



STGP12NB60KD - STGB12NB60KD

N-CHANNEL 18A - 600V TO-220/D²PAK
SHORT CIRCUIT PROOF PowerMESH™ IGBT

| TYPE | V _{CES} | V _{CE(sat)} (Max) @25°C | I _c (#) @ 100°C |
|--------------|------------------|-------------------------------------|-------------------------------|
| STGP12NB60KD | 600 V | < 2.8 V | 18 A |
| STGB12NB60KD | 600 V | < 2.8 V | 18 A |

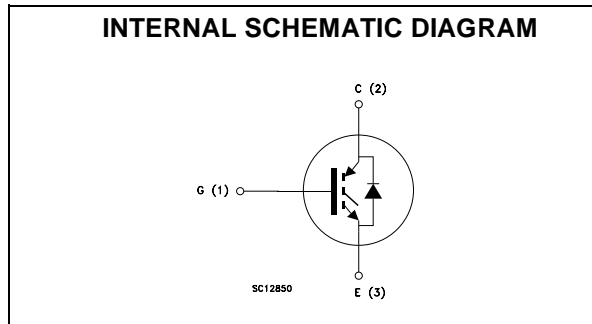
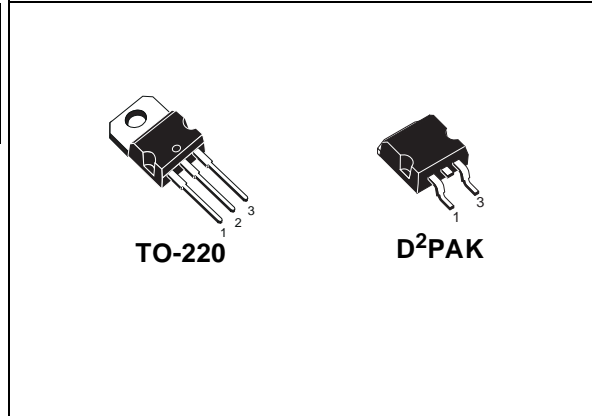
- HIGH INPUT IMPEDANCE
- LOW ON-LOSSES
- LOW GATE CHARGE
- HIGH CURRENT CAPABILITY
- OFF LOSSES INCLUDE TAIL CURRENT
- VERY HIGH FREQUENCY OPERATION
- TYPICAL SHORT CIRCUIT WITHSTAND TIME 10 MICROS
- CO-PACKAGED ANTIPARALLEL DIODE

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_{fall}) maintaining a low voltage drop.

APPLICATIONS

- HIGH FREQUENCY MOTOR CONTROLS
- SMPS
- UPS



ORDERING INFORMATION

| SALES TYPE | MARKING | PACKAGE | PACKAGING |
|----------------|------------|--------------------|-------------|
| STGP12NB60KD | GP12NB60KD | TO-220 | TUBE |
| STGB12NB60KDT4 | GB12NB60KD | D ² 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 | ± 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 | μs |
| 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 | $^\circ\text{C}$ |

(•) 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 ($V_{GE} = 0$) | $V_{CE} = \text{Max Rating}$, $T_C = 25^\circ\text{C}$ $V_{CE} = \text{Max Rating}$, $T_C = 125^\circ\text{C}$ | | | 50 100 | μA μA |
| I_{GES} | Gate-Emitter Leakage Current ($V_{CE} = 0$) | $V_{GE} = \pm 20\text{V}$, $V_{CE} = 0$ | | | ± 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 | $V_{GE} = 15\text{V}$, $I_C = 12\text{A}$ $V_{GE} = 15\text{V}$, $I_C = 12\text{A}$, $T_j = 125^\circ\text{C}$ | | 2.2 1.7 | 2.8 | V 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} C_{oes} C_{res} | Input Capacitance Output Capacitance Reverse Transfer Capacitance | $V_{CE} = 25\text{V}$, $f = 1\text{MHz}$, $V_{GE} = 0$ | | 890 110 22 | | pF pF pF |
| Q_g Q_{ge} Q_{gc} | Total Gate Charge Gate-Emitter Charge Gate-Collector Charge | $V_{CE} = 480\text{V}$, $I_C = 12\text{A}$, $V_{GE} = 15\text{V}$ | | 54 8 31 | | nC nC nC |
| I_{CL} | Latching Current | $V_{clamp} = 480\text{V}$, $V_{GE} = 15\text{V}$, $T_j = 125^\circ\text{C}$, $R_G = 10\ \Omega$ | | 48 | | A |
| T_{wsc} | Short Circuit WITHSTAND Time | $V_{CE} = 0.5 BV_{ces}$, $V_{GE} = 15\text{V}$ $T_j = 125^\circ\text{C}$, $R_G = 10\ \Omega$ | 10 | | | μs |

