TV Remote Control Extender

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INTRODUCTION

This device allows for the control of small appliances, even garage doors from the convenience of your easy chair, using an existing TV remote control.

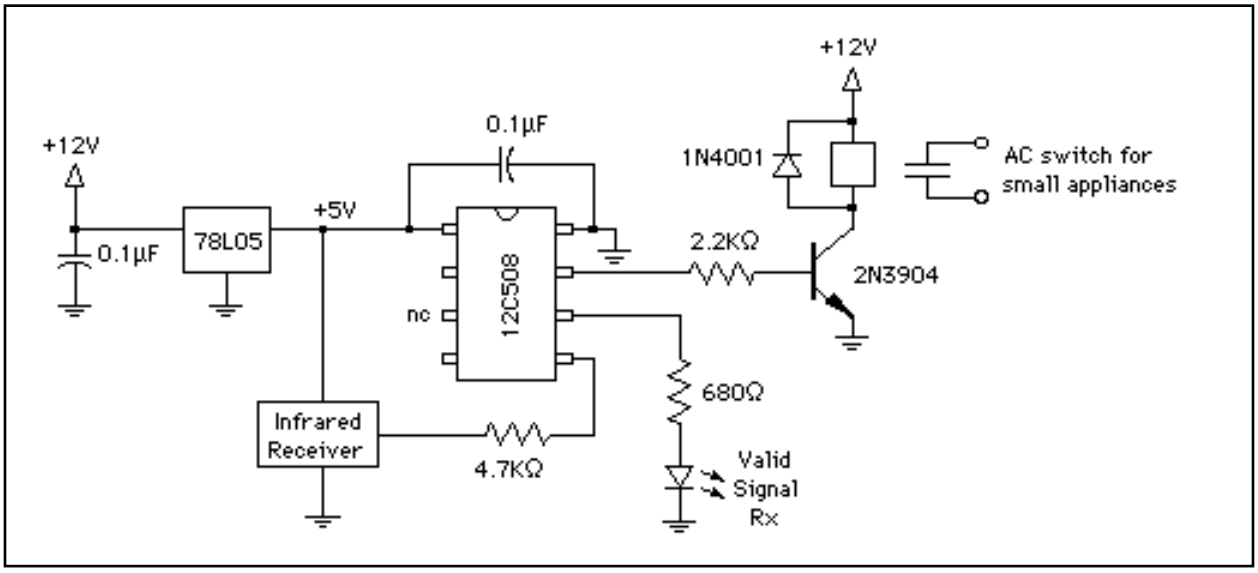
APPLICATION OPERATION

A Sony TV remote control signal is coupled to a PIC12C508 through an infrared detector module. Decoding of the waveform is performed in software to provide an on/off signal for controlling small lamps and appliances and a pulsed output for controlling momentary-type interfaces, such as electric garage door controls, etc.

This particular application decodes a Sony data stream, but could just have easily been designed to respond to other remote commands using similar techniques. Most universal remote controls default to the Sony mode on initial power up however, so it seemed a good choice.

In addition to providing one continuous output and a 0.25 sec pulsed output, my design provides a (visual feedback) 'valid signal received' output for driving an LED. I found it convenient to have this feedback, although it is not essential to the design. One output pin on the PICmicro™ remains uncommitted and can be easily programmed for an additional function.

FIGURE 1: SCHEMATIC



The listing that follows contains a description of the connections to the I.C.

BILL OF MATERIALS (BOM)

Part Number	Manufacture
PIC12C508	Microchip
IR Detector Module (~40KHz)	Various
78L05 regulator	Various
12 VDC relay	Various
2N3904 transistor	
1N4001 diode, LED, 2 - 0.1 µF capacitors,	
2.2K, 4.7K, and 680Ω resistors,12VDC supply	---

