



STG3P3M25N60

3 phase inverter
IGBT - SEMITOP[®]3 module

Features

- Low on-voltage drop ($V_{CE(sat)}$)
- Low C_{RES} / C_{IES} ratio (no cross-conduction susceptibility)
- Very soft ultra fast recovery antiparallel diode
- High frequency operation up to 70 kHz
- One screw mounting
- Compact design
- Semitop[®]3 is a trademark of Semikron

Applications

- High frequency inverters
- Motor drivers

Description

Using the latest high voltage technology based on a patented strip layout, STMicroelectronics has designed an advanced family of IGBTs, the PowerMESH[™] IGBT, with outstanding performances.

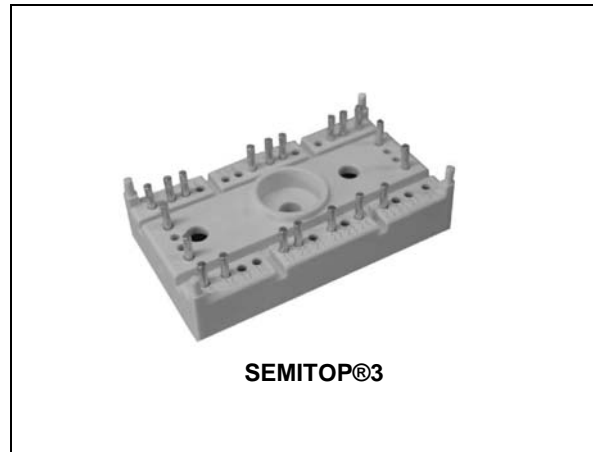


Figure 1. Internal schematic diagram

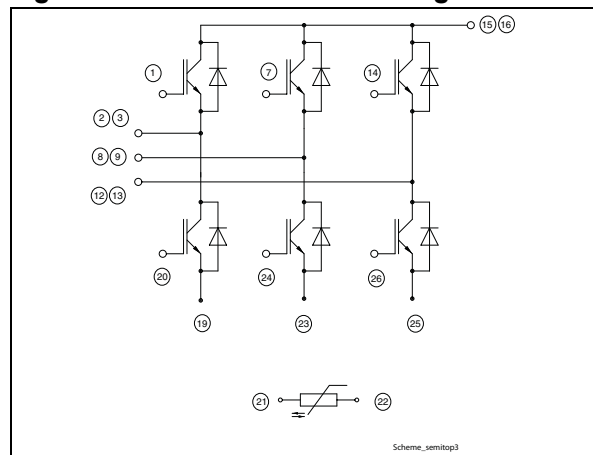


Table 1. Device summary

| Order code | Marking | Package | Packaging |
|--------------|------------|-----------|-----------|
| STG3P3M25N60 | G3P3M25N60 | SEMITOP®3 | Semibox |

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1 Electrical ratings

Table 2. Absolute maximum ratings

| Symbol | Parameter | Value | Unit |
|----------------|--|-------------|------|
| V_{CES} | Collector-emitter voltage ($V_{GE} = 0$) | 600 | V |
| $I_C^{(1)}$ | Collector current (continuous) at $T_s = 25\text{ °C}$ | 50 | A |
| $I_C^{(1)}$ | Collector current (continuous) at $T_s = 80\text{ °C}$ | 25 | A |
| V_{GE} | Gate-emitter voltage | ± 20 | V |
| $I_{CM}^{(2)}$ | Collector current (pulsed, $t_p < 1\text{ ms}$) $T_s = 25\text{ °C}$ | 100 | A |
| $I_{CM}^{(2)}$ | Collector current (pulsed, $t_p < 1\text{ ms}$) $T_s = 80\text{ °C}$ | 50 | A |
| I_F | Diode RMS forward current at $T_s = 25\text{ °C}$ | 19 | A |
| P_{TOT} | Total dissipation at $T_s = 25\text{ °C}$ | 96 | W |
| V_{ISO} | Insulation withstand voltage A.C. ($t = 1\text{ min/sec}$; $T_s = 25\text{ °C}$) | 2500/3000 | V |
| T_{stg} | Storage temperature | - 40 to 125 | °C |
| T_j | Operating junction temperature | - 40 to 150 | °C |

