Noritake **itron**

Specification: **CU406-KTW220A**
                           V F D   M o d u l e

Features: **40x1 Character Module**
                           5mm High Characters
                           Single 5V Supply
                           High Brightness Blue Green Display
                           Operating Temp -40°C to +85°C
                           ASCII, Katakana & Extended Character Font
                           16 User Definable Character RAM
                           8 Bit Parallel Interface
                           Asynchronous Serial Interfaces

Reference: 61533
Issue Date: 28 February 2011
Revision: F3

1.0 General Description

1.1 Scope

This specification covers the operating requirements of the vacuum fluorescent graphic display module CU406-KTW220A.

1.2 Construction

The module consists of a 40 x 1 dot graphic CIG-VFD, refresh RAM, character generator, DC/DC converter, display controller, and all necessary control logic. Interface level is CMOS compatible and the module can be connected to the CPU bus of host directly.

1.3 Outline

Power supply: + 5 V_{DC} only
Interface: Parallel interface (CMOS)
                   C-MOS Asynchronous Serial Interface
Function: Character display
                   Control commands
   Applied reliability spec: TT-99-3102
Applied production spec:TT-98-3413

2.0 Electrical Specification

2.1 Absolute Maximum Ratings

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition	Note
Power Supply Voltage	VCC	0	-	+6.0	VDC	GND=0V	
Logic Supply Voltage	VIN	0	-	Vcc+0.3	VDC	GND=0V	D0-D7, /WR /CS, SIN, /RESET

2.2 Electrical Ratings

Parameter		Symbol	Min.	Typ.	Max.	Unit	Condition	Note
Logic Input Voltage	'H'	VIH	3.5VDC	-	VCC	VDC	VCC=5.0V TA=25deg	
	'L'	VIL	0	-	1.5VDC			
Power Supply Voltage		VCC	4.75	5.0	5.25	VDC	GND=0V	

All driving voltages for the VFD are supplied by the DC/DC converter on board.

2.3 Electrical Characteristics

Measuring Conditions: Ambient temperature = 25º C, VCC =5.0VDC

Parameter		Symbol	Min.	Typ.	Max.	Unit	Condition	Note
Logic Output Voltage	"H"	VOH	4.5	—	VCC	VDC	IOH=-2.0mA	D7(Busyflag) BUSY, D0-D7
	"L"	VOL	0	—	0.33	VDC	IOL=2mA	
Power Supply Current		ICC	-	350	-	mADC		All dots ON

The power supply should be capable of supplying a higher current (x2) at 'power on' for 50ms

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3.0 Optical Specifications

Number of Characters:	40 (1 lines x 40 chars)
PCB Size:	226.0 mm x 40.0 mm (X x Y)
Display area:	178.5mm x 5.9mm(X x Y)
Character size:	3.0mm x 5.0mm(X x Y)
Character pitch:	4.5mm (X x Y)
Luminance:	350cd/m^2 Min. (900cd/m^2 Typ.)
Color of illumination:	Green (Blue Green)

4.0 Environmental Specifications

Operating temperature:	-40 to +85degrees C
Storage temperature:	-40 to +85degrees C
Storage humidity:	20 to 80 % R.H(Non Condensing) @ 25ºC
Vibration:	10-55Hz, all amplitude, X-Y-Z (Non operating)
Shock:	392m/s^2 (40G) X-Y-Z, 3times each direction (Non operating)

5.0 Interface

5.1 Type of Interface

This module provides the functions of 8 bit parallel and serial data write.
All data write should be done whilst BUSY line is low

CS	WR	Function	Bus direction
0	↑	Data write	Module ← Host
1	X	No operation	Module X Host

↑ :Rising edge of pulse X: Do not care

5.2 Parallel Interface

5.2.1 Basic function

The module sets the BUSY line upon receipt of data, and clears the line when ready to receive more data.

