

High-Speed CMOS Logic 16-Channel Analog Multiplexer/Demultiplexer

February 1998 - Revised July 2003

Features

- **Wide Analog Input Voltage Range**
- **Low "ON" Resistance**
 - $V_{CC} = 4.5V$ **70Ω (Typ)**
 - $V_{CC} = 6V$ **60Ω (Typ)**
- **Fast Switching and Propagation Speeds**
- **"Break-Before-Make" Switching. . . . 6ns (Typ) at 4.5V**
- **Available in Both Narrow and Wide-Body Plastic Packages**
- **Fanout (Over Temperature Range)**
 - Standard Outputs **10 LSTTL Loads**
 - Bus Driver Outputs **15 LSTTL Loads**
- **Wide Operating Temperature Range . . . -55°C to 125°C**
- **Balanced Propagation Delay and Transition Times**
- **Significant Power Reduction Compared to LSTTL Logic ICs**
- **HC Types**
 - **2V to 6V Operation**
 - **High Noise Immunity: $N_{IL} = 30\%$, $N_{IH} = 30\%$ of V_{CC} at $V_{CC} = 5V$**
- **HCT Types**
 - **4.5V to 5.5V Operation**
 - **Direct LSTTL Input Logic Compatibility, $V_{IL} = 0.8V$ (Max), $V_{IH} = 2V$ (Min)**
 - **CMOS Input Compatibility, $I_I \leq 1\mu A$ at V_{OL} , V_{OH}**

Description

The CD74HC4067 and CD74HCT4067 devices are digitally controlled analog switches that utilize silicon-gate CMOS technology to achieve operating speeds similar to LSTTL, with the low power consumption of standard CMOS integrated circuits.

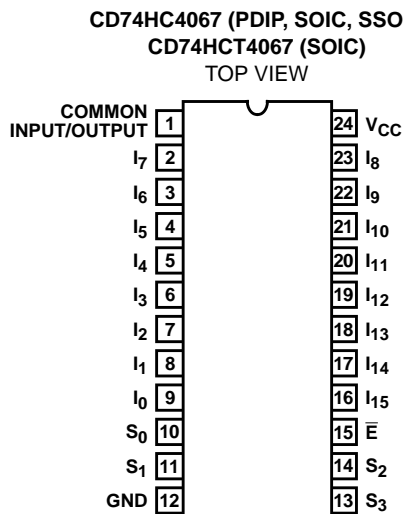
These analog multiplexers/demultiplexers control analog voltages that may vary across the voltage supply range. They are bidirectional switches thus allowing any analog input to be used as an output and vice-versa. The switches have low "on" resistance and low "off" leakages. In addition, these devices have an enable control which when high will disable all switches to their "off" state.

Ordering Information

PART NUMBER	TEMP. RANGE (°C)	PACKAGE
CD74HC4067E	-55 to 125	24 Ld PDIP
CD74HC4067M	-55 to 125	24 Ld SOIC
CD74HC4067M96	-55 to 125	24 Ld SOIC
CD74HC4067SM96	-55 to 125	24 Ld SSOP
CD74HCT4067M	-55 to 125	24 Ld SOIC

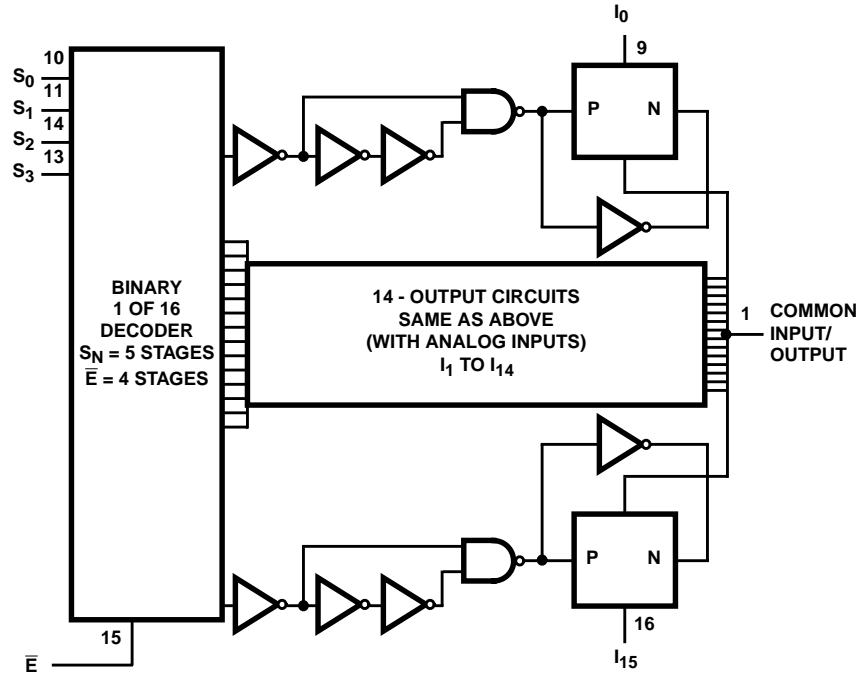
NOTE: When ordering, use the entire part number. The suffix 96 denotes tape and reel.

