

Complementary N- and P-Channel 20 V (D-S) MOSFET

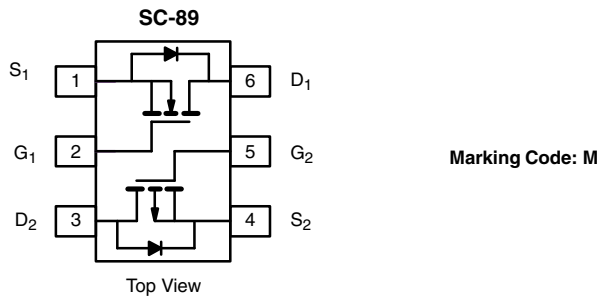
| PRODUCT SUMMARY | | | |
|-----------------|--------------|---------------------------|------------|
| | V_{DS} (V) | $R_{DS(on)}$ (Ω) | I_D (mA) |
| N-Channel | 20 | 5 at $V_{GS} = 4.5$ V | 200 |
| | | 7 at $V_{GS} = 2.5$ V | 175 |
| | | 9 at $V_{GS} = 1.8$ V | 150 |
| | | 10 at $V_{GS} = 1.5$ V | 50 |
| P-Channel | - 20 | 8 at $V_{GS} = - 4.5$ V | - 150 |
| | | 12 at $V_{GS} = - 2.5$ V | - 125 |
| | | 15 at $V_{GS} = - 1.8$ V | - 100 |
| | | 20 at $V_{GS} = - 1.5$ V | - 30 |

FEATURES

- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET® Power MOSFET: 1.5 V Rated
- Very Small Footprint
- High-Side Switching
- Low On-Resistance:
N-Channel, 5 Ω
P-Channel, 8 Ω
- Low Threshold: ± 0.9 V (typ.)
- Fast Switching Speed: 45 ns (typ.)
- 1.5 V Operation
- Gate-Source ESD Protected: 2000 V
- Compliant to RoHS Directive 2002/95/EC



RoHS
COMPLIANT
HALOGEN
FREE



Ordering Information: Si1035X-T1-GE3 (Lead (Pb)-free and Halogen-free)

BENEFITS

- Ease in Driving Switches
- Low Offset (Error) Voltage
- Low-Voltage Operation
- High-Speed Circuits
- Low Battery Voltage Operation

APPLICATIONS

- Replace Digital Transistor, Level-Shifter
- Battery Operated Systems
- Power Supply Converter Circuits
- Load/Power Switching Cell Phones, Pagers

| ABSOLUTE MAXIMUM RATINGS ($T_A = 25$ °C, unless otherwise noted) | | | | | | | |
|---|----------------|---------------|--------------|-----------|--------------|-------|----|
| Parameter | Symbol | N-Channel | | P-Channel | | Unit | |
| | | 5 s | Steady State | 5 s | Steady State | | |
| Drain-Source Voltage | V_{DS} | 20 | | - 20 | | V | |
| Gate-Source Voltage | V_{GS} | ± 5 | | | | | |
| Continuous Drain Current ($T_J = 150$ °C) ^a | I_D | $T_A = 25$ °C | 190 | 180 | - 155 | - 145 | mA |
| | | $T_A = 85$ °C | 140 | 130 | - 110 | - 105 | |
| Pulsed Drain Current ^b | I_{DM} | 650 | | - 650 | | | |
| Continuous Source Current (Diode Conduction) | I_S | 450 | 380 | - 450 | - 380 | | |
| Maximum Power Dissipation ^a | P_D | $T_A = 25$ °C | 280 | 250 | 280 | 250 | mW |
| | | $T_A = 85$ °C | 145 | 130 | 145 | 130 | |
| Operating Junction and Storage Temperature Range | T_J, T_{stg} | - 55 to 150 | | | | °C | |
| Gate-Source ESD Rating (HBM, Method 3015) | ESD | 2000 | | | | V | |

Notes:

a. Surface mounted on FR4 board.

b. Pulse width limited by maximum junction temperature.

