# SGS-THOMSON MICROELECTRONICS

# M22101
# M22102

## 4 X 4 X 2 CROSSPOINT SWITCHES WITH CONTROL MEMORY

- LOW ON RESISTANCE – 75 $\Omega$ TYP AT $V_{DD}$ = 12 V
- "BUILT-IN" LATCHED INPUTS
- LARGE ANALOG SIGNAL CAPACITY $\pm$ $V_{DD}$/2
- 10 MHz SWITCH BANDWITH
- MATCHED SWITCH CHARACTERISTICS
- $\Delta$ RON = 8 $\Omega$ TYP, AT $V_{DD}$ = 12 V
- HIGH LINEARITY – 0.25 % DISTORTION TYP, AT f = 1 kHz, $V_{IN}$ = 5 V, $V_{DD}$ - $V_{SS}$ = 10 V AND RI = 1 $\Omega$
- STANDARD CMOS NOISE IMMUNITY

## DESCRIPTION

The **M22101** and **M22102** crosspoint switches consist of 4 x 4 x 2 arrays of crosspoints (transmission gates), 4-line to 16-line decoders, and 16 latch circuits. Any one of the sixteen crosspoint pairs can be selected by applying the appropriate four-line address and any number of crosspoint pairs can be ON simultaneously. Corresponding crosspoints in each array are turned on and OFF simultaneously, also.

In the **M22101**, the selected crosspoint pair can be turned on or off by applying a logical ONE or ZERO, respectively, to the data input, and applying a ONE to the strobe input. When the device is "power-up", the state of the 16 switches is indeterminate.

Therefore all switches must be turned off by putting the strobe hight, data-in-low, and the addressing all switches in succession.

The selected pair of crosspoints in the **M22102** is turned on by applying a logical ONE to the $K_a$ (set) input while a logical ZERO is on the $K_b$ (reset) input, and turned off by applying a logical ONE to the $K_b$ input while a logical ZERO is on the $K_a$ input. In this respect the control latches of the **M22102** are similar to SET/RESET flip-flops. They differ, however, in that the simultaneous application of ONEs to the $K_a$ and $K_b$ inputs turns off (resets) all crosspoints. All crosspoints in both devices must be turned off as $V_{DD}$ is applied.



**B1**
(Plastic Package)

**F1**
(Ceramic Package)

**ORDER CODES :**
M22XXX B1     M22XXX F1
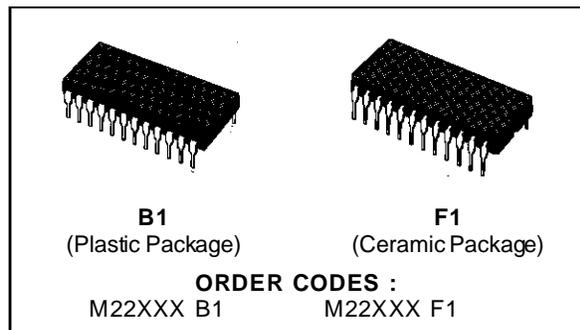
## PIN CONNECTIONS
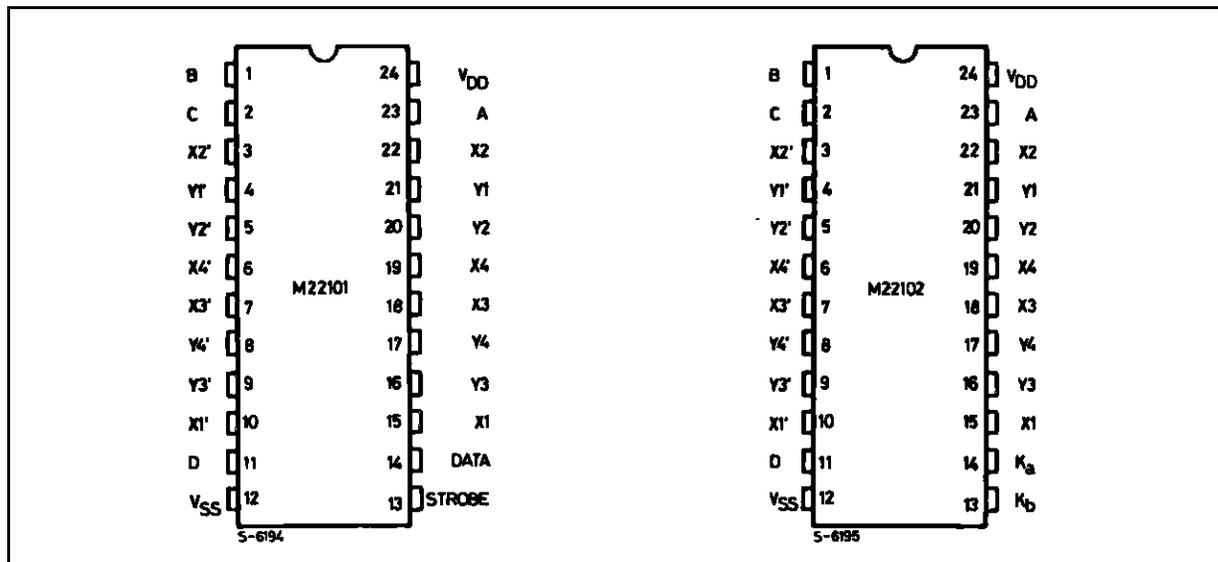
## ABSOLUTE MAXIMUM RATING

