



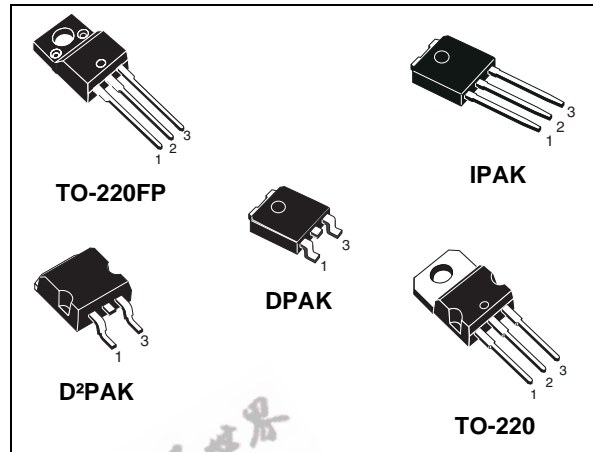
STB60N55F3 - STD60N55F3 - STF60N55F3 STP60N55F3 - STU60N55F3

N-channel 55V - 6.5mΩ - 80A - DPAK - IPAK - D²PAK - TO-220/FP
STripFET™ Power MOSFET

General features

| Type | V _{DSS} | R _{DS(on)} | I _D | P _w |
|------------|------------------|---------------------|----------------|----------------|
| STB60N55F3 | 55V | <8.5mΩ | 80A | 110W |
| STD60N55F3 | 55V | <8.5mΩ | 80A | 110W |
| STF60N55F3 | 55V | <8.5mΩ | 42A | 30W |
| STP60N55F3 | 55V | <8.5mΩ | 80A | 110W |
| STU60N55F3 | 55V | <8.5mΩ | 80A | 110W |

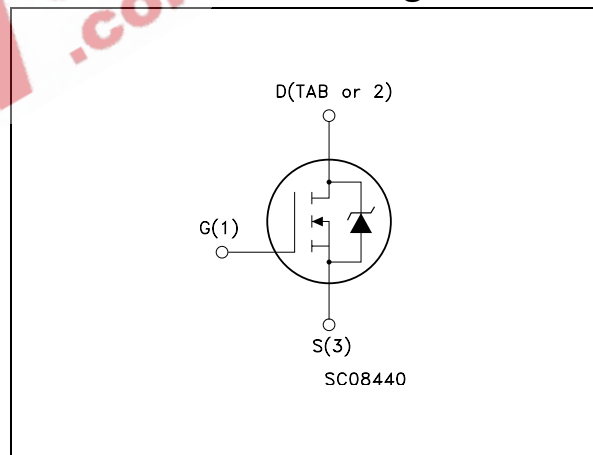
- Standard threshold drive
- 100% avalanche tested



Description

This n-channel enhancement mode Power MOSFET is the latest refinement of STMicroelectronics' unique "Single Feature Size™" strip-based process, which has decreased the critical alignment steps, offering remarkable manufacturing reproducibility. The outcome is a transistor with extremely high packing density for low onresistance, rugged avalanche characteristics and low gate charge.

Internal schematic diagram



Applications

- Switching application

Order codes

| Part number | Marking | Package | Packaging |
|-------------|---------|--------------------|-------------|
| STB60N55F3 | 60N55F3 | D ² PAK | Tape & reel |
| STD60N55F3 | 60N55F3 | DPAK | Tape & reel |
| STF60N55F3 | 60N55F3 | TO-220FP | Tube |
| STP60N55F3 | 60N55F3 | TO-220 | Tube |
| STU60N55F3 | 60N55F3 | IPAK | Tube |

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1 Electrical ratings

Table 1. Absolute maximum ratings

| Symbol | Parameter | Value | | Unit |
|------------------------------------|--|--|----------|------|
| | | DPAK/D ² PAK TO-220/IPAK | TO-220FP | |
| V _{DS} | Drain-source voltage (V _{GS} =0) | 55 | | V |
| V _{GS} | Gate-source voltage | ± 20 | | V |
| I _D | Drain current (continuous) at T _C = 25°C | 80 | 42 | A |
| I _D | Drain current (continuous) at T _C = 100°C | 56 | 30 | A |
| I _{DM} ⁽¹⁾ | Drain current (pulsed) | 320 | 168 | A |
| P _{TOT} | Total dissipation at T _C = 25°C | 110 | 30 | W |
| | Derating factor | 0.73 | 0.2 | W/°C |
| dv/dt ⁽²⁾ | Peak diode recovery voltage slope | 11 | | V/ns |
| E _{AS} ⁽³⁾ | Single pulse avalanche energy | 390 | | mJ |
| V _{ISO} | Insulation withstand voltage (RMS) from all three leads to external heat sink (t=1s; T _C =25°C) | -- | 2500 | V |
| T _j T _{stg} | Operating junction temperature Storage temperature | -55 to 175 | | °C |

1. Pulse width limited by safe operating area
2. I_{SD} ≤ 80A, di/dt ≤ 300A/μs, V_{DD} ≤ V_{(BR)DSS}, T_j ≤ T_{jmax}
3. Starting T_j=25°C, I_d=32A, V_{dd}=25V

Table 2. Thermal resistance

| Symbol | Parameter | Value | | | | | Unit |
|-------------------------------------|--|-------|------|--------------------|--------|----------|------|
| | | DPAK | IPAK | D ² PAK | TO-220 | TO-220FP | |
| R _{thj-case} | Thermal resistance junction-case max | 1.36 | | | 5 | °C/W | |
| R _{thj-pcb} ⁽¹⁾ | Thermal resistance junction-pcb max | 50 | -- | 35 | -- | -- | °C/W |
| R _{thj-a} | Thermal resistance junction-ambient max | -- | 100 | -- | 62.5 | | °C/W |
| T _l | Maximum lead temperature for soldering purpose | -- | 275 | -- | 300 | | °C |

