

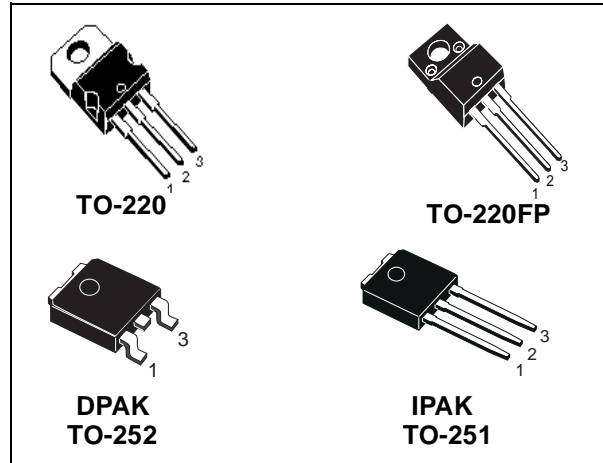


STP8NM60, STP8NM60FP STD5NM60, STD5NM60-1

N-CHANNEL 600V - 0.9Ω - 8A TO-220/TO-220FP/DPAK/IPAK
MDmesh™ Power MOSFET

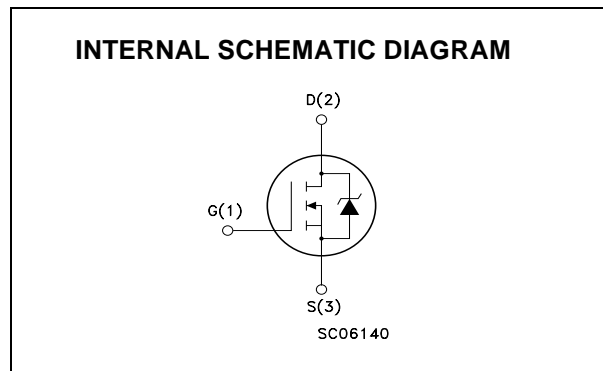
| TYPE | V _{DSS} | R _{DS(on)} | I _D | P _w |
|------------|------------------|---------------------|----------------|----------------|
| STP8NM60 | 600 V | < 1 Ω | 8 A | 100 W |
| STP8NM60FP | 600 V | < 1 Ω | 8 A(*) | 30 W |
| STD5NM60 | 600 V | < 1 Ω | 5 A | 96 W |
| STD5NM60-1 | 600 V | < 1 Ω | 5 A | 96 W |

- TYPICAL R_{DS(on)} = 0.9Ω
- HIGH dv/dt AND AVALANCHE CAPABILITIES
- 100% AVALANCHE TESTED
- LOW INPUT CAPACITANCE AND GATE CHARGE
- LOW GATE INPUT RESISTANCE



DESCRIPTION

The MDmesh™ is a new revolutionary MOSFET technology that associates the Multiple Drain process with the Company's PowerMESH™ horizontal layout. The resulting product has an outstanding low on-resistance, impressively high dv/dt and excellent avalanche characteristics. The adoption of the Company's proprietary strip technique yields overall dynamic performance that is significantly better than that of similar competition's products.



APPLICATIONS

The MDmesh™ family is very suitable for increase the power density of high voltage converters allowing system miniaturization and higher efficiencies.

ORDERING INFORMATION

| SALES TYPE | MARKING | PACKAGE | PACKAGING |
|------------|----------|----------|-------------|
| STP8NM60 | P8NM60 | TO-220 | TUBE |
| STP8NM60FP | P8NM60FP | TO-220FP | TUBE |
| STD5NM60T4 | D5NM60 | DPAK | TAPE & REEL |
| STD5NM60-1 | D5NM60 | IPAK | TUBE |

STP8NM60, STP8NM60FP, STD5NM60, STD5NM60-1

ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | | | Unit |
|--------------------|---|------------|------------|------------------------|--------------------------------------|
| | | STP8NM60 | STP8NM60FP | STD5NM60 STD5NM60-1 | |
| V_{DS} | Drain-source Voltage ($V_{GS} = 0$) | 600 | | | V |
| V_{DGR} | Drain-gate Voltage ($R_{GS} = 20\text{ k}\Omega$) | 600 | | | V |
| V_{GS} | Gate- source Voltage | ± 30 | | | V |
| I_D | Drain Current (continuous) at $T_C = 25^\circ\text{C}$ | 8 | 8 (*) | 5 | A |
| I_D | Drain Current (continuous) at $T_C = 100^\circ\text{C}$ | 5 | 5 (*) | 3.1 | A |
| $I_{DM}(\bullet)$ | Drain Current (pulsed) | 32 | 32 (*) | 20 | A |
| P_{TOT} | Total Dissipation at $T_C = 25^\circ\text{C}$ | 100 | 30 | 96 | W |
| | Derating Factor | 0.8 | 0.24 | 0.4 | W/ $^\circ\text{C}$ |
| dv/dt (1) | Peak Diode Recovery voltage slope | 15 | 15 | 15 | V/ns |
| V_{ISO} | Insulation Withstand Voltage (DC) | - | 2500 | - | V |
| T_j T_{stg} | Operating Junction Temperature Storage Temperature | -55 to 150 | | | $^\circ\text{C}$ $^\circ\text{C}$ |

(●) Pulse width limited by safe operating area

(1) $I_{SD} \leq 5\text{A}$, $di/dt \leq 400\text{A}/\mu\text{s}$, $V_{DD} \leq V_{(BR)DSS}$, $T_j \leq T_{JMAX}$.

