



STGF3NC120HD

N-CHANNEL 3A - 1200V TO-220FP

FAST PowerMESH™ IGBT with Integral Damper Diode

Table 1: General Features

| TYPE | V _{CES} | V _{CE(sat)} (Max) @25°C | I _C @100°C |
|--------------|------------------|-------------------------------------|--------------------------|
| STGF3NC120HD | 1200 V | < 2.8 V | 3 A |

- LOW ON-VOLTAGE DROP (V_{cesat})
- HIGH CURRENT CAPABILITY
- OFF LOSSES INCLUDE TAIL CURRENT
- HIGH SPEED

DESCRIPTION

This PowerMESH™ IGBT is designed using the latest high voltage technology based on a patented strip layout. A new lifetime control allows good switching performance and low voltage drop. This IGBT featuring a co-packaged diode is optimized for horizontal deflection applications in small and medium sets.

APPLICATIONS

- HORIZONTAL DEFLECTION
- HOME APPLIANCE
- LIGHTING

Figure 1: Package

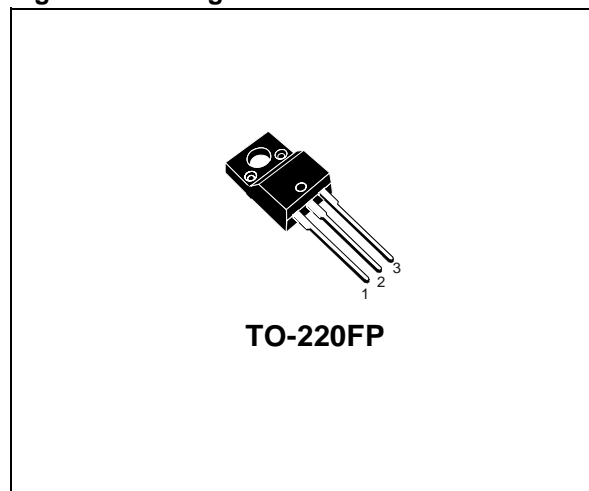


Figure 2: Internal Schematic Diagram

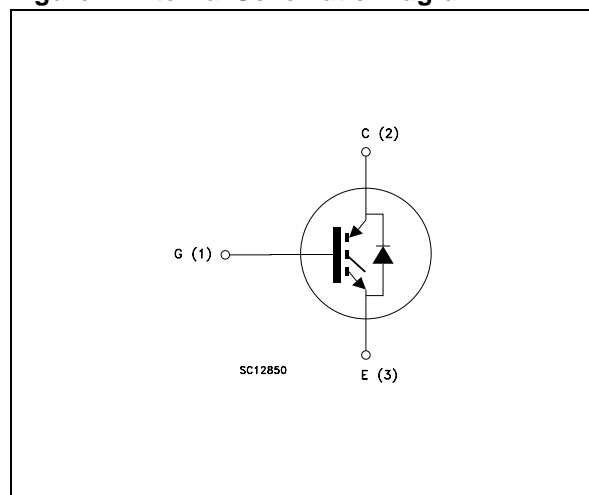


Table 2: Order Code

| PART NUMBER | MARKING | PACKAGE | PACKAGING |
|--------------|------------|----------|-----------|
| STGF3NC120HD | GF3NC120HD | TO-220FP | TUBE |

Table 3: Absolute Maximum ratings

| Symbol | Parameter | Value | Unit |
|-------------------------|--|------------|---------------------|
| V_{CES} | Collector-Emitter Voltage ($V_{GS} = 0$) | 1200 | V |
| V_{ECR} | Emitter-Collector Voltage | 20 | V |
| V_{GE} | Gate-Emitter Voltage | ± 20 | V |
| I_C | Collector Current (continuous) at $T_C = 25^\circ\text{C}$ | 6 | A |
| I_C | Collector Current (continuous) at $T_C = 100^\circ\text{C}$ | 3 | A |
| $I_{CM} (\blacksquare)$ | Collector Current (pulsed) | 10 | A |
| P_{TOT} | Total Dissipation at $T_C = 25^\circ\text{C}$ | 25 | W |
| | Derating Factor | 0.20 | W/ $^\circ\text{C}$ |
| V_{ISO} | Insulation withstand voltage AC ($t=1\text{sec}$, $T_C=25^\circ\text{C}$) | 2500 | V |
| T_{stg} | Storage Temperature | -55 to 150 | $^\circ\text{C}$ |
| T_j | Operating Junction Temperature range | | |

