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Code:

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.INCLUDE "m128def.inc"
	.EQU ZEROS = 0x00
	.EQU ONES = 0xFF

	.EQU INTN_START = 0x0100		; starting address for the stack
	.EQU INTN_END = 0x10FF

	.EQU EXTN_START = 0x1100
	.EQU EXTN_END = 0x18FF			; ending address for the stack
	.EQU addr = 0x0000			; defining an initial address at the
beginning to put the entered address into it later

	.CSEG
	.ORG 0x0050		; starting address for the program



start:
	 LDI R16, ZEROS
	 OUT DDRA, R16			; A - input (3-bit data input sequence)
	 OUT DDRB, R16			; B - input (8-bit binary input sequence)
	 OUT DDRC, R16			; C - input (save button)
	 OUT DDRE, R16			; E - input (high byte of the address)
	 STS DDRF, R16			; F - input (low byte of the address)

	 LDI R16, ONES
	 OUT DDRD, R16			; D - output (error detection led)
	 STS DDRG, R16			; G - output (External SRAM)

	 IN R17, PINA
	 IN R18, PINB
	 LDI R19, ZEROS
	 ADD R19, R17
	 LDI R16, ZEROS
	 ADD R16, R18

	 ANDI R19, 0b11100000	; masking the 3-input input in R19
	 LDI R20, 0b00110101	; CRC polynomial given (X5+X4+X2+1) filled with 2 0's
at the end
	 EOR R18, R20			; subtraction operation by using XOR
	 EOR R18, R20			; subtraction operation by using XOR
	 ANDI R18, 0b00011111	; masking the value in R18, remainder, to combine with
input A		; shift right 3 times in total to get 3-bits at the least
significant bits

	 OR R18, R19		; R18 gets the value that filled with the value in R17
	 CP R16, R18		; compare the entered input and the transmitted one at
the end
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         BRNE L1                        ; if they are nor equal, go to branch L1
         RJMP L2                        ; else, no error so branch to L1

         L1:
           SBI PORTD, 1
         L2:
           SBI PORTD, 0
              RJMP NO_ERROR


        NO_ERROR:
               IN R17, PINE ; high byte for the memory - 8 bits
               IN R19, PINF ; low byte for the memory - 8 bits

               LDI R21, HIGH(INTN_START)        ; R21 = 0x01
               LDI R22, HIGH(EXTN_END)          ; R22 = 0x18
               CP R17, R22
               BRLT CONTROL_ADDR                        ; if valid for the high limit,
branch to CONTROL_ADDR to check the low limit
               RJMP INVALID_ADDR                        ; if not, go to INVALID_ADDR

              INVALID_ADDR:
                     RJMP start                                 ; go back to the beginning
of the program


              CONTROL_ADDR:                             ; check the low limit and branch
to VALID_ADDR for further operations
                     CP R17, R21
                     BRGE VALID_ADDR


              VALID_ADDR:
                     LDI R16, 0x01
                     IN R20, PINC         ; save button
                     CP R16, R20                ; check if save button is pushed
                     BREQ EXT_MEMORY            ; if yes, go to EXT_MEMORY for further
checks and to save
                     RJMP INT_MEMORY            ; if not, go to INT_MEMORY for further
checks and to save


              EXT_MEMORY:          ; X register will be used for the external memory
                     LDI R16, HIGH(EXTN_START)
                     CP R17, R16                        ; compare the high of start
address with the high of entered memory address (in port E - R17)
                     BRLT INVALID_ADDR          ; invalid address for external memory
                     CP R17, R22                        ; comparing the high of end
address with the high of entered memory address (R17)
                     BRGE INVALID_ADDR

                     STS addr, R19              ; storing the value in R19 into addr as
the low bytes
                     STS addr+1, R17                    ; storing the value in R17 into
addr+1 as the high bytes
                     LDS XL, addr               ; loading the value in addr into XL which
is located at R26
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                    LDS XH, addr+1                  ; loading the value in addr into
XH which is located at R27
                    ST X, R18                       ; storing the value into the X
                    RJMP start

             INT_MEMORY:          ; Y register will be used for the internal memory
                    LDI R16, HIGH(INTN_END)
                    CP R17, R21                     ; compare the low of start address
with the low of entered memory address (in port E - R17)
                    BRLT INVALID_ADDR           ; invalid address for internal memory
                    CP R16, R17                     ; comparing the high of end
address with the high of entered memory address (R17)
                    BRLT INVALID_ADDR