1. Calculated value
2. Pulse width limited by max. junction temperature

Table 3. Thermal resistance (for single IGBT)

| Symbol | Parameter | Value | Unit |
|---------------|--|-------|------|
| $R_{th(j-s)}$ | Thermal resistance junction-sink ⁽¹⁾ max. | 1.3 | k/W |

1. Resistance value with conductive grease applied and maximum mounting torque equal to 2Nm

2 Electrical characteristics

($T_s = 25\text{ °C}$ unless otherwise specified)

Table 4. IGBT-Inverter parameters

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---------------|--|---|------|-------------|-----------|---------------------|
| $V_{(BR)CES}$ | Collector-emitter breakdown voltage ($V_{GE} = 0$) | $I_C = 1\text{ mA}$ | 600 | | | V |
| I_{CES} | Collector cut-off current ($V_{GE} = 0$) | $V_{CE} = 600\text{ V}$ $V_{CE} = 600\text{ V}, T_s = 125\text{ °C}$ | | | 10 1 | μA mA |
| I_{GES} | Gate-emitter leakage current ($V_{CE} = 0$) | $V_{GE} = \pm 20\text{ V}$ | | | ± 100 | nA |
| $V_{GE(th)}$ | Gate threshold voltage | $V_{CE} = V_{GE}, I_C = 250\text{ }\mu\text{A}$ | 3.75 | | 5.75 | V |
| $V_{CE(sat)}$ | Collector-emitter saturation voltage | $V_{GE} = 15\text{ V}, I_C = 20\text{ A}$ $V_{GE} = 15\text{ V}, I_C = 20\text{ A}, T_s = 125\text{ °C}$ | | 1.85 1.7 | 2.5 | V V |

Table 5. Dynamic

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------|------------------------------|--|------|------|------|------|
| $g_{fs}^{(1)}$ | Forward transconductance | $V_{CE} = 15\text{ V}, I_C = 20\text{ A}$ | | 15 | | S |
| C_{ies} | Input capacitance | $V_{CE} = 25\text{ V}, f = 1\text{ MHz},$ $V_{GE} = 0$ | | 2200 | | pF |
| C_{oes} | Output capacitance | | | 225 | | pF |
| C_{res} | Reverse transfer capacitance | | | 50 | | pF |
| Q_g | Total gate charge | $V_{CE} = 390\text{ V}, I_C = 20\text{ A},$ $V_{GE} = 15\text{ V},$ (see Figure 9) | | 100 | 140 | nC |
| Q_{ge} | Gate-emitter charge | | | 16 | | nC |
| Q_{gc} | Gate-collector charge | | | 45 | | nC |

