

## General Description

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

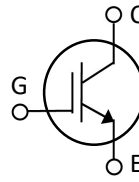
## Features

- 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

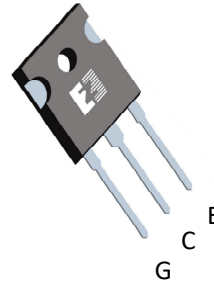
## Application

- PTC Heater

## Product Summary



$V_{CE} = 1200V$   
 $V_{CE(sat)} = 1.55V$   
 $I_C = 40A$



TO-247



## Ordering Information:

|                           |                 |
|---------------------------|-----------------|
| Part NO.                  | ZMBGA40N120S1AC |
| Marking                   | BG40N120S1A     |
| Packing information       | TUBE BULK       |
| Basic ordering unit (pcs) | 600             |

## Absolute Maximum Ratings ( $T_C=25^{\circ}C$ )

| Parameter                      | Symbol    | Conditions                                 | Value       | Unit        |
|--------------------------------|-----------|--------------------------------------------|-------------|-------------|
| Collector-emitter voltage      | $V_{CE}$  |                                            | 1200        | V           |
| Gate-emitter voltage           | $V_{GE}$  |                                            | $\pm 30$    | V           |
| Collector current              | $I_C$     | $T_C=25^{\circ}C$                          | 80          | A           |
|                                | $I_C$     | $T_C=100^{\circ}C$                         | 40          | A           |
| Pulsed collector current       | $I_{CM}$  | $T_C=25^{\circ}C$                          | 120         | 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   | $T_{sc}$  | $V_{GE}=15V, V_{CE}=600V, T_J=25^{\circ}C$ | 10          | us          |
| Operating Junction Temperature | $T_J$     |                                            | -55 to +175 | $^{\circ}C$ |
| Storage Temperature            | $T_{STG}$ |                                            | -55 to +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   | $R_{thJA}^{②}$ | -    | -    | 40   | °C/W |
| Soldering temperature (total time<10s) | $T_{sold}$     | -    | -    | 260  | °C   |

**•Electronic Characteristics**

| Parameter                            | Symbol        | Condition                                  | Min. | Typ. | Max. | Unit    |
|--------------------------------------|---------------|--------------------------------------------|------|------|------|---------|
| Collector-emitter breakdown voltage  | $V_{(BR)CES}$ | $V_{GE}=0V, I_C=250\mu A$                  | 1200 | -    | -    | V       |
| Collector-emitter saturation voltage | $V_{CE(sat)}$ | $V_{GE}=15V, I_C=40A$                      | -    | 1.55 | 2.00 | V       |
|                                      |               | $V_{GE}=15V, I_C=40A, T_J=175^\circ C$     | -    | 1.9  | -    |         |
| Gate-emitter threshold voltage       | $V_{GE(th)}$  | $V_{CE}=V_{GE}, I_C=1.5mA$                 | 5.0  | 6.0  | 7.0  | V       |
| Zero gate voltage collector current  | $I_{CES}$     | $V_{GE}=0V, V_{CE}=1200V, T_J=25^\circ C$  | -    | -    | 10.0 | $\mu A$ |
| Zero gate voltage collector current  | $I_{CES}$     | $V_{GE}=0V, V_{CE}=1200V, T_J=175^\circ C$ | -    | -    | 10.0 | mA      |
| Gate-emitter leakage current         | $I_{GES}$     | $V_{GE}=\pm 30V, V_{CE}=0V$                | -    | -    | 100  | nA      |

**•Dynamic characteristics , at  $T_J=25^\circ C$** 

| Parameter                    | Symbol    | Condition                            | Min. | Typ. | Max. | Unit |
|------------------------------|-----------|--------------------------------------|------|------|------|------|
| Input capacitance            | $C_{ies}$ | $f=1MHz, V_{CE}=600V$                | -    | 7093 | -    | pF   |
| Output capacitance           | $C_{oes}$ |                                      | -    | 30   | -    |      |
| Reverse transfer capacitance | $C_{res}$ |                                      | -    | 12   | -    |      |
| Total gate charge            | $Q_g$     | $V_{CC}=600V, I_C=40.0A, V_{GE}=15V$ | -    | 210  | -    | nC   |
| Gate-emitter charge          | $Q_{ge}$  |                                      | -    | 56   | -    | nC   |
| Gate-collector charge        | $Q_{gc}$  |                                      | -    | 78   | -    | nC   |

