

ARM Instructions Worksheet #10**SIMD and Saturating Instructions**

Prerequisite Reading: Chapter 11

Revised: April 20, 2020

Objectives: To use the web-based simulator ("CPULator") to better understand ...

1. The operation of saturating instructions (USAT, SSAT)
2. The operation of non-saturating a SIMD add instruction (UADD16)
3. The operation of saturating a SIMD add instruction (UQADD16)
4. The operation of SIMD multiply instructions (SMUAD, SMUADX)

To do offline: Answer the questions that follow the listing below. (Numbers at far left are memory addresses.)

```

                .syntax      unified
                .global      _start

00000000  _start:  LDR          R0,=10000          // *** EXECUTION BEGINS HERE ***
00000004          USAT          R2,10,R0
00000008          SSAT          R3,10,R0

0000000C          LDR          R0,=0x10011001
00000010          LDR          R1,=0xF00F800F
00000014          UADD16       R2,R0,R1
00000018          UQADD16     R3,R0,R1

0000001C          LDR          R0,=0x00030005
00000020          LDR          R1,=0x00070009
00000024          SMUAD        R2,R0,R1
00000028          SMUADX       R3,R0,R1

0000002C  done:   B           done          // Infinite loop

                .end

```

What is left in register R0 after executing the LDR instruction at 00000000₁₆?

R0 (hexadecimal)

What is left in register R2 after executing the USAT instruction at 00000004₁₆?

R2 (unsigned decimal)

What is left in register R3 after executing the SSAT instruction at 00000008₁₆?

R3 (signed decimal)

What is left in register R0 after executing the LDR instruction at 0000000C₁₆?

R0 (as hexadecimal)

What is left in register R1 after executing the LDR instruction at 00000010₁₆?

R1 (as hexadecimal)

What is left in register R2 after executing the UADD16 instruction at 00000014₁₆?

What is left in register R3 after executing the UQADD16 instruction at 00000018₁₆?

What is left in register R0 after executing the LDR instruction at 0000001C₁₆?

What is left in register R0 after executing the LDR instruction at 00000020₁₆?

What is left in register R0 after executing the SMUAD instruction at 00000024₁₆?

What is left in register R0 after executing the SMUADX instruction at 00000028₁₆?

Getting ready: Now use the simulator to collect the following information and compare to your earlier answers.

1. Click [here](#) to open a browser for the ARM instruction simulator with pre-loaded code.

Step 1: Press F2 exactly 3 times to execute the LDR, USAT, SSAT instruction sequence.

What is left in register R0 after executing the LDR instruction at 00000000₁₆?

What is left in register R2 after executing the USAT instruction at 00000004₁₆?

What is left in register R3 after executing the SSAT instruction at 00000008₁₆?

Step 2: Press F2 exactly 4 times to execute the LDR, LDR, UADD16, UQADD16 instruction sequence.

What is left in register R0 after executing the LDR instruction at 0000000C₁₆?

What is left in register R1 after executing the LDR instruction at 00000010₁₆?

What is left in register R2 after executing the UADD16 instruction at 00000014₁₆?

What is left in register R3 after executing the UQADD16 instruction at 00000018₁₆?

Step 3: Press F2 exactly 4 times to execute the LDR, LDR, SMUAD, SMUADX instruction sequence.

What is left in register R0 after executing the LDR instruction at 0000001C₁₆?

What is left in register R0 after executing the LDR instruction at 00000020₁₆?

What is left in register R0 after executing the SMUAD instruction at 00000024₁₆?

What is left in register R0 after executing the SMUADX instruction at 00000028₁₆?