Remote Emergency Notification System (RENS)

Group 5

Nazmul Alam

Saul Harari

Todd King

Overview

- Introduction
- Objective
- Sensor
- Transmitter/Receiver
- Code
- Components/Cost & Load Analysis
- Improvements & Upgrades
- Acknowledgements

Objective

- To design and build a system that demonstrates the ability to remotely detect trace gas levels and transmit this detection to a receiver unit utilizing a Basic Stamp, and digital and analog sensors, and actuators.
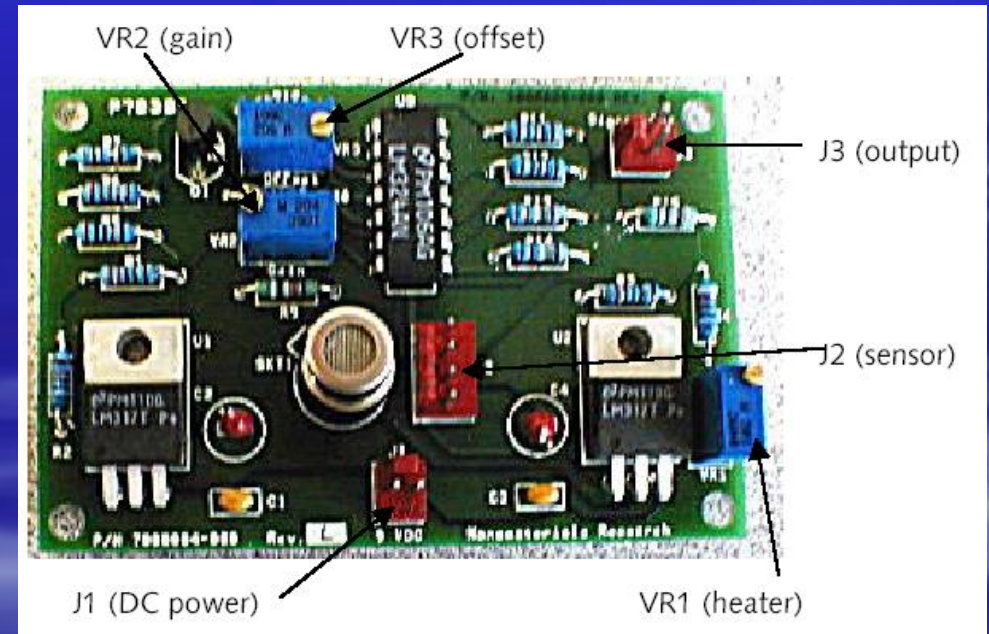
Sensor

- Types of Gas Sensors
  - IR absorption.
  - Metal Oxides. Tin oxide/ Titanium oxide.
 - Catalytic Combustible. Heated catalytic bead.
  - Etc

Trace Hydrogen Sensor

- Manufactured by Nanomaterials LLC
- High sensitivity to low concentrations of hydrogen(10-1000ppm)
- Fast response (~15 sec)
- Operating range
  - -20-50 degrees Celsius
  - 0-90% RH (non-condensing)
  - Low dependency on flow rate

Trace Hydrogen Sensor cont.

- Operates on a 9-24 VDC power supply

- Heater element operates at ~240 degrees Celsius

- Sensor output 0-5VDC continuous

- Sensor zero and gain are user adjustable
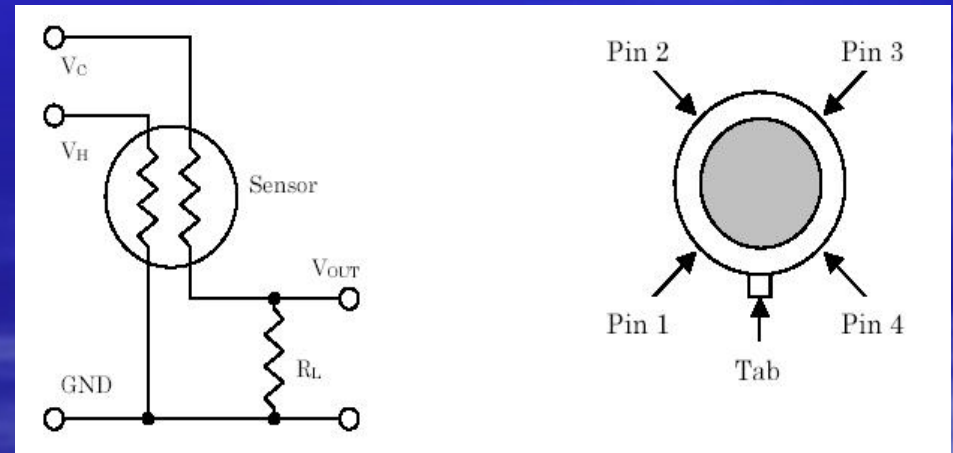
Future Semiconductor Sensor Technology

