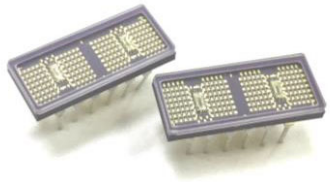
Data Sheet

HCMS-2333

CMOS Extended Temperature Range 5 × 7 Smart Alphanumeric Display



Description

This sunlight viewable 5 × 7 LED four-character display is contained in 12 pin dual-inline packages designed for displaying alphanumeric information. The display is designed with on-board CMOS integrated circuits. Two CMOS ICs form an on-board 28-bit serial-in/parallel-out shift register with constant current output LED row drivers. Decoded column data is clocked into the on-board shift register for each refresh cycle. Full character display is achieved with external column strobing.

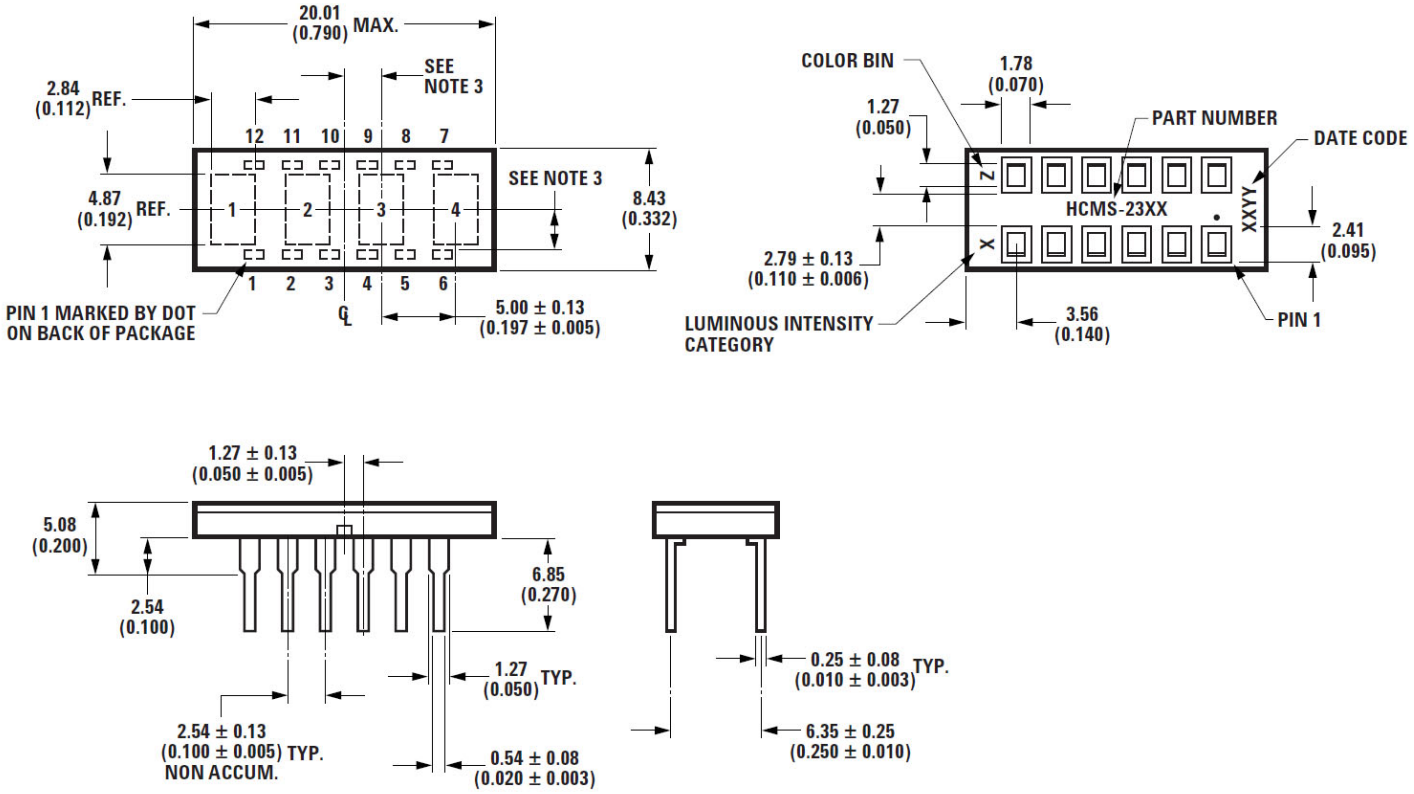
Features

- On-board low-power CMOS IC
- Integrated shift register with constant current LED drivers
- Wide operating temperature range: –55°C to +100°C
- Compact glass ceramic four-character package series X-Y stackable
- Sunlight viewable
- 5 × 7 LED matrix displays full ASCII set
- Character height of 5.0 mm (0.20 in.)
- Wide viewing angle
  - X axis = ± 50°
  - Y axis = ± 65°
- Usable in night vision lighting applications

Typical Application

- Avionics
- Communication systems
- Fire control systems
- Radar systems

Figure 1: Package Drawing



NOTE:

1. Dimensions are in mm (in.).
2. Unless otherwise specified, tolerance on dimensions is ± 0.38 mm (± 0.005 in.).
3. Characters are centered with respect to leads within ± 0.13 mm (± 0.005 in.).
4. Lead material is copper alloy, solder dipped.

Pin Function Assignment Table

