Agilent Technologies
Innovating the HP Way

Large 5 X 7 Dot Matrix Alphanumeric Displays 17.3/26.5 mm Character Heights

Technical Data

HDSP-440X Series
HDSP-450X Series
HDSP-470X Series
HDSP-510X Series
HDSP-540X Series
HDSP-L10X Series
HDSP-L20X Series
HDSP-M10X Series

Features

- **Multiple Colors Available**
- **Large Character Height**
- **5 X 7 Dot Matrix Font**
- **Viewable Up to 18 Meters (26.5 mm Display)**
- **X-Y Stackable**
- **Ideal for Graphics Panels**
- **Available in Common Row Anode and Common Row Cathode Configurations**
- **AlGaAs Displays Suitable for Low Power or Bright Ambients**

  Typical Intensity 1650 mcd at 2 mA Average Drive Current
- **Categorized for Intensity**
- **Mechanically Rugged**
- **Green Categorized for Color**

Description

The large 5 X 7 dot matrix alphanumeric display family consists of 26.5 mm (1.04 inch) and 17.3 mm (0.68 inch) character height packages. These devices have excellent viewability; the 26.5 mm character can be read at up to 18 meters (12 meters for the 0.68 inch part).

The 26.5 mm font has a 10.2 mm (0.4 inch) dual-in-line (DIP) configuration, while the 17.3 mm font has an industry standard 7.6 mm (0.3 inch) DIP configuration.

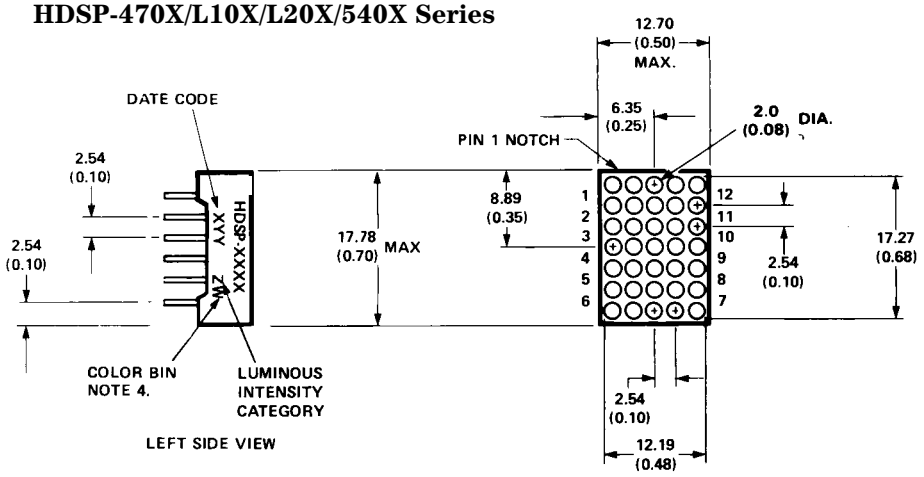
Applications include electronic instrumentation, computer peripherals, point of sale terminals, weighing scales, and industrial electronics.

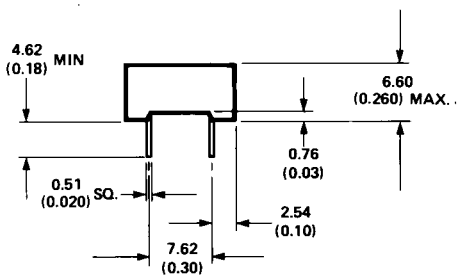
Devices

Standard Red	AlGaAs Red	High Efficiency Red	High Performance Green	Description
HDSP-4701	HDSP-L101	HDSP-L201	HDSP-5401	17.3 mm Common Row Anode
HDSP-4703	HDSP-L103	HDSP-L203	HDSP-5403	17.3 mm Common Row Cathode
HDSP-4401	HDSP-M101	HDSP-4501	HDSP-5101	26.5 mm Common Row Anode
HDSP-4403	HDSP-M103	HDSP-4503	HDSP-5103	26.5 mm Common Row Cathode

