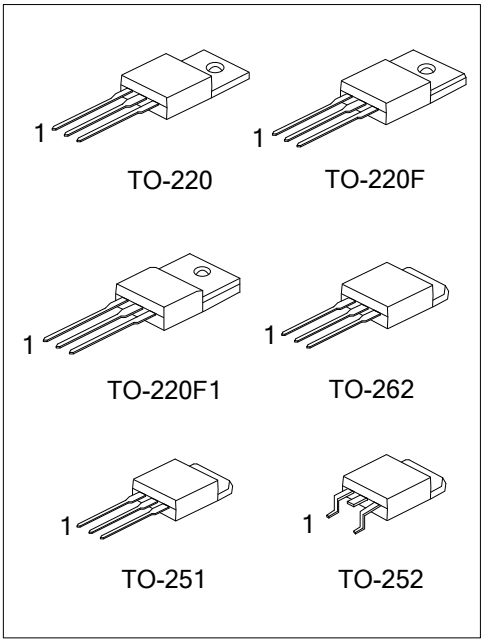
# 11NM65-U2

*Power MOSFET*

## 11A, 650V N-CHANNEL SUPER-JUNCTION MOSFET



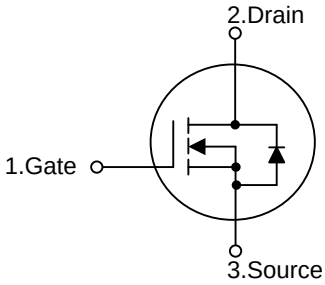

### ■ DESCRIPTION

The **UTC 11NM65-U2** is a Super Junction MOSFET Structure and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and a high rugged avalanche characteristics. This power MOSFET is usually used at AC-DC converters for power applications.

### ■ FEATURES

* $R_{DS(ON)} \leq 0.6\Omega$ @ $V_{GS}$=10V, $I_D$=5.5A
* By using Super Junction Structure
* Fast Switching
* With 100% Avalanche Tested

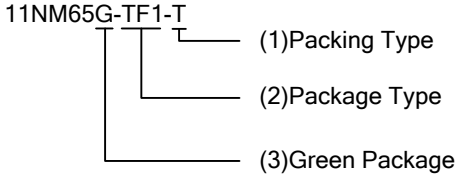
### ■ SYMBOL




### ■ ORDERING INFORMATION

| Ordering Number | | Package | Pin Assignment | | | Packing |
|---|---|---|---|---|---|---|
| Lead Free | Halogen Free | | 1 | 2 | 3 | |
| 11NM65L-TA3-T | 11NM65G-TA3-T | TO-220 | G | D | S | Tube |
| 11NM65L-TF3-T | 11NM65G-TF3-T | TO-220F | G | D | S | Tube |
| 11NM65L-TF1-T | 11NM65G-TF1-T | TO-220F1 | G | D | S | Tube |
| 11NM65L-TM3-T | 11NM65G-TM3-T | TO-251 | G | D | S | Tube |
| 11NM65L-TN3-R | 11NM65G-TN3-R | TO-252 | G | D | S | Tape Reel |
| 11NM65L-T2Q-T | 11NM65G-T2Q-T | TO-262 | G | D | S | Tube |

Note: Pin Assignment: G: Gate D: Drain S: Source

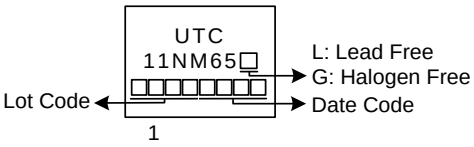



(1) T: Tube, R: Tape Reel

(2) TA3: TO-220, TF3: TO-220F, TF1: TO-220F1, TM3: TO-251, TN3: TO-252,T2Q: TO-262

(3) G: Halogen Free and Lead Free, L: Lead Free

## ■ MARKING



## ■ ABSOLUTE MAXIMUM RATINGS ($T_C$ =25°C, unless otherwise specified)

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DSS}$ | 650 | V |
| Gate-Source Voltage | | $V_{GSS}$ | ±30 | V |
| Drain Current | Continuous | $I_D$ | 11 | A |
| | Pulsed (Note 2) | $I_{DM}$ | 22 | A |
| Avalanche Energy | Single Pulsed (Note 3) | $E_{AS}$ | 80 | mJ |
| Peak Diode Recovery dv/dt (Note 4) | | dv/dt | 2.9 | V/ns |
| Power Dissipation | TO-220/TO-262 | $P_D$ | 80 | W |
| | TO-220F/TO-220F1 | | 28 | W |
| | TO-251/TO-252 | | 56 | W |
| Junction Temperature | | $T_J$ | +150 | °C |
| Storage Temperature Range | | $T_{STG}$ | -55 ~ +150 | °C |

