

CD4069UBMS

CMOS Hex Inverter

FN3321

Rev 0.00

December 1992

Features

- High Voltage Types (20V Rating)
- Standardized Symmetrical Output Characteristics
- Medium Speed Operation: $t_{PHL}, t_{PLH} = 30\text{ns}$ (typ) at 10V
- 100% Tested for Quiescent Current at 20V
- Maximum Input Current of $1\mu\text{A}$ at 18V Over Full Package Temperature Range; 100nA at 18V and +25°C
- Meets All Requirements of JEDEC Tentative Standard No. 13B, "Standard Specifications for Description of 'B' Series CMOS Devices"

Applications

- Logic Inversion
- Pulse Shaping
- Oscillators
- High-Input-Impedance Amplifiers

Description

CD4069UBMS types consist of six CMOS inverter circuits. These devices are intended for all general-purpose inverter applications where the medium-power TTL-drive and logic-level conversion capabilities of circuits such as the CD4009 and CD4049 Hex Inverter/Buffers are not required.

The CD4069UBMS is supplied in these 14 lead outline packages:

Braze Seal DIP	H4H
Frit Seal DIP	H1B
Ceramic Flatpack	H3W

Pinout

CD4069UBMS

TOP VIEW

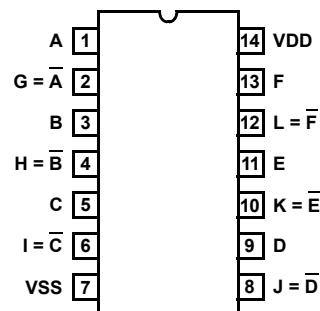
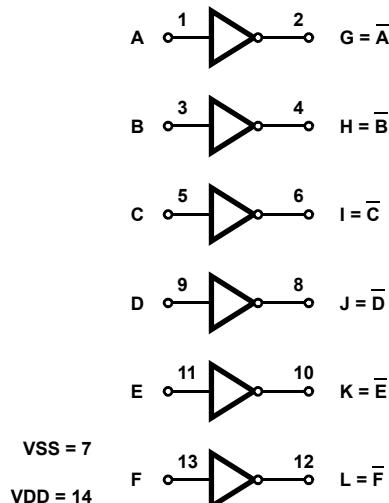
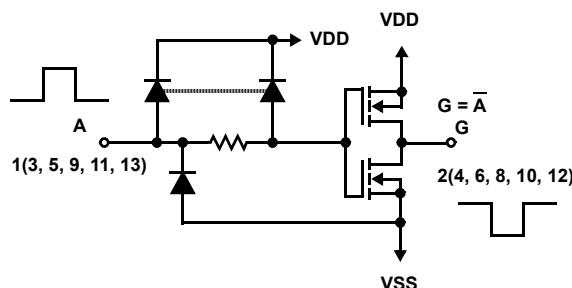
**Functional Diagram****Schematic Diagram**

FIGURE 1. SCHEMATIC DIAGRAM OF 1 OF 6 IDENTICAL INVERTERS

Absolute Maximum Ratings

DC Supply Voltage Range, (VDD)	-0.5V to +20V
(Voltage Referenced to VSS Terminals)	
Input Voltage Range, All Inputs	-0.5V to VDD +0.5V
DC Input Current, Any One Input	±10mA
Operating Temperature Range	-55°C to +125°C
Package Types D, F, K, H	
Storage Temperature Range (TSTG)	-65°C to +150°C
Lead Temperature (During Soldering)	+265°C
At Distance 1/16 ± 1/32 Inch (1.59mm ± 0.79mm) from case for 10s Maximum	

Reliability Information

Thermal Resistance	θ_{ja}	θ_{jc}
Ceramic DIP and FRIT Package	80°C/W	20°C/W
Flatpack Package	70°C/W	20°C/W
Maximum Package Power Dissipation (PD) at +125°C		
For TA = -55°C to +100°C (Package Type D, F, K)	500mW	
For TA = +100°C to +125°C (Package Type D, F, K)	Derate Linearity at 12mW/°C to 200mW	
Device Dissipation per Output Transistor	100mW	
For TA = Full Package Temperature Range (All Package Types)		
Junction Temperature	+175°C	

