

EE 451 FINAL SENIOR PROJECT PROPOSAL

**Microcontroller-Based Remote Locator Using Asynchronous
Serial Communication**

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Description

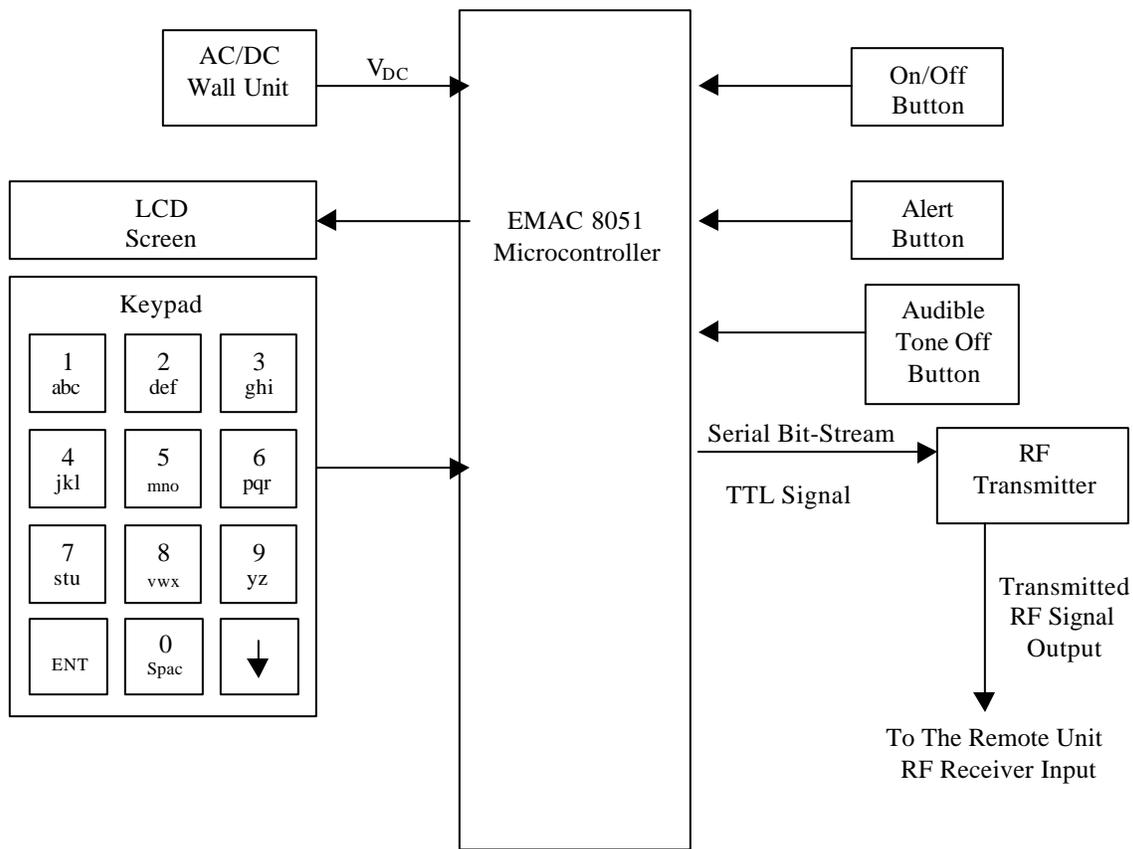
The goal of this project is to develop a remote locator device that is used to find lost items by sending an RF signal to small remote units connected to various items in the home, such as keys, TV remotes, etc. When an item is lost, the user scrolls through an LCD screen located on the base unit. The name of the lost item is found in a list of saved names and is selected for location. The remote unit attached to the desired item receives the RF transmitted digital ID code from the base unit and produces an audible alert tone to allow the user to locate the item. Each additional remote unit also receives the signal, but they do not produce the audible alert. The user is able to turn the alarm off on the portable device or use a button on the base unit.

