AN2574

4 ½ -Digit (±19999 count)
0.01% Accuracy, Premium Performance
DIGITAL PANEL INSTRUMENT

DESCRIPTION

The Analogic model AN2574 is a high accuracy, high performance 4½ -digit (±19999 counts) digital panel instrument. Features such as a gigaohm differential input, microvolt sensitivity, and programmable TRI-STATE BCD outputs, place this high quality precision instrument into a class by itself.

Three power options including 110VAC, 220VAC and +5VDC, and full-scale ranges of ±1.9999 Volts or ±199.99mV make the AN2574 universally applicable. Instrumentation features include a unique, guarded and isolated analog front end with common mode rejection ratios (CMRR) as high as 140dB, an auto-zeroed input circuit for long-term stability, FET input circuitry with low (picoAmp) input bias current and high (gigaohm) input resistance, and an optimized signal-enhancement filter which maximizes rejection of normal mode interference signals while providing input over-voltage protection of more than 100V. Serial and word-programmable TRI-STATE BCD outputs provide the utmost versatility and satisfy virtually all instrumentation requirements.

The displays are designed for maximum readability. Up close, several feet away, or off at an angle, the five large (.43") red LED digits are bright, clear, crisp and free from glare and interpretation problems even under high ambient light conditions. When an input overload condition occurs, all five digits are automatically blanked to prevent an erroneous reading; however, the polarity sign and decimal point remain displayed to show that the instrument is working properly.

Among the many outstanding features that assure high reliability and lasting performance of the AN2574 are: Comprehensive quality control and reliability procedures, e.g., minimum 100-hour temperature-cycled burn-in from 0°C to +50°C, with asynchronous power on/off cycles, instantaneous warmup and display (no waiting for readings to settle), isolation that "floats" the measuring circuits up to 1400 volts from the power-line ground, maximum rejection of ripple and noise provided by optimized input signal filtering, and true dual-slope integration.

AC power is supplied through a dual-primary, high efficiency power transformer. Parallel or series-connected dual primaries are designed for extremely large power line variations and dual secondary windings separate analog and digital circuits.

Packaged in a rugged DIN/NEMA high-impact molded plastic case (UL94V-0 rated) with front-panel-accessible span control, every AN2574 is conformance and vibration tested prior to shipment. Rated performance is guaranteed by a Quality Control certificate and calibration report enclosed with every instrument.

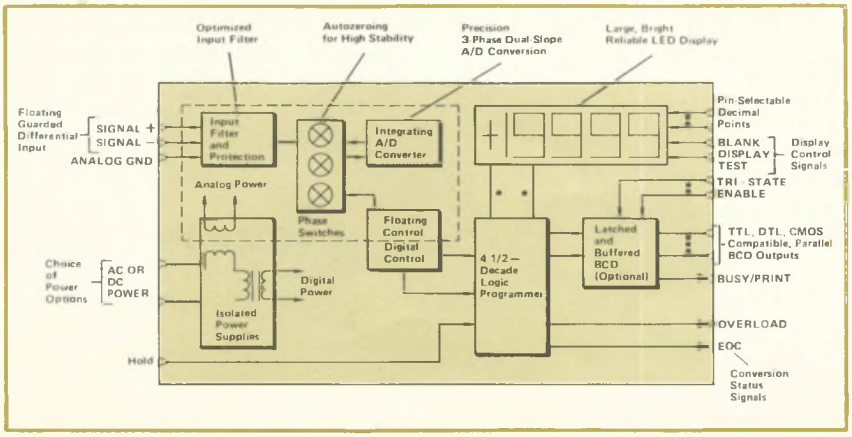


Fig. 1. AN2574 Functional Block Diagram

FEATURES

- High Performance – Low Cost.
- Accuracy of ±0.01% of Reading ±1 Count.
- 10 microVolt Sensitivity (for ±199.99mV FS).
- ±0.005% Readout Resolution for 19999 Counts.
- Bipolar, Differential, Guarded FET input.
- Ultra Low Bias Current (Less Than 50 picoAmps).
- Automatic Zero for Long-Term Stability.
- Input Protection for more than 100 Volts.
- Floating & Isolated Input (1400 Volts).
- High Input Impedance (1000 Megohms).
- CMRR Greater Than 140 dB.
- NMRR Greater Than 70 dB.
- 100msec Integration Period for Highest NMRR and CMRR.
- DISPLAY TEST, HOLD, BLANK, OVER-RANGE and EOC Control Signals.
- Serial BCD Output; Standard.
- TRI-STATE BCD Output, Word-Programmable; Optional.
- Ratiometric Capability, 3 or 4-Wire; Optional.
- Large .43" (11mm) LED Display for Maximum Readability.
- Universal Power Options Include:
  +5VDC ±5% @ 1.8 Watts.
  110VAC ±20% @ 2.7 Watts.
  220VAC ±20% @ 2.7 Watts.
- DIN/NEMA Standard Case; UL94V-0 Rated.
- 15-Month Recommended Recalibration Interval.
- Rear Screw Terminal Connector Available.

