

## Features

- Trench Power LV MOSFET Technology
- Moisture Sensitivity Level 3
- Halogen Free. "Green" Device<sup>(Note1)</sup>
- Epoxy Meets UL 94 V-0 Flammability Rating
- Lead Free Finish/RoHS Compliant ("P" Suffix Designates RoHS Compliant. See Ordering Information)

## Maximum Ratings

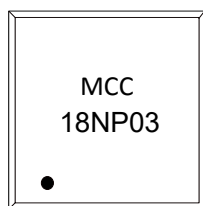
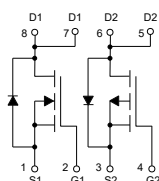
- Operating Junction Temperature Range : -55°C to +150°C
- Storage Temperature Range: -55°C to +150°C
- Thermal Resistance: 62.5°C/W Junction to Ambient<sup>(Note2)</sup>
- NMOS: Thermal Resistance: 4.5°C/W Junction to Case
- PMOS: Thermal Resistance: 5.5°C/W Junction to Case

| Parameter                                         |                       | Symbol          | Rating | Unit |
|---------------------------------------------------|-----------------------|-----------------|--------|------|
| N-Channel MOSFET                                  |                       |                 |        |      |
| Drain-Source Voltage                              |                       | V <sub>DS</sub> | 30     | V    |
| Gate-Source Voltage                               |                       | V <sub>GS</sub> | ±20    | V    |
| Continuous Drain Current                          | T <sub>C</sub> =25°C  | I <sub>D</sub>  | 20     | A    |
|                                                   | T <sub>C</sub> =100°C |                 | 12     |      |
| Pulsed Drain Current <sup>(Note 3)</sup>          |                       | I <sub>DM</sub> | 80     | A    |
| Total Power Dissipation <sup>(Note4)</sup>        |                       | P <sub>D</sub>  | 27     | W    |
| Single Pulsed Avalanche Energy <sup>(Note5)</sup> |                       | E <sub>AS</sub> | 25     | mJ   |
| P-Channel MOSFET                                  |                       |                 |        |      |
| Drain-Source Voltage                              |                       | V <sub>DS</sub> | -30    | V    |
| Gate-Source Voltage                               |                       | V <sub>GS</sub> | ±20    | V    |
| Continuous Drain Current                          | T <sub>C</sub> =25°C  | I <sub>D</sub>  | -20    | A    |
|                                                   | T <sub>C</sub> =100°C |                 | -12    |      |
| Pulsed Drain Current <sup>(Note 3)</sup>          |                       | I <sub>DM</sub> | -80    | A    |
| Total Power Dissipation <sup>(Note4)</sup>        |                       | P <sub>D</sub>  | 22     | W    |
| Single Pulsed Avalanche Energy <sup>(Note5)</sup> |                       | E <sub>AS</sub> | 81     | mJ   |

Note:

1. Halogen free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
2. The value of  $R_{\theta JA}$  is measured with the device mounted on 1in<sup>2</sup> FR-4 board with 2oz. Copper, in a still air environment with  $T_A=25^\circ\text{C}$ .
3. Repetitive rating; pulse width limited by max. junction temperature.
4.  $P_D$  is based on max. junction temperature, using junction-case thermal resistance.
5. NMOS:  $T_J=25$ ,  $V_{DD}=30\text{V}$ ,  $V_{GS}=10\text{V}$ ,  $R_G=25\Omega$ ,  $L=2\text{mH}$ .  
PMOS:  $T_J=25$ ,  $V_{DD}=-30\text{V}$ ,  $V_{GS}=-10\text{V}$ ,  $R_G=25\Omega$ ,  $L=2\text{mH}$ .