ELECTRICAL CHARACTERISTICS (CONTINUED)

SWITCHING ON

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

SWITCHING OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|----------------|-------------------------|---|------|------|------|---------------|
| t_c | Cross-over Time | $V_{CC} = 480\text{ V}, I_C = 12\text{ A},$ $R_{GE} = 10\Omega, V_{GE} = 15\text{ V}$ | | 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 | | μJ |
| E_{ts} | Total Switching Loss | | | 410 | | μJ |
| t_c | Cross-over Time | $V_{CC} = 480\text{ V}, I_C = 12\text{ A},$ $R_{GE} = 10\Omega, V_{GE} = 15\text{ V}$ $T_j = 125^\circ\text{C}$ | | 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 | | μJ |
| E_{ts} | Total Switching Loss | | | 830 | | μJ |

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

COLLECTOR-EMITTER DIODE

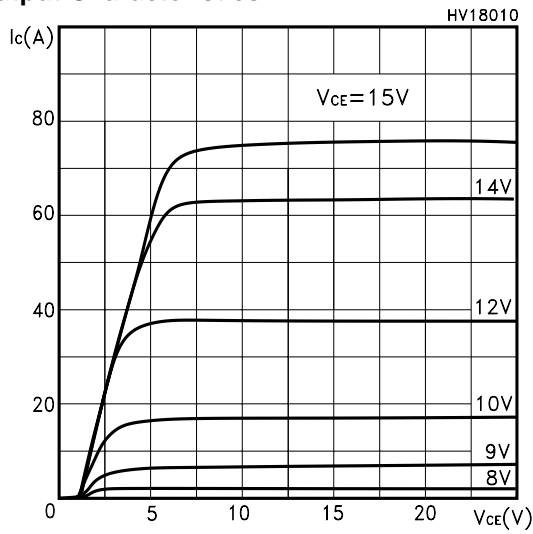
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------|--------------------------|---|------|------------|------|--------|
| I_f | Forward Current | | | | 12 | A |
| I_{fm} | Forward Current pulsed | | | | 48 | A |
| V_f | Forward On-Voltage | $I_f = 6\text{ A}$ $I_f = 6\text{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

(#) Calculated according to the iterative formula:

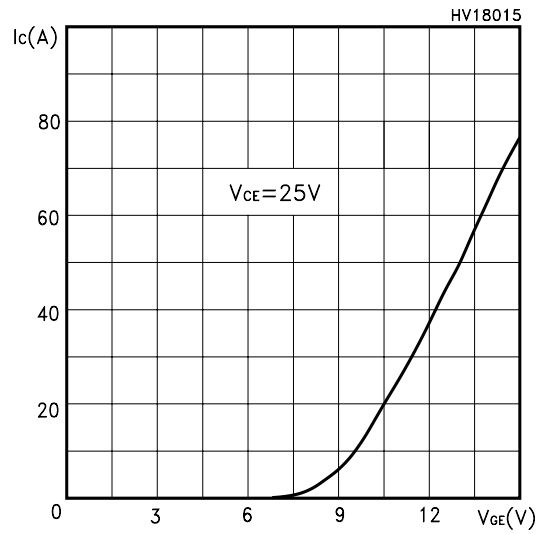
$$I_C(T_C) = \frac{T_{JMAX} - T_C}{R_{THJ-C} \times V_{CESAT(MAX)}(T_C, I_C)}$$

