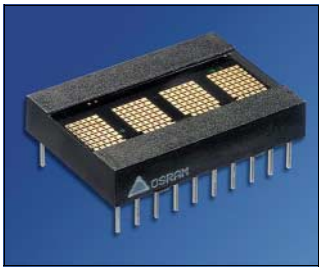
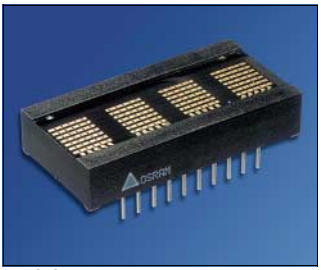
4-Character 5 x 7 Dot Matrix Alphanumeric Programmable Display™ with Built-in CMOS Control Functions

Lead (Pb) Free Product - RoHS Compliant

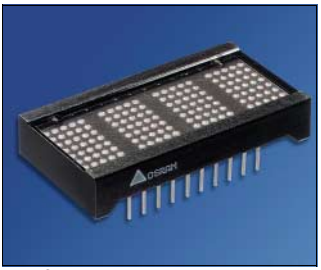
PD243X, PD353X, PD443X



PD243X



PD353X



PD443X

DESCRIPTION

These Programmable Displays are four digit display system modules. The characters are
5.08 mm by 3.56 mm (0.20" by 0.14") (PD243X),
6.86 mm by 5.08 mm (0.27" by 0.20") (PD353X), and
11.43 mm by 6.86 mm (0.45" by 0.27") (PD443X)
5 x 7 dot matrix arrays constructed with the latest solid state technology in light emitting diodes. Driving and controlling the LED arrays is a silicon gate CMOS integrated circuit. This integrated circuit provides all necessary LED drivers and complete multiplexing control logic.

Additionally, the IC has the necessary ROM to decode 128 ASCII alphanumeric characters and enough RAM to store the display's complete four digit ASCII message with special attributes. These attributes, all software programmable at the user's discretion, include a lamp test, brightness control, displaying cursors, alternating cursors and characters, and flashing cursors or characters.

The CMOS IC also incorporates special interface control circuitry to allow the user to control the module as a fully supported microprocessor peripheral. The module, under internal or external clock control, has asynchronous read, write, and memory clear over an eight bit parallel, TTL compatible, bi-directional data bus. Each module is fully encapsulated within a package
25.4 x 17.8 x 5.08 mm (1.0" x 0.7" x 0.2") (PD253X),
35.6 x 18.3 x 7.24 mm (1.4" x 0.72" x 0.285") (PD353X), and
38.1 x 20.8 x 7.24 mm (1.5" x 0.82" x 0.285") (PD443X).
The standard 20 pin DIP construction with two rows spaced at 15.2 mm (0.6") on 2.54 mm (0.1") centers is wave solderable.

See the end of this data sheet or refer to Appnotes 18, 19, 22, and 23 for further details on handling and assembling OSRAM Programmable Displays.

FEATURES

- Four Dot Matrix Characters in High Efficiency Red, Red, and Bright Green
  - PD2435/6/7, 5.08 mm (0.200") High
  - PD3535/6/7, 6.86 mm (0.270") High
  - PD4435/6/7, 11.43 mm (0.45") High
- Built-in Memory, Decoders, Multiplexer and Drivers
- Wide Viewing Angle, X Axis ± 55°, Y Axis ± 65°
- Categorized for Luminous Intensity
- 128 Character ASCII Format (Upper and Lower Case Characters)
- 8 Bit Bidirectional Data BUS
- READ/WRITE Capability
- Dual In-Line Package Configuration, 15.2 mm (0.600") Wide,
  2.54 mm (0.100") Pin Centers
- End-Stackable Package
- Internal or External Clock
- Built-in Character Generator ROM
- TTL Compatible
- Easily Cascaded for Multidisplay Operation
- Less CPU Time Required
- Software Controlled Features:
  - Programmable Highlight Attribute (Blinking, Non-Blinking)
  - Asynchronous Memory Clear Function
  - Lamp Test
  - Display Blank Function
  - Single or Multiple Character Blinking Function
  - Programmable Intensity (Three Brightness Levels)
- Extended Operating Temperature Range:
- PD243X, PD353X: –40°C to +85°C
- PD443X: –40°C to +70°C

Ordering Information

	Type	Color of Emission	Character Height mm (inch)	Ordering Code
	PD2435 PD2436 PD2437	high efficiency red red bright green	5.08 (0.200)	Q68000A3561 Q68000A8366 Q68000A3562
	PD3535 PD3536 PD3537	high efficiency red red bright green	6.86 (0.270)	Q68000A7964 Q68000A8365 Q68000A7965
	PD4435 PD4436 PD4437	high efficiency red red bright green	11.43 (0.450)	Q68000A8367 Q68000A8368 Q68000A8369

