

FEATURES

- Complete 32-Channel 12-Bit A/D Converter with Sample & Hold, Reference, Clock and 3-State Outputs
- Fast Conversion, less than 15 μ S
- Microprocessor Bus Interface
- Parallel or Serial Data Output Modes
- 65 ns Bus Access Time
- Remote Analog Ground Sensing
- Overvoltage Protected Input (± 50 V over the Supply Voltages)
- Precision Reference for Long Term Stability and Low Gain T.C.
- Guaranteed Linearity Over Temperature
- Guaranteed Performance at +12/-5 V, ± 12 & ± 15 V
- Low Power (3 mW per Channel Typical)
- 16 Channel Version: MP3276 & MP3275

GENERAL DESCRIPTION

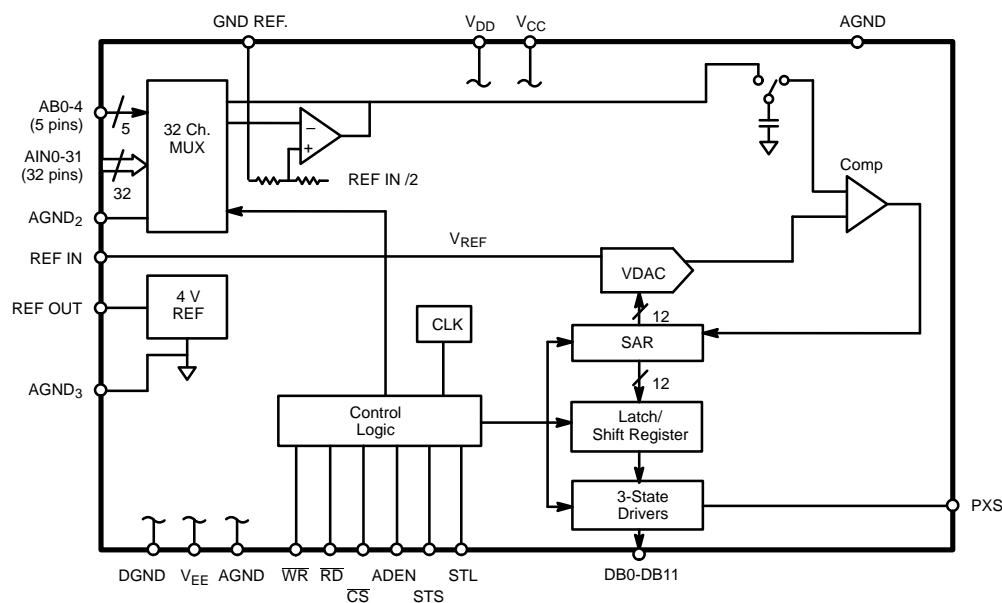
The MP3274 is a complete 32-channel, 12-bit Data Acquisition Subsystem with 3-state output buffers for direct interfacing to 16-bit microprocessor buses. Implemented using an advanced BiCMOS process, the converter combines a 32-channel passive overvoltage protected multiplexer instrumentation amp, a sample & hold, a SAR, a 12-bit decoded D/A, a comparator, a precision reference and the control logic to achieve an accurate, repeated conversion in less than 15 μ s, and a mux/instrumentation amp settling period of less than 10 μ s.

A unique input design provides input overvoltage protection to ± 50 V over the supply voltages. Therefore, an overvoltage

condition can exist on unselected channels without disrupting the measured channel or operation of the MP3274! The internal 4 V reference has sufficient output current to provide other system reference needs. Precision thin film scaling and offset resistors are laser trimmed to provide for less than 2 LSB INL for ± 10 V inputs on all channels.

In addition, the MP3274 will output either full scale (0111) for overrange and - full scale (1000....) for underrange conditions. This greatly simplifies microprocessor software development.

SIMPLIFIED BLOCK DIAGRAM

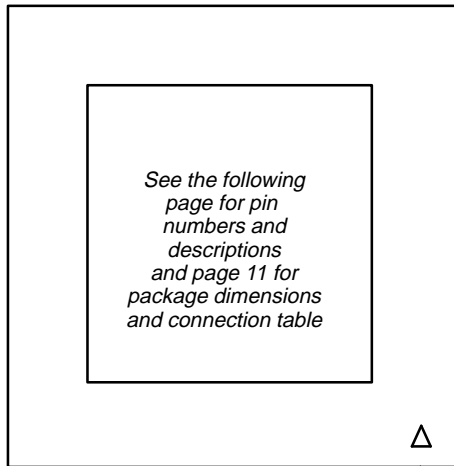


ORDERING INFORMATION

| Package Type | Temperature Range | Part No. | DNL (LSB) | INL (LSB) |
|--------------|-------------------|-----------|-----------|-----------|
| PGA | -40 to +85°C | MP3274AG | ±2 | ±2 |
| PGA | -55 to +125°C | MP3274SG* | ±2 | ±2 |
| PLCC | -40 to +85°C | MP3274AP | ±2 | ±2 |

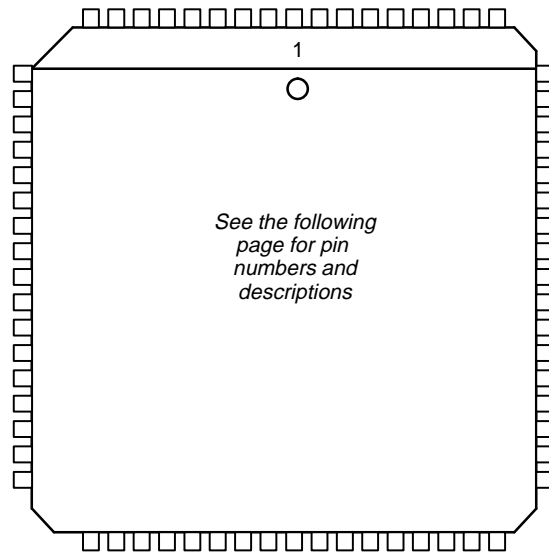
*Contact factory for non-compliant military processing

