

● General Description

Through advanced trench and field stop technology to provide very low $V_{CE(sat)}$, low gate charge, and excellent switching performance.

● Features

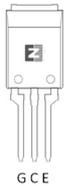
- Very low $V_{CE(sat)}$
- Low switching power loss
- Low switching surge and noise
- Low thermal resistance
- High short circuit capability (10us)
- AEC-Q101 qualified

● Application

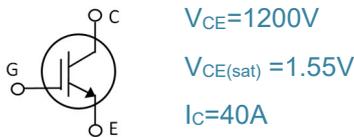
- PTC Heater



● Product Summary



TO-273



● Ordering Information

Part NO.	ZMBGA40N120S1AJ
Marking	BG40N120S1A
Packing information	BULK TUBE
Basic ordering unit (pcs)	1000

● Absolute Maximum Ratings ($T_A=25^{\circ}C$, unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Max.	Unit
Collector-emitter voltage	V_{CE}		-	1200	V
Gate-emitter voltage ^①	V_{GE}		-30	30	V
Continuous collector current	I_C	$V_{GE}=15V, T_C=25^{\circ}C$	-	80	A
	I_C	$V_{GE}=15V, T_C=100^{\circ}C$	-	40	A
Pulsed collector current ^①	I_{CM}	Pulsed; $t_p \leq 10 \mu s$; $T_C = 25^{\circ}C$;	-	160	A
Total power dissipation	P_D	$T_C=25^{\circ}C$	-	556	W
Total power dissipation	P_D	$T_A=25^{\circ}C$	-	3.8	W
Short circuit withstand time	T_{sc}	$V_{GE}=15 V, V_{CE}=600 V, T_J=25^{\circ}C$	-	10	us
Operating junction temperature	T_J		-55	175	$^{\circ}C$
Storage temperature	T_{STG}		-55	175	$^{\circ}C$

● Thermal resistance

Parameter	Symbol	Min.	Typ.	Max.	Unit
Thermal resistance, junction - case	R_{thJC}	-	-	0.27	°C/W
Thermal resistance, junction - ambient	R_{thJA}	-	-	40	°C/W
Soldering temperature (total time<10s)	T_{sold}	-	-	260	°C

● Electronic Characteristics ($T_j=25^{\circ}\text{C}$, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Collector-emitter breakdown voltage	BV_{CES}	$V_{GE}=0\text{V}$, $I_c=250\mu\text{A}$	1200	-	-	V
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{GE}=V_{CE}$, $I_c=1.5\text{mA}$	5	6	7	V
Zero gate voltage collector current	I_{CES}	$V_{GE}=0\text{V}$, $V_{CE}=1200\text{V}$, $T_j=25^{\circ}\text{C}$	-	-	10	μA
		$V_{GE}=0\text{V}$, $V_{CE}=1200\text{V}$, $T_j=175^{\circ}\text{C}$	-	-	10	mA
Gate-emitter leakage current	I_{GES}	$V_{GE}=\pm 30\text{V}$, $V_{CE}=0\text{V}$	-	-	100	nA
Collector-emitter saturation voltage	$V_{CE(sat)}$	$V_{GE}=15\text{V}$, $I_c=40\text{A}$, $T_j=25^{\circ}\text{C}$	-	1.55	2	V
		$V_{GE}=15\text{V}$, $I_D=40\text{A}$, $T_j=175^{\circ}\text{C}$	-	2	-	V
Forward transconductance	g_{FS}	$V_{CE}=20\text{V}$, $I_c=40\text{A}$	-	35	-	S

● Dynamic characteristics ($T_j=25^{\circ}\text{C}$, unless otherwise specified)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Input capacitance	C_{ies}	$f=100\text{KHz}$, $V_{CE}=600\text{V}$, $V_{GE}=0\text{V}$	-	7031	-	pF
Output capacitance	C_{oes}		-	29	-	pF
Reverse transfer capacitance	C_{res}		-	12	-	pF
Gate resistance	R_g	$f=1\text{MHz}$	-	1.8	-	Ω
Total gate charge	Q_g	$V_{CC}=600\text{V}$, $I_c=40\text{A}$, $V_{GE}=15\text{V}$	-	208	-	nC
Gate-emitter charge	Q_{ge}		-	57	-	nC
Gate-collector charge	Q_{gc}		-	79	-	nC

