

# NTZD3156C

## Small Signal MOSFET

20 V, 540 mA / -20 V, -430 mA

Complementary N- and P-Channel  
MOSFETs with Integrated Pull Up/Down  
Resistor and ESD Protection

### Features

- Leading Trench Technology for Low  $R_{DS(on)}$  Performance
- High Efficiency System Performance
- Low Threshold Voltage
- Integrated G-S Resistor on Both Devices
- ESD Protected Gate
- Small Footprint 1.6 x 1.6 mm
- These are Pb-Free Devices

### Applications

- Load/Power Switching with Level Shift
- Portable Electronic Products such as GPS, Cell Phones, DSC, PMP, Bluetooth Accessories

### MAXIMUM RATINGS ( $T_J = 25^\circ\text{C}$ unless otherwise specified)

| Parameter                                                         |                     |                               | Symbol         | Value               | Unit               |
|-------------------------------------------------------------------|---------------------|-------------------------------|----------------|---------------------|--------------------|
| Drain-to-Source Voltage                                           |                     |                               | $V_{DSS}$      | 20                  | V                  |
| Gate-to-Source Voltage                                            |                     |                               | $V_{GS}$       | $\pm 6$             | V                  |
| N-Channel Continuous Drain Current (Note 1)                       | Steady State        | $T_A = 25^{\circ}\text{C}$    | $I_D$          | 540                 | mA                 |
|                                                                   |                     | $T_A = 85^{\circ}\text{C}$    |                | 390                 |                    |
|                                                                   | $t \leq 5\text{ s}$ | $T_A = 25^{\circ}\text{C}$    |                | 570                 |                    |
| P-Channel Continuous Drain Current (Note 1)                       | Steady State        | $T_A = 25^{\circ}\text{C}$    |                | -430                |                    |
|                                                                   |                     | $T_A = 85^{\circ}\text{C}$    |                | -310                |                    |
|                                                                   | $t \leq 5\text{ s}$ | $T_A = 25^{\circ}\text{C}$    |                | -455                |                    |
| Power Dissipation (Note 1)                                        | Steady State        | $T_A = 25^{\circ}\text{C}$    | $P_D$          | 250                 | mW                 |
|                                                                   |                     |                               |                | $t \leq 5\text{ s}$ |                    |
| Pulsed Drain Current                                              | N-Channel           | $t_p = 10\text{ }\mu\text{s}$ | $I_{DM}$       | 1500                | mA                 |
|                                                                   | P-Channel           |                               |                | -750                |                    |
| Operating Junction and Storage Temperature                        |                     |                               | $T_J, T_{STG}$ | -55 to 150          | $^{\circ}\text{C}$ |
| Source Current (Body Diode)                                       |                     |                               | $I_S$          | 350                 | mA                 |
| Lead Temperature for Soldering Purposes (1/8" from case for 10 s) |                     |                               | $T_L$          | 260                 | $^{\circ}\text{C}$ |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Surface-mounted on FR4 board using 1 in sq. pad size (Cu area = 1.127 in sq [1 oz] including traces).

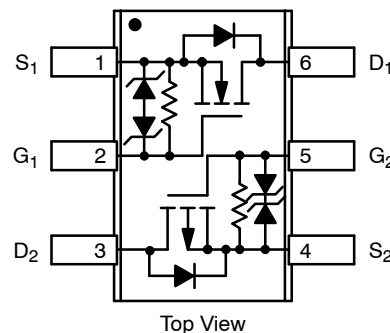


ON Semiconductor®

<http://onsemi.com>

| $V_{(BR)DSS}$      | $R_{DS(on)}$ Max      | $I_D$ Max (Note 1) |
|--------------------|-----------------------|--------------------|
| N-Channel<br>20 V  | 0.55 $\Omega$ @ 4.5 V | 540 mA             |
|                    | 0.7 $\Omega$ @ 2.5 V  |                    |
|                    | 0.9 $\Omega$ @ 1.8 V  |                    |
| P-Channel<br>-20 V | 0.9 $\Omega$ @ -4.5 V | -430 mA            |
|                    | 1.2 $\Omega$ @ -2.5 V |                    |
|                    | 2.0 $\Omega$ @ -1.8 V |                    |

### PINOUT: SOT-563



SOT-563-6  
CASE 463A  
STYLE 9

### MARKING DIAGRAM



ZC = Specific Device Code  
M = Date Code  
■ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

| Device       | Package | Shipping†          |
|--------------|---------|--------------------|
| NTZD3156CT1G | SOT-563 | 4000 / Tape & Reel |
| NTZD3156CT2G | SOT-563 | 4000 / Tape & Reel |
| NTZD3156CT5G | SOT-563 | 8000 / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# NTZD3156C

## Thermal Resistance Ratings

| Parameter                                   | Symbol          | Max | Unit |
|---------------------------------------------|-----------------|-----|------|
| Junction-to-Ambient – Steady State (Note 2) | $R_{\theta JA}$ | 116 | °C/W |
| Junction-to-Ambient – $t = 5$ s (Note 2)    |                 | 304 |      |

