OPTOELECTRONICS DESIGNER'S CATALOG 1977

Hewlett-Packard Components

OPTOELECTRONICS DESIGNER'S CATALOG 1977

A decade of intensive solid state research, the development of advanced manufacturing techniques and continued expansion has enabled Hewlett-Packard to become a high volume supplier of quality, competitively priced LED displays, LED lamps, isolators, and photodetectors.

In addition to our broad product line, Hewlett-Packard also offers the following services: immediate delivery from any of our authorized stocking distributors, applications support, special QA testing, and a one year guarantee on all of our optoelectronic products.

This package of products and services has enabled Hewlett-Packard to become a recognized leader in the optoelectronic industry.

A BRIEF SKETCH

Hewlett-Packard is one of the world's leading designers and manufacturers of electronic, medical, analytical, and computing instruments and systems, diodes, transistors, and optoelectronic products. Since its founding in Palo Alto, California, in 1939, HP has done its best to offer only products that represent significant technological advancements.

To maintain its leadership in instrument and component technology, Hewlett-Packard invests heavily in new product development. Research and development expenditures traditionally average about 10 percent of sales revenue, and 1,500 engineers and scientists are assigned the responsibilities of carrying out the company's various R and D projects.

HP produces more than 3,500 products at 30 domestic divisions in California, Colorado, Oregon, Idaho, Massachusetts, New Jersey and Pennsylvania and at overseas plants located in the German Federal Republic, Scotland, France, Japan, Singapore, Malaysia and Brazil.

However, for the customer, Hewlett-Packard is no farther away than the nearest telephone. Hewlett-Packard currently has sales and service offices located around the world.

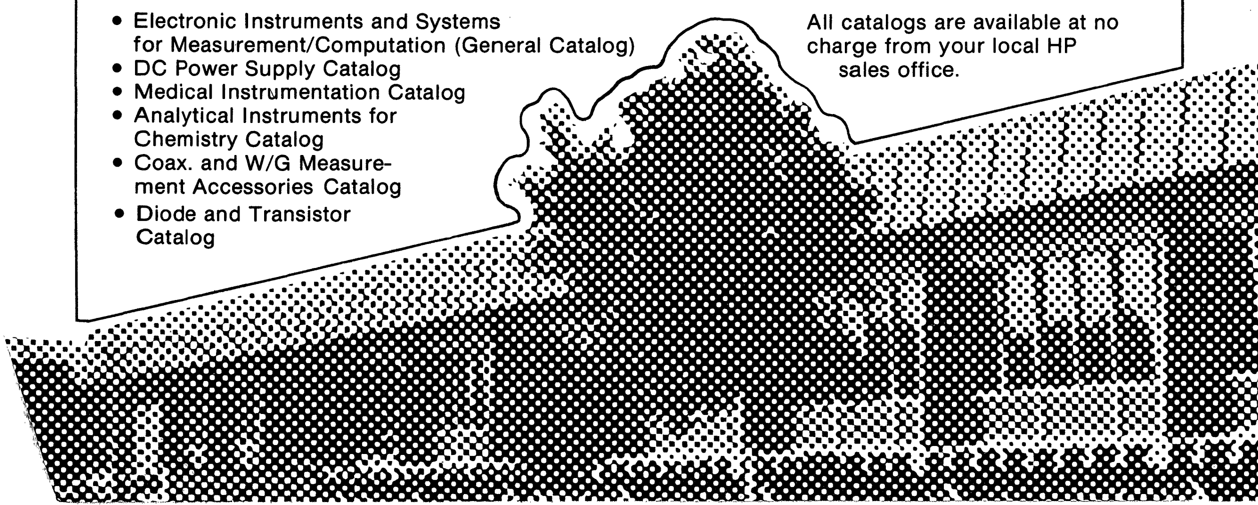
These field offices are staffed by trained engineers, each of whom has the primary responsibility of providing technical assistance and data to customers. A vast communications network has been established to link each field office with the factories and with corporate offices. No matter what the product or the request, a customer can be accommodated by a single contact with the company.

Hewlett-Packard is guided by a set of written objectives. One of these is "to provide products and services of the greatest possible value to our customers". Through application of advanced technology, efficient manufacturing, and imaginative marketing, it is the customer that the more than 30,000 Hewlett-Packard people strive to serve. Every effort is made to anticipate the customer's needs, to provide the customer with products that will enable more efficient operation, to offer the kind of service and reliability that will merit the customer's highest confidence, and to provide all of this at a reasonable price.

To better serve its many customers' broad spectrum of technological needs, Hewlett-Packard publishes several catalogs. Among these are:

- Electronic Instruments and Systems for Measurement/Computation (General Catalog)
- DC Power Supply Catalog
- Medical Instrumentation Catalog
- Analytical Instruments for Chemistry Catalog
- Coax. and W/G Measurement Accessories Catalog
- Diode and Transistor Catalog

All catalogs are available at no charge from your local HP sales office.



ABOUT THIS CATALOG

This Optoelectronics Designer's Catalog contains detailed, up-to-date specifications on our complete optoelectronic product line. It is divided into five major product sections: Solid State Lamps, Solid State Displays, Optocouplers, Emitters, and PIN Photodiodes. It also includes an Index on optoelectronic Application Notes which are available from any of the Hewlett-Packard Sales and Service Offices listed on page 150, and from any of the Distributors listed on page 198.

How To Use This Catalog

Three methods are incorporated for locating components:

- a Table of Contents that allows you to locate components by their general description,
- a Numeric Index that lists all components by part number, and
- a Selection Guide for each product group giving a brief overview of the product line.

How To Order

All Hewlett-Packard components may be ordered through any of the Sales and Service Offices listed on page 200. In addition, for immediate delivery of Hewlett-Packard optoelectronic components, contact any of the world-wide stocking distributors listed on page 198.

Hewlett-Packard assumes no responsibility for the use of any circuits described herein and makes no representations or warranties, express or implied, that such circuits are free from patent infringement.

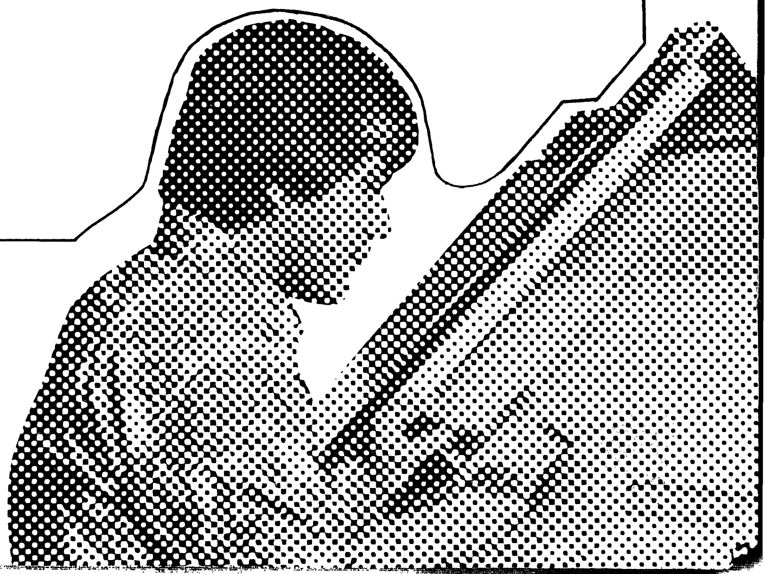
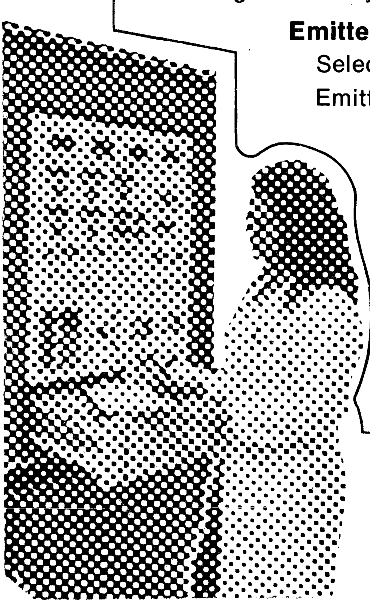


TABLE OF CONTENTS



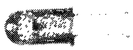
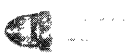
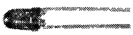
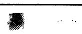
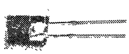
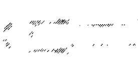
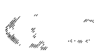
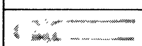
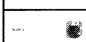
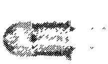
NUMERIC INDEX

Notes: 1. EIA Registered. Part No. changed. 2. Part No. changed.

OPTOELECTRONICS DESIGNER'S CATALOG 1977

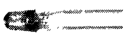
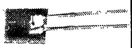
Solid State Lamps

High Efficiency Red, Yellow, Green LED Lamps

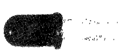
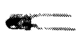
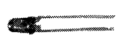
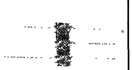
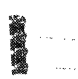
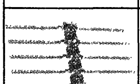
Device		Description							
Photo	Part No. 5082-	Color	Emitting Material	Lens	Package	Typical Luminous Intensity	2Θ½ [1]	Typical Forward Voltage	Page No.
	4650	High Efficiency Red (635nm)[2]	GaAsp on GaP	Red Diffused	T-1¾; Plastic; Long, General Purpose Leads[3]	2.0mcd @10mA	90°	2.2 Volts @10mA	26
	4655					4.0mcd @10mA			
	4657			Red Non-Diffused		12.0mcd @10mA	35°		
	4658					24.0mcd @10mA			
	4690			Red Diffused	T-1¾ (Low Profile) Plastic; Long, General Purpose Leads	3.5mcd @10mA	50°		20
	4693					7.0mcd @10mA			
	4694			Red Non-Diffused		8.0mcd @10mA	45°		
	4695					11.0mcd @10mA			
	4684			Red Diffused	T-1; Plastic; Long Leads[4]	2.5mcd @10mA	70°		34
	4160			Red Diffused	Submin.; Plastic; Radial Leads	3.0mcd @10mA	80°		16
	4670			Red Diffused	Rectangular; Plastic; Long, Gen. Purpose Leads	1.0mcd @ 15mA	100°		30
	4550	Yellow (583nm)[2]	GaAsP on GaP	Yellow Diffused	T-1¾; Plastic; Long General Purpose Leads[3]	1.8mcd @10mA	90°	2.2 Volts @10mA	26
	4555					3.0mcd @10mA			
	4557			Yellow Non-Diffused		9.0mcd @10mA	35°		
	4558					16.0mcd @10mA			
	4590			Yellow Diffused	T-1¾ (Low Profile) Plastic; Long, General Purpose Leads	3.5mcd @10mA	50°		20
	4592					6.0mcd @10mA			
	4595			Yellow Non-Diffused		6.5mcd @10mA	45°		
	4597					11.0mcd @10mA			
	4584			Yellow Diffused	T-1; Plastic; Long Leads[4]	2.5mcd @10mA	60°		34
	4150			Yellow Diffused	Submin.; Plastic; Radial Leads	2.0mcd @10mA	90°		16
	4570			Yellow Diffused	Rectangular; Plastic; Long, Gen. Purpose Leads	1.2mcd @ 15mA	100°		30
	4950	Green (565nm)[2]	GaP	Green Diffused	T-1¾; Plastic; Long General Purpose Leads[3]	1.8mcd @20mA	90°	2.4 Volts @20mA	26
	4955					3.0mcd @20mA			
	4957			Green Non-Diffused		9.0mcd @20mA	30°		
	4958					16.0mcd @20mA			
	4990			Green Diffused	T-1¾ (Low Profile) Plastic; Long General Purpose Leads	4.5mcd @20mA	50°		20
	4992					7.5mcd @20mA			
	4995			Green Non-Diffused		6.5mcd @20mA	40°		
	4997					11.0mcd @20mA			

NOTES: See Page 3.

For Applications Information, see pages 196 – 197.

Device		Description				Typical Luminous Intensity	2Θ½ [1]	Typical Forward Voltage	Page No.
Photo	Part No. 5082-	Color	Emitting Material	Lens	Package				
	4984	Green (565nm)[2]	GaP	Green Diffused	T-1; Plastic; Long Leads[4]	2.0mcd @20mA	60°	2.4 Volts @20mA	34
	4190			Green Diffused	Submin.; Plastic; Radial Leads	1.5mcd @20mA	70°		16
	4970			Green Diffused	Rectangular; Plastic; Long, Gen. Purpose Leads	1.2mcd @ 20mA	100°		30

Red LED Lamps

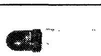
Device		Description				Typical Luminous Intensity	2Θ½ [1]	Typical Forward Voltage	Page No.
Photo	Part No. 5082-	Color	Emitting Material	Lens	Package				
	4850	Red (655nm)[2]	GaAsP on GaAs	Red Diffused	T-1¾; Plastic; Long Wire Wrap. Leads[3]	0.8mcd @20mA	95°	1.6 Volts @20mA	12
	4855					1.4mcd @20mA			
	4484				T-1; Plastic; Long Leads[4]	0.8mcd @20mA	120°		
	4494					1.4mcd @20mA			
	4790			Red Diffused	T-1¾ (Low Profile) Plastic; Long, Gen. Purpose Leads	1.2mcd @20mA	60°	1.6 Volts @20mA	20
	4791					2.5mcd @20mA			
	4480			Red Diffused	T-1; Plastic; Long Leads[4]	0.8mcd @20mA	120°	1.6 Volts @20mA	8
	4483			Clear Diffused					
	4486			Clear Non-Diffused			80°		
	4487			Clear Non-Diffused	T-1 (Low Profile); Plastic; Long Leads[4]	0.8mcd @20mA	120°	1.6 Volts @20mA	10
	4488					Guaranteed Min. 0.3mcd @20mA			
	4100			Red Diffused	Submin.; Plastic; Radial Leads	0.5mcd @10mA	45°	1.6 Volts @10mA	16
	4101					1.0mcd @10mA			
	HLMP-6203			Red Diffused	Array; Plastic Radial Leads	1.0mcd @ 10mA	45°	1.6 Volts @ 10mA	14
	HLMP-6204								
	HLMP-6205								

NOTES: 1. Θ½ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
2. Peak Wavelength.
3. Panel Mountable. For Panel Mounting Kit, see page 48.
4. PC Board Mountable.

For Applications Information, see pages 196-197.

Device		Description				Typical Luminous Intensity	2Θ½ [1]	Typical Forward Voltage	Page No.
Photo	Part No. 5082-	Color	Emitting Material	Lens	Package				
 4403/4440	4403	Red (655nm)[2]	GaAsP on GaAs	Red Diffused	T-1¾; Plastic; Short, Leads[3]	1.2mcd @20mA	75°	1.6 Volts @20mA	6
	4415				T-1¾; Plastic; Short, Bent Leads[4]				
 4415/4444	4440				T-1¾; Plastic; Short Leads[3]	0.7mcd @20mA			
	4444				T-1¾; Plastic; Short, Bent Leads[4]				
	4880			Red Diffused	T-1¾; Plastic; Long Wire Wrap. Leads[3]	0.8mcd @20mA	58°	1.6 Volts @20mA	6
	4883			Clear Non-Diffused			50°		
	4886			Clear Diffused			65°		
	4881			Red Diffused		1.3mcd @20mA	58°		
	4884			Clear Non-Diffused			50°		
	4887			Clear Diffused			65°		
	4882			Red Diffused		1.8mcd @20mA	58°		
	4885			Clear Non-Diffused			50°		
	4888			Clear Diffused			65°		

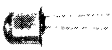
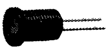
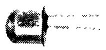
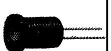
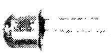
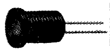
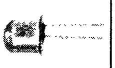
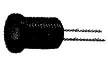
Integrated LED Lamps

Device		Description				Typical Luminous Intensity	2Θ½ [1]	Typical Forward Current	Page No.
Photo	Part No. 5082-	Color	Integration	Lens	Package				
	4732	Red (655nm) [2]	Voltage Sensing IC integrated with GaAsP LED chip	Red Diffused	T-1; Plastic; Long Leads[4]	0.7mcd @2.75V	95°	13mA @ 2.75V	38
	4860		Resistor chip integrated with GaAsP LED chip	Red Diffused	T-1¾; Plastic; Long Leads[3]	0.8mcd @5.0V	58°	16mA @ 5.0V	40
	4468			Clear Diffused	T-1; Plastic; Long Leads[4]		70°		

NOTES:
1. Θ½ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
2. Peak Wavelength.
3. Panel Mountable. For Panel Mounting Kit, see page 48.
4. PC Board Mountable.

For Applications Information, see pages 196-197.

Hermetically Sealed LED Lamps

Device		Description				Minimum Luminous Intensity	2Θ½ [1]	Typical Forward Voltage	Page No.
Photo	Part No.	Color	Emitting Material	Lens	Package				
	1N5765 JAN 1N5765[5] JAN TX 1N5765[5] (5082-4420)	Red (655nm)[2]	GaAsP on GaAs	Red Diffused	Hermetic/TO-46; Long Leads[4]	0.5mcd @ 20mA	70°	1.6 Volts @ 20mA	42
	5082-4787[6]				Panel Mount				
	1N6092[6] (5082-4620)	High Eff. Red (635nm)[2]	GaAsP on GaP	Red Diffused	Hermetic/TO-46 Long Leads[4]	1.0mcd @ 20mA		2.0 Volts @ 20mA	
	5082-4687[6]				Panel Mount				
	1N6093[6] (5082-4520)	Yellow (583nm)[2]	GaAsP on GaP	Yellow Diffused	Hermetic/TO-46 Long Leads[4]				
	5082-4587[6]				Panel Mount				
	1N6094[6] (5082-4920)	Green (565nm)[2]	GaP	Green Diffused	Hermetic/TO-46 Long Leads[4]	0.8mcd @ 25mA		2.1 Volts @ 25mA	
	5082-4987[6]				Panel Mount				

NOTES:
1. Θ½ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
2. Peak Wavelength.
3. Panel Mountable. For Panel Mounting Kit, see page 48.
4. PC Board Mountable.
5. Military Approved and qualified for High Reliability Applications.
6. Military Approved and qualified JAN and JAN TX versions of this part are now available.

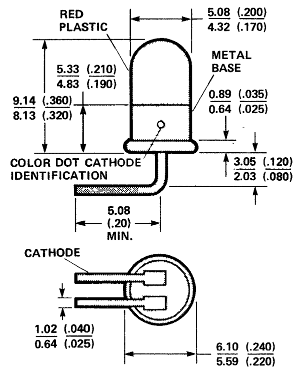
For Applications Information, see pages 196-197.

HEWLETT PACKARD COMPONENTS	SOLID STATE LAMPS	5082-4403 5082-4415 5082-4440 5082-4444 5082-4880 SERIES

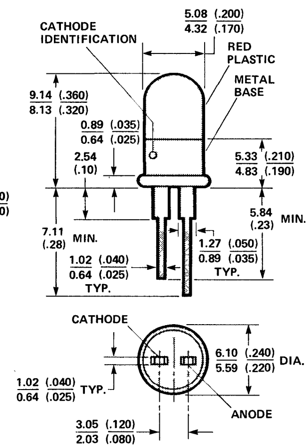
TECHNICAL DATA APRIL 1977

Features

- EASILY PANEL MOUNTABLE
- HIGH BRIGHTNESS OVER A WIDE VIEWING ANGLE
- RUGGED CONSTRUCTION FOR EASE OF HANDLING
- STURDY LEADS ON 25.4mm (0.10 in.) CENTERS
- IC COMPATIBLE/LOW POWER CONSUMPTION
- LONG LIFE



5082-4415
5082-4444

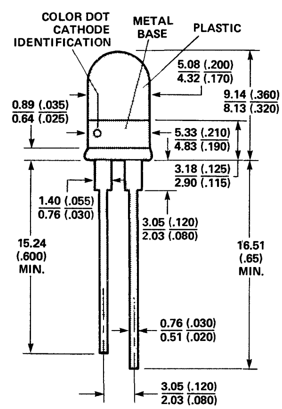


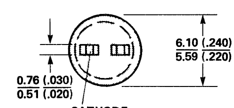
5082-4403
5082-4440

CATHODE COLOR DOT IDENTIFICATION	
5082-4403	WHITE DOT
5082-4440	ORANGE DOT
5082-4415	WHITE DOT
5082-4444	ORANGE DOT

DIMENSIONS IN MILLIMETRES AND (INCHES)

-4880 SERIES





CATHODE COLOR DOT IDENTIFICATION	
5082-4880, -4883, -4886	GREEN DOT
5082-4881, -4884, -4887	BLUE DOT
5082-4882, -4885, -4888	YELLOW DOT

Description

The 5082-4403, -4415, -4440, -4444 and the -4880 series are plastic encapsulated Gallium Arsenide Phosphide Light Emitting Diodes. They radiate light in the 655 nanometer (red light) region.

The 5082-4403 and -4440 are LEDs with a red diffused plastic lens, providing high visibility for circuit board or panel mounting with a clip.

The 5082-4415 and -4444 have the added feature of a 90° lead bend for edge mounting on circuit boards.

The 5082-4880 series is available in three different lens configurations. These are Red Diffused, Untinted Diffused, and Clear.

The Red Diffused lens provides an excellent off/on contrast ratio. The Clear lens is designed for applications where a point source is desired. It is particularly useful where the light must be focused or diffused with external optics. The Untinted Diffused lens is useful in masking the red color in the off condition.

LED SELECTION GUIDE

MINIMUM LIGHT OUTPUT (mcd)	LONG LEAD (UNBENT)		
	Red Diffused Lens	Clear Plastic Lens	Untinted Diffused Lens
0.5	5082-4880	5082-4883	5082-4886
1.0	5082-4881	5082-4884	5082-4887
1.6	5082-4882	5082-4885	5082-4888
	SHORT LEAD		
0.3	5082-4440	UNBENT	
0.8	5082-4403		
0.3	5082-4444	BENT	
0.8	5082-4415		

Maximum Ratings at T_A=25°C

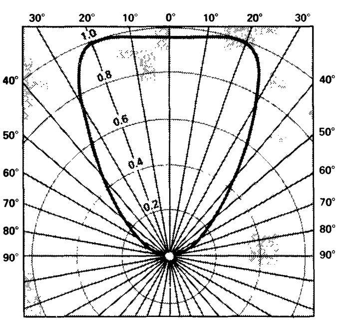
DC Power Dissipation .... 100 mW
(Derate linearly from 50°C at 1.6mW/°C.)
DC Forward Current .... 50 mA
Peak Transient Forward Current................. 1 Amp
(1μsec pulse width, 300 pps)
Isolation Voltage (between lead and base) .... 300 V
Operating and Storage
Temperature Range ....-55°C to +100°C
Lead Soldering Temperature .... 230°C for 7 sec

Electrical Characteristics at $T_A = 25°C$

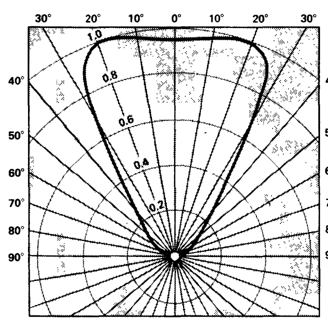
Symbol	Parameter	5082-4403 5082-4415 Min.	Typ.	Max.	5082-4440 5082-4444 Min.	Typ.	Max.	5082-4880 5082-4883 5082-4886 Min.	Typ.	Max.	5082-4881 5082-4884 5082-4887 Min.	Typ.	Max.	5082-4882 5082-4885 5082-4888 Min.	Typ.	Max.	Units	Test Conditions
I_V	Luminous Intensity	0.8	1.2		0.3	0.7		0.5	0.8		1.0	1.3		1.6	1.8		mcd	$I_F = 20mA$
λ_{PEAK}	Wavelength		655			655			655			655			655		nm	Measurement at Peak
τ_s	Speed of Response		15			15			15			15			15		ns	
C	Capacitance		200			200			200			200			200		pF	
θ_{JC}	Thermal Resistance		100			100			87			87			87		°C/W	Junction to Cathode Lead
V_F	Forward Voltage		1.6	2.0		1.6	2.0		1.6	2.0		1.6	2.0		1.6	2.0	V	$I_F = 20mA$
BV_R	Reverse Breakdown Voltage	3	10		3	10		3	10		3	10		3	10		V	$I_R = 100\mu A$

TYPICAL RELATIVE LUMINOUS INTENSITY VERSUS ANGULAR DISPLACEMENT

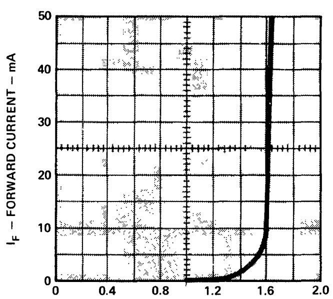
44XX



4880, 4881, 4882

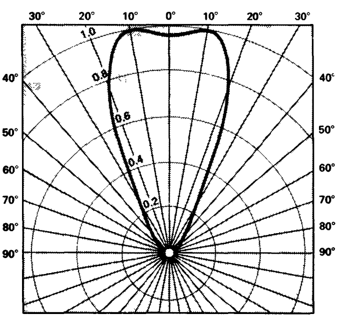


FORWARD CURRENT VS. VOLTAGE CHARACTERISTICS

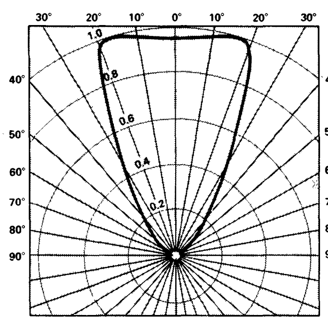


FORWARD CURRENT – VOLTAGE CHARACTERISTICS

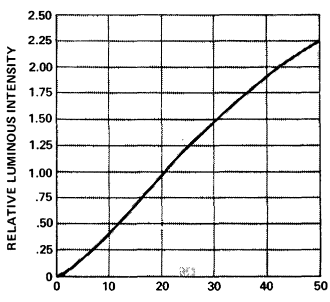
4883, 4884, 4885



4886, 4887, 4888



LUMINOUS INTENSITY VS. FORWARD CURRENT (I_F)



I_F – FORWARD CURRENT – mA

HEWLETT hp PACKARD
COMPONENTS

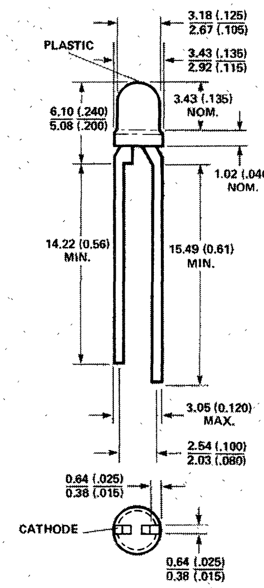
SOLID STATE LAMPS

5082-4480 SERIES

TECHNICAL DATA APRIL 1977

Features

- HIGH INTENSITY: 0.8mcd TYPICAL
- WIDE VIEWING ANGLE
- SMALL SIZE T-1 DIAMETER 3.18mm (0.125")
- IC COMPATIBLE
- RELIABLE AND RUGGED



DIMENSIONS IN MILLIMETERS AND (INCHES).

Description

The 5082-4480 is a series of Gallium Arsenide Phosphide Light Emitting Diodes designed for applications where space is at a premium, such as in high density arrays.

The 5082-4480 series is available in three lens configurations.

5082-4480 – Red Diffused lens provides excellent on-off contrast ratio, high axial luminous intensity, and wide viewing angle.

5082-4483 – Same as 5082-4480, but Untinted Diffused to mask red color in the "off" condition.

5082-4486 – Clear plastic lens provides a point source. Useful when illuminating external lens, annunciators, or photo-detectors.

PART NO.	LENS CONFIGURATION
5082-4480	Red Diffused
5082-4483	Untinted Diffused
5082-4486	Clear Plastic

Maximum Ratings at $T_A = 25°C$

DC Power Dissipation 100mW
(Derate linearly from 50°C at 1.6mW/°C)

DC Forward Current 50mA

Peak Forward Current . . . . 1 Amp
(1 μsec pulse width, 300 pps)

Operating and Storage
Temperature Range . . . . –55°C to +100°C

Lead Soldering Temperature . . . . 230°C for 7 sec.

Electrical Characteristics at $T_A = 25°C$

Symbol	Parameters	5082-4480 5082-4483 5082-4486			Units	Test Conditions
		Min.	Typ.	Max.		
I_V	Luminous Intensity	0.3	0.8		mcd	$I_F = 20mA$
λ_{PEAK}	Wavelength		655		nm	Measurement at Peak
τ_s	Speed of Response		15		ns	
C	Capacitance		200		pF	$V_F = 0$, f = 1MHz
θ_{JC}	Thermal Resistance		270		°C/W	Junction to Cathode Lead
V_F	Forward Voltage		1.6	2.0	V	$I_F = 20mA$
BV_R	Reverse Breakdown Voltage	3	10		V	$I_R = 10\mu A$

5082-4480 AND 5082-4483

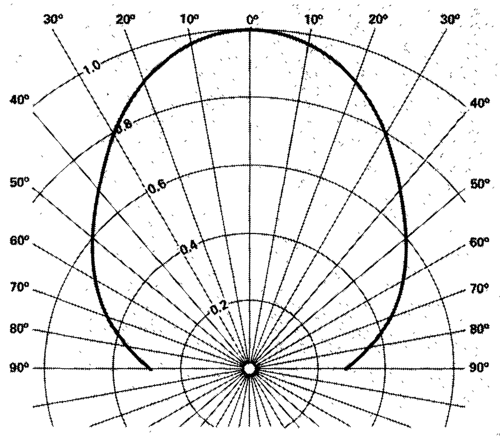


Figure 1. Relative Luminous Intensity vs. Angular Displacement.

5082-4486

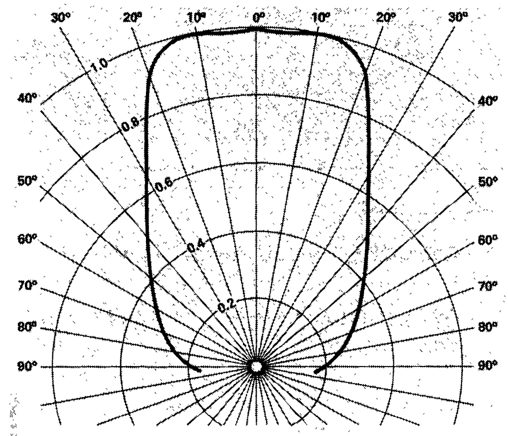


Figure 2. Relative Luminous Intensity vs. Angular Displacement.

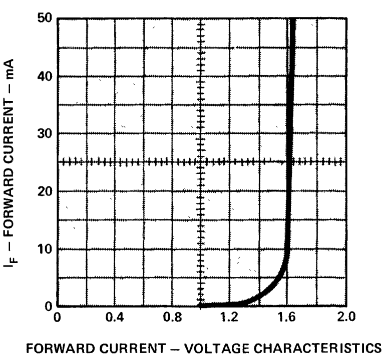


Figure 3. Forward Current vs. Voltage Characteristic.

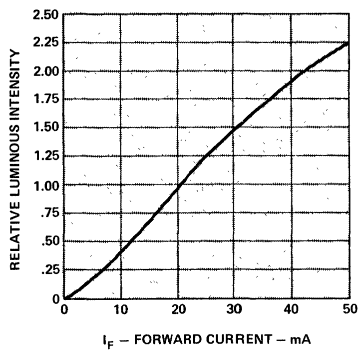


Figure 4. Luminous Intensity vs. Forward Current (I_F).

HEWLETT hp PACKARD
COMPONENTS

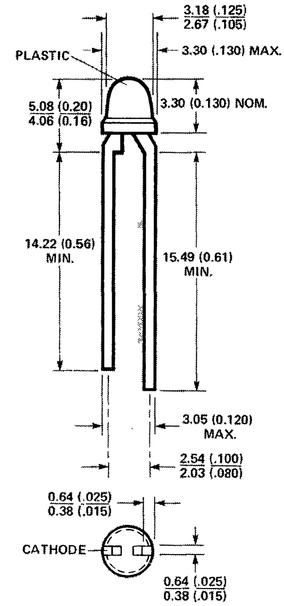
LOW PROFILE SOLID STATE LAMPS

5082-4487 5082-4488

TECHNICAL DATA APRIL 1977

Features

- LOW COST: BROAD APPLICATION
- LOW PROFILE: 4.57mm (0.18") LENS HEIGHT TYPICAL
- HIGH DENSITY PACKAGING
- LONG LIFE: SOLID STATE RELIABILITY
- LOW POWER REQUIREMENTS: 20mA @ 1.6V
- HIGH LIGHT OUTPUT: 0.8mcd TYPICAL



ALL DIMENSIONS ARE IN MILLIMETERS (INCHES).

Description

The 5082-4487 and 5082-4488 are Gallium Arsenide Phosphide Light Emitting Diodes for High Volume/ Low Cost Applications such as indicators for calculators, cameras, appliances, automobile instrument panels, and many other commercial uses.

The 5082-4487 is a clear lens, low profile T-1 LED lamp, and has a typical light output of 0.8 mcd at 20 mA.

The 5082-4488 is a clear lens, low profile T-1 LED lamp, and has a guaranteed minimum light output of 0.3 mcd at 20mA.

Absolute Maximum Ratings at T_A=25°C

DC Power Dissipation [Derate linearly from 50°C at 1.6mW/°C] 100mW
DC Forward Current 50mW
Peak Forward Current [1μsec pulse width, 300pps] . . . . 1 Amp
Operating and Storage Temperature Range . . . . −55°C to +100°C
Lead Soldering Temperature . . . . 230°C for 7 sec.

Electrical/Optical Characteristics at $T_A = 25°C$

Symbol	Parameters	5082-4487			5082-4488			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
I_V	Luminous Intensity		0.8		0.3	0.8		mcd	$I_F = 20mA$
λ_{PEAK}	Wavelength		655			655		nm	Measurement at Peak
τ_s	Speed of Response		10			10		ns	
C	Capacitance		100			100		pF	$V_F = 0$, f = 1MHz
V_F	Forward Voltage		1.6	2.0		1.6	2.0	V	$I_F = 20mA$
BV_R	Reverse Breakdown Voltage	3	10		3	10		V	$I_R = 100\mu A$

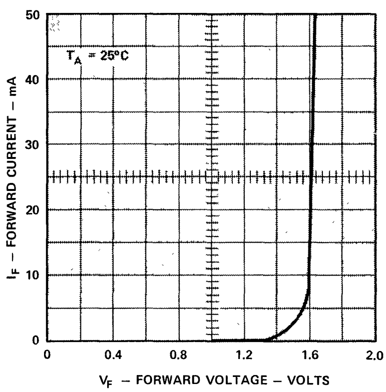


Figure 1. Typical Forward Current Versus Voltage Characteristic.

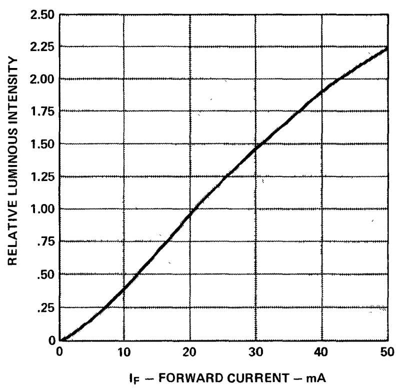


Figure 2. Typical Luminous Intensity Versus Forward Current.

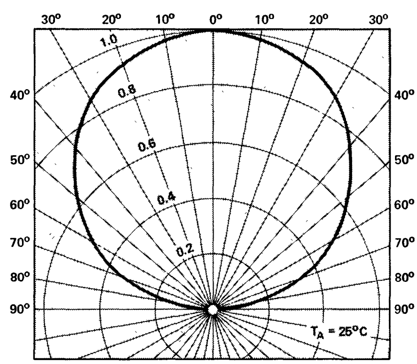


Figure 3. Typical Relative Luminous Intensity Versus Angular Displacement.

HEWLETT PACKARD

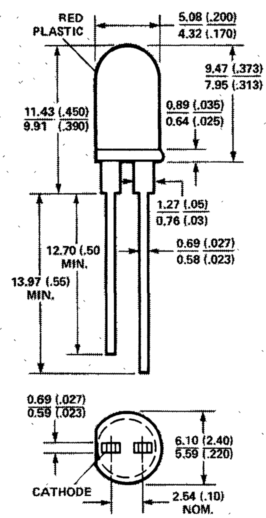
COMPONENTS

COMMERCIAL LIGHT EMITTING DIODES

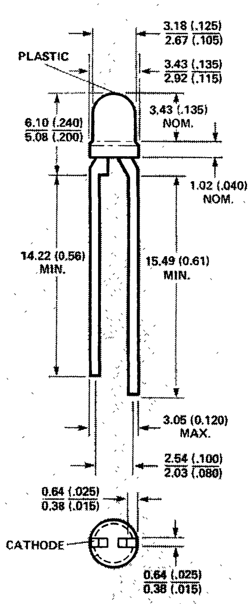
5082-4850
5082-4855
5082-4484
5082-4494

TECHNICAL DATA APRIL 1977

DIMENSIONS IN MILLIMETERS AND (INCHES)



5082-4850/4855



5082-4484/4494

Features

- **LOW COST: BROAD APPLICATION**
- **LONG LIFE: SOLID STATE RELIABILITY**
- **LOW POWER REQUIREMENTS: 20mA @ 1.6V**
- **HIGH LIGHT OUTPUT**
  0.8 mcd TYPICAL FOR 5082-4850/4484
  1.4 mcd TYPICAL FOR 5082-4855/4494
- **WIDE VIEWING ANGLE**
- **RED DIFFUSED LENS**

Description

The 5082-4850/4855 and 5082-4484/4494 are Gallium Arsenide Phosphide Light Emitting Diodes intended for **High Volume/Low Cost** applications such as indicators for appliances, automobile instrument panels and many other commercial uses.

The 5082-4850/4855 are T-1¾ lamp size, have red diffused lenses and can be panel mounted using mounting clip 5082-4707.

The 5082-4484/4494 are T-1 lamp size, have red diffused lenses and are ideal where space is at a premium, such as high density arrays.

Absolute Maximum Ratings at T_A=25°C

Power Dissipation 100mW
(Derate linearly from 50°C at 1.6mW/°C)

DC Forward Current 50mA

Peak Forward Current 1Amp
(1μsec pulse width, 300pps)

Operating and Storage
Temperature Range .... -55°C to +100°C

Lead Soldering Temperature .... 230°C for 7 sec.

Electrical Characteristics at $T_A = 25°C$

Symbol	Parameters	5082-4850			5082-4855			5082-4484			5082-4494			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
I_V	Luminous Intensity		0.8		0.8	1.4			0.8		0.8	1.4		mcd	$I_F = 20mA$
λ_{PEAK}	Wavelength		655			655			655			655		nm	Measurement at Peak
τ_s	Speed of Response		10			10			10			10		ns	
C	Capacitance		100			100			100			100		pF	$V_F = 0$, f = 1MHz
V_F	Forward Voltage		1.6	2.0		1.6	2.0		1.6	2.0		1.6	2.0	V	$I_F = 20mA$
BV_R	Reverse Breakdown Voltage	3	10		3	10		3	10		3	10		V	$I_R = 100\mu A$

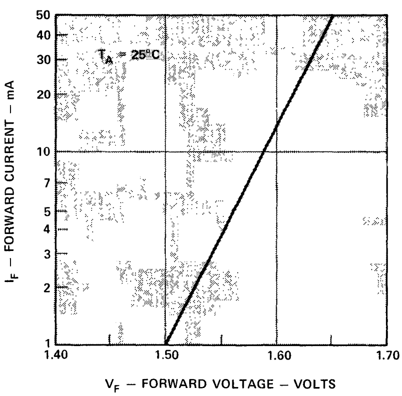


Figure 1. Forward Current Versus Forward Voltage Characteristic For 5082-4850/4855/4484/4494.

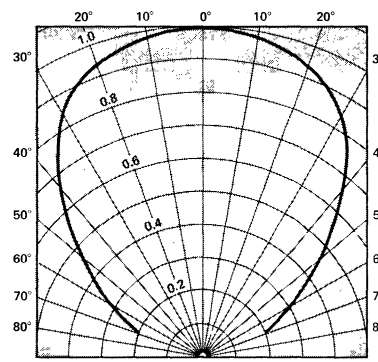


Figure 2. Relative Luminous Intensity Versus Angular Displacement For 5082-4850/4855.

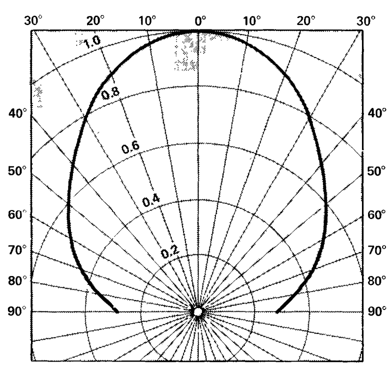


Figure 3. Relative Luminous Intensity Versus Angular Displacement For 5082-4484/4494.

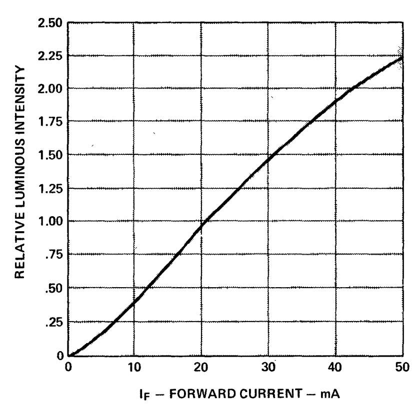


Figure 4. Relative Luminous Intensity Versus Forward Current For 5082-4850/4855/4484/4494.

HEWLETT hp PACKARD
COMPONENTS

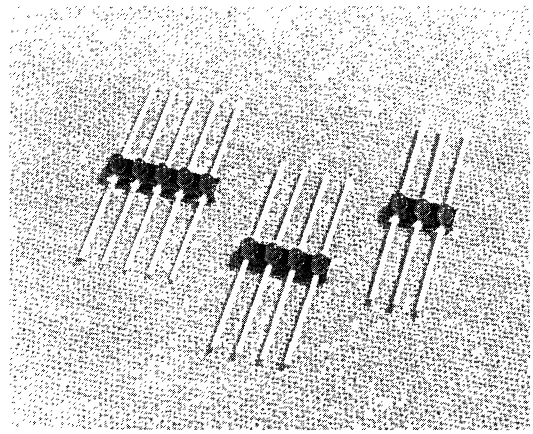
MATCHED ARRAYS OF SUBMINIATURE RED SOLID STATE LAMPS

3-ELEMENT • HLMP-6203
4-ELEMENT • HLMP-6204
5-ELEMENT • HLMP-6205

TECHNICAL DATA APRIL 1977

Features

- EXCELLENT UNIFORMITY BETWEEN ELEMENTS AND BETWEEN ARRAYS
- EASY INSERTION AND ALIGNMENT
- VERSATILE LENGTHS — 3,4,5 ELEMENTS
- END STACKABLE FOR LONGER ARRAYS
- COMPACT SUBMINIATURE PACKAGE STYLE
- NO CROSSTALK BETWEEN ELEMENTS



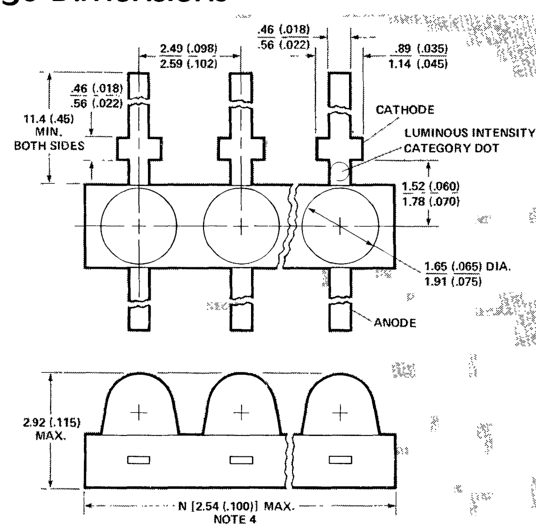
Description

The HLMP-62XX Series arrays are comprised of several Gallium Arsenide Phosphide Red Solid State Lamps molded as a single bar. Arrays are tested to assure uniformity between elements and matching between arrays. Each element has separately accessible leads and a red diffused lens which provides a wide viewing angle and a high on/off contrast ratio. Center-to-center spacing is 2.54mm (.100 in.) between elements and arrays are end stackable on 2.54mm (.100 in.) centers.

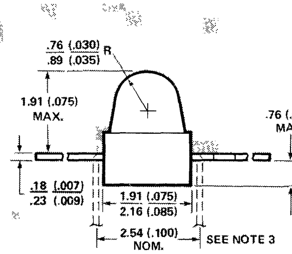
Absolute Maximum Ratings/Element at $T_A = 25°C$

Power Dissipation (derate linearly from 50° C at 1.6 mW/° C)	100 mW
Average Forward Current	50 mA
Peak Forward Current (see Figure 4)	1000 mA
Operating and Storage Temperature Range	-55° C to +100° C
Lead Soldering Temperature [1.6 mm (0.063 in.) from body]	230° C for 3 sec.

Package Dimensions



Notes:
1. All dimensions are in millimetres (inches).
2. Silver-plated leads. See Application Bulletin 3.
3. User may bend leads as shown.
4. Overall length is the number of elements times 2.54mm (.100 in.).



Electrical Specifications/Element at $T_A = 25°C$

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Axial Luminous Intensity	.5	1.0		mcd	I_F = 10 mA; Note 1	2
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points		45		Deg.	Note 2	5
λ_{PEAK}	Peak Wavelength		655		nm	Measurement @ Peak	
λ_d	Dominant Wavelength		640		nm	Note 3	
τ_s	Speed of Response		15		ns		
C	Capacitance		100		pF	V_F = 0; f = 1 MHz	
θ_{JC}	Thermal Resistance		125		°C/W	Junction to Cathode Lead at .79mm(.031in)from the body	
V_F	Forward Voltage		1.6	2.0	V	I_F = 10 mA	1
BV_R	Reverse Breakdown Voltage	3	10		V	I_R = 100 μA	
η_V	Luminous Efficacy		55		lm/W	Note 4	

Notes:
1. Arrays are categorized for luminous intensity with the intensity category designated by a color dot located on the cathode side of the package.
2. $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
3. Dominant wavelength, λ_d, is derived from the CIE Chromaticity Diagram and is that single wavelength which defines the color of the device.
4. Radiant intensity, I_e, in watts/steradian, may be found from the equation $I_e = I_v/\eta_v$, where I_v is the luminous intensity in candelas and η_v is the luminous efficacy in lumens/watt.

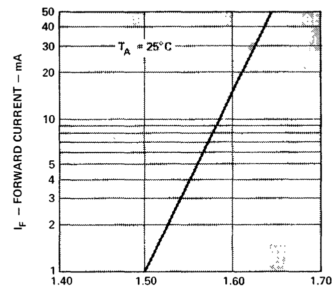


Figure 1. Forward Current vs. Forward Voltage.

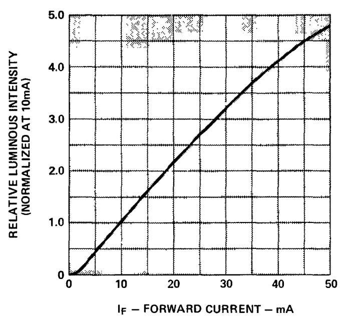


Figure 2. Relative Luminous Intensity vs. DC Forward Current.

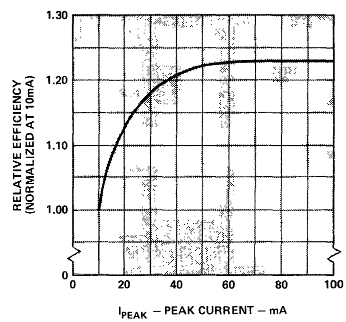


Figure 3. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

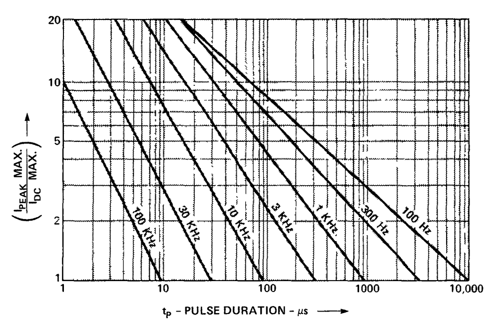


Figure 4. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings).

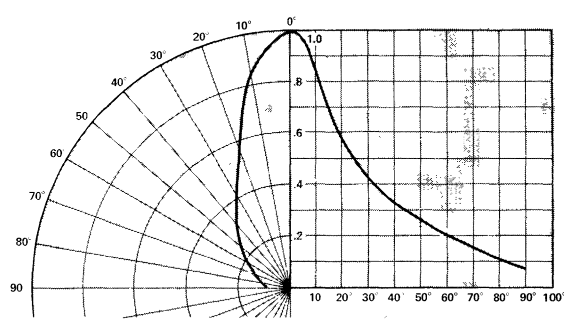


Figure 5. Relative Luminous Intensity vs. Angular Displacement.

HEWLETT PACKARD
COMPONENTS

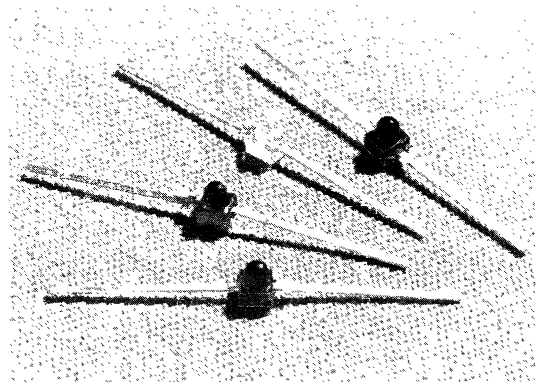
SUBMINIATURE SOLID STATE LAMPS

RED • 5082-4100/4101
HIGH EFFICIENCY RED • 5082-4160
YELLOW • 5082-4150
GREEN • 5082-4190

TECHNICAL DATA APRIL 1977

Features

- **SUBMINIATURE PACKAGE STYLE**
- **END STACKABLE ON 2.21mm (0.087 in.) CENTERS**
- **LOW PACKAGE PROFILE**
- **RADIAL LEADS**
- **WIDE VIEWING ANGLE**
- **LONG LIFE — SOLID STATE RELIABILITY**
- **CHOICE OF 4 BRIGHT COLORS**
  - **Red**
  - **High Efficiency Red**
  - **Yellow**
  - **Green**



Description

The 5082-4100/4101, 4150, 4160 and 4190 are solid state lamps encapsulated in a radial lead subminiature package of molded epoxy. They utilize a tinted, diffused lens providing high on-off contrast and wide-angle viewing.

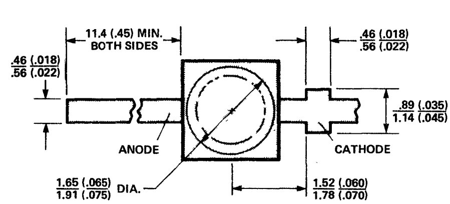
The -4100/4101 utilizes a GaAsP LED chip in a deep red molded package.

The -4160 has a high-efficiency red GaAsP on GaP LED chip in a light red molded package. This lamp's efficiency is comparable to that of the GaP red but does not saturate at low current levels.

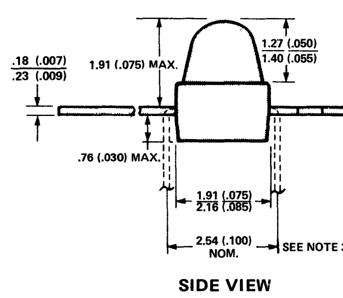
The -4150 provides a yellow GaAsP on GaP LED chip in a yellow molded package.

The -4190 provides a green GaP LED chip in a green molded package.

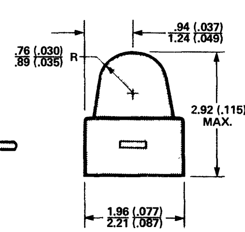
Package Dimensions



TOP VIEW



SIDE VIEW



END VIEW

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).
2. SILVER-PLATED LEADS. SEE APPLICATION BULLETIN 3.
3. USER MAY BEND LEADS AS SHOWN.

Absolute Maximum Ratings at T_A=25°C

Parameter	Red 4100/4101	High Eff. Red 4160	Yellow 4150	Green 4190	Units
Power Dissipation (derate linearly from 50°C at 1.6mW/°C)	100	120	120	120	mW
Average Forward Current	50	20	20	30	mA
Peak Forward Current	1000 See Fig. 5	60 See Fig. 10	60 See Fig. 15	60 See Fig. 20	mA
Operating and Storage Temperature Range	-55°C to 100°C				
Lead Soldering Temperature [1.6mm (0.063 in.) from body]	230°C for 3 seconds				

Electrical/Optical Characteristics at T_A=25°C

Symbol	Description	5082-4100/4101			5082-4160			5082-4150			5082-4190			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
I_v	Axial Luminous Intensity	–/0.5	.7/1.0		1.0	3.0		1.0	2.0		0.8 At I_F = 20mA	1.5		mcd	I_F=10mA, Figs. 3,8,13,18
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points		45			80			90			70		deg.	Note 1. Figures 6, 11, 16, 21
λ_{PEAK}	Peak Wavelength		655			635			583			565		nm	Measurement at Peak
λ_d	Dominant Wavelength		640			628			585			572		nm	Note 2
τ_S	Speed of Response		15			90			90			200		ns	
C	Capacitance		100			11			15			13		pF	V_F=0; f=1 MHz
θ_{JC}	Thermal Resistance		125			120			100			100		°C/W	Junction to Cathode Lead at 0.79mm (.031 in) from Body
V_F	Forward Voltage		1.6	2.0		2.2	3.0		2.2	3.0	At I_F = 20mA	2.4	3.0	V	I_F=10mA, Figures 2, 7, 12, 17
BV_R	Reverse Breakdown Voltage	3.0	10		5.0			5.0			5.0			V	I_R = 100μA
η_v	Luminous Efficacy		55			147			570			665		lm/W	Note 3

NOTES:
1. $\Theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
2. The dominant wavelength, λ_d, is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.
3. Radiant intensity, I_e, in watts/steradian, may be found from the equation $I_e=I_v/\eta_v$, where I_v is the luminous intensity in candelas and η_v is the luminous efficacy in lumens/watt.

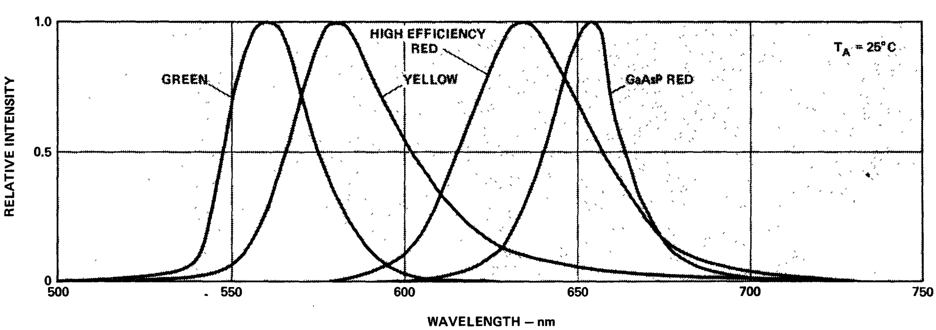


Figure 1. Relative Intensity vs. Wavelength.

Red 5082-4100/4101

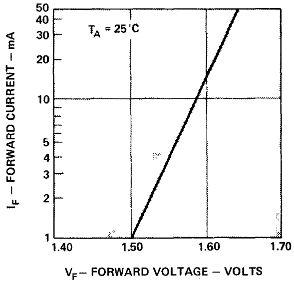


Figure 2. Forward Current vs. Forward Voltage.

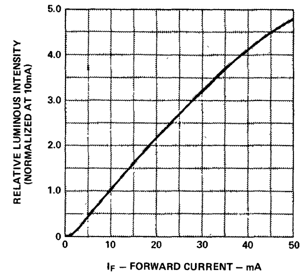


Figure 3. Relative Luminous Intensity vs. Forward Current.

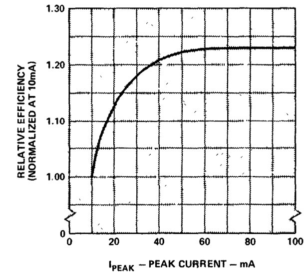


Figure 4. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

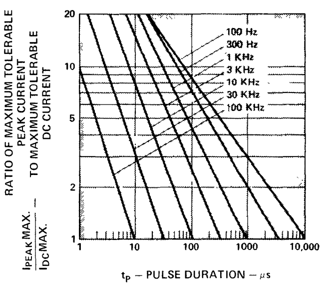


Figure 5. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)

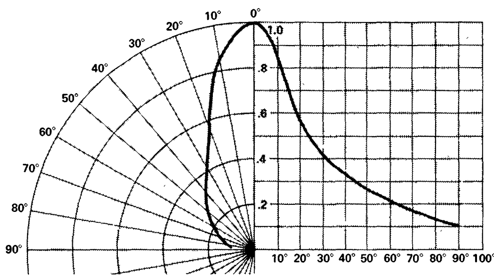


Figure 6. Relative Luminous Intensity vs. Angular Displacement.

High Efficiency Red 5082-4160

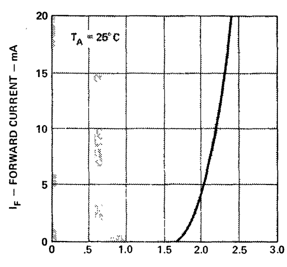


Figure 7. Forward Current vs. Forward Voltage.

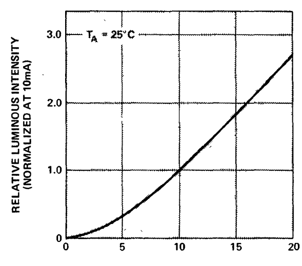


Figure 8. Relative Luminous Intensity vs. Forward Current.

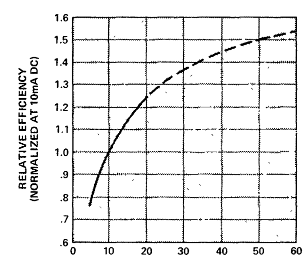


Figure 9. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

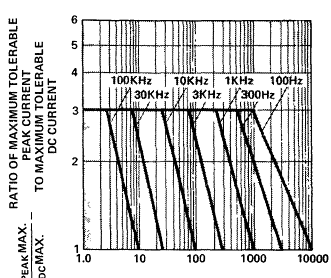


Figure 10. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)

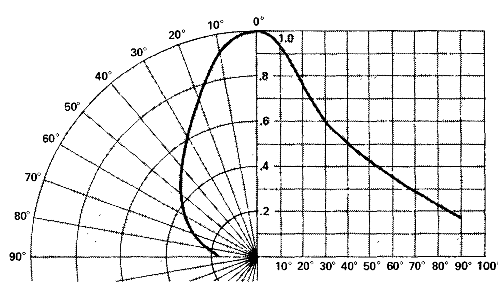


Figure 11. Relative Luminous Intensity vs. Angular Displacement.

Yellow 5082-4150

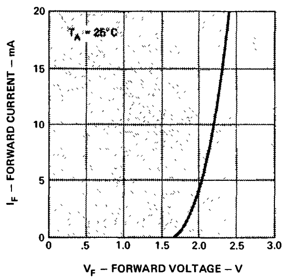


Figure 12. Forward Current vs. Forward Voltage.

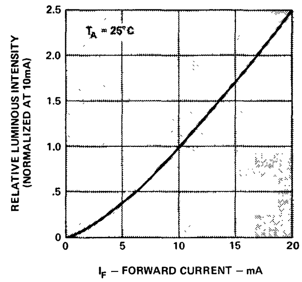


Figure 13. Relative Luminous Intensity vs. Forward Current.

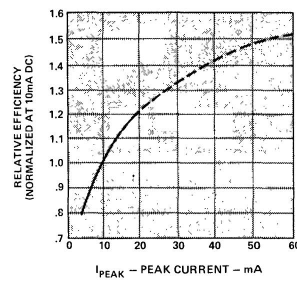


Figure 14. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

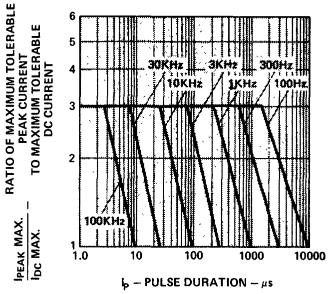


Figure 15. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)

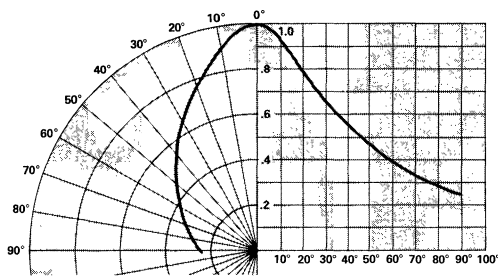


Figure 16. Relative Luminous Intensity vs. Angular Displacement.

Green 5082-4190

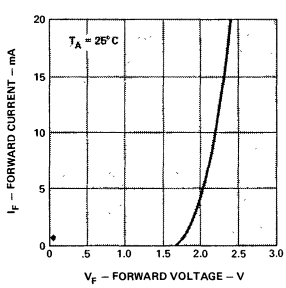


Figure 17. Forward Current vs. Forward Voltage.

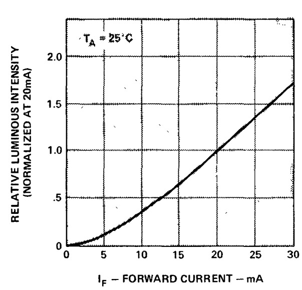


Figure 18. Relative Luminous Intensity vs. Forward Current.

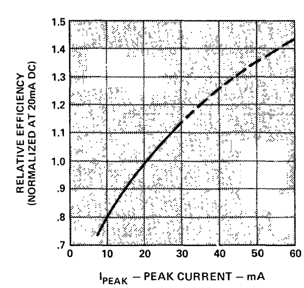


Figure 19. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

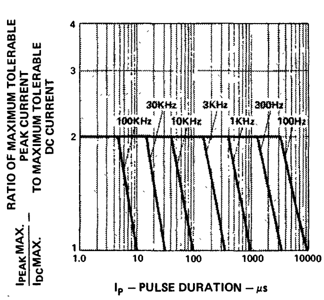


Figure 20. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)

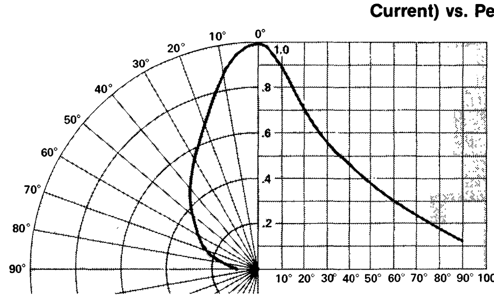


Figure 21. Relative Luminous Intensity vs. Angular Displacement.

HEWLETT PACKARD

COMPONENTS

LOW PROFILE SOLID STATE LAMPS

RED • 5082-4790 SERIES
HIGH EFFICIENCY RED • 5082-4690 SERIES
YELLOW • 5082-4590 SERIES
GREEN • 5082-4990 SERIES

TECHNICAL DATA APRIL 1977

Features

- HIGH INTENSITY
- LOW PROFILE: 5.8mm (0.23 in) NOMINAL
- T-1¾ DIAMETER PACKAGE
- LIGHT OUTPUT CATEGORIES
- DIFFUSED AND NON-DIFFUSED TYPES
- GENERAL PURPOSE LEADS
- IC COMPATIBLE/LOW CURRENT REQUIREMENTS
- RELIABLE AND RUGGED
- CHOICE OF 4 BRIGHT COLORS
  - Red High Efficiency Red
  - Yellow Green

Description

The 5082-4790/4791 are Gallium Arsenide Phosphide Red Light Emitting Diodes packaged in a Low Profile T-1¾ outline with a red diffused lens.

The 5082-4690 Series are Gallium Arsenide Phosphide on Gallium Phosphide High Efficiency Red Light Emitting Diodes packaged in a Low Profile T-1¾ outline.

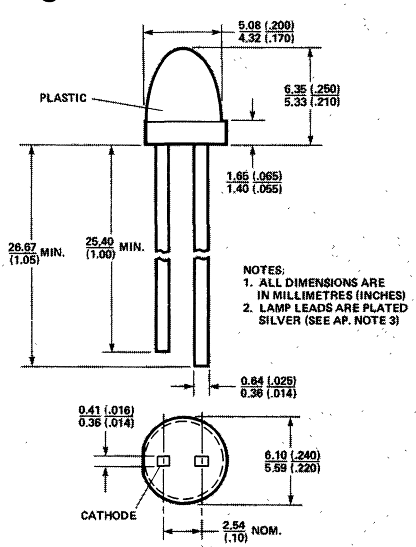
The 5082-4590 Series are Gallium Arsenide Phosphide on Gallium Phosphide Yellow Light Emitting Diodes packaged in a Low Profile T-1¾ outline.

The 5082-4990 Series are Gallium Phosphide Green Light Emitting Diodes packaged in a Low Profile T-1¾ outline.

The Low Profile T-1¾ package provides space savings and is excellent for backlighting applications.

Part Number 5082-	Application	Lens	Color
4690	Indicator — General Purpose	Diffused Wide Angle	High Efficiency Red
4693	Indicator — High Brightness	Diffused Wide Angle	High Efficiency Red
4694	General Purpose Point Source	Non-diffused Narrow Angle	High Efficiency Red
4695	High Brightness Annunciator	Non-diffused Narrow Angle	High Efficiency Red
4590	Indicator — General Purpose	Diffused Wide Angle	Yellow
4592	Indicator — High Brightness	Diffused Wide Angle	Yellow
4595	General Purpose Point Source	Non-diffused Narrow Angle	Yellow
4597	High Brightness Annunciator	Non-diffused Narrow Angle	Yellow
4990	Indicator — General Purpose	Diffused Wide Angle	Green
4992	Indicator — High Brightness	Diffused Wide Angle	Green
4995	General Purpose Point Source	Non-diffused Narrow Angle	Green
4997	High Brightness Annunciator	Non-diffused Narrow Angle	Green
4790	Indicator — General Purpose	Diffused Wide Angle	Red
4791	Indicator — High Brightness	Diffused Wide Angle	Red

Package Dimensions



Absolute Maximum Ratings at $T_A = 25°C$

Parameter	Red 4790 Series	Hi-Eff. Red 4690 Series	Yellow 4590 Series	Green 4990 Series	Units
Power Dissipation (derate linearly from 50°C at 1.6mW/°C)	100	120	120	120	mW
Average Forward Current	50	20	20	30	mA
Peak Forward Current	1000 See Fig. 5	60 See Fig. 10	60 See Fig. 15	60 See Fig. 20	mA
Operating and Storage Temperature Range	-55°C to + 100°C				
Lead Solder Temperature (1.6mm [0.63 inch] from body)	260°C For 5 Seconds				

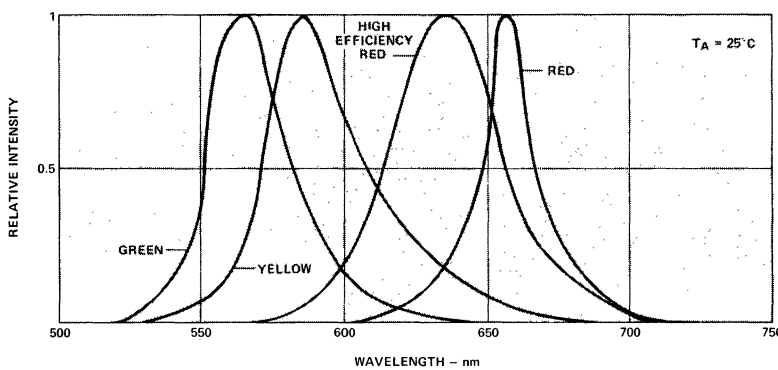


Figure 1. Relative Intensity versus Wavelength.

RED 5082-4790 SERIES
Electrical Specifications at $T_A = 25°C$

Symbol	Description	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions
I_V	Axial Luminous Intensity	4790	0.8	1.2		mcd	I_F = 20mA (Fig. 3)
		4791	1.6	2.5			
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points			60		deg.	Note 1 (Fig. 6)
λ_{PEAK}	Peak Wavelength			655		nm	Measurement @ Peak (Fig. 1)
λ_d	Dominant Wavelength			648		nm	Note 2
τ_s	Speed of Response			15		ns	
C	Capacitance			100		pF	V_F = 0; f = 1 MHz
θ_{JC}	Thermal Resistance			125		°C/W	Junction to Cathode Lead 1.6 mm (0.063 in.) from Body
V_F	Forward Voltage			1.6	2.0	V	I_F = 20mA (Fig. 2)
BV_R	Reverse Breakdown Voltage		3	10		V	I_R = 100μA
η_V	Luminous Efficacy			55		lm/W	Note 3

Notes: 1. $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity. 2. Dominant wavelength, λ_d, is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device. 3. Radiant Intensity I_e, in watts/steradian may be found from the equation $I_e = I_v/\eta_v$, where I_v is the luminous intensity in candelas and η_v is the luminous efficacy in lumens/watt.

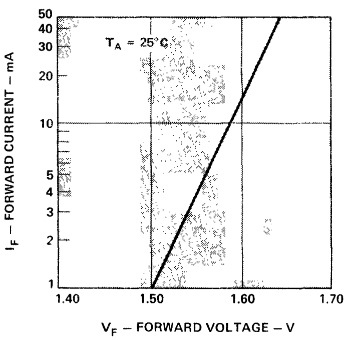


Figure 2. Forward Current versus Forward Voltage.

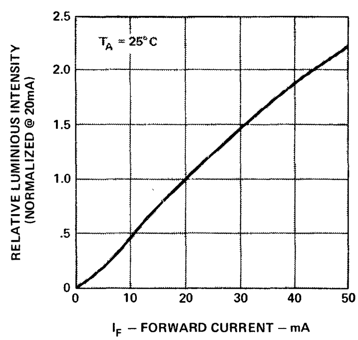


Figure 3. Relative Luminous Intensity versus Forward Current.

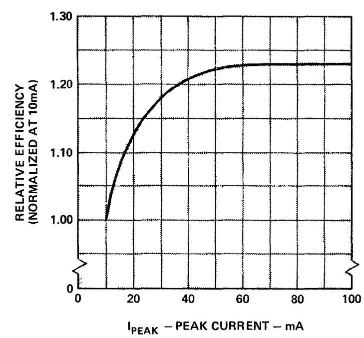


Figure 4. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current.

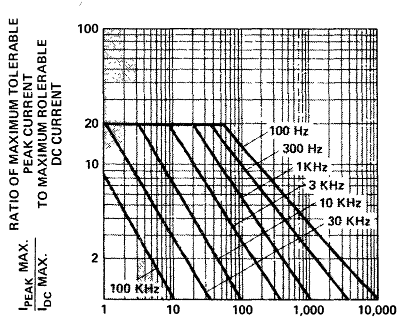


Figure 5. Maximum Tolerable Peak Current versus Pulse Duration. (I_{DC} MAX as per MAX Ratings)

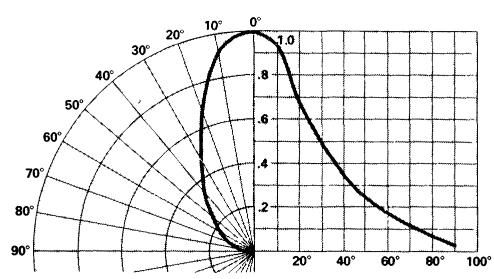


Figure 6. Relative Luminous Intensity versus Angular Displacement.

HIGH EFFICIENCY RED 5082-4690 SERIES

Electrical Specifications at $T_A = 25°C$

Symbol	Description	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions
I_V	Axial Luminous Intensity	4690 4693 4694 4695	1.5 5.0 4.0 8.0	3.5 7.0 8.0 11.0		mcd	$I_F = 10mA$ (Fig.8)
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points	4690 4693 4694 4695		50 50 45 45		deg.	Note 1 (Fig. 11)
λ_{PEAK}	Peak Wavelength			635		nm	Measurement @ Peak (Fig. 1)
λ_d	Dominant Wavelength			626		nm	Note 2
τ_s	Speed of Response			90		ns	
C	Capacitance			16		pF	$V_F = 0; f = 1$ MHz
θ_{JC}	Thermal Resistance			130		°C/W	Junction to Cathode Lead 1.6mm (0.063 in.) from Body
V_F	Forward Voltage			2.2	3.0	V	$I_F = 10mA$ (Fig. 7)
BV_R	Reverse Breakdown Voltage		5.0			V	$I_R = 100\mu A$
η_V	Luminous Efficacy			147		lm/W	Note 3

Notes: 1. $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity. 2. Dominant wavelength, λ_d, is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device. 3. Radiant Intensity I_e, in watts/steradian may be found from the equation $I_e = I_v/\eta_v$, where I_v is the luminous intensity in candelas and η_v is the luminous efficacy in lumens/watt.

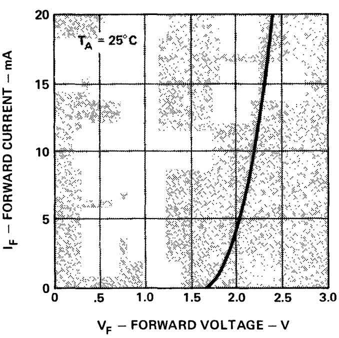


Figure 7. Forward Current versus Forward Voltage.

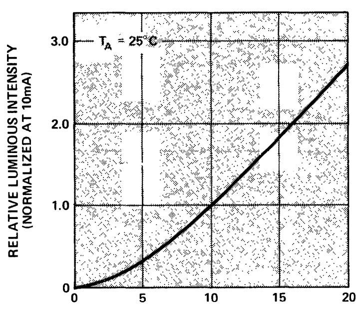


Figure 8. Relative Luminous Intensity versus Forward Current.

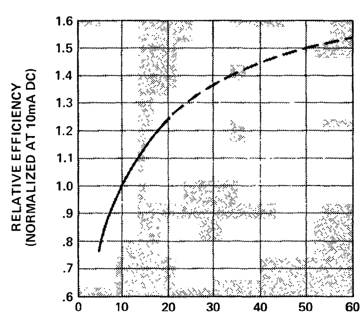


Figure 9. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current.

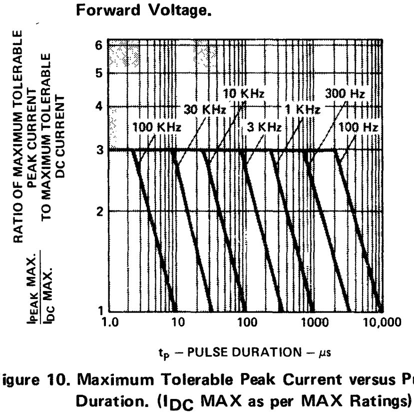


Figure 10. Maximum Tolerable Peak Current versus Pulse Duration. (I_{DC} MAX as per MAX Ratings)

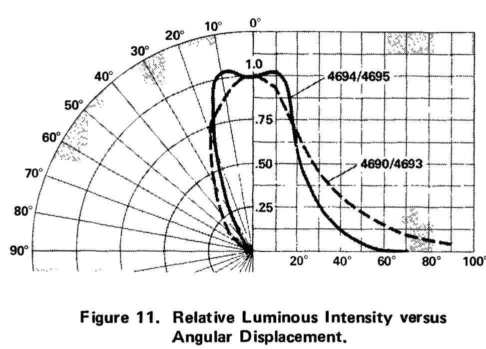


Figure 11. Relative Luminous Intensity versus Angular Displacement.

YELLOW 5082-4590 SERIES

Electrical Specifications at T_A=25°C

Symbol	Description	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions
I_v	Axial Luminous Intensity	4590 4592 4595 4597	1.5 4.5 4.0 8.0	3.5 6.0 6.5 11.0		mcd	I_F = 10mA (Fig. 13)
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity' Points	4590 4592 4595 4597		50 50 45 45		deg.	Note 1 (Fig. 16)
λ_{PEAK}	Peak Wavelength			583		nm	Measurement @ Peak (Fig. 1)
λ_d	Dominant Wavelength			585		nm	Note 2
τ_s	Speed of Response			90		ns	
C	Capacitance			18		pF	V_F = 0; f = 1 MHz
θ_{JC}	Thermal Resistance			100		°C/W	Junction to Cathode Lead 1.6mm (0.063 in.) from Body
V_F	Forward Voltage			2.2	3.0	V	I_F = 10mA (Fig. 12)
BV_R	Reverse Breakdown Voltage		5.0			V	I_R = 100μA
η_v	Luminous Efficacy			570		lm/W	Note 3

Notes: 1. $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity. 2. Dominant wavelength, λ_d, is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device. 3. Radiant Intensity I_e, in watts/steradian may be found from the equation $I_e = I_v/\eta_v$, where I_v is the luminous intensity in candelas and η_v is the luminous efficacy in lumens/watt.

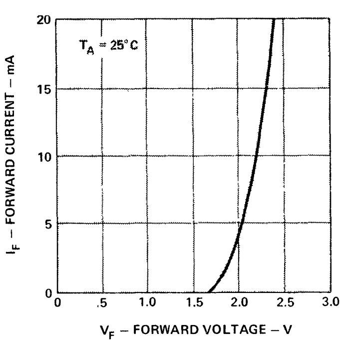


Figure 12. Forward Current versus Forward Voltage.

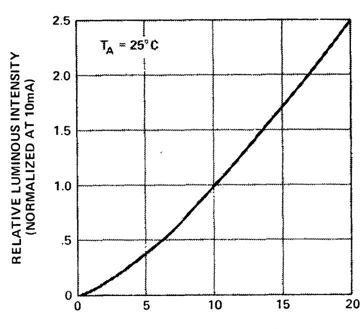


Figure 13. Relative Luminous Intensity versus Forward Current.

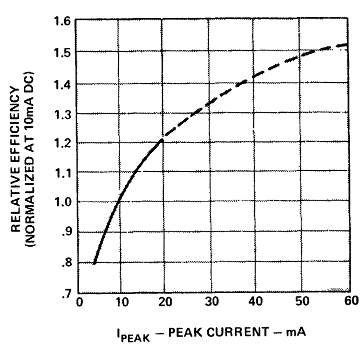


Figure 14. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current.

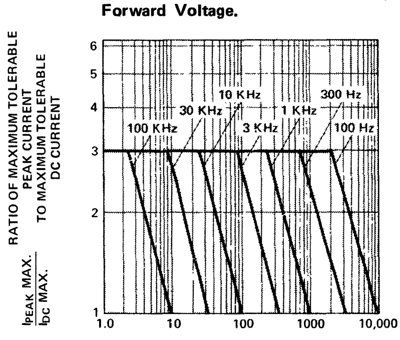


Figure 15. Maximum Tolerable Peak Current versus Pulse Duration. (I_{DC} MAX as per MAX Ratings).

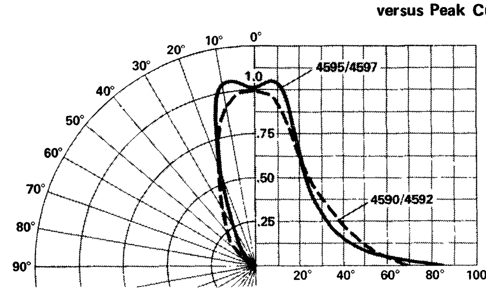


Figure 16. Relative Luminous Intensity versus Angular Displacement

GREEN 5082-4990 SERIES
Electrical Specifications at T_A=25°C

Symbol	Description	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions
I_V	Axial Luminous Intensity	4990 4992 4995 4997	2.0 6.0 3.5 8.0	4.5 7.5 6.5 11.0		mcd	I_F = 20mA (Fig.18)
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points	4990 4992 4995 4997		50 50 40 40		deg.	Note 1 (Fig.21)
λ_{PEAK}	Peak Wavelength			565		nm	Measurement @ Peak (Fig. 1)
λ_d	Dominant Wavelength			570		nm	Note 2
τ_s	Speed of Response			200		ns	
C	Capacitance			12		pF	V_F = 0; f = 1 MHz
θ_{JC}	Thermal Resistance			90		°C/W	Junction to Cathode Lead 1.6mm (0.063 in.) from Body
V_F	Forward Voltage			2.4	3.0	V	I_F = 20mA (Fig. 17)
BV_R	Reverse Breakdown Voltage		5.0			V	I_R = 100μA
η_V	Luminous Efficacy			665		lm/W	Note 3

Notes: 1. $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity. 2. Dominant wavelength, λ_d, is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device. 3. Radiant Intensity I_e, in watts/steradian may be found from the equation $I_e = I_v/\eta_v$, where I_v is the luminous intensity in candelas and η_v is the luminous efficacy in lumens/watt.

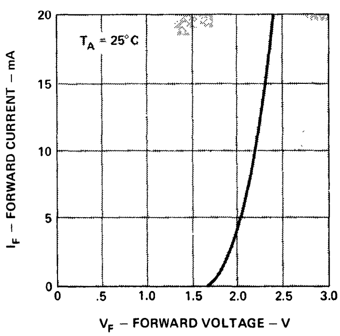


Figure 17. Forward Current versus Forward Voltage.

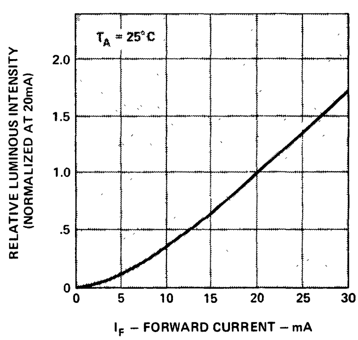


Figure 18. Relative Luminous Intensity versus Forward Current.

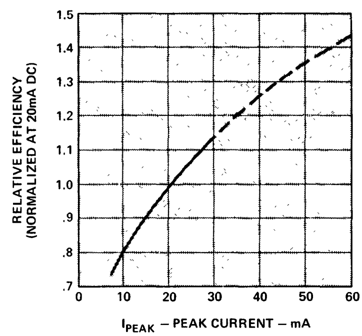


Figure 19. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current.

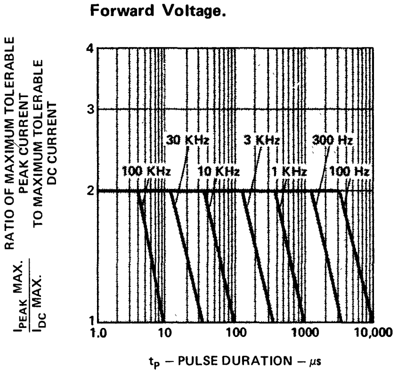


Figure 20. Maximum Tolerable Peak Current versus Pulse Duration. (I_{DC} MAX as per MAX ratings).

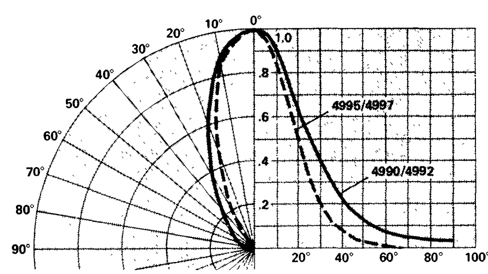


Figure 21. Relative Luminous Intensity versus Angular Displacement.

HEWLETT hp PACKARD
COMPONENTS

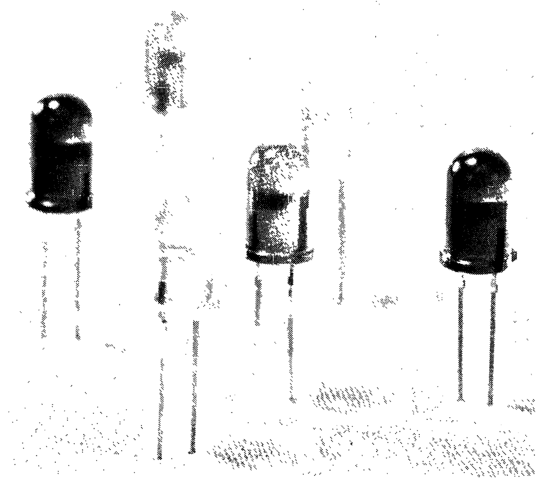
SOLID STATE LAMPS

HIGH EFFICIENCY RED • 5082-4650 Series
YELLOW • 5082-4550 Series
GREEN • 5082-4950 Series

TECHNICAL DATA APRIL 1977

Features

- HIGH INTENSITY
- CHOICE OF 3 BRIGHT COLORS
  - High Efficiency Red
  - Yellow
  - Green
- POPULAR T-1¾ DIAMETER PACKAGE
- LIGHT OUTPUT CATEGORIES
- WIDE VIEWING ANGLE AND NARROW VIEWING ANGLE TYPES
- GENERAL PURPOSE LEADS
- IC COMPATIBLE/LOW CURRENT REQUIREMENTS
- RELIABLE AND RUGGED

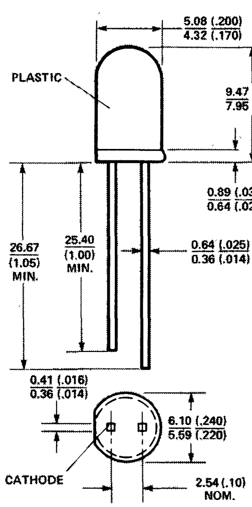


Description

The 5082-4650 and the 5082-4550 Series lamps are Gallium Arsenide Phosphide on Gallium Phosphide diodes emitting red and yellow light respectively. The 5082-4950 Series lamps are green light emitting Gallium Phosphide diodes.

General purpose and selected brightness versions of both the diffused and non-diffused lens type are available in each family.

Package Dimensions



NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).
2. SILVER-PLATED LEADS. SEE APPLICATION BULLETIN 3.

