



# STD60NF06

## N-CHANNEL 60V - 0.014Ω - 60A DPAK STripFET™ II POWER MOSFET

| TYPE      | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|-----------|------------------|---------------------|----------------|
| STD60NF06 | 60 V             | < 0.016 Ω           | 60A            |

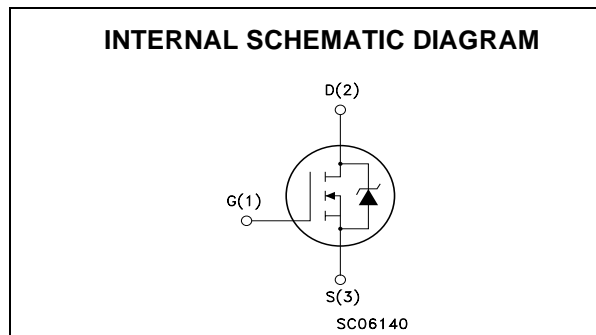
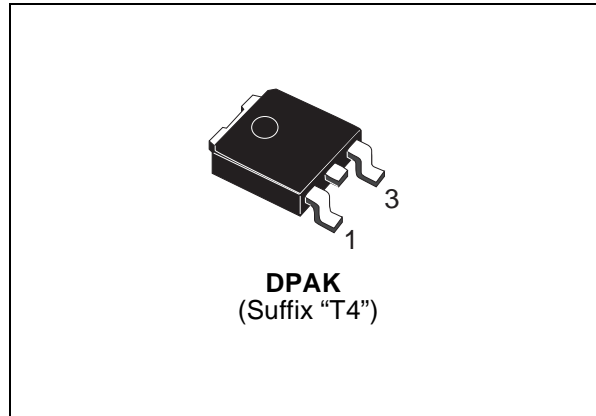
- TYPICAL R<sub>DS(on)</sub> = 0.014Ω
- EXCEPTIONAL dv/dt CAPABILITY
- 100% AVALANCHE TESTED
- APPLICATION ORIENTED CHARACTERIZATION

### DESCRIPTION

This Power Mosfet series realized with STMicroelectronics unique STripFET process has specifically been designed to minimize input capacitance and gate charge. It is therefore suitable as primary switch in advanced high-efficiency isolated DC-DC converters for Telecom and Computer application. It is also intended for any application with low gate charge drive requirements.

### APPLICATIONS

- HIGH-EFFICIENCY DC-DC CONVERTERS
- UPS AND MOTOR CONTROL
- AUTOMOTIVE



### ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter  | Value       | Unit |
|---------------------|--|-------------|------|
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)           | 60          | V    |
| V <sub>DGR</sub>    | Drain-gate Voltage (R <sub>GS</sub> = 20 kΩ)         | 60          | V    |
| V <sub>GS</sub>     | Gate- source Voltage                                 | ± 20        | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 25°C  | 60          | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>C</sub> = 100°C | 42          | A    |
| I <sub>DM</sub> (●) | Drain Current (pulsed)                               | 240         | A    |
| P <sub>TOT</sub>    | Total Dissipation at T <sub>C</sub> = 25°C           | 110         | W    |
|                     | Derating Factor                                      | 0.73        | W/°C |
| dv/dt (1)           | Peak Diode Recovery voltage slope                    | 4           | V/ns |
| T <sub>stg</sub>    | Storage Temperature                                  | - 55 to 175 | °C   |
| T <sub>j</sub>      | Operating Junction Temperature                       |             |      |

(●) Pulse width limited by safe operating area

(1) I<sub>SD</sub> ≤ 60A, di/dt ≤ 200 A/μs, V<sub>DD</sub> ≤ 24V, T<sub>j</sub> ≤ T<sub>j</sub>MAX

## STD60NF06

### THERMAL DATA

|                |  |     |      |      |
|----------------|--|-----|------|------|
| Rthj-case      | Thermal Resistance Junction-case               | Max | 1.36 | °C/W |
| Rthj-amb       | Thermal Resistance Junction-ambient            | Max | 100  | °C/W |
| T <sub>I</sub> | Maximum Lead Temperature For Soldering Purpose |     | 275  | °C   |

