TOUCH
DYNAMIC

WD- 230

User Manual

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Chapter 1 Introduction

1.1 Features

❑ The customer display is Vacuum Fluorescent Displays which has only 1 kind of display pattern.
1. 20 columns and 2 lines, each columns is 5x7 dots.

❑ Blue-green fluorescent color is clear and easy-to-read.

❑ The display panel is movable so that it can be adjusted for the best viewing angle.

❑ The customer display could have different height of dimension by adjusting the poles.

❑ The interface of customer display is USB with virtual RS-232 port, with baud rate selected from 9600 or 19200 bps, which is set 9600 bps as default.

❑ The user defined and international character sets are the standard of the customer display.

❑ The customer display supports 11 command modes, with EPSON command mode set as default.

❑ The customer display supports power from 5V to 12V, it prevents any mindless use of improper power input to cause malfunction.

❑ Easy configure & various settings through its multi-functional set-up Utility. For example, user can set up Welcome Message and plenty of code pages setting by their selves, and also including others advanced setting.

❑ Control boards design in top panel to prevent water or wet counter surface may damage from the bottom.

❑ 2nd Choice round-shape mini base for space-saving, stable and ingenious.

❑ Panel is structured to easy-detachable and available for wall mounting install and OEM.

Attention
1. This specification shall apply only to the product(s) coming along with this manual inside.
2. This manual may not apply to the previous or later product(s).
3. This specification may be modified without any notice. If it is necessary for "customers" to have a latest manual about specification, please inquire your suppliers.

Chapter 2 General Specification

2.1 VFD Panel Module

Display Method	Fluorescent Display Blue Green
Display Pattern	5x7 Dot Matrix
Brightness	500 ~ 1000 cd/m2
Character Size	5.5 (H) x 9.2 (W) mm
Dot Size (X * Y)	0.86 x 1.2 mm
Character Number	40 (20 columns x 2 lines)

2.2 Electricity

Central Control Unit	ROM : 64K RAM : 1KB RAM + 32K SRAM
Speed	CPU : 33 MHz
Baud rate	9600bps 19200bps
Interface	RS232 or USB
Power Source	DC +5V~12V
Power Consumption	Watts Average (Maximum 15 Watts)

2.3 Overall Dimensions (Panel)

Dimension of Panel	220(W)*40(H)*33.3(D)mm
Viewing Angle	0°~90°
Horizontal Rotation	Max 355°
Weight	960g

2.4 Environment

Operating Temperature	+10℃ to +40℃
Storage Temperature	-10℃ to +50℃
Relative Humidity	0% to 90% RH

2.5 Driver Interface

Interface	USB (Virtual COM Port)

The default protocol of virtual RS232 port is 9600 bps, non-parity, 8 data bits, 1 stop bit and with DTR/DSR control.

2.6 Function Setting

This Display has No switch, therefore all the settings would be done by Application Program (AP).

2.6.1   Baud Rate Setting

Function Description Baud Rate (bps)	9600 19200

2.6.2   Command Mode Setting

Command Type	Hex Code
LD220	00
EPSON POS D101(default)	01
UTC Standard	02
UTC Enhance	03
AEDEX	04
ADM788	05
DSP800	06
CD5220	07
EMAX	08
LOGIC CONTEOL	09

2.6.3   International Character Setting

(Please see more details in Appendix 1)

Firmware rev. 15.00.2														
International	**Dec**	**Hex**	0x23	0x24	0x40	0x5B	0x5C	0x5D	0x5E	0x60	0x7B	0x7C	0x7D	0x7E
USA	0	00	#	$	@	[	\	]	^	`	{	|	}	~
France	1	01	#	$	à	°	ç	§	^	`	é	ù	è	¨
Germany	2	02	#	$	§	Ä	Ö	Ü	^	`	ä	ö	ü	β
U.K.	3	03	£	$	@	[	\	]	^	`	{	|	}	~
Denmark I	4	04	#	$	@	Æ	Ø	Å	^	`	æ	ø	å	~
Sweden	5	05	#	¤	É	Ä	Ö	Å	Ü	é	ä	ö	å	ü
Italy	6	06	#	$	@	°	\	é	^	ù	à	ò	è	ì
Spain I	7	07	P$_t$	$	@	¡	Ñ	¿	^	`	¨	ñ	}	~
Japan	8	08	#	$	@	[	¥	]	^	`	{	|	}	~
Norway	9	09	#	¤	É	Æ	Ø	Å	Ü	é	æ	ø	å	ü
Denmark II	10	0A	#	$	É	Æ	Ø	Å	Ü	é	æ	ø	å	ü
Spain II	11	0B	#	$	á	¡	Ñ	¿	é	`	í	ñ	ó	ú
Latin America	12	0C	#	$	á	¡	Ñ	¿	é	ü	í	ñ	ó	ú
Korea	13	0D	#	$	@	[	₩	]	^	`	{	|	}	~
Slovenia/Croatia	14	0E	#	$	Ž	Š	Đ	Ć	Č	ž	š	đ	ć	č
China	15	0F	#	¥	@	[	\	]	^	`	{	|	}	~
Vietnam	16	10	đ	$	@	[	\	]	^	`	{	|	}	~
Arabia	17	11	#	$	@	[	\	]	^	`	{	|	}	~

