



## USJ60R190

Power MOSFET

### 20A, 600V N-CHANNEL SUPER-JUNCTION MOSFET

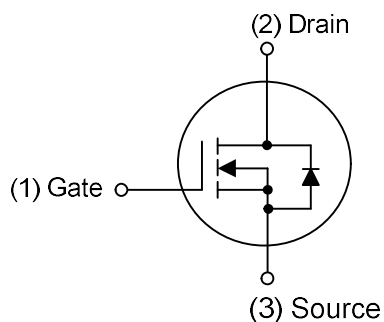
#### ■ DESCRIPTION

The **UTC USJ60R190** 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.

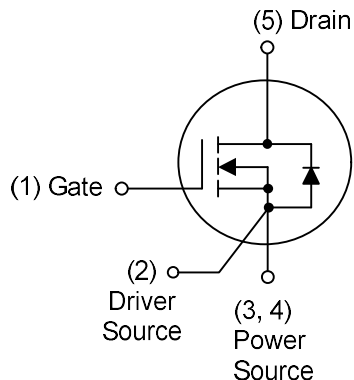
#### ■ FEATURES

- \*  $R_{DS(ON)} \leq 190 \text{ m}\Omega$  @  $V_{GS} = 10\text{V}$ ,  $I_D = 5.0\text{A}$
- \* Fast switching capability
- \* Avalanche energy tested
- \* Improved  $dv/dt$  capability, high ruggedness

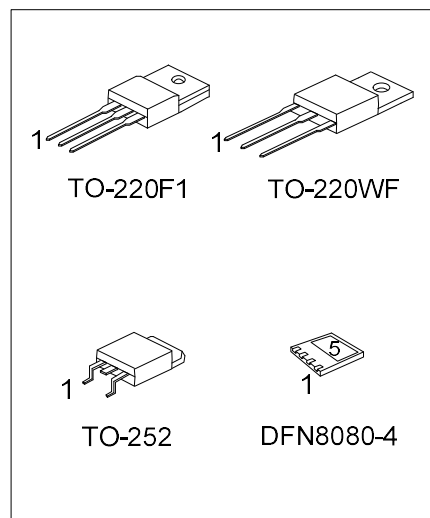
#### ■ SYMBOL



TO-220F1 / TO-220WF / TO-252



DFN8080-4



### ■ ORDERING INFORMATION

| Ordering Number       |                       | Package   | Pin Assignment |   |   |   |   | Packing   |
|-----------------------|-----------------------|-----------|----------------|---|---|---|---|-----------|
| Lead Free             | Halogen Free          |           | 1              | 2 | 3 | 4 | 5 |           |
| USJ60R190L-TF1-T      | USJ60R190G-TF1-T      | TO-220F1  | G              | D | S | - | - | Tube      |
| USJ60R190L-TW1-T      | USJ60R190G-TW1-T      | TO-220WF  | G              | D | S | - | - | Tube      |
| USJ60R190L-TN3-R      | USJ60R190G-TN3-R      | TO-252    | G              | D | S | - | - | Tube      |
| USJ60R190L-K04-8080-R | USJ60R190G-K04-8080-R | DFN8080-4 | G              | S | S | S | D | Tape Reel |

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

|                                                                                                  |                                                                                                                                                                   |
|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>USJ60R190G-TF1-T</p> <p>(1) Packing Type</p> <p>(2) Package Type</p> <p>(3) Green Package</p> | <p>(1) T: Tube, R: Tape Reel</p> <p>(2) TF1: TO-220F1, TW1: TO-220WF, TN3: TO-252, K04-8080: DFN8080-4</p> <p>(3) G: Halogen Free and Lead Free, L: Lead Free</p> |
|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|

### ■ MARKING

| TO-220F1 / TO-220WF / TO-252                                                | DFN8080-4                                                        |
|-----------------------------------------------------------------------------|------------------------------------------------------------------|
| <p>UTC USJ</p> <p>60R190Z</p> <p>Lot Code ←</p> <p>→ Date Code</p> <p>1</p> | <p>UTC</p> <p>USJ60R190</p> <p>Lot Code ←</p> <p>→ Date Code</p> |

