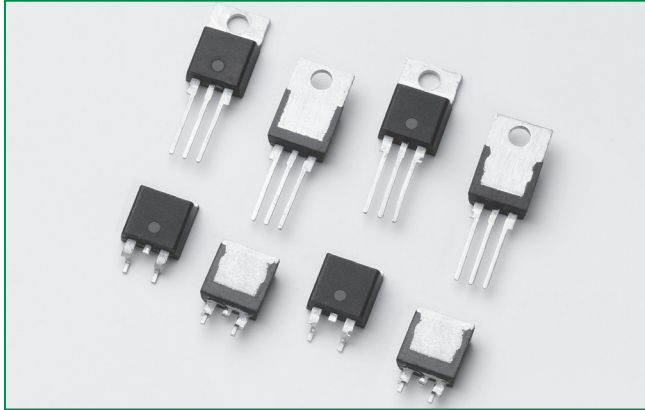


## S4040xQx Series

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 ( $t_q$ ) 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.

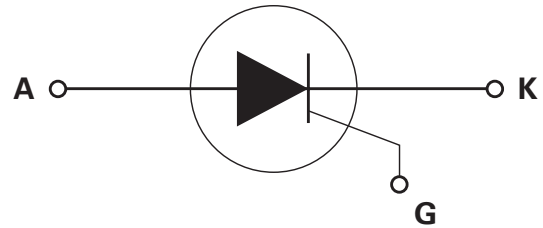
### Features & Benefits

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

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

| Symbol          | Test Conditions                                                                     |      | Sxx40xQ | Sxx40xQ2 | Sxx40xQ3 | Unit |
|-----------------|-------------------------------------------------------------------------------------|------|---------|----------|----------|------|
| I <sub>GT</sub> | V <sub>D</sub> = 12V; R <sub>L</sub> = 30 Ω                                         | MAX. | 35      | 45       | 65       | mA   |
|                 |                                                                                     | MIN. | 15      | 30       | 38       |      |
| V <sub>GT</sub> |                                                                                     | MAX. | 1.5     |          |          | V    |
| I <sub>GT</sub> | V <sub>D</sub> = 12V; R <sub>L</sub> = 30Ω; T <sub>J</sub> = -40°C                  | MAX. | 75      | 95       | 160      | mA   |
| dv/dt           | V <sub>D</sub> = V <sub>DRM</sub> ; gate open; T <sub>J</sub> = 100°C               | MIN. | 650     |          |          | V/μs |
|                 | V <sub>D</sub> = V <sub>DRM</sub> ; gate open; T <sub>J</sub> = 125°C               |      | 550     |          |          |      |
| V <sub>GD</sub> | V <sub>D</sub> = V <sub>DRM</sub> ; R <sub>L</sub> = 3.3 kΩ; T <sub>J</sub> = 125°C | MIN. | 0.2     |          |          | V    |
| I <sub>H</sub>  | I <sub>T</sub> = 400mA (initial)                                                    | MAX. | 70      | 120      | 200      | mA   |
| t <sub>q</sub>  | (1)                                                                                 | MAX. | 15      | 12       | 5        | μs   |
| t <sub>gt</sub> | I <sub>G</sub> = 2 x I <sub>GT</sub> ; PW = 15μs; I <sub>T</sub> = 80A              | TYP. | 3.0     |          |          | μs   |

Note :

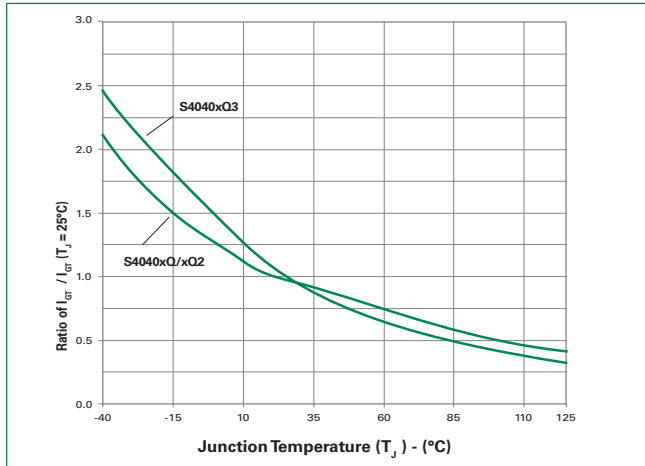
 (1)  $I_T = 0.5\text{A}; t_p = 50\ \mu\text{s}; dv/dt = 5\text{V}/\mu\text{s}; di/dt = 30\text{A}/\mu\text{s}$ 
**Static Characteristics**