**SwitchingCharacteristic, at  $T_J=25^\circ C$** 

|                        |              |                                                                                         |   |      |   |    |
|------------------------|--------------|-----------------------------------------------------------------------------------------|---|------|---|----|
| Turn-on delay time     | $t_{D(on)}$  | $T_J=25^\circ C, V_{CC}=600V, I_C=40.0A, V_{GE}=-15.0/15.0V, R_g=6.0\Omega, L=200\mu H$ | - | 64   | - | ns |
| Turn-on rise time      | $t_r$        |                                                                                         | - | 100  | - | ns |
| Turn-off delay time    | $t_{D(off)}$ |                                                                                         | - | 160  | - | ns |
| Turn-off fall time     | $t_f$        |                                                                                         | - | 312  | - | ns |
| Turn-on energy         | $E_{on}$     |                                                                                         | - | 2.8  | - | mJ |
| Turn-off energy        | $E_{off}$    |                                                                                         | - | 2.81 | - | mJ |
| Total switching energy | $E_{ts}$     |                                                                                         | - | 5.61 | - | mJ |

Switching Characteristic, at  $T_J=25^\circ\text{C}$

|                        |              |                                                                                                                                                     |   |      |   |    |
|------------------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|---|------|---|----|
| Turn-on delay time     | $t_{D(on)}$  | $T_J=25^\circ\text{C}$ ,<br>$V_{CC}=600\text{V}$ , $I_C=40.0\text{A}$ ,<br>$V_{GE}=-15.0/15.0\text{V}$ ,<br>$R_g=6.0\Omega$ ,<br>$L=200\mu\text{H}$ | - | 64   | - | ns |
| Turn-on rise time      | $t_r$        |                                                                                                                                                     | - | 100  | - | ns |
| Turn-off delay time    | $t_{D(off)}$ |                                                                                                                                                     | - | 160  | - | ns |
| Turn-off fall time     | $t_f$        |                                                                                                                                                     | - | 312  | - | ns |
| Turn-on energy         | $E_{on}$     |                                                                                                                                                     | - | 2.8  | - | mJ |
| Turn-off energy        | $E_{off}$    |                                                                                                                                                     | - | 2.81 | - | mJ |
| Total switching energy | $E_{ts}$     |                                                                                                                                                     | - | 5.61 | - | mJ |

