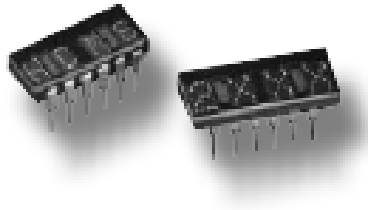
Data Sheet

HCMS-235x

CMOS Extended Temperature Range 5 × 7 Alphanumeric Display



Description

The Broadcom® HCMS-235x 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.

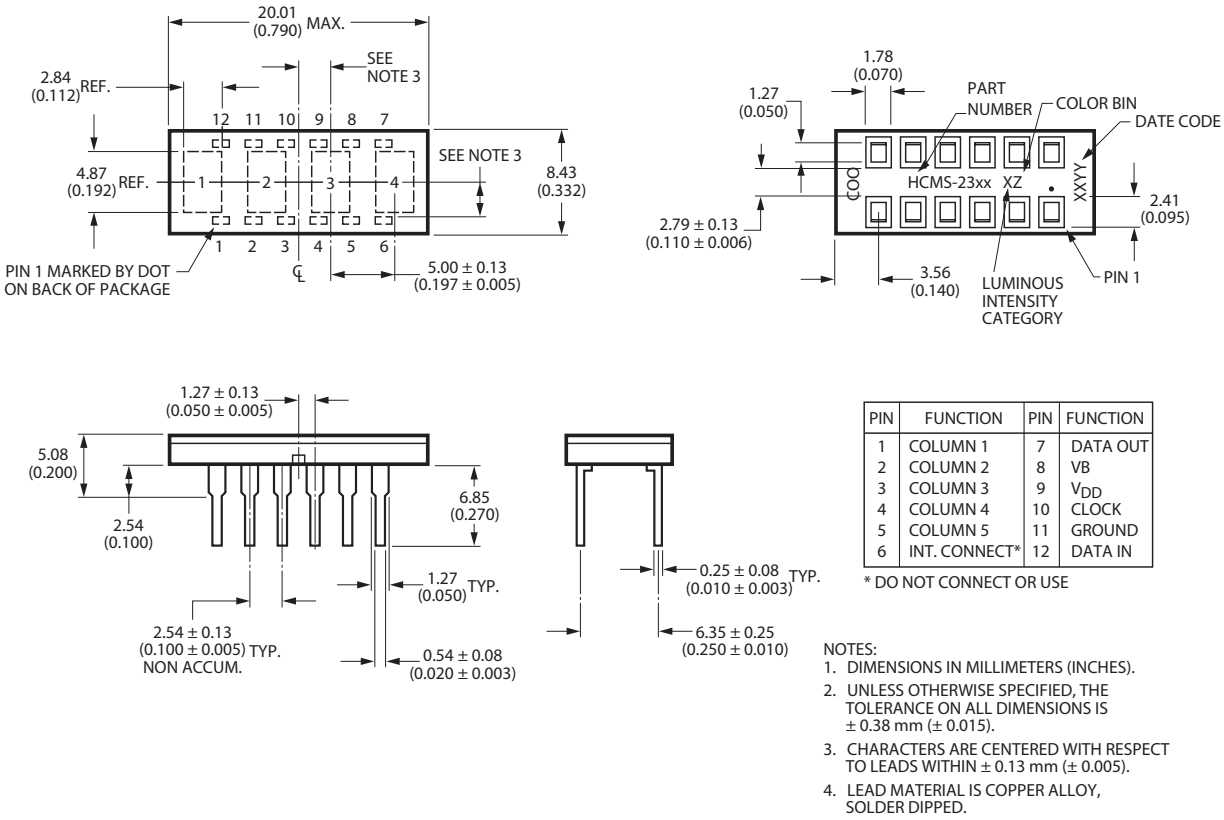
Features

- 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

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	–0.3V to 7.0V[a]
Data Input, Data Output, V_B	–0.3V to V_{DD}
Column Input Voltage, V_{COL}	–0.3V 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[b, c]
Maximum Allowable Package Power Dissipation, P_D[b, c] at T_A = 71°C	1.31W
Through-the-Wave Solder Temperature[d]	250°C for 3 seconds maximum
Solder Dipping Temperature[d]	260°C for 5 seconds maximum
ESD Protection at1.5 kΩ, 100 pF	V_Z= 4 kV

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-2353 derate above 71°C at 23 mW/°C, $R\theta_{J-A}$ = 45°C/W.
Derating based on $R\theta_{J-A}$ = 35°C/W per display for printed circuit board assembly.

d. 1.59 mm (0.063 in.) below body.