                    STS addr, R19               ; storing the value in R19 into addr as
the low bytes
                    STS addr+1, R17                 ; storing the value in R17 into
addr+1 as the high bytes
                    LDS YL, addr                ; loading the value in addr into YL which
is located at R28
                    LDS YH, addr+1                  ; loading the value in addr into
YH which is located at R29
                    ST Y, R18                       ; storing the value to the Y

             RJMP start
```

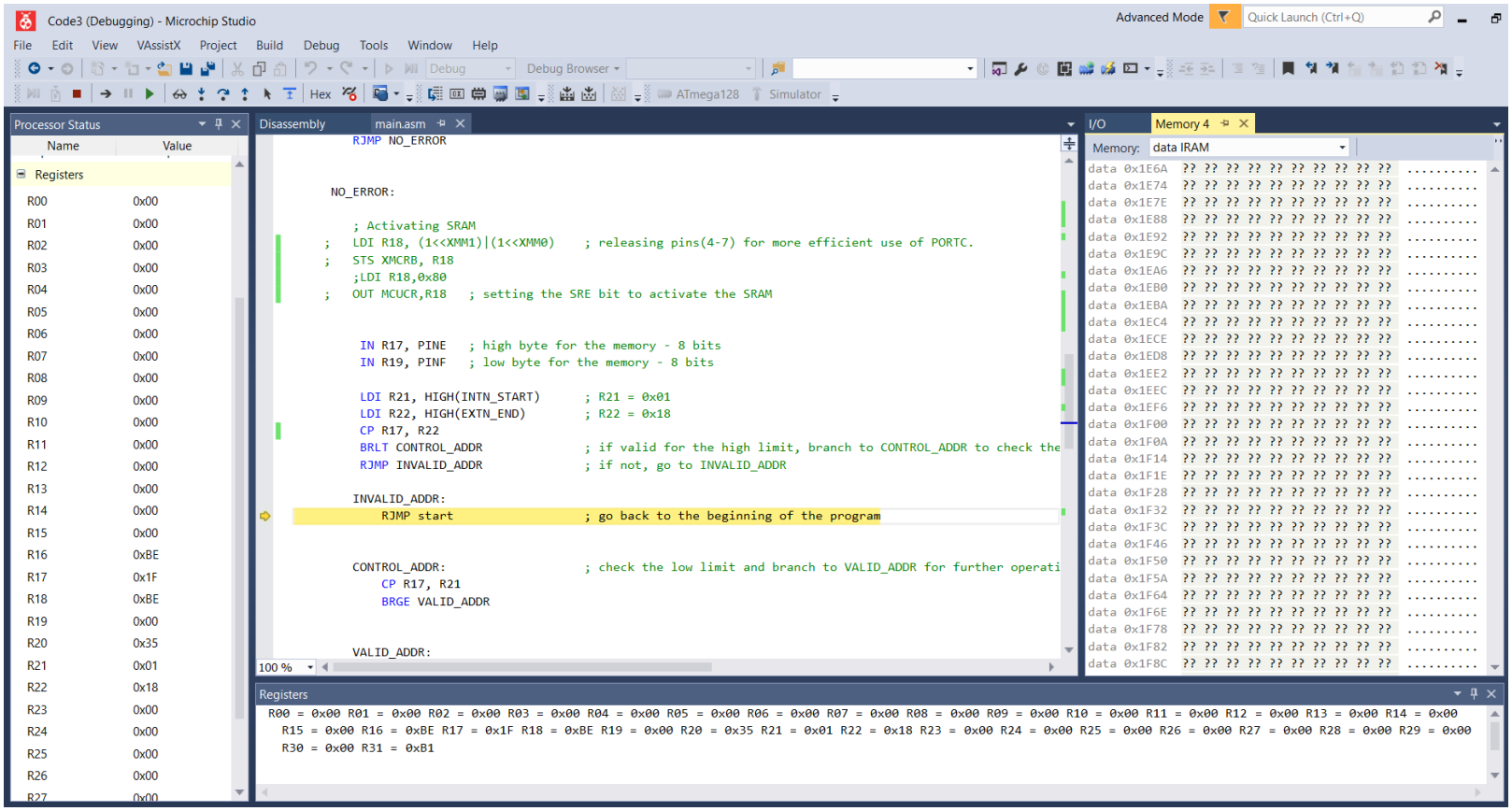
Debugging Outputs:

(Last case – address out of range)
Case where the values are;

