



# STGP12NB60KD - STGB12NB60KD

## N-CHANNEL 18A - 600V TO-220/D<sup>2</sup>PAK

### SHORT CIRCUIT PROOF PowerMESH™ IGBT

| TYPE         | V <sub>CES</sub> | V <sub>CE(sat)</sub><br>(Max) @ 25°C | I <sub>C</sub> (#)<br>@ 100°C |
|--------------|------------------|--------------------------------------|-------------------------------|
| STGP12NB60KD | 600 V            | < 2.8 V                              | 18 A                          |
| STGB12NB60KD | 600 V            | < 2.8 V                              | 18 A                          |

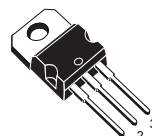
- HIGH INPUT IMPEDANCE
- LOW ON-LOSSES
- LOW GATE CHARGE
- HIGH CURRENT CAPABILITY
- OFF LOSSES INCLUDE TAIL CURRENT
- VERY HIGH FREQUENCY OPERATION
- TYPICAL SHORT CIRCUIT WITHSTAND TIME 10 MICROS
- CO-PACKAGED ANTIPARALLEL DIODE

#### DESCRIPTION

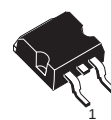
Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH™ IGBTs, with outstanding performances. The suffix "K" identifies a family optimized for high frequency applications (up to 50kHz) and short circuit proof in order to achieve very high switching performances (reduced t<sub>fall</sub>) maintaining a low voltage drop.

#### APPLICATIONS

- HIGH FREQUENCY MOTOR CONTROLS
- SMPS
- UPS

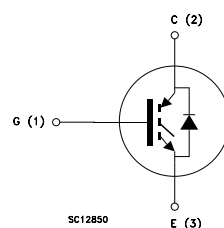


TO-220



D<sup>2</sup>PAK

#### INTERNAL SCHEMATIC DIAGRAM



#### ORDERING INFORMATION

| SALES TYPE     | MARKING    | PACKAGE            | PACKAGING   |
|----------------|------------|--------------------|-------------|
| STGP12NB60KD   | GP12NB60KD | TO-220             | TUBE        |
| STGB12NB60KDT4 | GB12NB60KD | D <sup>2</sup> PAK | TAPE & REEL |

## STGP12NB60KD - STGB12NB60KD

### ABSOLUTE MAXIMUM RATINGS

| Symbol            | Parameter                                                       | Value      | Unit                |
|-------------------|-----------------------------------------------------------------|------------|---------------------|
| $V_{CES}$         | Collector-Emitter Voltage ( $V_{GS} = 0$ )                      | 600        | V                   |
| $V_{ECR}$         | Emitter-Collector Voltage                                       | 20         | V                   |
| $V_{GE}$          | Gate-Emitter Voltage                                            | $\pm 20$   | V                   |
| $I_C$             | Collector Current (continuous) at $T_C = 25^\circ\text{C}$ (#)  | 30         | A                   |
| $I_C$             | Collector Current (continuous) at $T_C = 100^\circ\text{C}$ (#) | 18         | A                   |
| $I_{CM}(\bullet)$ | Collector Current (pulsed)                                      | 60         | A                   |
| $T_{sc}$          | Short Circuit Withstand                                         | 10         | $\mu\text{s}$       |
| $P_{TOT}$         | Total Dissipation at $T_C = 25^\circ\text{C}$                   | 125        | W                   |
|                   | Derating Factor                                                 | 1.0        | W/ $^\circ\text{C}$ |
| $T_{stg}$         | Storage Temperature                                             | -65 to 150 | $^\circ\text{C}$    |
| $T_j$             | Max. Operating Junction Temperature                             | 150        | $^\circ\text{C}$    |

( $\bullet$ ) Pulse width limited by safe operating area

### THERMAL DATA

|           |                                         |      |                           |
|-----------|-----------------------------------------|------|---------------------------|
| Rthj-case | Thermal Resistance Junction-case Max    | 1.0  | $^\circ\text{C}/\text{W}$ |
| Rthj-amb  | Thermal Resistance Junction-ambient Max | 62.5 | $^\circ\text{C}/\text{W}$ |

### ELECTRICAL CHARACTERISTICS ( $T_{CASE} = 25^\circ\text{C}$ UNLESS OTHERWISE SPECIFIED)

OFF

| Symbol        | Parameter                                     | Test Conditions                                                                                                     | Min. | Typ. | Max.      | Unit                           |
|---------------|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------|------|------|-----------|--------------------------------|
| $V_{BR}(CES)$ | Collector-Emitter Breakdown Voltage           | $I_C = 250\ \mu\text{A}$ , $V_{GE} = 0$                                                                             | 600  |      |           | V                              |
| $I_{CES}$     | Collector cut-off ( $V_{GE} = 0$ )            | $V_{CE} = \text{Max Rating}$ , $T_C = 25^\circ\text{C}$<br>$V_{CE} = \text{Max Rating}$ , $T_C = 125^\circ\text{C}$ |      |      | 50<br>100 | $\mu\text{A}$<br>$\mu\text{A}$ |
| $I_{GES}$     | Gate-Emitter Leakage Current ( $V_{CE} = 0$ ) | $V_{GE} = \pm 20\text{V}$ , $V_{CE} = 0$                                                                            |      |      | $\pm 100$ | nA                             |

ON (1)

| Symbol        | Parameter                            | Test Conditions                                                                                                      | Min. | Typ.       | Max. | Unit   |
|---------------|--------------------------------------|----------------------------------------------------------------------------------------------------------------------|------|------------|------|--------|
| $V_{GE(th)}$  | Gate Threshold Voltage               | $V_{CE} = V_{GE}$ , $I_C = 250\ \mu\text{A}$                                                                         | 5    |            | 7    | V      |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $V_{GE} = 15\text{V}$ , $I_C = 12\text{A}$<br>$V_{GE} = 15\text{V}$ , $I_C = 12\text{A}$ , $T_j = 125^\circ\text{C}$ |      | 2.2<br>1.7 | 2.8  | V<br>V |

