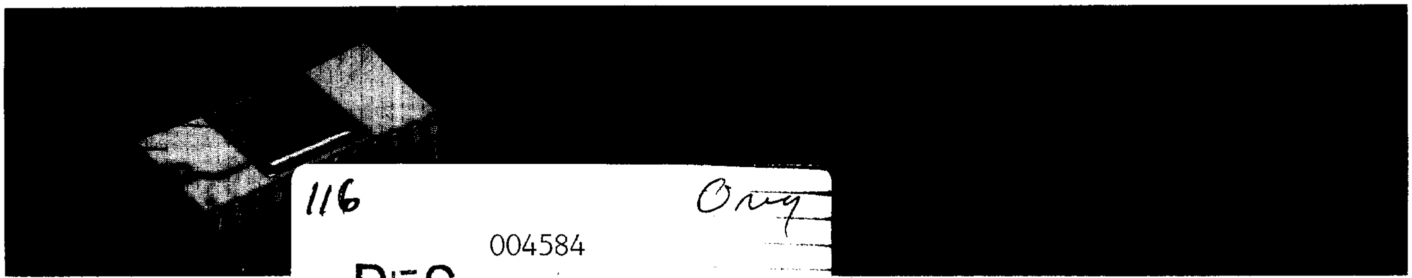


004584

DESCRIPTION

The Analogic MN562 Series comprises eight **pre-aged and stabilized**, integrated ~~circuit~~ externally referenced, 12-bit, digital-to-analog converters that provide ~~high precision,~~ good stability, extremely small size, and low cost for use in a ~~wide variety of D/A digi-~~tizing applications. These current output converters are explicitly characterized, conservatively specified, and exhaustively checked by definitive test programs to verify design reliability and to assure dependable performance, and offer a choice of operating temperature ranges, accuracy, stability, and digital input code. Each MN562 converter contains two fully compatible IC chips, an active circuit chip and a passive circuit chip, both internally integrated and mounted within a very low profile (0.232" or 5.89mm), hermetically sealed, ceramic, 24-lead, dual in-line package (DIP). The active circuit combines a unique, differential, non-saturating, current-switching cell with a control operational amplifier, while the passive circuit chip consists of a highly stable, laser-trimmed, SiCr, thin-film resistor network.

It is well known that laser-trimmed thin-film resistors will change in value with time, and that the largest change will occur during initial operation. Consequently, no matter how precisely thin-film resistors are laser-trimmed, some value degradation will take place. Most competitive IC DACs are merely trimmed for a total error of ±0.5 LSB at +25°C and then shipped. However, in operation, they may soon drift out of specification and become unsuitable for their intended usage. To minimize this effect, Analogic has implemented a definitive **pre-aging and stabilization** test program for the MN562 Series. This program has a two-fold purpose. First, the **pre-aging** test process assures that the initial, relatively large change in thin-film resistor value will be accounted for in our plant and will not appear as short-term surprise errors within the user's equipment. Secondly, the **stabilization** test process significantly extends the useful life of the MN562 Series in comparison with competitive IC DACs, ensuring longer-term accuracy and stability! Based upon test program results, Analogic can affirm that the total error of each MN562 converter will not exceed a fraction of an LSB over a six-month period. Therefore, full 12-bit accuracy and linearity are delivered and maintained under all rated operating conditions.

Depending on the particular MN562 ordered, the maximum relative accuracy is ±½ LSB, and the gain and differential linearity tempco's are less than 3ppm/°C and 2ppm/°C, respectively. In conjunction with an external operational amplifier, five output voltage ranges (±2.5V, +5V, ±5V, +10V, or ±10V) are user programmable. Either digital input code (standard binary or BCD) is DTL/TTL/CMOS compatible using positive true logic levels. In addition, the MN562 converters are direct pin, package, and function plug-in replacements for most commercially available IC DACs.

