

8-Bit Multiplying D/A Converter

DAC1408

The DAC1408 is a monolithic 8-bit multiplying digital-to-analog converter. It is designed for use where the output current is a linear product of an 8-bit digital word and an analog input voltage. The DAC1408 is a lead-to-lead replacement for the MC1408 and the SSS1408 devices.

- **Relative Accuracy $\pm 0,19\%$ Error Maximum DAC1408A**
- **7 And 6-Bit Accuracy Existing DAC1408B, DAC1408C**
- **Fast Settling Time To 1/2 LSB - 85ns**
- **Non-Inverting Digital Inputs are TTL and CMOS Compatible**
- **Output Voltage Swing +0,5V to -5.0V**
- **High-Speed Multiplying Input Slew Rate 4.0mA/ μ S**
- **Standard Supply Voltages +5.0V and -5.0V to -15V**
- **Low Full Scale Current Drift +10ppm / °C Typically**
- **Low Power Consumption 33mW at $\pm 5V$**

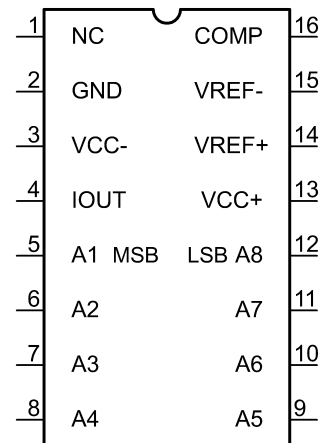
Absolute Maximum Ratings

Storage Temperature Range	
Ceramic DIP	-65°C to +175°C
Molded DIP	-65°C to +150°C
Operation Temperature Range	0°C to +70°C
Lead Temperature (soldering 10s)	265°C
Internal Power Dissipation ^{1,2}	1,04W
V+	+5.5V
V-	-16.5V
Digital Input Voltage (5V to 12V)	+5.5V
Applied Output Voltage	0.5V to -5.2V
Reference Current (I14)	5.0mA
Reference Amplifier Inputs (V14,V15)	5.5V, -16.5V

Notes:

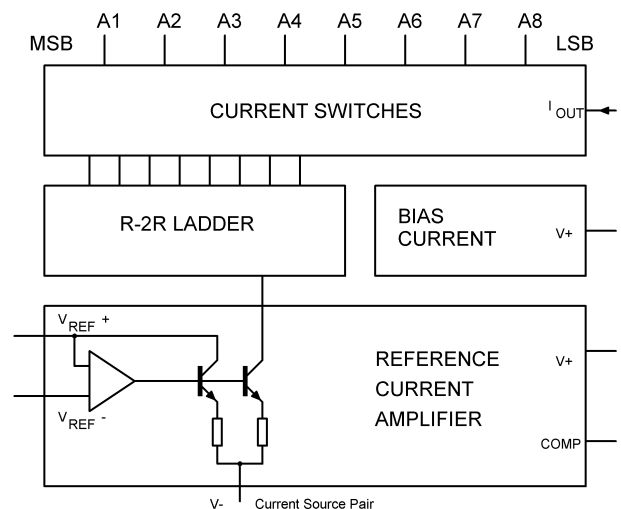
1. $T_{J\text{Max}} = 150^\circ\text{C}$
2. Ratings apply to ambient temperature at 25°C. Above this temperature, derate the 16L-Molded DIP at 8.3mW / °C

Connection Diagram 16-Lead DIP



top view
von oben

Equivalent Circuit



Applications

- *Tracking a/d Converters*
- *Successive Approximation a/d Converters*
- *2 1/2 Digit Panel Meters and DVMs*
- *Waveform Synthesis*
- *Sample and Hold*
- *Peak Detector*
- *Programmable Gain and Attenuation*
- *CRT Character Generation*
- *Audio Digitizing and Decoding*
- *Programmable Power Supplies*
- *Analog-Digital Multiplication*
- *Digital-Digital Multiplication*
- *Analog-Digital Division*
- *Digital Addition and Subtraction*
- *Speech Compression and Expansion*
- *Stepping Motor Drive*

Electrical Characteristics

TA = 0°C to 70°C, V+ = +5V, V- = -15V, V_{REF} / R14 = 2mA.

