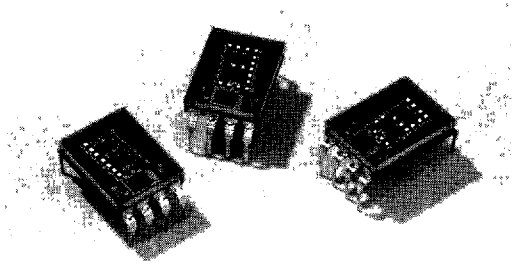
HEWLETT PACKARD

HERMETIC, NUMERIC AND HEXADECIMAL DISPLAYS FOR MILITARY APPLICATIONS

HIGH EFFICIENCY RED	
Low Power	HDSP-078X/078XTXV/078XTXVB
High Brightness	HDSP-079X/079XTXV/079XTXVB
YELLOW	HDSP-088X/088XTXV/088XTXVB
High Performance GREEN	HDSP-098X/098XTXV/098XTXVB

Features

- **CONFORM TO MIL-D-87157, QUALITY LEVEL A TEST TABLES**
- **TRUE HERMETIC PACKAGE FOR HIGH EFFICIENCY RED AND YELLOW[1]**
- **TXV AND TXVB VERSIONS AVAILABLE**
- **THREE CHARACTER OPTIONS Numeric, Hexadecimal, Over Range**
- **THREE COLORS High Efficiency Red, Yellow, High Performance Green**
- **4 x 7 DOT MATRIX CHARACTER**
- **HIGH EFFICIENCY RED, YELLOW, AND HIGH PERFORMANCE GREEN**
- **TWO HIGH EFFICIENCY RED OPTIONS Low Power, High Brightness**
- **PERFORMANCE GUARANTEED OVER TEMPERATURE**
- **HIGH TEMPERATURE STABILIZED**
- **GOLD PLATED LEADS**
- **MEMORY LATCH/DECODER/DRIVER TTL Compatible**
- **CATEGORIZED FOR LUMINOUS INTENSITY**



Description

These solid state displays have a 7.4 mm (0.29 inch) dot matrix character and an onboard IC with data memory latch/decoder and LED drivers in a glass/ceramic package

The hermetic HDSP-078X,-079X/-088X displays utilize a solder glass frit seal. The HDSP-098X displays utilize an epoxy glass-to-ceramic seal. All packages conform to the hermeticity requirements of MIL-D-87157, the general specification for LED displays. These displays are designed for use in military and aerospace applications.

The numeric devices decode positive BCD logic into characters "0-9", a "—" sign, decimal point, and a test pattern. The hexadecimal devices decode positive BCD logic into 16 characters, "0-9, A-F". An input is provided on the hexadecimal devices to blank the display (all LEDs off) without losing the contents of the memory.

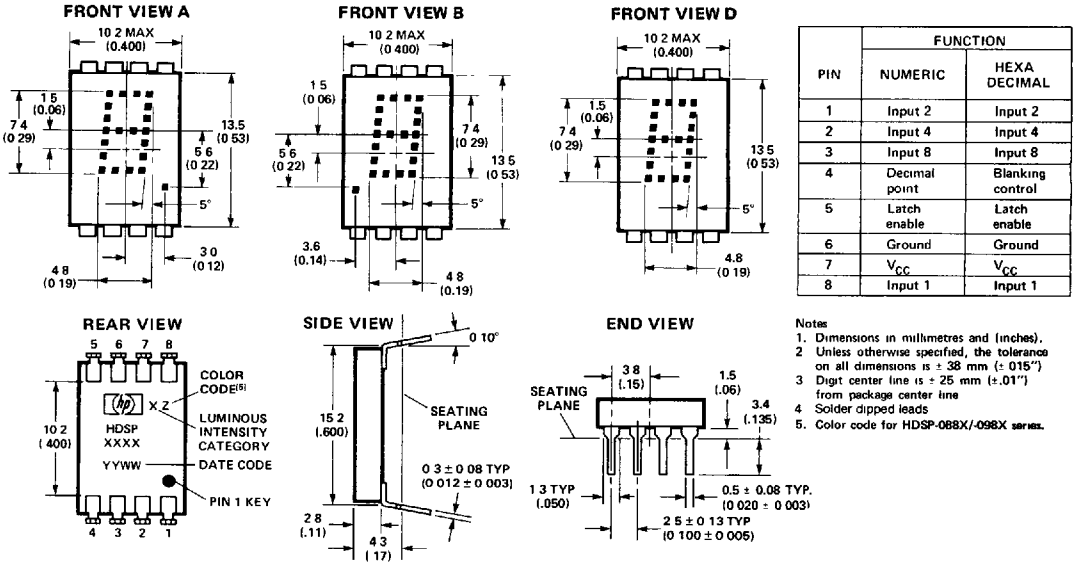
The over range device displays "±1" and right hand decimal point and is typically driven via external switching transistors.

