

# Process C1028

## BiCMOS 1.0 $\mu$ m

### Low TC P-Poly Resistor

#### Electrical Characteristics

T=25°C Unless otherwise noted

|  | Symbol                  | Minimum | Typical | Maximum                                       | Unit                   | Comments        |
|--|-------------------------|---------|---------|---|------------------------|-----------------|
| <b>N-Channel High Voltage Transistor</b> |                         |         |         |   |                        |                 |
| Threshold Voltage                        | HVT <sub>N</sub>        | 0.50    | 0.70    | 0.90  | V                      |                 |
| Punch Through Voltage                    | HVBVDSS <sub>N</sub>    | 25      |         |   | V                      |                 |
| ON Resistance                            | HVPR <sub>ON</sub>      | 200     | 240     | 350   | $\Omega$               | 100x2.0 $\mu$ m |
| Operating Voltage                        |                         |         |         | V <sub>GS</sub> = 5V<br>V <sub>DS</sub> = 20V | V                      |                 |
| <b>N-Channel Low Voltage Transistor</b>  |                         |         |         |   |                        |                 |
| Threshold Voltage                        | VT <sub>N</sub>         | 0.65    | 0.85    | 1.05  | V                      | 100x1.0 $\mu$ m |
| Body Factor                              | $\gamma$ <sub>N</sub>   | 0.75    | 0.85    | 0.95  | V <sup>1/2</sup>       | 100x1.0 $\mu$ m |
| Conduction Factor                        | $\beta$ <sub>N</sub>    | 79.0    | 87.0    | 95.0  | $\mu$ A/V <sup>2</sup> | 100x100 $\mu$ m |
| Effective Channel Length                 | Leff <sub>N</sub>       | 0.70    | 0.90    | 1.10  | $\mu$ m                | 100x1.0 $\mu$ m |
| Width Encroachment                       | $\Delta$ W <sub>N</sub> |         | 0.60    |   | $\mu$ m                | Per side        |
| Punch Through Voltage                    | BVDSS <sub>N</sub>      | 8       | 13      |   | V                      |                 |
| Poly Field Threshold Voltage             | VTFP <sub>N</sub>       | 14      | 18      |   | V                      |                 |

|  | Symbol                  | Minimum | Typical | Maximum   | Unit                   | Comments        |
|--|-------------------------|---------|---------|---|------------------------|-----------------|
| <b>P-Channel High Voltage Transistor</b> |                         |         |         |   |                        |                 |
| Threshold Voltage                        | HVT <sub>P</sub>        | -0.8    | -1.0    | -1.2  | V                      |                 |
| Punch Through Voltage                    | HVBVDSS <sub>P</sub>    | -25     |         |   | V                      |                 |
| ON Resistance                            | HVPR <sub>ON</sub>      | 400     | 450     | 600   | $\Omega$               | 100x3.0 $\mu$ m |
| Operating Voltage                        |                         | -15     |         | V <sub>GS</sub> = -5V<br>V <sub>DS</sub> = -20V | V                      |                 |
| <b>P-Channel Low Voltage Transistor</b>  |                         |         |         |   |                        |                 |
| Threshold Voltage                        | VT <sub>P</sub>         | -1.25   | -1.05   | -0.85   | V                      | 100x1.0 $\mu$ m |
| Body Factor                              | $\gamma$ <sub>P</sub>   | 0.40    | 0.50    | 0.60  | V <sup>1/2</sup>       | 100x1.0 $\mu$ m |
| Conduction Factor                        | $\beta$ <sub>P</sub>    | 24.0    | 28.0    | 32.0  | $\mu$ A/V <sup>2</sup> | 100x100 $\mu$ m |
| Effective Channel Length                 | Leff <sub>P</sub>       | 0.72    | 0.97    | 1.12  | $\mu$ m                | 100x1.0 $\mu$ m |
| Width Encroachment                       | $\Delta$ W <sub>P</sub> |         | 0.60    |   | $\mu$ m                | Per side        |
| Punch Through Voltage                    | BVDSS <sub>P</sub>      | -8      | -12     |   | V                      |                 |
| Poly Field Threshold Voltage             | VTF <sub>P(P)</sub>     | -14     | -18     |   | V                      |                 |

| Capacitance        | Symbol           | Minimum | Typical | Maximum | Unit                     | Comments |
|--------------------|------------------|---------|---------|---------|--------------------------|----------|
| Gate Oxide         | C <sub>OX</sub>  |         | 1.727   |         | fF/ $\mu$ m <sup>2</sup> |          |
| Metal-1 to Poly1   | C <sub>M1P</sub> |         | 0.046   |         | fF/ $\mu$ m <sup>2</sup> |          |
| Metal-2 to Metal-1 | C <sub>MM</sub>  |         | 0.038   |         | fF/ $\mu$ m <sup>2</sup> |          |

