

LD120/121A

4 1/2-Digit A/D Converter Set

FEATURES

- 0.005% ± 1 Count Accuracy
- ± 200.0 mV and ± 2.000 V Ranges
- Auto-zero
- Auto-polarity
- Over and Under Range Outputs

BENEFITS

- High System Performance
- Single Resistor Programming
- Nulls Out Offsets
- Single Reference
- Easily Interfaced

APPLICATIONS

- High Accuracy Digital Voltmeters and Panel Meters
- Digital Scales and Thermometers
- μ P Data Acquisition Systems
- Scientific Instrumentation

DESCRIPTION

The LD120 and LD121A form a precision 4 1/2 digit A/D converter system for use in display and microprocessor based data acquisition applications. Based on Siliconix's "Quantized Feedback" technique, intrinsic features include auto-polarity, auto-zero, and ratiometric operation. Except for a stable reference, no critical components are required to achieve rated performance. The technique used offers superior linearity, normal mode rejection, and stability due to the simultaneous integration of the unknown input and the reference voltages. Unlike other conversion techniques, the integrator output voltage never represents more than 100 counts. Thus, critical, high resolution performance is not required of either the integrator or the comparator.

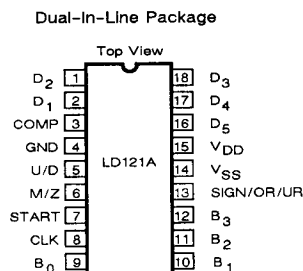
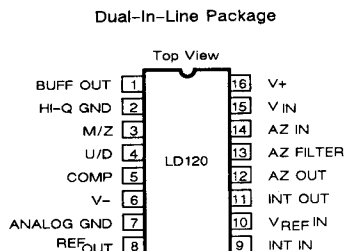
The LD120 analog processor is fabricated with a unique PMOS/Bipolar process. It contains all the necessary amplifiers, MOSFET switches, and switch driver circuits for the system. The reference voltage input is fully buffered in the LD120 to

eliminate the reference switch resistance as a source of error. All the amplifiers are internally compensated. The LD120 directly interfaces to the LD121A digital processor with no additional active components required.

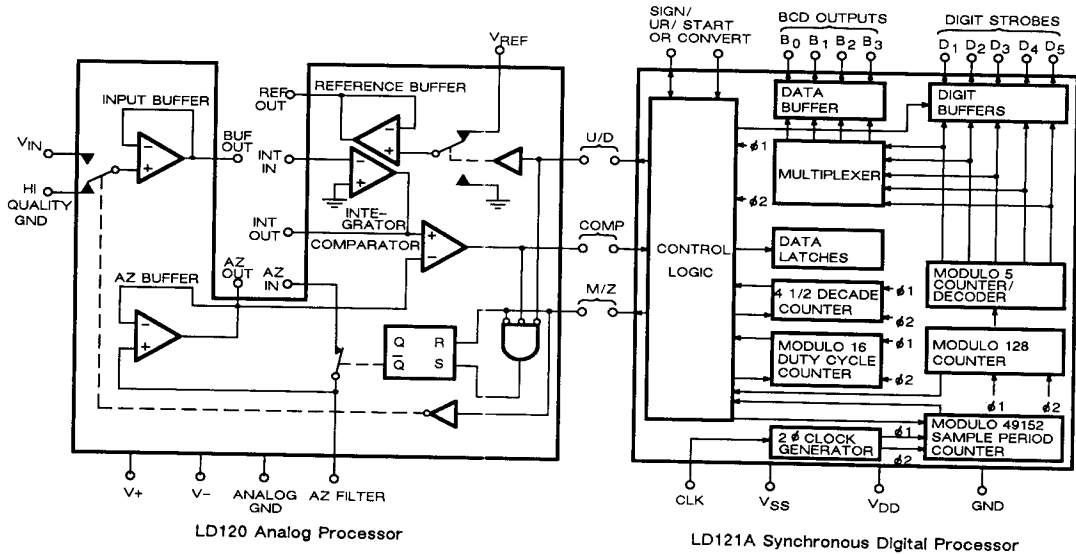
The LD121A synchronous processor contains all the digital circuitry for the quantized feedback system. Device outputs supply two overrange signals, underrange, sign and 4-1/2 digits of multiplexed BCD data. (All outputs are TTL compatible.) Overage is also indicated by blinking digit strobes above 20,000 counts. An input is provided to inhibit this feature at user option. Microprocessor controlled operation is simplified by a start conversion input that allows conversion-on-command.

Both devices are supplied in space saving 300 mil dual-in-line plastic packages for operation in the commercial, C suffix (0 to 70°C) temperature range.

PIN CONFIGURATION



FUNCTIONAL BLOCK DIAGRAM



SWITCH STATES ARE FOR A LOGIC "0" AT U/D AND M/Z INPUTS.

ABSOLUTE MAXIMUM RATINGS

V_{IN} (Pin 15, 2 LD120)	$V_- < V_{IN} < V_+$
I_{INPUT} (LD120)	± 1 mA
$V_+ - V_-$ (LD120)	32 V
$V_{SS} - V_{DD}$ (LD121A)	20 V
Any Pin (LD121A)	V_{DD} to $V_{SS} \pm 0.3$ V

V_{REF}	V_+
Operating Temperature	0 to 70°C
Storage Temperature	-65 to 125°C
Power Dissipation (Package) *	750 mW
* Device mounted with all leads welded or soldered to PC Board. Derated 6.3 mW/°C above 25°C.	

Not Recommended for New Designs

ELECTRICAL CHARACTERISTICS ^a									
PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V ₊ = 12 V V ₋ = V _{DD} = -12 V V _{SS} = 5 V	LIMITS				UNIT		
			1=25°C		C SUFFIX				
			TEMP	TYP ^d	MIN ^b	MAX ^b			
SYSTEM ^e									
Linearity		f _{CLOCK} = 163.84 kHz V _{REF} = 6.8 V	2 V Scale	1	± ¼	-1	1	Count	
			200 mV Scale	1	± ½	-2	2		
Noise ^f			2 V Scale	1	⅓		1		
			200 mV Scale	1	½		2		
Normal Mode Rejection Ratio	NMRR		f _L = 50 Hz or 60 Hz	1	40			dB	
				1	80				
Power Supply Rejection Ratio	PSRR			1	5		15	ppm/°C	
Gain T.C.				C _{STRG} = 1 μF R _{IN} ≤ 100 kΩ	1	1		5	Count
Zero Drift									

ELECTRICAL CHARACTERISTICS ^a						LD120 (LINEAR CIRCUIT)			
PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V ₊ = 12 V V ₋ = V _{DD} = -12 V V _{SS} = 5 V		LIMITS				UNIT	
				1=25°C		C SUFFIX			
				TEMP	TYP ^d	MIN ^b	MAX ^b		
INPUT BUFFER									
Analog Input Voltage	V _{ANALOG}		1		-5	5	V		
Output Source Current	I _{SOURCE}	V _{IN} = 2 V, Buff Out = 0 V	1	-100		-50	μA		
Output Sink Current	I _{SINK}	V _{IN} = -2 V, Buff Out = 0 V	1	800	400				
Input Current	I _{IN}	V _{IN} = ±2.8 V	1	2			pA		
Common-Mode Rejection Ratio	CMRR		1	-72			dB		
Input Current/ Input Voltage HIGH	I _{IH}	M/Z, U/D Inputs	V _{IN} = 2.0 V	1		20	μA		
Input Current/ Input Voltage LOW	I _{IL}		V _{IN} = 0.8 V	1		-100			