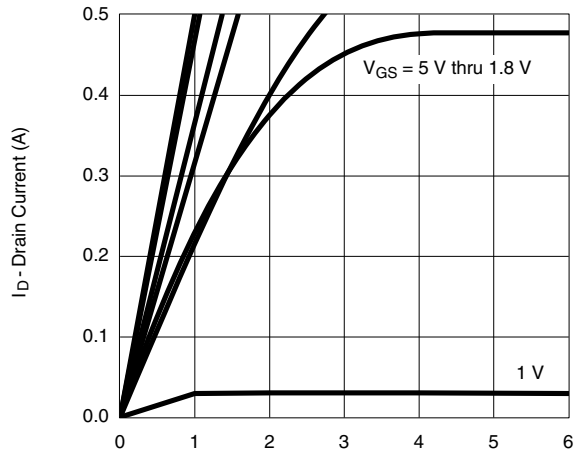
| SPECIFICATIONS ($T_J = 25\text{ }^\circ\text{C}$, unless otherwise noted) | | | | | | | |
|---|--------------|---|--|-----------|-----------|---------------|----|
| Parameter | Symbol | Test Conditions | Min. | Typ. | Max. | Unit | |
| Static | | | | | | | |
| Gate Threshold Voltage | $V_{GS(th)}$ | $V_{DS} = V_{GS}, I_D = 250\text{ }\mu\text{A}$ | N-Ch | 0.40 | | V | |
| | | $V_{DS} = V_{GS}, I_D = -250\text{ }\mu\text{A}$ | P-Ch | -0.40 | | | |
| Gate-Body Leakage | I_{GSS} | $V_{DS} = 0\text{ V}, V_{GS} = \pm 2.8\text{ V}$ | N-Ch | ± 0.5 | ± 1.0 | μA | |
| | | | P-Ch | ± 0.5 | ± 1.0 | | |
| | | $V_{DS} = 0\text{ V}, V_{GS} = \pm 4.5\text{ V}$ | N-Ch | ± 1.5 | ± 3.0 | | |
| | | | P-Ch | ± 1.0 | ± 3.0 | | |
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = 16\text{ V}, V_{GS} = 0\text{ V}$ | N-Ch | 1 | 500 | nA | |
| | | $V_{DS} = -16\text{ V}, V_{GS} = 0\text{ V}$ | P-Ch | -1 | -500 | | |
| | | $V_{DS} = 16\text{ V}, V_{GS} = 0\text{ V}, T_J = 85\text{ }^\circ\text{C}$ | N-Ch | | 10 | μA | |
| | | $V_{DS} = -16\text{ V}, V_{GS} = 0\text{ V}, T_J = 85\text{ }^\circ\text{C}$ | P-Ch | | -10 | | |
| On-State Drain Current ^a | $I_{D(on)}$ | $V_{DS} = 5\text{ V}, V_{GS} = 4.5\text{ V}$ | N-Ch | 250 | | mA | |
| | | $V_{DS} = -5\text{ V}, V_{GS} = -4.5\text{ V}$ | P-Ch | -200 | | | |
| Drain-Source On-State Resistance ^a | $R_{DS(on)}$ | $V_{GS} = 4.5\text{ V}, I_D = 200\text{ mA}$ | N-Ch | | 5 | Ω | |
| | | $V_{GS} = -4.5\text{ V}, I_D = -150\text{ mA}$ | P-Ch | | 8 | | |
| | | $V_{GS} = 2.5\text{ V}, I_D = 175\text{ mA}$ | N-Ch | | 7 | | |
| | | $V_{GS} = -2.5\text{ V}, I_D = 125\text{ mA}$ | P-Ch | | 12 | | |
| | | $V_{GS} = 1.8\text{ V}, I_D = 150\text{ mA}$ | N-Ch | | 9 | | |
| | | $V_{GS} = -1.8\text{ V}, I_D = -100\text{ mA}$ | P-Ch | | 15 | | |
| | | $V_{DS} = 1.5\text{ V}, I_D = 40\text{ mA}$ | N-Ch | | 10 | | |
| | | $V_{DS} = -1.5\text{ V}, I_D = -30\text{ mA}$ | P-Ch | | 20 | | |
| Forward Transconductance ^a | g_{fs} | $V_{DS} = 10\text{ V}, I_D = 200\text{ mA}$ | N-Ch | | 0.5 | S | |
| | | $V_{DS} = -10\text{ V}, I_D = -150\text{ mA}$ | P-Ch | | 0.4 | | |
| Diode Forward Voltage ^a | V_{SD} | $I_S = 150\text{ mA}, V_{GS} = 0\text{ V}$ | N-Ch | | 1.2 | V | |
| | | $I_S = -150\text{ mA}, V_{GS} = 0\text{ V}$ | P-Ch | | -1.2 | | |
| Dynamic^b | | | | | | | |
| Total Gate Charge | Q_g | $V_{DS} = 10\text{ V}, V_{GS} = 4.5\text{ V}, I_D = 150\text{ mA}$ $V_{DS} = -10\text{ V}, V_{GS} = -4.5\text{ V}, I_D = -150\text{ mA}$ | N-Ch | | 750 | pC | |
| Gate-Source Charge | Q_{gs} | | P-Ch | | 1500 | | |
| | | | N-Ch | | 75 | | |
| Gate-Drain Charge | Q_{gd} | | P-Ch | | 150 | | |
| | | N-Ch | | 225 | | | |
| Turn-On Time | t_{ON} | $V_{DD} = 10\text{ V}, R_L = 47\text{ }\Omega$ $I_D \cong 250\text{ mA}, V_{GEN} = 4.5\text{ V}, R_g = 10\text{ }\Omega$ | N-Ch | | 75 | ns | |
| | | | P-Ch | | 80 | | |
| Turn-Off Time | t_{OFF} | | $V_{DD} = -10\text{ V}, R_L = 65\text{ }\Omega$ $I_D \cong -150\text{ mA}, V_{GEN} = -4.5\text{ V}, R_g = 10\text{ }\Omega$ | N-Ch | | | 75 |
| | | | | P-Ch | | | 90 |

Notes:

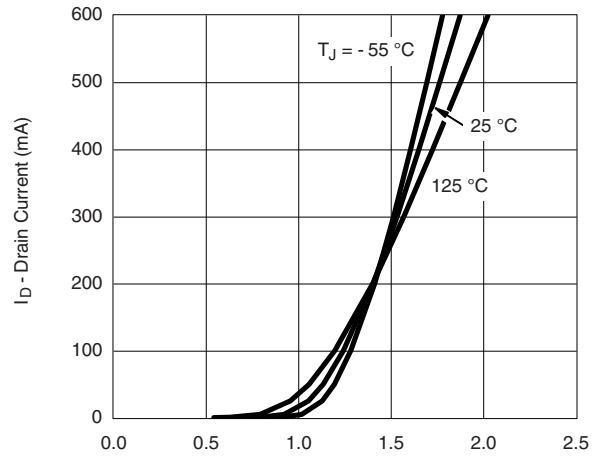
- a. Pulse test; pulse width $\leq 300\text{ }\mu\text{s}$, duty cycle $\leq 2\%$.
b. Guaranteed by design, not subject to production testing.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

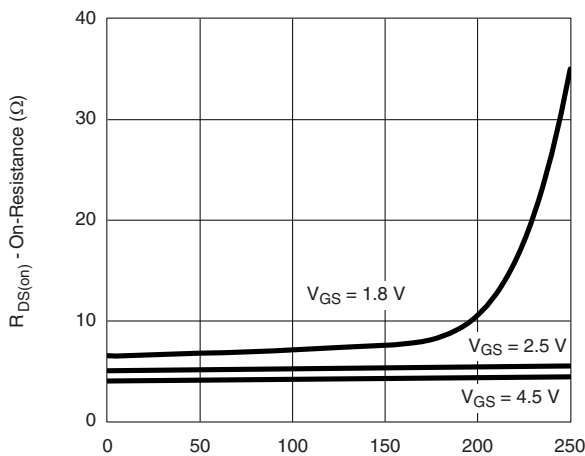
N-CHANNEL TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted)



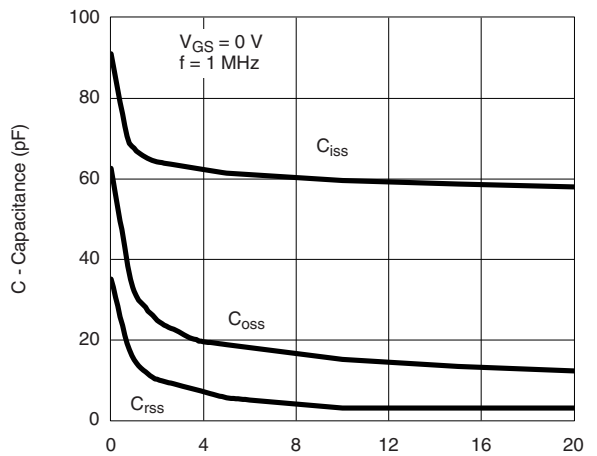
V_{DS} - Drain-to-Source Voltage (V)
Output Characteristics



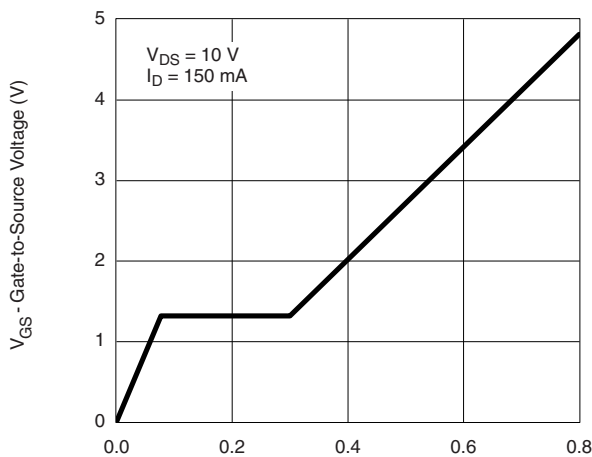
V_{GS} - Gate-to-Source Voltage (V)
Transfer Characteristics



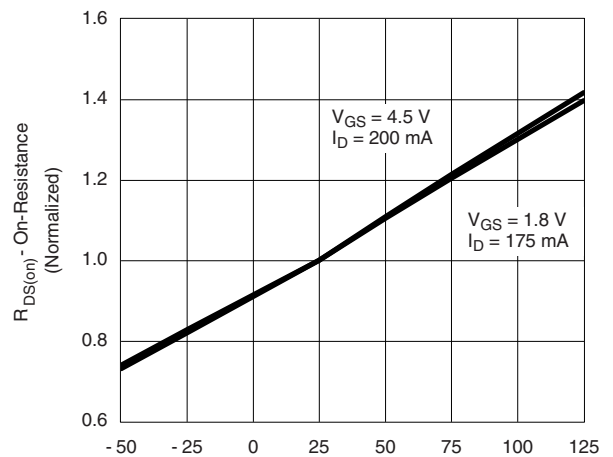
I_D - Drain Current (mA)
On-Resistance vs. Drain Current



