ZiLOG Development Platforms

Thermostat Application Module Kit

PUG001402-0103 Product User Guide

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Overview

The Thermostat Application Module provides a flexible platform for training and experimentation on a number of ZiLOG microcontroller and microprocessor devices. The module contains no processor. It is designed to attach to the eZ80 Development Platform, which contains both the processors and the control programs that make the development platforms function. Figure 1 shows a top view of the Thermostat Application Module.

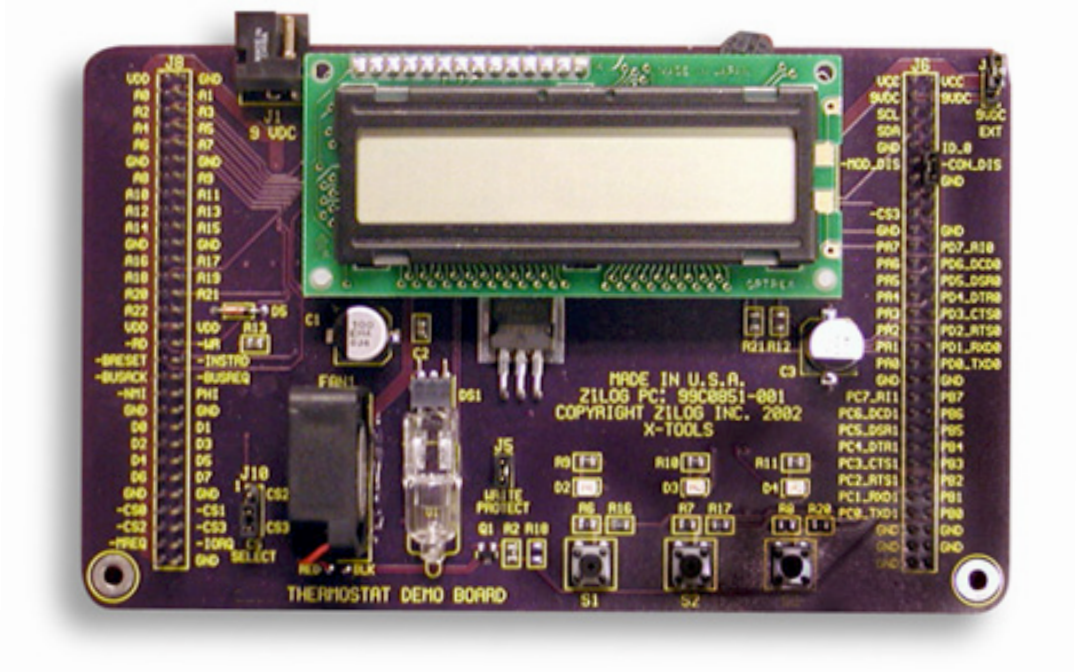

Figure 1. The Thermostat Application Module

The Thermostat Application Module provides the following functionality:

- Simple bit-I/O (LEDs, switches, lamp, and fan)
- Alphanumeric LCD display via the GPIO interface

- Temperature sensor via the I^2C interface
- EEPROM data storage via the I^2C interface
- Flash program storage for eZ80 family devices

Using simple bit I/O functionality, the user can experiment with the basic I/O and interrupt functionality of the target processor. By combining the temperature sensor with the lamp and fan actuation, more sophisticated real-time process control loop experiments can be conducted. The LCD display provides general utility toward developing more sophisticated user interfaces. Software drivers for the LCD display and the I^2C interface exist for several of the ZiLOG processor families. Check the ZiLOG website for the latest versions available.

Module Block Diagram

A block diagram of the Thermostat Application Module appears in Figure 2, which illustrates four major functional areas, all of which interface to the host processor through a plug-in header. These functional areas are:

1. GPIO for simple user interface functions.
2. GPIO for LCD interface.
3. I^2C for temperature sensor and EEPROM interface.
4. Flash memory for program storage (eZ80 option).

