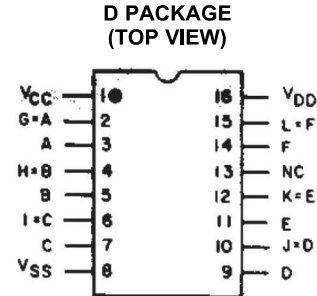


CMOS HEX BUFFER/CONVERTER

 Check for Samples: [CD4010B-Q1](#)

FEATURES

- Qualified for Automotive Applications
- 100% Tested for Quiescent Current at 20 V
- Maximum Input Current of 1 μ A at 18 V Over Full Package-Temperature Range:
100 nA at 18 V and 25°C
- 5-V, 10-V, and 15-V Parametric Ratings
- Latch-Up Performance Meets 100 mA per JESD 78, Class I



APPLICATIONS

- CMOS to DTL/TTL Hex Converter
- CMOS Current "Sink" or "Source" Driver
- CMOS High-to-Low Logic-Level Converter
- Multiplexer: 1-to-6 or 6-to-1

DESCRIPTION

CD4010B hex buffer/converter may be used as CMOS to TTL or DTL logic-level converters or CMOS high-sink-current drivers.

The CD4050B is the preferred hex buffer replacement for the CD4010B in all applications except multiplexers. For applications not requiring high sink current or voltage conversion, the CD4069UB hex inverter is recommended.

The CD4010B is supplied in 16-lead hermetic dual-in-line ceramic (D) packages.

ORDERING INFORMATION⁽¹⁾

T _A	PACKAGE ⁽²⁾		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-40°C to 125°C	SOIC – D	Reel of 2500	CD4010BQDRQ1	CD4010BQ

- (1) For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com.
- (2) Package drawings, thermal data, and symbolization are available at www.ti.com/packaging.



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

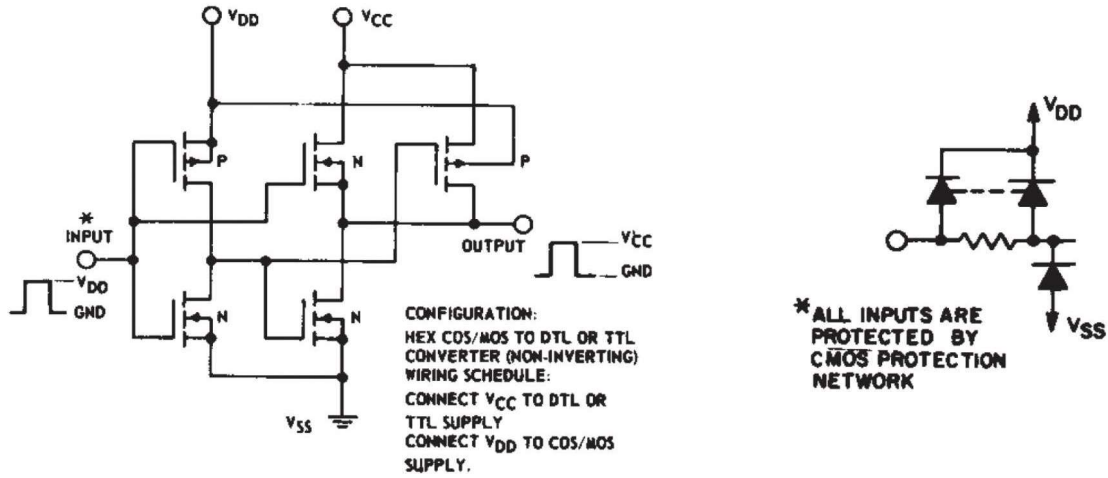
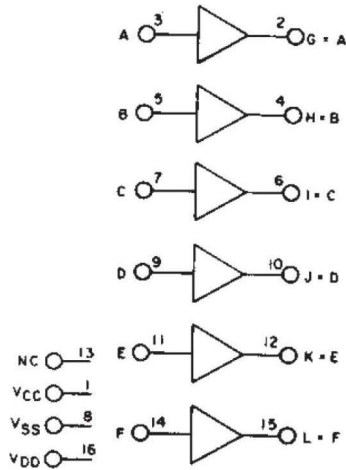


