Simple Alarm System

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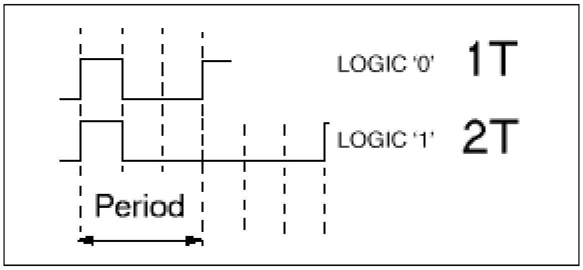
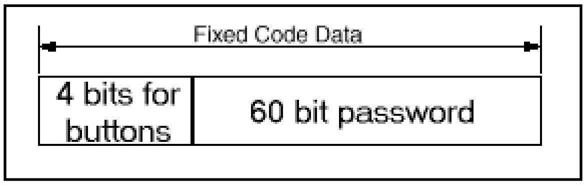
The alarm system discussed in this application note may be used to guard cars and homes. It is based on two PIC12C508s (one is used in the transmitter and the other one, in the main unit). The transmitter uses an infrared beam to send code names to the main unit. It has two commands: arm and disarm alarm. The code is fixed and is 64 bits long. When in disarm mode, it works like a central locking mechanism, and in arm mode, this feature is blocked.

FIGURE 1: CODE WORD TRANSMISSION FORMAT



Start and stop bits are separate and are 3T. The start bit is used to synchronize two RC generators in the main unit and in the receiver. Code word transmission format is shown in Figure 1. The main period is 400 µs, with 14 µs active pulse (except the first one pulse which is 20 µs). This format is ideal for infrared transmitters, since it saves battery power. With two 3V lithium batteries, the transmitter will work for more than a year with about six transmissions per day. Code word organization is shown in Figure 2. Only two bits of the first four bits are used. It took about 400 ms to send a transmission.

FIGURE 2: CODE WORD ORGANIZATION



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TRANSMITTER PARTS LIST

Capacitors:	C1 – 470 µF (electrolytic)
Diodes:	D1 – D2 Infrared light emitting diodes
Resistors:	R1 – 1 Ω
	R2 – 51 Ω
Miscellaneous:	U1 – PIC12C508 programmed with transmitter code
	U2 – 2N2222
	S1 – S2 - normally open push-button switches

MAIN UNIT PARTS LIST

Capacitors:	C1 – 47 µF (electrolytic)
	C2 – .1 µF
	C3 – 2200 µF (electrolytic)
Diodes:	D1 – D10 Any type diodes
	D11 – D14 high voltage diodes
	D15 – 1 amp rectifier
	LED – Red light emitting diode
Resistors:	R1 – R8 (2 kΩ)
	R9 – R11(100 kΩ)
	R12 – R16 (1 kΩ)
Miscellaneous:	U1 – PIC12C508 programmed with alarm code
	U2 – 78L05
	U3 – U7 (2N2222)

The main unit is protected with a small 3V lithium battery. This is needed if thieves try to disconnect the car battery. Disconnecting both batteries and then reconnecting one, automatically arms the main unit. The main unit is shown in Figure 3.