(\blacksquare) Pulse width limited by safe operating area

Table 4: Thermal Data

| | | Min. | Typ. | Max. | |
|----------------|--|------|------|------|---------------------------|
| $R_{thj-case}$ | Thermal Resistance Junction-case | | | 5.0 | $^\circ\text{C}/\text{W}$ |
| $R_{thj-amb}$ | Thermal Resistance Junction-ambient | | | 62.5 | $^\circ\text{C}/\text{W}$ |
| T_L | Maximum Lead Temperature for Soldering Purpose (1.6 mm from case, for 10 sec.) | | 300 | | $^\circ\text{C}$ |

ELECTRICAL CHARACTERISTICS ($T_{CASE} = 25^\circ\text{C}$ UNLESS OTHERWISE SPECIFIED)**Table 5: On/Off**

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------|---|--|------|------------|-----------|---------------------|
| $V_{BR(CES)}$ | Collector-Emitter Breakdown Voltage | $I_C = 1\text{ mA}$, $V_{GE} = 0$ | 1200 | | | V |
| I_{CES} | Collector cut-off Current ($V_{GE} = 0$) | $V_{CE} = \text{Max Rating}$, $T_C = 25^\circ\text{C}$ $V_{CE} = \text{Max Rating}$, $T_C = 125^\circ\text{C}$ | | | 50 1 | μA mA |
| I_{GES} | Gate-Emitter Leakage Current ($V_{CE} = 0$) | $V_{GE} = \pm 20\text{V}$, $V_{CE} = 0$ | | | ± 100 | nA |
| $V_{GE(th)}$ | Gate Threshold Voltage | $V_{CE} = V_{GE}$, $I_C = 250\text{ }\mu\text{A}$ | 2 | | 5 | V |
| $V_{CE(sat)}$ | Collector-Emitter Saturation Voltage | $V_{GE} = 15\text{V}$, $I_C = 3\text{ A}$ $V_{GE} = 15\text{V}$, $I_C = 3\text{ A}$, $T_C = 125^\circ\text{C}$ | | 2.3 2.2 | 2.8 | V V |

ELECTRICAL CHARACTERISTICS (CONTINUED)**Table 6: Dynamic**

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------|---|---|------|---------------|------|----------------|
| g_{fs} (1) | Forward Transconductance | $V_{CE} = 25\text{ V}$, $I_C = 3\text{ A}$ | | 4 | | S |
| C_{ies} | Input Capacitance | $V_{CE} = 25\text{ V}$, $f = 1\text{ MHz}$, $V_{GE} = 0$ | | 470 | | pF |
| C_{oes} | Output Capacitance | | | 45 | | pF |
| C_{res} | Reverse Transfer Capacitance | | | 6 | | pF |
| Q_g Q_{ge} Q_{gc} | Total Gate Charge Gate-Emitter Charge Gate-Collector Charge | $V_{CC} = 960\text{ V}$, $I_C = 3\text{ A}$, $V_{GE} = 15\text{ V}$ (see Figure 22) | | 24 3 10 | 32 | nC nC nC |
| I_{CL} | Turn-off SOA minimum current | $V_{clamp} = 960\text{ V}$, $T_j = 150^\circ\text{C}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$ | 10 | | | A |

(1) Pulsed: Pulse duration= 300 μs , duty cycle 1.5%**Table 7: Switching On**

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|--|--|------|------------------|------|------------------------------|
| $t_{d(on)}$ t_r (di/dt) _{on} | Turn-on Delay Time Current Rise Time Turn-on Current Slope | $V_{CC} = 800\text{ V}$, $I_C = 3\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_j = 25^\circ\text{C}$ (see Figure 20) | | 15 3.5 880 | | ns ns A/ μs |
| $t_{d(on)}$ t_r (di/dt) _{on} | Turn-on Delay Time Current Rise Time Turn-on Current Slope | $V_{CC} = 480\text{ V}$, $I_C = 3\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_j = 125^\circ\text{C}$ (see Figure 20) | | 14.5 4 770 | | ns ns A/ μs |

