HEWLETT PACKARD

T-41-35

2.3 Inch AlGaAs Red 5 x 8 Dot Matrix Alphanumeric Displays

Technical Data

HDSP-P101/HDSP-P151
HDSP-P103/HDSP-P153

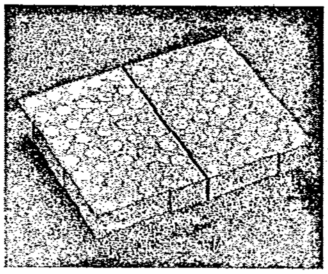
Features

- **Very Large Character Height**
- **Easily Expandable to Larger Displays**
- **X-Y Stackable**
- **Wide Viewing Angle**
- **Ideal for Graphics Panels**
- **Exceptional Brightness**
  HDSP-P15X Series Designed for High Ambient Light Conditions
- **Categorized for Intensity**
- **Mechanically Rugged**

Description

The large 5 x 8 dot matrix alphanumeric display uses newly developed Double Heterojunction (DH) AlGaAs/GaAs material technology. This LED material has outstanding light output efficiency over a wide range of drive currents. The color is deep red at the dominant wavelength of 637 nanometres. The 2.3 inch (58.4 mm) display is ideal for applications such as graphics displays and moving message panels.

The HDSP-P10X and HDSP-P15X have different optical characteristics that are optimized for different applications. The HDSP-P10X and HDSP-P15X displays differ in the amount of diffusant. The HDSP-P10X uses a large amount of diffusant. This causes the dots to have a



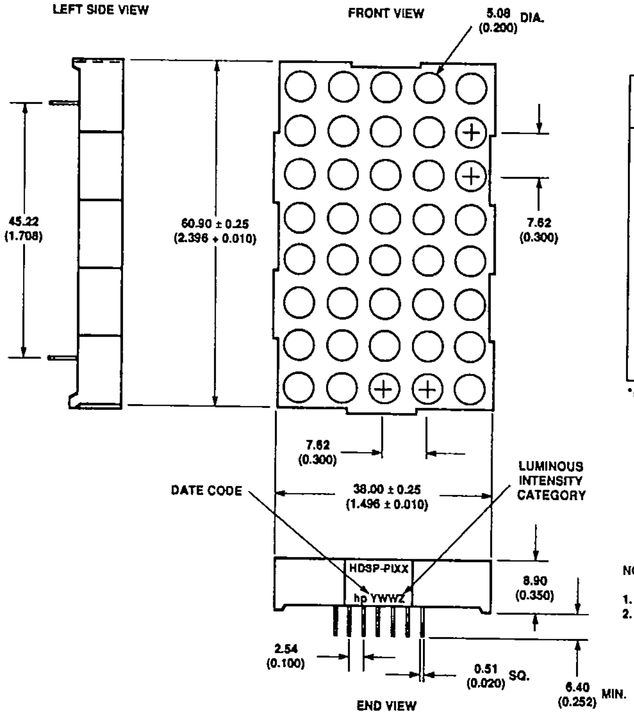
uniform appearance across the light emitting area. The HDSP-P15X uses a smaller amount of diffusant. This causes the dots to appear brightest in the center. The HDSP-P15X is designed for high ambient light conditions or long viewing distances, where brightness is more important than uniformity.

Absolute Maximum Ratings at 25°C

Average Power per Dot	36 mW
Peak Forward Current per Dot[1]	125 mA
Average Forward Current per Dot	11 mA
Operating Temperature Range	-20°C to +85°C
Storage Temperature Range	-20°C to +85°C
Reverse Voltage per Dot	3 V
Lead Solder Temperature (1.59 mm [1/16 inch] below seating plane)	260°C for 3 sec.

Note:
1. Do not exceed maximum average current per dot.

Package Dimensions



PIN	FUNCTION HDSP-P101/P151	HDSP-P103/P153
1	ROW 6 ANODE	ROW 6 CATHODE
2	ROW 8 ANODE	ROW 8 CATHODE
3	COLUMN 2 CATHODE	COLUMN 2 ANODE
4*	COLUMN 3 CATHODE	COLUMN 3 ANODE
5	ROW 5 ANODE	ROW 5 CATHODE
6	COLUMN 5 CATHODE	COLUMN 5 ANODE
7	ROW 7 ANODE	ROW 7 CATHODE
8	ROW 3 ANODE	ROW 3 CATHODE
9	ROW 1 ANODE	ROW 1 CATHODE
10	COLUMN 4 CATHODE	COLUMN 4 ANODE
11*	COLUMN 3 CATHODE	COLUMN 3 ANODE
12	ROW 4 ANODE	ROW 4 CATHODE
13	COLUMN 1 CATHODE	COLUMN 1 ANODE
14	ROW 2 ANODE	ROW 2 CATHODE

*NOTE: PIN 4 AND 11 ARE INTERNALLY CONNECTED.