PIN CONFIGURATIONS



↑
Index
Mark

68 Pin PGA
G68



68 Pin PLCC
P68

PIN OUT DEFINITIONS

| PLCC PIN NO. | PGA PADS | NAME | DESCRIPTION |
|--------------|----------|--------------------|-------------------------------------|
| 61 | 1 | V _{EE} | Negative Analog Supply |
| 62 | 2 | A _{IN} 24 | Analog Input 24 |
| 63 | 3 | A _{IN} 25 | Analog Input 25 |
| 64 | 4 | A _{IN} 26 | Analog Input 26 |
| 65 | 5 | A _{IN} 27 | Analog Input 27 |
| 66 | 6 | A _{IN} 28 | Analog Input 28 |
| 67 | 7 | A _{IN} 29 | Analog Input 29 |
| 68 | 8 | A _{IN} 30 | Analog Input 30 |
| 1 | 9 | A _{IN} 31 | Analog Input 31 |
| 2 | 10 | GND Ref. | Input Ground Reference |
| 3 | 11 | AGND | ADC Analog Ground |
| 4 | 12 | Ref In | Reference Input |
| 5 | 13 | Ref Out | Reference Output |
| 6 | 14 | AGND3 | Reference Analog Ground |
| 7 | 15 | DGND | Digital Ground |
| 8 | 16 | DB0/SDC | Data Output Bit 0/Serial Data Clock |
| 9 | 17 | N/C | No Connection |
| 10 | 18 | DB1 | Data Output Bit 1 |
| 11 | 19 | DB2 | Data Output Bit 2 |
| 12 | 20 | DB3 | Data Output Bit 3 |
| 13 | 21 | DB4 | Data Output Bit 4 |
| 14 | 22 | DB5 | Data Output Bit 5 |
| 15 | 23 | DB6 | Data Output Bit 6 |
| 16 | 24 | DB7 | Data Output Bit 7 |
| 17 | 25 | DB8 | Data Output Bit 8 |
| 18 | 26 | DB9 | Data Output Bit 9 |
| 19 | 27 | DB10 | Data Output Bit 10 |
| 20 | 28 | DB11/SDO | Data Output Bit 11/Serial Data Out |
| 21 | 29 | STS | Conversion Status |
| 22 | 30 | STL | Mux Settling Status |
| 23 | 31 | PXS | Parallel/XSerial |
| 24 | 32 | \overline{RD} | Read Enable |
| 25 | 33 | \overline{CS} | Chip Select |
| 26 | 34 | \overline{WR} | Write Enable |

| PLCC PIN NO. | PGA PADS | NAME | DESCRIPTION |
|--------------|----------|--------------------|--------------------------|
| 27 | 35 | ADEN | Address Enable |
| 28 | 36 | AB4 | Channel Address 4 |
| 29 | 37 | AB3 | Channel Address 3 |
| 30 | 38 | AB2 | Channel Address 2 |
| 31 | 39 | AB1 | Channel Address 1 |
| 32 | 40 | AB0 | Channel Address 0 |
| 33 | 41 | V _{DD} | Positive Digital Supply |
| 34 | 42 | V _{CC} | Positive Analog Supply |
| 35 | 43 | A _{IN} 0 | Analog Input 0 |
| 36 | 44 | A _{IN} 1 | Analog Input 1 |
| 37 | 45 | A _{IN} 2 | Analog Input 2 |
| 38 | 46 | A _{IN} 3 | Analog Input 3 |
| 39 | 47 | A _{IN} 4 | Analog Input 4 |
| 40 | 48 | A _{IN} 5 | Analog Input 5 |
| 41 | 49 | A _{IN} 6 | Analog Input 6 |
| 42 | 50 | A _{IN} 7 | Analog Input 7 |
| 43 | 51 | N/C | No Connection |
| 44 | 52 | A _{IN} 8 | Analog Input 8 |
| 45 | 53 | A _{IN} 9 | Analog Input 9 |
| 46 | 54 | A _{IN} 10 | Analog Input 10 |
| 47 | 55 | A _{IN} 11 | Analog Input 11 |
| 48 | 56 | A _{IN} 12 | Analog Input 12 |
| 49 | 57 | A _{IN} 13 | Analog Input 13 |
| 50 | 58 | A _{IN} 14 | Analog Input 14 |
| 51 | 59 | A _{IN} 15 | Analog Input 15 |
| 52 | 60 | AGND2 | Analog Ground Mux Return |
| 53 | 61 | A _{IN} 16 | Analog Input 16 |
| 54 | 62 | A _{IN} 17 | Analog Input 17 |
| 55 | 63 | A _{IN} 18 | Analog Input 18 |
| 56 | 64 | A _{IN} 19 | Analog Input 19 |
| 57 | 65 | A _{IN} 20 | Analog Input 20 |
| 58 | 66 | A _{IN} 21 | Analog Input 21 |
| 59 | 67 | A _{IN} 22 | Analog Input 22 |
| 60 | 68 | A _{IN} 23 | Analog Input 23 |

ELECTRICAL CHARACTERISTICS TABLE

Unless Otherwise Specified: $V_{DD} = 5\text{ V}$, $V_{CC} = 15\text{ V}$, $V_{EE} = -15\text{ V}$, $GND_{Ref} = 0\text{ V}$, $T_A = 25^\circ\text{C}$,

$V_{REFIN} = \text{Ref Out}$

| Parameter | Symbol | 25°C | | | Tmin to Tmax | | Units | Test Conditions/Comments |
|--|-------------|-------|-----|------------|--------------|-----------|-------|--------------------------|
| | | Min | Typ | Max | Min | Max | | |
| Resolution (All Grades) | N | 12 | | | 12 | | | Bits |
| KEY FEATURES | | | | | | | | |
| Resolution | | | 12 | | | 12 | | Bits |
| Conversion Time, Per Channel | t_{CONVR} | | | 15 | | 15 | | μs |
| ACCURACY (A, S Grade)¹ | | | | | | | | |
| Differential Non-Linearity | DNL | | 3/4 | 2 | | 2 | | LSB |
| Integral Non-Linearity | INL | | 1 | 2 | | 2 | | LSB |
| Zero Code Error | EZS | | 2 | ± 5 | | ± 10 | | LSB |
| Full Scale Error | EFS | | 0.1 | ± 0.35 | | ± 0.5 | | % |
| POWER SUPPLY REJECTION | | | | | | | | |
| $V_{CC} = 15\text{ V} \pm 1.5\text{ V}$ or $12\text{ V} \pm 0.6\text{ V}$ | | | | ± 1 | | ± 1 | | LSB |
| $V_{DD} = 5\text{ V} \pm 0.25\text{ V}$ | | | | ± 2 | | ± 2.5 | | LSB |
| $V_{EE} = -15\text{ V} \pm 1.5\text{ V}$ or $-12\text{ V} \pm 0.6\text{ V}$ or $-5\text{ V} \pm 0.25\text{ V}$ | | | | ± 1 | | ± 1 | | LSB |
| REFERENCE VOLTAGES | | | | | | | | |
| Ref. Voltage Input | Ref In | 3.6 | | 4.4 | | | | V |
| Ref. Voltage Output | Ref Out | 3.975 | | 4.025 | | | | V |
| Ref. Source Current | | 3.0 | 4.0 | | 3.0 | | | mA |
| Ref. Sink Current | | | 20 | | | | | μA |
| ANALOG INPUT² | | | | | | | | |
| Input Voltage Range ⁵ | V_{IN} | -10 | | 10 | -10 | 10 | | V |
| Ground Reference | GND Ref. | | | | | | | V |
| CM Range | | -3 | | 3 | -3 | 3 | | V |
| CM RR | | | TBD | | | | | LSB/V |
| Input Resistance | R_{IN} | 100 | 130 | | 100 | | | k Ω |
| Input Capacitance | C_{IN} | | 5 | | | | | pF |
| Aperture Delay | t_{AP} | | 180 | | | | | ns |
| Channel-to-Channel Isolation ² | | | -80 | -70 | | | | dB |
| DIGITAL INPUTS | | | | | | | | |
| \overline{CS} , \overline{WR} , RD AB0-AB4, ADEN | | | | | | | | |
| Logical "1" Voltage | V_{IH} | 2.4 | | 5.5 | 2.4 | 5.5 | | V |
| Logical "0" Voltage | V_{IL} | -0.5 | | 0.8 | -0.5 | 0.8 | | V |
| Leakage Currents ⁶ | I_{IN} | -5 | | 5 | -10 | 10 | | μA |
| Input Capacitance ² | | | 5 | | | | | pF |