- <u>Current sensor limitations</u>
  - Require large operating voltages
  - High resistance in the electrodes
  - Require elevated sensor temperatures
- <u>Current Research/Developments</u>
  - Sensor can operate at room temperature
  - Operating voltage range 1-10mV
  - Improved sensitivity 10-100 ppm
  - Reversible chemical processes
- <u>The Final Step</u>
  - Increased selectivity
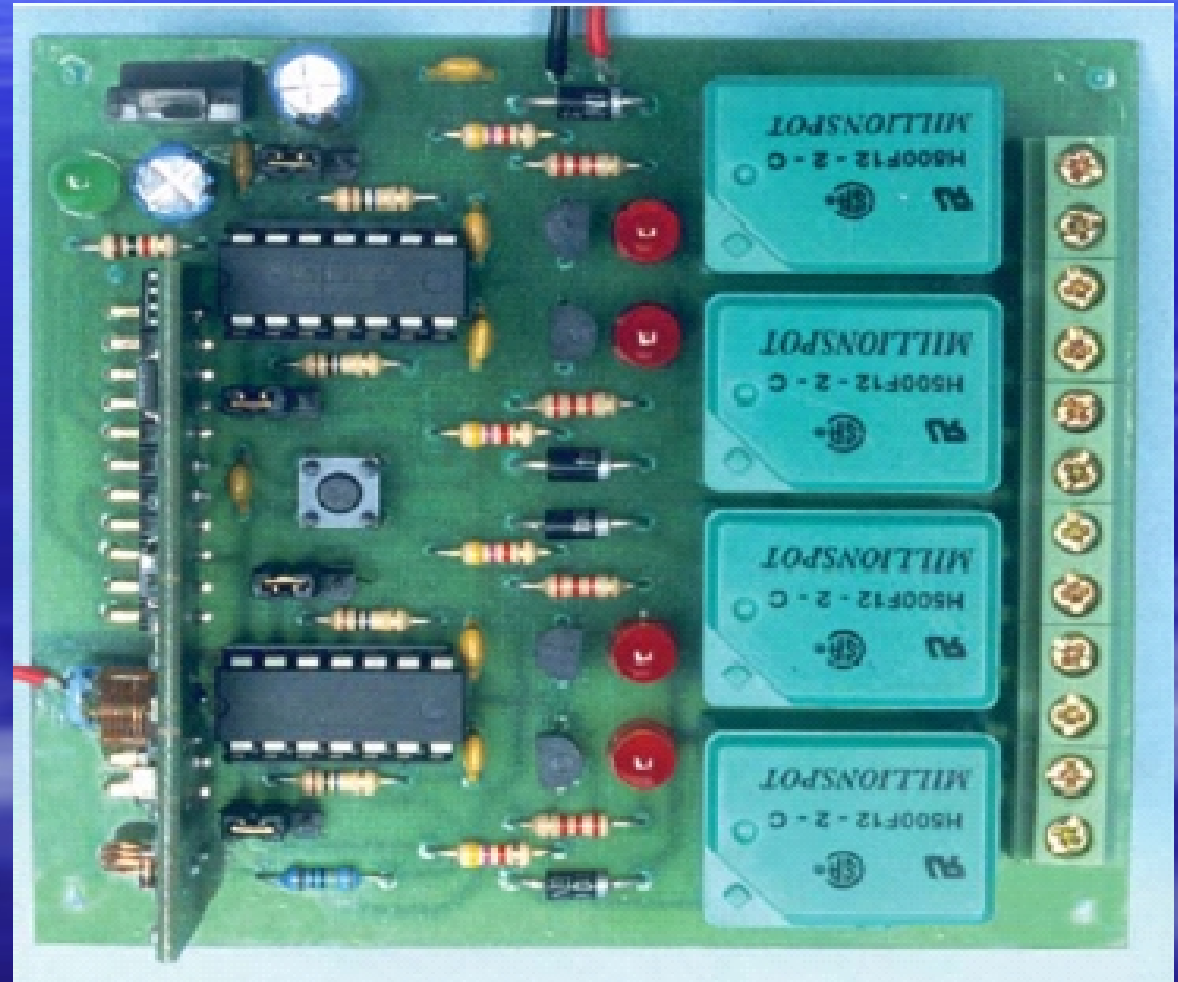 - Lower concentration levels

