

## Radiation Hardened Dual 4-Input Multiplexer

December 1992

### Features

- 3 Micron Radiation Hardened SOS CMOS
- Total Dose 200K or 1 Mega-RAD(Si)
- Dose Rate Upset >10<sup>10</sup> RAD(Si)/s 20ns Pulse
- Latch-Up Free Under Any Conditions
- Fanout (Over Temperature Range)
  - Standard Outputs . . . . . 10 LSTTL Loads
- Military Temperature Range . . . . . -55°C to +125°C
- Significant Power Reduction Compared to LSTTL ICs
- DC Operating Voltage Range . . . . . 4.5V to 5.5V
- LSTTL Input Compatibility
  - VIL = 0.8V Max
  - VIH = VCC/2 Min
- Input Current Levels I<sub>L</sub> ≤ 5μA at VOL, VOH

### Description

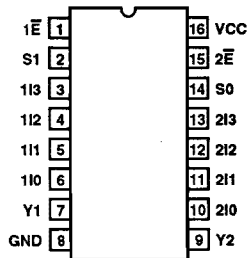
The Harris HCTS153MS is a Radiation Hardened dual 4-to-1 line selector/multiplexer which selects one of four sources for each section by the common select inputs, S0 and S1. When the enable inputs (1E, 2E) are high, the outputs are in the low logic state.

The HCTS153MS utilizes advanced CMOS/SOS technology to achieve high-speed operation. This device is a member of radiation hardened, high-speed, CMOS/SOS Logic Family.

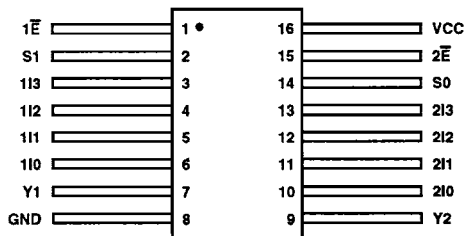
The HCTS153MS is supplied in a 16 lead Weld Seal Ceramic flatpack (K suffix) or a Weld Seal Ceramic Dual-In-Line Package (D suffix).

