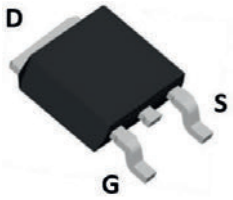
GOOD-ARK SEMICONDUCTOR

# GSFD65R400

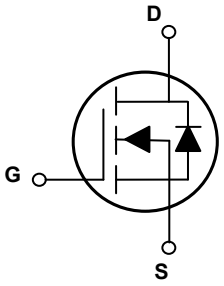
**650V N-Channel MOSFET**

## Main Product Characteristics

| | |
|---|---|
| $V_{(BR)DSS}$ | 650V |
| $R_{DS(ON)}$ | 0.40Ω (Max.) |
| $I_D$ | 11A |




TO-252 (DPAK)




Schematic Diagram

## Features and Benefits

- Advanced MOSFET process technology
- Ideal for high efficiency switched mode power supplies
- Low on-resistance with low gate charge
- Fast switching and reverse body recovery

RoHS Compliant

## Description

The GSFD65R400 utilizes the latest techniques to achieve high cell density and low on-resistance. These features make this device extremely efficient and reliable for use in high efficiency switch mode power supplies and a wide variety of other applications.

## Absolute Maximum Ratings ($T_A$=25°C unless otherwise specified)

| Parameter | Symbol | Max. | Unit |
|---|---|---|---|
| Drain-Source Voltage | $V_{DS}$ | 650 | V |
| Gate-to-Source Voltage | $V_{GS}$ | ±30 | V |
| Continuous Drain Current, @ Steady-State ($T_C$=25°C) | $I_D$ | 11 | A |
| Continuous Drain Current, @ Steady-State ($T_C$=100°C) | | 7 | A |
| Pulsed Drain Current | $I_{DM}$ | 44 | A |
| Power Dissipation ($T_C$=25°C) | $P_D$ | 96 | W |
| | | 0.77 | W/°C |
| Single Pulse Avalanche Energy[1] | $E_{AS}$ | 356 | mJ |
| Single Pulse Avalanche Current | $I_{AS}$ | 2.8 | A |
| Body Diode Reverse Voltage Slope[2] | dv/dt | 15 | V/ns |
| MOS dv/dt Ruggedness[3] | dv/dt | 100 | V/ns |
| Junction-to-Ambient (PCB Mounted, Steady-State) | $R_{\theta JA}$ | 62.5 | °C/W |
| Junction-to-Case | $R_{\theta JC}$ | 1.3 | °C/W |
| Operating Junction and Storage Temperature Range | $T_J/T_{STG}$ | -55 to +150 | °C |
| Soldering Temperature | $T_{sold}$ | 260 | °C |