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.[a]	Max.	Units
Supply Current, Dynamic[b]	I_{DDD}	f_{CLOCK} = 5 MHz	—	6.2	7.8	mA
Supply Current, Static[c]	$I_{DDDSoff}$	V_B = 0.4V, Data and Clock = 0.4V	—	1.8	26	mA
	I_{DDDSon}	V_B = 2.4V, Data and Clock = 0.4V	—	2.2	6.0	
Column Input Current	I_{COL}	V_B = 0.4V	—	—	10	µA
		V_B = 2.4V	—	500	650	mA
Input Logic High Data, V_B, Clock	V_{IH}	V_{DD} = 4.75V	2.0		—	V
Input Logic Low Data, V_B, Clock	V_{IL}	V_{DD} = 5.25V	—	—	0.8	V
Input Current	I_I	V_{DD} = 5.25V		—		µA
Data		V^d = 2.4V (Logic High) or	–46	–60	–103	
Clock, V_B		V^d = 0.4V (Logic Low)	–92	–120	–206	
Data Out Voltage	V_{OH}	V_{DD} = 4.75V I_{OH} = –0.5 mA I_{COL} = 0 mA	2.4	4.2	—	V
	V_{OL}	V_{DD} = 5.25V I_{OL} = 1.6 mA I_{COL} = 0 mA	—	0.2	0.4	V
Power Dissipation Per Package[e]	P_D	V_{DD} = 5.0V V_{COL} = 3.5V 17.5% DF V_B = 2.4V 15 LEDs ON per Character	—	668	—	mW
Thermal Resistance IC Junction-to-Pin[f]	$R_{\theta J\text{-}PIN}$		—	10	—	°C/W
Leak Rate			—	—	5×10^{-8}	cc/second

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

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) = $(P_D)(R\theta_{J\text{-}PIN} + R\theta_{PC\text{-}A}) + T_A$.

Optical Characteristics at T_A = 25°C

High Performance Green, HCMS-2353

Description	Symbol	Test Conditions	Min.	Typ.[a]	Max.	Units
Peak Luminous Intensity per LED[b] (Character Average)	I_{vPEAK}	V_{DD} = 5.0V V_{COL} = 3.5V V_B = 2.4V T_i = 25°C[c]	2400	3000	—	µcd
Dominant Wavelength[d, e]	λ_d		—	574	—	nm
Peak Wavelength	λ_{PEAK}		—	568	—	nm

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

b. These LED displays are categorized for luminous intensity, with the intensity category 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, is 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.

Yellow, HCMS-2351

Description	Symbol	Test Condition	Min	Typ.[a]	Max.	Units
Peak Luminous Intensity per LED[b] (Character Average)	I_{vPEAK}	V_{DD} = 5.0V V_{COL} = 3.5V V_B = 2.4V T_i = 25°C[c]	1600	2400	—	mcd
Dominant Wavelength[d, e]	λ_d	—	—	585	—	nm
Peak Wavelength	λ_{PEAK}	—	—	583	—	nm

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

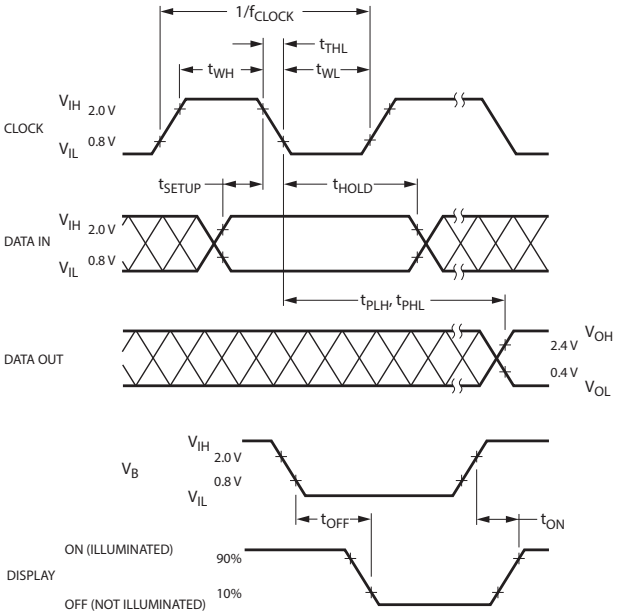
b. These LED displays are categorized for luminous intensity, with the intensity category designated by a letter code on the back of the package.

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

d. Dominant wavelength, λ_d, is 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.

Switching Characteristics



Parameter	Condition	Typ.	Max.	Units
f_{clock} CLOCK Rate		—	5	MHz
t_{PLH}, t_{PHL} Propgation 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	

