HEWLETT hp PACKARD

COMPONENTS

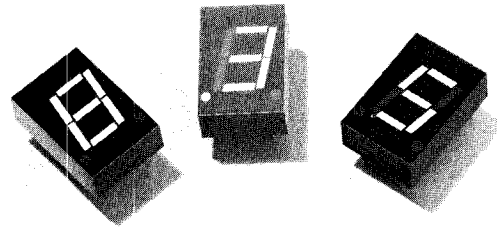
.43 INCH SEVEN SEGMENT DISPLAYS

HIGH EFFICIENCY RED • 5082-7650 SERIES
YELLOW • 5082-7660 SERIES
GREEN • 5082-7670 SERIES

TECHNICAL DATA APRIL 1976

Features

- **LARGE DIGIT**
  Viewing up to 6 meters (19.7 feet)
- **CHOICE OF 3 BRIGHT COLORS**
  High Efficiency Red
  Yellow
  Green
- **LOW CURRENT OPERATION**
  As Low as 3mA per Segment
  Designed for Multiplex Operation
- **EXCELLENT CHARACTER APPEARANCE**
  Evenly Lighted Segments
  Wide Viewing Angle
  Body Color Improves "Off" Segment Contrast
- **EASY MOUNTING ON PC BOARD OR SOCKETS**
  Industry Standard 7.62mm (.3") DIP Leads on 2.54mm (.1") Centers
- **CATEGORIZED FOR LUMINOUS INTENSITY**
  Assures Uniformity of Light Output from Unit to Unit within a Single Category
- **IC COMPATIBLE**
- **MECHANICALLY RUGGED**



Description

The 5082-7650, -7660, and -7670 series are large 10.92mm (.43 in.) Red, Yellow, and Green seven segment displays. These displays are designed for use in instruments, point of sale terminals, clocks, and appliances.

The -7650 and -7660 series devices utilize high efficiency LED chips which are made from GaAsP on a transparent GaP substrate.

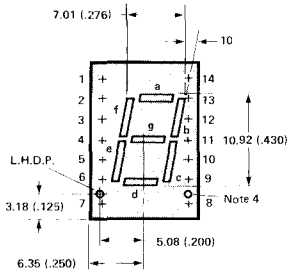
The -7670 series devices utilize chips made from GaP on a transparent GaP substrate.

Devices

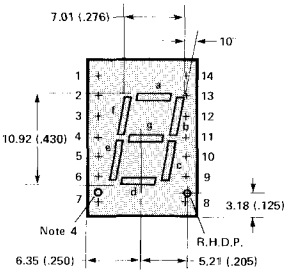
Part No. 5082-	Color	Description	Package Drawing
-7650	High Efficiency Red	Common Anode Left Hand Decimal	A
-7651	High Efficiency Red	Common Anode Right Hand Decimal	B
-7653	High Efficiency Red	Common Cathode Right Hand Decimal	C
-7656	High Efficiency Red	Universal Overflow ±1 Right Hand Decimal	D
-7660	Yellow	Common Anode Left Hand Decimal	A
-7661	Yellow	Comon Anode Right Hand Decimal	B
-7663	Yellow	Common Cathode Right Hand Decimal	C
-7666	Yellow	Universal Overflow ±1 Right Hand Decimal	D
-7670	Green	Common Anode Left Hand Decimal	A
-7671	Green	Common Anode Right Hand Decimal	B
-7673	Green	Common Cathode Right Hand Decimal	C
-7676	Green	Universal Overflow ±1 Right Hand Decimal	D

Note: Universal pinout brings the anode and cathode of each segment's LED out to separate pins, see internal diagram D.