### AVALANCHE CHARACTERISTICS

| Symbol          | Parameter  | Max Value | Unit |
|-----------------|--|-----------|------|
| I <sub>AR</sub> | Avalanche Current, Repetitive or Not-Repetitive (pulse width limited by T <sub>j</sub> max)                                | 30        | A    |
| E <sub>AS</sub> | Single Pulse Avalanche Energy (starting T <sub>j</sub> = 25 °C, I <sub>D</sub> = I <sub>AR</sub> , V <sub>DD</sub> = 30 V) | 350       | mJ   |

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

OFF

| Symbol               | Parameter   | Test Conditions   | Min. | Typ. | Max.    | Unit     |
|----------------------|---|---|------|------|---------|----------|
| V <sub>(BR)DSS</sub> | Drain-source Breakdown Voltage                        | I <sub>D</sub> = 250 μA, V <sub>GS</sub> = 0  | 60   |      |         | V        |
| I <sub>DSS</sub>     | Zero Gate Voltage Drain Current (V <sub>GS</sub> = 0) | V <sub>DS</sub> = Max Rating<br>V <sub>DS</sub> = Max Rating, T <sub>C</sub> = 125 °C |      |      | 1<br>10 | μA<br>μA |
| I <sub>GSS</sub>     | Gate-body Leakage Current (V <sub>DS</sub> = 0)       | V <sub>GS</sub> = ± 20V   |      |      | ±100    | nA       |

ON (1)

| Symbol              | Parameter                         | Test Conditions   | Min. | Typ.  | Max.  | Unit |
|---------------------|-----------------------------------|---|------|-------|-------|------|
| V <sub>GS(th)</sub> | Gate Threshold Voltage            | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250 μA | 2    |       | 4     | V    |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 30 A               |      | 0.014 | 0.016 | Ω    |

### DYNAMIC

| Symbol              | Parameter                    | Test Conditions  | Min. | Typ. | Max. | Unit |
|---------------------|------------------------------|--|------|------|------|------|
| g <sub>fs</sub> (1) | Forward Transconductance     | V <sub>DS</sub> = 15 V, I <sub>D</sub> = 30 A          |      | 20   |      | S    |
| C <sub>iss</sub>    | Input Capacitance            | V <sub>DS</sub> = 25 V, f = 1 MHz, V <sub>GS</sub> = 0 |      | 1810 |      | pF   |
| C <sub>oss</sub>    | Output Capacitance           |  |      | 360  |      | pF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance |  |      | 125  |      | pF   |

**ELECTRICAL CHARACTERISTICS (CONTINUED)**
**SWITCHING ON**

| Symbol      | Parameter          | Test Conditions  | Min. | Typ. | Max. | Unit |
|-------------|--------------------|--|------|------|------|------|
| $t_{d(on)}$ | Turn-on Delay Time | $V_{DD} = 30\text{ V}$ , $I_D = 30\text{ A}$<br>$R_G = 4.7\Omega$ , $V_{GS} = 10\text{ V}$<br>(see test circuit, Figure 3) |      | 16   |      | ns   |
| $t_r$       | Rise Time          |  |      | 108  |      | ns   |
| $Q_g$       | Total Gate Charge  | $V_{DD} = 48\text{ V}$ , $I_D = 60\text{ A}$<br>$V_{GS} = 10\text{ V}$   |      | 49   | 66   | nC   |
| $Q_{gs}$    | Gate-Source Charge |  |      | 18   |      | nC   |
| $Q_{gd}$    | Gate-Drain Charge  |  |      | 14   |      | nC   |