The base unit is microcontroller based and interfaces with an LCD screen and a keypad. The user menu is displayed on the LCD and allows three different modes of operation: save mode, alert mode, and load mode. These modes are described in the modes of operation section below.

Modes of Operation

- Save Mode:** This mode is used to save the name of each item to be located and to assign each item to its remote device. The names are entered into the list using the keypad. When the names of the items are saved into the menu, the user is then able to scroll through the list of names and locate the desired item in the when in the Alert Mode.
- Alert Mode:** The user uses the keypad to scroll down the list of saved items in order to find the desired item. He/she can then select the item and press the alert button to transmit the RF signal to each remote unit. The remote units then receive the transmitted signal and demodulate it. The demodulated signal is delivered to a comparator circuit, where each remote unit can compare the signal to its own ID number. When the correct remote receives the signal, it sounds the alarm on the remote so that the item can be found.
- Load Mode:** The load mode is used when the user wants to add or replace a remote device in the system. The additional remotes each have a preset code that is entered into the base unit and stored so that the base unit knows what signal to send in order to activate the remote.

Figure 1
Base Unit System Diagram



Base Unit Inputs

Vcc: An AC to DC wall transformer is used to power the base unit.

Keypad: The keypad is used to enter the names of the items, select the items, and store the eight-bit ID numbers of the locators. The keypad is a twelve button alpha numeric keypad that interfaces with a microcontroller and consists of a space button, an enter button, a scrolling button, all the letters of the alphabet, and the numbers 0-9.

On/Off button: This button turns the power to the base unit on and off.

Alert Button: This button is pressed in order to send the signal to the locator devices when it is desired to locate an item.

Audible Tone

Off Button: This button allows the user to turn the audible alert tone off from the base unit.

Base Unit Outputs

LCD: The display outputs the main menu and the modes of operation on the display screen.

Microcontroller: When the alert button is pressed, the base unit utilizes a microcontroller to output a UART compatible packed bit-stream to the transmitter. The bit-stream consists of a series of high bits, a low start bit, the eight-bit ID code, and two high stop bits.

RF Transmitter: The transmitter transmits the packed bit-stream to all of the remote units.

Figure 1 shows the high level block diagram of the base unit.

Remote Unit Inputs

Vcc: A small battery is used to power each remote unit and all of their components.

Off Button This button turns the audible alert tone off when it is pressed.

Remote Signal: Each remote unit receives the RF signal transmitted from the base unit, through the RF receiver, every time the alert button is pressed.

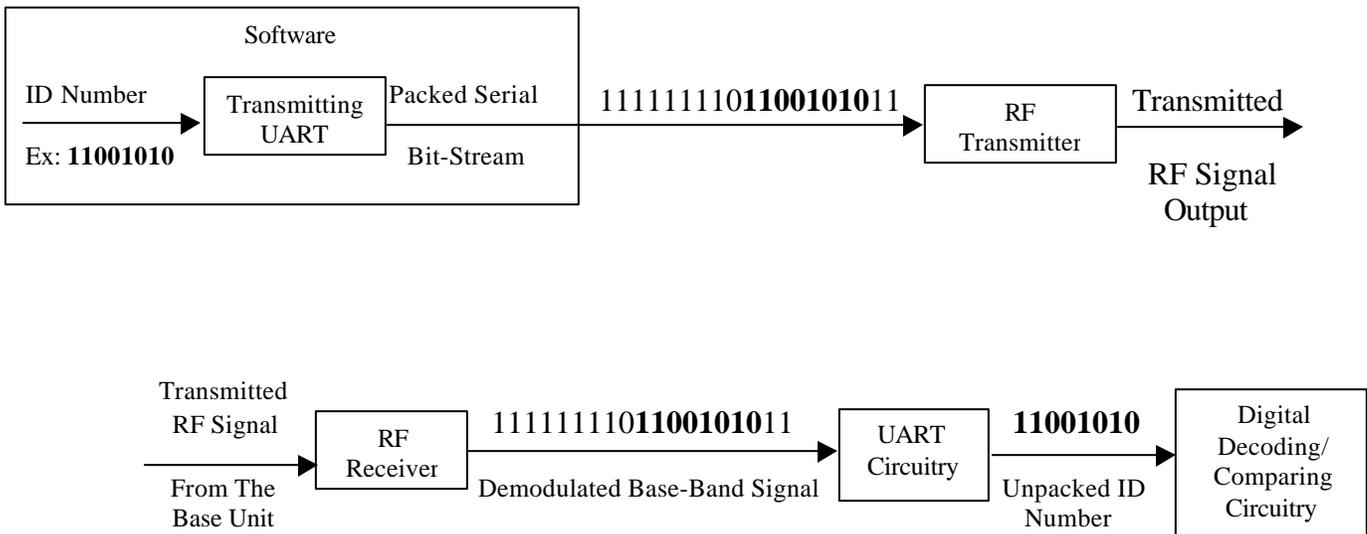
UART Circuitry: The UART is used to separate the ID number from the packed serial bit-stream transmitted from the base unit. The UART determines the beginning and the end of the transmitted signal and then removes the start and stop bits that were added to the ID number prior to transmission. The UART then outputs the intended ID number to the digital decoding and compare circuitry.