Note:
1. The HDSP-098X high performance green displays are epoxy sealed and conform to MIL-D-87157 hermeticity requirements.

Devices

Part Number HDSP-	Color	Description	Front View
0781/0781TXV/0781TXVB	High-Efficiency Red Low Power	Numeric, Right Hand DP	A
0782/0782TXV/0782TXVB		Numeric, Left Hand DP	B
0783/0783TXV/0783TXVB		Over Range ±1	C
0784/0784TXV/0784TXVB		Hexadecimal	D
0791/0791TXV/0791TXVB	High-Efficiency Red High Brightness	Numeric, Right Hand DP	A
0792/0792TXV/0792TXVB		Numeric, Left Hand DP	B
0783/0783TXV/0783TXVB		Over Range ±1	C
0794/0794TXV/0794TXVB		Hexadecimal	D
0881/0881TXV/0881TXVB	Yellow	Numeric, Right Hand DP	A
0882/0882TXV/0882TXVB		Numeric, Left Hand DP	B
0883/0883TXV/0883TXVB		Over Range ±1	C
0884/0884TXV/0884TXVB		Hexadecimal	D
0981/0981TXV/0981TXVB	High Performance Green	Numeric, Right Hand DP	A
0982/0982TXV/0982TXVB		Numeric, Left Hand DP	B
0983/0983TXV/0983TXVB		Over Range ±1	C
0984/0984TXV/0984TXVB		Hexadecimal	D

Package Dimensions



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

Notes
1. Dimensions in millimetres and (inches).
2. Unless otherwise specified, the tolerance on all dimensions is ± 38 mm (± 015")
3. Digit center line is ± 25 mm (±.01") from package center line
4. Solder dipped leads
5. Color code for HDSP-088X/-098X series.

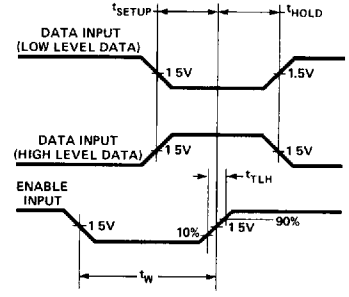


Figure 1. Timing Diagram

TRUTH TABLE					
BCD DATA[1]				NUMERIC	HEXA DECIMAL
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, displayed character, or DP
2 The decimal point input, DP, pertains only to the numeric displays
3 The blanking control input, B, pertains only to the hexadecimal displays Blanking input has no effect upon display memory

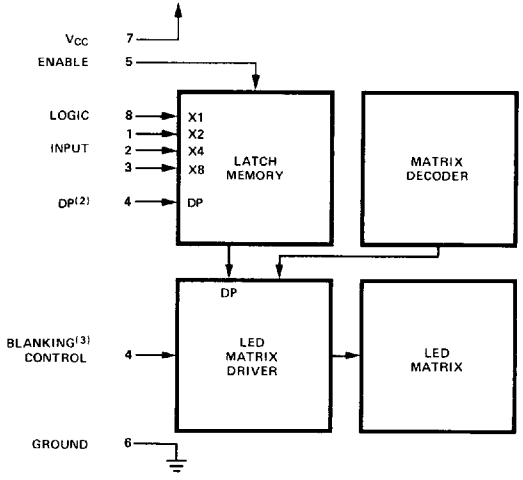


Figure 2. Logic Block Diagram

Absolute Maximum Ratings

Description	Symbol	Min.	Max.	Unit
Storage temperature, ambient HDSP-078X/-079X/-088X	T_S	-65	+125	°C
HDSP-098X		-55	+100	
Operating temperature, ambient[1]	T_A	-55	+100	°C
Supply voltage[2]	V_{CC}	-0.5	+7.0	V
Voltage applied to input logic, dp and enable pins	V_I, V_{DP}, V_E	-0.5	V_{CC}	V
Voltage applied to blanking input[2]	V_R	-0.5	V_{CC}	V
Maximum solder temperature at 1.59 mm (0.062 inch) below seating plane: t ≤ 5 seconds			260	°C