Figure 1. Schematic Diagram – One of Six Identical Stages

Functional Diagram



ABSOLUTE MAXIMUM RATINGS⁽¹⁾

over operating free-air temperature range (unless otherwise noted)

		VALUE	UNIT
V_{DD}	DC supply voltage range, voltages referenced to V_{SS} terminal	–0.5 to +20	V
	Input voltage range, all inputs	–0.5 to $V_{DD} + 0.5$	V
	DC input current, any one input	± 10	mA
P_D	Power dissipation per package	$T_A = -40^\circ\text{C}$ to $+100^\circ\text{C}$	500
		$T_A = +100^\circ\text{C}$ to $+125^\circ\text{C}$	Derate linearly at 12 mW/ $^\circ\text{C}$ to 200 mW
	Device dissipation per output transistor	$T_A =$ full package-temperature range (all packages types)	100
T_A	Operating temperature range	–40 to +125	$^\circ\text{C}$
T_{stg}	Storage temperature range	–65 to +150	$^\circ\text{C}$
	Latch-up performance per JESD 78, Class I	100	mA
ESD	Electrostatic discharge rating ⁽²⁾	Human-body model (HBM)	500
		Machine model (MM)	100
		Charged-Device Model (CDM)	1000

- (1) Stresses beyond those listed under *absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) Tested in accordance with AEC-Q100.

RECOMMENDED OPERATING CONDITIONS

		MIN	MAX	UNIT
V_{DD}	Supply voltage range ⁽¹⁾	3	18	V
V_{CC}		3	V_{DD}	
V_I	Input voltage range	V_{CC}	V_{DD}	V

- (1) The CD4010B has high-to-low level voltage conversion capability, but not low-to-high level; therefore, it is recommended that $V_{DD} > V_I > V_{CC}$.

STATIC ELECTRICAL CHARACTERISTICS

over operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS			LIMITS AT INDICATED TEMPERATURES (°C)						UNIT
	V _O	V _{IN}	V _{DD}	-40	+85	+125	+25			
							MIN	TYP	MAX	
I _{DD} Max Quiescent device current		0, 5	5	1	30	30	0.02			μA
		0, 10	10	2	60	60	0.02			
		0, 15	15	4	120	120	0.02			
		0,20	20	20	600	600	0.04			
I _{OL} Min Output low (sink) current	0.4	0, 5	4.5	3.1	2.1	1.8	2.6	3.4		mA
	0.4	0, 5	5	3.6	2.4	2.1	3	4		
	0.5	0, 10	10	9.6	6.4	5.6	8	10		
	1.5	0, 15	15	40	19	16	24	36		
I _{OH} Min Output high (source) current	4.6	0, 5	5	-0.23	-0.18	-0.15	-0.2	-0.4		mA
	2.5	0, 5	5	-0.9	-0.65	-0.58	-0.8	-1.6		
	9.5	0, 10	10	-0.5	-0.38	-0.33	-0.45	-0.9		
	13.5	0, 15	15	-1.6	-1.25	-1.1	-1.5	-3		
V _{OL} Max Output voltage: Low-level		0, 5	5	0.05			0	0.05		V
		0, 10	10	0.05			0	0.05		
		0, 15	15	0.05			0	0.05		
V _{OH} Min Output voltage: High-level		0, 5	5	4.95			4.95	5		V
		0, 10	10	9.95			9.95	10		
		0, 15	15	14.95			14.95	15		
V _{IL} Max Input low voltage	0.5		5	1.5				1.5		V
	1		10	3				3		
	1.5		15	4				4		
V _{IH} Min Input high voltage	4.5		5	3.5			3.5		V	
	9		10	7			7			
	13.5		15	11			11			
I _{IN} Max Input current		0, 18	18	±0.1	±1	±1	±10 ⁻⁵		±0.1	μA

DYNAMIC ELECTRICAL CHARACTERISTICS
 $T_A = 25^\circ\text{C}$, Input $t_r/t_f = 20\text{ ns}$, $C_L = 50\text{ pf}$, $R_L = 200\text{ k}\Omega$

