



# ADSD-1410

## Dual, 14-Bit, 10MSPS Sampling A/D Converter

### PRODUCT DATA

#### FEATURES

- 14-bit resolution
- 10MSPS sampling rate
- Functionally complete
- No missing codes over full military temperature range
- Edge-triggered, 1.7 Watts
- Small, 28-pin, ceramic DDIP
- Ideal for both time and frequency-domain applications

#### GENERAL DESCRIPTION

The low-cost ADSD-1410 is a dual 14-bit, 10MSPS sampling A/D converter. This device accurately samples full-scale input signals up to Nyquist frequencies with no missing codes. The dynamic performance of the ADSD-1410 has been optimized to achieve a signal-to-noise ratio (SNR) of 78dB and a total harmonic distortion (THD) of -80dB. Each channel is completely independent allowing operation with independent analog inputs and start convert signals.

Packaged in a miniature 28-pin DDIP, the functionally complete ADSD-1410 contains two individual fast-settling sample-and-hold amplifiers and subranging A/D converters, along with an internal reference, timing/control logic, and error-correction circuitry. Digital input and output levels are TTL. The ADSD-1410 only requires the rising edge of the start convert pulse to operate.

#### INPUT/OUTPUT CONNECTIONS

PIN	FUNCTION	PIN	FUNCTION
1	INPUT "A"	28	INPUT "B"
2	RANGE	27	-5V
3	+2.5V REFERENCE	26	+15V
4	ANALOG GROUND	25	+5VD
5	+5VA	24	DIGITAL GROUND
6	START CONVERT "A"	23	START CONVERT "B"
7	SELECT	22	ENABLE
8	BIT 14 (LSB)	21	BIT 1 ( $\overline{\text{MSB}}$ )
9	BIT 13	20	BIT 2
10	BIT 12	19	BIT 3
11	BIT 11	18	BIT 4
12	BIT 10	17	BIT 5
13	BIT 9	16	BIT 6
14	BIT 8	15	BIT 7

Requiring only  $\pm 5V$  and  $+15V$  supplies, the ADSD-1410 dissipates 1.7 Watts. The device is offered with a bipolar ( $\pm 2.0V$ ) analog input range and can be configured for  $\pm 1.0V$  to  $\pm 2.0V$  input ranges, using an external resistor. Models are available in the commercial  $0$  to  $+70^\circ C$ , and military  $-55$  to  $+125^\circ C$  operating temperature ranges. A proprietary, auto-calibrating, error-correcting circuit enables the device to achieve specified performance over the full military temperature range. Typical applications include medical imaging, radar, sonar, communications and instrumentation.