The UART receives the demodulated base-band signal from the receiver after transmission occurs. It must then unpack the serial bit-stream received from the receiver in order for the decoding/compare circuitry to determine the correct remote unit to alert.

To do this, the UART determines the start and stop bits of the remote signal. An initial stream of high bits indicates that the remote signal is being received. The UART then waits for the first low bit to be received. This initial low bit is also known as the start bit of the signal. This bit is how the UART recognizes the

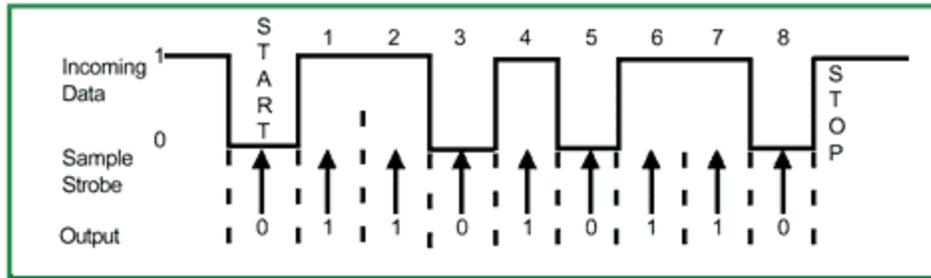
start of the input signal. After the UART receives the start bit, it knows that the next eight bits will be data bits that represent the ID number and the last two bits will be stop bits. The stop bits are always high and signal the end of the transmitted signal. The UART removes the excess bits from the desired ID number and outputs them to the digital decoding and compare circuitry. Figure 2 is a representation of how the UART will unpack the ID number.

Figure 2
UART Signal Packing and Unpacking



When the initial high bits received by the UART first drop low, a sample is taken halfway through the pulse in order to determine if the low drop is due to noise or the start bit. After determining the start bit, the UART samples at a standard 16 times the speed of the receiver clock and begins sampling halfway through each of the eight data bits. Sampling halfway through the pulses at 16 times the receiver clock keeps the UART from accidentally missing a pulse while unpacking the ID number. After the UART samples eight times, it locates and removes the two stop bits. The unpacked ID number is then sent to the digital decoding and compare circuitry. Figure 3 demonstrates the ideal asynchronous data sampling used to unpack the ID number.

