

## N and P Channel Enhancement Mode Power MOSFET

**Description**

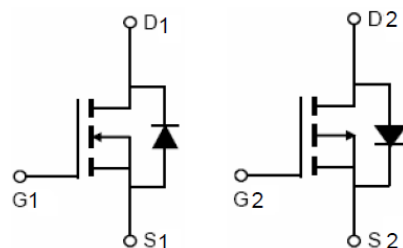
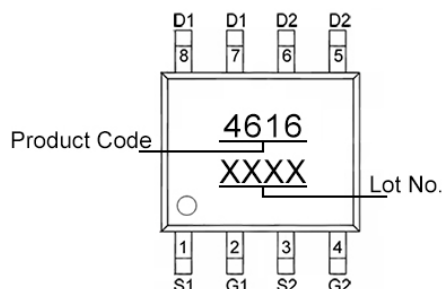
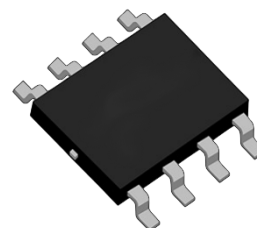
The HM4616P8X100 uses advanced trench technology to provide excellent  $R_{DS(ON)}$  and low gate charge. It can be used in a wide variety of applications.

**General Features**

- **N-Channel**
  - $V_{DS} = 30V$ ,  $I_D = 8.5A$
  - $R_{DS(ON)} < 16m\Omega$  @  $V_{GS}=10V$
  - $R_{DS(ON)} < 24m\Omega$  @  $V_{GS}=4.5V$
- **P-Channel**
  - $V_{DS} = -30V$ ,  $I_D = -7A$
  - $R_{DS(ON)} < 32m\Omega$  @  $V_{GS}=-10V$
  - $R_{DS(ON)} < 50m\Omega$  @  $V_{GS}=-4.5V$
- High Power and current handling capability
- Lead free product is acquired
- Surface Mount Package

**Application**

- PWM applications
- DC motor

**Schematic diagram****Marking and pin assignment****SOP-8****Absolute Maximum Ratings (TA=25°C unless otherwise noted)**

| Parameter                                        | Symbol         | N-Channel  | P-Channel | Unit |
|--------------------------------------------------|----------------|------------|-----------|------|
| Drain-Source Voltage                             | $V_{DS}$       | 30         | -30       | V    |
| Gate-Source Voltage                              | $V_{GS}$       | $\pm 20$   | $\pm 20$  | V    |
| Drain Current-Continuous                         | $I_D$          | 8.5        | -7        | A    |
| Drain Current-Continuous(TA=70°C)                | $I_D$          | 6.8        | -5.6      | A    |
| Pulsed Drain Current (Note 1)                    | $I_{DM}$       | 30         | -30       | A    |
| Maximum Power Dissipation                        | $P_D$          | 2          | 2         | W    |
| Operating Junction and Storage Temperature Range | $T_J, T_{STG}$ | -55 To 150 |           | °C   |

**Thermal Characteristic**

| Parameter                                        | Symbol          | N-Channel | P-Channel | Unit |
|--------------------------------------------------|-----------------|-----------|-----------|------|
| Thermal Resistance, Junction-to-Ambient (Note 2) | $R_{\theta JA}$ | 62.5      | 62.5      | °C/W |

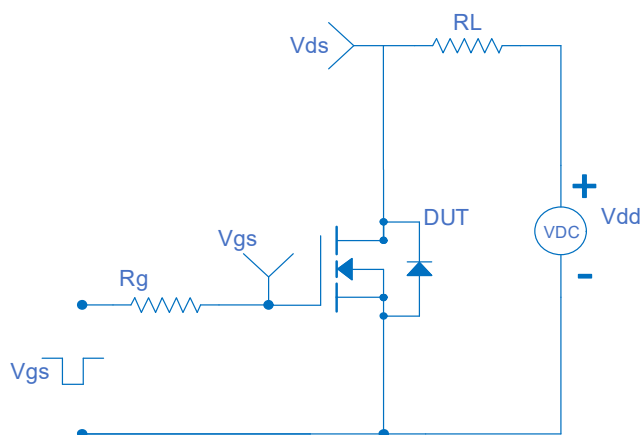
## N-Channel Electrical Characteristics (TA=25°C unless otherwise noted)