APPLICATIONS

- Precision Analytical Instrumentation.
- High Accuracy Digital Process Indicators With Universal Computer Bus Interface.
- Industrial Weighing and Scaling Systems.
- High Precision Thermocouple Digitizers.
- Laboratory Digital pH Meters.
- Portable Hanging-Scale Indicator.
- High Resolution Strain Gauge Digitizers.

ANALOGIC®
. . . The Digitizers

AN2574 SPECIFICATIONS

ANALOG INPUT

Configuration	Bipolar, floating differential input.
Full Scale Range	±1.9999VDC or ±199.99mVDC.
Input Resistance	1000 Megohms
Bias Current @ 25°C	
±1.9999VDC Full Scale	20pA typical, 50pA maximum.
±199.99mVDC Full Scale	50pA typical, 100pA maximum
Input Protection	
±1.9999VDC Full Scale	±100VDC or AC RMS continuous without damage.
±199.99mVDC Full Scale	±20VDC or AC RMS continuous without damage.
Input Filter	Single-pole, optimized signal-enhancement filter.
Normal Mode Rejection Ratio	70dB typical, 60dB minimum @ 50 or 60Hz.
Ratiometric Operation	Ratio input for use with external reference (Consult Factory).

COMMON MODE

Signal Return to Analog Ground	
Voltage (CMV)	±0.5VDC or AC peak.
DC Rejection Ratio (CMRR) DC	120dB typical, 100dB minimum.
AC Rejection Ratio (CMRR) AC	100dB typical, 80dB minimum @ 50 to 60Hz.
Analog Ground to AC Power Line	
Voltage (CMV)	1400VDC or AC peak.
AC Rejection Ratio (CMRR) AC	160dB minimum @ 50 to 60Hz.

PERFORMANCE

Accuracy	±0.01% of reading ±1 count.
Resolution	±0.005% for 19999 counts.
Range Tempco	±15ppm of reading /°C typical, ±30ppm of reading/°C maximum.
Zero Stability	Autozero, ±0.4 μ V/°C typical zero drift.
Step Response	Less than 400msec for ±0.01% of reading accuracy for a "+" or "−" full-scale step input.

DISPLAY

Type of Display	7-segment planar, red LED, 0.43" (11mm) high.
Polarity Indication	Automatic, "+" or "−" sign displayed.
OVERRANGE Indication	All digits blanked to prevent erroneous readout, "+" or "−" sign and decimal point remain on.
Decimal Points	4-position, user-programmable. (See Fig. 6).
Hold	Logic "0" (open collector or equivalent) holds last reading in display.
Blank	Logic "0" (open collector or equivalent) blanks display.
Display Test	Logic "0" (sink 0.2 mA to digital ground). Tests 28 segments of display by displaying "8888".

ANALOG TO DIGITAL CONVERSION

Technique	Dual-slope, 3-phase conversion with automatic zero correction, complete conversion each cycle.
Rate	2.5 conversions per second nominal for best visual interpretation. For higher speed, consult factory.
Input Integration Period	100 milliseconds nominal for optimum 50 and 60Hz noise rejection.

DIGITAL OUTPUTS

Parallel BCD (Optional)	Latched and buffered word-programmable TRI-STATE outputs are available for computer bus interfacing. The 20 bits of digital data are available as parallel output or organized for a 4, 8, 12, 16 or 20 bit data bus. A separate TRI-STATE ENABLE input (CMOS compatible 0 to +5V) controls each of the 4-bit bytes. BUSY and $\overline{\text{BUSY}}$ provide the user with output register status. All outputs are TTL and CMOS compatible. (One TTL load each). Positive True Logic.
Serial BCD (Standard)	12 data lines provide multiplexed BCD data (serial by digit, parallel by bit), POLARITY and EOC, (End of Conversion). All outputs are low power TTL and CMOS compatible, 0 to +5V. (One LP TTL load each).
OVERLOAD (OVLD)	Logic "0" indicates that output exceeds ±19999 counts, CMOS and low power TTL-compatible, 0 to +5V.
EOC	Falling edge of "End of Conversion" signal indicates conversion complete, CMOS (0 to +5VDC.) and low power TTL-compatible.

