the product specification is considered an acceptance of these revisions and updates. Prior to purchasing and using the product, users should verify the above information with WAYON to ensure that the product specification is the most current, effective, and complete. If users are particularly concerned about product parameters, please consult WAYON in detail or request relevant product test reports. Any data not explicitly mentioned in the product specification shall be subject to separate agreement.

4.Users are advised to pay attention to the parameter limit values specified in the product specification and maintain a certain margin in design or application to ensure that the product does not exceed the parameter limit values defined in the product specification. This precaution should be taken to avoid exceeding one or more of the limit values, which may result in permanent irreversible damage to the product, ultimately affecting the quality and reliability of the system or equipment.

5.The design of the product is intended to meet civilian needs and is not guaranteed for use in harsh environments or precision equipment. It is not recommended for use in systems or equipment such as medical devices, aircraft, nuclear power, and similar systems, where failures in these systems or equipment could reasonably be expected to result in personal injury. WAYON shall assume no responsibility for any consequences resulting from such usage.

6.Users should also comply with relevant laws, regulations, policies, and standards when using the product specification. Users are responsible for the risks and liabilities arising from the use of the product specification and must ensure that it is not used for illegal purposes. Additionally, users should respect the intellectual property rights related to the product specification and refrain from infringing upon any third-party legal rights. WAYON shall assume no responsibility for any disputes or controversies arising from the above-mentioned issues in any form.