# SCRs

## Nuclear Radiation Resistant, Planar

GA100
GA101
GA102

### FEATURES

- Optimized for Radiation Resistance
- Fully Characterized for "Worst Case" Design
- Post Radiation Design Limits Specified
- Passivated Planar Construction for Maximum Reliability and Parameter Uniformity
- Pulse Currents: to 30A
- Max. Trigger Current 20mA after 3 X $10^{14}$ NVT
- Max. Holding Current 30mA after 3 X $10^{14}$ NVT

### DESCRIPTION

The GA100 Series of Radiation Hard SCRs have been designed to provide significantly greater radiation tolerance than conventional SCRs or Transistors with the same current handling ability. This Series is capable of operation after exposure to $10^{15}$ NVT.

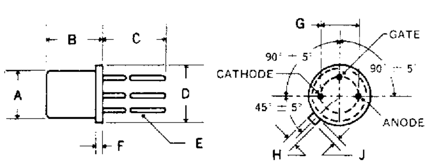
The radiation resistant characteristics of the GA100 series devices make them particularly desirable for use under radiation environments in squib firing circuits; inverters and converters; pulse generators; relay drivers; and modulator discharge switches.

### ABSOLUTE MAXIMUM RATINGS

| | GA100 | GA101 | GA102 |
|---|---|---|---|
| Repetitive Peak Off-State Voltage, $V_{DRM}$ | 30V | 60V | 80V |
| D.C. On-State Current, $I_T$ | | | |
| 75°C Ambient | | 200mA | |
| 100°C Case | | 400mA | |
| Repetitive Peak On-State Current, $I_{TRM}$ | | up to 30A | |
| Surge (non-rep.) On-State Current, $I_{TSM}$ (Sq. Pulse-50ms) | | 5A | |
| Peak Gate Current, $I_{GM}$ | | 250mA | |
| Average Gate Current, $I_{G(AV)}$ | | 25mA | |
| Reverse Gate Voltage, $V_{GR}$ | | 5V | |
| Reverse Gate Current, $I_{GR}$ | | 3mA | |
| Storage Temperature Range | | −65°C to +200°C | |
| Operating Temperature Range | | −65°C to +150°C | |

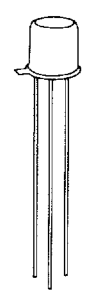
### MECHANICAL SPECIFICATIONS

GA100 GA101 GA102




| | INCHES | MILLIMETERS |
|---|---|---|
| A | .178-.195 DIA. | 4.52-4.95 DIA. |
| B | .170-.210 | 4.31-5.33 |
| C | .5 MIN. | 12.70 MIN. |
| D | .209-.230 DIA. | 5.31-5.84 DIA. |
| E | .017 ± .002 DIA. / .001 DIA. | .432 ± .051 / .025 |
| F | .020 MAX. | .508 MAX. |
| G | .100±.010 DIA. | 2.54±.254 DIA. |
| H | .041±.005 | 1.04±.127 |
| J | .028-.048 | .711-1.22 |

TO-18



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**ELECTRICAL SPECIFICATIONS (at 25°C unless noted)**