## Electrical Characteristics ($T_J$=25°C unless otherwise specified)

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| **On / Off Characteristics** | | | | | | |
| Drain-to-Source Breakdown Voltage | $V_{(BR)DSS}$ | $V_{GS}$=0V, $I_D$=250μA | 650 | - | - | V |
| Drain-to-Source Leakage Current | $I_{DSS}$ | $V_{DS}$=650V, $V_{GS}$=0V, $T_J$=25°C | - | - | 1.0 | μA |
| | | $V_{DS}$=650V, $V_{GS}$=0V, $T_J$=125°C | - | 1.5 | - | μA |
| Gate-to-Source Forward Leakage | $I_{GSS}$ | $V_{DS}$=0V, $V_{GS}$=30V | - | - | 100 | nA |
| | | $V_{DS}$=0V, $V_{GS}$=-30V | - | - | -100 | |
| Static Drain-to-Source On-Resistance | $R_{DS(ON)}$ | $V_{GS}$=10V, $I_D$=5.5A | - | 0.33 | 0.40 | Ω |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS}$=$V_{GS}$, $I_D$=250μA | 2.0 | - | 4.0 | V |
| **Dynamic and Switching Characteristics** | | | | | | |
| Input Capacitance | $C_{iss}$ | $V_{GS}$=0V, $V_{DS}$=100V, F=1MHz | - | 925 | - | pF |
| Output Capacitance | $C_{oss}$ | | - | 30 | - | |
| Reverse Transfer Capacitance | $C_{rss}$ | | - | 0.8 | - | |
| Total Gate Charge[4,5] | $Q_g$ | $I_D$=11A, $V_{DD}$=520V, $V_{GS}$=10V | - | 30 | - | nC |
| Gate-to-Source Charge[4,5] | $Q_{gs}$ | | - | 7.8 | - | |
| Gate-to-Drain ("Miller") Charge[4,5] | $Q_{gd}$ | | - | 15 | - | |
| Gate Plateau[4,5] | $V_{plateau}$ | | - | 6.9 | - | V |
| Turn-On Delay Time[4,5] | $t_{d(on)}$ | $V_{DD}$=325V, $V_{GS}$=10V, $R_G$=24Ω, $I_D$=11A | - | 15 | - | nS |
| Rise Time[4,5] | $t_r$ | | - | 35 | - | |
| Turn-Off Delay Time[4,5] | $t_{d(off)}$ | | - | 65 | - | |
| Fall Time[4,5] | $t_f$ | | - | 30 | - | |
| Gate Resistance | $R_g$ | F=1MHz | - | 3.6 | - | Ω |
| **Source-Drain Ratings and Characteristics** | | | | | | |
| Continuous Source Current (Body Diode) | $I_S$ | $T_C$=25°C, MOSFET symbol showing the integral reverse p-n junction diode. | - | - | 11 | A |
| Diode Pulse Current | $I_{S,\ pulse}$ | | - | - | 44 | A |
| Diode Forward Voltage | $V_{SD}$ | $I_S$=11A, $V_{GS}$=0V | - | - | 1.4 | V |
| Reverse Recovery Time[4] | $T_{rr}$ | Is=11A, $V_{GS}$=0V, $dI_F/dt$=100A/us | - | 254 | - | nS |
| Reverse Recovery Charge[4] | $Q_{rr}$ | | - | 3.2 | - | μC |
| Reverse Recovery Peak Current[4] | $I_{rrm}$ | | - | 25 | - | A |

Note:

1. L=79mH, $V_{DD}$=100V, $R_G$=25Ω, starting temperature $T_J$=25°C.
2. $V_{DS}$=0-400V, $I_{SD}$<=$I_S$, $T_J$=25°C.
3. $V_{DS}$=0-480V.
4. Pulse test: pulse width ≤ 300μs, duty cycle ≤ 2%.
5. Essentially independent of operating temperature.

