

# IGBT Modules

## Sixpack

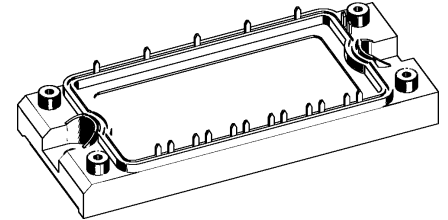
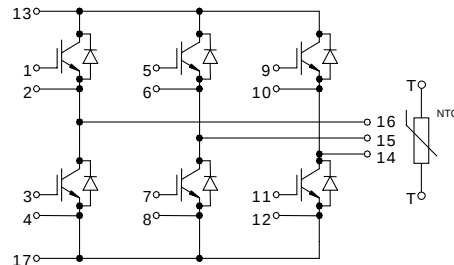
Short Circuit SOA Capability  
Square RBSOA

$$\begin{aligned} I_{C25} &= 62 \text{ A} \\ V_{CES} &= 1200 \text{ V} \\ V_{CE(sat) \text{ typ.}} &= 2.2 \text{ V} \end{aligned}$$

Preliminary Data

Type: NTC - Option:

MWI 35-12 A7 without NTC  
MWI 35-12 A7T with NTC



### IGBTs

| Symbol              | Conditions                                                                                                                        | Maximum Ratings                         |               |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|---------------|
| $V_{CES}$           | $T_{VJ} = 25^{\circ}\text{C to } 150^{\circ}\text{C}$                                                                             | 1200                                    | V             |
| $V_{GES}$           |                                                                                                                                   | $\pm 20$                                | V             |
| $I_{C25}$           | $T_C = 25^{\circ}\text{C}$                                                                                                        | 62                                      | A             |
| $I_{C80}$           | $T_C = 80^{\circ}\text{C}$                                                                                                        | 44                                      | A             |
| RBSOA               | $V_{GE} = \pm 15 \text{ V}$ ; $R_G = 39 \Omega$ ; $T_{VJ} = 125^{\circ}\text{C}$<br>Clamped inductive load; $L = 100 \mu\text{H}$ | $I_{CM} = 70$<br>$V_{CEK} \leq V_{CES}$ | A             |
| $t_{SC}$<br>(SCSOA) | $V_{CE} = V_{CES}$ ; $V_{GE} = \pm 15 \text{ V}$ ; $R_G = 39 \Omega$ ; $T_{VJ} = 125^{\circ}\text{C}$<br>non-repetitive           | 10                                      | $\mu\text{s}$ |
| $P_{tot}$           | $T_C = 25^{\circ}\text{C}$                                                                                                        | 280                                     | W             |

### Features

- NPT IGBT technology
- low saturation voltage
- low switching losses
- switching frequency up to 30 kHz
- square RBSOA, no latch up
- high short circuit capability
- positive temperature coefficient for easy paralleling
- MOS input, voltage controlled
- ultra fast free wheeling diodes
- solderable pins for PCB mounting
- package with copper base plate

### Advantages

- space savings
- reduced protection circuits
- package designed for wave soldering

### Typical Applications

- AC motor control
- AC servo and robot drives
- power supplies

| Symbol                                                                 | Conditions                                                                                                                                           | Characteristic Values<br>( $T_{VJ} = 25^{\circ}\text{C}$ , unless otherwise specified) |                                      |                                  |
|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|--------------------------------------|----------------------------------|
|                                                                        |                                                                                                                                                      | min.                                                                                   | typ.                                 | max.                             |
| $V_{CE(sat)}$                                                          | $I_C = 35 \text{ A}$ ; $V_{GE} = 15 \text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$                                     |                                                                                        | 2.2<br>2.6                           | 2.8<br>V                         |
| $V_{GE(th)}$                                                           | $I_C = 1.2 \text{ mA}$ ; $V_{GE} = V_{CE}$                                                                                                           | 4.5                                                                                    |                                      | 6.5 V                            |
| $I_{CES}$                                                              | $V_{CE} = V_{CES}$ ; $V_{GE} = 0 \text{ V}$ ; $T_{VJ} = 25^{\circ}\text{C}$<br>$T_{VJ} = 125^{\circ}\text{C}$                                        |                                                                                        | 2                                    | 2 mA                             |
| $I_{GES}$                                                              | $V_{CE} = 0 \text{ V}$ ; $V_{GE} = \pm 20 \text{ V}$                                                                                                 |                                                                                        |                                      | 200 nA                           |
| $t_{d(on)}$<br>$t_r$<br>$t_{d(off)}$<br>$t_f$<br>$E_{on}$<br>$E_{off}$ | Inductive load, $T_{VJ} = 125^{\circ}\text{C}$<br>$V_{CE} = 600 \text{ V}$ ; $I_C = 35 \text{ A}$<br>$V_{GE} = \pm 15 \text{ V}$ ; $R_G = 39 \Omega$ |                                                                                        | 100<br>80<br>500<br>70<br>5.4<br>4.2 | ns<br>ns<br>ns<br>ns<br>mJ<br>mJ |
| $C_{ies}$                                                              |                                                                                                                                                      |                                                                                        | 2000                                 | pF                               |
| $Q_{Gon}$                                                              |                                                                                                                                                      |                                                                                        | 140                                  | nC                               |
| $R_{thJC}$                                                             |                                                                                                                                                      |                                                                                        |                                      | 0.44 K/W                         |

