Low Cost, 8 Bit Monolithic A/D and D/A Converters Models ADC-MC8BC, ADC-MC8BM

FEATURES

- Low Cost
- 8 Bit Resolution
- Internal Reference
- Single Supply Operation
- Multifunction-A/D-D/A
- Full Mil Temp. Range Available

GENERAL DESCRIPTION

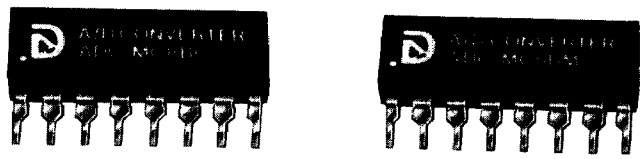
The ADC-MC8B is an 8-bit monolithic multifunction A/D-D/A converter with single +5 Volts supply operation. This device is a complete D/A converter which can be configured as an A/D converter by using the internal binary counter and two external IC's (311 comparator and a 74132 quad 2-input Schmitt trigger NAND gate).

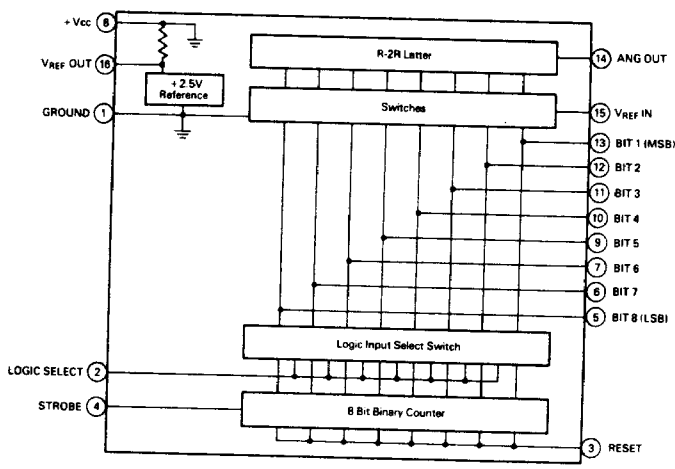
The ADC-MC8B consists of eight current switches, a specially designed ladder network using diffused resistors, a precision +2.5V reference, an eight bit binary counter and a logic input select switch. This feature allows a single control signal to determine whether the switches accept the output from the binary counter (A/D MODE) or external digital inputs (D/A MODE).

The converter can be used with the internal reference to give an output voltage range of 0 to +2.5V or connected to an external reference for a 0 to +3.0V range. Full scale settling time is 2.0μS MAX for the voltage output mode. Using the device as a counter-comparator A/D, a full scale conversion time of 500 μS can be achieved.

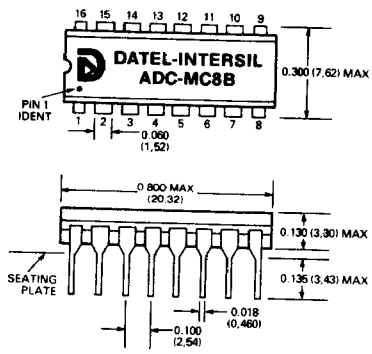
The ADC-MC8B is ideal for such applications as complete low cost D/A's, multiplying D/A's, low cost A/D's and precision ramp generators.

This converter is available in two operating temperature ranges. The ADC-MC8BC (0°C to 70°C) is packaged in a plastic 16 pin DIP and the ADC-MC8BM (-55°C to +125°C) is packaged in a ceramic DIP.