● Switching characteristics ($T_j=25^{\circ}\text{C}$)

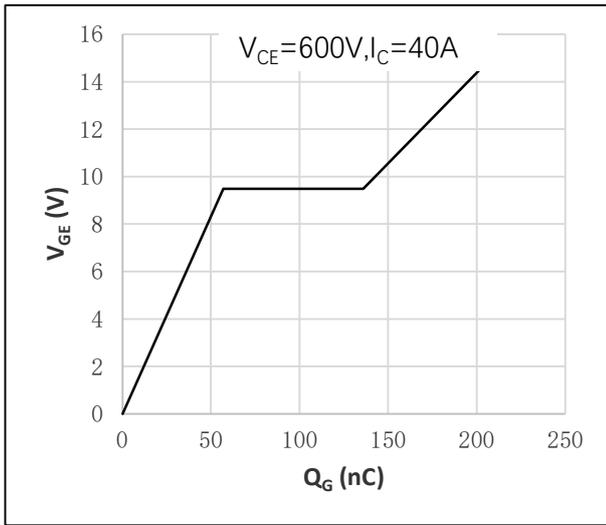
Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Turn-on delay time	$t_{d(on)}$	$T_j=25^{\circ}\text{C}$	-	59	-	ns
Turn-on rise time	t_r	$V_{GE}=15/-8\text{V}$,	-	47	-	ns
Turn-off delay time	$t_{d(off)}$	$V_{CE}=600\text{V}$,	-	167	-	ns

Turn-off fall time	t_f	$R_G = 6\Omega,$ $I_C = 40A,$ $L = 100\mu H$	-	44	-	ns
Turn-on energy	E_{on}		-	2.62	-	mJ
Turn-off energy	E_{off}		-	2.31	-	mJ
Total switching energy	E_{ts}		-	4.93	-	mJ
Reverse Bias Safe Operating Area	RBSOA	$T_j = 25^\circ C, V_{CC} = 1200V,$ $I_C = 160A,$ $V_{GE} = 15V/-8V, R_g = 10\Omega$	Full Square			-

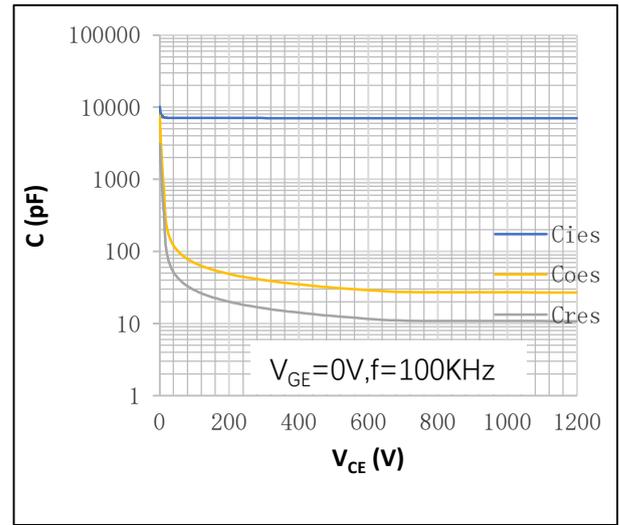
● Switching characteristics ($T_j = 150^\circ C$)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Turn-on delay time	$t_{d(on)}$	$T_j = 150^\circ C$ $V_{GE} = 15V/-8V,$ $V_{CE} = 600V,$ $R_G = 6\Omega,$ $I_C = 40A,$ $L = 100\mu H$	-	59	-	ns
Turn-on rise time	t_r		-	60	-	ns
Turn-off delay time	$t_{d(off)}$		-	186	-	ns
Turn-off fall time	t_f		-	53	-	ns
Turn-on energy	E_{on}		-	2.95	-	mJ
Turn-off energy	E_{off}		-	2.97	-	mJ
Total switching energy	E_{ts}		-	5.92	-	mJ

