

## LAB Atmel Studio Part 2-3

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Section: 02

### Program03

program3 (Debugging) - AtmelStudio

Standard Mode Quick Launch (Ctrl+Q)

File Edit View Project Build Debug Tools Help

Debug ATmega328P Simulator

Processor Status

Name	Value
R00	0x00
R01	0x00
R02	0x00
R03	0x00
R04	0x00
R05	0x00
R06	0x00
R07	0x00
R08	0x00
R09	0x00
R10	0x00
R11	0x00
R12	0x00
R13	0x00
R14	0x00
R15	0x00
R16	19
R17	33
R18	241
R19	28
R20	231
R21	67
R22	241
R23	52
R24	0x00
R25	0x00
R26	0x00
R27	0x00

Disassembly program3 main.asm

```
.include "m328pdef.inc"

.DEF VAR_A = R16
.DEF VAR_B = R17
.DEF VAR_C = R18
.DEF VAR_D = R19
.DEF VAR_E = R20
.DEF VAR_F = R21
.DEF VAR_G = R22
.DEF VAR_H = R23

.CSEG
.ORG 0x00
rjmp RESET

RESET: ldi VAR_A, 20
ldi VAR_B, 32
ldi VAR_C, 70
ldi VAR_D, 3
mov VAR_F, VAR_C
sub VAR_F, VAR_D
mov VAR_H, VAR_A
add VAR_H, VAR_B
mov VAR_C, VAR_H
sub VAR_C, VAR_F
mov VAR_E, VAR_C
subi VAR_E, 10
inc VAR_B
mov VAR_G, VAR_C
sub VAR_D, VAR_E
dec VAR_A

END: rjmp END

.DSEG
.ESEG
```

I/O

Filter:

Name Value

- Analog Comparator (AC)
- Analog-to-Digital Convert...
- CPU Registers (CPU)
- EEPROM (EEPROM)
- External Interrupts (EXINT)
- I/O Port (PORTB)
- I/O Port (PORTC)
- I/O Port (PORTD)
- Serial Peripheral Interface (...)
- Timer/Counter, 16-bit (TC1)
- Timer/Counter, 8-bit (TC0)
- Timer/Counter, 8-bit Asyn...
- Two Wire Serial Interface (...)
- USART (USART0)
- Watchdog Timer (WDT)