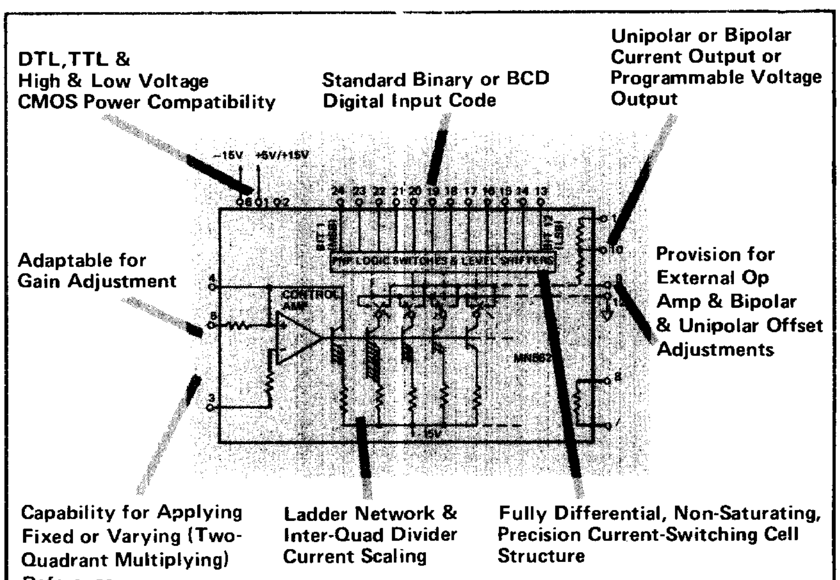


Figure 1. MN562 Simplified Schematic Diagram

FEATURES

- **True 12-Bit Accuracies**
- **Guaranteed Monotonicity Over Wide Operating Temperature Ranges of 0°C to +70°C, −25°C to +85°C or −55°C to +125°C**
- **Fast Speed: 1.5 to 1.8μs Settling Time to ½ LSB**
- **High Stability: IC Chip Structure with Gain TC of <5ppm/°C and Differential Linearity TC of <2ppm/°C**
- **Versatile Digital Input Interfacing**
  - **. . DTL/TTL/CMOS Compatibility**
  - **. . Positive True Logic Levels**
  - **. . Standard Binary or BCD Digital Code**
  - **. . Provision for Fixed or Varying External Reference Voltage with Multiplying Capability in Two Quadrants**
- **Unipolar or Bipolar Output Flexibility**
  - **. . Current Output of 0 to −2mA or ±1mA**
  - **. . Programmable Voltage Output Ranges of ±2.5V, +5V, ±5V, +10V or ±10V**
- **Hermetically Sealed, Ceramic, 24-Lead DIP with Extremely Low Profile (0.232" or 5.89mm)**
- **Direct Electrical and Mechanical Replacement for Most IC DACs**

APPLICATIONS

- **Data Acquisition Systems**
- **Automated Test Instruments**
- **Computer-Controlled Industrial Processors**
- **Medical, Scientific and Analytical Instruments**

