January 2000

CSYS Labs, Inc.

Product Information

TVM2464

Touch Vision LCD Module

Description:

The TVM2464 Touch Vision Module provides a complete user interface in a small, low cost, convenient to use module. It combines a graphics LCD display, touch activated panel overlay, interface electronics, LCD drivers, EL back light, and power supply voltage converters. Because the TVM2464 contains on board voltage converters, only a +5V power supply is required.

The TVM2464 includes a powerful custom programmed micro-processor which acts as an intelligent controller for the entire module and makes interfacing to the TVM2464 very easy. Communication with the TVM2464 is done through a 16 to 20 wire parallel port. Hand shaking signals are provided to make interfacing as simple as possible. A status register is also provided to better accommodate pipe lined communication.

A rich instruction set, for both text and graphics commands is provided. With these commands, the user can freely mix and manipulate graphics and text being displayed. Simple commands can be issued to position the cursor, set up the text window size and set system attributes. Graphics commands are provided to draw rectangles, boxes, lines, vectors or to set individual pixels.

Additional commands can be used to activate a touch panel switch area as well as place a button outline on the LCD display automatically. This makes writing soft buttons (program controlled keys) very easy. The program loads the TVM2464 with the button label and places the button via a single instruction. If enabled, the software automatically sizes the button, places the text in the center of the button, writes the button to the display, and then activates the touch panel in the button's location. When the button is pressed, the on board CPU signals the main CPU that a button has been actuated and makes the button's code available for reading by the main CPU. Other button commands may be used to activate a "phantom button" area, delete a button, or delete all buttons.

The TVM2464 has the ability to simultaneously mix as many as 5 fonts on the screen. Two of the fonts are pre-programmed into the TVM2464 controller. The other three fonts may be custom compiled using a font compiler and down loaded into the TVM2464's font memory. Any font may be used at any time for labels anywhere, including text inside a defined button area.

The TVM2464 has the capability to adjust LCD contrast electronically. This eliminates the need for any hardware contrast adjustments by end users of the equipment. In addition, a course adjustment trimmer is provided on the controller board to accommodate initial factory settings.

An EL back light panel (including high voltage driver) is included on the TVM2464. The back light can be turned ON and OFF via an on board switch by issuing a simple command to the TVM2464.

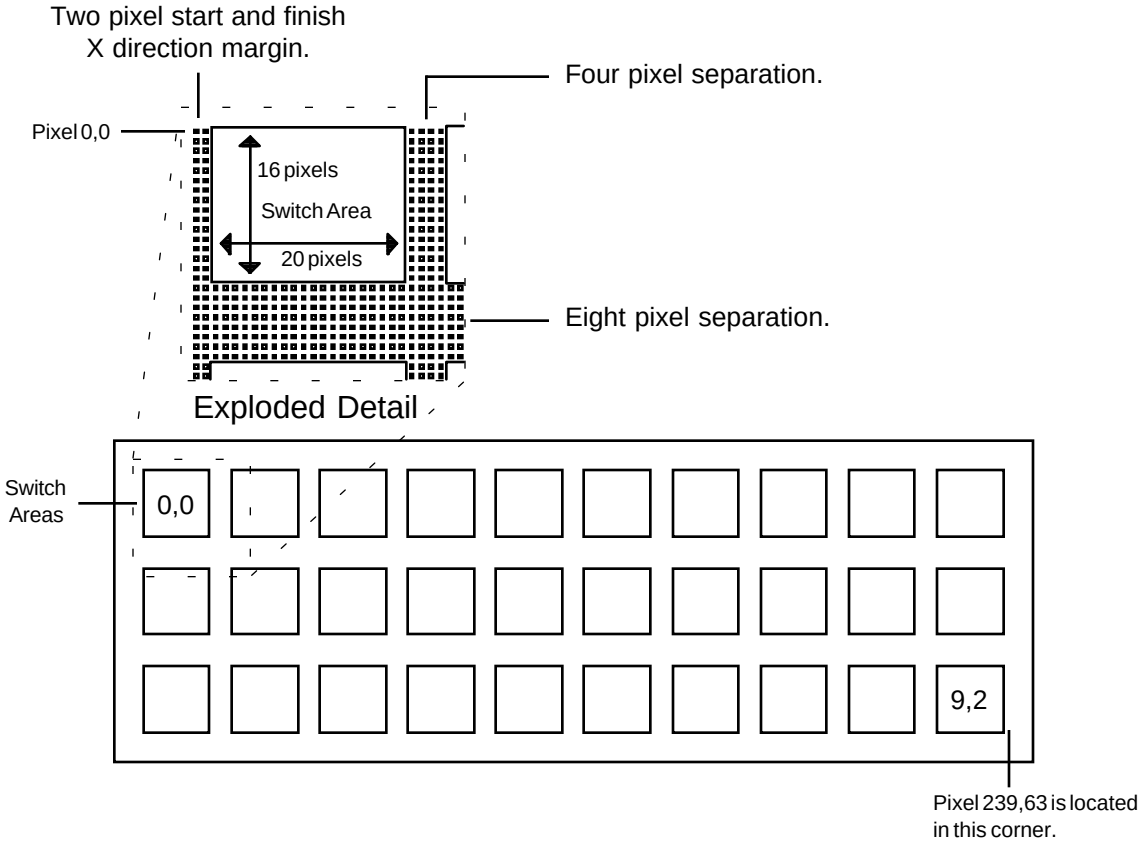
Features:

- 240 X 64 Super Twist LCD Display
- 3 X 10 Matrix Touch Panel Overlay
- Single +5V Power Supply Operation
- Low Power Consumption
- Optional EL Back Light
- Software Controlled Back Light
- Software Controlled Electronic Contrast
- 2 Built in Fonts
- Up to 3 Down Loaded Soft Fonts
- Audio Alarm and/or Key Click
- Freely Mix Text and Graphics
- Text Window Defined via Software
- Automatic Scrolling in Text Window
- Freely Mixed Multiple Font Types
- Auto Button Generation and Placement
- An Abundance of Graphics Commands
- Efficient 8 Bit Parallel Interface

Display and Touch Panel Layout

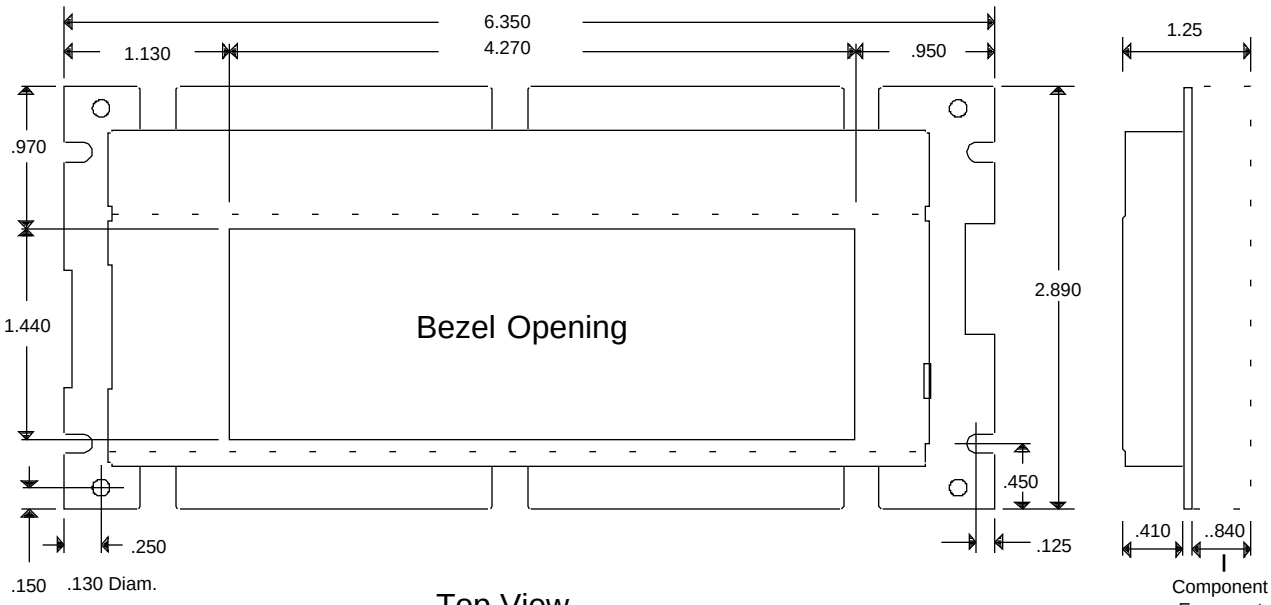
The LCD display is organized in an array 240 dots wide by 64 dots tall. The upper left hand corner of the display is always 0,0 (X,Y). The lower right is 239,63. All coordinates, whether for cursor placement or for placements of graphics use the same coordinate entry methodology and are always referenced to the upper left corner of the display.