Package Dimensions

HDSP-470X/L10X/L20X/540X Series

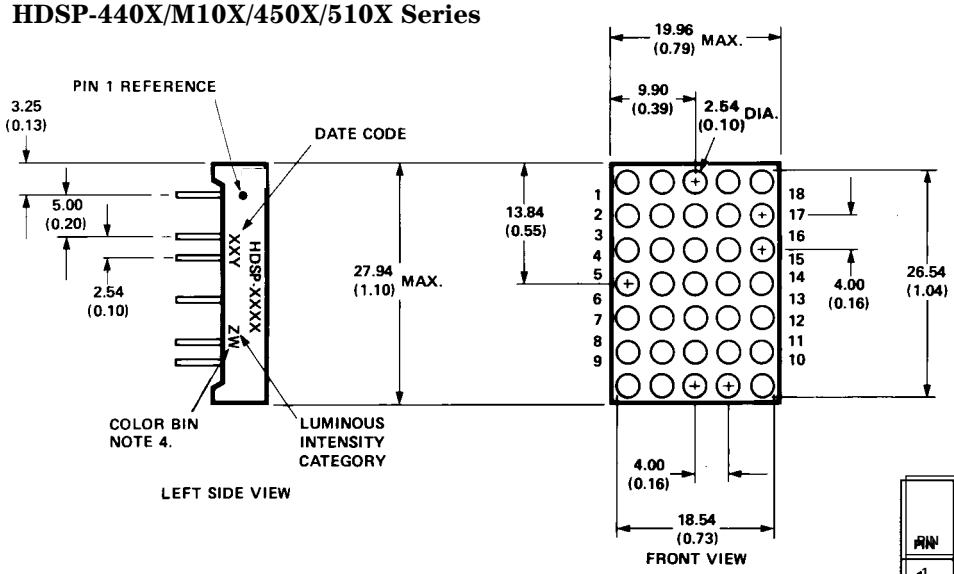


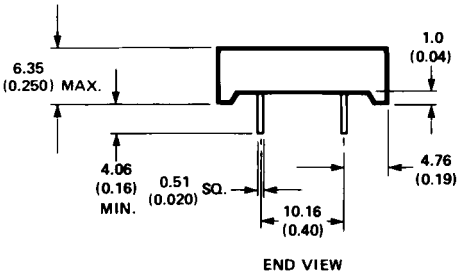


PIN	FUNCTION	
	HDSP-4701/-5401/ L101/L201	HDSP-4703/-5403/ L103/L203
1	COLUMN 1 CATHODE	ROW 1 CATHODE
2	ROW 3 ANODE	ROW 2 CATHODE
3	COLUMN 2 CATHODE	COLUMN 2 ANODE
4	ROW 5 ANODE	COLUMN 1 ANODE
5	ROW 6 ANODE	ROW 6 CATHODE
6	ROW 7 ANODE	ROW 7 CATHODE
7	COLUMN 4 CATHODE	COLUMN 3 ANODE
8	COLUMN 5 CATHODE	ROW 5 CATHODE
9	ROW 4 ANODE	COLUMN 4 ANODE
10	COLUMN 3 CATHODE	ROW 4 CATHODE
11	ROW 2 ANODE	ROW 3 CATHODE
12	ROW 1 ANODE	COLUMN 5 ANODE

NOTES:
1. ALL DIMENSIONS IN MILLIMETRES (INCHES).
2. ALL UNTOLERANCED DIMENSIONS ARE FOR REFERENCE ONLY.
3. A NOTCH ON SCRAMBLER SIDE DENOTES PIN 1.
4. FOR GREEN ONLY.

HDSP-440X/M10X/450X/510X Series



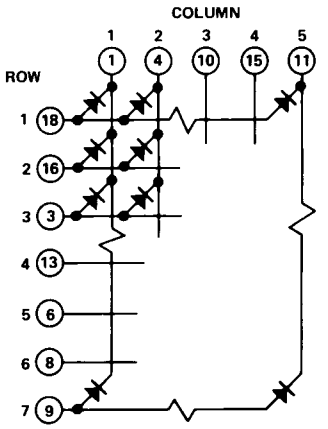


PIN	FUNCTION	
	HDSP-4401/-M101/ -4501/-5101	HDSP-4403/-M103/ -4503/-5103
1	COLUMN 1 CATHODE	ROW 1 CATHODE
2	NO PIN	NO PIN
3	ROW 3 ANODE	COLUMN 3 ANODE
4	COLUMN 2 CATHODE	ROW 3 CATHODE
5	NO PIN	NO PIN
6	ROW 5 ANODE	COLUMN 1 ANODE
7	NO PIN	NO PIN
8	ROW 6 ANODE	COLUMN 2 ANODE
9	ROW 7 ANODE	ROW 7 CATHODE
10	COLUMN 3 CATHODE	ROW 6 CATHODE
11	COLUMN 5 CATHODE	COLUMN 4 ANODE
12	NO PIN	NO PIN
13	ROW 4 ANODE	ROW 5 CATHODE
14	NO PIN	NO PIN
15	COLUMN 4 CATHODE	ROW 4 CATHODE
16	ROW 2 ANODE	ROW 2 CATHODE
17	NO PIN	NO PIN
18	ROW 1 ANODE	COLUMN 5 ANODE