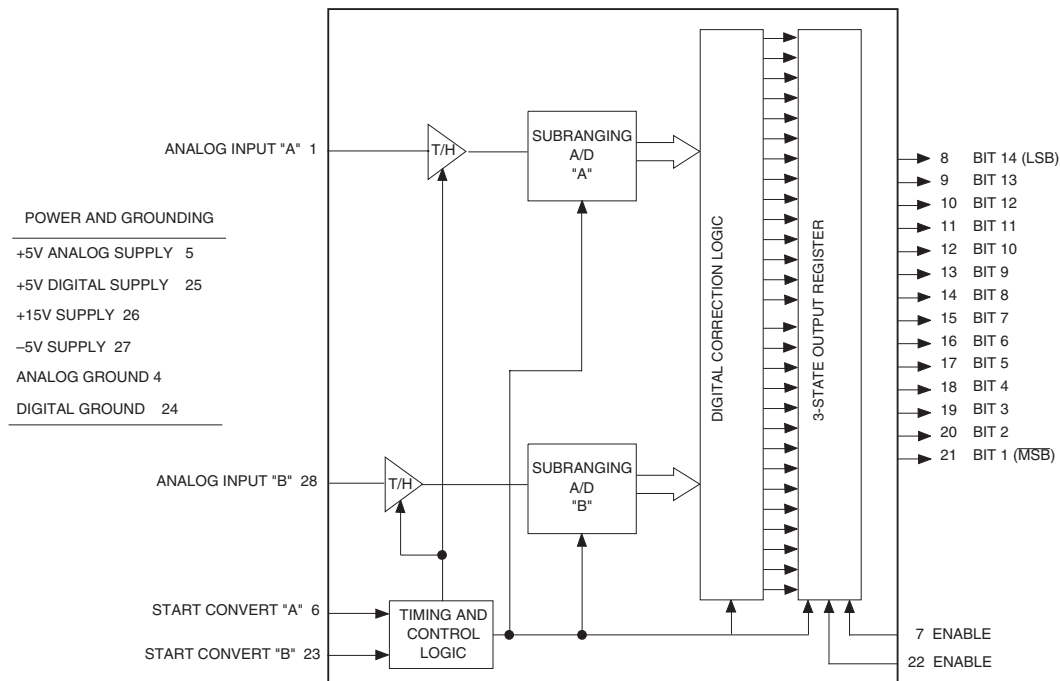


Figure 1. ADSD-1410 Functional Block Diagram

**ABSOLUTE MAXIMUM RATINGS**

PARAMETERS	LIMITS	UNITS
+5V Supply (Pins 5, 25)	0 to +6	Volts
+15V Supply (Pin 26)	12 to 17	Volts
-5V Supply (Pin 3)	0 to -6	Volts
Digital Inputs (Pins 6, 7, 22, 23)	-0.3 to +VDD +0.3	Volts
Analog Input (Pins 1, 28)	±5	Volts
Lead Temperature (10 seconds)	+300	°C

**PHYSICAL/ENVIRONMENTAL**

PARAMETERS	MIN.	TYP.	MAX.	UNITS
Operating Temp. Range, Case ADSD-1410	-55	—	+125	°C
Thermal Impedance θjc	—	6	—	°C/Watt
θca	—	23	—	°C/Watt
Storage Temperature Range	-65	—	+150	°C
Package Type Weight	28-pin, metal-sealed, ceramic DDIP 0.34oz (9.6 grams)			

**FUNCTIONAL SPECIFICATIONS**

(TA = +25°C, +VDD = +5V, -VDD = -5V, +Vcc = +15V, 10MSPS sampling rate, ±2V input range, and a minimum 3 minute warmup ① unless otherwise specified.)