Package Dimensions

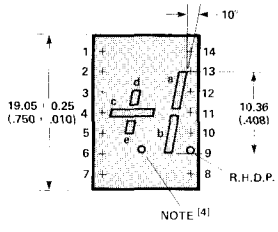


A

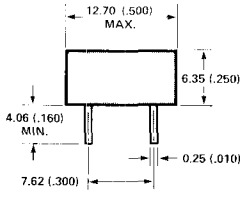


B,C

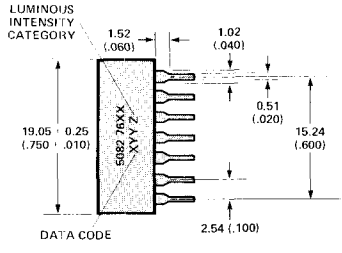
FRONT VIEW



D



END VIEW



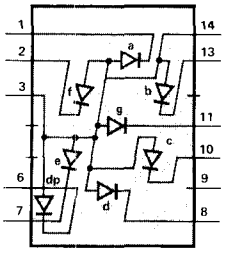
SIDE VIEW

PIN	FUNCTION A -7650/-7660/ -7670	B -7651/-7661/ -7671	C -7653/-7663/ -7673	D -7656/-7666/ -7676
1	CATHODE-a	CATHODE-a	ANODE-a	CATHODE-d
2	CATHODE-f	CATHODE-f	ANODE-f	ANODE-d
3	ANODE[3]	ANODE[3]	CATHODE[6]	NO PIN
4	NO PIN	NO PIN	NO PIN	CATHODE-c
5	NO PIN	NO PIN	NO PIN	CATHODE-e
6	CATHODE-dp	NO CONN.[5]	NO CONN.[5]	ANODE-e
7	CATHODE-e	CATHODE-e	ANODE-e	ANODE-c
8	CATHODE-d	CATHODE-d	ANODE-d	ANODE-dp
9	NO CONN.[5]	CATHODE-dp	ANODE-dp	CATHODE-dp
10	CATHODE-c	CATHODE-c	ANODE-c	CATHODE-b
11	CATHODE-g	CATHODE-g	ANODE-g	CATHODE-a
12	NO PIN	NO PIN	NO PIN	NO PIN
13	CATHODE-b	CATHODE-b	ANODE-b	ANODE-a
14	ANODE 3i	ANODE[3]	CATHODE[6]	ANODE-b

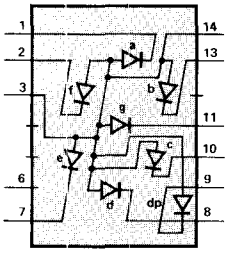
NOTES:

1. Dimensions in millimeters and (inches).
2. All untoleranced dimensions are for reference only.
3. Redundant anodes.
4. Unused dp position.
5. See Internal Circuit Diagram.
6. Redundant cathode.

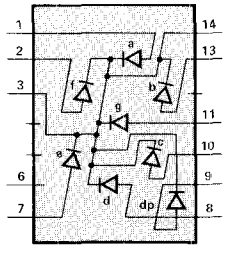
Internal Circuit Diagram



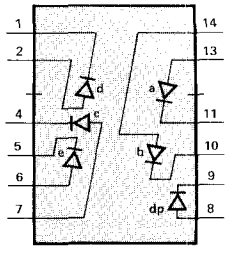
A



B



C



D

Absolute Maximum Ratings

DC Power Dissipation Per Segment or D.P.[1] (T_A=25°C) 50mW
Operating Temperature Range ..... −20°C to +85°C
Storage Temperature Range ..... −20°C to +85°C
Peak Forward Current Per Segment or D.P[3] (T_A=25°C) 60mA
DC Forward Current Per Segment or D.P.[1,2] (T_A=25°C) 20mA
Reverse Voltage Per Segment or D.P. 6.0V
Lead Soldering Temperature ..... 230°C for 3 Sec
[1.59mm (1/16 inch) below seating plane[4]]

Notes: 1. See power derating curve (Fig.2). 2. Derate average current from 50°C at 0.4mA/°C per segment. 3. See Maximum Tolerable Segment Peak Current vs. Pulse Duration curve, (Fig. 1). 4. Clean only in water, isopropanol, ethanol, Freon TF or TE (or equivalent) and Genesolv DI-15 or DE-15 (or equivalent).

