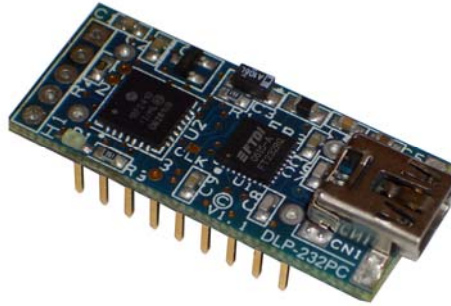
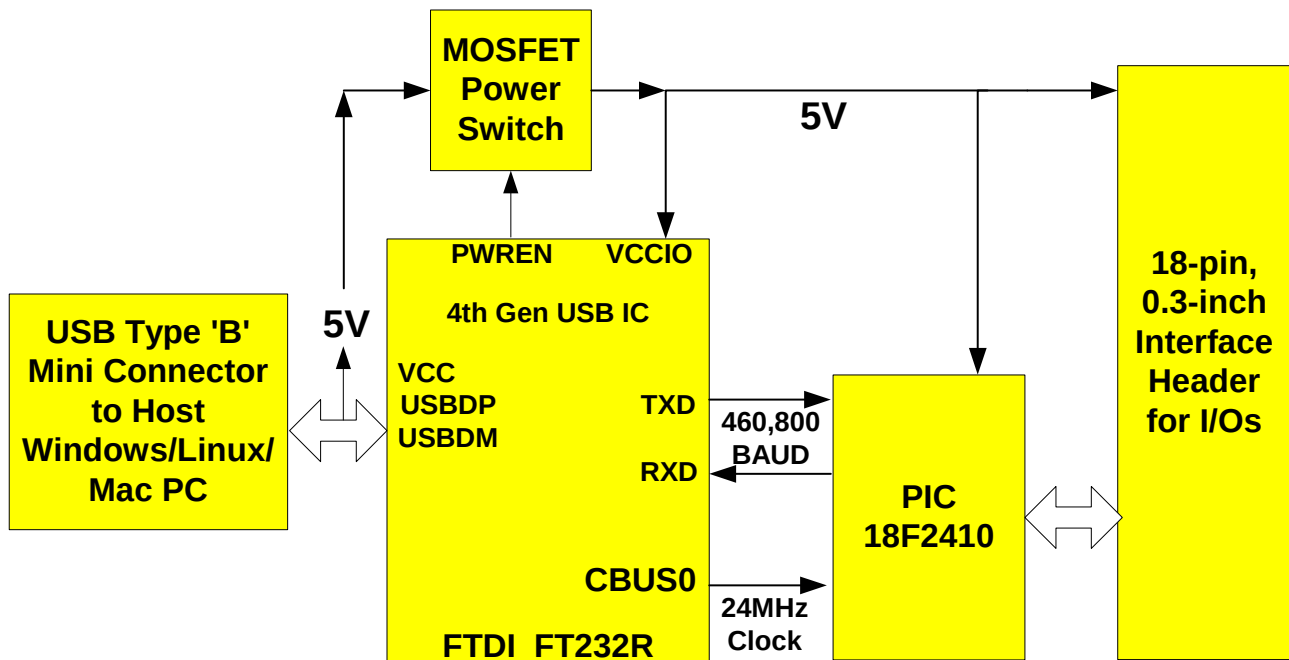




**DLP-232PC**  
LEAD-FREE

## MINIATURE USB - MICROCONTROLLER MODULE



### Applications:

- Data Acquisition
- Industrial/Process Control
- Process Monitoring

### Features:

- 14 Channels: Digital I/O, Temperature, 8 Configurable for Analog In (0-5 Volts)
- PIC18F2410 Microcontroller
- USB Port Powered
- USB 1.1 and 2.0 Compatible Interface
- Small Footprint: 1.375 x 0.6 Inch PCB
- Standard 18-Pin 0.3-Inch DIP Interface with 0.025 Square-Inch Posts
- Easy to Use with Single-Byte Commands; Can Utilize a Simple Terminal Emulator to Control All Functions

## 1.0 INTRODUCTION

The DLP-232PC Data Acquisition Module is a low-cost, easy-to-use data acquisition module for measuring voltages, controlling and monitoring processes, and acquiring temperature data. Each of the 14 available channels can be configured for digital I/O or temperature modes via single-byte commands. Eight of the 14 channels can be configured to measure analog voltages in the range of 0-5 volts. All operational power is taken from the host PC via the USB port.

