

## N - CHANNEL ENHANCEMENT MODE FAST POWER MOS TRANSISTOR

PRELIMINARY DATA

| TYPE     | V <sub>DSS</sub> | R <sub>DS(on)</sub> | I <sub>D</sub> |
|----------|------------------|---------------------|----------------|
| STU9NA60 | 600 V            | < 0.8 Ω             | 9 A            |

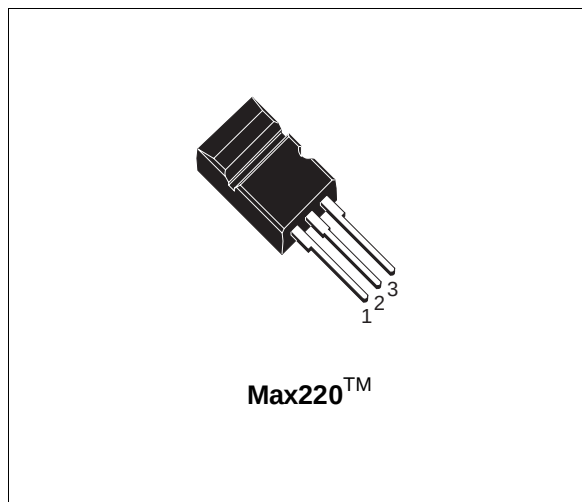
- TYPICAL R<sub>DS(on)</sub> = 0.68 Ω
- EFFICIENT AND RELIABLE MOUNTING THROUGH CLIP
- ± 30V GATE TO SOURCE VOLTAGE RATING
- 100% AVALANCHE TESTED
- GATE CHARGE MINIMIZED
- REDUCED THRESHOLD VOLTAGE SPREAD

### DESCRIPTION

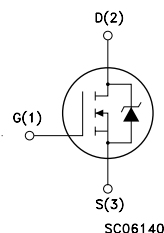
The Max220™ package is a new high volume power package exhibiting the same footprint as the industry standard TO-220, but designed to accommodate much larger silicon chips, normally supplied in bigger packages. The increased die capacity makes the device ideal to reduce component count in multiple paralleled TO-220 designs and save board space with respect to larger packages.

### APPLICATIONS

- HIGH CURRENT, HIGH SPEED SWITCHING
- SWITCH MODE POWER SUPPLIES (SMPS)
- DC-AC CONVERTERS FOR WELDING EQUIPMENT AND UNINTERRUPTIBLE POWER SUPPLIES (UPS)



### INTERNAL SCHEMATIC DIAGRAM



### ABSOLUTE MAXIMUM RATINGS

| Symbol              | Parameter                                             | Value      | Unit |
|---------------------|-------------------------------------------------------|------------|------|
| V <sub>DS</sub>     | Drain-source Voltage (V <sub>GS</sub> = 0)            | 600        | V    |
| V <sub>DGR</sub>    | Drain- gate Voltage (R <sub>GS</sub> = 20 kΩ)         | 600        | V    |
| V <sub>GS</sub>     | Gate-source Voltage                                   | ± 30       | V    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 25 °C  | 9          | A    |
| I <sub>D</sub>      | Drain Current (continuous) at T <sub>c</sub> = 100 °C | 5.7        | A    |
| I <sub>DM</sub> (•) | Drain Current (pulsed)                                | 36         | A    |
| P <sub>tot</sub>    | Total Dissipation at T <sub>c</sub> = 25 °C           | 145        | W    |
|                     | Derating Factor                                       | 1.16       | W/°C |
| T <sub>stg</sub>    | Storage Temperature                                   | -65 to 150 | °C   |
| T <sub>j</sub>      | Max. Operating Junction Temperature                   | 150        | °C   |

(•) Pulse width limited by safe operating area

**THERMAL DATA**

|                       |                                                |     |      |      |
|-----------------------|------------------------------------------------|-----|------|------|
| R <sub>thj-case</sub> | Thermal Resistance Junction-case               | Max | 0.86 | °C/W |
| R <sub>thj-amb</sub>  | Thermal Resistance Junction-ambient            | Max | 30   | °C/W |
| R <sub>thc-sink</sub> | Thermal Resistance Case-sink                   | Typ | 0.1  | °C/W |
| T <sub>l</sub>        | Maximum Lead Temperature For Soldering Purpose |     | 300  | °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, δ < 1%)                          | 9         | 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> = 50 V)   | 405       | mJ   |
| E <sub>AR</sub> | Repetitive Avalanche Energy (pulse width limited by T <sub>j</sub> max, δ < 1%)                                              | 16.2      | mJ   |
| I <sub>AR</sub> | Avalanche Current, Repetitive or Not-Repetitive (T <sub>c</sub> = 100 °C, pulse width limited by T <sub>j</sub> max, δ < 1%) | 5.7       | A    |

**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                                                | 600  |      |             | 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 x 0.8 T <sub>c</sub> = 125 °C |      |      | 250<br>1000 | μA<br>μA |
| I <sub>GSS</sub>     | Gate-body Leakage Current (V <sub>DS</sub> = 0)       | V <sub>GS</sub> = ± 30 V                                                                   |      |      | ± 100       | nA       |