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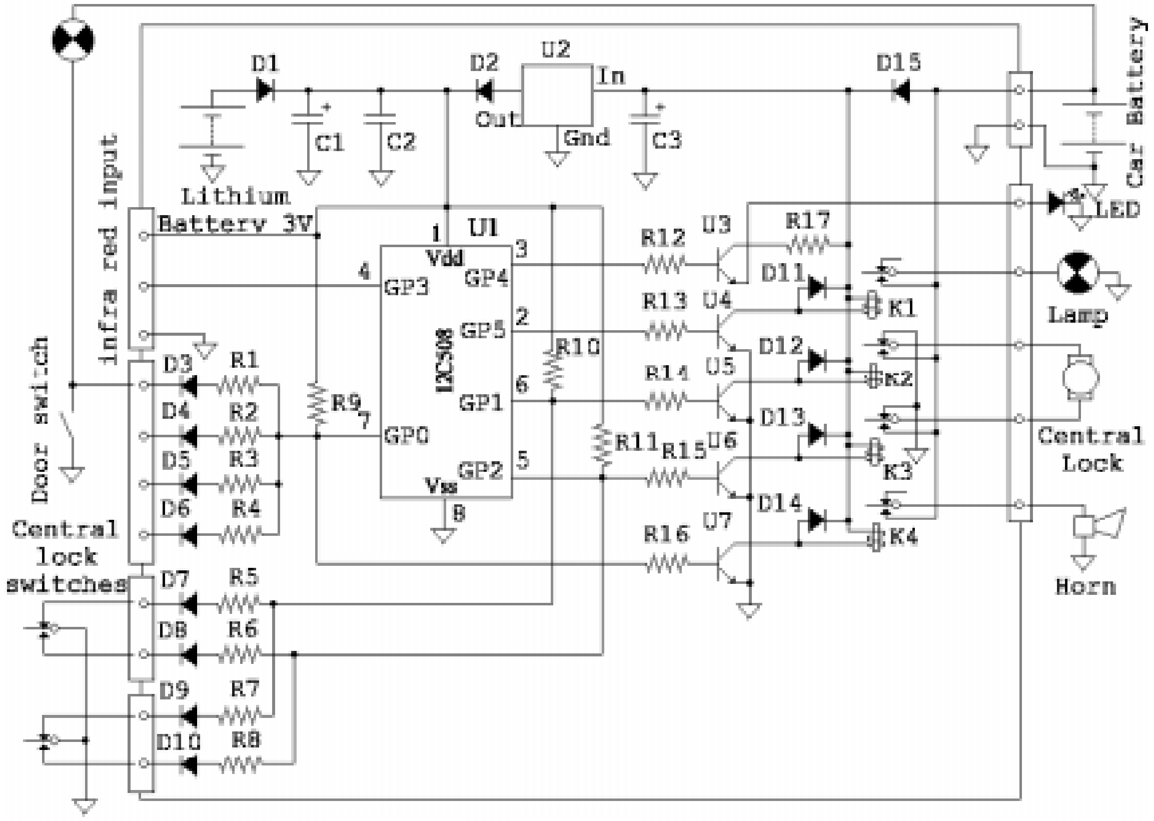
FIGURE 3: MAIN UNIT SCHEMATIC DIAGRAM



Any amplifier with positive pulses can be connected to the infrared input (TBA2800 for example)

QUICK CODE IDEAS

This code has macro commands that are helpful in PICmicros with no interrupts.

MICROCHIP TOOLS USED

MPLAB™ for Windows/16 Version 3.30.00

Assembler/Compiler version: MPASM v02.00

SOURCE CODE

Car Alarm System – Main Unit

```
; Car Alarm System (Main Unit) Version 01 K 1997
; Author: Kirill Yelizarov

                 LIST                        P=PIC12C508, R=HEX
                 INCLUDE                     “p12c508.inc”
                 INCLUDE “alr97k01.pas”      ;get password

                 __CONFIG _IntRC_OSC & _WDT_OFF & _CP_OFF & _MCLRE_OFF

ALARM_TIME     equ          0x0a       ;in intrusion mode make 10 signals

;----- Infrared input -----
#define        IRinp        GPIO,3           ;infrared input is connected to GP3 pin

;----- Alarm Main Functions Timing Table -----
;one tick (tk) equals to 32 ms

;----- LED -----
#define        LED          GPIO,4           ;LED is connected to GP4 pin
#define        LED_d        Flags,4          ;LED direction flag
LED_f                       equ       0x06   ;LED flashing time (6 tk = 192 ms)
LED_p                       equ       0x19   ;LED pause between flashes time (25 tk = 800 ms)

;----- Lights -----
#define        Lights       GPIO,5           ;Lights are connected to GP5 pin
#define Lights_d Flags,5;Lights direction flag
Lights_f       equ          0x0f             ;lights flashing time (15 tk = 480 ms)
Lights_p       equ          0x10             ;lights pause between flashes (16 tk = 512 ms)

;----- Beep -----
#define        Beep         GPIO,0           ;Horn is connected to GP0 pin
#define Beep_d              Flags,0          ;Beep direction flag
Beep_f                      equ       0x0f   ;beep activate time (15 tk = 480 ms)
Beep_p                      equ       0x10   ;beep sleep time (16 tk = 512 ms)

;----- Lock doors -----
#define        DLock        GPIO,2           ;Door lock relay and switch are connected to GP2 pin
#define        DLock_d      Flags,2          ;Lock direction flag
DLock_f                     equ       0x10   ;Lock activate time (16 tk = 512 ms)
DLock_p                     equ       0x01   ;should always be one

;----- Unlock doors -----
#define        DUnlock      GPIO,1           ;Door unlock relay and switch are connected to GP1
pin
#define        DUnlock_d Flags,1;Unlock direction flag
DUnlock_f      equ          0x10             ;Unlock activate time (16 tk = 512 ms)
DUnlock_p      equ          0x01             ;should always be one

;----- Input switch -----
#define        InSw         GPIO,0           ;Intrusion switch is connected to GP0
#define        InSw_f       KeyFlags,0       ;Intrusion flag
#define        Intrusion    AlarmFlags,2

;----- Open switch -----
#define        OpenSw       GPIO,1           ;Door open switch is connected to GP1
#define        OpenSw_f     KeyFlags,1       ;Door open flag
#define        Open         SwitchFlags,1

;----- Close switch -----
#define        CloseSw      GPIO,2           ;Door close switch is connected to GP2
#define        CloseSw_f    KeyFlags,2       ;Door close flag
#define        Close        SwitchFlags,2
```