2.6.4   Codepage Table Setting

(Please see more details in Appendix 2)

Firmware rev. 15.00.2			
Codepage	**Dec**	**Hex**	備註
CP-437	0	00	
Katakana	1	01	
CP-850	2	02	
CP-860	3	03	
CP-863	4	04	
CP-865	5	05	
CP-1252	16	10	
CP-866	17	11	
CP-852	18	12	
CP-858	19	13	
CP-1253	47	2F	
CP-1255	49	31	
CP-1257	50	33	
CP-1258	51	34	

Chapter 3 Interface

3.1 Interface

Data Transmission Method	Asynchronous Serial
Handshaking	DTR/DSR Control
Default Protocol	9600/19200 bps, non-parity, 8 data bits, 1 stop bit

3.1.1   Data Collecting

The DTR signal is as follows:

[HIGH]   This indicates that the display isn't ready to receive data.
It depends on the following conditions:
❑ The period from when the power is turned on to when the printer first becomes ready to receive data.
❑ When the remaining space in the receiving buffer becomes 128 bytes or less.
❑ When the DTR signal of the printer is HIGH when the printer is selected using the command.

[LOW]   This indicates that the display is ready to receive data.
It depends on the following conditions:
❑ When the printer first becomes ready to receive data after power-on.
❑ When the remaining space in the receiving buffer becomes 128 bytes or more.
❑ When the DTR signal of the printer is LOW when the printer is selected using the command.

3.1.1   Data Transmission

After confirming the DSR is LOW, data is transmitted to display.

3.2 Connector

3.2.1   Connector for Host Computer

```
    5  4  3  2  1
      ○ ○ ○ ○ ○
   ◎              ◎
       ○ ○ ○ ○
      9  8  7  6
```
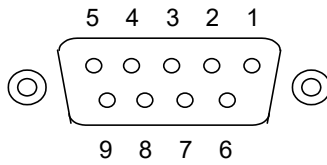
PIN Assignment

Pin No.	Signal	I/O	Description
1	NC		No Connection
2	TXD	OUTPUT	Transmit Data
3	RXD	INPUT	Receive Data
4	DSR	INPUT	Data Set Ready
5	GND		Power GND
6	DTR	OUTPUT	Data Terminal Ready
7	CTS		Clear To Send
8	RTS		Request to Send
9	By Selection		N.C. or +5V ~ +12V

Chapter 4 Command Description

4.1   LD220 Command Mode

Command	Hex	Function Description
HT	09	Move cursor right (Only valid in overwrite mode)
BS	08	Move cursor left (Only valid in overwrite mode)
CR	0D	Move cursor to left-most position (Only valid in overwrite mode)
ESC @	1B 40	Initialize customer display to initial state, clears display buffer, set display mode to shift and sets current display row to upper row
ESC U	1B 55	Select upper row as current row (Initial default)
ESC D	1B 44	Select lower row as current row
ESC A n	1B 41 n	Sets customer display disable or enable n=D, Disable ; n=E, Enable
ESC C r c	1B 43 r c	Move cursor to specified position (Only valid in overwrite mode) r=U, upper row ; r=D, lower row 1≦c≦20 (column number)
ESC E r n	1B 45 r n	Set special effect or display mode of specified row
ESC R n	1B 52 n	Set international font sets (Please refer International Font Set Table)
ESC = n	1B 3D n	Select peripheral n=1, printer ; n=2, display ; n=3, printer & display
ESC % n	1B 25 n	Set font pattern n=0, selected ; n=1, canceled
ESC & n s [p]	1B 26 n s data	Define user font pattern n=code for first character s=code for last character data=5 bytes required for each character