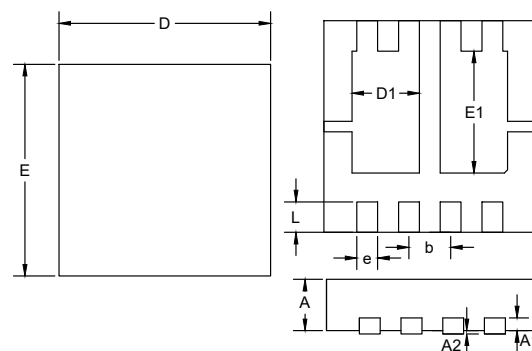
## Internal Structure and Marking Code



pin1

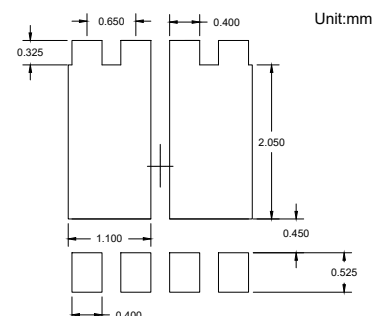
# Dual N&P-CHANNEL MOSFET

## DFN3333-D



| DIM | INCHES |       | MM    |       | NOTE |
|-----|--------|-------|-------|-------|------|
|     | MIN    | MAX   | MIN   | MAX   |      |
| A   | 0.030  | 0.033 | 0.750 | 0.850 |      |
| A1  | 0.008  |       | 0.200 |       | TYP  |
| A2  | -      | 0.002 | -     | 0.050 |      |
| D   | 0.128  | 0.132 | 3.250 | 3.350 |      |
| E   | 0.128  | 0.132 | 3.250 | 3.350 |      |
| D1  | 0.039  | 0.043 | 1.000 | 1.100 |      |
| E1  | 0.073  | 0.077 | 1.850 | 1.950 |      |
| b   | 0.026  |       | 0.650 |       | BSC  |
| e   | 0.012  | 0.014 | 0.300 | 0.350 |      |
| L   | 0.017  | 0.021 | 0.425 | 0.525 |      |

## Suggested Solder Pad Layout



**N-Channel MOSFE Electrical Characteristics @ 25°C (Unless Otherwise Specified)**

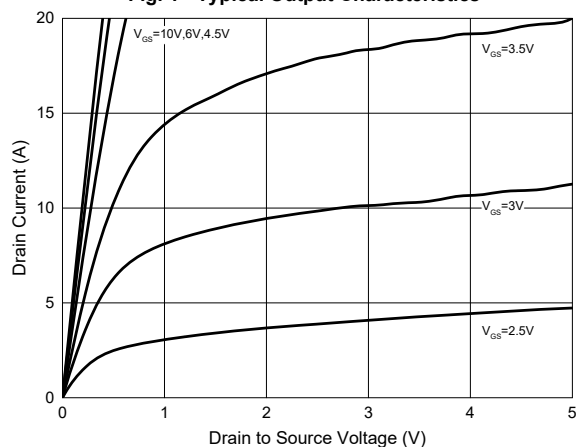
| Parameter                       | Symbol               | Test Conditions                                                                       | Min | Typ  | Max  | Unit |
|---------------------------------|----------------------|---------------------------------------------------------------------------------------|-----|------|------|------|
| Static Characteristics          |                      |                                                                                       |     |      |      |      |
| Drain-Source Breakdown Voltage  | V <sub>(BR)DSS</sub> | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA                                            | 30  |      |      | V    |
| Gate-Source Leakage Current     | I <sub>GSS</sub>     | V <sub>DS</sub> =0V, V <sub>GS</sub> =±20V                                            |     |      | ±100 | nA   |
| Zero Gate Voltage Drain Current | I <sub>DSS</sub>     | V <sub>DS</sub> =30V, V <sub>GS</sub> =0V                                             |     |      | 1    | μA   |
| Gate-Threshold Voltage          | V <sub>GS(th)</sub>  | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                              | 1.0 | 1.5  | 2.5  | V    |
| Drain-Source On-Resistance      | R <sub>DS(on)</sub>  | V <sub>GS</sub> =10V, I <sub>D</sub> =20A                                             |     | 15.5 | 20   | mΩ   |
|                                 |                      | V <sub>GS</sub> =4.5V, I <sub>D</sub> =10A                                            |     | 23   | 30   |      |
| Gate Resistance                 | R <sub>g</sub>       | f=1 MHz, Open drain                                                                   |     | 2    |      | Ω    |
| Diode Characteristics           |                      |                                                                                       |     |      |      |      |
| Continuous Body Diode Current   | I <sub>S</sub>       |                                                                                       |     |      | 20   | A    |
| Diode Forward Voltage           | V <sub>SD</sub>      | V <sub>GS</sub> =0V, I <sub>S</sub> =20A                                              |     |      | 1.2  | V    |
| Reverse Recovery Time           | t <sub>rr</sub>      | I <sub>F</sub> =10A, dI <sub>F</sub> /dt=350A/μs                                      |     | 18   |      | ns   |
| Reverse Recovery Charge         | Q <sub>rr</sub>      |                                                                                       |     | 1.7  |      | nC   |
| Dynamic Characteristics         |                      |                                                                                       |     |      |      |      |
| Input Capacitance               | C <sub>iss</sub>     | V <sub>DS</sub> =15V, V <sub>GS</sub> =0V, f=1MHz                                     |     | 380  |      | pF   |
| Output Capacitance              | C <sub>oss</sub>     |                                                                                       |     | 75   |      |      |
| Reverse Transfer Capacitance    | C <sub>rss</sub>     |                                                                                       |     | 60   |      |      |
| Total Gate Charge               | Q <sub>g</sub>       | V <sub>DS</sub> =15V, V <sub>GS</sub> =10V, I <sub>D</sub> =10A                       |     | 12.5 |      | nC   |
| Gate-Source Charge              | Q <sub>gs</sub>      |                                                                                       |     | 2.8  |      |      |
| Gate-Drain Charge               | Q <sub>gd</sub>      |                                                                                       |     | 2.5  |      |      |
| Turn-On Delay Time              | t <sub>d(on)</sub>   | V <sub>DD</sub> =15V, V <sub>GS</sub> =10V<br>R <sub>G</sub> =3Ω, I <sub>D</sub> =10A |     | 5    |      | ns   |
| Turn-On Rise Time               | t <sub>r</sub>       |                                                                                       |     | 31   |      |      |
| Turn-Off Delay Time             | t <sub>d(off)</sub>  |                                                                                       |     | 15   |      |      |
| Turn-Off Fall Time              | t <sub>f</sub>       |                                                                                       |     | 23   |      |      |

