Optoelectronics Designer's Catalog

Hewlett-Packard Components 1976

Optoelectronics
Designer's Catalog

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 26 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, and Brazil.

However, for the customer, Hewlett-Packard is no farther away than the nearest telephone. There are 172 HP sales and service offices located in 65 countries 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.

HP Optoelectronics

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.

About this Catalog

This Optoelectronics Designer's Catalog contains detailed, up-to-date specifications on our complete optoelectronic product line. It is divided into four major product sections: LED Lamps, LED Displays, Isolators, and Detectors. 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 148.

How To Use This Catalog
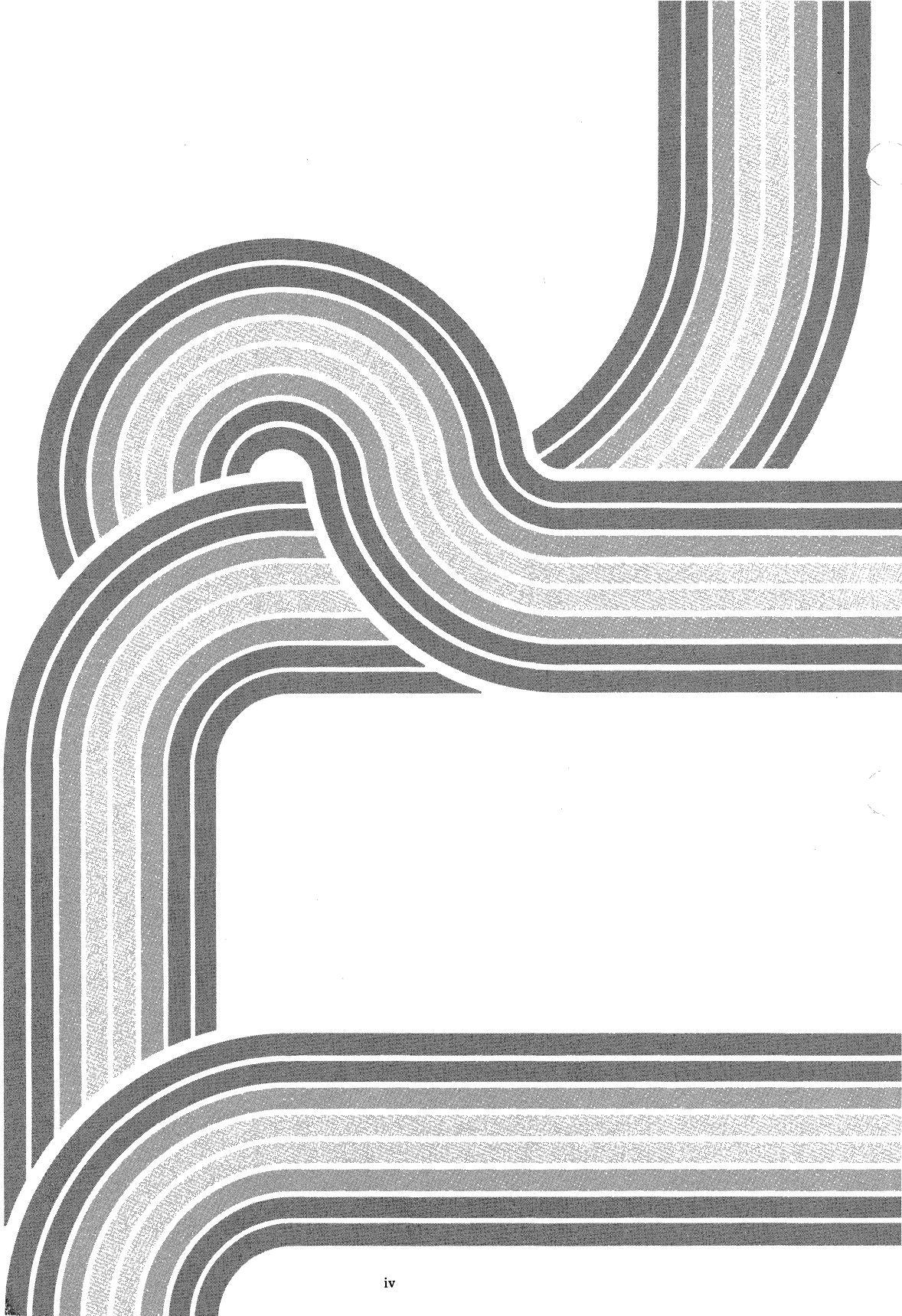
Three methods are incorporated for locating components:
● a Table of Contents that allows you to locate components by their general description,
● a Numeric Index that lists all components by part number, and
● a Selection Guide for each product group giving a brief overview of the product line.

How To Order

All Hewlett-Packard components may be ordered through any of the Sales and Service Offices listed on page 150. In addition, for immediate delivery of Hewlett-Packard optoelectronic components, contact any of the world-wide stocking distributors listed on page 148.

Table of Contents

Numeric Index

Numeric Index

Solid State Lamps

High Efficiency Red, Yellow, Green LED Lamps

Device						Typical Luminous Intensity	2Θ½ [1]	Typical Forward Voltage	Page No.
Photo	Part No. 5082-	Color	Emitting Material	Lens	Package				
	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	5
	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]	3.5mcd @10mA	50°		9
	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°		15
	4160			Red Diffused	Submin.; Plastic; Radial Leads	3.0mcd @10mA	80°		19
	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	5
	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]	3.5mcd @10mA	50°		9
	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°		15
	4150			Yellow Diffused	Submin.; Plastic; Radial Leads	2.0mcd @10mA	90°		19
	4950	Green (565nm)[2]	GaP	Green Diffused	T-1¾; Plastic; Long General Purpose Leads[3]	1.8mcd @20mA	90°	2.4 Volts @20mA	5
	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[3]	4.5mcd @20mA	50°		9
	4992					7.5mcd @20mA			
	4995			Green Non-Diffused		6.5mcd @20mA	40°		
	4997					11.0mcd @20mA			
	4984			Green Diffused	T-1; Plastic; Long Leads[4]	2.0mcd @20mA	60°		15
	4190			Green Diffused	Submin.; Plastic; Radial Leads	1.5mcd @20mA	70°		19

NOTES: 1. Θ½ is the off-axis angle at which the liminous intensity is half the axial luminous intensity.
2. Peak Wavelength.
3. Panel Mountable. For Panel Mounting Kit, see page 51.
4. PC Board Mountable.

For Applications Information, see pages 146-147.

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	23
	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[3]	1.2mcd @20mA	60°	1.6 Volts @20mA	9
	4791					2.5mcd @20mA			
	4480			Red Diffused	T-1; Plastic; Long Leads[4]	0.8mcd @20mA	120°	1.6 Volts @20mA	25
	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	27
	4488					Guaranteed Min. 0.3mcd @20mA			
	4100			Red Diffused	Submin.; Plastic; Radial Leads	0.5mcd @10mA	45°	1.6 Volts @10mA	19
	4101					1.0mcd @10mA			
4403/4440 4415/4444	4403			Red Diffused	T-1¾; Plastic; Short, Leads[3]	1.2mcd @20mA	75°	1.6 Volts @20mA	29
	4415				T-1¾; Plastic; Short, Bent Leads[4]				
	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	32
	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°		

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 51.
4. PC Board Mountable.

For Applications Information, see pages 146-147.

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	33
	4860		Resistor chip integrated with GaAsP LED chip	Red Diffused	T-1¾; Plastic; Long Leads[3]	0.8mcd @5.0V	58°	16mA @ 5.0V	35
	4468			Clear Diffused	T-1; Plastic; Long Leads[4]		70°		

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	37
	5082-4620	High Eff. Red (635nm)[2]	GaAsP on GaP	Red Diffused		1.0mcd @ 20mA		2.0 Volts @ 20mA	39
	5082-4520	Yellow (583nm)[2]	GaAsP on GaP	Yellow Diffused		1.0mcd @ 20mA		2.0 Volts @ 20mA	
	5082-4920	Green (565nm)[2]	GaP	Green Diffused		0.8mcd @ 25mA		2.1 Volts @ 25mA	

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 51.
4. PC Board Mountable.
5. Military Approved and qualified for High Reliability Applications.

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COMPONENTS

SOLID STATE LAMPS

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

TECHNICAL DATA APRIL 1976

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**

Package Dimensions

PLASTIC

5.08 (.200)
4.32 (.170)

9.47 (.373)
7.95 (.313)

0.89 (.035)
0.64 (.025)

26.67 (1.05) MIN.

25.40 (1.00) MIN.

0.64 (.025)
0.36 (.014)

0.41 (.016)
0.36 (.014)

6.10 (.240)
5.59 (.220)

CATHODE

2.54 (.10) NOM.

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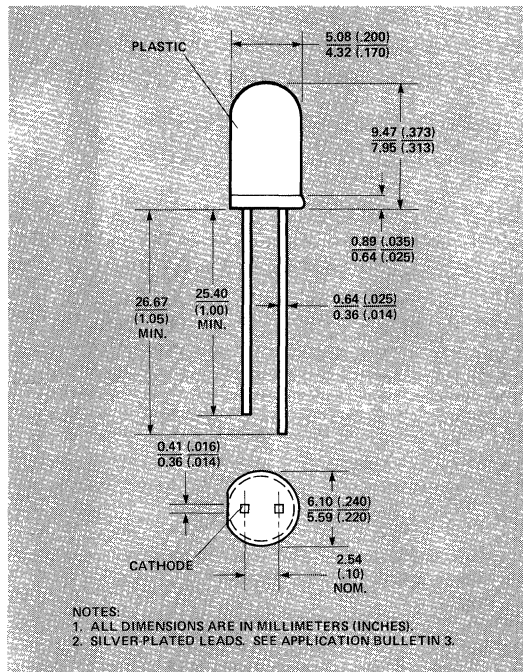
Description

The 5082-4650 Series are Gallium Arsenide Phosphide on Gallium Phosphide High Efficiency Red Light Emitting Diodes packaged in a T-1¾ outline. The 5082-4650/4655 have a red diffused lens which provides excellent on-off contrast ratio, high axial luminous intensity and a wide viewing angle. The 5082-4657/4658 have a red non-diffused lens which provides excellent on-off contrast ratio, very high axial luminous intensity and a narrow viewing angle.

The 5082-4550 Series are Gallium Arsenide Phosphide on Gallium Phosphide Yellow Light Emitting Diodes packaged in a T-1¾ outline. The 5082-4550/4555 have a yellow diffused lens which provides good on-off contrast ratio, high axial luminous intensity and a wide viewing angle. The 5082-4557/4558 have a yellow non-diffused lens which provides good on-off contrast ratio, very high axial luminous intensity and a narrow viewing angle.

The 5082-4950 Series are Gallium Phosphide Green Light Emitting Diodes packaged in a T-1¾ outline. The 5082-4950/4955 have a green diffused lens which provides good on-off contrast ratio, high axial luminous intensity and a wide viewing angle. The 5082-4957/4958 have a green non-diffused lens which provides good on-off contrast ratio, very high axial luminous intensity and a narrow viewing angle.

Electrical Characteristics at $T_A = 25°C$

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

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 (0.5 msec pulse width)	60	60	60	mA
Operating and Storage Temperature Range	−50°C to +100°C			
Lead Solder Temperature (1.6mm[0.063 inch] below package base)	260°C for 5 seconds			
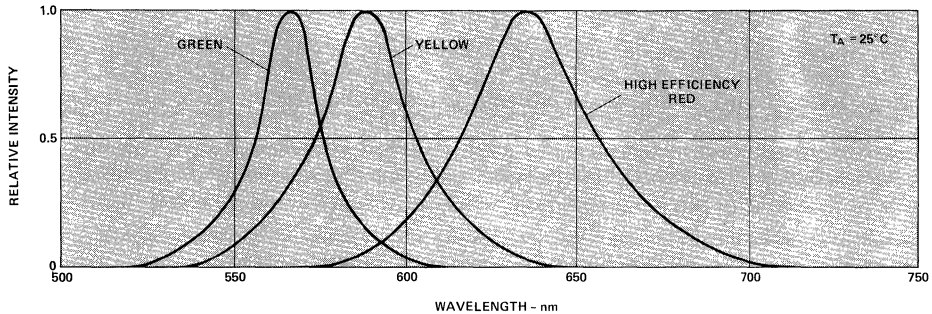
WAVELENGTH – nm

Figure 1. Relative Intensity vs. Wavelength.

High Efficiency Red 5082-4650 Series

V_F – FORWARD VOLTAGE – V

Figure 2. Forward Current vs. Forward Voltage

I_F – FORWARD CURRENT – mA

Figure 3. Relative Luminous Intensity vs. Forward Current.

I_PEAK – PEAK CURRENT – mA

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

t_P – PULSE DURATION – μs

Figure 5. Maximum Tolerable Peak Current vs. Pulse Duration. (I_DC MAX as per MAX Ratings.)

Figure 6. Relative Luminous Intensity vs. Angular Displacement.

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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.

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COMPONENTS
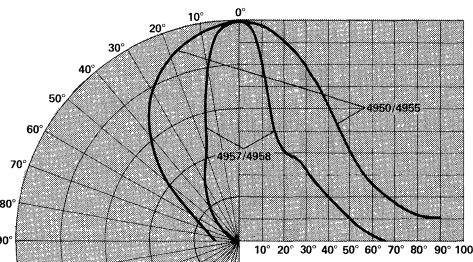
LOW PROFILE SOLID STATE LAMPS
RED • 5082-4790 SERIES
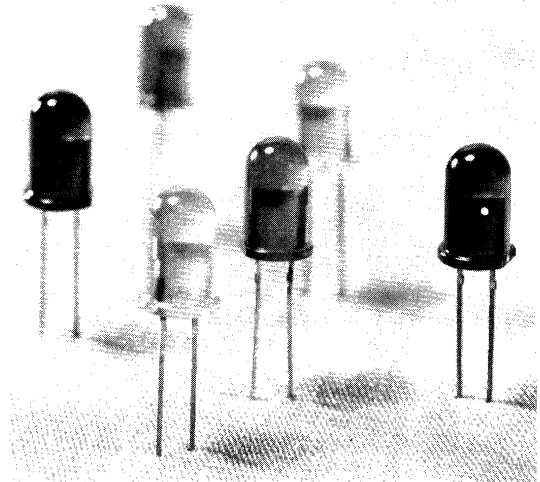HIGH EFFICIENCY RED • 5082-4690 SERIES
YELLOW • 5082-4590 SERIES
GREEN • 5082-4990 SERIES

TECHNICAL DATA   APRIL 1976

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

Package Dimensions

PLASTIC

5.08 (.200)
4.32 (.170)

6.35 (.250)
5.33 (.210)

1.65 (.065)
1.40 (.055)

26.67 MIN
(1.05)

25.40 MIN
(1.00)

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS (INCHES)
2. LAMP LEADS ARE PLATED SILVER (SEE AP. NOTE 3)

0.51 (.020)
0.36 (.014)

0.41 (.016)
0.36 (.014)

6.10 (.240)
5.59 (.220)

CATHODE

2.54 NOM
(.10)

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 which provides good on-off contrast ratio, good axial luminous intensity, and a wide viewing angle.

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 5082-4690/4693 have a red diffused lens which provides excellent on-off contrast ratio, high axial luminous intensity and a wide viewing angle. The 5082-4694/4695 have a red non-diffused lens which provides excellent on-off contrast ratio, very high axial luminous intensity and a narrow viewing angle.

The 5082-4590 Series are Gallium Arsenide Phosphide on Gallium Phosphide Yellow Light Emitting Diodes packaged in a Low Profile T-1¾ outline. The 5082-4590/4592 have a yellow diffused lens which provides good on-off contrast ratio, high axial luminous intensity and a wide viewing angle. The 5082-4595/4597 have a yellow non-diffused lens which provides good on-off contrast ratio, very high axial luminous intensity and a narrow viewing angle.

The 5082-4990 Series are Gallium Phosphide Green Light Emitting Diodes packaged in a Low Profile T-1¾ outline. The 5082-4990/4992 have a green diffused lens which provides good on-off contrast ratio, high axial luminous intensity and a wide viewing angle. The 5082-4995/4997 have a green non-diffused lens which provides good on-off contrast ratio, very high axial luminous intensity and a narrow viewing angle.
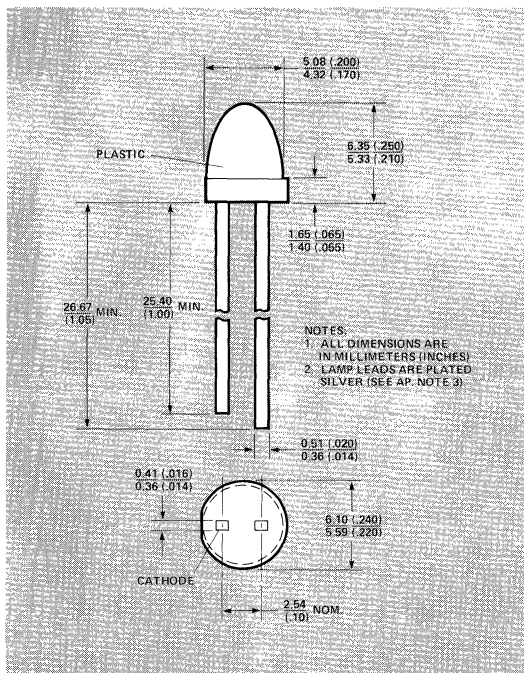
Absolute Maximum Ratings at T_A=25°C

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)	230°C For 7 Seconds				
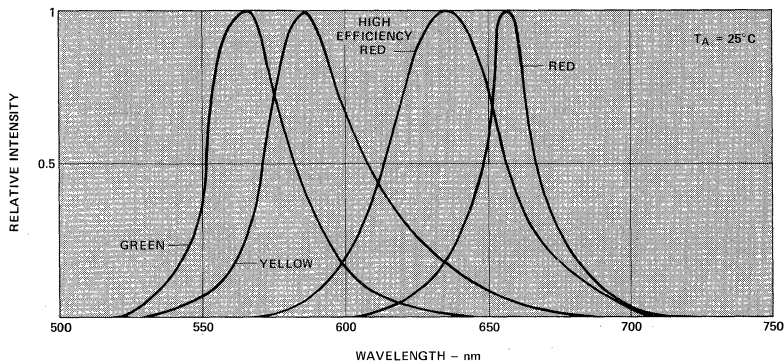
Figure 1. Relative Intensity versus Wavelength.

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.
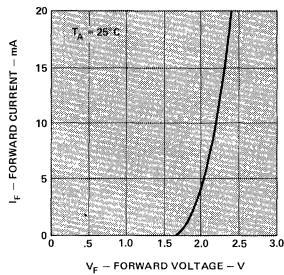

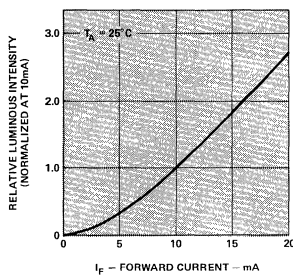Figure 2. Forward Current versus Forward Voltage.

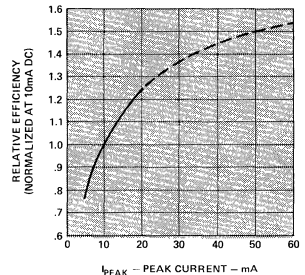Figure 3. Relative Luminous Intensity versus Forward Current.

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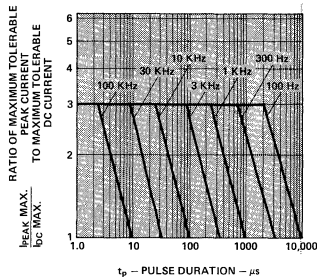

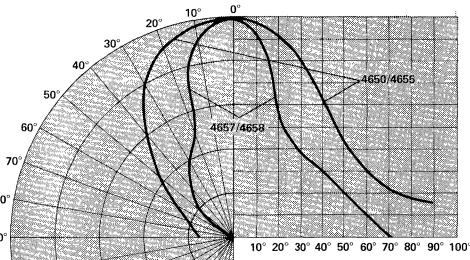Figure 5. Maximum Tolerable Peak Current versus Pulse Duration. (I_{DC} MAX as per MAX Ratings)

Figure 6. Relative Luminous Intensity versus Angular Displacement.

11
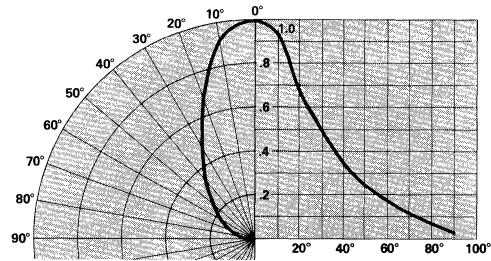
HIGH EFFICIENCY RED 5082-4690 SERIES
Electrical Specifications at $T_A = 25°C$

Symbol	Description	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions
I_V	Axial Luminous Intensity	4690	1.5	3.5		mcd	$I_F = 10mA$ (Fig.8)
		4693	5.0	7.0			
		4694	4.0	8.0			
		4695	8.0	11.0			
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points	4690		50		deg.	Note 1 (Fig. 11)
		4693		50			
		4694		45			
		4695		45			
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.
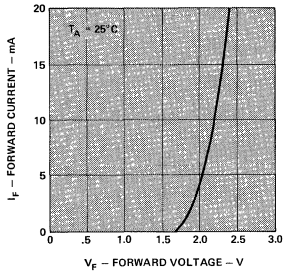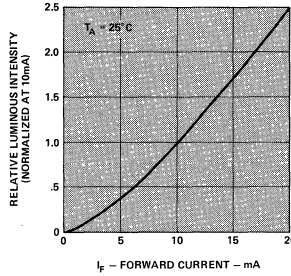

Figure 7. Forward Current versus Forward Voltage.

Figure 8. Relative Luminous Intensity versus Forward Current.
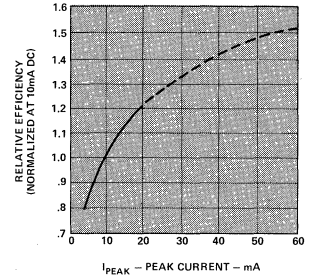

Figure 9. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current.
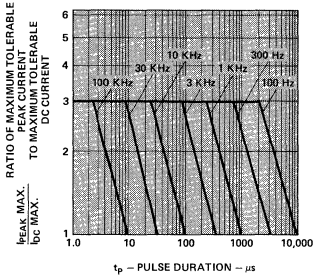

Figure 10. Maximum Tolerable Peak Current versus Pulse Duration. (I_{DC} MAX as per MAX Ratings)
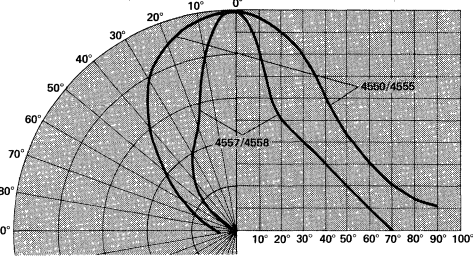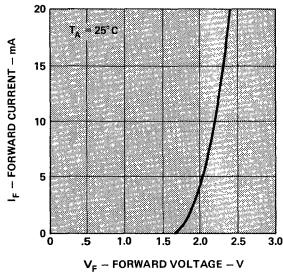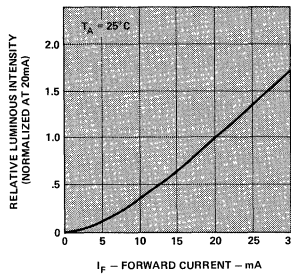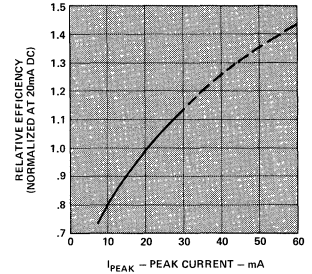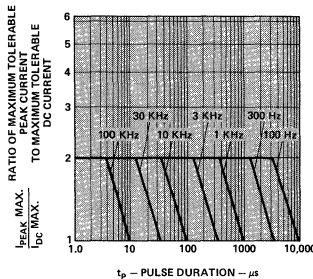

Figure 11. Relative Luminous Intensity versus Angular Displacement.

12
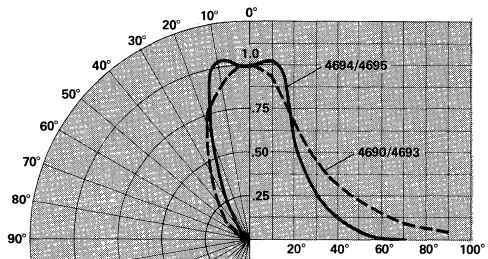
YELLOW 5082-4590 SERIES
Electrical Specifications at T_A=25°C

Symbol	Description	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions
I_V	Axial Luminous Intensity	4590	1.5	3.5		mcd	I_F = 10mA (Fig. 13)
		4592	4.5	6.0			
		4595	4.0	6.5			
		4597	8.0	11.0			
$2\theta_{1/2}$	Included Angle Between Half Luminous Intensity Points	4590		50		deg.	Note 1 (Fig. 16)
		4592		50			
		4595		45			
		4597		45			
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).

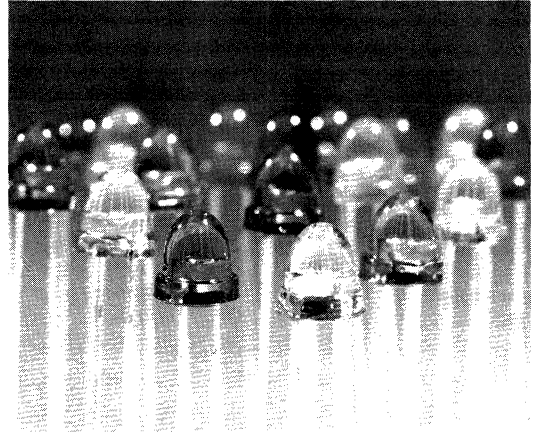Figure 16. Relative Luminous Intensity versus Angular Displacement

13
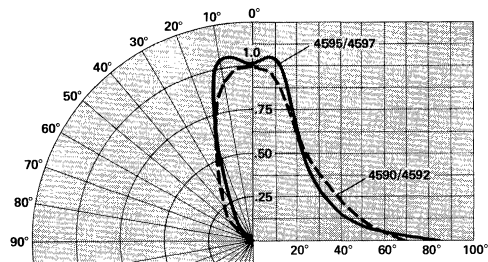
GREEN 5082-4990 SERIES
Electrical Specifications at T$_A$=25°C

Symbol	Description	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions
I$_V$	Axial Luminous Intensity	4990	2.0	4.5		mcd	I$_F$ = 20mA (Fig.18)
		4992	6.0	7.5			
		4995	3.5	6.5			
		4997	8.0	11.0			
2θ$_{1/2}$	Included Angle Between Half Luminous Intensity Points	4990		50		deg.	Note 1 (Fig.21)
		4992		50			
		4995		40			
		4997		40			
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. θ$_{1/2}$ 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$_V$/η$_V$, where I$_V$ is the luminous intensity in candelas and η$_V$ is the luminous efficacy in lumens/watt.
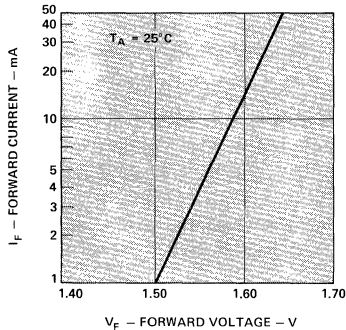

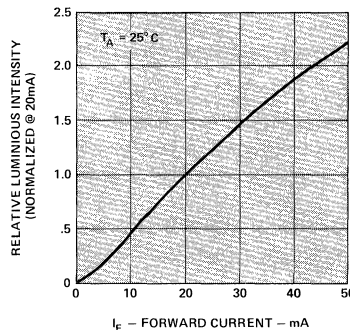Figure 17. Forward Current versus Forward Voltage.

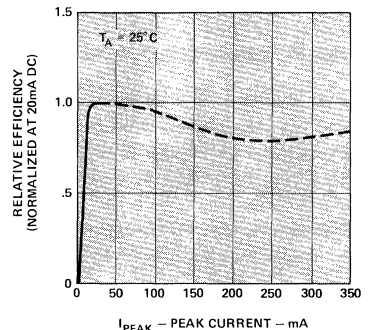Figure 18. Relative Luminous Intensity versus Forward Current.

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.

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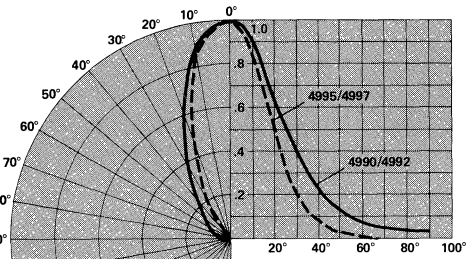
SOLID STATE LAMPS
HIGH EFFICIENCY RED • 5082-4684
YELLOW • 5082-4584
GREEN • 5082-4984

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
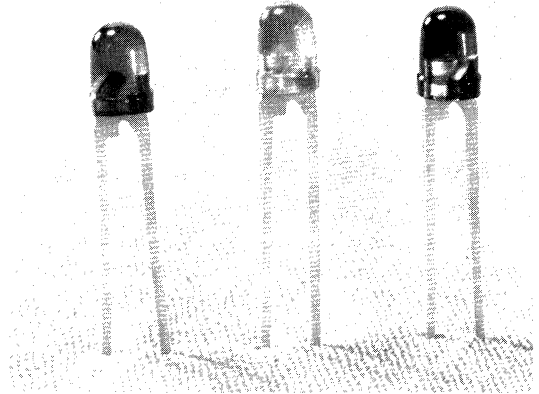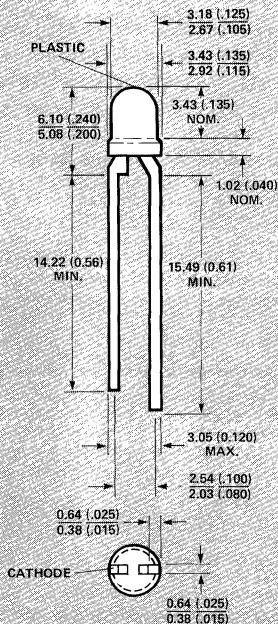
Package Dimensions

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 Min.	Typ.	Max.	5082-4584 Min.	Typ.	Max.	5082-4984 Min.	Typ.	Max.	Units	Test Conditions
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.
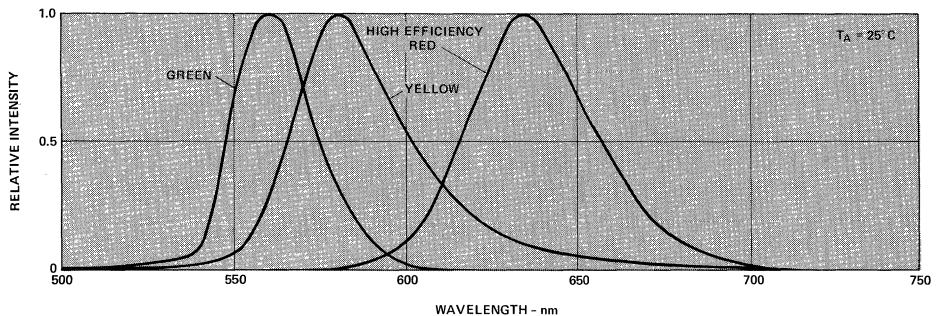
Figure 1. Relative Intensity vs. Wavelength.

High Efficiency Red 5082-4684

Figure 2. Forward Current vs. Forward Voltage.

Figure 3. Relative Luminous Intensity vs. Forward Current.

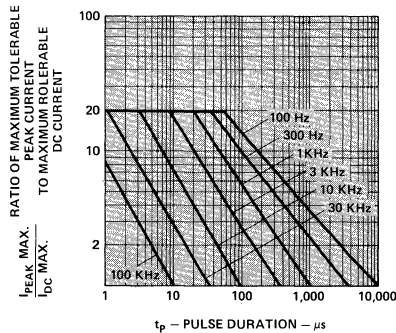Figure 4. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

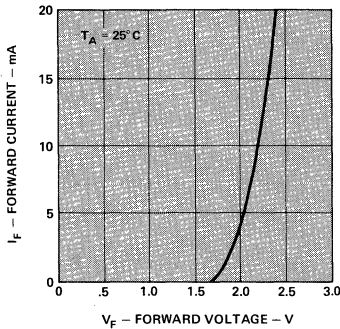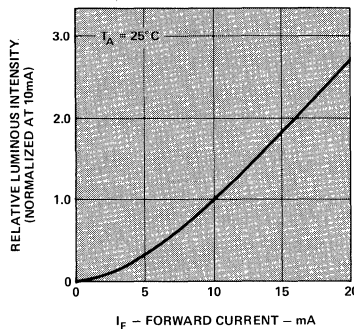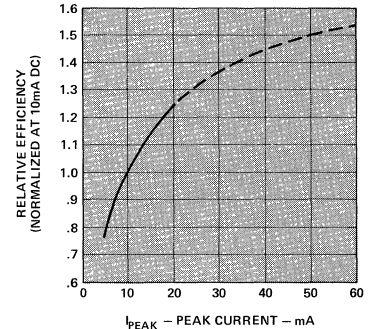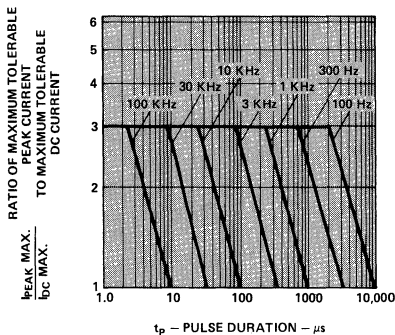Figure 5. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC}MAX as per MAX Ratings).
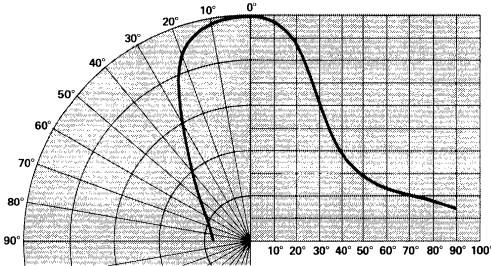
Figure 6. Relative Luminous Intensity vs. Angular Displacement.

Yellow 5082-4584
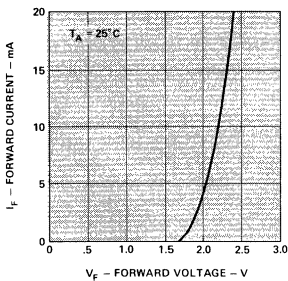
Figure 7. Forward Current vs. Forward Voltage.
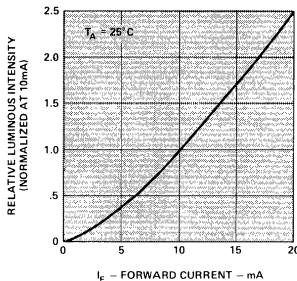
Figure 8. Relative Luminous Intensity vs. Forward Current.
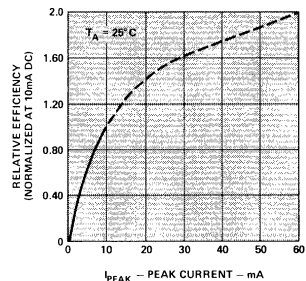
Figure 9. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.
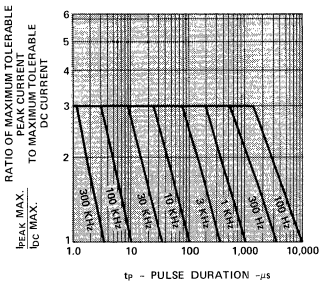
Figure 10. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings.)
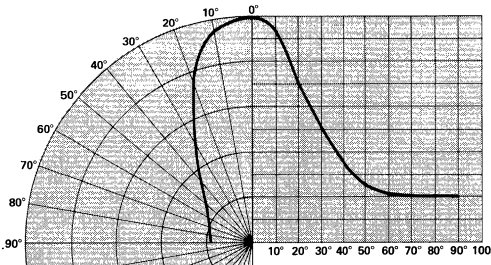
Figure 11. Relative Luminous Intensity vs. Angular Displacement.