(*) Limited only by maximum temperature allowed

THERMAL DATA

| | | TO-220 | TO-220FP | DPAK IPAK | |
|-----------|--|--------|----------|--------------|---------------------------|
| Rthj-case | Thermal Resistance Junction-case Max | 1.25 | 4.16 | 1.3 | $^\circ\text{C}/\text{W}$ |
| Rthj-amb | Thermal Resistance Junction-ambient Max | 62.5 | | | $^\circ\text{C}/\text{W}$ |
| T_I | Maximum Lead Temperature For Soldering Purpose | 300 | | | $^\circ\text{C}$ |

AVALANCHE CHARACTERISTICS

| Symbol | Parameter | Max Value | Unit |
|----------|---|-----------|------|
| I_{AR} | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T_j max) | 2.5 | A |
| E_{AS} | Single Pulse Avalanche Energy (starting $T_j = 25^\circ\text{C}$, $I_D = I_{AR}$, $V_{DD} = 50\text{ V}$) | 200 | mJ |

ELECTRICAL CHARACTERISTICS ($T_{CASE} = 25^\circ\text{C}$ UNLESS OTHERWISE SPECIFIED)

ON/OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|---------------|--|--|------|------|-----------|--------------------------------|
| $V_{(BR)DSS}$ | Drain-source Breakdown Voltage | $I_D = 250\ \mu\text{A}$, $V_{GS} = 0$ | 600 | | | V |
| I_{DSS} | Zero Gate Voltage Drain Current ($V_{GS} = 0$) | $V_{DS} = \text{Max Rating}$ $V_{DS} = \text{Max Rating}$, $T_C = 125^\circ\text{C}$ | | | 1 10 | μA μA |
| I_{GSS} | Gate-body Leakage Current ($V_{DS} = 0$) | $V_{GS} = \pm 30\text{V}$ | | | ± 100 | nA |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{DS} = V_{GS}$, $I_D = 250\ \mu\text{A}$ | 3 | 4 | 5 | V |
| $R_{DS(on)}$ | Static Drain-source On Resistance | $V_{GS} = 10\text{V}$, $I_D = 2.5\text{ A}$ | | 0.9 | 1 | Ω |

STP8NM60, STP8NM60FP, STD5NM60, STD5NM60-1

ELECTRICAL CHARACTERISTICS ($T_{CASE} = 25^{\circ}C$ UNLESS OTHERWISE SPECIFIED) DYNAMIC

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------------|--|--|------|------------------|------|----------------|
| g_{fs} (1) | Forward Transconductance | $V_{DS} = I_{D(on)} \times R_{DS(on)max}$, $I_D = 2.5A$ | | 2.4 | | S |
| C_{iss} C_{oss} C_{rss} | Input Capacitance Output Capacitance Reverse Transfer Capacitance | $V_{DS} = 25V$, $f = 1$ MHz, $V_{GS} = 0$ | | 440 100 10 | | pF pF pF |
| C_{oss} eq. (2) | Equivalent Output Capacitance | $V_{GS} = 0V$, $V_{DS} = 0V$ to 480V | | 50 | | pF |
| R_G | Gate Input Resistance | $f=1$ MHz Gate DC Bias = 0 Test Signal Level = 20mV Open Drain | | 4 | | Ω |

SWITCHING ON

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-------------------------------|--|--|------|--------------|------|----------------|
| $t_{d(on)}$ t_r | Turn-on Delay Time Rise Time | $V_{DD} = 300$ V, $I_D = 2.5$ A $R_G = 4.7\Omega$ $V_{GS} = 10$ V (Resistive Load see, Figure 3) | | 14 10 | | ns ns |
| Q_g Q_{gs} Q_{gd} | Total Gate Charge Gate-Source Charge Gate-Drain Charge | $V_{DD} = 400V$, $I_D = 5$ A, $V_{GS} = 10V$ | | 13 5 6 | 18 | nC nC nC |

SWITCHING OFF

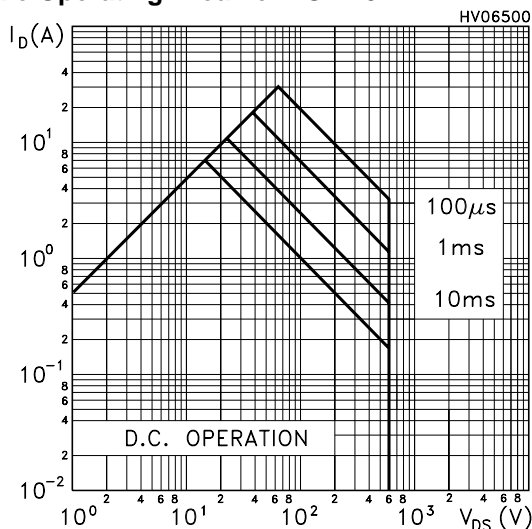
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|----------------------------------|---|--|------|---------------|------|----------------|
| $t_{d(off)}$ t_f | Turn-off Delay Time Fall Time | $V_{DD} = 300$ V, $I_D = 2.5$ A $R_G = 4.7\Omega$ $V_{GS} = 10$ V (Resistive Load see, Figure 3) | | 23 10 | | ns ns |
| $t_r(V_{off})$ t_f t_c | Off-voltage Rise Time Fall Time Cross-over Time | $V_{DD} = 480V$, $I_D = 5$ A, $R_G = 4.7\Omega$, $V_{GS} = 10V$ (Inductive Load see, Figure 5) | | 7 10 17 | | ns ns ns |