5.2.2   Parallel Interface timing
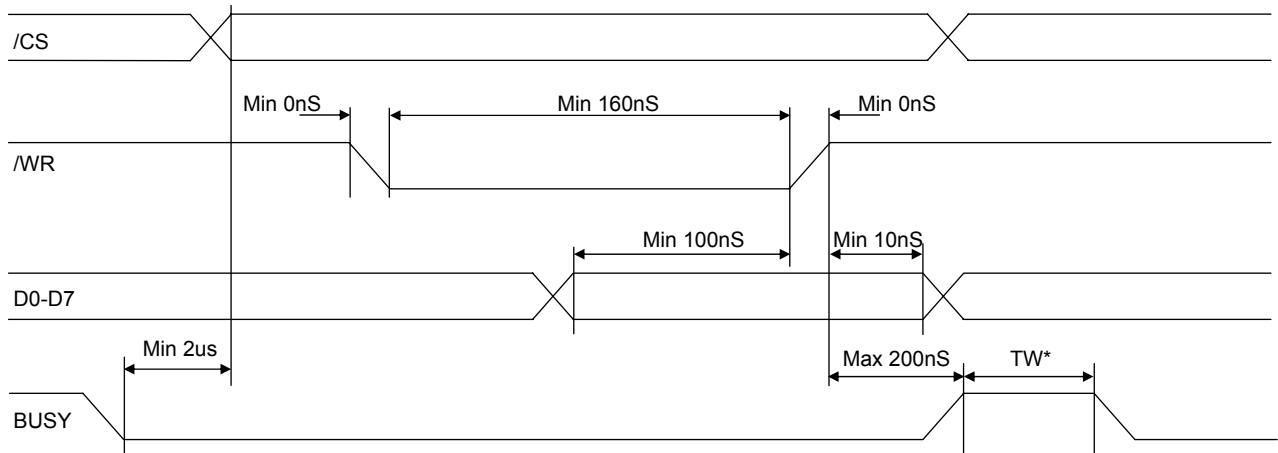
TW* - See note on BUSY TIME

5.3   Serial Timing

5.3.1   Basic function

Asynchronous serial interfaces are provided at TTL level. Baud rate & Parity can be selected using Jumper wires.

5.3.2   Asynchronous serial interface timing

D0 – LSB
D7 – MSB
PRTY – Parity Bit
STOP – STOP Bit
TW* - See note on BUSY TIME

5.4 BUSY Time

Input data execution time (TW*) at Quick Write Mode are shown as follows.

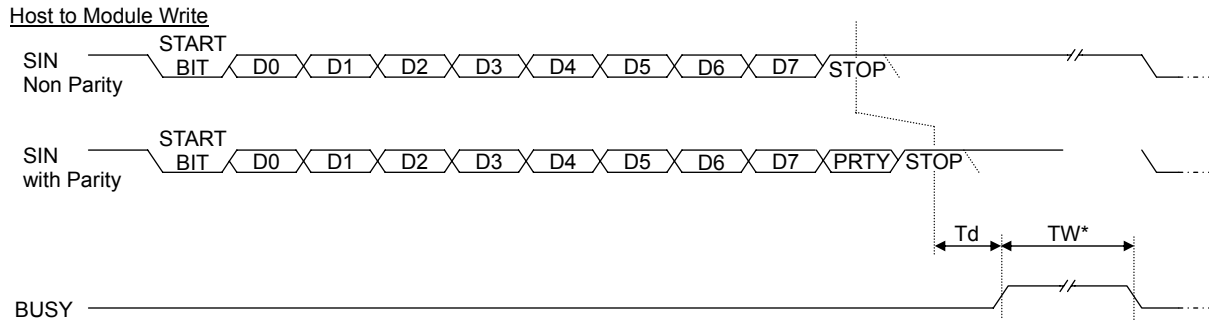| Data			Execution time (TW)			Data Writing Mode
			DC1 Mode	DC2 Mode	DC3 Mode	
Character Data, HT, LF			200 uS (MAX.)	1000 uS (MAX.) at scrolling	300 uS (MAX.) at scrolling	Quick Write Mode
BS,FF,CR,CT0,CT1,EUR DC1,DC2,DC3,DC4,DC5,DC6,DC7			200 uS (MAX.)			
CLR			900 uS (MAX.)			
CAN			300 uS (MAX.)			
ESC	1st byte		200 uS (MAX.)			
	2nd byte	"C"	200 uS (MAX.)			
		"I"	1400 uS (MAX.)			
		Expect "C","I"	200 uS (MAX.)			
	3rd byte		200 uS (MAX.)			