Green 5082-4984
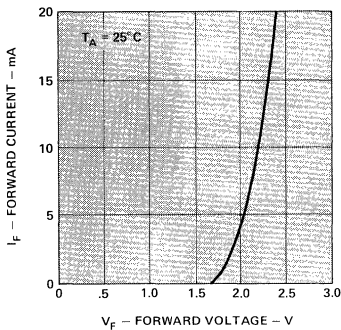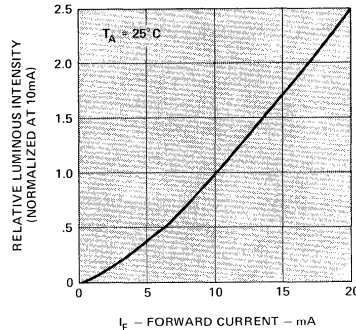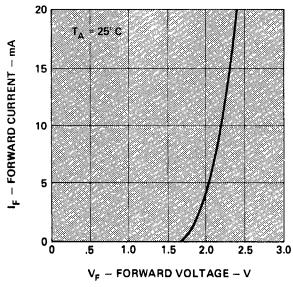

Figure 12. Forward Current vs. Forward Voltage.
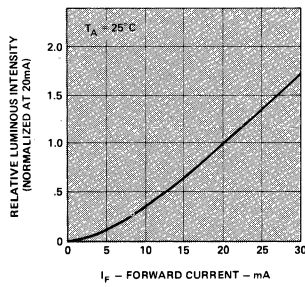
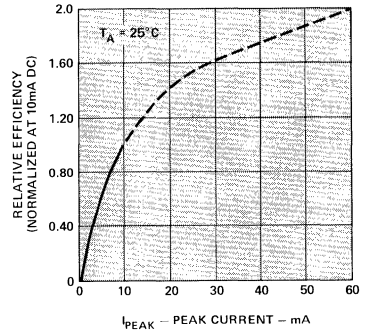Figure 13. Relative Luminous Intensity vs. Forward Current.
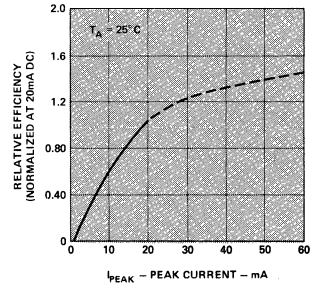
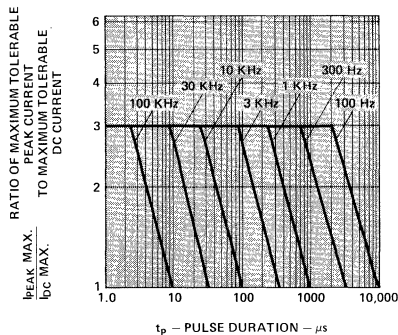Figure 14. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.
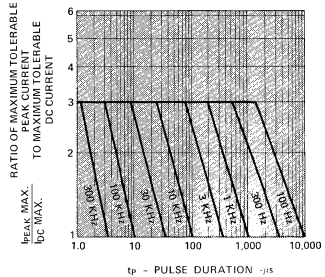
Figure 15. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings.)
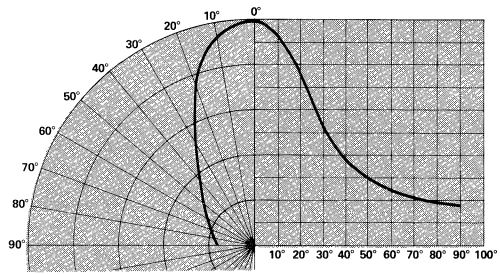
Figure 16. Relative Luminious Intensity vs. Angular Displacement.

SUBMINIATURE SOLID STATE LAMPS
RED • 5082-4100/4101
HIGH EFFICIENCY RED • 5082-4160
YELLOW • 5082-4150
GREEN • 5082-4190

TENTATIVE DATA   APRIL 1976

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
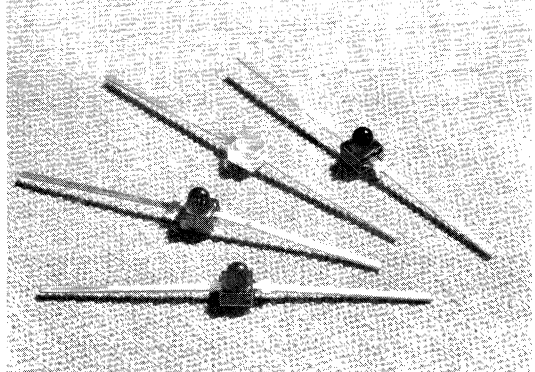
Description

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.

Arrays are available upon special request. They are comprised of a group of the subminiature lamps arranged in a molded linear configuration with separately accessible radial leads for each device. The center-to-center spacing is 2.54mm (0.100 in.).

Package Dimensions

11.4 (.45) MIN. BOTH SIDES
.46 (.018) / .56 (.022)
.46 (.018) / .56 (.022)
.89 (.035) / 1.14 (.045)
ANODE
CATHODE
1.65 (.065) / 1.91 (.075) DIA.
1.52 (.060) / 1.78 (.070)

TOP VIEW

.11 (.0045) / .22 (.0085)
1.91 (.075) MAX.
1.27 (.050) / 1.40 (.055)
.76 (.030) MAX.
1.91 (.075) / 2.16 (.085)
2.54 (.100) NOM.   SEE NOTE 3

SIDE VIEW

.94 (.037) / 1.24 (.049)
.76 (.030) / .89 (.035) R
2.92 (.115) MAX.
1.96 (.077) / 2.21 (.087)

END VIEW

NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS (INCHES).
2. SILVER-PLATED LEADS. SEE APPLICATION BULLETIN 3.
3. USER MAY BEND LEADS AS SHOWN.
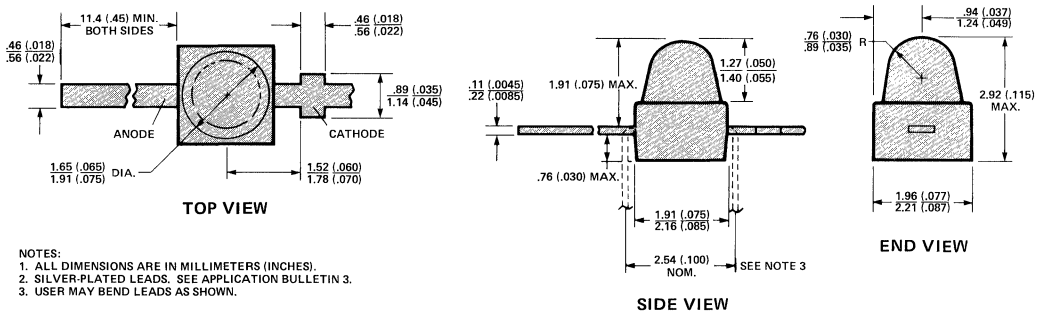
Absolute Maximum Ratings at T_A=25°C

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]	260°C for 5 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	1.5 At I_F = 20mA		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		2.4 At I_F = 20mA	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.
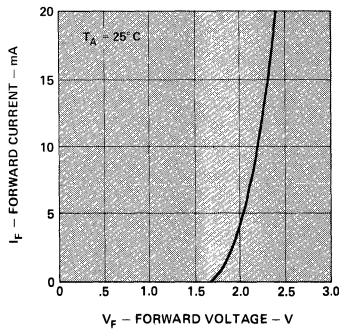

Figure 1. Relative Intensity vs. Wavelength.

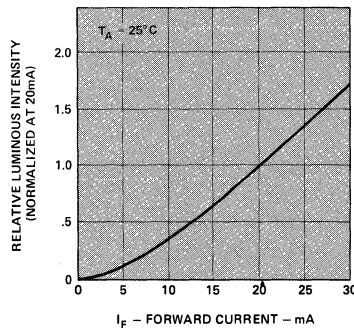# Red 5082-4100/4101
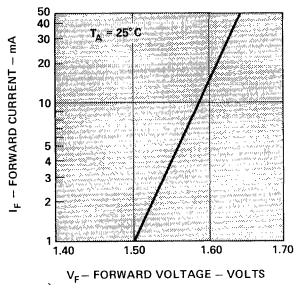
Figure 2. Forward Current vs.
Forward Voltage.
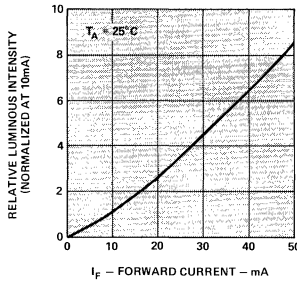
Figure 3. Relative Luminous Intensity
vs. Forward Current.
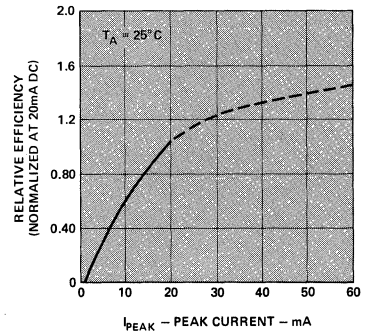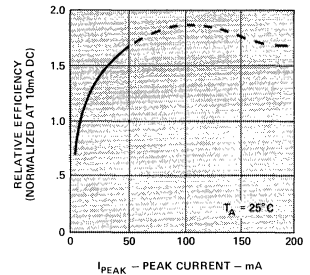

Figure 4. Relative Efficiency
(Luminous Intensity per Unit
Current) vs. Peak Current.
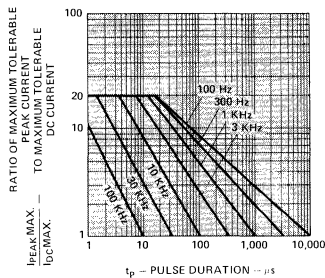
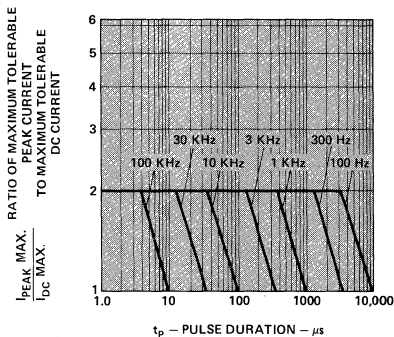Figure 5. Maximum Tolerable Peak Cur-
rent vs. Pulse Duration. (I_{DC} MAX
as per MAX Ratings)
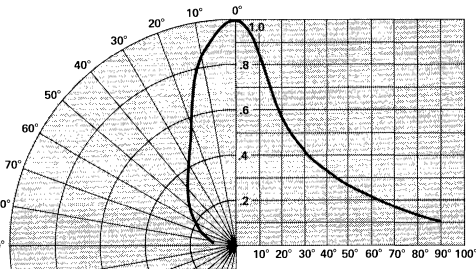
Figure 6. Relative Luminous Intensity vs. Angular Displacement.

High Efficiency Red 5082-4160
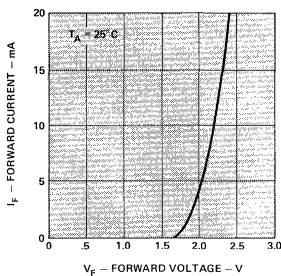
Figure 7. Forward Current vs.
Forward Voltage.
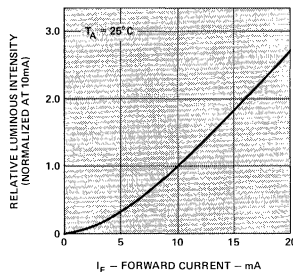
Figure 8. Relative Luminous Intensity
vs. Forward Current.
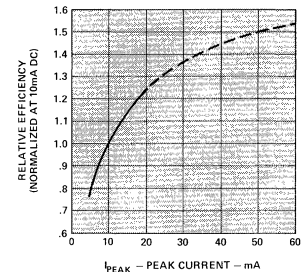
Figure 9. Relative Efficiency
(Luminous Intensity per Unit
Current) vs. Peak Current.
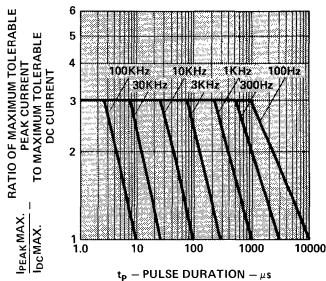
Figure 10. Maximum Tolerable Peak Cur-
rent vs. Pulse Duration. (I_{DC} MAX
as per MAX Ratings)
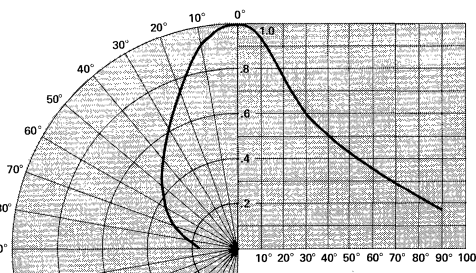
Figure 11. Relative Luminous Intensity vs. Angular Displacement.

Yellow 5082-4150
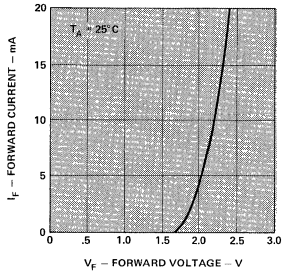
Figure 12. Forward Current vs. Forward Voltage.
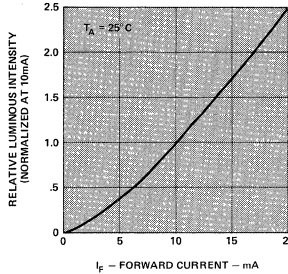
Figure 13. Relative Luminous Intensity vs. Forward Current.
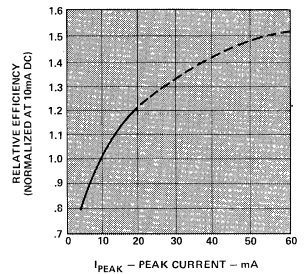
Figure 14. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.
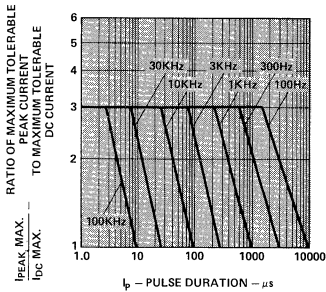
Figure 15. Maximum Tolerable Peak Current vs. Pulse Duration. (I_{DC} MAX as per MAX Ratings)
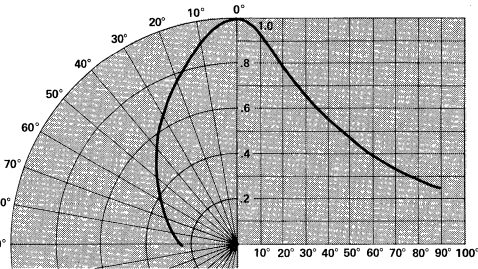
Figure 16. Relative Luminous Intensity vs. Angular Displacement.
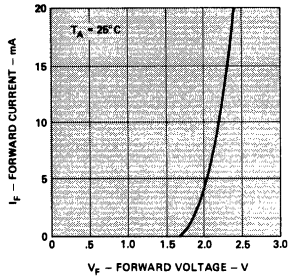
Green 5082-4190
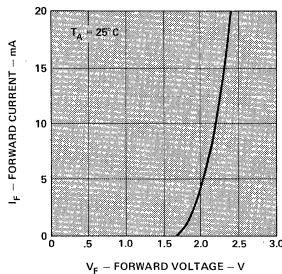
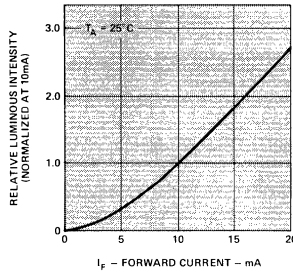Figure 17. Forward Current vs. Forward Voltage.
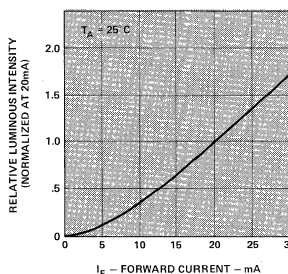
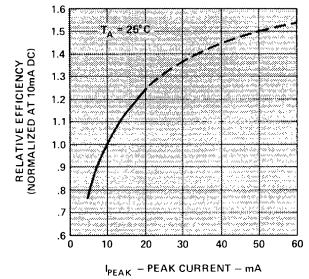Figure 18. Relative Luminous Intensity vs. Forward Current.

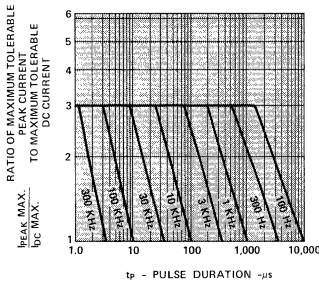Figure 19. Relative Efficiency (Luminous Intensity per Unit Current) vs. Peak Current.

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

Figure 21. Relative Luminous Intensity vs. Angular Displacement.

COMMERCIAL LIGHT EMITTING DIODES

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

DIMENSIONS IN MILLIMETERS AND (INCHES)

RED PLASTIC

5.08 (.200)
4.32 (.170)

9.47 (.373)
7.95 (.313)

11.43 (.450)
9.91 (.390)

0.89 (.035)
0.64 (.025)

1.27 (.05)
0.76 (.03)

12.70 (.50) MIN.

0.69 (.027)
0.58 (.023)

13.97 (.55) MIN.

0.69 (.027)
0.59 (.023)

6.10 (2.40)
5.59 (.220)

CATHODE

2.54 (.10) NOM.

5082-4850/4855

3.18 (.125)
2.67 (.105)

PLASTIC

3.43 (.135)
2.92 (.115)

6.10 (.240)
5.08 (.200)

3.43 (.135) NOM.

1.02 (.040) NOM.

14.22 (0.56) MIN.

15.49 (0.61) MIN.

3.05 (0.120) MAX.

2.54 (.100)
2.03 (.080)

0.64 (.025)
0.38 (.015)

CATHODE
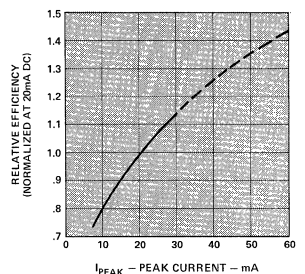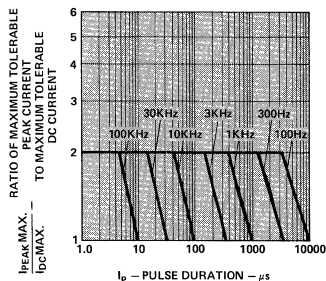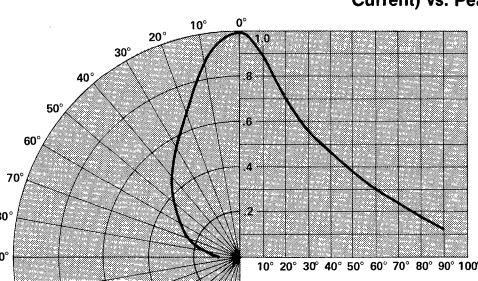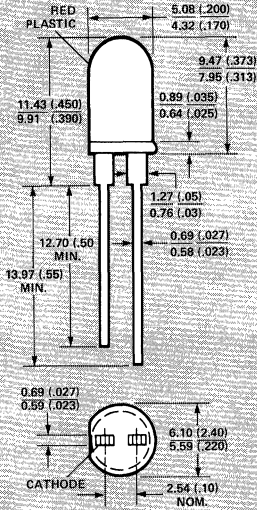
0.64 (.025)
0.38 (.015)
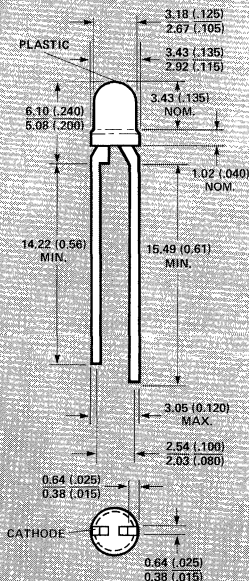
5082-4484/4494

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 = 100μA
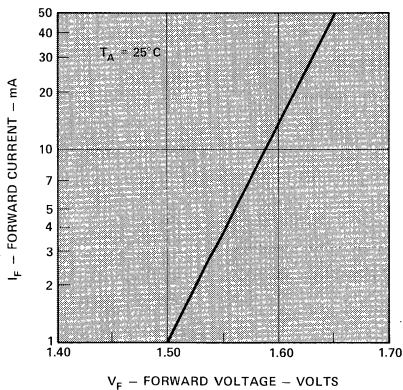
Figure 1. Forward Current Versus Forward Voltage Characteristic For 5082-4850/4855/4484/4494.
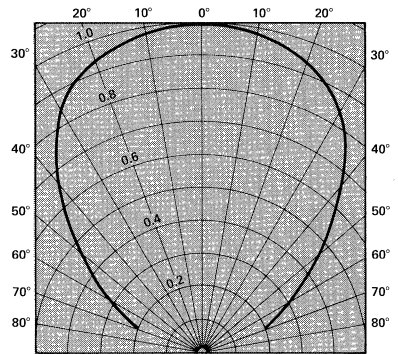
Figure 2. Relative Luminous Intensity Versus Angular Displacement For 5082-4850/4855.
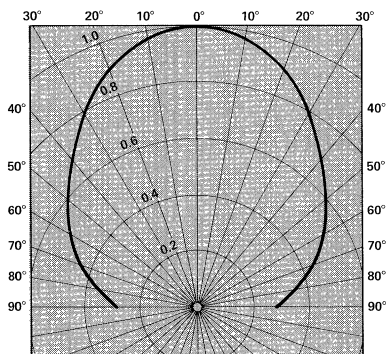
Figure 3. Relative Luminous Intensity Versus Angular Displacement For 5082-4484/4494.
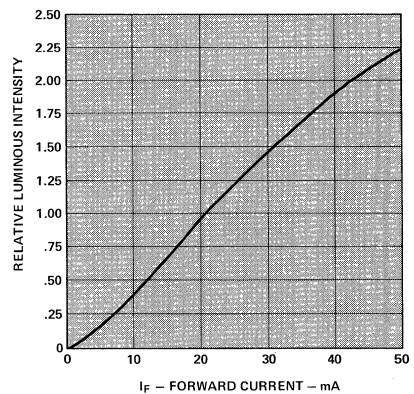
Figure 4. Relative Luminous Intensity Versus Forward Current For 5082-4850/4855/4484/4494.

Features

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

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.

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.

DIMENSIONS IN MILLIMETERS AND (INCHES).
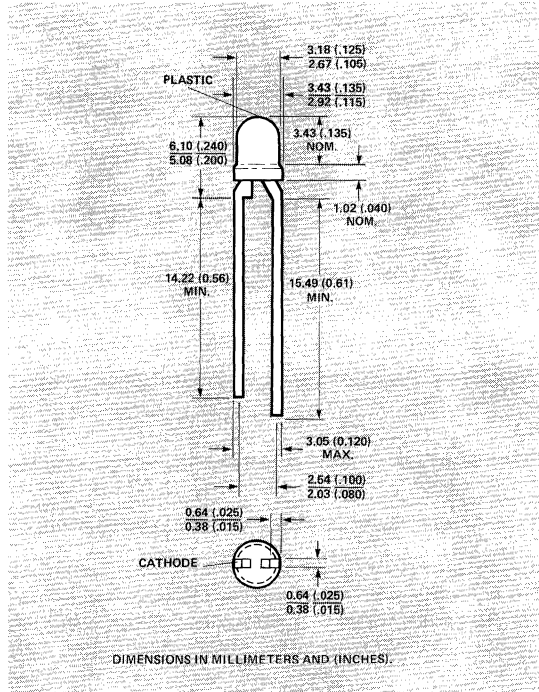
PART NO.	LENS CONFIGURATION
5082-4480	Red Diffused
5082-4483	Untinted Diffused
5082-4486	Clear Plastic

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
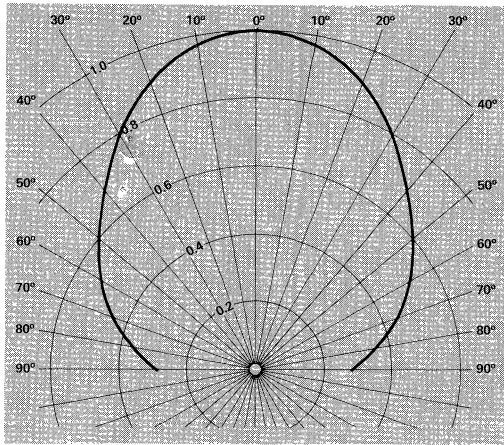
Figure 1. Relative Luminous Intensity
vs. Angular Displacement.

5082-4486

Figure 2. Relative Luminous Intensity
vs. Angular Displacement.
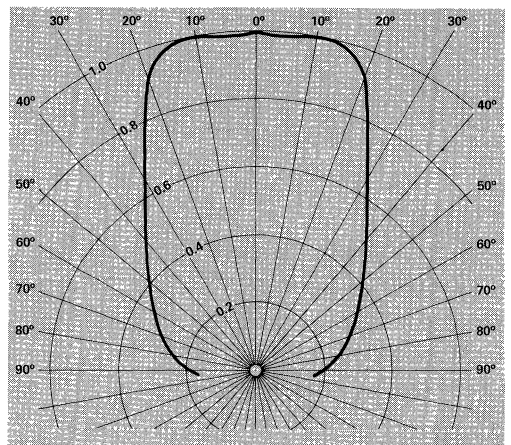
FORWARD CURRENT – VOLTAGE CHARACTERISTICS
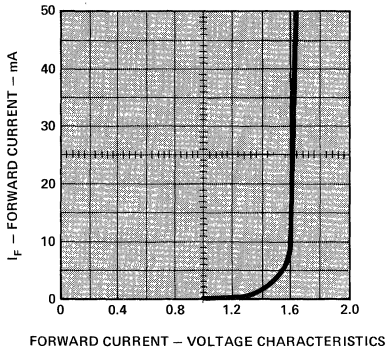
Figure 3. Forward Current vs. Voltage
Characteristic.
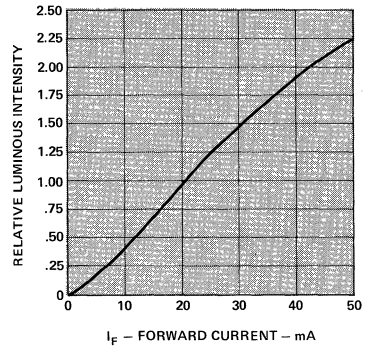
Figure 4. Luminous Intensity vs. Forward
Current (I_F).

LOW PROFILE SOLID STATE LAMPS

5082-4487
5082-4488

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 = 100μA
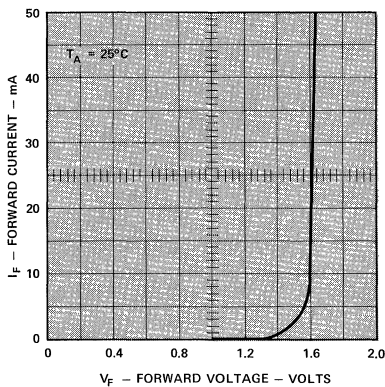
Figure 1. Typical Forward Current Versus Voltage Characteristic.
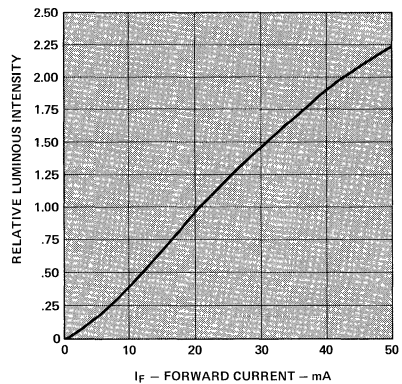
Figure 2. Typical Luminous Intensity Versus Forward Current.
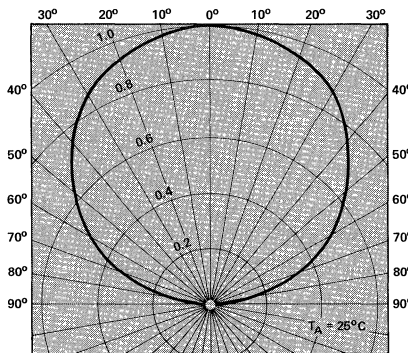
Figure 3. Typical Relative Luminous Intensity Versus Angular Displacement.

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HEWLETT hp PACKARD

COMPONENTS

SOLID STATE LAMPS

5082-4403
5082-4415
5082-4440
5082-4444

TECHNICAL DATA   APRIL 1976

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**

Description

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

The 5082-4403 and -4415 are LEDs with a red diffused plastic lens, providing high visibility for circuit board or panel mounting with a clip.

Both LEDs are designed for low power consumption, thus applicable for use in mobile and portable equipment.

The 5082-4440 and -4444 are economically priced LEDs with a red diffused plastic lens, providing a wide viewing angle for circuit board or panel mounting with clip. Both LEDs are designed for circuit status and other light indicating functions.

The 5082-4415 and -4444 have the added feature of a 90° lead bend for edge mounting on circuit boards.
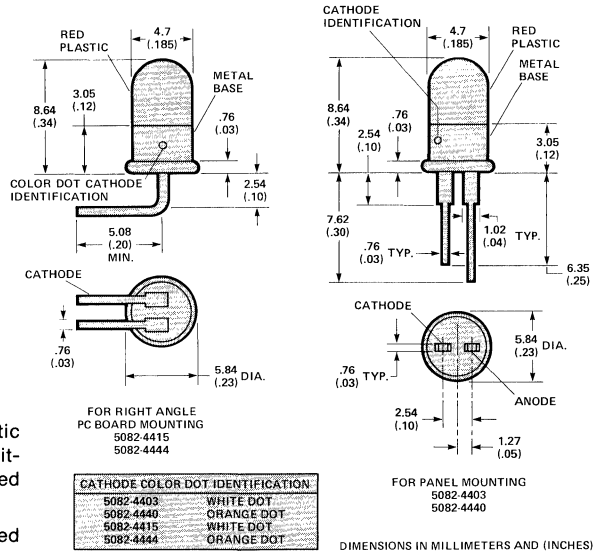
CATHODE COLOR DOT IDENTIFICATION	
5082-4403	WHITE DOT
5082-4440	ORANGE DOT
5082-4415	WHITE DOT
5082-4444	ORANGE DOT

FOR RIGHT ANGLE PC BOARD MOUNTING
5082-4415
5082-4444

FOR PANEL MOUNTING
5082-4403
5082-4440

DIMENSIONS IN MILLIMETERS AND (INCHES)

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	Parameters	5082-4403 5082-4415			5082-4440 5082-4444			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.		
I_V	Luminous Intensity	0.8	1.2		0.3	0.7		mcd	$I_F = 20$ mA
λ_{PEAK}	Wavelength	640	655	670	640	655	670	nm	Measurement at Peak
τ_s	Speed of Response		15			15		ns	
C	Capacitance		200			200		pF	$V_F = 0$, f = 1 MHz
θ_{JC}	Thermal Resistance		270			270		°C/W	Junction to Cathode Lead
V_F	Forward Voltage		1.6	2.0		1.6	2.0	V	$I_F = 20$ mA
BV_R	Reverse Breakdown Voltage	3	10		3	10		V	$I_R = 10$ µA
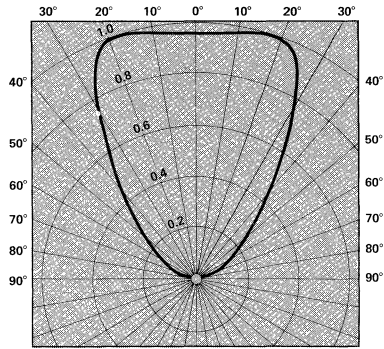
Figure 1. Relative Luminous Intensity vs. Angular Displacement.
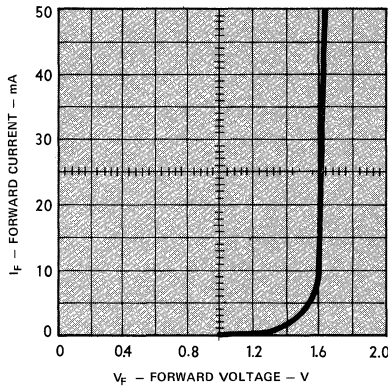
Figure 2. Forward Current — Voltage Characteristics.
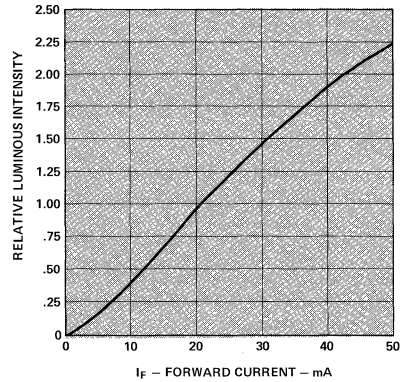
Figure 3. Brightness vs. Forward Current.

PC Board Mounting Information

The 5082-4403 and 5082-4440 are intended to be versatile in their mounting capability, as shown in the sketches following. Various printed circuit board mounting means are shown in Figures 4, 5, and 6. The enlarged lead section provides a controlled spacing for perpendicular mounting shown in Figure 4.

For right angle mounting as shown in Figure 6, order either a 5082-4415 or 5082-4444. The leads are bent at 90°, ready for insertion.
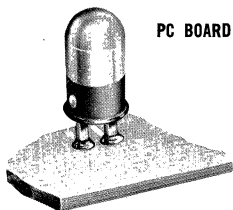
Figure 4. 5082-4403, -4440
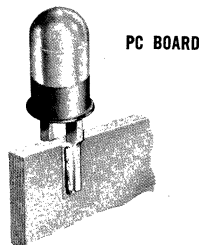
Figure 5. 5082-4403, -4440

Figure 6. 5082-4415, -4444

SOLID STATE LAMPS

5082-4880 SERIES
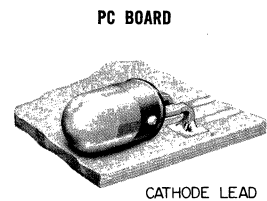
Features

- **WIRE WRAPPABLE**
- **EASILY PANEL MOUNTABLE; CLIP AVAILABLE**
- **STURDY WELDABLE LEADS: ON 2.54mm (0.10") CENTERS**
- **HIGH BRIGHTNESS OVER A WIDE VIEWING ANGLE**
- **RUGGED CONSTRUCTION FOR EASE OF HANDLING**
- **IC COMPATIBLE/LOW POWER CONSUMPTION**
- **LONG LIFE**

DIMENSIONS IN MILLIMETERS AND (INCHES)

Description

Wire Wrappable

The 5082-4880 series is designed to be wire wrapped with the Gardner Denver Models 14R2, 14XL1, and 14XA2 or equivalent. The LED can be panel or PC mounted and the leads directly wire wrapped without the use of a socket.

Light Output Selection

The 5082-4880 series is available with graded light output levels, so you can select the proper uniform light level for your application.

Lens Appearance

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.
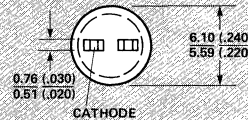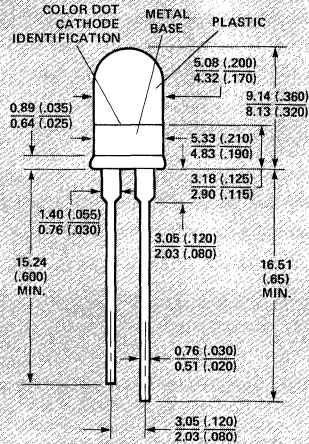
LED SELECTION GUIDE

MINIMUM LIGHT OUTPUT (mcd)	LENS TYPE		
	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

Absolute Maximum Ratings at T_A=25°C

DC Power Dissipation . . . . .100 mW

DC Forward Current 50mA

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

Isolation Voltage (between lead and case) . . . 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 - 4880 5082 - 4883 5082 - 4886			5082 - 4881 5082 - 4884 5082 - 4887			5082 - 4882 5082 - 4885 5082 - 4888			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
I_V	Luminous Intensity	0.5	0.8		1.0	1.3		1.6	1.8		mcd	I_F = 20 mA
I_V	Luminous Intensity								0.8		mcd	I_F = 10 mA
λ_{PEAK}	Wavelength		655			655			655		nm	Measurement at Peak
τ_s	Speed of Response		10			10			10		ns	
C	Capacitance		200			200			200		pF	
θ_{JC}	Thermal Resistance		270			270			270		$^o{}_c$/W	Junction to Cathode Lead
V_F	Forward Voltage		1.6	2.0		1.6	2.0		1.6	2.0	V	I_F = 20 mA
BV_R	Reverse Breakdown Voltage	3	4		3	4		3	4		V	I_R = 10 μA

TYPICAL RELATIVE LUMINOUS INTENSITY VERSUS ANGULAR DISPLACEMENT

4880, 4881, 4882   **4883, 4884, 4885**   **4886, 4887, 4888**
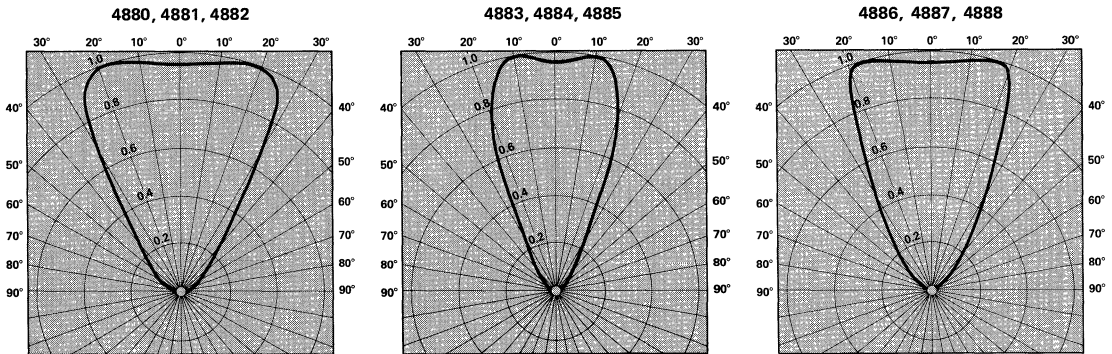
Figure 1. Forward Current vs. Voltage Characteristic.

Figure 2. Luminous Intensity vs. Forward Current (I_F).

