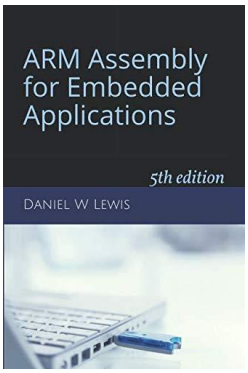


Programming Lab 8C

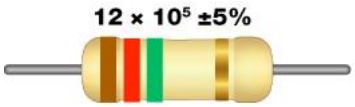
Resistor Color Codes

Click to download Lab8C-Main.c

Topics: Replacing division by reciprocal multiplication, replacing multiplication by a sequence of addition, subtraction and shift instructions.

Prerequisite Reading: Chapters 1-8
Revised: December 29, 2020

***Background*[1]:** Resistors use color bands to identify their value (in ohms) and a percentage tolerance. In 1952, the code was standardized by the International Electrotechnical Commission (IEC) in IEC 62:1952 and since 1963 also published as EIA (Electronic Industries Alliance) RS-279. Originally only meant to be used for fixed resistors, the color code was extended to also cover capacitors with IEC 62:1968.

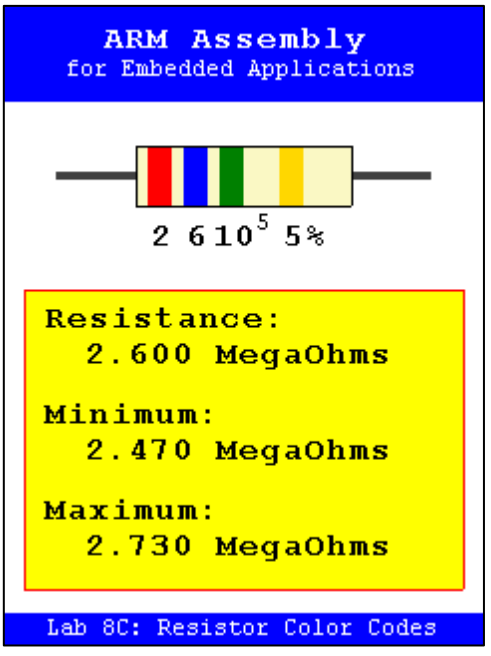


Color	1st Band	2nd Band	3rd Band (Multiplier)	4th Band (Tolerance)
Black	0	0	10^0	
Brown	1	1	10^1	
Red	2	2	10^2	
Orange	3	3	10^3	
Yellow	4	4	10^4	
Green	5	5	10^5	
Blue	6	6	10^6	
Violet	7	7	10^7	
Gray	8	8	10^8	
White	9	9	10^9	
Gold				±5%
Silver				±10%
No Color				±20%

To distinguish left from right there is a gap between the last two bands. The most common type of resistors has four color bands; the two left-most bands specify the two most-significant digits of the resistance, the third band specifies a multiplier (the number of trailing zeros), and the fourth specifies the percentage tolerance. If there is no fourth band, the tolerance is ±20%. (Although not considered here, resistors that require more precision use an additional band for a third significant digit.)

Assignment: The main program may be compiled and executed without writing any assembly. However, your task is to create alternative assembly language replacements for the three C functions shown below that translate the color code into a resistance value. The original C functions are defined as "weak", so that the linker will automatically replace them in the executable image by those you create in assembly; you do not need to remove the C version.

```
uint32_t Mul32X10(uint32_t multiplicand) ;
uint64_t Mul64X10(uint64_t multiplicand) ;
uint32_t Div32X10(uint32_t dividend) ;
```



The first function (`Mul32X10`) returns the 32-bit unsigned product of ten times its 32-bit argument, the second (`Mul64X10`) returns the 64-bit unsigned product of ten times its 64-bit argument, and the third (`Div32X10`) returns the 32-bit unsigned quotient of its argument divided by 10.

Important: Unlike the C versions of these functions, the objectives of this assignment are to (1) implement the first two functions without using a multiply instruction, and (2) to implement the third function without a divide instruction. No loops, `IT` blocks, or conditional branch instructions are allowed. Use this webpage to find instruction sequences to perform ***unsigned*** division by a constant.

Test your code with the main program. Touching any of the color bands on the displayed resistor changes the color of that band and thus the displayed values.

[1] Adapted from https://en.wikipedia.org/wiki/Electronic_color_code