TABLE 1. DC ELECTRICAL PERFORMANCE CHARACTERISTICS

PARAMETER	SYMBOL	CONDITIONS (NOTE 1)	GROUP A SUBGROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Supply Current	IDD	VDD = 20V, VIN = VDD or GND	1	+25°C	-	0.5	µA
			2	+125°C	-	50	µA
		VDD = 18V, VIN = VDD or GND	3	-55°C	-	0.5	µA
Input Leakage Current	IIL	VIN = VDD or GND	1	+25°C	-100	-	nA
			2	+125°C	-1000	-	nA
		VDD = 18V	3	-55°C	-100	-	nA
Input Leakage Current	IIH	VIN = VDD or GND	1	+25°C	-	100	nA
			2	+125°C	-	1000	nA
		VDD = 18V	3	-55°C	-	100	nA
Output Voltage	VOL15	VDD = 15V, No Load	1, 2, 3	+25°C, +125°C, -55°C	-	50	mV
Output Voltage	VOH15	VDD = 15V, No Load (Note 3)	1, 2, 3	+25°C, +125°C, -55°C	14.95	-	V
Output Current (Sink)	IOL5	VDD = 5V, VOUT = 0.4V	1	+25°C	0.53	-	mA
Output Current (Sink)	IOL10	VDD = 10V, VOUT = 0.5V	1	+25°C	1.4	-	mA
Output Current (Sink)	IOL15	VDD = 15V, VOUT = 1.5V	1	+25°C	3.5	-	mA
Output Current (Source)	IOH5A	VDD = 5V, VOUT = 4.6V	1	+25°C	-	-0.53	mA
Output Current (Source)	IOH5B	VDD = 5V, VOUT = 2.5V	1	+25°C	-	-1.8	mA
Output Current (Source)	IOH10	VDD = 10V, VOUT = 9.5V	1	+25°C	-	-1.4	mA
Output Current (Source)	IOH15	VDD = 15V, VOUT = 13.5V	1	+25°C	-	-3.5	mA
N Threshold Voltage	VNTH	VDD = 10V, ISS = -10µA	1	+25°C	-2.8	-0.7	V
P Threshold Voltage	VPTH	VSS = 0V, IDD = 10µA	1	+25°C	0.7	2.8	V
Functional	F	VDD = 2.8V, VIN = VDD or GND	7	+25°C	VOH > VDD/2	VOL < VDD/2	V
		VDD = 20V, VIN = VDD or GND	7	+25°C			
		VDD = 18V, VIN = VDD or GND	8A	+125°C			
		VDD = 3V, VIN = VDD or GND	8B	-55°C			
Input Voltage Low (Note 2)	VIL	VDD = 5V, VOH > 4.5V, VOL < 0.5V	1, 2, 3	+25°C, +125°C, -55°C	-	1.0	V
Input Voltage High (Note 2)	VIH	VDD = 5V, VOH > 4.5V, VOL < 0.5V	1, 2, 3	+25°C, +125°C, -55°C	4.0	-	V
Input Voltage Low (Note 2)	VIL	VDD = 15V, VOH > 13.5V, VOL < 1.5V	1, 2, 3	+25°C, +125°C, -55°C	-	2.5	V
Input Voltage High (Note 2)	VIH	VDD = 15V, VOH > 13.5V, VOL < 1.5V	1, 2, 3	+25°C, +125°C, -55°C	12.5	-	V

NOTES: 1. All voltages referenced to device GND, 100% testing being implemented.

3. For accuracy, voltage is measured differentially to VDD. Limit is 0.050V max.

2. Go/No Go test with limits applied to inputs.

TABLE 2. AC ELECTRICAL PERFORMANCE CHARACTERISTICS

PARAMETER	SYMBOL	CONDITIONS (NOTES 1, 2)	GROUP A SUBGROUPS	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Propagation Delay	TPHL TPLH	VDD = 5V, VIN = VDD or GND	9	+25°C	-	110	ns
			10, 11	+125°C, -55°C	-	149	ns
Transition Time	TTHL TTLH	VDD = 5V, VIN = VDD or GND	9	+25°C	-	200	ns
			10, 11	+125°C, -55°C	-	270	ns

NOTES:

1. CL = 50pF, RL = 200K, Input TR, TF < 20ns.
2. -55°C and +125°C limits guaranteed, 100% testing being implemented.

TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS

PARAMETER	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Supply Current	IDD	VDD = 5V, VIN = VDD or GND	1, 2	-55°C, +25°C	-	0.25	µA
				+125°C	-	7.5	µA
		VDD = 10V, VIN = VDD or GND	1, 2	-55°C, +25°C	-	0.5	µA
				+125°C	-	15	µA
		VDD = 15V, VIN = VDD or GND	1, 2	-55°C, +25°C	-	0.5	µA
				+125°C	-	30	µA
Output Voltage	VOL	VDD = 5V, No Load	1, 2	+25°C, +125°C, -55°C	-	50	mV
Output Voltage	VOL	VDD = 10V, No Load	1, 2	+25°C, +125°C, -55°C	-	50	mV
Output Voltage	VOH	VDD = 5V, No Load	1, 2	+25°C, +125°C, -55°C	4.95	-	V
Output Voltage	VOH	VDD = 10V, No Load	1, 2	+25°C, +125°C, -55°C	9.95	-	V
Output Current (Sink)	IOL5	VDD = 5V, VOUT = 0.4V	1, 2	+125°C	0.36	-	mA
Output Current (Sink)	IOL5	VDD = 5V, VOUT = 0.4V		-55°C	0.64	-	mA
Output Current (Sink)	IOL10	VDD = 10V, VOUT = 0.5V	1, 2	+125°C	0.9	-	mA
Output Current (Sink)	IOL10	VDD = 10V, VOUT = 0.5V		-55°C	1.6	-	mA
Output Current (Sink)	IOL15	VDD = 15V, VOUT = 1.5V	1, 2	+125°C	2.4	-	mA
Output Current (Sink)	IOL15	VDD = 15V, VOUT = 1.5V		-55°C	4.2	-	mA
Output Current (Source)	IOH5A	VDD = 5V, VOUT = 4.6V	1, 2	+125°C	-	-0.36	mA
Output Current (Source)	IOH5A	VDD = 5V, VOUT = 4.6V		-55°C	-	-0.64	mA
Output Current (Source)	IOH5B	VDD = 5V, VOUT = 2.5V	1, 2	+125°C	-	-1.15	mA
Output Current (Source)	IOH5B	VDD = 5V, VOUT = 2.5V		-55°C	-	-2.0	mA
Output Current (Source)	IOH10	VDD = 10V, VOUT = 9.5V	1, 2	+125°C	-	-0.9	mA
Output Current (Source)	IOH10	VDD = 10V, VOUT = 9.5V		-55°C	-	-2.6	mA
Output Current (Source)	IOH15	VDD = 15V, VOUT = 13.5V	1, 2	+125°C	-	-2.4	mA
Output Current (Source)	IOH15	VDD = 15V, VOUT = 13.5V		-55°C	-	-4.2	mA
Input Voltage Low	VIL	VDD = 10V, VOH > 9V, VOL < 1V	1, 2	+25°C, +125°C, -55°C	-	2	V
Input Voltage High	VIH	VDD = 10V, VOH > 9V, VOL < 1V	1, 2	+25°C, +125°C, -55°C	8	-	V
Propagation Delay	TPHL TPLH	VDD = 10V	1, 2, 3	+25°C	-	60	ns
		VDD = 15V	1, 2, 3	+25°C	-	50	ns
Transition Time	TTHL TTLH	VDD = 10V	1, 2, 3	+25°C	-	100	ns
		VDD = 15V	1, 2, 3	+25°C	-	80	ns

TABLE 3. ELECTRICAL PERFORMANCE CHARACTERISTICS (Continued)

PARAMETER	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Input Capacitance	CIN	Any Input	1, 2	+25°C	-	15	pF

NOTES:

1. All voltages referenced to device GND.
2. The parameters listed on Table 3 are controlled via design or process and are not directly tested. These parameters are characterized on initial design release and upon design changes which would affect these characteristics.
3. CL = 50pF, RL = 200K, Input TR, TF < 20ns.

TABLE 4. POST IRRADIATION ELECTRICAL PERFORMANCE CHARACTERISTICS

PARAMETER	SYMBOL	CONDITIONS	NOTES	TEMPERATURE	LIMITS		UNITS
					MIN	MAX	
Supply Current	IDD	VDD = 20V, VIN = VDD or GND	1, 4	+25°C	-	2.5	µA
N Threshold Voltage	VNTH	VDD = 10V, ISS = -10µA	1, 4	+25°C	-2.8	-0.2	V
N Threshold Voltage Delta	ΔVTN	VDD = 10V, ISS = -10µA	1, 4	+25°C	-	±1	V
P Threshold Voltage	VTP	VSS = 0V, IDD = 10µA	1, 4	+25°C	0.2	2.8	V
P Threshold Voltage Delta	ΔVTP	VSS = 0V, IDD = 10µA	1, 4	+25°C	-	±1	V
Functional	F	VDD = 18V, VIN = VDD or GND	1	+25°C	VOH > VDD/2	VOL < VDD/2	V
		VDD = 3V, VIN = VDD or GND					
Propagation Delay Time	TPHL TPLH	VDD = 5V	1, 2, 3, 4	+25°C	-	1.35 x +25°C Limit	ns

