



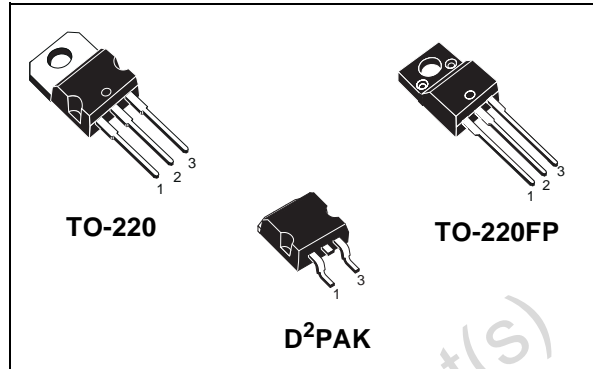
# STGP3NB60HD - STGP3NB60HDFP STGB3NB60HD

N-CHANNEL 3A - 600V - TO-220/TO-220FP/D<sup>2</sup>PAK

PowerMESH™ IGBT

| TYPE          | V <sub>CES</sub> | V <sub>CE(sat)</sub> (Max)<br>@25°C | I <sub>c</sub> (#)<br>@100°C |
|---------------|------------------|-------------------------------------|------------------------------|
| STGB3NB60HD   | 600 V            | < 2.8 V                             | 6 A                          |
| STGP3NB60HD   | 600 V            | < 2.8 V                             | 6 A                          |
| STGP3NB60HDFP | 600 V            | < 2.8 V                             | 6 A                          |

- HIGH INPUT IMPEDANCE (VOLTAGE DRIVEN)
- LOW GATE CHARGE
- HIGH FREQUENCY OPERATION
- HIGH CURRENT CAPABILITY
- OFF LOSSES INCLUDE TAIL CURRENT
- CO-PACKAGED WITH TURBOSWITCH™ ANTIPARALLEL DIODE



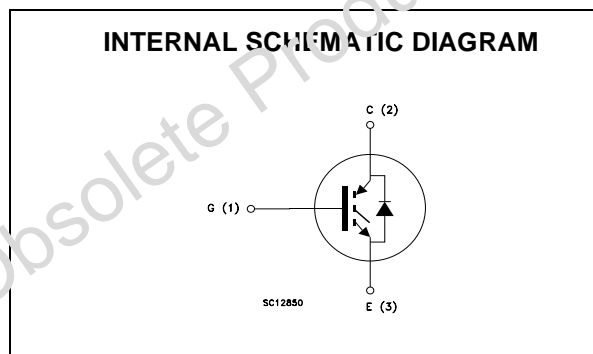
## DESCRIPTION

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 "H" identifies a family optimized for high frequency applications (up to 50kHz) in order to achieve very high switching performances (reduced fall) maintaining a low voltage drop.

## APPLICATIONS

- HIGH FREQUENCY MOTOR CONTROLS
- SMPS and PFC IN BOTH HARD SWITCH AND RESONANT TOPOLOGIES



## ORDERING INFORMATION

| SALES TYPE    | MARKING     | PACKAGE            | PACKAGING   |
|---------------|-------------|--------------------|-------------|
| STGB3NB60HDT4 | GB3NB60HD   | D <sup>2</sup> PAK | TAPE & REEL |
| STGP3NB60HD   | GP3NB60HD   | TO-220             | TUBE        |
| STGP3NB60HDFP | GP3NB60HDFP | TO-220FP           | TUBE        |

## STGP3NB60HD - STGP3NB60HDFP - STGB3NB60HD

### ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter  | Value                      |               | Unit |
|---------------------|--|----------------------------|---------------|------|
|                     |  | STGP3NB60HD<br>STGB3NB60HD | STGP3NB60HDFP |      |
| V <sub>CES</sub>    | Collector-Emitter Voltage (V <sub>GS</sub> = 0)              | 600                        |               | V    |
| V <sub>GE</sub>     | Gate-Emitter Voltage   | ± 20                       |               | V    |
| I <sub>C</sub>      | Collector Current (continuous) at T <sub>C</sub> = 25°C (#)  | 10                         |               | A    |
| I <sub>C</sub>      | Collector Current (continuous) at T <sub>C</sub> = 100°C (#) | 6                          |               | A    |
| I <sub>CM</sub> (■) | Collector Current (pulsed)                                   | 24                         |               | A    |
| P <sub>TOT</sub>    | Total Dissipation at T <sub>C</sub> = 25°C                   | 50                         | 25            | W    |
|                     | Derating Factor  | 0.4                        | 0.2           | W/°C |
| T <sub>stg</sub>    | Storage Temperature  | -55 to 150                 |               | °C   |
| T <sub>j</sub>      | Operating Junction Temperature                               |                            |               |      |

(■) Pulse width limited by safe operating area

### THERMAL DATA

|                       |   | TO-220/D <sup>2</sup> PAK | TO-220FP |      |
|-----------------------|---|---------------------------|----------|------|
| R <sub>thj-case</sub> | Thermal Resistance Junction-case Max    | 2.5                       | 5        | °C/W |
| R <sub>thj-amb</sub>  | Thermal Resistance Junction-ambient Max | 62.5                      |          | °C/W |

