



**THE DATASHEET OF  
HPDL-1414**

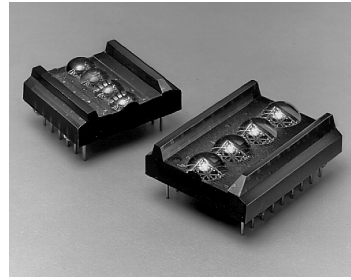


# HPDL-1414

## Four Character Smart Alphanumeric Displays



### Data Sheet



#### Description

The HPDL-1414 is a smart, four character, sixteen-segment, red GaAsP display. The HPDL-1414 has a character height of 2.85 mm (0.112"). The on-board CMOS IC contains memory, ASCII decoder, multiplexing circuitry and drivers. The monolithic LED characters are magnified by an immersion lens which increases both character size and luminous intensity. The encapsulated dual-in-line package provides a rugged, environmentally sealed unit.

The HPDL-1414 incorporates many improvements over competitive products. It has a wide operating temperature range, very fast IC access time, and improved ESD protection. The displays are also fully TTL compatible, wave solderable, and highly reliable. These displays are ideally suited for industrial and commercial applications where a good-looking, easy-to-use alphanumeric display is required.

#### Features

- **Smart alphanumeric display**  
Built-in RAM, ASCII decoder and LED drive circuitry
- **Wide operating temperature range**  
-40°C to +85°C
- **Fast access time**  
160 ns
- **Excellent ESD protection**  
Built-in input protection diodes
- **CMOS IC for low power consumption**
- **Full TTL compatibility over operating temperature range**  
 $V_{IL} = 0.8\text{ V}$   
 $V_{IH} = 2.0\text{ V}$
- **Wave solderable**
- **Rugged package construction**
- **End-stackable**
- **Wide viewing angle**

#### Typical Applications

- Portable data entry devices
- Medical equipment
- Process control equipment
- Test equipment
- Industrial instrumentation
- Computer peripherals
- Telecommunication instrumentation

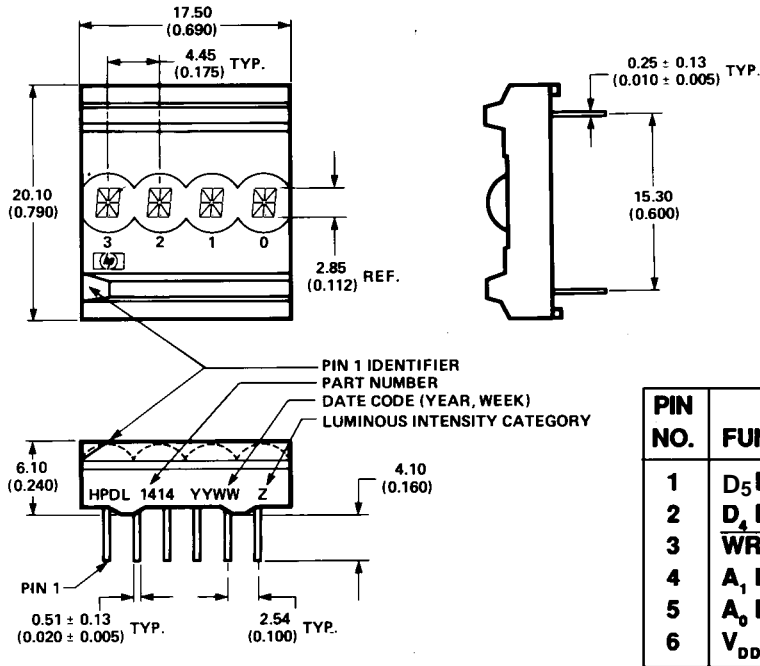
***ESD WARNING: STANDARD CMOS HANDLING PRECAUTIONS SHOULD BE OBSERVED WITH THE HPDL-1414.***

### Absolute Maximum Ratings

Supply Voltage,  $V_{DD}$  to Ground ..... -0.5 V to 7.0 V  
 Input Voltage, Any Pin to Ground ..... -0.5 V to  $V_{DD} + 0.5$  V  
 Free Air Operating Temperature Range,  $T_A$ <sup>[1]</sup> ..... -40°C to +85°C  
 Relative Humidity (non-condensing) at 65°C ..... 90%  
 Storage Temperature,  $T_S$ ..... -40°C to +85°C  
 Wave Solder Temperature,  
 1.59 mm (0.063 in.) below Body ..... 250°C for 3 secs  
 ESD Protection @ 1.5 k $\Omega$ , 100 pF .....  $V_Z = 2$  kV (each Pin)