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```
;----- AlarmFlags bits -----
NullFlag       equ          7
IRFlag                      equ       6
Disarm                      equ       5
Arm                         equ       4
AlarmFlag      equ          3
TimerFlag      equ          1
BeepFlag       equ          0

;----- Local DATA -----

IRCount                     equ       0x07   ;counter used in IRdelay
IRCorrection   equ          0x08             ;correction for infrared intervals
AlarmFlags     equ          0x09             ;alarm flags
Flags                       equ       0x0a   ;direction flags
LED_c                       equ       0x0b   ;LED counter
Lights_c       equ          0x0c             ;Lights counter
Beep_c                      equ       0x0d   ;Beep counter
DLock_c                     equ       0x0e   ;Lock counter
DUnlock_c      equ          0x0f             ;Unlock counter
Dig1                        equ       0x10   ;64 bit code
Dig2                        equ       0x11
Dig3           equ          0x12
Dig4           equ          0x13
Dig5                        equ       0x14
Dig6                        equ       0x15
Dig7           equ          0x16
Dig8           equ          0x17
KeyFlags       equ          0x18             ;key flags used by macro TestKey
AlarmCounter   equ          0x19             ;alarm counter
AlarmTris      equ          0x1a             ;alarm TRIS register
SwitchFlags    equ          0x1b             ;switch flags used by central lock

;----- Macro -----

Check          macro        r,rb,d,db,f,p,c
               local        out,pas
;r - working bit
;d - direction flag
;f - flashing time (in ticks) (d flag is set)
;p - pause between flashes (in ticks) (d flag is cleared)
;c - counter
;delay 10us max
         decfsz         c,F                       ;decrease counter
         goto           out
         btfss          d,db                      ;check direction
         goto           pas
         bcf            r,rb                      ;clear working bit
         bcf            d,db                      ;clear direction bit
         movlw          p                         ;read pause between flashes
         movwf          c                         ;and save it to counter
         goto           out                       ;out from macro
pas:
         bsf            r,rb                      ;set working bit
         bsf            d,db                      ;set direction bit
         movlw          f                         ;read flashing time
         movwf          c                         ;and save it to counter
out:
         endm

;This macro is used to search closed key
;button de bounce is 32 ms
;Delay 7us max
TestKey  macro          r,rb,f,fb,a,ab
         local          out,reset,setact
;r - pin to test
```

```
;f - pin flag (if pin r is low then set flag f, and check the next time pin r and flag f)
;a - actiun bit this pinb should be checked by the program and cleared by it


         btfsc          r,rb                 ;if pin is high then out and reset flag
         goto           reset
         btfsc          f,fb                 ;skip if flag is cleared
         goto           setact               ;else go and set action
         bsf            f,fb                 ;set flag and out
         goto           out
setact:
         bsf            a,ab                 ;set action
reset:
         bcf            f,fb                 ;and clear flag
out:
         endm

;----- CODE -----

         org     0
         goto    Start

;         ------------ S U B R O U T I N E S -------------

Receive
         btfsc   IRinp                                ;wait till IRinp becomes low
         goto    Receive

         clrf    Dig1                                 ;~22 us
         clrf    Dig2
         clrf    Dig3
         clrf    Dig4
         clrf    Dig5
         clrf    Dig6
         clrf    Dig7
         clrf    Dig8

         nop
         movlw   0xb8
         call    IRDelay                              ;delay 184*3-1+5=556 us
         movlw   0xb8
         call    IRDelay                              ;delay 184*3-1+5=556 us


