Murata Power Solutions

HDAS-524, HDAS-528

12-Bit, 400kHz, Complete Data Acquisition System

FEATURES

- 12-Bit resolution, 400kHz throughput
- 8 Channels single-ended or 4 channels differential
- Miniature, 40-pin, ceramic DDIP
- Full scale input range from 100mV to 10V
- Three-state outputs
- No missing codes

GENERAL DESCRIPTION

The HDAS-524 and HDAS-528 are complete data acquisition systems. Each contains an internal multiplexer, instrumentation amplifier, sample-hold, analog-to-digital converter and three-state outputs. Packaged in miniature, 40-pin, double-dip packages, the HDAS-524/528 have a low power dissipation of 2.6 Watts.

The HDAS-524 provides 4 differential inputs, and the HDAS-528 provides 8 single-ended inputs. An internal instrumenta- tion amplifier is characterized for gains of 1, 2, 4, 8, 10 and 100. The gain range is selectable through a single external resistor.

HDAS-524/528 OPERATION

The HDAS devices accept either 8 single-ended or 4 differential input signals. Tie unused channels to SIGNAL GROUND, pin 14. Channel selection is accomplished using the multiplexer address pins as shown in Table 1. Obtain additional channels by connecting external multiplexers.

The acquisition time is the amount of time the multiplexer, instrumentation amplifier and sample-hold require to settle within a specified range of accuracy. The acquisition time can be measured by how long $\overline{EOC}$ is low before the rising edge of the START CONVERT pulse for continuous operation. Higher

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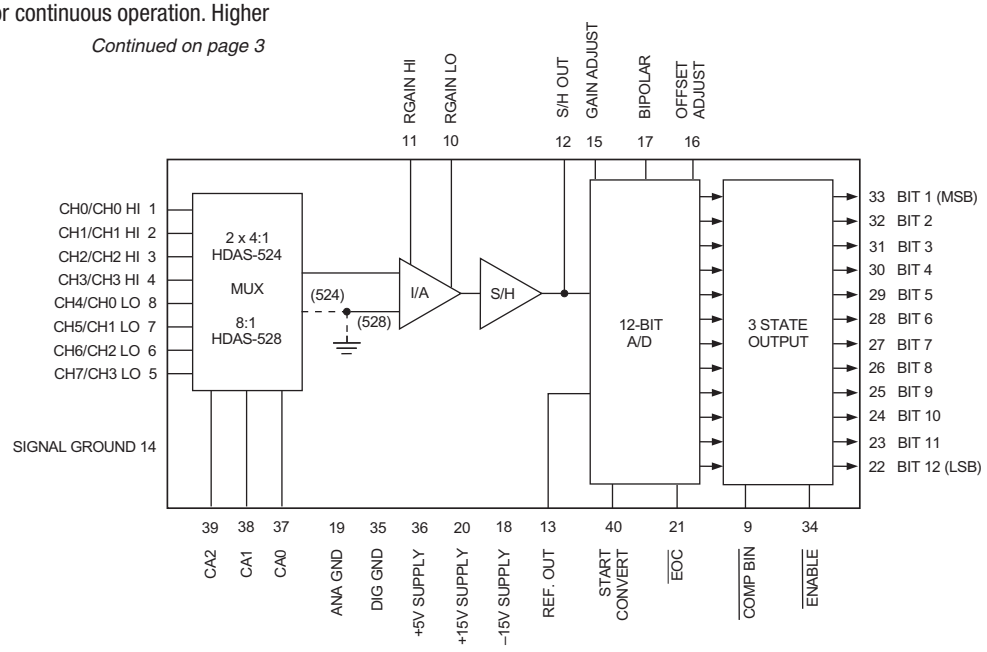
INPUT/OUTPUT CONNECTIONS