MECHANICAL DIMENSIONS INCHES (MM)



INPUT/OUTPUT CONNECTIONS

PIN	FUNCTION	PIN	FUNCTION
1	GROUND	9	BIT 5
2	LOGIC SELECT	10	BIT 4
3	RESET	11	BIT 3
4	STROBE	12	BIT 2
5	BIT 8 (LSB)	13	BIT 1 (MSB)
6	BIT 7	14	ANG OUT
7	BIT 6	15	V_{REF} IN
8	+Vcc	16	V_{REF} OUT

DATEL-INTERSIL, INC., 11 CABOT BOULEVARD, MANSFIELD, MA 02048/TEL. (617) 339-9341/TWX 710-346-1953/TLX 951340

SPECIFICATIONS, MODEL ADC-MC8B (Typical at 25°C, +5V supply unless otherwise noted)

MAXIMUM RATINGS	ADC-MC8BC ADC-MC8BM
Supply Voltage, Vcc	+7.0V
Digital Input Voltage	+5.5V
Reference Input Voltage	+5.5V

INPUT/OUTPUTS	
Coding, unipolar	Straight Binary
Coding, bipolar	Offset Binary
V_{REF} IN	0 to +3V
V_{REF} OUT	+2.55V,
Input Logic Level, Bit ON ("1")	+2.0V min.
Input Logic Level, Bit OFF ("0")	+0.7V max.
Output Logic Level, "1"	+2.4V min.
Output Logic Level, "0"	+0.4V max.
Logic Loading	1 TTL load
Parallel Output Data	12 Parallel lines of data held until next convert command.

REFERENCE	
V_{REF} OUT	+2.55V
V_{REF} Tempco	±40 ppm/°C

D/A PERFORMANCE		
Resolution	8 Bits (1 part in 256)	
Output Voltage Range	0 to +3.0V[2]	
Output Resistance	10K Ohms	
Nonlinearity	±1/2 LSB max.	±1 LSB max.[3]
Differential Linearity Error	±1/2 LSB max.	±1/2 LSB[4]
Zero Error	3 mV	8 mV
Gain Error	0.1%	
Zero Tempco	5μV/°C	
Gain Tempco	3 ppm/°C	
Nonlinearity Tempco	7.5 ppm/°C	
Monoticity	Guaranteed 0°C to +70°C	
Settling Time, full scale change to 1/2 LSB	2μS	
Settling Time, 1 LSB change to 1/2 LSB	1μS	

A/D PERFORMANCE	ADC-MC8BC ADC-MC8BM
Analog Input Range	Dependent on values of R_1 & R_2 (See Range Select Chart)
Resolution	8 Bits (1 part in 256)
Nonlinearity	±1/2 LSB
Differential Nonlinearity	±1/2 LSB
Conversion Time	500μS max.[5]

POWER REQUIREMENT	
Supply Voltage	+5.0V ±10%
Supply Current	30 mA typ., 40 mA max.

PHYSICAL-ENVIRONMENTAL		
Operating Temperature Range	0°C to 70°C	-55°C to +125°C
Storage Temperature Range	-55°C to +125°C	
Package Type	16 Pin Plastic	16 Pin Ceramic

NOTES:

1. Internal Reference requires .22 μf stabilization capacitor between Pin 1 and 16.
2. 0 to +2.55V when using internal reference
3. ±1/2 LSB max. nonlinearity from 0°C to +70°C
4. ±1/2 LSB max. differential nonlinearity from 0°C to +70°C
5. See Graph CONV. TIME vs VIN

ORDERING INFORMATION

MODEL	OPERATING TEMP. RANGE	CASE
ADC-MC8BC	0 to 70°C	Plastic
ADC-MC8BM	-55°C to +125°C	Ceramic

Trimming Potentiometers: TP2K and TP10K are available from Datel-Intersil

THE ADC-MC8BC and ADC-MC8BM ARE COVERED BY GSA CONTRACT

THEORY OF OPERATION

A negative going pulse on the START line will reset counter to all zeros and enable the clock. If the DAC's output is less than ANG IN, the counter is incremented and DAC's output increases by one LSB. These comparisons continue until DAC's output is equal to the analog signal, at which time the EOC goes low (Logic "0") indicating that the digital output data is valid. Maximum clock frequency is 512 kHz. This may be varied by using different values for R and C.

