



# 8-, 10-, 12-Bit Video Speed Hybrid Current & Voltage Out D/A Converter

## HDS-0820, -1025, -1250/HDH-0802, -1003, -1205

### FEATURES

- 25ns Current Settling to 0.1% (HDS)
- 200ns Voltage Settling to 0.1% (HDH)
- 10mA Current Out (HDS)
- Guaranteed Monotonicity Over Temperature
- No External Parts Required
- Reliable Hybrid Construction

### APPLICATIONS

- CRT Vector Displays
- TV Video Reconstruction
- Analytical and Medical Instruments

OBSOLETE

### GENERAL DESCRIPTION

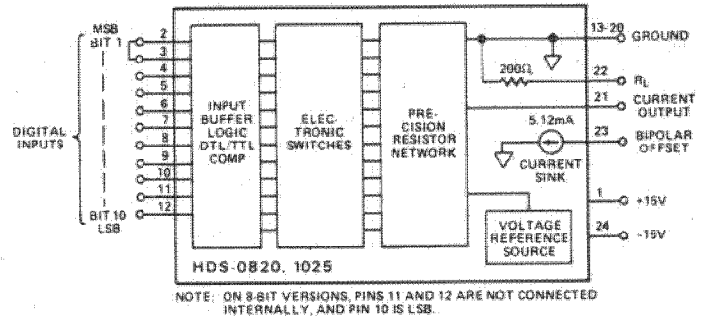
The HDS/HDH series of digital-to-analog converters are among the fastest precision settling current and voltage DACs available. They can be processed to guarantee monotonic over their operating temperature range. The current output models provide 10mA full scale allowing direct drive of capacitive loads and transmission lines. All versions have a precision reference and are active laser trimmed to specified accuracy, so no external adjustment pots or other components are required.

With six units available, engineering trade-offs can be made among resolution, speed, current or voltage output, and price. To facilitate this comparison major specifications are summarized in Table I.

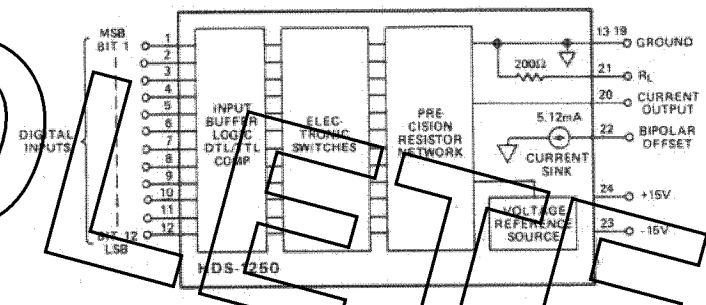
Other general specifications that apply to all devices include TTL logic; ceramic or hermetic metal package; unipolar or bipolar operation with internal offsetting reference.

The HDH voltage output devices provide access to the op amp summing point so that reduced full-scale output voltage swing can be provided. Operation with an external resistor shunting the internal 1k resistor will reduce the already low op amp offset drift.

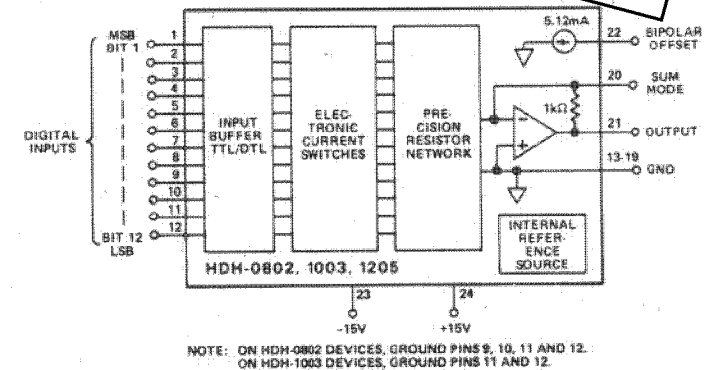
HDS-0820, HDS-1025 FUNCTIONAL BLOCK DIAGRAM



HDS-1250 FUNCTIONAL BLOCK DIAGRAM



HDH-0802, HDH-1003 AND HDH-1205 FUNCTIONAL BLOCK DIAGRAM



Model	Resolution	Full Scale Step Settling Time
<b>Current Output</b>		
HDS-0820	8 Bits	10mA Step 20ns to 0.4%
HDS-1025	10 Bits	25ns to 0.1%
HDS-1250	12 Bits	35ns to 0.025%
<b>Voltage Output</b>		
HDH-0802	8 Bits	10V Step 200ns to 0.4%
HDH-1003	10 Bits	300ns to 0.1%
HDH-1205	12 Bits	500ns to 0.125%

