

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

| PRODUCT SUMMARY     |                                    |                    |                       |
|---------------------|------------------------------------|--------------------|-----------------------|
| V <sub>DS</sub> (V) | R <sub>DS(on)</sub> (Ω)            | I <sub>D</sub> (A) | Q <sub>g</sub> (Typ.) |
| - 20                | 0.756 at V <sub>GS</sub> = - 4.5 V | - 0.35             | 1 nC                  |
|                     | 1.038 at V <sub>GS</sub> = - 2.5 V | - 0.35             |                       |
|                     | 1.44 at V <sub>GS</sub> = - 1.8 V  | - 0.1              |                       |
|                     | 2.4 at V <sub>GS</sub> = - 1.5 V   | - 0.05             |                       |

### FEATURES

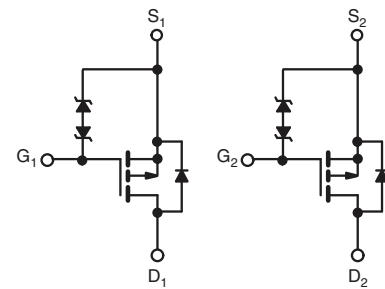
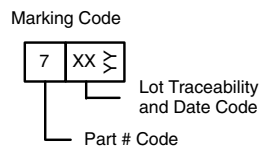
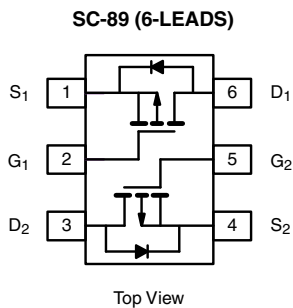
- Halogen-free According to IEC 61249-2-21 Definition
- TrenchFET<sup>®</sup> Power MOSFET
- 100 % R<sub>g</sub> Tested
- Typical ESD protection: 1000 V (HBM)
- Fast Switching Speed
- Compliant to RoHS Directive 2002/95/EC



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

### APPLICATIONS

- Load and Small Signal Switch for Portable Devices
- Drivers: Relays, Solenoids, Displays, Lamps
- Battery Operated Systems
- Smart Phones, Tablet PCs



Dual P-Channel MOSFET

Ordering Information: Si1023CX-T1-GE3 (Lead (Pb)-free and Halogen-free)

| ABSOLUTE MAXIMUM RATINGS (T <sub>A</sub> = 25 °C, unless otherwise noted) |                                   |                        |                        |   |
|---|-----------------------------------|------------------------|------------------------|---|
| Parameter   | Symbol                            | Limit                  | Unit                   |   |
| Drain-Source Voltage  | V <sub>DS</sub>                   | - 20                   | V                      |   |
| Gate-Source Voltage   | V <sub>GS</sub>                   | ± 8                    |                        |   |
| Continuous Drain Current (T <sub>J</sub> = 150 °C)                        | I <sub>D</sub>                    | T <sub>A</sub> = 25 °C | - 0.45 <sup>b, c</sup> | A |
|   |                                   | T <sub>A</sub> = 70 °C | - 0.36 <sup>b, c</sup> |   |
| Pulsed Drain Current (t = 300 μs)   | I <sub>DM</sub>                   | - 1.5                  |                        |   |
| Continuous Source-Drain Diode Current                                     | I <sub>S</sub>                    | - 0.18 <sup>b, c</sup> |                        |   |
| Maximum Power Dissipation   | P <sub>D</sub>                    | T <sub>A</sub> = 25 °C | 0.22 <sup>b, c</sup>   | W |
|   |                                   | T <sub>A</sub> = 70 °C | 0.14 <sup>b, c</sup>   |   |
| Operating Junction and Storage Temperature Range                          | T <sub>J</sub> , T <sub>stg</sub> | - 55 to 150            | °C                     |   |

| THERMAL RESISTANCE RATINGS                  |                   |                    |         |      |      |
|---|-------------------|--------------------|---------|------|------|
| Parameter                                   | Symbol            | Typical            | Maximum | Unit |      |
| Maximum Junction-to-Ambient <sup>a, b</sup> | R <sub>thJA</sub> | t ≤ 5 s            | 470     | 565  | °C/W |
|   |                   | Steady State State | 560     | 675  |      |

Notes:

- Maximum under steady state conditions is 675 °C/W.
- Surface mounted on 1" x 1" FR4 board.
- t = 5 s.