Maximum Ratings

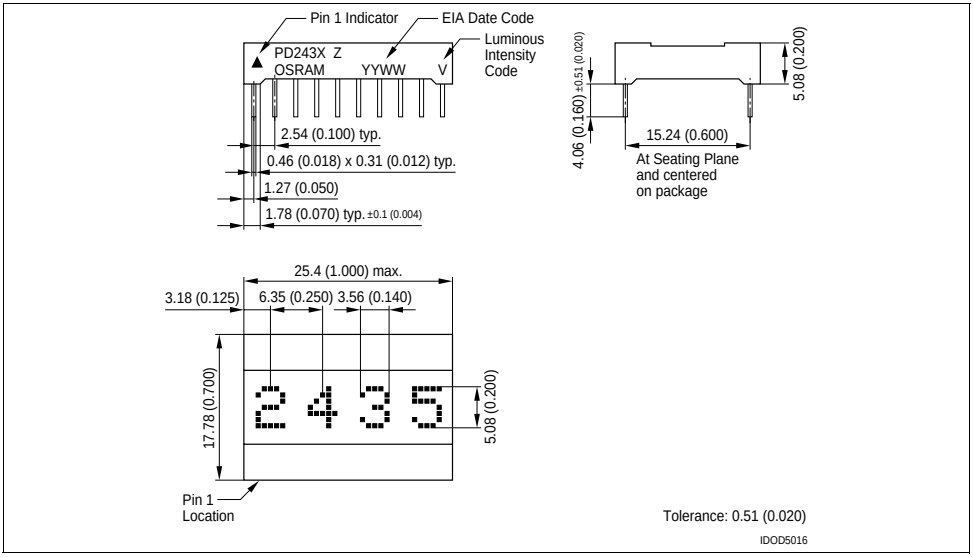
Parameter	Symbol	Values			Unit
		PD243X	PD353X	PD443X	
Operating temperature range	T_{op}	– 40 … + 85		–40…+70	°C
Storage temperature range	T_{stg}	– 40 … +100			°C
Viewing angle (off normal axis) hor. (typ.) ver. (typ.)	2φ	± 55 ± 65	± 55 ± 65	± 40 ± 65	deg deg.
DC Supply Voltage		-0.5 to + 7.0			Vdc
Input Voltage Relative to GND (all inputs)		-0.5 to V_{CC} +0.5			Vdc
Solder temperature 1.59 mm (0.063“) below seating plane, t < 5.0 s	T_s	260			°C

Characteristics
(T_A = 25 °C)

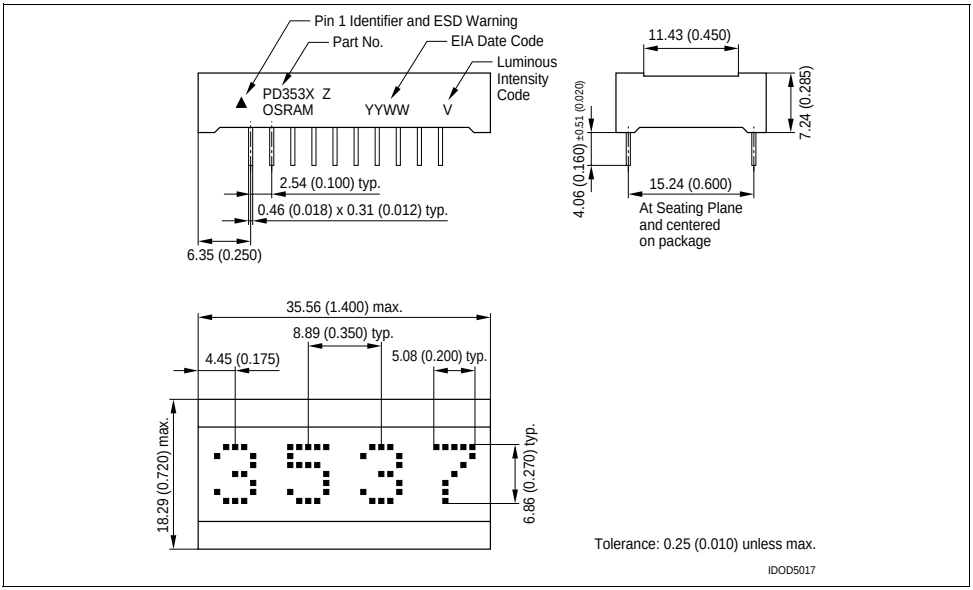
Parameter	Symbol	Values			Unit
		PDx435	PDx436	PDx437	
		high efficiency red	red	green	
Wavelength at peak emission (typ.) I_F = 50 mA	λ_{peak}	630	660	565	nm
Character Height	h	0.145 3.7	0.145 3.7	0.145 3.7	inch mm
Time averaged luminous intensity[1] (min.)		90	30	90	µcd/LED
LED to LED intensity matching (max.)		1.8:1.0	1.8:1.0	1.8:1.0	
Device to Device (one bin) (max.)		1.5:1.0	1.5:1.0	1.5:1.0	
Bin to Bin (adjacent bins) (max.)		1.9:1.0	1.9:1.0	1.9:1.0	

[1] Peak luminous intensity values can be calculated by multiplying these values by 7.

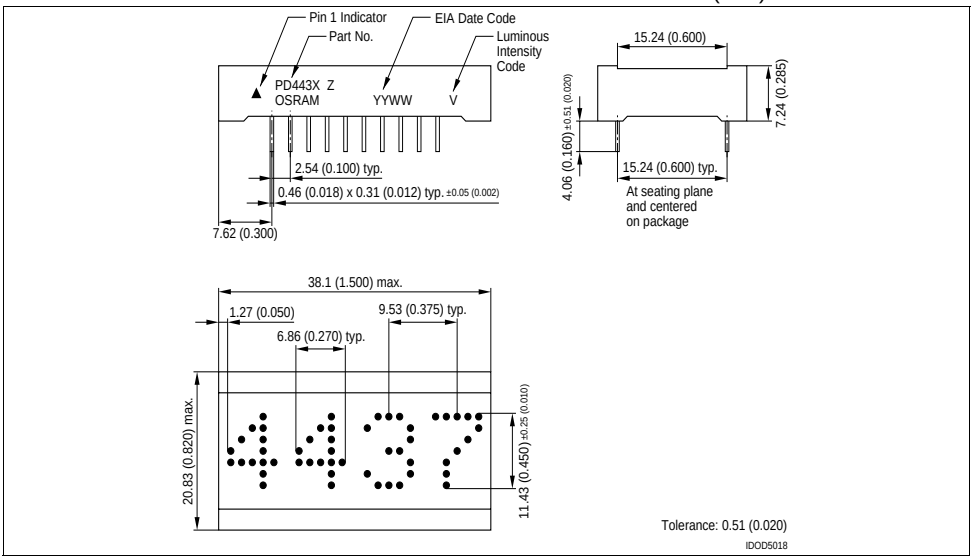
PD243X Dimensions in mm (inch)