Table I

# SPECIFICATIONS (typical @ +25°C with nominal power supply voltages unless otherwise noted)

MODEL	UNITS	CURRENT OUT			VOLTAGE OUT		
		HDS-0820	HDS-1025	HDS-1250	HDH-0802	HDH-1003	HDH-1205
RESOLUTION FS = Full Scale	Bits	8	10	12	8	10	12
LSB WEIGHT		40μA	10μA	2.5μA	40mV	10mV	2.5mV
ACCURACY (Relative to FS Including Linearity) ±% FS		0.1	0.05	0.0125	0.1	0.05	0.0125
Linearity		±10μA	±5μA	±1.25μA	±10mV	±5mV	±1.25mV
Monotonicity	LSB	±1/4	±1/2	±1/2	±1/4	±1/2	±1/2
Zero Offset (Initial)		15nA max	Guaranteed Over Operating Temperature Range			10mV typ 50mV max	*
<b>TEMPERATURE COEFFICIENTS</b>							
Linearity	ppm/°C	3	*	*	*	*	*
Gain	ppm/°C	30	*	*	*	*	*
Unipolar Offset	ppm/°C	3	*	*	*	*	*
Bipolar Offset	ppm/°C	15	*	*	*	*	*
<b>DATA INPUTS</b>							
Logic Compatibility		TTL and 5V CMOS					
Logic Voltage Levels Positive Logic "1" =	V	+2 to +7	*	*	*	*	*
"0" =	V	0 to +0.8	*	*	*	*	*
Logic Loading (Each Bit) "1" =	μA	40	*	*	*	*	*
"0" =	mA	-2.6	*	*	*	*	*
Codes		BIN, OBN			BIN, OBN		
<b>OUTPUT</b>							
Current Range FS							
Unipolar	mA	+10.24	*	+10.24	±25 max	**	**
Bipolar	mA	±5.12	*	±5.12	±25 max	**	**
Voltage Out FS <sup>1, 2</sup>							
Unipolar HDS with 200Ω	V	+1.024	*	+1.024	-10.24 ±0.1%	**	**
Internal Connected R <sub>L</sub>	V	±0.512	*	±0.512	±0.05%	**	**
Bipolar	V	±0.512	*	±0.512	±5.12 ±0.05%	**	**
Compliance	V	+1.5, -2	*	*	N/A	**	**
Impedance, Internal (See Figure 1)	Ω	200	*	*	0.1 max	**	**
<b>SETTLING TIME</b>							
Current	ns to % FS	20 to 0.4	25 to 0.1	35 to 0.025	N/A	N/A	N/A
Voltage <sup>2</sup>							
Unipolar or Bipolar Out, 75Ω Load, 0.56V p-p	ns to % FS	30 to 0.4	35 to 0.1	50 to 0.025	N/A	N/A	N/A
Unipolar or Bipolar Out, Internal 200Ω Load, 1.024V p-p	ns to % FS	45 to 0.4	50 to 0.1	60 to 0.025	N/A	N/A	N/A
10V Output Step	ns to % FS	N/A	N/A	N/A	200 to 0.4	300 to 0.1	500 to 0.025
5V Output Step	ns to % FS	N/A	N/A	N/A	150 to 0.4	200 to 0.1	350 to 0.025
<b>POWER REQUIREMENTS</b>							
+14.5V to +15.5V	mA max	42	*	55	70	**	**
-12V to -16V	mA max	14	*	18	40	**	**
Power Supply Rejection (+15V)	%/%	0.06	*	*	*	*	*
Power Supply Rejection Ration (-15V)	%/%	0.04	*	*	*	*	*
<b>TEMPERATURE RANGE</b>							
Operating - Glass Package	°C	0 to +70	*	*	*	*	*
Operating - "M" Metal Case <sup>3</sup>	°C	-55 to +125	*	*	*	*	*
Storage	°C	-55 to +125	*	*	*	*	*
<b>PACKAGE OPTIONS<sup>4</sup></b>							
		HY24E			HY24G		

## NOTES

<sup>1</sup> Other voltages may be obtained with external resistor.