Part Number 5082-	Application	Lens	Color
4650	Indicator — General Purpose	Diffused	High Efficiency Red
4655	Indicator — High Ambient	Wide Angle	
4657	Illuminator/Point Source	Non Diffused	
4658	Illuminator/High Brightness	Narrow Angle	
4550	Indicator General Purpose	Diffused	Yellow
4555	Indicator — High Ambient	Wide Angle	
4557	Illuminator/Point Source	Non-Diffused	
4558	Illuminator/High Brightness	Narrow Angle	
4950	Indicator — General Purpose	Diffused	Green
4955	Indicator — High Ambient	Wide Angle	
4957	Illuminator/Point Source	Non-Diffused	
4958	Illuminator/High Brightness	Narrow Angle	

Electrical Characteristics at $T_A = 25°C$

Symbol	Description	Device 5082-	Min.	Typ.	Max.	Units	Test Conditons
I_V	Luminous Intensity	4650 4655 4657 4658	1.0 3.0 9.0 15.0	2.0 4.0 12.0 24.0		mcd.	I_F = 10mA (Fig. 3)
		4550 4555 4557 4558	1.0 2.2 6.0 12.0	1.8 3.0 9.0 16.0		mcd.	I_F = 10mA (Fig. 8)
		4950 4955 4957 4958	1.0 2.2 6.0 12.0	1.8 3.0 9.0 16.0		mcd.	I_F = 20mA (Fig. 13)
$2\Theta_{1/2}$	Included Angle Between Half Luminous Intensity Points	4650 4655 4657 4658		90 90 35 35		Deg.	I_F = 10mA See Note 1 (Fig. 6)
		4550 4555 4557 4558		90 90 35 35		Deg.	I_F = 10mA See Note 1 (Fig. 11)
		4950 4955 4957 4958		90 90 30 30		Deg.	I_F = 20mA See Note 1 (Fig. 16)
λ_{PEAK}	Peak Wavelength	4650s 4550s 4950s		635 583 565		nm	Measurement at Peak (Fig. 1)
λ_d	Dominant Wavelength	4650s 4550s 4950s		626 585 572		nm	See Note 2 (Fig.1)
τ_S	Speed of Response	4650s 4550s 4950s		90 90 200		ns	
C	Capacitance	4650s 4550s 4950s		16 18 18		pF	V_F = 0, f = 1 MHz
Θ_{JC}	Thermal Resistance	4650s 4550s 4950s		135 135 145		°C/W	Junction to Cathode Lead at Seating Plane
V_F	Forward Voltage	4650s 4550s 4950s		2.2 2.2 2.4	3.0 3.0 3.0	V	I_F = 10mA (Fig. 2, I_F = 10mA Fig. 7, I_F = 20mA Fig. 12)
BV_R	Reverse Breakdown Volt.	All	5.0			V	I_R = 100μA
η_v	Luminous Efficacy	4650s 4550s 4950s		147 570 665		lumens/watt	See Note 3

NOTES:
1. $\Theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
2. The dominant wavelength, λ_d, is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.
3. Radiant intensity, I_e, in watts/steradian, may be found from the equation $I_e = I_v/\eta_v$, where I_v is the luminous intensity in candelas and η_v is the luminous efficacy in lumens/watt.

Absolute Maximum Ratings

Parameter	High Efficiency Red 4650 Series	Yellow 4550 Series	Green 4950 Series	Units
Power Dissipation (derate linearly from 50°C at 1.6mW/°C)	120	120	120	mW
Average Forward Current	20	20	30	mA
Peak Operating Forward Current	60 (Fig. 5)	60 (Fig. 10)	60 (Fig. 15)	mA
Operating and Storage Temperature Range	-55°C to +100°C			
Lead Solder Temperature (1.6mm[0.063 inch] below package base)	260°C for 5 seconds			

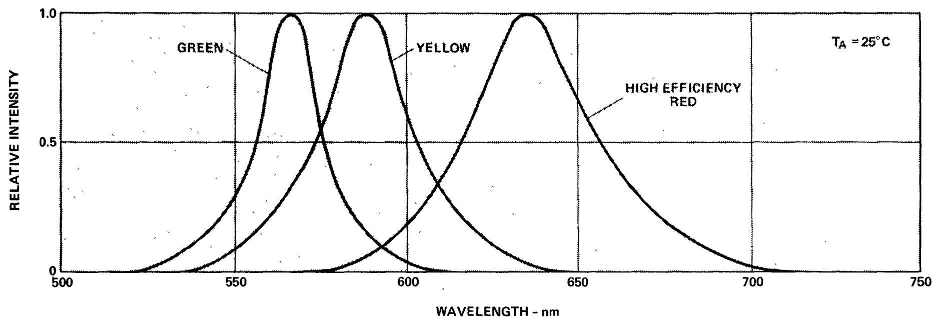


Figure 1. Relative Intensity vs. Wavelength.

High Efficiency Red 5082-4650 Series

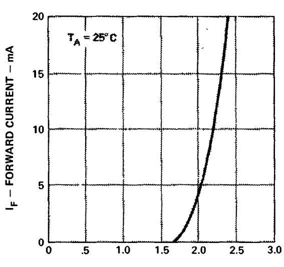


Figure 2. Forward Current vs. Forward Voltage

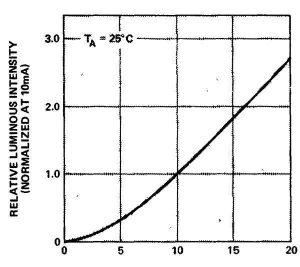


Figure 3. Relative Luminous Intensity vs. Forward Current.

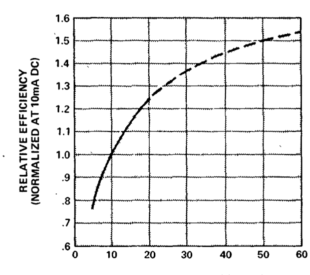


Figure 4. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

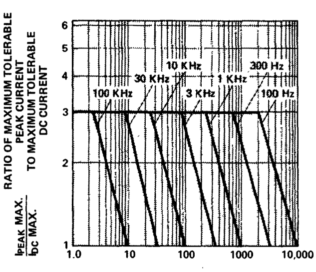


Figure 5. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings.)

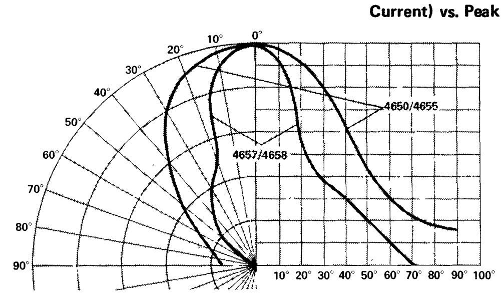


Figure 6. Relative Luminous Intensity vs. Angular Displacement.

Yellow 5082-4550 Series

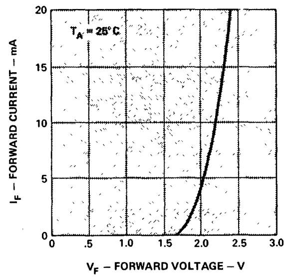


Figure 7. Forward Current vs. Forward Voltage.

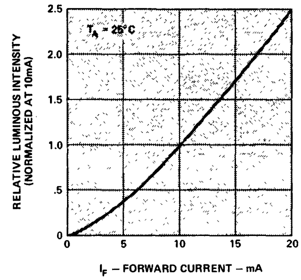


Figure 8. Relative Luminous Intensity vs. Forward Current.

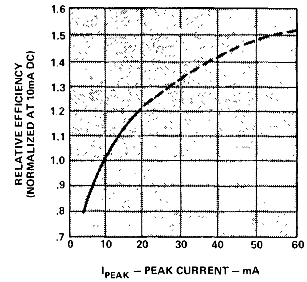


Figure 9. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

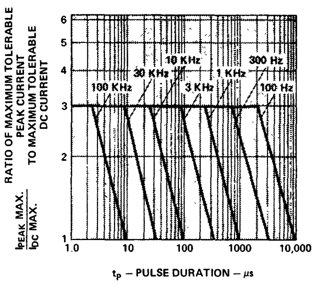


Figure 10. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)

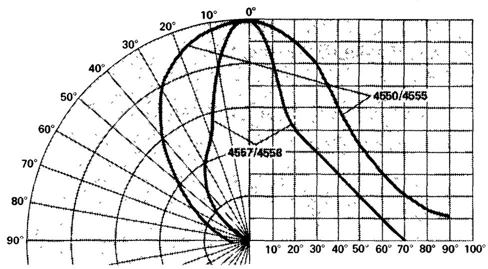


Figure 11. Relative Luminous Intensity vs. Angular Displacement.

Green 5082-4950 Series

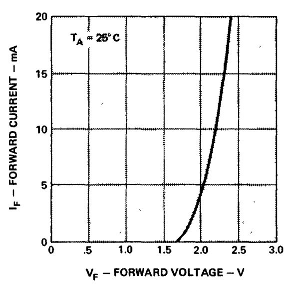


Figure 12. Forward Current vs. Forward Voltage.

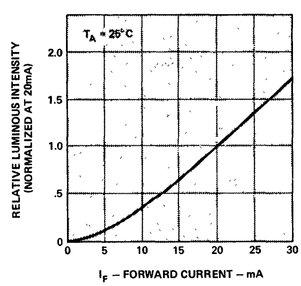


Figure 13. Relative Luminous Intensity vs. Forward Current.

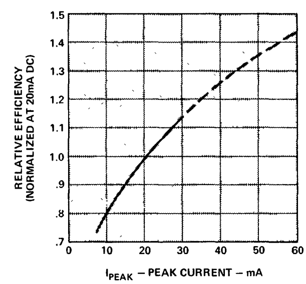


Figure 14. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

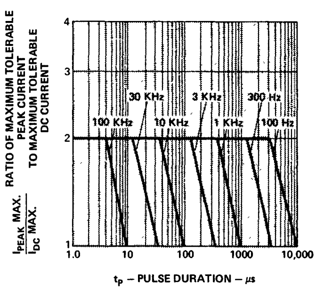


Figure 15. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)

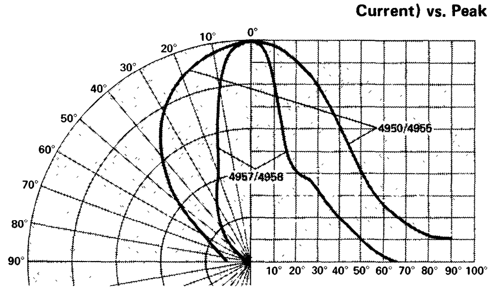


Figure 16. Relative Luminous Intensity vs. Angular Displacement.

HEWLETT PACKARD
COMPONENTS

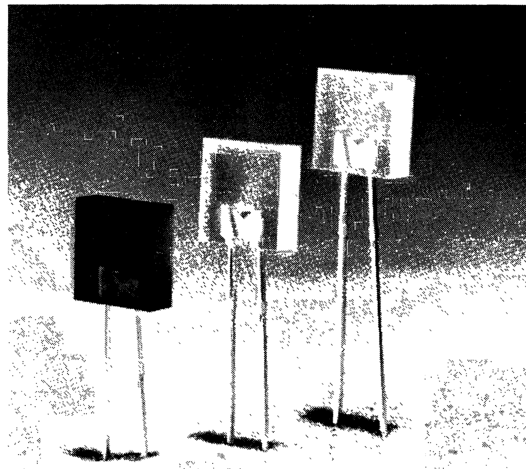
RECTANGULAR SOLID STATE LAMPS

HIGH EFFICIENCY RED 5082-4670
YELLOW 5082-4570
GREEN 5082-4970

TECHNICAL DATA APRIL 1977

Features

- RECTANGULAR PACKAGE
- FLAT HIGH INTENSITY EMITTING SURFACE
- STACKABLE ON 2.54 MM (0.100 INCH) CENTERS
- IDEAL AS FLUSH MOUNTED PANEL INDICATORS
- IDEAL FOR BACKLIGHTING LEGENDS
- LONG LIFE: SOLID STATE RELIABILITY
- CHOICE OF 3 BRIGHT COLORS
  HIGH EFFICIENCY RED
  YELLOW
  GREEN
- IC COMPATIBLE/LOW CURRENT REQUIREMENTS



Description

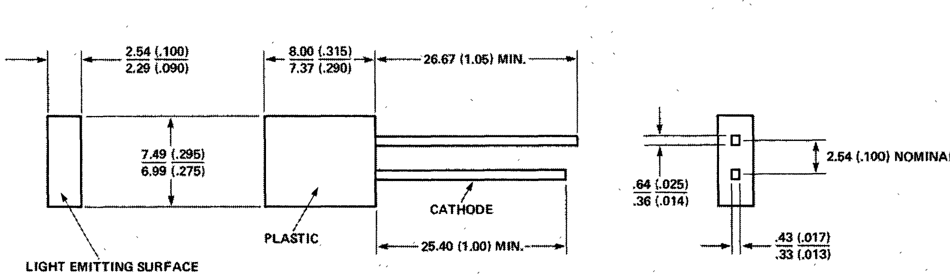
The 5082-4670, 4570 and 4970 are solid state lamps encapsulated in an axial lead rectangular epoxy package. They utilize a tinted, diffused epoxy to provide high on-off contrast and a flat high intensity emitting surface.

The -4670 has a high-efficiency red GaAsP on GaP LED chip in a light red epoxy package. This lamp's efficiency is comparable to that of the GaP red but extends to higher current levels.

The -4570 provides a yellow GaAsP on GaP LED chip in a yellow epoxy package.

The -4970 provides a green GaP LED chip in a green epoxy package.

Package Dimensions



NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS (INCHES).
2. SILVER-PLATED LEADS. SEE APPLICATION BULLETIN 3.

Absolute Maximum Ratings at $T_A = 25°C$

Parameter	High Efficiency Red 5082-4670	Yellow 5082-4570	Green 5082-4970	Units
Power Dissipation (derate linearly from 50°C at 1.6mW/°C)	120	120	120	mW
Average Forward Current	20	20	30	mA
Peak Forward Current	60 See Figure 5	60 See Figure 10	60 See Figure 15	mA
Operating and Storage Temperature Range	-55°C to 100°C			
Lead Soldering Temperature [1.6mm (0.063 in.) from body]	260°C for 5 seconds			

Electrical/Optical Characteristics at $T_A = 25°C$

Symbol	Description	5082-4670			5082-4570			5082-4970			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
I_V	Axial Luminous Intensity	0.8	1.0		1.0	1.2		1.0 At I_F = 20 mA	1.2		mcd	I_F = 15 mA Figs. 3,8,13 Note 1
$2\Theta_{1/2}$	Included Angle Between Half Luminous Intensity Points, Both Axes		100			100			100		deg.	Note 2. Figures 6,11,16
λ_{PEAK}	Peak Wavelength		635			583			565		nm	Measurement at Peak
λ_d	Dominant Wavelength		626			585			571		nm	Note 3
τ_S	Speed of Response		90			90			200		ns	
C	Capacitance		17			17			17		pF	V_F=0; f=1 MHz
Θ_{JC}	Thermal Resistance		130			130			130		°C/W	Junction to Cathode Lead at 1.6 mm (0.063 in.) from Body
V_F	Forward Voltage		2.3	3.0		2.3	3.0		2.4 At I_F = 20 mA	3.0	V	I_F=15 mA Figures 2,7,12
BV_R	Reverse Breakdown Voltage	5.0			5.0			5.0			V	I_R = 100 μA
η_v	Luminous Efficacy		147			570			665		lm/W	Note 4

NOTES:

1. Luminous sterance, L_V, in foot lamberts, may be found from the equation $L_V = 16.7\ I_V$, where I_V is the luminous intensity in millicandelas.
2. $\Theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
3. The dominant wavelength, λ_d, is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.
4. Radiant intensity, I_e, in watts/steradian, may be found from the equation $I_e = I_V/\eta_V$, where I_V is the luminous intensity in candelas and η_V is the luminous efficacy in lumens/watt.

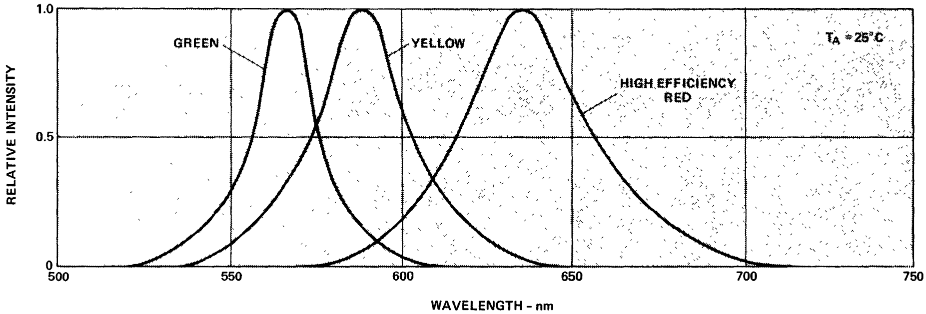


Figure 1. Relative Intensity vs. Wavelength.

HIGH EFFICIENCY RED 5082-4670

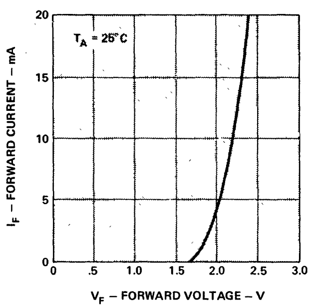


Figure 2. Forward Current vs. Forward Voltage.

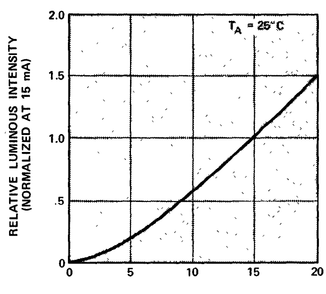


Figure 3. Relative Luminous Intensity vs. Forward Current.

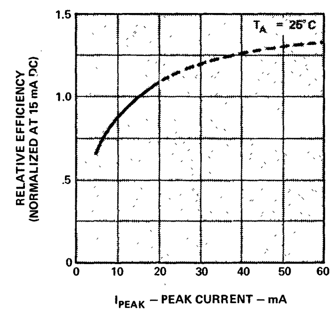


Figure 4. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

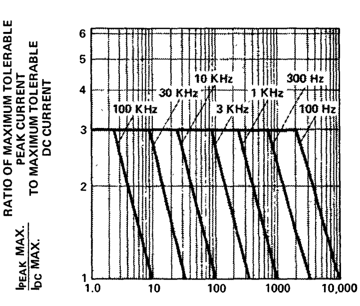


Figure 5. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings.)

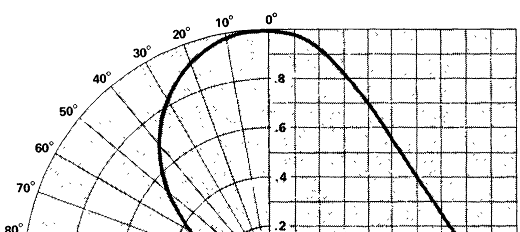


Figure 6. Relative Luminous Intensity vs. Angular Displacement.

YELLOW 5082-4570

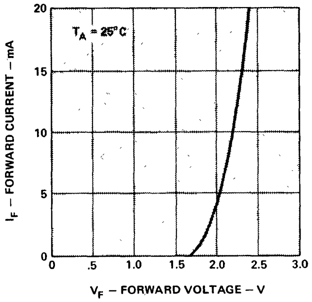


Figure 7. Forward Current vs. Forward Voltage.

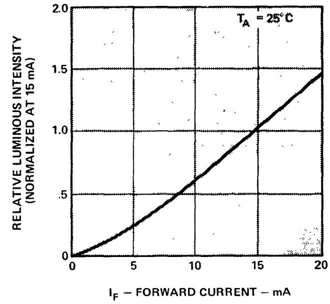


Figure 8. Relative Luminous Intensity vs. Forward Current.

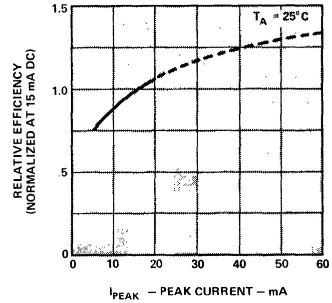


Figure 9. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

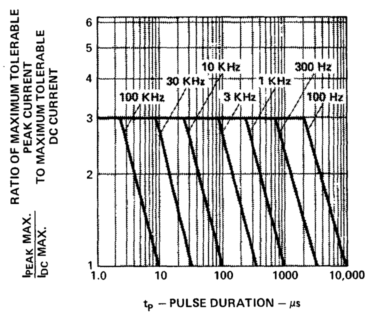


Figure 10. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings.)

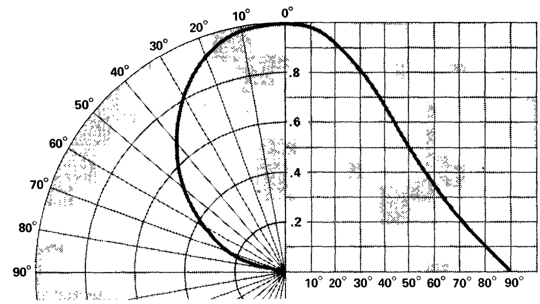


Figure 11. Relative Luminous Intensity vs. Angular Displacement.

GREEN 5082-4970

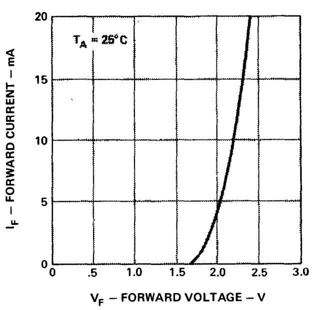


Figure 12. Forward Current vs. Forward Voltage.

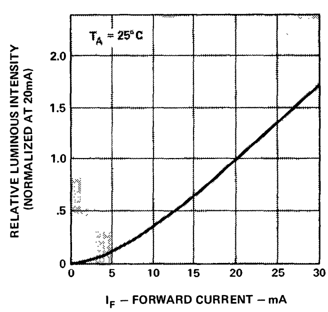


Figure 13. Relative Luminous Intensity vs. Forward Current.

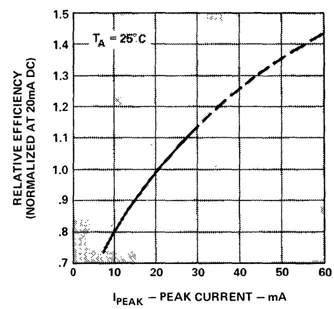


Figure 14. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

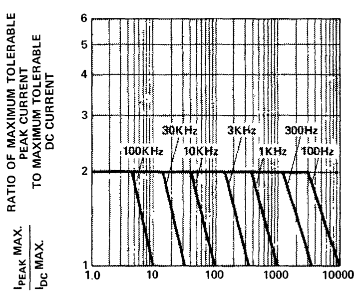


Figure 15. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings.)

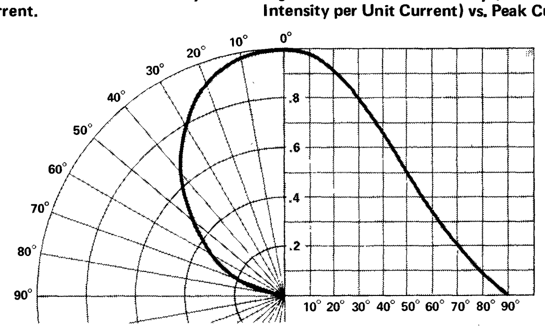


Figure 16. Relative Luminous Intensity vs. Angular Displacement.

HEWLETT PACKARD

COMPONENTS

SOLID STATE LAMPS

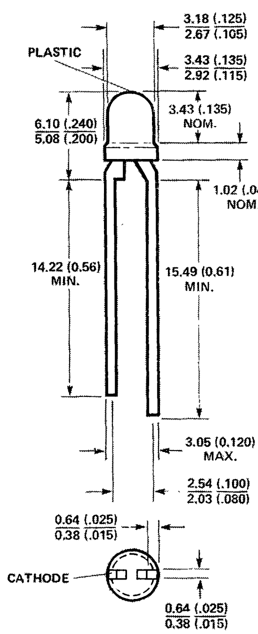
HIGH EFFICIENCY RED • 5082-4684
YELLOW • 5082-4584
GREEN • 5082-4984

TECHNICAL DATA APRIL 1977

Features

- HIGH INTENSITY
- WIDE VIEWING ANGLE
- SMALL SIZE T-1 DIAMETER 3.18mm (0.125 inch)
- IC COMPATIBLE
- RELIABLE AND RUGGED
- CHOICE OF 3 BRIGHT COLORS
  - HIGH EFFICIENCY RED
  - YELLOW
  - GREEN

Package Dimensions



NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS (INCHES).
2. SILVER-PLATED LEADS. SEE APPLICATION BULLETIN 3.

Description

The 5082-4684 is a Gallium Arsenide Phosphide on Gallium Phosphide High Efficiency Red Light Emitting Diode packaged in a T-1 outline with a red diffused lens, which provides excellent on-off contrast ratio, high axial luminous intensity and a wide viewing angle.

The 5082-4584 is a Gallium Arsenide Phosphide on Gallium Phosphide Yellow Light Emitting Diode packaged in a T-1 outline with a yellow diffused lens, which provides good on-off contrast ratio, high axial luminous intensity and a wide viewing angle.

The 5082-4984 is a Gallium Phosphide Green Light Emitting Diode packaged in a T-1 outline with a green diffused lens, which provides good on-off contrast ratio, high axial luminous intensity, and a wide viewing angle.

The 5082-4684, -4584, and -4984 are designed for applications where space is at a premium, such as in high density arrays.

Absolute Maximum Ratings at T_A=25°C

Parameter	High Efficiency Red 4684	Yellow 4584	Green 4984	Units
Power Dissipation (derate linearly from 50°C at 1.6mW/°C)	120	120	120	mW
Average Forward Current	20	20	30	mA
Peak Forward Current	60 See Fig. 5	60 See Fig. 10	60 See Fig. 15	mA
Operating and Storage Temperature Range	-55°C to 100°C			
Lead Soldering Temperature [1.6mm (0.063 in.) from body]	230°C for 7 seconds			

Electrical/Optical Characteristics at T_A=25°C

Symbol	Description	5082-4684			5082-4584			5082-4984			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
I_V	Axial Luminous Intensity	1.0	2.5		1.0	2.5		0.8	2.0 at I_F = 20mA		mcd	I_F = 10mA. Figs. 3, 8, 13
$2\Theta_{1/2}$	Included Angle Between Half Luminous Intensity Points		70			60			60		deg.	Note 1. Figures 6, 11, 16
λ_{PEAK}	Peak Wavelength		635			583			565		nm	Measurement at Peak
λ_d	Dominant Wavelength		628			585			572		nm	Note 2
τ_s	Speed of Response		90			90			200		ns	
C	Capacitance		20			15			8		pF	V_F = 0; f = 1 MHz
Θ_{JC}	Thermal Resistance		95			95			95		°C/W	Junction to Cathode Lead at 0.79mm (.031 in) from Body
V_F	Forward Voltage		2.2	3.0		2.2	3.0		2.4 at I_F = 20mA	3.0	V	I_F = 10mA, Figures 2, 7, 12
BV_R	Reverse Breakdown Voltage	5.0			5.0			5.0			V	I_R = 100μA
η_V	Luminous Efficacy		147			570			665		lm/W	Note 3

NOTES:

1. $\Theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
2. The dominant wavelength, λ_d, is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.
3. Radiant intensity, I_e, in watts/steradian, may be found from the equation $I_e = I_v/\eta_v$, where I_v is the luminous intensity in candelas and η_v is the luminous efficacy in lumens/watt.

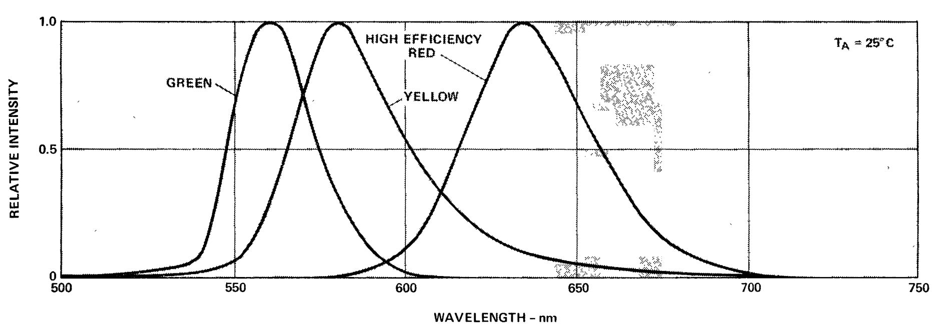


Figure 1. Relative Intensity vs. Wavelength.

High Efficiency Red 5082-4684

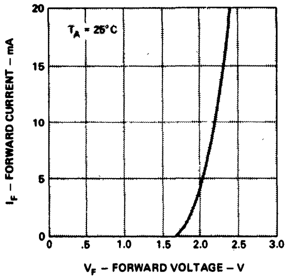


Figure 2. Forward Current vs. Forward Voltage.

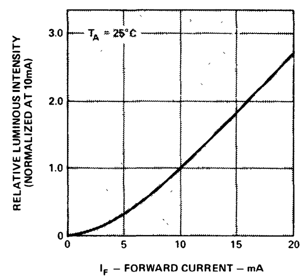


Figure 3. Relative Luminous Intensity vs. Forward Current.

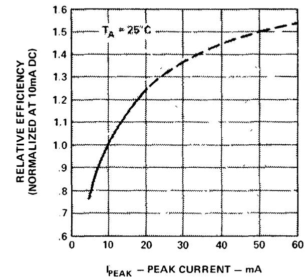


Figure 4. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

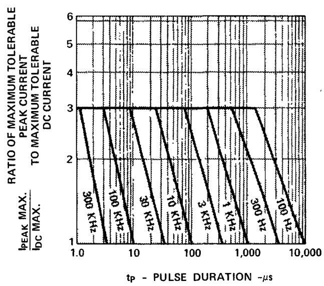


Figure 5. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC}MAX as per MAX Ratings).

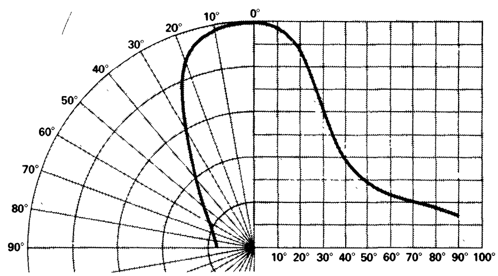


Figure 6. Relative Luminous Intensity vs. Angular Displacement.

Yellow 5082-4584

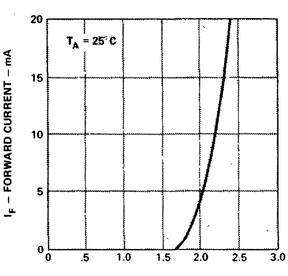


Figure 7. Forward Current vs. Forward Voltage.

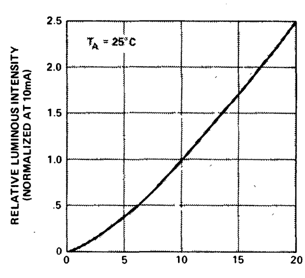


Figure 8. Relative Luminous Intensity vs. Forward Current.

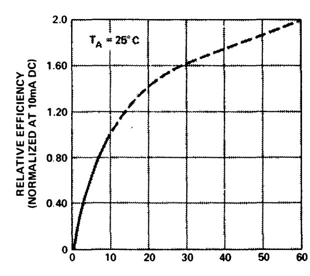


Figure 9. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

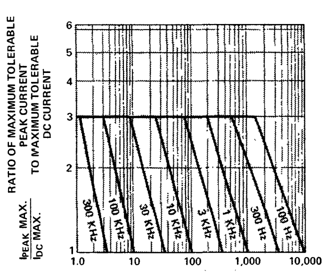


Figure 10. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings.)

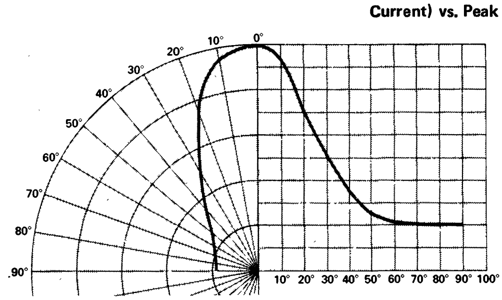


Figure 11. Relative Luminous Intensity vs. Angular Displacement.

Green 5082-4984

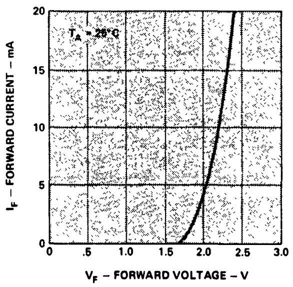


Figure 12. Forward Current vs. Forward Voltage.

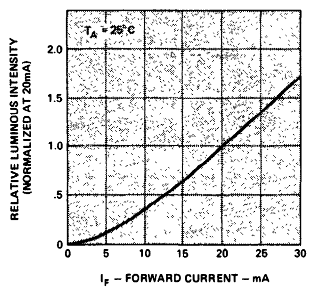


Figure 13. Relative Luminous Intensity vs. Forward Current.

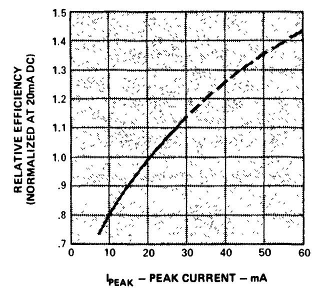


Figure 14. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

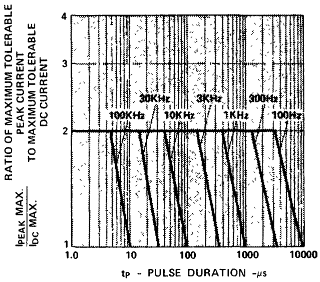


Figure 15. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings.)

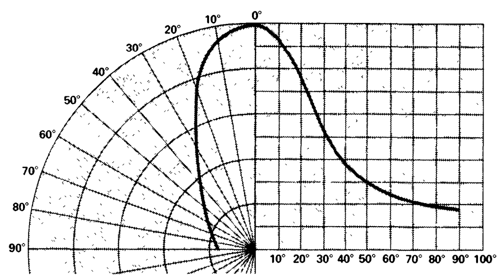


Figure 16. Relative Luminious Intensity vs. Angular Displacement.

HEWLETT PACKARD

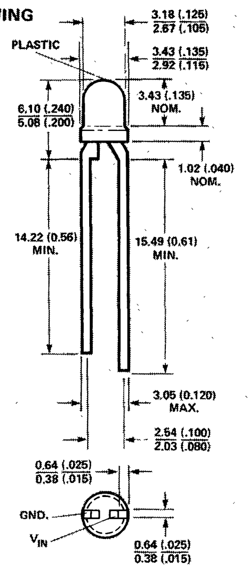
COMPONENTS

VOLTAGE SENSING LED

5082-4732

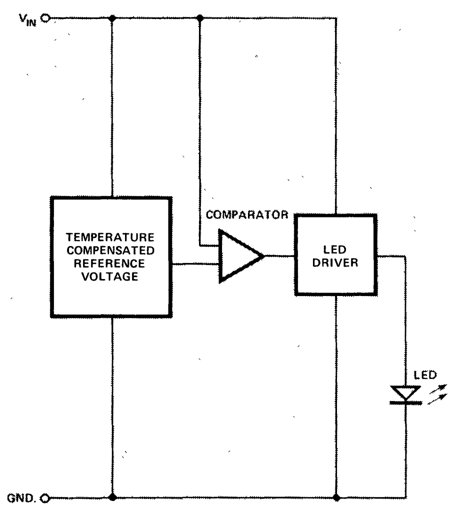
TECHNICAL DATA APRIL 1977

OUTLINE DRAWING



ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).

BLOCK DIAGRAM



Features

- **HIGH SENSITIVITY: 10mV ON TO OFF**
- **BUILT IN LED CURRENT LIMITING**
- **TEMPERATURE COMPENSATED THRESHOLD VOLTAGE**
- **COMPACT: PACKAGE INCLUDES INTEGRATED CIRCUIT AND LED**
- **GUARANTEED MINIMUM LUMINOUS INTENSITY**
- **THRESHOLD VOLTAGE CAN BE INCREASED WITH EXTERNAL COMPONENT**

Applications

- Push-to-test battery voltage tester (pagers, cameras, appliances, radios, test equipment. . .)
- Logic level indicator
- Power supply voltage monitor
- V-U meter
- Analog level sense
- Voltage indicating arrays — use several with different thresholds
- Current monitor

Description

The HP voltage sensing LEDs use an integrated circuit and a red GaAsP LED to provide a complete voltage sensing function in a standard red diffused T-1 LED package. When the input voltage (V_{IN}) exceeds the threshold voltage (V_{TH}) the LED turns "on". The high gain of the comparator provides unambiguous indication by the LED of the input voltage with respect to the threshold voltage. The V-I characteristics are resistive above and below the threshold voltage. This allows battery testing under simulated load conditions. Use of a resistor, diode or zener in series allows the threshold voltage to be increased to any desired voltage. A resistor in parallel allows the sensing LED to be used as a current threshold indicator.

The 5082-4732 has a nominal threshold voltage of 2.7V.

Absolute Maximum Ratings

Storage Temperature	-55°C to +100°C
Operating Temperature.	-55°C to +85°C
Lead Solder Temperature	230°C for 7 Sec
Input Voltage — V_{IN} [1]	+5V dc
Reverse Input Voltage — V_R	-0.5V

NOTES:

1. Derate linearly above 50°C free-air temperature at a rate of 37mV/°C.

Electro-Optical Characteristics at $T_A = 25°C$

Parameter	Sym.	5082-4732 Min.	Typ.	Max.	Units	Test Conditions	Fig.
Threshold Voltage	V_{TH}	2.5	2.7	2.9	V		1,2
Temperature Coefficient of Threshold	$\frac{\Delta V_{TH}}{\Delta T_A}$		−1		mV/°C		
Input Current	I_{IN}		13		mA	$V_{IN} = 2.75V$	2
			33	50	mA	$V_{IN} = 5.0V$	2
Luminous Intensity	I_v	0.3	0.7		mcd	$V_{IN} = 2.75V$	1
Wavelength	λ_{PEAK}		655		nm	Measurement at peak	
Dominant Wavelength	λ_d		639		nm	Note 1	

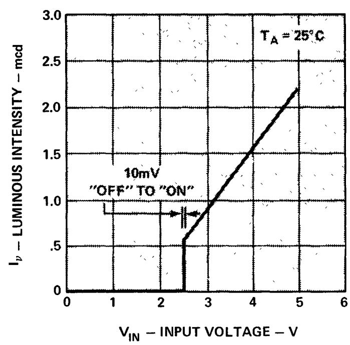


Figure 1. Luminous Intensity vs. Input Voltage.

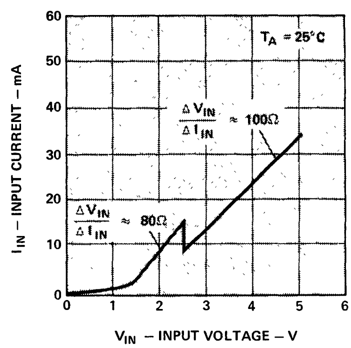


Figure 2. Input Current vs. Input Voltage.

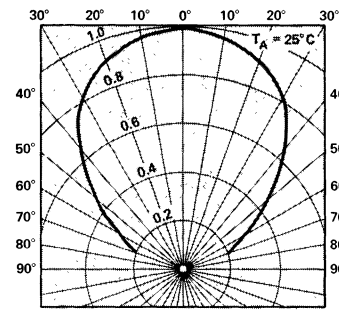
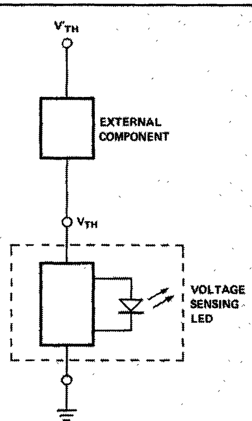


Figure 3. Relative Luminous Intensity vs. Angular Displacement.

Techniques For Increasing The Threshold Voltage



External Component	V'_{TH}	$TC = \frac{\Delta V'_{TH}}{\Delta T_A}$ (mV/°C)
Schottky Diode (HP 5082-2835)	$V_{TH} + 0.45V$	-2
P-N Diode (1N914)	$V_{TH} + 0.75V$	-2.5
LED (HP 5082-4484)	$V_{TH} + 1.6V$	-2.9
Zener Diode (V_Z)	$V_{TH} + V_Z$	−1 + Zener TC

Notes:
1. The dominant wavelength, λ_d, is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.
2. I_{TH} is the maximum current just below the threshold, V_{TH}. Since both I_{TH} and V_{TH} are variable, a precise value of V'_{TH} is obtainable only by selecting R to fit the measured characteristics of the individual devices (e.g., with curve tracer).
3. The temperature coefficient (TC) will be a function of the resistor TC and the value of the resistor.

HEWLETT PACKARD
COMPONENTS

RESISTOR LEDs

5082-4860
5082-4468

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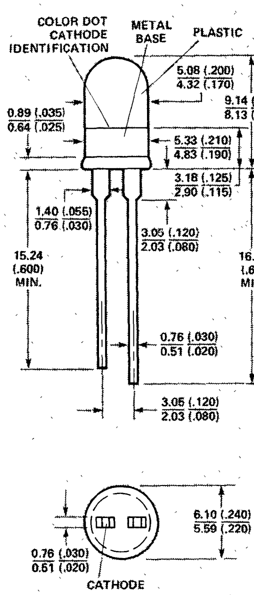
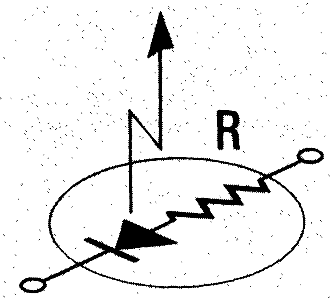
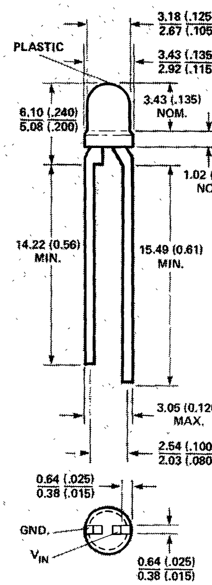


5082-4860



DIMENSIONS IN MILLIMETERS AND (INCHES)



5082-4468

Features

- **TTL COMPATIBLE: 16mA @ 5 VOLTS TYPICAL**
- **INTEGRAL CURRENT LIMITING RESISTOR**
- **T-1 DIAMETER PACKAGE, 3.18mm (.125 in.)**
  T-1¾ DIAMETER PACKAGE, 5.08mm (.200 in.)
- **RUGGED AND RELIABLE**

Description

The HP Resistor-LED series provides an integral current limiting resistor in series with the LED. Applications include panel mounted indicators, cartridge indicators, and lighted switches.

The 5082-4860 is a standard red diffused 5.08mm (.200") diameter (T-1¾ size) LED, with long wire wrappable leads.

The 5082-4468 is a clear diffused 3.18mm (.125") diameter (T-1 size) LED.

Absolute Maximum Ratings at T_A=25°C

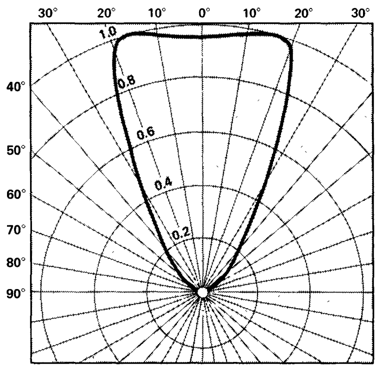
DC Forward Voltage [Derate linearly to 5V @ 100°C]	7.5V
Reverse Voltage	7V
Isolation Voltage [between lead and base of the 5082-4860]	300V
Operating and Storage Temperature Range	–55°C to +100°C
Lead Soldering Temperature	230°C for 7 sec.

Electrical Characteristics at $T_A = 25°C$

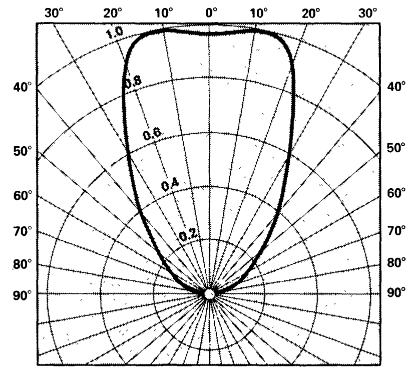
Symbol	Parameters	5082-4860/-4468			Units	Test Conditions
		Min.	Typ.	Max.		
I_V	Luminous Intensity	0.3	0.8		mcd	$V_F = 5.0V$
λ_{PEAK}	Wavelength		655		nm	Measurement at Peak
τ_s	Speed of Response		15		ns	
I_F	Forward Current		16	20	mA	$V_F = 5.0V$
BV_R	Reverse Breakdown Voltage	3			V	$I_R = 100\mu A$

TYPICAL RELATIVE LUMINOUS INTENSITY VERSUS ANGULAR DISPLACEMENT

4860



4468



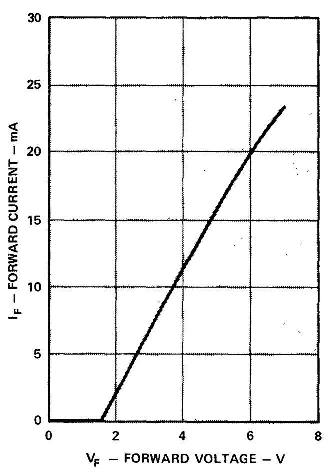


Figure 1. Typical DC Forward Current – Voltage Characteristic

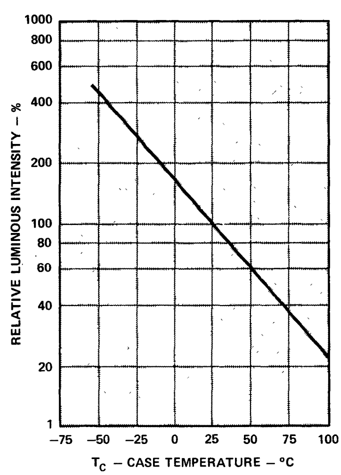


Figure 2. Relative Luminosity vs. Case Temperature

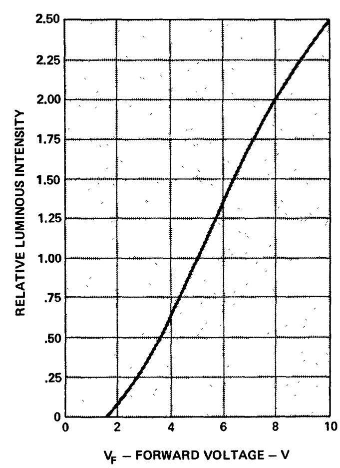


Figure 3. Relative Luminous Intensity vs. Voltage

HEWLETT hp PACKARD

COMPONENTS

HERMETIC SOLID STATE LAMPS

TO-46	PANEL MOUNT
1N6092* (5082-4620)	5082-4687
1N6093* (5082-4520)	5082-4587
1N6094* (5082-4920)	5082-4987
1N5765 (5082-4420)	5082-4787
JAN 1N5765	
JAN TX 1N5765	

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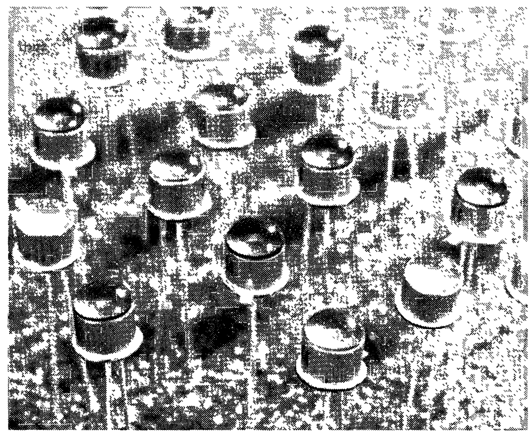
Features

- **CHOICE OF 4 COLORS**
  - **Red**
  - **High Efficiency Red**
  - **Yellow**
  - **Green**
- **DESIGNED FOR HIGH-RELIABILITY APPLICATIONS**
- **HERMETICALLY SEALED**
- **WIDE VIEWING ANGLE**
- **LOW POWER OPERATION**
- **IC COMPATIBLE**
- **LONG LIFE**
- **PANEL MOUNT OPTION HAS WIRE WRAPPABLE LEADS AND AN ELECTRICALLY ISOLATED CASE**



TO-46

Description

The 1N5765, 1N6092, 1N6093, and 1N6094 are hermetically sealed solid state lamps encapsulated in a TO-46 package with a tinted diffused plastic lens over a glass window. These hermetic lamps provide good on-off contrast, high axial luminous intensity and a wide viewing angle.

The 5082-4787, 4687, 4587 and 4987 are hermetically sealed solid state lamps encapsulated in a panel mountable fixture. The semiconductor chips are packaged in a hermetically sealed TO-46 package with a tinted diffused plastic lens over glass window. This TO-46 package is then encapsulated in a panel mountable fixture designed for high reliability applications. The encapsulated LED lamp assembly provides a high on-off contrast, a high axial luminous intensity and a wide viewing angle.

The 1N5765 and 5082-4787 utilize a GaAsP LED chip with a red diffused plastic lens over glass window.

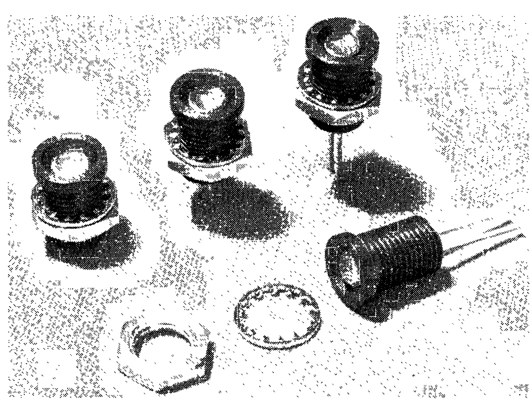
The 1N6092 and 5082-4687 have a high efficiency red GaAsP on GaP LED chip with a red diffused plastic lens over glass window. This lamp's efficiency is comparable to that of a GaP red but extends to higher current levels.

The 1N6093 and 5082-4587 provide a yellow GaAsP on GaP LED chip with a yellow diffused plastic lens over glass window.

The 1N6094 and 5082-4987 provide a green GaP LED chip with a green diffused plastic lens over glass window.

*These parts are now JAN and JAN TX qualified; they are also available in the panel mount option.

COLOR CODE IDENTIFICATION	
RED	1N5765, 5082-4787
HIGH EFFICIENCY RED	1N6092, 5082-4687
YELLOW	1N6093, 5082-4587
GREEN	1N6094, 5082-4987



HERMETIC PANEL MOUNT

JAN 1N5765: Samples of each lot are subjected to Group A inspection for parameters listed in Table I, and to Group B and Group C tests listed below. All tests are to the conditions and limits specified by MIL-S-19500/467. A summary of the data gathered in Groups A, B, and C lot acceptance testing is supplied with each shipment.

JAN TX 1N5765: Devices undergo 100% screening tests as listed below to the conditions and limits specified by MIL-S-19500/467. The JAN TX lot is then subjected to Group A, Group B and Group C tests as for the JAN 1N5765 above. A summary of the data gathered in Groups A, B and C acceptance testing can be provided upon request. Serialized data can be gathered, but lead times will be increased accordingly.

Group B Sample Acceptance Tests	Method MIL-STD-750
Physical Dimensions	2066
Solderability	2026
Thermal Shock	1056A
Temperature Cycling	1051A
Fine Leak Test	1071H
Gross Leak Test	1071C
Moisture Resistance	1021
Mechanical Shock	2016
Vibration	2056
Constant Acceleration	2006
Terminal Strength	2036E
Salt Atmosphere	1041
Temp. Storage (100°C, 340 hours)	1032
Operating Life (50mAdc, 340 hours)	1027

Group C Sample Acceptance Tests	Method MIL-STD-750
Low Temp. Operation (−55°C)	
Breakdown Voltage	4021
Temperature Cycling	1051A
Resistance to Solvents	*
Temp. Storage (100°C, 1K hours)	1031
Operating Life (50mAdc, 1K hours)	1026
Peak Forward Pulse Current	
TX Screening (100%)	
Temp. Storage (100°C, 72 hours)	
Temperature Cycling	1051A
Constant Acceleration	2006
Fine Leak Test	1071H
Gross Leak Test	1071C
Burn-in (50mAdc, 168 hours)	
Evaluation of Drift (I_{V1}, V_F, I_R)	

*MIL-STD-202 Method 215

Electrical / Optical Characteristics at T_A=25°C

(Per Table I, Group A Testing of MIL-S 19500/467)

Specification	Symbol	Min.	Max.	Units	Test Conditions
Luminous Intensity (Axial)	I_{v1}	0.5	3.0	mcd	I_F = 20mAdc, θ = 0°
Luminous Intensity (off Axis)	I_{v2}	0.3		mcd	I_F = 20mAdc, θ = 30° [see Note 2]
Wavelength	λ_v	630	700	nM	Design Parameter
Capacitance	C		300	pF	V_R = 0, f = 1MHz
Forward Voltage	V_F		2.0	Vdc	I_F = 20mAdc
Reverse Current	I_R		1	μAdc	V_R = 3Vdc [see Note 2]

NOTES:

1. Derate 0.67 mAdc/°C for T_A above 25°C.
2. These specifications apply only to JAN/JAN TX levels.

Absolute Maximum Ratings at $T_A = 25°C$

Parameter	Red 1N5765/4787	High Eff. Red 1N6092/4687	Yellow 1N6093/4587	Green 1N6094/4987	Units
Power Dissipation (derate linearly from 50°C at 1.6mW/°C)	100	120	120	120	mW
Average Forward Current	50	35	35	35	mA
Peak Forward Current	1000 See Fig. 5	60 See Fig. 10	60 See Fig. 15	60 See Fig. 20	mA
Operating and Storage Temperature Range	-55°C to 100°C				
Lead Soldering Temperature [1.6mm (0.063 in.) from body]	260°C for 7 seconds.				

Electrical/Optical Characteristics at $T_A = 25°C$

Symbol	Description	1N5765/5082-4787			1N6092/5082-4687			1N6093/5082-4587			1N6094/5082-4987			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
I_V	Axial Luminous Intensity	0.5	1.0		1.0	2.5		1.0	2.5		0.8 At I_F = 25mA	1.6		mcd	I_F = 20mA Figs. 3,8,13,18
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points		60			70			70			70		deg.	Note 1. Figures 6, 11, 16, 21
λ_{PEAK}	Peak Wavelength		655			635			583			565		nm	Measurement at Peak
λ_d	Dominant Wavelength		640			626			585			570		nm	Note 2
τ_S	Speed of Response		10			200			200			200		ns	
C	Capacitance		200			35			35			35		pF	V_F=0; f=1 MHz
θ_{JC}	Thermal Resistance*		425			425			425			425		°C/W	Note 3
θ_{JC}	Thermal Resistance**		550			550			550			550		°C/W	Note 3
V_F	Forward Voltage		1.6	2.0		2.0	3.0		2.0	3.0	At I_F = 25mA	2.1	3.0	V	I_F = 20mA Figures 2, 7, 12, 17
BV_R	Reverse Breakdown Voltage	4	5		5.0			5.0			5.0			V	I_R = 100μA
η_V	Luminous Efficacy		56			140			455			600		lm/W	Note 4

NOTES:
1. $\theta_{1/2}$ is the off-axis angle at which the luminous intensity is half the axial luminous intensity.
2. The dominant wavelength, λ_d, is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.
3. Junction to Cathode Lead with 3.18mm (0.125 inch) of leads exposed between base of flange and heat sink.
4. Radiant intensity, I_e, in watts/steradian, may be found from the equation $I_e = I_v/\eta_v$, where I_v is the luminous intensity in candelas and η_v is the luminous efficacy in lumens/watt.

*Panel mount.
**T0-46

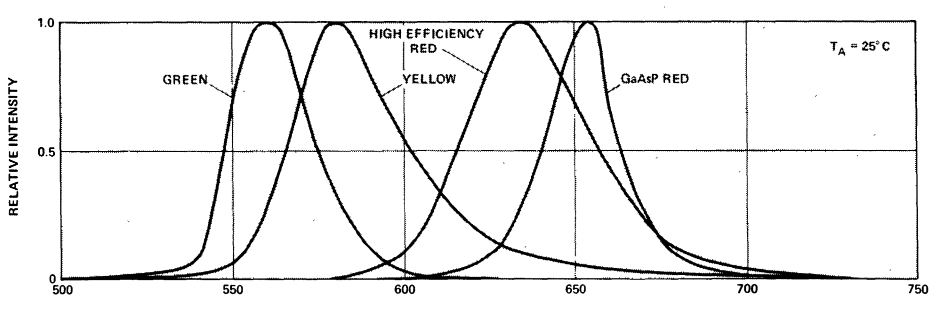
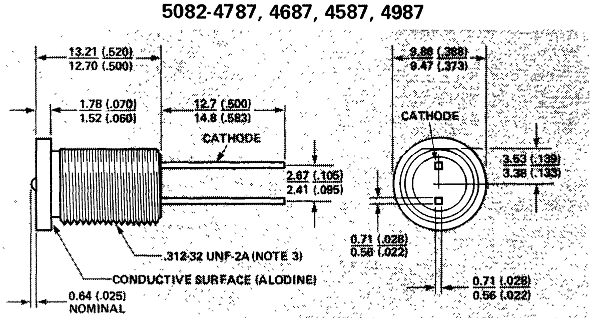


Figure 1. Relative Intensity vs. Wavelength.

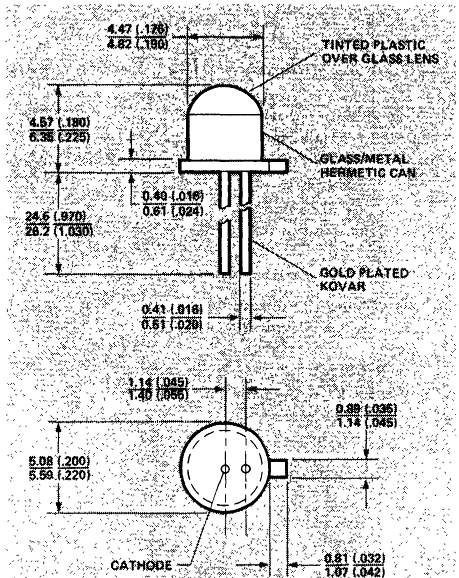
Package Dimensions

5082-4787, 4687, 4587, 4987



NOTES:
1. ALL EXTERNAL METAL SURFACES OF THE PACKAGE ARE BLACK ANODIZED EXCEPT FOR THE ALODINE AREA OF THE FLANGE AND THE GOLD PLATED LEADS.
2. MOUNTING HARDWARE WHICH INCLUDES ONE LOCK WASHER AND ONE HEX-NUT IS INCLUDED WITH EACH PANEL MOUNTABLE HERMETIC SOLID STATE LAMP.
3. USE OF METRIC DRILL SIZE 8.20 MILLIMETRES OR ENGLISH DRILL SIZE P (0.323 INCH) IS RECOMMENDED FOR PRODUCING HOLE IN THE PANEL FOR PANEL MOUNTING.
4. ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).

1N5765, 1N6092, 1N6093, 1N6094



OUTLINE TO-46

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).
2. GOLD-PLATED LEADS.

RED 1N5765/5082-4787

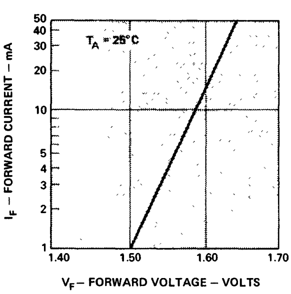


Figure 2. Forward Current vs. Forward Voltage.

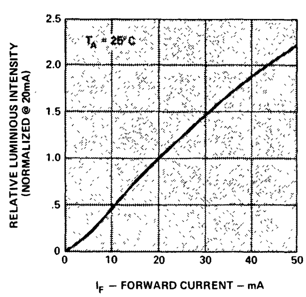


Figure 3. Relative Luminous Intensity vs. Forward Current.

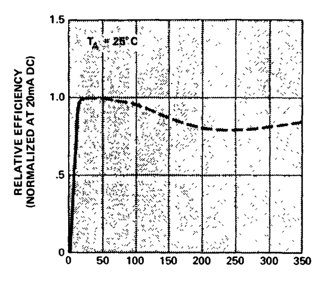


Figure 4. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

1N5765/4787

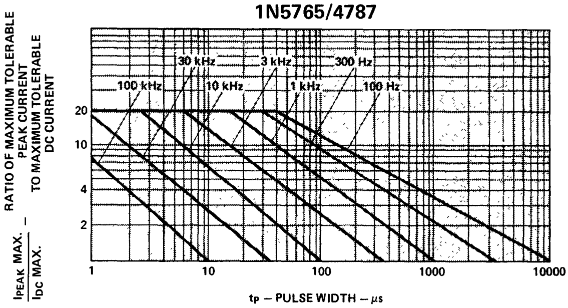


Figure 5. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)

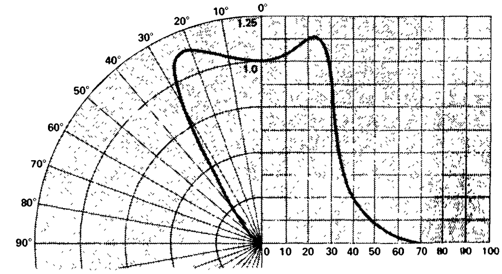


Figure 6. Relative Luminous Intensity vs. Angular Displacement.

HIGH EFFICIENCY RED 1N6092/5082-4687

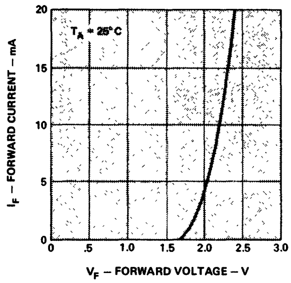


Figure 7. Forward Current vs. Forward Voltage.

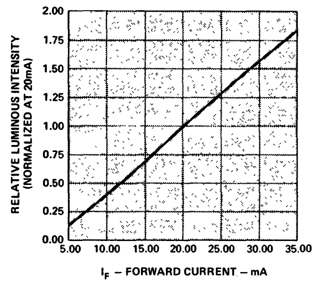


Figure 8. Relative Luminous Intensity vs. Forward Current.

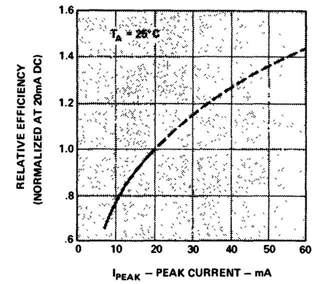


Figure 9. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

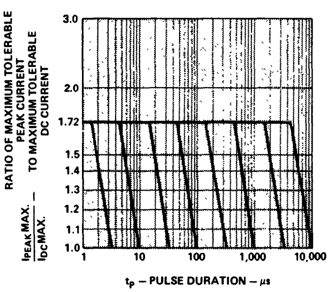


Figure 10. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)

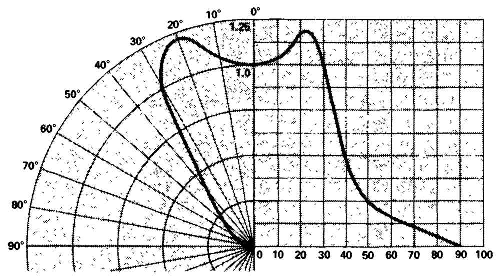


Figure 11. Relative Luminous Intensity vs. Angular Displacement.

YELLOW 1N6093/5082-4587

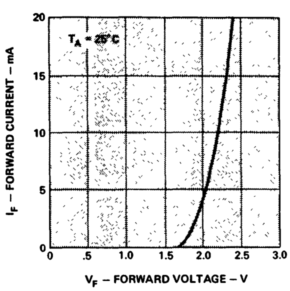


Figure 12. Forward Current vs. Forward Voltage.

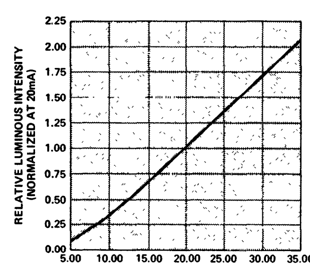


Figure 13. Relative Luminous Intensity vs. Forward Current.

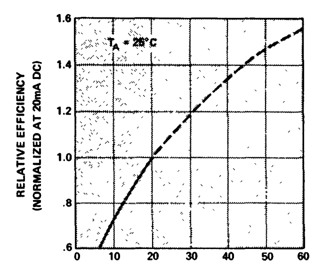


Figure 14. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

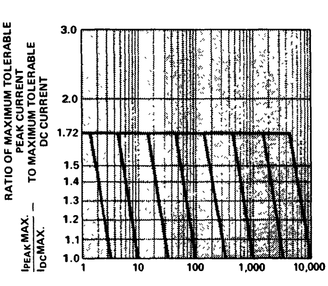


Figure 15. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)

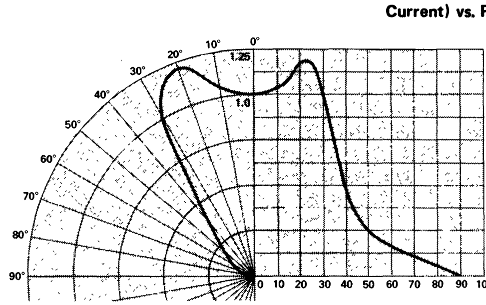


Figure 16. Relative Luminous Intensity vs. Angular Displacement.

GREEN 1N6094/5082-4987

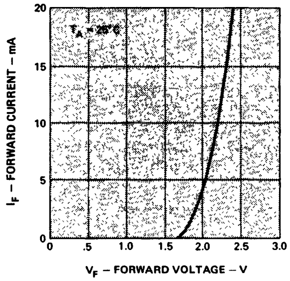


Figure 17. Forward Current vs. Forward Voltage.

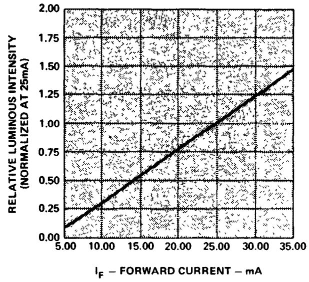


Figure 18. Relative Luminous Intensity vs. Forward Current.

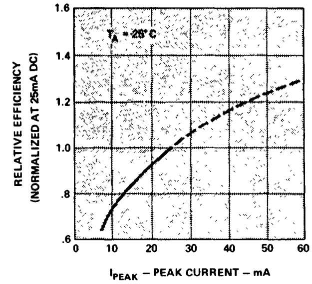


Figure 19. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

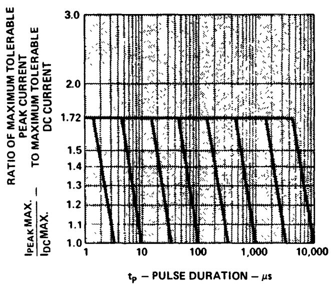


Figure 20. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)

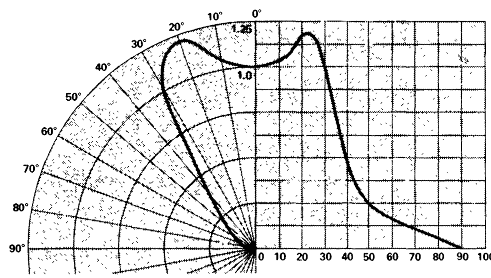


Figure 21. Relative Luminous Intensity vs. Angular Displacement.

HEWLETT hp PACKARD
COMPONENTS

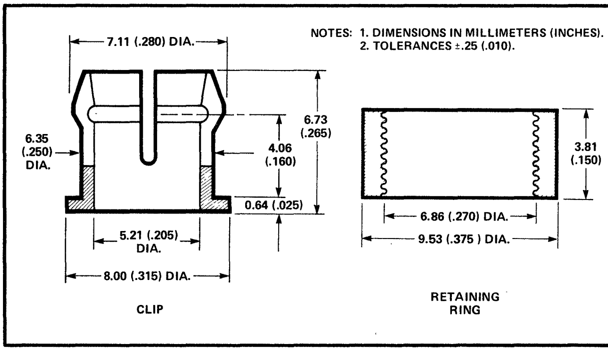
CLIP AND RETAINING RING FOR PANEL MOUNTED LEDs

5082-4707

TECHNICAL DATA APRIL 1977

Description

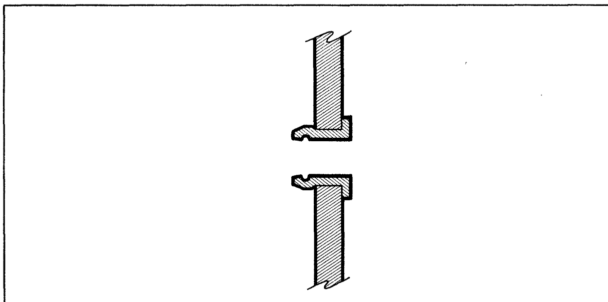
The 5082-4707 is a black plastic mounting clip and retaining ring. It is designed to panel mount Hewlett Packard Solid State T-1¾ size lamps. This clip and ring combination is intended for installation in instrument panels up to 3.18mm (.125") thick. For panels greater than 3.18mm (.125"), counterboring is required to the 3.18mm (.125") thickness.



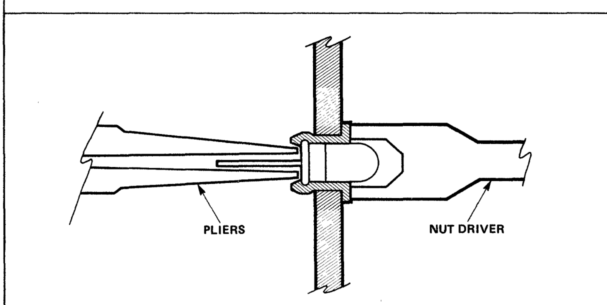
Mounting Instructions

1. Drill a 6.35mm (.250") dia. hole in the panel. Deburr but do not chamfer the edges of the hole.

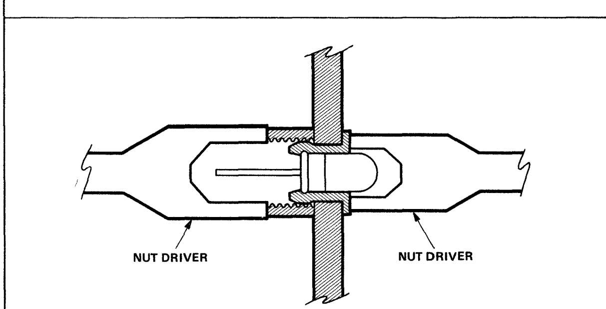
2. Press the panel clip into the hole from the front of the panel.



3. Press the LED into the clip from the back. Use blunt long nose pliers to push on the LED. Do not use force on the LED leads. A tool such as a nut driver may be used to press on the clip.



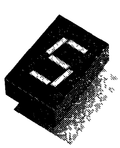
4. Slip a plastic retaining ring onto the back of the clip and press tight using tools such as two nut drivers.

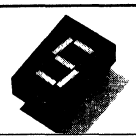
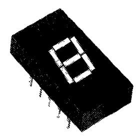
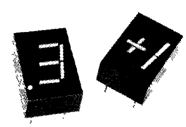


OPTOELECTRONICS DESIGNER'S CATALOG 1977

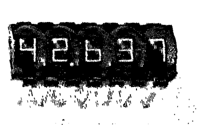
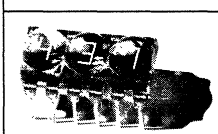
Solid State Displays

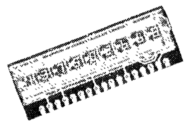
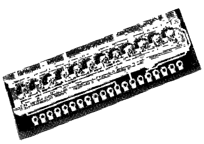
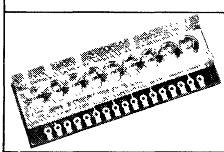
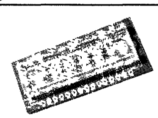
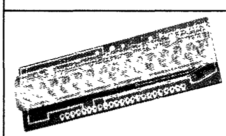
Red, High Efficiency Red, Yellow and Green Seven Segment LED Displays

Device		Description	Package	Application	Page No.
	5082-7610	7.62mm (.3") High Efficiency Red, Common Anode, LHDP	14 Pin Epoxy, 7.62mm (.3") DIP .75"H x .4"W x .18"D	General Purpose Market • Test Equipment • Digital Clocks • Clock Radios • TV Channel Indicators • Business Machines • Digital Instruments • Automobiles For further information ask for Application Note 941 and 964; Application Bulletins 1 through 4. (See page 196)	56
	5082-7611	7.62mm (.3") High Efficiency Red, Common Anode, RHDP			
	5082-7613	7.62mm (.3") High Efficiency Red, Common Cathode, RHDP	10 Pin Epoxy, 7.62mm (.3") DIP .75"H x .4"W x .18"D		
	5082-7616	7.62mm (.3") High Efficiency Red, Universal Polarity Overflow Indicator RHDP	14 Pin Epoxy, 7.62mm (.3") DIP .75"H x .4"W x .18"D		
	5082-7620	7.62mm (.3") Yellow, Common Anode LHDP			
	5082-7621	7.62mm (.3") Yellow, Common Anode RHDP			
	5082-7623	7.62mm (.3") Yellow, Common Cathode, RHDP	(Same as 5082-7613)		
	5082-7626	7.62mm (.3") Yellow, Universal Polarity & Overflow Indicator RHDP	14 Pin Epoxy, 7.62mm (.3") DIP .75"H x .4"W x .18"D		
	5082-7630	7.62mm (.3") Green, Common Anode LHDP			
	5082-7631	7.62mm (.3") Green, Common Anode RHDP			
	5082-7633	7.62mm (.3") Green, Common Cathode RHDP	(Same as 5082-7613)		
	5082-7636	7.62mm (.3") Green, Universal Polarity & Overflow Indicator RHDP	14 Pin Epoxy, 7.62mm (.3")DIP .75"H x .4"W x .18"D		
	5082-7650	10.92mm(.43") High Efficiency Red, Common Anode, LHDP	14 Pin Epoxy, 7.62mm (.3") DIP .75"H x .5"W x .25"D		61
	5082-7651	10.92mm (.43") High Efficiency Red, Common Anode, RHDP			
	5082-7653	10.92mm (.43") High Efficiency Red, Common Cathode RHDP			
	5082-7656	10.92mm (.43") High Efficiency Red Universal Polarity & Overflow Indicator RHDP			
	5082-7660	10.92mm(.43") Yellow Common Anode LHDP			
	5082-7661	10.92mm(.43") Yellow Common Anode RHDP			
	5082-7663	10.92mm(.43") Yellow Common Cathode RHDP			
	5082-7666	10.92mm(.43")Yellow Universal Polarity & Overflow Indicator RHDP			
	5082-7670	10.92mm(.43") Green Common Anode LHDP			
	5082-7671	10.92mm(.43") Green Common Anode RHDP			

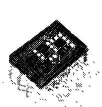
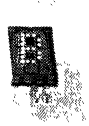
Device		Description	Package	Application	Page No.
	5082-7673	10.92mm(.43") Green Common Cathode RHDP	14 Pin Epoxy, 7.62mm (.3") DIP .75"H x .5"W x .25"D	General Purpose Market • Test Equipment • Digital Clocks • Clock Radios • TV Channel Indicators • Business Machines • Digital Instruments • Automobiles For further information ask for Application Note 941 and 964; Application Bulletins 1 through 4. (See page 196)	61
	5082-7676	10.92mm(.43") Green Universal Polarity & Overflow Indicator RHDP			
	5082-7730	7.62mm(.3") Red, Common Anode, LHDP	14 Pin Epoxy, 7.62mm(.3") DIP .75"H x .4"W x.18"D		66
	5082-7731	7.62mm(.3") Red, Common Anode, RHDP			
	5082-7736	7.62mm(.3") Red, Common Anode, Polarity & Overflow Indicator			
	5082-7740	7.62mm(.3") Red, Common Cathode, RHDP	10 Pin Epoxy, 7.62mm (.3") DIP .75"H x .4"W x .18"D		
	5082-7750	10.92mm(.43") Red, Common Anode, LHDP	14 Pin Epoxy, 7.62mm (.3") DIP .75"H x .5"W x .25"D		70
	5082-7751	10.92mm(.43") Red, Common Anode, RHDP			
	5082-7756	10.92mm(.43") Red, Universal Polarity & Overflow Indicator, RHDP			
	5082-7760	10.92mm(.43") Red, Common Cathode, RHDP			

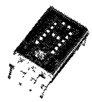
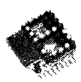
Red Seven Segment LED Displays

Device		Description	Package	Application	Page No.
	5082-7402	2.79mm(.11") Red, 3 Digits Right,[1] Centered D.P.	12 Pin Epoxy, 7.62mm (.3") DIP	Small Display Market • Portable/Battery Power Instruments • Portable Calculators • Digital Counters • Digital Thermometers • Digital Micrometers • Stopwatches • Cameras • Copiers • Digital Telephone Peripherals • Data Entry Terminals • Taxi Meters For further information ask for Application Note 937. (See page 196)	74
	5082-7403	2.79mm(.11") Red, 3 Digits Left,[1] Centered D.P.			
	5082-7404	2.79mm(.11") Red, 4 Digits Centered D.P.			
	5082-7405	2.79mm(.11") Red, 5 Digits, Centered D.P.	14 Pin Epoxy, 7.62mm (.3") DIP		
	5082-7412	2.79mm (.11") Red, 3 Digits Right,[1] RHDP	12 Pin Epoxy, 7.62mm (.3") DIP		
	5082-7413	2.79mm (.11") Red, 3 Digits Left,[1] RHDP			
	5082-7414	2.79mm(.11") Red, 4 Digit, RHDP			
	5082-7415	2.79mm(.11") Red, 5 Digit, RHDP	14 Pin Epoxy, 7.62mm (.3") DIP		
	5082-7432	2.79mm(.11") Red, 2 Digits Right,[2] RHDP	12 Pin Epoxy, 7.62mm (.3") DIP		78
	5082-7433	2.79mm(.11") Red, 3 Digits, RHDP			

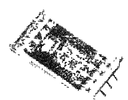
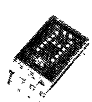
Device		Description	Package	Application	Page No.
	5082-7440	2.67mm(.105") Red, 8 Digits, Mounted on P.C. Board	50.8mm(2") P.C. Bd., 17 Term. Edge Con.	Small Display Market • Portable/Battery Power Instruments • Portable Calculators • Digital Counters • Digital Thermometers • Digital Micrometers • Stopwatches • Cameras • Copiers • Digital Telephone Peripherals • Data Entry Terminals • Taxi Meters For further information ask for Application Note 937. (See page 196)	82
	5082-7448	2.67mm(.105") Red, 8 Digits, Mounted on P.C. Board	60.3mm(2.375")PC Bd., 17 Term. Edge Con.		
	5082-7441	2.67mm(.105") Red, 9 Digits, Mounted on P.C. Board	50.8mm(2") PC Bd., 17 Term. Edge Con.		
	5082-7449	2.67mm(.105") Red, 9 Digits, Mounted on P.C. Board	60.3mm(2.375")PC Bd., 17 Term. Edge Con.		
	5082-7442	2.54mm(.100") Red, 12 Digits, Mounted on P.C. Board	60.3mm(2.375")PC Bd., 20 Term. Edge Con.		86
	5082-7445	2.54mm(.100") Red, 12 Digits, Mounted on P.C. Board	59.6mm(2.345")PC Bd., 20 Term. Edge Con.		
	5082-7444	2.54mm(.100") Red, 14 Digits, Mounted on P.C. Board	60.3mm(2.375") PC Bd., 22 Term. Edge Con.		
	5082-7446	2.92mm(.115") Red, 16 Digits, Mounted on P.C. Board	69.85mm(2.750")PC Bd., 24 Term. Edge Con.		
	5082-7447	2.85mm(.112") Red, 14 Digits, Mounted on P.C. Board	60.3mm(2.375") PC Bd., 22 Term. Edge Con.		
	5082-7240	2.59mm(.102") Red, 8 Digits, Mounted on P.C. Board	50.8mm (2") PC Bd., 17 Term. Edge Con.		90
	5082-7241	2.59mm(.102") Red, 9 Digits, Mounted on P.C. Board.			
	5082-7265	4.45mm(.175") Red, 5 Digits, Mounted on P.C. Board. Centered D.P.	50.8mm(2") PC Bd., 15 Term. Edge Con.		
	5082-7285	4.45mm(.175") Red, 5 Digits Mounted on P.C. Board. RHDP			
	5082-7275	4.45mm(.175") Red, 15 Digits, Mounted on P.C. Board. Centered D.P.	91.2mm(3.59") PC Bd., 23 Term. Edge Con.		
	5082-7295	4.45mm(.175") Red, 15 Digits, Mounted on P.C. Board. RHDP			

Integrated LED Displays

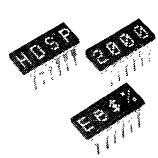
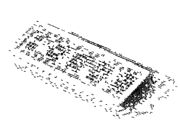
Device		Description	Package	Application	Page No.
	5082-7300	7.4mm (.29") 4x7 Single Digit Numeric, RHDP, Built-In Decover/Driver/Memory	8 Pin Epoxy, 15.2mm (.6") DIP	General Purpose Market • Test Equipment • Business Machines • Computer Peripherals • Avionics For further information ask for Application Note 934 on LED Display Installation Techniques	98
	5082-7302	7.4mm (.29") 4x7 Single Digit Numeric, LHDP, Built-In Decover/Driver/Memory			
	5082-7340	7.4mm (.29") 4x7 Single Digit Hexadecimal, Built-In Decoder/Driver/Memory			
	5082-7304	7.4mm (.29") Overrange Character Plus/Minus Sign			

Device		Description	Package	Application	Page No.
	5082-7356	7.4mm (.29") 4x7 Single Digit Numeric, RHDP, Built-In Decoder/Driver/Memory	8 Pin Glass Ceramic 15.2mm (.6") DIP	• Medical Equipment • Industrial and Process Control Equipment • Computers • Where Ceramic Package IC's are required.	102
	5082-7357	7.4mm(.29") 4x7 Single Digit Numeric, LHDP, Built-In Decoder/Driver/Memory			
	5082-7359	7.4mm (.29") 4x7 Single Digit Hexadecimal, Built-In Decoder/Driver/Memory			
	5082-7358	7.4mm(.29") Overrange Character Plus/Minus Sign			
	5082-7500	38.1mm (1.5") 5x7 Single Digit LHDP, Built-In Decoder/Driver	P.C. Board 10 Pin Edge Card Connector .396mm (.156") Centers	General Purpose Market • Test Equipment • Medical Equipment • Industrial Controls	107

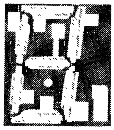
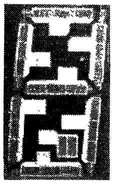
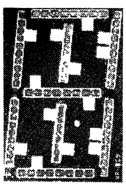
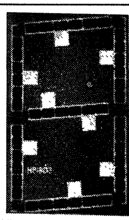
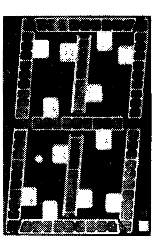
Hermetically Sealed Integrated LED Displays

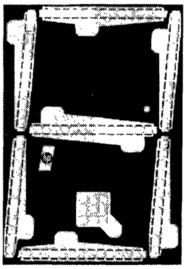
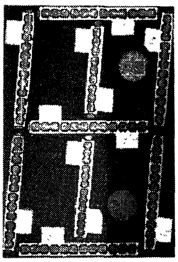
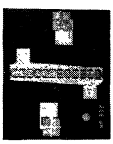
Device		Description	Package	Application	Page No.
	5082-7010	6.8mm (.27") 5x7 Single Digit Numeric, LHDP, Built-In Decoder/Driver	8 Pin Hermetic 2.54mm (.100") Pin Centers	• Ground, Airborne, Shipboard Equipment • Fire Control Systems • Space Flight Systems	109
	5082-7011	6.8mm (.27") Plus/Minus Sign			
	5082-7391	7.4mm (.29") 4x7 Single Digit Numeric, RHDP, Built-In Decoder/Driver/Memory	8 Pin Hermetic 15.2mm (.6") DIP with Gold Plated Leads	• Ground, Airborne, Shipboard Equipment • Fire Control Systems • Space Flight Systems • Other High Reliability Applications (TX Programs available, see page 115)	115
	5082-7392	7.4mm(.29") 4x7 Single Digit Numeric, LHDP, Built-In Decoder/Driver/Memory			
	5082-7395	7.4mm(.29") 4x7 Single Digit Hexadecimal, Built-In Decoder/Driver/Memory			
	5082-7393	7.4mm(.29") Overrange Character Plus/Minus Sign			

Alphanumeric LED Displays

Device		Description	Package	Application	Page No.
	HDSP-2000	3.8mm (.15") 5x7 Four Character Alphanumeric Built-In Shift Register, Drivers	12 Pin Ceramic 7.62mm (.3") DIP. Redglass Contrast Filter	• Programmable Calculators • Computer Terminals • Business Machines • Medical Instruments • Portable, Hand-held or mobile data entry, read-out or communications For further information ask for Application Note 966 and Application Bulletin 51	121
	5082-7100	7.4mm (.29") 5x7 Three Digit Alphanumeric	22 Pin Hermetic 15.2mm (.6") DIP	General Purpose Market • Business Machines • Calculators • Solid State CRT • High Reliability Applications For further information ask for Application Note 931 on Alphanumeric Displays	125
	5082-7101	7.4mm (.29") 5x7 Four Digit Alphanumeric	28 Pin Hermetic 15.2mm (.6") DIP		
	5082-7102	7.4mm (.29") 5x7 Five Digit Alphanumeric	36 Pin Hermetic 15.2mm (.6") DIP		

LED Chips

Device		Description	Shipping Carrier	Tilt Angle	Chip Size	Page No.
	5082-7811	7 Seg. 53 mil Character Height Monolithic LED Chip in Scribed Wafer Form	Wafer Mounted On Vinyl Film	6° (typical)	1.50x1.35mm (59x53mil)	129
	5082-7821	7 Seg. 53 mil Character Height Monolithic LED Chip	Waffle Pack			
	5082-7832	7 Seg. 80 mil Character Height Monolithic LED Chip in Scribed Wafer Form	Wafer Mounted OnVinyl Film	5° (typical)	2.24x1.42mm (88x56mil)	
	5082-7842	7 Seg. 80 mil Character Height Monolithic LED Chip	Waffle Pack			
	5082-7833	9 Seg. 80 mil Character Height Monolithic LED Chip in Scribed Wafer Form	Wafer Mounted on Vinyl Film	5°	2.24 x 1.62mm (88 x 64mm)	133
	5082-7843	9 Seg. 80 mil Character Height Monolithic LED Chip	Waffle Pack			
	5082-7837	7 Seg. 88 mil Character Height Monolithic LED Chip in Scribed Wafer Form	Wafer Mounted on Vinyl Film	5°	2.5 x 1.6mm (98 x 63mil)	
	5082-7847	7 Seg. 88 mil Character Height Monolithic LED Chip	Waffle Pack			
	5082-7838	2 Seg. "ONE" 88 mil Character Height Monolithic LED Chip in Scribed Wafer Form	Wafer Mounted on Vinyl Film	–	2.36 x 0.64mm (93 x 25mil)	
	5082-7848	2 Seg. "ONE" 88 mil Character Height Monolithic LED Chip	Waffle Pack			
	5082-7851	7 Seg. 100 mil Character Height Monolithic LED Chip in Scribed Wafer Form	Wafer Mounted On Vinyl Film	5°	2.27x1.91mm (107x75mil)	129
	5082-7861	7 Seg. 100 mil Character Height Monolithic LED Chip	Waffle Pack			
	5082-7852	9 Seg. 100 mil Character Height Monolithic LED Chip in Scribed Wafer Form	Wafer Mounted On Vinyl Film	5°	2.72x1.91mm (107x75mil)	
	5082-7862	9 Seg. 100 mil Character Height Monolithic LED Chip	Waffle Pack			
	5082-7853	2 Seg. 100 mil Character Height Monolithic LED Chip in Scribed Wafer Form	Wafer Mounted On Vinyl Film	5°	2.72x0.89mm (107x35mil)	
	5082-7863	2 Seg. 100 mil Character Height Monolithic LED Chip	Waffle Pack			

Device		Description	Shipping Carrier	Tilt Angle	Chip Size	Page No.
	5082-7871	7 Seg. 120 mil Character Height Monolithic LED Chip in Scribed Wafer Form	Wafer Mounted On Vinyl Film	5°	3.25x2.34mm (128x92mil)	129
	5082-7881	7 Seg. 120 mil Character Height Monolithic LED Chip	Waffle Pack			
	5082-7872	9 Seg. 120 mil Character Height Monolithic LED Chip in Scribed Wafer Form	Wafer Mounted on Vinyl Film	5°	3.25 x 2.34mm (128 x 92mil)	133
	5082-7882	9 Seg. 120 mil Character Height Monolithic LED Chip	Waffle Pack			
	5082-7856	Dash Colon Monolithic LED Chip in Scribed Wafer Form	Wafer Mounted on Vinyl Film	5°	0.18 x 0.18mm (7 x 7mil)	
	5082-7866	Dash Colon Monolithic LED Chip	Waffle Pack			
	5082-7892	11 mil Discrete LED	Waffle Pack		0.38x0.38mm (15x15mil)	129
	5082-7893	11 mil Discrete LED	Glass Vial			

HEWLETT PACKARD

COMPONENTS

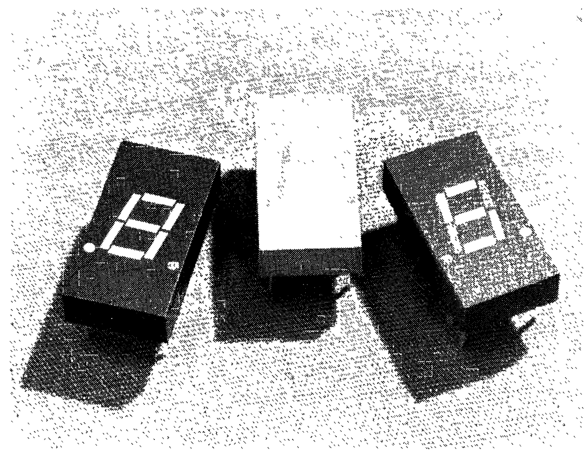
.3 INCH SEVEN SEGMENT DISPLAYS

HIGH EFFICIENCY RED · 5082-7610 SERIES
YELLOW · 5082-7620 SERIES
GREEN · 5082-7630 SERIES

TECHNICAL DATA APRIL 1977

Features

- **COMPACT SIZE**
- **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 in.) DIP Leads on 2.54mm (.1 in.) Centers
- **CATEGORIZED FOR LUMINOUS INTENSITY**
  Use of Like Categories Yields a Uniform Display
- **IC COMPATIBLE**
- **MECHANICALLY RUGGED**



Description

The 5082-7610, -7620, and -7630 series are 7.62mm (.3 in.) High Efficiency Red, Yellow, and Green seven segment displays. These displays are designed for use in instruments, point of sale terminals, clocks, and appliances.