2. Surface mounted on FR4 board using 1 in sq pad size (Cu area = 1.127 in sq [1 oz] including traces).

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise specified)

| Parameter                                                 | Symbol            | N/P | Test Condition                                   | Min                             | Typ | Max      | Unit          |
|-----------------------------------------------------------|-------------------|-----|--------------------------------------------------|---------------------------------|-----|----------|---------------|
| <b>OFF CHARACTERISTICS</b>                                |                   |     |                                                  |                                 |     |          |               |
| Drain-to-Source Breakdown Voltage                         | $V_{(BR)DSS}$     | N   | $V_{GS} = 0\text{ V}$                            | $I_D = 250\text{ }\mu\text{A}$  | 20  |          | V             |
|                                                           |                   | P   |                                                  | $I_D = -250\text{ }\mu\text{A}$ | -20 |          |               |
| Drain-to-Source Breakdown Voltage Temperature Coefficient | $V_{(BR)DSS}/T_J$ |     |                                                  |                                 | 20  |          | mV/°C         |
| Zero Gate Voltage Drain Current                           | $I_{DSS}$         | N   | $V_{GS} = 0\text{ V}, V_{DS} = 16\text{ V}$      | $T_J = 25^\circ\text{C}$        |     | 1.0      | $\mu\text{A}$ |
|                                                           |                   | P   | $V_{GS} = 0\text{ V}, V_{DS} = -16\text{ V}$     |                                 |     | -1.0     |               |
|                                                           |                   | N   | $V_{GS} = 0\text{ V}, V_{DS} = 16\text{ V}$      | $T_J = 125^\circ\text{C}$       |     | 2.0      | $\mu\text{A}$ |
|                                                           |                   | P   | $V_{GS} = 0\text{ V}, V_{DS} = -16\text{ V}$     |                                 |     | -5.0     |               |
| Gate-to-Source Leakage Current                            | $I_{GSS}$         | N   | $V_{DS} = 0\text{ V}, V_{GS} = \pm 4.5\text{ V}$ |                                 |     | $\pm 50$ | $\mu\text{A}$ |
|                                                           |                   | P   |                                                  |                                 |     | $\pm 50$ |               |

## ON CHARACTERISTICS (Note 3)

|                                        |                  |   |                                                |                                 |       |      |          |
|----------------------------------------|------------------|---|------------------------------------------------|---------------------------------|-------|------|----------|
| Gate Threshold Voltage                 | $V_{GS(TH)}$     | N | $V_{GS} = V_{DS}$                              | $I_D = 250\text{ }\mu\text{A}$  | 0.45  | 1.0  | V        |
|                                        |                  | P |                                                | $I_D = -250\text{ }\mu\text{A}$ | -0.45 | -1.0 |          |
| Gate Threshold Temperature Coefficient | $V_{GS(TH)}/T_J$ |   |                                                |                                 | 2.0   |      | -mV/°C   |
| Drain-to-Source On Resistance          | $R_{DS(on)}$     | N | $V_{GS} = 4.5\text{ V}, I_D = 540\text{ mA}$   |                                 | 0.19  | 0.55 | $\Omega$ |
|                                        |                  | P | $V_{GS} = -4.5\text{ V}, I_D = -430\text{ mA}$ |                                 | 0.39  | 0.9  |          |
|                                        |                  | N | $V_{GS} = 2.5\text{ V}, I_D = 500\text{ mA}$   |                                 | 0.26  | 0.7  |          |
|                                        |                  | P | $V_{GS} = -2.5\text{ V}, I_D = -300\text{ mA}$ |                                 | 0.53  | 1.2  |          |
|                                        |                  | N | $V_{GS} = 1.8\text{ V}, I_D = 350\text{ mA}$   |                                 | 0.36  | 0.9  |          |
|                                        |                  | P | $V_{GS} = -1.8\text{ V}, I_D = -150\text{ mA}$ |                                 | 0.72  | 2.0  |          |
| Forward Transconductance               | $g_{FS}$         | N | $V_{DS} = 10\text{ V}, I_D = 540\text{ mA}$    |                                 | 1.46  |      | S        |
|                                        |                  | P | $V_{DS} = -10\text{ V}, I_D = -430\text{ mA}$  |                                 | 1.18  |      |          |

## CHARGES, CAPACITANCES AND GATE RESISTANCE

|                              |           |   |                                                                    |  |    |  |    |
|------------------------------|-----------|---|--------------------------------------------------------------------|--|----|--|----|
| Input Capacitance            | $C_{ISS}$ | N | $f = 1\text{ MHz}, V_{GS} = 0\text{ V}$<br>$V_{DS} = 16\text{ V}$  |  | 72 |  | pF |
| Output Capacitance           | $C_{OSS}$ |   |                                                                    |  | 13 |  |    |
| Reverse Transfer Capacitance | $C_{RSS}$ |   |                                                                    |  | 10 |  |    |
| Input Capacitance            | $C_{ISS}$ | P | $f = 1\text{ MHz}, V_{GS} = 0\text{ V}$<br>$V_{DS} = -16\text{ V}$ |  | 93 |  |    |
| Output Capacitance           | $C_{OSS}$ |   |                                                                    |  | 15 |  |    |
| Reverse Transfer Capacitance | $C_{RSS}$ |   |                                                                    |  | 11 |  |    |

