

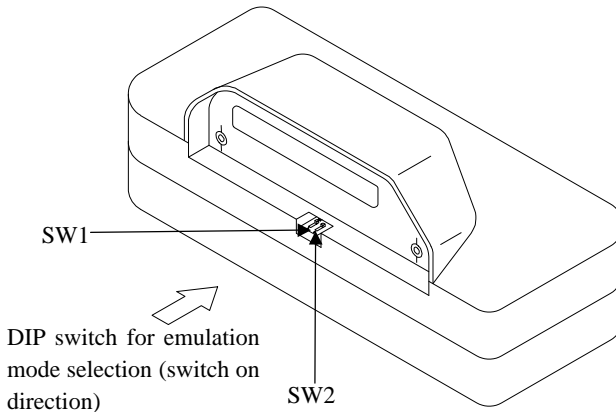
PD2100/2200 SERIES COMMAND EMULATION

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A. General Concept

This VFD customer display provides totally 5 emulation modes for software programming in controlling the display. The emulation mode is defined by adjusting the DIP SW on the back. See the figure below.



The relationship between the switch position and the emulation mode is summarized in the following table.

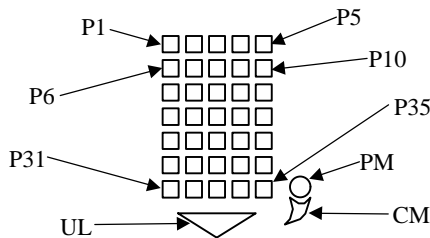
Emulation Mode	Futaba	Noritake	Aedex	ADM	Epson
SW 1	on	off	on	on	off
SW 2	on	on	off	off	off

Please note that the ADM emulation mode is only available on the models marked with “ADM” where the Aedex mode is not applicable. The Aedex emulation mode is available on the models not marked with “ADM” and where the ADM mode is not applicable. These DIP switches are not designed for changing every day and could be a little bit difficult to switch without proper tool. The switch positions must be changed only when power turned off to ensure appropriate operation.

All five emulation modes will be further explained later in this chapter, yet the followings are some brief introduction as they are compared to each other:

Mode	Futaba	Noritake	Aedex	ADM	Epson
Cursor	Blinking Block	Blinking Block	N.A.	N.A.	Non-displayable
Default mode	V. scroll up	Overwrite	N.A.	N.A.	Overwrite
User defined font	N.A.	2 characters	N.A.	N.A.	2 characters
Brightness control	YES	YES	NO	NO	YES
Pass through function	YES	YES	YES	NO	YES
Leading code change	YES	YES	YES	NO	NO
Font page select	YES	YES	NO	NO	YES
Timer clock	NO	NO	NO	NO	YES

On the VFD, there are totally at most 40 characters in 2 rows to be displayed at the same time, while each character displayed in the format of 5 by 7 rectangular dot matrix. To the lower right corner of each dot matrix there are a round shaped dot and a tail to form period and comma marks. For the characters in 2nd row of the VFD, there is one more feature to be displayed, which is the downward pointing triangle under each character. This triangular mark shall be referred to as the under-line mark for identification later on.



As illustrated in the above drawing, each rectangular dot in the font format shall be identified as P1, P2, . . . , P5, P6, P7, . . . , P10, P11, . . . , P35, PM, CM and UL. Where “P1” to “P35” stands for each dot in the 5 by 7

matrix, PM means the round dot to the lower right corner, CM notifies the tail to form a comma and UL denotes the under-line mark. These notations will be used in user defined fonts.

For user defined characters applicable to Noritake and EPSON emulation modes, each character is described in a 5 bytes string X1 to X5 in the following way:

	bit #7	bit #6	bit #5	bit #4	bit #3	bit #2	bit#1	bit #0
X1	P6	P5	P4	P3	P2	P1		
X2	P14	P13	P12	P11	P110	P9	P8	P7
X3	P22	P21	P20	P19	P18	P17	P16	P15
X4	P30	P29	P28	P27	P26	P25	P24	P23
X5	UL	CM	PM	P35	P34	P33	P32	P31

In the following sections, it is assumed that before any command given, the PST system should have been previously prepared for issuing command to the VFD unit through the command given under DOS environment:

```
C:\> mode com1 96,n,8,1 (enter)
```

And, since a great deal of the command to be issued to the VFD unit shall be in the non-displayable range, the examples of issuing command will be done mostly with the “Debug” utility provided by DOS. However, should any notation like [Ctrl-Z] appear in the example, it shall be understood correctly as pressing and holding “Ctrl” key while pressing “Z” key. And notation like [Alt-26] means pressing and holding “Alt” key while pressing and releasing in sequence the “2” and “6” key of the numerical keypad (please note that do not press those numbers above the letters) on a PC keyboard. The notation of bracket “<>” indicates hexadecimal code, for example, <1F> means the hexadecimal code which has a decimal value of 31. Yet, the lower case letter in the bracket denotes some variable in hexadecimal code and should not be taken directly for the code. For example, <bb> may range from <00> to <FF> and <Op> may range from <00> to <0F>. In the BASIC programming example to match the

display example or the printer result example in the later detail explanation of each command, it is presumed that the command **Open “COM1” for output as “#1”** has been issued beforehand. The above will be taken for granted and will no longer be mentioned separately.

B. Futaba Emulation Mode

This emulation mode comes into effect when both DIP switches are pushed up (turned on).

DIP SW	1	2
	on	on

The default status in this mode when power on after power on sign is that a block shaped cursor formed of 5 by 7 dots is blinking at a rate about 1 cycle per second at the leftmost position of the 1st row on the display area. Any displayable code under the correct protocol received will be displayed at the position of the cursor and the cursor will be moved to the right by one position. When the cursor is already at the rightmost position of either row, the leftmost position of the other row is considered as the position to the right. Yet, as this emulation mode defaults on vertical scroll up mode, the whole display will move upward and the cursor will move to the MSD (Most Significant Digit, also known as the leftmost position) of 2nd row when the cursor was at the rightmost position of 2nd row on receiving a displayable code. The non-displayable codes are basically used as commands to the display unit.