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DD}$ | Supply Voltage:  Ceramic Type | -0.5 to +20 | V |
| | Plastic Type | -0.5 to +18 | V |
| $V_i$ | Input Voltage | -0.5 to $V_{DD}$ + 0.5 | V |
| $I_l$ | DC Input Current (any one input) | ± 10 | mA |
| $P_{tot}$ | Total Power Dissipation (per package) | 200 | mW |
| | Dissipation per Output Transistor | | |
| | for Top = Full Package Temperature Range | 100 | mW |
| $T_{op}$ | Operating Temperature:  Ceramic Type | -55 to +125 | $^o$C |
| | Plastic Type | -40 to +85 | $^o$C |
| $T_{stg}$ | Storage Temperature | -65 to +150 | $^o$C |

Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for external periods may affect device reliability.

## RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{DD}$ | Supply Voltage:  Ceramic Type | 3 to 18 | V |
| | Plastic Type | 3 to 15 | V |
| $V_I$ | Input Voltage | 0 to $V_{DD}$ | V |
| $T_{op}$ | Operating Temperature:  Ceramic Type | -55 to +125 | $^o$C |
| | Plastic Type | -40 to +85 | $^o$C |

## CONTROL TRUTH TABLE FOR M22101

| Function | Address | | | | Strobe | Data | Select |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | | | |
| Switch-on | 1 | 1 | 1 | 1 | 1 | 1 | (X4 Y4) & (X4' Y4') |
| Switch-off | 1 | 1 | 1 | 1 | 1 | 0 | (X4 Y4) & (X4' Y4') |
| No Change | X | X | X | X | 0 | X | X X X X |

Note: 1 = High, 0 = Low, X = Don't Care

## CONTROL TRUTH TABLE FOR M22102

| Function | Address | | | | Strobe | Data | Select |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | | | |
| Switch-on | 1 | 1 | 1 | 1 | 1 | 0 | (X4 Y4) & (X4' Y4') |
| Switch-off | 1 | 1 | 1 | 1 | 0 | 1 | (X4 Y4) & (X4' Y4') |
| All Switch-off | X | X | X | X | 1 | 1 | All |
| No Change | X | X | X | X | 0 | 0 | X X X X |