SOURCE DRAIN DIODE

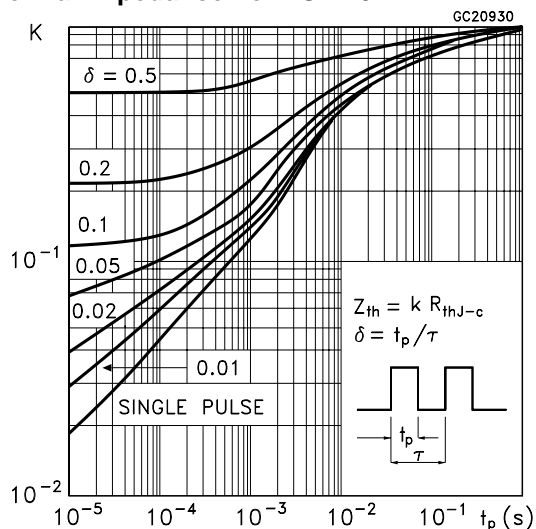
| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
|-----------------------------------|--|--|------|---------------------|---------|--------------------|
| I_{SD} I_{SDM} (2) | Source-drain Current Source-drain Current (pulsed) | | | | 8 32 | A A |
| V_{SD} (1) | Forward On Voltage | $I_{SD} = 5$ A, $V_{GS} = 0$ | | | 1.5 | V |
| t_{rr} Q_{rr} I_{RRM} | Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current | $I_{SD} = 5$ A, $di/dt = 100A/\mu s$ $V_{DD} = 100$ V, $T_j = 25^{\circ}C$ (see test circuit, Figure 5) | | 300 1950 13 | | ns μC A |
| t_{rr} Q_{rr} I_{RRM} | Reverse Recovery Time Reverse Recovery Charge Reverse Recovery Current | $I_{SD} = 5$ A, $di/dt = 100A/\mu s$ $V_{DD} = 100$ V, $T_j = 150^{\circ}C$ (see test circuit, Figure 5) | | 445 3005 13.5 | | ns μC A |

Note: 1. Pulsed: Pulse duration = 300 μs , duty cycle 1.5 %.
2. Pulse width limited by safe operating area.

