

## N-Channel 20 V (D-S) MOSFET

| PRODUCT SUMMARY     |                                  |                                 |                       |  |  |  |
|---------------------|----------------------------------|---------------------------------|-----------------------|--|--|--|
| V <sub>DS</sub> (V) | R <sub>DS(on)</sub> (Ω)          | I <sub>D</sub> (A) <sup>e</sup> | Q <sub>g</sub> (Typ.) |  |  |  |
|                     | 0.028 at V <sub>GS</sub> = 4.5 V | 6 <sup>a</sup>                  |                       |  |  |  |
| 20                  | 0.042 at V <sub>GS</sub> = 2.5 V | 6 <sup>a</sup>                  | 8.8 nC                |  |  |  |
|                     | 0.050 at V <sub>GS</sub> = 1.8 V | 5.6                             |                       |  |  |  |



- Halogen-free According to IEC 61249-2-21
  Definition
- TrenchFET<sup>®</sup> Power MOSFET
- 100 %  $\rm R_g$  Tested
- Compliant to RoHS Directive 2002/95/EC

#### **APPLICATIONS**

- DC/DC Converters
- Load Switch for Portable Applications

| Parameter  | Symbol                 | Limit                             | Unit                 |     |
|--|------------------------|-----------------------------------|----------------------|-----|
| Drain-Source Voltage<br>Gate-Source Voltage          |                        | V <sub>DS</sub>                   | 20                   | V   |
|  |                        | V <sub>GS</sub>                   | ± 12                 |     |
|  | T <sub>C</sub> = 25 °C |                                   | 6 <sup>a</sup>       |     |
| Continuous Droin Current (T 150 °C)                  | T <sub>C</sub> = 70 °C |                                   | 5.1                  |     |
| Continuous Drain Current ( $T_J = 150 \ ^{\circ}C$ ) | T <sub>A</sub> = 25 °C | I <sub>D</sub>                    | 5 <sup>b, c</sup>    |     |
|  | T <sub>A</sub> = 70 °C |                                   | 4 <sup>b, c</sup>    | A   |
| Pulsed Drain Current                                 |                        | I <sub>DM</sub>                   | 20                   |     |
| Outline Outline Duris Divide Outline                 | T <sub>C</sub> = 25 °C |                                   | 1.75                 |     |
| Continuous Source-Drain Diode Current                | T <sub>A</sub> = 25 °C | I <sub>S</sub>                    | 1.04 <sup>b, c</sup> |     |
|  | T <sub>C</sub> = 25 °C |                                   | 2.1                  |     |
| Maximum Davier Dissingtion                           | T <sub>C</sub> = 70 °C |                                   | 1.3                  | 14/ |
| Maximum Power Dissipation                            | T <sub>A</sub> = 25 °C | P <sub>D</sub>                    | 1.25 <sup>b, c</sup> | W   |
|  | T <sub>A</sub> = 70 °C |                                   | 0.8 <sup>b, c</sup>  |     |
| Operating Junction and Storage Temperature Range     |                        | T <sub>J</sub> , T <sub>stg</sub> | - 55 to 150          |     |
| Soldering Recommendations (Peak Tempera              |                        | 260                               |                      |     |

| THERMAL RESISTANCE RATINGS                  |              |                   |         |         |      |  |  |
|---|--------------|-------------------|---------|---------|------|--|--|
| Parameter                                   |              | Symbol            | Typical | Maximum | Unit |  |  |
| Maximum Junction-to-Ambient <sup>b, d</sup> | $t \le 5 s$  | R <sub>thJA</sub> | 80      | 100     | °C/W |  |  |
| Maximum Junction-to-Foot (Drain)            | Steady State | R <sub>thJF</sub> | 40      | 60      | 0/11 |  |  |

Notes:

a. Package limited

b. Surface Mounted on 1" x 1" FR4 board.

c. t = 5 s.

d. Maximum under steady state conditions is 125 °C/W.

e. Based on T\_C = 25 °C.