V_{DS} - Drain-to-Source Voltage (V)
Capacitance

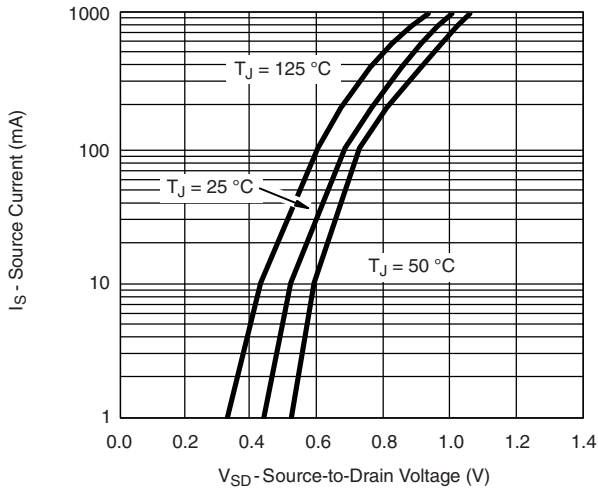


Q_g - Total Gate Charge (nC)
Gate Charge

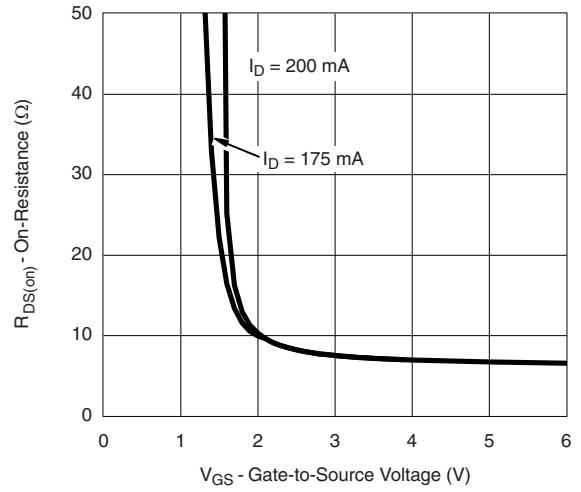


T_J - Junction Temperature ($^\circ\text{C}$)
On-Resistance vs. Junction Temperature

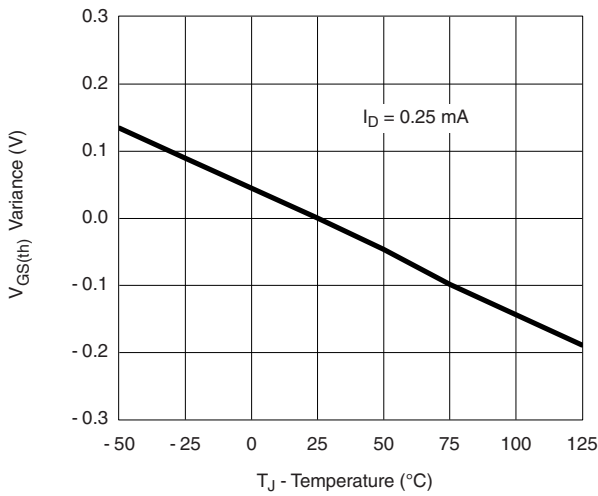
N-CHANNEL TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted)



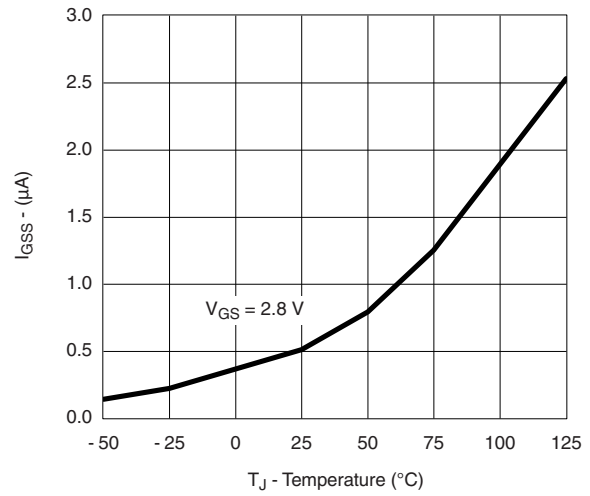
Source-Drain Diode Forward Voltage



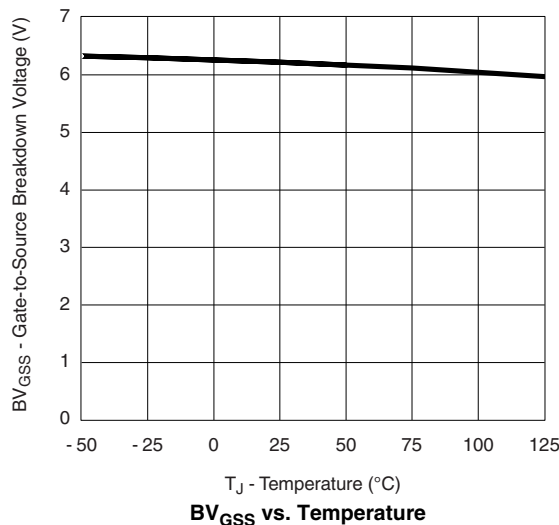
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage Variance vs. Temperature