The -7610, and -7620 series devices utilize high efficiency LED chips which are made from GaAsP on a transparent GaP substrate.

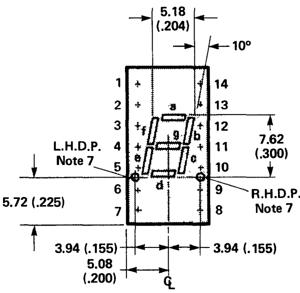
The -7630 series devices utilize chips made from GaP on a transparent GaP substrate.

Devices

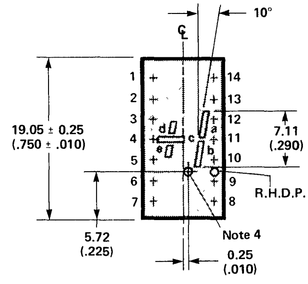
Part No. 5082-	Color	Description	Package Drawing
-7610	High Efficiency Red	Common Anode Left Hand Decimal	A
-7611	High Efficiency Red	Common Anode Right Hand Decimal	B
-7613	High Efficiency Red	Common Cathode Right Hand Decimal	C
-7616	High Efficiency Red	Universal Overflow ±1 Right Hand Decimal	D
-7620	Yellow	Common Anode Left Hand Decimal	A
-7621	Yellow	Common Anode Right Hand Decimal	B
-7623	Yellow	Common Cathode Right Hand Decimal	C
-7626	Yellow	Universal Overflow ±1 Right Hand Decimal	D
-7630	Green	Common Anode Left Hand Decimal	A
-7631	Green	Common Anode Right Hand Decimal	B
-7633	Green	Common Cathode Right Hand Decimal	C
-7636	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

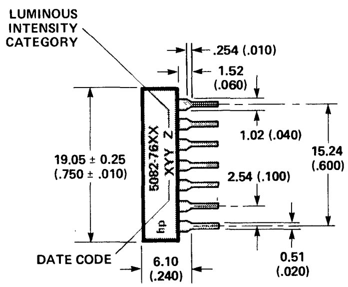


A,B,C

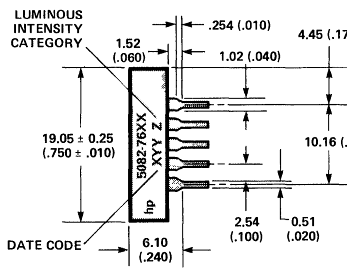


D

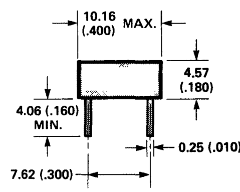
PIN	FUNCTION			
	A -7610/-7620/ -7630	B -7611/-7621/ -7631	C -7613/-7623/ -7633	D -7616/-7626/ -7636
1	CATHODE-a	CATHODE-a	CATHODE[6]	ANODE-d
2	CATHODE-f	CATHODE-f	ANODE-f	NO PIN
3	ANODE[3]	ANODE[3]	ANODE-g	CATHODE-d
4	NO PIN	NO PIN	ANODE-e	CATHODE-c
5	NO PIN	NO PIN	ANODE-d	CATHODE-e
6	CATHODE-dp	NO CONN.[5]	CATHODE[6]	ANODE-e
7	CATHODE-e	CATHODE-e	ANODE-dp	ANODE-c
8	CATHODE-d	CATHODE-d	ANODE-c	ANODE-dp
9	NO CONN.[5]	CATHODE-dp	ANODE-b	NO PIN
10	CATHODE-c	CATHODE-c	ANODE-a	CATHODE-dp
11	CATHODE-g	CATHODE-g		CATHODE-b
12	NO PIN	NO PIN		CATHODE-a
13	CATHODE-b	CATHODE-b		ANODE-a
14	ANODE[3]	ANODE[3]		ANODE-b



A,B,D
SIDE



C
SIDE

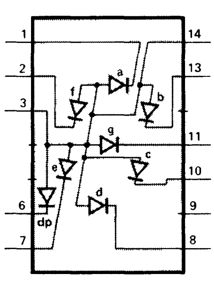


A,B,C,D
END

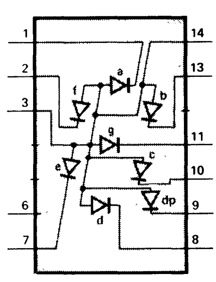
NOTES:

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.
7. See part number table for L.H.D.P. and R.H.D.P. designation.

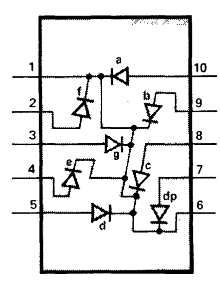
Internal Circuit Diagram



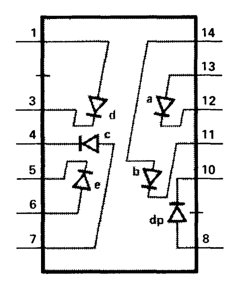
A



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
Average 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 DC current from 50°C at 0.4mA/°C per segment. 3. See pulse width limitation curve (Fig. 2) and Duty Factor Curve (Fig. 5). 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 5082-7610/-7611/-7613/-7616

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment (5,8)	I_v	5mA D.C.	70	250		μcd
		20mA D.C.		1430		μcd
(Digit Average)		60mA Pk: 1 of 6 Duty Factor		810		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		
		$I_F = 20mA$		2.0	2.5	V
		$I_F = 60mA$		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.	$\Delta V_F/°C$			−2.0		mV/°C

YELLOW 5082-7620/-7621/-7623/-7626

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment (5,8)	I_v	5mA D.C.	90	200		μcd
		20mA D.C.		1200		μcd
(Digit Average)		60mA Pk: 1 of 6 Duty Factor		740		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		
		$I_F = 20mA$		2.2	2.5	V
		$I_F = 60mA$		3.1		
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.	$V_F/°C$			−2.0		mV/°C

GREEN 5082-7630/-7631/-7633/-7636

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment (5,8)	I_v	10mA D.C.	150	300		μcd
		20mA D.C.		765		μcd
(Digit Average)		60mA Pk: 1 of 6 Duty Factor		540		μcd
Peak Wavelength	λ_{PEAK}			565		nm
Dominant Wavelength (6)	λ_d			572		nm
Forward Voltage/Segment or D.P.	V_F	$I_F = 5mA$		1.9		
		$I_F = 20mA$		2.2	2.5	V
		$I_F = 60mA$		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.	$\Delta V_F/°C$			−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:

$$I_{V_{T_A}} = I_{V_{25°C}}\, e^{[K(T_A - 25°C)]}.$$

Device	K
-7610 series	-.0131/°C
-7620 series	-.0112/°C
-7630 series	-.0104/°C

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
-7610 Series	1.65V	21Ω
-7620 Series	1.75V	25Ω
-7630 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, $I_{V\,SPEC}$

η_{IPEAK} = Relative efficiency at operating peak current.

$\eta_{IPEAK\,SPEC}$ = 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 Yellow 27 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 10.16mm (.4 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.

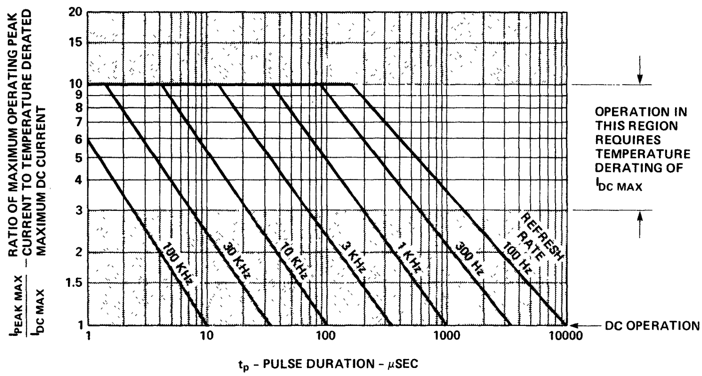


Figure 1. Maximum Tolerable Peak Current vs. Pulse Duration.

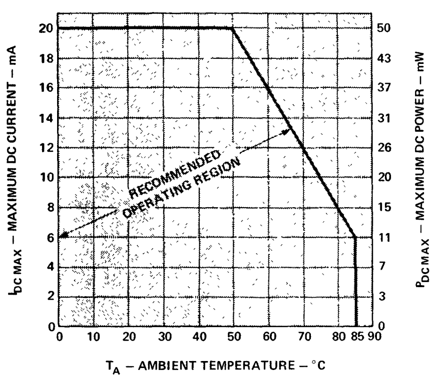


Figure 2. Maximum Allowable DC Current and DC Power Dissipation Per Segment as a Function of Ambient Temperature.

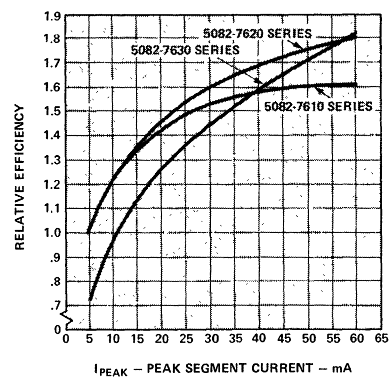


Figure 3. Relative Luminous Efficiency (Luminous Intensity per Unit Current) vs. Peak Segment Current.

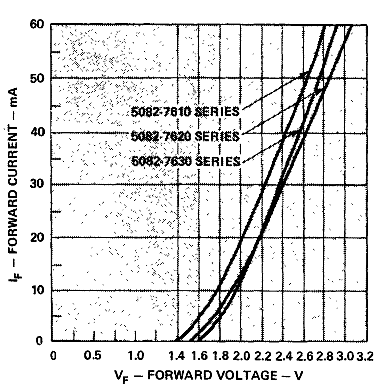


Figure 4. Forward Current vs. Forward Voltage Characteristic.

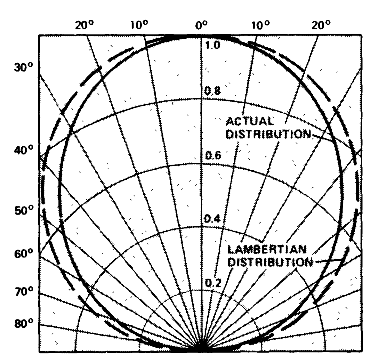


Figure 5. Normalized Angular Distribution of Luminous Intensity.

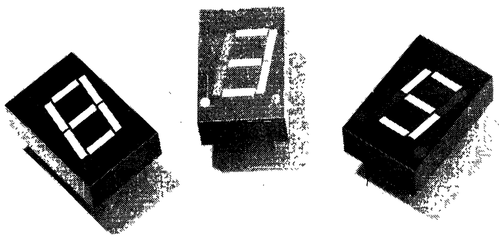
HEWLETT hp PACKARD
COMPONENTS

.43 INCH SEVEN SEGMENT DISPLAYS
HIGH EFFICIENCY RED • 5082-7650 SERIES
YELLOW • 5082-7660 SERIES
GREEN • 5082-7670 SERIES

TECHNICAL DATA APRIL 1977

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.

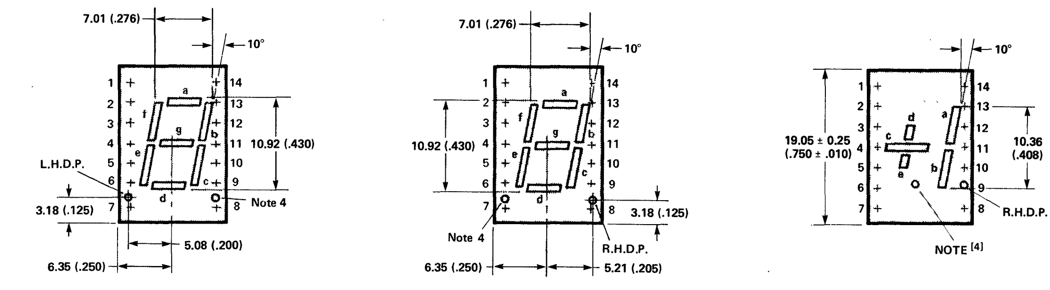
The -7670 series devices utilize chips made from GaP on a transparent GaP substrate.

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

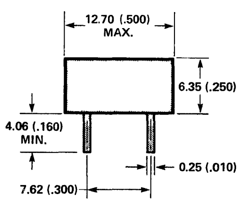
Note: Universal pinout brings the anode and cathode of each segment's LED out to separate pins, see internal diagram D.

Package Dimensions

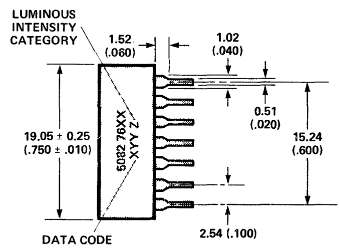


A B,C D

FRONT VIEW



END VIEW

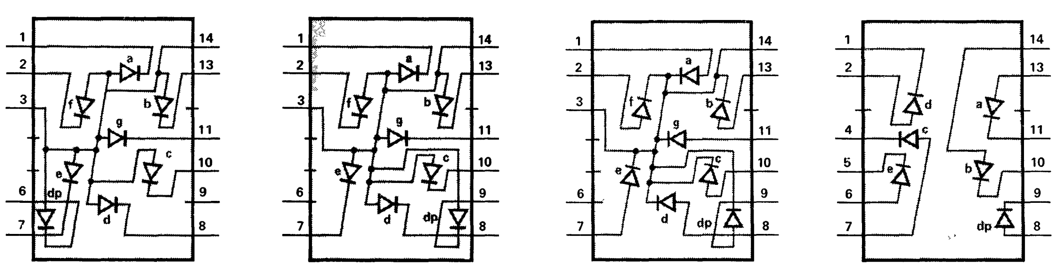


SIDE VIEW

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.

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[3]	ANODE[3]	CATHODE[6]	ANODE-b

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.	$\Delta V_F/°C$			−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.	$\Delta V_F/°C$			−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: $I_{V_{T_A}} = I_{V_{25°C}} e^{[K(T_A - 25°C)]}$.

DEVICE	K
-7650 Series	−.0131/°C
-7660 Series	−.0112/°C
-7670 Series	−.0104/°C

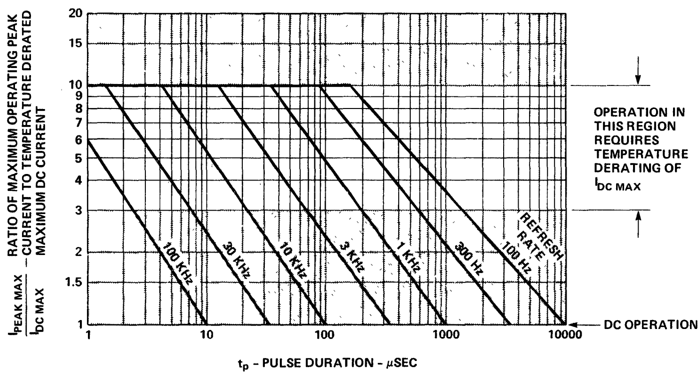


Figure 1. Maximum Tolerable Peak Current vs. Pulse Duration.

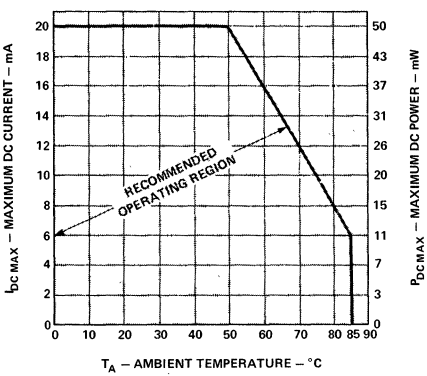


Figure 2. Maximum Allowable DC Current and DC Power Dissipation Per Segment as a Function of Ambient Temperature.

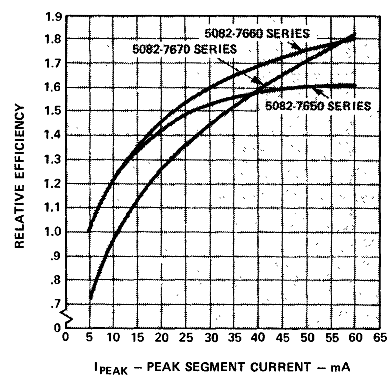


Figure 3. Relative Luminous Efficiency (Luminous Intensity per Unit Current) vs. Peak Segment Current.

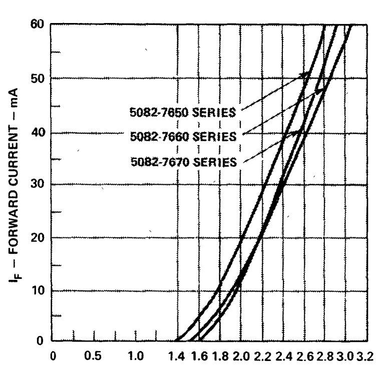


Figure 4. Forward Current vs. Forward Voltage Characteristic.

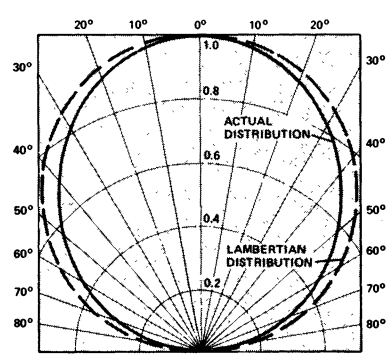


Figure 5. Normalized Angular Distribution of Luminous Intensity.

Operational Considerations

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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
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   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
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   Example: I_P = (2.5) (12mA) = 30mA peak
   I_{AVG}=(1/4) (30mA) = 7.5mA average.

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

η_{IPEAK} = Relative efficiency at operating peak current.

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MECHANICAL

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HEWLETT hp PACKARD

COMPONENTS

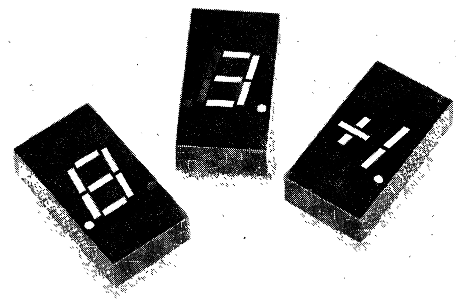
0.3 INCH RED SEVEN SEGMENT DISPLAY

5082-7730 SERIES 5082-7740

TECHNICAL DATA APRIL 1977

Features

- **5082-7730**
  Common Anode
  Left Hand D.P.
- **5082-7731**
  Common Anode
  Right Hand D.P.
- **5082-7736**
  Polarity and Overflow Indicator
  Universal Pinout
  Right Hand D.P.
- **5082-7740**
  Common Cathode
  Right Hand D.P.
- **EXCELLENT CHARACTER APPEARANCE**
  Continuous Uniform Segments
  Wide Viewing Angle
  High Contrast
- **IC COMPATIBLE**
  1.6V dc per Segment
- **STANDARD 0.3" DIP LEAD CONFIGURATION**
  PC Board or Standard Socket Mountable
- **CATEGORIZED FOR LUMINOUS INTENSITY**
  Assures Uniformity of Light Output from Unit to Unit withing a Single Category



Description

The HP 5082-7730/7740 series devices are common anode LED displays. The series includes a left hand and a right hand decimal point numeric display as well as a polarity and overflow indicator. The large 7.62 mm (0.3 in.) high character size generates a bright, continuously uniform seven segment display. Designed for viewing distances of up to 3 meters (9.9 feet), these single digit displays provide a high contrast ratio and a wide viewing angle.

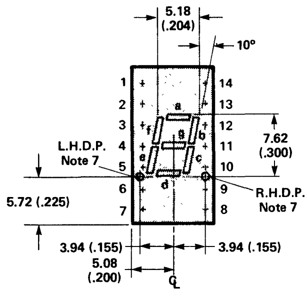
The 5082-7730 series devices utilize a standard 7.62 mm (0.3 in.) dual-in-line package configuration that permits mounting on PC boards or in standard IC sockets. Requiring a low forward voltage, these displays are inherently IC compatible, allowing for easy integration into electronic instrumentation, point of sale terminals, TVs, radios, and digital clocks.

Devices

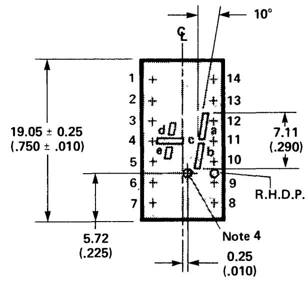
Part No. 5082-	Description	Package Drawing
7730	Common Anode Left Hand Decimal	A
7731	Common Anode Right Hand Decimal	B
7736	Universal Overflow ±1 Right Hand Decimal	C
7740	Common Cathode Right Hand Decimal	D

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

Package Dimensions

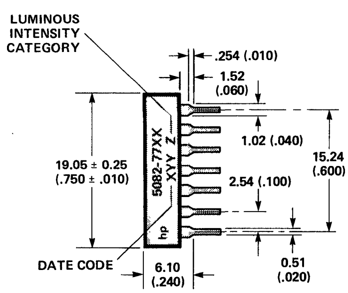


A,B,D

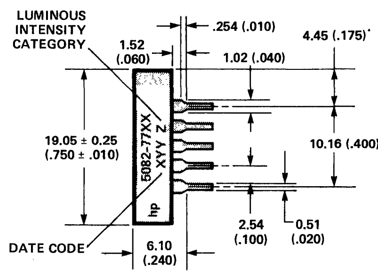


C

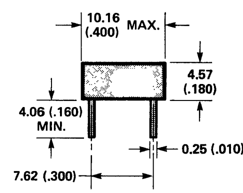
PIN	FUNCTION A -7730	B -7731	C -7736	D -7740
1	CATHODE-a	CATHODE-a	ANODE-d	CATHODE[6]
2	CATHODE-f	CATHODE-f	NO PIN	ANODE-f
3	ANODE[3]	ANODE[3]	CATHODE-d	ANODE-g
4	NO PIN	NO PIN	CATHODE-c	ANODE-e
5	NO PIN	NO PIN	CATHODE-e	ANODE-d
6	CATHODE-dp	NO CONN.[5]	ANODE-e	CATHODE[6]
7	CATHODE-e	CATHODE-e	ANODE-c	ANODE-dp
8	CATHODE-d	CATHODE-d	ANODE-dp	ANODE-c
9	NO CONN.[5]	CATHODE-dp	NO PIN	ANODE-b
10	CATHODE-c	CATHODE-c	CATHODE-dp	ANODE-a
11	CATHODE-g	CATHODE-g	CATHODE-b	
12	NO PIN	NO PIN	CATHODE-a	
13	CATHODE-b	CATHODE-b	ANODE-a	
14	ANODE[3]	ANODE[3]	ANODE-b	



A,B,C
SIDE



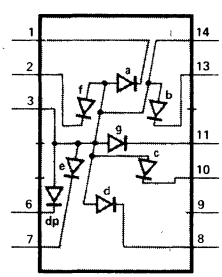
D
SIDE



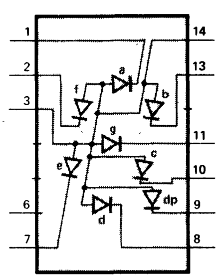
A,B,C,D
END

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.
7. See part number table for L.H.D.P. and R.H.D.P. designation.

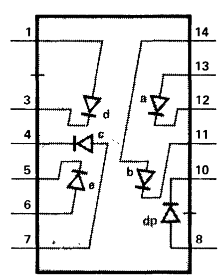
Internal Circuit Diagram



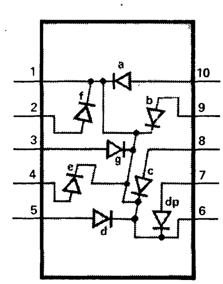
A



B



C



D

Absolute Maximum Ratings

DC Power Dissipation Per Segment or D.P.[1] (T_A=25°C) 42mW
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) 150mA
Average Forward Current Per Segment or D.P.[1,2] (T_A=25°C) 25mA
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 DC current from 50°C at 0.43mA/°C per segment. 3. See pulse width limitation curve (Fig. 2) and Duty Factor Curve (Fig. 5). 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

Description		Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment (2,4)	5082-7740	I_V	I_{PEAK} = 100mA 10% Duty Cycle	50	200		μcd
(Digit Average)	5082-7730/31/36	I_V	I_F = 20mA	100	350		
Peak Wavelength		λ_{PEAK}			655		nm
Dominant Wavelength (2)		λ_d			640		nm
Forward Voltage, any Segment or D.P.		V_F	I_F = 20mA		1.6	2.0	V
Reverse Current, any Segment or D.P.		I_R	V_R = 6V		10		μA
Rise and Fall Time (3)		t_r, t_f			10		ns
Temperature Coefficient of Forward Voltage		ΔV_F/°C			−2.0		mV/°C

Notes:
1. The digits are categorized for luminous intensity with the intensity category designated by a letter located on the right hand side of the package.
2. The dominant wavelength, λ_d, is derived from the CIE Chromaticity Diagram and is that single wavelength which defines the color of the device.
3. Time for a 10% - 90% change of light intensity for step change in current.
4. Temperature coefficient of luminous intensity I_V/°C is determined by the formula: $I_{V_{T_A}} = I_{V_{25°C}} e^{[(-.0188/°C)(T_A - 25°C)]}$.

Operational Considerations

ELECTRICAL

The 5082-7730/7740 series display is composed of eight light emitting diodes optically magnified to form seven individual segments and decimal point.

The diodes are made of GaAsP (Gallium Arsenide Phosphide) junction on a GaAs substrate. Diode turn-on voltage is approximately 1.55 volts and typical forward diode resistance is 5 ohms. For strobing at peak currents a user should take this forward resistance into account.

Typical forward voltage may be scaled from Figure 4 or calculated from the following formula:

$V_F = 1.55V + (3\Omega \times I_{PEAK})$

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 = 1kHz; 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=1kHz, $I_{P\,MAX}/I_{DC\,MAX}$ = 2.7.
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, $I_{DC\,MAX}$ = 16.4mA.
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=(2.7) (16.4mA) = 44.3mA peak
   I_{AVG}=(1/4) (44.3mA) = 11.1mA 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 reulting in the maximum possible time average luminous intensity.

This display may be operated at various peak currents (see Figure 3). Light output for a selected peak current can be calculated as follows:

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

I_{AVG} = Operating point average current
$I_{AVG\,SPEC}$ = Average current for data sheet luminous intensity value, $I_{V\,SPEC}$
$\eta_{I\,PEAK}$ = 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 $I_{PEAK\,SPEC}$

CONTRAST ENHANCEMENT

The 5082-7730/7740 series display may be effectively filtered using one of the following filter products: Homalite H100-1605: H 100-1804 (purple); Panelgraphic Ruby Red 60: Dark Red 63: Purple 90; Plexiglas 2423; 3M Brand Light Control Film for daylight viewing. For further information see Application Note 964.

MECHANICAL

The 5082-7730/7740 series devices are constructed utilizing a lead frame in a standard DIP package. The individual packages may be close-packed on 10.16mm (.4 in.) centers on a PC board. Also, the larger character height allows other character spacing options when desired. The lead frame 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. Isoproponal, Ethanol or water may also be used for cleaning operations.

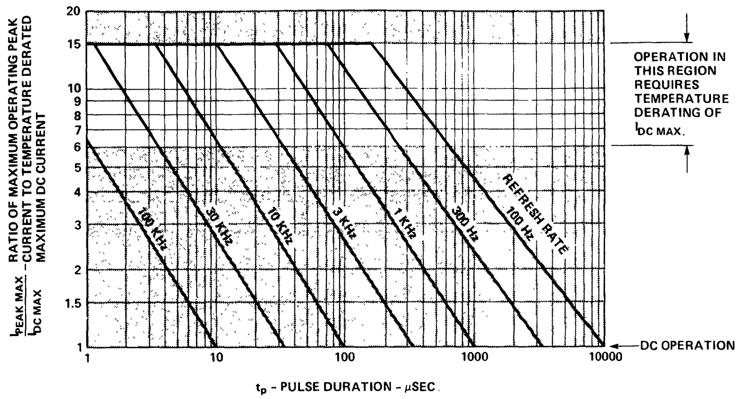


Figure 1. Maximum Tolerable Peak Current vs. Pulse Duration.

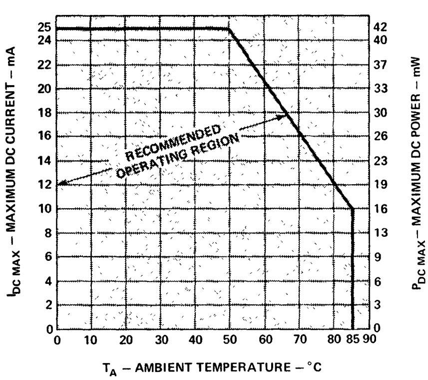


Figure 2. Maximum Allowable DC Current and DC Power Dissipation per Segment as a Function of Ambient Temperature.

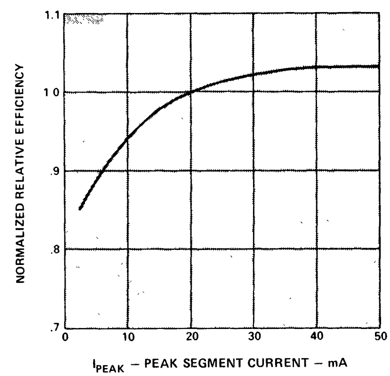


Figure 3. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current per Segment.

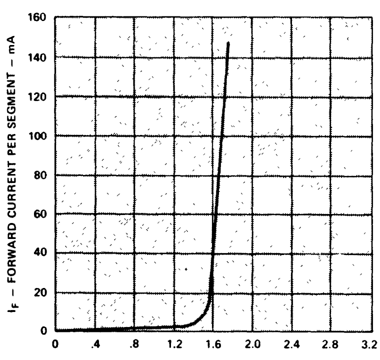


Figure 4. Forward Current vs. Forward Voltage.

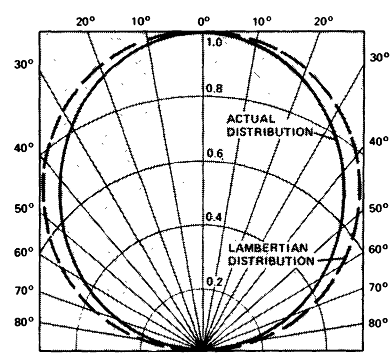


Figure 5. Normalized Angular Distrubution of Luminous Intensity.

HEWLETT hp PACKARD

COMPONENTS

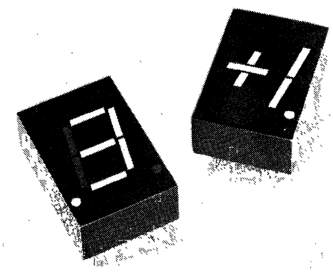
.43 INCH RED SEVEN SEGMENT DISPLAY

5082-7750 SERIES
5082-7760

TECHNICAL DATA APRIL 1977

Features

- **5082-7750**
  Common Anode
  Left Hand D.P.
- **5082-7751**
  Common Anode
  Right Hand D.P.
- **5082-7756**
  Polarity and Overflow Indicator
  Universal Pinout
  Right Hand D.P.
- **5082-7760**
  Common Cathode
  Right Hand D.P.
- **LARGE DIGIT**
  Viewing Up to 6 Meters (19.7 Feet)
- **EXCELLENT CHARACTER APPEARANCE**
  Continuous Uniform Segments
  Wide Viewing Angle
  High Contrast
- **IC COMPATIBLE**
- **STANDARD 7.62mm (.3 in.) DIP LEAD CONFIGURATION**
  PC Board or Standard Socket Mountable
- **CATEGORIZED FOR LUMINOUS INTENSITY**
  Assures Uniformity of Light Output from Unit to Unit within a Single Category



Description

The 5082-7750/7760 series are large 10.92mm (.43 in.) GaAsP LED seven segment displays. Designed for viewing distances up to 6 meters (19.7 feet), these single digit displays provide a high contrast ratio and a wide viewing angle.

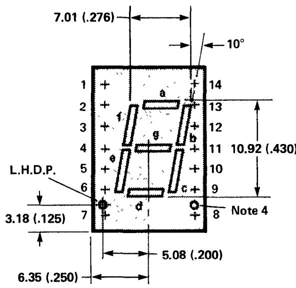
These devices utilize a standard 7.62mm (.3 in.) dual-in-line package configuration that permits mounting on PC boards or in standard IC sockets. Requiring a low forward voltage, these displays are inherently IC compatible, allowing for easy integration into electronic instrumentation, point of sale terminals, TVs, radios, and digital clocks.

Devices

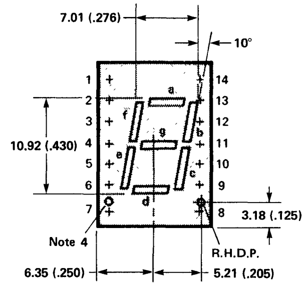
Part No. 5082-	Description	Package Drawing
–7750	Common Anode Left Hand Decimal	A
–7751	Common Anode Right Hand Decimal	B
–7756	Universal Overflow ±1 Right Hand Decimal	C
–7760	Common Cathode Right Hand Decimal	D

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

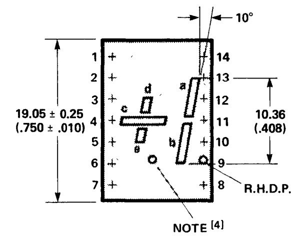
Package Dimensions



A

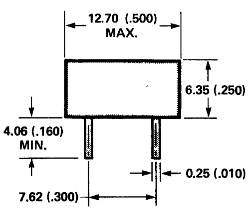


B,D

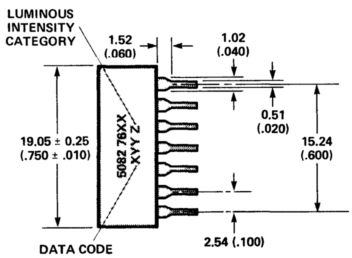


C

FRONT VIEW



END VIEW



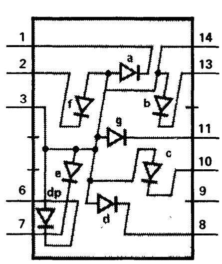
SIDE VIEW

PIN	FUNCTION			
	A -7750	B -7751	C -7756	D -7760
1	CATHODE-a	CATHODE-a	CATHODE-d	ANODE-a
2	CATHODE-f	CATHODE-f	ANODE-d	ANODE-f
3	ANODE [3]	ANODE [3]	NO PIN	CATHODE [6]
4	NO PIN	NO PIN	CATHODE-c	NO PIN
5	NO PIN	NO PIN	CATHODE-e	NO PIN
6	CATHODE-dp	NO CONN. [5]	ANODE-e	NO CONN. [5]
7	CATHODE-e	CATHODE-e	ANODE-c	ANODE-e
8	CATHODE-d	CATHODE-d	ANODE-dp	ANODE-d
9	NO CONN. [5]	CATHODE-dp	CATHODE-dp	ANODE-dp
10	CATHODE-c	CATHODE-c	CATHODE-b	ANODE-c
11	CATHODE-g	CATHODE-g	CATHODE-a	ANODE-g
12	NO PIN	NO PIN	NO PIN	NO PIN
13	CATHODE-b	CATHODE-b	ANODE-a	ANODE-b
14	ANODE [3]	ANODE [3]	ANODE-b	CATHODE [6]

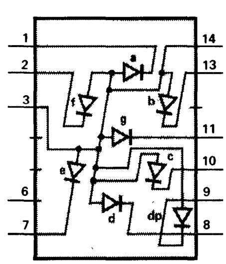
NOTES:

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 cathodes.

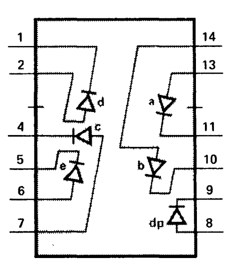
Internal Circuit Diagram



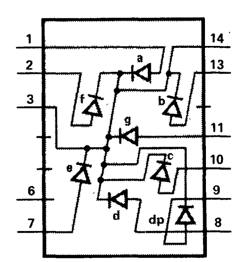
A



B



C



D

Absolute Maximum Ratings

DC Power Dissipation Per Segment or D.P.[1] (T_A=25° C)	42mW
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)	150mA
DC Forward Current Per Segment or D.P.[1,2] (T_A=25° C)	25mA
Reverse Voltage Per Segment or D.P.	6.0V
Lead Soldering Temperature [1.59mm (1/16 inch) below seating plane[4]]	230° C for 3 Sec

Notes: 1. See power derating curve (Fig.2). 2. Derate average current from 50° C at 0.43mA/° 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 $T_A=25°C$

Description	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment [2,4] (Digit Average)	I_V	I_{PEAK} = 100mA 12.5% Duty Cycle		350		μcd
		I_F = 20mA	150	400		μcd
Peak Wavelength	λ_{PEAK}			655		nm
Dominant Wavelength [2]	λ_d			645		nm
Forward Voltage, any Segment or D.P.	V_F	I_F = 20mA		1.6	2.0	V
Reverse Current, any Segment or D.P.	I_R	V_R = 6V		10		μA
Rise and Fall Time [3]	t_r, t_f			10		ns
Temperature Coefficient of Forward Voltage	$\Delta V_F/°C$			−2.0		mV/°C

Notes:
1. The digits are categorized for luminous intensity with the intensity category designated by a letter located on the right hand side of the package.
2. The dominant wavelength, λ_d, is derived from the CIE Chromaticity Diagram and is that single wavelength which defines the color of the device.
3. Time for a 10% - 90% change of light intensity for step change in current.
4. Temperature coefficient of luminous intensity $I_V/°C$ is determined by the formula: $I_{V_{TA}} = I_{V25°C}\ e^{[(-.0188/°C)(T_A - 25°C)]}$

Operational Considerations

ELECTRICAL

The 5082-7750/7760 series display is composed of eight light emitting diodes optically magnified to form seven individual segments and decimal point.

The diodes are made of GaAsP (Gallium Arsenide Phosphide) junction on a GaAs substrate. Diode turn-on voltage is approximately 1.55 volts and typical forward diode resistance is 5 ohms. For strobing at peak currents a user should take this forward resistance into account.

Typical forward voltage may be scaled from Figure 4 or calculated from the following formula:

$$V_F = 1.55V + (3\Omega \times I_{PEAK})$$

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 = 1kHz; 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 anf f=1kHz, $I_{P\ MAX}/I_{DC\ MAX} = 2.7$.
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, $I_{DC\ MAX}$ = 16.4mA.
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=(2.7) (16.4mA) = 44.3mA peak
   I_{AVG}=(1/4) (44.3mA) = 11.1mA 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 reulting in the maximum possible time average luminous intensity.

This display may be operated at various peak currents (see Figure 3). Light output for a selected peak current may be calculated from the 20mA value using the following formula:

$$I_v = (I_{v\ 20mA})\ \eta_{I_{PEAK}} \left(\frac{I_{F\ AVG}}{20mA}\right)$$

Where: I_v = Luminous Intensity at desired I_{AVG}

$I_{v\ 20mA}$ = Luminous Intensity at I_F = 20mA

I_{AVG} = Average Forward Current per segment = (I_{PEAK} × Duty Factor)

$\eta_{I_{PEAK}}$ = Relative Efficiency Factor at Peak Operating Forward Current from Figure 3.

CONTRAST ENHANCEMENT

The 5082-7750/7760 series display may be effectively filtered using one of the following filter products: Homalite H 100-1605 or H 100-1804 Purple; Panelgraphic Ruby Red 60, Dark Red 63 or Purple 90; Plexiglas 2423; 3M Brand Light Control Film for daylight viewing.

MECHANICAL

The 5082-7750/7760 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 lead frame 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. Isoproponal, Ethanol or water may also be used for cleaning operations.

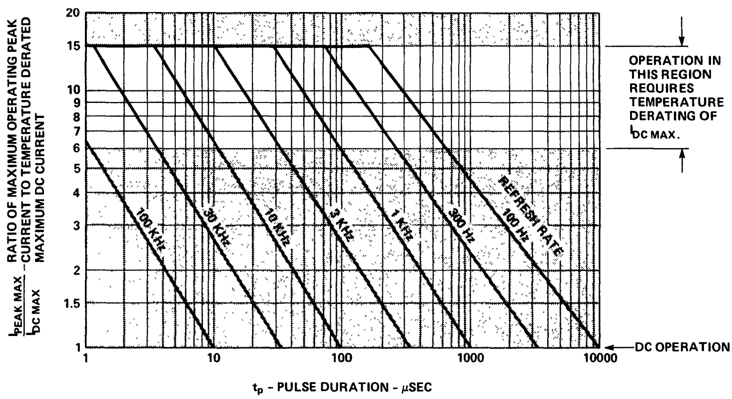


Figure 1. Maximum Tolerable Peak Current vs. Pulse Duration.

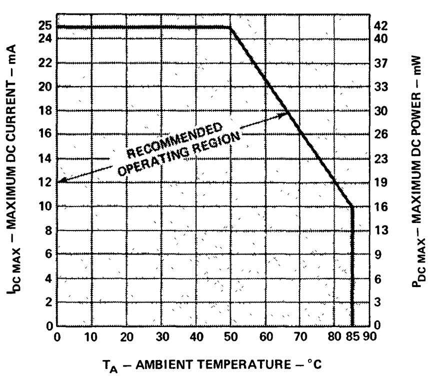


Figure 2. Maximum Allowable DC Current and DC Power Dissipation per Segment as a Function of Ambient Temperature.

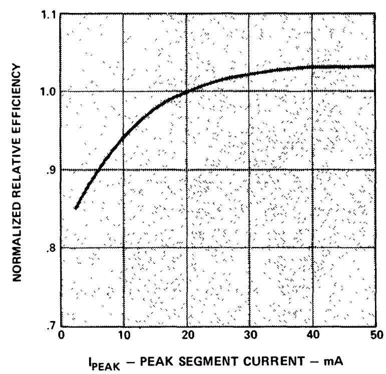


Figure 3. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current per Segment.

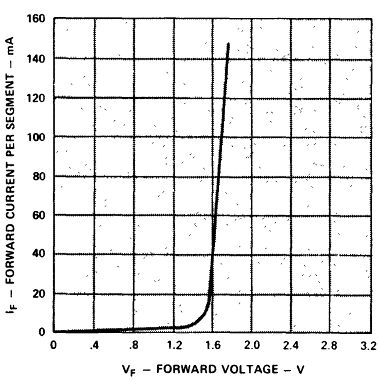


Figure 4. Forward Current versus Forward Voltage.

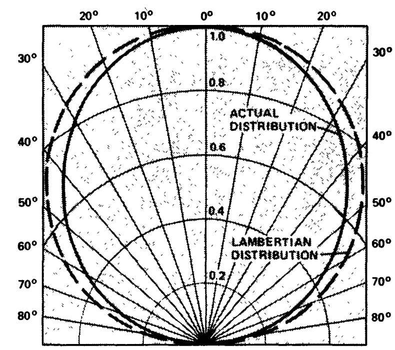


Figure 5. Normalized Angular Distrubution of Luminous Intensity.

HEWLETT hp PACKARD
COMPONENTS

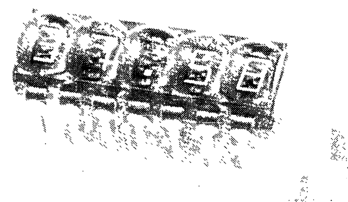
SOLID STATE NUMERIC INDICATOR (7 Segment Monolithic)

5082-7400 SERIES

TECHNICAL DATA APRIL 1977

Features

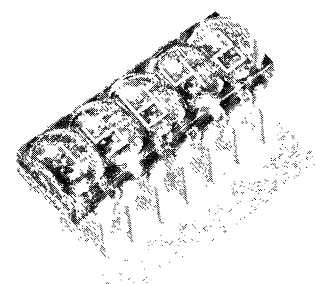
- **ULTRA LOW POWER**
  Excellent Readability at Only 500 μA Average per Segment
- **CONSTRUCTED FOR STROBED OPERATION**
  Minimizes Lead Connections
- **STANDARD DIP PACKAGE**
  End Stackable
  Integral Red Contrast Filter
  Rugged Construction
- **CATEGORIZED FOR LUMINOUS INTENSITY**
  Assures Uniformity of Light Output from Unit to Unit within a Single Category
- **IC COMPATIBLE**



Description

The HP 5082-7400 series are 2.79mm (.11″), seven segment GaAsP numeric indicators packaged in 3, 4, and 5 digit end-stackable clusters. An integral magnification technique increases the luminous intensity, thereby making ultra-low power consumption possible. Options include either the standard lower right hand decimal point or a centered decimal point for increased legibility in multi-cluster applications.

Applications include hand-held calculators, portable instruments, digital thermometers, or any other product requiring low power, low cost, minimum space, and long lifetime indicators.



Device Selection Guide

Digits per Cluster	Configuration		Part Number	
	Device		Center Decimal Point	Right Decimal Point
3 (right)	☐ 8 8 8		5082-7402	5082-7412
3 (left)	8 8 8 ☐		5082-7403	5082-7413
4	8 8 8 8		5082-7404	5082-7414
5	8 8 8 8 8		5082-7405	5082-7415

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current per Segment (Duration < 1 msec)	I_{PEAK}		110	mA
Average Current per Segment	I_{AVG}		5	mA
Power Dissipation per Digit [1]	P_D		80	mW
Operating Temperature, Ambient	T_A	–40	75	°C
Storage Temperature	T_S	–40	100	°C
Reverse Voltage	V_R		5	V

NOTES: 1. At 25°C; derate 1mW/°C above 25°C ambient. 2. See Mechanical Section for recommended flux removal solvents.

Electrical /Optical Characteristics at T_A=25°C

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment or dp [3,4] (Time Averaged)	I_V	I_{AVG} = 1mA (I_{PK} = 10mA duty cycle = 10%)	5	20		μcd
Peak Wavelength	λ_{PEAK}			655		nm
Forward Voltage/Segment or dp	V_F	I_F = 10mA		1.6	2.0	V
Reverse Current/Segment or dp	I_R	V_R = 5V			100	μA
Rise and Fall Time [5]	t_r, t_f			10		ns

NOTES: 3. The digits are categorized for luminous intensity. Intensity categories are designated by a letter located on the back side of the package. 4. Operation at Peak Currents less than 5mA is not recommended. 5. Time for a 10%-90% change of light intensity for step change in current.

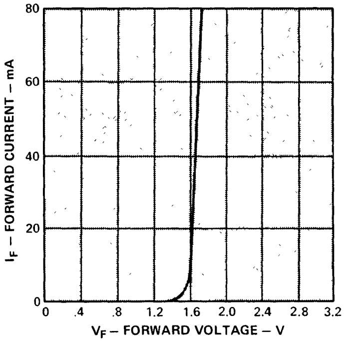


Figure 1. Forward Current vs. Forward Voltage.

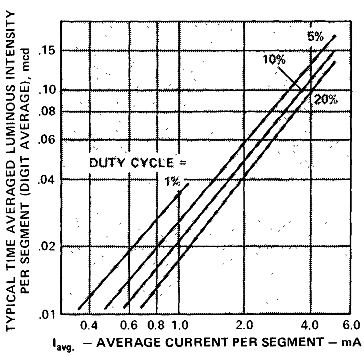


Figure 2. Typical Time Averaged Luminous Intensity per Segment (Digit Average) vs. Average Current per Segment.

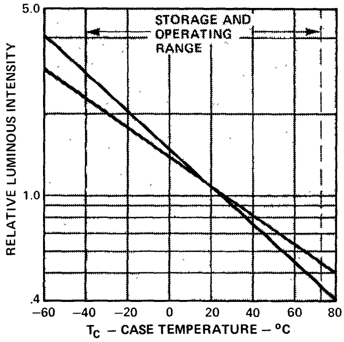


Figure 3. Relative Luminous Intensity vs. Case Temperature at Fixed Current Level.

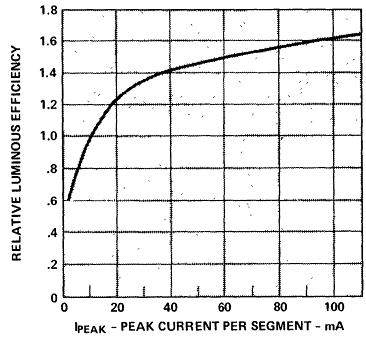


Figure 4. Relative Luminous Efficiency vs. Peak Current per Segment.

Package Description

NOTES: 1. Dimensions in millimeters and (inches).
2. Tolerances on all dimensions are ±0.038mm (±.015 in.) unless otherwise noted.

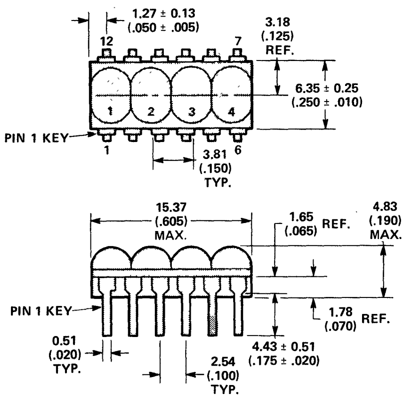


Figure 5. 5082-7402/-7403/-7404/-7412/-7413/-7414

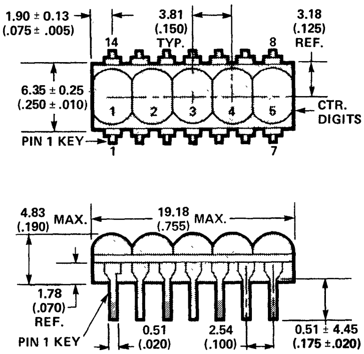
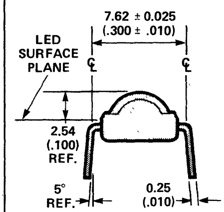


Figure 6. 5082-7405/7415



All Devices

Magnified Character Font Description

DIMENSIONS IN MILLIMETERS AND (INCHES).

DEVICES
5082-7402
5082-7403
5082-7404
5082-7405

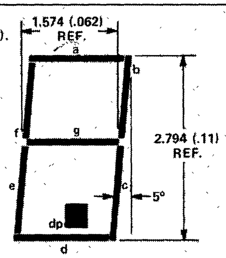


Figure 7. Center Decimal Point Configuration.

DIMENSIONS IN MILLIMETERS AND (INCHES).

DEVICES
5082-7412
5082-7413
5082-7414
5082-7415

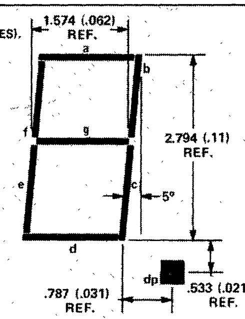


Figure 8. Right Decimal Point Configuration

Device Pin Description

PIN NO.	5082-7402/7412 FUNCTION	5082-7403/7413 FUNCTION	5082-7404/7414 FUNCTION	5082-7405/7415 FUNCTION
1	SEE NOTE 1.	CATHODE 1	CATHODE 1	CATHODE 1
2	ANODE e	ANODE e	ANODE e	ANODE e
3	ANODE c	ANODE c	ANODE c	ANODE c
4	CATHODE 3	CATHODE 3	CATHODE 3	CATHODE 3
5	ANODE dp	ANODE dp	ANODE dp	ANODE dp
6	CATHODE 4	SEE NOTE 1.	CATHODE 4	ANODE d
7	ANODE g	ANODE g	ANODE g	CATHODE 5
8	ANODE d	ANODE d	ANODE d	ANODE g
9	ANODE f	ANODE f	ANODE f	CATHODE 4
10	CATHODE 2	CATHODE 2	CATHODE 2	ANODE f
11	ANODE b	ANODE b	ANODE b	(See Note 1)
12	ANODE a	ANODE a	ANODE a	ANODE b
13	—	—	—	CATHODE 2
14	—	—	—	ANODE a

NOTE 1. Leave Pin unconnected

Electrical

Character encoding can be performed by commercially available BCD-7 segment decoder/driver circuits. Through the use of a strobing technique, only one decoder/driver is required for each display. In addition, the number of interconnection lines between the display and the drive circuitry is minimized to 8 + N, where N is the number of characters in the display.

Each of the segments on the display is "addressable" on two sets of lines — the "character enable" lines and the "segment enable" lines. Displays are wired so that all of the cathodes of all segments comprising one character are wired together to a single character enable line. Similarly, the anodes of each of like segments (e.g., all of the decimal points, all of the center line anodes, etc.) are wired to a single line. Therefore, a single digit in the cluster can be illuminated by connecting the appropriate character enable line, with the appropriate segment enable lines for the character being displayed. When each character in the display is illuminated in sequence, at a minimum of 100 times a second, flicker free characters are formed.

The decimal point in the 7412, 7413, 7414, and 7415 displays is located at the lower right of the digit for conventional driving schemes.

The 7402, 7403, 7404 and 7405 displays contain a centrally located decimal point which is activated in place of a digit. In long registers, this technique of setting off the decimal point significantly improves the display's readability. With respect to timing, the decimal point is treated as a separate character with its own unique time frame.

A detailed discussion of display circuits and drive techniques appears in Application Note 937.

Mechanical

The 5082-7400 series package is a standard 12 or 14 Pin DIP consisting of a plastic encapsulated lead frame with integral molded lenses. It is designed for plugging into DIP sockets or soldering into PC boards. The lead frame construction allows use of standard DIP insertion tools and techniques. Alignment problems are simplified due to the clustering of digits in a single package. The shoulders of the lead frame pins are intentionally raised above the bottom of the package to allow tilt mounting of up to 20° from the PC board.

To improve display contrast, the plastic incorporates a red dye that absorbs strongly at all visible wavelengths except the 655 nm emitted by the LED. In addition, the lead frames are selectively darkened to reduce reflectance. An additional filter, such as Plexiglass 2423, Panelgraphic 60 or 63, and Homalite 100-1600, will further lower the ambient reflectance and improve display contrast.

The devices can be soldered for up to 5 seconds at a maximum solder temperature of 230°C (1/16" below the seating plane). The plastic encapsulant used in these displays may be damaged by some solvents commonly used for flux removal. It is recommended that only Freon TE, Freon TE-35, Freon TF, Isopropanol, or soap and water be used for cleaning operations.

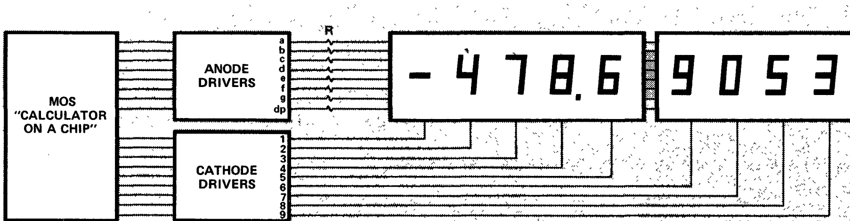


Figure 9. Block Diagram for Calculator Display Using Lower Right Hand Decimal Point.

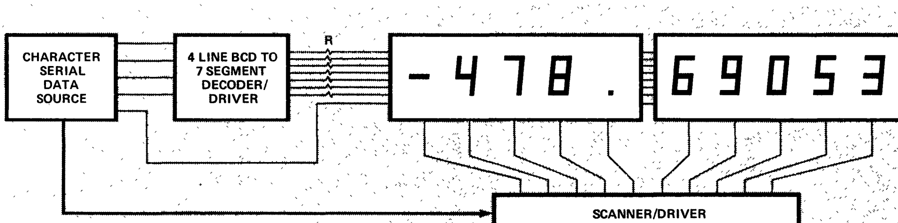


Figure 10. Block Diagram for Display Using Center Decimal Point.

HEWLETT PACKARD
COMPONENTS

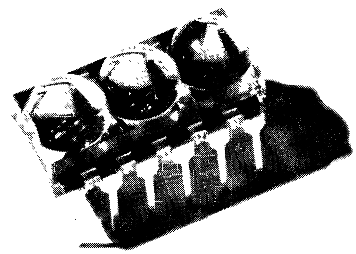
SOLID STATE NUMERIC INDICATOR (7 Segment Monolithic)

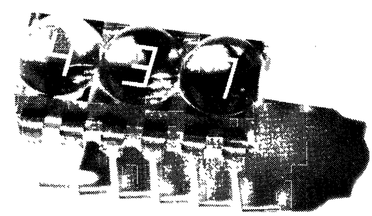
5082-7430 SERIES

TECHNICAL DATA APRIL 1977

Features

- **MOS COMPATIBLE**
  Can be Driven Directly from many MOS Circuits
- **LOW POWER**
  Excellent Readability at Only 250 μA Average per Segment
- **CONSTRUCTED FOR STROBED OPERATION**
  Minimizes Lead Connections
- **STANDARD DIP PACKAGE**
  End Stackable
  Integral Red Contrast Filter
  Rugged Construction
- **CATEGORIZED FOR LUMINOUS INTENSITY**
  Assures Uniformity of Light Output from Unit to Unit within a Single Category



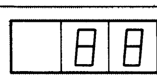
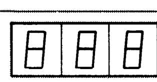


Description

The HP 5082-7430 series displays are 2.79mm (.11 inch, seven segment GaAsP numeric indicators packaged in 2 or 3 digit end-stackable clusters on 200 mil centers. An integral magnification technique increases the luminous intensity, thereby making ultra-low power consumption possible. These clusters have the standard lower right hand decimal points.

Applications include hand-held calculators, portable instruments, digital thermometers, or any other product requiring low power, low cost, minimum space, and long lifetime indicators.

Device Selection Guide

Digits per Cluster	Configuration		Part Number
	Device	Package	
2(right)		(Figure 5)	5082-7432
3		(Figure 5)	5082-7433

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current per Segment or dp (Duration $< 500\mu s$)	I_{PEAK}		50	mA
Average Current per Segment or dp	I_{AVG}		5	mA
Power Dissipation per Digit [1]	P_D		80	mW
Operating Temperature, Ambient	T_A	−40	75	°C
Storage Temperature	T_S	−40	100	°C
Reverse Voltage	V_R		5	V
Solder Temperature 1/16" below seating plane ($t \leq 3$ sec.) [2]			230	°C

NOTES: 1. Derate linearly @ 1 mW/°C above 25°C ambient. 2. See Mechanical section for recommended flux removal solvents.

Electrical/Optical Characteristics at T_A=25°C

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment or dp [3,4]	I_V	$I_{AVG} = 500\mu A$ ($I_{PK} = 5mA$ duty cycle = 10%)	10	40		μcd
Peak Wavelength	λ_{PEAK}			655		nm
Forward Voltage/Segment or dp	V_F	$I_F = 5mA$		1.55	2.0	V
Reverse Current/Segment or dp	I_R	$V_R = 5V$			100	μA
Rise and Fall Time [5]	t_r, t_f			10		ns

NOTES: 3. The digits are categorized for luminous intensity. Intensity categories are designated by a letter located on the back side of the package. 4. Operation at Peak Currents less than 3.5mA is not recommended. 5. Time for a 10%-90% change of light intensity for step change in current.

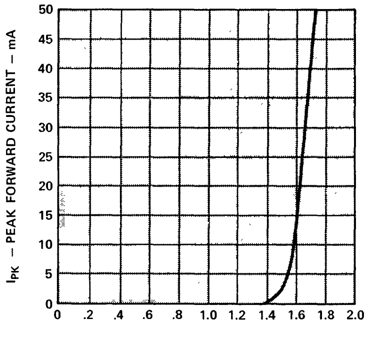


Figure 1. Peak Forward Current vs. Peak Forward Voltage

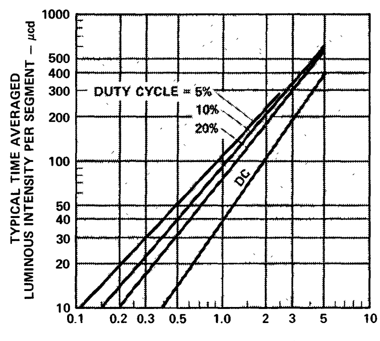


Figure 2. Typical Time Averaged Luminous Intensity per Segment vs. Average Current per Segment

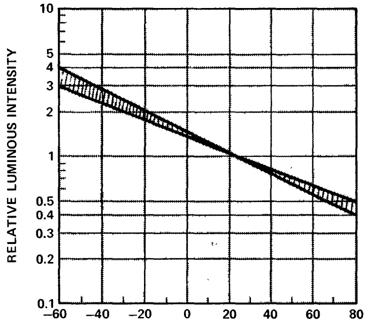


Figure 3. Relative Luminous Intensity vs. Ambient Temperature at Fixed Current Level

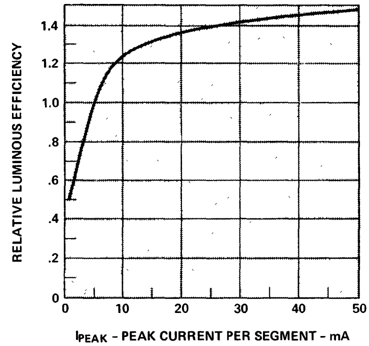


Figure 4. Relative Luminous Efficiency vs. Peak Current per Segment

Package Description

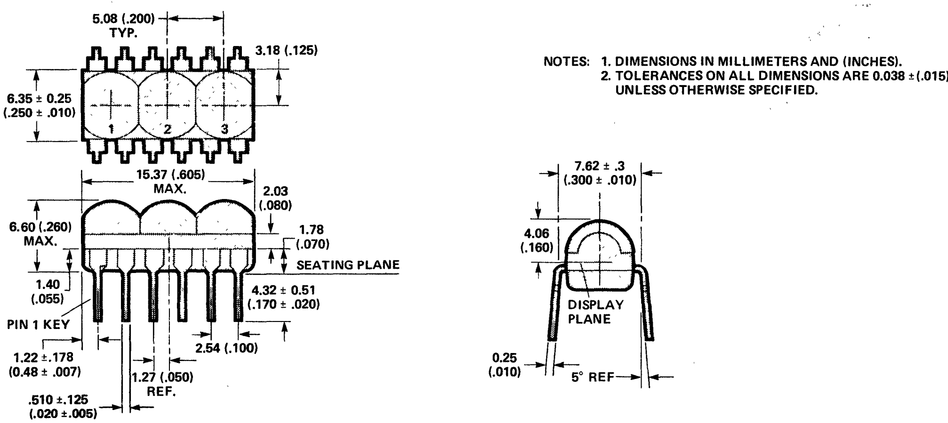


Figure 5.

Magnified Character Font Description

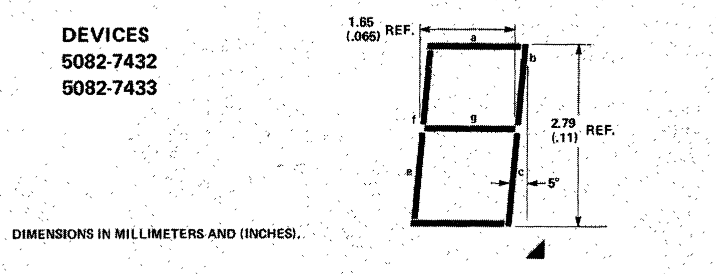


Figure 6.

Device Pin Description

PIN NUMBER	5082-7432 FUNCTION	5082-7433 FUNCTION
1	SEE NOTE 1.	CATHODE 1
2	ANODE e	ANODE e
3	ANODE d	ANODE d
4	CATHODE 2	CATHODE 2
5	ANODE c	ANODE c
6	ANODE dp	ANODE dp
7	CATHODE 3	CATHODE 3
8	ANODE b	ANODE b
9	ANODE g	ANODE g
10	ANODE a	ANODE a
11	ANODE f	ANODE f
12	SEE NOTE 1.	SEE NOTE 1.

NOTE 1. Leave Pin unconnected.

Electrical/Optical

The 5082-7430 series devices utilize a monolithic GaAsP chip of 8 common cathode devices for each display digit. The segment anodes of each digit are interconnected, forming an 8 by N line array, where N is the number of characters in the display. Each chip is positioned under an integrally molded lens giving a magnified character height of 2.79mm (0.11) inches. Satisfactory viewing will be realized within an angle of approximately ±20° from the center-line of the digit.

To improve display contrast, the plastic encapsulant contains a red dye to reduce the reflected ambient light. An additional filter, such as Plexiglass 2423, Panelgraphic 60 or 63, and Homalite 100-1600, will further lower the ambient reflectance and improve display contrast.

Character encoding on the 5082-7430 series devices is performed by standard 7 segment decoder/driver circuits. Through the use of strobing techniques only one decoder/driver is required for very long multidigit displays.

A discussion of display circuits and drive techniques appears in Application Note 946.

Mechanical

The 5082-7430 series package is a standard 12 Pin DIP consisting of a plastic encapsulated lead frame with integrally molded lenses. It is designed for plugging into DIP sockets or soldering into PC boards. Alignment problems are simplified due to the clustering of digits in a single package.

The devices can be soldered for up to 5 seconds at a maximum solder temperature of 230°C (1/16" below the seating plane). The plastic encapsulant used in these displays may be damaged by some solvents commonly used for flux removal. It is recommended that only Freon TE, Freon TE-35, Freon TF, Isopropanol, or soap and water be used for cleaning operations.

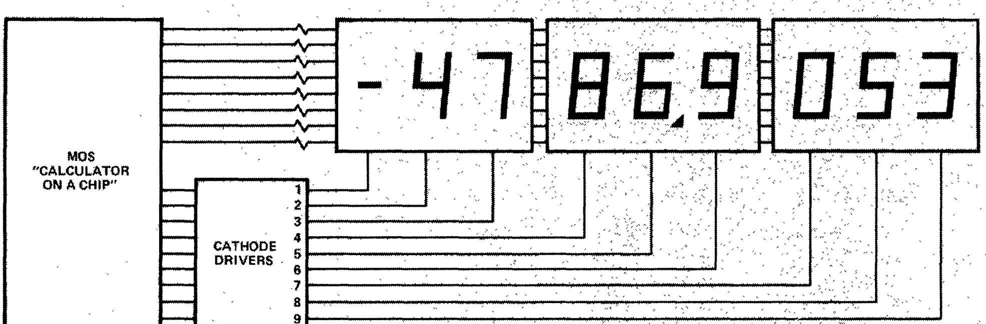


Figure 7. Block Diagram for Calculator Display

HEWLETT hp PACKARD
COMPONENTS

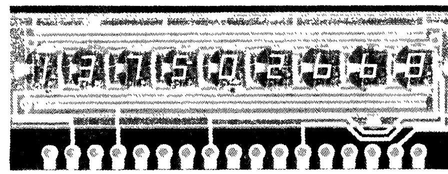
SPECIAL PARTS FOR CALCULATORS

5082-7440 SERIES

TECHNICAL DATA APRIL 1977

Features

- **MOS COMPATIBLE**
  Can be driven directly from MOS circuits.
- **LOW POWER**
  Excellent readability at only 250µA average per segment.
- **UNIFORM ALIGNMENT**
  Excellent alignment is assured by design.
- **MATCHED BRIGHTNESS**
  Uniformity of light output from digit to digit on a single PC Board.
- **AVAILABLE IN 50.8mm (2.0 inch) AND 60.325mm (2.375 inch) BOARD LENGTHS**

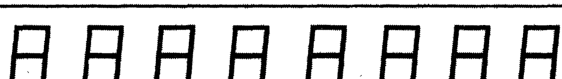
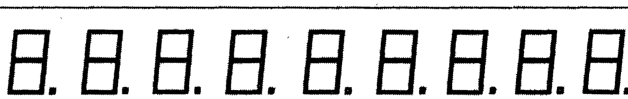


Description

The HP 5082-7440 series displays are 2.67mm (.105") high, seven segment GaAsP Numeric Indicators mounted in an eight or nine digit configuration on a P.C. Board. These special parts, designed specifically for calculators, have right hand decimal points and are mounted on 5.08mm (200 mil) centers. The plastic lens magnifies the digits and includes an integral protective bezel.

Applications are primarily portable, hand-held calculators and other products requiring low power, low cost and long lifetime indicators which occupy a minimum of space.

Device Selection Guide

Digits Per PC Board	Configuration		Part No.
	Device	Package	
8		(Figure 5)	5082-7440
			5082-7448
9		(Figure 5)	5082-7441
			5082-7449

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current per Segment or dp (Duration < 500μs)	I_{PEAK}		50	mA
Average Current per Segment or dp[1]	I_{AVG}		3	mA
Power Dissipation per Digit	P_D		50	mW
Operating Temperature, Ambient	T_A	-20	+85	°C
Storage Temperature	T_S	-20	+85	°C
Reverse Voltage	V_R		5	V
Solder Temperature at connector edge (t≤3 sec.)[2]			230	°C

NOTES: 1. Derate linearly @ 0.1mA/°C above 60°C ambient. 2. See Mechanical section for recommended soldering techniques and flux removal solvents.

Electrical/Optical Characteristics at T_A=25°C

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment or dp[3,4]	I_V	I_{AVG} = 500μA (I_{PK} = 5mA duty cycle = 10%)	9	40		μcd
Peak Wavelength	λ_{peak}			655		nm
Forward Voltage/Segment or dp	V_F	I_F = 5mA		1.55		V

NOTES: 3. See Figure 7 for test circuit.
4. Operation at Peak Currents of less than 3.5mA is not recommended.

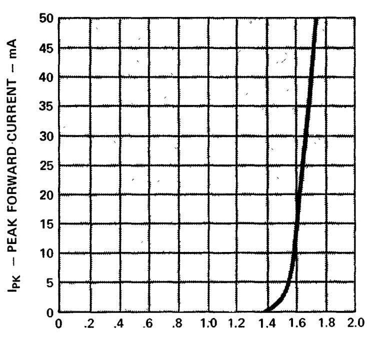


Figure 1. Peak Forward Current vs. Peak Forward Voltage

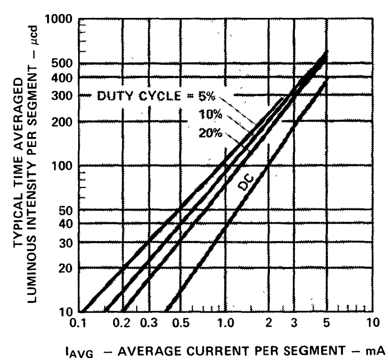


Figure 2. Typical Time Averaged Luminous Intensity per Segment vs. Average Current per Segment

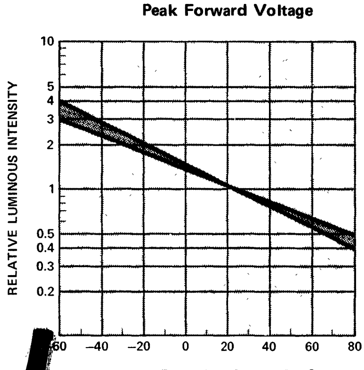


Figure 3. Relative Luminous Intensity vs. Ambient Temperature at Fixed Current Level

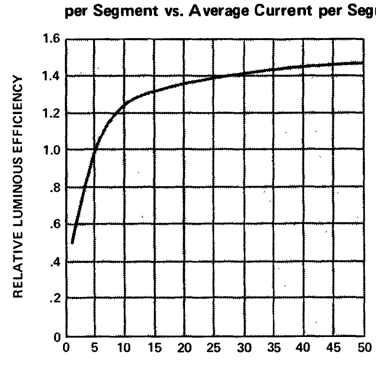


Figure 4. Relative Luminous Efficiency vs. Peak Current per Segment

Package Description

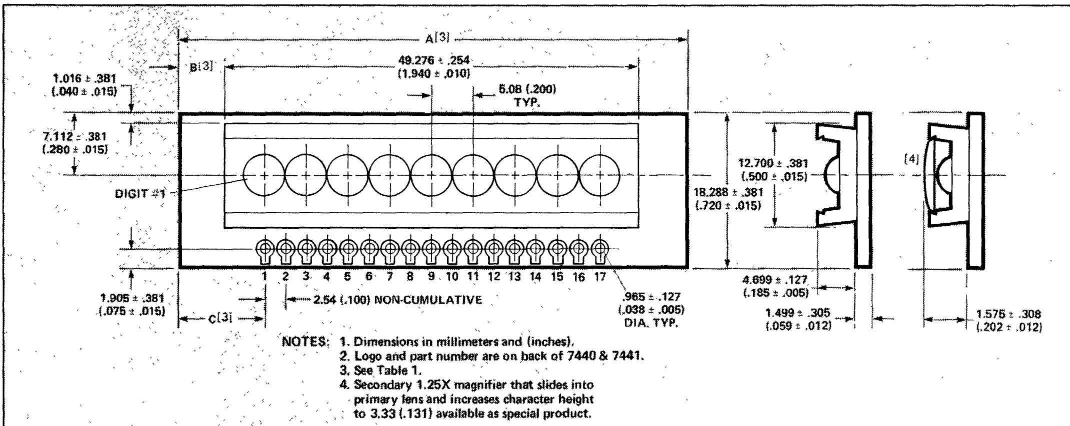


Figure 5.

Magnified Character Font Description

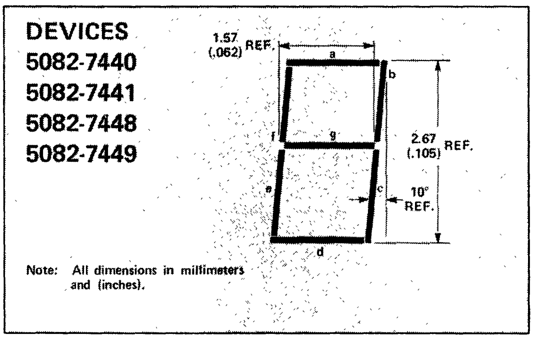


Figure 6.

Part No.	Dim. A	Dim. B	Dim. C
5082-7440	50.800(2.000)	0.760(.030)	5.08(.200)
5082-7441	50.800(2.000)	0.760(.030)	5.08(.200)
5082-7448	60.325(2.375)	5.512(.217)	9.830(.387)
5082-7449	60.325(2.375)	5.512(.217)	9.830(.387)

Tolerances: ±.381(.015)

Table 1.

Device Pin Description

Pin No.	5082-7440 5082-7448 Function	5082-7441 5082-7449 Function	Pin No.	5082-7440 5082-7448 Function	5082-7441 5082-7449 Function
1	N/C	Dig. 1 Cathode	10	Seg. d Anode	Seg. d Anode
2	Seg. c Anode	Seg. c Anode	11	Dig. 6 Cathode	Dig. 6 Cathode
3	Dig. 2 Cathode	Dig. 2 Cathode	12	Seg. g Anode	Seg. g Anode
4	d.p. Anode	d.p. Anode	13	Dig. 7 Cathode	Dig. 7 Cathode
5	Dig. 3 Cathode	Dig. 3 Cathode	14	Seg. b Anode	Seg. b Anode
6	Seg. a Anode	Seg. a Anode	15	Dig. 8 Cathode	Dig. 8 Cathode
7	Dig. 4 Cathode	Dig. 4 Cathode	16	Seg. f Anode	Seg. f Anode
8	Seg. e Anode	Seg. e Anode	17	Dig. 9 Cathode	Dig. 9 Cathode
9	Dig. 5 Cathode	Dig. 5 Cathode			

Electrical/Optical

The HP 5082-7440 series devices utilize a monolithic GaAsP chip containing 7 segments and a decimal point for each display digit. The segments of each digit are interconnected, forming an 8 by N line array, where N is the number of characters in the display. Each chip is positioned under a separate element of a plastic magnifying lens, producing a magnified character height of 0.105" (2,67mm). Satisfactory viewing will be realized within an angle of approximately ±20° from the centerline of the digit. The secondary lens magnifier that will increase character height from 2.67mm (0.105") to 3.33mm (0.131") and reduce viewing angle in the vertical plane only from ±20° to approximately ±18° is available as a special product. A filter, such as Plexiglass 2423, Panelgraphic 60 or 63, and Homalite 100-1600, will lower ambient reflectance and improve display contrast. Character encoding of the -7440 series devices is performed by standard 7 segment decoder driver circuits.

The 5082-7440 series devices are tested for digit to digit luminous intensity matching using the circuit depicted in Figure 7. Component values are chosen to give an I_F of 5mA per segment at a segment V_F of 1.55 volts. This test method is preferred in order to provide the best possible simulation of the end product drive circuit, thereby insuring excellent digit to digit matching. If the device is to be driven from V_{CC} potentials of less than 3.5 volts, it is recommended that the factory be contacted.

Mechanical

The 5082-7440 series devices are constructed on a standard printed circuit board substrate. A separately molded plastic lens containing 9 individual magnifying elements is attached to the PC board over the digits. The device may be mounted either by use of pins which may be soldered into the plate through holes at the connector edge of the board or by insertion into a standard PC board connector.

The devices may be soldered for up to 3 seconds per tab at a maximum soldering temperature of 230°C. Heat should be applied only to the edge connector tab areas of the PC board. Heating other areas of the board to temperatures in excess of 85°C can result in permanent damage to the display. It is recommended that a rosin core wire solder or a low temperature deactivating flux and solid core wire solder be used in soldering operations.

Special Cleaning Instructions

For bulk cleaning after a flow solder operation, the following process is recommended: Wash display in clean liquid Freon TP-35 or Freon TE-35 solvent for a time period up to 2 minutes maximum. Air dry for a sufficient length of time to allow solvent to evaporate from beneath display lens. Maintain solvent temperature below 30°C (86°F). Methanol, isopropanol, or ethanol may be used for hand cleaning at room temperature. Water may be used for hand cleaning if it is not permitted to collect under display lens.

Solvent vapor cleaning at elevated temperatures is not recommended as such processes will damage display lens. Ketones, esters, aromatic and chlorinated hydrocarbon solvents will also damage display lens. Alcohol base active rosin flux mixtures should be prevented from coming in contact with display lens.

These devices are constructed on a silver plated printed circuit board. To prevent the formation of a tarnish (Ag_2S) which could impair solderability, the boards should be stored in the unopened shipping packages until they are used. Further information on the storage, handling and cleaning of silver-plated components is contained in Hewlett-Packard Application Bulletin No. 3.

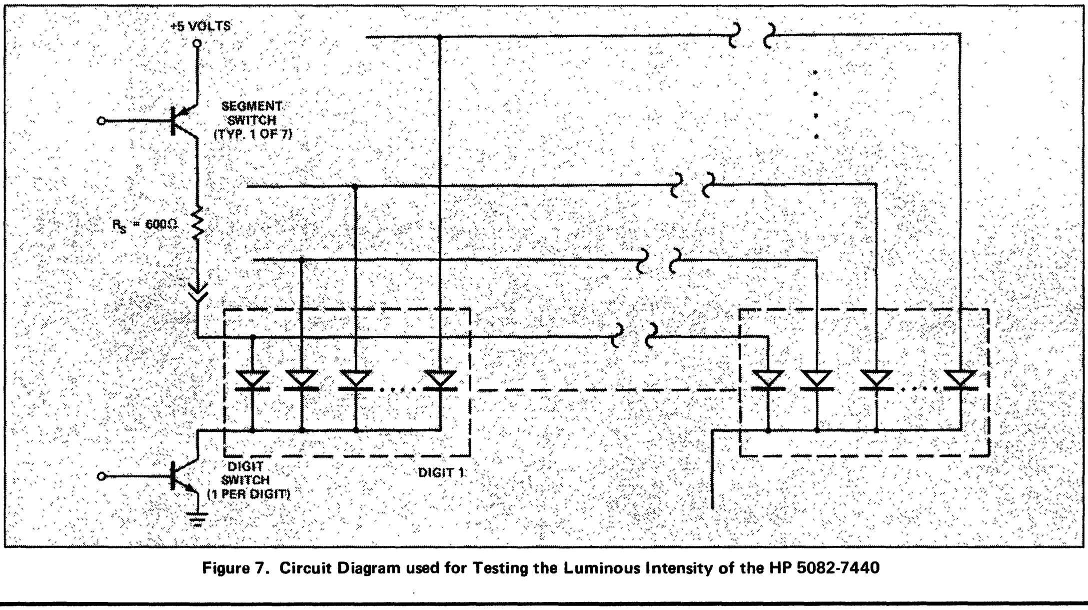


Figure 7. Circuit Diagram used for Testing the Luminous Intensity of the HP 5082-7440

HEWLETT hp PACKARD

COMPONENTS

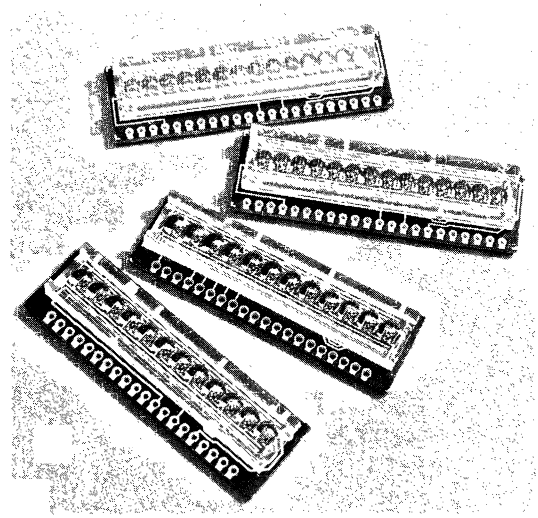
SPECIAL PARTS FOR SCIENTIFIC AND BUSINESS CALCULATORS

5082-7442
5082-7444
5082-7445
5082-7446
5082-7447

TECHNICAL DATA APRIL 1977

Features

- **12, 14, AND 16 DIGIT CONFIGURATIONS**
- **MOS COMPATIBLE**
  Can be driven directly from most MOS circuits.
- **LOW POWER**
  Excellent readability at only 250µA average per segment.
- **UNIFORM ALIGNMENT**
  Excellent Alignment is assured by design.
- **MATCHED BRIGHTNESS**
  Uniformity of light output from digit to digit on a single PC board.



