# P010xx

## Sensitive standard SCRs up to 0.8 A

## Features

- $I_{T(RMS)}$ up to 0.8 A
- $V_{DRM}/V_{RRM}$100, 200, 400 and 600 V
- $I_{GT}$from 5 to 200 µA

## 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 interruptors, 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.

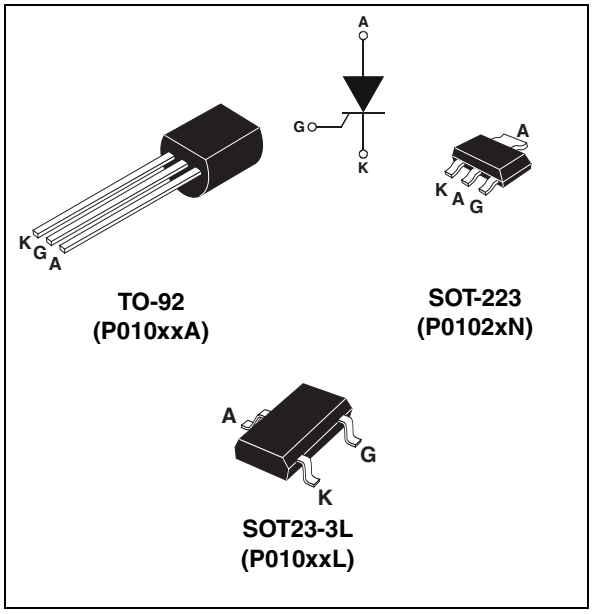



**Table 1. Device summary**

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

# 1 Characteristics

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

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

**Table 3. Absolute ratings (limiting values) P010xxL**

| Symbol | Parameter | | | Value | Unit |
|---|---|---|---|---|---|
| $I_{T(RMS)}$ | RMS on-state current (180° conduction angle) | | $T_{amb}$ = 36 °C | 0.25 | A |
| $IT_{(AV)}$ | Average on-state current (180° conduction angle) | | $T_{amb}$ = 36 °C | 0.16 | A |
| $I_{TSM}$ | Non repetitive surge peak on-state current | $t_p$ = 8.3 ms | $T_j$ = 25 °C | 7 | A |
| | | $t_p$ = 10 ms | | 6 | |
| $I^2t$ | $I^2t$ Value for fusing | $t_p$ = 10 ms | $T_j$ = 25 °C | 0.18 | $A^2s$ |
| dI/dt | Critical rate of rise of on-state current<br>$I_G$ = 2 x $I_{GT}$ , $t_r \leq$ 100 ns | F = 60 Hz | $T_j$ = 125 °C | 50 | A/µs |
| $I_{GM}$ | Peak gate current | $t_p$ = 20 µs | $T_j$ = 125 °C | 0.5 | A |
| $P_{G(AV)}$ | Average gate power dissipation | | $T_j$ = 125 °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 | °C |

