Dot and Bar-Graph Display Generators

GENERAL DESCRIPTION

The XR-2279 is a 12 point logarithmic dot or bar-graph generator/LED driver. The device compares an input signal with an adjustable reference and graphically displays the results. Since LED driving current is provided by on board adjustable current sources, no current limiting resistors are required. A special feature of the XR-2279 is the four highest outputs sink one half the current of the lower eight; this allows equivalent brightness with red and green mixed displays.

Dot or bar mode selection is provided. The twelve output levels are in 3 dB steps from −27 dB to +6 dB. The reference point is externally adjustable.

FEATURES

Direct LED Interface
Constant Three dB/Step Logarithmic Scale
External Dot/Bar Mode Select for Dot/Bar-Graph Formats
Adjustable Output Current Levels
Current Source Outputs

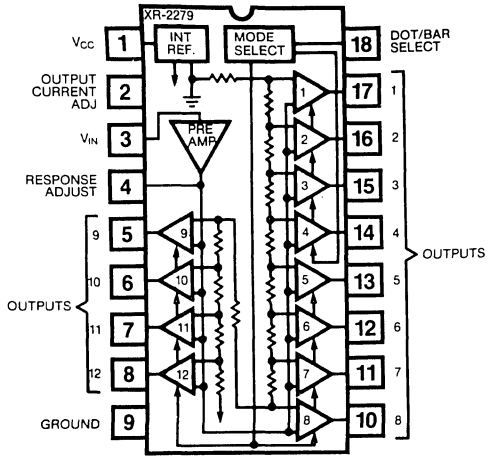
APPLICATIONS

Bar Graph Display Generator
Moving-dot Display Generator
Logarithmic Level Indicator
Sequential Level Indicator

ABSOLUTE MAXIMUM RATINGS

Power Supply	15V
Power Dissipation	625 mW
Derate Above 25°C	5 mW/°C
Operating Temperature Range	0°C to +75°C
Storage Temperature Range	−65°C to +150°C

FUNCTIONAL BLOCK DIAGRAM



ORDERING INFORMATION

Part Number	Package	Operating Temperature
XR-2279CP	Plastic	0°C to +70°C

SYSTEM DESCRIPTION

The XR-2279 is a 12 point logarithmic level detector circuit designed for direct interfacing to light emitting diode (LED) moving-dot or bar-graph displays. The circuit is comprised of an input buffer amplifier and 12 comparators which are biased from an internal voltage reference. Each comparator provides a high impedance current source output which are all very closely matched and simultaneously adjustable with a single external resistor. A control signal applied to the mode select Pin 18 determines whether the display is driven in a moving-dot or bar-graph format.

The circuit provides 12 discrete outputs for an input level range of −27 dB to +6 dB, referenced to an internally set zero dB level, typically 0.2 V_{RMS}. Each step represents 3 dB, and the reference level is adjustable.

The upper four outputs, 9-12 (see Equivalent Schematic Diagram), are internally set to provide one-half the current out as outputs 1-8. This is for driving red LEDs (as over-range indicators) which require less current than other colors.

XR-2279

ELECTRICAL CHARACTERISTICS

Test Conditions: V_{CC} = 12 Volts, T_A = 25°C, unless otherwise specified. (See Test Circuit of Figure 2.)

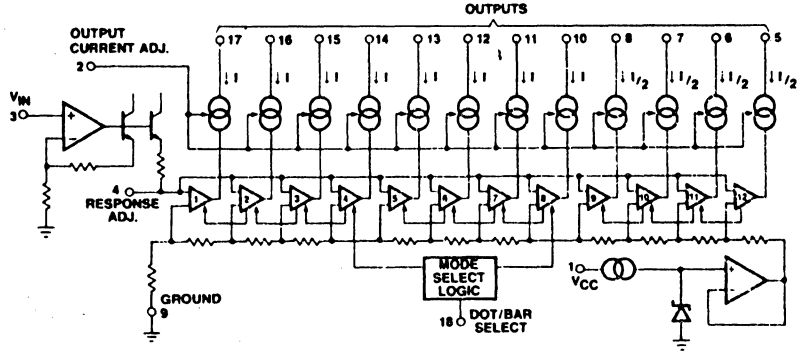
PARAMETERS	XR-2279 MIN	XR-2279 TYP	XR-2279 MAX	UNITS	CONDITIONS
Supply Voltage	10	12	14	V_{DC}	$V_{F(LED)}$ = 2V
Supply Current		5	10	mA	V_{IN} = OV
Output Current					R_2 = 27KΩ
Outputs 1 through 8	12	15	18	mA	Measured at Pins 10 through 17
Outputs 9 through 12	6	8	10	mA	Measured at Pins 5 through 8
Output Current Matching					R_2 = 27KΩ
Outputs 1 through 8	−2.0		+2.0	mA	Measured at Pins 10 through 17
Outputs 9 through 12	−1.0		+1.0	mA	Measured at Pins 5 through 8
Maximum Drive Current					R_2 varied - see Figure 4
Outputs 1 through 8			22	mA	Measured at Pins 10 through 17
Outputs 9 through 12			11	mA	Measured at Pins 5 through 8
Input Voltage for 0 dB Output	0.10	0.20	0.25	V_{RMS}	0 dB Output Threshold
Input Current		50		nA	Measured at Pin 3
Outputs					
Output 1 (Pin 7)		−27		dB	See Note 1
Output 2 (Pin 16)	−25.5	−24.0	−22.5	dB	
Output 3 (Pin 15)	−22.5	−21.0	−19.5	dB	
Output 4 (Pin 14)	−19.5	−18.0	−16.5	dB	
Output 5 (Pin 13)	−16.5	−15.0	−13.5	dB	
Output 6 (Pin 12)	−13.5	−12.0	−10.5	dB	
Output 7 (Pin 11)	−10.5	−9.0	−7.5	dB	
Output 8 (Pin 10)	−7.0	−6.0	−5.0	dB	
Output 9 (Pin 5)	−4.0	−3.0	−2.0	dB	
Output 10 (Pin 6)		0		dB	See Note 1
Output 11 (Pin 7)	+2.0	+3.0	+4.0	dB	
Output 12 (Pin 8)	+4.5	+6.0	+7.5	dB	