- NOTES: 1. All voltages referenced to device GND.
 2. CL = 50pF, RL = 200K, Input TR, TF < 20ns.
 3. See Table 2 for +25°C limit.
 4. Read and Record

TABLE 5. BURN-IN AND LIFE TEST DELTA PARAMETERS +25°C

PARAMETER	SYMBOL	DELTA LIMIT
Supply Current - SS1	IDD	±0.1µA
Output Current (Sink)	IOL5	± 20% x Pre-Test Reading
Output Current (Source)	IOH5A	± 20% x Pre-Test Reading

TABLE 6. APPLICABLE SUBGROUPS

CONFORMANCE GROUP	MIL-STD-883 METHOD	GROUP A SUBGROUPS	READ AND RECORD
Initial Test (Pre Burn-In)	100% 5004	1, 7, 9	IDD, IOL5, IOH5A
Interim Test 1 (Post Burn-In)	100% 5004	1, 7, 9	IDD, IOL5, IOH5A
Interim Test 2 (Post Burn-In)	100% 5004	1, 7, 9	IDD, IOL5, IOH5A
PDA (Note 1)	100% 5004	1, 7, 9, Deltas	
Interim Test 3 (Post Burn-In)	100% 5004	1, 7, 9	IDD, IOL5, IOH5A
PDA (Note 1)	100% 5004	1, 7, 9, Deltas	
Final Test	100% 5004	2, 3, 8A, 8B, 10, 11	
Group A	Sample 5005	1, 2, 3, 7, 8A, 8B, 9, 10, 11	
Group B	Subgroup B-5	1, 2, 3, 7, 8A, 8B, 9, 10, 11, Deltas	Subgroups 1, 2, 3, 9, 10, 11
	Subgroup B-6	1, 7, 9	
Group D	Sample 5005	1, 2, 3, 8A, 8B, 9	Subgroups 1, 2 3

NOTE: 1. 5% Parameteric, 3% Functional; Cumulative for Static 1 and 2.

TABLE 7. TOTAL DOSE IRRADIATION

CONFORMANCE GROUPS	MIL-STD-883 METHOD	TEST		READ AND RECORD	
		PRE-IRRAD	POST-IRRAD	PRE-IRRAD	POST-IRRAD
Group E Subgroup 2	5005	1, 7, 9	Table 4	1, 9	Table 4

TABLE 8. BURN-IN AND IRRADIATION TEST CONNECTIONS

FUNCTION	OPEN	GROUND	VDD	9V ± -0.5V	OSCILLATOR	
					50kHz	25kHz
Static Burn-In 1 (Note 1)	2, 4, 6, 8, 10, 12	1, 3, 5, 7, 9, 11, 13	14			
Static Burn-In 2 (Note 1)	2, 4, 6, 8, 10, 12	7	1, 3, 5, 9, 11, 13, 14			
Dynamic Burn-In (Note 1)	-	7	14	2, 4, 6, 8, 10, 12	1, 3, 5, 9, 11, 13	
Irradiation (Note 2)	2, 4, 6, 8, 10, 12	7	1, 3, 5, 9, 11, 13, 14			

NOTES:

1. Each pin except VDD and GND will have a series resistor of $10K \pm 5\%$, $VDD = 18V \pm 0.5V$
2. Each pin except VDD and GND will have a series resistor of $47K \pm 5\%$; Group E, Subgroup 2, sample size is 4 dice/wafer, 0 failures, $VDD = 10V \pm 0.5V$