POWER

Choice of 3 Power Inputs	110VAC RMS ±20%, 47 to 500Hz @ 2.7 watts nominal (88 to 132VAC input range). 220VAC RMS ±20%, 47 to 500Hz @ 2.7 watts nominal (176 to 264VAC input range). 5VDC ±5% @ 1.8 watts nominal.

ENVIRONMENTAL & PHYSICAL

Operating Temperature Range	-10°C to +55°C.
Storage Temperature Range	-40°C to +85°C.
Relative Humidity	0 to 90%, noncondensing.
Case	DIN/NEMA standard, high-impact molded plastic case UL94V-0 rated; metal case available (See Ordering Guide).
Dimensions	DIN/NEMA (See Fig. 13).
Weight	10 oz. (300 grams)
EMI/RFI	Shielding on five sides with metal case option.
Special Line Noise Suppression	Provision made for surge suppressor varistor and line input passive Pi filtering for industrial applications. (Consult factory).

RELIABILITY

MTBF	⩾100,000 Hours, calculated.
Burn-In	100 hours with 0 to +55°C temperature cycles and power on/off cycles.
Vibration	Each unit vibrated at 5g's for 30 seconds.
Calibration	NBS traceable, detailed certificate of calibration shipped with each unit.
Recalibration	Recommended at 15-month intervals.
Warranty	12 Months

PIN DESIGNATIONS

J1

(BOTTOM OF CASE)

Ratio Input	A	1	Signal In (+)
Analog GND	B	2	Signal Return (-)
HOLD	C	3	Guard
DISPLAY TEST	D	4	BLANK/OVERLOAD
EOC	E	5	Option
Most Significant Digit	F	6	Polarity
Digit 2 Strobe	H	7	Digit 4 Strobe
Digit 3 Strobe	J	8	Digit 5 Strobe
BCD 1	K	9	BCD 4
BCD 2	L	10	BCD 8
Decimal Point 1	M	11	Decimal Point 3
Decimal Point 2	N	12	Decimal Point 4
Digital GND	P	13	+5 Volts
No Connection	R	14	No Connection
AC Power In	S	15	AC Power In

J2

(TOP OF CASE)

TRI-STATE BCD OUTPUTS

BCD Digit 3: 100 / 200 / 400 / 800	A	1	1 / 2 / 4 / 8: BCD Digit 1
Enable Digit 3	E	5	Enable Digit 1
BCD Digit 4: 1K / 2K / 4K / 8K	F	6	10 / 20 / 40 / 80: BCD Digit 2
	H	7	
	J	8	
	K	9	
Enable Digit 4	L	10	Enable Digit 2
BUSY	M	11	10K
Dig. Gnd.	N	12	20K
BUSY	P	13	OVERRANGE — Digit 5
+5 Volts	R	14	Polarity
Spare	S	15	Enable Digit 5

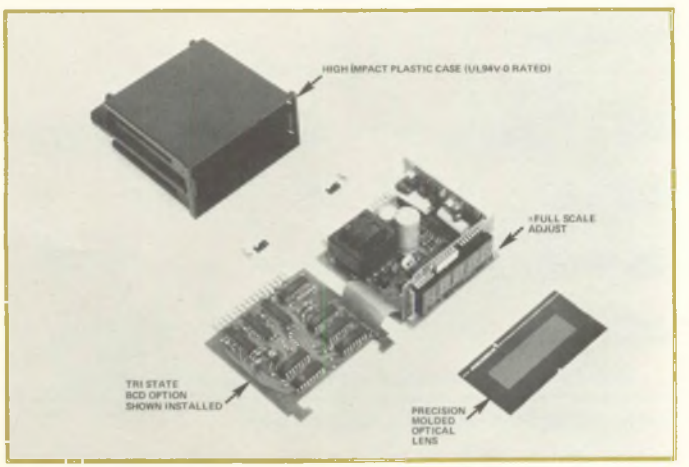


Fig. 14. Internal View.

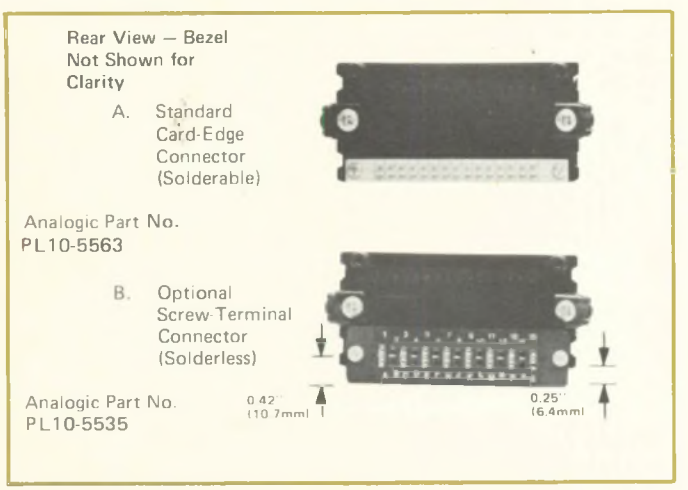


Fig. 15. Rear Panel Connectors.

