

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 Ω 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 Ω



RoHS*
COMPLIANT

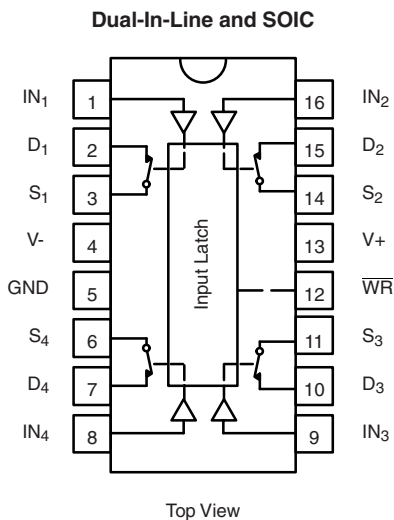
BENEFITS

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

APPLICATIONS

- μ 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" ≤ 0.8 V
Logic "1" ≥ 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 ^a , V _S , V _D | | (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) ^b | 16-Pin Plastic DIP ^c | 470 | mW |
| | 16-Pin SOIC ^d | 600 | |

Notes:

- a. Signals on S_X, D_X, or IN_X 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

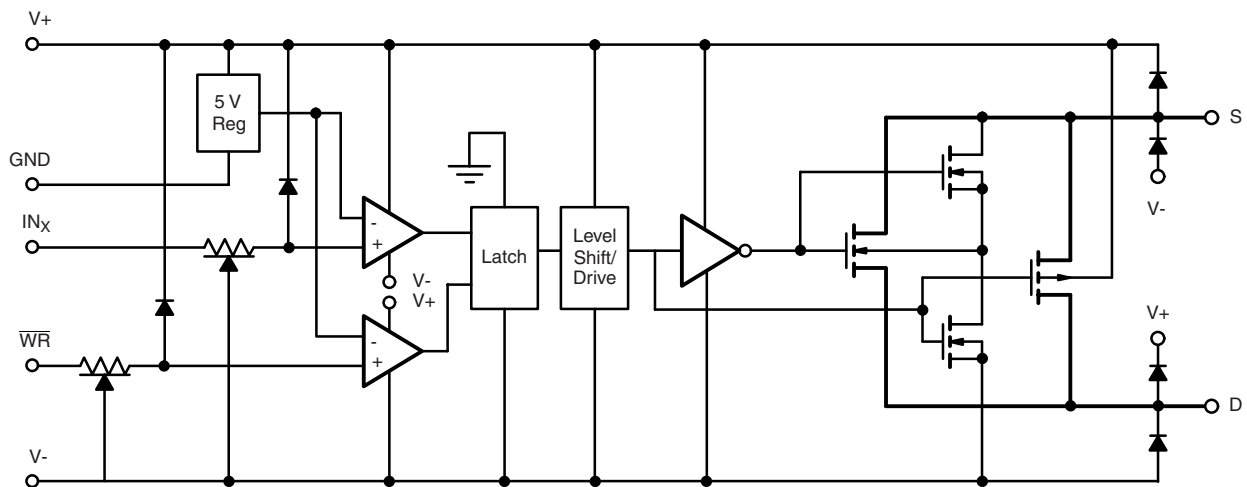


Figure 1.