Table 8: Switching Off

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|------|-------------------|------|----------------|
| $t_r(V_{off})$ $t_{d(off)}$ t_f | Off Voltage Rise Time Turn-off Delay Time Current Fall Time | $V_{CC} = 800\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$ $T_j = 25^\circ\text{C}$ (see Figure 20) | | 72 118 250 | | ns ns ns |
| $t_r(V_{off})$ $t_{d(off)}$ t_f | Off Voltage Rise Time Turn-off Delay Time Current Fall Time | $V_{CC} = 800\text{ V}$, $I_C = 3\text{ A}$, $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$ $T_j = 125^\circ\text{C}$ (see Figure 20) | | 132 210 470 | | ns ns ns |

Table 9: Switching Energy

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---|---|--|------|-------------------|------|---|
| E_{on} (2) E_{off} (3) E_{ts} | Turn-on Switching Losses Turn-off Switching Loss Total Switching Loss | $V_{CC} = 800\text{ V}$, $I_C = 3\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_j = 25^\circ\text{C}$ (see Figure 21) | | 236 290 526 | | μJ μJ μJ |
| E_{on} (2) E_{off} (3) E_{ts} | Turn-on Switching Losses Turn-off Switching Loss Total Switching Loss | $V_{CC} = 800\text{ V}$, $I_C = 3\text{ A}$ $R_G = 10\ \Omega$, $V_{GE} = 15\text{ V}$, $T_j = 125^\circ\text{C}$ (see Figure 21) | | 360 620 980 | | μJ μJ μJ |

(2) E_{on} is the turn-on losses when a typical diode is used in the test circuit in figure 2. If the IGBT is offered in a package with a co-pack diode, the co-pack diode is used as external diode. IGBTs & DIODE are at the same temperature (25°C and 125°C)

(3) Turn-off losses include also the tail of the collector current.

Table 10: Collector-Emitter Diode

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max | Unit |
|----------------------------------|--|---|------|------------------|---------|---------------|
| I_f I_{fm} | Forward Current Forward Current pulsed | | | | 3 12 | A A |
| V_f | Forward On-Voltage | $I_f = 1.5\text{ A}$ $I_f = 1.5\text{ A}, T_j = 125^\circ\text{C}$ | | 1.6 1.3 | 2.0 | V V |
| t_{rr} Q_{rr} I_{rm} | Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current | $I_f = 3\text{ A}, V_R = 40\text{ V}$ $T_j = 25^\circ\text{C}, di/dt = 100\text{ A}/\mu\text{s}$ (see Figure 23) | | 51 85 3.3 | | ns nC A |
| t_{rr} Q_{rr} I_{rm} | Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current | $I_f = 3\text{ A}, V_R = 40\text{ V}$ $T_j = 125^\circ\text{C}, di/dt = 100\text{ A}/\mu\text{s}$ (see Figure 23) | | 64 133 4.2 | | ns nC A |