Note: 1 = High, 0 = Low, X = Don't Care

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## DECODER TRUTH TABLE

| Address | | | | Select | | Address | | | | Select | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | B | C | D | | | A | B | C | D | | |
| 0 | 0 | 0 | 0 | X1 Y1 | X1' Y1' | 0 | 0 | 0 | 1 | X1 Y3 | X1' Y3' |
| 1 | 0 | 0 | 0 | X2 Y1 | X2' Y1' | 1 | 0 | 0 | 1 | X2 Y3 | X2' Y3' |
| 0 | 1 | 0 | 0 | X3 Y1 | X3' Y1' | 0 | 1 | 0 | 1 | X3 Y3 | X3' Y3' |
| 1 | 1 | 0 | 0 | X4 Y1 | X4' Y1' | 1 | 1 | 0 | 1 | X4 Y3 | X4' Y3' |
| 0 | 0 | 1 | 0 | X1 Y2 | X1' Y2' | 0 | 0 | 1 | 1 | X1 Y4 | X1' Y4' |
| 1 | 0 | 1 | 0 | X2 Y2 | X2' Y2' | 1 | 0 | 1 | 1 | X2 Y4 | X2' Y4' |
| 0 | 1 | 1 | 0 | X3 Y2 | X3' Y2' | 0 | 1 | 1 | 1 | X3 Y4 | X3' Y4' |
| 1 | 1 | 1 | 0 | X4 Y2 | X4' Y2' | 1 | 1 | 1 | 1 | X4 Y4 | X4' Y4' |

## FUNCTIONAL AND BLOCK DIAGRAM

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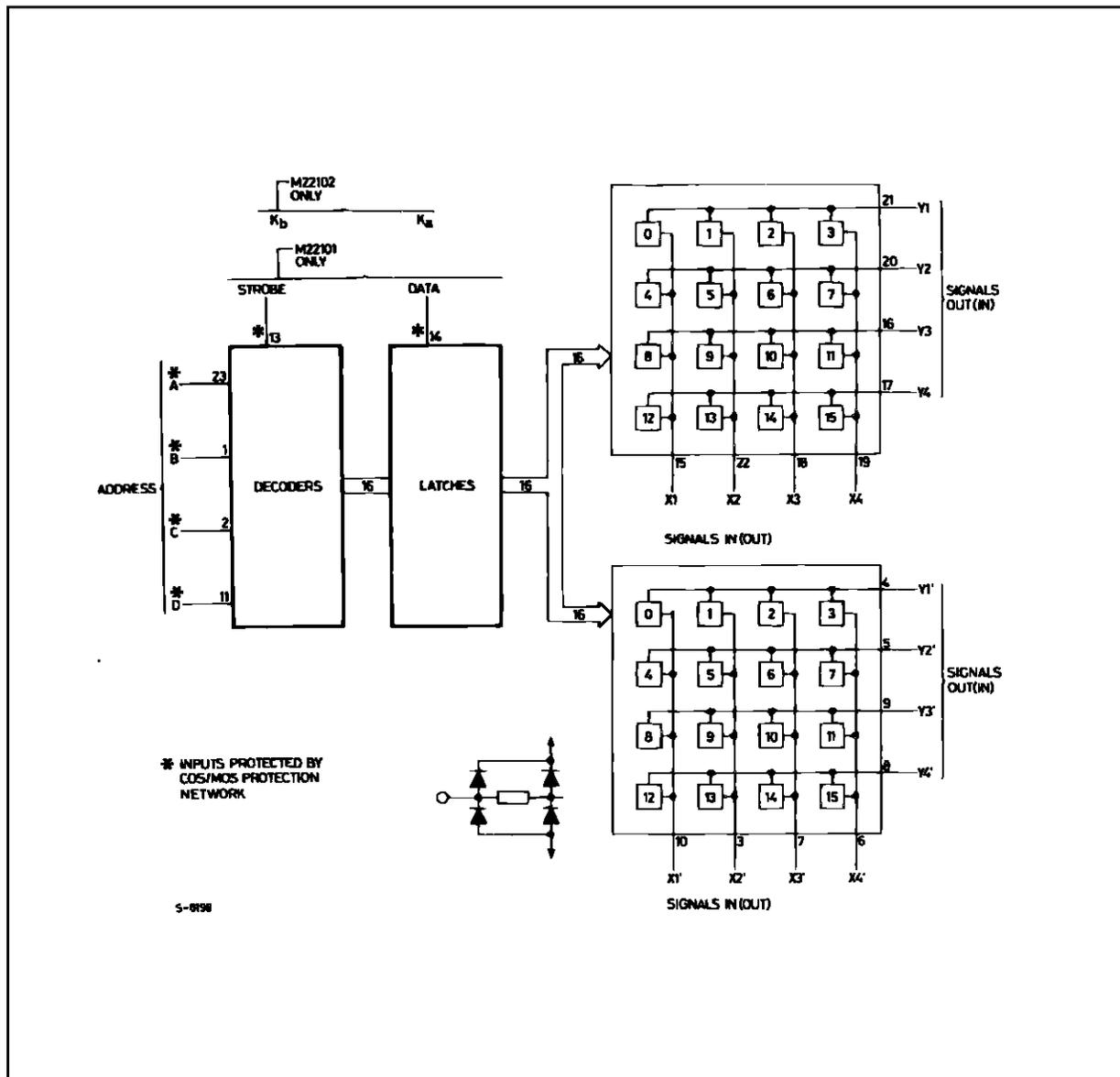
## STATIC ELECTRICAL CHARACTERISTICS (over recommended operating conditions)

