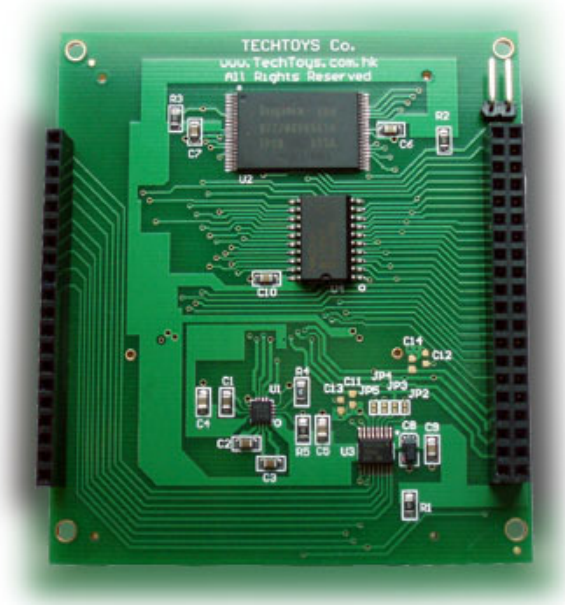
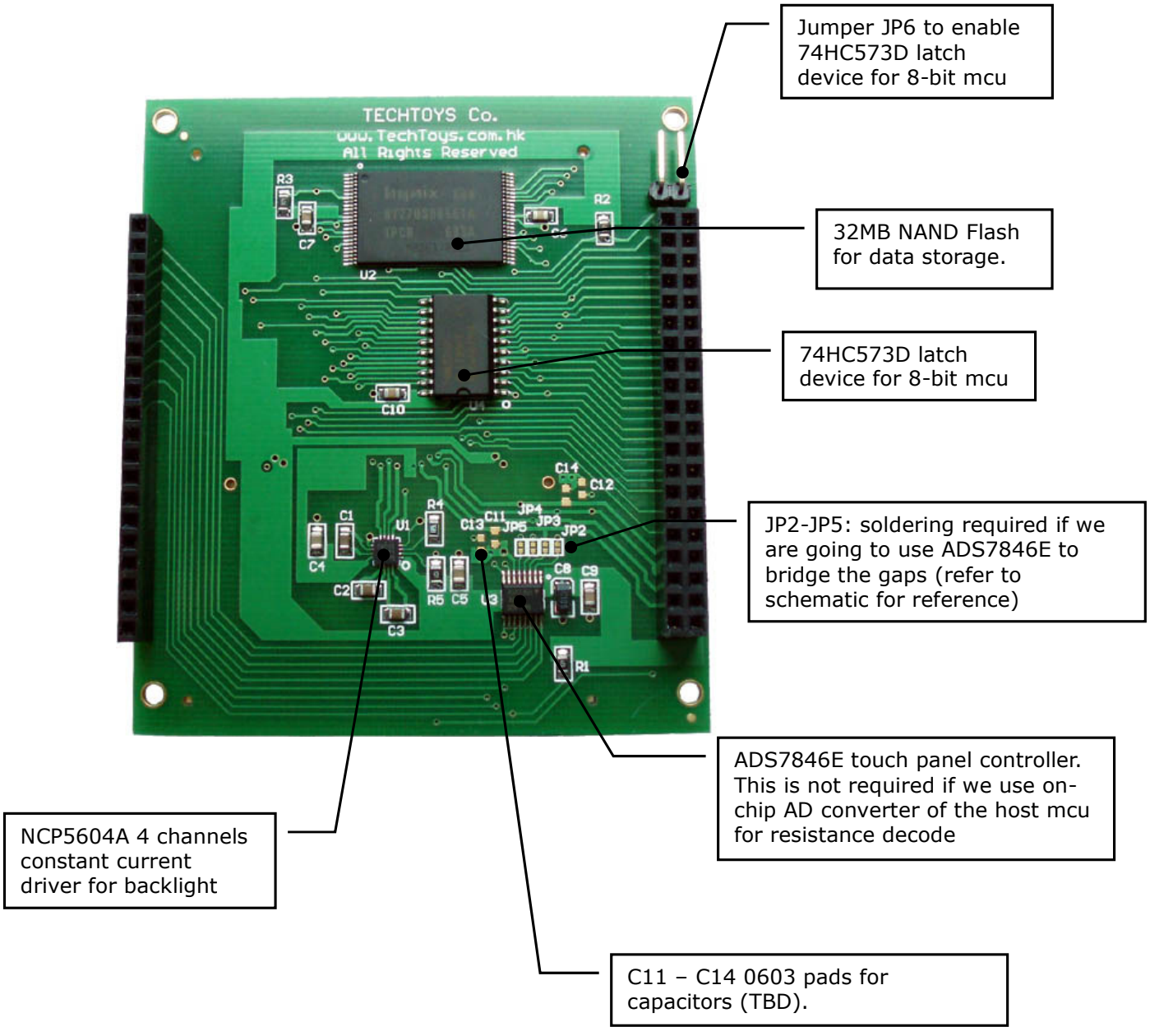
2.8” QVGA 262k TFT LCD module with Touch Panel integrated