### Package Dimensions

#### HPDL-1414



PIN NO.	FUNCTION	PIN NO.	FUNCTION
1	D <sub>5</sub> DATA INPUT	7	GND
2	D <sub>4</sub> DATA INPUT	8	D <sub>0</sub> DATA INPUT
3	$\overline{WR}$ WRITE	9	D <sub>1</sub> DATA INPUT
4	A <sub>1</sub> DIGIT SELECT	10	D <sub>2</sub> DATA INPUT
5	A <sub>0</sub> DIGIT SELECT	11	D <sub>3</sub> DATA INPUT
6	V <sub>DD</sub>	12	D <sub>6</sub> DATA INPUT

**NOTES:**  
 1. UNLESS OTHERWISE SPECIFIED, THE TOLERANCE ON ALL DIMENSIONS IS 0.254 mm (0.010 in.).  
 2. DIMENSIONS IN mm (inches).

### Recommended Operating Conditions

Parameter	Sym.	Min.	Nom.	Max.	Units
Supply Voltage	$V_{DD}$	4.5	5.0	5.5	V

### DC Electrical Characteristics

Parameter	Sym.	Min.	25°C Typ.	25°C Max.	Units	Test Conditions
Input Current	$I_{IL}$		45	100	$\mu A$	$V_{DD} = 5.0 V, V_{IL} = 0.8 V$
$I_{DD}$ Blank	$I_{DD} (\overline{BL})$		1.5	2.7	mA	$V_{DD} = 5.0 V, \overline{BL} = 0.8 V$
$I_{DD}$ 4 Digits ON (10 Segments per digit) <sup>[1,2]</sup>	$I_{DD}$		70	90	mA	$V_{DD} = 5.0 V$
Input Voltage High	$V_{IH}$	2.0			V	
Input Voltage Low	$V_{IL}$	GND		0.8	V	
Power Dissipation <sup>[3]</sup>	$P_D$		350	450	mW	$V_{DD} = 5.0 V$

#### Notes:

1. “%” illuminated in all four characters.
2. Measured at five seconds.
3. Power Dissipation =  $(V_{DD})(I_{DD})$  for 10 segments ON.

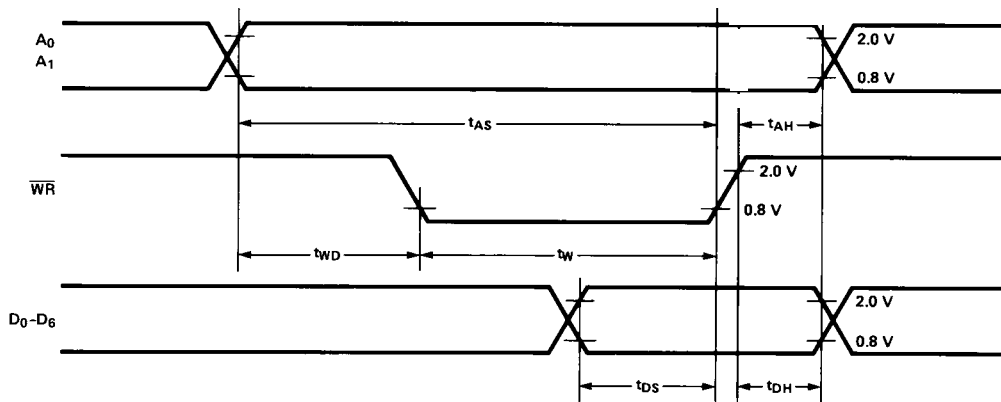
### Optical Characteristics at 25°C<sup>[6]</sup>

Parameter	Sym.	Min.	Typ.	Units	Test Conditions
Peak Luminous Intensity per Digit, 8 segments ON (character average)	$I_V$ Peak	0.4	1.0	mcd	$V_{DD} = 5.0 V,$ “*” illuminated in all 4 digits
Peak Wavelength	$\lambda_{Peak}$		655	nm	
Dominant Wavelength	$\lambda_d$		640	nm	
Off Axis Viewing Angle			$\pm 40$	degrees	

AC Timing Characteristics over Operating Temperature Range at  $V_{CC} = 4.5\text{ V}$

Parameter	Symbol	-20°C $t_{MIN}$	25°C $t_{MIN}$	70°C $t_{MIN}$	Units
Address Setup Time	$t_{AS}$	90	115	150	ns
Write Delay Time	$t_{WD}$	10	15	20	ns
Write Time	$t_W$	80	100	130	ns
Data Setup Time	$t_{DS}$	40	60	80	ns
Data Hold Time	$t_{DH}$	40	45	50	ns
Address Hold Time	$t_{AH}$	40	45	50	ns
Access Time		130	160	200	ns