ANALOGIC® . . . The Digitizers

MN562 SERIES SPECIFICATIONS*

PARAMETER	MN562KD/BIN MN562KD/BCD	MN562AD/BIN MN562AD/BCD	MN562SD/BIN MN562SD/BCD	MN562ID/BIN MN562ID/BCD
DIGITAL INPUTS				
TTL, Vcc = +5V, Pin 2 Open Ckt				
Bit ON (Logic 1)	≥2.0V @ 100nA max	≥2.0V @ 100nA max	≥2.0V @ 100nA max	≥2.0V @ 100nA max
Bit OFF (Logic 0)	≤0.8V @ −100μA max	≤0.8V @ −100μA max	≤0.8V @ −100μV max	≤0.8V @ −100μV max
CMOS 4.75V <Vcc ≤15.8V, Pin 2 Tied to Pin 1				
Bit ON (Logic 1)	≥70% Vcc @ 100nA max	≥70% Vcc @ 100nA max	≥70% Vcc @ 100nA max	≥70% Vcc @ 100nA max
Bit OFF (Logic 0)	≤30% Vcc @ −100μA max	≤30% Vcc @ −100μA max	≤30% Vcc @ −100μA max	≤30% Vcc @ −100μA max
ANALOG OUTPUTS				
Unipolar Current	0 to −2mA ±15%	0 to −2mA ±15%	0 to −2mA ±15%	0 to −2mA ±15%
Bipolar Current	−1 to +1mA ±15%	−1 to +1mA ±15%	−1 to +1mA ±15%	−1 to +1mA ±15%
Resistance	8.0kΩ	8.0kΩ	8.0kΩ	8.0kΩ
Leakage (All Bits OFF)	.05% of FSR max	.05% of FSR max	.05% of FSR max	.05% of FSR max
Capacitance	33pF typ	33pF typ	33pF typ	33pF typ
Compliance Voltage	−1.5 to +10V	−1.5 to +10V	−1.5 to +10V	−1.5 to +10V
Full Scale Voltage Ranges (Pin Selectable with External Amplifier)	±2.5V, +5V, ±5V, +10V, ±10V	±2.5V, +5V, ±5V, +10V, ±10V	±2.5V, +5V, ±5V, +10V, ±10V	±2.5V, +5V, ±5V, +10V, ±10V
REFERENCE VOLTAGE INPUT				
Input Impedance	20kΩ ±10%	20kΩ ±10%	20kΩ ±10%	20kΩ ±10%
Range	0 to +10V	0 to +10V	0 to +10V	0 to +10V
SPEED				
Settling Time to ½ LSB (All Bits ON-to-OFF or OFF-to-ON)	1.5 typ 1.8μs max settling into short circuit	1.5 typ 1.8μs max settling into short circuit	1.5 typ 1.8μs max settling into short circuit	1.5 typ 1.8μs max settling into short circuit
Major Carry Switching Transient to 90% Complete	400ns	400ns	400ns	400ns
ACCURACY (@ +25°C)				
Resolution	12 bits	12 bits	12 bits	12 bits
Relative Accuracy	±½ LSB .01%	±½ LSB .01%	±¼ LSB/BIN .006% ∓1/10 LSB/BCD .002%	±½ LSB .01%
Noise (0.1 to 10Hz; All Bits ON)	30μV p-p	30μV p-p	30μV p-p	30μV p-p
STABILITY				
Leakage Current Tempco				
0 to +70°C	2ppm of FSR/°C max	— — — — —	— — — — —	2ppm of FSR/°C max
−25°C to +85°C	— — — — —	2ppm of FSR/°C max	— — — — —	— — — — —
−55°C to +125°C	— — — — —	— — — — —	2ppm of FSR/°C max	— — — — —
Bipolar Offset Tempco	4ppm of FSR/°C max	4ppm of FSR/°C max	4ppm of FSR/°C max	7.5ppm of FSR/°C max
Gain Tempco (Exclusive of Ref.)	5ppm of FSR/°C max	5ppm of FSR/°C max	5ppm of FSR/°C max	7.5ppm of FSR/°C max