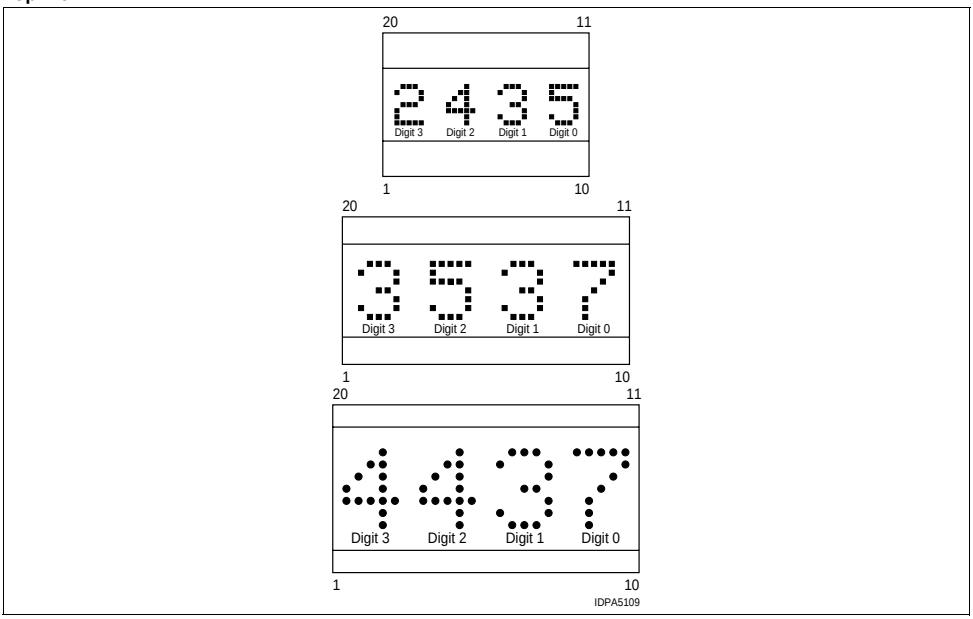
PD353X Dimensions in mm (inch)



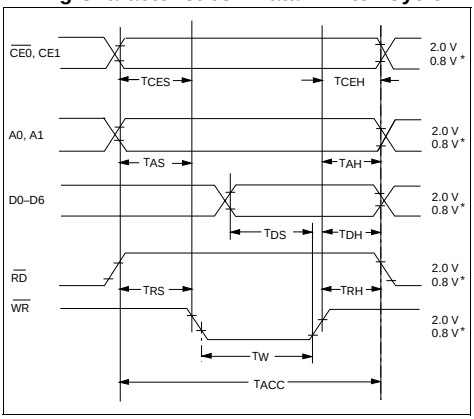
PD443X Dimensions in mm (inch)



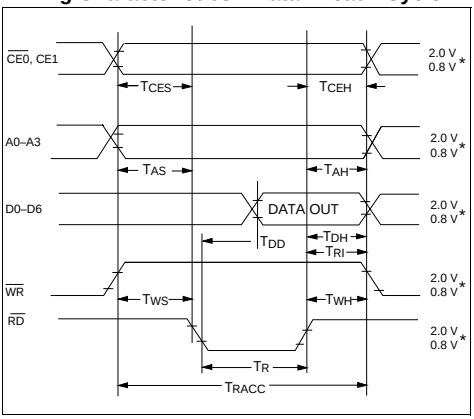
Top View



Timing Characteristics—Data “Write” Cycle



Timing Characteristics—Data “Read” Cycle



Notes:

1. Wait 1.0 µs between any Reads or Writes after writing a Control Word with a Clear (D7=1). Wait 1.0 µs between any Reads or Writes after Clearing a Control Word with a Clear (D7=0). All other Reads and Writes can be back to back.
2. All input voltages are V_{IL}=0.8 V, V_{IH}=2.0 V.
3. These waveforms are not edge triggered.
4. Data out voltages are measured with 100 pF on the data bus and the ability to source = –40 mA and sink=1.6 mA The rise and fall times are 60 ns. V_{OL}=0.4 V, V_{OH}=2.4 V.