Fig.1 Gate-Charge characteristics

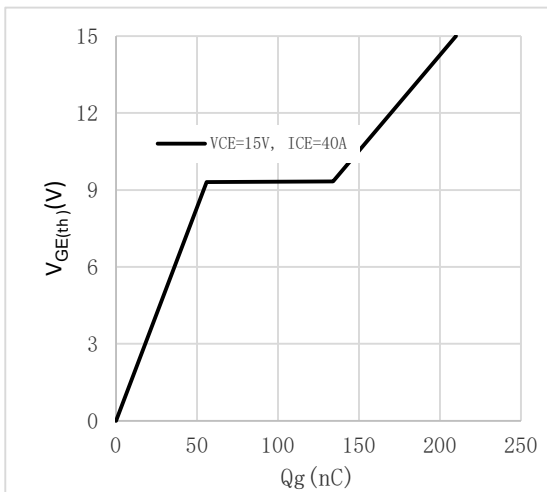


Fig.2 Capacitance characteristics

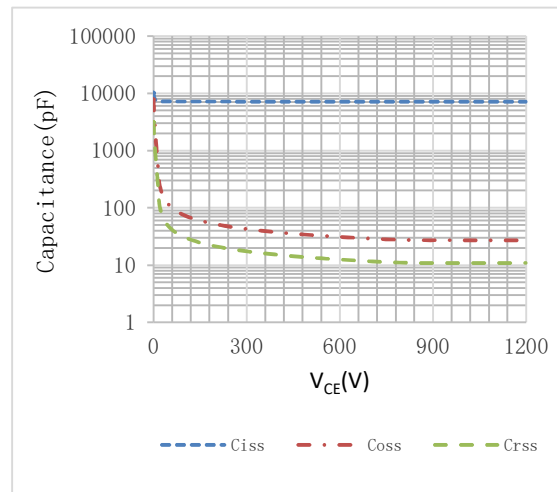


Fig.3 Power dissipation

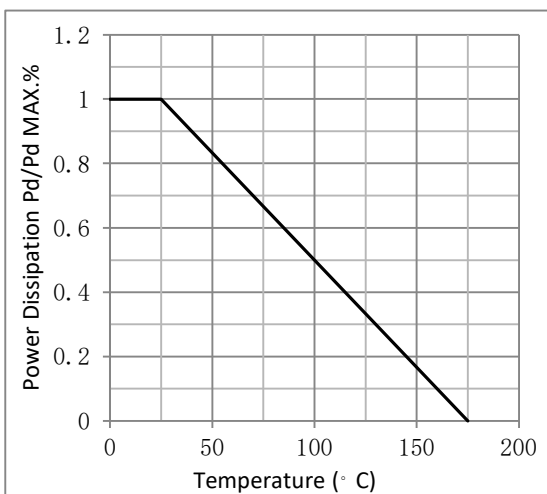


Fig.4 Typical output characteristics

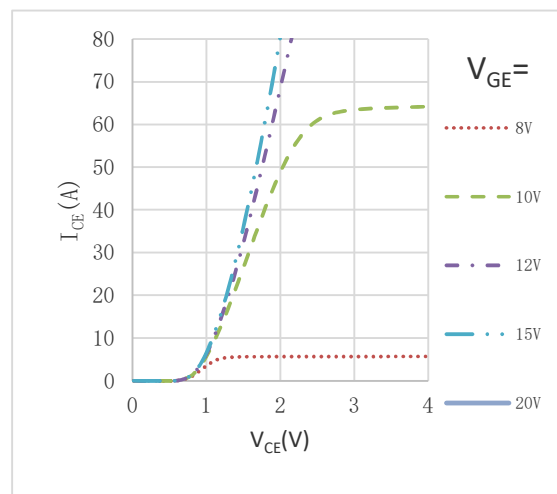


Fig.5 Threshold voltage V.S junction temperature

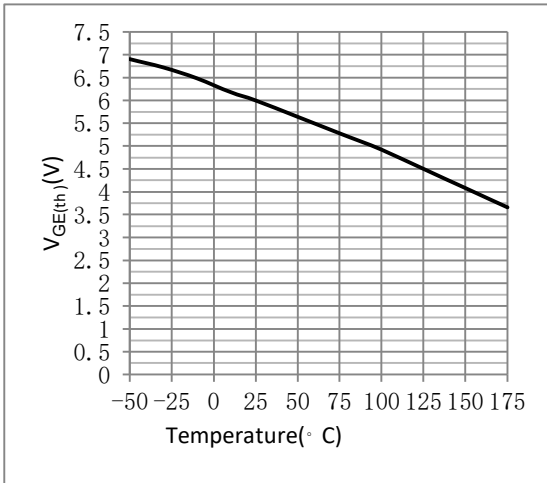


