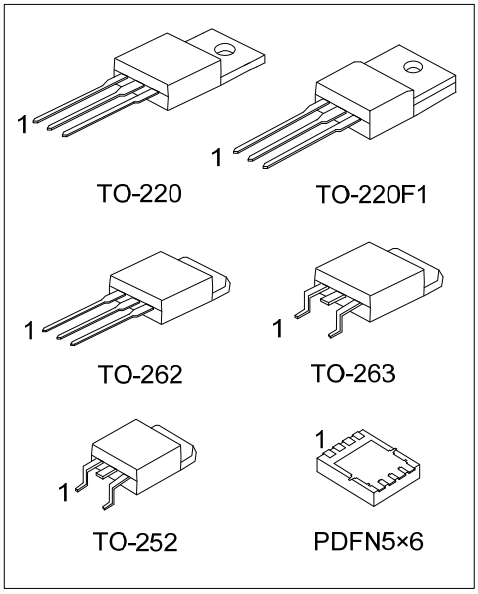
# USG135N10

**POWER MOSFET**

## 135A, 100V N-CHANNEL POWER MOSFET




### ■ DESCRIPTION

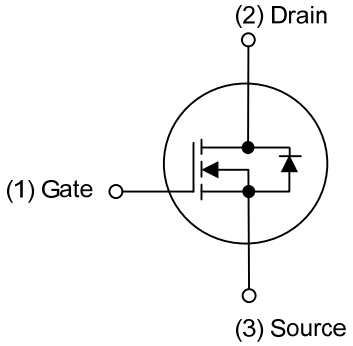
The UTC **USG135N10** is a N-channel Power MOSFET, it uses UTC's advanced technology to provide the customers with low $R_{DS(ON)}$ characteristic by high cell density trench technology.

The UTC **USG135N10** is suitable for high efficiency synchronous rectification in SMPS, UPS, hard switched and high frequency circuits.

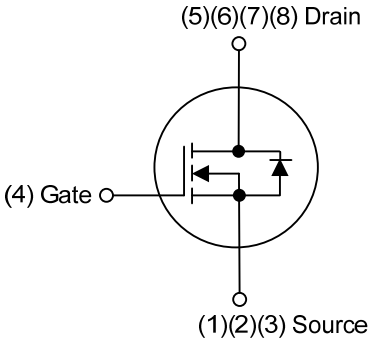
### ■ FEATURES

* $R_{DS(ON)} \leq 5.0\ m\Omega$ @ $V_{GS}$=10V, $I_D$=30A
  $R_{DS(ON)} \leq 7.2\ m\Omega$ @ $V_{GS}$=4.5V, $I_D$=20A
* High Switching Speed