### ■ ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub> = 25°C, unless otherwise specified.)

| PARAMETER                          |                        | SYMBOL           | RATINGS    | UNIT |
|------------------------------------|------------------------|------------------|------------|------|
| Drain-Source Voltage               |                        | V <sub>DSS</sub> | 600        | V    |
| Gate-Source Voltage                |                        | V <sub>GSS</sub> | ±30        | V    |
| Drain Current                      | Continuous             | I <sub>D</sub>   | 20         | A    |
|                                    | Pulsed (Note 2)        | I <sub>DM</sub>  | 60         | A    |
| Avalanche Energy                   | Single Pulsed (Note 3) | E <sub>AS</sub>  | 153        | mJ   |
| Peak Diode Recovery dv/dt (Note 4) |                        | dv/dt            | 1.5        | V/ns |
| Power Dissipation                  | TO-220F1/TO-220WF      | P <sub>D</sub>   | 29         | W    |
|                                    | TO-252                 |                  | 64         | W    |
|                                    | DFN8080-4              |                  | 62         | W    |
| Junction Temperature               |                        | T <sub>J</sub>   | +150       | °C   |
| Storage Temperature                |                        | T <sub>STG</sub> | -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 = 100mH, I<sub>AS</sub> = 1.8A, V<sub>DD</sub> = 50V, R<sub>G</sub> = 25 Ω Starting T<sub>J</sub> = 25°C

4. I<sub>SD</sub> ≤ 20A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C

### ■ THERMAL DATA

| PARAMETER           |                   | SYMBOL          | RATINGS     | UNIT |
|---------------------|-------------------|-----------------|-------------|------|
| Junction to Ambient | TO-220/TO-220F    | θ <sub>JA</sub> | 62.5        | °C/W |
|                     | TO-220F1/TO-220WF |                 |             |      |
|                     | TO-252            |                 | 110         | °C/W |
|                     | DFN8080-4         |                 | 35          | °C/W |
| Junction to Case    | TO-220F1/TO-220WF | θ <sub>JC</sub> | 4.31        | °C/W |
|                     | TO-252            |                 | 1.95 (Note) | °C/W |
|                     | DFN8080-4         |                 | 2.01 (Note) | °C/W |

Note: Device mounted on FR-4 substrate P<sub>C</sub> board, 2oz copper, with 1inch square copper plate.

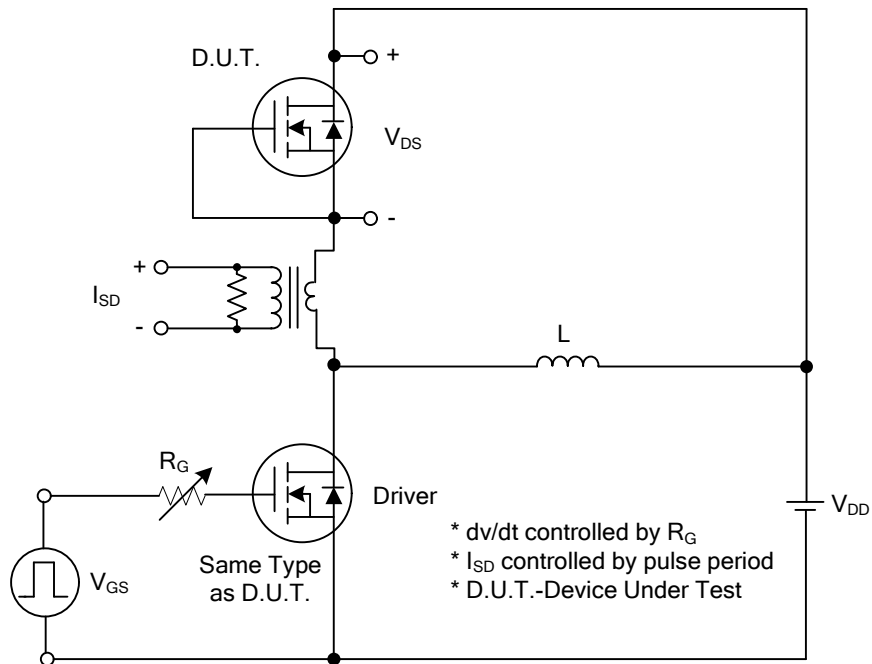
■ **ELECTRICAL CHARACTERISTICS** ( $T_J = 25^\circ\text{C}$ , unless otherwise specified.)