ORDERING GUIDE

AN2574 — [ ] — [ ] — [ ] — [ ]

	ENTER
FOR	
±1.9999 Volts Input Range	1
±199.99m Volts Input Range	01
FOR	ENTER
Serial BCD Output Only	X
Parallel Tri-State BCD Output	1
FOR	ENTER
110VAC ±20%	1
220VAC ±20%	2
+5VDC ± 5%	3
FOR	ENTER
Plastic Case (UL94V-0 Rated)	P
Metal Case	M

(Connectors Optional See Fig. 15)

NEED APPLICATION HELP?

CONSULT NEAREST ANALOGIC SALES OFFICE OR REPRESENTATIVE.

ANALOGIC

ANALOGIC CORPORATION ■ Audubon Road ■ Wakefield, Massachusetts 01880
Tel. (617) 246-0300 ■ TWX (710) 348-0425 ■ Telex 94-9307
ANALOGIC INTERNATIONAL ■ Audubon Road ■ Wakefield, Massachusetts 01880
Tel. (617) 246-0300 ■ TWX (710) 348-0425 ■ Telex 94-9307
ANALOGIC AG ■ Kanalstrasse 15 ■ Postfach CH-8152 ■ Glattbrugg ■ Switzerland
Tel. (41) 1-810-0666 ■ Telex 845-59699
ANALOGIC LIMITED ■ 68 High Street ■ Weybridge, Surrey KT13 8BN ■ England
Tel. (44) 932-41251 ■ Telex 851-928030
ANALOGIC REGIONAL OFFICES ■ Jericho, New York (516) 938-8333
Cincinnati, Ohio (606) 371-0064 ■ San Jose, Calif. (408) 247-6401
Tustin, Calif. (714) 838-7243 ■ Garland, Texas (214) 681-0483
Houston, Texas (713) 777-6360

Bulletin No. 16-100119 REV 2

PRINCIPLES OF OPERATION

The AN2574 utilizes an autozeroed, 3-phase dual-slope analog-to-digital converter which includes an input filter, a buffer stage, an integrator and a comparator. The input filter is optimized* and provides over-voltage protection with FET input clamp diodes. The input buffer is a voltage follower with a FET input stage which features high (gigaohm) input impedance and low (picoAmp) bias currents. A gain of 10 is provided in the buffer for the ±199.99mV full-scale option.

In each conversion cycle, the internal offset voltages are sensed and compensated for automatically (Autozero Phase). The displayed data is the digitized ratio of the input signal to the precision reference located in the instrument. Optionally, the user may introduce his own reference (scaled for +1 volt DC), where the output count of 10000 would represent an input equal to the full value of the external reference. (Display = V_{in}/V_{ref} x 10000).

A front panel-accessible span control permits the user to calibrate the precision internal reference to system standards. Analogic's precision reference is calibrated and traceable to NBS standards.

Signal return is separated from digital ground through the CMOS logic interface between the analog and digital circuits. Counting, latching, and control logic is contained in a custom, proprietary CMOS integrated circuit which drives the LED display in a multiplexed BCD format.

*Maximum filtering, while allowing a full-scale input step to settle to 1 count within 1 conversion period (400msec).

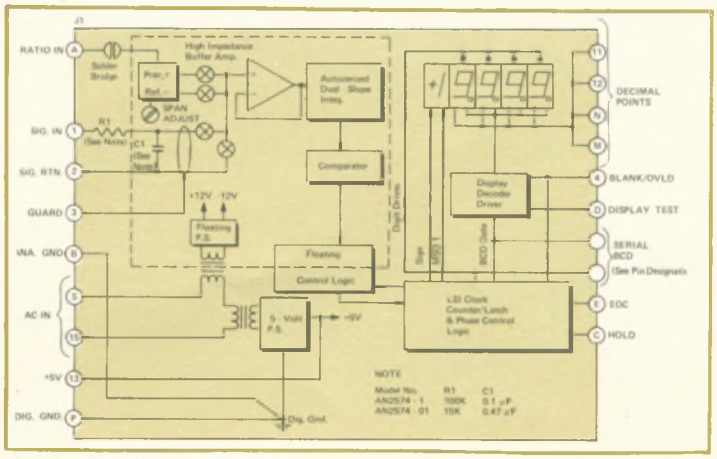


Fig. 2. Simplified Schematic Diagram.

