

ADS-CCD1202

12-Bit, 2MHz, Sampling A/D's for CCD Imaging Applications

FEATURES

- Unipolar input range (0 to +10V)
- 2MHz sampling rate
- 4096-to-1 dynamic range (72.2dB)
- Low noise, 600µVrms (1/4 of an LSB)
- Outstanding differential nonlinearity error (±0.45 LSB max.)

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- Small, 24-pin ceramic DDIP
- Low power, 1.75 Watts
- Operates from ±12V or ±15V supplies
- Edge-triggered, no pipeline delay
- Low cost

GENERAL DESCRIPTION

The functionally complete, easy-to-use ADS-CCD1202 is a 12-bit, 2MHz Sampling A/D Converter whose performance and production testing have been optimized for use in CCD applications. This device delivers the lowest noise (600μ Vrms) and the best differential linearity error (±0.45LSB maximum) of any commercially available 12-bit A/D in its speed class. It can respond to full scale input steps (from empty to full well) with less than a single count of error, and its input is immune to overvoltages that may occur due to blooming.

Packaged in an industry-standard, 24-pin, ceramic DDIP, the ADS-CCD1202 requires $\pm 15V$ (or $\pm 12V$) and $\pm 5V$ supplies and typically consumes 1.75 (1.45) Watts. The device is 100% production tested for all critical performance parameters and is fully specified over both the 0 to $\pm 70^{\circ}C$ and ± 55 to $\pm 125^{\circ}C$ operating temperature ranges.

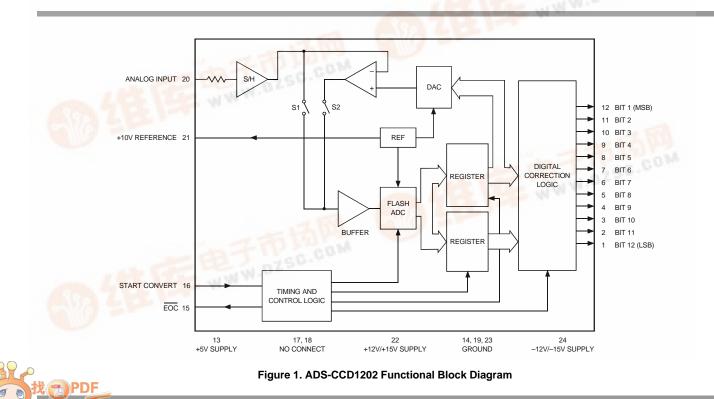
For those applications using correlated double sampling, the ADS-CCD1202 can be supplied without its internal samplehold amplifier and achieve conversion rates up to 2.5MHz.



INPUT/OUTPUT CONNECTIONS

PIN	FUNCTION	PIN	FUNCTION
1	BIT 12 (LSB)	24	-12V/-15V SUPPLY
2	BIT 11	23	GROUND
3	BIT 10	22	+12V/+15V SUPPLY
4	BIT 9	21	+10V REFERENCE OUT
5	BIT 8	20	ANALOG INPUT
6	BIT7	19	GROUND
7	BIT 6	18	NO CONNECT
8	BIT 5	17	NO CONNECT
9	BIT 4	16	START CONVERT
10	BIT 3	15	EOC
11	BIT 2	14	GROUND
12	BIT 1 (MSB)	13	+5V SUPPLY

DATEL will also entertain discussions about including the CDS circuit internal to the ADS-CCD1202. Contact us for details.





