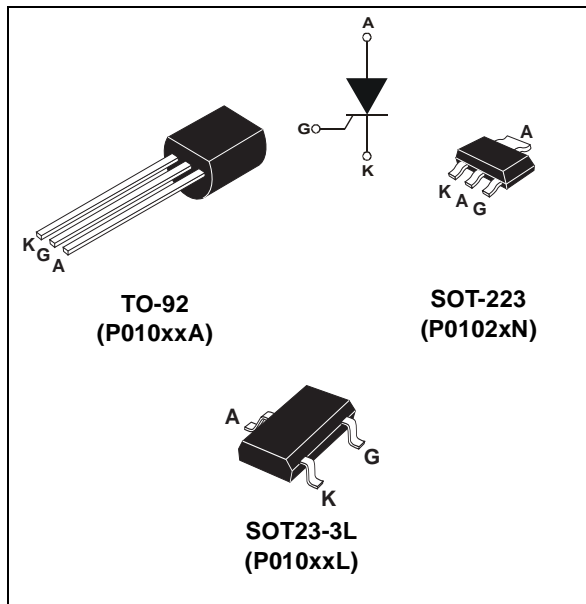


## Sensitive standard SCRs up to 0.8 A

Datasheet – production data


**Description**

Thanks to highly sensitive triggering levels, the P010XX SCR series is suitable for all applications where available gate current is limited, such as ground fault circuit interrupters, pilot circuits in solid state relays, stand-by mode power supplies, smoke and alarm detectors.

Available in through-hole or surface mount packages, the voltage capability of this series has been upgraded since its introduction and is now available up to 600 V.

**Table 1. Device summary**

| Symbol            | Value         | Unit    |
|-------------------|---------------|---------|
| $I_{T(RMS)}$      | up to 0.8     | A       |
| $V_{DRM}/V_{RRM}$ | up to 600     | V       |
| $I_{GT}$          | From 5 to 200 | $\mu A$ |

**Features**

- On-state rms current, 0.8 A
- Repetitive peak off-state voltage up to 600 V
- Triggering gate current from 5 to 200  $\mu A$
- ECOPACK<sup>®</sup>2 compliant component

# 1 Characteristics

**Table 2. Absolute ratings (limiting values) P010xxA and P010xxN**

| Symbol             | Parameter  |                         | Value                    | Unit                           |             |
|--------------------|--|-------------------------|--------------------------|--------------------------------|-------------|
| $I_{T(RMS)}$       | On-state rms current (180° conduction angle)   | TO-92                   | $T_j = 55\text{ °C}$     | 0.8                            | A           |
|                    |  | SOT-223                 | $T_{amb} = 70\text{ °C}$ |                                |             |
| $I_{T(AV)}$        | Average on-state current (180° conduction angle)   | TO-92                   | $T_j = 55\text{ °C}$     | 0.5                            | A           |
|                    |  | SOT-223                 | $T_{amb} = 70\text{ °C}$ |                                |             |
| $I_{TSM}$          | Non repetitive surge peak on-state current   | $t_p = 8.3\text{ ms}$   | $T_j = 25\text{ °C}$     | 8                              | A           |
|                    |  | $t_p = 10\text{ ms}$    |                          | 7                              |             |
| $I^2t$             | $I^2t$ value for fusing  | $t_p = 10\text{ ms}$    | $T_j = 25\text{ °C}$     | 0.24                           | $A^2s$      |
| $di/dt$            | Critical rate of rise of on-state current<br>$I_G = 2 \times I_{GT}, t_r \leq 100\text{ ns}$ | $F = 60\text{ Hz}$      | $T_j = 125\text{ °C}$    | 50                             | $A/\mu s$   |
| $I_{GM}$           | Peak gate current  | $t_p = 20\text{ }\mu s$ | $T_j = 125\text{ °C}$    | 1                              | A           |
| $P_{G(AV)}$        | Average gate power dissipation   |                         | $T_j = 125\text{ °C}$    | 0.1                            | 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. Absolute ratings (limiting values) P010xxL**