1. Command Summary

Listed below are commands available in this mode grouped by their functions, note that all the command codes given are expressed in Hexadecimal format:

Command Name	Hex Codes	Command Name	Hex Codes
Reset	1F	Digit select	10 pp
Brightness control	04 bb	Cursor on	13
Change font page	1E 0p	Cursor off	14
International character set	1C 0i	Back space	08
Moving sign	05 0D	Horizontal tab	11 09
Change leading code	06 x1 x2	Vertical scroll up	12 09
Set pass through flag	01	Cursor up/down	11 0A
Clear pass through flag	x1 x2 02	Line feed	12 0A
		Carriage return	0D

2. Command Detail

The followings are the detailed explanations on the commands applicable in Futaba emulation mode arranged in the (hexadecimal) numerical order of the command codes:

Command Code: <01>

Command Name: **Set pass through flag**

Command Result:

The customer display enters pass through mode until the clear pass through flag command is received. All data received by the VFD will be 100% passed on to the device connected at COM1 port.

Limitations:

It is recommended to connect only serial output device like a serial printer at COM1. The Clear pass through flag command should not create any puzzle to the printer.

Command Code: <04> <bb>

Command Name: **Brightness control**

Command Result:

When bb = 20, the brightness of VFD will be 20%.
When bb = 40, the brightness of VFD will be 40%.
When bb = 60, the brightness of VFD will be 60%.
When bb = FF, the brightness of VFD will be 100% of its maximum brightness.

Limitations:

Values of bb allowed are : (in hexadecimal) 20, 40, 60 and FF only

Command Code: <05> <0D>

Command Name: **Moving sign**

Command Result:

The upper row of VFD will first be cleared on receiving of <05> command and each character corresponding to the ASCII codes before <0D> will appear from the right of 1st row marching one after another toward the left end and after the last character disappears from the left end the first character will start all over again from the right end.

Limitations:

The maximum number of displayable characters between the command code <05> and the ending code <0D> is 60 (decimal). If there are already 60 displayable characters after “05” before “0D”, the moving sign starts without “0D”. Any non-displayable character within the moving sign string will be disregarded. Any code received after start of moving sign will stop the moving sign operation.

Command Code: <06> <x1> <x2>

Command Name: **Change leading code**

Command Result:

When the VFD is set to pass through mode after change of the leading code, the clear command from pass through must bear the changed leading code to be effective. For example, after <06> <03> <04>, the clear pass through command becomes <03> <04> <02>.

Limitations:

The default leading code is <21> <23> in hexadecimal form or !# in displayed form. The changed leading code will be effective till the power of VFD is turned off.

Command Code: <08>

Command Name: **Back space**

Command Result:

Moves cursor to the left by one digit (position) and erases the character at that digit.

Limitations:

When the cursor is at the most significant digit (MSD or leftmost position) of one row, the least significant digit (LSD or rightmost position) of the other row is considered as the left position of the cursor.

Command Code: <09>

Command Name: **(Horizontal tab)**

Command Result:

Works as command <11> <09> Horizontal tab or as command <12> <09> Vertical scroll up.

Limitations:

At power on or if the last command between the two choices given to VFD is <12> <09>, this command works exactly like <12> <09>.

If no <12> <09> command given after a <11> <09> command to VFD, then this command works exactly like <11> <09>.

Command Code: <0A>

Command Name: **(Line feed)**

Command Result:

Works as command <11> <0A> Cursor up/down or as command <12> <0A> Line feed.

Limitations:

At power on or if the last command between the two choices given to VFD is <12> <0A>, this command works exactly like <12> <0A>.

If no <12> <0A> command given after a <11> <0A> command to VFD, then this command works exactly like <11> <0A>.

Command Code: <0D>

Command Name: **Carriage return**

Command Result:

Cursor moves to the MSD (leftmost position) of the current row.

Limitations:

None

Command Code: <10> <pp>

Command Name: **Digit select**

Command Result:

Moves cursor to the position defined by the hexadecimal number <pp>, where <pp> starts counting sequentially from the MSD of the 1st row to the LSD of the 1st row then to the MSD of the 2nd row and finally down to the LSD of the 2nd row. The count of <pp> starts from <00>.

Limitations:

<pp> ranges from <00> to <27> only.

Command Code: <11> <09>

Command Name: **Horizontal tab**

Command Result:

Moves cursor to the right by one digit (position).

Limitations:

When the cursor is at the least significant digit (LSD) of one row, the most significant digit (MSD) of the other row is considered as the position to the right of the cursor.

Command Code: <11> <0A>

Command Name: **Cursor up/down**

Command Result:

Cursor moves up or down to corresponding position of the other row.

Limitations:

None

Command Code: <12> <09>

Command Name: **Vertical scroll up**

Command Result:

When cursor at LSD of 2nd row, this command clears the 1st row and scrolls the 2nd row up to 1st row, with the cursor now positioned at MSD of 2nd row.

When cursor at other position this command just moves the cursor one digit to the right.

Limitations:

Scrolls up only at last position otherwise works just like Horizontal tab.

Command Code: <12> <0A>

Command Name: **Line feed**

Command Result:

With cursor at 2nd row, all the 2nd row characters are moved up to 1st row, leaving 2nd row blank and cursor position unchanged.

If the cursor is at the 1st row, only the cursor is moved down to the same position of 2nd row, with all other display unchanged.

Limitations:

Line feed only at 2nd row, otherwise just like Cursor up/down.

Command Code: <13>

Command Name: **Cursor on**

Command Result:

This command turns cursor on or keeps cursor lighted. This is the default status. The cursor is a blinking block of 5 by 7 dots.

Limitations:

None

Command Code: <14>

Command Name: **Cursor off**

Command Result:

This command turns cursor off or keeps cursor off. However cursor position is not changed.