STGP12NB60KD - STGB12NB60KD

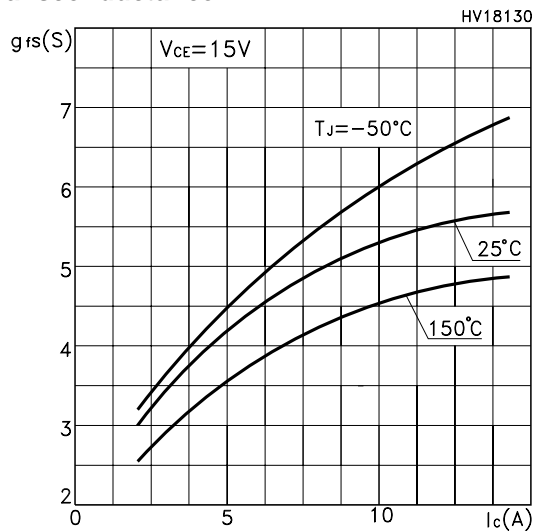
Output Characteristics



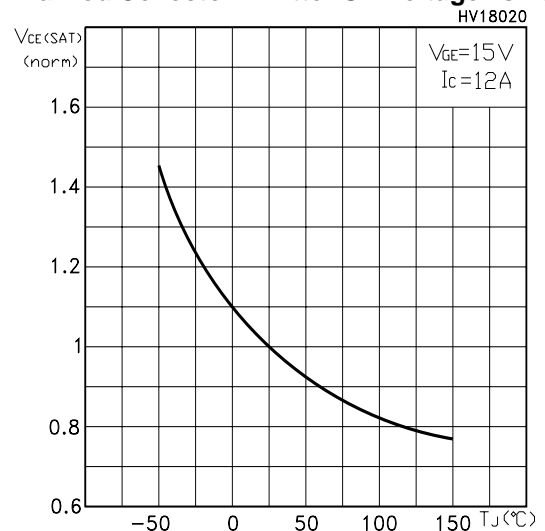
Transfer Characteristics



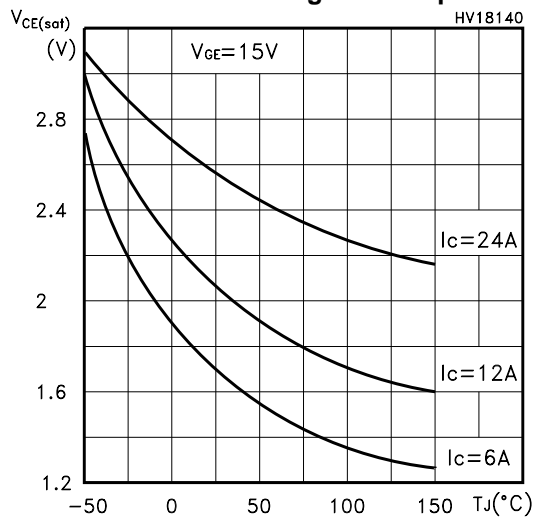
Transconductance



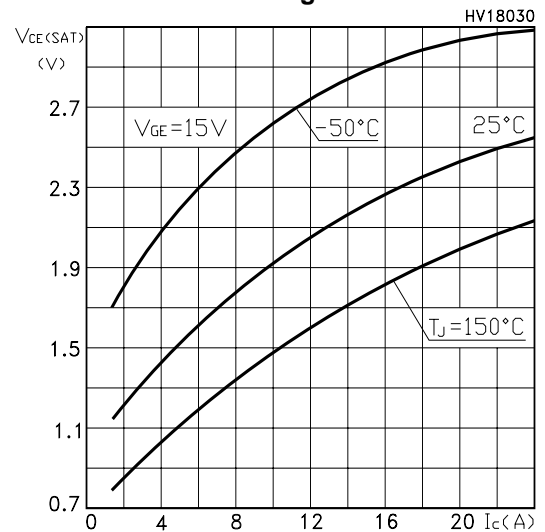
Normalized Collector-Emitter On Voltage vs Temp.



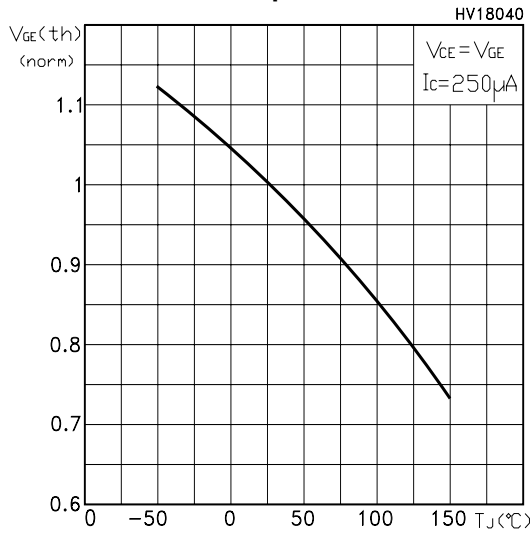
Collector-Emitter On Voltage vs Temperature