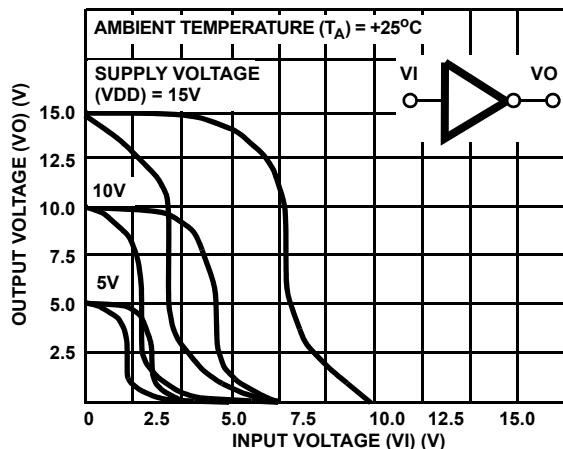
Typical Performance Characteristics

FIGURE 2. MINIMUM AND MAXIMUM VOLTAGE TRANSFER CHARACTERISTICS

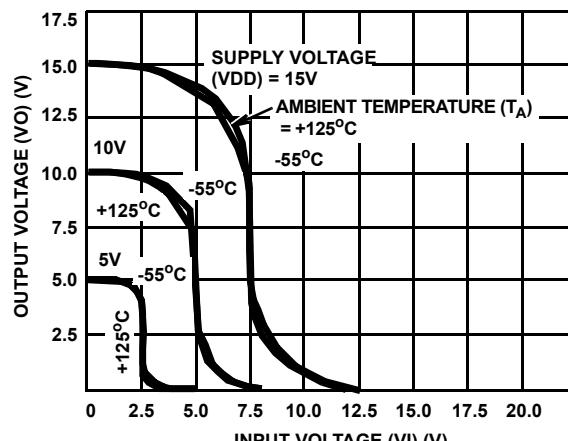


FIGURE 3. TYPICAL VOLTAGE TRANSFER CHARACTERISTICS AS A FUNCTION OF TEMPERATURE

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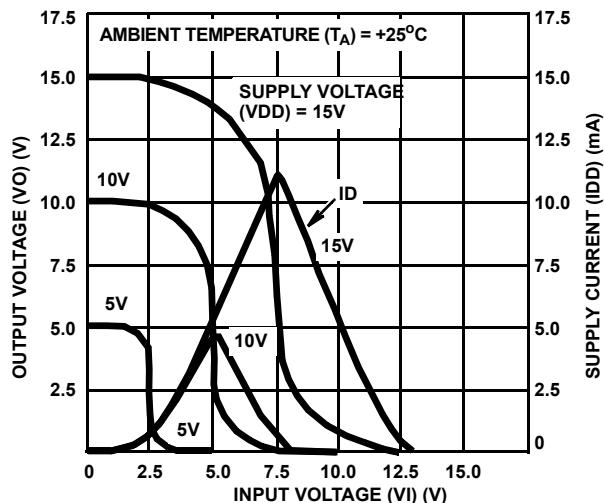
Typical Performance Characteristics (Continued)