Pin Number	Function	Pin Number	Function
1	Column 1	7	Data Out
2	Column 2	8	VB
3	Column 3	9	VDD
4	Column 4	10	Clock
5	Column 5	11	Ground
6	Internal connection[a]	12	Data In

a. Do not connect or use.

Absolute Maximum Ratings

Parameters	HCMS-2333	Units
Supply Voltage, V_{DD} to Ground[a]	–0.3V to 7.0V[a]	V
Data Input, Data Output, V_B	–0.3V to V_{DD}	V
Column Input Voltage, V_{COL}	–0.3V to V_{DD}	V
Free Air Operating Temperature Range, T_A	–40 to 85	ºC
Storage Temperature Range, T_S	–55 to 100	ºC
Maximum Allowable Package Power Dissipation, P_D[b,c] at T_A = 71ºC	1.31	Watts
Wave Solder Condition 1.6 mm Below Standoff	260°C peak for 3s maximum	
Soldering Dipping Condition 1.6 mm Below Standoff	250°C peak for 5s maximum	
ESD Protection at 1.5Ω, 100 pF	4 kV (each pin)	

a. Maximum duration 2 seconds.

b. Maximum allowable power dissipation is derived from V_{DD} = 5.25V, V_B = 2.4V, V_{COL} = 3.5V, 20 LEDs ON per character, 20% DF.

c. HCMS-2333 derate above 71ºC at 23 mW/ºC, $R\theta_{J-A}$ = 45ºC/W.

Recommended Operating Conditions over Operating Range (–55ºC to 100ºC).

Parameters	Symbol	Minimum	Nominal	Maximum	Units
Supply Voltage	V_{DD}	4.75	5.0	5.25	V
Data out Current, Low State	I_{OL}	—	—	1.6	mA
Data out Current, High State	I_{OH}	—	—	–0.5	mA
Column Input Voltage	V_{COL}	2.75	3.0	3.5	V
Setup Time	t_{SETUP}	10	—	—	ns
Hold Time	t_{HOLD}	25	—	—	ns
Clock Pulse Width High	$t_{WH(CLOCK)}$	50	—	—	ns
Clock Pulse Width Low	$t_{WL(CLOCK)}$	50	—	—	ns
Clock High to Low Transition	t_{THL}	—	—	200	ns
Clock Frequency	f_{CLOCK}	—	—	5	MHz