;this is a special correction routine
;this is needed to sincronize transmitter and receiver,
;because they are clocked with internal RC generators

         clrf    IRCorrection
         btfsc   IRinp                                ;0
         goto    SetCorrection
         incf    IRCorrection,F
         btfsc   IRinp                                ;1
         goto    SetCorrection
         incf    IRCorrection,F
         btfsc   IRinp                                ;2
         goto    SetCorrection
         incf    IRCorrection,F
         btfsc   IRinp                                ;3
         goto    SetCorrection
         incf    IRCorrection,F
         btfsc   IRinp                                ;4
         goto    SetCorrection
         incf    IRCorrection,F
         btfsc   IRinp                                ;5
         goto    SetCorrection
```

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```
incf    IRCorrection,F
btfsc          IRinp                     ;6
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;7
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;8
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;9
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;10
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;11
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;12
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;13
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;14
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;15
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;16
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;17
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;18
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;19
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;20
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;21
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;22
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;23
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;24
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;25
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;26
goto           SetCorrection
incf           IRCorrection,F
btfsc          IRinp                     ;27
goto           SetCorrection
```

```
         incf           IRCorrection,F
         btfsc          IRinp                     ;28
         goto           SetCorrection
         incf           IRCorrection,F
         btfsc          IRinp                     ;29
         goto           SetCorrection
         incf           IRCorrection,F
         btfsc          IRinp                     ;30
         goto           SetCorrection
         incf           IRCorrection,F
         btfsc          IRinp                     ;31
         goto           SetCorrection
         incf           IRCorrection,F
         btfsc          IRinp                     ;32
         goto           SetCorrection
         incf           IRCorrection,F
         btfsc          IRinp                     ;33
         goto           SetCorrection
         incf           IRCorrection,F
         btfsc          IRinp                     ;34
         goto           SetCorrection
         incf           IRCorrection,F
         btfsc          IRinp                     ;35
         goto           SetCorrection
         goto           BadRead

SetCorrection:

         movlw          0x7d                      ;~4 us after start
         call           IRDelay                   ;delay 126*3-1+5=383 us
         nop

         bsf            STATUS,C                  ;this STOP bit will end the loop
NextDigit:
         rrf            Dig8,F
         rrf            Dig7,F
         rrf            Dig6,F
         rrf            Dig5,F
         rrf            Dig4,F
         rrf            Dig3,F
         rrf            Dig2,F
         rrf            Dig1,F
         btfsc          STATUS,C                  ;check for STOP bit
         goto           Compare
         bsf            AlarmFlags,NullFlag       ;Set the null flag
RetryDigit:
         bcf            AlarmFlags,IRFlag         ;1 us Reset bit read flag
         nop
         nop
         nop
         btfsc          IRinp                     ;5th us look for a bit
         bsf            AlarmFlags,IRFlag         ;Set if bit read

         movlw          0x23
         movwf          IRCount

StartCorrection:                                  ;Delay 244+IRCorrection us
         movf           IRCount,W                 ;for T=400 us delay 261 us
         subwf          IRCorrection,W
         btfsc          STATUS,C
         goto           AddCorrection
AddCorrection:
         decfsz         IRCount,F
         goto           StartCorrection
         nop
```

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```
         nop
         nop
         movlw   0x23
         call           IRDelay                           ;Delay 35*3-1+5=109 us

         btfss          AlarmFlags,IRFlag
         goto           ResetFlag
         btfsc          AlarmFlags,NullFlag       ;If flag is clear it was “1”
         goto           Set0
         nop
         bsf            STATUS,C                          ;Set an overflow flag to read “1”
         goto           NextDigit
Set0:
         bcf            STATUS,C                          ;Reset an overflow flag to read “0”
         goto           NextDigit

ResetFlag:
         movlw   0x02
         callIRDelay                              ;Delay 2*3-1+5=10 us

         btfss          AlarmFlags,NullFlag;Error if an overflow flag already reset
         goto           BadRead
         bcf            AlarmFlags,NullFlag
         goto           RetryDigit

Compare:
         nop                             ;401th us
         nop
         nop
         nop
         btfsc          IRinp                     ;405th us watch for clear bit
         goto           BadRead

         movlw          0x23
         movwf          IRCount

StartCorrection1:                   ;Delay 244+IRCorrection us
         movf           IRCount,W                 ;for T=400 mks delay 261 us
         subwf          IRCorrection,W
         btfsc          STATUS,C
         goto           AddCorrection1
AddCorrection1:
         decfsz         IRCount,F
         goto           StartCorrection1
         nop