| PARAMETER                                             |         | SYMBOL              | TEST CONDITIONS                                                                                      | MIN | TYP  | MAX  | UNIT |
|-------------------------------------------------------|---------|---------------------|------------------------------------------------------------------------------------------------------|-----|------|------|------|
| OFF CHARACTERISTICS                                   |         |                     |                                                                                                      |     |      |      |      |
| Drain-Source Breakdown Voltage                        |         | BV <sub>DSS</sub>   | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA                                                           | 600 |      |      | V    |
| Drain-Source Leakage Current                          |         | I <sub>DSS</sub>    | V <sub>DS</sub> =600V, V <sub>GS</sub> =0V                                                           |     |      | 10   | μA   |
| Gate-Source Leakage Current                           | Forward | I <sub>GSS</sub>    | V <sub>DS</sub> =0V ,V <sub>GS</sub> =30V                                                            |     |      | 100  | nA   |
|                                                       | Reverse |                     | V <sub>DS</sub> =0V ,V <sub>GS</sub> =-30V                                                           |     |      | -100 | nA   |
| ON CHARACTERISTICS                                    |         |                     |                                                                                                      |     |      |      |      |
| Gate Threshold Voltage                                |         | V <sub>GS(TH)</sub> | V <sub>DS</sub> =V <sub>GS</sub> , I <sub>D</sub> =250μA                                             | 2.5 |      | 4.5  | V    |
| Drain-Source On-State Resistance                      |         | R <sub>DS(ON)</sub> | V <sub>GS</sub> =10V, I <sub>D</sub> =5.0A                                                           |     |      | 190  | mΩ   |
| DYNAMIC PARAMETERS                                    |         |                     |                                                                                                      |     |      |      |      |
| Input Capacitance                                     |         | C <sub>ISS</sub>    | V <sub>GS</sub> =0V, V <sub>DS</sub> =50V, f=1.0MHz                                                  |     | 1232 |      | pF   |
| Output Capacitance                                    |         | C <sub>OSS</sub>    |                                                                                                      |     | 401  |      | pF   |
| Reverse Transfer Capacitance                          |         | C <sub>RSS</sub>    |                                                                                                      |     | 21   |      | pF   |
| SWITCHING PARAMETERS                                  |         |                     |                                                                                                      |     |      |      |      |
| Total Gate Charge (Note 1)                            |         | Q <sub>G</sub>      | V <sub>DS</sub> =480V, V <sub>GS</sub> =10V, I <sub>D</sub> =20A<br>(Note 1, 2)                      |     | 56   |      | nC   |
| Gate to Source Charge                                 |         | Q <sub>GS</sub>     |                                                                                                      |     | 13   |      | nC   |
| Gate to Drain Charge                                  |         | Q <sub>GD</sub>     |                                                                                                      |     | 24   |      | nC   |
| Internal Gate Input Resistance                        |         | R <sub>G</sub>      | V <sub>GS</sub> =0V, f=1MHz                                                                          |     | 2.2  |      | Ω    |
| Turn-ON Delay Time (Note 1)                           |         | t <sub>D(ON)</sub>  | V <sub>DD</sub> =100V, V <sub>GS</sub> =10V,<br>I <sub>D</sub> =20A, R <sub>G</sub> =25Ω (Note 1, 2) |     | 23   |      | ns   |
| Rise Time                                             |         | t <sub>R</sub>      |                                                                                                      |     | 36   |      | ns   |
| Turn-OFF Delay Time                                   |         | t <sub>D(OFF)</sub> |                                                                                                      |     | 140  |      | ns   |
| Fall-Time                                             |         | t <sub>F</sub>      |                                                                                                      |     | 55   |      | ns   |
| SOURCE- DRAIN DIODE RATINGS AND CHARACTERISTICS       |         |                     |                                                                                                      |     |      |      |      |
| Maximum Continuous Drain-Source Diode Forward Current |         | I <sub>S</sub>      |                                                                                                      |     |      | 20   | A    |
| Drain-Source Diode Forward Voltage (Note 1)           |         | V <sub>SD</sub>     | I <sub>S</sub> =20A, V <sub>GS</sub> =0V                                                             |     |      | 1.4  | V    |
| Body Diode Reverse Recovery Time(Note 1)              |         | t <sub>rr</sub>     | I <sub>S</sub> =20A, V <sub>GS</sub> =0V,                                                            |     | 390  |      | ns   |
| Body Diode Reverse Recovery Charge                    |         | Q <sub>rr</sub>     | dI <sub>F</sub> /dt=100A/μs                                                                          |     | 5.7  |      | μC   |