1. Pulsed: pulse duration=300 μs , duty cycle 1.5%

Table 6. Switching on/off

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------|-----------------------|--|------|------|------|------------|
| $t_{d(on)}$ | Turn-on delay time | $V_{CC} = 300\text{ V}$, $I_C = 20\text{ A}$ | | 31 | | ns |
| t_r | Current rise time | $R_G = 3.3\ \Omega$, $V_{GE} = \pm 15\text{ V}$, (see Figure 10) | | 11 | | ns |
| $(di/dt)_{on}$ | Turn-on current slope | | | 1600 | | A/ μ s |
| $t_{d(on)}$ | Turn-on delay time | $V_{CC} = 300\text{ V}$, $I_C = 20\text{ A}$ | | 31 | | ns |
| t_r | Current rise time | $R_G = 3.3\ \Omega$, $V_{GE} = \pm 15\text{ V}$, $T_s = 125^\circ\text{C}$ (see Figure 10) | | 11.5 | | ns |
| $(di/dt)_{on}$ | Turn-on current slope | | | 1500 | | A/ μ s |
| $t_r(V_{off})$ | Off voltage rise time | $V_{CC} = 300\text{ V}$, $I_C = 20\text{ A}$ | | 28 | | ns |
| $t_{d(off)}$ | Turn-off delay time | $R_G = 3.3\ \Omega$, $V_{GE} = \pm 15\text{ V}$, (see Figure 10) | | 100 | | ns |
| t_f | Current fall time | | | 75 | | ns |
| $t_r(V_{off})$ | Off voltage rise time | $V_{CC} = 300\text{ V}$, $I_C = 20\text{ A}$ | | 66 | | ns |
| $t_{d(off)}$ | Turn-off delay time | $R_G = 3.3\ \Omega$, $V_{GE} = \pm 15\text{ V}$, $T_s = 125^\circ\text{C}$ (see Figure 10) | | 150 | | ns |
| t_f | Current fall time | | | 130 | | ns |

Table 7. Switching energy (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------|---------------------------|--|------|------|------|---------|
| $E_{on}^{(1)}$ | Turn-on switching losses | $V_{CC} = 300\text{ V}$, $I_C = 20\text{ A}$ | | 220 | | μ J |
| $E_{off}^{(2)}$ | Turn-off switching losses | $R_G = 3.3\ \Omega$, $V_{GE} = \pm 15\text{ V}$, (see Figure 10) | | 330 | | μ J |
| E_{ts} | Total switching losses | | | 550 | | μ J |
| $E_{on}^{(1)}$ | Turn-on switching losses | $V_{CC} = 300\text{ V}$, $I_C = 20\text{ A}$ | | 450 | | μ J |
| $E_{off}^{(2)}$ | Turn-off switching losses | $R_G = 3.3\ \Omega$, $V_{GE} = \pm 15\text{ V}$, $T_s = 125^\circ\text{C}$ (see Figure 10) | | 770 | | μ J |
| E_{ts} | Total switching losses | | | 1220 | | μ J |

1. 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-pak diode, the co-pack diode is used as external diode. IGBTs & Diode are at the same temperature (25°C and 125°C)

2. Turn-off losses include also the tail of the collector current

Table 8. Collector-emitter diode

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------|------------------------------|---|------|------------|------|--------|
| V_F | Forward on-voltage | $I_F = 10\text{ A}$ $I_F = 10\text{ A}, T_s = 125\text{ °C}$ | | 1.3 1.0 | 2.0 | V V |
| t_{rr} | Reverse recovery time | $I_F = 20\text{ A}, V_R = 40\text{ V},$ $di/dt = 100\text{ A}/\mu\text{s}$ | | 44 | | ns |
| t_a | | | | 32 | | ns |
| Q_{rr} | Reverse recovery charge | | | 66 | | nC |
| I_{rrm} | Reverse recovery current | | | 3 | | A |
| S | Softness factor of the diode | | | 0.375 | | |
| t_{rr} | Reverse recovery time | $I_F = 20\text{ A}, V_R = 40\text{ V},$ $di/dt = 100\text{ A}/\mu\text{s},$ $T_s = 125\text{ °C}$ | | 88 | | ns |
| t_a | | | | 56 | | ns |
| Q_{rr} | Reverse recovery charge | | | 237 | | nC |
| I_{rrm} | Reverse recovery current | | | 5.4 | | A |
| S | Softness factor of the diode | | | 0.57 | | |

Table 9. Temperature sensor

| Symbol | Parameter | conditions | Min. | Typ. | Max. | Unit |
|----------|-----------------------|--------------------------------|------|---------------|------|----------|
| R_{ts} | Equivalent resistance | 5%, $T_r = 25\text{ (100) °C}$ | | 5000 (493) | | Ω |