Pinout



CD74HC4067, CD74HCT4067

Functional Diagram



TRUTH TABLE

S0	S1	S2	S3	\bar{E}	SELECTED CHANNEL
X	X	X	X	1	None
0	0	0	0	0	0
1	0	0	0	0	1
0	1	0	0	0	2
1	1	0	0	0	3
0	0	1	0	0	4
1	0	1	0	0	5
0	1	1	0	0	6
1	1	1	0	0	7
0	0	0	1	0	8
1	0	0	1	0	9
0	1	0	1	0	10
1	1	0	1	0	11
0	0	1	1	0	12
1	0	1	1	0	13
0	1	1	1	0	14
1	1	1	1	0	15

H= High Level
 L= Low Level
 X= Don't Care

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Absolute Maximum Ratings

DC Supply Voltage, V_{CC} (Voltages Referenced to Ground)	-0.5V to 7V
DC Input Diode Current, I_{IK} For $V_I < -0.5V$ or $V_I > V_{CC} + 0.5V$	$\pm 20mA$
DC Drain Current, I_O For $-0.5V < V_O < V_{CC} + 0.5V$	$\pm 25mA$
DC Output Diode Current, I_{OK} For $V_O < -0.5V$ or $V_O > V_{CC} + 0.5V$	$\pm 20mA$
DC Output Source or Sink Current per Output Pin, I_O For $V_O > -0.5V$ or $V_O < V_{CC} + 0.5V$	$\pm 25mA$
DC V_{CC} or Ground Current, I_{CC}	$\pm 50mA$

Thermal Information

Thermal Resistance (Typical)	θ_{JA} ($^{\circ}C/W$)
E (PDIP) Package, Note 1	67
M (SOIC) Package, Note 2	46
SM (SSOP) Package, Note 2	63
Maximum Junction Temperature (Plastic Package)	$150^{\circ}C$
Maximum Storage Temperature Range	$-65^{\circ}C$ to $150^{\circ}C$

Operating Conditions

Temperature Range, T_A	$-55^{\circ}C$ to $125^{\circ}C$
Supply Voltage Range, V_{CC}	
HC Types2V to 6V
HCT Types	4.5V to 5.5V
DC Input or Output Voltage, V_I, V_O	0V to V_{CC}
Input Rise and Fall Time	
2V	1000ns (Max)
4.5V	500ns (Max)
6V	400ns (Max)

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.

NOTES:

1. The package thermal impedance is calculated in accordance with JESD 51-3.
2. The package thermal impedance is calculated in accordance with JESD 51-7.

DC Electrical Specifications

PARAMETER	SYMBOL	TEST CONDITIONS		V_{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
		V_I (V)	V_{IS} (V)		MIN	TYP	MAX	MIN	MAX	MIN	MAX	
HC TYPES												
High Level Input Voltage	V_{IH}	-	-	2	1.5	-	-	1.5	-	1.5	-	V
				4.5	3.15	-	-	3.15	-	3.15	-	V
				6	4.2	-	-	4.2	-	4.2	-	V
Low Level Input Voltage	V_{IL}	-	-	2	-	-	0.5	-	0.5	-	0.5	V
				4.5	-	-	1.35	-	1.35	-	1.35	V
				6	-	-	1.8	-	1.8	-	1.8	V
Maximum "ON" Resistance $I_O = 1mA$	R_{ON}	V_{CC} or GND	V_{CC} or GND	4.5	-	70	160	-	200	-	240	Ω
				6	-	60	140	-	175	-	210	Ω
		V_{CC} to GND	V_{CC} to GND	4.5	-	90	180	-	225	-	270	Ω
				6	-	80	160	-	200	-	240	Ω
Maximum "ON" Resistance Between Any Two Switches	ΔR_{ON}	-	-	4.5	-	10	-	-	-	-	-	Ω
				6	-	8.5	-	-	-	-	-	Ω
Switch "Off" Leakage Current 16 Channels	I_{IZ}	$\bar{E} = V_{CC}$	V_{CC} or GND	6	-	-	± 0.8	-	± 8	-	± 8	μA
Logic Input Leakage Current	I_I	V_{CC} or GND	-	6	-	-	± 0.1	-	± 1	-	± 1	μA