Transmitter/Receiver-Main Components

Transmitter Circuit Board
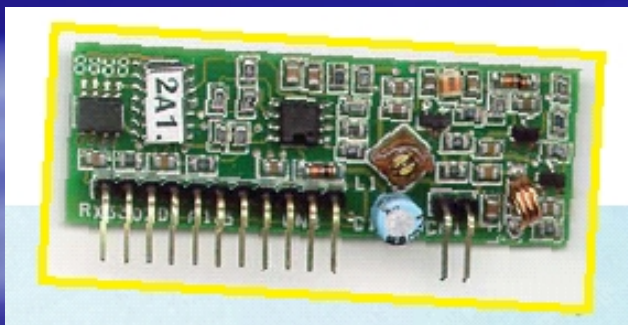
Receiver Circuit Board

Receiver Module Circuit Board

Transmitter/Receiver Specifications

- UHF (433.9Mhz), license-free (LIPD band) operation
- Range ~ 100 m
- Aligned transmitter and receiver modules
- Rolling-code ("code hopping") operation (7.3 x 10^9 codes)
- Receiver "learns" transmitter code
- Receiver can handle up to 15 transmitters
- 4 channels available, each either momentary (push on, release off) or latching (push on, push off) via jumpers
- Each channel relay contacts rated at 28VDC/12A (single pole changeover)
- 12VDC operation, we are using 5VDC on transmitter and 9VDC on receiver.
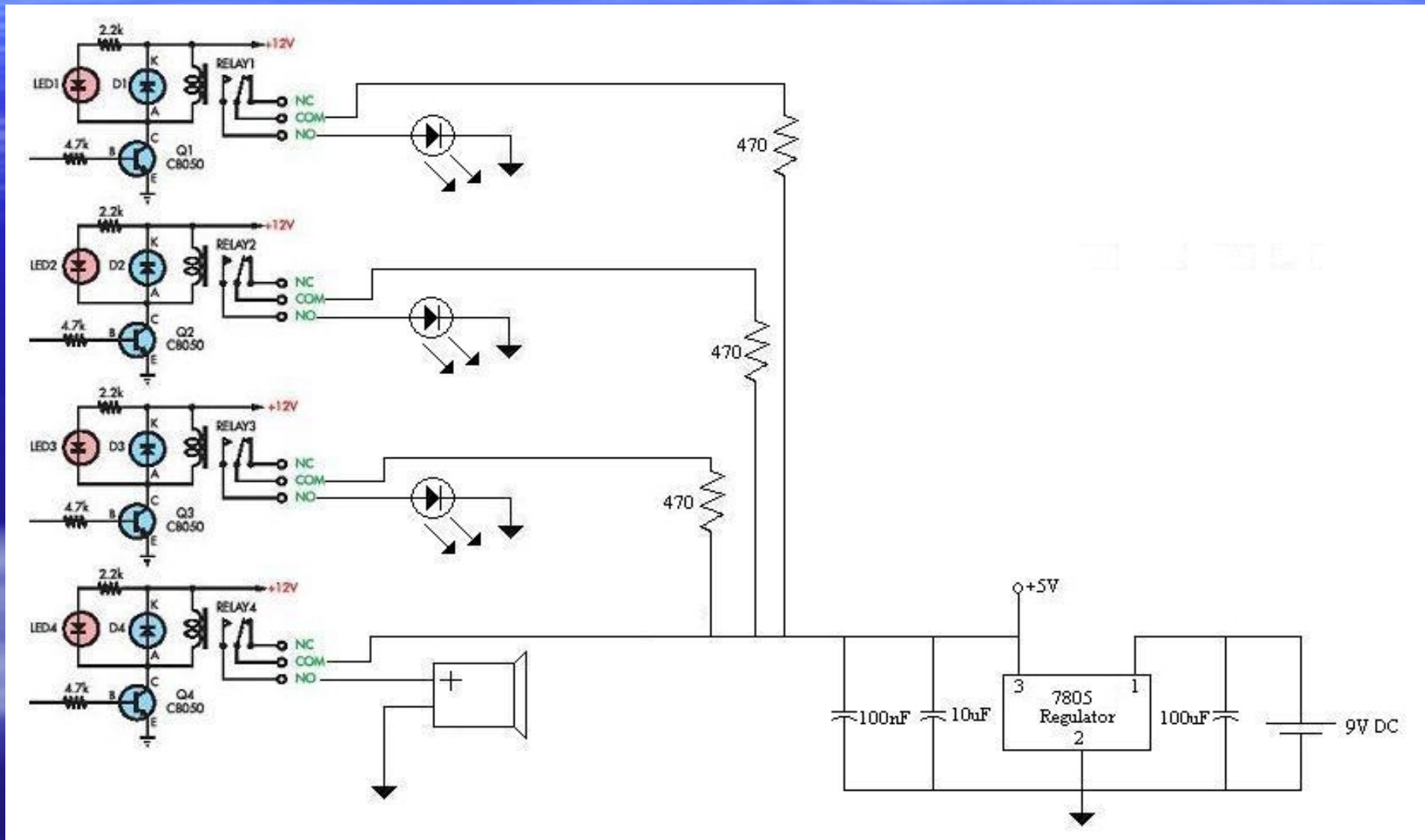
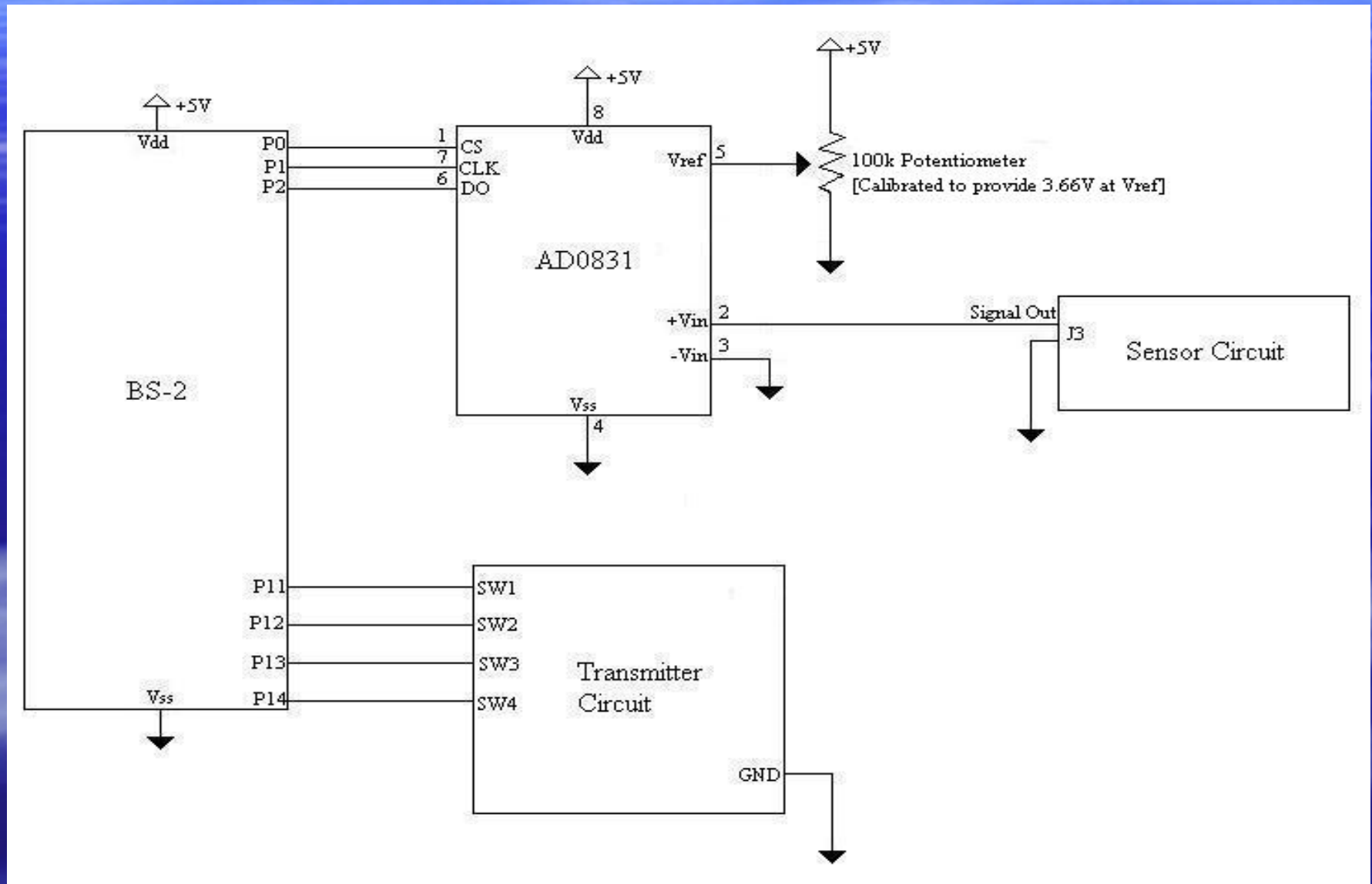# Receiver Module

