HEWLETT PACKARD

101 Element Bar Graph Array

Technical Data

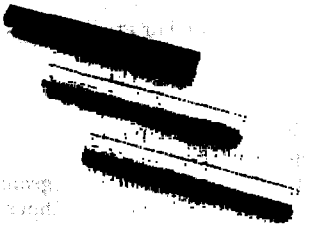
HDSP-8820
HDSP-8825
HDSP-8835

Features

- **High Resolution (1%)**
- **Excellent Element Appearance**
  Wide, Recognizable Elements
  Matched LEDs for Uniformity
  Excellent Element Alignment
- **Single-in-line Package Design**
  Sturdy Leads on Industry Standard 2.54 mm (0.100 in.) Centers
  Environmentally Rugged Package
  Common Cathode Configuration
- **Low Power Requirements**
  1.0 mA Average per Element at 1% Duty Cycle
- **Support Electronics**
  Easy Interface with Microprocessors

Applications

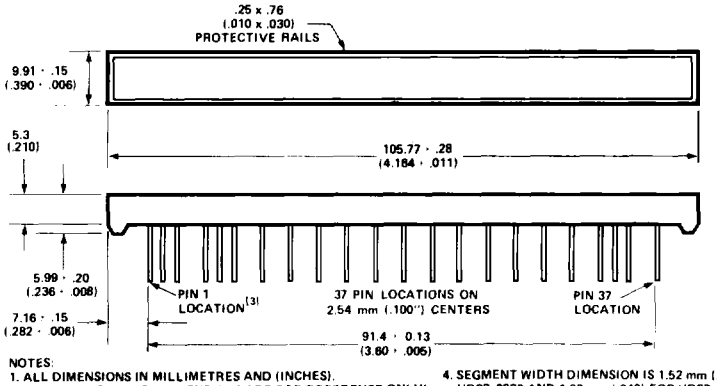
- **Industrial Process Control Systems**
- **Edgewise Panel Meters**
- **Instrumentation**
- **Position Indicators**
- **Fluid Level Indicators**



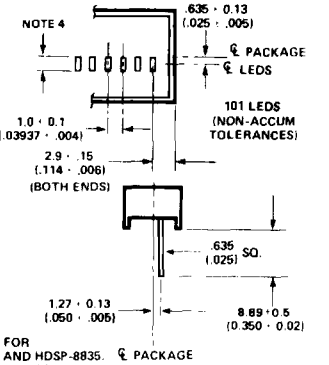
Description

The HDSP-88XX series is a family of 101-element LED linear arrays designed to display information in easily recognizable bar graph or position indicator form. The HDSP-8820, utilizing red GaAsP LED chips assembled on

Package Dimensions[1, 2]