The mode of each I/O is automatically changed with each command sent. For example, if an I/O is set to Digital Output – High and then the Digital Input Mode is selected, the I/O is first changed to Input Mode and then the high/low state is read and returned to the host.

The programming interface (ICSP) is available for custom firmware development.

## 2.0 SPECIFICATIONS

The DLP-232PC is a 5-volt system that derives its power from the host USB port. Each channel has the following capabilities:

Digital Output: Set high, or clear to low. (The actual high/low voltage depends upon sink/source current.)

Digital Input: Read the high/low state.

Analog In: (Channels 1-8 only) read and return the voltage on each I/O pin using a 10-bit A/D (0-5 volt range, accuracy based on 5-volt USB Host supply voltage).

Temperature: Measure temperature using a digital temperature sensor (purchased separately) in the range of 67 to 257°F (-55 to 125°C).

## 3.0 ABSOLUTE MAXIMUM RATINGS

Stresses above those listed here may cause permanent damage to the DLP-232PC:

Operating Temperature: 0-70°C

Voltage on I/Os with Respect to Ground: -0.3V to +5.3V

Sink/Source Current on Any I/O: 25mA

## 4.0 WARNINGS

- Unplug the DLP-232PC from the host PC before making electrical connection to the module to avoid possible damage caused by electrical surge.
- Observe static precautions to prevent damage to the DLP-232PC module.

## 5.0 USB DRIVERS

USB drivers for the following operating systems are available for download from the DLP Design website:

|                            |                |
|----------------------------|----------------|
| <b>Windows XP x64</b>      | <b>Mac OSX</b> |
| <b>Windows Server 2003</b> | <b>Mac OS9</b> |
| <b>Windows 2000</b>        | <b>Mac OS8</b> |
| <b>Windows 98, ME</b>      | <b>Linux</b>   |

These drivers are available for download from the following page: <http://www.dlpdesign.com/DNLD8/>.

**NOTE:** If you are using the dual-mode drivers from FTDI (CDM2.00.00) and wish to use the Virtual COM Port (VCP) drivers instead, then it may be necessary to disable the D2XX drivers first via Device Manager. Right click on the entry under USB Controllers that appears when the DLP-232PC is connected, select Properties, select the Advanced tab, check the option for “Load VCP” and click OK. Once you unplug and then replug the DLP-232PC, a COM port should appear in Device Manager under Ports (COM & LPT).

## 6.0 ANALOG CHANNEL SETUP

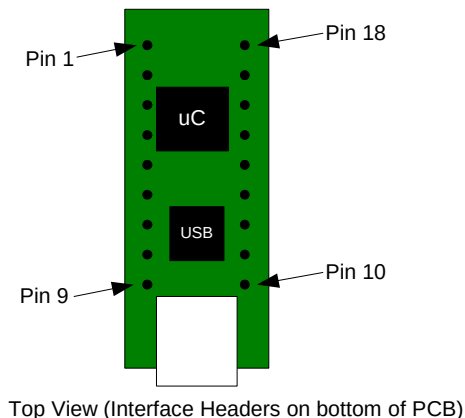
Channels that are to be used as analog inputs to measure voltage must be properly configured for analog mode. There are 9 possible scenarios for the A/D Setup listed at the end of Table 1 ranging from no analog channels active to all 8 channels active.

