

TOSHIBA INTELLIGENT POWER MODULE SILICON N CHANNEL IGBT

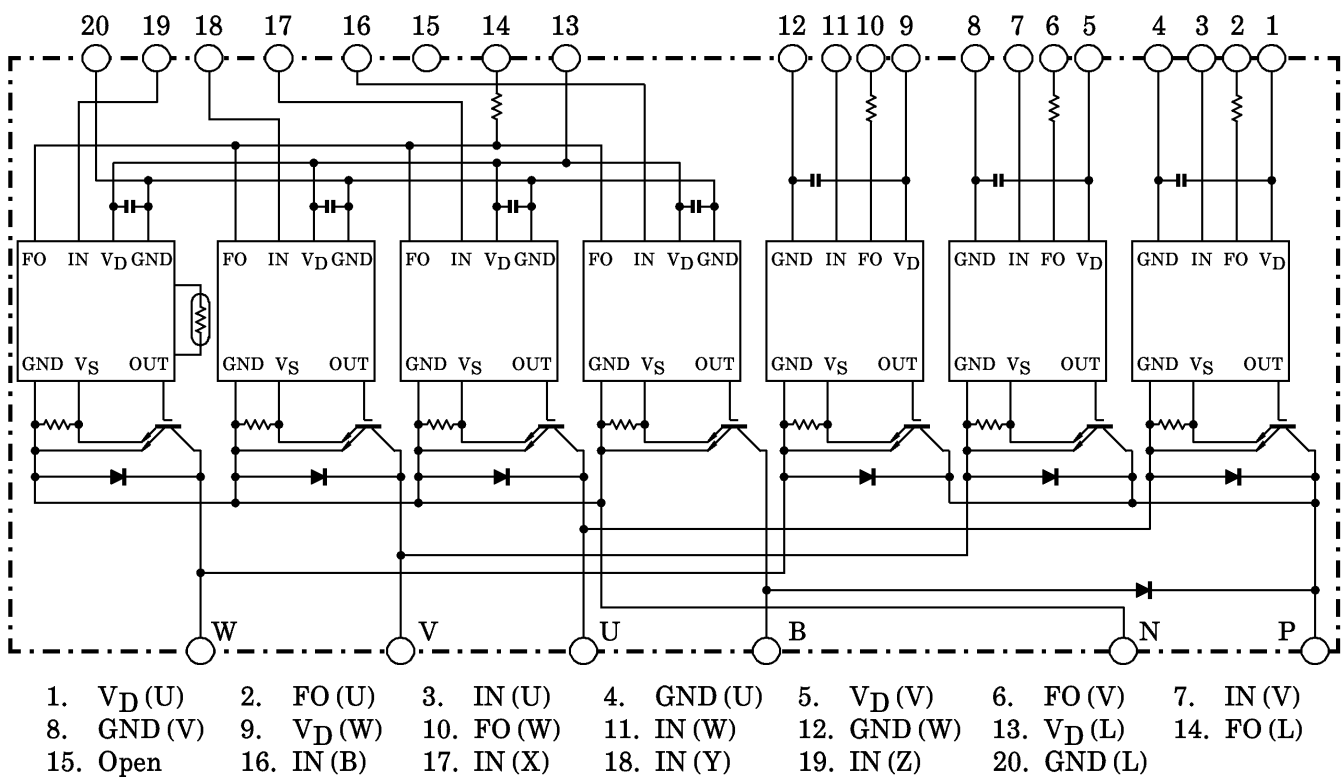
**MIG75J7CSA0A (600V / 75A 7in1)**

HIGH POWER SWITCHING APPLICATIONS

MOTOR CONTROL APPLICATIONS

- Integrates Inverter, Brake Power Circuit & 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.
- High Speed, Low Saturation Type IGBT :  $V_{CE(sat)} = 1.6 \text{ V (Typ.)}$

