

TOSHIBA INTELLIGENT GTR MODULE SILICON N CHANNEL IGBT

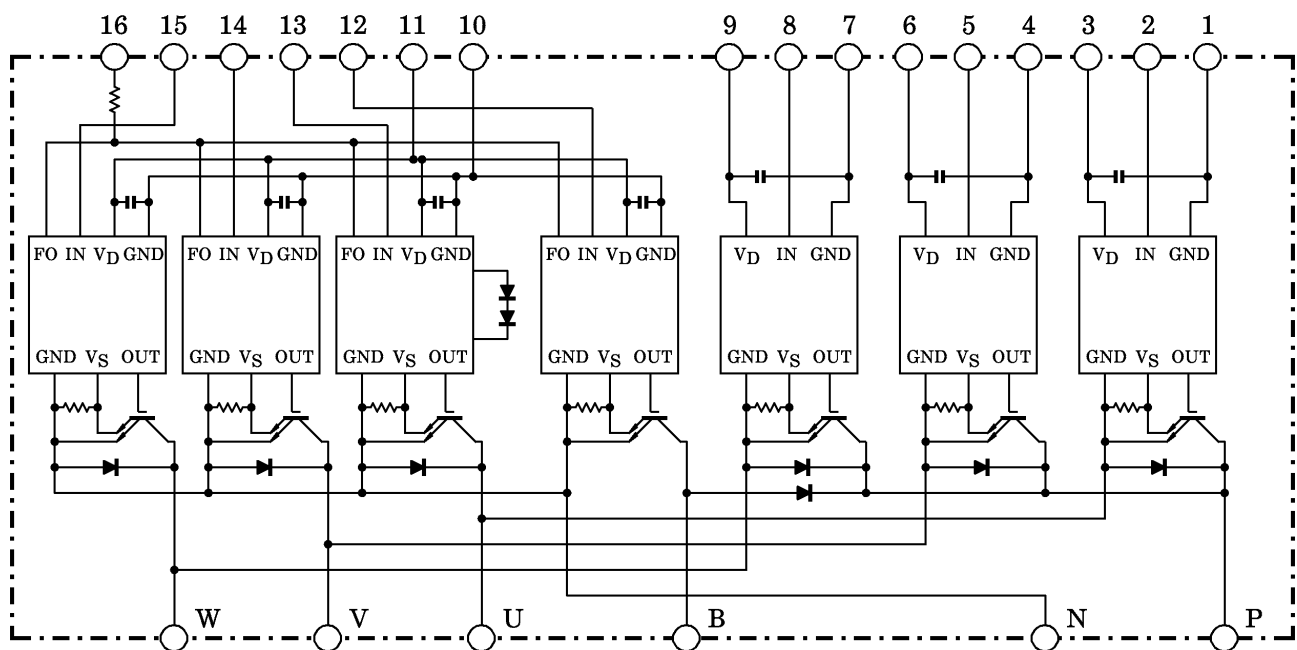
# MIG50J201HC

HIGH POWER SWITCHING APPLICATIONS

MOTOR CONTROL APPLICATIONS

- Integrates Inverter, Brake Power Circuits & Control Circuits (IGBT drive units, Protection units for Over-Current, Under-Voltage & Over-Temperature) in One Package.
- The Electrodes are Isolated from Case.
- High Speed Type IGBT :  $V_{CE(sat)} = 2.8 \text{ V (Max.)}$   
 $t_{off} = 3.0 \mu\text{s (Max.)}$   
 $t_{rr} = 0.30 \mu\text{s (Max.)}$
- Outline : TOSHIBA 2-110A1A
- Weight : 520 g