Switching Specifications (V_{CC}=4.5 V)

Write Cycle Timing					
Para-meter	**Description**	**Specification Minimum**			
		–40°C	**25°C**	**85°C**	**Units**
T_{CLR} (1)	Clear RAM	1.0	1.0	1.0	µs
T_{CLRD} (1)	Clear RAM Disable	1.0	1.0	1.0	µs
T_{AS}	Address Setup	10	10	10	ns
T_{CES}	Chip Enable Setup	0	0	0	ns
T_{RS}	Read Enable Setup	10	10	10	ns
T_{DS}	Data Setup	20	30	50	ns
T_{W}	Write Pulse	60	70	90	ns
T_{AH}	Address Hold	20	30	40	ns
T_{DH}	Data Hold	20	30	40	ns
T_{CEH}	Chip Enable Hold	0	0	0	ns
T_{RH}	Read Enable Hold	20	30	40	ns
T_{ACC}	Total Access Time = Setup Time + Write Time + Hold Time	90	110	140	ns

Switching Specifications (V_{CC}=4.5 V)

Read Cycle Timing					
Para-meter	**Description**	**Specification Minimum**			
		–40°C	**25°C**	**85°C**	**Units**
T_{AS}	Address Setup	0	0	0	ns
T_{CES}	Chip Enable	0	0	0	ns
T_{WS}	Write Enable Setup	20	30	40	ns
T_{DD}	Data Delay Time	100	150	175	ns
T_{R}	Read Pulse	150	175	200	ns
T_{AH}	Address Hold	0	0	0	ns
T_{DH}	Data Hold	0	0	0	ns
T_{TRI}	Time to Tristate (Max. time)	30	40	50	ns
T_{CEH}	Chip Enable Hold	0	0	0	ns
T_{WH}	Write Enable Hold	30	40	50	ns
T_{ACC}	Total Access Time = Setup Time + Read Time + Time to Tristate	200	245	290	ns
T_{WAIT} (1)	Wait Time between Reads	0	0	0	ns

DC Characteristics at 25°C

Parameter	Limits				Conditions
	Min.	Typ.	Max.	Units	
V_{CC}	4.5	5.0	5.5	Volts	Nominal
I_{CC} (Blank)	—	2.5	3.5	mA	V_{CC}=5.0 V, A2=1, all other inputs low.
I_{CC} 80 LEDs/unit (100% Bright) PD243X PD353X PD443X	—	 115 145 150	 130 165 170	 mA mA mA	 V_{CC}=5.0 V V_{CC}=5.0 V V_{CC}=5.0 V
V_{IL}	—	—	0.8	Volts	V_{CC}=4.5 V to 5.5 V
V_{IH}	2.0	—	—	Volts	V_{CC}=4.5 V to 5.5 V
I_{IL} (except D0 to D7) [1]	25	—	100	µA	V_{CC}=4.5 V to 5.5 V, V_{IN}=0.8 V
V_{OL}	—	—	0.4	Volts	V_{CC}=4.5 V to 5.5 V
V_{OH}	2.4	—	—	Volts	V_{CC}=4.5 V to 5.5 V
I_{OH}	–8.9	—	—	mA	V_{CC}=4.5 V, V_{OH}=2.4 V
I_{OL}	1.6	—	—	mA	V_{CC}=4.5 V, V_{OL}=0.4 V
Data I/O Bus Loading	—	—	100	pF	—
Clock I/O Bus Loading	—	—	240	pF	—

1) D0 to D7 have no pull-up resistors so current is negligible.

Pin Assignments and Definitions

Pin	Function	Definition	Pin	Function	Definition
1	$\overline{RD}$	Active low, will enable a processor to read all registers in the display.	11	$\overline{WR}$	Write. Active low. If the device is selected, a low on the write input loads the data into memory.
2	CLK I/O	If CLK SEL (pin 3) is low, then expect an external clock source into this pin. If CLK SEL is high, then this pin will be the master or source into this pin. If CLK SEL is high, then this pin will be the master or source for all other devices which have CLK SEL low.	12	D7	Data Bus bit 7 (MSB).
3	$\overline{CLKSEL}$	CLOCK SELECT determines the action of pin 2. CLK I/O, see the section on Cascading for an example.	13	D6	Data Bus bit 6.
4	$\overline{RST}$	Reset. Used to synchronize blinking. Will not clear the display. The reset pulse should be less than 1 ms	14	D5	Data Bus bit 5.
5	CE1	Chip enable (active high).	15	D4	Data Bus bit 4.
6	$\overline{CE0}$	Chip enable (active low).	16	D3	Data Bus bit 3.
7	A2	Address input (MSB).	17	D2	Data Bus bit 2.
8	A1	Address input.	18	D1	Data Bus bit 1.
9	A0	Address input (LSB).	19	D0	Data Bus bit 0 (LSB).
10	GND	Ground.	20	V_{CC}	Positive power pin.

Functional Description

The block diagram includes 5 major blocks and internal registers (indicated by dotted lines).

Display Memory consists of a 5 x 8 bit RAM block. Each of the four 8-bit words holds 7-bits of ASCII data (bits D0–D6) and an attribute select bit (Bit D6). The fifth 8-bit memory word is used as a control word register. A detailed description of the control register and its functions can be found in the Control Word section. Each 8-bit word is addressable and can be read from or written to.

The **Control Logic** dictates all of the features of the display device and is discussed in the Control Word section of this data sheet.

The **Character Generator** converts the 7-bit ASCII data into the proper dot pattern for the 128 characters shown in the character set chart.

The **Clock Source** can originate either from the internal oscillator clock or from an external source—usually from the output of another display in a multiple module array.

The **Display Multiplexer** controls all display output to the digit drivers so no additional logic is required for a display system.

The **Column Drivers** are connected directly to the display.

The **Display** has four digits. Each of the four digits is com-prised of 35 LEDs in a 5 x 7 dot array which makes up the alphanumeric characters.

The intensity of the display can be varied by the Control Word in steps of 0% (Blank), 25%, 50%, and full brightness.