### ■ SYMBOL




TO-220/TO-220F1
TO-252/TO-262/TO-263

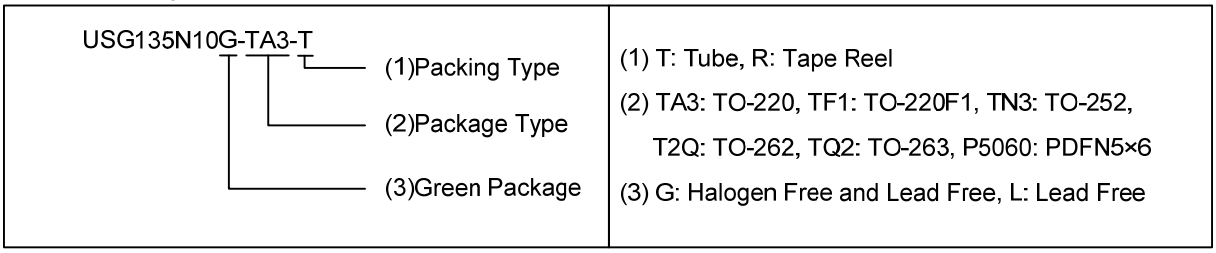



PDFN5×6

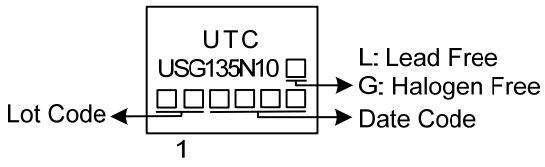
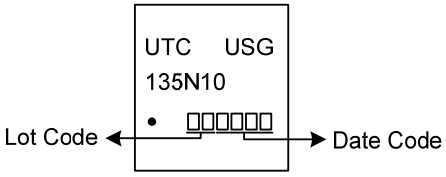
## ■ ORDERING INFORMATION

| Ordering Number | | Package | Pin Assignment | | | | | | | | Packing |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lead Free | Halogen Free | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| USG135N10L-TA3-T | USG135N10G-TA3-T | TO-220 | G | D | S | - | - | - | - | - | Tube |
| USG135N10L-TF1-T | USG135N10G-TF1-T | TO-220F1 | G | D | S | - | - | - | - | - | Tube |
| USG135N10L-TN3-R | USG135N10G-TN3-R | TO-252 | G | D | S | - | - | - | - | - | Tape Reel |
| USG135N10L-T2Q-T | USG135N10G-T2Q-T | TO-262 | G | D | S | - | - | - | - | - | Tube |
| USG135N10L-TQ2-T | USG135N10G-TQ2-T | TO-263 | G | D | S | - | - | - | - | - | Tube |
| USG135N10L-TQ2-R | USG135N10G-TQ2-R | TO-263 | G | D | S | - | - | - | - | - | Tape Reel |
| USG135N10L- P5060-R | USG135N10G-P5060-R | PDFN5×6 | S | S | S | G | D | D | D | D | Tape Reel |

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




## ■ MARKING

| TO-220 / TO-220F1 / TO-252 / TO-262 / TO-263 | PDFN5×6 |
|---|---|
|  |  |

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

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Drain-Source Voltage | | $V_{DSS}$ | 100 | V |
| Gate-Source Voltage | | $V_{GSS}$ | ±20 | V |
| Drain Current | Continuous | $I_D$ | 135 | A |
| | Pulsed (Note 2) | $I_{DM}$ | 270 | A |
| Single Pulsed Avalanche Energy (Note 3) | | $E_{AS}$ | 18.6 | mJ |
| Peak Diode Recovery dv/dt (Note 4) | | dv/dt | 3.8 | V/ns |
| Power Dissipation | TO-220/TO-262 TO-263 | $P_D$ | 142 | W |
| | TO-220F1 | | 45 | W |
| | TO-252 | | 71 | W |
| | PDFN5×6 | | 85 | W |
| Junction Temperature | | $T_J$ | +150 | °C |
| Storage Temperature Range | | $T_{STG}$ | -20 ~ +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= 0.1mH, $I_{AS}$ = 19.3A, $V_{DD}$ = 50V, $R_G$ = 25 Ω, Starting $T_J$ = 25°C
4. $I_{SD}$ ≤ 50A, di/dt ≤ 200A/μs, $V_{DD}$ ≤ $BV_{DSS}$, Starting $T_J$ = 25°C

## ■ THERMAL DATA

| PARAMETER | | SYMBOL | RATINGS | UNIT |
|---|---|---|---|---|
| Junction to Ambient | TO-220/TO-220F1 TO-262/TO-263 | $\theta_{JA}$ | 62.5 | °C/W |
| | TO-252 | | 110 | °C/W |
| | PDFN5×6 | | 65 (Note) | °C/W |
| Junction to Case | TO-220/TO-262 TO-263 | $\theta_{JC}$ | 0.88 | °C/W |
| | TO-220F1 | | 2.77 | °C/W |
| | TO-252 | | 1.76 (Note) | °C/W |
| | PDFN5×6 | | 1.47 (Note) | °C/W |