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.
2. Repetitive Rating : Pulse width limited by maximum junction temperature.
3. L=10mH, $I_{AS}$=4.0A, $V_{DD}$= 50V, $R_G$=25Ω, Starting $T_J$=25°C
4. $I_{SD}$ ≤11A, di/dt ≤200A/μs, $V_{DD}$ ≤$BV_{DSS}$, Starting $T_J$=25°C

## ■ THERMAL DATA

| PARAMETER | | SYMBOL | RATING | UNIT |
|---|---|---|---|---|
| Junction to Ambient | TO-220/TO-220F TO-220F1/TO-262 | $θ_{JA}$ | 62.5 | °C/W |
| | TO-251/TO-252 | | 110 | °C/W |
| Junction to Case | TO-220/TO-262 | $θ_{JC}$ | 1.56 | °C/W |
| | TO-220F/TO-220F1 | | 4.46 | °C/W |
| | TO-251/TO-252 | | 2.23 (Note) | °C/W |

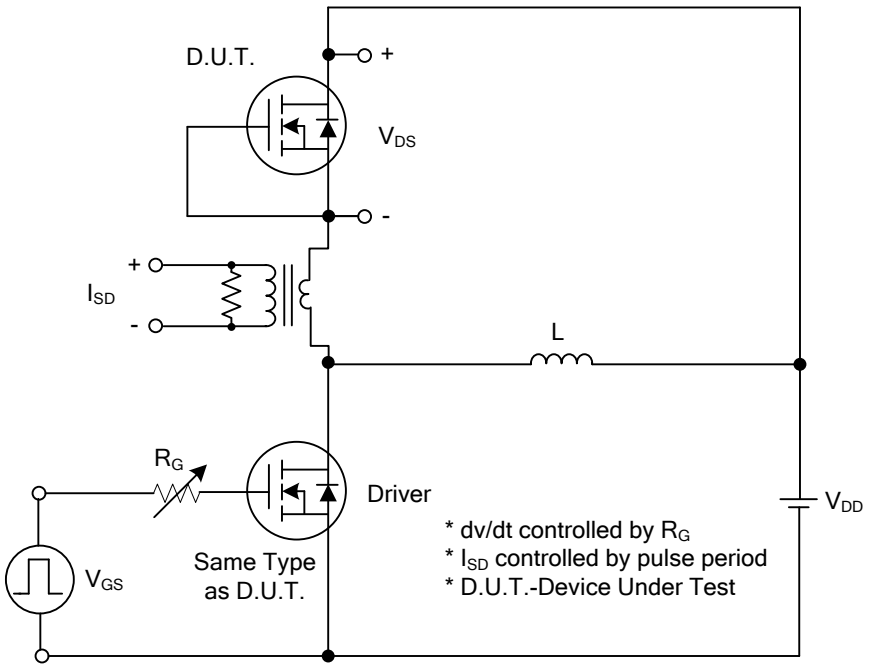
Note: Device mounted on FR-4 substrate PC board, 2oz copper, with 1inch square copper plate.