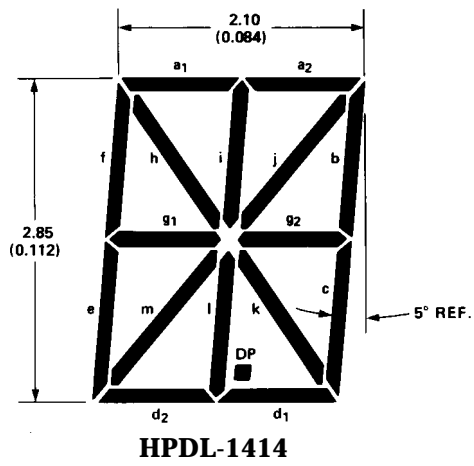
Timing Diagram



### Character Set

BITS		D <sub>3</sub>	D <sub>2</sub>	D <sub>1</sub>	D <sub>0</sub>														
		0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1		
		0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1		
		0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1		
		0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1		
D <sub>6</sub>	D <sub>5</sub>	D <sub>4</sub>	HEX	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	1	0	2	(space)	!	"	#	\$	%	&	'	<	>	*	+	,	-	.	/
0	1	1	3	0	1	2	3	4	5	6	7	8	9	=	/	<	=	>	?
1	0	0	4	a	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	0	1	5	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_

### Magnified Character Font Description



**Electrical Description**

**Display Internal Block Diagram  
HPDL-1414**

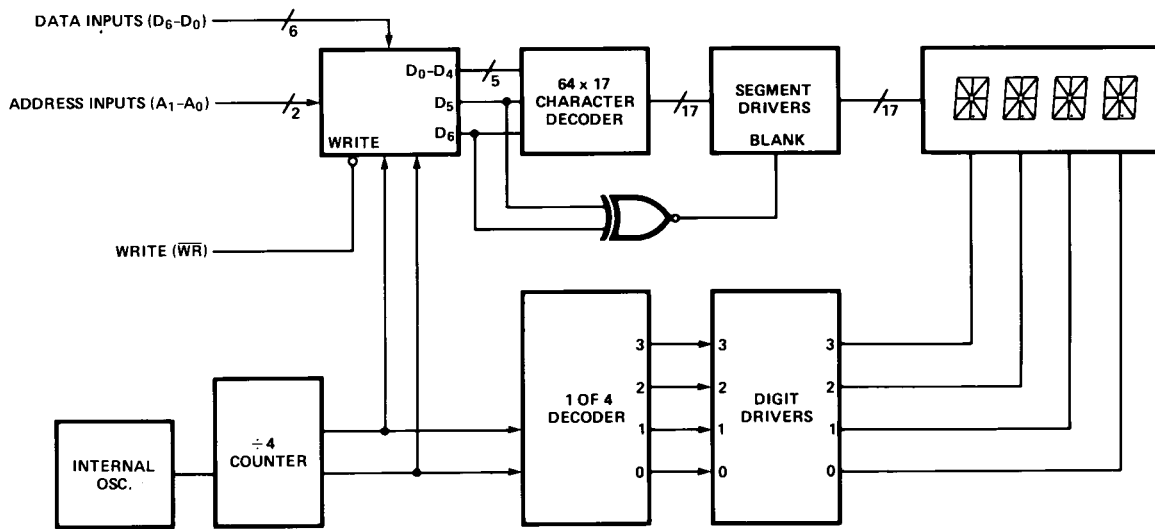
Figure 1 shows the internal block diagram of the HPDL-1414. It consists of two parts: the display LEDs and the CMOS IC. The CMOS IC consists of a four-word ASCII memory, a 64-word character generator, 17 segment drivers, four digit drivers, and the scanning circuitry necessary to multiplex the four monolithic LED characters. In normal

operation, the divide-by-four counter sequentially accesses each of the four RAM locations and simultaneously enables the appropriate display digit driver. The output of the RAM is decoded by the character generator which, in turn, enables the appropriate display segment drivers. Seven-bit ASCII data is stored in RAM. Since the display uses a 64-character decoder, half of the possible 128 input combinations are invalid. For each display location where  $D_5 = D_6$  in the

ASCII RAM, the display character is blanked.

**Data Entry HPDL-1414**

Figure 2 shows a truth table for the HPDL-1414. Data is loaded into the display through the DATA inputs ( $D_6-D_0$ ), ADDRESS inputs ( $A_1-A_0$ ), and WRITE ( $\overline{WR}$ ). After a character has been written to memory, the IC decodes the ASCII data, drives the display and refreshes it without any external hardware or software.