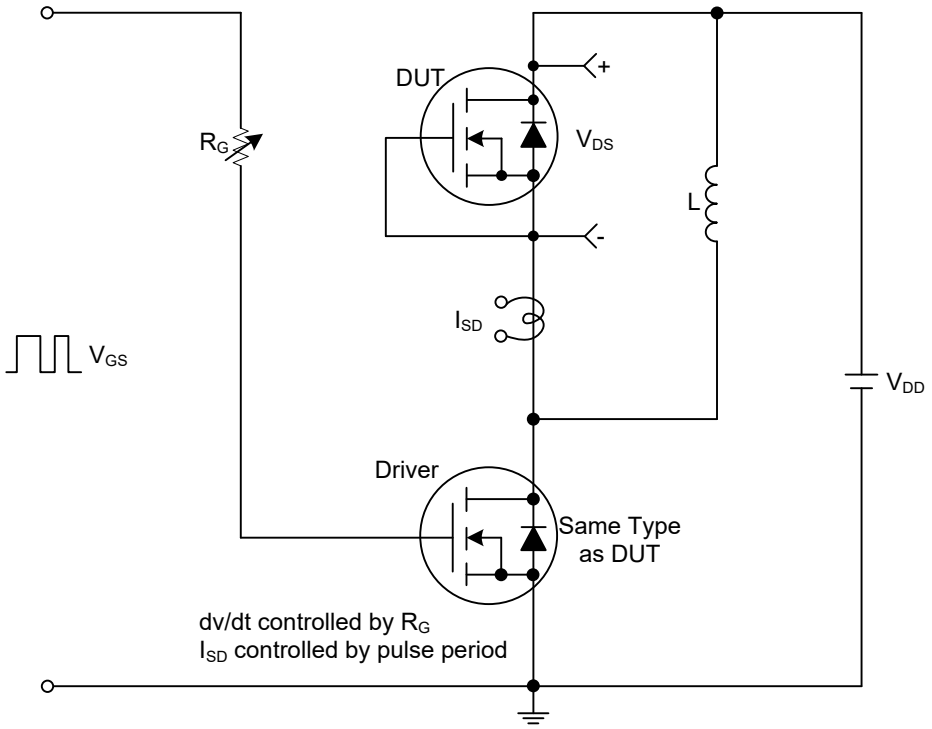
Note: Device mounted on FR-4 substrate PC board, 2oz copper, with 1inch square copper plate.