DYNAMIC

| Symbol                              | Parameter                                                               | Test Conditions                                                                                       | Min. | Typ.             | Max. | Unit           |
|-------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|------|------------------|------|----------------|
| $g_{fs}$                            | Forward Transconductance                                                | $V_{CE} = 25\text{V}$ , $I_C = 12\text{A}$                                                            |      | 5                |      | S              |
| $C_{ies}$<br>$C_{oes}$<br>$C_{res}$ | Input Capacitance<br>Output Capacitance<br>Reverse Transfer Capacitance | $V_{CE} = 25\text{V}$ , $f = 1\text{MHz}$ , $V_{GE} = 0$                                              |      | 890<br>110<br>22 |      | pF<br>pF<br>pF |
| $Q_g$<br>$Q_{ge}$<br>$Q_{gc}$       | Total Gate Charge<br>Gate-Emitter Charge<br>Gate-Collector Charge       | $V_{CE} = 480\text{V}$ , $I_C = 12\text{A}$ ,<br>$V_{GE} = 15\text{V}$                                |      | 54<br>8<br>31    |      | nC<br>nC<br>nC |
| $I_{CL}$                            | Latching Current                                                        | $V_{clamp} = 480\text{V}$ , $V_{GE} = 15\text{V}$ ,<br>$T_j = 125^\circ\text{C}$ , $R_G = 10\ \Omega$ |      | 48               |      | A              |
| $T_{wsc}$                           | Short Circuit WITHSTAND Time                                            | $V_{CE} = 0.5 V_{CES}$ , $V_{GE} = 15\text{V}$<br>$T_j = 125^\circ\text{C}$ , $R_G = 10\ \Omega$      | 10   |                  |      | $\mu\text{s}$  |

**ELECTRICAL CHARACTERISTICS (CONTINUED)****SWITCHING ON**

| Symbol         | Parameter                | Test Conditions                                               | Min. | Typ. | Max. | Unit       |
|----------------|--------------------------|---------------------------------------------------------------|------|------|------|------------|
| $t_{d(on)}$    | Turn-on Delay Time       | $V_{CC} = 480 \text{ V}, I_C = 12 \text{ A}$                  |      | 25   |      | ns         |
| $t_r$          | Rise Time                | $R_G = 10 \Omega, V_{GE} = 15 \text{ V}$                      |      | 14.5 |      | ns         |
| $(di/dt)_{on}$ | Turn-on Current Slope    | $V_{CC} = 480 \text{ V}, I_C = 12 \text{ A}, R_G = 10 \Omega$ |      | 590  |      | A/ $\mu$ s |
| $E_{on}$       | Turn-on Switching Losses | $V_{GE} = 15 \text{ V}, T_j = 125^\circ\text{C}$              |      | 180  |      | $\mu$ J    |

**SWITCHING OFF**

| Symbol         | Parameter               | Test Conditions                                                                                                           | Min. | Typ. | Max. | Unit    |
|----------------|-------------------------|---------------------------------------------------------------------------------------------------------------------------|------|------|------|---------|
| $t_c$          | Cross-over Time         | $V_{CC} = 480 \text{ V}, I_C = 12 \text{ A},$<br>$R_{GE} = 10 \Omega, V_{GE} = 15 \text{ V}$                              |      | 130  |      | ns      |
| $t_r(V_{off})$ | Off Voltage Rise Time   |                                                                                                                           |      | 25   |      | ns      |
| $t_{d(off)}$   | Delay Time              |                                                                                                                           |      | 96   |      | ns      |
| $t_f$          | Fall Time               |                                                                                                                           |      | 100  |      | ns      |
| $E_{off(**)}$  | Turn-off Switching Loss |                                                                                                                           |      | 258  |      | $\mu$ J |
| $E_{ts}$       | Total Switching Loss    |                                                                                                                           |      | 410  |      | $\mu$ J |
| $t_c$          | Cross-over Time         | $V_{CC} = 480 \text{ V}, I_C = 12 \text{ A},$<br>$R_{GE} = 10 \Omega, V_{GE} = 15 \text{ V}$<br>$T_j = 125^\circ\text{C}$ |      | 310  |      | ns      |
| $t_r(V_{off})$ | Off Voltage Rise Time   |                                                                                                                           |      | 80   |      | ns      |
| $t_{d(off)}$   | Delay Time              |                                                                                                                           |      | 150  |      | ns      |
| $t_f$          | Fall Time               |                                                                                                                           |      | 220  |      | ns      |
| $E_{off(**)}$  | Turn-off Switching Loss |                                                                                                                           |      | 650  |      | $\mu$ J |
| $E_{ts}$       | Total Switching Loss    |                                                                                                                           |      | 830  |      | $\mu$ J |

Note: 1. Pulsed: Pulse duration = 300  $\mu$ s, duty cycle 1.5 %.  
 2. Pulse width limited by max. junction temperature.  
 (\*\*) Losses include Also the Tail (Jedec Standardization)