INTRODUCTION

The part number TY280T_230320_BO (Board Rev 1B) is a development board for 2.8" QVGA TFT-LCD module completed with a 32MBx8bit NAND Flash, 74HC573D latch device, white LED backlight driver circuit, and a 4-wire touch screen controller all soldered onboard. Standardized 2.54mm PCB sockets have been included for sack of easy prototype procedure. Below please find an illustration of all components in details.



FEATURES OF THE LCD MODULE

ITEM	STANDARD VALUE	UNIT
LCD Type	2.8" QVGA TFT-LCD	-
Backlight	4 White LEDs in parallel	-
Module size	50.0(W) x 69.2(H) x 4.2(T) (with Touch Panel TP)	mm
TP viewing area	44.80 (W) x 63.10 (H)	mm
TP active area	44.20 (W) x 62.50 (H)	mm
LCD active area	43.20 (W) x 57.60 (H)	mm
Dot number	240 (RGB) x 320	-
Pixel pitch	0.18(h) x 0.18(v)	mm
Operation temperature	-10 ~ 70	°C
Storage temperature	-30 ~ 80	°C
Driver IC	ILI9325	-
Interface mode	8080 system 16 bit interface	-
Color mode	262k / 65k software control	-

ELECTRICAL CHARACTERISTICS*

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	Logic	V_{DD}	--	2.9	3.0	3.4	V
Input Voltage	H level	V_{IH}	--	$0.7V_{DD}$	--	V_{DD}	V
	L level	V_{IL}		0	--	$0.3V_{DD}$	
Current Consumption		I_{DD}	With internal voltage generation V_{DD} = 3.0V; T_{amb} = 25℃	--	--	20	mA

MAXIMUM RATINGS*

ITEM	SYMBOL	MIN.	MAX.	UNIT
Supply Voltage	V_{DD}	-0.4	4.0	V
Input Voltage	V_{IN}	-0.4	V_{DD} + 0.4	V
Operating temperature	T_{OPR}	-20	70	℃
Storage temperature	T_{STR}	-30	80	℃
Humidity	--	--	90	%RH

*Remarks: data for the bare LCD module only.

BACKLIGHT CHARACTERISTIC

ITEM	SYMBOL	MIN.	TYPICAL	MAX.	UNIT
LED module Forward voltage	V_{LED}	3.0	--	3.4	V
LED module current	I_{LED}	--	80	--	mA
L/G Surface Luminance	L_S	3200	--	4500	Cd/m^2
LCM Surface brightness uniformity	L_D	80	--	--	%

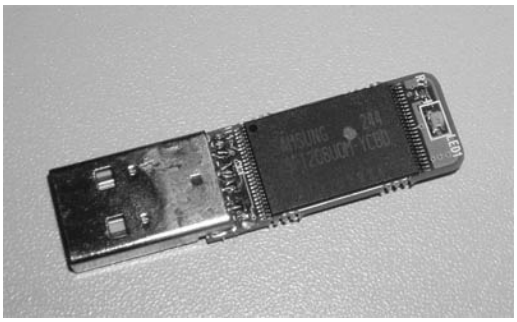
SCHEMATIC

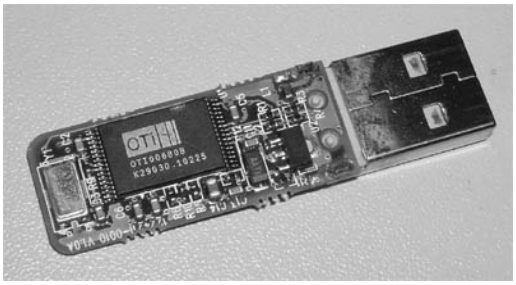
Please refer to our web site at

http://www.techtoys.com.hk/Displays/TY280T240320/TY280T_240320_BO.htm

for schematic of the breakout board. Besides the LCD module, there are several components of interest:

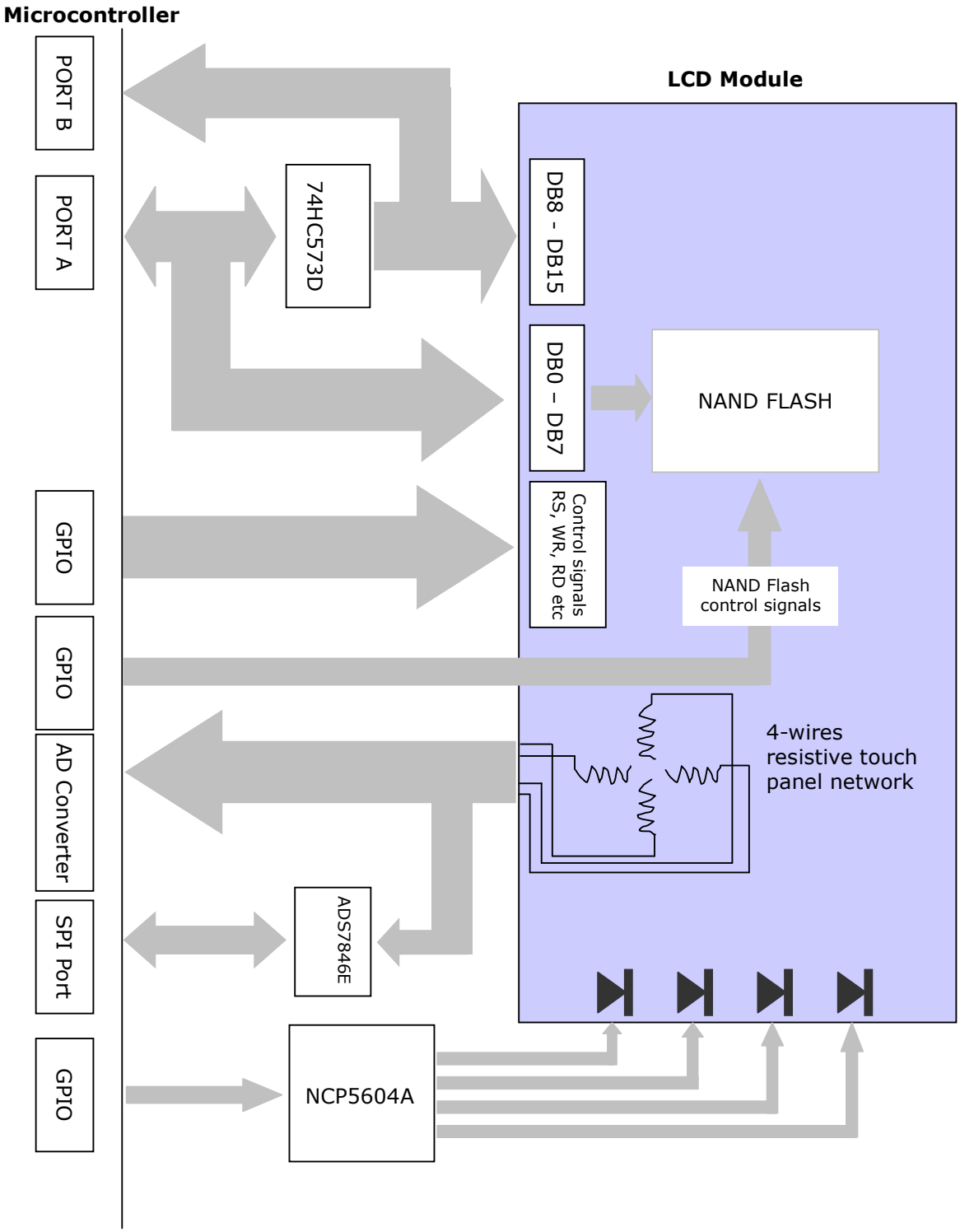
1. LED backlight circuit driven by On Semiconductor® NCP5604A
2. 32MB*8bit NAND Flash from Hynix Semiconductor®. This IC is useful for mass data storage such as jpeg or bitmap files. This is no stranger! Normally this chip is found in Thumb Drives today. Dedicated USB thumb drive controllers are used with firmware for low level USB connection, nandFlash driver as well as the USB Mass Storage Device firmware in a single controller chip (OTI as shown on the picture below).