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VOLTAGE SENSING LED | 5082-4732
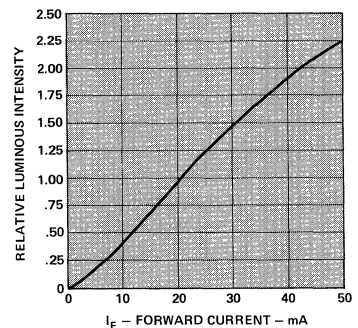
OUTLINE DRAWING
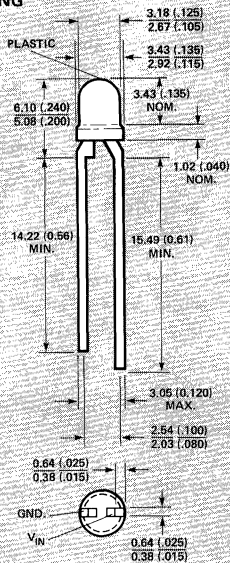
ALL DIMENSIONS ARE IN MILLIMETERS (INCHES)

BLOCK DIAGRAM
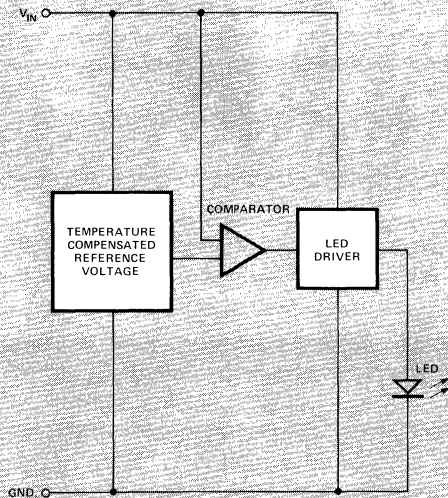
Features

- **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 2.5V.

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.	5082-4732 Typ.	5082-4732 Max.	Units	Test Conditions	Fig.
Threshold Voltage	V_{TH}	2.3	2.5	2.75	V		1,2
Temperature Coefficient of Threshold	$\dfrac{\Delta V_{TH}}{\Delta T_A}$		-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	
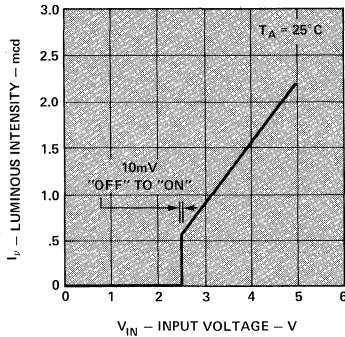
Figure 1. Luminous Intensity vs. Input Voltage.
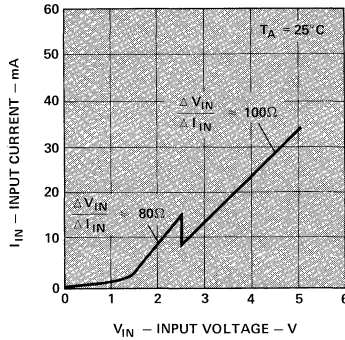
Figure 2. Input Current vs. Input Voltage.
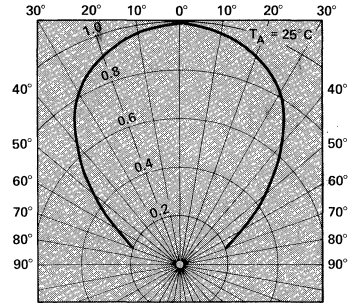
Figure 3. Relative Luminous Intensity vs. Angular Displacement.

Techniques For Increasing The Threshold Voltage

External Component		V'_{TH}	$TC = \dfrac{\Delta V'_{TH}}{\Delta T_A}$ (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		$V_{TH} + V_Z$	-1 + Zener TC
Series Resistor		$V_{TH} + I_{TH}R$ note 2	Note 3

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.
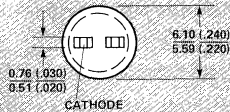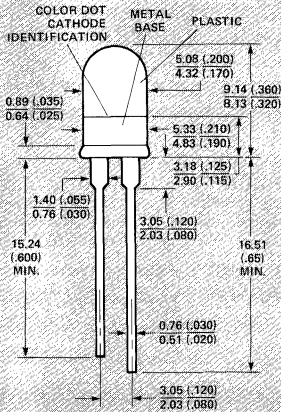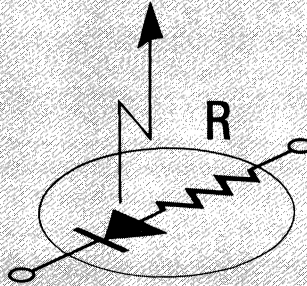
DIMENSIONS IN MILLIMETERS AND (INCHES)
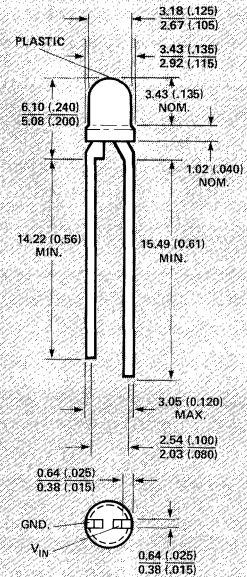
5082-4860   5082-4468

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	$I_R = 10\mu A$

TYPICAL RELATIVE LUMINOUS INTENSITY VERSUS ANGULAR DISPLACEMENT

4860

4468
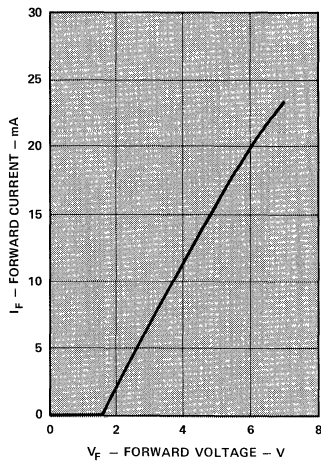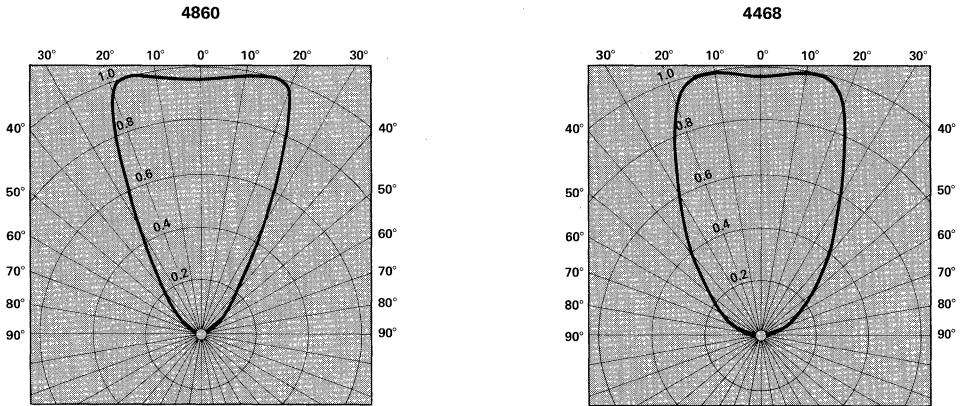
Figure 1. Typical DC Forward Current — Voltage Characteristic
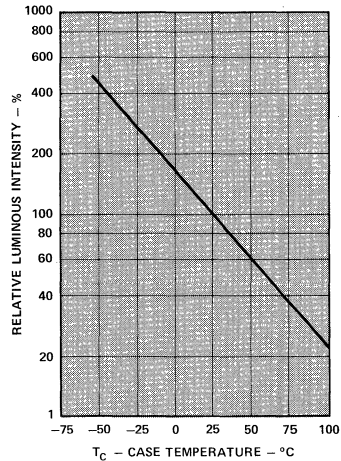
Figure 2. Relative Luminosity vs. Case Temperature
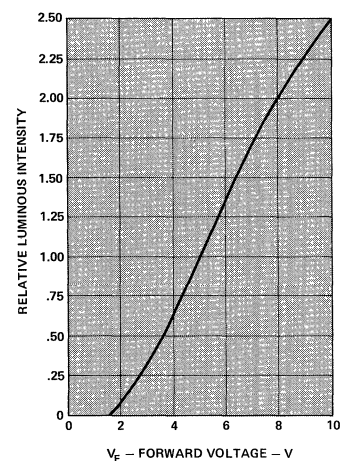
Figure 3. Relative Luminous Intensity vs. Voltage

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HEWLETT **hp** PACKARD

COMPONENTS

LIGHT EMITTING DIODE
MILITARY APPROVED
MIL-S-19500/467

1N5765
JAN 1N5765
JAN TX 1N5765

TECHNICAL DATA   APRIL 1976

Features

- **DESIGNED FOR HIGH-RELIABILITY APPLICATIONS**
- **HERMETICALLY SEALED**
- **LONG LIFE**
- **HIGH BRIGHTNESS OVER A WIDE VIEWING ANGLE**
- **IC COMPATIBLE/LOW POWER CONSUMPTION**

Description

The 1N5765 is a Gallium Arsenide Phosphide Light Emitting Diode, Solid State Lamp, designed for High Reliability applications. This hermetically sealed LED has been formally approved for use in military systems as a JAN/JAN TX component. HP commercial part number 5082-4420 is equivalent to the 1N5765.

Absolute Maximum Ratings at T_A=25°C

Breakdown Voltage . . . . 4 Vdc
Forward Current [see Note 1] . . . . 50 mAdc
Power Dissipation . . . . 150 mW
Peak Forward Current . . . . 3 Amp
(1μs Pulse Width, 300 pps)
Operating Temperature Range . . . . −65°C to +100°C
Storage Temperature Range . . . . −65° C to +100°C

GLASS/METAL HERMETIC CAN — TINTED PLASTIC OVER GLASS LENS — GOLD PLATED KOVAR — CATHODE

DIMENSIONS IN MILLIMETERS AND (INCHES)
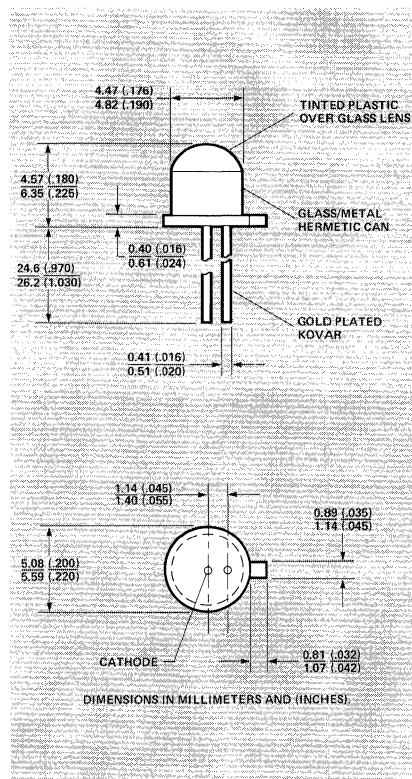
Electrical / Optical Characteristics at T_A=25°C
(Per Table I, Group A Testing of MIL-S 19500/467)

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

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 is supplied with each shipment.

Group B Sample Acceptance Tests	Method MIL-STD-750	Group C Sample Acceptance Tests	Method MIL-STD-750
Physical Dimensions	2066	Low Temp. Operation (−55°C)	
		Breakdown Voltage	4021
Solderability	2026	Temperature Cycling	1051A
		Resistance to Solvents	*
Thermal Shock	1056A	Temp. Storage (100°C, 1K hours)	1031
		Operating Life (50mAdc, 1K hours)	1026
Temperature Cycling	1051A	Peak Forward Pulse Current	
Fine Leak Test	1071H		
Gross Leak Test	1071C	TX Screening (100%)	
Moisture Resistance	1021	Temp. Storage (100°C, 72 hours)	
Mechanical Shock	2016	Temperature Cycling	1051A
Vibration	2056	Constant Acceleration	2006
Constant Acceleration	2006	Fine Leak Test	1071H
Terminal Strength	2036E	Gross Leak Test	1071C
Salt Atmosphere	1041	Burn-in (50mAdc, 168 hours)	
Temp. Storage (100°C, 340 hours)	1032	Evaluation of Drift	
Operating Life (50mAdc, 340 hours)	1027	(I_{V1}, V_F, I_R)	

*MIL-STD-202 Method 215
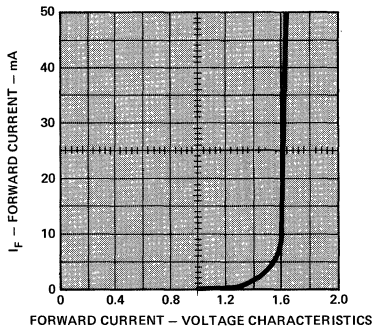
Typical Characteristic Curves
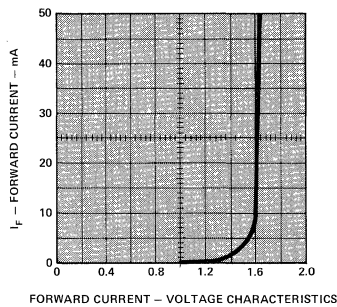
FORWARD CURRENT – VOLTAGE CHARACTERISTICS

Figure 1. Forward Current vs. Voltage Characteristic.
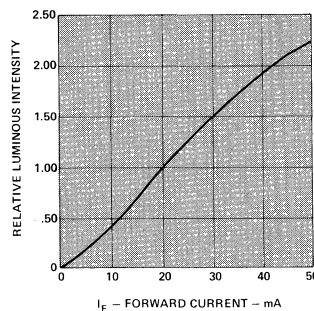
I_F – FORWARD CURRENT – mA

Figure 2. Luminous Intensity vs. Forward Current (I_F).

RADIATION PATTERN
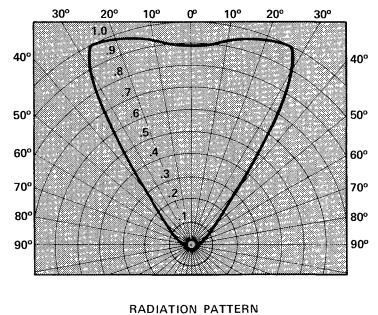
Figure 3. Relative Luminous Intensity vs. Angular Displacement.

HERMETIC SOLID STATE LAMPS
RED 5082-4420
HIGH EFFICIENCY RED 5082-4620
YELLOW 5082-4520
GREEN 5082-4920

TENTATIVE DATA   APRIL 1976

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**

Package Dimensions


4.47 (.176)
4.82 (.190)

TINTED PLASTIC
OVER GLASS LENS

4.57 (.180)
6.35 (.225)

GLASS/METAL
HERMETIC CAN

0.40 (.016)
0.61 (.024)

24.6 (.970)
26.2 (1.030)

GOLD PLATED
KOVAR

0.41 (.016)
0.51 (.020)

1.14 (.045)
1.40 (.055)

0.89 (.035)
1.14 (.045)

5.08 (.200)
5.59 (.220)

CATHODE

0.81 (.032)
1.07 (.042)

OUTLINE TO-46

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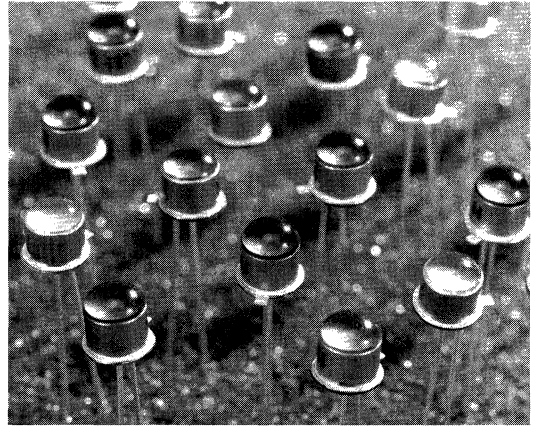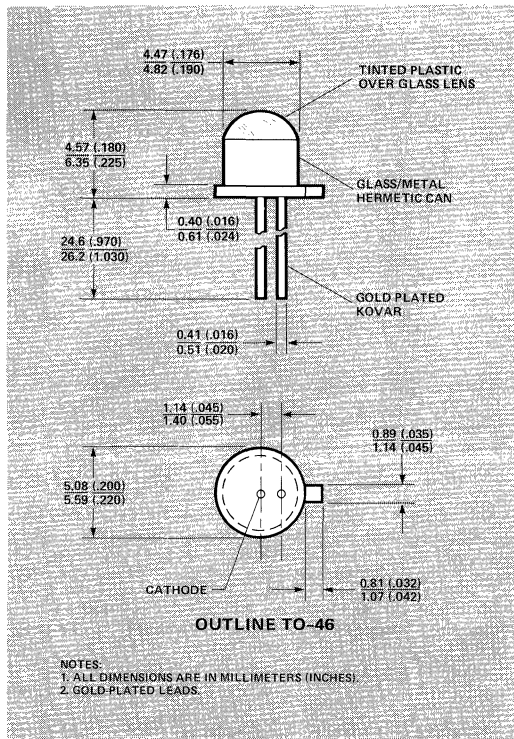
Description

The 5082-4420, 4620, 4520, and 4920 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 5082-4420 utilizes a GaAsP LED chip with a red diffused plastic lens over a glass window.

The 5082-4620 has a high efficiency red GaAsP on GaP LED chip with a red diffused plastic lens over a glass window. This lamp's efficiency is comparable to that of the GaP red but does not saturate at low current levels.

The 5082-4520 provides a yellow GaAsP on GaP LED chip with a yellow diffused plastic lens over a glass window.

The 5082-4920 provides a green GaP LED chip with a green diffused plastic lens over a glass window.

Absolute Maximum Ratings at T_A=25°C

Parameter	Red 4420	High Eff. Red 4620	Yellow 4520	Green 4920	Units
Power Dissipation (derate linearly from 50°C at 1.6mW/°C)	90	120	120	120	mW
Average Forward Current	50	35	35	35	mA
Peak Transient Forward Current	1 (1 usec pulse width, 300 pps)				Amp
Peak Operating Forward Current	100	60 (0.5 msec pulse width)			mA
Operating and Storage Temperature Range	-55°C to 100°C				
Lead Soldering Temperature [1.6mm (0.063 in.) below package line]	260°C for 7 seconds				

Electrical/Optical Characteristics at T_A=25°C

Symbol	Description	5082-4420			5082-4620			5082-4520			5082-4920			Units	Test Conditions
		Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.		
I_v	Axial Luminous Intensity	0.5			1.0	2.5		1.0	2.5		0.8	1.6 At I_F = 25mA		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			558		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		550			550			550			550		°C/W	Note 3
V_F	Forward Voltage		1.6	2.0		2.0	3.0		2.0	3.0		2.1 At I_F = 25mA	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.
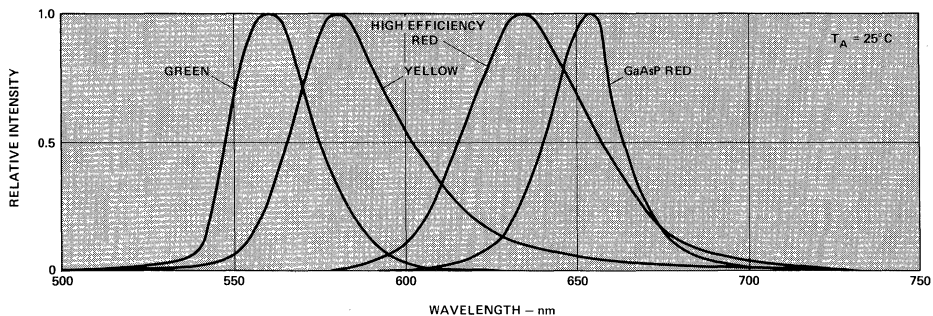
Figure 1. Relative Intensity vs. Wavelength.

RED 5082-4420
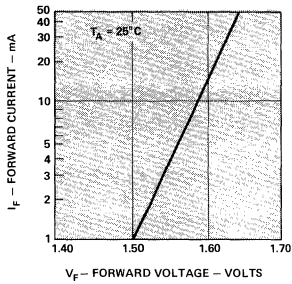
Figure 2. Forward Current vs.
Forward Voltage.
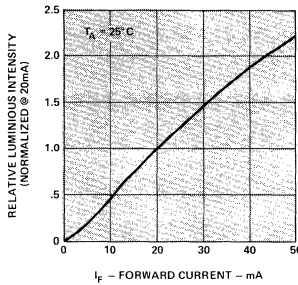
Figure 3. Relative Luminous Intensity
vs. Forward Current.
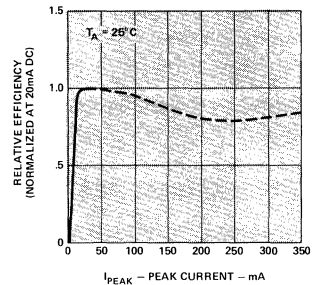
Figure 4. Relative Efficiency
(Luminous Intensity per Unit
Current) vs. Peak Current.
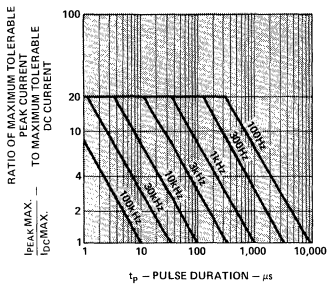
Figure 5. Maximum Tolerable Peak Cur-
rent vs. Pulse Duration. (I_{DC} MAX
as per MAX Ratings)
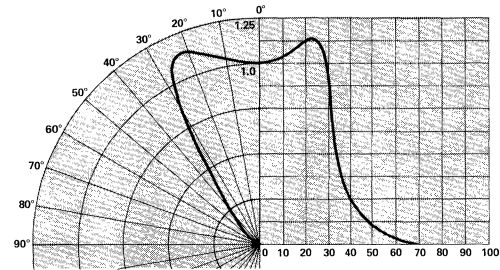

Figure 6. Relative Luminous Intensity vs. Angular Displacement.

HIGH EFFICIENCY RED 5082-4620

Figure 7. Forward Current vs.
Forward Voltage.
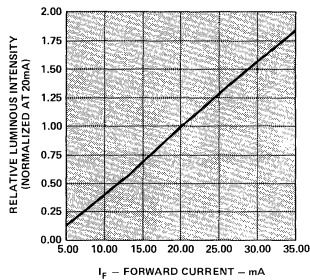
Figure 8. Relative Luminous Intensity
vs. Forward Current.

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

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

Figure 11. Relative Luminous Intensity vs. Angular Displacement.

41
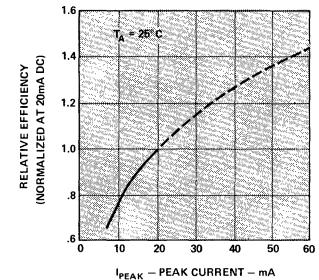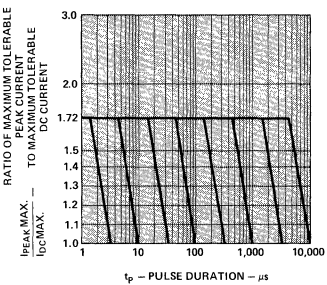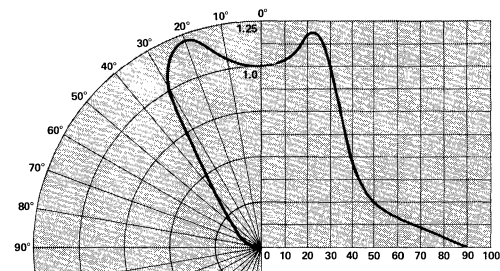
YELLOW 5082-4520
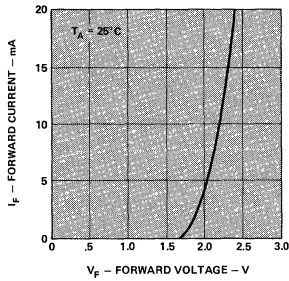
Figure 12. Forward Current vs.
Forward Voltage.
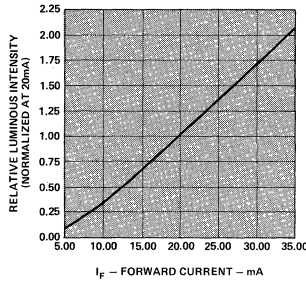
Figure 13. Relative Luminous Intensity
vs. Forward Current.
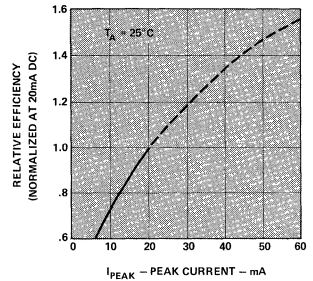
Figure 14. Relative Efficiency
(Luminous Intensity per Unit
Current) vs. Peak Current.
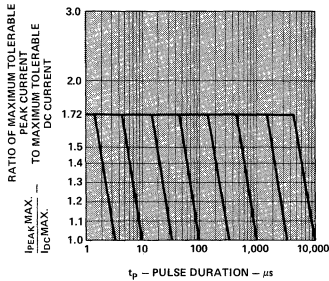
Figure 15. Maximum Tolerable Peak Cur-
rent vs. Pulse Duration. (I_{DC} MAX
as per MAX Ratings)
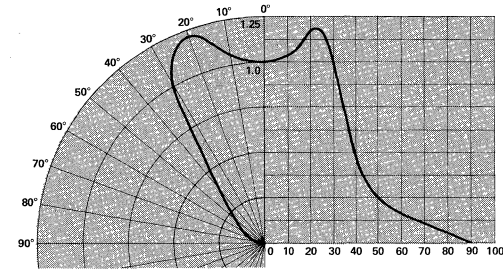
Figure 16. Relative Luminous Intensity vs. Angular Displacement.

GREEN 5082-4920
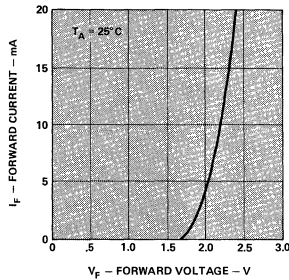
Figure 17. Forward Current vs.
Forward Voltage.
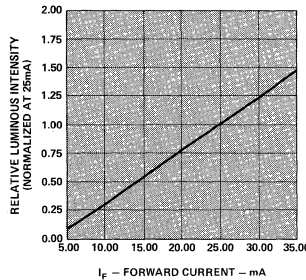
Figure 18. Relative Luminous Intensity
vs. Forward Current.
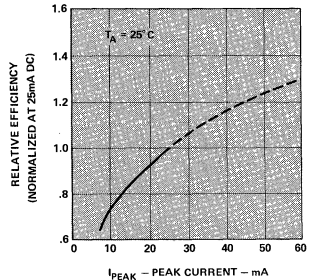
Figure 19. Relative Efficiency
(Luminous Intensity per Unit
Current) vs. Peak Current.
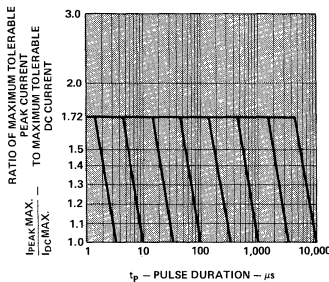
Figure 20. Maximum Tolerable Peak Cur-
rent vs. Pulse Duration. (I_{DC} MAX
as per MAX Ratings)
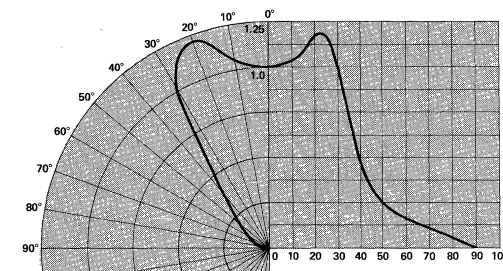
Figure 21. Relative Luminous Intensity vs. Angular Displacement.

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.
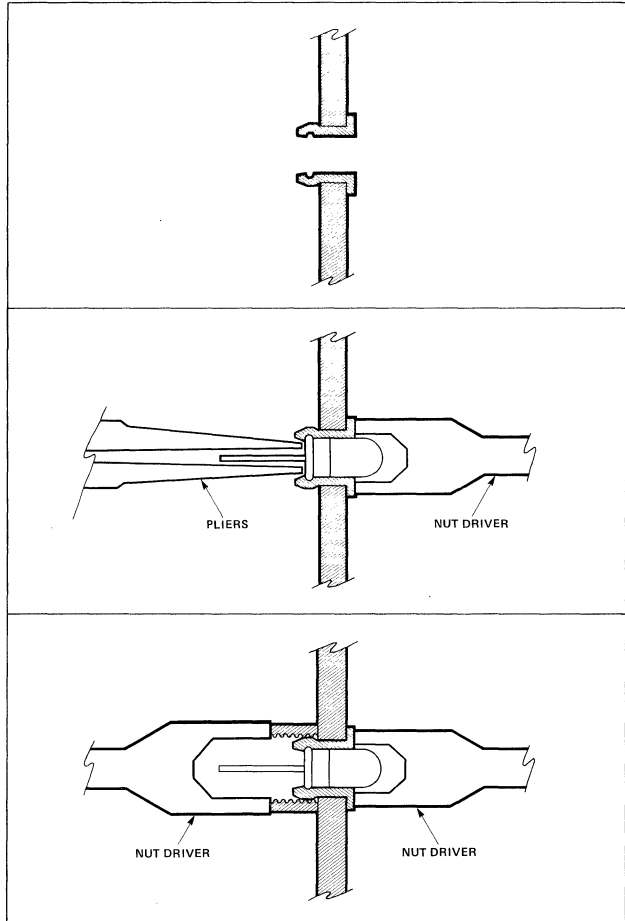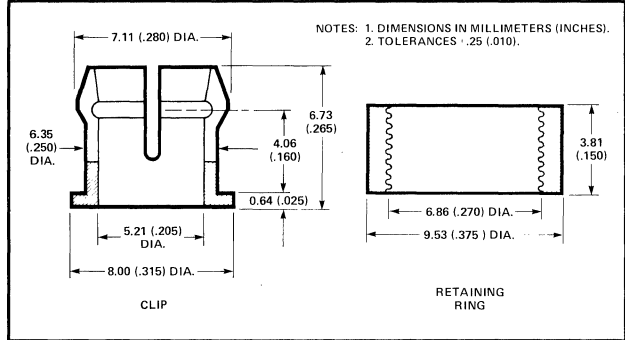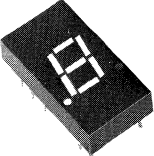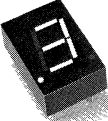
NOTES: 1. DIMENSIONS IN MILLIMETERS (INCHES).
2. TOLERANCES ±.25 (.010).

7.11 (.280) DIA.
6.73 (.265)
6.35 (.250) DIA.
4.06 (.160)
0.64 (.025)
5.21 (.205) DIA.
8.00 (.315) DIA.

CLIP

3.81 (.150)
6.86 (.270) DIA.
9.53 (.375) DIA.

RETAINING RING

PLIERS   NUT DRIVER

NUT DRIVER   NUT DRIVER

Solid State Displays

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

☐ Integrated Displays

☐ Hermetically Sealed Displays

☐ Alphanumeric Displays

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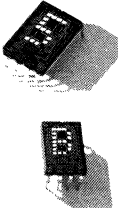
Red, High Efficiency Red, Yellow and Green Seven Segment LED Displays

Device		Description	Package	Application	Page No.
	5082-7650	10.92mm(.43") High Efficiency Red, Common Anode, LHDP	14 Pin Epoxy, .762mm (.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 146)	50
	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			
	5082-7673	10.92mm(.43") Green Common Cathode RHDP			
	5082-7676	10.92mm(.43") Green Universal Polarity & Overflow Indicator RHDP			
	5082-7730	7.62mm(.3") Red, Common Anode, LHDP	14 Pin Epoxy, .762mm(.3") DIP .75"H x .4"W x.18"D		55
	5082-7731	7.62mm(.3") Red, Common Anode, RHDP			
	5082-7732	7.62mm(.3") Red, Common Anode, Polarity & Overflow Indicator			
	5082-7740	7.62mm(.3") Red, Common Cathode, RHDP	10 Pin Epoxy, .762mm(.3") DIP .75"H x.4"W x.18"D		59
	5082-7750	10.92mm(.43") Red, Common Anode, LHDP	14 Pin Epoxy, .762mm(.3") DIP .75"H x .5"W x.25"D		61
	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			
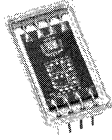
Red, Yellow and Green Seven Segment LED Displays

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 For further information ask for Application Note 937 (See page 146)	65
	5082-7403	2.79mm(.11") Red, 3 Digits Left,[1] Centered D.P.			
	5082-7404	.279mm(.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, .762mm (.3") DIP		69
	5082-7433	2.79mm (.11") Red, 3 Digits, RHDP			
	5082-7440	2.67mm(.105") Red, 8 Digits, Mounted on P.C. Board	50.8mm(2") P.C. Bd., 17 Term. Edge Con.		73
	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.		77
	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., 20 Term. Edge Con.		
	5082-7447	2.85mm(.112") Red, 14 Digits, Mounted on P.C. Board			
	5082-7240	2.59mm(.102") Red, 8 Digits, Mounted on P.C. Board	50.8mm (2") PC Bd., 17 Term. Edge Con.		81
	5082-7241	2.59mm(.102") Red, 9 Digits, Mounted on P.C. Board.			
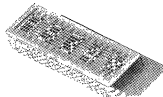
Integrated LED Displays

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	85
	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			
	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.	89
	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			
	5082-7500	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	93
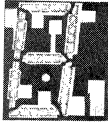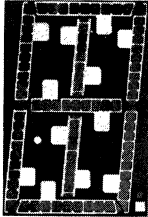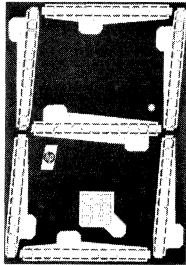
Hermetically Sealed Integrated LED Displays

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	95
	5082-7011	6.8mm (.27") Plus/Minus Sign			
	5082-7001	6.8mm (.27") 5x7 Three Digit Numeric, LHDP, Built-In Decoder/Driver	24 Pin Hermetic 2.54mm (.100") Pin Centers		106
	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 101)	101
	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			

Alphanumeric LED Displays

Device		Description	Package	Application	Page No.
	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	107
	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 & Broken Wafer Form	Wafer Mounted On Vinyl Film	6° (typical)	1.50x1.35mm (59x53mil)	111
	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 & Broken Wafer Form	Wafer Mounted On Vinyl Film	5° (typical)	2.24x1.42mm (88x56mil)	
	5082-7842	7 Seg. 80 mil Character Height Monolithic LED Chip	Waffle Pack			
	5082-7851	7 Seg. 100 mil Character Height Monolithic LED Chip in Scribed & Broken Wafer Form	Wafer Mounted On Vinyl Film	5°	2.27x1.91mm (107x75mil)	
	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 & Broken 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 & Broken 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			
	5082-7871	7 Seg. 120 mil Character Height Monolithic LED Chip in Scribed & Broken Wafer Form	Wafer Mounted On Vinyl Film	5°	3.25x2.34mm (128x92mil)	
	5082-7881	7 Seg. 120 mil Character Height Monolithic LED Chip	Waffle Pack			
	5082-7892	11 mil Discrete LED	Waffle Pack		0.38x0.38mm (15x15mil)	
	5082-7893	11 mil Discrete LED	Glass Vial			

HEWLETT hp PACKARD

COMPONENTS

.43 INCH SEVEN SEGMENT DISPLAYS

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

TECHNICAL DATA   APRIL 1976

Features

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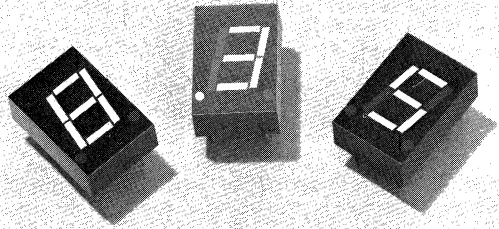
Description

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

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

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

Devices

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

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

Package Dimensions

A

B,C
FRONT VIEW

D

END VIEW

LUMINOUS INTENSITY CATEGORY

5082 76XX XYY Z

DATA CODE
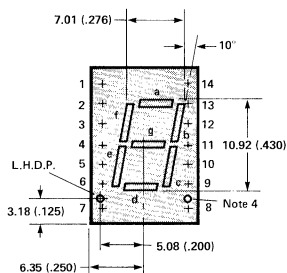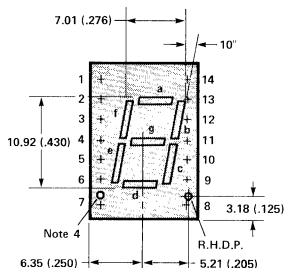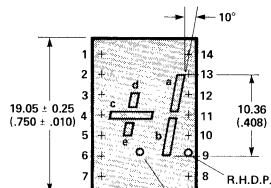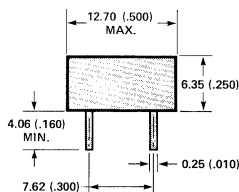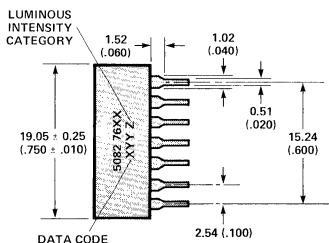
SIDE VIEW

	FUNCTION			
PIN	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-d	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

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

Internal Circuit Diagram

A

B

C

D
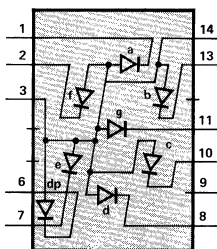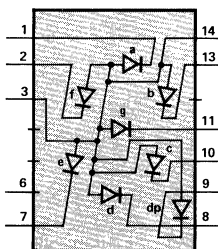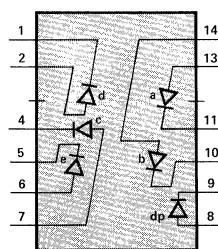
Absolute Maximum Ratings

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

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

Electrical/Optical Characteristics at T_A=25°C

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

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment[5,8]		5mA D.C.	135	300		μcd
	I_v	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		
		$I_F = 20mA$		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 5082-7660/-7661/-7663/-7666

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment[5,8]		5mA D.C.	100	250		μcd
	I_v	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		
		$I_F = 20mA$		2.2	2.5	V
		$I_F = 60mA$		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]		10mA D.C.	125	250		μcd
	I_v	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		
		$I_F = 20mA$		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: $I_{v_{T_A}} = I_{v_{25°C}} (.982)^{[T_A - 25°C]}$
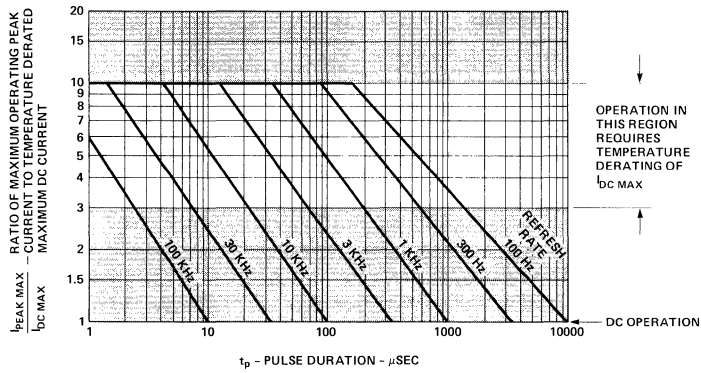
Figure 1. Maximum Tolerable Peak Current vs. Pulse Duration.
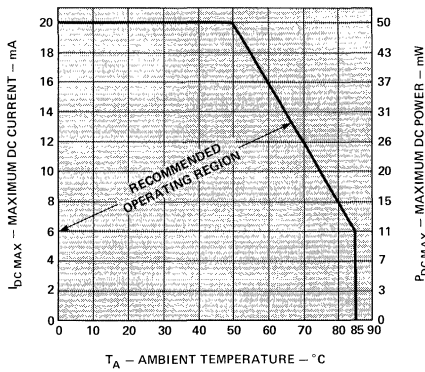
Figure 2. Maximum Allowable DC Current and DC
Power Dissipation Per Segment as a Function
of Ambient Temperature.
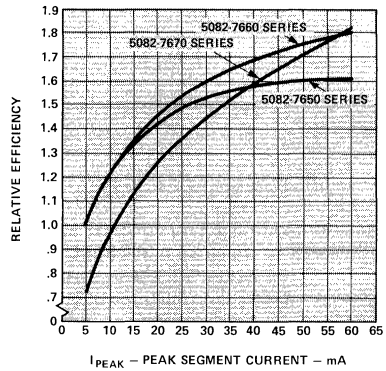
Figure 3. Relative Luminous Efficiency (Luminous
Intensity per Unit Current) vs. Peak Segment
Current.
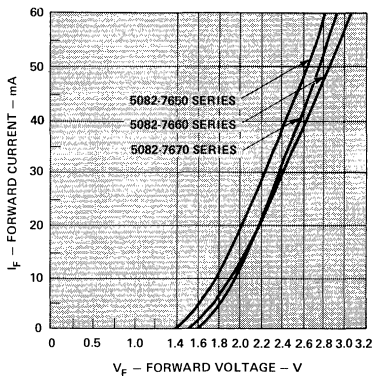
Figure 4. Forward Current vs. Forward Voltage
Characteristic.
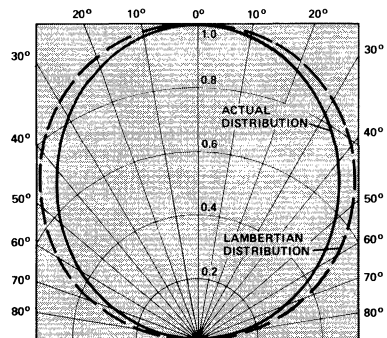
Figure 5. Normalized Angular Distribution of Luminous
Intensity.

