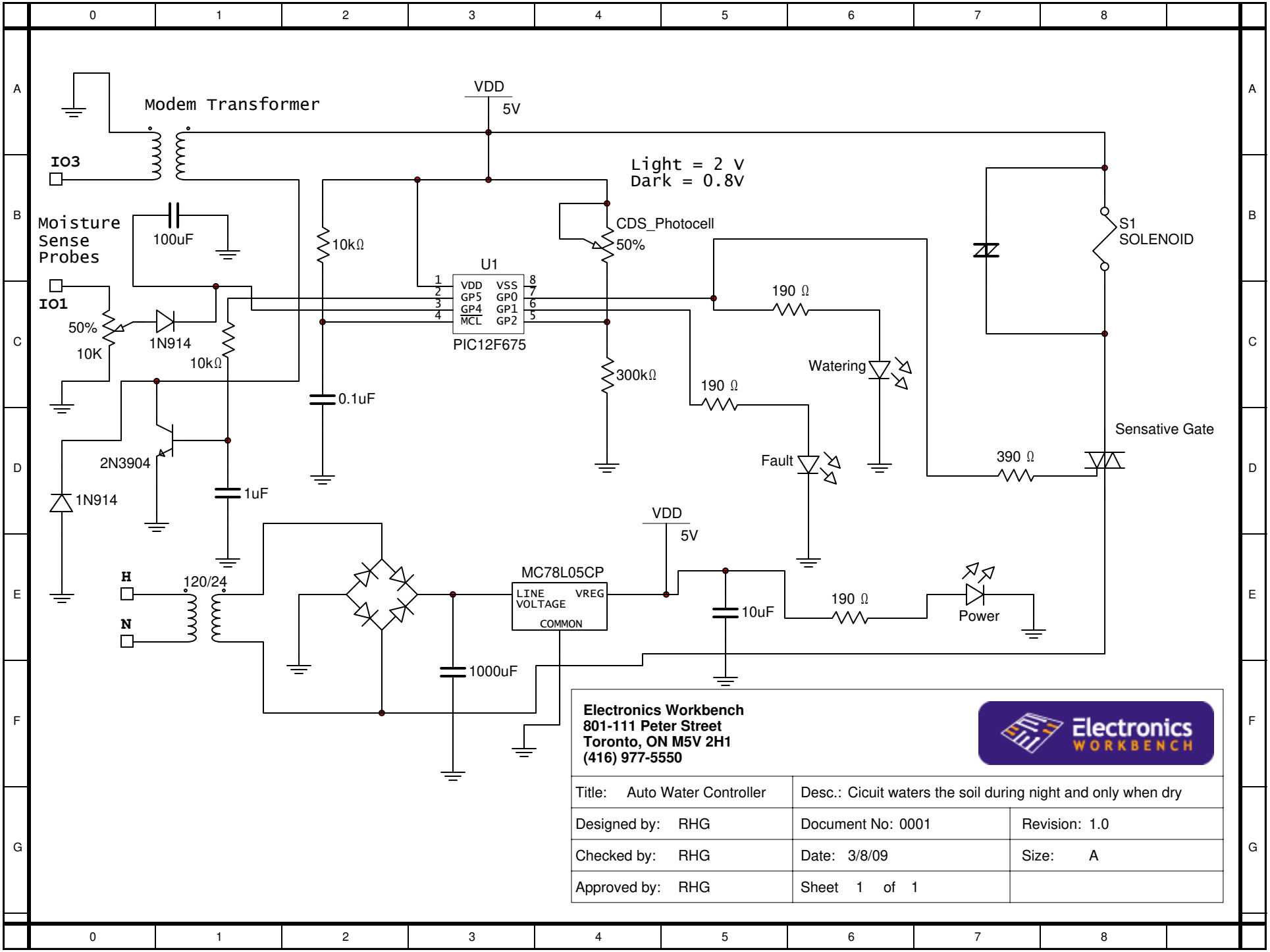
```
'****************************************************************
'*  Name    : Automatic Water Controler Circuit (using fuzzy logic)*
'*  Author  : Roy H. Guerra Jr.                                    *
'*  Notice  : Copyright (c) 2009 .                                 *
'*          : All Rights Reserved                                  *
'*  Date    : 3/10/2009                                            *
'*  Version : 1.0                                                  *
'*  Notes   : Use PIC12F675                                        *
'*          :                                                      *
'****************************************************************
'
'
' Hardware Interfaces:
' ====================
' 1. CDS Photocell input on GP2 (input)
'
' 2. Water Valve Solenoid fed from FET Transistor on GP0 (output)
'
' 3. Moisture sense probes on GP4 and GP5 (GP4 input and GP5 output)

' 4. MCLR Pin (GP3) is tied to 0.1uF capacitor to reset when power
'    is first turned on.
