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NTE1549
Integrated Circuit
Dot/Bar Display Driver

Description:

The NTE1549 is a monolithic integrated circuit that senses analog voltage levels and drives ten LEDs, LCDs, or vacuum fluorescent displays, providing an electronic version of the popular VU meter. One pin changes the display from a bar graph to a moving dot display. LED current drive is regulated and programmable, eliminating the need for current limiting resistors. The whole display system can operate from a single supply as low 3V or as high as 25V.

This IC contains an adjustable voltage reference and an accurate ten–step voltage divider. The high impedance input buffer accepts signals down to ground and up to within 1.5V of the positive supply. Further, it needs no protection against inputs of ±35V. The input buffer drives 10 individual comparators referenced to the precision divider. Accuracy is typically better than 0.2dB.

Audio applications include average or peak level indicators, and power meters. Replacing conventional meters with an LED bar graph results in a faster responding, more rugged display with high visibility that retains the ease of interpretation of an analog display.

The NTE1549 is extremely easy to apply. A 12V full–scale meter requires only one resistor in addition to the ten LEDs. One more resistor program in addition to the full–scale anywhere from 1.2V to 12V independent of supply voltage. LED brightness is easily controlled with a single pot.

The NTE1549 is very versatile. The outputs can drive LCDs, vacuum fluorescents and incandescent bulb as well as LEDs of any color. Multiple devices can be cascaded for a dot or bar mode display for increased range and/or resolution.

Features:

- Fast responding electronic VU meter
- Drives LEDs, LCDs, or vacuum fluorescents
- Bar or dot display mode externally selectable by user
- Expandable to displays of 70dB
- Internal voltage reference from 1.2V to 12V
- Operates with a single supply of 3V to 25V
- Inputs operate down to ground
- Output current programmable from 1mA to 30mA
- Input withstands ±35V without damabe or false outputs
- Outputs are current regulated, open collectors
- Directly drives TTL or CMOS
- The internal 10–step divider is floating and can be referenced to a wide range of voltages.

Absolute Maximum Ratings:

Power Dissipation (Note 1) 625mW
Supply Voltage 25V
Voltage on Output Drivers 25V
Input Signal Overvoltage (Note 2) . . . . ±35V
Divider Voltage . . . . –100mV to V^+
Reference Load Current 10mA
Storage Temperature Range . . . . –55° to +150°C
Lead Temperature (Soldering, 10 seconds) . . . . +300°C

Note 1. The maximum junction temperature of the NTE1549 is 100°C. Devices must be derated for operation at elevated temperatures. Junction to ambient thermal resistance is 120°C/W.

Note 2. Pin 5 input current must be limited to ±3mA. The addition of a 39k resistor in series with Pin5 allows ±100V signals without damage.

Electrical Characteristics: (Note 3)

Parameter	Test Conditions	Min	Typ	Max	Unit
Comparators					
Offset Voltage, Buffer and First Comparator	0V ≤ V_{RLO} = V_{RHI} ≤ 12V, I_{LED} = 1mA	–	3	10	mV
Offset Voltage, Buffer and Any Other Comparator	0V ≤ V_{RLO} = V_{RHI} ≤ 12V, I_{LED} = 1mA	–	3	15	mV
Gain ($\Delta I_{LED}/\Delta V_{IN}$)	$I_{(REF)}$ = 2mA, I_{LED} = 10mA	3	8	–	mA/mV
Input Bias Current (At Pin5)	0V ≤ V_{IN} ≤ (V+ =1.5V)	–	25	100	nA
Input Signal Overvoltage	No Change in Display	–35	–	+35	V
Voltage Divider					
Divider Resistance	Total Pin6 to Pin4	8	12	17	kΩ
Relative Accuracy (Input Change Between Any Two Threshold Points)	–1dB ≤ V_{IN} ≤ 3dB, Note 4	0.75	1.0	1.25	dB
	–7dB ≤ V_{IN} ≤ –1dB, Note 4	1.5	2.0	2.5	dB
	–10dB ≤ V_{IN} ≤ –7dB, Note 4	2.5	3.0	2.5	dB
Absolute Accuracy	V_{IN} = 2, 1, 0, –1dB	–0.25	–	+0.25	dB
	V_{IN} = –3, –5dB	–0.5	–	+0.5	dB
	V_{IN} = –7, –10, –20dB	–1	–	+1	dB
Voltage Reference					
Output Voltage	0.1mA ≤ $I_{L(REF)}$ ≤ 4mA, V+ = V_{LED} = 5V	1.2	1.28	1.34	V
Line Regulation	3V ≤ V+ ≤ 18V	–	0.01	0.03	%/V
Load Regulation	0.1mA ≤ $I_{L(REF)}$ ≤ 4mA, V+ = V_{LED} = 5V	–	0.4	2.0	%
Output Voltage Change with Temperature	0° ≤ T_A ≤ +70°C, $I_{L(REF)}$ = 1mA, V+ = V_{LED} = 5V	–	1	–	%
Adjust Pin Current		–	75	120	mA

Note 3. Unless otherwise stated, all specifications apply with the following conditions:
$3V_{DC}$ ≤ V+ ≤ 20VDC; –0.015V ≤ V_{RLO} ≤ 12VDC; T_A = +25°C, I_L(REF) = 0.2mA, Pin9 connected to Pin3 bar mode.