Recommended Operating Conditions

Description	Symbol	Min.	Nom.	Max.	Unit
Supply Voltage [2]	V_{CC}	4.5	5.0	5.5	V
Operating temperature, ambient [1]	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}			10	msec

Optical Characteristics at T_A = 25°C, V_{CC} = 5.0V

Device	Description	Symbol	Min.	Typ.	Max.	Unit
HDSP-078X Series	Luminous Intensity per LED (Digit Average)[3,4]	I_V	65	140		μcd
	Peak Wavelength	λ_{PEAK}		635		nm
	Dominant Wavelength[5]	λ_d		626		nm
HDSP-079X Series	Luminous Intensity per LED (Digit Average)[3,4]	I_V	260	620		μcd
	Peak Wavelength	λ_{PEAK}		635		nm
	Dominant Wavelength[5]	λ_d		626		nm
HDSP-088X Series	Luminous Intensity per LED (Digit Average)[3,4]	I_V	215	490		μcd
	Peak Wavelength	λ_{PEAK}		583		nm
	Dominant Wavelength[5,6]	λ_d		585		nm
HDSP-098X Series	Luminous Intensity per LED (Digit Average)[3,4]	I_V	298	1100		μcd
	Peak Wavelength	λ_{PEAK}		568		nm
	Dominant Wavelength	λ_d		574		nm

Notes

1 The nominal thermal resistance of a display mounted in a socket that is soldered onto a printed circuit board is $R\theta_{JA}$ = 50°C/W/device The device package thermal resistance is $R\theta_{J-PIN}$ = 15°C/W/device The thermal resistance device pin-to-ambient through the PC board should not exceed 35°C/W/device for operation at T_A = +100°C.

2. Voltage values are with respect to device ground, pin 6

3 These displays are categorized for luminous intensity with the intensity category designated by a letter code located on the back of the display package Case temperature of the device immediately prior to the light measurement is equal to 25°C

Electrical Characteristics; (T_A = -55° C to +100° C)

Description		Symbol	Test Conditions	Min.	Typ.[7]	Max.	Unit
Supply Current	HDSP-078X Series	I_{CC}	V_{CC} = 5.5 V Characters "5." or "B" displayed		78	105	mA
	HDSP-079X/-088X/ -098X Series				120	175	
Power Dissipation	HDSP-078X Series	P_T	V_{CC} = 5.5 V Characters "5." or "B" displayed		390	573	mW
	HDSP-079X/-088X/ -098X Series				690	963	
Logic, Enable and Blanking Low-Level Input Voltage		V_{IL}	V_{CC} = 4.5 V			0.8	V
Logic, Enable High-Level Input Voltage		V_{IH}		2.0			V
Blanking High Voltage; Display Blanked		V_{BH}		2.3			V
Logic and Enable Low-Level Input Current		I_{IL}	V_{CC} = 5.5 V			-1.6	mA
Blanking Low-Level Input Current		I_{BL}	V_{IL} = 0.4 V			-10	μA
Logic, Enable and Blanking High-Level Input Current		I_{IH}	V_{CC} = 5.5 V V_{IH} = 2.4 V			+40	μA
Weight					1.0		gm
Leak Rate						5 x 10^{-8}	cc/sec.

Notes.

4. The luminous intensity at a specific operating ambient temperature, $I_V(T_A)$ may be approximated from the following expotential equation. $I_V(T_A = I_V(25° C)\ e^{[k(T_A-25° C)]}$

Device	K
HDSP-078X Series HDSP-079X Series	-0.0131/° C
HDSP-088X Series	-0 0112/° C
HDSP-098X Series	-0 0104/° C

5. The dominant wavelength, λ_d, is derived from the CIE Chromaticity Diagram and is that single wavelength which defines the color of the device.
6. The HDSP-088X and HDSP-098X series devices are categorized as to dominant wavelength with the category disignated by a number on the back side of the display package.
7. All typical values at V_{CC} = 5.0 V and T_A = 25° C.

