

TOSHIBA INTELLIGENT GTR MODULE SILICON N CHANNEL IGBT

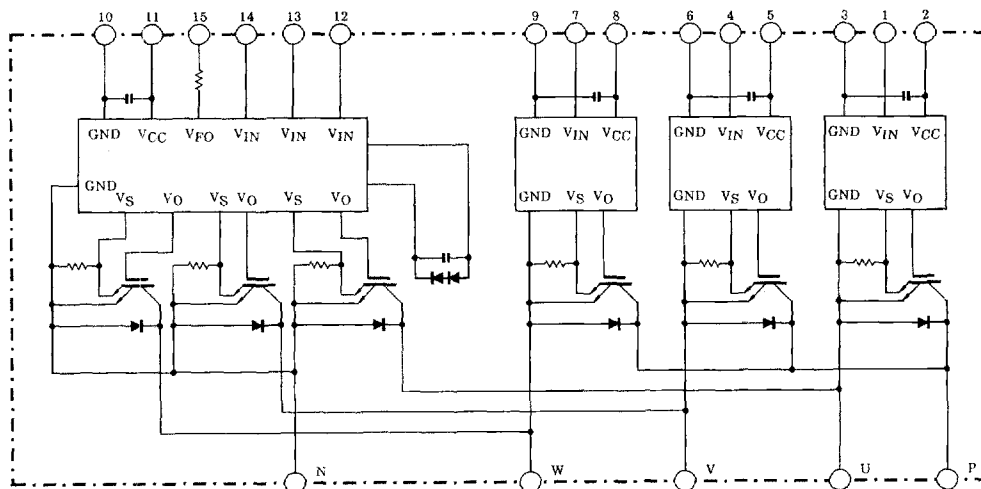
# MIG30J103H

HIGH POWER SWITCHING APPLICATIONS

MOTOR CONTROL APPLICATIONS

- Intelligent GTR Module that include IGBT drive circuits, overcurrent, undervoltage lockout, and overtemperature protection.
- The Electrodes are Isolated from Case.
- High speed type IGBT :  $V_{CE(sat)} \approx 2.7V$  (MAX.)  
 $t_{off} = 2.0\mu s$  (MAX.)  
 $t_{rr} = 0.25\mu s$  (MAX.)
- Outline : TOSHIBA 2-99E1A (See page 5 for the device outline)
- Weight : 80g

EQUIVALENT CIRCUIT



- |               |               |               |
|---------------|---------------|---------------|
| 1. $V_{INU}$  | 2. $V_{DU}$   | 3. $GND_U$    |
| 4. $V_{INV}$  | 5. $V_{DV}$   | 6. $GND_V$    |
| 7. $V_{INW}$  | 8. $V_{DW}$   | 9. $GND_W$    |
| 10. $GND_L$   | 11. $V_{DL}$  | 12. $V_{INX}$ |
| 13. $V_{INY}$ | 14. $V_{INZ}$ | 15. $V_{FO}$  |

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

|               | SYMBOL    | ITEM                        | CONDITION                | RATING          | UNIT             |
|---------------|-----------|-----------------------------|--------------------------|-----------------|------------------|
| Inverter Part | $V_{CC}$  | Supply Voltage              | P-N                      | 400             | V                |
|               | $V_{CES}$ | Collector-Emitter Voltage   | —                        | 600             | V                |
|               | $\pm I_C$ | Collector Current (DC)      | $T_c = 25^\circ\text{C}$ | 30              | A                |
|               | $P_C$     | Collector Power Dissipation | $T_c = 25^\circ\text{C}$ | 83              | W                |
|               | $T_j$     | Junction Temperature        | —                        | 150             | $^\circ\text{C}$ |
| Control Part  | $V_D$     | Supply Voltage              | —                        | 20              | V                |
|               | $V_{IN}$  | Input Voltage               | $V_{IN} = V_D$           | 20              | V                |
|               | $V_{FO}$  | Fowl Output Voltage         | $V_{FO} = V_D$           | 20              | V                |
|               | $I_{FO}$  | Fowl Output Current         | —                        | 7               | mA               |
| All System    | $T_c$     | Operating Temperature       | —                        | $-20 \sim +100$ | $^\circ\text{C}$ |
|               | $T_{stg}$ | Storage Temperature Range   | —                        | $-40 \sim +125$ | $^\circ\text{C}$ |
|               | $V_{ISO}$ | Isolation Voltage           | AC, 1 min                | 2500            | $V_{rms}$        |
|               | —         | Screw Torque                | M5                       | 2               | N·m              |