# P-Channel Electrical Characteristics @ 25°C (Unless Otherwise Specified)

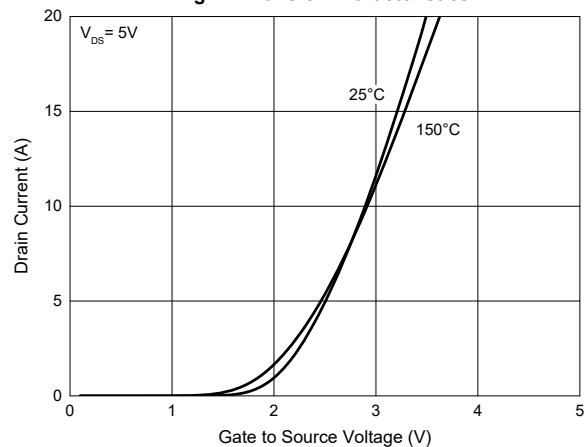
| Parameter                       | Symbol               | Test Conditions                                                                            | Min  | Typ  | Max  | Unit |
|---------------------------------|----------------------|--------------------------------------------------------------------------------------------|------|------|------|------|
| Static Characteristics          |                      |                                                                                            |      |      |      |      |
| Drain-Source Breakdown Voltage  | V <sub>(BR)DSS</sub> | V <sub>GS</sub> =0V, I <sub>D</sub> =-250μA                                                | -30  |      |      | V    |
| Gate-Source Leakage Current     | I <sub>GSS</sub>     | V <sub>DS</sub> =0V, V <sub>GS</sub> =±20V                                                 |      |      | ±100 | nA   |
| Zero Gate Voltage Drain Current | I <sub>DSS</sub>     | V <sub>DS</sub> =-30V, V <sub>GS</sub> =0V                                                 |      |      | -1   | μA   |
| Gate-Threshold Voltage          | V <sub>GS(th)</sub>  | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =-250μA                                  | -1.0 | -1.5 | -2.5 | V    |
| Drain-Source On-Resistance      | R <sub>DS(on)</sub>  | V <sub>GS</sub> =-10V, I <sub>D</sub> =-20A                                                |      | 14   | 18   | mΩ   |
|                                 |                      | V <sub>GS</sub> =-4.5V, I <sub>D</sub> =-10A                                               |      | 20   | 25   |      |
| Gate Resistance                 | R <sub>g</sub>       | f=1 MHz, Open drain                                                                        |      | 15   |      | Ω    |
| Diode Characteristics           |                      |                                                                                            |      |      |      |      |
| Continuous Body Diode Current   | I <sub>S</sub>       |                                                                                            |      |      | -20  | A    |
| Diode Forward Voltage           | V <sub>SD</sub>      | V <sub>GS</sub> =0V, I <sub>S</sub> =-20A                                                  |      |      | -1.2 | V    |
| Reverse Recovery Time           | t <sub>rr</sub>      | I <sub>F</sub> =-10A, dI <sub>F</sub> /dt=100A/μs                                          |      | 35   |      | ns   |
| Reverse Recovery Charge         | Q <sub>rr</sub>      |                                                                                            |      | 11   |      | nC   |
| Dynamic Characteristics         |                      |                                                                                            |      |      |      |      |
| Input Capacitance               | C <sub>iss</sub>     | V <sub>DS</sub> =-15V, V <sub>GS</sub> =0V, f=1MHz                                         |      | 1220 |      | pF   |
| Output Capacitance              | C <sub>oss</sub>     |                                                                                            |      | 170  |      |      |
| Reverse Transfer Capacitance    | C <sub>rss</sub>     |                                                                                            |      | 160  |      |      |
| Total Gate Charge               | Q <sub>g</sub>       | V <sub>DS</sub> =-15V, V <sub>GS</sub> =-10V, I <sub>D</sub> =-10A                         |      | 24   |      | nC   |
| Gate-Source Charge              | Q <sub>gs</sub>      |                                                                                            |      | 2    |      |      |
| Gate-Drain Charge               | Q <sub>gd</sub>      |                                                                                            |      | 6    |      |      |
| Turn-On Delay Time              | t <sub>d(on)</sub>   | V <sub>DD</sub> =-15V, V <sub>GS</sub> =-10V<br>R <sub>G</sub> =2.5Ω, I <sub>D</sub> =-10A |      | 11   |      | ns   |
| Turn-On Rise Time               | t <sub>r</sub>       |                                                                                            |      | 3    |      |      |
| Turn-Off Delay Time             | t <sub>d(off)</sub>  |                                                                                            |      | 70   |      |      |
| Turn-Off Fall Time              | t <sub>f</sub>       |                                                                                            |      | 50   |      |      |