| Symbol             | Parameter  |                         | Value                    | Unit                           |             |
|--------------------|--|-------------------------|--------------------------|--------------------------------|-------------|
| $I_{T(RMS)}$       | On-state rms current (180° conduction angle)   |                         | $T_{amb} = 36\text{ °C}$ | 0.25                           | A           |
| $I_{T(AV)}$        | Average on-state current (180° conduction angle)   |                         | $T_{amb} = 36\text{ °C}$ | 0.16                           | A           |
| $I_{TSM}$          | Non repetitive surge peak on-state current   | $t_p = 8.3\text{ ms}$   | $T_j = 25\text{ °C}$     | 7                              | A           |
|                    |  | $t_p = 10\text{ ms}$    |                          | 6                              |             |
| $I^2t$             | $I^2t$ value for fusing  | $t_p = 10\text{ ms}$    | $T_j = 25\text{ °C}$     | 0.18                           | $A^2s$      |
| $di/dt$            | Critical rate of rise of on-state current<br>$I_G = 2 \times I_{GT}, t_r \leq 100\text{ ns}$ | $F = 60\text{ Hz}$      | $T_j = 125\text{ °C}$    | 50                             | $A/\mu s$   |
| $I_{GM}$           | Peak gate current  | $t_p = 20\text{ }\mu s$ | $T_j = 125\text{ °C}$    | 0.5                            | A           |
| $P_{G(AV)}$        | Average gate power dissipation   |                         | $T_j = 125\text{ °C}$    | 0.02                           | 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 4. Electrical characteristics<sup>(1)</sup> P010xxA and P010xxN**

| Symbol                 | Test conditions  |                                   | Value                             | Unit                              |                  |            |
|------------------------|--|-----------------------------------|-----------------------------------|-----------------------------------|------------------|------------|
| $I_{GT}$               | $V_D = 12\text{ V}, R_L = 140\ \Omega$                               | Max.                              | 200                               | $\mu\text{A}$                     |                  |            |
| $V_{GT}$               |  | Max.                              | 0.8                               | V                                 |                  |            |
| $V_{GD}$               | $V_D = V_{DRM}, R_L = 3.3\text{ k}\Omega, R_{GK} = 1\text{ k}\Omega$ | $T_j = 125\text{ }^\circ\text{C}$ | Min.                              | 0.1                               | V                |            |
| $V_{RG}$               | $I_{RG} = 10\ \mu\text{A}$   |                                   | 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                  | $V_D = 67\% V_{DRM}, R_{GK} = 1\text{ k}\Omega$                      | $T_j = 125\text{ }^\circ\text{C}$ | Min.                              | 75                                | V/ $\mu\text{s}$ |            |
| $V_{TM}$               | $I_{TM} = 1.6\text{ A}, t_p = 380\ \mu\text{s}$                      | $T_j = 25\text{ }^\circ\text{C}$  | Max.                              | 1.95                              | V                |            |
| $V_{t0}$               | Threshold voltage  |                                   | $T_j = 125\text{ }^\circ\text{C}$ | Max.                              | 0.95             | V          |
| $R_d$                  | Dynamic resistance   |                                   | $T_j = 125\text{ }^\circ\text{C}$ | Max.                              | 600              | m $\Omega$ |
| $I_{DRM}$<br>$I_{RRM}$ | $V_{DRM} = V_{RRM} = 400\text{ V}$                                   | $R_{GK} = 1\text{ k}\Omega$       | Max.                              | 1                                 | $\mu\text{A}$    |            |
|                        | $V_{DRM} = V_{RRM} = 600\text{ V}$                                   | $R_{GK} = 1\text{ k}\Omega$       |                                   | 10                                |                  |            |
|                        | $V_{DRM} = V_{RRM}$  | $R_{GK} = 1\text{ k}\Omega$       |                                   | $T_j = 125\text{ }^\circ\text{C}$ |                  | 100        |

