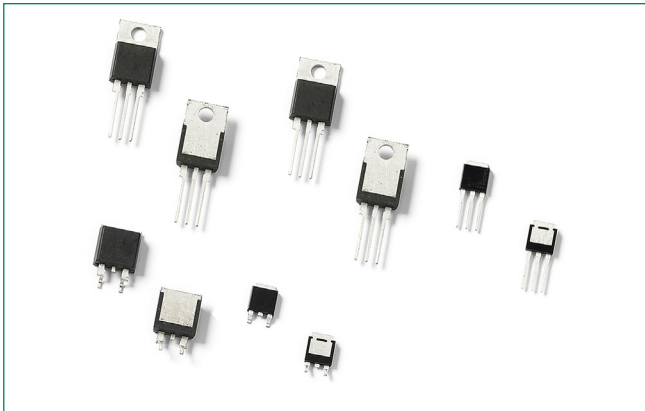


Sxx10xSx & Sxx10x Series



Main Features

| Symbol | Value | Unit |
|-------------------|-------------|------|
| $I_{T(RMS)}$ | 10 | A |
| V_{DRM}/V_{RRM} | 400 to 1000 | V |
| I_{GT} | 0.2 to 15 | mA |

Additional Information



Datasheet



Resources



Samples

Description

This Sxx10x SCR series is ideal for uni-directional switch applications such as phase control, heating, motor speed controls, converters/rectifiers and capacitive discharge ignitions.

These SCRs have a low gate current trigger level of 0.2 to 15 mA at approximately 1.5V, with a sensitive version of this series having a gate trigger current less than 500µA. The sensitive gate SCR version is easily triggered by sense coils, proximity switches, and microprocessors.

Features & Benefits

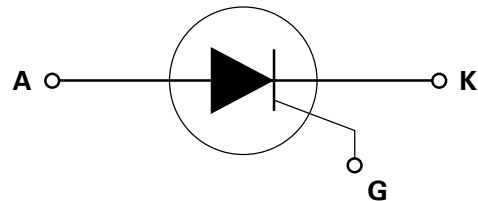
- Halogen-free and RoHS-compliant
- Glass – passivated junctions
- Voltage capability up to 1000 V
- Surge capability up to 100 A at 60 Hz half cycle

Applications

Typical applications includes capacitive discharge system for motorcycle engine CDI, portable generator engine ignition, strobe lights and nailers, as well as generic rectifiers, battery voltage regulators and converters. Also AC control & rectification for power tools, home/brown goods, white goods appliances and 2-wheeler rectifier/battery regulators.

Internally constructed isolated packages are offered for ease of heat sinking with highest isolation voltage.

Schematic Symbol



Absolute Maximum Ratings — Sensitive SCRs

| Symbol | Parameter | Test Conditions | | Value | Unit |
|--------------|---|--|--------------------------|------------|------------------------|
| $I_{T(RMS)}$ | RMS on-state current | Sxx10LSy | $T_c = 80^\circ\text{C}$ | 10 | A |
| | | Sxx10RSy / Sxx10NSy Sxx10DSy Sxx10Vsy | $T_c = 95^\circ\text{C}$ | | |
| $I_{T(AV)}$ | Average on-state current | Sxx10LSy | $T_c = 80^\circ\text{C}$ | 6.4 | A |
| | | Sxx10RSy / Sxx10NSy Sxx10DSy Sxx10Vsy | $T_c = 95^\circ\text{C}$ | | |
| I_{TSM} | Peak non-repetitive surge current | single half cycle; f = 50Hz; T_J (initial) = 25°C | | 83 | A |
| | | single half cycle; f = 60Hz; T_J (initial) = 25°C | | 100 | |
| I^2t | I^2t Value for fusing | $t_p = 8.3$ ms | | 41 | A^2s |
| di/dt | Critical rate of rise of on-state current | f = 60 Hz ; $T_J = 110^\circ\text{C}$ | | 100 | $\text{A}/\mu\text{s}$ |
| I_{GM} | Peak gate current | $T_J = 110^\circ\text{C}$ | | 1 | A |
| $P_{G(AV)}$ | Average gate power dissipation | $T_J = 110^\circ\text{C}$ | | 0.1 | W |
| T_{stg} | Storage temperature range | | | -40 to 150 | $^\circ\text{C}$ |
| T_J | Operating junction temperature range | | | -40 to 110 | $^\circ\text{C}$ |

Note: xx = voltage, y = sensitivity

Absolute Maximum Ratings — Standard SCRs

| Symbol | Parameter | Test Conditions | | Value | Unit |
|--------------|---|--|---------------------------|------------|------------------------|
| $I_{T(RMS)}$ | RMS on-state current | Sxx10L | $T_c = 95^\circ\text{C}$ | 10 | A |
| | | Sxx10R / Sxx10N Sxx10D Sxx10V | $T_c = 105^\circ\text{C}$ | | |
| $I_{T(AV)}$ | Average on-state current | Sxx10L | $T_c = 95^\circ\text{C}$ | 6.4 | A |
| | | Sxx10R / Sxx10N Sxx10D Sxx10V | $T_c = 105^\circ\text{C}$ | | |
| I_{TSM} | Peak non-repetitive surge current | single half cycle; f = 50Hz; T_J (initial) = 25°C | | 83 | A |
| | | single half cycle; f = 60Hz; T_J (initial) = 25°C | | 100 | |
| I^2t | I^2t Value for fusing | $t_p = 8.3$ ms | | 41 | A^2s |
| di/dt | Critical rate-of-rise of on-state current | f = 60 Hz $T_J = 125^\circ\text{C}$ | | 100 | $\text{A}/\mu\text{s}$ |
| I_{GM} | Peak gate current | $T_J = 125^\circ\text{C}$ | | 2 | A |
| $P_{G(AV)}$ | Average gate power dissipation | $T_J = 125^\circ\text{C}$ | | 0.5 | W |
| T_{stg} | Storage temperature range | | | -40 to 150 | $^\circ\text{C}$ |
| T_J | Operating junction temperature range | | | -40 to 125 | $^\circ\text{C}$ |

