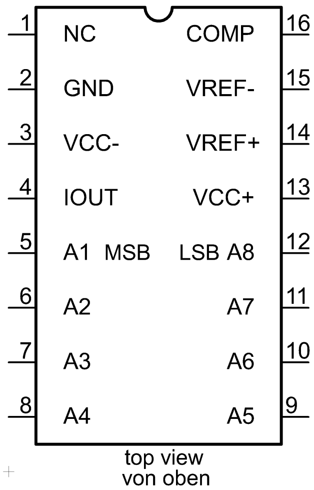
8-Bit Multiplying D/A Converter

DAC1508

The DAC1508 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 DAC1508 is a lead-to-lead replacement for the MC1508 and the SSS1508 devices.

- **Relative Accuracy ±0,19% Error Maximum**
- **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/µS**
- **Standard Supply Voltages +5.0V and -5.0V to -15V**
- **Low Full Scale Current Drift +10ppm / °C Typically**
- **Low Power Consuption 33mW at ±5V**

Connection Diagram
16-Lead DIP

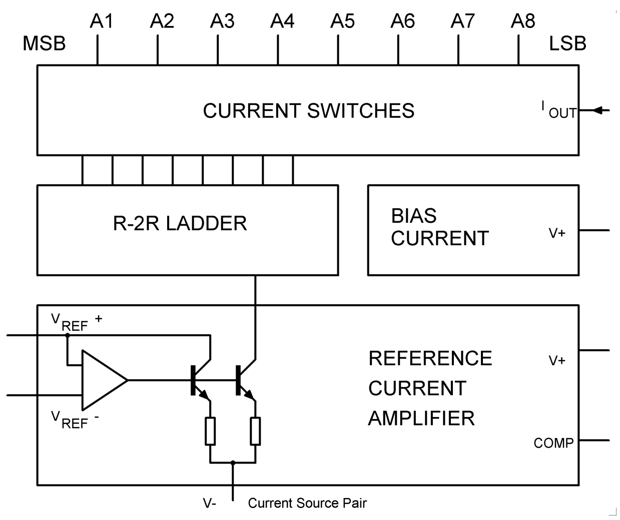


Absolute Maximum Ratings

Storage Temperature Range	
Ceramic DIP	-65°C to +175°C
Operation Temperature Range	-55°C to +125°C
Lead Temperature (soldering 10s)	265°C
Internal Power Dissipation [1,2]	1,50W
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. $T_{J\,Max}$ = 150°C
2. Ratings apply to ambient temperature at 25°C. Above this temperature, derate the 16L-Molded DIP at 10mW / °C

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 Attentuation*
- *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 = -55°C to 125°C, V+ = +5V, V- = -15V, V_{REF} / R14 = 2mA. All digital inputs at HIGH logic level.

DAC1508

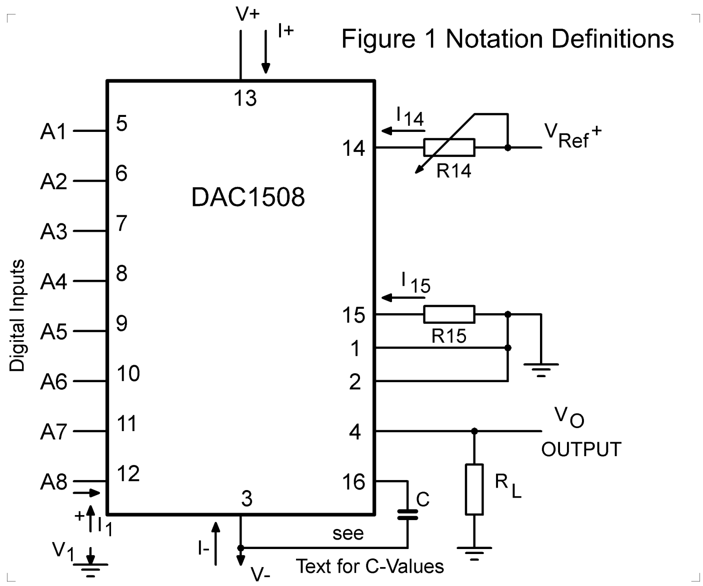
Symbol	Characteristic	Condition		Min	Typ	Max	Unit
E_r	Relative Accuracy (Error Relative to Full Scale I_O)	DAC1508				±0.19	%
t_S	Settling Time to Within 1/2 LSB (Includes t_{PLH})	TA = 25°C			85	135	ns
t_{PLH}, t_{PHL}	Propagation Delay	TA = 25°C			30	100	ns
TCI_O	Output Full Scale Current Drift				±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:

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

Source: Fairchild (1987)

Figure 1 Notation Definitions



Typical values: R14 = R15 = 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.

$$I_O = K\left[\frac{A1}{2} + \frac{A2}{4} + \frac{A3}{8} + \frac{A4}{16} + \frac{A5}{32} + \frac{A6}{64} + \frac{A7}{128} + \frac{A8}{256}\right]$$

where $K = \dfrac{V_{REF}}{R14}$

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

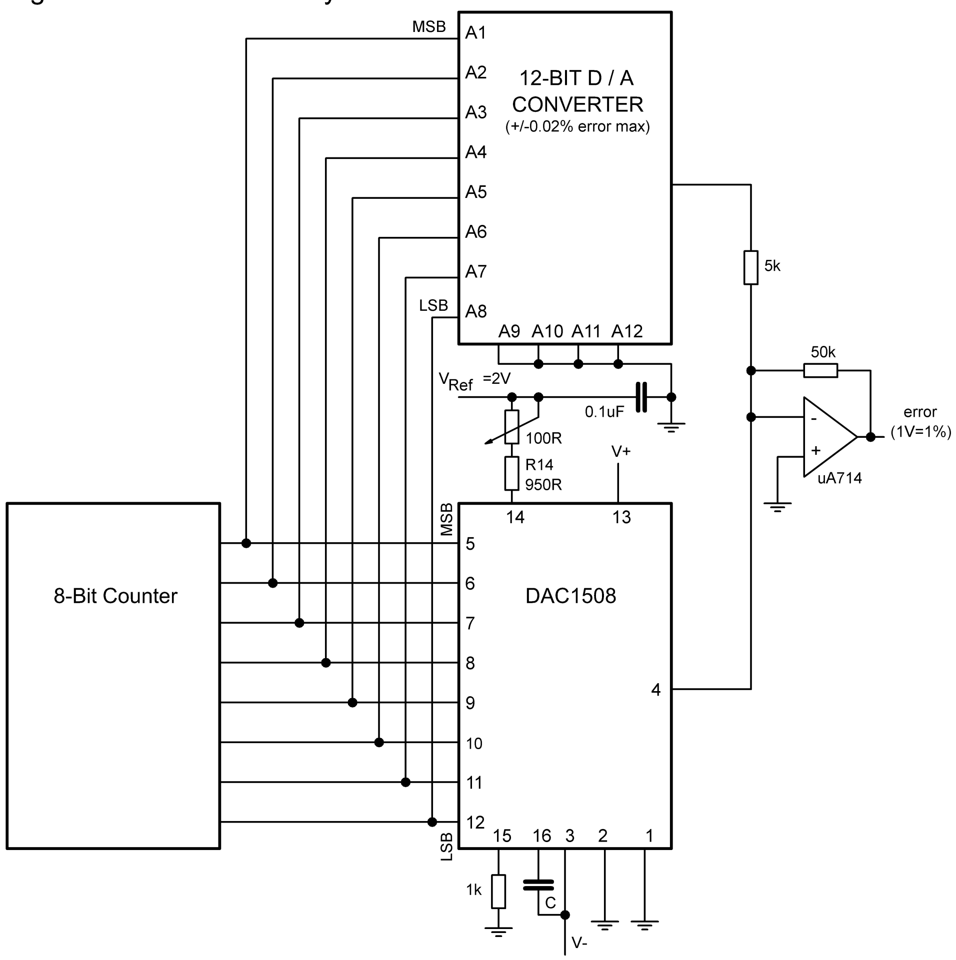


Figure 3 Transient Response and Settling Time

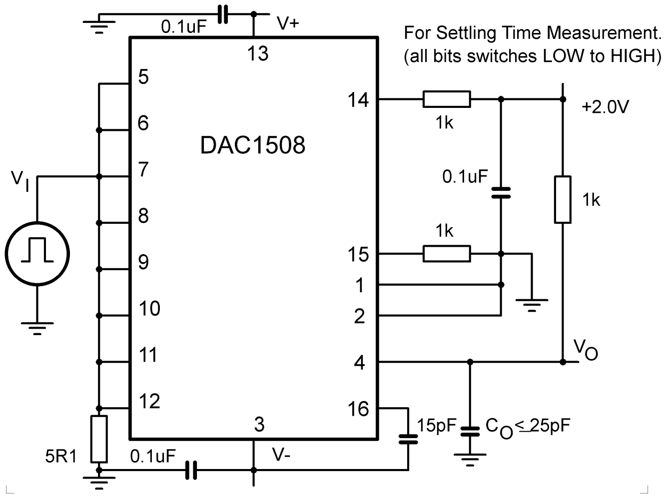


Figure 4 Positive V_{Ref}

