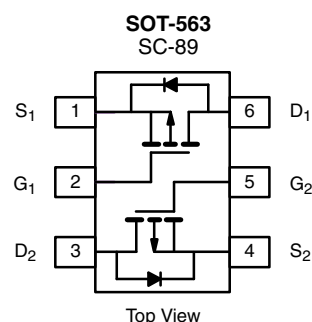


# Dual P-Channel 20 V (D-S) MOSFET

## PRODUCT SUMMARY

| $V_{DS}$ (V) | $R_{DS(on)}$ ( $\Omega$ ) | $I_D$ (mA) |
|--------------|---------------------------|------------|
| - 20         | 1.2 at $V_{GS} = - 4.5$ V | - 350      |
|              | 1.6 at $V_{GS} = - 2.5$ V | - 300      |
|              | 2.7 at $V_{GS} = - 1.8$ V | - 150      |



Marking Code: B

**Ordering Information:** Si1023X-T1-GE3 (Lead (Pb)-free and Halogen-free)

## FEATURES

- **Halogen-free According to IEC 61249-2-21 Definition**
- TrenchFET® Power MOSFET: 1.8 V Rated
- Very Small Footprint
- High-Side Switching
- Low On-Resistance: 1.2  $\Omega$
- Low Threshold: 0.8 V (typ.)
- Fast Switching Speed: 14 ns
- 1.8 V Operation
- Gate-Source ESD Protected: 2000 V
- Compliant to RoHS Directive 2002/95/EC



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

## BENEFITS

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

## APPLICATIONS

- Drivers: Relays, Solenoids, Lamps, Hammers, Displays, Memories
- 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         | 5 s         | Steady State | Unit |
|-----------------------------------------------------------|----------------|-------------|--------------|------|
| Drain-Source Voltage                                      | $V_{DS}$       | - 20        |              | V    |
| Gate-Source Voltage                                       | $V_{GS}$       | $\pm 6$     |              |      |
| Continuous Drain Current ( $T_J = 150$ °C) <sup>a</sup>   | $I_D$          | - 390       | - 370        | mA   |
|                                                           |                | - 280       | - 265        |      |
| Pulsed Drain Current <sup>b</sup>                         | $I_{DM}$       | - 650       |              |      |
| Continuous Source Current (Diode Conduction) <sup>a</sup> | $I_S$          | - 450       | - 380        |      |
| Maximum Power Dissipation <sup>a</sup>                    | $P_D$          | 280         | 250          | mW   |
|                                                           |                | 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.

| <b>SPECIFICATIONS</b> ( $T_J = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted) |              |                                                                                                                                         |       |         |         |               |
|--------------------------------------------------------------------------------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------|-------|---------|---------|---------------|
| Parameter                                                                            | Symbol       | Test Conditions                                                                                                                         | Min.  | Typ.    | Max.    | Unit          |
| <b>Static</b>                                                                        |              |                                                                                                                                         |       |         |         |               |
| Gate Threshold Voltage                                                               | $V_{GS(th)}$ | $V_{DS} = V_{GS}$ , $I_D = -250\text{ }\mu\text{A}$                                                                                     | -0.45 |         |         | V             |
| Gate-Body Leakage                                                                    | $I_{GSS}$    | $V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 4.5\text{ V}$                                                                                     |       | $\pm 1$ | $\pm 2$ | $\mu\text{A}$ |
| Zero Gate Voltage Drain Current                                                      | $I_{DSS}$    | $V_{DS} = -16\text{ V}$ , $V_{GS} = 0\text{ V}$                                                                                         |       | -0.3    | -100    | nA            |
|                                                                                      |              | $V_{DS} = -16\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 85\text{ }^{\circ}\text{C}$                                                    |       |         | -5      | $\mu\text{A}$ |
| On-State Drain Current <sup>a</sup>                                                  | $I_{D(on)}$  | $V_{DS} = -5\text{ V}$ , $V_{GS} = -4.5\text{ V}$                                                                                       | -700  |         |         | mA            |
| Drain-Source On-State Resistance <sup>a</sup>                                        | $R_{DS(on)}$ | $V_{GS} = -4.5\text{ V}$ , $I_D = -350\text{ mA}$                                                                                       |       | 0.8     | 1.2     | $\Omega$      |
|                                                                                      |              | $V_{GS} = -2.5\text{ V}$ , $I_D = -300\text{ mA}$                                                                                       |       | 1.2     | 1.6     |               |
|                                                                                      |              | $V_{GS} = -1.8\text{ V}$ , $I_D = -150\text{ mA}$                                                                                       |       | 1.8     | 2.7     |               |
| Forward Transconductance <sup>a</sup>                                                | $g_{fs}$     | $V_{DS} = -10\text{ V}$ , $I_D = -250\text{ mA}$                                                                                        |       | 0.4     |         | S             |
| Diode Forward Voltage <sup>a</sup>                                                   | $V_{SD}$     | $I_S = -150\text{ mA}$ , $V_{GS} = 0\text{ V}$                                                                                          |       | -0.8    | -1.2    | V             |
| <b>Dynamic<sup>b</sup></b>                                                           |              |                                                                                                                                         |       |         |         |               |
| Total Gate Charge                                                                    | $Q_g$        | $V_{DS} = -10\text{ V}$ , $V_{GS} = -4.5\text{ V}$ , $I_D = -250\text{ mA}$                                                             |       | 1500    |         | pC            |
| Gate-Source Charge                                                                   | $Q_{gs}$     |                                                                                                                                         |       | 150     |         |               |
| Gate-Drain Charge                                                                    | $Q_{gd}$     |                                                                                                                                         |       | 450     |         |               |
| Turn-On Time                                                                         | $t_{d(on)}$  | $V_{DD} = -10\text{ V}$ , $R_L = 47\text{ }\Omega$<br>$I_D \cong -200\text{ mA}$ , $V_{GEN} = -4.5\text{ V}$ , $R_g = 10\text{ }\Omega$ |       | 14      |         | ns            |
| Turn-Off Time                                                                        | $t_{d(off)}$ |                                                                                                                                         |       | 46      |         |               |