3. Pulse Test: pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$

# NTZD3156C

## ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ unless otherwise specified)

| Parameter | Symbol | N/P | Test Condition | Min | Typ | Max | Unit |
|-----------|--------|-----|----------------|-----|-----|-----|------|
|-----------|--------|-----|----------------|-----|-----|-----|------|

### CHARGES, CAPACITANCES AND GATE RESISTANCE

|                       |              |   |                                                                       |  |      |     |    |
|-----------------------|--------------|---|-----------------------------------------------------------------------|--|------|-----|----|
| Total Gate Charge     | $Q_{G(TOT)}$ | N | $V_{GS} = 4.5\text{ V}, V_{DS} = 10\text{ V}; I_D = 540\text{ mA}$    |  | 1.39 | 2.5 | nC |
| Threshold Gate Charge | $Q_{G(TH)}$  |   |                                                                       |  | 0.1  |     |    |
| Gate-to-Source Charge | $Q_{GS}$     |   |                                                                       |  | 0.26 |     |    |
| Gate-to-Drain Charge  | $Q_{GD}$     |   |                                                                       |  | 0.39 |     |    |
| Total Gate Charge     | $Q_{G(TOT)}$ | P | $V_{GS} = -4.5\text{ V}, V_{DS} = -10\text{ V}; I_D = -430\text{ mA}$ |  | 1.49 | 2.5 |    |
| Threshold Gate Charge | $Q_{G(TH)}$  |   |                                                                       |  | 0.1  |     |    |
| Gate-to-Source Charge | $Q_{GS}$     |   |                                                                       |  | 0.3  |     |    |
| Gate-to-Drain Charge  | $Q_{GD}$     |   |                                                                       |  | 0.37 |     |    |

### SWITCHING CHARACTERISTICS ( $V_{GS} = V$ ) (Note 4)

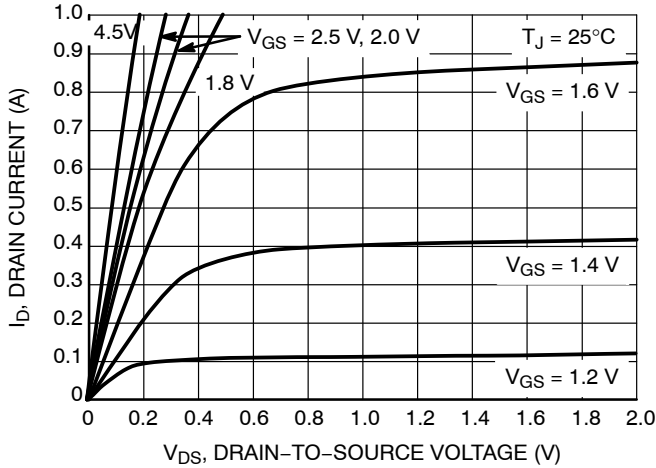
|                     |              |   |                                                                                         |  |      |  |    |
|---------------------|--------------|---|-----------------------------------------------------------------------------------------|--|------|--|----|
| Turn-On Delay Time  | $t_{d(ON)}$  | N | $V_{GS} = 4.5\text{ V}, V_{DD} = 10\text{ V}, I_D = 540\text{ mA}, R_G = 10\ \Omega$    |  | 7.7  |  | ns |
| Rise Time           | $t_r$        |   |                                                                                         |  | 5.3  |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |   |                                                                                         |  | 21   |  |    |
| Fall Time           | $t_f$        |   |                                                                                         |  | 10   |  |    |
| Turn-On Delay Time  | $t_{d(ON)}$  | P | $V_{GS} = -4.5\text{ V}, V_{DD} = -10\text{ V}, I_D = -430\text{ mA}, R_G = 10\ \Omega$ |  | 9.2  |  |    |
| Rise Time           | $t_r$        |   |                                                                                         |  | 6.5  |  |    |
| Turn-Off Delay Time | $t_{d(OFF)}$ |   |                                                                                         |  | 29   |  |    |
| Fall Time           | $t_f$        |   |                                                                                         |  | 19.5 |  |    |

### Drain-Source Diode Characteristics

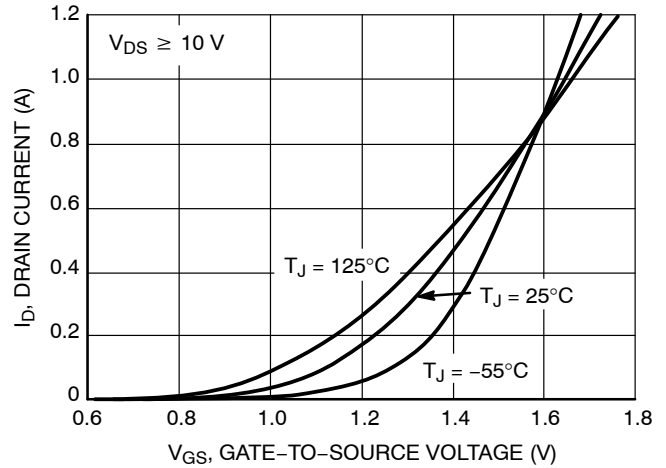
|                       |          |   |                                                           |                        |  |       |      |    |
|-----------------------|----------|---|-----------------------------------------------------------|------------------------|--|-------|------|----|
| Forward Diode Voltage | $V_{SD}$ | N | $V_{GS} = 0\text{ V}, T_J = 25^\circ\text{C}$             | $I_S = 350\text{ mA}$  |  | 0.77  | 1.2  | V  |
|                       |          | P |                                                           | $I_S = -350\text{ mA}$ |  | -0.77 | -1.2 |    |
|                       |          | N | $V_{GS} = 0\text{ V}, T_J = 125^\circ\text{C}$            | $I_S = 350\text{ mA}$  |  | 0.65  |      |    |
|                       |          | P |                                                           | $I_S = -350\text{ mA}$ |  | 0.63  |      |    |
| Reverse Recovery Time | $t_{RR}$ | N | $V_{GS} = 0\text{ V}, dI_S/dt = 100\text{ A}/\mu\text{s}$ | $I_S = 350\text{ mA}$  |  | 9.4   |      | ns |
|                       |          | P |                                                           | $I_S = -350\text{ mA}$ |  | 14.6  |      |    |