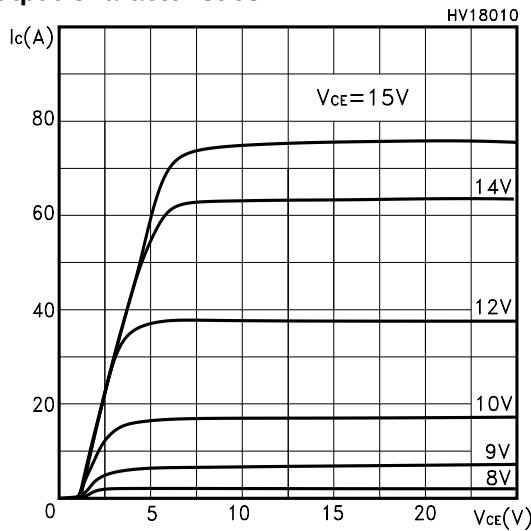
**COLLECTOR-EMITTER DIODE**

| Symbol    | Parameter                | Test Conditions                                                                                          | Min. | Typ.       | Max. | Unit   |
|-----------|--------------------------|----------------------------------------------------------------------------------------------------------|------|------------|------|--------|
| $I_f$     | Forward Current          |                                                                                                          |      |            | 12   | A      |
| $I_{fm}$  | Forward Current pulsed   |                                                                                                          |      |            | 48   | A      |
| $V_f$     | Forward On-Voltage       | $I_f = 6 \text{ A}$<br>$I_f = 6 \text{ A}, T_j = 125^\circ\text{C}$                                      |      | 1.3<br>1.1 | 1.9  | V<br>V |
| $t_{rr}$  | Reverse Recovery Time    | $I_f = 6 \text{ A}, V_R = 50 \text{ V},$<br>$T_j = 125^\circ\text{C}, di/dt = 100 \text{ A}/\mu\text{s}$ |      | 80         |      | ns     |
| $Q_{rr}$  | Reverse Recovery Charge  |                                                                                                          |      | 240        |      | nC     |
| $I_{rrm}$ | Reverse Recovery Current |                                                                                                          |      | 5.5        |      | A      |

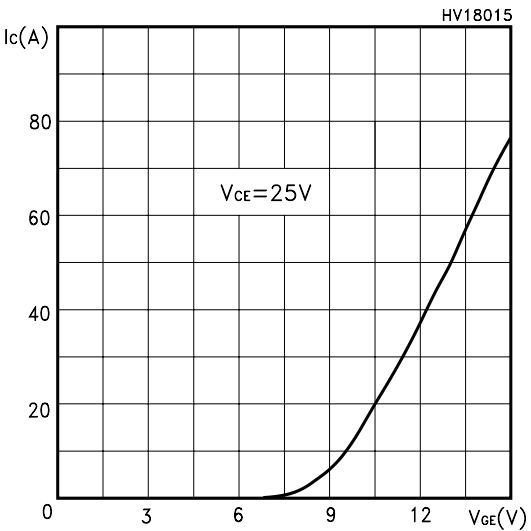
(#) Calculated according to the iterative formula:

$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C, I_C)}$$

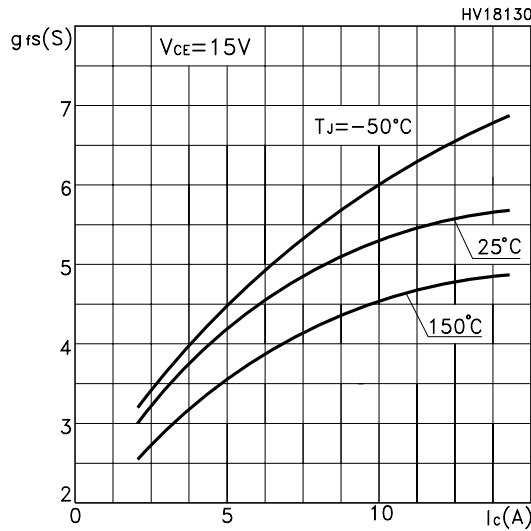
Output Characteristics



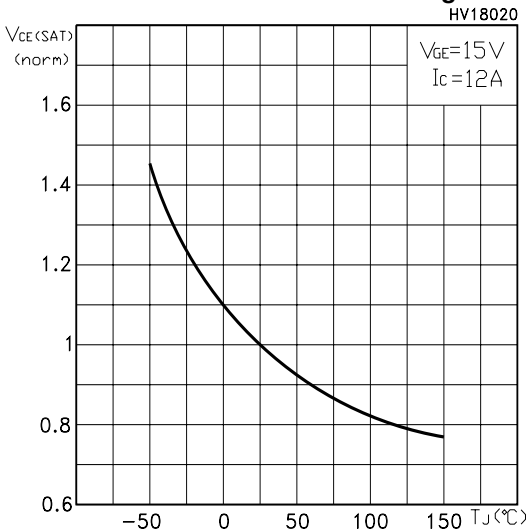
Transfer Characteristics



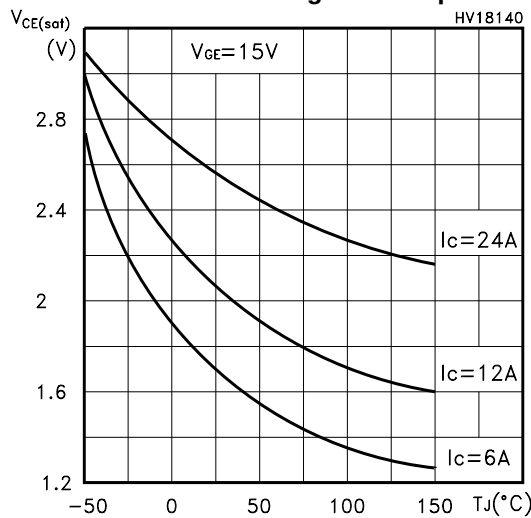
Transconductance



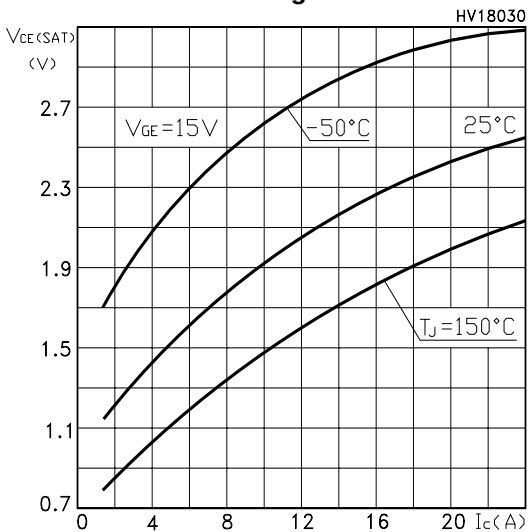
Normalized Collector-Emitter On Voltage vs Temp.