**Table 4. Electrical characteristics(1) P010xxA and P010xxN**

| Symbol | Test conditions | | | Value | Unit |
|---|---|---|---|---|---|
| $I_{GT}$ | $V_D$ = 12 V $R_L$ = 140 Ω | | Min. | - | µA |
| | | | Max. | 200 | |
| $V_{GT}$ | | | Max. | 0.8 | V |
| $V_{GD}$ | $V_D = V_{DRM}$ $R_L$ = 3.3 kΩ $R_{GK}$ = 1 kΩ | $T_j$ = 125 °C | Min. | 0.1 | V |
| $V_{RG}$ | $I_{RG}$ = 10 µA | | Min. | 8 | V |
| $I_H$ | $I_T$ = 50 mA $R_{GK}$ = 1 kΩ | | Max. | 5 | mA |
| $I_L$ | $I_G$ = 1 mA $R_{GK}$ = 1 kΩ | | Max. | 6 | mA |
| dV/dt | $V_D$ = 67 % $V_{DRM}$ $R_{GK}$ = 1 kΩ | $T_j$ = 125 °C | Min. | 75 | V/µs |
| $V_{TM}$ | $I_{TM}$ = 1.6 A tp = 380 µs | $T_j$ = 25 °C | Max. | 1.95 | V |
| $V_{t0}$ | Threshold voltage | $T_j$ = 125 °C | Max. | 0.95 | V |
| $R_d$ | Dynamic resistance | $T_j$ = 125 °C | Max. | 600 | mΩ |
| $I_{DRM}$ $I_{RRM}$ | $V_{DRM} = V_{RRM}$ = 400 V $R_{GK}$ = 1 kΩ | $T_j$ = 25 °C | Max. | 1 | µA |
| | $V_{DRM} = V_{RRM}$ = 600 V $R_{GK}$ = 1 kΩ | | | 10 | |
| | $V_{DRM} = V_{RRM}$ $R_{GK}$ = 1 kΩ | $T_j$ = 125 °C | | 100 | |

1. $T_j$ = 25 °C, unless otherwise specified

**Table 5. Electrical characteristics(1) P010xxL**

| Symbol | Test conditions | | | P0102xL | P0109AL | Unit |
|---|---|---|---|---|---|---|
| $I_{GT}$ | $V_D$ = 12 V $R_L$ = 140 Ω | | Max. | 200 | 1 | µA |
| $V_{GT}$ | | | Max. | 0.8 | | V |
| $V_{GD}$ | $V_D = V_{DRM}$ $R_L$ = 3.3 kΩ $R_{GK}$ = 1 kΩ | $T_j$ = 125 °C | Min. | 0.1 | | V |
| $V_{RG}$ | $I_{RG}$ = 10 µA | | Min. | 8 | | V |
| $I_H$ | $I_T$ = 50 mA $R_{GK}$ = 1 kΩ | | Max. | 6 | | mA |
| $I_L$ | $I_G$ = 1 mA $R_{GK}$ = 1 kΩ | | Max. | 7 | | mA |
| dV/dt | $V_D$ = 67 % $V_{DRM}$ $R_{GK}$ = 1 kΩ | $T_j$ = 125 °C | Min. | 200 | 100 | V/µs |
| $V_{TM}$ | $I_{TM}$ = 0.4 A tp = 380 µs | $T_j$ = 25 °C | Max. | 1.7 | | V |
| $V_{t0}$ | Threshold voltage | $T_j$ = 125 °C | Max. | 1.0 | | V |
| $R_d$ | Dynamic resistance | $T_j$ = 125 °C | Max. | 1000 | | mΩ |
| $I_{DRM}$ $I_{RRM}$ | $V_{DRM} = V_{RRM}$ | $T_j$ = 25 °C | Max. | 1 | | µA |
| | | $T_j$ = 125 °C | | 100 | | |