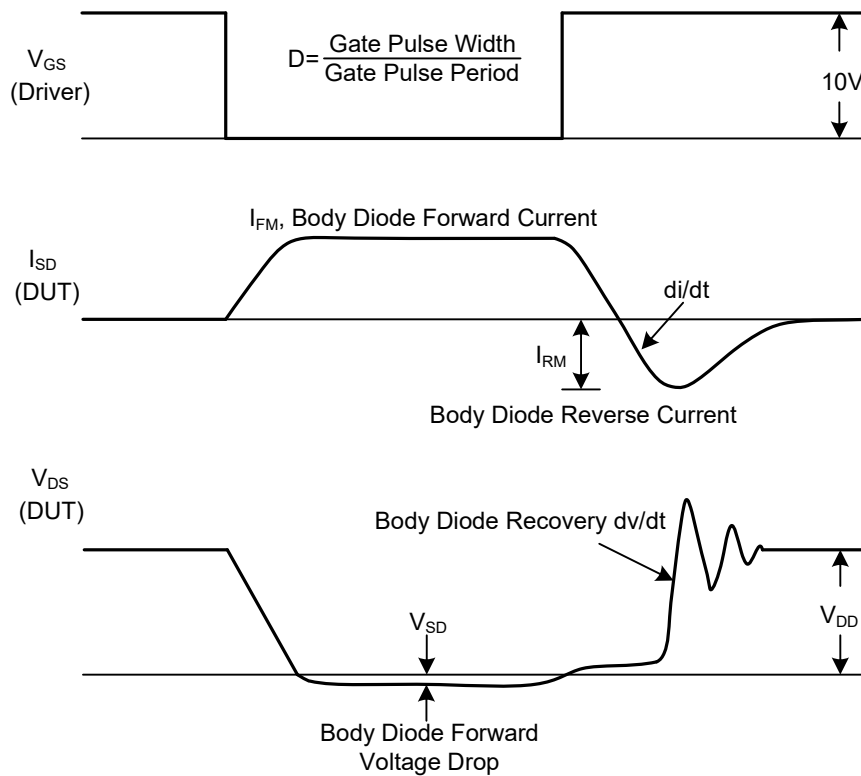
Notes: 1. Pulse Test: Pulse width  $\leq 300\mu s$ , Duty cycle  $\leq 2\%$ .