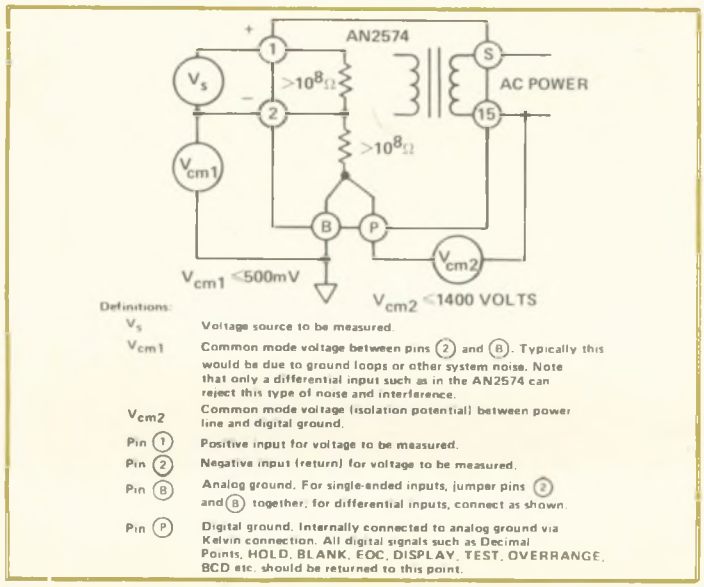


Fig. 3. Input Configurations and Common Mode Voltages.

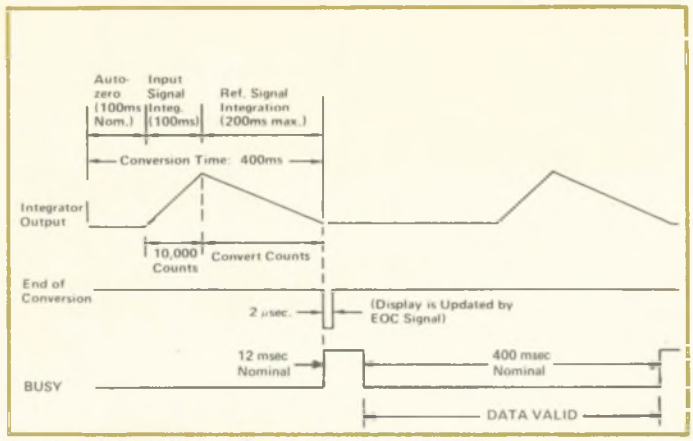


Fig. 4a. AN2574 Timing Diagram for Conversion Cycle.

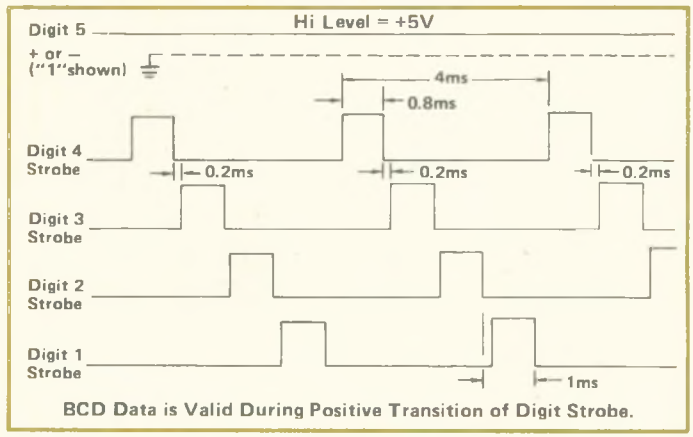
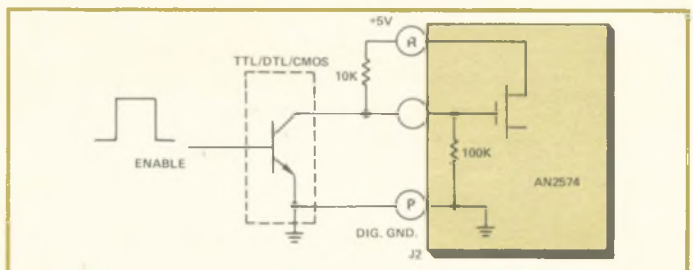


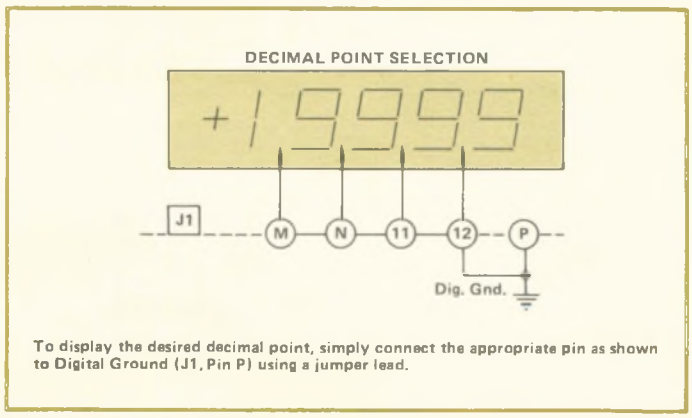
Fig. 4b. Display Timing Diagram for Serial Data.



