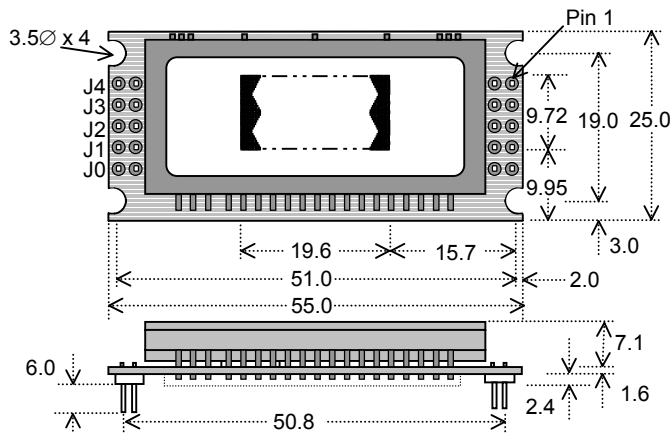


# Active Matrix Graphic VFD Module

# GW64x32C-K610A

- 64 x 32 Fine Dot Matrix
- Single 5V DC Supply
- Ultra High Brightness Display
- Wide Operating Temperature
- Async and SPI interfaces

This compact high brightness active matrix VF display module provides a compact solution for miniature information systems. The single 5V input power supply utilizes a unique patent applied technique without any inductive components or electrolytic capacitors. Please ask about custom commands and character fonts.



## PIN OUT

Pin	Sig	Pin	Sig
1	V <sub>CC</sub>	2	SCK
3	RX	4	SI
5	GND	6	SO
7	TX	8	/RES
9	MBusy	10	HBusy

Link 9 & 10 for SPI

Dimensions in mm. tolerances.

Uses patent applied PSU which has no inductive components. Brown out detector active when RES is not connected.

## ELECTRICAL SPECIFICATION

Parameter	Sym	Min	Typ	Max	Unit	Condition
Supply Voltage	V <sub>CC</sub>	4.5	5.0	5.5	V	V <sub>SS</sub> =0V
Supply Current	I <sub>CC</sub>	-	110	250	mA	V <sub>CC</sub> =5V All dots
Logic High Input	V <sub>IH</sub>	3.7	-	V <sub>CC</sub>	V	V <sub>SS</sub> =0V
Logic Low Input	V <sub>IL</sub>	0	-	0.3	V	V <sub>SS</sub> =0V

## ENVIRONMENTAL and OPTICAL SPECIFICATION

Parameter	Value
Display Area (XxY mm)	19.58 x 9.72
Dot Size/Pitch (XxY mm)	0.17 x 0.17/0.30 x 0.30
Luminance	3500 cd/m <sup>2</sup> Typ
Colour of Illumination	Blue-Green (Filter for colours)
Operating Temperature	-30°C to +80°C
Storage Temperature	-40°C to +85°C
Operating Humidity (non condensing)	10 to 90% @ 25°C

## SOFTWARE COMMANDS

Hex	Command
00-0F	Write user defined 8x8 icon in EEPROM to cursor
10+	Position Cursor where top left = 0,0 (10,x,y)
11	Set Pixel On at Cursor
12	Clear Pixel at Cursor
13+	Fill Area, co-ordinates inclusive (13,tx,ty,bx,by)
14+	Clear Area, co-ordinates inclusive (14,tx,ty,bx,by)
15+	Invert Area, co-ordinates inclusive (15,tx,ty,bx,by)
16+	Draw boxed outline, co-ordinates inclusive (16,tx,ty,bx,by)
17+	Draw line, diagonal allowed (17,tx,ty,bx,by)
18+	Send vertical graphic bytes (18, h/v inc, num, n1..n255 max)
19+	Send horiz. graphic bytes (19, h/v inc, num, n1..n255 max)
1A+	Download 8x8 icon to EEPROM. 1A,00-0F, n1,...n8
1B+	Extended Functions (Power Control and Semi-custom)
1C	Select Mini Font
1D	Select 5x7 Font
1E	Select 10x14 Font
1F	Select 20x28 Font
20-7F	Write ASCII Characters

The module defaults to a 4 x 10 character display using the 5x7 font with single pixel spacing. The cursor position auto increments after each character write. The bottom left of a character is placed at the cursor x,y. Data can be sent via the synchronous SPI or asynchronous RX input. Transmitted data is 'E' for error or 'R' at power on or module reset. The M(odule) Busy line indicates the module is busy when high. Connect the H(ost) Busy input to the MBusy to disable handshaking, which is mandatory for SPI communication.