1.  $T_j = 25\text{ }^\circ\text{C}$ , unless otherwise specified

**Table 5. Electrical characteristics<sup>(1)</sup> P010xxL**

| Symbol                 | Test conditions  |                                   | P0102xL                           | P0109AL | Unit          |                  |
|------------------------|--|-----------------------------------|-----------------------------------|---------|---------------|------------------|
| $I_{GT}$               | $V_D = 12\text{ V}, R_L = 140\ \Omega$                               | Max.                              | 200                               | 1       | $\mu\text{A}$ |                  |
| $V_{GT}$               |  | Max.                              | 0.8                               |         | V             |                  |
| $V_{GD}$               | $V_D = V_{DRM}, R_L = 3.3\text{ k}\Omega, R_{GK} = 1\text{ k}\Omega$ | $T_j = 125\text{ }^\circ\text{C}$ | Min.                              | 0.1     | V             |                  |
| $V_{RG}$               | $I_{RG} = 10\ \mu\text{A}$   |                                   | Min.                              | 8       | V             |                  |
| $I_H$                  | $I_T = 50\text{ mA}, R_{GK} = 1\text{ k}\Omega$                      |                                   | Max.                              | 6       | mA            |                  |
| $I_L$                  | $I_G = 1\text{ mA}, R_{GK} = 1\text{ k}\Omega$                       |                                   | Max.                              | 7       | mA            |                  |
| dV/dt                  | $V_D = 67\% V_{DRM}, R_{GK} = 1\text{ k}\Omega$                      | $T_j = 125\text{ }^\circ\text{C}$ | Min.                              | 200     | 100           | V/ $\mu\text{s}$ |
| $V_{TM}$               | $I_{TM} = 0.4\text{ A}, t_p = 380\ \mu\text{s}$                      | $T_j = 25\text{ }^\circ\text{C}$  | Max.                              | 1.7     |               | V                |
| $V_{t0}$               | Threshold voltage  |                                   | $T_j = 125\text{ }^\circ\text{C}$ | Max.    | 1.0           | V                |
| $R_d$                  | Dynamic resistance   |                                   | $T_j = 125\text{ }^\circ\text{C}$ | Max.    | 1000          | m $\Omega$       |
| $I_{DRM}$<br>$I_{RRM}$ | $V_{DRM} = V_{RRM}$  | $T_j = 25\text{ }^\circ\text{C}$  | Max.                              | 1       |               | $\mu\text{A}$    |
|                        |  | $T_j = 125\text{ }^\circ\text{C}$ |                                   | 100     |               |                  |

1.  $T_j = 25\text{ }^\circ\text{C}$ , unless otherwise specified

Table 6. Electrical device summary

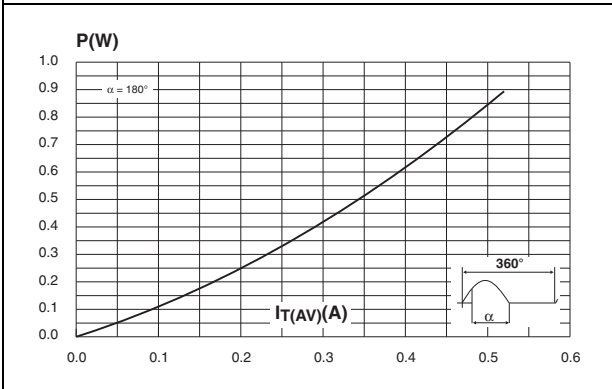
| Order code   | Voltage |       |       |       | Sensitivity | Package  | Packing mode          |
|--------------|---------|-------|-------|-------|-------------|----------|-----------------------|
|              | 100 V   | 200 V | 400 V | 600 V |             |          |                       |
| P0102AA 1AA3 | X       |       |       |       | 200 $\mu$ A | TO-92    | Bulk                  |
| P0102AA 5AL3 | X       |       |       |       | 200 $\mu$ A | TO-92    | Tape and reel 13 inch |
| P0102AL 5AA4 | X       |       |       |       | 200 $\mu$ A | SOT23-3L | Tape and reel 7 inch  |
| P0102BA 1AA3 |         | X     |       |       | 200 $\mu$ A | TO-92    | Bulk                  |
| P0102BL 5AA4 |         | X     |       |       | 200 $\mu$ A | SOT23-3L | Tape and reel 7 inch  |
| P0102DA 1AA3 |         |       | X     |       | 200 $\mu$ A | TO-92    | Bulk                  |
| P0102DA 2AL3 |         |       | X     |       | 200 $\mu$ A | TO-92    | Ammopack              |
| P0102DA 5AL3 |         |       | X     |       | 200 $\mu$ A | TO-92    | Tape and reel 13 inch |
| P0102DN 5AA4 | X       |       | X     |       | 200 $\mu$ A | SOT-223  | Tape and reel 7 inch  |
| P0102MA 1AA3 |         |       |       | X     | 200 $\mu$ A | TO-92    | Bulk                  |
| P0102MN 5AA4 |         |       |       | X     | 200 $\mu$ A | SOT-223  | Tape and reel 7 inch  |
| P0109AL 5AA4 | X       |       |       |       | 1 $\mu$ A   | SOT23-3L | Tape and reel 7 inch  |
| P0109DA 1AA3 |         |       | X     |       | 1 $\mu$ A   | TO-92    | Bulk                  |
| P0109DA 5AL3 |         |       | X     |       | 1 $\mu$ A   | TO-92    | Tape and reel 13 inch |