## N-MOSFET Curve Characteristics

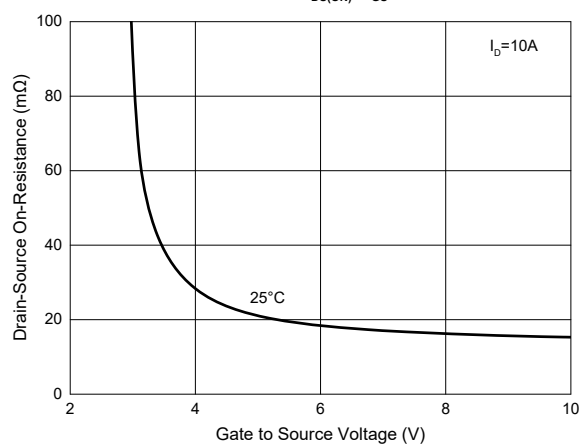
**Fig. 1 - Typical Output Characteristics**



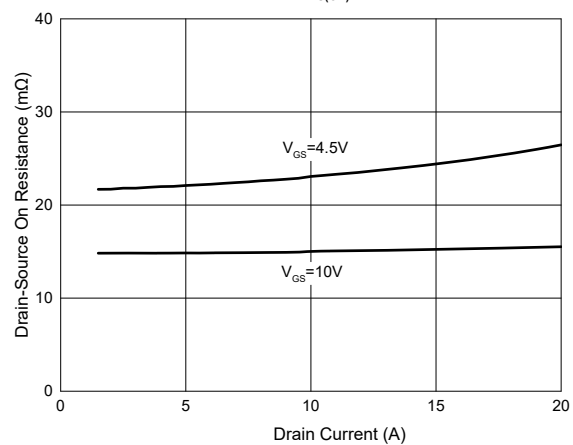
**Fig. 2 - Transfer Characteristics**



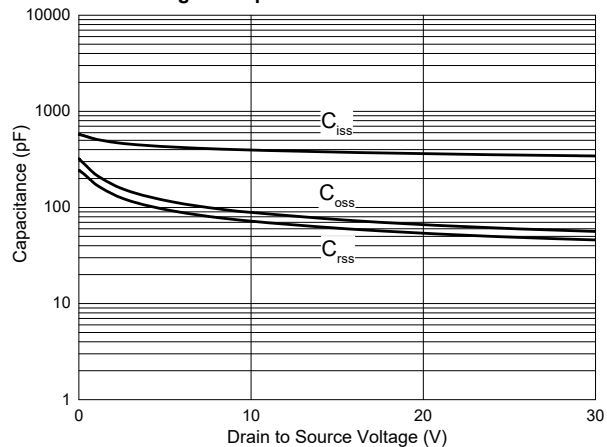
**Fig. 3 -  $R_{DS(ON)} - V_{GS}$**



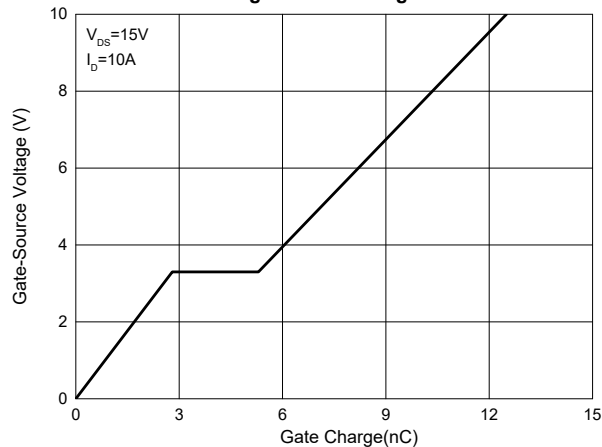