ELECTRICAL CHARACTERISTICS TABLE (CONT'D)

| Description | Symbol | 25°C | | | Tmin to Tmax | | Units | Conditions | |
|------------------------------|----------|-------|-----|-------|--------------|-------|---------------|--|--|
| | | Min | Typ | Max | Min | Max | | | |
| DIGITAL OUTPUTS | | | | | | | | | |
| (Data Format 2's Complement) | | | | | | | | | |
| DB0/SDC-DB11/SDO, STS, STL | | | | | | | | | |
| Logical "1" Voltage | V_{OH} | 4.0 | | | 2.4 | | V | $C_{OUT}=15\text{ pF}$ $I_{SOURCE} = 0.5\text{ mA}$ $I_{SINK} = 1.6\text{ mA}$ $V_{OUT}=GND\text{ to }V_{DD}$ | |
| Logical "0" Voltage | V_{OL} | | | 0.4 | | 0.4 | V | | |
| Tristate Leakage | I_{OZ} | -5 | | 5 | -5 | 5 | μA | | |
| POWER SUPPLIES | | | | | | | | | |
| Operating Range | | | | | | | | | |
| V_{DD} | | +4.5 | | +5.5 | +4.5 | +5.5 | V | Tested at -11.4 and -16.5 only | |
| V_{CC} | | +11.4 | | +16.5 | +11.4 | +16.5 | V | | |
| V_{EE} | | -4.75 | | -16.5 | -4.75 | -16.5 | V | | |
| Operating Current | | | | | | | | | |
| I_{DD} | | | 2 | 7 | | 7 | mA | | |
| I_{CC} | | | 5 | 8 | | 8 | mA | | |
| I_{EE} | | | 1.5 | 3 | | 3 | mA | | |
| Power Dissipation | | | 110 | 200 | | 200 | mW | | |

NOTES

- 1 Tester measures code transitions by dithering the voltage of the analog input (V_{IN}). The difference between the measured and the ideal code width is the DNL error. The INL error is the maximum distance (in LSBs) from the best fit line to any transition voltage Guaranteed. Not tested.
- 2 Specified values guarantee functionality. Refer to other parameters for accuracy.
- 3 Input bandwidth is a measure of performance of the A/D input stage (S/H + amplifier). Refer to other parameters for accuracy within the specified bandwidth.
- 4 All channel input pins and ground reference pin have protection which becomes active above $\pm 60\text{ V}$.
- 5 All digital inputs have diodes to V_{DD} and AGND. Input DC currents will not exceed specified limits for any input voltage between GND and V_{DD} .

Specifications are subject to change without notice

ABSOLUTE MAXIMUM RATINGS ($T_A = +25^\circ\text{C}$ unless otherwise noted)^{1, 2}

| | | | |
|--|--------------------------------------|--|--|
| V_{CC} to DGND | 0 to +16.5 V | REF OUT | Indefinite short to DGND, Momentary short to V_{CC} |
| V_{EE} to DGND | 0 to -16.5 V | Maximum Junction Temperature | 150°C |
| V_{DD} to DGND | 0 to +7 V | Package Power Dissipation Rating to 75°C | |
| AGND to DGND | $\pm 1\text{ V}$ | PGA, PLCC | 1800 mW |
| Digital Inputs/Outputs to DGND | -0.5 V to $V_{LOGIC} + 0.5\text{ V}$ | Derates above 75°C | 25 mW/°C |
| Analog Inputs ($A_{IN0} - A_{IN31}$, GND REF) to AGND | $\pm 60\text{ V}$ | Lead Temperature, Soldering | 300°C, 10 Sec |
| | | Storage Temperature (Ceramic) | -65°C to +150°C |

NOTES:

- 1 Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation at or above this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.
- 2 Any input pin which can see a value outside the absolute maximum ratings should be protected by Schottky diode clamps (HP5082-2835) from input pin to the supplies. All logic inputs have protection diodes which will protect the device from short transients outside the supplies of less than 100mA for less than 100 μs .

PRODUCT INFORMATION

Basic Description

The MP3274 is a fault protected data acquisition subsystem available in monolithic form. This product contains all of the circuitry necessary to acquire 32 channels of differential or single-ended analog signals at ± 10 V input range and 15kHz bandwidth. Connections to power, the analog input signals and the digital system are all that is required. The MP3274's input circuitry is protected against active input signals present with the MP3274 power off. This is also the case for any channel exceed-

ing the MP3274 analog input dynamic range without interfering with the channel being digitized. The channel address and channel conversion can be managed in two ways: random channel conversion or same channel conversion. Circuitry on the chip adds a MUX/instrumentation amp settling delay, when a new channel is selected ($ADEN = 1$). Conversion start is initiated without delay for the single-channel case ($ADEN = 0$). Data is available in either parallel or serial format.

TIMING

Control and Timing Considerations – Parallel Mode ($PXS = 1$)

The MP3274 can be operated in the stand-alone mode, with one line for control and everything else hard-wired; or under microprocessor control, where changes can be made dynamically. There are 4 control lines: $ADEN$, \overline{CS} , \overline{WR} , and \overline{RD} with their functions described in *Table 1*.