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## Diodes

| Symbol           | Conditions            | Maximum Ratings |   |
|------------------|-----------------------|-----------------|---|
| I <sub>F25</sub> | T <sub>C</sub> = 25°C | 50              | A |
| I <sub>F80</sub> | T <sub>C</sub> = 80°C | 33              | A |

| Symbol               | Conditions                                                                                                                            | Characteristic Values |           |            |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------|------------|
|                      |                                                                                                                                       | min.                  | typ.      | max.       |
| $V_F$                | $I_F = 35 \text{ A}; V_{GE} = 0 \text{ V}; T_{VJ} = 25^\circ\text{C}$<br>$T_{VJ} = 125^\circ\text{C}$                                 |                       | 1.9       | 2.8 V<br>V |
| $I_{RM}$<br>$t_{rr}$ | $I_F = 35 \text{ A}; di_F/dt = -400 \text{ A}/\mu\text{s}; T_{VJ} = 125^\circ\text{C}$<br>$V_R = 600 \text{ V}; V_{GE} = 0 \text{ V}$ |                       | 20<br>200 | A<br>ns    |
| $R_{thJC}$           | (per diode)                                                                                                                           |                       |           | 1.19 K/W   |

### Temperature Sensor NTC (MWI ... A7T version only)

| Symbol                    | Conditions | Characteristic Values |      |         |
|---------------------------|------------|-----------------------|------|---------|
|                           |            | min.                  | typ. | max.    |
| <b>R</b> <sub>25</sub>    | T = 25°C   | 4.75                  | 5.0  | 5.25 kΩ |
| <b>B</b> <sub>25/50</sub> |            |                       | 3375 | K       |

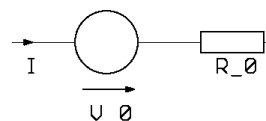
## Module

| Symbol     | Conditions                                     | Maximum Ratings |    |
|------------|------------------------------------------------|-----------------|----|
| $T_{VJ}$   |                                                | -40...+150      | °C |
| $T_{stg}$  |                                                | -40...+125      | °C |
| $V_{ISOL}$ | $I_{ISOL} \leq 1 \text{ mA}; 50/60 \text{ Hz}$ | 2500            | V~ |
| $M_d$      | Mounting torque (M5)                           | 2.7 - 3.3       | Nm |

| Symbol                | Conditions                   | Characteristic Values |      |      |
|-----------------------|------------------------------|-----------------------|------|------|
|                       |                              | min.                  | typ. | max. |
| $R_{\text{pin-chip}}$ |                              |                       | 5    | mΩ   |
| $d_s$                 | Creepage distance on surface | 6                     |      | mm   |
| $d_A$                 | Strike distance in air       | 6                     |      | mm   |
| $R_{\text{thCH}}$     | with heatsink compound       |                       | 0.02 | K/W  |
| <b>Weight</b>         |                              |                       | 180  | g    |

## Equivalent Circuits for Simulation

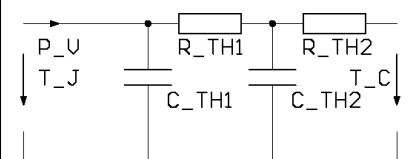
## Conduction



IGBT (typ. at  $V_{GE} = 15\text{ V}$ ;  $T_J = 125^\circ\text{C}$ )  
 $V_\theta = 1.6\text{ V}$ ;  $R_\theta = 28\text{ m}\Omega$

