



4051

CMOS IC

8-CHANNEL ANALOG MULTIPLEXERS/DEMULTIPLEXERS

DESCRIPTION

UTC **4051** is single 8-channel analog multiplexers/demultiplexers for application as digitally-controlled analog switches.

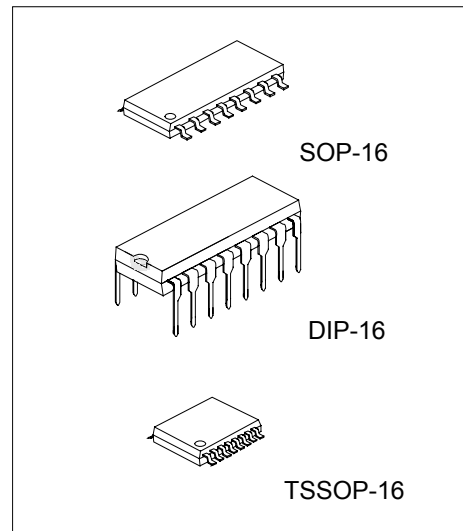
The device has three binary control inputs and an inhibit input. It feature low ON impedance and very low OFF leakage current. Control of analog signals up to the complete supply voltage range can be achieved.

FEATURES

- * Wide Analog Voltage Range: $V_{DD}-V_{EE} = 3V\sim 18V$.
(Note: V_{EE} must be V_{SS})
- * Break-Before-Make Switching Eliminates Channel Overlap.
- * Linearized Transfer Characteristics
- * Implement an SP8T solid state switch effectively.
- * Pin-to-Pin Replacement for CD4051

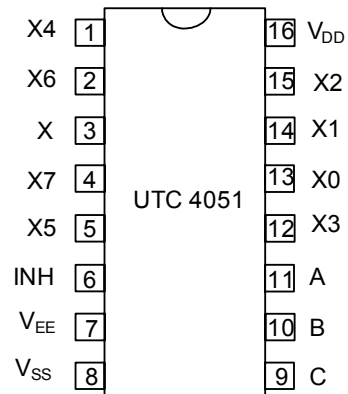
ORDERING INFORMATION

| Order Number | | Package | Packing |
|--------------|-------------------|----------|-----------|
| Normal | Lead Free Plating | | |
| 4051-S16-R | 4051L-S16-R | SOP-16 | Tape Reel |
| 4051-S16-T | 4051L-S16-T | SOP-16 | Tube |
| 4051-P16-R | 4051L-P16-R | TSSOP-16 | Tape Reel |
| 4051-P16-T | 4051L-P16-T | TSSOP-16 | Tube |
| 4051-D16-T | 4051L-D16-T | DIP-16 | Tube |



*Pb-free plating product number: 4051L

■ PIN CONFIGURATION



■ PIN DESCRIPTION

| PIN No. | SYMBOL | NAME AND FUNCTION |
|---------------------|----------|----------------------------|
| 3 | X | Common Input/Output |
| 6 | INH | Inhibit Inputs |
| 7 | V_{EE} | Supply Voltage |
| 8 | V_{SS} | Ground |
| 11,10,9 | A,B,C | Binary Control Inputs |
| 13,14,15,12,1,5,2,4 | X0~X7 | Independent Inputs/Outputs |
| 16 | V_{DD} | Positive Supply Voltage |

■ ABSOLUTE MAXIMUM RATING

| PARAMETER | SYMBOL | RATINGS | UNIT |
|--|----------------------|----------------------|-----------|
| DC Supply Voltage (Referenced to V_{EE} , V_{SS} V_{EE}) | V_{DD} | -0.5 ~ +18 | V |
| Input or Output Voltage (DC or Transient) (Referenced to V_{SS} for Control Inputs and V_{EE} for Switch I/O) | V_{IN} , V_{OUT} | -0.5 ~ V_{DD} +0.5 | V |
| Input Current (DC or Transient), per Control Pin | I_{IN} | ±10 | mA |
| Switch Through Current | I_{SW} | ±25 | mA |
| Power Dissipation Derating above 65 | P_D | 500 7 | mW mW/ |
| Junction Temperature | T_J | 125 | |
| Operating Temperature Range | T_{OPR} | -40 ~ +125 | |
| Storage Temperature Range | T_{STG} | -40 ~ +150 | |

Note: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. The device is guaranteed to meet performance specification within 0 ~70 operating temperature range and assured by design from -40 ~125 .