4.2 EPSON Command Mode

Command	Hex	Function Description
HT	09	Move cursor right
BS	08	Move cursor left
US LF	1F 0A	Move cursor up
LF	0A	Move cursor down
US CR	1F 0D	Move cursor to right-most position
CR	0D	Move cursor to left-most position
HOM	0B	Move cursor to home position
US B	1F 42	Move cursor to bottom position
US $ x y	1F 24 x y	Move cursor to specified position $1 \leq x(column) \leq 20$; $1 \leq y(row) \leq 2$
US C n	1F 43 n	Select/cancel cursor display n=0, canceled ; n=1, selected
CLR	0C	Clear display screen
CAN	18	Clear cursor line
US X n	1F 58 n	Brightness adjustment $1 \leq n \leq 4$
US E n	1F 45 n	Blink display screen $0 \leq n \leq 255$ (n*50msec) ON / (n*50msec) OFF n= 0, blinking is canceled n=255, display is turned off
ESC @	1B 40	Initialize display
ESC t n	1B 74 n	Select character code table $0 \leq n \leq 5$ (Please refer "Chapter 5")
ESC R n	1B 52 n	Select international character set (Please refer International Font Set Table)
US r n	1F 72 n	Select/cancel reverse character n=0, canceled ; n=1, selected
US MD1	1F 01	Specify overwrite mode
US MD2	1F 02	Specify vertical scroll mode
US MD3	1F 03	Specify horizontal scroll mode
US . n	1F 2E n	Specify period display n= display character code
US , n	1F 2C n	Specify comma display n= display character code
US ; n	1F 3B n	Specify semicolon (period+comma) display n= display character code
US # n m	1F 23 n m	Specify display annunciator,, turn the annunciator at "m" column on or off n=0,1 (Off, On) ; $0 \leq m \leq 20$

ESC & s n m [a(pl..p5)] (m-n+1)	1B 26 s n m [a(pl..p5)](m-n+1)	Define download characters s=1 ; 32≦n≦m≦126 ; a=5 (p1..p5 = pattern1..pattern5)
ESC ? n	1B 3F n	Cancel user-defined characters 32≦n≦126 (n=character code)
ESC % n	1B 25 n	Select/cancel download character set n=0, canceled ; n=1, selected
ESC W n s (x1 y1 x2 y2)	1B 57 n s (x1 y1 x2 y2)	Specify/cancel the window range n=1,2,3,4 (four windows) ; s=0,1 (disable, enable) 1≦x1≦x2≦20 (column) ; 1≦y1≦y2≦2 (row)
ESC = n	1B 3D n	Select peripheral device n=1, printer ; n=2, display ; n=3, printer & display
US :	1F 3A	Set starting/ending position of macro definition
US ^ n m	1F 5E n m	Execute and quit macro 0≦(n,m)≦255 n: specifies the time interval for display of characters in units of [n* 50msec] m: specifies the interval of macro execution every [m*50msec]
US @	1F 40	Execute self-test
US T h m	1F 54 h m	Display time :0≦h≦23 ; 0≦m≦59
US U	1F 55	Display of time counter

4.3 UTC Standard Command Mode

Command	Hex	Function Description
BS	08	Back space
HT	09	Horizontal tab
LF	0A	Line feed
CR	0D	Carriage return
DC0 p	10 p	Move cursor to specified position, 0≦p≦39 (Please refer Row Character Position Chart)
DC1	11	Over write display mode
DC2	12	Vertical scroll mode
DC3	13	Cursor on
DC4	14	Cursor off
ESC d	1B 64	Change to UTC enhanced mode
US	1F	Clear display

4.4 UTC Enhance Command Mode

Command	Hex	Function Description
ESC u A CR	1B 75 41 [data x 20] 0D	Upper line display
ESC u B CR	1B 75 42 [data x 20] 0D	Bottom line display
ESC u D CR	1B 75 44 [data x 45] 0D	Upper line message scroll continuously
ESC u E CR	1B 75 45 hh ':' mm 0D	Set and display 24 hour time $0 \leq h, m \leq 9$
ESC u F CR	1B 75 46 [data x 45] 0D	Upper line message scroll once pass
ESC u H..CR	1B 75 48 n m 0D	Change attention code 32 n ,m $\leq$ (Default attention code n=1Bh, m=75h)
ESC u 1 CR	1B 75 49 [data x 40] 0D	Two line display
ESC RS CR	1B 0F 0D	Change to UTC standard mode

4.5 AEDEX Command Mode

Command	Hex	Function Description
! # 1..CR	21 23 31 [data x 20] 0D	Upper line display
! # 2..CR	21 23 32 [data x 20] 0D	Bottom line display
! # 4..CR	21 23 34 [data x 45] 0D	Upper line message scroll continuously
! # 5..CR	21 23 35 hh ':' mm 0D	Set and display 24 hour time $0 \leq h, m \leq 9$
! # 5 CR	21 23 35 0D	Display 24 hour time
! # 6..CR	21 23 36 [data x 45] 0D	Upper line message scroll once pass
! # 8..CR	21 23 38 n m 0D	Change attention code $32 \leq n$,m (Default attention code n="!", m="#")
! # 9..CR	21 23 39 [data x 40] 0D	Two line display