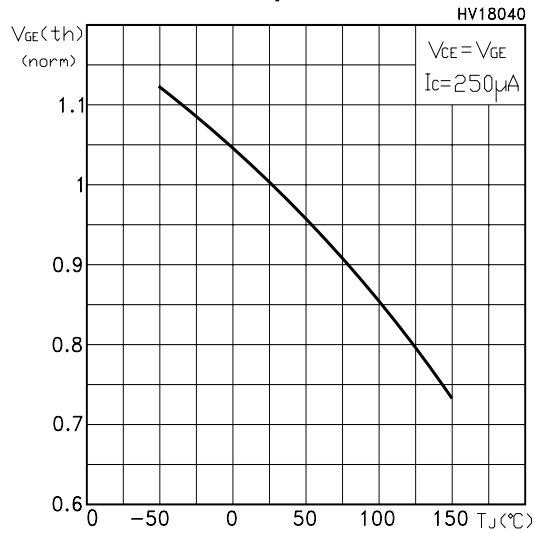
Collector-Emitter On Voltage vs Temperature



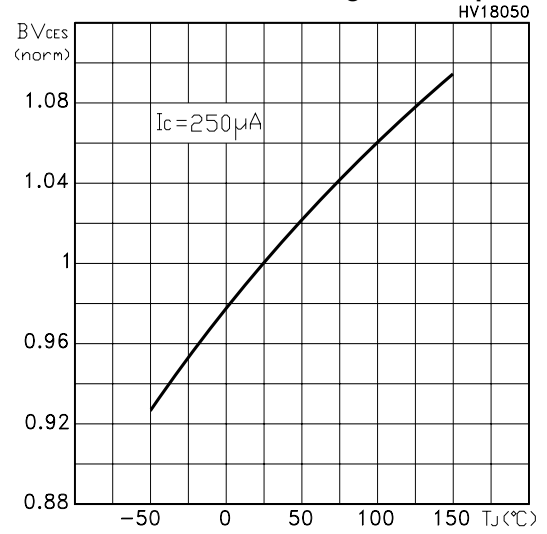
Collector-Emitter On Voltage vs Collector Current



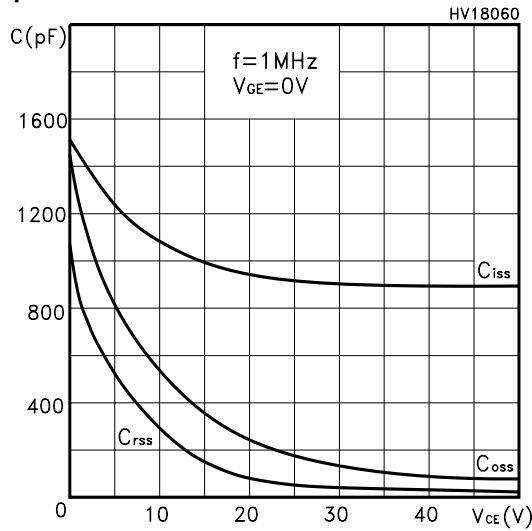
Gate Threshold vs Temperature



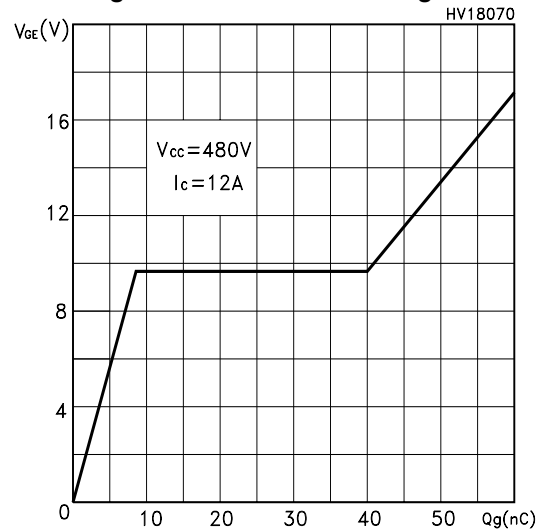
Normalized Breakdown Voltage vs Temperature