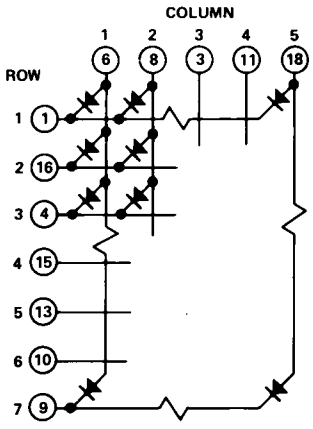
NOTES:
1. ALL DIMENSIONS IN MILLIMETRES (INCHES).
2. ALL UNTOLERANCED DIMENSIONS ARE FOR REFERENCE ONLY.
3. A BLACK DOT ON SCRAMBLER SIDE INDICATES PIN #1.
4. FOR GREEN ONLY.

Internal Circuit Diagrams

HDSP-4401/M101/4501/5101
COMMON ANODE ROW

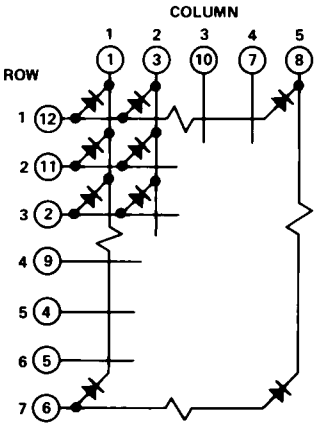


HDSP-4403/M103/4503/5103
COMMON CATHODE ROW

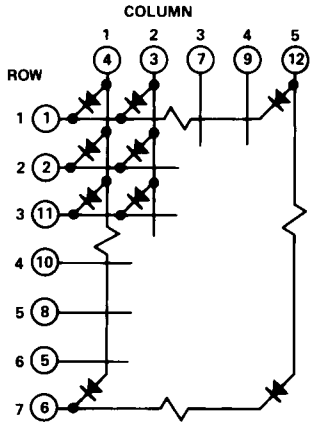


X = ROW OR COLUMN NUMBER, (X) = PIN NUMBER

HDSP-4701/L101/L201/5401
COMMON ANODE ROW



HDSP-4703/L103/L203/5403
COMMON CATHODE ROW



X = ROW OR COLUMN NUMBER, (X) = PIN NUMBER

Absolute Maximum Ratings at 25°C

Description	HDSP-470X/ 440X Series	HDSP-L10X/ M10X Series	HDSP-L20X/ 450X Series	HDSP-540X/ 510X Series
Average Power per Dot (T_A = 25°C)[1]	75 mW			
Peak Forward Current per Dot (T_A = 25°C)[1,2]	125 mA	125 mA	90 mA	90 mA
Average Forward Current per Dot (T_A = 25°C)[1,3]	32 mA	23 mA	15 mA	15 mA
Operating Temperature Range	-40°C to +85°C	-20°C to +85°C	-40°C to +85°C	-20°C to +85°C
Storage Temperature Range	-40°C to +85°C			
Lead Solder Temperature (1.59 mm [0.062 in.] below seating plane)	260°C for 3 s			

Notes:
1. Average power is based on 20 dots per character. Total package power dissipation should not exceed 1.5 W.
2. Do not exceed maximum average current per dot.
3. For the HDSP-440X/470X series displays, derate maximum average current above 35°C at 0.43 mA/°C. For the HDSP-L10X/M10X series displays, derate maximum average current above 35°C at 0.31 mA/°C. For the HDSP-L20X/450X series and HDSP-540X/510X series displays, derate maximum average current above 35°C at 0.2 mA/°C. This derating is based on a device mounted in a socket having a thermal resistance junction to ambient of 50°C/W per package.

Electrical/Optical Characteristics at T_A = 25°C

Standard Red HDSP-440X/470X Series

Description	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Luminous Intensity/Dot[4] (Digit Average)	I_V	100 mA pk: 1 of 5 Duty Factor (20 mA Avg.)				
HDSP-470X (17.3 mm)			360	770		µcd
HDSP-440X (26.5 mm)			400	800		
Peak Wavelength	λ_{PEAK}			655		nm
Dominant Wavelength[5]	λ_d			640		nm
Forward Voltage	V_F	I_F = 100 mA		1.8	2.2	V
Reverse Voltage[6]	V_R	I_R = 100 µA	3.0	12		V
Temperature Coefficient of V_F	ΔV_F/°C			-2.0		mV/°C
Thermal Resistance LED Junction-to-Pin per package						
HDSP-470X	$R\theta_{J\text{-}PIN}$			15		°C/W/
HDSP-440X				13		PACK

