

## 1.25 A sensitive gate SCR

### Features

- on-state rms current: 1.25 A
- repetitive peak off-state voltage: 600 V and 800 V
- gate triggering current: 50 and 200  $\mu$ A

### Applications

- ground fault circuit interrupters
- overvoltage crowbar protection in power supplies
- capacitive ignition circuits

### Description

The X02 SCR can be used as the on/off function in applications where topology does not offer high current for gate triggering.

This device is optimized in forward voltage drop and inrush current capabilities for reduced power losses and high reliability in harsh environments.



**Table 1. Device summary**

| Order code | Voltage |       | Sensitivity $\mu$ A | Package    |
|------------|---------|-------|---------------------|------------|
|            | 600 V   | 800 V |                     |            |
| X0202MA    | Y       |       | 200                 | TO-92      |
| X0202MN    | Y       |       | 200                 | SOT-223    |
| X0202NA    |         | Y     | 200                 | TO-92      |
| X0202NN    |         | Y     | 200                 | SOT-223    |
| X0205MA    | Y       |       | 50                  | TO-92      |
| X0205NA    |         | Y     | 50                  | TO-92      |
| X0202NUF   |         | Y     | 200                 | SMBflat-3L |

# 1 Characteristics

**Table 2. Absolute ratings (limiting values,  $T_J = 25\text{ °C}$  unless otherwise specified)**

| Symbol             | Parameter   |                         | Value                     | Unit                           |             |
|--------------------|---|-------------------------|---------------------------|--------------------------------|-------------|
| $I_{T(RMS)}$       | On-state rms current (180 °Conduction angle)  | TO-92                   | $T_L = 63\text{ °C}$      | 1.25                           | A           |
|                    |   | SOT-223                 | $T_{tab} = 99\text{ °C}$  |                                |             |
|                    |   | SMBflat-3L              | $T_{tab} = 111\text{ °C}$ |                                |             |
| $I_{T(AV)}$        | Average on-state current (180 °Conduction angle)  | TO-92                   | $T_L = 63\text{ °C}$      | 0.8                            | A           |
|                    |   | SOT-223                 | $T_{tab} = 99\text{ °C}$  |                                |             |
|                    |   | SMBflat-3L              | $T_{tab} = 111\text{ °C}$ |                                |             |
| $I_{TSM}$          | Non repetitive surge peak on-state current  | $t_p = 8.3\text{ ms}$   | $T_J = 25\text{ °C}$      | 25                             | A           |
|                    |   | $t_p = 10\text{ ms}$    |                           | 22.5                           |             |
| $I^2t$             | $I^2t$ Value for fusing   | $t_p = 10\text{ ms}$    | $T_J = 25\text{ °C}$      | 2.5                            | $A^2s$      |
| di/dt              | Critical rate of rise of on-state current<br>$I_G = 2 \times I_{GT}$ , $t_r \leq 100\text{ ns}$ | F = 60 Hz               | $T_J = 125\text{ °C}$     | 50                             | A/ $\mu s$  |
| $I_{GM}$           | Peak gate current   | $t_p = 20\text{ }\mu s$ | $T_J = 125\text{ °C}$     | 1.2                            | A           |
| $P_{G(AV)}$        | Average gate power dissipation  |                         | $T_J = 125\text{ °C}$     | 0.2                            | W           |
| $T_{stg}$<br>$T_J$ | Storage junction temperature range<br>Operating junction temperature range                      |                         |                           | - 40 to + 150<br>- 40 to + 125 | $^{\circ}C$ |