| Parameter                             | Symbol       | Condition                                                       | Min | Typ  | Max       | Unit       |
|---------------------------------------|--------------|-----------------------------------------------------------------|-----|------|-----------|------------|
| Off Characteristics                   |              |                                                                 |     |      |           |            |
| Drain-Source Breakdown Voltage        | $BV_{DSS}$   | $V_{GS}=0V, I_D=250\mu A$                                       | 30  | -    | -         | V          |
| Zero Gate Voltage Drain Current       | $I_{DSS}$    | $V_{DS}=30V, V_{GS}=0V$                                         | -   | -    | 1         | $\mu A$    |
| Gate-Body Leakage Current             | $I_{GSS}$    | $V_{GS}=\pm 20V, V_{DS}=0V$                                     | -   | -    | $\pm 100$ | nA         |
| On Characteristics (Note 3)           |              |                                                                 |     |      |           |            |
| Gate Threshold Voltage                | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=250\mu A$                                   | 1   | 1.5  | 2.2       | V          |
| Drain-Source On-State Resistance      | $R_{DS(ON)}$ | $V_{GS}=10V, I_D=6A$                                            | -   | 13   | 16        | m $\Omega$ |
|                                       |              | $V_{GS}=4.5V, I_D=4A$                                           | -   | 18   | 24        | m $\Omega$ |
| Dynamic Characteristics (Note 4)      |              |                                                                 |     |      |           |            |
| Input Capacitance                     | $C_{iss}$    | $V_{DS}=15V, V_{GS}=0V,$<br>$F=1.0MHz$                          | -   | 550  | -         | pF         |
| Output Capacitance                    | $C_{oss}$    |                                                                 | -   | 80   | -         | pF         |
| Reverse Transfer Capacitance (Note 4) | $C_{rss}$    |                                                                 | -   | 60   | -         | pF         |
| Gate Resistance                       | $R_g$        | $V_{DS}=V_{GS}=0V, F=1.0MHz$                                    | -   | 1.7  | -         | $\Omega$   |
| Switching Characteristics             |              |                                                                 |     |      |           |            |
| Turn-on Delay Time                    | $t_{d(on)}$  | $V_{DS}=15V, I_D=2A, R_L=1\Omega,$<br>$V_{GS}=10V, R_G=3\Omega$ | -   | 4.5  | -         | nS         |
| Turn-on Rise Time                     | $t_r$        |                                                                 | -   | 2.4  | -         | nS         |
| Turn-Off Delay Time                   | $t_{d(off)}$ |                                                                 | -   | 14   | -         | nS         |
| Turn-Off Fall Time                    | $t_f$        |                                                                 | -   | 2.5  | -         | nS         |
| Total Gate Charge                     | $Q_g$        | $V_{DS}=15V, I_D=6A, V_{GS}=10V$                                | -   | 7.1  | -         | nC         |
| Gate-Source Charge                    | $Q_{gs}$     |                                                                 | -   | 1.4  | -         | nC         |
| Gate-Drain Charge                     | $Q_{gd}$     |                                                                 | -   | 2.2  | -         | nC         |
| Drain-Source Diode Characteristics    |              |                                                                 |     |      |           |            |
| Diode Forward Voltage (Note 3)        | $V_{SD}$     | $V_{GS}=0V, I_S=1A$                                             | -   | -    | 1.2       | V          |
| Diode Forward Current (Note 2)        | $I_S$        |                                                                 | -   | -    | 8.5       | A          |
| Body Diode Reverse Recovery Time      | $t_{rr}$     | $I_F=6A, di/dt=100A/us$                                         | -   | 10.5 | -         | nS         |
| Body Diode Reverse Recovery Charge    | $Q_{rr}$     |                                                                 | -   | 4.5  | -         | nC         |

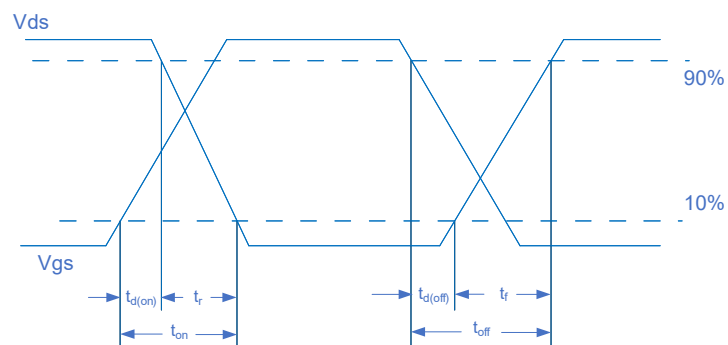
**Notes:**

1. Repetitive Rating: Pulse width limited by maximum junction temperature.
2. Surface Mounted on FR4 Board,  $t \leq 10$  sec.
3. Pulse Test: Pulse Width  $\leq 300\mu s$ , Duty Cycle  $\leq 2\%$ .
4. Guaranteed by design, not subject to product.

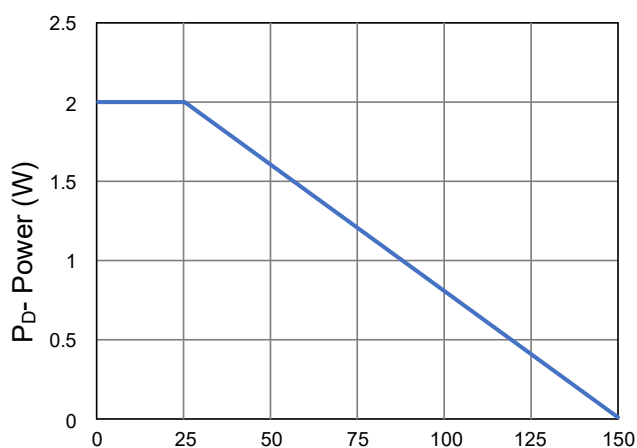
## Typical Electrical and Thermal Characteristics



**Figure 1 Switching Test Circuit**

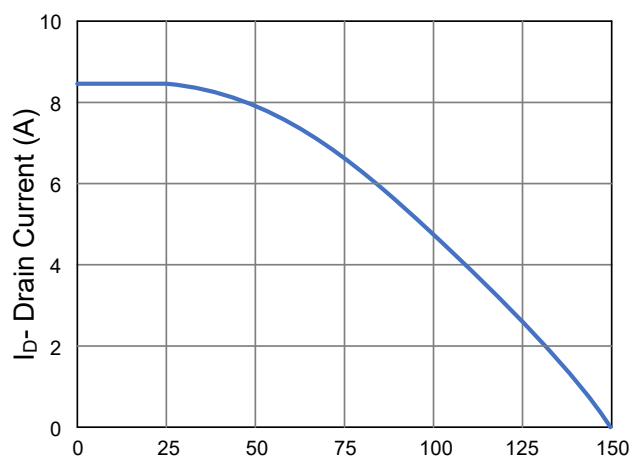


**Figure 2 Switching Waveform**



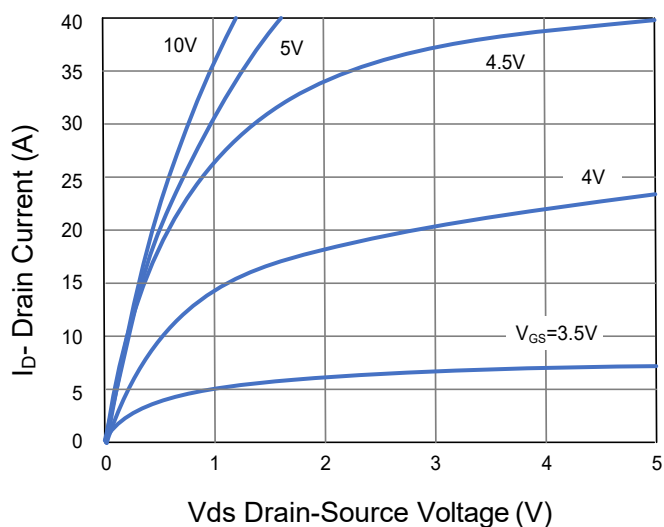
T<sub>J</sub>-Junction Temperature (°C)