PARAMETER	TEST CONDITIONS			LIMITS ALL PKGS		UNIT
	V_{DD} (V)	V_I (V)	V_{CC} (V)	TYP	MAX	
t_{PLH} Propagation delay time: low-to-high	5	5	5	100	200	ns
	10	10	10	50	100	
	10	10	5	50	100	
	15	15	15	35	70	
	15	15	5	35	70	
t_{PHL} Propagation time: high-to-low	5	5	5	65	130	ns
	10	10	10	35	70	
	10	10	5	30	70	
	15	15	15	25	50	
	15	15	5	20	40	
t_{TLH} Transition time: low-to-high	5	5	5	150	350	ns
	10	10	10	75	150	
	15	15	15	55	110	
t_{THL} Transition time: high-to-low	5	5	5	35	90	ns
	10	10	10	20	45	
	15	15	15	15	40	
C_{IN} Input capacitance				5	7.5	pF

TYPICAL CHARACTERISTICS

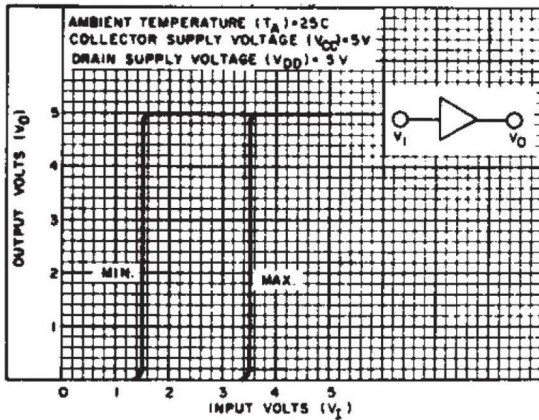


Figure 2. Minimum and Maximum Voltage Transfer Characteristics ($V_{DD} = 5\text{ V}$)

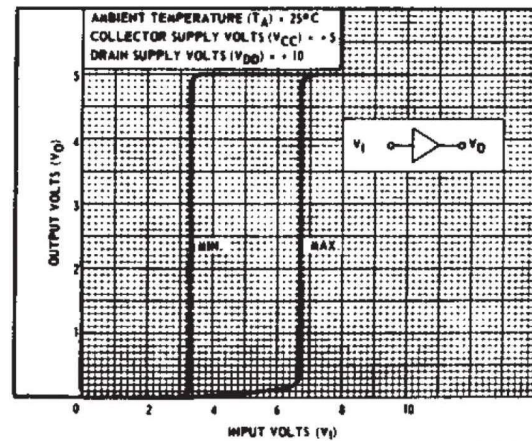


Figure 3. Minimum and Maximum Voltage Transfer Characteristics ($V_{DD} = 10\text{ V}$)

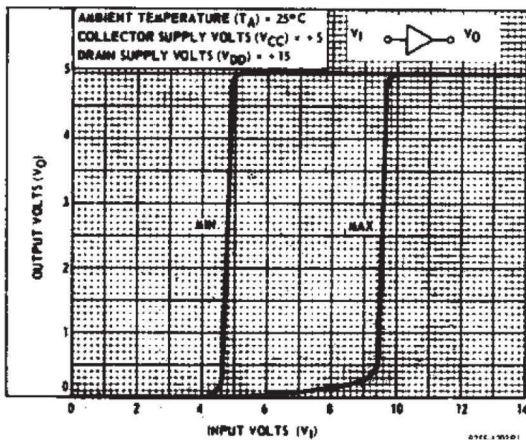


Figure 4. Minimum and Maximum Voltage Transfer Characteristics ($V_{DD} = 15\text{ V}$)