■ ELECTRICAL CHARACTERISTICS (Ta=25 , unless otherwise specified.)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|-----------------|---|----------------------------|-------|----------|----------|
| SUPPLY REQUIREMENTS (Voltages Referenced to V_{EE}) | | | | | | |
| Power Supply Voltage Range | V_{DD} | $V_{DD} - 3.0$ V_{SS} V_{EE} | 3 | | 18 | V |
| Quiescent Current per Package | $V_{DD}=5V$ | Control Inputs: $V_{IN} = V_{SS}$ or V_{DD} Switch I/O: V_{EE} $V_{IO} = V_{DD}$, and $\Delta V_{sw} = 500mV$ (Note 2) | | 0.005 | 5 | μA |
| | $V_{DD}=10V$ | | | 0.010 | 10 | |
| | $V_{DD}=15V$ | | | 0.015 | 20 | |
| Total Supply Current (Dynamic Plus Quiescent, Per Package) | $V_{DD}=5V$ | $T_a=25$ only (The channel component, $(V_{IN}-V_{out})/R_{on}$, is not included.) | $(0.07 \mu A/kHz) f + I_Q$ | | | μA |
| | $V_{DD}=10V$ | | $(0.20 \mu A/kHz) f + I_Q$ | | | |
| | $V_{DD}=15V$ | | $(0.36 \mu A/kHz) f + I_Q$ | | | |
| SWITCHES IN/OUT AND COMMONS OUT/IN -- X, Y, Z (Voltages Referenced to V_{EE}) | | | | | | |
| Recommended Peak-to-Peak Voltage Into or Out of the Switch | V_{IO} | Channel On or Off | 0 | | V_{DD} | V_{PP} |
| Recommended Static or Dynamic Voltage Across the Switch | ΔV_{sw} | Channel On | 0 | | 600 | mV |
| Output Offset Voltage | $V_{O(OFF)}$ | $V_{IN} = 0V$, No Load | | 10 | | μV |
| ON Resistance | $V_{DD}=5V$ | $\Delta V_{sw} = 500mV$ $V_{IN} = V_{IL}$ or V_{IH} (Control), and $V_{IN} = 0$ to V_{DD} (Switch) | | 250 | 1050 | Ω |
| | $V_{DD}=10V$ | | | 120 | 500 | |
| | $V_{DD}=15V$ | | | 80 | 280 | |
| ON Resistance Between Any Two Channels in the Same Package | $V_{DD}=5V$ | ΔR_{ON} | | 25 | 70 | Ω |
| | $V_{DD}=10V$ | | | 10 | 50 | |
| | $V_{DD}=15V$ | | | 10 | 45 | |
| Off-Channel Leakage Current | I_{OFF} | $V_{IN} = V_{IL}$ or V_{IH} (Control) Channel to Channel or Any One Channel, $V_{DD}=15V$ | | ±0.05 | ±100 | nA |
| Capacitance, Switch I/O | $C_{I/O}$ | Inhibit = V_{DD} | | 10 | | pF |
| Capacitance, Common O/I | $C_{O/I}$ | Inhibit = V_{DD} | | 17 | | pF |
| Capacitance, Feedthrough (Channel Off) | $C_{I/O}$ | Pins Not Adjacent | | 0.15 | | pF |
| | | Pins Adjacent | | 0.47 | | |

■ ELECTRICAL CHARACTERISTICS(Cont.)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT | |
|---|----------------------|---|---|----------|------|------|---|
| CONTROL INPUTS – INHIBIT A, B, C (Voltages Referenced to V_{SS}) | | | | | | | |
| Low Level Input Voltage | V _{DD} =5V | V _{IL} | R _{ON} = per spec, I _{OFF} = per spec | | 2.25 | 1.5 | V |
| | V _{DD} =10V | | | | 4.50 | 3.0 | |
| | V _{DD} =15V | | | 6.75 | 4.0 | | |
| High Level Input Voltage | V _{DD} =5V | V _{IH} | R _{ON} = per spec, I _{OFF} = per spec | | 3.5 | 2.75 | V |
| | V _{DD} =10V | | | | 7 | 5.5 | |
| | V _{DD} =15V | | | | 11 | 8.25 | |
| Input Leakage Current | I _{LEAK} | V _{IN} = 0 or V _{DD} , V _{DD} =15V | | ±0.00001 | ±0.1 | μA | |
| Input Capacitance | C _{IN} | | | 5.0 | 7.5 | pF | |