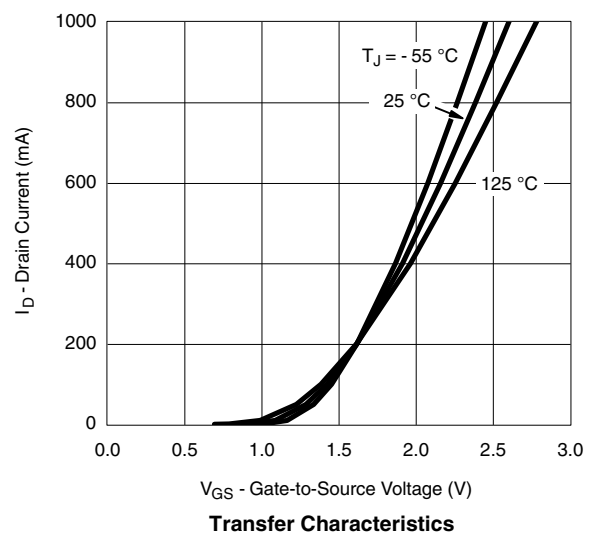
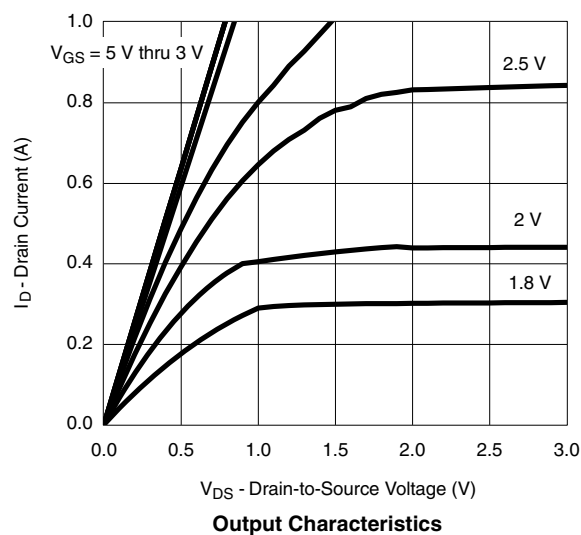
Notes:

a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .

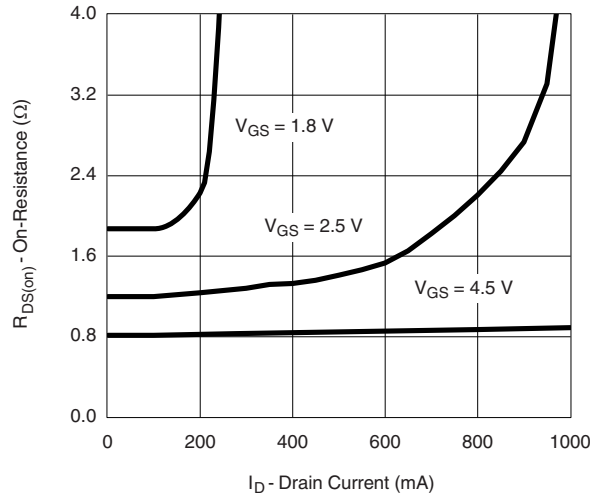
b. Guaranteed by design, not subject to production testing.

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.

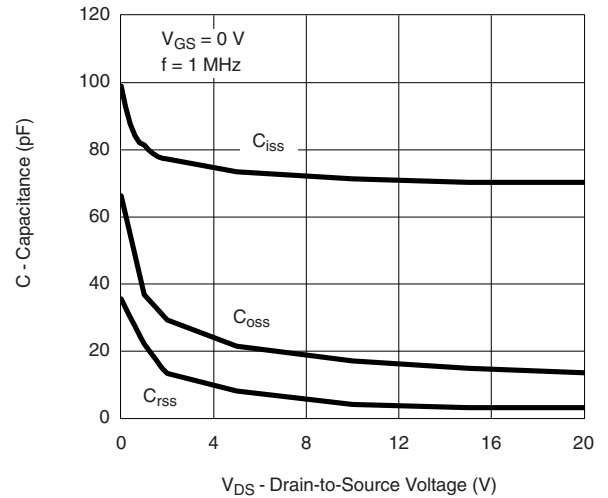
## TYPICAL CHARACTERISTICS ( $T_A = 25\text{ }^{\circ}\text{C}$ , unless otherwise noted)



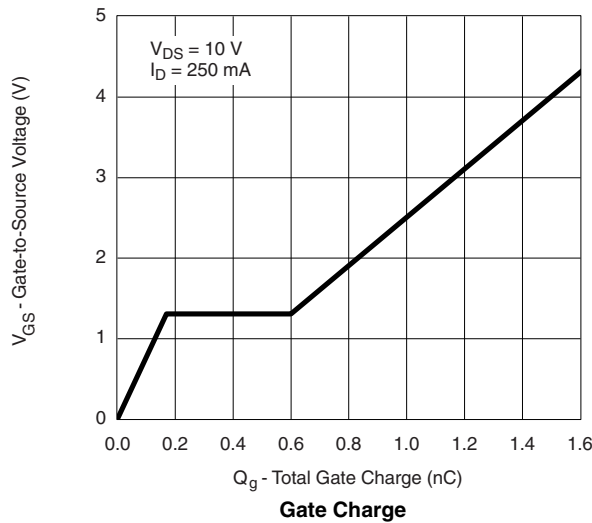
## TYPICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)