| Symbol | Parameter | | | $V_I$ (V) | $V_{DD}$ (V) | $T_{LOW}$ * Min. | $T_{LOW}$ * Max. | 25 °C Min. | 25 °C Typ. | 25 °C Max. | $T_{HIGH}$ * Min. | $T_{HIGH}$ * Max. | Unit |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CROSSPOINT** | | | | | | | | | | | | | |
| $I_L$ | Quiescent Supply Current | F1 | | | 5 | | | | 0.04 | 5 | | 150 | µA |
| | | | | | 10 | | | | 0.04 | 10 | | 300 | |
| | | | | | 15 | | | | 0.04 | 20 | | 600 | |
| | | | | | 20 | | | | 0.08 | 100 | | 3000 | |
| | | B1 | | | 5 | | | | 0.04 | 20 | | 150 | |
| | | | | | 10 | | | | 0.04 | 40 | | 300 | |
| | | | | | 15 | | | | 0.04 | 80 | | 600 | |
| $R_{ON}$ | On Resistance | F1 | Any Switch | | 5 | | 450 | 225 | | 1250 | | 1625 | Ω |
| | | | | | 10 | | 135 | 85 | | 180 | | 230 | |
| | | | | | 12 | | 100 | 75 | | 135 | | 175 | |
| | | | | | 15 | | 70 | 65 | | 95 | | 125 | |
| | | B1 | $V_{IS}$ = 0 to $V_{DD}$ | | 5 | | 1000 | 225 | | 1250 | | 1440 | |
| | | | | | 10 | | 145 | 85 | | 180 | | 205 | |
| | | | | | 12 | | 110 | 75 | | 135 | | 155 | |
| | | | | | 15 | | 75 | 65 | | 95 | | 110 | |
| ΔON | Resistance $\Delta R_{ON}$ (Between any two channels) | | | | 5 | | | | 35 | | | | Ω |
| | | | | | 10 | | | | 20 | | | | |
| | | | | | 12 | | | | 18 | | | | |
| | | | | | 15 | | | | 15 | | | | |
| OFF Channel Leakage Current | | F1 | All Switch OFF | 0/18 | 18 | | ±0.1 | | $±10^{-3}$ | ±0.1• | | ±1 | µA |
| | | B1 | | 0/15 | 15 | | ±0.3 | | $±10^{-3}$ | ±0.3 | | ±1 | |
| **CONTROL** | | | | | | | | | | | | | |
| $V_{IL}$ | Input Low Voltage | OFF Switch $I_L$ < 0.2 µA | | | 5 | | 1.5 | | | 1.5 | | 1.5 | V |
| | | | | | 10 | | 3 | | | 3 | | 3 | |
| | | | | | 15 | | 4 | | | 4 | | 4 | |
| $V_{IH}$ | Input High Voltage | ON Switch see $R_{ON}$ Characteristics | | | 5 | 3.5 | | 3.5 | | | 3.5 | | V |
| | | | | | 10 | 7 | | 7 | | | 7 | | |
| | | | | | 15 | 11 | | 11 | | | 11 | | |
| $I_I$ | Input Current | F1 | Any Control Input | 0/18 | 18 | | ±0.1 | | $±10^{-5}$ | ±0.1 | | ±1 | µA |
| | | B1 | | 0/15 | 15 | | ±0.3 | | $±10^{-5}$ | ±0.3 | | ±1 | |
| $C_I$ | Input Capacitance | Any Input | | | | | | | 5 | 7.5 | | | pF |

