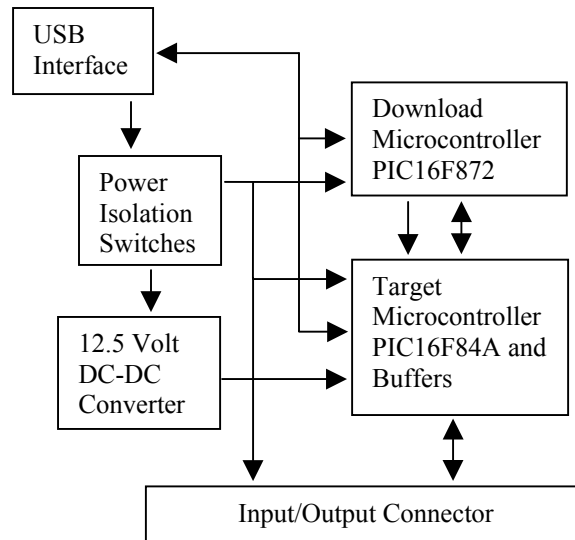
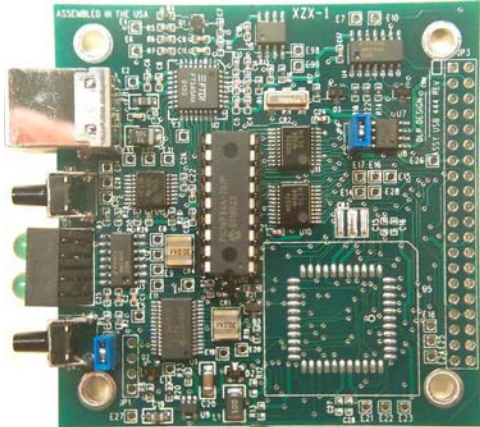


## DLP-IO16 Development System



### GENERAL DESCRIPTION

The DLP-IO16 consists of a Universal Serial Bus (USB) Interface, a PIC 16F84A (target) microcontroller and a Flash programming system. The USB interface is designed around FTDI's FT8U245AM and is used for both the Flash download process and host communications (16F84A to Host PC) at run time. The target processor (16F84A) will hold 1024 14-bit words of ROM, 68 bytes of RAM and 64 bytes of EEPROM, none of which is used by the on-board Flash Programming system. The Flash programming system is comprised of a PIC 16F872 and a 12.5-volt DV-DC converter and is used exclusively to perform the download process.

Hex file data can be written directly into the 16F84A's Flash memory without the need for an external device programmer. PC application software that runs under Windows 98/2000 is available from [dlpdesign.com](http://dlpdesign.com) as a free download that performs the Flash download process.

The DLP-IO16 connects to the user's hardware via 8 buffered digital inputs and 8 latched digital outputs. The digital outputs are implemented using an SN74HC374 and are specified to drive up to 15 LSTTL loads each. The digital inputs also use a SN74HC374 to latch the incoming digital data. The DLP-IO26 provides a larger (8K) Flash ROM and more I/O port lines for interfacing to target electronics. Refer to the datasheet for the DLP-IO26 for additional details.

## **DRIVER SOFTWARE**

FTDI's VCP (Virtual COM Port) drivers are provided royalty-free on the condition that they are only used with designs incorporating an FTDI device (ie the FT8U245AM and DLP-IO16). The latest release versions are available for download from [dlpdesign.com](http://dlpdesign.com) or [ftdichip.com](http://ftdichip.com).

The VCP driver download file is a combined set of drivers for Windows '98, Windows ME and Windows 2000. Unzip the file to a blank floppy disk or folder on your PC. The drivers can co-exist on the same floppy disk or folder since the INF files determine which set of drivers to load for each operating system version. Once loaded, the VCP drivers allow your application software, running on the host PC, to communicate with the DLP-IO16 as though it were connected to a COM (RS-232) port.

In addition to VCP drivers, FTDI's "D2XX Direct Drivers" for Windows offer an alternative solution to the VCP drivers which allows application software to interface with the FT8U245AM device using a DLL instead of a Virtual Com Port. The architecture of the D2XX drivers consists of a Windows WDM driver which communicates with the FT8U245AM device via the Windows USB Stack and a DLL which interfaces the Application Software (written in VC++, C++ Builder, Delphi, VB etc...) to the WDM driver. An INF installation file, uninstaller program and D2XX programmers guide complete the package.

