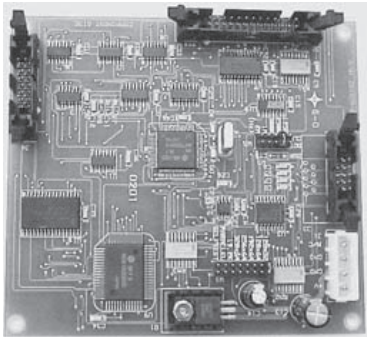**VISHAY**

Graphic Plasma
Display Controller

The PDS-500/-1 is a plasma graphic display controller which can drive a variety of popular plasma displays having a common 14 pin video interface. The controller can clock displays with 128 x 32, 128 x 64, 192 x 64, 256 x 64, and 320 x 64 pixel formats. When integrated with a display and optional DC/DC converter, the ASCII input graphics controller is the final ingredient needed to form a highly reliable, rugged, slim profile DC plasma display sub-system.

Interface to the PDS-500/-1 is through an 8-bit parallel or serial interface. The interface allows for efficient handshaking and flow of bidirectional data.

VISHAY DALE's DC Plasma Displays feature a patented open construction display technology assuring a stable, flicker free screen.

ENVIRONMENTAL SPECIFICATIONS

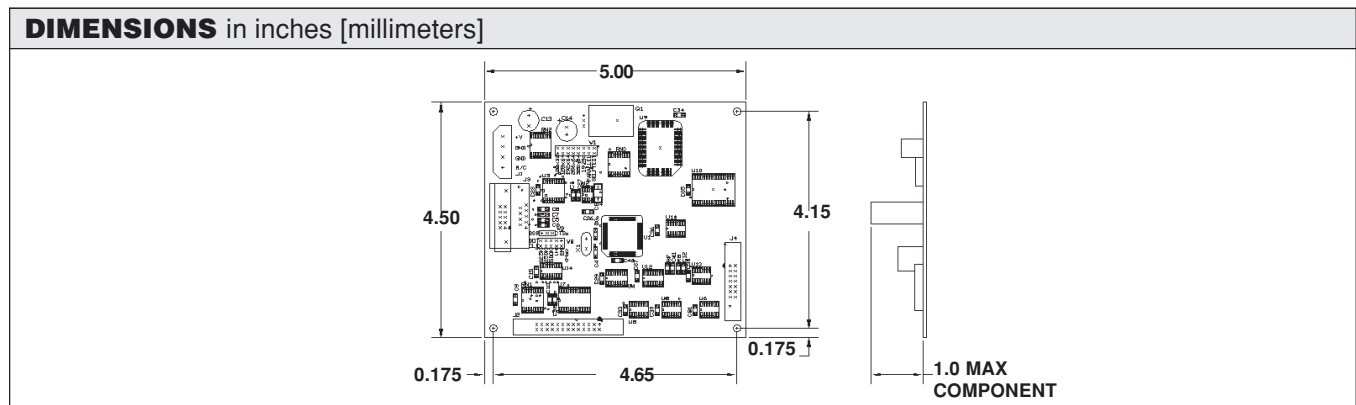|	
Operating temperature	- 20 to + 70 C
Storage temperature	- 55 to + 85 C
Operating humidity	90% RH non-condensing
Shock	30G
Vibration	0.018" DA, 10-50Hz
	2G acceleration from
	50 - 2000Hz log. sweep

FEATURES

- Drives 128 x 32, 128 x 64, 192 x 64, 256 x 64, and 320 x 64 displays for bright and vivid graphics
- Parallel interface or RS-232 serial interface
- Powerful software commands make display integration simple and efficient
- Single + 5Vdc (PDS-500) or + 12Vdc (PDS-500-1) supply required
- Jumper selected dot clock for optimum refresh rate
- Jumper selected display format
- Jumper selected communication rate and port
- Three fonts: 4 x 5, 5 x 7, and 10 x 14
- Custom non-standard characters may be loaded
- Graphic pictures (images) may be loaded
- Multiple page support for instant screen changes and animation

POWER SUPPLY (recommended)

	VOLTAGE (TOLERANCE)	CURRENT
PDS-500	+ 5Vdc (± 5%)	100mA max.
PDS-500-1	+ 12Vdc (+ 8V to + 24V)	100mA max.