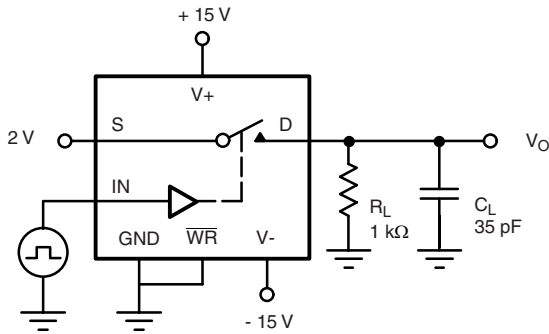
| SPECIFICATIONS ^a | | | | | | | |
|----------------------------------|-------------------------------------|---|--------------------|---------------------------|-------------------|-------------------|------|
| Parameter | Symbol | Test Conditions Unless Otherwise Specified V ₊ = 15 V, V ₋ = -15 V V _{IN} = 2.4 V, 0.8 V ^f , \overline{WR} = 0 | Temp. ^b | Limits -40 °C to 85 °C | | | Unit |
| | | | | Min. ^d | Typ. ^c | Max. ^d | |
| Analog Switch | | | | | | | |
| Analog Signal Range ^e | V _{ANALOG} | | Full | -15 | | 15 | V |
| Drain-Source On-Resistance | r _{DS(on)} | I _S = -10 mA, V _D = ±10 V | Room Full | | 60 | 90 135 | Ω |
| Source Off Leakage Current | I _{S(off)} | V _S = ±14 V, V _D = ±14 V | Room Full | -5 -100 | ±0.01 | 5 100 | nA |
| Drain Off Leakage Current | I _{D(off)} | | Room Full | -5 -100 | ±0.02 | 5 100 | |
| Drain On Leakage Current | I _{D(on)} | V _S = V _D = ±14 V | Room Full | -5 -200 | ±0.01 | 5 200 | |
| Digital Control | | | | | | | |
| Input Current | I _{INL} , I _{INH} | V _{IN} = 0 V or = 2.4 V | Room Full | -1 -10 | -0.0004 | 1 10 | μA |
| Dynamic Characteristics | | | | | | | |
| Turn-On Time | t _{ON} | See Figure 2 | Room | | | 550 | ns |
| Turn-Off Time | t _{OFF} | | Room | | | 340 | |
| Turn-On Time Write | t _{ON, WR} | See Figure 3 | Room | | | 550 | |
| Turn-Off Time Write | t _{OFF, 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 pF, V _{gen} = 0 V, R _{gen} = 0 Ω | Room | | 20 | | |
| Source-Off Capacitance | C _{S(off)} | f = 1 MHz, V _S , V _D = 0 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 V _{p-p} , f = 100 kHz | Room | | 70 | | dB |
| Interchannel Crosstalk | X _{TALK} | C _L = 15 pF, R _L = 1 kΩ | Room | | 90 | | |
| Power Supplies | | | | | | | |
| Positive Supply Current | I ₊ | All Channels On or Off V _{IN} = 0 V or 2.4 V | Full | | 0.8 | 1.5 | mA |
| Negative Supply Current | I ₋ | | Room | -1 | -0.4 | | |

Notes:

- a. Refer to PROCESS OPTION FLOWCHART.
- b. Room = 25 °C, Full = as determined by the operating temperature suffix.
- c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- d. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- e. Guaranteed by design, not subject to production test.
- f. 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



C_L (includes fixture and stray capacitance)

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

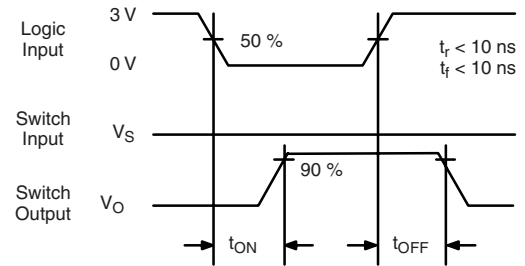
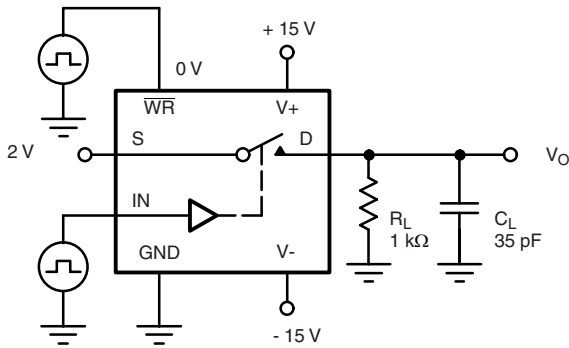


Figure 2. Switching Time



C_L (includes fixture and stray capacitance)