Above execution time are only talking about Quick Write Mode as mentioned.
Within Flicker less Mode, Approximately 2 to 15 times of above table should be considered.
Operating with Flicker less Mode, therefore, always watching of BUSY line is recommended.

6.0 Software Function

6.1 Character Commands

6.1.1 BS: Back Space (08H) Busy = 6us

Moves the cursor left by one character.
If the cursor is at the left end of the display no cursor movement is made.

6.1.2 HT: Horizontal Tab (09H) Busy = 6us (20us on scroll)

Moves the cursor right by one character.
If the cursor is at the right end of the display the cursor moves to the left end of the line below.
If the cursor is at the right end of the bottom line the action depends on the write mode currently selected. In DC1 and DC2 mode no cursor movement is made. In DC3 mode the entire contents of the display is scrolled left by one character, the right end character position is cleared. No cursor movement is made.

6.1.3 LF: Line Feed (0AH) Busy = 6us (20us on scroll)

The display is cleared. No cursor movement is made.

6.1.4 FF: Form Feed (0CH) Busy = 6us

Moves the cursor to the left end of the display.

6.1.5 CR: Carriage Return (0DH) Busy = 6us

Moves the cursor to the left end of the current line.

6.1.6   CLR: Clear (0EH) Busy = 65us

Clear all displayed characters. No cursor movement is made.

6.1.7   Cancel (0FH), Busy = 65us

Clear all displayed characters. No cursor movement is made.

6.1.8   Auto CR Mode (DC1) (11H), Busy = 6us

Specifies automatic carriage return mode. (default)

6.1.9   Overwrite Mode (DC2) (12H), Busy = 6us

Specifies character overwrite mode.

6.1.10   Horizontal Scroll Mode (DC3) (13H), Busy = 6us

Specifies horizontal scroll mode

6.1.11   Cursor Off (DC4) (14H), Busy = 6us

The cursor is displayed as a static underline. (default)

6.1.12   Cursor On (DC5) (15H), Busy = 6us

A blinking full block is displayed at the cursor position. The blink rate can be specified using the Blink Speed Control command.

6.1.13   Cursor Off (DC6) (16H), Busy = 6us

No cursor is displayed.

6.1.14   Cursor Off (DC7) (17H), Busy = 6us

A blinking full block is displayed at the cursor position. The blink rate can be specified using the Blink Speed Control command.

6.1.15   International Font (18H), Busy = 6us

All subsequent characters displayed will be from the International Font. This font can also be selected as the default by using the JA hardware jumper link (OPEN)

6.1.16   Katakana Font (19H), Busy = 6us

All subsequent characters displayed will be from the Katakana Font. This font can also be selected as the default by using the JA hardware jumper link (LINKED)

6.1.17   Euro Symbol (1AH), Busy = 6us

This command enables the Euro currency mark at location ADH in the International font. Sending the International font command (or after a reset) restores the character at location ADH to a blank (this is the default condition). This will affect any existing ADH characters already on the display.

6.1.18 User Defined Font (1BH + 43H + character code + data byte 1 + data byte 2 + data byte 3 + data byte 4 + data byte 5), Busy = 6us (1BH) + 4us (43H) + 6us (byte 1) + 6us (byte 2) + 6us (byte 3) + 6us (byte 4) + 15us (byte 5)

Define a user character. Up to 16 user characters can be defined and stored by the module. The specified character code can be 00H – FFH. Command codes can be overwritten with a UDF so be aware that doing so will disable that command. All UDF's are lost on power off or reset. If more than 16 UDF's are defined the older definitions are overwritten.

	7(MSB)	6	5	4	3	2	1	0(LSB)
Byte 1	P8	P7	P6	P5	P4	P3	P2	P1
Byte 2	P16	P15	P14	P13	P12	P11	P10	P9
Byte 3	P24	P23	P22	P21	P20	P19	P18	P17
Byte 4	P32	P31	P30	P29	P28	P27	P26	P25
Byte 5	*	*	*	*	UL	P35	P34	P33

* : don't care

Following is the dot assignment.