## CHARACTER SETS

### MINI FONT (PROPORTIONAL SPACING)

	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
20		!	"	#	\$	%	&	'	(	)	*	+	,	-	.	/
30	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
40	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	
50	p	q	r	s	t	u	v	w	x	y	z	[	\	]	^	_

### 5x7 FONT (FIXED SPACING)

	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
20		!	"	#	\$	%	&	'	(	)	*	+	,	-	.	/
30	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
40	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	
50	p	q	r	s	t	u	v	w	x	y	z	[	\	]	^	_
60	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
70	P	q	r	s	t	u	v	w	x	y	z	{		}	~	▀

### 10x14 FONT (FIXED SPACING)

	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
20		!	"	#	\$	%	&	'	(	)	*	+	,	-	.	/
30	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
40	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	
50	p	q	r	s	t	u	v	w	x	y	z	[	\	]	^	_
60	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
70	P	q	r	s	t	u	v	w	x	y	z	{		}	~	▀

### 20x28 FONT (FIXED SPACING)

	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
20																
30	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?

## CONTACT

**Noritake Sales Office Tel Nos**  
 Nagoya Japan: +81 (0)52-561-9867  
 Canada: +1-416-291-2946  
 Chicago USA: +1-847-439-9020  
 Munchen (D): +49 (0)89-3214-290  
 Itron UK: +44 (0)1493 601144  
 Rest Europe: +49 (0)61-0520-9220  
[www.noritake-itron.com](http://www.noritake-itron.com)

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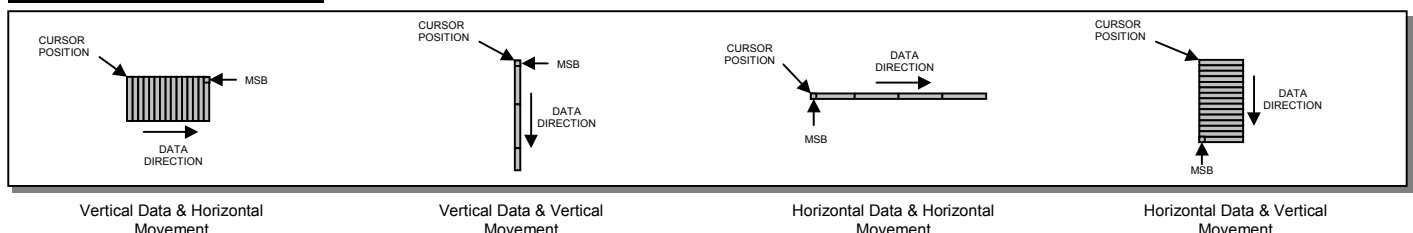
## SOFTWARE COMMANDS

