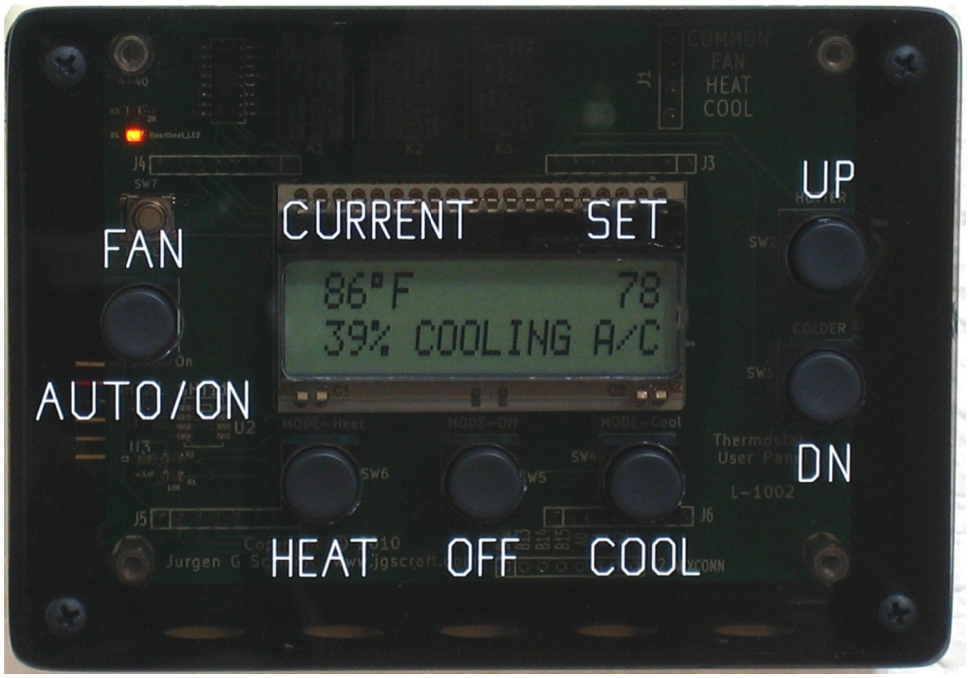
Web Accessible Thermostat
Instructions



Actual Size Image of Thermostat with Transparent Dark Grey Cover

Description and Features

The Web-Accessible Thermostat is a circuit board that must be mounted on the **PIC24 TCP/IP Developer and Experimenter** board to function. The combination provides the following features:

- Replaces standard 4-wire thermostat.
- Displays temperature (°F) and percent humidity.
- Uses Sensiron SHT11 sensor.
- Maintains simple user interface in the wall unit.
- Wall unit has backlight for the LCD display which is turned on briefly when a button is pushed.
- Web-browser access from any device that supports html and javascript.
- User-configurable start-up defaults.
- Sends email or text message on start-up or restart, such as after a power failure. (This feature does require access to a suitable mail server.)
- 7 PIC24 I/O lines available for custom use.
- All on a 3″ by 4″ board that mounts on the TCP/IP experimenter board.

Package Contents

- Preprogrammed JGS_ETH24_BASE board (if you bought the complete kit)
- Thermostat board with 2 or 3-line LCD display
- Case and simple faceplate (optional)
- Case and faceplate with text (optional)
- Complete MPLAB project containing all hardware dependent source code (sent via email)
- Copies of the Nuts & Volts articles (download from the website)
- Bootloader files (optional, sent via email)
- These instructions (download from the website)

Thermostat Installation

The thermostat requires a regulated 5-volt power supply that provides at least 500 milliamps and an Ethernet connection. If you want to control an HAC system, then you need to make the appropriate connections for that as well. Please refer to the article in the October 2011 issue of Nuts and Volts for the details. A copy of the article is available on the **www.jgscraft.com** website.

One you have connected the thermostat to power and your internal network you can customize some of the settings.