Electrical Characteristics over Operating Temperature Range

Parameters	Symbol	Min.	Typ.[a]	Max.	Units	Test Condition
Supply Current, Dynamic [b]	I_{DDD}	—	6.2	7.8	mA	fCLOCK =5 MHz
Supply Current, Static[c]	$I_{DDDSoff}$ I_{DDDSon}	—	—	—		V_B = 0.4V, Data and Clock = 0.4V V_B = 0.4V, Data and Clock = 0.4V
Column Input Current	I_{COL}	—	—	—		V_B = 0.4V V_B = 2.4V
Input Logic High Data, V_B, Clock	V_{IH}	2.0	—	—	V	V_{DD} = 4.75V
Input Logic Low Data, V_B, Clock	V_{IL}			0.8	V	V_{DD} = 5.25V
Input Current Data Clock, V_B	I_I	— –46 –92	— –60 –120	— –103 –206	µA	V_{DD} = 5.25V V_I[d] = 2.4V (Logic High) or V_I[d] = 0.4V (Logic Low)
Data Out Voltage	VOH	2.4	4.2	—	V	V_{DD} = 4.75V I_{OH} = –0.5 mA I_{COL} = 0 mA
	VOL	—	0.2	0.4	V	V_{DD} = 5.25V I_{OL} = 1.6 mA I_{COL} = 0 mA
Power Dissipation per Package[e]	P_D	—	668	—	mW	V_{DD} = 5.0V V_{COL} = 3.5V 17.5% DF V_B = 2.4V 15 LEDs ON per character
Thermal Resistance IC Junction-to-Pin[f]	$R_{\theta J\text{-}PIN}$	—	10	—	ºC/W	
Leak Rate		—	—	5×10^{-8}	cc/sec	

a. All typical values specified at V_{DD} = 5.0V and T_A = 25ºC.

b. I_{DD} Dynamic is the IC current while clocking column data through the on-board shift register at a clock frequency of 5 MHz, the display is not illuminated.

c. I_{DD} Static is the IC current after column data is loaded and not being clocked through the on-board shift register.

d. V_I represents the input voltage to an input pin.

e. Four characters are illuminated with a typical ASCII character composed of 15 dots per character.

f. IC junction temperature T_J (IC) = $(P_D)(R\theta_{PC\text{-}A})$ + T_A.

Optical Characteristics at T_A = 25ºC

V_{DD} = 5.0V at full brightness, LED color = yellow green.

Parameters	Min.	Typ.[a]	Test Condition
Luminous Intensity per Character Average (All Dots ON), I_V (mcd)[b]	76	159	V_{DD} = 5.0V V_{COL} = 3.5V V_B = 2.4V T_i = 25ºC[c]
Peak Wavelength, λ_{PEAK} (nm)	—	574	
Dominant Wavelength, λ_d (nm)[d, e]	—	572	

a. All typical values specified at V_{DD} = 5.0V and T_A = 25ºC.

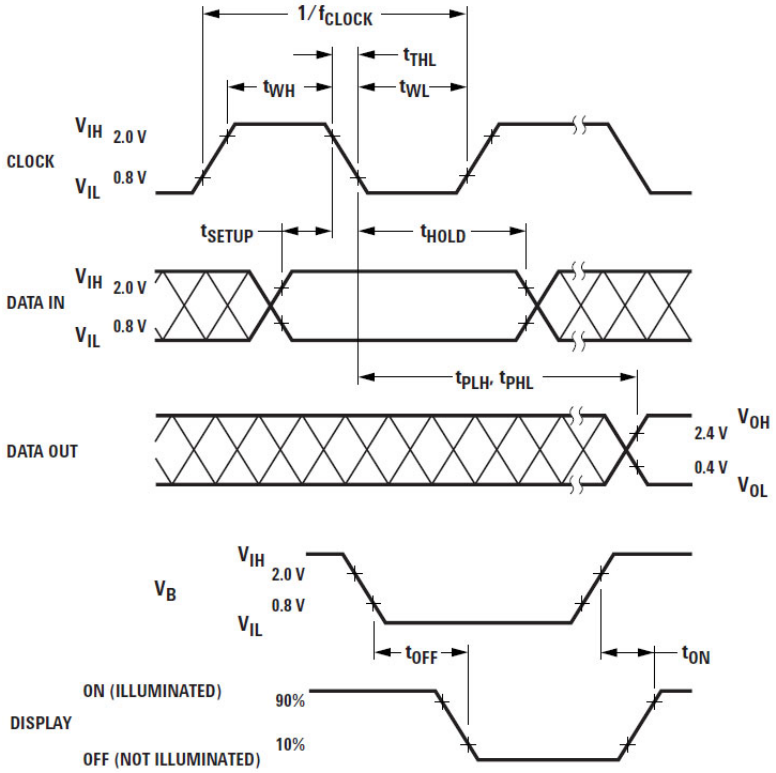
b. These LED displays are categorized for luminous intensity, with the intensity designated by a letter code on the back of the package.