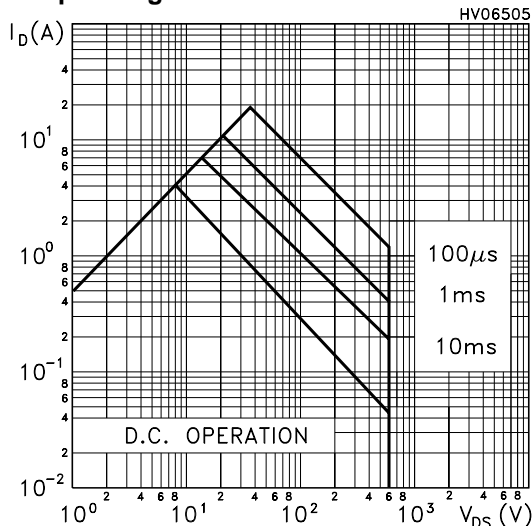
Safe Operating Area For TO-220



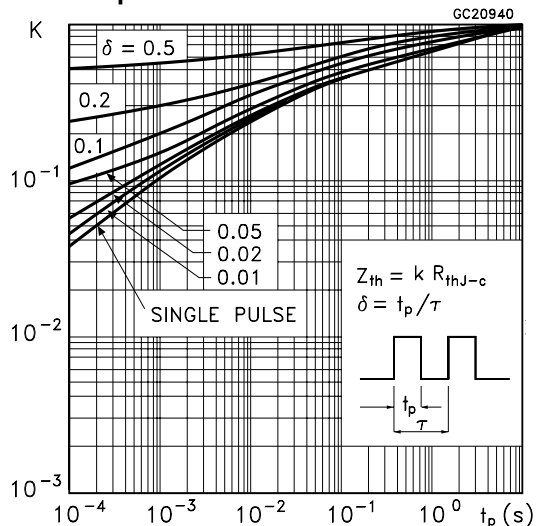
Thermal Impedance For TO-220



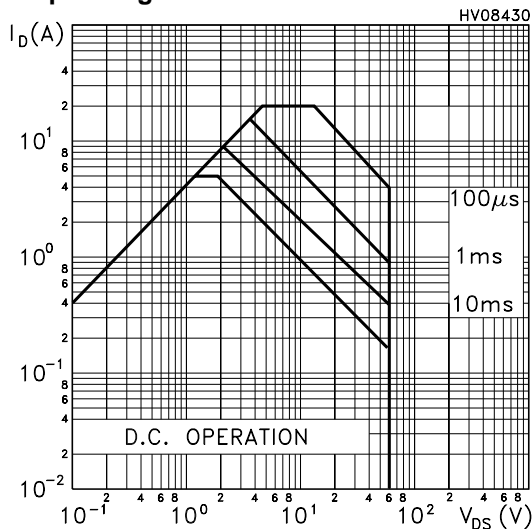
Safe Operating Area For TO-220FP



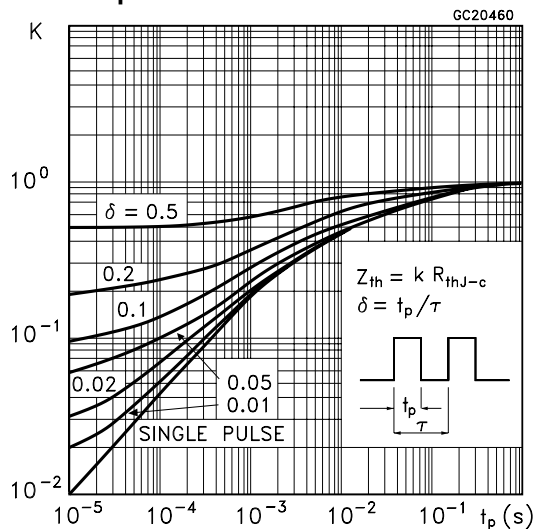
Thermal Impedance For TO-220FP



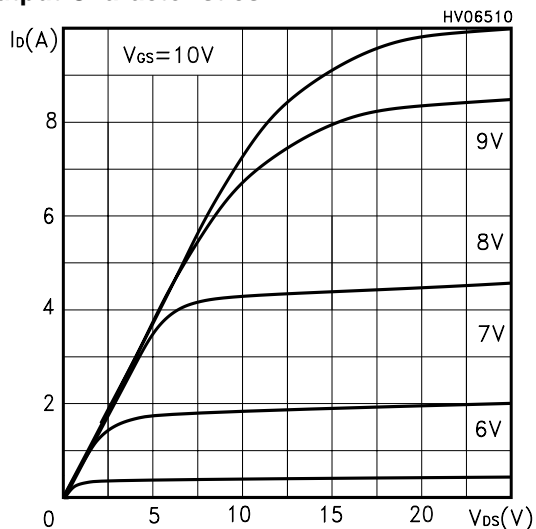
Safe Operating Area For DPAK/IPAK



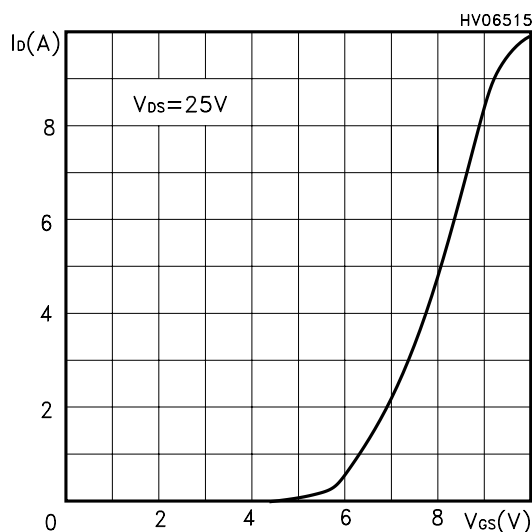
Thermal Impedance For DPAK/IPAK



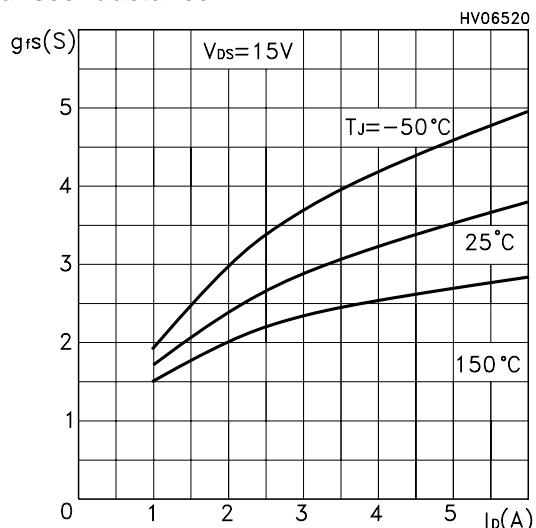