Figure 3: Output Characteristics

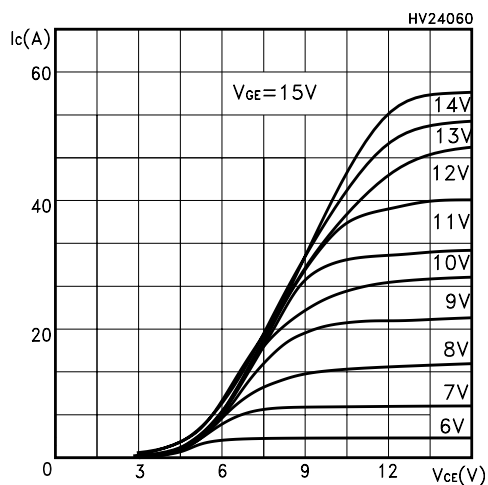


Figure 4: Transconductance

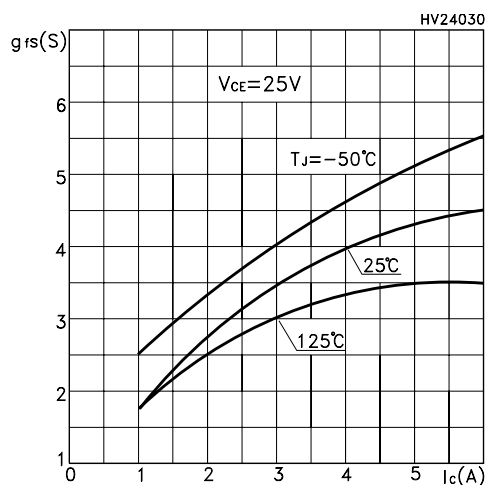


Figure 5: Collector-Emitter On Voltage vs Collector Current

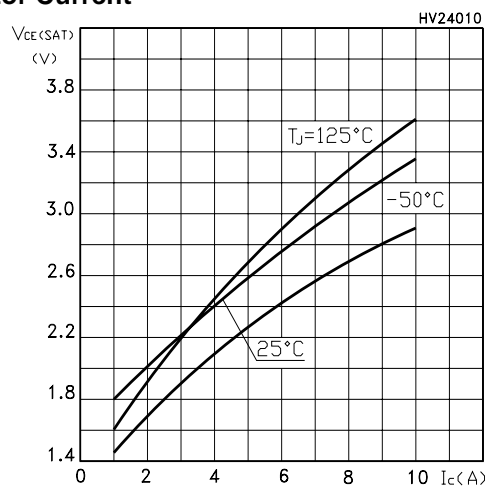


Figure 6: Transfer Characteristics

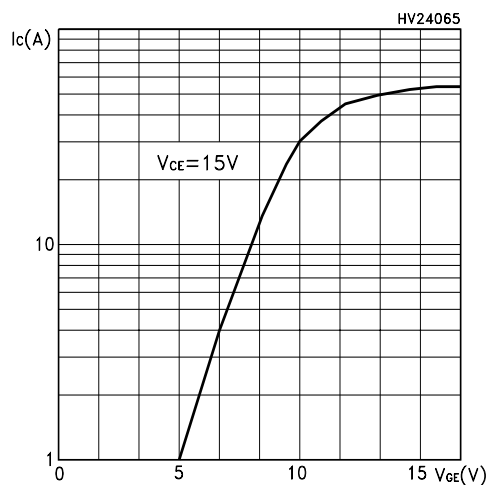


Figure 7: Collector-Emitter On Voltage vs Temperature

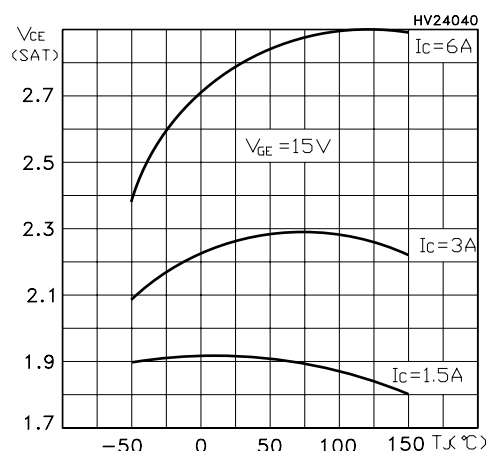


Figure 8: Normalized Gate Threshold vs Temperature

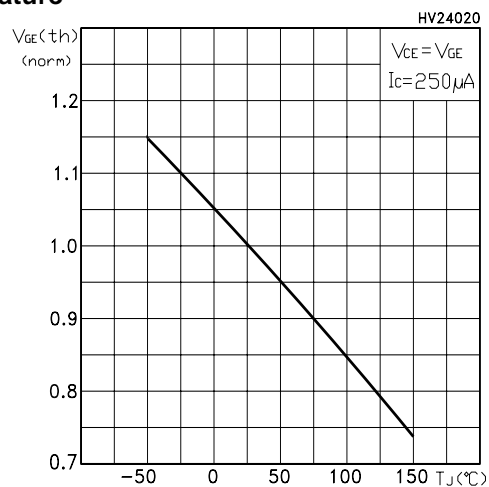