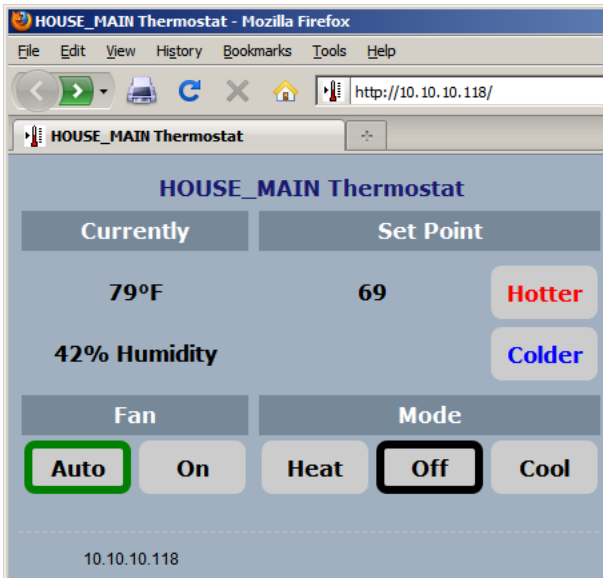
The default settings are:

- Use a DHCP server to set the IP addresses
- The set point temperature is set to 75° F
- The operating mode is set OFF
- The HOSTNAME or Thermostat is set to HOUSE_MAIN
- The email notification information is blank

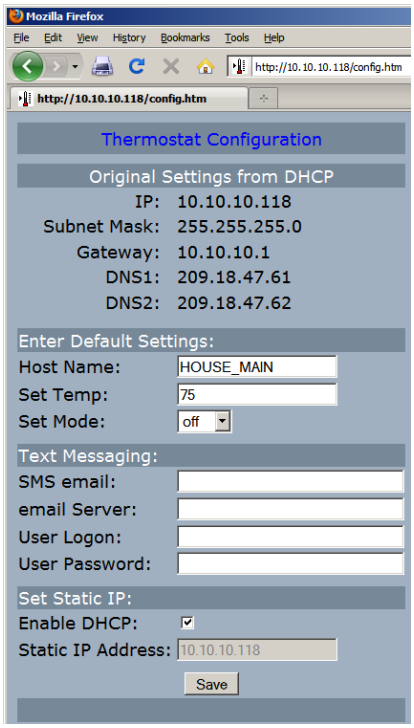
When you power on the thermostat and it's connected to your router, it will get an IP address. To see what this address is, press the UP and DN buttons on the thermostat simultaneously. This will display the thermostat ID and the IP address on the LCD. If you have connected a serial cable to the TCP/IP board and are monitoring the output, you will also see the IP address displayed in the terminal. (See the TCP/IP Board setup manual for the details.)

You can then use this address in your browser to access the thermostat. You should see something like this picture.

You can click on the various buttons to change the settings



Changing Default Settings



The thermostat comes with some preset default settings. To display and/or change them you need to display the configuration page. If your router assigned an IP address of 10.10.10.118, for example, then you would enter **`http://10.10.10.118/config.htm`** into your browser to access the configuration page. It should like this picture.

Since DHCP is turned on by default, various TCP/IP settings are filled in.

You can now go and customize some settings, for example, if you have more than one thermostat you will want to give each one a different Host Name.

Also, since DHCP dynamically assigns the IP address, this could change over time, especially after a power failure. To always keep the same address, uncheck the "Enable DHCP" check-box and either keep the assigned address or assign a new one. Most routers have a range of fixed addresses and a range of dynamically assigned ones. Picked one of the fixed addresses and be sure it's not used by any other device on your network.

Enter the default settings the thermostat should use when it powers on. Usually you will want the thermostat to default to "off". However, if you are at risk of pipes freezing in the winter, you may want to default to "Heat" and a temperature of, for example, 60° F.

Email or Text Message Notification

The software in the thermostat supports sending an email or text message every time it is powered on. This is useful if you want to be notified that there was a power failure and the thermostat has restarted with the power-on default settings.

To activate this feature, fill in the text messaging information. In order to send an email you need to logon to a mail server so that you can get the message into the network. To do this you need to have the logon information for an email account to use this feature. I have used it successfully with earthlink.net and the sendmail application which I run on my own servers. It will not work with email servers that require an encrypted connection, such as AOL, gmail, and hotmail.