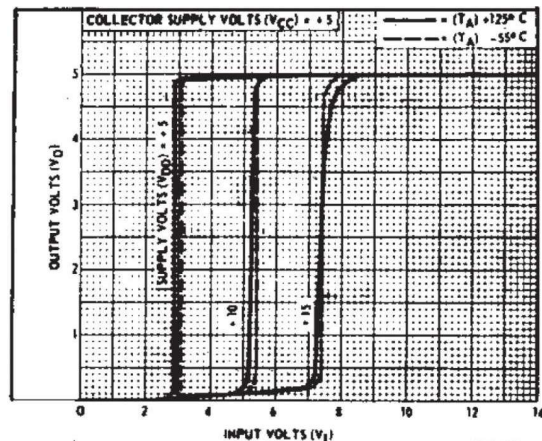


Figure 5. Typical Voltage Transfer Characteristics as a Function of Temperature

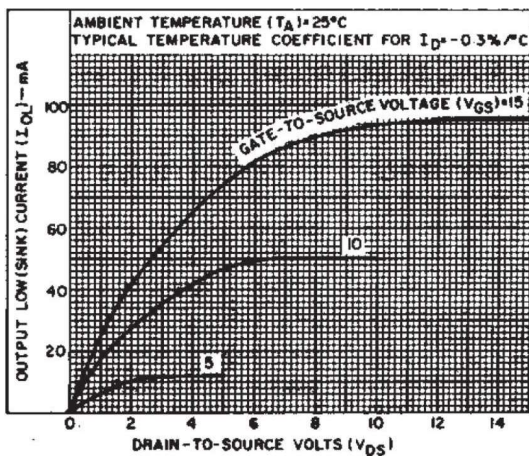


Figure 6. Typical Output Low (Sink) Current Characteristics

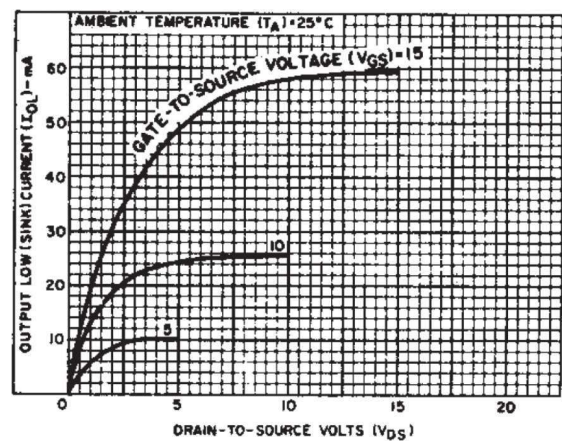


Figure 7. Minimum Output Low (Sink) Current Characteristics

TYPICAL CHARACTERISTICS (continued)