1. $T_j$ = 25 °C, unless otherwise specified

**Table 6. Thermal resistance**

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

1. S = Copper surface under tab.

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

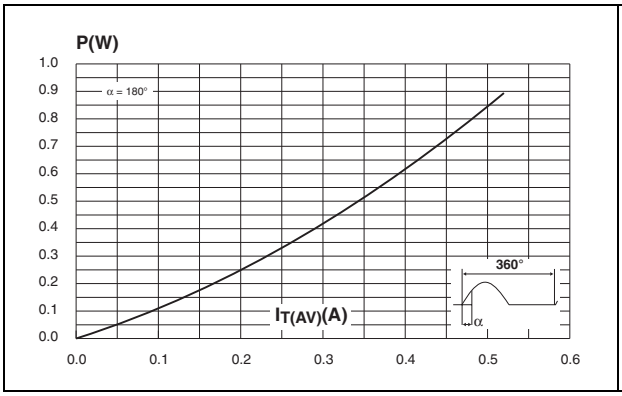



**Figure 2. Maximum average power dissipation vs. average on-state current P010xxL**

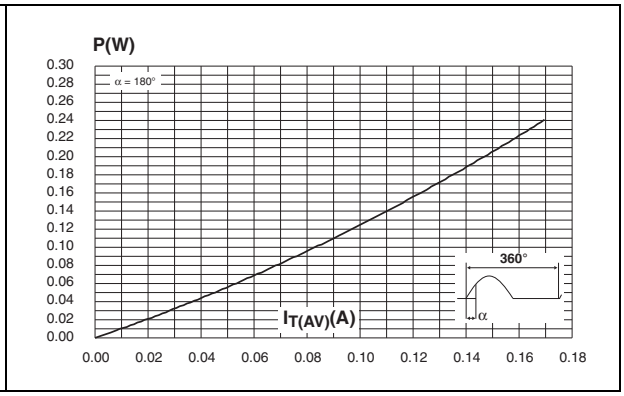



**Figure 3. Average and DC on-state current vs. lead temperature P010xxA and P010xxN**

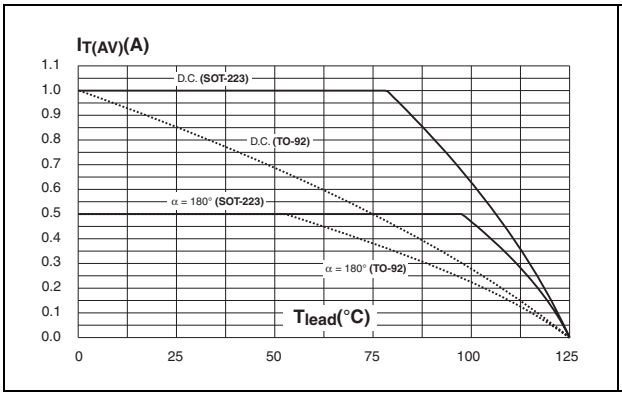



**Figure 4. Average and DC on-state current vs. ambient temperature P010xxA and P010xxN**

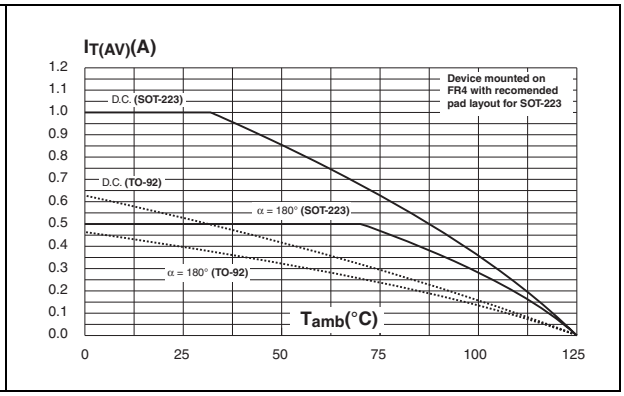


