| | |
|---|---|
| $V_{DSS}$ | 60 V |
| $I_D$ | 5 A |
| $R_{DS(ON)}$ | 60 mΩ |

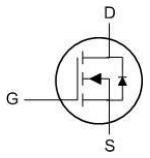
## Description

*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

*60V,5A, RDS(ON)=60mΩ@VGS=10V*
*Improved dv/dt capability*
*Fast switching*
*Green Device Available*

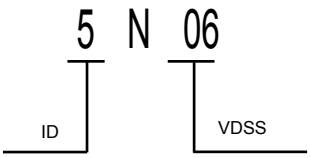
**Equivalent Circuit**






**SOT-89-3L top view**




# MAXIMUM RATINGS AND ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings

| Symbol | Parameter | Rating | Units |
|---|---|---|---|
| $V_{DS}$ | Drain-Source Voltage | 60 | V |
| $V_{GS}$ | Gate-Source Voltage | ±20 | V |
| $I_D$ | Drain Current – Continuous ($T_A$=25°C) | 5.0 | A |
| | Drain Current – Continuous ($T_A$=100°C) | 3.4 | A |
| $I_{DM}$ | Drain Current – Pulsed[1] | 15 | A |
| $P_D$ | Power Dissipation ($T_A$=25°C) | 1.35 | W |
| | Power Dissipation – Derate above 25°C | 0.011 | W/°C |
| $T_{STG}$ | Storage Temperature Range | -50 to 150 | °C |
| $T_J$ | Operating Junction Temperature Range | -50 to 150 | °C |

### Thermal Characteristics

| Parameter | Typ. | Max. | Unit |
|---|---|---|---|
| $R_{\theta JA}$ Thermal Resistance Junction to ambient | --- | 85 | °C/W |

# ELECTRICAL CHARACTERISTICS (TA = 25°C unless otherwise noted.)

## Off Characteristics

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $BV_{DSS}$ | Drain-Source Breakdown Voltage | $V_{GS}$=0V , $I_D$=250uA | 60 | --- | --- | V |
| $\triangle BV_{DSS}/\triangle T_J$ | $BV_{DSS}$ Temperature Coefficient | Reference to 25℃ , $I_D$=1mA | --- | 0.06 | --- | V/℃ |
| $I_{DSS}$ | Drain-Source Leakage Current | $V_{DS}$=60V , $V_{GS}$=0V , $T_J$=25℃ | --- | --- | 1 | uA |
| | | $V_{DS}$=48V , $V_{GS}$=0V , $T_J$=125℃ | --- | --- | 10 | uA |
| $I_{GSS}$ | Gate-Source Leakage Current | $V_{GS}$=±20V , $V_{DS}$=0V | --- | --- | ±100 | nA |

## On Characteristics

| | | | | | | |
|---|---|---|---|---|---|---|
| $R_{DS(ON)}$ | Static Drain-Source On-Resistance | $V_{GS}$=10V , $I_D$=4A | --- | 60 | 80 | mΩ |
| | | $V_{GS}$=4.5V , $I_D$=3A | --- | 70 | 90 | mΩ |
| $V_{GS(th)}$ | Gate Threshold Voltage | $V_{GS}$=$V_{DS}$ , $I_D$ =250uA | 1.0 | 1.5 | 2.5 | V |
| $\triangle V_{GS(th)}$ | $V_{GS(th)}$ Temperature Coefficient | | --- | -4.6 | --- | mV/℃ |