FIGURE 4. TYPICAL CURRENT AND VOLTAGE TRANSFER CHARACTERISTICS

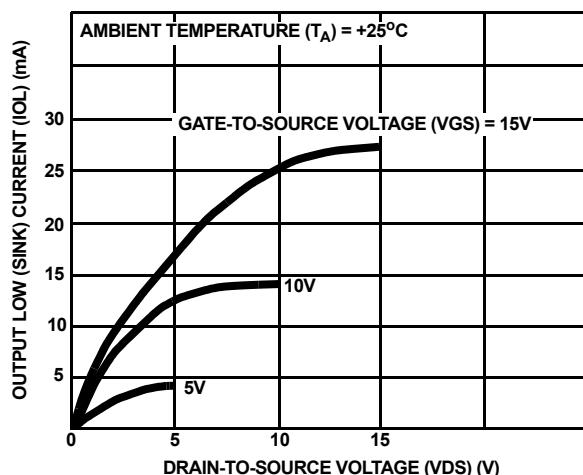


FIGURE 5. TYPICAL OUTPUT LOW (SINK) CURRENT CHARACTERISTICS

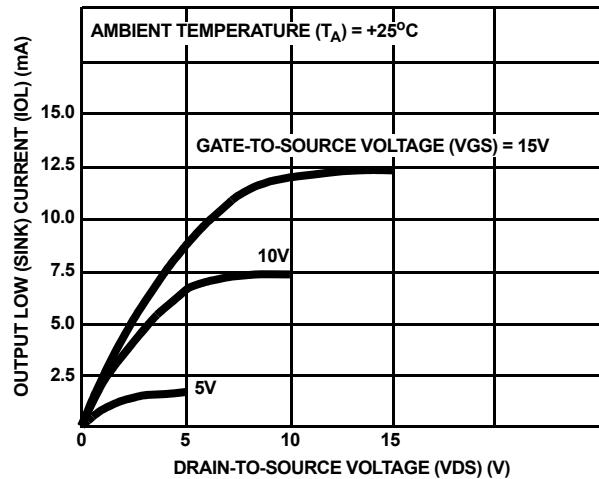


FIGURE 6. MINIMUM OUTPUT LOW (SINK) CURRENT CHARACTERISTICS

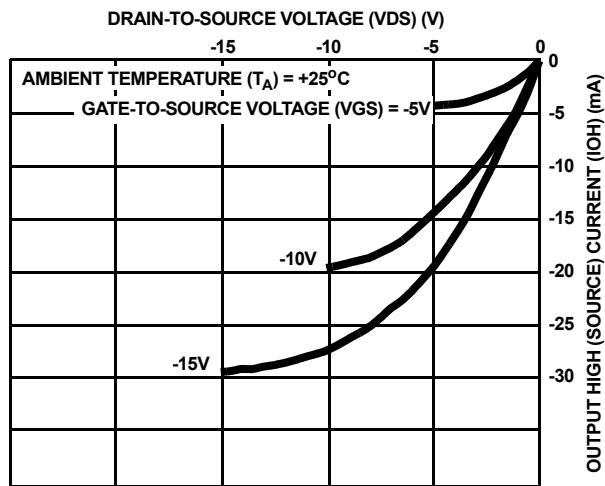


FIGURE 7. TYPICAL OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

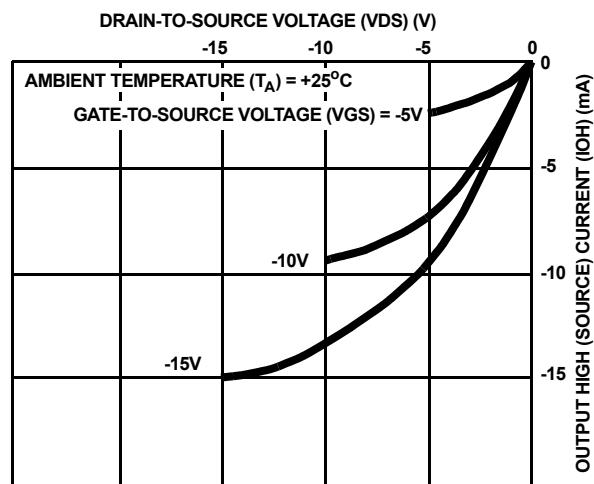


FIGURE 8. MINIMUM OUTPUT HIGH (SOURCE) CURRENT CHARACTERISTICS

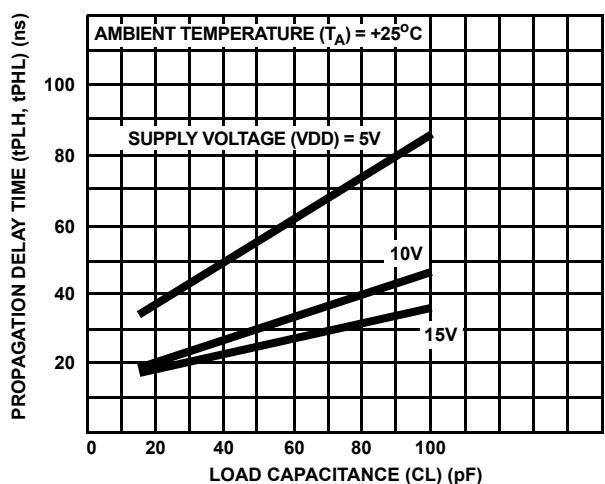


FIGURE 9. TYPICAL PROPAGATION DELAY TIME vs LOAD CAPACITANCE

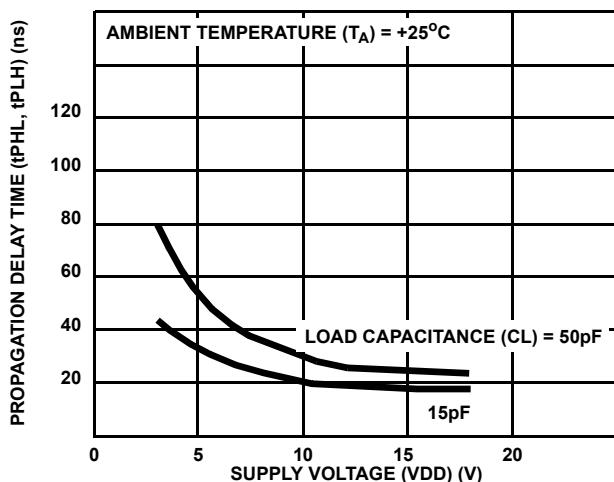
Typical Performance Characteristics (Continued)