Limitations:

None

Command Code: <1C> <0i>**Command Name:** **International character set****Command Result:**

Select international characters according to the value of “i”. The entire display will be changed at the same time.

Limitations:

The value of “i” is now limited to be between “0” and “B”. The country codes “i” and the countries are as below:

Country code	Country
0	USA
1	France
2	Germany
3	United Kingdom
4	Denmark I
5	Sweden
6	Italy
7	Spain
8	Japan
9	Norway
A	Denmark II
B	Ex-Jugoslavia

Command Code: <1E> <0p>

Command Name: **Change font page**

Command Result:

Select font page according to the value of “p”. The entire display will be changed at the same time.

Limitations:

The value of “p” is now limited to “0” and “1”. When “0” is selected, US and European fonts are displayed. When “1” is selected, US and Japanese fonts are displayed.

Command Code: <1F>

Command Name: **Reset**

Command Result:

All characters displayed will be erased and all settings except the leading code for clearing pass through flag will return to power on conditions.

Limitations:

The leading code for clearing pass through flag will not return to the default value <21> <23> if ever been changed by the <06> command.

Command Code: <x1> <x2> <02>

Command Name: **Clear pass through flag**

Command Result:

When the VFD is set to pass through mode by the <01> command, the VFD monitors the data received for the Clear pass through flag command. The default values for <x1> and <x2> are <21> and <23> in hexadecimal format or !# in displayable form unless ever been changed by the <06> Change leading code command.

Limitations:

The default leading code is <21> <23> in hexadecimal form or !# in displayed form. If a <06> Change leading code command has been executed, the changed code should be used in front of the <02> code. This leading code change will not be changed back by the <1F> Reset command and will only be reset by VFD power off.

C. Noritake Emulation Mode (Default Setting)

This emulation mode comes into effect when the left DIP switch is pushed down (turned off) and the right one is pushed up (turned on).

DIP SW	1	2
	off	on

The default status in this mode when power on after power on sign is that a block shaped cursor formed of 5 by 7 dots is blinking at a rate about 1 cycle per second at the leftmost position of the 1st row on the display area. Any displayable code under the correct protocol received will be displayed at the position of the cursor and the cursor will be moved to the right by one position. When the cursor is already at the rightmost position of either row, it will move to the leftmost position of the other row on receiving a displayable code. The non-displayable codes are basically used as commands to the display unit.

1. Command Summary

Listed below are commands available in this mode grouped by their functions, note that all the command codes given are expressed in Hexadecimal format:

Command Name	Hex Codes	Command Name	Hex Codes
Reset	1B 49	Cursor blinking Rate	1B 54 nn
Clear	0E	Cursor on	15
Brightness control	1B 4C bb	Cursor off	16
Change font page	1E 0p	Back space	08
International character set	1C 0i	Horizontal tab	11 09
Moving sign	05 0D	Vertical scroll up	12 09
Change leading code	06 x1 x2	Cursor up/down	11 0A
Set pass through flag	01	Line feed	12 0A
Clear pass through flag	x1 x2 02	Form feed	0C
Digit select	1B 48 pp	Carriage return	0D
User defined graphics/fonts	1B 43 ad x1 ~ x5		

2. Command Detail

The followings are the detailed explanations on the commands applicable in Noritake emulation mode arranged in the (hexadecimal) numerical order of the command codes:

Command Code: <01>

Command Name: **Set pass through flag**

Command Result:

The customer display enters pass through mode until the clear pass through flag command is received. All data received by the VFD will be 100% passed on to the device connected at COM1 port.

Limitations:

It is recommended to connect only serial output device like a serial printer at COM1. The Clear pass through flag command should not create any puzzle to the printer.

Command Code: <05> . . . <0D>

Command Name: **Moving sign**

Command Result:

The upper row of VFD will first be cleared on receiving of <05> command and each character corresponding to the ASCII codes before <0D> will appear from the right of 1st row marching one after another toward the left end and after the last character disappears from the left end the first character will start all over again from the right end.

Limitations:

The maximum number of displayable characters between the command code <05> and the ending code <0D> is 60 (decimal). If there are already 60 displayable characters after “05” before “0D”, the moving sign starts without “0D”. Any non-displayable character within the moving sign string will be disregarded. Any code received after start of moving sign will stop the moving sign operation.

Command Code: <06> <x1> <x2>

Command Name: **Change leading code**

Command Result:

When the VFD is set to pass through mode after change of the leading code, the clear command from pass through must bear the changed leading code to be effective. For example, after <06> <03> <04>, the clear pass through command becomes <03> <04> <02>.

Limitations:

The default leading code is <21> <23> in hexadecimal form or !# in displayed form. The changed leading code will be effective till the power of VFD is turned off.

Command Code: <08>

Command Name: **Back space**

Command Result:

Moves cursor to the left by one digit (position).

Limitations:

When the cursor is at the most significant digit (MSD or leftmost position) of 2nd row, this command moves the cursor to the least significant digit (LSD or rightmost position) of the 1st row. If the cursor is at the MSD of 1st row, nothing will happen.

Command Code: <09>

Command Name: **(Horizontal tab)**

Command Result:

Works as command <11> <09> Horizontal tab or as command <12> <09> Vertical scroll up.

Limitations:

At power on or if the last command between the two choices given to VFD is <12> <09>, this command works exactly like <12> <09>.

If no <12> <09> command given after a <11> <09> command to VFD, then this command works exactly like <11> <09>.

Command Code: <0A>

Command Name: **(Line feed)**

Command Result:

Works as command <11> <0A> Cursor up/down or as command <12> <0A> Line feed.

Limitations:

At power on or if the last command between the two choices given to VFD is <12> <0A>, this command works exactly like <12> <0A>.

If no <12> <0A> command given after a <11> <0A> command to VFD, then this command works exactly like <11> <0A>.

Command Code: <0C>

Command Name: **Form feed**

Command Result:

Moves cursor to the MSD (leftmost position) of the 1st row.