PIN	FUNCTION	PIN	FUNCTION
1	CH0/CH0 HI	40	START CONVERT
2	CH1/CH1 HI	39	CA2
3	CH2/CH2 HI	38	CA1
4	CH3/CH3 HI	37	CA0
5	CH7/CH3 LO	36	+5V SUPPLY
6	CH6/CH2 LO	35	DIGITAL GROUND
7	CH5/CH1 LO	34	$\overline{ENABLE}$
8	CH4/CH0 LO	33	BIT 1 (MSB)
9	$\overline{COMP\ BIN}$	32	BIT 2
10	RGAIN LO	31	BIT 3
11	RGAIN HI	30	BIT 4
12	S/H OUT	29	BIT 5
13	+10V REFERENCE OUT	28	BIT 6
14	SIGNAL GROUND	27	BIT 7
15	GAIN ADJUST	26	BIT 8
16	OFFSET ADJUST	25	BIT 9
17	BIPOLAR	24	BIT 10
18	–15V SUPPLY	23	BIT 11
19	ANALOG GROUND	22	BIT 12 (LSB)
20	+15V SUPPLY	21	$\overline{EOC}$



Typical topology is shown.

Figure 1. Functional Block Diagram

ABSOLUTE MAXIMUM RATINGS

PARAMETERS	MIN.	TYP.	MAX.	UNITS
+15V Supply, Pin 20	0	—	+18	Volts
–15V Supply, Pin 18	0	—	–18	Volts
+5V Supply, Pin 36	–0.5	—	+7	Volts
Digital Inputs, Pins 9, 34, 37-40	–0.3	—	$+V_{DD}$ +0.3	Volts
Analog Inputs, Pins 1–8	–15	—	+15	Volts
Lead Temperature (10 seconds)	—	—	300	°C

FUNCTIONAL SPECIFICATIONS

(Apply over the operating temperature range with ±15V and +5V supplies unless otherwise specified.)

ANALOG INPUTS	MIN.	TYP.	MAX.	UNITS
Number of Inputs				
HDAS-524	4 differential inputs			
HDAS-528	8 single-ended inputs			
Input Voltage Ranges				
Gain = 1	0 to +10V, ±10V			
Gain = 100	0 to +100mV, ±100mV			
I.A. Gain Ranges	1, 2, 4, 8, 10, 100			
Input Impedance				
CH On, CH Off	10^{11}	10^{12}	—	Ohms
Input Capacitance				
(-524) CH On, CH Off	—	—	12	pF
(-528) CH On, CH Off	—	—	25	pF
Input Bias Current	—	—	±200	pA
Input Offset Current	—	—	±50	pA
Input Offset Voltage	—	—	±10	mV
Common Mode Voltage Range	±11	—	—	Volts
CMRR, G = 1, @10Hz, Vcm = 1Vp-p	72	80	—	dB
Voltage Noise (RMS)				
Gain = 1	—	—	200	µV
Gain = 8	—	—	50	µV
MUX Crosstalk @125kHz	–72	—	—	dB
MUX ON Resistance	—	450	500	Ohms
Bias Current Tempco	Doubles (max.) every 10°C above +70°C			
Offset Current Tempco	Doubles (max.) every 10°C above +70°C			
Offset Voltage Tempco	(±30ppm/°C x gain) ±20ppm/°C (max.)			
Input Gain Equation	$GAIN = \frac{2k\Omega}{R_{GAIN}} + 1$			
DIGITAL INPUTS				
Logic Levels				
Logic 1	+2.0	—	—	Volts
Logic 0	—	—	+0.5	Volts
Logic Loading				
Logic 1	—	—	+5	µA
Logic 0	—	—	–600	µA
OUTPUTS				
Logic Levels				
Logic 1	+2.4	—	—	Volts
Logic 0	—	—	+0.4	Volts
Logic Loading				
Logic 1	—	—	–160	µA
Logic 0	—	—	+6.4	mA
Internal Reference				
Voltage, +25°C	+9.9	+10.0	+10.1	Volts
Drift	—	±5	±35	ppm/°C
External Current	—	—	1.5	mA
Output Coding	Straight binary/Offset binary Comp. binary/Comp. offset binary			

Footnotes:

① Specifications valid at +25°C and over the temperature ranges of 0 to +70°C or –55 to +125°C.

