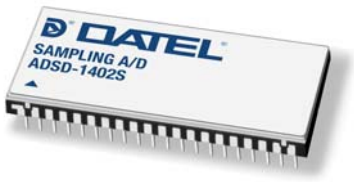
# ADSD-1402S

## Dual, 14-Bit, 2MSPS Sampling A/D Converter




## PRODUCT OVERVIEW

DATEL's ADSD-1402S is a functionally complete, dual 14- bit, 2MSPS, sampling A/D converter. Its standard, 40-pin, triple-wide SMT DIP contains two fast-settling sample/hold amplifiers, two 14-bit A/D converters, multiplexed output buffers, a precision reference, and all the timing and control logic necessary to operate from either two or a single start convert pulse.

The ADSD-1402S is optimized for wideband frequencydomain applications and is fully FFT tested. The ADSD-1402S requires only ±5V supplies and typically consumes 0.6 Watts. Models are available in either commercial 0 to +70°C or military -55 to +125°C (-EX suffix model) operating temperature ranges.

## FEATURES

- 14-bit resolution; 2MSPS sampling rate
- Functionally complete; ±5V input range
- No missing codes over full temperature range
- Edge-triggered; No pipeline delays
- ±5V supplies, 0.6 Watts
- Small, 40-pin, low-cost surface-mount TDIP
- 79dB SNR, –80dB THD
- Ideal for both time and frequency domain applications
- Out-of-range indicator

| INPUT/OUTPUT CONNECTIONS | | | |
|---|---|---|---|
| PIN | FUNCTION | PIN | FUNCTION |
| 1 | INPUT A | 40 | INPUT B |
| 2 | +5VA | 39 | +5VA |
| 3 | ANALOG GROUND | 38 | ANALOG GROUND |
| 4 | GAIN A | 37 | GAIN B |
| 5 | OFFSET A | 36 | OFFSET B |
| 6 | RANGE | 35 | N/C |
| 7 | 2.5V REF | 34 | N/C |
| 8 | ANALOG GROUND | 33 | ANALOG GROUND |
| 9 | –5V | 32 | –5V |
| 10 | $\overline{\text{ENABLE A}}$ | 31 | $\overline{\text{ENABLE B}}$ |

| INPUT/OUTPUT CONNECTIONS | | | |
|---|---|---|---|
| PIN | FUNCTION | PIN | FUNCTION |
| 11 | START A | 30 | START B |
| 12 | +5VD | 29 | $\overline{\text{EOC}}$ |
| 13 | BIT 14 (LSB) | 28 | BIT 1 (MSB) |
| 14 | BIT 13 | 27 | BIT 2 |
| 15 | BIT 12 | 26 | BIT 3 |
| 16 | BIT 11 | 25 | BIT 4 |
| 17 | BIT 10 | 24 | BIT 5 |
| 18 | BIT 9 | 23 | BIT 6 |
| 19 | BIT 8 | 22 | BIT 7 |
| 20 | DGND | 21 | DGND |