## ■ ELECTRICAL CHARACTERISTICS ($T_J$=25°C, unless otherwise specified)

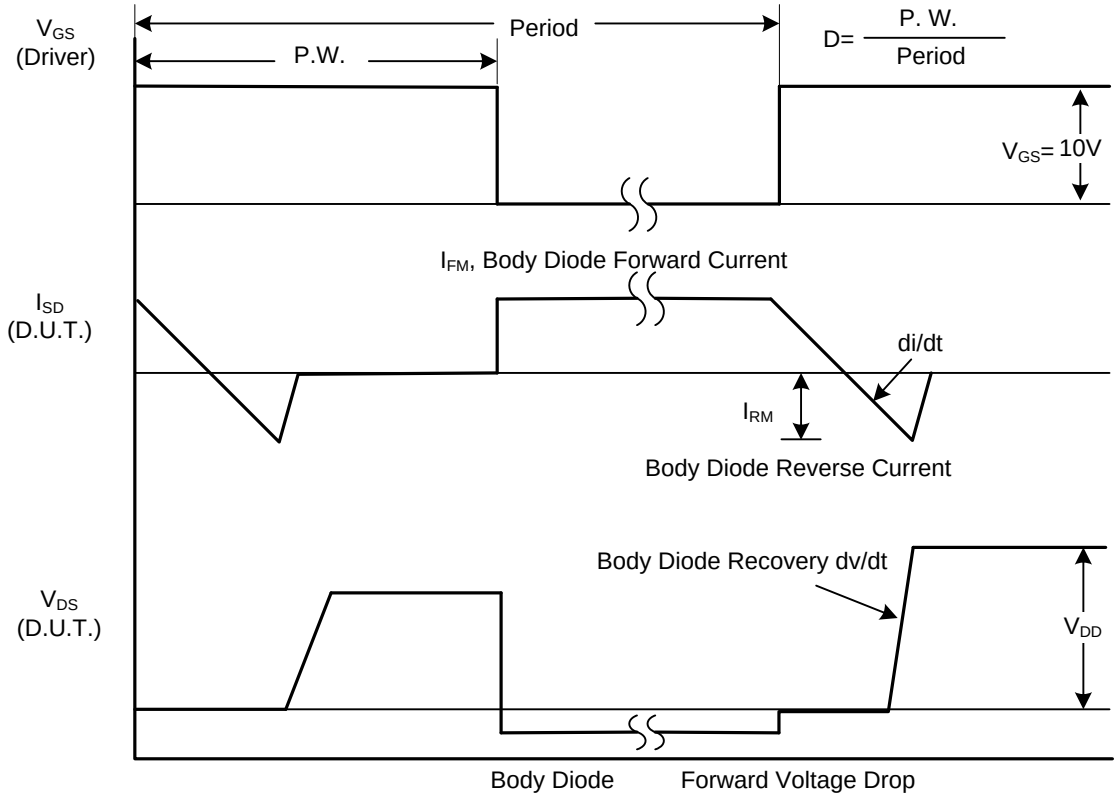
| PARAMETER | | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | | |
| Drain-Source Breakdown Voltage | | $BV_{DSS}$ | $V_{GS}$=0V, $I_D$=250μA | 650 | | | V |
| Drain-Source Leakage Current | | $I_{DSS}$ | $V_{DS}$=650V, $V_{GS}$=0V | | | 10 | μA |
| Gate-Source Leakage Current | Forward | $I_{GSS}$ | $V_{DS}$=0V ,$V_{GS}$=30V | | | 100 | nA |
| | Reverse | | $V_{DS}$=0V ,$V_{GS}$=-30V | | | -100 | nA |
| **ON CHARACTERISTICS** | | | | | | | |
| Gate Threshold Voltage | | $V_{GS(TH)}$ | $V_{DS}$= $V_{GS}$, $I_D$=250μA | 2.5 | | 4.5 | V |
| Drain-Source On-State Resistance | | $R_{DS(ON)}$ | $V_{GS}$=10V, $I_D$=5.5A | | | 0.6 | Ω |
| **DYNAMIC PARAMETERS** | | | | | | | |
| Input Capacitance | | $C_{ISS}$ | $V_{GS}$=0V, $V_{DS}$=25V, f=1.0MHz | | 650 | | pF |
| Output Capacitance | | $C_{OSS}$ | | | 420 | | pF |
| Reverse Transfer Capacitance | | $C_{RSS}$ | | | 30 | | pF |
| **SWITCHING PARAMETERS** | | | | | | | |
| Total Gate Charge (Note 1) | | $Q_G$ | $V_{DS}$=520V, $V_{GS}$=10V, $I_D$=11A , $I_G$=1mA (Note 1, 2) | | 23.5 | | nC |
| Gate to Source Charge | | $Q_{GS}$ | | | 5.5 | | nC |
| Gate to Drain Charge | | $Q_{GD}$ | | | 7.5 | | nC |
| Turn-ON Delay Time (Note 1) | | $t_{D(ON)}$ | $V_{DD}$=100V, $V_{GS}$=10V, $I_D$=11A, $R_G$=25Ω (Note 1, 2) | | 10 | | ns |
| Rise Time | | $t_R$ | | | 20 | | ns |
| Turn-OFF Delay Time | | $t_{D(OFF)}$ | | | 65 | | ns |
| Fall-Time | | $t_F$ | | | 35 | | ns |
| **SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS** | | | | | | | |
| Maximum Body-Diode Continuous Current | | $I_S$ | | | | 11 | A |
| Maximum Body-Diode Pulsed Current | | $I_{SM}$ | | | | 22 | A |
| Drain-Source Diode Forward Voltage (Note 1) | | $V_{SD}$ | $I_S$ =11A, $V_{GS}$=0V | | | 1.4 | V |
| Body Diode Reverse Recovery Time (Note 1) | | $t_{rr}$ | $I_S$ =11A, $V_{GS}$=0V, $dI_F/dt$=100A/μs | | 330 | | ns |
| Body Diode Reverse Recovery Charge | | $Q_{rr}$ | | | 4.4 | | μC |