Limitations:

None

Command Code: <0D>

Command Name: **Carriage return**

Command Result:

Cursor moves to the MSD (leftmost position) of the current row.

Limitations:

None

Command Code: <0E>

Command Name: **Clear**

Command Result:

All characters displayed will be cleared from the screen while the cursor remains at the same position as before this command.

Limitations:

None

Command Code: <11> <09>

Command Name: **Horizontal tab**

Command Result:

Moves cursor to the right by one digit (position).

Limitations:

When the cursor is at the least significant digit (LSD) of one row, the most significant digit (MSD) of the other row is considered as the position to the right of the cursor.

Command Code: <11> <0A>

Command Name: **Cursor up/down**

Command Result:

Cursor moves up or down to corresponding position of the other row.

Limitations:

None

Command Code: <12> <09>

Command Name: **Vertical scroll up**

Command Result:

When cursor at LSD of 2nd row, this command clears the 1st row and scrolls the 2nd row up to 1st row, with the cursor now positioned at MSD of 2nd row.

When cursor at other position this command just moves the cursor one digit to the right.

Limitations:

Scrolls up only at last position otherwise works just like Horizontal tab.

Command Code: <12> <0A>

Command Name: **Line feed**

Command Result:

With cursor at 2nd row, all the 2nd row characters are moved up to 1st row, leaving 2nd row blank and cursor position unchanged.

If the cursor is at the 1st row, only the cursor is moved down to the same position of 2nd row, with all other display unchanged.

Limitations:

Line feed only at 2nd row, otherwise just like Cursor up/down.

Command Code: <15>

Command Name: **Cursor on**

Command Result:

This command turns cursor on or keeps cursor lighted. This is the default status. The cursor is a blinking block of 5 by 7 dots.

Limitations:

None

Command Code: <16>

Command Name: **Cursor off**

Command Result:

This command turns cursor off or keeps cursor off. However cursor position is not changed.

Limitations:

None

Command Code: <1B> <43> <ad> **Command Name:** **User defined graphics/fonts**
<x1> ~ <x5>

Command Result:

This command creates a specific font to substitute the predefined font at the address defined by <ad> in the font table regardless of which font page is in use. The specific font is defined by the 5 bytes <x1>, <x2>, <x3>, <x4>, <x5> following the address code in a graphic manner. Referring to the dot definition as interpreted in page 8-2, to describe the 5 <x's> in bit form starting from MSB to LSB, we can list:

<x1> = P6 , P5 , P4 , P3 , P2 , P1 , DC , DC
<x2> = P14, P13, P12, P11, P10, P9 , P8 , P7
<x3> = P22, P21, P20, P19, P18, P17, P16, P15
<x4> = P30, P29, P28, P27, P26, P25, P24, P23
<x5> = UL , CM , PM, P35, P34, P33, P32, P31

The DC in the above means “don’t care”, that is the value of that bit will have no influence, the “UL” will have influence only when displayed in the 2nd row. Each “1” bit means a lighted dot at the corresponding position of the user defined font.

Limitations:

<ad> ranges from <20> to <FF>. Recommended to be between <A0> and <FF>.

Totally at most two fonts to be user defined. The two user defined font will always remain until the reset command or power off. After the third user defined font defined, the first one will be cleared off (back to predefined font), the second one becomes the first and then the third one becomes the second. During the process of defining any user defined font, the previously user defined font will be momentarily disabled.

Command Code: <1B> <48> <pp> **Command Name:** **Digit select**

Command Result:

Moves cursor to the position defined by the hexadecimal number <pp>, where <pp> starts counting sequentially from the MSD of the 1st row to the LSD of the 1st row then to the MSD of the 2nd row and finally down to the LSD of the 2nd row. The count of <pp> starts from <00>.

Limitations:

<pp> ranges from <00> to <27> only.

Command Code: <1B> <49> **Command Name:** **Reset**

Command Result:

All characters displayed will be erased and all settings except the leading code for clearing pass through flag will return to power on conditions.

Limitations:

The leading code for clearing pass through flag will not return to the default value <21> <23> if ever been changed by the <06> command.

Command Code: <1B> <4C> <bb> **Command Name:** **Brightness control**

Command Result:

When bb = 3F, the brightness of VFD will be 20%.
When bb = 7F, the brightness of VFD will be 50%.
When bb = BF, the brightness of VFD will be 75%.
When bb = FF, the brightness of VFD will be 100% of its maximum brightness.

Limitations:

Values of bb allowed are : (in hexadecimal) 3F, 7F, BF and FF only

Command Code: <1B> <54> <nn> **Command Name:** **Cursor blinking rate**

Command Result:

This command is used to define the blinking rate of the cursor when the cursor is on. The number <nn> is used to determine the period of blinking by multiplying the number “k” induced from number “nn” with a constant “31 millisecond”. The relationship between “k” and “nn” is that if “nn” = “00” then “k” = 256, and if “nn” ranges from “01” to “FF” then “k” is the direct numerical translation of “nn” and ranges from 1 to 255.

Limitations:

<nn> is a byte ranging from <00> to <FF>.

Command Code: <1C> <0i>**Command Name:** International character set**Command Result:**

Select international characters according to the value of “i”. The entire display will be changed at the same time.

Limitations:

The value of “i” is now limited to be between “0” and “B”. The country codes “i” and the countries are as below:

Country code	Country
0	USA
1	France
2	Germany
3	United Kingdom
4	Denmark I
5	Sweden
6	Italy
7	Spain
8	Japan
9	Norway
A	Denmark II
B	Ex-Yugoslavia

Command Code: <1E> <0p>

Command Name: **Change font page**

Command Result:

Select font page according to the value of “p”. The entire display will be changed at the same time.

Limitations:

The value of “p” is now limited to “0” and “1”. When “0” is selected, US and European fonts are displayed. When “1” is selected, US and Japanese fonts are displayed.

