

TOSHIBA INTELLIGENT POWER MODULE SILICON N CHANNEL IGBT

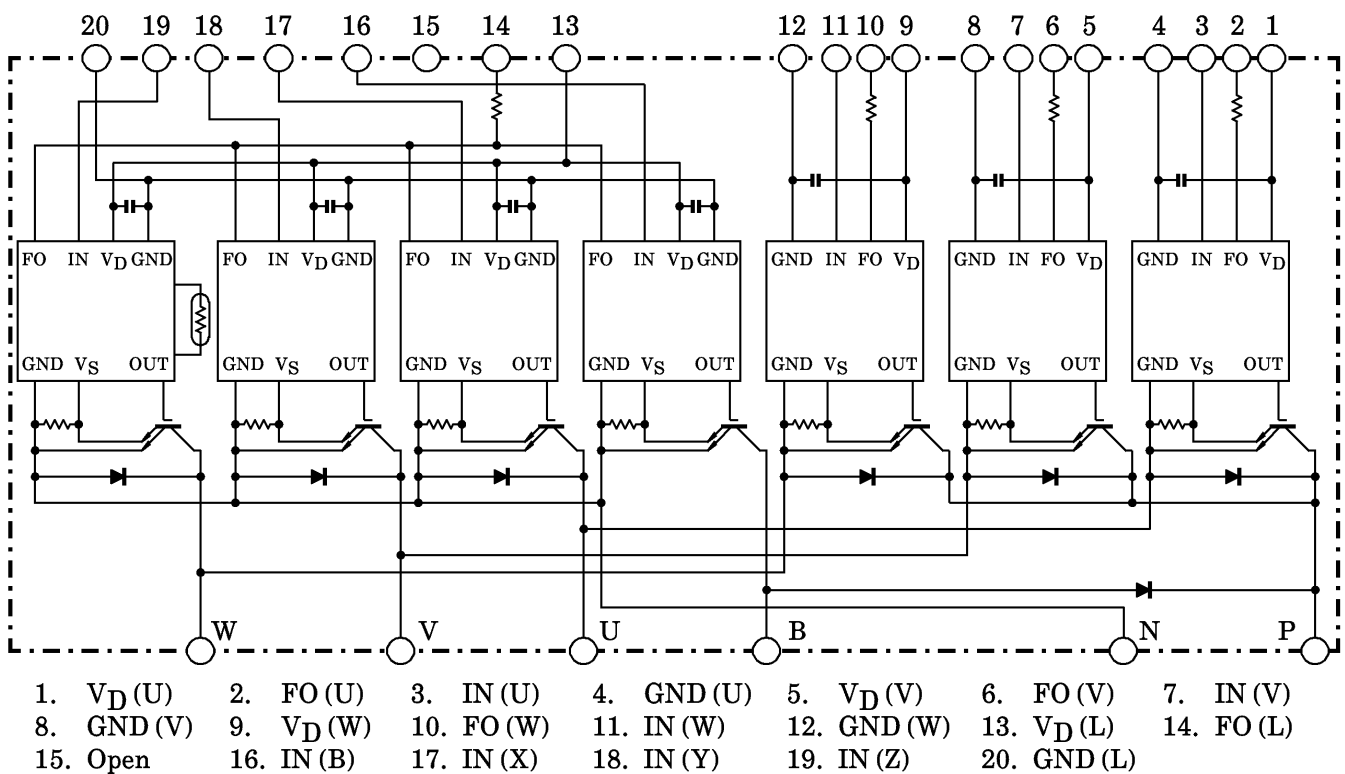
**MIG100J7CSA0A (600V / 100A 7in1)**

HIGH POWER SWITCHING APPLICATIONS

MOTOR CONTROL APPLICATIONS

- Integrates Inverter, Brake Power Circuits & Control Circuits (IGBT drive unit, Protection units for Short-Current, Over-Current, Under-Voltage & Over Temperature) in One Package.
- The Electrodes are Isolated from Case.
- $V_{CE(sat)} = 1.6\text{ V (Typ.)}$