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

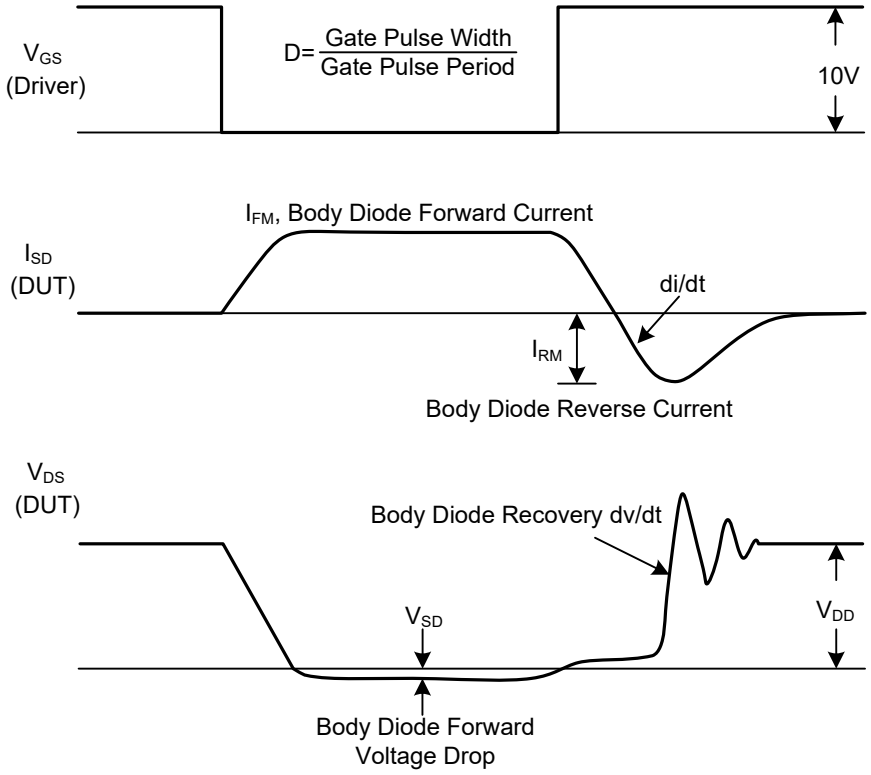
| PARAMETER | | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS** | | | | | | | |
| Drain-Source Breakdown Voltage | | $BV_{DSS}$ | $I_D$=250μA, $V_{GS}$=0V | 100 | | | V |
| Drain-Source Leakage Current | | $I_{DSS}$ | $V_{DS}$=80V, $V_{GS}$=0V | | | 1 | μA |
| Gate-Source Leakage Current | Forward | $I_{GSS}$ | $V_{GS}$=+20V, $V_{DS}$=0V | | | +100 | nA |
| | Reverse | | $V_{GS}$=-20V, $V_{DS}$=0V | | | -100 | nA |
| **ON CHARACTERISTICS** | | | | | | | |
| Gate Threshold Voltage | | $V_{GS(TH)}$ | $V_{DS}$=$V_{GS}$, $I_D$=250μA | 1.0 | | 3.0 | V |
| Static Drain-Source On-State Resistance | | $R_{DS(ON)}$ | $V_{GS}$=10V, $I_D$=30A | | | 5.0 | mΩ |
| | | | $V_{GS}$=4.5V, $I_D$=20A | | | 7.2 | mΩ |
| **DYNAMIC PARAMETERS** | | | | | | | |
| Input Capacitance | | $C_{ISS}$ | $V_{GS}$=0V, $V_{DS}$=25V, f=1.0MHz | | 5060 | | pF |
| Output Capacitance | | $C_{OSS}$ | | | 2260 | | pF |
| Reverse Transfer Capacitance | | $C_{RSS}$ | | | 220 | | pF |
| **SWITCHING PARAMETERS** | | | | | | | |
| Total Gate Charge (Note 1) | | $Q_G$ | $V_{DS}$=80V, $V_{GS}$=10V, $I_D$=135A, $I_G$=1mA (Note 1, 2) | | 100 | | nC |
| Gate to Source Charge | | $Q_{GS}$ | | | 14 | | nC |
| Gate to Drain Charge | | $Q_{GD}$ | | | 30 | | nC |
| Turn-on Delay Time (Note 1) | | $t_{D(ON)}$ | $V_{DD}$=50V, $V_{GS}$=10V, $I_D$=135A, $R_G$ =3.3Ω (Note 1, 2) | | 15 | | ns |
| Rise Time | | $t_R$ | | | 21 | | ns |
| Turn-off Delay Time | | $t_{D(OFF)}$ | | | 72 | | ns |
| Fall-Time | | $t_F$ | | | 36 | | ns |
| **SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS** | | | | | | | |
| Maximum Body-Diode Continuous Current | | $I_S$ | | | | 135 | A |
| Maximum Body-Diode Pulsed Current | | $I_{SM}$ | | | | 270 | A |
| Drain-Source Diode Forward Voltage (Note 1) | | $V_{SD}$ | $I_S$=135A, $V_{GS}$=0V | | | 1.4 | V |
| Reverse Recovery Time (Note 1) | | $t_{rr}$ | $I_S$=30A, $V_{GS}$=0V, $dI_F/dt$ =100A/μs | | 80 | | nS |
| Reverse Recovery Charge | | $Q_{rr}$ | | | 380 | | nC |