### ELECTRICAL CHARACTERISTICS (T<sub>CASE</sub> = 25 °C UNLESS OTHERWISE SPECIFIED)

OFF

| Symbol               | Parameter  | Test Conditions   | Min. | Typ. | Max.      | Unit     |
|----------------------|--|---|------|------|-----------|----------|
| V <sub>BR(CES)</sub> | Collector-Emitter Breakdown Voltage                | I <sub>C</sub> = 250 μA, V <sub>GE</sub> = 0  | 600  |      |           | V        |
| I <sub>CES</sub>     | Collector cut-off (V <sub>GE</sub> = 0)            | V <sub>CE</sub> = Max Rating, T <sub>C</sub> = 25 °C<br>V <sub>CE</sub> = Max Rating, T <sub>C</sub> = 125 °C |      |      | 50<br>100 | μA<br>μA |
| I <sub>GES</sub>     | Gate-Emitter Leakage Current (V <sub>CE</sub> = 0) | V <sub>GE</sub> = ±20V, V <sub>CE</sub> = 0   |      |      | ±100      | nA       |

ON (1)

| Symbol               | Parameter                            | Test Conditions  | Min. | Typ.       | Max. | Unit   |
|----------------------|--------------------------------------|--|------|------------|------|--------|
| V <sub>GE(th)</sub>  | Gate Threshold Voltage               | V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 250μA   | 3    |            | 5    | V      |
| V <sub>CE(sat)</sub> | Collector-Emitter Saturation Voltage | V <sub>GE</sub> = 15V, I <sub>C</sub> = 3 A<br>V <sub>GE</sub> = 15V, I <sub>C</sub> = 3 A, T <sub>j</sub> = 125°C |      | 2.4<br>1.9 | 2.8  | V<br>V |

(#) Calculated according to the iterative formula:

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

**ELECTRICAL CHARACTERISTICS (CONTINUED)**

**DYNAMIC**

| Symbol                              | Parameter   | Test Conditions   | Min. | Typ.             | Max. | Unit           |
|-------------------------------------|---|---|------|------------------|------|----------------|
| $g_{fs}$                            | Forward Transconductance  | $V_{CE} = 25\text{ V}, I_C = 3\text{ A}$                                  |      | 2.4              |      | S              |
| $C_{ies}$<br>$C_{oes}$<br>$C_{res}$ | Input Capacitance<br>Output Capacitance<br>Reverse Transfer Capacitance | $V_{CE} = 25\text{ V}, f = 1\text{ MHz}, V_{GE} = 0$                      |      | 235<br>33<br>6.6 |      | pF<br>pF<br>pF |
| $Q_g$<br>$Q_{ge}$<br>$Q_{gc}$       | Total Gate Charge<br>Gate-Emitter Charge<br>Gate-Collector Charge       | $V_{CE} = 480\text{ V}, I_C = 3\text{ A},$<br>$V_{GE} = 15\text{ V}$      |      | 21<br>6<br>7.6   | 27   | nC<br>nC<br>nC |
| $I_{CL}$                            | Latching Current  | $V_{clamp} = 480\text{ V}, T_j = 125^\circ\text{C}$<br>$R_G = 10\ \Omega$ | 12   |                  |      | A              |

**SWITCHING ON**

| Symbol                            | Parameter   | Test Conditions  | Min. | Typ.      | Max. | Unit                              |
|-----------------------------------|---|--|------|-----------|------|-----------------------------------|
| $t_{d(on)}$<br>$t_r$              | Turn-on Delay Time<br>Rise Time                   | $V_{CC} = 480\text{ V}, I_C = 3\text{ A}$<br>$R_G = 10\ \Omega, V_{GE} = 15\text{ V}$                          |      | 5<br>11   |      | ns<br>ns                          |
| $(di/dt)_{on}$<br>E <sub>on</sub> | Turn-on Current Slope<br>Turn-on Switching Losses | $V_{CC} = 480\text{ V}, I_C = 3\text{ A}, R_G = 10\ \Omega$<br>$V_{GE} = 15\text{ V}, T_j = 125^\circ\text{C}$ |      | 400<br>77 |      | A/ $\mu\text{s}$<br>$\mu\text{J}$ |

**SWITCHING OFF**

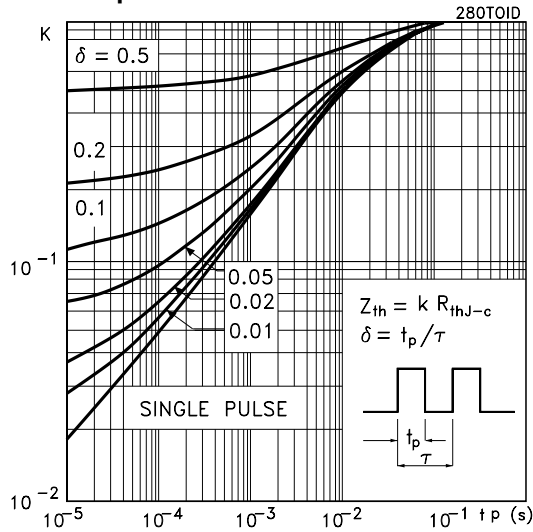
| Symbol  | Parameter  | Test Conditions  | Min. | Typ.                                | Max. | Unit   |
|---|--|--|------|-------------------------------------|------|--|
| $t_c$<br>$t_r(V_{off})$<br>$t_{d(off)}$<br>$t_f$<br>E <sub>off(**)</sub><br>E <sub>ts</sub> | Cross-over Time<br>Off Voltage Rise Time<br>Delay Time<br>Fall Time<br>Turn-off Switching Loss<br>Total Switching Loss | $V_{CC} = 480\text{ V}, I_C = 3\text{ A},$<br>$R_{GE} = 10\ \Omega, V_{GE} = 15\text{ V}$                              |      | 76<br>36<br>53<br>77<br>33<br>110   |      | ns<br>ns<br>ns<br>ns<br>$\mu\text{J}$<br>$\mu\text{J}$ |
| $t_c$<br>$t_r(V_{off})$<br>$t_{d(off)}$<br>$t_f$<br>E <sub>off(**)</sub><br>E <sub>ts</sub> | Cross-over Time<br>Off Voltage Rise Time<br>Delay Time<br>Fall Time<br>Turn-off Switching Loss<br>Total Switching Loss | $V_{CC} = 480\text{ V}, I_C = 3\text{ A},$<br>$R_{GE} = 10\ \Omega, V_{GE} = 15\text{ V}$<br>$T_j = 125^\circ\text{C}$ |      | 180<br>82<br>58<br>110<br>88<br>165 |      | ns<br>ns<br>ns<br>ns<br>$\mu\text{J}$<br>$\mu\text{J}$ |

