Vinh Khoa Ton October 22, 2014

Unsigned 16-bit Multiply 8-bit result in 24-bit number

Write a program to multiply a 16-bit unsigned number in the r25:r24 register pair by an 8-bit number in r26.return the answer in r4:r3:r2

 $r4:r3:32 = r25:r24 \times r26$

Simulation of the multiplication problem 10,000x250. The answer should equal 2,500,000 (0x2625A0).

```
Watch
.INCLUDE <m328pdef.inc>
                                              Value
                               Name
                                                          Type
                                                                             Location
muls16x8_24_test:
                                             0x27 '''
                                  R25
                                                          Register
                                                                             R25
     ldi r25,HIGH(10000);
                                             0x00 ''
                                  R24
                                                          Register
                                                                             R24
     ldi r24,LOW(10000)
                                  R26
                                             0x00 ''
                                                          Register
                                                                             R26
     ldi r26,250
                                  R4
                                             0x00 ''
                                                          Register
                                                                             R4
     rcall muls16x8_24
                                             0x00 ''
                                  R3
                                                                             R3
                                                          Register
     rjmp muls16x8_24_test
                                             0x00 ''
                                                          Register
```

Figure 1: Start of program with r25 initialized to 0x27

```
Watch
.INCLUDE <m328pdef.inc>
                               Name
                                              Value
                                                           Type
                                                                              Location
muls16x8_24_test:
                                              0x27 '''
                                                                             R25
                                   R25
                                                          Register
     ldi r25,HIGH(10000);
                                   R24
                                              0x10 '+'
                                                          Register
                                                                             R24
     ldi r24,LOW(10000)
                                   R26
                                              0x00 ''
                                                                             R26
                                                          Register
                                                                                    Ξ
     ldi r26,250
                                              0x00 ''
                                   R4
                                                          Register
                                                                             R4
     rcall muls16x8_24
                                   R3
                                              0x00 ''
                                                                             R3
                                                          Register
     rjmp muls16x8_24_test
                                   R2
                                              0x00 ''
                                                                             R2
                                                          Register
```

Figure 2: variable r24 is initialized to 0x10. Now r25:r24 is 0x2710 ($10,000_{10}$)

```
Watch
.INCLUDE <m328pdef.inc>
                                              Value
                               Name
                                                           Type
                                                                             Location
muls16x8_24_test:
                                             0x27 '''
                                   R25
                                                                             R25
                                                          Register
     ldi r25,HIGH(10000);
                                              0x10 '+'
                                   R24
                                                          Register
                                                                             R24
    ldi r24,LOW(10000)
                                   R26
                                                                             R26
                                             0xFA 'ú'
                                                          Register
    ldi r26,250
                                   R4
                                             0x00 ''
                                                                             R4
                                                          Register
    rcall muls16x8_24
                                             0x00 ''
                                   R3
                                                          Register
                                                                             R3
    rjmp muls16x8_24_test
                                             0x00 ''
                                                                             R2
                                                          Register
```

Figure 3: variable r26 is initialized to 0xFA (250₁₀)

.INCLUDE <m328pdef.inc></m328pdef.inc>	Watch				×
_	Name	Value	Туре	Location	
muls16x8_24_test: ldi r25,HIGH(10000); ldi r24,LOW(10000); ldi r26,250; rcall muls16x8_24; rjmp muls16x8_24_test	R25	0x27 '''	Register	R25	
	R24	0x10 '+'	Register	R24	≡
	R26	0xFA 'ú'	Register	R26	
	R4	0x26 '&'	Register	R4	
	R3	0x25 '%'	Register	R3	
	R2	0xA0 ' '	Register	R2	$\overline{\mathbf{v}}$

Figure 4: End of program with the result is 0x2625A0(2,500,000₁₀) containing in r4:r3:r2 registers