PERFORMANCE	MIN.	TYP.	MAX.	UNITS
Resolution	12	—	—	Bits
Integral Nonlinearity, +25°C	—	—	±0.75	LSB
0 to +70°C	—	—	±0.75	LSB
–55 to +125°C	—	—	±1.5	LSB
Differential Nonlinearity, +25°C	—	—	±0.75	LSB
0 to +70°C	—	—	±0.75	LSB
–55 to +125°C	—	—	±1	LSB
F.S. Abs. Accuracy, +25°C	—	±0.13	±0.3	%FSR
0 to +70°C	—	±0.15	±0.5	%FSR
–55 to +125°C	—	±0.25	±0.78	%FSR
Unipolar Zero Error, +25°C	—	±0.074	±0.15	%FSR
Unipolar Zero Tempco	—	±15	±30	ppm/°C
Bipolar Zero Error, +25°C	—	±0.074	±0.15	%FSR
Bipolar Zero Tempco	—	±5	±10	ppm/°C
Bipolar Offset Error, +25°C	—	±0.1	±0.25	%FSR
Bipolar Offset Tempco	—	±20	±40	ppm/°C
Gain Error, +25°C	—	±0.1	±0.25	%
Gain Tempco	—	±20	±40	ppm/°C
Harmonic Distortion (–FS)				
(DC to 5kHz, 10Vp-p) ①	—	–73	–65	dB
No Missing Codes	Over operating temperature range			
SIGNAL TIMING				
$\overline{\text{Enable}}$ to Data Valid Delay	—	—	10	ns
MUX Address Set-up Time	400	—	—	ns
Start Convert Pulse Width	50	100	—	ns
Data Valid After				
EOC Signal Goes Low	—	—	20	ns
Conversion Time, +25°C	—	—	800	ns
0 to +70°C	—	—	850	ns
–55 to +125°C	—	—	880	ns
Throughput Rates ①				
Gain = 1	400	—	—	kHz
Gain = 2	325	—	—	kHz
Gain = 4	275	—	—	kHz
Gain = 8	225	—	—	kHz
Gain = 10	175	—	—	kHz
Gain = 100	40	—	—	kHz
S/H PERFORMANCE				
Acquisition Time				
Full-Scale Step to ±0.01%	—	500	900	ns
Full-Scale Step to ±0.1%	—	400	750	ns
Aperture Delay	–50	–20	0	ns
Aperture Uncertainty	—	—	±150	ps
Slew Rate	±70	±90	—	V/µs
Hold Mode Settling Time				
To ±1mV	—	100	200	ns
To ±10mV	—	75	150	ns
Feedthrough Rejection	80	88	—	dB
Droop Rate ①	—	±0.1	±100	µV/µs
POWER SUPPLIES				
Range, +15V Supply	+14.25	+15.0	+15.75	Volts
–15V Supply	–14.25	–15.0	–15.75	Volts
+5V Supply	+4.75	+5.0	+5.25	Volts
Current, +15V Supply	—	+78	+90	mA
–15V Supply	—	–72	–82	mA
+5V Supply	—	+75	+95	mA
Power Dissipation	—	2.6	3	Watts
Power Supply Rejection	—	—	±0.05	%FSR/%V
PHYSICAL/ENVIRONMENTAL				
Oper. Temp. Range, Case, -MC,	0	—	+70	°C
-MM, 883	–55	—	+125	°C
Storage Temp. Range	–65	—	+150	°C
Package Type	40-pin ceramic DDIP			
Weight	0.56 ounces (16 grams)			

gains require the use of the RGAIN resistor to increase the acquisition time. The gain is equal to 1 without an RGAIN resistor. Table 2 refers to the appropriate RGAIN resistors for various throughputs.

The HDAS devices enter the hold mode and are ready for conversion upon the start convert going high. The conversion is complete within a maximum of 800ns (+25°C). EOC returns low, the data is valid and sent to the three-state output buffers. The sample/hold is now ready to acquire new data.