POWER SUPPLY CONNECTION J1

PIN	PDS-500	PDS-500-1
1	+ 5V	+ 12Vdc
2	Ground	Ground
3	Ground	Ground
4	Reserved	Reserved

mates to Amp # 1-480424-0 housing (1 required)
350689-1 socket pins (4 required)

ORDERING INFORMATION

DESCRIPTION	PART NUMBER
Display Controller (+ 5V)	PDS-500
Display Controller (+ 12V)	PDS-500-1
J1, Power connector kit	280108-05
J2, Data connector (parallel interface, 26 pin IDC)	280105-01
J3, Data connector (serial interface, 10 pin IDC)	280105-02
J4, Data connector (display interface)	280105-05
Standard warranty is 1 year parts and labor.	

DIMENSIONS in inches [millimeters]

FONT TABLES

FONT 1
Upper Nibble D7 – D4

Lower Nibble D3 – D0 (rows 0–F, columns 0–F)

FONT 2
Upper Nibble D7 – D4

Lower Nibble D3 – D0 (rows 0–F, columns 0–F)

FONT 3
Upper Nibble D7 – D4

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0				Ø	@	P	'	ᴘ	■							
1			!	1	A	Q	a	q	Ω							
2			"	2	B	R	b	r	°							
3			#	3	C	S	c	s	↑							
4			$	4	D	T	d	t	↓							
5			%	5	E	U	e	u	←							
6			&	6	F	V	f	v	→							
7			'	7	G	W	g	w								
8			(	8	H	X	h	×								
9			)	9	I	Y	i	y								
A			＊	:	J	Z	j	z								
B			+	;	K	[	k	{								
C			,	<	L	\	l										
D			−	=	M	]	m	}								
E			.	>	N	^	n	~								
F			/	?	O	_	o	△								

PARALLEL INTERFACE

J2, PARALLEL DATA CONNECTOR. Mates with 3M #3399-0000 or AMP 746285-6 26 pin, IDC connector. Note: PAR should be jumper selected on jumper block W1 for proper parallel interface operation.

DESCRIPTION OF SIGNALS

PIN NO	FUNCTION	DESCRIPTION
1,3,5,7 9,11,13 15	D0 - D7 (Data Bus)	Data written to and read from (input/output) the display unit through an 8 bit bi-directional data bus.
17	WRITE (WR) (input)	Write data on low to high trans.
21	READ (RD) (input)	Read data while low.
6,8,12, 14,16, 18,20,22	N/C	Not connected.
23	RESET (input)	Reset display to power-up condition when low, operate while high.
19	US (Unit Select) (input)	Read and Write commands only influence display while US is low.
25	BLANK (BL) (input)	Blank display while BL is low but maintain cursor and data.
4	BRIGHT/DIM (input)	Display at full brightness when high or half brightness when low.
24	BUSY (BU) (output)	When BUSY is high, no further data or commands should be given.
2,26	GROUND	Common to both power supply input and host data interface.
10	DATA PRESENT (DP) (output)	Data is ready to be read when the DATA PRESENT signal is high.

See timing diagram below.

INPUT/OUTPUT TIMING DIAGRAM, J2

BU - DP - WR - RD - US	FUNCTION
L - X - ↑ - H - L	Write character or control code.
X - H - H - L - L	Read data from display while low.
X - X - X - X - H	Input/Output inhibited.
Logic Level:	L = 0.0V min. to 0.8V max. H = 2.2V min. to 5.0V max. X = Don't Care

NOTE - Input load is one 74HCT type input with 4.7k to Vcc.

 Outputs are 74HC type.

Once data write is complete, BUSY signal is output. BUSY signal = "1" during data disposition and while the communication buffer is full.

DATA WRITE

When WR changes from "0" to "1" while US = "0" and RD = "1", data is latched. All data and character codes are shown in the Command Set section. WRITE signal should be normally high, strobe low then high when writing.

DATA READ

When RD = "0" while US = "0", WR = "1", and DP = "H", data may be read by the host. READ signal should be normally high, low when reading.

SERIAL INTERFACE

J3, SERIAL INTERFACE CONNECTOR. Optional serial interface, mates with AMP 10-pin IDC type 746288-1 or equivalent. The baud rate is jumper selected by jumper block W1 for 9600 or 19.2K baud.

SERIAL INTERFACE PIN CONNECTIONS.

DISPLAY CONNECTOR J3 AND HOST CONNECTION					
PIN	DESCRIPTION	DB-9	DB-25	DESCRIPTION	
1	n/c (reserved)				
2	n/c (reserved)				
3	TxD (output)	2	3	R x D	
4	CTS (input)	7	4	RTS	
5	RxD (input)	3	2	T x D	
6	RTS (output)	8	5	CTS	
7	n/c (reserved)				
8	n/c (reserved)				
9	GND	5	7	GND	
10	n/c (reserved)				

W1 JUMPER (CONFIGURATION)

Shunt pairs of pins on jumper W1 to select display format, serial interface baud rate, parallel interface operation, or self-test functions.