ANALOG INPUT	+25°C			0 to +70°C			-55 to +125°C			UNITS
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Bipolar Input Voltage Range ②	—	±2	—	—	±2	—	—	±2	—	Volts
Input Resistance (Vin A), (Vin B)	—	400	—	—	400	—	—	400	—	Ω
Input Capacitance	—	6	15	—	6	15	—	6	15	pF
<b>DIGITAL INPUT</b>										
Logic Levels										
Logic "1"	+2.0	—	—	+2.0	—	—	+2.0	—	—	Volts
Logic "0"	—	—	+0.8	—	—	+0.8	—	—	+0.8	Volts
Logic Loading "1"	—	—	+20	—	—	+20	—	—	+20	μA
Logic Loading "0"	—	—	-20	—	—	-20	—	—	-20	μA
Start Convert Positive Pulse Width ③	45	50	55	45	50	55	45	50	55	ns
<b>STATIC PERFORMANCE</b>										
Resolution	—	14	—	—	14	—	—	14	—	Bits
Integral Nonlinearity (DC Input)	—	±1	—	—	±2	—	—	±3	—	LSB
Differential Nonlinearity (fin = 10kHz)	-0.90	±0.5	+1	-0.90	±0.5	+1	-0.99	±0.5	+1.25	LSB
Full Scale Absolute Accuracy	—	±0.1	±0.3	—	±0.15	±0.5	—	±0.5	±0.8	%FSR
Bipolar Zero Error (Tech Note 2)	—	±0.3	±0.5	—	±0.3	±0.5	—	±0.5	±0.9	%FSR
Gain Error (Tech Note 2)	—	±0.3	±0.5	—	±0.3	±0.5	—	±0.5	±0.9	%FSR
No Missing Codes (fin = 10kHz)	14	—	—	14	—	—	14	—	—	Bits
<b>DYNAMIC PERFORMANCE</b>										
Peak Harmonics (-0.5dB)										
dc to 975kHz	—	-80	-78	—	-80	-78	—	-80	-76	dB
975kHz to 2.4MHz	—	-76	-70	—	-76	-70	—	-76	-68	dB
Total Harmonic Distortion (-0.5dB)										
dc to 975kHz	—	-80	-77	—	-80	-77	—	-80	-74	dB
975kHz to 2.4MHz	—	-75	-69	—	-75	-69	—	-75	-69	dB
Signal-to-Noise Ratio										
(w/o distortion, -0.5dB)										
dc to 975kHz	76	78	—	76	78	—	76	77	—	dB
975kHz to 2.4MHz	75	77	—	75	77	—	75	76	—	dB
Signal-to-Noise Ratio ④										
(& distortion, -0.5dB)										
dc to 975kHz	74	74	—	74	74	—	73	73	—	dB
975kHz to 2.4MHz	68	72	—	68	72	—	67	72	—	dB
Noise	—	150	—	—	150	—	—	150	—	μVrms
Two-tone Intermodulation										
Distortion (fin = 240kHz, 200kHz fs = 10MHz, -0.5dB)	—	-76	-70	—	-76	-70	—	-76	-70	dB
Input Bandwidth (-3dB)										
Small Signal (-20dB input)	—	30	—	—	30	—	—	30	—	MHz
Large Signal (-0.5dB input)	—	20	—	—	20	—	—	20	—	MHz
Feedthrough Rejection (fin = 500kHz)	—	78	—	—	78	—	—	78	—	dB
Slew Rate	—	TBD	—	—	TBD	—	—	TBD	—	V/μs
Aperture Delay Time	—	+1	—	—	+1	—	—	+1	—	ns
Aperture Uncertainty	—	5	—	—	5	—	—	5	—	ps rms

DYNAMIC PERFORMANCE (Cont.)	+25°C			0 to +70°C			-55 to +125°C			UNITS
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
<b>S/H Acquisition Time</b> (to ±0.003%FSR, 4V step)	—	45	—	—	45	—	—	45	—	ns
<b>Overshoot Recovery Time</b>	—	175	—	—	175	—	—	175	—	ns
<b>A/D Conversion Rate</b>	10	—	—	10	—	—	10	—	—	MHz
<b>DIGITAL OUTPUTS</b>										
<b>Logic Levels</b>										
Logic "1"	+2.4	—	—	+2.4	—	—	+2.4	—	—	Volts
Logic "0"	—	—	+0.4	—	—	+0.4	—	—	+0.4	Volts
Logic Loading "1"	—	—	-4	—	—	-4	—	—	-4	mA
Logic Loading "0"	—	—	+4	—	—	+4	—	—	+4	mA
<b>Output Coding</b>	Two's Complement									
<b>POWER REQUIREMENTS</b>										
<b>Power Supply Ranges</b>										
+5V Supply	+4.75	+5.0	+5.25	+4.75	+5.0	+5.25	+4.9	+5.0	+5.25	Volts
-5V Supply	-4.75	-5.0	-5.25	-4.75	-5.0	-5.45	-4.9	-5.2	-5.45	Volts
+15V Supply	+14.75	+15	+15.5	+14.75	+15	+15.5	+14.75	+15	+15.25	Volts
<b>Power Supply Currents</b>										
+5V Supply	—	220	270	—	220	270	—	220	270	mA
-5V Supply	—	25	35	—	25	35	—	25	35	mA
+15V Supply	—	20	35	—	20	35	+14.5	35	35	mA
<b>Power Dissipation</b>	—	1.7	1.9	—	1.7	1.9	—	1.7	1.9	Watts
<b>Power Supply Rejection</b>	—	—	±0.05	—	—	±0.05	—	—	±0.05	%FSR/%V
<b>Footnotes:</b>										
① All power supplies should be on before applying a start convert pulse. All supplies and the clock (start convert pulses) must be present during warmup periods. The device must be continuously converting during this time.						④ Effective bits is equal to: $\frac{(\text{SNR} + \text{Distortion}) - 1.76 + \left[ 20 \log \frac{\text{Full Scale Amplitude}}{\text{Actual Input Amplitude}} \right]}{6.02}$				
② Contact DATEL for other input voltage ranges.										
③ A 50ns wide start convert pulse is used for all production testing. For applications requiring less than an 10MSPS sampling rate, wider start convert pulses can be used.										