Table 7. Thermal resistance

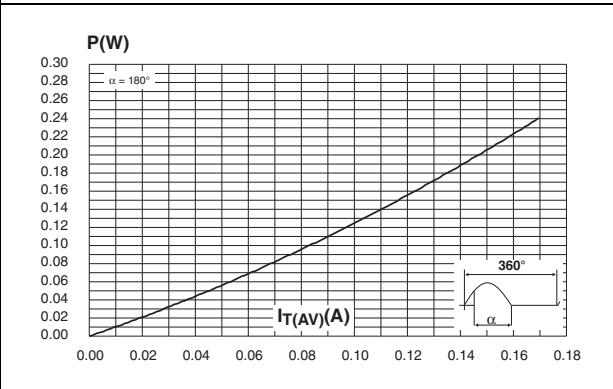
| Symbol        | Parameter  |                                       | Maximum | Unit           |
|---------------|--|---------------------------------------|---------|----------------|
| $R_{th(j-a)}$ | Junction to case (DC)  | TO-92                                 | 80      | $^{\circ}$ C/W |
| $R_{th(j-t)}$ | Junction to tab (DC)   | SOT-223                               | 30      | $^{\circ}$ C/W |
| $R_{th(j-a)}$ | Junction to ambient (DC)   | TO-92                                 | 150     | $^{\circ}$ C/W |
|               |  | $S^{(1)} = 5 \text{ cm}^2$<br>SOT-223 | 60      |                |
| $R_{th(j-a)}$ | Junction to ambient (mounted on FR4 with recommended pad layout) | SOT23-3L                              | 400     | $^{\circ}$ C/W |

1. S = Copper surface under tab.

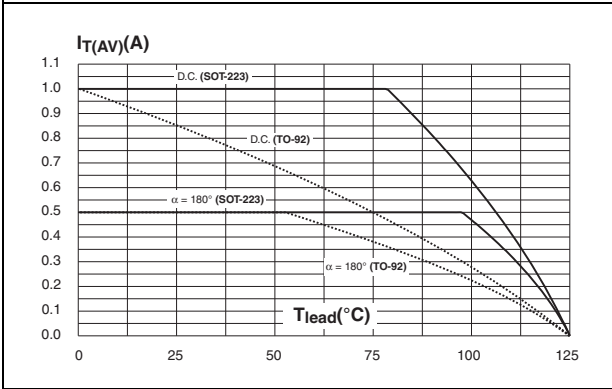
**Figure 1. Maximum average power dissipation versus average on-state current P010xxA and P010xxN**



**Figure 2. Maximum average power dissipation versus average on-state current P010xxL**



**Figure 3. Average and DC on-state current versus lead temperature P010xxA and P010xxN**



**Figure 4. Average and DC on-state current versus ambient temperature P010xxA and P010xxN**

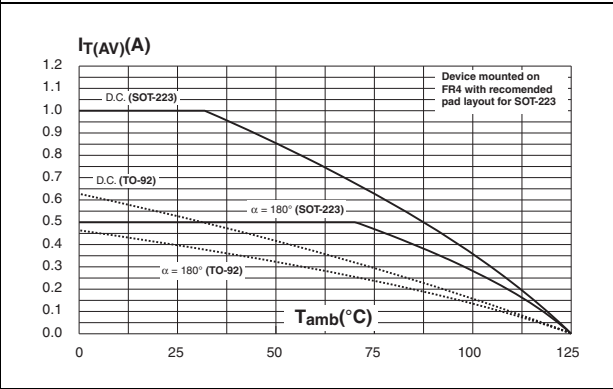


Figure 5. Average and DC on-state current versus case temperature P010xxL

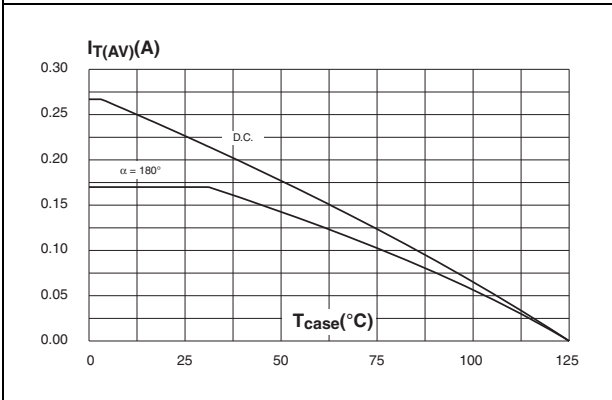


Figure 6. Relative variation of thermal impedance junction to ambient versus pulse duration