**Table 3. Electrical characteristics ( $T_J = 25\text{ °C}$  unless otherwise specified)**

| Symbol   | Test conditions  |                       | X0202 | X0205 | Unit    |            |
|----------|--|-----------------------|-------|-------|---------|------------|
| $I_{GT}$ | $V_D = 12\text{ V}$ , $R_L = 140\text{ }\Omega$                            | Min.                  |       | 20    | $\mu A$ |            |
|          |  | Max.                  | 200   | 50    |         |            |
| $V_{GT}$ |  | Max.                  | 0.8   |       | V       |            |
| $V_{GD}$ | $V_D = V_{DRM}$ , $R_L = 3.3\text{ k}\Omega$ , $R_{GK} = 1\text{ k}\Omega$ | $T_J = 125\text{ °C}$ | Min.  | 0.1   |         | V          |
| $V_{RG}$ | $I_{RG} = 10\text{ }\mu A$   |                       | Min.  | 8     |         | V          |
| $I_H$    | $I_T = 50\text{ mA}$ , $R_{GK} = 1\text{ k}\Omega$                         |                       | Max.  | 5     |         | mA         |
| $I_L$    | $I_G = 1\text{ mA}$ , $R_{GK} = 1\text{ k}\Omega$                          |                       | Max.  | 6     |         | mA         |
| dV/dt    | $V_D = 67\% V_{DRM}$ , $R_{GK} = 1\text{ k}\Omega$                         | $T_J = 110\text{ °C}$ | Min.  | 10    | 15      | V/ $\mu s$ |

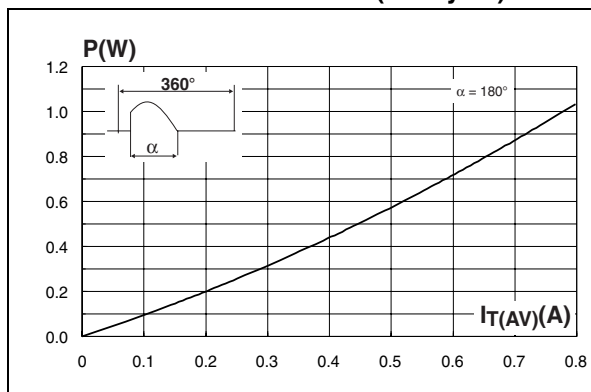
**Table 4. Static electrical characteristics**

| Symbol              | Test conditions                                    |                       | X0202 | X0205 | Unit    |
|---------------------|--|-----------------------|-------|-------|---------|
| $V_{TM}$            | $I_{TM} = 2.5\text{ A}$ , $t_p = 380\text{ }\mu s$ | $T_J = 25\text{ °C}$  | 1.45  |       | V       |
| $V_{TO}$            | Threshold voltage                                  | $T_J = 125\text{ °C}$ | 0.9   |       | V       |
| $R_d$               | Dynamic resistance                                 |                       | Max.  | 200   |         |
| $I_{DRM}$ $I_{RRM}$ | $V_{DRM} = V_{RRM}$ , $R_{GK} = 1\text{ k}\Omega$  | $T_J = 25\text{ °C}$  | 5     |       | $\mu A$ |
|                     |  | $T_J = 125\text{ °C}$ | 500   |       | $\mu A$ |

**Table 5. Thermal resistances**

| Symbol        | Parameter                |                       | Value      | Unit |
|---------------|--------------------------|-----------------------|------------|------|
| $R_{th(j-l)}$ | Junction to leads (DC)   | TO-92                 | Max.       | °C/W |
| $R_{th(j-t)}$ | Junction to tab (DC)     | SOT-223               |            |      |
| $R_{th(j-t)}$ | Junction to tab (DC)     | SMBflat-3L            |            |      |
| $R_{th(j-a)}$ | Junction to ambient (DC) | S = 5 cm <sup>2</sup> | TO-92      | 150  |
|               |                          |                       | SOT-223    | 60   |
|               |                          |                       | SMBflat-3L | 75   |

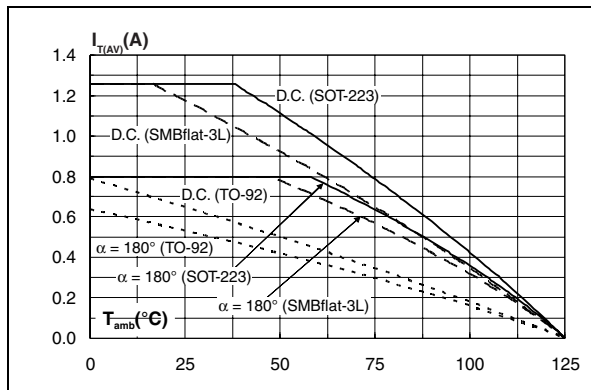
**Figure 1. Maximum average power dissipation versus average on-state current (full cycle)**