AlGaAs Red HDSP-L10X/M10X Series

Description	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Luminous Intensity/Dot[4] (Digit Average)	I_V	10 mA pk: 1 of 5 Duty Factor (2 mA Avg.)				
HDSP-L10X (17.3 mm)			730	1650		µcd
HDSP-M10X (26.5 mm)			760	1850		
Luminous Intensity/Dot[4] (Digit Average)	I_V	30 mA pk: 1 of 14 Duty Factor (2.1 mA Avg.)				
HDSP-L10X				1750		µcd
HDSP-M10X				1980		
Peak Wavelength	λ_{PEAK}			645		nm
Dominant Wavelength[5]	λ_d			637		nm
Forward Voltage	V_F	I_F = 10 mA		1.7	2.1	V
Reverse Voltage[6]	V_R	I_R = 100 µA	3.0	15.0		V
Temperature Coefficient of V_F	ΔV_F/°C			-2.0		mV/°C
Thermal Resistance LED Junction-to-Pin per package						
HDSP-L10X	$R\theta_{J\text{-}PIN}$			20		°C/W/
HDSP-M10X				18		PACK

High Efficiency Red HDSP-450X/L20X Series

Description	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Luminous Intensity/Dot[4] (Digit Average)	I_V	50 mA pk: 1 of 5 Duty Factor (10 mA Avg.)				
HDSP-L20X (17.3 mm)			1150	2800		µcd
HDSP-450X (26.5 mm)			1400	3500		
Luminous Intensity/Dot[4] (Digit Average)	I_V	30 mA pk: 1 of 14 Duty Factor (2.1 mA Avg.)				
HDSP-L20X				740		µcd
HDSP-450X				930		
Peak Wavelength	λ_{PEAK}			635		nm
Dominant Wavelength[5]	λ_d			626		nm
Forward Voltage	V_F	I_F = 50 mA		2.6	3.5	V
Reverse Voltage[6]	V_R	I_R = 100 µA	3.0	25.0		V
Temperature Coefficient of V_F	$\Delta V_F/°C$			-2.0		mV/°C
Thermal Resistance LED Junction-to-Pin per package						
HDSP-L20X	$R\theta_{J\text{-}PIN}$			15		°C/W/
HDSP-450X				13		PACK

High Performance Green HDSP-540X/510X Series

Description	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Luminous Intensity/Dot[4] (Digit Average)	I_V	50 mA pk: 1 of 5 Duty Factor (10 mA Avg.)				
HDSP-540X (17.3 mm)			1290	4000		µcd
HDSP-510X (26.5 mm)			1540	4500		
Luminous Intensity/Dot[4] (Digit Average)	I_V	30 mA pk: 1 of 14 Duty Factor (2.1 mA Avg.)				
HDSP-540X				570		µcd
HDSP-510X				630		
Peak Wavelength	λ_{PEAK}			566		nm
Dominant Wavelength[5,7]	λ_d			571		nm
Forward Voltage	V_F	I_F = 50 mA		2.6	3.5	V
Reverse Voltage[6]	V_R	I_R = 100 µA	3.0	25.0		V
Temperature Coefficient of V_F	$\Delta V_F/°C$			-2.0		mV/°C
Thermal Resistance LED Junction-to-Pin per package						
HDSP-540X	$R\theta_{J\text{-}PIN}$			15		°C/W/
HDSP-510X				13		PACK

Notes:
4. The displays are categorized for luminous intensity with the intensity category designated by a letter on the left hand side of the package. The luminous intensity minimum and categories are determined by computing the numerical average of the individual dot intensities.
5. The dominant wavelength is derived from the C.I.E. Chromaticity diagram and is that single wavelength which defines the color of the device.
6. Typical specification for reference only. Do not exceed absolute maximum ratings.
7. The displays are categorized for dominant wavelength with the category designated by a number adjacent to the intensity category letter.

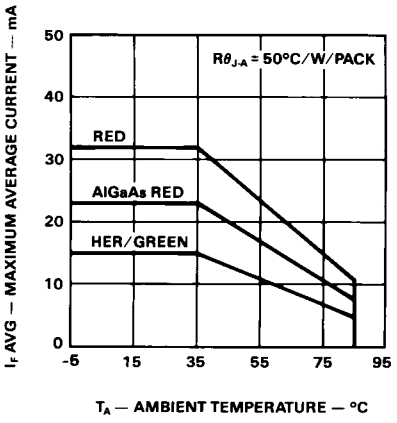


Figure 1. Maximum Allowable Average Current Per Dot as a Function of Ambient Temperature.