3. Touch Panel controller ADS7846E from Texas Instrument®. This controller is optional because it is possible to interface directly the resistive wires to AD converters of a microcontroller. An example has been provided by Microchip GUI library. Demonstration program is available from our web site with port for Microchip Library using the Touch Panel. However, it is just in case that you do not want to use the Microchip library, ADS7846E is a nice device to play with. Please make sure JP2 – JP5 pads would be shunt to enable the controller. You need to apply solder a bit to these pads to complete the bridges joining XR, XL, YU, YD wires to ADS7846's inputs.
4. 3-State Octal latch 74HC573D for data IO. It is because the LCD module uses 16-bit addressing, we need a data latch to extend the bus width from 8-bit to 16-bit if we are using a low-end 8-bit microcontroller. A good example is PIC18LF4550 with embedded USB port. However, if there are enough data lines from the microcontroller, it is always advisable to use 16-bit addressing for higher efficiency. What we need is just to make sure JP6 jumper is not connected to disable the latch (high impedance output). In this case, we may use a complete 16-bit port to drive LCD module. Referring to block diagram on next page, it could be a microcontroller's PORT[0:15] directly interface DB[0:15] of the module.

BLOCK DIAGRAM



SOFTWARE : Microchip Graphics Display Solution

There are a number of GUI libraries known to the author. To name a few of those:

1. Easy GUI by IBIS Solutions ApS (www.easygui.com)
2. emWin supplied by Segger Microcontroller GmbH & Co. KG (www.segger.com)
3. Graphical User Interface (GUI) libraries by RAMTEX International (www.ramtex.dk)
4. µC/GUI by Micrium (www.micrium.com)
5. wxWidgets (http://www.wxwidgets.org/)

All of them focus on GUI libraries for embedded systems with charges. The last item being the wxWidget is an open source GUI; however, it seems not for small embedded systems as it requires C++ and powerful processor and OS like Windows CE.

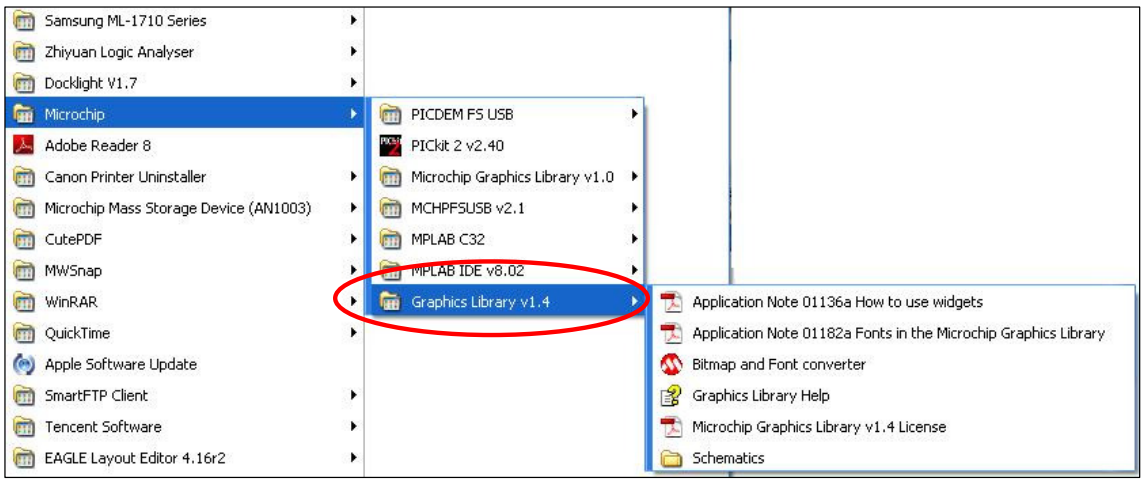
The author is deeply surprised by the strategy of Microchip that a full-blown Graphical User Interface (GUI) library is provided free with source code. One may find its relevant information from Microchip web site at

http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=2608&param=en532067

Web seminars and application notes are available for download at no cost and a Free Licensed Microchip Graphic Library with schematics, drivers, documentation, and utilities also there as long as you are using this GUI on Microchip products. Normally such drivers and support would be sold at a certain cost, sometimes rather expensive too. Now we may use this library with only minor modification. This manual describes the procedure to port a new driver IC to the Microchip Graphic Library.