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DC Electrical Specifications (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS		V _{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
		V _I (V)	V _{IS} (V)		MIN	TYP	MAX	MIN	MAX	MIN	MAX	
Quiescent Device Current I _O = 0mA	I _{CC}	V _{CC} or GND	-	6	-	-	8	-	80	-	160	μA
HCT TYPES												
High Level Input Voltage	V _{IH}	-	-	4.5	2	-	-	2	-	2	-	V
Low Level Input Voltage	V _{IL}	-	-	4.5	-	-	0.8	-	0.8	-	0.8	V
Maximum "ON" Resistance I _O = 1mA	R _{ON}	V _{CC} or GND	V _{CC} or GND	4.5	-	70	160	-	200	-	240	Ω
		V _{CC} to GND	V _{CC} to GND	4.5	-	90	180	-	225	-	270	Ω
Maximum "ON" Resistance Between Any Two Switches	ΔR _{ON}	-	-	4.5	-	10	-	-	-	-	-	Ω
Switch "Off" Leakage Current 16 Channels	I _{Iz}	$\bar{E} = V_{CC}$	V _{CC} or GND	6	-	-	±0.8	-	±8	-	±8	μA
Logic Input Leakage Current	I _I	V _{CC} or GND (Note 3)	-	6	-	-	±0.1	-	±1	-	±1	μA
Quiescent Device Current	I _{CC}	V _{CC} or GND	-	6	-	-	8	-	80	-	160	μA
Additional Quiescent Device Current Per Input Pin: 1 Unit Load	ΔI _{CC} (Note 4)	V _{CC} -2.1	-	-	-	100	360	-	450	-	490	μA

NOTES:

3. Any voltage between V_{CC} and GND.
4. For dual-supply systems theoretical worst case (V_I = 2.4V, V_{CC} = 5.5V) specification is 1.8mA.

HCT Input Loading Table

INPUT	UNIT LOAD
S ₀ - S ₃	0.5
\bar{E}	0.3

NOTE: Unit Load is ΔI_{CC} limit specified in DC Electrical Specifications table, e.g., 360μA max at 25°C.

Switching Specifications Input t_r, t_f = 6ns

PARAMETER	SYMBOL	TEST CONDITIONS	V _{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
HC TYPES											
Propagation Delay Time Switch In to Out	t _{PLH} , t _{PHL}	C _L = 50pF	2	-	-	75	-	95	-	110	ns
			4.5	-	-	15	-	19	-	22	ns
			6	-	-	13	-	16	-	19	ns
		C _L = 15pF	5	-	6	-	-	-	-	-	ns

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Switching Specifications Input $t_r, t_f = 6\text{ns}$ (Continued)