The TRI-STATE ENABLE input controls for each of the five 4-bit bytes are CMOS compatible (0 to +5V). Multiple lines may be tied together and enabled simultaneously.

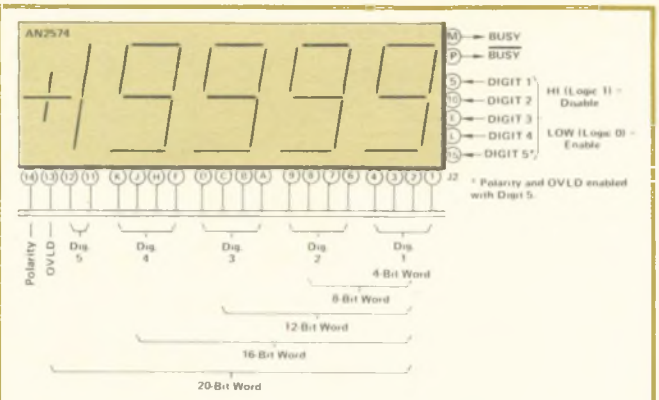
The BCD output is automatically enabled by an internal 100K ohm pull-down resistor and can be disabled by an external 10Kohm pull-up resistor, connected between the appropriate ENABLE input and J2 pin R (+5V) as shown. This allows data to be controlled by a mechanical switch, TTL, DTL or CMOS logic. (Note: External 10Kohm resistor not required for CMOS interface).

Fig. 5. Interfacing to BCD Enable Inputs.



To display the desired decimal point, simply connect the appropriate pin as shown to Digital Ground (J1, Pin P) using a jumper lead.

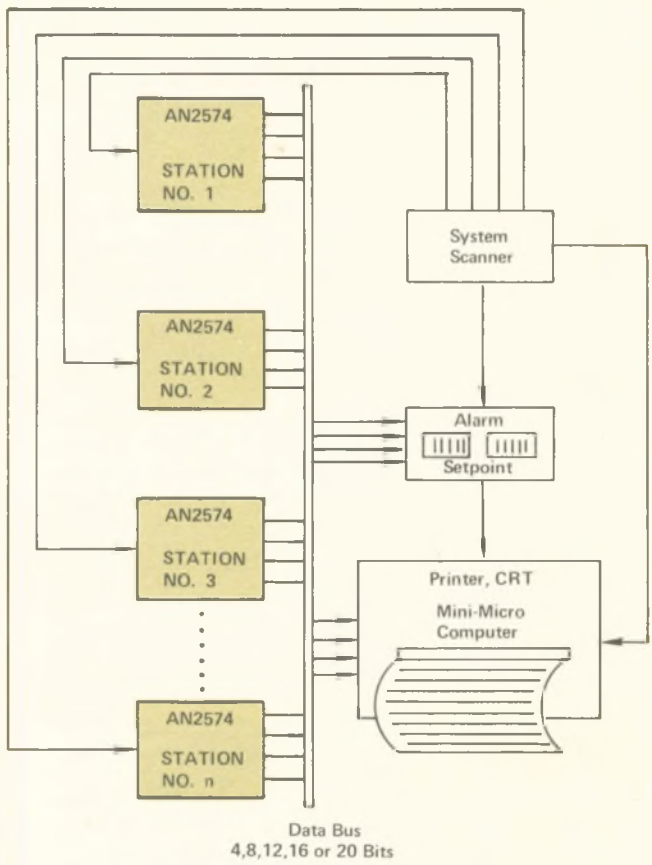
Fig. 6. Decimal Point Position Terminals.



Word Programming		
Bits/Word	Enable Pins	Digits Enabled
20	N/A	All Digits plus OVLD and Polarity
16 16	5 & 10 & E & L 15	1 & 2 & 3 & 4 5, OVLD, Polarity
12 12	5 & 10 & E L & 15	1 & 2 & 3 4 & 5, OVLD, Polarity
8 8 8	5 & 10 E & L 15	1 & 2 3 & 4 5, OVLD, Polarity
4 4 4 4 4	5 10 E L 15	1 2 3 4 5, OVLD, Polarity

When the word-programmable TRI-STATE BCD option is installed, 20-bits of latched and Buffered Parallel BCD outputs are available on connector J2 and are automatically enabled. BUSY and $\overline{\text{BUSY}}$ indicate when data is valid. The same BCD option can be used when the AN2574 must interface with a data bus structure which requires data in 4, 8, 12, 16 or 20 bit bytes. This can be accomplished simply by jumpering the DIGIT ENABLE lines together, according to word size (see chart). A high level (Logic 1) disables the BCD output.