The latest version of the D2XX Direct driver adds support for simultaneous access and control of multiple FT8U245AM devices. An Extended Open function (FT\_OpenEx ) has been added allowing the device to be opened either by it's Product Description or by Serial Number both of which can be programmed to be unique. A complementary List Devices function (FT\_ListDevices) has been added to allow application software to determine which devices are currently available for use, again by product description or by serial number.

Download FTDI Application Notes AN232-03, AN232-05, AN232-06, and AN232-07 for detailed instructions on how to install and remove the drivers for Windows 98 and 2000.

## **EEPROM WRITE UTILITY**

The DLPIO16 has the option to accept manufacturer-specific information that is written into the 93C46 EEPROM. Parameters that can be programmed include the VID and the PID identifiers, the manufacturer's product string and a serial number.

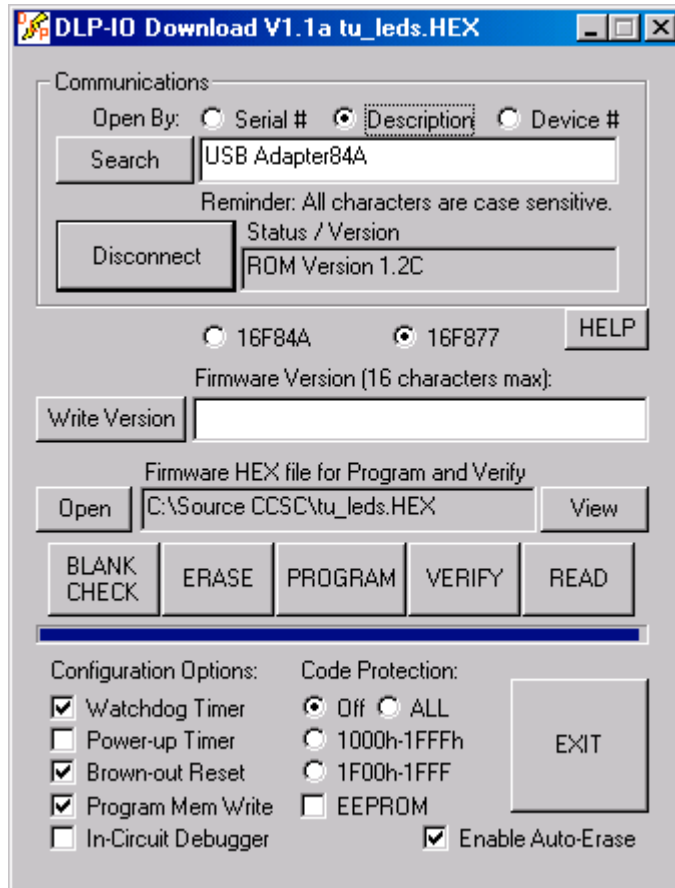
FTD2XXST is the latest EEPROM serializer and testing utility for the FT8U245AM device. It replaces the VCP based 232Prog utility. FTD2XXST is based on the new D2XX drivers and will work on Win '98, Win ME and Win 2000 platforms. You must download and install the latest release of the D2XX drivers in order to run this application. Refer to the SER200.PDF guide that is included in the EEPROM Write Utility's download zip file for details on how to use the serializer.

If you have VCP drivers installed on the PC that is to perform the EEPROM write process you must uninstall these drivers and install the D2XX drivers prior to running the serializer utility.

Please note that these utilities are intended for use by manufacturers and not by end-users of the products.

### Windows Software Operation

A 32-bit Windows application that performs the firmware download process is available as a free download from [dlpdesign.com](http://dlpdesign.com). The application uses the DLL version of the device drivers.



The HELP button can be clicked at any time to read a description of each control.

This download application uses the “OpenEx” function that allows multiple DLP-IOx boards to be connected to the same PC in a well-organized manner.

This function will open the named device and return a handle that will be used for subsequent accesses. When the Search button is clicked, a dialog window is opened and all FTDI devices connected to the system are listed for easy selection. The device name can be its serial number or a device description; both are text strings that are programmed into an EEPROM that is directly connected to the FT8U245AM. A third method, open by device number, can be used for new boards that have not had a serial number or description string written to the non-volatile RAM.

Download configuration options include enabling or disabling the Watchdog Timer, Power-up Timer, Brown-out Reset, In-Circuit Debugger and Code Protection modes. Refer to the datasheet for the target microcontroller for a full description of each available download option.