Table 1. MUX Channel Addressing

MUX ADDRESS PINS 39 CA2	38 CA1	37 CA0	CHANNEL	
0	0	0	0	
0	0	1	1	HDAS-524
0	1	0	2	(2-BIT ADDRESS)
0	1	1	3	
1	0	0	4	
1	0	1	5	HDAS-528
1	1	0	6	(3-BIT ADDRESS)
1	1	1	7	

Table 2. Input Range Parameters

INPUT RANGE	GAIN	RGAIN	THROUGHPUT
0 to +10V	1	OPEN	400kHz
0 to +5V	2	2kΩ	325kHz
0 to +2.5V	4	665Ω	275kHz
0 to +1.25V	8	287Ω	225kHz
0 to +1V	10	221Ω	175kHz
0 to +100mV	100	20Ω	40kHz
±10V	1	OPEN	400kHz
±5V	2	2kΩ	325kHz
±2.5V	4	665Ω	275kHz
±1.25V	8	287Ω	225kHz
±1V	10	221Ω	175kHz
±100mV	100	20Ω	40kHz

$$R_{GAIN} = \frac{2k\Omega}{(GAIN - 1)} \qquad GAIN = \frac{2k\Omega}{R_{GAIN}} + 1$$

Table 3. Zero and Gain Adjust

INPUT RANGE	ZERO ADJUST +1/2LSB	GAIN ADJUST +FS – 1 1/2LSB
0 to +10V	+1.22mV	+9.9963V
±10V	+2.44mV	+9.9927V

CALIBRATION PROCEDURE

1. Connect the converter per Figure 2 and Tables 2 and 3 for the appropriate input range. Apply a pulse of 100 nano-seconds (typical) to the START CONVERT input (pin 40) at a rate of 100kHz. This rate is chosen to reduce flicker if LED's are used on the outputs for calibration purposes.
2. Zero Adjustments
   Apply a precision voltage reference source between the analog input and SIGNAL GROUND (pin 14). Adjust the output of the reference source per Table 3. For unipolar, adjust the zero trimming potentiometer so that the output code flickers equally between 0000 0000 0000 and 0000 0000 0001 with the COMP BIN (pin 9) tied high (straight binary) or between 1111 1111 1111 and 1111 1111 1110 with the COMP BIN (pin 9) tied low (complementary binary).
   For bipolar operation, adjust the potentiometer such that the code flickers equally between 1000 0000 0000 and 1000 0000 0001 with COMP BIN (pin 9) tied high (offset binary) or between 0111 1111 1111 and 0111 1111 1110 with COMP BIN (pin 9) tied low (complementary offset binary).
3. Full-Scale Adjustment
   Set the output of the voltage reference used in step 2 to the value shown in Table 3. Adjust the gain trimming potentiometer so that the output code flickers equally between 1111 1111 1110 and 1111 1111 1111 or 0000 0000 0001 and 0000 0000 0000 for complementary coding.
4. To confirm proper operation of the device, vary the precision reference voltage source to obtain the output coding listed in Table 4.

