

## 1. General description

The XD4069 is a general purpose hex unbuffered inverter. Each inverter has a single stage.

It operates over a recommended  $V_{DD}$  power supply range of 3 V to 15 V referenced to  $V_{SS}$  (usually ground). Unused inputs must be connected to  $V_{DD}$ ,  $V_{SS}$ , or another input.

## 2. Features and benefits

- Fully static operation
- 5 V, 10 V, and 15 V parametric ratings
- Standardized symmetrical output characteristics
- Specified from  $-40\text{ }^{\circ}\text{C}$  to  $+85\text{ }^{\circ}\text{C}$  and  $-40\text{ }^{\circ}\text{C}$  to  $+125\text{ }^{\circ}\text{C}$
- Complies with JEDEC standard JESD 13-B

## 3. Applications

- Oscillator

## 4. Functional diagram

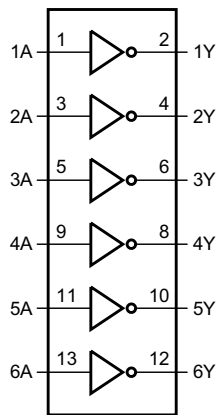


Fig 1. Functional diagram

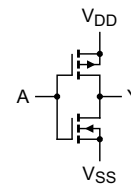


Fig 2. Schematic diagram (one inverter)

## 5. Pinning information

### 5.1 Pinning

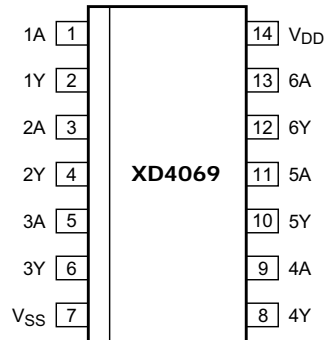


Fig 3. Pin configuration

### 5.2 Pin description

Table 1. Pin description

Symbol	Pin	Description
1A to 6A	1, 3, 5, 9, 11, 13	input
1Y to 6Y	2, 4, 6, 8, 10, 12	output
V <sub>SS</sub>	7	ground (0 V)
V <sub>DD</sub>	14	supply voltage

## 6. Limiting values

Table 2. Limiting values

*In accordance with the Absolute Maximum Rating System.*

Symbol	Parameter	Conditions	Min	Max	Unit
V <sub>DD</sub>	supply voltage		-0.5	+18	V
I <sub>IK</sub>	input clamping current	V <sub>I</sub> < -0.5 V or V <sub>I</sub> > V <sub>DD</sub> + 0.5 V	-	±10	mA
V <sub>I</sub>	input voltage		-0.5	V <sub>DD</sub> + 0.5	V
I <sub>OK</sub>	output clamping current	V <sub>O</sub> < -0.5 V or V <sub>O</sub> > V <sub>DD</sub> + 0.5 V	-	±10	mA
I <sub>I/O</sub>	input/output current		-	±10	mA
I <sub>DD</sub>	supply current		-	50	mA
T <sub>stg</sub>	storage temperature		-65	+150	°C
T <sub>amb</sub>	ambient temperature		-40	+125	°C
P <sub>tot</sub>	total power dissipation	T <sub>amb</sub> = -40 °C to +125 °C			
		DIP-14 [1]	-	500	mW
P	power dissipation	per output	-	100	mW

[1] DIP-14 packages: above T<sub>amb</sub> = 70 °C, P<sub>tot</sub> derates linearly with 8 mW/K.

## 7. Recommended operating conditions

Table 3. Recommended operating conditions

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>DD</sub>	supply voltage		3	-	15	V
V <sub>I</sub>	input voltage		0	-	V <sub>DD</sub>	V
T <sub>amb</sub>	ambient temperature	in free air	-40	-	+125	°C

## 8. Static characteristics

Table 4. Static characteristics

V<sub>SS</sub> = 0 V; V<sub>I</sub> = V<sub>SS</sub> or V<sub>DD</sub>; unless otherwise specified.

Symbol	Parameter	Conditions	V <sub>DD</sub>	T <sub>amb</sub> = -40 °C		T <sub>amb</sub> = +25 °C		T <sub>amb</sub> = +85 °C		T <sub>amb</sub> = +125 °C		Unit
				Min	Max	Min	Max	Min	Max	Min	Max	
V <sub>IH</sub>	HIGH-level input voltage	I <sub>O</sub>   < 1 μA	5 V	4	-	4	-	4	-	4	-	V
			10 V	8	-	8	-	8	-	8	-	V
			15 V	12.5	-	12.5	-	12.5	-	12.5	-	V
V <sub>IL</sub>	LOW-level input voltage	I <sub>O</sub>   < 1 μA	5 V	-	1	-	1	-	1	-	1	V
			10 V	-	2	-	2	-	2	-	2	V
			15 V	-	2.5	-	2.5	-	2.5	-	2.5	V
V <sub>OH</sub>	HIGH-level output voltage	I <sub>O</sub>   < 1 μA	5 V	4.95	-	4.95	-	4.95	-	4.95	-	V
			10 V	9.95	-	9.95	-	9.95	-	9.95	-	V
			15 V	14.95	-	14.95	-	14.95	-	14.95	-	V
V <sub>OL</sub>	LOW-level output voltage	I <sub>O</sub>   < 1 μA	5 V	-	0.05	-	0.05	-	0.05	-	0.05	V
			10 V	-	0.05	-	0.05	-	0.05	-	0.05	V
			15 V	-	0.05	-	0.05	-	0.05	-	0.05	V
I <sub>OH</sub>	HIGH-level output current	V <sub>O</sub> = 2.5 V	5 V	-	-1.7	-	-1.4	-	-1.1	-	-1.1	mA
		V <sub>O</sub> = 4.6 V	5 V	-	-0.64	-	-0.5	-	-0.36	-	-0.36	mA
		V <sub>O</sub> = 9.5 V	10 V	-	-1.6	-	-1.3	-	-0.9	-	-0.9	mA
		V <sub>O</sub> = 13.5 V	15 V	-	-4.2	-	-3.4	-	-2.4	-	-2.4	mA
I <sub>OL</sub>	LOW-level output current	V <sub>O</sub> = 0.4 V	5 V	0.64	-	0.5	-	0.36	-	0.36	-	mA
		V <sub>O</sub> = 0.5 V	10 V	1.6	-	1.3	-	0.9	-	0.9	-	mA
		V <sub>O</sub> = 1.5 V	15 V	4.2	-	3.4	-	2.4	-	2.4	-	mA
I <sub>I</sub>	input leakage current		15 V	-	±0.1	-	±0.1	-	±1.0	-	±1.0	μA
I <sub>DD</sub>	supply current	all valid input combinations; I <sub>O</sub> = 0 A	5 V	-	0.25	-	0.25	-	7.5	-	7.5	μA
			10 V	-	0.5	-	0.5	-	15.0	-	15.0	μA
			15 V	-	1.0	-	1.0	-	30.0	-	30.0	μA
C <sub>I</sub>	input capacitance	digital inputs		-	-	-	7.5	-	-	-	pF	

## 9. Dynamic characteristics

**Table 5. Dynamic characteristics**

$T_{amb} = 25\text{ }^{\circ}\text{C}$ ; for waveforms see [Figure 4](#); for test circuit see [Figure 5](#).

Symbol	Parameter	Conditions	V <sub>DD</sub>	Extrapolation formula <sup>[1]</sup>	Min	Typ	Max	Unit
t <sub>PHL</sub>	HIGH to LOW propagation delay	nA to nY;	5 V	$18\text{ ns} + (0.55\text{ ns/pF})C_L$	-	45	90	ns
			10 V	$9\text{ ns} + (0.23\text{ ns/pF})C_L$	-	20	40	ns
			15 V	$7\text{ ns} + (0.16\text{ ns/pF})C_L$	-	15	25	ns
t <sub>PLH</sub>	LOW to HIGH propagation delay	nA to nY	5 V	$13\text{ ns} + (0.55\text{ ns/pF})C_L$	-	40	80	ns
			10 V	$9\text{ ns} + (0.23\text{ ns/pF})C_L$	-	20	40	ns
			15 V	$7\text{ ns} + (0.16\text{ ns/pF})C_L$	-	15	30	ns
t <sub>THL</sub>	HIGH to LOW output transition time	output nY	5 V	$10\text{ ns} + (1.00\text{ ns/pF})C_L$	-	60	120	ns
			10 V	$9\text{ ns} + (0.42\text{ ns/pF})C_L$	-	30	60	ns
			15 V	$6\text{ ns} + (0.28\text{ ns/pF})C_L$	-	20	40	ns
t <sub>TLH</sub>	LOW to HIGH output transition time	output nY	5 V	$10\text{ ns} + (1.00\text{ ns/pF})C_L$	-	60	120	ns
			10 V	$9\text{ ns} + (0.42\text{ ns/pF})C_L$	-	30	60	ns
			15 V	$6\text{ ns} + (0.28\text{ ns/pF})C_L$	-	20	40	ns

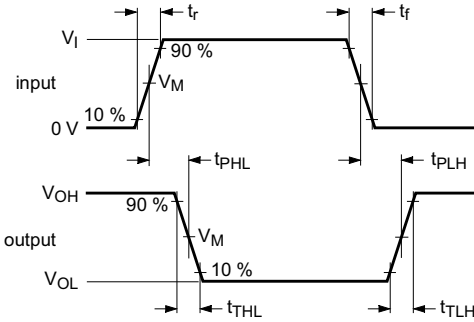
[1] The typical value of the propagation delay and output transition time can be calculated with the extrapolation formula ( $C_L$  in pF).

**Table 6. Dynamic power dissipation**

$V_{SS} = 0\text{ V}$ ;  $t_r = t_f \leq 20\text{ ns}$ ;  $T_{amb} = 25\text{ }^{\circ}\text{C}$ .

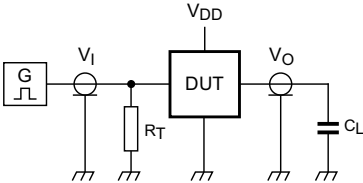
Symbol	Parameter	V <sub>DD</sub>	Typical formula	Where
P <sub>D</sub>	dynamic power dissipation	5 V	$P_D = 600 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2\text{ (}\mu\text{W)}$	f <sub>i</sub> = input frequency in MHz; f <sub>o</sub> = output frequency in MHz; C <sub>L</sub> = output load capacitance in pF; $\Sigma(f_o \times C_L)$ = sum of the outputs; V <sub>DD</sub> = supply voltage in V.
		10 V	$P_D = 4000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2\text{ (}\mu\text{W)}$	
		15 V	$P_D = 22000 \times f_i + \Sigma(f_o \times C_L) \times V_{DD}^2\text{ (}\mu\text{W)}$	

**10. Waveforms**



Measurement points:  $V_M = 0.5V_{DD}$ .  
 Logic levels:  $V_{OL}$  and  $V_{OH}$  are typical output voltage levels that occur with the output load.

**Fig 4. Propagation delay and transition times**



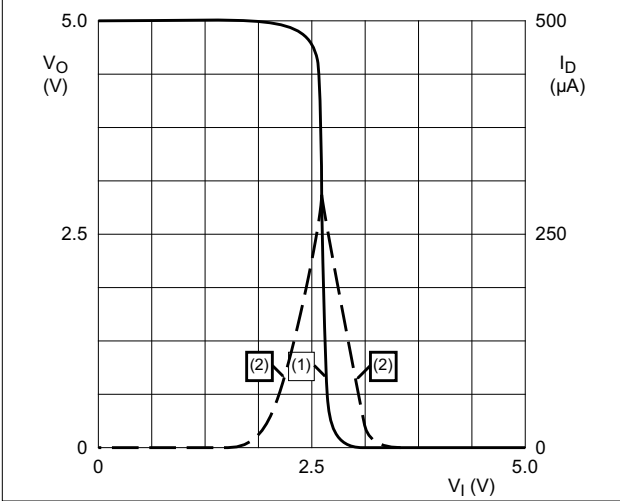
Definitions for test circuit:  
 $C_L$  = load capacitance including jig and probe capacitance;  
 $R_T$  = termination resistance should be equal to the output impedance  $Z_o$  of the pulse generator;  
 For test data refer to [Table 7](#).

**Fig 5. Test circuit for measuring switching times**

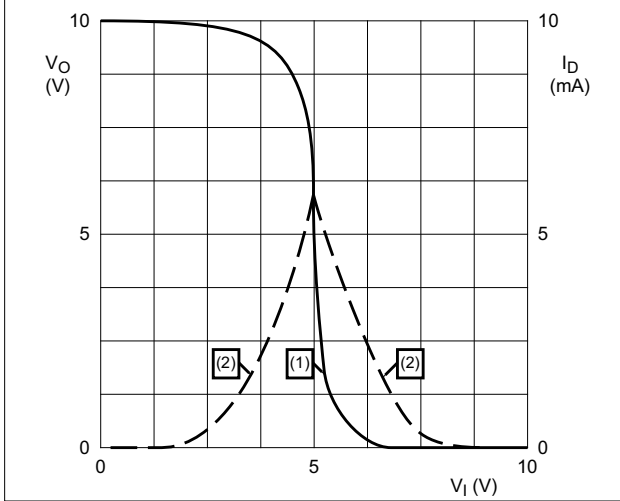
**Table 7. Test data**

Supply voltage	Input		Load
$V_{DD}$	$V_I$	$t_r, t_f$	$C_L$
5 V to 15 V	$V_{SS}$ or $V_{DD}$	$\leq 20$ ns	50 pF

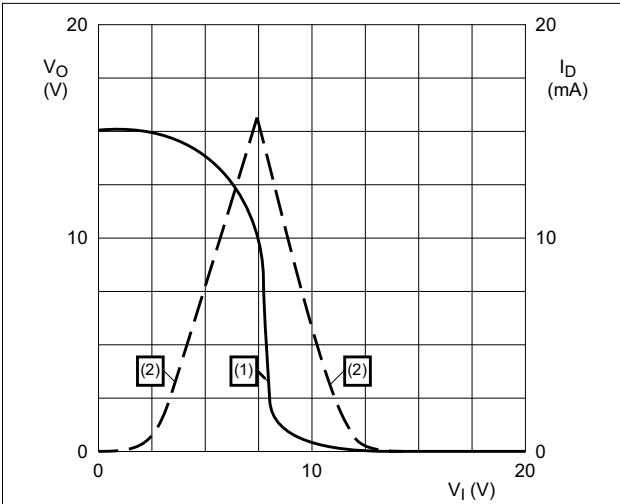
10.1 Transfer characteristics



a.  $V_{DD} = 5\text{ V}; I_O = 0\text{ A}$



b.  $V_{DD} = 10\text{ V}; I_O = 0\text{ A}$



c.  $V_{DD} = 15\text{ V}; I_O = 0\text{ A}$

- (1)  $V_O$  = output voltage.
- (2)  $I_D$  = drain current.

Fig 6. Typical transfer characteristics

**11. Application information**

Some examples of applications for the XD4069.

Figure 7 shows an astable relaxation oscillator using two HEF4069UB inverters and 2 BAW62 diodes. The oscillation frequency is mainly determined by  $R1 \times C1$ , provided  $R1 \ll R2$  and  $R2 \times C2 \ll R1 \times C1$ .

The function of  $R2$  is to minimize the influence of the forward voltage across the protection diodes on the frequency;  $C2$  is a stray (parasitic) capacitance.

The period  $T_p$  is given by  $T_p = T_1 + T_2$ ,

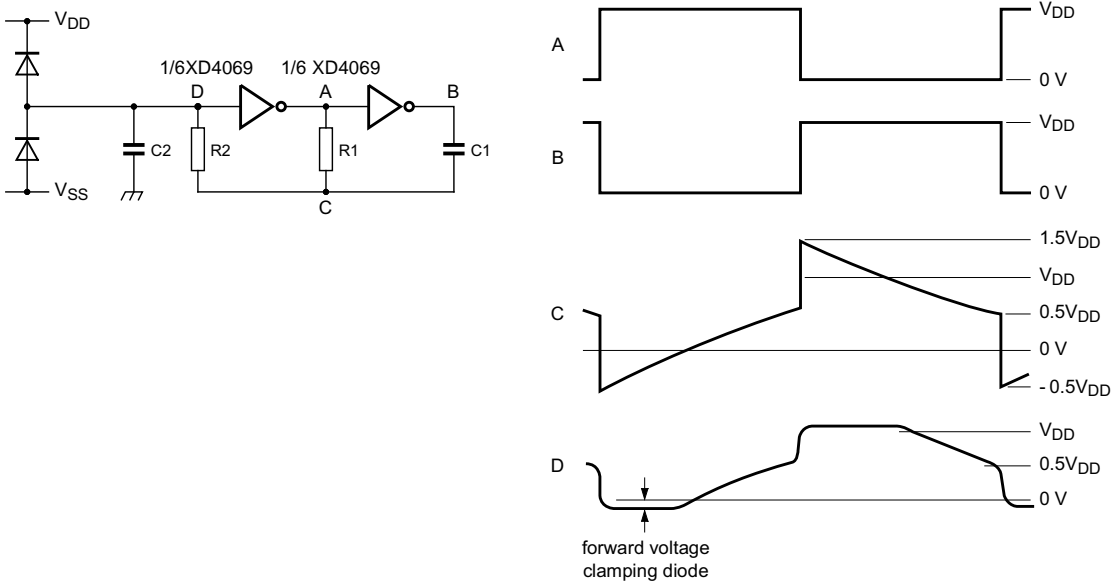
where:

$$T_1 = R1C1 \ln \frac{V_{DD} + V_{ST}}{V_{ST}}$$

$$T_2 = R1C1 \ln \frac{2V_{DD} - V_{ST}}{V_{DD} - V_{ST}}$$

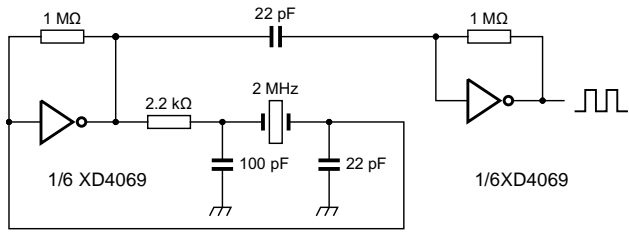
$V_{ST}$  = the signal threshold level of the inverter.

The period is fairly independent of  $V_{DD}$ ,  $V_{ST}$  and temperature. The duty factor, however, is influenced by  $V_{ST}$ .



**Fig 7. Astable relaxation oscillator**

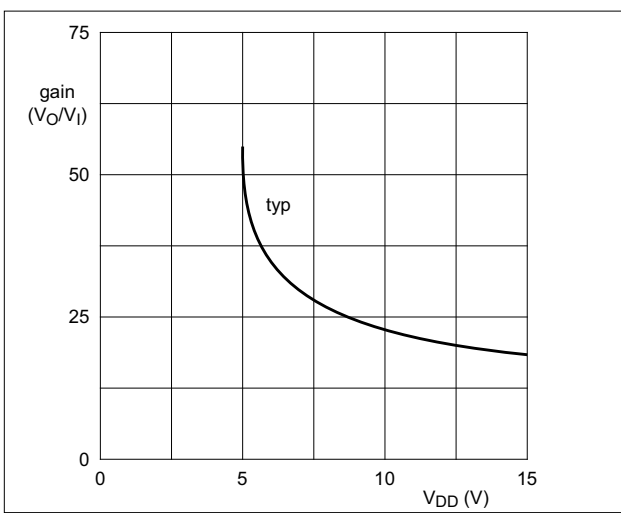
**Figure 8** shows a crystal oscillator for frequencies up to 10 MHz using two HEF4069UB inverters. The second inverter amplifies the oscillator output voltage to a level sufficient to drive other Local Oxidation CMOS (LOCMOS) circuits.



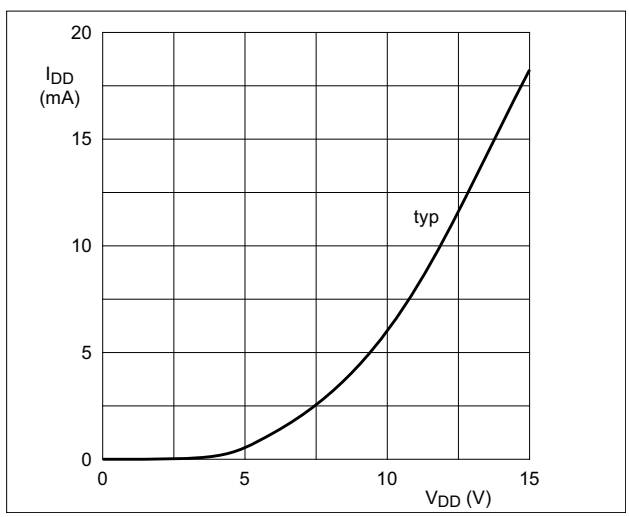
The output inverter is used to amplify the oscillator output voltage to a level sufficient to drive other LOCMOS circuits.

**Fig 8. Crystal oscillator**

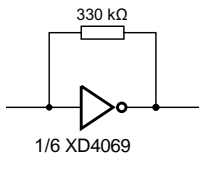
**Figure 9** and **Figure 10** show voltage gain and supply current. **Figure 11** shows the test set-up and an example of an analog amplifier using one XD4069.



**Fig 9. Typical voltage gain as a function of supply voltage**



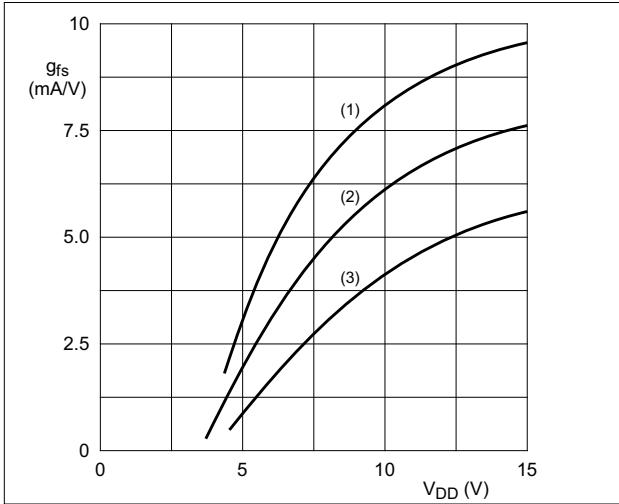
**Fig 10. Typical supply current as a function of supply voltage**



**Fig 11. Test set-up**

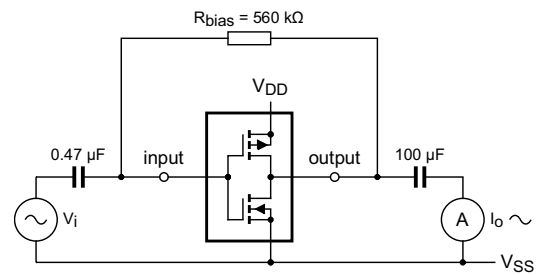


Figure 12 shows typical forward transconductance and Figure 13 shows the test set-up.



- (1) Average +2σ; where: 'σ' is the standard deviation.
- (2) Average.
- (3) Average -2σ; where: 'σ' is the standard deviation.

**Fig 12. Typical forward transconductance as a function of supply voltage at T<sub>amb</sub> = 25 °C**

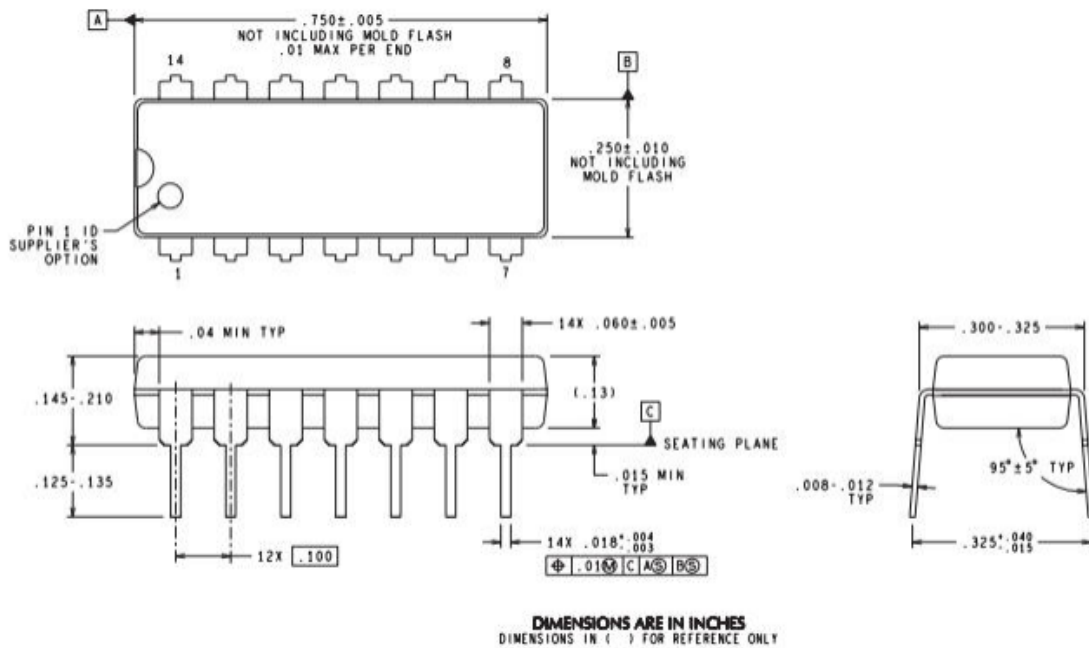


$$g_{fs} = \frac{dI_o}{dV_i} \text{ at } V_O \text{ is constant.}$$

f<sub>i</sub> = 1 kHz

**Fig 13. Test set-up**

### DIP14



以上信息仅供参考. 如需帮助联系客服人员。谢谢 XINLUDA