If a PIC Flash device is code protected, the read function will return all 1's for the data read, and a standard bulk erase will not work correctly. The only way to erase a device that was previously programmed with code protection turned on is by issuing commands 1 and 7 while in Load Configuration mode. The download application mentioned above will perform both a standard bulk erase and a code-protected bulk erase when the Erase function is selected. This allows the target processor to be code protected such that the firmware cannot be read but will still allow for future downloads to occur.

A firmware version string of 16 characters (maximum) can be written to the EEPROM memory in the download microcontroller. This string is read automatically every time the download process is initiated, and can be written any time the download application is running and connected to the target. EEPROM memory in the download microcontroller was used for storage of the version string instead of the target microcontroller's EEPROM so that all of the EEPROM memory in the target would remain available for project use.

The Connect function will attempt to initiate communications with the DLP-IO16 board using the serial number, the device description string or just the device number found in the Search edit box. The character string in the text box can either be entered manually by the user or it can be placed there as a result of using the Search function.

If the desired DLP-IOx board is present in the system then the Connect function will be successful and the version string for the attached board will appear in the Firmware Version edit box. Additionally, as part of the Connect process, the processor type (16F84A or 16F877) will be automatically selected by the processor selection radio buttons. Connect mode can be terminated either by clicking on Disconnect or by pressing the reset button while the Connect LED is solidly lit.

The Open function will launch a dialog that allows selection of the HEX file that is to be written to the Flash memory of the target processor. As the HEX file is loaded, each line of data in the file is checked for errors by calculating and verifying its checksum. The HEX file can contain configuration settings, processor ID codes and EEPROM data as well as program data.

The Blank Check function will read the entire contents of the Flash memory program area and verify that every location is set to an all 1's condition. This is the expected state of the Flash memory after an Erase function has been successfully completed.

The Program function will read the currently selected HEX file, verify the data to be written and then send the data to the Download processor. Each 14-bit word is checked immediately after it is written for errors. Any errors that occur during the download process are immediately reported and the download process is halted. If the target processor is not blank the Program function will report an error.

The Auto-erase function, when selected, will begin each Program function by bulk erasing the program memory area of the target processor.

The Verify function will read the entire contents of the target processor and verify the program data read against the HEX file. The configuration data read from the target processor is verified by comparing it against the configuration settings in the GUI (Graphical User Interface). The comparison is made in this way since the user has the ability to override the HEX file's configuration settings with the settings in the GUI.

The Read function will read the entire contents of the target processor and place all of its program, EEPROM, ID and configuration data in a dialog window that is launched automatically.

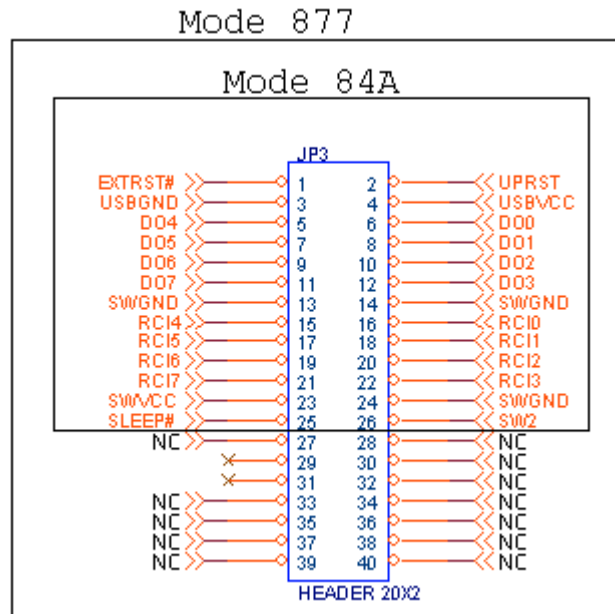
## **Quick Start Guide**

This guide requires the use of a Windows 98/2000 PC that is equipped with a USB port.