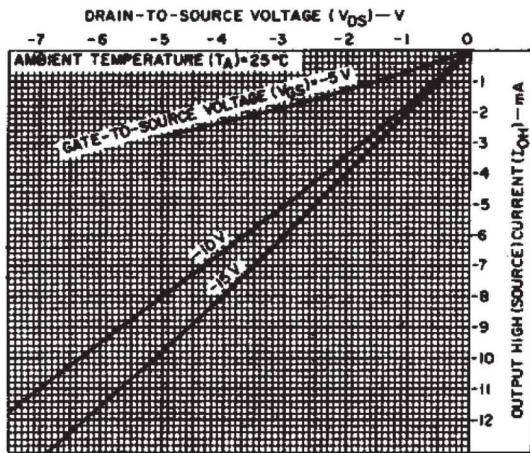


Figure 8. Typical Output High (Source) Current Characteristics

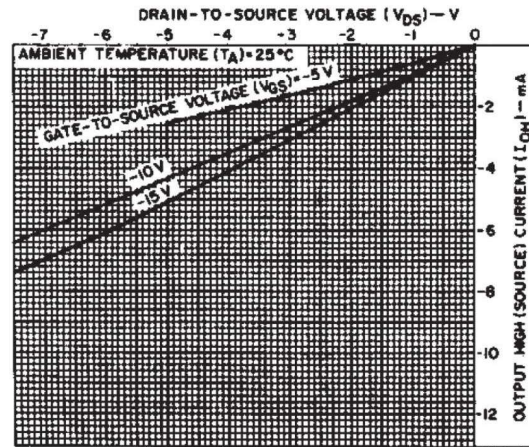


Figure 9. Minimum Output High (Source) Current Characteristics

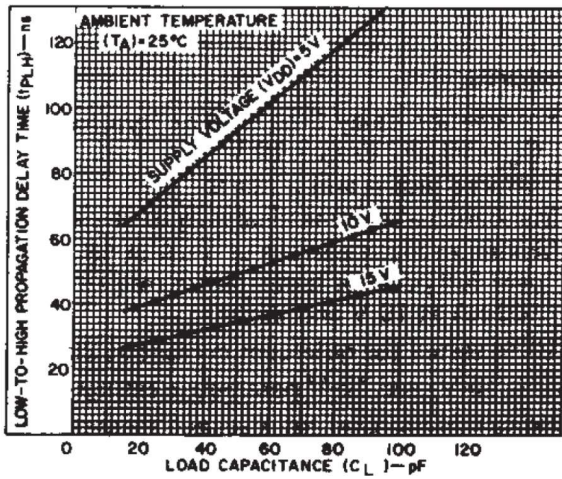


Figure 10. Typical Low-to-High Propagation Delay Time vs Load Capacitance

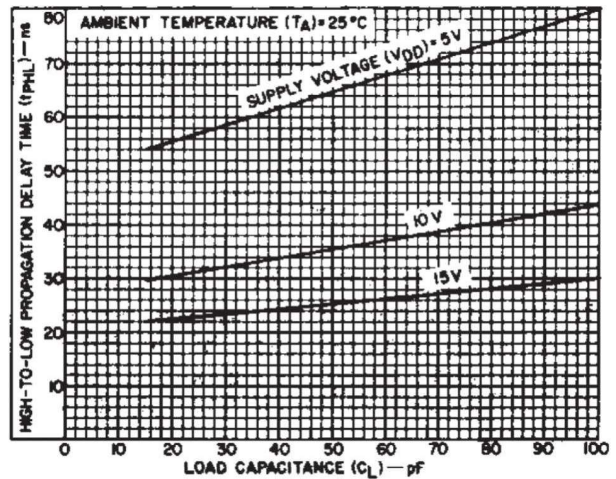


Figure 11. Typical High-to-Low Propagation Delay Time vs Load Capacitance

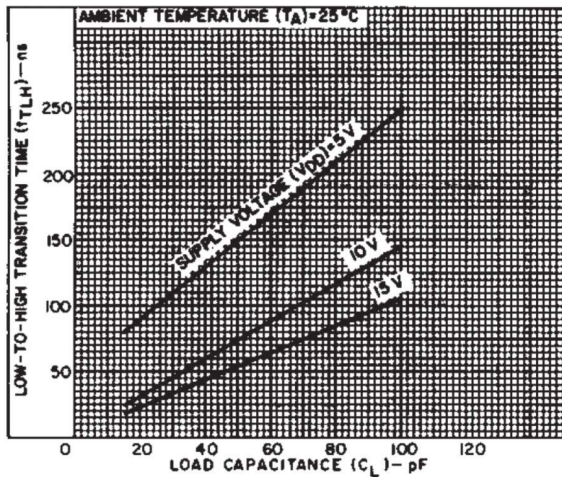


Figure 12. Typical Low-to-High Transition Time vs Load Capacitance

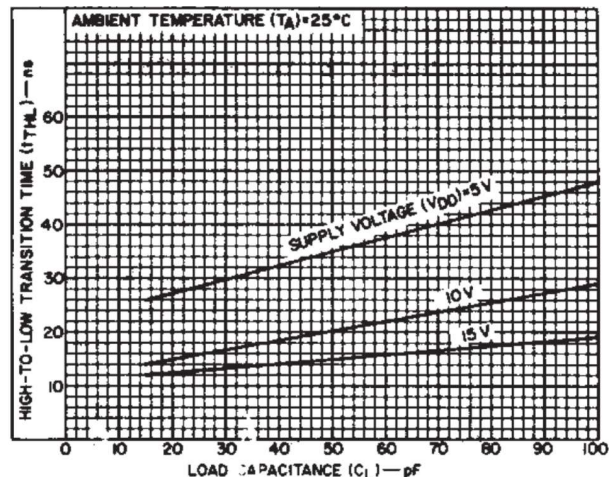


Figure 13. Typical High-to-Low Transition Time vs Load Capacitance

TYPICAL CHARACTERISTICS (continued)