Fig. 7. Word-Programming Tri-State BCD Output.



The TRI-STATE BCD outputs of the AN2574 may be tied together into a common data bus and individually enabled for input to a single recording device, such as a printer, digital comparator, computer or other peripheral equipment. This eliminates costly external switching of multiple BCD lines and simplifies system interfacing.

Fig. 8a. Mulitple Station Monitor.

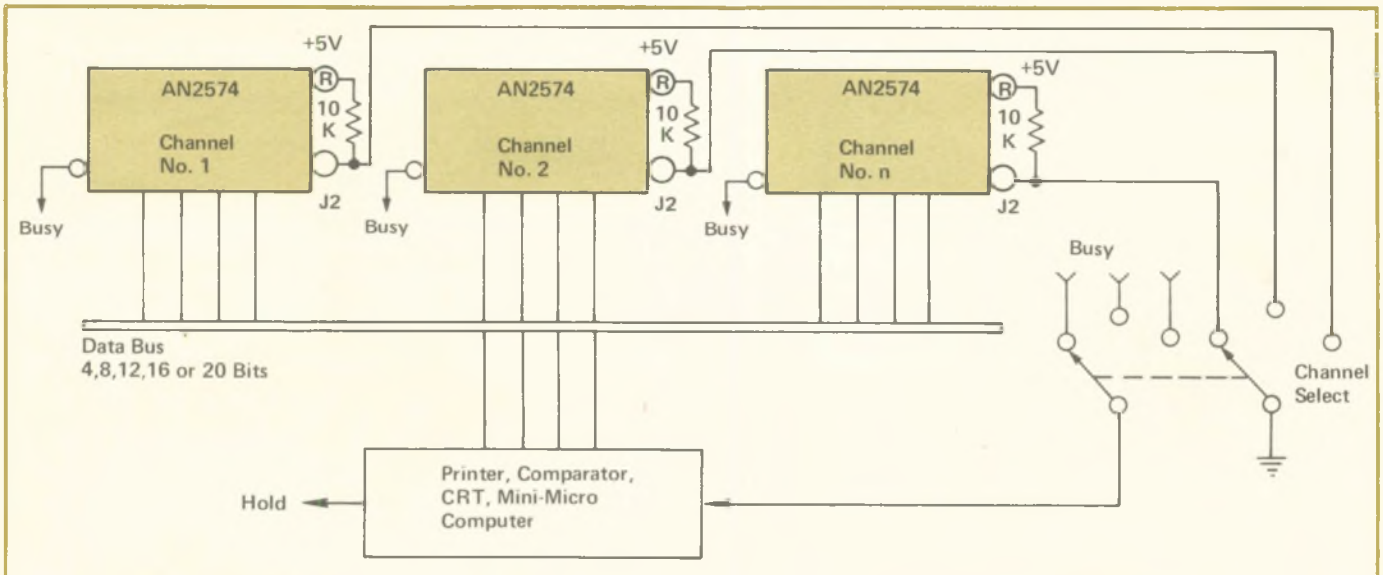


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Fig. 8b. Multiple Channel Data Acquisition.

APPLICATION DATA

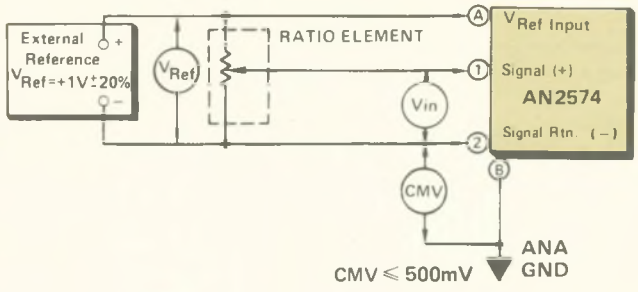


Fig. 9a. Using AN2574 for 3-Wire Ratiometric Measurements.