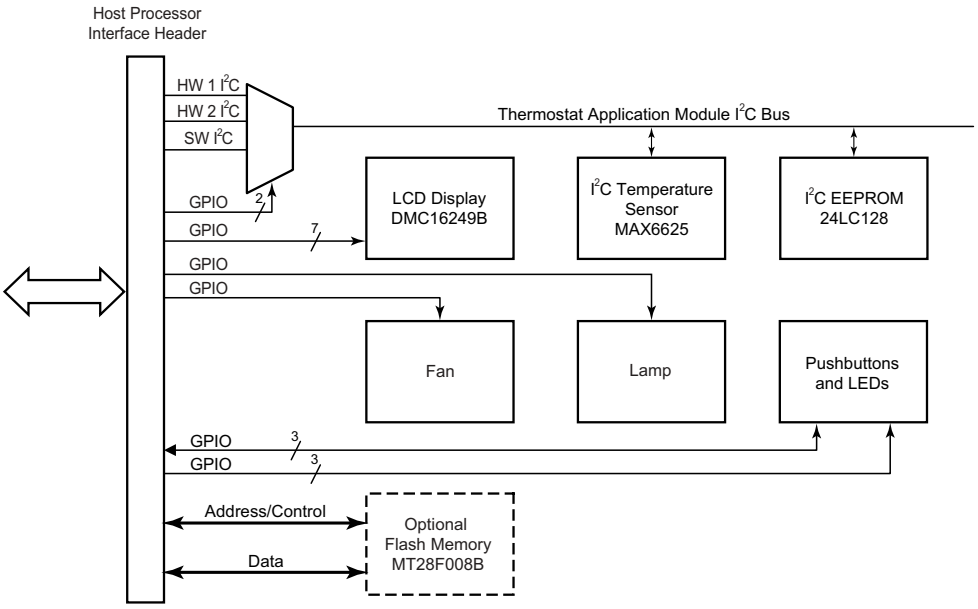

Figure 2. Thermostat Application Module Block Diagram

GPIO for Simple User Interface

The Thermostat Application Module provides the following simple user interface functions:

- 3 Pushbutton switches (input)
- 3 LEDs (output)
- 1 Lamp (output)
- 1 Fan (output)

Each of these simple functions is individually controlled (or sensed) by a single I/O line of the target processor.

Note: The lamp and fan are powered from a 9VDC power supply. This supply is provided by a separate power connector on the Thermostat Application Module, or via the interface connector to the development platform. If the 9VDC supply is not present, all functions of the Thermostat Application Module still operate correctly; however, the lamp and fan do not activate.

GPIO for LCD Interface

The Thermostat Application Module provides a 2x16-character LCD display that uses an industry-standard 4-bit parallel interface. This interface is implemented using 7 GPIO lines and software. The LCD can be used for a more sophisticated menu-driven user interface or status display.

I^2C Interface

The Thermostat Application Module implements a 2-wire I^2C bus to provide communication to the temperature sensor and the EEPROM. Because different processors offer multiple hardware I^2C channels, as well as the possibility to produce I^2C using only GPIO and software, a hardware multiplexer is provided between the processor interface connector and the I^2C devices on the module. As a result, three different source pin combinations are permitted on the development platform. Selection of the multiplexer input is performed by GPIO control. Assignment of the source channels is a function of the development platform attached to the Thermostat Application Module, as well as the application software running on that development platform. Software drivers for the I^2C bus exist for several of the ZiLOG processor families. Check the ZiLOG website for the latest version available.

Flash Memory

A 1MB Flash memory device is included on the Thermostat Application Module for use with eZ80 systems. This memory can be mapped into the memory space of the eZ80 by use of the eZ80's chip select pins. Optionally, by removing a

jumper, this memory can be disabled from use by the eZ80. This memory allows demonstration applications specifically related to the Thermostat Application Module to be loaded and available as soon as the module is connected to an eZ80 system. The memory is of a general-purpose nature, and can be utilized for any appropriate purpose.

Hardware Requirements

The Thermostat Application Module requires a development platform to function. Supported combinations of development platforms are indicated in Table 1.

Table 1. Development Platforms Supporting the Thermostat Application Module

Development Platform	Processor	Development Platform Part Numbers
eZ80 Evaluation Board	eZ80190	eZ801900110ZCO eZ801900111ZCO eZ801900210ZCO eZ801900211ZCO
eZ80 Development Platform	eZ80L92	eZ80L920210ZCO
	eZ80F91	eZ80F910200ZCO
	eZ80F92/F93	eZ80F920200ZCO
Z8 Encore! Development Platform	Z8 Encore!	Z8ENCORE000ZCO

The Thermostat Application Module requires 5VDC @ 50mA, which is provided by the development platform interface connectors. To operate the lamp and fan, an additional 9VDC @ 450mA supply is required. Presently, only the eZ80 and Z8 Encore! development platforms provide this supply across the development platform interface connectors. To use the Thermostat Application Module with other development platforms, an external 9VDC power supply must be used.