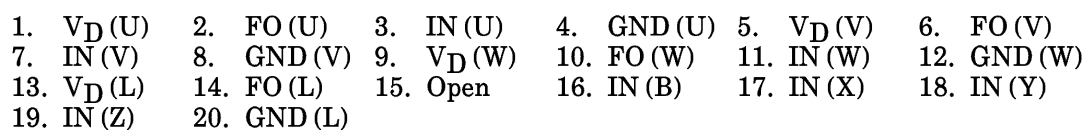
## EQUIVALENT CIRCUIT



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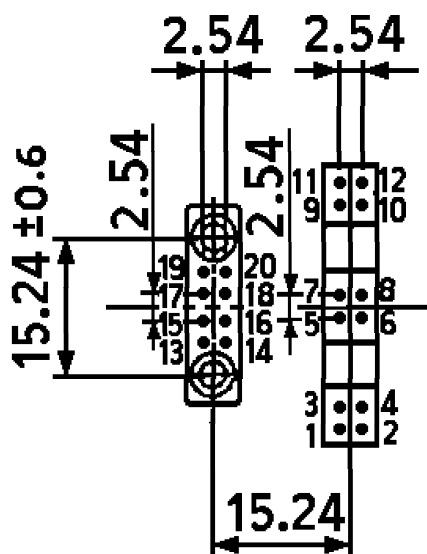
Unit : mm



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    | $I_C$     | 75              | A                |
|          | Forward Current             | $T_c = 25^\circ\text{C}$ , DC    | $I_F$     | 75              | A                |
|          | Collector Power Dissipation | $T_c = 25^\circ\text{C}$         | $P_C$     | 220             | 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                | M4 (Terminal) /<br>M5 (Mounting) | —         | 2 / 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>$I_C = 75\text{ A}$ ,<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                      | $V_F$             | $I_F = 75\text{ A}$                                                                                                                                    |                           | 1.3  | 1.7  | 2.1  | V             |
| Switching Time                       | $t_{on}$          | $V_{CC} = 300\text{ V}$ , $I_C = 75\text{ A}$<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  |               |
|                                      | $t_{off}$         |                                                                                                                                                        |                           | —    | 1.6  | 2.9  |               |
|                                      | $t_c(\text{off})$ |                                                                                                                                                        |                           | —    | 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            | $I_{CEX}$     | $V_{CE} = 600\text{ V}$                                                                                                                          | $T_j = 25^\circ\text{C}$  | —    | —    | 1             |
|                                      |               |                                                                                                                                                  | $T_j = 125^\circ\text{C}$ | —    | —    | 10            |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | $V_D = 15\text{ V},$<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                       | $t_{on}$      | $V_{CC} = 300\text{ V}, I_C = 50\text{ A}$<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  | $\mu\text{s}$ |
|                                      | $t_{c(on)}$   |                                                                                                                                                  | —                         | 0.65 | 1.2  |               |
|                                      | $t_{rr}$      |                                                                                                                                                  | —                         | 0.45 | 0.9  |               |
|                                      | $t_{off}$     |                                                                                                                                                  | —                         | 1.85 | 3.2  |               |
|                                      | $t_{c(off)}$  |                                                                                                                                                  | —                         | 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     | $I_D(H)$                                | $V_D = 15\text{ V}$                             | —    | 8    | mA               |
|                                         | Low Side      |                                         |                                                 | —    | 42   |                  |
| Input On Signal Voltage                 | $V_{IN(on)}$  | $V_D = 15\text{ V}, I_C = 50\text{ mA}$ | 1.4                                             | 1.6  | 1.8  | V                |
| Input Off Signal Voltage                | $V_{IN(off)}$ | —                                       | 2.2                                             | 2.5  | 2.8  |                  |
| Fault Output Current                    | Protection    | $I_{FO(on)}$                            | $V_D = 15\text{ V}$                             | —    | 10   | mA               |
|                                         | Normal        |                                         |                                                 | —    | —    |                  |
| Over Current Protection Trip Level      | Inverter      | OC                                      | $V_D = 15\text{ V}, T_j \leq 125^\circ\text{C}$ | 120  | —    | A                |
|                                         | Brake         |                                         |                                                 | 80   | —    |                  |
| Short Circuit Protection Trip Level     | Inverter      | SC                                      | $V_D = 15\text{ V}, T_j \leq 125^\circ\text{C}$ | 150  | —    | A                |
|                                         | Brake         |                                         |                                                 | 100  | —    |                  |
| Over Current Cut-Off Time               | $t_{off(OC)}$ | $V_D = 15\text{ V}$                     | —                                               | 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 | —    | —    | 0.56 | °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