Operational Considerations

ELECTRICAL

These devices use a modified 4 x 7 dot matrix of light emitting diodes to display decimal/hexadecimal numeric information. The high efficiency red and yellow displays use GaAsP/GaP LEDs and the high performance green displays use GaP/GaP LEDs. The LEDs 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. 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 6.7 MHz rate.

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

The blanking control input on the hexadecimal displays blanks (turns off) the displayed information without disturbing the contents of display memory. The display is blanked at a minimum threshold level of 2.0 volts When blanked, the display standby power is nominally 250 mW at T_A = 25° C

The ESD susceptibility of the IC devices is Class A of MIL-STD-883 or Class 2 of DOD-STD-1686 and DOD-HDBK-263.

MECHANICAL

These displays are hermetically sealed for use in environments that require a high reliability device. These displays are designed and tested to meet a helium leak rate of 5 x 10^{-8} cc/sec.

These displays may be mounted by soldering directly to a printed circuit board or insertion into a socket. The lead-to-lead pin spacing is 2.54 mm (0.100 inch) and the lead row spacing is 15.24 mm (0.600 inch). These displays may be end stacked with 2.54 mm (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 base-to-ambient thermal resistance of less than 35° C watt/device 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

These displays are 100% preconditioned by 24 hour storage at 125°C, at 100°C for the HDSP-098X Series.

CONTRAST ENHANCEMENT

These display devices are designed to provide an optimum ON/OFF contrast when placed behind an appropriate contrast enhancement filter. The following filters are suggested:

Display Color	Ambient Lighting		
	Dim	Moderate	Bright
HDSP-088X Yellow	Panelgraphic Yellow 27 Chequers Amber 107	Polaroid HNCP 37 3M Light Control Film Panelgraphic Gray 10	Polaroid Gray HNCP10 HOYA Yellowish-Orange HLF-608-3Y Marks Gray MCP-0301-8-10
HDSP-078X/-079X HER	Panelgraphic Ruby Red 60 Chequers Red 112	Chequers Grey 105	Polaroid Gray HNCP10 HOYA Reddish-Orange HLF-608-5R Marks Gray MCP-0301-8-10 Marks Reddish-Orange MCP-0201-2-22
HDSP-098X HP Green	Panelgraphic Green 48 Chequers Green 107		Polaroid Gray HNCP10 HOYA Yellow-Green HLF-608-1G Marks Yellow-Green MCP-0101-5-12

Over Range Display

The over range devices display "±1" and decimal point. The character height and package configuration are the same as the numeric and hexadecimal devices. Character selection is obtained via external switching transistors and current limiting resistors

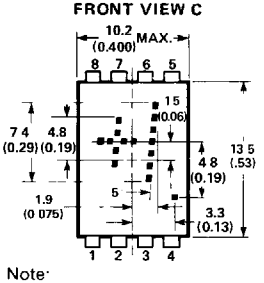
Absolute Maximum Ratings

Description	Symbol	Min.	Max.	Unit
Storage Temperature, Ambient	T_S	-65	+125	°C
Operating Temperature Ambient	T_A	-55	+100	°C
Forward Current, Each LED	I_F		10	mA
Reverse Voltage, Each LED	V_R		5	V

Character	Pin			
	1	2,3	4	8
+	1	X	X	1
—	0	X	X	1
1	X	1	X	X
Decimal Point	X	X	1	X
Blank	0	0	0	0

Notes
0 Line switching transistor in Figure 7 cutoff
1 Line switching transistor in Figure 7 saturated
X 'don't care'

Package Dimensions



Pin	Function
1	Plus
2	Numeral One
3	Numeral One
4	DP
5	Open
6	Open
7	Vcc
8	Minus/Plus

Note:
1 Dimensions in millimetres and (inches)