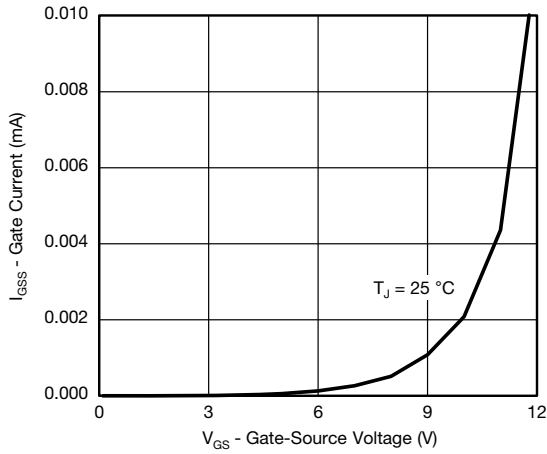
| <b>SPECIFICATIONS</b> ( $T_J = 25\text{ }^\circ\text{C}$ , unless otherwise noted) |                         |   |       |       |          |                      |
|--|-------------------------|---|-------|-------|----------|----------------------|
| Parameter  | Symbol                  | Test Conditions   | Min.  | Typ.  | Max.     | Unit                 |
| <b>Static</b>  |                         |   |       |       |          |                      |
| Drain-Source Breakdown Voltage   | $V_{DS}$                | $V_{GS} = 0\text{ V}$ , $I_D = -250\text{ }\mu\text{A}$   | - 20  |       |          | V                    |
| $V_{DS}$ Temperature Coefficient   | $\Delta V_{DS}/T_J$     | $I_D = -250\text{ }\mu\text{A}$   |       | - 12  |          | mV/ $^\circ\text{C}$ |
| $V_{GS(th)}$ Temperature Coefficient   | $\Delta V_{GS(th)}/T_J$ |   |       | 1.8   |          |                      |
| Gate-Source Threshold Voltage  | $V_{GS(th)}$            | $V_{DS} = V_{GS}$ , $I_D = -250\text{ }\mu\text{A}$   | - 0.4 |       | - 1      | V                    |
| Gate-Source Leakage  | $I_{GSS}$               | $V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 8\text{ V}$   |       |       | $\pm 30$ | $\mu\text{A}$        |
|  |                         | $V_{DS} = 0\text{ V}$ , $V_{GS} = \pm 4.5\text{ V}$   |       |       | $\pm 1$  |                      |
| Zero Gate Voltage Drain Current  | $I_{DSS}$               | $V_{DS} = -20\text{ V}$ , $V_{GS} = 0\text{ V}$   |       |       | - 1      |                      |
|  |                         | $V_{DS} = -20\text{ V}$ , $V_{GS} = 0\text{ V}$ , $T_J = 85\text{ }^\circ\text{C}$  |       |       | - 10     |                      |
| On-State Drain Current <sup>a</sup>  | $I_{D(on)}$             | $V_{DS} \geq 5\text{ V}$ , $V_{GS} = -4.5\text{ V}$   | - 1.5 |       |          | A                    |
| Drain-Source On-State Resistance <sup>a</sup>                                      | $R_{DS(on)}$            | $V_{GS} = -4.5\text{ V}$ , $I_D = -0.35\text{ A}$   |       | 0.630 | 0.756    | $\Omega$             |
|  |                         | $V_{GS} = -2.5\text{ V}$ , $I_D = -0.35\text{ A}$   |       | 0.865 | 1.038    |                      |
|  |                         | $V_{GS} = -1.8\text{ V}$ , $I_D = -0.1\text{ A}$  |       | 1.20  | 1.44     |                      |
|  |                         | $V_{GS} = -1.5\text{ V}$ , $I_D = -0.05\text{ A}$   |       | 1.6   | 2.4      |                      |
| Forward Transconductance   | $g_{fs}$                | $V_{DS} = -10\text{ V}$ , $I_D = -0.4\text{ A}$   |       | 1     |          | S                    |
| <b>Dynamic<sup>b</sup></b>   |                         |   |       |       |          |                      |
| Input Capacitance  | $C_{iss}$               | $V_{DS} = -10\text{ V}$ , $V_{GS} = 0\text{ V}$ , $f = 1\text{ MHz}$  |       | 45    |          | pF                   |