## Dynamic and switching Characteristics

| | | | | | | |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge[2,3] | $V_{DS}$=30V , $V_{GS}$=10V , $I_D$=10A | --- | 16.4 | --- | nC |
| $Q_{gs}$ | Gate-Source Charge[2,3] | | --- | 3.1 | --- | |
| $Q_{gd}$ | Gate-Drain Charge[2,3] | | --- | 3.7 | --- | |
| $T_{d(on)}$ | Turn-On Delay Time[2,3] | $V_{DD}$=30V , $V_{GS}$=10V , $R_G$=6Ω $I_D$=1A | --- | 4.6 | --- | ns |
| $T_r$ | Rise Time[2,3] | | --- | 14.8 | --- | |
| $T_{d(off)}$ | Turn-Off Delay Time[2,3] | | --- | 27.2 | --- | |
| $T_f$ | Fall Time[2,3] | | --- | 7.8 | --- | |
| $C_{iss}$ | Input Capacitance | $V_{DS}$=30V , $V_{GS}$=0V , F=1MHz | --- | 900 | --- | pF |
| $C_{oss}$ | Output Capacitance | | --- | 80 | --- | |
| $C_{rss}$ | Reverse Transfer Capacitance | | --- | 52 | --- | |

## Drain-Source Diode Characteristics and Maximum Ratings

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_S$ | Continuous Source Current | $V_G$=$V_D$=0V , Force Current | --- | --- | 5.0 | A |
| $I_{SM}$ | Pulsed Source Current | | --- | --- | 10 | A |
| $V_{SD}$ | Diode Forward Voltage | $V_{GS}$=0V , $I_S$=1A , $T_J$=25℃ | --- | --- | 1.2 | V |

Note :
1. Repetitive Rating : Pulsed width limited by maximum junction temperature.
2. $V_{DD}$=50V,$V_{GS}$=10V,L=0.1mH,$I_{AS}$=23A.,$R_G$=25Ω, Starting $T_J$=25℃
3. The data tested by pulsed , pulse width ≦ 300us , duty cycle ≦ 2%.
4. Essentially independent of operating temperature.