Output Characteristics



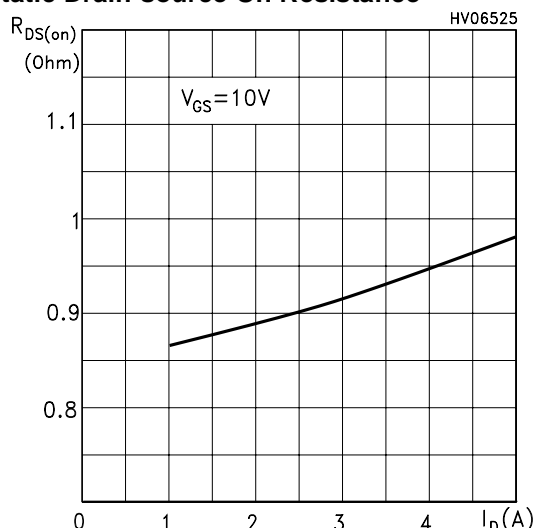
Transfer Characteristics



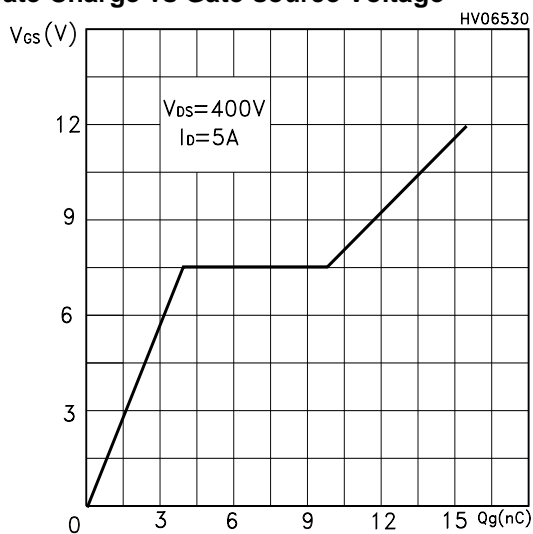
Transconductance



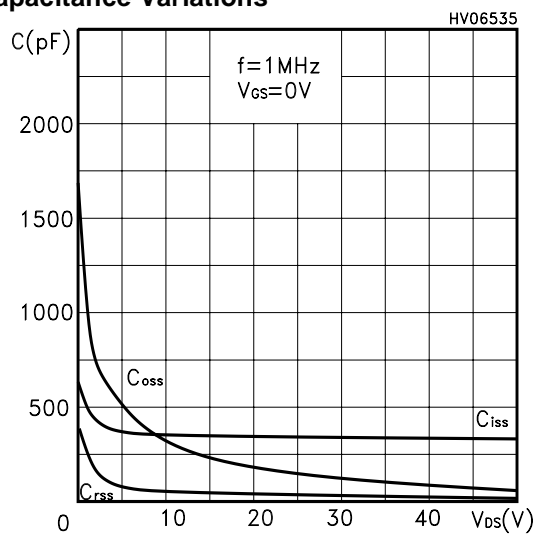
Static Drain-source On Resistance



Gate Charge vs Gate-source Voltage

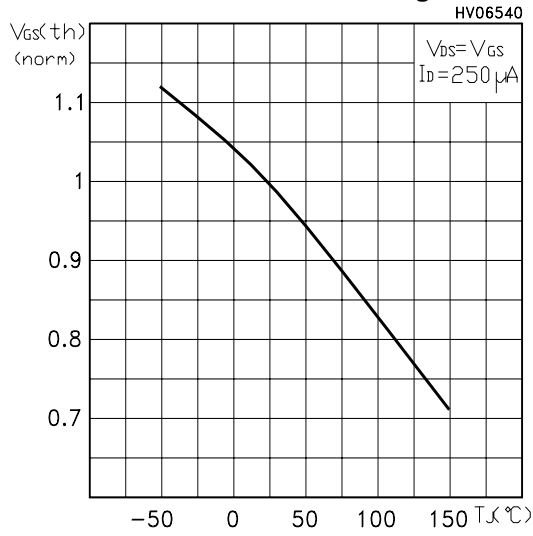


Capacitance Variations

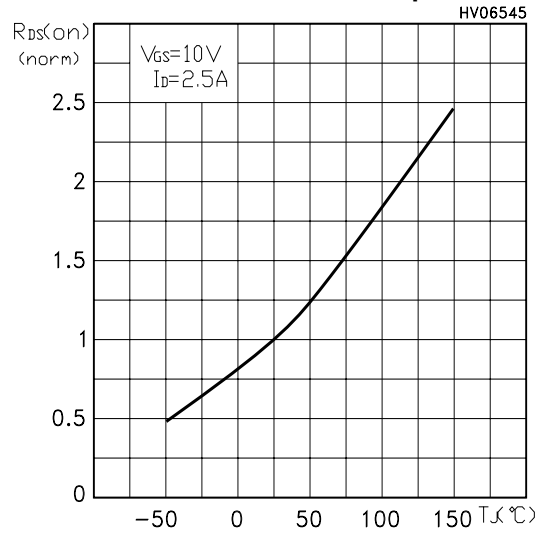


STP8NM60, STP8NM60FP, STD5NM60, STD5NM60-1

Normalized Gate Threshold Voltage vs Temp.