PROCEDURE

The first step is to download a copy of the Microchip Graphics Library. The current version at time of writing is v1.4. After download and installation, one would get a new folder under ***C:\Microchip Solutions*** if the default configurations have been accepted. Under Windows Explorer, browse to ***All Programs\Microchip\Microchip Graphics Library v1.4*** you will see all documentations in pdf and a help file. Full detail of the library has been provided under the ***Microchip Graphics Library Help (html help)*** and we hereby follow its instruction to port a new LCD driver for our 2.8" LCD module.



LIBRARY STRUCTURE

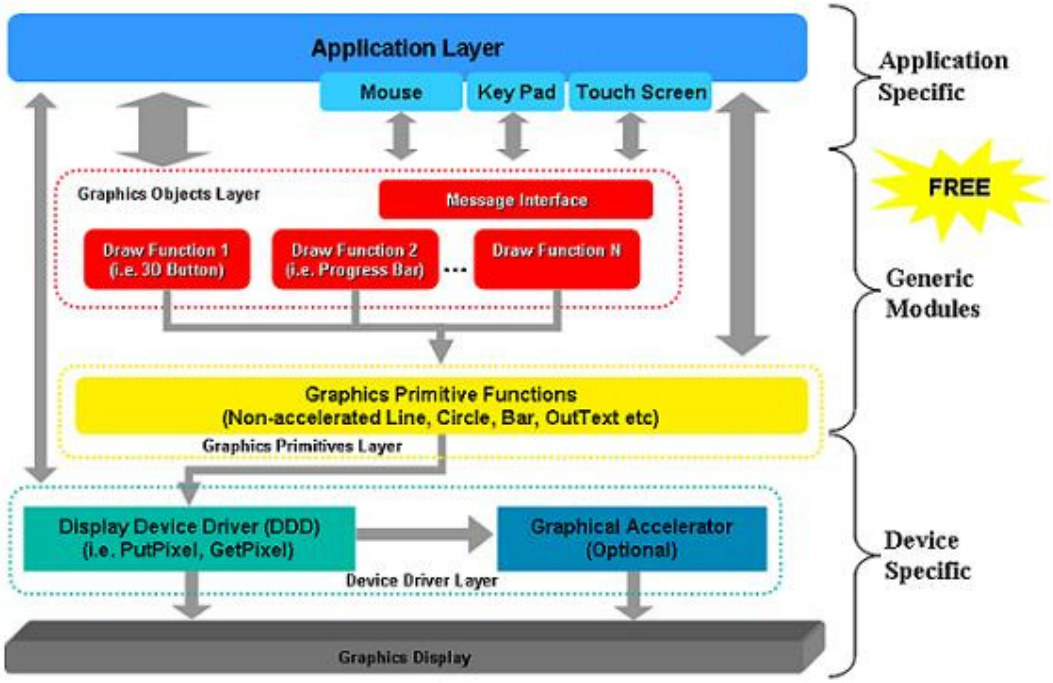
There are hundreds of LCD driver-ICs in the world. At time of writing only the following driver-ICs are supported by the original Graphics Library. They are located under

..\Microchip Solutions\Microchip\Graphics for *.c driver and
..\Microchip Solutions\Microchip\Include\Graphics for *.h header

Driver IC	Orientation
Densitron HIT1270L	Landscape
LG LGDP4531	Landscape / portrait
Renesas R61505	Landscape / portrait
Samsung S6D0129 / S6D0139	Landscape / portrait
Sino Wealth SH1101A OLED	Landscape
Orise SPFD5408	Landscape / portrait
Solomon Sys Tech SSD1339 OLED	128*128 matrix
Solomon Sys Tech SSD1906	Landscape / portrait
Solomon Sys Tech SSD1303	Landscape

If we are going to use the library with a third-party LCD module, we need to port the graphics library to our target driver IC. Thanks to the modular design, we only need to deal with the low-level I/O layer for ILI9325.

Navigate to ***Library Structure*** under ***Contents*** of the Help file we learn the library architecture. We only need to deal with the Device Specific layer and there are three files involved.