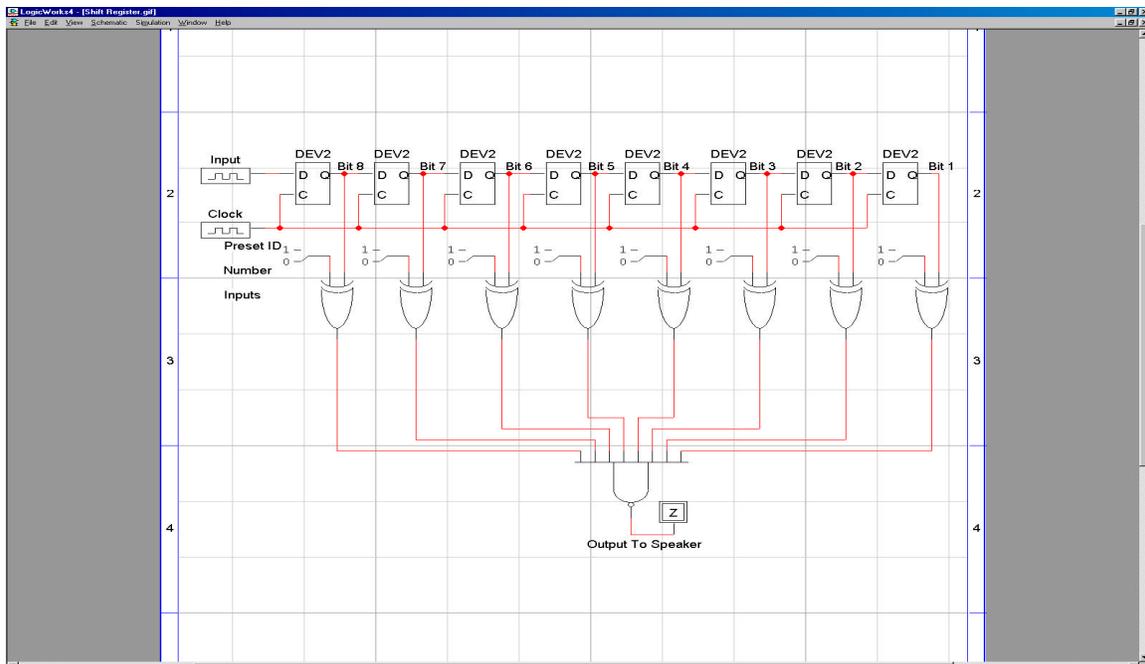
Figure 3
Unpacked Remote Asynchronous Signal



Digital Decoding/

Comparing Circuitry: The purpose of this circuitry is to determine the ID code that has been transmitted and to compare this code to the preset code of the remote unit. Each bit of the ID number is stored in a different flip-flop of an eight-bit shift register in order to decode and determine the ID number. The output of each flip-flop will be compared to the preset number for each remote unit. If each flip-flop output matches the preset number, the circuitry produces a high output to the tone generating circuitry. If the ID codes do not match, the decoding logic produces a low output to the tone generating circuitry. Figure 4 shows the schematic for an eight-bit Shift register with compare circuitry.