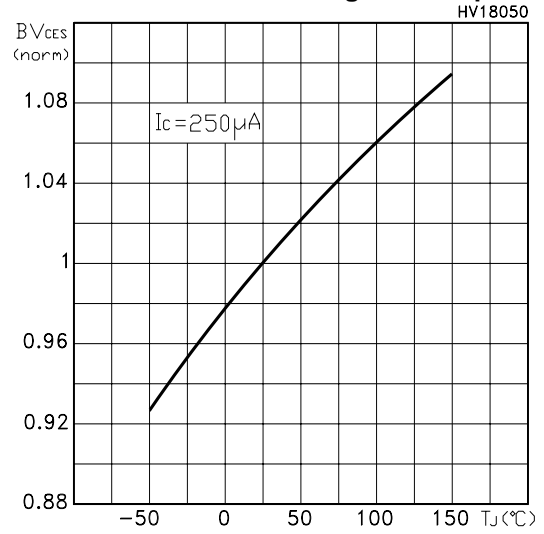
Collector-Emitter On Voltage vs Collector Current



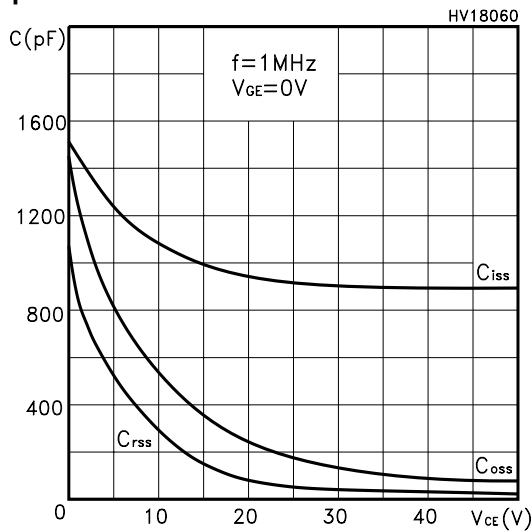
Gate Threshold vs Temperature



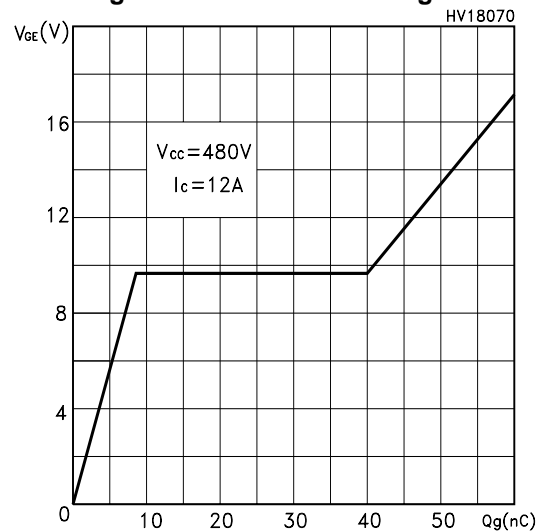
Normalized Breakdown Voltage vs Temperature