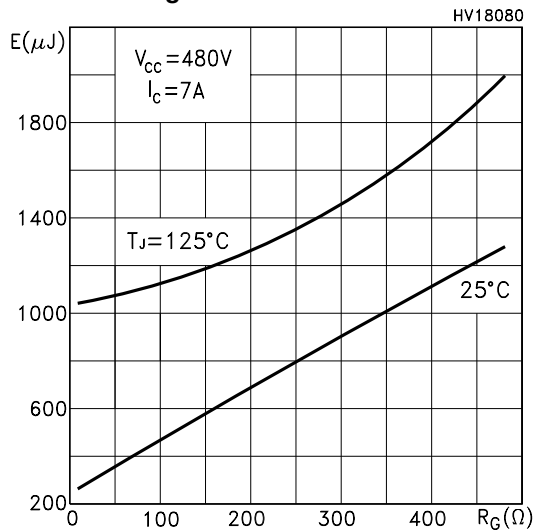
Capacitance Variations



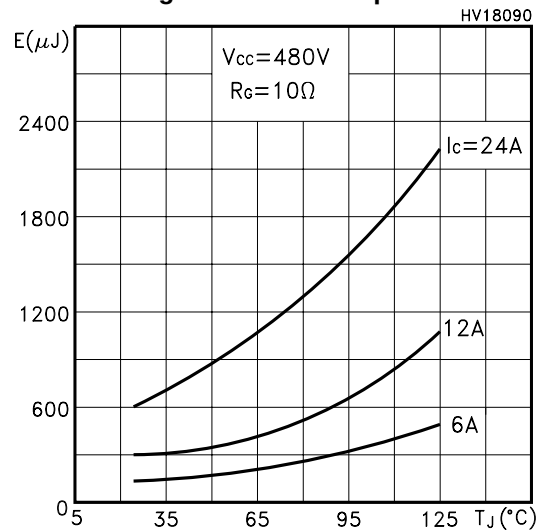
Gate Charge vs Gate-Emmitter Voltage



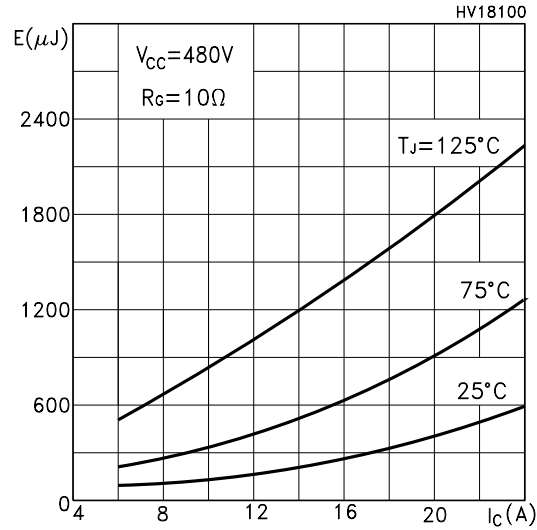
Total Switching Losses vs Gate Resistance



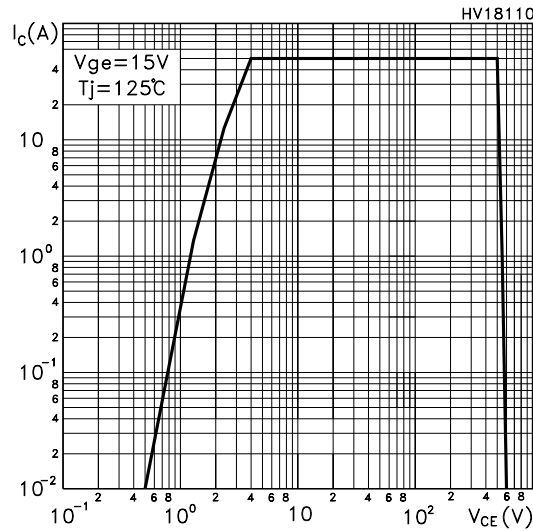
Total Switching Losses vs Temperature



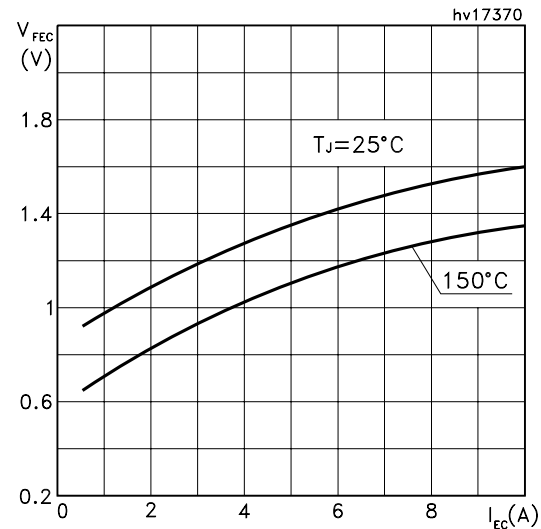
Total Switching Losses vs Collector Current