SMS email: this is where you want the message sent. If you are sending a text message to a phone then you should use an email address that has one of the following formats:

AT&T	**phonenumber@txt.att.net**
Sprint	**phonenumber@messaging.sprintpcs.com**
T-Mobile	**phonenumber@tmomail.net**
Virgin Mobile	**phonenumber@vmobl.com**
Cingular	**phonenumber@cingularme.com**
Verizon	**phonenumber@vtext.com**
Nextel	**phonenumber@messaging.nextel.com**

where "phonenumber" is the 10 digit phone number to which you are sending the text message. If you are sending an email then enter a regular email address.

email Server: this is the outgoing mail server address, which usually looks something like smtp.webserver.com.

User Logon: is the user logon for accessing the email account.

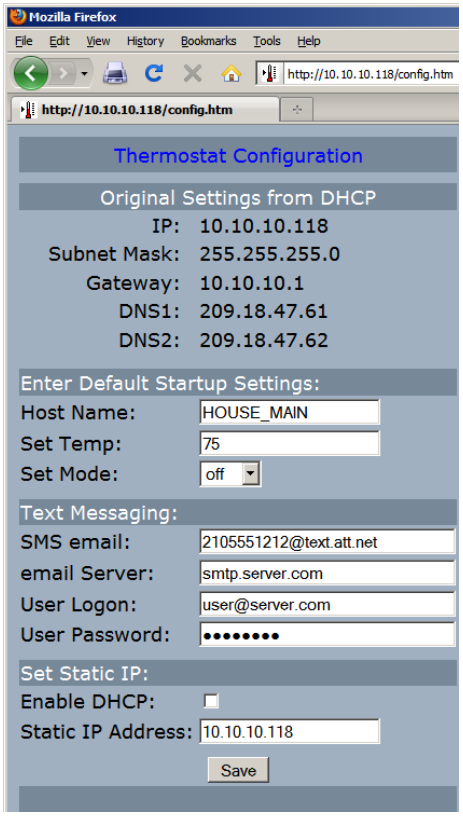
User Password: is the password.

Once you make changes to the thermostat configuration, click on the "Save" button. The thermostat will reset. You may need to hit the "Back" button on your browser to refresh the screen. If you changed to a Static IP Address, be sure to enter that address in the browser.

The completed configuration should look something like this:

To turn off the text or email notification just blank out the SMS email field.

Please note: There is no error checking so be sure to enter the information correctly and be sure that the mail server you are using does not require encryption. There will not be any feedback if you enter any invalid information.



Setting Up Your Programming Environment

If you are planning on modifying the software for the thermostat, follow the instructions in the manual for the TCP/IP board to set up your Microchip MPLAB programming environment. The zip file that was sent to you contains a directory "**`@Thermostat`**". Copy this directory into the

`c:\Microchip Solutions v2011-07-14\TCPIP` directory.

Comment out line 320 in **`C:\Microchip Solutions v2011-07-14\Microchip\TCPIP Stack\ENC26J60.c`**

Copy StackTsk.h to **`C:\Microchip Solutions v2011-07-14\Microchip\Include\TCPIP Stack`**

Within the @Thermostat directory, double-click on the JGS_Thermostat.mcp file to open the project.

The thermostat design has two different PCBs and comes with either a 2 or 3-line LCD. The zip file includes precompiled hex files for all the current versions:

JGS_THERMOSTAT_L1002_2L.hex 2-line LCD for 2010 version of the PCB
Compiler macros: THERM_PCB_L1002 THERM_LCD_2LINE

JGS_THERMOSTAT_L1002_3L.hex 3-line LCD for 2010 version of the PCB
Compiler macros: THERM_PCB_L1002 THERM_LCD_3LINE

JGS_THERMOSTAT_M0906_2L.hex 2-line LCD for 2011 version of the PCB
Compiler macros: THERM_PCB_M0906 THERM_LCD_2LINE

JGS_THERMOSTAT_M0906_3L.hex 3-line LCD for 2011 version of the PCB
Compiler macros: THERM_PCB_M0906 THERM_LCD_3LINE

You can regenerate any of these hex files by setting the relevant macros in the project configuration. Note that the project always produces a hex file labeled JGS_Thermostat.hex.

The MPLAB project files you receive will be preconfigured for the hardware you ordered.