PXS is the control pin for formatting data for serial or parallel control.

| \overline{CS} | \overline{WR} | \overline{RD} | $ADEN$ | Data | STL | STS | Comments |
|---|-----------------|-----------------|--------|----------|-----|-----|---|
| ADC Channel Select and Start Convert (See Figure 1. and Table 2.) | | | | | | | |
| 1 | X | X | X | — | 0 | 0 | No operation |
| 0 | ↓ | 1 | 0 | Hi-Z | 0 | 0 | No operation if $ADEN = 0$ |
| 0 | ↓ | 1 | 1 | Hi-Z | ↑ | 0 | Input MUX channel selected, STL set on \overline{WR} falling edge |
| 0 | 0 | 1 | X | Hi-Z | 1 | 0 | MUX select disabled |
| 0 | ↑ | 1 | X | Hi-Z | 0 | ↑ | Start convert on \overline{WR} rising edge |
| 0 | 1 | 1 | X | Hi-Z | ↓ | ↑ | Start convert on STL falling edge |
| 0 | 1 | 1 | X | Hi-Z | 0 | ↓ | STS goes low at end of conversion |
| Read ADC Data – Parallel Output Mode ($PXS = 1$) (See Figure 2. and Table 3.) | | | | | | | |
| 0 | 1 | ↓ | X | — | 0 | 0 | Data outputs enabled |
| 0 | X | 0 | X | ADC | 0 | 0 | Data from previous conversion on data bus |
| 0 | X | ↑ | X | Hi-Z | 0 | 0 | Data outputs disabled |
| 0 | 1 | X | X | Hi-Z | 0 | 1 | Data/ \overline{RD} disabled while STS high |
| 0 | X | 0 | X | Last ADC | 1 | 0 | Data from last conversion on data bus |
| 0 | ⌋ | 0 | 0 | Hi-Z | 0 | ↑ | STL, MUX select disabled with $ADEN = 0$, data outputs disabled on STS rising edge |
| 0 | ⌋ | 0 | X | ADC | 0 | ↓ | New data appears on data bus on falling edge of STS |

Note 1: If $\overline{RD} = 1$, data outputs remain high impedance. It is recommended that \overline{RD} will not change during a conversion in order to reduce noise. It is further recommended that $\overline{RD} = 1$ during conversion to reject any noise present on the data bus.

Table 1. Logic Truth Table for $PXS = 1$ (Parallel Mode)

The MP3274 is easily interfaced to a wide variety of microprocessors and other digital systems. Discussion of the timing requirements of the MP3274 control signals will provide the system designer with useful insight into the operation of the device.

Figure 1. shows a complete timing diagram for the MP3274 convert start operation.

Either \overline{WR} or \overline{CS} may be used to initiate a conversion. We recommend using \overline{WR} as used in Figure 1. It is quieter and has less propagation delay than \overline{CS} . If \overline{CS} is used to trigger the conversion the specified set-up times will be longer.

A conversion is started by taking \overline{WR} low, then high again (conversion is enabled on the rising edge of \overline{WR}). There are two possible conditions that will affect conversion timing.

1. ADEN = 1. At the falling edge of \overline{WR} , the input channel is determined by the data present on the address bits. The track and hold begins to settle after which STL returns low, indicating that the multiplexer and the buffer amp have settled to less than 1/2 LSB of final value. If the rising edge of \overline{WR} returns high prior to STL going low, conversion will begin on the falling edge of STL. If the rising edge of \overline{WR} is delayed until after STL returns low, the input signal is sampled and the conversion is started at the rising edge of \overline{WR} giving the user better control of the sampling time.

2. ADEN = 0. At the falling edge of \overline{WR} the data present at the address is ignored and the channel selected during the previous conversion remains selected. In this case the track and hold settling time is omitted and STL never goes high. At the rising edge of \overline{WR} the input signal is sampled, and conversion is started.

There are two possible states that the data outputs could be in during a conversion.

1. If \overline{RD} is held high during a conversion the outputs would remain high impedance throughout the conversion. This is the preferred method of operation as any noise present on the data bus is rejected.
2. If \overline{RD} and \overline{CS} are held low during a conversion, the data present will be from the previous conversion until the present conversion is completed when STS returns low. The data from the new conversion will appear on the outputs. The state of \overline{RD} or \overline{CS} should not change during a conversion.

Once a conversion is started and the STL or STS line goes high, convert start commands will be ignored until the conversion cycle is completed. The output data buffers cannot be enabled during conversion. In addition, all inputs and outputs which change during conversion can introduce noise, and should be avoided when possible.

| ADC Write Timing | Time Interval | 25°C | Tmin to Tmax | Limits | Comments/Test Conditions |
|--|-----------------|------|--------------|--------|--|
| ADC Control Timing | | | | | |
| \overline{CS} to \overline{WR} Set-Up Time | t ₁ | 0 | 0 | ns min | |
| \overline{CS} to \overline{WR} Hold Time | t ₂ | 0 | 0 | ns min | |
| Address to \overline{WR} Set-Up Time | t ₃ | 0 | 0 | ns min | |
| Address to \overline{WR} Hold Time | t ₄ | 0 | 0 | ns min | |
| \overline{WR} Pulse Width | t ₅ | 80 | 80 | ns min | |
| ADEN to \overline{WR} Set-Up Time | t ₆ | | 0 | ns min | |
| ADC Conversion Timing | | | | | |
| \overline{WR} to STL Delay | t ₇ | 150 | 150 | ns max | Load ckt of Figure 5, C _L = 20 pF, ADEN = 1 |
| STL High (mux/amp settle) | t ₈ | 10 | 15 | µs max | Load ckt of Figure 5, C _L = 20 pF |
| STL to STS Low (Converting) | t ₉ | 15 | 20 | µs max | Load ckt of Figure 5, C _L = 20 pF |
| \overline{WR} to STS High (ADEN = 0) | t ₁₂ | 200 | 250 | ns max | STL = 0 when ADEN = 0 |
| \overline{WR} to STS Low (ADEN = 1) | t ₁₀ | 15 | 20 | µs max | |
| STS High to Bus Relinquish Time | t ₁₃ | 150 | 150 | ns max | Load ckt of Figure 4 |
| STS Low to Data Valid (\overline{RD} = 0) | t ₁₄ | 50 | 50 | ns max | Load ckt of Figure 3, C _L = 20 pF |

Table 2. ADC Write Timing
(See Figure 1.)