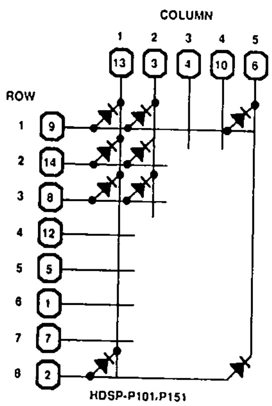
NOTES:

1. ALL DIMENSIONS IN MILLIMETRES (INCHES).
2. ALL UNTOLERANCED DIMENSIONS ARE FOR REFERENCE ONLY.

SOLID STATE DISPLAYS

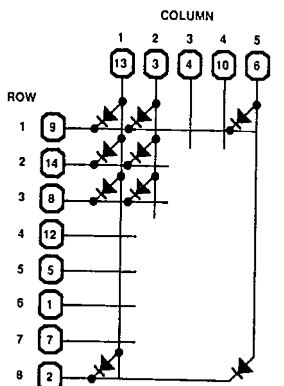
Internal Circuit Diagram

COMMON ROW ANODE



HDSP-P101,P151

COMMON ROW CATHODE



HDSP-P103/P153

Electrical/Optical Characteristics at T_A = 25°C

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions
Luminous Intensity/Dot (Digit Average)[1]	I_V				μcd	I_P = 50 mA: 1/5 duty factor (10 mA Avg.)
HDSP-P101		5000	12000			
HDSP-P151[2]		6000	15000			
Peak Wavelength	λ_{PEAK}		645		nm	
Dominant Wavelength[3]	λ_d		637		nm	
Forward Voltage/Dot	V_F		1.9	2.5	V	I_F = 50 mA
Reverse Voltage/Dot[4]	V_R	3.0	15.0		V	I_R = 100 μA
Temperature Coefficient of V_F/Dot	ΔV_F/°C		-2.0		mV/°C	
Thermal Resistance LED Junction-to-Pin per Package	$R\theta_{J-PIN}$		18		°C/W/Pack	

Notes:
1. The displays are categorized for luminous intensity with the intensity category designated by a letter on the bottom end of the package. The luminous intensity minimum and categories are determined by computing the numerical average of the individual dot intensities.
2. The HDSP-P151 is designed for high ambient light operation. Mixing the HDSP-P101 and the HDSP-P151 displays may cause digit to digit mismatch.
3. The dominant wavelength, λ_d, is derived from the C.I.E. Chromaticity diagram and is that single wavelength which defines the color of the device.
4. Typical specification for reference only. Do not exceed absolute maximum ratings.

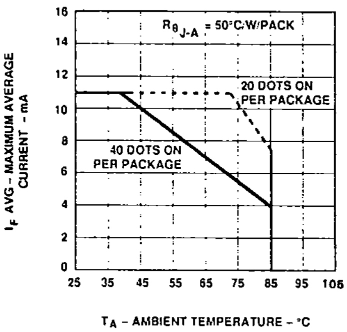


Figure 1. Maximum Allowable Average Current per Dot vs. Ambient Temperature. T_J MAX = 110°C.

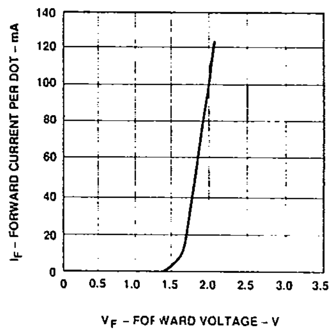


Figure 2. Forward Current vs. Forward Voltage.

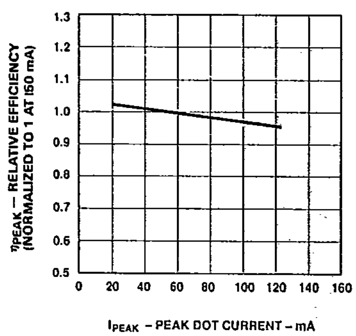


Figure 3. Relative Luminous Efficiency (per Dot) vs. Peak Current per Dot.

Operational Considerations

Electrical Description

These display devices are composed of light emitting diodes, with the light from each LED optically stretched to form individual dots.

These display devices are well suited for strobed operation. The typical forward voltage can be scaled from Figure 2. These values should be used to calculate the current limiting resistor value and the typical power dissipation. Expected maximum V_F values, for driver circuit design and maximum power dissipation, may be calculated using the following V_FMAX model:

$V_F MAX = 1.8\ V + I_{Peak}\ (20\ \Omega)$
For: $I_{Peak} \leq 20$ mA

$V_F MAX = 2.0\ V + I_{Peak}\ (10\ \Omega)$
For: $I_{Peak} \geq 20$ mA

Figure 3 allows the designer to calculate the luminous intensity at different peak and average currents. The following equation calculates intensity at different peak and average currents:

$I_V AVG = (I_F AVG / I_F AVG\ DATA\ SHEET)(\eta_{peak})(I_V DATA\ SHEET)$

Where:

I_FAVG is the desired time averaged LED current.