Setup and Installation

Jumper Locations

This section discusses the three jumpers that are located on the Thermostat Application Module, as indicated in Figure 3. These jumpers can be repositioned to meet the requirements of the application developer.

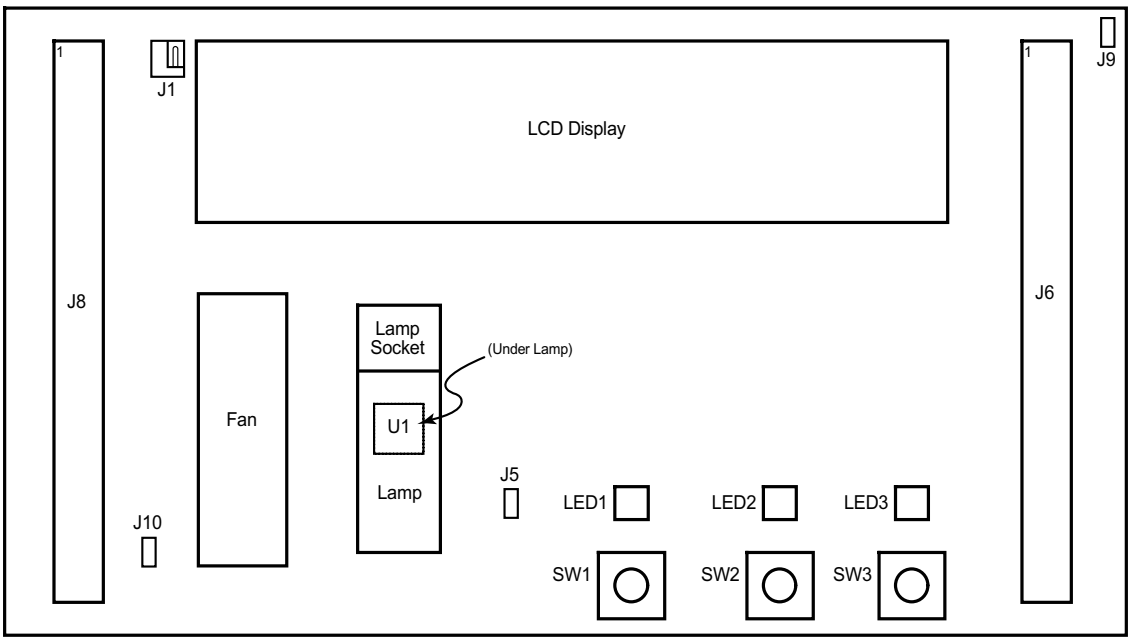

Figure 3. Thermostat Application Module Block Diagram

Write Protect Jumper for Flash Memory (J5)

When installed, the boot sector area of Flash memory on the Thermostat Application Module cannot be altered. This J5 jumper must be removed to reprogram this boot sector. The default position for this jumper is *Installed*.

Chip Select Jumper for Flash Memory (J10)

If the J10 jumper is installed, Flash memory on the Thermostat Application Module is not enabled. If installed in the CS2 (upper) position, chip select 2 of the eZ80 is used to enable Flash memory. This CS2 position is the default for use with the eZ80 Evaluation Board for the eZ80190 device. If installed in the CS3 (lower) position, chip select 3 of the eZ80 is used to enable Flash memory. This CS3 position is the default for use with the eZ80 Development Platform.

External 9VDC Power (J9)

When the J9 jumper is installed, 9VDC power is drawn from the development platform via header J6. The external 9VDC power connector (J1) is still connected. The default position is *Not Installed*.

Installation Procedure

The Thermostat Application Module is designed to be attached to the top of one of the ZiLOG development platforms listed in Table 1. The pins located on the top of the Thermostat Application Module J6 and J8 headers are available for the attachment of test probes.

Caution: Always use a grounding strap to prevent damage resulting from electrostatic discharge (ESD).

1. The Thermostat Application Module should be aligned with the J6 and J8 connectors of the development platform. Firm downward pressure must be applied to seat the connectors.

Caution: Because there is no keying of the connectors, care should be exercised to ensure correct alignment and orientation.