**SWITCHING OFF**

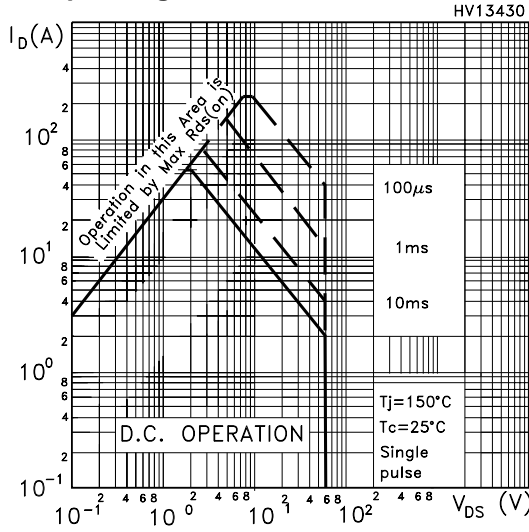
| Symbol                         | Parameter   | Test Conditions  | Min.  | Typ.     | Max.           | Unit     |
|--------------------------------|---|--|---|----------|----------------|----------|
| $t_{d(off)}$<br>$t_f$          | Turn-off-Delay Time<br>Fall Time                      | $V_{DD} = 30\text{ V}$ , $I_D = 30\text{ A}$ ,<br>$R_G = 4.7\Omega$ , $V_{GS} = 10\text{ V}$<br>(see test circuit, Figure 3) |   | 43<br>20 |                | ns<br>ns |
| $t_{d(off)}$<br>$t_f$<br>$t_c$ | Off-voltage Rise Time<br>Fall Time<br>Cross-over Time |  | $V_{clamp} = 48\text{ V}$ , $I_D = 60\text{ A}$<br>$R_G = 4.7\Omega$ , $V_{GS} = 10\text{ V}$<br>(see test circuit, Figure 3) |          | 40<br>12<br>21 |          |

**SOURCE DRAIN DIODE**

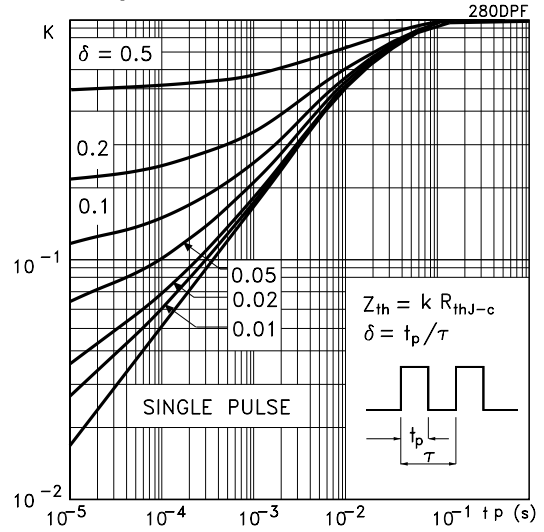
| Symbol                            | Parameter  | Test Conditions   | Min. | Typ.           | Max. | Unit          |
|-----------------------------------|--|---|------|----------------|------|---------------|
| $I_{SD}$                          | Source-drain Current   |   |      |                | 60   | A             |
| $I_{SDM(2)}$                      | Source-drain Current (pulsed)  |   |      |                | 240  | A             |
| $V_{SD(1)}$                       | Forward On Voltage   | $I_{SD} = 60\text{ A}$ , $V_{GS} = 0$   |      |                | 1.3  | V             |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse Recovery Time<br>Reverse Recovery Charge<br>Reverse Recovery Current | $I_{SD} = 60\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$ ,<br>$V_{DD} = 25\text{ V}$ , $T_J = 150^\circ\text{C}$<br>(see test circuit, Figure 5) |      | 73<br>182<br>5 |      | ns<br>nC<br>A |

Note: 1. Pulsed: Pulse duration = 300  $\mu\text{s}$ , duty cycle 1.5 %.  
2. Pulse width limited by safe operating area.