Normalized On Resistance vs Temperature



Source-drain Diode Forward Characteristics

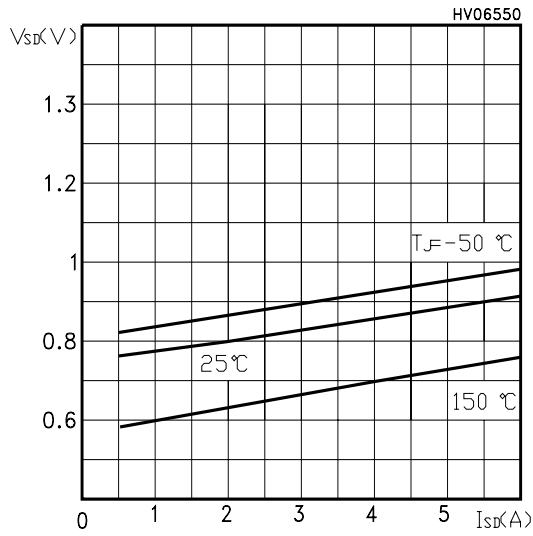


Fig. 1: Unclamped Inductive Load Test Circuit

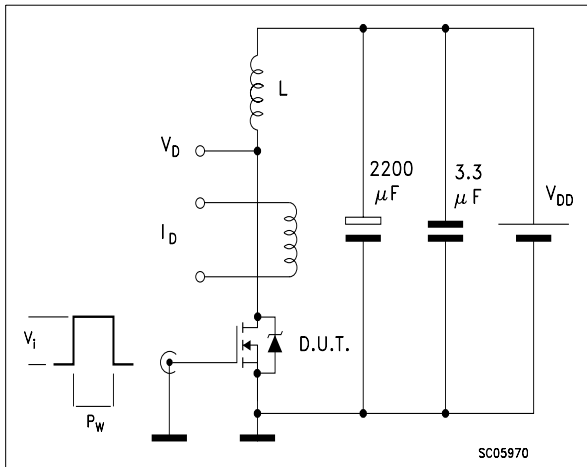


Fig. 2: Unclamped Inductive Waveform

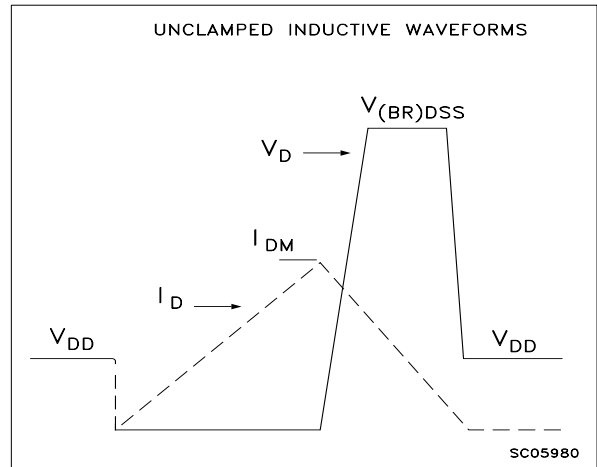


Fig. 3: Switching Times Test Circuit For Resistive Load

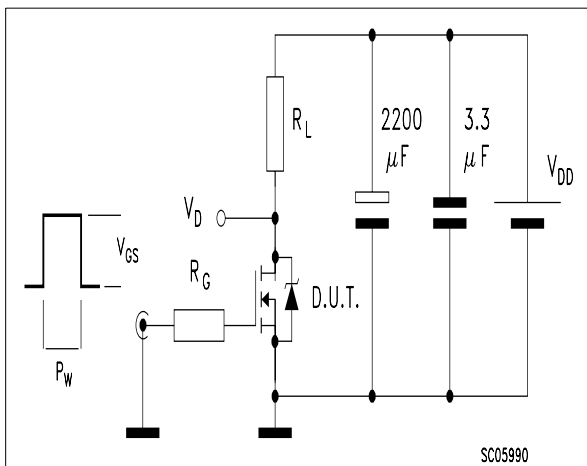


Fig. 4: Gate Charge test Circuit

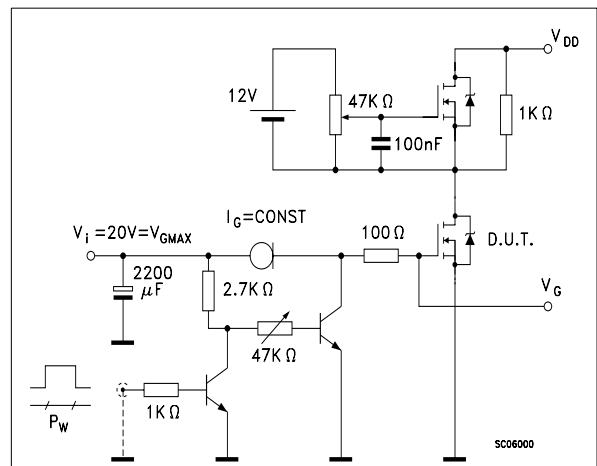
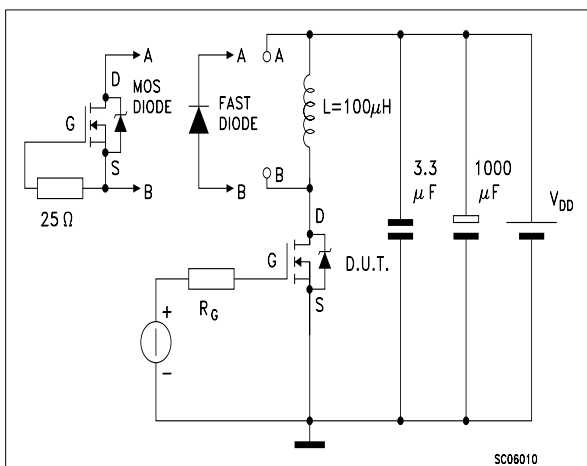
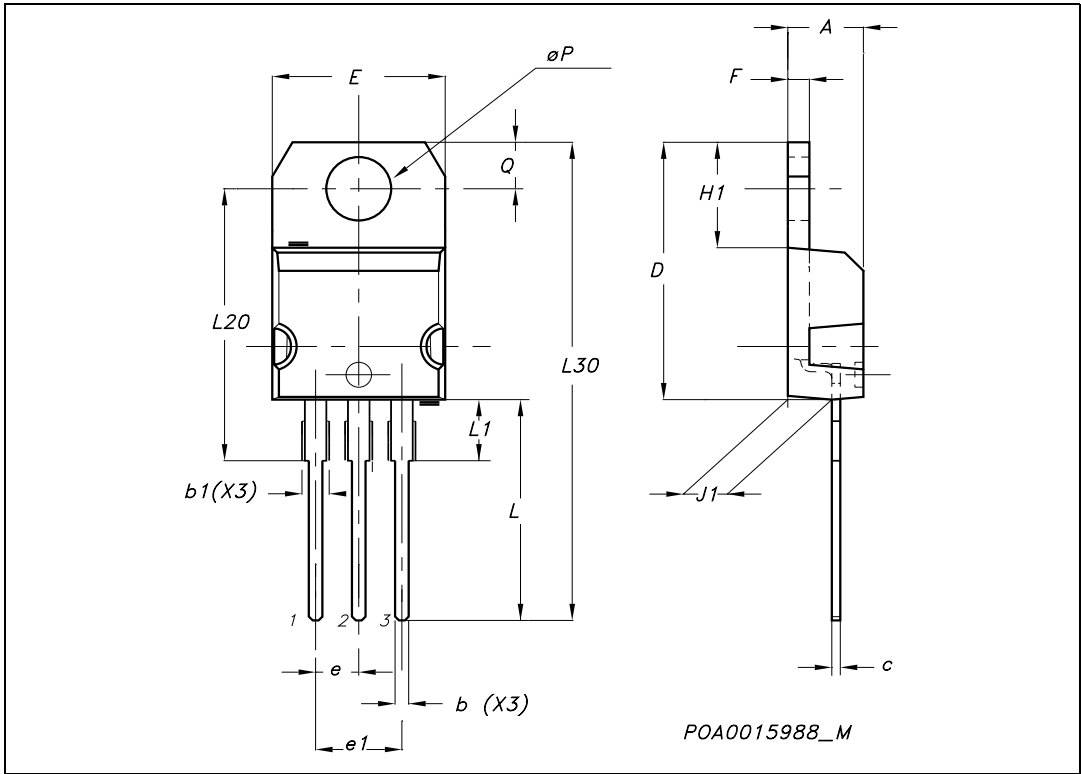