Fig.6 IC vs. Junction Temperature<sup>③</sup>

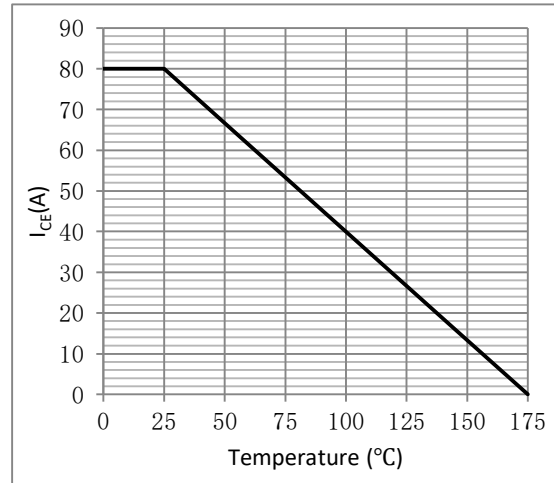


Fig.7 Collector-Emitter VS gate source voltage

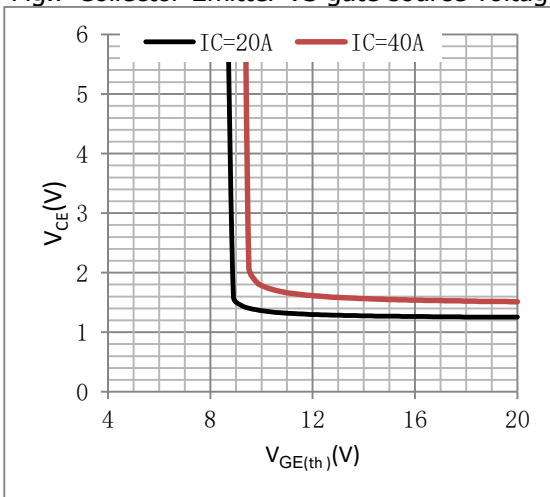


Figure 8. Transfer characteristics

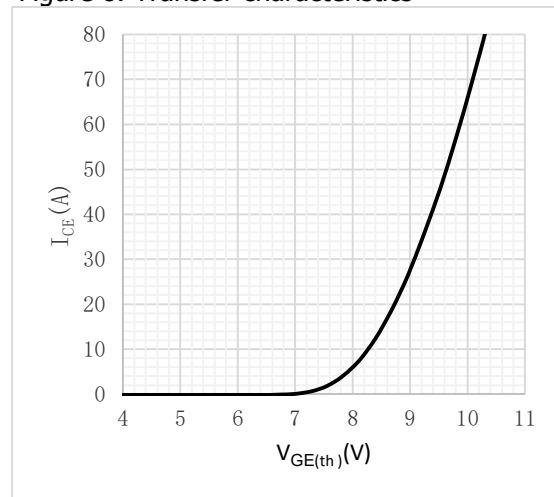


Fig.9 Safe operating area

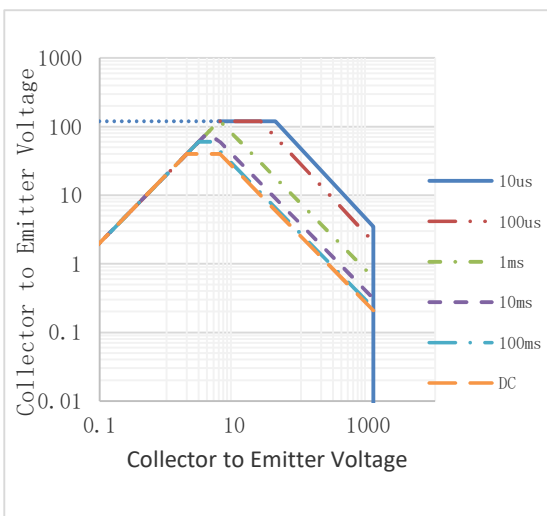
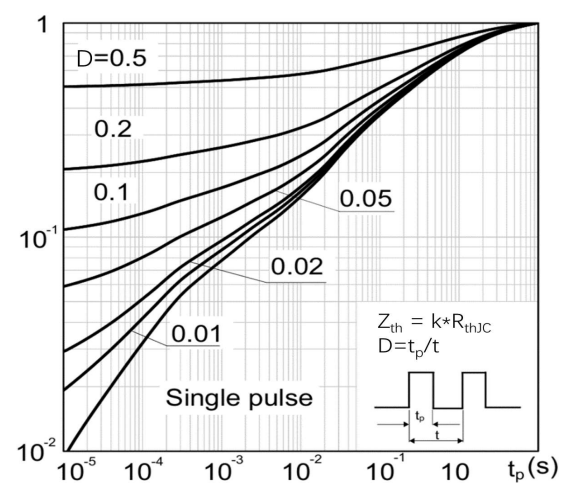
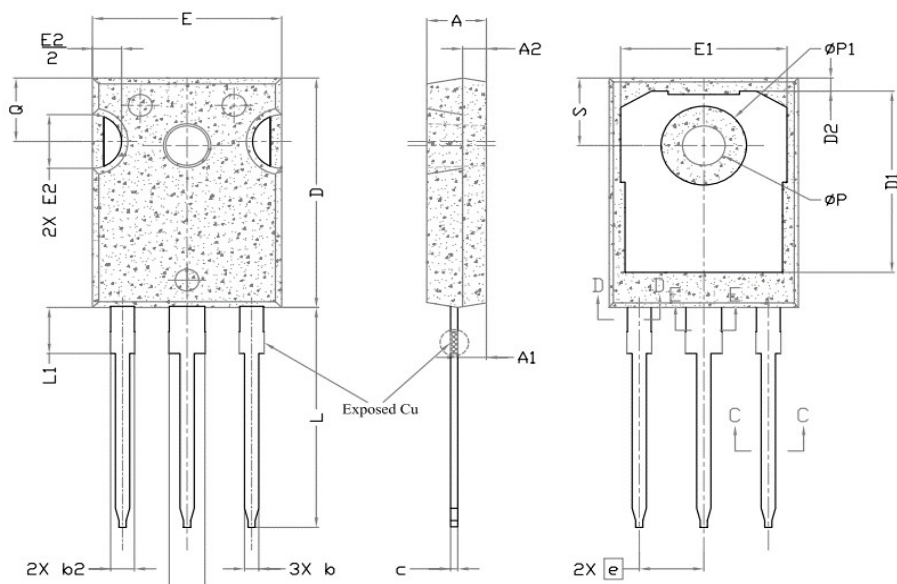