## Typical Electrical and Thermal Characteristic Curves

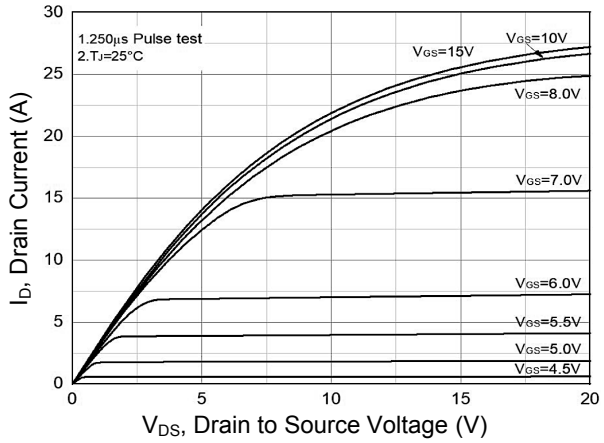



**Figure 1. Typical Output Characteristics**

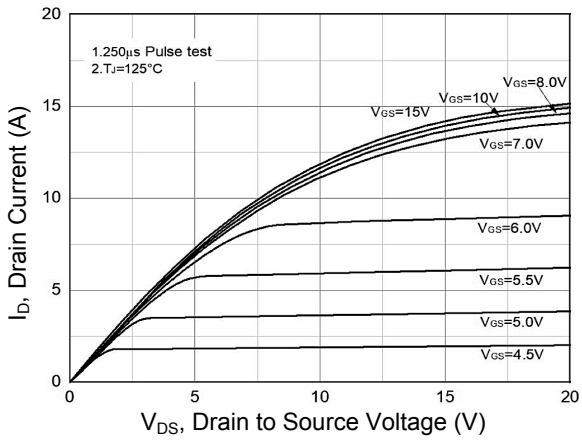



**Figure 2. Typical Output Characteristics**

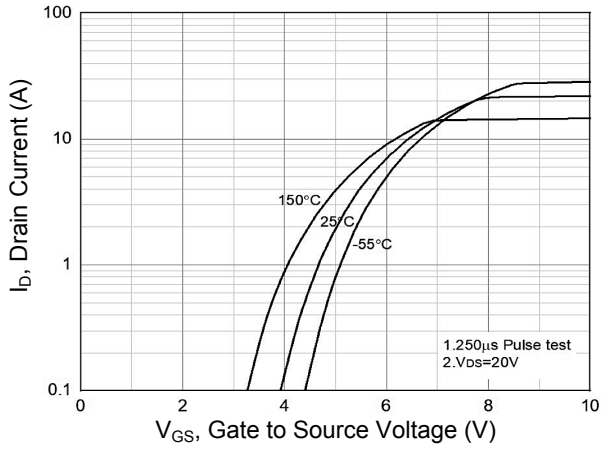



**Figure 3. Transfer Characteristics**

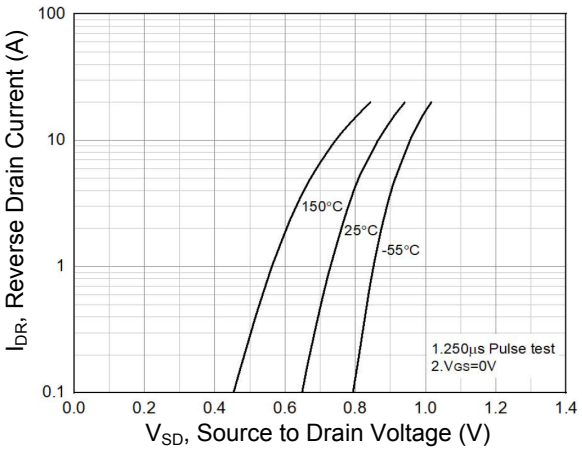



**Figure 4. Body Diode Characteristics**

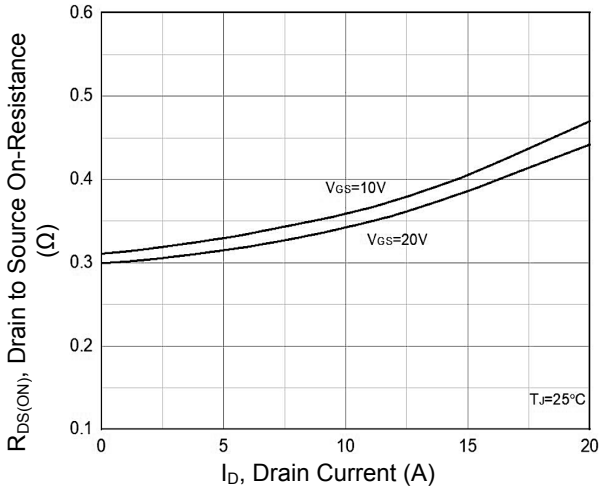



**Figure 5. $R_{DS(ON)}$ vs. Drain Current**

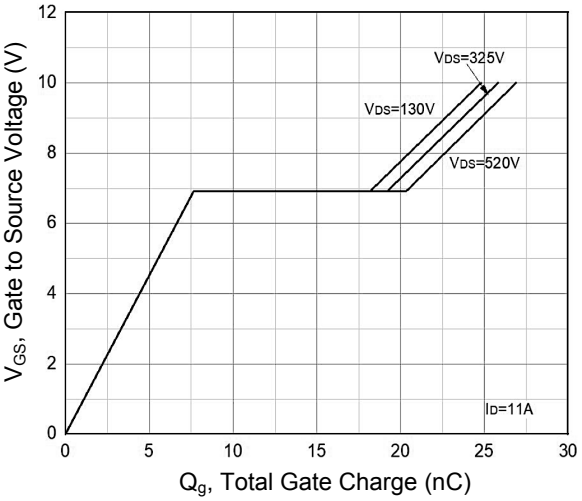



**Figure 6. Gate Charge Characteristics**

## Typical Electrical and Thermal Characteristic Curves

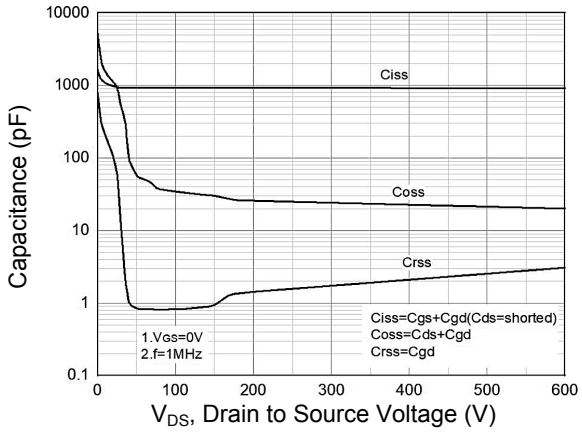