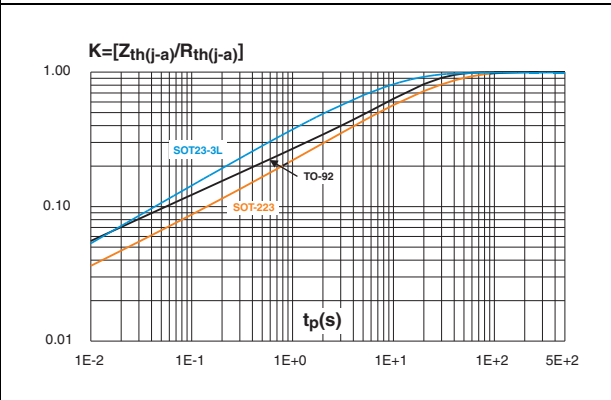


Figure 7. Gate trigger, holding, and latching currents with gate trigger voltage versus junction temperature

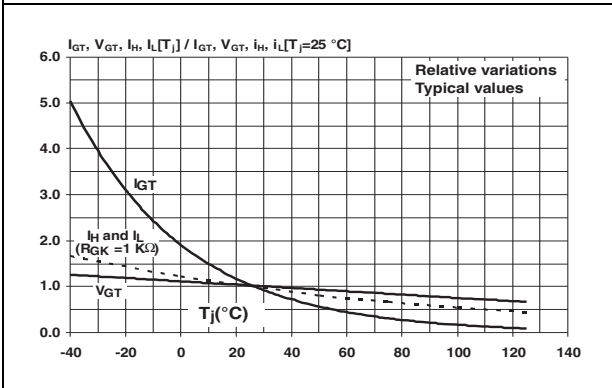


Figure 8. Relative variation of holding current versus gate-cathode resistance

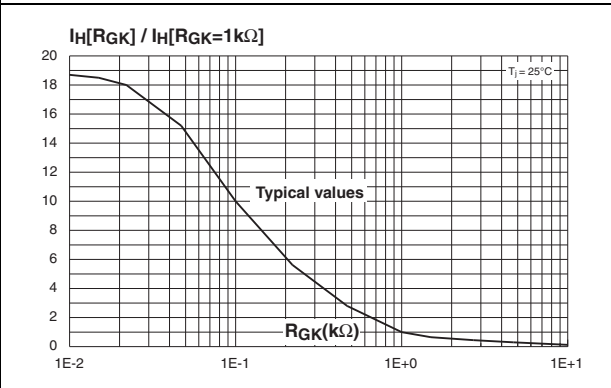


Figure 9. Relative variation of dV/dt immunity versus gate-cathode resistance

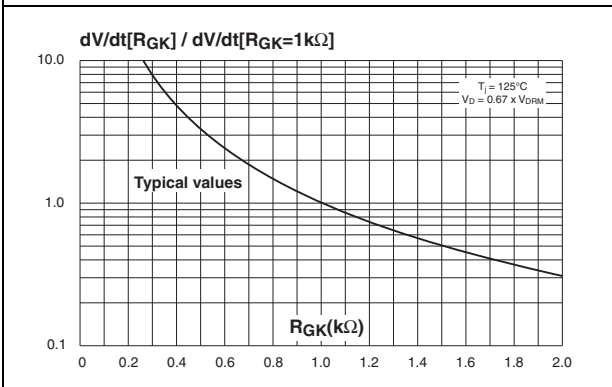


Figure 10. Relative variation of dV/dt immunity versus gate-cathode capacitance

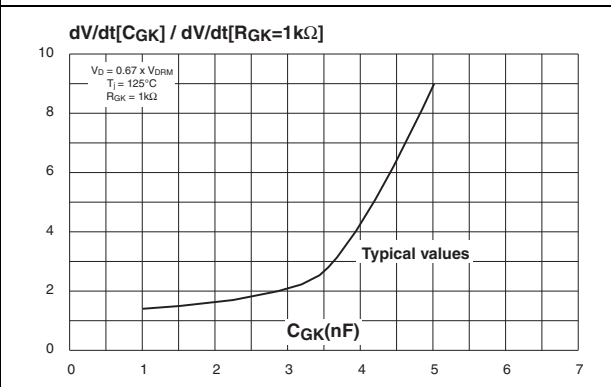


Figure 11. Surge peak on-state current versus number of cycles

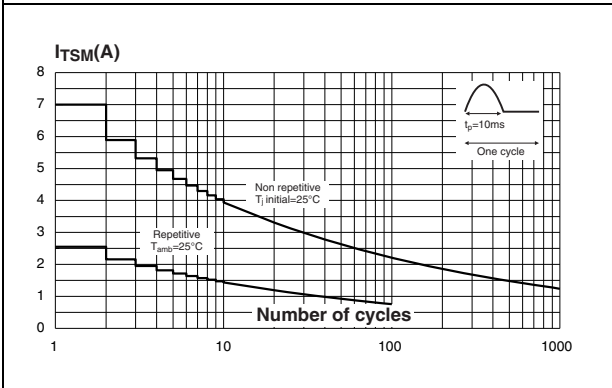