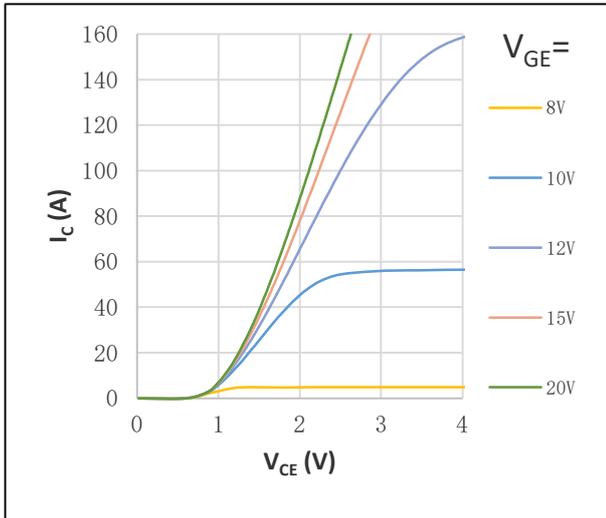
● Fig.1 Gate-emitter voltage as a function of gate charge; Typical values; $T_j=25^\circ\text{C}$



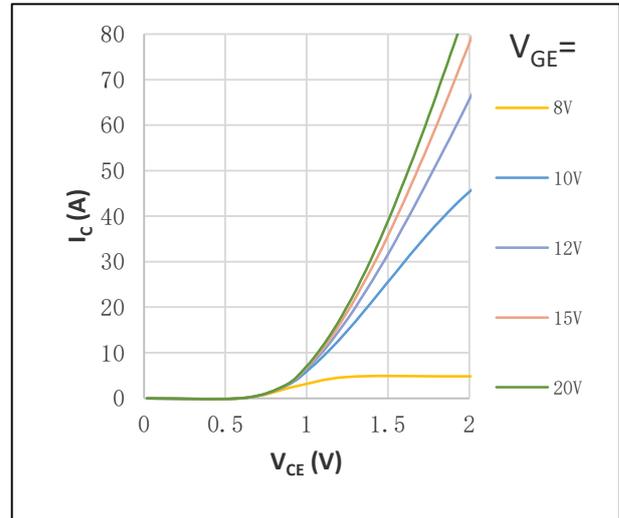
● Fig.2 Input, output and reverse transfer capacitances as a function of collector-emitter voltage; Typical values; $T_j=25^\circ\text{C}$



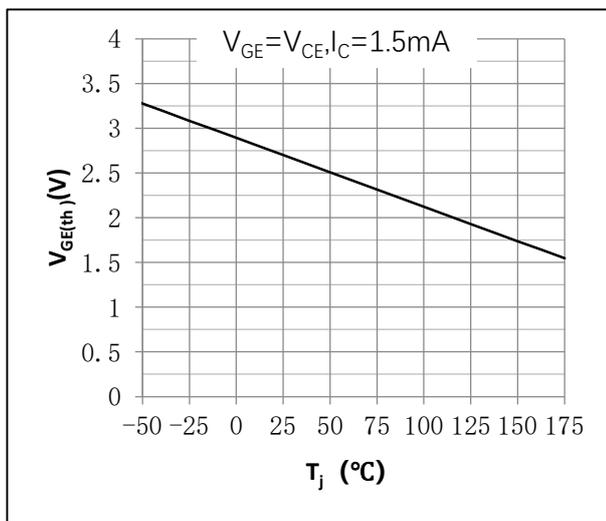
● Fig.3 Output characteristics: collector current as a function of collector-emitter voltage; Typical values; $T_j=25^\circ\text{C}$