ELECTRICAL CHARACTERISTICS ^a			LD120 (LINEAR CIRCUIT) (Cont'd)					
PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V ₊ = 12 V V ₋ = V _{DD} = -12 V V _{SS} = 5 V	LIMITS				UNIT	
			1=25°C		C SUFFIX			
			TEMP	TYP ^d	MIN ^b	MAX ^b		
AZ BUFFER								
Output Source Current	I _{SOURCE}		1	-100				μA
Output Sink Current	I _{SINK}		1	800				
Offset Voltage	V _{OS}	V _{OUT} = 0 V	1		-50	50		mV
On Resistance ^g	r _{DS(ON)}	V _{STRG} = -4 V I _{DS} = 30 μA	1	6		20		kΩ
REFERENCE BUFFER								
Reference Buffer Source Current	I _{SOURCE}	V _{IN} (U/D IN) = 0.8 V V _O = 0 V	1	-800		-400		μA
Reference Buffer Sink Current	I _{SINK}	V _{IN} (U/D IN) = 2.0 V V _O = 2 V	1	100				
INTEGRATOR								
Integrator Source Current ^h	I _{SOURCE}	V _{IN} (INT. IN) = -100 mV V _O = 0 V	1	-100		-50		μA
Integrator Sink Current ^h	I _{SINK}	V _{IN} (INT. IN) = 100 mV V _O = 0 V	1	800	400			
Output Swing			1		-10	10		V
COMPARATOR								
Comparator Output Swing	V _{OUT}	R _L = 10 k to 5 V AZ Filter IN = 100 mV Integrator OUT = 0 V	1		-5			V
Comparator Offset Voltage	V _{OS}		1		-5	5		mV
SUPPLY								
Positive Supply Voltage	V ₊		1	12	9	15		V
Negative Supply Voltage	V ₋		1	-12	-15	-9		
Positive Supply Current	I ₊		1			3.5		mA
Negative Supply Current	I ₋		1		-3.5			

Not Recommended for New Designs

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ELECTRICAL CHARACTERISTICS ^a				LD121 (DIGITAL CIRCUIT)			
PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V ₊ = 12 V V ₋ = V _{DD} = -12 V V _{SS} = 5 V	LIMITS				UNIT
			1=25° C		C SUFFIX		
			TEMP	TYP ^d	MIN ^b	MAX ^b	
INPUTS							
Input Voltage HIGH	V _{INH}	Comparator Input Sign/OR/OR/Blink ⁱ Start, CLK IN	1		4		V
Input Voltage LOW	V _{INL}		1			0.5	
Input Current/ Input Voltage HIGH	I _{INH}	V _{IN} = 5 V (Sign/OR/OR ⁱ)	1	170		300	μA
Input Current/ Input Voltage LOW	I _{INL}	V _{IN} = 0 V (Start Convert, Clock)	1	-150	-400		
OUTPUTS							
Output Voltage HIGH	V _{OH}	Bit Lines Sign/OR/UR Digital Strokes	I _{OH} = -40 μA	1		2.4	V
Output Voltage LOW	V _{OL}		I _{OL} = 1.6 mA	1		0.6	
Output Voltage HIGH	V _{OH}	M/Z	I _{OH} = -150 μA	1		4	
Output Voltage LOW	V _{OL}		I _{OL} = 0.8 mA	1		0.6	
Output Voltage HIGH	V _{OH}	U/D	I _{OH} = -0.5 μA			4	
Output Voltage LOW	V _{OL}		I _{OL} = 0.8 mA			0.6	
DYNAMIC							
Start Convert ^j	t _p		1		20		μs
Clock Frequency	f _{CLOCK}	50% Duty Cycle	1		50	250	kHz
Rep. Rate (Strokes)		f _{CLOCK} ÷ 640	1		78	470	Hz
SUPPLY							
Positive Supply Voltage	V _{SS}	Range Over Which Functionality is Guaranteed	1	5	4.5	5.5	V
Negative Supply Voltage	V _{DD}		1	-12	-13.2	-10.8	
Positive Supply Current ^k	I _{SS}		1	14		25	mA
Negative Supply Current	I _{DD}		1	-14	-25		

ELECTRICAL CHARACTERISTICS ^a

NOTES:

- a. Refer to PROCESS OPTION FLOWCHART for additional information.
- b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.
- c. Guaranteed by design, not subject to production test.
- d. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- e. System parameters not directly tested.
- f. Bit width over which reading is stable 95% of the time.
- g. V_{STRG} must be more positive than -4 V.
- h. Reference source impedance must be less than $10\text{ k}\Omega$.
- i. Pin characteristic only during D4 strobe time.
- j. Minimum positive going pulse width to initiate conversion.
- k. All outputs disconnected.

Not Recommended for New Designs