Figure 9: Normalized Breakdown Voltage vs Temperature

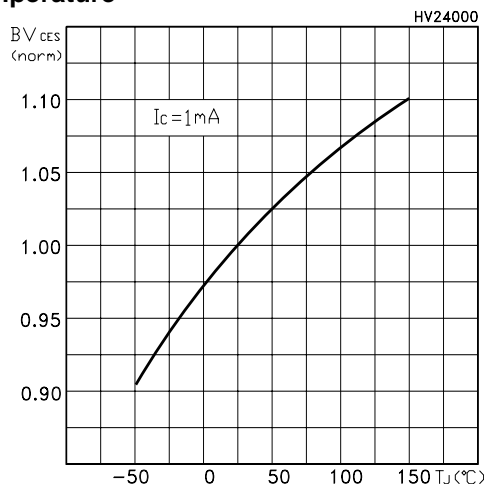


Figure 10: Capacitance Variations

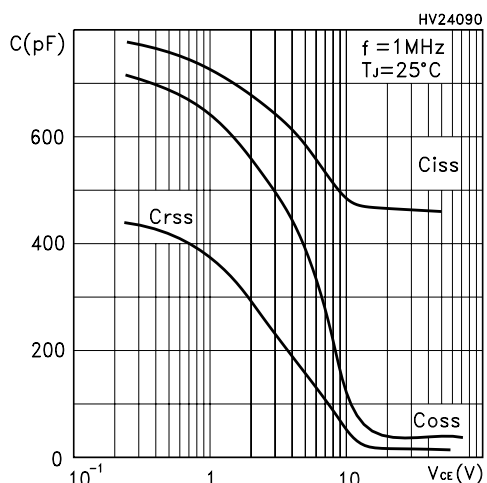


Figure 11: Switching Losses vs Gate Resistance

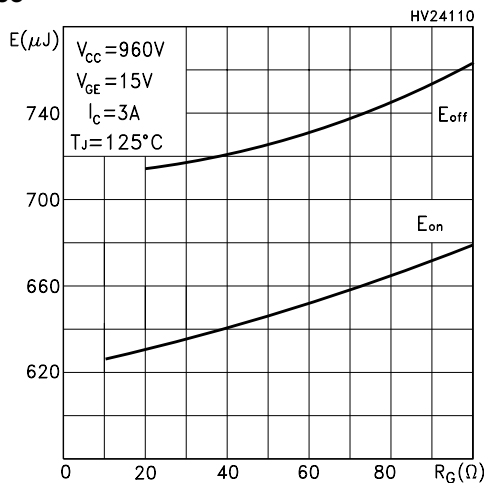


Figure 12: Gate Charge vs Gate-Emitter Voltage

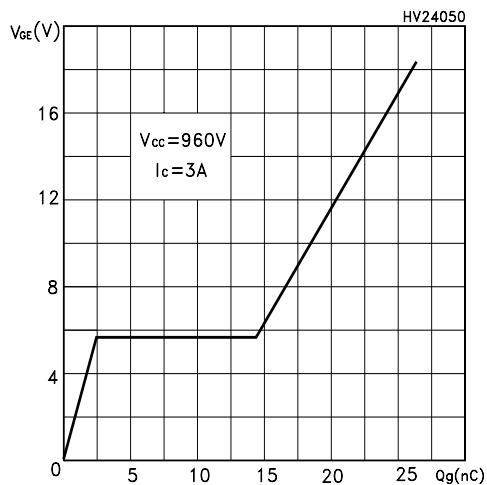


Figure 13: Switching Losses vs Temperature

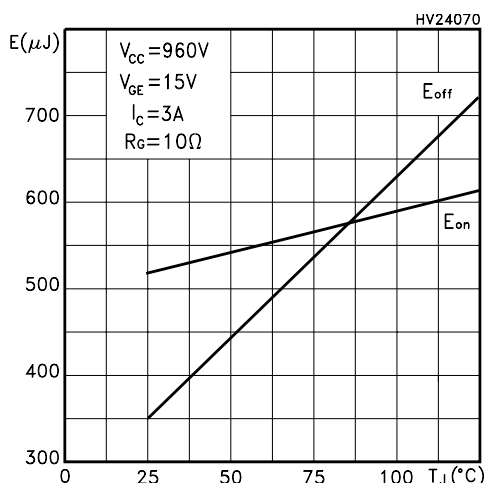


Figure 14: Switching Losses vs Collector Current

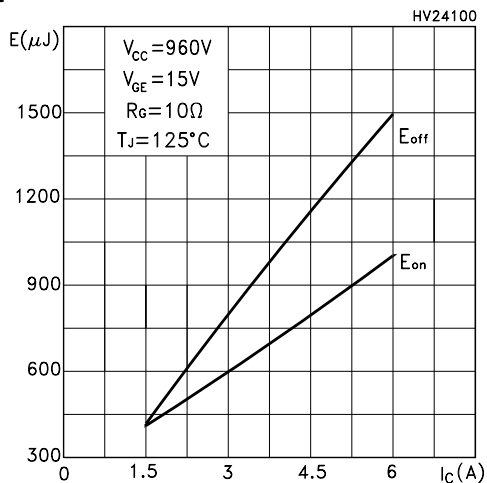


Figure 15: Thermal Impedance