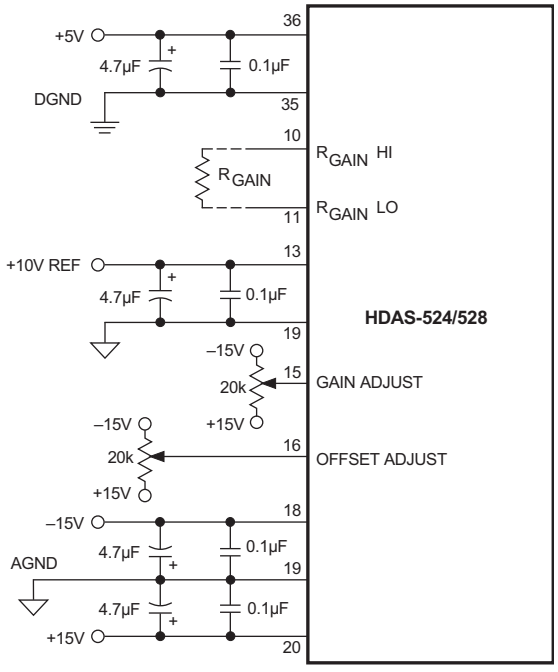


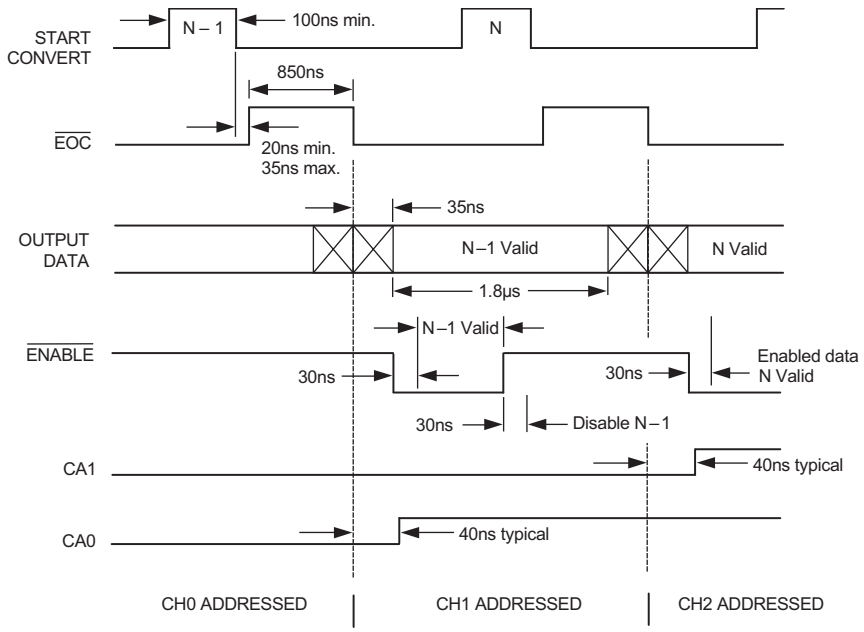
Figure 2. Typical Connection Diagram

Notes:

1. For unipolar operation, connect pin 12 to pin 17.
2. For bipolar operation, connect pin 13 to pin 17.
3. Position RGAIN as close as possible to pins 10 and 11. Use RN55C, 1% resistors.
4. If gain and offset adjusts are not used, connect pin 15 to ground and leave pin 16 open.

TECHNICAL NOTES

1. Rated performance requires using good high-frequency circuit board layout techniques. The analog and digital ground pins are not connected to each other internally. Avoid ground-related problems by connecting the analog, signal and digital grounds to one point, the ground plane beneath the converter. Due to the inductance and resistance of the power supply return paths, return the analog and digital grounds separately to the power supplies. This prevents contamination of the analog ground by noisy digital ground currents.
2. Double-level multiplexing allows expanding the multiplexer channel capacity of the HDAS-528 from 8 single-ended channels to 128 single-ended channels or the HDAS-524 from 4 differential channels to 32 differential channels.
3. Obtain straight binary/offset binary output coding by tying $\overline{\text{COMP BIN}}$ (pin 9) to +5V or leaving it open. The device has an internal pull-up resistor on this pin. To obtain complementary binary or complementary offset binary output coding, tie pin 9 to ground. The $\overline{\text{COMP BIN}}$ signal is compatible to CMOS/TTL logic levels for those users desiring logic control of this function.
4. To enable the three-state outputs, connect $\overline{\text{ENABLE}}$ (pin 34) to a logic "0" (low). To disable, connect pin 34 to a logic "1" (high).



Notes:

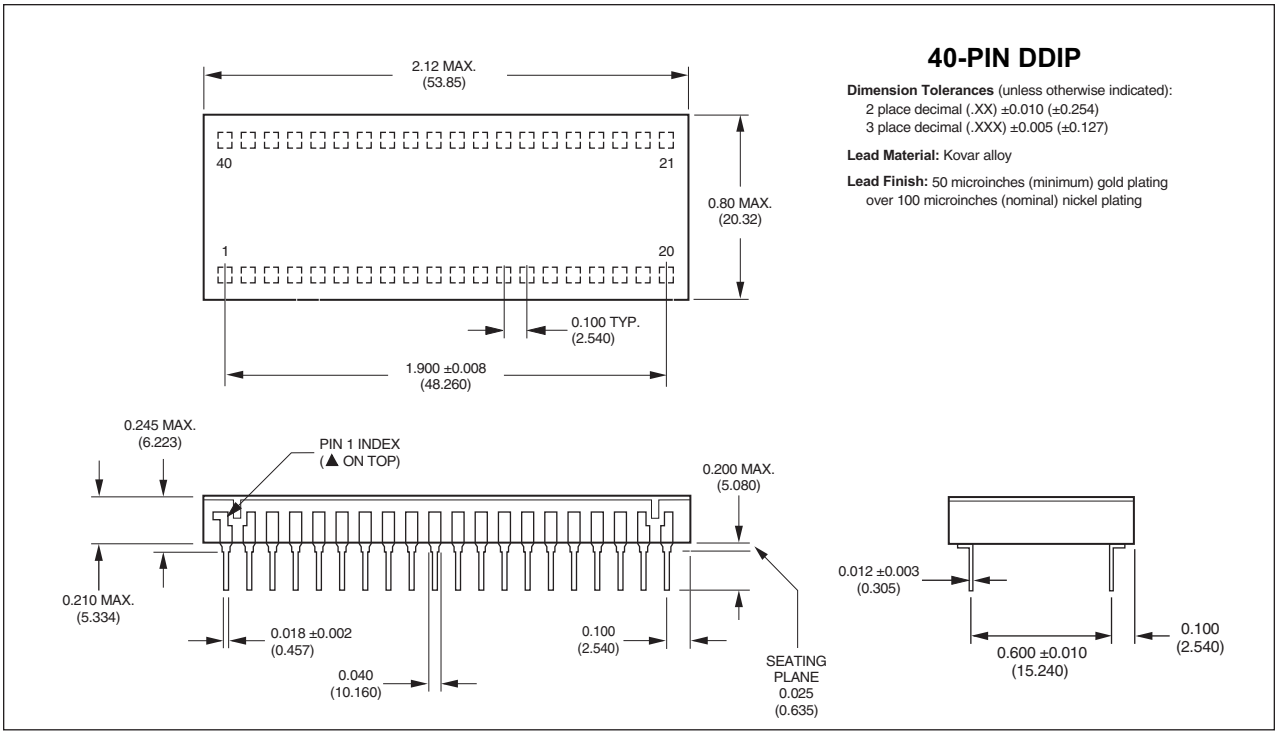
1. A START CONVERT pulse greater than 150ns will slow the throughput.
2. Retriggering START CONVERT before EOC goes low will not start a new conversion.
3. Times shown apply over the 0 to +70°C operating temperature range.

Figure 3. HDAS-524/528 Timing Diagram

Table 4. Output Coding

		STRAIGHT BINARY	COMP. BINARY		
UNIPOLAR SCALE	INPUT RANGE 0 to +10V	OUTPUT CODING MSB LSB	OUTPUT CODING MSB LSB	INPUT RANGE ±10V	BIPOLAR SCALE
+FS – 1LSB	+9.9976V	1111 1111 1111	0000 0000 0000	+9.9951V	+FS – 1LSB
+7/8FS	+8.7500V	1110 0000 0000	0001 1111 1111	+7.5000V	+3/4FS
+3/4FS	+7.5000V	1100 0000 0000	0011 1111 1111	+5.0000V	+1/2FS
+1/2FS	+5.0000V	1000 0000 0000	0111 1111 1111	0.0000V	0
+1/4FS	+2.5000V	0100 0000 0000	1011 1111 1111	–5.0000V	–1/2FS
+1/8FS	+1.2500V	0010 0000 0000	1101 1111 1111	–7.5000V	–3/4FS
+1LSB	+0.0024V	0000 0000 0001	1111 1111 1110	–9.9951V	–FS + 1LSB
0	0.0000V	0000 0000 0000	1111 1111 1111	–10.0000V	–FS
		OFFSET BINARY	COMP. OFF. BINARY		

Mechnical Dimensions
INCHES (mm)



40-PIN DDIP

Dimension Tolerances (unless otherwise indicated):
2 place decimal (.XX) ±0.010 (±0.254)
3 place decimal (.XXX) ±0.005 (±0.127)

Lead Material: Kovar alloy

Lead Finish: 50 microinches (minimum) gold plating over 100 microinches (nominal) nickel plating

Ordering Information		
Model No.	**Input**	**Operating Temp. Range**
HDAS-524MC	4D Channels	0 to +70°C
HDAS-524MM	4D Channels	–55 to +125°C
HDAS-528MC	8SE Channels	0 to +70°C
HDAS-528MM	8SE Channels	–55 to +125°C
HDAS-528/883	8SE Channels	–55 to +125°C
Receptacle for PC board mounting can be ordered through AMP Inc., Part #3-331272-8 (Component Lead Socket), 40 required. Contact Murata Power Solutions for MIL-STD-883 product specifications.		

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