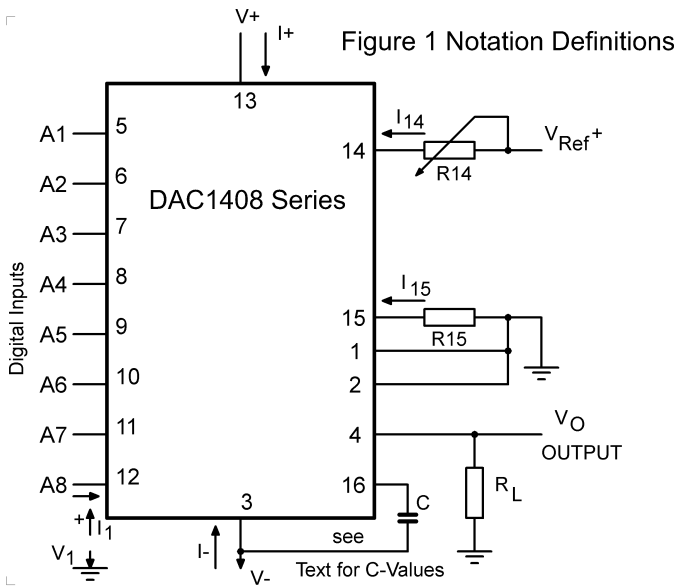
All digital inputs at HIGH logic level.

DAC1408

Symbol	Characteristic	Condition	Min	Typ	Max	Unit	
E _r	Relative Accuracy (Error Relative to Full Scale I _O)	DAC1408A			±0.19	%	
		DAC1408B ¹			±0.39		
		DAC1408C ¹			±0.78		
t _s	Settling Time to Within 1/2 LSB (Includes t _{PLH})	TA = 25°C		85	135	ns	
t _{PLH} , t _{PHL}	Propagation Delay	TA = 25°C		30	100	ns	
TCI _O	Output Full Scale Current Drift			±20		ppm /°C	
V _{IH}	Logic Input Voltage HIGH		2			V	
V _{IL}	Logic Input Voltage LOW				0.8		
I _{IH}	Logic Input Current HIGH	V _{IH} = 5.0V		0	0.04	mA	
I _{IL}	Logic Input Current LOW	V _{IL} = 0.8V		-0.4	-0.8		
I _{I5}	Reference Input Bias Current			-1.0	-5.0	µA	
I _{OR}	Output Current Range	V- = -5.0V	0	2.0	2.1	mA	
		V- = -6.0 to -15V	0	2.0	4.2		
I _O	Output Current	VREF = 2.000V, R14 = 1.0kΩ	1.9	1.99	2.1	mA	
I _{O MIN}	Output Current	All bits LOW		0	4.0	µA	
V _{OC}	Output Voltage Compliance	Er ≤ 0.19% at T _A = 25°C	V- = -5.0V			-0.55, +0.4	V
			V- = below -10V			-5.0, +0.5	
d _I / d _t	Reference Current Slew Rate			4.0		mA /µs	
PSRR (-)	Output Current Supply Sensitivity			0.5	2.7	µA /V	
I+	Supply Current	All bits LOW		+13.5	+22	mA	
I-				-7.5	-13		
V _{R+}	Power Supply Voltage Range	T _A = 25°C	+4.5	+5.0	+5.5	V	
V _{R-}			-4.5	-15	-16.5		
P _C	Power Consumption	All bits LOW, V- = -5.0V		105	170	mW	
		All bits LOW, V- = -15.0V		190	305		
		All bits HIGH, V- = -5.0V		90			
		All bits HIGH, V- = -15.0V		160			

Notes:

- All current switches are tested to guarantee at least 50% of rated output current.
- All bits switched



Typical values: $R_{14} = R_{15} = 1k$
 $V_{REF} = +20V$
 $C = 15pF$

V_1 and I_1 apply to inputs A1 thru A8

The Resistor tied to lead 15 is to temperature compensate the bias current and may not be necessary for all applications.