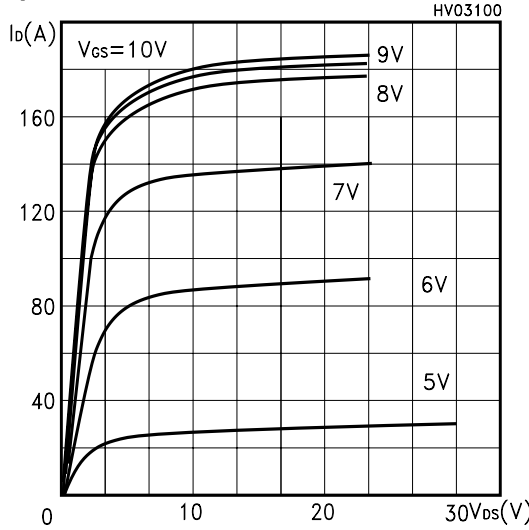
Safe Operating Area for DPAK



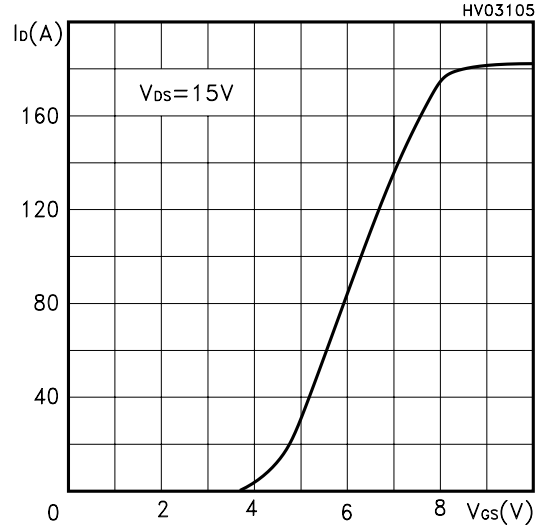
Thermal Impedance for DPAK



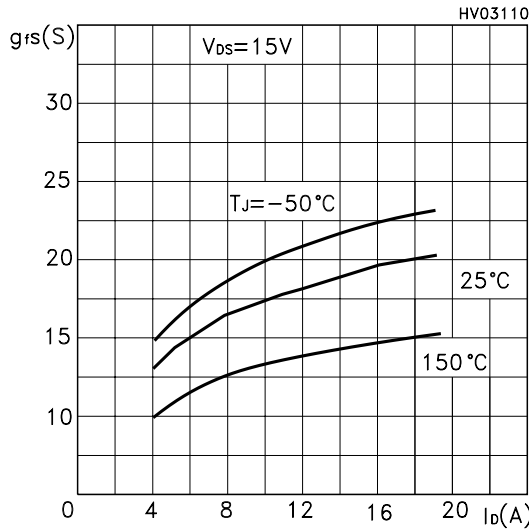
Output Characteristics



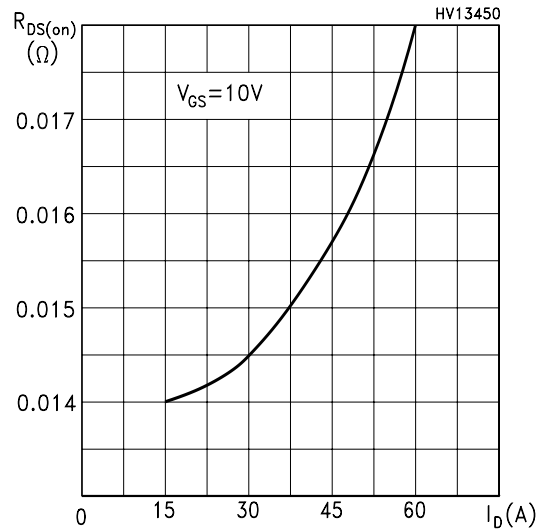
Transfer Characteristics



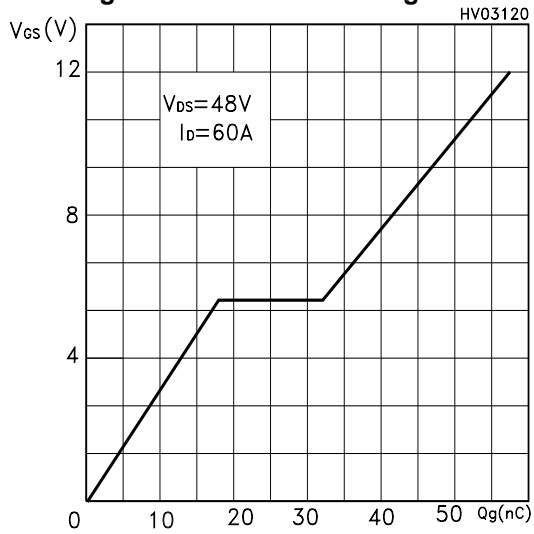
Transconductance



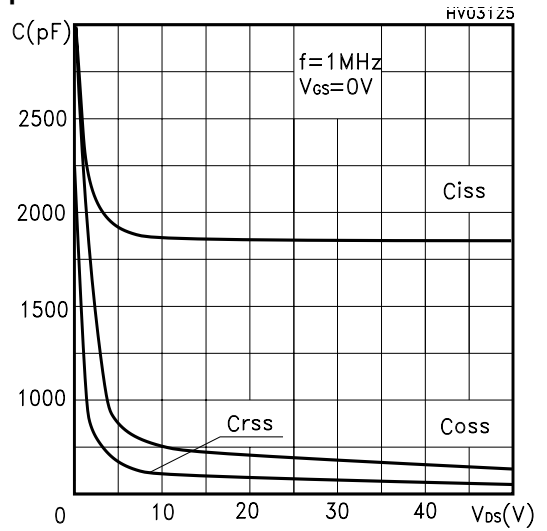
Static Drain-source On Resistance



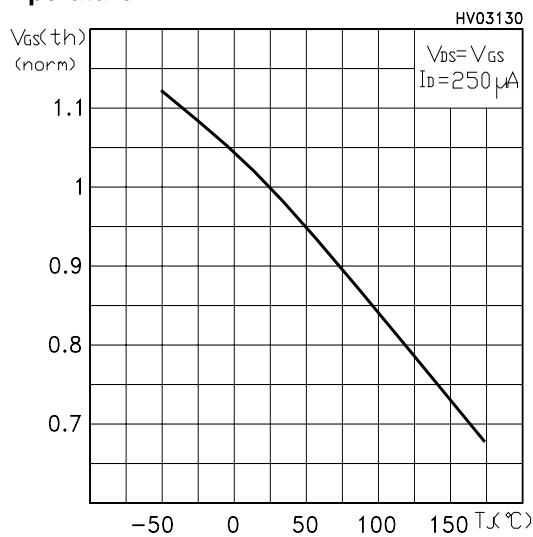
**Gate Charge vs Gate-source Voltage**



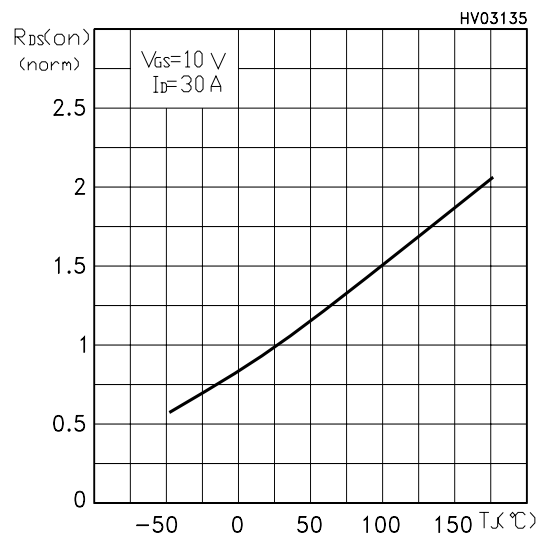