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

## Inverter Part

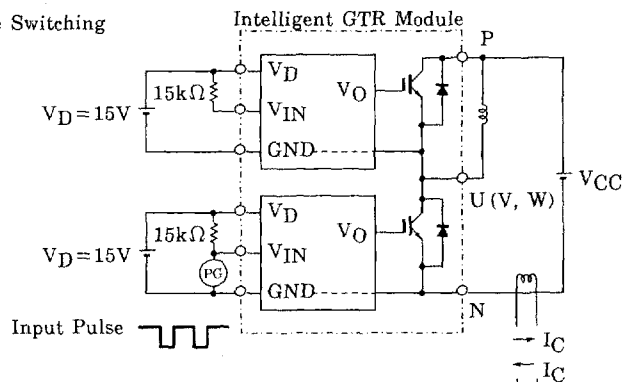
| SYMBOL        | ITEM                                 | TEST CONDITION                                                                                                                           | SPEC |      |      | UNIT          |
|---------------|--------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
|               |                                      |                                                                                                                                          | MIN. | TYP. | MAX. |               |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $V_D = 15\text{V}$<br>$I_{IN} = 0\text{mA}$<br>$I_C = 30\text{A}$                                                                        | —    | 2.1  | 2.7  | V             |
|               |                                      | $I_C = 30\text{A}$ ,<br>$T_j = 125^\circ\text{C}$                                                                                        | —    | —    | 3.0  |               |
| $V_F$         | Forward Voltage                      | $I_F = 30\text{A}$                                                                                                                       | —    | 2.0  | 2.7  | V             |
| $t_{on}$      | Switching Time                       | $V_{CC} = 300\text{V}$<br>$I_C = 30\text{A}$<br>$V_D = 15\text{V}$<br>$I_{IN} = 1\text{mA} \leftrightarrow 0\text{mA}$<br>Inductive Load | 0.5  | 1.3  | 2.0  | $\mu\text{s}$ |
| $t_{c(on)}$   |                                      |                                                                                                                                          | —    | 0.3  | 1.0  |               |
| $t_{off}$     |                                      |                                                                                                                                          | 0.5  | 1.0  | 2.0  |               |
| $t_{c(off)}$  |                                      |                                                                                                                                          | —    | 0.5  | 1.5  |               |
| $t_{rr}$      |                                      |                                                                                                                                          | —    | 0.15 | 0.25 |               |
| $I_{CES}$     | Collector Cut-off Current            | $V_{CE} = 600\text{V}$<br>$T_j = 25^\circ\text{C}$                                                                                       | —    | —    | 1    | mA            |
|               |                                      | $T_j = 125^\circ\text{C}$                                                                                                                | —    | —    | 20   |               |

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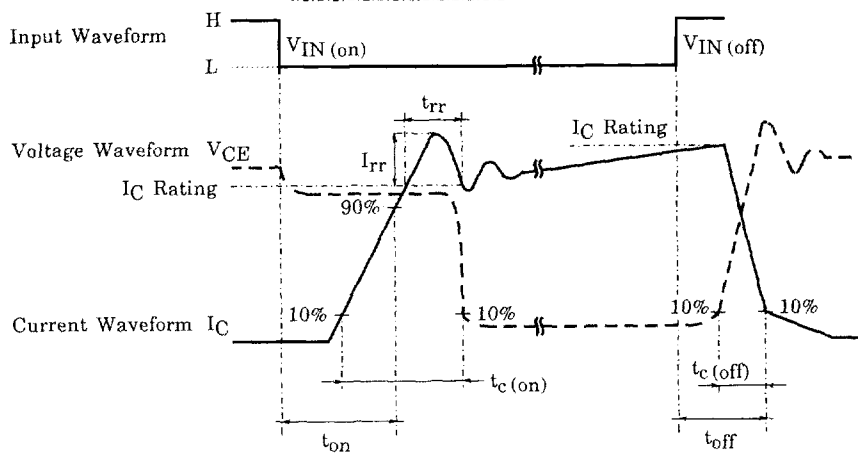
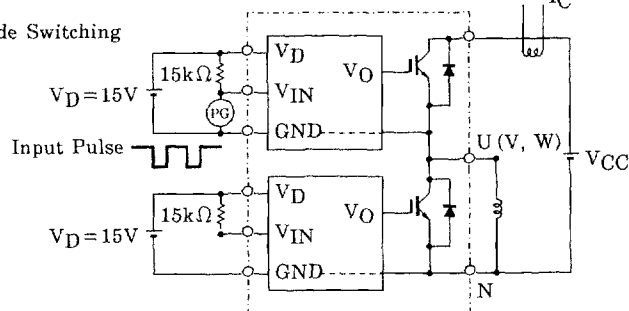
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## Note 1 : Switching Time Test Circuit &amp; Timing Chart

## a) Low Side Switching



## b) High Side Switching

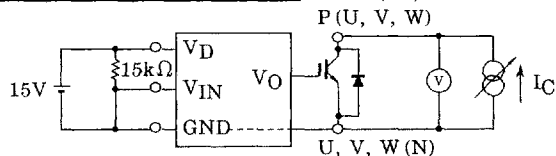
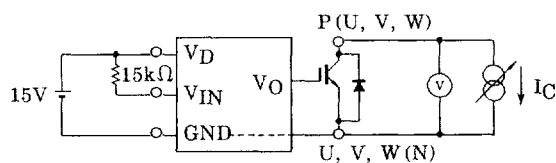
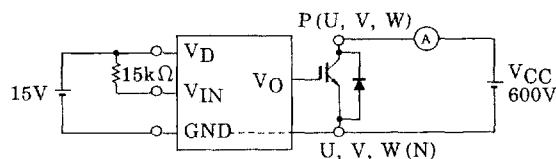
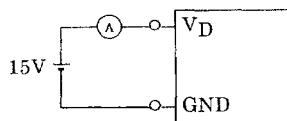
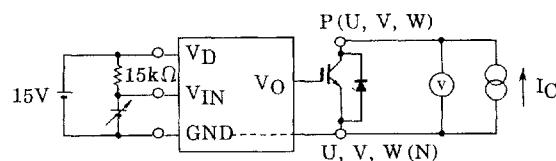
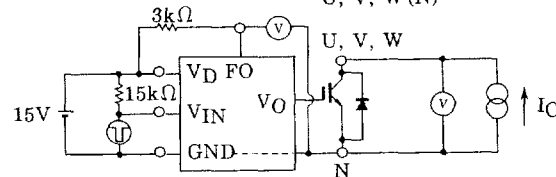
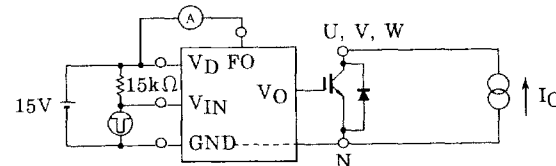


Control Part ( $T_j = 25^\circ\text{C}$ )

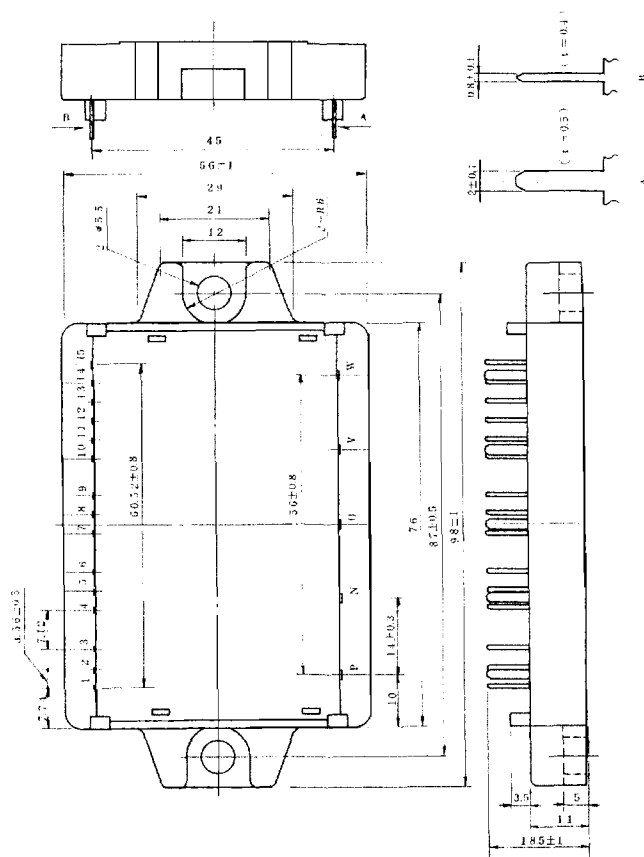
| SYMBOL        | ITEM                                    | TEST CONDITION                                 | SPEC |      |      | UNIT             |
|---------------|-----------------------------------------|------------------------------------------------|------|------|------|------------------|
|               |                                         |                                                | MIN. | TYP. | MAX. |                  |
| $I_D$         | Circuit Current                         | $V_D = 15\text{V}$ High Side                   | 6    | 12   | 18   | mA               |
|               |                                         | Low Side                                       | 11   | 23   | 35   |                  |
| $V_{IN(on)}$  | Input On Signal Voltage                 | —                                              | 1.0  | 1.3  | 1.6  | V                |
| $V_{IN(off)}$ | Input Off Signal Voltage                |                                                | 1.5  | 1.8  | 2.1  |                  |
| $I_{FO}$      | Foul Output Current (Protection)        | $V_D = 15\text{V}, V_{FO} = 15\text{V}$        | 3    | 5    | 7    | mA               |
|               | Foul Output Current (Normal)            |                                                | —    | —    | 1    |                  |
| OC            | Over Current Protection Trip Level      | $V_D = 15\text{V}$                             | 46   | 55   | —    | A                |
|               |                                         | $V_D = 15\text{V}, T_j \leq 125^\circ\text{C}$ | 39   | —    | —    |                  |
| $t_{off(OC)}$ | Over Current Cut Off Time               | $V_D = 15\text{V}$                             | 5    | 10   | 18   | $\mu\text{s}$    |
| OT            | Over Temperature Protection             | Trip Level                                     | 100  | 110  | 120  | $^\circ\text{C}$ |
|               |                                         | Reset Level                                    | 80   | 90   | 100  |                  |
| UV            | Control Supply Under-Voltage Protection | Trip Level                                     | 11.3 | 12.0 | 12.7 | V                |
| $UV_r$        |                                         | Reset Level                                    | 11.8 | 12.5 | 13.2 |                  |
| $t_{FO}$      | Foul Output Pulse Width                 | $V_D = 15\text{V}$                             | 5    | 10   | 15   | ms               |