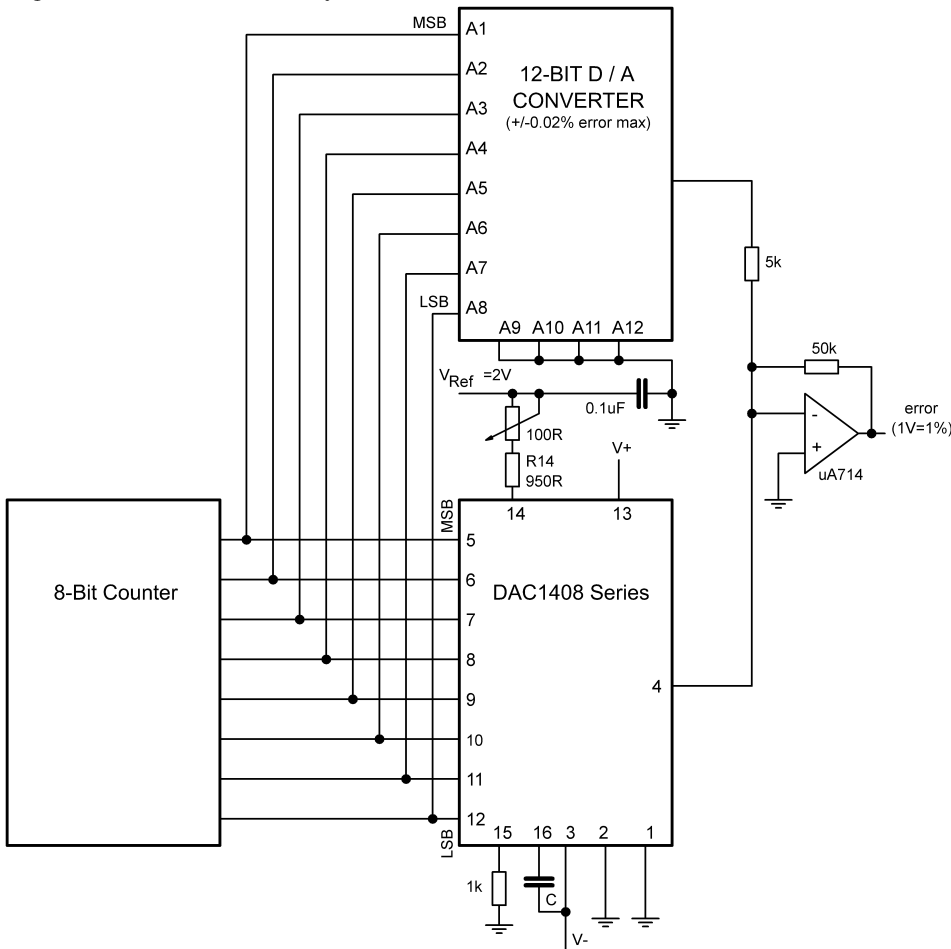
$$I_O = K \left[\frac{A_1}{2} + \frac{A_2}{4} + \frac{A_3}{8} + \frac{A_4}{16} + \frac{A_5}{32} + \frac{A_6}{64} + \frac{A_7}{128} + \frac{A_8}{256} \right]$$

