

## Quad SPST CMOS Analog Switch with Latches

### DESCRIPTION

The DG221B is a monolithic quad single-pole, single-throw analog switch designed for precision switching applications in communication, instrumentation and process control systems.

Featuring independent onboard latches and a common  $\overline{WR}$  pin, each DG221B can be memory mapped, and addressed as a single data byte for simultaneous switching.

The DG221B combines low power and low on-resistance (60  $\Omega$  typical) while handling continuous currents up to 20 mA. An epitaxial layer prevents latchup.

The device features true bidirectional performance in the on condition.

### FEATURES

- Accepts 150 ns write pulse width
- 5 V on-chip regulator
- Latches are transparent with  $\overline{WR}$  low
- Low on-resistance: 60  $\Omega$



**RoHS\***  
COMPLIANT

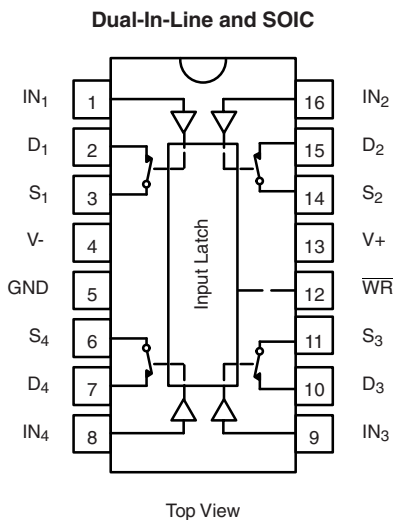
### BENEFITS

- Compatible with most  $\mu$ P buses
- Allows wide power supply tolerance without affecting TTL compatibility
- Reduced power consumption
- Allows flexibility of design

### APPLICATIONS

- $\mu$ P based systems
- Automatic test equipment
- Communication systems
- Data acquisition systems
- Medical instrumentation
- Factory automation

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Four latchable SPST switches per package

TRUTH TABLE		
$IN_x$	$\overline{WR}$	Switch
0	0	ON
1	0	OFF
X		Control data latched-in, switches on or off as selected by last $IN_x$
X	1	Maintains previous state

Logic "0"  $\leq 0.8$  V  
Logic "1"  $\geq 2.4$  V

\* Pb containing terminations are not RoHS compliant, exemptions may apply.

ORDERING INFORMATION			
Temp. Range	Package	Standard Part Number	Lead (Pb)-free Part Number
- 40 °C to 85 °C	16-Pin Plastic DIP	DG221BDJ	DG221BDJ-E3
	16-Pin Narrow SOIC	DG221BDY DG221BDY-T1	DG221BDY-E3 DG221BDY-T1-E3

ABSOLUTE MAXIMUM RATINGS			
Parameter		Limit	Unit
Voltages Referenced V+ to V-		34	V
GND		25	
Digital Inputs <sup>a</sup> , V <sub>S</sub> , V <sub>D</sub>		(V-) - 2 to (V+) + 2 or 20 mA, whichever occurs first	
Continuous Current (Any Terminal)		30	mA
Continuous Current, S or D		20	
Peak Current, S or D (Pulsed at 1 ms, 10 % duty cycle max.)		70	
Storage Temperature	(DJ and DY Suffix)	- 65 to 125	°C
Power Dissipation (Package) <sup>b</sup>	16-Pin Plastic DIP <sup>c</sup>	470	mW
	16-Pin SOIC <sup>d</sup>	600	

Notes:

- a. Signals on S<sub>X</sub>, D<sub>X</sub>, or IN<sub>X</sub> exceeding V+ or V- will be clamped by internal diodes. Limit forward diode current to maximum current ratings.
- b. All leads welded or soldered to PC board.
- c. Derate 6.5 mW/°C above 25 °C.
- d. Derate 7.7 mW/°C above 75 °C.