Note: xx = voltage

Electrical Characteristics ($T_J = 25^\circ\text{C}$, unless otherwise specified) – Sensitive SCRs

| Symbol | Test Conditions | | Value | | Unit |
|-----------|---|------|----------|----------|------------------|
| | | | Sxx10xS2 | Sxx10xS3 | |
| I_{GT} | $V_D = 6V$ $R_L = 100\ \Omega$ | MAX. | 200 | 500 | μA |
| V_{GT} | $V_D = 6V$ $R_L = 100\ \Omega$ | MAX. | 0.8 | | V |
| dv/dt | $V_D = V_{DRM}$; $R_{GK} = 1k\Omega$; $T_J = 110^\circ\text{C}$ | TYP. | 8 | | V/ μs |
| V_{GD} | $V_D = V_{DRM}$; $R_L = 3.3\ k\Omega$; $T_J = 110^\circ\text{C}$ | MIN. | 0.2 | | V |
| V_{GRM} | $I_{GR} = 10\mu\text{A}$ | MIN. | 6 | | V |
| I_H | $I_T = 20\text{mA}$ (initial) | MAX. | 6 | 8 | mA |
| t_q | (1) | MAX. | 50 | 45 | μs |
| t_{gt} | $I_G = 2 \times I_{GT}$; $PW = 15\mu\text{s}$; $I_T = 12\text{A}$ | TYP. | 4 | 5 | μs |

Note: xx = voltage, x = package
 (1) $I_T = 2\text{A}$; $t_p = 50\mu\text{s}$; $dv/dt = 5\text{V}/\mu\text{s}$; $di/dt = 30\text{A}/\mu\text{s}$

Electrical Characteristics ($T_J = 25^\circ\text{C}$, unless otherwise specified) – Standard SCRs

| Symbol | Test Conditions | | | Value | Unit |
|----------|---|-------|------|--------|------------------|
| | | | | Sxx10x | |
| I_{GT} | $V_D = 12V$ $R_L = 60\ \Omega$ | - | MAX. | 15 | mA |
| V_{GT} | $V_D = 12V$ $R_L = 60\ \Omega$ | - | MAX. | 1.5 | V |
| dv/dt | $V_D = V_{DRM}$; gate open; $T_J = 100^\circ\text{C}$ | 400V | MIN. | 350 | V/ μs |
| | | 600V | | 300 | |
| | | 800V | | 250 | |
| | $V_D = V_{DRM}$; gate open; $T_J = 125^\circ\text{C}$ | 1000V | | 100 | |
| | | 400V | | 250 | |
| | | 600V | | 225 | |
| V_{GD} | $V_D = V_{DRM}$; $R_L = 3.3\ k\Omega$; $T_J = 125^\circ\text{C}$ | - | MIN. | 0.2 | V |
| I_H | $I_T = 200\text{mA}$ (initial) | - | MAX. | 30 | mA |
| t_q | (1) | - | MAX. | 35 | μs |
| t_{gt} | $I_G = 2 \times I_{GT}$; $PW = 15\mu\text{s}$; $I_T = 20\text{A}$ | - | TYP. | 2 | μs |

Note: xx = voltage, x = package
 (1) $I_T = 2\text{A}$; $t_p = 50\mu\text{s}$; $dv/dt = 5\text{V}/\mu\text{s}$; $di/dt = 30\text{A}/\mu\text{s}$

Static Characteristics

| Symbol | Test Conditions | | Value | Unit |
|---------------------------|---|---------------------------|------------|------|
| V_{TM} | $I_T = 20\text{A}$; $t_p = 380\ \mu\text{s}$ | | MAX. | 1.6 |
| I_{DRM} / I_{RRM} | Sxx10xyy | $T_J = 25^\circ\text{C}$ | 400 - 600V | 5 |
| | | $T_J = 110^\circ\text{C}$ | 400 - 600V | 250 |
| | Sxx10x | $T_J = 25^\circ\text{C}$ | 400 - 800V | 10 |
| | | | 1000V | 20 |
| | | $T_J = 100^\circ\text{C}$ | 400 - 800V | 200 |
| | | | 1000V | 3000 |
| $T_J = 125^\circ\text{C}$ | 400 - 800V | 500 | | |

Note: xx = voltage, x = package, yy = sensitivity

Thermal Resistances

| Symbol | Parameter | Value | Unit | |
|-------------------|-----------------------|---------------------|------|------|
| $R_{\theta(J-C)}$ | Junction to case (AC) | Sxx10RSy / Sxx10NSy | 1.6 | °C/W |
| | | Sxx10LSy | 3.0 | |
| | | Sxx10VSY | 1.7 | |
| | | Sxx10DSy | 1.45 | |
| | | Sxx10R / Sxx10N | 1.6 | |
| | | Sxx10L | 3.0 | |
| | | Sxx10V | 1.7 | |
| | | Sxx10D | 1.45 | |
| $R_{\theta(J-A)}$ | Junction to ambient | Sxx10RSy | 40 | °C/W |
| | | Sxx10LSy | 65 | |
| | | Sxx10VSY | 85 | |
| | | Sxx10R | 40 | |
| | | Sxx10L | 50 | |
| | | Sxx10V | 70 | |

Note: xx = voltage, y = sensitivity

Figure 1: Normalized DC Gate Trigger Current vs. Junction Temperature (Sensitive SCR)

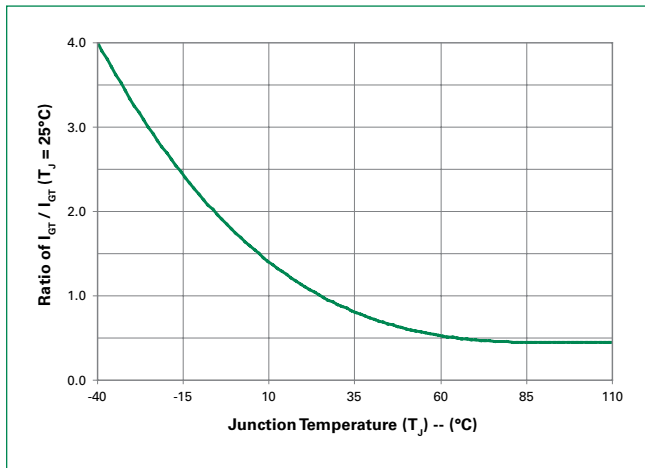


Figure 2: Normalized DC Gate Trigger Current vs. Junction Temperature (Standard SCR)