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

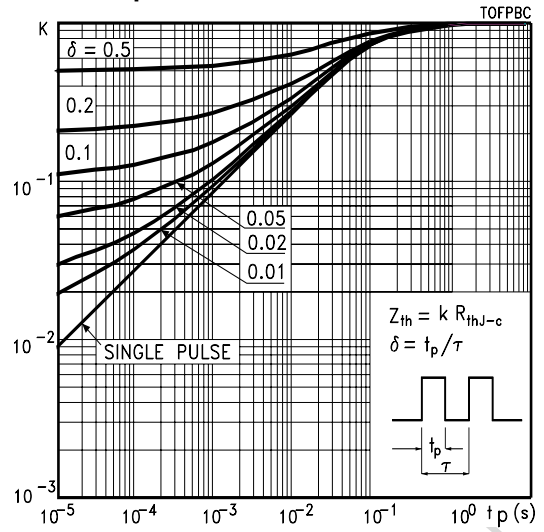
**COLLECTOR-EMITTER DIODE**

| Symbol                            | Parameter  | Test Conditions   | Min. | Typ.            | Max.    | Unit          |
|-----------------------------------|--|---|------|-----------------|---------|---------------|
| $I_f$<br>$I_{fm}$                 | Forward Current<br>Forward Current pulsed                                    |   |      |                 | 3<br>24 | A<br>A        |
| $V_f$                             | Forward On-Voltage   | $I_f = 3\text{ A}$<br>$I_f = 3\text{ A}, T_j = 125^\circ\text{C}$                                     |      | 1.6<br>1.4      | 2.0     | V<br>V        |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{rrm}$ | Reverse Recovery Time<br>Reverse Recovery Charge<br>Reverse Recovery Current | $I_f = 3\text{ A}, V_R = 35\text{ V},$<br>$T_j = 125^\circ\text{C}, di/dt = 100\text{ A}/\mu\text{s}$ |      | 45<br>70<br>2.7 |         | ns<br>nC<br>A |

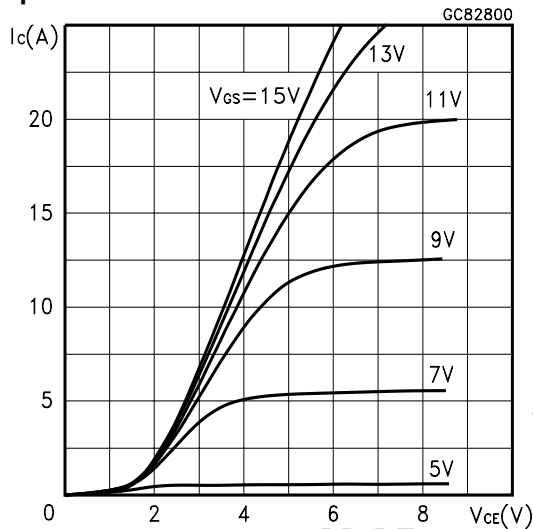
Thermal Impedance for TO-220/D<sup>2</sup>PAK