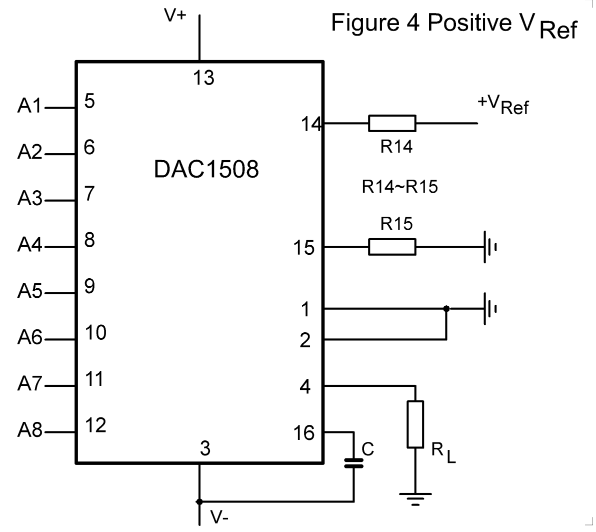


Figure 5 Negative V_{Ref}

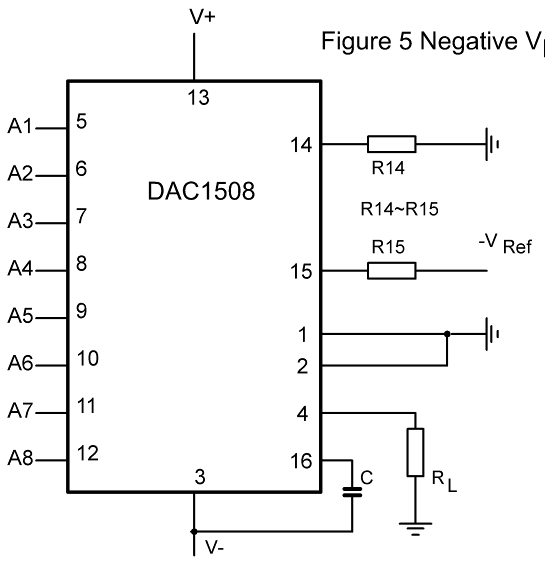
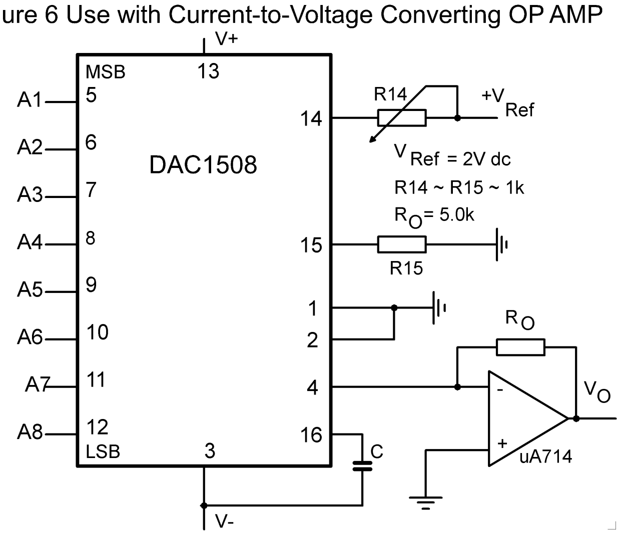


Figure 6 Use with Current-to-Voltage Converting OP AMP



Theoretical V_O

$$V_O = \frac{V_{REF}}{R14}(R_O)\left[\frac{A1}{2}+\frac{A2}{4}+\frac{A3}{8}+\frac{A4}{16}+\frac{A5}{32}+\frac{A6}{64}+\frac{A7}{128}+\frac{A8}{256}\right]$$

Adjust V_{REF} R14 or R_O so that V_O with all digital inputs at HIGH level is equal to 9.961 Volts.

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

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