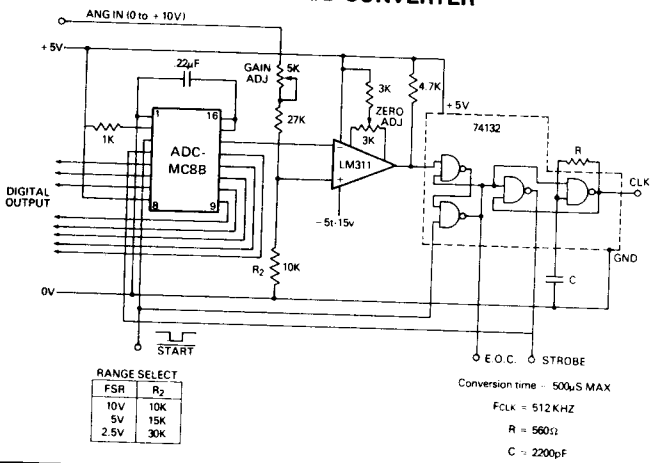
Full Scale voltage may also be changed by setting R_1 and R_2 to desired gain function.

1% Metal Film resistors and 100 ppm/°C trim pots are recommended for best performance over temperature.

CALIBRATION PROCEDURES

1. Connect converter as shown in connection diagram. Apply continuous start commands to the START input.
2. ZERO ADJUSTMENT—Ground analog input. Vary ZERO ADJ. potentiometer until LSB flickers between logic "1" and "0" with all other bits at logic "0".
3. GAIN ADJUSTMENT—Apply FS-1/2 LSB to ANG IN. Vary GAIN ADJ. potentiometer until LSB flickers between logic "1" and "0" with all other bits at logic"1".

8 BIT A/D CONVERTER

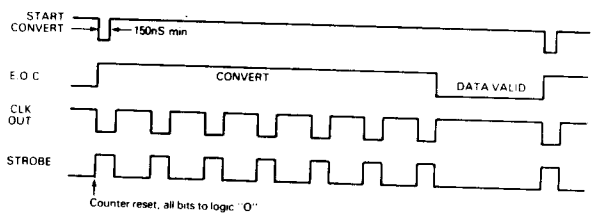


RANGE SELECT

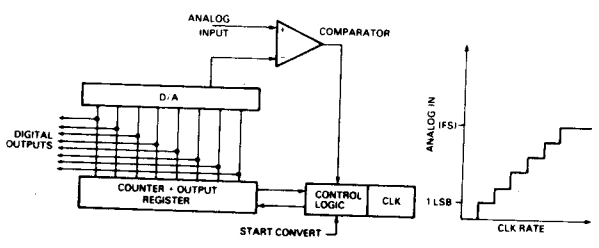
FSR	R_2
10V	10K
5V	15K
2.5V	30K

Conversion time = 500µS MAX
F_{CLK} = 512 KHZ
R = 560Ω
C = 2200pF

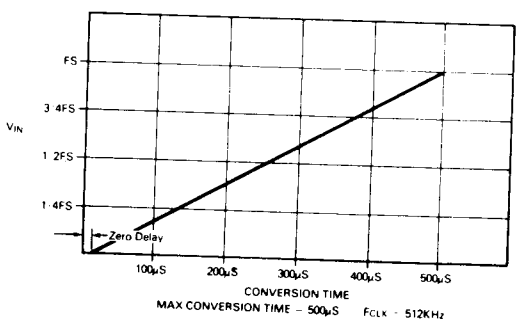
A/D TIMING DIAGRAM



COUNTER-COMPARATOR A/D



CONVERSION TIME VS. VIN



MAX CONVERSION TIME = 500µS F_{CLK} = 512KHz

THEORY OF OPERATION

Vout is directly proportional to digital input. R_L should be kept ≥650K Ohms to assure good T.C. To remove offset voltage and calibration of converter, a buffer amplifier is necessary. The sources impedance of the inverting input should be approximately 6K Ohms to minimize temperature drift.