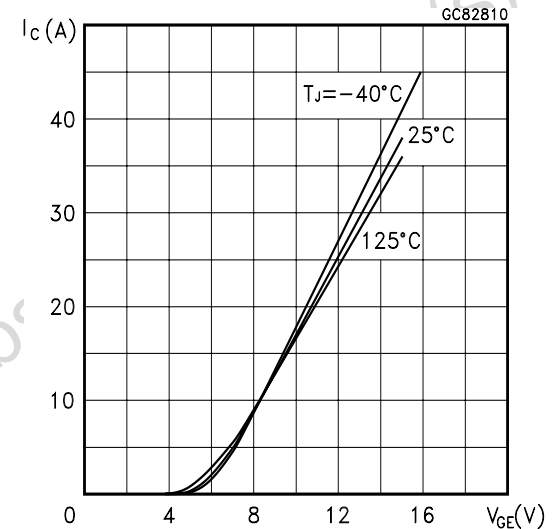
Thermal Impedance for TO-220FP



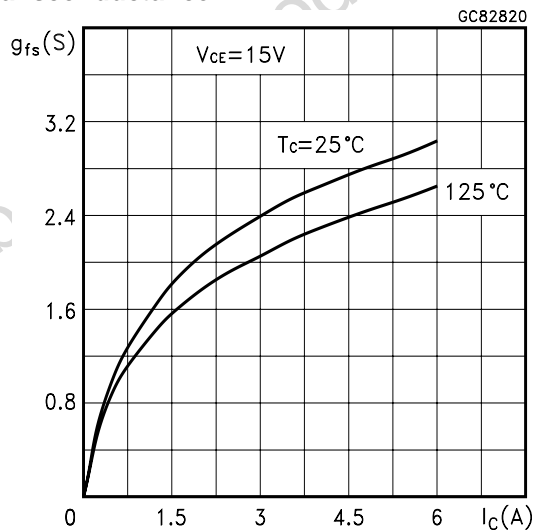
Output Characteristics



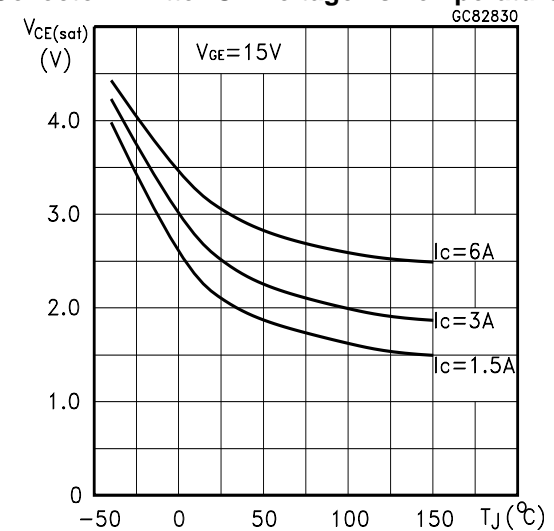
Transfer Characteristics



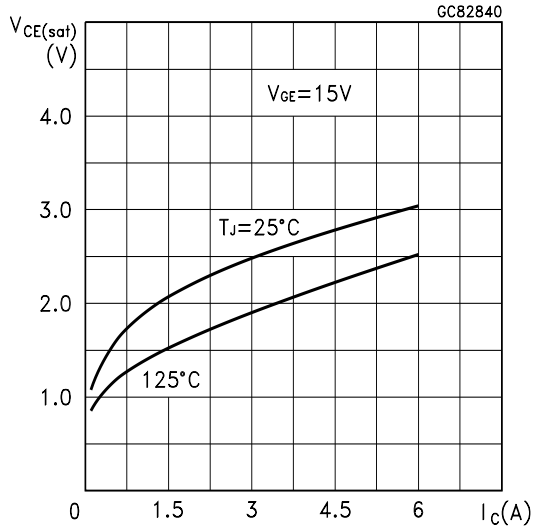
Transconductance



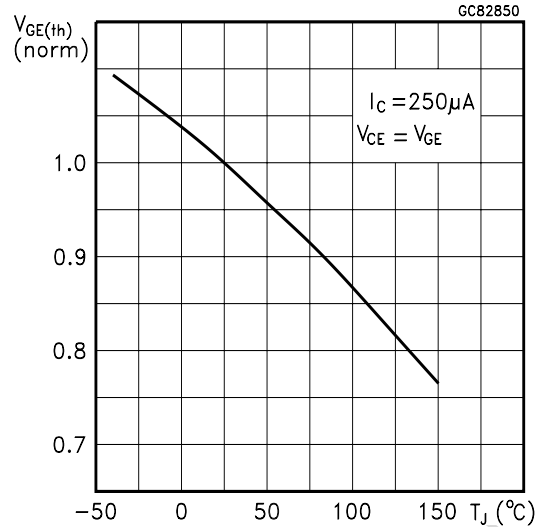
Collector-Emitter On Voltage vs Temperature



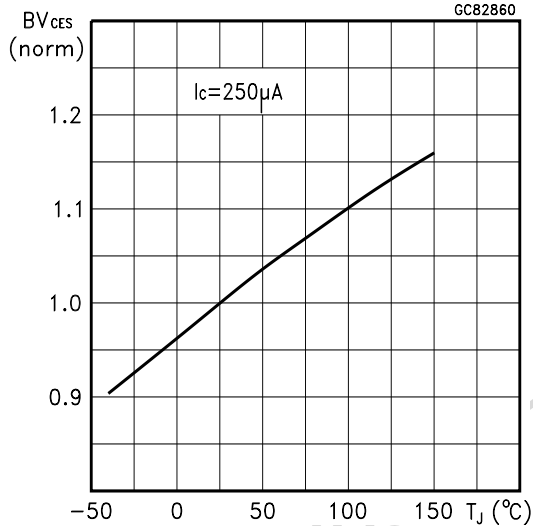
Collector-Emitter On Voltage vs Collector Current



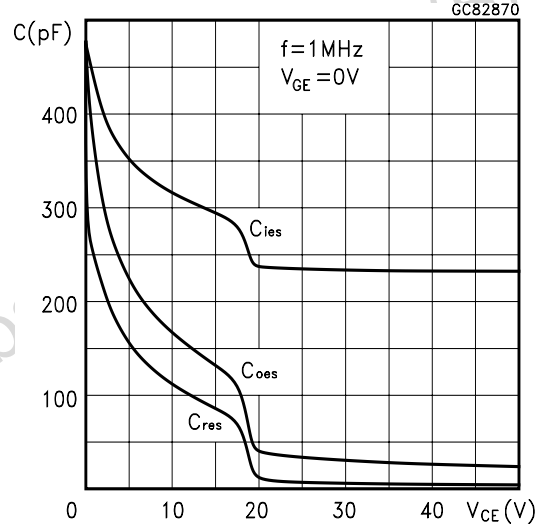
Gate Threshold vs Temperature



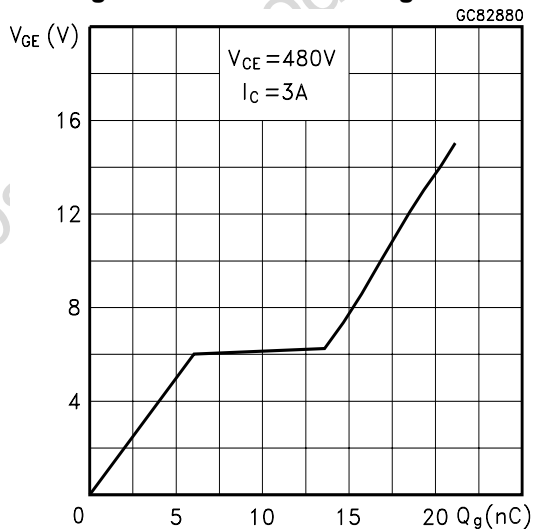
Normalized Breakdown Voltage vs Temperature