4. Switching characteristics are independent of operating junction temperatures

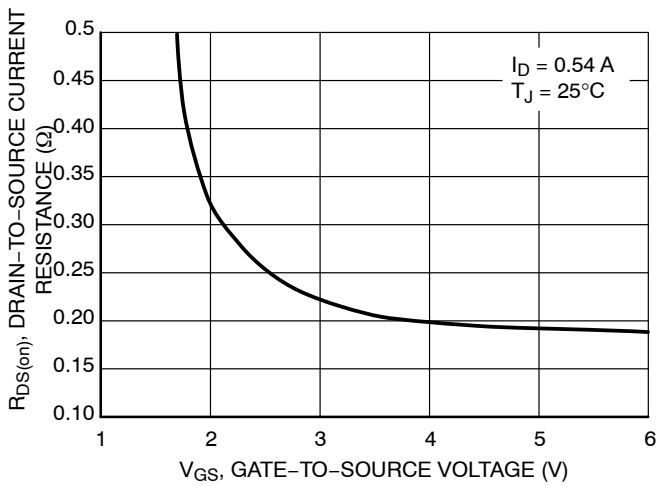
**N-CHANNEL TYPICAL PERFORMANCE CURVES** ( $T_J = 25^\circ\text{C}$  unless otherwise noted)



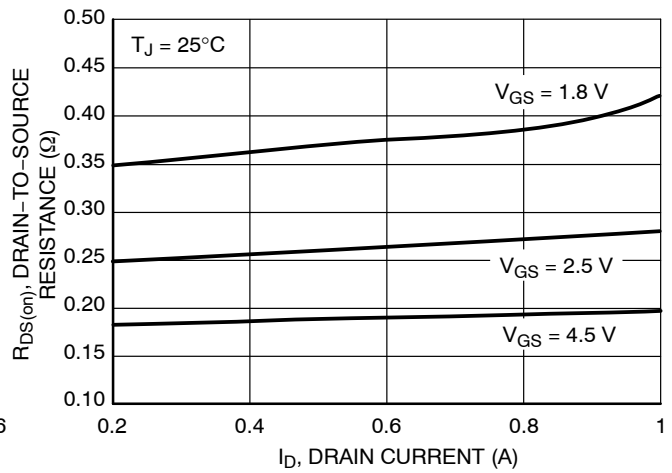
**Figure 1. On-Region Characteristics**



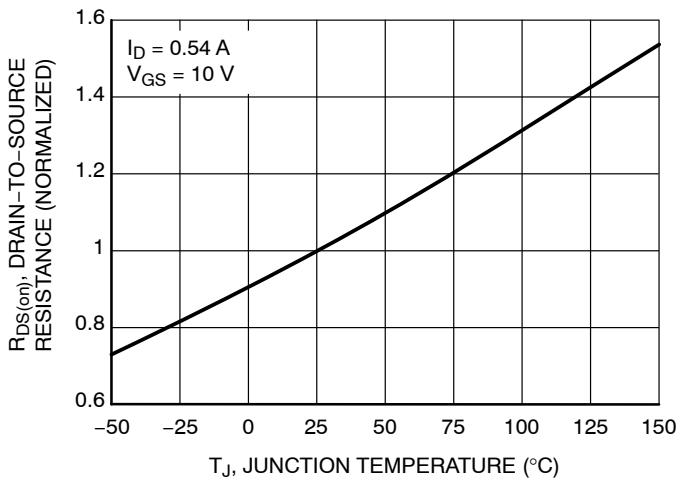
**Figure 2. Transfer Characteristics**



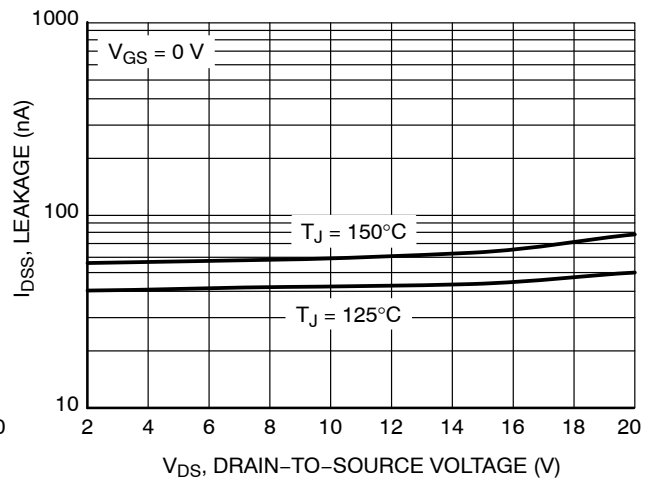
**Figure 3. On-Resistance versus Gate-to-Source Voltage**



