Agilent HCMS-235x
CMOS Extended Temperature Range 5 x 7 Alphanumeric Display

Data Sheet

Description

This sunlight viewable 5 x 7 LED four-character display is contained in 12 pin dual-in-line 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.

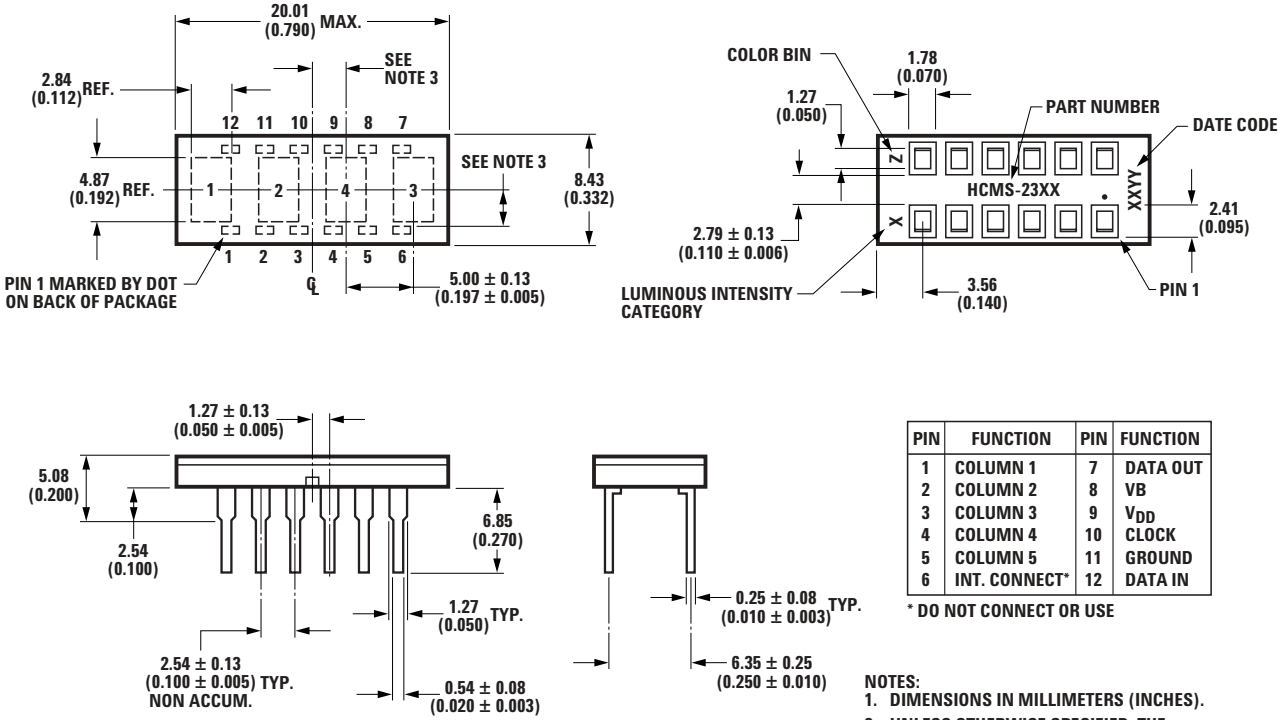
Features

- **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 4 character package**
  Series X-Y stackable
- **Sunlight viewable**
- **5 x 7 LED matrix displays full ASCII set**
- **Character height of 5.0 mm (0.20 inch)**
- **Wide viewing angle**
  X Axis = ±50°
  Y Axis = ±65°
- **Usable in night vision lighting applications**

Typical Applications

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

Package Dimensions



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

* DO NOT CONNECT OR USE

NOTES:
1. DIMENSIONS IN MILLIMETERS (INCHES).
2. UNLESS OTHERWISE SPECIFIED, THE TOLERANCE ON ALL DIMENSIONS IS ± 0.38 mm (± 0.015).
3. CHARACTERS ARE CENTERED WITH RESPECT TO LEADS WITHIN ± 0.13 mm (± 0.005).
4. LEAD MATERIAL IS COPPER ALLOY, SOLDER DIPPED.