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

## ■ TEST CIRCUITS AND WAVEFORMS



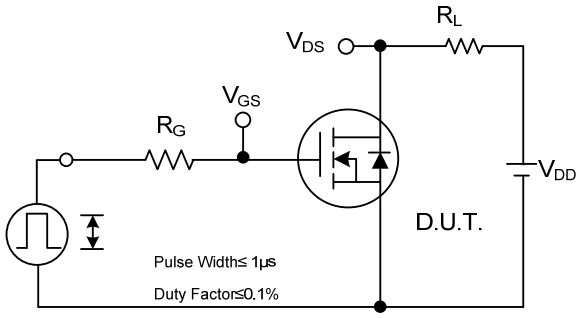

**Peak Diode Recovery dv/dt Test Circuit**



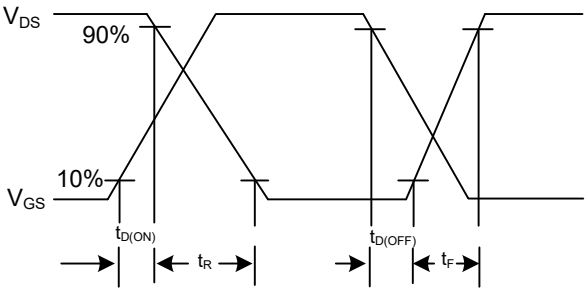

Peak Diode Recovery dv/dt Test Circuit and Waveforms

**Peak Diode Recovery dv/dt Waveforms**

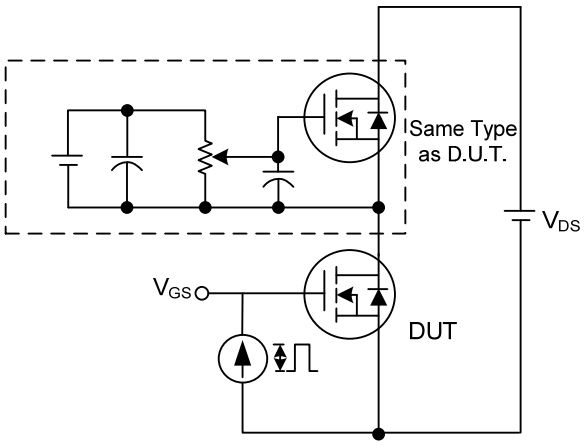
## ■ TEST CIRCUITS AND WAVEFORMS



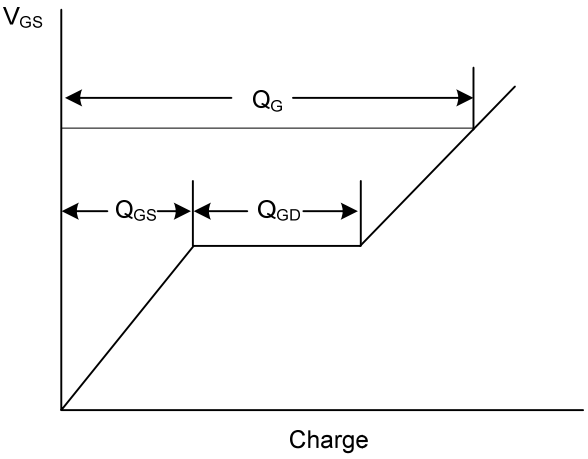