FREE

SOT-23 G 1 S 2 Top View

| <b>SPECIFICATIONS</b> $T_J = 25 \text{ °C}$ , unless otherwise noted |                         |  |          |       |          |          |  |
|--|-------------------------|--|----------|-------|----------|----------|--|
| Parameter  | Symbol                  | Test Conditions  | Min.     | Тур.  | Max.     | Unit     |  |
| Static   |                         |  |          |       |          |          |  |
| Drain-Source Breakdown Voltage                                       | V <sub>DS</sub>         | $V_{GS}$ = 0 V, $I_D$ = 250 $\mu$ A  | 20       |       |          | V        |  |
| V <sub>DS</sub> Temperature Coefficient                              | $\Delta V_{DS}/T_{J}$   | I <sub>D</sub> = 250 μA  |          | 25    |          | - mV/°C  |  |
| V <sub>GS(th)</sub> Temperature Coefficient                          | $\Delta V_{GS(th)}/T_J$ | 1 <u>0</u> – 200 m (   |          | - 2.6 |          |          |  |
| Gate-Source Threshold Voltage  | V <sub>GS(th)</sub>     | $V_{DS} = V_{GS}$ , $I_D = 250 \ \mu A$  | 0.45     |       | 1.0      | V        |  |
| Gate-Source Leakage  | I <sub>GSS</sub>        | $V_{DS} = 0 V, V_{GS} = \pm 8 V$   |          |       | ± 100    | nA       |  |
|  | 1                       | $V_{DS} = 20 V, V_{GS} = 0 V$  |          |       | 1        | μΑ       |  |
| Zero Gate Voltage Drain Current                                      | IDSS                    | $V_{DS}$ = 20 V, $V_{GS}$ = 0 V, $T_{J}$ = 70 °C   |          |       | 10       |          |  |
| On-State Drain Current <sup>a</sup>                                  | I <sub>D(on)</sub>      | $V_{DS} \le 5$ V, $V_{GS}$ = 4.5 V   | 20       |       |          | Α        |  |
|  |                         | $V_{GS} = 4.5 \text{ V}, \text{ I}_{D} = 5.0 \text{ A}$  |          | 0.028 | 28       |          |  |
| Drain-Source On-State Resistance <sup>a</sup>                        | R <sub>DS(on)</sub>     | $V_{GS} = 2.5 \text{ V}, \text{ I}_{D} = 4.7 \text{ A}$  |          | 0.042 |          | Ω        |  |
|  |                         | V <sub>GS</sub> = 1.8 V, I <sub>D</sub> = 4.3 A  |          | 0.050 |          |          |  |
| Forward Transconductance <sup>a</sup>                                | 9 <sub>fs</sub>         | V <sub>DS</sub> = 10 V, I <sub>D</sub> = 5.0 A   |          | 24    |          | S        |  |
| Dynamic <sup>b</sup>   |                         |  |          |       | <u> </u> | I        |  |
| Input Capacitance  | C <sub>iss</sub>        |  |          | 865   |          |          |  |
| Output Capacitance   | C <sub>oss</sub>        | V <sub>DS</sub> = 10 V, V <sub>GS</sub> = 0 V, f = 1 MHz                                       |          | 105   |          | pF       |  |
| Reverse Transfer Capacitance   | C <sub>rss</sub>        |  |          | 55    |          |          |  |