1. When mounted on FR-4 board of 1inch², 2oz Cu

2 Electrical characteristics

(T_{CASE}=25°C unless otherwise specified)

Table 3. Static

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|----------------------|---|---|------|------|-----------|----------|
| V _{(BR)DSS} | Drain-source breakdown voltage | I _D = 250μA, V _{GS} = 0 | 55 | | | V |
| I _{DSS} | Zero gate voltage drain current (V _{GS} = 0) | V _{DS} = Max rating, V _{DS} = Max rating, T _c = 125°C | | | 10 100 | μA μA |
| I _{GSS} | Gate body leakage current (V _{DS} = 0) | V _{GS} = ±20V | | | ±200 | nA |
| V _{GS(th)} | Gate threshold voltage | V _{DS} = V _{GS} , I _D = 250μA | 2 | | 4 | V |
| R _{DS(on)} | Static drain-source on resistance | V _{GS} = 10V, I _D = 32A | | 6.5 | 8.5 | mΩ |

Table 4. Dynamic

| Symbol | Parameter | Test conditions | Min | Typ. | Max. | Unit |
|--------------------------------|------------------------------|--|-----|------|------|------|
| g _{fs} ⁽¹⁾ | Forward transconductance | V _{DS} = 25V, I _D = 32A | | 50 | | S |
| C _{iss} | Input capacitance | V _{DS} = 25V, f = 1MHz, V _{GS} = 0 | | 2200 | | pF |
| C _{oss} | Output capacitance | | | 500 | | pF |
| C _{rss} | Reverse transfer capacitance | | | 25 | | pF |
| Q _g | Total gate charge | V _{DD} = 27V, I _D = 65A | | 33.5 | 45 | nC |
| Q _{gs} | Gate-source charge | V _{GS} = 10V | | 12.5 | | nC |
| Q _{gd} | Gate-drain charge | (see Figure 15) | | 9.5 | | nC |

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

Table 5. Switching on/off (inductive load)

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|-----------------------|----------------------------------|---|------|------------|------|----------|
| $t_{d(on)}$ t_r | Turn-on delay time Rise time | $V_{DD} = 27V, I_D = 32A,$ $R_G = 4.7\Omega, V_{GS} = 10V$ <i>(see Figure 17)</i> | | 20 50 | | ns ns |
| $t_{d(off)}$ t_f | Turn-off delay time Fall time | $V_{DD} = 27V, I_D = 32A,$ $R_G = 4.7\Omega, V_{GS} = 10V$ <i>(see Figure 17)</i> | | 35 11.5 | | ns ns |

Table 6. Source drain diode

| Symbol | Parameter | Test conditions | Packages | Min. | Typ. | Max. | Unit |
|-----------------------------------|--|---|---|------|-----------------|-----------|---------------|
| I_{SD} $I_{SDM}^{(1)}$ | Source-drain current Source-drain current (pulsed) | | DPAK-D ² PAK- I ² PAK-TO-220 | | | 80 320 | A A |
| I_{SD} $I_{SDM}^{(1)}$ | Source-drain current Source-drain current (pulsed) | | TO-220FP | | | 42 168 | A A |
| V_{SD} | Forward on voltage | $I_{SD} = 65A, V_{GS} = 0$ | | | | 1.5 | V |
| t_{rr} Q_{rr} I_{RRM} | Reverse recovery time Reverse recovery charge Reverse recovery current | $I_{SD} = 65A, V_{DD} = 30V,$ $di/dt = 100A/\mu s,$ $T_j = 150^\circ C$ <i>(see Figure 16)</i> | | | 47 87 3.7 | | ns nC A |