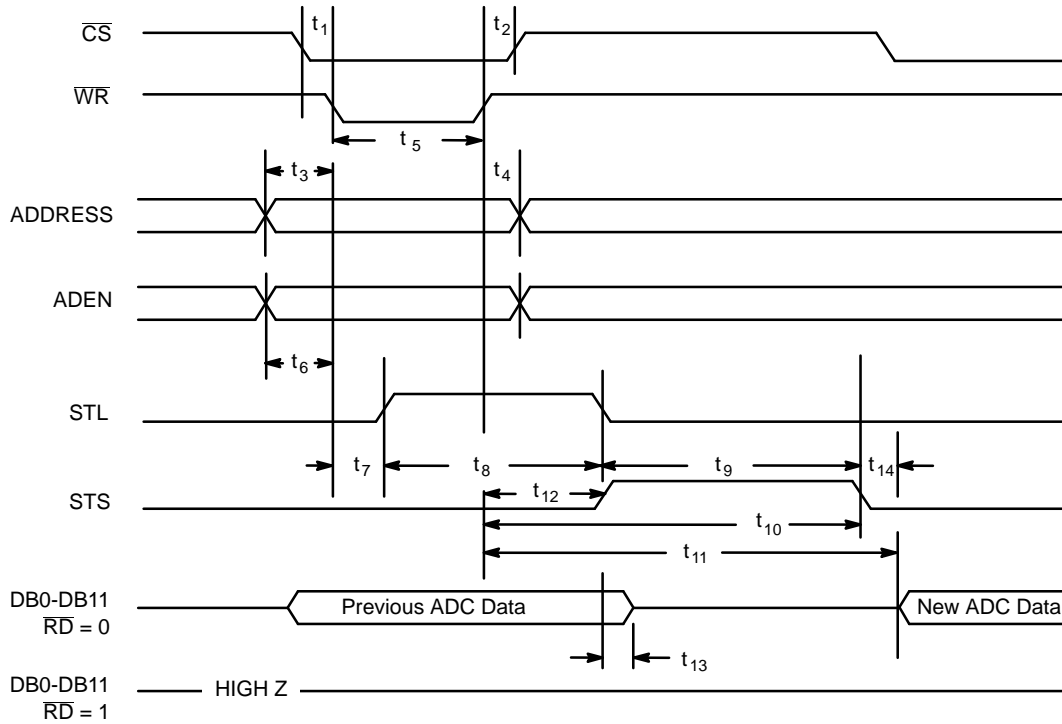


Figure 1. Timing for ADC Channel Select Start Conversion

| ADC Read Timing | Time Interval | 25°C | Tmin to Tmax | Limits | Comments/Test Conditions |
|--|---------------|------|--------------|--------|--|
| \overline{CS} to \overline{RD} Set-Up Time | t_{15} | 0 | 0 | ns min | Load ckt of Figure 3., $C_L = 20$ pF Load ckt of Figure 3., $C_L = 100$ pF Load ckt of Figure 4. |
| \overline{CS} to \overline{RD} Hold Time | t_{16} | 0 | 0 | ns min | |
| \overline{RD} to Data Valid Delay | t_{17} | 100 | 150 | ns max | |
| | | 150 | 200 | ns max | |
| Bus Relinquish Time after \overline{RD} High | t_{18} | 100 | 150 | ns max | |
| \overline{RD} Pulse Width | t_{19} | 100 | 150 | ns min | |

Table 3. ADC Read Timing
(See Figure 2.)

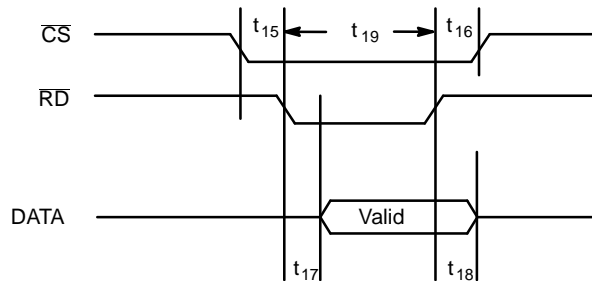


Figure 2. Timing for ADC Read

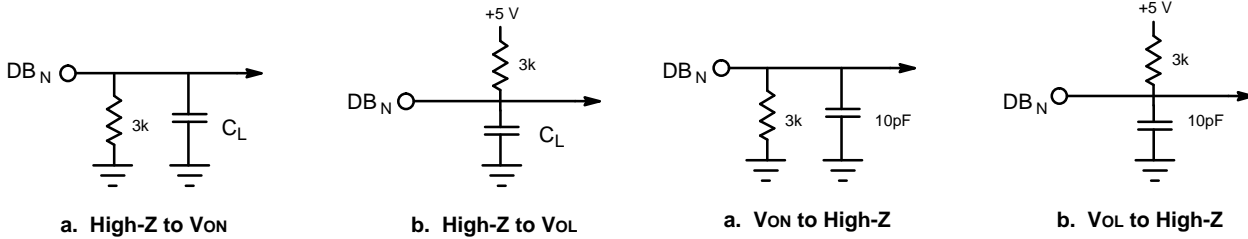


Figure 3. Load Circuit for Data Access Time Test

Figure 4. Load Circuit for Bus Relinquish Time Test

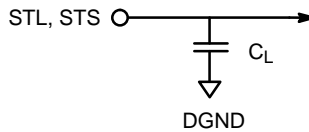


Figure 5. Load Circuit for \overline{WR} to STS Delay

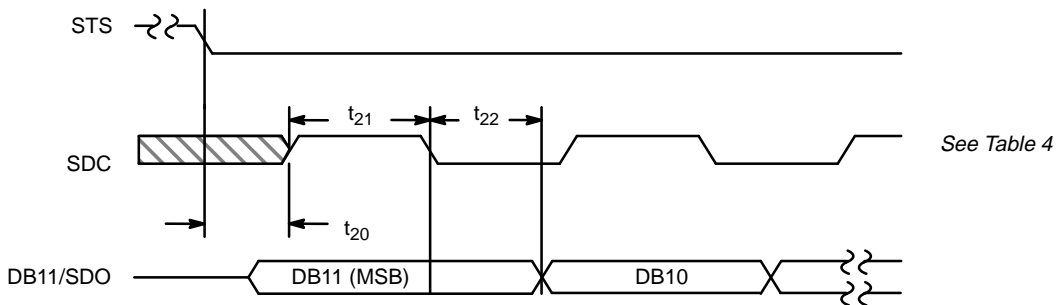
Serial Data Output Mode (PXS = 0)

The MP3274 output data is available in serial form when PXS = 0 prior to the \overline{RD} high-to-low transition. When PXS = 0, the DB11/SDO pin functions as the serial data output. The DB0/SDC pin functions as the serial clock input and all other data outputs are 3-stated.