Analog channels must be activated in order starting with Channel 1. For example, if a systems design requires a single analog channel and 13 digital I/O channels, then that analog channel must be Channel 1. (Refer to the end of Table 1 for additional detail.)

## 7.0 USING THE DLP-232PC

Simply connect the DLP-232PC to the PC to initiate the loading of drivers. Once the drivers are loaded, the DLP-232PC is ready for use. All commands are single-byte commands.

You can either utilize a simple terminal emulator program or write your own program in your language of choice. Begin by opening the COM port, set the baud rate to 460800 (1 start bit, No parity, 8 data bits, 1 stop bit), and send single-byte commands as shown in Table 1. The Ping command can be used to locate the correct COM port used for communicating with the DLP-232PC, or you can look in Device Manager to see which port Windows has assigned to the DLP-232PC.



**TABLE 1**

| Channel 1 (Pin 5) Commands |           |                |                                                 |
|----------------------------|-----------|----------------|-------------------------------------------------|
| ASCII Character            | Hex Value | Description    | Return / Comments                               |
| 1                          | 0x31      | Dig Out – High | Nothing returned                                |
| Q                          | 0x51      | Dig Out – Low  | Nothing returned                                |
| A                          | 0x41      | Digital Input  | Returns 0 or 1 (See Note 1)                     |
| Z                          | 0x5A      | Analog In      | Returns measured voltage (See Note 1)           |
| 9                          | 0x39      | Temperature    | Returns current temperature (See Notes 1 and 2) |

| Channel 2 (Pin 4) Commands |      |                |  |
|----------------------------|------|----------------|--|
| 2                          | 0x32 | Dig Out – High |  |
| W                          | 0x57 | Dig Out – Low  |  |
| S                          | 0x53 | Digital Input  |  |
| X                          | 0x58 | Analog In      |  |
| 0                          | 0x30 | Temperature    |  |

| Channel 3 (Pin 1) Commands |      |                |  |
|----------------------------|------|----------------|--|
| 3                          | 0x33 | Dig Out – High |  |
| E                          | 0x45 | Dig Out – Low  |  |
| D                          | 0x44 | Digital Input  |  |
| C                          | 0x43 | Analog In      |  |
| -                          | 0x2D | Temperature    |  |

| Channel 4 (Pin 2) Commands |      |                |  |
|----------------------------|------|----------------|--|
| <b>4</b>                   | 0x34 | Dig Out – High |  |
| <b>R</b>                   | 0x52 | Dig Out – Low  |  |
| <b>F</b>                   | 0x46 | Digital Input  |  |
| <b>V</b>                   | 0x56 | Analog In      |  |
| <b>=</b>                   | 0x3D | Temperature    |  |

| Channel 5 (Pin 3) Commands |      |                |  |
|----------------------------|------|----------------|--|
| <b>5</b>                   | 0x35 | Dig Out – High |  |
| <b>T</b>                   | 0x54 | Dig Out – Low  |  |
| <b>G</b>                   | 0x47 | Digital Input  |  |
| <b>B</b>                   | 0x42 | Analog In      |  |
| <b>O</b>                   | 0x4F | Temperature    |  |

| Channel 6 (Pin 17) Commands |      |                |  |
|-----------------------------|------|----------------|--|
| <b>6</b>                    | 0x36 | Dig Out – High |  |
| <b>Y</b>                    | 0x59 | Dig Out – Low  |  |
| <b>H</b>                    | 0x48 | Digital Input  |  |
| <b>N</b>                    | 0x4E | Analog In      |  |
| <b>P</b>                    | 0x50 | Temperature    |  |

| Channel 7 (Pin 16) Commands |      |                |  |
|-----------------------------|------|----------------|--|
| <b>7</b>                    | 0x37 | Dig Out – High |  |
| <b>U</b>                    | 0x55 | Dig Out – Low  |  |
| <b>J</b>                    | 0x4A | Digital Input  |  |
| <b>M</b>                    | 0x4D | Analog In      |  |
| <b>[</b>                    | 0x5B | Temperature    |  |