| Symbol                              | Test Conditions                              |                        |      | S4040xQ | S4040xQ2 | S4040xQ3 | Unit |
|-------------------------------------|----------------------------------------------|------------------------|------|---------|----------|----------|------|
| V <sub>TM</sub>                     | I <sub>T</sub> = 80A; t <sub>p</sub> = 380μs |                        | MAX. | 1.8     |          | 2.2      | V    |
| I <sub>DRM</sub> / I <sub>RRM</sub> | V <sub>DRM</sub> / V <sub>RRM</sub>          | T <sub>J</sub> = 25°C  | MAX. | 10      |          | μA       |      |
|                                     |                                              | T <sub>J</sub> = 100°C |      | 1000    |          |          |      |
|                                     |                                              | T <sub>J</sub> = 125°C |      | 2000    |          |          |      |

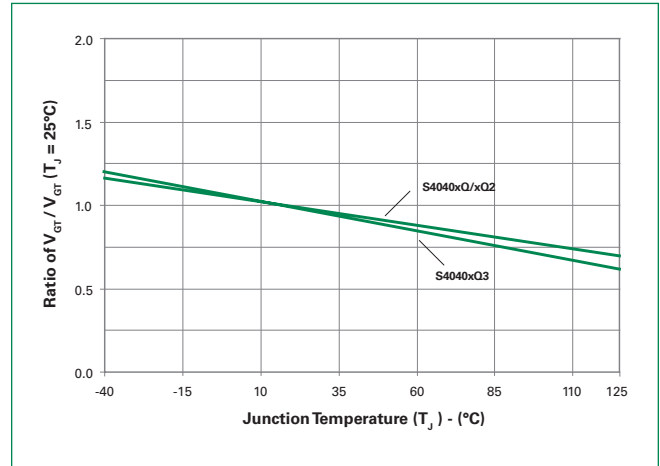
**Thermal Resistances**

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

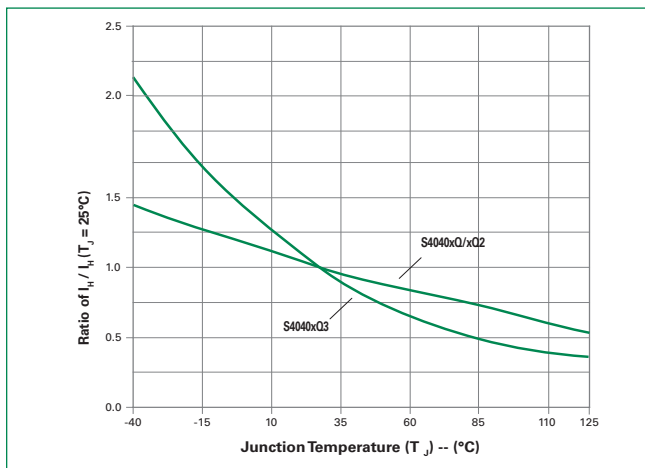
**Figure 1: Normalized DC Gate Trigger Current vs. Junction Temperature**



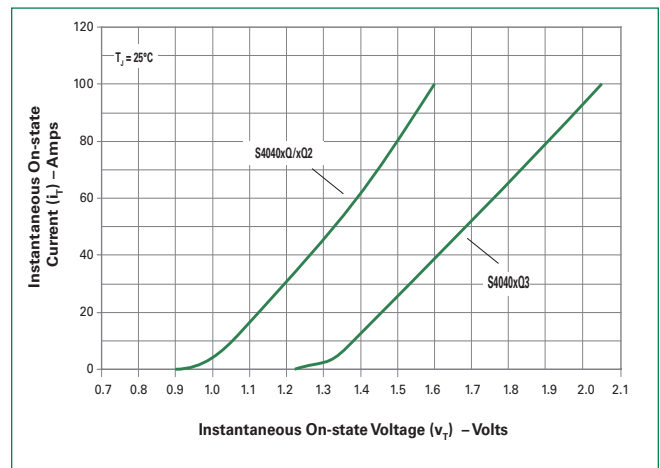
**Figure 2: Normalized DC Gate Trigger Voltage vs. Junction Temperature**