Command Code: <x1> <x2> <02>

Command Name: **Clear pass through flag**

Command Result:

When the VFD is set to pass through mode by the <01> command, the VFD monitors the data received for the Clear pass through flag command. The default values for <x1> and <x2> are <21> and <23> in hexadecimal format or !# in displayable form unless ever been changed by the <06> Change leading code command.

Limitations:

The default leading code is <21> <23> in hexadecimal form or !# in displayed form. If a <06> Change leading code command has been executed, the changed code should be used in front of the <02> code. This leading code change will not be changed back by the <1B> <49> Reset command and will only be reset by VFD power off.

D. Aedex Emulation Mode

This emulation mode comes into effect when the left DIP switch is pushed up (turned on) and the right one is pushed down (turned off).

DIP SW	1	2
	on	off

When the VFD is powered on, a power on sign is displayed for about 5 seconds and then the screen is wiped out for receiving commands. The VFD under this emulation mode is always set in the pass through mode whilst the VFD is monitoring the data received for the “attention code”. The attention code is composed of two characters and the default attention code is “!#” in displayed form or <21> <23> in hexadecimal internal code. Note that only alpha numerical codes are accepted in this emulation mode except the carriage return as the terminator for every command. Following procedures describes how the VFD works on the data received.

1. The VFD monitors whatever the data received and transmits the data to the pass through connected serial printer when the data does not match the first character of the attention code (defaulted as “!” the exclamation point). The data will be trapped by the VFD if it matches the first character of the attention code and the VFD starts checking for the second character of the attention code.
2. The data received will be transmitted to the pass through connected serial printer if it does not match the second character of the attention code (defaulted as “#” the number sign) and the VFD resumes monitoring for the first character of the attention code. The data will be further trapped by the VFD if it matches the second character of the attention code and the VFD starts checking for the “function code”.
3. The VFD will transmit the data received to the pass through connected serial printer and return to monitoring for the first character of the attention code if the data received does not match any of the function codes, which are some numbers ranging from 1 to 9. The VFD traps all data afterwards and takes these data to perform the function if the function code matches.

4. On receiving a complete command code (attention code + function code), the VFD clears the function area on the display (top, bottom or both rows) and get ready for that command. The limitation on the length of data for each function is different from each other. There must be a “CR” code (carriage return <0D>) immediately after the data as a terminator to conclude the function. After that carriage return, the VFD monitors all data received for the first character of the attention code and transmit them to the pass through connected serial printer again.

Based on the knowledge of the above procedure, the user can avoid problem with the pass through connected serial printer through following precautions:

1. Avoid the situation that the data to be transmitted to the pass through connected serial printer contain any part which resemble the attention code used, especially the 1st character of the attention code, or
2. Use the Change attention code command (function code “8”) to prevent the coincidence of attention code and data to pass through, or
3. If neither of the above is possible, check through the data to be pass through transmitted for the 1st character of the attention code and double it up, provided the second character of the attention code is different from the 1st character of the attention code, or
4. Use function code “7” to stop trapping of VFD and all data afterwards sent to the pass through connected serial printer with one disadvantage that the VFD no longer works until the reset by turning power to the VFD off and on again.

1. Command Summary

The available function codes and some of the limitations are listed in the following table. Note that the complete command form must be:

Attention code + Function code + Data + Carriage return

Function Code	Command Name	Function Area	Data Length
1	Display top	Top row	Max. 20 characters
2	Display bottom	Bottom row	Max. 20 characters
4	On going scroll	Top row	Max. 60 characters
6	One time scroll	Top row	Max. 40 characters
7	Stop trapping	N.A.	No characters
8	Change attention code	N.A.	2 characters
9	Display whole area	Both rows	Max. 40 characters

2. Command Detail

The followings are the detailed explanations on the commands applicable in Aedex emulation mode arranged in the (hexadecimal) numerical order of the command codes:

Function Code: 1

Command Name: Display top

Command Result:

The top row of VFD will first be cleared and all data between the function code “1” and the carriage return will be displayed from left to right on the 1st row of VFD.

Limitations:

Data length is limited to 20 characters. If there is no carriage return up to the 21st character of data, the 21st character will be transmitted to the pass through connected serial printer. This command can be used to terminate the On going scroll command (function code “4”).

Function Code: 2**Command Name: Display bottom****Command Result:**

The bottom row of VFD will first be cleared and all data between the function code “2” and the carriage return will be displayed from left to right on the 2nd row of VFD.

Limitations:

Data length is limited to 20 characters. If there is no carriage return up to the 21st character of data, the 21st character will be transmitted to the pass through connected serial printer.

Function Code: 4**Command Name: On going scroll****Command Result:**

The top row of VFD will first be cleared and all data between the function code “4” and the carriage return will be displayed from the right end of the 1st row marching toward the left end one character after another. It will start over repeatedly when the last character of the string disappears from the display.

Limitations:

Data length is limited to 60 characters. If there is no carriage return up to the 61st character of data, the 61st character will be transmitted to the pass through connected serial printer. This scrolling will be stopped when receiving next “display top” (function code “1”) or “display whole area” (function code “9”) command.

Function Code: 6

Command Name: One time scroll

Command Result:

The top row of VFD will first be cleared and all data between the function code “6” and the carriage return will be displayed from the right end of the 1st row marching toward the left end one character after another. The 1st row of VFD remains blank after the last character of the string disappears from the display.

Limitations:

Data length is limited to 60 characters. If there is no carriage return up to the 61st character of data, the 61st character will be transmitted to the pass through connected serial printer. However, when function code “4” is working, this command is not applicable due to conflict in data buffer.

Function Code: 7

Command Name: Stop trapping

Command Result:

The VFD stops monitoring the data passed through for any attention code any longer, all data pass through to the serial device connected. The display on VFD remains unchanged until power of VFD turned off.

Limitations:

This command is seldom used and should be used only under great caution as it is a way of no return. The VFD can no longer respond to any command as it is instructed not to monitor the data. The only reset is power off/on.

Function Code: 8**Command Name: Change attention code****Command Result:**

The attention code after this command will be changed to the two characters following the function code “8” in this command.