**Figure 4. On-Resistance versus Drain Current and Gate Voltage**

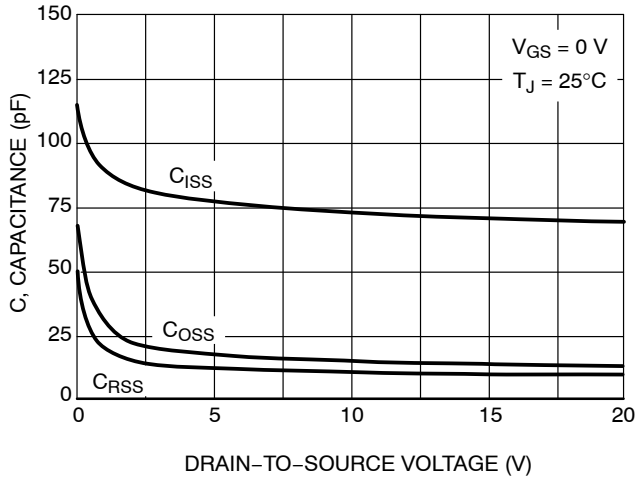


**Figure 5. On-Resistance Variation with Temperature**

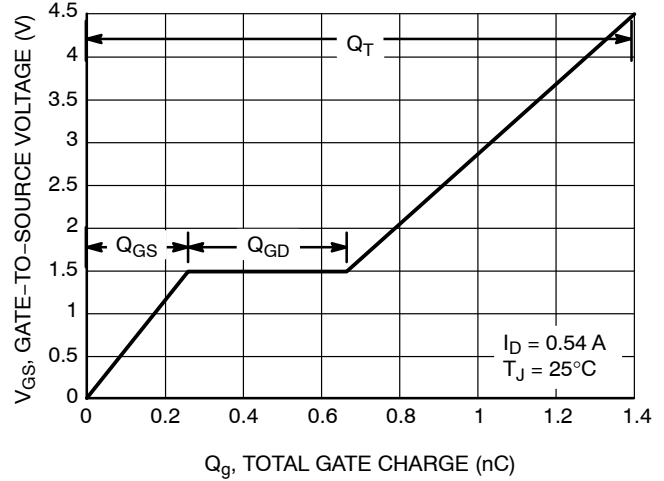


**Figure 6. Drain-to-Source Leakage Current versus Voltage**

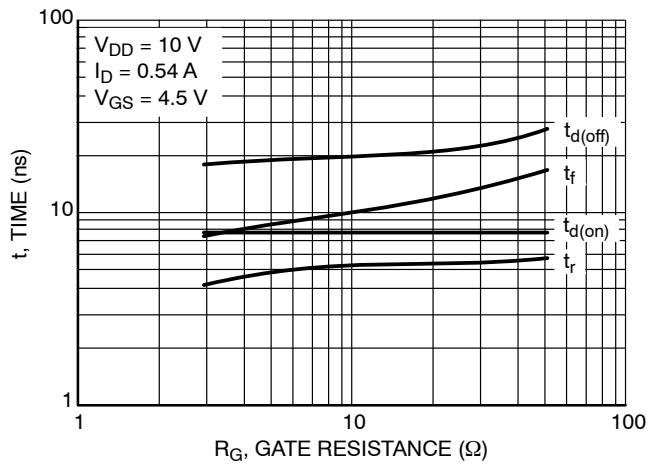
**N-CHANNEL TYPICAL PERFORMANCE CURVES** ( $T_J = 25^\circ\text{C}$  unless otherwise noted)