If you are going to make changes to the thermostat code you should have a good understanding of the following:

- the Microchip MPLAB IDE
- the Microchip TCP/IP stack as described in the help file that comes with the Microchip Application Libraries
- C programming
- the source ode files that come with the project

Optional Ethernet Bootloader

If you look at the project files you will find **`p24HJ128GP204_EBLE_app.gld`**. This has also been added to the project as a linker script. This file places the thermostat application in the flash memory of the microprocessor in such a way that it leaves room to put in a bootloader. The same application hex file can be used with or without the bootloader.

If you purchased the bootloader option then the following files were sent to you by email:

p24HJ128GP204_EBLE_app.gld – this is a linker script that tells the compiler how much room to reserve in the processor memory for the bootloader.

XTEA.exe – compresses and encrypts the application hex file for loading. This is a console application and must be run in a DOS window or Command Prompt.

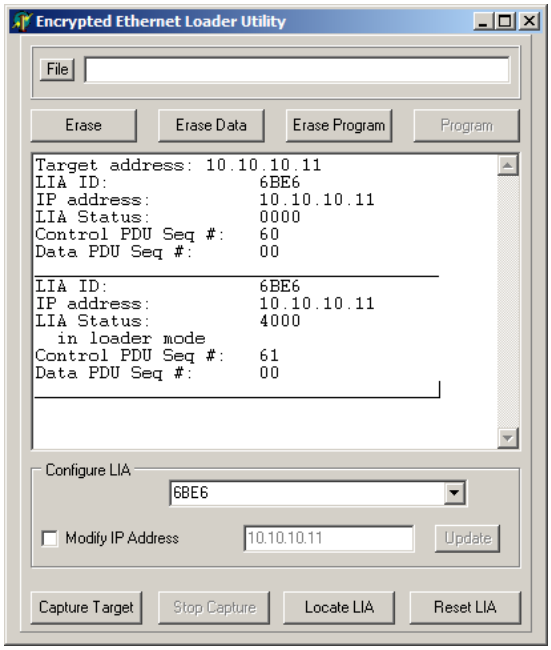
Encrypted_ENC_loader.exe – PC application that loads new applications to the hardware.

Encrypted_ENC_loader.inc – control file for Encrypted_ENC_loader.exe.

ENC_C30.hex – this is the bootloader that must be loaded onto the microprocessor via the ICSP connector. This hex file will only work with the TCP/IP Developer and Experimenter board. If you want the source code for the bootloader so you can use it with other hardware, you can buy that from Brush Electronics (**`www.brushelectronics.com`**).

BE Encrypted Ethernet Bootloader System Ver 1.3.pdf – manual for using the bootloader.

Put all of the files in the project directory.



The steps for using the Ethernet Bootloader are as follows:

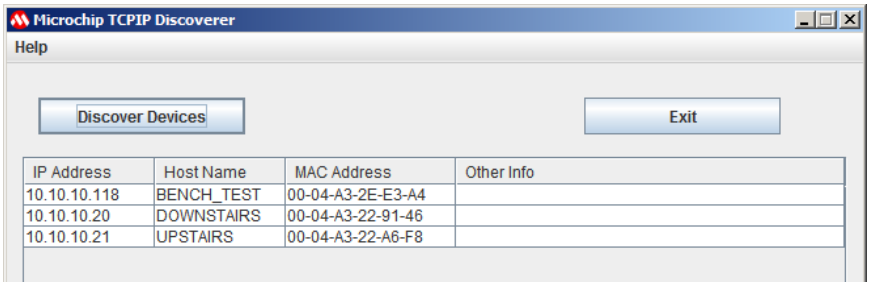
1. Using the ICSP plug load **ENC_C30.hex** onto the target hardware, which is referred to as the LIA (LAN Interface Adapter). This only needs to be done once.
2. Compile the application, producing a new JGS_Thermostat.hex.
3. Encrypt and compress the application using **XTEA.exe** by typing "xtea JGS_Thermostat.hex" in a DOS window or Command Prompt. This will produce a file JGS_Thermostat.cry.
4. Start the **Encrypted_ENC_loader.exe** application
5. Click the "Capture Target" button and reset the thermostat by going the config screen and hit "save" which causes a reset. Upon reset, the bootloader will run first and for 5 seconds will scan for the loader utility when it finds it and makes a connection you should see something like this in the loader:

6. Select the JGS_Thermostat.cry file and click the “Program” button. After a while you will see a “Programming Complete” message.
7. Reset the hardware by clicking on the “Reset LIA” button.
8. All these steps should be performed promptly to avoid timeouts.
9. Restart at step 2 after revising the application.