• Determined by minimum feasible leakage measurement for automatic testing

* $T_{LOW}$ = -55 °C for **HCC** device: -40 °C for **HCF** device.

* $T_{HIGH}$ = +125 °C for **HCC** device: +85 °C for **HCF** device.

The Noise Margin for both "1" and "0" level is: 1V min. with $V_{DD}$ = 5 V, 2 V min. with $V_{DD}$ = 10 V, 2.5 V min. with $V_{DD}$ = 15 V

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**DYNAMIC ELECTRICAL CHARACTERISTICS** ($T_{amb}$ = 25 $^o$C, $C_L$ = 50 pF, $R_L$ = 200 K$\Omega$,
typical temperature coefficent for all $V_{DD}$ values is 03 %/$^o$C, all input rise and fall times= 20 ns)

| Symbol | Parameter | Test Conditions | | Value | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | $V_{DD}$ (V) | Min. | Typ. | Max. | |
| $t_{PHL}$ $t_{PLH}$ | Propagation Delay Time Address or Strobe Inputs to Output | $R_L$ = 10 K$\Omega$ $C_L$ = 50 pF | 12 | | 200 | | ns |
| $t_{PHL}$ $t_{PLH}$ | Propagation Delay Time Across Crosspoint | | | | 20 | | ns |
| | Minimum Strobe Pulse Width | | | | 80 | | ns |

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## Plastic DIP24 (0.25) MECHANICAL DATA

| DIM. | mm | | | inch | | |
|------|------|------|------|------|------|------|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| a1 | | 0.63 | | | 0.025 | |
| b | | 0.45 | | | 0.018 | |
| b1 | 0.23 | | 0.31 | 0.009 | | 0.012 |
| b2 | | 1.27 | | | 0.050 | |
| D | | | 32.2 | | | 1.268 |
| E | 15.2 | | 16.68 | 0.598 | | 0.657 |
| e | | 2.54 | | | 0.100 | |
| e3 | | 27.94 | | | 1.100 | |
| F | | | 14.1 | | | 0.555 |
| I | | 4.445 | | | 0.175 | |
| L | | 3.3 | | | 0.130 | |