**Capacitance Variations**



**Normalized Gate Threshold Voltage vs Temperature**



**Normalized On Resistance vs Temperature**



**Source-drain Diode Forward Characteristics**

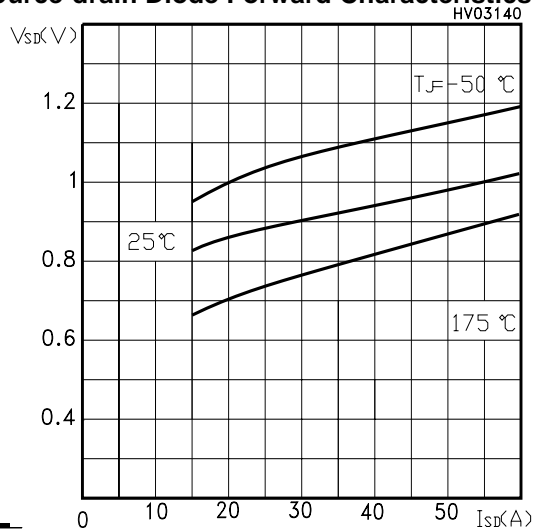


Fig. 1: Unclamped Inductive Load Test Circuit



Fig. 2: Unclamped Inductive Waveform



Fig. 3: Switching Times Test Circuit For Resistive Load



Fig. 4: Gate Charge test Circuit

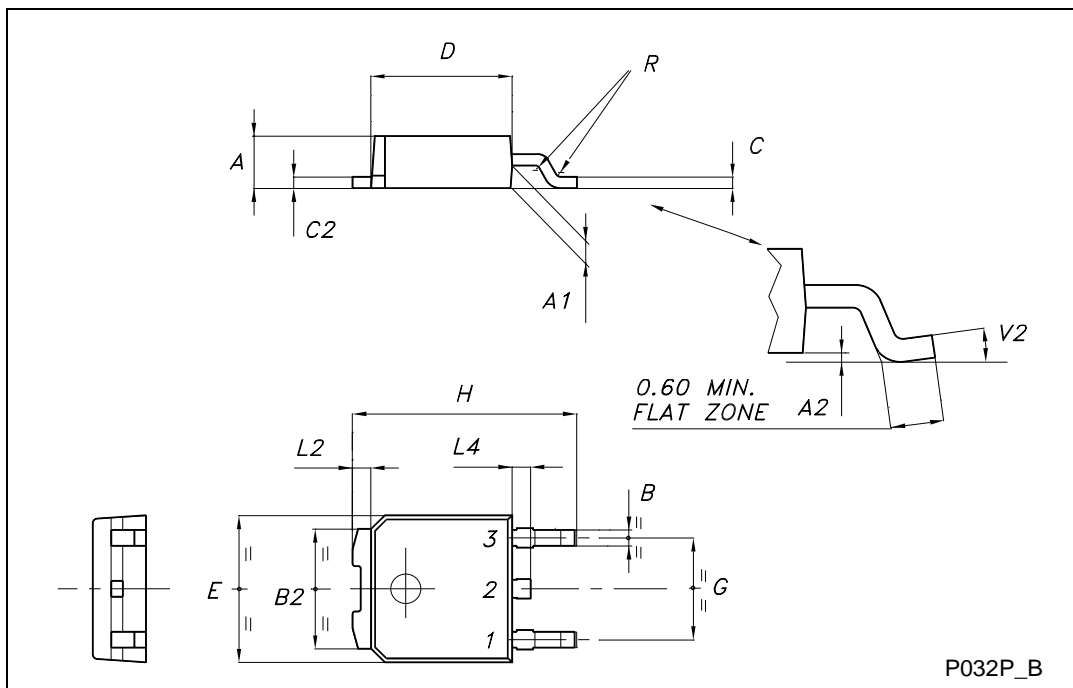


Fig. 5: Test Circuit For Inductive Load Switching And Diode Recovery Times



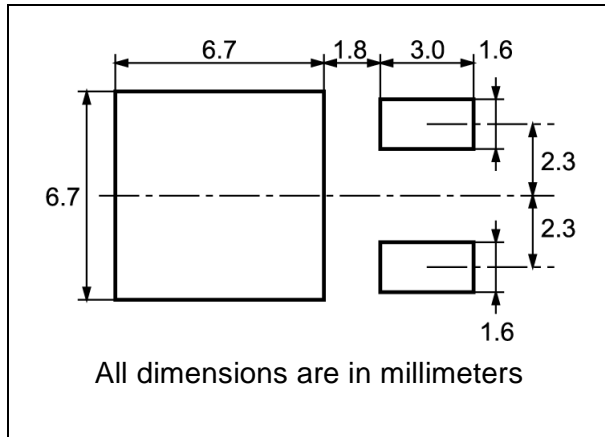
TO-252 (DPAK) MECHANICAL DATA

| 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°    |

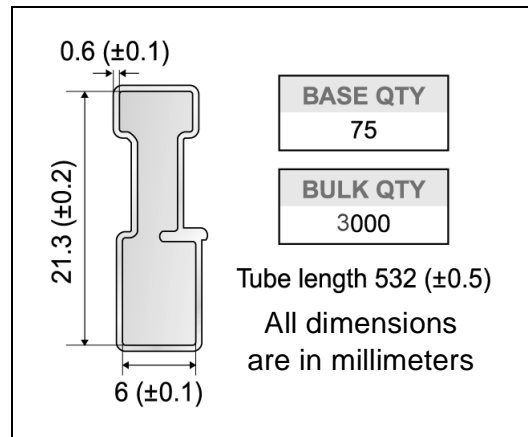


P032P\_B

**DPAK FOOTPRINT**



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



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

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

For machine ref. only including draft and radii concentric around B<sub>0</sub>

TRL

FEED DIRECTION

Bending radius R min.

**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 |

\* on sales type



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