**Fig. 4 -  $R_{DS(ON)} - I_D$**



**Fig. 5 - Capacitance Characteristics**

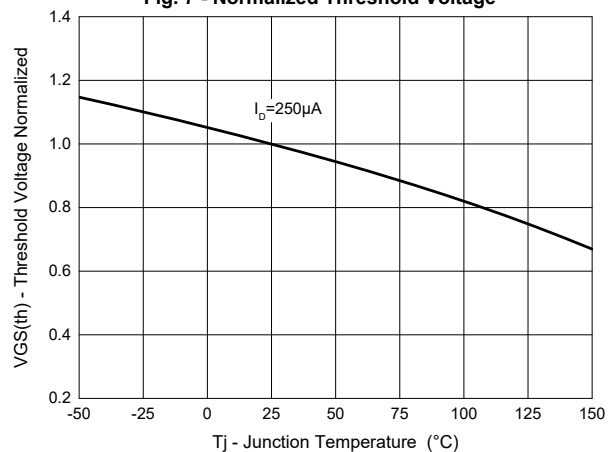


**Fig. 6 - Gate Charge**

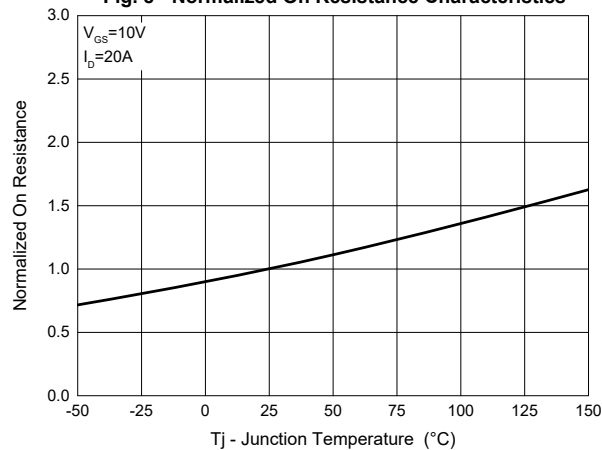


## N-MOSFET Curve Characteristics

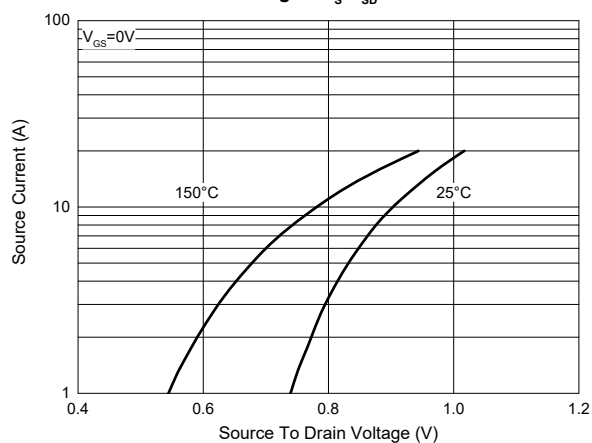
**Fig. 7 - Normalized Threshold Voltage**



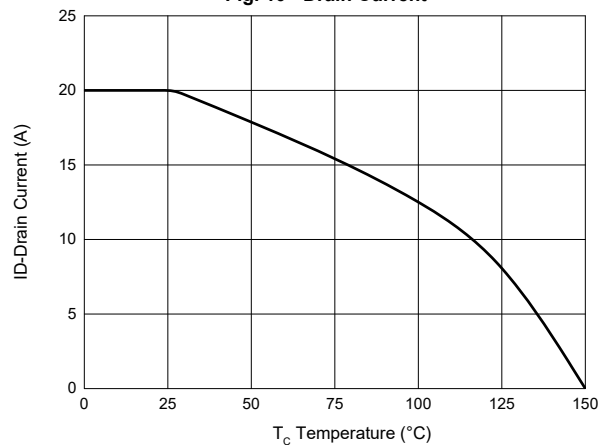
**Fig. 8 - Normalized On Resistance Characteristics**