P1	P2	P3	P4	P5
P6	P7	P8	P9	P10
P11	P12	P13	P14	P15
P16	P17	P18	P19	P20
P21	P22	P23	P24	P25
P26	P27	P28	P29	P30
P31	P32	P33	P34	P35

UL

6.1.19 Cursor Moving (1BH + 48H + Position), Busy = 6us (1BH) + 4us (48H) + 4us (position)

The cursor is moved to the specified position. The relationship between the position value and the display is as follows:

Left end	2nd Column	3rd Column	-	Right End
00H	01H	02H	-	27H

6.1.20 Luminance, (1BH + 4CH + luminance), Busy = 6us (1BH) + 4us (4CH) + 4us (luminance)

The display luminance can be set to one of 4 levels.
Luminance = 00H – 3FH specifies 25%
Luminance = 40H – 7FH specifies 50%
Luminance = 80H – BFH specifies 75%
Luminance = COH – FFH specifies 100% (default)

6.1.21 Flickerless Writing Mode, (1BH + 53H), Busy = 6us (1BH) + 6us (53H)

Set flickerless write mode. By default, priority is given to data communication and display flicker can occur if data is sent to the display continuously. If flickerless writing mode is specified, priority is given to display refresh to avoid possible flicker. Command and data busy times will be up to 200us longer when this mode is set.

6.1.22 Blink Speed Control, (1BH + 54H + speed), Busy = 6us (1BH) + 4us (54H) + 6us (speed)

The blink rate of the cursor can be specified. Rate = speed x 30ms. (default = 14H)

6.1.23 Initialise, (1BH + 49H), Busy = 6us (1BH) + 40us (49H)

Clear the display, erase any defined characters, set the cursor position to the top left of the display and reset all settings to defaults.

6.1.24 Character Write, (20H – FFH), Busy = 7us (20us on scroll)

Display the specified character from the currently selected font (or UDF is defined) at the current cursor position. After the character is written to the display a horizontal tab automatically follows.

7.0 Character Sets

7.1 International Font

	00	10	20	30	40	50	60	70	80	90	A0	B0	C0	D0	E0	F0
00																
01																
02																
03																
04																
05																
06																
07																
08																
09																
0A																
0B																
0C																
0D																
0E																
0F																

7.2 Katakana Font

	00	10	20	30	40	50	60	70	80	90	A0	B0	C0	D0	E0	F0
00																
01																
02																
03																
04																
05																
06																
07																
08																
09																
0A																
0B																
0C																
0D																
0E																
0F																

8.0   Setup

8.1   Jumper

No.	Function	Default
J0	Baud Rate	Open
J1		
J2		
J3	Parity	Open
J4		
JA	Font	Open

8.1.1   Baud Rate

J0	J1	J2	Baud
Open	Open	Open	19200
Link	Open	Open	9600
Open	Link	Open	4800
Link	Link	Open	2400
Open	Open	Link	1200

8.1.2   Parity

J3	J4	Parity
Open	Open	EVEN
Link	Open	ODD
O/L	Link	NONE

8.1.3   Font

JA	Font
O	International
L	Katakana

9.0   Connector

9.1   IDC Data Connector

1
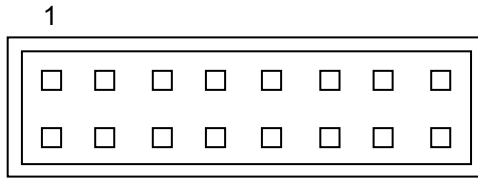
Pin No.	Signal name	Pin No.	Signal name
1	D7	2	D6
3	D5	4	D4
5	D3	6	D2
7	D1	8	D0
9	/WR	10	/CS
11	Sin/Test	12	BUSY
13	GND (0V)	14	GND (0V)
15	VCC (5V)	16	VCC (5V)

9.2   3 Pin Power Connector

1   2   3
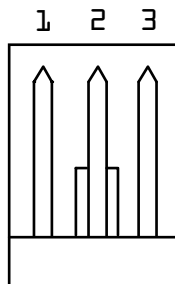
Pin No.	Signal name
1	VCC (5V)
2	SIN/TEST
3	GND (0V)

10.0   Notation of firmware version

The firmware version is written in the following position.