| Output Capacitance   | $C_{oss}$               |   |       | 15    |          |                      |
| Reverse Transfer Capacitance   | $C_{rss}$               |   |       | 10    |          |                      |
| Total Gate Charge  | $Q_g$                   | $V_{DS} = -10\text{ V}$ , $V_{GS} = -4.5\text{ V}$ , $I_D = -0.4\text{ A}$  |       | 1.65  | 2.50     | nC                   |
|  |                         | $V_{DS} = -10\text{ V}$ , $V_{GS} = -2.5\text{ V}$ , $I_D = -0.4\text{ A}$  |       | 1     | 2        |                      |
| Gate-Source Charge   | $Q_{gs}$                |   |       | 0.2   |          |                      |
| Gate-Drain Charge  | $Q_{gd}$                |   |       | 0.26  |          |                      |
| Gate Resistance  | $R_g$                   | $f = 1\text{ MHz}$  | 2.4   | 12    | 24       | $\Omega$             |
| Turn-On Delay Time   | $t_{d(on)}$             | $V_{DD} = -10\text{ V}$ , $R_L = 33.3\text{ }\Omega$<br>$I_D \cong -0.3\text{ A}$ , $V_{GEN} = -4.5\text{ V}$ , $R_g = 1\text{ }\Omega$ |       | 9     | 18       | ns                   |
| Rise Time  | $t_r$                   |   |       | 10    | 20       |                      |
| Turn-Off Delay Time  | $t_{d(off)}$            |   |       | 10    | 20       |                      |
| Fall Time  | $t_f$                   |   |       | 8     | 16       |                      |
| Turn-On Delay Time   | $t_{d(on)}$             | $V_{DD} = -10\text{ V}$ , $R_L = 33.3\text{ }\Omega$<br>$I_D \cong -0.3\text{ A}$ , $V_{GEN} = -8\text{ V}$ , $R_g = 1\text{ }\Omega$   |       | 1     | 2        |                      |
| Rise Time  | $t_r$                   |   |       | 8     | 16       |                      |
| Turn-Off Delay Time  | $t_{d(off)}$            |   |       | 9     | 18       |                      |
| Fall Time  | $t_f$                   |   |       | 5     | 10       |                      |
| <b>Drain-Source Body Diode Characteristics</b>                                     |                         |   |       |       |          |                      |
| Pulse Diode Forward Current <sup>a</sup>   | $I_{SM}$                |   |       |       | - 1.5    | A                    |
| Body Diode Voltage   | $V_{SD}$                | $I_S = -0.3\text{ A}$   |       | - 0.8 | - 1.2    | V                    |
| Body Diode Reverse Recovery Time   | $t_{rr}$                | $I_F = -0.3\text{ A}$ , $di/dt = 100\text{ A}/\mu\text{s}$  |       | 16    | 24       | ns                   |
| Body Diode Reverse Recovery Charge   | $Q_{rr}$                |   |       | 8     | 16       | nC                   |
| Reverse Recovery Fall Time   | $t_a$                   |   |       | 11    |          | ns                   |
| Reverse Recovery Rise Time   | $t_b$                   |   |       | 5     |          |                      |