c. T_i refers to the initial case temperature of the display immediately prior to the light measurement.

d. Dominant wavelength, λ_d, derived from the CIE chromaticity diagram, and represents the single wavelength that defines the color of the device.

e. Categorized for color with the color category designated by a number on the back of the package.

Figure 2: Switching Characteristics



Timing Characteristics

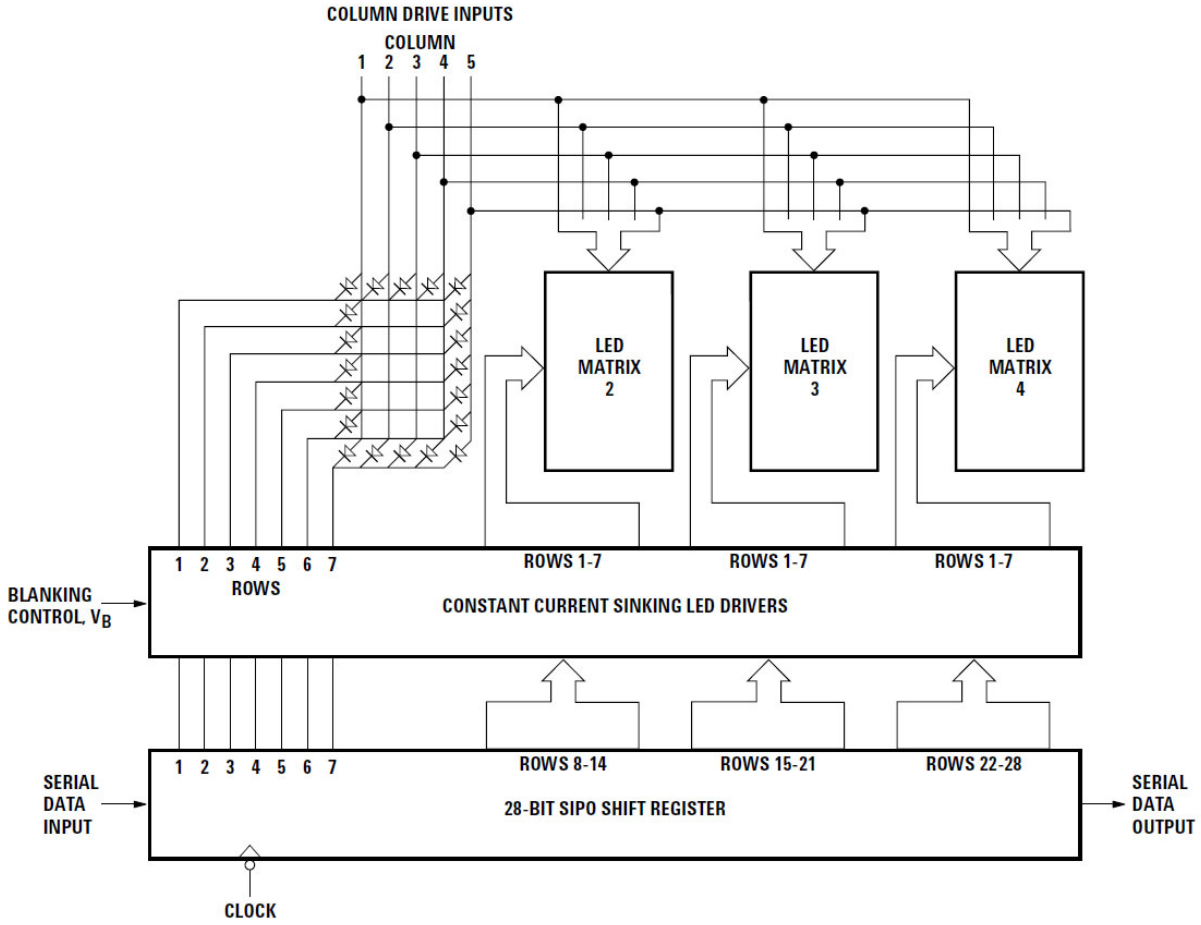
Parameter	Condition	Typ.	Max.	Units
f_{CLOCK} CLOCK Rate		—	5	MHz
t_{PLH}, t_{PHL} Propagation Delay CLOCK to DATA OUT	C_L = 15 pF R_L = 2.4 kΩ	—	105	ns
t_{OFF} V_B (0.4V) to Display OFF		4	5	µs
t_{ON} V_B (2.4V) to Display ON		1	2	µs