2. Essentially independent of operating temperature.

## ■ TEST CIRCUITS AND WAVEFORMS

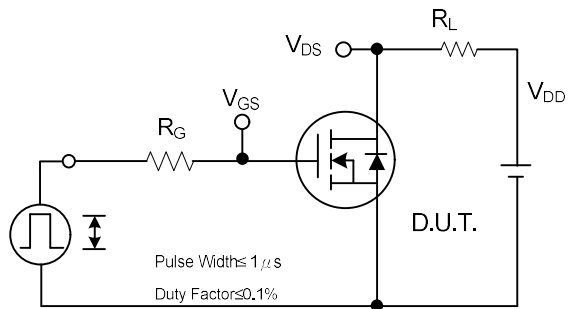


Peak Diode Recovery  $dv/dt$  Test Circuit

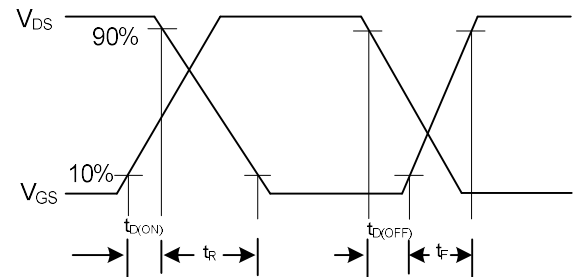


Peak Diode Recovery  $dv/dt$  Waveforms

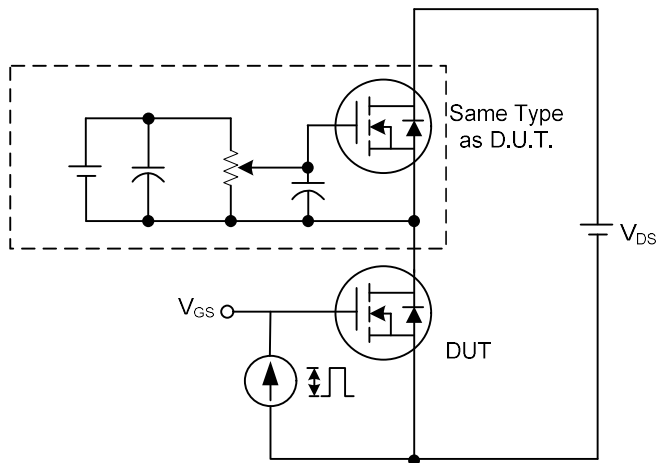
### ■ TEST CIRCUITS AND WAVEFORMS



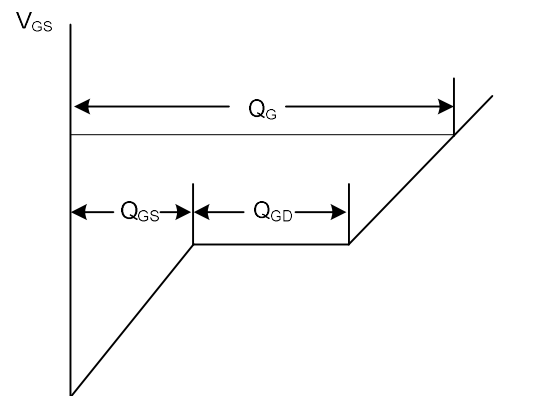
Switching Test Circuit