PARAMETER	SYMBOL	TEST CONDITIONS	V_{CC} (V)	25°C			-40°C TO 85°C		-55°C TO 125°C		UNITS
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
Switch Turn On \bar{E} to Out	t_{PZH}, t_{PZL}	$C_L = 50\text{pF}$	2	-	-	275	-	345	-	415	ns
			4.5	-	-	55	-	69	-	83	ns
			6	-	-	47	-	59	-	71	ns
		$C_L = 15\text{pF}$	5	-	23	-	-	-	-	-	ns
Switch Turn On Sn to Out	t_{PZH}, t_{PZL}	$C_L = 50\text{pF}$	2	-	-	300	-	375	-	450	ns
			4.5	-	-	60	-	75	-	90	ns
			6	-	-	51	-	64	-	76	ns
		$C_L = 15\text{pF}$	5	-	25	-	-	-	-	-	ns
Switch Turn Off \bar{E} to Out	t_{PHZ}, t_{PLZ}	$C_L = 50\text{pF}$	2	-	-	275	-	345	-	415	ns
			4.5	-	-	55	-	69	-	83	ns
			6	-	-	47	-	59	-	71	ns
		$C_L = 15\text{pF}$	5	-	23	-	-	-	-	-	ns
Switch Turn Off Sn to Out	t_{PHZ}, t_{PLZ}	$C_L = 50\text{pF}$	2	-	-	290	-	365	-	435	ns
			4.5	-	-	58	-	73	-	87	ns
			6	-	-	49	-	62	-	74	ns
		$C_L = 50\text{pF}$	5	-	21	-	-	-	-	-	ns
Input (Control) Capacitance	C_I	-	-	-	10	-	10	-	10	pF	
Power Dissipation Capacitance (Notes 5, 6)	C_{PD}	-	5	-	93	-	-	-	-	pF	
HCT TYPES											
Propagation Delay Time Switch In to Out	t_{PLH}, t_{PHL}	$C_L = 50\text{pF}$	4.5	-	-	15	-	19	-	22	ns
		$C_L = 15\text{pF}$	5	-	6	-	-	-	-	-	ns
Switch Turn On \bar{E} to Out	t_{PZH}, t_{PZL}	$C_L = 50\text{pF}$	4.5	-	-	60	-	75	-	90	ns
		$C_L = 15\text{pF}$	5	-	25	-	-	-	-	-	ns
Switch Turn On Sn to Out	t_{PZH}, t_{PZL}	$C_L = 50\text{pF}$	4.5	-	-	60	-	75	-	90	ns
		$C_L = 15\text{pF}$	5	-	25	-	-	-	-	-	ns
Switch Turn Off \bar{E} to Out	t_{PHZ}, t_{PLZ}	$C_L = 50\text{pF}$	4.5	-	-	55	-	69	-	83	ns
		$C_L = 15\text{pF}$	5	-	23	-	-	-	-	-	ns
Switch Turn Off Sn to Out	t_{PHZ}, t_{PLZ}	$C_L = 50\text{pF}$	4.5	-	-	58	-	73	-	87	ns
		$C_L = 15\text{pF}$	5	-	21	-	-	-	-	-	ns
Input (Control) Capacitance	C_I	-	-	-	10	-	10	-	10	pF	
Power Dissipation Capacitance (Notes 5, 6)	C_{PD}	-	5	-	96	-	-	-	-	pF	

NOTES:

5. C_{PD} is used to determine the dynamic power consumption, per package.

6. $P_D = C_{PD} V_{CC}^2 f_i + \sum (C_L + C_S) V_{CC}^2 f_o$ where f_i = input frequency, f_o = output frequency, C_L = output load capacitance, C_S = switch capacitance, V_{CC} = supply voltage.

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Analog Channel Specifications $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	V_{CC} (V)	HC/HCT	UNITS
Switch Frequency Response Bandwidth at -3dB (Figure 2)	Figure 4, Notes 7, 8	4.5	89	MHz
Sine Wave Distortion	Figure 5	4.5	0.051	%
Feedthrough Noise E to Switch	Figure 6, Notes 8, 9	4.5	TBE	mV
Feedthrough Noise S to Switch			TBE	mV
Switch "OFF" Signal Feedthrough (Figure 3)	Figure 7	4.5	-75	dB
Switch Input Capacitance, C_S		-	5	pF
Common Capacitance, C_{COM}		-	50	pF

NOTES:

7. Adjust input level for 0dBm at output, $f = 1\text{MHz}$.
8. V_{IS} is centered at $V_{CC}/2$.
9. Adjust input for 0dBm at V_{IS} .