Watch 1

Name	Value	Type
------	-------	------

Memory 4

Memory: data IRAM Address: 0x0000,data

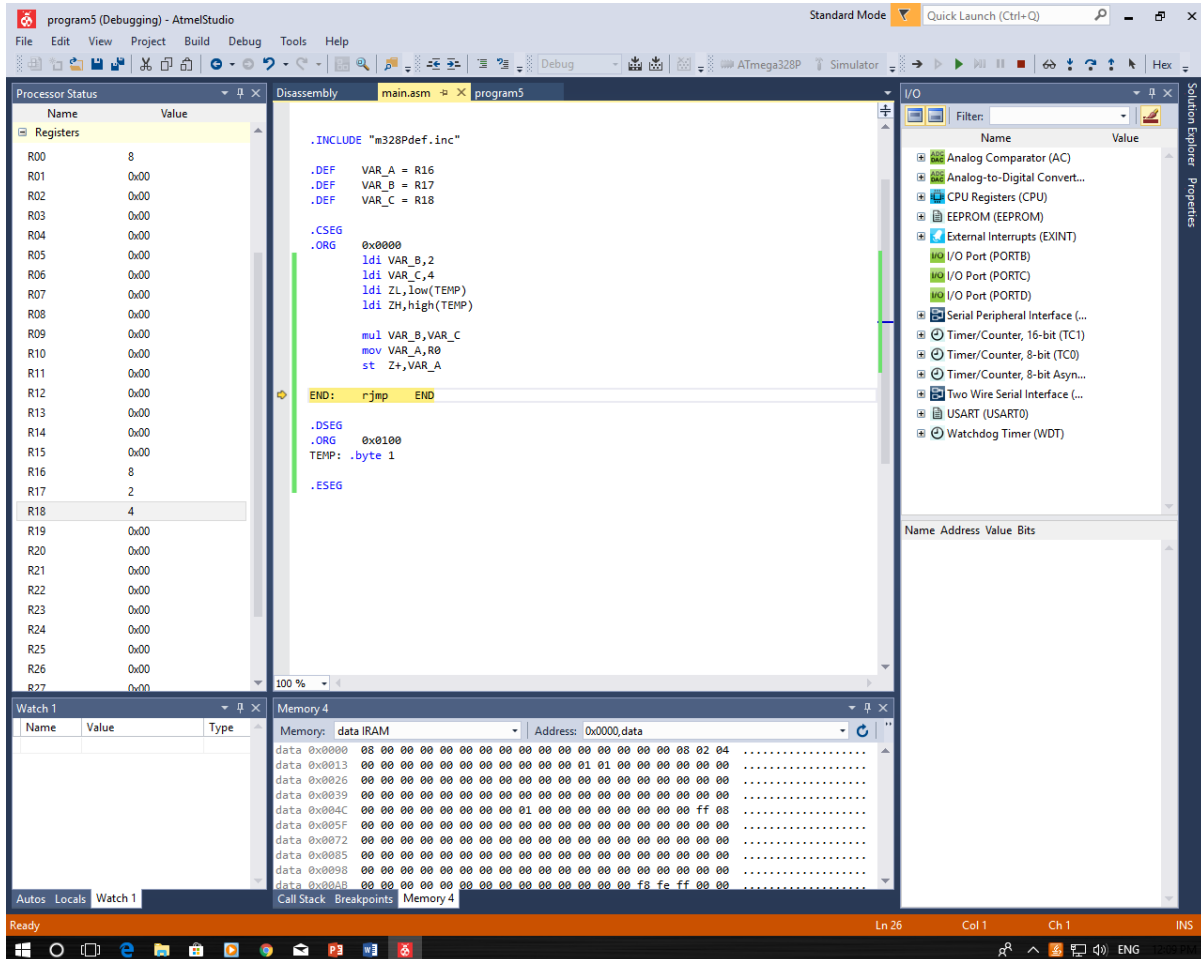
Address	Value
data 0x0000	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
data 0x0010	19 33 241 28 231 67 241 52 0 0 0 0 0 0 0 0
data 0x0020	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
data 0x0030	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
data 0x0040	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
data 0x0050	0 0 0 0 1 0 0 0 0 0 0 0 0 255 8 33
data 0x0060	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
data 0x0070	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
data 0x0080	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