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



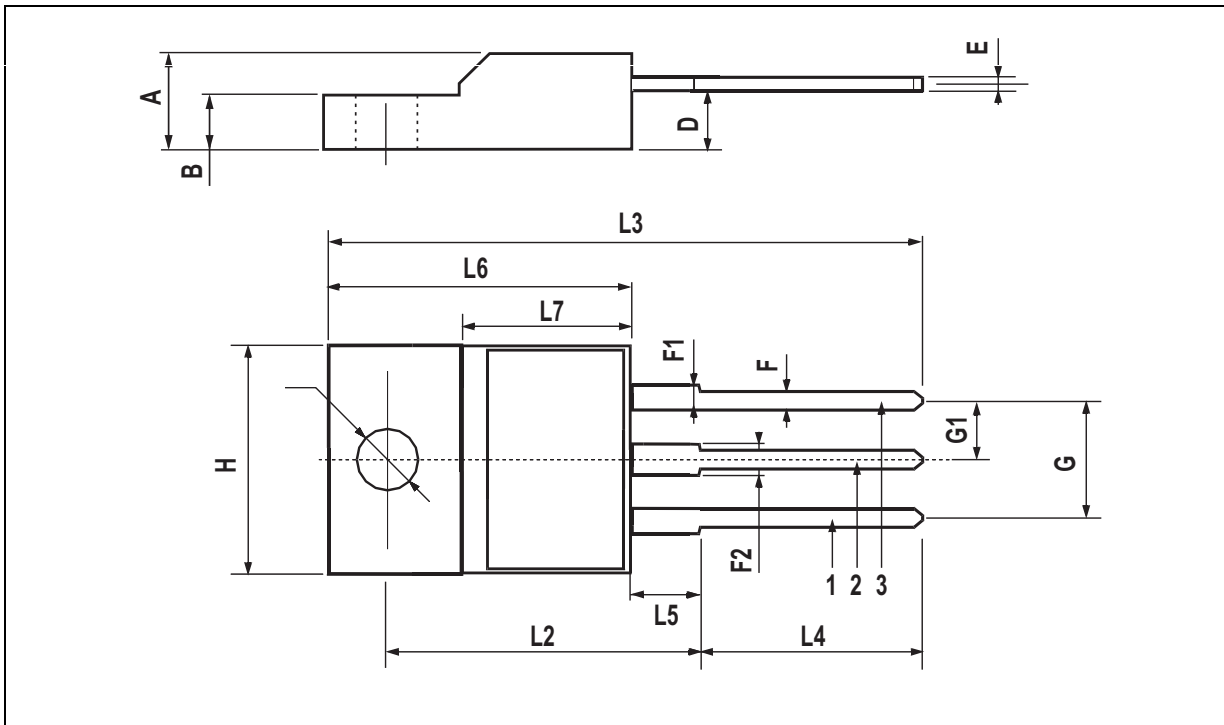
TO-220 MECHANICAL DATA

| 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 |



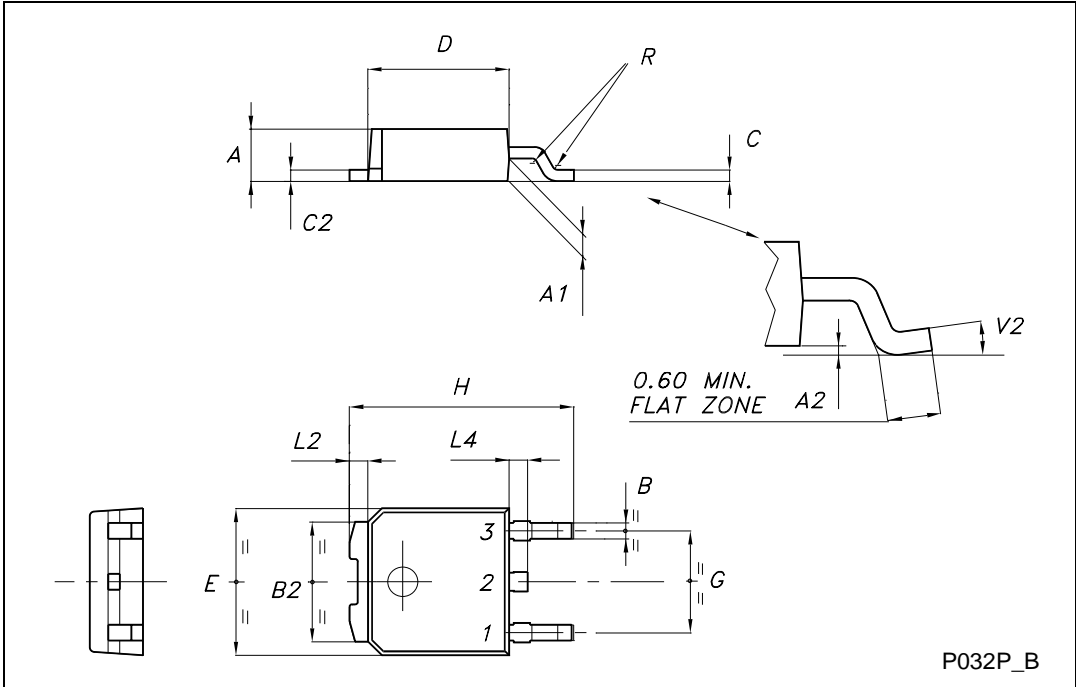
TO-220FP MECHANICAL DATA

| 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 |



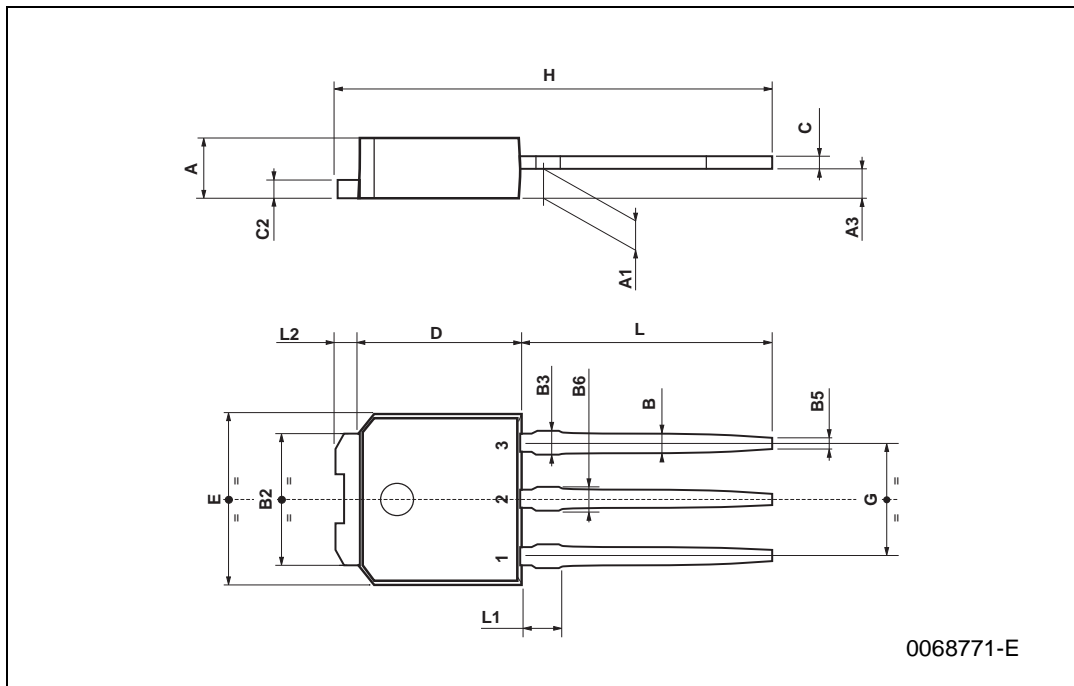
TO-252 (DPAK) MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|------|-------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 2.20 | | 2.40 | 0.087 | | 0.094 |
| A1 | 0.90 | | 1.10 | 0.035 | | 0.043 |
| A2 | 0.03 | | 0.23 | 0.001 | | 0.009 |
| B | 0.64 | | 0.90 | 0.025 | | 0.035 |
| B2 | 5.20 | | 5.40 | 0.204 | | 0.213 |
| C | 0.45 | | 0.60 | 0.018 | | 0.024 |
| C2 | 0.48 | | 0.60 | 0.019 | | 0.024 |
| D | 6.00 | | 6.20 | 0.236 | | 0.244 |
| E | 6.40 | | 6.60 | 0.252 | | 0.260 |
| G | 4.40 | | 4.60 | 0.173 | | 0.181 |
| H | 9.35 | | 10.10 | 0.368 | | 0.398 |
| L2 | | 0.8 | | | 0.031 | |
| L4 | 0.60 | | 1.00 | 0.024 | | 0.039 |
| V2 | 0° | | 8° | 0° | | 0° |