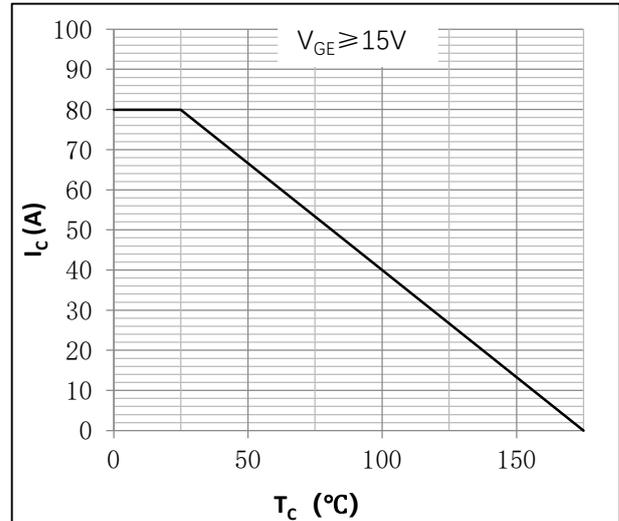
● Fig.4 Output characteristics: collector current as a function of collector-emitter voltage; Typical values: Expanded curve; $T_j=25^\circ\text{C}$



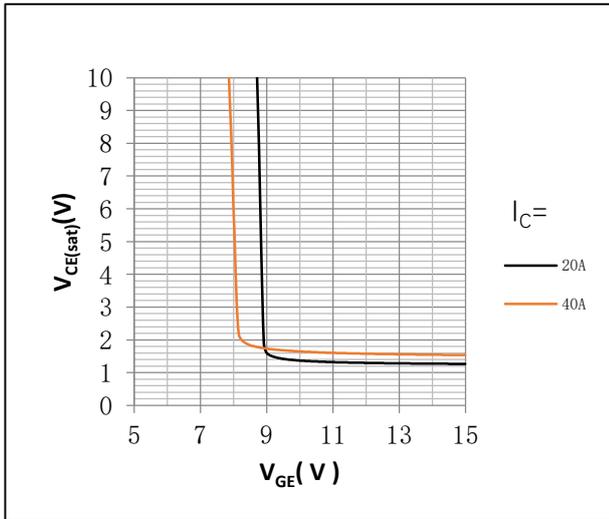
● Fig.5 Gate-emitter threshold voltage as a function of junction temperature; Typical values



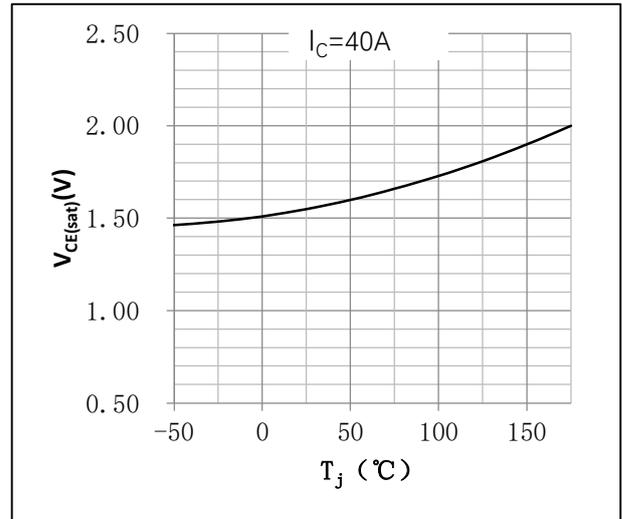
● Fig.6 Continuous collector current as a function of case temperature²; Calculative values