## RATING AND CHARACTERISTIC CURVES

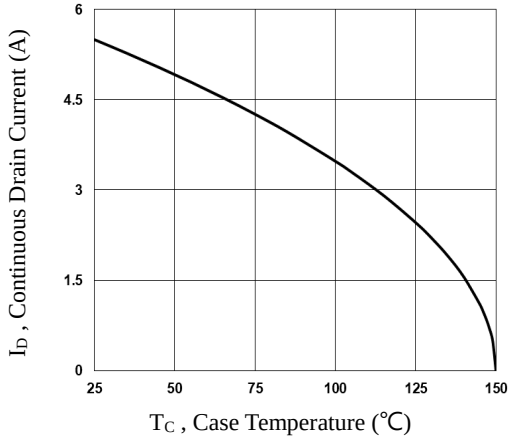



**Fig.1 Continuous Drain Current vs. $T_C$**

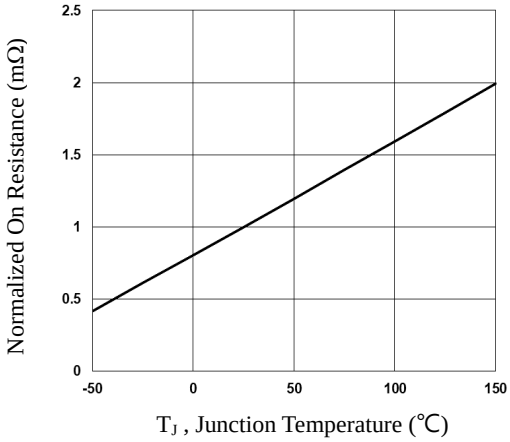



**Fig.2 Normalized RDSON vs. $T_J$**

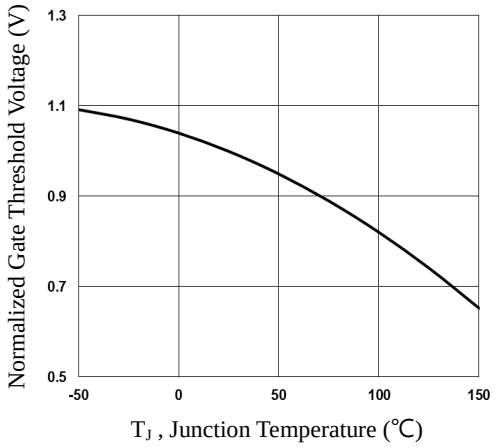



**Fig.3 Normalized $V_{th}$ vs. $T_J$**

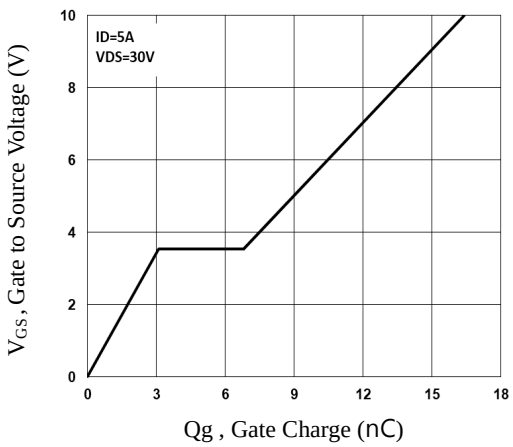



**Fig.4 Gate Charge Waveform**

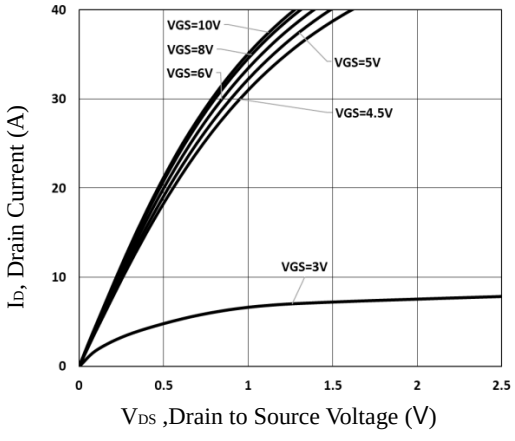



**Fig.5 Typical Output Characteristics**

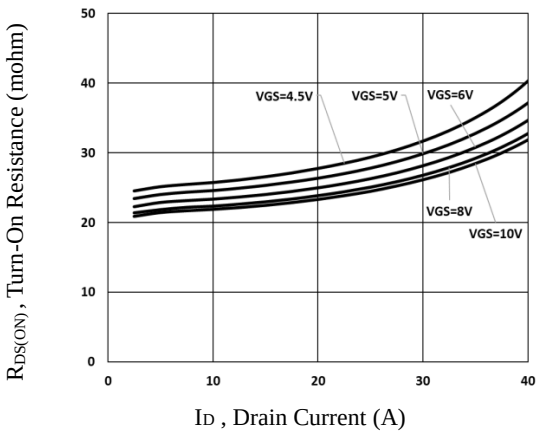



**Fig.6 Turn-On Resistance vs. $I_D$**

## RATING AND CHARACTERISTIC CURVES

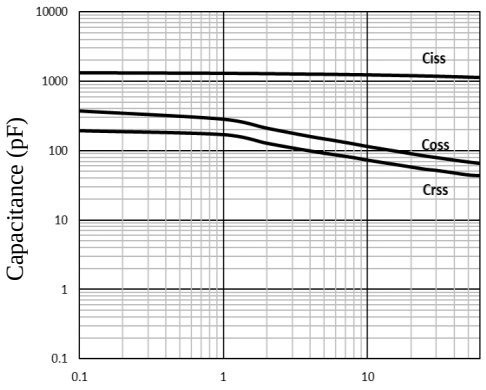



**Fig.7 Capacitance Characteristics**

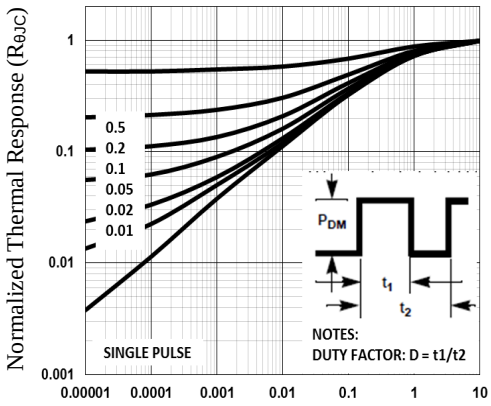



**Fig.8 Normalized Transient Impedance**

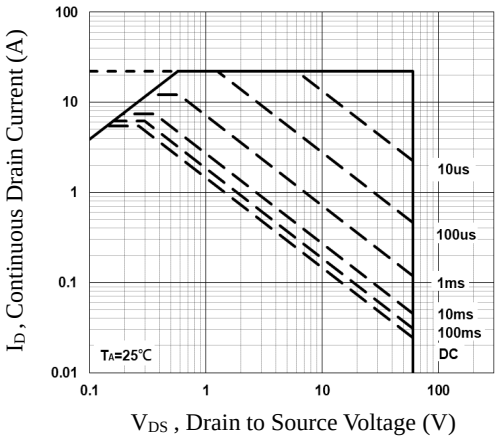



**Fig.9 Maximum Safe Operation Area**

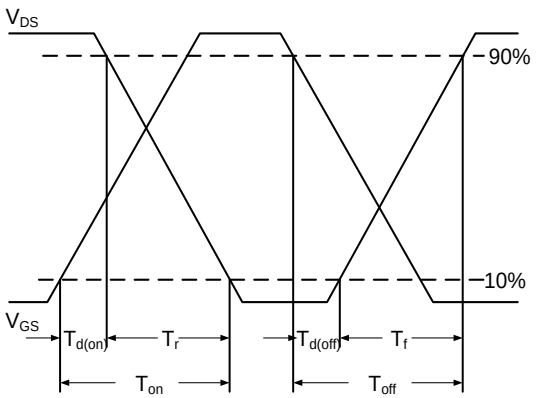