Figure 4
8-Bit Shift Register With Compare Circuitry



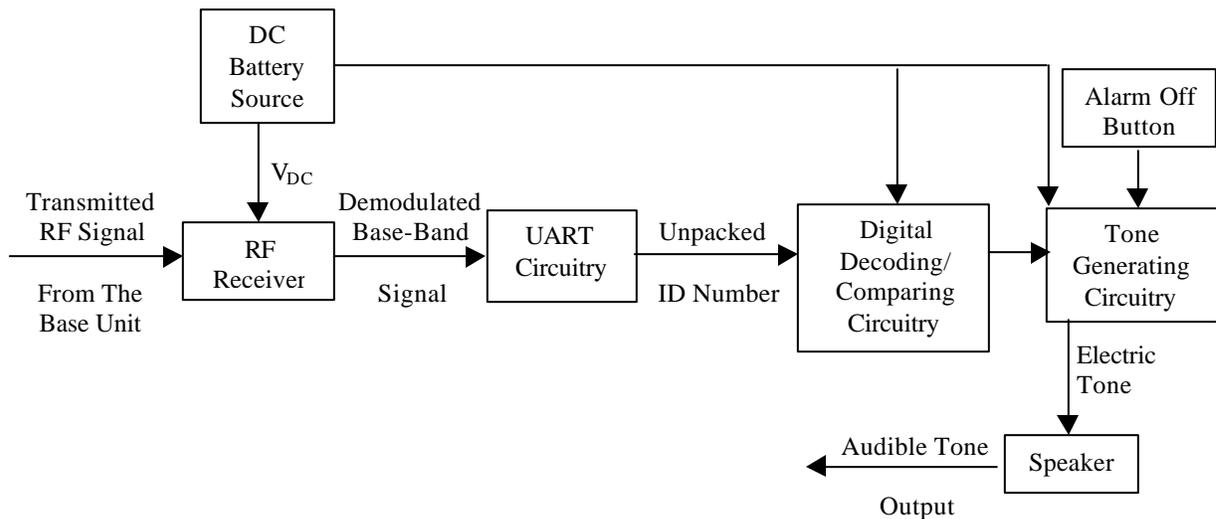
Remote Unit Output

Tone Generating Circuitry:

The speaker on the locator device produces an audible alert tone when it receives a high input from the comparator circuitry.

Figure 3 shows the high level block diagram of the remote units.

Figure 5
Remote Unit Hardware Diagram



Operation By Mode

Main Menu: The main menu allows the user to choose which mode of operation to use. This menu is displayed on the LCD and the user uses the keypad to select the desired mode. Figure 4 show the software flow chart for the main menu.

Save Mode: The LCD prompts the user to choose which remote unit to save a name to. The user then uses the keypad to choose which remote to name, and can then use the keypad to enter the desired name. The microcontroller then saves the entered name in a module and the LCD goes back to displaying the main menu. The remote unit is not used during this mode of operation. Figure 5 shows the software flow chart for the Save Mode.

Load Mode: The LCD prompts the user to choose which remote unit is being added or replaced. The keypad is then used to choose the proper remote unit for loading. Next, the LCD prompts the user to enter the new ID number for the remote unit, using the keypad. When this is complete, the

microcontroller saves the ID number in a module and the LCD goes back to displaying the main menu. The remote unit is not used during this mode of operation. Figure 6 shows the software flow chart for the Load Mode.

Alert Mode: The LCD prompts the user to choose which remote unit is to be found. The keypad is used to scroll through the list and choose the name of the desired item to be located. The microprocessor repeatedly sends the saved ID number to the RF transmitter for a preset number of times. The transmitter transmits the RF remote signal to the remote unit receiver. The receiver then demodulates the received signal and outputs the signal to the decoding circuitry. The decoding circuitry determines the ID number and compares it to the preset number of each remote unit. The remote unit that has the matching ID number produces the audible alert tone until the user turns it off on the base unit or the remote unit itself, using the alarm off button. Figure 7 shows the software flow chart for the Alert Mode.