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

2.1 Electrical characteristics (curves)

Figure 1. Safe operating area for TO-220 D²PAK / IPAK / DPAK

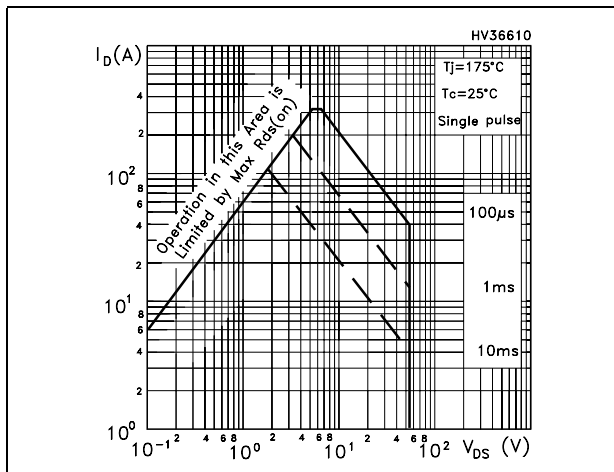


Figure 2. Thermal impedance for TO-220 D²PAK / IPAK / DPAK

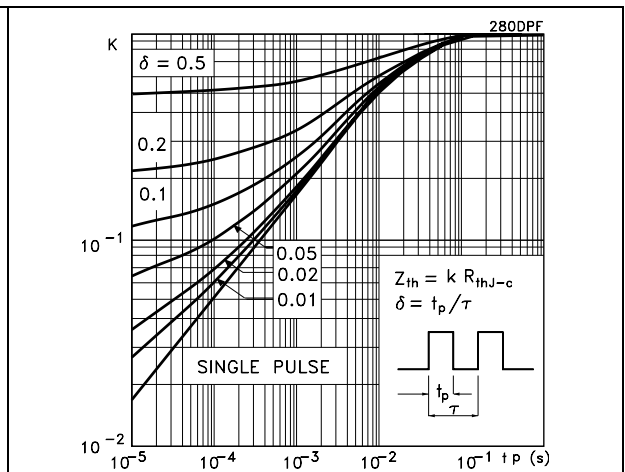


Figure 3. Safe operating area for TO-220FP

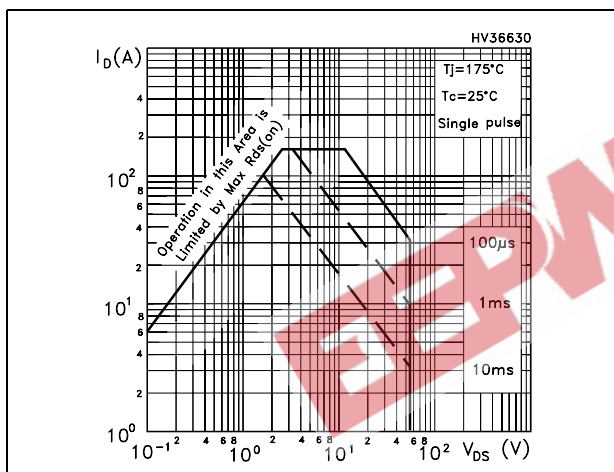


Figure 4. Thermal impedance for TO-220FP

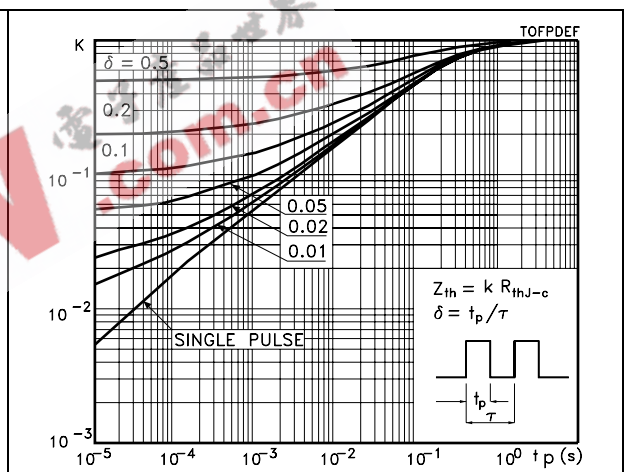


Figure 5. Output characteristics

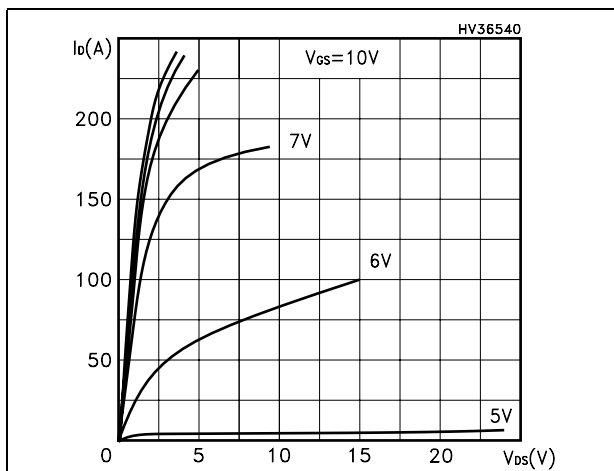


Figure 6. Transfer characteristics

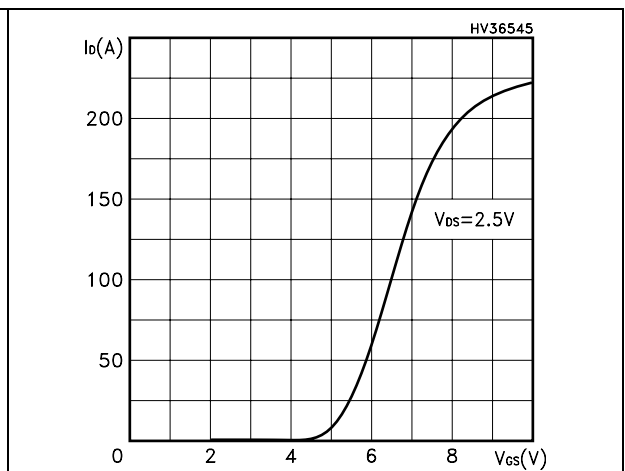


Figure 7. Normalized BV_{DSS} vs temperature Figure 8. Static drain-source on resistance