Electrical Description

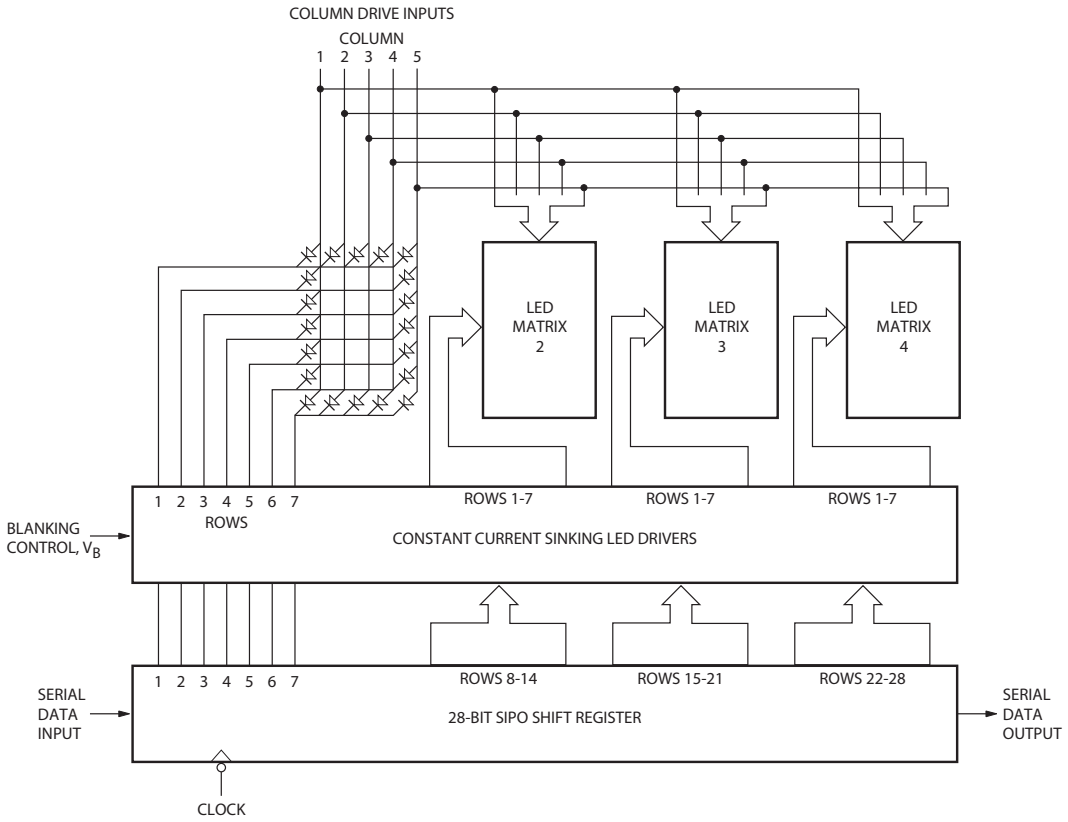
The display contains four 5 x 7 LED dot matrix characters and two CMOS integrated circuits, as shown in Figure 1. The two CMOS integrated circuits form an on-board 28-bit serial-in/parallel-out shift register that accepts standard TTL logic levels. The Data Input, pin 12, is connected to bit position 1 and the Data Output, pin 7, is connected to bit position 28. The shift register puts out 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, which 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 that the display is off when loading data. The display is blank 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 rating of Class 3 of MIL-STD-883E, HBM. Take normal CMOS handling precautions when handling 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 ambients.

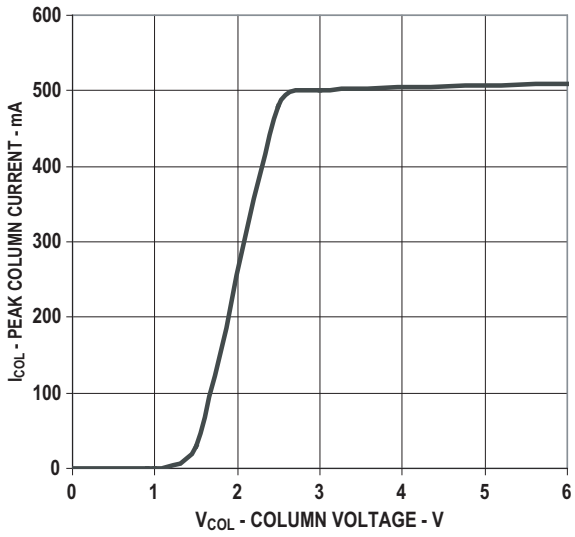
Night Vision Lighting

When used with the proper NVG/DV filters, the HCMS-235x display may be used in night vision lighting applications. For a list of NVG/DV filters and a description 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



Intensity Bin Limits

Intensity Bin Limits for HCMS-2351

Bin	Intensity Range (mcd)	
	Min.	Max.
Q	11.197	15.774
R	13.437	19.718
S	16.797	23.662
T	20.156	29.577
U	25.195	35.492

Intensity Bin Limits for HCMS-2353

Bin	Intensity Range (mcd)	
	Min.	Max.
S	16.797	23.662
T	20.156	29.577
U	25.195	35.492
V	30.234	44.366
W	37.739	52.239

Color Bin Limits

Color	Color Bin	QA	
		Min.	Max.
Yellow	3	581.5	585.0
	4	584.0	587.5
	5	586.5	590.0
	6	589.0	592.5
	7	591.5	595.0
Green	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 Characteristics at T_A = 25°C.

Option Code Definition

H C M S - 2 3 5 x - x_1 x_2 x_3 x x

Iv Bin Range Identifier		
x_1 x_2	x_1	Minimum Iv bin
	x_2	Maximum Iv bin
Color Bin Range Identifier		
x_3	A	Color bin 2 or 3
	B	Color bin 4 or 5
	C	Color bin 5 or 6
	D	Color bin 3 or 4