Operational Considerations

ELECTRICAL

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

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

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

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

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

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

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

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

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

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

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

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

I_{AVG} = Operating point average current

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

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 Amber 23 or Homalite (100-1720, 100-1726); for green, Panelgraphic Green 48 or Homalite (100-1440, 100-1425). Another excellent contrast enhancement material for all colors is the 3M light control film.

MECHANICAL

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

0.3 INCH RED SEVEN SEGMENT DISPLAY

5082-7730 SERIES

TECHNICAL DATA APRIL 1976

Features

- **5082-7730**
  Common Anode
  Left Hand D.P.

- **5082-7731**
  Common Anode
  Right Hand D.P.

- **5082-7732**
  Common Anode
  Polarity and Overflow Indicator

- **EXCELLENT CHARACTER APPEARANCE**
  Continuous Uniform Segments
  Wide Viewing Angle
  High Contrast

- **IC COMPATIBLE**

- **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 within a Single Category
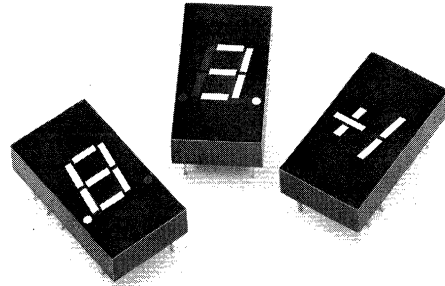
Description

The HP 5082-7730 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 7.62mm (0.3 in.) high character size generates a bright, continuously uniform seven segment display. Designed for viewing distances of up to 10 feet, these single digit displays provide a high contrast ratio and a wide viewing angle.

The 5082-7730 series devices utilize a standard 7.62mm (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.

Package Dimensions

| PIN	FUNCTION [5]	
	5082-7730	**5082-7731**
1	CATHODE - a	CATHODE - a
2	CATHODE - f	CATHODE - f
3	ANODE [3]	ANODE [3]
4	NO PIN	NO PIN
5	NO PIN	NO PIN
6	CATHODE - dp	NO CONN.
7	CATHODE - e	CATHODE - e
8	CATHODE - d	CATHODE - d
9	NO CONN.	CATHODE - dp
10	CATHODE - c	CATHODE - c
11	CATHODE - g	CATHODE - g
12	NO PIN	NO PIN
13	CATHODE - b	CATHODE - b
14	ANODE [3]	ANODE [3]

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.

Maximum Ratings

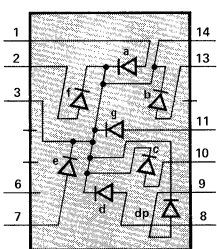Power Dissipation T_A = 25°C. . . . . 460 mW
Operating Temperature Range . . . . −20°C to + 85°C
Storage Temperature Range . . . . −20°C to + 85°C
Average Forward Current/Segment or Decimal Pt. T_A = 25°C [1] . . . . 25 mA
Peak Forward Current/Segment or Decimal Pt. T_A = 25°C (Pulse Duration $\leqslant$ 500 μs) . . . . 150 mA
Reverse Voltage/Segment or Decimal Pt. 6V
Maximum Solder Temperature 1.59mm (1.16 in.) Below Seating Plane (t $\leqslant$ 3 sec) [2] . . . . 230°C

NOTES:
1. Derate from 35°C at 0.3mA/°C per segment or decimal point.
2. Clean only in Freon TE, Freon TF, Isopropanol, Ethanol, Genesolv DI-15 or DE-15, or water.

Electrical/Optical Characteristics at T_A=25°C

Description	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment [1] (Digit Average)	I_v	I_{PEAK} = 100mA 10% Duty Cycle		200		μcd
		I_F = 20mA DC	100	350		
Peak Wavelength	λ_{PEAK}			655		nm
Dominant Wavelength [2]	λ_d			639		nm
Forward Voltage/Segment or D.P.	V_F	I_F = 20mA		1.6	2.0	V
Reverse Current/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
Temperature Coefficient of Luminous Intensity	$\Delta I_v/°C$			-1.0		%/°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. Dominant wavelength, λ_d, is derived from the C.I.E. Chromaticity diagram and represents that single wavelength which is perceived by the eye.
3. Time for a 10%-90% change of light intensity for step change in current.

Figure 1. Normalized Angular Distribution of Luminous Intensity.

Figure 2. Forward Current versus Forward Voltage.

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

Figure 4. Direct Drive Circuit for the 5082-7730/7731 Common Anode Display.
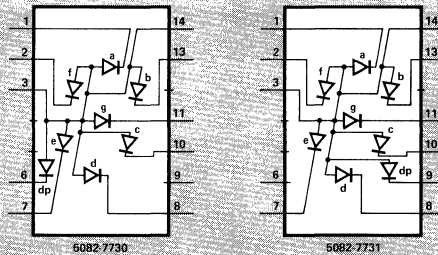
Figure 5. Internal Circuit Diagram.

The common anode 5082-7730 series devices are arrays of eight discrete light emitting diodes, which are optically magnified to form seven individual segments plus a decimal point. As depicted in Figure 4, character encoding on the 7730 and the 7731 can be performed by commercially available BCD-7 segment decoder/driver circuits. Through the use of strobing techniques, only one decoder/driver is required to drive a display containing up to 16 characters as outlined in Figure 6. When each character in the display is illuminated in sequence, at a minimum of 100 times per second, flicker-free characters are formed. Under average current drive conditions of 10mA/segment, the display is easily readable to distances of ten feet and will retain good contrast under relatively high ambient lighting conditions.

The 5082-7730 series devices are constructed utilizing a lead frame in a standard DIP package. The individual packages

may be close-packed at 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 Freon TF, Freon TE, (for Freons, up to 2 min. max. at boiling temp.), Isoproponal, Ethanol, Genesolv DI-15, Genesolv DE-15, or water be used for cleaning operations. To improve display contrast, the entire front surface of the display, except for emitting areas, is finished in a uniform flat black. Additional filters may be incorporated, if desired, to further lower the ambient reflectance and improve display contrast. See Hewlett Packard Application Note 964 for further information regarding the contrast enhancement.
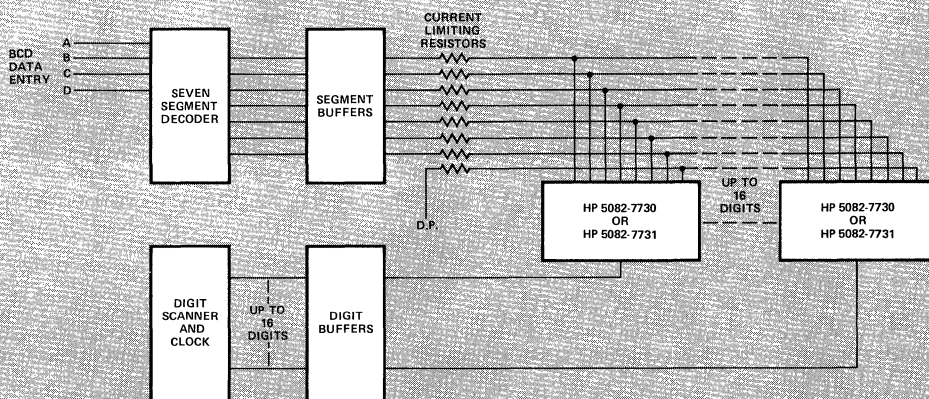
Figure 6. General Strobe Drive Scheme for Common Anode (5082-7730/7731) Displays.

Polarity and Overflow Indicator—5082-7732

ABSOLUTE MAXIMUM RATINGS

Power Dissipation $T_A = 25°C$ . . . . 345 mW
Operating Temperature Range . . . . −20°C to +85°C
Storage Temperature Range . . . . −20°C to +85°C
Average Forward Current/Segment or Decimal Point [1] $T_A = 25°C$ . . . . 25 mA
Peak Forward Current/Segment or Decimal Point $T_A = 25°C$ (Pulse Duration $\leqslant 500\mu s$) . . . . 150 mA
Reverse Voltage Segment or Decimal Point 6V
Reverse Voltage Segment a-b or d 12V
Maximum Solder Temperature 1.59mm (1.16 in.) Below Seating Plane (t $\leqslant$ 3 sec) [2] . . . . 230°C

NOTES:
1. Derate from 35°C at 0.3mA/°C per segment or decimal point.
2. Clean only in Freon TE, Freon TF, Isopropanol, Ethanol, Genesolv DI-15 or DE-15, or water.

ELECTRICAL/OPTICAL CHARACTERISTICS AT 25°C

Description	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment [1]	$I_{\nu\ AVE.}$	$I_{PEAK} = 100mA$ 10% Duty Cycle		200		μcd
		$I_F = 20mA$		350		
Peak Wavelength	λ_{PEAK}			655		nm
Forward Voltage, Segments a-b or d	V_F	$I_F = 20mA$		3.2	4.0	V
Forward Voltage, Segments c or dp	V_F	$I_F = 20mA$		1.6	2.0	V
Reverse Current, Segments a-b or d	I_R	$V_R = 12V$			10	μA
Reverse Current, Segments c or dp	I_R	$V_R = 6V$			10	μA
Rise and Fall Time [2]	t_r, t_f			10		ns
Temperature Coefficient of Forward Voltage Segments a-b or d	$\Delta V_F /°C$			−4.0		mV/°C
Temperature Coefficient of Forward Voltage Segments c or dp	$\Delta V_F /°C$			−2.0		mV/°C
Temperature Coefficient of Luminous Intensity	$\Delta I_\nu /°C$			−1.0		%/°C

NOTES: 1. The digits are categorized for luminous intensity with the intensity categories designated by a letter located on the right hand side of the package.
2. Time for a 10%-90% change of light intensity for step change in current.

PACKAGE DIMENSIONS — 5082-7732

PIN NO.	FUNCTION
1	Anode c, d
2	No Pin
3	No Pin
4	Internal Connection [3]
5	No Pin
6	No Pin
7	Cathode d
8	Cathode c
9	Cathode dp
10	Cathode a-b
11	Internal Connection [3]
12	No Pin
13	No Pin
14	Anode a-b, dp

NOTES:
1. Dimensions in millimeters and (inches).
2. All untoleranced dimensions are for reference only.
3. See Internal Circuit Diagram.

HEWLETT *hp* PACKARD

COMPONENTS

0.3 INCH RED
SEVEN SEGMENT
DISPLAY

5082-7740

TECHNICAL DATA APRIL 1976

Features

- **COMMON CATHODE**

- **RIGHT HAND DP**

- **EXCELLENT CHARACTER APPEARANCE**
  Continuous Uniform Segments
  Wide Viewing Angle
  High Contrast

- **IC COMPATIBLE**

- **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 within a Single Category
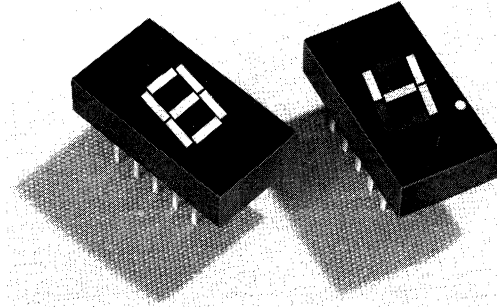
Description

The HP 5082-7740 is a common cathode LED numeric display with a right hand decimal point. The large 7.62mm (0.3") high character size generates a bright, continuously uniform 7 segment display. Designed for viewing distances of up to 10 feet, this single digit display has been human engineered to provide a high contrast ratio and wide viewing angle.

The 5082-7740 utilizes a standard 7.62mm (.3") dual-in-line package configuration that allows for quick mounting on PC boards or in standard IC sockets. Requiring a forward voltage of only 1.6V, the display is inherently IC compatible allowing for easy integration into electronic calculators, creit card verifiers, TVs, radios, and digital clocks.

Package Dimensions

PIN	FUNCTION 5082-7740
1	CATHODE [3]
2	ANODE - f
3	ANODE - g
4	ANODE - e
5	ANODE - d
6	CATHODE [3]
7	ANODE - dp
8	ANODE - c
9	ANODE - b
10	ANODE - a

NOTES:
1. Dimensions in millimeters and (inches)
2. All untoleranced dimensions are for reference only.
3. Redundant cathodes.
4. LHDP not electrically connected.

HP 5082-7740
EQUIVALENT CIRCUIT

Absolute Maximum Ratings

Power Dissipation $T_A = 25°C$	460 mW
Operating Temperature Range	−20°C to + 85°C
Storage Temperature Range	−20°C to + 85°C
Average Forward Current/Segment or Decimal Pt. $T_A = 25°C$ [1]	25 mA
Peak Forward Current/Segment or Decimal Pt. $T_A = 25°C$ (Pulse Duration ≤ 500μs)	150 mA
Reverse Voltage/Segment or Decimal Pt.	6 V
Max. Solder Temperature 1.59mm (1/16″) Below Seating Plane (t≤3 sec.) [2]	230°C

NOTES: 1. Derate from 35°C at .3mA/°C per segment or D.P.
2. Clean only in Freon TF, Isopropanol, Ethanol, Freon TE, Genesolv DI-15, Genesolv DE-15, or water.

Electrical/Optical Characteristics at T_A=25°C

Description	Symbol	Test Condition	Min.	Typ.	Max.	Units
Luminous Intensity/Segment[1]	I_ν AVE	I_{PEAK} = 100mA 10% Duty Cycle	50	200		μcd
		I_F = 20mA DC		350		
Peak Wavelength	λ_{PEAK}			655		nm
Dominant Wavelength [2]	λ_d			639		nm
Forward Voltage/Segment or D.P.	V_F	I_F = 100mA		2.0	2.3	V
Reverse Current/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
Temperature Coefficient of Luminous Intensity	$\Delta I_\nu /°C$			−1.0		%/°C

NOTES:
1. The digits are categorized for luminous intensity such that the variation from digit to digit within a category is not discernible to the eye. Intensity categories are designated by a letter located on the right hand side of the package.
2. Dominant wavelength, λ_d, is derived from the C.I.E. Chromaticity diagram and represents that single wavelength which is perceived by the eye.
3. Time for a 10%-90% change of light intensity for step change in current.

Figure 1. Normalized Angular Distribution of Luminous Intensity.

Figure 2. Forward Current versus Forward Voltage.

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

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HEWLETT **hp** PACKARD

COMPONENTS

.43 INCH RED
SEVEN SEGMENT
DISPLAY

5082-7750 SERIES
5082-7760

TECHNICAL DATA APRIL 1976

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
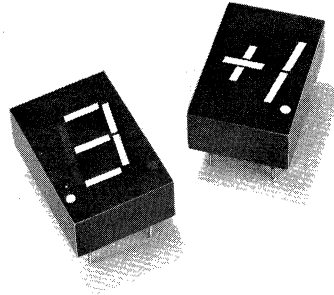
Description

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

FRONT VIEW

C
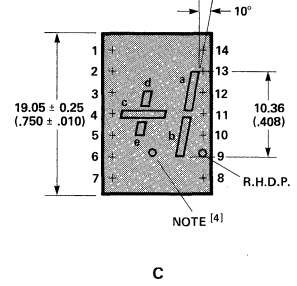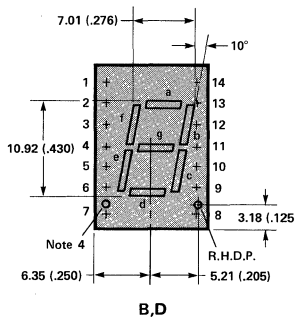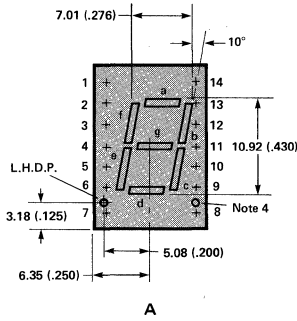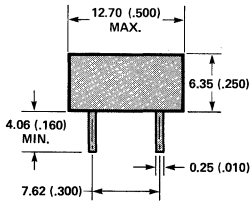
END VIEW
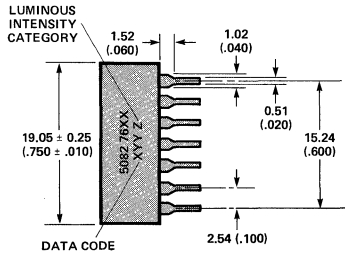
SIDE VIEW

	FUNCTION			
PIN	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
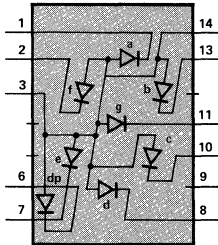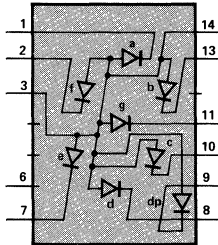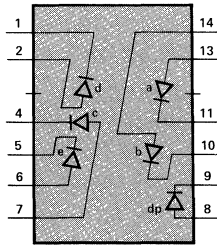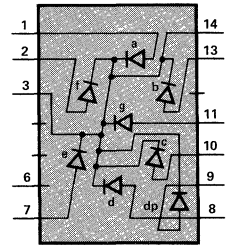
Absolute Maximum Ratings

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 .... 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 0.43mA/°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		
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
Temperature Coefficient of Luminous Intensity	$\Delta I_V/°C$			−1.0		%/°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: $I_{V_{TA}} = I_{V25°C} (.982)^{[T_A - 25°C]}$

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:
$$V_F = 1.55V + (5\Omega \times I_{PEAK})$$

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,
   $I_{P\ MAX}/I_{DC\ MAX}$ = 3.0.
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=(3.0) (16.4mA) = 49.2mA peak
   I_{AVG}=(1/4) (49.2mA) = 12.3mA 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; Panelgraphic Ruby Red 60 or Dark Red 63; 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.
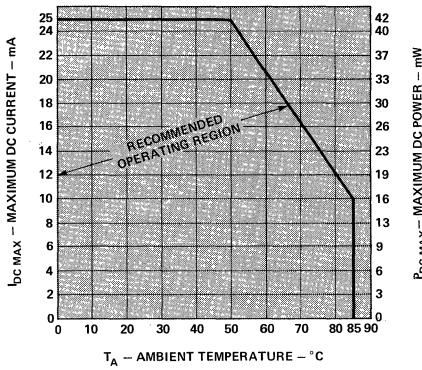
Figure 2. Maximum Allowable DC Current and DC Power Dissipation per Segment as a Function of Ambient Temperature.
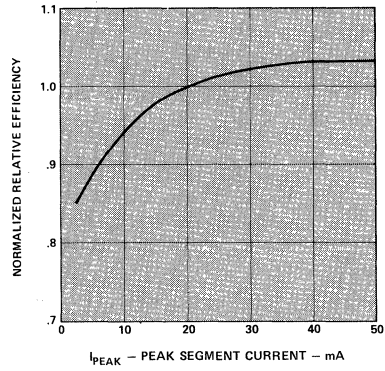
Figure 3. Relative Efficiency (Luminous Intensity per Unit Current) versus Peak Current per Segment.
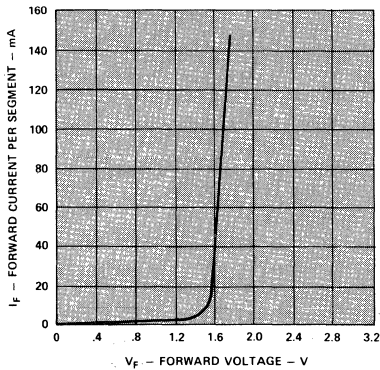
Figure 4. Forward Current versus Forward Voltage.

Figure 5. Normalized Angular Distrubution of Luminous Intensity.

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COMPONENTS

SOLID STATE
NUMERIC INDICATOR
(7 Segment Monolithic)

5082-7400
SERIES

TECHNICAL DATA APRIL 1976
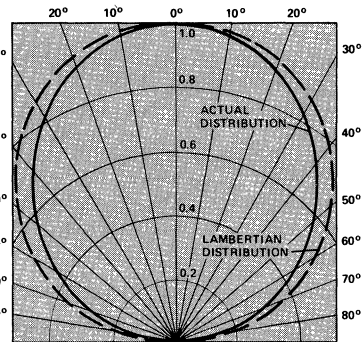
Features

- **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**
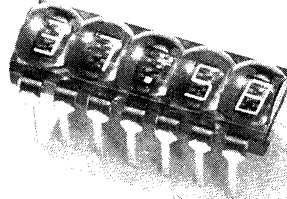
Description

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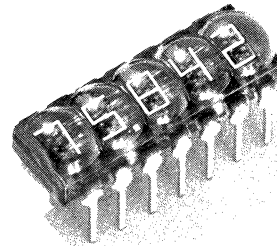
Applications include hand-held calculators, portable instruments, digital thermometers, or any other product requiring low power, low cost, minimum space, and long lifetime indicators.

Device Selection Guide

Configuration			Part Number	
Digits per Cluster	Device		Center Decimal Point	Right Decimal Point
3 (right)			5082-7402	5082-7412
3 (left)			5082-7403	5082-7413
4			5082-7404	5082-7414
5			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] (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 [4]	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. 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

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

Figure 6. 5082-7405/7415

All Devices

Magnified Character Font Description

Figure 7. Center Decimal Point Configuration.

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

Figure 8. Right Decimal Point Configuration

DEVICES
5082-7412
5082-7413
5082-7414
5082-7415
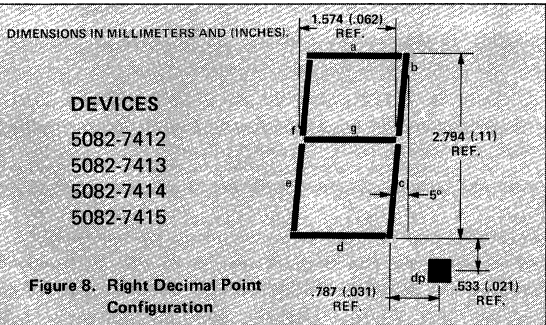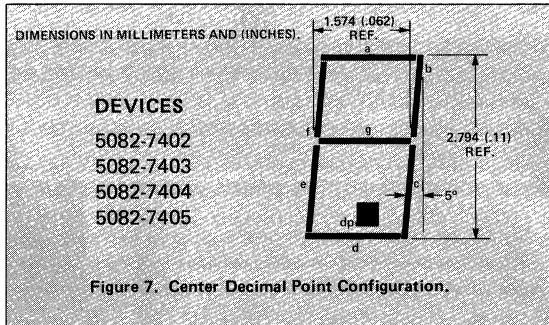
Device Pin Description

PIN NO.	5082-7402/7412 FUNCTION	5082-7403/7413 FUNCTION	5082-7404/7414 FUNCTION	5082-7405/7415 FUNCTION
1	N/C	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	N/C	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 11 unconnected.

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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.
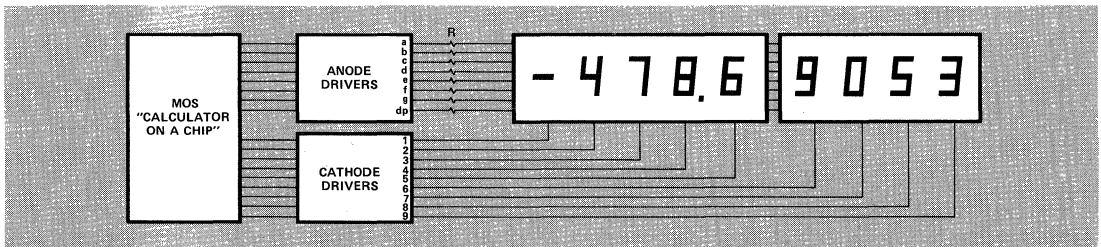
Figure 9. Block Diagram for Calculator Display Using Lower Right Hand Decimal Point.
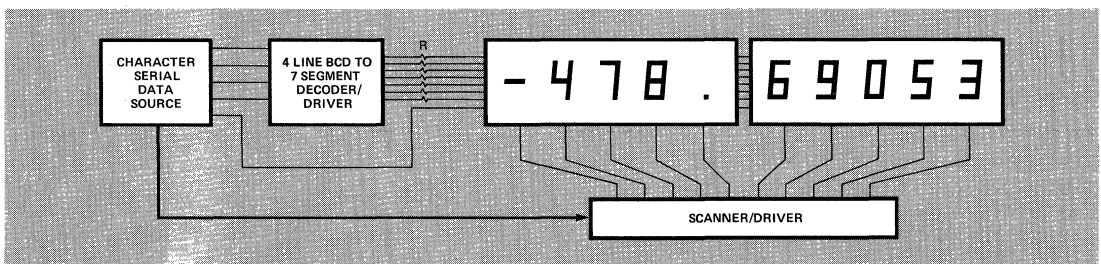
Figure 10. Block Diagram for Display Using Center Decimal Point.

Features

- **MOS COMPATIBLE**
  Can be Driven Directly from many
  MOS Circuits

- **LOW POWER**
  Excellent Readability at Only 250 µA
  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
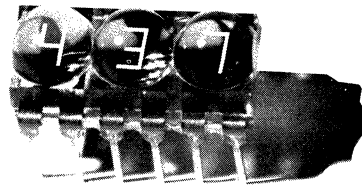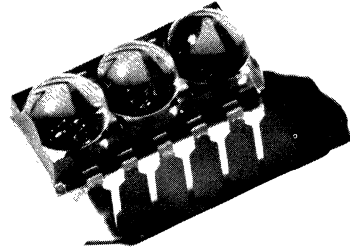
Description

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 < 500μs)	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 ≤ 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]	I_V	I_AVG = 500μA (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 [4]	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. Time for a 10%-90% change of light intensity for step change in current.

Figure 1. Peak Forward Current vs. Peak Forward Voltage
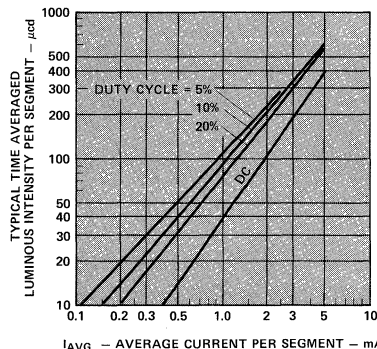
Figure 2. Typical Time Averaged Luminous Intensity per Segment vs. Average Current per Segment

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

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

Package Description

NOTES: 1. DIMENSIONS IN MILLIMETERS AND (INCHES).
2. TOLERANCES ON ALL DIMENSIONS ARE 0.038 ± (.015) UNLESS OTHERWISE SPECIFIED.

Figure 5.

Magnified Character Font Description

DEVICES
5082-7432
5082-7433

DIMENSIONS IN MILLIMETERS AND (INCHES).
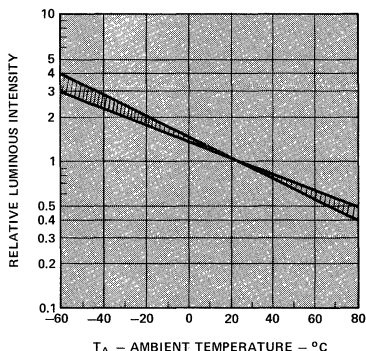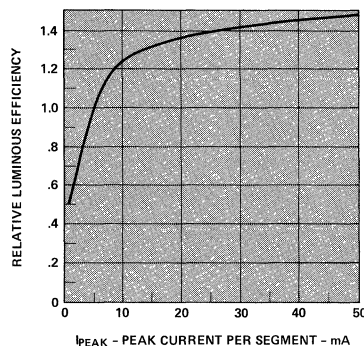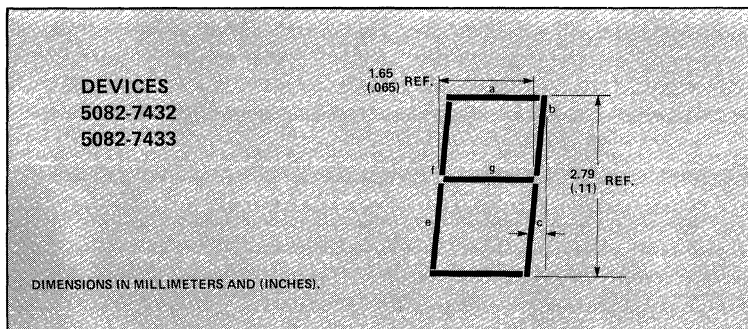
Figure 6.

Device Pin Description

PIN NUMBER	5082-7432 FUNCTION	5082-7433 FUNCTION
1	N/C	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	N/C	N/C

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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 $\pm 20°$ 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 3 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.
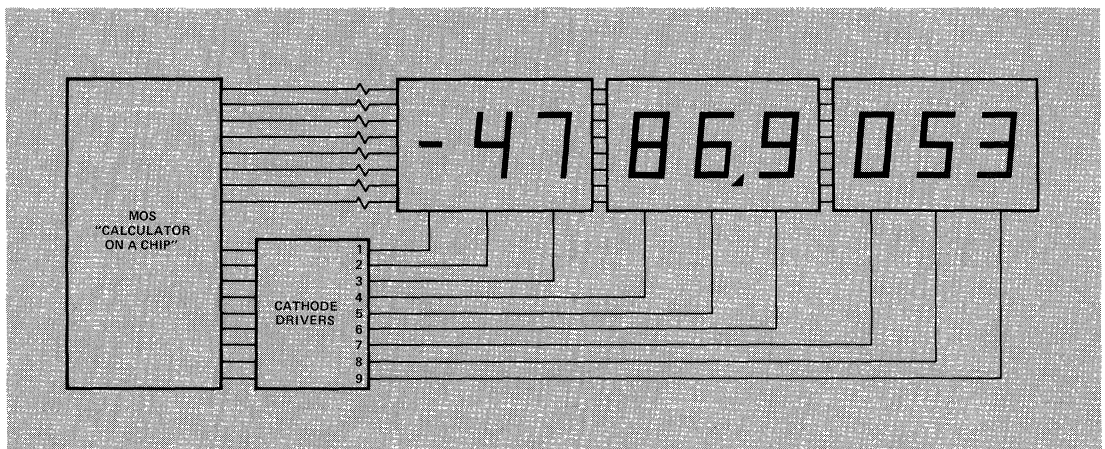
Figure 7. Block Diagram for Calculator Display

HEWLETT *hp* PACKARD

COMPONENTS

SPECIAL PARTS
FOR CALCULATORS

5082-7440
SERIES

TECHNICAL DATA APRIL 1976

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
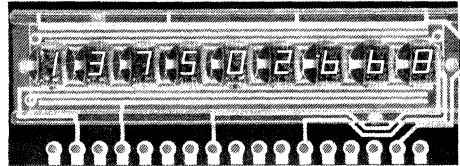
Description

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	8.8.8.8.8.8.8.8.	(Figure 5)	5082-7440
			5082-7448
9	8.8.8.8.8.8.8.8.8.	(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	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 [3]	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.
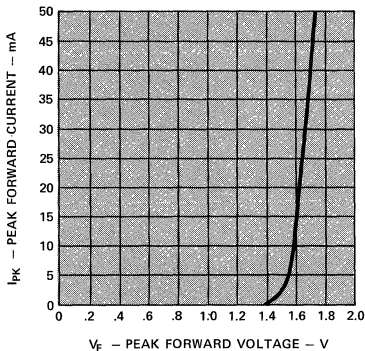
Figure 1. Peak Forward Current vs. Peak Forward Voltage

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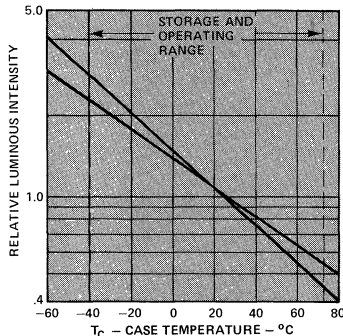

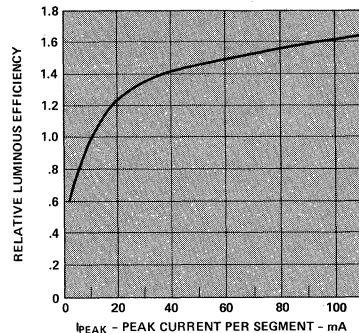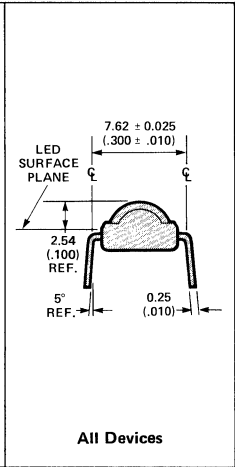Figure 3. Relative Luminous Intensity vs. Ambient Temperature at Fixed Current Level
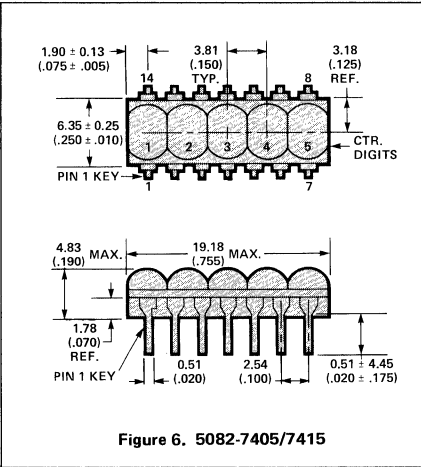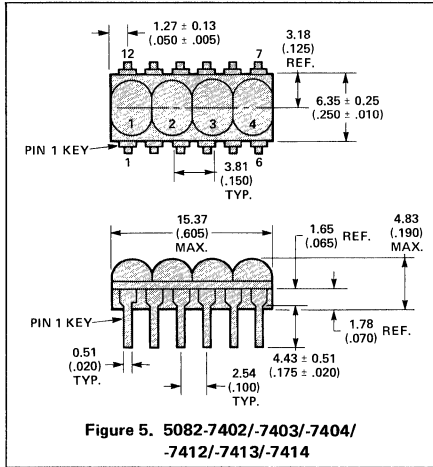

Figure 4. Relative Luminous Efficiency vs. Peak Current per Segment

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Package Description

Figure 5.

