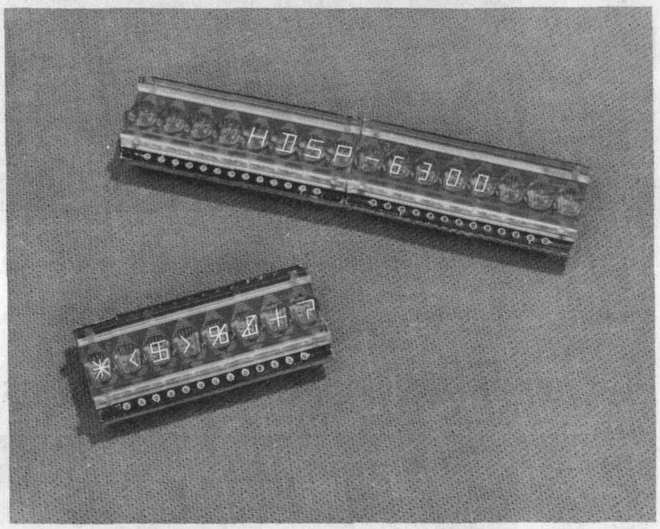
HEWLETT hp PACKARD

COMPONENTS

18 SEGMENT SOLID STATE ALPHANUMERIC DISPLAY

HDSP-6300

TECHNICAL DATA JUNE 1979



Features

- **ALPHANUMERIC**
  Displays 64 Character ASCII Set and Special Characters
- **18 SEGMENT FONT INCLUDING CENTERED D.P. AND COLON**
- **3.56mm (0.140") CHARACTER HEIGHT**
- **APPLICATION FLEXIBILITY WITH PACKAGE DESIGN**
  8 Character Dual-In-Line Package
  End Stackable
  Sturdy Leads on 2.54mm (0.100") Centers
  Common Cathode Configuration
- **LOW POWER**
  As Low as 1.0-1.5mA Average Per Segment Depending on Peak Current Levels
- **EXCELLENT CHARACTER APPEARANCE**
  Continuous Segment Font
  High On/Off Contrast
  5.08mm (0.200") Character Spacing
  Excellent Character Alignment
  Excellent Readability at 1.5 Metres
- **SUPPORT ELECTRONICS**
  Can Be Driven With ROM Decoders and Drivers
  Easy Interfacing With Microprocessors and LSI Circuitry
- **CATEGORIZED FOR LUMINOUS INTENSITY**
  Assures Uniformity of Light Output From Unit to Unit Within a Single Category

Description

The HDSP-6300 is an eighteen segment GaAsP red alphanumeric display mounted in an 8 character dual-in-line package configuration that permits mounting on PC boards or in standard IC sockets. The monolithic light emitting diode character is magnified by the integral lens which increases both character size and luminous intensity, thereby making low power consumption possible. The eighteen segments consist of sixteen segments for alphanumeric and special characters plus centered decimal point and colon for good visual aesthetics. Character spacing yields 5 characters per inch.

Applications

These alphanumeric displays are attractive for applications such as computer peripherals and mobile terminals, desk top calculators, in-plant control equipment, hand-held instruments and other products requiring low power, display compactness and alphanumeric display capability.

Absolute Maximum Ratings

Symbol	Parameter	Min.	Max.	Units
I_{PEAK}	Peak Forward Current Per Segment or DP (Duration ≤ 417μs)		150	mA
I_{AVG}	Average Current Per Segment or DP[1]		6.25	mA
P_D	Average Power Dissipation Per Character[1,2]		133	mW
T_A	Operating Temperature, Ambient	-40	85	°C
T_S	Storage Temperature	-40	100	°C
V_R	Reverse Voltage		5	V
	Solder Temperature at 1.59mm (1/16 inch) below seating plane, t ≤ 5 Seconds		260	°C

NOTES:
1. Maximum allowed drive conditions for strobed operation are derived from Figures 1 and 2. See electrical section of operational considerations.
2. Derate linearly above T_A = 50°C at 2.47 mW/°C. P_D Max. (T_A = 85°C) = 47 mW.

Electrical/Optical Characteristics at T_A=25°C

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Units
I_V	Luminous Intensity, Time Average, Character Total with 16 Segments Illuminated [3,4]	I_{PEAK} = 24mA 1/16 Duty Factor	400	1200		μcd
V_F	Forward Voltage Per Segment or DP	I_F = 24mA (One Segment On)		1.6	1.9	V
λ_{PEAK}	Peak Wavelength			655		nm
λ_d	Dominant Wavelength [5]			640		nm
I_R	Reverse Current Per Segment or DP	V_R = 5V		10		μA

NOTES:
3. The luminous intensity ratio between segments within a digit is designed so that each segment will have the same luminous sterance. Thus each segment will appear with equal brightness to the eye.
4. Operation at peak currents of less than 7mA is not recommended.
5. The dominant wavelength, λd, is derived from the C.I.E. chromaticity diagram and represents that single wavelength which defines the color of the device, standard red.