**Figure 2. Average and DC on-state current versus tab (SOT-223, SMBflat-3L) or lead (TO-92) temperature**



**Figure 3. Average and DC on-state current versus ambient temperature**



**Figure 4. Relative variation of thermal impedance junction to ambient versus pulse duration**



**Figure 5. Relative variation of triggering, holding and latching current versus junction temperature**



**Figure 6. Relative variation of holding current versus gate-cathode resistance (typical values)**



**Figure 7. Relative variation of dV/dt immunity versus gate-cathode resistance (typical values)**



**Figure 8. Relative variation of dV/dt immunity versus gate-cathode capacitance (typical values)**



**Figure 9. Surge peak on-state current versus number of cycles**



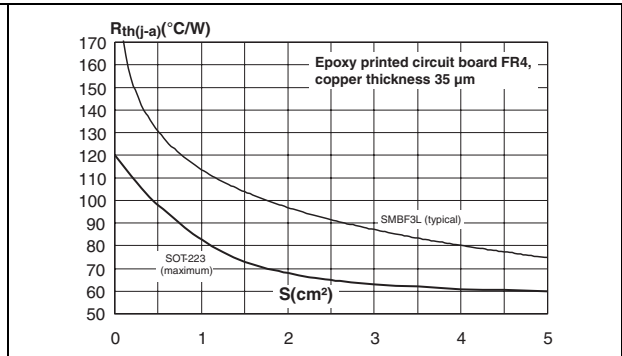
**Figure 10. Non repetitive surge peak on state current for a sinusoidal pulse and corresponding value of  $I^2T$**



Figure 11. On-state characteristics (maximum values)