where $K = \frac{V_{REF}}{R_{14}}$

and $A_n = "1"$ if A_n is at HIGH level

and $A_n = "0"$ if A_n is at LOW level

Figure 2 Relative Accuracy Test Circuit



DAC1408

Figure 3 Transient Response and Settling Time

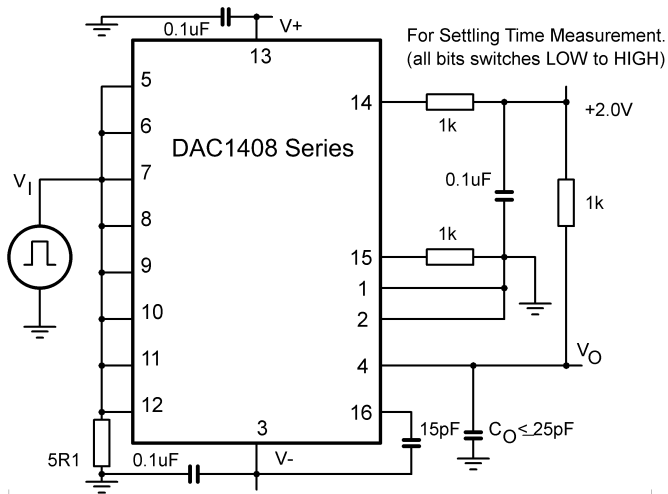


Figure 4 Positive V_{Ref}

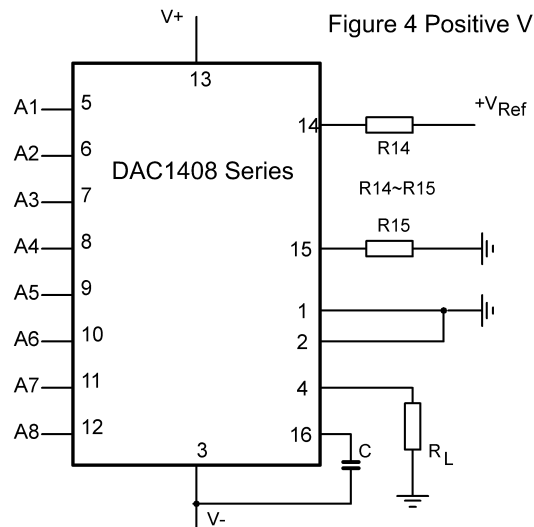


Figure 5 Negative V_{Ref}

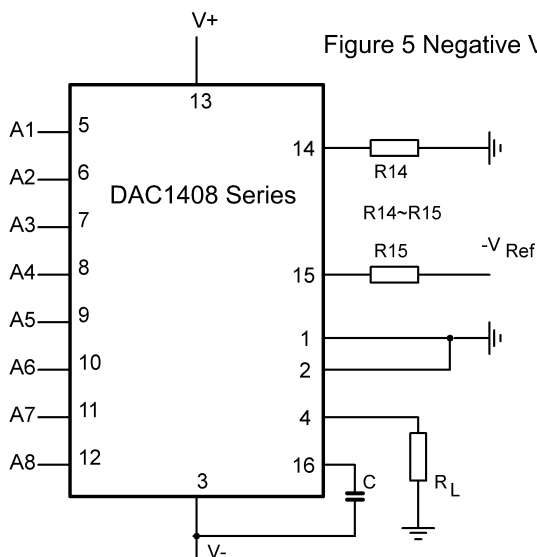
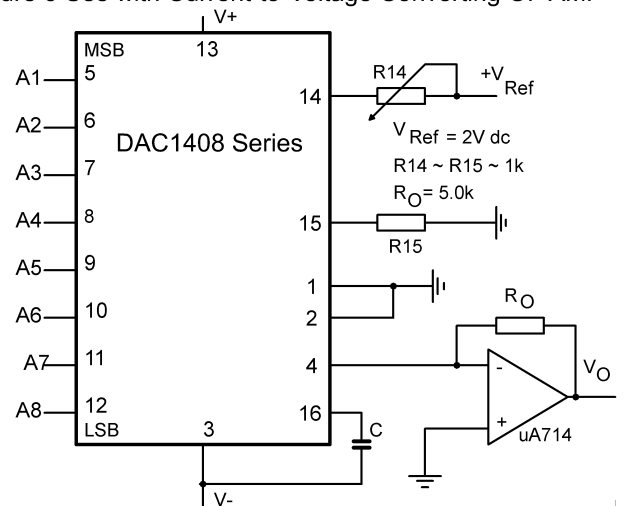


Figure 6 Use with Current-to-Voltage Converting OP AMP



Theoretical V_O

$$V_O = \frac{V_{REF}}{R_{14}} (R_O) \left[\frac{A_1}{2} + \frac{A_2}{4} + \frac{A_3}{8} + \frac{A_4}{16} + \frac{A_5}{32} + \frac{A_6}{64} + \frac{A_7}{128} + \frac{A_8}{256} \right]$$

Adjust V_{REF} R_{14} or R_O so that V_O with all digital inputs at HIGH level is equal to 9.961 Volts.

$$V_O = \frac{2V}{1k} (5k) \left[\frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16} + \frac{1}{32} + \frac{1}{64} + \frac{1}{128} + \frac{1}{256} \right]$$

$$= 10V \frac{256}{256} = 9.961V$$