Free Wheeling Diode (typ. at  $T_J = 125^\circ\text{C}$ )  
 $V_\theta = 1.3\text{ V}; R_\theta = 24.9\text{ m}\Omega$

### Thermal Response



IGBT (typ.)

$$C_{th1} = 0.166 \text{ J/K}; R_{th1} = 0.342 \text{ K/W}$$

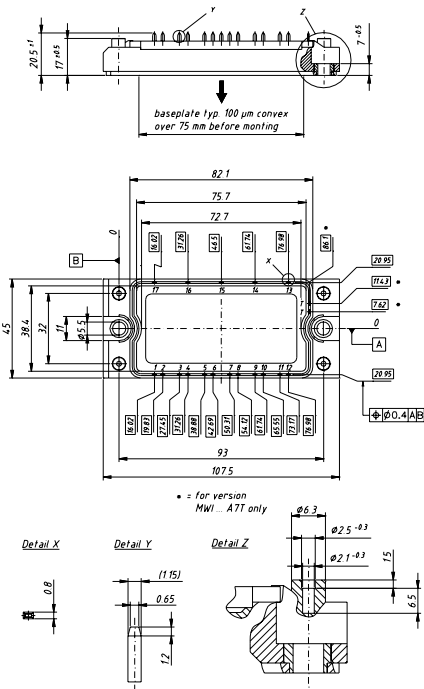
$$C_{th2} = 1.921 \text{ J/K}; R_{th2} = 0.098 \text{ K/W}$$

Free Wheeling Diode (typ.)