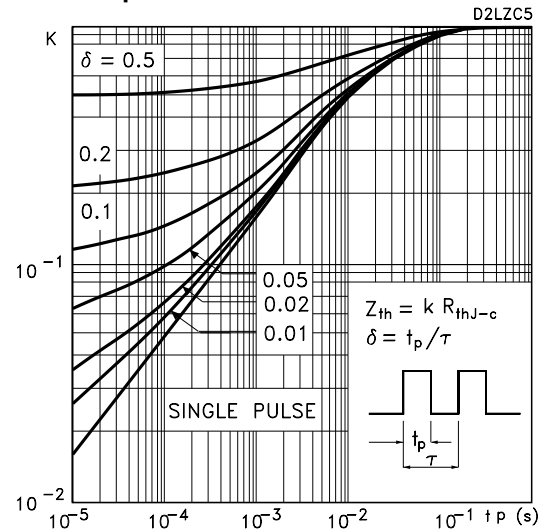
Turn-Off SOA



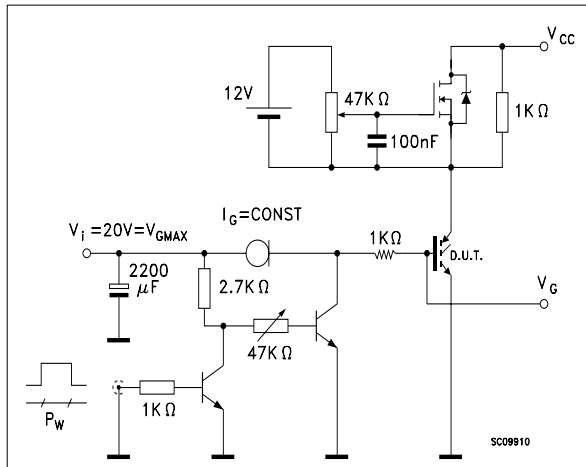
Diode Forward Voltage



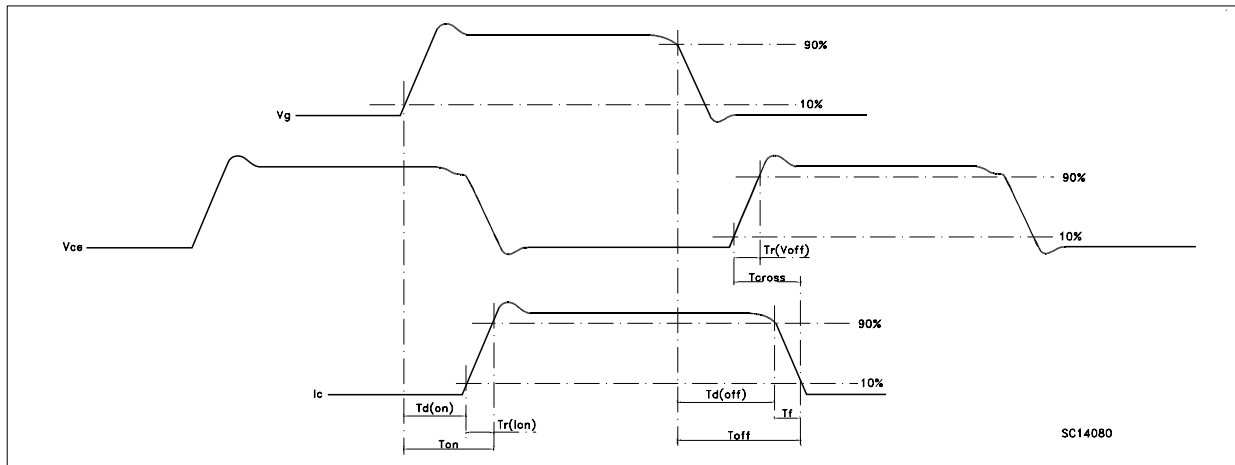
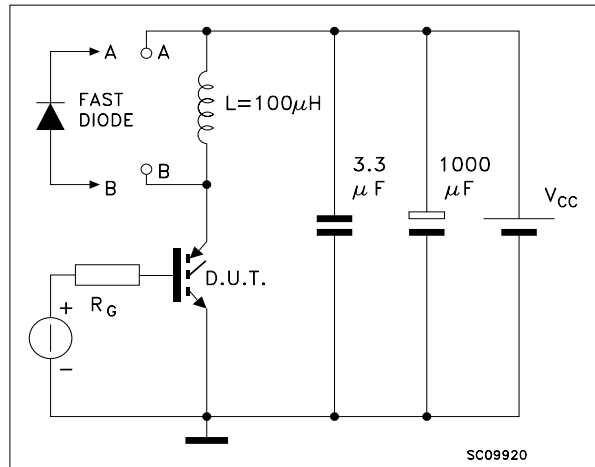
Thermal Impedance