### SCHEMATIC DIAGRAM Typical Channel

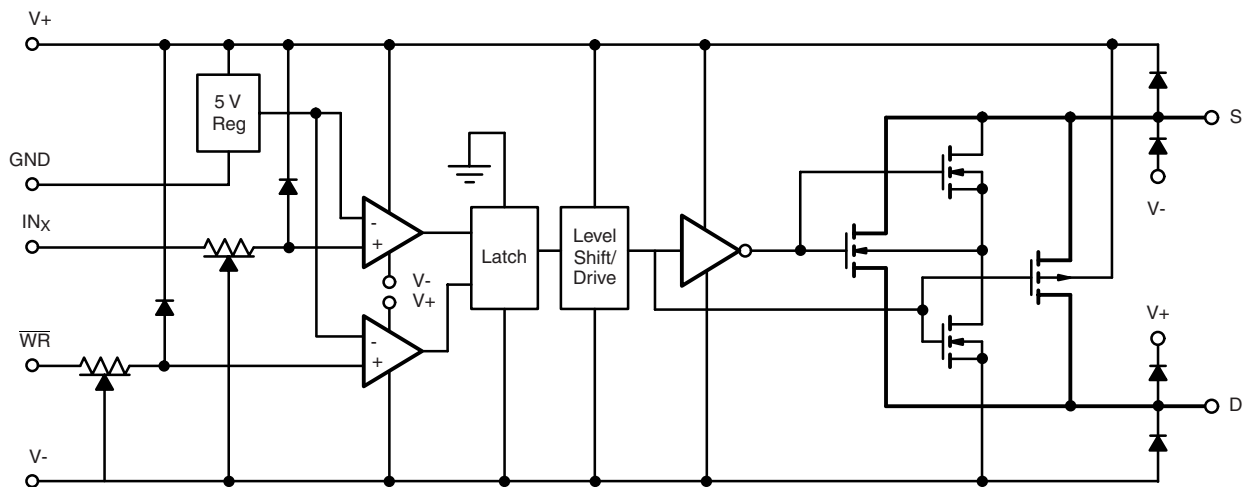


Figure 1.



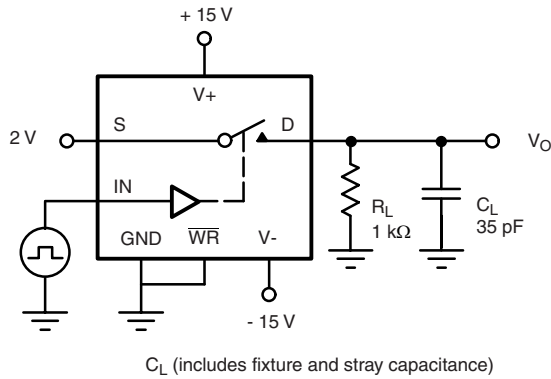
<b>SPECIFICATIONS<sup>a</sup></b>							
Parameter	Symbol	Test Conditions Unless Otherwise Specified $V_+ = 15\text{ V}$ , $V_- = -15\text{ V}$ $V_{IN} = 2.4\text{ V}$ , $0.8\text{ V}^f$ , $\overline{WR} = 0$	Temp. <sup>b</sup>	Limits -40 °C to 85 °C			Unit
				Min. <sup>d</sup>	Typ. <sup>c</sup>	Max. <sup>d</sup>	
<b>Analog Switch</b>							
Analog Signal Range <sup>e</sup>	$V_{ANALOG}$		Full	-15		15	V
Drain-Source On-Resistance	$r_{DS(on)}$	$I_S = -10\text{ mA}$ , $V_D = \pm 10\text{ V}$	Room Full		60	90 135	$\Omega$
Source Off Leakage Current	$I_{S(off)}$	$V_S = \pm 14\text{ V}$ , $V_D = \pm 14\text{ V}$	Room Full	-5 -100	$\pm 0.01$	5 100	nA
Drain Off Leakage Current	$I_{D(off)}$		Room Full	-5 -100	$\pm 0.02$	5 100	
Drain On Leakage Current	$I_{D(on)}$	$V_S = V_D = \pm 14\text{ V}$	Room Full	-5 -200	$\pm 0.01$	5 200	
<b>Digital Control</b>							
Input Current	$I_{INL}$ , $I_{INH}$	$V_{IN} = 0\text{ V}$ or $= 2.4\text{ V}$	Room Full	-1 -10	-0.0004	1 10	$\mu\text{A}$
<b>Dynamic Characteristics</b>							
Turn-On Time	$t_{ON}$	See Figure 2	Room			550	ns
Turn-Off Time	$t_{OFF}$		Room			340	
Turn-On Time Write	$t_{ON, \overline{WR}}$	See Figure 3	Room			550	
Turn-Off Time Write	$t_{OFF, \overline{WR}}$		Room			340	
Write Pulse Width	$t_W$	See Figure 4	Room	150	120		
Input Setup Time	$t_S$		Room	180	130		
Input Hold Time	$t_H$		Room	20	18		
Charge Injection	Q	$C_L = 1000\text{ pF}$ , $V_{gen} = 0\text{ V}$ , $R_{gen} = 0\ \Omega$	Room		20		pC
Source-Off Capacitance	$C_{S(off)}$	$f = 1\text{ MHz}$ , $V_S$ , $V_D = 0\text{ V}$	Room		8		pF
Drain-Off Capacitance	$C_{D(off)}$		Room		9		
Channel On Capacitance	$C_{D(on)}$		Room		29		
Off-Isolation	OIRR	$V_S = 1\text{ V}_{p-p}$ , $f = 100\text{ kHz}$	Room		70		dB
Interchannel Crosstalk	$X_{TALK}$	$C_L = 15\text{ pF}$ , $R_L = 1\text{ k}\Omega$	Room		90		
<b>Power Supplies</b>							
Positive Supply Current	$I_+$	All Channels On or Off $V_{IN} = 0\text{ V}$ or $2.4\text{ V}$	Full		0.8	1.5	mA
Negative Supply Current	$I_-$		Room	-1	-0.4		