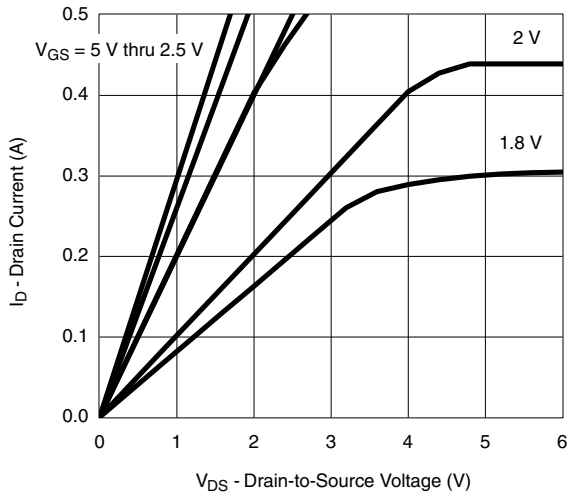


I_{GSS} vs. Temperature

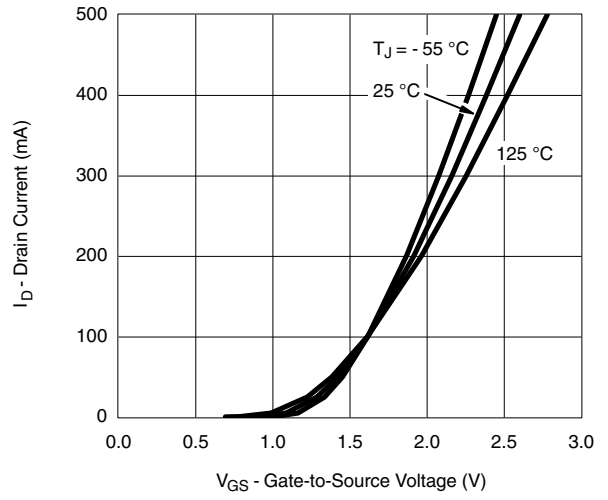


BV_{GSS} vs. Temperature

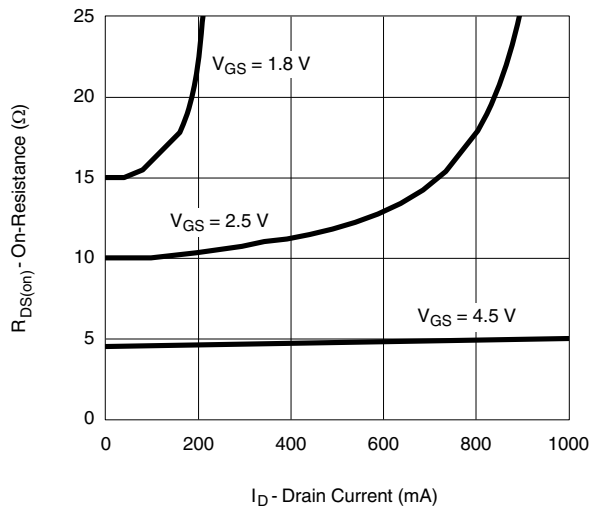
P-CHANNEL TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted)