Typical Performance Curves

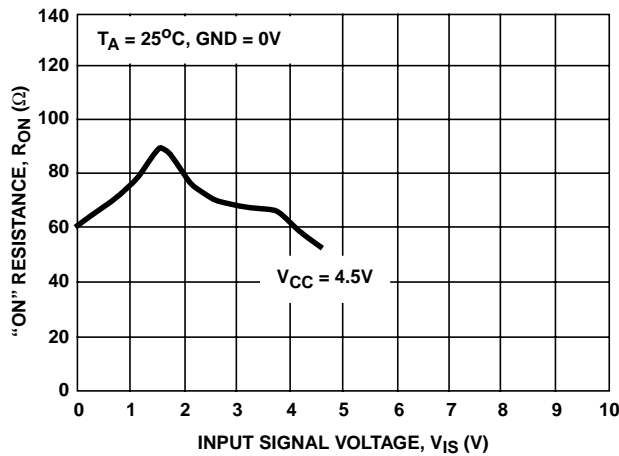


FIGURE 1. TYPICAL "ON" RESISTANCE vs INPUT SIGNAL VOLTAGE

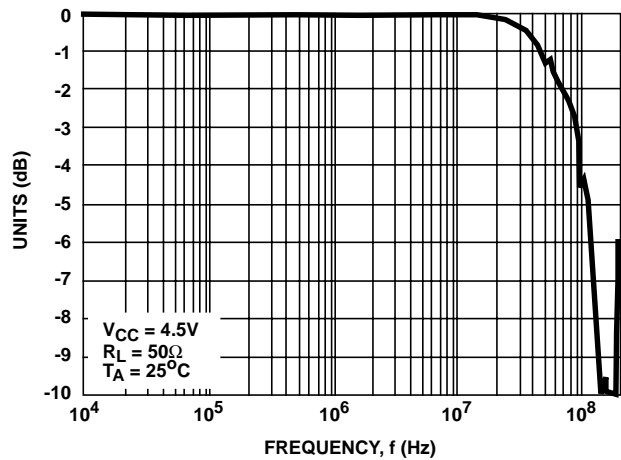


FIGURE 2. TYPICAL SWITCH FREQUENCY RESPONSE

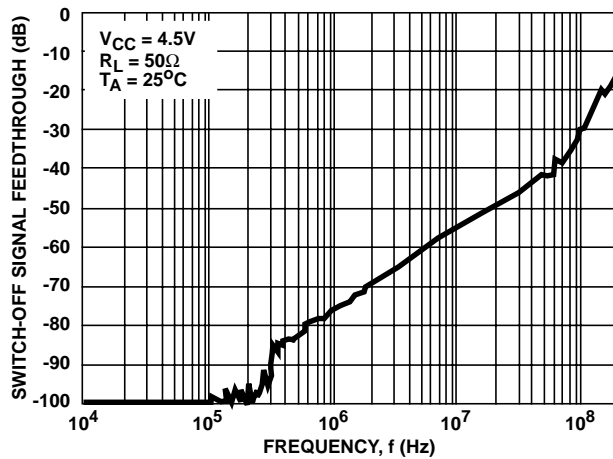


FIGURE 3. TYPICAL SWITCH-OFF SIGNAL FEEDTHROUGH vs FREQUENCY

Analog Test Circuits

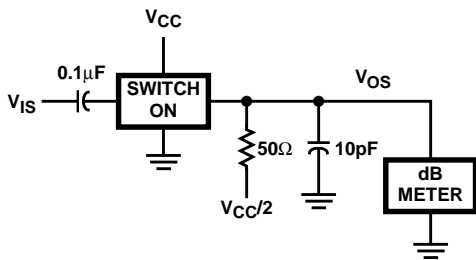
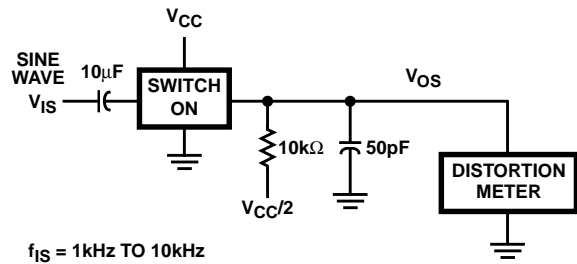