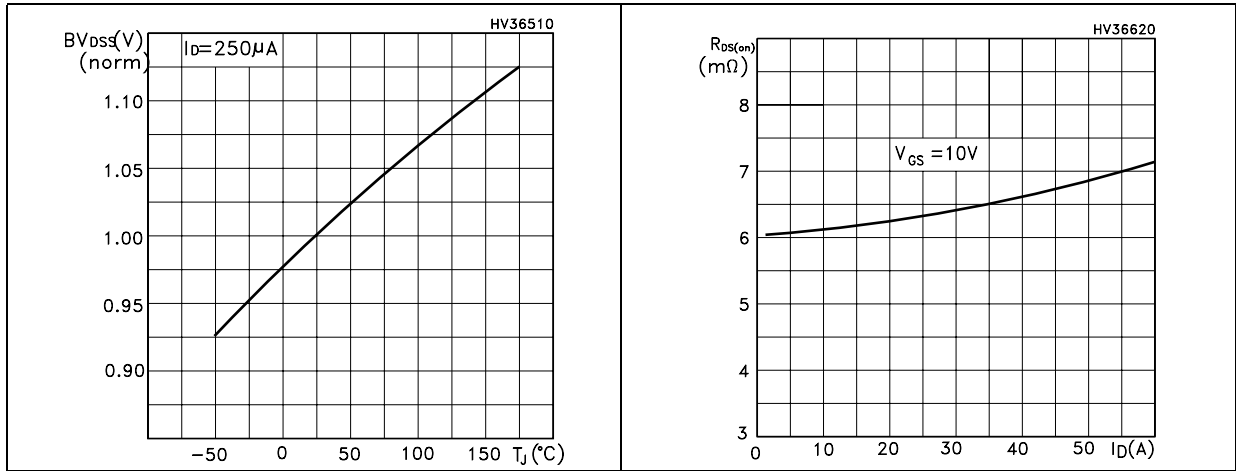


Figure 9. Gate charge vs gate-source voltage Figure 10. Capacitance variations

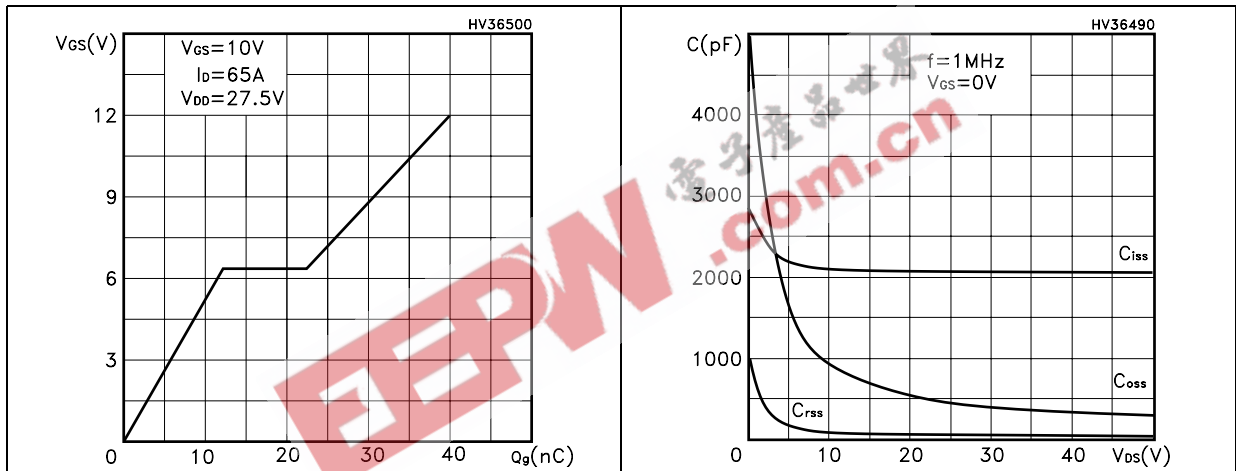


Figure 11. Normalized gate threshold voltage vs temperature Figure 12. Normalized on resistance vs temperature

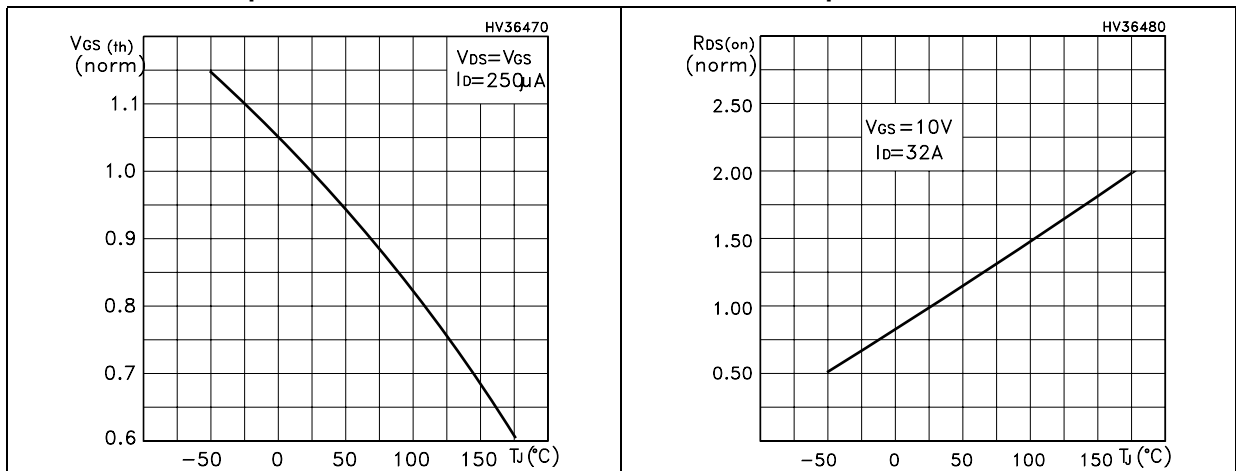
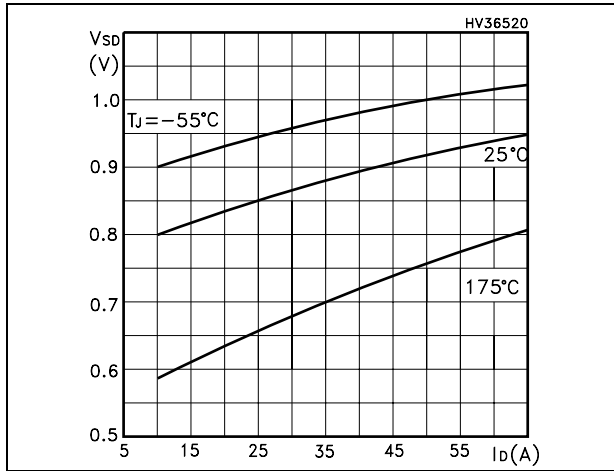