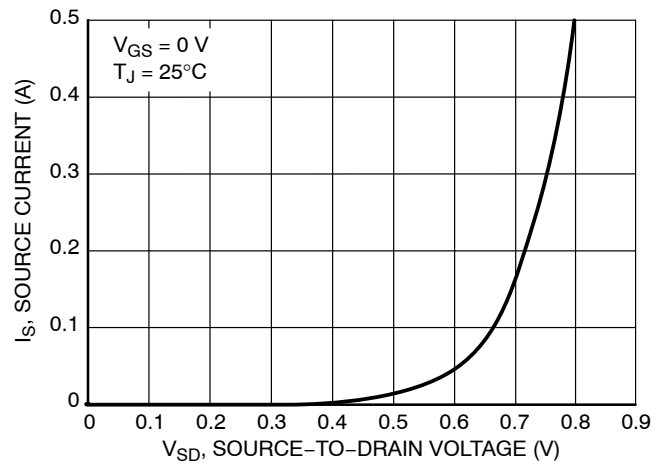
**Figure 7. Capacitance Variation**



**Figure 8. Gate-to-Source and Drain-to-Source Voltage versus Total Charge**

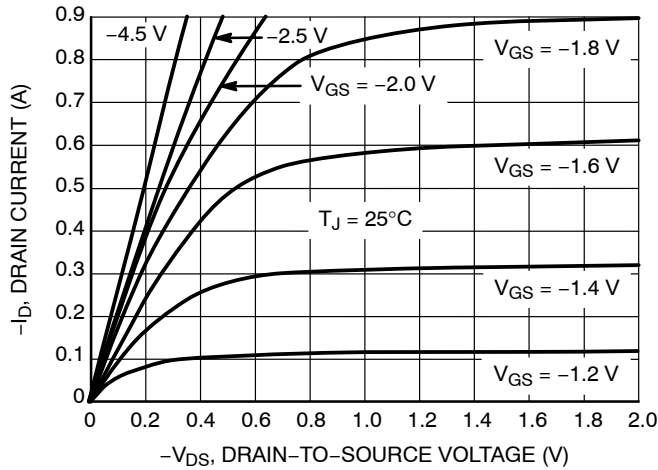


**Figure 9. Resistive Switching Time Variation versus Gate Resistance**

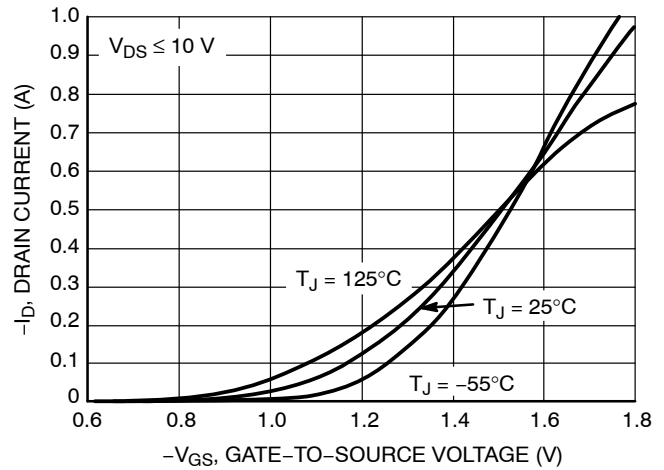


**Figure 10. Diode Forward Voltage versus Current**

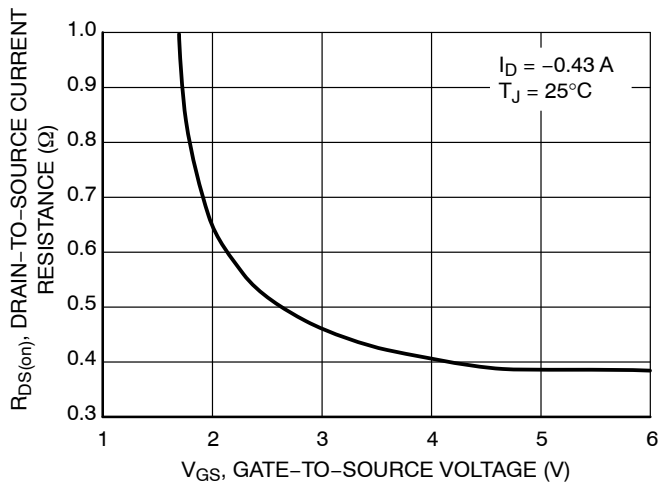
**P-CHANNEL TYPICAL PERFORMANCE CURVES** ( $T_J = 25^\circ\text{C}$  unless otherwise noted)



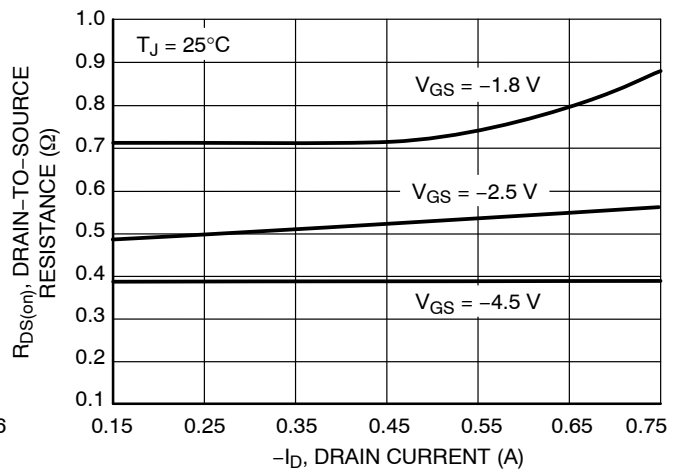
**Figure 11. On-Region Characteristics**