## BLOCK DIAGRAM

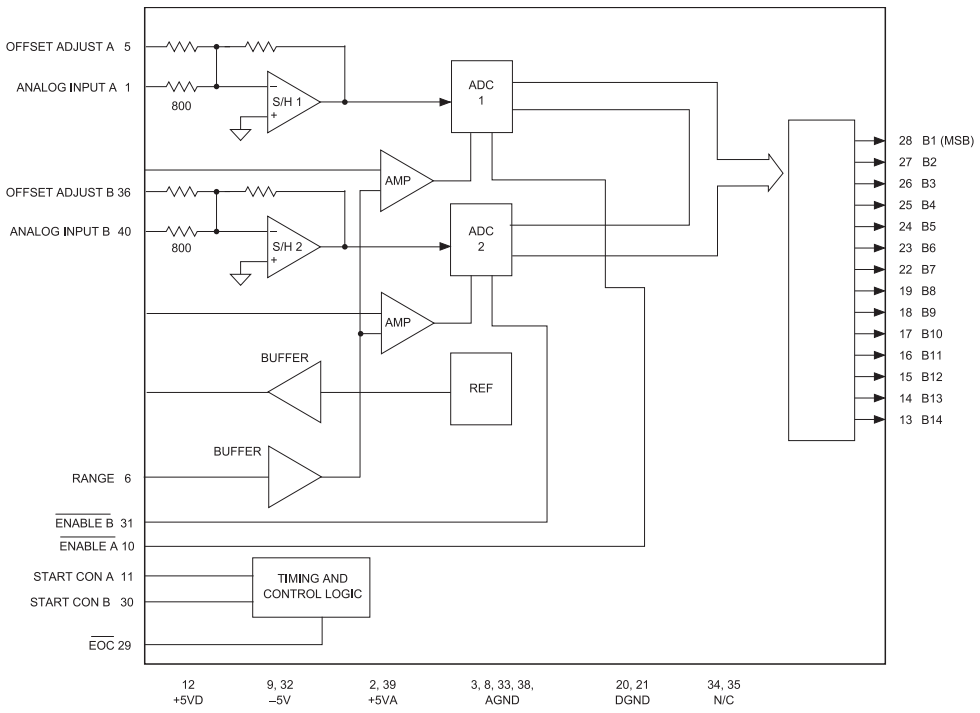



**Figure 1. ADSD-1402S Functional Block Diagram**

| ABSOLUTE MAXIMUM RATINGS | | |
|---|---|---|
| **PARAMETERS** | **LIMITS** | **UNITS** |
| +5V Supply (Pins 2, 12, 39) | 0 to +6 | Volts |
| –5V Supply (Pins 9, 32) | 0 to –6 | Volts |
| Digital Inputs (Pins 3, 10, 11, 31) | –0.3 to +VDD +0.3 | Volts |
| Analog Input (Pins 1, 40) | ±5 | Volts |
| Lead Temp. (10 seconds) | +300 | °C |

## FUNCTIONAL SPECIFICATIONS

(TA = +25°C, +VDD = +5V, Vee = –5V, 2MSPS sampling rate,Vin = ±5V and a minimum 7 minute warmup unless otherwise specified.)

| ANALOG INPUTS | MIN. | TYP. | MAX. | UNITS |
|---|---|---|---|---|
| Input Voltage Range | — | ±5V | — | Volts |
| Input Impedence | — | 400 | — | Ω |
| Input Capacitance | — | 7 | 15 | pF |
| **DIGITAL INPUTS** | | | | |
| Logic Levels | | | | |
| Logic "1" | +2.0 | — | — | Volts |
| Logic "0" | — | — | +0.8 | Volts |
| Logic Loading "1" | — | — | +20 | µA |
| Logic Loading "0" | — | — | –20 | µA |
| **PERFORMANCE** | | | | |
| Integral Non-Linearity (fin = 10KHz) | | | | |
| +25°C | — | ±1 | — | LSB |
| 0 to +70°C | — | ±1 | — | LSB |
| –55 to +125°C | — | ±2 | — | LSB |
| Differential Non-Linearity (fin = 10KHz) | | | | |
| +25°C | –0.99 | ±0.5 | +1.75 | LSB |
| 0 to +70°C | –0.99 | ±0.5 | +2.5 | LSB |
| –55 to +125°C | –0.99 | ±0.75 | +2.5 | LSB |
| Offset Error | | | | |
| +25°C (see Figure 3) | — | ±0.25 | ±0.5 | %FSR |
| 0 to +70°C | — | ±0.25 | ±0.5 | %FSR |
| –55 to +125°C | — | ±0.5 | ±0.8 | %FSR |
| Gain Error | | | | |
| +25°C (see Figure 3) | — | ±0.3 | ±0.6 | %FSR |
| 0 to +70°C | — | ±0.3 | ±0.6 | %FSR |
| –55 to +125°C | — | ±0.6 | ±0.8 | %FSR |
| No Missing Codes (fin = 975kHz) | | | | |
| 14 Bits | –55 to +125°C | | | |
| Resolution | 14 Bits | | | |
| **OUTPUTS** | **MIN.** | **TYP.** | **MAX.** | **UNITS** |
| Output Coding | Offset Bin. | | | |
| Logic Level | | | | |
| Logic "1" | +2.4 | — | — | Volts |
| Logic "0" | — | — | +0.4 | Volts |
| Logic Loading "1" | — | — | 4 | µA |
| Logic Loading "0" | — | — | 4 | mA |
| Internal Reference | | | | |
| Voltage, +25°C | +2.45 | +2.5 | +2.55 | Volts |
| 0 to +70°C | +2.45 | +2.5 | +2.55 | Volts |
| External Current | — | — | 5 | mA |

