

## MSC39N02X

### 30V N-Channel MOSFETs

#### Description

These N-Channel enhancement mode power field effect transistors are using trench DMOS technology. This advanced technology has been especially tailored to minimize on-state resistance, provide superior switching performance, and withstand high energy pulse in the avalanche and commutation mode. These devices are well suited for high efficiency fast switching applications.

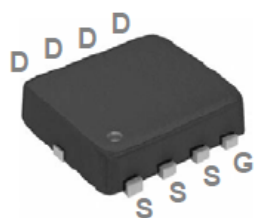
#### Features

- 30V,130A,  $R_{DS(ON)} = 1.6m\Omega @ V_{GS} = 10V$
- Improved dv/dt capability
- Fast switching
- Green Device Available
- RoHS compliant package

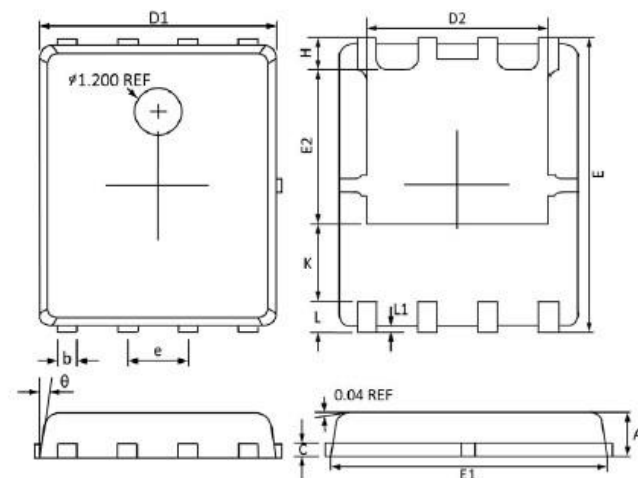
#### Applications

- MB / VGA / Server Vcore
- POL Applications
- SMPS 2nd SR
- BMS System

#### PPAK5X6 Pin Configuration

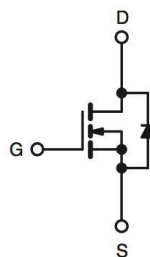


**RoHS**  
COMPLIANT



| Symbol | Dimensions In Millimeters |       | Dimensions In Inches |       |
|--------|---------------------------|-------|----------------------|-------|
|        | MAX                       | MIN   | MAX                  | MIN   |
| A      | 1.100                     | 0.800 | 0.043                | 0.031 |
| b      | 0.510                     | 0.330 | 0.020                | 0.013 |
| C      | 0.300                     | 0.200 | 0.012                | 0.008 |
| D1     | 5.100                     | 4.800 | 0.201                | 0.189 |
| D2     | 4.100                     | 3.610 | 0.161                | 0.142 |
| E      | 6.200                     | 5.900 | 0.244                | 0.232 |
| E1     | 5.900                     | 5.700 | 0.232                | 0.224 |
| E2     | 3.780                     | 3.350 | 0.149                | 0.132 |
| e      | 1.27BSC                   |       | 0.05BSC              |       |
| H      | 0.700                     | 0.410 | 0.028                | 0.016 |
| K      | 1.500                     | 1.100 | 0.059                | 0.043 |
| L      | 0.710                     | 0.510 | 0.028                | 0.020 |
| L1     | 0.200                     | 0.060 | 0.008                | 0.002 |
| θ      | 12°                       | 0°    | 12°                  | 0°    |

#### Graphic symbol



### MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

#### Absolute Maximum Ratings ( $T_A=25^\circ\text{C}$ unless otherwise noted)

| Symbol   | Parameter                                                                | Value    | Unit |
|----------|--------------------------------------------------------------------------|----------|------|
| $V_{DS}$ | Drain-Source Voltage                                                     | 30       | V    |
| $V_{GS}$ | Gate-Source Voltage                                                      | $\pm 20$ | V    |
| $I_D$    | Drain Current - Continuous ( $T_C=25^\circ\text{C}$ ) (Chip Limitation)  | 130      | A    |
|          | Drain Current - Continuous ( $T_C=100^\circ\text{C}$ ) (Chip Limitation) | 82       | A    |
| $I_{DM}$ | Drain Current - Pulsed <sup>1</sup>                                      | 520      | A    |
| EAS      | Single Pulse Avalanche Energy <sup>2</sup>                               | 245      | mJ   |