Notes:

- Refer to PROCESS OPTION FLOWCHART.
- Room = 25 °C, Full = as determined by the operating temperature suffix.
- Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- Guaranteed by design, not subject to production test.
- $V_{IN}$  = input voltage to perform proper function.

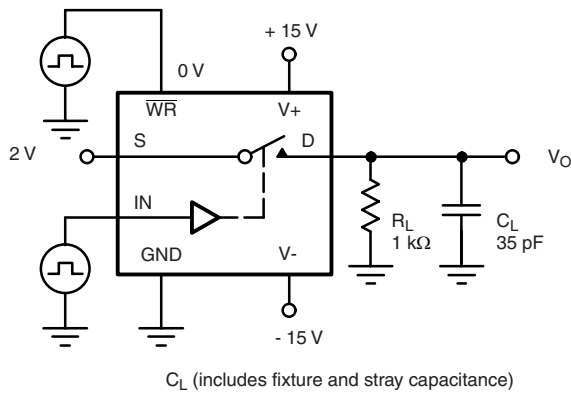
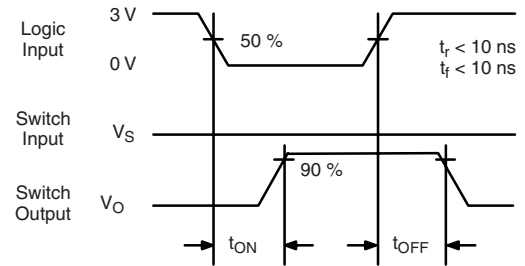
*Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

## TEST CIRCUITS



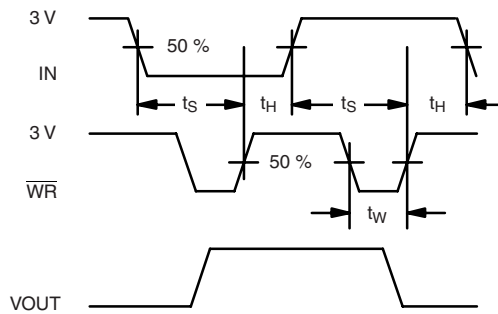
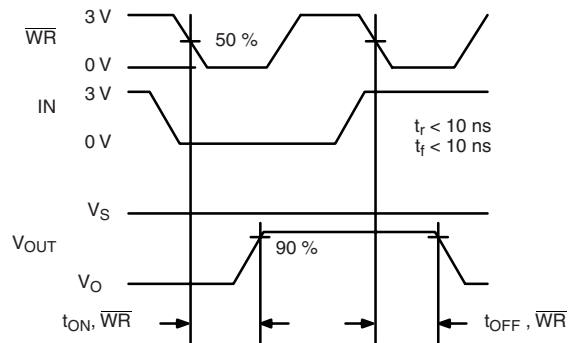
$$V_O = V_S \frac{R_L}{R_L + r_{DS(on)}}$$