Autos Locals Watch 1

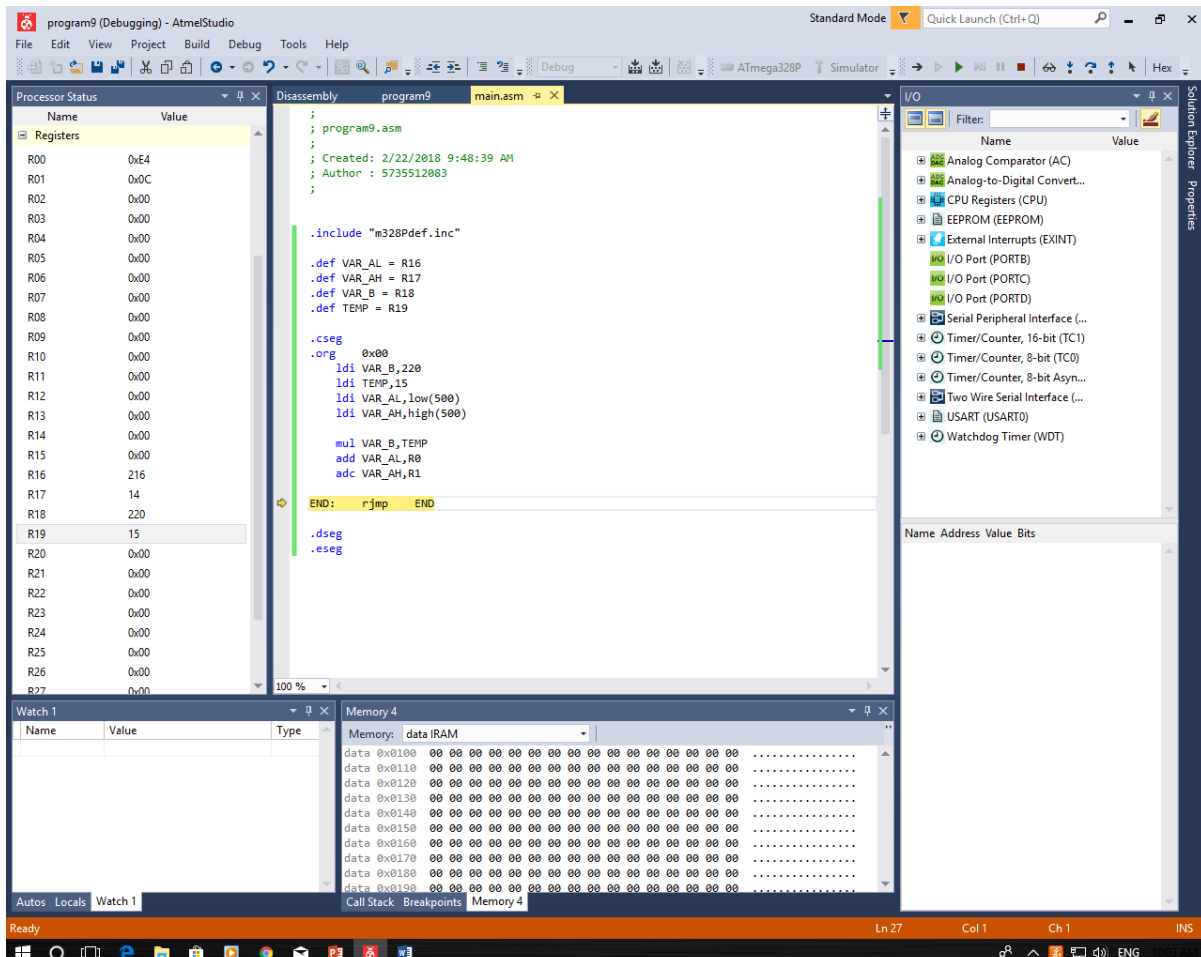
Call Stack Breakpoints Memory 4

Ln 41 Col 1 Ch 1 INS

## Program05



## Program09



## Program09 (SRAM)

**Processor Status**

Name	Value
R00	228
R01	216
R02	14
R03	220
R04	0x00
R05	0x00
R06	0x00
R07	0x00
R08	0x00
R09	0x00
R10	0x00
R11	0x00
R12	0x00
R13	0x00
R14	0x00
R15	0x00
R16	216
R17	14
R18	220
R19	15
R20	0x00
R21	0x00
R22	0x00
R23	0x00
R24	0x00
R25	0x00
R26	0x04
R27	0x00

**Disassembly**

```

#include "m328Pdef.inc"

.def VAR_AL = R16
.def VAR_AH = R17
.def VAR_B = R18
.def TEMP = R19

.cseg
.org 0x00
ldi VAR_B,220
ldi TEMP,15
ldi VAR_AL,low(500)
ldi VAR_AH,high(500)

mul VAR_B,TEMP
add VAR_AL,R0
adc VAR_AH,R1

ldi XL,low(pointerA)
ldi XL,high(pointerA)

st X+,VAR_AL
st X+,VAR_AH
st X+,VAR_B

END: rjmp END

.dseg
.org 0x100
pointerA: .byte 2
pointerB: .byte 1
.eseg
    
```

**Watch 1**

Name	Value	Type
------	-------	------

**Memory 4**

Address	0x0000	0x0001	0x0002	0x0003	0x0004	0x0005	0x0006	0x0007	0x0008	0x0009	0x000A	0x000B	0x000C	0x000D	0x000E	0x000F	0x0010	0x0011	0x0012	0x0013	0x0014	0x0015	0x0016	0x0017	0x0018	0x0019	0x001A	0x001B	0x001C	0x001D	0x001E	0x001F
data 0x0000	228	216	14	220	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
data 0x0010	216	14	220	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
data 0x0020	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
data 0x0030	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
data 0x0040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
data 0x0050	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	255	8	0	0	0	0	0	0	0	0	0	0	0	0	0	
data 0x0060	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
data 0x0070	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
data 0x0080	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