FIGURE 10. TYPICAL PROPAGATION DELAY TIME vs SUPPLY VOLTAGE

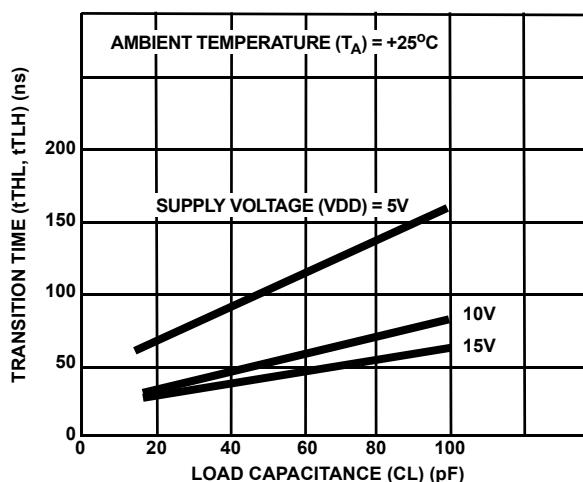


FIGURE 11. TYPICAL TRANSITION TIME vs LOAD CAPACITANCE

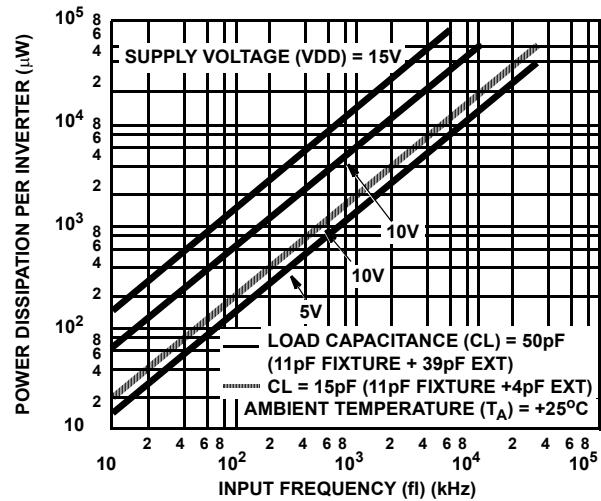


FIGURE 12. TYPICAL DYNAMIC POWER DISSIPATION vs FREQUENCY

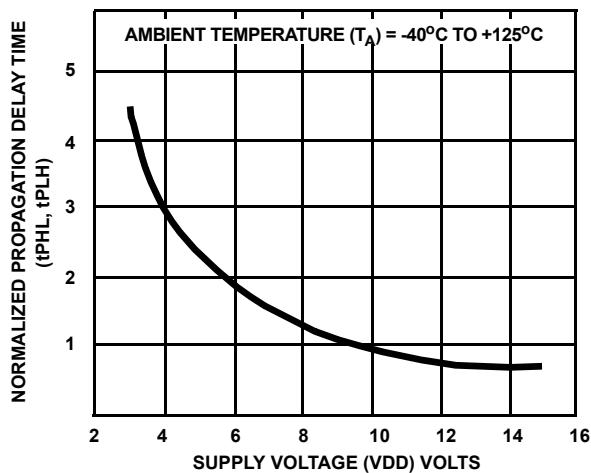


FIGURE 13. VARIATION OF NORMALIZED PROPAGATION DELAY TIME (tPHL AND tPLH) WITH SUPPLY VOLTAGE

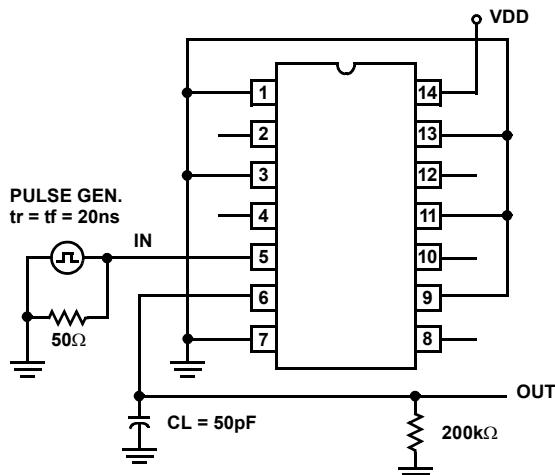


FIGURE 14. DYNAMIC ELECTRICAL CHARACTERISTICS TEST CIRCUIT AND WAVEFORMS

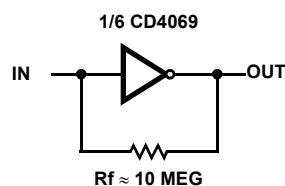
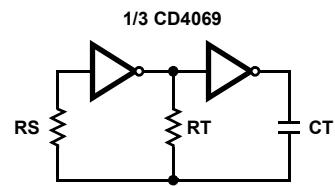
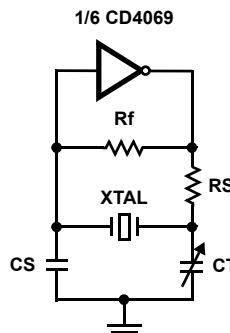


FIGURE 15. HIGH-INPUT IMPEDANCE AMPLIFIER



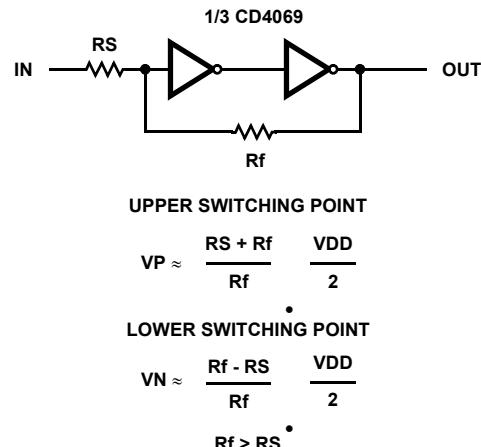