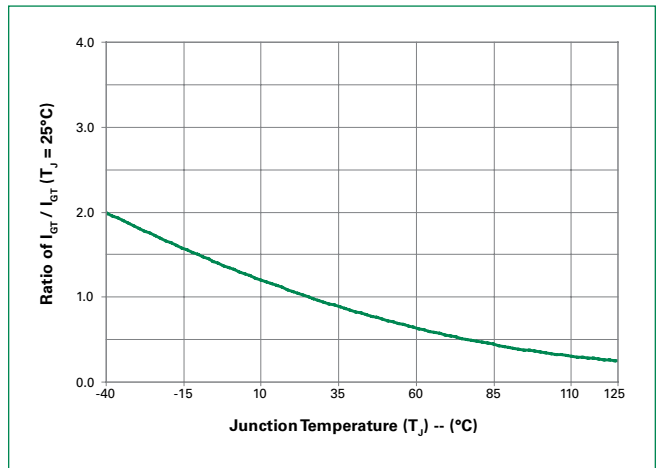


Figure 3: Normalized DC Gate Trigger Voltage vs. Junction Temperature

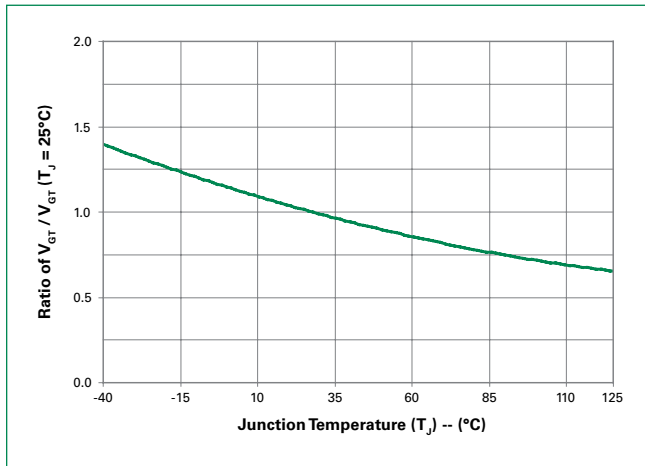


Figure 4: Normalized DC Holding Current vs. Junction Temperature

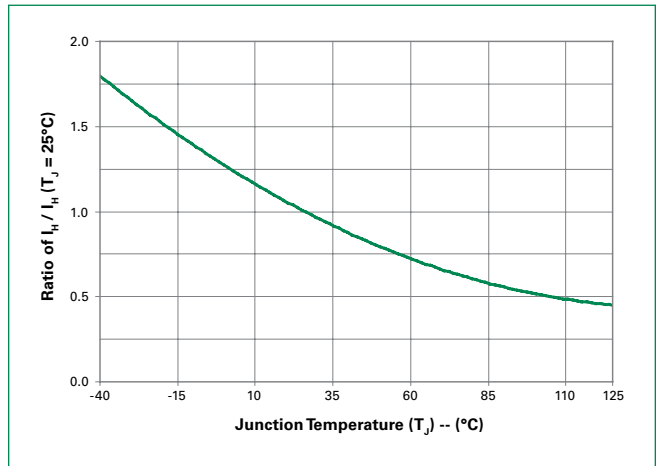


Figure 5: On-State Current vs. On-State Voltage (Typical)