## Notes:

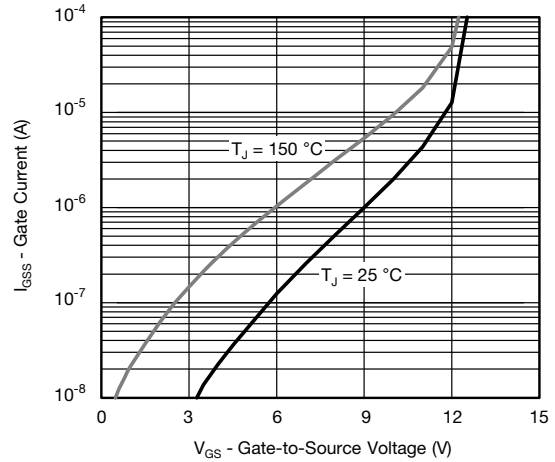
- a. Pulse test; pulse width  $\leq 300\text{ }\mu\text{s}$ , duty cycle  $\leq 2\%$ .  
b. Guaranteed by design, not subject to production testing.

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.

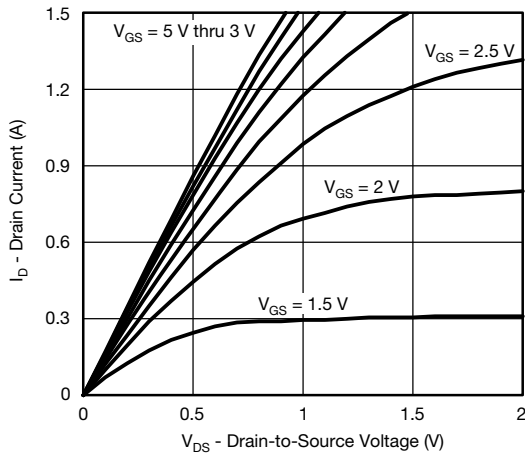
**P-CHANNEL TYPICAL CHARACTERISTICS** (25 °C, unless otherwise noted)



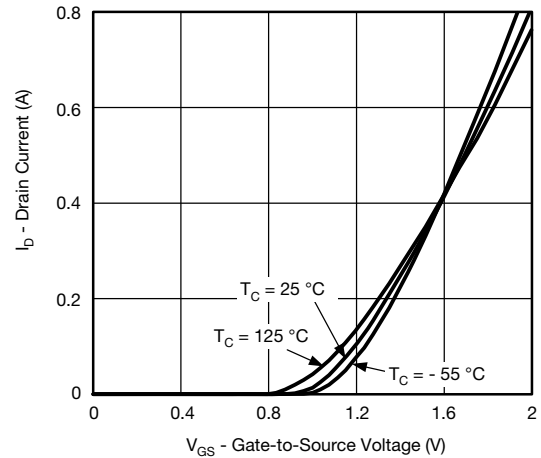
**Gate Current vs. Gate-Source Voltage**



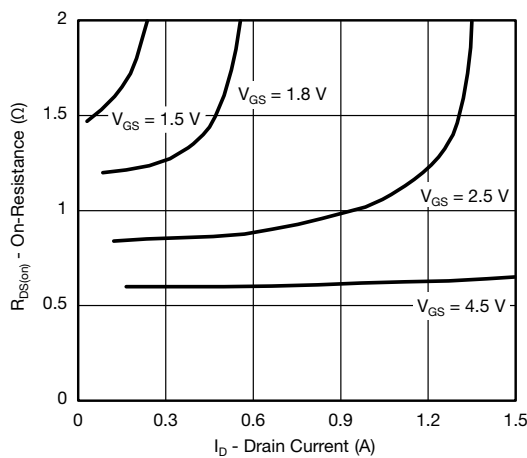
**Gate Current vs. Gate-Source Voltage**