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PARAMETERS	LIMITS	UNITS
+12V/+15V Supply (Pin 22)	0 to +16	Volts
-12V/-15V Supply (Pin 24)	0 to -16	Volts
+5V Supply (Pin 13)	0 to +6	Volts
Digital Input (Pin 16)	-0.3 to +V _{DD} +0.3	Volts
Analog Input (Pin 20)	-5 to +14	Volts
Lead Temp. (10 seconds)	+300	°C

PHYSICAL/ENVIRONMENTAL

PARAMETERS	MIN.	TYP.	MAX.	UNITS
Operating Temp. Range, Case ADS-CCD1202MC ADS-CCD1202MM Thermal Impedance	0 -55		+70 +125	ပံ
Өјс	_	5	—	°C/Watt
Өса	_	24	_	°C/Watt
Storage Temperature Range	-65	-	+150	°C
Package Type Weight				

FUNCTIONAL SPECIFICATIONS

 $(T_A = +25^{\circ}C, \pm V_{CC} = \pm 15V \text{ (or } \pm 12V), + V_{DD} = +5V, 1.2MHz \text{ sampling rate, and a minimum 1 minute warmup} \text{ unless otherwise specified.})$

		+25°C			0 to +70°C			-55 to +125° (C	
ANALOG INPUT	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS
Input Voltage Range Input Resistance Input Capacitance	 0.99 	0 to +10 1 7	— 1.01 15	 0.99 	0 to +10 1 7	 1.01 15	 0.99 	0 to +10 1 7	— 1.01 15	Volts kΩ pF
DIGITAL INPUTS	1					I	1			
Logic Levels Logic "1" Logic "0" Logic Loading "1" Logic Loading "0" Start Convert Positive Pulse Width 3	+2 	 200	+0.8 +20 -20	+2 — — —	 200		+2 	 200		Volts Volts μΑ μΑ ns
STATIC PERFORMANCE	1					1	1			
Resolution Integral Nonlinearity (fin = 10kHz) Differential Nonlinearity (fin = 10kHz) Full Scale Absolute Accuracy Offset Error (Tech Note 2) Gain Error (Tech Note 2) No Missing Codes (fin = 10kHz)	 12	$ \begin{array}{c} 12 \\ \pm 0.5 \\ + 0.25 \\ + 0.1 \\ \pm 0.15 \\ \pm 0.1 \\ \\ \end{array} $	±0.45 ±0.3 ±0.3 ±0.4	 12	$ \begin{array}{c} 12 \\ \pm 0.5 \\ \pm 0.25 \\ \pm 0.2 \\ \pm 0.2 \\ \pm 0.4 \\ \\ \end{array} $	 ±0.45 ±0.5 ±0.5 ±0.8 	 12	$12 \\ \pm 1 \\ \pm 0.35 \\ \pm 0.3 \\ \pm 0.5 \\ \pm 0.5 \\ \pm 0.5 \\$	 ±0.75 ±0.8 ±1.2 ±1.4 	Bits LSB LSB %FSR %FSR % Bits
DYNAMIC PERFORMANCE	1									
Peak Harmonics (-0.5dB) dc to 500kHz 500kHz to 1MHz Total Harmonic Distortion (-0.5dB)		80 77	-75 -71	_	-80 -77	-75 -71		-76 -73	-72 -66	dB dB
dc to 500kHz 500kHz to 1MHz Signal-to-Noise Ratio (w/o distortion, -0.5dB)	_	-76 -75	-73 -70	_	-76 -75	-73 -70	_	-74 -71	-70 -65	dB dB
dc to 500kHz 500kHz to 1MHz Signal-to-Noise Ratio @ (8 distortion, –0.5dB)	71 71	72 72	_	71 71	72 72		71 70	72 72	_	dB dB
dc to 500kHz 500kHz to 1MHz Two-tone Intermodulation Distortion	70 68	71 71	_	70 68	71 71		68 65	70 69	_	dB dB
(fin = 200kHz, 500kHz fs = 2MHz, -0.5dB) Noise Input Bandwidth (-3dB)	_ _	-83 600	_	_	-82 600	_ _	_ _	81 600	_	dB µVrms
Small Signal (–20dB input) Large Signal(–0.5dB input) Feedthrough Rejection		9 8	_ _	 	9 8	_ _	_ _	9 8	_	MHz MHz
(fin = 1MHz) Slew Rate Aperture Delay Time Aperture Uncertainty	_ _ _ _	82 ±200 ±20 5	_ _ _	 	82 ±200 ±20 5	_ _ _ _	_ _ _ _	82 ±200 ±20 5	_ _ _	dB V/µs ns ps rms
S/H Acquisition Time (to ±0.01%FSR, 10V step) Overvoltage Recovery Time A/D Conversion Rate	150 — 2	190 400 —	230 500 —	150 2	190 400 —	230 500 —	150 — 2	190 400 —	230 500 —	ns ns MHz



查询"ADS-CCD1202MM"供应商 _{+25℃}		0	to +70°C			–55 to +125°C				
ANALOG OUTPUT	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	UNITS
Internal Reference										
Voltage	+9.95	+10.0	+10.05	+9.95	+10.0	+10.05	+9.95	+10.0	+10.05	Volts
Drift	_	±5	_	—	±5	—	—	±5	—	ppm/ºC
External Current	—	—	1.5	—	—	1.5	—	-	1.5	mA
DIGITAL OUTPUTS										
Logic Levels										
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
elay, Falling Edge of EOC										
to Output Data Valid	—	—	35	—	—	35	—	—	35	ns
output Coding					Straight Binar	y				
OWER REQUIREMENTS, ±	15V									
Power Supply Range										
+15V Supply	+14.5	+15.0	+15.5	+14.5	+15.0	+15.5	+14.5	+15.0	+15.5	Volts
–15V Supply	-14.5	-15.0	-15.5	-14.5	-15.0	-15.5	-14.5	-15.0	-15.5	Volts
+5V Supply	+4.75	+5.0	+5.25	+4.75	+5.0	+5.25	+4.75	+5.0	+5.25	Volts
ower Supply Current										
+15V Supply	_	+43	+55	_	+43	+55	—	+43	+55	mA
–15V Supply	_	-48	-55	_	-48	-55	—	-48	-55	mA
+5V Supply	_	+82	+95	_	+82	+95	—	+82	+95	mA
Power Dissipation	_	1.75	1.95	_	1.75	1.95	—	1.75	1.95	Watts
Power Supply Rejection	—	—	±0.01	—	—	±0.01	—	-	±0.01	%FSR/%
POWER REQUIREMENTS, ±	12V									
Power Supply Range										
+12V Supply	+11.5	+12.0	+12.5	+11.5	+12.0	+12.5	+11.5	+12.0	+12.5	Volts
–12V Supply	-11.5	-12.0	-12.5	-11.5	-12.0	-12.5	-11.5	-12.0	-12.5	Volts
+5V Supply	+4.75	+5.0	+5.25	+4.75	+5.0	+5.25	+4.75	+5.0	+5.25	Volts
ower Supply Current										-
+12V Supply	—	+43	+55	—	+43	+55	—	+43	+55	mA
–12V Supply	—	-48	-55	-	-48	-55	-	-48	-55	mA
+5V Supply	—	+82	+95	-	+82	+95	—	+82	+95	mA
ower Dissipation	—	1.45	1.65	-	1.45	1.65	-	1.45	1.65	Watts
ower Supply Rejection		—	±0.01	—	—	±0.01	—	—	±0.01	%FSR/%
ootnotes:				@ E	ffective bits is	equal to:	_			-
① All power supplies must be on before applying a start convert pulse. All					(0)			Full Sca	ale Amplitude	e
supplies and the clock (START (CONVERT) must be	e present duri	ing warmup		(SNR + [Distortion) – 1	.76 + 20 lo	Actual In	put Amplitud	le
periods. The device must be continuously converting during this time.			L				<u> </u>			
② Contact DATEL for availability of	other input voltage	ranges.					6.02			
③ A 200ns wide start convert pulse		•	ha	5	his is the time	e required hef	ore the A/D o	utnut data is	valid after	

③ A 200ns wide start convert pulse is used for all production testing.

⑤ This is the time required before the A/D output data is valid after the analog input is back within the specified range.

TECHNICAL NOTES

 Obtaining fully specified performance from the ADS-CCD1202 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 (14, 19, and 23) directly to a large *analog* ground plane beneath the package.

