

TENTATIVE

TOSHIBA INTEGRATED IGBT MODULE SILICON N CHANNEL IGBT

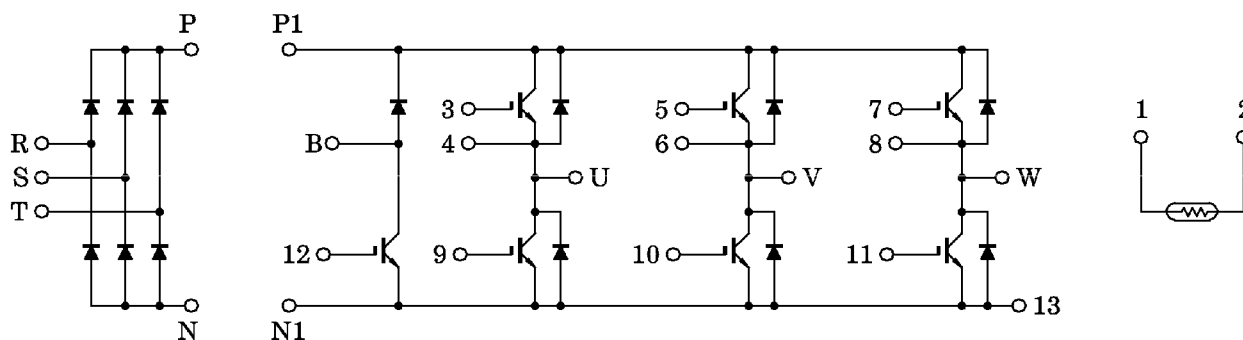
# MIG20J906E, MIG20J906EA

HIGH POWER SWITCHING APPLICATIONS

MOTOR CONTROL APPLICATIONS

- Integrates Inverter, Converter and Brake Power Circuits and Thermistor in One Package.
- Output (Inverter Stage) : 3 $\phi$  20 A / 600 V IGBT
- Input (Converter Stage) : 3 $\phi$  30 A / 800 V Silicon Rectifier
- The Electrodes are Isolated from Case.
- Outline
  - MIG20J906E : 2-108E5A
  - MIG20J906EA : 2-108E6A
- Weight : 190 g

EQUIVALENT CIRCUIT



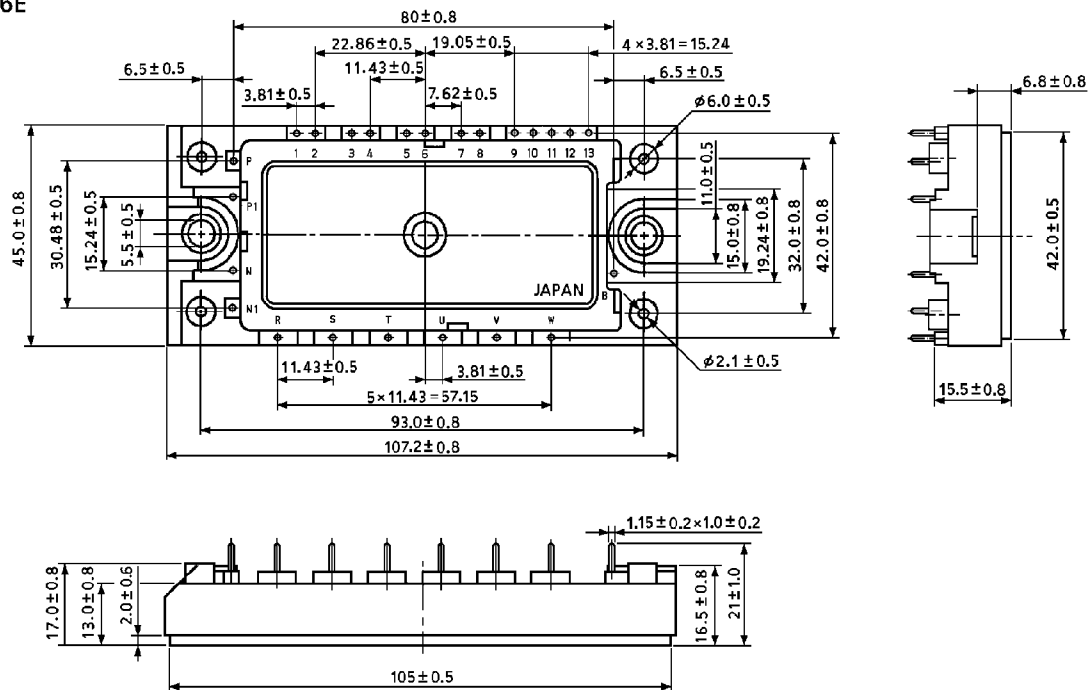
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## Package Dimension