Absolute Maximum Ratings

Parameter	Value
Supply Voltage V_{DD} to Ground	–0.3 V to 7.0 V[1]
Data Input, Data Output, V_B	–0.3 V to V_{DD}
Column Input Voltage, V_{COL}	–0.3 V to V_{DD}
Free Air Operating Temperature Range, T_A	–55°C to +100°C
Storage Temperature Range, T_s	–55°C to +100°C
Maximum Allowable Package Power Dissipation, P_D[2,3] at T_A = 71°C	1.31 Watts
Through-the-Wave Solder Temperature 1.59 mm (0.063") Below Body	250°C for 3 secs. max.
ESD Protection @ 1.5 kΩ, 100 pF	V_Z = 4 kV

Notes:
1. Maximum duration 2 seconds.
2. Maximum allowable power dissipation is derived from V_{DD} = 5.25 V, V_B = 2.4 V, V_{COL} = 3.5 V, 20 LEDs ON per character, 20% DF.
3. HCMS-2353 derate above 71°C at 23 mW/°C, $R\theta_{J\text{-}A}$ = 45°C/W.
   Derating based on $R\theta$PC-A = 35°C/W per display for printed circuit board assembly.

Recommended Operating Conditions
Over Operating Range (–55°C to + 100°C)

Parameter	Symbol	Min.	Typ.	Max	Units
Supply Voltage	V_{DD}	4.75	5.00	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 Range (–55°C to + 100°C)

Parameter	Symbol	Test Conditions	Min	Typ.*	Max	Units
Supply Current, Dynamic[1]	I_{DDD}	f_{CLOCK} = 5 MHz		6.2	7.8	mA
Supply Current, Static[2]	$I_{DDDSoff}$ I_{DDDSon}	V_B = 0.4 V, Data and Clock = 0.4 V V_B = 2.4 V, Data and Clock = 0.4 V		1.8 2.2	26 6.0	mA
Column Input Current	I_{COL}	V_B = 0.4 V			10	µA
		V_B = 2.4 V		500	650	mA
Input Logic High Data, V_B, Clock	V_{IH}	V_{DD} = 4.75 V	2.0			V
Input Logic Low Data, V_B, Clock	V_{IL}	V_{DD} = 5.25 V			0.8	V
Input Current Data Clock, V_B	I_I	V_{DD} = 5.25 V V_I[3] = 2.4 V (Logic High) or V_I[3] = 0.4 V (Logic Low)	 –46 –92	 –60 –120	 –103 –206	µA
Data Out Voltage	V_{OH}	V_{DD} = 4.75 V I_{OH} = –0.5 mA I_{COL} = 0 mA	2.4	4.2		V
	V_{OL}	V_{DD} = 5.25 V I_{OL} = 1.6 mA I_{COL} = 0 mA		0.2	0.4	V
Power Dissipation Per Package[4]	P_D	V_{DD} = 5.0 V V_{COL} = 5.0 V 17.5% DF V_B = 2.4 V 15 LEDs ON per Character		668		mW
Thermal Resistance IC Junction-to-Pin [5]	$R\theta_{J\text{-}PIN}$			10		°C/W
Leak Rate					$5x10^{-8}$	cc/sec

*All typical values specified at V_{DD} = 5.0 V and T_A = 25°C.

Notes:
1. 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.
2. I_{DD} Static is the IC current after column data is loaded and not being clocked through the on-board shift register.
3. V_I represents the input voltage to an input pin.
4. Four characters are illuminated with a typical ASCII character composed of 15 dots per character.
5. IC junction temperature T_J (IC) = $(P_D)(R\theta_{J\text{-}PIN} + R\theta_{PC\text{-}A}) + T_A$.