### Pinouts

16 PIN CERAMIC DUAL-IN-LINE  
MIL-STD-1835 DESIGNATOR, CDIP2-T16, LEAD FINISH C  
TOP VIEW



16 PIN CERAMIC FLAT PACK  
MIL-STD-1835 DESIGNATOR, CDFP4-F16, LEAD FINISH C  
TOP VIEW



### Truth Table

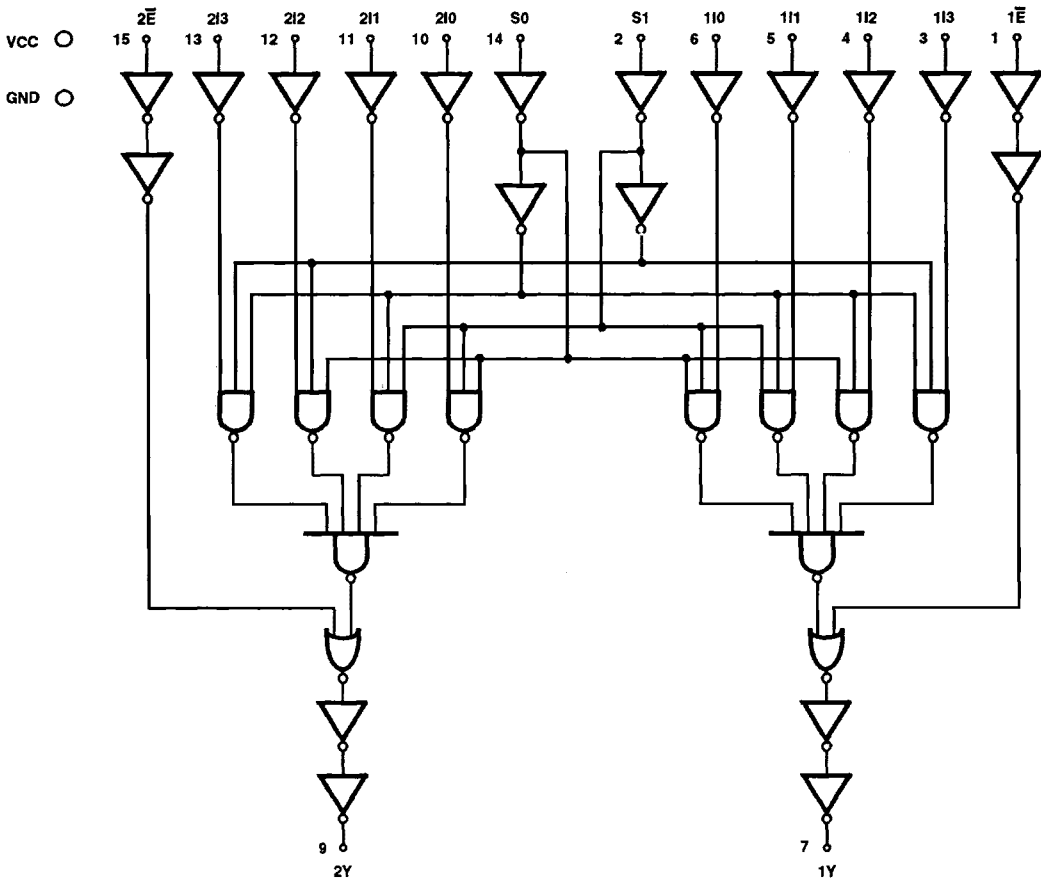
SELECT INPUTS		DATA INPUTS				ENABLE	OUTPUT
S1	S0	I0	I1	I2	I3	1E	Y
X	X	X	X	X	X	H	L
L	L	L	X	X	X	L	L
L	L	H	X	X	X	L	H
L	H	X	L	X	X	L	L
L	H	X	H	X	X	L	H
H	L	X	X	L	X	L	L
H	L	X	X	H	X	L	H
H	H	X	X	X	L	L	L
H	H	X	X	X	H	L	H

Select inputs A and B are common to both sections  
H = High Level, L = Low Level, X = Immaterial

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## Functional Block Diagram



# Specifications HCTS153MS

## Absolute Maximum Ratings

Supply Voltage (VCC) .....	-0.5V to +7.0V
Input Voltage Range, All Inputs .....	-0.5V to VCC +0.5V
DC Input Current, Any One Input .....	±10mA
DC Drain Current, Any One Output .....	±25mA
(All Voltage Reference to the VSS Terminal)	
Storage Temperature Range (TSTG) .....	-65°C to +150°C
Lead Temperature (Soldering 10sec) .....	+265°C
Junction Temperature (TJ) .....	+175°C
ESD Classification .....	Class 1

## Reliability Information

Thermal Impedance .....	$\theta_{JA}$	$\theta_{JC}$
Weld Seal DIC .....	75°C/W	16°C/W
Weld Seal Flat Pack .....	64°C/W	12°C/W
Power Dissipation per Package (PD)		
For $T_A = -55^\circ\text{C}$ to $+100^\circ\text{C}$ .....	1W	
For $T_A = +100^\circ\text{C}$ to $+125^\circ\text{C}$ .....	Derate Linearly at 13mW/°C	

*CAUTION: As with all semiconductors, stress listed under "Absolute Maximum Ratings" may be applied to devices (one at a time) without resulting in permanent damage. This is a stress rating only. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. The conditions listed under "Electrical Performance Characteristics" are the only conditions recommended for satisfactory device operation.*

## Operating Conditions

Supply Voltage (VCC) .....	+4.5V to +5.5V	Input Low Voltage (VIL) .....	0.0V to 0.8V
Input Rise and Fall Times at VCC = 4.5V (TR, TF) .....	500ns Max	Input High Voltage (VIH) .....	VCC/2 to VCC
Operating Temperature Range (TA) .....	-55°C to +125°C		

**TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS**

PARAMETERS	SYMBOL	(NOTE 1) CONDITIONS	GROUP A SUB- GROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Quiescent Current	ICC	VCC = 5.5V, VIN = VCC or GND	1	+25°C	-	40	µA
			2, 3	+125°C, -55°C	-	750	µA
Output Current (Sink)	IOL	VCC = 4.5V, VIH = 4.5V, VOUT = 0.4V, VIL = 0V	1	+25°C	4.8	-	mA
			2, 3	+125°C, -55°C	4.0	-	mA
Output Current (Source)	IOH	VCC = 4.5V, VIH = 4.5V, VOUT = VCC - 0.4V, VIL = 0V	1	+25°C	-4.8	-	mA
			2, 3	+125°C, -55°C	-4.0	-	mA
Output Voltage Low	VOL	VCC = 4.5V, VIH = 2.25V, IOL = 50µA, VIL = 0.8V	1, 2, 3	+25°C, +125°C, -55°C	-	0.1	V
		VCC = 5.5V, VIH = 2.75V, IOL = 50µA, VIL = 0.8V	1, 2, 3	+25°C, +125°C, -55°C	-	0.1	V
Output Voltage High	VOH	VCC = 4.5V, VIH = 2.25V, IOH = -50µA, VIL = 0.8V	1, 2, 3	+25°C, +125°C, -55°C	VCC -0.1	-	V
		VCC = 5.5V, VIH = 2.75V, IOH = -50µA, VIL = 0.8V	1, 2, 3	+25°C, +125°C, -55°C	VCC -0.1	-	V
Input Leakage Current	IIN	VCC = 5.5V, VIN = VCC or GND	1	+25°C	-0.5	0.5	µA
			2, 3	+125°C, -55°C	-5.0	5.0	µA
Noise Immunity Functional Test	FN	VCC = 4.5V, VIH = 2.25V, VIL = 0.8V (Note 2)	7, 8A, 8B	+25°C, +125°C, -55°C	-	-	-

**NOTES:**

1. All voltages referenced to device GND.
2. For functional tests, VO ≥ 4.0V is recognized as a logic "1", and VO ≤ 0.5V is recognized as a logic "0".

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**TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS**

PARAMETER	SYMBOL	(NOTES 1, 2) CONDITIONS	GROUP A SUB- GROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Input to Output	TPHL	VCC = 4.5V	9	+25°C	2	30	ns
			10, 11	+125°C, -55°C	2	34	ns
	TPLH	VCC = 4.5V	9	+25°C	2	20	ns
			10, 11	+125°C, -55°C	2	23	ns
Select to Output	TPHL	VCC = 4.5V	9	+25°C	2	39	ns
			10, 11	+125°C, -55°C	2	46	ns
	TPLH	VCC = 4.5V	9	+25°C	2	28	ns
			10, 11	+125°C, -55°C	2	32	ns
Enable to Data	TPHL	VCC = 4.5V	9	+25°C	2	17	ns
			10, 11	+125°C, -55°C	2	19	ns
	TPLH	VCC = 4.5V	9	+25°C	2	19	ns
			10, 11	+125°C, -55°C	2	22	ns

**NOTES:**

1. All voltages referenced to device GND.
2. AC measurements assume RL = 500Ω, CL = 50pF, Input TR = TF = 3ns, VIL = GND, VIH = 3V.

**TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS**

PARAMETER	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Capacitance Power Dissipation	CPD	VCC = 5.0V, f = 1MHz	1	+25°C	Typical 50		pF
			1	+125°C	Typical 60		pF
Input Capacitance	CIN	VCC = Open, f = 1MHz	1	+25°C	-	10	pF
			1	+125°C	-	10	pF
Output Transition Time	TTHL TTLH	VCC = 4.5V	1	+25°C	-	15	ns
			1	+125°C	-	22	ns

**NOTES:**

1. The parameters listed in Table 3 are controlled via design or process parameters. Min and Max Limits are guaranteed but not directly tested. These parameters are characterized upon initial design release and upon design changes which affect these characteristics.