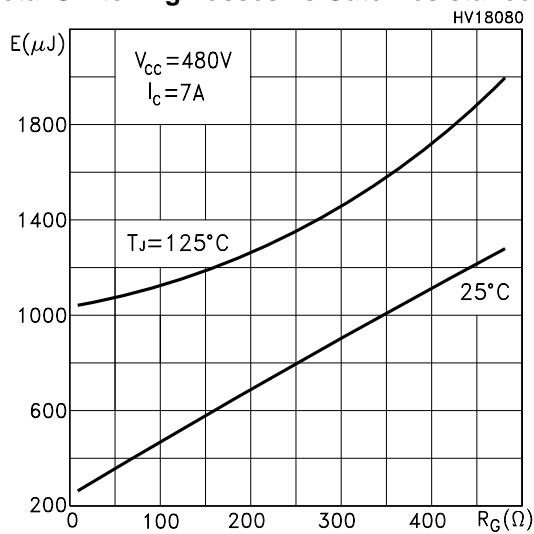
Capacitance Variations



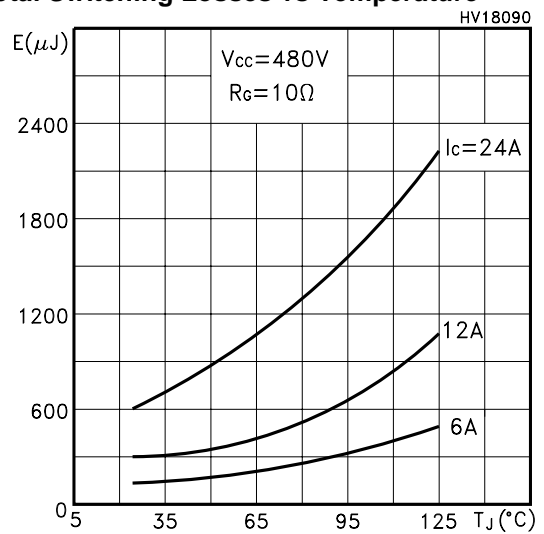
Gate Charge vs Gate-Emitter Voltage



Total Switching Losses vs Gate Resistance

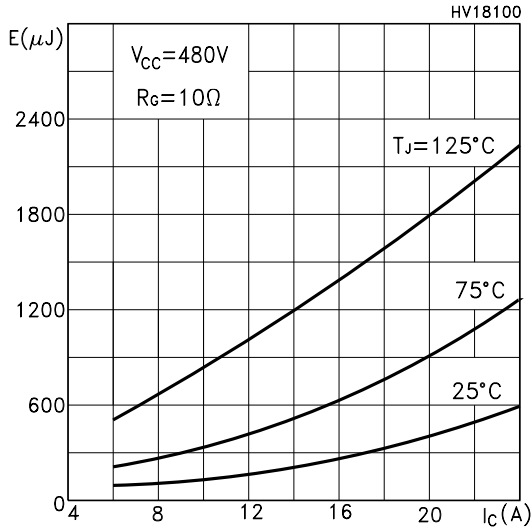


Total Switching Losses vs Temperature

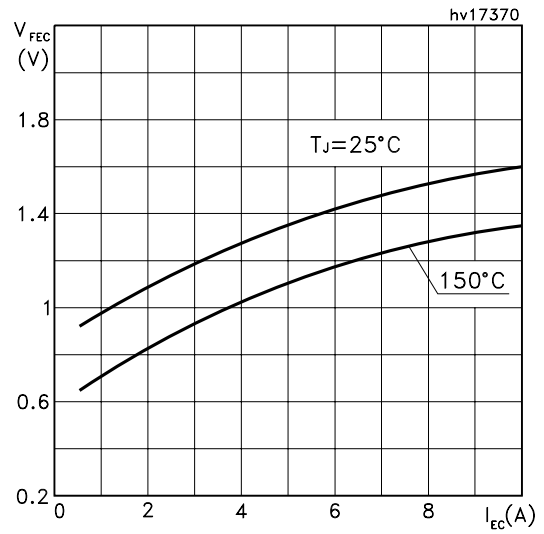


STGP12NB60KD - STGB12NB60KD

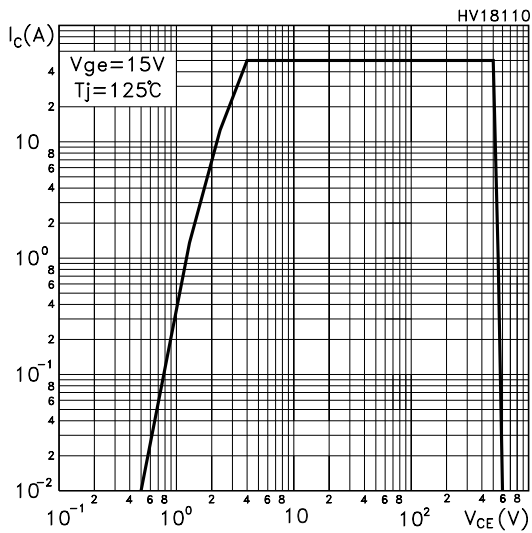
Total Switching Losses vs Collector Current