You have just reloaded the application via the Ethernet. If you have made changes to the web pages, be sure to run the MPFS2.jar utility. This is found in

`C:\Microchip Solutions v2011-07-14\Microchip\TCPIP Stack\Utilities`

as a java application so you will need to have a java runtime environment on your system. The companion utility TCPIP Discoverer.jar is useful for finding “lost” Microchip-based TCP/IP hardware. If the Announce feature is turned on in the application, then they announce themselves to the Discoverer application.

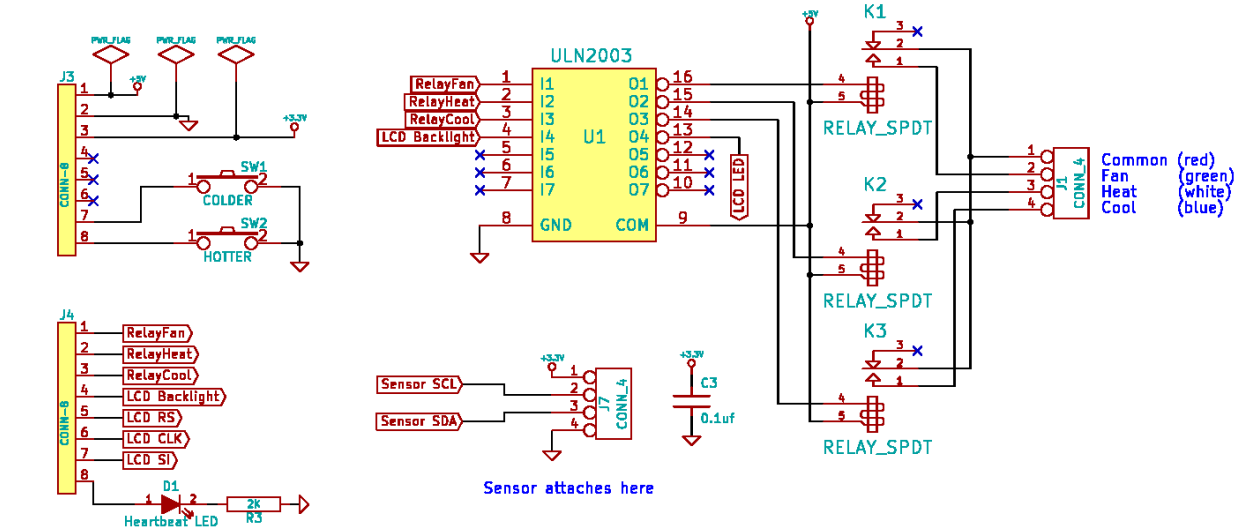


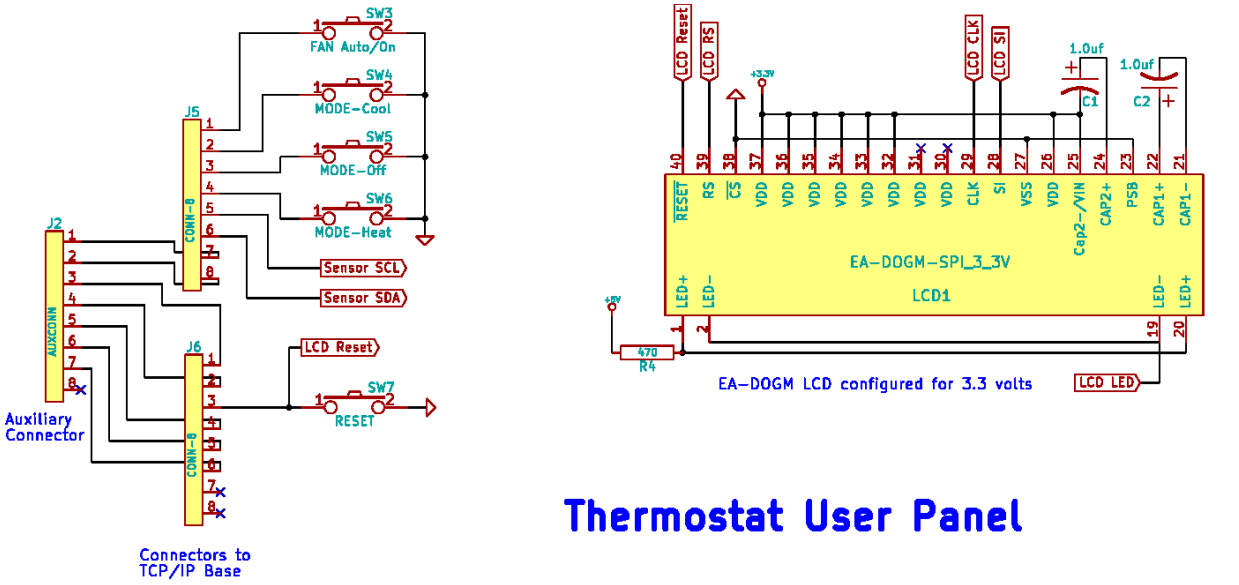
Both the Demo App and the Thermostat projects have the announce feature turned on by default.

