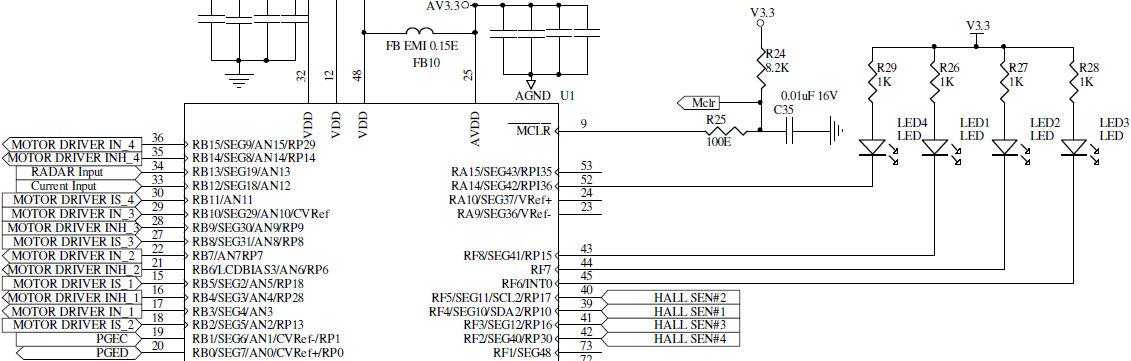
**Autonomous Tractor Safety System**

**Objective 4.0** To generate a 40 KHz, 50 % duty cycle PWM wave in ATSS PCB board using the instruction cycle frequency (FCY = FOSC/2) of 16 MHz. LED3 is made to blink after every time period

PWM period = (PR3 + 1) \* Tcy \* timer prescale = (1 / 40 K) = (PR3 + 1) \* (1/16 M) \* 1; PR3 = 399

Duty cycle = 50% (200)

****

**TRISF** DATA DIRECTION REGISTER F: 0x0000

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| TRISF15 | TRISF14 | TRISF13 | TRISF12 | TRISF11 | TRISF10 | TRISF9 | TRISF8 |
| I/O | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| TRISF7 | TRISF6 | TRISF5 | TRISF4 | TRISF3 | TRISF2 | TRISF1 | TRISF0 |
| I/O | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
|  | 0 |  |  |  |  |  |  |
|  | Output |  |  |  |  |  |  |

**TRISB** DATA DIRECTION REGISTER B: 0x0000

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| TRISB15 | TRISB14 | TRISB13 | TRISB12 | TRISB11 | TRISB10 | TRISB9 | TRISB8 |
| I/O | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| TRISB7 | TRISB6 | TRISB5 | TRISB4 | TRISB3 | TRISB2 | TRISB1 | TRISB0 |
| I/O | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
|  |  |  |  |  |  |  | 0 |
|  |  |  |  |  |  |  | OUTPUT |

**ANSB** DATA DIRECTION REGISTER B: 0x0000

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ANSB15 | ANSB14 | ANSB13 | ANSB12 | ANSB11 | ANSB10 | ANSB9 | ANSB8 |
| I/O | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ANSB7 | ANSB6 | ANSB5 | ANSB4 | ANSB3 | ANSB2 | ANSB1 | ANSB0 |
| I/O | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
|  |  |  |  |  |  |  | 0 |
|  |  |  |  |  |  |  | DIGITAL |

**LATF** OUTPUT LATCH REGISTER F: 0x0040

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| LATF15 | LATF14 | LATF13 | LATF12 | LATF11 | LATF10 | LATF9 | LATF8 |
| I/O | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| LATF7 | LATF6 | LATF5 | LATF4 | LATF3 | LATF2 | LATF1 | LATF0 |
| I/O | I/O | I/O | I/O | I/O | I/O | I/O | I/O |
|  | 1 |  |  |  |  |  |  |
|  | LED3 off |  |  |  |  |  |  |

**T3CON TIMER3 (16 BIT) CONTROL REGISTER**: 0x8000

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| TON | - | TSIDL | - | - | - | - | - |
| TIMER3 ON |  | TMR3 STOP IN IDLE MODE |  |  |  |  | |
| 1 |  | 0 |  |  |  |  |  |
| TMR3 START |  | TMR3 CONTINUES IN IDLE MODE |  |  |  |  |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| - | TGATE | TCKPS1 | TCKPS0 | - | - | TCS | - |
|  | T3 GATED TIME ACCUM EN | TMR3 PRESCALE SELECT | |  |  | TMR3 CLK SRC SELECT |  |
|  | 0 | 1 | 0 |  |  | 0 |  |
|  | DISABLE | TMR3 PRESCALE 1:1 | |  |  | INT CLK (Fosc/2) |  |