Soldering Side

Electrical Test

Serial Number

CON2

CON4

xxxxxx

P

JC JB JA J0 J1 J2 J3 J4

CU406-KTW220A   v2

Part Number

Version Number
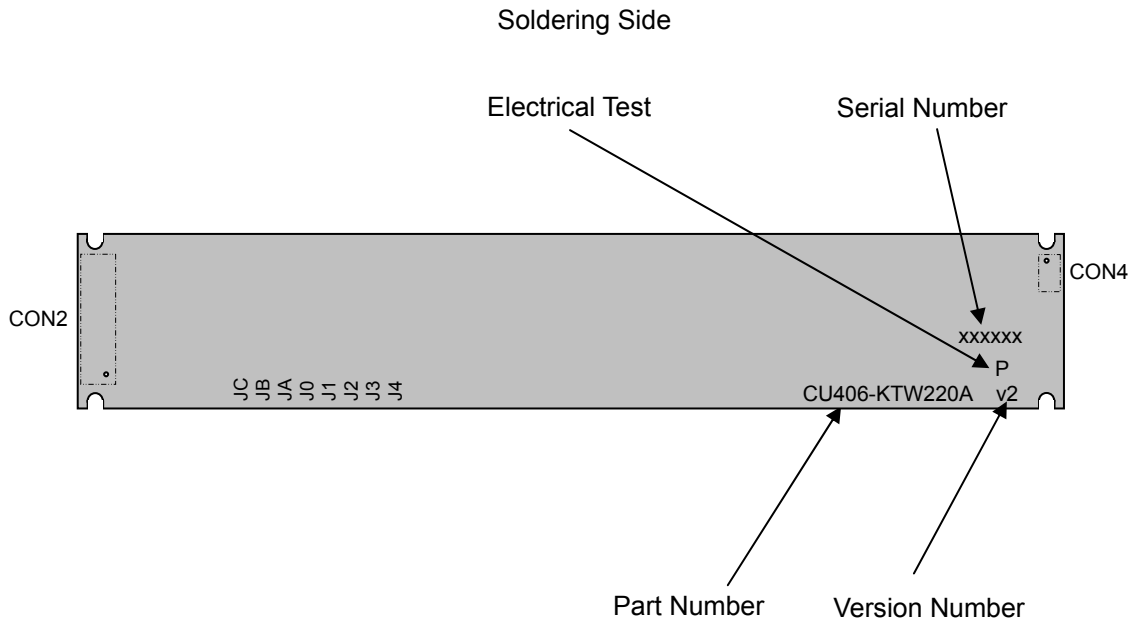
11.0   Outline Drawing
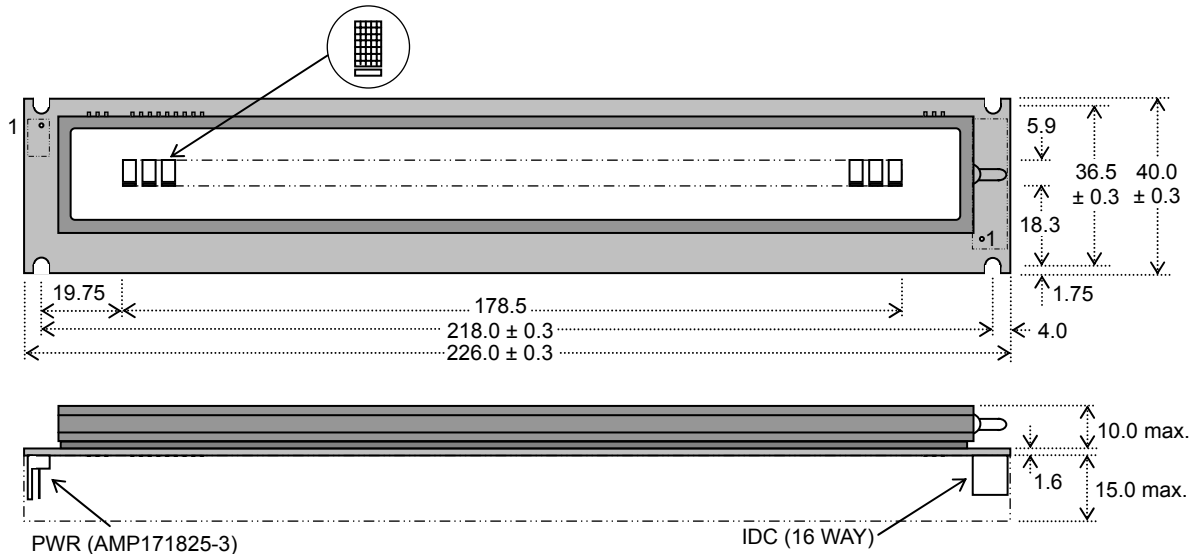
Dimensions in mm & subject to tolerances. Mounting holes 3.5mm dia.