I_FAVG DATA SHEET is the time averaged data sheet test current for I_VDATA SHEET.

η_{peak} is the relative efficiency at the peak current, scaled from Figure 3.

I_VAVG is the calculated time averaged luminous intensity resulting from I_FAVG.

For example, what is the luminous intensity of an AlGaAs Red (HDSP-P15X) driven at 100 mA peak 1/100 duty factor?

$I_F AVG = (100\ mA)(0.01) = 1\ mA$
I_FAVG DATA SHEET = 10 mA
$\eta_{Peak} = 0.97$
I_V DATA SHEET = 15000 µcd

Therefore

$I_V AVG = (1\ mA/10\ mA)(0.97)(15000\ \mu cd) = 1455\ \mu cd$

Thermal Considerations

The device thermal resistance may be used to calculate the junction temperature of the central LED. The following equation calculates the junction temperature of the central (hottest) LED.

$T_J = T_A + (P_D)(R\theta_{J-A})(N)$
$P_D = (V_F MAX)(I_F AVG)$
$R\theta_{J-A} = R\theta_{J-PIN} + R\theta_{PIN-A}$

T_J is the junction temperature of the central LED.
T_A is the ambient temperature.
P_D is the power dissipated by one LED.
N is the number of LEDs on per character.
V_FMAX is calculated using the appropriate V_F model.
$R\theta_{J-A}$ is the package thermal resistance from the central LED to the ambient.
$R\theta_{J-PIN}$ is the package thermal resistance from the central LED to the pin.
$R\theta_{PIN-A}$ is the thermal resistance from the pin to the ambient.

For example, what is the maximum ambient temperature an HDSP-P1XX can operate with the following conditions:

$I_{Peak} = 125$ mA
$I_F AVG = 11$ mA
$R\theta_{J-A} = 50°C/W$
N = 40
$T_J MAX = 110°C$

$V_F MAX = 2.0\ V + (0.125\ A)(10\ \Omega) = 3.25\ V$
$P_D = (3.25\ V)(0.011\ A) = 0.03575\ W$
$T_A = 110°C - (50°C/W)(0.03575)(40) = 38.5°C$

The maximum number of dots on for the ASCII character set is 20. What is the maximum ambient temperature an HDSP-P1XX can operate with the following conditions:

$I_{Peak} = 125$ mA
$I_F AVG = 11$ mA
$R\theta_{J-A} = 50°C/W$
N = 20
$T_J MAX = 110°C$

$V_F MAX = 2.0\ V + (0.125\ A)(10\ \Omega) = 3.25\ V$
$P_D = (3.25\ V)(0.011\ A) = 0.03575\ W$
$T_A = 110°C - (50°C/W)(0.03575)(20) = 74.3°C$

Contrast Enhancement

The objective of contrast enhancement is to provide good display readability in the end use ambient light. The concept is to employ both luminance and chrominance contrast techniques to enhance the readability. This is accomplished by having the OFF dots blend into the display background and the ON dots stand out vividly against this same background. Therefore, these display devices are assembled with a gray package and matching encapsulating epoxy in the dots.

Contrast enhancement may be achieved by using one of the following suggested filters:

Panelgraphic RUBY RED 60 or GRAY 10
SGL-Homalite H100-1605 RED or H100-1650 GRAY
3M Louvered Filter R6310 RED or ND0220 GRAY

For further information on contrast enhancement please see Application Note 1015.

Mechanical

Specially developed plastics are used to optimize the displays optical performance. These plastics restrict the solvents that may be used for cleaning. Only mixtures of Freon (F113) and alcohol should be used for vapor cleaning processes. Total immersion time in the vapors is two minutes. Some suggested mixtures are Freon TE, Arklone A or K, or Genesolv DI-15 or DE-15. A 60°C (140°F) water cleaning process may also be used. This process includes a neutralizer rinse (3% ammonia solution or equivalent), a surfactant rinse (1% detergent solution or equivalent), a water rinse, and a thorough air dry.

Room temperature cleaning may be done with Freon T-E35 or T-P35, Ethanol, Isopropanol, or water with a mild detergent.

Cleaning agents from the ketone family (acetone, methyl ethyl ketone, etc.) and from the chlorinated hydrocarbon family (methylene chloride, trichloroethylene, carbon tetrachloride, etc.) are not recommended for cleaning LED parts. All of these various solvents attack or dissolve the encapsulating epoxies used to form the package of plastic LED parts.