Limitations:

Only the displayable codes are accepted for new attention code. The carriage return “<0D>” must not be forgotten. This command is not only useful in avoiding the conflicts between the data to the pass through connected device and the default attention code, but also handy when several device each with different attention code are daisy chained to respond separately.
The attention code will reset back to the default “!#” every time power on.

Function Code: 9**Command Name: Display whole area****Command Result:**

The top row of VFD will first be cleared and all data between the function code “9” and the carriage return will be displayed with the 1st 20 characters displayed from left to right on the 1st row of VFD and the 2nd 20 characters displayed from left to right on the 2nd row of VFD.

Limitations:

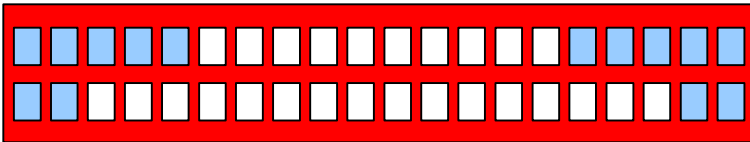
Data length is limited to 40 characters. If there is no carriage return up to the 41st character of data, the 41st character will be transmitted to the pass through connected serial printer. This command can be used to terminate the On going scroll command (function code “4”).

E. ADM Emulation Mode

This emulation mode comes into effect when the left DIP switch is pushed up (turned on) and the right one is pushed down (turned off).

DIP SW	1	2
	on	off

The actual VFD display area in this emulation mode is much smaller than the normal 2 x 20 characters of PD2100/PD2200 series. The following graph explains the locations of the VFD used in this mode.



In this graph the darkened area denotes the entire VFD panel. The shaded rectangles indicate character positions unused in this mode. The white rectangles indicate operating character positions in this mode.

When the VFD is powered on in this mode, an internal diagnostics is performed and both lines are filled with “x” and later with “o” in two passes. Then “.00” is displayed at the first line indicating that the unit is ready for operation.

1. Command Summary

The available command codes and some of the limitations are listed in the following table. Note that the complete command form must be:

Control code [+ Data / Line #] [+ Carriage return]

Control Code	Command Name	Function Area
<0C>h	Clear Display	Line 1 +Line 2
<0D>h	Carriage Return	End of Command
<0E>h	Write Line 1	Line 1
<0F>h	Write Line 2	Line 2
<10>h	Write Decimal Point	Line 1
<11>h	Blink Line	Line 1 or Line 2
<12>h	Clear Blink	Line 1 or Line 2
<1E>h	Write Field 1	Left 8 characters of Line 2
<1F>h	Write Field 2	Right 8 characters of Line 2

2. Command Detail

The followings are the detailed explanations on the commands applicable in ADM emulation mode arranged in the (hexadecimal) numerical order of the command codes:

Command Code: <0C>

Command Name: **Clear display**

Command Result:

Both line 1 and line 2 are cleared.

Limitations:

None.

Command Code: <0E> data <0D> **Command Name:** Write line 1

Command Result:

Line 1 is first cleared and data entry starts from the left. Once the line is full, next entry initiates a scroll to the left. CR (<0D>) or any control character (<00> to <1F>) terminates this operation. CR also brings back the decimal point to the location previously set. Data display aligned to the right can be achieved by filling the line with space first then sending the characters.

Limitations:

Acceptable characters range from <20> to <7F>. The period mark (<2E>) can be displayed with every characters as it takes no extra character space.

Command Code: <0F> data <0D> **Command Name:** Write line 2

Command Result:

Line 2 is first cleared and data entry starts from the left. Once the line is full, next entry initiates a scroll to the left. CR (<0D>) or any control character (<00> to <1F>) terminates this operation. Data display aligned to the right can be achieved by filling the line with space first then sending the characters.

Limitations:

Acceptable characters range from <20> to <7F>. The comma (<2C>) or period (<2E>) can be displayed with every characters as it takes no extra character space.

Command Code: <10> N

Command Name: **Write decimal point**

Command Result:

N stands for the decimal location counted from the right. Decimal location is stored in the register of the display and can be recalled by entering CR after writing in line 1.

Limitations:

N ranges from <31> to <37>.

Command Code: <11> N <0D>

Command Name: **Blink line**

Command Result:

Current characters on line 1 or line 2 will start to blink.

Limitations:

N = <31> or <32>.

Command Code: <12> N <0D>

Command Name: **Clear blink**

Command Result:

Current characters on line 1 or line 2 will stop blinking.

Limitations:

N = <31> or <32>.

Command Code: <1E> data <0D> *Command Name:* **Write field 1**

Command Result:

Field 1 (left eight characters of line 2) is first cleared and data entry starts from the left. Eighth entry or any control character can terminate this operation.

Limitations:

None.

Command Code: <1F> data <0D> *Command Name:* **Write field 2**

Command Result:

Field 2 (right eight characters of line 2) is first cleared and data entry starts from the left of field 2. After filling the field, next entry initiates a scroll in field 2.

Limitations:

None.

F. Epson Emulation Mode

This emulation mode comes into effect when both DIP switch are pushed down (turned off).

DIP SW	1	2
	off	off

The default status in this mode when power on after power on sign is a blank screen with an invisible cursor at the leftmost position of the 1st row on the display area. Any displayable code under the correct protocol received will be displayed at the position of the cursor and the cursor will be moved to the right by one position. When the cursor is already at the rightmost position of either row, the leftmost position of the other row is considered as the position to the right. The non-displayable codes are basically used as commands to the display unit.