4.6 ADM788 Command Mode

Command	Hex	Function Description
CLR	0C	Clear display
CR	0D	Carriage return
SLE1	0E	Clear up line and move cursor to upper line left most end
SLE2	0F	Clear low line and move cursor to lower line left most end
DC0	10 n	Set period to upper line last n position $1 \leq n \leq 7$
DC1	11 n	Set line blinking n=1, upper line n=2, lower line
DC2	12 n	Clear line blinking n=1, upper line n=2, lower line
SF1	1E	Clear field 1 and move cursor to field 1 fast position
SF2	1F	Clear field 2 and move cursor to field 2 fast position

4.7 DSP800 Command Mode

Command	Hex	Function Description
EOT SOH I n ETB	04 01 49 n 17	Select international character set (Please refer International Font Set Table)
EOT SOH P n ETB	04 01 50 n 17	Move cursor to specified position $49 \leq n \leq 88$
EOT SOH C n m ETB	04 01 43 n m 17	Clear display range from n position to m position and move cursor to n position $49 \leq n \leq m \leq 88$
EOT SOH S n ETB	04 01 53 n 17	Save the current displaying data (40 characters) to n'th layer for demo display $1 \leq n \leq 3$ (n specify the layer 1, 2, or 3)
EOT SOH D n m ETB	04 01 44 n m 17	Display the saved data $1 \leq n \leq 3$ (n specify the layer 1, 2, or 3) "m" can be ignored
EOT SOH A n ETB	04 01 41 n 17	Brightness adjustment $1 \leq n \leq 4$
EOT SOH = n ETB	04 01 3D n 17	Select peripheral device n=1, printer ; n=2, display
EOT SOH % ETB	04 01 25 17	Initialize display

4.8 CD5220 Command Mode

Command	Hex	Function Description
ESC DC1	1B 11	Overwrite mode
ESC DC2	1B 12	Vertical scroll mode
ESC DC3	1B 13	Horizontal scroll mode
ESC Q A CR	1B 51 41 [N]20 0D	Set string display mode, write string to upper line
ESC Q B CR	1B 51 42 [N]20 0D	Set string display mode, write string to lower line
ESC Q D CR	1B 51 44 [N]m20 0D	Upper line message scroll continuously m<40
ESC [D	1B 5B 44	Move cursor left
BS	08	Move cursor left
ESC [C	1B 5B 43	Move cursor right
HT	09	Move cursor right
ESC [A	1B 5B 41	Move cursor up
ESC [B	1B 5B 42	Move cursor down
LF	0A	Move cursor down
ESD [H	1B 5B 48	Move cursor to home position
HOM	0B	Move cursor to home position
ESC [L	1B 5B 4C	Move cursor to left-most position
CR	0D	Move cursor to left-most position
ESC [R	1B 5B 52	Move cursor to right-most position
ESC [K	1B 5B 4B	Move cursor to bottom position
ESC l x y	1B 6C x y	Move cursor to specified position $1 \leq x \leq 20$ (column) ; y=1,2 (row)
ESC @	1B 40	Initialize display
ESC W s x1 x2 y	1B 57 s x1 x2 y	Enable or disable the window range at horizontal scroll mode s=0,1 (disable, enable) $1 \leq x1 \leq x2 \leq 20$ (column) ; y=1,2 (row)
CLR	0C	Clear display screen, and clear string mode
CAN	18	Clear cursor line, and clear string mode
ESC * n	1B 2A n	Brightness adjustment $1 \leq n \leq 4$
ESC & s n m [a(pl..p5)] (m-n+1)	1B 26 s n m [a(pl..p5)] (m-n+1)	Define download characters s=1 ; $32 \leq n \leq m \leq 126$; a=5 (p1..p5 = pattern1..pattern5)
ESC ? n	1B 3F n	Delete download characters $32 \leq n \leq 126$ (n=character code)
ESC % n	1B 25 n	Select / cancel download character set. n=0, canceled ; n=1, selected
ESC _ n	1B 5F n	Set cursor ON/OFF n=0,1 (Off,On)

ESC f n	1B 66 n	Select international fonts set
ESC c n	1B 63 n	Select fonts, ASCII code or JIS code
ESC = n	1B 3D n	Select peripheral device n=1, printer ; n=2, display ; n=3, printer & display