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#### Absolute Maximum Ratings ( $T_A=25^\circ\text{C}$ unless otherwise noted)

| Symbol           | Parameter                                           | Value       | Unit                |
|------------------|-----------------------------------------------------|-------------|---------------------|
| I <sub>AS</sub>  | Single Pulse Avalanched Current <sup>2</sup>        | 70          | A                   |
| P <sub>D</sub>   | Power Dissipation ( $T_C=25^\circ\text{C}$ )        | 166         | W                   |
|                  | Power Dissipation - Derate above $25^\circ\text{C}$ | 1.33        | W/ $^\circ\text{C}$ |
| T <sub>J</sub>   | Operating Junction Temperature Range                | -55 to +175 | $^\circ\text{C}$    |
| T <sub>STG</sub> | Storage Temperature Range                           | -55 to +175 | $^\circ\text{C}$    |

#### Thermal Characteristics

| Symbol           | Parameter                              | Typ. | Max. | Units              |
|------------------|----------------------------------------|------|------|--------------------|
| R <sub>ΘJA</sub> | Thermal Resistance Junction to ambient | --   | 62   | $^\circ\text{C/W}$ |
| R <sub>ΘJC</sub> | Thermal Resistance Junction to Case    | --   | 0.9  |                    |

#### Electrical Characteristics ( $T_J=25^\circ\text{C}$ , unless otherwise noted)

##### Static State Characteristics

| Symbol              | Parameter                      | Test Conditions                                                                                                                                                           | Min | Typ.       | Max.       | Units |
|---------------------|--------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------------|------------|-------|
| BV <sub>DSS</sub>   | Drain-Source Breakdown Voltage | V <sub>GS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250uA                                                                                                                | 30  |            |            | V     |
| I <sub>GSS</sub>    | Gate-Source Leakage Current    | V <sub>DS</sub> = 0 V, V <sub>GS</sub> = $\pm 20$ V                                                                                                                       |     |            | $\pm 100$  | nA    |
| I <sub>DSS</sub>    | Drain-Source Leakage Current   | V <sub>DS</sub> = 27 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = $25^\circ\text{C}$<br>V <sub>DS</sub> = 24 V, V <sub>GS</sub> = 0 V, T <sub>J</sub> = $125^\circ\text{C}$ |     |            | 1<br>10    | uA    |
| R <sub>DS(on)</sub> | Drain-Source On-Resistance     | V <sub>GS</sub> = 10 V, I <sub>D</sub> = 30 A<br>V <sub>GS</sub> = 4.5 V, I <sub>D</sub> = 15 A                                                                           |     | 1.2<br>1.8 | 1.6<br>2.4 | mΩ    |
| V <sub>GS(th)</sub> | Gate Threshold Voltage         | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = -250μA                                                                                                               | 1   | 1.6        | 2.5        | V     |
| g <sub>fs</sub>     | Forward Tranconductance        | V <sub>DS</sub> = 10 V, I <sub>D</sub> = 15 A                                                                                                                             |     | 30         |            | S     |