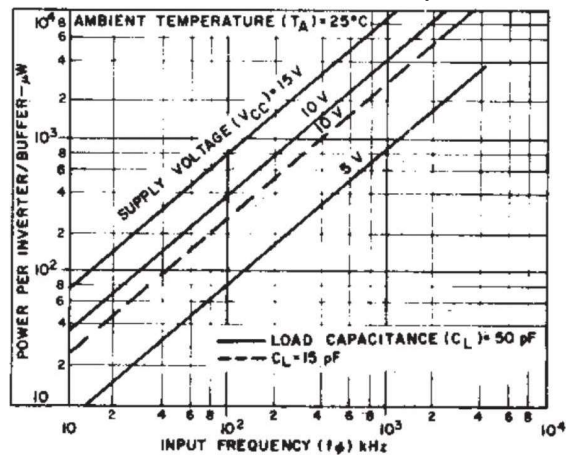


Figure 14. Typical Dissipation Characteristics

PARAMETER MEASUREMENT INFORMATION

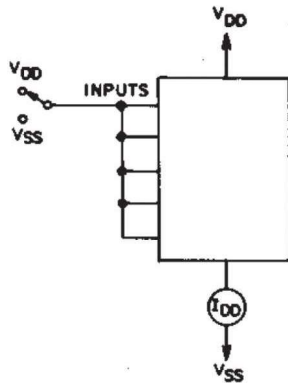


Figure 15. Quiescent Device Current Test Circuit

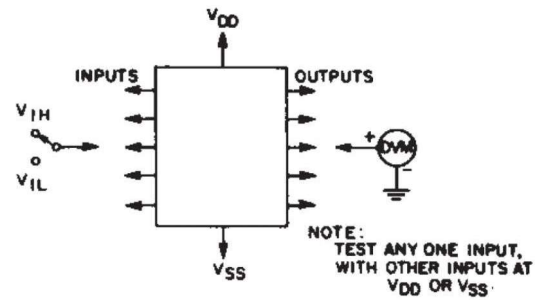


Figure 16. Noise Immunity Test Circuit

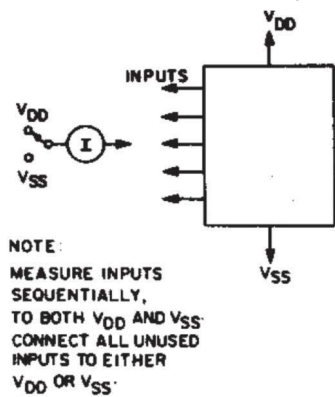
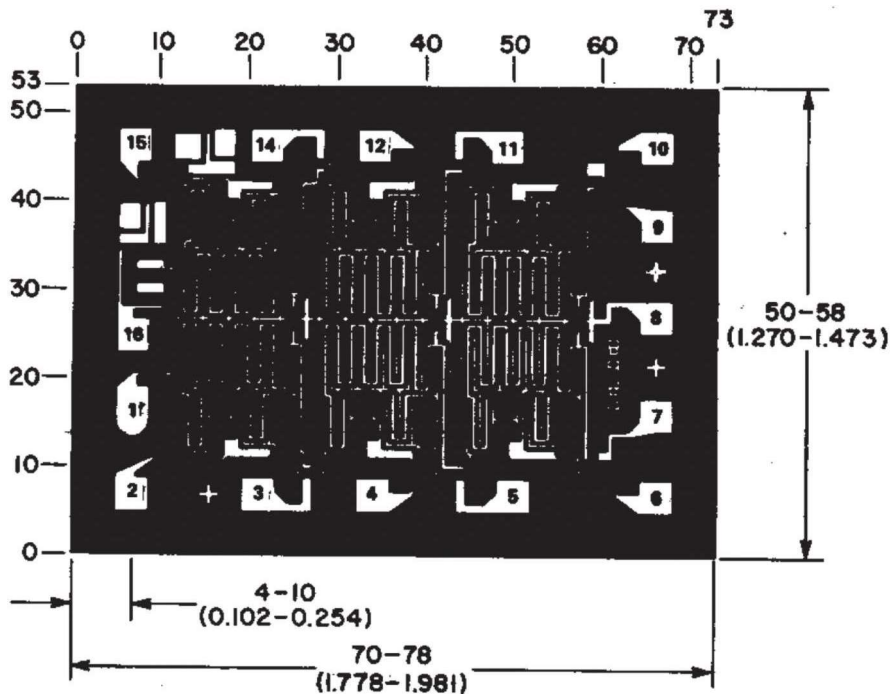


Figure 17. Input Current Test Circuit



Note: Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduation are in mils (10^{-3} inch).

Figure 18. Dimensions and Layout