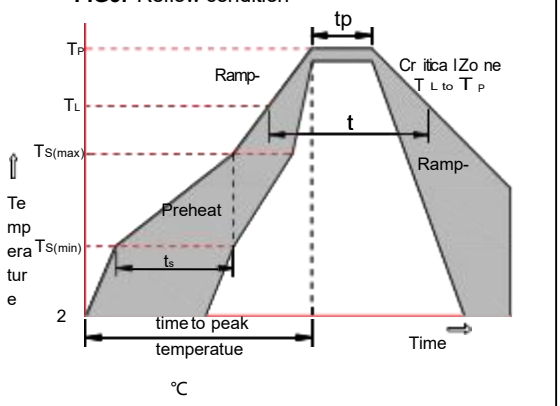



**Fig.10 Switching Time Waveform**

## Soldering parameters

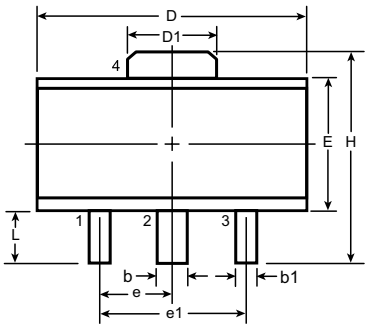
| Reflow Condition | | Pb-Free assembly (see as bellow) |
|---|---|---|
| Pre Heat | -Temperature Min ($T_{s(min)}$) | +150℃ |
| | -Temperature Max($T_{s(max)}$) | +200℃ |
| | -Time (Min to Max) (ts) | 60-180 secs. |
| Average ramp up rate (Liquid us Temp ($T_L$) to peak) | | 3℃/sec. Max |
| $T_{s(max)}$ to $T_L$ - Ramp-up Rate | | 3℃/sec. Max |
| Reflow | -Temperature($T_L$)(Liquid us) | +217℃ |
| | -Temperature($t_L$) | 60-150 secs. |
| Peak Temp ($T_p$) | | +260(+0/-5)℃ |
| Time within 5℃ of actual Peak Temp ($t_p$) | | 30 secs. Max |
| Ramp-down Rate | | 6℃/sec. Max |
| Time 25℃ to Peak Temp ($T_P$) | | 8 min. Max |
| Do not exceed | | +260℃ |