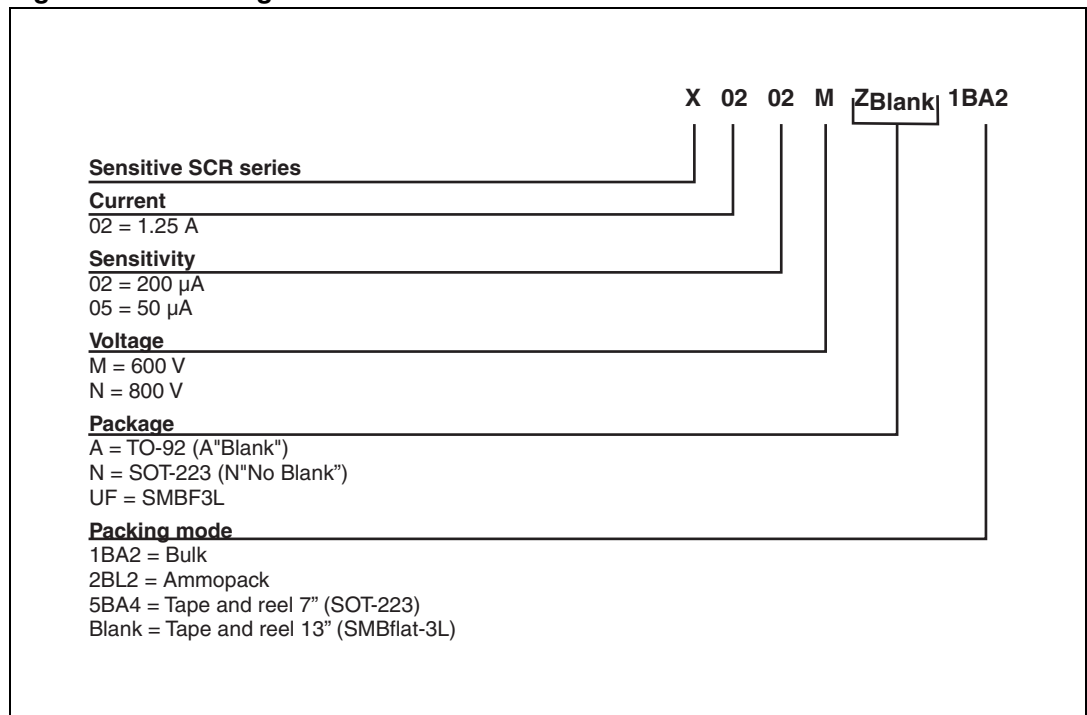


Figure 12. Thermal resistance junction to ambient versus copper surface under tab (SOT-223, SMBflat-3L)



## 2 Ordering information scheme

Figure 13. Ordering information scheme



### 3 Package information

- Epoxy meets UL94, V0
- Lead-free packages

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**Table 6. TO-92 dimensions**

| Ref | Dimensions  |      |      |        |       |       |
|-----|-------------|------|------|--------|-------|-------|
|     | Millimeters |      |      | Inches |       |       |
|     | Min.        | Typ. | Max. | Min.   | Typ.  | Max.  |
| A   |             | 1.35 |      |        | 0.053 |       |
| B   |             |      | 4.70 |        |       | 0.185 |
| C   |             | 2.54 |      |        | 0.100 |       |
| D   | 4.40        |      |      | 0.173  |       |       |
| E   | 12.70       |      |      | 0.500  |       |       |
| F   |             |      | 3.70 |        |       | 0.146 |
| a   |             |      | 0.50 |        |       | 0.019 |



**Table 7. SOT-223 dimensions**

| Ref.             | Dimensions  |      |      |        |       |       |
|------------------|-------------|------|------|--------|-------|-------|
|                  | Millimeters |      |      | Inches |       |       |
|                  | Min.        | Typ. | Max. | Min.   | Typ.  | Max.  |
| A                |             |      | 1.80 |        |       | 0.071 |
| A1               |             | 0.02 | 0.10 |        | 0.001 | 0.004 |
| B                | 0.60        | 0.70 | 0.85 | 0.024  | 0.027 | 0.033 |
| B1               | 2.90        | 3.00 | 3.15 | 0.114  | 0.118 | 0.124 |
| c                | 0.24        | 0.26 | 0.35 | 0.009  | 0.010 | 0.014 |
| D <sup>(1)</sup> | 6.30        | 6.50 | 6.70 | 0.248  | 0.256 | 0.264 |
| e                |             | 2.3  |      |        | 0.090 |       |
| e1               |             | 4.6  |      |        | 0.181 |       |
| E <sup>(1)</sup> | 3.30        | 3.50 | 3.70 | 0.130  | 0.138 | 0.146 |
| H                | 6.70        | 7.00 | 7.30 | 0.264  | 0.276 | 0.287 |
| V                | 10° max     |      |      |        |       |       |

1. Do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.15mm (0.006inches)

**Figure 14. SOT-223 footprint**



**Table 8. SMBflat-3L dimensions**

| Ref. | Dimensions  |      |      |        |       |       |
|------|-------------|------|------|--------|-------|-------|
|      | Millimeters |      |      | Inches |       |       |
|      | Min.        | Typ. | Max. | Min.   | Typ.  | Max.  |
| A    | 0.90        |      | 1.10 | 0.035  |       | 0.043 |
| b    | 0.35        |      | 0.65 | 0.014  |       | 0.026 |
| b4   | 1.95        |      | 2.20 | 0.07   |       | 0.087 |
| c    | 0.15        |      | 0.40 | 0.006  |       | 0.016 |
| D    | 3.30        |      | 3.95 | 0.130  |       | 0.156 |
| E    | 5.10        |      | 5.60 | 0.201  |       | 0.220 |
| E1   | 4.05        |      | 4.60 | 0.156  |       | 0.181 |
| L    | 0.75        |      | 1.50 | 0.030  |       | 0.059 |
| L1   |             | 0.40 |      |        | 0.016 |       |
| L2   |             | 0.60 |      |        | 0.024 |       |
| e    |             | 1.60 |      |        | 0.063 |       |