4.9 EMAX Command Mode

Command	Hex	Function Description
ESC DC1	1B 11	Overwrite mode
ESC DC2	1B 12	Vertical mode
ESC DC3	1B 13	Horizontal scroll mode
ESC [D	1B 5B 44	Move cursor left
BS	08	Move cursor left
ESC [C	1B 5B 43	Move cursor right
HT	09	Move cursor right
ESC [A	1B 5B 41	Move cursor up
ESC [B	1B 5B 42	Move cursor down
ESC [H	1B 5B 48	Move cursor to home position
HOM	0B	Move cursor to home position
ESC [L	1B 5B 4C	Move cursor to left-most position
CR	0D	Move cursor to left-most position
ESC [R	1B 5B 52	Move cursor to right-most position
ESC [K	1B 5B 4B	Move cursor to bottom position
ESC l x y	1B 6C x y	Move cursor to specified position $1 \leq x \leq 20$, y =1,2
ESC @	1B 40	Initialize display
CLR	0C	Clear display screen, and clear string mode
CAN	18	Clear cursor line, and clear string mode
ESC * n	1B 2A n $1 \leq n \leq 4$	Brightness mode
ESC _ n	1B 5F n n = 0,1	Set cursor ON/OFF
ESC f n	1B 66 n	Select international fonts
ESC c n	1B 63 n	Select fonts, ASCII code or JIS code
ESC = n	1B 3D	Select peripheral device, display or printer n = 1; enable printer, disable display n = 2; disable printer, enable display n = 3; enable printer, enable display

4.10   LOGIC Command Mode

Command	Hex	Function Description
^Q	11	Overwrite mode
^R	12	Vertical mode
^I	09	Horizontal tab
^H	08	Back space
^J	0A	Line feed
^M	0D	Carriage return
^S	13	Cursor on
^T	14	Cursor off
^P	10	Digital select e.g.10 00 MSD of top row 10 13 LSD of top row 10 14 MSD of bottom row 10 27 LSD of bottom row
^_	1F	Reset
^D n	04 n	Brightness mode 04 FF – 100% Brightness mode 04 60 – 60% Brightness mode 04 40 – 40% Brightness mode 04 20 – 20% Brightness mode

Chapter 5Setup AP Introduction

5.1 Setup AP General Introduction

AP Version: v6.1.0.5
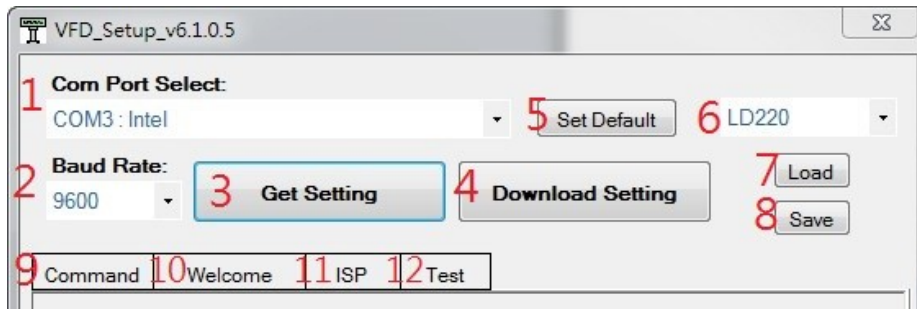
Number	Button	Function Description
1	Com Port Select	Here you can connect this Setup AP with your display by choosing the correct com port position.
2	Baud Rate	Please make sure the Baud Rate setting here is the same with your display.
3	Get Setting	Clicking this to get Setting from Display. You can also use this function to make sure the connection is success.
4	Download Setting	After you finish all the setting, please click this button to apply all the settings to display.
5	Set Default	Click here to make this display back to default setting. Before you click this, please make sure the display model in "6" is what you need.
6	Display model	This Setup AP is compatible for many Displays. So here you can see the matching display model.
7	Load	You can load back the setting file by clicking this.
8	Save	You can save all the settings by clicking this, then you would get a setting file.
9	Command	In this sheet, you can have most of the basic display setting done.
10	Welcome	In this sheet you can finish all the settings for "Welcome" Mode (Stand-by mode) of display.
11	ISP	When you need to update the Firmware version, please come to this sheet and finish all the settings.
12	Test	In this sheet you can finish the basic function testing of the display.