## TECHNICAL NOTES

- Obtaining fully specified performance from the ADSD-1410 requires careful attention to pc card layout and power supply decoupling. The device's analog and digital ground systems are connected to each other internally. For optimal performance, tie all ground pins (4 and 24) directly to a large **analog** ground plane beneath the package.  
  
Bypass all power supplies to ground with 4.7µF tantalum capacitors in parallel with 0.1µF ceramic capacitors. Locate the bypass capacitors as close to the unit as possible.
- The ADSD-1410 achieves its specified accuracies without the need for external calibration. It is recommended that the +5VA and +5VD supplies should be powered up from the same source. The standard input range is ±2.0 Volts. Users desiring an input range from ±1.0 Volts to ±2.0 Volts, can use an external input resistor (see page 4).
- A passive bandpass filter is used at the input of the A/D for all production testing.

## THERMAL REQUIREMENTS

All DATEL sampling A/D converters are fully characterized and specified over operating temperature (case) range of -55 to +125°C. All room temperature (T<sub>A</sub> = +25°C) production testing is performed without the use of heat sinks or forced air cooling. Thermal impedance figures for each device are listed in their respective specification tables.

These devices do not normally require heat sinks, however, standard precautionary design and layout procedures should be used to ensure devices do not overheat. The ground and power planes beneath the package, as well as all pcb signal runs to and from the device, should be as heavy as possible to help conduct heat away from the package.

Electrically-insulating, thermally-conductive "pads" may be installed underneath the package. Devices should be soldered to boards rather than socketed, and of course, minimal air flow over the surface can greatly help reduce the package temperature.

In more severe ambient conditions, the package/junction temperature of a given device can be reduced dramatically (typically 35%) by using one of DATEL's HS Series heat sinks. See Ordering Information for the assigned part number. Request DATEL Application Note AN8, "Heat Sinks for DIP Data Converters", or contact DATEL directly, for additional information.

**ANALOG INPUT RANGE**

The standard ADSD-1410 has a ±2.0 Volt input range. Users desiring an input range from ±1.0 Volt up to 2.0 Volts, can use an external resistor (RSET), between the RANGE (pin 2) and ANALOG GROUND (pin 4) pins.

RSET is determined as follows:

$$\text{For } \pm V \text{ input voltage range, } R_{SET} = \frac{V}{10 - 5V}$$

Examples: For V = ±2V, RSET = Infinity

$$\text{For } V = \pm 1V, R_{SET} = \frac{1}{10 - 5V} = 200 \text{ Ohms}$$

**TIMING**

The ADSD-1410 has a three-pipeline delay for valid output (see Figure 2 and Table 2). The particular subranging A/D's output data is selected with the SELECT pin (pin 7), A/D "A"

being selected when the SELECT pin is "low", and A/D "B" being selected when SELECT pin is "high". A particular A/D's conversion is initiated by the appropriate START CONVERT signal and the output "word" will appear at the output data bits, after three start convert signals have been given (assumes output brought high with the ENABLE pin (pin 22)). The detailed timing specifications are given in Table 2, and show both dual A/D operation, and also when just a single channel is used. The "internal data" times are given as information only, indicating when internal systems events (ground current flows) occur.