The touch panel is organized as an array, 10 wide by 3 tall, of touch sensitive cells. The upper left hand cell is referred to as 0,0 and the lower right cell is 9,2. Each cell is 20 pixels wide by 16 pixels high. A horizontal space 4 pixels wide and a vertical space 8 pixels wide is left as an easement between each touch panel cell.



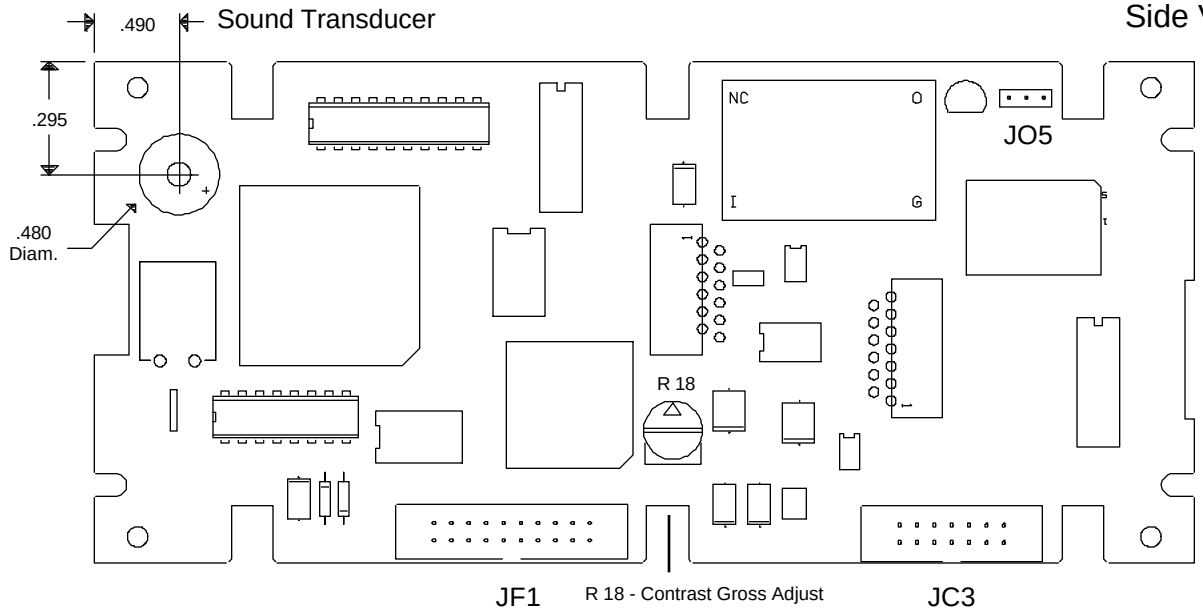
LCD display with the touch panel overlay.

Mechanical Outlines:



Top View

Side View



Back View

System Interface

Connecting the TVM2464 to the main micro-processor is done via a 20 pin ribbon cable which is connected to JF1 at the bottom of the module. Power and ground are provided to the module through this cable. The TVM2464 uses an 8 bit instruction/data bus as well as 2 address lines. There are also several control signals and status lines.

Pin #	Function	Description	Type
1	VSS	VSS Power connection	Power
2	RESET/	Module Reset, Negative	Out
3	DEN/	Module Enable, Negative	In
4	DRD/	Read, Negative	In
5	DWR/	Write, Negative	In
6	DIBF	Input Buffer Full, Positive	Out
7	DOBF/	Output Buffer Full, Negative	Out
8	ERROR	Module Error, Positive	Out
9	KEYPRESS	Key Pressed Flag, Positive	Out
10	DA0	Address 0	In
11	DA1	Address 1	In
12	D0	Data 0	I/O
13	D1	Data 1	I/O
14	D2	Data 2	I/O
15	D3	Data 3	I/O
16	D4	Data 4	I/O
17	D5	Data 5	I/O
18	D6	Data 6	I/O
19	D7	Data 7	I/O
20	VCC	Power	Power

Instructions for the TVM2464 are always written to address 0. If the instruction requires additional data, the data is written to address 1. This is done to facilitate data strings of arbitrary length such as text input or down loading of fonts. String data is always terminated by writing the next instruction to address 0. Instructions having data of an arbitrary amount are referred to as having “String” data.