Optical Characteristics at T_A = 25°C
High Performance Green HCMS-2353

Description	Symbol	Test Condition	Min.	Typ.*	Max.	Units
Peak Luminous Intensity per LED[6] (Character Average)	I_{vPEAK}	V_{DD} = 5.0 V V_{COL} = 5.0 V V_B = 2.4 V T_i = 25°C[7]	2400	3000		µcd
Dominant Wavelength[8,9]	λ_d			574		nm
Peak Wavelength	λ_{PEAK}			568		nm

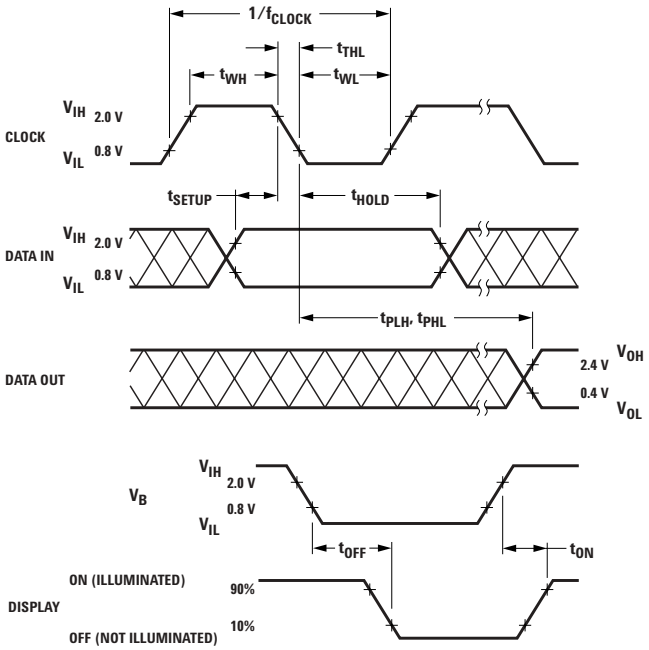
Yellow HCMS-2351

Description	Symbol	Test Condition	Min	Typ.*	Max.	Units
Peak Luminous Intensity per LED [6] (Character Average)	I_{vPEAK}	V_{DD} = 5.0V V_{COL} = 5.0 V V_B = 2.4V Ti = 25°C [7]	1600	2400		µcd
Dominant Wavelength [8,9]	λ_d			585		nm
Peak Wavelength	λ_{PEAK}			583		nm

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

Notes:
6. These LED displays are categorized for luminous intensity, with the intensity category designated by a letter code on the back of the package.
7. T_i refers to the initial case temperature of the display immediately prior to the light measurement.
8. Dominant wavelength, λ_d, is derived from the CIE Chromaticity Diagram, and represents the single wavelength which defines the color of the device.
9. Categorized for color with the color category designated by a number on the back of the package.

Switching 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 (0.4 V) to Display OFF		4	5	µs
t_{ON} V_B (2.4 V) to Display ON		1	2	

Electrical Description

The display contains four 5 x 7 LED dot matrix characters and two CMOS integrated circuits, as shown in Figure 1. 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 insure 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. Refer to Application Note 1016 for drive circuit information.