Fig.10 Max transient thermal impedance for IGBT



•TO-247 Package Outline



| SYMBOL | DIMENSIONS |       |       | NOTES |
|--------|------------|-------|-------|-------|
|        | MIN.       | NOM.  | MAX.  |       |
| A      | 4.83       | 5.02  | 5.21  |       |
| A1     | 2.29       | 2.41  | 2.55  |       |
| A2     | 1.50       | 2.00  | 2.49  |       |
| b      | 1.12       | 1.20  | 1.33  |       |
| b1     | 1.12       | 1.20  | 1.28  |       |
| b2     | 1.91       | 2.00  | 2.39  | 6     |
| b3     | 1.91       | 2.00  | 2.34  |       |
| b4     | 2.87       | 3.00  | 3.22  | 6, 8  |
| b5     | 2.87       | 3.00  | 3.18  |       |
| c      | 0.55       | 0.60  | 0.69  | 6     |
| c1     | 0.55       | 0.60  | 0.65  |       |
| D      | 20.80      | 20.95 | 21.10 | 4     |
| D1     | 16.25      | 16.55 | 17.65 | 5     |
| D2     | 0.51       | 1.19  | 1.35  |       |
| E      | 15.75      | 15.94 | 16.13 | 4     |
| E1     | 13.46      | 14.02 | 14.16 | 5     |
| E2     | 4.32       | 4.91  | 5.49  | 3     |
| e      | 5.44BSC    |       |       |       |
| L      | 19.81      | 20.07 | 20.32 |       |
| L1     | 4.10       | 4.19  | 4.40  | 6     |
| ØP     | 3.56       | 3.61  | 3.65  | 7     |
| ØP1    | 7.19REF.   |       |       |       |
| Q      | 5.39       | 5.79  | 6.20  |       |
| S      | 6.04       | 6.17  | 6.30  |       |

**Note:**

① Pulse Test: Pulse width  $\leq 300\mu\text{s}$ , Duty cycle  $\leq 2\%$ , Accumulation time  $\leq 50$  hours; For DC , the following test conditions can be passed:  $V_{GE}=20V/-10V$ ,  $T_j=175^\circ\text{C}$ ,  $t=1000$  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       | 2024/10/23 | New    |
|         |            |        |
|         |            |        |
|         |            |        |
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