**Solution Explorer**

- Analog Comparator (AC)
- Analog-to-Digital Convert...
- CPU Registers (CPU)
- EEPROM (EEPROM)
- External Interrupts (EXINT)
- I/O Port (PORTB)
- I/O Port (PORTC)
- I/O Port (PORTD)
- Serial Peripheral Interface (...)
- Timer/Counter, 16-bit (TC1)
- Timer/Counter, 8-bit (TC0)
- Timer/Counter, 8-bit Asyn...
- Two Wire Serial Interface (...)
- USART (USART0)
- Watchdog Timer (WDT)

## Program12

**Processor Status**

Name	Value
R00	156
R01	255
R02	0x00
R03	0x00
R04	0x00
R05	0x00
R06	0x00
R07	0x00
R08	0x00
R09	0x00
R10	0x00
R11	0x00
R12	0x00
R13	0x00
R14	0x00
R15	0x00
R16	156
R17	100
R18	255
R19	0x00
R20	0x00
R21	0x00
R22	0x00
R23	0x00
R24	0x00
R25	0x00
R26	0x00
R27	0x00

**Disassembly**

```

.INCLUDE "m328Pdef.inc"

.DEF VAR_A = R16
.DEF VAR_B = R17
.DEF VAR_C = R18
.DEF TEMP = R19

.CSEG
.ORG 0x00
ldi VAR_A,-10
ldi VAR_B,100

cp VAR_A,VAR_B
brlt LESS ; a<b
breql EQUAL ; a=b
brgt MORE ; a>b

LESS: ldi VAR_C,-1
rjmp ENDIF

EQUAL: ldi VAR_C,0
rjmp ENDIF

MORE: ldi VAR_C,1

ENDIF: muls VAR_B,VAR_C
mov VAR_A,R0

END: rjmp END

.DSEG
.ESEG
    
```

**Watch 1**

Name	Value	Type
------	-------	------

**Memory 4**

Address	0x0000	0x0001	0x0002	0x0003	0x0004	0x0005	0x0006	0x0007	0x0008	0x0009	0x000A	0x000B	0x000C	0x000D	0x000E	0x000F	0x0010	0x0011	0x0012	0x0013	0x0014	0x0015	0x0016	0x0017	0x0018	0x0019	0x001A	0x001B	0x001C	0x001D	0x001E	0x001F
data 0x0000	9c	ff	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
data 0x0013	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
data 0x0026	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
data 0x0039	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
data 0x004C	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
data 0x005F	15	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
data 0x0072	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
data 0x0085	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
data 0x0098	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
data 0x00AB	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	

**Solution Explorer**

- Analog Comparator (AC)
- Analog-to-Digital Convert...
- CPU Registers (CPU)
- EEPROM (EEPROM)
- External Interrupts (EXINT)
- I/O Port (PORTB)
- I/O Port (PORTC)
- I/O Port (PORTD)
- Serial Peripheral Interface (...)
- Timer/Counter, 16-bit (TC1)
- Timer/Counter, 8-bit (TC0)
- Timer/Counter, 8-bit Asyn...
- Two Wire Serial Interface (...)
- USART (USART0)
- Watchdog Timer (WDT)

## Program13

program19 (Debugging) - AtmelStudio

Standard Mode Quick Launch (Ctrl+Q)

File Edit View Project Build Debug Tools Help

Debug ATmega328P Simulator

Processor Status

Name	Value
R03	0x00
R04	0x00
R05	0x00
R06	0x00
R07	0x00
R08	0x00
R09	0x00
R10	0x00
R11	0x00
R12	0x00
R13	0x00
R14	0x00
R15	0x00
R16	16
R17	5
R18	4
R19	17
R20	0x00
R21	0x00
R22	0x00
R23	0x00
R24	0x00
R25	0x00
R26	14
R27	1
R28	0x00
R29	0x00
R30	0x00
R31	0x00