##### Dynamic Characteristics

| Symbol              | Parameter                          | Test Conditions                                                                                 | Min | Typ. | Max.  | Units |
|---------------------|------------------------------------|-------------------------------------------------------------------------------------------------|-----|------|-------|-------|
| Q <sub>g</sub>      | Total Gate Charge <sup>3,4</sup>   | V <sub>DS</sub> = 15 V, I <sub>D</sub> = 10 A,<br>V <sub>GS</sub> = 4.5 V                       | --  | 65   | 120   | nC    |
| Q <sub>gs</sub>     | Gate-Source Charge <sup>3,4</sup>  |                                                                                                 | --  | 16   | 30    | nC    |
| Q <sub>gd</sub>     | Gate-Drain Charge <sup>3,4</sup>   |                                                                                                 | --  | 21   | 40    | nC    |
| C <sub>ISS</sub>    | Input Capacitance                  | V <sub>DS</sub> = 25 V<br>f = 1 MHz, V <sub>GS</sub> = 0 V                                      | --  | 7720 | 11000 | pF    |
| C <sub>OSS</sub>    | Output Capacitance                 |                                                                                                 | --  | 945  | 1400  | pF    |
| C <sub>RSS</sub>    | Reverse Transfer Capacitance       |                                                                                                 | --  | 435  | 650   | pF    |
| R <sub>g</sub>      | Total Gate Charge                  | V <sub>DS</sub> = 0 V, f = 1 MHz, V <sub>GS</sub> = 0 V                                         | --  | 1.2  | 2.4   | Ω     |
| t <sub>d(on)</sub>  | Turn-On Delay Time <sup>3,4</sup>  | I <sub>D</sub> = 10 A, R <sub>G</sub> = 10 Ω,<br>V <sub>GS</sub> = 10 V, V <sub>DD</sub> = 20 V | --  | 24.6 | 48    | ns    |
| t <sub>r</sub>      | Rise Time <sup>3,4</sup>           |                                                                                                 | --  | 62.8 | 120   | ns    |
| t <sub>d(off)</sub> | Turn-Off Delay Time <sup>3,4</sup> |                                                                                                 | --  | 224  | 440   | ns    |
| t <sub>f</sub>      | Fall Time <sup>3,4</sup>           |                                                                                                 | --  | 162  | 320   | ns    |

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### Static State Characteristics

| Symbol | Parameter                     | Test Conditions                         | Min | Typ. | Max. | Units |
|--------|-------------------------------|-----------------------------------------|-----|------|------|-------|
| EAS    | Single Pulse Avalanche Energy | $V_{DD}=25V$ , $L=0.1mH$ , $I_{AS}=30A$ | 45  |      |      | mJ    |

### Drain-Source Diode Characteristics and Maximum Ratings

| Symbol   | Parameter                          | Test Conditions                                 | Min | Typ. | Max. | Units |
|----------|------------------------------------|-------------------------------------------------|-----|------|------|-------|
| $I_S$    | Continuous Source Current          | $V_G = V_D = 0V$ , Force Current                | --  | --   | 130  | A     |
| $I_{SM}$ | Pulsed Source Current <sup>3</sup> |                                                 | --  | --   | 260  | A     |
| $V_{SD}$ | Diode Forward Voltage <sup>3</sup> | $V_{GS} = 0V$ , $I_S = 1A$ , $T_J = 25^\circ C$ | --  | --   | 1    | V     |

#### Note :

- 1.Repetitive Rating : Pulsed width limited by maximum junction temperature.
2. $V_{DD}=25V$ ,  $V_{GS}=10V$ ,  $L=1mH$ ,  $I_{AS}=70A$ .,  $R_G=25\Omega$ , Starting  $T_J=25^\circ C$ .
- 3.The data tested by pulsed , pulse width  $\leq 300\mu s$  , duty cycle  $\leq 2\%$ .
- 4.Essentially independent of operating temperature.

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#### ■ Characteristics Curve