Receiver Circuit Diagram

4-CHANNEL UHF "ROLLING CODE" REMOTE CONTROL RECEIVER
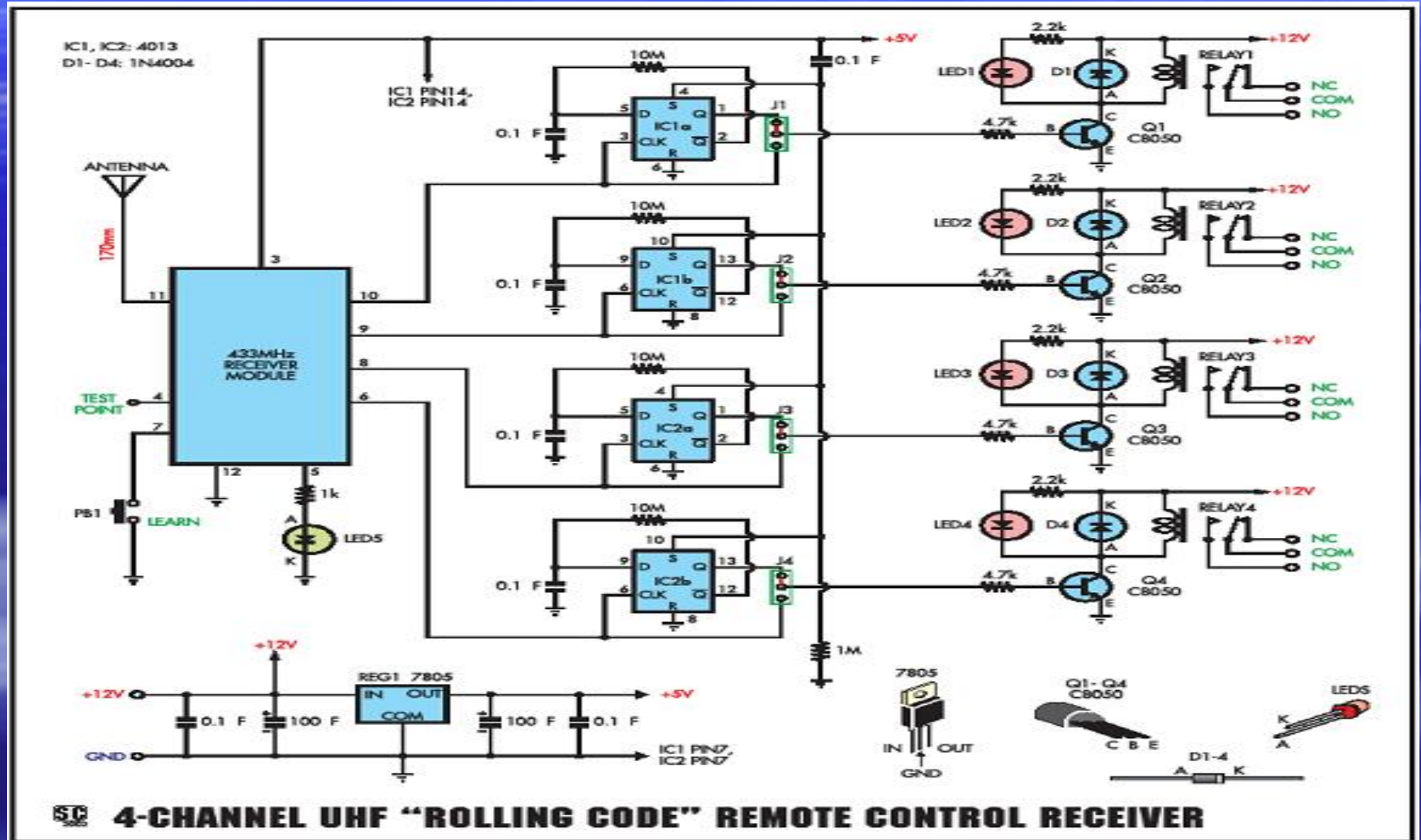
Receiver Output Schematic