;compare received data with password
         movlw          PASS8
         xorwf          Dig8,W
         btfss          STATUS,Z
         goto           BadCode

         movlw          PASS7
         xorwf          Dig7,W
         btfss          STATUS,Z
         goto           BadCode

         movlw          PASS6
         xorwf          Dig6,W
         btfss          STATUS,Z
         goto           BadCode

         movlw          PASS5
         xorwf          Dig5,W
         btfss          STATUS,Z
         goto           BadCode
         movlw          PASS4
         xorwf          Dig4,W
         btfss          STATUS,Z
         goto           BadCode

         movlw          PASS3
         xorwf          Dig3,W
         btfss          STATUS,Z
         goto           BadCode

         movlw          PASS2
         xorwf          Dig2,W
         btfss          STATUS,Z
         goto           BadCode

         movf           Dig1,W
         andlw          b'00001111'
         xorlw          PASS1
         btfss          STATUS,Z
         goto           BadCode

         movlw          0x20                      ;
         call           IRDelay                   ;delay 32*3-1+5=100 us
         nop

         btfsc          IRinp                     ;805 us
         goto           BadRead

         movlw          0x23
         movwf          IRCount

StartCorrection2:                                 ;Delay 244+IRCorrection us
         movf           IRCount,W                 ;for T=400 us delay 261 us
         subwf          IRCorrection,W
         btfsc          STATUS,C
         goto           AddCorrection2
AddCorrection2:
         decfsz         IRCount,F
         goto           StartCorrection2
         nop

         movlw          0x2b
         call           IRDelay                   ;delay 43*3-1+5=133 us
         nop

         btfss          IRinp                     ;5th us look for a STOP bit
         goto           BadRead

         movlw          b'00110000'
         andwf          Dig1,W
         btfsc          STATUS,Z
         goto           BadRead
         iorwf   AlarmFlags,F                     ;Save function (ON/OFF)
         retlw          0x00
BadCode:
         bsf            Intrusion                 ;Set an intrusion flag for bad code
BadRead:
         retlw          0x00