**Figure 3 Power De-rating**

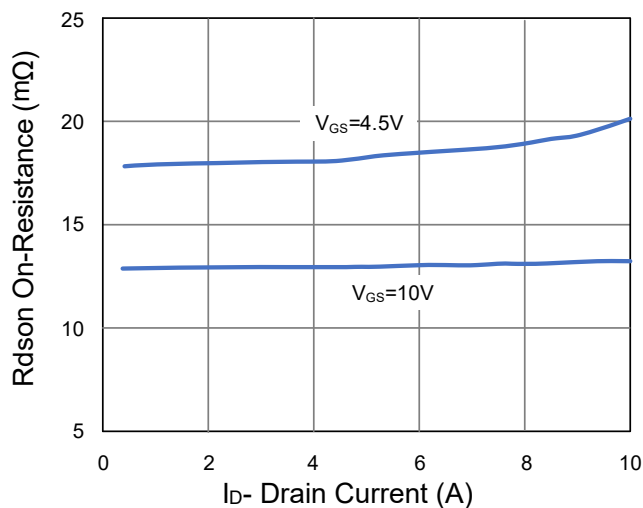


T<sub>J</sub>-Junction Temperature (°C)

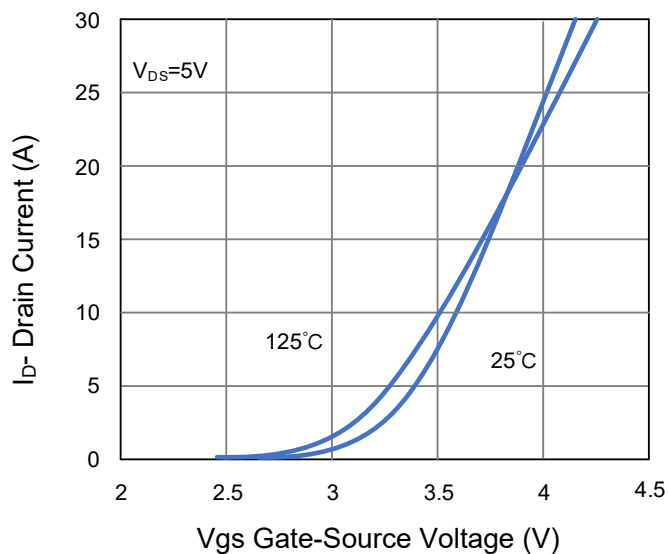
**Figure 4 Drain Current**



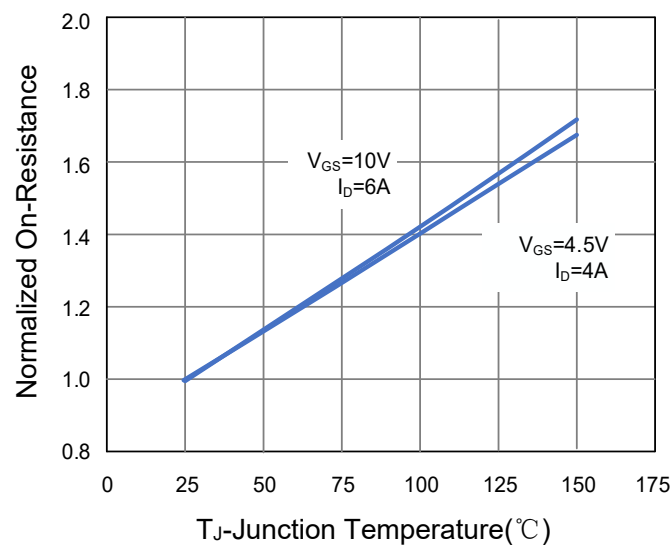
**Figure 5 Output Characteristics**



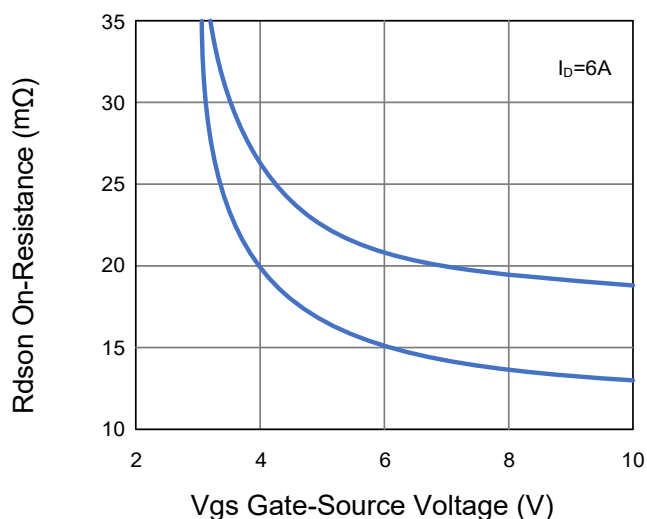
**Figure 6 Rdson vs Drain Current**



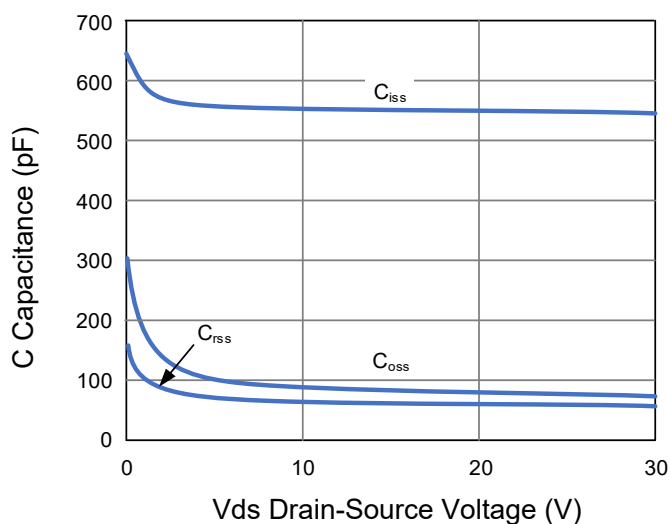
**Figure 7 Transfer Characteristics**



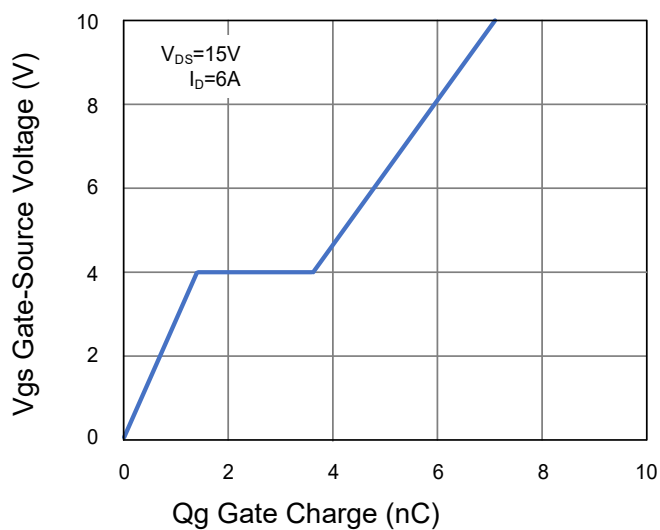
**Figure 8 Rdson vs Junction Temperature**



