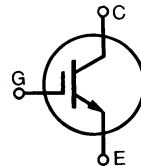


## Ultra-Low $V_{CE(sat)}$ IGBT

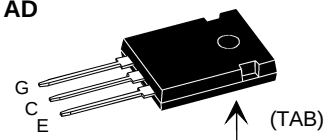
**IXGH 31N60**  
**IXGT 31N60**

$V_{CES} = 600 \text{ V}$   
 $I_{C25} = 60 \text{ A}$   
 $V_{CE(sat)} = 1.7 \text{ V}$

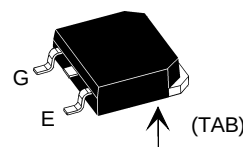


| Symbol                                                                          | Test Conditions                                                                                                       | Maximum Ratings                  |                  |
|---------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|----------------------------------|------------------|
| $V_{CES}$                                                                       | $T_J = 25^\circ\text{C to } 150^\circ\text{C}$                                                                        | 600                              | V                |
| $V_{CGR}$                                                                       | $T_J = 25^\circ\text{C to } 150^\circ\text{C}; R_{GE} = 1 \text{ M}\Omega$                                            | 600                              | V                |
| $V_{GES}$                                                                       | Continuous                                                                                                            | $\pm 20$                         | V                |
| $V_{GEM}$                                                                       | Transient                                                                                                             | $\pm 30$                         | V                |
| $I_{C25}$                                                                       | $T_C = 25^\circ\text{C}$                                                                                              | 60                               | A                |
| $I_{C90}$                                                                       | $T_C = 90^\circ\text{C}$                                                                                              | 31                               | A                |
| $I_{CM}$                                                                        | $T_C = 25^\circ\text{C}, 1 \text{ ms}$                                                                                | 80                               | A                |
| <b>SSOA (RBSOA)</b>                                                             | $V_{GE} = 15 \text{ V}, T_{VJ} = 125^\circ\text{C}, R_G = 10 \Omega$<br>Clamped inductive load, $L = 100 \mu\text{H}$ | $I_{CM} = 62$<br>@ $0.8 V_{CES}$ | A                |
| $P_C$                                                                           | $T_C = 25^\circ\text{C}$                                                                                              | 150                              | W                |
| $T_J$                                                                           |                                                                                                                       | -55 ... +150                     | $^\circ\text{C}$ |
| $T_{JM}$                                                                        |                                                                                                                       | 150                              | $^\circ\text{C}$ |
| $T_{stg}$                                                                       |                                                                                                                       | -55 ... +150                     | $^\circ\text{C}$ |
| $M_d$                                                                           | Mounting torque (M3) TO-247                                                                                           | 1.13/10                          | Nm/lb.in.        |
| Maximum lead temperature for soldering<br>1.6 mm (0.062 in.) from case for 10 s |                                                                                                                       | 300                              | $^\circ\text{C}$ |
| <b>Weight</b>                                                                   | TO-247                                                                                                                | 6                                | g                |
|                                                                                 | TO-268                                                                                                                | 4                                | g                |

TO-247 AD



TO-268



G = Gate, C = Collector,  
E = Emitter, TAB = Collector

### Features

- International standard package
- Low  $V_{CE(sat)}$ 
  - for minimum on-state conduction losses
- High current handling capability
- MOS Gate turn-on
  - drive simplicity

### Applications

- AC motor speed control
- DC servo and robot drives
- DC choppers
- Uninterruptible power supplies (UPS)
- Switch-mode and resonant-mode power supplies