The **Reset** pin when activated clears the internal counter. A reset is usually done after power up and is of very short duration-nanoseconds or microseconds. If the reset pin is held low for a longer time (milliseconds) some or all LEDs in the bottom row may light up. The appearance of lit LEDs during a “reset” is not an indication of a malfunctioning part. It is advisable to keep the reset pulse as short as possible to avoid displaying a row of lit LEDs.

Microprocessor Interface

The interface to the microprocessor is through the address lines. (A0–A2), the data bus (D0–D7), two chip select lines ($\overline{CE0}$, CE1), and read ($\overline{RD}$) and write ($\overline{WR}$) lines.

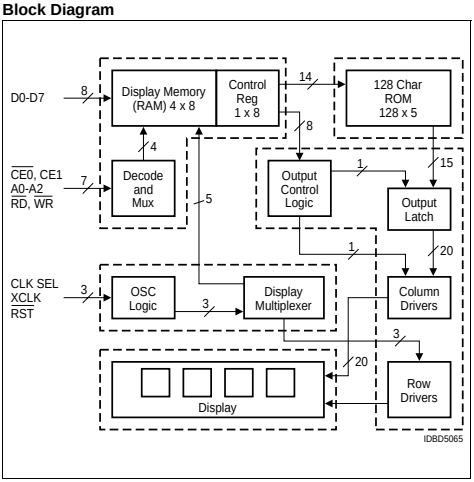
The $\overline{CE0}$ should be held low when executing a read, or write operation. CE1 must be held high.

The read and write lines are both active low. During a valid read the data input lines (D0–D7) become outputs. A valid write will enable the data as input lines.

Input Buffering

If a cable length of 6 inches or more is used, all inputs to the display should be buffered with a tri-state non-inverting buffer mounted as close to the display as conveniently possible. Recommended buffers are: 74LS245 for the data lines and 74LS244 for the control lines.

Block Diagram



Mode Selection

$\overline{CEO}$	CE1	$\overline{RD}$	$\overline{WR}$	Operation
0	1	0	0	None
1	X	X	X	None
X	0	X	X	None
X	X	1	1	None

0=Low logic level, 1=High logic level, X=Don’t care

Data Input Commands

$\overline{CEO}$	CE1	$\overline{RD}$	$\overline{WR}$	A2	A1	A0	D7	D6	D5	D4	D3	D2	D1	D0	Operation
1	0	X	X	X	X	X	X	X	X	X	X	X	X	X	No Change
0	1	0	1	1	0	0	X	X	X	X	X	X	X	X	Read Digit 0 Data to Bus
0	1	1	0	1	0	0	0	0	1	0	0	1	0	0	($) Written to Digit 0
0	1	1	0	1	0	1	0	1	0	1	0	1	1	1	(W) Written to Digit 1
0	1	1	0	1	1	0	0	1	1	0	0	1	1	0	(f) Written to Digit 2
0	1	1	0	1	1	1	0	0	1	1	0	0	1	1	(3) Written to Digit 3
0	1	1	0	1	0	0	1	X	X	X	X	X	X	X	Char. Written to Digit 0 and Cursor Enabled

There are five registers within the display. Four of these registers are used to hold the ASCII/attribute code of the four display characters. The fifth register is the Control Word, which is used to blink, blank, clear, or dim the entire display, or to change the presentation (attributes) of individual characters.

Adressing

The addresses within the display device are shown below. Digit 0 is the rightmost digit of the display, while digit 3 is on the left. Although there is only one Control Word, it is duplicated at the four address locations 0–3. Data can be read from any of these locations. When one of these locations is written to, all of them will change together.

Address			Contents
A2	A1	A0	
0	X	X	Control Word
1	0	0	Digit 0 (rightmost)
1	0	1	Digit 1
1	1	0	Digit 2
1	1	1	Digit 3 (leftmost)

Bit D7 of any of the display digit locations is used to allow an attribute to be assigned to that digit. The attributes are discussed in the next section. If Bit D7 is set to a one, that character will be displayed using the attribute. If bit D7 is cleared, the character will display normally.

Control Word

When address bit A2 is taken low, the Control Word is accessed. The same Control Word appears in all four of the lower address spaces of the display. Through the Control Word, the display can be cleared, the lamps can be tested, display brightness can be selected, and attributes can be set for any characters which have been loaded with their most significant bit (D7) set high.

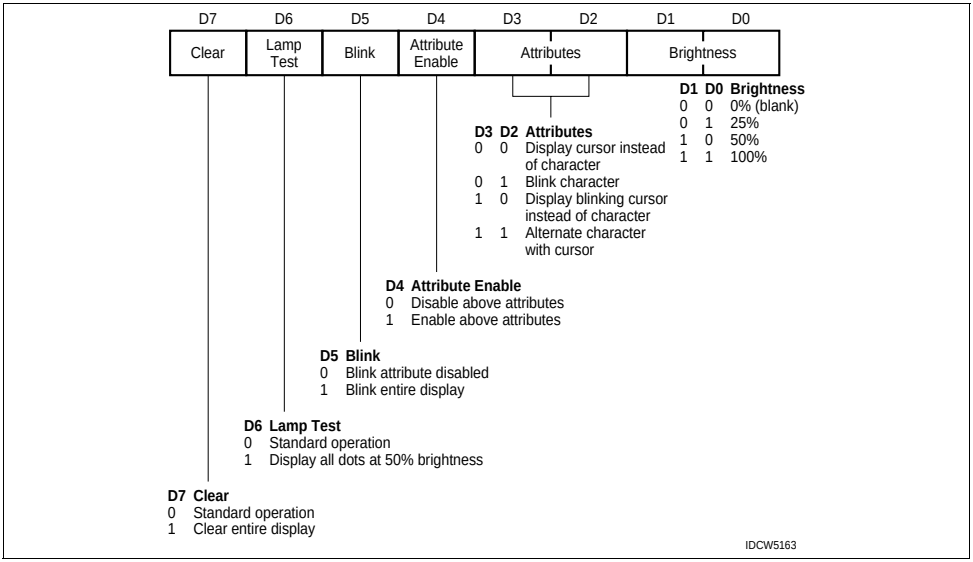
Brightness (D0, D1): The state of the lower two bits of the Control Word are used to set the brightness of the entire display, from 0% to 100%. The table below shows the correspondence of these bits to the brightness.