128 x 32	APD-128G032/A
128 x 64	APD-128G064/D
192 x 64	APD-192G064/-x
256 x 64	APD-256G064/A/-x
320 x 64	APD-320G064/-x
19.2K	19,200 baud serial communications
PARALLEL	8-bit parallel interface communications
SELF TEST	Self Test, graphic mode

At least 1 jumper must be placed to select display pixel format.

Default communications is serial 9600 baud, unless 19.2K or PARALLEL is jumpered.

Jumpering both SELF TEST and PARALLEL will run a self demo configured for the 128 x 64 display.

Note: Display must be reset (power-up condition) to activate jumper selection.

W2 JUMPER (DOT CLOCK)

The following dot clock settings are recommended for the various display formats:

DISPLAY SIZE	JUMPER SETTING	SCAN RATE
128 x 32	500 (250)kHz	122 (61)Hz
128 x 64	1MHz (500KHz)	122 (61)Hz
192 x 64	1MHz	81Hz
256 x 64	2MHz (1MHz)	122Hz (61Hz)
320 x 64	2MHz	97Hz

The scan rate may affect the dim brightness level, there should be little or no affect on the bright level.

DISPLAY INTERFACE

J4, DISPLAY INTERFACE CONNECTOR. Mates with AMP 14-pin IDC type 746285-2 or equivalent. Connects directly to VISHAY DALE display models APD-128G032/A, APD-128G064/D, APD-192G064/-x, APD-256G064/-x, and APD-320G064/-x.

DISPLAY INTERFACE PIN CONNECTIONS	
PIN NUMBER	DESCRIPTION
1	display enable
2	GND
3	row data (VSYNC)
4	GND
5	row clock (HSYNC)
6	GND
7	column latch (HSYNC)
8	GND
9	dot clock
10	GND
11	dot data
12	GND
13	no connection (reserved)
14	GND

For an explanation of these signals, refer to the appropriate display data sheet.

COMMAND STRUCTURE, TEXT MODE (SOFTWARE INSTRUCTIONS)

The ASCII control code characters from 00h to 1Fh are reserved by the controller for the command interpreter. A brief listing of the available commands and their description follows. Text mode operation is not true text mode, but rather simulated in graphics mode. Text and Graphics may be mixed on the same screen.

HEX CODE	NUMBER OF BYTES	TEXT FUNCTIONS
00-07		No function
08	1	Back Space Cursor: Moves the cursor 1 column to the left in the current row. If the cursor is at the 1st column it will move to the end of the previous line.
09	1	Horizontal Tab: Moves the cursor 1 column to the right. Will wrap around until the end of the screen. If mode is set to SCROLL then the screen will scroll up one line at the last character position of the last row, if not in SCROLL mode then the cursor will wrap to the HOME position.
0A	1	Line Feed: Moves cursor down one row while remaining in same column position. If mode is set to SCROLL, when the cursor is at bottom row of screen, the screen will move (scroll) up 1 row and bottom row will be cleared (filled with spaces) when line feed is invoked. If not in SCROLL mode then the cursor will wrap to the first row.
0B	1	Vertical Tab: Moves cursor up one row while remaining in the same column position. The cursor will wrap to the bottom row after the top row.
0C	1	Clear Screen: Fill the screen with blank characters, cursor moves to HOME position.
0D	1	Carriage Return: Moves cursor to the first column of the present row.
0E	1	Home Cursor: Moves cursor to the 1st character position of the 1st row, the HOME position.
0F		NO OPERATION
10		NO OPERATION
11	3	Position Cursor: Moves cursor to a specified column, row address depending upon next 2 bytes sent. The format is x,y or col, row. The upper left corner is 0,0.
12	2	Select Cursor: Following byte selects cursor style: *01h = Blinking Underbar 02h = Non-Blinking Underbar 03h = Blinking Block 04h = Non-Display Cursor
13		NO OPERATION
14	2	Select Character Font: Following byte selects one of 4 character generator fonts: 01h = font 1: 4x5 character in 5x6 block *02h = font 2: 5x7 character in 6x8 block 03h = font 3: 10x14 character in 12x16 block The cursor is moved to the home position when changing fonts.
15	1	Select reverse video characters (black on orange)
16		NO OPERATION
17		NO OPERATION
18		NO OPERATION
19	1	*Select normal video characters (orange on black). This disables the previous command (15h).
1A		RESERVED, do not use
1B		see ESCAPE control codes
1C	1	Set to Scroll Mode: Sets the display mode so that whenever the cursor reaches the last position in the last column or a line feed occurs while cursor is on last row, the screen will scroll up one row. The top row of data will be lost and the bottom row of the display will be erased.
1D	1	*Set to AutoWrap Mode: In this mode, the cursor will automatically wrap around to the next row. When the last character position on the screen is reached, the cursor will return to HOME position.
1E	1	Blank Display: The display is blanked but display memory is maintained and new data can be entered.
1F	1	*UnBlank Display: The display is restored/turned to active state.