Table 1. Output Coding

MSB	LSB	INPUT VOLT. ±V	BIPOLAR SCALE
01	1111 1111 1111	+1.99976	+FS - 1LSB
01	1000 0000 0000	+1.50000	+3/4FS
01	0000 0000 0000	+1.00000	+1/2FS
00	0000 0000 0000	0.00000	0
11	0000 0000 0000	-1.00000	-1/2FS
10	1000 0000 0000	-1.50000	-3/4FS
10	0000 0000 0001	-1.99976	-FS+1LSB
10	0000 0000 0000	-2.00000	-FS

TWO'S COMP

**Timing Specifications**

+5VD (pin 25) = +5V, Digital Output Load CL=35pF Typ		Min(ns)	Typ(ns)	Max(ns)
Tpw	Minimum convert pulse width	45	50	55
Tnctdv	New conversion to internal data valid	12	12	20
Toetdv	Output enable to data valid	20	30	37
Tseltdv	Select change to data valid	20	25	37
Tdctdv	Internal data to data valid	12	14	16
Todtdz	Output disable to high-impedence	30	35	45
Tctdv	Conversion to data valid	24	30	36

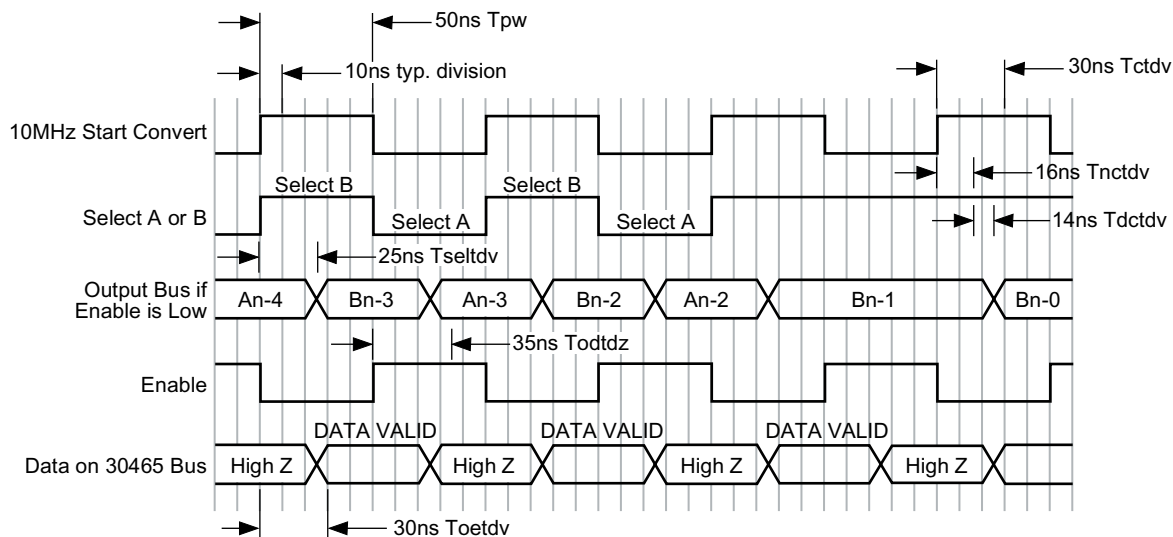


Figure 2. Timing Diagram