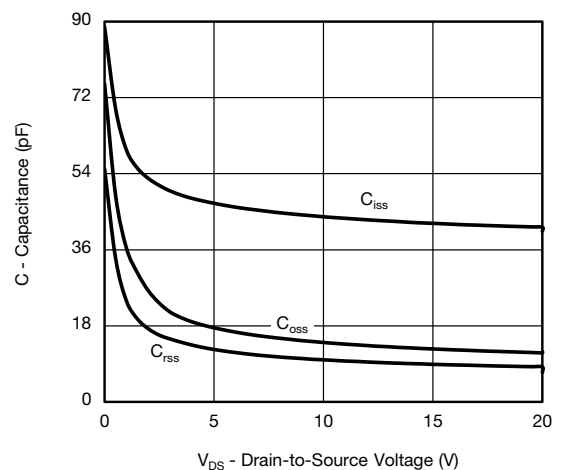
**Output Characteristics**



**Transfer Characteristics**

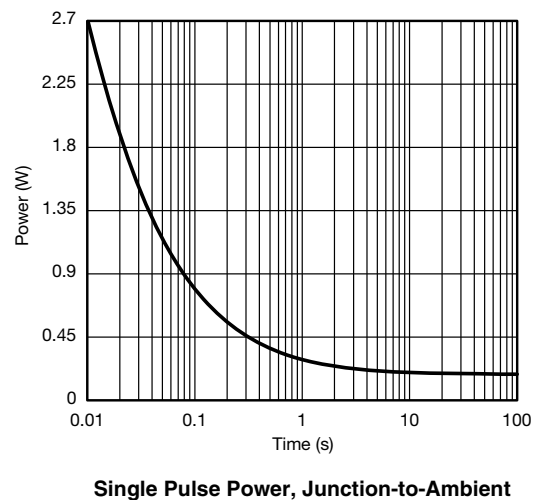
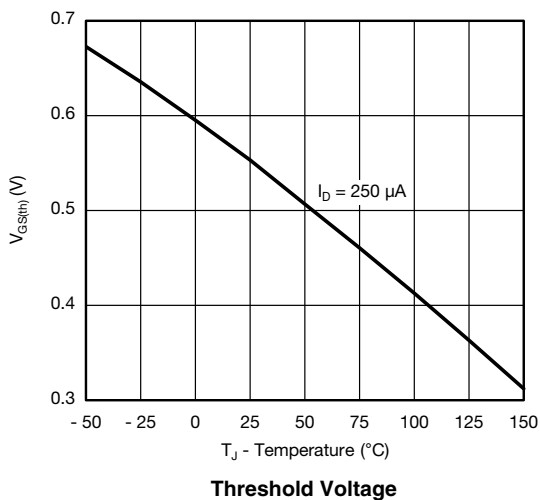
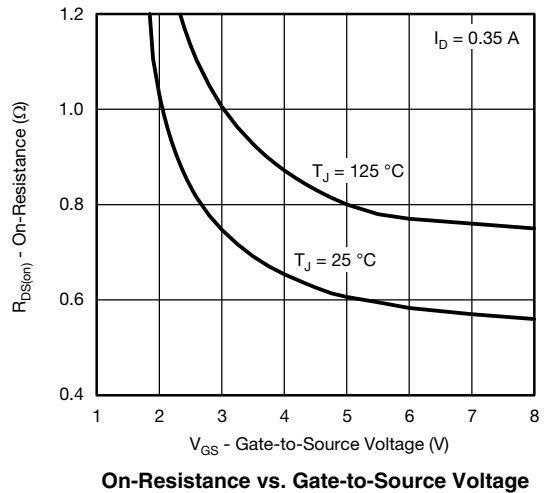
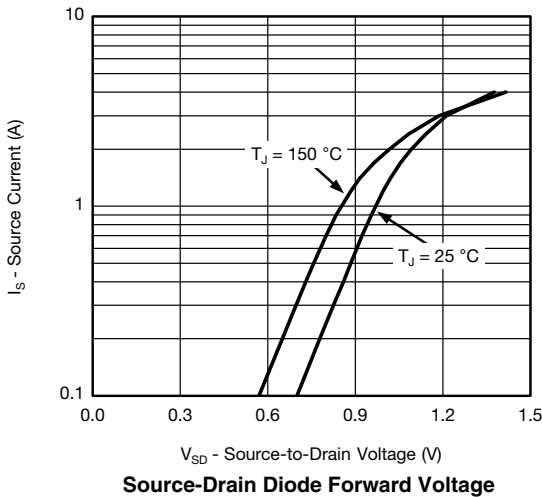
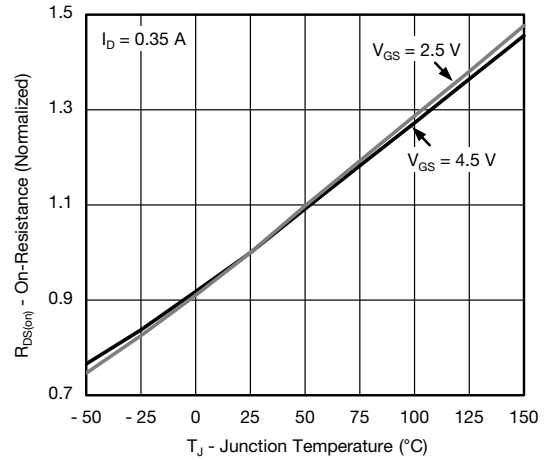
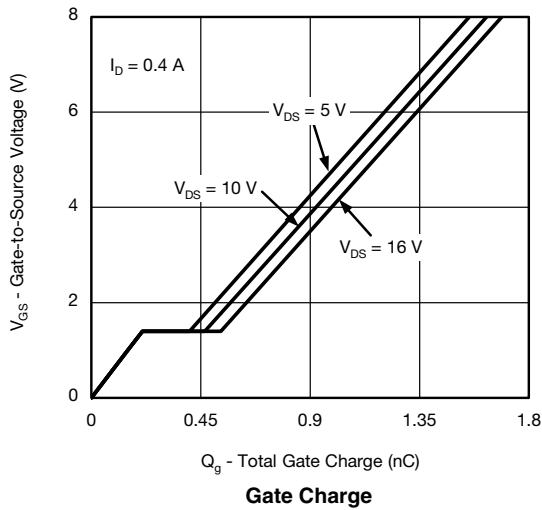