Figure 6
Software Flow Chart For The Main Menu

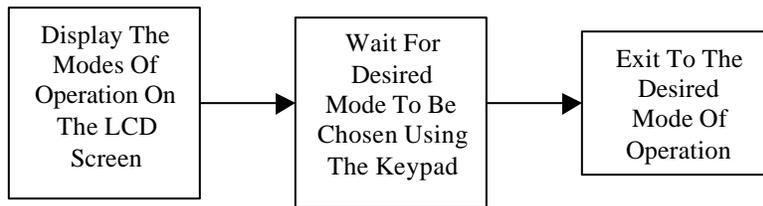


Figure 7
Software Flow Chart For The Save Mode

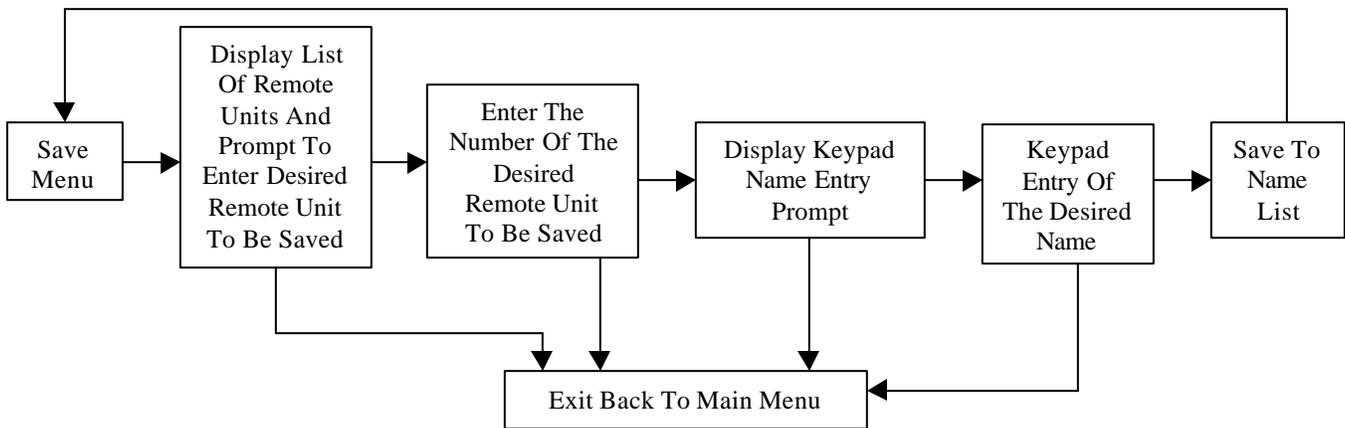


Figure 8
Software Flowchart For The Load Mode

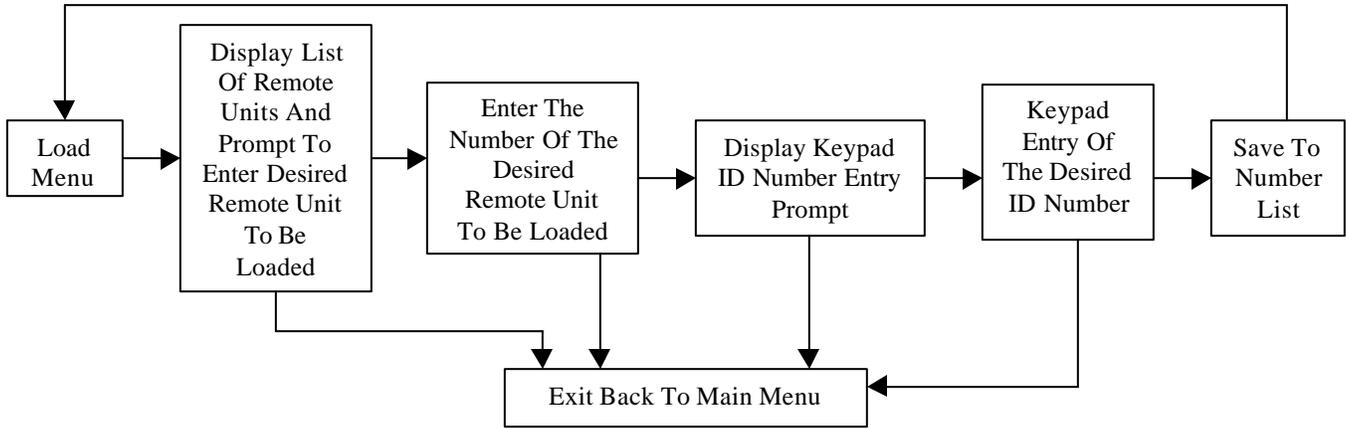
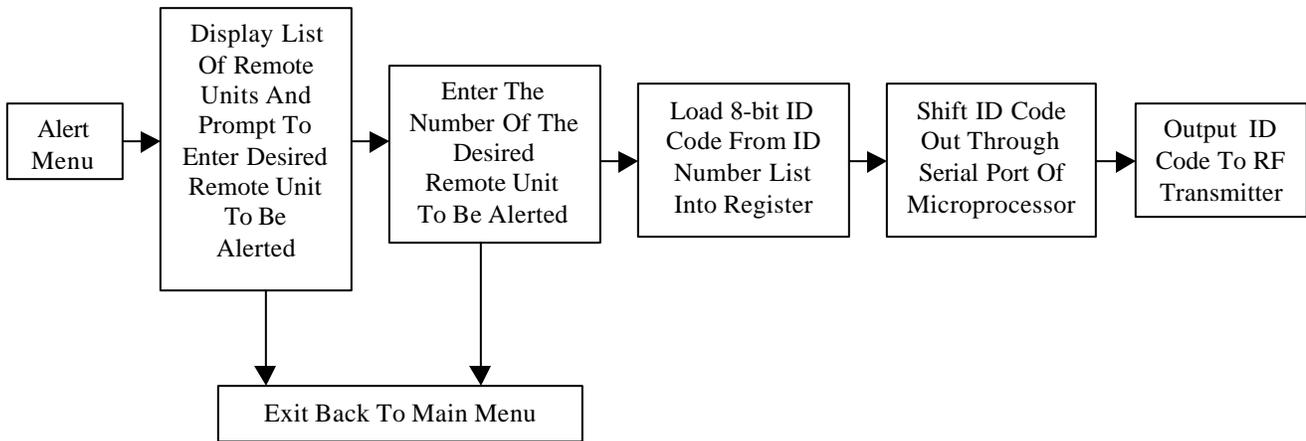


