Littelfuse
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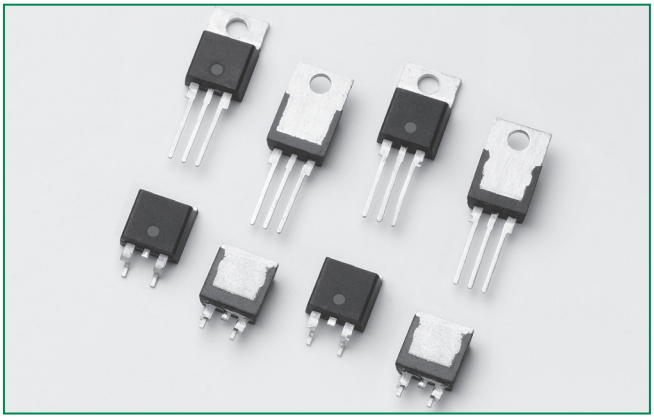
# Teccor® brand Thyristors
## 40 Amp Low $T_q$ SCR

## S4040xQx Series

RoHS



## Main Features

| Symbol | Value | Unit |
|---|---|---|
| $I_{T(RMS)}$ | 40 | A |
| $V_{DRM}/V_{RRM}$ | 400 | V |
| $I_{GT}$ | 15 to 65 | mA |

## Description

The S4040xQx series of SCRs offer fast turn-off time (tq) characteristics required for applications such as power inverters, switching regulator, and high frequency pulse circuits.

These fast turn-off time SCRs offer high dv/dt and high di/dt characteristics required in higher frequency (>1000 PPS) switching circuits.

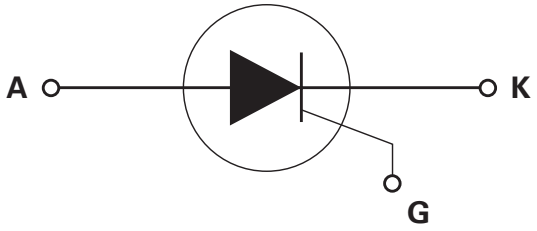
## Features & Benefits

- RoHS compliant
- Glass – passivated junctions
- Voltage capability up to 400 V
- Surge capability up to 520 A
- TO-220 and TO-263 packages

## Applications

Fast turn-off time SCRs are ideal for multi phase voltage regulator circuits, DC/AC inverters, and higher frequency pulsing power supplies.

## Schematic Symbol




## Absolute Maximum Ratings

| Symbol | Parameter | Test Conditions | Value | Unit |
|---|---|---|---|---|
| $I_{T(RMS)}$ | RMS on-state current | $T_C$ = 100°C | 40 | A |
| $I_{T(AV)}$ | Average on-state current | $T_C$ = 100°C | 25.0 | A |
| $I_{TSM}$ | Peak non-repetitive surge current | single half cycle; f = 50Hz; $T_J$ (initial) = 25°C | 430 | A |
| | | single half cycle; f = 60Hz; $T_J$ (initial) = 25°C | 520 | |
| $I^2t$ | $I^2t$ Value for fusing | $t_p$ = 8.3 ms | 1122 | $A^2s$ |
| di/dt | Critical rate of rise of on-state current | f = 60Hz ; $T_J$ = 125°C | 175 | A/µs |
| $I_{GM}$ | Peak gate current | $T_J$ = 125°C | 3.5 | A |
| $P_{G(AV)}$ | Average gate power dissipation | $T_J$ = 125°C | 0.8 | W |
| $T_{stg}$ | Storage temperature range | | -40 to 150 | °C |
| $T_J$ | Operating junction temperature range | | -40 to 125 | °C |



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## Electrical Characteristics ($T_J$ = 25°C, unless otherwise specified)

| Symbol | Test Conditions | | Sxx40xQ | Sxx40xQ2 | Sxx40xQ3 | Unit |
|---|---|---|---|---|---|---|
| $I_{GT}$ | $V_D$ = 12V; $R_L$ = 30 Ω | MAX. | 35 | 45 | 65 | mA |
| | | MIN. | 15 | 30 | 38 | |
| $V_{GT}$ | | MAX. | 1.5 | | | V |
| $I_{GT}$ | $V_D$ = 12V; $R_L$ = 30Ω; $T_J$ = -40°C | MAX. | 75 | 95 | 160 | mA |
| dv/dt | $V_D = V_{DRM}$; gate open; $T_J$ = 100°C | MIN. | 650 | | | V/µs |
| | $V_D = V_{DRM}$; gate open; $T_J$ = 125°C | | 550 | | | |
| $V_{GD}$ | $V_D = V_{DRM}$; $R_L$ = 3.3 kΩ; $T_J$ = 125°C | MIN. | 0.2 | | | V |
| $I_H$ | $I_T$ = 400mA (initial) | MAX. | 70 | 120 | 200 | mA |
| $t_q$ | (1) | MAX. | 15 | 12 | 5 | µs |
| $t_{gt}$ | $I_G = 2 \times I_{GT}$; PW = 15µs; $I_T$ = 80A | TYP. | 3.0 | | 3.5 | µs |

Note :
(1) $I_T$=0.5A; $t_p$=50µs; dv/dt=5V/µs; di/dt=-30A/µs

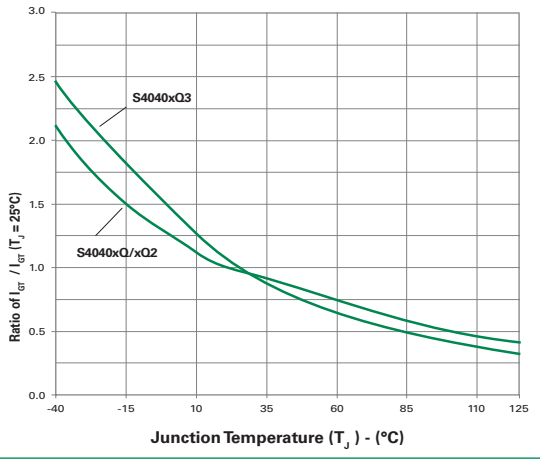
## Static Characteristics

| Symbol | Test Conditions | | | S4040xQ | S4040xQ2 | S4040xQ3 | Unit |
|---|---|---|---|---|---|---|---|
| $V_{TM}$ | $I_T$ = 80A; $t_p$ = 380µs | | MAX. | 1.8 | | 2.2 | V |
| $I_{DRM}$ / $I_{RRM}$ | $V_{DRM}$ / $V_{RRM}$ | $T_J$ = 25°C | MAX. | 10 | | | µA |
| | | $T_J$ = 100°C | | 1000 | | | |
| | | $T_J$ = 125°C | | 2000 | | | |

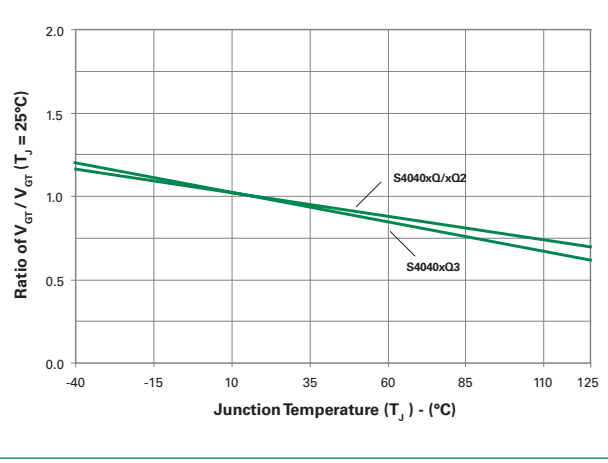
## Thermal Resistances

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{\theta(J-C)}$ | Junction to case (AC) | 0.6 | °C/W |
| $R_{\theta(J-A)}$ | Junction to ambient | 40 | °C/W |

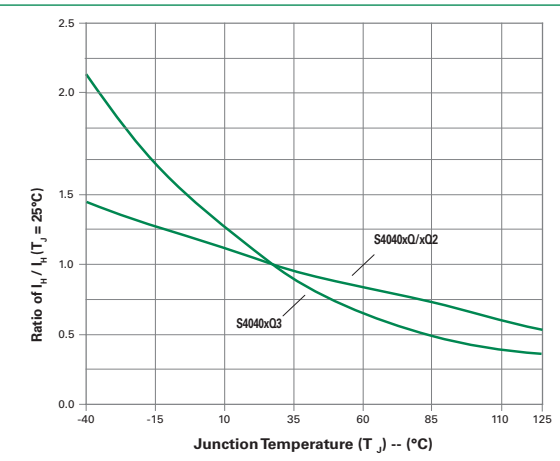
## Figure 1: Normalized DC Gate Trigger Current vs. Junction Temperature



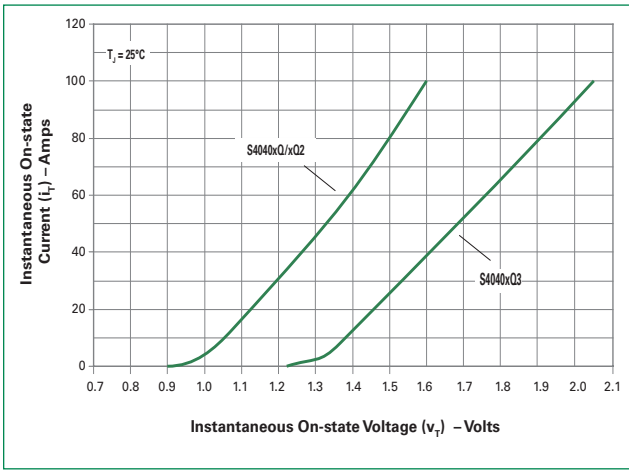

## Figure 2: Normalized DC Gate Trigger Voltage vs. Junction Temperature



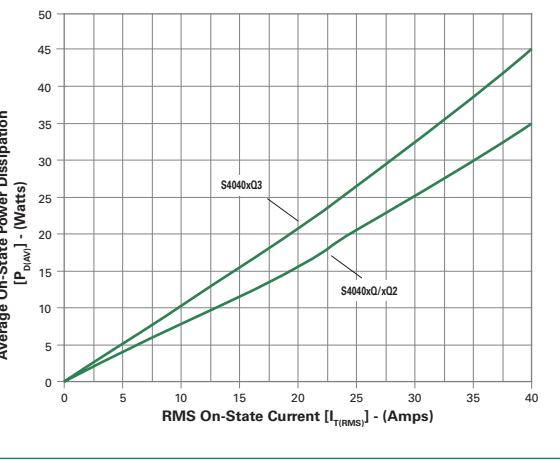

## Figure 3: Normalized DC Holding Current vs. Junction Temperature



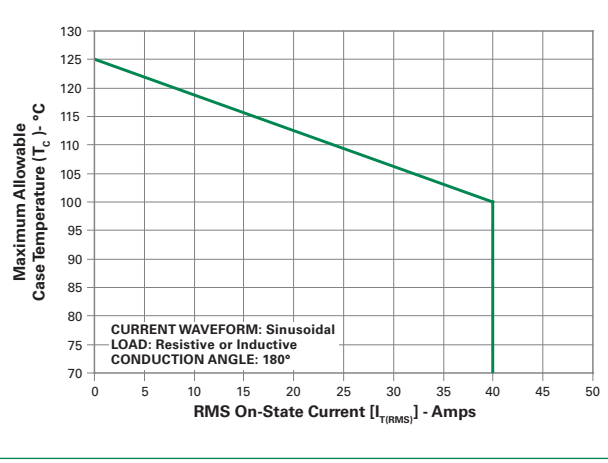

## Figure 4: On-State Current vs. On-State Voltage (Typical)




## Figure 5: Power Dissipation (Typical) vs. RMS On-State Current




## Figure 6: Maximum Allowable Case Temperature vs. RMS On-State Current

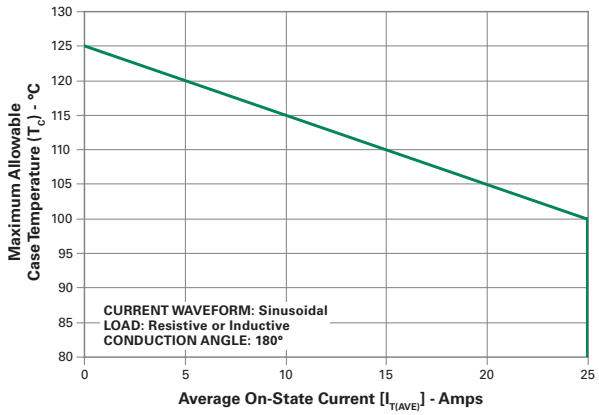




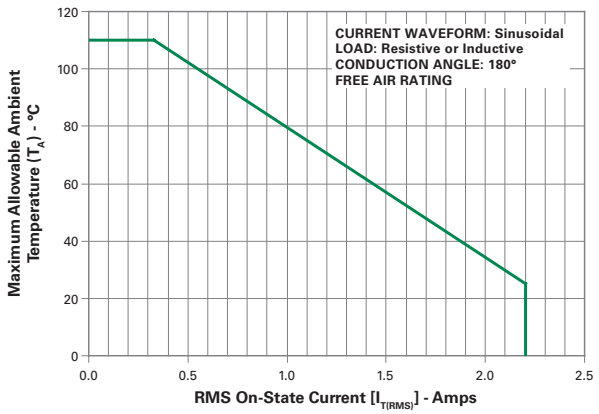



Revised: 12/09/15

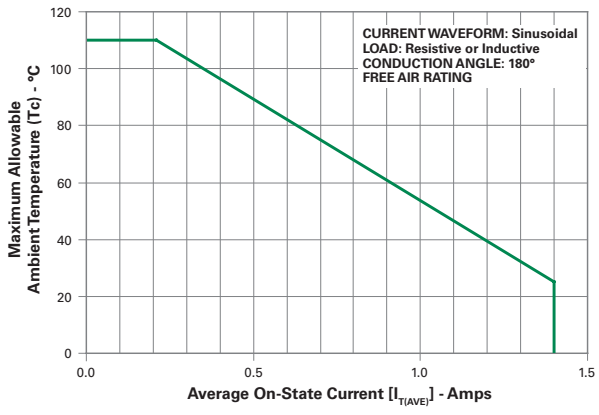
## Figure 7: Maximum Allowable Case Temperature vs. Average On-State Current



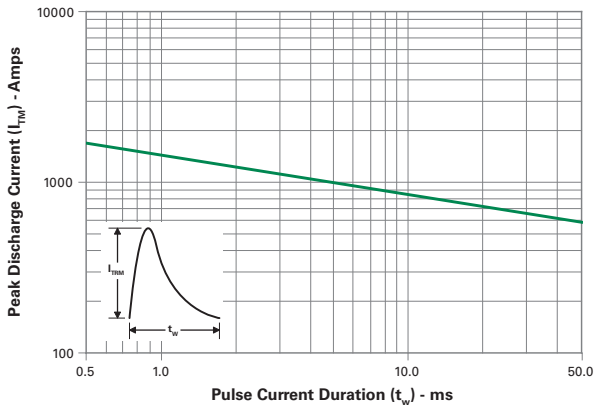

## Figure 8: Maximum Allowable Ambient Temperature vs. RMS On-State Current



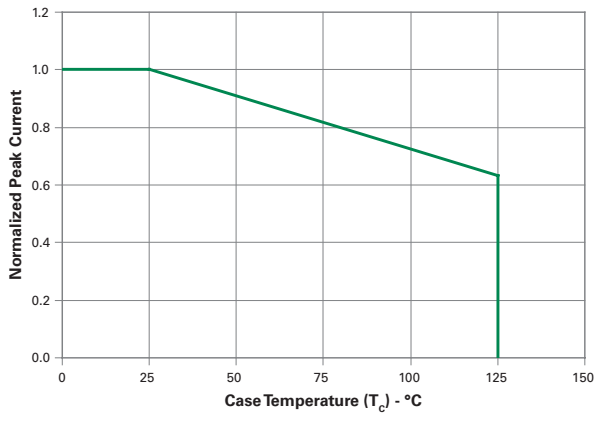

## Figure 9: Maximum Allowable Ambient Temperature vs. Average On-State Current




## Figure 10: Peak Capacitor Discharge Current




## Figure 11: Peak Capacitor Discharge Current Derating

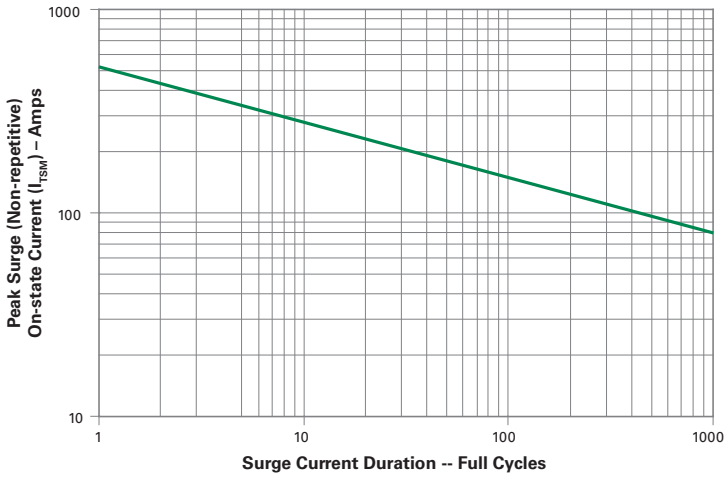







Revised: 12/09/15

## Figure 12: Surge Peak On-State Current vs. Number of Cycles

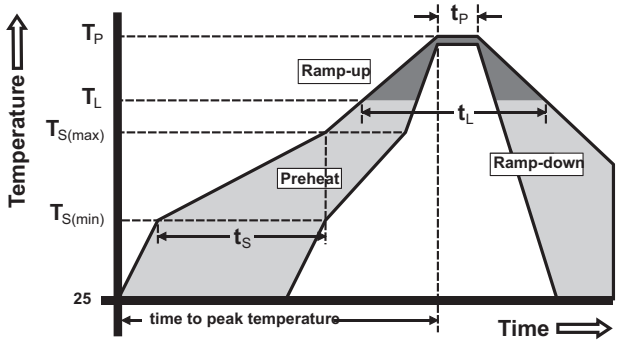



SUPPLY FREQUENCY: 60 Hz Sinusoidal
LOAD: Resistive
RMS On-State Current: [$I_{T(RMS)}$]: Maximum Rated Value at Specified Case Temperature

Notes:
1. Gate control may be lost during and immediately following surge current interval.
2. Overload may not be repeated until junction temperature has returned to steady-state rated value.

## 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 classification 94V-0 |
| **Lead Material** | Copper Alloy |

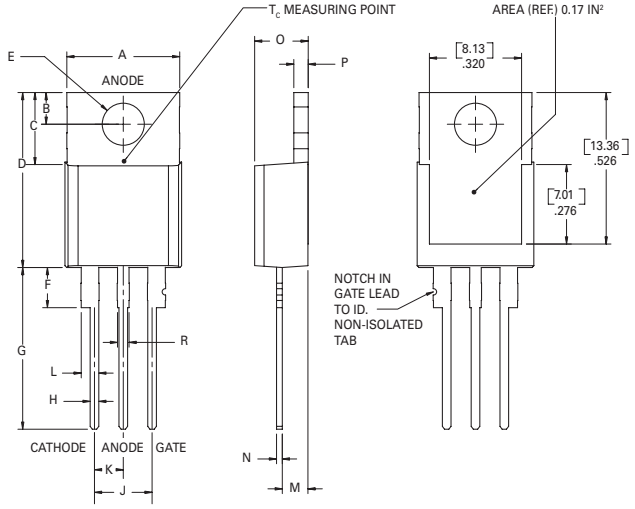
## Design Considerations

Careful selection of the correct device 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 device 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 |

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




Note: Maximum torque to be applied to mounting tab is 8 in-lbs. (0.904 Nm).

| 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 |



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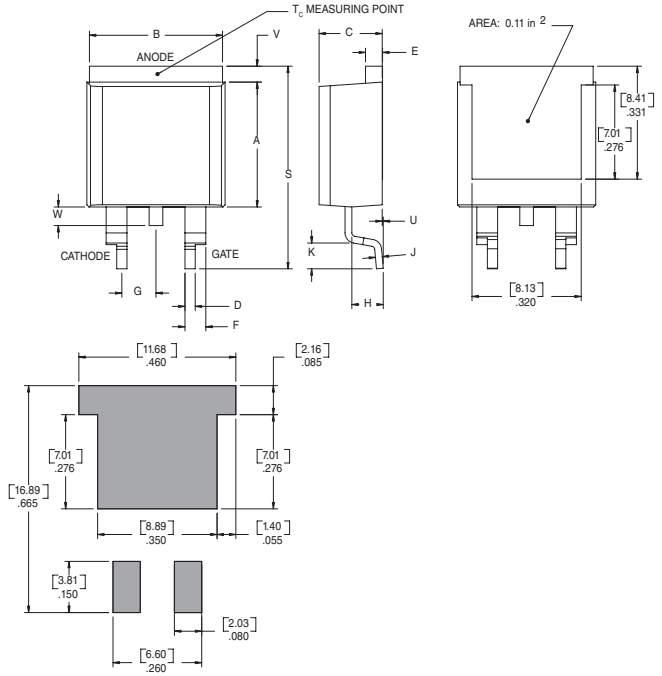
## Dimensions –TO- 263 (N-package) — D²-Pak Surface Mount




| 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 | 0.63 | 0.89 |
| E | 0.048 | 0.055 | 1.22 | 1.40 |
| F | 0.060 | 0.075 | 1.52 | 1.91 |
| G | 0.095 | 0.105 | 2.41 | 2.67 |
| H | 0.083 | 0.093 | 2.11 | 2.36 |
| 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 | 15.87 |
| 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 |

## Part Numbering System

S 40 40 R Q _ 56

**DEVICE TYPE**
S: SCR

**VOLTAGE RATING**
40: 400V

**CURRENT RATING**
40: 40A

**PACKAGE TYPE**
R: TO-220 (Non-isolated)
N: TO-263 ($D^2$- Pak)

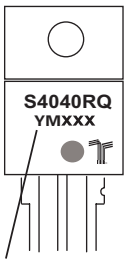
**Lead Form Dimensions**
xx: Lead Form Option

**TURN-OFF TIME**
[blank]: 15µs
2: 12µs
3: 5µs

**LOW TURN OFF TIME TYPE**

## Part Marking System

TO-220 AB - (R Package)
TO-263 (N Package)




Date Code Marking
Y:Year Code
M: Month Code
XXX: Lot Trace Code