$$C_{th1} = 0.081 \text{ J/K}; R_{th1} = 0.973 \text{ K/W}$$

$$C_{th2} = 0.915 \text{ J/K}; R_{th2} = 0.217 \text{ K/W}$$

**Dimensions in mm (1 mm = 0.0394")**



Higher magnification see outlines.pdf

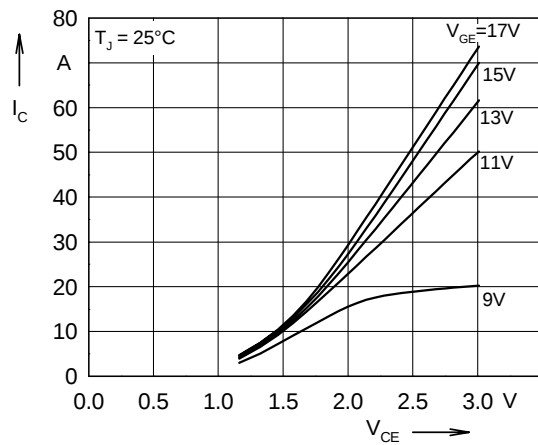


Fig. 1 Typ. output characteristics

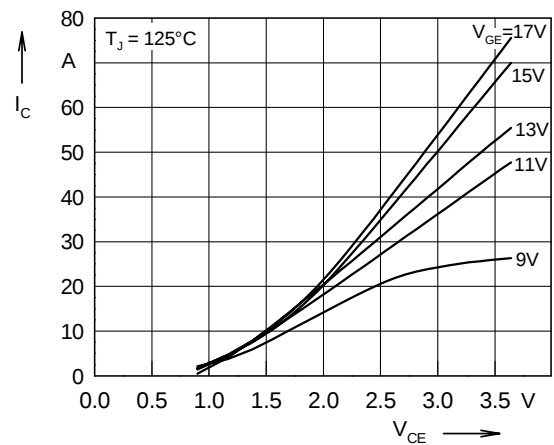


Fig. 2 Typ. output characteristics

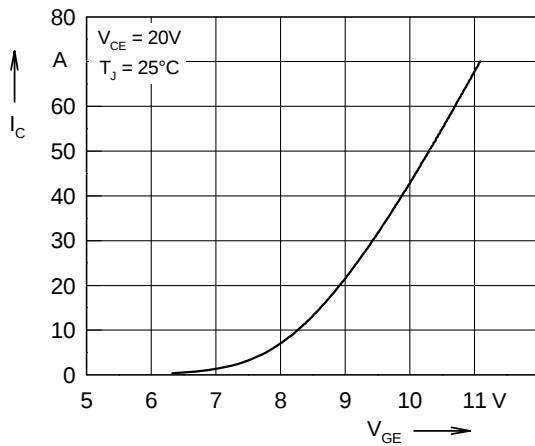


Fig. 3 Typ. transfer characteristics

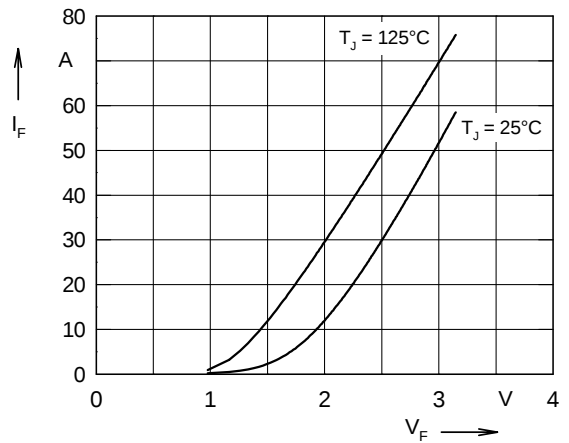


Fig. 4 Typ. forward characteristics of free wheeling diode

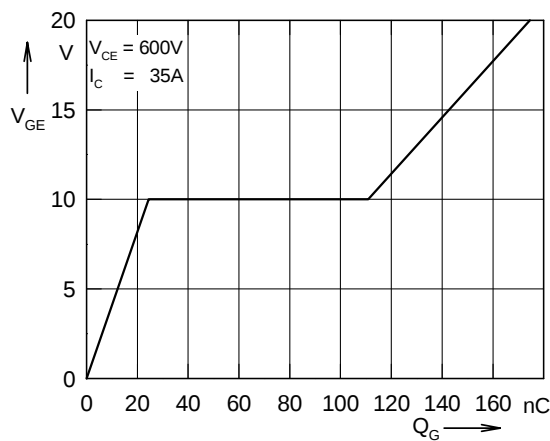


Fig. 5 Typ. turn on gate charge

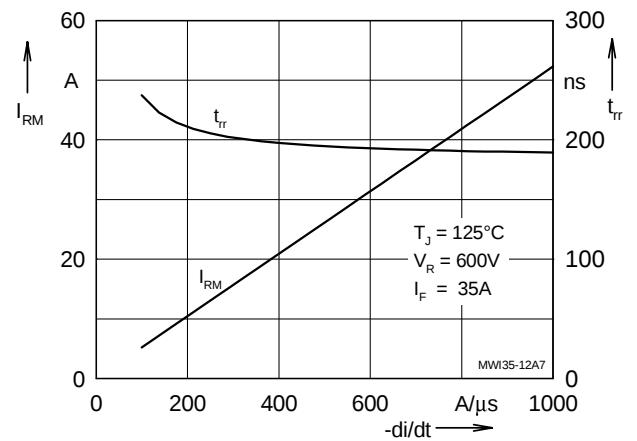