Diff. Linearity Tempco	2ppm of FSR/°C max	2ppm of FSR/°C max	2ppm of FSR/°C max	2ppm of FSR/°C max
*Expected Total Error (Nonlinearity) Drift after 6 months. (See Note 2)	<0.1 LSB	<0.1 LSB	<0.1 LSB	<0.1 LSB
Monotonicity	Guaranteed over full operating temp. range	Guaranteed over full operating temp. range	Guaranteed over full operating temp. range	Guaranteed over full operating temp. range
Power Supply Gain Sensitivity				
+5Vdc (Vcc)	2ppm of FSR/°C max	2ppm of FSR/°C max	2ppm of FSR/°C max	5ppm of FSR/°C max
+15Vdc (Vcc)	2ppm of FSR/°C max	2ppm of FSR/°C max	2ppm of FSR/°C max	5ppm of FSR/°C max
−15Vdc (Vee)	6ppm of FSR/°C max	6ppm of FSR/°C max	6ppm of FSR/°C max	6ppm of FSR/°C max
POWER SUPPLY REQUIREMENTS				
Vcc (+4.75 to +15.8Vdc)	15mA	15mA	15mA	15mA
Vee (−15Vdc ±5%)	20mA	20mA	20mA	20mA
EXTERNAL ADJUSTMENTS (See Fig. 2 & Table 1.)				
Gain Adjustment Range	±0.25% of FSR	±0.25% of FSR	±0.25% of FSR	±0.25% of FSR
Binary Bipolar Offset Range	±0.25% of FSR	±0.25% of FSR	±0.25% of FSR	±0.25% of FSR
Binary-Coded-Decimal Bipolar Offset Range	±0.17% of FSR	±0.17% of FSR	±0.17% of FSR	±0.17% of FSR
ENVIRONMENTAL & PHYSICAL				
Operating Temperature Range	0° to +70°C	−25° to +85°C	−55° to +125°C	0 to +70°C
Storage Temperature Range	−55°C to +150°C	−55°C to +150°C	−55°C to +150°C	−55°C to +150°C
Dimensions	0.611" W x 0.232" H x 1.200" D (15.52mm W x 5.89mm H x 30.48mm D)	0.611" W x 0.232" H x 1.200" D (15.52mm W x 5.89mm H x 30.48mm D)	0.611" W x 0.232" H x 1.200" D (15.52mm W x 5.89mm H x 30.48mm D)	0.611" W x 0.232" H x 1.200" D (15.52mm W x 5.89mm H x 30.48mm D)
MULTIPLYING MODE PERFORMANCE (All Models)				
Quadrants	2: bipolar operation at digital input only.			
Reference Voltage	0 to +10V unipolar. Digital input code multiplies reference voltage.			
Accuracy	10 bits (±0.05% of reduced F.S.) for 1 Vdc reference voltage.			
Reference Feedthrough (Unipolar mode; All Bits OFF; 0 to +10V p-p; Sinewave Frequency for ½ LSB p-p Feedthrough)	2kHz	2kHz	2kHz	2kHz
Output Slew Rate (All Bits ON & 10V Step Change in Ref. Voltage)	1mA/μs	1mA/μs	1mA/μs	1mA/μs
Output Settling Time (All Bits ON & 10V Step Change in Ref. Voltage)	5μs to 0.01% F.S.	5μs to 0.01% F.S.	5μs to 0.01% F.S.	5μs to 0.01% F.S.
Control Amplifier Small-Signal Closed Loop Bandwidth	1MHz	1MHz	1MHz	1MHz