EQUIVALENT CIRCUIT



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

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MAXIMUM RATINGS ( $T_j = 25^\circ\text{C}$ )

| STAGE    | CHARACTERISTIC              | CONDITION                     | SYMBOL    | RATINGS         | 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 | $I_C$     | 50              | A                |
|          | 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             | $^\circ\text{C}$ |
| 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 | $I_C$     | 30              | A                |
|          | Reverse Voltage             | —                             | $V_R$     | 600             | V                |
|          | Forward Current             | $T_c = 25^\circ\text{C}$ , DC | $I_F$     | 30              | A                |
|          | Collector Power Dissipation | $T_c = 25^\circ\text{C}$      | $P_C$     | 80              | 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 (L) 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 minute                   | $V_{ISO}$ | 2500            | V                |
|          | Screw Torque                | M5                            | —         | 3               | N·m              |

ELECTRICAL CHARACTERISTICS ( $T_j = 25^\circ\text{C}$ )

a. Inverter stage

| CHARACTERISTIC                       | SYMBOL               | TEST CONDITION   | MIN.                      | TYP. | MAX. | UNIT          |    |
|--------------------------------------|----------------------|--|---------------------------|------|------|---------------|----|
| Collector Cut-Off Current            | $I_{CEX}$            | $V_{CEX} = 600\text{ V}$   | $T_j = 25^\circ\text{C}$  | —    | —    | 1             | mA |
|                                      |                      |  | $T_j = 125^\circ\text{C}$ | —    | —    | 20            |    |
| Collector-Emitter Saturation Voltage | $V_{CE}(\text{sat})$ | $V_D = 15\text{ V}$ , $I_C = 50\text{ A}$<br>$V_{IN} = 15\text{ V} \rightarrow 0\text{ V}$                               | $T_j = 25^\circ\text{C}$  | —    | 2.3  | 2.8           | V  |
|                                      |                      |  | $T_j = 125^\circ\text{C}$ | —    | 2.3  | —             |    |
| Forward Voltage                      | $V_F$                | $I_F = 50\text{ A}$  | —                         | 2.1  | 3.0  | V             |    |
| Switching Time                       | $t_{on}$             | $V_{CC} = 300\text{ V}$ , $I_C = 50\text{ A}$<br>$V_D = 15\text{ V}$ , $V_{IN} = 15\text{ V} \leftrightarrow 0\text{ V}$ | —                         | 0.8  | 2.0  | $\mu\text{s}$ |    |
|                                      | $t_{off}$            |  | —                         | 1.2  | 3.0  |               |    |
|                                      | $t_f$                | Inductive load   | —                         | 0.25 | 0.5  |               |    |
|                                      | $t_{rr}$             | (Note 1)   | —                         | 0.1  | 0.3  |               |    |

b. Brake stage

| CHARACTERISTIC                       | SYMBOL                | TEST CONDITION   | MIN.                   | TYP. | MAX. | UNIT |    |
|--------------------------------------|-----------------------|--|------------------------|------|------|------|----|
| Collector Cut-Off Current            | I <sub>CEX</sub>      | V <sub>CEX</sub> = 600 V   | T <sub>j</sub> = 25°C  | —    | —    | 1    | mA |
|                                      |                       |  | T <sub>j</sub> = 125°C | —    | —    | 20   |    |
| Collector-Emitter Saturation Voltage | V <sub>CE (sat)</sub> | V <sub>D</sub> = 15 V, I <sub>C</sub> = 30 A<br>V <sub>IN</sub> = 15 V → 0 V | T <sub>j</sub> = 25°C  | —    | 1.7  | 2.7  | V  |
|                                      |                       |  | T <sub>j</sub> = 125°C | —    | 1.6  | —    |    |
| Reverse Current                      | I <sub>R</sub>        | V <sub>R</sub> = 600 V   | T <sub>j</sub> = 25°C  | —    | —    | 1    | mA |
|                                      |                       |  | T <sub>j</sub> = 125°C | —    | —    | 20   |    |
| Forward Voltage                      | V <sub>F</sub>        | I <sub>F</sub> = 30 A  | —                      | 2.0  | 2.5  | V    |    |
| Switching Time                       | t <sub>on</sub>       | V <sub>CC</sub> = 300 V, I <sub>C</sub> = 30 A                               | —                      | 0.9  | 2.0  | μs   |    |
|                                      | t <sub>off</sub>      | V <sub>D</sub> = 15 V, V <sub>IN</sub> = 15 V ↔ 0 V                          | —                      | 1.7  | 3.0  |      |    |
|                                      | t <sub>f</sub>        | Inductive load   | —                      | 0.25 | 0.5  |      |    |
|                                      | t <sub>rr</sub>       | (Note 1)   | —                      | 0.15 | 0.3  |      |    |