**IFS0 INTERRUPT FLAG STATUS REGISTER 0**: 0x0000

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| - | DMA1IF | AD1IF | U1TXIF | U1RXIF | SPI1IF | SPF1IF | T3IF |
|  | DMA CH1 INT | ADC1 COMPLETE | UART1 Tx REQUEST | UART1 Rx REQUEST | SPI1 INT OCCURRED | SPI1 FAULT INT | TMR3 INT REQUEST |
|  |  |  |  |  |  |  | 0 |
|  |  |  |  |  |  |  | CLEAR FLG |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| T2IF | OC2IF | IC2IF | DMA0IF | T1IF | OC1IF | IC1IF | INT0IF |
| TMR2 INT REQUEST | O/P CMP CH2 INT | I/P CH 2 CAPTURE | DMA CH0 INT | TMR1 INT REQUEST | O/P CMP CH1 INT | I/P CH 1 CAPTURE | EXT TNT CH0 INT |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

**IFE0 INTERRUPT ENABLE CONTROL REGISTER 0**: 0x0100

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| - | DMA1IE | AD1IE | U1TXIE | U1RXIE | SPI1IE | SPF1IE | T3IE |
|  | DMA CH1 INT | ADC1 COMPLETE | UART1 Tx REQUEST | UART1 Rx REQUEST | SPI1 INT OCCURRED | SPI1 FAULT INT | TMR3 INT REQUEST |
|  |  |  |  |  |  |  | 1 |
|  |  |  |  |  |  |  | ENABLE |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| T2IE | OC2IE | IC2IE | DMA0IE | T1IE | OC1IE | IC1IE | INT0IE |
| TMR2 INT REQUEST | O/P CMP CH2 INT | I/P CH 2 CAPTURE | DMA CH0 INT | TMR1 INT REQUEST | O/P CMP CH1 INT | I/P CH 1 CAPTURE | EXT TNT CH0 INT |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

**IPC2 INTERRUPT PRIORITY CONTROL REGISTER 2**: 0x0004

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| - | U1RXIP2 | U1RXIP1 | U1RXIP0 | - | SP1IP2 | SP1IP1 | SP1IP0 |
|  | UART1 Rx INT PRIORITY SELECT | | |  | SPI1 INTERRUPT PRIORITY SELECT | | |
|  |  |  |  |  |  |  |  |
|  |  | | |  |  | | |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| - | SPF1IP2 | SPF1IP1 | SPF1IP0 | - | T3IP2 | T3IP1 | T3IP0 |
|  | SPI1 FAULT INTERRUPT PRIORITY | | |  | TIMER3 INT PRIORITY SELECT | | |
|  |  |  |  |  | 1 | 0 | 0 |
|  |  | | |  |  | | |

**RPOR0** PERIPHERAL PIN SELECT OUTPUT REGISTER 0: 0x0012

OC1 OUTPUT (Function 18) is PWM

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| - | - | RP1R5 | RP1R4 | RP1R3 | RP1R2 | RP1R1 | RP1R0 |
|  |  | RP1 OUTPUT PIN MAPPING BITS | | | | | |
|  |  |  |  |  |  |  |  |
|  |  |  | | | | | |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| - | - | RP0R5 | RP0R4 | RP0R3 | RP0R2 | RP0R1 | RP0R0 |
|  |  | RP0 OUTPUT PIN MAPPING BITS | | | | | |
|  |  | 0 | 1 | 0 | 0 | 1 | 0 |
|  |  |  | | | | | |

**OC1CON1**: 0x0406

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| - | - | OCSIDL | OCTSEL2 | OCTSEL1 | OCTSEL0 | ENFLT2 | ENFLT1 |
|  |  | OC1 IN IDLE MODE | OC1 TIMER SELECT | | | FAULT2 ENABLE | FAULT1 ENABLE |
|  |  | 0 | 0 | 0 | 1 | 0 | 0 |
|  |  | CONTINUE | TIMER3 | | | DISABLED | DISABLED |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ENFLT0 | OCFLT2 | OCLFT1 | OCLFT0 | TRIGMODE | OCM2 | OCM1 | OCM0 |
| FAULT0 ENABLE | FAULT2 STATUS | FAULT1 STATUS | FAULT0 STATUS | TRIGGER MODE STATUS | OUTPUT COMPARE MODE SELECT | | |
| 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| DISABLED | NO FAULT | NO FAULT | NO FAULT | TRIGSTAT CLEARED BY S/W | EDGE ALIGNED PWM MODE ON OC1 | | |