1. Command Summary

Listed below are commands available in this mode grouped by their functions, note that all the command codes given are expressed in Hexadecimal format:

Command Name	Command & Hex Codes	Command Name	Command & Hex Codes
Move cursor left	BS 08	Mark semicolon	US ; 1F 3B
Move cursor right	HT 09	Clear mark	US < 1F 3C
Move cursor down	LF 0A	Set/cancel display screen blinking	US E 1F 45 n
Move cursor home position	HOM 0B	Set and display counter (time)	US T 1F 54 h m
Clear display screen	CLR 0C	Brightness adjustment	US X 1F 58 <0n>
Move cursor to left-most position	CR 0D	Set/cancel user-defined characters	ESC % 1B 25 <0n>
Clear cursor line	CAN 18	Define user-defined characters	ESC & 1B 26 addr x1 x2 x3 x4 x5
Specify overwrite mode	US MD1 1F 01	Delete user-defined characters	ESC ? 1B 3F <0n>
Specify vertical scroll mode	US MD2 1F 02	Show firmware version	US @ 1F 40
Specify horizontal scroll mode	US MD3 1F 03	Select peripheral device	ESC = 1B 3D <0n>
Move cursor up	US LF 1F 0A	Select character code page table	ESC t 1B 74 <0n>
Move cursor to right-most position	US CR 1F 0D	Move cursor to bottom position	US B 1F 42
Move cursor to specified position	US \$ 1F 24 n m	Initialize display	ESC @ 1B 40
Mark comma	US , 1F 2C	International character set	ESC R 1B 52 <0i>
Mark period	US . 1F 2E	Display counter (time)	US U 1F 55

2. Command Detail

The followings are the detailed explanations on the commands applicable in Epson emulation mode arranged in the (hexadecimal) numerical order of the command codes:

Command Code: <08>

Command Name: **Move cursor left**

Command Result:

Moves cursor to the left by one digit (position).

Limitations:

When the cursor is at the most significant digit (MSD or leftmost position) of one row, the least significant digit (LSD or rightmost position) of the other row is considered as the left position of the cursor.

Command Code: <09>

Command Name: **Move cursor right**

Command Result:

Moves cursor to the right by one digit (position).

Limitations:

When the cursor is at the least significant digit (LSD or rightmost position) of one row, the most significant digit (MSD or leftmost position) of the other row is considered as the right position of the cursor.

Command Code: <0A>

Command Name: Move cursor down

Command Result:

1. In overwrite mode: Cursor moves up or down to corresponding position of the other row.
2. In vertical scroll mode: Cursor moves from 1st row to same position of 2nd row or cursor stays on 2nd row and everything else scrolled up by one line.
3. In horizontal scroll mode: Cursor moves to same position of 2nd row.

Limitations:

Command function is dependent of mode.

Command Code: <0B>

Command Name: Move cursor home

Command Result:

Moves cursor to the leftmost position of 1st row.

Limitations:

None

Command Code: <0C>

Command Name: Clear display screen

Command Result:

Clears display screen and moves cursor to home.

Limitations:

None

Command Code: <0D>

Command Name: **Move cursor to leftmost position**

Command Result:

Moves cursor to the leftmost of the current row.

Limitations:

None

Command Code: <18>

Command Name: **Clear cursor line**

Command Result:

Clears the line where the cursor is and moves cursor to leftmost position of that line.

Limitations:

None

Command Code: <1B> <25> <0n>

Command Name: **Set/cancel user defined characters**

Command Result:

When “n” = “0”, the user defined characters are disabled and the original fonts are used.

When “n” = “1”, the user defined characters are enabled and displayed instead of the original fonts.

Limitations:

Value of n is either “0” or “1”.

Command Code: <1B> <26> <ad>
<x1> ~ <x5>

Command Name: Define user defined characters

Command Result:

This command creates a specific font to substitute the predefined font at the address defined by <ad> in the font table regardless of which font page is in use. The specific font is defined by the 5 bytes <x1>, <x2>, <x3>, <x4>, <x5> following the address code in a graphic manner. Referring to the dot definition as interpreted in page 8-2, to describe the 5 <x's> in bit form starting from MSB to LSB, we can list:

<x1> = P6 , P5 , P4 , P3 , P2 , P1 , DC , DC
<x2> = P14, P13, P12, P11, P10, P9 , P8 , P7
<x3> = P22, P21, P20, P19, P18, P17, P16, P15
<x4> = P30, P29, P28, P27, P26, P25, P24, P23
<x5> = UL , CM , PM, P35, P34, P33, P32, P31

The DC in the above means “don’t care”, that is the value of that bit will have no influence, the “UL” will have influence only when displayed in the 2nd row. Each “1” bit means a lighted dot at the corresponding position of the user defined font.

Limitations:

<ad> ranges from <20> to <FF>. Recommended to be between <A0> and <FF>.

Totally at most two fonts to be user defined. The two user defined font will always remain until the reset command or power off. After the third user defined font defined, the first one will be cleared off (back to predefined font), the second one becomes the first and then the third one becomes the second. During the process of defining any user defined font, the previously user defined font will be momentarily disabled.

Command Code: <1B> <3D> <0n> *Command Name:* **Select peripheral device**

Command Result:

When “n” = “1”, the printer is selected as the output device.

When “n” = “2”, the VFD is selected as the output device.

When “n” = “3”, both printer and VFD are selected as output devices.

Limitations:

Value of “n” must be among “1” “2” and “3”.

Command Code: <1B> <3F> <0n> *Command Name:* **Delete user defined characters**

Command Result:

When n = 0, the first user defined character will be deleted and the original font of that address will be used in stead.

When n = 1, the second user defined character will be deleted and the original font of that address will be used in stead.

Limitations:

Value of n is either “0” or “1”.

Command Code: <1B> <40> *Command Name:* **Initialize display**

Command Result:

This command clears VFD display and moves cursor home

Limitations:

None

Command Code: <1B> <52> <0i>**Command Name:** International character set**Command Result:**

Select international characters according to the value of “i”. The entire display will be changed at the same time.

Limitations:

The value of “i” is now limited to be between “0” and “B”. The country codes “i” and the countries are as below:

Country code	Country
0	USA
1	France
2	Germany
3	United Kingdom
4	Denmark I
5	Sweden
6	Italy
7	Spain
8	Japan
9	Norway
A	Denmark II
B	Ex-Jugoslavia

Command Code: <1B> <74> <0n>

Command Name: **Select character code table**

Command Result:

When n = 0, the fonts in page 0 of font table are used for characters to display.
When n = 1, the fonts in page 1 of font table are used for characters to display.