They are
..\Microchip\Graphics\device.c
..\Microchip\Include\Graphics\device.h
..\Microchip\Include\Graphics\Graphics.h

PRIMITIVE DEMO

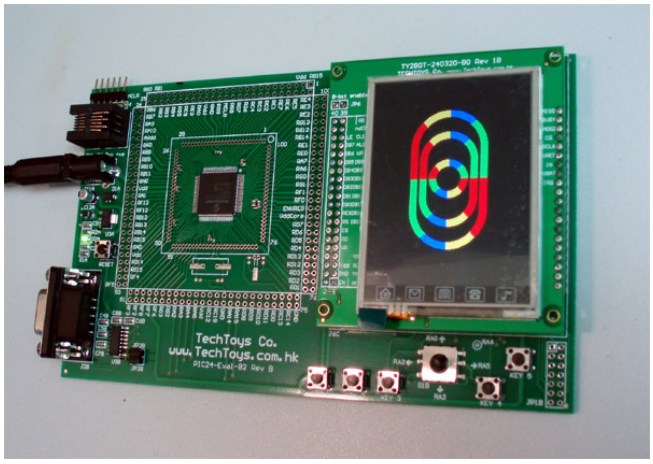
In our case, *device.c* and *device.h* become *ILI9325P_16BIT.c* and *ILI9325P_16.BIT.h* with indication of the driver IC, portrait orientation denoted as "P", and it is a 16 bit driver. There are several steps involved to start a new project with Microchip Graphics Library of course. One may refer to the help.html file again and navigate to ***Miscellaneous Topics*** → ***Starting a New Project*** to learn all relevant procedures to create a fresh project from scratch. Else, one may also consider downloading our fully-built example to get a kick-start with the Primitive Demo. This demonstration program is based on the hardware platform (part no: PIC24-Eval-B2 Rev B) for PIC24FJ128GA010 microcontroller. Let's take a look at the wiring for development board PIC24-Eval-1B.

PIC24FJ128GA010		**TFT color LCD module**
PMD[7:0]	———	DB[7:0]
PMA[7:0]	———	DB[15:8]
RA7	——	RESET (/RES)
PMA8	——	Data or Command (RS)
RD12	——	Chip select (/CS)
PMPRD	——	Read enable (/RD)
PMPWR	——	Write enable (/WR)
RB10	——	YD
RB13	——	XL
RB12	——	YU
RB11	——	XR
RD1	——	EN pin of NCP5604A (for backlight)
3.3V	——	VDD

Relevant hyperlinks:

www.techtoys.com.hk/Displays/TY280T240320/TY280T_240320_BO.htm under Doc 09

www.techtoys.com.hk/PIC_boards/PIC24-Eval-B2/PIC24-Eval-B2_RevB.htm



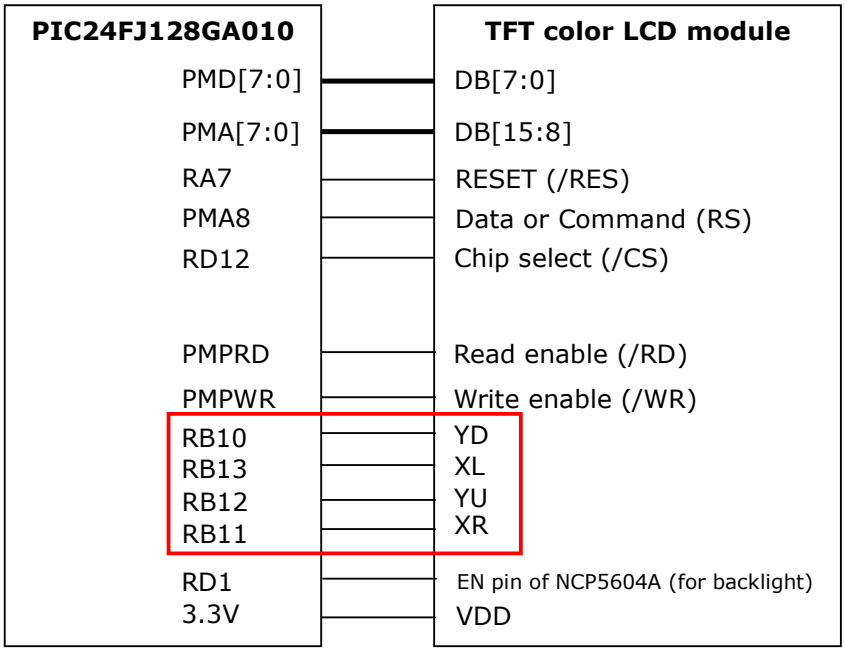
TOUCH PANEL DEMO (AN1136)

Our example is modified from the source code for the application note AN1136 released by Microchip. This note discusses the know-how to use Widgets in Microchip Graphics Library. A port for our 2.8" TFT LCD has been completed with full source code available from the following hyperlink.