3VDC ≤ V_{LED} ≤ V+; V_{REF}, V_{RHI}, V_{RLO} ≤ (V+ –1.5V); For higher power dissipations, pulse testing is used.

–0.015V ≤ V_{RHI} ≤ $12V_{DC}$; 0V ≤ V_{IN} ≤ V+ –1.5V

Note 4. Accuracy is measured referred to +3dB = +3dB = $+10.000V_{DC}$ at Pin5, with $+10.000V_{DC}$ at Pin6, and 0.000 V_{DC} at Pin4. At lower full–scale voltages, buffer and comparator offset voltage may add significant error.

Electrical Characteristics (Cont'd): (Note 3)

Parameter	Test Conditions	Min	Typ	Max	Unit
Output Drivers					
LED Current	$V+ = V_{LED} = 5V$, $I_{L(REF)} = 1mA$	7	10	13	mA
LED Current Difference (Between Largest and Smallest LED Currents)	$V_{LED} = 5V$, $I_{LED} = 2mA$	–	0.12	0.4	mA
	$V_{LED} = 5V$, $I_{LED} = 20mA$	–	1.2	3.0	mA
LED Current Regulation	$2V \le V_{LED} \le 17V$, $I_{LED} = 2mA$	–	0.1	0.25	mA
	$2V \le V_{LED} \le 17V$, $I_{LED} = 20mA$	–	1.0	3.0	mA
Dropout Voltage	$I_{LED(ON)} = 20mA$ @ $V_{LED} = 0.4mA$, $\Delta I_{LED} = 2mA$	–	–	1.5	V
Saturation Voltage	$I_{LED} = 2mA$, $I_{L(REF)} = 0.4mA$	–	0.15	0.4	V
Output Leakage, Each Collector	Bar Mode, Note 5	–	0.1	100	µA
Output Leakage, Pin10 through Pin18	Dot Mode, Note 5	–	0.1	100	µA
Output Leakage, Pin1		60	150	450	µA
Supply Current					
Standby Supply Current (All Outputs Off)	$V+ = +5V$, $I_{L(REF)} = 0.2mA$	–	2.4	4.2	mA
	$V+ = +20V$, $I_{L(REF)} = 1mA$	–	6.1	9.2	mA

Note 3. Unless otherwise stated, all specifications apply with the following conditions: $3V_{DC} \le V+ \le 20VDC$; $-0.015V \le V_{RLO} \le 12VDC$; $T_A = +25°C$, $I_L(REF) = 0.2mA$, Pin9 connected to Pin3 bar mode.

$3VDC \le V_{LED} \le V+$; V_{REF}, V_{RHI}, $V_{RLO} \le (V+ -1.5V)$; For higher power dissipations, pulse testing is used.

$-0.015V \le V_{RHI} \le 12V_{DC}$; $0V \le V_{IN} \le V+ -1.5V$

Note 5. Bar mode results when Pin9 is within 20mV of V+. Dot mode results when Pin9 is pulled at least 200mV below V+. LED #10 (Pin10 output current) is disabled if Pin9 is pulled 0.9V or more below V_{LED}.

Threshold Voltage: (Note 4)

dB	Volts			dB	Volts		
	Min	Typ	Max		Min	Typ	Max
3	9.985	10.000	10.015	–3 ±1/2	4.732	5.012	5.309
2 ±1/4	8.660	8.913	9.173	–5 ±1/2	3.548	3.981	4.467
1 ±1/4	7.718	7.943	8.175	–7 ±1	2.818	3.162	3.548
0 ±1/4	6.879	7.079	7.286	–10 ±1	1.995	2.239	2.512
–1 ±1/2	5.957	6.310	6.683	–20 ±1	0.631	0.708	0.794

Note 4. Accuracy is measured referred to +3dB = +3dB = $+10.000V_{DC}$ at Pin5, with $+10.000V_{DC}$ at Pin6, and 0.000 V_{DC} at Pin4. At lower full–scale voltages, buffer and comparator offset voltage may add significant error.

Pin Connection Diagram