**Figure 5. Average and DC on-state current vs. case temperature P010xxL**

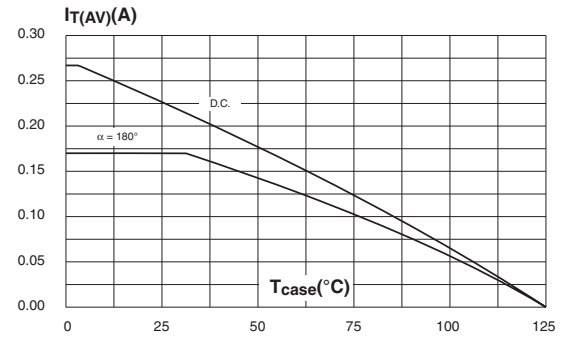



**Figure 6. Relative variation of thermal impedance junction to ambient vs. pulse duration**

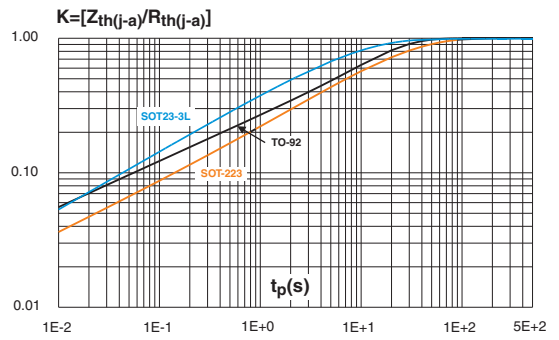



**Figure 7. Relative variation of gate trigger, holding, and latching currents vs. junction temperature**

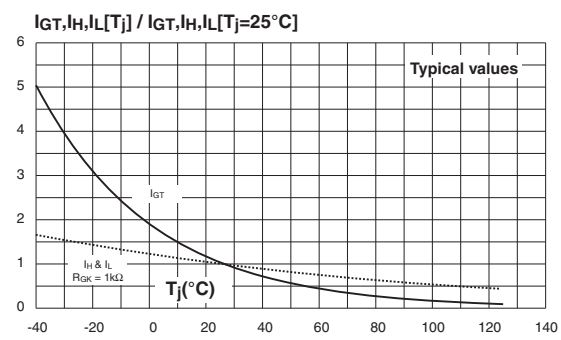



**Figure 8. Relative variation of holding current vs. gate-cathode resistance**

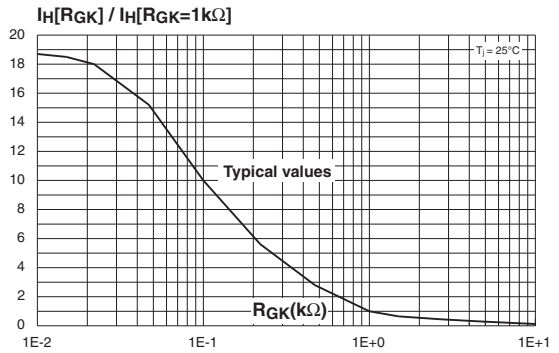



**Figure 9. Relative variation of dV/dt immunity vs. gate-cathode resistance**

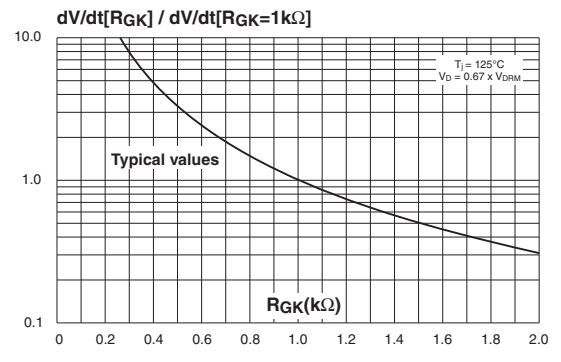