Figure 13. Source-drain diode forward characteristics



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3 Test circuit

Figure 14. Switching times test circuit for resistive load

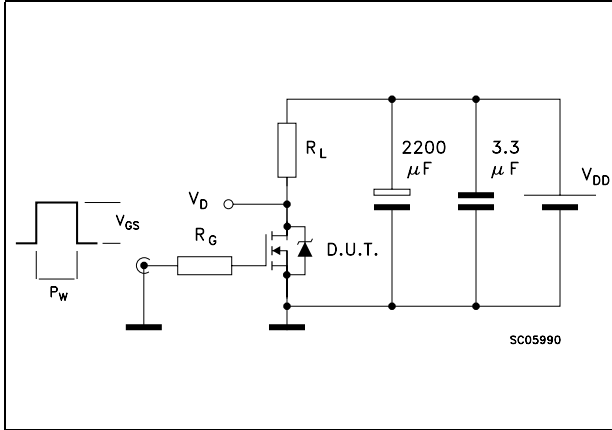


Figure 15. Gate charge test circuit

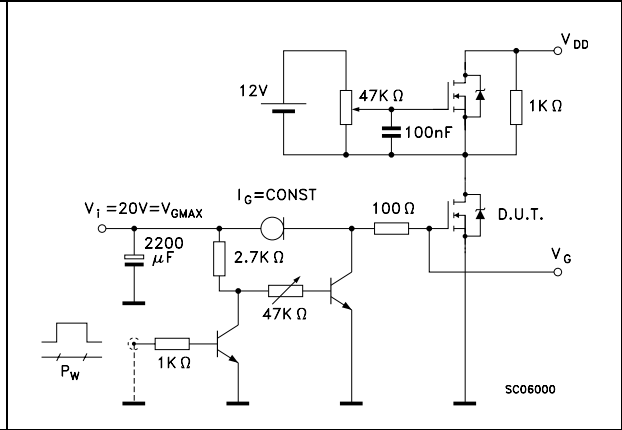


Figure 16. Test circuit for inductive load switching and diode recovery times

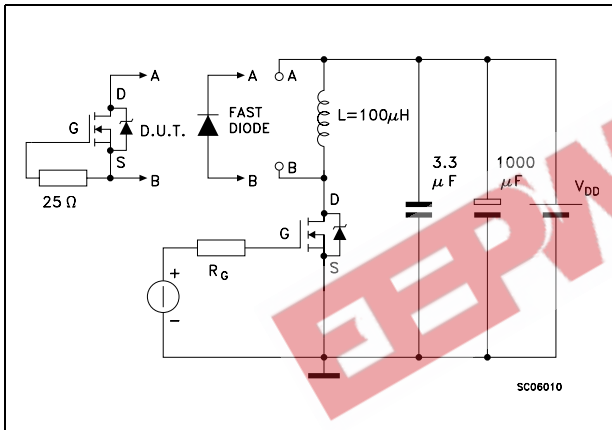


Figure 17. Unclamped Inductive load test circuit

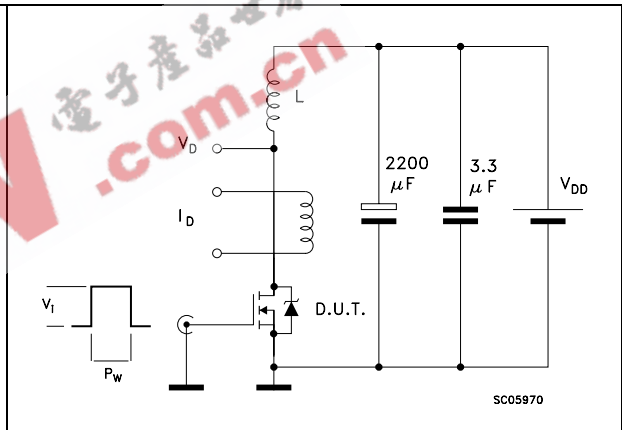


Figure 18. Unclamped inductive waveform

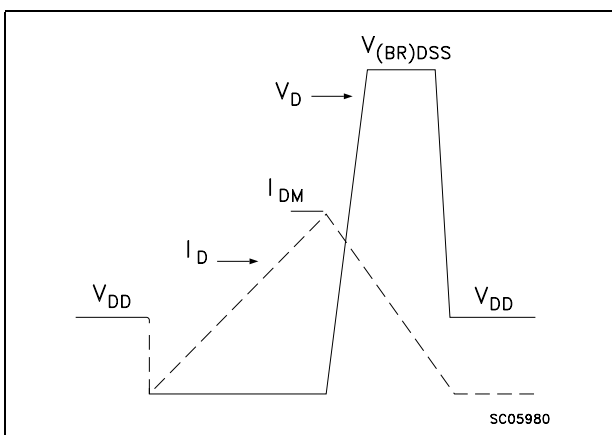
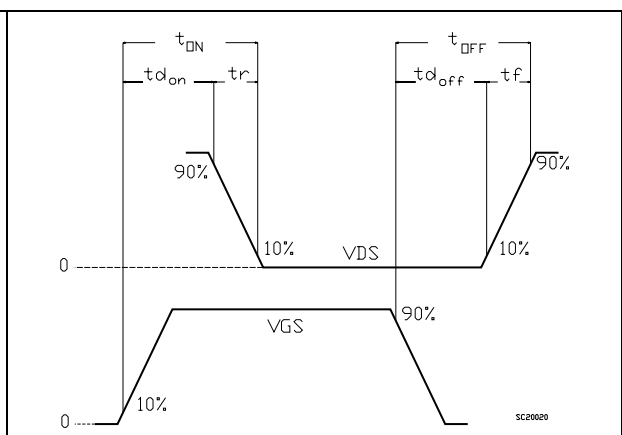