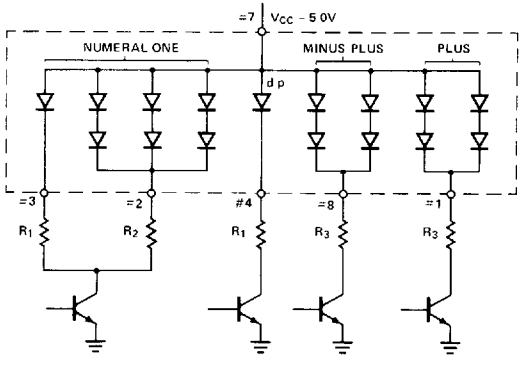


Figure 3. Typical Driving Circuit

Luminous Intensity Per LED

(Digit Average) at $T_A = 25°C$

Device	Test Conditions	Min.	Typ.	Units
HDSP-0783	$I_F = 2.8$ mA	65	140	μcd
	$I_F = 8$ mA		620	μcd
HDSP-0883	$I_F = 8$ mA	215	490	μcd
HDSP-0983	$I_F = 8$ mA	298	1100	μcd

Recommended Operating Conditions $V_{CC} = 5.0V$

Device		Forward Current Per LED, mA	Resistor Value		
			R_1	R_2	R_3
HDSP-0783	Low Power	2.8	1300	200	300
	High Brightness	8	360	47	68
HDSP-0883		8	360	36	56
HDSP-0983		8	360	30	43

Electrical Characteristics ($T_A = -55°C$ to $+100°C$)

Device	Description	Symbol	Test Condition	Min.	Typ.	Max.	Units
HDSP-0783	Power Dissipation (all LEDs Illuminated)	P_T	$I_F = 2.8$ mA		72		mW
			$I_F = 8$ mA		224	282	
	Forward Voltage per LED	V_F	$I_F = 2.8$ mA		1.6		V
			$I_F = 8$ mA		1.75	2.2	
HDSP-0883	Power Dissipation (all LEDs Illuminated)	P_T	$I_F = 8$ mA		237	282	mW
	Forward Voltage per LED	V_F			1.90	2 2	V
HDSP-0983	Power Dissipation (all LEDs illuminated)	P_T	$I_F = 8$ mA		243	282	mW
	Forward Voltage per LED	V_F			1.85	2.2	V

High Reliability Testing

Two standard reliability testing programs are available. The TXVB program is in conformance with Quality Level A Test Tables of MIL-D-87157 for hermetically sealed displays with 100% screening tests. A TXVB product is tested to Tables I, II, IIIa, and IVa, A second program is an HP modification to the full conformance program and offers the 100% screening portion of Level A, Table I, and Group A, Table II.

PART MARKING SYSTEM

Standard Product	With Table I and II	With Tables I, II, IIIa and IVa
HDSP-078X	HDSP-078XTXV	HDSP-078XTXVB
HDSP-079X	HDSP-079XTXV	HDSP-079XTXVB
HDSP-088X	HDSP-088XTXV	HDSP-088XTXVB
HDSP-098X	HDSP-098XTXV	HDSP-098XTXVB

100% Screening **TABLE I. QUALITY LEVEL A OF MIL-D-87157**

Test Screen	MIL-STD-750 Method	Conditions
1. Precap Visual	2072	Interpreted by HP Procedure 5956-7572-52
2. High Temperature Storage	1032	$T_A = 125°C$, Time = 24 hours[4]
3. Temperature Cycling	1051	Condition B, 10 Cycles, 15 Min. Dwell
4. Constant Acceleration	2006	10,000 G at Y_1 orientation
5. Fine Leak	1071	Condition H
6. Gross Leak	1071	Condition C or K[5]
7. Interim Electrical/Optical Tests[2]	—	I_V, I_{CC}, I_{BL}, I_{BH}, I_{EL}, I_{EH}, I_{IL}, and I_{IH} $T_A = 25°C$
8. Burn-In[1, 3]	1015	Condition B at $V_{CC} = 5V$ and cycle through logic at 1 character per second. $T_A = 100°C$, t = 160 hours
9. Final Electrical Test[2]	—	Same as Step 7
10. Delta Determinations	—	$\Delta I_V = -20\%$, $\Delta I_{CC} = \pm 10$ mA, $\Delta I_{IH} = \pm 10\mu A$ and $\Delta I_{EH} = \pm 13\ \mu A$
11. External Visual [1]	2009	

Notes:
1 MIL-STD-883 Test Method applies
2 Limits and conditions are per the electrical/optical characteristics
3 Burn-in for the over range display shall use Condition B at a nominal $I_F = 8$ mA per LED, with all LEDs illuminated for T = 160 hours minimum
4. $T_A = +100°C$ for HDSP-098X Series.
5. Fluid temperature = +100°C for HDSP-098X Series.