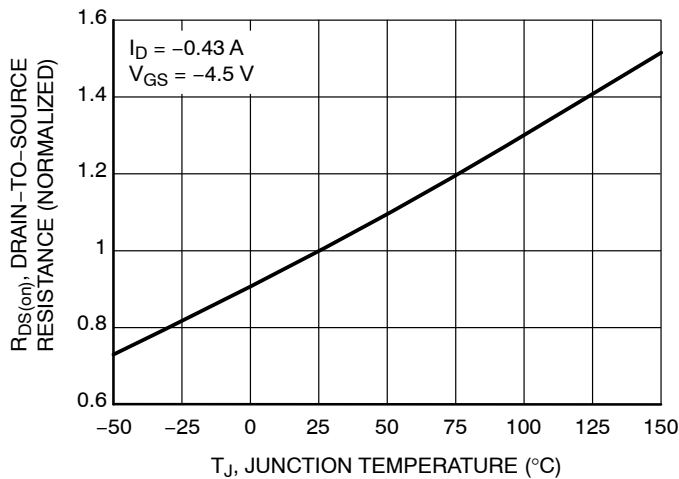
**Figure 12. Transfer Characteristics**



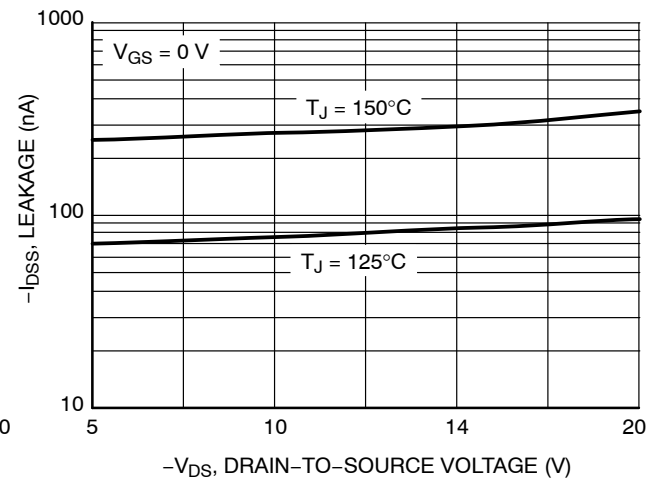
**Figure 13. On-Resistance versus Gate-to-Source Voltage**



**Figure 14. On-Resistance versus Drain Current and Gate Voltage**

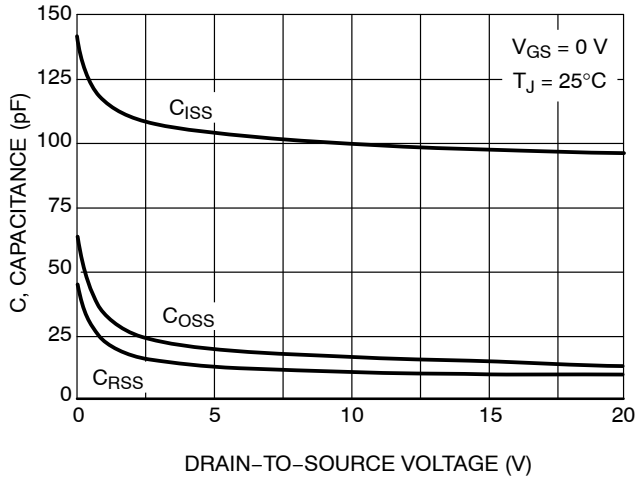


**Figure 15. On-Resistance Variation with Temperature**

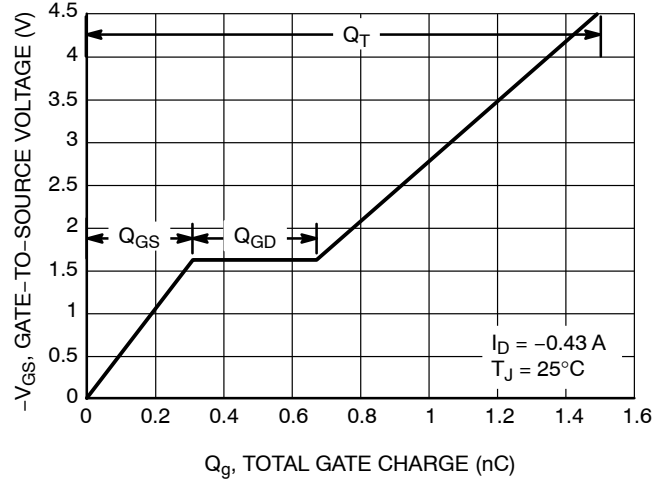


**Figure 16. Drain-to-Source Leakage Current versus Voltage**

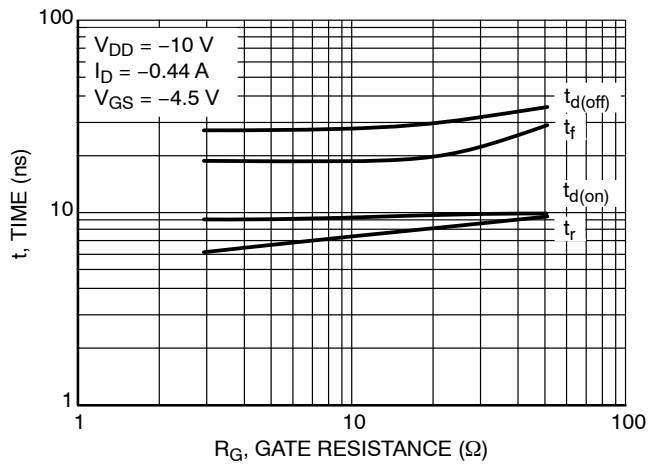
**P-CHANNEL TYPICAL PERFORMANCE CURVES** ( $T_J = 25^\circ\text{C}$  unless otherwise noted)