Figure 2. Switching Time



$$V_O = V_S \frac{R_L}{R_L + r_{DS(on)}}$$

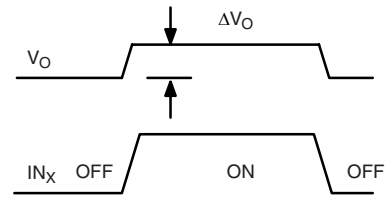
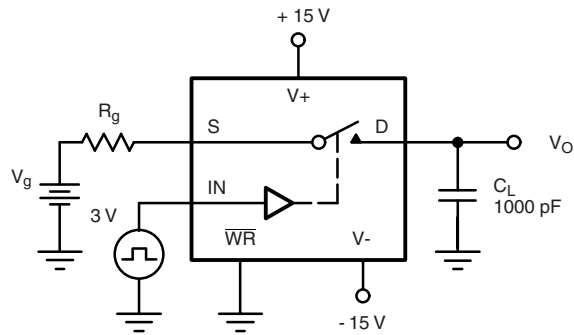
Figure 3.  $\overline{WR}$  Switching Time



$t_H$  = Hold Time  
 $t_S$  = Setup Time  
 $t_W$  = WR Pulse Width

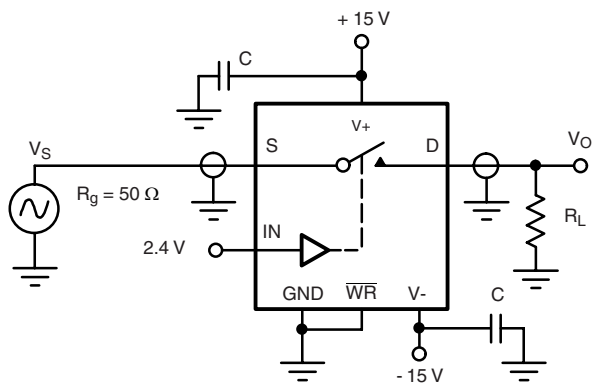
Figure 4.  $\overline{WR}$  Setup Conditions

**TEST CIRCUITS**



$\Delta V_O$  = measured voltage error due to charge injection  
The charge injection in coulombs is  $Q = C_L \times \Delta V_O$

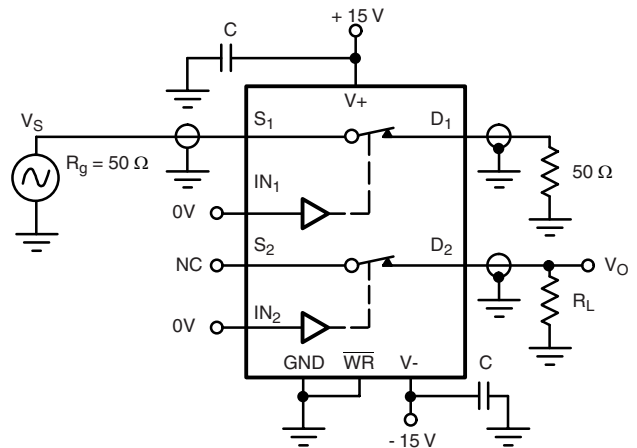
**Figure 5. Charge Injection**



$$\text{Off Isolation} = 20 \log \left| \frac{V_S}{V_O} \right|$$

C = RF bypass

**Figure 6. Off Isolation**



$$X_{\text{TALK}} \text{ Isolation} = 20 \log \left| \frac{V_S}{V_O} \right|$$

C = RF bypass

**Figure 7. Channel-to-Channel Crosstalk**

<b>APPLICATION HINTS<sup>a</sup></b>					
V+ Positive Supply Voltage (V)	V- Negative Supply Voltage (V)	GND (V)	WR (V)	V <sub>IN</sub> Logic Input Voltage V <sub>INH(min)</sub> /V <sub>INL(max)</sub> (V)	V <sub>S</sub> or V <sub>D</sub> Analog Voltage Range (V)
15	- 15	0	2.4/0.8	2.4/0.8	- 15 to 15
10	- 10	0	2.4/0.8	2.4/0.8	- 10 to 10
10	- 5	0	2.4/0.8	2.4/0.8	- 5 to 10

Notes:

a. Application hints are for DESIGN AID ONLY, not guaranteed and not subject to production testing.

## APPLICATIONS

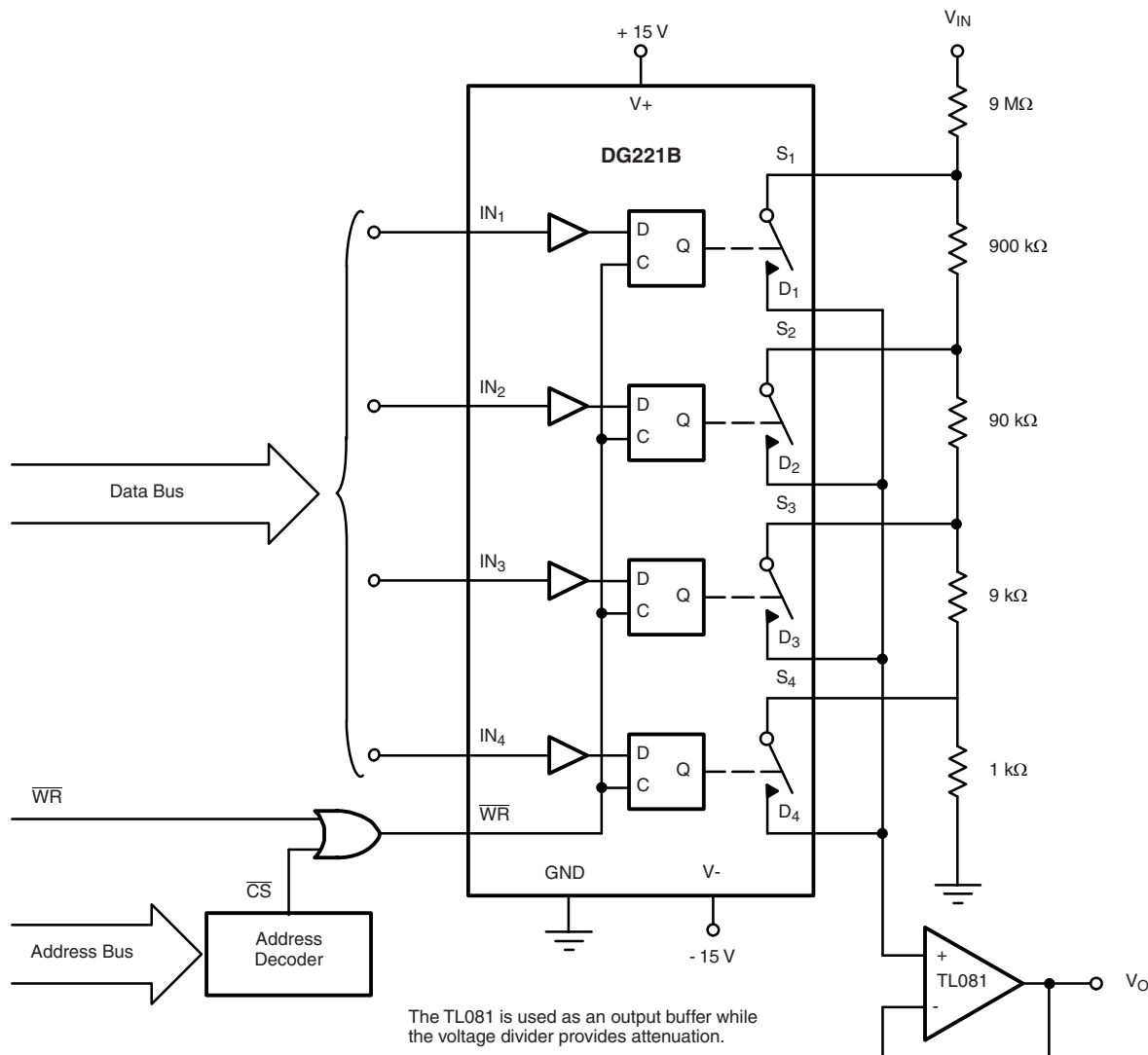


Figure 7.  $\mu$ P-Controlled Analog Signal Attenuator

TRUTH TABLE					
IN <sub>1</sub>	IN <sub>2</sub>	IN <sub>3</sub>	IN <sub>4</sub>	$\overline{WR}^a$	ON SWITCH
0	0	0	0	0	All
1	1	1	1	0	None
0	1	1	1	0	1
1	0	1	1	0	2
1	1	0	1	0	3
1	1	1	0	0	4

OUTPUT ATTENUATION FOR FIGURE 7					
$\overline{WR}$	IN <sub>1</sub>	IN <sub>2</sub>	IN <sub>3</sub>	IN <sub>4</sub>	Gain
0	0	1	1	1	0.1
0	1	0	1	1	0.01
0	1	1	0	1	0.001
0	1	1	1	0	0.0001

Notes:

a.  $\overline{WR}$  may be held at "0" for temporary operation similar to DG201A/DG201B. With  $\overline{WR}$  at "0" SW<sub>1</sub> will remain on as long as IN<sub>1</sub> is held at "0" V.