SOFTWARE LISTING:

```
;
;                                                IR Remote
;                                                =========
;                                                       by Jim Nagy, Oct.1997
;
;            An infra-red receiver circuit for controlling various appliances.
;            This circuit continuously monitors the output of a standard infra-red
;            receiver module for Sony command strings. Upon receipt of the correct
;            command, outputs are either turned on, off, or pulsed.
;
;            As programmed, this circuit responds to the codes:
;                       3 - 3 - 0      turns pin 7 (GP0) off
;                       3 - 3 - 1      turns pin 7 (GP0) on
;                       3 - 3 - 3      toggles the output on pin 7 (GP0)
;                         3 - 3 - 5              pulses pin 2 (GP5) on for 0.25sec

;                Circuit connections are as follows:
;                 - +5V is connected to pin 1, gnd to pin 8
;                 - An active high (continuous) output is on GP0 (pin 7)
;                 - An active high (pulsed) output is available at GP5 (pin 2)
;                 - An active high 'valid code received' signal is on GP1 (pin 6)
;                 - GP3 (pin 4) is configured as an active low MCLR, with internal pullup
;                In the present configuration, the output from GP4 (pin 3) is not used.
;
;                ******************************************************************************

; Program Equates
ZeroKey          EQU 9                          ; Sony key codes
OneKey                   EQU 0
ThreeKey         EQU 2
FiveKey          EQU 4

LED                      EQU 1                  ; GPIO bit#

; Standard Equates
W                        EQU 0
F                        EQU 1

GPWUF            EQU 7
PA0              EQU 5
TO               EQU 4
PD               EQU 3
Z                EQU 2
Zero             EQU 2
DC               EQU 1
C                EQU 0
Carry            EQU 0

; fuses
MCLRDisabled     EQU 0
MCLREnabled      EQU H'10'
CodeProtect      EQU 0
NoCodeProtect    EQU H'08'
WDTDisabled      EQU 0
WDTEnabled       EQU H'04'
IntRCOsc         EQU H'02'
ExtRCOsc         EQU H'03'
XTOsc                    EQU H'01'
LPOsc                    EQU 0

; '508 Registers
INDF             EQU      H'00'
TMR0             EQU      H'01'
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PCL             EQU      H'02'
STATUS          EQU      H'03'
FSR             EQU      H'04'
OSCCAL          EQU      H'05'
GPIO            EQU      H'06'

; Program variables
Flags           EQU      H'07'                          ; standard signals
TFlag           EQU      0                              ; bit 0 of Flags

Temp            EQU H'08'             ; scratch pad register

CntrLo          EQU H'09'             ; Timing Counter (low byte)
CntrMid EQU H'0A'         ;                               ""(middle byte)
CntrHi          EQU H'0B'             ;                 ""(hi byte)

BitCnt          EQU H'0C'             ; used when receiving a byte
Command EQU H'0D'         ; the command byte last received

;               ******************************************
;               Set the ID words...

                        ORG H'0200'
ID0                     Data.W       H'0000'
ID1                     Data.W       H'0000'
ID2                     Data.W       H'0004'
ID3                     Data.W       H'0009'

;               ******************************************
;               and the Fuse bits...

                        ORG H'0FFF'
CONFIG          Data.W   MCLREnabled + NoCodeProtect + WDTDisabled + IntRCOsc


;               ******************************************
;               PIC starts here on power up...
;               ******************************************

                        ORG H'00'

                        MOVWF        OSCCAL             ; store the factory osc. calibration
value
                        GOTO                 Init                           ; and jump past
the subroutines



;               ******************************************
;               Subroutines...

;               ******************************************
;                       Delay
;               Waits approx W mSec then returns
Delay           CLRF     Temp
dl                      NOP                                 ; 255 * 4 uS loop
                        DECFSZ       Temp,F
                        GOTO         dl
                        MOVWF        Temp                   ; repeat the loop W times
                        DECFSZ       Temp,W
                        GOTO         Delay
                        RETLW        0



;               ******************************************
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;                       GetaByte
;                Wait up to 2 secs for a 12 bit word. Sony data is sent as 7 bits
;                for command then 5 bits for device code (both LSB first). We only
;                want a command byte, so pad out the 7 bits to 8, and ignore rest.

GetaByte
                        CLRF    CntrLo          ; reset the counters
                        MOVLW   H'80'           ; (but preload the middle byte
                        MOVWF   CntrMid         ; to get more accurate timing)
                        CLRF    CntrHi

gb1                     INCF    CntrLo,F        ; wait for a signal
                        BTFSC   STATUS,Zero
                        INCF    CntrMid,F
                        BTFSC   STATUS,Zero
                        INCF    CntrHi,F
                        MOVLW   D'3'            ; but no more than 2 sec
                        SUBWF   CntrHi,W        ; (2.5*256*256*12uS ~ 2sec)
                        BTFSC   STATUS,Carry
                        GOTO    Main            ; abort if time is exceeded
                        BTFSC   GPIO,2          ; else check for a signal
                        GOTO    gb1             ; and if none, loop

;               there is a signal...
                        CALL    HdrCheck        ; see if it's a header
                        BTFSS   STATUS,Carry    ; and go on if it is
                        GOTO    gb1             ; else keep waiting

;               the agc header was OK, now get the command...
                        MOVLW   D'7'            ; prepare to receive 7 bits
                        MOVWF   BitCnt
gb2                     CALL    GetaBit
                        RRF     Command,F
                        DECFSZ  BitCnt,F        ; and loop 'til they're all here
                        GOTO    gb2
                        RRF     Command,F       ; fake an 8th bit
                        BCF     Command,7       ; that's always 0

;               next, get the device code, but ignore it...
                        MOVLW   D'5'
                        MOVWF   BitCnt          ; prepare to receive 5 bits
gb3                     CALL    GetaBit
                        DECFSZ  BitCnt,F
                        GOTO    gb3

;               as a final test, make sure there were only 12 bits...
                        CLRF    CntrLo          ; reset the timers
                        CLRF    CntrMid
gb4                     BTFSS   GPIO,2          ; check for no signal for rest of frame
                        GOTO    Main            ; if there is any signal, abort
                        INCF    CntrLo,F
                        BTFSC   STATUS,Zero
                        INCF    CntrMid,F
                        MOVLW   D'4'            ; check how long we've waited
                        SUBWF   CntrMid,W       ; (4*256*10uS is approx 10mS)
                        BTFSS   STATUS,Carry
                        GOTO    gb4             ; loop until the 10mS is up
                        RETLW   0



;               ****************************************
;                       GetaBit
;               -> returns with Carry=1 if bit=1, and Carry=0 if bit=0
;               Determines the value of the bit currently being sent. Measurements seem
;               to conflict with information obtained on the Sony format, and initial
```