Magnified Character Font Description

DEVICES
5082-7440
5082-7441
5082-7448
5082-7449

Note: All dimensions in millimeters and (inches).
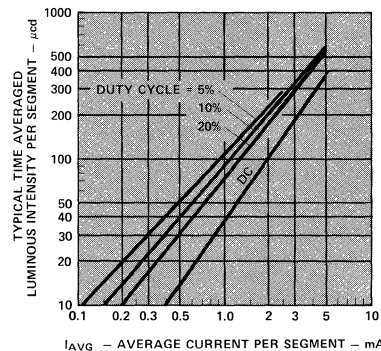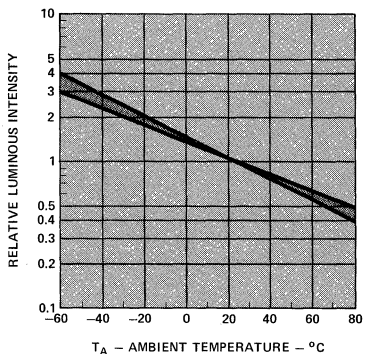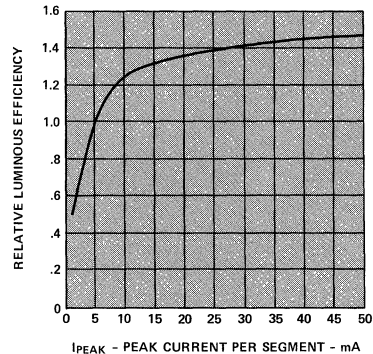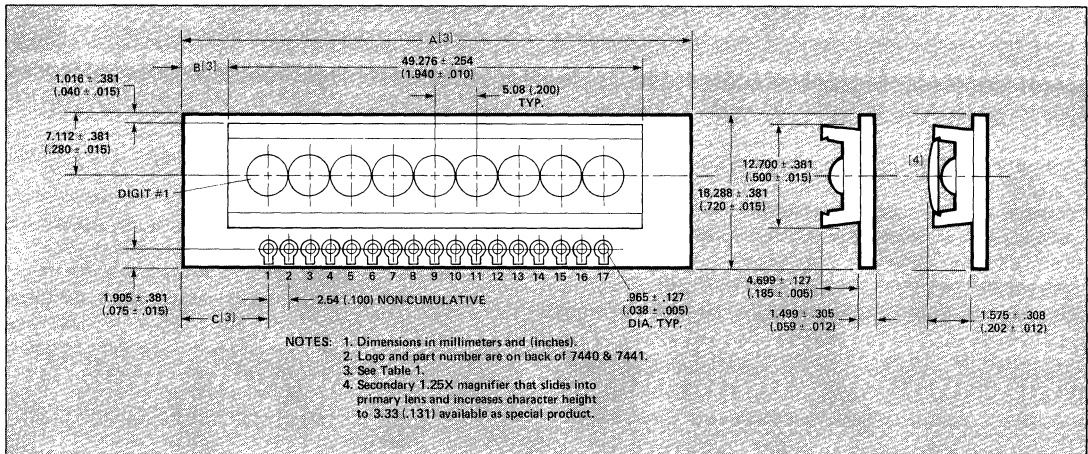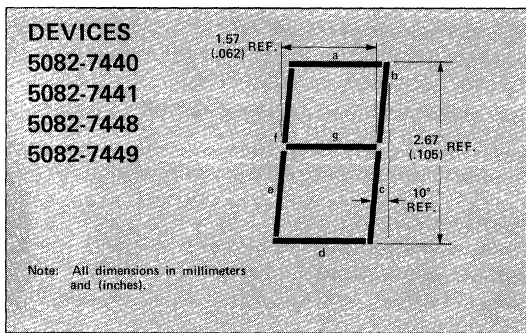
Figure 6.

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
5082-7447

TENTATIVE DATA APRIL 1976

Features

- **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.
- **14-DIGIT AVAILABLE IN TWO DIGIT HEIGHTS [mm (inches)] [2.54(.100) AND 2.84(.112)]**
- **12-DIGIT DISPLAYS AVAILABLE IN TWO PINOUTS.**
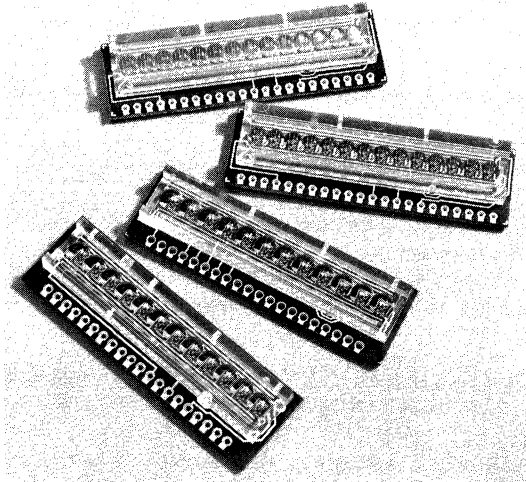
Description

The HP 5082-7442, 7444, 7445, and 7447 are seven segment GaAsP Numeric indicators mounted in 12 or 14 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 digit configurations. 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	Digit Height mm (inches)	Configuration		Package	Part No. 5082-
		DEVICE			
12	2.54 (.100)			Figure 4	7442 and 7445
14	2.54 (.100)			Figure 5	7444
14	2.84 (.112)			Figure 5	7447 *

*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 <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 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
7442/7445 7444/7447	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.
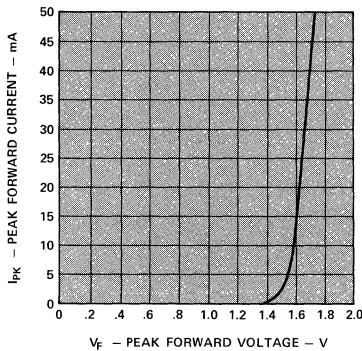
Figure 1. Peak Forward Current vs. Peak Forward Voltage
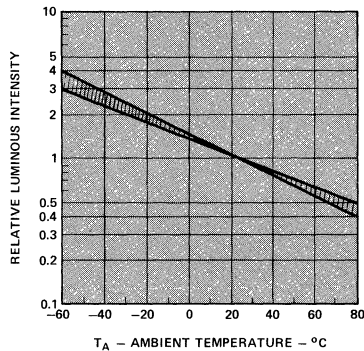
Figure 2. Relative Luminous Intensity vs. Ambient Temperature at Fixed Current Level.

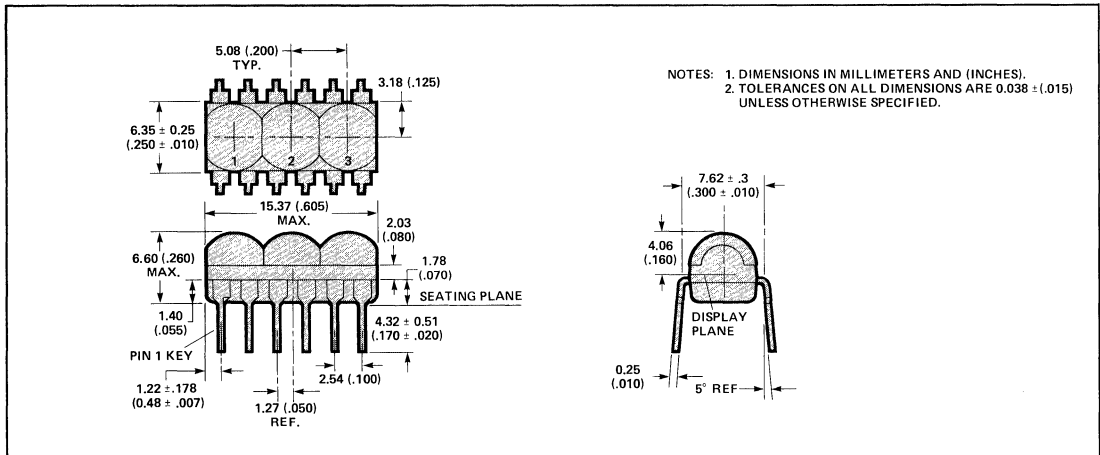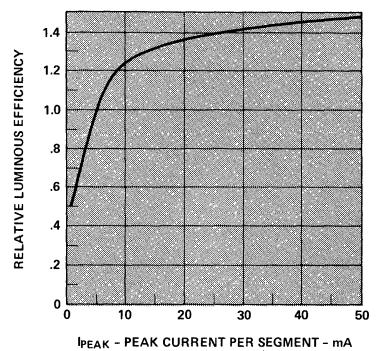**Figure 3. Relative Luminous Efficiency vs. Peak Current per Segment.**

Electrical/Optical

The HP 5082-7442, 7444, 7445 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 3.5 volts, it is recommended that the factory be contacted.

Mechanical Specifications

The 5082-7442, 7444, 7445 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
1	Cathode - Digit 1	Anode - Segment a
2	Cathode - Digit 2	Anode - Segment f
3	Cathode - Digit 3	Anode - Segment b
4	Anode - Segment c	Anode - Segment c
5	Cathode - Digit 4	Anode - Segment d
6	Anode - DP	Anode - Segment DP
7	Cathode - Digit 5	Anode - Segment e
8	Anode - Segment a	Anode - Segment g
9	Cathode - Digit 6	Cathode - Digit 3
10	Anode - Segment e	Cathode - Digit 2
11	Cathode - Digit 7	Cathode - Digit 4

Pin No.	5082-7442 5082-7444 5082-7447 Function	5082-7445 Function
12	Anode - Segment d	Cathode - Digit 1
13	Cathode - Digit 8	Cathode - Digit 5
14	Anode - Segment g	Cathode - Digit 12
15	Cathode - Digit 9	Cathode - Digit 6
16	Anode - Segment b	Cathode - Digit 11
17	Cathode - Digit 10	Cathode - Digit 7
18	Anode - Segment f	Cathode - Digit 10
19	Cathode - Digit 11	Cathode - Digit 9
20	Cathode - Digit 12	Cathode - Digit 8
21*	Cathode - Digit 13	
22*	Cathode - Digit 14	

*7444 and 7447 only.

Package Dimensions
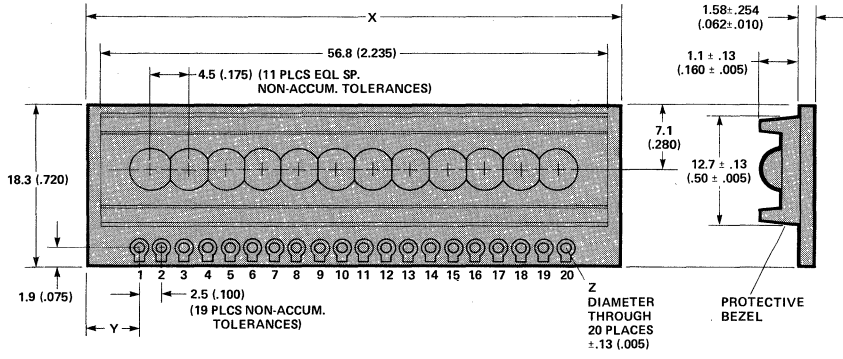
DEVICE	X	Y	Z
5082-7442	60.3 (2.375)	6.03 (.2375)	1.02 (.040)
5082-7445	59.6 (2.345)	5.70 (.2225)	1.42 (.056)
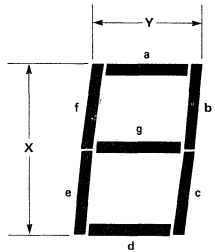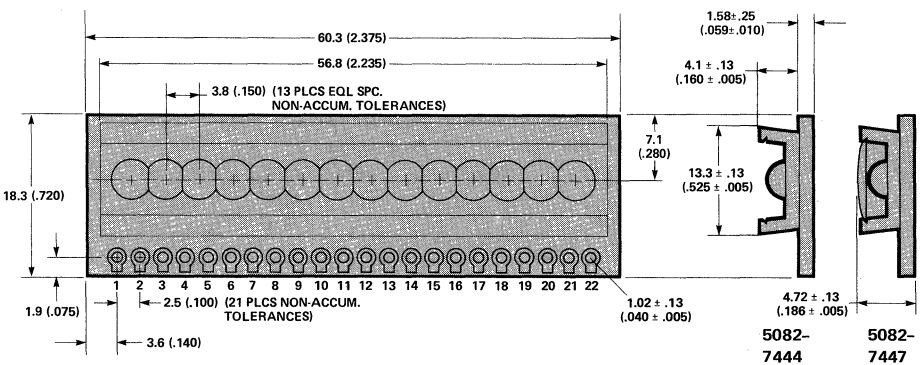
5082-7444   5082-7447

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)
5082-7447	2.84 (.112)	1.40 (.055)

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

HEWLETT *hp* PACKARD

COMPONENTS

SPECIAL PARTS
FOR CALCULATORS

5082-7240
SERIES

TECHNICAL DATA APRIL 1976

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.
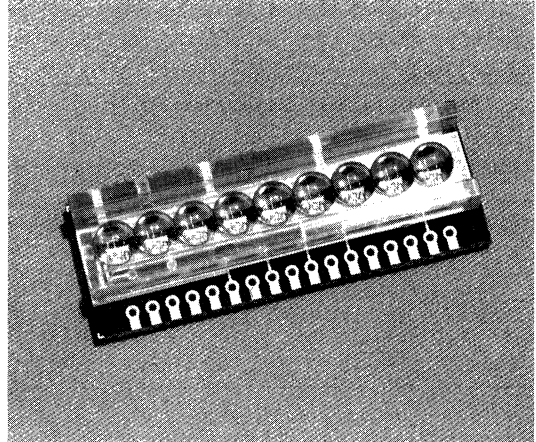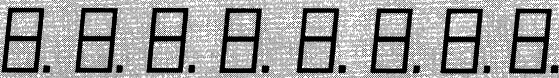
Description

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	$\boxed{8}.\ \boxed{8}.\ \boxed{8}.\ \boxed{8}.\ \boxed{8}.\ \boxed{8}.\ \boxed{8}.\ \boxed{8}.$	(Figure 5)	5082-7240
9	$\boxed{8}.\ \boxed{8}.\ \boxed{8}.\ \boxed{8}.\ \boxed{8}.\ \boxed{8}.\ \boxed{8}.\ \boxed{8}.\ \boxed{8}.$	(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	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 [3]	V_F	I_F = 5mA		1.6		V

NOTES: 3. See Figure 7 for test circuit.
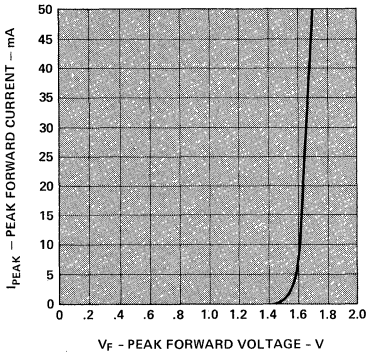
Figure 1. Peak Forward Current vs. Peak Forward Voltage
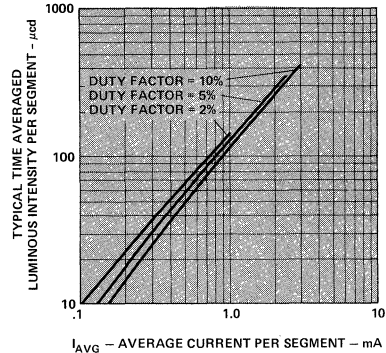
Figure 2. Typical Time Averaged Luminous Intensity per Segment vs. Average Current per Segment

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

DEVICES
5082-7240
5082-7241

Note: All dimensions in millimeters and (inches).
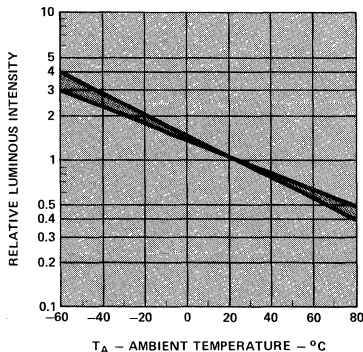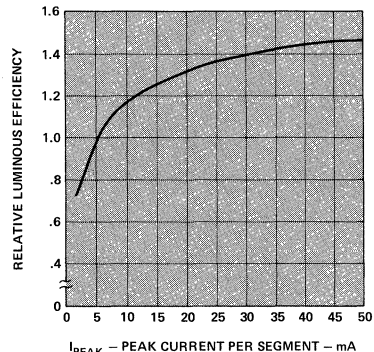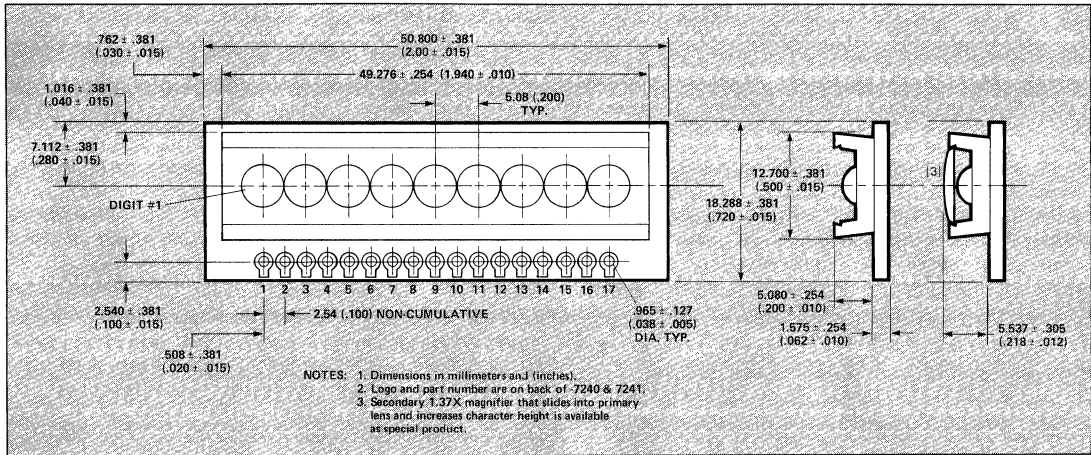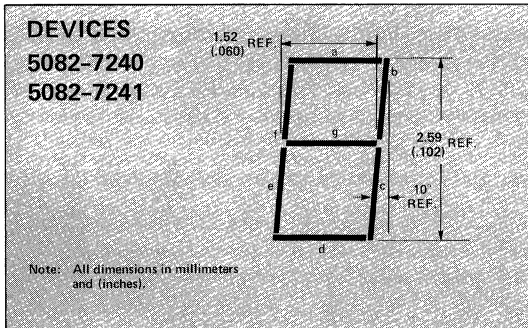
Figure 6.

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

NUMERIC and HEXADECIMAL INDICATORS

5082-7300 SERIES

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
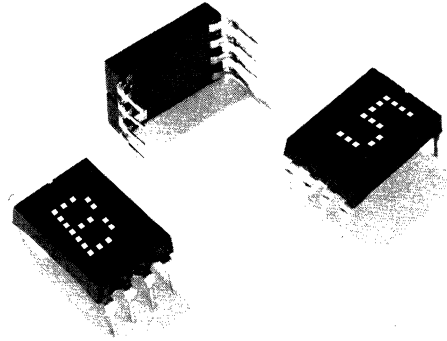
Description

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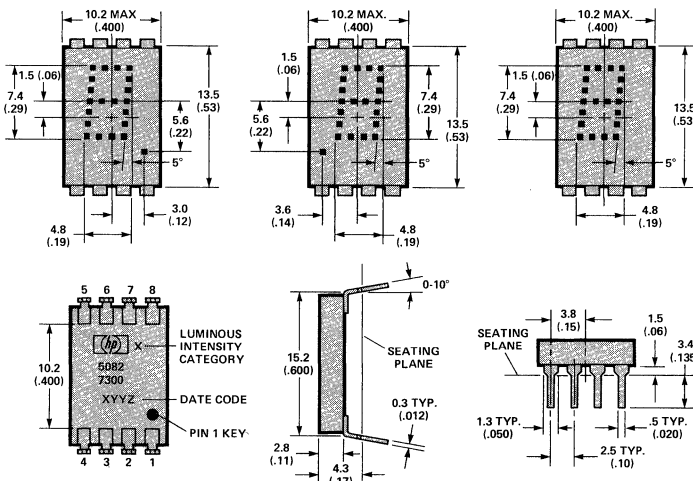
		FUNCTION	
	PIN	5082-7300 and 7302 Numeric	5082-7340 Hexadecimal
	1	Input 2	Input 2
	2	Input 4	Input 4
	3	Input 8	Input 8
	4	Decimal point	Blanking control
	5	Latch enable	Latch enable
	6	Ground	Ground
	7	V_{cc}	V_{cc}
	8	Input 1	Input 1

NOTES:
1. Dimensions in millimeters and (inches).
2. Unless otherwise specified, the tolerance is ±.38mm (±.015").
3. Vertical digit center line is ±.51mm (±.02") from vertical package center line.

ABSOLUTE MAXIMUM RATINGS

DESCRIPTION	SYMBOL	MIN	MAX	UNIT
Storage temperature, ambient	T_S	–40	+100	°C
Operating temperature, case	T_C	–20	+85	°C
V_{CC} Pin potential to ground pin	V_{CC}	–0.5	+7.0	V
Voltage applied to input logic pins and decimal point [1]	V_I	–0.5	+5.5	V
Voltage applied to latch enable	V_E	–0.5	+5.5	V
Voltage applied to blanking control [2]	V_B	–0.5	+5.5	V

NOTES: 1. Decimal point applies only to 7300/7302. 2. Applies only to 7340.

RECOMMENDED OPERATING CONDITIONS

DESCRIPTION	SYMBOL	MIN	NOM	MAX	UNIT
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Low Level Input Voltage	V_{IL}	0		0.8	V
High Level Input Voltage	V_{IH}	2.0		5.25	V
Latch enable voltage–data being entered	V_{EL}	0		0.8	V
Latch enable voltage–data not being entered	V_{EH}	2.0		5.25	V
Blanking control voltage–display not blanked [1]	V_{BL}	0		0.8	V
Blanking control voltage–display blanked [1]	V_{BH}	3.5		5.25	V

NOTE: 1. Applies only to 7340.

ELECTRICAL/OPTICAL CHARACTERISTICS (T_C = –20°C to +85°C, unless otherwise specified)

DESCRIPTION	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply current	I_{CC}	V_{CC} = 5.5V		94[1]	170[2]	mA
Power dissipation	P_T	V_{CC} = 5.5V		470[1]	935[2]	mW
Luminous intensity per LED (Digit average) [3] [5]	I_ν	V_{CC} = 5.0V, T_C = 25°C	32	70		μcd
Enable Pulse Width	t_W	V_{CC} = 5.0V, V_{EL} = 0.4V	120			nsec
Time data must be held before positive transition of enable line	t_{SETUP}	V_{IL} = 0.4V, V_{EH} = 2.4V	50			nsec
Time data must be held after positive transition of enable line	t_{HOLD}	V_{IH} = 2.4V, T_C = 25°C	50			nsec
Blanking control current "L" state [4]	I_{BL}	V_{CC} = 5.5V, V_{BL} = 0.8V			200	μA
Blanking control current "H" state [4]	I_{BH}	V_{CC} = 5.5V, V_{BH} = 4.5V			2.0	mA
Logic and latch enable currents "L" state	I_{IL} I_{EL}	V_{CC} = 5.5V V_I, V_E = 0.4V			–1.6	mA
Logic and latch enable currents "H" state	I_{IH} I_{EH}	V_{CC} = 5.5V V_I, V_E = 2.4V			+250	μA
Peak wavelength	λ_{PEAK}	T_C = 25°C		655		nm
Spectral halfwidth	$\Delta\lambda\ \frac{1}{2}$	T_C = 25°C		30		nm
Weight				0.8		gm

NOTES: 1. V_{CC} = 5.0V with statistical average number of LED's lit. 2. Worst case condition excluding test state on 5082-7300/-7302.
3. The digits are categorized for luminous intensity such that the variation from digit to digit within a category is not discernible to the eye. Intensity categories are designated by a letter located on the reverse side of the package contiguous with the Hewlett-Packard logo marking.
4. Applies only to 7340.
5. I_ν as a function of temperature, $I_\nu(T)$, may be calculated from the relationship; $I_\nu(T) = I_\nu(25°C)(.985)^{[T_C - 25°C]}$; $I_\nu(T)$ = Luminous intensity at any particular case temperature; $I_\nu(25°C)$ = Luminous intensity at T_C = 25°C; T_C = Case temperature at which luminous intensity is to be calculated.

TRUTH TABLE FOR 5082-7300 SERIES DEVICES

CHARACTER		INPUTS						CHARACTER		INPUTS					
5082–7300/7302 Numeric	5082–7340 Hex.	X8	X4	X2	X1	E	B[1]	5082–7300/7302 NUMERIC	5082–7340 Hex.	X8	X4	X2	X1	E	B[1]
0	0	L	L	L	L	L	L	Test	A	H	L	H	L	L	L
1	1	L	L	L	H	L	L	Blank	B	H	L	H	H	L	L
2	2	L	L	H	L	L	L	Blank	C	H	H	L	L	L	L
3	3	L	L	H	H	L	L	Minus	D	H	H	L	H	L	L
4	4	L	H	L	L	L	L	Blank	E	H	H	H	L	L	L
5	5	L	H	L	H	L	L	Blank	F	H	H	H	H	L	L
6	6	L	H	H	L	L	L	Hold	Hold	X	X	X	X	H	X
7	7	L	H	H	H	L	L	—	Blank [1]	X	X	X	X	X	H
8	8	H	L	L	L	L	L	Decimal pt. on [2]	—	DP[I] = L					
9	9	H	L	L	H	L	L	Decimal pt. off [2]	—	DP[I] = H					

NOTES:
1. The blanking control input, B, pertains to the 5082-7340 Hexadecimal indicator only.
2. The decimal point input pertains to the 5082-7300 and -7302 Numeric Indicators only.
3. H = logic 'High'; L = logic 'Low'; x = 'don't care'.
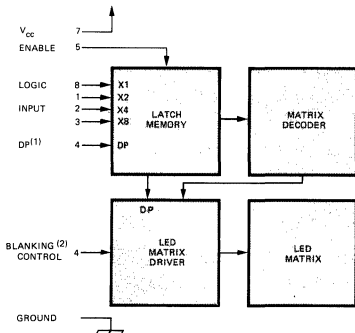
Notes 1. 5082 – 7300/-7302 only
   2. 5082 – 7340 only

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

Figure 2. Typical Blanking Control Current Vs. Voltage for 5082-7340 Only.

Figure 3. Typical Blanking Control Input Current Vs. Temperature, 5082-7340.

Figure 4. Typical Latch Enable Input Current Vs. Voltage for the 5082-7300 Series Devices.
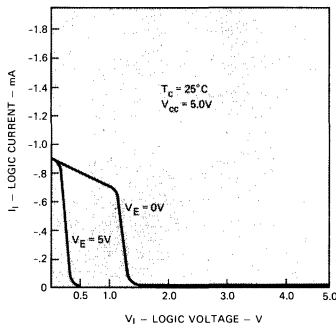
Figure 5. Typical Logic and Decimal Point Input Current Vs. Voltage for the 5082-7300 Series Devices. Decimal Point Applies to 5082-7300 Only.
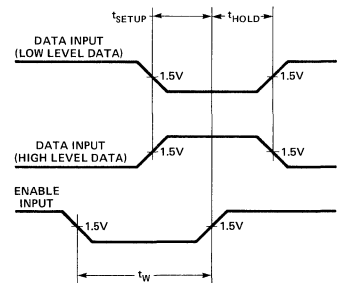
Figure 6. Timing Diagram of 5082-7300 Series Logic.

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. (±.38 mm)
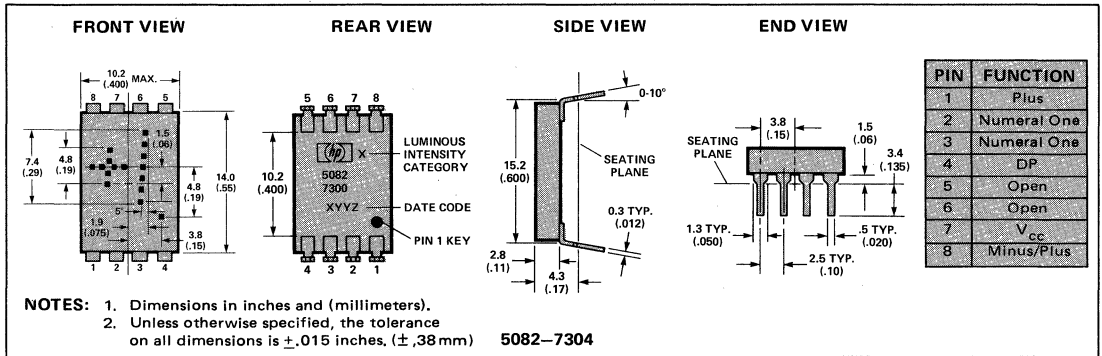
5082–7304

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'

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.
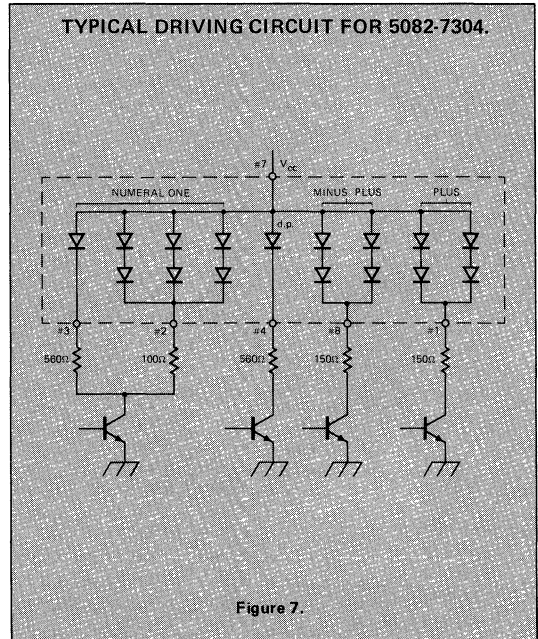
TYPICAL DRIVING CIRCUIT FOR 5082-7304.

Figure 7.

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	λpeak	T$_C$ = 25°C		655		nm
Spectral halfwidth	Δλ$_{1/2}$	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
5082-7359

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
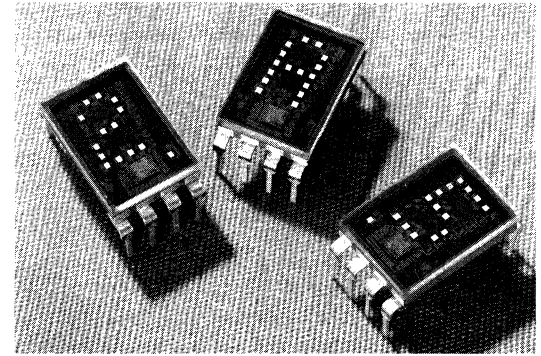
pattern, and four blanks in the invalid BCD states. The unit employs a right-hand decimal point. Typical applications include control systems, instrumentation, communication systems and transportation equipment.

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.

A companion overrange display with right hand decimal point (±1.) is available upon request from the Opto-electronics Division of Hewlett-Packard.

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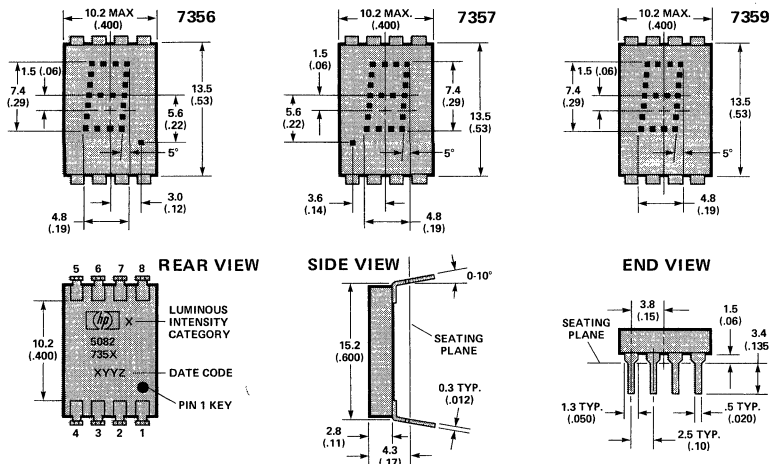
	FUNCTION	
PIN	5082-7356 AND 7357 NUMERIC	5082-7359 HEXA-DECIMAL
1	Input 2	Input 2
2	Input 4	Input 4
3	Input 8	Input 8
4	Decimal point	Blanking control
5	Latch enable	Latch enable
6	Ground	Ground
7	V_{CC}	V_{CC}
8	Input 1	Input 1

NOTES:
1. Dimensions in millimeters and (inches).
2. Unless otherwise specified the tolerance on all dimensions is ±.38mm (±.015").
3. Vertical digit center line is ±.51mm (±.02") from vertical 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		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}				0.8	V
Logic high-level input voltage	V_{IH}		2.0			V
Enable low-voltage; data being entered	V_{EL}	V_{CC}=4.5V			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.
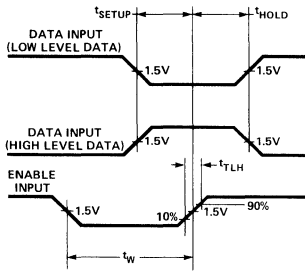
Figure 2. Block Diagram of 5082-7350 Series Logic.

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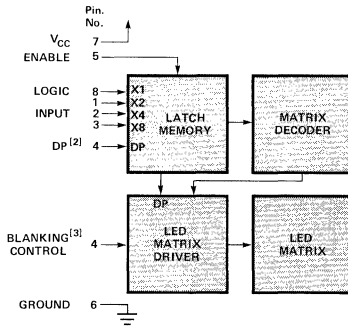
Notes:
1. H = Logic High; L = Logic Low. With the enable input at logic high changes in BCD input logic levels have no effect upon display memory or displayed character.
2. The decimal point input, DP, pertains only to the 5082-7356 and 5082-7357 displays.
3. The blanking control input, B, pertains only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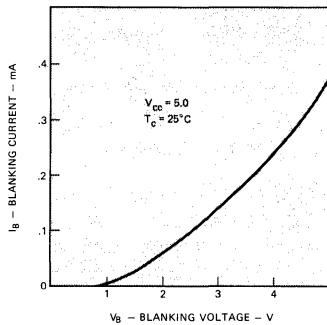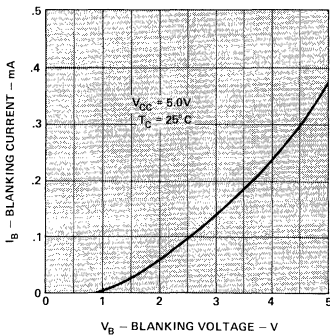

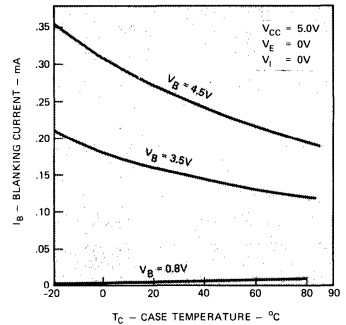**Figure 3. Typical Blanking Control Current vs. Voltage for 5082-7359.**
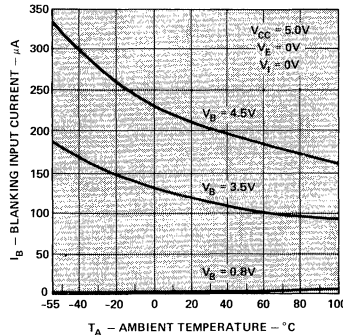
Figure 4. Typical Blanking Control Input Current vs. Ambient Temperature for 5082-7359.
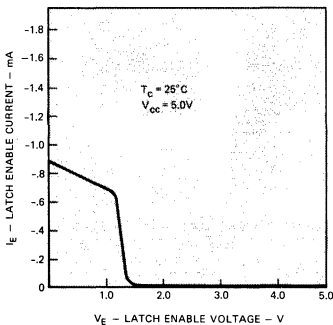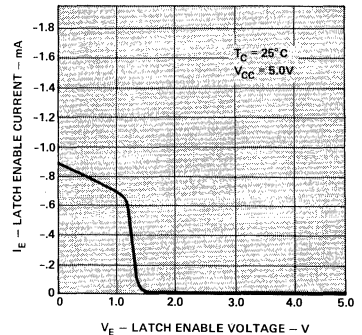

Figure 5. Typical Latch Enable Input Current vs. Voltage.
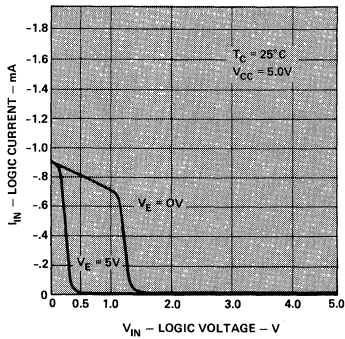
Figure 6. Typical Logic and Decimal Point Input Current vs. Voltage.
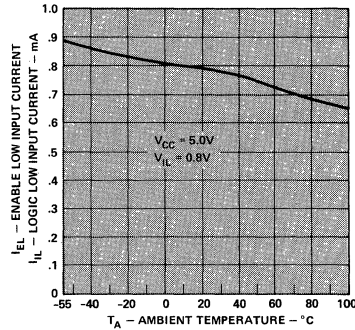
Figure 7. Typical Logic and Enable Low Input Current vs. Ambient Temperature.
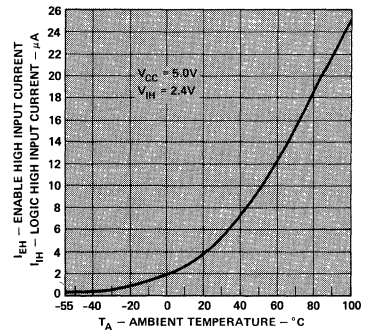
Figure 8. Typical Logic and Enable High Input Current vs. Ambient Temperature.