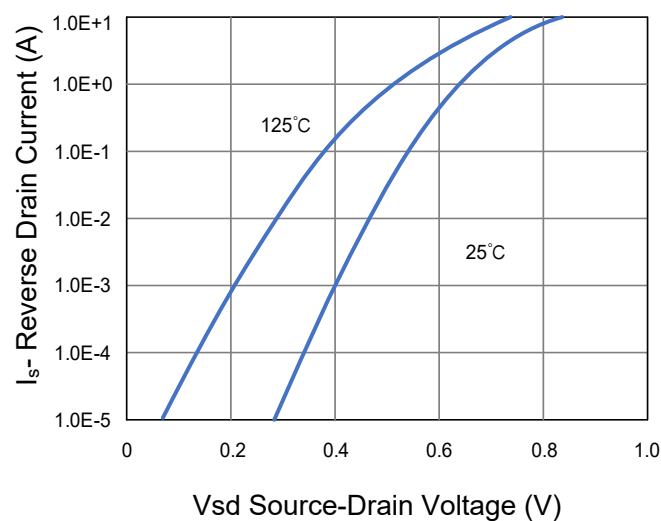
**Figure 9 Rdson vs V\_GS**



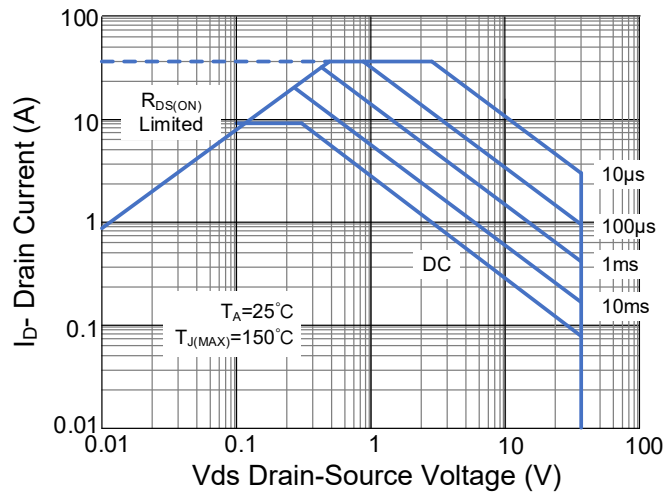
**Figure 10 Capacitance vs Vds**



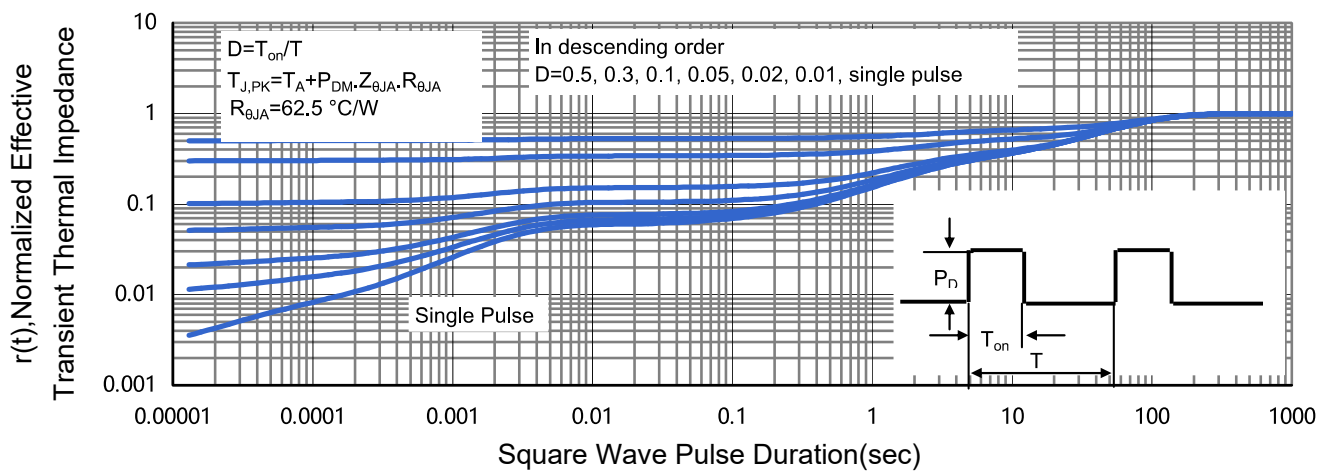
**Figure 11 Gate Charge**



**Figure 12 Source- Drain Diode Forward**



**Figure 13 Safe Operation Area**



**Figure 14 Normalized Maximum Transient Thermal Impedance**

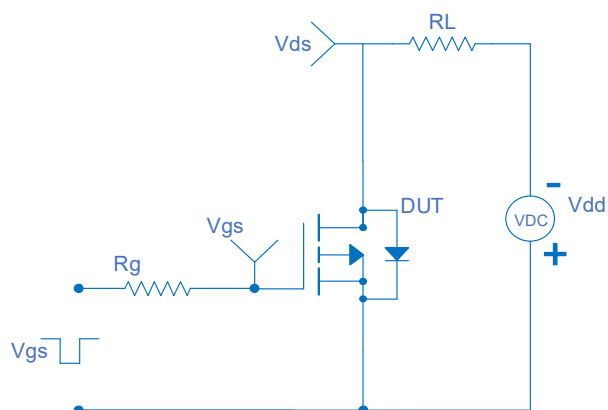
## P-Channel Electrical Characteristics (TA=25°C unless otherwise noted)

| Parameter                             | Symbol       | Condition                                                   | Min | Typ  | Max       | Unit       |
|---------------------------------------|--------------|-------------------------------------------------------------|-----|------|-----------|------------|
| Off Characteristics                   |              |                                                             |     |      |           |            |
| Drain-Source Breakdown Voltage        | $BV_{DSS}$   | $V_{GS}=0V, I_D=-250\mu A$                                  | -30 | -    | -         | V          |
| Zero Gate Voltage Drain Current       | $I_{DSS}$    | $V_{DS}=-30V, V_{GS}=0V$                                    | -   | -    | -1        | $\mu A$    |
| Gate-Body Leakage Current             | $I_{GSS}$    | $V_{GS}=\pm 20V, V_{DS}=0V$                                 | -   | -    | $\pm 100$ | nA         |
| On Characteristics (Note 3)           |              |                                                             |     |      |           |            |
| Gate Threshold Voltage                | $V_{GS(th)}$ | $V_{DS}=V_{GS}, I_D=-250\mu A$                              | -1  | -1.5 | -2.2      | V          |
| Drain-Source On-State Resistance      | $R_{DS(ON)}$ | $V_{GS}=-10V, I_D=-6A$                                      | -   | 27   | 32        | m $\Omega$ |
|                                       |              | $V_{GS}=-4.5V, I_D=-4A$                                     | -   | 39   | 50        | m $\Omega$ |
| Dynamic Characteristics (Note 4)      |              |                                                             |     |      |           |            |
| Input Capacitance                     | $C_{iss}$    | $V_{DS}=-15V, V_{GS}=0V,$<br>$F=1.0MHz$                     | -   | 630  | -         | pF         |