**Figure 10. Relative variation of dV/dt immunity vs. gate-cathode capacitance**

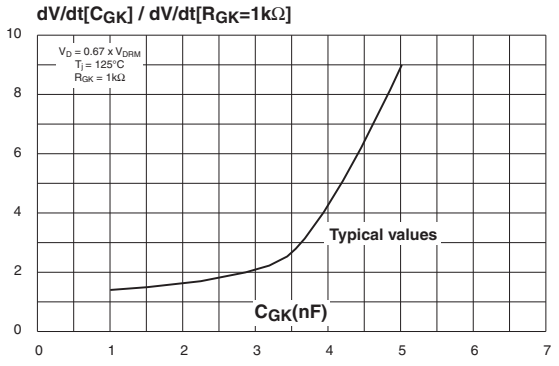


**Figure 11. Surge peak on-state current versus number of cycles**

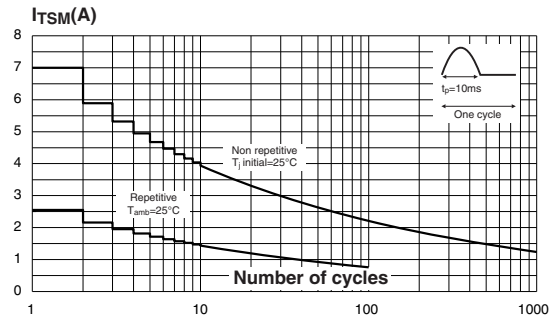



**Figure 12. Non-repetitive surge peak on-state current and corresponding value of I²t**

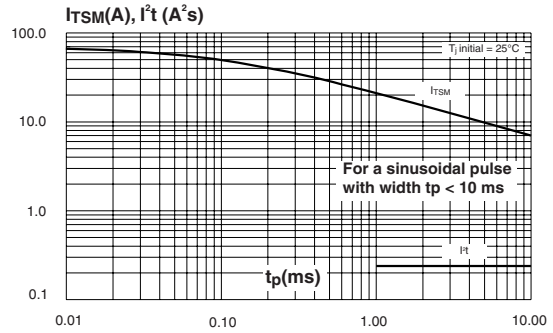



**Figure 13. On-state characteristics P010xxA, P010xxN**

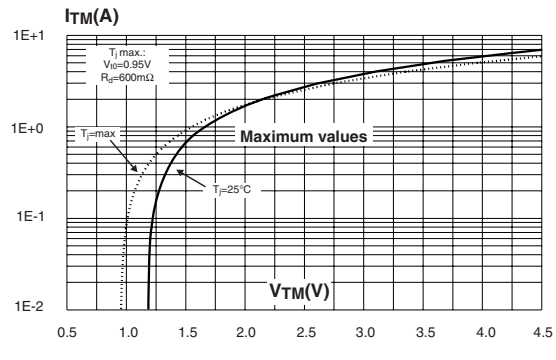



**Figure 14. On-state characteristics P010xxL**

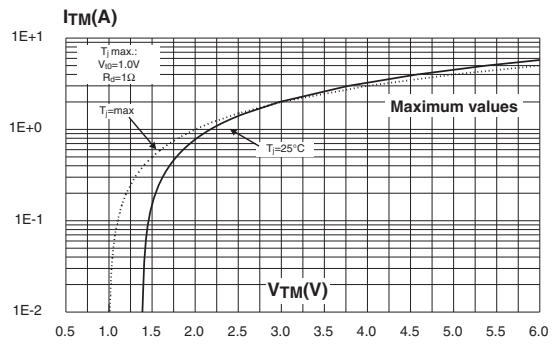