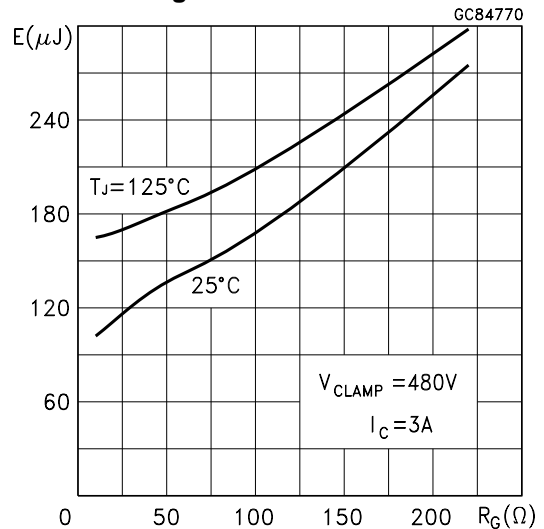
Capacitance Variations



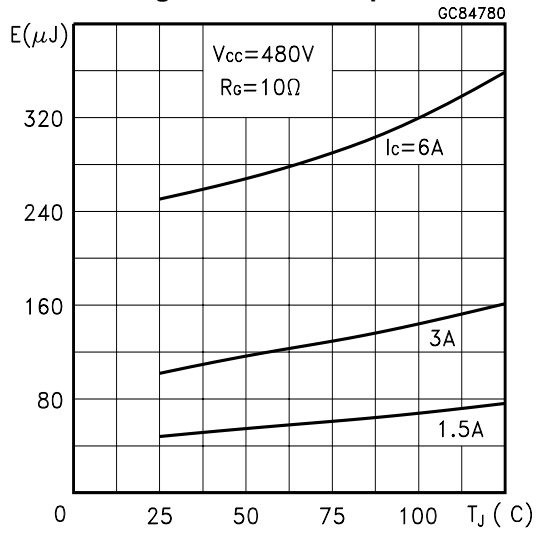
Gate Charge vs Gate-Emitter Voltage



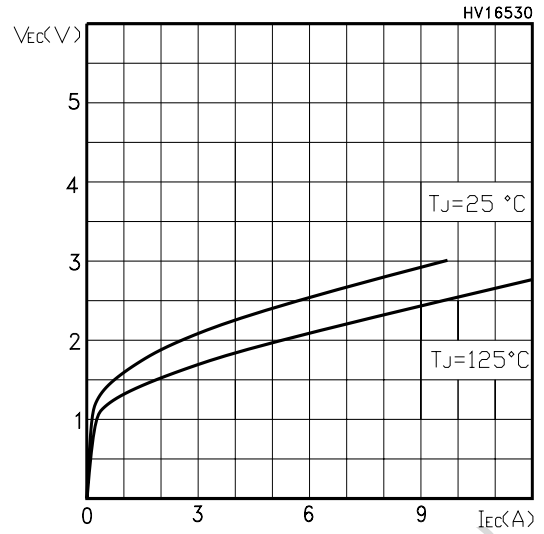
Total Switching Losses vs Gate Resistance