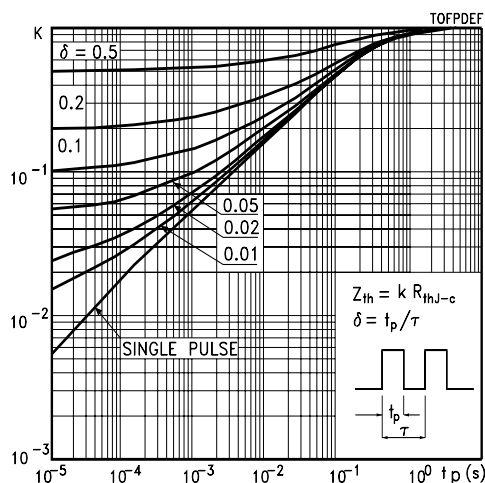


Figure 16: Collector-Emitter Diode Characteristics

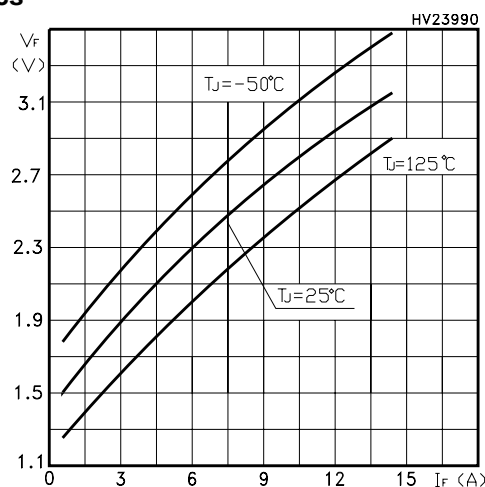


Figure 17: Turn-Off SOA

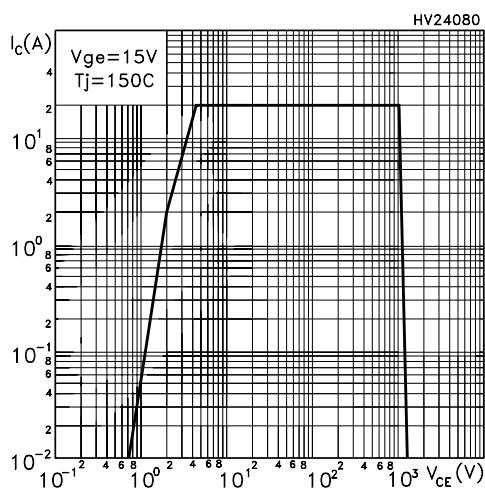


Figure 18: Power Losses

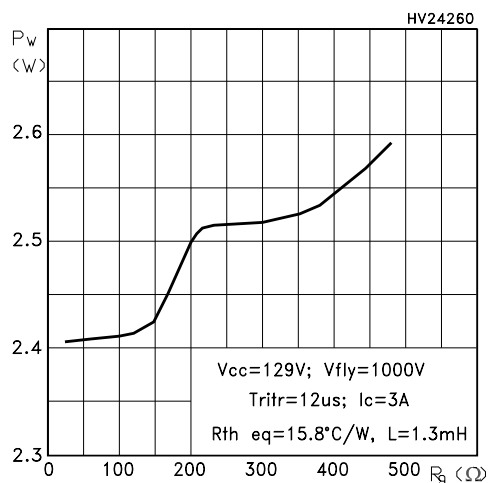


Figure 19: Power Losses

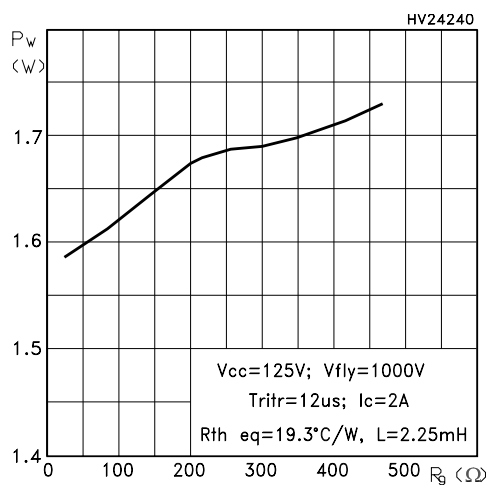


Figure 22: Gate Charge Test Circuit

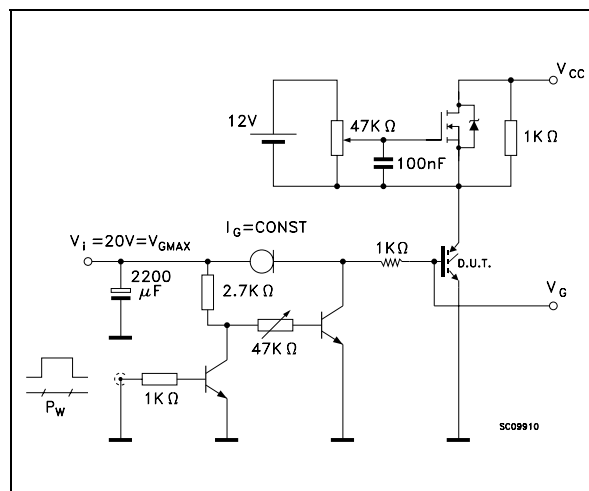
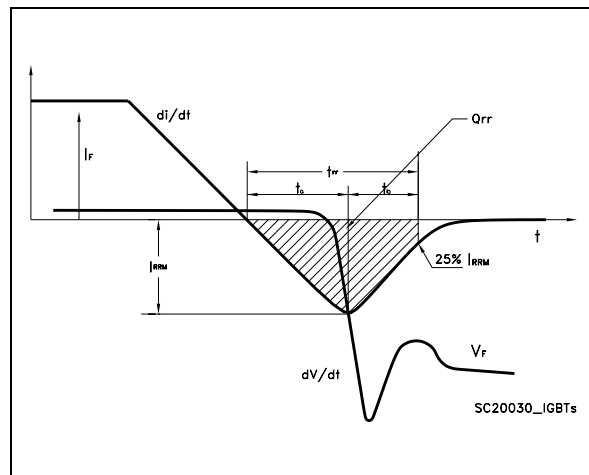


Figure 23: Diode Recovery Time Waveforms