*Typical @ +25°C and 10V ref. unless otherwise specified.
Note 1. Based on extended Analogic pre-aging & stabilization test program for laser-trimmed thin-film resistor networks.

Unipolar DAC Operation (See Figure 2).

1. Output Range Connections
Determine output range required. For +5.0V FSR, connect external operational amplifier output to Pin 10 and short Pin 11 to Pin 9. For +10.0V FSR, connect external op amp output to Pin 10 and terminate Pin 11 to Pin 10. For both cases connect Ext Ref, R2, R3 and R4 circuitry as shown.

2. Zero Adjustment
Set all bits to OFF. Adjust R4 until external op amp output is 0 (zero) volts.

3. Gain Adjustment
For straight binary DACs, set all bits to ON. For BCD DACs, set bits 1, 4, 5, 8, 9 and 12 to ON (BCD 999); set bits 2, 3, 6, 7, 10 and 11 to OFF. Adjust R2 until external op amp output is as follows:

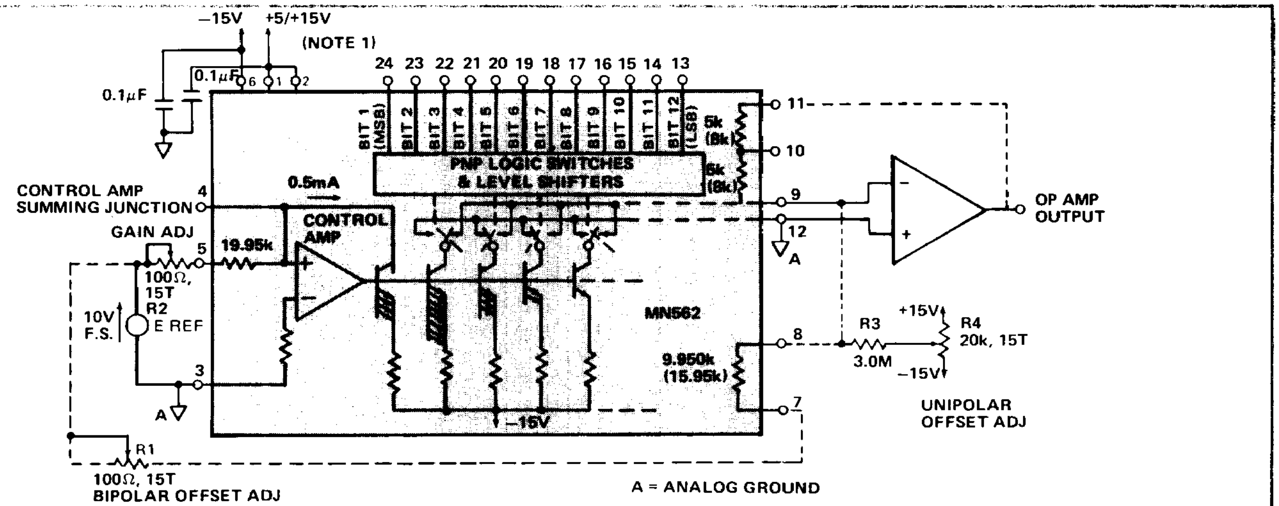
Binary	BCD
+4.9988V for +5.0V Range	+4.995V for +5.0V Range
+9.9976V for +10.0V Range	+9.990V for +10.0V Range

Bipolar DAC Operation (See Figure 2).

1. Output Range Connections
Determine output range required. For ±2.5V FSR, connect external operational amplifier output to Pin 10 and short Pin 11 to Pin 9. For ±5.0V FSR, connect external op amp output to Pin 10 and terminate Pin 11 to Pin 10. For ±10.0V FSR, connect external op amp output to Pin 11 and leave Pin 10 open. For all three cases, connect Ext Ref, R1, and R2 circuitry as shown, including Bipolar offset resistor (Pins 7 & 8).

2. Offset Adjustment
Set all bits to OFF. Adjust R1 until external op amp output is as follows:
−2.5000V for ±2.5V Range
−5.0000V for ±5.0V Range
−10.0000V for ±10.0V Range

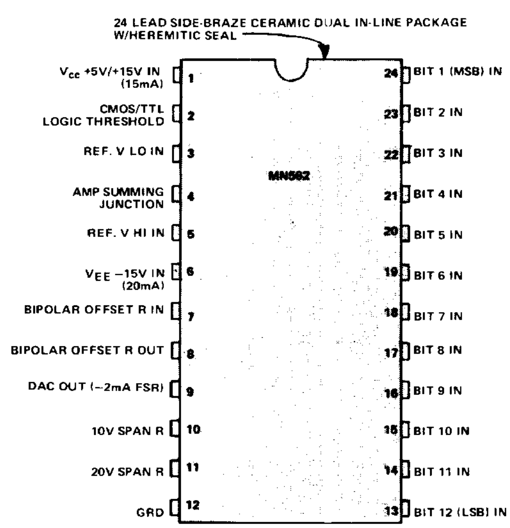
3. Gain Adjustment
For straight binary DACs, set bit 1 (MSB) to ON and bits 2 through 12 to OFF. For BCD DACs, set bits 2 and 4 (BCD 500) to ON and bits 1, 3, and 5 through 12 to OFF. Adjust R2 until external op amp output is 0 (zero) volts.