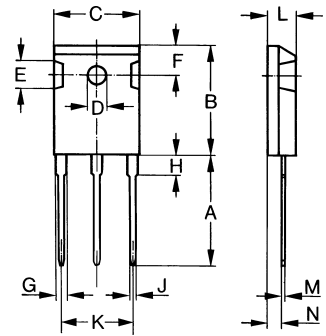
### Advantages

- Easy to mount with 1 screw (isolated mounting screw hole)
- Low losses, high efficiency
- High power density

| Symbol        | Test Conditions                                        | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |      |                                        |
|---------------|--------------------------------------------------------|-----------------------------------------------------------------------------------|------|----------------------------------------|
|               |                                                        | min.                                                                              | typ. | max.                                   |
| $BV_{CES}$    | $I_C = 250 \mu\text{A}, V_{GE} = 0 \text{ V}$          | 600                                                                               |      | V                                      |
| $V_{GE(th)}$  | $I_C = 250 \mu\text{A}, V_{CE} = V_{GE}$               | 2.5                                                                               |      | 5.5 V                                  |
| $I_{CES}$     | $V_{CE} = 0.8 \cdot V_{CES}$<br>$V_{GE} = 0 \text{ V}$ |                                                                                   |      | 100 $\mu\text{A}$<br>500 $\mu\text{A}$ |
| $I_{GES}$     | $V_{CE} = 0 \text{ V}, V_{GE} = \pm 20 \text{ V}$      |                                                                                   |      | $\pm 100 \text{ nA}$                   |
| $V_{CE(sat)}$ | $I_C = I_{C90}, V_{GE} = 15 \text{ V}$                 |                                                                                   |      | 1.7 V                                  |

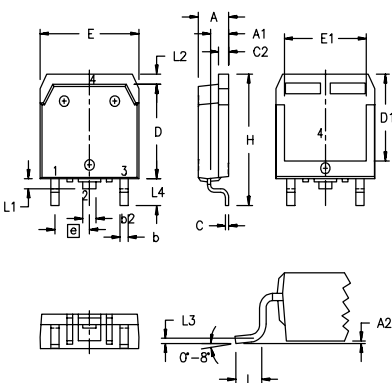
| Symbol       | Test Conditions                                                                                                                                                                                                                                                                                                                   | Characteristic Values<br>( $T_J = 25^\circ\text{C}$ , unless otherwise specified) |      |          |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------|----------|
|              |                                                                                                                                                                                                                                                                                                                                   | min.                                                                              | typ. | max.     |
| $g_{fs}$     | $I_C = I_{C90}, V_{CE} = 10\text{ V}$ ,<br>Pulse test, $t \leq 300\text{ }\mu\text{s}$ , duty cycle $\leq 2\%$                                                                                                                                                                                                                    | 10                                                                                | 16   | S        |
| $C_{ies}$    | $V_{CE} = 25\text{ V}$ , $V_{GE} = 0\text{ V}$ , $f = 1\text{ MHz}$                                                                                                                                                                                                                                                               |                                                                                   | 1500 | pF       |
| $C_{oes}$    |                                                                                                                                                                                                                                                                                                                                   |                                                                                   | 130  | pF       |
| $C_{res}$    |                                                                                                                                                                                                                                                                                                                                   |                                                                                   | 40   | pF       |
| $Q_g$        | $I_C = I_{C90}, V_{GE} = 15\text{ V}$ , $V_{CE} = 0.5 V_{CES}$                                                                                                                                                                                                                                                                    |                                                                                   | 80   | 100 nC   |
| $Q_{ge}$     |                                                                                                                                                                                                                                                                                                                                   |                                                                                   | 15   | 30 nC    |
| $Q_{gc}$     |                                                                                                                                                                                                                                                                                                                                   |                                                                                   | 30   | 40 nC    |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 25^\circ\text{C}</math></b><br>$I_C = I_{C90}, V_{GE} = 15\text{ V}$ , $L = 100\text{ }\mu\text{H}$ ,<br>$V_{CE} = 0.8 V_{CES}, R_G = R_{off} = 10\text{ }\Omega$<br>Remarks: Switching times may increase<br>for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$ , higher $T_J$ or<br>increased $R_G$  |                                                                                   | 15   | ns       |
| $t_{ri}$     |                                                                                                                                                                                                                                                                                                                                   |                                                                                   | 25   | ns       |
| $t_{d(off)}$ |                                                                                                                                                                                                                                                                                                                                   |                                                                                   | 400  | 800 ns   |
| $t_{fi}$     |                                                                                                                                                                                                                                                                                                                                   |                                                                                   | 400  | 800 ns   |
| $E_{off}$    |                                                                                                                                                                                                                                                                                                                                   |                                                                                   | 6    | mJ       |
| $t_{d(on)}$  | <b>Inductive load, <math>T_J = 125^\circ\text{C}</math></b><br>$I_C = I_{C90}, V_{GE} = 15\text{ V}$ , $L = 100\text{ }\mu\text{H}$ ,<br>$V_{CE} = 0.8 V_{CES}, R_G = R_{off} = 10\text{ }\Omega$<br>Remarks: Switching times may increase<br>for $V_{CE}(\text{Clamp}) > 0.8 \cdot V_{CES}$ , higher $T_J$ or<br>increased $R_G$ |                                                                                   | 15   | ns       |
| $t_{ri}$     |                                                                                                                                                                                                                                                                                                                                   |                                                                                   | 25   | ns       |
| $E_{on}$     |                                                                                                                                                                                                                                                                                                                                   |                                                                                   | 0.2  | mJ       |
| $t_{d(off)}$ |                                                                                                                                                                                                                                                                                                                                   |                                                                                   | 800  | ns       |
| $t_{fi}$     |                                                                                                                                                                                                                                                                                                                                   |                                                                                   | 800  | ns       |
| $E_{off}$    |                                                                                                                                                                                                                                                                                                                                   |                                                                                   | 12   | mJ       |
| $R_{thJC}$   | (TO-247)                                                                                                                                                                                                                                                                                                                          |                                                                                   | 0.25 | 0.83 K/W |
| $R_{thCK}$   |                                                                                                                                                                                                                                                                                                                                   |                                                                                   |      | K/W      |

