

## Radiation Hardened Quad 2-Input Exclusive OR Gate

April 1995

### Features

- 1.25 Micron Radiation Hardened SOS CMOS
- Total Dose 300K RAD (Si)
- Single Event Upset (SEU) Immunity <math>< 1 \times 10^{-10}</math> Errors/Bit-Day (Typ)
- SEU LET Threshold >80 MEV-cm<sup>2</sup>/mg
- Dose Rate Upset >10<sup>11</sup> RAD (Si)/s, 20ns Pulse
- Latch-Up Free Under Any Conditions
- Military Temperature Range: -55°C to +125°C
- Significant Power Reduction Compared to ALSTTL Logic
- DC Operating Voltage Range: 4.5V to 5.5V
- Input Logic Levels
  - VIL = 30% of VCC Max
  - VIH = 70% of VCC Min
- Input Current ≤1μA at VOL, VOH

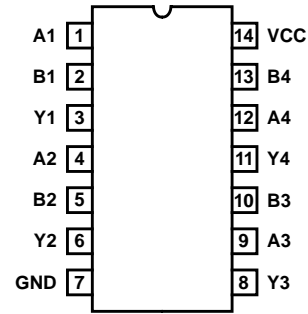
### Description

The Intersil ACS86MS is a radiation hardened quad 2-input exclusive OR gate. A high logic level on both inputs forces the output to a logic low state.

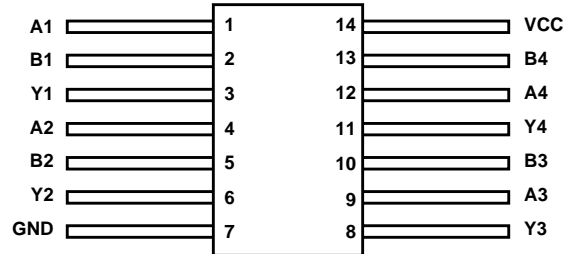
The ACS86MS utilizes advanced CMOS/SOS technology to achieve high-speed operation. This device is a member of the radiation hardened, high-speed, CMOS/SOS Logic Family.

### Pinouts

14 LEAD CERAMIC DUAL-IN-LINE  
MIL-STD-1835 DESIGNATOR, CDIP2-T14, LEAD FINISH C  
TOP VIEW



14 LEAD CERAMIC FLATPACK  
MIL-STD-1835 DESIGNATOR, CDFP3-F14, LEAD FINISH C  
TOP VIEW



### Ordering Information

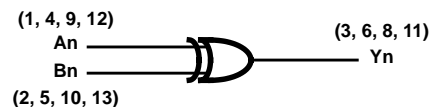
PART NUMBER	TEMPERATURE RANGE	SCREENING LEVEL	PACKAGE
ACS86DMSR	-55°C to +125°C	Intersil Class S Equivalent	14 Lead SBDIP
ACS86KMSR	-55°C to +125°C	Intersil Class S Equivalent	14 Lead Ceramic Flatpack
ACS86D/Sample	+25°C	Sample	14 Lead SBDIP
ACS86K/Sample	+25°C	Sample	14 Lead Ceramic Flatpack
ACS86HMSR	+25°C	Die	Die

### Truth Table

INPUTS		OUTPUT
An	Bn	Yn
L	L	L
L	H	H
H	L	H
H	H	L

NOTE: L = Logic Level Low, H = Logic Level High

### Functional Diagram



# Specifications ACS86MS

## Absolute Maximum Ratings

Supply Voltage	-0.5V to +6.0V
Input Voltage Range	-0.5V to VCC +0.5V
DC Input Current, Any One Input	±10mA
DC Drain Current, Any One Output	±50mA
Storage Temperature Range (TSTG)	-65°C to +150°C
Lead Temperature (Soldering 10s)	+265°C
Junction Temperature (TJ)	+175°C
ESD Classification	Class 1

(All Voltages Referenced to VSS)