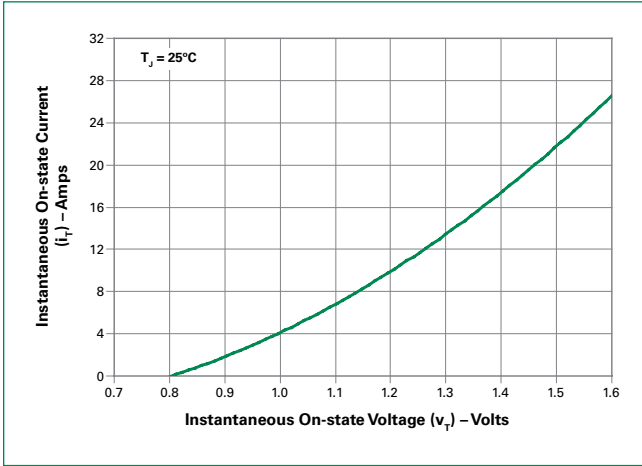


Figure 6: Power Dissipation (Typical) vs. RMS On-State Current

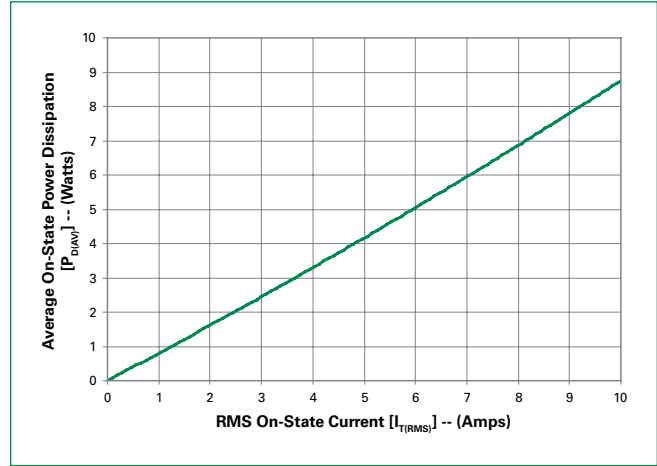


Figure 7: Maximum Allowable Case Temperature vs. RMS On-State Current

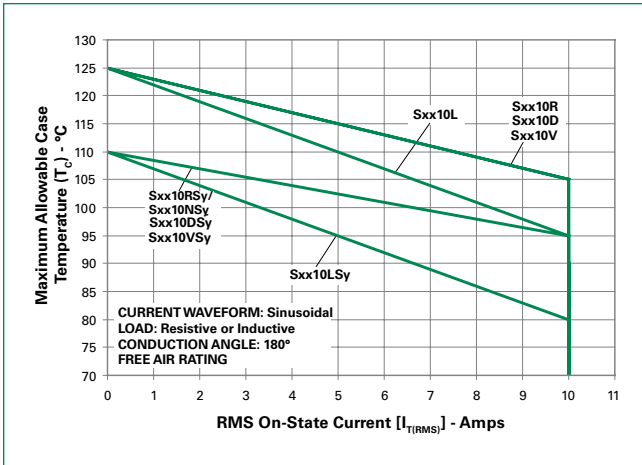


Figure 8: Maximum Allowable Case Temperature vs. Average On-State Current

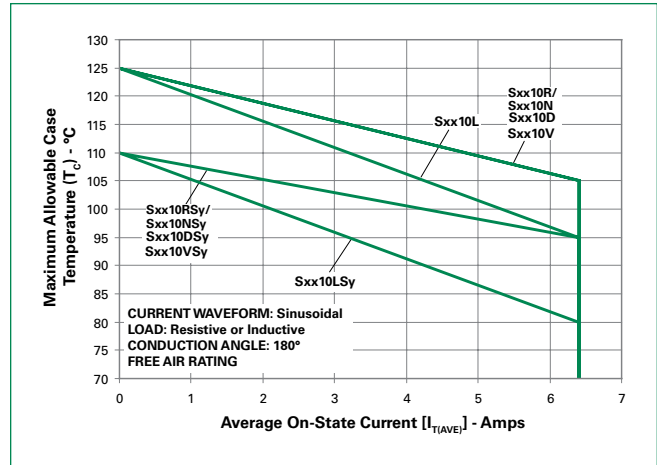


Figure 9: Maximum Allowable Ambient Temperature vs. RMS On-State Current

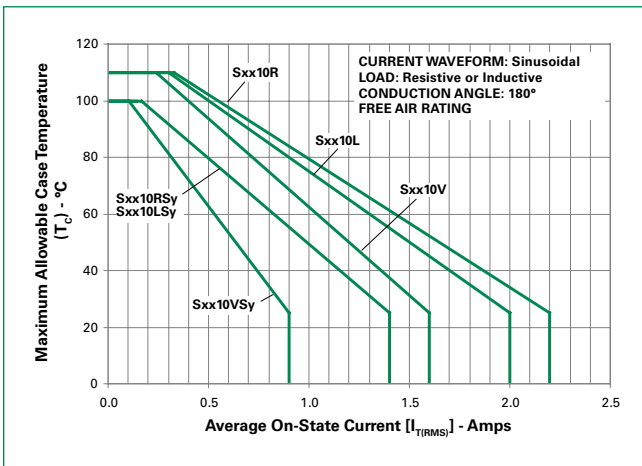
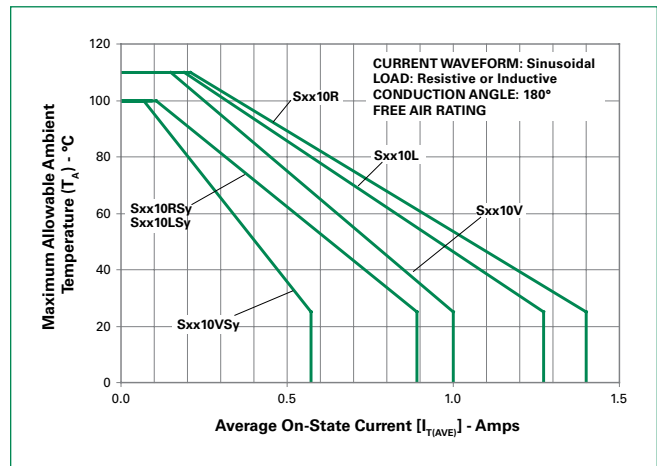


Figure 10: Maximum Allowable Ambient Temperature vs. Average On-State Current



Note: xx = voltage, y = sensitivity

Figure 11: Peak Capacitor Discharge Current

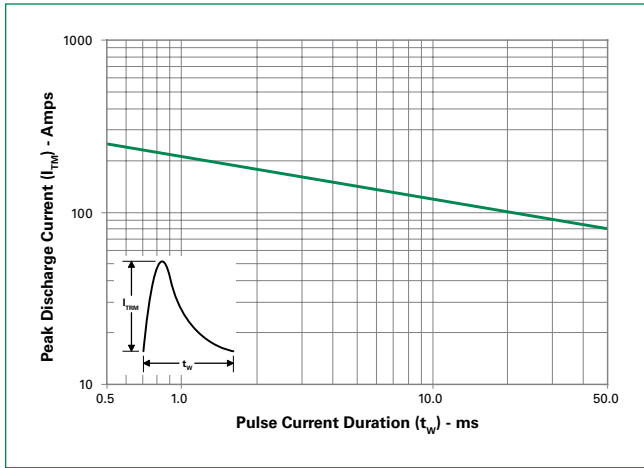


Figure 12: Peak Capacitor Discharge Current Derating

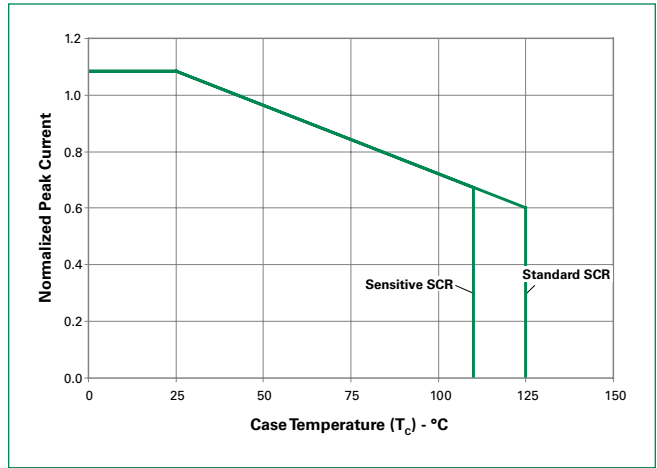


Figure 13-1: Typical DC Holding Current with R_{GK} vs. Junction Temperature for S60010xS2

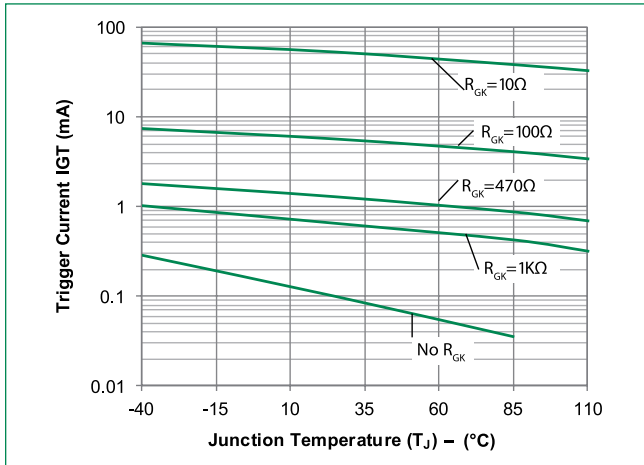


Figure 13-1: Typical DC Holding Current with R_{GK} vs. Junction Temperature for S60010xS3

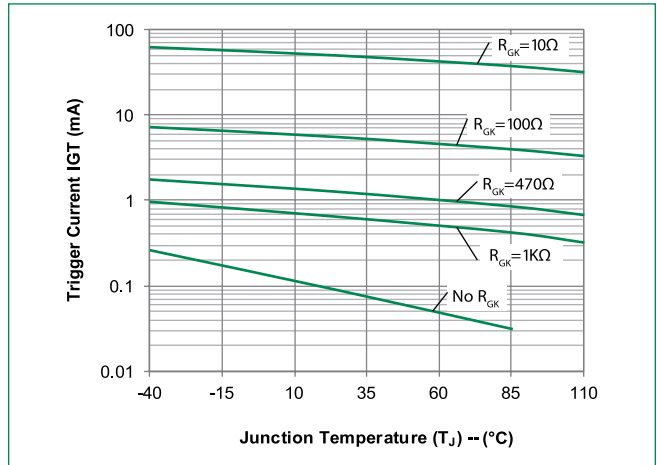


Figure 14-1: Typical DC Holding Current with R_{GK} vs. Junction Temperature for S60010xS2