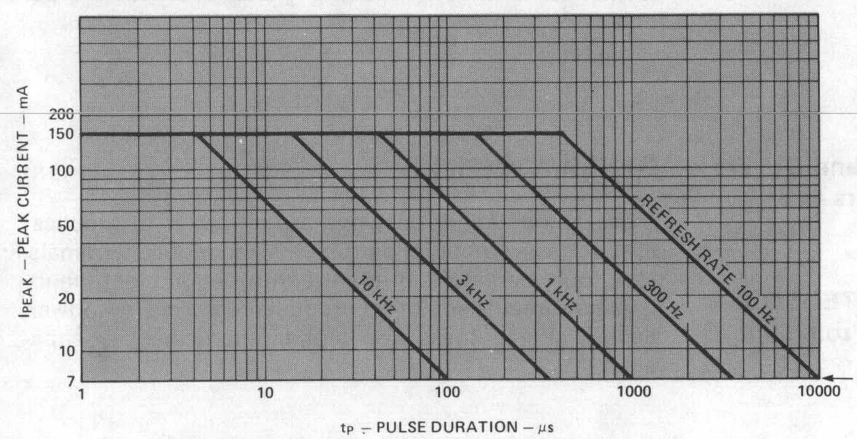


Figure 1. Maximum Allowed Peak Current vs. Pulse Duration. Derate derived operating conditions above T_A = 50°C using Figure 2.

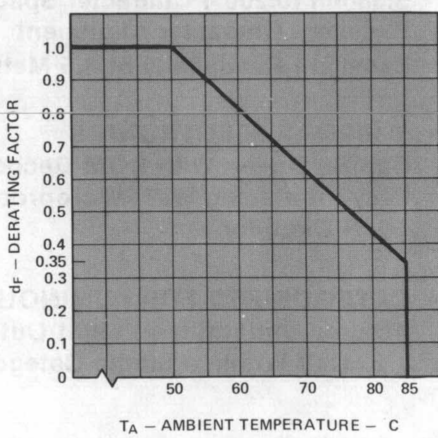


Figure 2. Temperature Derating Factor For Operating Conditions When T_A Exceeds 50°C.

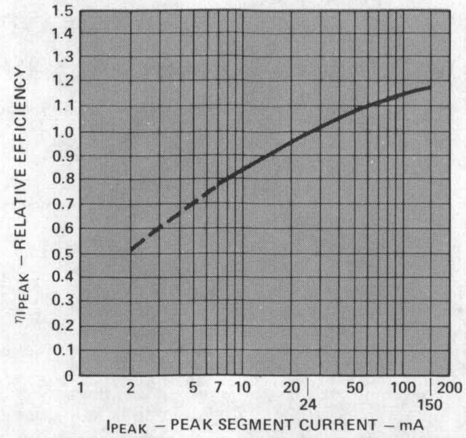


Figure 3. Relative Luminous Efficiency (Luminous Intensity Per Unit Current) vs. Peak Segment Current.

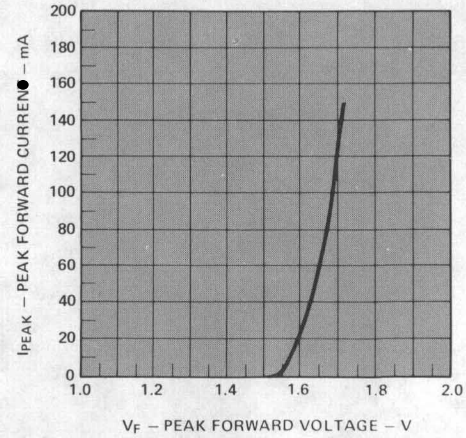


Figure 4. Peak Forward Segment Current vs. Peak Forward Voltage.