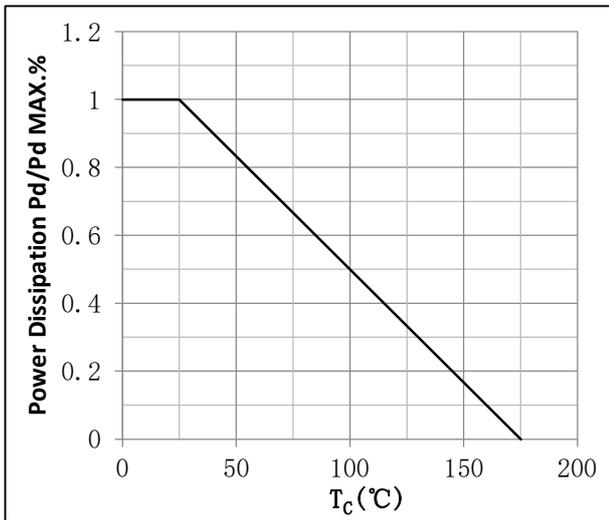
● Fig.7 Collector-emitter saturation voltage as a function of gate-emitter voltage; Typical values



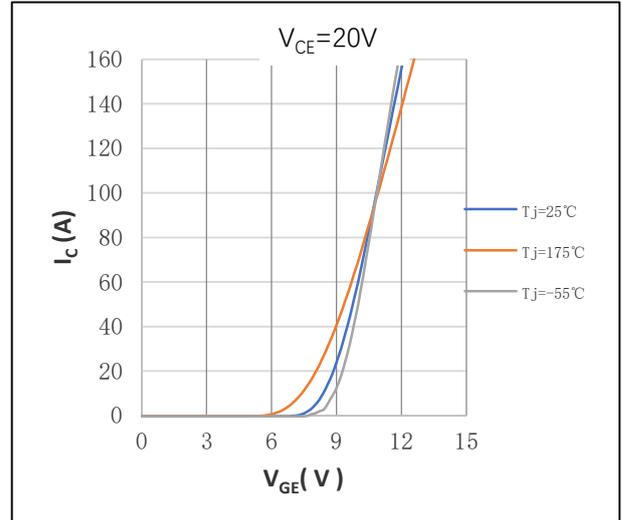
● Fig.8 Fig.6 Collector-emitter saturation voltage as a function of junction temperature; Typical values; $T_j=25^\circ C$



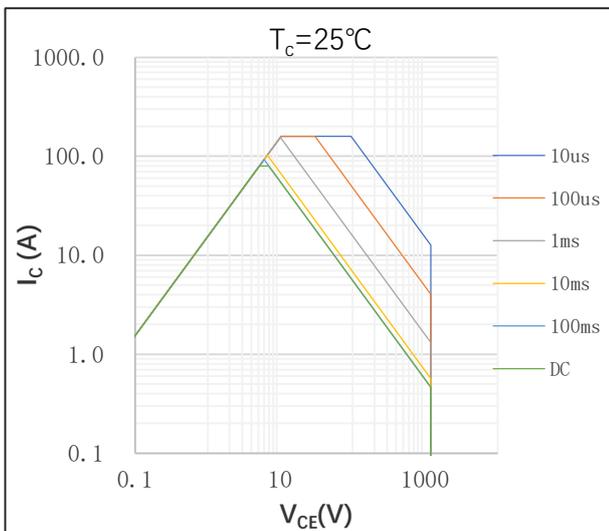
● Figure 9. Normalized total power dissipation as a function of case temperature; Calculative values Normalized Power Dissipation = $P_d/P_d(25^\circ C)$



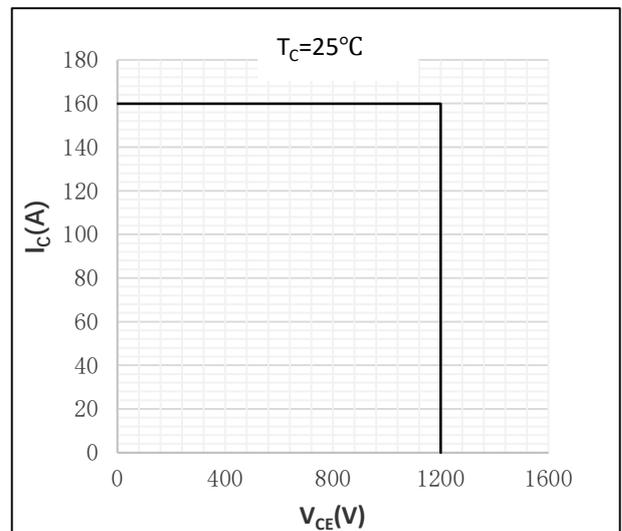
● Figure 10. Transfer characteristics: Collector current as a function of gate-emitter voltage; Typical values