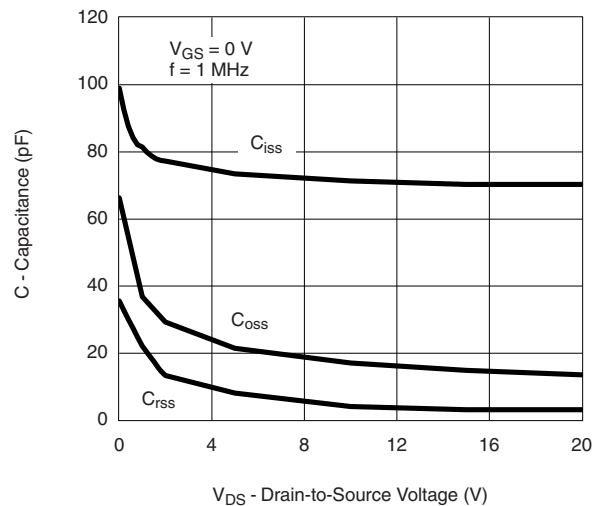
Output Characteristics



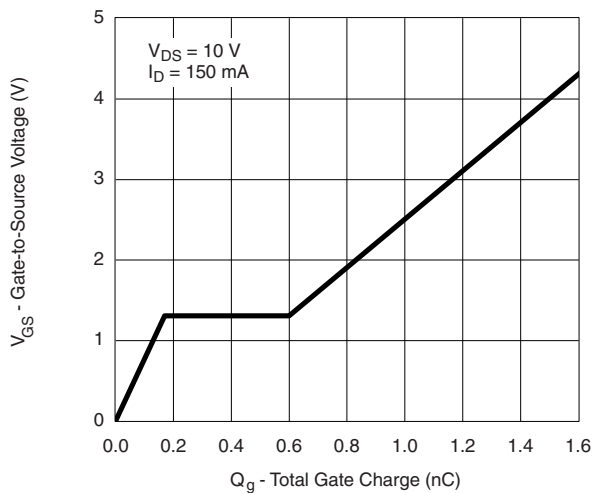
Transfer Characteristics



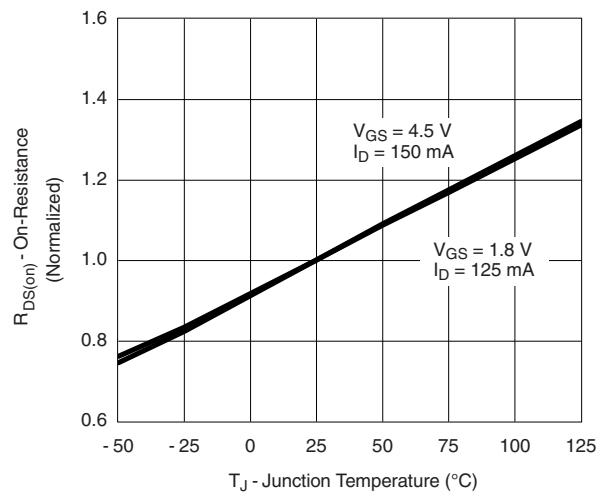
On-Resistance vs. Drain Current



Capacitance

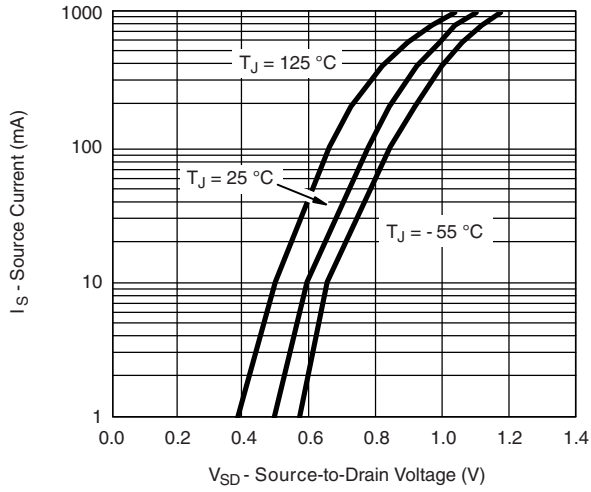


Gate Charge

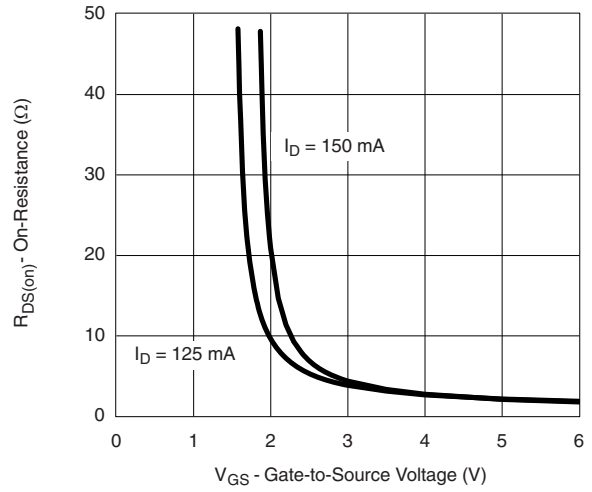


On-Resistance vs. Junction Temperature

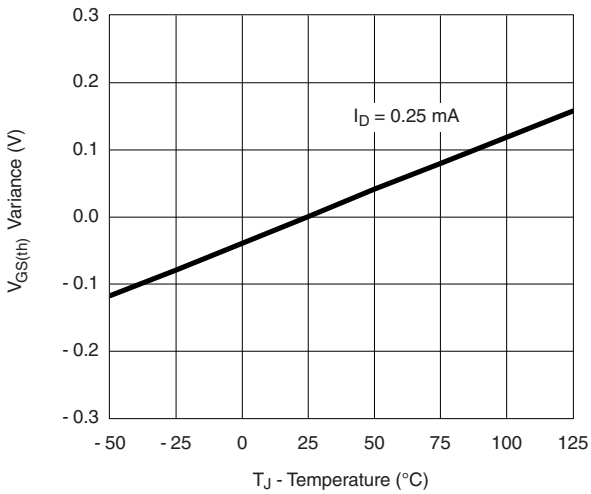
P-CHANNEL TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted)