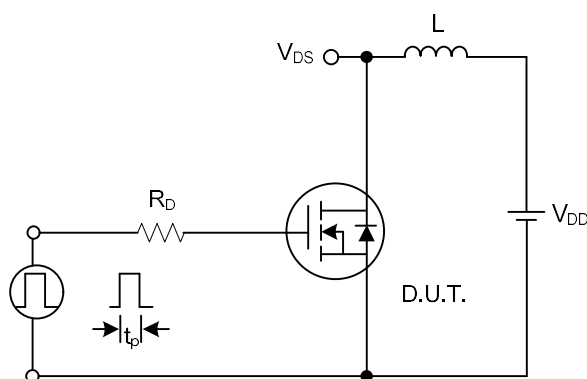
Switching Waveforms



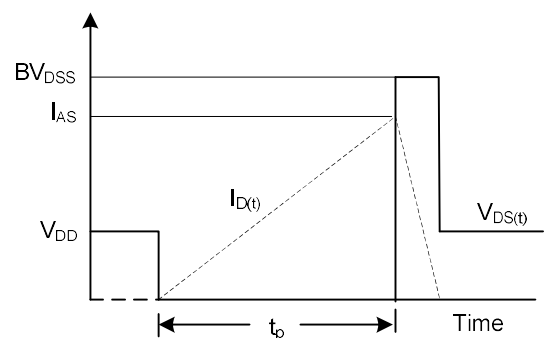
Gate Charge Test Circuit



Charge  
Gate Charge Waveform

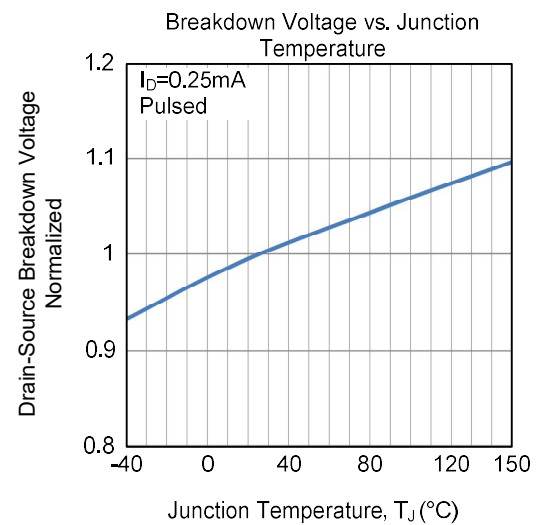
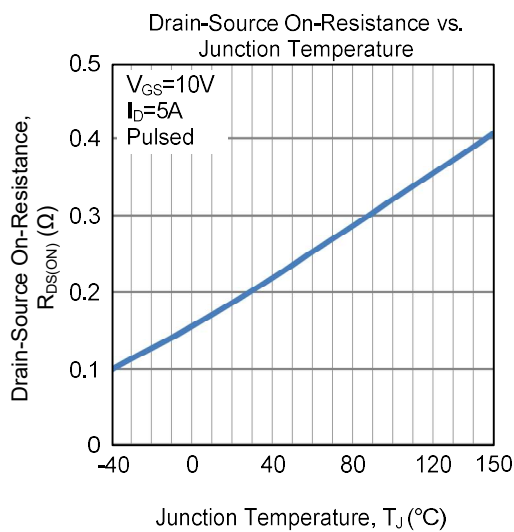
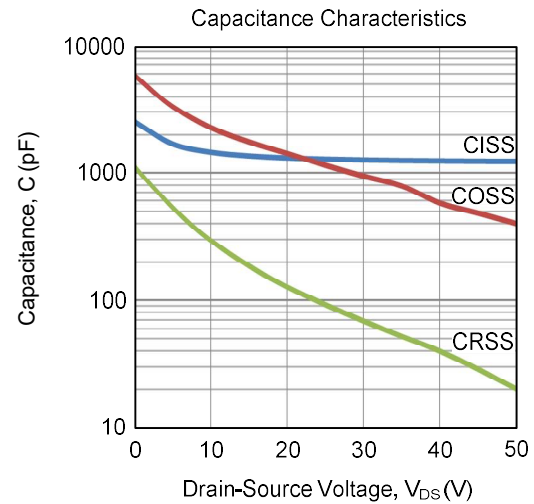
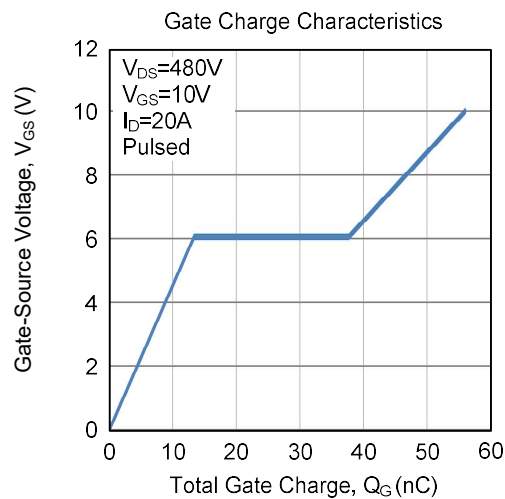
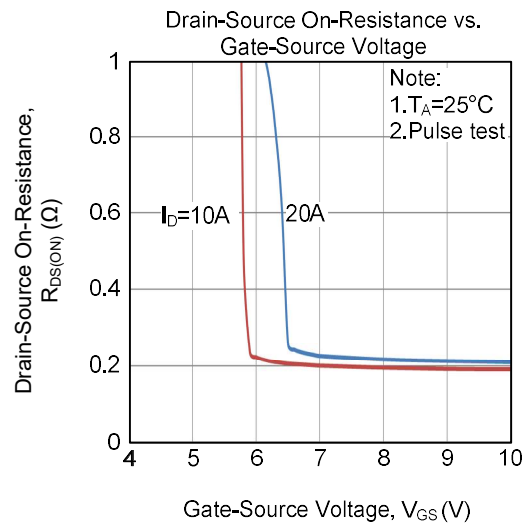
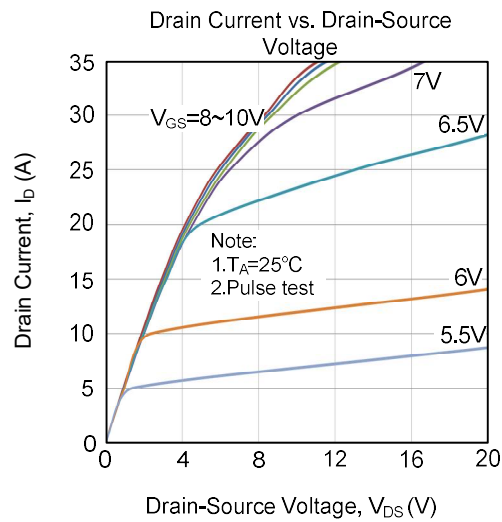