■ DYNAMIC ELECTRICAL CHARACTERISTICS

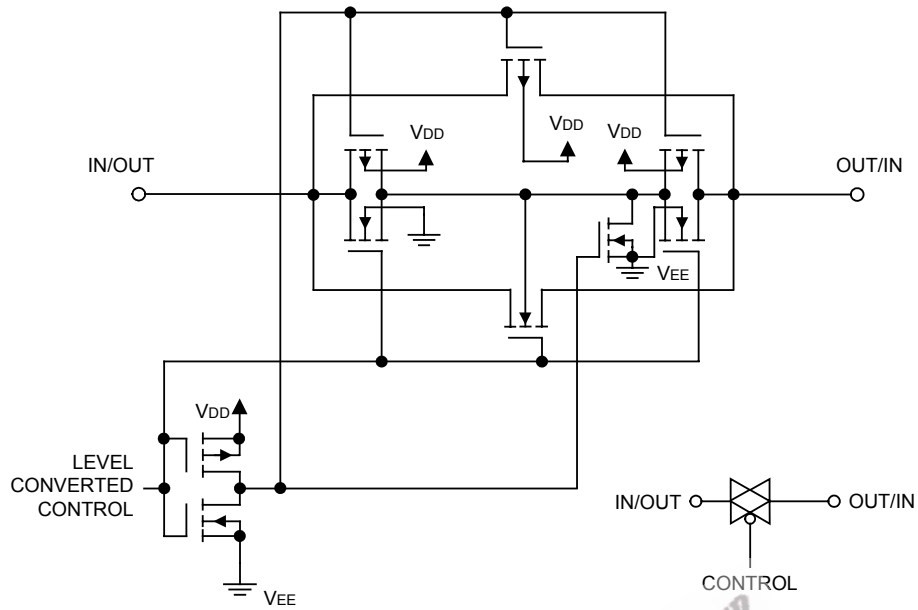
(C_L = 50pF, T_a=25 °C, V_{EE} = V_{SS}, unless otherwise specified)

| PARAMETER | SYMBOL | V _{DD} -V _{EE} V _{dC} | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--|--|---|---|-----|------|-----|------|
| Propagation Delay Times Switch Input to Switch Output (R _L = 10 kΩ) | t _{PLH} , t _{PHL} | 5 | t _{PLH} , t _{PHL} = (0.17 ns/pF)C _L + 26.5ns | | 35 | 90 | ns |
| | | 10 | t _{PLH} , t _{PHL} = (0.08 ns/pF)C _L + 11ns | | 15 | 40 | |
| | | 15 | t _{PLH} , t _{PHL} = (0.06 ns/pF)C _L + 9ns | | 12 | 30 | |
| Inhibit to Output | t _{PHZ} , t _{PLZ} t _{PZH} , t _{PZL} | 5 | (R _L =10kΩ, V _{EE} =V _{SS}) Output "1" or "0" to High Impedance, or High Impedance to "1" or "0" Level | | 350 | 700 | ns |
| | | 10 | | | 170 | 340 | |
| | | 15 | | | 140 | 280 | |
| Control Input to Output | t _{PLH} , t _{PHL} | 5 | R _L = 10 kΩ, V _{EE} = V _{SS} | | 360 | 720 | ns |
| | | 10 | | | 160 | 320 | |
| | | 15 | | | 120 | 240 | |
| Total Harmonic Distortion | THD | 10 | R _L = 10KΩ, f = 1 kHz, V _{in} = 5 V _{PP} | | 0.07 | | % |
| Bandwidth | BW | 10 | R _L = 1kΩ, V _{IN} = 1/2 (V _{DD} -V _{EE}) p-p, C _L = 50pF, 20 Log (V _{out} /V _{in}) = -3dB | | 17 | | MHz |
| Off Channel Feedthrough Attenuation | | 10 | R _L =1KΩ, V _{IN} = 1/2 (V _{DD} -V _{EE}) p-p f _{IN} = 4.5 MHz | | -50 | | dB |
| Channel Separation | | 10 | R _L = 1kΩ, V _{IN} = 1/2 (V _{DD} -V _{EE}) p-p f _{IN} = 3MHz | | -50 | | dB |
| Crosstalk, Control Input to Common O/I | | 10 | R ₁ = 1kΩ, R _L = 10kΩ Control t _{TLH} = t _{THL} = 20ns, Inhibit = V _{SS} | | 75 | | mV |

Note 1. Data of "TYP" is intended as an indication of the IC's potential performance.

2. For voltage drops across the switch(ΔV_{sw})>600mV (>300mV at high temperature), excessive V_{DD} current may be drawn, i.e. the current out of the switch may contain both V_{DD} and switch input components. The reliability of the device will be unaffected unless the Maximum Ratings are exceeded.