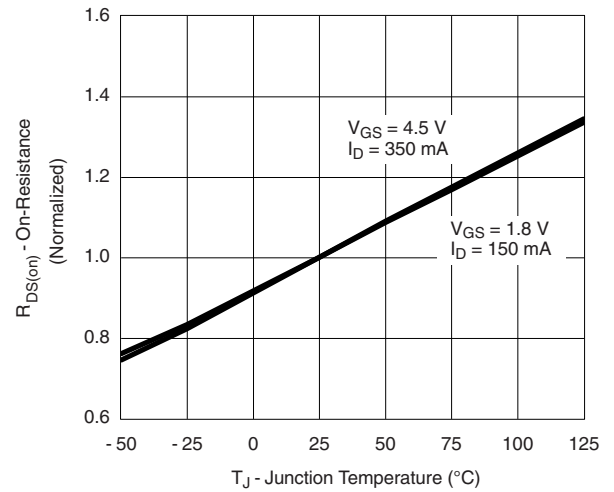
On-Resistance vs. Drain Current



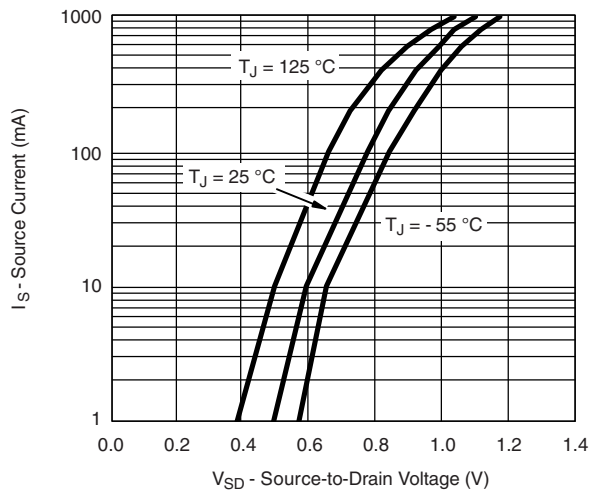
Capacitance



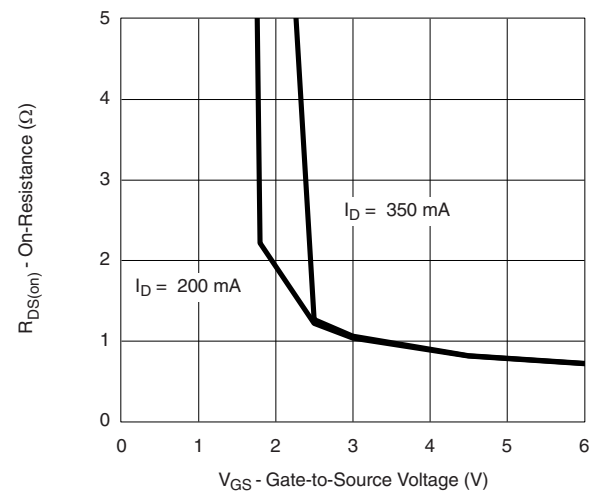
Gate Charge