Any instruction requiring more data before it can execute may be aborted by writing the next instruction to the instruction register.

Some instructions will return data. This data is always read at address 0. The status register may be read at any time from address 3. The table below summarizes the address mapping.

DA1	DA0	Write	Read
0	0	Instruction	Data
0	1	Data	
1	0		
1	1		Status

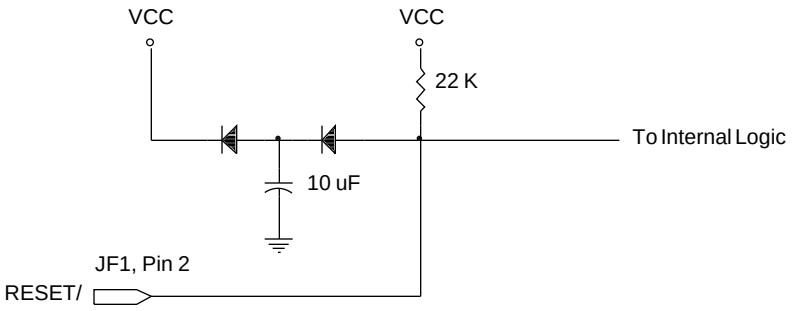
Signal Descriptions

DEN/	DWR/	DRD/	DA0	DA1	Action
1	x	x	x	x	No Action
0	1	1	x	x	No Action
0	0	1	0	0	Write Instruction
0	0	1	1	0	Write Data
0	0	1	0	1	Illegal
0	0	1	1	1	Illegal
0	1	0	0	0	Read Data
0	1	0	1	0	Illegal
0	1	0	0	1	Illegal
0	1	0	1	1	Read Status Register

Interface Signals

RESET/

A logic 0 level on this pin causes a reset of the module. If this pin is left open, the internal RC reset network on the module will cause a reset. It should be noted that the internal capacitor in the TVM2464 will hold down the RESET/ line and any external circuitry tied to the this pin.



DEN/, DRD/, DWR/

A logic 0 level on DEN/ and DWR/ will cause a write to the TVM2464. A logic 0 level on DEN/ and DRD/ will cause a read from the TVM2464. Please refer to page 4 for DA0 and DA1 addressing information.

DIBF (Input Buffer Full)

The TVM2464 uses an 8255 PPI device to act as an I/O buffer to the controller. Instruction and data information is always written to this buffer. The I/O buffer can hold information for the next instruction while the controller processes the current instruction so there is one level of pipe lining of data to the module. This is an important point to remember when interfacing the module. DIBF provides a signal to indicate if the TVM2464 can accept data. A logic 0 indicates that the TVM2464 is ready for the next instruction or data. A logic 1 indicates that the input buffer to the controller is full and the module is busy. Therefore the DIBF

signal does not indicate that the controller has completed execution of the current instruction, it only indicates that the input buffer is empty and that new information may be written. DIBF can also be read through the status register.

DOBF/ (Output Buffer Full)

A logic 0 on DOBF/ indicates that the controller has placed data into the I/O buffer to be read by the external micro-processor. As soon as the data is read, the DOBF/ line returns to a logic 1. DOBF/ can also be read through the status register. DOBF/ will stay set until the data is read from the TVM2464 or until the reset line is pulled low. i.e. if a user program requests information, but never takes this information, the DOBF/ flag will remain set. When the next request for information is made, the main program will detect the DOBF/ flag set and immediately retrieve the previous instruction's information. To avoid this problem, be sure to always read the output register when the DOBF/ flag is set .

ERROR

Because of the intelligent nature of the TVM2464, some instructions may cause an error if they can not be executed. One cause may be providing the instruction with data that produces an internal error. An example would be trying to place a button on top of another button. The second button would not be placed and the ERROR flag would be set to a logic 1. It will stay set until the next instruction is executed. The ERROR flag has different meanings depending on the instruction being executed. Please refer to Section 2 for the specific ERROR flag meaning for each instruction. ERROR can also be read through the status register.