Fig. 6 Typ. turn off characteristics of free wheeling diode

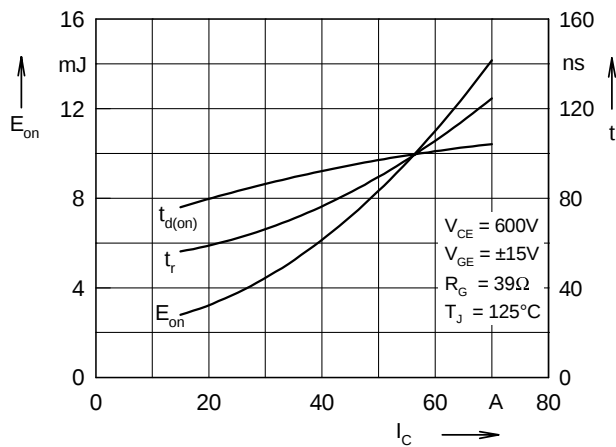


Fig. 7 Typ. turn on energy and switching times versus collector current

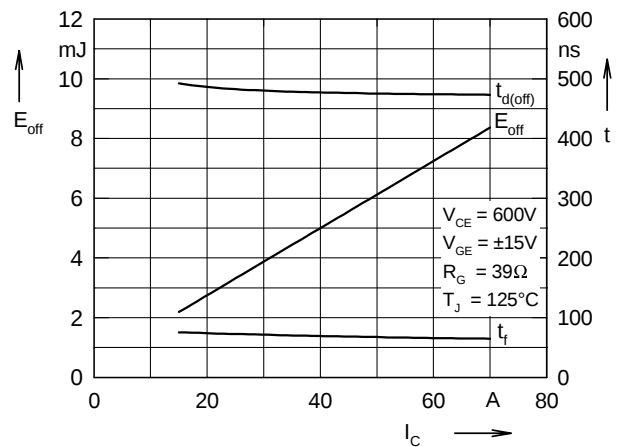


Fig. 8 Typ. turn off energy and switching times versus collector current

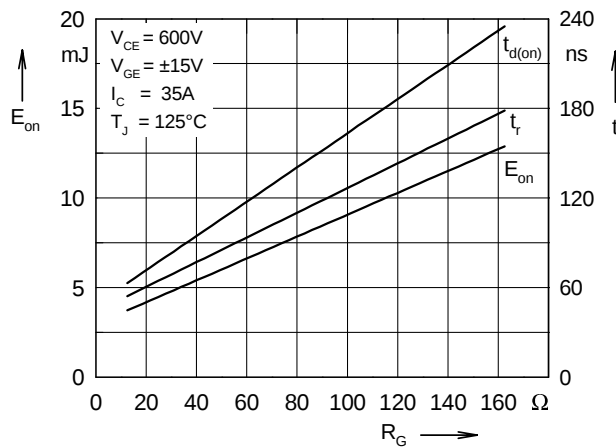


Fig. 9 Typ. turn on energy and switching times versus gate resistor

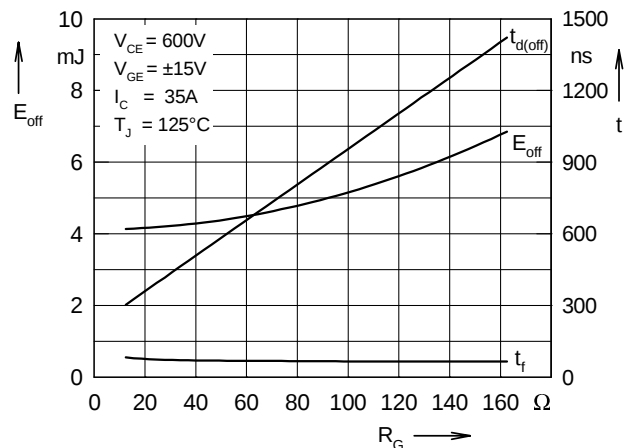


Fig. 10 Typ. turn off energy and switching times versus gate resistor

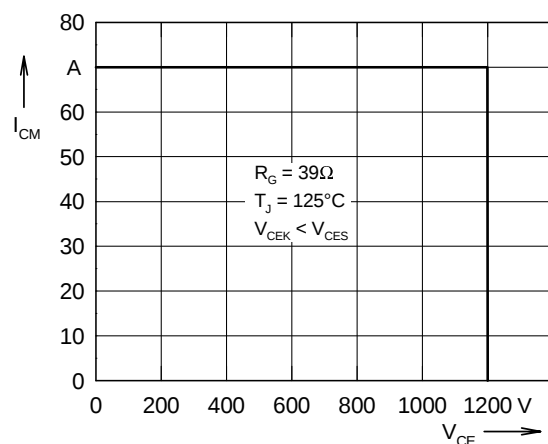


Fig. 11 Reverse biased safe operating area RBSOA

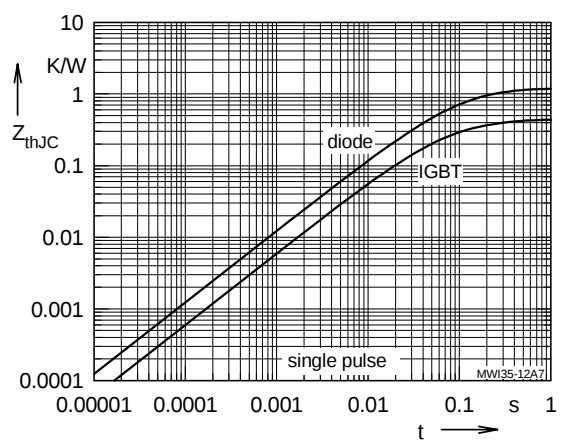


Fig. 12 Typ. transient thermal impedance