|  |                         | $V_{DS} = 10 \text{ V}, \text{ V}_{GS} = 5 \text{ V}, \text{ I}_{D} = 5.0 \text{ A}$           |          | 12    | 18       |          |  |
| Total Gate Charge  | Qg                      |  |          | 8.8   | 14       | nC       |  |
| Gate-Source Charge   | Q <sub>gs</sub>         | $V_{DS} = 10 \text{ V}, \text{ V}_{GS} = 4.5 \text{ V}, \text{ I}_{D} = 5.0 \text{ A}$         |          | 1.1   |          |          |  |
| Gate-Drain Charge  | Q <sub>gd</sub>         |  |          | 0.7   |          |          |  |
| Gate Resistance  | R <sub>g</sub>          | f = 1 MHz  | 0.5      | 2.4   | 4.8      | Ω        |  |
| Turn-On Delay Time   | t <sub>d(on)</sub>      |  |          | 8     | 16       |          |  |
| Rise Time  | t <sub>r</sub>          | $V_{DD}$ = 10 V, $R_L$ = 2.2 $\Omega$  |          | 17    | 26       |          |  |
| Turn-Off Delay Time  | t <sub>d(off)</sub>     | $\text{I}_\text{D} \cong$ 4 A, $\text{V}_\text{GEN}$ = 4.5 V, $\text{R}_\text{g}$ = 1 $\Omega$ |          | 31    | 47       |          |  |
| Fall Time  | t <sub>f</sub>          |  |          | 8     | 16       |          |  |
| Turn-On Delay Time   | t <sub>d(on)</sub>      |  |          | 5     | 10       | ns       |  |
| Rise Time  | t <sub>r</sub>          | $V_{DD} = 10 \text{ V}, \text{ R}_{1} = 2.2 \Omega$  |          | 13    | 20       |          |  |
| Turn-Off Delay Time  | t <sub>d(off)</sub>     | $I_D \cong 4 \text{ A}, V_{\text{GEN}} = 5 \text{ V}, \text{R}_g = 1 \Omega$                   |          | 21    | 32       |          |  |
| Fall Time  | t <sub>f</sub>          | -  |          | 6     | 12       |          |  |
| Drain-Source Body Diode Characteristic                               |                         |  | I        | l °   |          | <b>I</b> |  |
| Continuous Source-Drain Diode Current                                | Is                      | T <sub>C</sub> = 25 °C   |          |       | 1.75     | Γ        |  |
| Pulse Diode Forward Current  | I <sub>SM</sub>         | ~  |          |       | 20       | A        |  |
| Body Diode Voltage   | V <sub>SD</sub>         | I <sub>S</sub> = 4 A, V <sub>GS</sub> = 0 V  |          | 0.75  | 1.2      | v        |  |
| Body Diode Reverse Recovery Time                                     | t <sub>rr</sub>         | 6 / 46 -   |          | 12    | 20       | ns       |  |
| Body Diode Reverse Recovery Charge                                   | Q <sub>rr</sub>         |  |          | 5     | 10       | nC       |  |
| Reverse Recovery Fall Time   | t <sub>a</sub>          | $I_F = 4 \text{ A}, \text{ dI/dt} = 100 \text{ A/}\mu\text{s}, T_J = 25 ^\circ\text{C}$        |          | 7     |          |          |  |
|  | y Rise Time $t_b$       |  | <u> </u> | 5     | <u> </u> | ns       |  |