KEYPRESS

The KEYPRESS flag indicates that a button has been pressed and that the external micro-processor may now read the "Button Code". This code indicates which button has been pressed. The "Button Code" is assigned to a button when it is placed on the display. More information can be found in section 3.6.1 of the Designer's Manual. KEYPRESS can also be read through the status register.

DA0, DA1

DA0 and DA1 are used to address the different module registers. Please refer to the table on page 4 for more information.

D0 - D7

D0 through D7 forms the 8 bit bi-directional data buss to the module.

Status Register

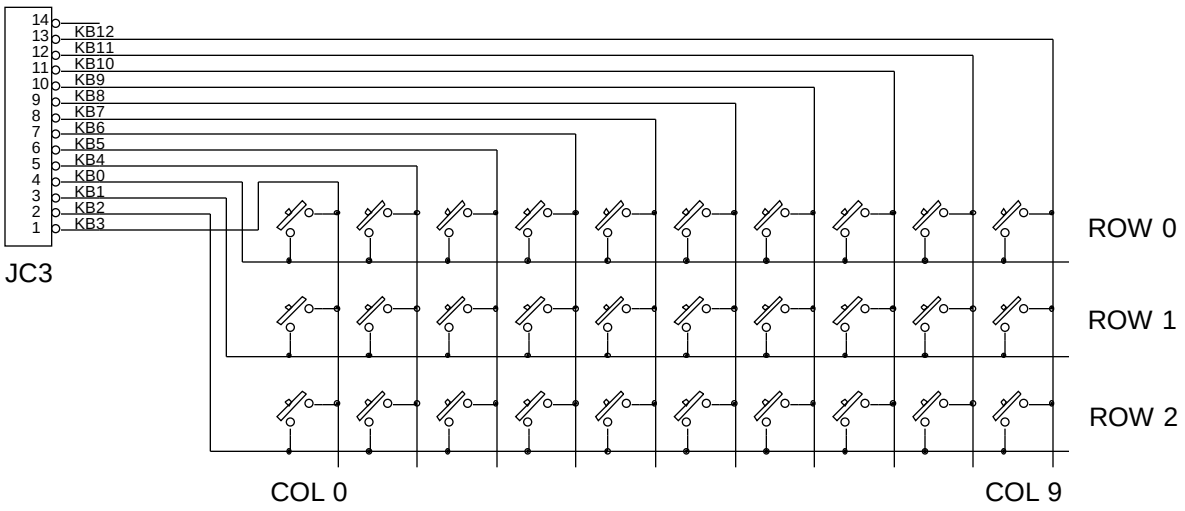
In some applications you may prefer to read a status register rather than use "hardware hand shaking". A status register is provided on the TVM2464 which stores the "hand shaking" signals previously described. The status register can be read at address 3 at any time without affecting the writing or reading of instructions or data. See the table below for more information.

The status register has a signal, CPUBUSY, that can be used to indicate whether or not the CPU is executing the current instruction. This flag is set high when an instruction is loaded into the instruction register (address 0) and stays set high until the instruction is completed.

Bit	Function
0(LSB)	DIBF
1	DOBF/
2	ERROR
3	KEYPRESS
4	CPUBUSY
5	0
6	0
7(MSB)	0

Auxiliary Keyboard Connector

For applications using the TVM2464 without the touch panel or with additional external keys, a separate keyboard interface connector is provided. Any keyboard matrix of up to 3 by 10 keys is compatible with the TVM2464. A schematic for an external keyboard is shown below.