**OC1CON2**: 0x000D

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| FLTMD | FLTOUT | FLTTRIEN | OCINV | - | DCB1 | DCB0 | OC32 |
| FAULT MODE | FAULT SELECT | FAULT O/P STATE SELECT | OCMP INVERT |  | PWM DUTY CYCLE LSBs | | CASCADE 2 OC MODULES EN |
| 0 | 0 | 0 | 0 |  | 0 | 0 | 0 |
| FAULT UNTIL NEW PWM START | PWM LOW ON FAULT | PIN I/O UNAFFECTED BY FAULT | OC1 NOT INVERTED |  | OC1 FALLING EDGE OCCURS AT THE START OF INSTR CYCLE | | NO CASCADING |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| OCTRIG | TRIGSTAT | OCTRIS | SYNSEL4 | SYNSEL3 | SYNSEL2 | SYNSEL1 | SYNSEL0 |
| OC1 TRIGGER/SYNC SELECT | TIMER TRIGGER STATUS | OC1 O/P PIN DIRECTION | TRIGGER/SYNCHRONIZATION SOURCE SELECT BITS | | | | |
| 0 | 0 |  | 0 | 1 | 1 | 0 | 1 |
| SYNCHRONOUS WITH SYNSEL | T3 NOT TRIGGERED AND IS CLEAR | OC1 FUNCTION IS ON PIN OC1 | TIMER3 | | | | |

**Code Prg04.c**

/\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

Source code file: Prg04.c

Author, version, date: PSS ver 1.0 01.11.24

Program function: PWM RF8 LED1 RF7 LED2 RF6 LED3 RA14 LED4

Simulation: PIC24FJ128GA308 MCU, MPLAB X IDE ver 6.05, XC16 ver 2.10

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*/

/\*

PWM period = (PR3 + 1) \* Tcy \* timer prescale = (1 / 40 K) = (PR3 + 1) \* (1/16 M) \* 1; PR3 = 399

Duty cycle = 50% (200)

\*/

#include <xc.h>

#include <libpic30.h>

uint16\_t count **=** 0**;**

void initializePwm **(**void**);**

int main**()**

**{**

initializePwm**();**

**while** **(**1**);**

**}**

void initializePwm **(**void**)**

**{**

TRISF **=** 0x0000**;** // RF6 is set in output mode

LATF **=** 0x0040**;** // Set RF6 LED3 LOW initially

ANSB **=** 0x0000**;** // Pin 20 RB0(RP0) set in digital mode

TRISB **=** 0x0000**;** // Pin 20 RB0(RP0) set in output mode

RPOR0 **=** 0x0012**;** // Peripheral Pin Select-RP0(pin 20) defined as PWM output

// OC1 Output compare(Function 18)

T3CON **=** 0x8000**;** // Enable TMR3-TON(1), TCKPS(00)-1:1, T32(0)-16 bit timer,

// TCS(0)-internal clock-instr cycle = Fosc/2 = 16 MHz

PR3 **=** 400 **-** 1**;** // Set period for given bitrate

IFS0bits**.**T3IF **=** 0**;** // Clear interrupt flag

IEC0bits**.**T3IE **=** 1**;** // Enable TMR3 interrupt

IPC2bits**.**T3IP **=** 4**;** // TRIP<2:0> (100) default value

OC1R **=** OC1RS **=** 200**;** // Inititalize at 50% duty cycle

OC1CON1 **=** 0x0406**;** // OCTSEL(001)-T3, OCM(110)-edge aligned PWM mode on OC1

OC1CON2 **=** 0x000D**;** // SYNCSEL(01101)-T3 synchronous trigger mode, OCTRIG(0)-

// synchronous mode

**}**

void \_\_attribute\_\_**((**interrupt**,** shadow**,** no\_auto\_psv**))** \_T3Interrupt**(**void**)**

**{**

IFS0bits**.**T3IF **=** 0**;** // Clear T3 interrupt flag

count**++;**

**if** **(**count **>** 40000**)** // PWM period = (1/40K) = 25 us

**{**

count **=** 40000**;**

**if** **(**count **%** 2**)**

LATFbits**.**LATF6 **=** 0**;**// LED3 RF6 is turned ON once in two seconds

**else**

LATFbits**.**LATF6 **=** 1**;**// LED3 RF6 is turned OFF

**}**

**}**