**On-Resistance vs. Drain Current**

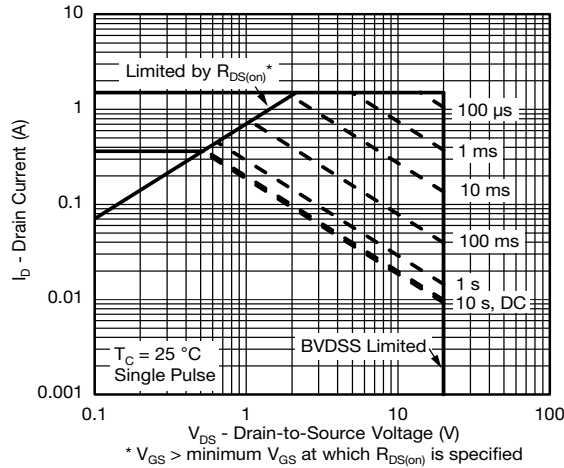


**Capacitance**

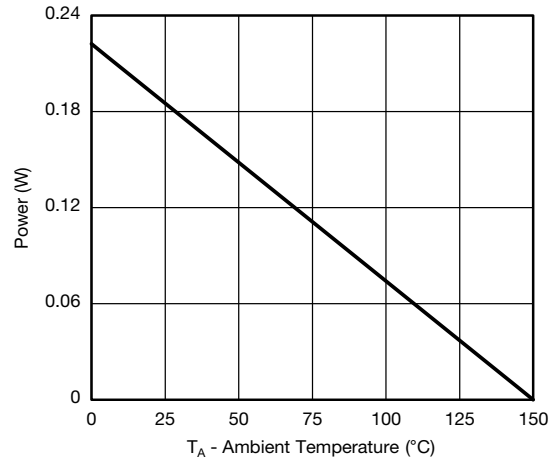
## P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



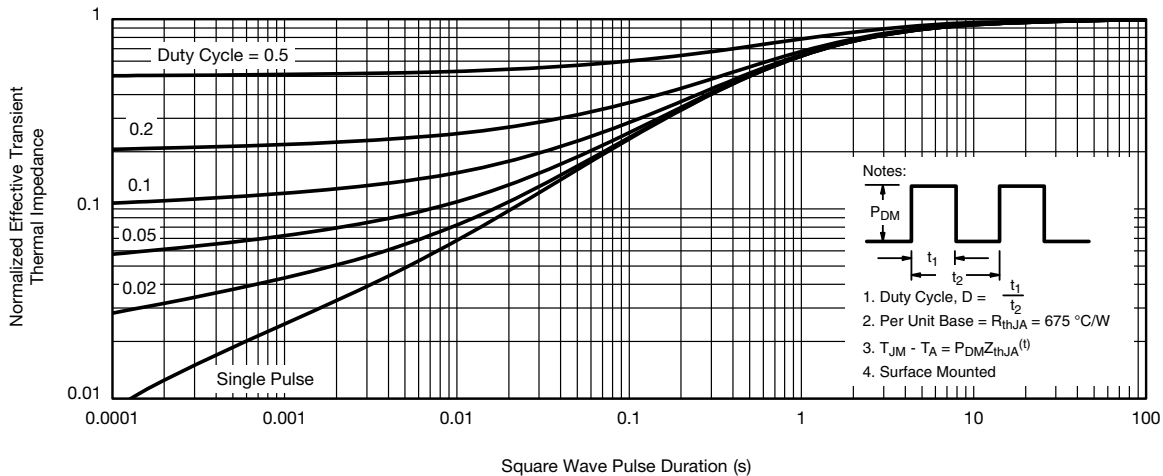
## P-CHANNEL TYPICAL CHARACTERISTICS (25 °C, unless otherwise noted)



**Safe Operating Area, Junction-to-Ambient**



**Power Derating, Junction-to-Ambient**



**Normalized Thermal Transient Impedance, Junction-to-Ambient**

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



### Notes

- Dimensions in millimeters.
- 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.
- 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.
- Datums A, B and D to be determined 0.10 mm from the lead tip.
- Terminal numbers are shown for reference only.
- 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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