The serial data output sequence is MSB (DB11) first to LSB (DB0) last. The MSB (DB11) data bit appears at DB11/SDO when STS goes low. The second most significant bit appears at DB11/SDO on the next DB0/SDC high-to-low transition. The LSB (DB0) is present at DB11/SDO on the 11th SDC high-to-low transition.

The control pin functions (ADEN, \overline{CS} , \overline{WR} , and \overline{RD}) are the same as the parallel mode of operation. Further information regarding serial control and timing is shown in Figure 6., Table 4. and Table 5.

For a minimum interconnect serial environment, the channel address state can be generated in at least two ways, using an address counter, or using an address serial to parallel converter. \overline{WR} can then be used as the counter clock or shift register load signal as well as the A/D converter start convert signal on the rising edge. (Note that the falling edge loads the address present at the address port.)



SDC should be in a high state during the STS high period. SDC can make the first high to low transition after t₂₁. In normal use it is assumed that PXS is hardwired low. However, if the mode of operation is changed, PXS must go low prior to \overline{RD} going low.

Figure 6. Serial Data Mode Timing

| Serial Data Output Timing | Time Interval | 25°C | Tmin to Tmax | Limits | Comments/Test Conditions |
|---|---------------|--------|--------------|--------|---|
| STS low to SDO (DB11) Valid, $\overline{RD} = 0$ Minimum clock high pulse width SDC low to data valid delay | t_{20} | 50 | 50 | ns max | Load Ckt 4 of Figure 3. |
| | t_{21} | 50 | 80 | ns max | Load ckt of Figure 3., $C_L = 20\text{pF}$ Load ckt of Figure 3., $C_L = 100\text{pF}$ |
| | t_{22} | 150 ns | 200 | ns max | |
| | | 200 ns | 250 | ns max | |

Table 4. Serial Data Output Mode Timing (See Figure 6.)

| CS | PXS | WR | RD | ADEN | Data | STL | STS | DB0/SDC | Comments |
|---|-----|----|----|------|------------|-----|-----|---------|---|
| ADC Channel Select and Start Convert | | | | | | | | | |
| 1 | X | X | X | X | — | 0 | 0 | X | No Operation |
| 0 | ↓ | X | 1 | X | Hi-Z | 0 | 0 | X | Serial mode enabled (1) |
| 0 | 0 | ↓ | 1 | 0 | Hi-Z | 0 | 0 | X | No operation if ADEN = 0 |
| 0 | 0 | ↓ | 1 | 1 | Hi-Z | ↑ | 0 | X | Input MUX channel selected, STL set on falling edge of WR |
| 0 | 0 | 0 | 1 | X | Hi-Z | 1 | 0 | X | MUX select disabled |
| 0 | 0 | ↑ | 1 | X | Hi-Z | 0 | ↑ | X | Start convert on WR rising edge |
| 0 | 0 | 1 | 1 | X | Hi-Z | ↓ | ↑ | X | Start convert on STL falling edge |
| 0 | 0 | 1 | 1 | X | Hi-Z | 0 | ↓ | X | STS goes low at end of conversion |
| Read ADC Data (See Table 4. and Figure 6.) | | | | | | | | | |
| 0 | 0 | 1 | ↓ | X | — | 0 | 0 | 1 | Serial output (DB11/SDO) and serial clock input (DB0/SDC) enabled |
| 0 | 0 | X | X | X | MSB (DB11) | 0 | 0 | 1 | MSB data available at DB11/SDO |
| 0 | 0 | X | 0 | X | DB10 | 0 | 0 | ↓ | Next significant bit shifted out to DB11/SDO |
| 0 | 0 | X | 0 | X | DB10 | 0 | 0 | 0 | No Operation |
| 0 | 0 | X | 0 | X | DB10 | 0 | 0 | ↑ | No Operation |
| 0 | 0 | X | 0 | X | DB9 | 0 | 0 | ↓ | Next significant bit shifted out to DB11/SDO |
| 0 | 0 | X | ↑ | X | Hi-Z | 0 | 0 | X | Data outputs/SDC input disabled |
| 0 | X | 1 | X | X | Hi-Z | 0 | 1 | X | Data outputs/RD disabled when STS = 1 |
| 0 | X | ⌋ | 0 | 0 | Hi-Z | 0 | ↑ | 1 | STL, MUX select disabled when ADEN = 0 |
| 0 | 0 | ⌋ | 0 | X | MSB (DB11) | 0 | ↓ | 1 | New data appears at DB11/SDO on falling edge of STS |

Note 1: If $\overline{RD} = 1$, data outputs remain high impedance. It is recommended that \overline{RD} will not change during a conversion in order to reduce noise. It is further recommended that $\overline{RD} = 1$ during conversion to reject any noise present on the data bus.

Table 5. Logic Truth Table – Serial Data Output Mode

| 2's Complement Output Code (Hexidecimal) | | | | | | Ideal Transition Voltage |
|--|------|---------------|------|------|------------|--------------------------|
| 0111 | 1111 | 1110 (7fe) to | 0111 | 1111 | 1111 (7ff) | +FS – 1 1/2 LSB |
| 0000 | 0000 | 0000 (000) to | 0000 | 0000 | 0001 (001) | 0 V +1/2 LSB |
| 1111 | 1111 | 1111 (fff) to | 0000 | 0000 | 0000 (000) | 0 V –1/2 LSB |
| 1000 | 0000 | 0000(800) to | 1000 | 0000 | 0001 (801) | –FS +1/2 LSB |

Table 6. Key Output Codes vs. Input Voltage (2's Complement Code)

APPLICATION INFORMATION

The MP3274 is a complete A/D converter system, with its own built-in reference and clock. It may be used by itself (“stand-alone” operation), or it may be interfaced with a microprocessor which can control both conversion and formatting of output.

Successful application of the MP3274 requires careful attention to four main areas:

- 1) Physical layout.
- 2) Connection/Trimming according to mode of operation.
- 3) Conditioning of input signals.
- 4) Control and Timing considerations.

Physical Layout

The 12-bit accuracy of the MP3274 represents a dynamic range of 72dB. In order that this be preserved, thorough precautions must be taken to avoid any interfering signals, whether conducted or radiated.

- Avoid placing the chip and its analog signals near logic traces. In general, using a double sided printed circuit card with a good ground plane on the component side is recommended. Routing analog signals between ground traces will help isolate digital control logic. If these lines cross, do so at right angles. The GND Ref. is the positive terminal of the MUX/Instrumentation amplifier and will provide common mode noise rejection. It should be close to and shielded together with the channel inputs in order to take advantage of this feature.
- Power supplies should be quiet and well regulated. Grounds should be tied together at the package and back to the system ground with a single path. Bypass the supplies at the device with a 0.01 to 0.1µF ceramic cap and a 10-47 µF tantalum type, in parallel.