| Output Capacitance                    | $C_{oss}$    |                                                             | -   | 90   | -         | pF         |
| Reverse Transfer Capacitance (Note 4) | $C_{rss}$    |                                                             | -   | 60   | -         | pF         |
| Switching Characteristics             |              |                                                             |     |      |           |            |
| Turn-on Delay Time                    | $t_{d(on)}$  | $V_{DD}=-15V, R_L=2.8\Omega,$<br>$V_{GS}=-10V, R_G=3\Omega$ | -   | 8    | -         | nS         |
| Turn-on Rise Time                     | $t_r$        |                                                             | -   | 5    | -         | nS         |
| Turn-Off Delay Time                   | $t_{d(off)}$ |                                                             | -   | 28   | -         | nS         |
| Turn-Off Fall Time                    | $t_f$        |                                                             | -   | 12   | -         | nS         |
| Total Gate Charge                     | $Q_g$        | $V_{DS}=-15V, I_D=-4A, V_{GS}=-10V$                         | -   | 14   | -         | nC         |
| Gate-Source Charge                    | $Q_{gs}$     |                                                             | -   | 2    | -         | nC         |
| Gate-Drain Charge                     | $Q_{gd}$     |                                                             | -   | 3    | -         | nC         |
| Drain-Source Diode Characteristics    |              |                                                             |     |      |           |            |
| Diode Forward Voltage (Note 3)        | $V_{SD}$     | $V_{GS}=0V, I_S=-1A$                                        | -   | -    | -1.2      | V          |
| Diode Forward Current (Note 2)        | $I_S$        |                                                             | -   | -    | -7        | A          |
| Body Diode Reverse Recovery Time      | $t_{rr}$     | $I_F=-6A, di/dt=100A/us$                                    | -   | 15   | -         | nS         |
| Body Diode Reverse Recovery Charge    | $Q_{rr}$     |                                                             | -   | 9.7  | -         | nC         |