**TABLE 4. DC POST RADIATION ELECTRICAL PERFORMANCE CHARACTERISTICS**

PARAMETERS	SYMBOL	(NOTES 1, 2) CONDITIONS	TEMP- ERATURE	200K RAD LIMITS		1M RAD LIMITS		UNITS
				MIN	MAX	MIN	MAX	
Quiescent Current	ICC	VCC = 5.5V, VIN = VCC or GND	+25°C	-	0.75	-	2.0	mA
Output Current (Sink)	IOL	VCC = 4.5V, VIN = VCC or GND, VOUT = 0.4V	+25°C	4.0	-	4.0	-	mA
Output Current (Source)	IOH	VCC = 4.5V, VIN = VCC or GND, VOUT = VCC -0.4V	+25°C	-4.0	-	-4.0	-	mA

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**TABLE 4. DC POST RADIATION ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)**

PARAMETERS	SYMBOL	(NOTES 1, 2) CONDITIONS	TEMP- ERATURE	200K RAD LIMITS		1M RAD LIMITS		UNITS
				MIN	MAX	MIN	MAX	
Output Voltage Low	VOL	VCC = 4.5V or 5.5V, VIH = VCC/2, VIL = 0.8V at 200K RAD, VIL = 0.3V at 1M RAD, IOL = 50µA	+25°C	-	0.1	-	0.1	V
Output Voltage High	VOH	VCC = 4.5V or 5.5V, VIH = VCC/2, VIL = 0.8V at 200K RAD, VIL = 0.3V at 1M RAD, IOH = -50µA	+25°C	VCC -0.1	-	VCC -0.1	-	V
Input Leakage Current	IIN	VCC = 5.5V, VIN = VCC or GND	+25°C	-5	+5	-5	+5	µA
Noise Immunity Functional Test	FN	VCC = 4.5V, VIH = 2.25V, VIL = 0.8V at 200K RAD, VIL = 0.3V at 1M RAD (Note 3)	+25°C	-	-	-	-	-
Input to Output	TPHL	VCC = 4.5V	+25°C	2	34	2	43	ns
	TPLH	VCC = 4.5V	+25°C	2	23	2	29	ns
Select to Data	TPHL	VCC = 4.5V	+25°C	2	46	2	58	ns
	TPLH	VCC = 4.5V	+25°C	2	32	2	40	ns
Enable to Data	TPHL	VCC = 4.5V	+25°C	2	19	2	24	ns
	TPLH	VCC = 4.5V	+25°C	2	22	2	28	ns

**NOTES:**

1. All voltages referenced to device GND.
2. AC measurements assume RL = 500Ω, CL = 50pF, Input TR = TF = 3ns, VIL = GND, VIH = 3V.
3. For functional tests VO ≥ 4.0V is recognized as a logic "1", and VO ≤ 0.5V is recognized as a logic "0".

**TABLE 5. BURN-IN AND OPERATING LIFE TEST, DELTA PARAMETERS (+25°C)**

PARAMETER	GROUP B SUBGROUP	DELTA LIMIT
ICC	5	12µA
IOL/IOH	5	-15% of 0 Hour

**TABLE 6. APPLICABLE SUBGROUPS**

CONFORMANCE GROUPS		METHOD	GROUP A SUBGROUPS	READ AND RECORD
Initial Test (Preburn-In)		100%/5004	1, 7, 9	ICC, IOL/H
Interim Test I (Postburn-In)		100%/5004	1, 7, 9	ICC, IOL/H
Interim Test II (Postburn-In)		100%/5004	1, 7, 9	ICC, IOL/H
PDA		100%/5004	1, 7, 9, Deltas	
Interim Test III (Postburn-In)		100%/5004	1, 7, 9	
PDA		100%/5004	1, 7, 9, Deltas	
Final Test		100%/5004	2, 3, 8A, 8B, 10, 11	
Group A (Note 1)		Sample/5005	1, 2, 3, 7, 8A, 8B, 9, 10, 11	
Group B	Subgroup B-5	Sample/5005	1, 2, 3, 7, 8A, 8B, 9, 10, 11, Deltas	Subgroups 1, 2, 3, 9, 10, 11
	Subgroup B-6	Sample/5005	1, 7, 9	
Group D		Sample/5005	1, 2, 3, 7, 8A, 8B, 9, 10, 11	