NOTE 1. For DTL and TTL compatibility, connect +5V to Pin 1 and leave Pin 2 open. For low voltage CMOS compatibility, connect +5V to Pin 1 and short Pin 2 to Pin 1. For high voltage CMOS compatibility, connect +15V to Pin 1 and short Pin 2 to Pin 1.
NOTE 2. Resistor values in parentheses are for BCD DACs.

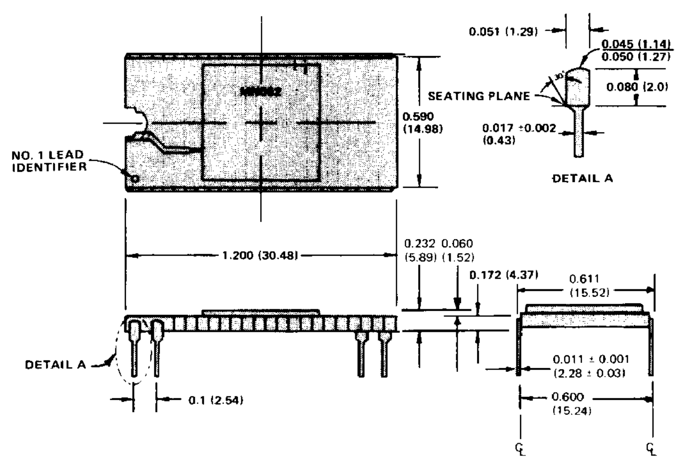
Figure 2. MN562 Operational Schematic Diagram

PIN DESIGNATIONS TOP VIEW



OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).



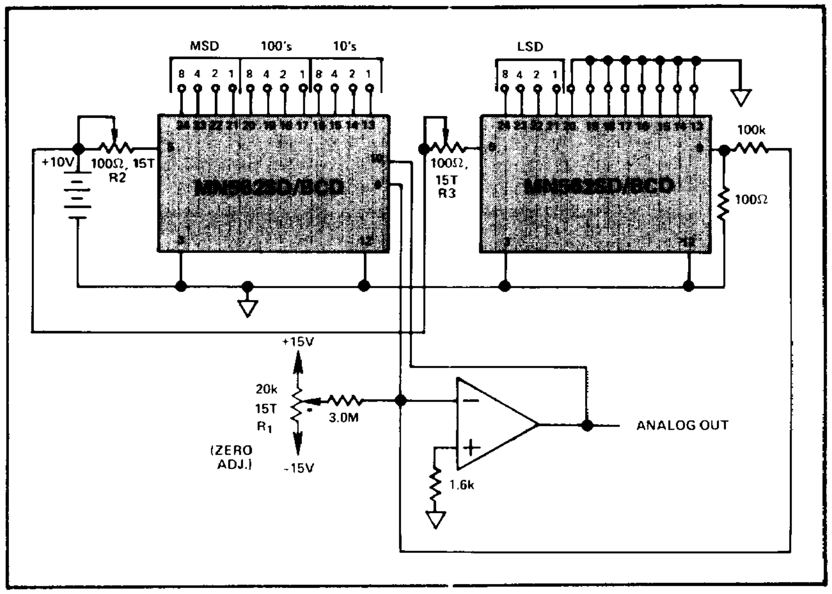


Figure 3. MN562S in 4-Digit BCD DAC Application

4-DIGIT BCD DAC

Two MN562S BCDs can be interconnected to construct a 4-digit (0.01%) BCD DAC (see Fig. 3). The least significant digit (LSD) DAC current output is attenuated by a factor of 1000 by the 100Ω and 100kΩ resistors. This current is summed with the current output of the MSD DAC to obtain a 9.999V full scale voltage output.

ZERO AND SCALE ADJUSTMENTS

Set all bits to OFF. Adjust R1 until DAC output is 0 (zero) volts (see Fig. 3). Set 8 bit and 1 bit to ON for MSD, 100s, digit and 10s digit. Adjust R2 until DAC output is 9.990 volts.

Set 8 bit and 1 bit to ON for first three digits. Set 8 bit and 1 bit to ON for LSD. Adjust R3 until DAC output is 9.999V.