## TO-247 AD (IXFH) Outline



| Dim. | Millimeter |       | Inches |       |
|------|------------|-------|--------|-------|
|      | Min.       | Max.  | Min.   | Max.  |
| A    | 19.81      | 20.32 | 0.780  | 0.800 |
| B    | 20.80      | 21.46 | 0.819  | 0.845 |
| C    | 15.75      | 16.26 | 0.610  | 0.640 |
| D    | 3.55       | 3.65  | 0.140  | 0.144 |
| E    | 4.32       | 5.49  | 0.170  | 0.216 |
| F    | 5.4        | 6.2   | 0.212  | 0.244 |
| G    | 1.65       | 2.13  | 0.065  | 0.084 |
| H    | -          | 4.5   | -      | 0.177 |
| J    | 1.0        | 1.4   | 0.040  | 0.055 |
| K    | 10.8       | 11.0  | 0.426  | 0.433 |
| L    | 4.7        | 5.3   | 0.185  | 0.209 |
| M    | 0.4        | 0.8   | 0.016  | 0.031 |
| N    | 1.5        | 2.49  | 0.087  | 0.102 |

## TO-268AA (D<sup>3</sup> PAK)



| Dim. | Millimeter |       | Inches   |      |
|------|------------|-------|----------|------|
|      | Min.       | Max.  | Min.     | Max. |
| A    | 4.9        | 5.1   | .193     | .201 |
| A1   | 2.7        | 2.9   | .106     | .114 |
| A2   | .02        | .25   | .001     | .010 |
| b    | 1.15       | 1.45  | .045     | .057 |
| b2   | 1.9        | 2.1   | .75      | .83  |
| C    | .4         | .65   | .016     | .026 |
| D    | 13.80      | 14.00 | .543     | .551 |
| E    | 15.85      | 16.05 | .624     | .632 |
| E1   | 13.3       | 13.6  | .524     | .535 |
| e    | 5.45 BSC   |       | .215 BSC |      |
| H    | 18.70      | 19.10 | .736     | .752 |
| L    | 2.40       | 2.70  | .094     | .106 |
| L1   | 1.20       | 1.40  | .047     | .055 |
| L2   | 1.00       | 1.15  | .039     | .045 |
| L3   | 0.25 BSC   |       | .010 BSC |      |
| L4   | 3.80       | 4.10  | .150     | .161 |

## Min. Recommended Footprint