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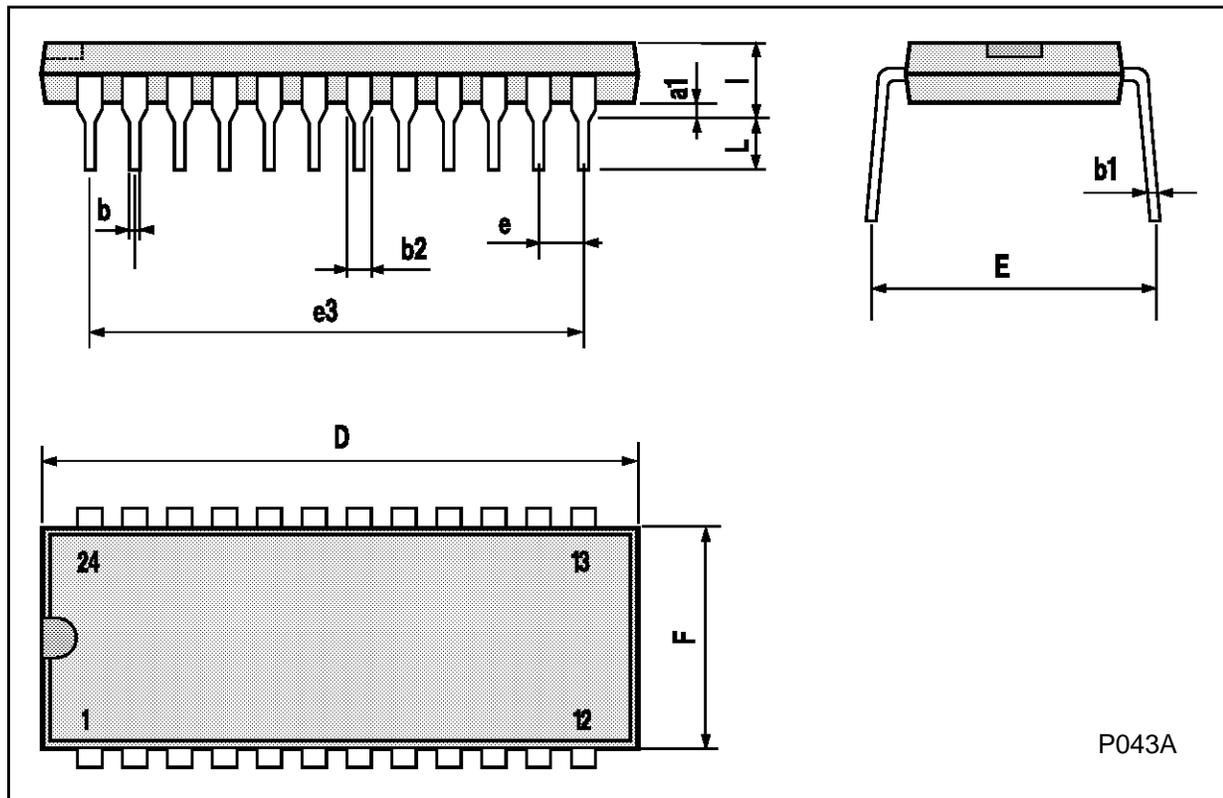
## Ceramic DIP24 MECHANICAL DATA

| DIM. | mm | | | inch | | |
|---|---|---|---|---|---|---|
| | MIN. | TYP. | MAX. | MIN. | TYP. | MAX. |
| A | | | 32.3 | | | 1.272 |
| B | 13.05 | | 13.36 | 0.514 | | 0.526 |
| C | 3.9 | | 5.08 | 0.154 | | 0.200 |
| D | 3 | | | 0.118 | | |
| E | 0.5 | | 1.78 | 0.020 | | 0.070 |
| e3 | | 27.94 | | | 1.100 | |
| F | 2.29 | | 2.79 | 0.090 | | 0.110 |
| G | 0.4 | | 0.55 | 0.016 | | 0.022 |
| I | 1.17 | | 1.52 | 0.046 | | 0.060 |
| L | 0.22 | | 0.31 | 0.009 | | 0.012 |
| M | 1.52 | | 2.49 | 0.060 | | 0.098 |
| N1 | 4° (min.), 15° (max.) | | | | | |
| P | 15.4 | | 15.8 | 0.606 | | 0.622 |
| Q | | | 5.71 | | | 0.225 |



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