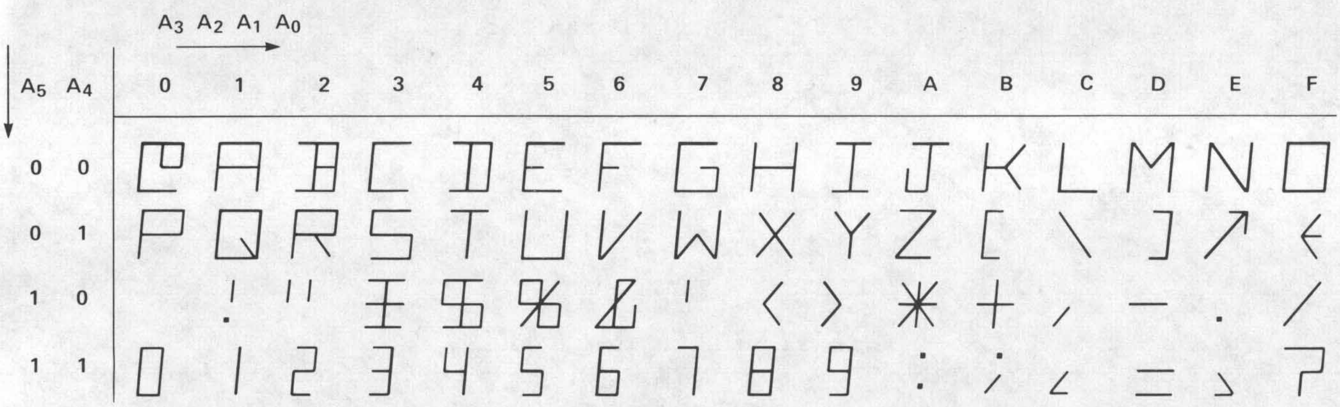
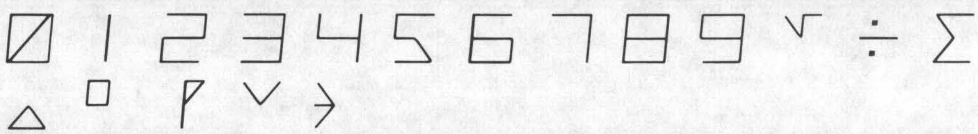


Figure 5. Typical 64 Character ASCII Set.



Additional Character Font

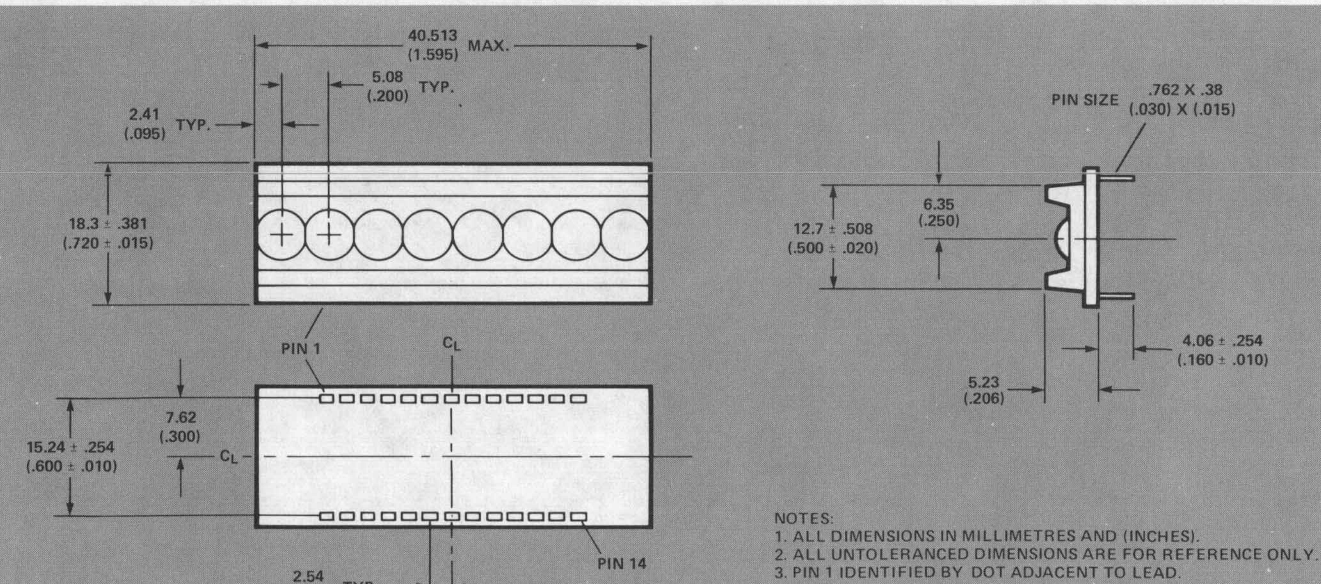


Figure 6.