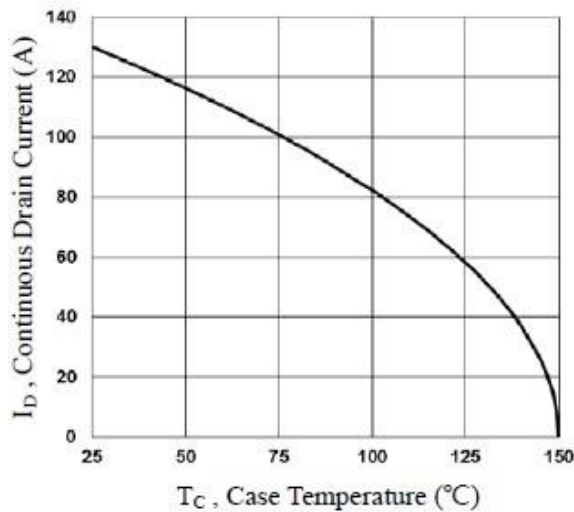


FIG.1-CONTINUOUS DRAIN CURRENT VS.  $T_C$

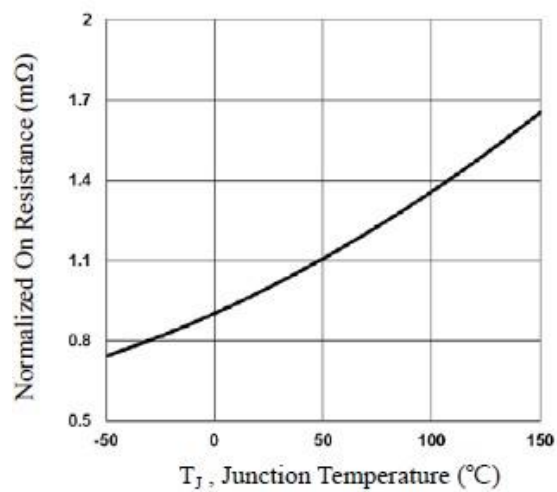


FIG.2-NORMALIZED  $R_{DS(on)}$  VS.  $T_J$

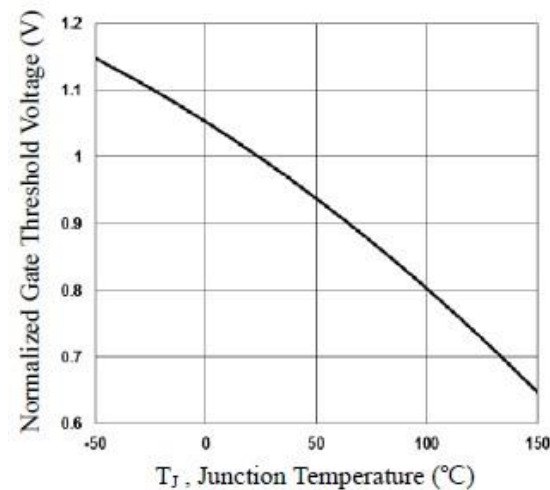


FIG.3-NORMALIZED  $V_{TH}$  VS.  $T_J$

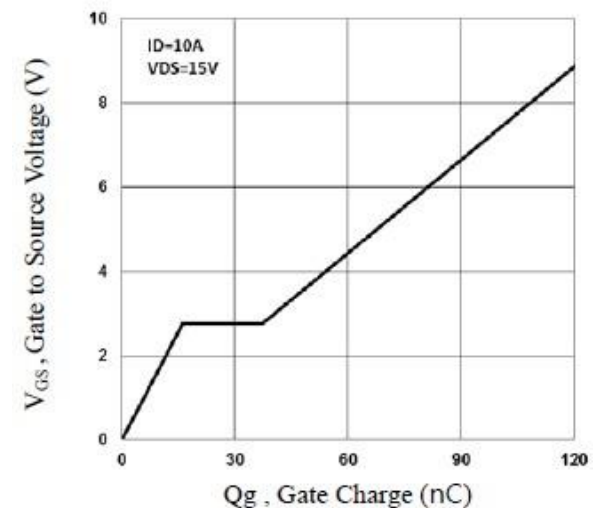


FIG.4-GATE CHARGE WAVEFORM