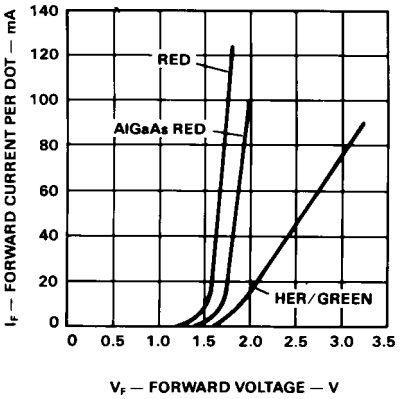


Figure 2. Forward Current vs. Forward Voltage.

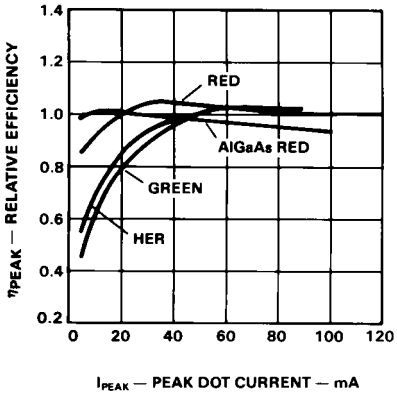


Figure 3. Relative Efficiency (Luminous Intensity per Unit Dot) vs. Peak Current per Dot.

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 values 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 models:

Red (HDSP-440X/470X):
V_FMAX = 1.55 V + I_{PEAK}(6.5 Ω)
For $I_{PEAK} \geq$ 5 mA
AlGaAs Red
(HDSP-L10X/M10X):
V_FMAX = 1.8 V + I_{PEAK}(20 Ω)
For $I_{PEAK} \leq$ 20 mA
V_FMAX = 2.0 V + I_{PEAK}(10 Ω)
For $I_{PEAK} \geq$ 20 mA
HER (HDSP-450X/L20X):
V_FMAX = 1.75 V + I_{PEAK}(35 Ω)
For $I_{PEAK} \geq$ 5 mA
Green (HDSP-540X/510X):
V_FMAX = 1.75 V + I_{PEAK}(38 Ω)
For $I_{PEAK} \geq$ 5 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_VAVG = (I_FAVG/I_FAVG DATA SHEET)(η_{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_V DATA SHEET is the time averaged data sheet luminous intensity, resulting from I_FAVG DATA SHEET.
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-L10X) driven at 50 mA peak 1/5 duty factor?

I_FAVG = 50 mA * 0.2 = 10 mA
I_FAVG DATA SHEET = 2 mA
η_{PEAK} = 0.98
I_V DATA SHEET = 1650 µcd

Therefore

I_VAVG = (10 mA/2 mA)(0.98)
(1650 µcd) = 8085 µcd

Thermal Considerations

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

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

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.
$V_F MAX$ is calculated using the appropriate V_F model.
$R\theta_{J\text{-}A}$ is the package thermal resistance from the central LED to the ambient.
$R\theta_{J\text{-}PIN}$ is the package thermal resistance from the central LED to pin.
$R\theta_{PIN\text{-}A}$ is the package thermal resistance from the pin to the ambient.

For example, what is the maximum ambient temperature an HDSP-L10X can operate with the following conditions:

I_{PEAK} = 125 mA
$I_F AVG$ = 10 mA
$R\theta_{J\text{-}A}$ = 50°C/W
N = 35
$T_J MAX$ = 110°C

$V_F MAX$ = 2.0 V + (0.125 A)(10)
= 3.25 V
P_D = (3.25 V)(0.01 A)
= 0.0325 W
T_A = 110°C –
(50°C/W)(0.0325 W)(35)
= 53°C

The maximum number of dots ON for the ASCII character set is 20. What is the maximum ambient temperature an HDSP-L10X can operate with the following conditions:

I_{PEAK} = 125 mA
$I_F AVG$ = 10 mA
$R\theta_{J\text{-}A}$ = 50°C/W
N = 20
$T_J MAX$ = 110°C

$V_F MAX$ = 3.25 V
P_D = 0.0325 W
T_A = 110°C –
(50°C/W)(0.0325 W)(20)
= 77°C

Therefore, the maximum ambient temperature can be increased by reducing the average number of dots ON from 35 to 20 dots ON per display.

Contrast Enhancement

For information on contrast enhancement please see Application Note 1015.

Soldering/Cleaning

For Soldering/Cleaning information on soldering LEDs please refer to Application Note 1027.

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Obsoletes 5963-7392E

5964-6373E (11/99)