“Stand-Alone” Operation

The MP3274 can be used in “stand-alone” operation, which is useful in systems not requiring full computer bus interface capability. This operation is available for either parallel or serial mode.

For this operation, $\overline{CS} = 0$, $ADEN = 1$, and conversion is controlled by \overline{WR} . The 3-state buffers are enabled when \overline{RD} goes low. There are two possible conditions that the 3-state buffers could be in during a conversion. If \overline{RD} goes low prior to \overline{WR} , the output buffers are enabled and the data from the previous conversion is available at the outputs during $STL = 1$. At the end of the present conversion which is initiated at the rising edge of \overline{WR} , STS returns low and the new conversion result is placed on the output data buffers.

If \overline{WR} goes low prior to \overline{RD} the data buffers remain in a high impedance state and conversion is initiated at the rising edge of \overline{WR} . Upon the end of the conversion the STS returns low and the conversion result is placed on the output data buffers.

Ground Reference

The ground reference pin can be used for remote ground sensing of a common mode input signal with a maximum 6 V p-p around AGND.

This common input can also be used to dither each input’s “zero”. By averaging multiple conversions digitally, higher resolution for each input conversion can be obtained. Patterns for this dither can be a ramp, a stair step, or white noise.

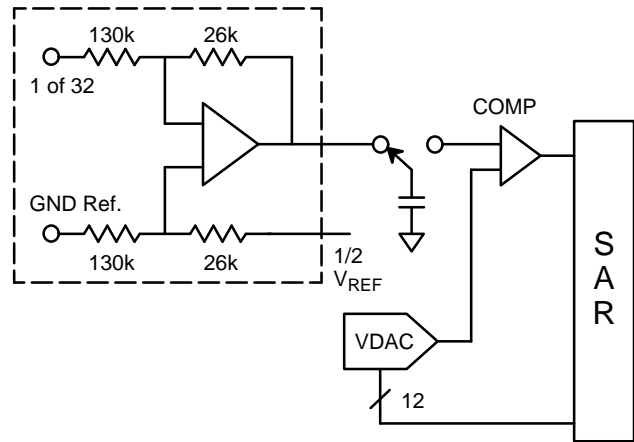


Figure 7. Equivalent Input Circuit

Quasi Differential Sampling

Method 1

For remote ground sensing where the remote ground does not change more than ± 3 V from the A/D ground, connect GND Ref to the remote ground.

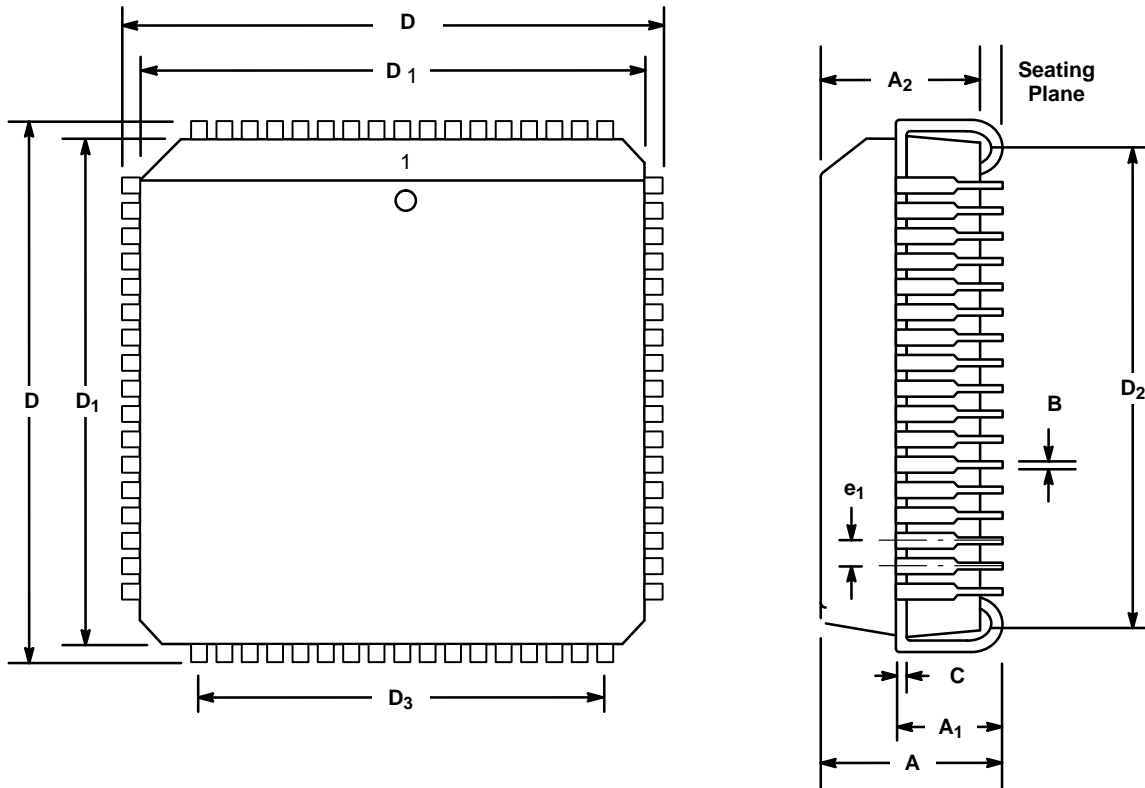
Method 2

Where Method 1 applies to each channel or group of channels, add a mux to allow connecting the appropriate ground to GND Ref.

Method 3

Use two parts. Tie both GND Ref pins together and connect this node to the “common” remote GND. Control the sample point by connecting each STL through an “OR” gate whose output is “NAND” connect with \overline{WR} (inverted \overline{WR}). Use this output as \overline{WR} to both \overline{WR} inputs. By controlling the \overline{WR} , sample delay differences between the two converters is minimized. Two parts from the same date code will further minimize this difference. Treat one A/D as the (+) terminal and the other as the (-) terminal of the differential signal. Now the difference can be taken digitally.