Unclamped Inductive Switching Test Circuit

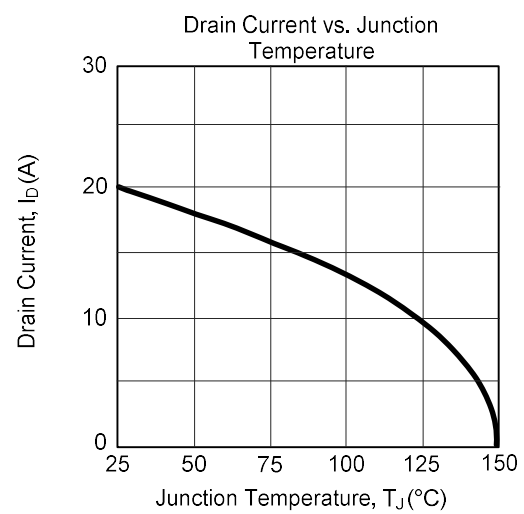
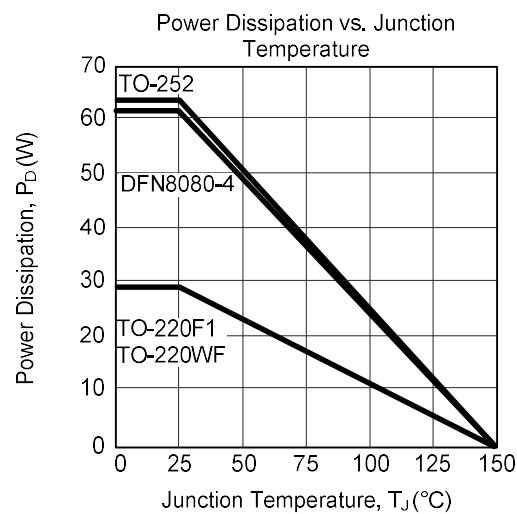
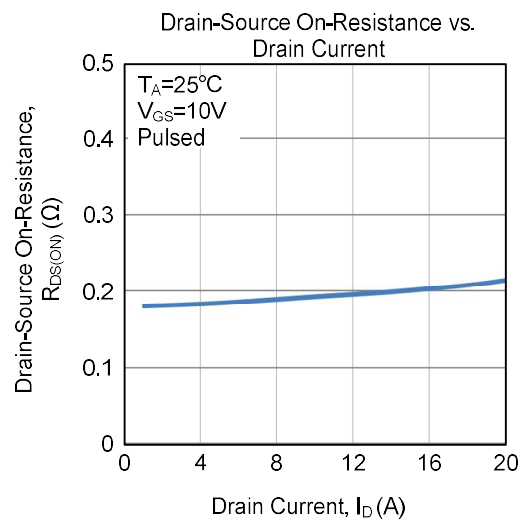
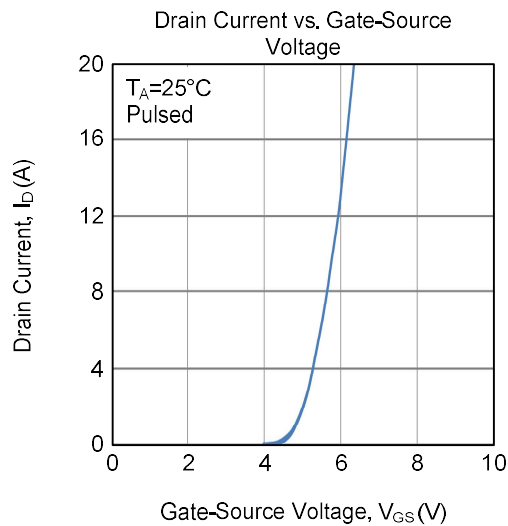
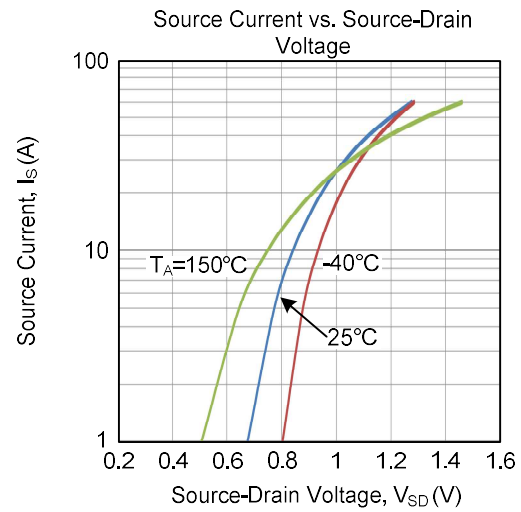