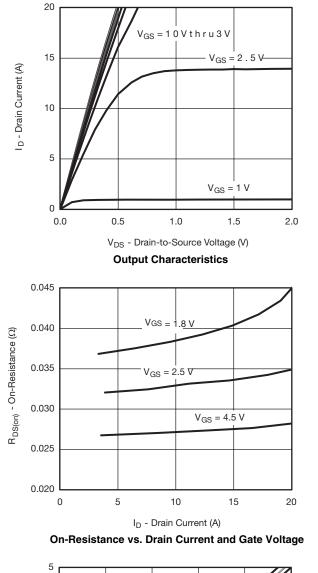
Notes:

a. Pulse test; pulse width  $\leq$  300  $\mu s,$  duty cycle  $\leq$  2 % b. Guaranteed by design, not subject to production testing.

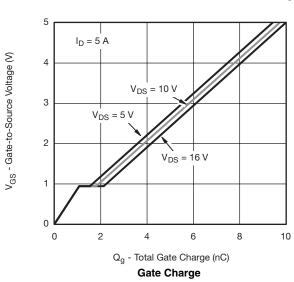
Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

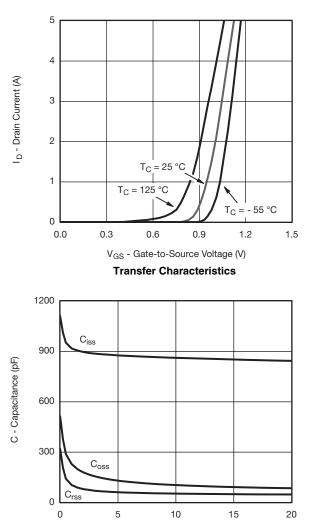
emi 'Bsemi.com



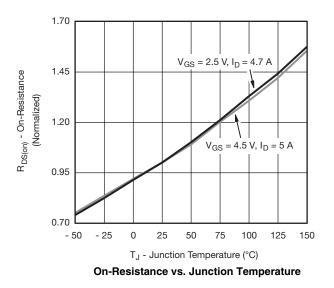


#### TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted

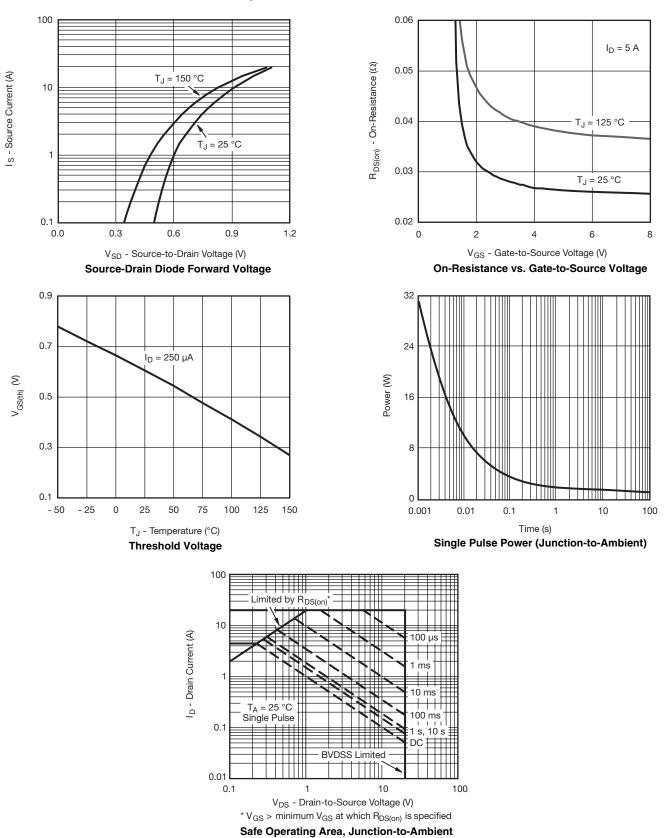




V<sub>DS</sub> - Drain-to-Source Voltage (V) Capacitance



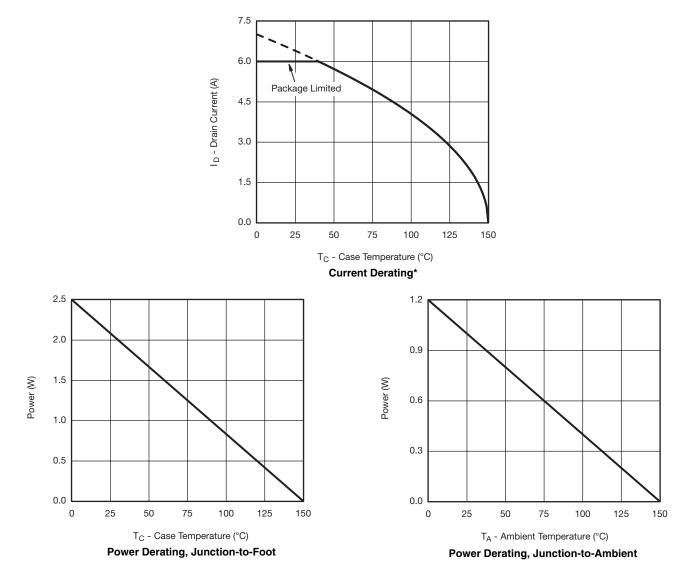




#### TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



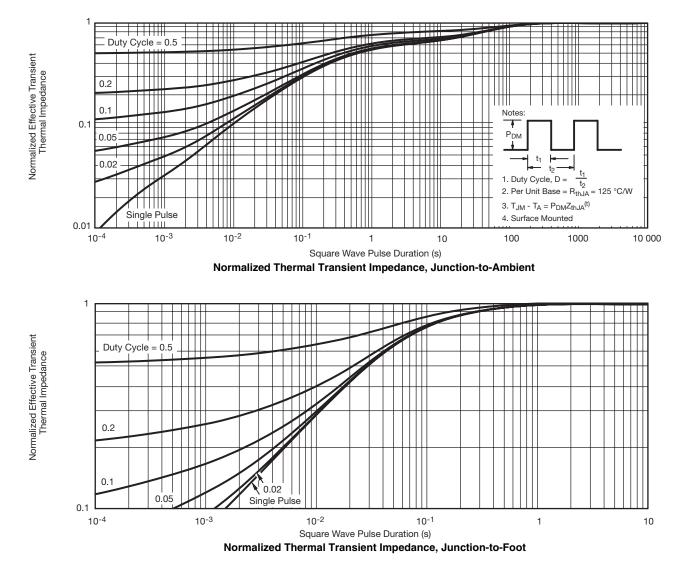
#### TYPICAL CHARACTERISTICS 25 °C, unless otherwise noted



\* The power dissipation  $P_D$  is based on  $T_{J(max.)} = 150$  °C, using junction-to-case thermal resistance, and is more useful in settling the upper dissipation limit for cases where additional heatsinking is used. It is used to determine the current rating, when this rating falls below the package limit.

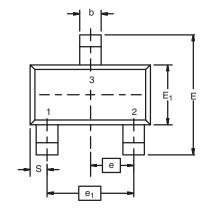


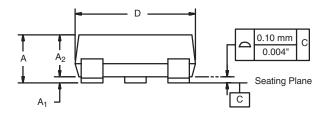


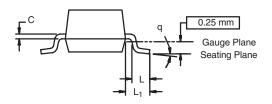




### SOT-23 (TO-236): 3-LEAD



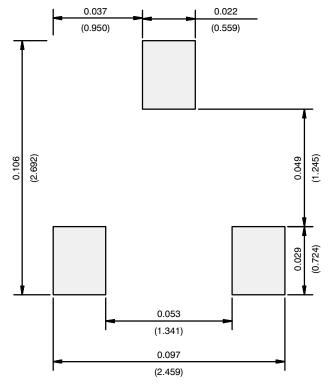




| Dim                                   | MILLIN   | <b>IETERS</b> | INCHES     |       |  |
|---------------------------------------|----------|---------------|------------|-------|--|
|                                       | Min      | Max           | Min        | Max   |  |