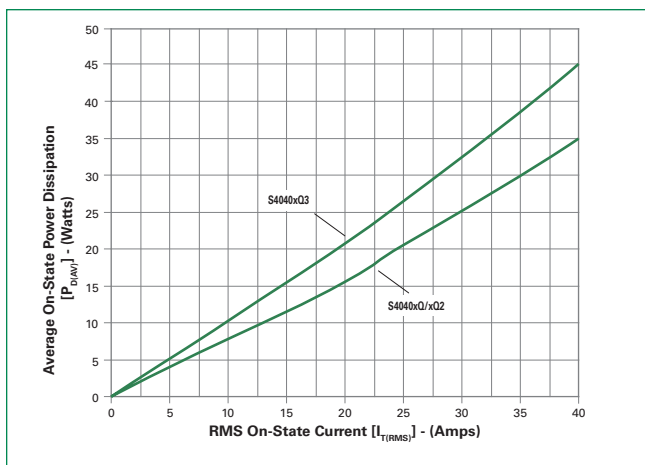
**Figure 3: Normalized DC Holding Current vs. Junction Temperature**



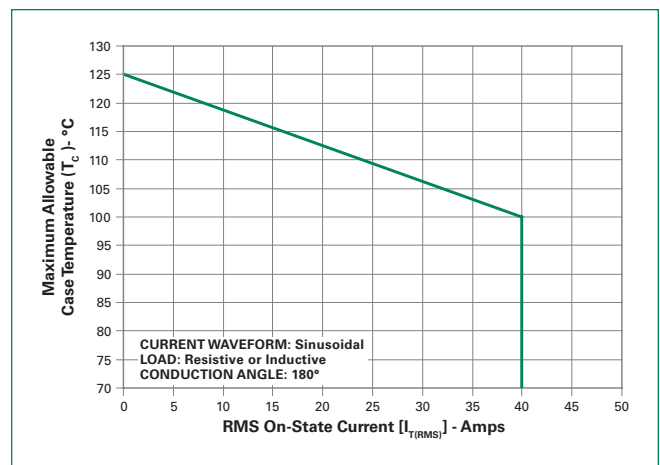
**Figure 4: On-State Current vs. On-State Voltage (Typical)**



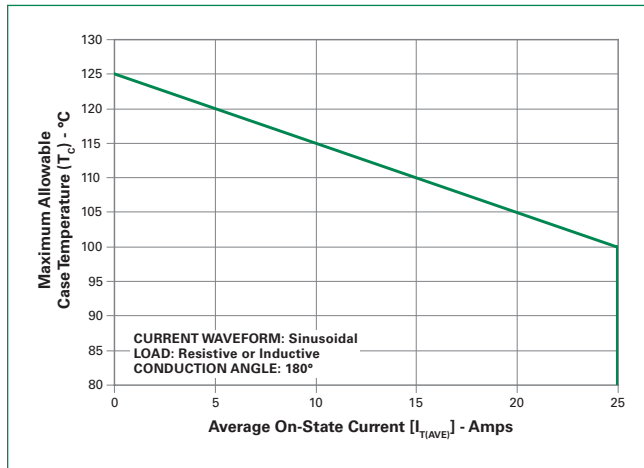
**Figure 5: Power Dissipation (Typical) vs. RMS On-State Current**



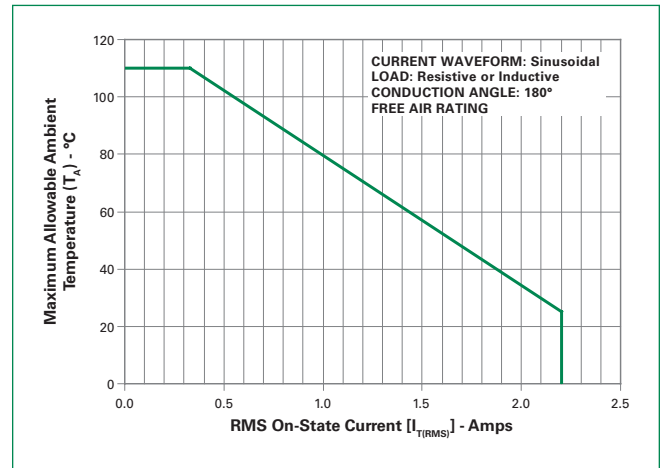
**Figure 6: Maximum Allowable Case Temperature vs. RMS On-State Current**