1. Download the DLL version of the device drivers from either [dlpdesign.com](http://dlpdesign.com) or [ftdichip.com](http://ftdichip.com). Unzip the drivers onto a blank floppy disk or into a folder on the hard drive.
2. Download the serializer program from either [dlpdesign.com](http://dlpdesign.com) or [ftdichip.com](http://ftdichip.com). Unzip the package and place it in a folder on the hard drive.
3. Download the Windows download application from [dlpdesign.com](http://dlpdesign.com), unzip the program file and place it either on the desktop or in a folder on the hard drive.
4. Download the example software (DLPIO16X) from [dlpdesign.com](http://dlpdesign.com), unzip the package and place it in a folder.
5. Connect the DLP-IO16 board to the PC via a standard, 6-foot USB cable. When prompted, select the folder where the DLL version of the device drivers were stored in step one. Windows will then complete the installation of the device drivers for the DLP-IO16 board. Reboot the PC if prompted to do so.
6. Run the serializer program and write the VID (0403), PID (6001), a description string of your choosing and serial number as instructed in the instruction manual (PDF) that was downloaded with the serializer software. Terminate the serializer program and disconnect the DLP-IO16 board from the USB cable. Wait 10 seconds and reconnect the DLP-IO16 board. Reboot the PC if instructed to do so.
7. Run the download application that was saved to the hard drive in step 3. Select the Open by description radio button and click on Search. In the dialog window select the description string written in step 6.

8. Press the reset button on the DLP-IO16 board. This is the button closest to the USB connector. The LED next to the reset button will start to blink. Click on the Connect button in the download application. The LED will be on solid and the version string edit box will be blank. At this point the download software is connected to the DLP-IO16 and will remain connected until instructed to disconnect.
9. Enter a version string of Ver. 1.0a (or one of your choosing) in the Firmware Version edit box and click on Write Version. This will write the version string to the download processor. Click on Disconnect and then once again on Connect. The new version will appear in the Status/Version edit box.
10. Click on Open and select the HEX file that was stored to the hard drive in step 4.
11. Click on Erase to bulk erase the Flash memory in the DLP-IO16's target processor. Click on the Program button and wait for the program process to complete.
12. Click on Disconnect. The connect led will blink for 10 seconds and then turn off. The test LED will blink indicating that the 16F84A processor is running.
13. Run the test program stored to the hard drive in step 4. Enter different values for the flash rate and click on the Send button. The test LED will flash at the appropriate rate.

## DIGITAL I/O INTERFACE



Connection to target electronics is made a 40-pin connector (JP3), however only 26 pins of the connector are used by the DLP-IO16.

Pin Number	Description
1	External Reset for the USB interface (input)
2	Target Microprocessor Reset (active high)(output)
3	USB Port Ground
4	USB Port VCC
13, 14, 24	Switched Ground
23	Switched Vcc
25	SLEEP# USB Standby Indicator
26	SW2 Test Switch
5,6,7,8,9,10,11,12	Digital Outputs
15,16,17,18,19,20,21,22	Digital Inputs

The External reset pin (pin 1) can be used by the target electronics to reset the USB interface on the DLP-IO16. The target microcontroller reset signal (pin 2) is made available such that target electronics can also be held in the reset state, if desired, during the firmware download process.

Five-volt power is made available for target electronics but care must be taken to not exceed a total of 500mA drawn from the USB port.

The SW2 signal can be used by target electronics as a control signal (jumper JP2 removed) or read by the DLP-IO16 via U11.

A 74HC374 octal D flip-flop is used to buffer the digital outputs. Output data from the target microcontroller is latched by the DOUT port pin which is generated by U13 the 74HC138 3-8 line decoder. The truth table for the 74HC138 is shown here.

MUXA	MUXB	MUXG2A	74HC138 Active Low Output
0	0	1-0	Y0 – USB Read
1	0	1-0	Y1 – USB Write
0	1	1-0	Y2 – DOUT
1	1	1-0	Y3 – DIN