**Figure 15. Thermal resistance junction to ambient vs. copper surface under tab P010xxN**

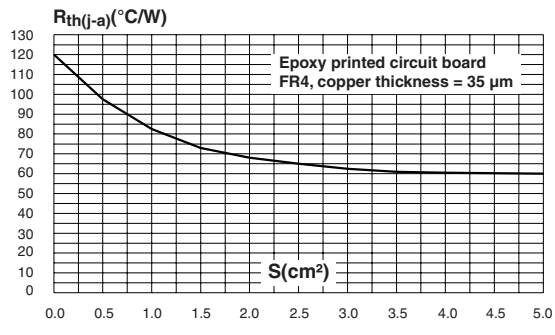
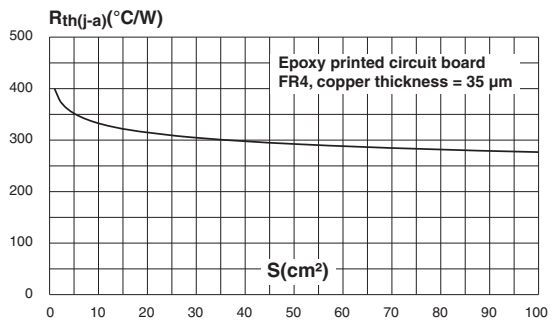
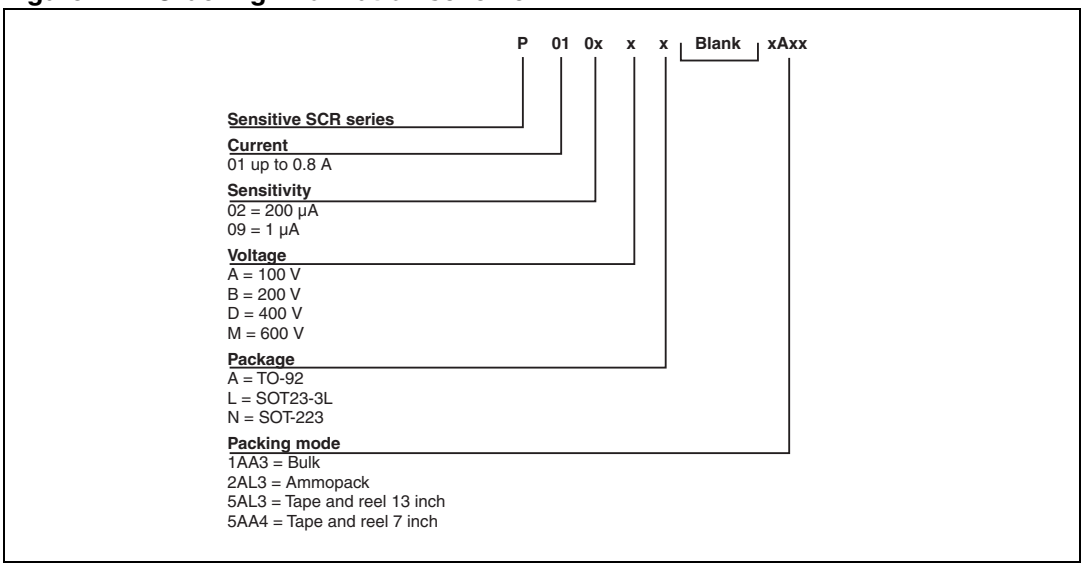



**Figure 16. Thermal resistance junction to ambient vs copper surface under tab P010xxL**



# 2 Ordering information scheme

**Figure 17. Ordering information scheme**

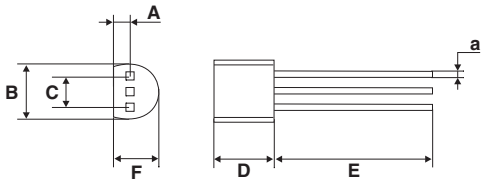



# 3 Package information

- Epoxy meets UL94, V0

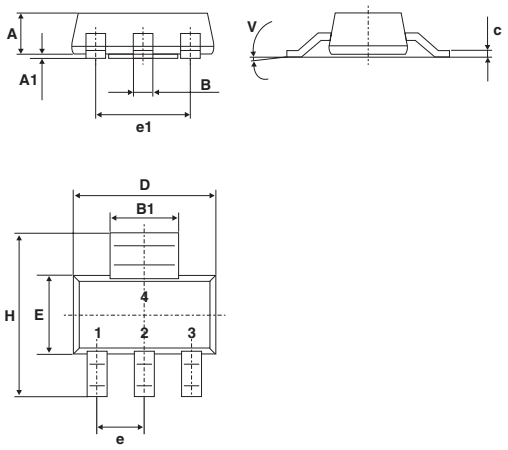
In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a lead-free second level interconnect. The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at *www.st.com*.