**Figure 7. Capacitance Characteristics**

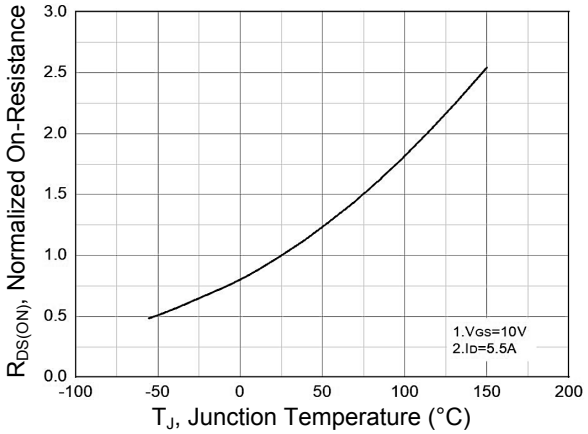



**Figure 8. Normalized $R_{DS(ON)}$ vs. $T_J$**

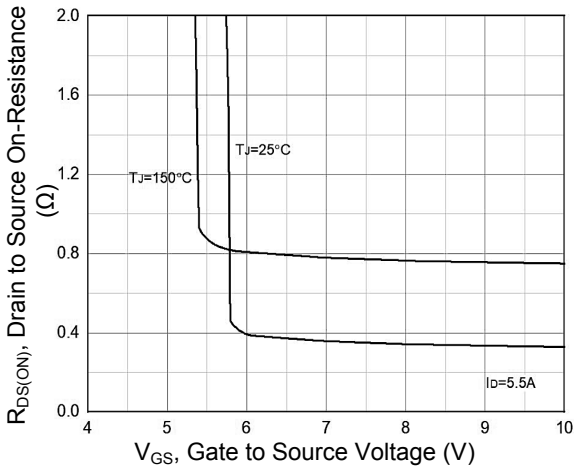



**Figure 9. $R_{DS(ON)}$ vs. $V_{GS}$**

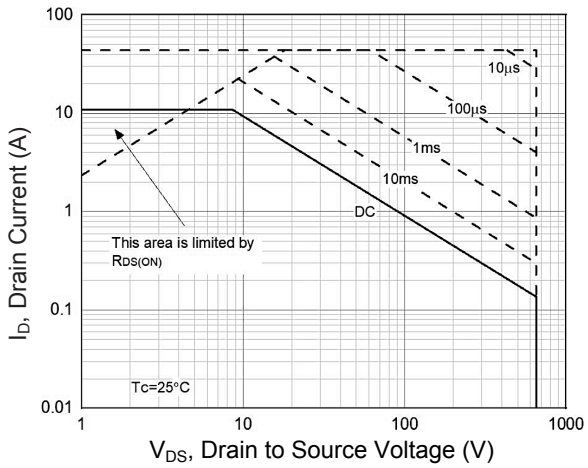



**Figure 10. Safe Operation Area**

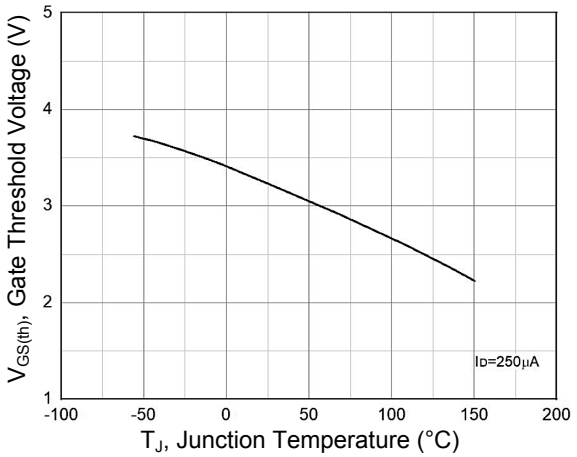



**Figure 11. Gate Threshold Voltage vs. $T_J$**

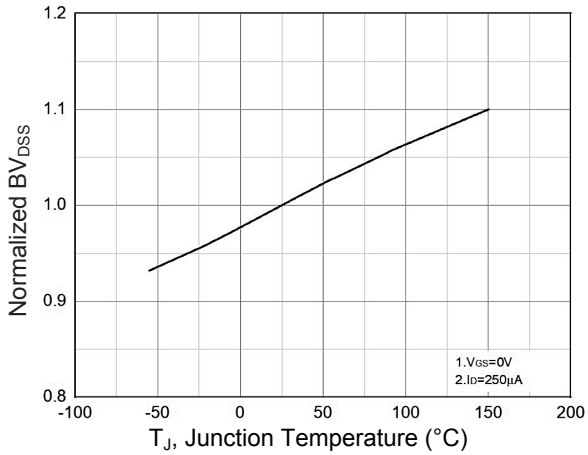
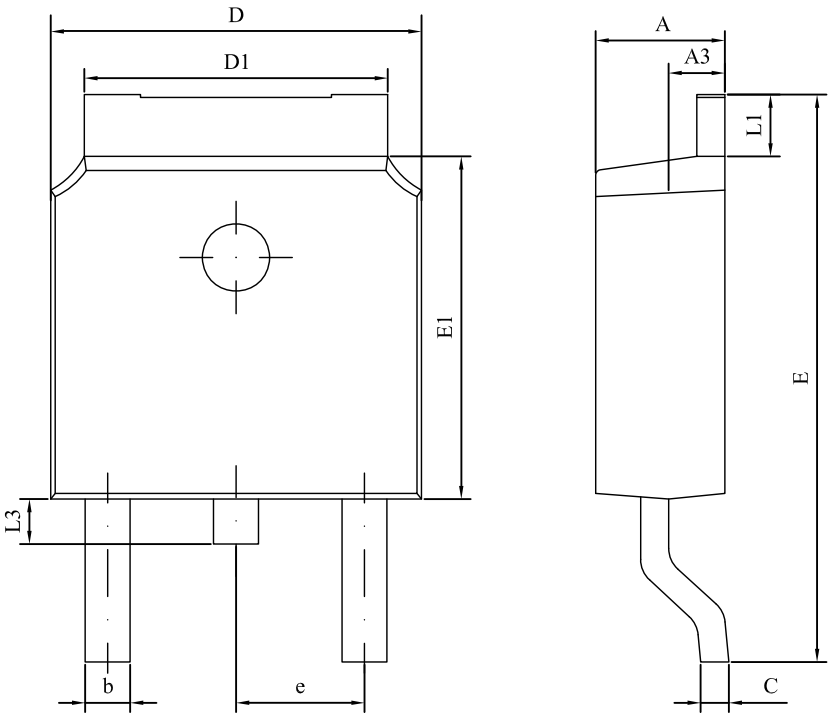



**Figure 12. Normalized $BV_{DSS}$ vs. $T_J$**

## Package Outline Dimensions TO-252(DPAK)




| Symbol | Dimensions In Millimeters | | Dimensions In Inches | |
|---|---|---|---|---|
| | Min. | Max. | Min. | Max. |
| A | 2.15 | 2.40 | 0.085 | 0.094 |
| A3 | 0.90 | 1.10 | 0.035 | 0.043 |
| b | 0.50 | 0.90 | 0.020 | 0.035 |
| C | 0.40 | 0.65 | 0.016 | 0.026 |
| D | 6.30 | 6.90 | 0.248 | 0.272 |
| D1 | 4.95 | 5.50 | 0.195 | 0.217 |
| E | 9.40 | 10.41 | 0.370 | 0.410 |
| E1 | 5.90 | 6.30 | 0.232 | 0.248 |
| e | 2.286 BSC | | 0.090 BSC | |
| L1 | 0.89 | 1.27 | 0.035 | 0.050 |
| L3 | 0.60 | 1.10 | 0.024 | 0.043 |

## Order Information

| Device | Package | Marking | Carrier | Quantity |
|---|---|---|---|---|
| GSFD65R400 | TO-252 (DPAK) | D65R400 | Tape & Reel | 2,500 Pcs / Reel |