

## Radiation Hardened Octal Bus Transceiver, Tri-State, Non-Inverting

December 1992

### Features

- 3 Micron Radiation Hardened CMOS SOS
- Total Dose 200K or 1 Mega-RAD(Si)
- Latch-Up Free Under Any Conditions
- Fanout (Over Temperature Range)
  - Bus Driver Outputs - 15 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  $I_I \leq 5\mu A$  at VOL, VOH

### Description

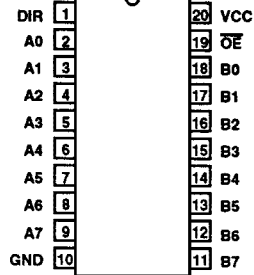
The Harris HCS245MS is a Radiation Hardened Non-Inverting Octal Bidirectional Bus Transceiver, Tri-State, intended for two-way asynchronous communication between data busses. The HCS245MS allows data transmission from the A bus to the B bus or from the B bus to the A bus. The logic level at the direction input (DIR) determines the data direction. The output enable input ( $\overline{OE}$ ) puts the I/O port in the high-impedance state when high.

The HCS245MS utilizes advanced CMOS/SOS technology to achieve high-speed operation. This device is a member of radiation hardened, high-speed, CMOS/SOS Logic Family.

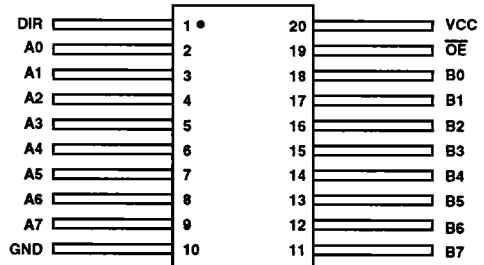
The HCS245MS is supplied in a 20 lead Weld Seal Ceramic flatpack (K suffix) or a Weld Seal Ceramic Dual-In-Line Package (D suffix).

### Pinouts

20 PIN CERAMIC DUAL-IN-LINE  
MIL-STD-1835 DESIGNATOR CDIP2-T20, LEAD FINISH C  
TOP VIEW



20 PIN CERAMIC FLAT PACK  
MIL-STD-1835 DESIGNATOR CDFP4-F20, LEAD FINISH C  
TOP VIEW



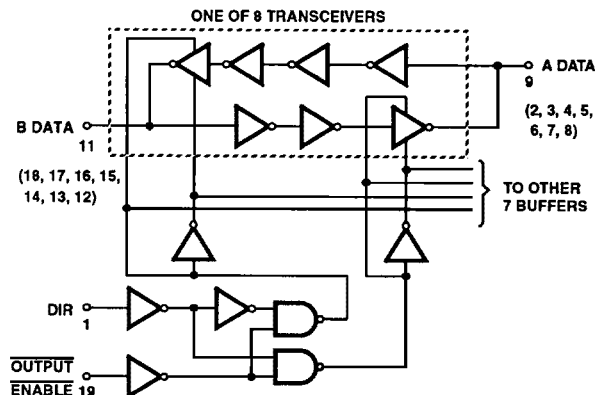
### Truth Table

CONTROL INPUTS		OPERATION
$\overline{OE}$	DIR	
L	L	B Data to A Bus
L	H	A Data to B Bus
H	X	Isolation

H = High Voltage Level, L = Low Voltage Level, X = Immaterial

To prevent excess currents in the High-Z (Isolation) modes, all I/O terminals should be terminated with 10k $\Omega$  to 1M $\Omega$  resistors.