Bypass all power supplies, as well as the REFERENCE OUTPUT (pin 21), to ground with 4.7 μ F tantalum capacitors in parallel with 0.1 μ F ceramic capacitors. Locate the bypass capacitors as close to the unit as possible. If the user-installed offset and gain adjusting circuit shown in Figure 2 is used, also locate it as close to the ADS-CCD1202 as possible.

- ADS-CCD1202 achieves its specified accuracies without external calibration. If required, the device's small initial offset and gain errors can be reduced to zero using the input circuit of Figure 2. When using this circuit, or any similar offset and gaincalibration hardware, make adjustments following warmup. To avoid interaction, always adjust offset before gain.
- When operating the ADS-CCD1202 from ±12V supplies, do not drive external circuitry with the REFERENCE OUTPUT (pin 21). The reference's accuracy and drift specifications may not be met, and loading the circuit may cause accuracy errors within the converter.
- 4. A passive bandpass filter is used at the input of the A/D for all production testing.
- Applying a start pulse while a conversion is in progress (EOC = logic "1") initiates a new and inaccurate conversion cycle. Data for the interrupted and subsequent conversions will be invalid.

Table 1.	Zero an	d Gain	Adjust
----------	---------	--------	--------

Input Voltage	Zero Adjust	Gain Adjust
Range	+1/2 LSB	+FS – 1 1/2 LSB
0 to +10V	+1.2207mV	+9.99634V



CALIB在ATION PROCEDURE2MM"供应商

(Refer to Figures 2 and 3)

Any offset and/or gain calibration procedures should not be implemented until devices are fully warmed up. To avoid interaction, offset must be adjusted before gain. The ranges of adjustment for the circuit of Figure 2 are guaranteed to compensate for the ADS-CCD1202's initial accuracy errors and may not be able to compensate for additional system errors.

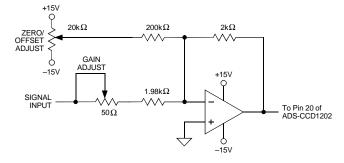


Figure 2. ADS-CCD1202 Calibration Circuit

All fixed resistors in Figure 2 should be metal-film types, and multi-turn potentiometers should have TCR's of 100ppm/°C or less to minimize drift with temperature. In many applications, the CCD will require an offset-adjust (black balance) circuit near its output and also a gain stage, presumably with adjust capabilities, to match the output voltage of the CCD to the input range of the AID. If one is performing a "system I/O calibration" (from light in to digital out), these circuits can be used to compensate for the relatively small initial offset and gain errors of the A/D. This would eliminate the need for the circuit shown in Figure 2.

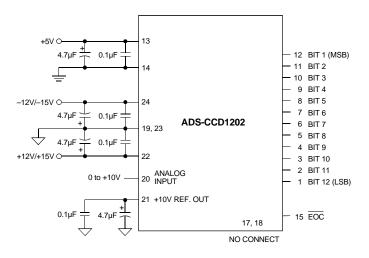


Figure 3. Typical ADS-CCD1202 Connection Diagram

A/D converters are calibrated by positioning their digital outputs exactly on the transition point between two adjacent digital output codes. This can be accomplished by connecting LED's to the digital outputs and adjusting until certain LED's "flicker" equally between on and off. Other approaches employ digital comparators or microcontrollers to detect when the outputs change from one code to the next. For the ADS-CCD1202, offset adjusting is normally accomplished at the point where all output bits are 0's and the LSB just changes from a 0 to a 1. This digital output transition ideally occurs when the applied analog input is +1/2LSB (+1.2207mV).

Gain adjusting is accomplished when all bits are 1's and the LSB just changes from a 1 to a 0. This transition ideally occurs when the analog input is at +full scale minus 1 1/2 LSB's (+9.99634V).