Limitations:

Values of n is either “0” or “1”.

Command Code: <1F> <01>

Command Name: **Specify overwrite mode**

Command Result:

As a result of this command, the VFD enters “overwrite mode” which is the default mode engaged when power on. In this mode, the display starts from the leftmost position of the 1st row, then goes on till the rightmost position of the 1st row. The leftmost position of the 2nd row is considered as the next position to the rightmost position of 1st row. When the display comes to the rightmost position of the 2nd row, it just goes on from the leftmost position of the 1st row again.

Limitations:

None

Command Code: <1F> <02>

Command Name: Specify vertical scroll mode

Command Result:

As a result of this command, the VFD enters “vertical scroll mode”. In this mode, the display starts from the leftmost position of the 1st row, then goes on till the rightmost position of the 1st row. The leftmost position of the 2nd row is considered as the next position to the rightmost position of 1st row. When the display comes to the rightmost position of the 2nd row, the entire 2nd row moves up to become the 1st row and goes on displaying from the leftmost position of the 2nd row.

Limitations:

It scrolls down for the “Move cursor up” command when cursor at 1st row.

Command Code: <1F> <03>

Command Name: Specify horizontal scroll mode

Command Result:

As a result of this command, the VFD enters “horizontal scroll mode”. In this mode, the display starts from the leftmost position of the 1st row, then goes on till the rightmost position of the 1st row. Each character added will be displayed at the rightmost position of 1st row while the whole original 1st row scrolls left by one position. The same rule applies on the 2nd row.

Limitations:

The “Move cursor down” command when cursor at 2nd row and the “Move cursor up” command when cursor at 1st row will be no function at all.

Command Code: <1F> <0A>**Command Name:** **Move cursor up****Command Result:**

1. In overwrite mode: Cursor moves up or down to corresponding position of the other row.
2. In vertical scroll mode: Cursor moves from 2nd row to same position of 1st row or cursor stays on 1st row and everything else scrolled down by one line.
3. In horizontal scroll mode: Cursor moves to same position of 1st row.

Limitations:

None

Command Code: <1F> <0D>**Command Name:** **Move cursor to rightmost position****Command Result:**

Moves cursor to the rightmost position of the current row.

Limitations:

None

Command Code: <1F> <24>
<n> <m>**Command Name:** **Move cursor to specified position****Command Result:**

This command moves cursor to position specified by “n” and “m”, where “n” specifies position in the row and “m” specifies which row to move cursor to.

Limitations:

Value of <n> ranges from <01> to <14> in hexadecimal or “1” to “20” in decimal expression. Value of <m> is either <01> or <02>.

Command Code: <1F> <2C>

Command Name: **Mark comma**

Command Result:

This command displays a comma mark (CM) at the position of the cursor.

Limitations:

None

Command Code: <1F> <2E>

Command Name: **Mark period**

Command Result:

This command displays a period mark (PM) at the position of the cursor.

Limitations:

None

Command Code: <1F> <3B>

Command Name: **Mark semicolon**

Command Result:

This command displays a semicolon mark (comma and period marks, CM + PM) at the position of the cursor.

Limitations:

None

Command Code: <1F> <3C>

Command Name: **Clear mark**

Command Result:

This command clears marks (a comma mark, a period mark or comma and period marks; CM, PM or CM + PM) at the position of the cursor.

Limitations:

None

Command Code: <1F> <40>

Command Name: **Show firmware version**

Command Result:

As a result to this command, the VFD display is cleared and the firmware version is displayed. The cursor is placed at 1st position of 1st row after the version display.

Limitations:

None

Command Code: <1F> <42>

Command Name: **Move cursor to bottom position**

Command Result:

This command moves cursor to the rightmost position (LSD) of 2nd row.

Limitations:

None

Command Code: <1F> <45> <n>

Command Name: **Set/cancel
display screen blinking**

Command Result:

This command determines how the whole display screen blinks or not according to value of <n>.

1. When <n> = <00>, the screen displays steadily.
2. When <n> lies between <00> and <FF>, the whole screen blinks at a period T, where $T = \langle n \rangle \times 31 \text{ msec}$.
3. When <n> = <FF>, the screen becomes blank.

Limitations:

Value of “n” ranges from “00” to “FF” in hexadecimal or “0”to “255” in normal decimal expression.

Command Code: <1F> <54>
<h> <m>

Command Name: **Set and display
counter (time)**

Command Result:

This command clears the display and shows the running time starting from the set figure defined by <h> and <m> to the right side of 2nd row. The cursor will be moved to home position. The <h> and <m> though given in the hexadecimal form are in fact defined in BCD (binary coded decimal), so in this command <0D> in the hexadecimal means the decimal “13” and <3B> in the hexadecimal means decimal “59”.

Limitations:

<h> value ranges from <00> to <17> in the hexadecimal form.
<m> value ranges from <00> to <3B> in the hexadecimal form.
The time display will be erased though the counting goes on internally as soon as the cursor is moved to the 2nd row.

Command Code: <1F> <55>

Command Name: **Display counter (time)**

Command Result:

If there is not yet any time count set since power of VFD turned on , this command starts counting from 00:01:00 to the right side of 2nd row after clearing the display.

If there is already any time count set by this <1F> <55> command or the <1F> <54> command since last power on, this command clears the screen and resumes the time display.

Limitations:

The time display will be erased though the counting goes on internally as soon as the cursor is moved to the 2nd row.

Command Code: <1F> <58> <0n>

Command Name: **Brightness adjustment**

Command Result:

This command adjusts the brightness of the VFD display according to value of “n”. When “n” = 4, it will be full brightness and is the default. The brightness decreases as “n” decreases.

Limitations:

Value of “n”: “1”; “2”; “3”; “4”.