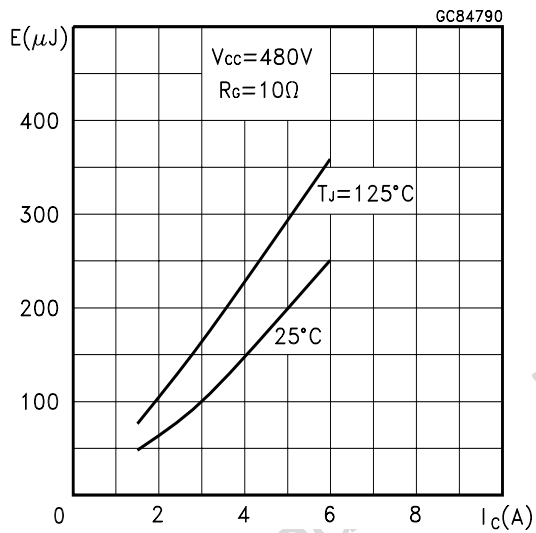
Total Switching Losses vs Temperature



Emitter-collector Diode Characteristics



Total Switching Losses vs Collector Current



Switching Off Safe Operating Area

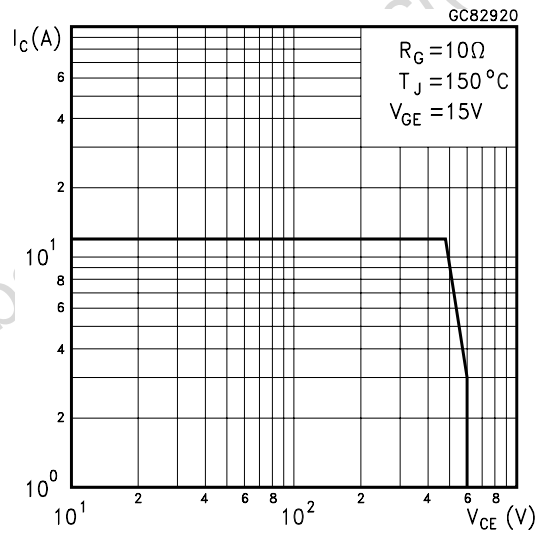


Fig. 1: Gate Charge test Circuit

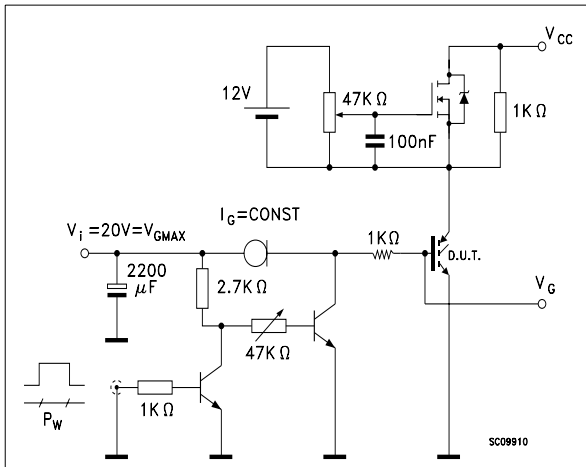
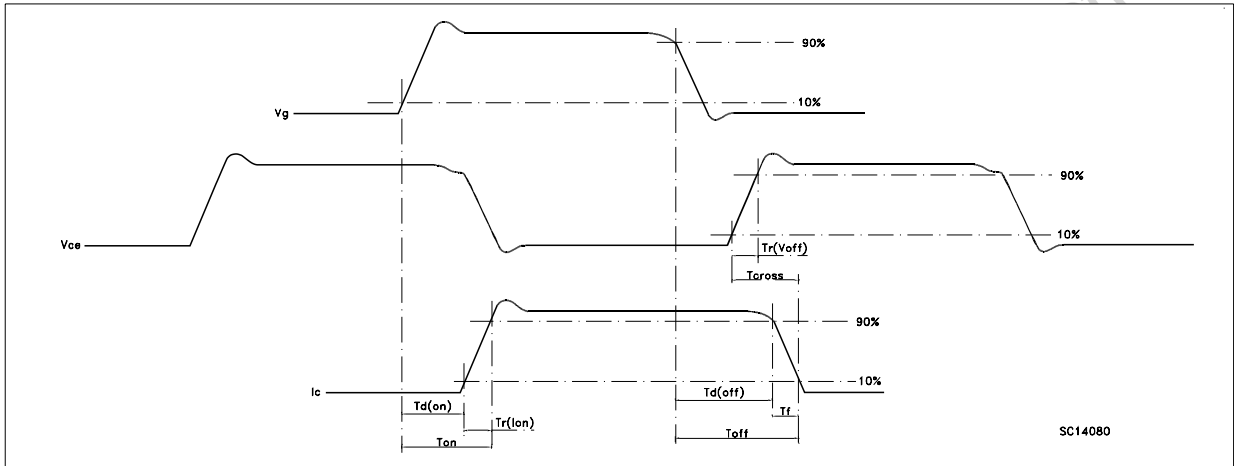
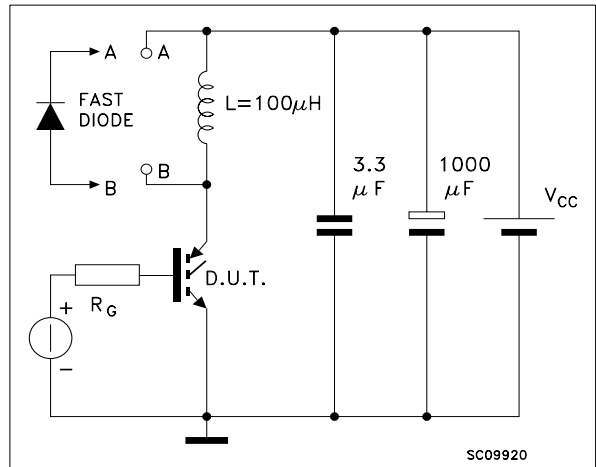


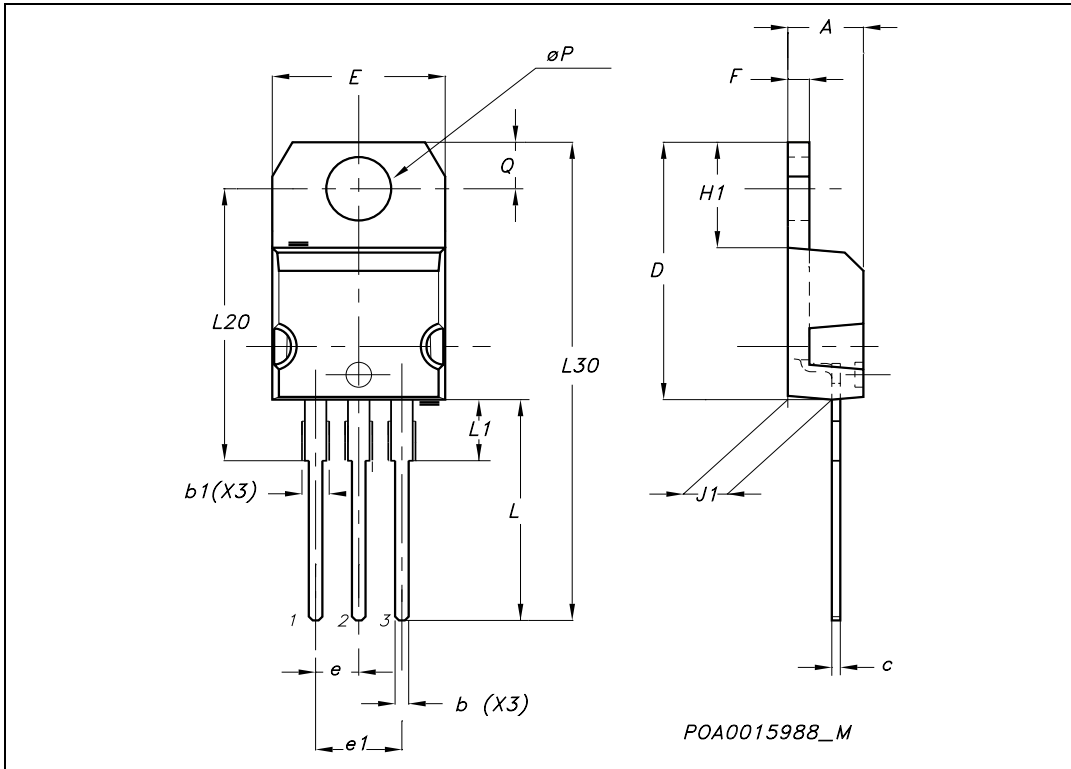
Fig. 2: Test Circuit For Inductive Load Switching