Description

The HP 5082-7442, 7444, 7446, and 7447 are seven segment GaAsP Numeric indicators mounted in 12, 14, or 16 digit configurations on a P.C. board. These special parts, designed specifically for scientific and business calculators, have right hand decimal points and are mounted on 175 mil (4.45mm) centers in the 12 digit configurations and 150 mil (3.81mm) centers in the 14 and 16 digit configurations. The plastic lens magnifies the digits and includes an integral protective bezel.

Applications are primarily portable, hand held calculators, digital telephone peripherals, data entry terminals and other products requiring low power, low cost, and long lifetime indicators which occupy a minimum of space.

Device Selection Guide

Digits Per PC Board	Digit Height mm (inches)	Configuration DEVICE	Package	Part No. 5082-
12	2.54 (.100)	8.8.8.8.8.8.8.8.8.8.8.8.	Figure 4	7442 and 7445
14	2.54 (.100)	8.8.8.8.8.8.8.8.8.8.8.8.8.8.	Figure 5	7444
14	2.84 (.112)	8.8.8.8.8.8.8.8.8.8.8.8.8.8.	Figure 5	7447 *
16	2.92 (.115)	8.8.8.8.8.8.8.8.8.8.8.8.8.8.8.8.	Figure 6	7446

*5082-7447 is a 5082-7444 with a slide-in cylindrical lens to provide added magnification.

Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current per Segment or dp (Duration $<500\mu s$)	I_{PEAK}		50	mA
Average Current per Segment or dp[1]	I_{AVG}		3	mA
Power Dissipation per Digit	P_D		50	mW
Operating Temperature, Ambient	T_A	−20	+85	°C
Storage Temperature	T_S	−20	+85	°C
Reverse Voltage	V_R		5	V
Solder Temperature at connector edge ($t \leq 3$ sec.)[2]			230	°C

NOTES: 1. Derate linearly at 0.1mA/°C above 60°C ambient.
2. See Mechanical section for recommended soldering techniques and flux removal solvents.

Electrical/Optical Characteristics at $T_A = 25°C$

Part No.	Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
7442/7445	Luminous Intensity/ Segment or dp[3] (Digit Average)	I_V	5mA Peak 1/12 Duty Cycle	7	35		μcd
7444/7447			5mA Peak 1/14 Duty Cycle	7	35		μcd
7446			5mA Peak 1/16 Duty Cycle				
7442/7445 7444/7447 7446	Peak Wavelength	λ_{PEAK}			655		nm
	Forward Voltage/ Segment or dp	V_F	$I_F = 5mA$		1.55		V

NOTE: 3. Operation at Peak Currents of less than 3.5mA is not recommended.

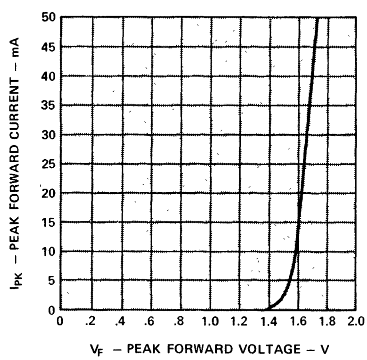


Figure 1. Peak Forward Current vs. Peak Forward Voltage

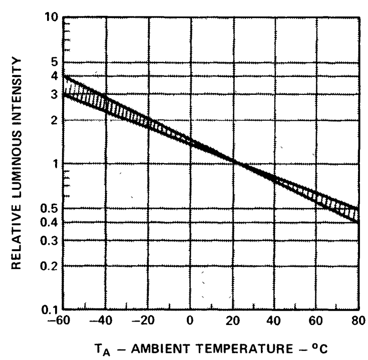


Figure 2. Relative Luminous Intensity vs. Ambient Temperature at Fixed Current Level.

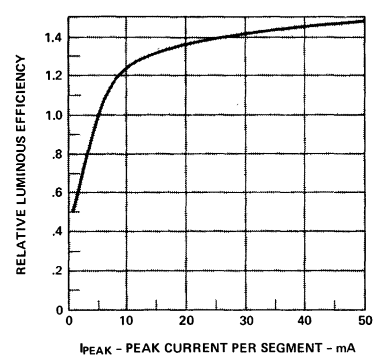


Figure 3. Relative Luminous Efficiency vs. Peak Current per Segment.

Electrical/Optical

The HP 5082-7442, 7444, 7445, 7446 and 7447 devices utilize a monolithic GaAsP chip containing 7 segments and a decimal point for each display digit. The segments of each digit are interconnected, forming an 8 by N line array, where N is the number of digits in the display. Each chip is positioned under a separate element of a plastic magnifying lens, producing a magnified character. Satisfactory viewing will be realized within an angle of approximately ±20° from the centerline of the digit. A filter, such as plexiglass 2423, Panelgraphic 60 or 63, and Homalite 100-1600, will lower the ambient reflectance and improve display contrast. Digit encoding of these devices is performed by standard 7 segment decoder driver circuits.

These devices are tested for digit-to-digit luminous intensity matching. This test is performed with a power supply of 5V and component values selected to supply 5mA I_{PEAK} at $V_F = 1.55V$. If the device is to be driven from V_{CC} potentials of less than 3.5volts, it is recommended that the factory be contacted.

Mechanical Specifications

The 5082-7442, 7444, 7445, 7446, and 7447 devices are constructed on a silver plated printed circuit board substrate. A molded plastic lens array is attached to the PC board over the digits to provide magnification.

These devices may be mounted using any one of several different techniques. The most straightforward is the use of standard PC board edge connectors. A less expensive approach can be implemented through the use of stamped or etched metal mounting clips such as those available from Burndy (Series LED-B) or JAV Manufacturing (Series 1255). Some of these devices will also serve as an integral display support. A third approach would be the use of a row of wire stakes which would first be soldered to the PC mother-board and the display board then inserted over the wire stakes and soldered in place.

The devices may be soldered for up to 3 seconds per tab at a maximum soldering temperature of 230°C. Heat should be applied only to the edge connector tab areas of the PC board. Heating other areas of the board to temperatures in excess of 85°C can result in permanent damage to the lens. It is recommended that a rosin core wire solder or a low temperature deactivating flux and solid core wire solder be used in soldering operations. A solder containing approximately 2% silver (Sn 62) will enhance solderability by preventing leaching of the plated silver off the PC board into the solder solution.

Special Cleaning Instructions

For bulk cleaning after a flow solder operation, the following process is recommended. Wash display in clean liquid Freon TP - 35 or Freon TE - 35 solvent for a time period up to 2 minutes maximum. Air dry for a sufficient length of time to allow solvent to evaporate from beneath display lens. Maintain solvent temperature below 30°C (86°F). Methanol, isopropanol, or ethanol may be used for cleaning at room temperature. Soap and water solutions may be utilized for removing water-soluble fluxes from the contact area but must not be allowed to collect under the display lens.

Solvent vapor cleaning at elevated temperatures is not recommended as such processes will damage display lens. Ketones, esters, aromatic and chlorinated hydrocarbon solvents will also damage display lens. Alcohol base active rosin flux mixtures should be prevented from coming in contact with display lens.

These devices are constructed on a silver plated printed circuit board. To prevent the formation of a tarnish (Ag_2S) which could impair solderability, the boards should be stored in the unopened shipping packages until they are used. Further information on the storage, handling and cleaning of silver-plated components is contained in Hewlett-Packard Application Bulletin No. 3.

Device Pin Description

Pin No.	5082-7442 5082-7444 5082-7447 Function	5082-7445 Function	5082-7446 Function
1	Cathode-Digit 1	Anode-Segment a	Cathode-Digit 1
2	Cathode-Digit 2	Anode-Segment f	Cathode-Digit 2
3	Cathode-Digit 3	Anode-Segment b	Cathode-Digit 3
4	Anode-Segment c	Anode-Segment c	Cathode-Digit 4
5	Cathode-Digit 4	Anode-Segment d	Cathode-Digit 5
6	Anode-DP	Anode-Segment DP	Anode-Segment e
7	Cathode-Digit 5	Anode-Segment e	Cathode-Digit 6
8	Anode-Segment a	Anode-Segment g	Anode-Segment d
9	Cathode-Digit 6	Cathode-Digit 3	Cathode-Digit 7
10	Anode-Segment e	Cathode-Digit 2	Anode-Segment a
11	Cathode-Digit 7	Cathode-Digit 4	Cathode-Digit 8
12	Anode-Segment d	Cathode-Digit 1	Anode-Segment DP
13	Cathode-Digit 8	Cathode-Digit 5	Cathode-Digit 9
14	Anode-Segment g	Cathode-Digit 12	Anode-Segment c
15	Cathode-Digit 9	Cathode-Digit 6	Cathode-Digit 10
16	Anode-Segment b	Cathode-Digit 11	Anode-Segment g
17	Cathode-Digit 10	Cathode-Digit 7	Cathode-Digit 11
18	Anode-Segment f	Cathode-Digit 10	Anode-Segment b
19	Cathode-Digit 11	Cathode-Digit 9	Cathode-Digit 12
20	Cathode-Digit 12	Cathode-Digit 8	Anode-Segment f
21	Cathode-Digit 13		Cathode-Digit 13
22	Cathode-Digit 14		Cathode-Digit 14
23			Cathode-Digit 15
24			Cathode-Digit 16

Package Dimensions

DEVICE	X	Y	Z
5082-7442	60.3 (2.375)	6.03 (.2375)	1.02 (.040)
5082-7445	59.6 (2.345)	5.70 (.2225)	1.42 (.056)

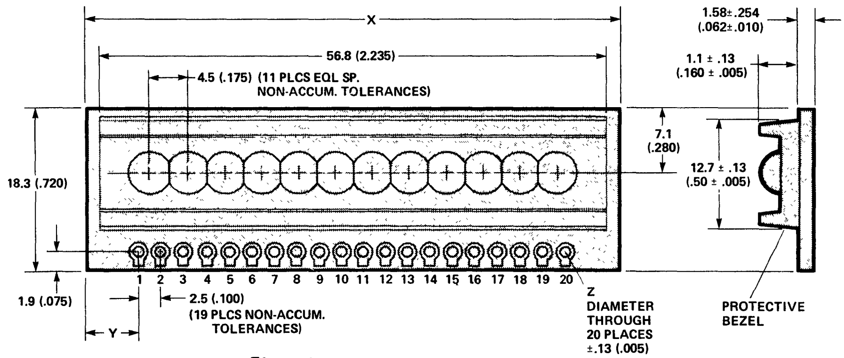


Figure 4.

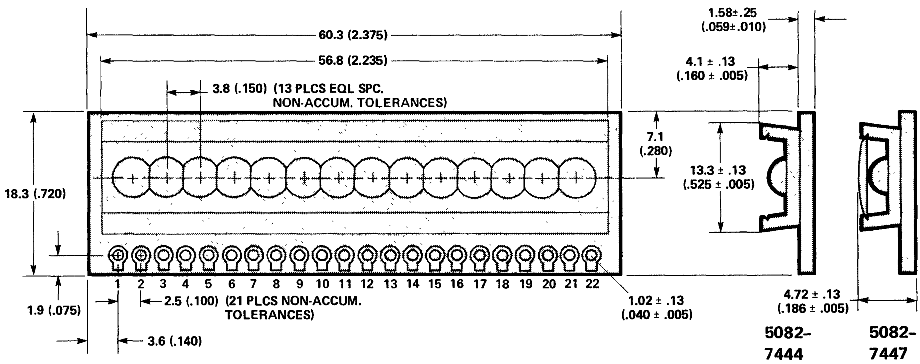


Figure 5.

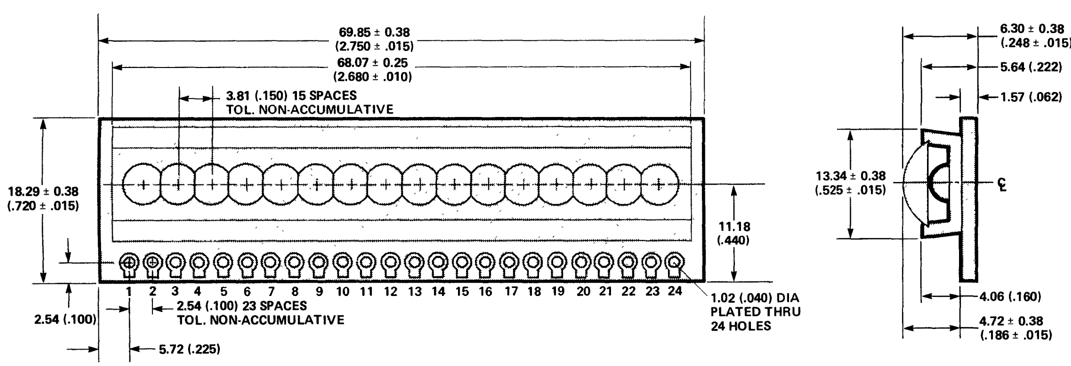
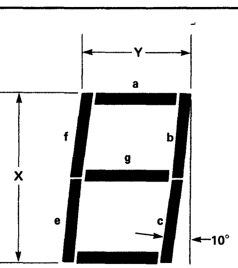


Figure 6.



DEVICE	X	Y
5082-7442	2.54 (.100)	1.42 (.056)
5082-7444	2.54 (.100)	1.40 (.055)
5082-7445	2.54 (.100)	1.42 (.056)
5082-7446	2.92 (.115)	1.40 (.055)
5082-7447	2.84 (.112)	1.40 (.055)

NOTES:
1. ALL DIMENSIONS IN MILLIMETRES AND (INCHES).
2. TOLERANCES ON ALL DIMENSIONS ARE ±0.38 (.015) UNLESS OTHERWISE SPECIFIED.

HEWLETT PACKARD
COMPONENTS

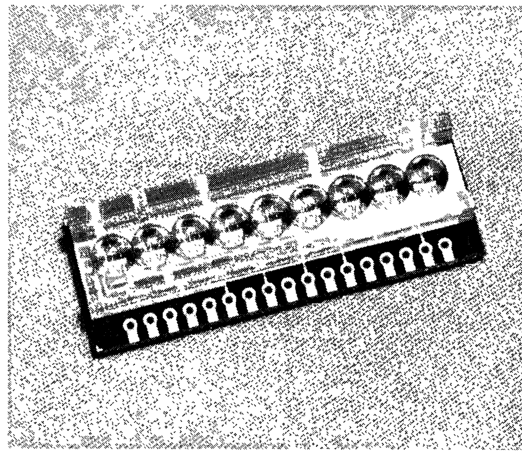
SPECIAL PARTS FOR CALCULATORS

5082-7240 SERIES

TECHNICAL DATA APRIL 1977

Features

- **MOS COMPATIBLE**
  Can be driven directly from MOS circuits.
- **LOW POWER**
  Excellent readability at only 250µA average per segment.
- **UNIFORM ALIGNMENT**
  Excellent alignment is assured by design.
- **MATCHED BRIGHTNESS**
  Uniformity of light output from digit to digit on a single PC Board.
- **STATE OF THE ART LENS DESIGN**
  Assures the best possible character height, viewing angle, off-axis distortion tradeoff.



Description

The HP 5082-7240 series displays are 2.59mm (.102") high, seven segment GaAsP Numeric Indicators mounted in an eight or nine digit configuration on a P. C. Board. These special parts, designed specifically for calculators, have right hand decimal points and are mounted on 5.08mm (200 mil) centers. The plastic lens over the digits has a magnifier and a protective bezel built-in. A secondary magnifying lens, available on special request, can be added to the primary lens for additional character enlargement.

Applications are primarily portable, hand-held calculators and other products requiring low power, low cost and long lifetime indicators which occupy a minimum of space.

Device Selection Guide

Digits Per PC Board	Configuration		Part No.
	Device	Package	
8	8.8.8.8.8.8.8.8.	(Figure 5)	5082-7240
9	8.8.8.8.8.8.8.8.8.	(Figure 5)	5082-7241

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current per Segment or dp (Duration < 500µs)	I_{PEAK}		50	mA
Average Current per Segment or dp [1]	I_{AVG}		3	mA
Power Dissipation per Digit	P_D		50	mW
Operating Temperature, Ambient	T_A	-20	+85	°C
Storage Temperature	T_S	-20	+85	°C
Reverse Voltage	V_R		5	V
Solder Temperature at connector edge (t≤3 sec.) [2]			230	°C

NOTES: 1. Derate linearly @ 0.1mA/°C above 60°C ambient. 2. See Mechanical section for recommended soldering techniques and flux removal solvents.

Electrical/Optical Characteristics at T_A=25°C

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment or dp [3,4]	I_V	I_{AVG} = 500µA (I_{PK} = 5mA duty cycle = 10%)	12.5	50		µcd
Peak Wavelength	λ_{peak}			655		nm
Forward Voltage/Segment or dp	V_F	I_F = 5mA		1.6		V

NOTES: 3. See Figure 7 for test circuit.
4. Operation at Peak Currents of less than 3.0mA is not recommended.

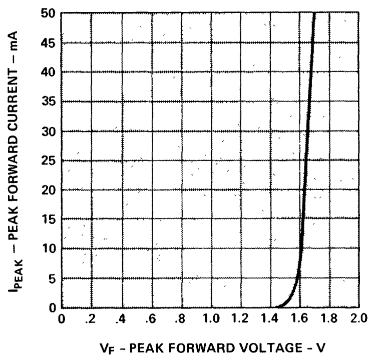


Figure 1. Peak Forward Current vs. Peak Forward Voltage

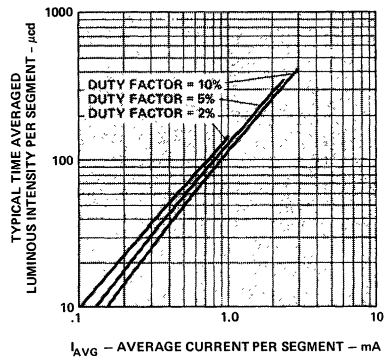


Figure 2. Typical Time Averaged Luminous Intensity per Segment vs. Average Current per Segment

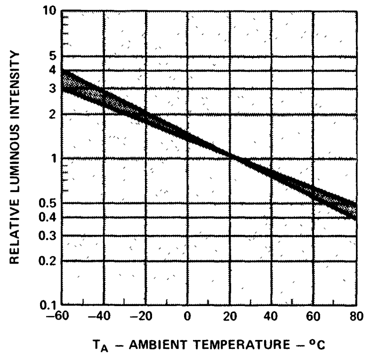


Figure 3. Relative Luminous Intensity vs. Ambient Temperature at Fixed Current Level

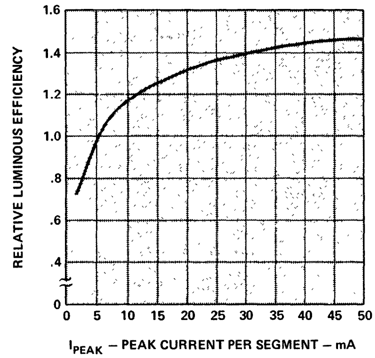


Figure 4. Relative Luminous Efficiency vs. Peak Current per Segment

Package Description

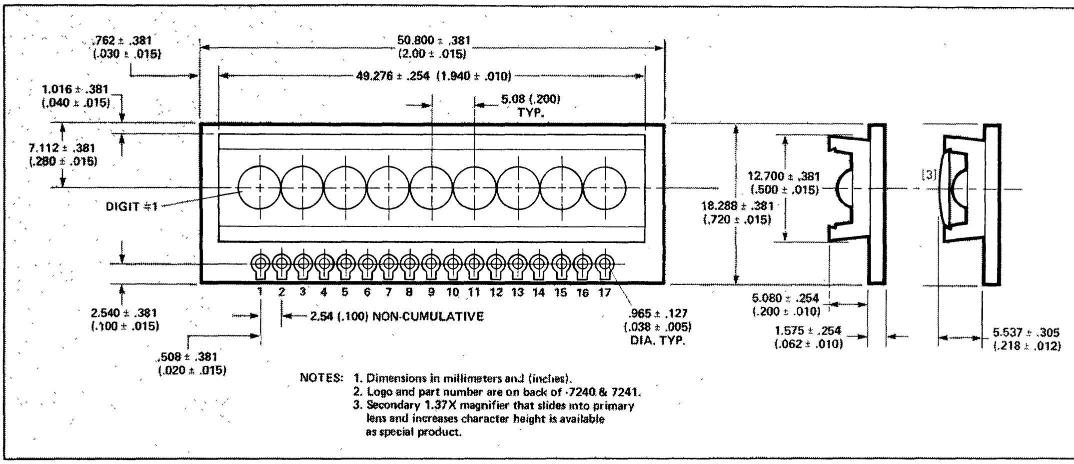


Figure 5.

Magnified Character Font Description

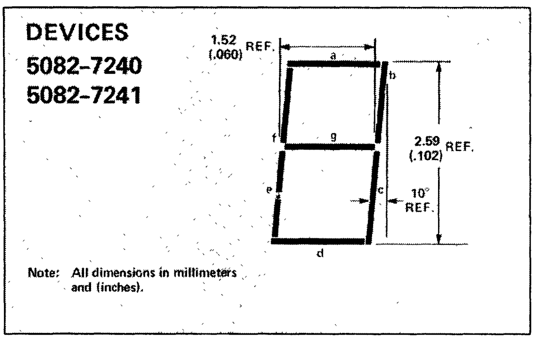


Figure 6.

Device Pin Description

Pin No.	5082-7240 Function	5082-7241 Function	Pin No.	5082-7240 Function	5082-7241 Function
1	NOTE 4	Dig. 1 Cathode	10	Seg. d Anode	Seg. d Anode
2	Seg. c Anode	Seg. c Anode	11	Dig. 6 Cathode	Dig. 6 Cathode
3	Dig. 2 Cathode	Dig. 2 Cathode	12	Seg. g Anode	Seg. g Anode
4	d.p. Anode	d.p. Anode	13	Dig. 7 Cathode	Dig. 7 Cathode
5	Dig. 3 Cathode	Dig. 3 Cathode	14	Seg. b Anode	Seg. b Anode
6	Seg. a Anode	Seg. a Anode	15	Dig. 8 Cathode	Dig. 8 Cathode
7	Dig. 4 Cathode	Dig. 4 Cathode	16	Seg. f Anode	Seg. f Anode
8	Seg. e Anode	Seg. e Anode	17	Dig. 9 Cathode	Dig. 9 Cathode
9	Dig. 5 Cathode	Dig. 5 Cathode			

NOTE 4: Leave pin 1 unconnected on the 5082-7240.

Electrical/Optical

The HP 5082-7240 series devices utilize a monolithic GaAsP chip containing 7 segments and a decimal point for each display digit. The segments of each digit are interconnected, forming an 8 by N line array, where N is the number of characters in the display. Each chip is positioned under a separate element of a plastic magnifying lens, producing a magnified character height of 2.59mm (0.102"). Satisfactory viewing will be realized within an angle of approximately ±20° from the centerline of the digit. A secondary lens magnifier that will increase character height from 2.59mm (.102") to 3.56mm (.140") is available as a special product. Character encoding of the 7240 series devices is performed by standard 7 segment decoder driver circuits.

The 5082-7240 series devices are tested for digit to digit luminous intensity matching using the circuit depicted in Figure 7. Component values are chosen to give an I_F of 5mA per segment at a segment V_F of 1.6 volts. This test method is preferred in order to provide the best possible simulation of the end product drive circuit, thereby insuring excellent digit to digit matching. If the device is to be driven from V_{CC} potentials of less than 3.5 volts, it is recommended that the factory be contacted.

Mechanical

The 5082-7240 series devices are constructed on a standard printed circuit board substrate. A separately molded plastic lens bar containing 9 individual magnifying elements is attached to the PC board over the digits. The device may be mounted either by use of pins which may be soldered into the plate through holes at the connector edge of the board or by insertion into a standard PC board connector.

The devices may be soldered for up to 3 seconds per tab at a maximum soldering temperature of 230°C. Heat should be applied only to the edge connector tab areas of the PC board. Heating other areas of the board to temperatures in excess of 85°C can result in permanent damage to the display. It is recommended that a rosin core wire solder or a low temperature deactivating flux and solid core wire solder be used in soldering operations.

Special Cleaning Instructions

For bulk cleaning after a flow solder operation, the following process is recommended: Wash display in clean liquid Freon TP-35 or Freon TE-35 solvent for a time period up to 2 minutes maximum. Air dry for a sufficient length of time to allow solvent to evaporate from beneath display lens. Maintain solvent temperature below 30°C (86°F). Methanol, isopropanol, or ethanol may be used for hand cleaning at room temperature. Water may be used for hand cleaning if it is not permitted to collect under display lens.

Solvent vapor cleaning at elevated temperatures is not recommended as such processes will damage display lens. Ketones, esters, aromatic and chlorinated hydrocarbon solvents will also damage display lens. Alcohol base active rosin flux mixtures should be prevented from coming in contact with display lens.

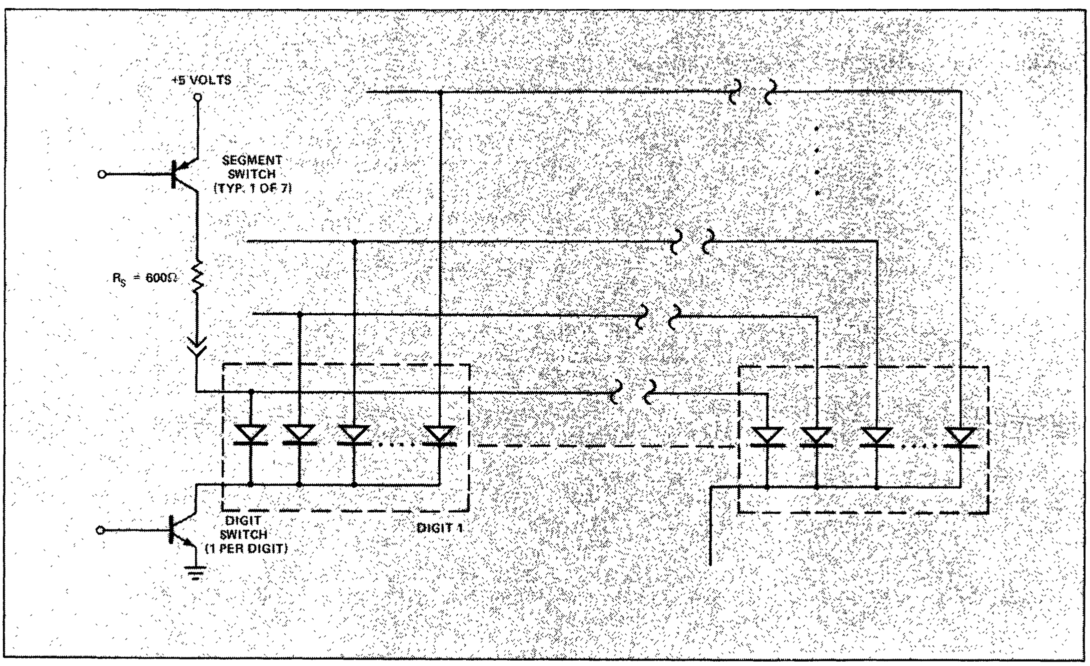


Figure 7. Circuit Diagram used for Testing the Luminous Intensity of the HP 5082-7240

HEWLETT hp PACKARD
COMPONENTS

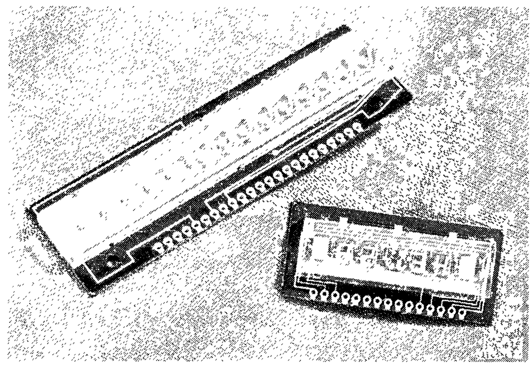
LARGE MONOLITHIC NUMERIC INDICATORS

5082-7265
5082-7275
5082-7285
5082-7295

TECHNICAL DATA APRIL 1977

Features

- LARGE 4.45mm (.175") CHARACTER HEIGHT
- LOW POWER
  Satisfactory Readability can be Achieved with Drive Currents as Low as 1.0-1.5mA Average per Segment Depending on Peak Current Levels
- MOS COMPATIBLE
  Can be Driven Directly from MOS Circuits
- COMPACT INFORMATION DISPLAY
  5.84mm (.23") Digit Spacing Yields Over 4 Characters per Inch.
- HIGH AMBIENT READABILITY
  High Sterance Emitting Areas Mean Excellent Readability in High Ambient Light Conditions
- HIGH LEGIBILITY AND NUMBER RECOGNITION
  High On/Off Contrast and Fine Line Segments Improve Viewer Recognition of the Displayed Number
- UNIFORM ALIGNMENT
  Excellent Alignment is Assured by Design
- MATCHED BRIGHTNESS
  Provides Uniform Light Output from Digit to Digit on a Single PC Board
- EASY MOUNTING
  Flexible Mounting in Desired Position with Edge Connectors or Soldered Wires

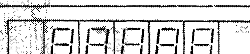


Description

The HP 5082-7265, 7275, 7285, and 7295 displays are 4.45 mm (.175") seven segment GaAsP numeric indicators mounted in 5 or 15 digit configurations on a PC Board. 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. Options include both a right hand decimal point and centered decimal version for improved legibility. The digits are mounted on 5.84 mm (230 mil) centers.

These displays are attractive for applications such as digital instruments, desk top calculators, avionics and automobile displays, P.O.S. terminals, in-plant control equipment, and other products requiring low power, display compactness, readability in high ambients, or highly legible, long lifetime numerical displays.

Device Selection Guide

Digits Per PC Board	Configuration			Part No. 5082-
	Device	Package	Character	
5		(Figure 5)	Center Decimal Point (Figure 7)	7265
15		(Figure 6)	Center Decimal Point (Figure 7)	7275
5		(Figure 5)	Right Decimal Point (Figure 7)	7285
15		(Figure 6)	Right Decimal Point (Figure 7)	7295

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current per Segment or DP (Duration <35μs)	I_{PEAK}		200	mA
Average Current per Segment or DP [1]	I_{AVG}		7	mA
Power Dissipation per Digit [2]	P_D		125	mW
Operating Temperature, Ambient	T_A	-20	+70	°C
Storage Temperature	T_S	-20	+80	°C
Reverse Voltage	V_R		5	V
Solder Temperature at connector edge (t≤3 sec.) [3]			230	°C

NOTES: 1. Derate linearly at 0.12 mA/°C above 25°C ambient.
2. Derate linearly at 2.3 mW/°C above 25°C ambient.
3. See Mechanical section for recommended soldering techniques and flux removal solvents.

Electrical/Optical Characteristics at $T_A = 25°C$

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment or dp (Time Averaged) 15 digit display 5082-7275, 5082-7295 [4,6]	I_v	$I_{avg.} = 2$ mA (30 mA Peak 1/15 duty cycle)	30	90		μcd
Luminous Intensity/Segment or dp (Time Averaged) 5 digit display 5082-7265, 5082-7285 [4,6]	I_v	$I_{avg.} = 2$ mA (10 mA Peak 1/5 duty cycle)	30	70		μcd
Forward Voltage per Segment or dp 5082-7275, 5082-7295 15 digit display	V_F	$I_F = 30$ mA		1.60	2.3	V
Forward Voltage per Segment or dp 5082-7265, 5082-7285 5 digit display	V_F	$I_F = 10$ mA		1.55	2.0	V
Peak Wavelength	λ_{PEAK}			655		nm
Dominant Wavelength [5]	λ_d			640		nm
Reverse Current per Segment or dp	I_R	$V_R = 5V$			100	μA
Temperature Coefficient of Forward Voltage	$\Delta V_F/°C$			-2.0		mV/°C

NOTES: 4. The luminous intensity at a specific ambient temperature, $I_V(T_A)$, may be calculated from this relationship:
$I_V(T_A) = I_{V(25°C)} (.985)^{(T_A - 25°C)}$
5. The dominant wavelength λ_d, is derived from the C.I.E. Chromaticity Diagram and represents the single wavelength which defines the color of the device.
6. Operation at peak currents of less than 6.0 mA is not recommended.

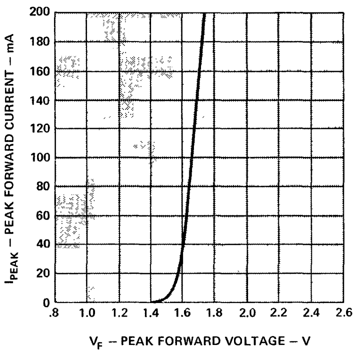


Figure 1. Peak Forward Current vs. Peak Forward Voltage.

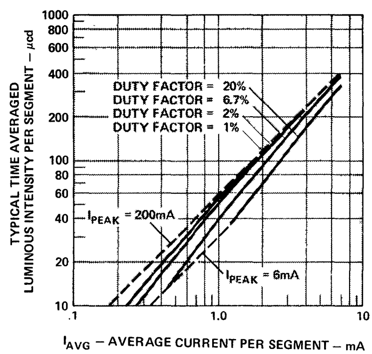


Figure 2. Typical Time Averaged Luminous Intensity per Segment vs. Average Current per Segment.

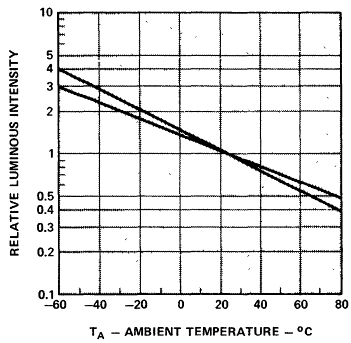


Figure 3. Relative Luminous Intensity vs. Ambient Temperature at Fixed Current Level.

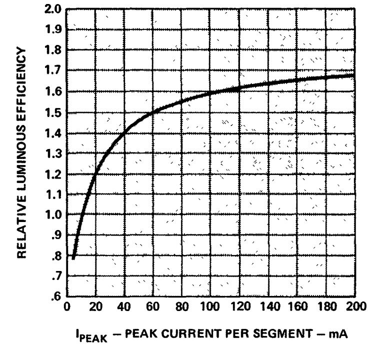


Figure 4. Relative Luminous Efficiency vs. Peak Current per Segment.

Electrical

The HP 5082-7265, 7275, 7285, and 7295 devices utilize a seven segment monolithic GaAsP chip. The 5082-7285 and 7295 devices use a separate decimal point chip located to the right of each digit. The 5082-7265 and 7275 devices use a centered decimal point on the monolithic seven segment chip. The centered decimal point version improves the displays readability by dedicating an entire digit position to distinguishing the decimal point. In the driving scheme for the centered decimal point version the decimal point is treated as a separate character with its own time frame.

The segments and decimal points of each digit are interconnected, forming an 8 by N line array, where N is the number of characters in the display. Character encoding is performed by standard 7 segment decoder driver circuits. A detailed discussion of display circuits and drive techniques appears in Applications Note 937.

These devices are tested for digit to digit luminous intensity using the circuit depicted in Figure 8. Component values are chosen to give a Peak I_F of 10 mA per segment for the 5 digit displays and 30 mA per segment for the 15 digit displays. This test method is preferred in order to provide the best possible simulation of the end product drive circuit, thereby ensuring excellent digit to digit matching. If the device is to be driven at peak currents of less than 6.0 mA, it is recommended that the HP field salesman or factory be contacted.

For special product applications, the number of digits per display can be altered. It is also possible to provide a colon instead of the centered decimal point. Contact the HP field salesman or factory to discuss such special modifications.

Optical

Each chip is positioned under a separate element of a plastic magnifying lens, producing a magnified character height of 4.45mm (.175"). To increase vertical viewing angle the secondary cylindrical magnifier can be removed reducing character height to 3.86mm (.152"). A filter, such as Panelgraphic 60 or 63, or Homalite 100-1600, will lower ambient reflectance and improve display contrast.

Mechanical

These devices are constructed on a standard printed circuit board substrate. A separately molded plastic lens is attached to the PC board over the digits. The lens is an acrylic styrene material that gives good optical lens performance, but is subject to scratching so care should be exercised in handling.

The device may be mounted either by use of pins which may be soldered into the plated through holes at the connector edge of the PC board or by insertion into a standard PC board connector. The devices may be soldered for up to 3 seconds per tab at a maximum soldering temperature of 230°C. Heat should be applied only to the edge connector tab areas of the PC board. Heating other areas of the board to temperatures in excess of 85°C can result in permanent damage to the display. It is recommended that a rosin core wire solder or a low temperature deactivating flux and solid wire solder be used in soldering operations.

The PC board is silver plated. To prevent the formation of a tarnish (Ag_2S) which could impair solderability the displays should be stored in the unopened shipping packages until they are used. Further information on the storage, handling, and cleaning of silver plated components is contained in Hewlett-Packard Application Bulletin No. 3.

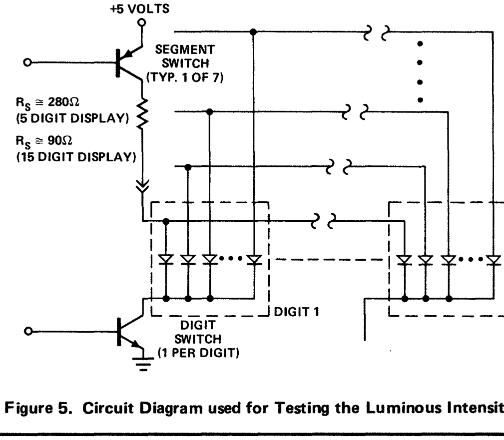


Figure 5. Circuit Diagram used for Testing the Luminous Intensity.

Package Dimensions

ALL DIMENSIONS IN MILLIMETERS AND (INCHES). TOLERANCES ARE ±0.203 (±.008) UNLESS OTHERWISE NOTED

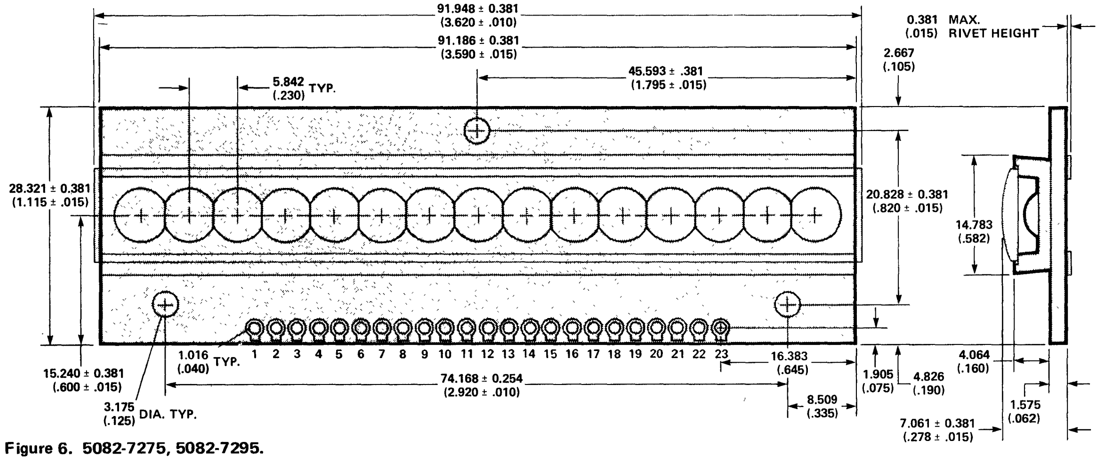


Figure 6. 5082-7275, 5082-7295.

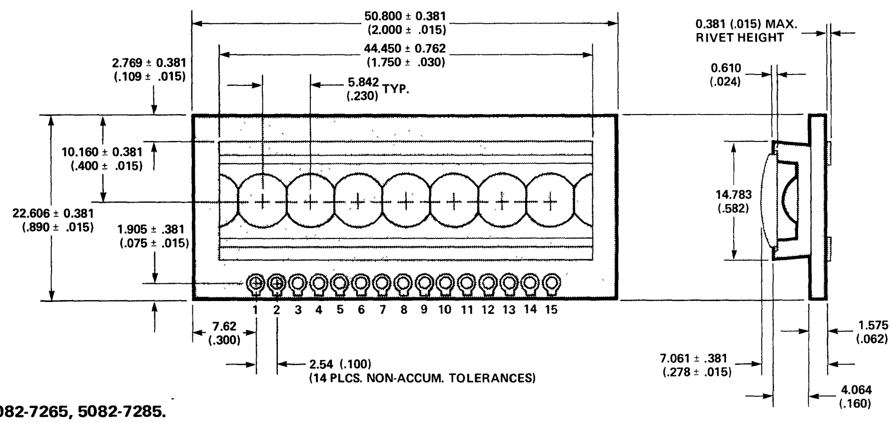
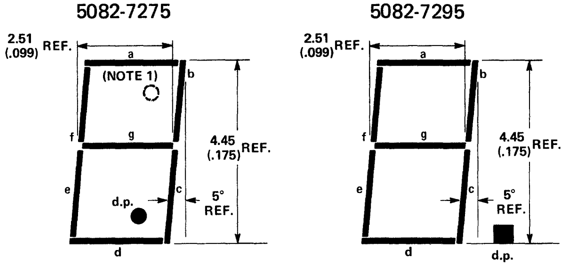


Figure 7. 5082-7265, 5082-7285.

Magnified Character Font Description

DEVICES	DEVICES
5082-7265	5082-7285
5082-7275	5082-7295



ALL DIMENSIONS IN MILLIMETERS AND (INCHES).

NOTE 1. Bonding Option for Colon Instead of Decimal Point. See Electrical Section.

Figure 8.

Device Pin Description

Pin No.	5082-7265 5082-7285 Function	5082-7275 5082-7295 Function
1	Anode Segment b	Cathode Digit 1
2	Anode Segment g	Cathode Digit 2
3	Anode Segment e	Cathode Digit 3
4	Cathode Digit 1	Cathode Digit 4
5	Cathode Digit 2	Anode Segment dp
6	Cathode Digit 3	Cathode Digit 5
7	Cathode Digit 4	Anode Segment c
8	Cathode Digit 5	Cathode Digit 6
9	Cathode Digit 6	Anode Segment e
10	Cathode Digit 7	Cathode Digit 7
11	Anode Segment dp	Anode Segment a
12	Anode Segment d	Cathode Digit 8
13	Anode Segment c	Anode Segment g
14	Anode Segment a	Cathode Digit 9
15	Anode Segment f	Anode Segment d
16		Cathode Digit 10
17		Anode Segment f
18		Cathode Digit 11
19		Anode Segment b
20		Cathode Digit 12
21		Cathode Digit 13
22		Cathode Digit 14
23		Cathode Digit 15

HEWLETT hp PACKARD

COMPONENTS

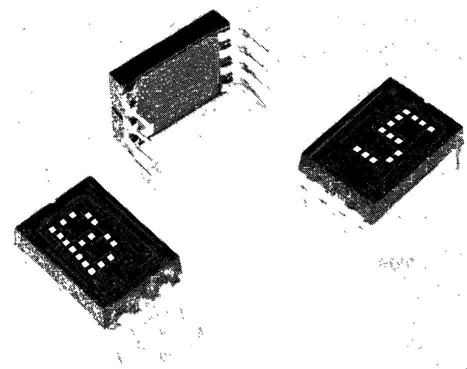
NUMERIC and HEXADECIMAL INDICATORS

5082-7300
5082-7302
5082-7304
5082-7340

TECHNICAL DATA APRIL 1977

Features

- **NUMERIC 5082-7300/-7302**
  0-9, Test State, Minus Sign, Blank States
  Decimal Point
  7300 Right Hand D.P.
  7302 Left Hand D.P.
- **HEXADECIMAL 5082-7340**
  0-9, A-F, Base 16 Operation
  Blanking Control, Conserves Power
  No Decimal Point
- **DTL/TTL COMPATIBLE**
- **INCLUDES DECODER/DRIVER WITH 5 BIT MEMORY**
  8421 Positive Logic Input
- **4 x 7 DOT MATRIX ARRAY**
  Shaped Character, Excellent Readibility
- **STANDARD .600 INCH x .400 INCH DUAL-IN-LINE PACKAGE INCLUDING CONTRAST FILTER**
- **CATEGORIZED FOR LUMINOUS INTENSITY**
  Assures Uniformity of Light Output from Unit to Unit within a Single Category



Description

The HP 5082-7300 series solid state numeric and hexadecimal indicators with on-board decoder/driver and memory provide a reliable, low-cost method for displaying digital information.

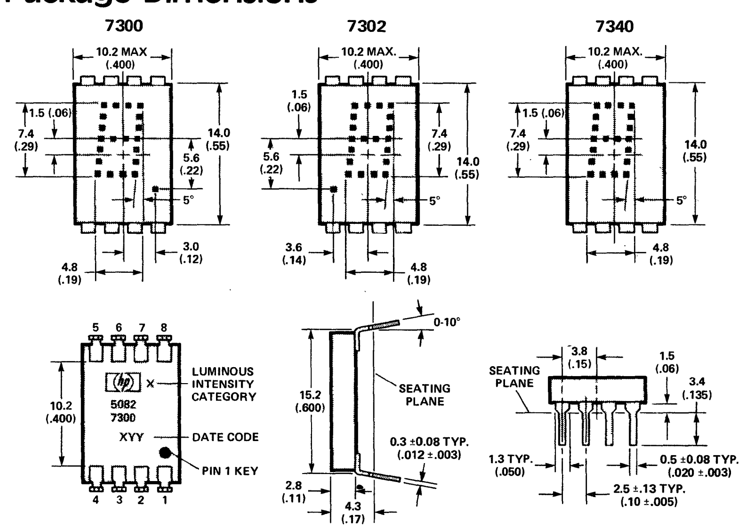
The 5082-7300 numeric indicator decodes positive 8421 BCD logic inputs into characters 0-9, a "-" sign, a test pattern, and four blanks in the invalid BCD states, The unit employs a right-hand decimal point. Typical applications include point-of-sale terminals, instrumentation, and computer systems.

The 5082-7302 is the same as the 5082-7300, except that the decimal point is located on the left-hand side of the digit.

The 5082-7340 hexadecimal indicator decodes positive 8421 logic inputs into 16 states, 0-9 and A-F. In place of the decimal point an input is provided for blanking the display (all LED's off), without losing the contents of the memory. Applications include terminals and computer systems using the base-16 character set.

The 5082-7304 is a (± 1.) overrange character, including decimal point, used in instrumentation applications.

Package Dimensions



PIN	FUNCTION: 5082-7300 and 7302 Numeric	FUNCTION: 5082-7340 Hexadecimal
1	Input 2	Input 2
2	Input 4	Input 4
3	Input 8	Input 8
4	Decimal point	Blanking control
5	Latch enable	Latch enable
6	Ground	Ground
7	V_{cc}	V_{cc}
8	Input 1	Input 1

NOTES:
1. Dimensions in millimetres and (inches).
2. Unless otherwise specified, the tolerance on all dimensions is ±.38mm (±.015")
3. Digit center line is ±.25mm (±.01") from package center line.

Absolute Maximum Ratings

Description	Symbol	Min.	Max.	Unit
Storage temperature, ambient	T_S	−40	+100	°C
Operating temperature, case [1,2]	T_C	−20	+85	°C
Supply voltage [3]	V_{CC}	−0.5	+7.0	V
Voltage applied to input logic, dp and enable pins	V_I, V_{DP}, V_E	−0.5	+7.0	V
Voltage applied to blanking input [7]	V_B	−0.5	V_{CC}	V
Maximum solder temperature at 1.59mm (.062 inch) below seating plane; t ≤ 5 seconds			230	°C

Recommended Operating Conditions

Description	Symbol	Min.	Nom.	Max.	Unit
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Operating temperature, case	T_C	-20		+85	°C
Enable Pulse Width	t_W	120			nsec
Time data must be held before positive transition of enable line	t_{SETUP}	50			nsec
Time data must be held after positive transition of enable line	t_{HOLD}	50			nsec
Enable pulse rise time	t_{TLH}			200	nsec

Electrical/Optical Characteristics (T_C = -20° C to +85° C, unless otherwise specified).

Description	Symbol	Test Conditions	Min.	Typ.[4]	Max.	Unit
Supply Current	I_{CC}	V_{CC}=5.5V (Numeral 5 and dp lighted)		112	170	mA
Power dissipation	P_T			560	935	mW
Luminous intensity per LED (Digit average) [5,6]	I_v	V_{CC}=5.0V, T_C=25° C	32	70		μcd
Logic low-level input voltage	V_{IL}	V_{CC}=4.5V			0.8	V
Logic high-level input voltage	V_{IH}		2.0			V
Enable low-voltage; data being entered	V_{EL}				0.8	V
Enable high-voltage; data not being entered	V_{EH}		2.0			V
Blanking low-voltage; display not blanked [7]	V_{BL}				0.8	V
Blanking high-voltage; display blanked [7]	V_{BH}		3.5			V
Blanking low-level input current [7]	I_{BL}	V_{CC}=5.5V, V_{BL}=0.8V			20	μA
Blanking high-level input current [7]	I_{BH}	V_{CC}=5.5V, V_{BH}=4.5V			2.0	mA
Logic low-level input current	I_{IL}	V_{CC}=5.5V, V_{IL}=0.4V			−1.6	mA
Logic high-level input current	I_{IH}	V_{CC}=5.5V, V_{IH}=2.4V			+250	μA
Enable low-level input current	I_{EL}	V_{CC}=5.5V, V_{EL}=0.4V			−1.6	mA
Enable high-level input current	I_{EH}	V_{CC}=5.5V, V_{EH}=2.4V			+250	μA
Peak wavelength	λ_{PEAK}	T_C=25° C		655		nm
Dominant Wavelength [8]	λ_d	T_C=25° C		640		nm
Weight				0.8		gm

Notes: 1. Nominal thermal resistance of a display mounted in a socket which is soldered into a printed circuit board: Θ_{JA}=50° C/W; Θ_{JC}=15° C/W; 2. Θ_{CA} of a mounted display should not exceed 35° C/W for operation up to T_C = +85° C. 3. Voltage values are with respect to device ground, pin 6. 4. All typical values at V_{CC}=5.0 Volts, T_C=25° C. 5. These displays are categorized for luminous intensity with the intensity category designated by a letter located on the back of the display contiguous with the Hewlett-Packard logo marking. 6. The luminous intensity at a specific case temperature, $I_V(T_C)$ may be calculated from this relationship: $I_V(T_C)=I_V(25° C)\, e^{[-.0188/°C\,(T_C-25°C)]}$ 7. Applies only to 7340. 8. The dominant wavelength, λ_d, is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.

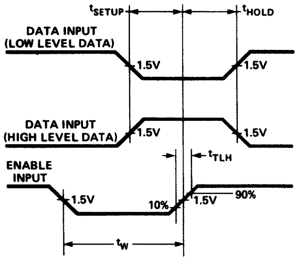


Figure 1. Timing Diagram of 5082-7300 Series Logic.

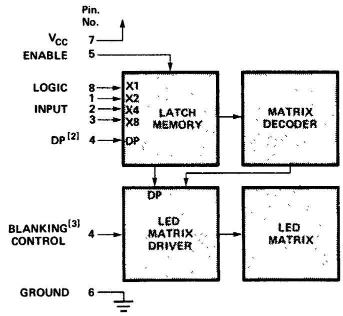


Figure 2. Block Diagram of 5082-7300 Series Logic.

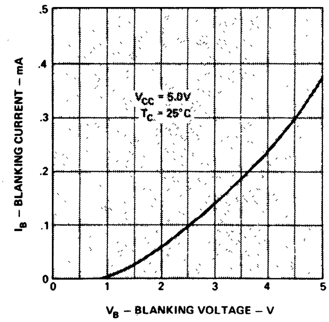


Figure 3. Typical Blanking Control Current vs. Voltage for 5082-7340.

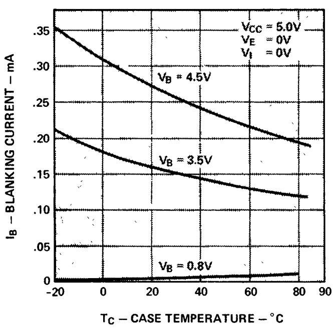


Figure 4. Typical Blanking Control Input Current vs. Temperature 5082-7340.

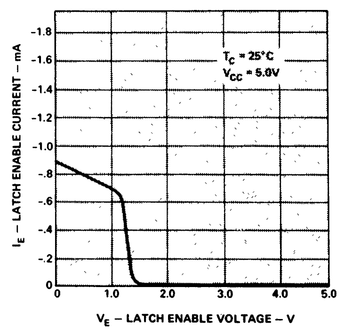


Figure 5. Typical Latch Enable Input Current vs. Voltage for the 5082-7300 Series Devices.

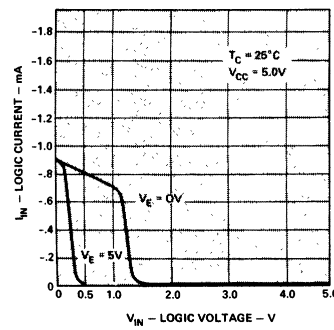


Figure 6. Typical Logic and Decimal Point Input Current vs. Voltage for the 5082-7300 Series Devices. Decimal Point Applies to 5082-7300 and -7302 Only.

TRUTH TABLE

BCD DATA[1]				5082-7300/7302	5082-7340
X_8	X_4	X_2	X_1		
L	L	L	L	0	0
L	L	L	H	1	1
L	L	H	L	2	2
L	L	H	H	3	3
L	H	L	L	4	4
L	H	L	H	5	5
L	H	H	L	6	6
L	H	H	H	7	7
H	L	L	L	8	8
H	L	L	H	9	9
H	L	H	L	[illegible]	A
H	L	H	H	(BLANK)	B
H	H	L	L	(BLANK)	C
H	H	L	H	····	D
H	H	H	L	(BLANK)	E
H	H	H	H	(BLANK)	F
DECIMAL PT.[2]				ON	V_{DP} = L
				OFF	V_{DP} = H
ENABLE[1]				LOAD DATA	V_E = L
				LATCH DATA	V_E = H
BLANKING[3]				DISPLAY-ON	V_B = L
				DISPLAY-OFF	V_B = H

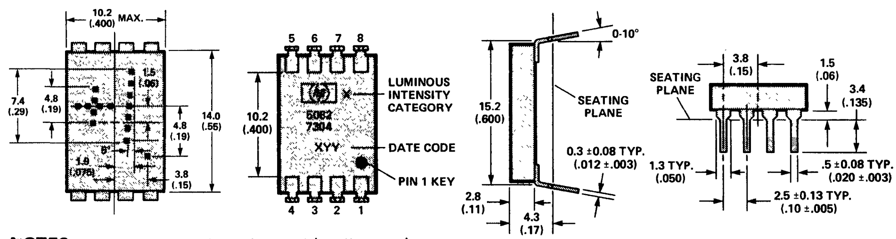
Notes:

1. H = Logic High; L = Logic Low. With the enable input at logic high changes in BCD input logic levels have no effect upon display memory or displayed character.
2. The decimal point input, DP, pertains only to the 5082-7300 and 5082-7302 displays.
3. The blanking control input, B, pertains only to the 5082-7340 hexadecimal display. Blanking input has no effect upon display memory.

Solid State Over Range Character

For display applications requiring a ±, 1, or decimal point designation, the 5082-7304 over range character is available. This display module comes in the same package as the 5082-7300 series numeric indicator and is completely compatible with it.

Package Dimensions



PIN	FUNCTION
1	Plus
2	Numeral One
3	Numeral One
4	DP
5	Open
6	Open
7	V_{CC}
8	Minus/Plus

NOTES: 1. Dimensions in inches and (millimeters).
2. Unless otherwise specified, the tolerance on all dimensions is ±.015 inches. (± .38mm)

5082—7304

TRUTH TABLE FOR 5082-7304

CHARACTER	PIN			
	1	2,3	4	8
+	H	X	X	H
—	L	X	X	H
1	X	H	X	X
Decimal Point	X	X	H	X
Blank	L	L	L	L

NOTES: L: Line switching transistor in Fig. 7 cutoff.
H: Line switching transistor in Fig. 7 saturated.
X: 'don't care'

TYPICAL DRIVING CIRCUIT FOR 5082-7304.

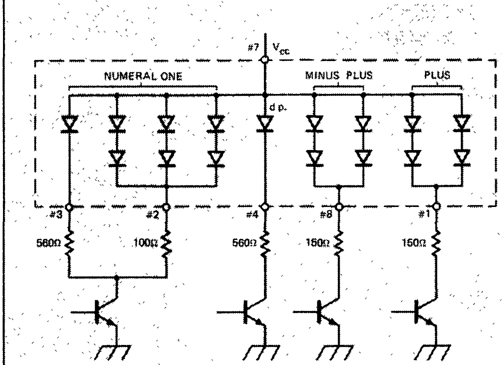


Figure 7.

Absolute Maximum Ratings

DESCRIPTION	SYMBOL	MIN	MAX	UNIT
Storage temperature, ambient	T_S	-40	+100	°C
Operating temperature, case	T_C	-20	+85	°C
Forward current, each LED	I_F		10	mA
Reverse voltage, each LED	V_R		4	V

RECOMMENDED OPERATING CONDITIONS

	SYMBOL	MIN	NOM	MAX	UNIT
LED supply voltage	V_{CC}	4.5	5.0	5.5	V
Forward current, each LED	I_F		5.0	10	mA

NOTE:
LED current must be externally limited. Refer to figure 7 for recommended resistor values.

Electrical/Optical Characteristics (T_C = -20°C TO +85°C, UNLESS OTHERWISE SPECIFIED)

DESCRIPTION	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Forward Voltage per LED	V_F	I_F = 10 mA		1.6	2.0	V
Power dissipation	P_T	I_F = 10 mA all diodes lit		250	320	mW
Luminous Intensity per LED (digit average)	I_v	I_F = 6 mA T_C = 25°C	32	70		μcd
Peak wavelength	λ_{peak}	T_C = 25°C		655		nm
Spectral halfwidth	$\Delta\lambda_{1/2}$	T_C = 25°C		30		nm
Weight				0.8		gm

HEWLETT hp PACKARD

COMPONENTS

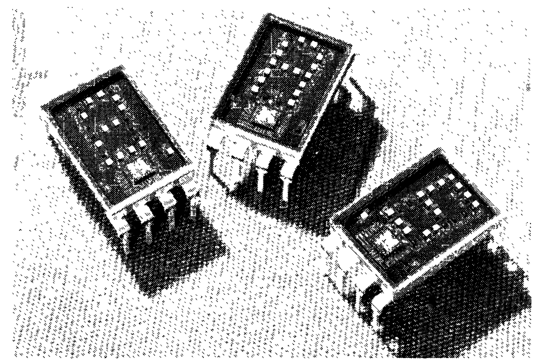
NUMERIC AND HEXADECIMAL DISPLAYS FOR INDUSTRIAL APPLICATIONS

5082-7356
5082-7357
5082-7358
5082-7359

TECHNICAL DATA APRIL 1977

Features

- **CERAMIC/GLASS PACKAGE**
- **ADDED RELIABILITY**
- **NUMERIC 5082-7356/-7357**
  0-9, Test State, Minus Sign, Blank States
  Decimal Point
  7356 Right Hand D.P.
  7357 Left Hand D.P.
- **HEXADECIMAL 5082-7359**
  0-9, A-F, Base 16 Operation
  Blanking Control, Conserves Power
  No Decimal Point
- **TTL COMPATIBLE**
- **INCLUDES DECODER/DRIVER WITH 5 BIT MEMORY**
  8421 Positive Logic Input and Decimal Point
- **4 x 7 DOT MATRIX ARRAY**
  Shaped Character, Excellent Readability
- **STANDARD DUAL-IN-LINE PACKAGE**
  15.2mm x 10.2mm (.6 inch x .4 inch)
- **CATEGORIZED FOR LUMINOUS INTENSITY**
  Assures Uniformity of Light Output from Unit to Unit within a Single Category



Description

The HP 5082-7350 series solid state numeric and hexadecimal indicators with on-board decoder/driver and memory provide 7.4mm (0.29 inch) displays for use in adverse industrial environments.

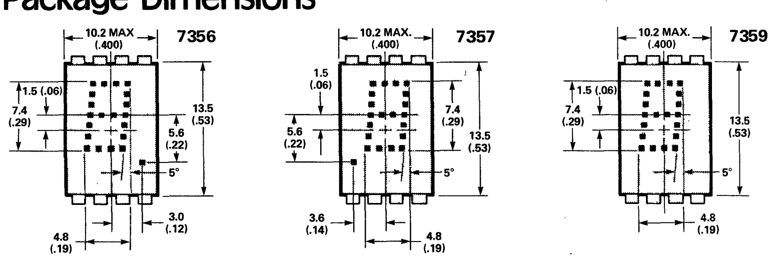
The 5082-7356 numeric indicator decodes positive 8421 BCD logic inputs into characters 0-9, a " –" sign, a test pattern, and four blanks in the invalid BCD states. The unit employs a right-hand decimal point. Typical applications include control systems, instrumentation, communication systems and transportation equipment.

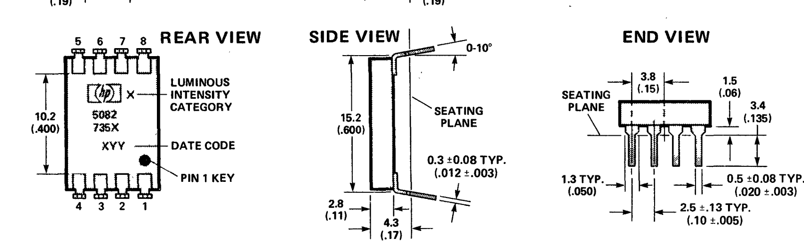
The 5082-7357 is the same as the 5082-7356 except that the decimal point is located on the left-hand side of the digit.

The 5082-7359 hexadecimal indicator decodes positive 8421 logic inputs into 16 states, 0-9 and A-F. In place of the decimal point an input is provided for blanking the display (all LED's off), without losing the contents of the memory. Applications include terminals and computer systems using the base-16 character set.

The 5082-7358 is a "±1." overrange display, including a right hand decimal point.

Package Dimensions





PIN	FUNCTION 5082-7356 AND 7357 NUMERIC	5082-7359 HEXA-DECIMAL
1	Input 2	Input 2
2	Input 4	Input 4
3	Input 8	Input 8
4	Decimal point	Blanking control
5	Latch enable	Latch enable
6	Ground	Ground
7	V_{CC}	V_{CC}
8	Input 1	Input 1

NOTES:
1. Dimensions in millimetres and (inches).
2. Unless otherwise specified, the tolerance on all dimensions is ±.38mm (±.015")
3. Digit center line is ±.25mm (±.01") from package center line.

Absolute Maximum Ratings

Description	Symbol	Min.	Max.	Unit
Storage temperature, ambient	T_S	−65	+125	°C
Operating temperature, ambient [1,2]	T_A	−55	+100	°C
Supply voltage [3]	V_{CC}	−0.5	+7.0	V
Voltage applied to input logic, dp and enable pins	V_I, V_{DP}, V_E	−0.5	+7.0	V
Voltage applied to blanking input [7]	V_B	−0.5	V_{CC}	V
Maximum solder temperature at 1.59mm (.062 inch) below seating plane; t ≤ 5 seconds			260	°C

Recommended Operating Conditions

Description	Symbol	Min.	Nom.	Max.	Unit
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Operating temperature, ambient	T_A	0		+70	°C
Enable Pulse Width	t_W	100			nsec
Time data must be held before positive transition of enable line	t_{SETUP}	50			nsec
Time data must be held after positive transition of enable line	t_{HOLD}	50			nsec
Enable pulse rise time	t_{TLH}			200	nsec

Electrical/Optical Characteristics (T_A = 0°C to +70°C, unless otherwise specified).

Description	Symbol	Test Conditions	Min.	Typ.[4]	Max.	Unit
Supply Current	I_{CC}	V_{CC}=5.5V (Numeral 5 and dp lighted)		112	170	mA
Power dissipation	P_T			560	935	mW
Luminous intensity per LED (Digit average) [5,6]	I_v	V_{CC}=5.0V, T_A=25°C	40	85		μcd
Logic low-level input voltage	V_{IL}	V_{CC}=4.5V			0.8	V
Logic high-level input voltage	V_{IH}		2.0			V
Enable low-voltage; data being entered	V_{EL}				0.8	V
Enable high-voltage; data not being entered	V_{EH}		2.0			V
Blanking low-voltage; display not blanked [7]	V_{BL}				0.8	V
Blanking high-voltage; display blanked [7]	V_{BH}		3.5			V
Blanking low-level input current [7]	I_{BL}	V_{CC}=5.5V, V_{BL}=0.8V			50	μA
Blanking high-level input current [7]	I_{BH}	V_{CC}=5.5V, V_{BH}=4.5V			1.0	mA
Logic low-level input current	I_{IL}	V_{CC}=5.5V, V_{IL}=0.4V			−1.6	mA
Logic high-level input current	I_{IH}	V_{CC}=5.5V, V_{IH}=2.4V			+100	μA
Enable low-level input current	I_{EL}	V_{CC}=5.5V, V_{EL}=0.4V			−1.6	mA
Enable high-level input current	I_{EH}	V_{CC}=5.5V, V_{EH}=2.4V			+130	μA
Peak wavelength	λ_{PEAK}	T_A=25°C		655		nm
Dominant Wavelength [8]	λ_d	T_A=25°C		640		nm
Weight				1.0		gm

Notes: 1. Nominal thermal resistance of a display mounted in a socket which is soldered into a printed circuit board: Θ_{JA}=50°C/W; Θ_{JC}=15°C/W; 2. Θ_{CA} of a mounted display should not exceed 35°C/W for operation up to T_A=+100°C. 3. Voltage values are with respect to device ground, pin 6. 4. All typical values at V_{CC}=5.0 Volts, T_A=25°C. 5. These displays are categorized for luminous intensity with the intensity category designated by a letter located on the back of the display contiguous with the Hewlett-Packard logo marking. 6. The luminous intensity at a specific ambient temperature, $I_V(T_A)$, may be calculated from this relationship: $I_V(T_A)=I_{V(25°C)}(.985)^{[T_A-25°C]}$ 7. Applies only to 7359. 8. The dominant wavelength, λ_d, is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.

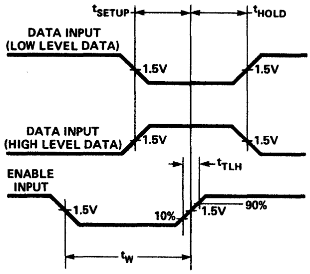


Figure 1. Timing Diagram of 5082-7350 Series Logic.

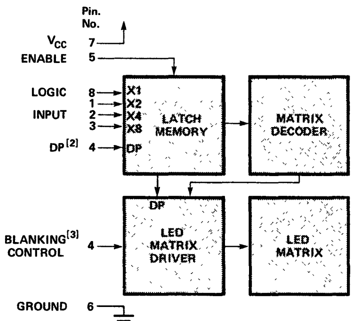


Figure 2. Block Diagram of 5082-7350 Series Logic.

TRUTH TABLE					
BCD DATA[1]				5082-7356/7357	5082-7359
X_8	X_4	X_2	X_1		
L	L	L	L	0	0
L	L	L	H	1	1
L	L	H	L	2	2
L	L	H	H	3	3
L	H	L	L	4	4
L	H	L	H	5	5
L	H	H	L	6	6
L	H	H	H	7	7
H	L	L	L	8	8
H	L	L	H	9	9
H	L	H	L	□	A
H	L	H	H	(BLANK)	B
H	H	L	L	(BLANK)	C
H	H	L	H	-	D
H	H	H	L	(BLANK)	E
H	H	H	H	(BLANK)	F
DECIMAL PT.[2]				ON	V_{DP} = L
				OFF	V_{DP} = H
ENABLE[1]				LOAD DATA	V_E = L
				LATCH DATA	V_E = H
BLANKING[3]				DISPLAY ON	V_B = L
				DISPLAY OFF	V_B = H

Notes:

1. H = Logic High; L = Logic Low. With the enable input at logic high changes in BCD input logic levels have no effect upon display memory or displayed character.
2. The decimal point input, DP, pertains only to the 5082-7356 and 5082-7357 displays.
3. The blanking control input, B, pertains only to the 5082-7359 hexadecimal display. Blanking input has no effect upon display memory.

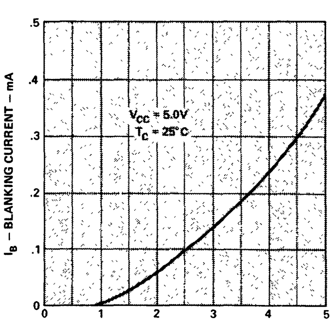


Figure 3. Typical Blanking Control Current vs. Voltage for 5082-7359.

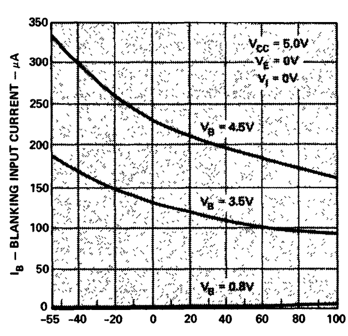


Figure 4. Typical Blanking Control Input Current vs. Ambient Temperature for 5082-7359.

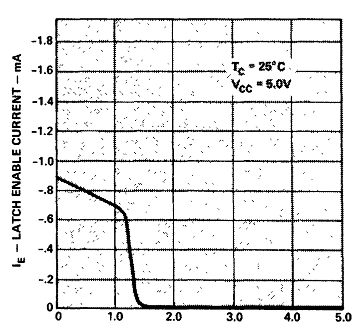


Figure 5. Typical Latch Enable Input Current vs. Voltage.

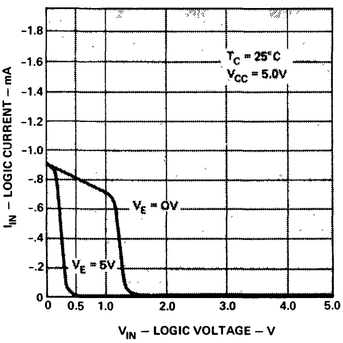


Figure 6. Typical Logic and Decimal Point Input Current vs. Voltage.

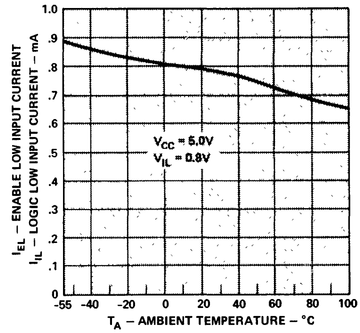


Figure 7. Typical Logic and Enable Low Input Current vs. Ambient Temperature.

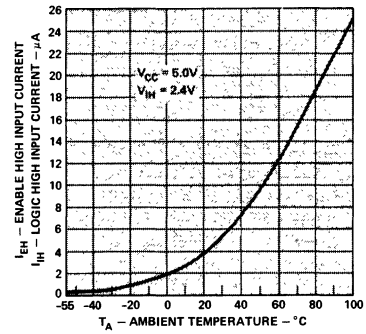


Figure 8. Typical Logic and Enable High Input Current vs. Ambient Temperature.

Operational Considerations

ELECTRICAL

The 5082-7350 series devices use a modified 4 x 7 dot matrix of light emitting diodes (LED's) to display decimal/hexadecimal numeric information. The LED's are driven by constant current drivers. BCD information is accepted by the display memory when the enable line is at logic low and the data is latched when the enable is at logic high. To avoid the latching of erroneous information, the enable pulse rise time should not exceed 200 nanoseconds. Using the enable pulse width and data setup and hold times listed in the Recommended Operating Conditions allows data to be clocked into an array of displays at a 6.7MHz rate.

The blanking control input on the 5082-7395 display blanks (turns off) the displayed hexadecimal information without disturbing the contents of display memory. The display is blanked at a minimum threshold level of 3.5 volts. This may be easily achieved by using an open collector TTL gate and a pull-up resistor. For example, (1/6) 7416 hexinverter buffer/driver and a 120 ohm pull-up resistor will provide sufficient drive to blank eight displays. The size of the blanking pull-up resistor may be calculated from the following formula, where N is the number of digits:

$$R_{blank} = (V_{CC} - 3.5V)/[N\ (1.0mA)]$$

The decimal point input is active low true and this data is latched into the display memory in the same fashion as is the BCD data. The decimal point LED is driven by the on-board IC.

MECHANICAL

These hermetic displays are designed for use in adverse industrial environments.

These displays may be mounted by soldering directly to a printed circuit board or inserted into a socket. The lead-to-lead pin spacing is 2.54mm (0.100 inch) and the lead row spacing is 15.24mm (0.600 inch). These displays may be end stacked with 2.54mm (0.100 inch) spacing between outside pins of adjacent displays. Sockets such as Augat 324-AG2D (3 digits) or Augat 508-AG8D (one digit, right angle mounting) may be used.

The primary thermal path for power dissipation is through the device leads. Therefore, to insure reliable operation up to an ambient temperature of +100°C, it is important to maintain a case-to-ambient thermal resistance of less than 35°C/watt as measured on top of display pin 3.

Post solder cleaning may be accomplished using water, Freon/alcohol mixtures formulated for vapor cleaning processing (up to 2 minutes in vapors at boiling) or Freon/alcohol mixtures formulated for room temperature cleaning. Suggested solvents: Freon TF, Freon TE, Genesolv DI-15, Genesolv DE-15.

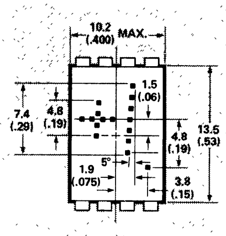
CONTRAST ENHANCEMENT

The 5082-7350 displays have been designed to provide the maximum posible ON/OFF contrast when placed behind an appropriate contrast enhancement filter. Some suggested filters are Panelgraphic Ruby Red 60 and Dark Red 63, SGL Homalite H100-1605, 3M Light Control Film and Polaroid HRCP Red Circular Polarizing Filter. For further information see Hewlett-Packard Application Note 964.

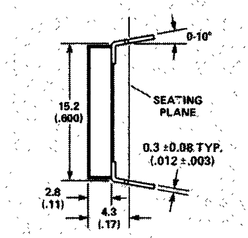
Solid State Over Range Character

For display applications requiring a ±, 1, or decimal point designation, the 5082-7358 over range character is available. This display module comes in the same package as the 5082-7350 series numeric indicator and is completely compatible with it.

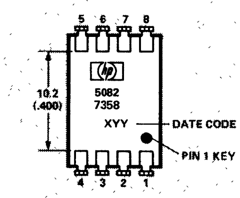
Package Dimensions



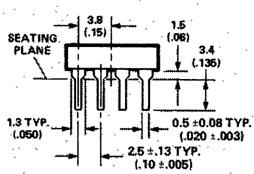
FRONT



SIDE



REAR



END

NOTES:
1. DIMENSIONS IN MILLIMETRES AND (INCHES).
2. UNLESS OTHERWISE SPECIFIED, THE TOLERANCE ON ALL DIMENSIONS IS ±.38 MM (± .015 INCHES).

PIN	FUNCTION
1	Plus
2	Numeral One
3	Numeral One
4	DP
5	Open
6	Open
7	V_{cc}
8	Minus/Plus

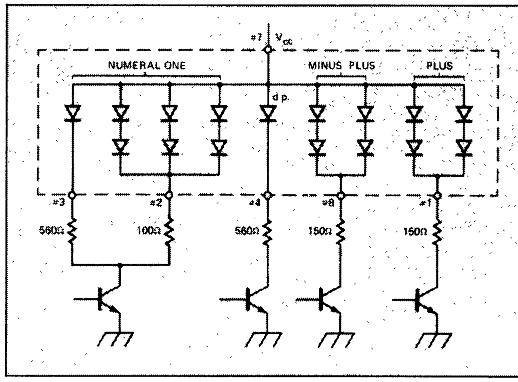


Figure 9. Typical Driving Circuit.

TRUTH TABLE

CHARACTER	PIN			
	1	2,3	4	8
+	H	X	X	H
–	L	X	X	H
1	X	H	X	X
Decimal Point	X	X	H	X
Blank	L	L	L	L

NOTES: L: Line switching transistor in Figure 9 cutoff.
H: Line switching transistor in Figure 9 saturated.
X: 'Don't care'

Electrical/Optical Characteristics

5082-7358 (T_A = 0°C to 70°C, Unless Otherwise Specified)

DESCRIPTION	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Forward Voltage per LED	V_F	I_F = 10 mA		1.6	2.0	V
Power dissipation	P_T	I_F = 10 mA all diodes lit		280	320	mW
Luminous Intensity per LED (digit average)	I_v	I_F = 6 mA T_C = 25°C	40	85		μcd
Peak wavelength	λ_{peak}	T_C = 25°C		655		nm
Dominant Wavelength	λ_d	T_C = 25°C		640		nm
Weight				1.0		gm

Recommended Operating Conditions

	SYMBOL	MIN	NOM	MAX	UNIT
LED supply voltage	V_{CC}	4.5	5.0	5.5	V
Forward current, each LED	I_F		5.0	10	mA

NOTE:
LED current must be externally limited. Refer to Figure 9 for recommended resistor values.

Absolute Maximum Ratings

DESCRIPTION	SYMBOL	MIN.	MAX.	UNIT
Storage temperature, ambient	T_S	-65	+125	°C
Operating temperature, ambient	T_A	-55	+100	°C
Forward current, each LED	I_F		10	mA
Reverse voltage, each LED	V_R		4	V

HEWLETT hp PACKARD
COMPONENTS

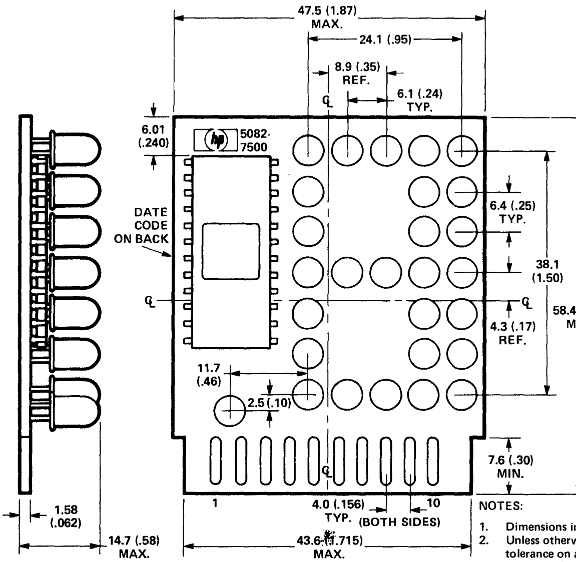
SOLID STATE NUMERIC 1.5 INCH INDICATOR

5082-7500

TECHNICAL DATA APRIL 1977

Features

- **1.5 INCH HIGH CHARACTER**
  Readable From 60 Feet
- **ON-BOARD DECODER/DRIVER**
  8421 Positive Logic Input
  DTL-TTL Compatible
- **5 x 7 DOT MATRIX**
  Shaped Character For Excellent Readability
- **SINGLE PLANE CONSTRUCTION**
  Wide Viewing Angle
- **EDGE MOUNTING IN STANDARD PC BOARD CONNECTORS (.156" Centers)**
- **RELIABLE, RUGGED, LONG OPERATING LIFE**



PIN	FUNCTION
1	V_{CC}
2	DP
3	X1
4	X2
5	X4
6	X8
7	GROUND
8	NC
9	NC
10	V_{LED}

NOTES:
1. Dimensions in millimeters and (inches).
2. Unless otherwise specified, the tolerance on all dimensions is ±0.38mm (±.015 in.).

Description

The HP 5082-7500 is a 38.1mm (1.5 in.) numeric indicator utilizing discrete red light emitting diodes arranged in a 5 x 7 dot matrix. Inclusion of the decoder/driver permits direct addressing by the standard BCD code.

The large size and high efficiency light emitters permit viewing distances up to 60 feet. The single plane of light emitters permits wide viewing angles and low mounting space requirements. Applications include equipment for scales, process control and medical measurement, and other data systems requiring ease of readability at a distance.

Absolute Maximum Ratings

Description	Symbol	Min.	Max.	Unit
Storage Temperature, Ambient	T_S	–40	85	°C
Operating Temperature, Ambient	T_A	–20	70	°C
Logic Supply Voltage [1]	V_{CC}	–0.5	7	V
LED Supply Voltage [1, 2]	V_{LED}	–0.5	5.25	V
Voltage Applied to BCD [1, 2] and Decimal Point Inputs	V_I	–0.5	5.25	V

[1] Voltage values are with respect to ground pin. [2] V_I or V_{LED} not to exceed V_{CC} by more than 0.5V at any time.

Recommended Operating Conditions

Description	Symbol	Min.	Nom.	Max.	Unit
Logic Supply Voltage	V_{CC}	4.5	5.0	5.5	V
LED Supply Voltage, Display ON [1]	V_{LED}	4.5	5.0	5.25	V
LED Supply Voltage, Display OFF [2]	V_{LED}	–0.5	0	1.0	V
Operating Temperature, Ambient	T_A	–20	25	70	°C

[1] All selected LEDs remain uniformly lit. [2] All LEDs remain off.

Electrical / Optical Characteristics (T_A = –20°C to 70°C, Unless Noted)

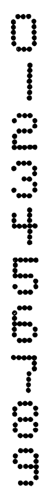
Description	Symbol	Test Conditions	Min.	Typ.	Max.	Units
Logic Voltage, "L" State	V_{IL}	V_{CC} = 4.5V	0		0.8	V
Logic Voltage, "H" State	V_{IH}	V_{CC} = 5.5V	2.0		5.25	V
Logic Supply Current	I_{CC}	V_{CC} = 5.5V		37 [1]	65	mA
LED Supply Current	I_{LED}	V_{CC} = 5.5V, V_{LED} = 5.25V		250 [1]	460	mA
Power Dissipation	P_D	V_{CC} = 5.5V, V_{LED} = 5.25V		1.4 [1]	2.8	W
Luminous Intensity per LED (digit average)	I	V_{CC} = 5.0V, V_{LED} = 5.0V T_A = 25°C	0.8	1.25		mcd
Logic Current, "L" State	I_{IL}	V_{CC} = 5.5V, V_{in} = 0.4V			–1.6	mA
Logic Current, "H" State	I_{IH}	V_{CC} = 5.5V, V_{in} = 2.4V			+100	µA
Decimal Point Current	I_{dp} [3]	V_{CC} = 5.5V, V_{LED} = 5.25V V_{dp} = 0.4V		–25 [2]	–35	mA
Peak Wavelength	λ_{PEAK}			655		nm
Spectral Halfwidth	$\Delta\lambda_{1/2}$			30		nm
Weight				25		gm

[1] V_{CC}=5.0V, V_{LED}=5.0V with statistical average number of LEDs lit, T_A=25°C. [2] V_{CC}=5.0V, V_{LED}=5.0V, T_A=25°C.

[3] Pin 2 is connected to the decimal point LED thru a 120Ω series current limiting resistor. This pin should be connected to ground thru a NPN switching transistor.

Truth Table

Character	X8	X4	X2	X1
0	L	L	L	L
1	L	L	L	H
2	L	L	H	L
3	L	L	H	H
4	L	H	L	L
5	L	H	L	H
6	L	H	H	L
7	L	H	H	H
8	H	L	L	L
9	H	L	L	H
BLANK	H	L	H	L
BLANK	H	L	H	H
BLANK	H	H	L	L
BLANK	H	H	L	H
BLANK	H	H	H	L
BLANK	H	H	H	H
D.P. ON		D.P. (IN) = L		
D.P. OFF		D.P. (IN) = H		



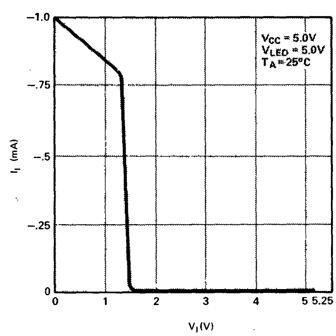


Figure 1. Typical BCD logic input current vs. input voltage.

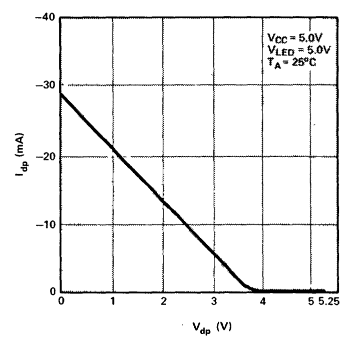


Figure 2. Typical decimal point input current as a function of dp input voltage.

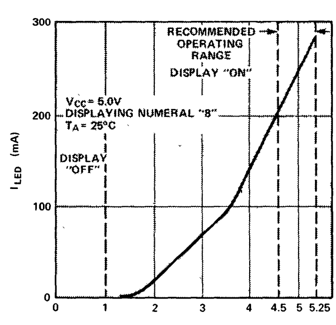


Figure 3. Typical I_{LED} as a function of V_{LED}.

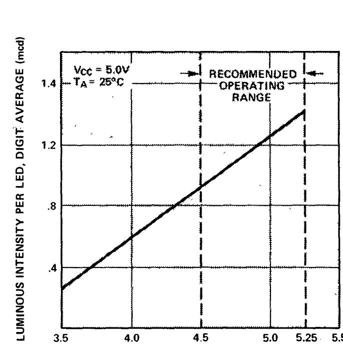


Figure 4. Typical luminous intensity per LED (digit average) as a function of V_{LED}.