**Table 7. 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 8. SOT-223 Dimensions**




| Ref. | Dimensions | | | | | |
|---|---|---|---|---|---|---|
| | Millimeters | | | Inches | | |
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 1.80 | | | 0.071 |
| A1 | | 0.02 | | | 0.001 | |
| B | 0.60 | 0.70 | 0.80 | 0.024 | 0.027 | 0.031 |
| B1 | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| c | 0.24 | 0.26 | 0.32 | 0.009 | 0.010 | 0.013 |
| D | 6.30 | 6.50 | 6.70 | 0.248 | 0.256 | 0.264 |
| e | | 2.3 | | | 0.090 | |
| e1 | | 4.6 | | | 0.181 | |
| E | 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 | | | | | |

**Figure 18. Footprint (dimensions in mm)**

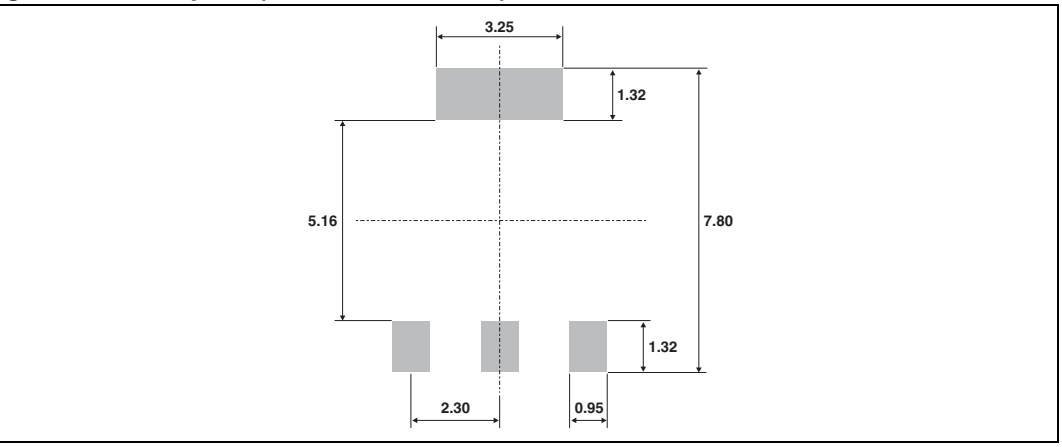
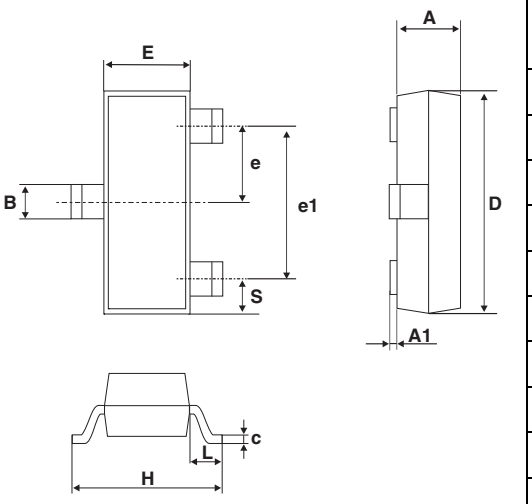
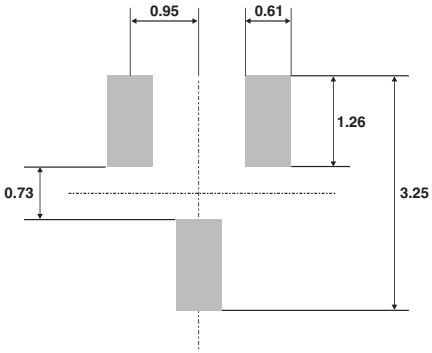


**Table 9. SOT23-3L dimensions**




| 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 19. Footprint (dimensions in mm)**



# 4 Ordering information

**Table 10. 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 |

# 5 Revision history

**Table 11. Document revision history**

| Date | Revision | Description of changes |
|---|---|---|
| 24-Nov-2008 | 1 | First issue. |

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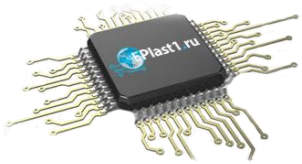
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