Figure 19. Switching time waveform



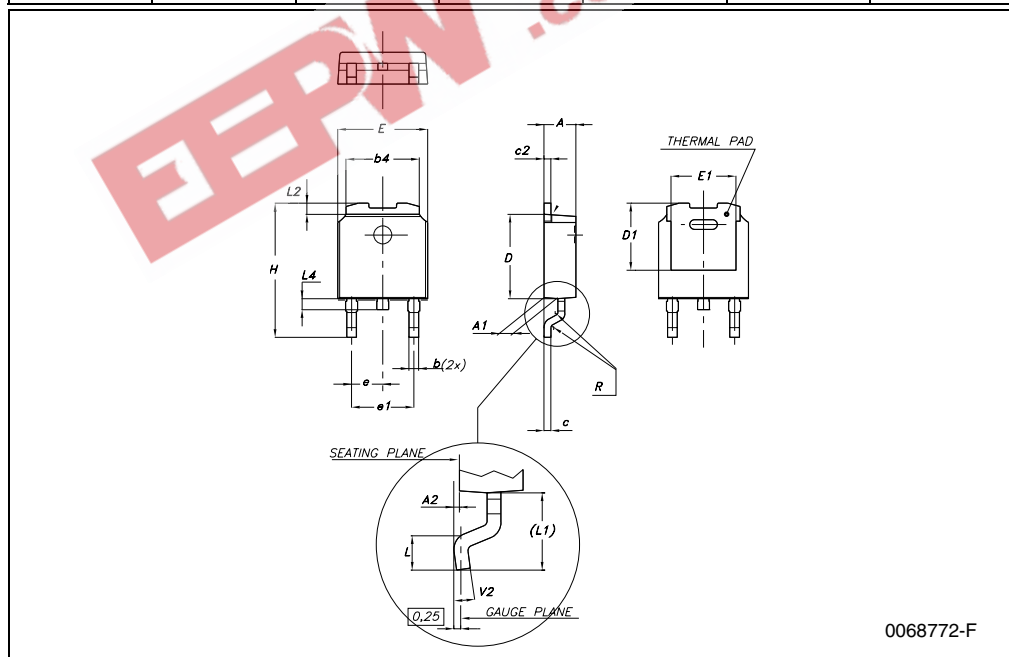
4 Package mechanical data

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

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DPAK MECHANICAL DATA

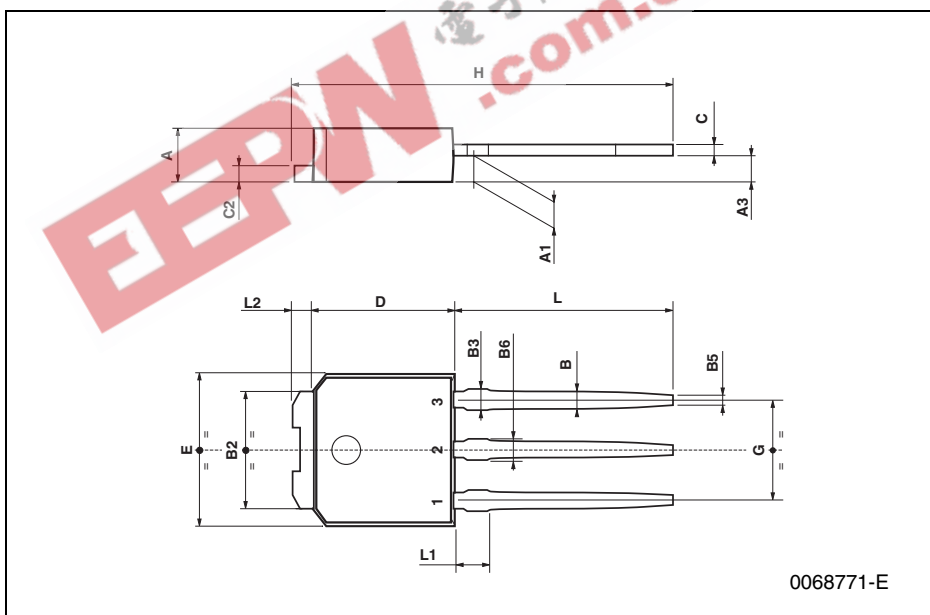
| DIM. | mm. | | | inch | | |
|------|------|------|------|-------|-------|-------|
| | MIN. | TYP | MAX. | MIN. | TYP. | MAX. |
| A | 2.2 | | 2.4 | 0.086 | | 0.094 |
| A1 | 0.9 | | 1.1 | 0.035 | | 0.043 |
| A2 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| B | 0.64 | | 0.9 | 0.025 | | 0.035 |
| b4 | 5.2 | | 5.4 | 0.204 | | 0.212 |
| C | 0.45 | | 0.6 | 0.017 | | 0.023 |
| C2 | 0.48 | | 0.6 | 0.019 | | 0.023 |
| D | 6 | | 6.2 | 0.236 | | 0.244 |
| D1 | | 5.1 | | | 0.200 | |
| E | 6.4 | | 6.6 | 0.252 | | 0.260 |
| E1 | | 4.7 | | | 0.185 | |
| e | | 2.28 | | | 0.090 | |
| e1 | 4.4 | | 4.6 | 0.173 | | 0.181 |
| H | 9.35 | | 10.1 | 0.368 | | 0.397 |
| L | 1 | | | 0.039 | | |
| (L1) | | 2.8 | | | 0.110 | |
| L2 | | 0.8 | | | 0.031 | |
| L4 | 0.6 | | 1 | 0.023 | | 0.039 |
| R | | 0.2 | | | 0.008 | |
| V2 | 0° | | 8° | 0° | | 8° |