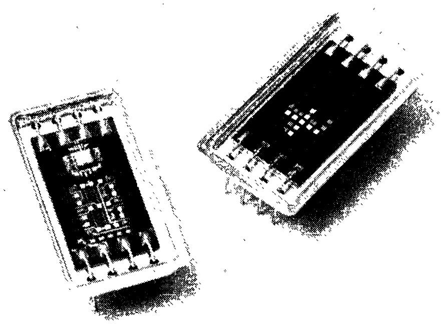
SOLID STATE NUMERIC INDICATOR

5082-7010
5082-7011

TECHNICAL DATA APRIL 1977

Features

- RUGGED, SHOCK RESISTANT, HERMETIC
- DESIGNED TO MEET MIL STANDARDS
- INCLUDES DECODER/DRIVER
  BCD Inputs
- TTL/DTL COMPATIBLE
- CONTROLLABLE LIGHT OUTPUT
- 5 x 7 LED MATRIX CHARACTER



Description

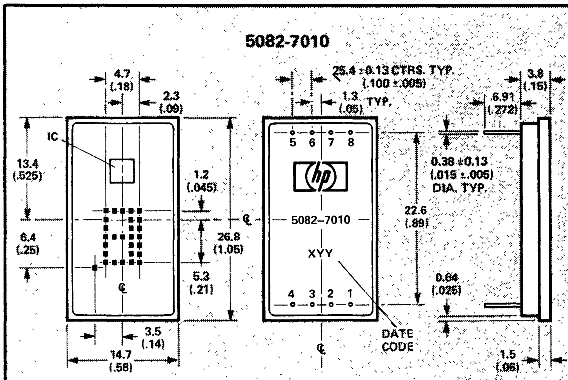
The HP 5082-7010 solid state numeric indicator with built-in decoder/driver provides a hermetically tested 6.8mm (0.27 in.) display for use in military or adverse industrial environments. Typical applications include ground, airborne and shipboard equipment, fire control systems, medical instruments, and space flight systems.

The 5082-7010 is a modified 5x7 matrix display that indicates the numerals 0-9 when presented with a BCD code. The BCD code is negative logic with blanks displayed for invalid codes. A left-hand decimal point is included which must be externally current limited.

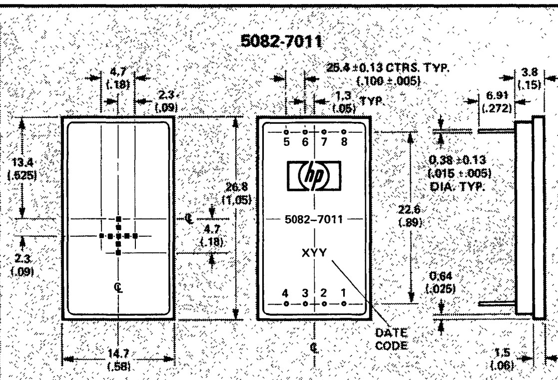
The 5082-7011 is a companion plus/minus sign in the same hermetically tested package. Plus/minus indications require only that voltage be applied to two input pins.

Both displays allow luminous intensity to be varied by changing the DC drive voltage or by pulse duration modulation of the LED voltage.

Package Dimensions



PIN	FUNCTION	PIN	FUNCTION
1	Input 1	5	Input 4
2	V_{DP}	6	Ground
3	V_{LED}	7	V_{CC}
4	Input 8	8	Input 2



PIN	FUNCTION	PIN	FUNCTION
1	NC	5	NC
2	NC	6	Ground
3	Plus	7	Minus/Plus
4	NC	8	NC

Notes:
1. Unless otherwise specified, the tolerance on all dimensions is ±0.38 mm. (±0.015 inches).
2. All dimensions in millimetres and (inches).
3. The package and mounting pins are tin plated Kovar.

Absolute Maximum Ratings

Description	Symbol	Min.	Max.	Unit
Storage Temperature, Ambient	T_S	–65	+100	°C
Operating Temperature, Case	T_C	–55	+95	°C
Logic Supply Voltage to Ground	V_{CC}	–0.5	+7.0	V
Logic Input Voltage	V_I	–0.5	+5.5	V
LED Supply Voltage to Ground	V_{LED}[1]	–0.5	+5.5	V
Decimal Point Current	I_{DP}		–10	mA

Note: 1. Above T_C = 65°C derate V_{LED} per derating curve in Figure 10.

Recommended Operating Conditions

Description	Symbol	Min.	Nom.	Max.	Unit
Logic Supply Voltage	V_{CC}	4.5	5.0	5.5	V
LED Supply Voltage, Display Off	V_{LED}	–0.5	0	+1.0	V
LED Supply Voltage, Display On	V_{LED}	3.0	4.2	5.5	V
Decimal Point Current	I_{DP}[2]	0	–5.0	–10.0	mA
Logic Input Voltage, "H" State	V_{IH}	2.0		5.5	V
Logic Input Voltage, "L" State	V_{IL}	0		0.8	V

Note: 2. Decimal point current must be externally current limited. See application information.

Electrical/Optical Characteristics

Case Temperature, T_C = 0°C to 70°C, unless otherwise specified

Description	Symbol	Test Conditions		Min.	Typ.[4]	Max.	Unit
Logic Supply Current	I_{CC}	V_{CC} = 5.5V			45	75	mA
LED Supply Current	I_{LED} [3] [5]	V_{CC}	V_{LED}				mA
		5.5V	5.5V		255	350	
		5.5V	4.2V		170	235	
		5.5V	3.5V		125		
Logic Input Current, "H" State (ea. input)	I_{IH}	V_{CC} = 5.5V, V_{IH} = 2.4V				100	μA
Logic Input Current, "L" State (ea. input)	I_{IL}	V_{CC} = 5.5V, V_{IL} = 0.4V				–1.6	mA
Decimal Point Voltage Drop	$V_{LED} - V_{DP}$	I_{DP} = –10mA			1.6	2.0	V
Power Dissipation	P_T [3] [5]	V_{CC}	V_{LED}				W
		5.5V	5.5V		1.7	2.3	
		5.5V	4.2V		1.0	1.4	
		5.5V	3.5V		0.7		
Luminous Intensity per LED (digit avg.)	I_v	V_{LED}	T_C				μcd
		5.5V	25°C	60	115		
		4.2V	25°C	40	80		
		3.5V	25°C		50		
Peak Wavelength	λ_{peak}				655		nm
Spectral Halfwidth	$\Delta\lambda_{1/2}$				30		nm
Weight					4.9		gram

Notes:
3. With numeral 8 displayed.
4. All typical values at T_C = 25°C.
5. T_C = 0°C to 65°C for V_{LED} = 5.5V.

Truth Table

Character	Logic X8	X4	X2	X1
0	H	H	H	H
1	H	H	H	L
2	H	H	L	H
3	H	H	L	L
4	H	L	H	H
5	H	L	H	L
6	H	L	L	H
7	H	L	L	L
8	L	H	H	H
9	L	H	H	L
Blank	L	H	L	H
Blank	L	H	L	L
Blank	L	L	H	H
Blank	L	L	H	L
Blank	L	L	L	H
Blank	L	L	L	L

V_{IL} = 0.0 to 0.8V
V_{IH} = 2.0 to 5.5V

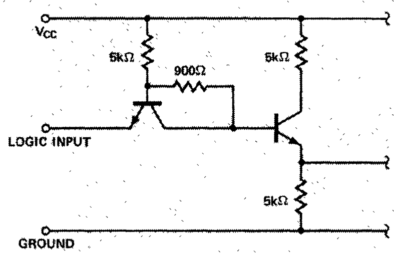


Figure 1. Equivalent input circuit of the 5082-7010 decoder. Note: Display metal case is isolated from ground pin #6.

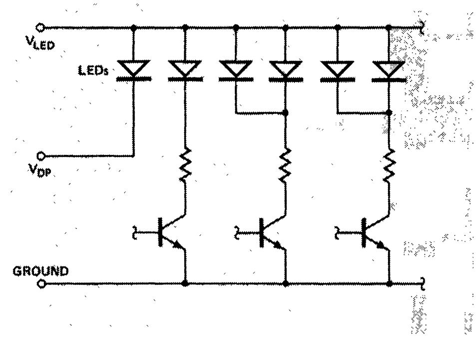


Figure 2. Equivalent circuit of the 5082-7010 as seen from LED and decimal point drive lines.

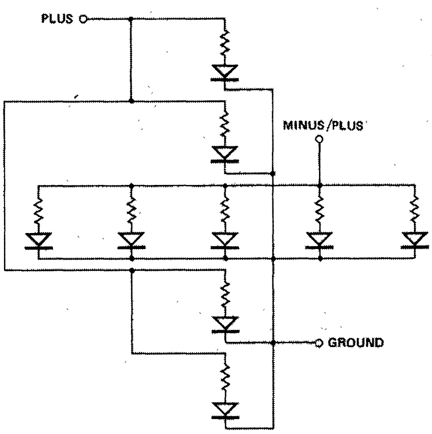


Figure 3. Equivalent circuit of 5082-7011 plus/minus sign. All resistors 345Ω typical. Note: Display metal case is isolated from ground pin #6.

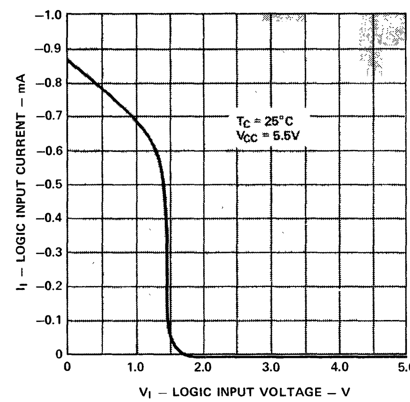


Figure 4. Input current as a function of input voltage, each input.

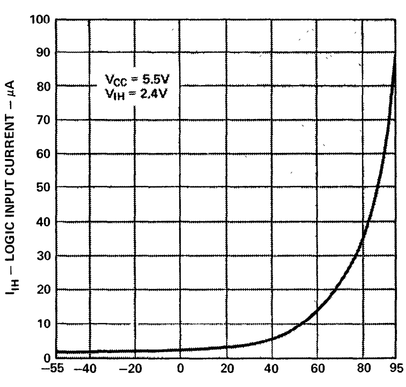


Figure 5. Logic "H" input current as a function of case temperature, each input.

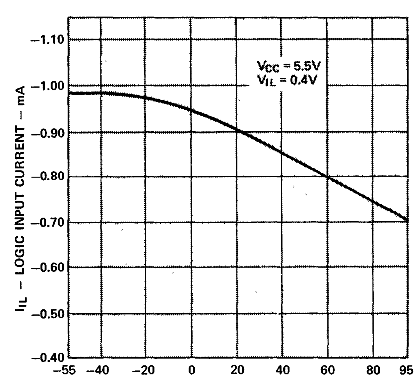


Figure 6. Logic "L" input current as a function of case temperature, each input.

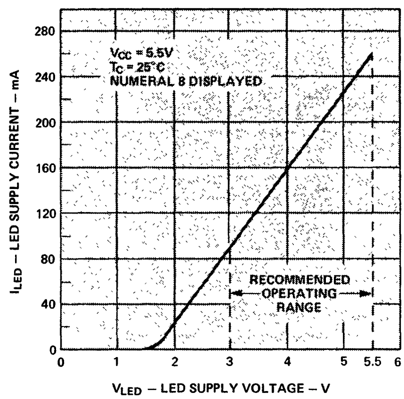


Figure 7. LED supply current as a function of LED supply voltage.

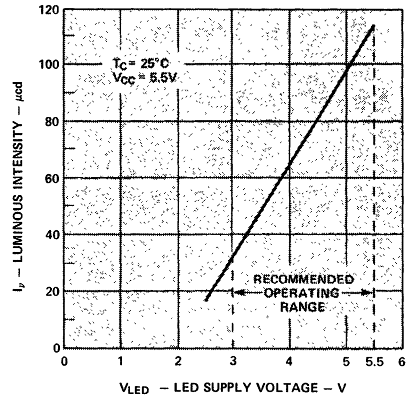


Figure 8. Luminous intensity per LED (digit average) as a function of LED supply voltage.

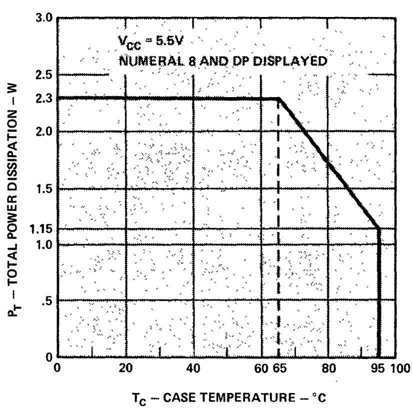


Figure 9. Maximum power derating as a function of case temperature.

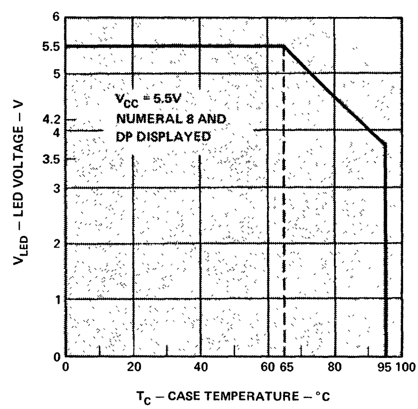


Figure 10. LED voltage derating as a function of case temperature.

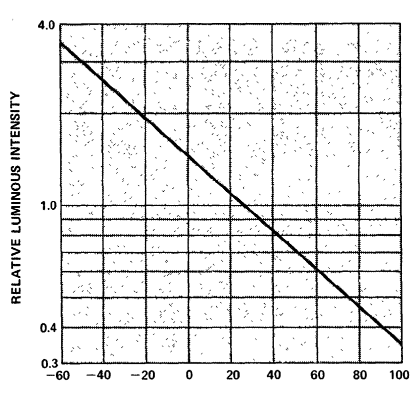


Figure 11. Relative luminous intensity as a function of case temperature at fixed current level.

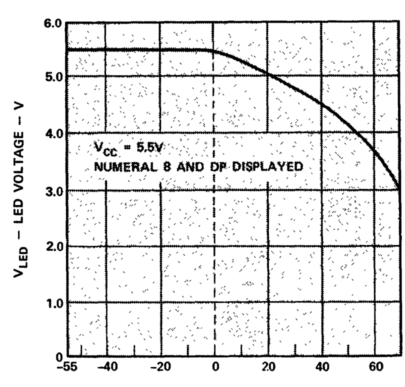


Figure 12. LED voltage derating as a function of ambient temperature, display soldered into P.C. board without heat sink.

Solid State Plus/Minus Sign 5082-7011

For display applications requiring ± designation, the 5082-7011 solid state plus/minus sign is available. This display module comes in the same package as the 5082-7010 numeric indicator and is completely compatible with it. Plus or minus information can be indicated by supplying voltage to one (minus sign) or two (plus sign) input leads. A third lead is provided for the ground connection. Luminous intensity is controlled by changing the LED drive voltage. Each LED has its own built-in 345Ω (nominal) current limiting resistor. Therefore, no external current limiting is required for voltages at 5.5V or lower. Like the numeric indicator, the -7011 plus/minus sign is TTL/DTL compatible.

Truth Table

CHARACTER	PIN	
	3	7
+	H	H
–	L	H
Blank	L	L

V_L = –0.5 to 1.0V

V_H = 3.0 to 5.5V

Electrical/Optical Characteristics

Case Temperature, T_C = 0°C to 70°C, unless otherwise specified

Description	Symbol	Test Conditions	Min.	Typ.[1]	Max.	Unit
LED Supply Current	I_{LED}	V_{LED} = 5.5V		105	150	mA
		V_{LED} = 4.2V		70	100	
Power Dissipation	P_T	V_{LED} = 5.5V		0.6	0.9	W
		V_{LED} = 4.2V		0.3	0.6	
Luminous Intensity per LED (Digit Avg.)	I_ν [2]	V_{LED} = 5.5V	60	115		μcd
		V_{LED} = 4.2V	40	80		
		V_{LED} = 3.5V		50		
Peak Wavelength	λ_{peak}			655		nm
Spectral Halfwidth	$\Delta\lambda_{1/2}$			30		nm
Weight				4.9		gram

Notes: 1. All typical values at T_C = 25°C
2. At T_C = 25°C

Absolute Maximum Ratings

Description	Symbol	Min.	Max.	Unit
Storage Temperature, Ambient	T_S	–65	+100	°C
Operating Temperature, Case	T_C	–55	+95	°C
Plus, Plus/Minus Input Potential to Ground	V_{LED}	–0.5	5.5	V

Recommended Operating Conditions

Description	Symbol	Min.	Nom.	Max.	Unit
LED Supply Voltage, Display Off	V_{LED}	–0.5	0	1.0	V
LED Supply Voltage, Display On	V_{LED}	3.0	4.2	5.5	V

Applications

Decimal Point Limiting Resistor

The decimal point of the 5082-7010 display requires an external current limiting resistor, between pin 2 and ground. Recommended resistor value is 220Ω, 1/4 watt.

Mounting

The 5082-7010 and 5082-7011 displays are packaged with two rows of 4 contact pins each in a DIP configuration with a row center line spacing of 0.890 inches.

Normal mounting is directly onto a printed circuit board. If desired, these displays may be socket mounted using contact strip connectors such as Augat's 325-AGI or AMP 583773-1 or 583774-1.

Heat Sink Operation

Optimum display case operating temperature for the 5082-7010 and 7011 displays is T_C=0°C to 70°C as measured on back surface. Maintaining the display case operating temperature within this range may be achieved by mounting the display on an appropriate heat sink or metal core printed circuit board. Thermal conducting compound such as Wakefield 120 or Dow Corning 340 can be used between display and heat sink. See figure 10 for V_{LED} derating vs. display case temperature.

Operation Without Heat Sink

These displays may also be operated without the use of a heat sink. The thermal resistance from case to ambient for these displays when soldered into a printed circuit board is nominally θ_{CA}=30°C/W. See figure 12 for V_{LED} derating vs. ambient temperature.

Cleaning

Post solder cleaning may be accomplished using water, Freon/alcohol mixtures formulated for vapor cleaning processing (up to 2 minutes in vapors at boiling) or Freon/alcohol mixtures formulated for room temperature cleaning. Suggested solvents: Freon TF, Freon TE, Genesolv DI-15, Genesolv DE-15.

HEWLETT hp PACKARD
COMPONENTS

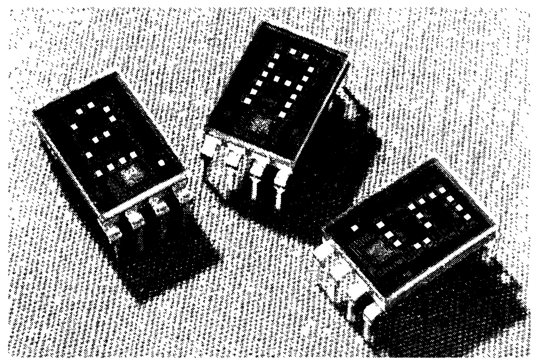
NUMERIC AND HEXADECIMAL DISPLAYS FOR HIGH RELIABILITY APPLICATIONS

5082-7391
5082-7392
5082-7393
5082-7395

TECHNICAL DATA APRIL 1977

Features

- PERFORMANCE GUARANTEED OVER TEMPERATURE
- HERMETICITY GUARANTEED
- TXV SCREENING AVAILABLE
- GOLD PLATED LEADS
- HIGH TEMPERATURE STABILIZED
- NUMERIC
  5082-7391 Right Hand D.P.
  5082-7392 Left Hand D.P.
- HEXADECIMAL
  5082-7395
- TTL COMPATIBLE
- DECODER/DRIVER WITH 5 BIT MEMORY
- 4 x 7 DOT MATRIX ARRAY
  Shaped Character, Excellent Readability
- STANDARD DUAL-IN-LINE PACKAGE
- CATEGORIZED FOR LUMINOUS INTENSITY
  Assures Uniformity of Light Output from Unit to Unit within a Single Category



Description

The HP 5082-7390 series solid state numeric and hexadecimal indicators with on-board decoder/driver and memory are hermetically tested 7.4mm (0.29 inch) displays for use in military and aerospace applications.

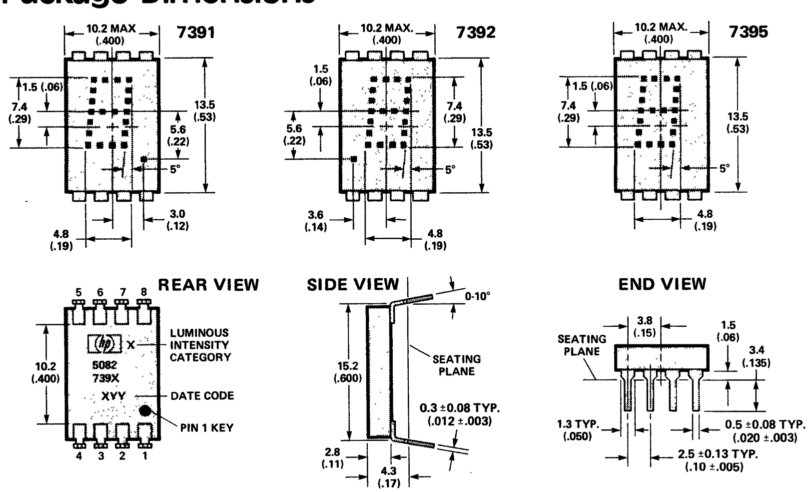
The 5082-7391 numeric indicator decodes positive 8421 BCD logic inputs into characters 0-9, a " –" sign, a test pattern, and four blanks in the invalid BCD states. The unit employs a right-hand decimal point. Typical applications include control systems, instrumentation, communication systems and transportation equipment.

The 5082-7392 is the same as the 5082-7391 except that the decimal point is located on the left-hand side of the digit.

The 5082-7395 hexadecimal indicator decodes positive 8421 logic inputs into 16 states, 0-9 and A-F. In place of the decimal point an input is provided for blanking the display (all LED's off), without losing the contents of the memory. Applications include terminals and computer systems using the base-16 character set.

The 5082-7393 is a "±1." overrange display, including a right hand decimal point.

Package Dimensions



PIN	FUNCTION: 5082-7391 AND 7392 NUMERIC	FUNCTION: 5082-7395 HEXA-DECIMAL
1	Input 2	Input 2
2	Input 4	Input 4
3	Input 8	Input 8
4	Decimal point	Blanking control
5	Latch enable	Latch enable
6	Ground	Ground
7	V_{CC}	V_{CC}
8	Input 1	Input 1

NOTES:
1. Dimensions in millimetres and (inches).
2. Unless otherwise specified, the tolerance on all dimensions is ±.38mm (±.015")
3. Digit center line is ±.25mm (±.01") from package center line.
4. Lead material is gold plated copper alloy.

Absolute Maximum Ratings

Description	Symbol	Min.	Max.	Unit
Storage temperature, ambient	T_S	−65	+125	°C
Operating temperature, ambient [1,2]	T_A	−55	+100	°C
Supply voltage [3]	V_{CC}	−0.5	+7.0	V
Voltage applied to input logic, dp and enable pins	V_I, V_{DP}, V_E	−0.5	+7.0	V
Voltage applied to blanking input [7]	V_B	−0.5	V_{CC}	V
Maximum solder temperature at 1.59mm (.062 inch) below seating plane; $t \leqslant 5$ seconds			260	°C

Recommended Operating Conditions

Description	Symbol	Min.	Nom.	Max.	Unit
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Operating temperature, ambient [1,2]	T_A	−55		+100	°C
Enable Pulse Width	t_W	100			nsec
Time data must be held before positive transition of enable line	t_{SETUP}	50			nsec
Time data must be held after positive transition of enable line	t_{HOLD}	50			nsec
Enable pulse rise time	t_{TLH}			200	nsec

Electrical/Optical Characteristics (T_A = −55° C to +100° C, unless otherwise specified)

Description	Symbol	Test Conditions	Min.	Typ. [4]	Max.	Unit
Supply Current	I_{CC}	V_{CC}=5.5V (Numeral		112	170	mA
Power dissipation	P_T	5 and dp lighted)		560	935	mW
Luminous intensity per LED (Digit average) [5,6]	I_v	V_{CC}=5.0V, T_A=25° C	40	85		μcd
Logic low-level input voltage	V_{IL}	V_{CC}=4.5V			0.8	V
Logic high-level input voltage	V_{IH}		2.0			V
Enable low-voltage; data being entered	V_{EL}				0.8	V
Enable high-voltage; data not being entered	V_{EH}		2.0			V
Blanking low-voltage; display not blanked [7]	V_{BL}				0.8	V
Blanking high-voltage; display blanked [7]	V_{BH}		3.5			V
Blanking low-level input current [7]	I_{BL}	V_{CC}=5.5V, V_{BL}=0.8V			50	μA
Blanking high-level input current [7]	I_{BH}	V_{CC}=5.5V, V_{BH}=4.5V			1.0	mA
Logic low-level input current	I_{IL}	V_{CC}=5.5V, V_{IL}=0.4V			−1.6	mA
Logic high-level input current	I_{IH}	V_{CC}=5.5V, V_{IH}=2.4V			+100	μA
Enable low-level input current	I_{EL}	V_{CC}=5.5V, V_{EL}=0.4V			−1.6	mA
Enable high-level input current	I_{EH}	V_{CC}=5.5V, V_{EH}=2.4V			+130	μA
Peak wavelength	λ_{PEAK}	T_A=25° C		655		nm
Dominant Wavelength [8]	λ_d	T_A=25° C		640		nm
Weight				1.0		gm
Leak Rate					5×10^{-7}	cc/sec

Notes: 1. Nominal thermal resistance of a display mounted in a socket which is soldered into a printed circuit board: Θ_{JA}=50° C/W; Θ_{JC}=15° C/W. 2. Θ_{CA} of a mounted display should not exceed 35° C/W for operation up to T_A=+100° C. 3. Voltage values are with respect to device ground, pin 6. 4. All typical values at V_{CC}=5.0 Volts, T_A=25° C. 5. These displays are categorized for luminous intensity with the intensity category designated by a letter located on the back of the display contiguous with the Hewlett-Packard logo marking. 6. The luminous intensity at a specific ambient temperature, $I_V(T_A)$, may be calculated from this relationship: $I_V(T_A) = I_{V(25°C)}(.985)^{[T_A - 25°C]}$ 7. Applies only to 7395. 8. The dominant wavelength, λ_d, is derived from the CIE chromaticity diagram and represents the single wavelength which defines the color of the device.

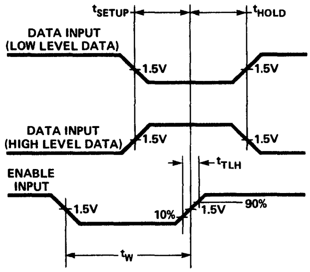


Figure 1. Timing Diagram of 5082-7390 Series Logic.

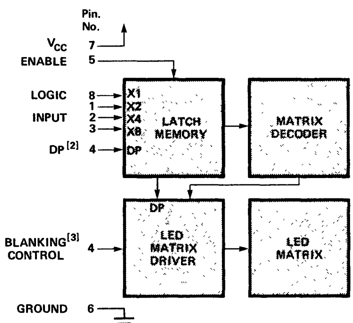


Figure 2. Block Diagram of 5082-7390 Series Logic.

TRUTH TABLE					
BCD DATA[1]				5082-7391/7392	5082-7395
X_8	X_4	X_2	X_1		
L	L	L	L	0	0
L	L	L	H	1	1
L	L	H	L	2	2
L	L	H	H	3	3
L	H	L	L	4	4
L	H	L	H	5	5
L	H	H	L	6	6
L	H	H	H	7	7
H	L	L	L	8	8
H	L	L	H	9	9
H	L	H	L	H	A
H	L	H	H	(BLANK)	B
H	H	L	L	(BLANK)	C
H	H	L	H	–	D
H	H	H	L	(BLANK)	E
H	H	H	H	(BLANK)	F
DECIMAL PT.[2]		ON			V_{DP} = L
		OFF			V_{DP} = H
ENABLE[1]		LOAD DATA			V_E = L
		LATCH DATA			V_E = H
BLANKING[3]		DISPLAY-ON			V_B = L
		DISPLAY-OFF			V_B = H

Notes:

1. H = Logic High; L = Logic Low. With the enable input at logic high changes in BCD input logic levels have no effect upon display memory or displayed character.
2. The decimal point input, DP, pertains only to the 5082-7391 and 5082-7392 displays.
3. The blanking control input, B, pertains only to the 5082-7395 hexadecimal display. Blanking input has no effect upon display memory.

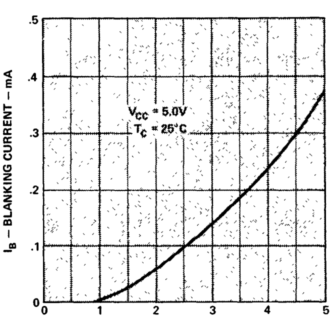


Figure 3. Typical Blanking Control Current vs. Voltage for 5082-7395.

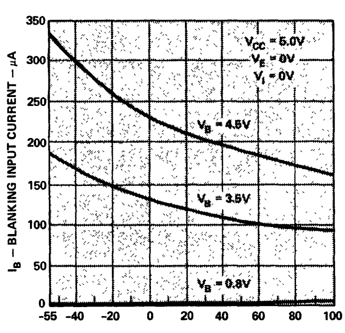


Figure 4. Typical Blanking Control Input Current vs. Ambient Temperature for 5082-7395.

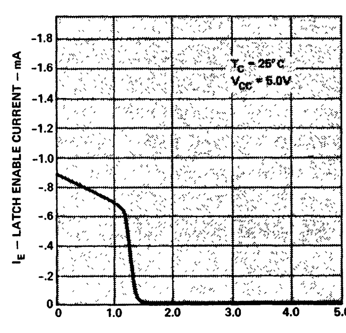


Figure 5. Typical Latch Enable Input Current vs. Voltage.

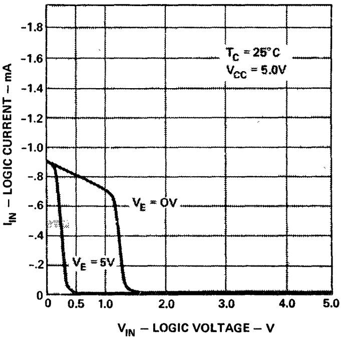


Figure 6. Typical Logic and Decimal Point Input Current vs. Voltage.

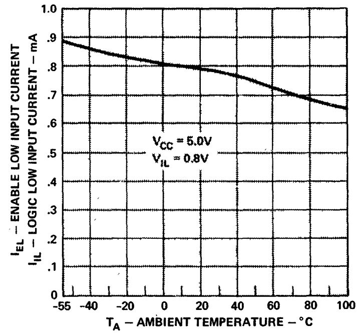


Figure 7. Typical Logic and Enable Low Input Current vs. Ambient Temperature.

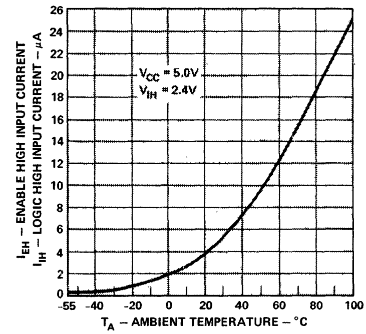


Figure 8. Typical Logic and Enable High Input Current vs. Ambient Temperature.

Operational Considerations

ELECTRICAL

The 5082-7390 series devices use a modified 4 x 7 dot matrix of light emitting diodes (LED's) to display decimal/hexadecimal numeric information. The LED's are driven by constant current drivers. BCD information is accepted by the display memory when the enable line is at logic low and the data is latched when the enable is at logic high. To avoid the latching of erroneous information, the enable pulse rise time should not exceed 200 nanoseconds. Using the enable pulse width and data setup and hold times listed in the Recommended Operating Conditions allows data to be clocked into an array of displays at a 6.7MHz rate.

The blanking control input on the 5082-7395 display blanks (turns off) the displayed hexadecimal information without disturbing the contents of display memory. The display is blanked at a minimum threshold level of 3.5 volts. This may be easily achieved by using an open collector TTL gate and a pull-up resistor. For example, (1/6) 7416 hexinverter buffer/driver and a 120 ohm pull-up resistor will provide sufficient drive to blank eight displays. The size of the blanking pull-up resistor may be calculated from the following formula, where N is the number of digits:

$$R_{blank} = (V_{CC} - 3.5V)/[N\ (1.0mA)]$$

The decimal point input is active low true and this data is latched into the display memory in the same fashion as is the BCD data. The decimal point LED is driven by the on-board IC.

MECHANICAL

5082-7390 series displays are hermetically tested for use in environments which require a high reliability device. These displays are designed and tested to meet a helium leak rate of 5 x 10^{-7} cc/sec and a standard dye penetrant gross leak test.

These displays may be mounted by soldering directly to a printed circuit board or inserted into a socket. The lead-to-lead pin spacing is 2.54mm (0.100 inch) and the lead row spacing is 15.24mm (0.600 inch). These displays may be end stacked with 2.54mm (0.100 inch) spacing between outside pins of adjacent displays. Sockets such as Augat 324-AG2D (3 digits) or Augat 508-AG8D (one digit, right angle mounting) may be used.

The primary thermal path for power dissipation is through the device leads. Therefore, to insure reliable operation up to an ambient temperature of +100°C, it is important to maintain a case-to-ambient thermal resistance of less than 35°C/watt as measured on top of display pin 3.

Post solder cleaning may be accomplished using water, Freon/alcohol mixtures formulated for vapor cleaning processing (up to 2 minutes in vapors at boiling) or Freon/alcohol mixtures formulated for room temperature cleaning. Suggested solvents: Freon TF, Freon TE, Genesolv DI-15, Genesolv DE-15.

PRECONDITIONING

5082-7390 series displays are 100% preconditioned by 24 hour storage at 125°C.

CONTRAST ENHANCEMENT

The 5082-7390 displays have been designed to provide the maximum posible ON/OFF contrast when placed behind an appropriate contrast enhancement filter. Some suggested filters are Panelgraphic Ruby Red 60 and Dark Red 63, SGL Homalite H100-1605, 3M Light Control Film and Polaroid HRCP Red Circular Polarizing Filter. For further information see Hewlett-Packard Application Note 964.

High Reliability Test Program

Hewlett-Packard provides standard high reliability test programs, patterned after MIL-M-38510 in order to facilitate the use of HP products in military programs.

HP offers two levels of high reliability testing:

The TXV prefix identifies a part which has been preconditioned and screened per Table 1.

The TXVB prefix identifies a part which has been preconditioned and screened per Table 1, and comes from a lot which has been subjected to the Group B tests described in Table 2.

PART NUMBER SYSTEM

Standard Product	With TXV Screening	With TXV Screening Plus Group B
5082-7391	TXV-7391	TXVB-7391
5082-7392	TXV-7392	TXVB-7392
5082-7395	TXV-7395	TXVB-7395

Table 1. TXV Preconditioning and Screening — 100%.

Examination or Test	MIL-STD-883 Methods	Conditions
1. Internal Visual Inspection	HP Procedure 72-Q352	
2. Electrical Test: I_V, I_{CC}, I_{BL}, I_{BH}, I_{EL}, I_{EH}, I_{IL}, I_{IH}.		Per Electrical/Optical Characterstics.
3. High Temperature Storage	1008	125°C, 168 hours.
4. Temperature Cycling	1010	−65°C to +125°C, 10 cycles.
5. Acceleration	2001	2,000 G, Y_1 orientation.
6. Helium Leak Test	1014	Condition A, limit pressure to 25psi for 1 hour.
7. Gross Leak Test	1014	Condition D, 40psi for 1 hour.
8. Electrical Test: Same as Step 2		
9. Burn-in	1015	T_A=100°C, t=168 hours, at V_{CC}=5.0V and cycling through logic at 1 character per sec.
10. Electrical Test as in Step 2		
11. Sample Electrical Test Over Temperature: I_{CC}, I_{BL}, I_{BH}, I_{EL}, I_{EH}, I_{IL}, I_{IH}		Per Electrical Characteristics, T_A -55°C, +100°C, LTPD=7
12. External Visual	2009	

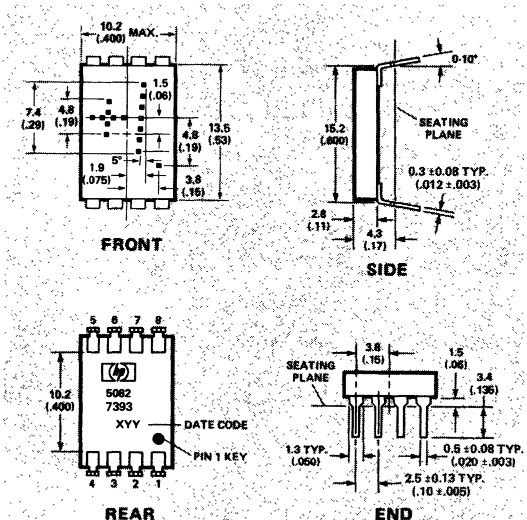
Table 2. Group B.

Examination or Test	MIL-STD-883 Method	MIL-STD-883 Condition	LTPD
Subgroup 1			20
Physical Dimensions	2008	Package Dimensions per Product Outline Drawing.	
Subgroup 2			15
Solderability	2003	Immersion within 0.062" of seating plane 260°C, t=5 sec., omit aging.	
Temperature Cycling	1010	10 cycles −65°C to +125°C	
Thermal Shock	1011	Test Condition A	
Hermetic Seal	1014	Condition A, limit pressure to 25psi for 1 hour, and Condition D, 40psi for 1 hour.	
Moisture Resistance	1004	Omit initial conditioning.	
End Points: Electrical Test		Same as Step 2, Table 1.	
Subgroup 3			15
Shock – Non-operating	2002	1500 G, t=0.5ms, 5 blows in each orientation X_1, Y_1, Y_2.	
Vibration Variable Frequency	2007	Non-operating.	
Constant Acceleration	2001	2,000 G, Y_1 orientation.	
End Points: Electrical Test		Same as Step 2, Table 1.	
Subgroup 4			15
Terminal Strength	2004	Test Condition B2.	
End Points: Hermetic Seal	1014	Condition A, limit pressure to 25psi for 1 hour, and Condition D, 40psi for 1 hour.	
Subgroup 5			15
Salt Atmosphere	1009	Test Condition A	
Subgroup 6			λ=7
High Temperature Life	1008	T_A= 125°C, non-operating, t=1000 hours.	
End Points: Electrical Test		Same as Step 2, Table 1.	
Subgroup 7			λ=5
Steady State Operating Life	1005	T_A=100°C, t=1000 hours, at V_{CC}=5.0V and cycling through logic at 1 character per second.	
End Points: Electrical Test		Same as Step 2, Table 1.	

Solid State Over Range Character

For display applications requiring a ±, 1, or decimal point designation, the 5082-7393 over range character is available.This display module comes in the same package as the 5082-7390 series numeric indicator and is completely compatible with it.

Package Dimensions



NOTES:
1. DIMENSIONS IN MILLIMETRES AND (INCHES).
2. UNLESS OTHERWISE SPECIFIED, THE TOLERANCE ON ALL DIMENSIONS IS ±.38 MM (± .015 INCHES).

PIN	FUNCTION
1	Plus
2	Numeral One
3	Numeral One
4	DP
5	Open
6	Open
7	V_{cc}
8	Minus/Plus

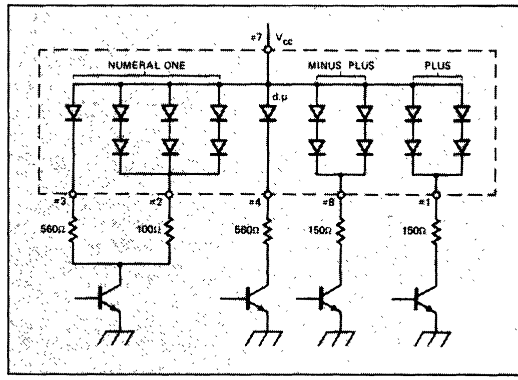


Figure 9. Typical Driving Circuit.

TRUTH TABLE

CHARACTER	PIN			
	1	2,3	4	8
+	H	X	X	H
–	L	X	X	H
1	X	H	X	X
Decimal Point	X	X	H	X
Blank	L	L	L	L

NOTES: L: Line switching transistor in Figure 9 cutoff.
H: Line switching transistor in Figure 9 saturated.
X: 'Don't care'

Electrical/Optical Characteristics

5082-7393 (T_A = –55°C to +100°C, Unless Otherwise Specified)

DESCRIPTION	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Forward Voltage per LED	V_F	I_F = 10 mA		1.6	2.0	V
Power dissipation	P_T	I_F = 10 mA all diodes lit		280	320	mW
Luminous Intensity per LED (digit average)	I_v	I_F = 6 mA T_C = 25°C	40	85		µcd
Peak wavelength	λ_{peak}	T_C = 25°C		655		nm
Dominant Wavelength	λ_d	T_C = 25°C		640		nm
Weight				1.0		gm

Recommended Operating Conditions

	SYMBOL	MIN	NOM	MAX	UNIT
LED supply voltage	V_{CC}	4.5	5.0	5.5	V
Forward current, each LED	I_F		5.0	10	mA

NOTE:
LED current must be externally limited. Refer to Figure 9 for recommended resistor values.

Absolute Maximum Ratings

DESCRIPTION	SYMBOL	MIN.	MAX.	UNIT
Storage temperature, ambient	T_S	-65	+125	°C
Operating temperature, ambient	T_A	-55	+100	°C
Forward current, each LED	I_F		10	mA
Reverse voltage, each LED	V_R		4	V

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COMPONENTS

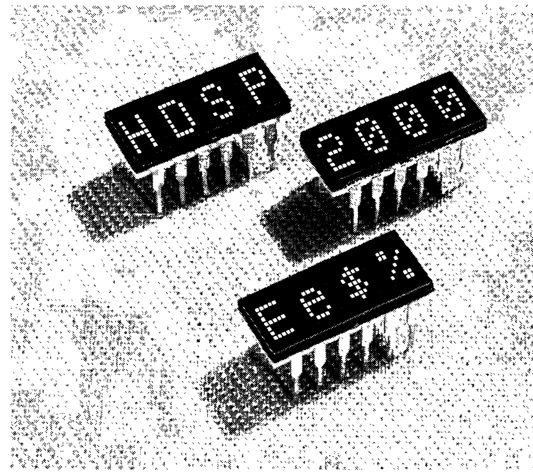
FOUR CHARACTER SOLID STATE ALPHANUMERIC DISPLAY

HDSP-2000

TECHNICAL DATA APRIL 1977

Features

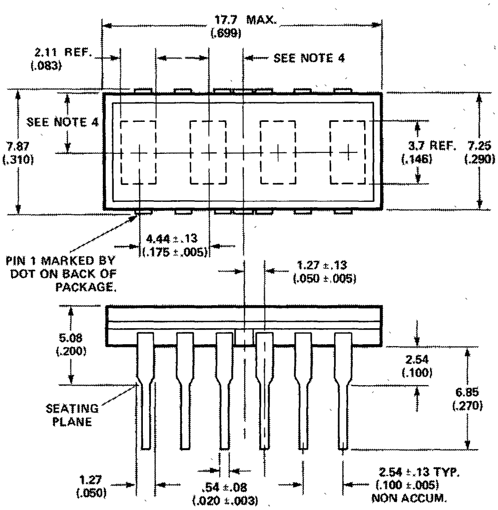
- **INTEGRATED SHIFT REGISTERS WITH CONSTANT CURRENT DRIVERS**
- **CERAMIC 7.62 mm (.3 in.) DIP**
  Integral Red Glass Contrast Filter
- **WIDE VIEWING ANGLE**
- **END STACKABLE 4 CHARACTER PACKAGE**
- **PIN ECONOMY**
  12 Pins for 4 Characters
- **TTL COMPATIBLE**
- **5x7 LED MATRIX DISPLAYS FULL ASCII CODE**
- **RUGGED, LONG OPERATING LIFE**
- **CATEGORIZED FOR LUMINOUS INTENSITY**
  Assures Ease of Package to Package Brightness Matching

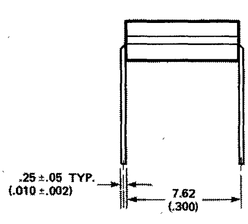


Description

The HP HDSP-2000 display is a 3.8mm (0.15 inch) 5x7 LED array for display of alphanumeric information. The device is available in 4 character clusters and is packaged in a 12-pin dual-in-line type package. An on-board SIPO (serial-in-parallel-out) 7 bit shift register associated with each digit controls constant current LED row drivers. Full character display is achieved by external column strobing. The constant current LED drivers are externally programmable and typically capable of sinking 13.5mA peak per diode. Applications include interactive I/O terminals, point of sale equipment, portable telecommunications gear, and hand held equipment requiring alphanumeric displays.

Package Dimensions





PIN	FUNCTION	PIN	FUNCTION
1	COLUMN 1	7	DATA OUT
2	COLUMN 2	8	V_B
3	COLUMN 3	9	V_{CC}
4	COLUMN 4	10	CLOCK
5	COLUMN 5	11	GROUND
6	INT. CONNECT*	12	DATA IN

*DO NOT CONNECT OR USE

NOTES:
1. DIMENSIONS IN mm (inches).
2. UNLESS OTHERWISE SPECIFIED THE TOLERANCE ON ALL DIMENSIONS IS ±.38 mm (±.015")
3. LEAD MATERIAL IS GOLD PLATED COPPER ALLOY.
4. CHARACTERS ARE CENTERED WITH RESPECT TO LEADS WITHIN ±.13mm (±.005").

Absolute Maximum Ratings

Supply Voltage V_{CC} to Ground .... −0.5V to 6.0V
Inputs, Data Out and V_B .... −0.5V to V_{CC}
Column Input Voltage, V_{COL} .... −0.5V to +6.0V
Free Air Operating Temperature Range, T_A[2] .... −20°C to +70°C
Storage Temperature Range, T_S ..... -55°C to +100°C
Maximum Allowable Package Dissipation at T_A = 25°C[1,2,6] .... 1.70 Watts
Maximum Solder Temperature 1.59mm (.063") Below Seating Plane t<5 secs .... 260°C

Recommended Operating Conditions

Parameter	Symbol	Min.	Nom.	Max.	Units
Supply Voltage	V_{CC}	4.75	5.0	5.25	V
Data Out Current, Low State	I_{OL}			1.6	mA
Data Out Current, HighState	I_{OH}			−0.5	mA
Brightness Input Voltage, I_{COL} Min.	V_B	0		0.4	V
Brightness Input Voltage, I_{COL} Max.	V_B	2.0		V_{CC}	V
Column Input Voltage, Column On	V_{COL}	3.0		V_{CC}	V
Setup Time	t_{setup}	200	100		ns
Hold Time	t_{hold}	30	0		ns
Width of Clock	$t_{w(Clock)}$	75			ns
Clock Frequency	f_{clock}	0		1.5	MHz
Clock Transition Time	t_{THL}			200	ns
Free Air Operating Temperature Range	T_A	−20		70	°C

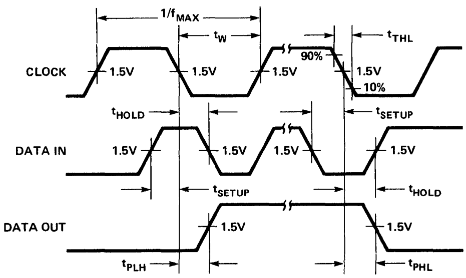
Electrical Characteristics Over Operating Temperature Range

(Unless otherwise specified.)

Description		Symbol	Test Conditions		Min.	Typ.*	Max.	Units
Supply Current		I_{CC}	V_{CC} = 5.25V, V_{CLOCK} = V_{DATA} = 2.4V, All SR Stages = Logical 1	V_B = 0V		44	55	mA
				V_B = 5.25V		70	90	mA
Brightness Input Current		I_B	V_{CC} = V_{COL} = 5.25V, V_B = 0.4V			−0.3	−1.0	mA
Column Current at any Column Input		I_{COL}	All SR Stages = Logical 1			10	30	mA
Brightness Input Current		I_B	V_{CC} = V_B = V_{COL} = 5.25V			10	40	μA
Column Current at any Column Input		I_{COL}	All SR Stages = Logical 1			350	435	mA
Peak Luminous Intensity per LED[3] (Character Average)		I_{vPEAK}	V_{CC} = V_B = 5.0V, V_{COL} = 3.5V, T_i = 25°C[4]		105	200		μcd
Clock or Data Input Threshold High		V_{IH}	V_{CC} = V_B = V_{COL} = 4.75V		2.0			V
Clock or Data Input Threshold Low		V_{IL}					0.8	V
Input Current Logical 1	Clock	I_{IH}	V_{CC} = 5.25V, V_{IH} = 2.4V			20	80	μA
	Data In	I_{IH}				10	40	μA
Input Current Logical 0	Clock	I_{IL}	V_{CC} = 5.25V, V_{IL} = 0.4V			−0.5	−1.90	mA
	Data In	I_{IL}				−0.25	−0.95	mA
Data Out Voltage (with 4 characters illuminated)		V_{OH}	V_{CC} = 4.75V, I_{OH} = −0.5mA, V_{COL} = 0V		2.4	3.4		V
		V_{OL}	V_{CC} = 4.75V, I_{OL} = 1.6mA, V_{COL} = 0V			0.2	0.6	V
Power Dissipation Per Package		P_D	V_{CC} = V_B = 5.25V, V_{COL} = 3.0V, 15 LEDs on per character			0.73		W
Peak Wavelength		λ_{PEAK}				655		nm
Dominant Wavelength[5]		λ_d				639		nm

*All typical values specified at V_{CC} = 5.0V and T_A = 25°C unless otherwise noted.

NOTES:
1. Maximum absolute dissipation is with the device in a socket having a thermal resistance from pins to ambient of 35°C/watt.
2. The device should be derated linearly above 25°C at 16mW/°C (see Electrical Description on page 3).
3. The characters are categorized for Luminous Intensity with the intensity category designated by a letter code on the bottom of the package.
4. T_i refers to the initial case temperature of the device immediately prior to the light measurement.
5. Dominant wavelength λ_d, is derived from the CIE chromaticity diagram, and represents the single wavelength which defines the color of the device.
6. Maximum allowable dissipation is derived from V_{CC} = V_B = V_{COL} = 5.25 Volts, 20 LEDs on per character.



Parameter	Condition	Min.	Typ.	Max.	Units
f_{max} Max. CLOCK Rate		1.5			MHz
t_{PLH}, t_{PHL} Propagation delay CLOCK to DATA OUT	$C_L = 15pF$ $R_L = 1.2k\Omega$			400	ns

Figure 1. Switching Characteristics. (V_{CC} = 5V, T_A = -20°C to +70°C)

Mechanical and Thermal Considerations

The HDSP-2000 is available in a standard 12 lead ceramic-glass dual in-line package. It is designed for plugging into DIP sockets or soldering into PC boards. The packages may be horizontally or vertically stacked for character arrays of any desired size.

The -2000 can be operated over a wide range of temperature and supply voltages. Full power operation at T_A = 25°C ($V_{CC} = V_B = V_{COL}$ = 5.25V) is possible by providing a total thermal resistance from the seating plane of the pins to ambient of 35°C/W/cluster maximum. For operation above T_A = 25°C, the maximum device dissipation should be derated above 25°C at 16mW/°C (see Figure 2). Power derating can be achieved by either decreasing V_{COL} or decreasing the average drive current through pulse width modulation of V_B.

The -2000 display has an integral contrast enhancement filter in the glass lens. Additional front panel contrast filters may by desirable in most actual display applications. Some suggested filters are Panelgraphic Ruby Red 60, SGL Homalite H100-1605 and Plexiglass 2423. Hewlett-Packard Application Note 964 treats this subject in greater detail.

Post solder cleaning may be accomplished using water, Freon/alcohol mixtures formulated for vapor cleaning processing (up to 2 minutes in vapors at boiling) or Freon/alcohol mixtures formulated for room temperature cleaning. Suggested solvents: Freon TF, Freon TE, Genesolv DI-15, Genesolv DE-15.

Electrical Description

The HDSP-2000 four character alphanumeric display has been designed to allow the user maximum flexibility in interface electronics design. Each four character display module features Data In and Data Out terminals arrayed for easy PC board interconnection such that display strings of up to 80 digits may be driven from a single character generator. Data Out represents the output of the 7th bit of digit number 4 shift register. Shift register clocking occurs on the high to low transition of the Clock input. The like columns of each character in a display cluster are tied to a single pin. Figure 5 is the block diagram for the HDSP-2000. High true data in the shift register enables the output current mirror driver stage associated with each row of LEDs in the 5x7 diode array.

The reference current for the current mirror is generated from the output voltage of the V_B input buffer applied across the resistor R. The TTL compatible V_B input may either be tied to V_{CC} for maximum display intensity or pulse width modulated to achieve intensity control and reduction in power consumption.

The normal mode of operation is depicted in the block diagram of Figure 6. In this circuit, binary input data for digit 4, column 1 is decoded by the 7 line output ROM and then loaded into the 7 on board shift register locations 1 through 7 through a parallel-in-serial-out shift register. Column 1 data for digits 3, 2 and 1 is similarly decoded and shifted into the display shift register locations. The column 1 input is now enabled for an appropriate period of time, T. A similar process is repeated for columns 2, 3, 4 and 5. If the time necessary to decode and load data into the shift register is t, then with 5 columns, each column of the display is operating at a duty factor of:

$$D.F. = \frac{T}{5(t+T)}$$

The time frame, t + T, allotted to each column of the display is generally chosen to provide the maximum duty factor consistent with the minimum refresh rate necessary

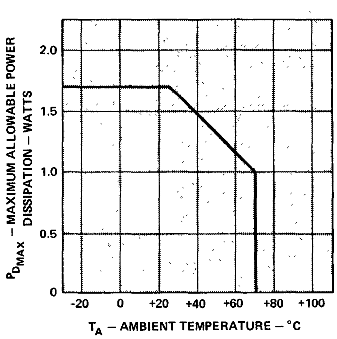


Figure 2. Maximum Allowable Power Dissipation vs. Temperature.

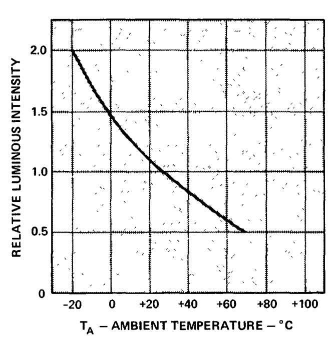


Figure 3. Relative Luminous Intensity vs. Temperature.

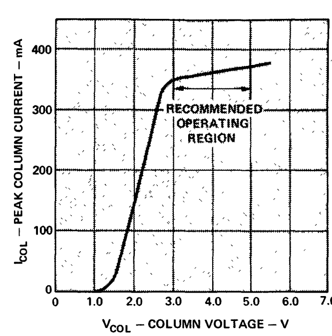


Figure 4. Peak Column Current vs. Column Voltage.

to achieve a flicker free display. For most strobed display systems, each column of the display should be refreshed (turned on) at a minimum rate of 100 times per second.

With 5 columns to be addressed, this refresh rate then gives a value for the time t + T of:

$1/[5 \times (100)] = 2$ msec.

If the device is operated at 1.5 MHz clock rate maximum, it is possible to maintain $t \ll T$. For short display strings, the duty factor will then approach 20%. For longer display strings operation at column duty factors of less than 10% will still provide adequate display intensity in most applications. For further applications information, refer to HP Application Note 966.

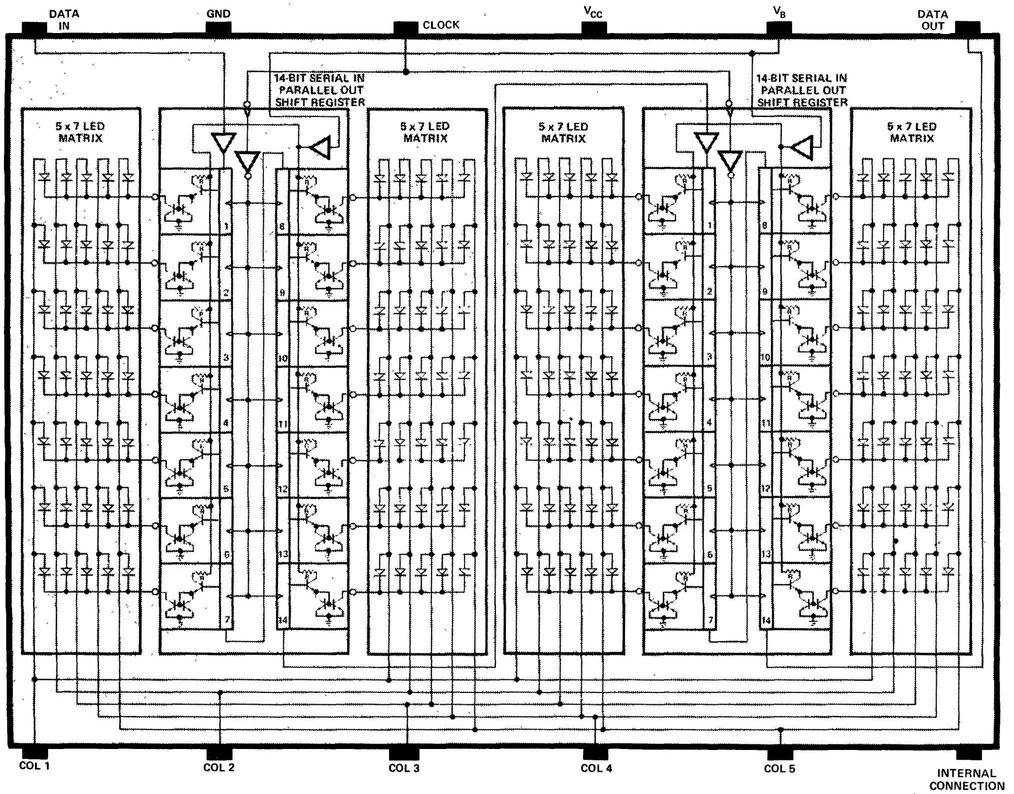


Figure 5. Block Diagram of the HDSP-2000.

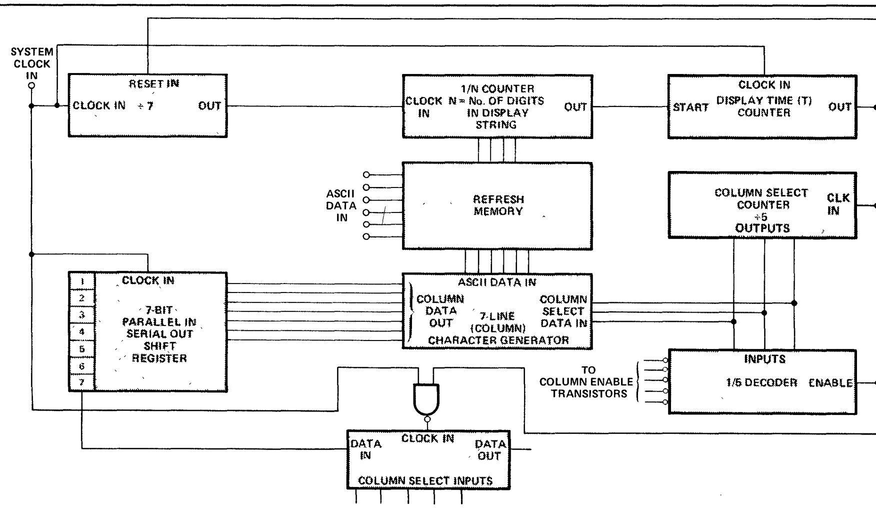


Figure 6. Block Diagram of a Basic Display System.

HEWLETT hp PACKARD
COMPONENTS

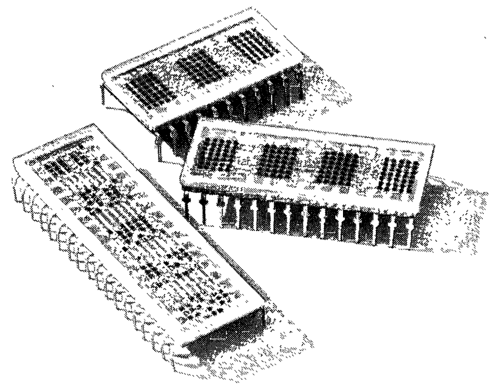
LED SOLID STATE ALPHANUMERIC INDICATOR

5082-7100
5082-7101
5082-7102

TECHNICAL DATA APRIL 1977

Features

- **5 x 7 LED MATRIX CHARACTER**
  Human Factors Engineered
- **BRIGHTNESS CONTROLLABLE**
- **IC COMPATIBLE**
- **SMALL SIZE**
  Standard 15.24mm (.600 inch) Dual In-Line Package; 6.9mm (.27 inch) Character Height
- **WIDE VIEWING ANGLE**
- **RUGGED, SHOCK RESISTANT**
  Hermetically Sealed
  Designed to Meet MIL Standards
- **LONG OPERATING LIFE**



Description

The Hewlett-Packard 5082-7100 Series is an X-Y addressable, 5 x 7 LED Matrix capable of displaying the full alphanumeric character set. This alphanumeric indicator series is available in 3, 4, or 5 character end-stackable clusters. The clusters permit compact presentation of information, ease of character alignment, minimum number of interconnections, and compatibility with multiplexing driving schemes.

Alphanumeric applications include computer terminals, calculators, military equipment and space flight readouts.

The **5082-7100** is a three character cluster.
The **5082-7101** is a four character cluster.
The **5082-7102** is a five character cluster.

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units
Peak Forward Current Per LED (Duration $<$ 1ms)	I_{PEAK}		100	mA
Average Current Per LED	I_{AVG}		10	mA
Power Dissipation Per Character (All diodes lit)[1]	P_D		700	mW
Operating Temperature, Case	T_C	−55	95	°C
Storage Temperature	T_S	−55	100	°C
Reverse Voltage Per LED	V_R		4	V

Note 1: At 25°C Case Temperature; derate 8.5mW/°C above 25°C.

Electrical / Optical Characteristics at T_C=25°C

Parameter	Symbol	Min.	Typ.	Max.	Units
Peak Luminous Intensity Per LED (Character Average) @ Pulse Current of 100mA/LED	$I_{v\,(PEAK)}$	1.0	2.2		mcd
Reverse Current Per LED @ V_R = 4V	I_R		10		μA
Peak Forward Voltage @ Pulse Current of 50mA/LED	V_F		1.7	2.0	V
Peak Wavelength	λ_{PEAK}		655		nm
Spectral Line Halfwidth	$\Delta\lambda_{1/2}$		30		nm
Rise and Fall Times [1]	t_r, t_f		10		ns

Note 1. Time for a 10% - 90% change of light intensity for step change in current.

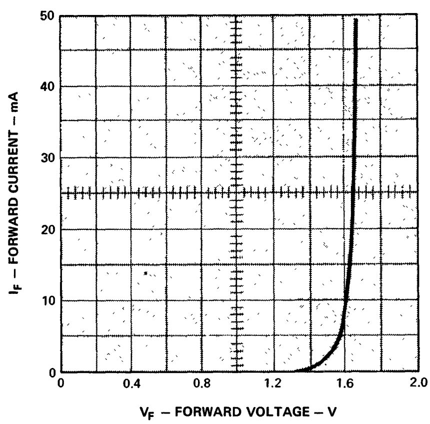


Figure 1. Forward Current-Voltage Characteristic.

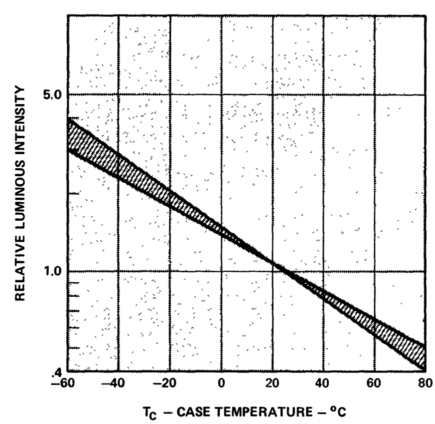


Figure 2. Relative Luminous Intensity vs. Case Temperature at Fixed Current Level.

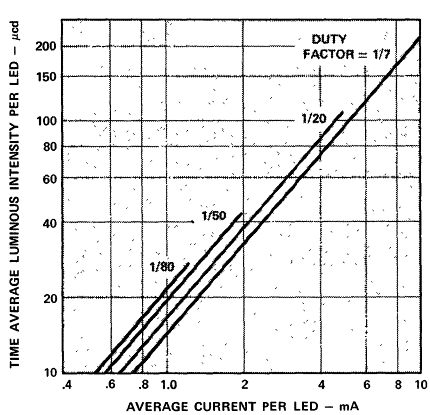


Figure 3. Typical Time Average Luminous Intensity per LED vs. Average Current per LED.

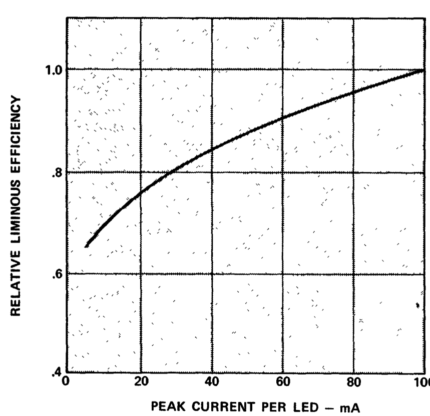
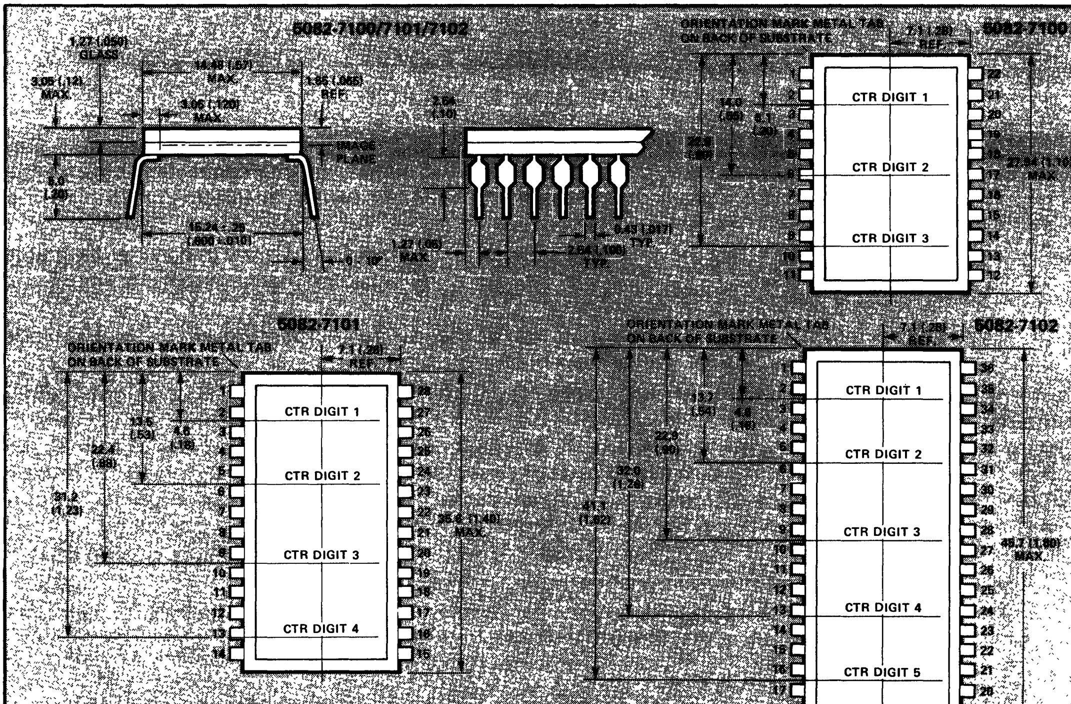


Figure 4. Typical Relative Luminous Efficiency vs. Peak Current per LED.

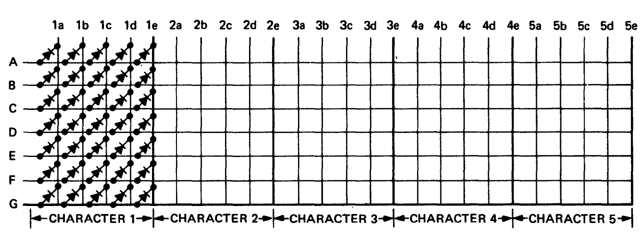
Package Dimensions and Pin Configurations



Notes: 1. Dimensions are in millimeters and (inches).
2. Unless otherwise specified, the tolerance on all dimensions is ±0.38mm (±.015 in.).
3. Character Size 6.9 x4.9mm (.27 x .19 in.)

Device Pin Description

5082-7100				5082-7101				5082-7102			
Pin	Function	Pin	Function	Pin	Function	Pin	Function	Pin	Function	Pin	Function
1	Anode G	12	Anode B	1	N/C	15	Anode C	1	N/C	19	5e
2	1c	13	3d	2	1c	16	4c	2	1c	20	5c
3	1d	14	3b	3	1e	17	4a	3	1e	21	5a
4	Anode F	15	Anode A	4	Anode G	18	Anode B	4	Anode F	22	Anode D
5	Anode E	16	2e	5	2b	19	3e	5	2b	23	4e
6	2b	17	2c	6	2d	20	3b	6	2d	24	4c
7	2d	18	2a	7	Anode D	21	3a	7	2e	25	N/C
8	Anode C	19	Anode D	8	Anode E	22	2e	8	Anode E	26	Anode C
9	3a	20	1e	9	3c	23	2c	9	3c	27	3d
10	3c	21	1b	10	3d	24	2a	10	3e	28	3b
11	3e	22	1a	11	Anode F	25	Anode A	11	Anode G	29	3a
				12	4b	26	1d	12	4a	30	Anode B
				13	4d	27	1b	13	4b	31	2c
				14	4e	28	1a	14	4d	32	2a
								15	N/C	33	Anode A
								16	5b	34	1d
								17	5d	35	1b
								18	N/C	36	1a



5082-7100/7101/7102
Schematic Wiring Diagram

Operating Considerations

ELECTRICAL

The 5 x 7 matrix of LED's, which make up each character, are X-Y addressable. This allows for a simple addressing, decoding and driving scheme between the display module and customer furnished logic.

There are three main advantages to the use of this type of X-Y addressable array:

1. It is an elementary addressing scheme and provides the least number of interconnection pins for the number of diodes addressed. Thus, it offers maximum flexibility toward integrating the display into particular applications.
2. This method of addressing offers the advantage of sharing the Read-Only-Memory character generator among several display elements. One character generating ROM can be shared over 25 or more 5 x 7 dot matrix characters with substantial cost savings.
3. In many cases equipments will already have a portion of the required decoder/driver (timing and clock circuitry plus buffer storage) logic circuitry available for the display.

To form alphanumeric characters a method called "scanning" or "strobing" is used. Information is addressed to the display by selecting one row of diodes at a time, energizing the appropriate diodes in that row and then proceeding to the next row. After all rows have been excited one at a time, the process is repeated. By scanning through all rows at least 100 times a second, a flicker free character can be produced. When information moves sequentially from row to row of the display (top to bottom) this is row scanning, as illustrated in Figure 5. Information can also be moved from column to column (left to right across the display) in a column scanning mode. For most applications (5 or more characters to share the same ROM) it is more economical to use row scanning.

A much more detailed description of general scanning techniques along with specific circuit recommendations is contained in HP Application Note 931.

MECHANICAL/THERMAL MOUNTING

The solid state display typically operates with 200mW power dissipation per character. However, if the operating conditions are such that the power dissipation exceeds the derated maximum allowable value, the device should be heat sunk. The usual mounting technique combines mechanical support and thermal heat sinking in a common structure. A metal strap or bar can be mounted behind the display using silicone grease to insure good thermal control. A well-designed heat sink can limit the case temperature to within 10°C of ambient.

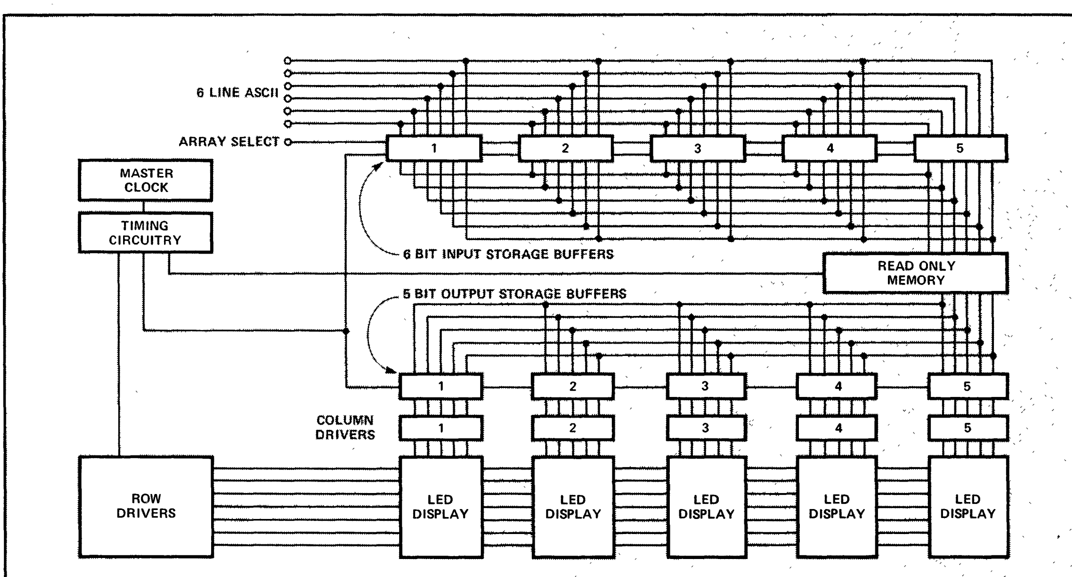


Figure 5. Row Scanning Block Diagram.

HEWLETT hp PACKARD
COMPONENTS

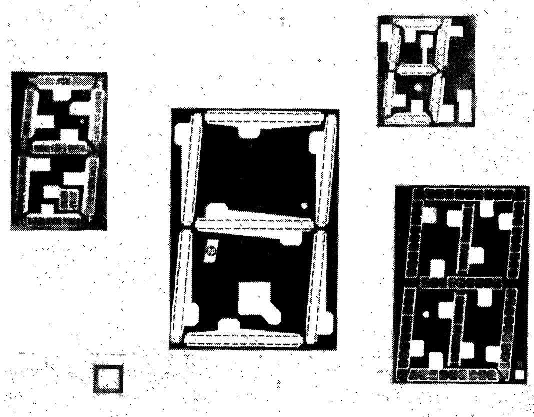
MONOLITHIC LED CHIPS

5082-7800 SERIES

TECHNICAL DATA APRIL 1977

Features

- **FOUR CHARACTER SIZES, COMMON CATHODE**
  53 mil, 80 mil, 100 mil, 120 mil.
- **DISCRETE AND MONOLITHIC COLON CHIPS**
- **AVERAGE LUMINOUS INTENSITY AND DISTRIBUTION SPECIFIED FOR EACH WAFER**
- **100% ELECTRICALLY TESTED AND VISUALLY INSPECTED**
- **LOW POWER**
  MOS Compatible
- **CONTINUOUS SEGMENTS**
  Excellent Aesthetic Appearance



Description

The HP 5082-7800 series are common cathode monolithic chips, specifically designed for hybrid applications. Chips are available in seven segment, nine segment and one digit fonts. Colons are available in discrete or monolithic form. All chips are made of GaAsP material and are suitable for die attach and wire bonding to appropriate substrates. Chips are 100% visually inspected to HP standard criteria.

Packaging

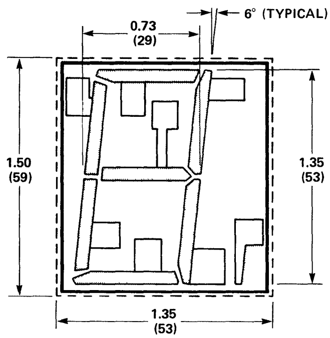
Hewlett Packard offers chips packaged on vinyl film or in waffle packages.

Device Selection Guide

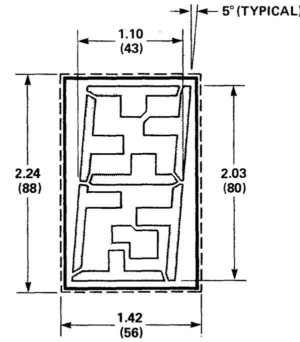
Character Height	Font	Chip Size	Tilt Angle Degrees	Stroke Width mm (mil)	Minimum Bonding Pad Size	Vinyl Film P/N 5082-	Waffle Pack P/N 5082-
1.35 mm (53 mil)	7 segment	1.50 x 1.35 mm (59 x 53 mil)	6 (Typical)	0.084 (3.3)	0.15 x 0.18 mm (6 x 7 mil)	7811	7821
2.03 mm (80 mil)	7 segment	2.24 x 1.42 mm (88 x 56 mil)	5 (Typical)	0.127 (5)	0.15 x 0.18 mm (6 x 7 mil)	7832	7842
2.54 mm (100 mil)	7 segment	2.72 x 1.91 mm (107 x 75 mil)	5	0.114 (4.5)	0.18 x 0.23 mm (7 x 9 mil)	7851	7861
2.54 mm (100 mil)	9 segment	2.72 x 1.91 mm (107 x 75 mil)	5	0.114 (4.5)	0.18 x 0.23 mm (7 x 9 mil)	7852	7862
2.54 mm (100 mil)	1 or colon	2.72 x 0.89 mm (107 x 35 mil)	5	0.114 (4.5)	0.18 x 0.23 mm (7 x 9 mil)	7853	7863
3.05 mm (120 mil)	7 segment	3.25 x 2.34 mm (128 x 92 mil)	5	0.102 (4)	0.20 x 0.30 mm (8 x 12 mil)	7871	7881
0.28 mm (011 mil) square	decimal point or colon	0.38 x 0.38 mm (15 x 15 mil)	—	—	0.12 mm (4.8 mil) diameter	7890*	7892*

*Standard packaging is a vial (P/N 5082-7893).

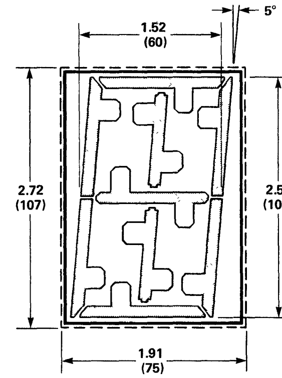
Device Dimensions



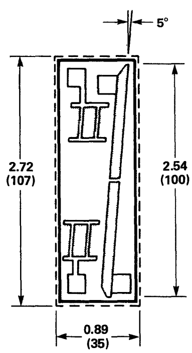
5082-7811/21



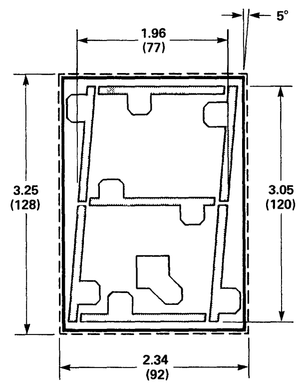
5082-7832/42



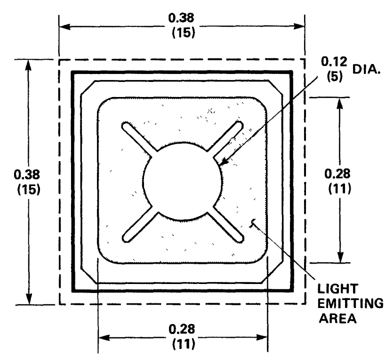
5082-7851/61, 5082-7852/62



5082-7853/63



5082-7871/81



5082-7890/93

All dimensions are in millimeters and (mils).
Detailed drawings of each chip are available upon request.

Absolute Maximum Ratings

Storage Temperature Range [1] .... −40°C to +125°C

Reverse Voltage [1] 5V

Assembly Temperature (Duration ⩽5 min.) .... 420°C

Operating Junction Temperature .... 125°C

Description	1.35 mm (53 mil)	2.03 mm (80 mil)	2.54 mm (100 mil)	3.05 (120 mil)	0.28 mm (11 mil)	Units
Peak Forward Current/Segment (pulse duration ⩽500 μsec.)	50	100	25	25	100	mA
Average Forward Current/Segment	5	5	6	6	10	mA
Wire Bonder Force	125	125	125	125	95	gm

Note 1. Rating applies to chip only.

Electrical/Optical Characteristics at $T_A = 25°C$

Common Specifications for All Devices

I_R, Reverse Current/Segment .... 100 μA max. at $V_R = 5V$

λ_{PEAK}, Peak Wavelength .... 655 nm (typical)

λ_d, Dominant Wavelength [1] .... 640 nm (typical)

Θ_{JC}, Chip Thermal Resistance (Junction to back contact)

11 mil and 53 mil .... 85°C/W

80 mil, 100 mil and 120 mil .... 45°C/W

Electrical/Optical Characteristics at $T_A = 25°C$

5082-7811/21 **1.35 mm (53 mil) Character Height**

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity/Segment (Digit Average)	50	70	——	μcd	I_F = 5mA DC	2
	Segment to Segment Intensity Ratio (Within Each Digit)	——	1.2:1	1.7:1		I_F = 5mA DC	
$\frac{\sigma}{\bar{I}_V}$ (2)	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	——	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V	I_F = 5mA DC	1

5082-7832/42 **2.03 mm (80 mil) Character Height**

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity/Segment (Digit Average)	80	150	——	μcd	I_F = 10mA DC	2
	Segment to Segment Intensity Ratio (Within Each Digit)	——	1.2:1	1.7:1		I_F = 10mA DC	
$\frac{\sigma}{\bar{I}_V}$ (2)	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	——	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V	I_F = 10mA DC	1

5082-7851/61, -7852/62, -7853/63 **2.54 mm (100 mil) Character Height**

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity/Segment (Digit Average)	60	85	——	μcd	I_F = 6mA DC	3
	Segment to Segment Intensity Ratio (Within Each Digit)	——	1.2:1	1.7:1		I_F = 6mA DC	
$\frac{\sigma}{\bar{I}_V}$ (2)	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	——	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V	I_F = 6mA DC	1

5082-7871/81 **3.05 mm (120 mil) Character Height**

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity/Segment (Digit Average)	60	85	——	μcd	I_F = 6mA DC	3
	Segment to Segment Intensity Ratio (Within Each Digit)	——	1.2:1	1.7:1		I_F = 6mA DC	
$\frac{\sigma}{\bar{I}_V}$ (2)	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	——	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V	I_F = 6mA DC	1

5082-7890/92/93 **0.28 mm (11 mil) Square**

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity (Wafer Average)	45	80	140	μcd	I_F = 6mA	3
$\frac{\sigma}{\bar{I}_V}$ (2)	Luminous Intensity Normalized Standard Deviation	——	0.10	0.15			
V_F	Forward Voltage	1.4	1.6	1.8	V	I_F = 6mA	1

Notes: 1. Dominant wavelength, λ_d, is derived from the C.I.E. chromaticity diagram and represents that single wavelength which defines the color of the device.
2. $\bar{I}_V$ is the mean value and σ is the standard deviation of the wafer luminous intensity.

Typical Characteristic Curves

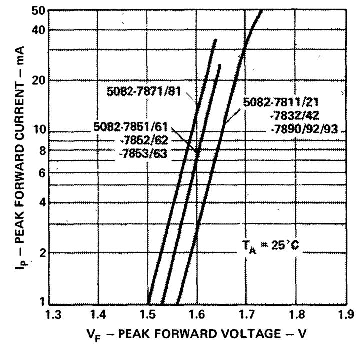


Figure 1. Peak Forward Current vs. Peak Forward Voltage.

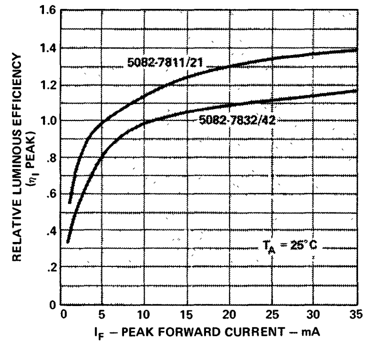


Figure 2. Relative Luminous Efficiency (Luminous Intensity per Unit Current) vs. Peak Current per Segment.

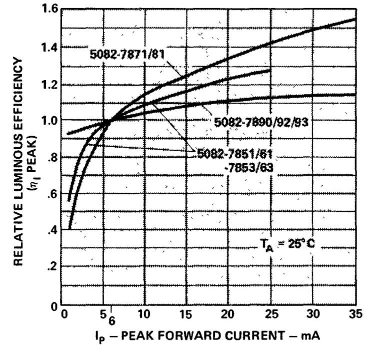


Figure 3. Relative Luminous Efficiency (Luminous Intensity per Unit Current) vs. Peak Current per Segment.

Strobing Considerations

The time average luminous intensity at $T_A = 25^\circ C$ may be calculated for any specific drive condition from the following formula:

$$I_V \text{ time avg} = \left[\frac{I_{avg}}{I_{DC\ spec}}\right]\left[\eta_{I\ PEAK}\right]\left[I_{V\ spec}\right]$$

Where: I_{avg} = average operating current

$I_{DC\ spec}$ = data sheet current at which $I_{V\ spec}$ is measured

$I_{V\ spec}$ = data sheet luminous intensity at $I_{DC\ spec}$

$\eta_{I\ PEAK}$ = relative luminous efficiency at peak operating current (See Figures 2 and 3).

The luminous intensity at any chip operating temperature may be calculated using the following formula:

$$I_V(T_A) = I_V(25^\circ C)\exp\left[(-0.0188/^\circ C)(T_A - 25^\circ C)\right]$$

Assembly Information

The cathode metallization (chip back contact) is a gold/germanium alloy and the anode bonding pads are aluminum. Conductive silver epoxy for die attach is preferred. If eutectic die attach is used, gold/germanium preforms are recommended. Gold wire of .025 mm (1 mil) or .038 mm (1.5 mil) diameter should be used for lead bonding. The .025 mm diameter wire is recommended for the .28 mm (11 mil) decimal point die. The substrate temperature should be in the range of 275-330° C and the bonder capillary temperature should be set between 100° C and 350° C. Ultrasonic wire bonding may be used also.