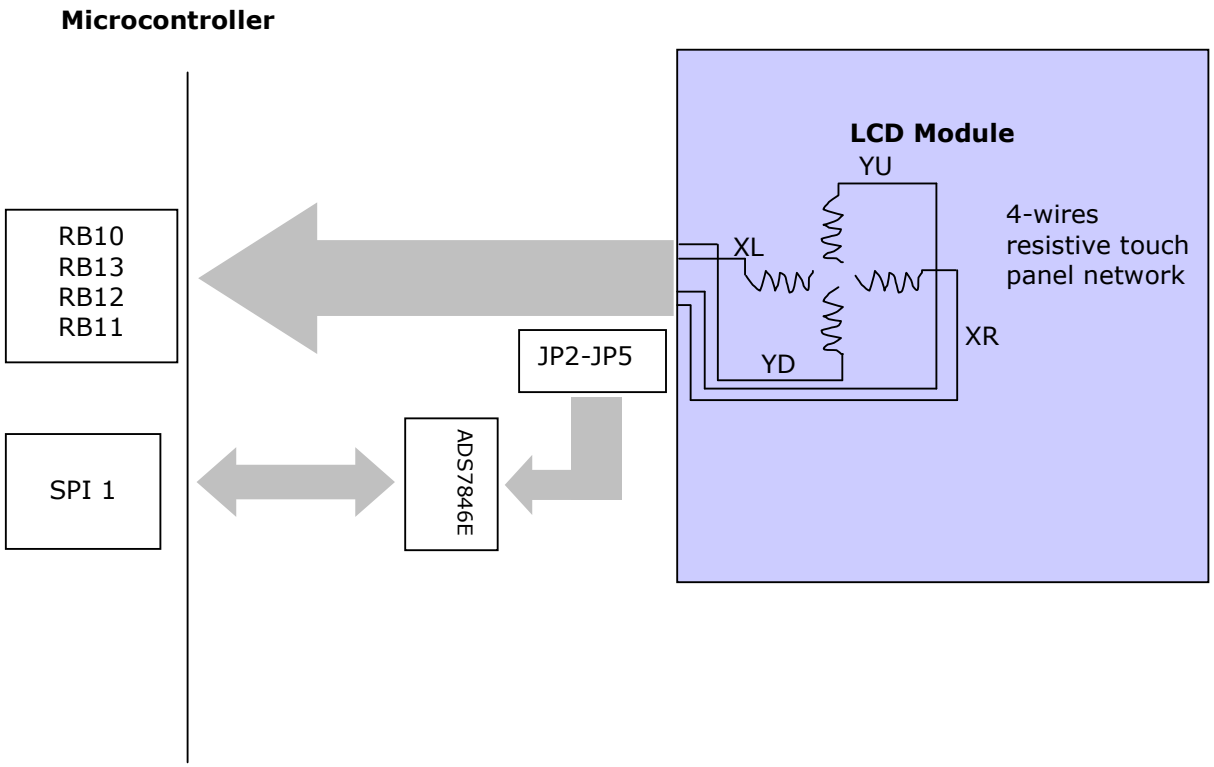
www.techtoys.com.hk/Displays/TY280T240320/TY280T_240320_BO.htm under Doc 10

Location of AN1136 is available at
http://www.microchip.com/stellent/idcplg?IdcService=SS_GET_PAGE&nodeId=2608&param=en532067

In Touch Panel demo, we need to emphasize RB10, RB13, RB12, and RB11 with an interface to YD (Y Down), XL (X left), YU (Y Up), and XR (X Right) respectively.



A better illustration is repeated by the block diagram next page with focus on the Touch Panel portion.



We have two choices to decode the Touch Panel signal:

1. Use internal Analog-to-Digital converter of a microcontroller
2. Use the external ADS7846E Touch Panel driver onboard by manually shunt jumpers JP2 to JP5.

Since we are using the Microchip library for now, the first option has been adapted. Two files *TouchScreen.h* and *TouchScreen.c* are taking care of decode task. The real-life demo by running the program is shown below. One may use finger or stylus for touch panel action. Calibration of the Touch Panel is enabled if one hold KEY 1 and press RESET for PIC24-Eval-B2 board.