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;               attempts at adaptive routines were not reliable enough. I've used hard-
;               coded values instead to determine the bit values. Sony bits seem
;               to be sent as 400uS of no carrier followed by either 800uS ('0') or
;               1400uS ('1') of carrier (although tolerances are wide).

GetaBit         CLRF    CntrLo                  ; reset the counter,
b1                      INCF    CntrLo,F        ; determine no-carrier time
                        MOVLW   D'100'
                        SUBWF   CntrLo,W        ; allow up to 800uS (100*8uS)
                        BTFSC   STATUS,Carry
                        GOTO    Main            ; and abort if too long
                        BTFSC   GPIO,2          ; keep counting 'til the carrier comes
                        GOTO    b1

;               a space of less than 800uS was received...
                        MOVLW   D'25'           ; make sure it was greater than
                        SUBWF   CntrLo,W        ; 25*8uS = 200uS
                        BTFSS   STATUS,Carry
                        GOTO    Main            ; abort if it was too short


;               determine the length of the IR pulse being received...
                        CLRF    CntrLo
b2                      INCF    CntrLo,F        ; count this pass
                        MOVLW   D'225'
                        SUBWF   CntrLo,W        ; allow up to 1800uS (225*8uS)
                        BTFSC   STATUS,Carry
                        GOTO    Main            ; and abort if too long
                        BTFSS   GPIO,2          ; keep counting 'til the pulse ends
                        GOTO    b2

;               signal is gone. Was it long enough?
                        MOVLW   D'50'           ; make sure it was greater than
                        SUBWF   CntrLo,W        ; 50*8uS = 400uS
                        BTFSS   STATUS,Carry
                        GOTO    Main            ; if not, abort

;               and was it a 1 or a 0 ?
                        MOVLW   D'125'          ; compare the width to 1000uS
                        SUBWF   CntrLo,W        ; which sets/resets the carry
                        RETLW   0



;               ****************************************
;                       HdrCheck
;               -> returns with Carry=1 if it is a header, and 0 if it is not
;               Called with the input low (carrier being received).
;               Checks to see if this is a valid agc header.