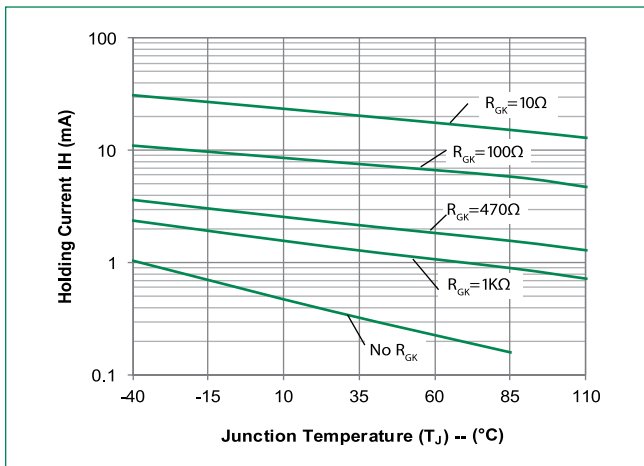


Figure 14-2: Typical DC Holding Current with R_{GK} vs. Junction Temperature for S60010xS3

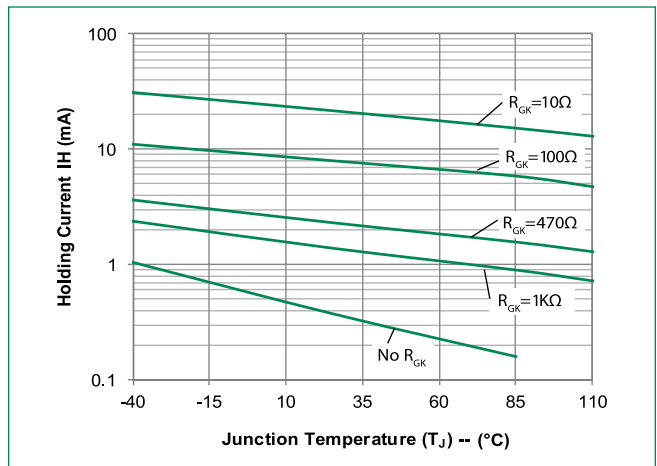


Figure 15-1: Typical Static dv/dt with R_{GK} vs. Junction Temperature for S60010xS2

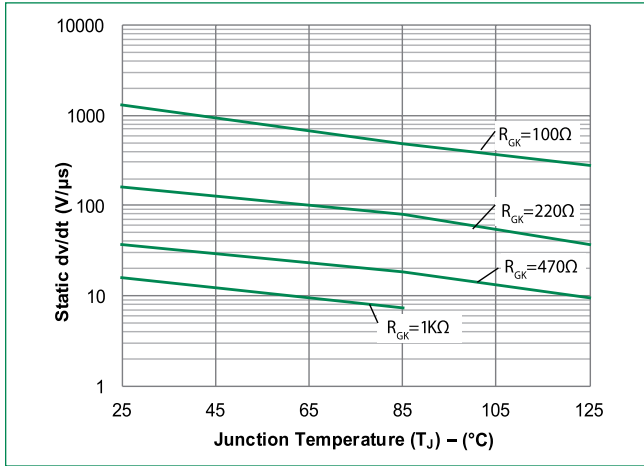


Figure 15-2: Typical Static dv/dt with R_{GK} vs. Junction Temperature for S60010xS3

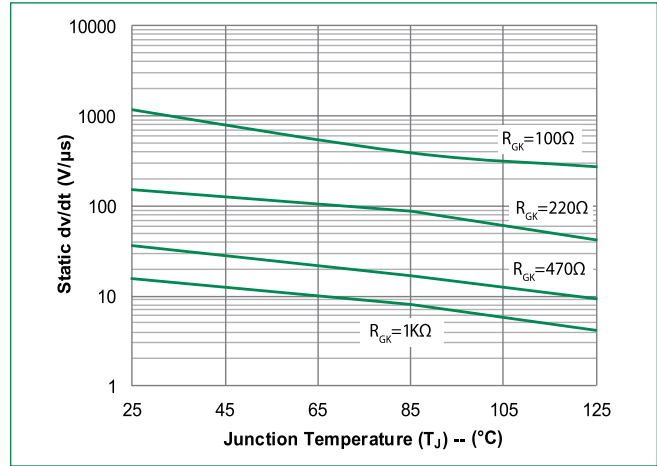


Figure 16-1: Typical turn off time with R_{GK} vs. Junction Temperature for S60010xS2

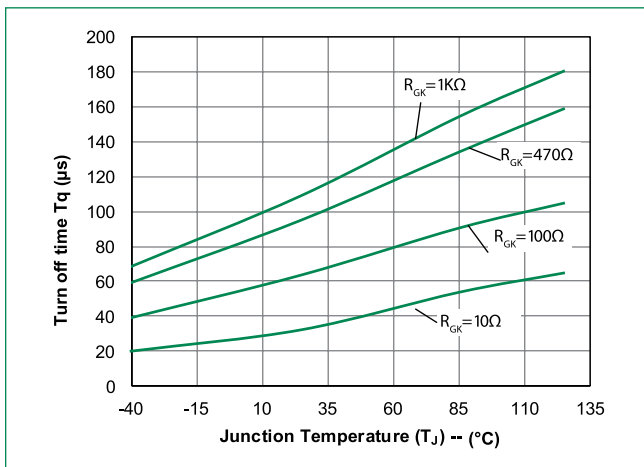


Figure 16-2: Typical DC Gate Trigger Current with R_{GK} vs. Junction Temperature for S60010xS3