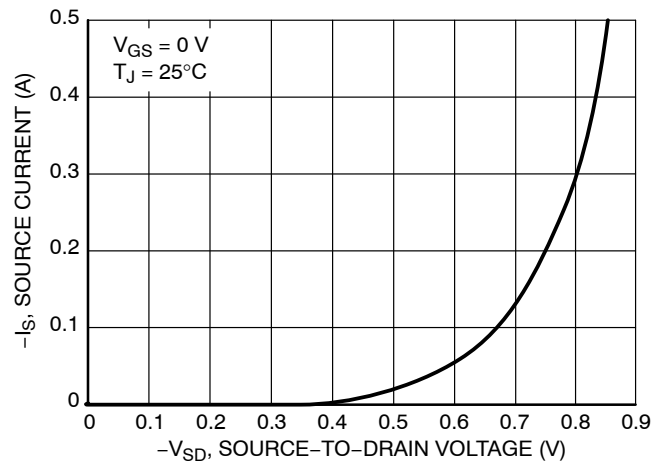
**Figure 17. Capacitance Variation**



**Figure 18. Gate-to-Source and Drain-to-Source Voltage versus Total Charge**



**Figure 19. Resistive Switching Time Variation versus Gate Resistance**



**Figure 20. Diode Forward Voltage versus Current**



**SOT-563-6 1.60x1.20x0.55, 0.50P**  
**CASE 463A**  
**ISSUE J**

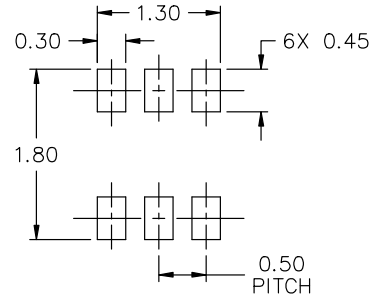
DATE 15 FEB 2024

NOTES:

1. DIMENSIONING AND TOLERANCING CONFORM TO ASME Y14.5-2018.
2. ALL DIMENSION ARE IN MILLIMETERS.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.



| DIM | MILLIMETERS |      |      |
|-----|-------------|------|------|
|     | MIN.        | NOM. | MAX. |
| A   | 0.50        | 0.55 | 0.60 |
| b   | 0.17        | 0.22 | 0.27 |
| c   | 0.08        | 0.13 | 0.18 |
| D   | 1.50        | 1.60 | 1.70 |
| E   | 1.10        | 1.20 | 1.30 |
| e   | 0.50 BSC    |      |      |
| H   | 1.50        | 1.60 | 1.70 |
| L   | 0.10        | 0.20 | 0.30 |



STYLE 1:  
PIN 1. EMITTER 1  
2. BASE 1  
3. COLLECTOR 2  
4. EMITTER 2  
5. BASE 2  
6. COLLECTOR 1

STYLE 2:  
PIN 1. EMITTER 1  
2. EMITTER 2  
3. BASE 2  
4. COLLECTOR 2  
5. BASE 1  
6. COLLECTOR 1

STYLE 3:  
PIN 1. CATHODE 1  
2. CATHODE 1  
3. ANODE/ANODE 2  
4. CATHODE 2  
5. CATHODE 2  
6. ANODE/ANODE 1

STYLE 4:  
PIN 1. COLLECTOR  
2. COLLECTOR  
3. BASE  
4. EMITTER  
5. COLLECTOR  
6. COLLECTOR

STYLE 5:  
PIN 1. CATHODE  
2. CATHODE  
3. ANODE  
4. ANODE  
5. CATHODE  
6. CATHODE

STYLE 6:  
PIN 1. CATHODE  
2. ANODE  
3. CATHODE  
4. CATHODE  
5. CATHODE  
6. CATHODE

STYLE 7:  
PIN 1. CATHODE  
2. ANODE  
3. CATHODE  
4. CATHODE  
5. ANODE  
6. CATHODE

STYLE 8:  
PIN 1. DRAIN  
2. DRAIN  
3. GATE  
4. SOURCE  
5. DRAIN  
6. DRAIN

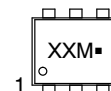
STYLE 9:  
PIN 1. SOURCE 1  
2. GATE 1  
3. DRAIN 2  
4. SOURCE 2  
5. GATE 2  
6. DRAIN 1

STYLE 10:  
PIN 1. CATHODE 1  
2. N/C  
3. CATHODE 2  
4. ANODE 2  
5. N/C  
6. ANODE 1

STYLE 11:  
PIN 1. EMITTER 2  
2. BASE 2  
3. COLLECTOR 1  
4. EMITTER 1  
5. BASE 1  
6. COLLECTOR 2

\* FOR ADDITIONAL INFORMATION ON OUR Pb-FREE STRATEGY AND SOLDERING DETAILS, PLEASE DOWNLOAD THE ON SEMICONDUCTOR SOLDERING AND MOUNTING TECHNIQUES REFERENCE MANUAL, SOLDERM/D.

**GENERIC  
MARKING DIAGRAM\***



XX = Specific Device Code  
M = Month Code  
▪ = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

|                         |                                        |                                                                                                                                                                                  |
|-------------------------|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
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| <b>DESCRIPTION:</b>     | <b>SOT-563-6 1.60x1.20x0.55, 0.50P</b> | <b>PAGE 1 OF 1</b>                                                                                                                                                               |

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