**Switching Test Circuit**



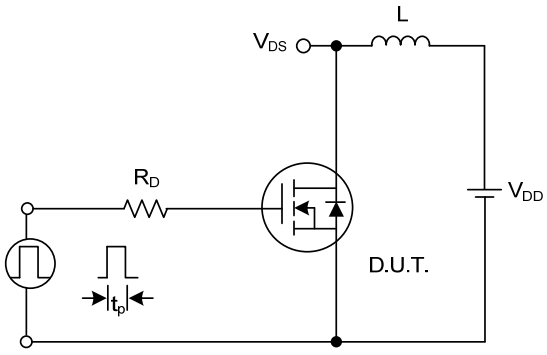

**Switching Waveforms**



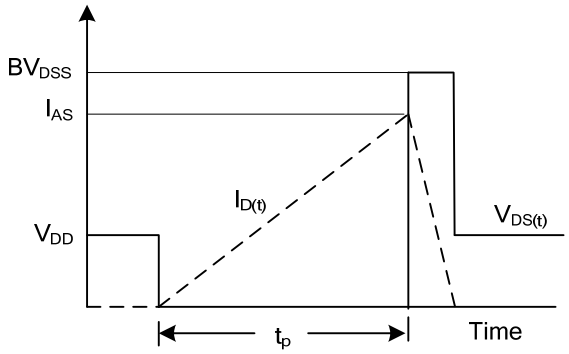

**Gate Charge Test Circuit**




**Gate Charge Waveform**



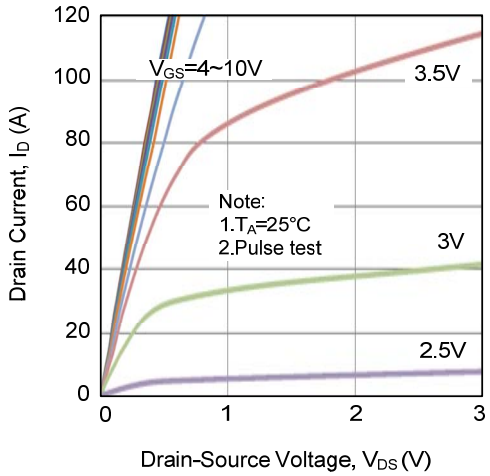

**Unclamped Inductive Switching Test Circuit**



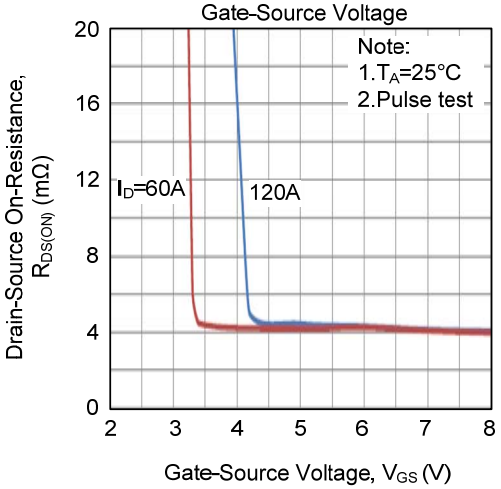

**Unclamped Inductive Switching Waveforms**

## ■ TYPICAL CHARACTERISTICS

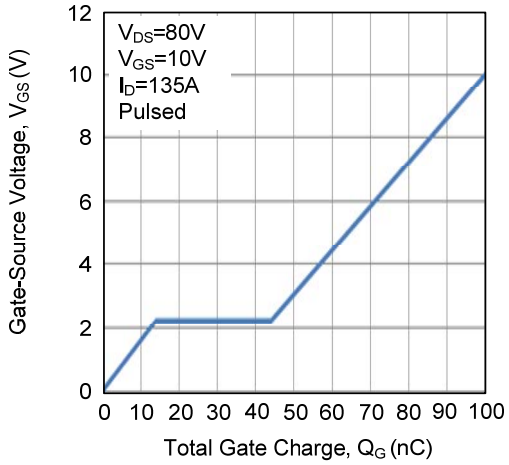
Drain Current vs. Drain-Source Voltage