5.2 Setup AP "Command" sheet
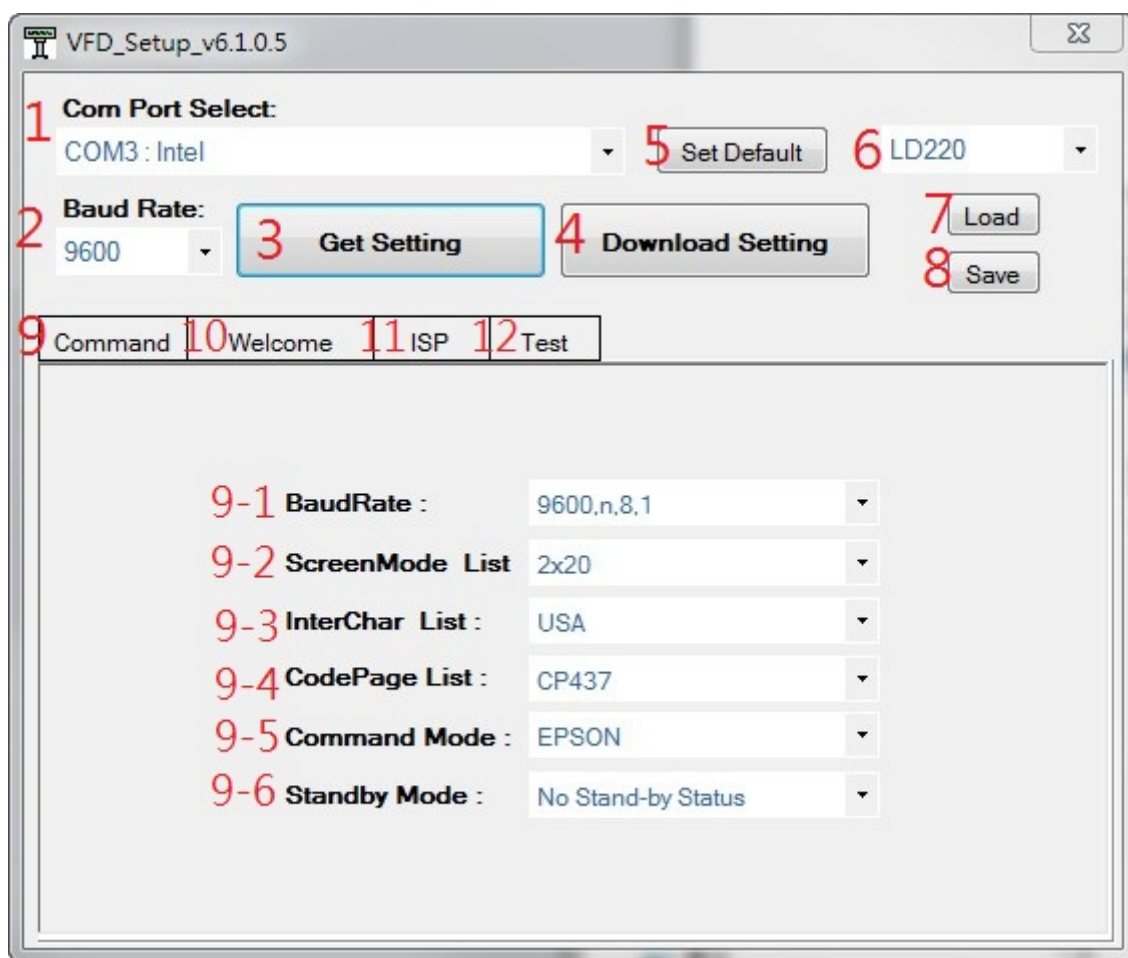
Number	Button	Function Description	
9-1	Baud Rate	9600,n,8,1	19200,n,8,1
9-2	Screen Mode List	2x20, this display supports 2 Lines, 1st line for 20 Character max. 2nd Line for 40 Character max.	
9-3	Inter Char List	International Character List. Including 18 kinds of Language.	
9-4	CodePage List	Code Page List. Including 14 kinds of Language.	
9-5	Command mode	Display command mode, supports 10 kinds of command. Including EPSON, LD220, UTC Standard, UTC Standard, AEDEX, ADM788, DSP800, CD5220, EMAX, Logic control	
9-6	Standby model	Here you can decide how long this display will get into Standby (Welcome) mode, from 1 minute to 10 minutes for option, or never get into standby mode.	

