DLP-TEMP9

USB / Data-Acquisition Module

INTRODUCTION

The DLP-Temp9 is a USB/microcontroller based 9-channel data-acquisition system preprogrammed with firmware for reading digital temperature-sensing devices. The DLP-Temp9 board is equipped with a Type A male USB connector for direct connection to a USB port. No cable is required for connection to the host computer unless the board is to be located away from the host, in which case a user-supplied, 6-foot max, USB A-A (male-female) extension cable can be used.

The digital temperature-sensing device supported is the Dallas Semiconductor DS18B20. Nine of these sensors can be monitored simultaneously while connected to the DLP-Temp9 via Category 5 cable at distances up to 200 feet. For instruction on how to connect the sensors to the DLP-Temp9 via Category 5 cable, refer to the Application section of this document. All power for the DLP-Temp9's circuitry and DS18B20 temperature sensors is taken from the USB port so no external power source is required.

The microcontroller used is the PIC16F84A Flash-based microcontroller from Microchip. The 16F84A is preprogrammed for digital I/O and reading the digital temperature sensors, but it can also be erased and reprogrammed with user code if desired. Reprogramming the micro requires a user-supplied device programmer. (Refer to the schematic at the end of this document for the pin out of the programming header.)

The microcontroller uses a single port pin and a pull-up resistor to communicate with each digital temperature sensor. (Refer to the DS18B20's datasheet for a complete description of its communications protocol.) The firmware for the DLP-Temp9 was written in C, and is available upon purchase of the DLP-Temp9 from DLP Design.

USB INTERFACE

The USB interface was implemented using the FT232BM USB-UART IC from FTDI. This device connects to the host computer via the Type A USB (male) connector, and supports the eight standard RS232 serial signals. Only the TX and RX signals are used on the DLP-Temp9 board and are all that is required to form a serial connection to the host computer.

In order for the DLP-Temp9 (and FT232BM) to receive incoming serial data from the host, FTDI's VCP (Virtual Com Port) drivers must be installed. The driver installation process is initiated by simply plugging the DLP-Temp9 into a USB port. The driver installation wizard will prompt for the location of the drivers files (in a folder or on a floppy) and copy the required files to the proper destination such that the next time the board is connected the driver files will be automatically loaded without prompting the user. The VCP driver files can be downloaded for free from **dlpdesign.com** or **ftdichip.com**.

Once the drivers are loaded and the com port number for the DLP-Temp9 is set in Device Manager, the application program running on the host simply opens what it thinks is an RS232 port (9600, N, 8, 1) and begins communicating with the 16F84A microcontroller.

COMMUNICATIONS PROTOCOL

For this design, a rather simplistic protocol was selected in an attempt to present the design in as basic a way as possible. Single-byte commands are used to communicate with the 12F629 microcontroller. The following table shows the command list:

COMMAND	16F84A Response
R (read and convert)	Send back 18 bytes of data from the sensors, and start another temperature conversion in both sensors. Two bytes are sent back for each port on the board. If a temperature sensor is present, the two bytes will contain temperature data and are the actual first two bytes of data read from the DS18B20 temperature sensor. If the port is configured as digital input, the high/low state of the port is returned in each of the two bytes. If the port is configured as an output, the data returned is the current state of the port.
P (ping)	Echo the letter 'Q' back to the host.
I (Set Input)	Change the setup of a port to input. This is a two-byte command. The second byte is the port number (1-9) that is to be made an input. This command also writes the new port configuration setup to the EEPROM memory in the 16F84A. ***EEPROM addresses 50-63 are dedicated to the storage of port setup information and must not be used by the host application.*** The desired port is set to high impedance input immediately upon receipt of this command.
O (Set Output)	Change the setup of a port to output. This is a three-byte command. The second byte is the port number (1-9) that is to be made an output. The third byte is the desired high/low state of the port pin. This command also writes the new port configuration setup to the EEPROM memory in the 16F84A. ***EEPROM addresses 50-63 are dedicated to the storage of port setup information and must not be used by the host application.*** The desired port is set high or low immediately upon receipt of this command.

E (EEPROM Read/Write)	Read and write the EEPROM memory. This is a three- to four-byte command. The second byte determines if this command is to be a read (0) or write (1). The third byte is the desired address to be read/written. If this is a write command, the fourth byte is the data to be written. If this is a read command, the forth byte is not required. ***EEPROM addresses 50-63 are dedicated to the storage of port setup information and must not be used by the host application.***

APPLICATION

The DLP-Temp9 can be used to monitor temperature at the board or at a distance from the board. The board supports the monitoring of up to 9 temperatures, 9 digital I/O's, or any mixture of digital I/O's and temperature sensors.

The board comes with one sensor that is not soldered to the board so that the user has the option of locating the sensor at a distance from the board using Category 5 cable. This design has been successfully tested with both sensors located 200 feet away from the board using Category 5 cable. Two pairs of wires in the Category 5 cable are required for the connection. One pair is for power and ground, and the other pair is for data and ground.

To configure the board for use with a temperature sensor, a value of 3 must be written to the appropriate EEPROM location.

S5	S3	S8	S6	S4	S2	S1	S9	S7	Sensor Number
50	51	52	53	54	60	61	62	63	EEPROM Address

DISCLAIMER

This product and its documentation are supplied on an as-is basis, and no warranty as to their suitability for any particular purpose is either made or implied. DLP Design will not accept any claim for damages whatsoever arising as a result of use or failure of this product. Your statutory rights are not affected.

This product or any variant of it is not intended for use in any medical appliance, device, or system in which the failure of the product might reasonably be expected to result in personal injury.

This document provides preliminary information that may be subject to change without notice.

CONTACT INFORMATION

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

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

Email: support@dlpdesign.com
Internet: http://www.dlpdesign.com

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