2.1 Typical characteristics (curves)

Figure 2. Output characteristics at $T_s = 25^\circ\text{C}$

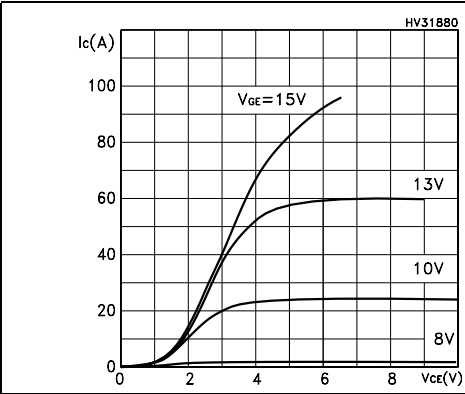


Figure 3. Output characteristics at $T_s = 125^\circ\text{C}$

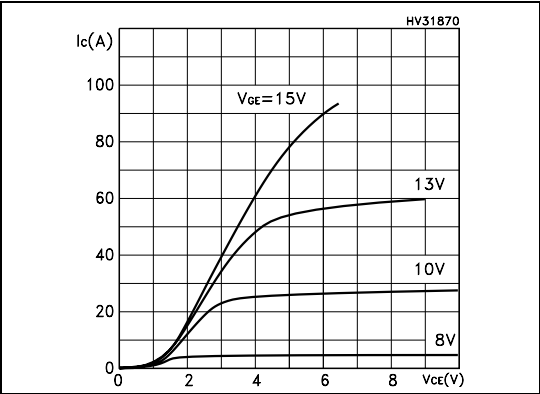


Figure 4. Capacitance variation

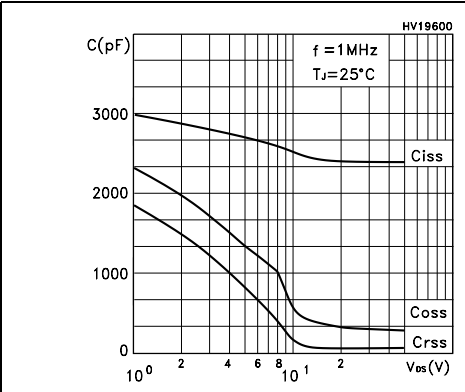


Figure 5. Gate charge vs gate-emitter voltage

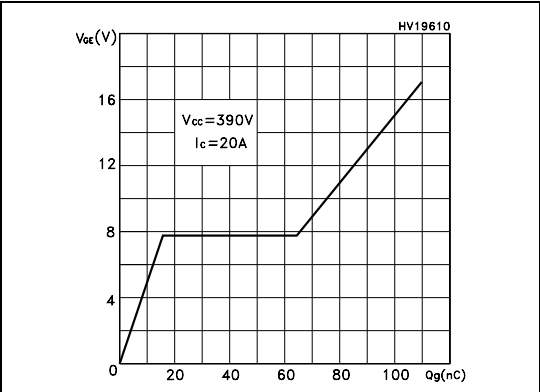


Figure 6. Total switching losses vs gate resistance

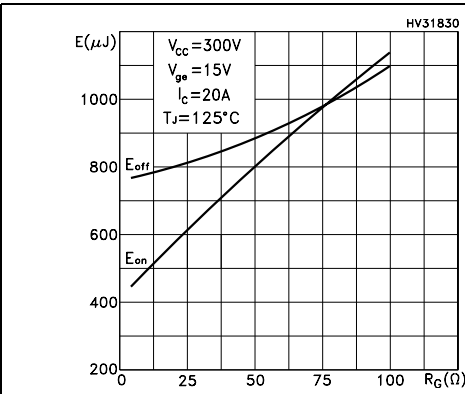
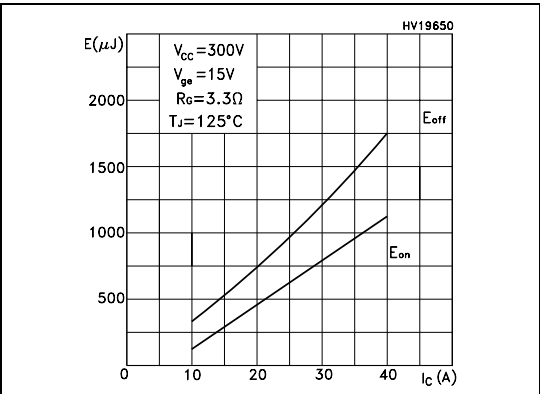