Electrical Description

The display contains four 5 × 7 LED dot-matrix characters and two CMOS integrated circuits, as shown in Figure 2. The two CMOS integrated circuits form an on-board 28-bit serial-in/parallel-out shift register that will accept standard TTL logic levels. The Data Input, pin 12, is connected to bit position 1 and the Data Output, pin 7, is connected to bit position 28. The shift register outputs control constant current sinking LED row drivers. A logic 1 stored in the shift register enables the corresponding LED row driver and a logic 0 stored in the shift register disables the corresponding LED row driver.

The electrical configuration of these CMOS IC alphanumeric displays allows for an effective interface to a display controller circuit that supplies decoded character information. The row data for a given column (one 7-bit byte per character) is loaded (bit serial) into the on-board 28-bit shift register with high to low transitions of the Clock input. To load decoded character information into the display, column data for character 4 is loaded first and the column data for character 1 is loaded last in the following manner. The 7 data bits for column 1, character 4, are loaded into the on-board shift register. Next, the 7 data bits for column 1, character 3, are loaded into the shift register, shifting the character 4 data over one character position. This process is repeated for the other two characters until all 28 bits of column data (four 7-bit bytes of character column data) are loaded into the on-board shift register. Then the column 1 input, V_{COL} pin 1, is energized to illuminate column 1 in all four characters. This process is repeated for columns 2, 3, 4, and 5. All V_{COL} inputs should be at logic low to ensure the display is off when loading data. The display will be blanked when the blanking input V_B, pin 8, is at logic low regardless of the outputs of the shift register or whether one of the V_{COL} inputs is energized.

Figure 3: HCMS-2333 Display Block Diagram



ESD Susceptibility

The display has an ESD susceptibility rating of Class 3 of MIL-STD-883E, HBM. Observe normal CMOS handling precautions with these devices.

Soldering and Post Solder Cleaning

These displays may be soldered with a standard wave solder process using either an RMA flux and solvent cleaning or an OA flux and aqueous cleaning. For optimum soldering, the solder wave temperature should be 245°C and the dwell time for any display lead passing through the wave should be 1.5 to 2 seconds. For more detailed information, refer to Application Note 1027, *Soldering LED Components*.

Contrast Enhancement

When used with the proper contrast enhancement filters, the display is readable in sunlight.