Unit : mm

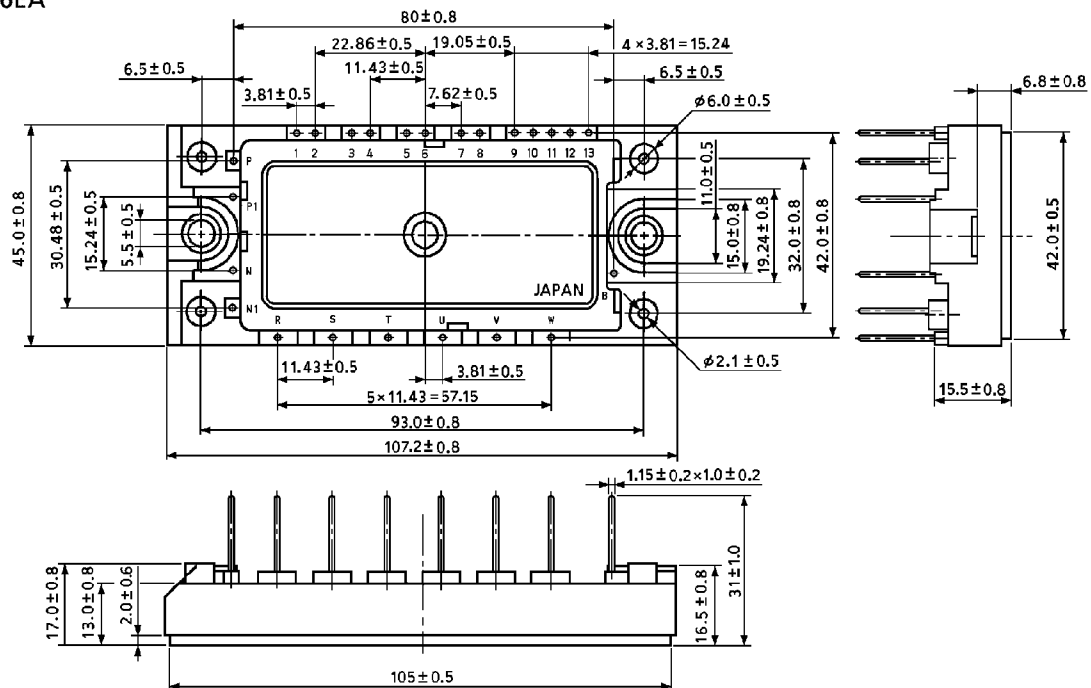
## MIG20J906E



2-108E5A

Unit : mm

## MIG20J906EA



2-108E6A

## MAXIMUM RATINGS (Ta = 25°C)

| STAGE                                               |      | CHARACTERISTIC                                               |      | SYMBOL            | RATING                | UNIT |
|-----------------------------------------------------|------|--------------------------------------------------------------|------|-------------------|-----------------------|------|
| Inverter                                            |      | Collector-Emitter Voltage                                    |      | V <sub>CES</sub>  | 600                   | V    |
|                                                     |      | Gate-Emitter Voltage                                         |      | V <sub>GES</sub>  | ±20                   | V    |
|                                                     |      | Collector Current                                            | DC   | I <sub>C</sub>    | 25 / 20               | A    |
|                                                     |      |                                                              | 1 ms | I <sub>CP</sub>   | 50 / 40               | A    |
|                                                     |      | Forward Current                                              | DC   | I <sub>F</sub>    | 20                    | A    |
|                                                     |      |                                                              | 1 ms | I <sub>FM</sub>   | 40                    | A    |
| Collector Power Dissipation (T <sub>c</sub> = 25°C) |      | P <sub>C</sub>                                               | 90   | W                 |                       |      |
| Converter                                           |      | Repetitive Peak Reverse Voltage                              |      | V <sub>RRM</sub>  | 800                   | V    |
|                                                     |      | Average Output Rectified Current                             |      | I <sub>O</sub>    | 30                    | A    |
|                                                     |      | Peak One Cycle Surge Forward Current (50 Hz, Non-Repetitive) |      | I <sub>FSM</sub>  | 400                   | A    |
| Brake                                               | IGBT | Collector-Emitter Voltage                                    |      | V <sub>CES</sub>  | 600                   | V    |
|                                                     |      | Gate-Emitter Voltage                                         |      | V <sub>GES</sub>  | ±20                   | V    |
|                                                     |      | Collector Current                                            | DC   | I <sub>C</sub>    | 25 / 20               | A    |
|                                                     |      |                                                              | 1 ms | I <sub>CP</sub>   | 50 / 40               | A    |
|                                                     |      | Collector Power Dissipation (T <sub>c</sub> = 25°C)          |      | P <sub>C</sub>    | 90                    | W    |
|                                                     | FWD  | Reverse Voltage                                              |      | V <sub>R</sub>    | 600                   | V    |
|                                                     |      | Forward Current                                              | DC   | I <sub>F</sub>    | 20                    | A    |
|                                                     |      |                                                              | 1 ms | I <sub>FM</sub>   | 40                    | A    |
| Module                                              |      | Junction Temperature                                         |      | T <sub>j</sub>    | 150                   | °C   |
|                                                     |      | Storage Temperature Range                                    |      | T <sub>stg</sub>  | −40~125               | °C   |
|                                                     |      | Isolation Voltage                                            |      | V <sub>Isol</sub> | 2500<br>(AC 1 minute) | V    |
|                                                     |      | Screw Torque                                                 |      | —                 | 6                     | N·m  |

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

## a. Inverter stage

| CHARACTERISTIC                       |               | SYMBOL               | TEST CONDITION                                                                                                 | MIN. | TYP. | MAX.      | UNIT                      |
|--------------------------------------|---------------|----------------------|----------------------------------------------------------------------------------------------------------------|------|------|-----------|---------------------------|
| Gate Leakage Current                 |               | $I_{GES}$            | $V_{GE} = \pm 20\text{ V}, V_{CE} = 0$                                                                         | —    | —    | $\pm 500$ | nA                        |
| Collector Cut-Off Current            |               | $I_{CES}$            | $V_{CE} = 600\text{ V}, V_{GE} = 0$                                                                            | —    | —    | 1.0       | mA                        |
| Gate-Emitter Cut-Off Voltage         |               | $V_{GE(\text{off})}$ | $I_C = 2\text{ mA}, V_{CE} = 5\text{ V}$                                                                       | 5.0  | —    | 8.0       | V                         |
| Collector-Emitter Saturation Voltage |               | $V_{CE(\text{sat})}$ | $I_C = 20\text{ A}, T_j = 25^\circ\text{C}$                                                                    | —    | 2.3  | 2.8       | V                         |
|                                      |               |                      | $V_{GE} = 15\text{ V}, T_j = 125^\circ\text{C}$                                                                | —    | —    | —         |                           |
| Input Capacitance                    |               | $C_{ies}$            | $V_{CE} = 10\text{ V}, V_{GE} = 0,$<br>$f = 1\text{ MHz}$                                                      | —    | —    | —         | pF                        |
| Switching Time                       | Rise Time     | $t_r$                | $V_{CC} = 300\text{ V}$<br>$I_C = 20\text{ A}$<br>$V_{GE} = \pm 15\text{ V}$<br>$R_G = 62\ \Omega$<br>(Note 1) | —    | 0.10 | 0.20      | $\mu\text{s}$             |
|                                      | Turn-On Time  | $t_{on}$             |                                                                                                                | —    | 0.25 | 0.50      |                           |
|                                      | Fall Time     | $t_f$                |                                                                                                                | —    | 0.15 | 0.30      |                           |
|                                      | Turn-Off Time | $t_{off}$            |                                                                                                                | —    | 0.50 | 0.80      |                           |
| Forward Voltage                      |               | $V_F$                | $I_F = 20\text{ A}, V_{GE} = 0$                                                                                | —    | 2.0  | 2.8       | V                         |
| Reverse Recovery Time                |               | $t_{rr}$             | $I_F = 20\text{ A}, V_{GE} = -10\text{ V},$<br>$di/dt = 100\text{ A}/\mu\text{s}$                              | —    | 0.08 | 0.15      | $\mu\text{s}$             |
| Thermal Resistance                   |               | $R_{th(j-c)}$        | Transistor                                                                                                     | —    | —    | 1.39      | $^\circ\text{C}/\text{W}$ |
|                                      |               |                      | Diode                                                                                                          | —    | —    | 2.6       |                           |