Notes: 1. Pulse Test : Pulse width ≤ 300μs, Duty cycle ≤ 2%.
2. Essentially independent of operating temperature.

## ■ TEST CIRCUITS AND WAVEFORMS

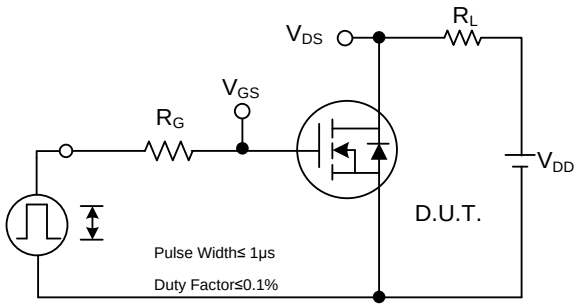



**Peak Diode Recovery dv/dt Test Circuit**

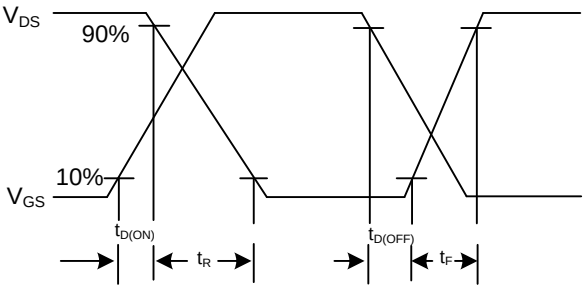



**Peak Diode Recovery dv/dt Waveforms**

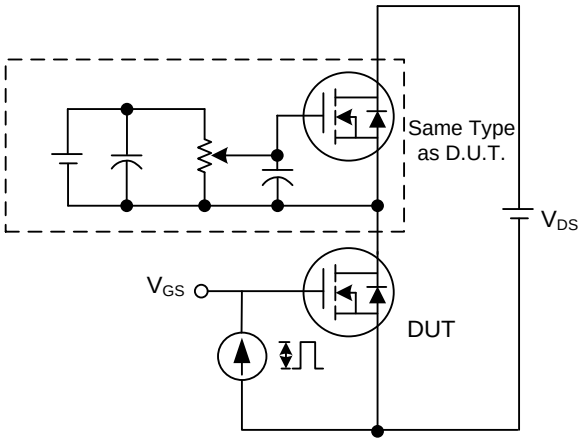
## ■ TEST CIRCUITS AND WAVEFORMS



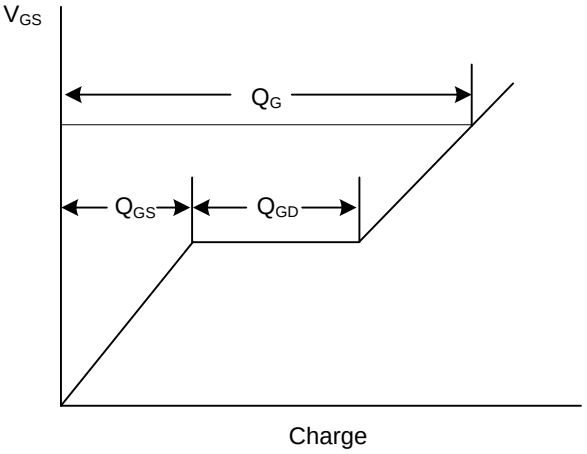