For more detailed assembly information, refer to Hewlett-Packard Application Bulletin No. 8.

Visual Inspection

All chips are 100% visually inspected to HP specification. A copy of the visual inspection specification is available on request. Also available is a visual training manual.

Recommended Incoming Inspection Procedures

Hewlett-Packard guarantees all visual parameters. Customers should perform incoming inspection to the same levels. It is important that these chips be handled carefully. Excessive or rough handling of chips can cause scratched or broken units. All shipments must be accepted or rejected on a lot basis. Samples should be selected and tested for the visual specifications to the recommended AQL level. Before a lot will be authorized for return, the inspected units should be returned to Hewlett-Packard for our verification. Returns cannot be accepted after the entire lot has been removed from its shipping container. Returns must be made in the original shipping container.

HEWLETT PACKARD
COMPONENTS

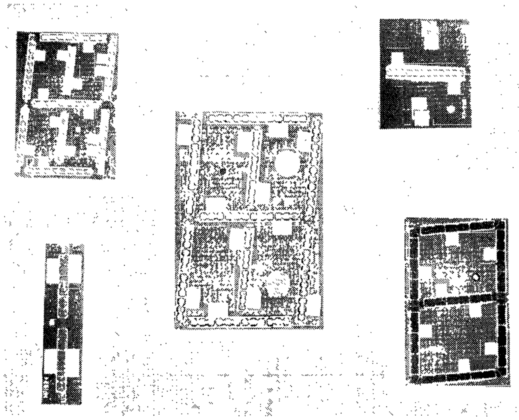
MONOLITHIC LED CHIPS

5082-7833/43
5082-7837/47
5082-7838/48
5082-7856/66
5082-7872/82

TECHNICAL DATA APRIL 1977

Features

- **THREE CHARACTER SIZES, COMMON CATHODE**
  80 mil, 88 mil, 120 mil
- **MONOLITHIC DASH AND COLON CHIP**
- **AVERAGE LUMINOUS INTENSITY AND DISTRIBUTION SPECIFIED FOR EACH WAFER**
- **100% ELECTRICALLY TESTED AND VISUALLY INSPECTED**
- **LOW POWER**
  MOS Compatible
- **CONTINUOUS SEGMENTS**
  Excellent Aesthetic Appearance



Description

The HP 5082-7800 series are common cathode monolithic chips, specifically designed for hybrid applications. Chips are available in seven segment, nine segment, "one" digit and dash colon fonts.

All chips are made of GaAsP material and are suitable for die attach and wire bonding to appropriate substrates. Chips are 100% visually inspected to HP standard criteria.

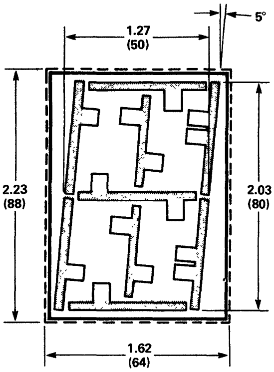
Packaging

Hewlett-Packard offers chips packaged on vinyl film or in waffle packages.

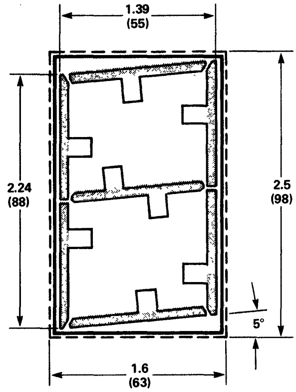
Device Selection Guide

Character Height	Font	Chip Size	Tilt Angle Degrees	Stroke Width mm (mil)	Minimum Bonding Pad Size	Vinyl Film P/N 5082-	Waffle Pack P/M 5082-
Dash Colon		1.70 x 1.45 mm (67 x 57 mil)	5	0.088 (3.5)	0.18 x 0.18 mm (7 x 7 mil)	7856	7866
2.03 mm (80 mil)	9 segment	2.24 x 1.62 mm (88 x 64 mil)	5	0.127 (5)	0.15 x 0.18 mm (6 x 7 mil)	7833	7843
2.24 mm (88 mil)	7 segment	2.5 x 1.6 mm (98 x 63 mil)	5	0.076 (3)	0.18 x 0.18 mm (7 x 7 mil)	7837	7847
2.24 mm (88 mil)	2 segment "ONE"	2.36 x 0.64 mm (93 x 25 mil)	—	0.076 (3)	0.18 x 0.18 mm (7 x 7 mil)	7838	7848
3.05 mm (120 mil)	9 segment	3.25 x 2.34 mm (128 x 92 mil)	5	0.102 (4)	0.20 x 0.30 mm (8 x 12 mil)	7872	7882

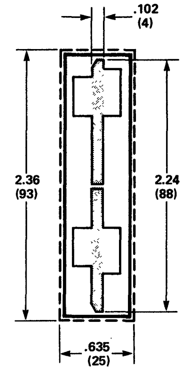
Device Dimensions



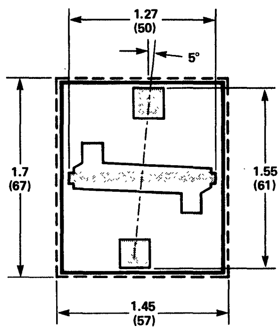
5082-7833/43



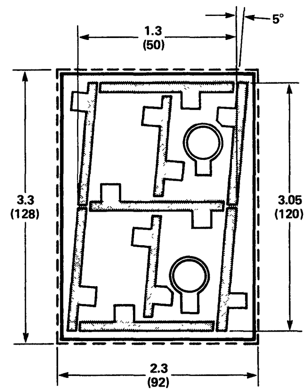
5082-7837/47



5082-7838/48



5082-7856/66



5082-7872/82

All dimensions are in millimeters and (mils).
Detailed drawings of each chip are available upon request.

Absolute Maximum Ratings

Storage Temperature Range[1] .... −40° C to +125° C
Reverse Voltage 5V
Assembly Temperature (Duration ≤ 5 min.) .... 420° C
Operating Junction Temperature .... 125° C

Description	Dash Colon	2.03 mm (80 mil)	2.24 mm (88 mil)	3.05 mm (120 mil)	Units
Peak Forward Current/Segment (pulse duration ≤ 500 μsec.)	25	25	25	25	mA
Average Forward Current/Segment	10	10	10	10	mA
Wire Bonder Force (Thermo-compression)	125	125	125	125	gm

Note 1. Rating applies to chip only.

Electrical/Optical Characteristics at $T_A = 25°C$

Common Specifications for All Devices

I_R, Reverse Current/Segment .... 100 μA max. at $V_R = 5$ V
λ_{PEAK}, Peak Wavelength .... 655 nm (typical)
λ_d, Dominant Wavelength[1] .... 640 nm (typical)
Θ_{JC}, Chip Thermal Resistance (Junction to back contact) .... 45° C/W

Electrical/Optical Characteristics at T_A=25°C

5082-7856/66 **Dash — Colon Chip**

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity/Segment (Digit Average)	60	85	–	μcd	I_F = 6 mA DC	2
	Segment to Segment Intensity Ratio (Within Each Digit)	–	1.2:1	1.7:1			
$\frac{\sigma^{(2)}}{\bar{I}_V}$	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	–	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V		1

5082-7833/43 **2.03 mm (80 mil) Character Height**

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity/Segment (Digit Average)	60	85	–	μcd	I_F = 6 mA DC	2
	Segment to Segment Intensity Ratio (Within Each Digit)	–	1.2:1	1.7:1			
$\frac{\sigma^{(2)}}{\bar{I}_V}$	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	–	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V		1

5082-7837/47, -7838/48 **2.24 mm (88 mil) Character Height**

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity/Segment (Digit Average)	60	85	–	μcd	I_F = 6 mA DC	2
	Segment to Segment Intensity Ratio (Within Each Digit)	–	1.2:1	1.7:1			
$\frac{\sigma^{(2)}}{\bar{I}_V}$	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	–	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V		1

5082-7872/82 **3.05 mm (120 mil) Character Height**

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_V	Luminous Intensity/Segment (Digit Average)	60	85	–	μcd	I_F = 6 mA DC	2
	Segment to Segment Intensity Ratio (Within Each Digit)	–	1.2:1	1.7:1			
$\frac{\sigma^{(2)}}{\bar{I}_V}$	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	–	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V		1

Notes: 1. Dominant wavelength, λ_d, is derived from the C.I.E. chromaticity diagram and represents that single wavelength which defines the color of the device.
2. $\bar{I}_V$ is the mean value and σ is the standard deviation of the wafer luminous intensity.

Typical Characteristic Curves

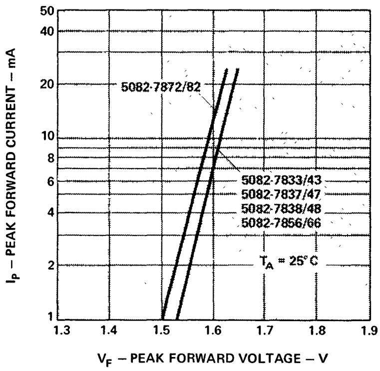


Figure 1. Peak Forward Current vs. Peak Forward Voltage.

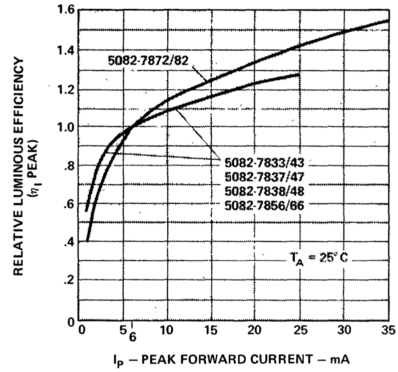


Figure 2. Relative Luminous Efficiency (Luminous Intensity per Unit Current) vs. Peak Current per Segment.

Strobing Considerations

The time average luminous intensity at $T_A = 25°C$ may be calculated for any specific drive condition from the following formula:

$$I_V \text{ time avg} = \left[\frac{I_{avg}}{I_{DC\ spec}}\right]\left[\eta_{I\ PEAK}\right]\left[I_{V\ spec}\right]$$

Where: I_{avg} = average operating current

$I_{DC\ spec}$ = data sheet current at which $I_{V\ spec}$ is measured

$I_{V\ spec}$ = data sheet luminous intensity at $I_{DC\ spec}$

$\eta_{I\ PEAK}$ = relative luminous efficiency at peak operating current (See Figures 1 and 2).

The luminous intensity at any chip operating temperature may be calculated using the following formula:

$I_V = (I_V \text{ at } 25°C) \exp[-0.018/°C\ (T_A - 25°C)]$

Assembly Information

The cathode metallization (chip back content) is a gold/germanium alloy and the anode bonding pads are aluminum. Conductive silver epoxy for die attach is preferred. If eutectic die attach is used, gold/germanium preforms are recommended. Thermocompression or ultrasonic bonding with gold wire as well as aluminum ultrasonic bonding may be used with typical IC bonding parameter settings.

For more detailed assembly information, refer to Hewlett-Packard Applcation Bulletin No. 8.

Visual Inspection

All chips are 100% visually inspected to HP specification. A copy of the visual inspection specification is available on request.

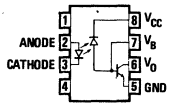
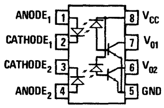
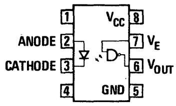
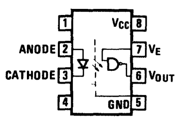
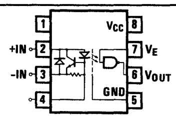
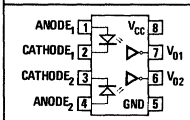
Recommended Incoming Inspection Procedures

Helwett-Packard guarantees all visual parameters. Customers should perform incoming inspection to the same levels. It is important that these chips be handled carefully. Excessive or rough handling of chips can cause scratched or broken units. All shipments must be accepted or rejected on a lot basis. Samples should be selected and tested for the visual specifications to the recommended AQL level. Before a lot will be authorized for return, the inspected units should be returned to Hewlett-Packard for our verification. Returns cannot be accepted after the entire lot has been removed from its shipping container.

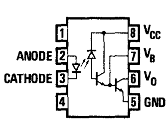
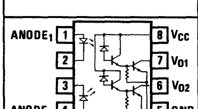
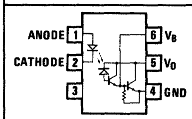
OPTOELECTRONICS DESIGNER'S CATALOG 1977

Optocouplers

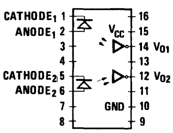
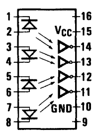
High Speed Optocouplers

Device		Description	Application[1]	Typical Data Rates	Current Transfer Ratio	Specified Input Current	Input To Output Insulation	Page No.
	6N135 (5082-4350)	Transistor Output	Line Receiver, Analog Circuits, TTL/CMOS, TTL/LSTTL Ground Isolation	1M bit/s	7% Min.	16mA	3000Vdc[3]	140
	6N136 (5082-4351)				19% Min.			
	HCPL-2502 (5082-4352)				15-22%[2]			
	HCPL-2530 (5082-4354)	Dual Channel Transistor Output	Line Receiver, Analog Circuits, TTL/CMOS, TTL/LSTTL Ground Isolation	1M bit/s	7% Min.	16mA	3000Vdc[3]	144
	HCPL-2531 (5082-4355)				19% Min.			
	6N137 (5082-4360)	Optically Coupled Logic Gate	Line Receiver, High Speed Logic Ground Isolation	10M Bit/s	700% Typ.	5.0mA	3000Vdc[3]	148
	HCPL-2601 (5082-4361)	High Common Mode Rejection, Optically Coupled Logic Gate	Line Receiver, High Speed Logic Ground Isolation In High Ground or Induced Noise Environments	10M bit/s	700% Typ.	5.0mA	3000Vdc[3]	152
	HCPL-2602	Optically Coupled Line Receiver	Replace Conventional Line Receivers In High Ground or Induced Noise Environments	10M bit/s	700% Typ.	5.0mA	3000Vdc[3]	156
	HCPL-2630 (5082-4364)	Dual Channel Optically Coupled Gate	Line Receiver, High Speed Logic Ground Isolation	10M bit/s	700% Typ.	5.0mA	3000Vdc[3]	162

Low Input Current/High Gain Optocouplers

Device		Description	Application[1]	Typical Data Rates	Current Transfer Ratio	Specified Input Current	Input To Output Insulation	Page No.
	6N138 (5082-4370)	Low Saturation Voltage, High Gain Output, V_{CC}=7VMax.	Line Receiver, Low Current Ground Isolation, TTL/TTL, LSTTL/TTL, CMOS/TTL	300k bit/s	300% Min.	1.6mA	3000Vdc[3]	166
	6N139 (5082-4371)	Low Saturation Voltage, High Gain Output, V_{CC}=18V Max.	Line Receiver, Ultra Low Current Ground Isolation, CMOS/LSTTL CMOS/TTL, CMOS/CMOS		400% Min.	0.5mA		
	HCPL-2730	Dual Channel, High Gain, V_{CC}=7V Max.	Line Receiver, Polarity Sensing, Low Current Ground Isolation	300k bit/s	300% Min.	1.6mA	3000Vdc[3]	170
	HCPL-2731	Dual Channel, High Gain, V_{CC}=18V Max.			400%Min.	0.5mA		
	4N45	Darlington Output V_{CC}=7V Max.	AC Isolation, Relay-Logic Isolation	3k bit/s	250% Min.	1.0mA	3000Vdc[3]	174
	4N46	Darlington Output V_{CC}=20V Max.			350% Min.	0.5mA		

High Reliability Optocouplers

Device		Description	Application[1]	Typical Data Rates	Current Transfer Ratio	Specified Input Current	Input To Output Insulation	Page No.
	6N134 (5082-4365) 6N134 TXV (TX-4365) 6N134 TXVB (TXB-4365)	Dual Channel Hermetically Sealed Optically Coupled Logic Gate. TXV – Screened TXVB – Screened with Group B Data	Line Receiver, Ground Isolation for High Reliability Systems	10M bit/s	400% Typ.	10mA	1500Vdc	178
	HCPL-2770 TXHCPL-2770 TXBHCPL-2770	Hermetically Sealed Package Containing 4 Low Input Current, High Gain Isolators	Line Receiver, Low Power Ground Isolation for High Reliability Systems	300k bit/s	300% Min.	0.5mA	1500Vdc	182

Notes: 1. For further information ask for Application Notes AN939, AN947, AN948, AN951-1 and AN951-2 (See pages 196-197).
2. The HCPL-2502 Current Transfer Ratio Specification is guaranteed to be 15% minimum and 22% maximum.
3. Recognized under the Component Recognition Program of Underwriters Laboratories Inc. (File No. E55361).

HEWLETT hp PACKARD

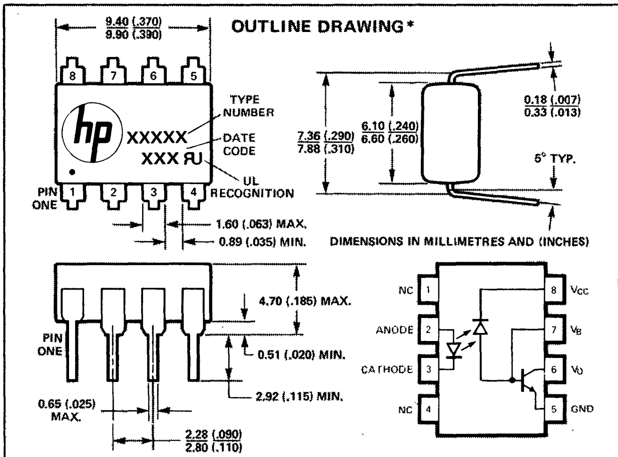
COMPONENTS

HIGH SPEED OPTICALLY COUPLED ISOLATORS

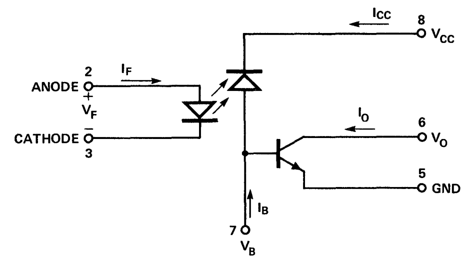
6N135 (5082-4350)
6N136 (5082-4351)
HCPL-2502 (5082-4352)

TECHNICAL DATA APRIL 1977

OUTLINE DRAWING*



SCHEMATIC



Features

- **HIGH SPEED: 1 Mbit/s**
- **TTL COMPATIBLE**
- **RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC. (FILE NO. E55361)**
- **HIGH COMMON MODE TRANSIENT IMMUNITY: 1000V/µs**
- **3000Vdc INSULATION VOLTAGE**
- **2 MHz BANDWIDTH**
- **OPEN COLLECTOR OUTPUT**

Description

These diode-transistor optocouplers use a light emitting diode and an integrated photon detector to provide 3000V dc electrical insulation between input and output. Separate connection for the photodiode bias and output transistor collector improve the speed up to a hundred times that of a conventional photo-transistor isolator by reducing the base-collector capacitance.

The 6N135 is suitable for use in TTL/CMOS, TTL/LTTL or wide bandwidth analog applications. Current transfer ratio (CTR) for the 6N135 is 7% minimum at I_F = 16 mA.

The 6N136 is suitable for high speed TTL/TTL applications. A standard 16 mA TTL sink current through the input LED will provide enough output current for 1 TTL load and a 5.6 kΩ pull-up resistor. CTR of the 6N136 is 19% minimum at I_F = 16 mA.

The HCPL-2502 is suitable for use in applications where matched or known CTR is desired. CTR is 15 to 22% at I_F = 16 mA.

*JEDEC Registered Data. (The HCPL-2502 is not registered.)

Applications

- **Line Receivers** — High common mode transient immunity (>1000V/µs) and low input-output capacitance (0.6pF).
- **High Speed Logic Ground Isolation** — TTL/TTL, TTL/LTTL, TTL/CMOS, TTL/LSTTL.
- **Replace Slow Phototransistor Isolators** — Pins 2-7 of the -4350 series conform to pins 1-6 of 6 pin phototransistor isolators. Pin 8 can be tied to any available bias voltage of 1.5V to 15V for high speed operation.
- **Replace Pulse Transformers** — Save board space and weight.
- **Analog Signal Ground Isolation** — Integrated photon detector provides improved linearity over phototransistor type.

Absolute Maximum Ratings*

Storage Temperature	-55°C to +125°C
Operating Temperature	-55°C to 100°C
Lead Solder Temperature	260°C for 10s (1.6mm below seating plane)
Average Input Current — I_F	25mA[1]
Peak Input Current — I_F	50mA[2] (50% duty cycle, 1 ms pulse width)
Peak Transient Input Current — I_F	1.0A (≤1µs pulse width, 300pps)
Reverse Input Voltage — V_R (Pin 3-2)	5V
Input Power Dissipation	45mW[3]
Average Output Current — I_O (Pin 6)	8mA
Peak Output Current	16mA
Emitter-Base Reverse Voltage (Pin 5-7)	5V
Supply and Output Voltage — V_{CC} (Pin 8-5), V_O (Pin 6-5)	-0.5V to 15V
Base Current — I_B (Pin 7)	5mA
Output Power Dissipation	100mW[4]

See notes, following page.

Electrical Specifications ($T_A = 25°C$)

Parameter	Sym.	Device	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Current Transfer Ratio	CTR*	6N135	7	18		%	$I_F = 16mA, V_O = 0.4V, V_{CC} = 4.5V$	2	5
		6N136	19	24		%			
		HCPL-2502	15		22	%			
Logic Low Output Voltage	V_{OL}	6N135		0.1	0.4	V	$I_F = 16mA, I_O = 1.1mA, V_{CC} = 4.5V$		
		6N136 HCPL-2502		0.1	0.4	V	$I_F = 16mA, I_O = 2.4mA, V_{CC} = 4.5V$		
Logic High Output Current	I_{OH}*			3	500	nA	$I_F = 0mA, V_O = V_{CC} = 5.5V$	6	
Logic High Output Current	I_{OH}*				100	μA	$I_F = 0mA, V_O = V_{CC} = 15V$		
Logic Low Supply Current	I_{CCL}			16		μA	$I_F = 16mA, V_O = Open, V_{CC} = 15V$		
Logic High Supply Current	I_{CCH}*			0.02	1	μA	$I_F = 0mA, V_O = Open, V_{CC} = 15V$		
Input Forward Voltage	V_F*			1.5	1.7	V	$I_F = 16mA$	3	
Temperature Coefficient of Forward Voltage	$\frac{\Delta V_F}{\Delta T_A}$			-1.8		mV/°C	$I_F = 16mA$		
Input Reverse Breakdown Voltage	BV_R*		5			V	$I_R = 10\mu A$		
Input Capacitance	C_{IN}			60		pF	$f = 1MHz, V_F = 0$		
Input-Output Insulation Leakage Current	I_{I-O}*				1.0	μA	45% Relative Humidity, t=5 sec. $V_{I-O} = 3000$ Vdc		6
Resistance (Input-Output)	R_{I-O}			10^{12}		Ω	$V_{I-O} = 500V$ dc		6
Capacitance (Input-Output)	C_{I-O}			0.6		pF	$f = 1MHz$		6
Transistor DC Current Gain	h_{FE}			150		–	$V_O = 5V, I_O = 3mA$		

Switching Specifications ($T_A = 25°C$)

$V_{CC} = 5V$, $I_F = 16mA$ UNLESS OTHERWISE SPECIFIED

Parameter	Sym.	Device	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time To Logic Low at Output	t_{PHL}*	6N135		0.5	1.5	μs	$R_L = 4.1k\Omega$	5,9	8,9
		6N136 HCPL-2502		0.2	0.8	μs	$R_L = 1.9k\Omega$		
Propagation Delay Time To Logic High at Output	t_{PLH}*	6N135		0.4	1.5	μs	$R_L = 4.1k\Omega$	5,9	8,9
		6N136 HCPL-2502		0.3	0.8	μs	$R_L = 1.9k\Omega$		
Common Mode Transient Immunity at Logic High Level Output	CM_H	6N135		1000		V/μs	$I_F = 0mA, V_{CM} = 10V_{p-p}, R_L = 4.1k\Omega$	10	7,8,9
		6N136 HCPL-2502		1000		V/μs	$I_F = 0mA, V_{CM} = 10V_{p-p}, R_L = 1.9k\Omega$		
Common Mode Transient Immunity at Logic Low Level Output	CM_L	6N135		-1000		V/μs	$V_{CM} = 10V_{p-p}, R_L = 4.1k\Omega$	10	7,8,9
		6N136 HCPL-2502		-1000		V/μs	$V_{CM} = 10V_{p-p}, R_L = 1.9k\Omega$		
Bandwidth	BW			2		MHz	$R_L = 100\Omega$	8	10

NOTES:
1. Derate linearly above 70°C free-air temperature at a rate of 0.8mA/°C.
2. Derate linearly above 70°C free-air temperature at a rate of 1.6mA/°C.
3. Derate linearly above 70°C free-air temperature at a rate of 0.9mW/°C.
4. Derate linearly above 70°C free-air temperature at a rate of 2.0mW/°C.
5. CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.
6. Device considered a two-terminal device: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7, and 8 shorted together.
7. Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{CM}/dt on the leading edge of the common mode pulse, V_{CM}, to assure that the output will remain in a Logic High state (i.e., $V_O > 2.0V$). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{CM}/dt on the trailing edge of the common mode pulse signal, V_{CM}, to assure that the output will remain in a Logic Low state (i.e., $V_O < 0.8V$).
8. The 1.9kΩ load represents 1 TTL unit load of 1.6mA and a 5.6kΩ pull-up resistor.
9. The 4.1kΩ load represents 1 LSTTL unit load of 0.36mA and a 6.1kΩ pull-up resistor.
10. The frequency at which the ac output voltage is 3 dB below the low frequency asymptote.

*JEDEC Registered Data.

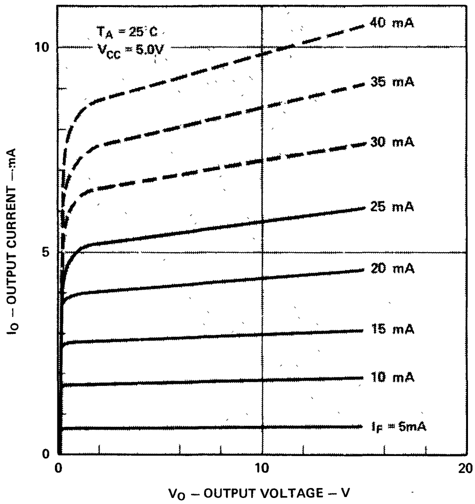


Figure 1. DC and Pulsed Transfer Characteristics.

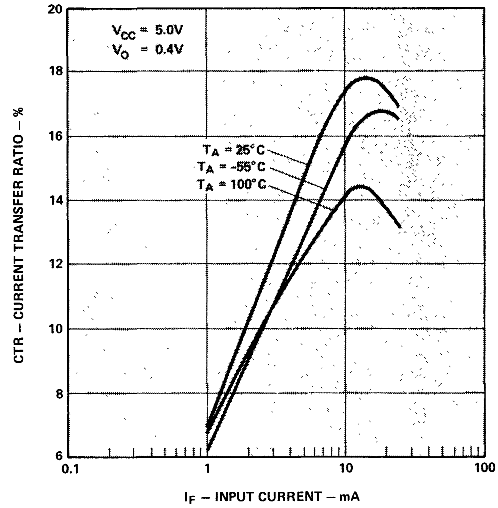


Figure 2. Current Transfer Ratio vs. Input Current.

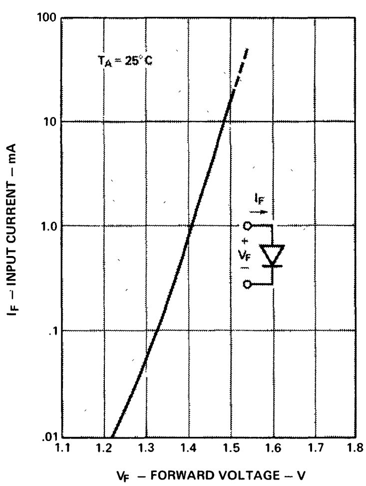


Figure 3. Input Current vs. Forward Voltage.

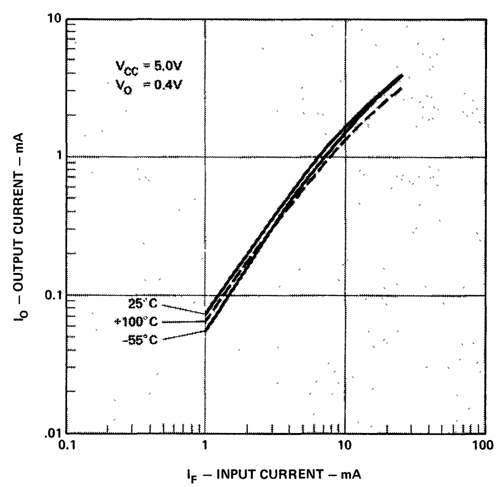


Figure 4. Output Current vs. Input Current.

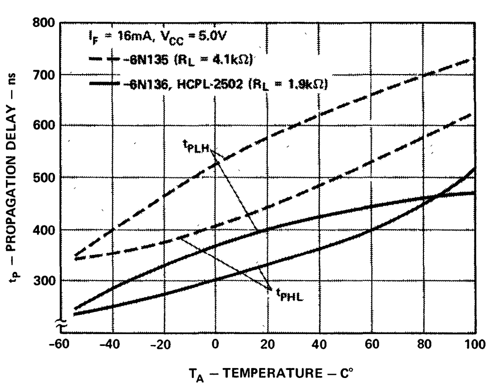


Figure 5. Propagation Delay vs. Temperature.

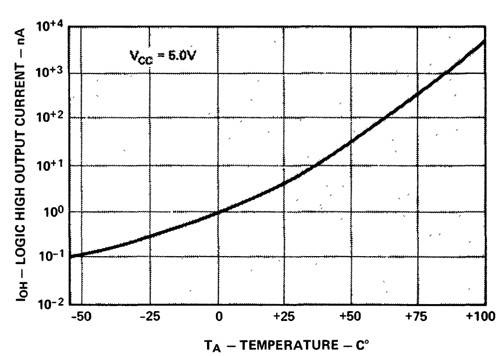


Figure 6. Logic High Output Current vs. Temperature.

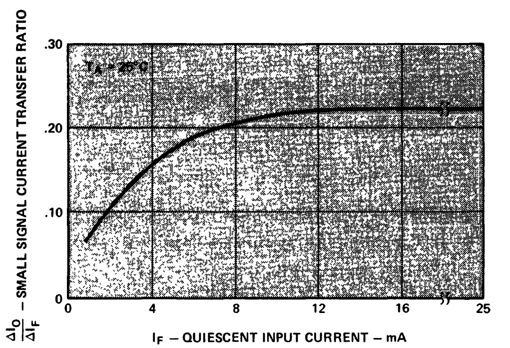


Figure 7. Small-Signal Current Transfer Ratio vs. Quiescent Input Current.

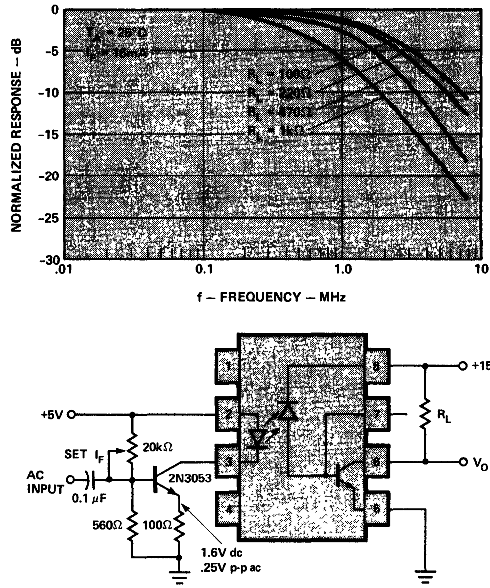


Figure 8. Frequency Response.

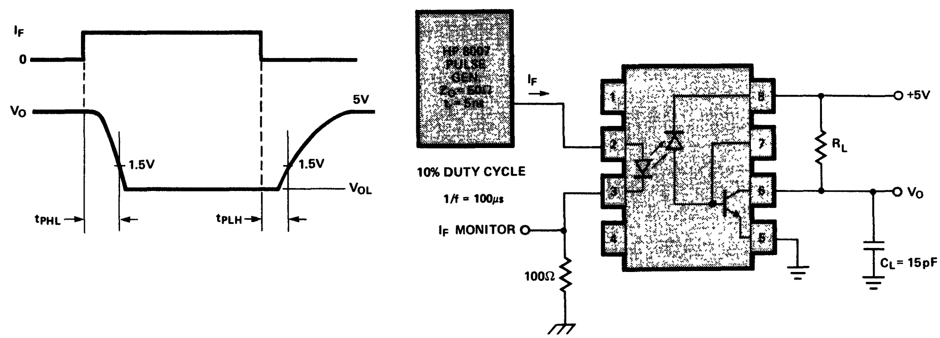


Figure 9. Switching Test Circuit.

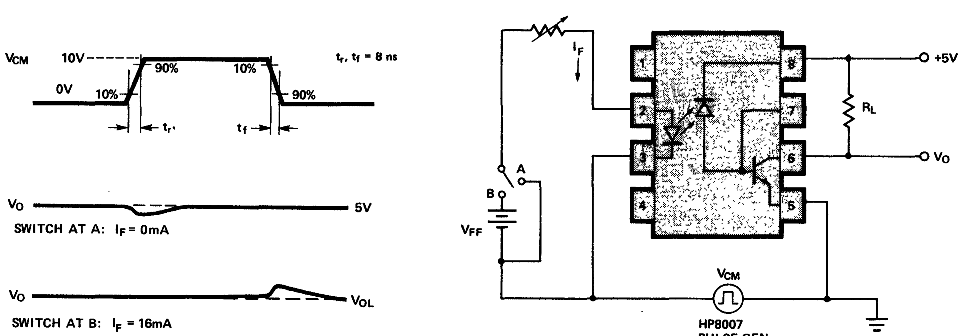


Figure 10. Test Circuit for Transient Immunity and Typical Waveforms.

*JEDEC Registered Data.

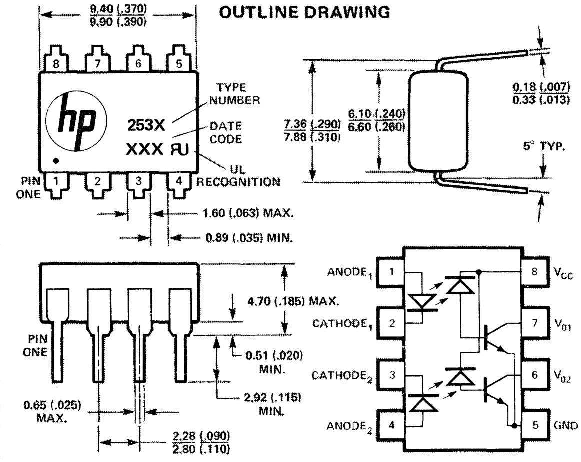
HEWLETT hp PACKARD
COMPONENTS

DUAL HIGH SPEED OPTICALLY COUPLED ISOLATORS

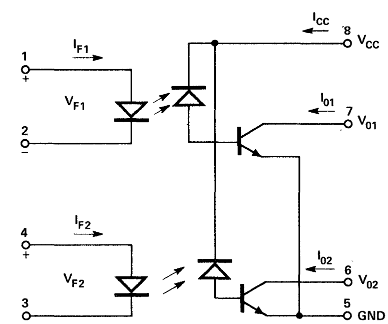
HCPL-2530 (5082-4354)
HCPL-2531 (5082-4355)

TECHNICAL DATA APRIL 1977

OUTLINE DRAWING



SCHEMATIC



Features

- **HIGH SPEED: 1 Mbit/s**
- **TTL COMPATIBLE**
- **HIGH COMMON MODE TRANSIENT IMMUNITY: >1000V/μs**
- **HIGH DENSITY PACKAGING**
- **3000Vdc INSULATION VOLTAGE**
- **3 MHz BANDWIDTH**
- **OPEN COLLECTOR OUTPUTS**
- **RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC. (FILE NO. E55361)**

Applications

- **Line Receivers** — High common mode transient immunity (>1000V/μs) and low input-output capacitance (0.6pF).
- **High Speed Logic Ground Isolation** — TTL/TTL, TTL/LTTL, TTL/CMOS, TTL/LSTTL.
- **Replace Pulse Transformers** — Save board space and weight.
- **Analog Signal Ground Isolation** — Integrated photon detector provides improved linearity over phototransistor type.
- **Polarity Sensing.**
- **Isolated Analog Amplifier** — Dual channel packaging enhances thermal tracking.

Description

The HCPL-2530/31 dual isolators contain a pair of light emitting diodes and integrated photon detectors with 3000V dc electrical insulation between input and output. Separate connection for the photodiode bias and output transistor collectors improve the speed up to a hundred times that of a conventional phototransistor isolator by reducing the base-collector capacitance.

The HCPL-2530 is suitable for use in TTL/CMOS, TTL/LSTTL or wide bandwidth analog applications. Current transfer ratio (CTR) for the -2530 is 7% minimum at I_F = 16 mA.

The HCPL-2531 is suitable for high speed TTL/TTL applications. A standard 16 mA TTL sink current through the input LED will provide enough output current for 1 TTL load and a 5.6kΩ pull-up resistor. CTR of the -2531 is 19% minimum at I_F = 16 mA.

Absolute Maximum Ratings

Storage Temperature . . . . -55°C to +125°C
Operating Temperature . . . . -55°C to +100°C
Lead Solder Temperature . . . . 260°C for 10s (1.6mm below seating plane)
Average Input Current — I_F (each channel) . . . . . . 25mA[1]
Peak Input Current — I_F (each channel) . . . . 50mA[2] (50% duty cycle, 1 ms pulse width)
Peak Transient Input Current — I_F (each channel) . . . . 1.0 A (≤1μs pulse width, 300pps)
Reverse Input Voltage — V_R (each channel) 5V
Input Power Dissipation (each channel) . . . . 45mW[3]
Average Output Current — I_O (each channel) 8mA
Peak Output Current — I_O (each channel). 16mA
Supply and Output Voltage — V_{CC} (Pin 8-5), V_O (Pin 7,6-5) . . . . -0.5V to 15V
Output Power Dissipation (each channel) . . . . . . 35mW[4]

See notes, following page.

Electrical Specifications AT $T_A = 25°C$

Parameter	Sym.	Device HCPL-	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Current Transfer Ratio	CTR	2530	7	18		%	$I_F = 16mA, V_O = 0.4V, V_{CC} = 4.5V$	2	5,6
		2531	19	24		%			
Logic Low Output Voltage	V_{OL}	2530		0.1	0.4	V	$I_F = 16mA, I_O = 1.1mA, V_{CC} = 4.5V$		5
		2531		0.1	0.4	V	$I_F = 16mA, I_O = 2.4mA, V_{CC} = 4.5V$		
Logic High Output Current	I_{OH}			3	500	nA	$I_F = 0mA, V_O = V_{CC} = 5.5V$	6	5
Logic High Output Current	I_{OH}				100	μA	$I_F = 0mA, V_O = V_{CC} = 15V$		5
Logic Low Supply Current	I_{CCL}			32		μA	$I_{F1} = I_{F2} = 16mA$; $V_{O1} = V_{O2} =$ Open, $V_{CC} = 15V$		
Logic High Supply Current	I_{CCH}			0.05	2	μA	$I_{F1} = I_{F2} = 0mA$; $V_{O1} = V_{O2} =$ Open, $V_{CC} = 15V$		
Input Forward Voltage	V_F			1.5	1.7	V	$I_F = 16mA$	3	5
Temperature Coefficient of Forward Voltage	$\frac{\Delta V_F}{\Delta T_A}$			-1.8		mV/°C	$I_F = 16mA$		5
Input Reverse Breakdown Voltage	V_R		5			V	$I_F = 10\mu A$		5
Input Capacitance	C_{IN}			60		pF	$f = 1 MHz, V_F = 0$		5
Input – Output Insulation Leakage Current	I_{I-O}				1.0	μA	45% Relative Humidity, t = 5 s; $V_{I-O} = 3000Vdc$		7
Resistance (Input-Output)	R_{I-O}			10^{12}		Ω	$V_{I-O} = 500V$ dc		7
Capacitance (Input-Output)	C_{I-O}			0.6		pF	f = 1 MHz		7
Input-Input Insulation Leakage Current	I_{I-I}			0.005		μA	45% Relative Humidity, t=5s, $V_{I-I} = 500Vdc$		8
Resistance (Input-Input)	R_{I-I}			10^{11}		Ω	$V_{I-I} = 500V$ dc		8
Capacitance (Input-Input)	C_{I-I}			0.25		pF	f = 1 MHz		8

Switching Specifications AT $T_A = 25°C$, $V_{CC} = 5V$, $I_F = 16mA$, UNLESS OTHERWISE SPECIFIED

Parameter	Sym.	Device HCPL-	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time To Logic Low at Output	t_{PHL}	2530		0.3	1.5	μs	$R_L = 4.1k\Omega$	5,9	10,11
		2531		0.2	0.8	μs	$R_L = 1.9k\Omega$		
Propagation Delay Time to Logic High at Output	t_{PLH}	2530		0.4	1.5	μs	$R_L = 4.1k\Omega$	5,9	10,11
		2531		0.3	0.8	μs	$R_L = 1.9k\Omega$		
Common Mode Transient Immunity at Logic High Level Output	CM_H	2530		1000		V/μs	$I_F = 0mA, R_L = 4.1k\Omega, V_{CM} = 10V_{p-p}$	10	9,10,11
		2531		1000		V/μs	$I_F = 0mA, R_L = 1.9k\Omega, V_{CM} = 10V_{p-p}$		
Common Mode Transient Immunity at Logic Low Level Output	CM_L	2530		-1000		V/μs	$V_{CM} = 10V_{p-p}, R_L = 4.1k\Omega$	10	9,10,11
		2531		-1000		V/μs	$V_{CM} = 10V_{p-p}, R_L = 1.9k\Omega$		
Bandwidth	BW			3		MHz	$R_L = 100\Omega$	8	12

NOTES:
1. Derate linearly above 70°C free-air temperature at a rate of 0.8mA/°C.
2. Derate linearly above 70°C free-air temperature at a rate of 1.6mA/°C.
3. Derate linearly above 70°C free-air temperature at a rate of 0.9mW/°C.
4. Derate linearly above 70°C free-air temperature at a rate of 1.0mW/°C.
5. Each channel.
6. CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.
7. Device considered a two-terminal device: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7, and 8 shorted together.
8. Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together.
9. Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{CM}/dt on the leading edge of the common mode pulse V_{CM}, to assure that the output will remain in a Logic High state (i.e., $V_O > 2.0V$). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{CM}/dt on the trailing edge of the common mode pulse signal, V_{CM}, to assure that the output will remain in a Logic Low state (i.e., $V_O < 0.8V$).
10. The 1.9kΩ load represents 1 TTL unit load of 1.6mA and the 5.6kΩ pull-up resistor.
11. The 4.1kΩ load represents 1 LSTTL unit load of 0.36mA and 6.1kΩ pull-up resistor.
12. The frequency at which the ac output voltage is 3dB below the low frequency asymptote.

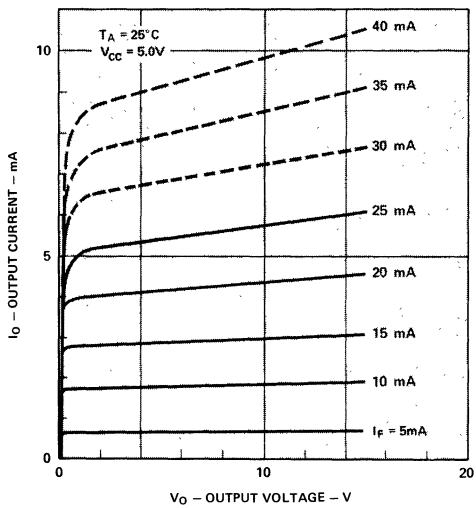


Figure 1. DC and Pulsed Transfer Characteristics.

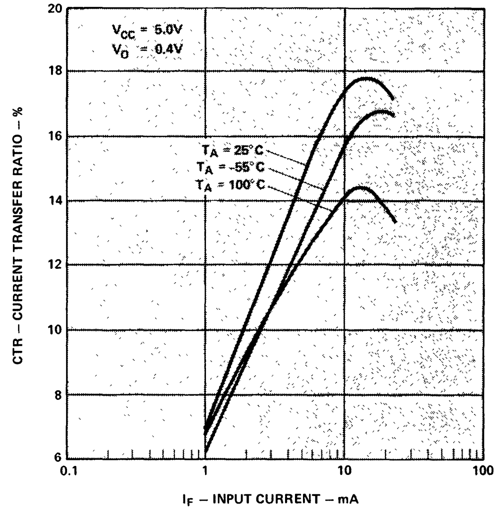


Figure 2. Current Transfer Ratio vs. Input Current.

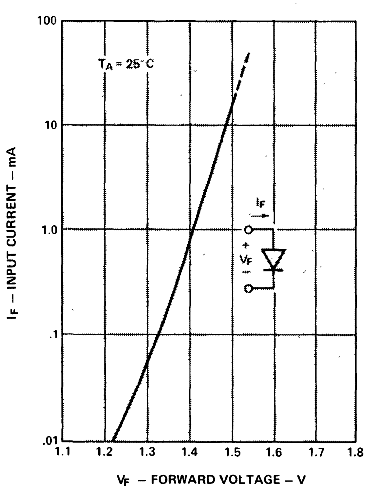


Figure 3. Input Current vs. Forward Voltage.

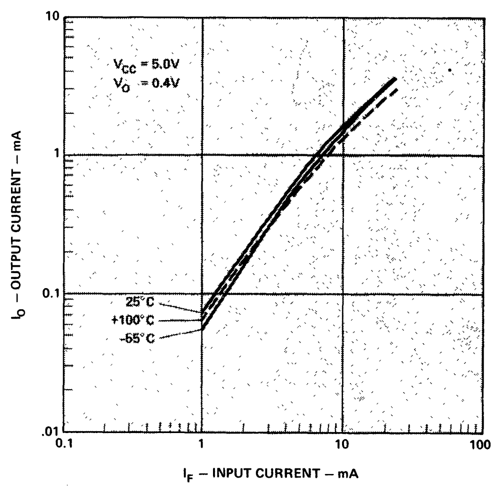


Figure 4. Output Current vs. Input Current.

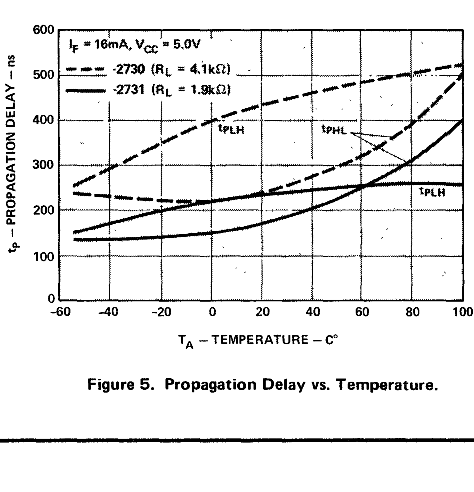


Figure 5. Propagation Delay vs. Temperature.

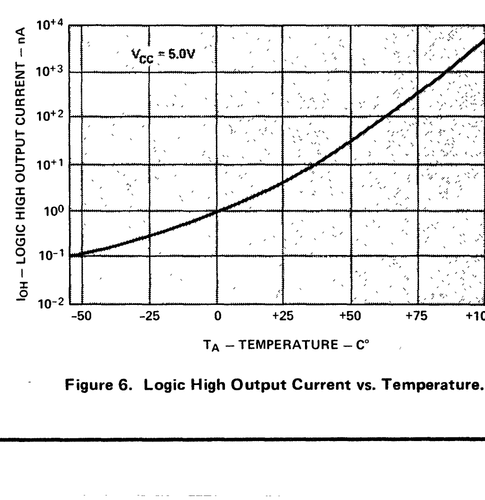


Figure 6. Logic High Output Current vs. Temperature.

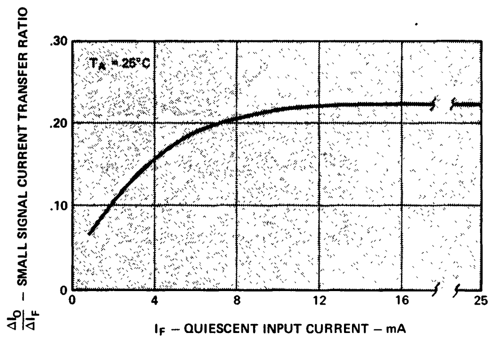


Figure 7. Small-Signal Current Transfer Ratio vs. Quiescent Input Current.

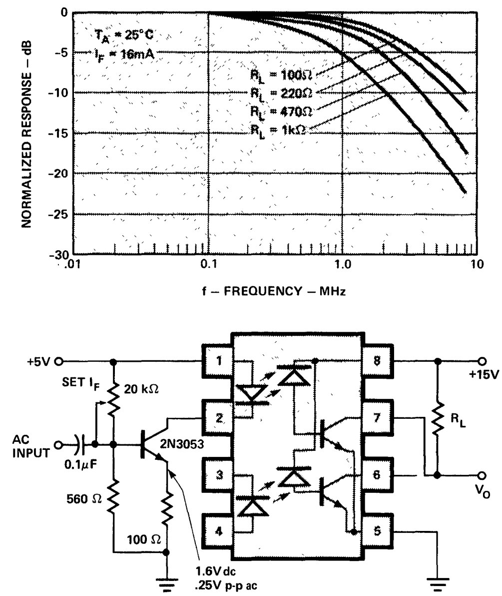


Figure 8. Frequency Response.

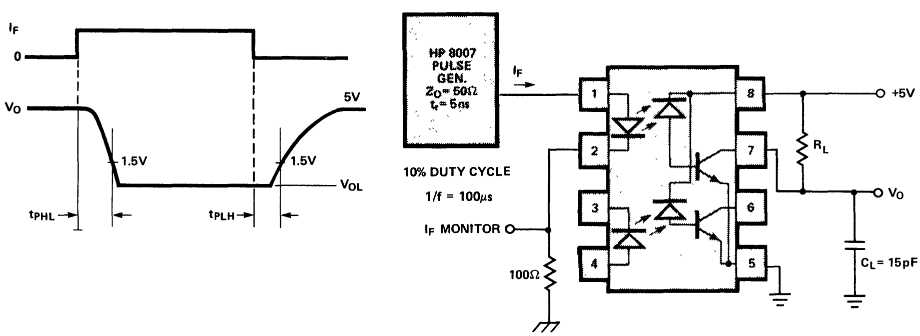


Figure 9. Switching Test Circuit.

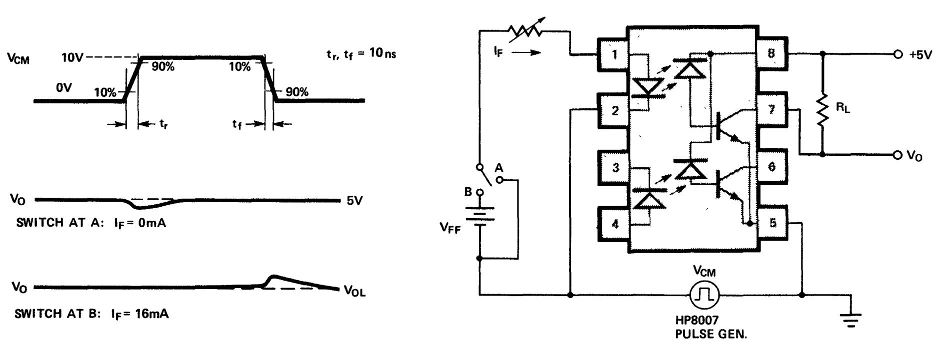


Figure 10. Test Circuit for Transient Immunity and Typical Waveforms.

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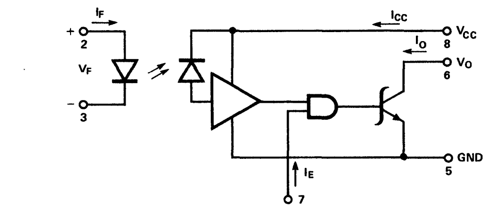
COMPONENTS

DTL/TTL COMPATIBLE OPTICALLY COUPLED GATE

6N137 (5082-4360)

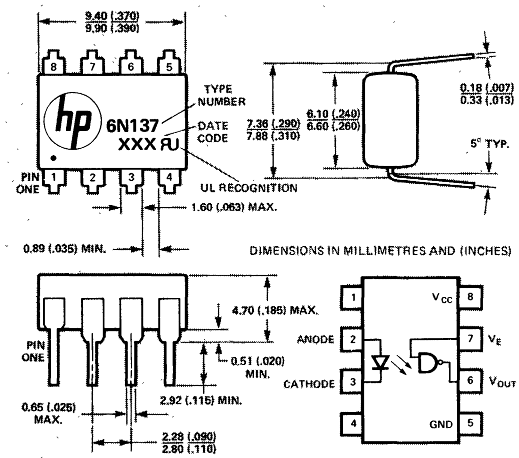
TECHNICAL DATA APRIL 1977



NOTE:
A .01 to 0.1μF BYPASS CAPACITOR MUST BE CONNECTED BETWEEN PINS 8 AND 5.

Figure 1.

OUTLINE DRAWING*



Features

- DTL/TTL COMPATIBLE: 5V SUPPLY
- ULTRA HIGH SPEED
- LOW INPUT CURRENT REQUIRED
- HIGH COMMON MODE REJECTION
- GUARANTEED PERFORMANCE OVER TEMPERATURE
- RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC. (FILE NO. E55361)
- 3000V dc INSULATION VOLTAGE

Description/Applications

The 6N137 consists of a GaAsP photon emitting diode and a unique integrated detector. The photons are collected in the detector by a photodiode and then amplified by a high gain linear amplifier that drives a Schottky clamped open collector output transistor. The circuit is temperature, current and voltage compensated.

This unique isolator design provides maximum DC and AC circuit isolation between input and output while achieving DTL/TTL circuit compatibility. The isolator operational parameters are guaranteed from 0°C to 70°C, such that a minimum input current of 5mA will sink an eight gate fan-out (13mA) at the output with 5 volt V_{CC} applied to the detector. This isolation and coupling is achieved with a typical propagation delay of 45nsec. The enable input provides gating of the detector with input sinking and sourcing requirements compatible with DTL/TTL interfacing and a propagation delay of 25 ns typical.

The 6N137 can be used in high speed digital interfacing applications where common mode signals must be rejected, such as for a line receiver and digital programming of floating power supplies, motors, and other machine control systems. The elimination of ground loops can be accomplished in system interfaces such as between a computer and a peripheral memory, printer, controller, etc.

The open collector output provides capability for bussing, OR'ing and strobing.

Recommended Operating Conditions

	Sym.	Min.	Max.	Units
Input Current, Low Level Each Channel	I_{FL}	0	250	μA
Input Current, High Level Each Channel	I_{FH}	6.3**	10	mA
High Level Enable Voltage	V_{EH}	2.0	5.5	V
Low Level Enable Voltage (Output High)	V_{EL}	0	0.8	V
Supply Voltage, Output	V_{CC}	4.5	5.5	V
Fan Out (TTL Load)	N		8	
Operating Temperature	T_A	0	70	°C

Absolute Maximum Ratings*

(No derating required up to 70°C)

Storage Temperature .... −55°C to +125°C
Operating Temperature .... 0°C to +70°C
Lead Solder Temperature .... 260°C for 10s (1.6mm below seating plane)
Peak Forward Input Current .... 20mA (≤1 msec Duration)
Average Forward Input Current 10mA
Reverse Input Voltage 5V
Enable Input Voltage .... 5.5V (Not to exceed V_{CC} by more than 500mV)
Supply Voltage - V_{CC} .... 7V (1 Minute Maximum)
Output Current - I_O 50mA
Output Collector Power Dissipation 85mW
Output Voltage - V_O 7V

**6.3mA condition permits at least 20% CTR degradation guardband. Initial switching threshold is 5mA or less.

*JEDEC Registered Data.

Electrical Characteristics

OVER RECOMMENDED TEMPERATURE (T_A = 0°C TO 70°C) UNLESS OTHERWISE NOTED

Parameter	Symbol	Min.	Typ.**	Max.	Units	Test Conditions	Figure	Note
High Level Output Current	I_{OH}*		50	250	μA	V_{CC}=5.5V, V_O=5.5V, I_F=250μA, V_E=2.0V	6	
Low Level Output Voltage	V_{OL}*		0.5	0.6	V	V_{CC}=5.5V, I_F=5mA, V_{EH}=2.0V, I_{OL} (Sinking) =13mA	5	
High Level Enable Current	I_{EH}		-1.0		mA	V_{CC}=5.5V, V_E=2.0V		
Low Level Enable Current	I_{EL}*		-1.6	-2.0	mA	V_{CC}=5.5V, V_E=0.5V		
High Level Supply Current	I_{CCH}*		7	15	mA	V_{CC}=5.5V, I_F=0, V_E=0.5V		
Low Level Supply	I_{CCL}*		13	18	mA	V_{CC}=5.5V, I_F=10mA, V_E=0.5V		
Input-Output Insulation Leakage Current	I_{I-O}*			1.0	μA	Relative Humidity=45%, T_A=25°C, t=5s, V_{I-O}=3000Vdc		5
Resistance (Input-Output)	R_{I-O}		10^{12}		Ω	V_{I-O}=500V, T_A=25°C		5
Capacitance (Input-Output)	C_{I-O}		0.6		pF	f=1MHz, T_A=25°C		5
Input Forward Voltage	V_F*		1.5	1.75	V	I_F=10mA, T_A=25°C	4	8
Input Reverse Breakdown Voltage	BV_R*		5		V	I_R=10μA, T_A=25°C		
Input Capacitance	C_{IN}		60		pF	V_F=0, f=1MHz		
Current Transfer Ratio	CTR		700		%	I_F=5.0mA, R_L=100Ω	2	7

**All typical values are at V_{CC} = 5V, T_A = 25°C

Switching Characteristics at T_A=25°C, V_{CC}=5V

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Propagation Delay Time to High Output Level	t_{PLH}*		45	75	ns	R_L=350Ω, C_L=15pF, I_F=7.5mA	7,9	1
Propagation Delay Time to Low Output Level	t_{PHL}*		45	75	ns	R_L=350Ω, C_L=15pF, I_F=7.5mA	7,9	2
Output Rise-Fall Time (10-90%)	t_r, t_f		25		ns	R_L=350Ω, C_L=15pF, I_F=7.5mA		
Propagation Delay Time of Enable from V_{EH} to V_{EL}	t_{ELH}		25		ns	R_L=350Ω, C_L=15pF, I_F=7.5mA, V_{EH}=3.0V, V_{EL}=0.5V	8	3
Propagation Delay Time of Enable from V_{EL} to V_{EH}	t_{EHL}		15		ns	R_L=350Ω, C_L=15pF, I_F=7.5mA V_{EH}=3.0V, V_{EL}=0.5V	8	4
Common Mode Transient Immunity at Logic High Output Level	CM_H		50		v/μs	V_{CM}=10V R_L=350Ω, V_O(min.)=2V, I_F=0mA	11	6
Common Mode Transient Immunity at Logic Low Output Level	CM_L		-150		v/μs	V_{CM}=10V R_L=350Ω, V_O(max.)=0.8V, I_F=5mA	11	6

*JEDEC Registered Data.

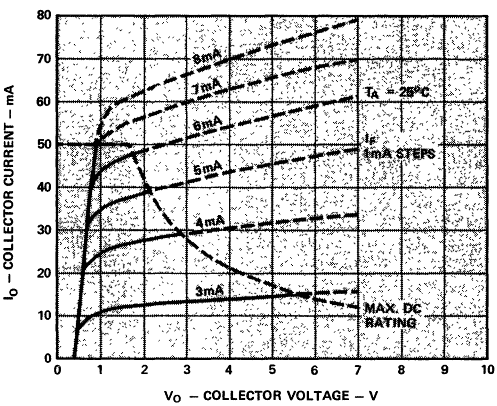
Operating Procedures and Definitions

Logic Convention. The 5082-4360 is defined in terms of positive logic.

Bypassing. A ceramic capacitor (.01 to 0.1μF) should be connected from pin 8 to pin 5. Its purpose is to stabilize the operation of the high gain linear amplifier. Failure to provide the bypassing may impair the switching properties. The total lead length between capacitor and isolator should not exceed 20mm.

Polarities. All voltages are referenced to network ground (pin 5). Current flowing toward a terminal is considered positive.

Enable Input. No external pull-up required for a logic (1), i.e., can be open circuit.



Note: Dashed characteristics — denote pulsed operation only.

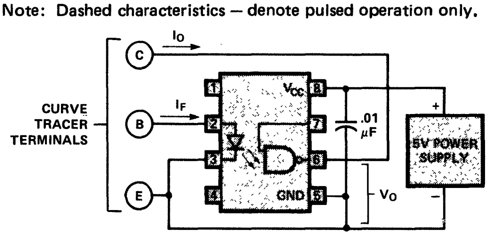
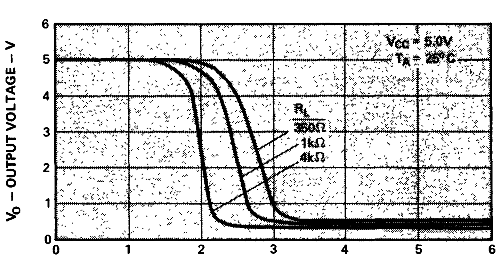


Figure 2. Isolator Collector Characteristics.



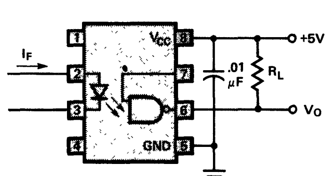


Figure 3. Input-Output Characteristics.

NOTES:

1. The t_{PLH} propagation delay is measured from the 3.75mA point on the trailing edge of the input pulse to the 1.5V point on the trailing edge of the output pulse.
2. The t_{PHL} propagation delay is measured from the 3.75mA point on the leading edge of the input pulse to 1.5V point on the leading edge of the output pulse.
3. The t_{ELH} enable propagation delay is measured from the 1.5V point of the trailing edge of the input pulse to the 1.5V point on the trailing edge of the output pulse.
4. The t_{EHL} enable propagation delay is measured from the 1.5V point on the leading edge of the input pulse to the 1.5V point on the leading edge of the output pulse.
5. Device considered a two terminal device: pins 2 and 3 shorted together, and pins 5, 6, 7, and 8 shorted together.
6. Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{CM}/dt on the leading edge of the common mode pulse, V_{CM}, to assure that the output will remain in a Logic High state (i.e., $V_O > 2.0V$). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{CM}/dt on the trailing edge of the common mode pulse signal, V_{CM}, to assure that the output will remain in a Logic Low state (i.e., $V_O < 0.8V$).
7. DC Current Transfer Ratio is defined as the ratio of the output collector current to the forward bias input current times 100%.
8. At 10mA V_F decreases with increasing temperature at the rate of 1.6mV/°C.

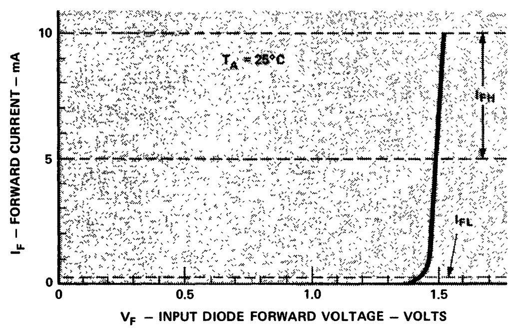


Figure 4. Input Diode Forward Characteristic.

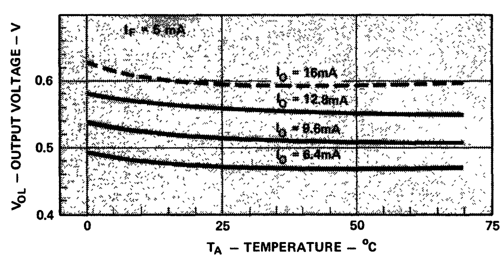


Figure 5. Output Voltage, V_{OL} vs. Temperature and Fan-Out.

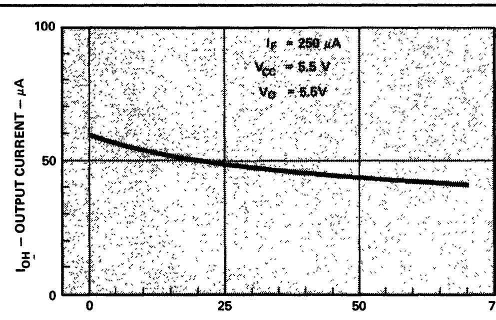


Figure 6. Output Current, I_{OH} vs. Temperature (I_F=250μA).

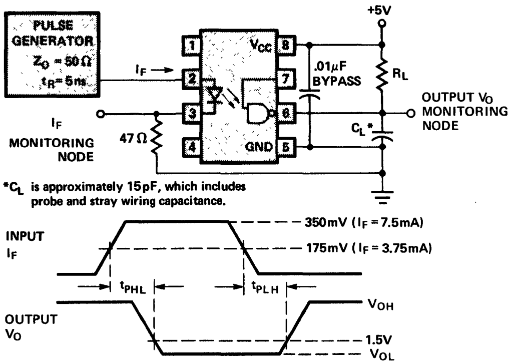


Figure 7. Test Circuit for t_{PHL} and t_{PLH}.**

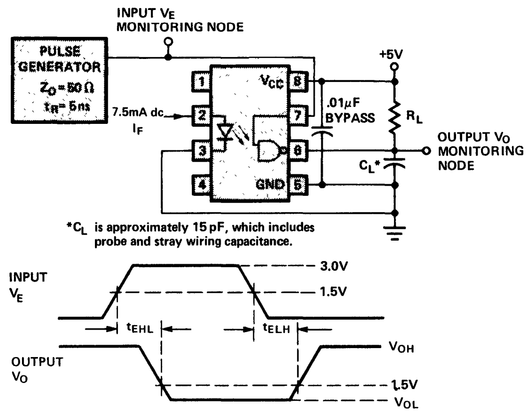


Figure 8. Test Circuit for t_{ELH} and t_{EHL}.

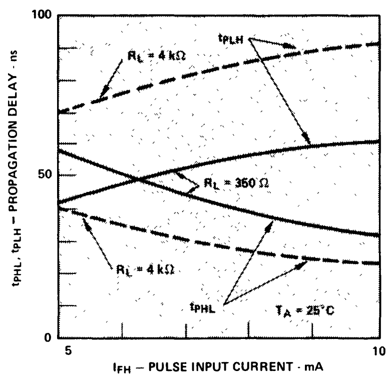


Figure 9. Propagation Delay, t_{PHL} and t_{PLH} vs. Pulse Input Current, I_{FH}.

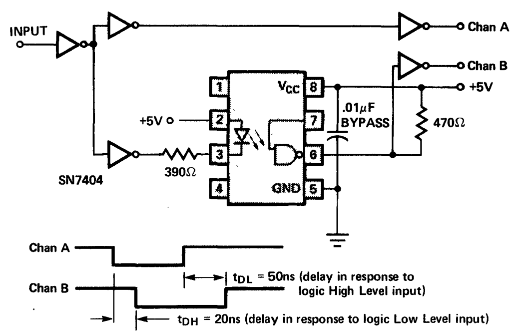


Figure 10. Response Delay Between TTL Gates.

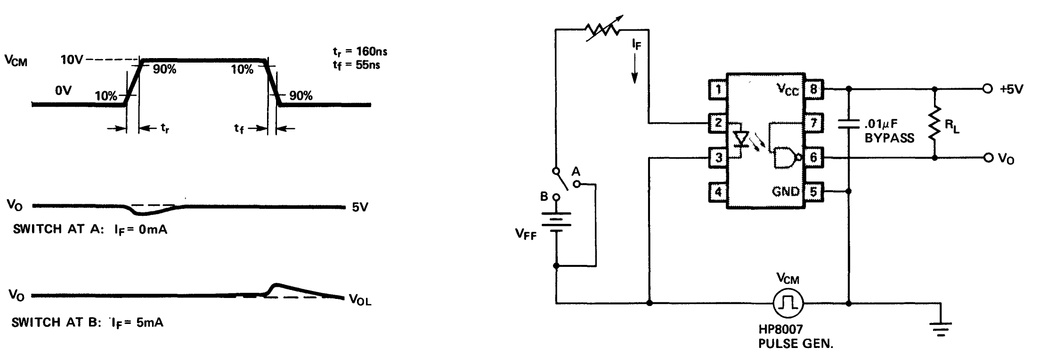


Figure 11. Test Circuit for Transient Immunity and Typical Waveforms.

** JEDEC Registered Data.

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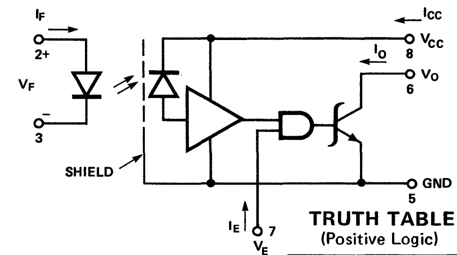
COMPONENTS

HIGH CMR, HIGH SPEED OPTICALLY COUPLED GATE

HCPL-2601 (5082-4361)

TECHNICAL DATA APRIL 1977

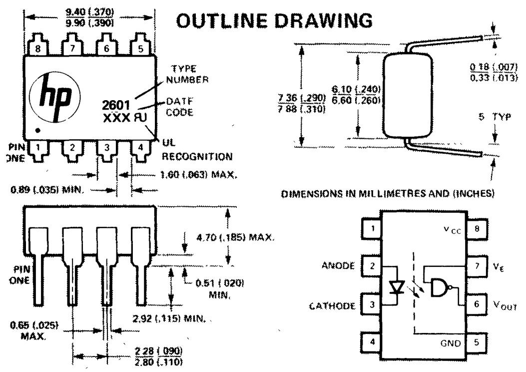


TRUTH TABLE
(Positive Logic)

Input	Enable	Output
H	H	L
L	H	H
H	L	H
L	L	H

A 0.01 TO 0.1 μF BYPASS CAPACITOR MUST BE CONNECTED BETWEEN PINS 8 AND 5 (See Note 1).

Figure 1. Schematic.



Features

- **INTERNAL SHIELD FOR HIGH COMMON MODE REJECTION (CMR)**
- **HIGH SPEED**
- **GUARANTEED MINIMUM COMMON MODE TRANSIENT IMMUNITY: 1000V/μs**
- **LSTTL/TTL COMPATIBLE**
- **LOW INPUT CURRENT REQUIRED: 5mA**
- **GUARANTEED PERFORMANCE OVER TEMPERATURE: 0°C to 70°C**
- **STROBABLE OUTPUT**
- **RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC. (FILE NO. E55361)**
- **3000 Vdc INSULATION VOLTAGE**

Description

The HCPL-2601 optically coupled gate combines a GaAsP light emitting diode and an integrated high gain photon detector. An enable input allows the detector to be strobed. The output of the detector I.C. is an open collector Schottky clamped transistor. The internal shield provides a guaranteed common mode transient immunity specification of 1000 volts/μsec., equivalent to rejecting a 300 volt P-P sinusoid at 1 MHz.

This unique design provides maximum D.C. and A.C. circuit isolation while achieving TTL compatibility. The isolator D.C. operational parameters are guaranteed from 0°C to 70°C allowing troublefree system performance. This isolation is achieved with a typical propagation delay of 35 nsec.

The HCPL-2601's are suitable for high speed logic interfacing, input/output buffering, as line receivers in environments that conventional line receivers cannot tolerate and are recommended for use in extremely high ground or induced noise environments.

Applications

- Isolated Line Receiver
- Simplex/Multiplex Data Transmission
- Computer-Peripheral Interface
- Microprocessor System Interface
- Digital Isolation for A/D, D/A Conversion
- Switching Power Supply
- Instrument Input/Output Isolation
- Ground Loop Elimination
- Pulse Transformer Replacement

Recommended Operating Conditions

	Sym.	Min.	Max.	Units
Input Current, Low Level	I_{FL}	0	250	μA
Input Current, High Level	I_{FH}	6.3*	20	mA
Supply Voltage, Output	V_{CC}	4.5	5.5	V
High Level Enable Voltage	V_{EH}	2.0	5.5	V
Low Level Enable Voltage	V_{EL}	0	0.8	V
Fan Out (TTL Load)	N		8	
Operating Temperature	T_A	0	70	°C

Absolute Maximum Ratings

(No Derating Required up to 70°C)

Storage Temperature .... −55°C to +125°C
Operating Temperature .... 0°C to +70°C
Lead Solder Temperature .... 260°C for 10 s
(1.6mm below seating plane)
Forward Input Current − I_F (see Note 2) .... 20 mA
Reverse Input Voltage .... 5 V
Supply Voltage − V_{CC} .... 7 V
Enable Input Voltage − V_E .... 5.5 V
(Not to exceed V_{CC} by more than 500 mV)
Output Collector Current − I_O .... 25 mA
Output Collector Power Dissipation .... 40 mW
Output Collector Voltage − V_O .... 7 V

*6.3mA condition permits at least 20% CTR degradation guardband. Initial switching threshold is 5mA or less.

Electrical Characteristics

(Over Recommended Temperature, $T_A = 0°C$ to $+70°C$, Unless Otherwise Noted)

Parameter	Symbol	Min.	Typ.*	Max.	Units	Test Conditions	Figure	Note
High Level Output Current	I_{OH}		7	250	μA	$V_{CC} = 5.5V$, $V_O = 5.5V$, $I_F = 250\ \mu A$, $V_E = 2.0\ V$	2	
Low Level Output Voltage	V_{OL}		0.4	0.6	V	$V_{CC} = 5.5V$, $I_F = 5\ mA$ $V_E = 2.0\ V$, I_{OL} (Sinking) = 13 mA	3	
High Level Supply Current	I_{CCH}		10	15	mA	$V_{CC} = 5.5V$, $I_F = 0$, $V_E = 0.5\ V$		
Low Level Supply Current	I_{CCL}		15	18	mA	$V_{CC} = 5.5V$, $I_F = 10\ mA$, $V_E = 0.5\ V$		
Low Level Enable Current	I_{EL}		−1.6	−2.0	mA	$V_{CC} = 5.5\ V$, $V_E = 0.5\ V$		
High Level Enable Current	I_{EH}		−1.0		mA	$V_{CC} = 5.5\ V$, $V_E = 2.0V$		
High Level Enable Voltage	V_{EH}	2.0			V			11
Low Level Enable Voltage	V_{EL}			0.8	V			
Input Forward Voltage	V_F		1.5	1.75	V	$I_F = 10\ mA$, $T_A = 25°C$	4	
Input Reverse Breakdown Voltage	BV_R	5			V	$I_R = 10\ \mu A$, $T_A = 25°C$		
Input Capacitance	C_{IN}		60		pF	$V_F = 0$, f = 1 MHz		
Input Diode Temperature Coefficient	$\frac{\Delta V_F}{\Delta T_A}$		−1.6		mV/°C	$I_F = 10\ mA$		
Input-Output Insulation Leakage Current	I_{I-O}			1	μA	Relative Humidity = 45% $T_A = 25°C$, t = 5 s, $V_{I-O} = 3000$ Vdc		3
Resistance (Input-Output)	R_{I-O}		10^{12}		Ω	$V_{I-O} = 500\ V$		3
Capacitance (Input-Output)	C_{I-O}		0.6		pF	f = 1 MHz		3

*All typical values are at $V_{CC} = 5V$, $T_A = 25°C$.

Switching Characteristics ($T_A = 25°C$, $V_{CC} = 5V$)

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Propagation Delay Time to High Output level	t_{PLH}		35	75	ns	$R_L = 350\ \Omega$ $C_L = 15\ pF$ $I_F = 7.5\ mA$	6	4
Propagation Delay Time to Low Output Level	t_{PHL}		35	75	ns		6	5
Output Rise Time (10–90%)	t_r		25		ns			
Output Fall Time (90–10%)	t_f		15		ns			
Propagation Delay Time of Enable from V_{EH} to V_{EL}	t_{ELH}		25		ns	$R_L = 350\ \Omega$, $C_L = 15\ pF$, $I_F = 7.5\ mA$, $V_{EH} = 3\ V$, $V_{EL} = 0\ V$	9	6
Propagation Delay Time of Enable from V_{EL} to V_{EH}	t_{EHL}		15		ns	$R_L = 350\ \Omega$, $C_L = 15\ pF$, $I_F = 7.5\ mA$, $V_{EH} = 3\ V$, $V_{EL} = 0\ V$	9	7
Common Mode Transient Immunity at High Output Level	CM_H	1000	10,000		V/μs	$V_{CM} = 50\ V$ (peak), V_O (min.) = 2 V, $R_L = 350\ \Omega$, $I_F = 0\ mA$	12	8,10
Common Mode Transient Immunity at Low Output Level	CM_L	−1000	−10,000		V/μs	$V_{CM} = 50\ V$ (peak), V_O (max.) = 0.8 V, $R_L = 350\ \Omega$, $I_F = 7.5\ mA$	12	9,10

NOTES:

1. Bypassing of the power supply line is required, with a 0.01 μF ceramic disc capacitor adjacent to each isolator as illustrated in Figure 15. The power supply bus for the isolator(s) should be separate from the bus for any active loads, otherwise a larger value of bypass capacitor (up to 0.1 μF) may be needed to suppress regenerative feedback via the power supply.
2. Peaking circuits may produce transient input currents up to 50 mA, 50 ns maximum pulse width, provided average current does not exceed 20 mA.
3. Device considered a two terminal device: pins 1, 2, 3 and 4 shorted together, and pins 5, 6, 7 and 8 shorted together.
4. The t_{PLH} propagation delay is measured from the 3.75 mA point on the trailing edge of the input pulse to the 1.5 V point on the trailing edge of the output pulse.
5. The t_{PHL} propagation delay is measured from the 3.75 mA point on the leading edge of the input pulse to the 1.5V point on the leading edge of the output pulse.
6. The t_{ELH} enable propagation delay is measured from the 1.5 V point on the trailing edge of the enable input pulse to the 1.5 V point on the trailing edge of the output pulse.
7. The t_{EHL} enable propagation delay is measured from the 1.5 V point on the leading edge of the enable input pulse to the 1.5 V point on the leading edge of the output pulse.
8. CM_H is the maximum tolerable rate of rise of the common mode voltage to assure that the output will remain in a high logic state (i.e., V_{OUT} >2.0 V).
9. CM_L is the maximum tolerable rate of fall of the common mode voltage to assure that the output will remain in a low logic state (i.e., V_{OUT} <0.8 V).
10. For sinusoidal voltages, $\left(\frac{|dv_{CM}|}{dt}\right)_{max} = \pi f_{CM} V_{CM}$ (p-p)
11. No external pull up is required for a high logic state on the enable input.

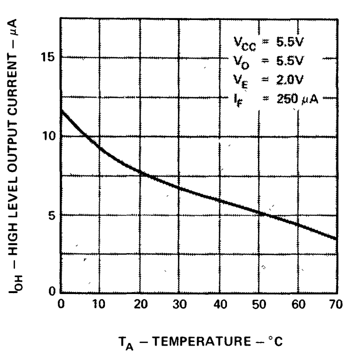


Figure 2. High Level Output Current vs. Temperature.

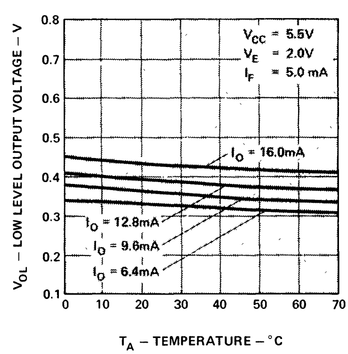


Figure 3. Low Level Output Voltage vs. Temperature.

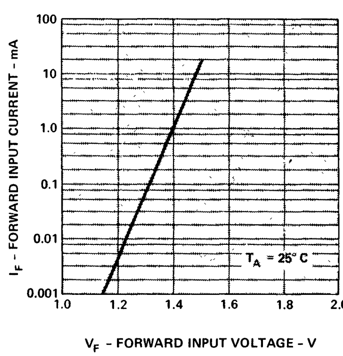


Figure 4. Input Diode Forward Characteristic.

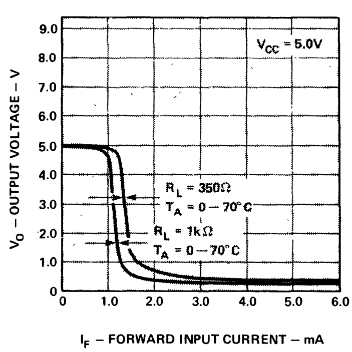


Figure 5. Output Voltage vs. Forward Input Current.

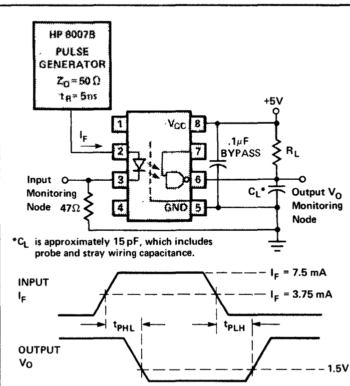


Figure 6. Test Circuit for t_{PHL} and t_{PLH}.

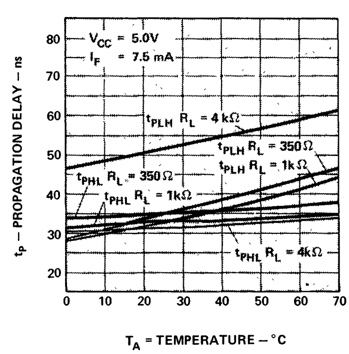


Figure 7. Propagation Delay vs. Temperature.

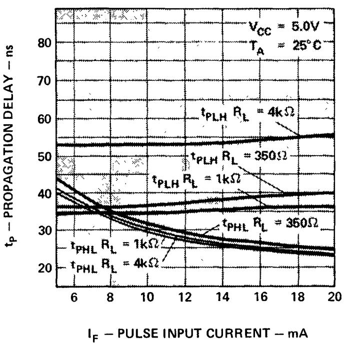


Figure 8. Propagation Delay vs. Pulse Input Current.

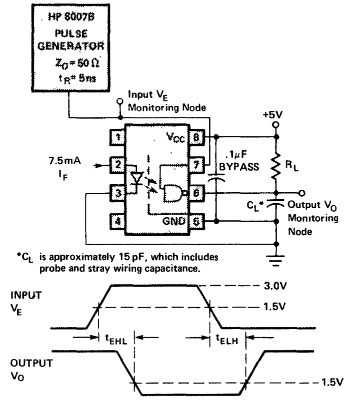


Figure 9. Test Circuit for t_{EHL} and t_{ELH}.

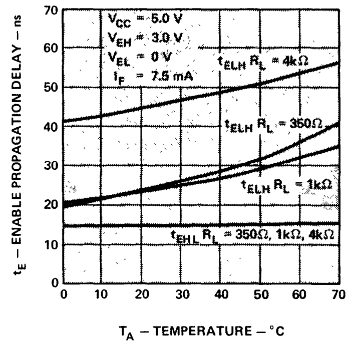


Figure 10. Enable Propagation Delay vs. Temperature.

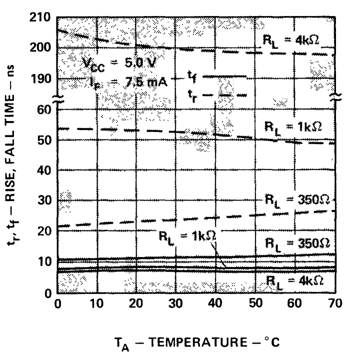


Figure 11. Rise, Fall Time vs. Temperature.

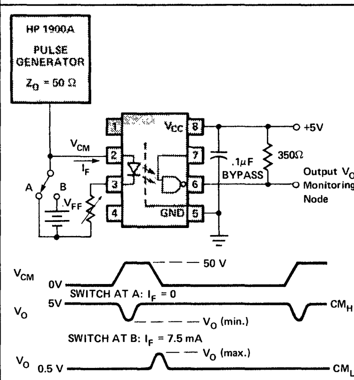


Figure 12. Test Circuit for Common Mode Transient Immunity and Typical Waveforms.

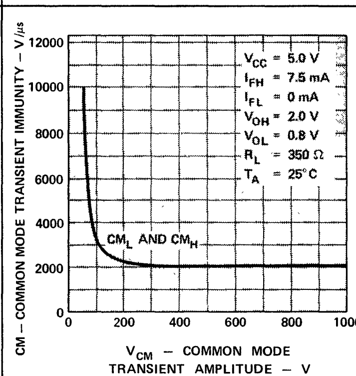


Figure 13. Common Mode Transient Immunity vs. Common Mode Transient Amplitude.

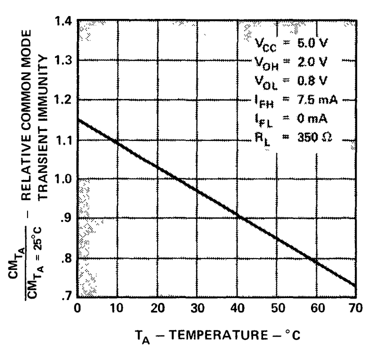


Figure 14. Relative Common Mode Transient Immunity vs. Temperature.