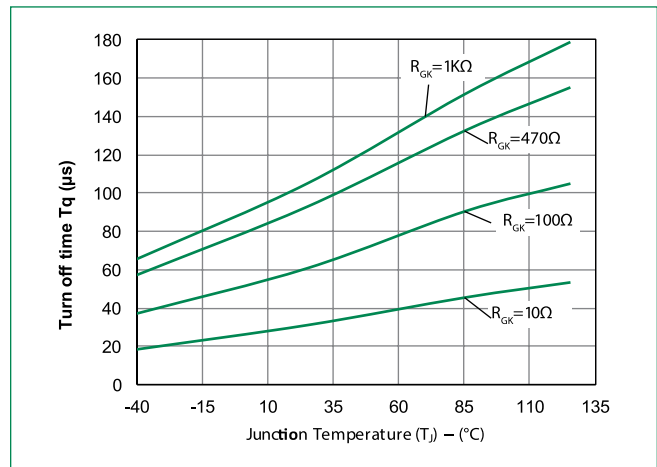
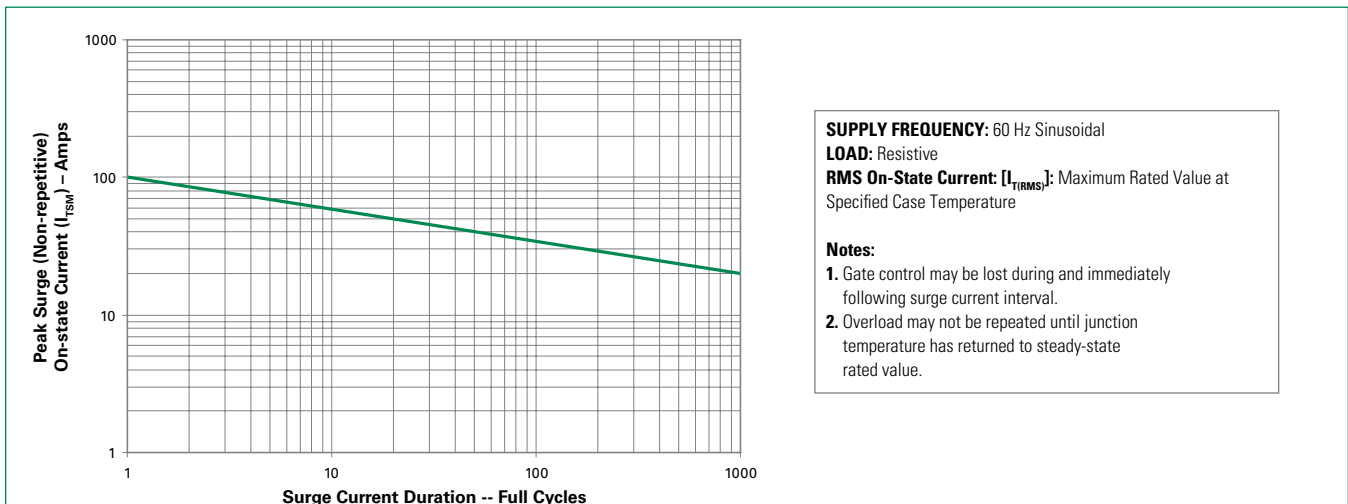
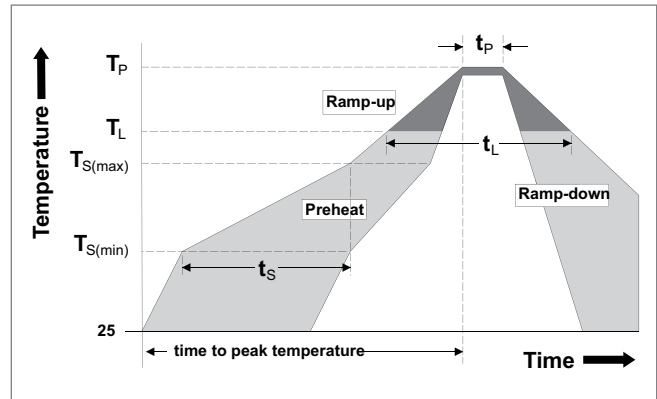


Figure 17: Surge Peak On-State Current vs. Number of Cycles



Soldering Parameters

| | | |
|--|------------------------------------|-------------------------|
| Reflow Condition | | Pb – Free assembly |
| Pre Heat | - Temperature Min ($T_{s(min)}$) | 150°C |
| | - Temperature Max ($T_{s(max)}$) | 200°C |
| | - Time (min to max) (t_s) | 60 – 180 secs |
| Average ramp up rate (Liquidus Temp) (T_L) to peak | | 5°C/second max |
| $T_{s(max)}$ to T_L - Ramp-up Rate | | 5°C/second max |
| Reflow | - Temperature (T_L) (Liquidus) | 217°C |
| | - Temperature (t_L) | 60 – 150 seconds |
| Peak Temperature (T_p) | | 260 ^{+0/-5} °C |
| Time within 5°C of actual peak Temperature (t_p) | | 20 – 40 seconds |
| Ramp-down Rate | | 5°C/second max |
| Time 25°C to peak Temperature (T_p) | | 8 minutes Max. |
| Do not exceed | | 280°C |



Physical Specifications

| | |
|------------------------|---|
| Terminal Finish | 100% Matte Tin-plated |
| Body Material | UL Recognized epoxy meeting flammability rating 94V-0 |
| Lead Material | Copper Alloy |

Design Considerations

Careful selection of the correct component for the application's operating parameters and environment will go a long way toward extending the operating life of the Thyristor. Good design practice should limit the maximum continuous current through the main terminals to 75% of the component rating. Other ways to ensure long life for a power discrete semiconductor are proper heat sinking and selection of voltage ratings for worst case conditions. Overheating, overvoltage (including dv/dt), and surge currents are the main killers of semiconductors. Correct mounting, soldering, and forming of the leads also help protect against component damage.

Environmental Specifications

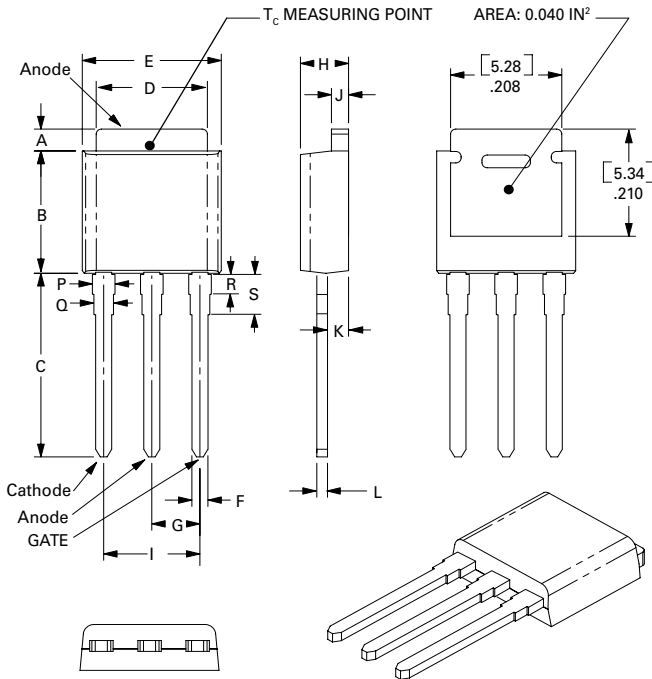
| Test | Specifications and Conditions |
|----------------------------------|--|
| AC Blocking | MIL-STD-750, M-1040, Cond A Applied Peak AC voltage @ 125°C for 1008 hours |
| Temperature Cycling | MIL-STD-750, M-1051, 100 cycles; -40°C to +150°C; 15-min dwell-time |
| Temperature/Humidity | EIA / JEDEC, JESD22-A101 1008 hours; 320V - DC: 85°C; 85% rel humidity |
| High Temp Storage | MIL-STD-750, M-1031, 1008 hours; 150°C |
| Low-Temp Storage | 1008 hours; -40°C |
| Resistance to Solder Heat | MIL-STD-750 Method 2031 |
| Solderability | ANSI/J-STD-002, category 3, Test A |
| Lead Bend | MIL-STD-750, M-2036 Cond E |