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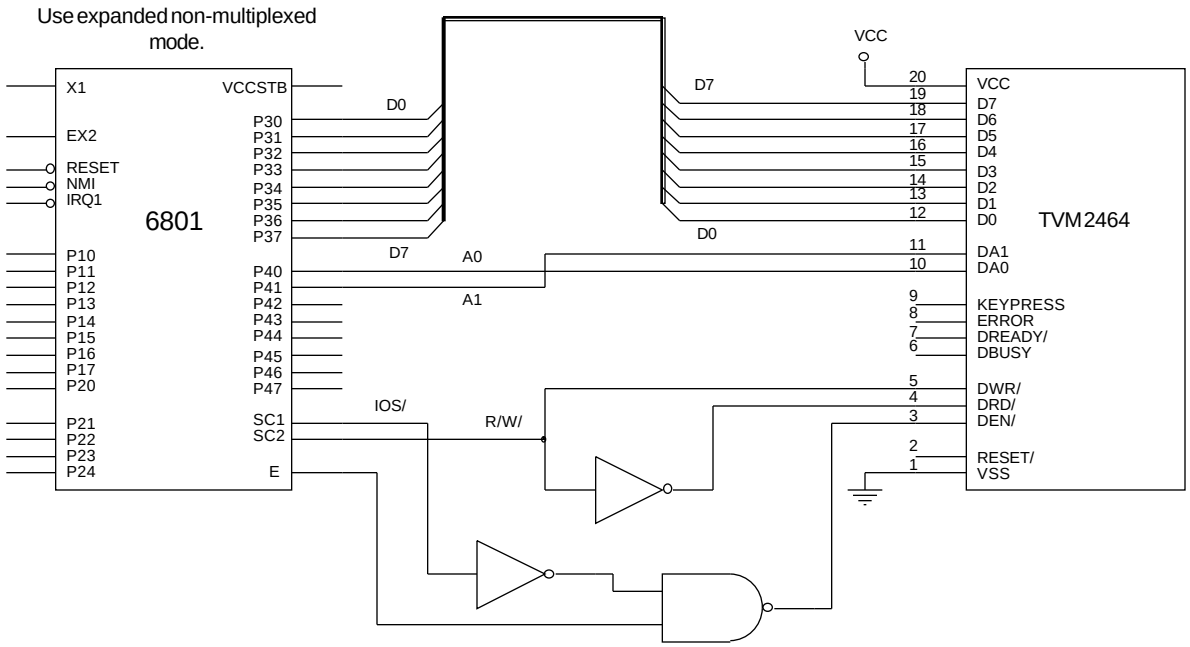
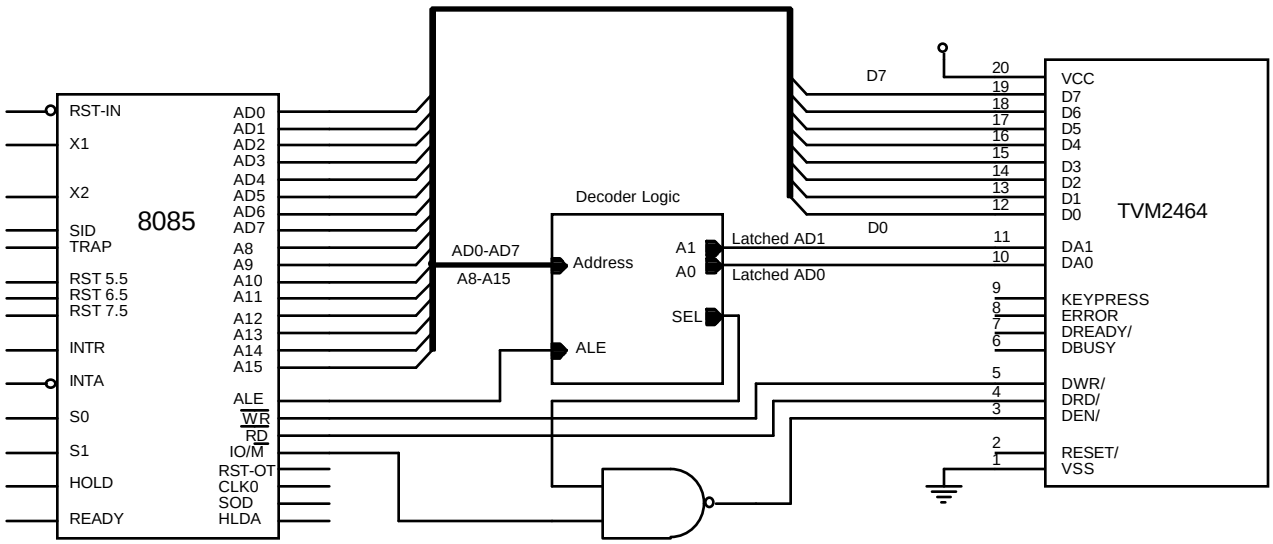
Interface Examples