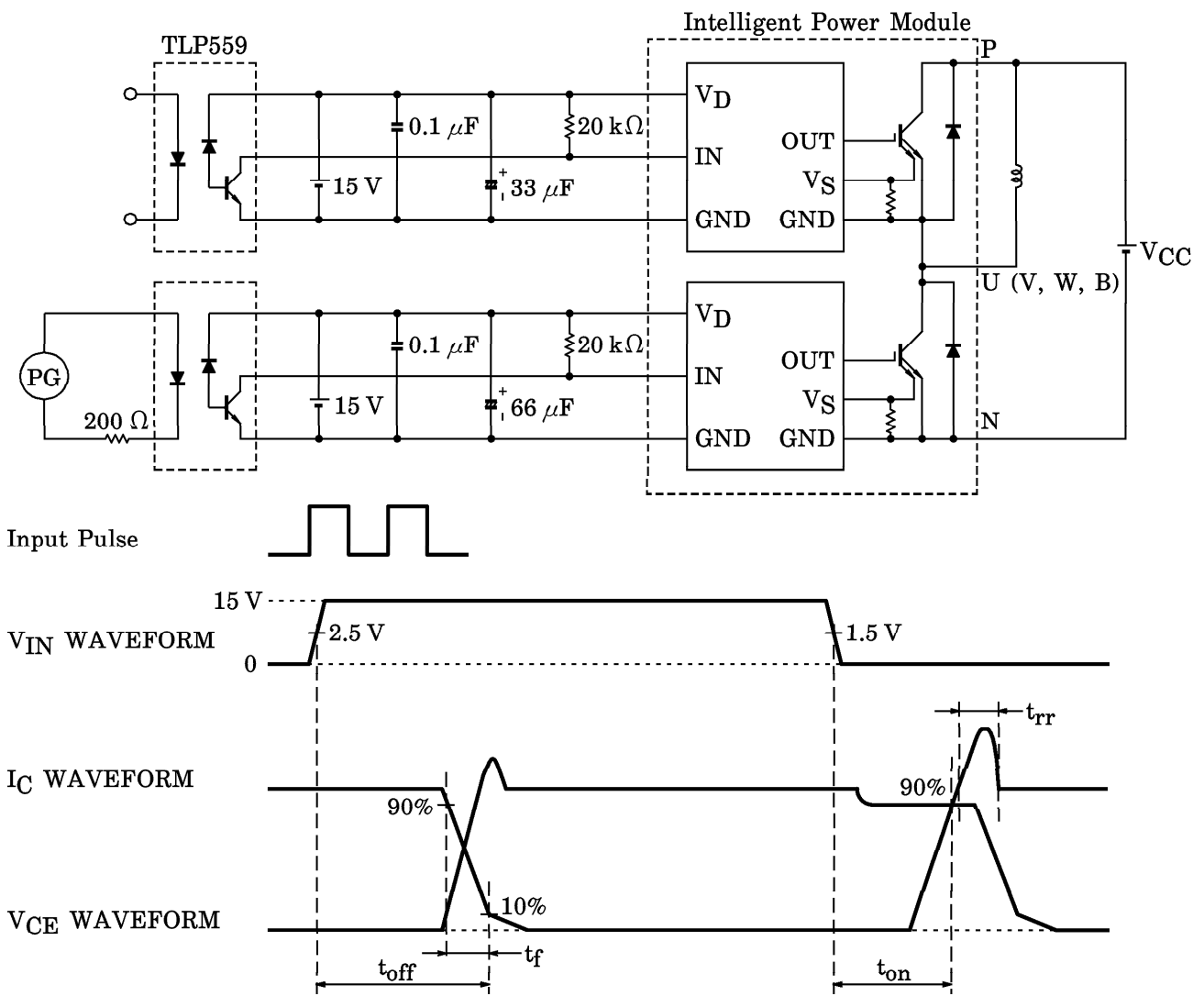
c. Control stage (T<sub>j</sub> = 25°C)