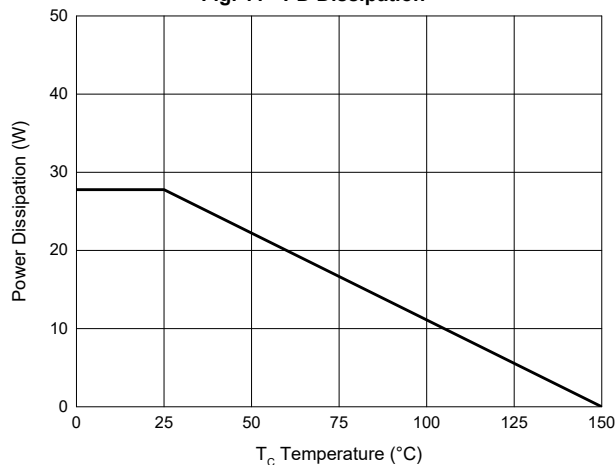
**Fig. 9 -  $I_S$ - $V_{SD}$**



**Fig. 10 - Drain Current**



**Fig. 11 - PD Dissipation**



## N-MOSFET Curve Characteristics

Fig. 12 - Safe Operation Area

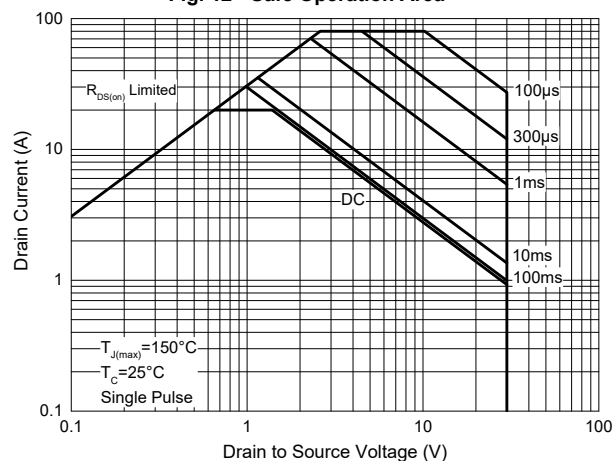
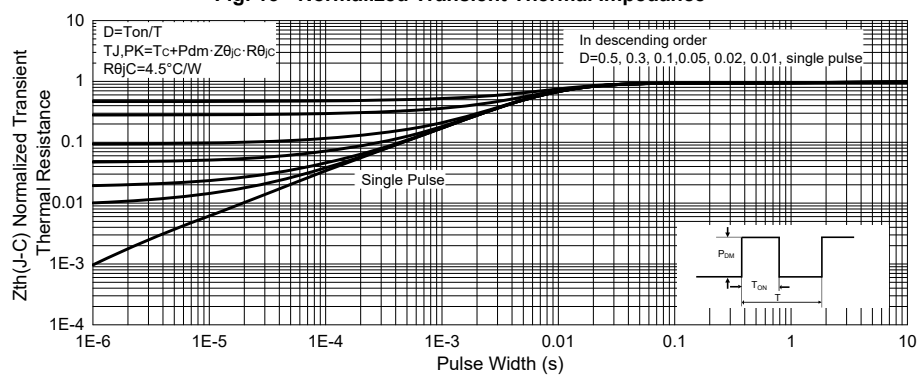
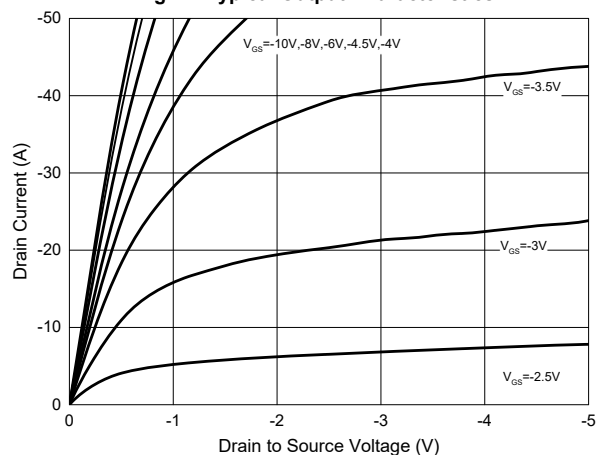


Fig. 13 - Normalized Transient Thermal Impedance

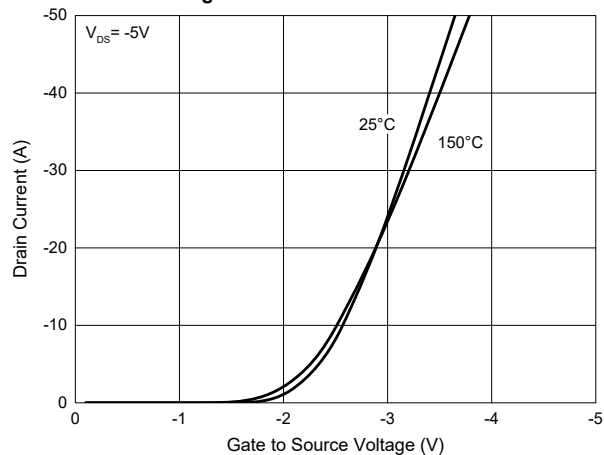


## P-MOSFET Curve Characteristics

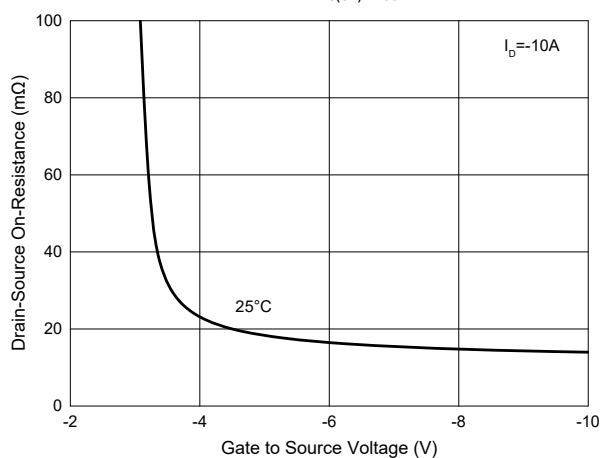
**Fig. 1 - Typical Output Characteristics**