Refer to Application Note 1029, *Luminous Contrast and Sunlight Readability of the HDSP-235X Series Alphanumeric Displays for Sunlight Viewable Applications*, for information on contrast enhancement for sunlight and daylight ambient. Refer to Application Note 1015, *Contrast Enhancement Techniques for LED Displays*, for information on contrast enhancement in moderate ambient.

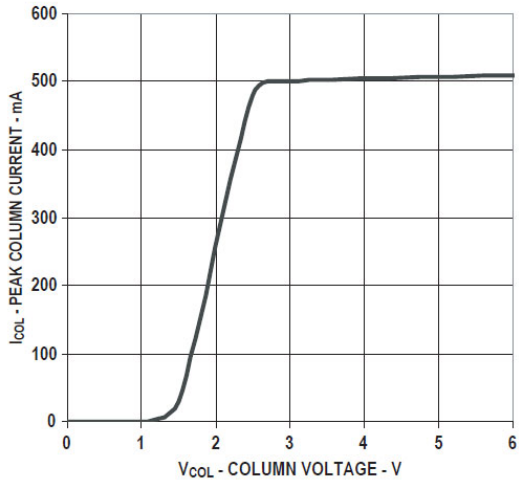
Night Vision Lighting

When used with the proper NVG/DV filters, HCMS-235x display may be used in night vision lighting applications. For a list of NVG/DV filters and a discussion on night vision lighting technology, refer to Application Note 1030, *LED Displays and Indicators and Night Vision Imaging System Lighting*.

Controller Circuits, Power Calculations, and Display Dimming

Refer to Application Note 1016, *Using the HDSP-2000 Alphanumeric Display Family*, for information on controller circuits to drive these displays, how to do power calculations, and a technique for display dimming.

Figure 4: Peak Column Current vs. Column Voltage at T_A = 25ºC



Precautionary Notes

Mechanical Considerations

The HCMS-2333 is assembled by die attaching and wire bonding 140 LED chips and two CMOS ICs to a thermally conductive printed circuit board. A glass lens placed over the substrate creates an air gap over the LED wire bonds. Figure 5 shows the proper method to insert the display by hand. To prevent damage to the display, apply pressure uniformly with fingers located at both ends of the part. Using a tool, shown in Figure 6, such as a screwdriver or pliers to push the display into the printed circuit board or socket may damage the display. The force exerted by a screwdriver is sufficient to damage the glass lens. Any damaged glass lens exposing the LEDs wire bonds cause shorts or opens that result in catastrophic failure of the LEDs.