| CHARACTERISTIC                          | SYMBOL                | TEST CONDITION                                | MIN. | TYP. | MAX. | UNIT |
|---|-----------------------|---|------|------|------|------|
| Control Circuit Current                 | High Side             | V <sub>D</sub> = 15 V                         | —    | 8    | —    | mA   |
|   | Low Side              |   | —    | 35   | —    |      |
| Input-On Signal Voltage                 | V <sub>IN (on)</sub>  | V <sub>D</sub> = 15 V, I <sub>C</sub> = 50 mA | 1.3  | 1.5  | 1.7  | V    |
| Input-Off Signal Voltage                | V <sub>IN (off)</sub> | V <sub>D</sub> = 15 V, I <sub>C</sub> = 50 mA | 2.2  | 2.5  | 2.8  | V    |
| Fault Output Current                    | Protection            | V <sub>D</sub> = 15 V                         | 8    | 10   | 12   | mA   |
|   | Normal                |   | —    | —    | 1    |      |
| Over Current Protection Trip Level      | Inverter              | V <sub>D</sub> = 15 V, T <sub>j</sub> = 125°C | 75   | 100  | —    | A    |
|   | Brake                 |   | 40   | —    | —    |      |
| Short Circuit Protection Trip Level     | Inverter              | V <sub>D</sub> = 15 V, T <sub>j</sub> = 125°C | 110  | 150  | —    | A    |
|   | Brake                 |   | 60   | —    | —    |      |
| Over Current Cut-Off Time               | t <sub>off (OC)</sub> | V <sub>D</sub> = 15 V                         | —    | 5    | —    | μs   |
| Over Temperature Protection             | Trip Level            | Case temperature                              | 110  | 118  | 125  | °C   |
|   | Reset Level           |   | —    | 80   | —    |      |
| Control Supply Under Voltage Protection | Trip Level            | —   | 11.0 | 12.0 | 12.5 | V    |
|   | Reset Level           |   | —    | 12.5 | —    |      |
| Fault Output Pulse Width                | t <sub>FO</sub>       | V <sub>D</sub> = 15 V                         | 1    | 2    | 3    | ms   |

d. Thermal resistance ( $T_j = 25^\circ\text{C}$ )