Figure 7. Total switching losses vs collector current



3 Test circuits

Figure 8. Test circuit for inductive load switching

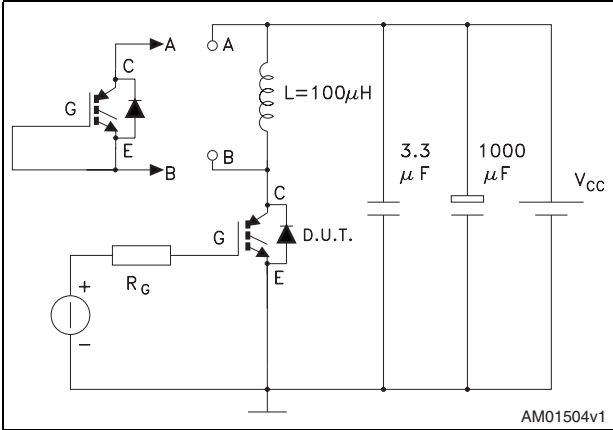


Figure 9. Gate charge test circuit

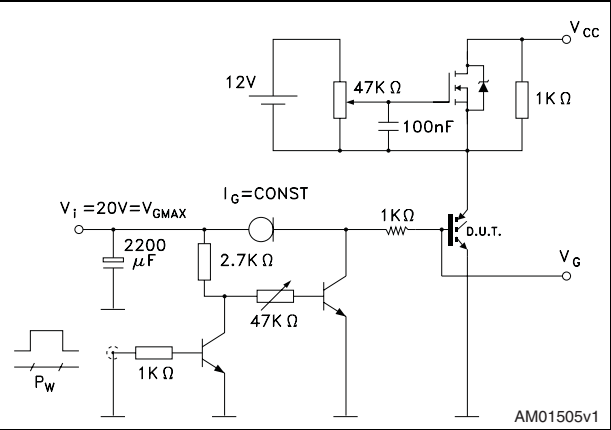


Figure 10. Switching waveform

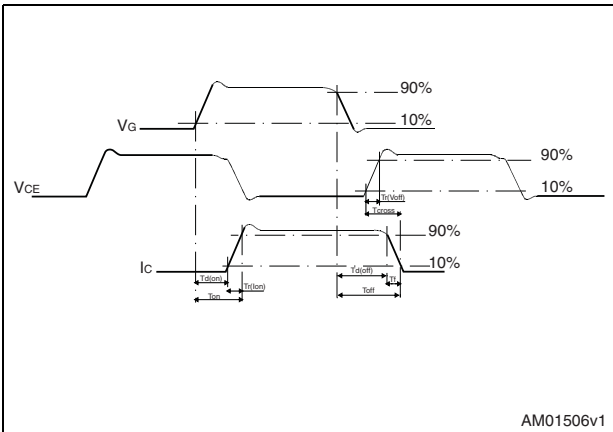
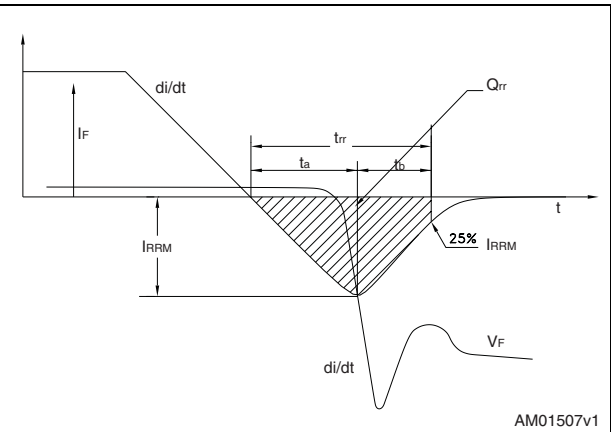