Instruction	Hex	Description
UDF Write (BUSY = 14ms)	00H-0FH	Display user defined character (0-15) at current cursor position. The cursor is shifted 8 pixels on each UDF write. All UDF characters have an 8x8-pixel format and can be defined using the 'UDF Store' command.
Cursor Positioning (BUSY = 50us)	10H+x+y	Set cursor position. X = 0 to 63, Y = 0 to 31. The cursor can be positioned off-screen in the vertical direction. The cursor position is automatically advanced on each character write. A cursor position of 0,0 defines the top left-hand corner of the display.
Pixel On (BUSY = 14ms)	11H	Turn off single pixel at current cursor position.
Pixel Off (BUSY = 14ms)	12H	Turn on single pixel at current cursor position.
Area Fill (BUSY = 50us & 14ms [last byte])	13H+x1+y1+x2+y2	Turn on all pixels within co-ordinates x1, y1 to x2, y2. The first co-ordinates x1, y1 should point to the top-left of the area, and x2, y2 should point to the bottom-right.
Area Clear (BUSY = 50us & 14ms [last byte])	14H+x1+y1+x2+y2	Turn off all pixels within co-ordinates x1, y1 to x2, y2. The first co-ordinates x1, y1 should point to the top-left of the area, and x2, y2 should point to the bottom-right.
Area Invert (BUSY = 50us & 14ms [last byte])	15H+x1+y1+x2+y2	Invert all pixels within co-ordinates x1, y1 to x2, y2. The first co-ordinates x1, y1 should point to the top-left of the area, and x2, y2 should point to the bottom-right.
Box Outline (BUSY = 50us & 14ms [last byte])	16H+x1+y1+x2+y2	Draw single pixel width box outline from x1, y1 to x2, y2. The first co-ordinates x1, y1 should point to the top-left of the area, and x2, y2 should point to the bottom-right.
Draw Line (BUSY = 50us & 14ms [last byte])	17H+x1+y1+x2+y2	Draw a single pixel width line from x1, y1 to x2, y2. Both co-ordinates must be within the display area. e.g. 17H+00H+00H+3FH+1FH - draws a diagonal line from the top-left corner to the bottom-right corner.
Vertical Graphic Write (BUSY = 50us & 14ms [last byte])	18H+dir+num+data	Display vertical graphic data (D7 uppermost). Data direction can be either horizontal (0) or vertical (1). Data is displayed on last data byte sent. See 'Graphical Data Writes' below.
Horizontal Graphic Write (BUSY = 50us & 14ms [last byte])	19H+dir+num+data	Display horizontal graphic data (D7 leftmost). Data direction can be either horizontal (0) or vertical (1). Data is displayed on last data byte sent. See 'Graphical Data Writes' below.
UDF Store (BUSY = 50us and 4ms for each UDF data byte)	1AH+UDF+data	Store user defined character (00H-0FH) in non-volatile EEPROM. Characters are in an 8x8-pixel format The character data should consist of 8 vertical bytes with the MSB uppermost. e.g. 1AH+05H+FFH+81H+81H+81H+81H+81H+81H+81H+81H+FFH - defines a box at user defined character 05H. - display box character
Escape (BUSY = 50us)	1BH+x...	Perform extended command, see 'Escape Command' table below.
Mini Font (BUSY = 50us)	1CH	Select proportional mini font. The cursor movement amount is dictated by the width of the character written, plus a one-pixel gap.
5x7 Font (BUSY = 50us)	1DH	Select 5x7 font (default). The cursor is advanced by 6 pixels on each character write.
10x14 Font (BUSY = 50us)	1EH	Select 10x14 font. The cursor is advanced by 12 pixels on each character write.
20x28 Font (BUSY = 50us)	1FH	Select 20x28 font. The cursor is advanced by 24 pixels on each character write.
ASCII Write (BUSY = 14ms)	20H-7FH	Text is written to the display in the selected font. The cursor is moved right on each character write, if the end of the display is reached, the cursor will move back to the left-hand side of the display.

## ESCAPE COMMANDS

Automatic Latch (BUSY = 50us)	1BH+41H	All data written is immediately displayed. (default)
PSU Off (BUSY = 50us)	1BH+46H	Turn off the VFD Module's PSU. All data communication remains active.
Luminance (BUSY = 50us)	1BH+4CH+n	Set display luminance level n = 0 (display off), 1 (minimum) to 7 (maximum). (default = 7)
Manual Latch (BUSY = 50us)	1BH+4DH	All hidden data is displayed. All subsequent written data is hidden until the next manual latch command. This can be helpful for slow display updates.
PSU On (BUSY = 50us)	1BH+4FH	Enable VFD module's PSU. (default)
RESET (BUSY = 15ms)	1BH+52H	Reset module to power on defaults. Luminance level is set to maximum. Display is cleared. 5x7 font is selected. Automatic latch is enabled. Cursor is positioned to 0,7. 'R' is sent to the host.