Electrical/Optical Characteristics at T_A=25°C

HIGH EFFICIENCY RED 5082-7650/-7651/-7653/-7656

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment[5,8]	I_v	5mA D.C.	135	300		μcd
		20mA D.C.		1720		μcd
(Digit Average)		60mA Pk: 1 of 6 Duty Factor		970		μcd
Peak Wavelength	λ_{PEAK}			635		nm
Dominant Wavelength[6]	λ_d			626		nm
Forward Voltage/Segment or D.P.	V_F	I_F = 5mA		1.7		V
		I_F = 20mA		2.0	2.5	
		I_F = 60mA		2.8		
Reverse Current/Segment or D.P.	I_R	V_R = 6V		10		μA
Response Time[7]	t_r, t_f			90		ns
Temperature Coefficient of V_F/Segment or D.P.	ΔV_F/°C			−2.0		mV/°C

YELLOW 5082-7660/-7661/-7663/-7666

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment[5,8]	I_v	5mA D.C.	100	250		μcd
		20mA D.C.		1500		μcd
(Digit Average)		60mA Pk: 1 of 6 Duty Factor		925		μcd
Peak Wavelength	λ_{PEAK}			583		nm
Dominant Wavelength[6]	λ_d			585		nm
Forward Voltage/Segment or D.P.	V_F	I_F = 5mA		1.8		V
		I_F = 20mA		2.2	2.5	
		I_F = 60mA		3.1		
Reverse Current/Segment or D.P.	I_R	V_R = 6V				μA
Response Time[7]	t_r, t_f			90		ns
Temperature Coefficient of V_F/Segment or D.P.	V_F/°C			−2.0		mV/°C

GREEN 5082-7670/-7671/-7673/-7676

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment[5,8]	I_v	10mA D.C.	125	250		μcd
		20mA D.C.		640		μcd
(Digit Average)		60mA Pk: 1 of 6 Duty Factor		450		μcd
Peak Wavelength	λ_{PEAK}			565		nm
Dominant Wavelength[6]	λ_d			572		nm
Forward Voltage/Segment or D.P.	V_F	I_F = 10mA		1.9		V
		I_F = 20mA		2.2	2.5	
		I_F = 60mA		2.9		
Reverse Current/Segment or D.P.	I_F	V_R = 6V		10		μA
Response Time[7]	t_r, t_f			90		ns
Temperature Coefficient of V_F/Segment or D.P.	ΔV_F/°C			−2.0		mV/°C

NOTES: 5. The digits are categorized for luminous intensity with the intensity category designated by a letter located on the right hand side of the package.
6. 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.
7. Time for a 10% - 90% change of light intensity for step change in current.
8. Temperature coefficient of luminous intensity I_v/°C is determined by the formula: $I_{v\,T_A} = I_{v\,25°C}\,(.982)^{[T_A - 25°C]}$

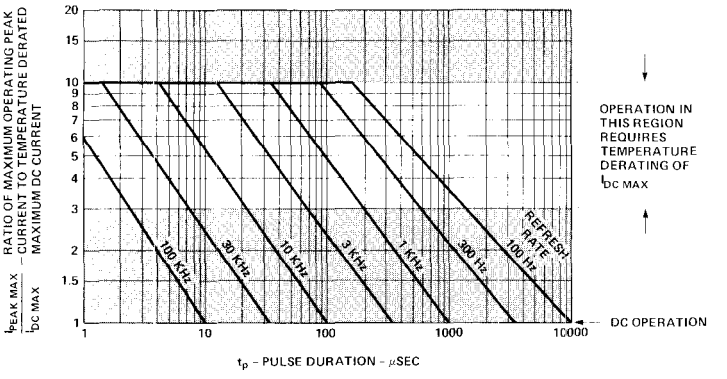


Figure 1. Maximum Tolerable Peak Current vs. Pulse Duration.