HdrCheck
                        CLRF    Temp            ; look for the ~2.5mS long header...
hc1                     INCF    Temp,F          ; count each pass thru the loop
                        BSF     GPIO,2
                        MOVLW   B'00001000'     ; Pulse GP2 to reset the Schmitt trigger
                        TRIS    GPIO            ; (input drifts due to ambient light)
                        MOVLW   B'00001100'     ;
                        TRIS    GPIO
                        MOVLW   D'250'          ; check for too long a burst
                        SUBWF   Temp,W          ; (250*13uS ~ 3.25mS)
                        BTFSC   STATUS,Carry
                        GOTO    hc2             ; abort if the header is too long
                        BTFSS   GPIO,2          ; check if the signal is still there
                        GOTO    hc1             ; and if so, keep looping

;               a pulse of less than 3mS duration has been received...
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                        MOVLW   D'138'          ; make sure it was greater than
                        SUBWF   Temp,W          ; 138*13uS ~ 1.8mS
                        RETLW   0               ; C=1 if T>1.8mS

hc2                     CLRW
                        ADDWF   Temp,W          ; adding 0 to any number clears C
                        RETLW   0


;               ******************************************
;                       KeyIsUp
;               Waits for no header for at least 65mS. Auto-repeat causes signals
;               to be sent about every 45mS, so a 65mS pause should signify that
;               the key has been released (is up).

KeyIsUp         CLRF    TMR0                    ; reset the timer
                        BCF     Flags,TFlag     ; and the timeout flag
ku1                     CLRW
                        BTFSS   GPIO,2          ; if there's a signal,
                        CALL    HdrCheck        ; see if it's a header
                        BTFSC   STATUS,Carry
                        GOTO    KeyIsUp         ; loop if it is
                        BTFSC   TMR0,7
                        BSF     Flags,TFlag     ; else flag that timeout is pending
                        BTFSS   Flags,TFlag     ; timeout pending?
                        GOTO    ku1                 ; no
                        BTFSC   TMR0,7              ; yes - has it rolled over?
                        GOTO    ku1                 ; no - keep waiting
                        BCF     GPIO,LED            ; make sure the LED is off
                        RETLW 0


;               ******************************************
;               Power On jumps to here...
;               ******************************************

Init                    CLRF    GPIO            ; initialize the output port
                        MOVLW   B'00001100'     ; GP2 and GP3 are inputs, and
                        TRIS    GPIO            ; the others are outputs

                        CLRWDT                  ; set up the timers...
                        MOVLW   B'11000111'     ; int clock to TMR0, uses /256 prescaler
                        OPTION                  ; no pullups, and no wakeup on change

Main                    CALL    KeyIsUp         ; make sure no key is pressed
                        CALL    GetaByte        ; then get the first control byte
                        MOVF    Command,W
                        XORLW   ThreeKey        ; see if it's a 3
                        BTFSS   STATUS,Zero
                        GOTO    Main            ; if not, start over
                        BSF     GPIO,LED        ; else turn the LED on, and
                        CALL    KeyIsUp         ; wait for key release

                        CALL    GetaByte        ; get the second control byte
                        MOVF    Command,W
                        XORLW   ThreeKey        ; see if it's a 3
                        BTFSS   STATUS,Zero
                        GOTO    Main            ; if not, start over
                        BSF     GPIO,LED        ; else turn the LED on, and
                        CALL    KeyIsUp         ; wait for key release

                        CALL    GetaByte        ; get the third control byte

                        MOVF    Command,W
                        XORLW   ZeroKey
                        BTFSC   STATUS,Zero     ; and see if it's a 0
```

NOTES: