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NTE1508
Integrated Circuit
10–Step Dot/Bar Display Driver for Linear Scale

Description:

The NTE1508 is a monolithic integrated circuit in an 18–Lead DIP type package that senses analog voltage levels and drives 10 LEDs, providing a linear analog display. A single pin changes the display from a moving dot to a bar graph. Current drive to the LEDs is regulated and programmable, eliminating the need for resistors. This feature is one that allows operation of the whole system from less than 3V.

The circuit contains its own adjustable reference and accurate 10–step voltage divider. The low–bias–current input buffer accepts signals down to GND, or V–, yet needs no protection against inputs of 35V above or below GND. The buffer drives 10 individual comparators referenced to the precision divider. Indication non–linearity can thus be held typically to 1/2%, even over a wide temperature range.

Versatility was designed into the NTE1508 so that controller, visual alarm, and expanded scale functions are easily added on to the display system. The circuit can drive LEDs of many color, or low–current incandescent lamps. Many NTE1508s can be “chained” to form displays of 20 to over 100 segments. Both ends of the voltage divider are externally available so that 2 drivers can be made into a zero–center meter.

The NTE1508 is very easy to apply as an analog meter circuit. A 1.2V full–scale meter requires only 1 resistor and a single 3V to 15V supply in addition to the 10 display LEDs. If the 1 resistor is a pot, it becomes the LED brightness control

When in the dot mode, there is a small amount of overlap or “fade” (about 1mV) between segments. This assures that at no time will all LEDs be “OFF”, and thus any ambiguous display is avoided. Various novel displays are possible.

Much of the display flexibility derives from the fact that all outputs are individual, DC regulated currents. Various effects can be achieved by modulating these currents. The individual outputs can drive a transistor as well as a LED at the same time, so controller functions including “staging” control can be performed. The NTE1508 can also act as a programmer, or sequencer.

Features:

- Drives LEDs, LCDs or vacuum fluorescents
- Bar or dot display mode externally selectable by user
- Expandable to displays of 100 steps
- Internal voltage reference from 1.2V to 12V
- Operates with single supply of less than 3V
- Inputs operate down to GND
- Output current programmable from 2 to 30mA
- No multiplex switching or interaction between outputs
- Input withstands ±35V without damage or false outputs
- LED driver outputs are current regulated, open–collectors
- Outputs can interfere with TTL or CMOS logic
- The internal 10–step divider is floating and can be referenced to a wide range of voltages

Absolute Maximum Ratings:

Power Dissipation (Note 1) 1365mW
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 (During soldering, 10sec) . . . . . +260°C

Note 1. The maximum junction temperature of the NTE1508 is +100°C. Device must be derated for operation at elevated temperatures. Junction to ambient thermal resistance is 55°C/W.

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

Electrical Characteristics: (Note 2, unless otherwise specified, all specifications apply with the following conditions:

$3V_{DC} \le V+ \le 20V_{DC}$
$3V_{DC} \le V_{LED} \le V+$
$-0.015V \le V_{RLO} \le 12V_{DC}$
$-0.015V \le V_{RHI} \le 12V_{DC}$
$V_{REF}, V_{RHI}, V_{RLO} \le (V+ - 1.5V)$
$0V \le V_{IN} \le V+ - 1.5V$
T_A +25°C, $I_{L(REF)}$ = 0.2mA,
V_{LED} = 3V, Pin9 connected to Pin3 (Bar Mode)

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

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

Electrical Characteristics (Cont'd): (Note 2, unless otherwise specified, all specifications apply with the following conditions:

$3V_{DC} \le V+ \le 20V_{DC}$ $V_{REF}, V_{RHI}, V_{RLO} \le (V+ -1.5V)$
$3V_{DC} \le V_{LED} \le V+$ $0V \le V_{IN} \le V+ -1.5V$
$-0.015V \le V_{RLO} \le 12V_{DC}$ T_A +25°C, $I_{L(REF)}$ = 0.2mA,
$-0.015V \le V_{RHI} \le 12V_{DC}$ V_{LED} = 3V, Pin9 connected to Pin3 (Bar Mode)

Parameter	Test Conditions		Min	Typ	Max	Unit
Output Drivers (Cont'd)						
Dropout Voltage	$I_{LED(ON)}$ = 20mA, V_{LED} = 5V, ΔI_{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 4		–	0.1	10	µA
Output Leakage	Dot Mode, Note 4	Pin10 to Pin18	–	0.1	10	µA
		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 4. Bar mode results when Pin9 is within 20mV of V+. Dot mode results when Pin9 is pulled at least 200mV below V+ or left open circuit. LED No. 10 (Pin10 output current) is disabled if Pin9 is pulled 0.9V or more below V_{LED}.

Pin Connection Diagram