1-0 - Indicates a high to low transition

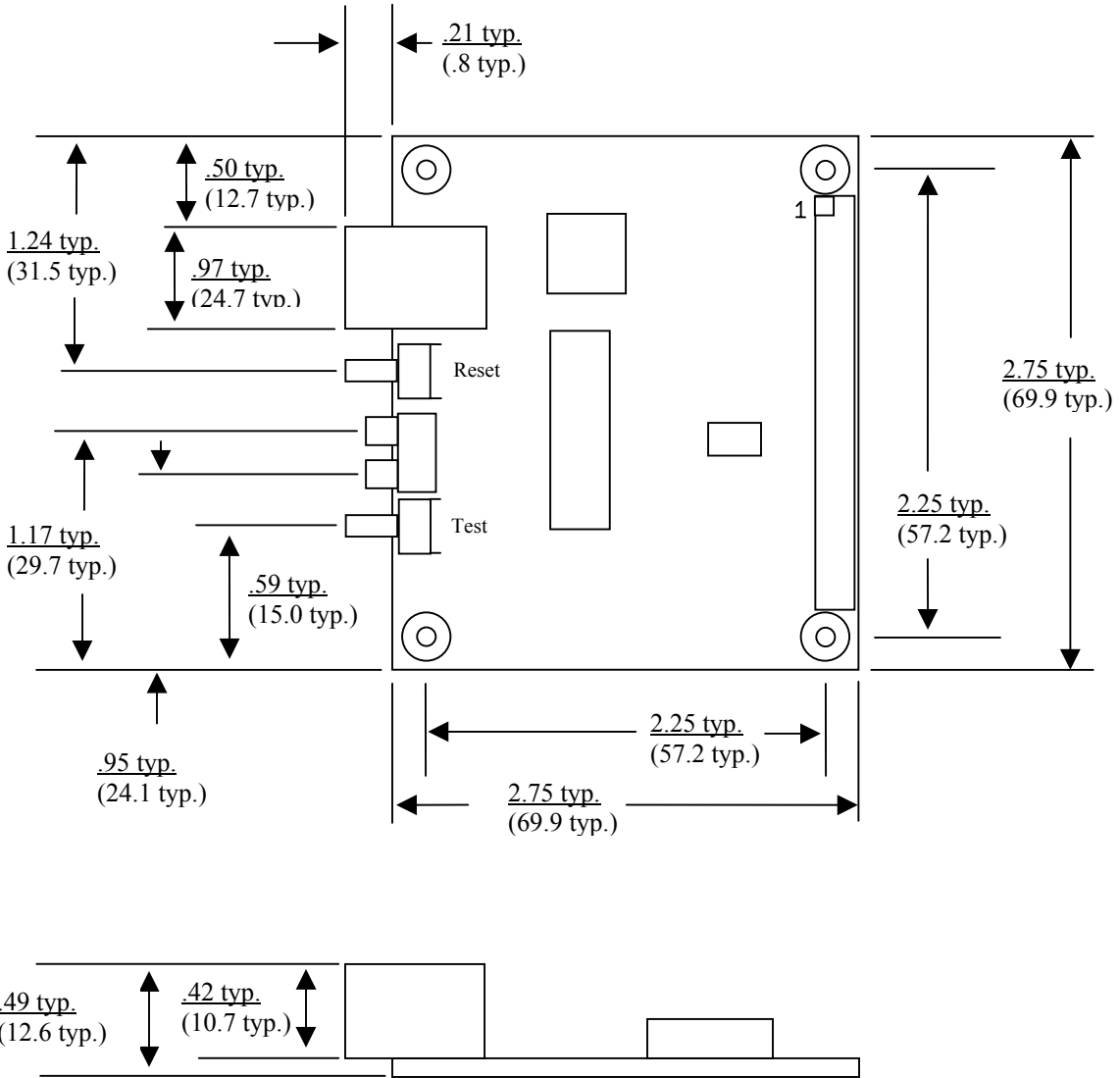
### POWER SUPPLY

The DLP-IO16 takes all needed operational power from the host PC's USB port. When the host PC goes to Standby mode, the DLP-IO16 will also go to Standby mode after 3 milliseconds of no USB bus activity. If the 5-volt power for the DLP-IO16 board is supplied by the target electronics via the Digital I/O Interface connector (JP3) then the jumper at JP4 must be removed. To help ensure compliance with the USB specification, power for the USB interface electronics (FT8U245AM) should be supplied by the host PC's USB interface.



# Mechanical Drawings

Inches(millimeters) unless otherwise noted



## Specifications (preliminary)

Storage Temperature	-65°C to + 150°C
Ambient Temperature (Power Applied)	0°C to + 70°C

### DC Characteristics ( Ambient Temperature = 0 - 70 Degrees C ) (Preliminary)

Description	Min	Max	Units	Condition
Operating Supply Voltage	4.5	5.25	V	Taken from the PC's USB Port
Operating Supply Current		70*	mA	Normal Operation
Operating Supply Current		500**	uA	USB Suspend

\* Current specification does not include current drawn by target electronics via processor port pins.

\*\* Early versions of the DLP-IO16 boards may not meet the minimum current requirement in Standby mode.

Please note that no software or documentation is shipped with the DLP-IO16. The latest version of the drivers, Windows application software and all documentation can be downloaded at any time from [www.dlpdesign.com](http://www.dlpdesign.com).

## Disclaimer

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