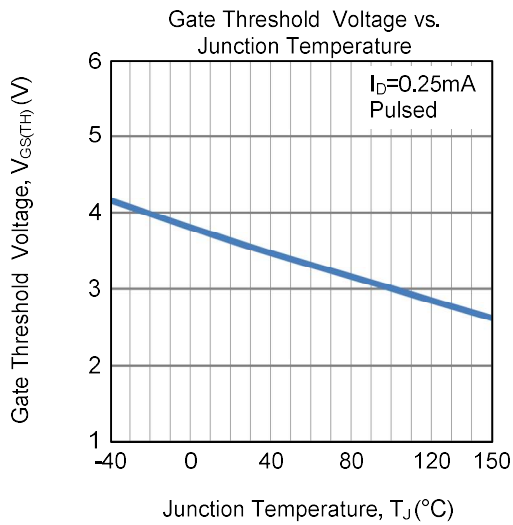


Unclamped Inductive Switching Waveforms

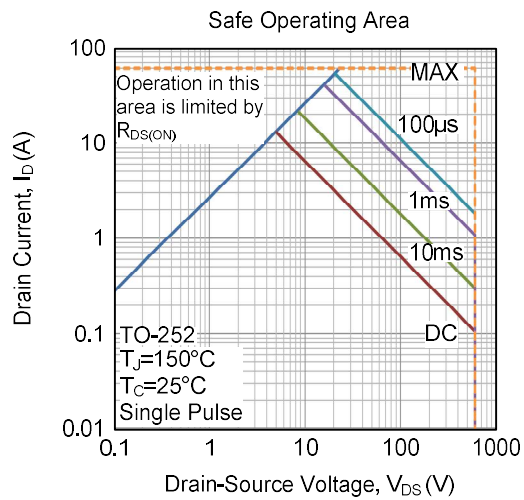
## ■ TYPICAL CHARACTERISTICS



### ■ TYPICAL CHARACTERISTICS (Cont.)



## ■ TYPICAL CHARACTERISTICS (Cont.)



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