| Α                                     | 0.89     | 1.12          | 0.035      | 0.044 |  |
| A <sub>1</sub>                        | 0.01     | 0.10          | 0.0004     | 0.004 |  |
| A <sub>2</sub>                        | 0.88     | 1.02          | 0.0346     | 0.040 |  |
| b                                     | 0.35     | 0.50          | 0.014      | 0.020 |  |
| C                                     | 0.085    | 0.18          | 0.003      | 0.007 |  |
| D                                     | 2.80     | 3.04          | 0.110      | 0.120 |  |
| E                                     | 2.10     | 2.64          | 0.083      | 0.104 |  |
| E <sub>1</sub>                        | 1.20     | 1.40          | 0.047      | 0.055 |  |
| е                                     | 0.95 BSC |               | 0.0374 Ref |       |  |
| e <sub>1</sub>                        | 1.90 BSC |               | 0.0748 Ref |       |  |
| L                                     | 0.40     | 0.60          | 0.016      | 0.024 |  |
| L <sub>1</sub>                        | 0.64 Ref |               | 0.025 Ref  |       |  |
| S                                     | 0.50 Ref |               | 0.020 Ref  |       |  |
| q                                     | 3°       | 8°            | 3°         | 8°    |  |
| ECN: S-03946-Rev. K, 09-<br>DWG: 5479 | Jul-01   |               | ,          |       |  |



#### **RECOMMENDED MINIMUM PADS FOR SOT-23**



Recommended Minimum Pads Dimensions in Inches/(mm)



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