;Delay for timing intervals where actual delay is
;W*3-1+5 us with 4MHz oscillator
IRDelay
         movwf          IRCount
DelayStart:
         decfsz         IRCount,F
```

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```
         goto           DelayStart
         retlw          0x00

;                 ------------ M A I N -------------

Start:
         clrf           GPIO
         movlw          b’11000110’      ;Dissable weak pull-ups and wake up on pin change
         option                                   ;and set prescaller to 1:128
         movlw          b’00001111’      ;Set GP4 an GP5 as output and the rest are inputs
         movwf          AlarmTris        ;save data to alarm tris register
         tris           GPIO

         clrf           AlarmFlags                ;clear alarm flags
         clrf           Flags                     ;clear direction flags
         clrf           SwitchFlags               ;clear central lock switch flags
         movlw          0x01
         movwf          Beep_c
         movwf          Lights_c
         movwf          LED_c
         movwf          DLock_c
         movwf          DUnlock_c

MainLoop:
         btfsc          IRinp                     ;Check IR input pin
         call           Receive

         btfsc          TMR0,3                    ;if timer0 highest bit is cleared
         goto           Skip                      ;then check flag else goto Skip
         btfsc          AlarmFlags,TimerFlag
         goto           Tick
Skip:
         bsf            AlarmFlags,TimerFlag      ;set TimerFlag
         btfss          TMR0,3                    ;if timer0 highest bit is cleared
         bcf            AlarmFlags,TimerFlag      ;then clear TimerFlag
         goto           MainLoop
Tick:
         bcf            AlarmFlags,TimerFlag      ;clear TimerFlag
         btfsc          IRinp                     ;Check IR input pin
         call           Receive
         btfsc          Open
         goto           _Open
         btfsc          Close
         goto           _Close
         btfss          AlarmFlags,AlarmFlag
         goto           _Armed                    ;if falg is cleared it is arm mode
         goto           _Disarmed
_Armed:
         btfsc          Intrusion
         goto           _Intrusion
         btfsc          IRinp                     ;Check IR input pin
         call           Receive
         Check          LED,LED_d,LED_f,LED_p,LED_c;check LED (delay 10us)
         btfsc          IRinp                     ;Check IR input pin
         call           Receive
         TestKey        InSw,InSw_f,Intrusion     ;test intrusion switch (delay 7us)
         movlw          ALARM_TIME
         movwf          AlarmCounter              ;set alarm counter
         btfsc          AlarmFlags,Disarm
         goto           DisarmAlarm
         goto           MainLoop

_Intrusion:
         btfsc          AlarmFlags,Disarm
         goto           DisarmAlarm
         bcf            AlarmTris,0               ;set GP0 to be output
         movf           AlarmTris,W
         tris           GPIO
         bsf            LED                       ;turn on LED
         btfsc          IRinp                     ;Check IR input pin
         call           Receive
         Check          Lights,Lights_d,Lights_f,Lights_p,Lights_c ;check Lights (delay 10us)
         btfsc          IRinp                     ;Check IR input pin
         call           Receive
         Check          Beep,Beep_d,Beep_f,Beep_p,Beep_c ;check Beep (delay 10us)
         decfsz         AlarmCounter,F
         goto           MainLoop
         bcf            Intrusion
         bsf            AlarmTris,0               ;set GP0 to be input
         movf           AlarmTris,W
         tris           GPIO
         bcf            LED                       ;turn off LED
         goto           MainLoop

_Disarmed:
         bcf            LED                       ;turn LED off
         btfsc          IRinp                     ;Check IR input pin
         call           Receive
         TestKey        OpenSw,OpenSw_f,Open      ;test open switch (delay 7us)
         btfsc          IRinp                     ;Check IR input pin
         call           Receive
         TestKey        CloseSw,CloseSw_f,Close   ;test close switch (delay 7us)
         btfsc          AlarmFlags,Arm
         goto           ArmAlarm
         goto           MainLoop

_Open:
         bcf            AlarmTris,1               ;set GP1 to be output
         movf           AlarmTris,W
         tris           GPIO
         btfsc          IRinp                     ;Check IR input pin
         call           Receive
         Check          DUnlock,DUnlock_d,DUnlock_f,DUnlock_p,DUnlock_c;check Unlock (delay 10us)
         btfsc          DUnlock_d                 ;wait till direction flag changes its state
         goto           MainLoop
         bsf            AlarmTris,1               ;set GP1 to be input
         bcf            Open
         movf           AlarmTris,W
         tris           GPIO
         goto           MainLoop

_Close:
         bcf            AlarmTris,2               ;set GP2 to be output
         movf           AlarmTris,W
         tris           GPIO
         btfsc          IRinp                     ;Check IR input pin
         call           Receive
         Check          DLock,DLock_d,DLock_f,DLock_p,DLock_c;check Lock (delay 10us)
         btfsc          DLock                     ;wait till direction flag changes its state
         goto           MainLoop
         bsf            AlarmTris,2               ;set GP2 to be input
         bcf            Close
         movf           AlarmTris,W
         tris           GPIO
         goto           MainLoop

ArmAlarm:
         bcf            AlarmFlags,Arm
         bsf            Close
         goto           MainLoop

DisarmAlarm:
```

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```
        bcf             AlarmFlags,Disarm
        bsf             Open
        goto            MainLoop

        org             0x1ff
        movlw           b’01110000’                 ;set OSCCAL

        end
```

Car Alarm System - Transmitter

```
;Car Alarm System (Transmitter) v1.0 1997
;Author: Kirill Yelizarov

         LIST                       P=PIC12C508, R=HEX
         INCLUDE                    p12c508.inc
         INCLUDE                    alr97k01.pas ;get password

         __CONFIG _ExtRC_OSC & _WDT_OFF & _CP_OFF & _MCLRE_OFF

;----- GPIO Port bits -----
IRLED                   equ         2              ;Infrared LED pin

;----- Local DATA SFRs -----
Count                   equ         0x07
DelayCountequ           0x08
DelayCountLowequ        0x09
DelayCountHiequ         0x0a

;----- Password SFRs -----
Dig1                    equ         0x10
Dig2                    equ         0x11
Dig3                    equ         0x12
Dig4                    equ         0x13
Dig5                    equ         0x14
Dig6                    equ         0x15
Dig7                    equ         0x16
Dig8                    equ         0x17