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

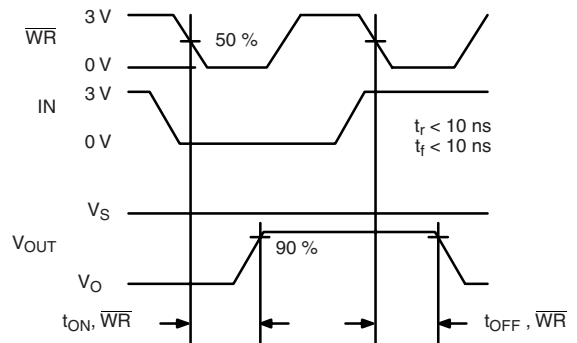
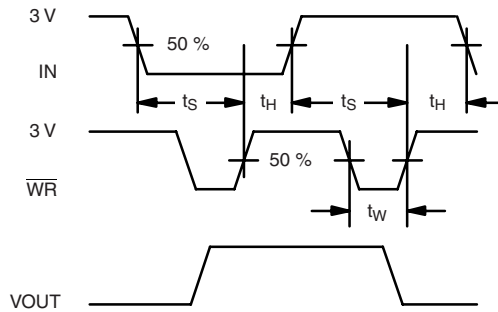


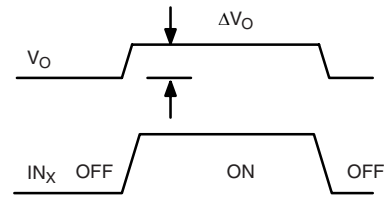
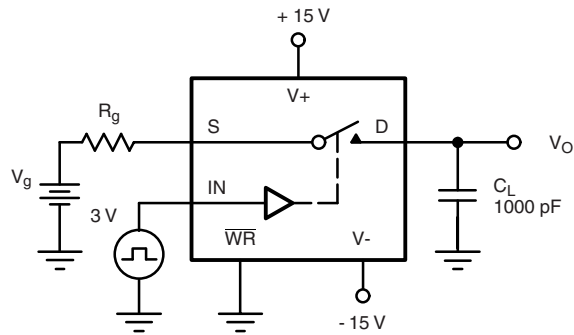
Figure 3. \overline{WR} Switching Time



t_H = Hold Time
 t_S = Setup Time
 t_W = \overline{WR} Pulse Width

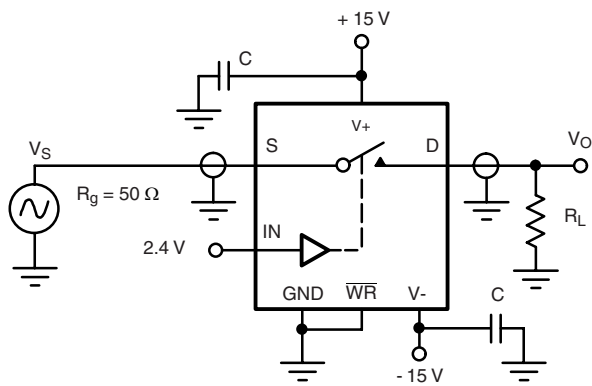
Figure 4. \overline{WR} Setup Conditions

TEST CIRCUITS



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

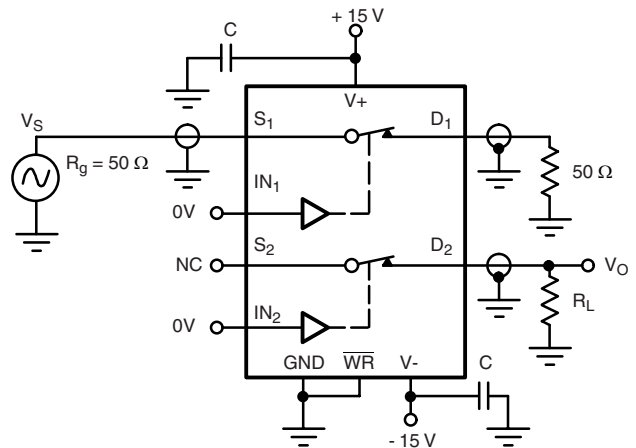
Figure 5. Charge Injection



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

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

| APPLICATION HINTS^a | | | | | |
|---|---|------------|-----------|---|--|
| V+ Positive Supply Voltage (V) | V- Negative Supply Voltage (V) | GND (V) | WR (V) | V _{IN} Logic Input Voltage V _{INH(min)} /V _{INL(max)} (V) | V _S or V _D 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