<sup>2</sup> For HDS series,  $V_{OUT} = I_{OUT} \times R_{equivalent}$  which is the value of the 200Ω internal impedance in parallel with the external load resistance. Thus, by correct selection of external R<sub>L</sub>  $V_{OUT}$  can be any magnitude up to the + or - compliance voltage. See Figures 1 and 2.

<sup>3</sup> Contact factory or local Analog Devices sales office for "M" Metal Case device specifications and prices.

<sup>4</sup> See Section 19 for package outline information.

\* Specifications same as HDS-0820.

\*\* Specifications same as HDH-0802.

Specifications subject to change without notice.

**PIN DESIGNATIONS  
HDS-0820, HDS-1025**

PIN	FUNCTION
1	+15V
2,3*	BIT 1 (MSB)
4	BIT 2
5	BIT 3
6	BIT 4
7	BIT 5
8	BIT 6
9	BIT 7
10	BIT 8
11	BIT 9 (HDS-1025)
12	BIT 10
13-20	GND
21	OUTPUT (I <sub>Q</sub> )
22	R <sub>i</sub> 200Ω
23	BIPOLAR OFFSET
24	-15V

\*PINS 2 AND 3 MUST BE CONNECTED TOGETHER EXTERNALLY.

**PIN DESIGNATIONS  
HDS-1250**

PIN	FUNCTION
1	BIT 1 (MSB)
2	BIT 2
3	BIT 3
4	BIT 4
5	BIT 5
6	BIT 6
7	BIT 7
8	BIT 8
9	BIT 9
10	BIT 10
11	BIT 11
12	BIT 12
13-19	GND
20	OUTPUT (I <sub>Q</sub> )
21	R <sub>i</sub> 200Ω
22	BIPOLAR OFFSET
23	-15V
24	+15V

**PIN DESIGNATIONS  
HDH SERIES**

PIN	FUNCTION
1	BIT 1 (MSB)
2	BIT 2
3	BIT 3
4	BIT 4
5	BIT 5
6	BIT 6
7	BIT 7
8	BIT 8
9	BIT 9
10	BIT 10
11	BIT 11
12	BIT 12
13-19	GROUND
20	SUM NODE
21	OUTPUT
22	BIPOLAR OFFSET
23	-15V
24	+15V

ON HDH-0802 DEVICES, GROUND PINS 9, 10, 11 AND 12.  
ON HDH-1003 DEVICES, GROUND PINS 11 AND 12.

Analog Output, ±5.12mA	Offset Binary
+5.11mA (1LSB)	111.....1
+2.56mA	110.....0
0mA	100.....0
-2.56mA	010.....0
-5.12mA	000.....0

Analog Output, 0 to +10.24mA	Straight Binary
+10.23mA	111.....1
+7.68mA	110.....0
+5.12mA	100.....0
+2.56mA	010.....0
0mA	000.....0

Table II. Coding HDS Series

Analog Output, ±5.12V	Complement Offset Binary
-5.1175V	111.....1
-2.56V	110.....0
0V	100.....0
+2.56V	010.....0
+5.12V	000.....0

Analog Output, 0 to +10.24V	Complement Binary
-10.2375V	111.....1
-7.68V	110.....0
-5.12V	100.....0
-2.56V	010.....0
0V	000.....0