Obsolete Product

**TO-220 MECHANICAL DATA**

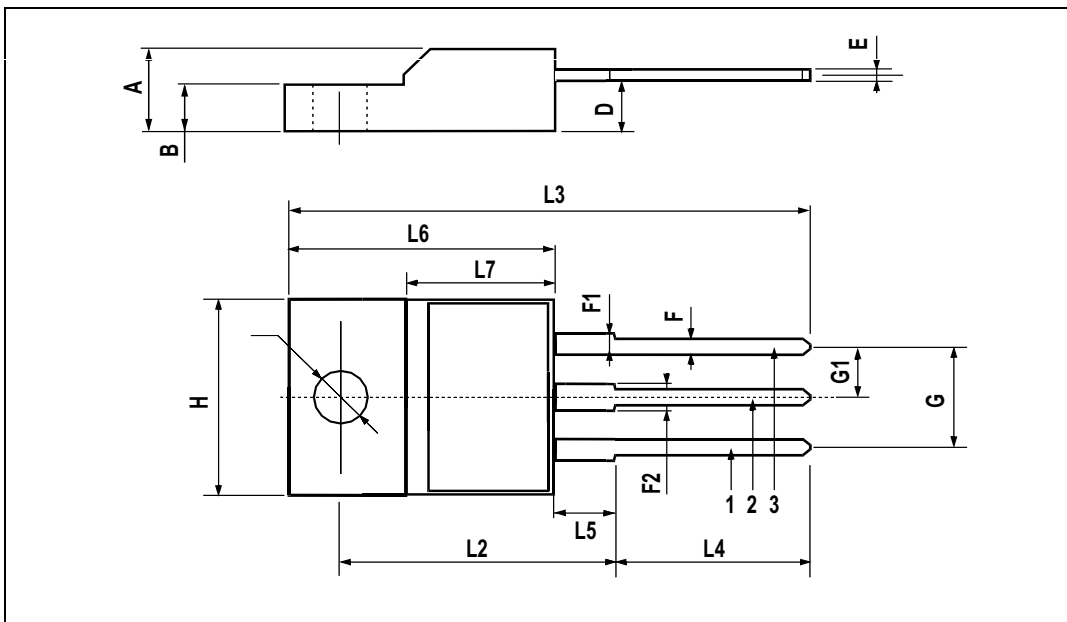
| DIM. | mm.   |       |       | inch  |       |       |
|------|-------|-------|-------|-------|-------|-------|
|      | MIN.  | TYP.  | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 4.40  |       | 4.60  | 0.173 |       | 0.181 |
| b    | 0.61  |       | 0.88  | 0.024 |       | 0.034 |
| b1   | 1.15  |       | 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 |