**Figure 15. SMBflat-3L footprint dimensions**

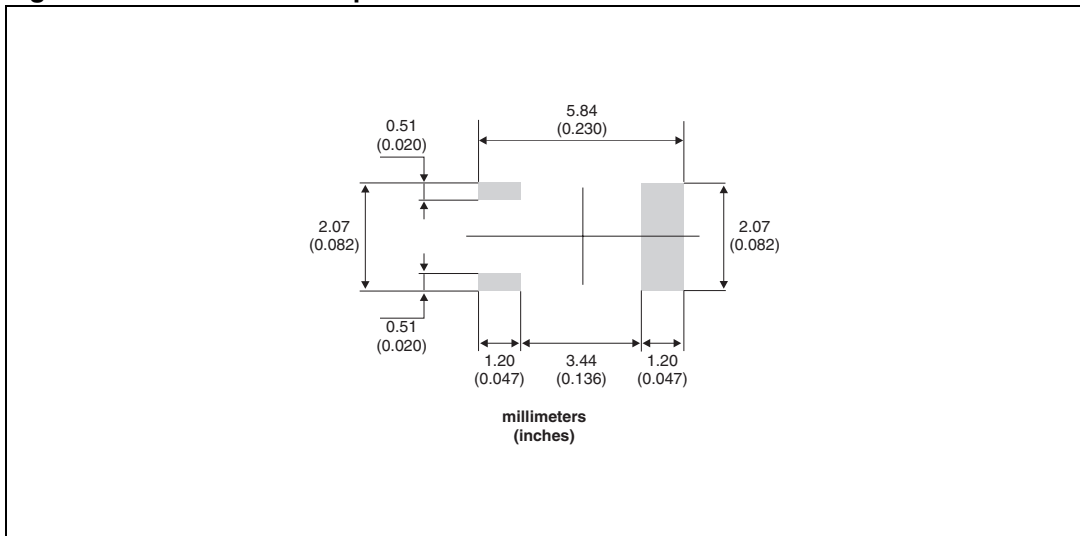




Figure 16. Footprint and connectors for SOT-223 or SMBflat-3L (dimensions in mm)



## 4 Ordering information

**Table 9. Ordering information**

| Order code   | Marking  | Package    | Weight    | Base qty | Delivery mode |
|--------------|----------|------------|-----------|----------|---------------|
| X0202MA 1BA2 | X0202 MA | TO-92      | 0.2 g     | 2500     | Bulk          |
| X0202MA 2BL2 | X0202 MA | TO-92      | 0.2 g     | 2000     | Ammopack      |
| X0202MN5BA4  | X2M      | SOT-223    | 0.12 g    | 1000     | Tape and reel |
| X0202NA 1BA2 | X0202 NA | TO-92      | 0.2 g     | 2500     | Bulk          |
| X0202NA 2BL2 | X0202 NA | TO-92      | 0.2 g     | 2000     | Ammopack      |
| X0202NN5BA4  | X2N      | SOT-223    | 0.12 g    | 1000     | Tape and reel |
| X0205MA 1BA2 | X0205 MA | TO-92      | 0.2 g     | 2500     | Bulk          |
| X0205MA 2BL2 | X0205 MA | TO-92      | 0.2 g     | 2000     | Ammopack      |
| X0205NA 1BA2 | X0205 NA | TO-92      | 0.2 g     | 2500     | Bulk          |
| X0202NUF     | X2N      | SMBflat-3L | 46.914 mg | 5000     | Tape and reel |

## 5 Revision history

**Table 10. Document revision history**

| Date        | Revision | Changes   |
|-------------|----------|---|
| Sep-2000    | 3        | Previous issue                                  |
| 14-Jan-2011 | 4        | Added SMBflat-3L package and ECOPACK statement. |

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