## Reliability Information

Thermal Impedance	$\theta_{JA}$	$\theta_{JC}$
DIP	74°C/W	24°C/W
Flatpack	116°C/W	30°C/W
Maximum Package Power Dissipation at +125°C		
DIP	0.7W	
Flatpack	0.4W	
Maximum Device Power Dissipation	(TBD)W	
Gate Count	52 Gates	

*CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.*

## Operating Conditions

Supply Voltage Range	+4.5V to +5.5V	Input High Voltage (VIH)	VCC to 70% of VCC
Input Rise and Fall Time at 4.5V VCC (TR, TF)	10ns/V Max	Input Low Voltage (VIL)	0V to 30% of VCC
Operating Temperature Range	-55°C to +125°C		

**TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS**

PARAMETER	SYMBOL	(NOTE 1) CONDITIONS	GROUP A SUB- GROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Supply Current	ICC	VCC = 5.5V, VIN = VCC or GND	1	+25°C	-	5	μA
			2, 3	+125°C, -55°C	-	100	μA
Output Current (Source)	IOH	VCC = 4.5V, VIH = 4.5V, VOUT = VCC -0.4V, VIL = 0V, (Note 2)	1	+25°C	-12	-	mA
			2, 3	+125°C, -55°C	-8	-	mA
Output Current (Sink)	IOL	VCC = 4.5V, VIH = 4.5V, VOUT = 0.4V, VIL = 0V, (Note 2)	1	+25°C	12	-	mA
			2, 3	+125°C, -55°C	8	-	mA
Output Voltage High	VOH	VCC = 5.5V, VIH = 3.85V, VIL = 1.65V, IOH = -50μA	1, 2, 3	+25°C, +125°C, -55°C	VCC -0.1	-	V
		VCC = 4.5V, VIH = 3.15V, VIL = 1.35V, IOH = -50μA	1, 2, 3	+25°C, +125°C, -55°C	VCC -0.1	-	V
Output Voltage Low	VOL	VCC = 5.5V, VIH = 3.85V, VIL = 1.65V, IOL = 50μA	1, 2, 3	+25°C, +125°C, -55°C	-	0.1	V
		VCC = 4.5V, VIH = 3.15V, VIL = 1.35V, IOL = 50μA	1, 2, 3	+25°C, +125°C, -55°C	-	0.1	V
Input Leakage Current	IIN	VCC = 5.5V, VIN = VCC or GND	1	+25°C	-	±0.5	μA
			2, 3	+125°C, -55°C	-	±1.0	μA
Noise Immunity Functional Test	FN	VCC = 4.5V, VIH = 3.15V, VIL = 1.35V, (Note 3)	7, 8A, 8B	+25°C, +125°C, -55°C	-	-	V

**NOTES:**

1. All voltages referenced to device GND.
2. Force/measure functions may be interchanged.
3. For functional tests, VO ≥4.0V is recognized as a logic "1", and VO ≤0.5V is recognized as a logic "0".

# Specifications ACS86MS

**TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS**

PARAMETER	SYMBOL	(NOTES 1, 2) CONDITIONS	GROUP A SUB- GROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Propagation Delay Input to Output	TPHL	VCC = 4.5V, VIH = 4.5V, VIL = 0V	9	+25°C	2	12	ns
	TPLH	VCC = 4.5V, VIH = 4.5V, VIL = 0V	10, 11	+125°C, -55°C	2	13	ns

NOTES:

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

**TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS**

PARAMETER	SYMBOL	CONDITIONS	NOTE	TEMP	LIMITS			UNITS
					MIN	TYP	MAX	
Capacitance Power Dissipation	CPD	VCC = 5.0V, VIH = 5.0V, VIL = 0V, f = 1MHz	1	+25°C	-	TBD	-	pF
			1	+125°C	-	TBD	-	pF
Input Capacitance	CIN	VCC = 5.0V, VIH = 5.0V, VIL = 0V, f = 1MHz	1	+25°C	-	-	10	pF
			1	+125°C	-	-	10	pF

NOTE:

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. POST IRRADIATION ELECTRICAL PERFORMANCE CHARACTERISTICS**

PARAMETER	SYMBOL	(NOTE 1) CONDITIONS	TEMPERATURE	RAD LIMITS		UNITS
				MIN	MAX	
Supply Current	ICC	VCC = 5.5V, VIN = VCC or GND	+25°C	-	100	μA
Output Current (Source)	IOH	VCC = VIH = 4.5V, VOUT = VCC - 0.4V, VIL = 0	+25°C	-8.0	-	mA
Output Current (Sink)	IOL	VCC = VIH = 4.5V, VOUT = 0.4V, VIL = 0	+25°C	8.0	-	mA
Output Voltage High	VOH	VCC = 5.5V, VIH = 3.85V, VIL = 1.65V, IOH = -50μA	+25°C	VCC - 0.1	-	V
		VCC = 4.5V, VIH = 3.15V, VIL = 1.35V, IOH = -50μA	+25°C	VCC - 0.1	-	V
Output Voltage Low	VOL	VCC = 5.5V, VIH = 3.85V, VIL = 1.65V, IOL = 50μA	+25°C	-	0.1	V
		VCC = 4.5V, VIH = 3.15V, VIL = 1.35V, IOL = 50μA	+25°C	-	0.1	V
Input Leakage Current	IIN	VCC = 5.5V, VIN = VCC or GND	+25°C	-	±1	μA
Noise Immunity Functional Test	FN	VCC = 4.5V, VIH = 3.15V, VIL = 1.35V, (Note 2)	+25°C	-	-	V
Propagation Delay Input to Output	TPHL	VCC = 4.5V, VIH = 4.5V, VIL = 0V	+25°C	2	13	ns
	TPLH					

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".

**TABLE 5. DELTA PARAMETERS (+25°C)**

PARAMETER	SYMBOL	(NOTE 1) DELTA LIMIT	UNITS
Supply Current	ICC	±1.0	μA
Output Current	IOL/IOH	±15	%

NOTE:

1. All delta calculations are referenced to 0 hour readings or pre-life readings.

## Specifications ACS86MS

**TABLE 6. APPLICABLE SUBGROUPS**

CONFORMANCE GROUP		METHOD	GROUP A SUBGROUPS	READ AND RECORD
Initial Test (Preburn-In)		100%/5004	1, 7, 9	ICC, IOL/H
Interim Test 1 (Postburn-In)		100%/5004	1, 7, 9	ICC, IOL/H
Interim Test 2 (Postburn-In)		100%/5004	1, 7, 9	ICC, IOL/H
PDA		100%/5004	1, 7, 9, Deltas	
Interim Test 3 (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, 7, 9	

NOTE:

1. Alternate Group A testing may be exercised in accordance with MIL-STD-883, Method 5005.

**TABLE 7. TOTAL DOSE IRRADIATION**

CONFORMANCE GROUP	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. BURN-IN TEST CONNECTIONS (+125°C < TA < 139°C)**

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

NOTE:

1. Each pin except VCC and GND will have a series resistor of 500Ω ±5%.

**TABLE 9. IRRADIATION TEST CONNECTIONS (TA = +25°C, ±5°C)**

FUNCTION	OPEN	GROUND	VCC ±0.5V
Irradiation Circuit (Note 1)	3, 6, 8, 11	7	1, 2, 4, 5, 9, 10, 12, 13, 14

NOTE:

1. Each pin except VCC and GND will have a series resistor of 47kΩ ±5%. Group E, Subgroup 2, sample size is 4 dice/wafer, 0 failures.