0068772-F

TO-251 (IPAK) MECHANICAL DATA

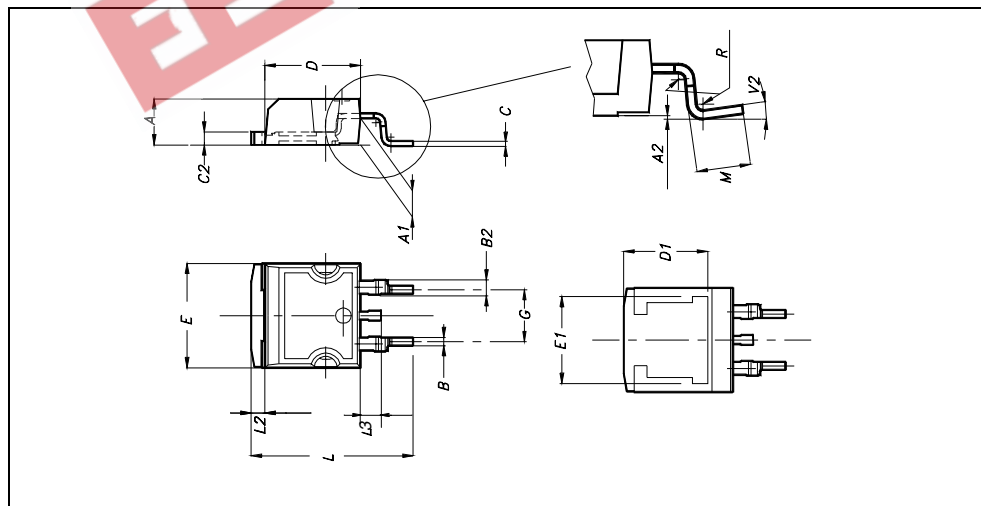
| DIM. | mm | | | inch | | |
|------|------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 2.2 | | 2.4 | 0.086 | | 0.094 |
| A1 | 0.9 | | 1.1 | 0.035 | | 0.043 |
| A3 | 0.7 | | 1.3 | 0.027 | | 0.051 |
| B | 0.64 | | 0.9 | 0.025 | | 0.031 |
| B2 | 5.2 | | 5.4 | 0.204 | | 0.212 |
| B3 | | | 0.85 | | | 0.033 |
| B5 | | 0.3 | | | 0.012 | |
| B6 | | | 0.95 | | | 0.037 |
| C | 0.45 | | 0.6 | 0.017 | | 0.023 |
| C2 | 0.48 | | 0.6 | 0.019 | | 0.023 |
| D | 6 | | 6.2 | 0.236 | | 0.244 |
| E | 6.4 | | 6.6 | 0.252 | | 0.260 |
| G | 4.4 | | 4.6 | 0.173 | | 0.181 |
| H | 15.9 | | 16.3 | 0.626 | | 0.641 |
| L | 9 | | 9.4 | 0.354 | | 0.370 |
| L1 | 0.8 | | 1.2 | 0.031 | | 0.047 |
| L2 | | 0.8 | 1 | | 0.031 | 0.039 |