**Fig. 1: Gate Charge test Circuit**

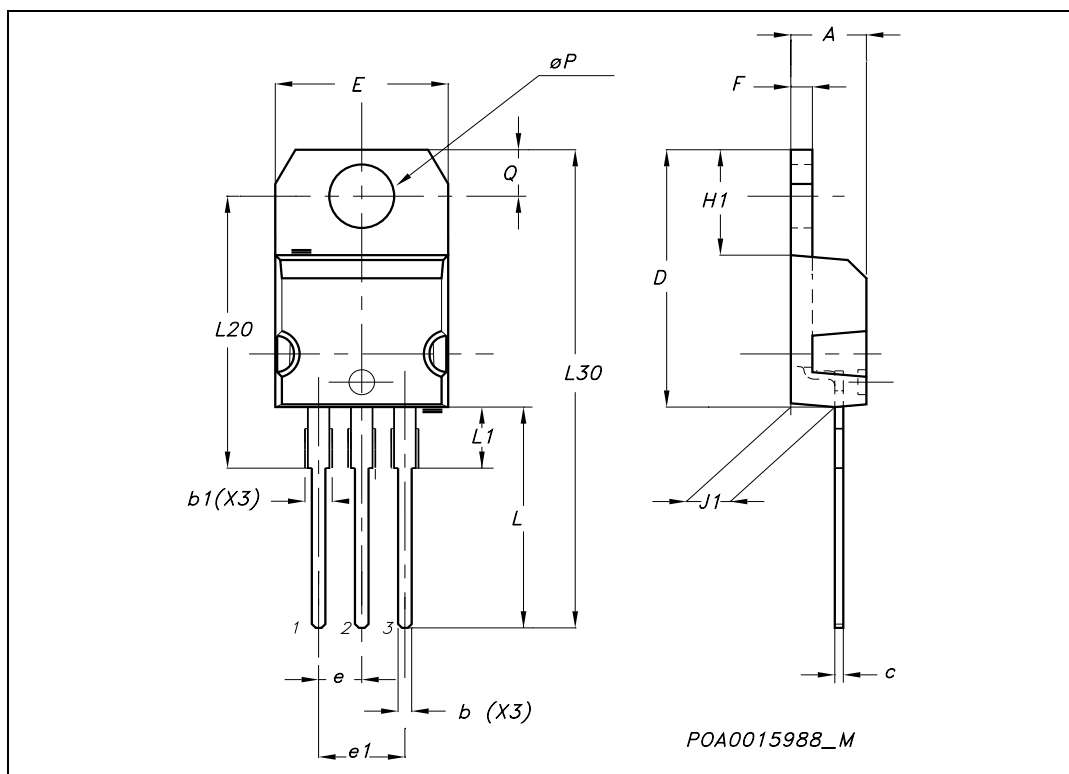


**Fig. 2: Test Circuit For Inductive Load Switching**



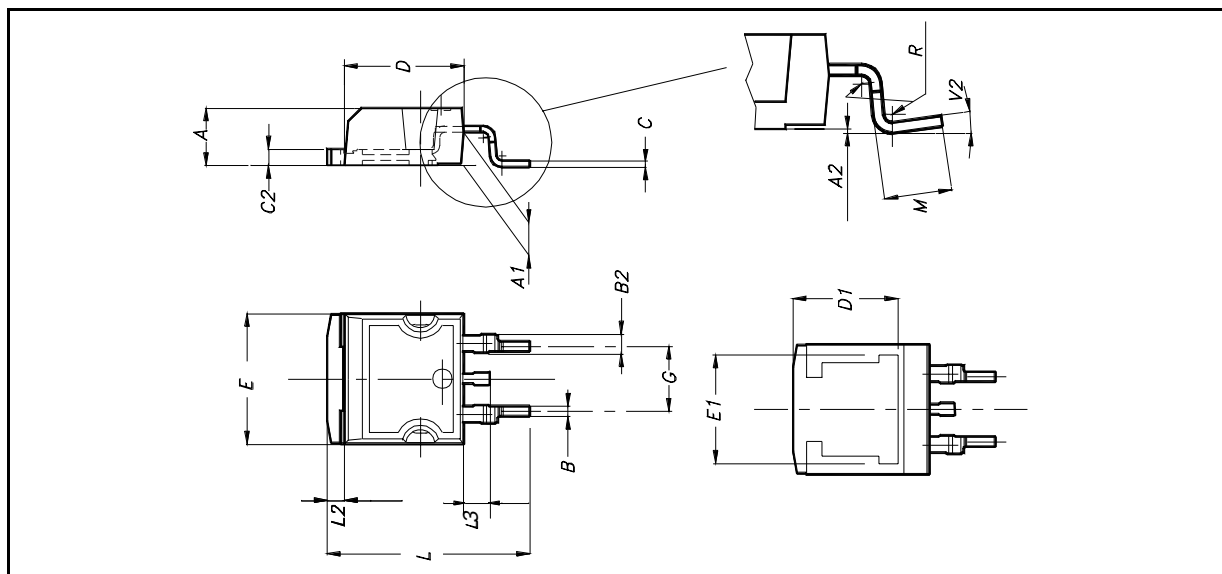
## TO-220 MECHANICAL DATA

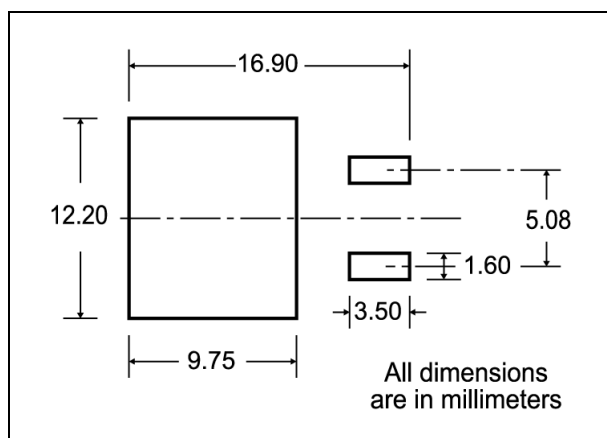
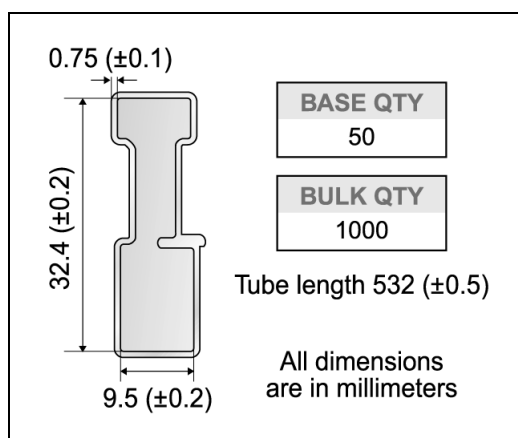
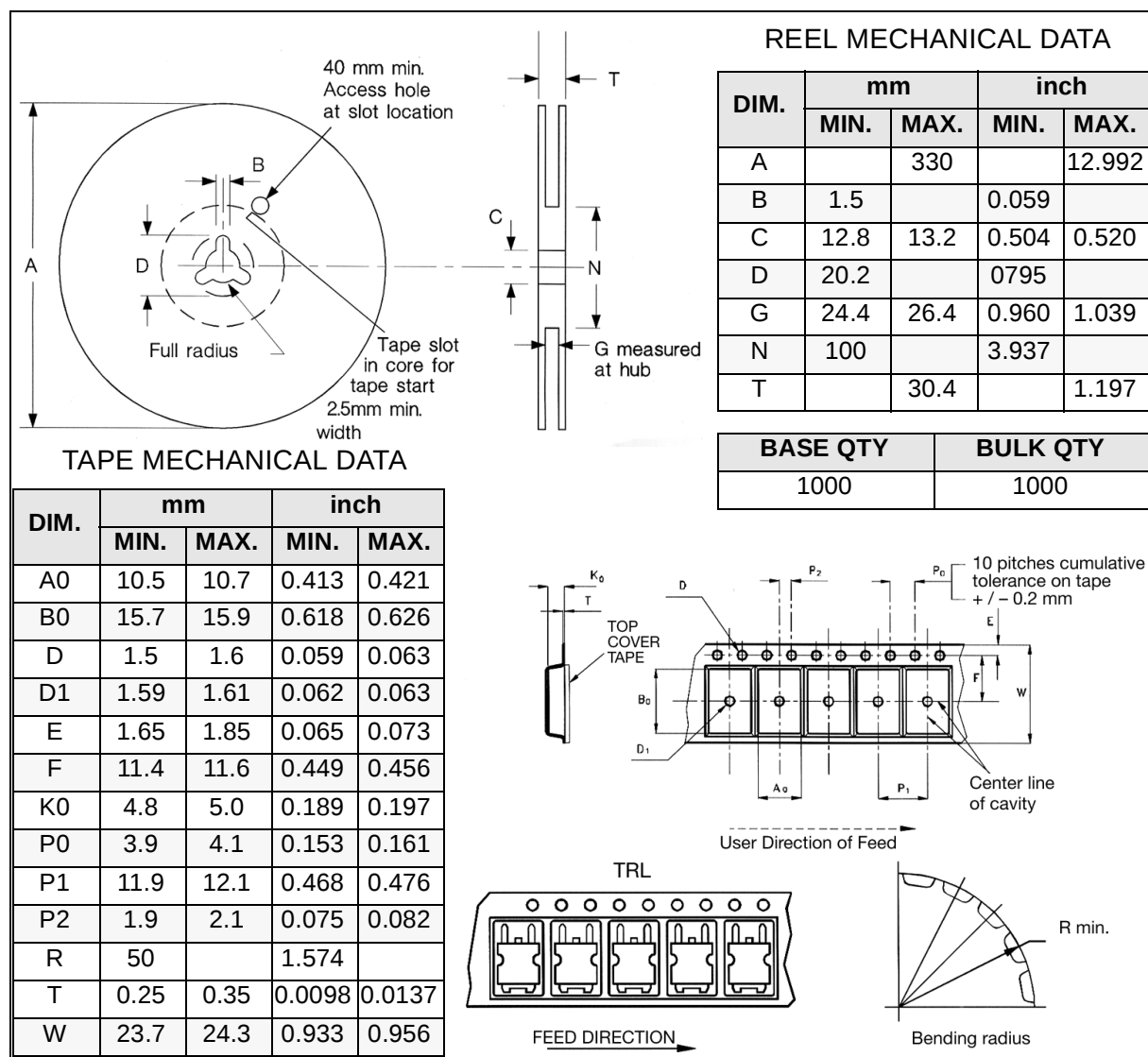
| DIM. | mm.   |       |       | inch  |       |       |
|------|-------|-------|-------|-------|-------|-------|
|      | MIN.  | TYP.  | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 4.40  |       | 4.60  | 0.173 |       | 0.181 |
| b    | 0.61  |       | 0.88  | 0.024 |       | 0.034 |
| b1   | 1.15  |       | 1.70  | 0.045 |       | 0.066 |
| c    | 0.49  |       | 0.70  | 0.019 |       | 0.027 |
| D    | 15.25 |       | 15.75 | 0.60  |       | 0.620 |
| E    | 10    |       | 10.40 | 0.393 |       | 0.409 |
| e    | 2.40  |       | 2.70  | 0.094 |       | 0.106 |
| e1   | 4.95  |       | 5.15  | 0.194 |       | 0.202 |
| F    | 1.23  |       | 1.32  | 0.048 |       | 0.052 |
| H1   | 6.20  |       | 6.60  | 0.244 |       | 0.256 |
| J1   | 2.40  |       | 2.72  | 0.094 |       | 0.107 |
| L    | 13    |       | 14    | 0.511 |       | 0.551 |
| L1   | 3.50  |       | 3.93  | 0.137 |       | 0.154 |
| L20  |       | 16.40 |       |       | 0.645 |       |
| L30  |       | 28.90 |       |       | 1.137 |       |
| øP   | 3.75  |       | 3.85  | 0.147 |       | 0.151 |