## EQUIVALENT CIRCUIT

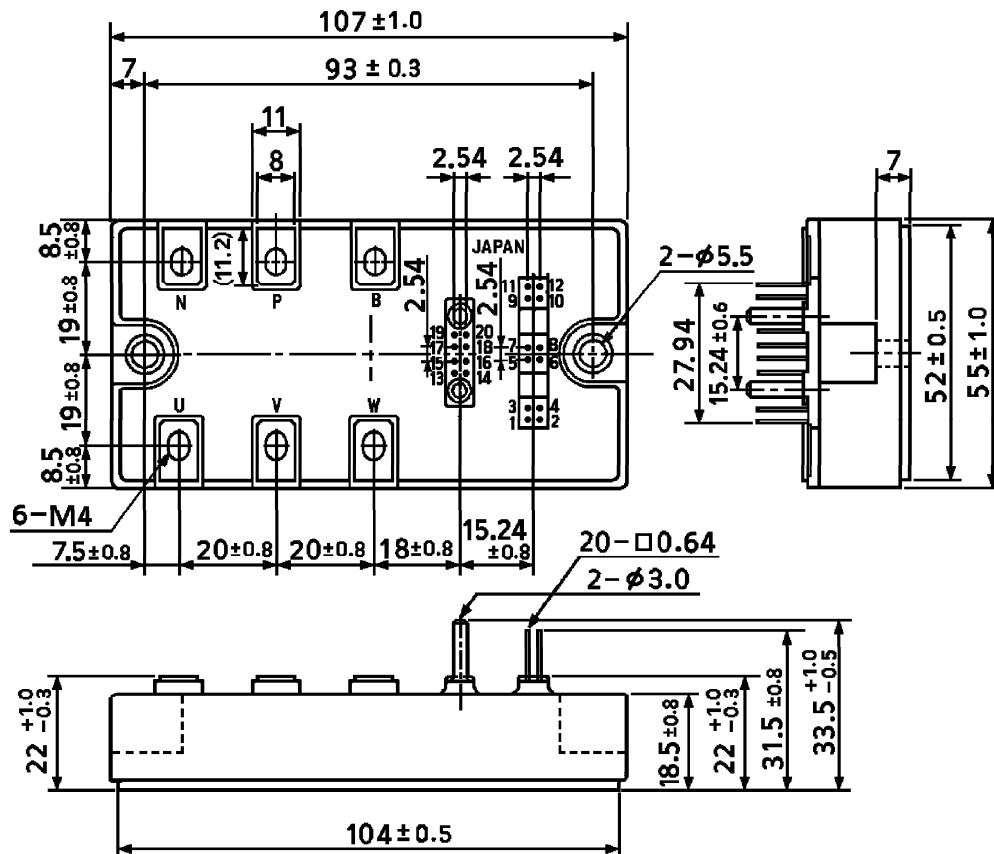


961001EAA1

- TOSHIBA is continually working to improve the quality and the reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.