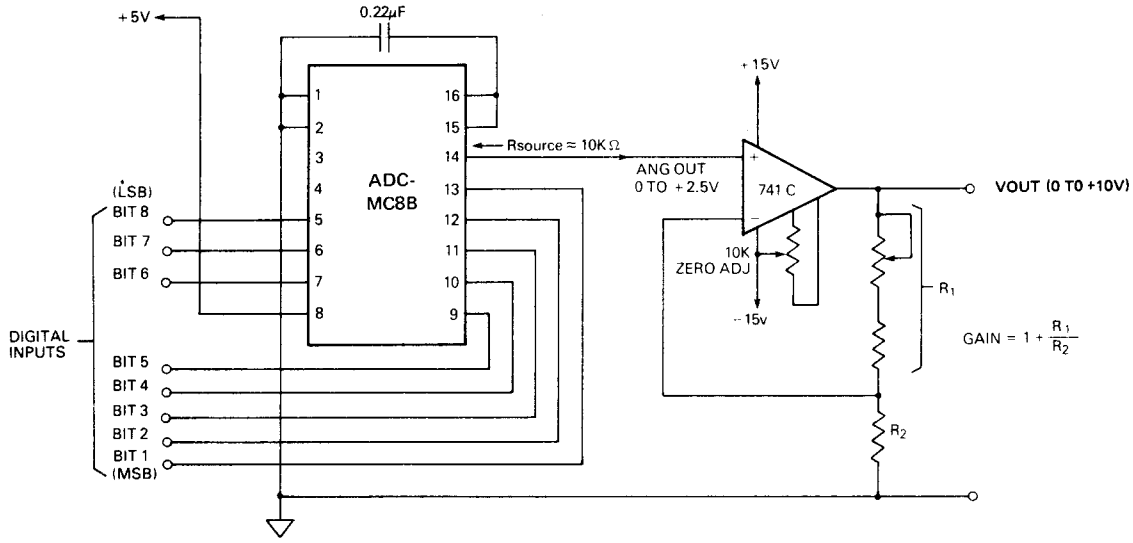
1% Metal Film resistors and 100 ppm/°C trim pots are recommended for best performance over temperature. For best settling time, a fast buffer amplifier is required (DATEL -INTERSIL'S AM-452).

CALIBRATION PROCEDURE

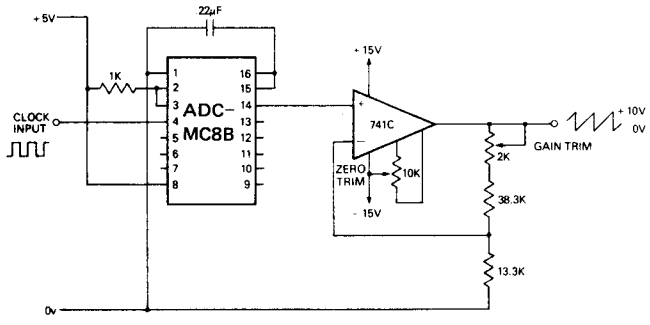
1. Connect converter as shown in connections diagram. Apply continuous start commands to the START input.
2. Set all bits to logic "0" and vary ZERO ADJ. potentiometer until Vout is equal to zero volts.
3. Set all bits to logic "1" and vary GAIN ADJ. potentiometer until Vout = Nominal F.S.- 1 LSB

$$LSB = \frac{FSR}{256}$$

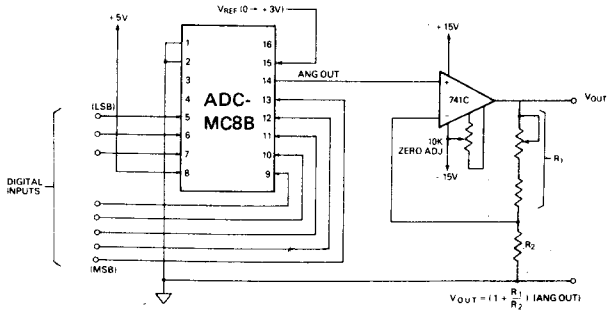
BASIC D/A WITH OUTPUT BUFFER



PRECISION RAMP GENERATOR



MULTIPLYING D/A



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