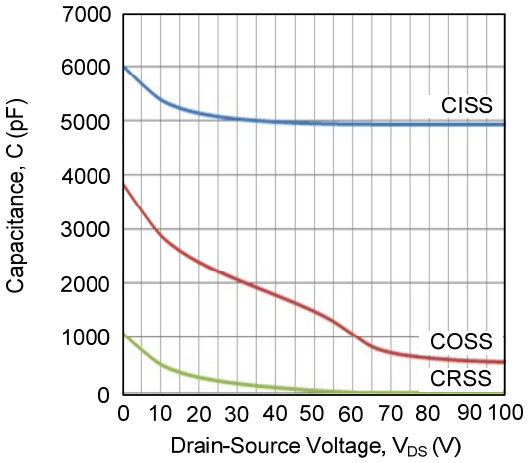

Drain-Source On-Resistance vs. Gate-Source Voltage



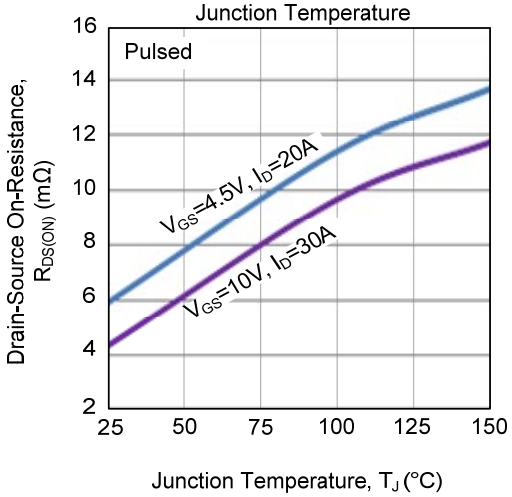

Gate Charge Characteristics



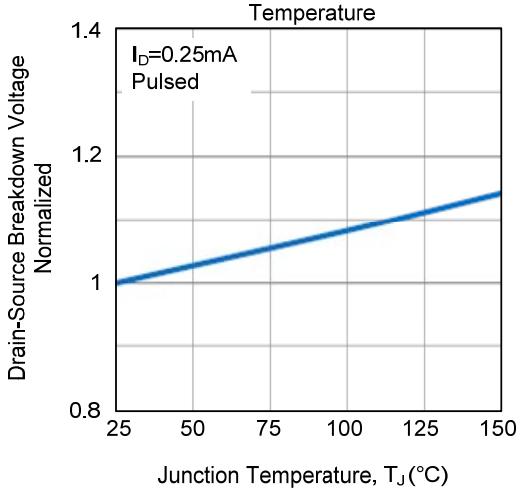

Capacitance Characteristics




Drain-Source On-Resistance vs. Junction Temperature

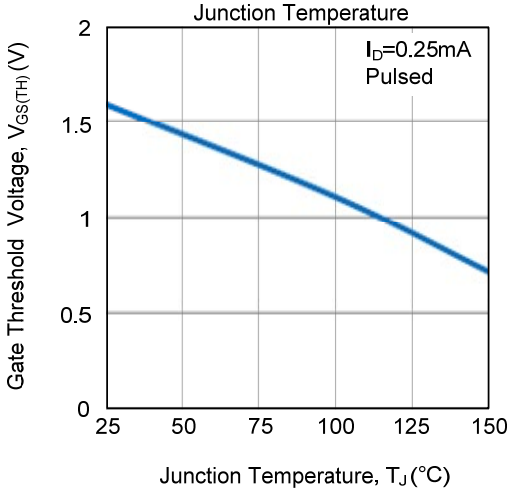



Breakdown Voltage vs. Junction Temperature

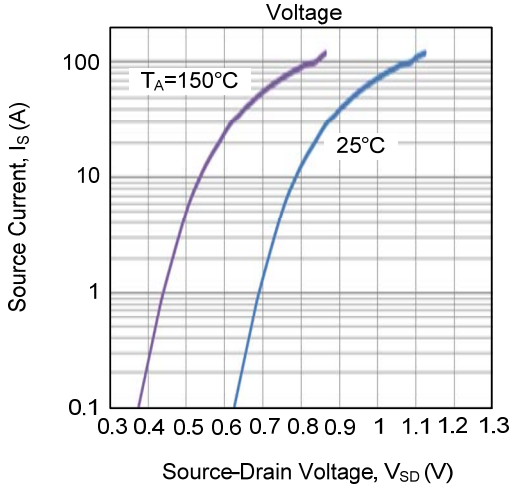


## ■ TYPICAL CHARACTERISTICS (Cont.)

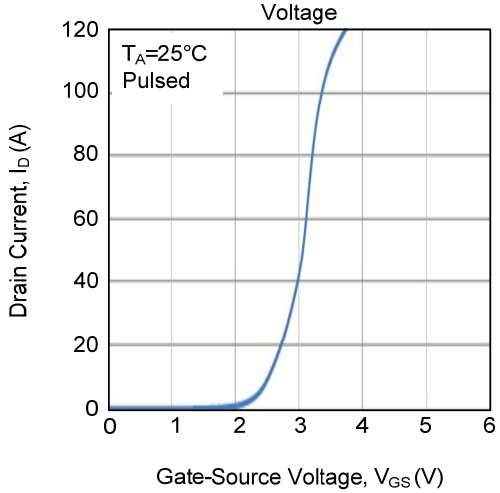