Notice for the Cautious Handling of VFD Modules

Handling and Usage Precautions:
Please carefully follow the appropriate product application notes for proper usage, safety handling, and operation standards for maximum performance.

[VFD tubes are made of glass]
- Because the edges of the VFD glass-envelop are not smooth, it is necessary to handle carefully to avoid injuries to your hands
- Please avoid breaking the VFD glass-envelop to prevent injury from sharp glass particles.
- The tip of the exhaust pipe is fragile so avoid shock from impact.
- It is recommended to allow sufficient open space surrounding the exhaust pipe to avoid possible damage.
- Please design the PCB for the VFD-module within 0.3 mm warping tolerance to avoid any forces that may damage the display due to PCB distortion causing a breakdown of the electrical circuit leading to VFD failure.

[High voltage]
- Avoid touching conductive electrical parts, because the VFD-module uses high voltage exceeding 30   100 volts.
- Even when electric power is turned off, it may take more than one minute for the electrical current to discharge.

[Cable connection]
- Do not unplug the power and/or data cables of VFD-modules during operating condition because unrecoverable damage may result.
- Sending input signals to the VFD-module during a power off condition sometimes causes I/O port damage.
- It is recommended to use a 30 cm or shorter signal cable to prevent functional failures.

[Electrostatic charge]
- VFD-modules needs electrostatic free packaging and protection from electrostatic charges during handling and usage.

[Structure]
- During operation, VFD and VFD-modules generate heat. Please consider sufficient heat radiation dissipation using heat sink solutions.
- We prefer to use UL grade materials or components in conjunction with VFD-modules.
- Wrap and twist motion causes stress and may break VFDs & VFD modules. Please adhere to allowances within 0.3mm at the point of attachment.

[Power]
- Apply regulated power to the VFD-module within specified voltages to protect from failures.
- Because some VFD-modules may consume in rush current equal to twice the typical current at power-on timing, we recommend using a sufficient power capability and quick starting of the power regulator.
- VFD-module needs a specified voltage at the point of connection. Please use an adequate power cable to avoid a decrease in voltage. We also recommend inserting a power fuse for extra protection.

[Operating consideration]
- Illuminating phosphor will decrease in brightness during extended operation. If a fixed pattern illuminates for an extended period,(several hours), the phosphor efficiency will decrease compared to the non operating phosphor causing a non uniform brightness among pixels. Please consider programming the display patterns to use all phosphor segments evenly. Scrolling may be a consideration for a period of time to refresh the phosphor condition and improve even illumination to the pixels.
- We recommend using a signal cable 30cm or less to avoid some possible disturbances to the signal.

[Storage and operating environment]
- Please use VFD-modules under the recommended specified environmental conditions. Salty, sulfur and dusty environments may damage the VFD-module even during storage.

[Discard]
- Some VFDs contain a small amount of cadmium in the phosphor and lead in the solder. When discarding VFDs or VFD-modules, please adhere to governmental related laws or regulations.

[Others]
- Although the VFD-module is designed to be protected from electrical noise, please plan your circuitry to exclude as much noise as possible.
- Do not reconstruct or repair the VFD-module without our authorization. We cannot assure the quality or reliability of unauthorized reconstructed VFD-modules.

Notice:
We do not authorize the use of any patents that may be inherent in these specifications.
Neither whole nor partial copying of these specifications are permitted without our approval.
If necessary , please ask for assistance from our sales consultant.
This product is not designed for military, aerospace, medical or other life-critical applications. If you choose to use this product for these applications, please ask us for prior consultation or we cannot take responsibility for problems that may occur.