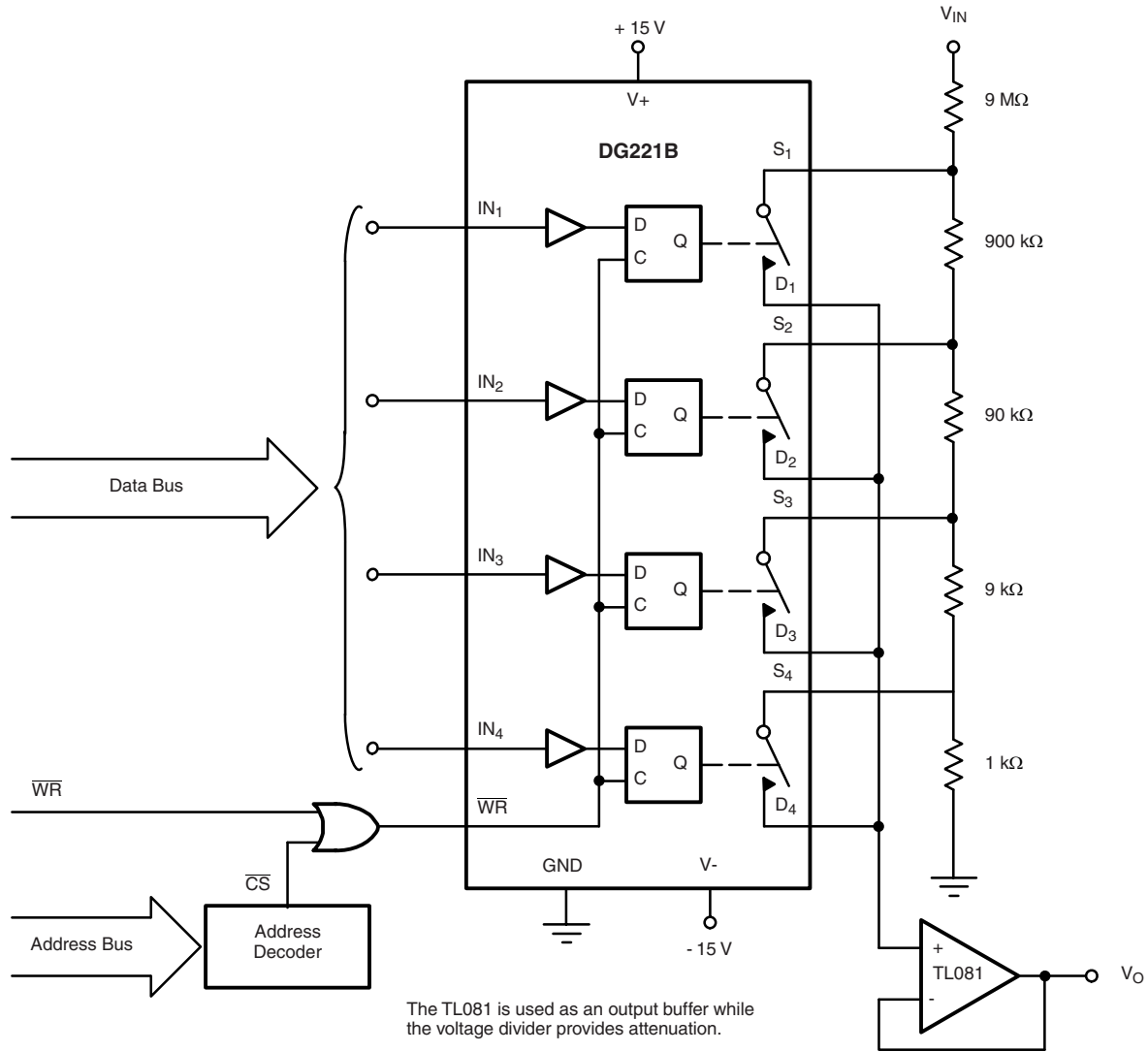


Figure 7. μP-Controlled Analog Signal Attenuator

| TRUTH TABLE | | | | | |
|-----------------|-----------------|-----------------|-----------------|-------------------|-----------|
| IN ₁ | IN ₂ | IN ₃ | IN ₄ | \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 ₁ | IN ₂ | IN ₃ | IN ₄ | 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 |

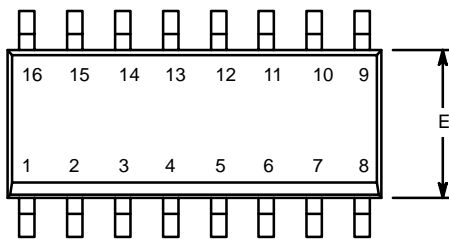
Notes:

a. \overline{WR} may be held at "0" for temporary operation similar to DG201A/DG201B. With \overline{WR} at "0" SW₁ will remain on as long as IN₁ is held at "0" V.