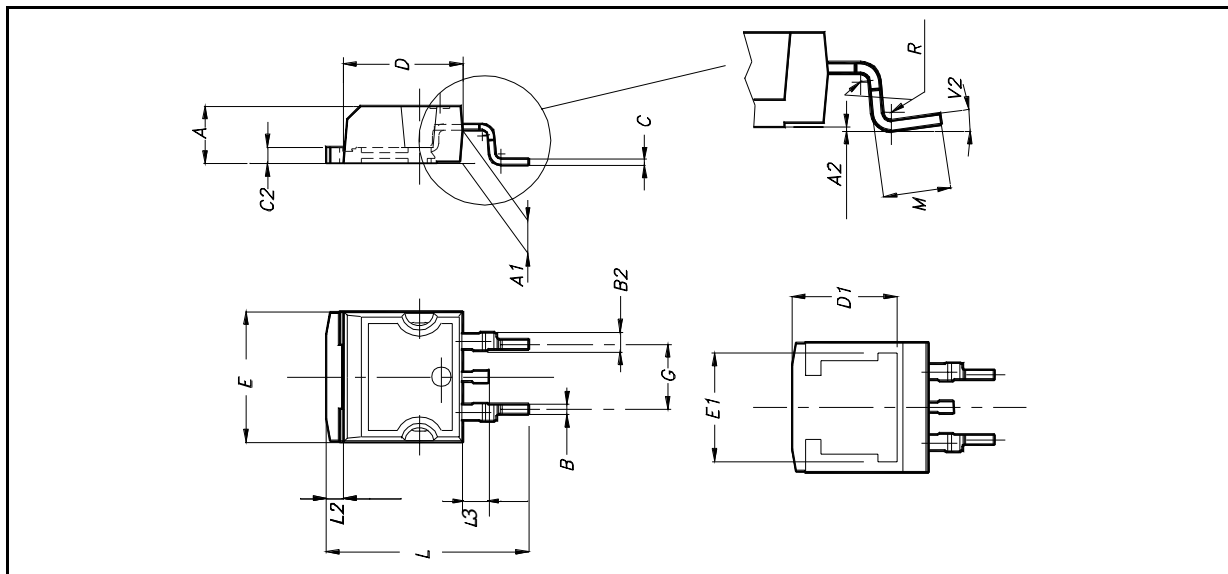
**TO-220FP MECHANICAL DATA**

| DIM. | mm.  |     |      | inch  |       |       |
|------|------|-----|------|-------|-------|-------|
|      | MIN. | TYP | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 4.4  |     | 4.6  | 0.173 |       | 0.181 |
| B    | 2.5  |     | 2.7  | 0.098 |       | 0.106 |
| D    | 2.5  |     | 2.75 | 0.098 |       | 0.108 |
| E    | 0.45 |     | 0.7  | 0.017 |       | 0.027 |
| F    | 0.75 |     | 1    | 0.030 |       | 0.039 |
| F1   | 1.15 |     | 1.7  | 0.045 |       | 0.067 |
| F2   | 1.15 |     | 1.7  | 0.045 |       | 0.067 |
| G    | 4.95 |     | 5.2  | 0.195 |       | 0.204 |
| G1   | 2.4  |     | 2.7  | 0.094 |       | 0.106 |
| H    | 10   |     | 10.4 | 0.393 |       | 0.409 |
| L2   |      | 16  |      |       | 0.630 |       |
| L3   | 28.6 |     | 30.6 | 1.126 |       | 1.204 |
| L4   | 9.8  |     | 10.6 | .0385 |       | 0.417 |
| L5   | 2.9  |     | 3.6  | 0.114 |       | 0.141 |
| L6   | 15.9 |     | 16.4 | 0.626 |       | 0.645 |
| L7   | 9    |     | 9.3  | 0.354 |       | 0.366 |
| Ø    | 3    |     | 3.2  | 0.118 |       | 0.126 |

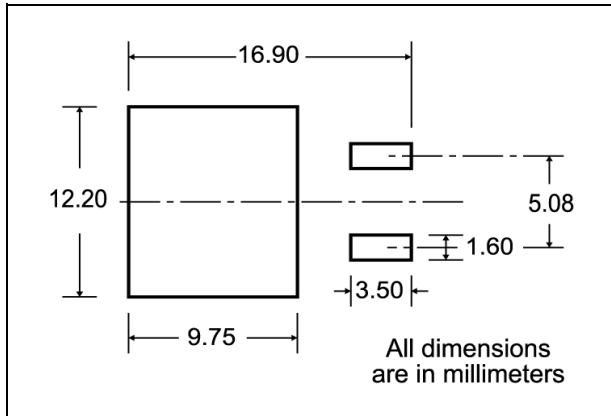


**D<sup>2</sup>PAK MECHANICAL DATA**

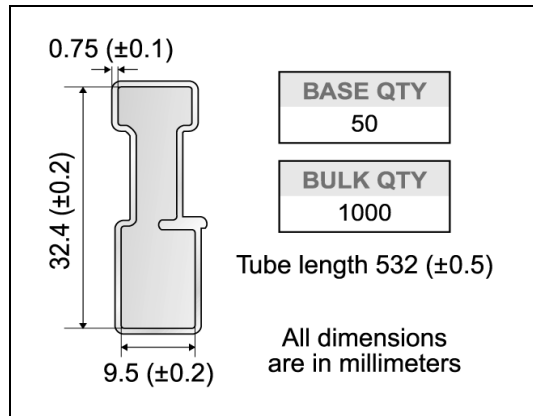
| DIM. | mm.  |     |       | inch  |       |       |
|------|------|-----|-------|-------|-------|-------|
|      | MIN. | TYP | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 4.4  |     | 4.6   | 0.173 |       | 0.181 |
| A1   | 2.49 |     | 2.69  | 0.098 |       | 0.106 |
| A2   | 0.03 |     | 0.23  | 0.001 |       | 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°   |     | 4°    |       |       |       |



**D<sup>2</sup>PAK FOOTPRINT**



**TUBE SHIPMENT (no suffix)\***



**TAPE AND REEL SHIPMENT (suffix "T4")\***

Diagram showing the tape mechanical data. Dimensions include A (width), B (width), C (width), D (width), E (width), F (width), G (width), H (width), I (width), J (width), K (width), L (width), M (width), N (width), O (width), P (width), Q (width), R (width), S (width), T (width). A 40 mm min. access hole is shown at the slot location. The tape slot in the core for tape start has a 2.5 mm min. width. The full radius is also indicated.

**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  |

|                 |      |
|-----------------|------|
| <b>BASE QTY</b> | 1000 |
| <b>BULK QTY</b> | 1000 |

**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 |

Diagram showing the tape and reel shipment details. Dimensions include K<sub>0</sub>, T, D, P<sub>2</sub>, P<sub>0</sub>, E, F, W, B<sub>0</sub>, D<sub>1</sub>, A<sub>0</sub>, P<sub>1</sub>. A 10-pitch cumulative tolerance on tape is indicated as + / - 0.2 mm. The center line of the cavity is also shown. The bending radius is R min. The user direction of feed and feed direction are also indicated.

\* 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>