■ TEST CIRCUIT

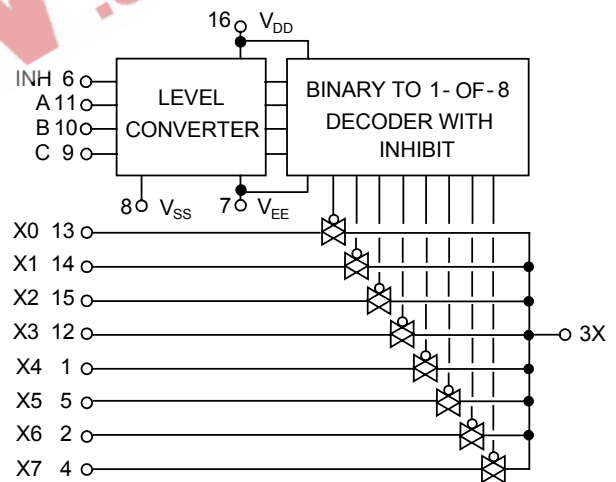


Switch Circuit Schematic

■ TRUTH TABLE

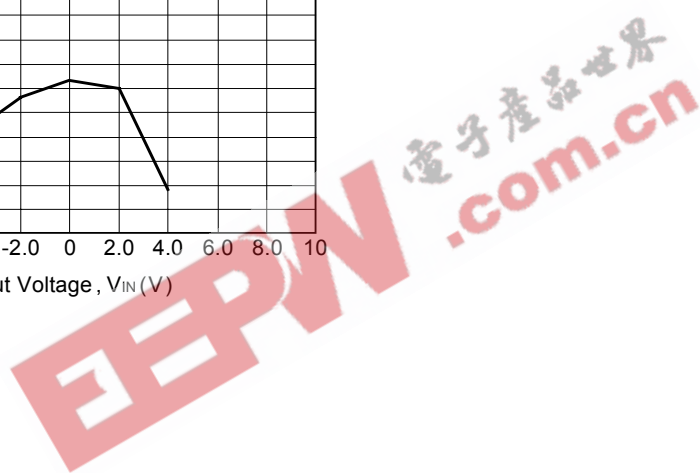
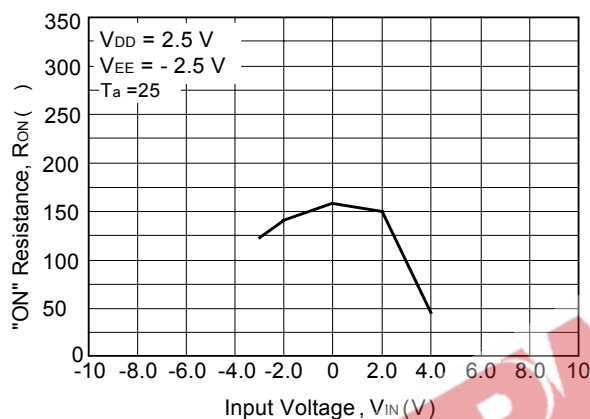
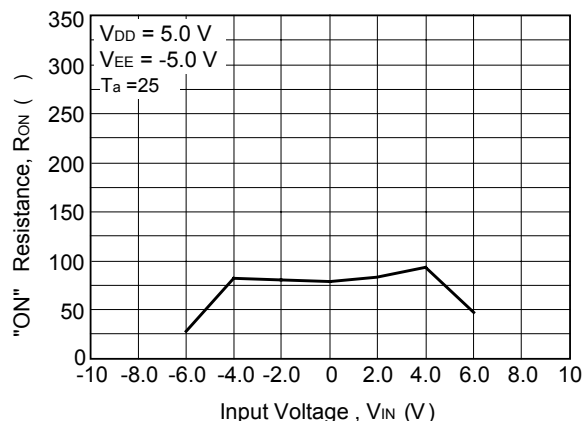
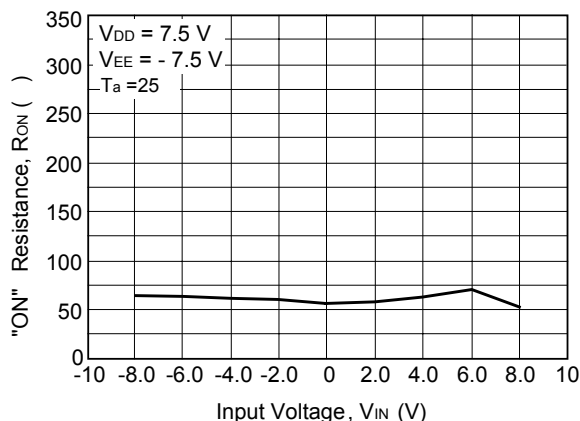
| Control Inputs | | | | ON Switches |
|----------------|---|---|---|-------------|
| INHIBIT | C | B | A | |
| 0 | 0 | 0 | 0 | X0 |
| 0 | 0 | 0 | 1 | X1 |
| 0 | 0 | 1 | 0 | X2 |
| 0 | 0 | 1 | 1 | X3 |
| 0 | 1 | 0 | 0 | X4 |
| 0 | 1 | 0 | 1 | X5 |
| 0 | 1 | 1 | 0 | X6 |
| 0 | 1 | 1 | 1 | X7 |
| 1 | x | x | x | None |

x = Don't Care



UTC 4051 Functional Diagram

■ TYPICAL CHARACTERISTICS



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