## b. Converter stage

| CHARACTERISTIC                       | SYMBOL        | TEST CONDITION           | MIN. | TYP. | MAX. | UNIT                      |
|--------------------------------------|---------------|--------------------------|------|------|------|---------------------------|
| Repetitive Peak Reverse Current      | $I_{RRM}$     | $V_{RRM} = 800\text{ V}$ | —    | —    | 50   | $\mu\text{A}$             |
| Peak Forward Voltage                 | $V_{FM}$      | $I_{FM} = 30\text{ A}$   | —    | 1.05 | 1.20 | V                         |
| Peak One Cycle Surge Forward Current | $I_{FSM}$     | 50 Hz sine-half-wave     | 400  | —    | —    | A                         |
| Thermal Resistance                   | $R_{th(j-c)}$ | —                        | —    | —    | 1.56 | $^\circ\text{C}/\text{W}$ |

## c. Brake stage

| CHARACTERISTIC                       |               | SYMBOL               | TEST CONDITION                                                                                                   | MIN. | TYP. | MAX.      | UNIT               |
|--------------------------------------|---------------|----------------------|------------------------------------------------------------------------------------------------------------------|------|------|-----------|--------------------|
| Gate Leakage Current                 |               | $I_{GES}$            | $V_{GE} = \pm 20 \text{ V}, V_{CE} = 0$                                                                          | —    | —    | $\pm 500$ | nA                 |
| Collector Cut-Off Current            |               | $I_{CES}$            | $V_{CE} = 600 \text{ V}, V_{GE} = 0$                                                                             | —    | —    | 1.0       | mA                 |
| Reverse Current                      |               | $I_R$                | $V_R = 600 \text{ V}$                                                                                            | —    | —    | 1.0       | mA                 |
| Gate-Emitter Cut-Off Voltage         |               | $V_{GE}(\text{off})$ | $I_C = 2 \text{ mA}, V_{CE} = 5 \text{ V}$                                                                       | 5.0  | —    | 8.0       | V                  |
| Collector-Emitter Saturation Voltage |               | $V_{CE}(\text{sat})$ | $I_C = 20 \text{ A}$<br>$V_{GE} = 15 \text{ V}$<br>$T_j = 25^\circ\text{C}$                                      | —    | 2.3  | 2.8       | V                  |
|                                      |               |                      | $T_j = 125^\circ\text{C}$                                                                                        | —    | —    | —         |                    |
| Input Capacitance                    |               | $C_{ies}$            | $V_{CE} = 10 \text{ V}, V_{GE} = 0,$<br>$f = 1 \text{ MHz}$                                                      | —    | 1850 | —         | pF                 |
| Switching Time                       | Rise Time     | $t_r$                | $V_{CC} = 600 \text{ V}$<br>$I_C = 20 \text{ A}$<br>$V_{GE} = \pm 15 \text{ V}$<br>$R_G = 62 \Omega$<br>(Note 1) | —    | 0.10 | 0.20      | $\mu\text{s}$      |
|                                      | Turn-On Time  | $t_{on}$             |                                                                                                                  | —    | 0.25 | 0.50      |                    |
|                                      | Fall Time     | $t_f$                |                                                                                                                  | —    | 0.15 | 0.30      |                    |
|                                      | Turn-Off Time | $t_{off}$            |                                                                                                                  | —    | 0.50 | 0.80      |                    |
| Forward Voltage                      |               | $V_F$                | $I_F = 20 \text{ A}, V_{GE} = 0$                                                                                 | —    | 2.0  | 2.8       | V                  |
| Thermal Resistance                   |               | $R_{th(j-c)}$        | Transistor                                                                                                       | —    | —    | 1.39      | $^\circ\text{C/W}$ |
|                                      |               |                      | Diode                                                                                                            | —    | —    | 2.6       |                    |

## d. Thermistor

| CHARACTERISTIC        | SYMBOL      | TEST CONDITION                                    | MIN.  | TYP. | MAX.  | UNIT      |
|-----------------------|-------------|---------------------------------------------------|-------|------|-------|-----------|
| Zero-power Resistance | $R_{25}$    | $I_{TM} = 0.2 \text{ mA}, T_c = 25^\circ\text{C}$ | 17.31 | 20   | 23.14 | $k\Omega$ |
| B Value               | $B_{25/85}$ | $T_c = 25^\circ\text{C} / T_c = 85^\circ\text{C}$ | —     | 3760 | —     | K         |

(Note 1) Switching Time Test Circuit &amp; Timing Chart