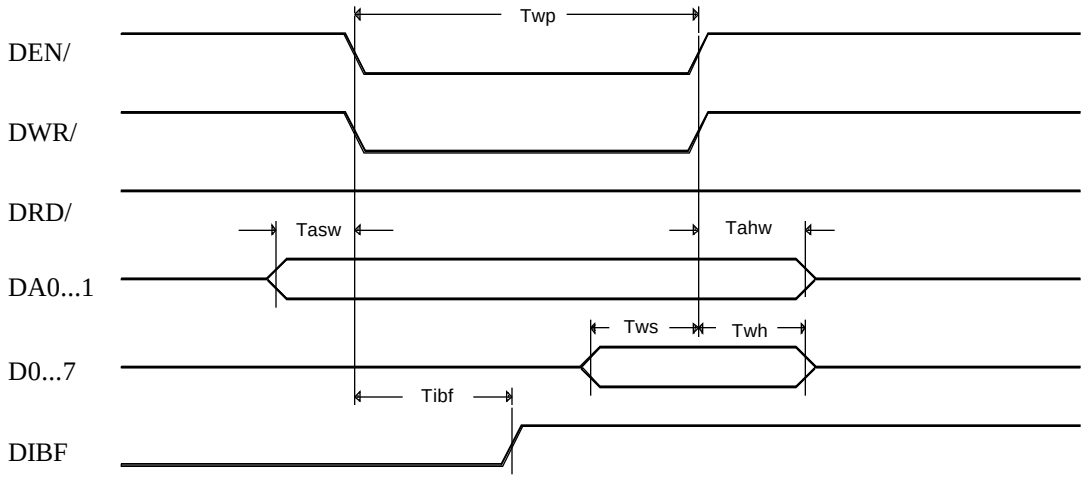


DC Electrical Characteristics:

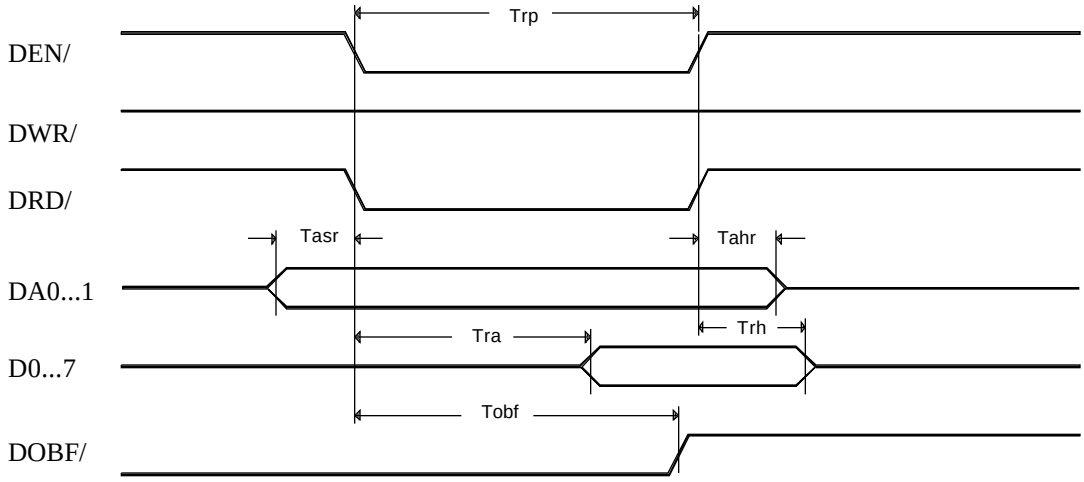
V_{CC} = 5.0V +/- 10% unless otherwise specified.
T_A = 25 C Unless otherwise specified.