Offset Adjust Procedure

- 1. Apply a train of pulses to the START CONVERT input (pin 16) so the converter is continuously converting. If using LED's on the outputs, a 200kHz conversion rate will reduce flicker.
- 2. Apply +1.2207mV to the ANALOG INPUT (pin 20).
- 3. Adjust the offset potentiometer until the output bits are 0000 0000 00000 and the LSB flickers between 0 and 1.

Gain Adjust Procedure

- 1. Apply +9.99634V to the ANALOG INPUT (pin 20).
- 2. Adjust the gain potentiometer until all output bits are 1's and the LSB flickers between 1 and 0.

Table 2. ADS-CCD1202 Output Coding

Input Voltage	Unipolar	Digital Output			
(0 to +10V)	Scale	MSB LSB			
+9.9976	+FS – 1LSB	1111 1111 1111			
+7.5000	+3/4 FS	1100 0000 0000			
+5.0000	+1/2 FS	1000 0000 0000			
+2.5000	+1/4 FS	0100 0000 0000			
+0.0024	+1LSB	0000 0000 0001			
0	0	0000 0000 0000			

THERMAL REQUIREMENTS

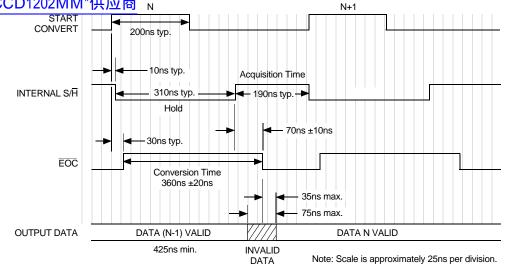
All DATEL sampling A/D converters are fully characterized and specified over operating temperature (case) ranges of 0 to $+70^{\circ}$ C and -55 to $+125^{\circ}$ C. All room-temperature (T_A = $+25^{\circ}$ C) production testing is performed without the use of heat sinks or forced-air cooling. Thermal impedance figures for each device are listed in their respective specification tables.

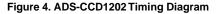
These devices do not normally require heat sinks, however, standard precautionary design and layout procedures should be used to ensure devices do not overheat. The ground and power planes beneath the package, as well as all pcb signal runs to and from the device, should be as heavy as possible to help 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. See page 1-183 of the DATEL Data Acquisition Components Catalog for more information on the HS Series. Request DATEL Application Note AN-8, "Heat Sinks for DIP Data Converters,"or contact DATEL directly, for additional information.



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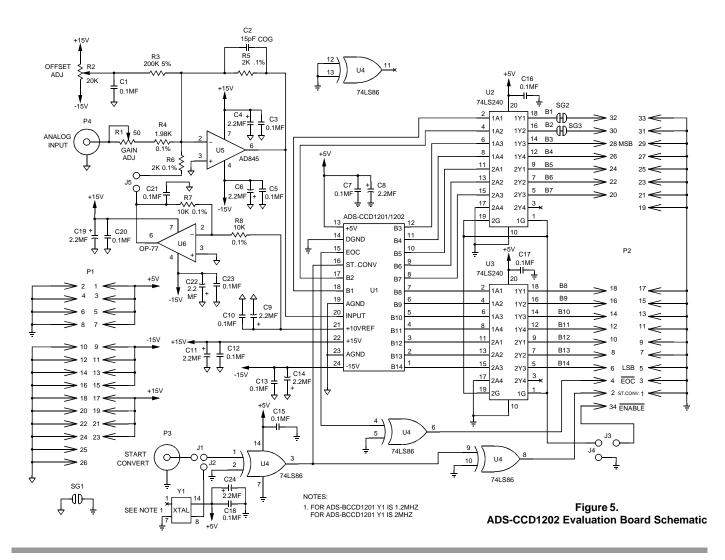




TIMING

The ADSCCD-1202 is an edge triggered device. A conversion is initiated by the rising edge of the start convert pulse and no additional external timing signals are required. The device does

not employ "pipeline" delays to increase its throughput rate. It does not require multiple start convert pulses to bring valid digital data to its output pins.