| Test | Symbol | Preradiation Limits | | | Post 3 x 10[14] NVT Design Limits | | Units | Test Conditions |
|---|---|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | Min. | Max. | | |
| SUBGROUP 1<br>Visual and Mechanical | — | — | — | — | — | — | — | MIL-STD-750<br>Method 2071 |
| SUBGROUP 2 (25°C Tests) | | | | | | | | |
| Off-State Current | $I_{DRM}$ | — | .005 | 0.1 | — | 1.0 | μA | $R_{GK}$ = 220Ω, $V_{DRM}$ = Rating |
| Reverse Gate Current | $I_{GR}$ | — | .01 | 0.1 | — | 1.0 | μA | $V_{GR}$ = 2V |
| Input Trigger Current (Note 2) | $I_{ST}$ | 1.8 | 2.3 | 3.5 | — | 20 | mA | $R_{GK}$ = 220Ω, $V_D$ = 5V |
| Gate Trigger Voltage | $V_{GT}$ | 0.4 | 0.5 | 0.7 | — | 1.5 | V | $R_{GK}$ = 220Ω, $V_D$ = 5V |
| On-State Voltage | $V_T$ | 0.8 | 1.1 | 1.5 | — | 3.0 | V | $i_T$ = 1A (pulse test) |
| Holding Current | $I_H$ | 0.3 | 0.7 | 10 | — | 30 | mA | $R_{GK}$ = 220Ω |
| SUBGROUP 3 (25°C Tests) | | | | | | | | |
| Off-State Voltage-Critical Rate of Rise | $dv_c/dt$ | 20 | 40 | — | — | — | V/μs | $R_{GK}$ = 220Ω, $V_D$ = 30V |
| Gate Trigger-on Pulse Width | $t_{pg}$ (on) | — | .02 | .05 | — | 0.1 | μs | $I_G$ = 25mA, $I_T$ = 1A, $V_D$ = 30V |
| Delay Time | $t_d$ | — | .02 | — | — | — | μs | $I_G$ = 25mA, $I_T$ = 1A, $V_D$ = 30V |
| Rise Time | $t_r$ | — | .05 | — | — | — | μs | $I_G$ = 25mA, $I_T$ = 1A, $V_D$ = 30V |
| Circuit Commutated Turn-off Time | $t_q$ | — | 1.5 | 2.5 | — | 1.0 | μs | $I_T$ = 1A, $i_R$ = 1A, $R_{GK}$ = 220Ω |
| SUBGROUP 4 (125°C Tests) | | | | | | | | |
| High Temp Off-State Current | $I_{DRM}$ | — | 10 | 100 | — | 100 | μA | $R_{GK}$ = 220Ω, $V_{DRM}$ = Rating |
| High Temp Gate Trigger Voltage | $V_{GT}$ | 0.1 | .17 | — | 0.1 | — | V | $R_{GK}$ = 220Ω, $V_D$ = 5V |

**Notes:** 1. Off-State voltage ratings apply over the operating temperature range provided the gate is connected to the cathode through an appropriate resistor, or other adequate bias is used.
2. Total Input Trigger Current, including current required by 220Ω gate bias resistance.

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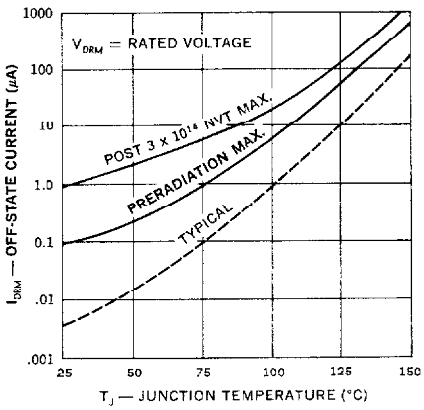
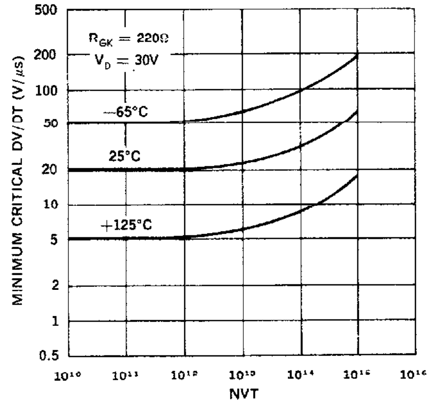
**DESIGN CONSIDERATIONS**