D7	D6	D5	D4	D3	D2	D1	D0	Operation
0	0	X	X	X	X	0	0	Blank
0	0	X	X	X	X	0	1	25% brightness
0	0	X	X	X	X	1	0	50% brightness
0	0	X	X	X	X	1	1	Full brightness

X=don't care

Attributes (D2–D4): Bits D2, D3, and D4 control the visual attributes (i.e., blinking) of those display digits which have been written with bit D7 set high. In order to use any of the four attributes, the Cursor Enable bit (D4 in the Control Word) must be set. When the Cursor Enable bit is set, and bit D7 in a character location is set, the character will take on one of the following display attributes.

Control Word Format



D7	D6	D5	D4	D3	D2	D1	D0	Operation
0	0	0	0	X	X	B	B	Disable highlight attribute
0	0	0	1	0	0	B	B	Display cursor* instead of character
0	0	0	1	0	1	B	B	Blink single character
0	0	0	1	1	0	B	B	Display blinking cursor* instead of character
0	0	0	1	1	1	B	B	Alternate character with cursor*

*"Cursor"= all dots in a single character space lit to half brightness
X=Don't care
B=Depends on the selected brightness.

Attributes are non-destructive. If a character with bit D7 set is replaced by a cursor (Control Word bit D4 is set, and D3=D2=0) the character will remain in memory and can be revealed again by clearing D4 in the Control Word.

Blink (D5): The entire display can be caused to blink at a rate of approximately 2.0 Hz by setting bit D5 in the Control Word. This blinking is independent of the state of D7 in all character locations.

To synchronize the blink rate in a bank of these devices, it is necessary to tie all devices' clocks and resets together as described in a later section of this data sheet.

D7	D6	D5	D4	D3	D2	D1	D0	Operation
0	0	1	X	X	X	B	B	Blinking display

Lamp Test (D6): When the Lamp Test bit is set, all dots in the entire display are lit at half brightness. When this bit is cleared, the display returns to the characters that were showing before the lamp test.

D7	D6	D5	D4	D3	D2	D1	D0	Operation
0	1	0	X	X	X	X	X	Lamp test

Clear Data (D7): When D7 is set (D7=1) in the Control Word, all (display) memory bits are reset to zero and the display goes blank.

D7	D6	D5	D4	D3	D2	D1	D0	Operation
1	0	X	X	X	X	X	X	Clear

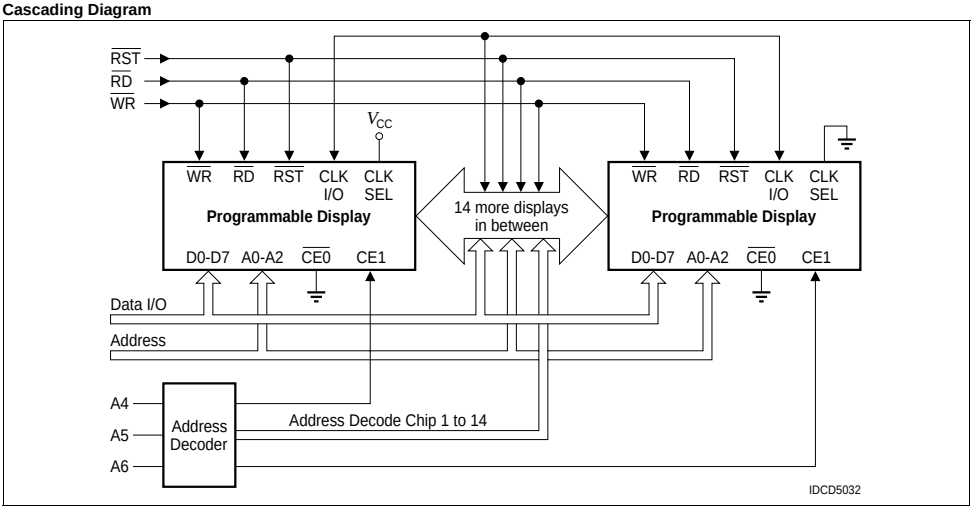
A second control word must be written into the chip with D7 reset (D7=0) to set up attributes and brightness levels.

The SMC-4740 oscillator is designed to drive up to 16 displays with input loading of 15 pF each.

The general requirements for cascading 16 displays are:

1. Determine the correct address for each display.
2. Tie $\overline{CE0}$ to ground and use CE1 from an address.
3. Select one of the displays to provide the clock for the other displays.
4. Tie $\overline{CLKSEL}$ to ground on other displays.
5. Use $\overline{RST}$ to synchronize the blinking between the displays.

Cascading Diagram



How to Load Information Into the Display

Information loaded into the display can be either ASCII data or Control Word data. The following procedure (see also Typical Loading Sequence) will demonstrate a typical loading sequence and the resulting visual display. The word STOP is used in all of the following examples.