2. If operation of the lamp and fan is required, a 9VDC source must be provided. For the eZ80 Evaluation Board for the eZ80190 device, that source must be an external power supply connected to J1. For the eZ80 and Z8 Encore! development platforms, that supply can either be the external power supply or the development platform itself. If development platform power is to be used, disconnect the external power supply from J1 and insert a jumper into J9.

Interface Connector Pin Description

The interface connectors J6 and J8 provide both the method to connect the Thermostat Application Module to the development platform as well as a convenient attachment point for test equipment. Connector J6 provides access to the I/O port bits and connector J8 provides access to the eZ80 address and data buses.

Different development platforms assign different I/O pins to the various functions available on the Thermostat Application Modules. This differentiation is necessary due to the different number of I/O pins available on the various processors supported. The I/O pin assignments are listed in Table 2.

Table 2. J6 I/O Pin Assignments by Development Platform*

Thermostat Application Module Pin	Development Platform I/O Pin					Thermostat Application Module Function	Active State
	eZ80190	eZ80L92	eZ80F91	eZ80F92/ eZ80F93	Z8 Encore!		
54	PB0	PB0	PB0	PB0	PC1	Switch S1	Low
52	PB1	PB1	PB1	PB1	PC0	Switch S2	Low
50	PB2	PB2	PB2	PB2	PC2	Switch S3	Low
48	PB3	PB3	PB3	PB3	PC3	Lamp	High
46	PB4	PB4	PB4	PB4	PC6	LED 1	High
44	PB5	PB5	PB5	PB5	PC7	LED 2	High
42	PB6	PB6	PB6	PB6	PC5	LED 3	High
40	PB7	PB7	PB7	PB7	PC4	Fan	High
36	PD0	PD0	PD0	PD0	PA6	I^2C SCL—Source #1	—
34	PD1	PD1	PD1	PD1	PA7	I^2C SDA—Source #1	—
33	PA1	EM_D1	EM_D1	EM_D1	PE1	LCD/Write (Control)	—
31	PA2	EM_D2	EM_D2	EM_D2	PE2	LCD/Read (Control)	—
29	PA3	EM_D3	EM_D3	EM_D3	PE3	LCD RegSelect (Control)	—
28	PD4	PD4	PD4	PD4	PA3	I^2C MUX Select LSB	High
27,25,23,21	PA4:7	EM_D4:7	EM_D4:7	EM_D4:7	PE4:7	LCD DB4:7 (Data Bus)	—
24	PD6	PD6	PD6	PD6	PA1	I^2C SCL—Source #0	—
22	PD7	PD7	PD7	PD7	PA0	I^2C SDA—Source #0	—
10	N/C	ID_0	ID_0	ID_0	ID_0	I^2C Mux Select MSB	High
7	N/C	SDA	SDA	SDA	SDA	I^2C SDA—Source #2	—
5	N/C	SCL	SCL	SCL	SCL	I^2C SCL—Source #2	—

Note: *Pin assignments for the eZ80L92, eZ80F91, and eZ80F92/eZ80F93 devices are identical.

Caution: Due to the high-speed nature of the signals on the J8 connector, care should be exercised in the electrical loading of these pins if test equipment or other circuitry is attached.

Caution: Care should be exercised when developing or modifying software to operate with the Thermostat Application Module to ensure that the correct I/O mapping is selected for the processor chosen.

Programming Considerations

The Thermostat Application Module contains four elements that require sophisticated programming techniques for proper operation. To ensure proper operation of these devices, the manufacturer data sheets for the devices should be consulted if the user intends to write code to work directly with these devices. See Table 3.

Note: If ZiLOG-provided drivers are used, the information in Table 3 is not required.

Table 3. Application Module Device Information

Device	Manufacturer	Part Number	I^2C Device Address
LCD Display	Optrex	DMC16249B	—
I^2C Temp. Sensor	Maxim	MAX6625	90h
I^2C EEPROM	Atmel	AT24C128	A2h
Flash Memory	Micron	MT28F008B	—

Sample Software Project

A typical application for the Thermostat Application Module is to implement a Heating Ventilation & Air Conditioning (HVAC) system simulation. In this example, a means is provided to establish upper and lower temperature limits. The temperature sensor is read on a periodic basis. If the temperature is discovered to be below the lower setpoint, then the lamp is turned ON. As a result, the temperature sensor is instructed to begin heating. When the temperature rises above the upper setpoint, the Lamp is turned OFF and the fan is turned ON. As a result, the temperature sensor is instructed to begin cooling. Various enhancements can be added to this basic process control loop, such as the delivery of the ambient temperature to the LCD display, allowing use of the switches to program different modes of operation or adjust the setpoints, or even the ability to force failure modes where the temperature is allowed to exceed a setpoint.