Thermal Resistance ( $T_j = 25^\circ\text{C}$ )

| SYMBOL        | ITEM                                         | TEST CONDITION | SPEC |      |      | UNIT               |
|---------------|----------------------------------------------|----------------|------|------|------|--------------------|
|               |                                              |                | MIN. | TYP. | MAX. |                    |
| $R_{th(j-c)}$ | Junction to Case Thermal Resistance          | INV. IGBT      | —    | —    | 1.5  | $^\circ\text{C/W}$ |
| $R_{th(j-c)}$ |                                              | INV. FWD       | —    | —    | 4.5  |                    |
| $R_{th(c-f)}$ | Case to Fin Thermal Resistance with compound | —              | —    | 0.2  | —    |                    |

ELECTRICAL CHARACTERISTICS TEST CIRCUIT ( $V_{CE(sat)}$ ,  $V_F$ ,  $I_{CES}$ ,  $I_D$ ,  $V_{IN}$ ,  $I_{FO}$ ,  $t_{FO}$ )a)  $V_{CE(sat)}$ b)  $V_F$ c)  $I_{CES}$ d)  $I_D$ e)  $V_{IN(OFF)}$  $V_{IN(ON)}$ f)  $t_{FO}$ g)  $I_{FO}$ 

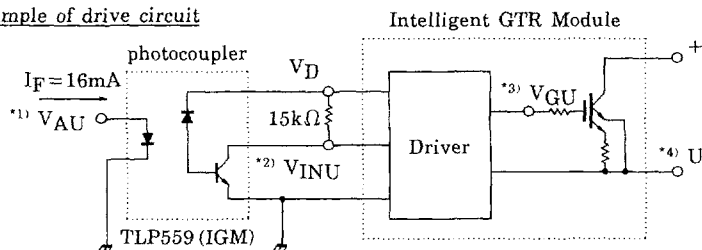
Unit in mm



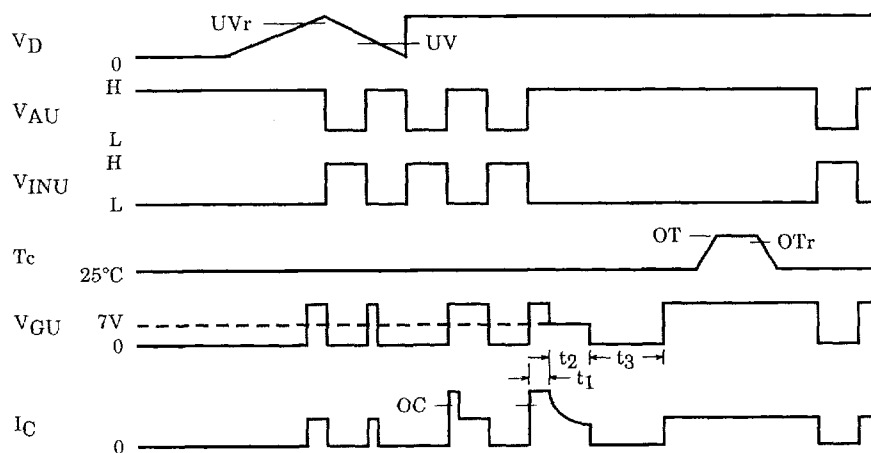
- |               |               |               |
|---------------|---------------|---------------|
| 1. $V_{INU}$  | 2. $V_{DU}$   | 3. $GND_U$    |
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| 7. $V_{INW}$  | 8. $V_{DW}$   | 9. $GND_W$    |
| 10. $GND_L$   | 11. $V_{DL}$  | 12. $V_{INX}$ |
| 13. $V_{INY}$ | 14. $V_{INZ}$ | 15. $V_{FO}$  |