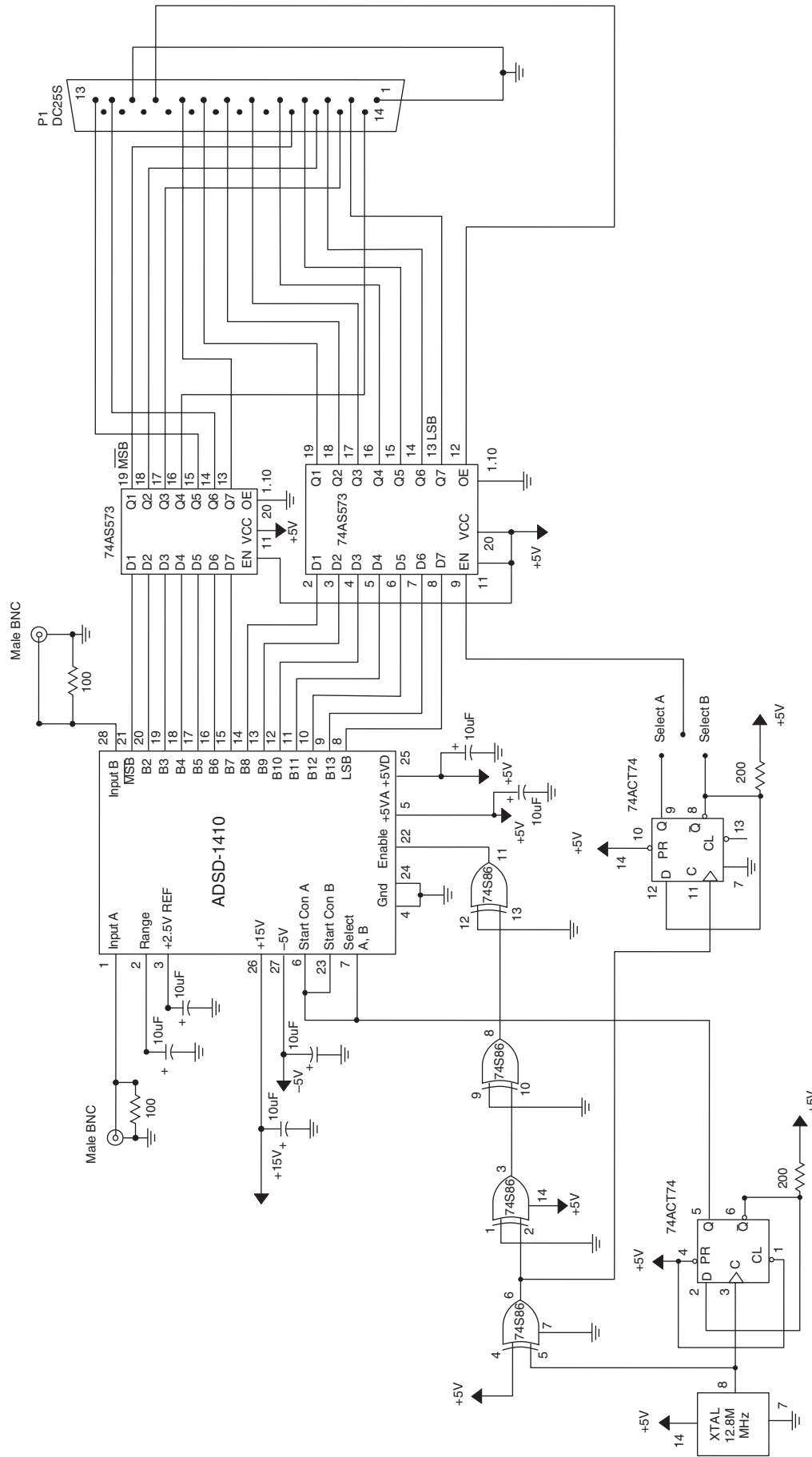
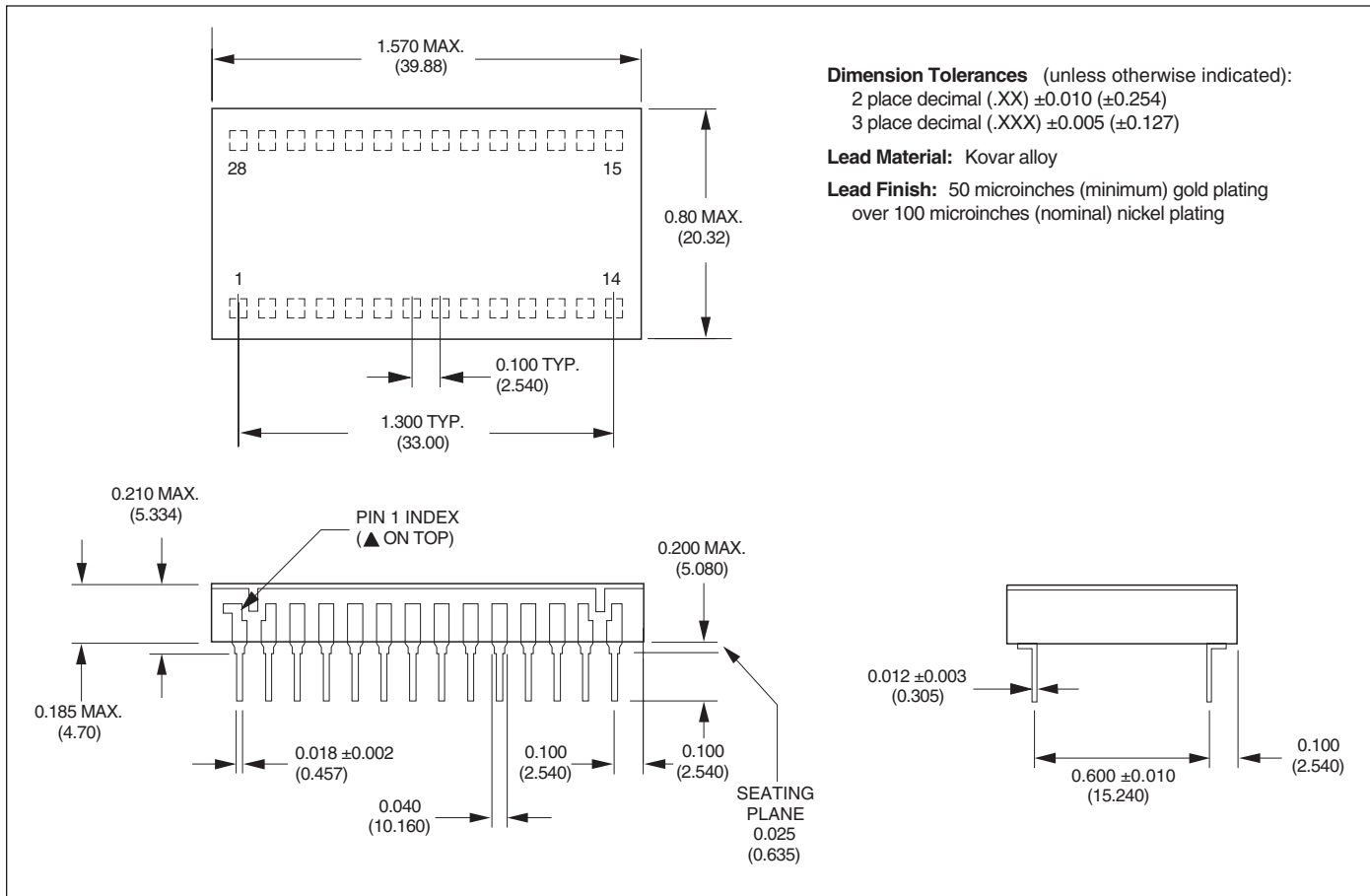


Figure 3. ADSD-1410 Connection Diagram

**MECHANICAL DIMENSIONS**  
INCHES (mm)



**ORDERING INFORMATION**

MODEL	OPERATING TEMP. RANGE	28-PIN PACKAGE	ACCESSORIES
ADSD-1410MC	0 to +70°C	DDIP	HS-24 Heat Sink for all ADSD-1410 models
ADSD-1410MM	-55 to +125°C	DDIP	



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