

## Lab 5: 8-bit Signed Number Multiply

The purpose of this lab is to design and implement a program that multiplies two 8-bit signed numbers using the partial product-shift algorithm we discussed in class. This program is much more complicated than your four-function calculator because now we are dealing with *signed* numbers. Do not simply sum the multiplicand within a loop over the multiplier, and do not use the MUL function. The input numbers will range from -128 to +127, so you must be sure to have the correct sign in the result.

Include a program description and flow chart in your report, and a well-commented program listing.

**Prelab:** Design the logic for your program, including the sign manipulation for the result and the partial product-shift algorithm. This is the most difficult part of this exercise, and you will NOT complete the assignment if you wait to do this in lab! You will probably need to read and write 16-bit numbers in memory, so the instructions LDD, LDX, STD, and STX will be useful. You may want to also investigate the ADDD, SUBD, and LSLD instructions.

Implement and test your program using *AS11* and *Wookie*, the software tools introduced in Lab 3. Test your design by computing the hexadecimal products of these 8-bit signed numbers:

$$\text{\$17} \times \text{\$2D} = ?$$

$$\text{\$D3} \times \text{\$17} = ?$$

$$\text{\$80} \times \text{\$7F} = ?$$

$$\text{\$81} \times \text{\$81} = ?$$

Include the results of these tests in your lab report, along with the decimal equivalents of the equations.

**Lab Work:** Demonstrate your working program to the TA using the four test equations above. Also demonstrate the program using numbers picked by the TA.