### Functional Diagram



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### 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 .....	$\theta_{j\alpha}$	$\theta_{jc}$
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 30% of VCC
Input Rise and Fall Times at 4.5V VCC (TR, TF) .....	500ns Max.	Input High Voltage (VIH) .....	70% of VCC to VCC
Operating Temperature Range ( $T_A$ ) .....	-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	7.2	-	mA
			2, 3	+125°C, -55°C	6.0	-	mA
Output Current (Source)	IOH	VCC = 4.5V, VIH = 4.5V, VOUT = VCC -0.4V, VIL = 0V	1	+25°C	7.2	-	mA
			2, 3	+125°C, -55°C	6.0	-	mA
Output Voltage Low	VOL	VCC = 4.5V, VIH = 3.15V, IOL = 50μA, VIL = 1.35V	1, 2, 3	+25°C, +125°C, -55°C	-	0.1	V
		VCC = 5.5V, VIH = 3.85V, IOL = 50μA, VIL = 1.65V	1, 2, 3	+25°C, +125°C, -55°C	-	0.1	V
Output Voltage High	VOH	VCC = 4.5V, VIH = 3.15V, IOH = -50μA, VIL = 1.35V	1, 2, 3	+25°C, +125°C, -55°C	VCC -0.1	-	V
		VCC = 5.5V, VIH = 3.85V, IOH = -50μA, VIL = 1.65V	1, 2, 3	+25°C, +125°C, -55°C	VCC -0.1	-	V
Input Leakage Current	IIN	VCC = 5.5V, VIN = VCC or GND, VCC = 4.5V and 5.5V	1	+25°C	-	±0.5	μA
			2, 3	+125°C, -55°C	-	±5.0	μA
Tri-State Output Leakage Current	IOZ	Applied Voltage = 0V or VCC	1	+25°C	-	±1	μA
			2, 3	+125°C, -55°C	-	±50	μA
Noise Immunity Functional Test	FN	VCC = 4.5V, VIH = 0.70(VCC), VIL = 0.30(VCC) (Note 2)	7, 8A, 8B	+25°C, +125°C, -55°C	-	-	-

**NOTE:**

1. All voltages reference to device GND.
2. For functional tests,  $VO \geq 4.0V$  is recognized as a logic "1", and  $VO \leq 0.5V$  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	
Propagation Delay Data to Output	TPLH TPHL	VCC = 4.5V	9	+25°C	2	19	ns
			10, 11	+125°C, -55°C	2	23	ns
Enable to Output	TPZL TPZH	VCC = 4.5V	9	+25°C	2	26	ns
			10, 11	+125°C, -55°C	2	30	ns
Disable to Output	TPLZ TPHZ	VCC = 4.5V	9	+25°C	2	28	ns
			10, 11	+125°C, -55°C	2	33	ns

**NOTES:**

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

**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 45		pF
			1	+125°C, -55°C	Typical 45		pF
Input Capacitance	CIN	VCC = Open, f = 1MHz	1	+25°C	-	10	pF
			1	+125°C, -55°C	-	10	pF
Output Transition Time	TTHL TTLH	VCC = 4.5V	1	+25°C	-	12	ns
			1	+125°C, -55°C	-	18	ns

**NOTES:**

- 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	-	3.75	mA
Output Current (Sink)	IOL	VCC = 4.5V, VIN = VCC or GND, VOUT = 0.4V	+25°C	6.0	-	5.0	-	mA
Output Current (Source)	IOH	VCC = 4.5V, VIN = VCC or GND, VOUT = VCC - 0.4V	+25°C	-6.0	-	-5.0	-	mA
Output Voltage Low	VOL	VCC = 4.5V and 5.5V, VIH = 0.70(VCC), VIL = 0.30(VCC) at 200K RAD, VIL = 0.12(VCC) at 1M RAD, IOL = 50μA	+25°C	-	0.1	-	0.1	V
Output Voltage High	VOH	VCC = 4.5V and 5.5V, VIH = 0.70(VCC), VIL = 0.30(VCC) at 200K RAD, VIL = 0.12(VCC) 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	μA
Tri-State Output Leakage Current	IOZ	Applied Voltage = 0V or VCC	+25°C	-	±50	-	±100	μA

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LOGIC

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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	
Noise Immunity Functional Test	FN	VCC = 4.5V, VIH = 0.70(VCC), VIL = 0.30(VCC) at 200K RAD, VIL = 0.12(VCC) at 1M RAD (Note 3)	+25°C	-	-	-	-	-
Propagation Delay Data to Output	TPLH TPHL	VCC = 4.5V	+25°C	2	23	2	28	ns
Enable to Output	TPZL TPZH	VCC = 4.5V	+25°C	2	30	2	36	ns
Enable to Output	TPLZ TPHZ	VCC = 4.5V	+25°C	2	33	2	33	ns

**NOTES:**

1. All voltages referenced to device GND.
2. AC measurements assume RL = 500Ω, CL = 50pF, Input TR = TF = 3ns, VIL = GND, VIH = VCC.
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
IOZL/IOZH	5	±200nA

**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	ICC, IOL/H
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 testing in accordance with Method 5005 of MIL-STD-883 may be exercised.