Disassembly program19 main.asm

```

.INCLUDE "m328Pdef.inc"

.DEF VAR_A = R16
.DEF VAR_B = R17
.DEF VAR_CL = R18
.DEF VAR_CH = R19
.DEF TEMP = R20

.CSEG
.ORG 0x00
ldi XL,low(pointerA)
ldi XH,high(pointerA)
ld VAR_A,X+
ld VAR_B,X+
ld VAR_CL,X+
ld VAR_CH,X+

ldi TEMP,0
cp VAR_B,VAR_A
brsh TRUE ; b>=a
rjmp FALSE

TRUE: add VAR_CL,VAR_A
      adc VAR_CH,TEMP
      rjmp ENDIF

FALSE: add VAR_CL,VAR_B
      adc VAR_CH,TEMP

ENDIF: ldi XL,low(pointerC)
      ldi XH,high(pointerC)
      st X+,VAR_CL
      st X+,VAR_CH

END: rjmp END

.DSEG
.ORG 0x10A
    
```

I/O

Name	Value
Analog Comparator (AC)	
Analog-to-Digital Convert...	
CPU Registers (CPU)	
EEPROM (EEPROM)	
External Interrupts (EXINT)	
I/O Port (PORTB)	
I/O Port (PORTC)	
I/O Port (PORTD)	
Serial Peripheral Interface (...)	
Timer/Counter, 16-bit (TC1)	
Timer/Counter, 8-bit (TC0)	
Timer/Counter, 8-bit Asyn...	
Two Wire Serial Interface (...)	
USART (USART0)	
Watchdog Timer (WDT)	

Watch 1

Name	Value	Type

Memory 4

Address	Value
0x010A	10 05 04 11 00 00 00 00 00 00 00 00 00 00 00 00
0x011D	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0130	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0143	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0156	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0169	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x017C	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x018F	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x01A2	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x01B5	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

Autos Locals Watch 1

Ready Ln 43 Col 1 Ch 1 INS

## Program17

program17 (Debugging) - AtmelStudio

Standard Mode Quick Launch (Ctrl+Q)

File Edit View Project Build Debug Tools Help

Debug ATmega328P Simulator

Processor Status

Name	Value
R00	0x00
R01	0x00
R02	0x00
R03	0x00
R04	0x00
R05	0x00
R06	0x00
R07	0x00
R08	0x00
R09	0x00
R10	0x00
R11	0x00
R12	0x00
R13	0x00
R14	0x00
R15	0x00
R16	254
R17	49
R18	0x00
R19	0x00
R20	0x00
R21	0x00
R22	0x00

Disassembly program17 main.asm

```

.INCLUDE "m328Pdef.inc"

.DEF VAR_A = R16
.DEF VAR_B = R17
.DEF VAR_CL = R18
.DEF VAR_CH = R19
.DEF TEMP = R20

.CSEG
.ORG 0x00
ldi VAR_B,0xFF ; 255
ldi VAR_A,30

FOR: cpi VAR_A,10
      brsh LOOP
      rjmp ENDFOR

LOOP: lsl VAR_A ; a = a*2
      add VAR_B,VAR_A
      brcc ENDF ; C = 0
      clr VAR_A ; C = 1

ENDFOR: dec VAR_A
      rjmp FOR

ENDLOOP: inc VAR_A

END: rjmp END

.DSEG
.ORG 0x10A
;pointerA: .byte 1
;pointerB: .byte 1
;pointerC: .byte 2

.ESEG
    
```

I/O

Name	Value
Analog Comparator (AC)	
Analog-to-Digital Convert...	
CPU Registers (CPU)	
EEPROM (EEPROM)	
External Interrupts (EXINT)	
I/O Port (PORTB)	
I/O Port (PORTC)	
I/O Port (PORTD)	
Serial Peripheral Interface (...)	
Timer/Counter, 16-bit (TC1)	
Timer/Counter, 8-bit (TC0)	
Timer/Counter, 8-bit Asyn...	
Two Wire Serial Interface (...)	
USART (USART0)	
Watchdog Timer (WDT)	

Watch 1

Name	Value	Type

Memory 4

Address	Value
0x0000	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0013	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0026	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0039	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x004C	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x005F	21 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0072	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0085	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0098	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x00AB	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