Gate Threshold Voltage vs. Junction Temperature



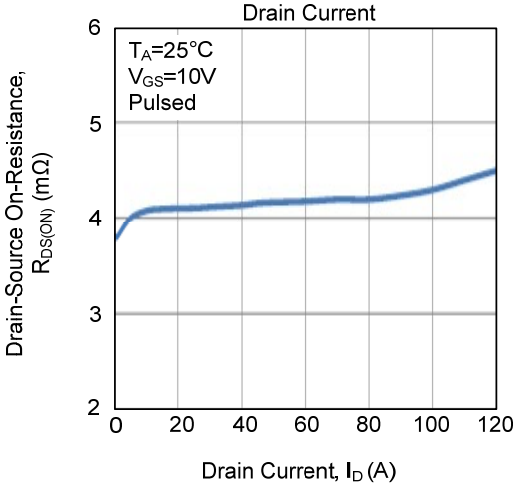

Source Current vs. Source-Drain Voltage



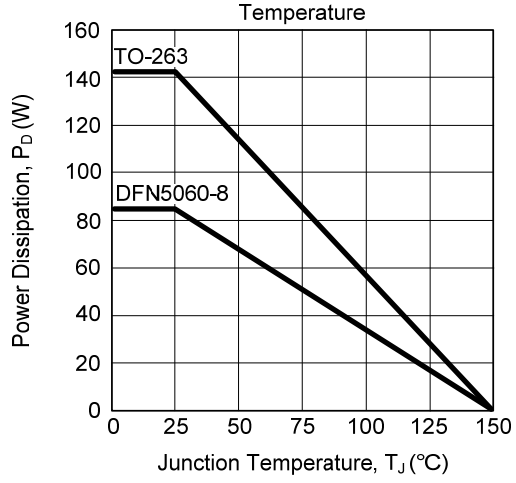

Drain Current vs. Gate-Source Voltage



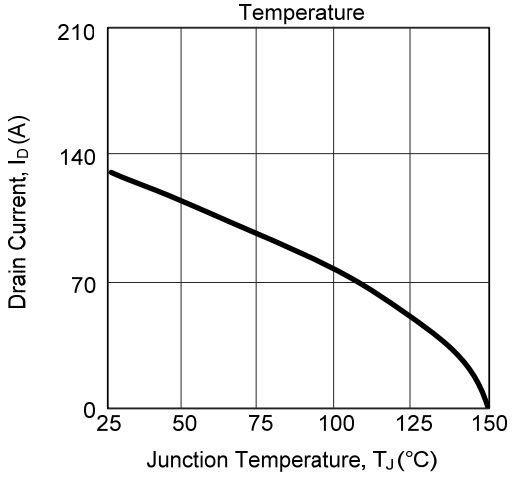

Drain-Source On-Resistance vs. Drain Current




Power Dissipation vs. Junction Temperature




Drain Current vs. Junction Temperature



## ■ TYPICAL CHARACTERISTICS (Cont.)