| Channel 8 (Pin 15) Commands |      |                |  |
|-----------------------------|------|----------------|--|
| <b>8</b>                    | 0x38 | Dig Out – High |  |
| <b>I</b>                    | 0x49 | Dig Out – Low  |  |
| <b>K</b>                    | 0x4B | Digital Input  |  |
| <b>, (Comma)</b>            | 0x2C | Analog In      |  |
| <b>]</b>                    | 0x5D | Temperature    |  |

| Channel 9 (Pin 6) Commands |      |                |  |
|----------------------------|------|----------------|--|
| <b>/</b>                   | 0x2F | Dig Out – High |  |
| <b>a</b>                   | 0x61 | Dig Out – Low  |  |
| <b>b</b>                   | 0x62 | Digital Input  |  |
| <b>c</b>                   | 0x63 | Temperature    |  |

| Channel 10 (Pin 8) Commands |      |                |  |
|-----------------------------|------|----------------|--|
| <b>d</b>                    | 0x64 | Dig Out – High |  |
| <b>e</b>                    | 0x65 | Dig Out – Low  |  |
| <b>f</b>                    | 0x66 | Digital Input  |  |
| <b>g</b>                    | 0x67 | Temperature    |  |

| Channel 11 (Pin 11) Commands |      |                |  |
|------------------------------|------|----------------|--|
| <b>h</b>                     | 0x68 | Dig Out – High |  |
| <b>i</b>                     | 0x69 | Dig Out – Low  |  |
| <b>j</b>                     | 0x6a | Digital Input  |  |
| <b>k</b>                     | 0x6b | Temperature    |  |

| Channel 12 (Pin 12) Commands |      |                |  |
|------------------------------|------|----------------|--|
| <b>l</b>                     | 0x6c | Dig Out – High |  |
| <b>m</b>                     | 0x6d | Dig Out – Low  |  |
| <b>n</b>                     | 0x6e | Digital Input  |  |
| <b>o</b>                     | 0x6f | Temperature    |  |

| Channel 13 (Pin 13) Commands |      |                |  |
|------------------------------|------|----------------|--|
| <b>p</b>                     | 0x70 | Dig Out – High |  |
| <b>q</b>                     | 0x71 | Dig Out – Low  |  |
| <b>r</b>                     | 0x72 | Digital Input  |  |
| <b>s</b>                     | 0x73 | Temperature    |  |

| Channel 14 (Pin 14) Commands |      |                |  |
|------------------------------|------|----------------|--|
| <b>t</b>                     | 0x74 | Dig Out – High |  |
| <b>&amp;</b>                 | 0x26 | Dig Out – Low  |  |
| <b>*</b>                     | 0x2A | Digital Input  |  |
| <b>(</b>                     | 0x28 | Temperature    |  |

| Setup Commands (Remembered Until Power is Cycled) |      |               |                                                                                   |
|---------------------------------------------------|------|---------------|-----------------------------------------------------------------------------------|
| <b>`</b>                                          | 0x60 | Return ASCII  | Default setting; nothing returned (Accent Grave character just left of the 1 key) |
| <b>\</b>                                          | 0x5C | Return Binary | Nothing returned                                                                  |
| <b>L</b>                                          | 0x4C | Set °F        | Default setting; nothing returned                                                 |
| <b>;</b>                                          | 0x3B | Set °C        | Nothing returned                                                                  |

| Ping Command |      |            |                                                                                                                         |
|--------------|------|------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>'</b>     | 0x27 | Issue Ping | Q (0x51) will be returned if the DLP-232PC is found on the selected port (Apostrophe character just right of the ; key) |