Autos Locals Watch 1

Ready Ln 29 Col 1 Ch 1 INS

## Program18

**Processor Status**

Name	Value
negloset	00000000
Status Register	00000000
Cycle Counter	57
Frequency	1,000 MHz
Stop Watch	57.00 µs
<b>Registers</b>	
R00	5
R01	0x00
R02	0x00
R03	0x00
R04	0x00
R05	0x00
R06	0x00
R07	0x00
R08	0x00
R09	0x00
R10	0x00
R11	0x00
R12	0x00
R13	0x00
R14	0x00
R15	0x00
R16	1
R17	2
R18	5
R19	0x00
R20	8
R21	5
R22	0x00

**Disassembly** (main.asm)

```

.INCLUDE "m328Pdef.inc"

.DEF VAR_A = R16
.DEF VAR_B = R17
.DEF VAR_CL = R18
.DEF VAR_CH = R19
.DEF VAR_D = R20
.DEF VAR_E = R21

.CSEG
.ORG 0x00
ldi VAR_CL,1
ldi VAR_CH,0
ldi VAR_A,1
ldi VAR_B,2
ldi VAR_D,10
ldi VAR_E,5

LOOP: mul VAR_A,VAR_E
      movw VAR_CL,R0
      sub VAR_D,VAR_B
      cp VAR_A,VAR_B
      brsh LOOP

END: rjmp END

.DSEG
.ESEG
    
```

**Watch 1**

Name	Value	Type

**Memory 4** (data IRAM)

Address	Value
0x0100	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0113	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0126	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0139	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x014C	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x015F	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0172	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0185	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0198	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x01AB	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

**I/O**

Name	Value
Analog Comparator (AC)	
Analog-to-Digital Convert...	
CPU Registers (CPU)	
EEPROM (EEPROM)	
External Interrupts (EXINT)	
I/O Port (PORTB)	
I/O Port (PORTC)	
I/O Port (PORTD)	
Serial Peripheral Interface (...)	
Timer/Counter, 16-bit (TC1)	
Timer/Counter, 8-bit (TC0)	
Timer/Counter, 8-bit Asyn...	
Two Wire Serial Interface (...)	
USART (USART0)	
Watchdog Timer (WDT)	

## Program19

**Processor Status**

Name	Value
<b>Registers</b>	
R00	27
R01	0x00
R02	0x00
R03	0x00
R04	0x00
R05	0x00
R06	0x00
R07	0x00
R08	0x00
R09	0x00
R10	0x00
R11	0x00
R12	0x00
R13	0x00
R14	0x00
R15	0x00
R16	15
R17	27
R18	3
R19	3
R20	0x00
R21	0x00
R22	0x00
R23	0x00
R24	0x00
R25	0x00
R26	0x00
R27	0x00

**Disassembly** (main.asm)

```

.INCLUDE "m328Pdef.inc"

.DEF VAR_A = R16
.DEF VAR_B = R17
.DEF VAR_I = R18
.DEF TEMP = R19

.CSEG
.ORG 0x00
ldi VAR_A,15
ldi VAR_B,1
ldi VAR_I,0
ldi TEMP,3

WHILE: cp VAR_B,VAR_A
      brlt LOOP
      rjmp ENDL0OP

LOOP: muls VAR_B,TEMP
      mov VAR_B,R0
      inc VAR_I
      rjmp WHILE

ENDL0OP:

END: rjmp END

.DSEG
.ESEG
    
```

**Watch 1**

Name	Value	Type

**Memory 4** (data IRAM)

Address	Value
0x010A	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x011D	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0130	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0143	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0156	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x0169	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x017C	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x018F	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x01A2	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0x01B5	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

**I/O**

Name	Value
Analog Comparator (AC)	
Analog-to-Digital Convert...	
CPU Registers (CPU)	
EEPROM (EEPROM)	
External Interrupts (EXINT)	
I/O Port (PORTB)	
I/O Port (PORTC)	
I/O Port (PORTD)	
Serial Peripheral Interface (...)	
Timer/Counter, 16-bit (TC1)	
Timer/Counter, 8-bit (TC0)	
Timer/Counter, 8-bit Asyn...	
Two Wire Serial Interface (...)	
USART (USART0)	
Watchdog Timer (WDT)	