OUTLINE : TOSHIBA 2-108G1A

Unit : mm

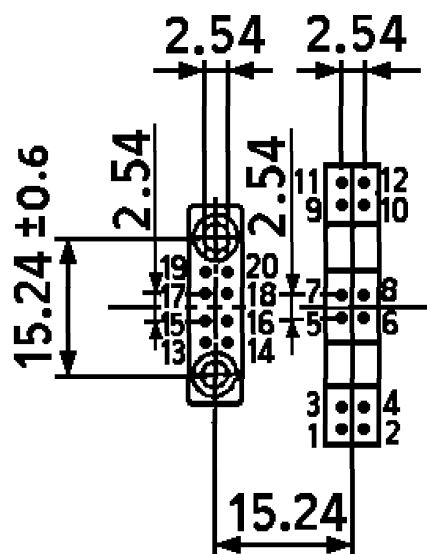


- |               |             |              |            |              |             |
|---------------|-------------|--------------|------------|--------------|-------------|
| 1. $V_D$ (U)  | 2. FO (U)   | 3. IN (U)    | 4. GND (U) | 5. $V_D$ (V) | 6. FO (V)   |
| 7. IN (V)     | 8. GND (V)  | 9. $V_D$ (W) | 10. FO (W) | 11. IN (W)   | 12. GND (W) |
| 13. $V_D$ (L) | 14. FO (L)  | 15. Open     | 16. IN (B) | 17. IN (X)   | 18. IN (Y)  |
| 19. IN (Z)    | 20. GND (L) |              |            |              |             |

Weight : 278 g (Typ.)

## SIGNAL TERMINAL LAYOUT

Unit : mm



- |               |             |              |            |              |             |
|---------------|-------------|--------------|------------|--------------|-------------|
| 1. $V_D$ (U)  | 2. FO (U)   | 3. IN (U)    | 4. GND (U) | 5. $V_D$ (V) | 6. FO (V)   |
| 7. IN (V)     | 8. GND (V)  | 9. $V_D$ (W) | 10. FO (W) | 11. IN (W)   | 12. GND (W) |
| 13. $V_D$ (L) | 14. FO (L)  | 15. Open     | 16. IN (B) | 17. IN (X)   | 18. IN (Y)  |
| 19. IN (Z)    | 20. GND (L) |              |            |              |             |

## MAXIMUM RATINGS

| STAGE    | CHARACTERISTIC              | CONDITION                     | SYMBOL    | RATING          | UNIT             |
|----------|-----------------------------|-------------------------------|-----------|-----------------|------------------|
| Inverter | Supply Voltage              | P-N Power Terminal            | $V_{CC}$  | 450             | V                |
|          | Collector-Emitter Voltage   | —                             | $V_{CES}$ | 600             | V                |
|          | Collector Current           | $T_c = 25^\circ\text{C}$ , DC | $I_C$     | 100             | A                |
|          | Forward Current             | $T_c = 25^\circ\text{C}$ , DC | $I_F$     | 100             | A                |
|          | Collector Power Dissipation | $T_c = 25^\circ\text{C}$      | $P_C$     | 290             | W                |
|          | Junction Temperature        | —                             | $T_j$     | 150             | $^\circ\text{C}$ |
| Brake    | Supply Voltage              | P-N Power Terminal            | $V_{CC}$  | 450             | V                |
|          | Collector-Emitter Voltage   | —                             | $V_{CES}$ | 600             | V                |
|          | Collector Current           | $T_c = 25^\circ\text{C}$ , DC | $I_C$     | 50              | A                |
|          | Reverse Voltage             | —                             | $V_R$     | 600             | V                |
|          | Forward Current             | $T_c = 25^\circ\text{C}$ , DC | $I_F$     | 50              | A                |
|          | Collector Power Dissipation | $T_c = 25^\circ\text{C}$      | $P_C$     | 150             | W                |
|          | Junction Temperature        | —                             | $T_j$     | 150             | $^\circ\text{C}$ |
| Control  | Control Supply Voltage      | $V_D$ -GND Terminal           | $V_D$     | 20              | V                |
|          | Input Voltage               | IN-GND Terminal               | $V_{IN}$  | 20              | V                |
|          | Fault Output Voltage        | FO-GND Terminal               | $V_{FO}$  | 20              | V                |
|          | Fault Output Current        | FO Sink Current               | $I_{FO}$  | 14              | mA               |
| Module   | Operating Temperature       | —                             | $T_c$     | $-20 \sim +100$ | $^\circ\text{C}$ |
|          | Storage Temperature Range   | —                             | $T_{stg}$ | $-40 \sim +125$ | $^\circ\text{C}$ |
|          | Isolation Voltage           | AC 1 min                      | $V_{ISO}$ | 2500            | V                |
|          | Screw Torque (Terminal)     | M4                            | —         | 2               | Nm               |
|          | Screw Torque (Mounting)     | M5                            | —         | 3               | Nm               |