NOTE:"*" indicates power up default

COMMAND SET, GRAPHIC MODE (Software Instructions)

CURSOR LOCATION

All graphic cursor locations are based upon pixel location - NOT - character column and row locations. For example, the upper left hand corner is 000,000 (X,Y) while the lower right hand corner might be 127,063 (X,Y). The cursor indicates the upper left corner of the location of the character. The cursor auto-increments based upon the character font size by the width of the font. The graphic mode cursor is not visible, it may be desirable to turn-off the text mode cursor when performing graphics operations.

WRITE MODE

Within most commands, the LOGIC BYTE must be included:

0 = SET PIXELS   (turn-on foreground pixels)

1 = XOR PIXELS   (invert foreground pixels)

2 = RESET PIXELS   (turn-off foreground pixels)

3 = OVERWRITE   (turn-on foreground and turn-off background pixels, image write and graphic text commands only)

4 = REVERSE VIDEO OVERWRITE   (turn-off foreground and turn-on background pixels, image write and graphic text commands only)

FONT SIZE

The FONT SIZE must be written before text is written. There are three standard fonts included in the graphics mode. Refer to font tables for supported characters and fonts.

1 = FONT 1, a 4 x 5 character in a 5 x 6 block

2 = FONT 2, a 5 x 7 character in a 6 x 8 block

3 = FONT 3, a 10 x 14 character in a 12 x 16 block.

NOTE- In graphics mode, the LOGIC byte and FONT byte are sent in ASCII format. For example, to select font 2, send 32h -NOT 02h.

DATA FORMAT

All addresses must be sent in ASCII format. Column and row positions begin at the upper left hand corner at address 000,000 (X,Y). A pixel address consists of a column address followed by row address. Addresses are sent to the panel as a three character ASCII sequence for column (x) followed by a three character ASCII sequence for row (y). An example is the upper left hand pixel is 000,000 while the lower right hand corner is 127,063.

NOTE: Spaces and commas are shown in the graphic sequences only for clarity and must not occur in the actual commands transmitted to the panel.

GRAPHIC COMMANDS

HEX CODE	GRAPHIC FUNCTIONS
1B,41	Fill Area: logic byte, X1, Y1 (upper left corner), X2, Y2 (lower right corner). ESC A l xxx yyy xxx yyy
1B,42	Draw Box: logic byte, X1, Y1 (upper left hand corner) X2, Y2 (lower right hand corner). ESC B l xxx yyy xxx yyy
1B,43	Clear Screen: This command will clear the current graphic screen (all pixels off). To clear all graphics pages, see the ESC G sequence. ESC C
1B,44	Set Pixel (Dot) Command: logic byte (l), x,y pixel address, end of data delimiter. ESC D l xxx yyy ESC \(single pixel) ESC D l xxx yyy xxx yyy .... ESC \ (continuous)
1B,45	Draw Ellipse: logic byte, major axis intercept offset, minor axis intercept offset (axis's intercept offset is measured in pixels from the center point), center point, from angle theta (t), in degrees, to phi (p). A complete rotation would be from 001 to 360. ESC E l mmm www xxx yyy ttt ppp
1B,47	Clear all graphics pages. ESC G
1B,49	Write Graphic Image: logic byte, X1, Y1 (upper left hand corner), X2, Y2 (width and height), data. ESC I l xxx yyy xxx yyy ddd .... X1 start coordinate and X2 width must both be multiples of 8. The number of data bytes transmitted must be equal to (X2 width / 8) * Y2 height. The first data byte transmitted will map into the 8 pixels on the top line in the upper left hand corner of the image with the least significant bit at the left and the most significant bit at the right. Successive bytes will write to the next byte to the right. When all bytes are written for this line, the next byte will map into the left most byte of the next line down. Graphical representation of each data byte: lsb x x x x x x msb Graphical representation of data array: **data0 data1 ...** **data(width/8) data(width/8 + 1) ...** **data(2*width/8) data(2*width/8 + 1) ...** **data(n*width/8) data(n*width/8 + 1) ...** **data(height-1)*(width/8)...data(height)*(width/8)-1** Contact factory for free image editor and monochrome bitmap conversion utilities.
1B,4A	Read Graphic image: X1, Y1 (upper left corner), X2, Y2 (lower right corner). ESC J xxx yyy xxx yyy Graphic image information is returned by the display after receipt of this command. X1 start coordinate and X2 width must both be multiples of 8. Refer to the WRITE GRAPHIC IMAGE command for the data format returned by the display.
1B,4C	Draw Line(s): logic byte, X1, Y1 (beginning of line), X2, Y2 (end of line), data delimiter (for single lines) ESC L l xxx yyy xxx yyy ESC \ (for continuous lines) ESC L l xxx yyy xxx yyy ..... xxx yyy ESC /