Magnified Character Font Description

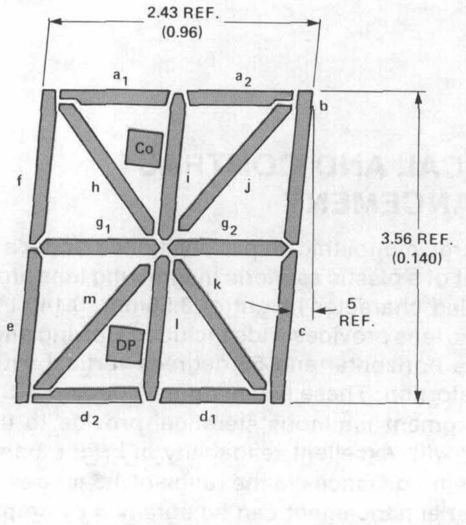


Figure 7.

Device Pin Description

Pin No.	Function	
1	Anode	Segment K
2	Anode	Segment D_1
3	Anode	Segment C
4	Cathode	Digit 1
5	Cathode	Digit 2
6	Cathode	Digit 3
7	Cathode	Digit 4
8	Anode	Segment L
9	Anode	Segment G_2
10	Anode	Segment E
11	Anode	Segment M
12	Anode	Segment D_2
13	Anode	Segment DP
14	Anode	Segment A_2
15	Anode	Segment I
16	Anode	Segment J
17	Cathode	Digit 8
18	Cathode	Digit 7
19	Cathode	Digit 6
20	Cathode	Digit 5
21	Anode	Segment C_o
22	Anode	Segment G_1
23	Anode	Segment B
24	Anode	Segment F
25	Anode	Segment H
26	Anode	Segment A_1

Operational Considerations

ELECTRICAL

The HDSP-6300 device utilizes large monolithic 18 segment GaAsP LED chips including centered decimal point and colon. Like segments of each digit are electrically interconnected to form an 18 by N array, where N is the quantity of characters in the display. In the driving scheme the decimal point or colon is treated as a separate character with its own time frame. A detailed discussion of character font capabilities, ASCII code to 18 segment decoding, and display drive techniques will appear in a forthcoming application note.

This display is designed specifically for strobed (multiplexed) operation, with a minimum recommended peak forward current per segment of 7.0 mA. Under normal operating situations the maximum number of illuminated segments needed to represent a given character is 10. Therefore, except where noted, the information presented in this data sheet is for a maximum of 10 segments illuminated per character.*

*More than 10 segments may be illuminated in a given character, provided the maximum allowed character power dissipation, temperature derated, is not exceeded.

The typical forward voltage values, scaled from Figure 4, should be used for calculating the current limiting resistor values and typical power dissipation. Expected maximum V_F values for the purpose of driver circuit design may be calculated using the following V_F model:

$$V_F = 1.85V + I_{PEAK}\,(1.8\Omega)$$
For: $30mA \leq I_{PEAK} \leq 150mA$
$$V_F = 1.58V + I_{PEAK}\,(10.7\Omega)$$
For: $10mA \leq I_{PEAK} \leq 30mA$

Pulsed operating conditions on a per segment basis are derived from Figure 1 and are temperature derated using Figure 2. Figure 1 relates maximum allowed segment peak current, I_{PEAK}, to the maximum allowed pulse duration, t_p, for various strobing refresh rates, f. To most effectively utilize Figure 1, perform the following steps:

1. Determine desired duty factor, DF.
   Example: Sixteen characters, DF = 1/16
2. Determine desired refresh rate, f. Use duty factor to calculate pulse duration, t_p. Note: $DF = f \bullet t_p$
   Example: $f = 1kHz$, $t_p = 62.5\mu s$

3. Enter Figure 1 at the calculated t_p. Move vertically to the refresh rate line and record the corresponding value of I_{PEAK}.

   Example: At $t_p = 62.5\mu s$ and $f = 1kHz$, $I_{PEAK} = 100mA$
   $I_{AVG} = I_{PEAK} \bullet DF = (100mA)(1/16) = 6.25mA$

4. The maximum allowed operating conditions, not temperature derated, are now known. If the operating ambient temperature is above 50°C, the operating conditions derived from Figure 1 must be temperature derated.

   Figure 2 derates the product $I_{PEAK} \bullet t_p$ with ambient temperature. The designer has the option of maintaining either t_p or I_{PEAK} and derating I_{PEAK} or t_p. The choice of derating I_{PEAK} results in a lower power dissipation with the least loss of light output. To obtain the temperature derated operating conditions perform the following steps.