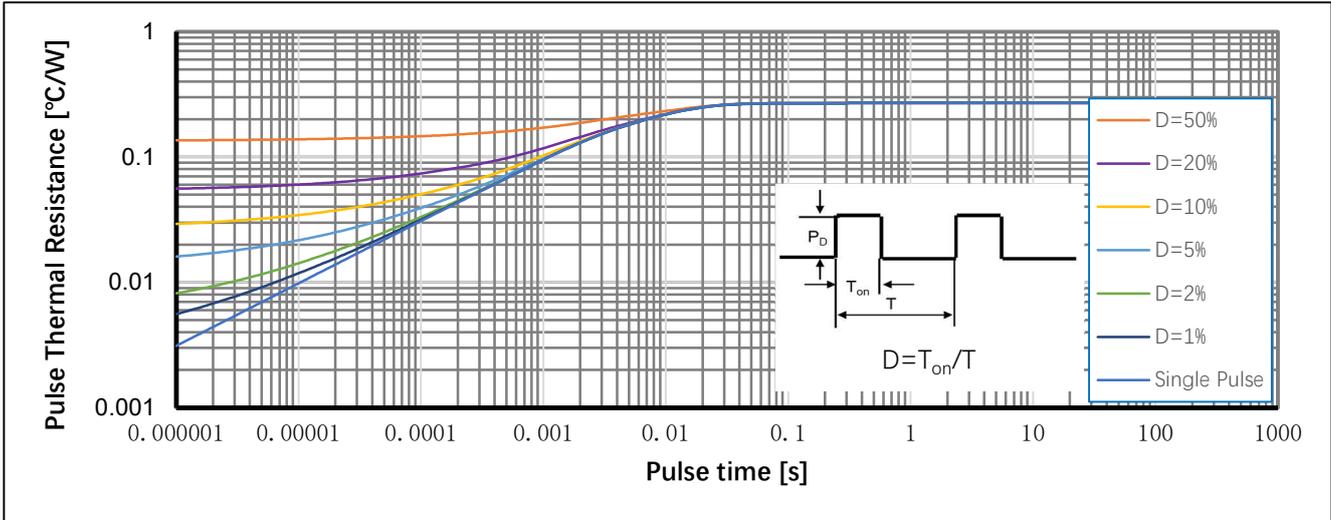
● Fig.11 Safe operating area: continuous and peak collector currents as a function of collector-emitter voltage; Calculative values