The Java Thermostat Application Note (AN0104) discusses an Internet-enabled HVAC simulation system using the eZ80190 device, and is supported by source code[1]. This system offers the ability to perform the above functions in addition to

supporting a graphical user interface accessible via any Internet browser. It also supplies automatic email generation in the event of an over-temperature failure condition. Be sure to periodically check the ZiLOG website for other Application Notes featuring the Thermostat Application module.

1. There are two source code files: AN0104-SC01.zip and AN0104-SC02.zip.

Schematic Diagrams

Figures 3 and 4 diagram the layout of the Thermostat Application Module.

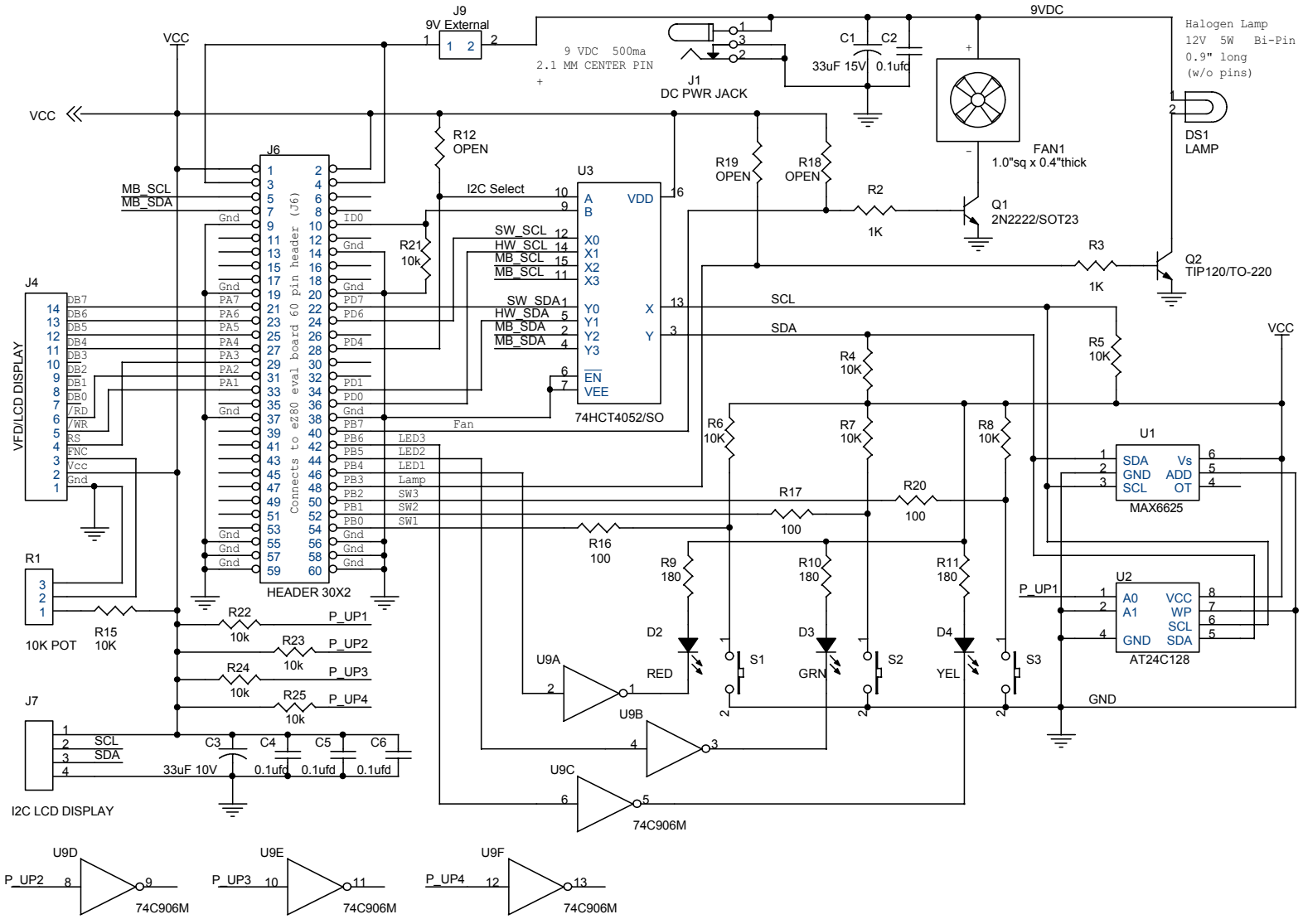

Figure 3. Thermostat Application Module Schematic Diagram, Top View

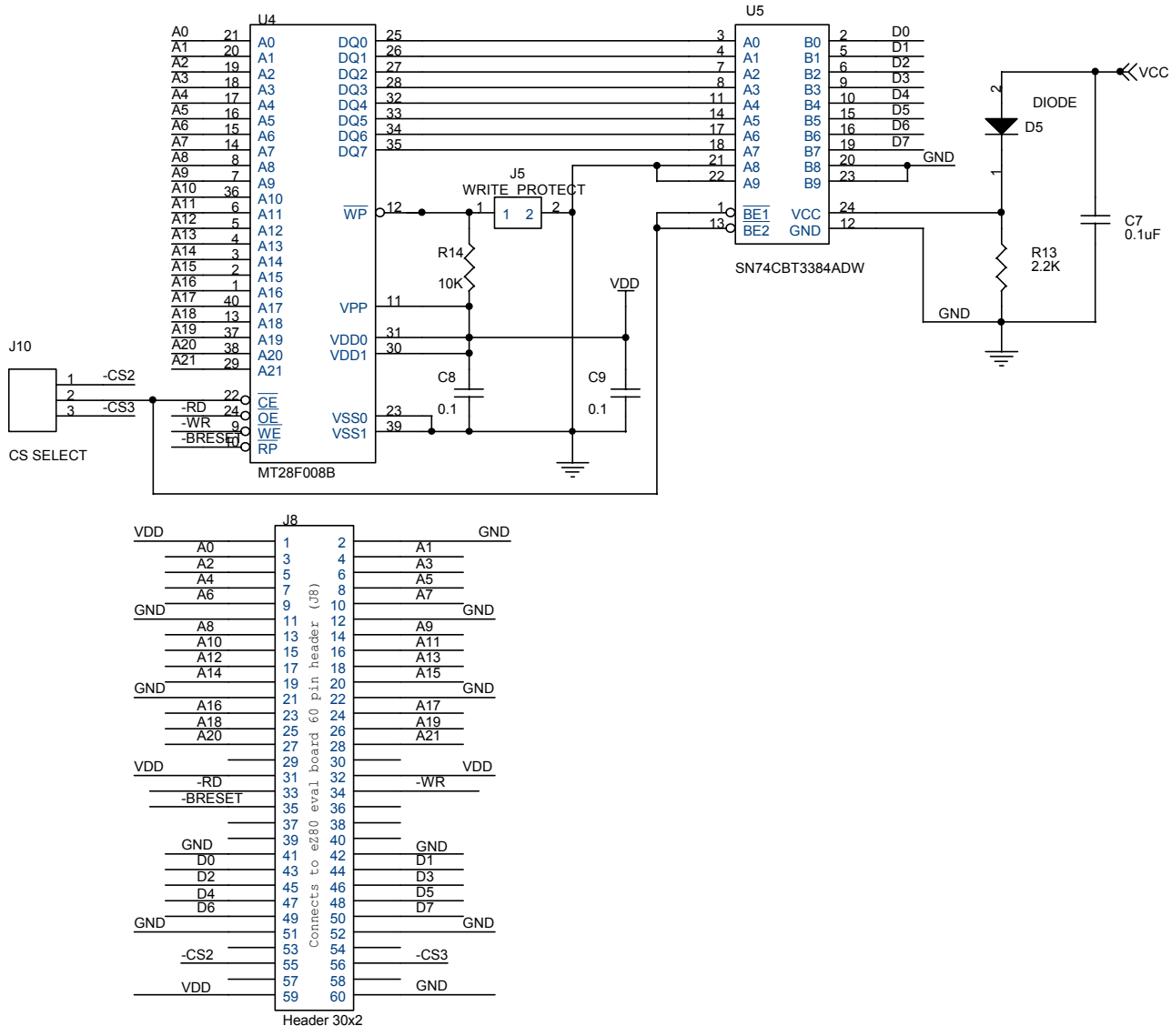

Figure 4. Thermostat Application Module Schematic Diagram, Bottom View

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