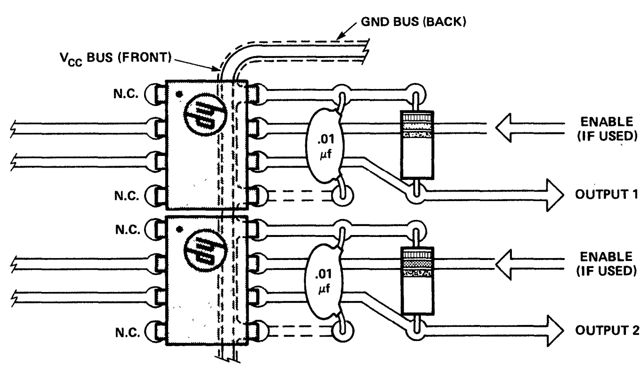


Figure 15. Recommended Printed Circuit Board Layout.

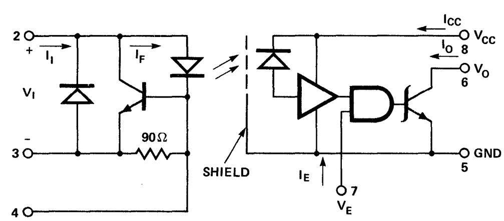
HEWLETT hp PACKARD

COMPONENTS

HIGH CMR, HIGH SPEED OPTICALLY COUPLED LINE RECEIVER

HCPL-2602

TECHNICAL DATA APRIL 1977



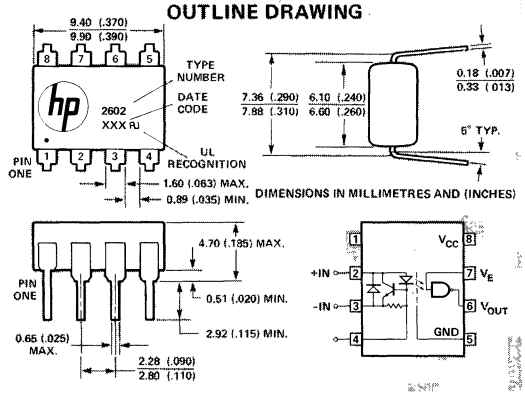
A 0.01 TO 0.1 μF BYPASS CAPACITOR MUST BE CONNECTED BETWEEN PINS 8 AND 5 (See Note 1).

Figure 1. Schematic.

TRUTH TABLE
(Positive Logic)

Input	Enable	Output
H	H	L
L	H	H
H	L	H
L	L	H

OUTLINE DRAWING



Features

- LINE TERMINATION INCLUDED — NO EXTRA CIRCUITRY REQUIRED
- ACCEPTS A BROAD RANGE OF DRIVE CONDITIONS
- GUARDBANDED FOR LED DEGRADATION
- LED PROTECTION MINIMIZES LED EFFICIENCY DEGRADATION
- HIGH SPEED — 10Mbs (LIMITED BY TRANSMISSION LINE IN MANY APPLICATIONS)
- INTERNAL SHIELD PROVIDES EXCELLENT COMMON MODE REJECTION
- EXTERNAL BASE LEAD ALLOWS "LED PEAKING" AND LED CURRENT ADJUSTMENT
- 3000 Vdc INSULATION VOLTAGE
- RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC. (FILE NO. E55361)

Applications

- **Isolated Line Receiver**
- **Simplex/Multiplex Data Transmission**
- **Computer-Peripheral Interface**
- **Microprocessor System Interface**
- **Digital Isolation for A/D, D/A Conversion**
- **Current Sensing**
- **Instrument Input/Output Isolation**
- **Ground Loop Elimination**
- **Pulse Transformer Replacement**

Description

The HCPL-2602 optically coupled line receiver combines a GaAsP light emitting diode, an input current regulator and an integrated high gain photon detector. The input regulator serves as a line termination for line receiver applications. It clamps the line voltage and regulates the LED current so line reflections do not interfere with circuit performance.

The regulator allows a typical LED current of 8.5 mA before it starts to shunt excess current. The output of the detector IC is an open collector Schottky clamped transistor. An enable input gates the detector. The internal detector shield provides a guaranteed common mode transient immunity specification of 1000V/μsec, equivalent to rejecting a 300V P-P sinusoid at 1 MHz.

DC specifications are defined similar to TTL logic and are guaranteed from 0° C to 70° C allowing trouble free interfacing with digital logic circuits. An input current of 5 mA will sink an eight gate fan-out (TTL) at the output with a typical propagation delay from input to output of only 45 nsec.

The HCPL-2602's are useful as line receivers in high noise environments that conventional line receivers cannot tolerate. The higher LED threshold voltage provides improved immunity to differential noise and the internally shielded detector provides orders of magnitude improvement in common mode rejection with little or no sacrifice in speed.

Electrical Characteristics

(Over Recommended Temperature, T_A = 0° C to +70° C, Unless Otherwise Noted)

Parameter	Symbol	Min.	Typ.*	Max.	Units	Test Conditions	Figure	Note
High Level Output Current	I_{OH}		7	250	μA	V_{CC} = 5.5V, V_O = 5.5V I_I=250 μA, V_E=2.0V	4	
Low Level Output Voltage	V_{OL}		0.4	0.6	V	V_{CC}=5.5V, I_I=5 mA V_E=2.0V, I_{OL} (Sinking)=13 mA	5	2
Input Voltage	V_I		2.0	2.4	V	I_I=5 mA	3	
			2.3	2.7		I_I=60 mA	3	
Input Reverse Voltage	V_R		0.75	0.95	V	I_R=5 mA		
Low Level Enable Current	I_{EL}		-1.6	-2.0	mA	V_{CC}=5.5V, V_E=0.5V		
High Level Enable Current	I_{EH}		-1.0		mA	V_{CC}=5.5V, V_E=2.0V		
High Level Enable Voltage	V_{EH}	2.0			V			11
Low Level Enable Voltage	V_{EL}			0.8	V			
High Level Supply Current	I_{CCH}		10	15	mA	V_{CC}=5.5V, I_I=0, V_E=0.5V		
Low Level Supply Current	I_{CCL}		16	19	mA	V_{CC}=5.5V, I_I=60 mA V_E=0.5V		
Input Capacitance	C_{IN}		90		pF	V_I=0, f=1 MHz, (PIN 2-3)		
Input-Output Insulation Leakage Current	I_{I-O}			1	μA	Relative Humidity=45% T_A=25° C, t=5 s, V_{I-O}=3000 Vdc		3
Resistance (Input-Output)	R_{I-O}		10^{12}		Ω	V_{I-O}=500V		3
Capacitance (Input-Output)	C_{I-O}		0.6		pF	f = 1 MHz		3

*All typical values are at V_{CC} = 5V, T_A = 25° C.

Switching Characteristics

(T_A = 25°C, V_{CC} = 5V)

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Propagation Delay Time to High Output Level	t_{PLH}		45	75	ns	R_L = 350 Ω C_L = 15 pF I_I = 7.5 mA	6	4
Propagation Delay Time to Low Output Level	t_{PHL}		45	75	ns		6	5
Output Rise Time (10-90%)	t_r		25		ns			
Output Fall Time (90-10%)	t_f		15		ns			
Propagation Delay Time of Enable from V_{EH} to V_{EL}	t_{ELH}		25		ns	R_L=350Ω, C_L=15 pF, I_I=7.5 mA, V_{EH}=3 V, V_{EL}=0 V	10	6
Propagation Delay Time of Enable from V_{EL} to V_{EH}	t_{EHL}		15		ns		10	7
Common Mode Transient Immunity at High Output Level	CM_H	1000	10,000		V/μs	V_{CM}=50 V (peak), V_O (min.)=2 V, R_L=350Ω, I_I=0 mA	12	8
Common Mode Transient Immunity at Low Output Level	CM_L	-1000	-10,000		V/μs	V_{CM}=50 V (peak), V_O (max.)=0.8 V, R_L=350Ω, I_I=7.5 mA	12	9

Using the HCPL-2602 Optically Coupled Line Receiver

The primary objectives to fulfill when connecting an optoisolator to a transmission line are to provide a minimum, but not excessive, LED current and to properly terminate the line. The internal regulator in the HCPL-2602 simplifies this task. Excess current from variable drive conditions such as line length variations, line driver differences and power supply fluctuations are shunted by the regulator. In fact, with the LED current regulated, the line current can be increased to improve the immunity of the system to differential-mode-noise and to enhance the data rate capability. The designer must keep in mind the 60 mA input current maximum rating of the HCPL-2602, in such cases, and may need to use series limiting or shunting to prevent overstress.

Design of the termination circuit is also simplified; in most cases the transmission line can simply be connected directly to the input terminals of the HCPL-2602 without the need for additional series or shunt resistors. If reversing line drive is used it may be desirable to use two HCPL-2602's, or an external Schottky diode to optimize data rate.

Polarity Non-Reversing Drive

High data rates can be obtained with the HCPL-2602 with polarity non-reversing drive. Figure (a) illustrates how a 74S140 line driver can be used with the HCPL-2602 and shielded, twisted pair or coax cable without any additional components. There are some reflections due to the "active termination" but they do not interfere with circuit performance because the regulator clamps the line voltage. At longer line lengths t_{PLH} increases faster than t_{PHL} since the switching threshold is not exactly halfway between asymptotic line conditions. If optimum data rate is desired, a series resistor and peaking capacitor can be used to equalize t_{PLH} and t_{PHL}. In general, the peaking capacitance should be as large as possible; however, if it is too large it may keep the regulator from achieving turn-off during the negative (or zero) excursions of the input signal. A safe rule:

make $C \leqslant 16t$
where C = peaking capacitance in picofarads
t = data bit interval in nanoseconds

Polarity Reversing Drive

A single HCPL-2602 can also be used with polarity reversing drive (Figure b). Current reversal is obtained by way of the substrate isolation diode (substrate to collector). Some reduction of data rate occurs, however, because the substrate diode stores charge, which must be removed when the current changes to the forward direction. The effect of this is a longer t_{PHL}. This effect can be eliminated and data rate improved considerably by use of a Schottky diode on the input of the HCPL-2602.

For optimum noise rejection as well as balanced delays a split-phase termination should be used along with a flip-flop at the output (Figure c). The result of current reversal in split-phase operation is seen in Figure (c) with switches A and B both OPEN. The isolator inputs are then connected in ANTI-SERIES; however, because of the higher steady-state termination voltage, in comparison to the single HCPL-2602 termination, the forward current in the substrate diode is lower and consequently there is less junction charge to deal with when switching.

Closing switch B with A open is done mainly to enhance common mode rejection, but also reduces propagation delay slightly because line-to-line capacitance offers a slight peaking effect. With switches A and B both CLOSED, the shield acts as a current return path which prevents either input substrate diode from becoming reversed biased. Thus the data rate is optimized as shown in Figure (c).

Improved Noise Rejection

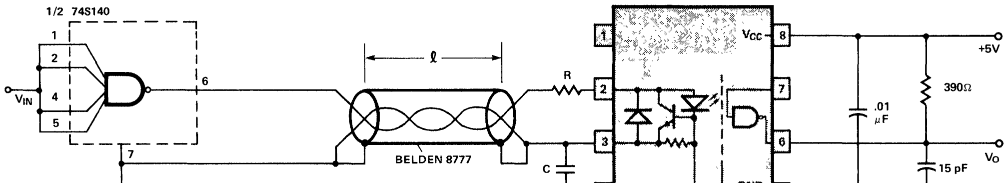
Use of additional logic at the output of two HCPL-2602's operated in the split phase termination, will greatly improve system noise rejection in addition to balancing propagation delays as discussed earlier.

A NAND flip-flop offers infinite common mode rejection (CMR) for NEGATIVELY sloped common mode transients but requires $t_{PHL} > t_{PLH}$ for proper operation. A NOR flip-flop has infinite CMR for POSITIVELY sloped transients but requires $t_{PHL} < t_{PLH}$ for proper operation. An exclusive-OR flip-flop has infinite CMR for common mode transients of EITHER polarity and operates with either $t_{PHL} > t_{PLH}$ or $t_{PHL} < t_{PLH}$.

With the line driver and transmission line shown in Figure (c), $t_{PHL} > t_{PLH}$, so NAND gates are preferred in the R-S flip-flop. A higher drive amplitude or different circuit configuration could make $t_{PHL} < t_{PLH}$, in which case NOR gates would be preferred. If it is not known whether $t_{PHL} > t_{PLH}$ or $t_{PHL} < t_{PLH}$, or if the drive conditions may vary over the boundary for these conditions, the exclusive-OR flip-flop of Figure (d) should be used.

RS-422 and RS-423

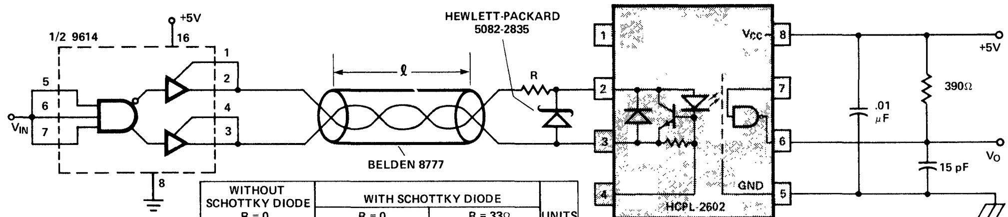
Line drivers designed for RS-422 and RS-423 generally provide adequate voltage and current for operating the HCPL-2602. Most drivers also have characteristics allowing the HCPL-2602 to be connected directly to the driver terminals. Worst case drive conditions, however, would require current shunting to prevent overstress of the HCPL-2602.



	R = 0, C = 0			R = 32Ω, C = 0			R = 33Ω, C = 430 pF			UNITS
ℓ	<1	30	90	<1	30	90	<1	30	90	m
t_{PHL}	40	50	75	40	50	100	30	45	75	nsec
t_{PLH}	45	65	175	40	50	80	40	45	75	nsec

PROPAGATION TIMES SHOWN EXCLUDE DRIVER AND LINE DELAYS.

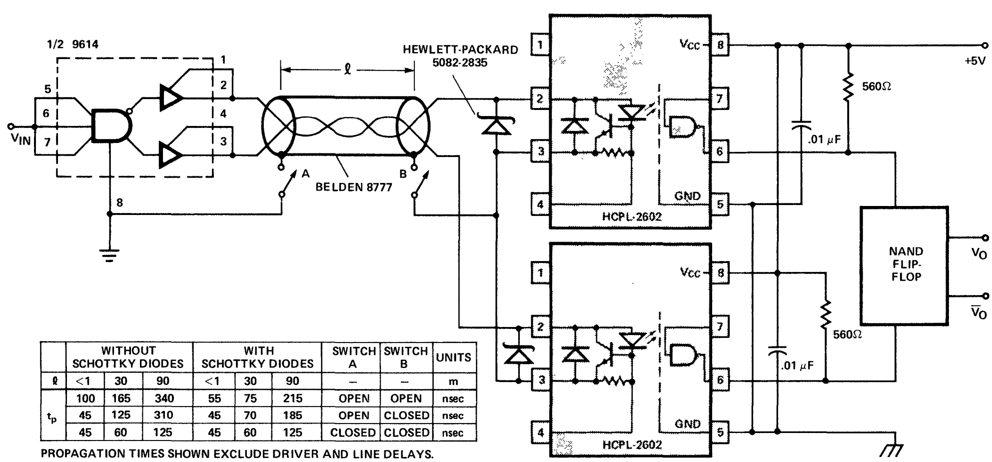
Figure a. Polarity Non-Reversing.



	WITHOUT SCHOTTKY DIODE R = 0			WITH SCHOTTKY DIODE R = 0			WITH SCHOTTKY DIODE R = 33Ω			UNITS
ℓ	<1	30	90	<1	30	90	<1	30	90	m
t_{PHL}	210	365	450	50	80	235	50	70	200	nsec
t_{PLH}	35	45	60	35	45	60	35	45	60	nsec

PROPAGATION TIMES SHOWN EXCLUDE DRIVER AND LINE DELAYS.

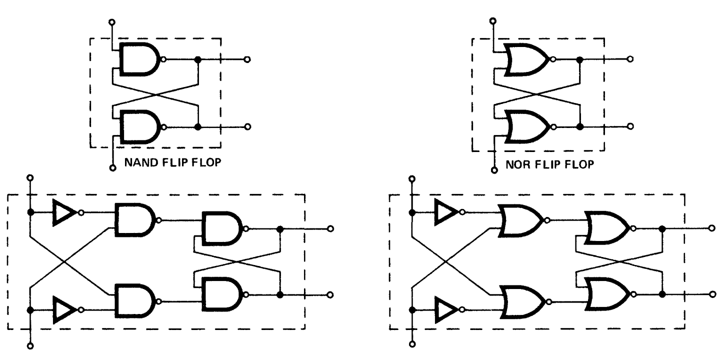
Figure b. Polarity Reversing, Single Ended.



	WITHOUT SCHOTTKY DIODES			WITH SCHOTTKY DIODES			SWITCH A	SWITCH B	UNITS
ℓ	<1	30	90	<1	30	90	–	–	m
t_p	100	165	340	55	75	215	OPEN	OPEN	nsec
t_p	45	125	310	45	70	185	OPEN	CLOSED	nsec
t_p	45	60	125	45	60	125	CLOSED	CLOSED	nsec

PROPAGATION TIMES SHOWN EXCLUDE DRIVER AND LINE DELAYS.

Figure c. Polarity Reversing, Split Phase.



NAND flip flop tolerates simultaneously HIGH inputs; NOR flip flop tolerates simultaneously LOW inputs; EXCLUSIVE-OR flip flop tolerates simultaneously HIGH OR LOW inputs without causing either of the outputs to change.

Figure d. Flip Flop Configurations.

Recommended Operating Conditions

	Sym.	Min.	Max.	Units
Input Current, Low Level	I_{IL}	0	250	μA
Input Current, High Level	I_{IH}	5	60	mA
Supply Voltage, Output	V_{CC}	4.5	5.5	V
High Level Enable Voltage	V_{EH}	2.0	5.5	V
Low Level Enable Voltage	V_{EL}	0	0.8	V
Fan Out (TTL Load)	N		8	
Operating Temperature	T_A	0	70	°C

Absolute Maximum Ratings

Storage Temperature .... −55° C to +125° C
Operating Temperature .... 0° C to +70° C
Lead Solder Temperature .... 260° C for 10 s
(1.6mm below seating plane)
Forward Input Current — I_I .... 60 mA
Reverse Input Current .... 60 mA
Supply Voltage — V_{CC} .... 7 V
Enable Input Voltage — V_E .... 5.5 V
(Not to exceed V_{CC} by more than 500 mV)
Output Collector Current — I_O .... 25 mA
Output Collector Power Dissipation .... 40 mW
Output Collector Voltage — V_O .... 7 V
Input Current, Pin 4 .... ±10 mA

NOTES:

1. Bypassing of the power supply line is required, with a 0.01 μF ceramic disc capacitor adjacent to each isolator as illustrated in Figure 15. The power supply bus for the isolator(s) should be separate from the bus for any active loads, otherwise a larger value of bypass capacitor (up to 0.1 μF) may be needed to suppress regenerative feedback via the power supply.
2. The HCPL-2602 is tested such that operation at I_I minimum of 5 mA will provide the user a minimum of 20% guardband for LED light output degradation.
3. Device considered a two terminal device: pins 1, 2, 3 and 4 shorted together, and pins 5, 6, 7 and 8 shorted together.
4. The t_{PLH} propagation delay is measured from the 3.75 mA point on the trailing edge of the input pulse to the 1.5 V point on the trailing edge of the output pulse.
5. The t_{PHL} propagation delay is measured from the 3.75 mA point on the leading edge of the input pulse to the 1.5V point on the leading edge of the output pulse.
6. The t_{ELH} enable propagation delay is measured from the 1.5 V point on the trailing edge of the enable input pulse to the 1.5 V point on the trailing edge of the output pulse.
7. The t_{EHL} enable propagation delay is measured from the 1.5 V point on the leading edge of the enable input pulse to the 1.5 V point on the leading edge of the output pulse.
8. CM_H is the maximum tolerable rate of rise of the common mode voltage to assure that the output will remain in a high logic state (i.e., V_{OUT} >2.0 V).
9. CM_L is the maximum tolerable rate of fall of the common mode voltage to assure that the output will remain in a low logic state (i.e., V_{OUT} <0.8 V).
10. For sinusoidal voltages, $\left(\frac{|dv_{CM}|}{dt}\right)_{max} = \pi f_{CM} V_{CM}$ (p-p)
11. No external pull up is required for a high logic state on the enable input.

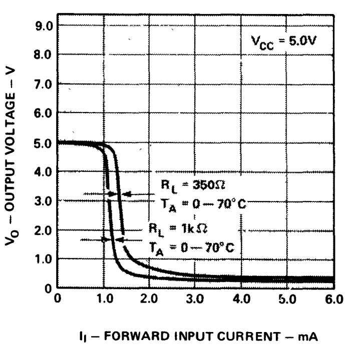


Figure 2. Output Voltage vs. Forward Input Current.

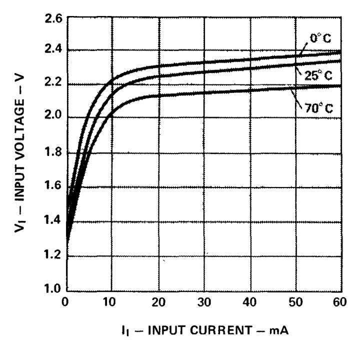


Figure 3. Input Characteristics.

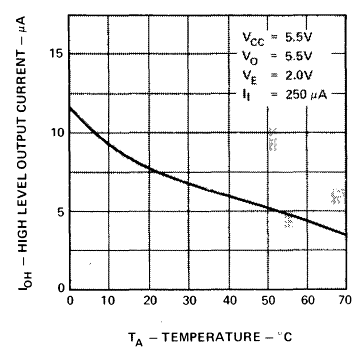


Figure 4. High Level Output Current vs. Temperature.

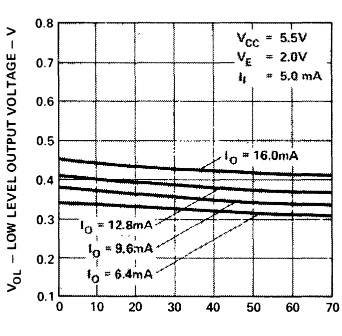


Figure 5. Low Level Output Voltage vs. Temperature.

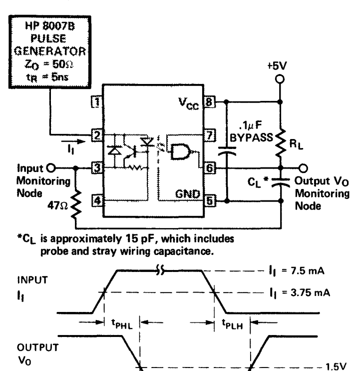


Figure 6. Test Circuit for t_{PHL} and t_{PLH}.

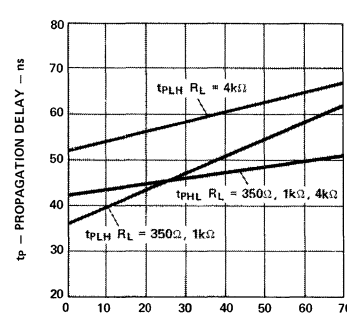


Figure 7. Propagation Delay vs. Temperature.

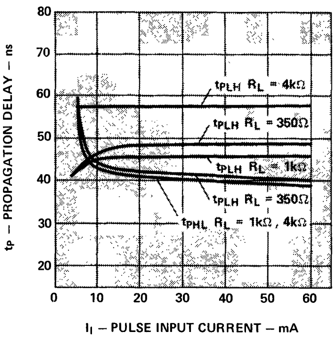


Figure 8. Propagation Delay vs. Pulse Input Current.

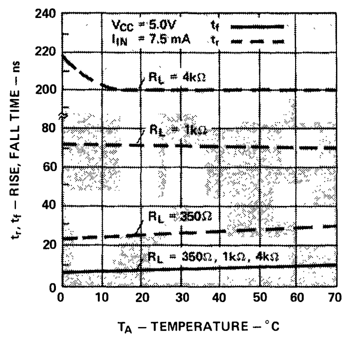


Figure 9. Rise, Fall Time vs. Temperature.

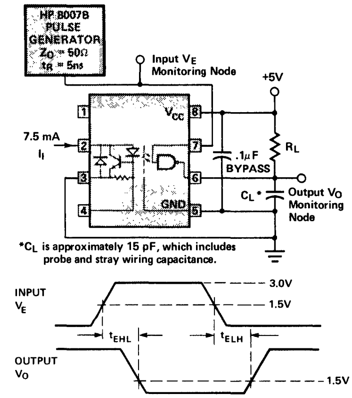


Figure 10. Test Circuit for t_{EHL} and t_{ELH}.

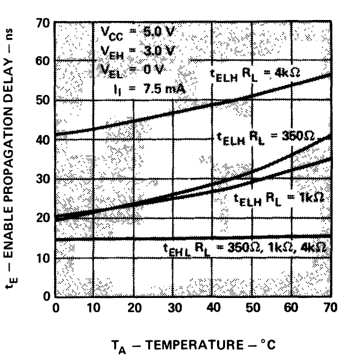


Figure 11. Enable Propagation Delay vs. Temperature.

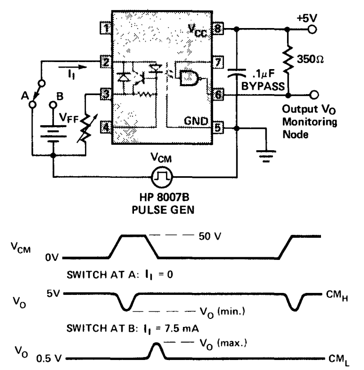


Figure 12. Test Circuit for Common Mode Transient Immunity and Typical Waveforms.

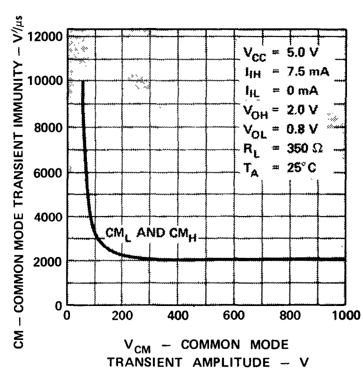


Figure 13. Common Mode Transient Immunity vs. Common Mode Transient Amplitude.

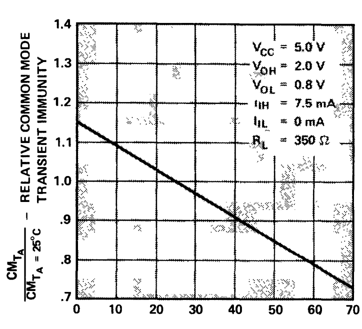


Figure 14. Relative Common Mode Transient Immunity vs. Temperature.

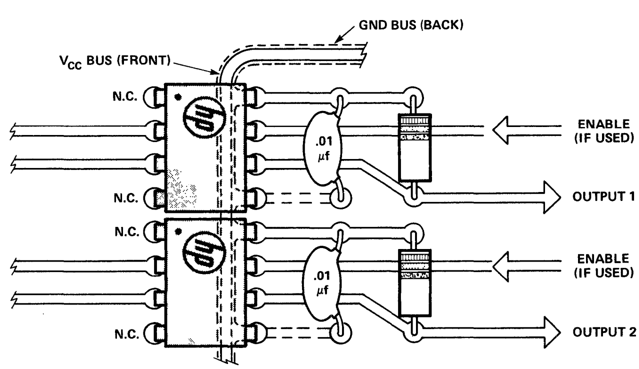


Figure 15. Recommended Printed Circuit Board Layout.

HEWLETT PACKARD

COMPONENTS

DUAL DTL/TTL COMPATIBLE OPTICALLY COUPLED GATE

HCPL-2630 (5082-4364)

TECHNICAL DATA APRIL 1977

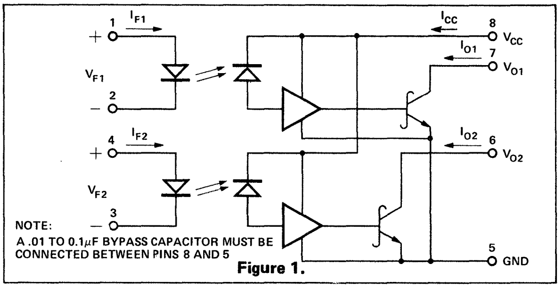


Figure 1.

Features

- HIGH DENSITY PACKAGING
- DTL/TTL COMPATIBLE: 5V SUPPLY
- ULTRA HIGH SPEED
- LOW INPUT CURRENT REQUIRED
- HIGH COMMON MODE REJECTION
- GUARANTEED PERFORMANCE OVER TEMPERATURE
- RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC. (FILE NO. E55361)
- 3000Vdc INSULATION VOLTAGE

Description/Applications

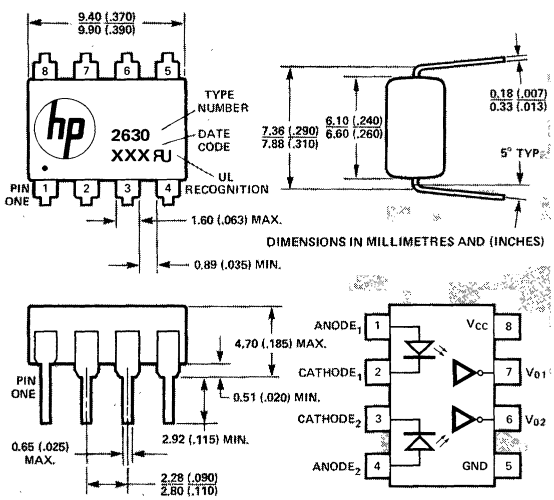
The HCPL-2630 consists of a pair of inverting optically coupled gates each with a GaAsP photon emitting diode and a unique integrated detector. The photons are collected in the detector by a photodiode and then amplified by a high gain linear amplifier that drives a Schottky clamped open collector output transistor. Each circuit is temperature, current and voltage compensated.

This unique dual isolator design provides maximum DC and AC circuit isolation between each input and output while achieving DTL/TTL circuit compatibility. The isolator operational parameters are guaranteed from 0°C to 70°C, such that a minimum input current of 5 mA in each channel will sink an eight gate fan-out (13 mA) at the output with 5 volt V_{CC} applied to the detector. This isolation and coupling is achieved with a typical propagation delay of 50 nsec.

The HCPL-2630 can be used in high speed digital interface applications where common mode signals must be rejected such as for a line receiver and digital programming of floating power supplies, motors, and other machine control systems. The elimination of ground loops can be accomplished between system interfaces such as between a computer and a peripheral memory, printer, controller, etc.

The open collector output provides capability for bussing, strobing and "WIRED-OR" connection. In all applications, the dual channel configuration allows for high density packaging, increased convenience and more usable board space.

OUTLINE DRAWING



Recommended Operating Conditions

	Sym.	Min.	Max.	Units
Input Current, Low Level Each Channel	I_{FL}	0	250	μA
Input Current, High Level Each Channel	I_{FH}	6.3*	10	mA
Supply Voltage, Output	V_{CC}	4.5	5.5	V
Fan Out (TTL Load) Each Channel	N		8	
Operating Temperature	T_A	0	70	°C

Absolute Maximum Ratings

(No derating required up to 70°C)

Storage Temperature .... -55°C to +125°C
Operating Temperature .... 0°C to +70°C
Lead Solder Temperature .... 260°C for 10s (1.6mm below seating plane)
Peak Forward Input Current (each channel) ..... 20 mA (≤ 1 msec Duration)
Average Forward Input Current (each channel) ..... 10 mA
Reverse Input Voltage (each channel) 5V
Supply Voltage - V_{CC} .... 7V (1 Minute Maximum)
Output Current - I_O (each channel) .... 16 mA
Output Voltage - V_O (each channel) 7V
Output Collector Power Dissipation .... 60 mW

*6.3mA condition permits at least 20% CTR degradation guardband. Initial switching threshold is 5mA or less.

Electrical Characteristics

OVER RECOMMENDED TEMPERATURE (T_A = 0°C TO 70°C) UNLESS OTHERWISE NOTED

Parameter	Symbol	Min.	Typ.*	Max.	Units	Test Conditions	Figure	Note
High Level Output Current	I_{OH}		50	250	μA	V_{CC} = 5.5V, V_O = 5.5V, I_F = 250μA		3
Low Level Output Voltage	V_{OL}		0.5	0.6	V	V_{CC} = 5.5V, I_F = 5mA I_{OL} (Sinking) = 13mA		3
High Level Supply Current	I_{CCH}		14	30	mA	V_{CC} = 5.5V, I_F = 0 (Both Channels)		
Low Level Supply	I_{CCL}		26	36	mA	V_{CC} = 5.5V, I_F = 10mA (Both Channels)		
Input - Output Insulation Leakage Current	I_{I-O}			1.0	μA	Relative Humidity = 45% T_A = 25°C, t = 5s, V_{I-O} = 3000Vdc		4
Resistance (Input-Output)	R_{I-O}		10^{12}		Ω	V_{I-O} = 500V, T_A = 25°C		4
Capacitance (Input-Output)	C_{I-O}		0.6		pF	f = 1MHz, T_A = 25°C		4
Input Forward Voltage	V_F		1.5	1.75	V	I_F = 10mA, T_A = 25°C	4	7,3
Input Reverse Breakdown Voltage	BV_R	5			V	I_R = 10μA, T_A = 25°C		
Input Capacitance	C_{IN}		60		pF	V_F = 0, f = 1MHz		3
Input-Input Insulation Leakage Current	I_{I-I}		0.005		μA	Relative Humidity = 45%, t=5s, V_{I-I}=500V		8
Resistance (Input-Input)	R_{I-I}		10^{11}		Ω	V_{I-I} = 500V		8
Capacitance (Input-Input)	C_{I-I}		0.25		pF	f = 1MHz		8
Current Transfer Ratio	CTR		700		%	I_F = 5.0mA, R_L = 100Ω	2	6

*All typical values are at V_{CC} = 5V, T_A = 25°C

Switching Characteristics at T_A=25°C, V_{CC}=5V

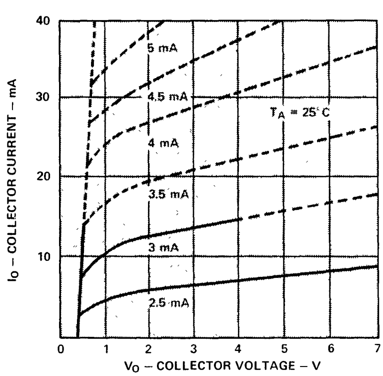
EACH CHANNEL

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Propagation Delay Time to High Output Level	t_{PLH}		55	75	ns	R_L = 350 Ω, C_L = 15pF, I_F = 7.5mA	5,6	1
Propagation Delay Time to Low Output Level	t_{PHL}		40	75	ns	R_L = 350 Ω, C_L = 15pF, I_F = 7.5mA	5,6	2
Output Rise-Fall Time (10-90%)	t_r, t_f		25		ns	R_L = 350 Ω, C_L = 15pF, I_F = 7.5mA		
Common Mode Transient Immunity at High Output Level	CM_H		50		V/μs	V_{CM} = 10V_{p-p}, R_L = 350 Ω, V_O (min.) = 2V, I_F = 0mA	8	5
Common Mode Transient Immunity at Low Output Level	CM_L		-150		V/μs	V_{CM} = 10V_{p-p}, R_L = 350 Ω, V_O (max.) = 0.8V I_F = 7.5mA	8	5

NOTE: It is essential that a bypass capacitor (.01μF to 0.1μF, ceramic) be connected from pin 8 to pin 5. Total lead length between both ends of the capacitor and the isolator pins should not exceed 20mm. Failure to provide the bypass may impair the switching properties.

NOTES:

1. The t_{PLH} propagation delay is measured from the 3.75 mA point on the trailing edge of the input pulse to the 1.5V point on the trailing edge of the output pulse.
2. The t_{PHL} propagation delay is measured from the 3.75 mA point on the leading edge of the input pulse to the 1.5V point on the leading edge of the output pulse.
3. Each channel.
4. Measured between pins 1, 2, 3, and 4 shorted together, and pins 5, 6, 7, and 8 shorted together.
5. Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{CM}/dt on the leading edge of the common mode pulse, V_{CM}, to assure that the output will remain in a Logic High state (i.e., $V_O > 2.0V$). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{CM}/dt on the trailing edge of the common mode pulse signal, V_{CM}, to assure that the output will remain in a Logic Low state (i.e., $V_O < 0.8V$).
6. DC Current Transfer Ratio is defined as the ratio of the output collector current to the forward bias input current times 100%.
7. At 10mA VF decreases with increasing temperature at the rate of 1.9mV/°C.
8. Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together.



NOTE: Dashed characteristics indicate pulsed operation.

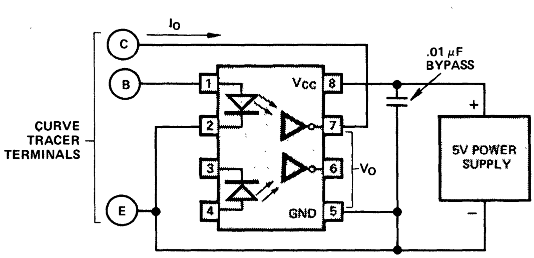


Figure 2. Isolator Transfer Characteristics.

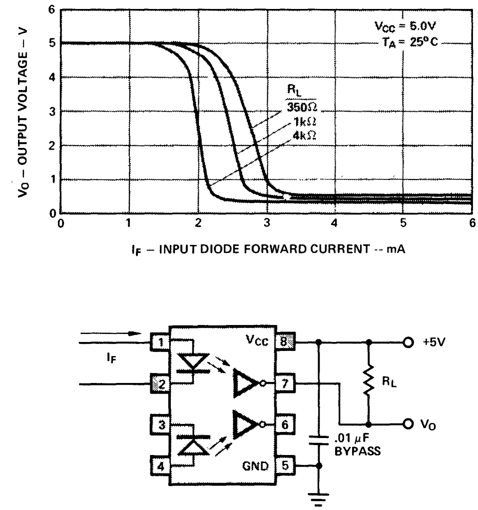


Figure 3. Input-Output Characteristics.

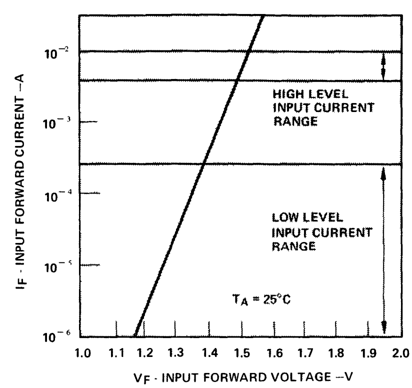


Figure 4. Input Diode Forward Characteristic

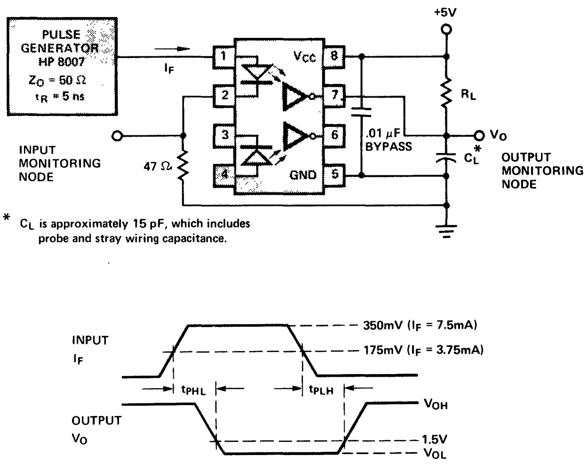


Figure 5. Test Circuit for t_{PHL} and t_{PLH}.

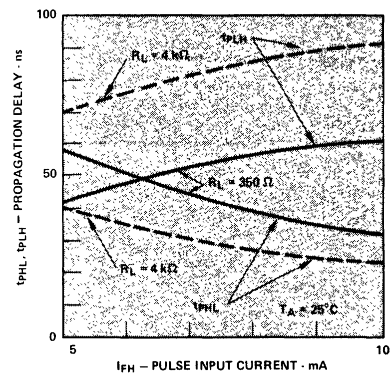


Figure 6. Propagation Delay, t_{PHL} and t_{PLH} vs. Pulse Input Current, I_{FH}.

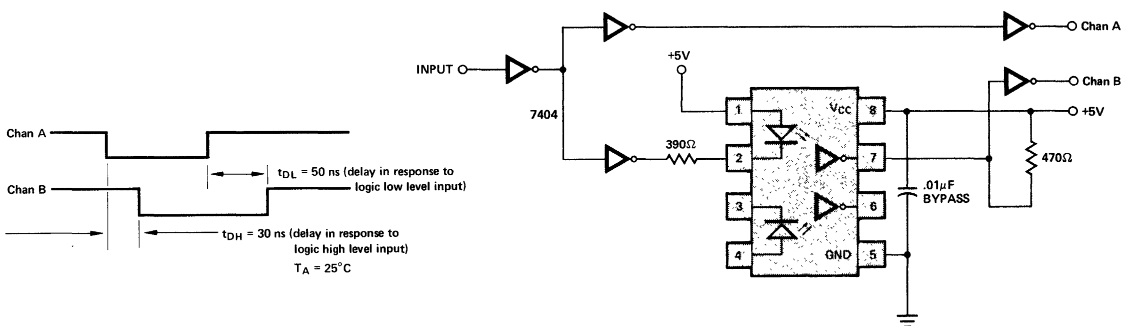


Figure 7. Response Delay Between TTL Gates.

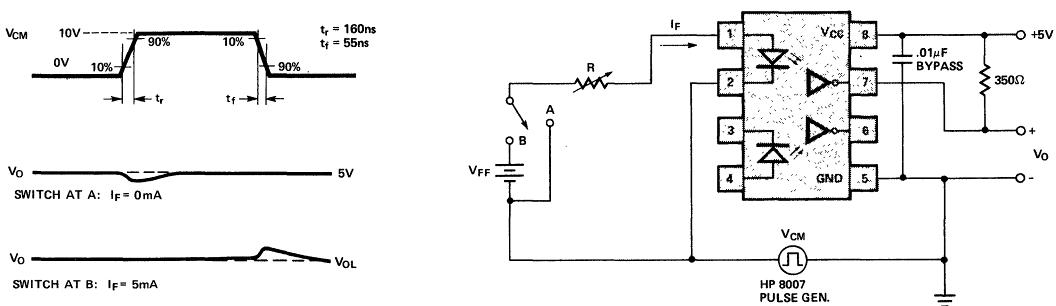


Figure 8. Test Circuit for Transient Immunity and Typical Waveforms.

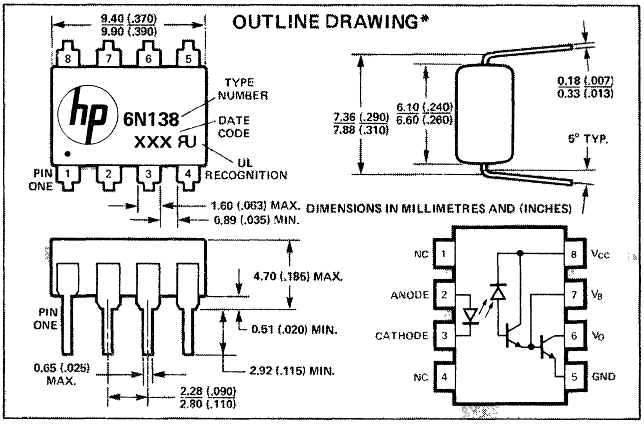
HEWLETT PACKARD

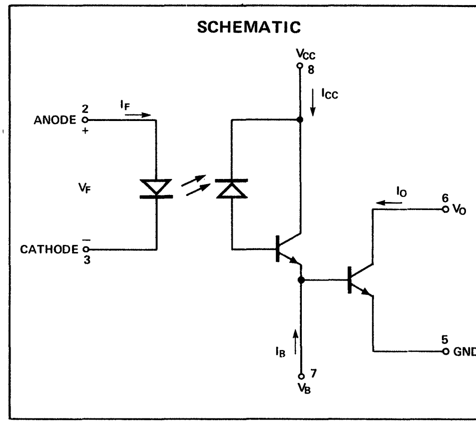
COMPONENTS

LOW INPUT CURRENT, HIGH GAIN OPTICALLY COUPLED ISOLATORS

6N138 (5082-4370)
6N139 (5082-4371)

TECHNICAL DATA APRIL 1977





Features

- **HIGH CURRENT TRANSFER RATIO — 800% TYPICAL**
- **LOW INPUT CURRENT REQUIREMENT — 0.5mA**
- **TTL COMPATIBLE OUTPUT — 0.1V V_{OL}**
- **3000 Vdc INSULATION VOLTAGE**
- **HIGH COMMON MODE REJECTION — 500V/µs**
- **PERFORMANCE GUARANTEED OVER TEMPERATURE 0°C to 70°C**
- **BASE ACCESS ALLOWS GAIN BANDWIDTH ADJUSTMENT**
- **HIGH OUTPUT CURRENT — 60mA**
- **DC TO 1M bit/s OPERATION**
- **RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC. (FILE NO. E55361)**

Description

These high gain series isolators use a Light Emitting Diode and an integrated high gain photon detector to provide 3000V dc electrical insulation, 500V/µs common mode transient immunity and extremely high current transfer ratio between input and output. Separate pins for the photodiode and output stage result in TTL compatible saturation voltages and high speed operation. Where desired the V_{CC} and V_O terminals may be tied together to achieve conventional photodarlington operation. A base access terminal allows a gain bandwidth adjustment to be made.

The 6N139 is suitable for use in CMOS, LTTL or other low power applications. A 400% minimum current transfer ratio is guaranteed over a 0-70°C operating range for only 0.5mA of LED current.

The 6N138 is suitable for use mainly in TTL applications. Current Transfer Ratio is 300% minimum over 0-70°C for an LED current of 1.6mA [1 TTL unit load (U.L.)]. A 300% minimum CTR enables operation with 1 U.L. in, 1 U.L. out with a 2.2 kΩ pull-up resistor.

*JEDEC Registered Data.

Applications

- Ground Isolate Most Logic Families – TTL/TTL, CMOS/TTL, CMOS/CMOS, LTTL/TTL, CMOS/LTTL
- Low Input Current Line Receiver – Long Line or Partyline
- EIA RS-232C Line Receiver
- Telephone Ring Detector
- 117 V ac Line Voltage Status Indicator – Low Input Power Dissipation
- Low Power Systems – Ground Isolation

Absolute Maximum Ratings*

Storage Temperature	−55°C to +125°C
Operating Temperature	0°C to +70°C
Lead Solder Temperature	260°C for 10s (1.6mm below seating plane)
Average Input Current – I_F	20mA [1]
Peak Input Current – I_F	40mA (50% duty cycle, 1 ms pulse width)
Peak Transient Input Current – I_F	1.0A (≤ 1µs pulse width, 300 pps)
Reverse Input Voltage – V_R	5V
Input Power Dissipation	35mW [2]
Output Current – I_O (Pin 6)	60mA [3]
Emitter-Base Reverse Voltage (Pin 5-7)	0.5V
Supply and Output Voltage – V_{CC} (Pin 8-5), V_O (Pin 6-5)	
5082-4370	−0.5 to 7V
5082-4371	−0.5 to 18V
Output Power Dissipation	100mW [4]

See notes, following page.

Electrical Specifications

OVER RECOMMENDED TEMPERATURE (T_A = 0°C to 70°C), UNLESS OTHERWISE SPECIFIED

Parameter	Sym.	Device	Min.	Typ.**	Max.	Units	Test Conditions	Fig.	Note
Current Transfer Ratio	CTR*	6N139	400 500	800 900		%	I_F = 0.5mA, V_O = 0.4V, V_{CC} = 4.5V I_F = 1.6mA, V_O = 0.4V, V_{CC} = 4.5V	3	5,6
		6N138	300	600		%	I_F = 1.6mA, V_O = 0.4V, V_{CC} = 4.5V		
Logic Low Output Voltage	V_{OL}	6N139		0.1 0.1 0.2	0.4 0.4 0.4	V	I_F = 1.6mA, I_O = 6.4mA, V_{CC} = 4.5V I_F = 5mA, I_O = 15mA, V_{CC} = 4.5V I_F = 12mA, I_O = 24mA, V_{CC} = 4.5V	1,2	6
		6N138		0.1	0.4	V	I_F = 1.6mA, I_O = 4.8mA, V_{CC} = 4.5V		
Logic High Output Current	I_{OH}*	6N139		0.05	100	μA	I_F = 0mA, V_O = V_{CC} = 18V		6
		6N138		0.1	250	μA	I_F = 0mA, V_O = V_{CC} = 7V		
Logic Low Supply Current	I_{CCL}			0.2		mA	I_F = 1.6mA, V_O = Open, V_{CC} = 5V		6
Logic High Supply Current	I_{CCH}			10		nA	I_F = 0mA, V_O = Open, V_{CC} = 5V		6
Input Forward Voltage	V_F*			1.4	1.7	V	I_F = 1.6mA, T_A = 25°C	4	
Input Reverse Breakdown Voltage	BV_R*		5		V		I_R = 10μA, T_A=25°C		
Temperature Coefficient of Forward Voltage	$\frac{\Delta V_F}{\Delta T_A}$			−1.8		mV/°C	I_F = 1.6mA		
Input Capacitance	C_{IN}			60		pF	f=1MHz, V_F = 0		
Input - Output Insulation Leakage Current	I_{I-O}*				1.0	μA	45% Relative Humidity, T_A = 25°C t = 5 s, V_{I-O} = 3000Vdc		7
Resistance (Input-Output)	R_{I-O}			10^{12}		Ω	V_{I-O} = 500Vdc		7
Capacitance (Input-Output)	C_{I-O}			0.6		pF	f=1MHz		7

**All typicals at T_A = 25°C and V_{CC} = 5V, unless otherwise noted.

Switching Specifications

AT T_A = 25°C

Parameter	Sym.	Device	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time To Logic Low at Output	t_{PHL}*	6N139		5 0.2	25 1	μs	I_F = 0.5mA, R_L = 4.7kΩ I_F = 12mA, R_L = 270Ω	9	6,8
		6N138		1	10	μs	I_F = 1.6mA, R_L = 2.2kΩ		
Propagation Delay Time To Logic High at Output	t_{PLH}*	6N139		5 1	60 7	μs	I_F = 0.5mA, R_L = 4.7kΩ I_F = 12mA, R_L = 270Ω	9	6,8
		6N138		4	35	μs	I_F = 1.6mA, R_L = 2.2kΩ		
Common Mode Transient Immunity at Logic High Level Output	CM_H			500		V/μs	I_F = 0mA, R_L = 2.2kΩ, R_{CC} = 0 $\lvert V_{cm} \rvert$ = $10V_{p-p}$	10	9,10
Common Mode Transient Immunity at Logic Low Level Output	CM_L			−500		V/μs	I_F = 1.6mA, R_L = 2.2kΩ, R_{CC} = 0 $\lvert V_{cm} \rvert$ = $10V_{p-p}$	10	9,10

NOTES:

1. Derate linearly above 50°C free-air temperature at a rate of 0.4mA/°C.
2. Derate linearly above 50°C free-air temperature at a rate of 0.7mW/°C.
3. Derate linearly above 25°C free-air temperature at a rate of 0.7mA/°C.
4. Derate linearly above 25°C free-air temperature at a rate of 2.0mW/°C.
5. DC CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.
6. Pin 7 Open.
7. Device considered a two-terminal device: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7, and 8 shorted together.
8. Use of a resistor between pin 5 and 7 will decrease gain and delay time. See Application Note 951-1 for more details.
9. Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{cm}/dt on the leading edge of the common mode pulse, V_{cm}, to assure that the output will remain in a Logic High state (i.e., $V_O > 2.0V$). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{cm}/dt on the trailing edge of the common mode pulse signal, V_{cm}, to assure that the output will remain in a Logic Low state (i.e., $V_O < 0.8V$).
10. In applications where dV/dt may exceed 50,000V/μs (such as static discharge) a series resistor, R_{CC}, should be included to protect the detector IC from destructively high surge currents. The recommended value is $R_{CC} \approx \frac{1V}{0.15\, I_F\,(mA)}$ kΩ.

*JEDEC Registered Data.

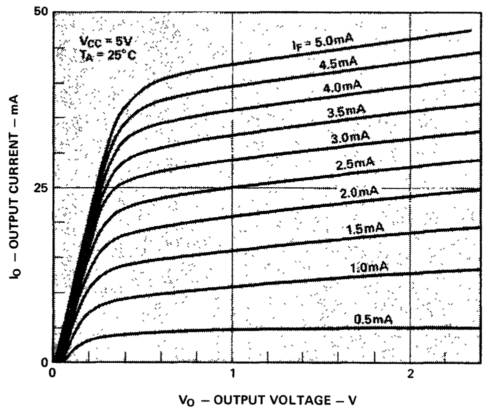


Figure 1. 6N139 DC Transfer Characteristics.

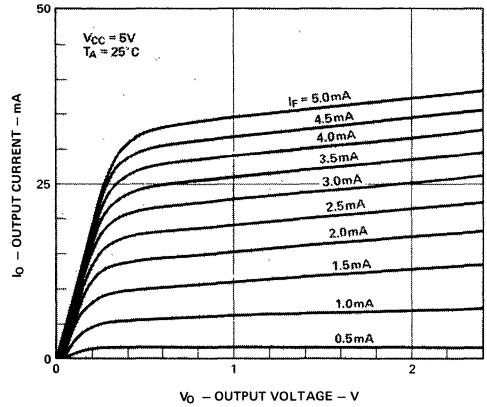


Figure 2. 6N138 DC Transfer Characteristics.

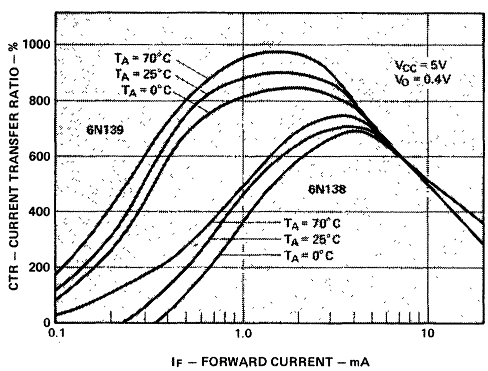


Figure 3. Current Transfer Ratio vs. Forward Current.

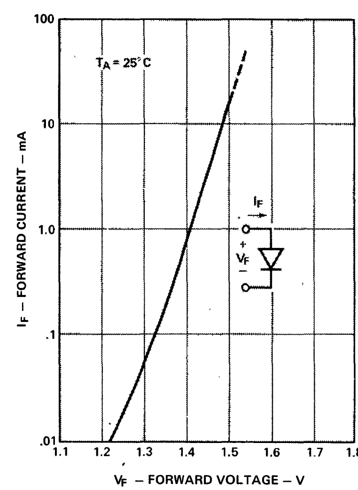


Figure 4. Input Diode Forward Current vs. Forward Voltage.

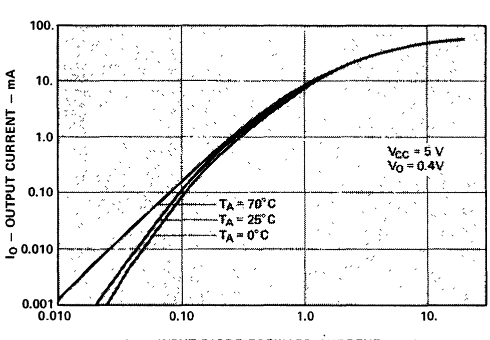


Figure 5. 6N139 Output Current vs. Input Diode Forward Current.

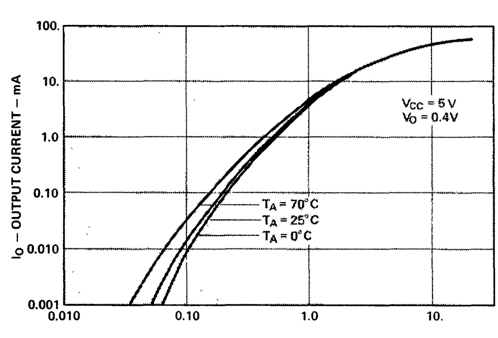


Figure 6. 6N138 Output Current vs. Input Diode Forward Current.

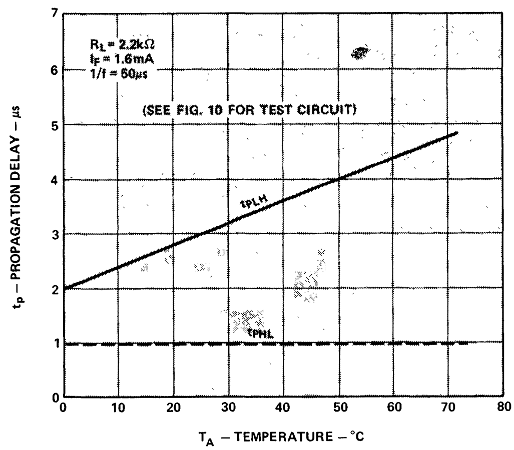


Figure 7. Propagation Delay vs. Temperature.

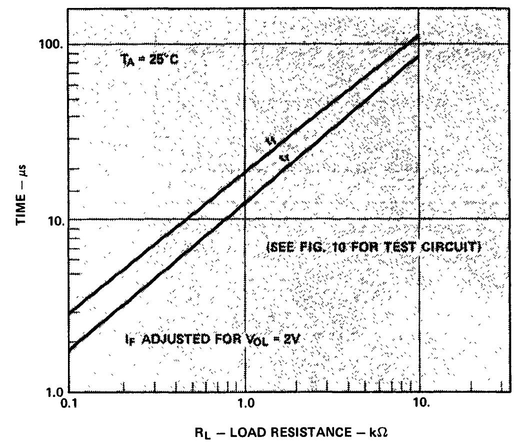


Figure 8. Non Saturated Rise and Fall Times vs. Load Resistance.

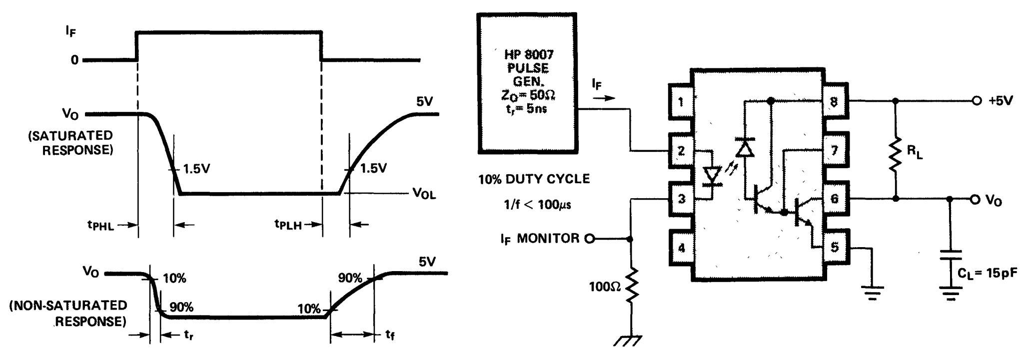


Figure 9. Switching Test Circuit.*

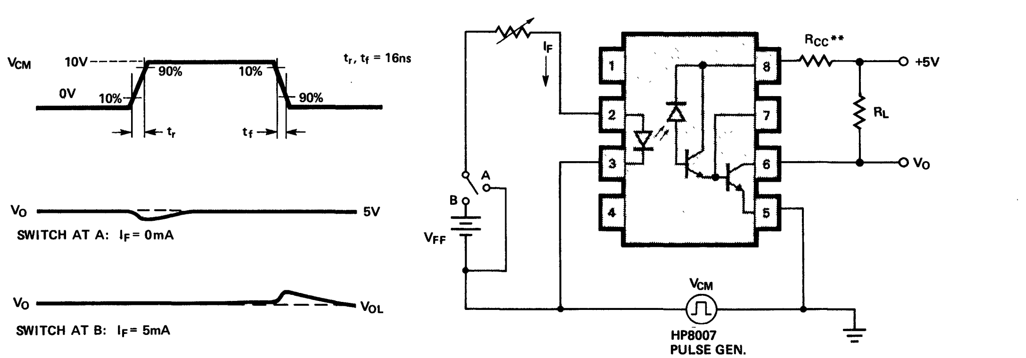


Figure 10. Test Circuit for Transient Immunity and Typical Waveforms.

**See Note 10

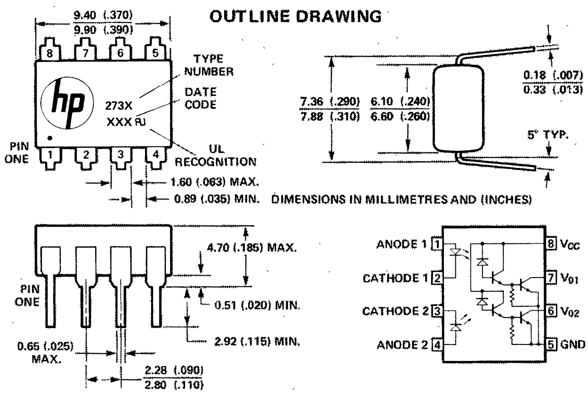
*JEDEC Registered Data.

DUAL LOW INPUT CURRENT, HIGH GAIN OPTICALLY COUPLED ISOLATORS

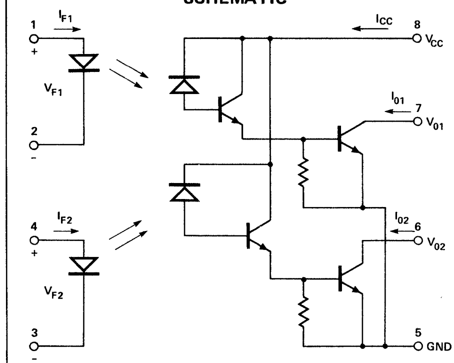
HCPL-2730
HCPL-2731

TECHNICAL DATA APRIL 1977

OUTLINE DRAWING



SCHEMATIC



Features

- HIGH CURRENT TRANSFER RATIO — 1000% TYPICAL
- LOW INPUT CURRENT REQUIREMENT — 0.5 mA
- LOW OUTPUT SATURATION VOLTAGE — 1.0V TYPICAL
- HIGH DENSITY PACKAGING
- 3000V DC INSULATION VOLTAGE
- PERFORMANCE GUARANTEED OVER 0°C TO 70°C TEMPERATURE RANGE
- HIGH COMMON MODE REJECTION
- DATA RATES UP TO 200K BIT/s
- HIGH FANOUT
- RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES, INC. (FILE NO. E55361).

Applications

- Digital Logic Ground Isolation
- Telephone Ring Detector
- EIA RS-232C Line Receiver
- Low Input Current Line Receiver — Long Line or Partyline
- Microprocessor Bus Isolation
- Current Loop Receiver
- Polarity Sensing
- Level Shifting
- Line Voltage Status Indicator — Low input Power Dissipation

Description

The HCPL-2730/31 dual channel isolators contain a separated pair of GaAsP light emitting diodes optically coupled to a pair of integrated high gain photon detectors. They provide extremely high current transfer ratio, 3000V dc electrical insulation and excellent input-output common mode transient immunity. A separate pin for the photodiodes and first gain stages (V_{CC}) permits lower output saturation voltage and higher speed operation than possible with conventional photodarlington type isolators. The separate V_{CC} pin can be strobed low as an output disable. In addition V_{CC} may be as low as 1.6V without adversely affecting the parametric performance.

Guaranteed operation at low input currents and the high current transfer ratio (CTR) reduce the magnitude and effects of CTR degradation.

The outstanding high temperature performance of this split Darlington type output amplifier results from the inclusion of an integrated emitter-base bypass resistor which shunts photodiode and first stage leakage currents to ground.

The HCPL-2731 has a 400% minimum CTR at an input current of only 0.5 mA making it ideal for use in low input current applications such as MOS, CMOS and low power logic interfacing or RS232C data transmission systems. In addition, the high CTR and high output current capability make this device extremely useful in applications where a high fanout is required. Compatibility with high voltage CMOS logic systems is guaranteed by the 18V V_{CC} and V_O specifications and by testing output high leakage (I_{OH}) at 18V.

The HCPL-2730 is specified at an input current of 1.6 mA and has a 7V V_{CC} and V_O rating. The 300% minimum CTR allows TTL to TTL interfacing with an input current of only 1.6 mA.

Important specifications such as CTR, leakage current and output saturation voltage are guaranteed over the 0°C to 70°C temperature range to allow trouble-free system operation.

Electrical Specifications

(Over Recommended Temperature T_A = 0°C to 70°C, Unless Otherwise Specified)

Parameter	Sym.	Device HCPL-	Min.	Typ.*	Max.	Units	Test Conditions	Fig.	Note
Current Transfer Ratio	CTR	2731	400	1000		%	I_F = 0.5mA, V_O = 0.4V, V_{CC} = 4.5V	2	6,7
			500	1100			I_F = 1.6mA, V_O = 0.4V, V_{CC} = 4.5V		
		2730	300	1000		%	I_F = 1.6mA, V_O = 0.4V, V_{CC} = 4.5V	2	
Logic Low Output Voltage	V_{OL}	2731		0.1	0.4	V	I_F = 1.6mA, I_O = 8mA, V_{CC} = 4.5V		6
				0.1	0.4		I_F = 5mA, I_O = 15mA, V_{CC} = 4.5V		
				0.2	0.4		I_F = 12mA, I_O = 24mA, V_{CC} = 4.5V		
		2730		0.1	0.4	V	I_F = 1.6mA, I_O = 4.8mA, V_{CC} = 4.5V		
Logic High Output Current	I_{OH}	2731		0.005	100	µA	I_F = 0 mA, V_O = V_{CC} = 18V		6
		2730		0.01	250	µA	I_F = 0mA, V_O = V_{CC} = 7V		
Logic Low Supply Current	I_{CCL}	2731		1.2		mA	I_{F1} = I_{F2} = 1.6mA, V_{01} = V_{02} = Open; V_{CC} = 18V		
		2730		0.9			V_{CC} = 7V		
Logic High Supply Current	I_{CCH}	2731		5		nA	I_{F1} = I_{F2} = 0mA, V_{01} = V_{02} = Open; V_{CC} = 18V		
		2730		4			V_{CC} = 7V		
Input Forward Voltage	V_F			1.4	1.7	V	I_F = 1.6mA, T_A = 25°C	4	6
Input Reverse Breakdown Voltage	BV_R		5			V	I_R = 10 µA, T_A = 25°C		
Temperature Coefficient of Forward Voltage	$\frac{\Delta V_F}{\Delta T_A}$			-1.8		mV/°C	I_F = 1.6mA		6
Input Capacitance	C_{IN}			60		pF	f = 1 MHz, V_F = 0		6
Input-Output Insulation Leakage Current	$I_{I\text{-}O}$				1.0	µA	45% Relative Humidity, T_A = 25°C, t = 5s, $V_{I\text{-}O}$ = 3000Vdc		8
Resistance (Input-Output)	$R_{I\text{-}O}$			10^{12}		Ω	$V_{I\text{-}O}$ = 500Vdc		8
Capacitance (Input-Output)	$C_{I\text{-}O}$			0.6		pF	f = 1 MHz		8
Input-Input Insulation Leakage Current	$I_{I\text{-}I}$			0.005		µA	45% Relative Humidity, t = 5s, $V_{I\text{-}I}$ = 500Vdc		9
Resistance (Input-Input)	$R_{I\text{-}I}$			10^{11}		Ω	$V_{I\text{-}I}$ = 500Vdc		9
Capacitance (Input-Input)	$C_{I\text{-}I}$			0.25		pF	f = 1 MHz		9

*All typicals at T_A = 25°C

Switching Specifications at T_A=25°C

Parameter	Sym.	Device HCPL-	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time To Logic Low at Output	t_{PHL}	2731		25	100	µs	I_F = 0.5mA, R_L = 4.7kΩ	9	
		2730/1		5	20	µs	I_F = 1.6mA, R_L = 2.2kΩ		
				0.5	2		I_F = 12mA, R_L = 270Ω		
Propagation Delay Time To Logic High at Output	t_{PLH}	2731		20	60	µs	I_F = 0.5mA, R_L = 4.7kΩ	9	
		2730/1		10	35		I_F = 1.6mA, R_L = 2.2kΩ		
				1	10		I_F = 12mA, R_L = 270Ω		
Common Mode Transient Immunity at Logic High Level Output	CM_H			500		V/µs	I_F = 0mA, R_L = 2.2kΩ, $\lvert V_{CM}\rvert$ = 10$V_{p\text{-}p}$	10	10,11
Common Mode Transient Immunity at Logic Low Level Output	CM_L			-500		V/µs	I_F = 1.6mA, R_L = 2.2kΩ, $\lvert V_{CM}\rvert$ = 10$V_{p\text{-}p}$	10	10,11

NOTES:
1. Derate linearly above 50°C free-air temperature at a rate of 0.5mA/°C.
2. Derate linearly above 50°C free-air temperature at a rate of 0.9mW/°C.
3. Derate linearly above 35°C free-air temperature at a rate of 0.6mA/°C.
4. Pin 5 should be the most negative voltage at the detector side.
5. Derate linearly above 35°C free-air temperature at a rate of 1.7mW/°C. Output power is collector output power plus supply power.
6. Each channel.
7. CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.
8. Device considered a two-terminal device: Pins 1, 2, 3, and 4 shorted together and Pins 5, 6, 7, and 8 shorted together.
9. Measured between pins 1 and 2 shorted together, and pins 3 and 4 shorted together.
10. Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{CM}/dt on the leading edge of the common mode pulse V_{CM}, to assure that the output will remain in Logic High state (i.e., $V_O > 2.0V$). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{CM} dt on the trailing edge of the common mode pulse signal, V_{CM}, to assure that the output will remain in a Logic Low state (i.e., $V_O < 0.8V$).
11. In applications where dV/dt may exceed 50,000 V/µs (such as a static discharge) a series resistor, R_{CC}, should be included to protect the detector IC from destructively high surge currents. The recommended value is $R_{CC} \approx \frac{1V}{0.3\ I_F\ (mA)}$ kΩ.

Absolute Maximum Ratings

Storage Temperature .... -55°C to +125°C
Operating Temperature .... -40°C to +85°C
Lead Solder Temperature .... 260°C for 10 sec
(1.6mm below seating plane)
Average Input Current — I_F
(each channel) .... 20 mA[1]
Peak Input Current — I_F
(each channel) .... 40 mA
(50% duty cycle, 1 ms pulse width)
Reverse Input Voltage — V_R
(each channel) 5V

Input Power Dissipation
(each channel) .... 35 mW[2]
Output Current — I_O
(each channel) .... 60 mA[3]
Supply and Output Voltage — V_{CC} (Pin 8-5), V_O (Pin 7,6-5)[4]
HCPL-2730 .... -0.5 to 7V
HCPL-2731 .... -0.5 to 18V
Output Power Dissipation
(each channel) .... 100 mW[5]

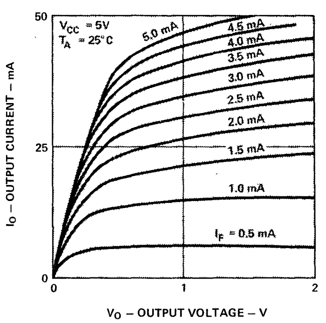


Figure 1. DC Transfer Characteristics.

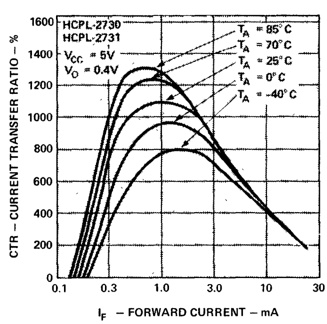


Figure 2. Current Transfer Ratio vs. Forward Current.

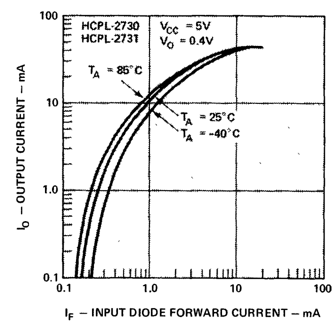


Figure 3. Output Current vs. Input Diode Forward Current.

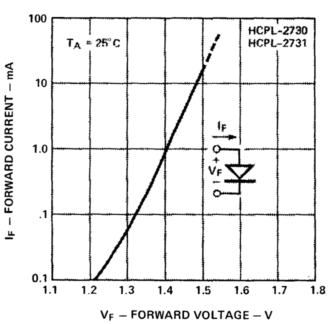


Figure 4. Input Diode Forward Current vs. Forward Voltage.

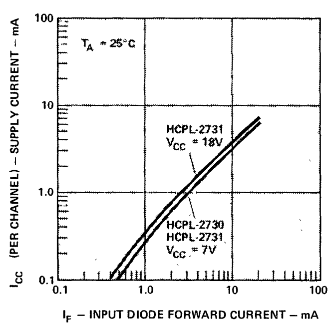


Figure 5. Supply Current Per Channel vs. Input Diode Forward Current.

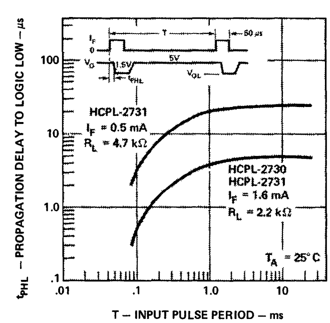


Figure 6. Propagation Delay To Logic Low vs. Pulse Period.

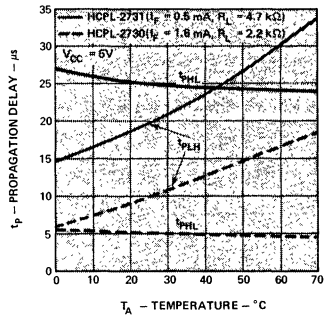


Figure 7. Propagation Delay vs. Temperature.

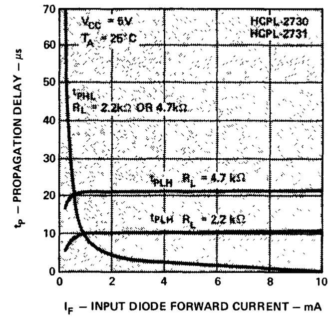


Figure 8. Propagation Delay vs. Input Diode Forward Current.

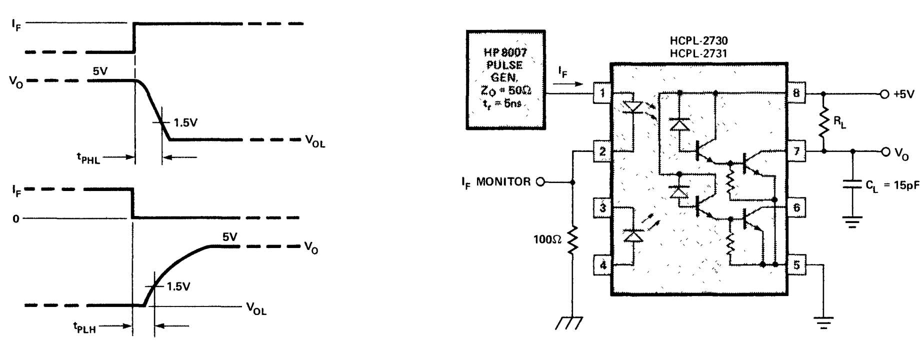
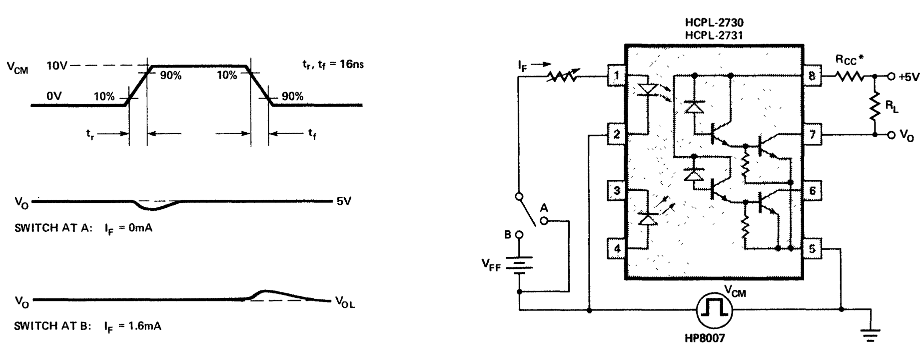


Figure 9. Switching Test Circuit.



*See Note 11.

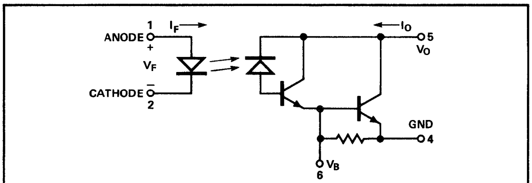
Figure 10. Test Circuit for Transient Immunity and Typical Waveforms.

HEWLETT hp PACKARD
COMPONENTS

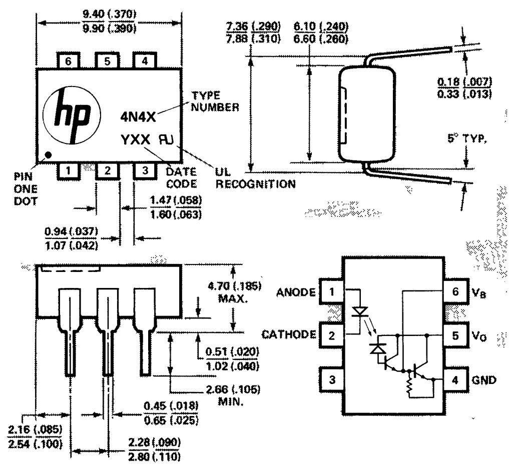
LOW INPUT CURRENT, HIGH GAIN OPTOCOUPLER

4N45
4N46

TECHNICAL DATA APRIL 1977



Schematic



DIMENSIONS IN MILLIMETERS AND (INCHES).

Outline Drawing*

Features

- **HIGH CURRENT TRANSFER RATIO — 1000% TYPICAL**
- **LOW INPUT CURRENT REQUIREMENT — 0.5 mA**
- **3000 Vdc INSULATION VOLTAGE**
- **PERFORMANCE GUARANTEED OVER 0°C TO 70°C TEMPERATURE RANGE**
- **RECOGNIZED UNDER THE COMPONENT PROGRAM OF UNDERWRITERS LABORATORIES INC. (FILE NO. E55361)**
- **INTERNAL BASE-EMITTER RESISTOR MINIMIZES OUTPUT LEAKAGE**
- **GAIN-BANDWIDTH ADJUSTMENT PIN**
- **HIGH COMMON MODE REJECTION**

Description

The 4N45/46 optocouplers contain a GaAsP light emitting diode optically coupled to a high gain photodetector IC.

The excellent performance over temperature results from the inclusion of an integrated emitter-base bypass resistor which shunts photodiode and first stage leakage currents to ground. External access to the second stage base provides better noise rejection than a conventional photodarlington detector. An external resistor or capacitor at the base can be added to make a gain-bandwidth or input current threshold adjustment. The base lead can also be used for feedback.

The high current transfer ratio at very low input currents permits circuit designs in which adequate margin can be allowed for the effects of CTR degradation over time.

The 4N46 has a 350% minimum CTR at an input current of only 0.5mA making it ideal for use in low input current applications such as MOS, CMOS and low power logic interfacing. Compatibility with high voltage CMOS logic systems is assured by the 20V minimum breakdown voltage of the output transistor and by the guaranteed maximum output leakage (I_{OH}) at 18V.

The 4N45 has a 250% minimum CTR at 1.0mA input current and a 7V minimum breakdown voltage rating.

*JEDEC Registered Data.

Applications

- **Telephone Ring Detector**
- **Digital Logic Ground Isolation**
- **Low Input Current Line Receiver**
- **Line Voltage Status Indicator — Low Input Power Dissipation**
- **Logic to Reed Relay Interface**
- **Level Shifting**
- **Interface Between Logic Families**

Absolute Maximum Ratings*

Storage Temperature .... -55°C to +125°C
Operating Temperature .... -40°C to +70°C
Lead Solder Temperature .... 260°C for 10 s.
(1.6mm below seating plane)
Average Input Current — I_F .... 20 mA[1]
Peak Input Current — I_F .... 40 mA
(50% duty cycle, 1ms pulse width)
Peak Transient Input Current — I_F 1.0A
($\leqslant 1\ \mu s$ pulse width, 300pps)
Reverse Input Voltage — V_R 5V
Input Power Dissipation .... 35mW[2]
Output Current — I_O (Pin 5) .... 60 mA[3]
Emitter-Base Reverse Voltage (Pins 4-6) 0.5V
Output Voltage — V_O (Pin 5-4)
4N45 .... -0.5 to 7V
4N46 .... -0.5 to 20V
Output Power Dissipation .... 100mW[4]

See notes, following page

Electrical Specifications

OVER RECOMMENDED TEMPERATURE (T_A = 0°C TO 70°C), UNLESS OTHERWISE SPECIFIED

Parameter	Sym.	Device	Min.	Typ.**	Max.	Units	Test Conditions	Fig.	Note
Current Transfer Ratio	CTR*	4N46	350	1500		%	I_F = 0.5mA, V_O = 1.0V	4	5,6
			500	1500			I_F = 1.0mA, V_O = 1.0V		
			200	600			I_F = 10mA, V_O = 1.2V		
		4N45	250	1200		%	I_F = 1.0mA, V_O = 1.0V		
			200	500			I_F = 10mA, V_O = 1.2V		
Logic Low Output Voltage	V_{OL}	4N46		.90	1.0	V	I_F = 0.5mA, I_{OL} = 1.75mA		6
				.92	1.0		I_F = 1.0mA, I_{OL} = 5.0mA		
				.95	1.2		I_F = 10mA, I_{OL} = 20mA		
		4N45		.90	1.0	V	I_F = 1.0mA, I_{OL} = 2.5mA		
				.95	1.2		I_F = 10mA, I_{OL} = 20mA		
Logic High Output Current	I_{OH}*	4N46		.001	100	µA	I_F = 0mA, V_O = 18V		6
		4N45		.001	250	µA	I_F = 0mA, V_O = 5V		
Input Forward Voltage	V_F*			1.4	1.7	V	I_F = 1.0mA, T_A = 25°C	1	
Temperature Coefficient of Forward Voltage	$\frac{\Delta V_F}{\Delta T_A}$			-1.8		mV/°C	I_F = 1.0mA		
Input Reverse Breakdown Voltage	BV_R*		5			V	I_R = 10µA, T_A = 25°C		
Input Capacitance	C_{IN}			60		pF	f = 1MHz, V_F = 0		
Input-Output Insulation Leakage Current	I_{I-O}*				1.0	µA	45% Relative Humidity, T_A=25°C t = 5 s, V_{I-O} = 3000VDC		7
Resistance (Input-Output)	R_{I-O}			10^{12}		Ω	V_{I-O} = 500VDC		7
Capacitance (Input-Output)	C_{I-O}			0.6		pF	f = 1MHz		7

Switching Specifications

AT T_A = 25°C

Parameter	Symbol	Min.	Typ.**	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time To Logic Low at Output	t_{PHL}		80		µs	I_F = 1.0mA, R_L = 10kΩ	8	6,8
	t_{PHL}*		5	50	µs	I_F = 10mA, R_L = 220Ω		
Propagation Delay Time To Logic High at Output	t_{PLH}		1500		µs	I_F = 1.0mA, R_L = 10kΩ	8	6,8
	t_{PLH}*		150	500	µs	I_F = 10mA, R_L = 220Ω		
Common Mode Transient Immunity at Logic High Level Output	CM_H		500		V/µs	I_F = 0mA, R_L = 10kΩ $\|V_{cm}\|$ = $10V_{p-p}$	9	9
Common Mode Transient Immunity at Logic Low Level Output	CM_L		-500		V/µs	I_F = 1.0mA, R_L = 10kΩ $\|V_{cm}\|$ = $10V_{p-p}$	9	9

*JEDEC Registered Data.
**All typicals at T_A = 25°C, unless otherwise noted.

NOTES:

1. Derate linearly above 50°C free-air temperature at a rate of 0.4mA/°C.
2. Derate linearly above 50°C free-air temperature at a rate of 0.7mW/°C.
3. Derate linearly above 25°C free-air temperature at a rate of 0.8mA/°C.
4. Derate linearly above 25°C free-air temperature at a rate of 1.5mW/°C.
5. DC CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.
6. Pin 6 Open.
7. Device considered a two-terminal device: Pins 1, 2, 3 shorted together and Pins 4, 5, and 6 shorted together.
8. Use of a resistor between pin 4 and 6 will decrease gain and delay time. (See Figures 10 and 12).
9. Common mode transient immunity in Logic High level is the maximum tolerable (positive) dV_{cm}/dt on the leading edge of the common mode pulse, V_{cm}, to assure that the output will remain in a Logic High state (i.e., $V_O > 2.5V$). Common mode transient immunity in Logic Low level is the maximum tolerable (negative) dV_{cm}/dt on the trailing edge of the common mode pulse signal, V_{cm}, to assure that the output will remain in a Logic Low state (i.e., $V_O < 2.5V$).

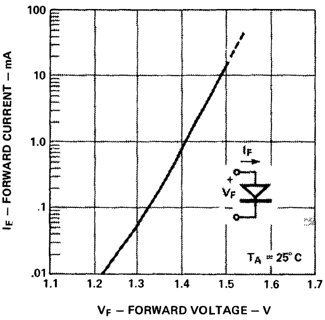


Figure 1. Input Diode Forward Current vs. Forward Voltage.

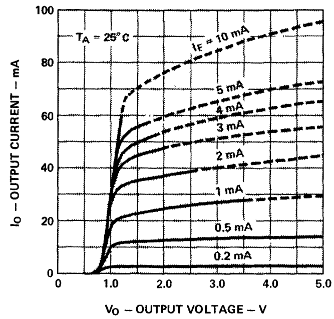


Figure 2. Typical DC Transfer Characteristics.

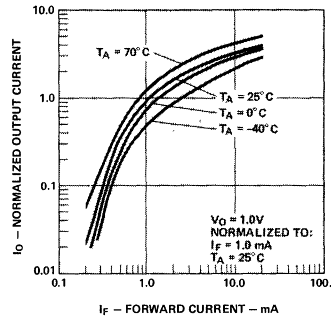


Figure 3. Output Current vs. Input Current.