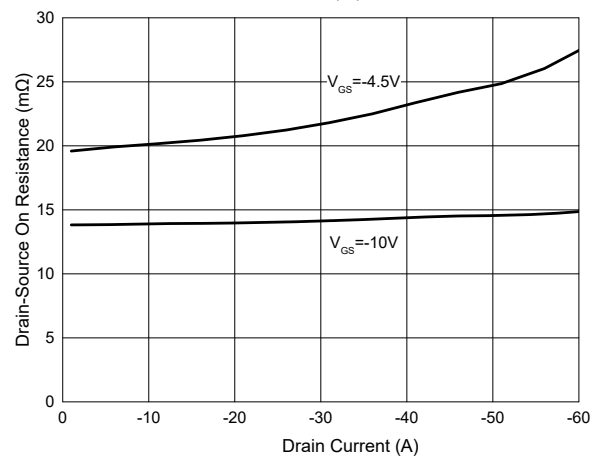
**Fig. 2 - Transfer Characteristics**



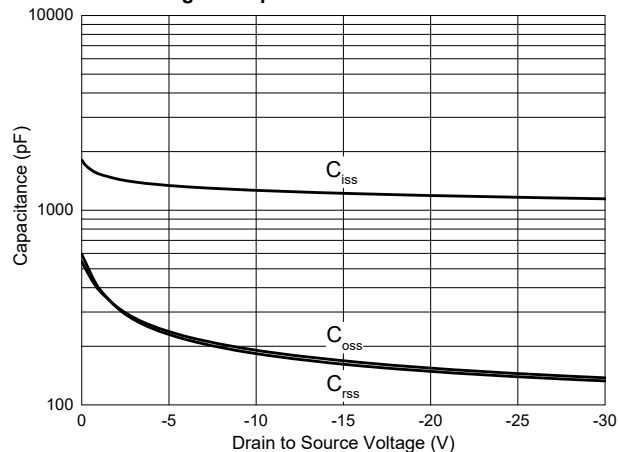
**Fig. 3 -  $R_{DS(ON)}$  -  $V_{GS}$**



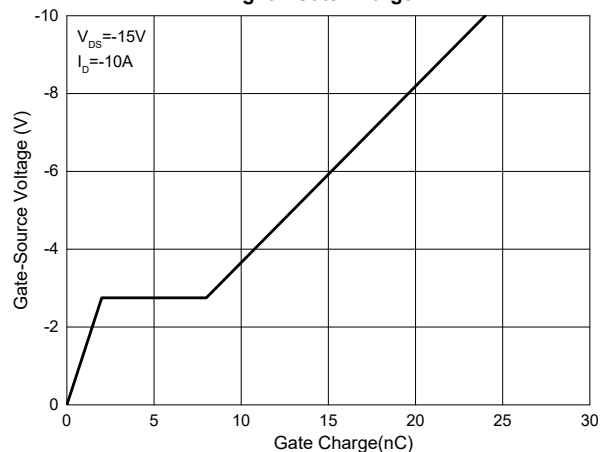
**Fig. 4 -  $R_{DS(ON)}$  -  $I_D$**



**Fig. 5 - Capacitance Characteristics**

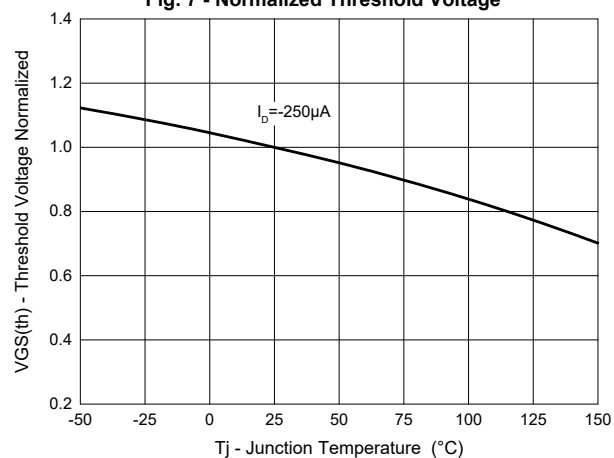


**Fig. 6 - Gate Charge**

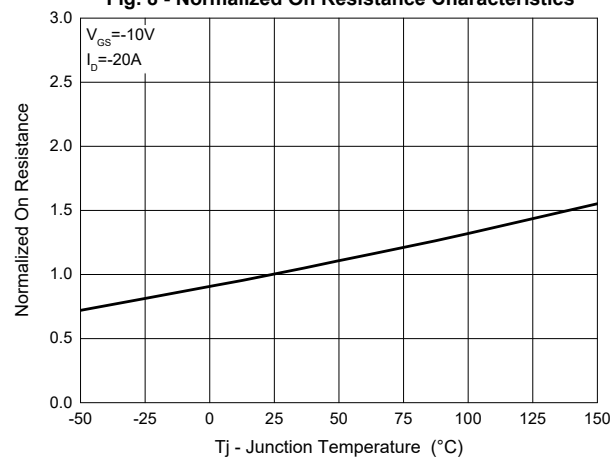


## P-MOSFET Curve Characteristics

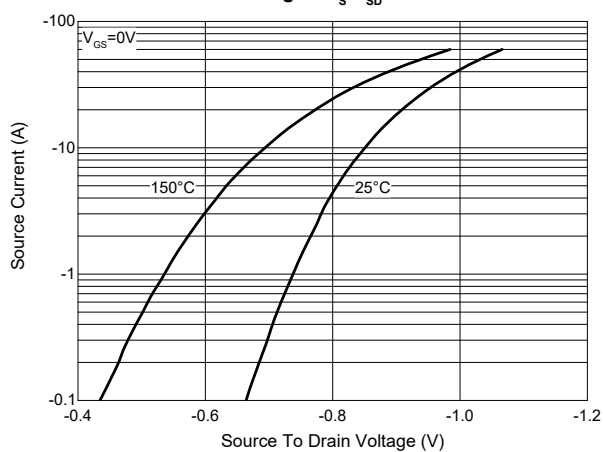
**Fig. 7 - Normalized Threshold Voltage**