5.3 Setup AP "Welcome" sheet
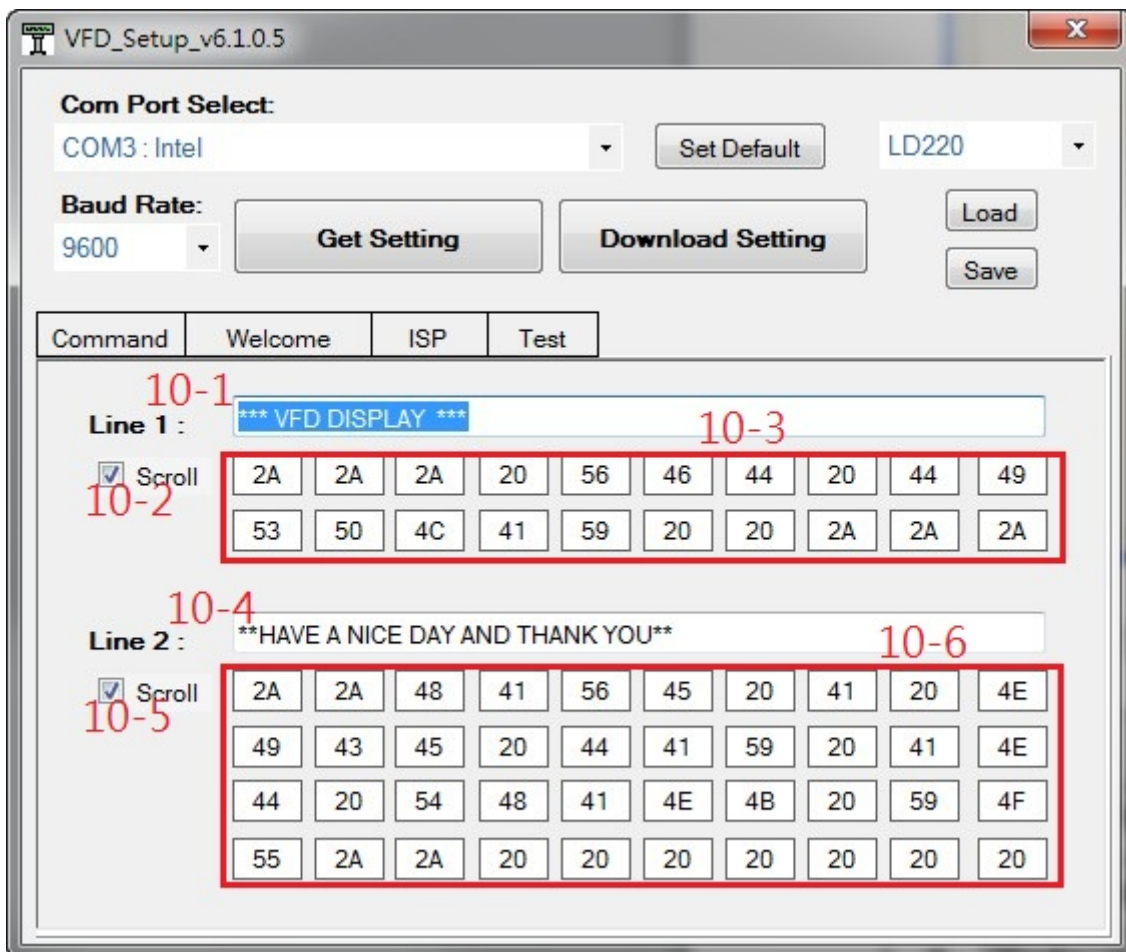
Number	Button	Function Description
10-1	Content insert	You can type in your content for Welcome (Standby) Mode for Line 1 in this column. Max for 20 Characters.
10-2	Scrolling for line 1	Select for scrolling.
10-3	Hex Mode	You can type in your content "in Hex" for Welcome (Standby) Mode in this column. Max for 20 Characters.
10-4	Content insert	You can type in your content for Welcome (Standby) Mode for Line 2 in this column. Max for 40 Characters.
10-5	Scrolling for line 2	Select for scrolling.
10-6	Hex Mode	You can type in your content "in Hex" for Welcome (Standby) Mode in this column. Max for 40 Characters.