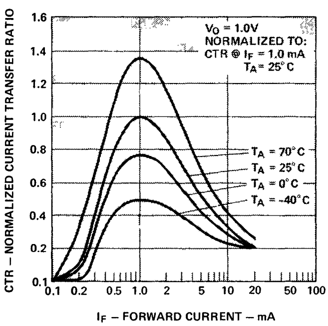


Figure 4. Current Transfer Ratio vs. Input Current.

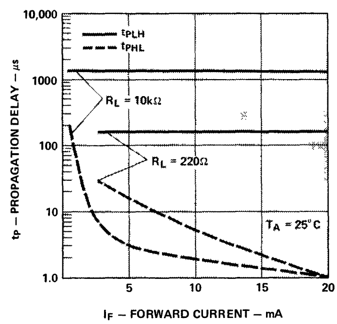


Figure 5. Propagation Delay vs. Forward Current.

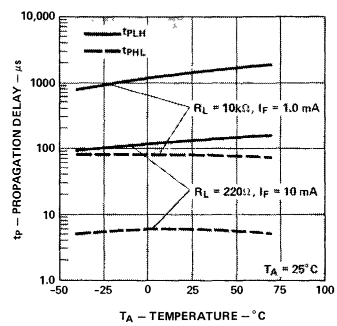


Figure 6. Propagation Delay vs. Temperature.

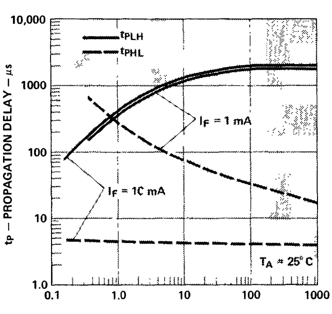


Figure 7. Propagation Delay vs Load Resistor.

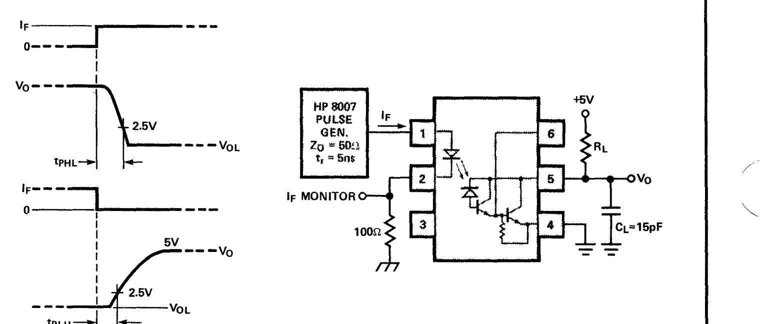


Figure 8. Switching Test Circuit

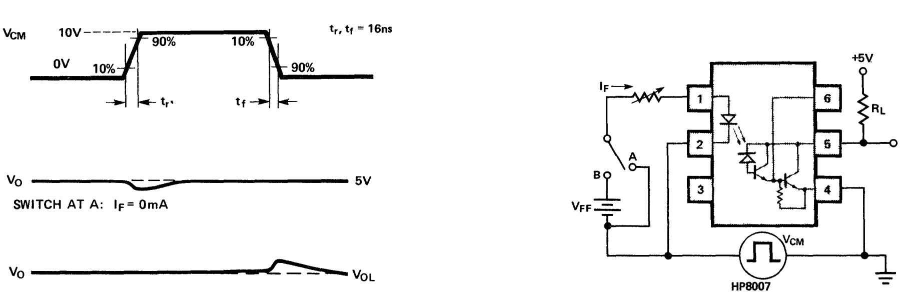


Figure 9. Test Circuit for Transient Immunity and Typical Waveforms.

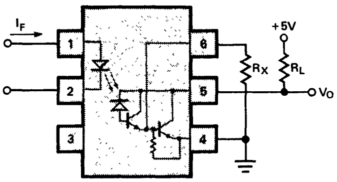


Figure 10. External Base Resistor, R_X

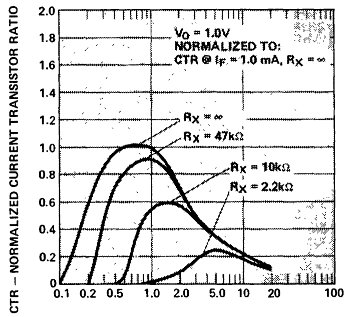


Figure 11. Effect of R_X On Current Transfer Ratio

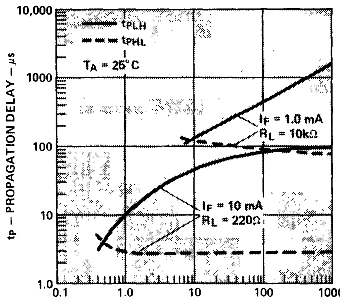
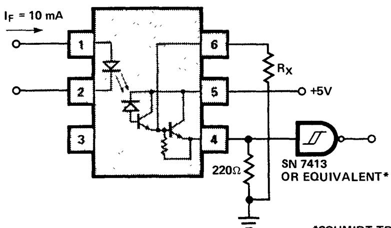


Figure 12. Effect of R_X On Propagation Delay

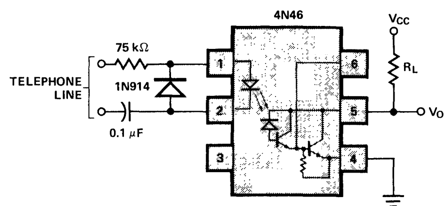
Applications



R_X (kΩ)	t_{PHL} (μs)	t_{PLH} (μs)
∞	5	320
100	5	200
47	5	140
20	6	80
10	6	45

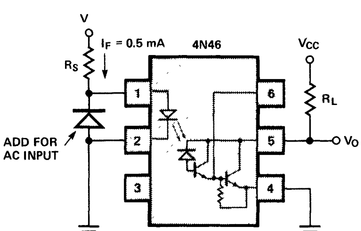
*SCHMIDT TRIGGER RECOMMENDED BECAUSE OF LONG t_r, t_f.

TTL Interface



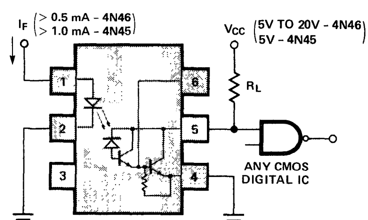
NOTE: AN INTEGRATOR MAY BE REQUIRED AT THE OUTPUT TO ELIMINATE DIALING PULSES AND LINE TRANSIENTS.

Telephone Ring Detector

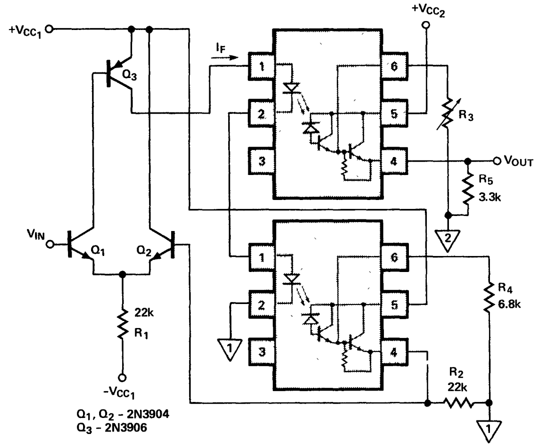


V (Vdc or Vrms)	R_S	V • I_F (mW)
24	47kΩ	11
48	100kΩ	22
115	220kΩ	62
230	470kΩ	113

Line Voltage Monitor



CMOS Interface



Analog Signal Isolation

CHARACTERISTICS

$R_{IN} \approx 30M\Omega$, $R_{OUT} \approx 50\Omega$
$V_{IN(MAX.)} = V_{CC_1} - 1V$, LINEARITY BETTER THAN 5%

DESIGN COMMENTS

R_1 - NOT CRITICAL $\left(\ll \frac{V_{IN\,(MAX.)} - (-V_{CC_1}) - V_{BE}}{I_{F\,(MAX.)}}\right) h_{FE}\, Q_3$

R_2 - NOT CRITICAL (OMIT IF 0.2 TO 0.3V OFFSET IS TOLERABLE)

$R_4 > \frac{V_{IN\,(MAX.)} + V_{BE}}{1\text{ mA}}$

$R_5 > \frac{V_{IN\,(MAX.)}}{2.5\text{ mA}}$

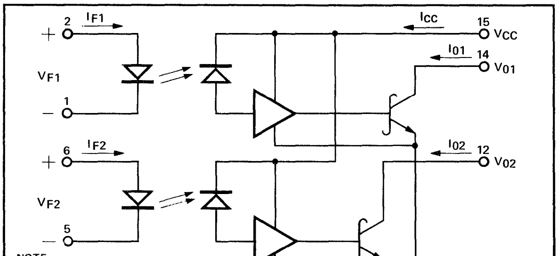
NOTE: ADJUST R_3 SO $V_{OUT} = V_{IN}$ AT $V_{IN} = \frac{V_{IN\,(MAX.)}}{2}$

DUAL CHANNEL HERMETICALLY SEALED OPTICALLY COUPLED ISOLATOR

HEWLETT hp PACKARD
COMPONENTS

6N134 (5082-4365)
6N134 TXV (TX -4365)
6N134 TXV B (TXB-4365)

TECHNICAL DATA APRIL 1977



NOTE:
A .01 TO 0.1µF BYPASS CAPACITOR MUST BE CONNECTED BETWEEN PINS 15 AND 10.

Features

- **HERMETICALLY SEALED**
- **HIGH SPEED**
- **PERFORMANCE GUARANTEED OVER -55°C TO +125°C AMBIENT TEMPERATURE RANGE**
- **STANDARD HIGH RELIABILITY SCREENED PARTS AVAILABLE**
- **TTL COMPATIBLE INPUT AND OUTPUT**
- **HIGH COMMON MODE REJECTION**
- **DUAL-IN-LINE PACKAGE**
- **1500Vdc INSULATION VOLTAGE**
- **EIA REGISTRATION**

Applications

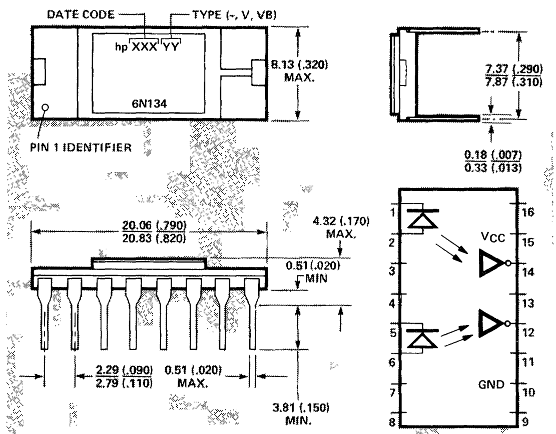
- Logic Ground Isolation
- Line Receiver
- Computer - Peripheral Interface
- High Density Packaging
- High Reliability Systems

Description

The 6N134 consists of a pair of inverting optically coupled gates, each with a light emitting diode and a unique high gain integrated photon detector in a hermetically sealed ceramic package. The output of the detector is an open collector Schottky clamped transistor.

This unique dual isolator design provides maximum DC and AC circuit isolation between each input and output while achieving TTL circuit compatibility. The isolator operational parameters are guaranteed from -55°C to +125°C, such that a minimum input current of 10 mA in each channel will sink a six gate fanout (10 mA) at the output with 4.5 to 5.5 V V_{CC} applied to the detector. This isolation and coupling is achieved with a typical propagation delay of 55 nsec.

OUTLINE DRAWING*



DIMENSIONS IN MILLIMETRES AND (INCHES).

Recommended Operating Conditions

TABLE I

	Sym.	Min.	Max.	Units
Input Current, Low Level Each Channel	I_{FL}	0	250	µA
Input Current, High Level Each Channel	I_{FH}	12.5**	20	mA
Supply Voltage	V_{CC}	4.5	5.5	V
Fan Out (TTL Load) Each Channel	N		6	
Operating Temperature	T_A	–55	125	°C

Absolute Maximum Ratings*

(No derating required up to 125°C)

Storage Temperature . . . . -65°C to +150°C
Operating Temperature . . . . -55°C to +125°C
Lead Solder Temperature . . . . 260°C for 10s (1.6mm below seating plane)
Peak Forward Input Current (each channel) . . . . 40 mA (≤ 1 ms Duration)
Average Input Forward Current (each channel) . . . . . 20 mA
Input Power Dissipation (each channel) . . . . 35 mW
Reverse Input Voltage (each channel) 5V
Supply Voltage - V_{CC} 7V
Output Current - I_O (each channel) . . . . 25 mA
Output Power Dissipation (each channel) . . . . 40 mW
Output Voltage - V_O (each channel) 7V
Total Power Dissipation (both channels) . . . . 350 mW

**12.5mA condition permits at least 20% CTR degradation guardband. Initial switching threshold is 10mA or less.

*JEDEC Registered Data.

TABLE II
Electrical Characteristics
OVER RECOMMENDED TEMPERATURE (T_A = –55°C TO +125°C) UNLESS OTHERWISE NOTED

Parameter	Symbol	Min.	Typ.**	Max.	Units	Test Conditions	Figure	Note
High Level Output Current	I_{OH}*		1	250	μA	V_{CC} = 5.5V, V_O = 5.5V, I_F = 250μA		1
Low Level Output Voltage	V_{OL}*		0.5	0.6	V	V_{CC} = 5.5V, I_F = 10mA I_{OL} (Sinking) = 10mA		1
High Level Supply Current	I_{CCH}*		18	28	mA	V_{CC} = 5.5V, I_F = 0 (Both Channels)		
Low Level Supply Current	I_{CCL}*		26	36	mA	V_{CC} = 5.5V, I_F = 20mA (Both Channels)		
Input Forward Voltage	V_F*		1.5	1.75	V	I_F = 20mA, T_A = 25°C	1	1
Input Reverse Breakdown Voltage	BV_R*	5			V	I_R = 10μA, T_A = 25°C		
Input Capacitance	C_{IN}		60		pF	V_F = 0, f = 1MHz		1
Input Diode Temperature Coefficient	$\frac{\Delta V_F}{\Delta T_A}$		–1.9		mV/°C	I_F = 20mA		1
Input – Output Insulation Leakage Current	I_{I-O}*			1.0	μA	V_{I-O} = 1500Vdc, Relative Humidity = 45% T_A = 25°C, t = 5s		2
Resistance (Input-Output)	R_{I-O}		10^{12}		Ω	V_{I-O} = 500V		3
Capacitance (Input-Output)	C_{I-O}		1.7		pF	f = 1MHz		3
Input-Input Insulation Leakage Current	I_{I-I}		0.5		nA	Relative Humidity = 45%, V_{I-I}=500V, t=5s		4
Resistance (Input-Input)	R_{I-I}		10^{12}		Ω	V_{I-I} = 500V		4
Capacitance (Input-Input)	C_{I-I}		0.55		pF	f = 1MHz		4

**All typical values are at V_{CC} = 5V, T_A = 25°C

TABLE III
Switching Characteristics AT T_A = 25°C, V_{CC} = 5V EACH CHANNEL

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Propagation Delay Time to High Output Level	t_{PLH}*		65	90	ns	R_L = 510Ω, C_L = 15pF, I_F = 13mA	2,3	5
Propagation Delay Time to Low Output Level	t_{PHL}*		55	90	ns	R_L = 510Ω, C_L = 15pF I_F = 13mA	2,3	6
Output Rise-Fall Time (10-90%)	t_r, t_f		25		ns	R_L = 510Ω, C_L = 15pF I_F = 13mA		
Common Mode Transient Immunity at High Output Level	CM_H		250		V/μs	V_{CM} = 10V (peak), V_O (min.) = 2V, R_L = 510Ω, I_F = 0mA	6	7
Common Mode Transient Immunity at Low Output Level	CM_L		–750		V/μs	V_{CM} = 10V (peak), V_O(max.) = 0.8V, R_L = 510Ω, I_F = 10mA	6	8

NOTES:

1. Each channel.
2. Measured between pins 1 through 8 shorted together and pins 9 through 16 shorted together.
3. Measured between pins 1 and 2 or 5 and 6 shorted together, and pins 9 through 16 shorted together.
4. Measured between pins 1 and 2 shorted together, and pins 5 and 6 shorted together.
5. The t_{PLH} propagation delay is measured from the 6.5mA point on the trailing edge of the input pulse to the 1.5V point on the trailing edge of the output pulse.
6. The t_{PHL} propagation delay is measured from the 6.5mA point on the leading edge of the input pulse to the 1.5V point on the leading edge of the output pulse.
7. CM_H is the max. tolerable common mode transient to assure that the output will remain in a high logic state (i.e., $V_O > 2.0V$).
8. CM_L is the max. tolerable common mode transient to assure that the output will remain in a low logic state (i.e., $V_O < 0.8V$).
9. It is essential that a bypass capacitor (.01 to 0.1μF, ceramic) be connected from pin 10 to pin 15. Total lead length between both ends of the capacitor and the isolator pins should not exceed 20mm.

*JEDEC Registered Data.

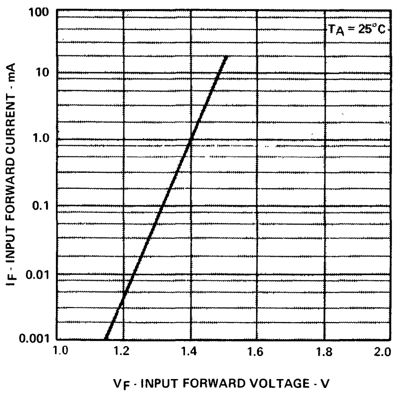


Figure 1. Input Diode Forward Characteristic

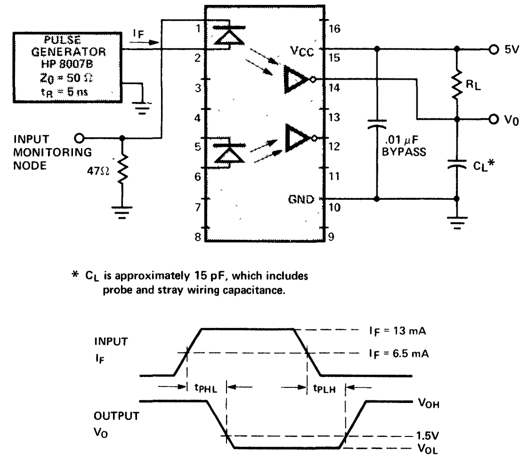


Figure 2. Test Circuit for t_{PHL} and t_{PLH}*

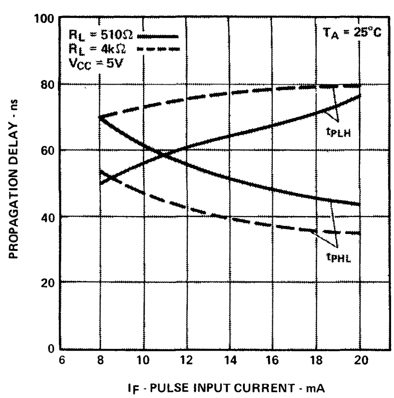


Figure 3. Propagation Delay, t_{PHL} and t_{PLH} vs. Pulse Input Current, I_{FH}

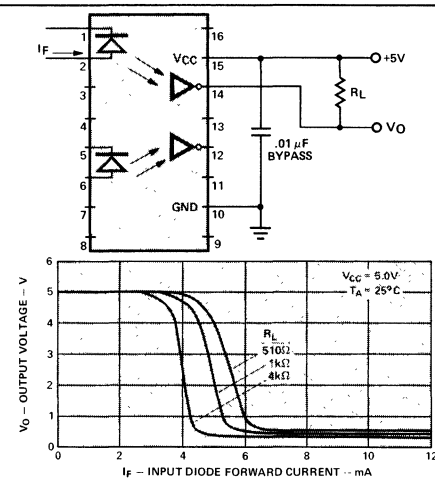


Figure 4. Input-Output Characteristics

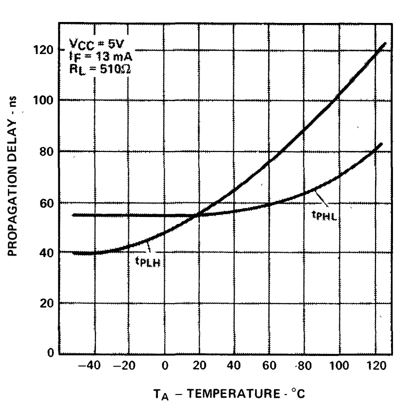


Figure 5. Propagation Delay vs. Temperature

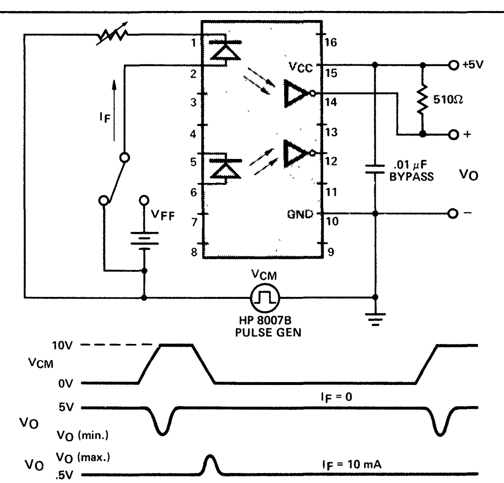


Figure 6. Typical Common Mode Rejection Characteristics/Circuit

*JEDEC Registered Data.

High Reliability Test Program

Hewlett Packard provides standard high reliability test programs, patterned after MIL-M-38510 in order to facilitate the use of HP products in military programs.

HP offers two levels of high reliability testing:

- The TXV prefix identifies a part which has been preconditioned and screened per Table IV.
- The TXVB prefix identifies a part which has been preconditioned and screened per Table IV, and comes from a lot which has been subjected to the Group B tests detailed in Table V.

Part Number System

Commercial Product	With TX Screening	With TX Screening Plus Group B
6N134 (5082-4365)	6N134 TXV (TX-4365)	6N134 TXVB (TXB-4365)

TABLE IV TXV Preconditioning and Screening — 100%

Examination or Test	MIL-STD-883 Methods	Conditions
1. Pre-Cap Visual Inspection	HP Procedure 72-4063,4	
2. Electrical Test: I_{OH}, V_{OL}, I_{CCH}, I_{CCL}, V_F, BV_R, I_{I-O}		Per Table II, T_A = 25°C
3. High Temperature Storage	1008	168 hrs. @ 150°C
4. Temperature Cycling	1010	-65°C to +150°C
5. Acceleration	2001	20KG, Y_1
6. Helium Leak Test	1014	Test Cond. A
7. Gross Leak Test	1014	Test Cond. C
8. Electrical Test: V_{OL}		Per Table II, T_A = 25°C
9. Burn-In	1015	168 hrs., T_A = 125°C, V_{CC}=5.5V, I_F=13mA, I_O=25mA
10. Electrical Test: Same as Step 2		
11. Evaluate Drift		Max. ΔV_{OL} = ±20%
12. Sample Electrical Test: I_{OH}, V_{OL}, I_{CCH}, I_{CCL}		Per Table II, LTPD=7 T_A = -55°C, +125°C
13. Sample Electrical Test: t_{PLH}, t_{PHL}		Per Table II, T_A=25°C, LTPD=7
14. External Visual	2009	

TABLE V, GROUP B

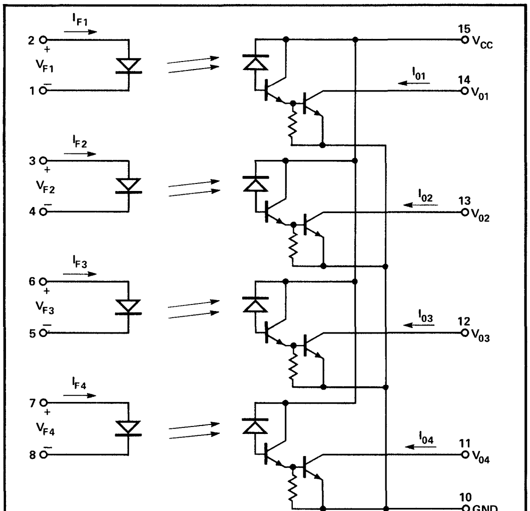
Examination or Test	MIL-STD-883 Method	MIL-STD-883 Condition	LTPD
Subgroup 1			15
Physical Dimensions	2008	See Product Outline Drawing	
Subgroup 2			20
Solderability	2003	Immersion within 2.5mm of body, 16 terminations	
Subgroup 3			15
Temperature Cycling	1010	Test Condition B	
Thermal Shock	1011	Test Condition A, 5 cycles	
Hermetic Seal, Fine Leak	1014	Test Condition A	
Hermetic Seal, Gross Leak	1014	Test Condition C, Step 1	
End Points: I_{OH}, V_{OL}, I_{CCH}, I_{CCL}, V_F, BV_R, I_{I-O}		Per Table II, T_A = 25°C	
Subgroup 4			15
Shock, non-operating	2002	1500 G, t = 0.5 ms, 5 blows in each orientation X_1, Y_1, Y_2	
Constant Acceleration	2001	20KG, Y_1	
End Points: Same as Subgroup 3			
Subgroup 5			15
Terminal Strength, tension	2004	Test Condition A, 4.5N (1 lb.), 15s	
Subgroup 6			
High Temperature Life	1008	T_A = 150°C	λ = 7
End Points: Same as Subgroup 3			
Subgroup 7			
Steady State Operating Life	1005	V_{CC} = 5.5V, I_F = 13mA, I_O = 25mA, T_A = 25°C	
End Points: Same as Subgroup 3			

HEWLETT PACKARD
COMPONENTS

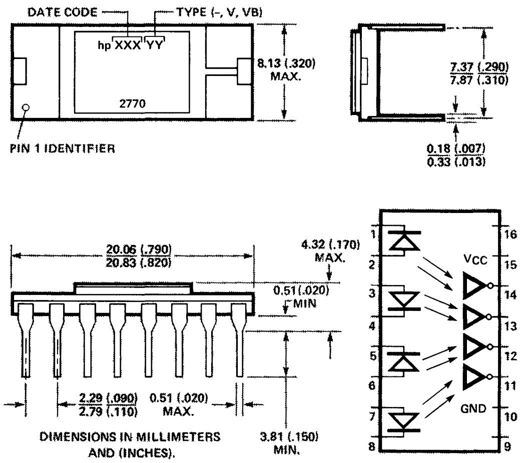
HERMETICALLY SEALED, FOUR CHANNEL, LOW INPUT CURRENT OPTOCOUPLER

HCPL-2770 TXVHCPL-2770 TXVBHCPL-2770

TECHNICAL DATA FEBRUARY 1977



Schematic



Outline Drawing

Features

- HERMETICALLY SEALED
- HIGH DENSITY PACKAGING
- HIGH CURRENT TRANSFER RATIO: 500% TYPICAL
- PERFORMANCE GUARANTEED OVER -55°C TO 100°C AMBIENT TEMPERATURE RANGE
- STANDARD HIGH RELIABILITY SCREENED PARTS AVAILABLE
- 1500 VDC INSULATION VOLTAGE
- LOW INPUT CURRENT REQUIREMENT: 0.5 mA
- LOW OUTPUT SATURATION VOLTAGE: 0.1V TYPICAL
- LOW POWER CONSUMPTION

Applications

- Isolated Input Line Receiver
- System Test Equipment Isolation
- Digital Logic Ground Isolation
- Vehicle Command/Control Isolation
- EIA RS-232C Line Receiver
- Microprocessor System Interface
- Current Loop Receiver
- Level Shifting
- Process Control Input/Output Isolation

Description

The HCPL-2770 contains four GaAsP light emitting diodes, each of which is optically coupled to a corresponding integrated high gain photon detector. A common pin for the photodiodes and first stage of each detector IC (V_{CC}) permits lower output saturation voltage and higher speed operation than possible with conventional photodarlington type optocouplers. Also, the separate V_{CC} pin can be strobed low as an output disable or operated with supply voltages as low as 1.6V without adversely affecting the parametric performance.

The outstanding high temperature performance of this split Darlington type output amplifier results from the inclusion of an integrated emitter-base bypass resistor which shunts photodiode and first stage leakage currents to ground.

The high current transfer ratio at very low input currents permits circuit designs in which adequate margin can be allowed for the effects of CTR degradation over time.

The HCPL-2770 has a 300% minimum CTR at an input current of only 0.5mA making it ideal for use in low input current applications such as MOS, CMOS and low power logic interfacing or RS-232C data transmission systems. Compatibility with high voltage CMOS logic systems is assured by the 18V V_{CC} and by the guaranteed maximum output leakage (I_{OH}) at 18V.

Important specifications such as CTR, leakage current, supply current and output saturation voltage are guaranteed over the -55°C to 100°C temperature range to allow trouble free system operation.

TABLE I

Recommended Operating Conditions

	Symbol	Min.	Max.	Units
Input Current, Low Level (Each Channel)	I_{FL}		2	μA
Input Current, High Level (Each Channel)	I_{FH}	0.5	5	mA
Supply Voltage	V_{CC}	1.6	18	V

Absolute Maximum Ratings

Storage Temperature .... -65°C to +150°C
Operating Temperature .... -55°C to +100°C
Lead Solder Temperature .... 260°C for 10 s. (1.6mm below seating plane)
Peak Input Current (each channel, ≤1 ms duration) .... 20 mA
Average Input Current, I_F (each channel) .... 10 mA
Reverse Input Voltage, V_R (each channel) 5V
Output Current, I_O (each channel) .... 40 mA
Output Voltage, V_O (each channel) ...... -0.5 to 20 V[1]
Supply Voltage, V_{CC} .... -0.5 to 20 V[1]
Output Power Dissipation (each channel) ... 50 mW[2]

TABLE II

Electrical Characteristics T_A = -55°C to 100°C, Unless Otherwise Specified

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Current Transfer Ratio	CTR	300 300 200	1000 750 400		% % %	I_F=0.5mA, V_O=0.4V, V_{CC}=4.5V I_F=1.6mA, V_O=0.4V, V_{CC}=4.5V I_F=5mA, V_O=0.4V, V_{CC}=4.5V	3	3,4
Logic High Output Current	I_{OH}		.005	250	μA	I_F = 2μA V_O=V_{CC}=18V		3,5
Logic Low Supply Current	I_{CCL}		2	4	mA	I_{F1}=I_{F2}=I_{F3}=I_{F4}=1.6mA V_{CC}=18V		
Logic High Supply Current	I_{CCH}		.010	40	μA	I_{F1}=I_{F2}=I_{F3}=I_{F4}=0 V_{CC}=18V		
Input Forward Voltage	V_F		1.4	1.7	V	I_F=1.6mA, T_A=25°C	1	3
Input Reverse Breakdown Voltage	BV_R	5			V	I_R=10μA, T_A=25°C		3
Temperature Coefficient of of Forward Voltage	$\frac{\Delta V_F}{\Delta T_A}$		-1.8		mV/°C	I_F = 1.6mA		3
Input Capacitance	C_{IN}		60		pF	f = 1MHz, V_F = 0, T_A = 25°C		3
Input-Output Insulation Leakage Current	I_{I-O}			1.0	μA	45% Relative Humidity, T_A=25°C, t = 5 s., V_{I-O} = 1500 Vdc		6
Resistance (Input-Output)	R_{I-O}		10^{12}		Ω	V_{I-O} = 500 Vdc, T_A = 25°C		3,7
Capacitance (Input-Output)	C_{I-O}		1.5		pF	f = 1MHz, T_A = 25°C		3,7
Input-Input Insulation Leakage Current	I_{I-I}		0.5		nA	45% Relative Humidity, V_{I-I}=500 Vdc, T_A=25°C, t=5 s.		8
Resistance (Input-Input)	R_{I-I}		10^{12}		Ω	V_{I-I} = 500Vdc, T_A = 25°C		8
Capacitance (Input-Input)	C_{I-I}		1		pF	f = 1MHz, T_A = 25°C		8

TABLE III

Switching Characteristics T_A = 25°C, V_{CC} = 5V Each Channel

Parameter	Symbol	Min.	Typ.	Max.	Units	Test Conditions	Figure	Note
Propagation Delay Time To Logic High At Output	t_{PLH}		25	60	μs	I_F=0.5mA, R_L=4.7kΩ	8	
			10	20	μs	I_F=5mA, R_L=680Ω	8	
Propagation Delay Time To Logic Low At Output	t_{PHL}		35	100	μs	I_F=0.5mA, R_L=4.7kΩ	8	
			2	5	μs	I_F=5mA, R_L=680Ω	8	
Common Mode Transient Immunity At Logic High Level Output	CM_H	500	1000		V/μs	I_F=0, R_L=1.5kΩ $\|V_{CM}\|$ = $50V_{p-p}$	9	9,11
Common Mode Transient Immunity At Logic Low Level Output	CM_L	-500	-1000		V/μs	I_F=1.6mA, R_L=1.5kΩ $\|V_{CM}\|$ = $50V_{p-p}$	9	10,11

NOTES:

1. Pin 10 should be the most negative voltage at the detector side.
2. Output power is collector output power plus one fourth of total supply power.
3. Each channel.
4. CURRENT TRANSFER RATIO is defined as the ratio of output collector current, I_O, to the forward LED input current, I_F, times 100%.
5. I_F=2μA for channel under test. For all other channels, I_F=10mA.
6. Device considered a two-terminal device: Pins 1 through 8 are shorted together and pins 9 through 16 are shorted together.
7. Measured between each input pair shorted together and all output pins.
8. Measured between adjacent input pairs shorted together, i.e. between pins 1 and 2 shorted together and pins 3 and 4 shorted together, etc.
9. CM_H is the maximum tolerable common mode transient to assure that the output will remain in a high logic state (i.e. V_O > 2.0V).
10. CM_L is the maximum tolerable common mode transient to assure that the output will remain in a low logic state (i.e. V_O < 0.8V).
11. In applications where dV/dt may exceed 50,000 V/μs (such as a static discharge) a series resistor, R_{CC}, should be included to protect the detector IC's from destructively high surge currents. The recommended value is $R_{CC} \approx \frac{1V}{0.6\ I_F\ (mA)}$ kΩ.

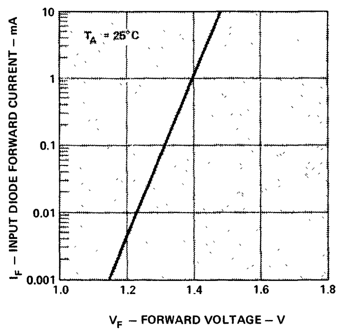


Figure 1. Input Diode Forward Current vs. Forward Voltage.

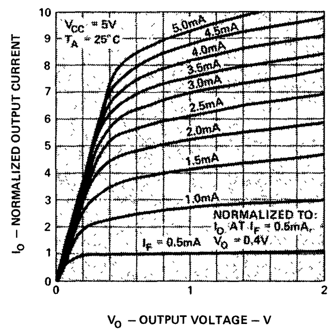


Figure 2. Normalized DC Transfer Characteristics.

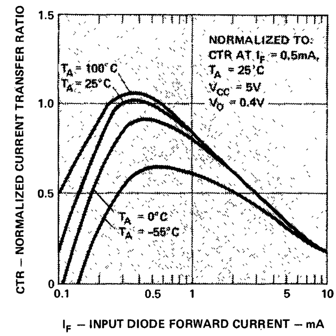


Figure 3. Normalized Current Transfer Ratio vs. Input Diode Forward Current.

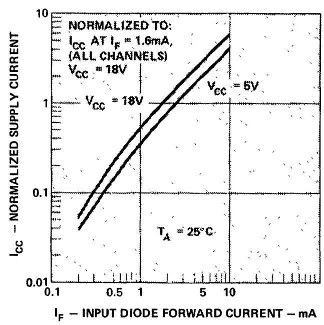


Figure 4. Normalized Supply Current vs. Input Diode Forward Current.

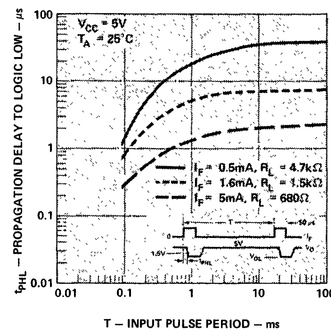


Figure 5. Propagation Delay to Logic Low vs. Input Pulse Period.

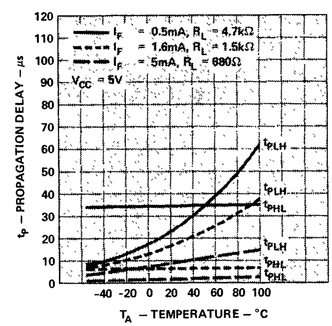


Figure 6. Propagation Delay vs. Temperature

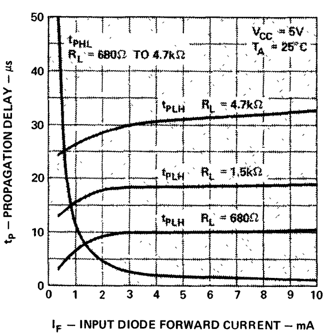


Figure 7. Propagation Delay vs. Input Diode Forward Current.

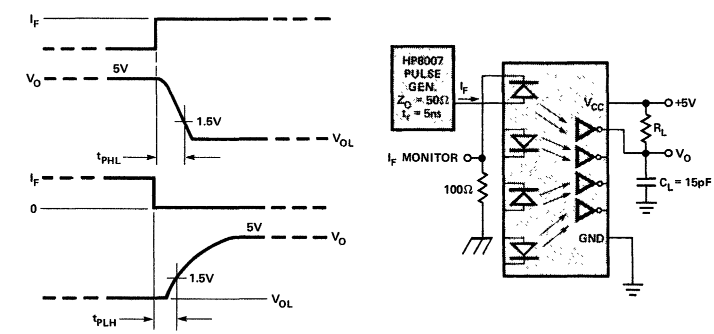


Figure 8. Switching Test Circuit.

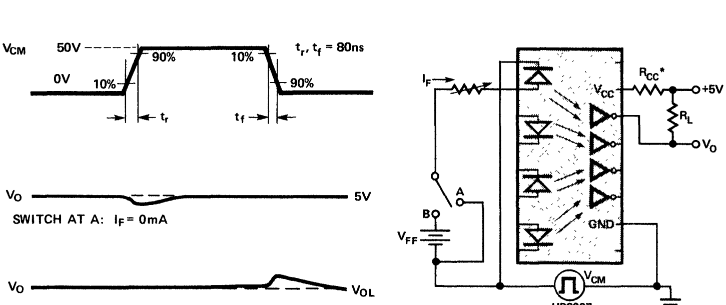


Figure 9. Test Circuit for Transient Immunity and Typical Waveforms.

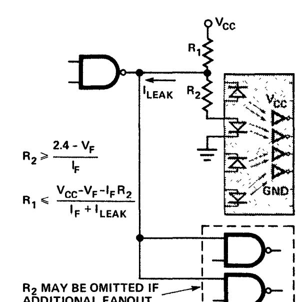


Figure 10. Recommended drive circuitry using TTL logic.

High Reliability Test Program

Hewlett Packard provides standard high reliability test programs, patterned after MIL-M-38510 in order to facilitate the use of HP products in military programs.

HP offers two levels of high reliability testing:

- The TXV prefix identifies a part which has been preconditioned and screened per Table IV.
- The TXVB prefix identifies a part which has been preconditioned and screened per Table IV, and comes from a lot which has been subjected to the Group B tests detailed in Table V.

Part Number System

Commercial Product	With TXV Screening	With TXV Screening Plus Group B
HCPL-2770	TXVHCPL-2770	TXVBHCPL-2770

TABLE IV TXV Preconditioning and Screening — 100%

	Examination or Test	MIL-STD-883 Methods	Conditions
1.	Pre-Cap Visual Inspection	OED Procedure	72-4063, 72-4064
2.	High Temperature Storage	1008	72 hrs. @ 150°C
3.	Temperature Cycling	1010	-65°C to +150°C
4.	Acceleration	2001	20KG, Y_1
5.	Helium Leak Test	1014	Cond. A
6.	Gross Leak Test	1014	Cond. C
7.	Electrical Test CTR, I_{OH}, I_{CCL}, I_{CCH}, V_F, BV_R:		T_A = 25°C, per Table II
8.	Burn-In	1015	V_{CC} = 18V, I_F = 5mA, I_O = 10mA t = 168 hrs. @ T_A = 100°C
9.	Electrical Test: Same as step 7 and I_{I-O}		T_A = 25°C, per Table II
10.	Evaluate Drift		Max. ΔCTR = ±25% @ I_F = 1.6mA
11.	External Visual	2009	

TABLE V, Group B

Examination or Test	MIL-STD-883 Method	Condition	LTPD
Subgroup 1			
Physical Dimensions	2016	See Product Outline Drawing	15
Subgroup 2			
Solderability	2003	Immersion within 2.5mm of body, 8 terminations	20
Subgroup 3			
Temperature Cycling	1010	Test Condition B	15
Thermal Shock	1011	Test Condition A, 5 cycles	
Hermetic Seal, Fine Leak	1014	Test Condition A	
Hermetic Seal, Gross Leak	1014	Test Condition C	
End Points:			
CTR, I_{OH}, I_{CCL}, I_{CCH}, V_F, BV_R		Per Table II, T_A = 25°C	
Subgroup 4			
Shock, non-operating	2002	1500 G, t = 0.5 ms, 5 blows in each orientation X_1, Y_1, Y_2	15
Constant Acceleration	2001	20KG, Y_1	
End Points:			
Same as Subgroup 3			
Subgroup 5			
Terminal Strength, tension	2004	Test Condition A, 4.5N (1 lb.), 15s.	15
Subgroup 6			
High Temperature Life	1008	T_A = 150°C, non-operating	λ = 7
End Points:			
Same as Subgroup 3			
Subgroup 7			
Steady State Operating Life	1005	V_{CC} = 18V, I_F = 5mA, I_O = 10mA, T_A = 100°C	λ = 7
End Points:			
Same as Subgroup 3			

OPTOELECTRONICS DESIGNER'S CATALOG 1977

Emitters

• Features	• Advantages	• Benefits
Near IR emission	Visible	Facilitates alignment
Functions with most silicon phototransistors and photodiodes	Easy to use	Cost effective implementation
Plastic Package	Low cost	Cost effective implementation
HEMT 3300 uses isotrophic LED chip	Provides floodlight type beam	Well suited for applications that require a large area to be irradiated
HEMT 6000 uses surface emitter LED chip	Provides bright spot of light	Facilitates focusing light on active area of photodetector
HEMT 6000 has offset wirebond	Active area of the chip is not masked or shadowed	Facilitates use with fiber optics
HEMT 6000 has reciprocal optical port	Can function as an emitter or narrow band detector	Single device performs two functions

PIN Photodiodes

• Features	• Advantages	• Benefits
Offset wirebond	Can be used with fiber optics	Fiber can be placed directly over active area
All HP PIN photodiodes have anti-reflective coating	Converts more incident radiation (light) into photocurrent	High Responsivity
Wide spectral response (ultraviolet through IR)	A single device can cover the light spectrum plus UV and IR	Works with a variety of sources
Low junction capacitance	Wide bandwidth	Can detect high speed pulses
ULTRA Linear	Permits operation over 10 decades	Eliminates the need for equalization

HEWLETT hp PACKARD
COMPONENTS

670nm HIGH RADIANT INTENSITY EMITTER

HEMT-3300

TECHNICAL DATA APRIL 1977

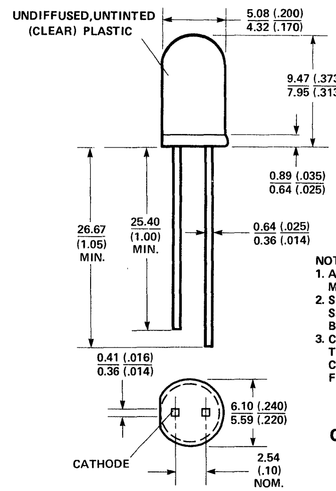
Features

- HIGH EFFICIENCY
- NONSATURATING OUTPUT
- NARROW BEAM ANGLE
- VISIBLE FLUX AIDS ALIGNMENT
- BANDWIDTH: DC TO 3 MHz
- IC COMPATIBLE/LOW CURRENT REQUIREMENT

Description

The HEMT-3300 is a visible, near-IR, source using a GaAsP on GaP LED chip optimized for maximum quantum efficiency at 670 nm. The emitter's beam is sufficiently narrow to minimize stray flux problems, yet broad enough to simplify optical alignment. This product is suitable for use in consumer and industrial applications such as optical transducers and encoders, smoke detectors, assembly line monitors, small parts counters, paper tape readers and fiber optic drivers.

Package Dimensions



NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).
2. SILVER-PLATED LEADS SEE APPLICATION BULLETIN 3.
3. CHIP CENTERING WITHIN THE PACKAGE IS CONSISTENT WITH FOOTNOTE 3.

Outline T - 1¾

Electrical/Optical Characteristics at $T_A = 25°C$

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Figure
I_e	Axial Radiant Intensity	200	500		μW/sr	I_F = 10 mA	3,4
K_e	Temperature Coefficient of Intensity		-0.009		$°C^{-1}$	I_F = 10 mA, Note 1	
η_V	Luminous Efficacy		22		lm/W	Note 2	
$2\Theta_{1/2}$	Half Intensity Total Angle		22		deg.	Note 3, I_F = 10 mA	6
λ_{PEAK}	Peak Wavelength		670		nm	Measured at Peak	1
$\Delta\lambda_{PEAK}/\Delta T$	Spectral Shift Temperature Coefficient		0.089		nm/°C	Measured at Peak, Note 4	
t_r	Output Rise Time (10% – 90%)		120		ns	I_{PEAK} = 10 mA	
t_f	Output Fall Time (90% – 10%)		50		ns	I_{PEAK} = 10 mA Pulse	
C_O	Capacitance		15		pF	V_F = 0; f = 1 MHz	
BV_R	Reverse Breakdown Voltage	5.0			V	I_R = 100 μA	
V_F	Forward Voltage		1.9	2.5	V	I_F = 10 mA	2
$\Delta V_F/\Delta T$	Temperature Coefficient of V_F		-2.2		mV/°C	I_F = 100 μA	
Θ_{JC}	Thermal Resistance		160		°C/W	Junction to cathode lead at seating plane.	

Notes: 1. $I_e(T) = I_e(25°C)\exp[K_e(T - 25°C)]$ 2. $I_V = \eta_V I_e$ where I_V is in candela, I_e in watts/steradian and η_V in lumen/watt.
3. $\Theta_{1/2}$ is the off-axis angle at which the radiant intensity is half the axial intensity. The deviation between the mechanical and optical axis is typically within a conical half-angle of five degrees. 4. $\lambda_{PEAK}(T) = \lambda_{PEAK}(25°C) + (\Delta\lambda_{PEAK}/\Delta T)(T - 25°C)$.

Maximum Ratings at T_A=25°C

Power Dissipation .... 120 mW
(derate linearly from 50°C at 1.6 mW/°C)
Average Forward Current .... 30 mA
(derate linearly from 50°C at 0.4 mA/°C)
Peak Forward Current .... See Figure 5
Operating and Storage
Temperature Range .... -55°C to +100°C
Lead Soldering Temperature .... 260°C for 5 sec.
(1.6 mm [0.063 inch] from body)

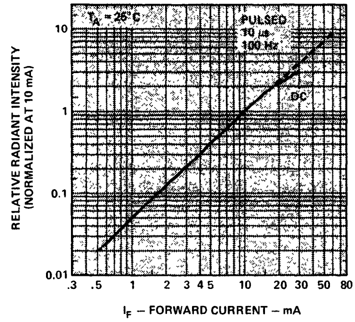


Figure 3. Relative Radiant Intensity versus Forward Current.

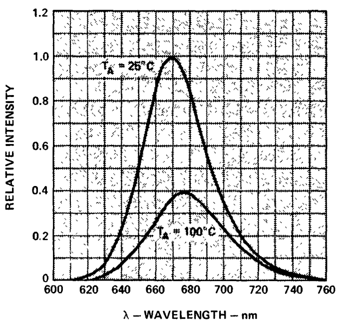


Figure 1. Relative Intensity versus Wavelength.

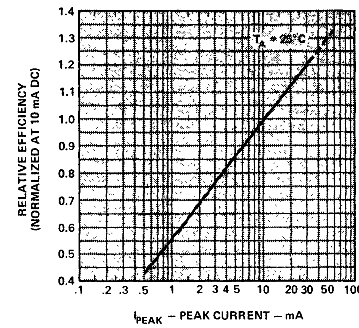


Figure 4. Relative Efficiency (Radiant Intensity per Unit Current) versus Peak Current.

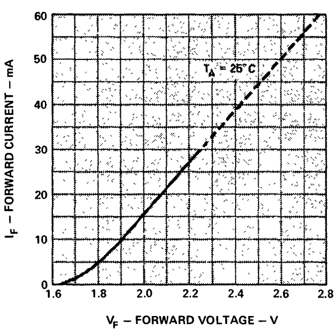


Figure 2. Forward Current versus Forward Voltage.

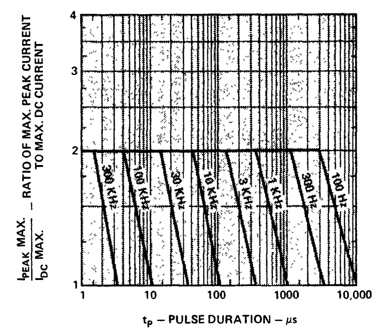


Figure 5. Maximum Tolerable Peak Current versus Pulse Duration. (I_{DC} MAX as per MAX Ratings)

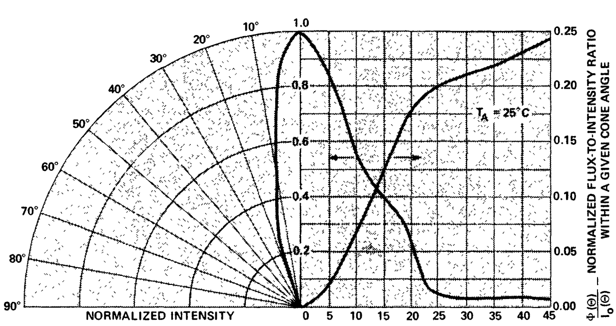


Figure 6. Far-Field Radiation Pattern.

HEWLETT hp PACKARD
COMPONENTS

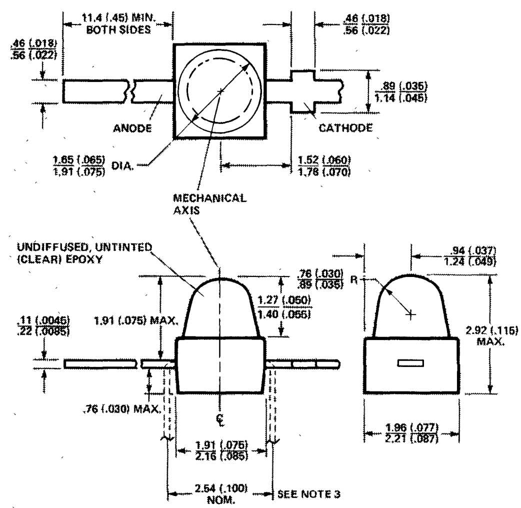
700nm HIGH INTENSITY SUBMINIATURE EMITTER

HEMT-6000

TECHNICAL DATA APRIL 1977

Features

- HIGH RADIANT INTENSITY
- NARROW BEAM ANGLE
- NONSATURATING OUTPUT
- BANDWIDTH: DC TO 5 MHz
- IC COMPATIBLE/LOW CURRENT REQUIREMENT
- VISIBLE FLUX AIDS ALIGNMENT



NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETRES (INCHES).
2. SILVER-PLATED LEADS. SEE APPLICATION BULLETIN 3.
3. USER MAY BEND LEADS AS SHOWN.
4. EPOXY ENCAPSULANT HAS A REFRACTIVE INDEX OF 1.53.
5. CHIP CENTERING WITHIN THE PACKAGE IS CONSISTENT WITH FOOTNOTE 3.

Description

The HEMT-6000 uses a GaAsP chip designed for optimum tradeoff between speed and quantum efficiency. This optimization allows a flat modulation bandwidth of 5 MHz without peaking, yet provides a radiant flux level comparable to that of 900nm IREDs. The subminiature package allows operation of multiple closely-spaced channels, while the narrow beam angle minimizes crosstalk. The nominal 700nm wavelength can offer spectral performance advantages over 900nm IREDs, and is sufficiently visible to aid optical alignment. Applications include paper-tape readers, punch-card readers, bar code scanners, optical encoders or transducers, interrupt modules, safety interlocks, tape loop stabilizers and fiber optic drivers.

Maximum Ratings at $T_A = 25°C$

Power Dissipation .... 50 mW
(derate linearly from 70°C @ 1.0mW/°C)

Average Forward Current .... 20 mA
(derate linearly from 70°C @ 0.4mA/°C)

Peak Forward Current .... See Figure 5

Operating and Storage
Temperature Range .... -55° to +100°C

Lead Soldering
Temperature .... 260°C for 5 sec.
[1.6 mm (0.063 in.) from body]

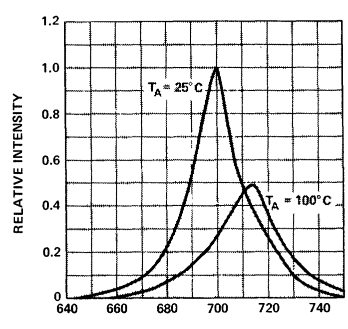


Figure 1. Relative Intensity versus Wavelength.

Electrical/Optical Characteristics at $T_A = 25°C$

Symbol	Description	Min.	Typ.	Max.	Units	Test Conditions	Fig.
I_e	Radiant Intensity along Mechanical Axis	100	250		μW/sr	I_F = 10 mA	3,4
K_e	Temperature Coefficient of Intensity		-0.005		$°C^{-1}$	Note 1	
η_v	Luminous Efficacy		2.5		lm/W	Note 2	
$2\Theta_{1/2}$	Optical Axis Half Intensity Total Angle		16		deg.	Note 3, I_F = 10 mA	6
λ_{PEAK}	Peak Wavelength (Range)		690-715		nm	Measured @ Peak	1
$\Delta\lambda_{PEAK}/\Delta T$	Spectral Shift Temperature Coefficient		.193		nm/°C	Measured @ Peak, Note 4	
t_r	Output Rise Time (10%-90%)		70		ns	I_{PEAK} = 10 mA	
t_f	Output Fall Time (90%-10%)		40		ns	I_{PEAK} = 10 mA	
C_o	Capacitance		65		pF	V_F = 0; f = 1 MHz	
BV_R	Reverse Breakdown Voltage	5	12		V	I_R = 100 μA	
V_F	Forward Voltage		1.5	1.8	V	I_F = 10 mA	2
$\Delta V_F/\Delta T$	Temperature Coefficient of V_F		-2.1		mV/°C	I_F = 100 μA	
Θ_{JC}	Thermal Resistance		140		°C/W	Junction to cathode lead at 0.79 mm (.031 in) from body	

NOTES:
1. $I_e(T) = I_e(25°C) \exp[K_e(T - 25°C)]$.
2. $I_v = \eta_v I_e$ where I_v is in candela, I_e in watts/steradian, and η_v in lumen/watt.
3. $\Theta_{1/2}$ is the off-axis angle at which the radiant intensity is half the intensity along the optical axis. The deviation between the mechanical and the optical axis is typically within a conical half-angle of three degrees.
4. $\lambda_{PEAK}(T) = \lambda_{PEAK}(25°C) + (\Delta\lambda_{PEAK}/\Delta T)(T - 25°C)$

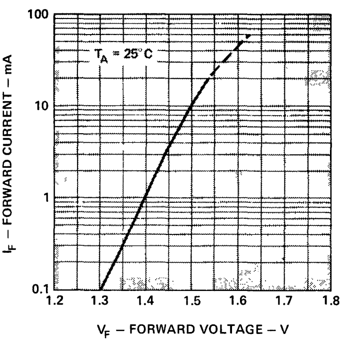


Figure 2. Forward Current versus Forward Voltage.

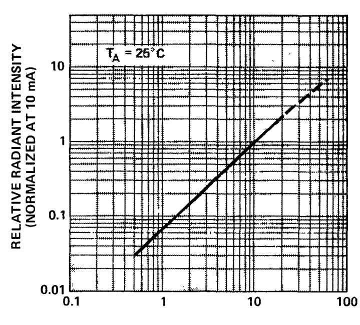


Figure 3. Relative Radiant Intensity versus Forward Current.

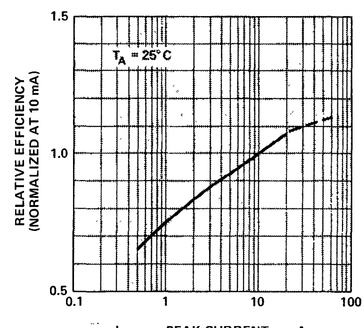


Figure 4. Relative Efficiency (Radiant Intensity per Unit Current) versus Peak Current.

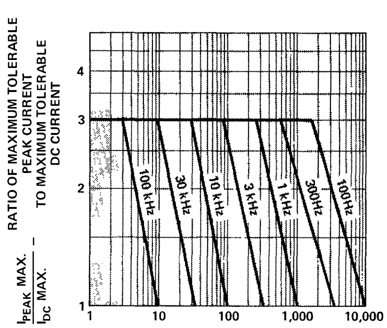


Figure 5. Maximum Tolerable Peak Current versus Pulse Duration. (I_{DC} MAX as per MAX Ratings)

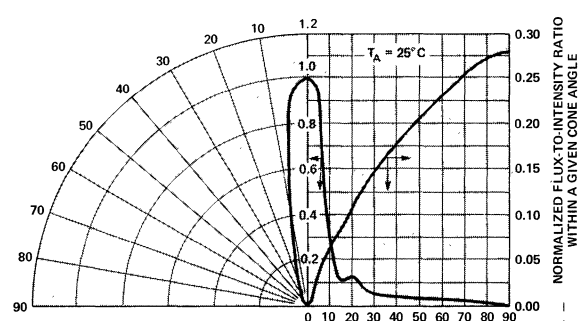


Figure 6. Far-Field Radiation Pattern.

HEWLETT hp PACKARD
COMPONENTS

PIN PHOTODIODES

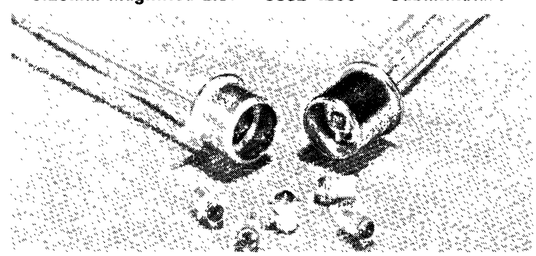
5082-4200 SERIES

TECHNICAL DATA APRIL 1977

Features

- HIGH SENSITIVITY (NEP<-108 dBm)
- WIDE DYNAMIC RANGE (1% LINEARITY OVER 100 dB)
- BROAD SPECTRAL RESPONSE
- HIGH SPEED (T_r, T_f,<1ns)
- STABILITY SUITABLE FOR PHOTOMETRY/ RADIOMETRY
- HIGH RELIABILITY
- FLOATING, SHIELDED CONSTRUCTION
- LOW CAPACITANCE
- LOW NOISE

Active area: 1mm Diam 5082-4207 — TALL SIZE (TO-18)
0.5mm Diam 5082-4203, 5082-4204 — TALL SIZE (TO-18); 5082-4220 – Short (TO-46)
0.25mm Magnified 2.5x 5082-4205 – Subminiature



Description

The HP silicon planar PIN photodiodes are ultra-fast light detectors for visible and near infrared radiation. Their response to blue and violet is unusually good for low dark current silicon photodiodes.

These devices are suitable for applications such as high speed tachometry, optical distance measurement, star tracking, densitometry, radiometry, and fiber-optic termination.

The speed of response of these detectors is less than one nanosecond. Laser pulses shorter than 0.1 nanosecond may be observed. The frequency response extends from dc to 1 GHz.

The low dark current of these planar diodes enables detection of very low light levels. The quantum detection efficiency is constant over ten decades of light intensity, providing a wide dynamic range.

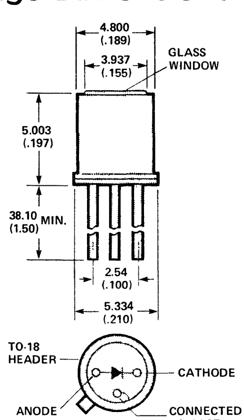
The 5082-4203, -4204, and -4207 are packaged on a standard TO-18 header with a flat glass window cap. For versatility of circuit connection, they are electrically insulated from the header. The light sensitve area of the 5082-4203 and -4204 is 0.508mm (0.020 inch) in diameter and is located 1.905mm (0.075 inch) behind the window. The light sensitive area of the 5082-4207 is 1.016mm (0.040 inch) in diameter and is also located 1.905mm (0.075 inch) behind the window.

The 5082-4205 is in a low capacitance Kovar and ceramic package of very small dimensions, with a hemispherical glass lens.

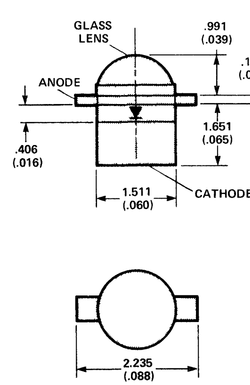
The 5082-4220 is packaged on a TO-46 header with the 0.508mm(0.020 inch) diameter sensitive area located 2.540mm (0.100 inch) behind a flat glass window.

Package Dimensions

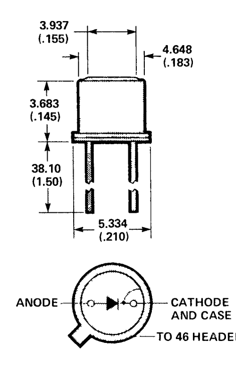
DIMENSIONS IN MILLIMETERS (INCHES).



-4203, -4204, -4207



-4205



-4220

Absolute Maximum Ratings

Parameter	-4203	-4204	-4205	-4207	-4220	Units
P_{MAX} Power Dissipation 1	100	100	50	100	100	mW
Peak Reverse Voltage2	200	200	200	200	200	volts
Steady Reverse Voltage3	50	20	50	20	50	volts

Electrical/Optical Characteristics at $T_A = 25°C$

Symbol	Description	-4203			-4204			-4205			-4207			-4220			Units
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
$R_{E,0} = R_\phi \cdot A$	Axial Incidance Response at 770nm[4]		1.0			1.0			1.5*			4.0			1.0		$\frac{\mu A}{mW/cm^2}$
A	Active Area4		2×10^{-3}			2×10^{-3}			3×10^{-3}*			8×10^{-3}			2×10^{-3}		cm^2
R_ϕ	Flux Responsivity 770 nm5 (Fig. 1, 3)		.5			.5			.5			.5			.5		$\frac{\mu A}{\mu W}$
I_D	Dark Current6 (Fig. 4)			2.0			0.6			.15			2.5			5.0	nA
NEP	Noise Equivalent Power 7 (Fig. 8)			5.1×10^{-14}			2.8×10^{-14}			1.4×10^{-14}			5.7×10^{-14}			8.1×10^{-14}	$\frac{W}{\sqrt{Hz}}$
D*	Detectivity8	8.7×10^{11}			1.6×10^{12}			4.0×10^{12}*			1.5×10^{12}			5.6×10^{11}			$\frac{cm\sqrt{Hz}}{W}$
C_j	Junction Capacitance9 (Fig. 5)		1.5			2.0			0.7			5.5			2.0		pF
C_P	Package Capacitance 10		2			2						2					pF
t_r, t_f	Zero Bias Speed (Rise, Fall Time) 11		300			300			300			300			300		ns
t_r, t_f	Rev.-Bias Speed (Rise, Fall Time) 12			1			1			1			1			1	ns
R_S	Series Resistance			50			50			50			50			50	Ω

*see Note 4.

NOTES:

1. Peak Pulse Power

   When exposing the diode to high level incidance the following photocurrent limits must be observed:

   $$I_p \text{ (avg MAX.)} < \frac{P_{MAX} - P_\phi}{E_c}; \text{ and in addition:}$$

   $$I_p(\text{PEAK}) < \frac{1000 \text{ A}}{t\ (\mu sec)} \text{ or } < 500 mA \text{ or } < \frac{I_p \text{ (avg MAX.)}}{f \times t}$$

   whichever of the above three conditions is least.

   I_p - photocurrent (A) f - pulse repetion rate (MHz)
   E_c - supply voltage (V) P_ϕ - power input via photon flux
   t - pulse duration (μs) P_{MAX} - max dissipation (W)

   Power dissipation limits apply to the sum of both the optical power input to the device and the electrical power input from flow of photocurrent when reverse voltage is applied.
2. Exceeding the Peak Reverse Voltage will cause permanent damage to the diode. Forward current is harmless to the diode, within the power dissipation limit. For optimum performance, the diode should be reversed biased with E_c between 5 and 20 volts.
3. Exceeding the Steady Reverse Voltage may impair the low-noise properties of the photodiodes, an effect which is noticeable only if operation is diode-noise limited (see Figure 8).
4. The 5082-4205 has a lens with approximately 2.5x magnification; the actual junction area is 0.5×10^{-3} cm^2, corresponding to a diameter of 0.25mm (.010"). Specification includes lens effect.
5. At any particular wavelength and for the flux in a small spot falling entirely within the active area, responsivity is the ratio of incremental photodiode current to the incremental flux producing it. It is related to quantum efficiency, η_q in electrons per photon by:

   $$R_\phi = \eta_q \left(\frac{\lambda}{1240}\right)$$

   where λ is the wavelength in nanometers. Thus, at 770nm, a responsivity of 0.5 A/W corresponds to a quantum efficiency of 0.81 (or 81%) electrons per photon.
6. At -10V for the 5082-4204, -4205, and -4207; at -25V for the 5082-4203 and -4220.
7. For (λ, f, Δf) = (770nm, 100Hz, 6Hz) where f is the frequency for a spot noise measurement and Δf is the noise bandwidth, NEP is the optical flux required for unity signal/noise ratio normalized for bandwidth. Thus:

   $$NEP = \frac{I_N/\sqrt{\Delta f}}{R_\phi}$$

   where $I_N/\sqrt{\Delta f}$ is the bandwidth — normalized noise current computed from the shot noise formula:

   $$I_N/\sqrt{\Delta f} = \sqrt{2qI_D} = 17.9 \times 10^{-15} \sqrt{I_D} \ (A/\sqrt{Hz}) \text{ where } I_D \text{ is in nA.}$$
8. Detectivity, D* is the active-area-normalized signal to noise ratio. It is computed: $D^* = \frac{\sqrt{A}}{NEP} \left(\frac{cm\sqrt{Hz}}{W}\right)$ for A in cm^2, for (λ, f, Δf) = (770nm, 100Hz, 6Hz).
9. At -10V for 5082-4204, -4205, -4207, -4220; at -25V for 5082-4203.
10. Between diode cathode lead and case — does not apply to 5082-4205, -4220.
11. With 50Ω load.
12. With 50Ω load and -20V bias.

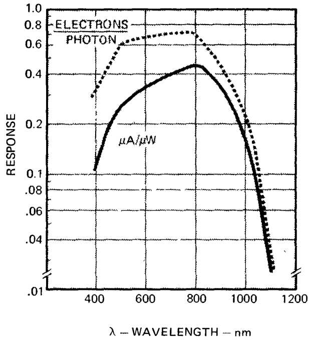


Figure 1. Spectral Response.

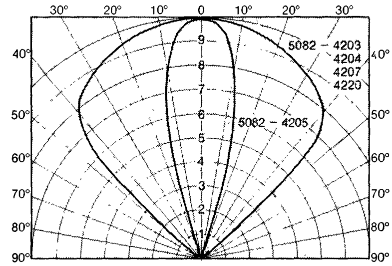


Figure 2. Relative Directional Sensitivity of the PIN Photodiodes.

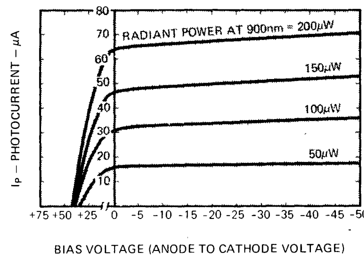


Figure 3. Typical Output Characteristics at λ = 900nm.

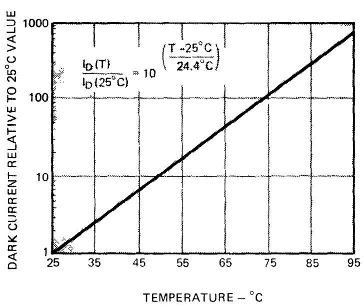


Figure 4. Dark Current at -10V Bias vs. Temperature.

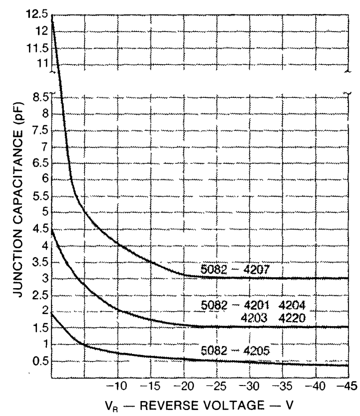


Figure 5. Typical Capacitance Variation With Applied Voltage.

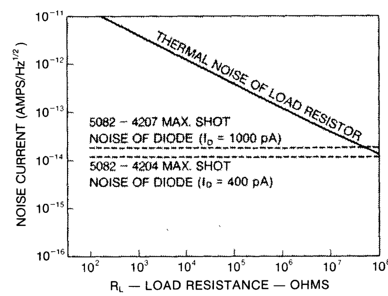


Figure 6. Noise vs. Load Resistance.

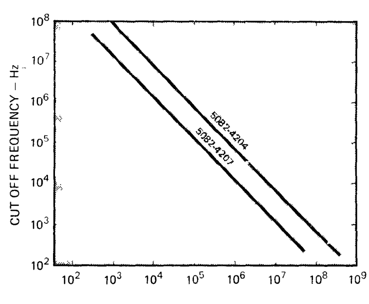


Figure 7. Photodiode Cut-Off Frequency vs. Load Resistance (C = 2pF).

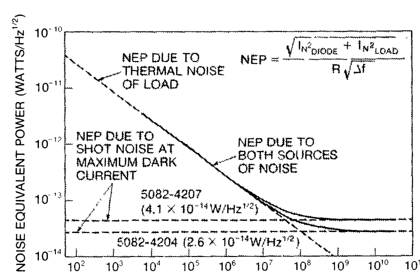


Figure 8. Noise Equivalent Power vs. Load Resistance.

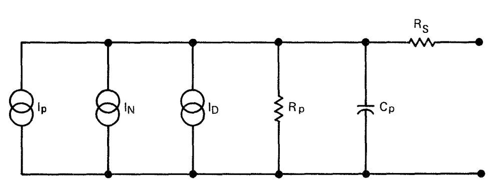


Figure 9. Photodiode Equivalent Circuit.

I_P=Signal current ≈ 0.5μA/μW x flux input at 770 nm

I_N= Shot noise current

<1.2 x 10^{-14} amps/Hz$^{1/2}$(5082-4204)

<4 x 10^{-14} amps/Hz$^{1/2}$(5082-4207)

I_D= Dark current

<600 x 10^{-12} amps at -10 V dc (5082-4204)

<2500 x 10^{-12} amps at -10 V dc (5082-4207)

R_P = 10^{11}Ω

R_S = <50Ω

Application Information

NOISE FREE PROPERTIES

The noise current of the PIN diodes is negligible. This is a direct result of the exceptionally low leakage current, in accordance with the shot noise formula $I_N = (2qI_R\Delta f)^{1/2}$ Since the leakage current does not exceed 600 picoamps for the 5082-4204 at a reverse bias of 10 volts, shot noise current is less than 1.4×10^{-14} amp $Hz^{-1/2}$ at this voltage.

Excess noise is also very low, appearing only at frequencies below 10 Hz, and varying approximately as 1/f. When the output of the diode is observed in a load, thermal noise of the load resistance (R_L) is 1.28×10^{-10} $(R_L)^{-1/2} \times (\Delta f)^{1/2}$ at 25°C, and far exceeds the diode shot noise for load resistance less than 100 megohms (see Figure 6). Thus in high frequency operation where low values of load resistance are required for high cut-off frequency, all PIN photodiodes contribute virtually no noise to the system (see Figures 6 and 7).

HIGH SPEED PROPERTIES

Ultra-fast operation is possible because the HP PIN photodiodes are capable of a response time less than one nanosecond. A significant advantage of this device is that the speed of response is exhibited at relatively low reverse bias (−10 to −20 volts).

OFF-AXIS INCIDENCE RESPONSE

Response of the photodiodes to a uniform field of radiant incidence E_e, parallel to the polar axis is given by $I = (RA) \times E_e$ for 770nm. The response from a field not parallel to the axis can be found by multiplying (RA) by a normalizing factor obtained from the radiation pattern at the angle of operation. For example, the multiplying factor for the 5082-4207 with incidence E_e at an angle of 40° from the polar axis is 0.8. If $E_e = 1mW/cm^2$, then $I_p = k \times (RA) \times E_e$; $I_p = 0.8 \times 4.0 \times 1 = 3.2$ μamps.

SPECTRAL RESPONSE

To obtain the response at a wavelength other than 770nm, the relative spectral response must be considered. Referring to the spectral response curve, Figure 1, obtain response, X, at the wavelength desired. Then the ratio of the response at the desired wavelength to response at 770nm is given by:

$$\text{RATIO} = \frac{X}{0.5}$$

Multiplying this ratio by the incidence response at 770nm gives the incidence response at the desired wavelength.

ULTRAVIOLET RESPONSE

Under reverse bias, a region around the outside edge of the nominal active area becomes responsive. The width of this annular ring is approximately 25μm (0.001 inch) at −20V, and expands with higher reverse voltage. Responsivity in this edge region is higher than in the interior, particularly at shorter wavelengths; at 400nm the interior, responsivity is 0.1 A/W while edge responsivity is 0.35 A/W At wavelengths shorter than 400nm, attenuation by the glass window affects response adversely; hence UV detection is improved by removal of the glass or substitution of a sapphire window (available on special order). Speed of response for edge incidence is t_r, $t_f \approx$ 300ns.

5082-4205 MOUNTING RECOMMENDATIONS

a. The 5082-4205 is intended to be soldered to a printed circuit board having a thickness of from 0.51 to 1.52mm (0.02 to 0.06 inch).

b. Soldering temperature should be controlled so that at no time does the case temperature approach 280°C. The lowest solder melting point in the device is 280°C (gold-tin eutectic). If this temperature is approached, the solder will soften, and the lens may fall off. Lead-tin solder is recommended for mounting the package, and should be applied with a small soldering iron, for the shortest possible time, to avoid the temperature approaching 280°C.

c. Contact to the lens end should be made by soldering to one or both of the tabs provided. Care should be exercised to prevent solder from coming in contact with the lens.

d. If printed circuit board mounting is not convenient, wire leads may be soldering or welded to the devices using the precautions noted above.

LINEAR OPERATION

Having an equivalent circuit as shown in Figure 9, operation of the photodiode is most linear when operated with a current amplifier as shown in Figure 10.

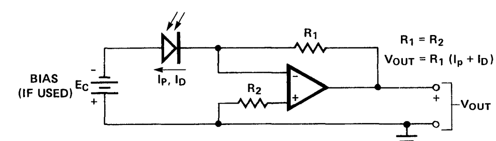


Figure 10. Linear Operation.

Lowest noise is obtained with $E_c = 0$, but higher speed and wider dynamic range are obtained if $5 < E_c < 20$ volts. The amplifier should have as high an input resistance as possible to permit high loop gain. If the photodiode is reversed, bias should also be reversed.

LOGARITHMIC OPERATION

If the photodiode is operated at zero bias with a very high impedance amplifier, the output voltage will be:

$$V_{OUT} = \left(1 + \frac{R_2}{R_1}\right) \cdot \frac{kT}{q} \cdot \ln \left(1 + \frac{I_P}{I_S}\right)$$

where $I_S = I_F \left(e^{\frac{qV}{kT}} - 1\right)^{-1}$ at $0 < I_F < 0.1mA$

using a circuit as shown in Figure 11.

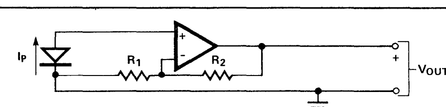


Figure 11. Logarithmic Operation.

Output voltage, V_{OUT}, is positive as the photocurrent, I_P, flows back through the photodiode making the anode positive.

APPLICATION INFORMATION INDEX

APPLICATION NOTES

APPLICATION NOTE 915

Threshold Detection of Visible and Infrared Radiation with PIN Photodiodes

Traditionally, the detection and demodulation of extremely low level optical signals has been performed with multiplier phototubes. Because of this tradition, solid-state photodetectors are often overlooked even though they have a number of clear functional advantages and in some applications provide superior performance as well. Some of these advantages are summarized in this note and become even more apparent in the discussion following.

APPLICATION NOTE 931

Solid State Alphanumeric Display...Decoder/Driver Circuitry

Hewlett-Packard offers a series of solid state displays capable of producing multiple alphanumeric characters utilizing 5 x 7 dot arrays of GaAsP light emitting diodes (LED's). These 5 x 7 dot arrays exhibit clear, easily read characters. In addition, each array is X-Y addressable to allow for a simple addressing, decoding, and driving scheme between the display module and external logic.

Methods of addressing, decoding and driving information to such an X-Y addressable matrix are covered in detail in this application note. The note starts with a general definition of the scanning or strobing technique used for this simplified addressing and then proceeds to describe horizontal and vertical strobing. Finally, a detailed circuit description is given for a practical vertical strobing application.

APPLICATION NOTE 934

5082-7300 Series Solid State Display Installation Techniques

The 5082-7300 series Numeric/Hexadecimal Indicators are an excellent solution to most standard display problems in commercial, industrial and military applications. The unit integrates the display character and associated drive electronics in a single package. This advantage allows for space, pin and labor cost reductions, at the same time improving overall reliability.

The information presented in this note describes general methods of incorporating the -7300 into varied applications.

APPLICATION NOTE 937

Monolothic Seven Segment LED Display Installation Techniques

The Hewlett-Packard series of small endstackable monolithic GaAsP displays are designed for strobing, a drive method that allows time sharing of the character generator among the digits in a display.

This Application Note begins with an explanation of the strobing technique, followed by a discussion of the uses and advantages of the right hand and center decimal point products.

Several circuits are given for typical applications. Finally, a discussion of interfacing to various data forms is presented along with comments on mounting the displays.

APPLICATION NOTE 939

High Speed Optically Coupled Isolators

Often designers are faced with the problem of providing circuit isolation in order to prevent ground loops and common mode signals. Typical devices for doing this have been relays, transformers and line receivers. However, both relays and transformers are low speed devices, incompatible with modern logic circuits. Line receiver circuits are fast enough, but are limited to a common mode voltage of 3 volts. In addition, they do not protect very well against ground loop signals. Now Optically Coupled Isolators are available which solve most isolation problems.

This Application Note contains a description of Hewlett-Packard's high speed isolators, and discusses their applications in digital and analog systems.

APPLICATION NOTE 941

5082-7700 Series Seven Segment LED Display Applications

The HP 5082-7700 series of LED displays are available in both common anode and common cathode configurations. These single digit displays have been engineered to provide a high contrast ratio and a wide viewing angle.

This Application Note begins with DC drive techniques and circuits. Next is an explanation of the strobe drive technique and the resultant increase in device efficiency. This is followed by general strobing circuits and some typical applications such as clocks, calculators and counters.

Finally, information is presented on general operating conditions, including intensity uniformity, light output control as a function of ambient light, contrast enhancement and device mounting.

APPLICATION NOTE 945

Photometry of Red LEDs

Nearly all LEDs are used either as discrete indicator lamps or as elements of a segmented or dot-matrix display. As such, they are viewed directly by human viewers, so the primary criteria for determining their performance is the judgement of a viewer. Equipment for measuring LED light output should, therefore, simulate human vision.

This Application Note will provide answers to these questions:

1. What to measure (definitions of terms)
2. How to measure it (apparatus arrangement)
3. Whose equipment to use (criteria for selection)

APPLICATION NOTE 946

5082-7430 Series Monolithic Seven Segment Displays

The HP 5082-7430 series solid state displays are common cathode, 2 and 3 digit clusters capable of displaying numeric and selected alphabetic data. These GaAsP displays employ an integral magnification technique to increase both the character size and the luminous intensity of each monolithic digit. The resultant 2.79mm (0.11") high character is viewable at distances of up to 5 feet when operated at as little as 0.5mW per segment.

These displays are designed for strobed operation. In strobing, the decoder is timeshared among the digits in the display, which are illuminated one at a time.

Typical applications, such as an Electronic Stopwatch, a battery operated Event Counter and a Four Function Calculator are discussed in this note.

APPLICATION NOTE 947

Digital Data Transmission Using Optically Coupled Isolators

Optically coupled isolators make ideal line receivers for digital data transmission applications. They are especially useful for elimination of common mode interference between two isolated data transmission systems. This application note describes design considerations and circuit techniques with special emphasis on selection of line drivers, transmission lines, and line receiver termination for optimum data rate and common mode rejection. Both resistive and active terminations are described in detail. Specific techniques are described for multiplexing applications, and for common mode rejection and data rate enhancement.

APPLICATION NOTE 948

Performance of the 5082-4350/51/60 Series of Isolators in Short to Moderate Length Digital Data Transmission Systems

Optically coupled isolators (opto-isolators) can function as excellent alternatives to integrated circuit line receivers in digital data transmission applications. Their major advantages consist of superior common-mode noise rejection and true ground isolation between the two subsystems.

This application note describes the basic design elements of a data transmission link and presents examples of systems that will be useful at distances that range from 1 ft. to 300 ft. and have a moderate overall cost.

APPLICATION NOTE 951-1

Applications for Low Input Current, High Gain Optically Coupled Isolators

Optically coupled isolators are useful in applications where large common mode signals are encountered. Examples are: line receivers, logic isolation, power lines, medical equipment and telephone lines. This application note has at least one example in each of these areas for the 5082-4370 series high CTR isolators.

APPLICATION NOTE 951-2

Linear Applications of Optically Coupled Isolators

Optically coupled isolators can be used to transfer an analog signal between two isolated systems. In many instances, isolators can replace expensive transformers, instrumentation amplifiers, and A/D conversion schemes. This application note discusses several circuit techniques by which 5082-4350 series optically coupled isolators can be used to transmit analog information. The operation of each circuit is explained in detail and typical circuit performance is given.

APPLICATION NOTE 964

Contrast Enhancement Techniques

This Application Note presents various criteria and techniques that a display engineer should consider to obtain optimum contrast enhancement for red, yellow and green LED displays. A representative list of filter manufacturers and available filters is given at the end of this discussion.

APPLICATION NOTE 966

The HDSP-2000 provides a unique yet simple and low cost method for addressing display data to a 5 x 7 alphanumeric display. This application note is intended to serve as a design and application guide for users of the HDSP-2000. The information presented will cover the theory of the device design and operation, considerations for specific circuit design, thermal management, power derating and heat sinking, and intensity modulation techniques.

APPLICATION BULLETINS

APPLICATION BULLETIN 1

Construction and Performance of High Efficiency Red, Yellow and Green LED Materials

The high luminous efficiency of Hewlett-Packard's High Efficiency Red, Yellow and Green lamps and displays is made possible by a new kind of light emitting material utilizing a GaP transparent substrate. This application bulletin discusses the construction and performance of this material as compared to standard red GaAsP and red GaP materials.

APPLICATION BULLETIN 3

Soldering Hewlett-Packard Silver Plated Lead Frame LED Devices

Many of Hewlett-Packard's commercial LED devices use a silver plated lead frame. Soldering to a silver lead frame provides a reliable electrical and mechanical connection and is no more complicated than soldering to a gold lead frame. Some suggestions on how to handle and solder silver plated lead frame devices are presented.

APPLICATION BULLETIN 4

Detection and Indication of Segment Failures in Seven Segment LED Displays

The occurrence of a segment failure in certain applications of 7 segment displays can have serious consequences if a resultant erroneous message is read by the viewer. This application bulletin discusses three techniques for detecting open segment lines and presenting this information to the viewer.

APPLICATION BULLETIN 8

Assembly and Handling Techniques for Monolithic Display Chips

Die attach, lead bonding and intensity matching of LED display chips present special problems for the manufacturers of hybrid modules. This application bulletin discusses some of the basic considerations for handling of gallium arsenide phosphide materials.

APPLICATION BULLETIN 50

Hewlett Packard Watch Chip Drawings

As an aid to designers of hybrid devices using LED display chips and discrete LEDs, this bulletin provides detailed dimensional information on all Hewlett-Packard 5082-7800 series display chip products.

APPLICATION BULLETIN 51

Interfacing the HDSP-2000 Display to a Microprocessor

Interface of the HDSP-2000 alphanumeric display to a microprocessor involves the design of a relatively simple interface element. This bulletin briefly discusses the trade-offs involved in the design of such an interface and provides a specific example of an interface to the 8080 microprocessor along with appropriate software.

APPLICATION BULLETIN 52

Large Monolithic LED Displays

The trend to incorporate more complex functions into smaller package configurations that are portable and battery powered is reaching a point where the limiting items are the space and power constraints imposed upon the display at the operator-to-machine interface. The large monolithic LED display has been designed to meet many of these constraints. This application bulletin describes the beneficial features of a large monolithic LED display and presents circuits which interface the display to CMOS logic and to a microprocessor.

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OPTOELECTRONICS APPLICATIONS MANUAL

The commercial availability of the Light Emitting Diode has provided electronic system designers with a revolutionary component for application in the areas of information display and photocouplers.

Many electronic engineers have encountered the need for a resource of information about the application of and designing with LED products. This book is intended to serve as an engineering guide to the use of a wide range of solid state optoelectronic products.

The book is divided into chapters covering each of the generalized LED product types. Additional chapters treat such peripheral information as contrast enhancement techniques, photometry and radiometry, LED reliability, mechanical considerations of LED devices, photodiodes and LED theory.

This book is available from Hewlett-Packard or from the McGraw Hill Publishing Company.

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