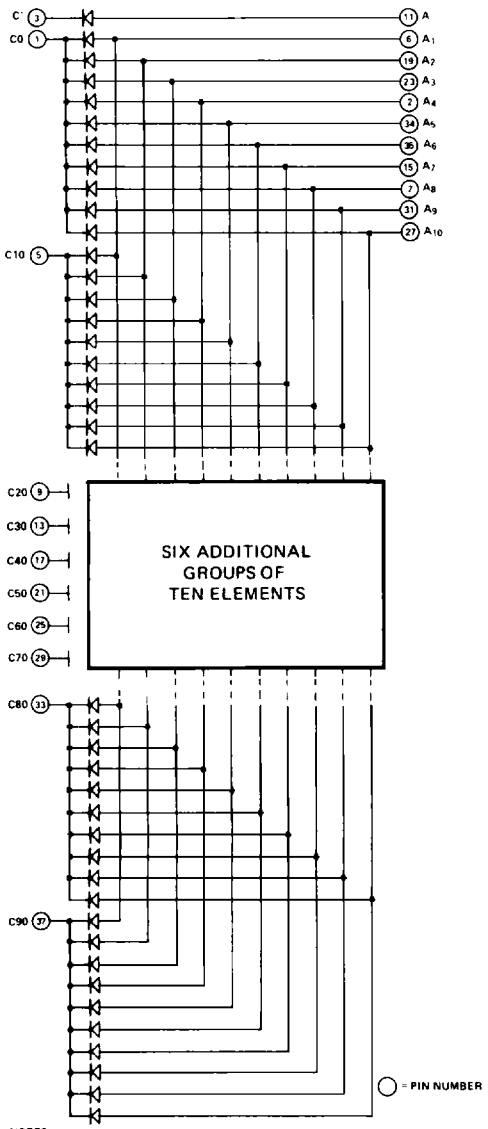
MAGNIFIED ELEMENT DESCRIPTION



NOTES:
1. ALL DIMENSIONS IN MILLIMETRES AND (INCHES).
2. ALL UNTOLERANCED DIMENSIONS ARE FOR REFERENCE ONLY.
3. PIN 1 IDENTIFIED BY INK DOT ADJACENT TO LEAD AND HP PART NUMBER ON BACK OF PACKAGE.
4. SEGMENT WIDTH DIMENSION IS 1.52 mm (.060) FOR HDSP-8820 AND 1.02 mm (.040) FOR HDSP-8825 AND HDSP-8835. ALL OTHER DIMENSIONS INCLUDING CENTERLINE OF LEDs AND PACKAGE ARE IDENTICAL ON ALL 3 DEVICES.

a PC board and enclosed in a red polycarbonate cover with an epoxy backfill seal, has 1.52 mm (0.060 inch) wide segments. The HDSP-8825 and HDSP-8835 are high efficiency red and high performance green respectively, each with a 1.02 mm (0.040 inch) segment width. The HDSP-8825 and HDSP-8835 have a clear polycarbonate lens. Mechanical considerations and pin-out are identical among all 3 devices. The common cathode chips are addressed via 22 single-in-line pins extending from the back side of the package.

Internal Circuit Diagram[5,6]



NOTES:
5. ELEMENT LOCATION NUMBER = COMMON CATHODE NUMBER + ANODE NUMBER. FOR EXAMPLE, ELEMENT 83 IS OBTAINES BY ADDRESSING C80 AND A3
6. A' AND C' ARE ANODE AND CATHODE OF ELEMENT ZERO.

Device Pin Description

PIN LOCATION	FUNCTION
1	C0
2	A4
3	C'(6)
4	No Pin
5	C10
6	A1
7	A8
8	No Pin
9	C20
10	No Pin
11	A'(6)
12	No Pin
13	C30
14	No Pin
15	A7
16	No Pin
17	C40
18	No Pin
19	A2
20	No Pin
21	C50
22	No Pin
23	A3
24	No Pin
25	C60
26	No Pin
27	A10
28	No Pin
29	C70
30	No Pin
31	A9
32	No Pin
33	C80
34	A5
35	A6
36	No Pin
37	C90

Absolute Maximum Ratings

Parameter	HDSP-8820	HDSP-8825	HDSP-8835
Average Power per Element (T_A = 25° C)	15 mW	20 mW	20 mW
Peak Forward Current per Element (T_A = 25° C) [7] (Pulse Width ≤ 300 μs)	200 mA	150 mA	150 mA
Average Forward Current per Element (T_A = 25° C) [8]	7 mA	5 mA	5 mA
Operating Temperature Range	-40° to +85° C	-40° to +85° C	-40° to +85° C
Storage Temperature Range	-40° to +85° C	-40° to +85° C	-40° to +85° C
Reverse Voltage per Element or DP	5.0 V	5.0 V	5.0 V
Lead Solder Temperature 1.59 mm [1.16 inch] below seating plane [9]	260° C for 3 sec.	260° C for 3 sec.	260° C for 3 sec.

Notes:

7. See Figures 1 and 2 to establish pulsed operating conditions.
8. Derate maximum average forward current above T_A = 70° C at 0.16 mA/°C/Element for the HDSP-8820 and 0.11 mA/°C/Element for the HDSP-8825 and HDSP-8835. See Figures 3 and 4.
9. Clean only in water, Isopropanol, Ethanol, Freon TF or TE (or equivalent) and Genesolv DI-15 or DE-15 (or equivalent). See mechanical section of this data sheet for information on wave soldering conditions.