**ON (\*)**

| 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                                                             | 2.25 | 3    | 3.75       | V      |
| R <sub>DS(on)</sub> | Static Drain-source On Resistance | V <sub>GS</sub> = 10 V I <sub>D</sub> = 4.5 A<br>V <sub>GS</sub> = 10 V I <sub>D</sub> = 4.5 A T <sub>c</sub> = 100°C |      | 0.68 | 0.8<br>1.6 | Ω<br>Ω |
| I <sub>D(on)</sub>  | On State Drain Current            | V <sub>DS</sub> > I <sub>D(on)</sub> x R <sub>DS(on)max</sub><br>V <sub>GS</sub> = 10 V                               | 9    |      |            | A      |

**DYNAMIC**

| Symbol              | Parameter                    | Test Conditions                                                                      | Min. | Typ. | Max. | Unit |
|---------------------|------------------------------|--------------------------------------------------------------------------------------|------|------|------|------|
| g <sub>fs</sub> (*) | Forward Transconductance     | V <sub>DS</sub> > I <sub>D(on)</sub> x R <sub>DS(on)max</sub> I <sub>D</sub> = 4.5 A | 5    | 6.6  |      | S    |
| C <sub>iss</sub>    | Input Capacitance            | V <sub>DS</sub> = 25 V f = 1 MHz V <sub>GS</sub> = 0                                 |      | 1770 | 2300 | pF   |
| C <sub>oss</sub>    | Output Capacitance           |                                                                                      |      | 230  | 300  | pF   |
| C <sub>rss</sub>    | Reverse Transfer Capacitance |                                                                                      |      | 65   | 85   | pF   |

**ELECTRICAL CHARACTERISTICS** (continued)**SWITCHING ON**

| Symbol                        | Parameter                                                    | Test Conditions                                                         | Min.                                           | Typ.           | Max.     | Unit           |
|-------------------------------|--------------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------|----------------|----------|----------------|
| $t_{d(on)}$<br>$t_r$          | Turn-on Time<br>Rise Time                                    | $V_{DD} = 300\text{ V}$<br>$R_G = 4.7\ \Omega$                          | $I_D = 4.5\text{ A}$<br>$V_{GS} = 10\text{ V}$ | 21<br>32       | 30<br>45 | ns<br>ns       |
| $(di/dt)_{on}$                | Turn-on Current Slope                                        | $V_{DD} = 600\text{ V}$<br>$R_G = 47\ \Omega$                           | $I_D = 9\text{ A}$<br>$V_{GS} = 10\text{ V}$   | 180            |          | A/ $\mu$ s     |
| $Q_g$<br>$Q_{gs}$<br>$Q_{gd}$ | Total Gate Charge<br>Gate-Source Charge<br>Gate-Drain Charge | $V_{DD} = 600\text{ V}$<br>$I_D = 9\text{ A}$<br>$V_{GS} = 10\text{ V}$ |                                                | 75<br>11<br>36 | 105      | nC<br>nC<br>nC |

**SWITCHING OFF**

| Symbol                          | Parameter                                             | Test Conditions                                | Min.                                         | Typ.           | Max.           | Unit           |
|---------------------------------|-------------------------------------------------------|------------------------------------------------|----------------------------------------------|----------------|----------------|----------------|
| $t_{r(Voff)}$<br>$t_f$<br>$t_c$ | Off-voltage Rise Time<br>Fall Time<br>Cross-over Time | $V_{DD} = 600\text{ V}$<br>$R_G = 4.7\ \Omega$ | $I_D = 9\text{ A}$<br>$V_{GS} = 10\text{ V}$ | 16<br>18<br>26 | 25<br>27<br>37 | ns<br>ns<br>ns |

**SOURCE DRAIN DIODE**

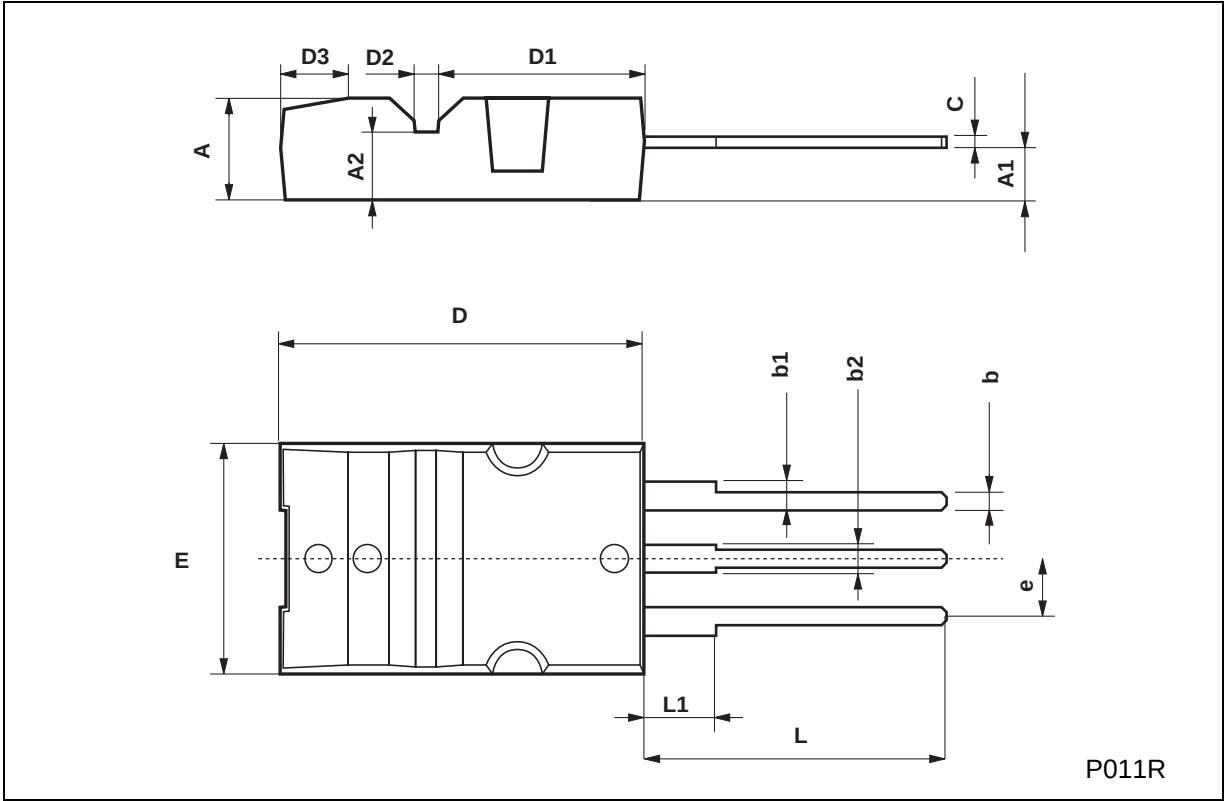
| Symbol                            | Parameter                                                                    | Test Conditions                                  | Min.                                                                    | Typ.              | Max.    | Unit               |
|-----------------------------------|------------------------------------------------------------------------------|--------------------------------------------------|-------------------------------------------------------------------------|-------------------|---------|--------------------|
| $I_{SD}$<br>$I_{SDM}(\bullet)$    | Source-drain Current<br>Source-drain Current (pulsed)                        |                                                  |                                                                         |                   | 9<br>36 | A<br>A             |
| $V_{SD} (*)$                      | Forward On Voltage                                                           | $I_{SD} = 9\text{ A}$<br>$V_{GS} = 0$            |                                                                         |                   | 1.6     | V                  |
| $t_{rr}$<br>$Q_{rr}$<br>$I_{RRM}$ | Reverse Recovery Time<br>Reverse Recovery Charge<br>Reverse Recovery Current | $I_{SD} = 9\text{ A}$<br>$V_{DD} = 100\text{ V}$ | $di/dt = 100\text{ A}/\mu\text{s}$<br>$T_j = 150\text{ }^\circ\text{C}$ | 660<br>11.9<br>36 |         | ns<br>$\mu$ C<br>A |

(\*) Pulsed: Pulse duration = 300  $\mu$ s, duty cycle 1.5 %

(\bullet) Pulse width limited by safe operating area

Max220 MECHANICAL DATA

| DIM. | mm    |      |       | inch  |       |       |
|------|-------|------|-------|-------|-------|-------|
|      | MIN.  | TYP. | MAX.  | MIN.  | TYP.  | MAX.  |
| A    | 4.3   |      | 4.6   | 0.169 |       | 0.181 |
| A1   | 2.2   |      | 2.4   | 0.087 |       | 0.094 |
| A2   | 2.9   |      | 3.1   | 0.114 |       | 0.122 |
| b    | 0.7   |      | 0.93  | 0.027 |       | 0.036 |
| b1   | 1.25  |      | 1.4   | 0.049 |       | 0.055 |
| b2   | 1.2   |      | 1.38  | 0.047 |       | 0.054 |
| c    | 0.45  |      | 0.6   |       | 0.18  | 0.023 |
| D    | 15.9  |      | 16.3  |       | 0.626 | 0.641 |
| D1   | 9     |      | 9.35  | 0.354 |       | 0.368 |
| D2   | 0.8   |      | 1.2   | 0.031 |       | 0.047 |
| D3   | 2.8   |      | 3.2   | 0.110 |       | 0.126 |
| e    | 2.44  |      | 2.64  | 0.096 |       | 0.104 |
| E    | 10.05 |      | 10.35 | 0.396 |       | 0.407 |
| L    | 13.2  |      | 13.6  | 0.520 |       | 0.535 |
| L1   | 3     |      | 3.4   | 0.118 |       | 0.133 |



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