**FIG5:** Reflow condition

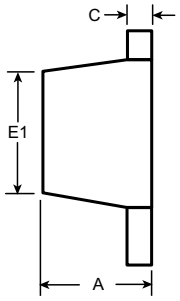



## Package Dimensions & Suggested Pad Layout

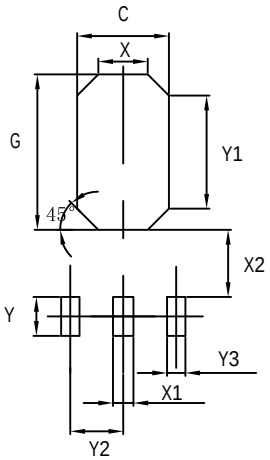
**SOT89**




**Top View**




**Side View**

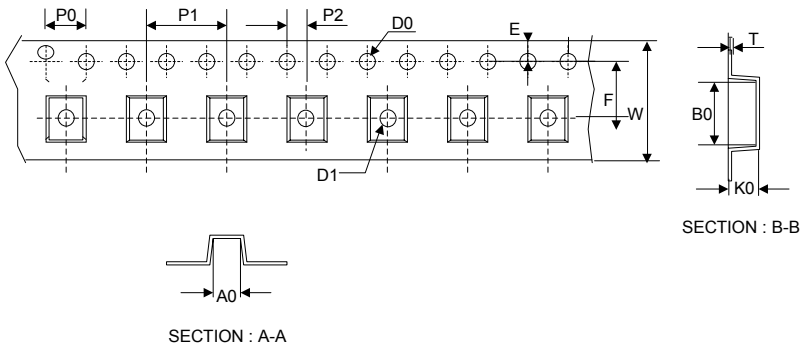



| Symbol | | A | b | b1 | C | D | D1 | E | E1 | e | e1 | H | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dimensions (mm) | MIN | 1.40 | 0.44 | 0.36 | 0.3 | 4.40 | 1.50 | 2.29 | 2.00† | 1.50 BSC | 3.00 BSC | 3.94 | 0.89 |
| | NOM | - | - | - | - | - | - | - | - | | | - | - |
| | MAX | 1.60 | 0.56 | 0.48 | 0.5 | 4.60 | 1.75 | 2.60 | 2.29 | | | 4.25 | 1.20 |

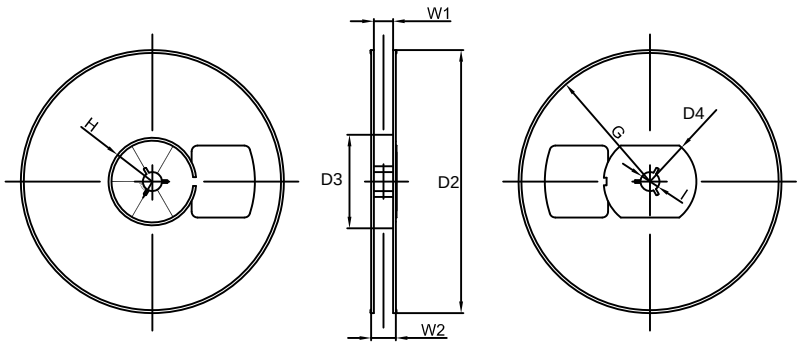
| Dimensions | Value (in mm) |
|---|---|
| C | 2.50 |
| G | 3.60 |
| X | 1.40 |
| X1 | 0.90 |
| X2 | 0.90 |
| Y | 1.40 |
| Y1 | 2.60 |
| Y2 | 1.50 |
| Y3 | 0.90 |

## Tape & rell specification

Tape




13” Reel




| Symbol | Dimension (mm) |
|---|---|
| P0 | 4.00±0.20 |
| P1 | 8.00±0.20 |
| P2 | 2.00±0.20 |
| D0 | 1.60±0.20 |
| D1 | 1.60±0.20 |
| E | 1.75±0.20 |
| F | 7.50±0.15 |
| W | 16.00±0.20 |
| A0 | 6.30±0.20 |
| B0 | 8.25±0.20 |
| K0 | 2.60±0.20 |
| T | 0.23±0.10 |
| D2 | 180.0±5.0 |
| D3 | 60Min. |
| D4 | R32.0±2.0 |
| G | R86.5±2.0 |
| H | R30.0±2.0 |
| I | 13.0±2.0 |
| W1 | 13.20±2.0 |
| W2 | 16.50±2.0 |
| Quantity: 1000PCS | |