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 |

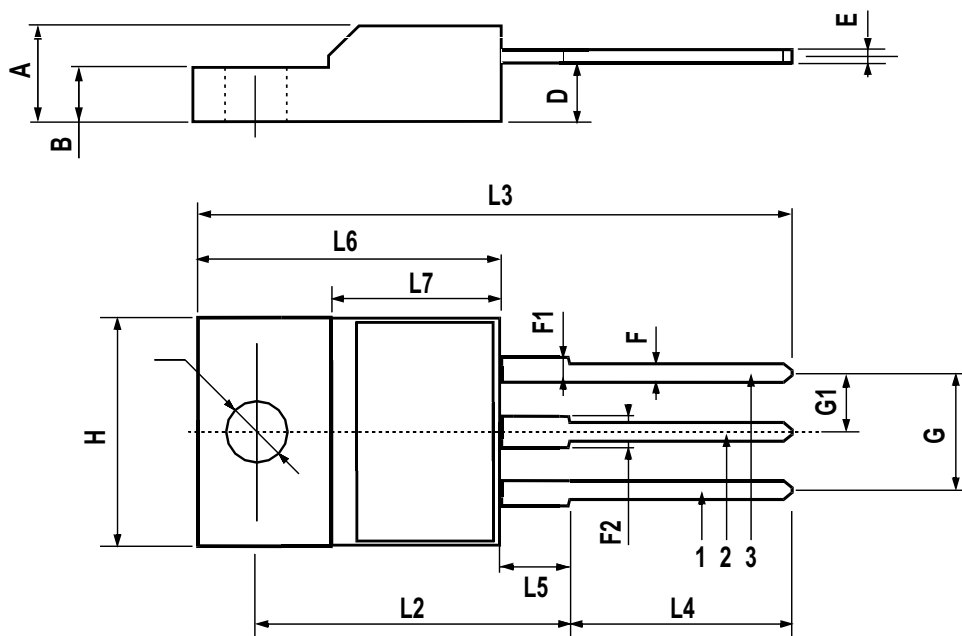


Table 11: Revision History

| Date | Revision | Description of Changes |
|-------------|----------|------------------------|
| 13-Dec-2004 | 1 | First release |
| 21-Jan-2005 | 2 | Modified Curve 17 |

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

All other names are the property of their respective owners

© 2005 STMicroelectronics - All Rights Reserved

STMicroelectronics group of companies

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