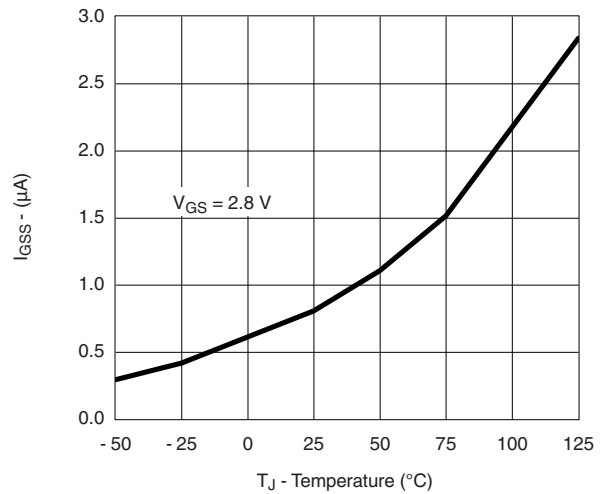
Source-Drain Diode Forward Voltage



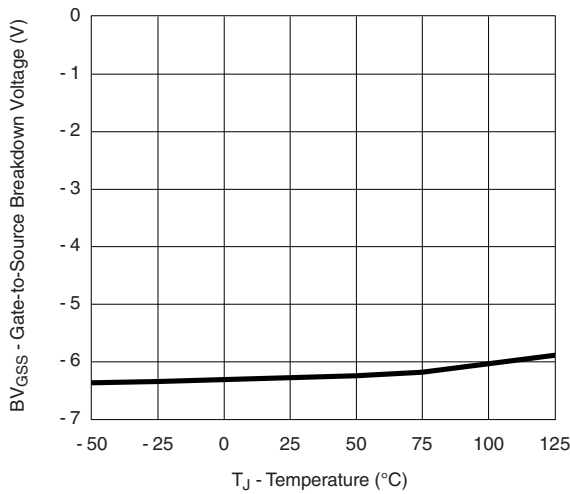
On-Resistance vs. Gate-to-Source Voltage