## Electrical Characteristics

| Vertical NPN Transistor | Symbol   | Minimum | Typical | Maximum | Unit | Comments  |
|-------------------------|----------|---------|---------|---------|------|-----------|
| Beta                    | $h_{FE}$ | 50      | 100     | 150     |      | 4.5x4.5mm |
| Early Voltage           | $V_{AN}$ | 30      | 34      |         |      |           |
| Cut-Off Frequency       | $f_t$    |         | 6.2     |         | GHz  |           |

| Lateral PNP   | Symbol   | Minimum | Typical | Maximum | Unit | Comments |
|---------------|----------|---------|---------|---------|------|----------|
| Beta          | $h_{FE}$ | 10      | 40      | 100     |      |          |
| Early Voltage | $V_{AP}$ |         | TBD     |         | V    |          |

| Low TCR P-Poly Resistor | Symbol | Minimum | Typical | Maximum | Unit              | Comments |
|-------------------------|--------|---------|---------|---------|-------------------|----------|
| Resistivity             |        | 180     | 230     | 290     | $\Omega/\square$  |          |
| TCR                     |        | -100    | 0       | +50     | ppm/ $^{\circ}$ C |          |

## Physical Characteristics

| Diffusion & Thin Films        | Symbol                    | Minimum | Typical | Maximum | Unit              | Comments   |
|-------------------------------|---------------------------|---------|---------|---------|-------------------|------------|
| Starting Material p<100>      |                           | 25      |         | 50      | $\Omega$ -cm      |            |
| Well (field) Sheet Resistance | $\rho_{N\text{-well}(f)}$ | 0.65    | 0.80    | 1.10    | $K\Omega/\square$ | n-well     |
| N+ Sheet Resistance           | $\rho_{N+}$               | 22.0    | 37.0    | 50.0    | $\Omega/\square$  |            |
| N+ Junction Depth             | $x_{jN+}$                 |         | 0.45    |         | $\mu$ m           |            |
| P+ Sheet Resistance           | $\rho_{P+}$               | 40.0    | 57.0    | 80.0    | $\Omega/\square$  |            |
| P+ Junction Depth             | $x_{jP+}$                 |         | 0.50    |         | $\mu$ m           |            |
| High-Voltage Gate Oxide Th    | $HT_{GOX}$                |         | 20      |         | nm                |            |
| Gate Oxide Thickness          | $T_{GOX}$                 |         | 20      |         | nm                |            |
| Interpoly Oxide Thickness     | $IP_{OX}$                 |         | 47      |         |                   |            |
| Gate Poly Sheet Resistance    | $\rho_{POLY1}$            | 23.0    | 38.0    | 53.0    | $\Omega/\square$  |            |
| Metal-1 Sheet Resistance      | $\rho_{M1}$               | 35.0    | 45.0    | 65.0    | $m\Omega/\square$ |            |
| Metal-2 Sheet Resistance      | $\rho_{M2}$               | 19.0    | 25.0    | 35.0    | $m\Omega/\square$ |            |
| Passivation Thickness         | $T_{PASS}$                |         | 200+900 |         | nm                | oxide+nit. |

## Layout Rules

|                                 |                 |                              |               |
|---------------------------------|-----------------|------------------------------|---------------|
| Min Channel Width               | 2.0 $\mu$ m     | Contact to Poly Space        | 1.0 $\mu$ m   |
| Min spacing, active region, 5V  | 1.2 $\mu$ m     | Contact Overlap of Diffusion | 1.0 $\mu$ m   |
| Min spacing, active region, 12V | 2.0 $\mu$ m     |                              |               |
| Poly1 (Gate) Width/Space        | 1.0/1.4 $\mu$ m | Contact Overlap of Poly      | 0.8 $\mu$ m   |
| Poly2 Width/Space               | 1.6/2.0 $\mu$ m | Metal-1 Overlap of Contact   | 0.8 $\mu$ m   |
| Contact Width/Space             | 1.2x1.2 $\mu$ m | Metal-1 Overlap of Via       | 0.8 $\mu$ m   |
| Metal-1 Width/Space             | 1.4/1.2 $\mu$ m | Minimum Pad Opening          | 65x65 $\mu$ m |
| Metal-2 Width/Space             | 1.8/1.4 $\mu$ m | Minimum Pad to Pad Spacing   | 5.0 $\mu$ m   |
| Via Width/Space                 | 1.2/1.8 $\mu$ m | Minimum Pad Pitch            | 80 $\mu$ m    |