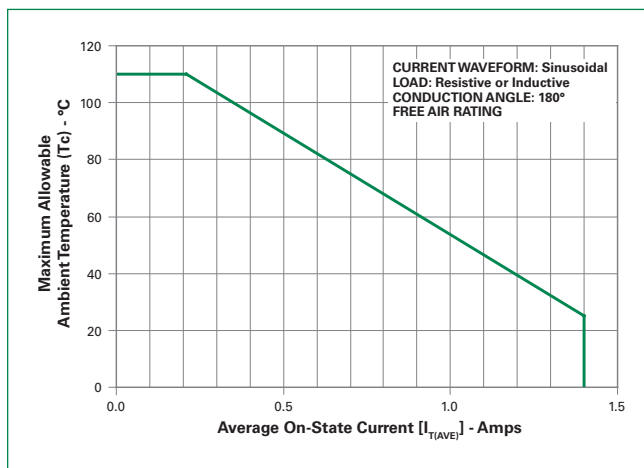
**Figure 7: Maximum Allowable Case Temperature vs. Average On-State Current**



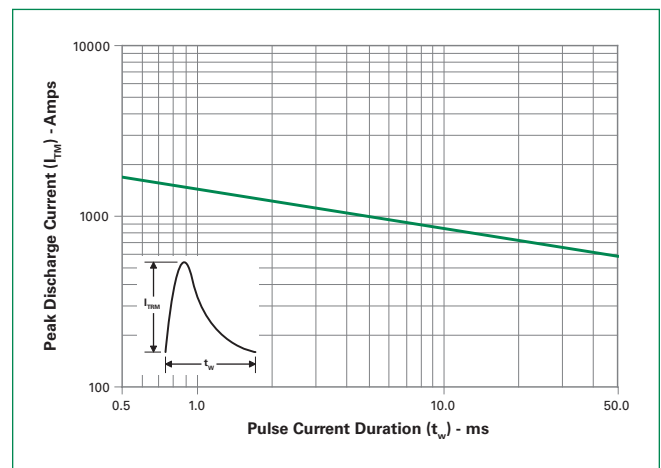
**Figure 8: Maximum Allowable Ambient Temperature vs. RMS On-State Current**



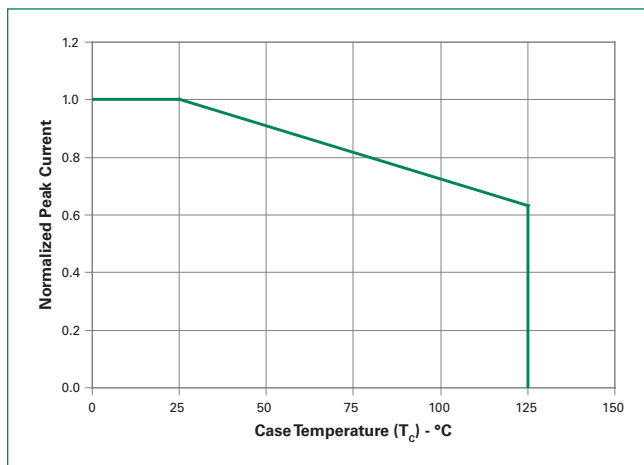
**Figure 9: Maximum Allowable Ambient Temperature vs. Average On-State Current**



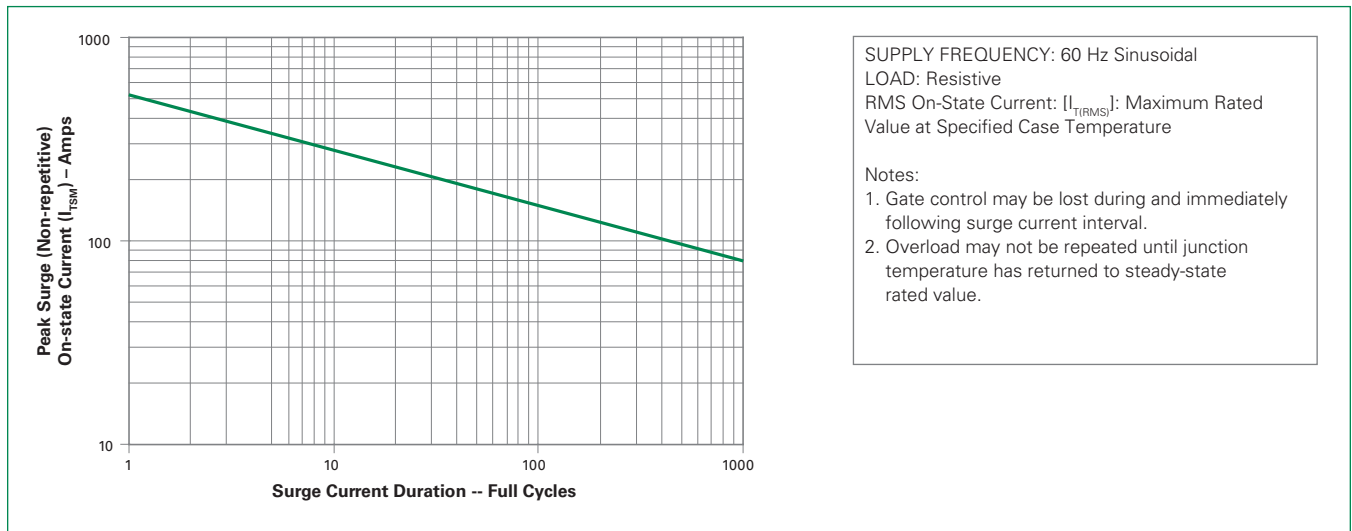
**Figure 10: Peak Capacitor Discharge Current**



**Figure 11: Peak Capacitor Discharge Current Derating**

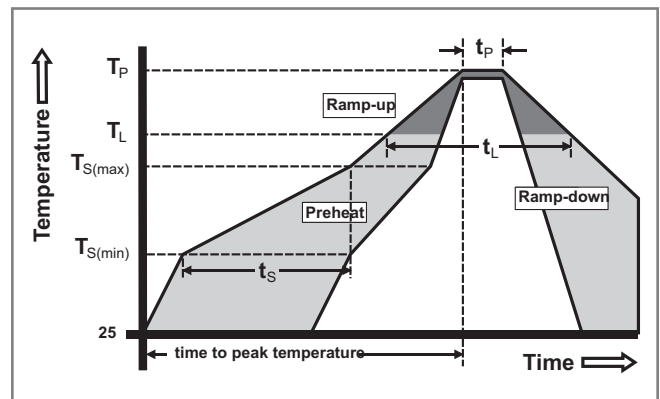


**Figure 12: Surge Peak On-State Current vs. Number of Cycles**



### 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 <sup>+0/-5</sup> °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

|                        |                                                               |
|------------------------|---------------------------------------------------------------|
| <b>Terminal Finish</b> | 100% Matte Tin-plated                                         |
| <b>Body Material</b>   | UL recognized epoxy meeting flammability classification 94V-0 |
| <b>Lead Material</b>   | Copper Alloy                                                  |

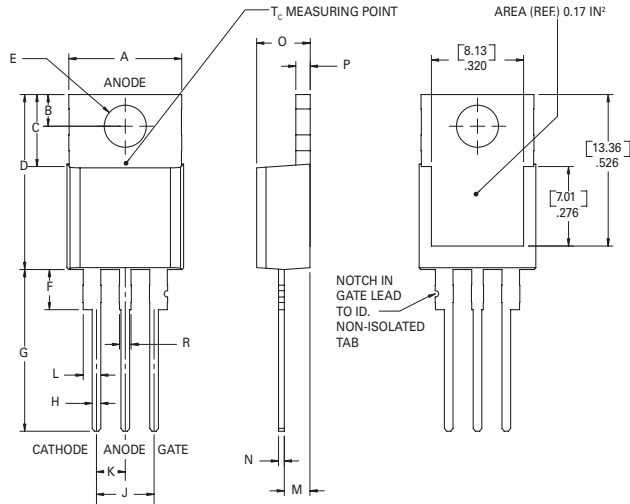
### Design Considerations

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

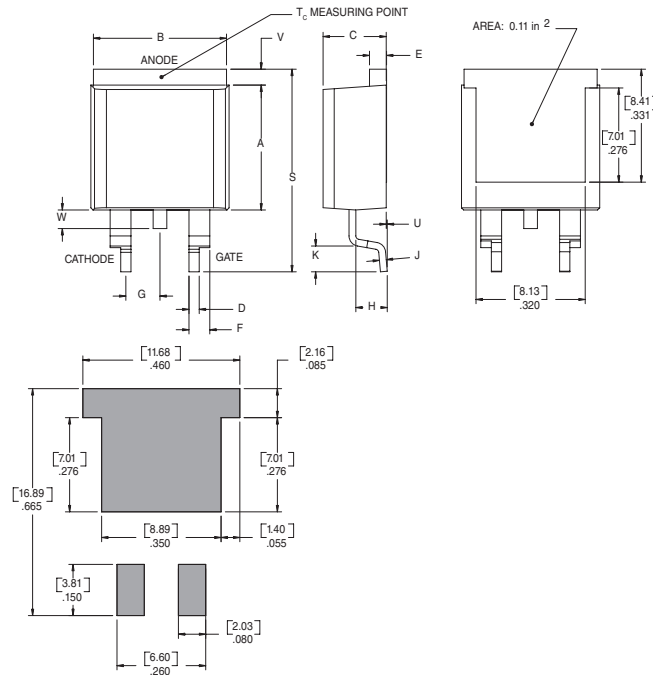
### Dimensions — TO-220AB (R-Package) — Non-Isolated Mounting Tab Common with Center Lead



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

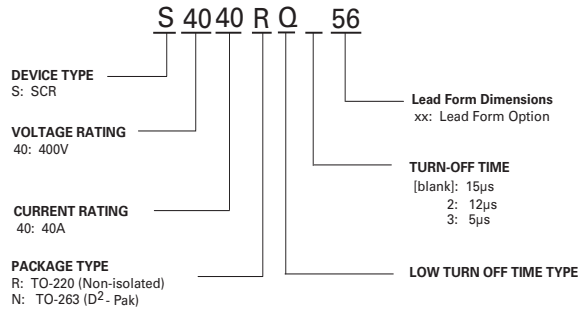
| Dimension | Inches |       | Millimeters |       |
|-----------|--------|-------|-------------|-------|
|           | Min    | Max   | Min         | Max   |
| A         | 0.380  | 0.420 | 9.65        | 10.67 |
| B         | 0.105  | 0.115 | 2.67        | 2.92  |
| C         | 0.230  | 0.250 | 5.84        | 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  |

**Dimensions – TO- 263 (N-package) — D<sup>2</sup>-Pak Surface Mount**



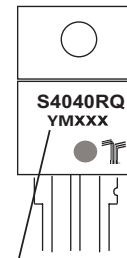
| Dimension | Inches |       | Millimeters |       |
|-----------|--------|-------|-------------|-------|
|           | Min    | Max   | Min         | Max   |
| A         | 0.360  | 0.370 | 9.14        | 9.40  |
| B         | 0.380  | 0.420 | 9.65        | 10.67 |
| C         | 0.178  | 0.188 | 4.52        | 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**



**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

## Product Selector

| Part Number | Voltage | Gate Sensitivity | Type         | Package  |
|-------------|---------|------------------|--------------|----------|
|             | 400V    |                  |              |          |
| S4040RQ     | X       | 15-35            | Standard SCR | TO-220AB |
| S4040NQ     | X       | 15-35            | Standard SCR | TO-263   |
| S4040RQ2    | X       | 30-45            | Standard SCR | TO-220AB |
| S4040NQ2    | X       | 30-45            | Standard SCR | TO-263   |
| S4040RQ3    | X       | 38-65            | Standard SCR | TO-220AB |
| S4040NQ3    | X       | 38-65            | Standard SCR | TO-263   |

## Packing Options

| Part Number | Marking  | Weight | Packing Mode     | Base Quantity     |
|-------------|----------|--------|------------------|-------------------|
| S4040RQTP   | S4040RQ  | 2.2g   | Tube             | 500 (50 per tube) |
| S4040RQ2TP  | S4040RQ2 | 2.2g   | Tube             | 500 (50 per tube) |
| S4040RQ3TP  | S4040RQ3 | 2.2g   | Tube             | 500 (50 per tube) |
| S4040NQRP   | S4040NQ  | 1.6g   | Embossed Carrier | 500               |
| S4040NQ2RP  | S4040NQ2 | 1.6g   | Embossed Carrier | 500               |
| S4040NQ3RP  | S4040NQ3 | 1.6g   | Embossed Carrier | 500               |

## Reel Pack (RP) for TO-263 Embossed Carrier Specifications

### Meets all EIA-481-2 Standards