5. Determine maximum operating ambient temperature.
   Example: $T_A = 70°C$

6. Multiply $I_{PEAK} \bullet t_p$.
   Example: $(100mA)(62.5\mu s) = 6250mA \bullet \mu s$

7. From Figure 2 determine derating factor, d_F. Multiply above $I_{PEAK} \bullet t_p$ product by d_F.

   Example: At $T_A = 70°C$, $d_F = 0.62$
   $d_F(I_{PEAK} \bullet t_p) = (0.62)(6250) = 3875mA \bullet \mu s$

8. Calculate derated operating conditions.

   Example: Maintain $t_p = 62.5\mu s$ and derate I_{PEAK}

$$I_{PEAK} = \frac{4312.5mA \bullet \mu s}{62.5\mu s} = 62mA \text{ peak current}$$

The maximum allowed operating conditions, temperature derated to an ambient of 70°C are now determined.

Example: $f = 1kHz$, $t_p = 62.5\mu s$, $I_{PEAK} = 62mA$ and $I_{AVG} = 3.9mA$.

The above calculations determine the maximum allowed strobing conditions. Operation at a reduced combination of peak current and pulse width may be desirable to adjust display light output to match ambient light levels and/or to insure even more reliable operation.

Refresh rates of 1kHz or faster provide the most efficient operation resulting in the maximum possible light output for long character strings.

The time average luminous intensity may be calculated using the relative efficiency characteristic of Figure 3, $\eta_{I_{PEAK}}$, and correcting for operating ambient temperature. The time average luminous intensity at $T_A = 25°C$ is calculated as follows:

$$I_{V\ TIME\ AVG} = \left[\frac{I_{PEAK} \bullet DF}{1.5mA}\right] [\eta_{I_{PEAK}}] [I_{V\ DATA\ SHEET}]$$

Example: $$I_{V\ TIME\ AVG} = \left[\frac{(62mA)(1/16)}{1.5mA}\right] [1.10] [1200\mu cd]$$

$I_{V\ TIME\ AVG} = 3410\ \mu cd$ digit, total for 16 segments, $T_A = 25°C$

This time average luminous intensity is corrected for temperature by the following exponential equation:

$$I_V(T_A) = I_V(25°C)e^{[-.0188/°C\ (T_A - 25°C)]}$$

Example: for $T_A = 70°C$,
$I_V(70°C) = (3410\mu cd)e^{[-.0188(70-25°C)]} = 1463\mu cd$/digit total for 16 segments

OPTICAL AND CONTRAST ENHANCEMENT

Each large monolithic chip is positioned under a separate element of a plastic aspheric magnifying lens producing a magnified character height of 3.56mm (0.140 inch). The aspheric lens provides wide included viewing angles of 60 degrees horizontal and 55 degrees vertical with low off axis distortion. These two features, coupled with the very high segment luminous sterance, provide to the user a display with excellent readability in bright ambient light for viewing distances in the range of 1.5 metres. Effective contrast enhancement can be obtained by employing an optical filter product such as Panelgraphic Ruby Red 60, Dark Red 63 or Purple 90; SGL Homalite H100-1605 Red or H100-1804 Purple; or Plexiglas 2423. For very bright ambients, such as indirect sunlight, the 3M Red 655 or Neutral Density Light Control Film is recommended.

MECHANICAL

This device is constructed by LED die attaching and wire bonding to a high temperature PC board substrate. A precision molded plastic lens is attached to the PC board.

The HDSP-6300 can be end stacked to form a character string which is a multiple of a basic eight character grouping. These devices may be soldered onto a printed circuit board or inserted into 28 pin DIP LSI sockets. The socket spacing must allow for device end stacking.

The absolute maximum allowed LED junction temperature, $T_{j(max)}$, is 110°C. The maximum power ratings have been established so as not to exceed this limit. For most reliable operation, it is recommended that the PC board thermal resistance to ambient be less than 140°C/W/character. This will then establish a maximum thermal resistance LED junction-to-ambient of 390°C/W/character.

Optimum wave soldering is accomplished by using a good quality RMA rosin flux (organic acid flux is not recommended) and setting the solder wave temperature and dwell time at 245°C for 1-1/2 to 2 seconds. For device cleaning in a vapor cleaning process, only mixtures of Freon (F113) and alcohol are recommended with an immersion time in the vapors for less than 2 minutes. Suggested cleaning solvents are Freon TE, Genesolv DI-15 or DE-15, Arklone A or K. Room temperature cleaning may be accomplished with Freon T-E35 or T-P35, Ethanol or Isopropanol.

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