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NTE2054
Integrated Circuit
A/D Converter for 3–Digit Display

Description:

The NTE2054 is an I^2L monolithic Analog to Digital converter in a 16–Lead DIP type package that provides a 3–digit multiplexed BCD output. This device, when used with an NTE2032 BCD–to–Seven–Segment Decoder/Driver and a minimum of external parts, implements a complete 3–digit display.

Features:

- Dual–Slope A/D Conversion
- Multiplexed BCD Display
- Ultra–Stable Internal Band–Gap Voltage Reference
- Capable of Reading 99mV below GND with a Single Supply
- Differential Input
- Internal Timing – No External Clock Required
- Choice of Low–Speed (4Hz) or High–Speed (96Hz) Conversion Rate
- “Hold” Inhibits Conversion but Maintains Delay

Absolute Maximum Ratings:

DC Supply Voltage (between Pin7 and Pin14), V+ . . . . . +7V

Input Voltage (Pin10 or Pin11 to GND), V_I . . . . . ±15V

Device Dissipation (Up to T_A = +55°C), P_D 750mW
Derate Linearly Above T_A = +55°C . . . . . 7.9mW/°C

Operating Temperature Range, T_A . . . . . 0° to +75°C

Storage Temperature Range, T_{stg} . . . . . –65° to +150°C

Lead Temperature, T_L
(During Soldering, 1/16 ±1/32 in. (1.59 ±0.79mm) from case for 10sec Max) . . . . . +265°C

Electrical Characteristics: (T_A = +25°C, V+ = 5V, Zero pot centered, gain pot = 2.4kΩ unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Operating Supply Voltage Range	V+		4.5	5.0	5.5	V
Supply Current	I+	100kΩ to V+ on Pin3, Pin4, Pin5	–	–	17	mA
Input Impedance	Z_i		–	100	–	MΩ
Input Bias Current	I_{IB}	Pin10 and Pin11	–	–80	–	nA
Unadjusted Zero Offset		$V_{11} – V_{10}$ = 0V, Read Decoded Output	–12	–	+12	mV
Unadjusted Gain		$V_{11} – V_{10}$ = 900mV, Read Decoded Output	846	–	954	mV
Linearity		Note 1, Note 2	–1	–	+1	Count
Conversion Rate Slow Mode		Pin6 = Open or GND	–	4	–	Hz
Fast Mode		Pin6 = 5V	–	96	–	Hz
Conversion Control Voltage (Hold Mode) at Pin6			0.8	1.2	1.6	V
Common–Mode Input Voltage Range	V_{ICR}	Note 3, Note 4	–0.2	–	+0.2	V
BCD Sink Current at Pin1, Pin2, Pin15, and Pin16		$V_{BCD} \geq$ 0.5V, at Logic Zero State	0.4	1.6	–	mA
Digit Select Sink Current at Pin3, Pin4, and Pin5		$V_{Digit\ Select}$ = 4V at Logic Zero State	1.6	2.5	–	mA
Zero Temperature Coefficient		V_I = 0V, Zero Pot Centered	–	10	–	μV/°V
Gain Temperature Coefficient		V_I = 900mV, Gain Pot = 2.4kΩ	–	0.005	–	%/°C

Note 1. Apply zero volts across V_{11} to V_{10}. Adjust zero potentiometer to give 000mV reading. Apply 900mV to input and adjust gain potentiometer to give 900mV reading.

Note 2. Linearity is measured as a difference from a straight line drawn through zero and positive full scale. Limits do not include ±0.5 count bit digitizing error.

Note 3. For applications where negative Pin10 is not operated at Pin7 potential, a return path of not more than 100kΩ resistance must be provided for input bias currents.

Note 4. The common–mode input voltage above ground cannot exceed +0.2V if the full input signal range of 999mV is required at Pin11. That is, Pin11 may not operate higher than 1.2V positive with respect to GND or 0.2V negative with respect to GND. If the maximum input signal is less than 999mV, the common–mode input voltage may be raised accordingly.

Circuit Description:

The heart of the NTE2054 is the V/I converter and reference–current generator. The V/I converter converts the input voltage applied between Pin10 and Pin11 to a current that charges the integrating capacitor on Pin12 for a predetermined time interval. At the end of the charging interval, the V/I converter is disconnected from the integrated capacitor, and a band–gap reference constant–current source of opposite polarity is connected. The number of clock counts that elapse before the charge is restored to its original value is a direct measure of the signal induced current. The restoration is sensed by the comparator, which in turn latches the counter. The count is then multiplexed to the BCD outputs.

Circuit Description (Cont'd):

The timing for the NTE2054 is supplied by a 786Hz ring oscillator, and the input at Pin6 determines the sampling rate. A 5V input provides a high–speed sampling rate (96Hz), and grounding or floating Pin6 provides a low–speed (4Hz) sampling rate. When Pin6 is fixed at +1.2V (by placing a 12k resistor between Pin6 and the +5V supply) a "hold" feature is available. While the NTE2054 is in the hold mode, sampling continues at 4Hz but the display data are latched to the last reading prior to the application of the 1.2V. Removal of the 1.2V restores continuous display changes. Note, however, that the sampling rate remains at 4Hz.

The "EEE" or "–––" displays indicate that the range of the system has been exceeded in the positive or negative direction, respectively. Negative voltages to –99mV are displayed with the minus sign in the MSD. The BCD code is 1010 for a negative overrange (–––) and 1011 for a positive overrange (EEE).

Pin Connection Diagram