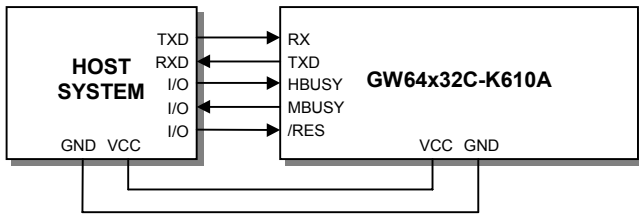
## GRAPHICAL DATA WRITES



## INTERFACING TO THE GW64x32C-K610A

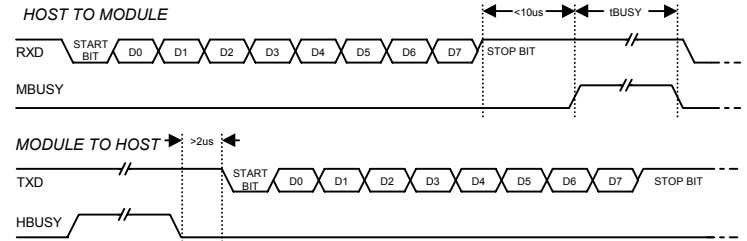
The VFD module contains two serial ports for synchronous and asynchronous communication, both at TTL. The busy line should be monitored to ensure data is interpreted correctly.

### ASYNCHRONOUS SERIAL COMMUNICATION

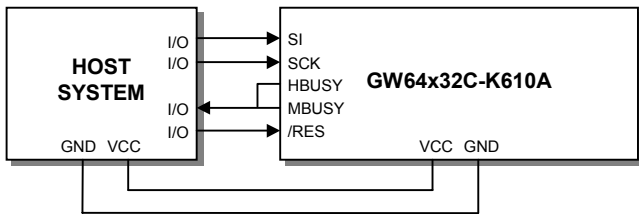


The communication speed and parity can be changed with the jumper links J0-J4. These settings will be applied at power-up and with hardware reset. The default settings are 19200 baud, with no parity.

Hardware handshaking is available using the module busy 'MBUSY' and host busy 'HBUSY' control lines. The module contains a receive buffer of 32 bytes.

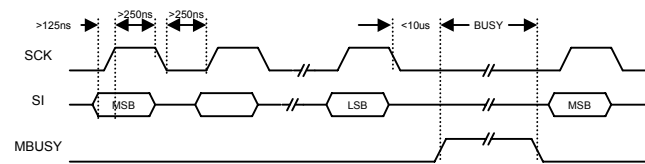


### SYNCHRONOUS SERIAL COMMUNICATION

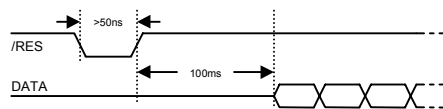


If the busy line is not being monitored, the host must provide adequate delays for the module to process the data. These data/command busy times are specified in the software command section.

When using synchronous communications, the user must ensure that the module busy 'MBUSY' and host busy 'HBUSY' lines are tied together at power up. The host system can still monitor the MBUSY line. Data is clocked in on the rising edge of SCK. The most significant bit of the data byte should be sent first.



### RESET TIMING



The module is reset when a low level signal is applied to the /RES line. This will cause the module to recheck the jumper links, clear the display and set all defaults. All icon data is retained. During this initialisation period, the user must delay any transmission to the module.

### DISPLAYING TEXT

The module contains 4 font sizes, a proportional mini-font, 5x7 pixel, 10x14 pixel and a 20x28-pixel font. Characters of any size can be written to any part of the display. All data sent to the module from 20H to 7FH is treated as character data. Characters are positioned above the current cursor position, see Fig1. Each character written has will include a space to the right and below, this space size is dependant upon the selected font. The mini-font & 5x7 pixel font have a one pixel space, the 10x14 font has a 2 pixel space, and the 20x28 pixel font has a 4 pixel space. This space should be taken into consideration when positioning the character. After each character is written to the display, the cursor position is automatically advanced by the width of the selected character font plus it's space. If the cursor position advances off the display, it will automatically be moved to the left side of the display (x = 0).

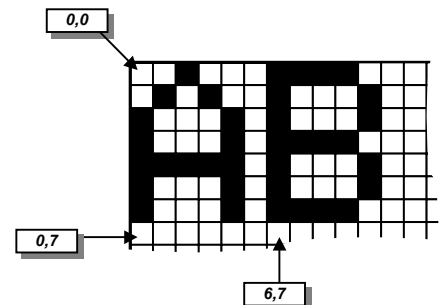
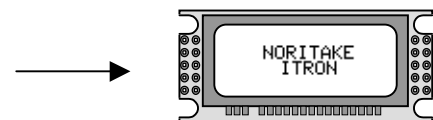
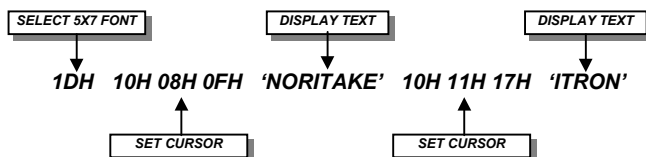


Fig1: Cursor Positioning, example of writing 2 characters from cursor position 0,7.