Electrical/Optical Characteristics at T_A = 25°C

RED HDSP-8820

Parameter	Symbol	Units	Min.	Typ.	Max.	Test Conditions
Time averaged Luminous Intensity per Element (Unit average) [10]	I_v	μcd	8	20		100 mA Pk.: 1 of 110 Duty Factor
Peak Wavelength	λ_{PEAK}	nm		655		
Dominant Wavelength [11]	λ_d	nm		640		
Forward Voltage per Element	V_F	V		1.7	2.1	I_F = 100 mA
Reverse Voltage per Element	V_R	V	3.0			I_R = 100 μA
Temperature Coefficient V_F per Element	ΔV_F/° C	mV/° C		-2.0		
Thermal Resistance LED Junction-to-Pin	$R\Theta_{J\ PIN}$	° C/W/ LED		700		

HIGH EFFICIENCY RED HDSP-8825

Parameter	Symbol	Units	Min.	Typ.	Max.	Test Conditions
Time averaged Luminous Intensity per Element (Unit average) [10]	I_v	μcd	60	175		100 mA Pk.: 1 of 110 Duty Factor
Peak Wavelength	λ_{PEAK}	nm		635		
Dominant Wavelength [11]	λ_d	nm		626		
Forward Voltage per Element	V_F	V		2.3	3.1	I_F = 100 mA
Reverse Voltage per Element	V_R	V	3.0			I_R = 100 μA
Temperature Coefficient V_F per Element	ΔV_F/° C	mV/° C		-2.0		
Thermal Resistance LED Junction-to-Pin	$R\Theta_{J\ PIN}$	° C/W/ LED		1000		

Electrical/Optical Characteristics at T_A = 25°C (continued)

HIGH PERFORMANCE GREEN HDSP-8835

Parameter	Symbol	Units	Min.	Typ.	Max.	Test Conditions
Time Averaged Luminous Intensity per Element (Unit average)[10]	I_V	μcd	70	175		100 mA Pk.: 1 of 110 Duty Factor
Peak Wavelength	λ_{PEAK}	nm		568		
Dominant Wavelength[11]	λ_d	nm		574		
Forward Voltage per Element	V_F	V		2.3	3.1	I_F = 100 mA
Reverse Voltage per Element	V_R	V	3.0			I_F = 100 μA
Temperature Coefficient V_F per Element	ΔV_F/°C	mV/°C		-2.0		
Thermal Resistance LED Junction-to-Pin	$R\theta_{J-PIN}$	°C/W/ LED		1000		

Notes:

10. Operation at peak currents of less than 100 mA may cause intensity mismatch. Consult factory for low current operation.
11. The dominant wavelength, λd, is derived from the CIE chromaticity diagram and is the single wavelength which defines the color of the device.

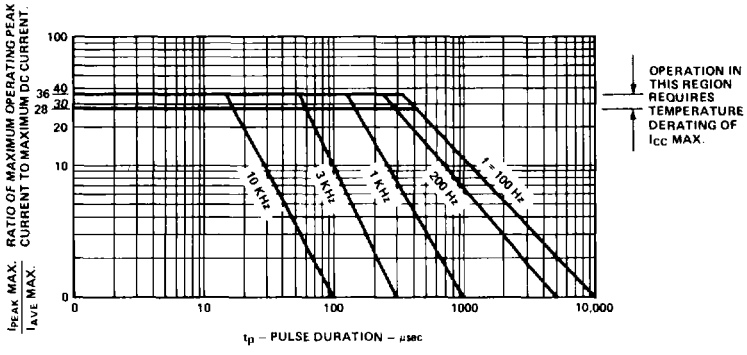


Figure 1. Maximum Tolerable Peak Current vs. Pulse Duration HDSP-8820.