TABLE II
GROUP A ELECTRICAL TESTS — MIL-D-87157

Test	Parameters	LTPD
Subgroup 1 DC Electrical Tests at 25°C[1]	I_V, I_{CC}, I_{BL}, I_{BH}, I_{EL}, I_{EH}, I_{IL}, and I_{IH} and visual function, T_A = 25°C	5
Subgroup 2 DC Electrical Tests at High Temperature[1]	Same as Subgroup 1, except delete I_V and visual function T_A = +100°C	7
Subgroup 3 DC Electrical Tests at Low Temperature[1]	Same as Subgroup 1, except delete I_V and visual function T_A = -55°C	7
Subgroup 4, 5, and 6 not applicable		
Subgroup 7 Optical and Functional Tests at 25°C	Satisfied by Subgroup 1	5
Subgroup 8 External Visual	MIL-STD-883, Method 2009	7

Notes:
1 Limits and conditions are per the electrical/optical characteristics.

TABLE IIIa
GROUP B, CLASS A AND B OF MIL-D-87157

Test	MIL-STD-750 Method	Conditions	Sample Size
Subgroup 1 Resistance to Solvents	1022		4 Devices/ 0 Failures
Internal Visual and Design Verification[1]	2075[7]		1 Device/ 0 Failures
Subgroup 2[2,3] Solderability	2026	T_A = 245°C for 5 seconds	LTPD = 15
Subgroup 3 Thermal Shock (Temp Cycle)	1051	Condition B1, 15 min Dwell	LTPD = 15
Moisture Resistance[4]	1021		
Fine Leak	1071	Condition H	
Gross Leak	1071	Condition C or K[9]	
Electrical/Optical Endpoints[5]	—	I_V, I_{CC}, I_{BL}, I_{BH}, I_{EL}, I_{EH}, I_{IL}, I_{IH} and visual function T_A = 25°C	
Subgroup 4 Operating Life Test (340 hrs.)[6]	1027	T_A = +100°C at V_{CC} = 5.0V and cycling through logic at 1 character per second	LTPD = 10
Electrical/Optical Endpoints[5]	—	Same as Subgroup 3	
Subgroup 5 Non-operating (Storage) Life Test (340 hrs.)	1032	T_A = +125°C[7,8]	LTPD = 10
Electrical/Optical Endpoints[5]	—	Same as Subgroup 3	

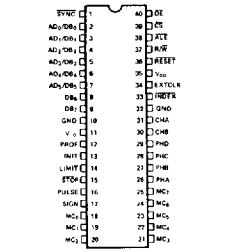
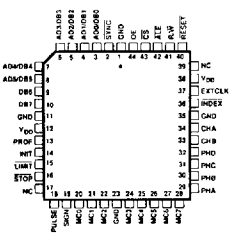
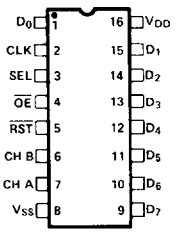
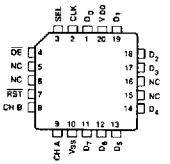
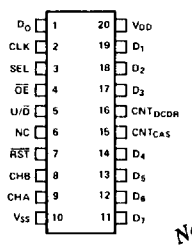
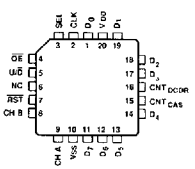
Notes:
1. Visual inspection performed through the display window
2. Whenever electrical/optical tests are not required as endpoints, electrical rejects may be used
3. The LTPD applies to the number of leads inspected except in no case shall less than 3 displays be used to provide the number of leads required
4. Initial conditioning is a 15° inward bend, one cycle
5. Limits and conditions are per the electrical/optical characteristics
6. Burn-in for the over range display shall use Condition B at a nominal $I_F \pm 8$ mA with '+' illuminated for t = 160 hours.
7. Equivalent to MIL-STD-883, Method 2014
8. T_A = +100°C for HDSP-098X Series.
9. Fluid temperature = +100°C for HDSP-098X Series.