The following example displays two text messages in the center of the display.



## DISPLAYING GRAPHICS

Graphical images can be displayed on the VFD module in either a horizontal or vertical byte orientation. The cursor is automatically advanced in a downward direction, or a forward (left-right) direction. The most significant bit is positioned to the top (vertical data) or to the left (horizontal data).

The following example displays a simple graphic image. The vertical graphics command is used to send the top 20 bytes, then the bottom 20 bytes of graphical data.

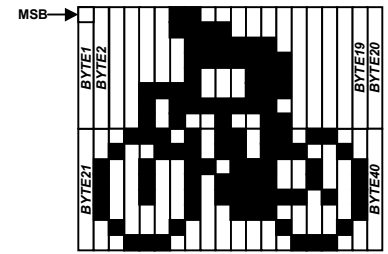
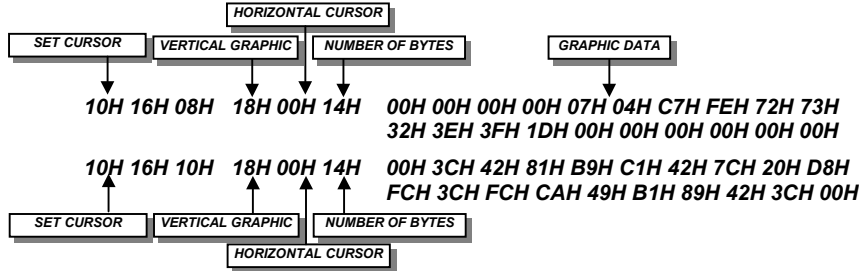
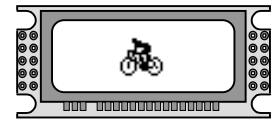


Fig2: Example Graphic Image



## USING USER DEFINED CHARACTERS/ICONS

16 User defined icons/characters can be stored in the VFD module's EEPROM, these are retained when the power is removed. All icons have an 8x8-pixel format. The icon data should be in a vertical format, with the MSB uppermost. Displaying an icon is much the same procedure for displaying any standard character. A user character/icon is displayed with 00H-0FH.

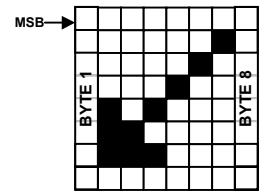
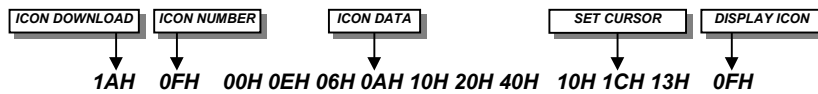
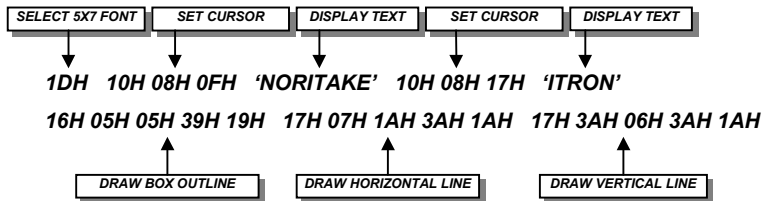


Fig3: Example Icon

## DRAWING COMMANDS

The box, line and pixel commands allow the creation of complex displays without the need for the transferring a complete image. The line command can draw a single pixel width line from any point of the display, in any direction. The following example draws a box with a drop shadow around some text.



## DISPLAY UPDATE

If the display is visually slow in updating, the user can issue a command to buffer all display changes. The user can then latch this data with one command, and the display will change instantaneously. The manual latch command (1BH + 4DH) should be issued before data transfer (to disable automatic update), and after data transfer. To revert back to an immediate display update, use the automatic latch command (1BH + 41H).