Figure 9
Software Flowchart For Alert Mode



Standards

Code of Federal Regulations Par 15-Title 47: Radio Frequency Demodulation.

UART standards for packing and unpacking serial bit streams.

Data Sheet

Dimensions	L X W X H			
Base Unit:	6" X 4" X 3"			
Remote Unit	.5" X .5" X .125"			
Number of remote units:	8			
Power Supply	Min	Typ	Max	Unit
Operating Voltage				
Base Unit:	7		15	Vdc
Remote Unit:	2.7	3.3	13	Vdc
Current Consumption				
Base Unit:		45	85	mA
Remote Unit:	10	13	29	mA
Power:				
Base Unit:	.315		1.3	W
Remote Unit:	27	43	377	mW
Operational Temp:	0		70	°C

The values on this data sheet were estimated due to the fact that nothing has actually been built and tested in the lab yet. The dimensions for the base unit were based off of the dimensions of a Micro Pac 8051 microcontroller board and an LCD screen. The remote unit dimensions were based off another remote unit device that was found during a patent search. The power supply ratings were based off of the microcontroller board for the base unit and the receiver for the remote unit.

Schedule of Tasks

January

Week 4: Finish all assignments for EE 419 and 451.

February

Week 1: Begin hardware design for remote the remote units and work on the web page .

Week 2: Begin simulation of hardware, review microcontroller code, and work on the web page.

Week 3: Debug and test simulations and review microcontroller code.

Week 4: Finish all simulation and begin building in lab, review microcontroller code, and work on web page.

March

Week 1: Build the hardware for the remote units and test.

Week 2: Continue testing of hardware and reviewing microcontroller language.

Week 3: Finish testing the remote units and finish review of microcontroller language.

Week 4: Begin writing the microcontroller software and work on the web page.

April

Week 1: Write main menu and LCD software.

Week 2: Debug any problems with written software, and write, the modes different modes of operation software.

Week 3: Debug all software and begin the implementation of the combination of the hardware with the software.

Week 4: Test the software and hardware combination.

May

Week 1: Write the final project report and the oral presentation and finish the web page.

Other Works

Patent Number WO0217265:

A remote control locator system (10) that can be retro-fitted to any existing remote control device in a straightforward manner. The remote control locator system (10) comprises a sending unit (20) and a receiving unit (30, 130). The sending unit (20) includes a transmitter residing (28) in a sending unit housing (26) and an activation mechanism (25) coupled to the transmitter (28) to send a locator signal when the activation mechanism (25) is activated by a user. The receiving unit (30, 130) includes a receiver (46) residing in a receiving unit housing (38) to receive the locator signal and to emit an audible sound when the receiver (46) receives the locator signal.

Sharper Image Item Finder: \$50

Key Ringer Item Finder: \$30

Bibliography

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