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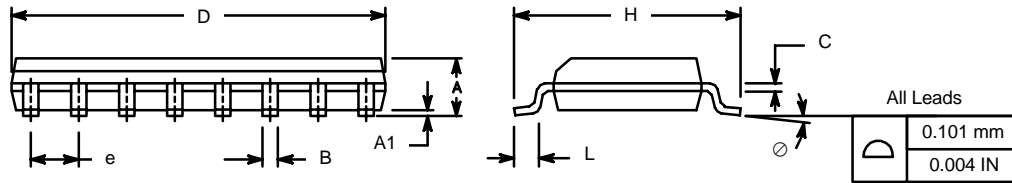


SOIC (NARROW): 16-LEAD
JEDEC Part Number: MS-012

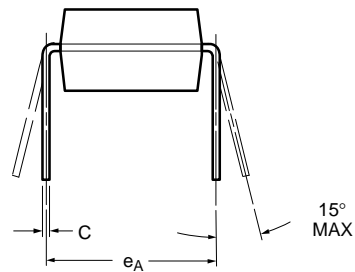
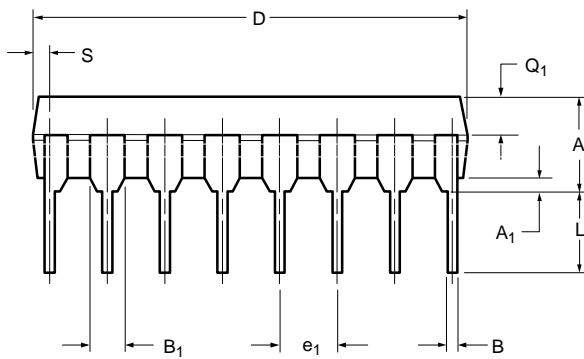
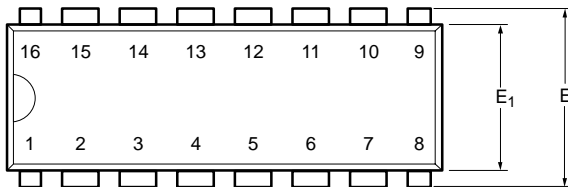


| Dim | MILLIMETERS | | INCHES | |
|----------------|-------------|-------|-----------|-------|
| | Min | Max | Min | Max |
| A | 1.35 | 1.75 | 0.053 | 0.069 |
| A ₁ | 0.10 | 0.20 | 0.004 | 0.008 |
| B | 0.38 | 0.51 | 0.015 | 0.020 |
| C | 0.18 | 0.23 | 0.007 | 0.009 |
| D | 9.80 | 10.00 | 0.385 | 0.393 |
| 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