0068771-E

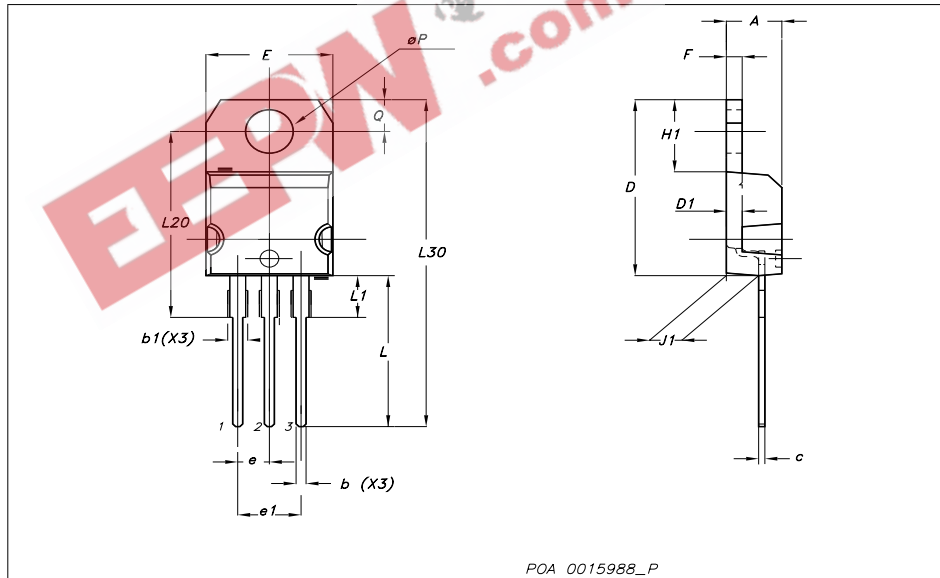
D²PAK MECHANICAL DATA

| 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° | | 4° | | | |



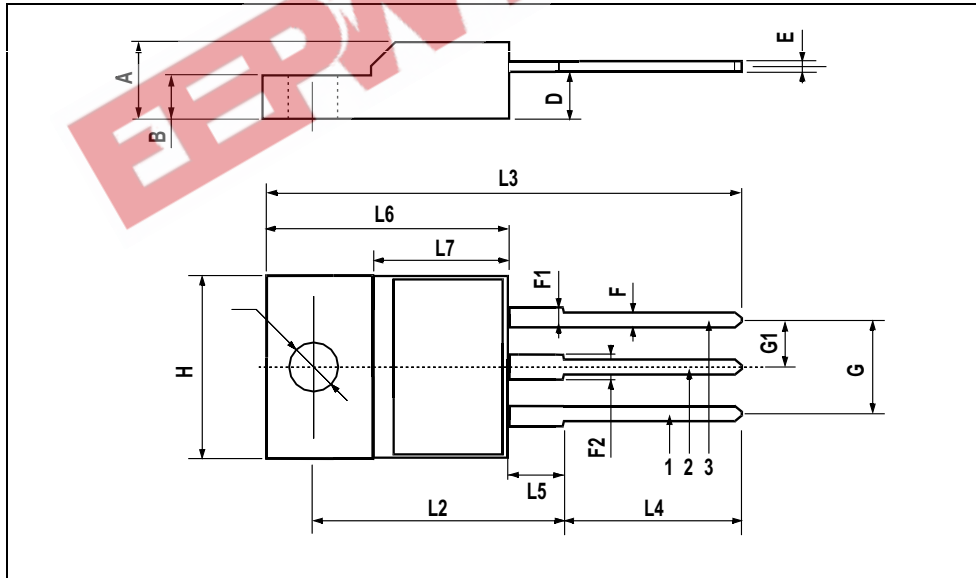
TO-220 mechanical data

| 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 | 1.14 | | 1.70 | 0.044 | | 0.066 |
| c | 0.49 | | 0.70 | 0.019 | | 0.027 |
| D | 15.25 | | 15.75 | 0.6 | | 0.62 |
| D1 | | 1.27 | | | 0.050 | |
| 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 | | 0.051 |
| 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 | |
| θP | 3.75 | | 3.85 | 0.147 | | 0.151 |
| Q | 2.65 | | 2.95 | 0.104 | | 0.116 |



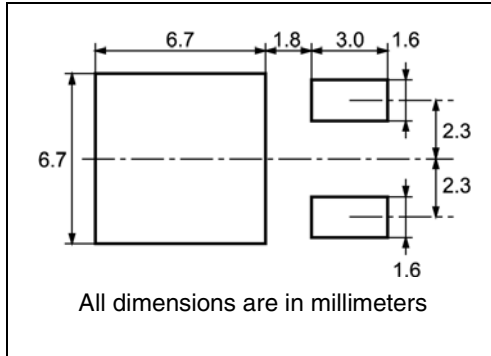
TO-220FP MECHANICAL DATA

| 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 |



5 Packaging mechanical data

DPAK FOOTPRINT



TAPE AND REEL SHIPMENT

40 mm min. Access hole at slot location

Full radius

Tape slot in core for tape start 2.5mm min. width

G measured at hub

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 | 16.4 | 18.4 | 0.645 | 0.724 |
| N | 50 | | 1.968 | |
| T | | 22.4 | | 0.881 |

| BASE QTY | BULK QTY |
|----------|----------|
| 2500 | 2500 |

TAPE MECHANICAL DATA

| DIM. | mm | | inch | |
|------|------|------|-------|-------|
| | MIN. | MAX. | MIN. | MAX. |
| A0 | 6.8 | 7 | 0.267 | 0.275 |
| B0 | 10.4 | 10.6 | 0.409 | 0.417 |
| B1 | | 12.1 | | 0.476 |
| D | 1.5 | 1.6 | 0.059 | 0.063 |
| D1 | 1.5 | | 0.059 | |
| E | 1.65 | 1.85 | 0.065 | 0.073 |
| F | 7.4 | 7.6 | 0.291 | 0.299 |
| K0 | 2.55 | 2.75 | 0.100 | 0.108 |
| P0 | 3.9 | 4.1 | 0.153 | 0.161 |
| P1 | 7.9 | 8.1 | 0.311 | 0.319 |
| P2 | 1.9 | 2.1 | 0.075 | 0.082 |
| R | 40 | | 1.574 | |
| W | 15.7 | 16.3 | 0.618 | 0.641 |

TOP COVER TAPE

Center line of cavity

User Direction of Feed

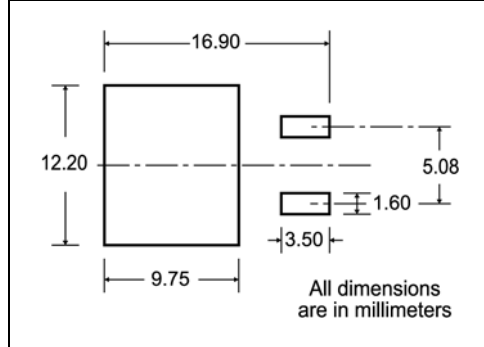
FEED DIRECTION

Bending radius R min.

For machine ref. only including draft and radii concentric around B0

10 pitches cumulative tolerance on tape +/- 0.2 mm

D²PAK FOOTPRINT



TAPE AND REEL SHIPMENT

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 |

TR

* on sales type

6 Revision history

Table 7. Revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 09-Feb-2007 | 1 | First release |
| 22-Feb-2007 | 2 | Description has been updated |
| 07-Mar-2007 | 3 | The Figure 1 , Figure 3 , Figure 8 has been changed |

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