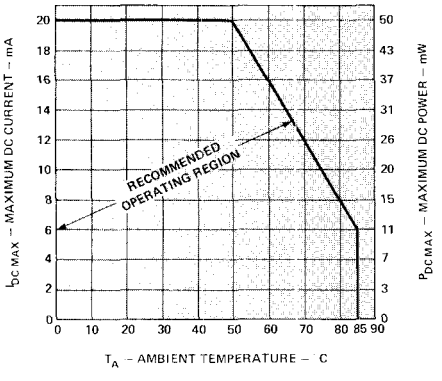


Figure 2. Maximum Allowable DC Current and DC Power Dissipation Per Segment as a Function of Ambient Temperature.

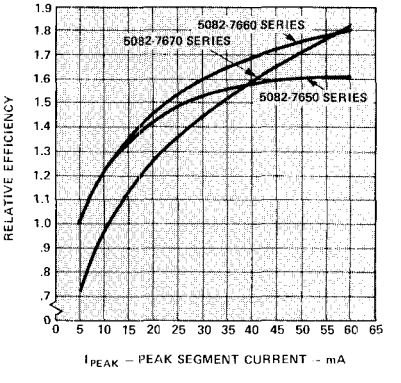


Figure 3. Relative Luminous Efficiency (Luminous Intensity per Unit Current) vs. Peak Segment Current.

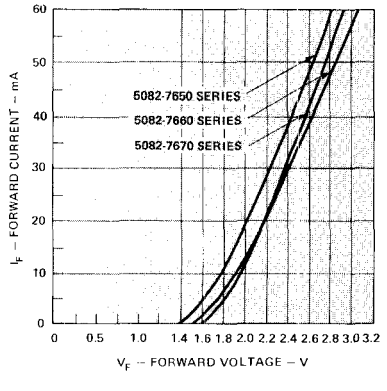


Figure 4. Forward Current vs. Forward Voltage Characteristic.

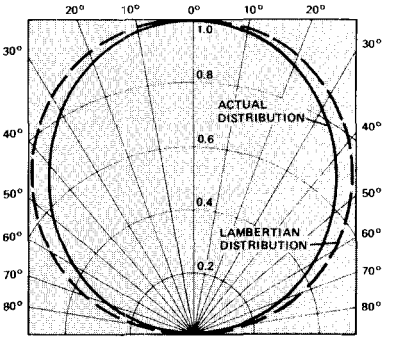


Figure 5. Normalized Angular Distribution of Luminous Intensity.

Operational Considerations

ELECTRICAL

The 5082-7600 series of display products are arrays of eight light emitting diodes which are optically magnified to form seven individual segments plus a decimal point.

The diodes in these displays utilize a Gallium Arsenide Phosphide junction on a Gallium Phosphide substrate to produce high efficiency red and yellow emission spectra and a Gallium Phosphide junction for the green. In the case of the red displays, efficiency is improved by at least a factor of 4 over the standard Gallium Arsenide Phosphide based technology. The use of Gallium Phosphide as the substrate does result in an internal dynamic resistance in the range of 12-48Ω. It is this resistance which causes the substantially higher forward voltage specifications in the new devices.

The user should be careful to scale the appropriate forward voltage from the V_F versus I_F curve, Figure 4, when designing for a particular forward current. Another way to obtain V_F would be to use the following formula:

$$V_F = V_{5mA} + R_S (I_F - 5mA)$$

where V_{5mA} and R_S are found in the following table:

Device	V_{5mA}	R_S
-7650 Series	1.65V	21Ω
-7660 Series	1.75V	25Ω
-7670 Series	1.85V	19Ω

Figure 1 relates refresh rate, f, and pulse duration, t_P, to a ratio which defines the maximum desirable operating peak current as a function of derated dc current, $I_{P\ MAX}/I_{DC\ MAX}$. To most effectively utilize Figure 1, perform the following steps:

1. Determine desired duty factor.
   Example: Four digit display, duty factor = 1/4
2. Determine desired refresh rate, f. Use duty factor to calculate pulse duration, t_P.
   Note: ft_P = Duty Factor
   Example: f=1 kHz; t_P=250 μsec
3. Enter Figure 1 at the calculated t_P. Move vertically to the refresh rate line and then record the corresponding value of $I_{P\ MAX}/I_{DC\ MAX}$.
   Example: At t_P=250 μsec and f=1 kHz,
   $I_{P\ MAX}/I_{DC\ MAX}$=2.5
4. From Figure 2, determine the value for $I_{DC\ MAX}$.
   Note: $I_{DC\ MAX}$ is derated above T_A=50° C
   Example: At T_A=70° C, $I_{DC\ MAX}$=12mA
5. Calculate $I_{P\ MAX}$ from $I_{P\ MAX}/I_{DC\ MAX}$ ratio and calculate I_{AVG} from I_P and duty factor.
   Example: I_P = (2.5) (12mA) = 30mA peak
   I_{AVG}=(1/4) (30mA) = 7.5mA average.

   The above calculations determine the maximum tolerable strobing conditions. Operation at a reduced peak current or duty factor is suggested to help insure even more reliable operation.

Refresh rates of 1kHz or faster provide the most efficient operation resulting in the maximum possible time average luminous intensity.

These displays may be operated in the strobed mode at currents up to 60mA peak. When operating at peak currents above 5mA for red and yellow or 10mA for green, there will be an improvement in the relative efficiency of the display (see Figure 3). Light output at higher currents can be calculated using the following relationship:

$$I_{V\ TIME\ AVG} = \left[\frac{I_{AVG}}{I_{AVG\ SPEC}}\right]\left[\frac{\eta I_{PEAK}}{\eta I_{PEAK\ SPEC}}\right]\left[I_{V\ SPEC}\right]$$

I_{AVG} = Operating point average current

$I_{AVG\ SPEC}$ = Average current for data sheet luminous intensity value, $I_{V\ SPEC}$

ηI_{PEAK} = Relative efficiency at operating peak current.

$\eta I_{PEAK\ SPEC}$ = Relative efficiency at data sheet peak current where luminous intensity $I_{V\ SPEC}$ is specified.

$I_{V\ SPEC}$ = Data sheet luminous intensity, specified at $I_{AVG\ SPEC}$ and $I_{PEAK\ SPEC}$.

Example: I_P = 40mA and I_{AVG} = 10mA:

$$I_{V\ TIME\ AVG} = \left(\frac{10mA}{5mA}\right)\left(\frac{1.58}{1}\right)(300\mu d) = 948\mu cd/seg.$$

CONTRAST ENHANCEMENT

The 5082-7600 series devices have been optimized for use in actual display systems. In order to maximum "ON-OFF" contrast, the bodies of the displays have been painted to match the appearance of an unilluminated segment. The emission wavelength of the red displays has been shifted from the standard GaAsP – 655nm to 635nm in order to provide an easier to read device.

All of the colored display products should be used in conjunction with contrast enhancing filters. Some suggested contrast filters: for red displays, Panelgraphic Scarlet Red 65 or Homalite 1670; for yellow displays, Panelgraphic Amber 23 or Homalite (100-1720, 100-1726); for green, Panelgraphic Green 48 or Homalite (100-1440, 100-1425). Another excellent contrast enhancement material for all colors is the 3M light control film.

MECHANICAL

The 5082-7600 series devices are constructed utilizing a lead frame in a standard DIP package. The individual packages may be close-packed on 12.7mm (.5 in.) centers on a PC board. Also, the larger character height allows other character spacing options when desired. The leadframe has an integral seating plane which will hold the package approximately 1.52mm (.060 in.) above the PC board during standard soldering and flux removal operation. To optimize device performance, new materials are used that are limited to certain solvent materials for flux removal. It is recommended that only mixtures of Freon and alcohol be used for post solder vapor cleaning processes with an immersion time in the vapors up to two minutes maximum. Suggested products are Freon TF, Freon TE, Genesolv DI-15 and Genesolv DE-15. Isopropanol, Ethanol or water may also be used for cleaning operations.