Note 1:

Determine exact value of input voltage to produce zero dB output. This is done by increasing the ac input signal amplitude until Output 10 (Pin 6) begins conduction.

Reduce input voltage level to −27 dB referenced to the input level of Note 1. Adjust R_1 until Output 1 (Pin 17) begins conduction.

EQUIVALENT SCHEMATIC DIAGRAM



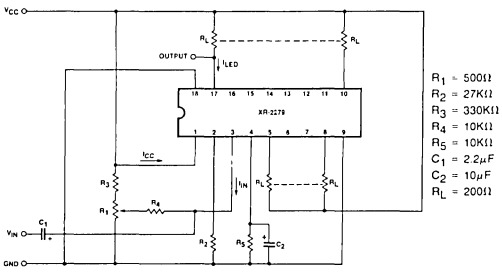


Figure 2. Generalized Test Circuit

PRINCIPLES OF OPERATION

As shown in the equivalent circuit schematic, the circuit is comprised of 12 voltage comparators with current source outputs. One input in each of the comparators is connected to a common voltage line. The input voltage, V_{IN}, is applied to this signal line through a buffer amplifier. The remaining input of each of the comparators is biased from an internal resistor ladder connected to a voltage reference on the IC chip. Thus, each of the 12 ladder taps corresponds to the particular output thresholds, listed as outputs one through twelve, in the electrical characteristics.

As the input voltage applied to the device is increased, each of the 12 comparators in the chip changes state sequentially at the time the input signal levels reach their respective threshold levels. The output currents of the last four outputs (Pins 5 through 8) are set at one-half the current output of the first eight outputs. This is done to minimize power dissipation since the last four outputs normally drive red LEDs to indicate "over-range" condition. The red LEDs are normally more efficient than other colors and require approximately one-half as much current for the same brightness.

Figure 3 shows the typical output current waveforms for operating in the moving-dot mode. The mode of operation is selected by the logic state at Pin 18. If this pin is grounded, the output display is in the moving-dot format where only one of the current outputs is active at any one time, depending on the input signal level (see Figure 3(b)).

If Pin 18 is left an open circuit, then the IC operates as a bar-graph display generator. In this mode of operation, the external LEDs are connected in series, in groups of four to minimize power dissipation.

The outputs of the comparators, (4), (8), and (12), continue conducting in this manner as long as the voltage level is above the respective threshold points.

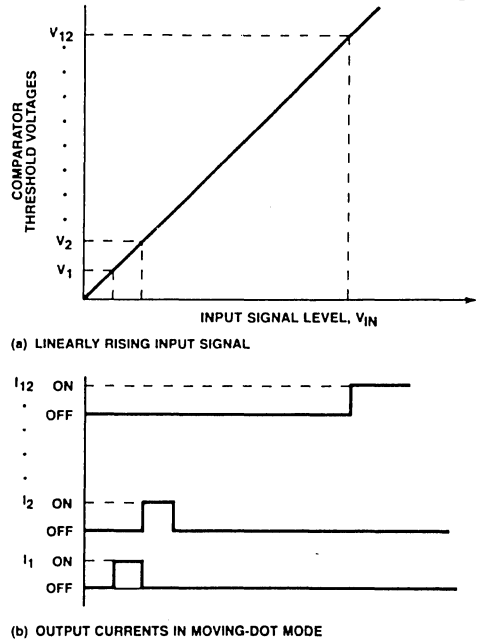


Figure 3. Typical Output Waveforms in Moving-Dot Display Mode

EXTERNAL ADJUSTMENTS

Output Brightness Adjustment

The output current level for each of the 12 outputs is controlled by an external current setting resistor, R_2, ($R_2 \geq 20$ kΩ) connected from Pin 2 to Ground. Figure 4 shows the available output drive current, I_{LED}, as a function of R_2.