Diode Forward Voltage



Turn-Off SOA



Thermal Impedance

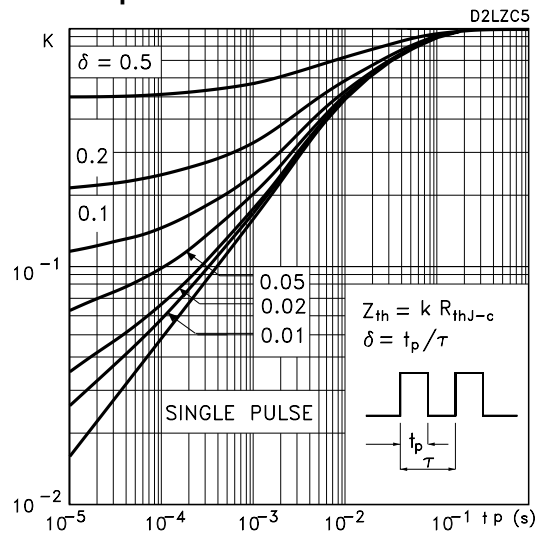


Fig. 1: Gate Charge test Circuit

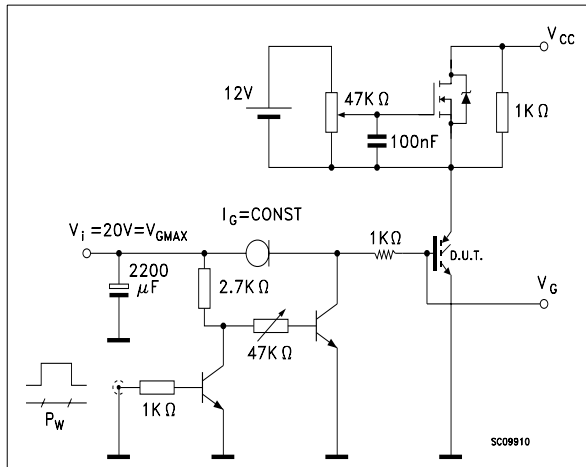
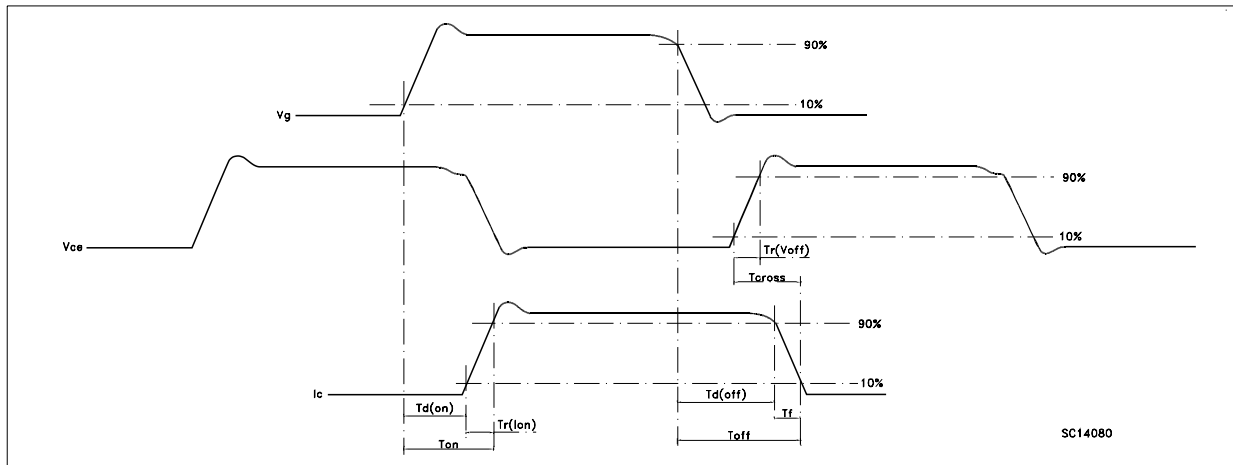
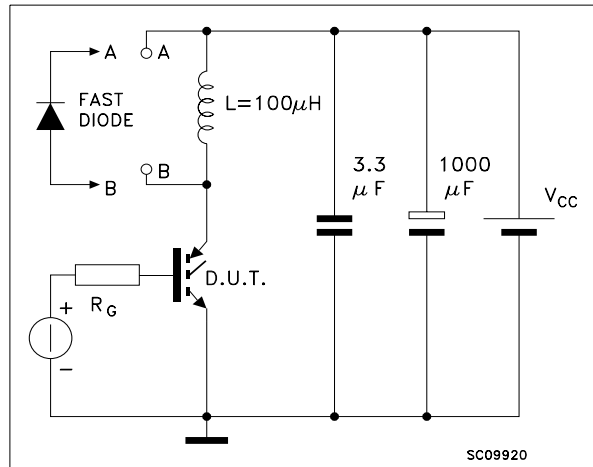
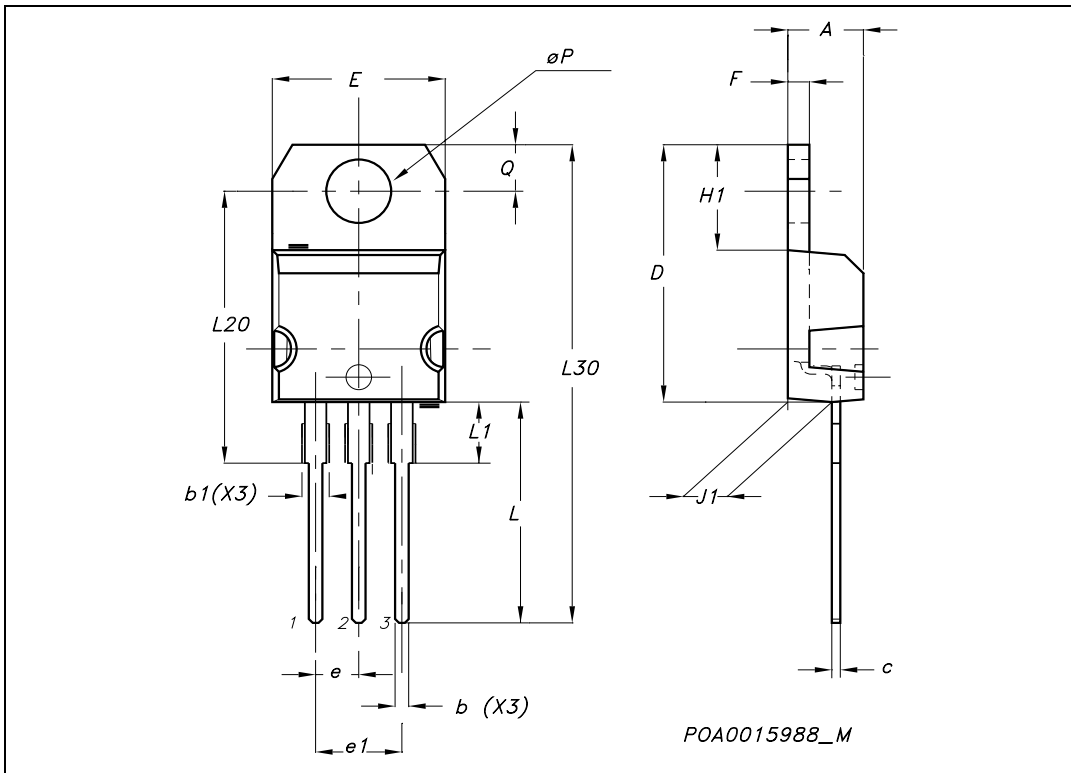