TABLE IVa
GROUP C, CLASS A AND B OF MIL-D-87157

Test	MIL-STD-750 Method	Conditions	Sample Size
Subgroup 1 Physical Dimensions	2066		2 Devices/ 0 Failures
Subgroup 2[2,7,9] Lead Integrity	2004	Condition B2	LTPD = 15
Fine Leak	1071	Condition H	
Gross Leak	1071	Condition C or K[10]	
Subgroup 3 Shock	2016	1500G, Time = 0.5 ms, 5 blows in each orientation X_1, Y_1, Z_1	LTPD = 15
Vibration, Variable Frequency	2056		
Constant Acceleration	2006	10,000G at Y_1 orientation	
External Visual[4]	1010 or 1011		
Electrical/Optical Endpoints[8]	—	I_V, I_{CC}, I_{BL}, I_{BH}, I_{EL}, I_{EH}, I_{IL}, I_{IH} and visual Function, $T_A = 25°C$	
Subgroup 4[1,3] Salt Atmosphere	1041		LTPD = 15
External Visual[4]	1010 or 1011		
Subgroup 5 Bond Strength[5]	2037	Condition A	LTPD = 20 (C = 0)
Subgroup 6 Operating Life Test[6]	1026	$T_A = +100°C$	$\lambda = 10$
Electrical/Optical Endpoints[8]	—	Same as Subgroup 3	

Notes:
1. Whenever electrical/optical tests are not required as endpoints, electrical rejects may be used.
2. The LTPD applies to the number of leads inspected except in no case shall less than three displays be used to provide the number of leads required.
3. Solderability samples shall not be used.
4. Visual requirements shall be as specified in MIL-STD-883, Methods 1010 or 1011.
5. Displays may be selected prior to seal.
6. If a given inspection lot undergoing Group B inspection has been selected to satisfy Group C inspection requirements, the 340 hour life tests may be continued on test to 1000 hours in order to satisfy the Group C Life Test requirements. In such cases, either the 340 hour endpoint measurements shall be made a basis for Group B lot acceptance or the 1000 hour endpoint measurement shall be used as the basis for both Group B and Group C acceptance.
7. MIL-STD-883 test method applies.
8. Limits and conditions are per the electrical/optical characteristics.
9. Initial conditioning is a 15° inward bend, 3 cycles.
10. Fluid temperature = +100°C for HDSP-098X Series.

Motion Control ICS – HCTL-XXXX Series

Package Outline Drawing	Part No.	Package	Description	Page No.
	HCTL-1100	PDIP	CMOS General Purpose Motion Control IC	1-104
	HCTL-1100 OPT PLC	PLCC	CMOS General Purpose Motion Control IC	
	HCTL-2000	PDIP	CMOS Quadrature Decoder/Counter IC, 12-bit Counter	1-86
	HCTL-2016	PDIP	CMOS Quadrature Decoder/Counter IC, 16-bit Counter	
	*New* HCTL-2016 OPT PLC	PLCC	CMOS Quadrature Decoder/Counter IC, 16-bit Counter	1-102
	HCTL-2020	PDIP	CMOS Quadrature Decoder/Counter IC, 16-bit Counter, Quadrature Decoder Output Signals, Cascade Output Signals	1-86
	*New* HCTL-2020 OPT PLC	PLCC	CMOS Quadrature Decoder/Counter IC, 16-bit Counter, Quadrature Decoder Output Signals, Cascade Output Signals	1-102

Accessories for Encoders and Encoder Modules

Package Outline Drawing	Part No.	Description	Page No.
	HEDS-8902	4-wire connector with 15.5 cm (6.1 in.) flying leads. Locks into HEDS-5500 and HEDS-5600 2 channel encoders. Also fits HEDS-9000, HEDS-9100, and HEDS-9200 2 channel encoder modules.	1-61 1-22 1-28
	HEDS-8903	5-wire connector with 15.5 cm (6.1 in.) flying leads. Locks into HEDS-5540 and HEDS-5640 three channel encoders. Also fits HEDS-9040 and HEDS-9140 three channel encoder modules.	1-61 1-32
	HEDS-8905	Alignment Tool for HEDS-9140	1-32
	HEDS-8906	Alignment Tool for HEDS-9040	1-32
	HEDS-8901	Gap Setting shown for film codewheels	1-51
	HEDS-8932	Gap Setting shown for glass codewheels	1-51
	HEDS-8910 OPT 0 □□	Alignment Tool for HEDS-5540/5545 and HEDS-5640/5645. Order in appropriate shaft size.	1-61