PIC24HJ128GP204 Pin Reference with TCP/IP Base Assignments

Name	Pin Number	Pin Type	CNxx Pullup	RPxx	ANxx	Functions (selected)	TCP/IP Base / Thermostat Testing Fixture (J3)
Vdd	17,28,40						
Vss	6,16,29,39						
MCLR	18						Reset button
Vcap	7						
RA0	19	I/O ST	CN2		AN0	Vref+	
RA1	20	I/O ST	CN3		AN1	Vref-	
RA2	30	I/O ST	CN30			OSC1, CLKI	Clock input from ENC28J60
RA3	31	I/O ST	CN31			OSC2, CLKO	CS for MAC address chip
RA4	34	I/O ST	CN0			SOSCO	optional RTCC Xtal LED1
RA7	13	I/O ST				PMA7	
RA8	32	I/O ST				PMA8	CS for ENC28J60
RA9	35	I/O ST				PMA9	LED2
RA10	12	I/O ST				PMA10	
RB0	21	I/O ST	CN4	RP0	AN2		RX1, ICSP PGD
RB1	22	I/O ST	CN5	RP1	AN3		TX1, ICSP PGC
RB2	23	I/O ST	CN6	RP2	AN4		
RB3	24	I/O ST	CN7	RP3	AN5		SPI1 SCK
RB4	33	I/O ST	CN1	RP4		SOSCI	optional RTCC Xtal LED0
RB5	41	I/O ST	CN27	RP5			Relay Heat
RB6	42	I/O ST	CN24	RP6			Relay Cool
RB7	43	I/O ST	CN23	RP7			LCD Backlight
RB8	44	I/O ST	CN22	RP8		SCL1	LCD RS
RB9	1	I/O ST	CN21	RP9		SDA1	LCD SPI2 SCK
RB10	8	I/O ST	CN16	RP10			PB Off
RB11	9	I/O ST	CN15	RP11			PB Heat
RB12	10	I/O ST	CN14	RP12	AN12		Temp Sensor
RB13	11	I/O ST	CN13	RP13	AN11		Temp Sensor
RB14	14	I/O ST	CN12	RP14	AN10		optional TX2
RB15	15	I/O ST	CN11	RP15	AN9		optional RX2
RC0	25	I/O ST	CN8	RP16	AN6		SPI1 SDI
RC1	26	I/O ST	CN9	RP17	AN7		SPI1 SDO
RC2	27	I/O ST	CN10	RP18	AN8		CS for Serial Flash
RC3	36	I/O ST	CN28	RP19			PB Colder PB0
RC4	37	I/O ST	CN25	RP20			PB Hotter PB1
RC5	38	I/O ST	CN26	RP21			Relay Fan
RC6	2	I/O ST	CN18	RP22			LCD SPI2 SDO
RC7	3	I/O ST	CN17	RP23			Heartbeat LED
RC8	4	I/O ST	CN20	RP24			PB Fan
RC9	5	I/O ST	CN19	RP25			PB Cool

Thermostat Board Circuit Diagram





Thermostat User Panel