**Switching Test Circuit**



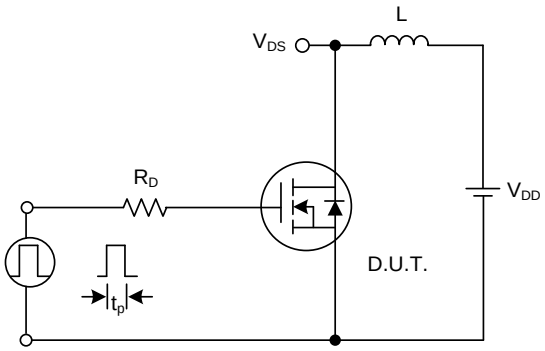

**Switching Waveforms**



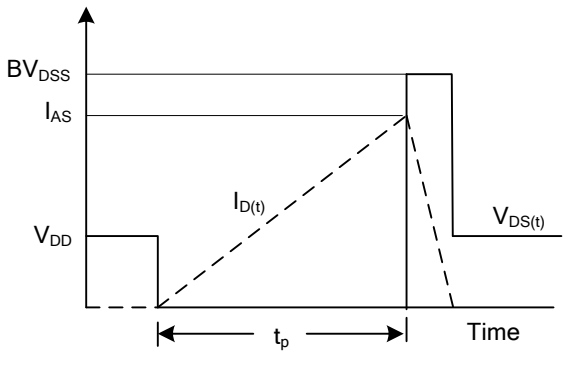

**Gate Charge Test Circuit**




**Gate Charge Waveform**



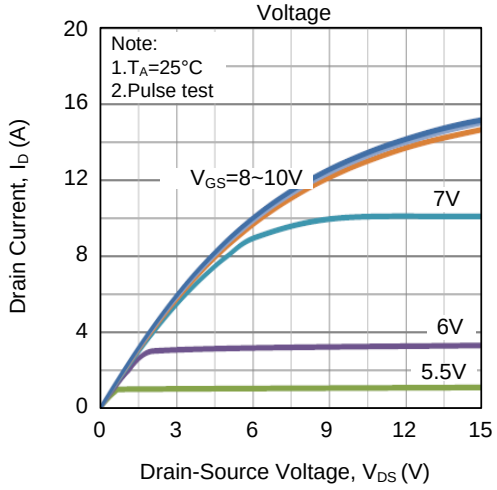

**Unclamped Inductive Switching Test Circuit**



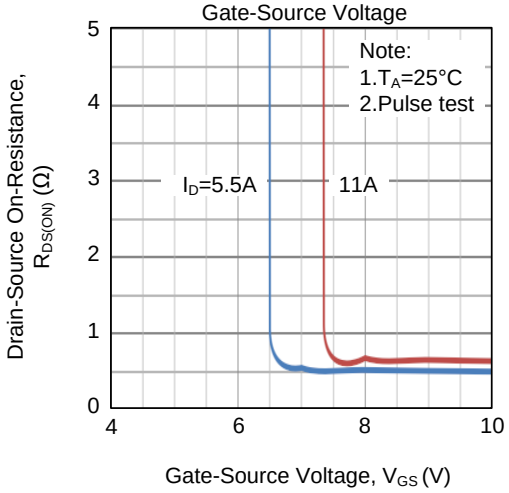

**Unclamped Inductive Switching Waveforms**

## ■ TYPICAL CHARACTERISTICS

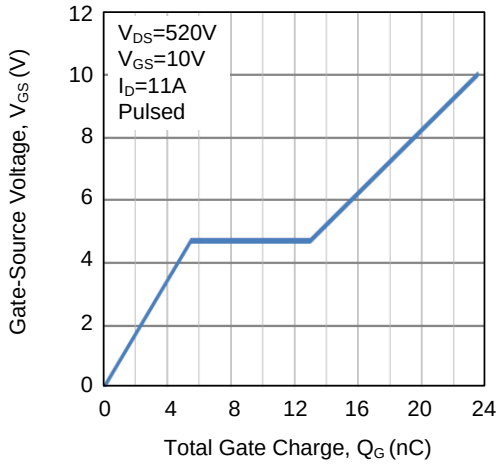
Drain Current vs. Drain-Source Voltage



