EE461 Microprocessor-based Digital Design

Timer 0

Assignment 14 Solutions

1. A PIC16F874 with a crystal oscillator frequency f_{XTAL} = 12 MHz is to be used in a system that automatically loads 9 mm ammunition rounds into a 160-round bandolier. To accomplish this, the RA4/T0CI input of the PIC1 6 is connected to a sensor that detects each individual round as it passes through an optical sensing unit. Each time it detects such a round, it issues a low-going pulse to the PIC16.

   To make the hardware work correctly, your assistance is required. Use hexadecimal to show suitable initial contents for the registers TMR0, INTCON, and OPTION REG so that Timer 0 will increment once for every 32nd falling signal presented at theRA4/T0CI input and will generate an interrupt after the fifth such period has elapsed.

   It is essential that you explain all your choices thoroughly, using an intelligent combination of English statements and mathematics.

   SOLUTION

   Because the TMR0 register overflows when its contents change from FF_{16} to 0, we should initialize the counter to the value —5, which is 11111011_2 = FB_{16}. When the fifth increment occurs, the timer will roll over and force an interrupt.

   Producing a single increment of TMR0 for every 32 pulses requires that we set the prescalar rate to 1:32. We can accomplish this by setting the PS2:PS0 bits of OPTION _REG to 100_2.

   The prescalar bit PSA in OPTION REG needs to be a zero in order that the prescaler be assigned to the Timer 0 module.

   The source edge select bit T0SE should be a 1 in order to make the timer sensitive to falling input signals.

   The T0CS bit of OPTION REG should be a 1 to make sure that external signals on (T0CKI) will drive the counter.

   If the system is to be interrupt driven, we need to set the GIE bit of the INTCON register to enable interrupts globally and we also need to set the TMR01E interrupt enable bit to permit Timer 0 to generate interrupts. The

INTF bit should be clear initially to ensure that no spurious interrupt is recognized. The PEIE is immaterial and can be made 0.

To summarize:

Register	Field	Value	Contents
TMR0			FB_{16}
INTCON	GIE	1	$10100000_2 = A0_{16}$
	PEIE	0	
	TMR0IE	1	
	TMR0IF	0	
OPTION REG	T0CS	1	$00110100 = 34_{16}$
	T0SE	1	
	PSA	0	
	PS2:PS0	100_2	