| DYNAMIC PERFORMANCE | MIN. | TYP. | MAX. | UNITS |
|---|---|---|---|---|
| Total Harm. Distort. (–0.5dB) | | | | |
| dc to 500kHz | — | –79 | –72 | dB |
| 500kHz to 1MHz | — | –73 | –70 | dB |
| Signal-to-Noise Ratio (w/o distortion, –0.5dB ) | | | | |
| dc to 500kHz | 76 | 80 | — | dB |
| 500kHz to 1MHz | 76 | 80 | — | dB |
| Signal-to-Noise Ratio (and distortion, –0.5dB) | | | | |
| dc to 500kHz | 70 | 74 | — | dB |
| 500kHz to 1MHz | 69 | 73 | — | dB |
| Spurious Free Dyn. Range ① | | | | |
| dc to 500kHz | — | –85 | –74 | dB |
| 500kHz to 1MHz | — | –74 | –70 | dB |
| Two-tone IMD Distortion (fin = 975kHz, | | | | |
| fs = 2.0Mhz, –0.5dB) | — | –76 | — | dB |
| Input Bandwidth (–3dB) | | | | |
| Small Signal (–20dB input) | — | 16 | — | MHz |
| Large Signal (–0.5dB input) | — | 12 | — | MHz |
| Slew Rate | — | ±250 | — | V/µs |
| Aperture Delay Time | — | — | ±10 | ns |
| Aperature Uncertainty | — | — | 5 | ps |
| S/HAquisitionTime(to±0.003%FSR),stepinput | — | 100 | 150 | ns |
| Conversion Rate | 2 | — | — | MHz |
| Feedthrough Rejection (fin = 1MHz) | — | 85 | — | dB |
| Noise | — | 250 | — | µVrms |
| **POWER REQUIREMENTS** | | | | |
| Power Supply Ranges | | | | |
| –5V Supply | –5.25 | –5 | –4.75 | Volts |
| +5V Supply | +4.75 | +5.0 | +5.25 | Volts |
| Power Supply Currents | | | | |
| –5V Supply | –80 | –70 | — | mA |
| +5V Supply | — | +50 | +70 | mA |
| Power Dissipation | — | 0.6 | 0.75 | Watts |
| Power Supply Rejection | — | — | ±0.01 | %FSR%V |
| **PHYSICAL/ENVIRONMENTAL** | | | | |
| Operating Temp. Range, Case | | | | |
| ADSD-1402SMC | 0 | — | +70 | °C |
| ADSD-1402SMM | –55 | — | +125 | ° C |
| Storage Temperature Range | –65 | — | +150 | °C |
| Weight | | 16.1/0.6 | | grams/oz |
| Package Type | 0-pin, SMT TDIP | | | |

Footnote:
① Same specification as In-Band Harmonics and Peak Harmonics.

## TECHNICAL NOTES

1. Rated performance requires using good high-frequency circuit board layout techniques. Connect the digital and analog grounds to one point, the analog ground plane beneath the converter. Due to the inductance and resistance of the power supply return paths, return the analog and digital ground separately to the power supplies.