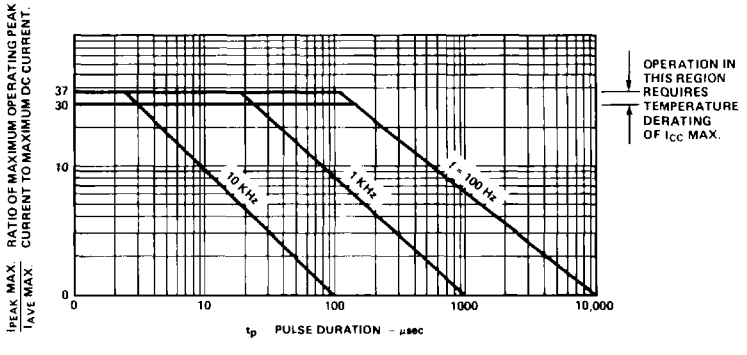


Figure 2. Maximum Tolerable Peak Current vs. Pulse Duration HDSP-8825 and HDSP-8835.

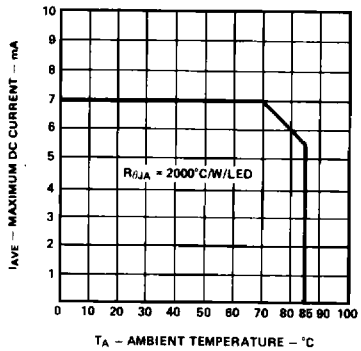


Figure 3. Maximum Allowable D.C. Current per LED vs. Ambient Temperature. Deratings Based on Maximum Allowable Thermal Resistance, LED Junction-to-Ambient on a per LED Basis. T_{JMAX} = 115° C HDSP-8820.

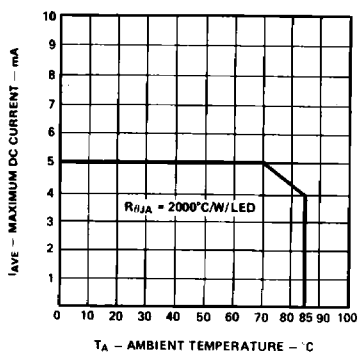


Figure 4. Maximum Allowable D.C. Current per LED vs. Ambient Temperature. Deratings Based on Maximum Allowable Thermal Resistance, LED Junction-to-Ambient on a per LED Basis. T_{JMAX} = 115° C HDSP-8825/ HDSP-8835.

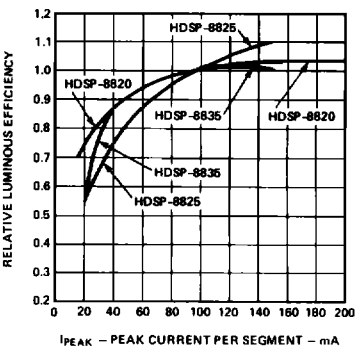


Figure 5. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Segment Current.

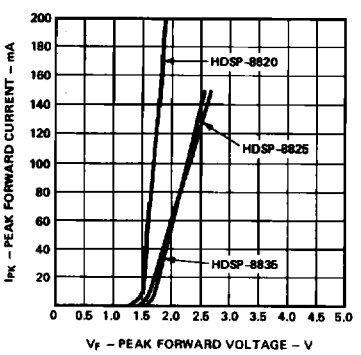


Figure 6. Forward Current vs. Forward Voltage.

For a Detailed Explanation on the Use of Data Sheet Information, See Application Note 1005.

Operational Considerations

Electrical

The HDSP-88XX is a 101 element bar graph array. The linear array is arranged as ten groups of ten LED elements plus one additional element. The ten elements of each group have common cathodes. Like elements in the ten groups have common anodes. The device is addressed via 22 single-in-line pins extending from the back side of the display.