5.4 Setup AP "ISP" sheet
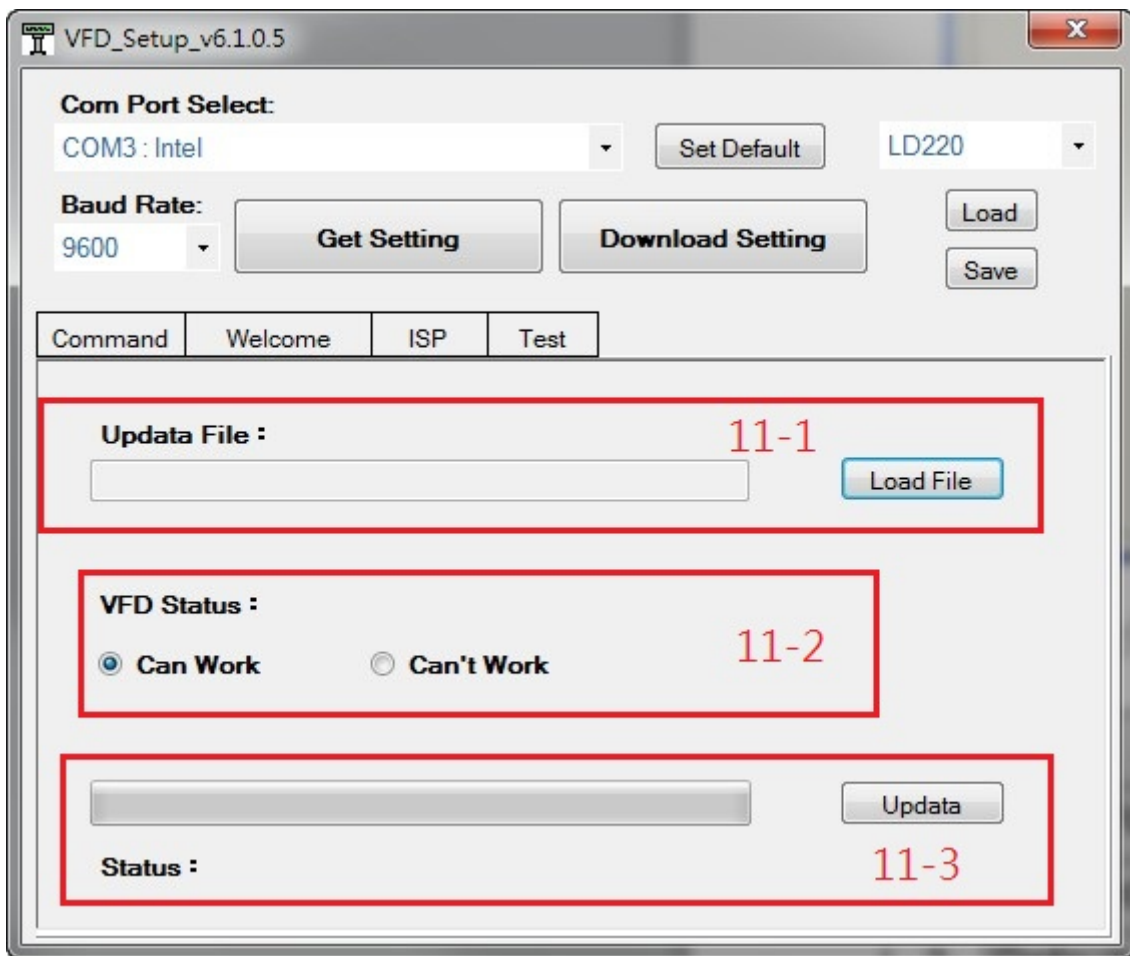
Number	Button	Function Description
11-1	Load File	Please insert the Firmware File by clicking "Load File", then you can see the file path in left side column.
11-2	VFD Status	Before you start to update the firmware, please select the status of display here. If your display is well-functioned, please select "Can work". If your display is not working, please select "Can't work".
11-3	Updata	After you finished above 2 steps, Load file and VFD Status, please clicking "update" to start the firmware updating.

5.5 Setup AP "TEST" sheet

Number	Button	Function Description
12-1	Text Column	You can freely enter any content here.
12-2	Text	Click here to apply the content you entered (12-1) to display.
12-3	Blink / Reverse	● Select "Blink" to show the content you entered and be flashing on the display. ● Select "Reverse" to show the content you entered and in reverse way. For example, green background with white font.
12-4	Text At	Please go to "12-5" first to decide the position of display you would like to test, then click 12-4 "Text At" to start the testing.
12-5	Row / Column	This function is to let you test the certain position of the display.
12-6	Clear	Clear all the content you entered.
12-7	All Test	All function testing automatically.
12-8	Codepage	You can change the codepage you would like to test here in 12-8.
12-9	Reload	And you can refresh the codepage list by clicking 12-9 "Reload".
12-9	Codepage testing	● Clicking "Codepage 0x80~0x9F" to test the position 0x80~0x9F of the codepage you select in 12-8. ● Clicking "Codepage 0xA0~0xBF" to test the position 0xA0~0xBF of the codepage you select in 12-8. ● Clicking "Codepage 0xC0~0xDF" to test the position 0xC0~0xDF of the codepage you select in 12-8. ● Clicking "Codepage 0xE0~0xEF" to test the position 0xE0~0xEF of the codepage you select in 12-8.

Appendix 1

USA	
France	
Germany	
U.K.	
Denmark I	
Sweden	
Italy	
Spain I	
Japan	
Norway	
Denmark II	
Spain II	
Latin America	
Korea	

Slovenia/ Croatia	
China	
Vietnam	

Appendix 2

CP437 (0x80~0xFF)

Katakana (0x80~0xFF)

CP-850 (0x80~0xFF)

CP-860 (0x80~0xFF)

CP-863 (0x80~0xFF)

CP-865 (0x80~0xFF)

CP-1252 (0x80~0xFF)

CP-866 (0x80~0xFF)

CP-852 (0x80~0xFF)

CP-858 (0x80~0xFF)

CP-1253 (0x80~0xFF)

CP-1255 (0x80~0xFF)

(Not available on 5x7 dots pixel Display)

CP-1257 (0x80~0xFF)

CP-1258 (0x80~0xFF)