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 10MHz 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 twelve 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.

HEWLETT hp PACKARD

COMPONENTS

SOLID STATE NUMERIC 1.5 INCH INDICATOR

5082-7500

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 STAND-**
  ARD 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.).
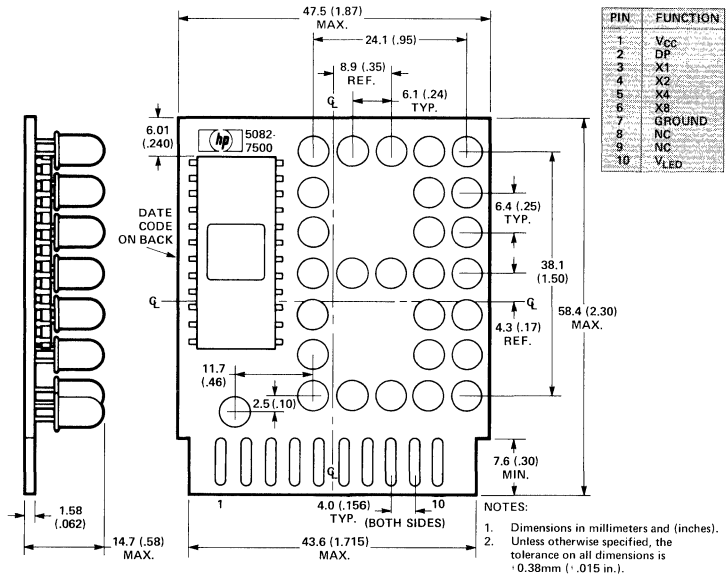
Description

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			
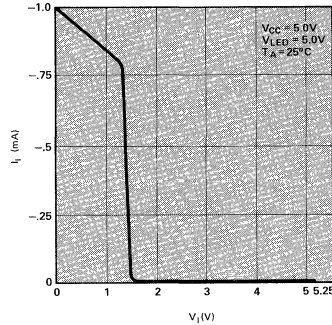
Figure 1. Typical BCD logic input current vs. input voltage.
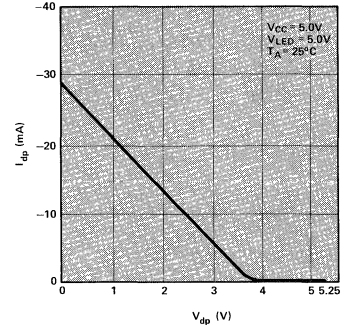
Figure 2. Typical decimal point input current as a function of dp input voltage.
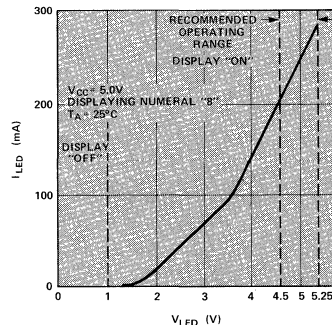
Figure 3. Typical I_{LED} as a function of V_{LED}.
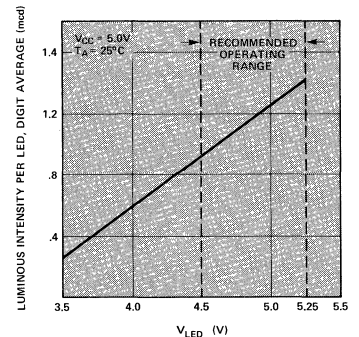
Figure 4. Typical luminous intensity per LED (digit average) as a function of V_{LED}.

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SOLID STATE NUMERIC INDICATOR

5082-7010
5082-7011

TECHNICAL DATA   APRIL 1976

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**
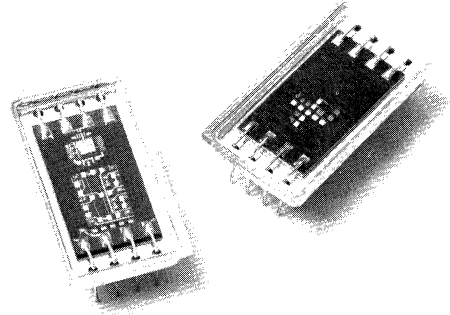
Description

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
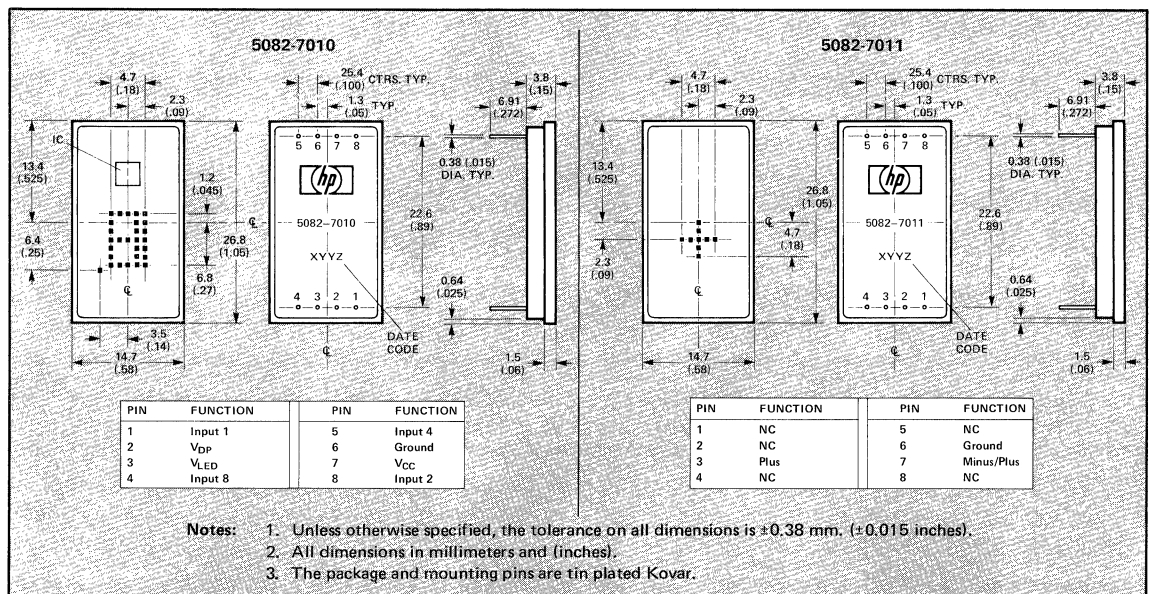
5082-7010

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

5082-7011

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 millimeters 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_ν	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

Char-acter	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
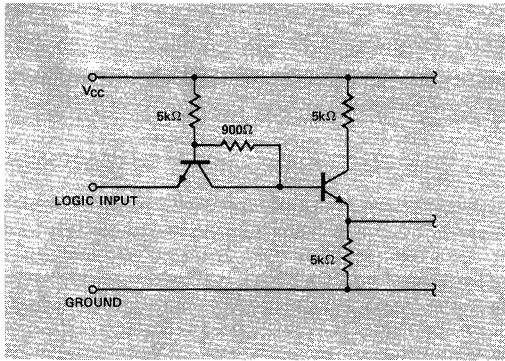
Figure 1. Equivalent input circuit of the 5082-7010 decoder. Note: Display metal case is isolated from ground pin #6.
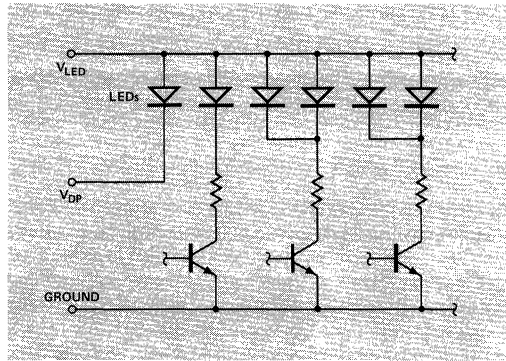
Figure 2. Equivalent circuit of the 5082-7010 as seen from LED and decimal point drive lines.
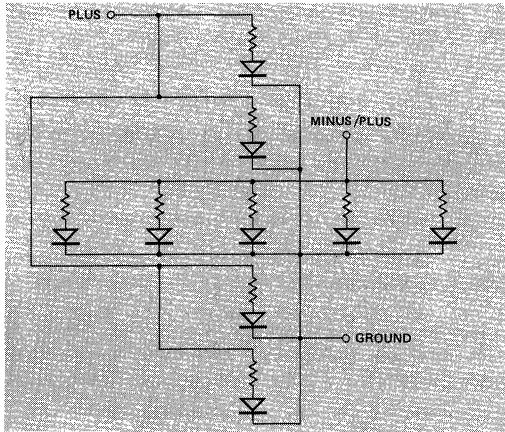
Figure 3. Equivalent circuit of 5082-7011 plus/minus sign. All resistors 345Ω typical. Note: Display metal case is isolated from ground pin #6.
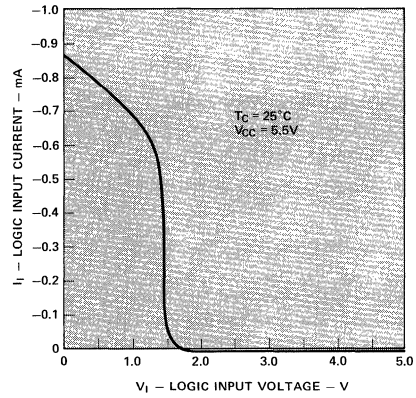
Figure 4. Input current as a function of input voltage, each input.
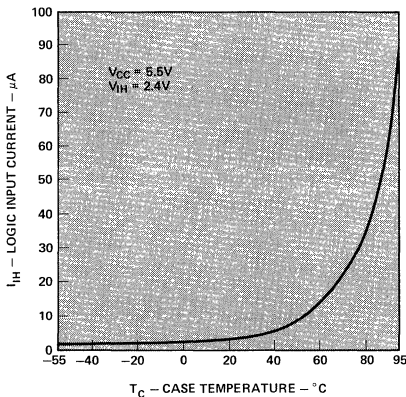
Figure 5. Logic "H" input current as a function of case temperature, each input.
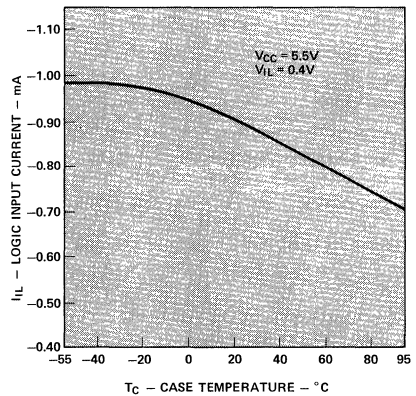
Figure 6. Logic "L" input current as a function of case temperature, each input.
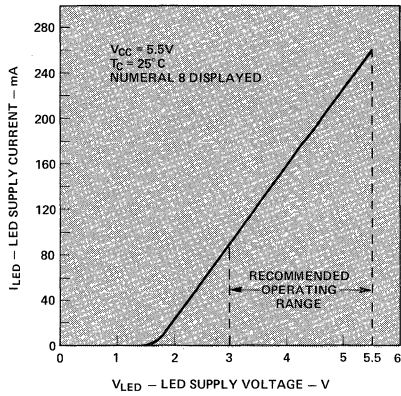
Figure 7. LED supply current as a function of LED supply voltage.
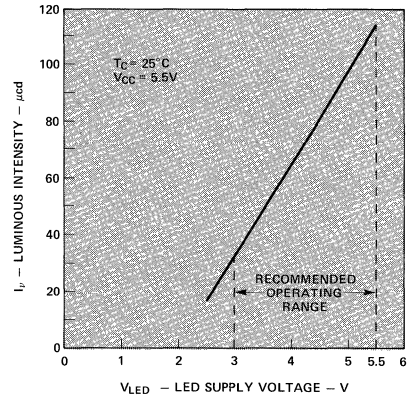
Figure 8. Luminous intensity per LED (digit average) as a function of LED supply voltage.
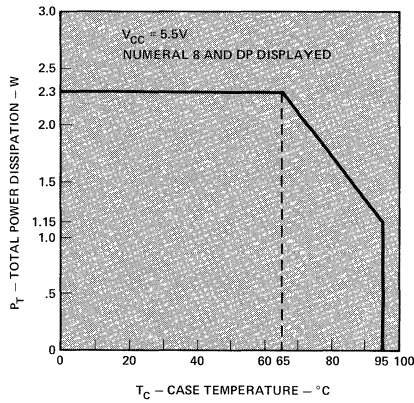
Figure 9. Maximum power derating as a function of case temperature.
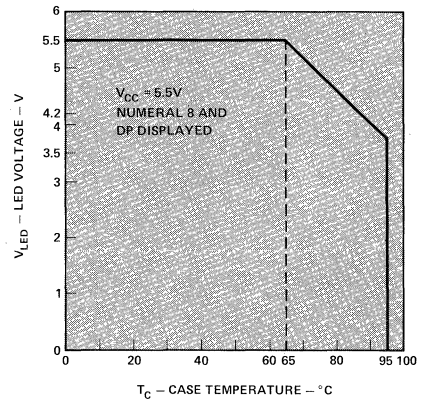
Figure 10. LED voltage derating as a function of case temperature.
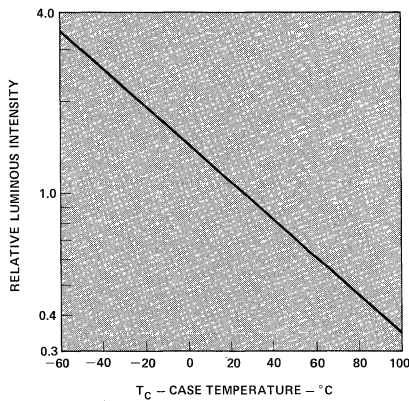
Figure 11. Relative luminous intensity as a function of case temperature at fixed current level.
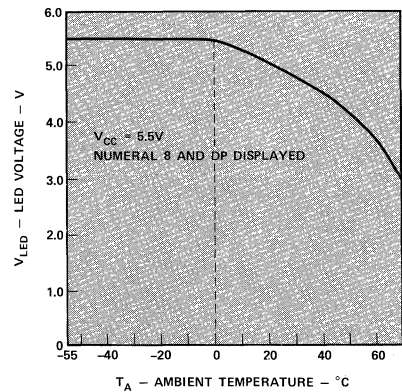
Figure 12. LED voltage derating as a function of ambient temperature, display soldered into P.C. board without heat sink.

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	$\Delta\lambda_{½}$			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 $\theta_{CA} = 30°C/W$. 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- 7395

TECHNICAL DATA   APRIL 1976

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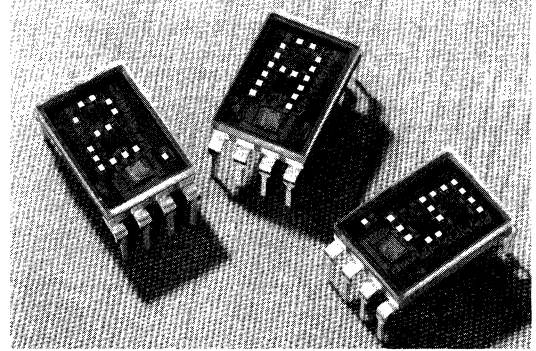
The 5082-7391 numeric indicator decodes positive 8421 BCD logic inputs into characters 0-9, a " −" sign, a test pattern, and four blanks in the invalid BCD states. The unit employs a right-hand decimal point. Typical applications include control systems, instrumentation, communication systems and transportation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

A companion overrange display with right hand decimal point (±1.) is available upon request from the Optoelectronics Division of Hewlett-Packard.

Package Dimensions

PIN	FUNCTION	
	5082-7391 AND 7392 NUMERIC	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 millimeters and (inches).
2. Unless otherwise specified the tolerance on all dimensions is ±.38mm (±.015").
3. Vertical digit center line is ±.51mm (±.02") from vertical 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 ≤ 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}				0.8	V
Logic high-level input voltage	V_{IH}		2.0			V
Enable low-voltage; data being entered	V_{EL}	V_{CC}=4.5V			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.
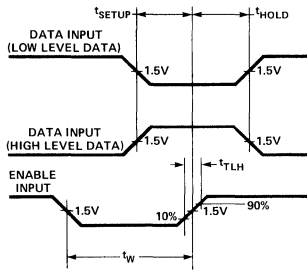
Figure 1. Timing Diagram of 5082-7390 Series Logic.
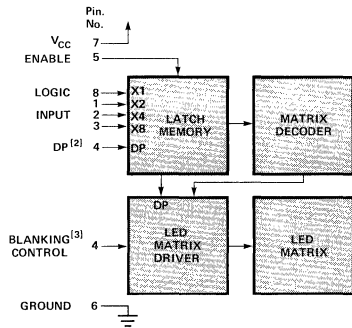
Figure 2. Block Diagram of 5082-7390 Series Logic.

TRUTH TABLE					
BCD DATA[1]				5082-7391/7392	5082-7395
X_8	X_4	X_2	X_1		
L	L	L	L		
L	L	L	H		
L	L	H	L		
L	L	H	H		
L	H	L	L		
L	H	L	H		
L	H	H	L		
L	H	H	H		
H	L	L	L		
H	L	L	H		
H	L	H	L		
H	L	H	H	(BLANK)	
H	H	L	L	(BLANK)	
H	H	L	H	---	
H	H	H	L	(BLANK)	
H	H	H	H	(BLANK)	
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.
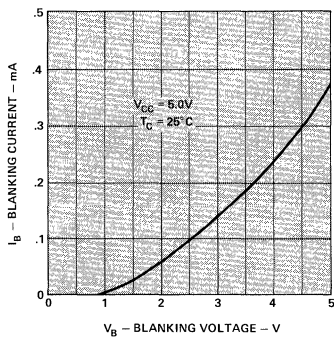
Figure 3. Typical Blanking Control Current vs. Voltage for 5082-7395.
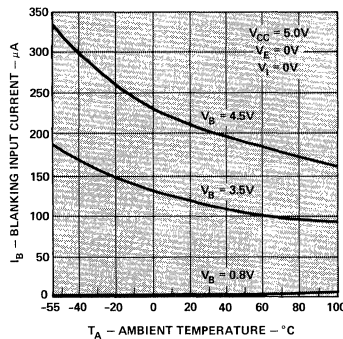
Figure 4. Typical Blanking Control Input Current vs. Ambient Temperature for 5082-7395.

Figure 5. Typical Latch Enable Input Current vs. Voltage.
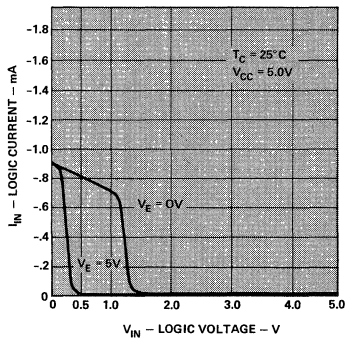
103

Figure 6. Typical Logic and Decimal Point Input Current vs. Voltage.
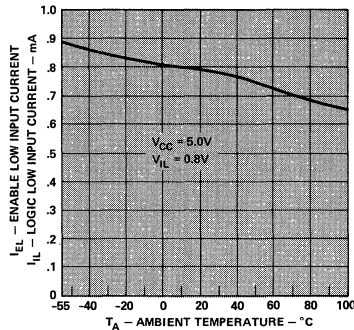
Figure 7. Typical Logic and Enable Low Input Current vs. Ambient Temperature.
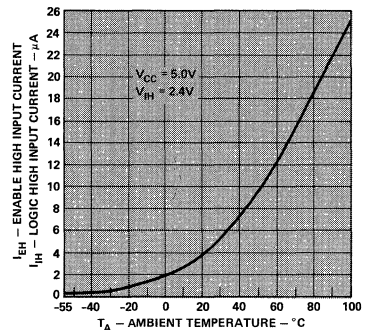
Figure 8. Typical Logic and Enable High Input Current vs. Ambient Temperature.

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 10MHz 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 twelve 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	HPA 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.
2. 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=25°C, t=168 hours, at V_{CC}=5.5V and cycling through logic at 1 character per sec.
10. Electrical Test as in Step 2		

Table 2. Group B.

Examination or Test	MIL-STD-883 Method	MIL-STD-883 Condition	LTPD
Subgroup 1 Physical Dimensions	2008	Package Dimensions per Product Outline Drawing.	20
Subgroup 2 Solderability	2003	Immersion within 0.062" of seating plane 260°C, t=5 sec., omit aging.	15
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 Shock − Non-operating	2002	1500 G, t=0.5ms, 5 blows in each orientation X_1, Y_1, Y_2.	15
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 Terminal Strength	2004	Test Condition B2.	15
End Points: Hermetic Seal	1014	Condition A, limit pressure to 25psi for 1 hour, and Condition D, 40psi for 1 hour.	
Subgroup 5 Salt Atmosphere	1009	Test Condition A	15
Subgroup 6 High Temperature Life	1008	T_A= 125°C, non-operating, t=1000 hours.	λ=7
End Points: Electrical Test		Same as Step 2, Table 1.	
Subgroup 7 Steady State Operating Life	1005	T_A=25°C, t=1000 hours, at V_{CC}=5.5V and cycling through logic at 1 character per second.	λ=5
End Points: Electrical Test		Same as Step 2, Table 1.	

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 5082-7001 triple digit 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 5082-7001 is a modified 5 x 7 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 5082-7010 is a single digit version of the 5082-7001 solid state numeric indicator. The 5082-7011 is a compan-

ion plus/minus sign in the same single digit hermetically tested package used for the 5082-7010. Plus/minus indications require only that voltage be applied to two input pins.

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

Electrical /Optical Specifications

The 5082-7010/11 data sheet lists the electrical/optical specifications for the 5082-7001 and 5082-7010/11 displays.

Package Dimensions

5082-7001

FRONT VIEW   REAR VIEW   SIDE VIEW

FUNCTION	PIN 5082-7001		
	Digit 1	Digit 2	Digit 3
Input 1	1	5	9
Input 2	24	20	16
Input 4	21	17	13
Input 8	4	8	12
V_{CC}	23	19	15
V_{LED}	3	7	11
V_{DP} (Decimal Point)	2	6	10
Ground	22	18	14

Notes:
1. Unless otherwise specified, the tolerance on all dimensions is ±0.38mm (±.015 in.).
2. All dimensions in millimeters and (inches).
3. The 5082-7010/11 data sheet gives the package dimensions and pin out function table for these displays.

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COMPONENTS

LED SOLID STATE
ALPHANUMERIC
INDICATOR

5082-7100
5082-7101
5082-7102

TECHNICAL DATA   APRIL 1976

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**
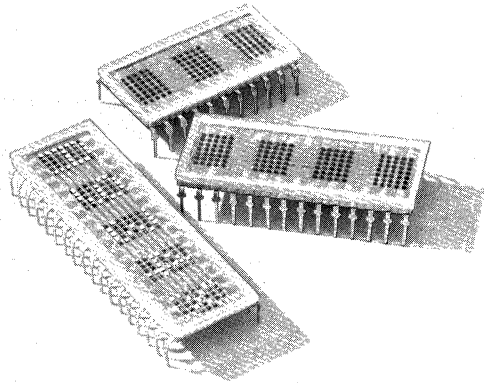
Description

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.
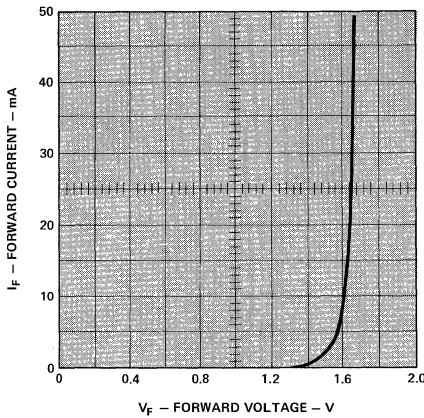
Figure 1. Forward Current-Voltage Characteristic.
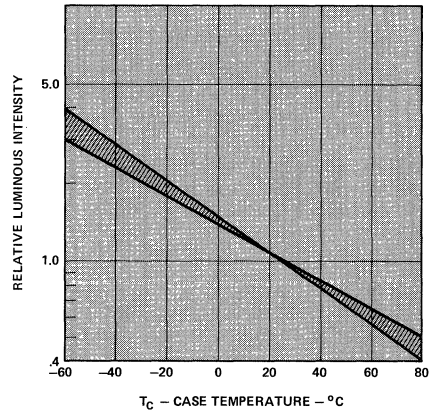
Figure 2. Relative Luminous Intensity vs. Case Temperature at Fixed Current Level.
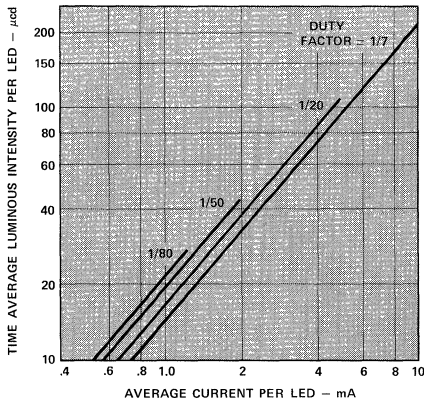
Figure 3. Typical Time Average Luminous Intensity per LED vs. Average Current per LED.
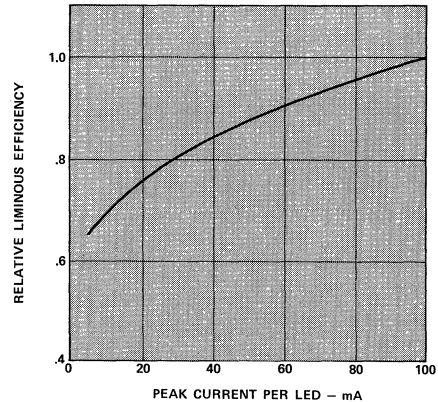
Figure 4. Typical Relative Luminous Efficiency vs. Peak Current per LED.

Package Dimensions and Pin Configurations

5082-7100/7101/7102

1.27 (.050) GLASS
3.05 (.12) MAX.
14.48 (.57) MAX.
3.05 (.120) MAX.
1.65 (.065) REF.
IMAGE PLANE
2.54 (.10)
5.0 (.20)
15.24 ± .25 (.600 ± .010)
0 - 10°
1.27 (.05) MAX.
0.43 (.017) TYP.
2.54 (.100) TYP.

5082-7100
ORIENTATION MARK METAL TAB ON BACK OF SUBSTRATE
7.1 (.28) REF.
CTR DIGIT 1
CTR DIGIT 2
CTR DIGIT 3
14.0 (.55)
5.1 (.20)
22.9 (.90)
27.94 (1.10) MAX.

5082-7101
ORIENTATION MARK METAL TAB ON BACK OF SUBSTRATE
7.1 (.28) REF.
CTR DIGIT 1
CTR DIGIT 2
CTR DIGIT 3
CTR DIGIT 4
13.5 (.53)
4.6 (.18)
22.4 (.88)
31.2 (1.23)
35.6 (1.40) MAX.

5082-7102
ORIENTATION MARK METAL TAB ON BACK OF SUBSTRATE
7.1 (.28) REF.
CTR DIGIT 1
CTR DIGIT 2
CTR DIGIT 3
CTR DIGIT 4
CTR DIGIT 5
13.7 (.54)
4.6 (.18)
22.9 (.90)
32.0 (1.26)
41.1 (1.62)
45.7 (1.80) MAX.

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

CHARACTER 1 — CHARACTER 2 — CHARACTER 3 — CHARACTER 4 — CHARACTER 5

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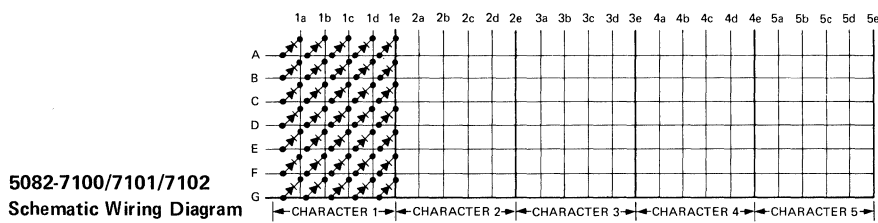
Operating Considerations

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 200 mW 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.
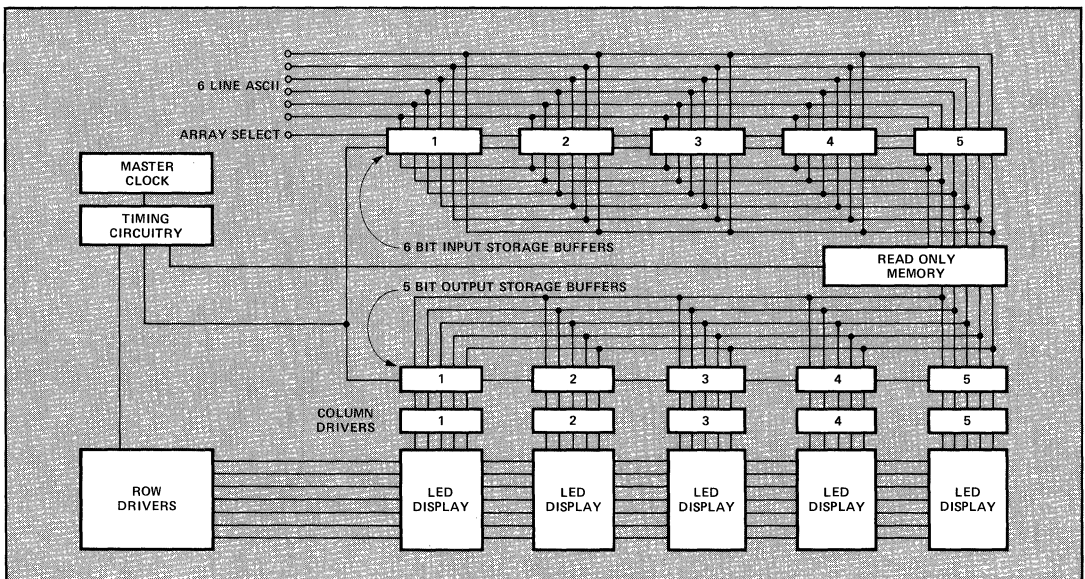
Figure 5.   Row Scanning Block Diagram.

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
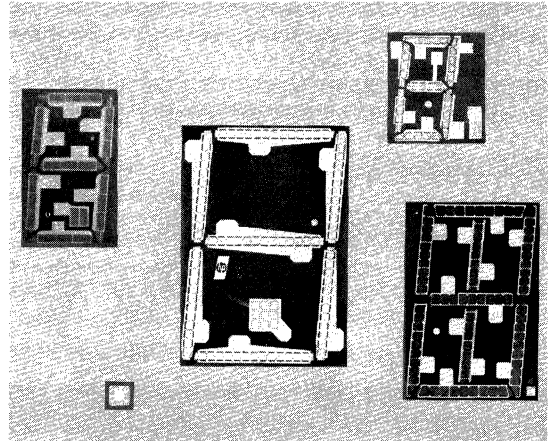
Description

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. The recommended vinyl film allows ease of handling wafers, maintains the orientation of adjacent dice, and optimizes digit-to-digit luminous intensity matching.

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
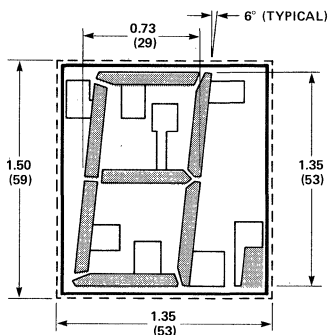
5082-7811/21
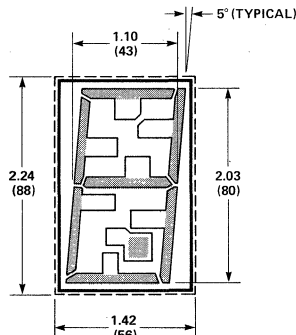
5082-7832/42
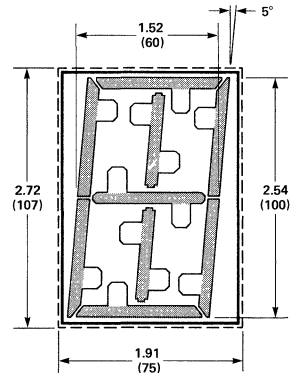
5082-7851/61, 5082-7852/62
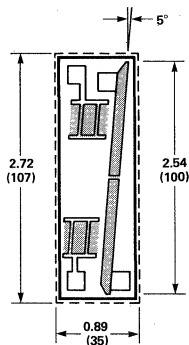
5082-7853/63
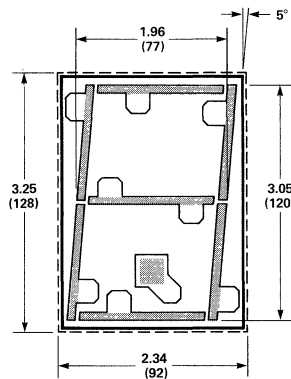
5082-7871/81
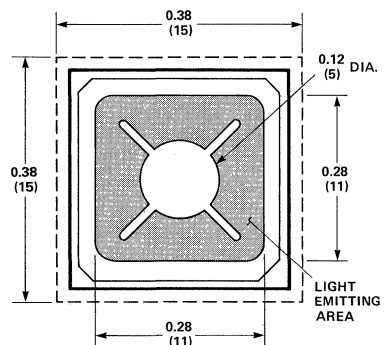
5082-7890/93

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

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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	
$\dfrac{\sigma^{(2)}}{\overline{I_V}}$	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	——	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V	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	
$\dfrac{\sigma^{(2)}}{\overline{I_V}}$	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	——	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V	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	
$\dfrac{\sigma^{(2)}}{\overline{I_V}}$	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	——	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V	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	
$\dfrac{\sigma^{(2)}}{\overline{I_V}}$	Luminous Intensity Normalized Standard Deviation (Digit to Digit)	——	0.10	0.15			
V_F	Forward Voltage/Segment	1.4	1.6	1.8	V	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
$\dfrac{\sigma^{(2)}}{\overline{I_V}}$	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. $\overline{I_V}$ is the mean value and σ is the standard deviation of the wafer luminous intensity.

Typical Characteristic Curves
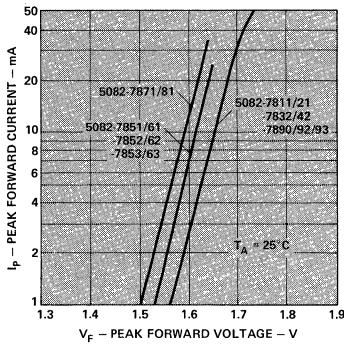
Figure 1. Peak Forward Current vs. Peak Forward Voltage.
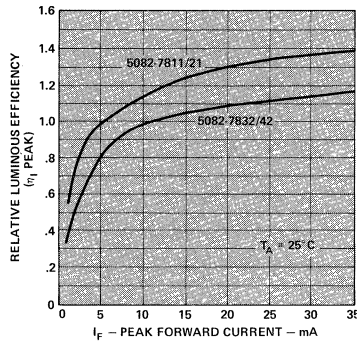
Figure 2. Relative Luminous Efficiency (Luminous Intensity per Unit Current) vs. Peak Current per Segment.
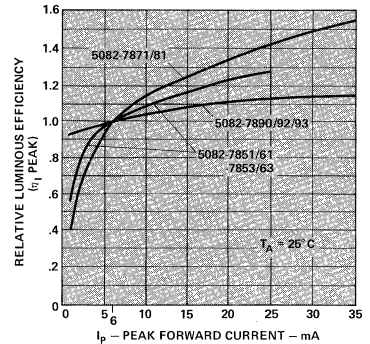
Figure 3. Relative Luminous Efficiency (Luminous Intensity per Unit Current) vs. Peak Current per Segment.