# Specifications ACS86MS

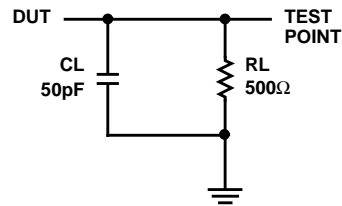
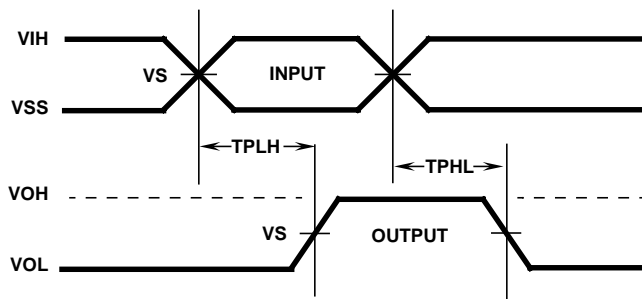
## Intersil - Space Products MS Screening

Wafer Lot Acceptance (All Lots) Method 5007 (Includes SEM)	100% Static Burn-In 2 Method 1015, 24 Hours at +125°C Min
Radiation Verification (Each Wafer) Method 1019, 4 Samples/Wafer, 0 Rejects	100% Interim Electrical Test 2 (Note 1)
100% Nondestructive Bond Pull Method 2023	100% Dynamic Burn-In Method 1015, 240 Hours at +125°C or 180 Hours at +135°C
100% Internal Visual Inspection Method 2010	100% Interim Electrical Test 3 (Note 1)
100% Temperature Cycling Method 1010 Condition C (-65° to +150°C)	100% Final Electrical Test
100% Constant Acceleration	100% Fine and Gross Seal Method 1014
100% PIND Testing	100% Radiographics Method 2012 (2 Views)
100% External Visual Inspection	100% External Visual Method 2009
100% Serialization	Group A (All Tests) Method 5005 (Class S)
100% Initial Electrical Test	Group B (Optional) Method 5005 (Class S) (Note 2)
100% Static Burn-In 1 Method 1015, 24 Hours at +125°C Min	Group D (Optional) Method 5005 (Class S) (Note 2)
100% Interim Electrical Test 1 (Note 1)	CSI and/or GSI (Optional) (Note 2)
	Data Package Generation (Note 3)

**NOTES:**

- Failures from interim electrical tests 1 and 2 are combined for determining PDA (PDA = 5% for subgroups 1, 7, 9 and delta failures combined, PDA = 3% for subgroup 7 failures). Interim electrical tests 3 PDA (PDA = 5% for subgroups 1, 7, 9 and delta failures combined, PDA = 3% for subgroup 7 failures).
- These steps are optional, and should be listed on the purchase order if required.
- Data Package Contents:  
 Cover Sheet (P.O. Number, Customer Number, Lot Date Code, Intersil Number, Lot Number, Quantity).  
 Certificate of Conformance (as found on shipper).  
 Lot Serial Number Sheet (Good Unit(s) Serial Number and Lot Number).  
 Variables Data (All Read, Record, and delta operations).  
 Group A Attributes Data Summary.  
 Wafer Lot Acceptance Report (Method 5007) to include reproductions of SEM photos. NOTE: SEM photos to include percent of step coverage.  
 X-Ray Report and Film, including penetrometer measurements.  
 GAMMA Radiation Report with initial shipment of devices from the same wafer lot; containing a Cover Page, Disposition, RAD Dose, Lot Number, Test Package, Spec Number(s), Test Equipment, etc. Irradiation Read and Record data will be on file at Intersil.

### Propagation Delay Timing Diagram and Load Circuit



**AC VOLTAGE LEVELS**

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

# ACS86MS

## Die Characteristics

### DIE DIMENSIONS:

88 mils x 88 mils  
2.24mm x 2.24mm

### METALLIZATION:

Type: AlSiCu  
Metal 1 Thickness: 6.75kÅ (Min), 8.25kÅ (Max)  
Metal 2 Thickness: 9kÅ (Min), 11kÅ (Max)