**NOTE:**

1. Alternate group A inspection in accordance with method 5005 of MIL-STD-883 may be exercised.

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**TABLE 7. TOTAL DOSE IRRADIATION**

CONFORMANCE GROUPS	METHOD	TEST		READ AND RECORD	
		PRE RAD	POST RAD	PRE RAD	POST RAD
Group E Subgroup 2	5005	1, 7, 9	Table 4	1, 9	Table 4 (Note 1)

NOTE:

1. Except FN test which will be performed 100% Go/No-Go.

**TABLE 8. STATIC AND DYNAMIC BURN-IN TEST CONNECTIONS**

OPEN	GROUND	1/2 VCC = 3V ± 0.5V	VCC = 6V ± 0.5V	OSCILLATOR	
				50kHz	25kHz
STATIC BURN-IN I TEST CONNECTIONS (Note 1)					
7, 9	1 - 6, 8, 10 - 15	-	16	-	-
STATIC BURN-IN II TEST CONNECTIONS (Note 1)					
7, 9	8	-	1 - 6, 10 - 16	-	-
DYNAMIC BURN-IN TEST CONNECTIONS (Note 2)					
-	1, 3, 5, 8, 11, 13, 15	7, 9	4, 6, 10, 12, 16	14	2

NOTES:

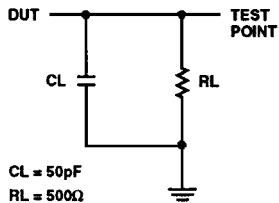
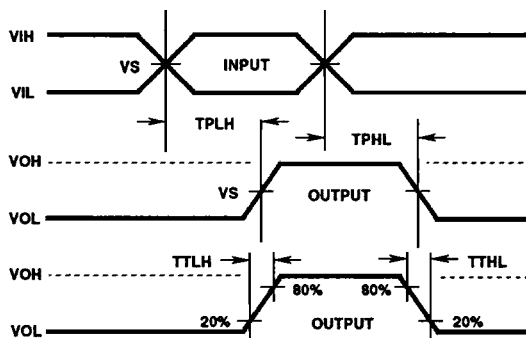
1. Each pin except VCC and GND will have a resistor of 10KΩ ± 5% for static burn-in
2. Each pin except VCC and GND will have a resistor of 1KΩ ± 5% for dynamic burn-in

**TABLE 9. IRRADIATION TEST CONNECTIONS**

OPEN	GROUND	VCC = 5V ± 0.5V
7, 9	8	1 - 6, 10 - 16

NOTE: Each pin except VCC and GND will have a resistor of 47KΩ ± 5% for irradiation testing.  
Group E, Subgroup 2, sample size is 4 dice/wafer 0 failures.

**AC Timing Diagram and Load Circuit**



**AC VOLTAGE LEVELS**

PARAMETER	HCTS	UNITS
VCC	4.50	V
VIH	3.00	V
VS	1.30	V
VIL	0	V
GND	0	V

# HCTS153MS

## Die Characteristics

### DIE DIMENSIONS:

2.13 x 2.13 mils  
84mm x 84mm

### METALLIZATION:

Type: AlSi  
Metal Thickness:  $11\text{k}\text{\AA} \pm 1\text{k}\text{\AA}$

### GLASSIVATION:

Type:  $\text{SiO}_2$   
Thickness:  $13\text{k}\text{\AA} \pm 2.6\text{k}\text{\AA}$

### DIE ATTACH:

Material: Silver Epoxy

### WORST CASE CURRENT DENSITY:

$<2.0 \times 10^5 \text{A/cm}^2$

### BOND PAD SIZE:

$100\mu\text{m} \times 100\mu\text{m}$   
4 x 4 mils

## Metallization Mask Layout

HCTS153MS