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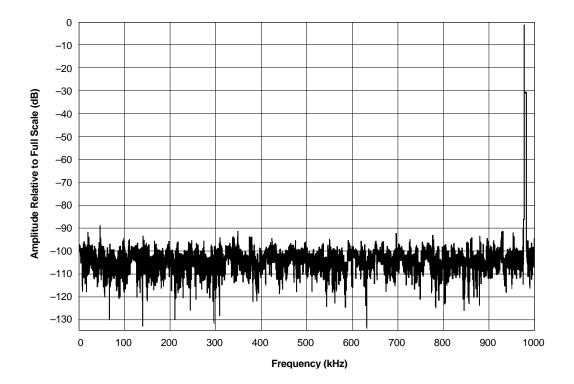
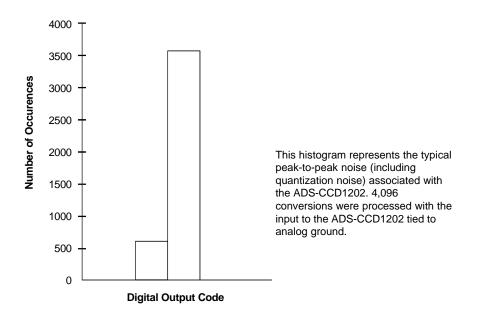
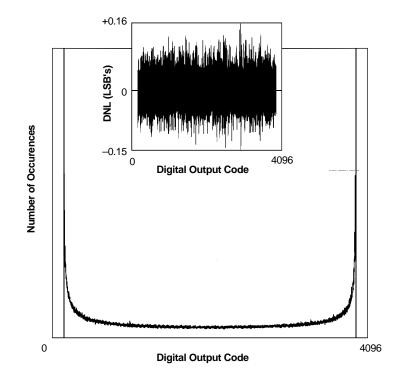


Figure 6. ADS-CCD1202 FFT (fin = 975kHz, fs = 2MHz, Vin = -0.5dB, 4,096 points)

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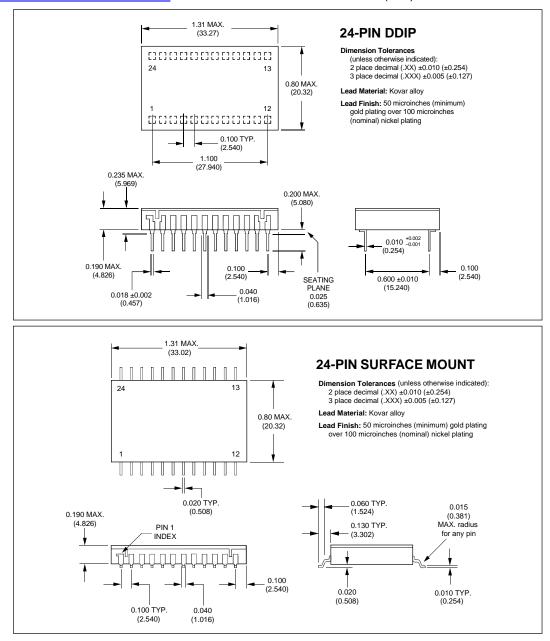








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ORDERING INFORMATION

Accessories

24 required.

HS-24

ADS-BCCD1202

OPERATING

MODEL NUMBER ADS-CCD1202MC ADS-CCD1202MM TEMP. RANGE

0 to +70°C -55 to +125°C

Unipolar (0 to +10V) Unipolar (0 to +10V)

ANALOG INPUT

Contact DATEL for availability of surface-mount packaging or high-reliability screening





DS-0288A

Evaluation Board (without ADS-CCD1202)

Heat Sink for ADS-CCD1201 models

Receptacles for pc board mounting can be ordered through

Amp Inc., part number 3-331272-8 (component lead socket),

10/96

DATEL, Inc. 11 Cabot Boulevard, Mansfield, MA 02048-1194 Tel: (508) 339-3000 / Fax: (508) 339-6356 For immediate assistance 1-800-233-2765

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