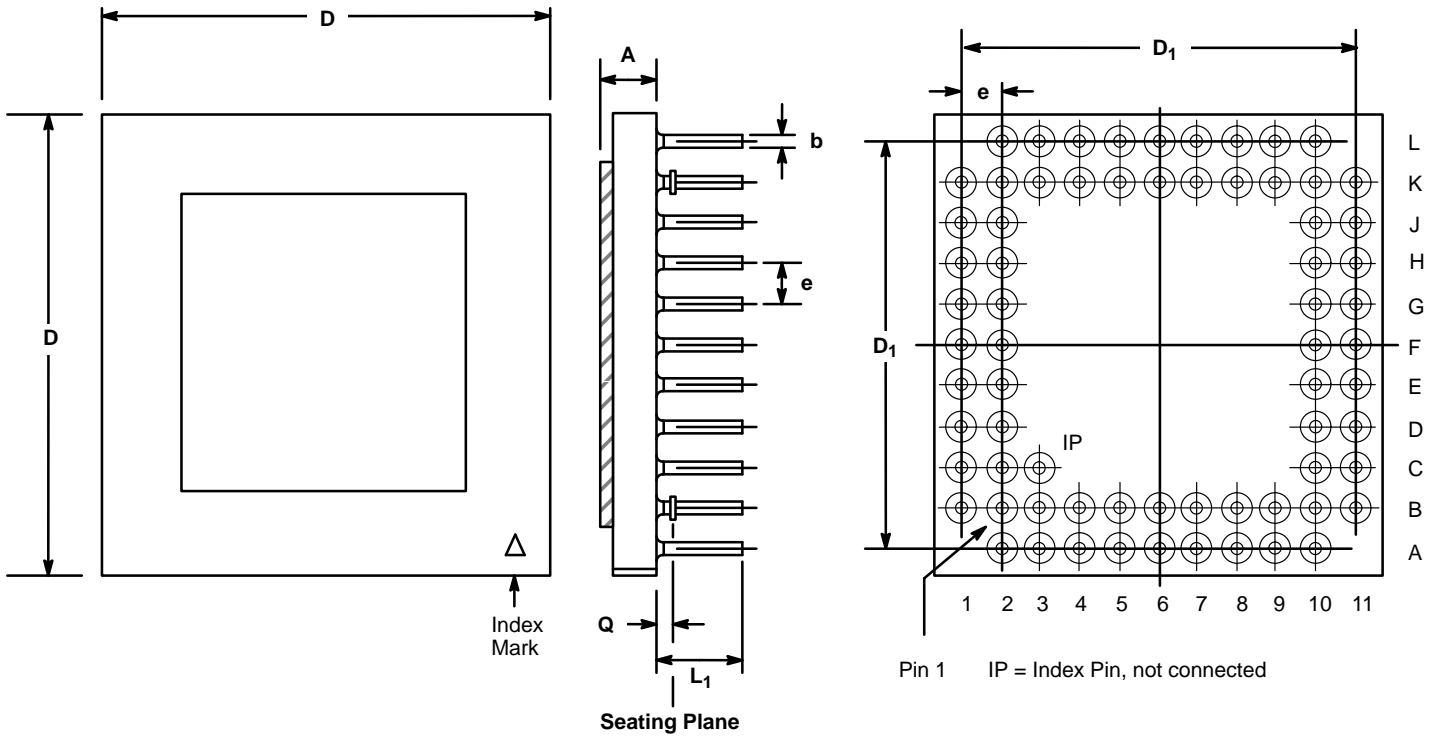
68 LEAD PLASTIC LEADED CHIP CARRIER (PLCC) P68



| SYMBOL | INCHES | | MILLIMETERS | |
|--------------------|-----------|--------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | .165 | .180 | 4.19 | 4.57 |
| A ₁ | .095 | .118 | 2.51 | 3.00 |
| A ₂ | 0.146 | 0.154 | 3.71 | 3.91 |
| B | 0.013 | 0.021 | 0.330 | 0.553 |
| C | 0.097 | 0.0103 | 0.246 | 0.261 |
| D | .985 | .995 | 25.02 | 25.27 |
| D ₁ (1) | .950 | .954 | 24.13 | 24.23 |
| D ₂ | .890 | .930 | 22.60 | 23.62 |
| D ₃ | 0.800 Ref | | 20.32 Ref. | |
| e ₁ | 0.050 BSC | | 1.27 BSC | |

Note: (1) Dimension D₁ does not include mold protrusion.
Allowed mold protrusion is 0.254 mm/0.010 in.

**68 LEAD PIN GRID ARRAY
(PGA)
G68**



| SYMBOL | INCHES | | MILLIMETERS | |
|--------|------------|-------|-------------|-------|
| | MIN | MAX | MIN | MAX |
| A | 0.079 | 0.095 | 2.00 | 2.41 |
| b | 0.016 | 0.020 | 0.406 | 0.508 |
| D | 1.086 | 1.110 | 27.6 | 28.2 |
| D_1 | 0.788 | 0.812 | 20.0 | 20.6 |
| e | 0.100 typ. | | 2.54 typ. | |
| L_1 | 0.170 | 0.190 | 4.32 | 4.83 |
| Q | 0.050 typ. | | 1.27 typ. | |

| CONNECTION TABLE | | | | | | | |
|------------------|-----|-----|-----|-----|-----|-----|-----|
| PAD | PIN | PAD | PIN | PAD | PIN | PAD | PIN |
| 1 | B2 | 18 | K2 | 35 | K10 | 52 | B10 |
| 2 | B1 | 19 | L2 | 36 | K11 | 53 | A10 |
| 3 | C2 | 20 | K3 | 37 | J10 | 54 | B9 |
| 4 | C1 | 21 | L3 | 38 | J11 | 55 | A9 |
| 5 | D2 | 22 | K4 | 39 | H10 | 56 | B8 |
| 6 | D1 | 23 | L4 | 40 | H11 | 57 | A8 |
| 7 | E2 | 24 | K5 | 41 | G10 | 58 | B7 |
| 8 | E1 | 25 | L5 | 42 | G11 | 59 | A7 |
| 9 | F2 | 26 | K6 | 43 | F10 | 60 | B6 |
| 10 | F1 | 27 | L6 | 44 | F11 | 61 | A6 |
| 11 | G2 | 28 | K7 | 45 | E10 | 62 | B5 |
| 12 | G1 | 29 | L7 | 46 | E11 | 63 | A5 |
| 13 | H2 | 30 | K8 | 47 | D10 | 64 | B4 |
| 14 | H1 | 31 | L8 | 48 | D11 | 65 | A4 |
| 15 | J2 | 32 | K9 | 49 | C10 | 66 | B3 |
| 16 | J1 | 33 | L9 | 50 | C11 | 67 | A3 |
| 17 | K1 | 34 | L10 | 51 | B11 | 68 | A2 |

Note: The letters A-H and numbers 1-8 are the coordinates of a grid. For example, pin 1 is at the intersections of the "B" vertical line and the "2" horizontal line.

Notes

Notes

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