This display is designed specifically for strobed (multiplexed) operation. Minimum peak forward current at which all elements will be illuminated is 15 mA. Display aesthetics are specified at 100 mA, 1/110 DF, peak forward current. The typical forward voltage values, scaled from Figure 6 should be used for calculating the current limiting resistor value and typical power dissipation. Expected maximum VF values, for the purpose of driver circuit design and maximum power dissipation, may be calculated using the following VF model:

HDSP-8820
$V_{FMAX} = 2.02\ V + I_{PEAK}\ (0.8\Omega)$
For $I_{PEAK} > 40$ mA

HDSP-8825
$V_{FMAX} = 1.7\ V + I_{PEAK}\ (14\ \Omega)$
For $I_{PEAK} > 40$ mA

HDSP-8835
$V_{FMAX} = 1.7\ V + I_{PEAK}\ (14\ )$
For $I_{PEAK} > 40$ mA

The time averaged luminous intensity at $T_A = 25°$ C may be calculated using:
I_V Time Avg. =
$[I_{F\text{-}AVG}/I_{F\text{-}SPEC\text{-}AVG}] \cdot \eta I_{PEAK} \cdot I_{V\text{-}SPEC}$

where η, relative efficiency, may be determined from Figure 5.

The circuit in Figure 7 displays an analog input voltage in bar graph form with 101 bit resolution. The 74390 dual decade counter has been configured to count from 0 to 99. The 1Q outputs correspond to "ones" and the 20 outputs correspond to "tens". The "one" outputs from the counter drives the display element anodes through a 7442 1 of 10 BCD decoder. Sprague UDN 2585 drivers source the anodes with 80 mA peak/segment. The "ten" outputs from the counter drive the group cathodes through a 74145 BCD decoder. The circuit multiplexes segments 100 to 91 first, then segments 90 to 81, and so on with segments 10 to 1 last. During the time that the output from the T.I. TL507C A/D converter is low the corresponding display elements will be illuminated.

The TL507C is an economical A/D converter with 7 bit resolution. The single output is pulse-width-modulated to correspond to the analog input voltage magnitude. With V_{CC} = 5 V the analog input voltage range is 1.3 V to 3.9 V. The TL507C output is reset each time the 74390 resets. Duration of the high output pulse is shorter for larger analog input voltages. A high output from the TL507C disables the display by forcing the 7442 inputs to an invalid state. Hence, as the analog input voltage increases more elements of the bar graph display are illuminated. Display element zero is DC driven.

The circuit in Figure 8 uses the HDSP-88XX as a 100 bit position indicator. Two BCD input words define the position of the illuminated element. Display duty factor, 1/100, is controlled by the $\overline{\text{ENABLE}}$ signal.

Mechanical

Suitable conditions for wave soldering depend on the specific kind of equipment and procedure used. A cool down period after flow solder and before flux rinse is recommended.