1. Curve 1 shows the off-state current, $I_{DRM}$ of the SCR as a function of temperature. $I_{DRM}$ is increased by radiation damage, but is not a design consideration at the recommended gate bias levels.
   In order to optimize for radiation tolerance, reverse blocking capability has not been retained as a design feature. Devices with reverse blocking capability can be provided.
2. Minimum critical dv/dt levels are defined in Curve 2. The dv/dt capability is improved after radiation because of reduced triggering sensitivity. dv/dt is therefore a design consideration only prior to radiation.
3. Curves 3 and 4 show the limits of Gate Trigger Voltage and Total Input Trigger Current prior to radiation. Maximum design limits after a total radiation dosage of 3 x 10[14] NVT is also shown. Curves 5 and 6 show the maximum limits of Gate Trigger Voltage and Total Input Trigger Currents as a junction of neutron dosage. The minimum level of Trigger current prior to radiation is established by the shunting effect of a 220 ohm resistor between gate and cathode. After radiation the device is less sensitive and Total Trigger Current will increase to a level relatively independent of the bias resistance. The 220 ohm resistor is recommended since it raises the minimum preradiation trigger current to a level that is closer to the post radiation limit and minimizes the percentage change in this parameter.
4. Current ratings shown in Curves 10, 11, and 12 apply after the device has been subjected to 3 x 10[14] NVT. Current ratings prior to radiation are greater than the values indicated.
5. Gamma radiation produces a reversible ionization (leakage) current within the device which is directly proportional to the Gamma flux level. When the Gamma flux level is in the range of 10 to 100 Roentgens per microsecond for burst durations greater than 1 microsecond, the device will self trigger ON. For the radiation bursts associated with nuclear explosions, the Gamma flux level will invariably cause device triggering at radiation levels significantly below the levels that would produce detectable permanent device damage due to cumulative neutron dosage. In applications where the burst effect triggering cannot be tolerated, it is necessary to reset the device after the radiation burst. Special circuit approaches such as additional SCRs to crowbar or otherwise cancel the output function may be used.