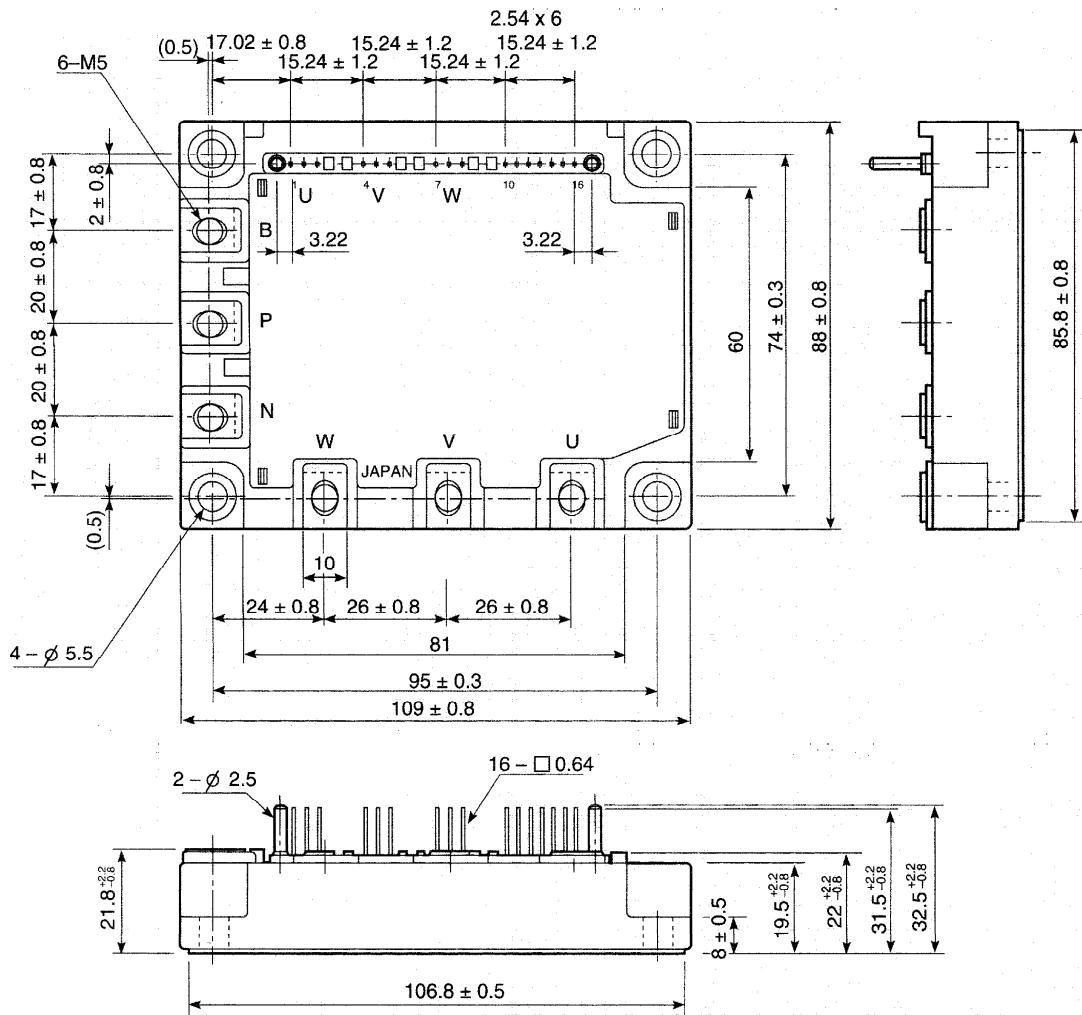
| CHARACTERISTIC                      | SYMBOL        | TEST CONDITION      | MIN. | TYP. | MAX.  | UNIT               |
|-------------------------------------|---------------|---------------------|------|------|-------|--------------------|
| Junction to Case Thermal Resistance | $R_{th(j-c)}$ | Inverter IGBT stage | —    | —    | 0.833 | $^\circ\text{C/W}$ |
|                                     |               | Inverter FRD stage  | —    | —    | 2.000 |                    |
|                                     |               | Brake IGBT stage    | —    | —    | 1.562 |                    |
|                                     |               | Brake FRD stage     | —    | —    | 2.000 |                    |
| Case to Fin Thermal Resistance      | $R_{th(c-f)}$ | Compound is applied | —    | 0.05 | —     | $^\circ\text{C/W}$ |

(Note 1) Switching time test circuit & timing chart



OUTLINE

Unit : mm



|                 | GND | IN | VD  | GND | IN  | VD | GND | VD | IN  | IN  | IN  | IN  | FO |    |    |    |
|-----------------|-----|----|-----|-----|-----|----|-----|----|-----|-----|-----|-----|----|----|----|----|
|                 | (U) |    | (V) |     | (W) |    |     |    | (B) | (X) | (Y) | (Z) |    |    |    |    |
| Signal Terminal | 1   | 2  | 3   | 4   | 5   | 6  | 7   | 8  | 9   | 10  | 11  | 12  | 13 | 14 | 15 | 16 |