**FOR TYPICAL COMPONENT
VALUES AND CIRCUIT PERFORMANCE,
SEE APPLICATION NOTE AN-6466**

FIGURE 16. TYPICAL RC OSCILLATOR CIRCUIT



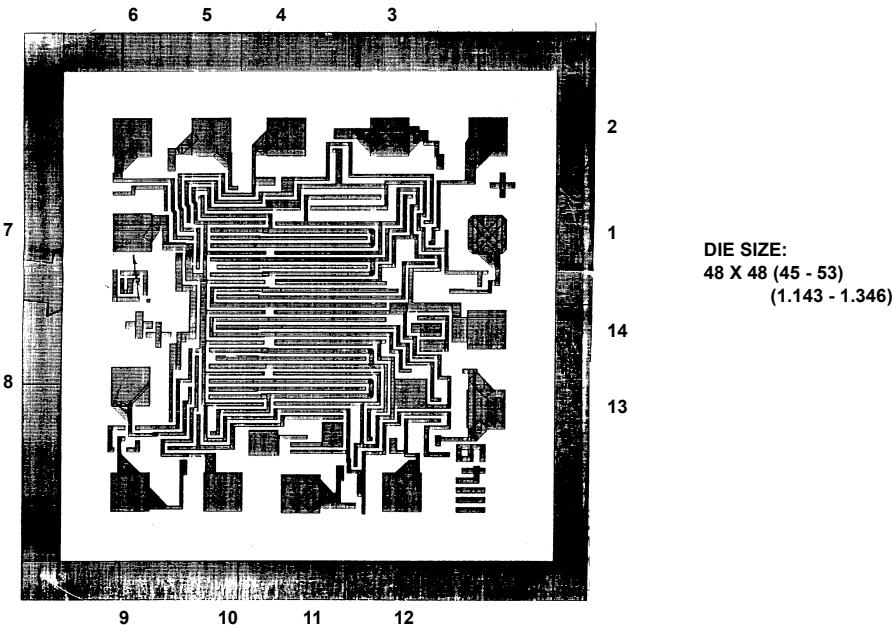
**FOR TYPICAL COMPONENT
VALUES AND CIRCUIT
PERFORMANCE, SEE
APPLICATION NOTES:
AN-6086 AND AN-6539**

FIGURE 17. TYPICAL CRYSTAL OSCILLATOR CIRCUIT



**FIGURE 18. INPUT PULSE SHAPING CIRCUIT
(SCHMITT TRIGGER)**

Chip Dimensions and Pad Layout



Dimension in parenthesis are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils (10^{-3} inch).

METALLIZATION: Thickness: 11kÅ – 14kÅ, AL.

PASSIVATION: 10.4kÅ - 15.6kÅ, Silane

BOND PADS: 0.004 inches X 0.004 inches MIN

DIE THICKNESS: 0.0198 inches - 0.0218 inches