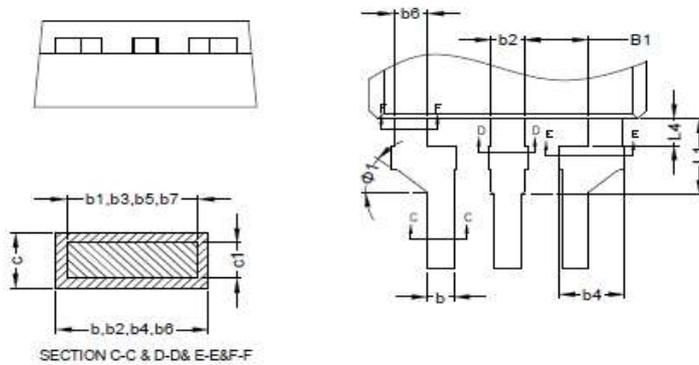
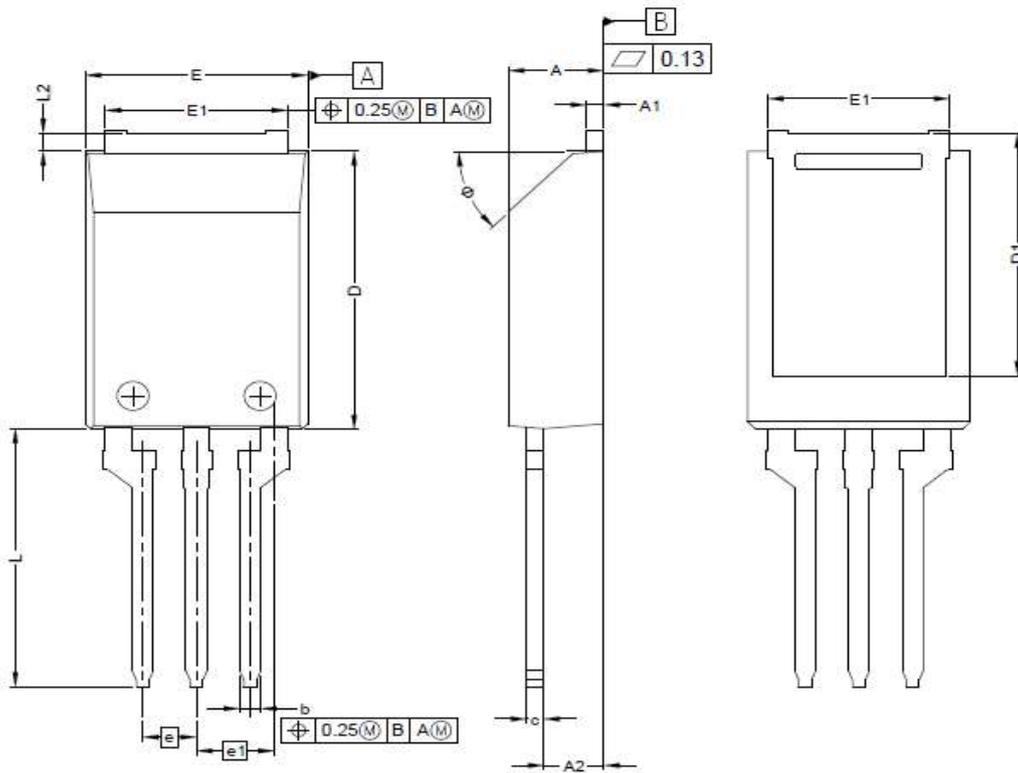
● Fig.12 Reverse bias safe operating area: peak collector currents as a function of collector-emitter voltage; Calculative values



● Fig.13 Transient thermal impedance from junction to case as a function of pulse duration; max values



● Package Outline



Symbol	MIN	MAX	Symbol	MIN	MAX
A	4.34	4.74	c1	0.60	0.90
A1	0.50	1.00	D	14.00	15.00
A2	2.50	3.00	D1	12.50	13.50
B1	(2.20)	-	E	10.00	11.00
b	0.90	1.30	E1	8.00	9.00
b1	0.80	1.10	e	2.55 BSC	
b2	1.25	1.65	e1	3.66 BSC	
b3	1.10	1.55	L	13.00	14.50
b4	2.35	2.55	L1	3.00	3.50
b5	2.30	2.50	L2	0.50	1.50
b6	1.25	1.65	L4	-	1.50
b7	1.10	1.55	φ	42.50	47.50
c	0.70	1.00	φ1	-	42.50

● Note

① Pulse : $V_{GE}=+20V/-20V$, Duty cycle=50%, $T_j=175^{\circ}C$, $t=1000$ hours; For DC , the following test conditions can be passed: $V_{GE}=+20V/-10V$, $T_j=175^{\circ}C$, $t=1000$ hours;

② Practically the current will be limited by PCB, thermal design and operating temperature. $V_{GE}=15V$.

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● Revision History

Version	Date	Change
A	2023/10/23	New
B	2025/6/25	Apply new datasheet format