Set Brightness

Step 1 Set the brightness level of the entire display to your preference (example: 100%)

Load Four Characters

Step 2 Load an “S” in the left hand digit.

Step 3 Load a “T” in the next digit.

Step 4 Load an “O” in the next digit.

Step 5 Load a “P” in the right hand digit.

If you loaded the information correctly, the display now should show the word “STOP.”

Blink a Single Character

Step 6 Into the digit, second from the right, load the hex code “CF,” which is the code for an “O” with the D7 bit added as a control bit.

Note:

The “O” is the only digit which has the control bit (D7) added to normal ASCII data.

Step 7 Load enable blinking character into the control word register. The display should show “STOP” with a flashing “O”.

Add Another Blinking Character

Step 8 Into the left hand digit, load the hex code “D3” which gives an “S” with the D7 bit added as a control bit. The display should show “STOP” with flashing “O” and a flashing “S.”

Alternate Character/Cursor Enable

Step 9 Load enable alternate character/cursor into the control word register. The display now should show “STOP” with the “O” and the “S” alternating between the letter and cursor (all dots lit).

Initiate Four Character Blinking

(Regardless of Control Bit setting)

Step 10 Load enable display blinking. The display now should show the entire word “STOP” blinking.

Typical Loading Sequence

	$\overline{CEO}$	CE1	$\overline{RD}$	$\overline{WR}$	A2	A1	A0	D7	D6	D5	D4	D3	D2	D1	D0	Display
1.	L	H	H	L	L	X	X	0	0	0	0	0	0	1	1	
2.	L	H	H	L	H	H	H	0	1	0	1	0	0	1	1	S
3.	L	H	H	L	H	H	L	0	1	0	1	0	1	0	0	ST
4.	L	H	H	L	H	L	H	0	1	0	0	1	1	1	1	STO
5.	L	H	H	L	H	L	L	0	1	0	1	0	0	0	0	STOP
6.	L	H	H	L	H	L	H	1	1	0	0	1	1	1	1	STOP
7.	L	H	H	L	L	X	X	0	0	0	1	0	1	1	1	STO*P
8.	L	H	H	L	H	H	H	1	1	0	1	0	0	1	1	S*TO*P
9.	L	H	H	L	L	X	X	0	0	0	1	1	1	1	1	S†TO†P
10.	L	H	H	L	L	X	X	0	0	1	0	0	0	1	1	S*T*O*P*

* Blinking character
† Character alternating with cursor (all dots lit)

Electrical and Mechanical Considerations

The CMOS IC of the display is designed to provide resistance to both Electrostatic Discharge Damage and Latch Up due to voltage or current surges. Several precautions are strongly recommended to avoid overstressing these built-in safeguards.

ESD Protection

Display users should be careful to handle the devices consistent with Standard ESD protection procedures. Operators should wear appropriate wrist, ankle or feet ground straps and avoid clothing that collects static charges. Work surfaces, tools and transport carriers that come into contact with unshielded devices or assemblies should also be appropriately grounded.

Latch up Protection

Latch up is a condition that occurs in CMOS ICs after the input protection diodes have been broken down. These diodes can be reversed through several means:

V_{IN}<GND, V_{IN}>V_{CC} + 0.5 V, or through excessive currents forced on the inputs. When these situations exist, the IC may develop the response of an SCR and begin conducting as much as one amp through the V_{CC} pin. This destructive condition will persist (latched) until device failure or the device is turned off.

The Voltage Transient Suppression Techniques and buffer interfaces for longer cable runs help considerably to prevent latch conditions from occurring. Additionally, the following Power Up and Power Down sequence should be observed.

Power up Sequence

1. Float all active signals by tri-stating inputs to displays.
2. Apply V_{CC} and GND to the display.
3. Apply active signals to the displays by enabling all input signals per application.

Power Down Sequence

1.Float all active signals by tri-stating the inputs to the display.

2.Turn off the power to the display.

Soldering Considerations

These displays can be hand soldered with SN63 solder using a grounded iron set to 260°C.

Wave soldering is also possible following these conditions: Preheat that does not exceed 93°C on the solder side of the PC board or a package surface temperature of 85°C. Water soluble organic acid flux (except carboxylic acid) or rosin-based RMA flux without alcohol can be used.

Wave temperature is 245°C ±5°C with a dwell between 1.5 sec to 3.0 sec. Exposure to the wave should not exceed temperatures above 260°C, for 5 sec at 1.59 mm (0.063") below the seating plane. The packages should not be immersed in the wave.

Voltage Transient Suppression

It has become common practice to provide 0.01 µF bypass capacitors liberally in digital systems. Like other CMOS circuitry, the Intelligent Display controller chip has very low power consumption and the usual 0.01 µF would be adequate were it not for the LEDs. To prevent power supply transients, capacitors with low inductance and high capacitance at high frequencies are required. This suggests a solid tantalum or ceramic disc for high frequency bypass. For multiple display module systems distribute the bypass capacitors evenly, keeping capacitors as close to the power pins as possible. Use a 0.01 µF capacitor for each display module and a 22 µF for every third display module.