## ELECTRICAL CHARACTERISTICS

a. Inverter Stage ( $T_j = 25^\circ\text{C}$ )

| CHARACTERISTIC                       | SYMBOL            | TEST CONDITION                                                                                                                                          |                           | MIN. | TYP. | MAX. | UNIT          |
|--------------------------------------|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------|------|------|---------------|
| Collector Cut-Off Current            | $I_{CEX}$         | $V_{CE} = 600\text{ V}$                                                                                                                                 | $T_j = 25^\circ\text{C}$  | —    | —    | 1    | mA            |
|                                      |                   |                                                                                                                                                         | $T_j = 125^\circ\text{C}$ | —    | —    | 10   |               |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$     | $V_D = 15\text{ V}$ ,<br>$I_C = 100\text{ A}$ ,<br>$V_{IN} = 15\text{ V} \rightarrow 0\text{ V}$                                                        | $T_j = 25^\circ\text{C}$  | 1.3  | 1.6  | 2.0  | V             |
|                                      |                   |                                                                                                                                                         | $T_j = 125^\circ\text{C}$ | —    | 1.6  | —    |               |
| Forward Voltage                      | $V_F$             | $I_F = 100\text{ A}$                                                                                                                                    |                           | 1.5  | 1.9  | 2.3  | V             |
| Switching Time                       | $t_{on}$          | $V_{CC} = 300\text{ V}$ , $I_C = 100\text{ A}$<br>$V_D = 15\text{ V}$ , $V_{IN} = 15\text{ V} \leftrightarrow 0\text{ V}$<br>Inductive Load<br>(Note 1) |                           | —    | 1.3  | 2.2  | $\mu\text{s}$ |
|                                      | $t_c(\text{on})$  |                                                                                                                                                         |                           | —    | 0.4  | 1.0  |               |
|                                      | $t_{rr}$          |                                                                                                                                                         |                           | —    | 0.2  | 0.6  |               |
|                                      | $t_{off}$         |                                                                                                                                                         |                           | —    | 1.7  | 3.0  |               |
|                                      | $t_c(\text{off})$ |                                                                                                                                                         |                           | —    | 0.4  | 0.8  |               |

b. Brake Stage ( $T_j = 25^\circ\text{C}$ )

| CHARACTERISTIC                       | SYMBOL               | TEST CONDITION                                                                                                                                   | MIN.                      | TYP. | MAX. | UNIT          |
|--------------------------------------|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------|------|---------------|
| Collector Cut-Off Current            | $I_{CE}$             | $V_{CE} = 600\text{ V}$                                                                                                                          | $T_j = 25^\circ\text{C}$  | —    | —    | 1             |
|                                      |                      |                                                                                                                                                  | $T_j = 125^\circ\text{C}$ | —    | —    | 10            |
| Collector-Emitter Saturation Voltage | $V_{CE(\text{sat})}$ | $V_D = 15\text{ V},$<br>$I_C = 50\text{ A},$<br>$V_{IN} = 15\text{ V} \rightarrow 0\text{ V}$                                                    | $T_j = 25^\circ\text{C}$  | —    | 1.6  | 2.0           |
|                                      |                      |                                                                                                                                                  | $T_j = 125^\circ\text{C}$ | —    | 1.6  | —             |
| Reverse Current                      | $I_R$                | $V_R = 600\text{ V}$                                                                                                                             | $T_j = 25^\circ\text{C}$  | —    | —    | 1             |
|                                      |                      |                                                                                                                                                  | $T_j = 125^\circ\text{C}$ | —    | —    | 10            |
| Forward Voltage                      | $V_F$                | $I_F = 50\text{ A}$                                                                                                                              | 1.5                       | 1.9  | 2.3  | V             |
| Switching Time                       | $t_{\text{on}}$      | $V_{CC} = 300\text{ V}, I_C = 50\text{ A}$<br>$V_D = 15\text{ V}, V_{IN} = 15\text{ V} \leftrightarrow 0\text{ V}$<br>Inductive Load<br>(Note 1) | —                         | 1.4  | 2.6  | $\mu\text{s}$ |
|                                      | $t_{\text{c(on)}}$   |                                                                                                                                                  | —                         | 0.65 | 1.2  |               |
|                                      | $t_{\text{rr}}$      |                                                                                                                                                  | —                         | 0.45 | 0.9  |               |
|                                      | $t_{\text{off}}$     |                                                                                                                                                  | —                         | 1.85 | 3.2  |               |
|                                      | $t_{\text{c(off)}}$  |                                                                                                                                                  | —                         | 0.4  | 0.7  |               |