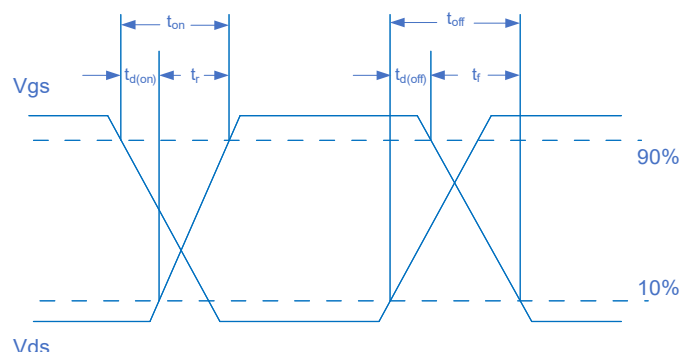
**Notes:**

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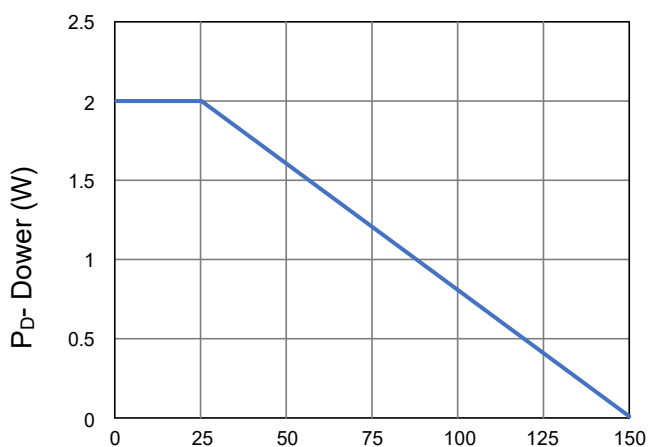
## Typical Electrical and Thermal Characteristics



**Figure 1 Switching Test Circuit**

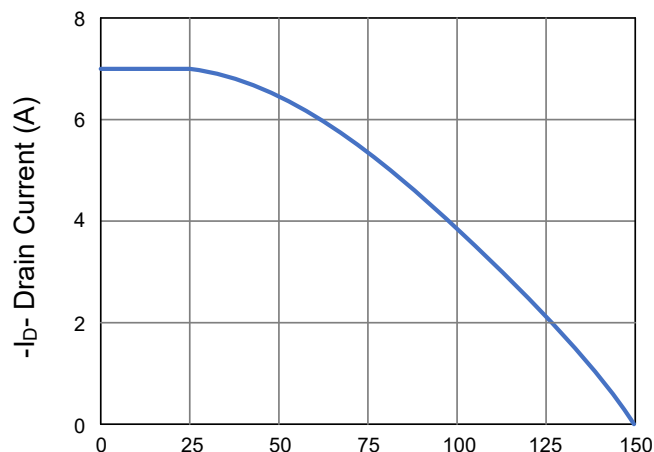


**Figure 2 Switching Waveform**



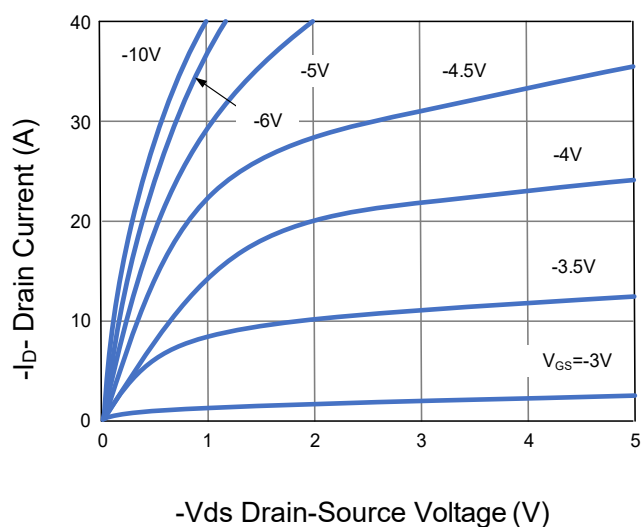
T<sub>J</sub>-Junction Temperature (°C)

**Figure 3 Power De-rating**

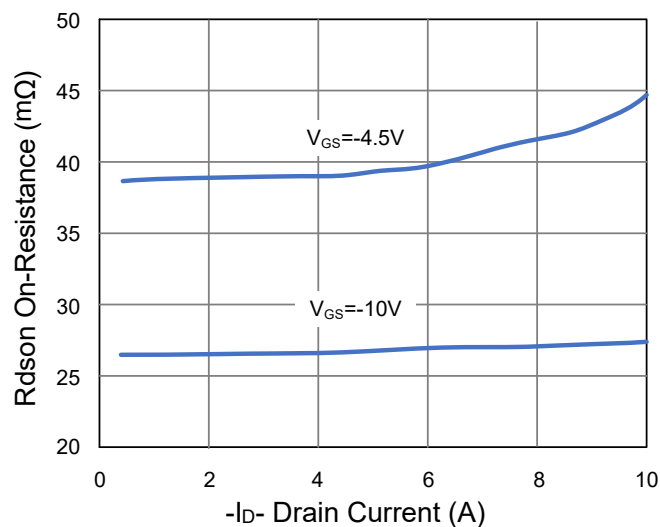


T<sub>J</sub>-Junction Temperature (°C)