'
' 5. A WatchDog Timer Fault illuminates the "Fault LED"
'
'
' Device Programming Modes (Fuses)
' ================================
' Internal Oscillator (RC)
' Enable Watch Dog Timer
' Disable Power-up timer
' Disable Brown-out detect
' Reset on GP3 Enabled
' GP4 & GP5 as I/O
' EE Program Disabled
'
'
' Software Declarations
' =====================
'
```

```
' Define A/D Parameters
' ----------------------
DEFINE  ADC_BITS    10   ' Set number of bits in result
DEFINE  ADC_CLOCK   3    ' Set clock source (3=rc)
DEFINE  ADC_SAMPLEUS 50  ' Set sampling time in uS

'
' Special Register & Interrupt Declarations
' -----------------------------------------
OPTION_REG = %10000000   ' Disable PORTB pull-ups
INTCON = %00000000   ' Disable Interrupts
WPU = %00000000      ' Disable Resistor Pullup's
VRCON.7 = 0          ' Disable Voltage Reference
TRISIO = %00011100   ' GP0, GP1, GP5 are outputs, GP2, GP3 & GP4 are inputs
ADCON0.7 = 1         ' Right justify 10 bit A/D conversion
ANSEL = %01111100    ' GP2&GP4 set to Anolog Inputs, use Internal RC Oscillator
CMCON = 7        ' Analog comparators off
'
'
' Declare Program Variables
' -------------------------
Adval1 VAR WORD      ' Temp RAM storage for GP2 A/D conversion value
Adval2 VAR WORD      ' Temp RAM storage for GP4 A/D conversion value
I VAR BYTE       ' Temp Storage variable for loop counting
J VAR BYTE       ' Temp Storage variable for loop counting
'
'
' Declare Program Modifiers
' -------------------------
Water VAR GPIO.0     ' Name for GP0 Port
Fault VAR GPIO.1     ' Name for GP1 Port
'
'
' Declare Initial Power On States
' -------------------------------
Water = 0        ' Set Initial Power Up States to Off
Fault = 0
I = 0
J = 0
'
```

```
'
' Main Program Start
' ==================
'
Loop:
    Water = 0    ' Ensures water not on
    Fault = 0    ' Ensures fault LED not on
    GOSUB AtoD   ' Go to A/D subroutine
    GOSUB Transmit   ' Go to Transmit subroutine
    GOSUB Recieve    ' Go to Recieve subroutine
    GOSUB Error ' Go to Error subroutine

GOTO Loop               ' Back to Program Beginning

END
'
'
' A/D Subroutine
'---------------
' Notes - Scale equation is as follows:
' A/D resolution is 2^10 = 1024
' 5 Volts = 1024 (using A/D reference of VSS), Digital = Vin * (1024/ 5)
' Scale using a multiplier value of 500 for best accuracy & adlusting Digital
' scaling (0-500)
' Scale equation = Vin * [((1024/5) * 500) / 1024] = Vin * 100
' Adval1 is Dark = 1.8 volts "Vin" so; 1.8 * 100 = 180.  Ensuring a 20% margin,
' gives 216
' Adval2 is low soil conductivity = 0.5 volt "Vin" so 0.5 * 100 = 50 no margin
' required, adjust Pot.
AtoD:   ADCIN 2, Adval1      ' Read channel 2 to adval1
    PAUSE 100        ' Delay 100mS for conversion time
    Adval1 = (Adval1 */ 500)>>2 ' equates to: (Adval1 * 500)/1024
    PAUSE 10         ' Small delay

    ADCIN 3, Adval2      ' Read channel 3 to adval2
    PAUSE 100        ' Delay 100mS for conversion time
    Adval2 = (Adval2 */ 500)>>2 ' equates to: (Adval2 * 500)/1024
    PAUSE 10         ' Small delay
    RETURN           ' Return to main program
'
```

```
'
'Transmit Subroutine
'-------------------
' Pulse of 10mS on and 1 mS off with a repitition rate of "10"
Transmit:
    FOR I = 0 TO 9  'perform pulse transmission 10 times
    PULSOUT GPIO.5, 1000     ' (100 * 10uS = 10 mS)
    PAUSE 1      ' Off time
    NEXT I       ' Next pulse
    I = 0        ' Clear counter
    RETURN       ' Return to main program
'
'
'Recieve Subroutine
'-------------------
' Uses fuzzy logic to determine when to turn on water soleniod and duration
' Fuzzy Logic Rules:
' 1) If getting dark and soil very dry then water very long
' 2) If getting dark and soil dry then water medium
' 3) If getting dark and soil semi dry then water low
' 4) If light or soil wet then do not water
Recieve:
    IF (Adval1 < 216) AND (Adval2 < 50) THEN     ' Rule #1
        FOR J = 0 TO 59      ' (60 * 1 minute = 1 Hour)
        Water = 1                ' Turn on water soleniod
        PAUSE 60000 ' 1 minute time delay
        NEXT J
    ENDIF
    J = 0        ' Clear counter

    IF (Adval1 < 216) AND (Adval2 > 50 AND Adval2 < 150) THEN    ' Rule #2
        FOR J = 0 TO 29      ' (30 * 1 minute = 0.5 Hour)
        Water = 1                ' Turn on water soleniod
        PAUSE 60000 ' 1 minute time delay
        NEXT J
    ENDIF
    J = 0        ' Clear counter

    IF (Adval1 < 216) AND (Adval2 > 150 AND Adval2 < 250 ) THEN ' Rule #3
        FOR J = 0 TO 14      ' (15 * 1 minute = 0.25 Hour)
```

```
        Water = 1               ' Turn on water soleniod
        PAUSE 60000 ' 1 minute time delay
        NEXT J
    ENDIF
    J = 0       ' Clear counter

' Note- Rule#4 is alreday built in since none of the above conditions are true

    RETURN      ' Return to Main Program
'
'
' Fault Subroutine
' ----------------
' Looks for a WDT Lockup of Microcontroller
Error:
    IF STATUS.4 = 0 THEN    ' Checks for a WDT Lockup in the status register
    Fault = 1       ' Turn on Fault LED
    Water = 1       ' Turn off water, if on
    STOP            ' Stops Program Execution
    ENDIF
    RETURN          ' Return to main program
```

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|---|---|---|
| Title: Auto Water Controller | Desc.: Cicuit waters the soil during night and only when dry | |
| Designed by: RHG | Document No: 0001 | Revision: 1.0 |
| Checked by: RHG | Date: 3/8/09 | Size: A |
| Approved by: RHG | Sheet 1 of 1 | |