## N-CHANNEL ENHANCEMENT MODE PowerMESH ${ }^{\text {тм }}$ MOSFET

PRELIMINARY DATA

| TYPE | V ${ }_{\text {dss }}$ | RdS(on) | ID |
| :---: | :---: | :---: | :---: |
| STU13NB60 | 600 V | $<0.45 \Omega$ | 12.6 A |

- TYPICAL RDs(on) $=0.4 \Omega$
- EXTREMELY HIGH dv/dt CAPABILITY
- 100\% AVALANCHE TESTED
- VERY LOW INTRINSIC CAPACITANCES
- GATE CHARGE MINIMIZED
- $\pm 30 \mathrm{~V}$ GATE TO SOURCE VOLTAGE RATING


## DESCRIPTION

Using the latest high voltage MESH OVERLAY™ process, SGS-Thomson has designed an advanced family of power MOSFETs with outstanding performances. The new patent pending strip layout coupled with the Company's proprietary edge termination structure, gives the lowest $\mathrm{R}_{\mathrm{DS}(o n)}$ per area, exceptional avalanche and $\mathrm{dv} / \mathrm{dt}$ capabilities and unrivalled gate charge and switching characteristics.

## APPLICATIONS

- SWITCH MODE POWER SUPPLIES (SMPS)
- DC-AC CONVERTERS FOR WELDING EQUIPMENT AND UNINTERRUPTIBLE POWER SUPPLIES AND MOTOR DRIVE


## INTERNAL SCHEMATIC DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
| :---: | :--- | :---: | :---: |
| $\mathrm{V}_{\mathrm{DS}}$ | Drain-source Voltage $\left(\mathrm{V}_{\mathrm{GS}}=0\right)$ | 600 | V |
| $\mathrm{~V}_{\mathrm{DGR}}$ | Drain- gate Voltage $\left(\mathrm{R}_{\mathrm{GS}}=20 \mathrm{k} \Omega\right)$ | 600 | V |
| $\mathrm{~V}_{\mathrm{GS}}$ | Gate-source Voltage | $\pm 30$ | V |
| $\mathrm{ID}_{\mathrm{D}}$ | Drain Current (continuous) at $\mathrm{T}_{\mathrm{C}}=25^{\circ} \mathrm{C}$ | 12.6 | A |
| $\mathrm{I}_{\mathrm{D}}$ | Drain Current (continuous) at $\mathrm{T}_{\mathrm{C}}=100^{\circ} \mathrm{C}$ | 7.9 | A |
| $\mathrm{I}_{\mathrm{DM}}(\cdot)$ | Drain Current (pulsed) | 50.4 | A |
| $\mathrm{P}_{\text {tot }}$ | Total Dissipation at $\mathrm{T}_{\mathrm{C}}=25^{\circ} \mathrm{C}$ | 160 | W |
|  | Derating Factor | 1.28 | $\mathrm{~W} /{ }^{\circ} \mathrm{C}$ |
| $\mathrm{dv} / \mathrm{dt}(1)$ | Peak Diode Recovery voltage slope | 4.5 | $\mathrm{~V} / \mathrm{ns}$ |
| $\mathrm{T}_{\mathrm{stg}}$ | Storage Temperature | -65 to 150 | ${ }^{\circ} \mathrm{C}$ |
| $\mathrm{T}_{\mathrm{j}}$ | Max. Operating Junction Temperature | 150 | ${ }^{\circ} \mathrm{C}$ |

(•) Pulse width limited by safe operating area
(1) $\mathrm{I}_{\mathrm{SD}} \leq 13 \mathrm{~A}, \mathrm{di} / \mathrm{dt} \leq 200 \mathrm{~A} / \mu \mathrm{S}, \mathrm{V}_{\mathrm{DD}} \leq \mathrm{V}_{(\mathrm{BR}) \mathrm{DSS}}, \mathrm{Tj} \leq \mathrm{T}_{\mathrm{JMAX}}$

This is preliminary information on a new product now in development or undergoing evaluation. Details are subject to change without notice.

## THERMAL DATA

| $R_{\text {thj-case }}$ | Thermal | Resistance Junction-case | Max | 0.78 | ${ }^{\circ} \mathrm{C} / \mathrm{W}$ |
| :---: | :--- | :--- | :---: | :---: | :---: |
| $R_{\text {thj-amb }}$ | Thermal | Resistance Junction-ambient | Max | 62.5 | ${ }^{\circ} \mathrm{C} / \mathrm{W}$ |
| $\mathrm{R}_{\text {thc-sink }}$ | Thermal | Resistance Case-sink | Typ | 0.5 | ${ }^{\circ} \mathrm{C} / \mathrm{W}$ |
| $\mathrm{T}_{\text {I }}$ | Maximum Lead Temperature For Soldering Purpose | 300 | ${ }^{\circ} \mathrm{C}$ |  |  |

## AVALANCHE CHARACTERISTICS

| Symbol | Parameter | Max Value | Unit |
| :---: | :--- | :---: | :---: |
| $\mathrm{I}_{\mathrm{AR}}$ | Avalanche Current, Repetitive or Not-Repetitive <br> (pulse width limited by $T_{j}$ max, $\left.\delta<1 \%\right)$ | 12.6 | A |
| $\mathrm{E}_{\mathrm{AS}}$ | Single Pulse Avalanche Energy <br> $\left(\right.$ starting $\left.T_{j}=25^{\circ} \mathrm{C}, \mathrm{I}_{\mathrm{D}}=\mathrm{I}_{A R}, V_{D D}=50 \mathrm{~V}\right)$ | 800 | mJ |

ELECTRICAL CHARACTERISTICS ( $\mathrm{T}_{\text {case }}=25^{\circ} \mathrm{C}$ unless otherwise specified)
OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $V_{\text {(BR) }}$ DSS | Drain-source <br> Breakdown Voltage | $\begin{array}{ll} \mathrm{I}_{\mathrm{D}}=250 \mu \mathrm{~A} & \mathrm{~V}_{\mathrm{GS}}=0 \\ @ 100^{\circ} \mathrm{C} & \\ \hline \end{array}$ | 600 |  |  | V |
| Idss | Zero Gate Voltage <br> Drain Current ( $\mathrm{V}_{\mathrm{GS}}=0$ ) | $\begin{array}{\|ll\|} \hline \text { V } D S \\ \text { V Max Rating } & \\ \text { V Max Rating } & \mathrm{T}_{\mathrm{C}}=125^{\circ} \mathrm{C} \\ \hline \end{array}$ |  |  | $\begin{gathered} 1 \\ 50 \end{gathered}$ | $\begin{aligned} & \mu \mathrm{A} \\ & \mu \mathrm{~A} \end{aligned}$ |
| Igss | Gate-body Leakage Current ( $\mathrm{V}_{\mathrm{DS}}=0$ ) | $\mathrm{V}_{\mathrm{GS}}= \pm 30 \mathrm{~V}$ |  |  | $\pm 100$ | nA |

ON (*)

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
| :---: | :--- | :--- | :---: | :---: | :---: | :---: |
| $\mathrm{V}_{\mathrm{GS}(\mathrm{th})}$ | Gate Threshold <br> Voltage | $\mathrm{V}_{\mathrm{DS}}=\mathrm{V}_{\mathrm{GS}} \quad \mathrm{ID}_{\mathrm{D}}=250 \mu \mathrm{~A}$ | 3 | 4 | 5 | V |
| RDS(on) | Static Drain-source On <br> Resistance | $\mathrm{V}_{\mathrm{GS}}=10 \mathrm{~V} \quad \mathrm{ID}_{\mathrm{D}}=6.3 \mathrm{~A}$ | 0.4 | 0.45 | $\Omega$ |  |
| $\mathrm{I}_{\mathrm{D}(\mathrm{on})}$ | On State Drain Current | $\mathrm{V}_{\mathrm{DS}}>\mathrm{I}_{\mathrm{D}(o n)} \times \mathrm{RDS}^{(o n) \max }$ <br> $\mathrm{V}_{\mathrm{GS}}=10 \mathrm{~V}$ | 12.6 |  |  | A |

## DYNAMIC

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\mathrm{g}_{\mathrm{fs}}(*)$ | Forward <br> Transconductance | $\mathrm{V}_{\mathrm{DS}}>\mathrm{I}_{\mathrm{D} \text { (on) }} \times \mathrm{R}_{\text {DS(on) } \max } \quad \mathrm{I}_{\mathrm{D}}=6.3 \mathrm{~A}$ | 6 | 9 |  | S |
| $\begin{aligned} & \mathrm{C}_{\text {iss }} \\ & \mathrm{C}_{\text {oss }} \\ & \mathrm{C}_{\text {rss }} \end{aligned}$ | Input Capacitance Output Capacitance Reverse Transfer Capacitance | $\mathrm{V}_{\mathrm{DS}}=25 \mathrm{~V} \quad \mathrm{f}=1 \mathrm{MHz} \quad \mathrm{VGS}_{\mathrm{GS}}=0$ |  | $\begin{gathered} 2950 \\ 370 \\ 33 \end{gathered}$ | $\begin{gathered} 3840 \\ 480 \\ 43 \end{gathered}$ | pF pF pF |

ELECTRICAL CHARACTERISTICS (continued)
SWITCHING ON

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{gathered} \mathrm{t}_{\mathrm{d}(\text { on })} \\ \mathrm{t}_{\mathrm{r}} \end{gathered}$ | Turn-on Time Rise Time | $\begin{array}{\|lc} \hline \mathrm{V}_{\mathrm{DD}}=300 \mathrm{~V} & \mathrm{I}_{\mathrm{D}}=6.3 \mathrm{~A} \\ \mathrm{R}_{\mathrm{G}}=4.7 \Omega & \mathrm{~V}_{\mathrm{GS}}=10 \mathrm{~V} \\ \text { (see test circuit, figure } 3 \text { ) } \\ \hline \end{array}$ |  | $\begin{aligned} & 30 \\ & 14 \end{aligned}$ | $\begin{aligned} & 42 \\ & 20 \end{aligned}$ | $\begin{aligned} & \text { ns } \\ & \text { ns } \end{aligned}$ |
| $\begin{aligned} & \mathrm{Q}_{\mathrm{g}} \\ & \mathrm{Q}_{\mathrm{gs}} \\ & \mathrm{Q}_{\mathrm{gd}} \end{aligned}$ | Total Gate Charge Gate-Source Charge Gate-Drain Charge | $\mathrm{V}_{\mathrm{DD}}=480 \mathrm{~V} \mathrm{I}_{\mathrm{D}}=12.6 \mathrm{~A} \mathrm{~V}_{\mathrm{GS}}=10 \mathrm{~V}$ |  | $\begin{aligned} & \hline 65 \\ & 18 \\ & 27 \end{aligned}$ | 91 | $\begin{aligned} & \mathrm{nC} \\ & \mathrm{nC} \\ & \mathrm{nC} \end{aligned}$ |

## SWITCHING OFF

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
| :---: | :--- | :--- | :--- | :---: | :---: | :---: |
| $\mathrm{t}_{\mathrm{r}}$ (Voff) | Off-voltage Rise Time | $\mathrm{V}_{\mathrm{DD}}=480 \mathrm{~V} \quad \mathrm{ID}=12.6 \mathrm{~A}$ |  | 21 | 29 | ns |
| $\mathrm{t}_{\mathrm{f}}$ | Fall Time | $\mathrm{R}_{\mathrm{G}}=4.7 \Omega \quad \mathrm{~V}_{\mathrm{GS}}=10 \mathrm{~V}$ |  | 18 | 25 | ns |
| $\mathrm{t}_{\mathrm{c}}$ | Cross-over Time | (see test circuit, figure 5$)$ |  | 32 | 45 | ns |

## SOURCE DRAIN DIODE

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Unit |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $\begin{gathered} \mathrm{I}_{\mathrm{SD}} \\ \mathrm{I}_{\mathrm{SDM}}(\cdot) \end{gathered}$ | Source-drain Current Source-drain Current (pulsed) |  |  |  | 12.6 | $\begin{aligned} & \mathrm{A} \\ & \mathrm{~A} \end{aligned}$ |
| V SD (*) | Forward On Voltage | $\mathrm{I}_{\mathrm{SD}}=12.6 \mathrm{~A} \quad \mathrm{~V}_{\mathrm{GS}}=0$ |  |  | 1.6 | V |
| trr <br> $Q_{r r}$ <br> IRRM | Reverse Recovery <br> Time <br> Reverse Recovery <br> Charge <br> Reverse Recovery <br> Current | $\begin{aligned} & \mathrm{I}_{\mathrm{SD}}=12.6 \mathrm{~A} \quad \text { di/dt }=100 \mathrm{~A} / \mathrm{\mu s} \\ & \mathrm{~V}_{\mathrm{DD}}=100 \mathrm{~V} \quad \mathrm{~T}_{\mathrm{j}}=150^{\circ} \mathrm{C} \\ & \text { (see test circuit, figure } 5 \text { ) } \end{aligned}$ |  | $\begin{gathered} 820 \\ 9.6 \\ 23.5 \end{gathered}$ |  | ns <br> $\mu \mathrm{C}$ <br> A |

(*) Pulsed: Pulse duration = $300 \mu \mathrm{~s}$, duty cycle $1.5 \%$
(•) Pulse width limited by safe operating area

Fig. 1: Unclamped Inductive Load Test Circuit


Fig. 3: Switching Times Test Circuits For
Resistive Load


Fig. 2: Unclamped Inductive Waveform


Fig. 4: Gate Charge test Circuit


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


## 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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