LD120/121A
4 1/2-Digit A/D Converter Set

Siliconix incorporated

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
- µP 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.

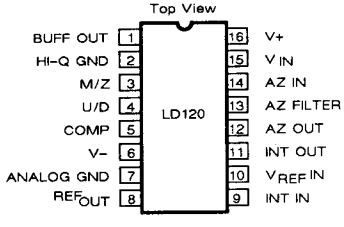
The LD121A synchronous processor contains all the digital circuitry for the quantized feedback system. Device outputs supply two overrange signals, underrange, sign and 4-1/2 digits of multiplexed BCD data. (All outputs are TTL compatible.) Overrange is also indicated by blinking digit strobes above 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

Dual-In-Line Package

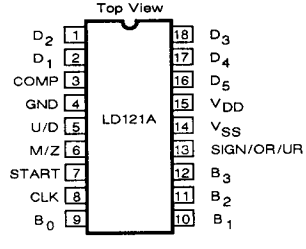
Top View



Order Number: LD120CJ

Dual-In-Line Package

Top View



Order Number: LD121ACJ

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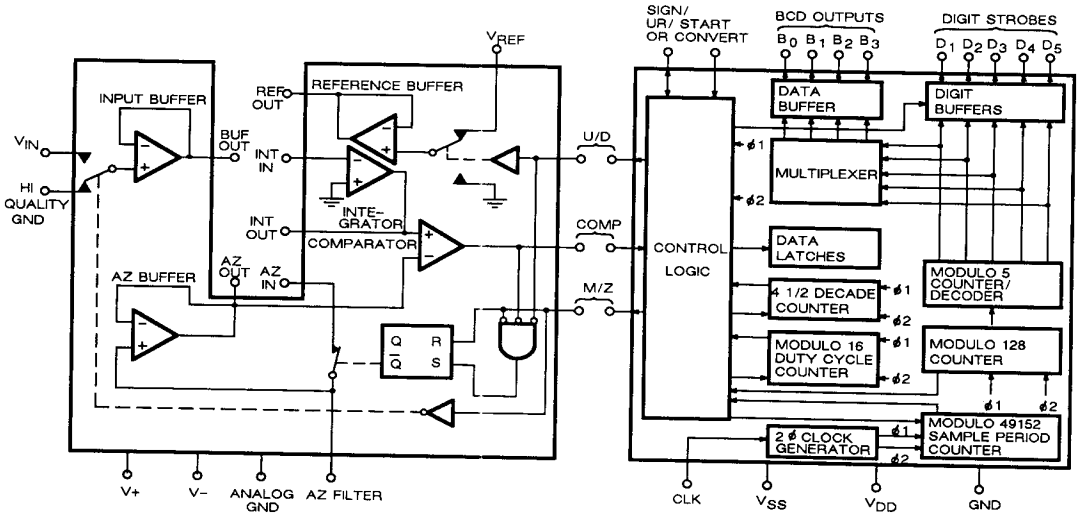
FUNCTIONAL BLOCK DIAGRAM



LD120 Analog Processor

LD121A Synchronous Digital Processor

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

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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} ±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.

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ELECTRICAL CHARACTERISTICS [a]								
PARAMETER	SYMBOL	Test Conditions Unless Otherwise Specified: V+ = 12 V, V- = V_{DD} = -12 V, V_{SS} = 5 V		LIMITS 1=25°C TEMP	LIMITS 1=25°C TYP [d]	LIMITS C SUFFIX MIN [b]	LIMITS C SUFFIX MAX [b]	UNIT
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
Power Supply Rejection Ratio	PSRR			1	80			
Gain T.C.				1	5		15	ppm/°C
Zero Drift			C_{STRG} = 1 µF, R_{IN} ≤ 100 kΩ	1	1		5	Count

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 1=25°C TEMP	LIMITS 1=25°C TYP [d]	LIMITS C SUFFIX MIN [b]	LIMITS C SUFFIX MAX [b]	UNIT
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		

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ELECTRICAL CHARACTERISTICS [a]			LD120 (LINEAR CIRCUIT) (Cont'd)				
		Test Conditions Unless Otherwise Specified: $V+ = 12$ V, $V- = V_{DD} = -12$ V, $V_{SS} = 5$ V	LIMITS				
			1=25°C		C SUFFIX		
PARAMETER	SYMBOL		TEMP	TYP [d]	MIN [b]	MAX [b]	UNIT
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		

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ELECTRICAL CHARACTERISTICS [a]				LD121 (DIGITAL CIRCUIT)				
				LIMITS				
		Test Conditions Unless Otherwise Specified: V_+ = 12 V, V_- = V_{DD} = −12 V, V_{SS} = 5 V		1=25°C		C SUFFIX		
PARAMETER	SYMBOL			TEMP	TYP [d]	MIN [b]	MAX [b]	UNIT
INPUTS								
Input Voltage HIGH	V_{INH}	Comparator Input Sign/UR/OR/Blink [l] 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/UR [l])		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 Strobes	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 (Strobes)		$f_{CLOCK} \div 640$		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		

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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 kΩ .
i. Pin characteristic only during D4 strobe time.
j. Minimum positive going pulse width to initiate conversion.
k. All outputs disconnected.