Fig. 2: Test Circuit For Inductive Load Switching



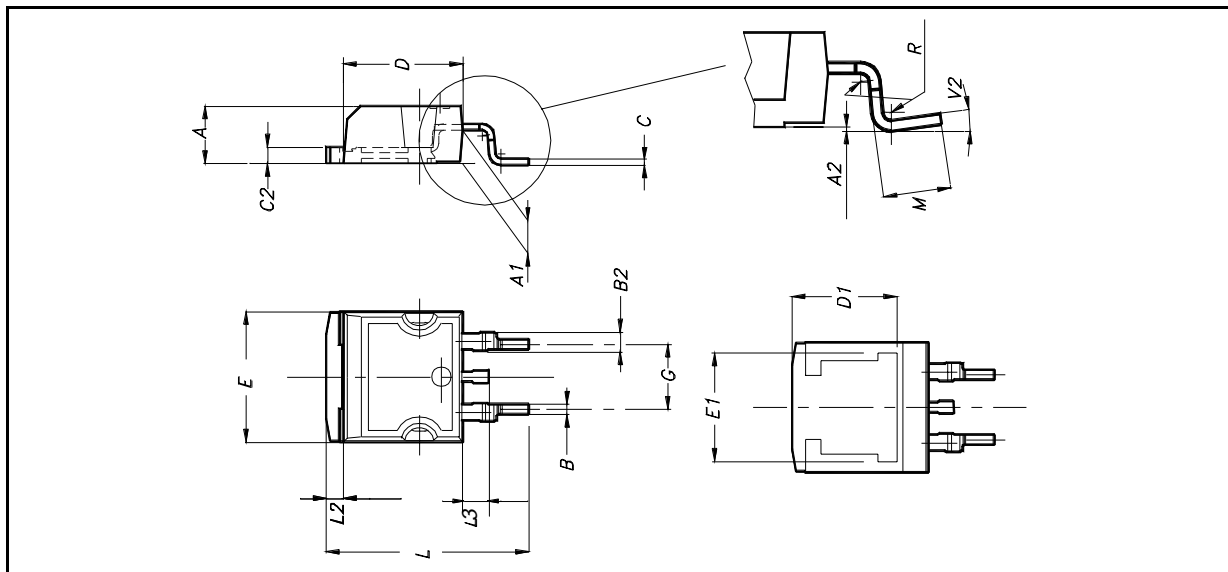
TO-220 MECHANICAL DATA

| 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 |

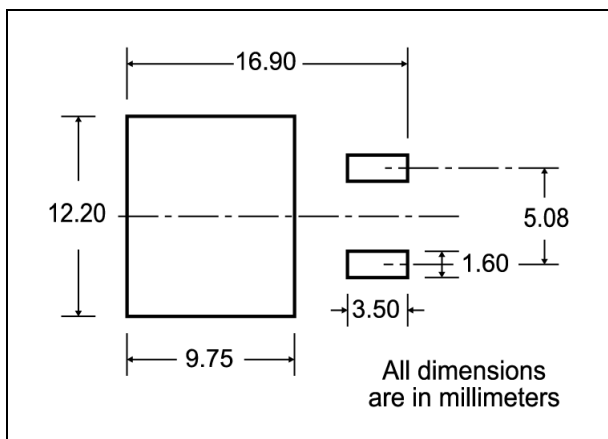


D²PAK MECHANICAL DATA

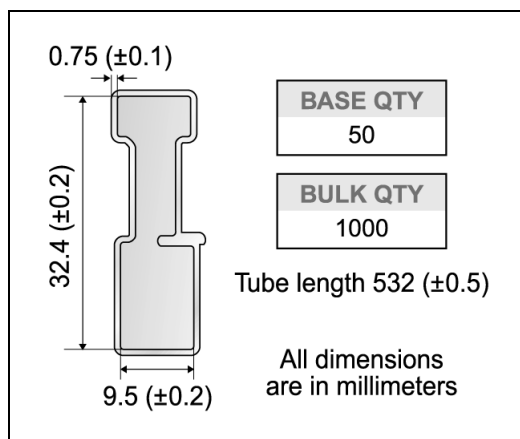
| DIM. | mm. | | | inch | | |
|------|------|-----|-------|-------|-------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | 4.4 | | 4.6 | 0.173 | | 0.181 |
| A1 | 2.49 | | 2.69 | 0.098 | | 0.106 |
| A2 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| B | 0.7 | | 0.93 | 0.027 | | 0.036 |
| B2 | 1.14 | | 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° | | | |



D²PAK FOOTPRINT



TUBE SHIPMENT (no suffix)*



TAPE AND REEL SHIPMENT (suffix "T4")*

TAPE MECHANICAL DATA

| DIM. | mm | | inch | |
|------|------|------|--------|--------|
| | MIN. | MAX. | MIN. | MAX. |
| A0 | 10.5 | 10.7 | 0.413 | 0.421 |
| B0 | 15.7 | 15.9 | 0.618 | 0.626 |
| D | 1.5 | 1.6 | 0.059 | 0.063 |
| D1 | 1.59 | 1.61 | 0.062 | 0.063 |
| E | 1.65 | 1.85 | 0.065 | 0.073 |
| F | 11.4 | 11.6 | 0.449 | 0.456 |
| K0 | 4.8 | 5.0 | 0.189 | 0.197 |
| P0 | 3.9 | 4.1 | 0.153 | 0.161 |
| P1 | 11.9 | 12.1 | 0.468 | 0.476 |
| P2 | 1.9 | 2.1 | 0.075 | 0.082 |
| R | 50 | | 1.574 | |
| T | 0.25 | 0.35 | 0.0098 | 0.0137 |
| W | 23.7 | 24.3 | 0.933 | 0.956 |

REEL MECHANICAL DATA

| DIM. | mm | | inch | |
|------|------|------|-------|--------|
| | MIN. | MAX. | MIN. | MAX. |
| A | | 330 | | 12.992 |
| B | 1.5 | | 0.059 | |
| C | 12.8 | 13.2 | 0.504 | 0.520 |
| D | 20.2 | | 0.795 | |
| G | 24.4 | 26.4 | 0.960 | 1.039 |
| N | 100 | | 3.937 | |
| T | | 30.4 | | 1.197 |

| | |
|-----------------|-----------------|
| BASE QTY | BULK QTY |
| 1000 | 1000 |

TRAILER (TRL)

* on sales type



Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

© The ST logo is a registered trademark of STMicroelectronics

© 2003 STMicroelectronics - Printed in Italy - All Rights Reserved
STMicroelectronics GROUP OF COMPANIES

Australia - Brazil - Canada - China - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco
Singapore - Spain - Sweden - Switzerland - United Kingdom - United States.

© <http://www.st.com>