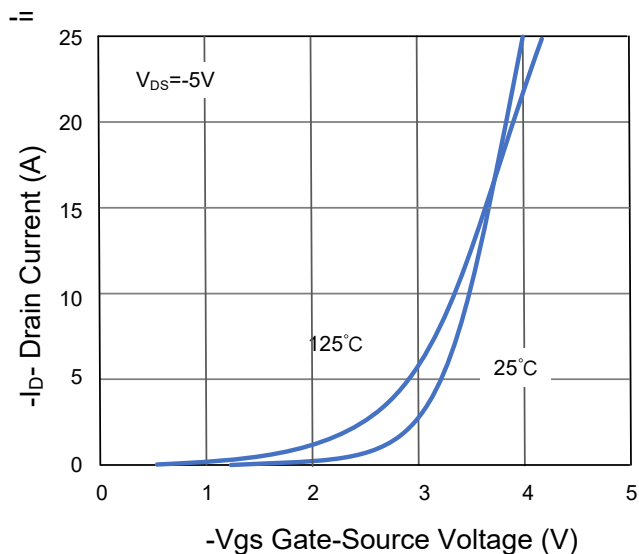
**Figure 4 Drain Current**



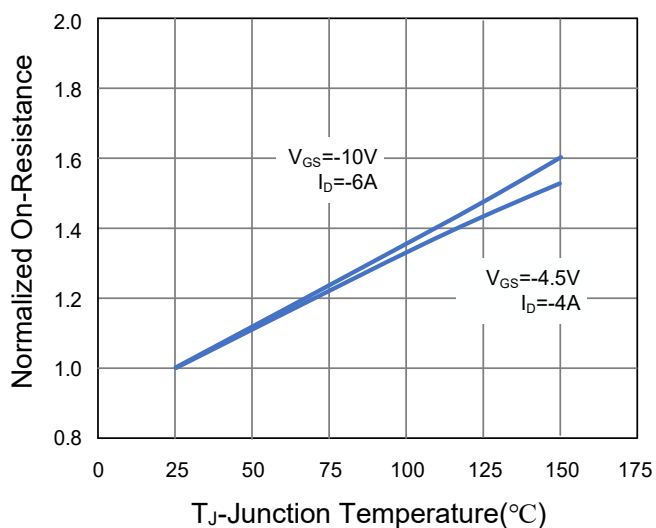
**Figure 5 Output Characteristics**



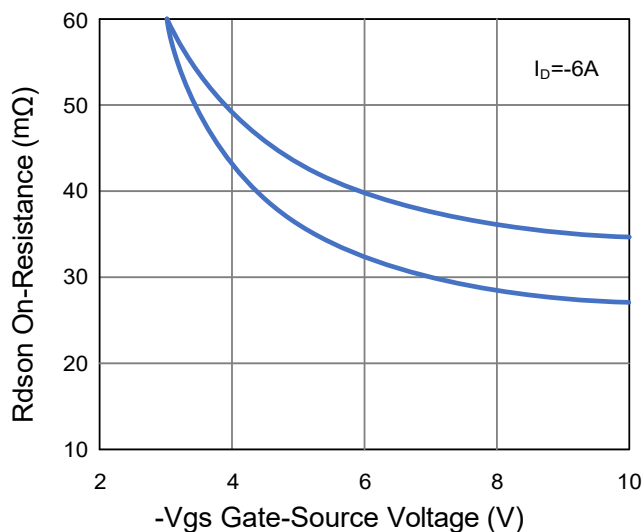
**Figure 6 Rdson vs Drain Current**



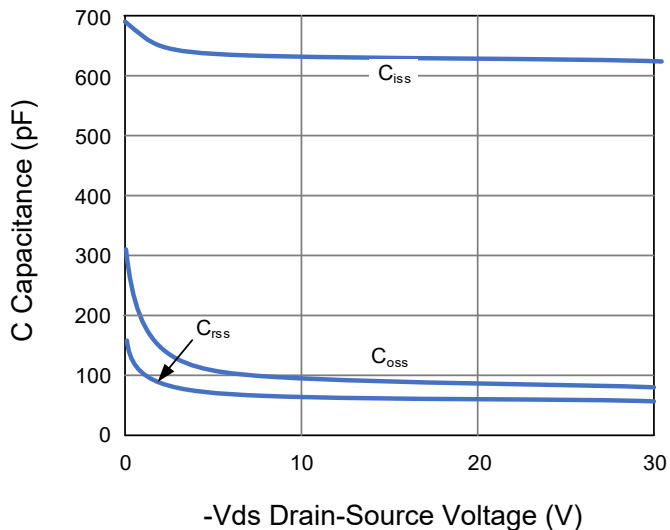
**Figure 7 Transfer Characteristics**



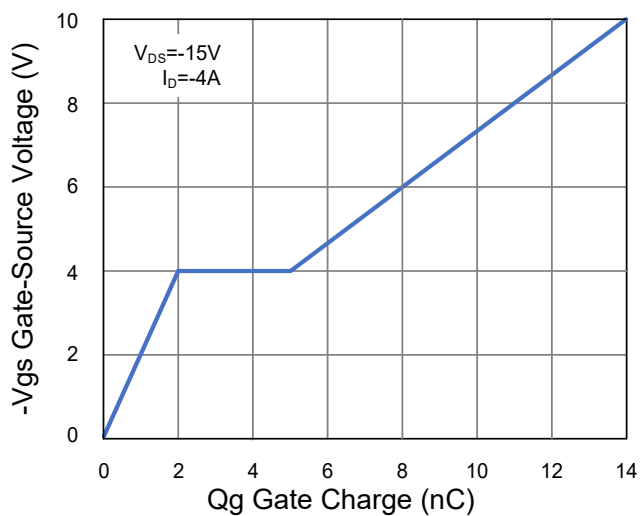
**Figure 8 Rdson vs Junction Temperature**