GRAPHIC COMMANDS continued

SET DISPLAY PAGE: page

ESC P ppp

Sets the active page of the video RAM which is visible on the display. Page is a three byte value (ASCII representation). Default is page 000. See table for number of pages supported in each of the display formats.

DISPLAY FORMAT	NUMBER OF PAGES	
128 x 32	128	(000-127)
128 x 64	64	(000-063)
192 x 64	42	(000-041)
256 x 64	32	(000-031)
320 x 64	25	(000-024)

SET WRITE PAGE: PAGE

ESC Q ppp

Sets the active read/write page of video RAM on which all subsequent commands operate. Default is page 000. The write page may be different than the display page. Pages may be written while another page is displayed, invisible to the viewer.

Combine Pages: logic byte, p1 (source page 1), p2 (source page 2), p3 (destination page).

ESC R l ppp ppp ppp

Combines graphic information on source pages using logic write modes 0, 1, or 2 and places that information on the destination page.

Text Write: logic byte (l), font byte (f), x,y starting address, ASCII text. Wrap around will occur.

ESC T l f xxx yyy aaaa..aaaa ESC \

UPLOAD CUSTOM CHARACTER: FONT, DATA

ESC U f ddd...

The custom character becomes ASCII value FFh and replaces any character which may be mapped at that location. One custom character is allowed for each font. To restore the original default character mapped at location FFh, upload a blank character where all data bytes are zero. To use multiple custom characters in a single font, upload new data as needed. Custom characters previously printed to the screen will not change when a new character is loaded.
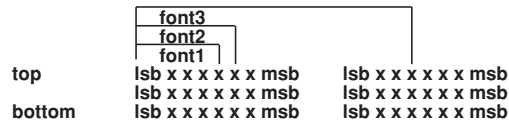
The number of data bytes is dependant on the font:

FONT	NUMBER OF DATA BYTES	WIDTH	HEIGHT	
1	6	5 bits	6 lines	(1 byte/line)
2	8	6 bits	8 lines	(1 byte/line)
3	32	12 bits	16 lines	(2 bytes/line)

For fonts 1 and 2, each byte represents a character line. The first byte is the top line of the character. Subsequent bytes map each line of the character. Typically, the right column and the bottom row of a character are blank for spaces between characters.

For font 3, two bytes (a word value) are required to represent each character line. The first byte represents the left part of the character, the second byte represents the right part of the character. The first word value is the top line of the character, subsequent words map each line of the character. Typically, the left and right columns and top and bottom rows of a character are blank for spaces between characters.

Graphical representation of character data:

```
                    font3
                    font2
                    font1
top         lsb x x x x x x msb    lsb x x x x x x msb
            lsb x x x x x x msb    lsb x x x x x x msb
bottom      lsb x x x x x x msb    lsb x x x x x x msb
```

Content he factory for free support to aid in generating character data.

POWER UP CONDITION

Immediately upon power up the following is set:

The module is in the graphics mode (text mode is simulated in graphics mode, no true text mode is supported).

The screen will have a message printed as follows:

RAM OK   ROM OK   mm-dd-yy

This message indicates the hardware test has passed successfully. The "mm-dd-yy" indicates the date the firmware was released.

Power up RESET cycle on display module takes approximately 250 mS to complete. It is suggested the user wait for that time period to elapse before entering data.

Disclaimer

All product specifications and data are subject to change without notice.

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