Threshold Voltage Variance vs. Temperature

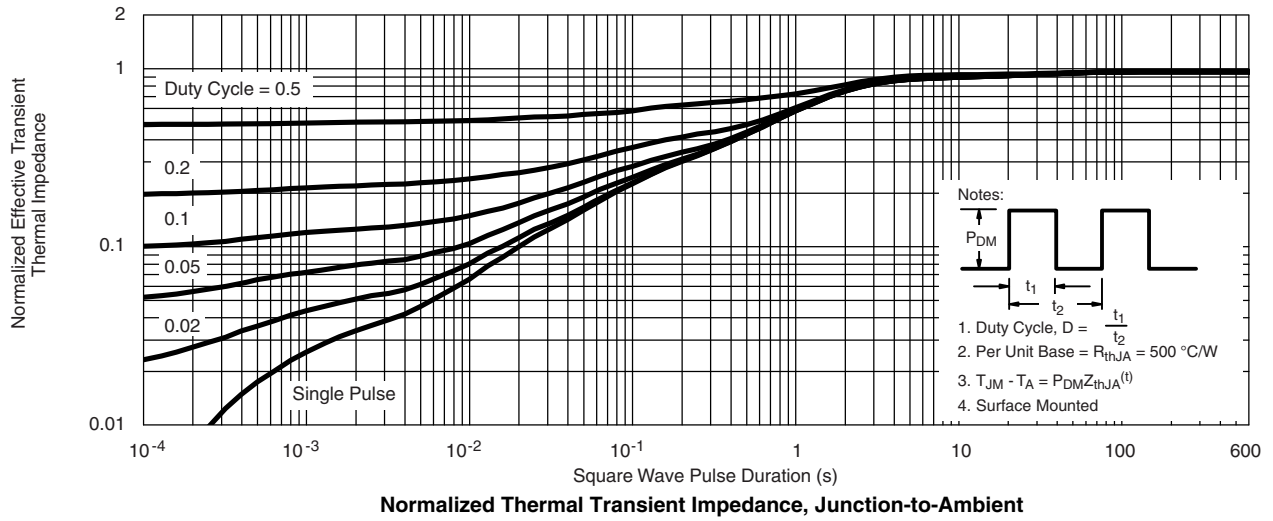


I_{GSS} vs. Temperature



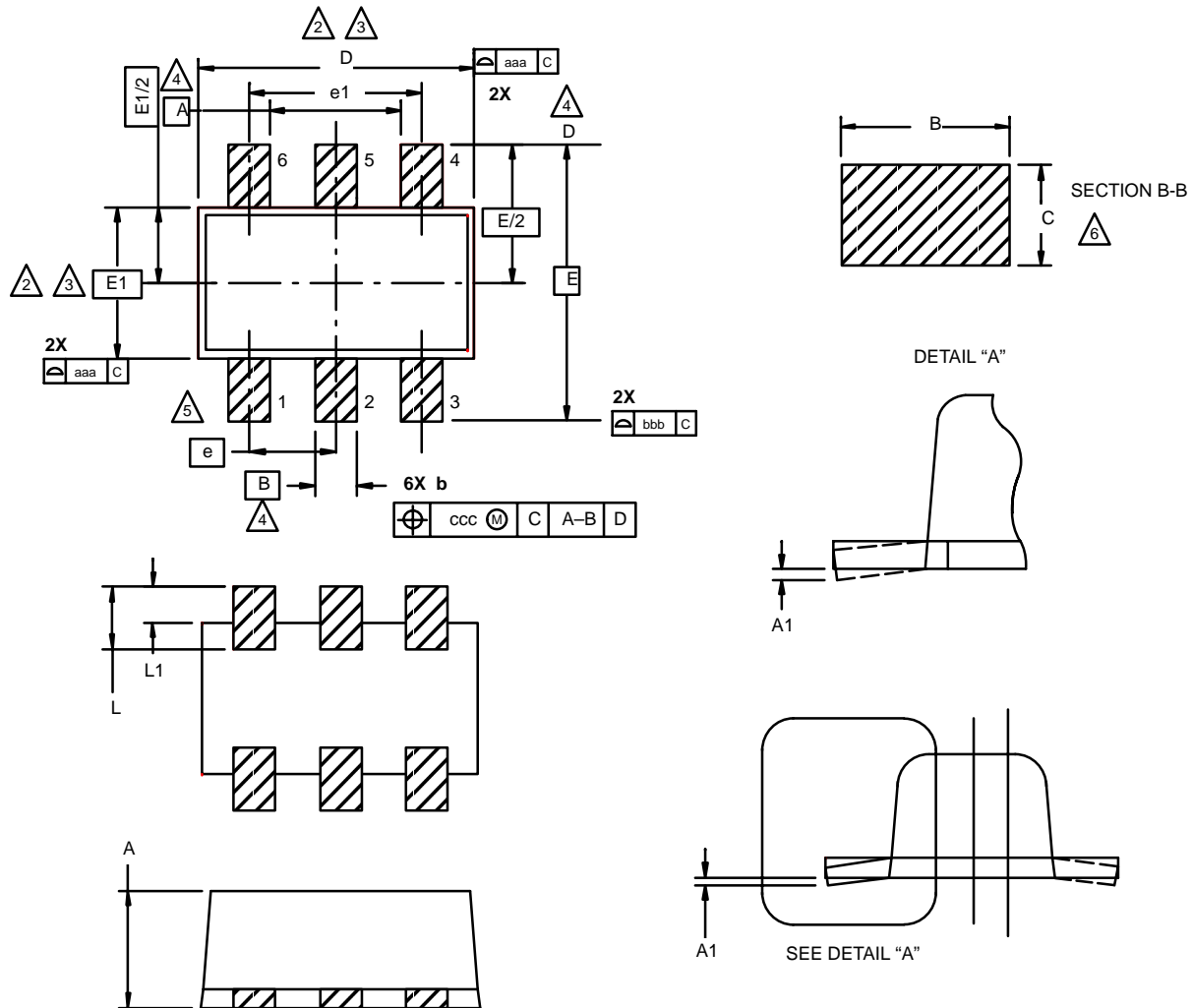
BV_{GSS} vs. Temperature

N- OR P-CHANNEL TYPICAL CHARACTERISTICS ($T_A = 25\text{ }^\circ\text{C}$, unless otherwise noted)



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SC89: 6- LEADS (SOT-563F)



NOTES:

1. Dimensions in millimeters.

2 Dimension D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.15 mm per dimension E1 does not include interlead flash or protrusion, interlead flash or protrusion shall not exceed 0.15 mm per side.

3 Dimensions D and E1 are determined at the outmost extremes of the plastic body exclusive of mold flash, the bar burrs, gate burrs and interlead flash, but including any mismatch between the top and the bottom of the plastic body.

4 Datums A, B and D to be determined 0.10 mm from the lead tip.

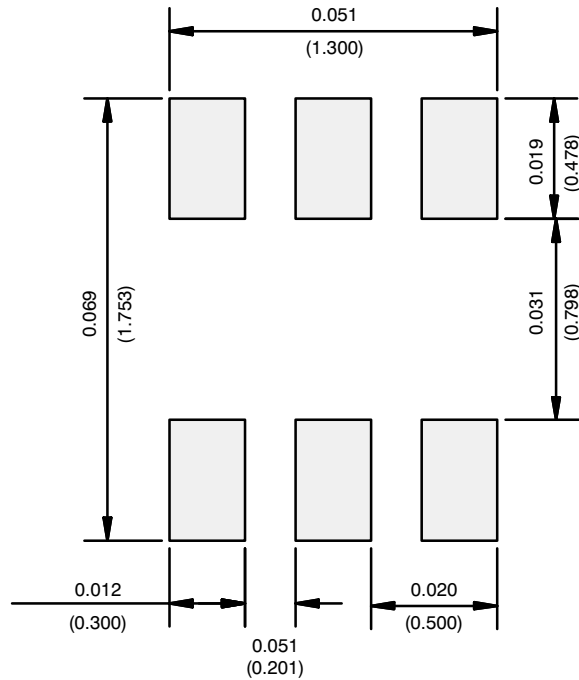
5 Terminal numbers are shown for reference only.

6 These dimensions apply to the flat section of the lead between 0.08 mm and 0.15 mm from the lead tip.

| Dim | MILLIMETERS | | Note | Symbol | Tolerances Of Form And Position |
|-----|-------------|------|------|--------|---------------------------------|
| | Min | Max | | | |
| A | 0.56 | 0.60 | | aaa | 0.10 |
| A1 | 0.00 | 0.10 | | bbb | 0.10 |
| b | 0.15 | 0.30 | | ccc | 0.10 |
| c | 0.10 | 0.18 | | | |
| D | 1.50 | 1.70 | 2, 3 | | |
| E | 1.55 | 1.70 | | | |
| E1 | 1.20 BSC | | 2, 3 | | |
| e | 0.50 BSC | | | | |
| e1 | 1.00 BSC | | | | |
| L | 0.35 BSC | | | | |
| L1 | 0.20 BSC | | | | |

ECN: E-00499—Rev. B, 02-Jul-01
DWG: 5880

RECOMMENDED MINIMUM PADS FOR SC-89: 6-Lead



Recommended Minimum Pads
Dimensions in Inches/(mm)

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