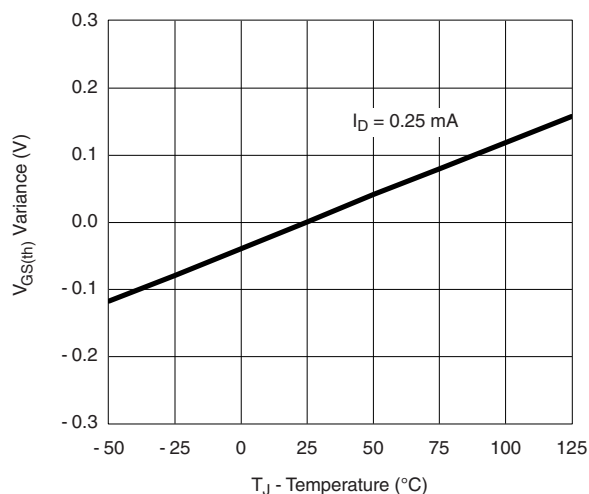
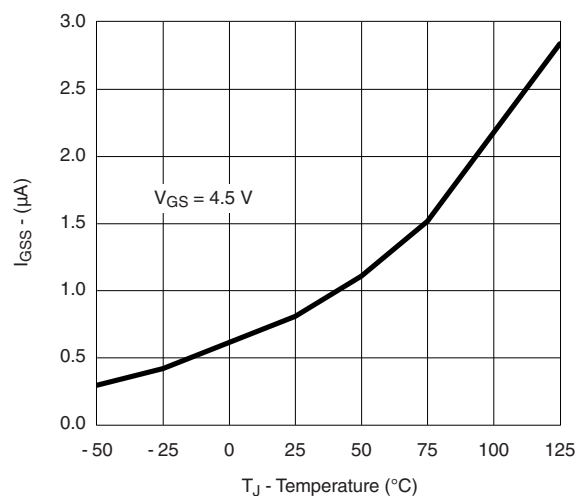
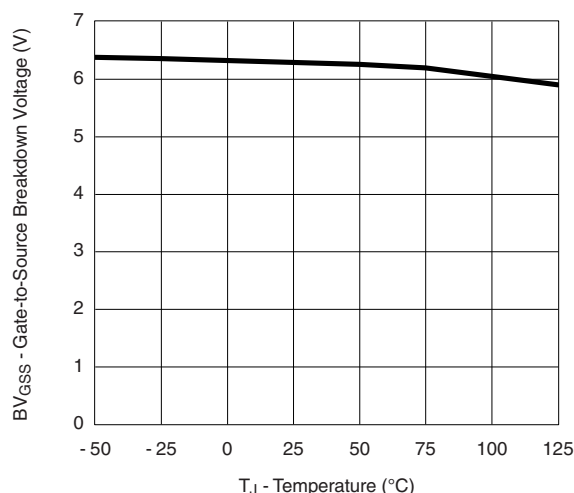
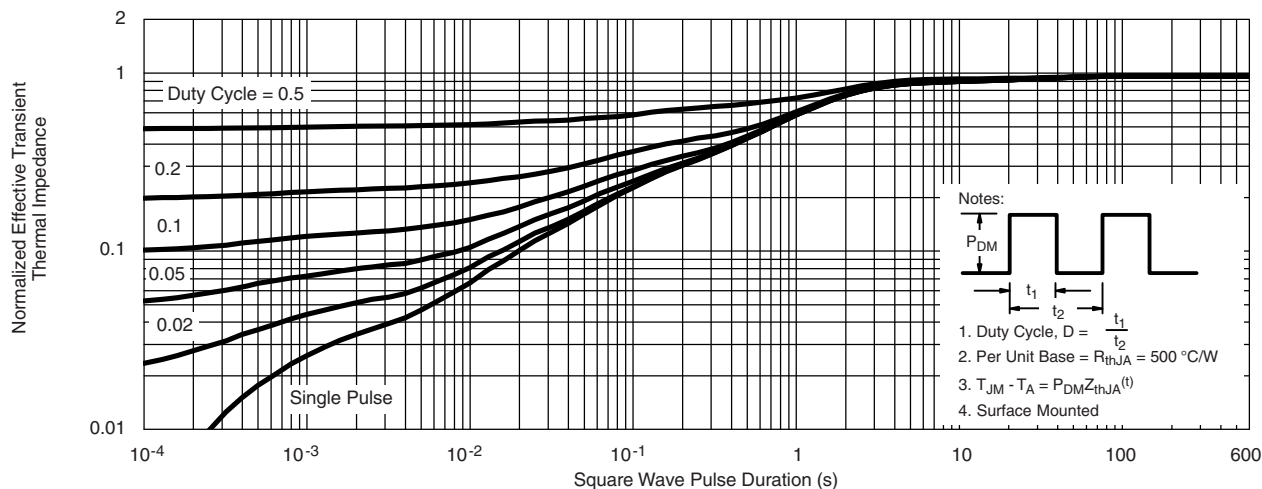
On-Resistance vs. Junction Temperature