Table III. Coding HDH Series

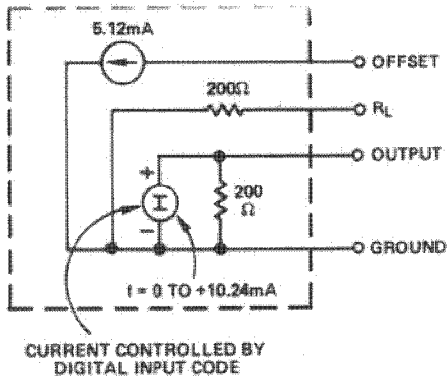


Figure 1. HDS Current Equivalent Circuit

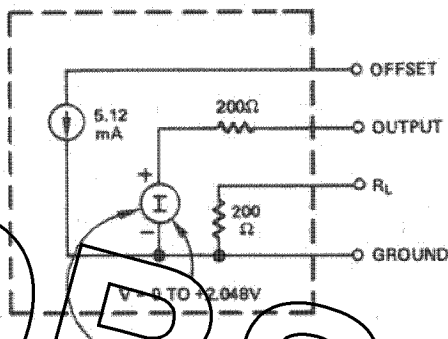


Figure 2. HDS Voltage Equivalent Circuit

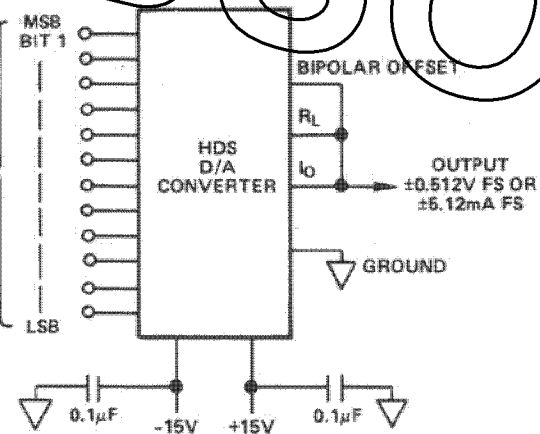


Figure 3. Bipolar Current Output

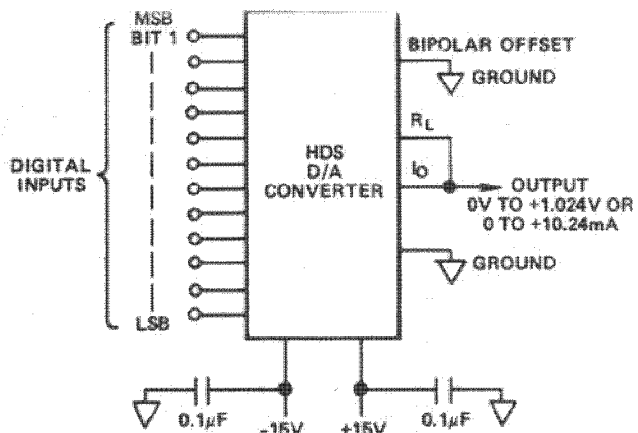
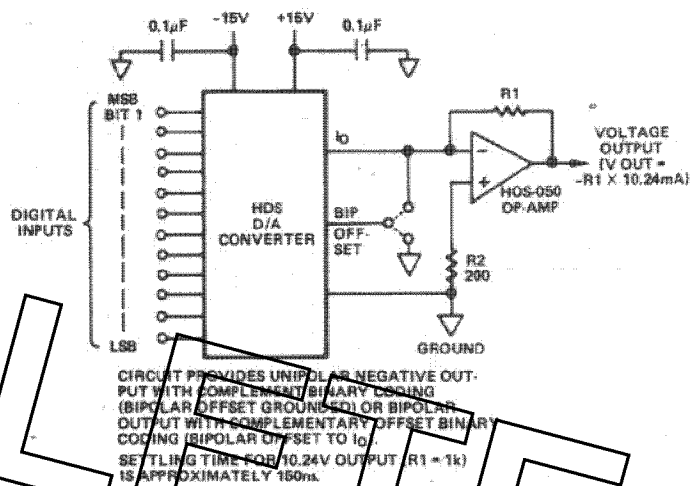


Figure 4. Unipolar Current Output



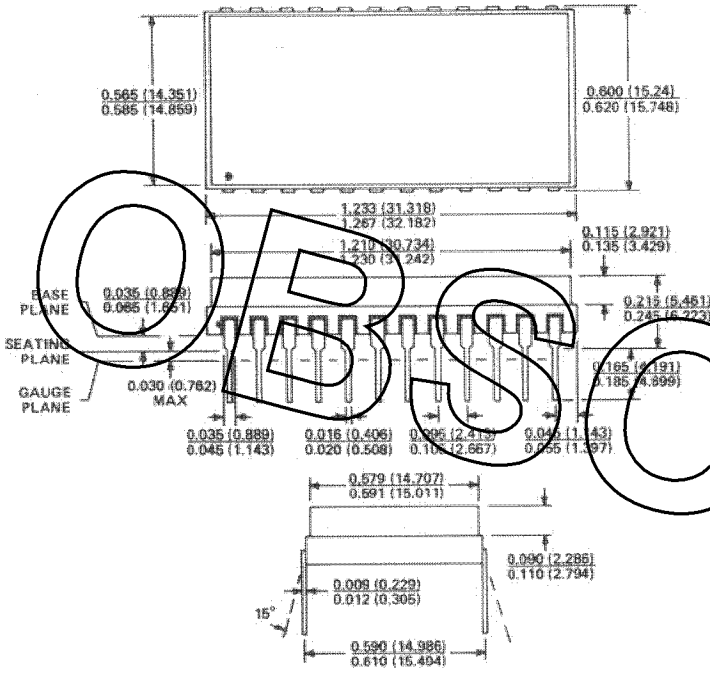
CIRCUIT PROVIDES UNIPOLAR NEGATIVE OUTPUT WITH COMPLEMENTARY BINARY CODING (BIPOlar OFFSET GROUND) OR BIPOlar OUTPUT WITH COMPLEMENTARY OFFSET BINARY CODING (BIPOlar OFFSET TO Io).  
SETTLING TIME FOR 10.24V OUTPUT (R1 = 1k) IS APPROXIMATELY 150ns.