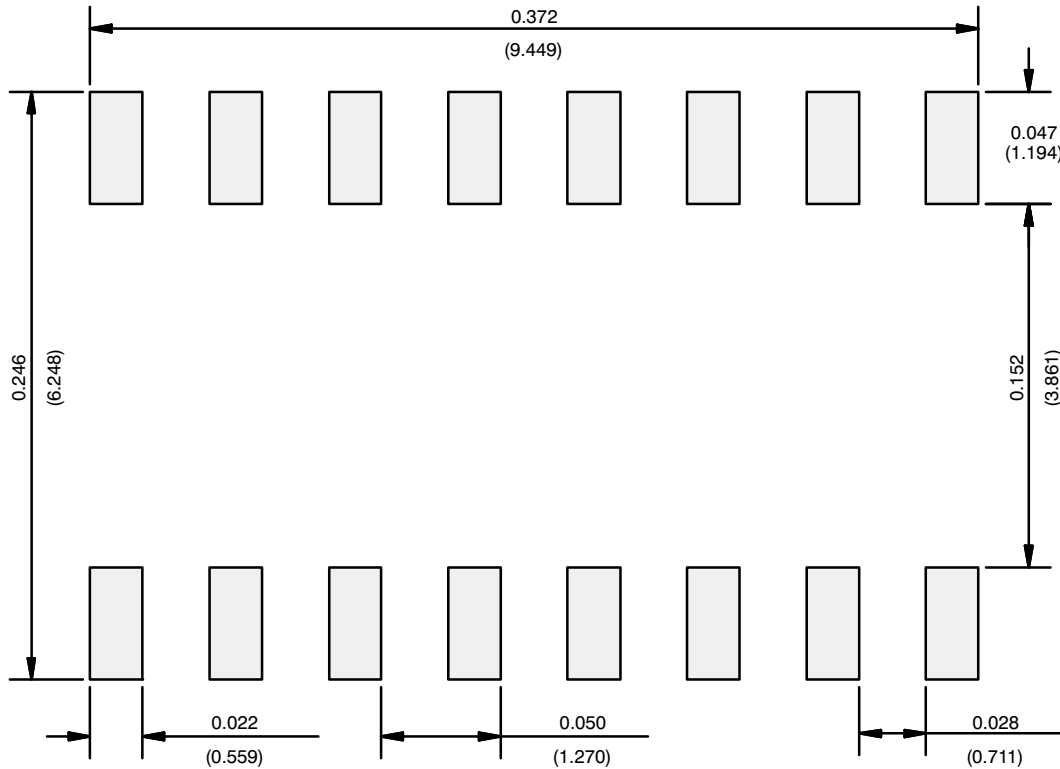
PDIP: 16-LEAD



| Dim | MILLIMETERS | | INCHES | |
|----------------------|-------------|-------|--------|-------|
| | Min | Max | Min | Max |
| A | 3.81 | 5.08 | 0.150 | 0.200 |
| A₁ | 0.38 | 1.27 | 0.015 | 0.050 |
| B | 0.38 | 0.51 | 0.015 | 0.020 |
| B₁ | 0.89 | 1.65 | 0.035 | 0.065 |
| C | 0.20 | 0.30 | 0.008 | 0.012 |
| D | 18.93 | 21.33 | 0.745 | 0.840 |
| E | 7.62 | 8.26 | 0.300 | 0.325 |
| E₁ | 5.59 | 7.11 | 0.220 | 0.280 |
| e₁ | 2.29 | 2.79 | 0.090 | 0.110 |
| e_A | 7.37 | 7.87 | 0.290 | 0.310 |
| L | 2.79 | 3.81 | 0.110 | 0.150 |
| Q₁ | 1.27 | 2.03 | 0.050 | 0.080 |
| S | 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)

[Return to Index](#)



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