FIGURE 4. FREQUENCY RESPONSE TEST CIRCUIT



$f_{IS} = 1\text{kHz TO } 10\text{kHz}$

FIGURE 5. SINE WAVE DISTORTION TEST CIRCUIT

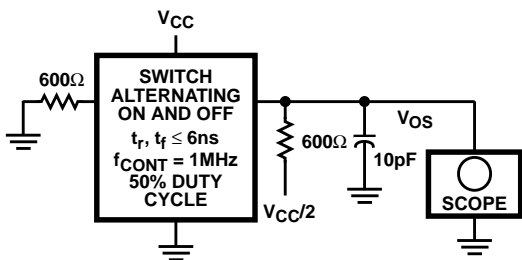


FIGURE 6. CONTROL-TO-SWITCH FEEDTHROUGH NOISE TEST CIRCUIT

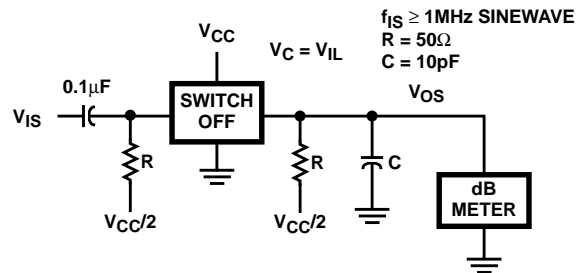


FIGURE 7. SWITCH OFF SIGNAL FEEDTHROUGH TEST CIRCUIT

Test Circuits and Waveforms

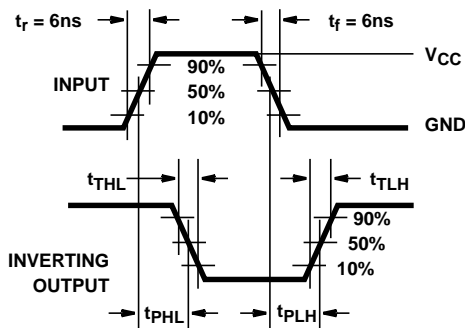


FIGURE 8. HC TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

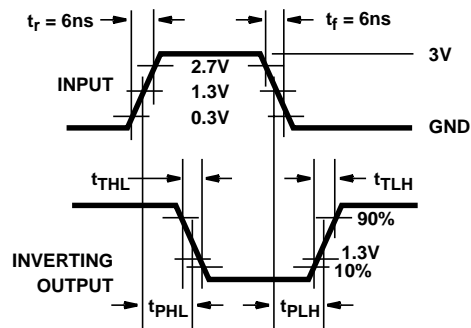


FIGURE 9. HCT TRANSITION TIMES AND PROPAGATION DELAY TIMES, COMBINATION LOGIC

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
CD74HC4067M	LIFEBUY	SOIC	DW	24	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC4067M	
CD74HC4067M96	ACTIVE	SOIC	DW	24	2000	RoHS & Green	NIPDAU SN	Level-1-260C-UNLIM	-55 to 125	HC4067M	Samples
CD74HC4067M96E4	LIFEBUY	SOIC	DW	24	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC4067M	
CD74HC4067M96G4	LIFEBUY	SOIC	DW	24	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC4067M	
CD74HC4067MG4	ACTIVE	SOIC	DW	24	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HC4067M	Samples
CD74HC4067SM96	ACTIVE	SSOP	DB	24	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HP4067	Samples
CD74HC4067SM96E4	ACTIVE	SSOP	DB	24	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HP4067	Samples
CD74HC4067SM96G4	ACTIVE	SSOP	DB	24	2000	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HP4067	Samples
CD74HCT4067M	ACTIVE	SOIC	DW	24	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HCT4067M	Samples
CD74HCT4067ME4	ACTIVE	SOIC	DW	24	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HCT4067M	Samples
CD74HCT4067MG4	ACTIVE	SOIC	DW	24	25	RoHS & Green	NIPDAU	Level-1-260C-UNLIM	-55 to 125	HCT4067M	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBSOLETE: TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

⁽⁵⁾ Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

⁽⁶⁾ Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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OTHER QUALIFIED VERSIONS OF CD74HCT4067 :

- Automotive : [CD74HCT4067-Q1](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

TAPE AND REEL INFORMATION

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
CD74HC4067M96	SOIC	DW	24	2000	330.0	24.4	10.75	15.7	2.7	12.0	24.0	Q1
CD74HC4067M96	SOIC	DW	24	2000	330.0	24.4	10.75	15.7	2.7	12.0	24.0	Q1
CD74HC4067M96G4	SOIC	DW	24	2000	330.0	24.4	10.75	15.7	2.7	12.0	24.0	Q1
CD74HC4067SM96	SSOP	DB	24	2000	330.0	16.4	8.2	8.8	2.5	12.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
CD74HC4067M96	SOIC	DW	24	2000	364.0	361.0	36.0
CD74HC4067M96	SOIC	DW	24	2000	350.0	350.0	43.0
CD74HC4067M96G4	SOIC	DW	24	2000	350.0	350.0	43.0
CD74HC4067SM96	SSOP	DB	24	2000	356.0	356.0	35.0

TUBE


*All dimensions are nominal

Device	Package Name	Package Type	Pins	SPQ	L (mm)	W (mm)	T (μm)	B (mm)
CD74HC4067M	DW	SOIC	24	25	506.98	12.7	4826	6.6
CD74HC4067MG4	DW	SOIC	24	25	506.98	12.7	4826	6.6
CD74HCT4067M	DW	SOIC	24	25	506.98	12.7	4826	6.6
CD74HCT4067ME4	DW	SOIC	24	25	506.98	12.7	4826	6.6
CD74HCT4067MG4	DW	SOIC	24	25	506.98	12.7	4826	6.6

DW (R-PDSO-G24)

PLASTIC SMALL OUTLINE



- NOTES:
- A. All linear dimensions are in inches (millimeters). Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
 - D. Falls within JEDEC MS-013 variation AD.

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-150

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