Microcontroller Interface

PBasic Code: Level Transmission

```
LEVEL1:
debug "Level 1",cr
high 11                                          'turn on LED1
high 14                                          'turn on ALARM
pause 2000                                       'wait 2 second
low 11                                           'turn off LED1
low 14                                           'turn off ALARM
goto main

LEVEL2:                                          'similar process as above
debug "Level 2",cr
high 12
high 14
pause 2000
low 12
low 14
goto main

LEVEL3:                                          'similar process as above
debug "Level 3",cr
high 13
high 14
pause 2000
low 13
low 14
```

PBasic Code: DAQ and Level Check

```
MAIN:

high 0                          'this gets the output from the ADC and stores it in SensorOut
low 0
low 1
pulsout 1,210
shiftin 2,1,msbpost,[SensorOut\8]
pause 1000

if(SensorOut=0 or SensorOut=1) then main

debug ? SensorOut,cr

if (SensorOut > (temp+20)) then StoreVal          'if input is different by 8 levels
if (SensorOut < (temp-20)) then StoreVal          'then store value

CheckLevel:
if (SensorOut>200) then level3                    'check to see what the current level is
if (SensorOut>135) then level2                    'and go to that level
if (SensorOut>70) then level1

GOTO MAIN
```

PBasic Code: ROM Storage

```
gaslevel data (256)        'array of 256 in the EEPROM

for i=0 to 255             'loop to clear all 256 data values
write gaslevel + i,0
next
```

```
StoreVal:
temp=SensorOut                              'store the current input into temp
write gaslevel+i,SensorOut                  'store input into EEPROM
i=i+1                                       'increment index
goto CheckLevel
```

PBasic Code: Data Retrieval

```
x var word                'used to store the data from EEPROM
i var byte                'used to index into array in EEPROM
gaslevel data (256)       'array of 256 in EEPROM

for i=0 to 255            'loop to get all 256 data values
read gaslevel + i,x
debug ? x,cr              'output the data to debug window
next
end
```

Components and Cost Analysis

Component	Quantity	Cost
BOE	1	$100.00
Trace Hydrogen Eval. Kit	1	$ 75.00
Tx/Rx kit	1	$ 44.95
Mounting hardware	numerous	$ 7.95
Project box 7x5x3	1	$ 5.99
Project box 6x4x2	1	$ 4.99
2.1 mm power jack	2	$ 4.98
3.6Khz Piezo Speaker	1	$ 3.99
DPDT 6A Toggle switch	1	$ 3.99
2.1 mm coax plug	1	$ 2.49
Heat shrink tubing packet	1	$ 2.29
Pack 10 small wire clips	1	$ 1.99
PC board	1	$ 1.69
7805 Voltage Regulator	1	$ 1.49
9 Pin female DSUB connector	1	$ 1.49
9 Pin male DSUB plug	2	$ 1.49
Pk5 LED snap-holders	1	$ 1.19
10 mFd 35VDC capacitor	1	$ 0.99
.1 mFd disc capacitor	2	$ 0.99
100 mFd 35 VDC capacitor	1	$ 0.99
Total		$268.93

Load Analysis

Module	Voltage	$Current_{Tx-on}$/$Current_{Tx-off}$	$Power_{Tx-on}$/$Power_{Tx-off}$
Transmitter	5VDC	1.10mA/0mA	5.5mW/0mW
Receiver	9VDC	61.7mA/7.1mA	555.3mW/63.9mW
LED/Piezo	9VDC	12.5mA/0mA	112.5mW/0mW
Sensor	12VDC	136mA	1.632W
BS2	9VDC	28.6mA/28.6mA	257.4mW/257.4mW

Improvements and Modifications

- Sensor system can be modified with an array of sensors to detect multiple agents.
- Communication modules can be changed to suit geographical conditions.
  - E.g. AM/FM, Ethernet, Modem, Hardwired comm systems.
- Future designs would incorporate integrated technologies to enable smaller module packages.
  - E.g. Replacement of BOE and Basic Stamp, Tx/Rx IC modules, larger ROM storage for data logging.
- Alternative forms of power supplies can be utilized to power the various modules.
  - E.g. Solar cells, hardwired power supplies.

Acknowledgements

- **Professor Vikram Kapila**
  - Department of Mechanical Engineering, Polytechnic University
- **Clayton J. Kostelecky**
  - Nanomaterials Research LLC
- **Professor Kalle Levon**
  - Department Head and Director, Polymer Research Institute, Polytechnic University
- **Nathan Lee**
  - Graduate Assistant, Department of Mechanical Engineering, Polytechnic University