Figure 11. Diode recovery time waveform



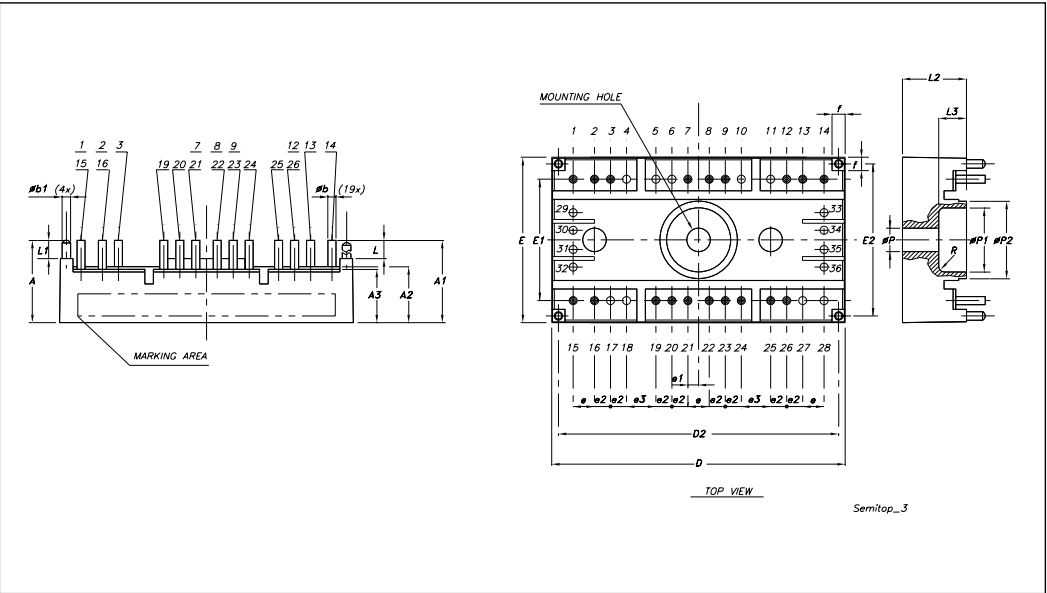
4 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com

SEMITOP®3 mechanical data

| Dim | mm | | |
|-----|-------|-------|-------|
| | Min | Typ | Max |
| A | 15.30 | 15.50 | 15.70 |
| A1 | 15.23 | 15.43 | 15.63 |
| A2 | | 10.50 | |
| A3 | | 10 | |
| øb | | 1.50 | |
| øb1 | | 1.60 | |
| D | 54.70 | 55 | 55.30 |
| D2 | | 52.50 | |
| E | 30.70 | 31 | 31.30 |
| E1 | 22.55 | 22.75 | 23 |
| E2 | | 28.50 | |
| e | 3.90 | 4 | 4.10 |
| e1 | | 2 | |
| e2 | 2.90 | 3 | 3.10 |
| e3 | 5.40 | 5.50 | 5.60 |
| f | | 2.50 | |
| L | | 3.43 | |
| L1 | | 3.50 | |
| L2 | 11.80 | 12 | 12.20 |
| L3 | | 5.20 | |
| øP | 4.30 | 4.40 | 4.50 |
| øP1 | | 12 | |
| øP2 | | 14.50 | |
| R | | 1 | |

SEMITOP®3 is a trademark of SEMIKRON



5 Revision history

Table 10. Revision history

| Date | Revision | Changes |
|-------------|----------|--|
| 29-May-2006 | 1 | Initial release |
| 02-Oct-2008 | 2 | <ul style="list-style-type: none">– Updated Figure 6 and Figure 7– Document status promoted from preliminary data to datasheet. |

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