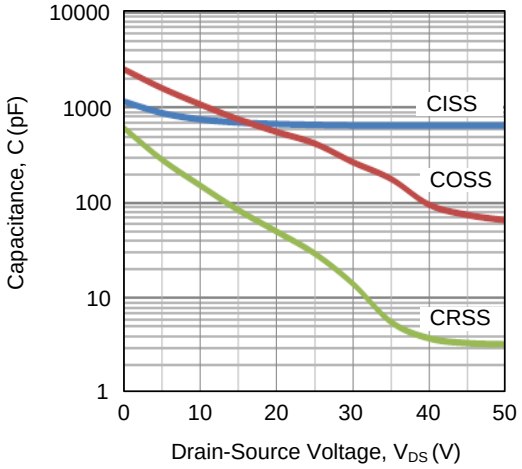

Drain-Source On-Resistance vs. Gate-Source Voltage



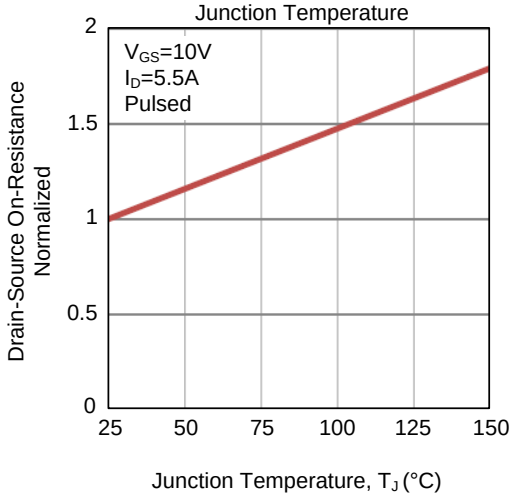

Gate Charge Characteristics



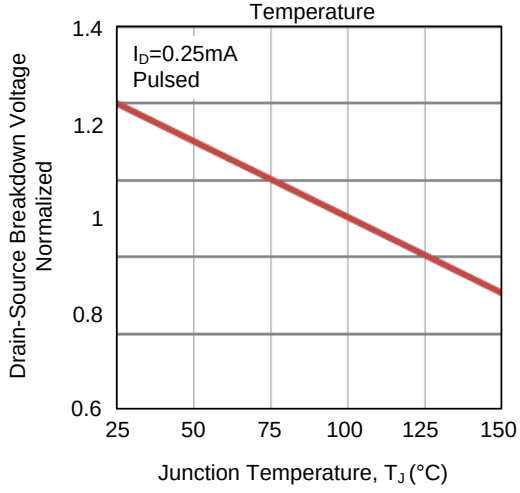

Capacitance Characteristics




Drain-Source On-Resistance vs. Junction Temperature

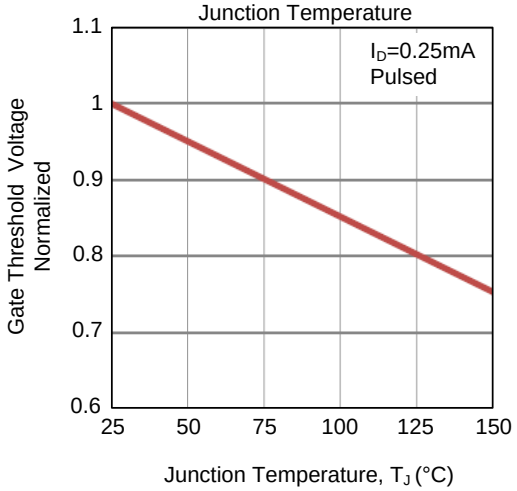



Breakdown Voltage vs. Junction Temperature

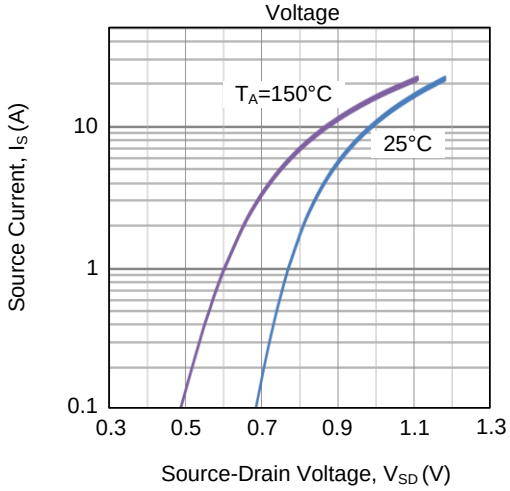


## ■ TYPICAL CHARACTERISTICS (Cont.)

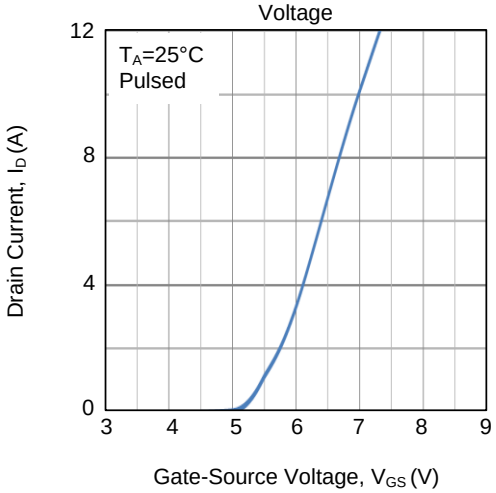
Gate Threshold Voltage vs. Junction Temperature



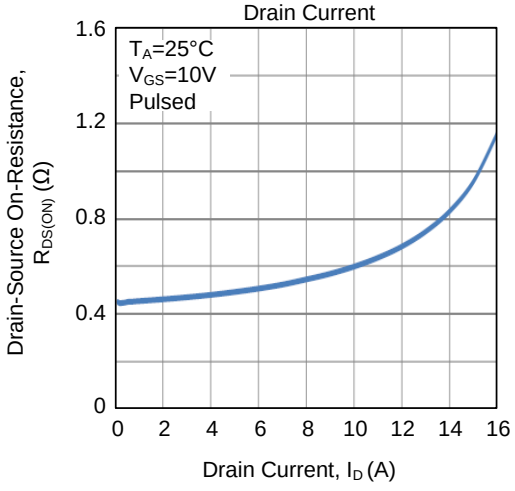

Source Current vs. Source-Drain Voltage



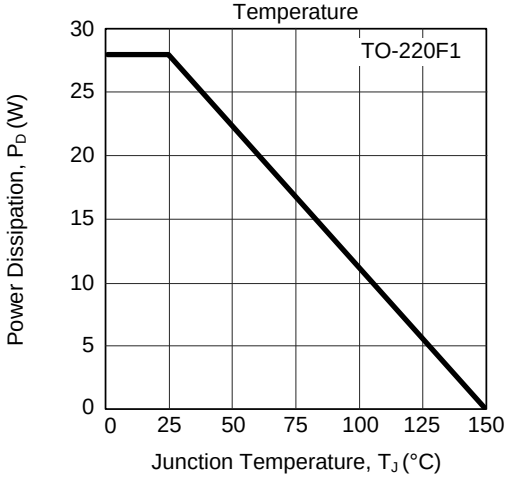

Drain Current vs. Gate-Source Voltage



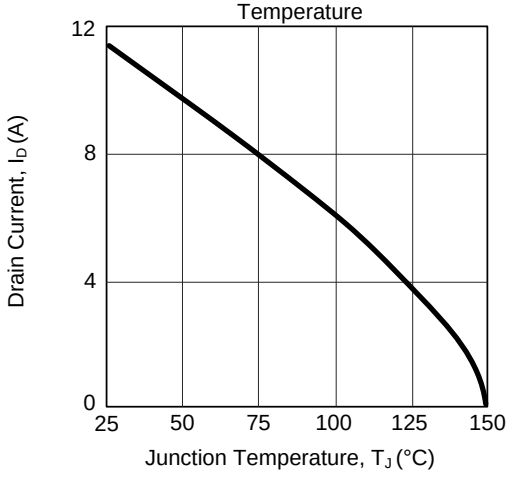

Drain-Source On-Resistance vs. Drain Current




Power Dissipation vs. Junction Temperature




Drain Current vs. Junction Temperature



## ■ TYPICAL CHARACTERISTICS (Cont.)