Notes:

1. A2 must be held high for ASCII data.
2. Bit D7=1 enables attributes for the assigned digit.

Character Set

ASCII CODE				D0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
				D1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
				D2	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
				D3	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
D6	D5	D4	HEX		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0	0	0																	
0	0	1	1																	
0	1	0	2																	
0	1	1	3																	
1	0	0	4																	
1	0	1	5																	
1	1	0	6																	
1	1	1	7																	

IDCS5087

Revision History: 2006-01-23
Previous Version: 2004-12-09

Page	Subjects (major changes since last revision)	Date of change
all	Lead free device	2006-01-23

Attention please!
The information describes the type of component and shall not be considered as assured characteristics.
Terms of delivery and rights to change design reserved. Due to technical requirements components may contain dangerous substances. For information on the types in question please contact our Sales Organization.
If printed or downloaded, please find the latest version in the Internet.
Packing
Please use the recycling operators known to you. We can also help you – get in touch with your nearest sales office. By agreement we will take packing material back, if it is sorted. You must bear the costs of transport. For packing material that is returned to us unsorted or which we are not obliged to accept, we shall have to invoice you for any costs incurred.
Components used in life-support devices or systems must be expressly authorized for such purpose! Critical components[1)] may only be used in life-support devices or systems[2)] with the express written approval of OSRAM OS.
[1)] A critical component is a component used in a life-support device or system whose failure can reasonably be expected to cause the failure of that life-support device or system, or to affect its safety or the effectiveness of that device or system.
[2)] Life support devices or systems are intended (a) to be implanted in the human body, or (b) to support and/or maintain and sustain human life. If they fail, it is reasonable to assume that the health and the life of the user may be endangered.

Post Solder Cleaning Procedures

The least offensive cleaning solution is hot D.I. water (60°C) for less than 15 minutes. Addition of mild saponifiers is acceptable. Do not use commercial dishwasher detergents.

For faster cleaning, solvents may be used. Carefully choose the solvents as some may chemically attack the package. Maximum exposure should not exceed two minutes at elevated temperatures. Acceptable solvents are: TF (trichlorotrifluoroethane), TA, 111 Trichloroethane, and unheated acetone. [1]

Note:

1) Acceptable commercial solvents are: Basic TF Arklone P. Genesolv D, Genesolv DA, BlacoTron TF and Blaco-Tron TA.

Do not use solvents containing alcohol, methanol, methylene chloride, ethanol, TP35, TCM, TMC, TMS+, TE, and TES. Since many commercial mixtures exist, you should contact your preferred solvent vendor for chemical composition information. Some major solvent manufacturers are: Allied Chemical Corporation, Specialty Chemical Division, Morristown, NJ; Baron-Blakeslee, Chicago, IL; Dow Chemical, Midland, MI; E.I. DuPont de Nemours & Co., Wilmington, DE.

For further information refer to Appnotes 18 and 19.

An alternative to soldering and cleaning the display modules is to use sockets. Naturally, 20 pin DIP sockets 15.24 mm (0.600") wide with 2.54 mm (0.100") centers work well for single displays. Multiple display assemblies are best handled by longer SIP sockets or DIP sockets when available for uniform package alignment. Socket manufacturers include: Aries Electronics, Inc., Frenchtown, NJ; Garry Manufacturing, New Brunswick, NJ; Robinson-Nugent, New Albany, IN; and Samtec Electronic Hardware, New Albany, IN.

For further information refer to Appnote 22.

Optical Considerations

The character heights of these displays allows readability up to eight feet. Proper filter selection allows the user to build a display that can be used over this distance.

Filters allow the user to enhance the contrast ratio between a lit LED and the character background. This will maximize discrimination of different characters as perceived by the display user. The only limitation is cost. So first consider the ambient lighting environment to maximize the cost benefit ratio for using filters.

Incandescent (with almost no green) or fluorescent (with almost no red) lights do not have the flat spectral response of sunlight. Plastic band-pass filters are inexpensive and effective in optimizing contrast ratios. The PD2435/3535/4435 is high efficiency red display and should be matched with a long wavelength pass filter in the 570 nm to 590 nm range. The PD2436/3536/4436 is a standard red display and should be matched with a long wavelength pass filter in the 600 nm to 620 nm range. The PD2437/3537/4437 should be matched with a yellow-green band-pass filter that peaks at 565 nm. For displays of multiple colors, neutral density grey filters offer the best compromise.

Additional contrast enhancement can be gained through shading the displays. Plastic band-pass filters with built-in louvers offer the “next step up” in contrast improvement. Plastic filters can be further improved with anti-reflective coatings to reduce glare. The trade-off is “fuzzy” characters. Mounting the filters close to the display reduces this effect. Care should be taken not to overheat the plastic filters by allowing for proper air flow.

Optimal filter enhancements for any condition can be gained through the use of circular polarized, anti-reflective, band-pass filters. The circular polarizing further enhances contrast by reducing the light that travels through the filter and reflects back off the display to less than 1%. Proper intensity selection of the displays will allow 10,000 foot candle sunlight viewability.

Several filter manufacturers supply quality filter materials. Some of them are: Panelgraphic Corporation, W. Caldwell, NJ; SGL Homalite, Wilmington, DE; 3M Company, Visual Products Division, St. Paul, MN; Polaroid Corporation, Polarizer Division, Cambridge, MA; Marks Polarized Corporation, Deer Park, NY; Hoya Optics, Inc., Fremont, CA.

One last note on mounting filters: recessing display and bezel assemblies is an inexpensive way to provide a shading effect in overhead lighting situations. Several Bezel manufacturers are: R.M.F. Products, Batavia, IL; Nobex Components, Griffith Plastic Corp., Burlingame, CA; Photo Chemical Products of California, Santa Monica, CA; I.E.E.Atlas, Van Nuys, CA.

See Appnote 23.

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