## TIMING CHART (High side)

## Typical example of drive circuit

\*1) or V<sub>AV</sub>, V<sub>AW</sub>\*2) or V<sub>INV</sub>, V<sub>INW</sub>\*3) or V<sub>GV</sub>, V<sub>GW</sub>

\*4) or V, W



UV : Under-Voltage Trip Level

UVr : Under-Voltage Reset Level

OT : Over Temperature Trip Level

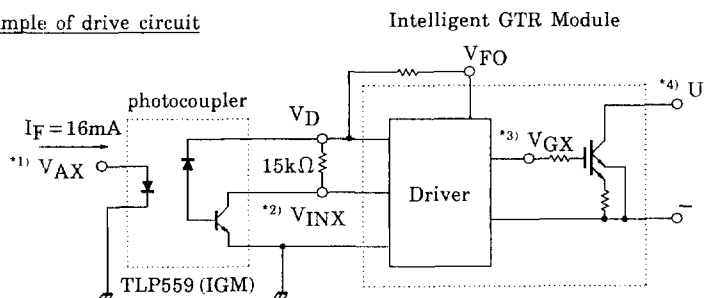
OTr : Over Temperature Reset Level

OC : Over Current

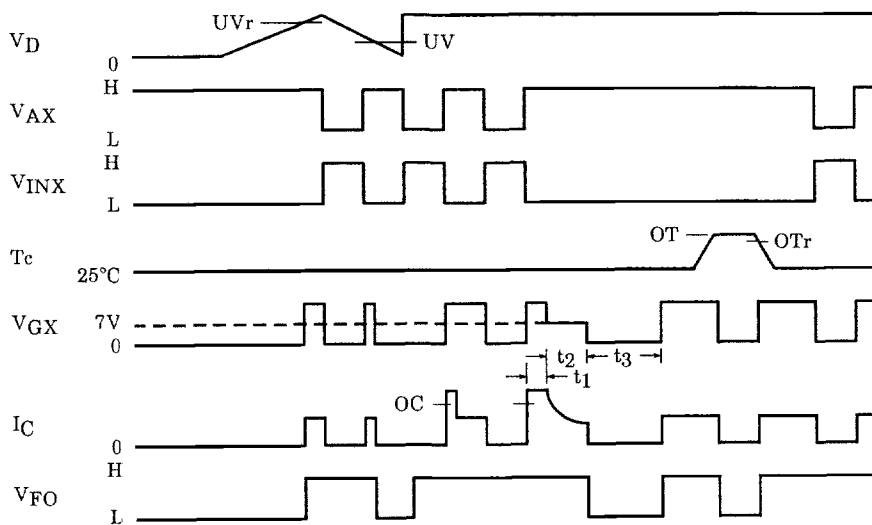
t<sub>1</sub> : 2.5μs (Typ.)t<sub>2</sub> : 10μs (Typ.)t<sub>3</sub> : 10ms (Typ.)

## TIMING CHART (Low side)

Typical example of drive circuit



- \*1) or  $V_{AY}$ ,  $V_{AZ}$   
 \*2) or  $V_{INX}$ ,  $V_{INZ}$   
 \*3) or  $V_{GY}$ ,  $V_{GZ}$   
 \*4) or  $V$ ,  $W$



UV : Under-Voltage Trip Level  
 UVr : Under-Voltage Reset Level  
 OT : Over Temperature Trip Level  
 OTr : Over Temperature Reset Level  
 OC : Over Current

$t_1$  :  $2.5\mu s$  (Typ.)  
 $t_2$  :  $10\mu s$  (Typ.)  
 $t_3$  :  $10ms$  (Typ.)