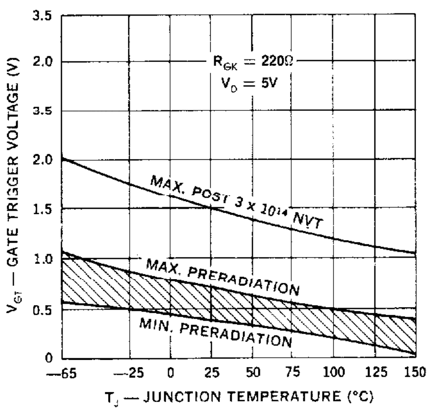
1. **Off-State Current**



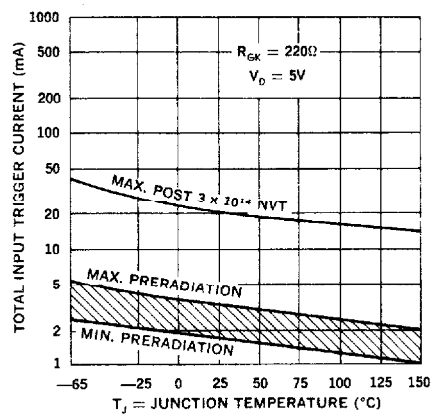

2. **Minimum Critical DV/DT vs. Neutron Dosage**



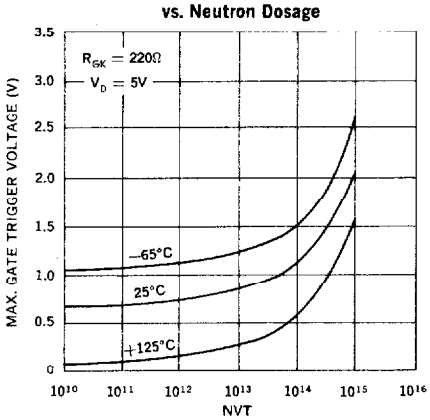

3. **Gate Trigger Voltage**



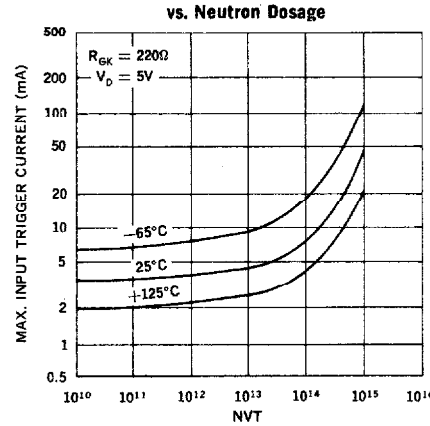

4. **Input Trigger Current**



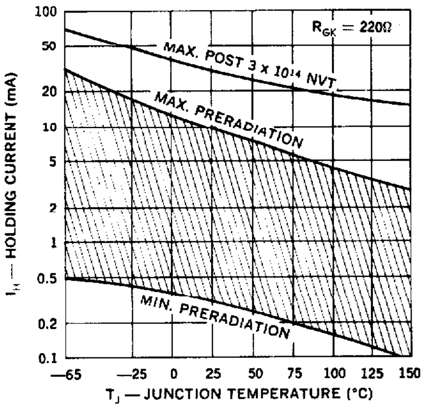

5. **Max. Gate Trigger Voltage vs. Neutron Dosage**



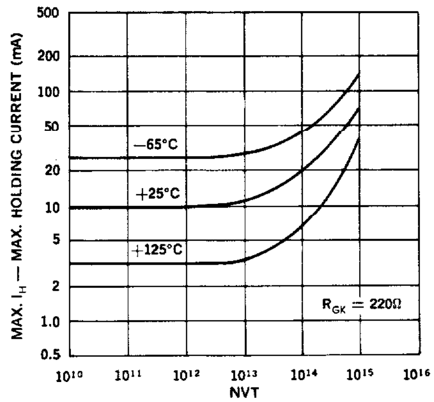

6. **Max. Input Trigger Current vs. Neutron Dosage**



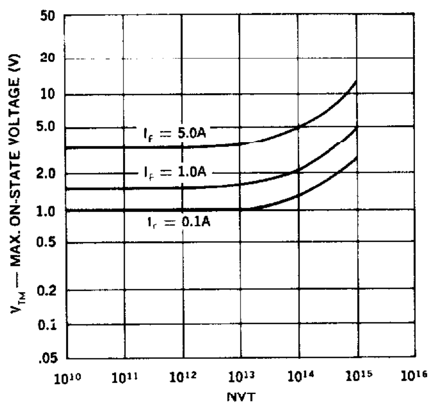
7. Holding Current



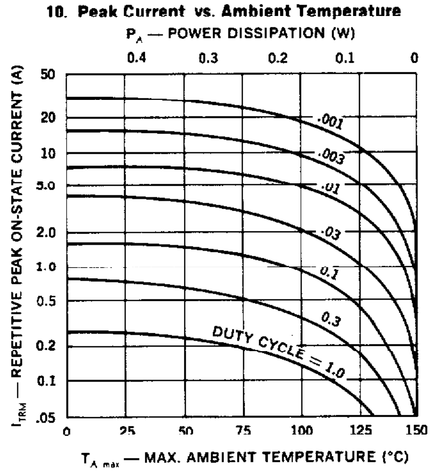

8. Max. Holding Current vs. Neutron Dosage



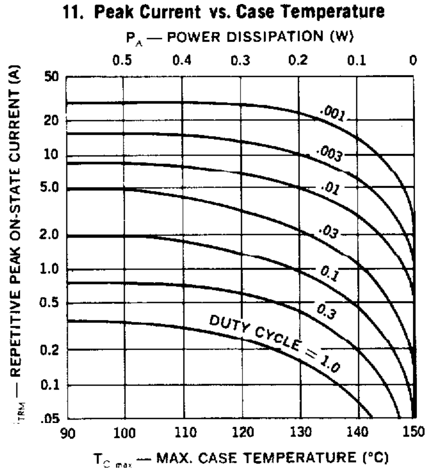

9. Max. On-State Voltage vs. Neutron Dosage



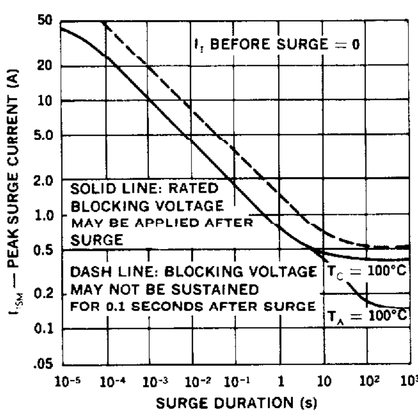

10. Peak Current vs. Ambient Temperature




11. Peak Current vs. Case Temperature




12. Surge Current vs. Time

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