Strobing Considerations

The time average luminous intensity at $T_A = 25°$ 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:

$$I_V = (I_V \text{ at } 25° \text{C}) \ (.982)^{[T_A - 25° C]}$$

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.

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.

Isolators

☐ High Speed Isolators

☐ High Reliability Isolators

☐ Low Input Current/High Gain Isolators

High Speed Isolators

Device		Description	Application[1]	Typical Data Rates	Current Transfer Ratio	Specified Input Current	Input To Output Insulation	Page No
	5082-4350	High Speed Transistor Output Isolator	Line Receiver, Analog Circuits, TTL/CMOS, TTL/LTTL, Ground Isolation	1M bit/s	7% Min.			117
	5082-4351				15% Min.	16mA	3000Vdc[4]	
	5082-4352				15-22%[3]			
	5082-4354	Dual 5082-4350	Line Receiver, Analog Circuits, TTL/CMOS, TTL/LTTL, Ground Isolation	1M bit/s	7% Min.	16mA	3000Vdc[4]	121
	5082-4355	Dual 5082-4351			15% Min.			
	5082-4360[2]	Ultra High Speed Optically Coupled Logic Gate	Line Receiver, High Speed Logic Ground Isolation	10M bit/s	600% Typ.	5.0mA	3000Vdc[4]	125
	5082-4364[2]	Dual 5082-4360	Line Receiver, High Speed Logic Ground Isolation	10M bit/s	600% Typ.	5.0mA	3000Vdc[4]	129

High Reliability Isolators

Device		Description	Application[1]	Typical Data Rates	Current Transfer Ratio	Specified Input Current	Input To Output Insulation	Page No.
	5082-4365[2] (6N134)	Dual Channel Hermetically Sealed Optically Coupled Logic Gate. TX — Screened TXB — Screened with Group B Data	Line Receiver, Ground Isolation for High Reliability Systems	10M bit/s	400% Typ.	10mA	1500Vdc	133
	TX-4365[2]							
	TXB-4365[2]							

Low Input Current/High Gain Isolators

Device		Description	Application[1]	Typical Data Rates	Current Transfer Ratio	Specified Input Current	Input To Output Insulation	Page No.
	5082-4370[2]	Low Input Current, High Gain. V_{CC} = 7V Max.	Line Rec., Low Current Gnd. Isolation, TTL/TTL, LTTL/TTL, CMOS/TTL	300k bit/s	300% Min.	1.6mA	3000Vdc[4]	137
	5082-4371[2]	Low Input Current, High Gain. V_{CC} = 18V Max.	Line Receiver, Ultra Low Current Ground Isolation, CMOS/LTTL, CMOS/TTL, CMOS/CMOS		400% Min.	0.5mA	3000Vdc[4]	

NOTES:
1. For further information ask for Application Notes 939, 948, 951-1, 951-2 and 947. (See pages 146 and 147.)
2. Performance guaranteed over complete operational temperature range.
3. The 5082-4352 Current Transfer Ratio Specification is guaranteed to be 15% minimum and 22% maximum.
4. Recognized under the component recognition program of Underwriters Laboratories Inc. (File No. E55361).

OUTLINE DRAWING

SCHEMATIC
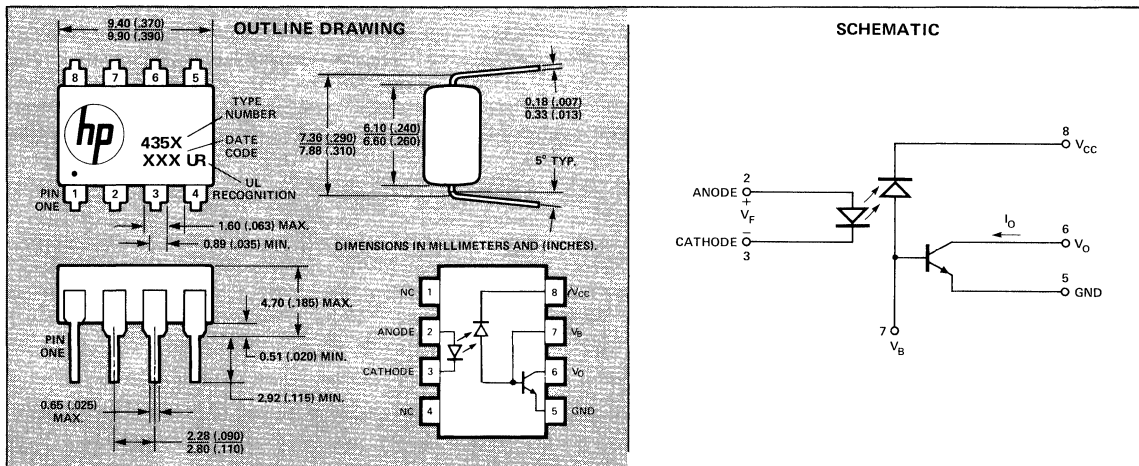
Features

- **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

The 5082-4350 series isolators 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 phototransistor isolator by reducing the base-collector capacitance.

The 5082-4350 is suitable for use in TTL/CMOS, TTL/LTTL or wide bandwidth analog applications. Current transfer ratio (CTR) for the -4350 is 7% minimum at I_F = 16 mA.

The 5082-4351 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 -4351 is 15% minimum at I_F = 16 mA.

The 5082-4352 is suitable for use in applications where matched or known CTR is desired. CTR is 15 to 22% at I_F = 16 mA.

Applications

- **Line Receivers** — High common mode transient immunity (>1000V/μs) allows use of low cost twisted pair cable instead of coax.
- **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 10Sec
(1/16" 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
(⩽1μsec 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 5082-	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Current Transfer Ratio	CTR	4350	7	18		%	$I_F = 16mA$, $V_O = 0.4V$, $V_{CC} = 4.5V$	2	5
		4351	15	22		%			
		4352	15		22	%			
Logic Low Output Voltage	V_{OL}	4350		0.1	0.4	V	$I_F = 16mA$, $I_O = 1.1mA$, $V_{CC} = 4.5V$		
		4351, 4352		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 Voltage	V_R		5			V	$I_R = 10μA$		
Input Capacitance	C_O			40		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 5082-	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time To Logic Low at Output	t_{PHL}	4350		0.5	1.5	μs	$R_L = 4.1k\Omega$	5,9	8,9
		4351, 4352		0.2	0.8	μs	$R_L = 1.9k\Omega$		
Propagation Delay Time To Logic High at Output	t_{PLH}	4350		0.4	1.5	μs	$R_L = 4.1k\Omega$	5,9	8,9
		4351, 4352		0.3	0.8	μs	$R_L = 1.9k\Omega$		
Common Mode Transient Immunity at Logic High Level Output	CM_H	4350		>1000		V/μs	$I_F = 0mA$, $V_{CM} = 10V_{P-P}$, $R_L = 4.1k\Omega$	10	7,8,9
		4351, 4352		>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	4350		<−1000		V/μs	$V_{CM} = 10V_{P-P}$, $R_L = 4.1k\Omega$	10	7,8,9
		4351, 4352		<−1000		V/μs	$V_{CM} = 10V_{P-P}$, $R_L = 1.9k\Omega$		
Bandwidth	BW			2		MH_z	$R_L = 100\Omega$	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 LTTL unit load of 0.18mA and a 5.6kΩ pull-up resistor.
10. The frequency at which the ac output voltage is 3 dB 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.

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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.

DUAL HIGH SPEED OPTICALLY COUPLED ISOLATORS

5082-4354
5082-4355

TECHNICAL DATA APRIL 1976

OUTLINE DRAWING

SCHEMATIC
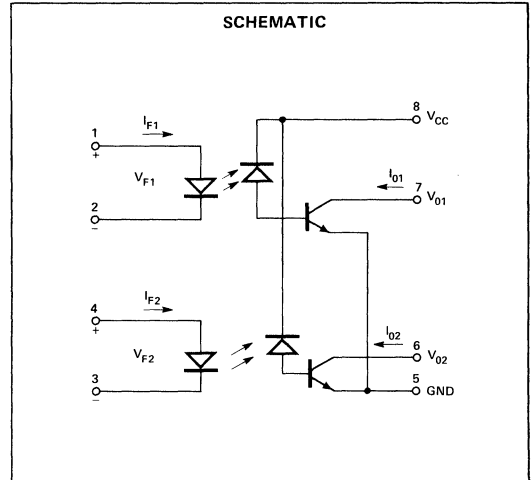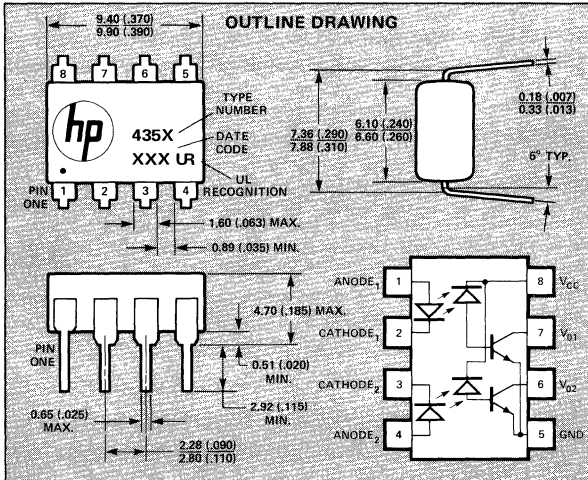
Features

- **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) allows use of low cost twisted pair cable instead of coax.
- **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

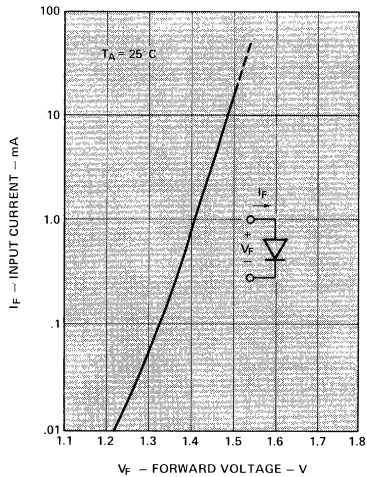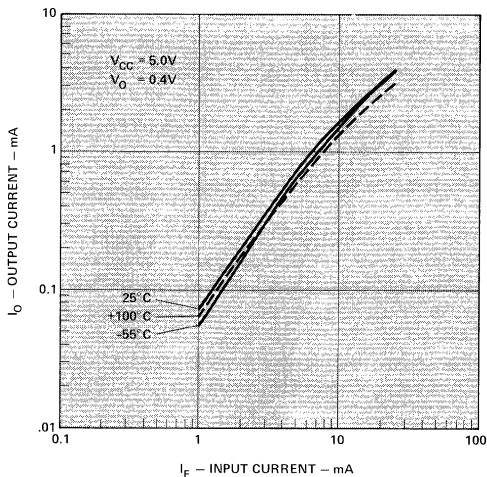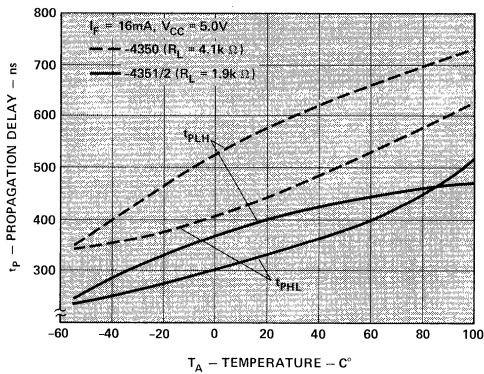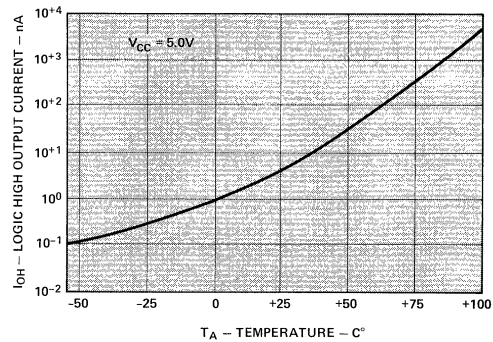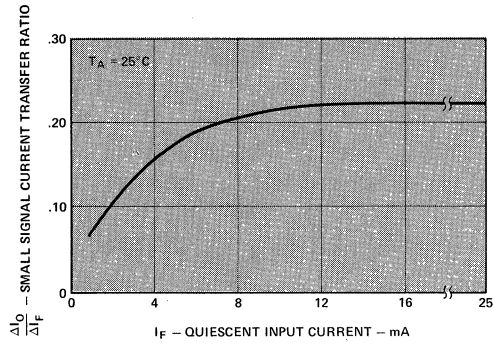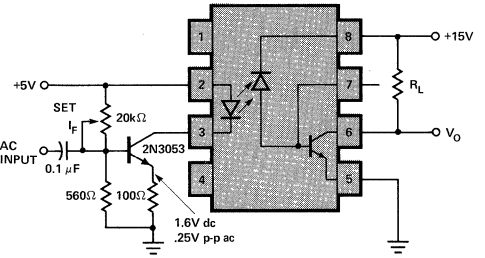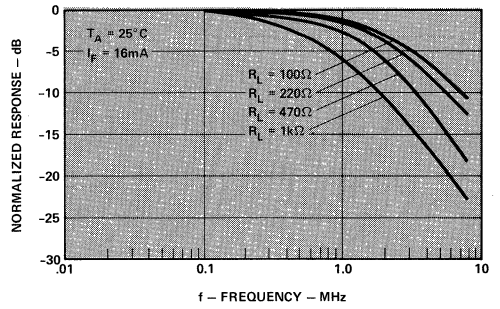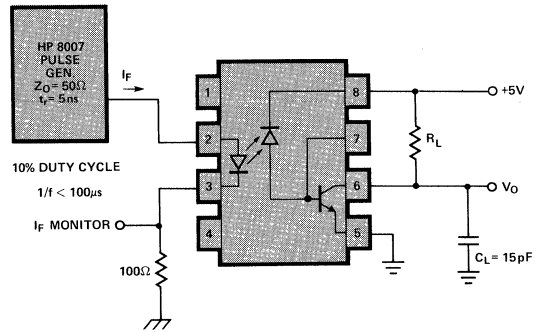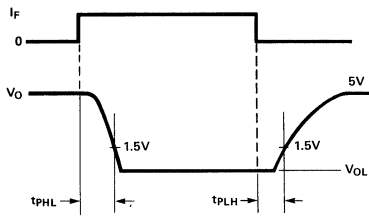The 5082-4354/55 dual isolators contain a pair of light emitting diodes and integrated photon detectors with 3000V dc electrical insulation between input and output. Separate connection for the photodiode bias and output transistor collectors improve the speed up to a hundred times that of a conventional phototransistor isolator by reducing the base-collector capacitance.

The 5082-4354 is suitable for use in TTL/CMOS, TTL/LTTL or wide bandwidth analog applications. Current transfer ratio (CTR) for the -4354 is 7% minimum at I_F = 16 mA.

The 5082-4355 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 -4355 is 15% 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 10Sec
(1/16" 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
(≤1µsec 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, page 2.

Electrical Specifications AT $T_A = 25°C$

Parameter	Sym.	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Current Transfer Ratio	CTR	4354	7	18		%	$I_F = 16mA$, $V_O = 0.4V$, $V_{CC} = 4.5V$	2	5,6
		4355	15	22		%			
Logic Low Output Voltage	V_{OL}	4354		0.1	0.4	V	$I_F = 16mA$, $I_O = 1.1mA$, $V_{CC}=4.5V$		5
		4355		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, $V_{CC} = 15V$		5
Logic High Supply Current	I_{CCH}			0.05	2	μA	$I_{F1} = I_{F2} = 0mA$ $V_{O1} = V_{O2} = $ Open, $V_{CC} = 15V$		5
Input Forward Voltage	V_F			1.5	1.7	V	$I_F = 16mA$	3	5
Temperature Coefficient of Forward Voltage	$\dfrac{\Delta V_F}{\Delta T_A}$			-1.8		$mV/°C$	$I_F = 16mA$		5
Input Reverse Voltage	V_R		5			V	$I_F = 10\mu A$		5
Input Capacitance	C_O			40		pF	$f = 1MHz$, $V_F = 0$		5
Input – Output Insulation Leakage Current	I_{I-O}				1.0	μA	45% Relative Humidity, $t = 5$ sec $V_{IO} = 3000Vdc$		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	$f = 1MHz$		7
Insulation Voltage (Input-Input)	V_{I-I}			1500		V	45% Relative Humidity		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	$f = 1MHz$		8

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

Parameter	Sym.	Device 5082-	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time To Logic Low at Output	t_{PHL}	4354		0.3	1.5	μs	$R_L = 4.1k\Omega$	5,9	10,11
		4355		0.2	0.8	μs	$R_L = 1.9k\Omega$		
Propagation Delay Time to Logic High at Output	t_{PLH}	4354		0.4	1.5	μs	$R_L = 4.1k\Omega$	5,9	10,11
		4355		0.3	0.8	μs	$R_L = 1.9k\Omega$		
Common Mode Transient Immunity at Logic High Level Output	CM_H	4354		>1000		$V/\mu s$	$I_F = 0mA$, $R_L = 4.1k\Omega$, $V_{CM} = 10V_{p-p}$	10	9,10,11
		4355		>1000		$V/\mu s$	$I_F = 0mA$, $R_L = 1.9k\Omega$, $V_{CM} = 10V_{p-p}$		
Common Mode Transient Immunity at Logic Low Level Output	CM_L	4354		<-1000		$V/\mu s$	$V_{CM} = 10V_{p-p}$, $R_L = 4.1k\Omega$	10	9,10,11
		4355		<-1000		$V/\mu s$	$V_{CM} = 10V_{p-p}$, $R_L = 1.9k\Omega$		
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 LTTL unit load of 0.18mA and 5.6kΩ 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.

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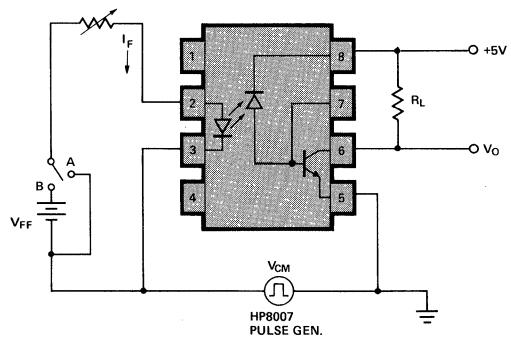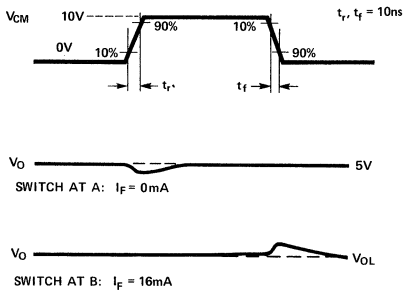

Figure 8. Frequency Response.

Figure 9. Switching Test Circuit.

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

DTL/TTL COMPATIBLE OPTICALLY ISOLATED GATE

5082-4360

NOTE:
A .01 to 0.1µF BYPASS CAPACITOR MUST BE
CONNECTED BETWEEN PINS 8 AND 5.   **Figure 1.**

Features

- **DTL/TTL COMPATIBLE: 5V SUPPLY**
- **ULTRA HIGH SPEED**
- **LOW INPUT CURRENT REQUIRED: 5mA**
- **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 5082-4360 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 Vcc 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 nsec typical.

The 5082-4360 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 syst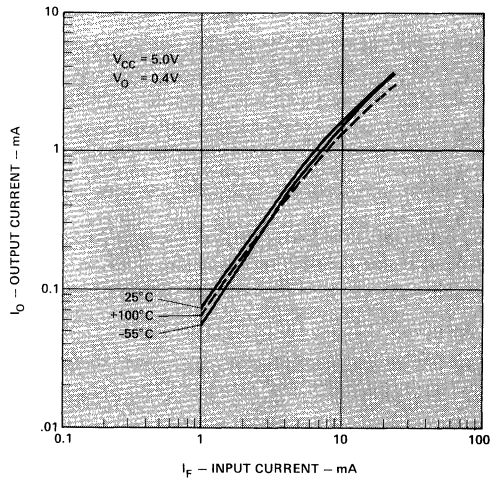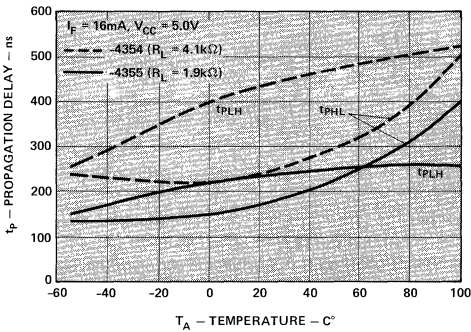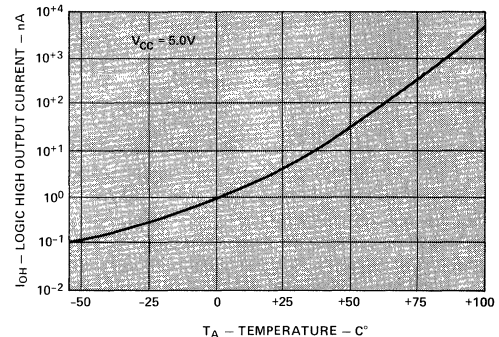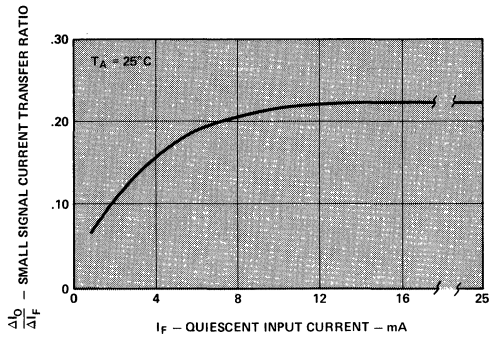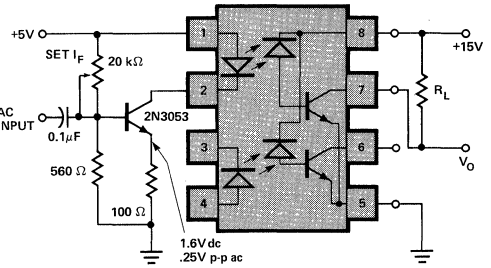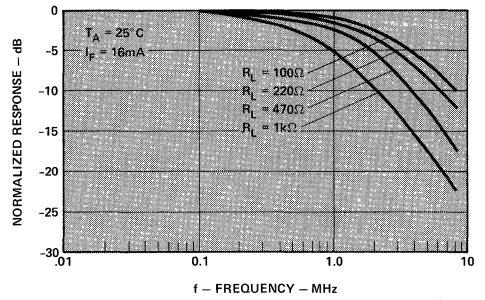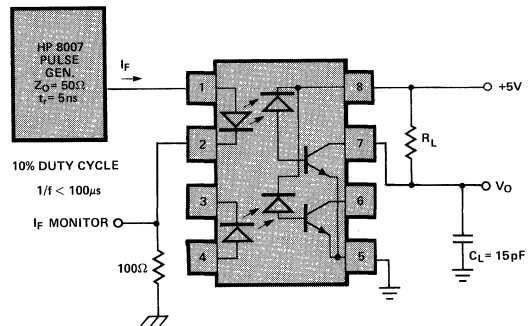ems. The elimination of ground loops can be accomplished between system interfaces such as a computer and a peripheral memory.

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

PIN CONNECTION DIAGRAM

Recommended Operating Conditions

	Sym.	Min.	Typ.	Max.	Units
Input Current, Low Level Each Channel	I_{FL}	0		250	µA
Input Current, High Level Each Channel	I_{FH}	5	7.5	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	5.0	5.5	V
Fan Out (TTL Load)	N			8	
Operating Temperature	T_A	0	25	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 Sec.
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

Electrical Characteristics

OVER RECOMMENDED TEMPERATURE ($T_A = 0°C - 70°C$) UNLESS OTHERWISE NOTED

Parameter	Symbol	Min.	Typ.*	Max.	Units	Test Conditions	Figure	Note
High Level Output Current	I_{OH}		50	250	μA	$V_{CC}=5.5V$, $V_O=5.5V$, $I_F=250\mu A$, $V_{EH}=2.0V$	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	$V_{CC}=5.5V$, $V_{EH}=2.0V$		
Low Level Enable Current	I_{EL}		-1.6	2.0	mA	$V_{CC}=5.5V$, $V_{EL}=0.5V$		
High Level Supply Current	I_{CCH}		7	15	mA	$V_{CC}=5.5V$, $I_F=0$ $V_{EL}=0.5V$		
Low Level Supply	I_{CCL}		13	18	mA	$V_{CC}=5.5V$, $I_F=10mA$ $V_{EL}=0.5V$		
Input–Output Insulation Leakage Current	I_{I-O}			1.0	μA	Relative Humidity=45% $T_A=25°C$, t=5sec, 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	$I_R=10\mu A$, $T_A=25°C$		
Input Capacitance	C_{in}		40		pF	$V_F=0$, f=1MHz		
Current Transfer Ratio	CTR		600		%	$I_F=5.0mA$, $R_L=100\Omega$	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	$R_L=350\Omega$, $C_L=15pF$, $I_F=7.5mA$	7,9	1
Propagation Delay Time to Low Output Level	t_{PHL}		45	75	ns	$R_L=350\Omega$, $C_L=15pF$, $I_F=7.5mA$	7,9	2
Output Rise-Fall Time (10-90%)	t_r, t_f		25		ns	$R_L=350\Omega$, $C_L=15pF$, $I_F=7.5mA$		
Propagation Delay Time of Enable from V_{EH} to V_{EL}	t_{ELH}		25		ns	$R_L=350\Omega$, $C_L=15pF$, $I_F=7.5mA$, $V_{EH}=3.0V$, $V_{EL}=0.5V$	8	3
Propagation Delay Time of Enable from V_{EL} to V_{EH}	t_{EHL}		15		ns	$R_L=350\Omega$, $C_L=15pF$, $I_F=7.5mA$ $V_{EH}=3.0V$, $V_{EL}=0.5V$	8	4
Common Mode Transient Immunity at Logic High Output Level	CM_H		50		$v/\mu s$	$V_{CM}=10V$ $R_L=350\Omega$, V_O(min.)=2V, $I_F=0mA$	11	6
Common Mode Transient Immunity at Logic Low Output Level	CM_L		150		$v/\mu s$	$V_{CM}=10V$ $R_L=350\Omega$, V_O(max.)=0.8V, $I_F=$ 5mA	11	6

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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.

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 input pulse to the 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.

Note: Dashed characteristics — denote pulsed operation only.
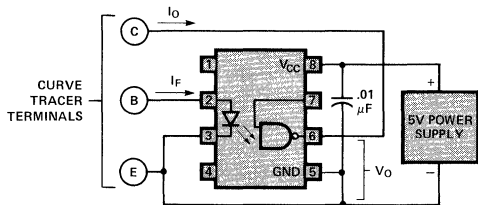
Figure 2. Isolator Collector Characteristics.

Figure 3. Input-Output Characteristics.

Figure 4. Input Diode Forward Characteristic.

Figure 5. Output Voltage, V_{OL} vs. Temperature and Fan-Out.
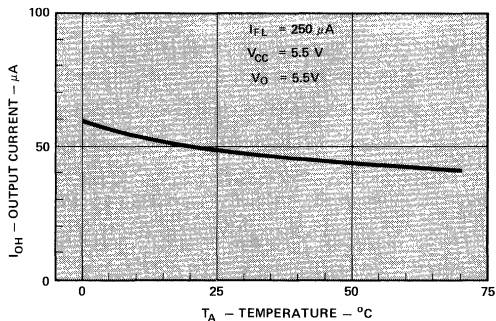
Figure 6. Output Current, I_{OH} vs. Temperature (I_F=250μA).
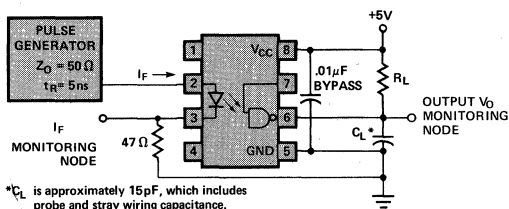
127
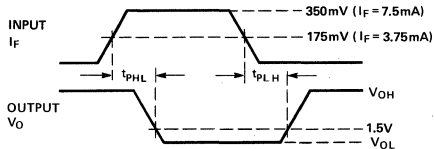
Figure 7. Test Circuit for t_{PHL} and t_{PLH}.
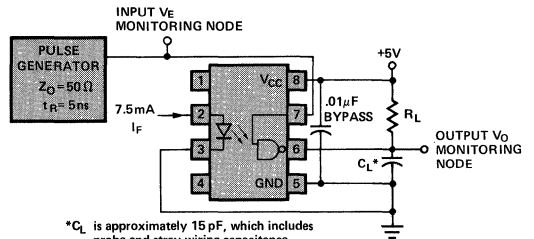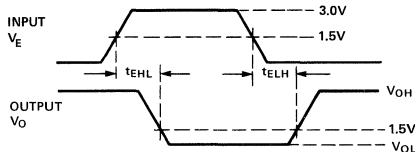
Figure 8. Test Circuit for t_{ELH} and t_{EHL}.
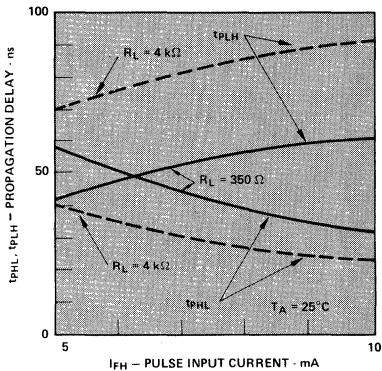
Figure 9. Propagation Delay, t_{PHL} and t_{PLH} vs. Pulse Input Current, I_{FH}.
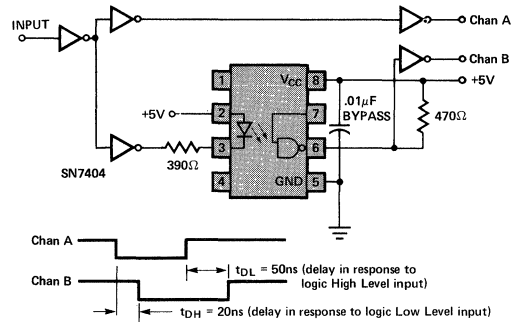
Figure 10. Response Delay Between TTL Gates.
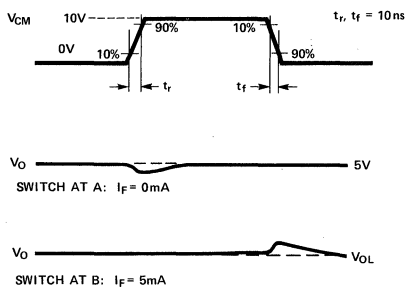
Figure 11. Test Circuit for Transient Immunity and Typical Waveforms.

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DUAL DTL/TTL COMPATIBLE OPTICALLY ISOLATED GATE

5082-4364

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

Figure 1.

PIN CONNECTION DIAGRAM

DIMENSIONS IN MILLIMETERS AND (INCHES).
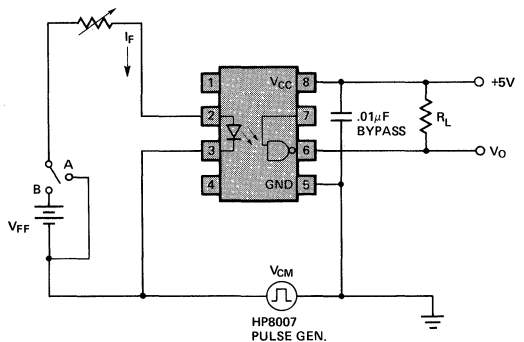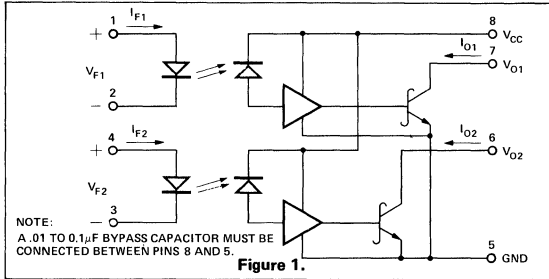
Features

- **HIGH DENSITY PACKAGING**
- **DTL/TTL COMPATIBLE: 5V SUPPLY**
- **ULTRA HIGH SPEED**
- **LOW INPUT CURRENT REQUIRED: 5mA**
- **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 5082-4364 consists of a pair of inverting optically isolated 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 5082-4364 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 a computer and a peripheral memory.

The open collector output provides capability for bussing, OR'ing, and strobing. In all applications, the dual channel configuration allows for high density packaging, increased convenience and more usable board space.
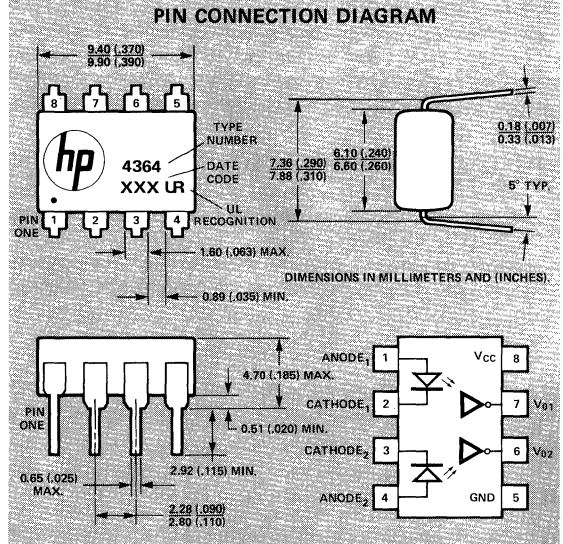
Recommended Operating Conditions

	Sym.	Min.	Typ.	Max.	Units
Input Current, Low Level					
Each Channel	I_{FL}	0		250	μA
Input Current, High Level					
Each Channel	I_{FH}	5	7.5	10	mA
Supply Voltage, Output	V_{CC}	4.5	5.0	5.5	V
Fan Out (TTL Load)					
Each Channel	N			8	
Operating Temperature	T_A	0	25	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 Sec.

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

Electrical Characteristics

OVER RECOMMENDED TEMPERATURE ($T_A = 0°C - 70°C$) UNLESS OTHERWISE NOTED

Parameter	Symbol	Min.	Typ.*	Max.	Units	Test Conditions	Figure	Note
High Level Output Current	I_{OH}		50	250	μA	$V_{CC} = 5.5V$, $V_O = 5.5V$, $I_F = 250\mu A$		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	$V_{CC} = 5.5V$, $I_F = 0$ Each Channel		
Low Level Supply	I_{CCL}		26	36	mA	$V_{CC} = 5.5V$, $I_F = 10mA$ Each Channel		
Input – Output Insulation Leakage Current	I_{I-O}			1.0	μA	Relative Humidity = 45% $T_A = 25°C$, t = 5 sec, $V_{I-O} = 3000Vdc$		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	$I_R = 10\mu A$, $T_A = 25°C$		
Input Capacitance	C_{in}		40		pF	$V_F = 0$, f = 1MHz		3
Insulation Voltage (Input-Input)	V_{I-I}		1500		V	Relative Humidity = 45%		8
Resistance (Input-Input)	R_{I-I}		10^{11}		Ω	$V_{I(1-2)} = 500V$		8
Capacitance (Input-Input)	C_{I-I}		0.25		pF	f = 1MHz		8
Current Transfer Ratio	CTR		600		%	$I_F = 5.0mA$, $R_L = 100\Omega$	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	$R_L = 350\,\Omega$, $C_L = 15pF$, $I_F = 7.5mA$	5,6	1
Propagation Delay Time to Low Output Level	t_{PHL}		40	75	ns	$R_L = 350\,\Omega$, $C_L = 15pF$, $I_F = 7.5mA$	5,6	2
Output Rise-Fall Time (10-90%)	t_r, t_f		25		ns	$R_L = 350\,\Omega$, $C_L = 15pF$, $I_F = 7.5mA$		
Common Mode Transient Immunity at High Output Level	CM_H		50		V/μs	$V_{CM} = 10V_{p-p}$, $R_L = 350\,\Omega$, V_O (min.) = 2V, $I_F = 0mA$	8	5
Common Mode Transient Immunity at Low Output Level	CM_L		150		V/μs	$V_{CM} = 10V_{p-p}$, $R_L = 350\,\Omega$, 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 V_F 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.