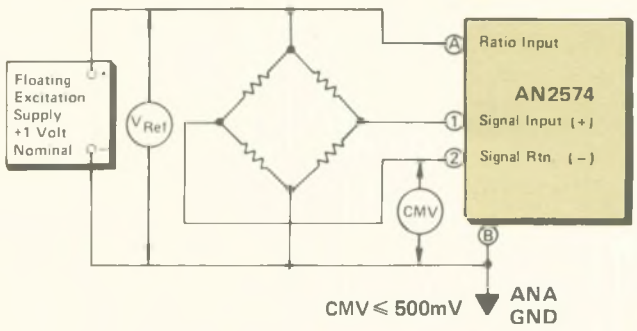


Fig. 9b. Using AN2574 for 4-Wire Ratiometric Measurements.

NOTE: (Consult Factory for Ratiometric Option).
A voltage ratio measurement can eliminate the need for a costly precision power supply to provide transducer excitation. This is accomplished by the dual-slope integrating A/D converter which displays the digitized ratio of V_{in}/V_{ref} x 10000. Thus, if the external reference varies, the signal voltage will change proportionally. This makes the long term accuracy of the external reference supply noncritical and it need only be stable during the measurement period.

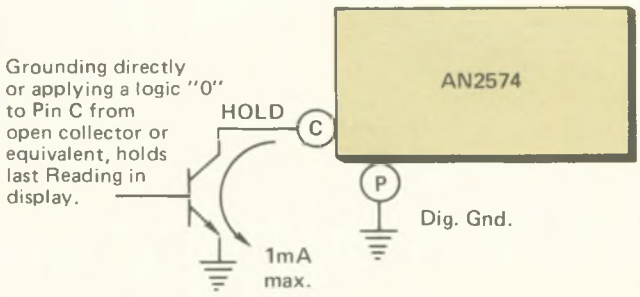
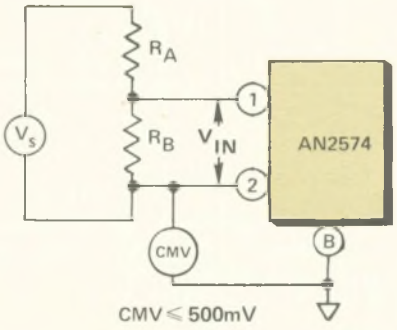


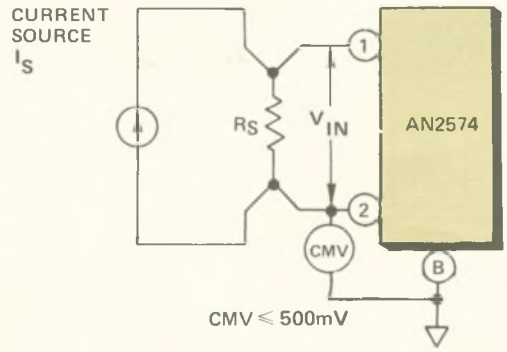
Fig. 10. Holding The Display.



For signal voltages V_S greater than 2 Volts, select R_A and R_B for proper scaling such that V_{IN} is ≤2 Volts for a "1.9999" Display.* Program Decimal Point accordingly (See Fig. 6).

*According to $V_{IN} = \left(\frac{R_B}{R_A + R_B}\right) \times V_S$.

Fig. 11. Input Scaling.



Select shunt resistance R_S according to following:

$$R_S = \frac{\text{Desired Full Scale Count}}{\text{Full Scale Range of Input Current}} \times K$$

where

K = 0.0001 for 1.9999 V_{IN}
K = 0.00001 for 0.19999 V_{IN}

Fig. 12. Input Current Scaling.

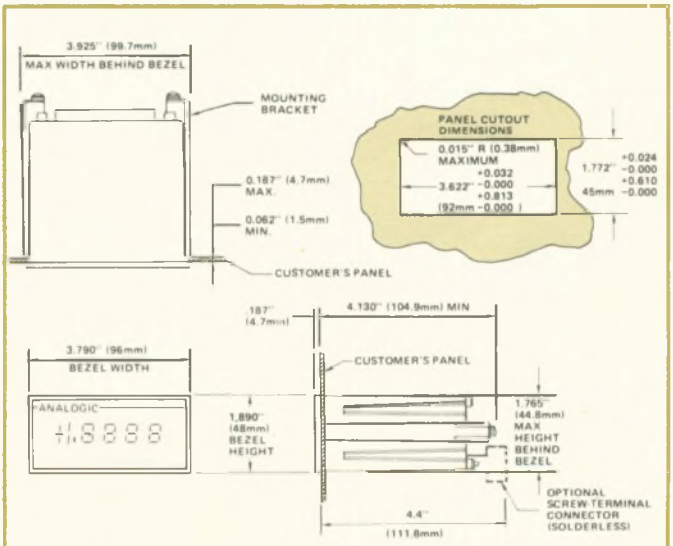


Fig. 13. Panel Mounting and Outline Dimensions.