Source-Drain Diode Forward Voltage

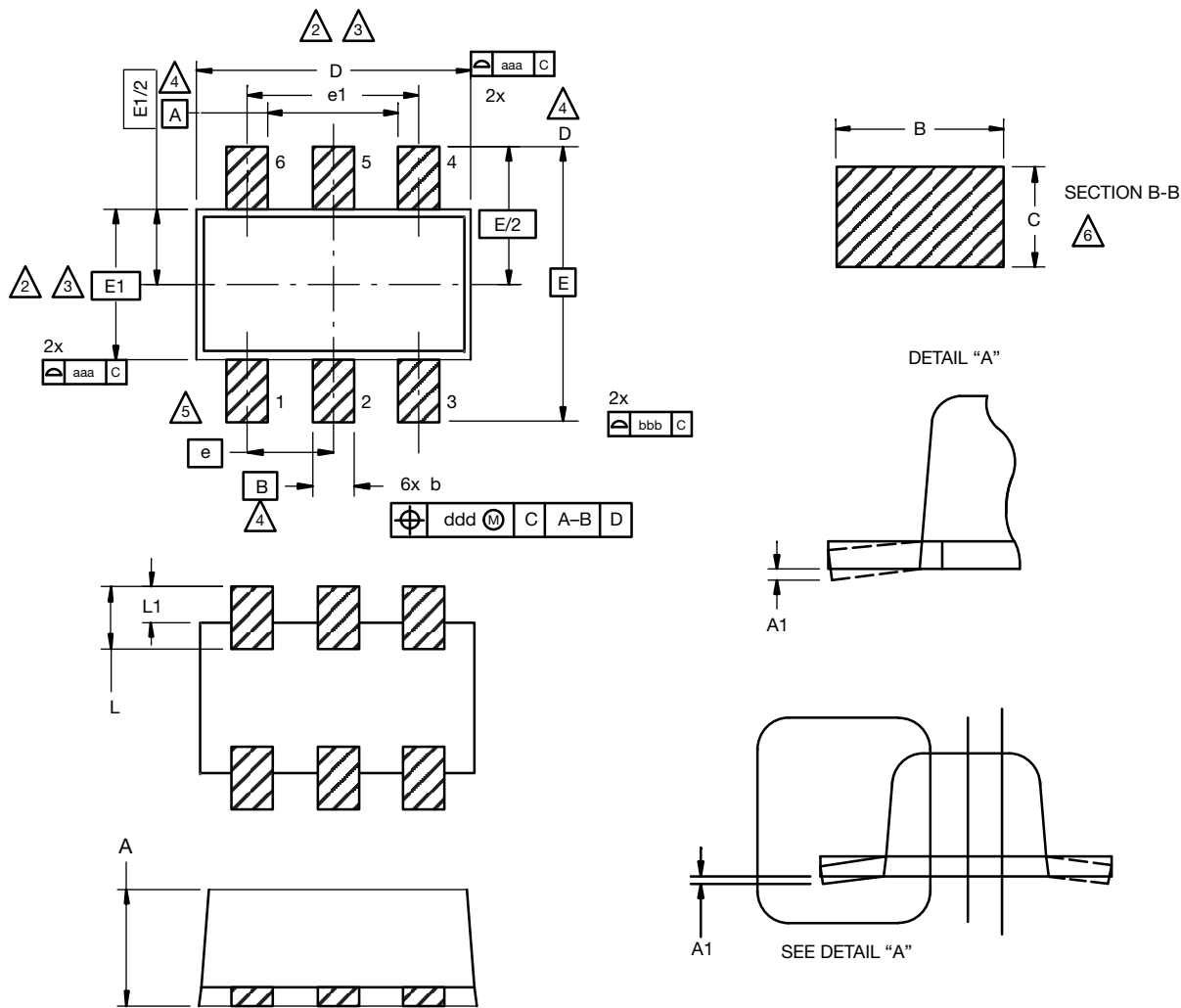


On-Resistance vs. Gate-to-Source Voltage

**TYPICAL CHARACTERISTICS** ( $T_A = 25^\circ\text{C}$ , unless otherwise noted)**Threshold Voltage Variance vs. Temperature** **$I_{GSS}$  vs. Temperature** **$BV_{GSS}$  vs. Temperature****Normalized Thermal Transient Impedance, Junction-to-Ambient**

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## SC-89 6-Leads (SOT-563F)



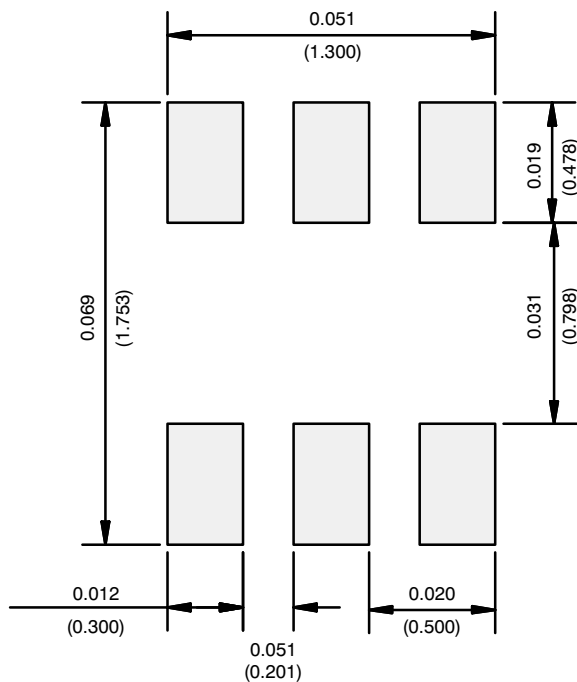
## Notes

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 |      |      |
|------|-------------|------|------|
|      | MIN.        | NOM. | MAX. |
| A    | 0.56        | 0.58 | 0.60 |
| A1   | 0           | 0.02 | 0.10 |
| b    | 0.15        | 0.22 | 0.30 |
| c    | 0.10        | 0.14 | 0.18 |
| D    | 1.50        | 1.60 | 1.70 |
| E    | 1.50        | 1.60 | 1.70 |
| E1   | 1.15        | 1.20 | 1.25 |
| e    | 0.45        | 0.50 | 0.55 |
| e1   | 0.95        | 1.00 | 1.05 |
| L    | 0.25        | 0.35 | 0.50 |
| L1   | 0.10        | 0.20 | 0.30 |

C14-0439-Rev. C, 11-Aug-14  
DWG: 5880

## RECOMMENDED MINIMUM PADS FOR SC-89: 6-Lead



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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