**Figure 1. HPDL-1414 Internal Block Diagram.**

$\overline{WR}$	$A_1$	$A_0$	$D_6$	$D_5$	$D_4$	$D_3$	$D_2$	$D_1$	$D_0$	$DIG_3$	$DIG_2$	$DIG_1$	$DIG_0$
L	L	L	a	a	a	a	a	a	a	NC	NC	NC	$\overline{R}$
L	L	H	b	b	b	b	b	b	b	NC	NC	$\overline{B}$	NC
L	H	L	c	c	c	c	c	c	c	NC	$\overline{C}$	NC	NC
L	H	H	d	d	d	d	d	d	d	$\overline{D}$	NC	NC	NC
H	X	X	X	X	X	X	X	X	X	Previously Written Data			

L = LOGIC LOW INPUT  
H = LOGIC HIGH INPUT  
X = DON'T CARE  
"a" = ASCII CODE CORRESPONDING TO SYMBOL " $\overline{R}$ "  
NC = NO CHANGE

**Figure 2. HPDL-1414 Write Truth Table.**

### Optical Considerations/Contrast Enhancement

The HPDL-1414 display uses a precision aspheric immersion lens to provide excellent readability and low off-axis distortion. The aspheric lens produces a magnified character height of 2.85 mm (0.112 in.) and a viewing angle of  $\pm 40^\circ$ . These features provide excellent readability at distances up to 1.5 metres (4 feet).

Each display is tested for luminous intensity and marked with an intensity category on the side of the display package. To ensure intensity matching for multiple package applications, mixing intensity categories for a given panel is not recommended.

The display is designed to provide maximum contrast when placed behind an appropriate contrast enhancement filter. For further information on contrast enhancement, see Application Note 1015.

### Mechanical and Electrical Considerations

The HPDL-1414 is a dual in-line package that can be stacked horizontally and vertically to create arrays of any size. These displays are designed to operate continuously between  $-40^\circ\text{C}$  to  $+85^\circ\text{C}$  with a maximum of 10 segments on per digit.

The HPDL-1414 is assembled by die attaching and wire bonding the four GaAsP/GaAs monolithic LED chips and the CMOS IC to a printed circuit board. An immersion lens is formed by placing the PC board assembly into a nylon lens filled with epoxy. Backfill epoxy environmentally seals the display package. This package construction provides the display with a high tolerance to temperature cycling.

The inputs to the CMOS IC are protected against static discharge and input current latchup. However, for best results standard CMOS handling precautions should be used. Prior to use, the HPDL-1414 should be stored in anti-static tubes or conductive material. During assembly a grounded conductive work area should be used, and assembly personnel should wear conductive wrist straps. Lab coats made of synthetic material should be avoided since they are prone to static charge build-up. Input current latchup is caused when the CMOS inputs are subjected either to a voltage below ground ( $V_{\text{IN}} < \text{ground}$ ) or to a voltage higher than  $V_{\text{DD}}$  ( $V_{\text{IN}} > V_{\text{DD}}$ ) and when a high

current is forced into the input. To prevent input current latchup and ESD damage, unused inputs should be connected either to ground or to  $V_{\text{DD}}$ . Voltages should not be applied to the inputs until  $V_{\text{DD}}$  has been applied to the display. Transient input voltages should be eliminated.

### Soldering and Post Solder Cleaning Instructions

The HPDL-1414 may be hand soldered or wave soldered with SN63 solder. Hand soldering may be safely performed only with an electronically temperature-controlled and securely grounded soldering iron. For best results, the iron tip temperature should be set at  $315^\circ\text{C}$  ( $600^\circ\text{F}$ ). For wave soldering, a rosin-based RMA flux can be used. The solder wave temperature should be  $245^\circ\text{C} \pm 5^\circ\text{C}$  ( $473^\circ\text{F} \pm 9^\circ\text{F}$ ), and the dwell in the wave should be set at  $1\frac{1}{2}$  to 3 seconds for optimum soldering. Preheat temperature should not exceed  $93^\circ\text{C}$  ( $200^\circ\text{F}$ ) as measured on the solder side of the PC board.

For further information on soldering and post solder cleaning, see Application Note 1027, *Soldering LED Components*.

### Intensity Bin Limits

<b>Bin</b>	<b>Intensity Range (mcd)</b>	
	<b>Min.</b>	<b>Max.</b>
E	0.43	0.58
F	0.50	0.70
G	0.59	0.84
H	0.71	1.01
I	0.85	1.24
J	1.02	1.52
K	1.23	1.83

**Note:**

Test conditions as specified in Optical Characteristic table.

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