## CALIBRATION PROCEDURE

1. Connect the converter per Figure 3. Apply a pulse of 100 nanoseconds minimum to START CONVERT (pin 11) at a rate of 200kHz. This rate is chosen to reduce flicker if LED's are used on the outputs for calibration purposes.
2. Zero (Offset) Adjustments

   Apply a precision voltage reference source between ANALOG INPUT A (pin 1) and SIGNAL GROUND (pin 3), then adjust the reference source output per Table 2. Adjust trimpot R2 until the code flickers equally between 10 0000 0000 0000 and 10 0000 0000 0001.
3. Full-Scale (Gain) Adjustments

   Set the output of the voltage reference used in step 2 to the value shown in Table 2.

   Adjust the gain trimpot R1 until the output code flickers equally between 11 1111 1111 1110 and 11 1111 1111 1111.
4. Repeat above steps for Analog Input B (Pin 40). Use trimpot R3 for the zero (Offset) adjustment and trimpot R4 for the Full-Scale (Gain) adjustment.
5. To confirm proper operation of the device, vary the precision reference voltage source to obtain the output coding listed in Table 3.

| INPUT RANGE | OFFSET ADJUST +1/2 LSB | GAIN ADJUST FS – 1½ LSB |
|---|---|---|
| ±5V | +0.000305V | +4.999085V |

**Table 2. Offset and Gain Adjustments**

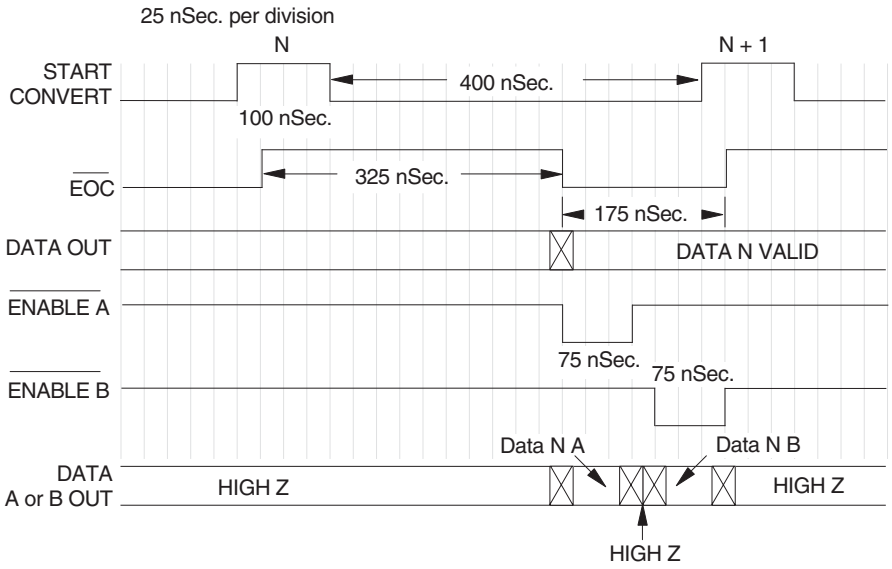
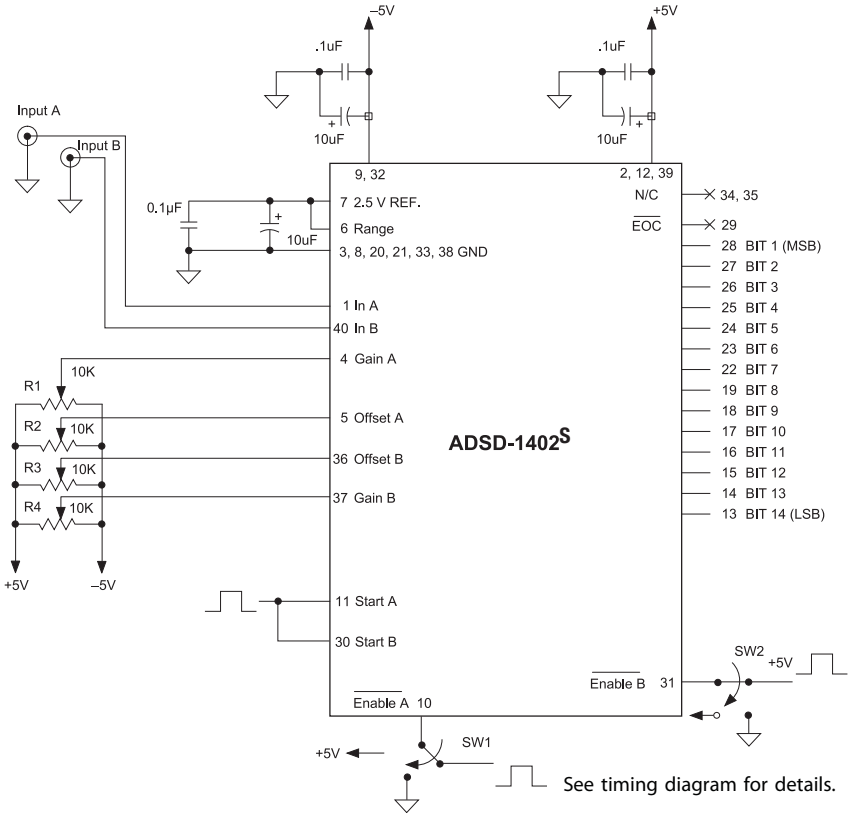



**Figure 2. ADSD-1402S Timing Diagram**

| OUTPUT CODING MSB LSB | INPUT RANGE ±5V | BIPOLAR SCALE |
|---|---|---|
| 11 1111 1111 1111 | +4.999390 | +FS – 1LSB |
| 11 1000 0000 0000 | +4.250000 | +3/4FS |
| 11 0000 0000 0000 | +2.500000 | +1/2FS |
| 10 0000 0000 0000 | ±0.000000 | 0 |
| 01 0000 0000 0000 | –2.500000 | –1/2FS |
| 00 1000 0000 0000 | –4.250000 | –3/4FS |
| 00 0000 0000 0001 | –4.999390 | –FS+1LSB |
| 00 0000 0000 0000 | –5.000000 | –FS |

**Table 3. Output Coding**




**Notes:**

① Recommended to use same supply source for +5 Analog and +5 Digital. Try using as clean of a supply as possible (Bypass caps., 10uF and .1uF).

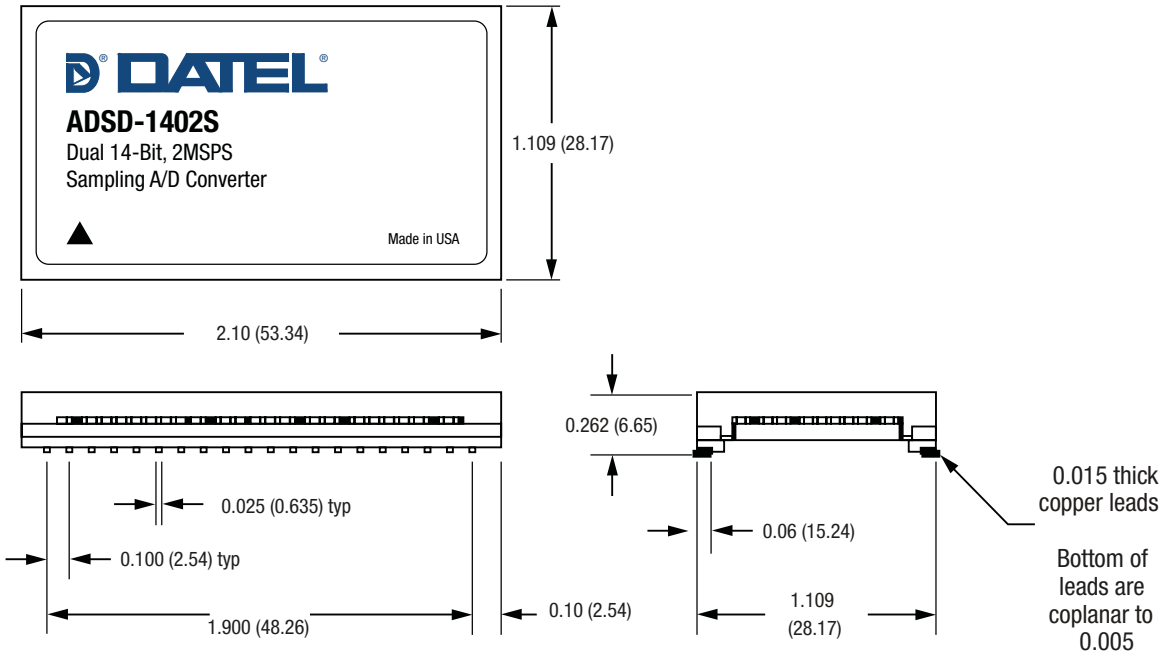
② Outputs are enabled by either turning $\overline{\text{ENABLE}}$ A (Pin 10) or $\overline{\text{ENABLE}}$ B (Pin 31) low for prespective analog inputs A or B. A high on ENABLE A or ENABLE B results in disabling the output bus (High Z).