Figure 12. Non-repetitive surge peak on-state current and corresponding value of I²t

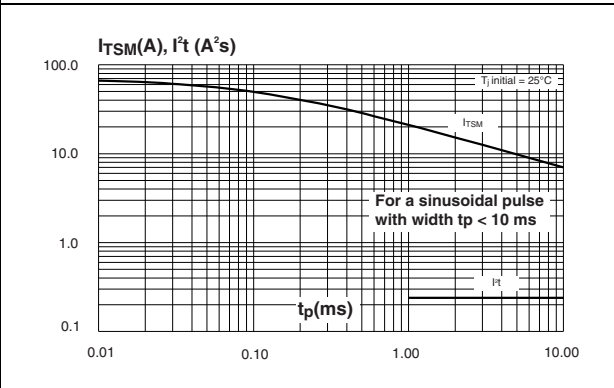


Figure 13. On-state characteristics P010xxA, P010xxN

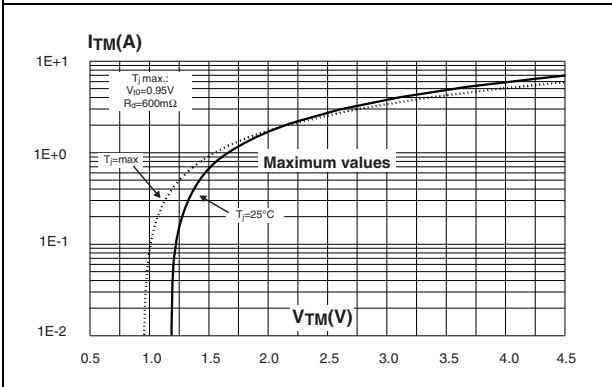


Figure 14. On-state characteristics P010xxL

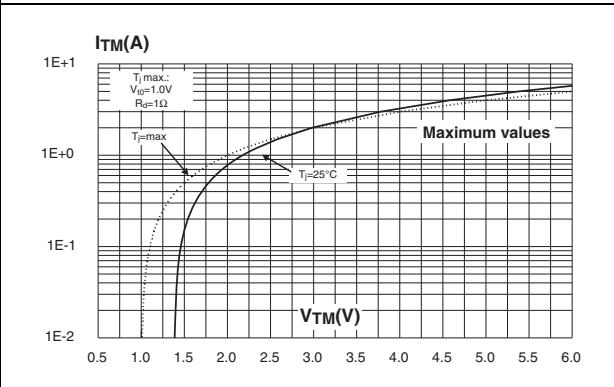


Figure 15. Thermal resistance junction to ambient versus copper surface under tab P010xxN

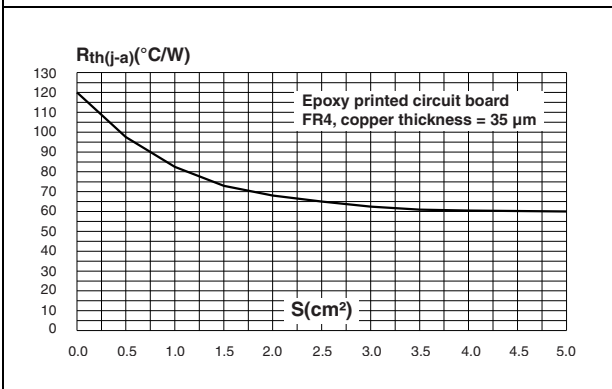
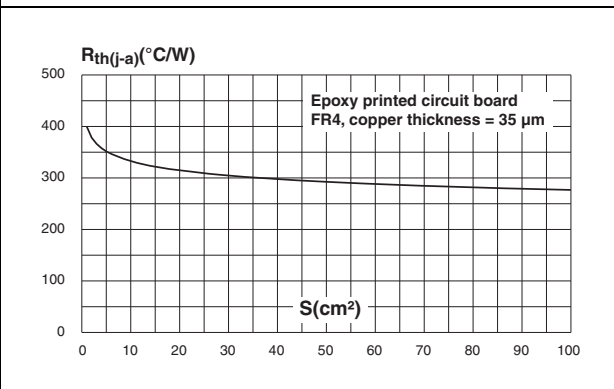


Figure 16. Thermal resistance junction to ambient versus copper surface under tab P010xxL



## 2 Package information

- Epoxy meets UL94, V0
- Lead-free package

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK® is an ST trademark.