Figure 5: Proper Method to Manually Insert a Display

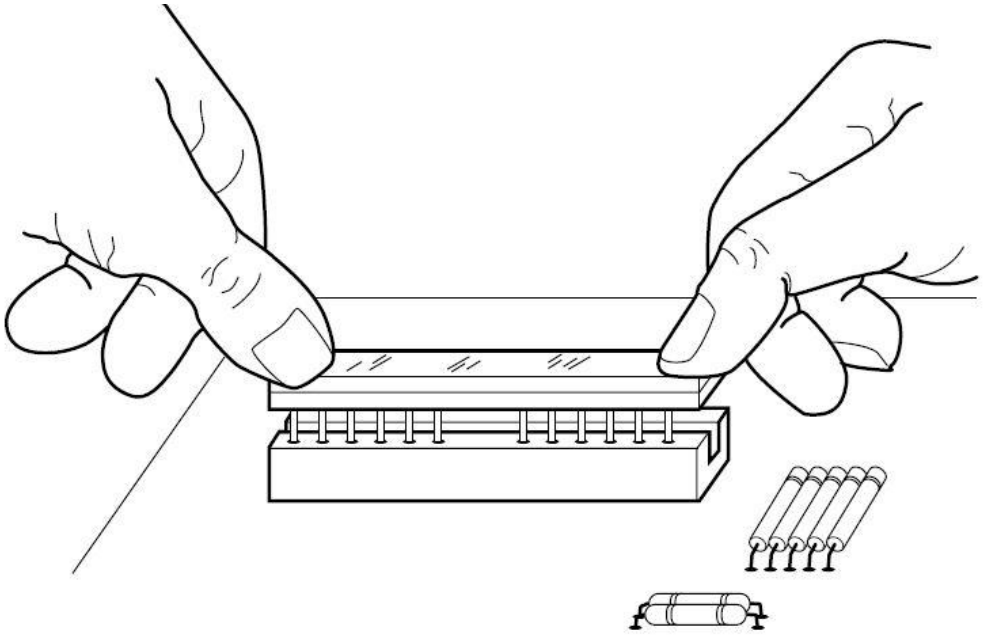
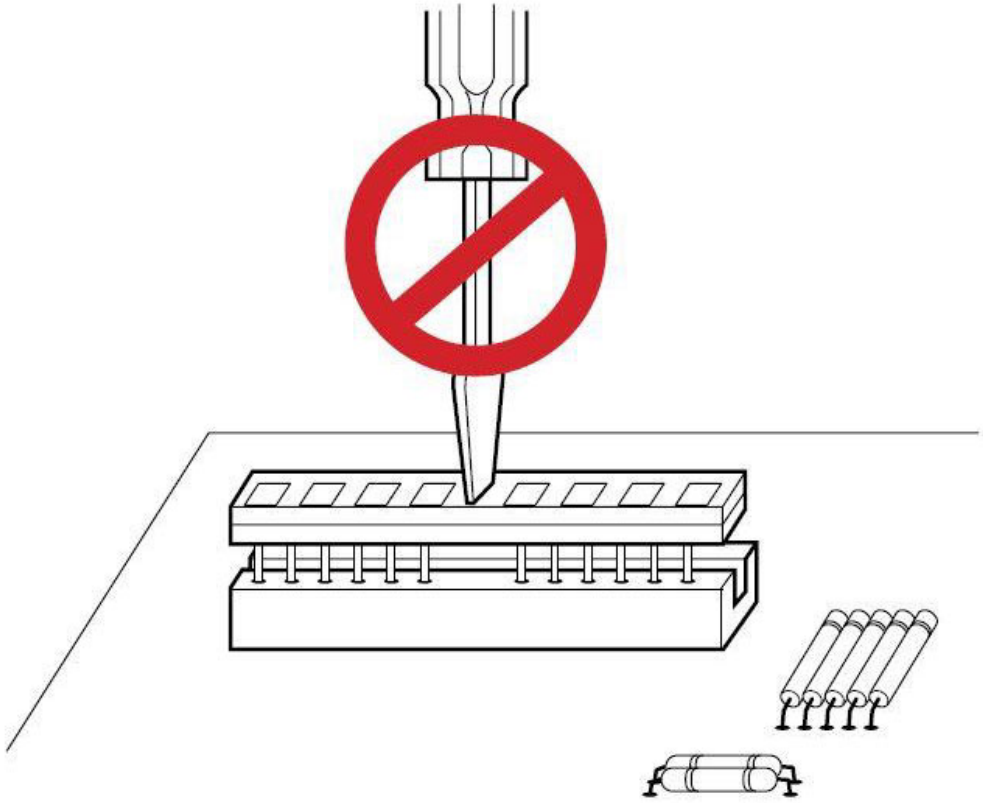


Figure 6: Improper Method to Manually Insert a Display



Intensity Bin Limits

Bin	Iv, average per character (All dots on) (mcd)	
	Min.	Max.
B	76	121
C	99	157
D	128	204
E	167	266

NOTE: Test conditions as specified in Optical Characteristic table.

Color Bin Limits

Color Bin	Color Range (nm)	
	Min.	Max.
1	576.0	580.0
2	573.0	577.0
3	570.0	574.0
4	567.0	571.0

NOTE: Test conditions as specified in Optical Characteristic table.

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