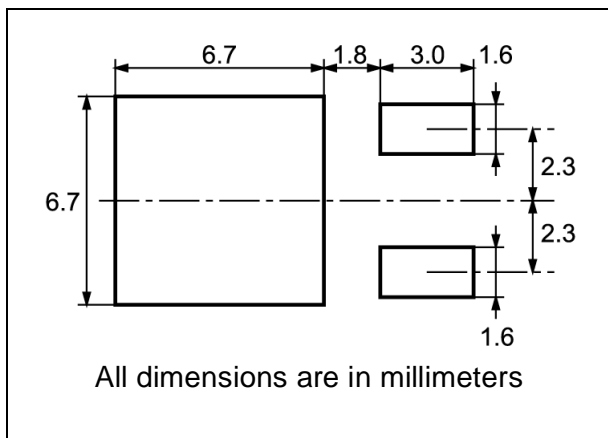


TO-251 (IPAK) MECHANICAL DATA

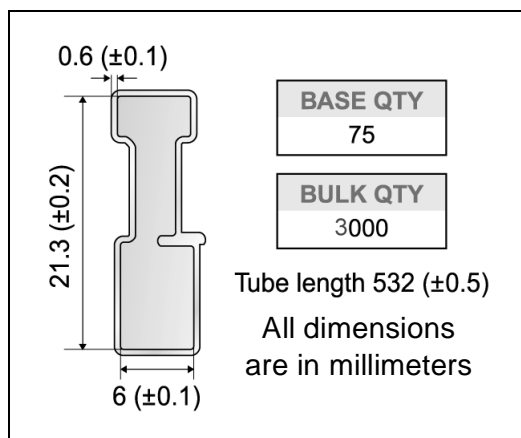
| DIM. | mm | | | inch | | |
|------|------|------|------|-------|-------|-------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | 2.2 | | 2.4 | 0.086 | | 0.094 |
| A1 | 0.9 | | 1.1 | 0.035 | | 0.043 |
| A3 | 0.7 | | 1.3 | 0.027 | | 0.051 |
| B | 0.64 | | 0.9 | 0.025 | | 0.031 |
| B2 | 5.2 | | 5.4 | 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 |



DPAK FOOTPRINT



TUBE SHIPMENT (no suffix)*



TAPE AND REEL SHIPMENT (suffix "T4")*

40 mm min. Access hole at slot location

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

Full radius

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 |

10 pitches cumulative tolerance on tape +/- 0.2 mm

Center line of cavity

User Direction of Feed

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

TRL

FEED DIRECTION

Bending radius R min.

* on sales type 12/13



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