### GLASSIVATION:

Type: SiO<sub>2</sub>  
Thickness: 8kÅ ±1kÅ

### DIE ATTACH:

Material: Silver Glass or JM7000 Polymer after 7/1/95

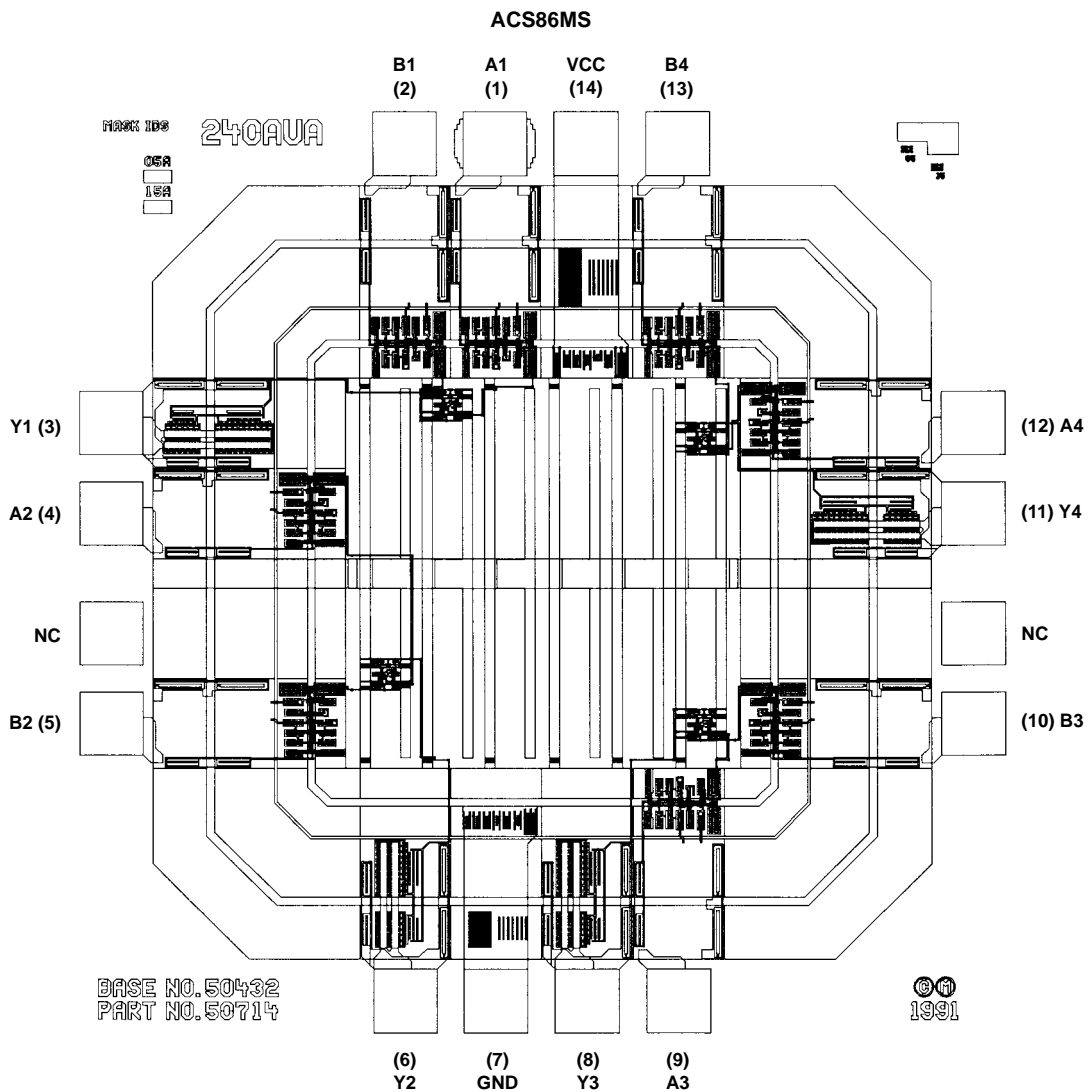
### WORST CASE CURRENT DENSITY:

< 2.0 x 10<sup>5</sup> A/cm<sup>2</sup>

### BOND PAD SIZE:

> 4.3 mils x 4.3 mils  
> 110µm x 110µm

## Metallization Mask Layout



All Intersil semiconductor products are manufactured, assembled and tested under **ISO9000** quality systems certification.

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