**Figure 3. ADSD-1402S Connection Diagram**

## THERMAL REQUIREMENTS

The ADSD-1402S sampling A/D converter is fully characterized and specified over the commercial operating temperature (ambient) range of 0 to +70°C and military temperature range of –55 to +125°C (EX suffix). All room-temperature (TA = +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. 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.

## MECHANICAL DIMENSIONS INCHES (MM)

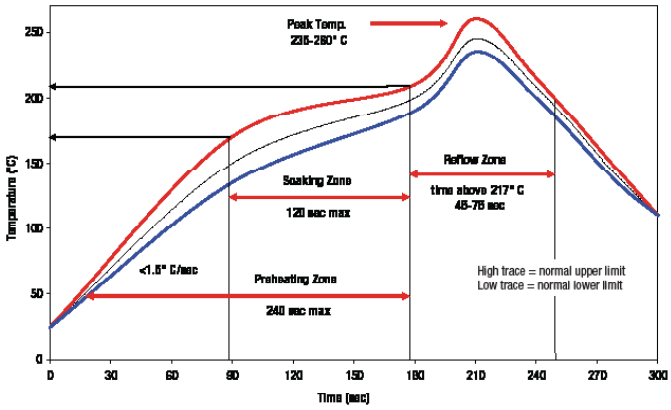



## Soldering Guidelines

DATEL recommends the specifications below when installing these converters. These specifications vary depending on the solder type. Exceeding these specifications may cause damage to the product. Your production environment may differ therefore please thoroughly review these guidelines with your process engineers.

| REFLOW SOLDER OPERATIONS FOR SURFACE-MOUNT PRODUCTS (SMT) | |
|---|---|
| For Sn/Ag/Cu based solders: | |
| Preheat Temperature | Less than 1 ºC. per second |
| Time over Liquidus | 45 to 75 seconds |
| Maximum Peak Temperature | 260 ºC. |
| Cooling Rate | Less than 3 ºC. per second |
| For Sn/Pb based solders: | |
| Preheat Temperature | Less than 1 ºC. per second |
| Time over Liquidus | 60 to 75 seconds |
| Maximum Peak Temperature | 235 ºC. |
| Cooling Rate | Less than 3 ºC. per second |

## Recommended Lead-free Solder Reflow Profile




| ORDERING INFORMATION | | | | | |
|---|---|---|---|---|---|
| MODEL NUMBER | OPERATING TEMP. RANGE | PACKAGE | ROHS | ACCESSORIES | |
| ADSD-1402S | 0 to +70°C | SMT-TDIP | No | HS-40 | Heat Sink for all ADSD-1402S models |
| ADSD-1402S-EX | -55to +125°C | SMT-TDIP | No | | |
| ADSD-1402S-C | 0 to +70°C | SMT-TDIP | Yes | | |
| ADSD-1402S-EX-C | -55to +125°C | SMT-TDIP | Yes | | |


**11 Cabot Boulevard, Mansfield, MA 02048-1151 USA**
**ITAR and ISO 9001/14001 REGISTERED**