| Q    | 2.65  |       | 2.95  | 0.104 |       | 0.116 |



D<sup>2</sup>PAK MECHANICAL DATA

| DIM. | mm.  |     |       | inch  |       |       |
|------|------|-----|-------|-------|-------|-------|
|      | MIN. | TYP | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 4.4  |     | 4.6   | 0.173 |       | 0.181 |
| A1   | 2.49 |     | 2.69  | 0.098 |       | 0.106 |
| A2   | 0.03 |     | 0.23  | 0.001 |       | 0.009 |
| B    | 0.7  |     | 0.93  | 0.027 |       | 0.036 |
| B2   | 1.14 |     | 1.7   | 0.044 |       | 0.067 |
| C    | 0.45 |     | 0.6   | 0.017 |       | 0.023 |
| C2   | 1.23 |     | 1.36  | 0.048 |       | 0.053 |
| D    | 8.95 |     | 9.35  | 0.352 |       | 0.368 |
| D1   |      | 8   |       |       | 0.315 |       |
| E    | 10   |     | 10.4  | 0.393 |       |       |
| E1   |      | 8.5 |       |       | 0.334 |       |
| G    | 4.88 |     | 5.28  | 0.192 |       | 0.208 |
| L    | 15   |     | 15.85 | 0.590 |       | 0.625 |
| L2   | 1.27 |     | 1.4   | 0.050 |       | 0.055 |
| L3   | 1.4  |     | 1.75  | 0.055 |       | 0.068 |
| M    | 2.4  |     | 3.2   | 0.094 |       | 0.126 |
| R    |      | 0.4 |       |       | 0.015 |       |
| V2   | 0°   |     | 8°    |       |       |       |



**D<sup>2</sup>PAK FOOTPRINT****TUBE SHIPMENT (no suffix)\*****TAPE AND REEL SHIPMENT (suffix "T4")\***

\* on sales type

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