Product Selector

| Part Number | Voltage | | | | Gate Sensitivity | Type | Package |
|-------------|---------|------|------|-------|------------------|---------------|---------|
| | 400V | 600V | 800V | 1000V | | | |
| Sxx10RS2 | X | X | - | - | 0.2mA | Sensitive SCR | TO-220R |
| Sxx10LS2 | X | X | - | - | 0.2mA | Sensitive SCR | TO-220L |
| Sxx10VS2 | X | X | - | - | 0.2mA | Sensitive SCR | TO-251 |
| Sxx10DS2 | X | X | - | - | 0.2mA | Sensitive SCR | TO-252 |
| Sxx10RS3 | X | X | - | - | 0.5mA | Sensitive SCR | TO-220R |
| Sxx10LS3 | X | X | - | - | 0.5mA | Sensitive SCR | TO-220L |
| Sxx10VS3 | X | X | - | - | 0.5mA | Sensitive SCR | TO-251 |
| Sxx10DS3 | X | X | - | - | 0.5mA | Sensitive SCR | TO-252 |
| Sxx10R | X | X | X | X | 15mA | Standard SCR | TO-220R |
| Sxx10L | X | X | X | X | 15mA | Standard SCR | TO-220L |
| Sxx10V | X | X | X | X | 15mA | Standard SCR | TO-251 |
| Sxx10D | X | X | X | X | 15mA | Standard SCR | TO-252 |
| Sxx10NS2 | X | X | - | - | 15mA | Sensitive SCR | TO-263 |
| Sxx10NS3 | X | X | - | - | 15mA | Sensitive SCR | TO-263 |
| Sxx10N | X | X | X | X | 15mA | Standard SCR | TO-263 |

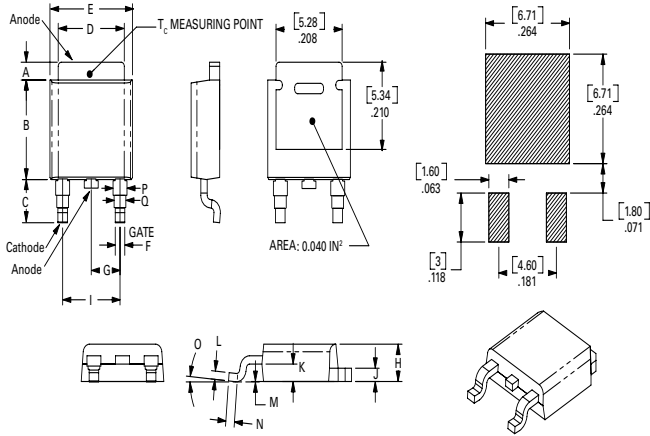
Note: xx = Voltage/10

Dimensions – TO-251AA (V/I-Package) – V/I-PAK Through Hole



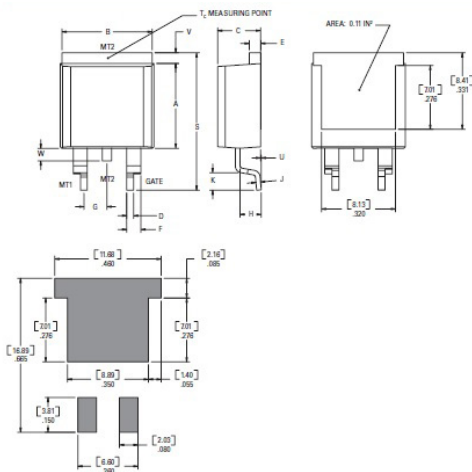
| Dimension | Inches | | | Millimeters | | |
|-----------|--------|-------|-------|-------------|------|------|
| | Min | Typ | Max | Min | Typ | Max |
| A | 0.037 | 0.040 | 0.043 | 0.94 | 1.01 | 1.09 |
| B | 0.235 | 0.242 | 0.245 | 5.97 | 6.15 | 6.22 |
| C | 0.350 | 0.361 | 0.375 | 8.89 | 9.18 | 9.53 |
| D | 0.205 | 0.208 | 0.213 | 5.21 | 5.29 | 5.41 |
| E | 0.255 | 0.262 | 0.265 | 6.48 | 6.66 | 6.73 |
| F | 0.027 | 0.031 | 0.033 | 0.69 | 0.80 | 0.84 |
| G | 0.087 | 0.090 | 0.093 | 2.21 | 2.28 | 2.36 |
| H | 0.085 | 0.092 | 0.095 | 2.16 | 2.34 | 2.41 |
| I | 0.176 | 0.180 | 0.184 | 4.47 | 4.57 | 4.67 |
| J | 0.018 | 0.020 | 0.023 | 0.46 | 0.51 | 0.58 |
| K | 0.035 | 0.037 | 0.039 | 0.90 | 0.95 | 1.00 |
| L | 0.018 | 0.020 | 0.023 | 0.46 | 0.52 | 0.58 |
| P | 0.042 | 0.047 | 0.052 | 1.06 | 1.20 | 1.32 |
| Q | 0.034 | 0.039 | 0.044 | 0.86 | 1.00 | 1.11 |
| R | 0.034 | 0.039 | 0.044 | 0.86 | 1.00 | 1.11 |
| S | 0.074 | 0.079 | 0.084 | 1.86 | 2.00 | 2.11 |

Dimensions — TO-252AA (D-Package) — D-PAK Surface Mount



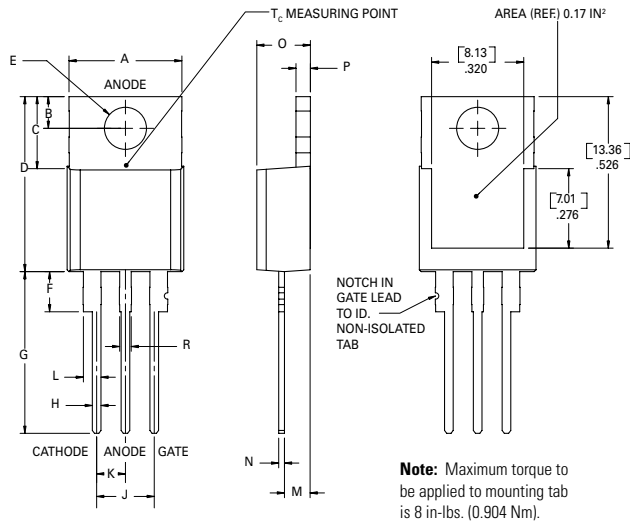
| Dimension | Inches | | | Millimeters | | |
|-----------|--------|-------|-------|-------------|------|------|
| | Min | Typ | Max | Min | Typ | Max |
| A | 0.037 | 0.040 | 0.043 | 0.94 | 1.01 | 1.09 |
| B | 0.235 | 0.243 | 0.245 | 5.97 | 6.16 | 6.22 |
| C | 0.106 | 0.108 | 0.113 | 2.69 | 2.74 | 2.87 |
| D | 0.205 | 0.208 | 0.213 | 5.21 | 5.29 | 5.41 |
| E | 0.255 | 0.262 | 0.265 | 6.48 | 6.65 | 6.73 |
| F | 0.027 | 0.031 | 0.033 | 0.69 | 0.80 | 0.84 |
| G | 0.087 | 0.090 | 0.093 | 2.21 | 2.28 | 2.36 |
| H | 0.085 | 0.092 | 0.095 | 2.16 | 2.33 | 2.41 |
| I | 0.176 | 0.179 | 0.184 | 4.47 | 4.55 | 4.67 |
| J | 0.018 | 0.020 | 0.023 | 0.46 | 0.51 | 0.58 |
| K | 0.035 | 0.037 | 0.039 | 0.90 | 0.95 | 1.00 |
| L | 0.018 | 0.020 | 0.023 | 0.46 | 0.51 | 0.58 |
| M | 0.000 | 0.000 | 0.004 | 0.00 | 0.00 | 0.10 |
| N | 0.021 | 0.026 | 0.027 | 0.53 | 0.67 | 0.69 |
| O | 0° | 0° | 5° | 0° | 0° | 5° |
| P | 0.042 | 0.047 | 0.052 | 1.06 | 1.20 | 1.32 |
| Q | 0.034 | 0.039 | 0.044 | 0.86 | 1.00 | 1.11 |

Dimensions — TO-263 (N-Package) — D²PAK Surface Mount



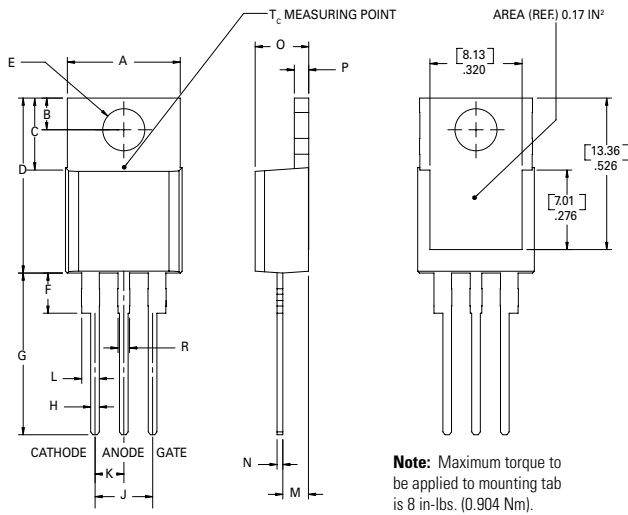
| Dimension | Inches | | Millimeters | |
|-----------|--------|-------|-------------|-------|
| | Min | Max | Min | Max |
| A | 0.360 | 0.370 | 9.14 | 9.40 |
| B | 0.380 | 0.420 | 9.65 | 10.67 |
| C | 0.178 | 0.188 | 4.52 | 4.78 |
| D | 0.025 | 0.035 | 0.64 | 0.89 |
| E | 0.045 | 0.060 | 1.14 | 1.52 |
| F | 0.060 | 0.075 | 1.52 | 1.91 |
| G | 0.095 | 0.105 | 2.41 | 2.67 |
| H | 0.092 | 0.102 | 2.34 | 2.59 |
| J | 0.018 | 0.024 | 0.46 | 0.61 |
| K | 0.090 | 0.110 | 2.29 | 2.79 |
| S | 0.590 | 0.625 | 14.99 | 15.88 |
| V | 0.035 | 0.045 | 0.89 | 1.14 |
| U | 0.002 | 0.010 | 0.05 | 0.25 |
| W | 0.040 | 0.070 | 1.02 | 1.78 |

Dimensions — TO-220AB (R-Package) — Non-Isolated Mounting Tab Common with Center Lead



| Dimension | Inches | | Millimeters | |
|-----------|--------|-------|-------------|-------|
| | Min | Max | Min | Max |
| A | 0.380 | 0.420 | 9.65 | 10.67 |
| B | 0.105 | 0.115 | 2.67 | 2.92 |
| C | 0.230 | 0.250 | 5.84 | 6.35 |
| D | 0.590 | 0.620 | 14.99 | 15.75 |
| E | 0.142 | 0.147 | 3.61 | 3.73 |
| F | 0.110 | 0.130 | 2.79 | 3.30 |
| G | 0.540 | 0.575 | 13.72 | 14.61 |
| H | 0.025 | 0.035 | 0.64 | 0.89 |
| J | 0.195 | 0.205 | 4.95 | 5.21 |
| K | 0.095 | 0.105 | 2.41 | 2.67 |
| L | 0.060 | 0.075 | 1.52 | 1.91 |
| M | 0.085 | 0.095 | 2.16 | 2.41 |
| N | 0.018 | 0.024 | 0.46 | 0.61 |
| O | 0.178 | 0.188 | 4.52 | 4.78 |
| P | 0.045 | 0.060 | 1.14 | 1.52 |
| R | 0.038 | 0.048 | 0.97 | 1.22 |

Dimensions — TO-220AB (L-Package) — Isolated Mounting Tab



| Dimension | Inches | | Millimeters | |
|-----------|--------|-------|-------------|-------|
| | Min | Max | Min | Max |
| A | 0.380 | 0.420 | 9.65 | 10.67 |
| B | 0.105 | 0.115 | 2.67 | 2.92 |
| C | 0.230 | 0.250 | 5.84 | 6.35 |
| D | 0.590 | 0.620 | 14.99 | 15.75 |
| E | 0.142 | 0.147 | 3.61 | 3.73 |
| F | 0.110 | 0.130 | 2.79 | 3.30 |
| G | 0.540 | 0.575 | 13.72 | 14.61 |
| H | 0.025 | 0.035 | 0.64 | 0.89 |
| J | 0.195 | 0.205 | 4.95 | 5.21 |
| K | 0.095 | 0.105 | 2.41 | 2.67 |
| L | 0.060 | 0.075 | 1.52 | 1.91 |
| M | 0.085 | 0.095 | 2.16 | 2.41 |
| N | 0.018 | 0.024 | 0.46 | 0.61 |
| O | 0.178 | 0.188 | 4.52 | 4.78 |
| P | 0.045 | 0.060 | 1.14 | 1.52 |
| R | 0.038 | 0.048 | 0.97 | 1.22 |