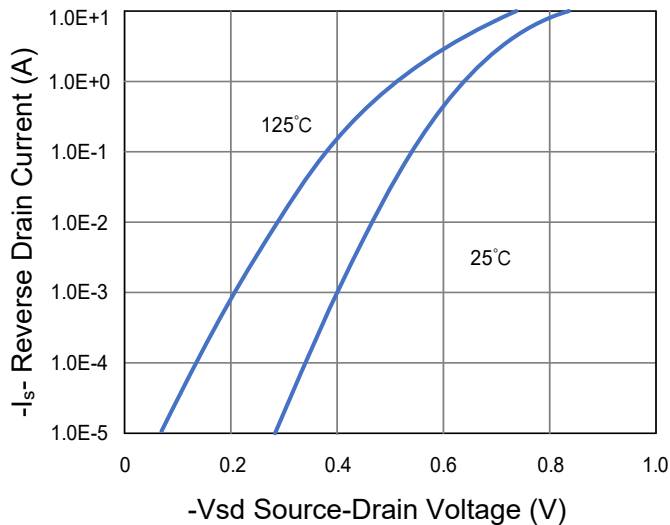
**Figure 9 Rdson vs Vgs**



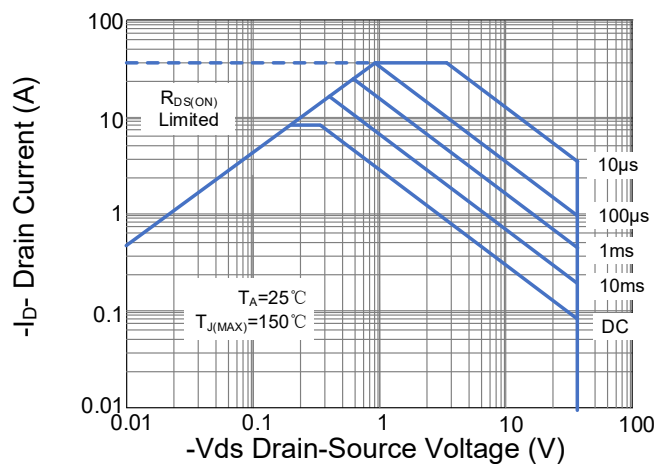
**Figure 10 Capacitance vs Vds**



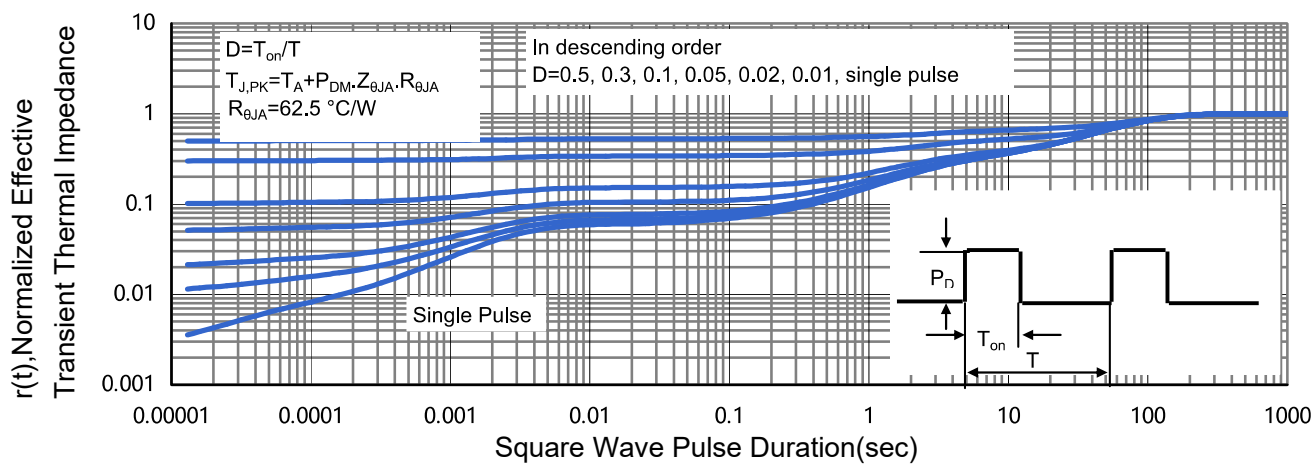
**Figure 11 Gate Charge**



**Figure 12 Source- Drain Diode Forward**

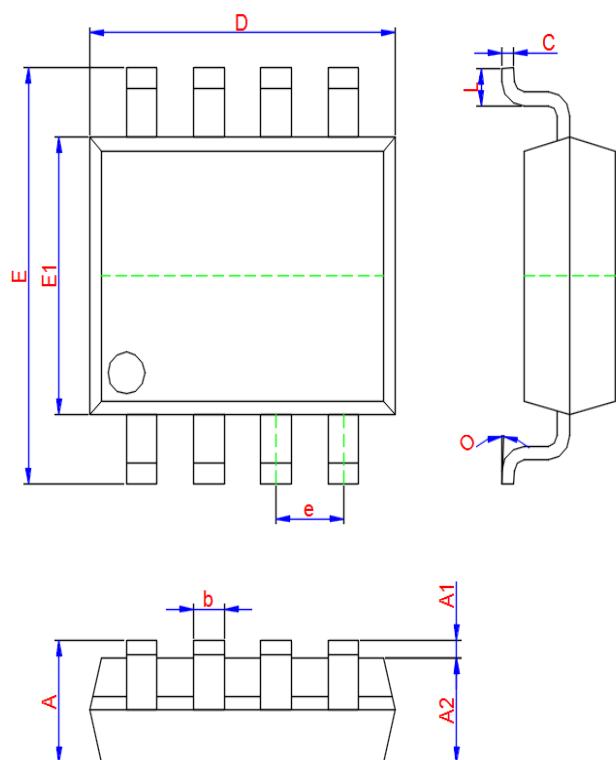


**Figure 13 Safe Operation Area**



**Figure 14 Normalized Maximum Transient Thermal Impedance**

## SOP-8 Package Information



| Symbol | Dimensions In Millimeters |       |       |
|--------|---------------------------|-------|-------|
|        | Min.                      | Typ.  | Max.  |
| A      | 1.350                     | 1.550 | 1.750 |
| A1     | 0.100                     | 0.175 | 0.250 |
| A2     | 1.350                     | 1.450 | 1.550 |
| b      | 0.330                     | 0.420 | 0.510 |
| c      | 0.170                     | 0.210 | 0.250 |
| D      | 4.700                     | 4.900 | 5.100 |
| e      | 1.270 TYP.                |       |       |
| E      | 5.800                     | 6.000 | 6.200 |
| E1     | 3.750                     | 3.900 | 4.050 |
| L      | 0.400                     | 0.835 | 1.270 |
| O      | 0°                        | 4°    | 8°    |

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- 1) Comply with applicable safety standards in designing a secure system architecture;
- 2) Implement redundancy, fire-prevention measures, and malfunction prevention protocols;
- 3) Mitigate risks of accidents, fires, or societal damages resulting from product use.
- 4) Designers must ensure Hypersemi products operate strictly within specified parameters defined in the latest product specifications.