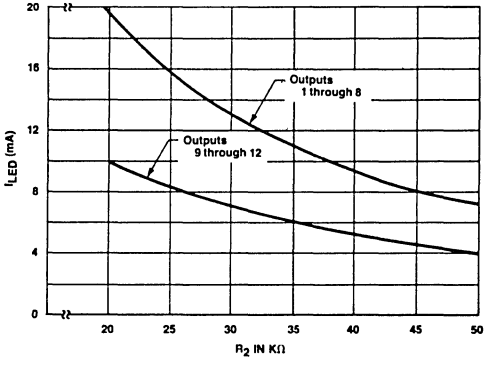


Figure 4. Output Drive Current as a Function of Current Setting Resistor, R_2

Response Adjustment

Transient response of the circuit is adjusted by an external resistor, R_5, and capacitor, C_2, connected from Pin 4 to ground. Typical component values for audio frequency applications, from 20 Hz to 20 kHz, are: R_5 = 10 kΩ and C_2 = 10 μF. The internal impedance at Pin 4 is approximately 100 ohms. C_2 functions as a holding capacitor of the internal peak rectifier circuit, with R_5 controlling its decay time.

Scale Adjustment

The output thresholds for the XR-2279 are measured relative to an internal zero dB reference level. Thus, for a given input signal dynamic range, each circuit must be calibrated with respect to the zero dB reference level setting. This calibration is performed by adjusting the potentiometer, R_1, shown in Figure 2, with an audio frequency ac signal applied to the circuit in two steps, as follows:

Step 1: Determine exact value of input voltage to produce zero dB output. This is done by increasing the ac input signal amplitude until Output 10 (Pin 7) begins conduction.

Step 2: Reduce input voltage level to −27 dB referenced to the input level of Step 1. Adjust R_1 until Output 1 (Pin 7) begins conduction.

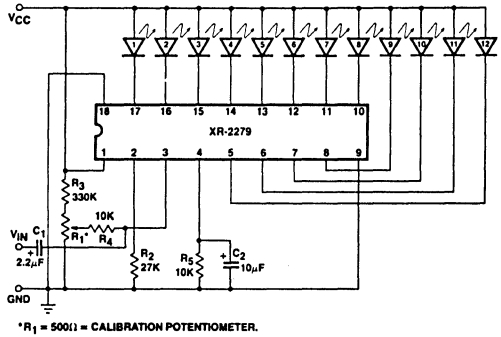


Figure 5. Circuit Connection for Moving-Dot Display Generation

MOVING-DOT DISPLAY

Figure 5 shows the basic connection of the XR-2279 as a moving-dot display generator and driver. In this mode of operation pin 18 is connected to ground. Increasing the voltage at the input will cause each one of the 12 LEDs to turn on, one at a time, at the appropriate input level, and thus generate a moving dot of light. Output waveforms for this mode are shown in Figure 3(b).

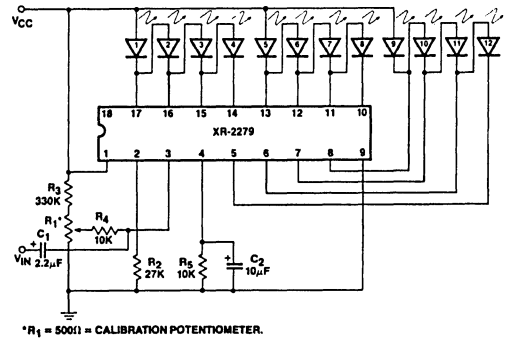


Figure 6. Circuit Connection for Bar-Graph Display Generation

will turn on and stay on as the input signal amplitude is increased as long as the input voltage stays above the threshold level corresponding to that particular output.

AUDIO LEVEL INDICATOR

Figure 7 shows a complete audio level indicator system made up of the XR-2279 Display Generator and an adjustable gain amplifier. For a given dynamic range of the input audio voltage, V_A, the potentiometer R_6 is used to set the gain of the input amplifier which is adjusted to give the desired zero dB output level from the display generator IC. The potentiometer R_1 is then adjusted to set the lowest output level; i.e., the −27 dB level. The display output format can be either the moving-dot or the bar-graph type, by choosing the LED interconnections and the logic signal applied to Pin 18.

BAR-GRAPH DISPLAY

Figure 6 shows the basic circuit connection for the XR-2279 as a bar-graph display generator and driver. Note that in this mode of operation the 12 LEDs are connected in series in three groups of four LEDs, and the mode-select terminal (Pin 18) is left an open circuit. Each LED

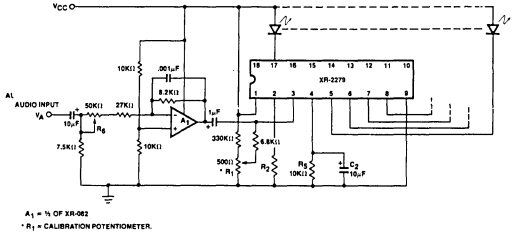


Figure 7. Typical Audio Level Indicator System Using the XR-2279.