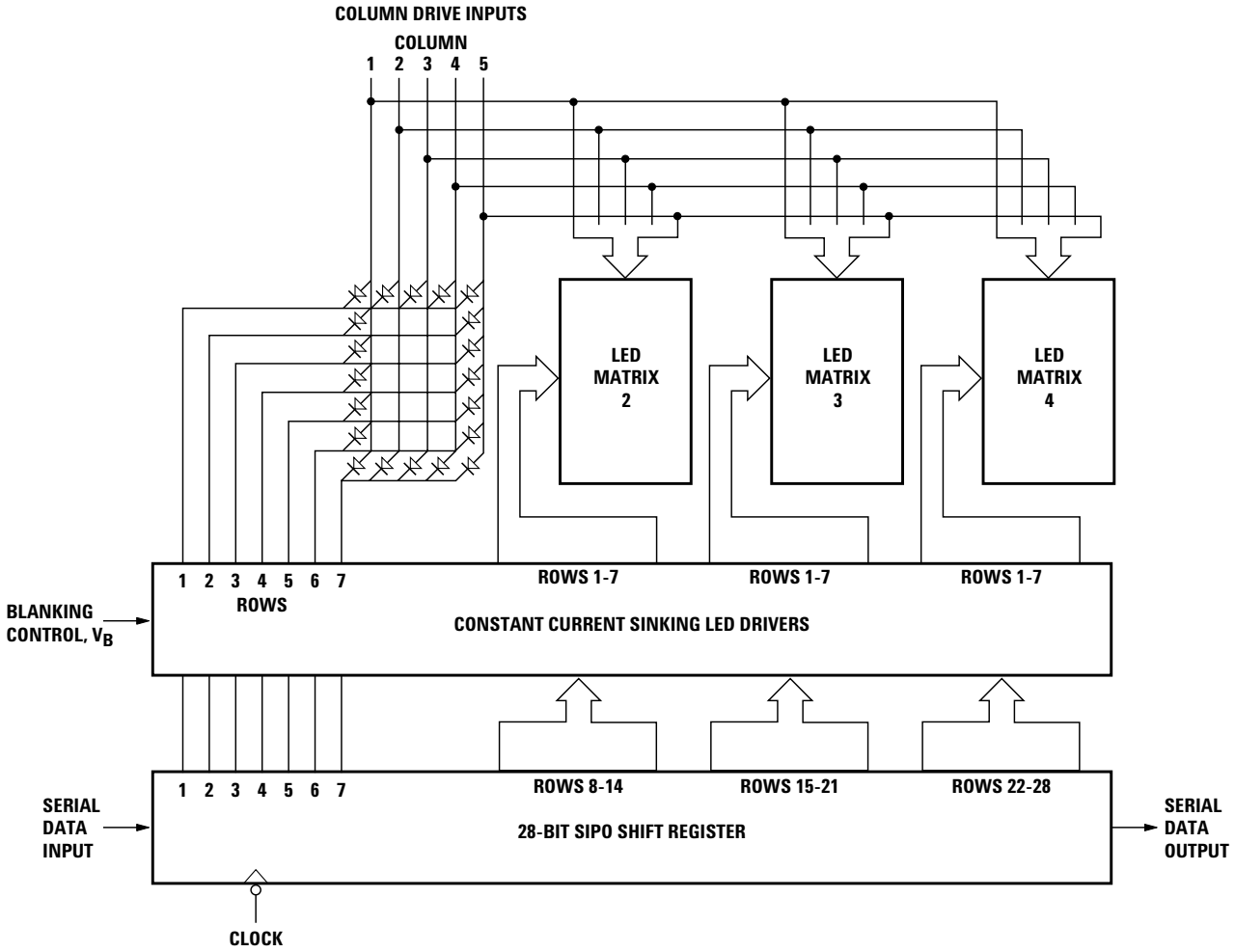


Figure 1. Display block diagram.

ESD Susceptibility

The display has an ESD susceptibility ratings of CLASS 3 of MIL-STD-883E, HBM. It is recommended that normal CMOS handling precautions be observed 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 Component*s.

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 Alpha-numeric Displays for Sunlight Viewable Applications,* for information on contrast enhancement for sun-light and daylight ambient. Refer to Application Note 1015, *Contrast Enhancement Techniques for LED Displays,* for information on contrast enhancement in moderate ambients.

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.

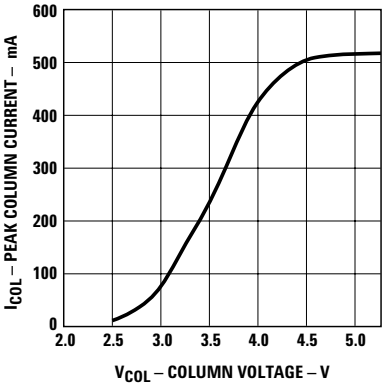


Figure 2. Peak column current vs. column voltage at T_A = 25°C.

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For product information and a complete list of distributors, please go to our web site.

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