;----- CODE -----

         org            0
         btfsc          STATUS,GPWUF
         goto           Transmit
         clrf           GPIO
         movlw          b’00000000’        ;Enable weak pull-up on GP0 and GP1
         option                                    ;and wake up on pin change
         movlw          b’00111011’        ;Set GP2 as output and the rest are inputs
         tris           GPIO
         goto           _Sleep

;Delay for timing intervals where actual delay is
;W*3-1+5 us with 4MHz oscillator
Delay
         movwf          DelayCount
DelayStart:
         decfsz         DelayCount,F
         goto           DelayStart
         retlw          0x00

;Delay for key de bounce where actual delay is
;W ms with 4MHz oscillator
LongDelay
         movwf          DelayCountHi
         clrf           DelayCountLow
DelayLoop:
         nop
         incfsz         DelayCountLow,F
         goto           DelayLoop
         decfsz         DelayCountHi,F
         goto           DelayLoop
         retlw          0x00

Transmit:
         comf           GPIO,W                     ;read and invert GPIO
```

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```
         andlw          b’00000011’
         btfsc          STATUS,Z                  ;check if a button is pressed
         goto           _Sleep                    ;if not go to sleep
         movlw          0x1e
         call           LongDelay                 ;wait for 30 ms
         comf           GPIO,W                    ;read and invert GPIO again
         andlw          b’00000011’
         btfsc          STATUS,Z                  ;check if a button is still pressed
         goto           _Sleep                    ;if not go to sleep
         xorlw          PASS1                     ;xor pressed buttons with PASS1 digit
         movwf          Dig1                      ;assign password
         swapf          Dig1,W
         movlw          PASS2
         movwf          Dig2
         movlw          PASS3
         movwf          Dig3
         movlw          PASS4
         movwf          Dig4
         movlw          PASS5
         movwf          Dig5
         movlw          PASS6
         movwf          Dig6
         movlw          PASS7
         movwf          Dig7
         movlw          PASS8
         movwf          Dig8

         movlw          0x40
         movwf          Count                     ;64 bits transmission†

         bsf            GPIO,IRLED                ;Send START bit
         nop                                      ;each bit is a 14 us pulse
         nop                                      ;but the Start one is 20 us
         movlw          0x04
         call           Delay                     ;delay 4*3-1+5=16 us
         bcf            GPIO,IRLED

         movlw          0xc3
         call           Delay                     ;delay195*3-1+5=589 us
         nop
         nop
         movlw          0xc2
         call           Delay                     ;delay194*3-1+5=586 us

NextDig:
         bsf            GPIO,IRLED                ;Send another bit
         bcf            STATUS,C
         rrf            Dig8,F
         rrf            Dig7,F
         rrf            Dig6,F
         rrf            Dig5,F
         rrf            Dig4,F
         rrf            Dig3,F
         rrf            Dig2,F
         rrf            Dig1,F                    ;rotate 64 bits to get the next bit
         nop                                      ;to transmit and place it into STATUS,C
         nop
         nop
         nop
         bcf            GPIO,IRLED

         movlw          0x0a
         call           Delay                     ;delay 10*3-1+5=34 us

         btfss          STATUS,C                  ;if STATUS,C is low
         goto           Send0                     ;then delay between bits is 400 us
         movlw          0x84                        ;else add another 400 us
         call           Delay                       ;delay 132*3-1+5=400 us

Send0:
         movlw          0x71
         call           Delay                       ;delay 113*3-1+5=343 us

         decfsz         Count,F                     ;last bit is not reached
         goto           NextDig

         nop

         bsf            GPIO,IRLED                  ;send END bit
         nop
         nop
         movlw          0x02
         call           Delay                       ;delay 2*3-1+5=10 us
         bcf            GPIO,IRLED

         movlw          0xc4
         call           Delay                       ;delay196*3-1+5=592 us
         nop
         nop
         movlw          0xc3
         call           Delay                       ;delay195*3-1+5=589 us

         bsf            GPIO,IRLED                  ;send STOP bit
         nop
         nop
         movlw          0x02
         call           Delay                       ;delay 2*3-1+5=10 us
         bcf            GPIO,IRLED
_Sleep:
         sleep                                      ;go to sleep

         org            0x1ff
         movlw          b’01110000’                 ;set OSCCAL

         end
```

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Alarm Pass

```
PASS1            equ            0x01
PASS2            equ            0x23
PASS3            equ            0x45
PASS4            equ            0x67
PASS5            equ            0x89
PASS6            equ            0xab
PASS7            equ            0xcd
PASS8            equ            0xef
```

NOTES:

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