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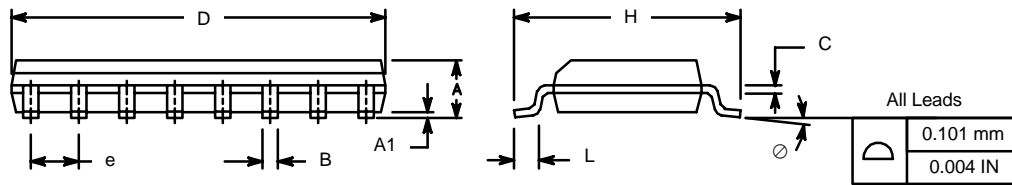


**SOIC (NARROW): 16-LEAD**  
JEDEC Part Number: MS-012

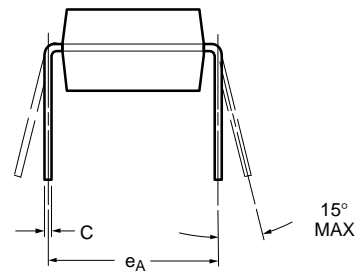
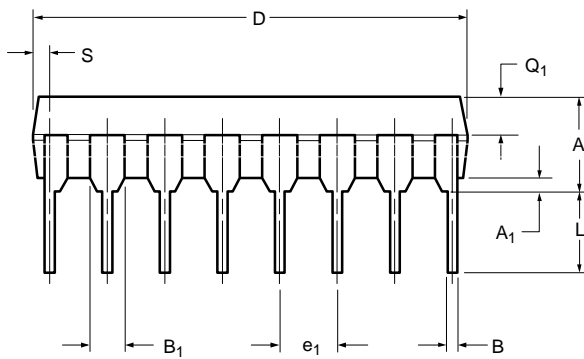
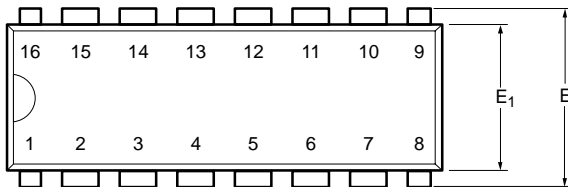


Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
A	1.35	1.75	0.053	0.069
A <sub>1</sub>	0.10	0.20	0.004	0.008
B	0.38	0.51	0.015	0.020
C	0.18	0.23	0.007	0.009
D	9.80	10.00	0.385	0.393
E	3.80	4.00	0.149	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
L	0.50	0.93	0.020	0.037
∅	0°	8°	0°	8°

ECN: S-03946—Rev. F, 09-Jul-01  
DWG: 5300



### PDIP: 16-LEAD



Dim	MILLIMETERS		INCHES	
	Min	Max	Min	Max
<b>A</b>	3.81	5.08	0.150	0.200
<b>A<sub>1</sub></b>	0.38	1.27	0.015	0.050
<b>B</b>	0.38	0.51	0.015	0.020
<b>B<sub>1</sub></b>	0.89	1.65	0.035	0.065
<b>C</b>	0.20	0.30	0.008	0.012
<b>D</b>	18.93	21.33	0.745	0.840
<b>E</b>	7.62	8.26	0.300	0.325
<b>E<sub>1</sub></b>	5.59	7.11	0.220	0.280
<b>e<sub>1</sub></b>	2.29	2.79	0.090	0.110
<b>e<sub>A</sub></b>	7.37	7.87	0.290	0.310
<b>L</b>	2.79	3.81	0.110	0.150
<b>Q<sub>1</sub></b>	1.27	2.03	0.050	0.080
<b>S</b>	0.38	1.52	.015	0.060

ECN: S-03946—Rev. D, 09-Jul-01  
DWG: 5482



## RECOMMENDED MINIMUM PADS FOR SO-16



Recommended Minimum Pads  
Dimensions in Inches/(mm)

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