Table 8. 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 9. 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 17. Footprint (dimensions in mm)

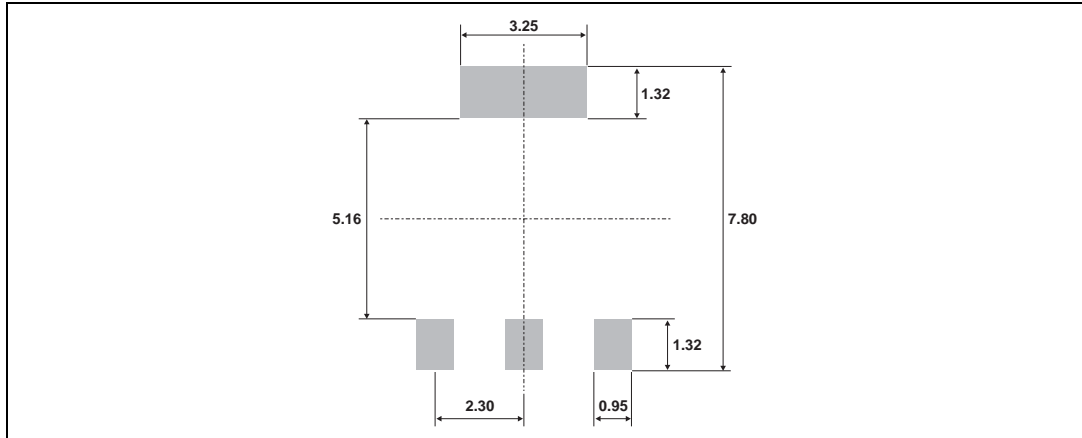
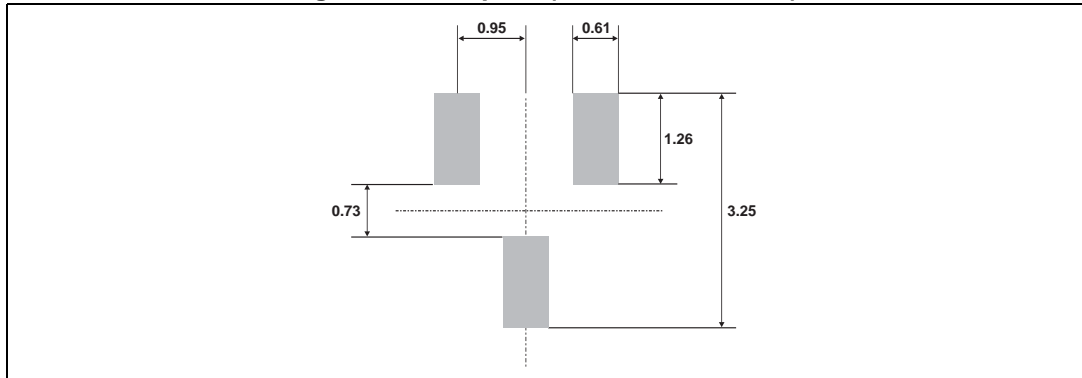


Table 10. SOT23-3L dimensions

| Ref. | Dimensions  |      |            |       |
|------|-------------|------|------------|-------|
|      | Millimeters |      | Inches     |       |
|      | Min.        | Max. | Min.       | Max.  |
| A    | 0.89        | 1.4  | 0.035      | 0.055 |
| A1   | 0           | 0.1  | 0          | 0.004 |
| B    | 0.3         | 0.51 | 0.012      | 0.02  |
| c    | 0.085       | 0.18 | 0.003      | 0.007 |
| D    | 2.75        | 3.04 | 0.108      | 0.12  |
| e    | 0.85        | 1.05 | 0.033      | 0.041 |
| e1   | 1.7         | 2.1  | 0.067      | 0.083 |
| E    | 1.2         | 1.6  | 0.047      | 0.063 |
| H    | 2.1         | 2.75 | 0.083      | 0.108 |
| L    | 0.6 typ.    |      | 0.024 typ. |       |
| S    | 0.35        | 0.65 | 0.014      | 0.026 |

Figure 18. Footprint (dimensions in mm)



### 3 Ordering information

Figure 19. Ordering information scheme

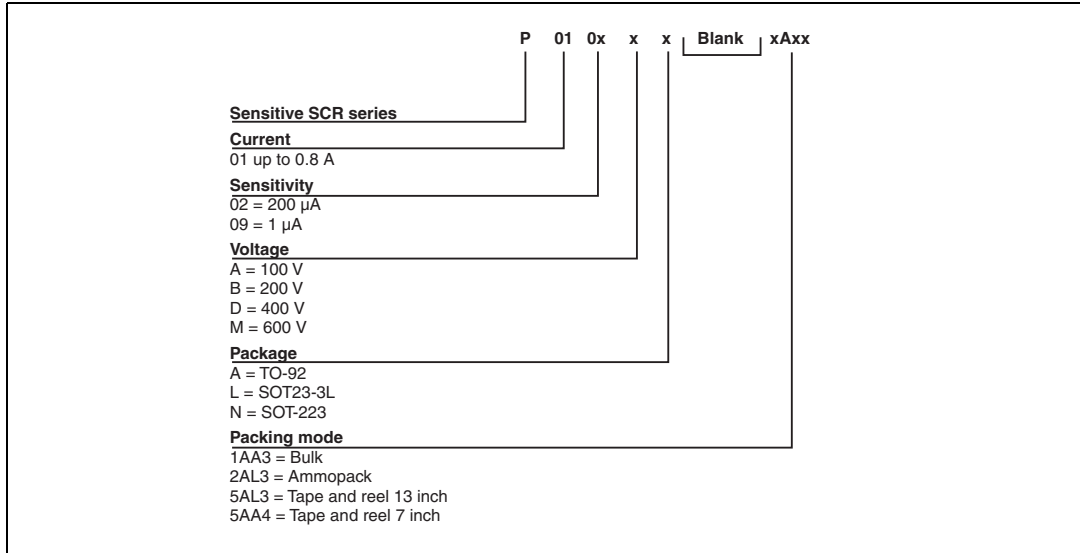


Table 11. Ordering information

| Order code   | Marking  | Package  | Weight | Base qty | Packing mode          |
|--------------|----------|----------|--------|----------|-----------------------|
| P0102AA 1AA3 | P0102 AA | TO-92    | 0.2 g  | 2500     | Bulk                  |
| P0102AA 5AL3 | P0102 AA | TO-92    | 0.2 g  | 2000     | Tape and reel 13 inch |
| P0102AL 5AA4 | P2A      | SOT23-3L | 0.01 g | 3000     | Tape and reel 7 inch  |
| P0102BA 1AA3 | P0102 BA | TO-92    | 0.2 g  | 1000     | Bulk                  |
| P0102BL 5AA4 | P2B      | SOT23-3L | 0.01 g | 3000     | Tape and reel 7 inch  |
| P0102DA 1AA3 | P0102 DA | TO-92    | 0.2 g  | 2500     | Bulk                  |
| P0102DA 2AL3 | P0102 DA | TO-92    | 0.2 g  | 2000     | Ammopack              |
| P0102DA 5AL3 | P0102 DA | TO-92    | 0.2 g  | 2000     | Tape and reel 13 inch |
| P0102DN 5AA4 | P2D      | SOT-223  | 0.11 g | 3000     | Tape and reel 7 inch  |
| P0102MA 1AA3 | P0102 MA | TO-92    | 0.2 g  | 2500     | Bulk                  |
| P0102MN 5AA4 | P2M      | SOT-223  | 0.11 g | 2000     | Tape and reel 7 inch  |
| P0109AL 5AA4 | P9A      | SOT23-3L | 0.01 g | 3000     | Tape and reel 7 inch  |
| P0109DA 1AA3 | P0109 DA | TO-92    | 0.2 g  | 2500     | Bulk                  |
| P0109DA 5AL3 | P0109 DA | TO-92    | 0.2 g  | 2000     | Tape and reel 13 inch |

## 4 Revision history

**Table 12. Document revision history**

| Date        | Revision | Changes   |
|-------------|----------|---|
| 24-Nov-2008 | 1        | First issue.  |
| 01-Apr-2014 | 2        | Added $V_{GT}$ in <a href="#">Figure 7</a> , updated <a href="#">Figure 11</a> and <a href="#">Table 9</a> and reformatted to current standard. |

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