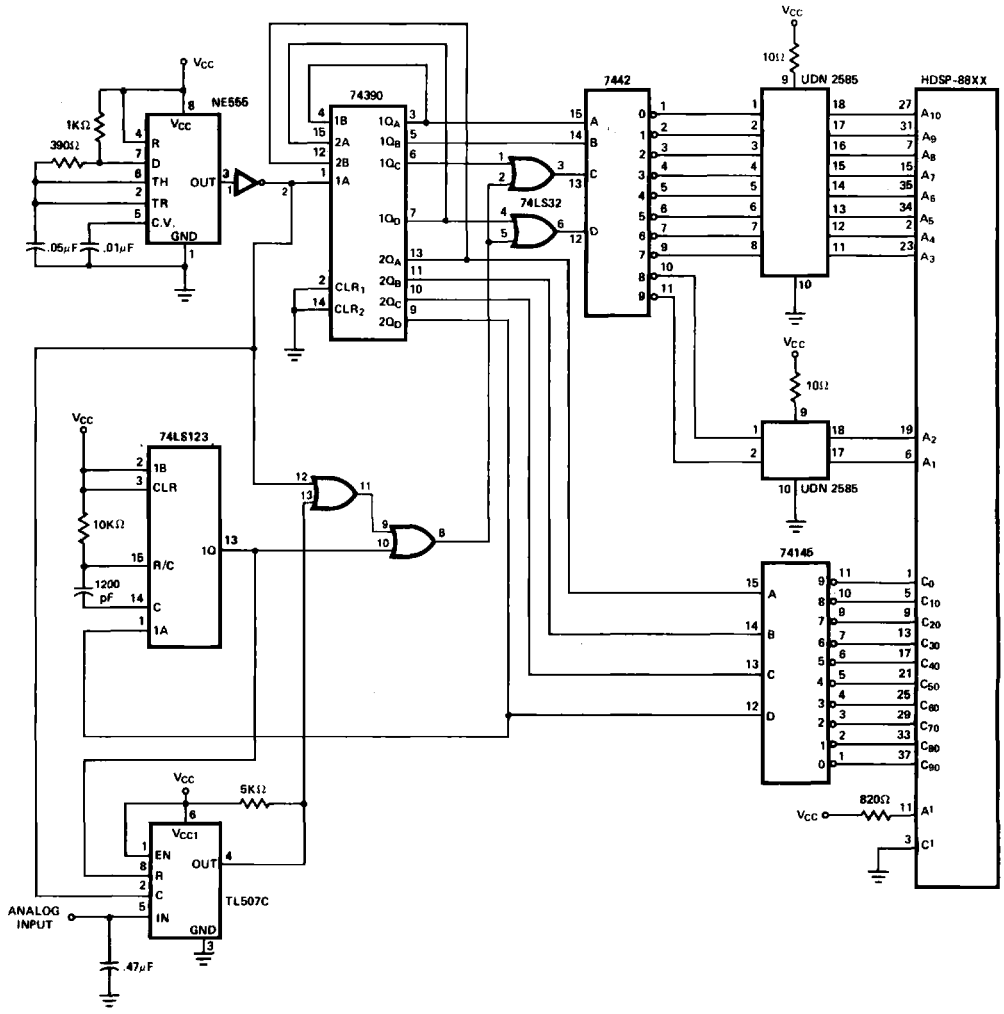


Figure 7. 101 Element Bar Graph.

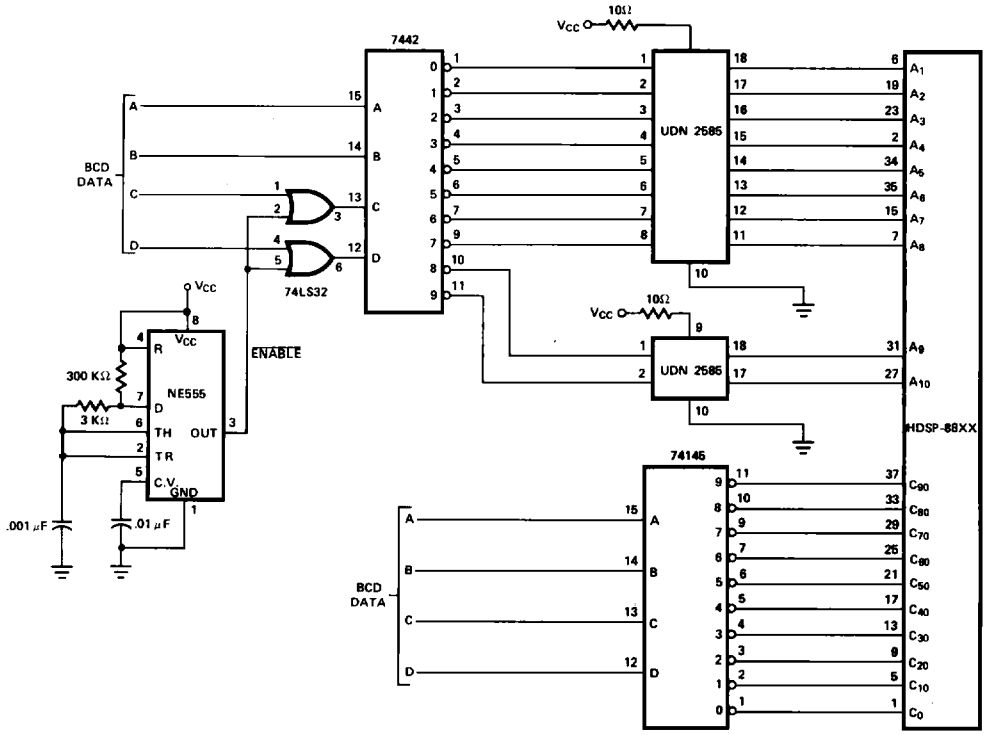


Figure 8. 100 Element Position Indicator.