| A/D Setup |      |               |                                    |
|-----------|------|---------------|------------------------------------|
| <b>u</b>  | 0x75 | No Analogs    | A/D Converter disabled             |
| <b>v</b>  | 0x76 | CH1 Only      | A/D active on Channel 1 only       |
| <b>w</b>  | 0x77 | CH1 and CH2   | A/D active on Channels 1 and 2     |
| <b>x</b>  | 0x78 | CH1,2,3       | A/D active on Channels 1 through 3 |
| <b>y</b>  | 0x79 | CH1,2,3,4     | A/D active on Channels 1 through 4 |
| <b>z</b>  | 0x7A | CH1,2,3,4,5   | A/D active on Channels 1 through 5 |
| <b>#</b>  | 0x23 | CH1,2,3,4,5,6 | A/D active on Channels 1 through 6 |
| <b>\$</b> | 0x24 | CH1 – CH7     | A/D active on Channels 1 through 7 |
| <b>%</b>  | 0x25 | CH1 – CH8     | A/D active on Channels 1 through 8 |

| LED Commands |      |         |  |
|--------------|------|---------|--|
| <b>{</b>     | 0x7B | LED Off |  |
| <b>}</b>     | 0x7D | LED On  |  |

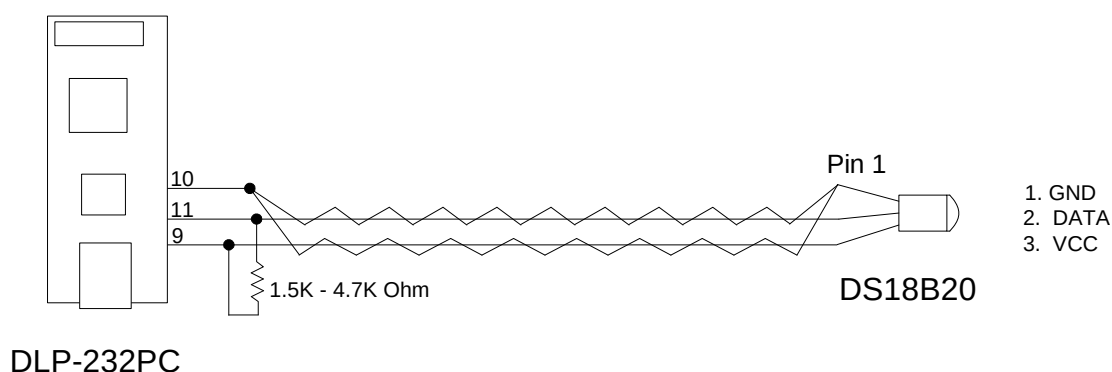
**Note 1** – Data is returned in either the form of ASCII characters (ex: 1.25V, 78.2°F) or binary (raw data) depending upon the current mode. The power-up default mode is ASCII such that data is easily read using a terminal emulator program.

**Note 2** – Requires DS18B20 digital temperature sensor (purchased separately). See Section 8.0 of this document for connection details.

## 8.0 TEMPERATURE

Up to 14 DS18B20 digital temperature sensors can be connected to the DLP-232PC. For best performance, use Category 5 type computer cable to connect the sensors to the DLP-232PC. Two pairs of wires in the Cat 5 cable are required for the connection. The first pair is for Power (5V) and Ground, and the second pair is designated as Data and Ground. In addition, a pull-up resistor is required for the data line in the range of 1.5K-4.7K Ohms. Figure 1 shows an example of this connection using I/O Channel 11:

**FIGURE 1**

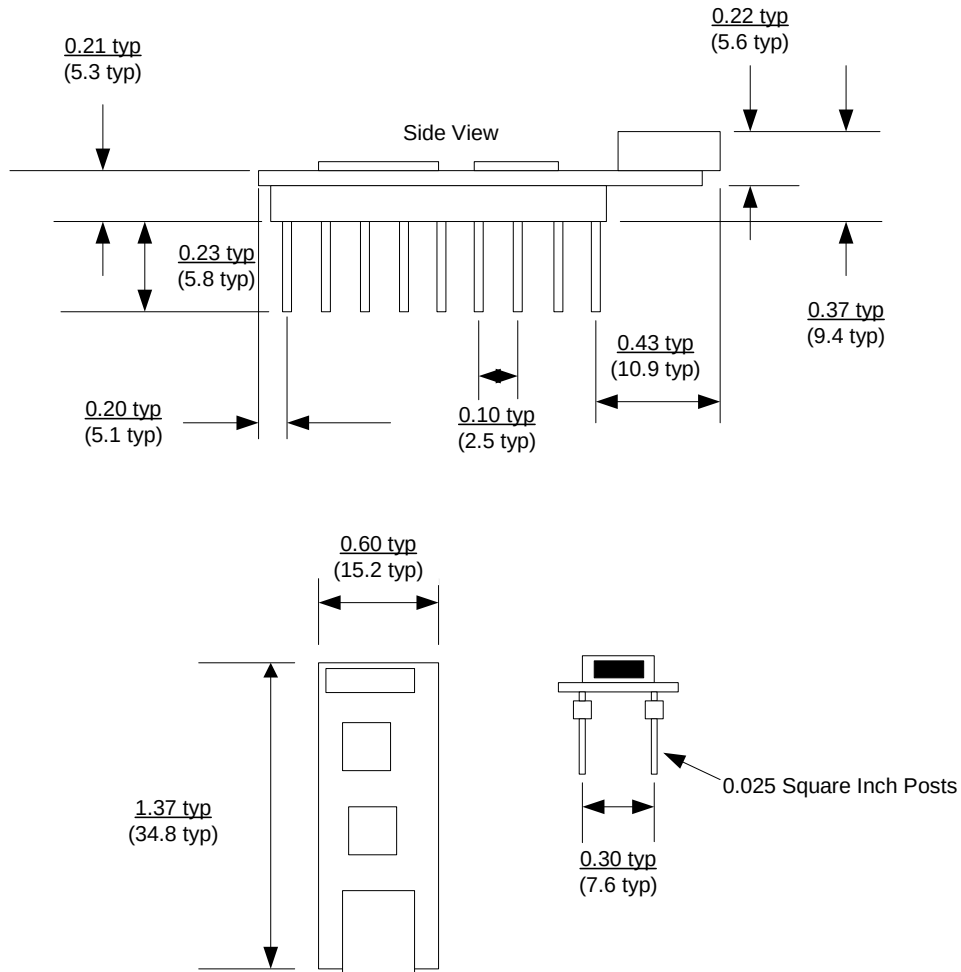


The first time temperature data is requested, a value of 999.99° (0xFF x 2 if in Binary Mode) is returned. Subsequent reads will return valid temperature data if a temperature sensor is properly configured and connected to the specified I/O port. If no sensor is connected, a Temperature command will always return 999.99°. Please note that the PAR versions of the sensor (DS18B20+PAR) will not work with the 232PC firmware.

## 9.0 RETURN DATA TYPES

By default, the DLP-232PC returns data to the host PC in the form of ASCII text such that it can be easily displayed and read using a simple terminal emulator. Alternatively, data can be returned in binary form requiring the user's host app to calculate the voltage and temperature values. The commands used to set the return data types (0x60 and 0x5C) are shown at the end of Table 1.

## 10.0 MECHANICAL DIMENSIONS IN INCHES (MM) (PRELIMINARY)



## 11.0 DISCLAIMER

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## **12.0 CONTACT INFORMATION**

DLP Design, Inc.  
1605 Roma Lane  
Allen, TX 75013

Phone: 469-964-8027  
Fax: 415-901-4859

Email Sales: [sales@dlpdesign.com](mailto:sales@dlpdesign.com)  
Email Support: [support@dlpdesign.com](mailto:support@dlpdesign.com)  
Website URL: <http://www.dlpdesign.com>