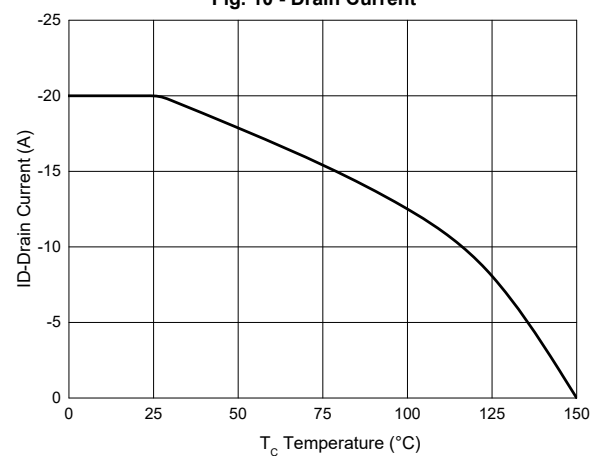
**Fig. 8 - Normalized On Resistance Characteristics**



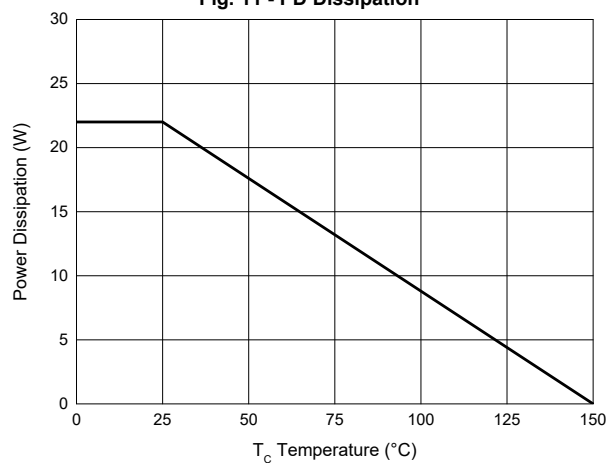
**Fig. 9 -  $I_S - V_{SD}$**



**Fig. 10 - Drain Current**



**Fig. 11 - PD Dissipation**



## P-MOSFET Curve Characteristics

Fig. 12 - Safe Operation Area

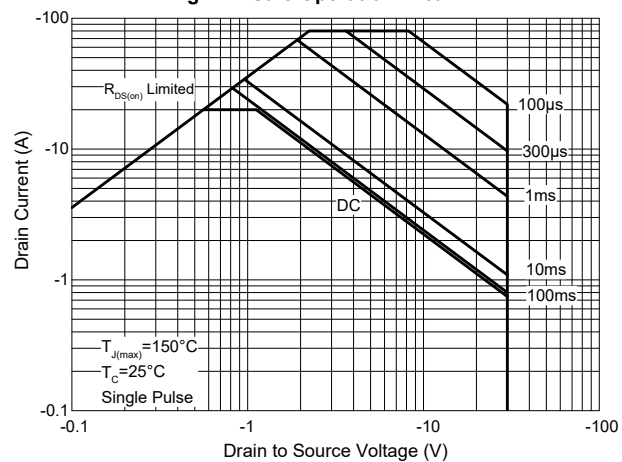
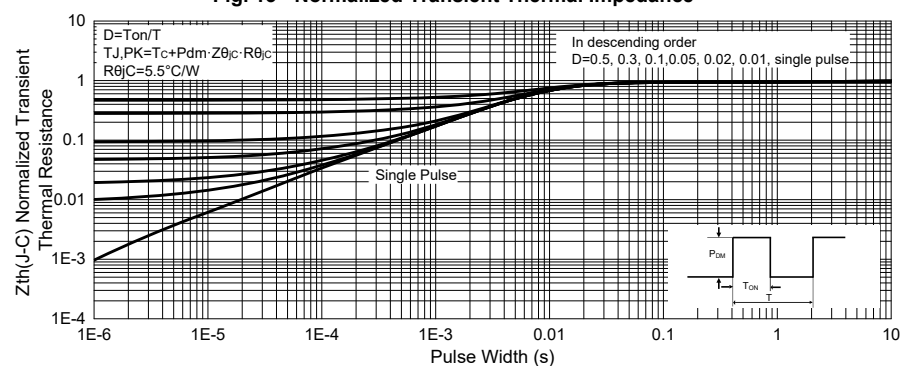


Fig. 13 - Normalized Transient Thermal Impedance



## Ordering Information

| Device         | Packing               |
|----------------|-----------------------|
| Part Number-TP | Tape&Reel: 5Kpcs/Reel |

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