c. Control Stage ( $T_j = 25^\circ\text{C}$ )

| CHARACTERISTIC                          | SYMBOL               | TEST CONDITION                          | MIN.                                            | TYP. | MAX. | UNIT             |
|-----------------------------------------|----------------------|-----------------------------------------|-------------------------------------------------|------|------|------------------|
| Control Circuit Current                 | High Side            | $I_D(\text{H})$                         | $V_D = 15\text{ V}$                             | —    | 8    | mA               |
|                                         | Low Side             |                                         |                                                 | —    | 42   |                  |
| Input On Signal Voltage                 | $V_{IN(\text{on})}$  | $V_D = 15\text{ V}, I_C = 50\text{ mA}$ | 1.4                                             | 1.6  | 1.8  | V                |
| Input Off Signal Voltage                | $V_{IN(\text{off})}$ | —                                       | 2.2                                             | 2.5  | 2.8  |                  |
| Fault Output Current                    | Protection           | $I_{FO(\text{on})}$                     | $V_D = 15\text{ V}$                             | —    | 10   | mA               |
|                                         | Normal               |                                         |                                                 | —    | —    |                  |
| Over Current Protection Trip Level      | Inverter             | OC                                      | $V_D = 15\text{ V}, T_j \leq 125^\circ\text{C}$ | 160  | —    | A                |
|                                         | Brake                |                                         |                                                 | 80   | —    |                  |
| Short Circuit Protection Trip Level     | Inverter             | SC                                      | $V_D = 15\text{ V}, T_j \leq 125^\circ\text{C}$ | 200  | —    | A                |
|                                         | Brake                |                                         |                                                 | 100  | —    |                  |
| Over Current Cut-Off Time               | $t_{\text{off(OC)}}$ | $V_D = 15\text{ V}$                     | —                                               | 5    | —    | $\mu\text{s}$    |
| Over Temperature Protection             | Trip Level           | OT                                      | Case Temperature                                | 110  | 118  | $^\circ\text{C}$ |
|                                         | Reset Level          |                                         |                                                 | —    | 98   |                  |
| Control Supply Under Voltage Protection | Trip Level           | UV                                      | —                                               | 11.0 | 12.0 | V                |
|                                         | Reset Level          |                                         |                                                 | 12.0 | 12.5 |                  |
| Fault Output Pulse Width                | $t_{FO}$             | $V_D = 15\text{ V}$                     | 1                                               | 2    | 3    | ms               |

d. Thermal Resistance (Tc = 25°C)

| CHARACTERISTIC                      | SYMBOL        | TEST CONDITION      | MIN. | TYP. | MAX. | UNIT   |
|-------------------------------------|---------------|---------------------|------|------|------|--------|
| Junction to Case Thermal Resistance | $R_{th(j-c)}$ | Inverter IGBT Stage | —    | —    | 0.43 | °C / W |
|                                     |               | Inverter FRD Stage  | —    | —    | 0.63 |        |
|                                     |               | Brake IGBT Stage    | —    | —    | 0.83 |        |
|                                     |               | Brake FRD Stage     | —    | —    | 1.0  |        |

(Note 1) : Switching time test circuit & timing chart