**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.

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**TABLE 8. STATIC BURN-IN 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)					
2 - 9	1, 10 - 19	-	20	-	-
STATIC BURN-IN II TEST CONNECTIONS (Note 1)					
-	10	-	1 - 9, 11 - 20	-	-
DYNAMIC BURN-IN TEST CONNECTIONS (Note 2)					
-	10	11 - 18	1, 20	2 - 9	19

**NOTES:**

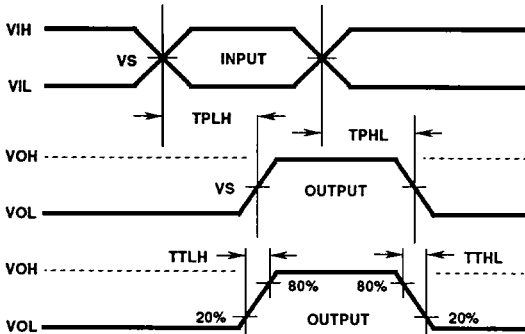
1. Each pin except VCC and GND will have a resistor of 10KΩ ± 5% for static burn-in.
2. Each pin except VCC and GND will have a resistor of 680Ω ± 5% for dynamic burn-in.

**TABLE 9. IRRADIATION TEST CONNECTIONS**

OPEN	GROUND	VCC = 5V ± 0.5V
-	10	1 - 9, 11 - 20

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

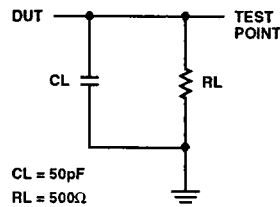
### AC Timing Diagrams



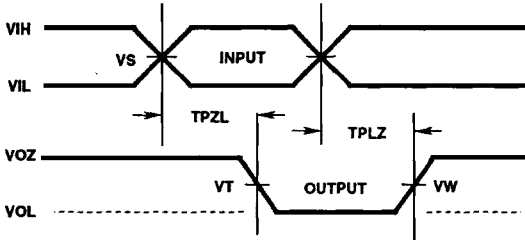
**AC VOLTAGE LEVELS**

PARAMETER	HCS	UNITS
VCC	4.50	V
VIH	4.50	V
VS	2.25	V
VIL	0	V
GND	0	V

### AC Load Circuit



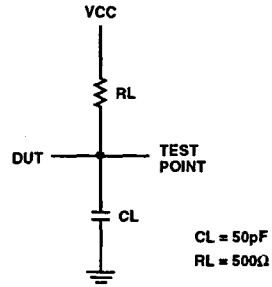
**Tri-State Low Timing Diagrams**



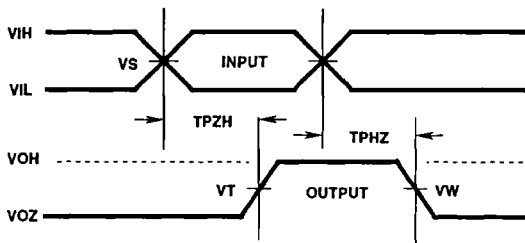
**TRI-STATE LOW VOLTAGE LEVELS**

PARAMETER	HCS	UNITS
VCC	4.50	V
VIH	4.50	V
VS	2.25	V
VT	2.25	V
VW	0.90	V
GND	0	V

**Tri-State Low Load Circuit**



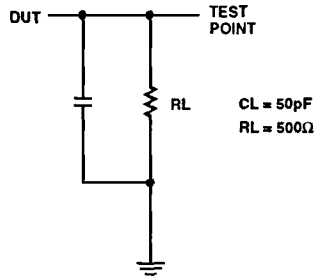
**Tri-State High Timing Diagrams**



**TRI-STATE HIGH VOLTAGE LEVELS**

PARAMETER	HCS	UNITS
VCC	4.50	V
VIH	4.50	V
VS	2.25	V
VT	2.25	V
VW	3.60	V
GND	0	V

**Tri-State High Load Circuit**



# HCS245MS

## Die Characteristics

### DIE DIMENSIONS:

124 x 110 mils

### 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 mils x 4 mils

## Metallization Mask Layout