Figure 3. Input-Output Characteristics.
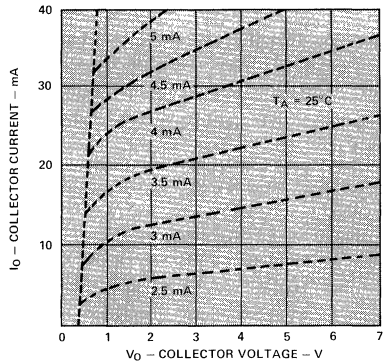
NOTE: Dashed characteristics indicate pulsed operation.
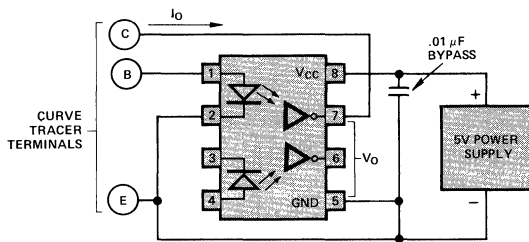
Figure 2. Isolator Transfer Characteristics.
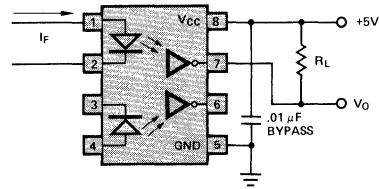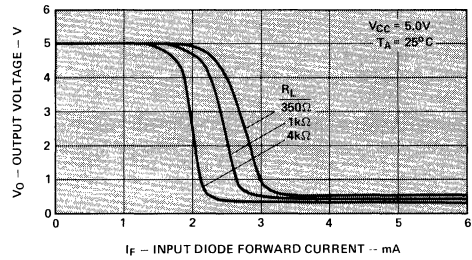
Figure 4. Input Diode Forward Characteristic

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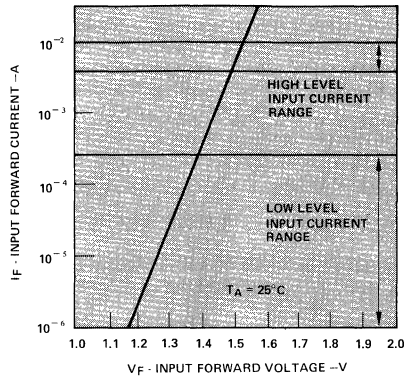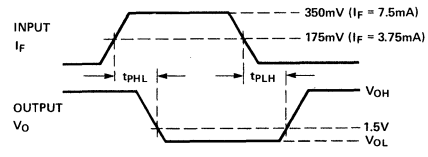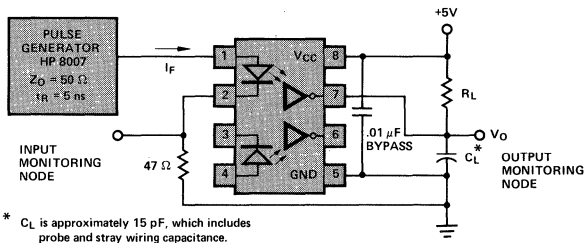
Figure 5. Test Circuit for t_{PHL} and t_{PLH}.
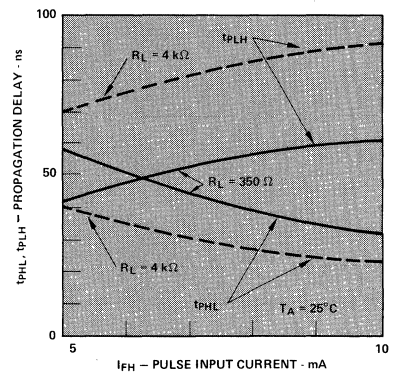
Figure 6. Propagation Delay, t_{PHL} and t_{PLH} vs. Pulse Input Current, I_{FH}.
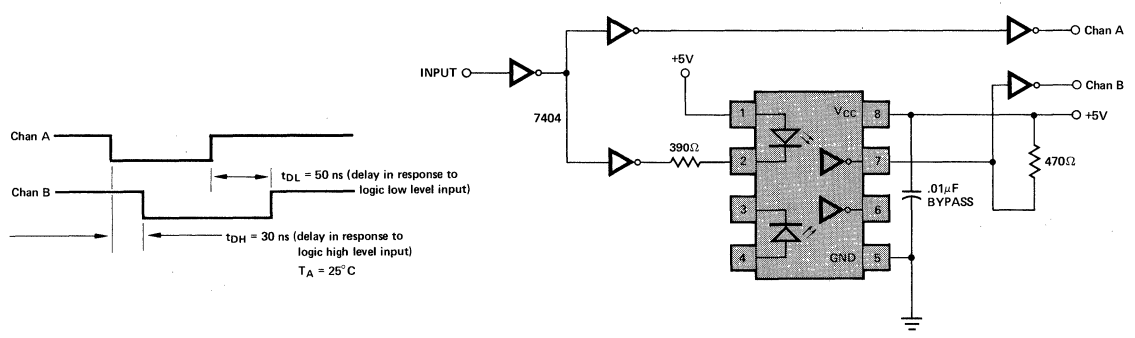
Figure 7. Response Delay Between TTL Gates.
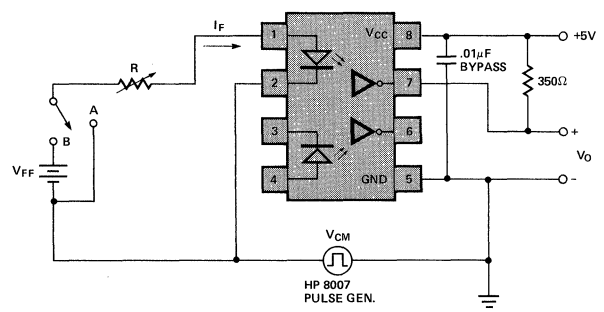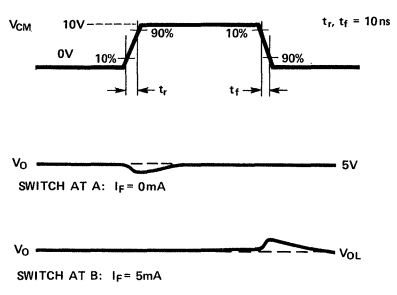
Figure 8. Test Circuit for Transient Immunity and Typical Waveforms.

DUAL CHANNEL HERMETICALLY SEALED OPTICALLY COUPLED ISOLATOR

5082-4365 (6N134)
TX-4365
TXB-4365

TECHNICAL DATA APRIL 1976

NOTE:
A .01 TO 0.1µF BYPASS CAPACITOR MUST BE CONNECTED BETWEEN PINS 15 AND 10.

DIMENSIONS IN MILLIMETERS AND (INCHES).

Outline Drawing
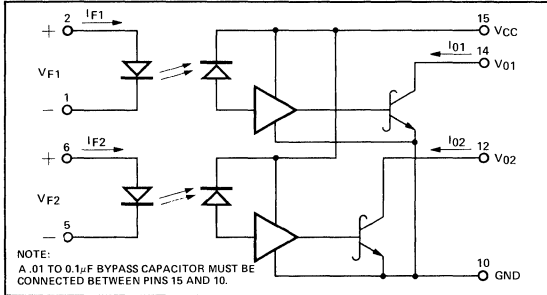
Features

- **HERMETICALLY SEALED**
- **HIGH SPEED**
- **PERFORMANCE GUARANTEED OVER -55°C TO +125°C AMBIENT TEMPERATURE RANGE**
- **HIGH RELIABILITY SCREENING PROGRAM AVAILABLE**
- **TTL COMPATIBLE INPUT AND OUTPUT**
- **HIGH COMMON MODE REJECTION**
- **DUAL-IN-LINE PACKAGE**
- **1500Vdc INSULATION VOLTAGE**
- **DUAL CHANNEL**
- **EIA REGISTRATION**

Applications

- Logic Ground Isolation
- Line Receiver
- Computer - Peripheral Interface
- High Density Packaging
- High Reliability Systems

Description

The 5082-4365 consists of a pair of inverting optically isolated 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.
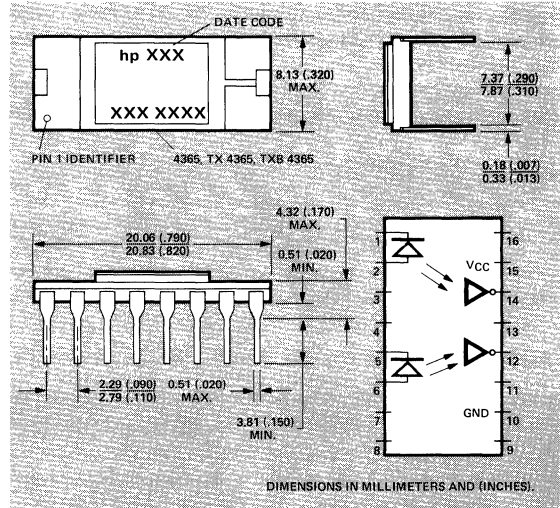
Recommended Operating Conditions

TABLE I

	Sym.	Min.	Typ.	Max.	Units
Input Current, Low Level Each Channel	I_{FL}	0		250	µA
Input Current, High Level Each Channel	I_{FH}	10	13	20	mA
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Fan Out (TTL Load) Each Channel	N			6	
Operating Temperature	T_A	-55	25	125	°C

Absolute Maximum Ratings

Storage Temperature . . . . -65°C to +150°C
Operating Temperature . . . . -55°C to +125°C
Lead Solder Temperature . . . . 260°C for 10 Sec.
Peak Forward Input
    Current (each channel) . . . . . 40 mA (≤1 msec Duration)
Average Input Forward Current (each channel) . . . . . 20 mA
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

TABLE II, GROUP A
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, Each Channel		
Low Level Supply Current	I_{CCL}		26	36	mA	V_{CC} = 5.5V, I_F = 20mA, Each Channel		
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	$\dfrac{\Delta V_F}{\Delta T_A}$		−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 = 5sec		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
Insulation Voltage (Input-Input)	V_{I-I}		1500		V_{dc}	Relative Humidity = 45%		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.
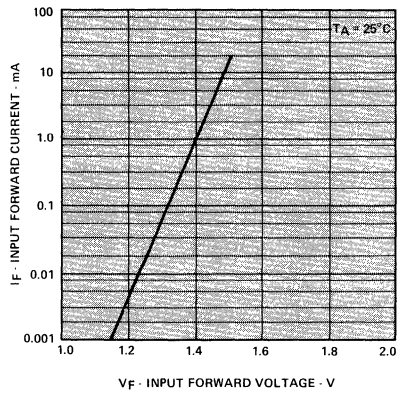
Figure 1. Input Diode Forward Characteristic
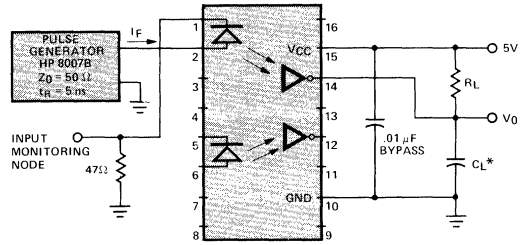
* C_L is approximately 15 pF, which includes probe and stray wiring capacitance.
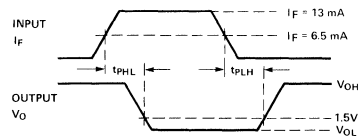
Figure 2. Test Circuit for t_{PHL} and t_{PLH}
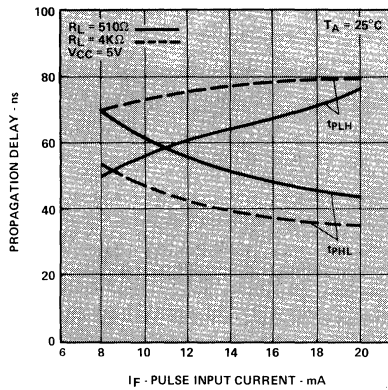
Figure 3. Propagation Delay, t_{PHL} and t_{PLH} vs. Pulse Input Current, I_{FH}
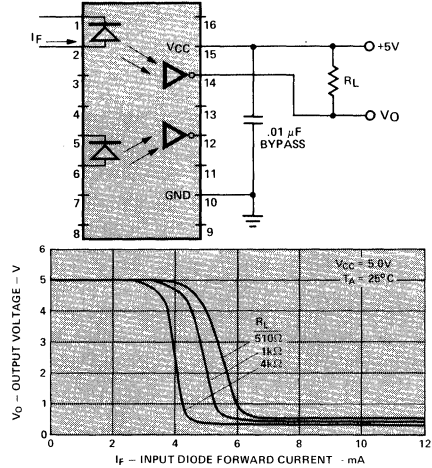
Figure 4. Input-Output Characteristics
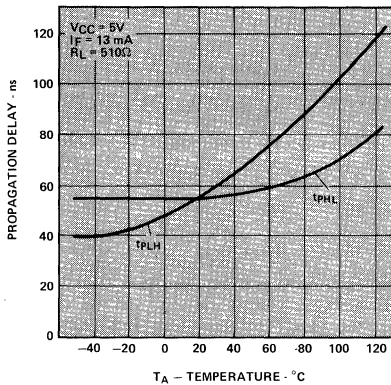
Figure 5. Propagation Delay vs. Temperature
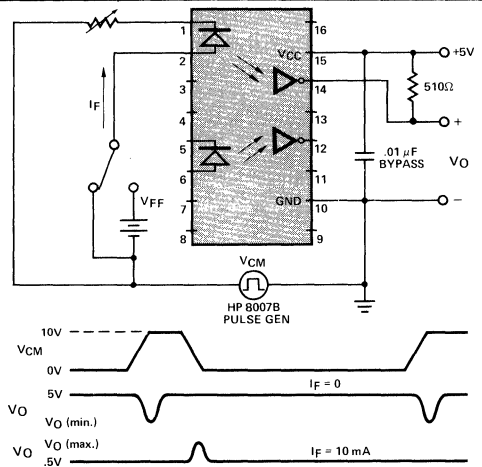
Figure 6. Typical Common Mode Rejection Characteristics/Circuit

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 TX prefix identifies a part which has been preconditioned and screened per Table IV.
- The TXB 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
5082-4365 (6N134)	TX-4365	TXB-4365

TABLE IV TX 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: Group A*, Table II, 100%, $T_A = 25°C$		
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	Cond. A
7. Gross Leak Test	1014	Cond. C, Step 1
8. Electrical Test: read V_{OL} per Table II, $T_A = 25°C$		
9. Burn-In, $V_{CC} = 5.5V$, $I_F = 13mA$, $I_O = 25mA$	1015	168 hrs. @ $T_A = 25°C$
10. Electrical Test: Group A*, Table II		
11. Evaluate drift		Max. $\Delta V_{OL} = ±20\%$

*Min/Max guaranteed parameters only.

TABLE V, GROUP B

Examination or Test	MIL-STD-883 Method	Condition	LTPD
Subgroup 1			15
Physical Dimensions	2008	See Product Outline Drawing	
Subgroup 2			20
Solderability	2003	Immersion within 0.10" of body, 8 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 Per Table II, $T_A = 25°C$	
End Points: Group A			
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, 1 lb., 15 sec.	
Subgroup 6			$\lambda = 7$
High Temperature Life	1008	$T_A = 125°C$, non-operating	
End Points: Per Step 10, Table IV			
Subgroup 7			$\lambda = 7$
Steady State Operating Life	1005	$V_{CC} = 5.5V$, $I_F = 13mA$, $I_O = 25mA$, $T_A = 25°C$	
End Points: Same as Subgroup 6			

HEWLETT hp PACKARD

COMPONENTS

LOW INPUT CURRENT, HIGH GAIN OPTICALLY COUPLED ISOLATORS

5082-4370
5082-4371

OUTLINE DRAWING

9.40 (.370)
8.90 (.390)

8 7 6 5

TYPE NUMBER

hp 437X

DATE CODE
XXX UR

UL RECOGNITION

PIN ONE 1 2 3 4

6.10 (.240)
6.60 (.260)

7.36 (.290)
7.88 (.310)

0.18 (.007)
0.33 (.013)

5° TYP.

1.60 (.063) MAX. DIMENSIONS IN MILLIMETERS AND (INCHES).
0.89 (.035) MIN.

4.70 (.185) MAX.

PIN ONE

0.51 (.020) MIN.

0.65 (.025) MAX.

2.28 (.090)
2.80 (.110)

2.92 (.115) MIN.

NC 1 | 8 V_CC
ANODE 2 | 7 V_B
CATHODE 3 | 6 V_O
NC 4 | 5 GND

SCHEMATIC

V_CC 8

ANODE 2 +

V_F

CATHODE 3

6 V_O

5 GND

7 V_B

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

The 5082-4370 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 5082-4371 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 5082-4370 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.

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 10 Sec
(1/16″ 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
(≤ 1μsec pulse width, 300pps)
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, page 2.

Electrical Specifications
OVER RECOMMENDED TEMPERATURE (T_A = 0°C to 70°C), UNLESS OTHERWISE SPECIFIED

Parameter	Sym.	Device 5082-	Min.	Typ.*	Max.	Units	Test Conditions	Fig.	Note
Current Transfer Ratio	CTR	4371	400	800		%	I_F = 0.5mA, V_O = 0.4V, V_{CC} = 4.5V		
			500	900			I_F = 1.6mA, V_O = 0.4V, V_{CC} = 4.5V		5,6
		4370	300	600		%	I_F = 1.6mA, V_O = 0.4V, V_{CC} = 4.5V		
Logic Low Output Voltage	V_{OL}	4371		0.1	0.4	V	I_F = 1.6mA, I_O = 6.4mA, V_{CC} = 4.5V		
				0.1	0.4	V	I_F = 5mA, I_O = 15mA, V_{CC} = 4.5V		6
				0.2	0.4		I_F = 12mA, I_O = 24mA, V_{CC} = 4.5V		
		4370		0.1	0.4	V	I_F = 1.6mA, I_O = 4.8mA, V_{CC} = 4.5V		
Logic High Output Current	I_{OH}	4371		0.05	100	μA	I_F = 0mA, V_O = V_{CC} = 18V		6
		4370		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		
Temperature Coefficient of Forward Voltage	$\frac{\Delta V_F}{\Delta T_A}$			-1.8		mV/°C	I_F = 1.6mA		
Input Capacitance	C_O			40		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 sec., 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 5082-	Min.	Typ.	Max.	Units	Test Conditions	Fig.	Note
Propagation Delay Time To Logic Low at Output	t_{PHL}	4371		5	25	μs	I_F = 0.5mA, R_L = 4.7kΩ		
				0.2	1		I_F = 12mA, R_L = 270Ω	9	6,8
		4370		1	10	μs	I_F = 1.6mA, R_L = 2.2kΩ		
Propagation Delay Time To Logic High at Output	t_{PLH}	4371		5	60	μs	I_F = 0.5mA, R_L = 4.7kΩ		
				1	7	μs	I_F = 12mA, R_L = 270Ω	9	6,8
		4370		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, $|V_{cm}|$ = 10V_{p-p}	10	9
Common Mode Transient Immunity at Logic Low Level Output	CM_L			<-500		V/μs	I_F = 1.6mA, R_L = 2.2kΩ, $|V_{cm}|$ = 10V_{p-p}	10	9

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).
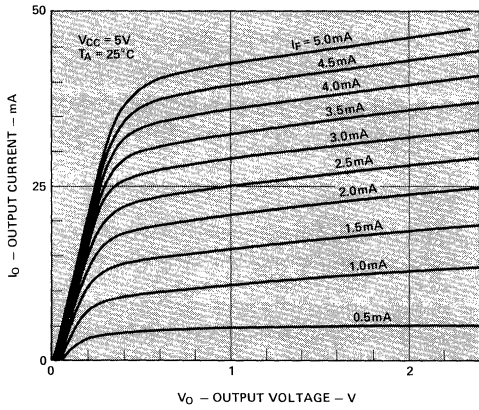
Figure 1. 5082-4371 DC Transfer Characteristics.
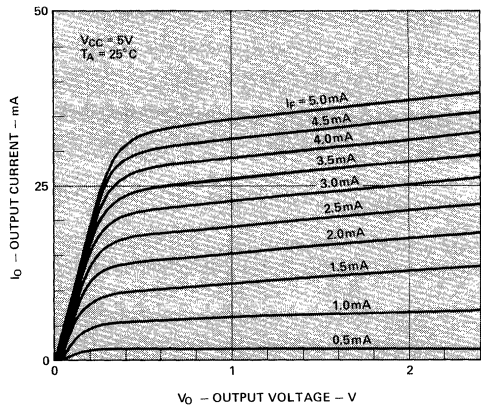
Figure 2. 5082-4370 DC Transfer Characteristics.
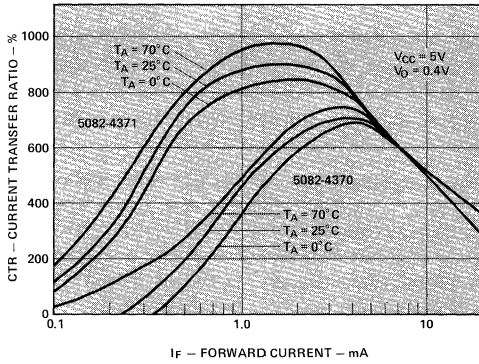
Figure 3. Current Transfer Ratio vs. Forward Current.
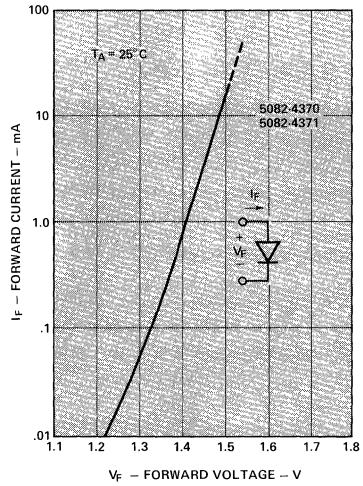
Figure 4. Input Diode Forward Current vs. Forward Voltage.
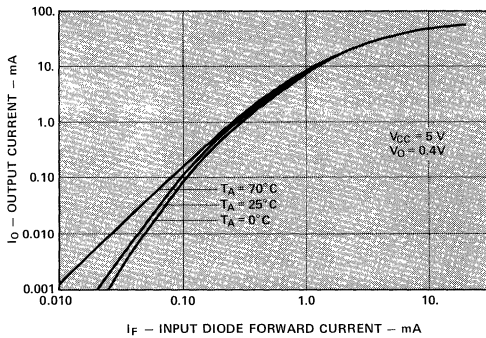
Figure 5. 5082-4371 Output Current vs. Input Diode Forward Current.
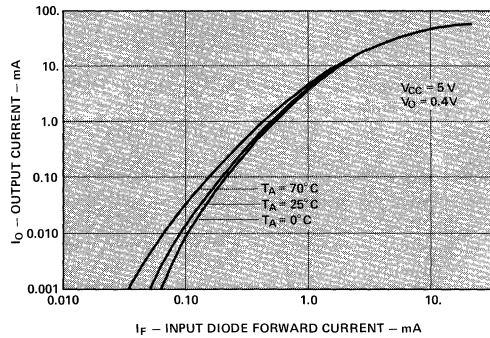
Figure 6. 5082-4370 Output Current vs. Input Diode Forward Current.
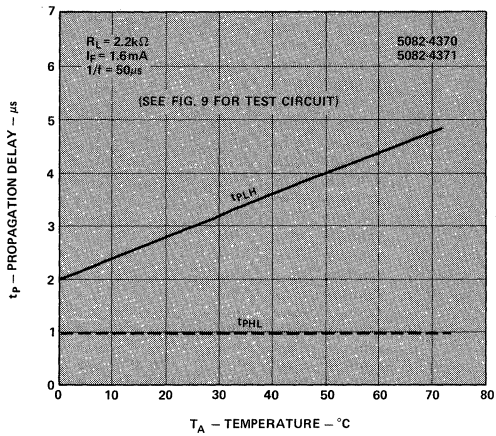
Figure 7. Propagation Delay vs. Temperature.
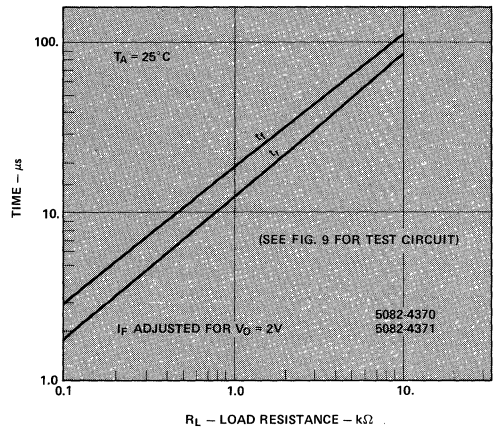
Figure 8. Non Saturated Rise and Fall Times vs. Load Resistance.
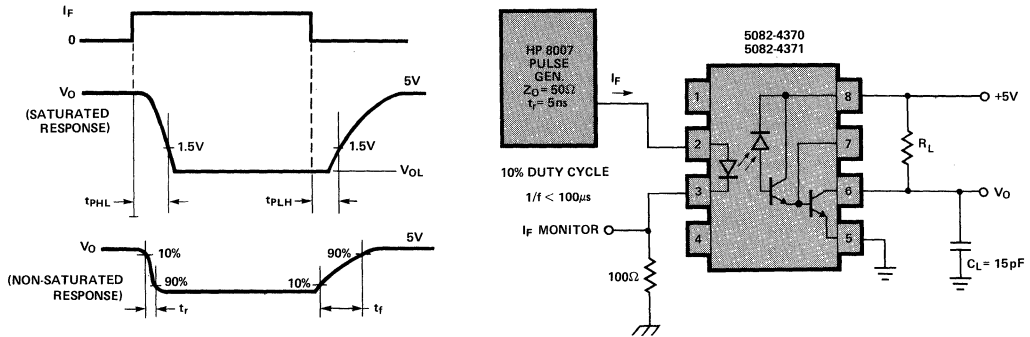
Figure 9. Switching Test Circuit.

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

140
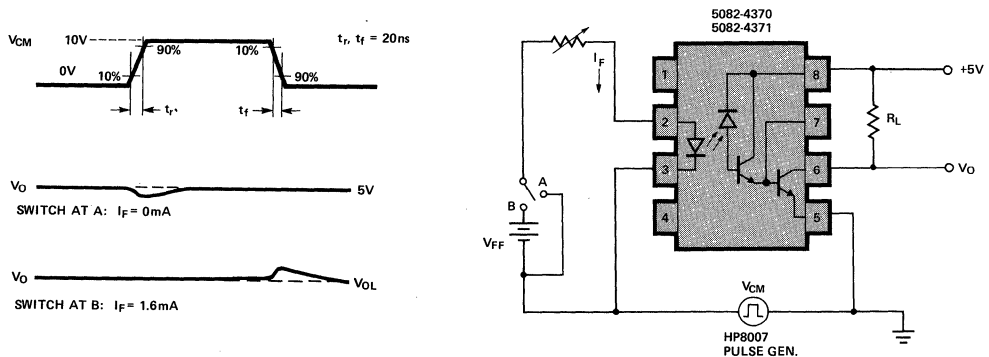
Photodetectors (PIN Photodiodes)

Features
- [ ] High Speed: 1ns Speed of Response
- [ ] Wide Dynamic Range: dc to 1 GHz
- [ ] Low Noise

Benefits
- [ ] Allows Detection of Fast Light Sources, e.g., Lasers
- [ ] Applicable to Many Different Light Sources

Applications
- [ ] Detection of IR Radiation
- [ ] Card Readers
- [ ] Tape Readers
- [ ] Isolators

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**

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.

Active area: 1mm Diam	5082-4207 ⎱ TALL SIZE
	5082-4203 ⎰ (TO-18)
0.5mm Diam	5082-4204
	5082-4220 — Short (TO-46)
0.25mm Magnified 2.5x	5082-4205 — Subminiature
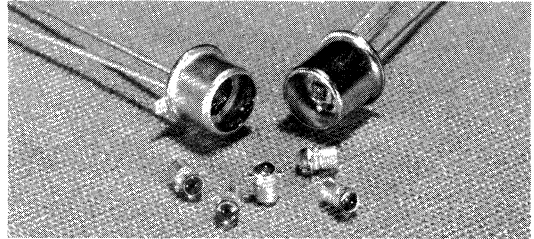
The 5082-4203, -4204, and -4207 are packaged on a standard TO-18 header with a flat glass window cap. For versatility of circuit connection, they are electrically insulated from the header. The light sensitve area of the 5082-4203 and -4204 is 0.508mm (0.020 inch) in diameter and is located 1.905mm (0.075 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
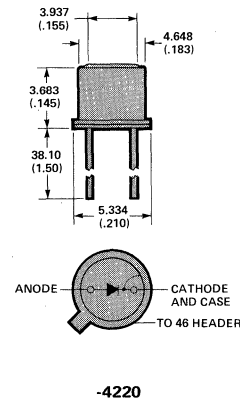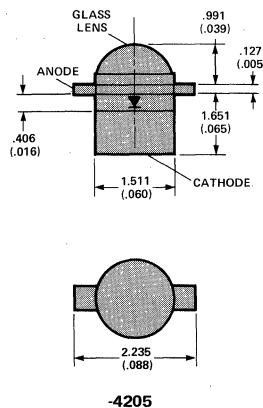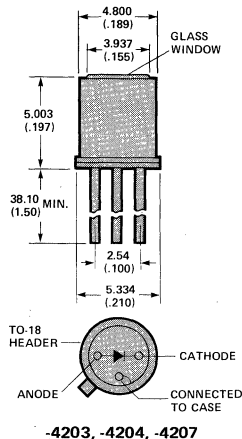
-4205

-4220

Absolute Maximum Ratings

Parameter	-4203	-4204	-4205	-4207	-4220	Units
P_{MAX} Power Dissipation [1]	100	100	50	100	100	mW
Peak Reverse Voltage[2]	200	200	200	200	200	volts
Steady Reverse Voltage[3]	50	20	50	20	50	volts

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

Symbol	Description	-4203 Min.	Typ.	Max.	-4204 Min.	Typ.	Max.	-4205 Min.	Typ.	Max.	-4207 Min.	Typ.	Max.	-4220 Min.	Typ.	Max.	Units
RA	Axial Incidance Response at 770nm [4]		1.0			1.0			1.5*			4.0			1.0		$\frac{\mu A}{mW/cm[2]}$
A	Active Area[4]		2×10^{-3}			2×10^{-3}			3×10^{-3}*			8×10^{-3}			2×10^{-3}		cm[2]
R	Responsivity 770 nm[5] (Fig. 1, 3)		.5			.5			.5			.5			.5		$\frac{\mu A}{\mu W}$
I_D	Dark Current[6] (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*	Detectivity[8]	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 Capacitance[9] (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 (avg) $< \dfrac{P_{MAX} - P_\phi}{E_c}$; and in addition:

   $I_p(PEAK) < \dfrac{1000 \, A}{t \, (\mu sec)}$ or $I_p < 500mA$ or $I_p(PEAK) < \dfrac{I_p \, (avg)}{f \times t}$

   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:

   $R = \eta_q \left(\dfrac{\lambda}{1240}\right)$

   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:

   $NEP = \dfrac{I_N/\sqrt{\Delta f}}{R}$ 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/$\sqrt{Hz}$) where I_D is in nA.
8. Detectivity, D* is the active-area-normalized signal to noise ratio. It is computed: for (λ, f, Δf) = (770nm, 100Hz, 6Hz).

   $D^* = \dfrac{\sqrt{A}}{NEP} \left(\dfrac{cm \sqrt{Hz}}{W}\right)$ for A in cm^2,
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.
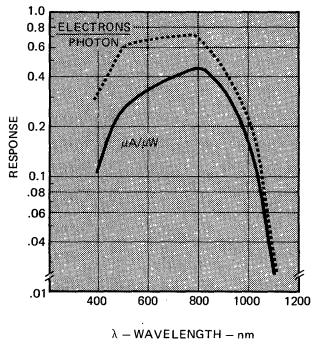
Figure 1. Spectral Response.
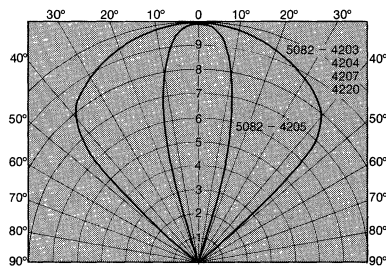
Figure 2. Relative Directional Sensitivity of the PIN Photodiodes.
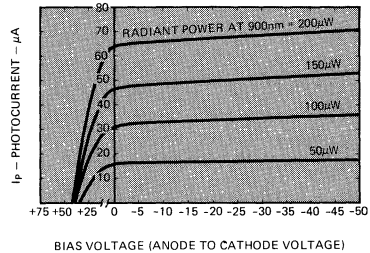
Figure 3. Typical Output Characteristics at λ = 900nm.

$$\frac{I_D(T)}{I_D(25°C)} = 10^{\left(\frac{T-25°C}{24.4°C}\right)}$$
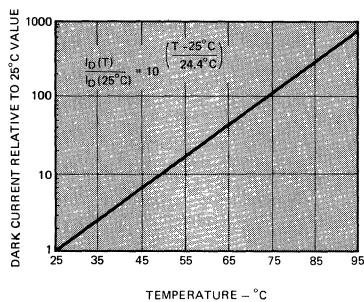
Figure 4. Dark Current at –10V Bias vs. Temperature.
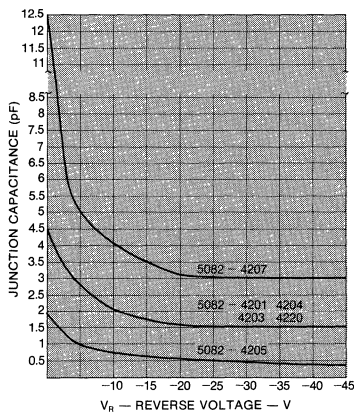
Figure 5. Typical Capacitance Variation With Applied Voltage.

5082 – 4207 MAX. SHOT NOISE OF DIODE (I_D = 1000 pA)

5082 – 4204 MAX. SHOT NOISE OF DIODE (I_D = 400 pA)
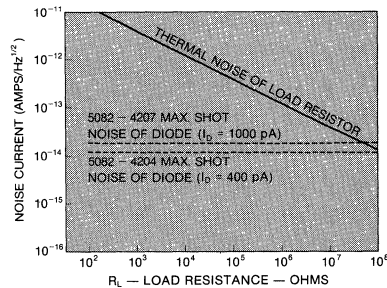
Figure 6. Noise vs. Load Resistance.
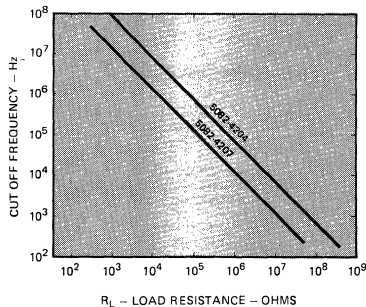
Figure 7. Photodiode Cut-Off Frequency vs. Load Resistance (C = 2pF).

NEP DUE TO THERMAL NOISE OF LOAD

$$NEP = \frac{\sqrt{I_N{}^2{}_{DIODE} + I_N{}^2{}_{LOAD}}}{R\sqrt{\Delta f}}$$

NEP DUE TO SHOT NOISE AT MAXIMUM DARK CURRENT

NEP DUE TO BOTH SOURCES OF NOISE

5082-4207 (4.1×10^{-14} W/Hz$^{1/2}$)

5082-4204 (2.6×10^{-14} W/Hz$^{1/2}$)
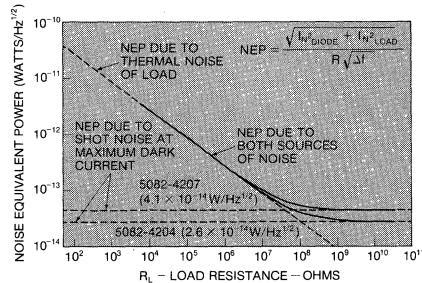
Figure 8. Noise Equivalent Power vs. Load Resistance.
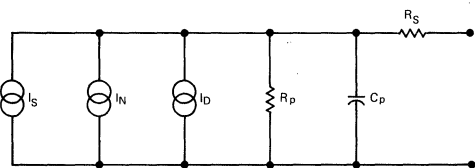
Figure 9. Photodiode Equivalent Circuit.

I_S = Signal current $\approx 0.5\mu A/\mu W \times P$ input

I_N = Shot noise current
   $< 1.2 \times 10^{-14}$ amps/Hz$^{1/2}$(5082-4204)
   $< 4 \times 10^{-14}$ amps/Hz$^{1/2}$(5082-4207)

I_D = Dark current
   $< 600 \times 10^{-12}$ amps at –10 V dc (5082-4204)
   $< 2500 \times 10^{-12}$ amps at –10 V dc (5082-4207)

$R_P = 10^{11}\Omega$

$R_S = <50\Omega$

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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:

$$RATIO = \frac{X}{0.5}$$

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.
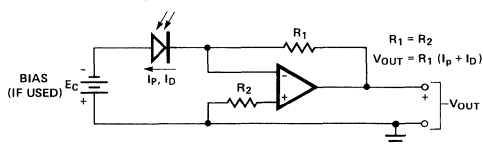
Figure 10. Linear Operation.

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:

$$V_{OUT} = \left(1 + \frac{R_2}{R_1}\right) \frac{kT}{q} \ln \left(1 + \frac{I_p}{I_s}\right)$$

where $I_s = I_F \left(e^{\frac{qV}{kT}} - 1\right)^{-1}$ at $I_F < 0.1mA$

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

Monolithic 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.

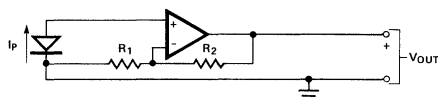### APPLICATION NOTE 939

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 judgment 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 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 2

New Operating Curves for 5082-7600 Series Displays

The 5082-7600 series data sheets contain operating curves to assist the designer in determining the limits whithin which the display may be reliably operated. A description of each curve is presented along with a design example illustrating their use.

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 electical 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.

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