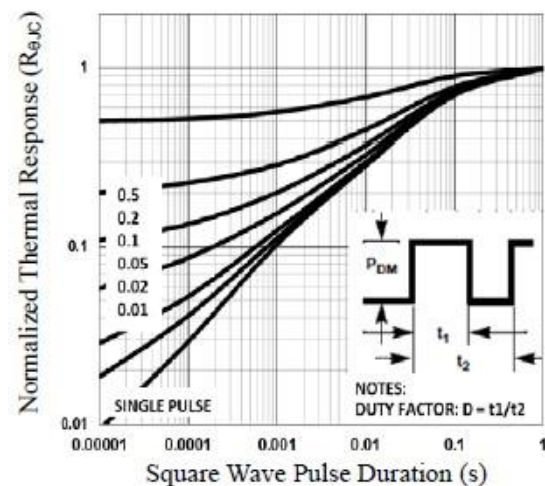


FIG.5-NORMALIZED TRANSIENT IMPEDANCE

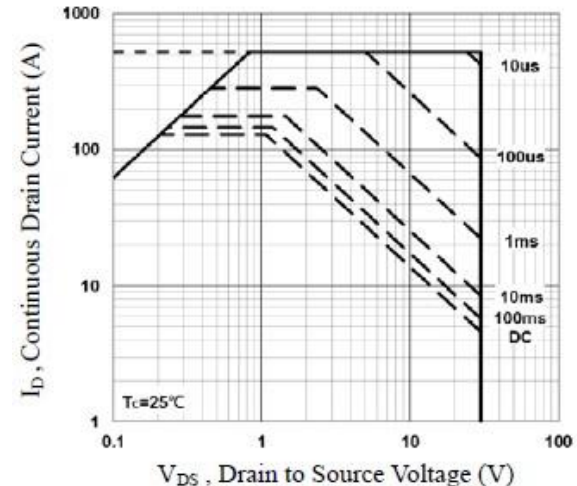
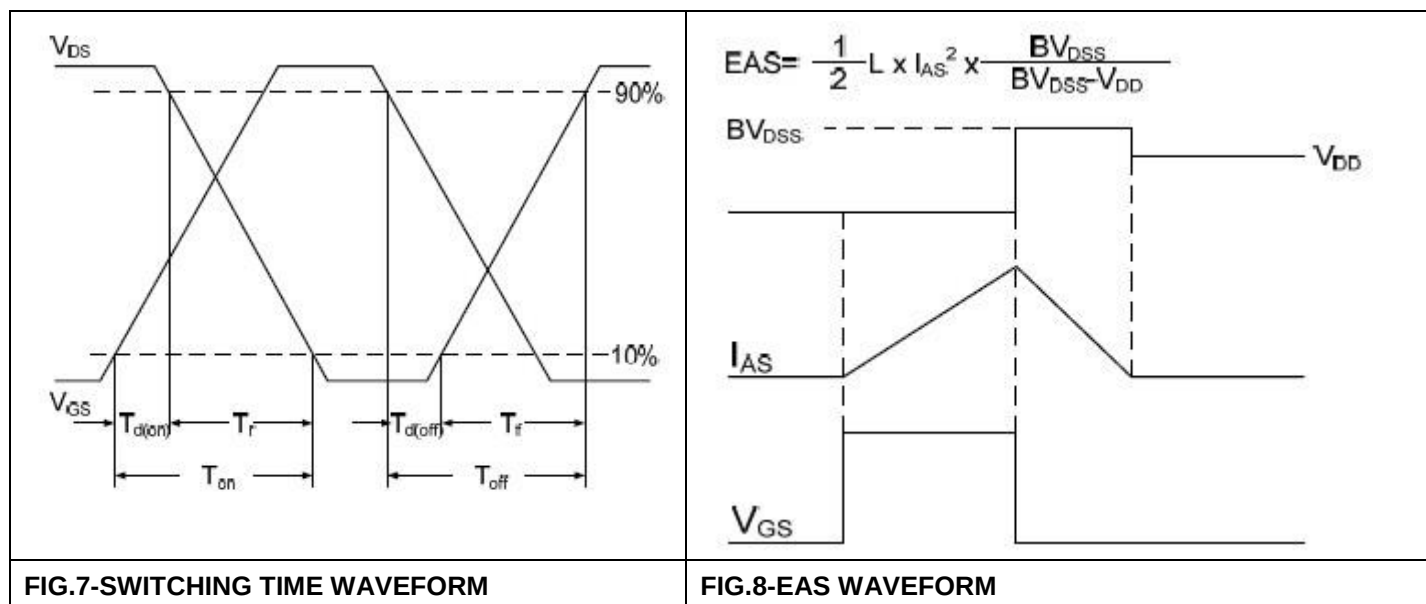


FIG.6-MAXIMUM SAFE OPERATION AREA

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### ■ Characteristics Curve



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