RECOMMENDED VOLTAGE REFERENCE FOR MN562

To take full advantage of the high accuracy of the MN562, a voltage reference compatible with true 12-bit performance is recommended. Figure 4 shows a typical 10V (<8ppm/°C) reference circuit.

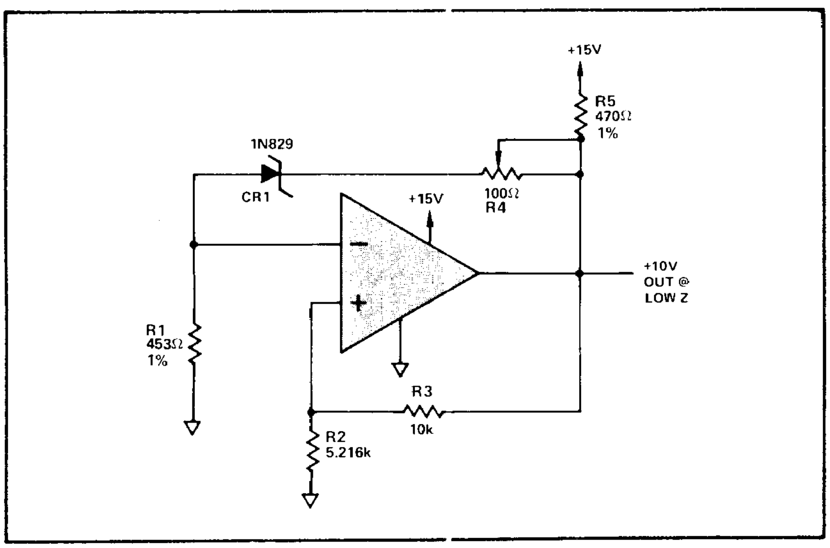


Figure 4. Typical MN562 <8ppm/°C 10V Voltage Reference Circuit

Simply Specify MN562 — [X][D] — [XXX]

Operating Temperature Range

For	Enter
0°C to +70°C	KD* or ID*
−25°C to +85°C	AD
−55°C to +125°C	SD

Digital Input Code Format

For	Enter
Standard Binary	BIN
Binary Coded Decimal	BCD

*See MN562 Series Specifications for Selection of Accuracy and Stability.

An error budget has been computed as an aid to the designer using the MN562.

CIRCUIT ELEMENT	TEMPERATURE COEFFICIENT	TOTAL ERROR (Worst Case)
Resistors R3 & R2 (10kΩ, 5.216kΩ)	±1ppm/°C Tracking	1.32ppm/°C [1]
Potentiometer R4 (100Ω)	10ppm/°C	0.75ppm/°C
Zener Diode CR1 (1N829)	5ppm/°C 2μV/°C [2]	5ppm/°C 0.42ppm/°C
Unnulled Amplifier	200pA/°C [3]	0.13ppm/°C
		7.62ppm/°C (worst case)
		(5.24ppm/°C rss)

[1] Assuming worst case
[2] Offset Voltage Drift
[3] Bias Current Drift

POWER SUPPLIES

Designed to provide all necessary DC power for both analog and digital circuitry of data acquisition systems, this series comes in two basic forms — chassis mount and modular. Both DC-DC and AC-line-powered designs are available in a wide range and variety of voltages and currents. Send for brochure entitled: "Modular Power Supplies for Data Conversion Systems".

ANALOGIC
ANALOGIC INTERNATIONAL
Audubon Road ▪ Wakefield, Massachusetts 01880
Tel. (617) 246-0300 ▪ TWX (710) 348-0425 ▪ Telex 94-9307
ANALOGIC LIMITED
68 High Street ▪ Weybridge, Surrey KT13 8BN ▪ England
Tel. Wey 41251 ▪ Telex (851) 928030
ANALOGIC REGIONAL OFFICES
San Jose, Calif. (408) 247-6401 ▪ Tustin, Calif. (714) 838-7243
Cincinnati, Ohio (606) 371-0064

AVAILABLE FROM:

Bulletin No. 16-100060 REV 2