Figure 5. Inverting Unipolar or Bipolar Voltage Output

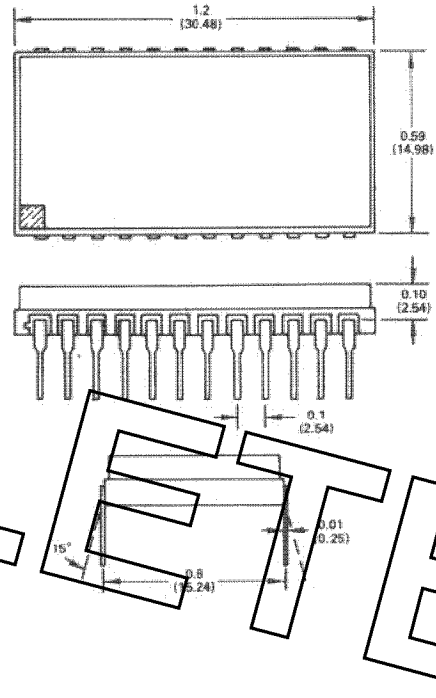
**ORDERING INFORMATION**  
Order model number HDS-0820, HDS-1025, HDS-1250, HDH-0802, HDH-1003, HDH-1205. Models with extended operating temperature range, hermetically-sealed metal-case construction (M versions). Consult factory or local Analog Devices sales office for further information.

24-PIN PACKAGES  
(Continued)

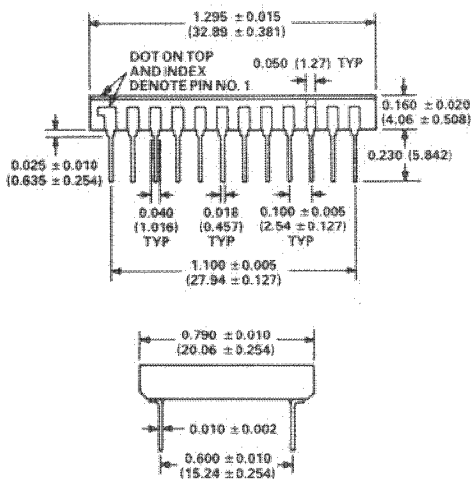
HY24C  
24-Pin Hybrid Package



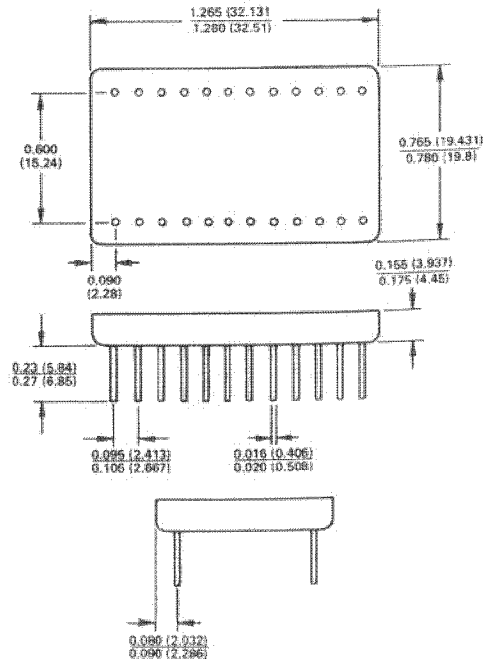
HY24D  
24-Pin Hybrid Package



HY24E  
24-Pin Hybrid Package



HY24G  
24-Pin Hybrid Package



Dimensions shown in inches and (mm).  
Lead No. 1 Identified by Dot or Notch.