Parameter	Min	Typ	Max	Units	Conditions
Power Supply Voltage	4.5		5.5	Volts	
Supply Current					
EL Off		50	75	mA	
EL On		95	125	mA	
I_{OL} Input Low Voltage					
D7-D0,DA1, DA0,DWR/,DRD/,DEN/	-0.5		0.8	Volts	
I_{OH} Input Hi Voltage					
D7-D0,DA1, DA0,DWR/,DRD/,DEN/	2.0		VCC	Volts	
I_{OZ} Output Floating Leakage D0-D7	±50		±300	uA	V_{IN} = Vcc or 0V
V_{OL} Output Low Voltage					
D7-D0,DBUSY DREADY/,ERROR KEYPRESS			.4	Volts	I_{OL} = 2.5mA
V_{OH} Output Hi Voltage					
D7-D0,DBUSY	3.0			Volts	I_{OH} = -2.5mA
DREADY/,ERROR KEYPRESS	V_{CC} -.4			Volts	I_{OH} = -100uA
Output Floating Leakage D0-D7			±10	uA	V_{IN} = V_{CC} or 0V
RESET/ Active Low			.5	Volts	22K Pull Up
RESET/ Inactive Hi	4.5			Volts	
Key Board Strobe KB0-KB2			0.5	Volts	I_{OL} = 50mA
Key Board Column Input Low KB3-KB12			0.8	Volts	100K Pull Up
Key Board Column Input Hi KB3-KB12	4.0		Open	Volts	100K Pull Up
External EL Supply Voltage	3.0		5.5	Volts	
External EL Supply Current			65	mA	

Timing Waveforms



Write Cycle Timing



Read Cycle Timing

AC Electrical Characteristics

V_{CC} = 5.0V +-10% unless otherwise specified
T_A = 25 C Unless otherwise specified

Symbol	Parameter	Min	Max	Units
T_{wp}	Write Pulse Width	100		nS
T_{asw}	Address Setup Write	5		nS
T_{ahw}	Address Hold Write	50		nS
T_{ws}	Write Data Setup	20		nS
T_{wh}	Write Data Hold	60		nS
T_{ibf}	Write to IBF High		100	nS
T_{rp}	Read Pulse Width	100		nS
T_{asr}	Address Setup Read	5		nS
T_{ahr}	Address Hold Read	0		nS
T_{ra}	Read Data Access		100	nS
T_{rh}	Read End to Data Tri-state		50	nS
T_{obf}	Read to OBF High		100	nS

Instruction Set Summary

Font Selection	
Select Font	00000xxx
Down Load Font	00001xxx,SizeX,SizeY,Offset,Descenders String...
Set Font Attributes	000110ab
Cursor Positioning	
SetXY	00100000,Xpos,Ypos
ReadXY	00100001,[Xpos],[Ypos]
Cursor Up	00100010
Cursor Down	00100011
Cursor Left	00100100
Cursor Right	00100101
SetX	00100110,Xpos
SetY	00100111,Ypos
Set Cursor Attributes	00010abc
Text Configuration	
Set Text Window	00101000,AX,AY,BX,BY
Set Pitch	00101010,Pitch
Set Height	00101011,Height
Text Input	
Input String	00101100,String...

Instruction Set Summary (cont.)

Graphics Input	
Draw Box	0100TTTF,AX,AY,BX,BY
Draw Block	011000TT,AX,AY,BX,BY
Draw Horiz	011001TT,Xpos,Ypos,Length
Draw Vert	011010TT,Xpos,Ypos,Length
Draw Vector	011011TT,AX,AY,BX,BX
Set Pixel	011100TT,Xpos,Ypos
Button Input	
Place Button	00110000,KeyCode,Position
Load Button Buffer	00110001,String...
Get Button Size	00110010,KeyCode,[RData]
Place Phantom Butt.	00110011,KeyCode,Position,BLength
Delete Button	00110100,KeyCode
Delete All Buttons	00110101
Read KeyCode	00110110,[RData]
Set Button Attributes	00111abc
Display Control	
Blank Display	10000000
Clear Display	10000111
Refresh	10000001
Set Auto Refresh	100010ab
Dump Display RAM	10000100,[RData...]
Load Display RAM	10000101,String...
Move Block Vert	01110100,AX,AY,BX,BY,Distance
Move Block Horiz	01110101,AX,AY,BX,BY,Distance
System Instructions	
Soft Reset	11111110
Set Contrast	11110011,Data
Set EL	1111010a
NOP	11111111
Set Beeper	1111000a
Read Key Matrix	11110010,[RData]

Additional Information

Applications information plus expanded information on the instruction set can be found in the TVM2464 Designer's Manual. If you need additional technical information, please contact C Sys Labs.

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