A=101(0xA0), B=10111110(0xBE), C=0 (internal memory save), E=0x1F, F=0x00
R16->B, R17->E, R18->transmitted output (equals to B if no error), R19->F, R20->CRC polynomial (G), R21->save button, R22->high bytes of ending address of the stack

is tested:

Address = 0x1F00 (no data as the address is out of range)



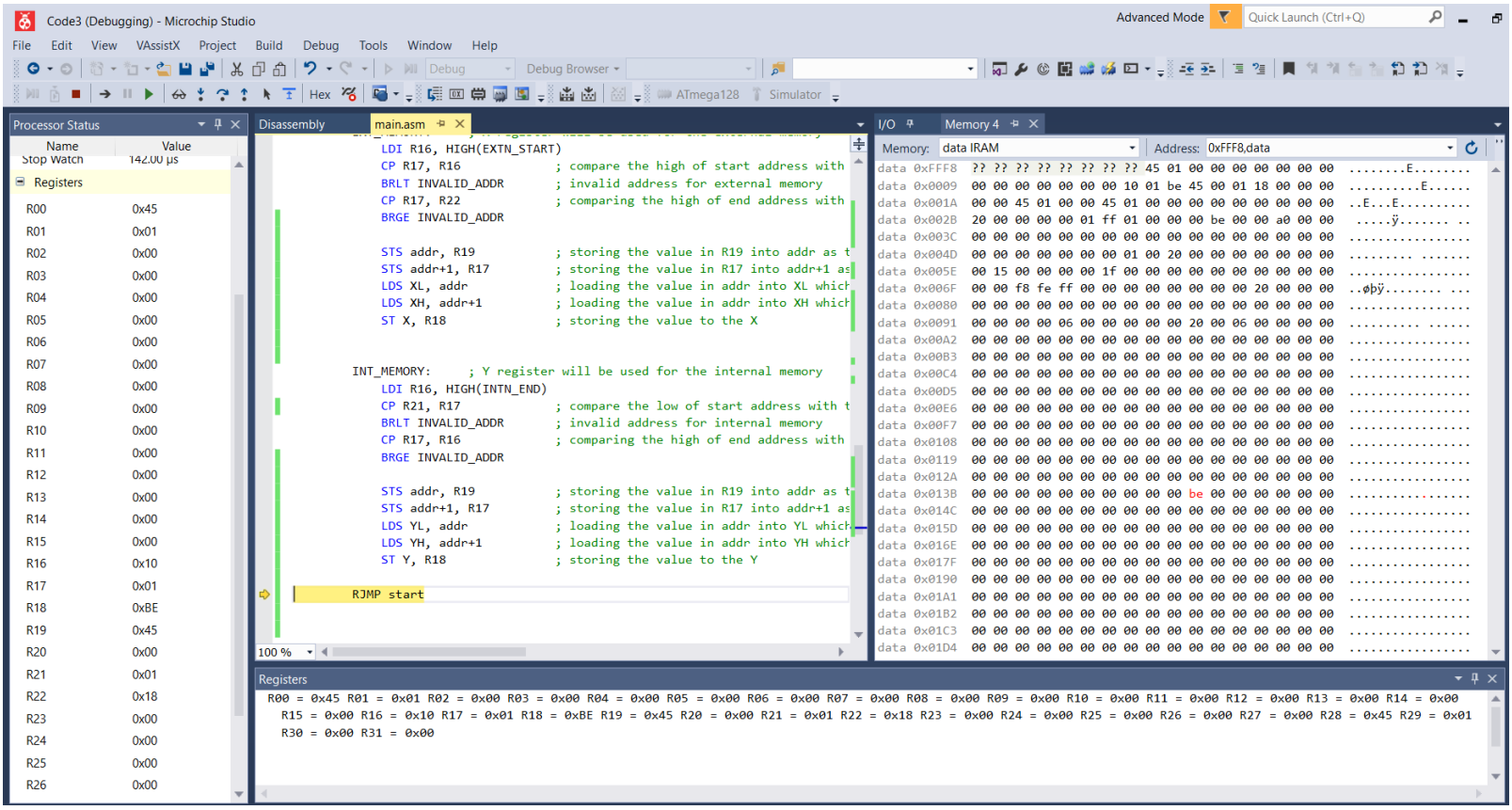
No data is saved in any of the memory, either internal or external, as the address is out of range.

Case where the values are;

A=101(0xA0), B=10111110(0xBE), C=0 (internal memory save), E=0x01, F=0x45
R16->B, R17->E, R18->transmitted output (equals to B if no error), R19->F, R20->CRC polynomial (G), R21->save button, R22->high bytes of ending address of the stack

is tested:

Address = 0x0145 (holding the value 0xBE which is in R18 as expected)



As the address entered is valid and the save button is not pushed, the value of R18 will be saved in the internal memory at address entered which is 0x0145. It can be seen from the figure, that address is holding 0xbe as expected.

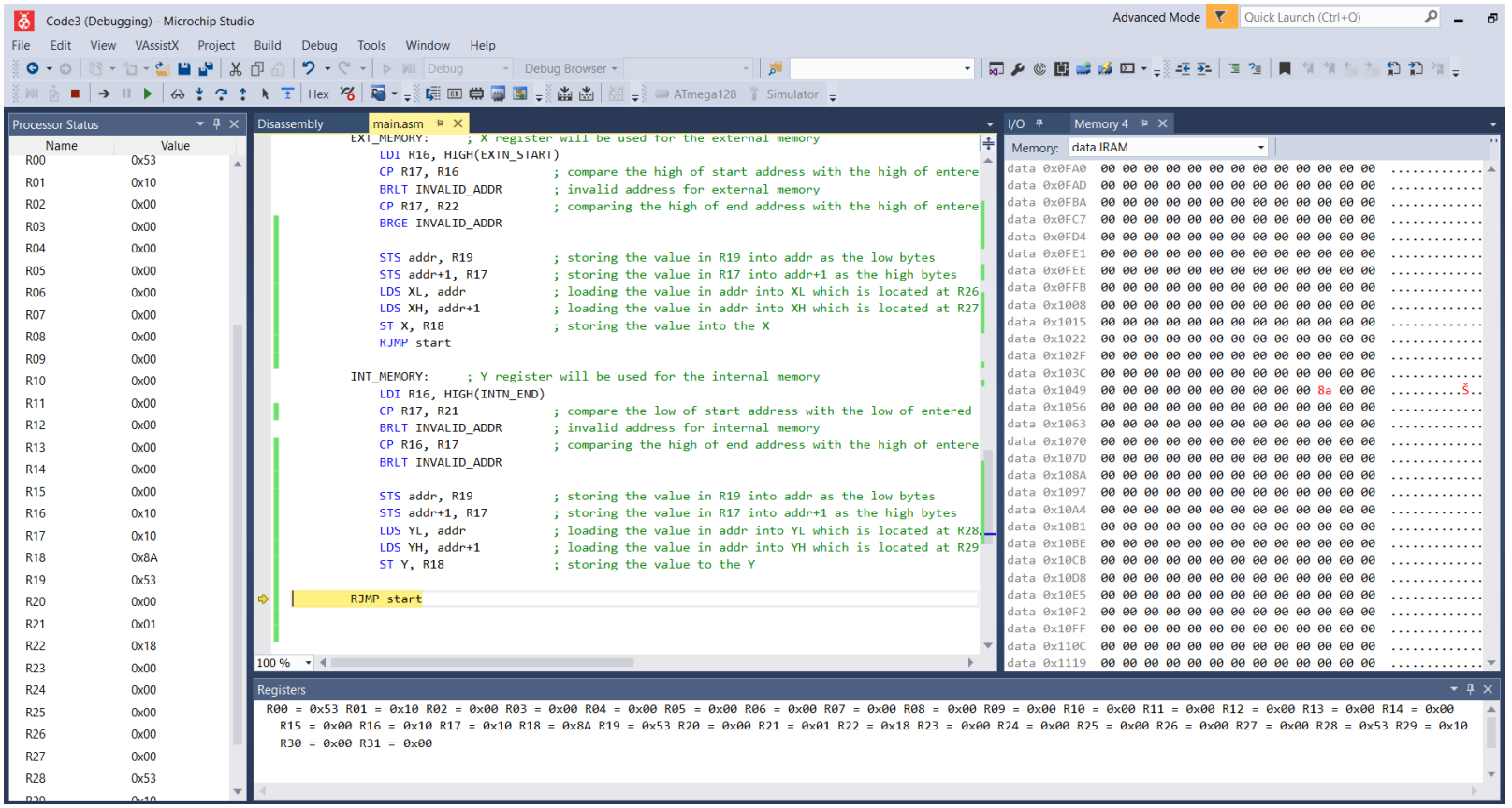
Case where the values are;

A=100(0x80), B=10001010(0x8A), C=0 (internal memory save), E=0x10, F=0xE0

R16->B, R17->E, R18->transmitted output (equals to B if no error), R19->F, R20->CRC polynomial (G), R21->save button, R22->high bytes of ending address of the stack

is tested:

Address = 0x10E0 (holding the value 0x8A which is in R18 as expected)



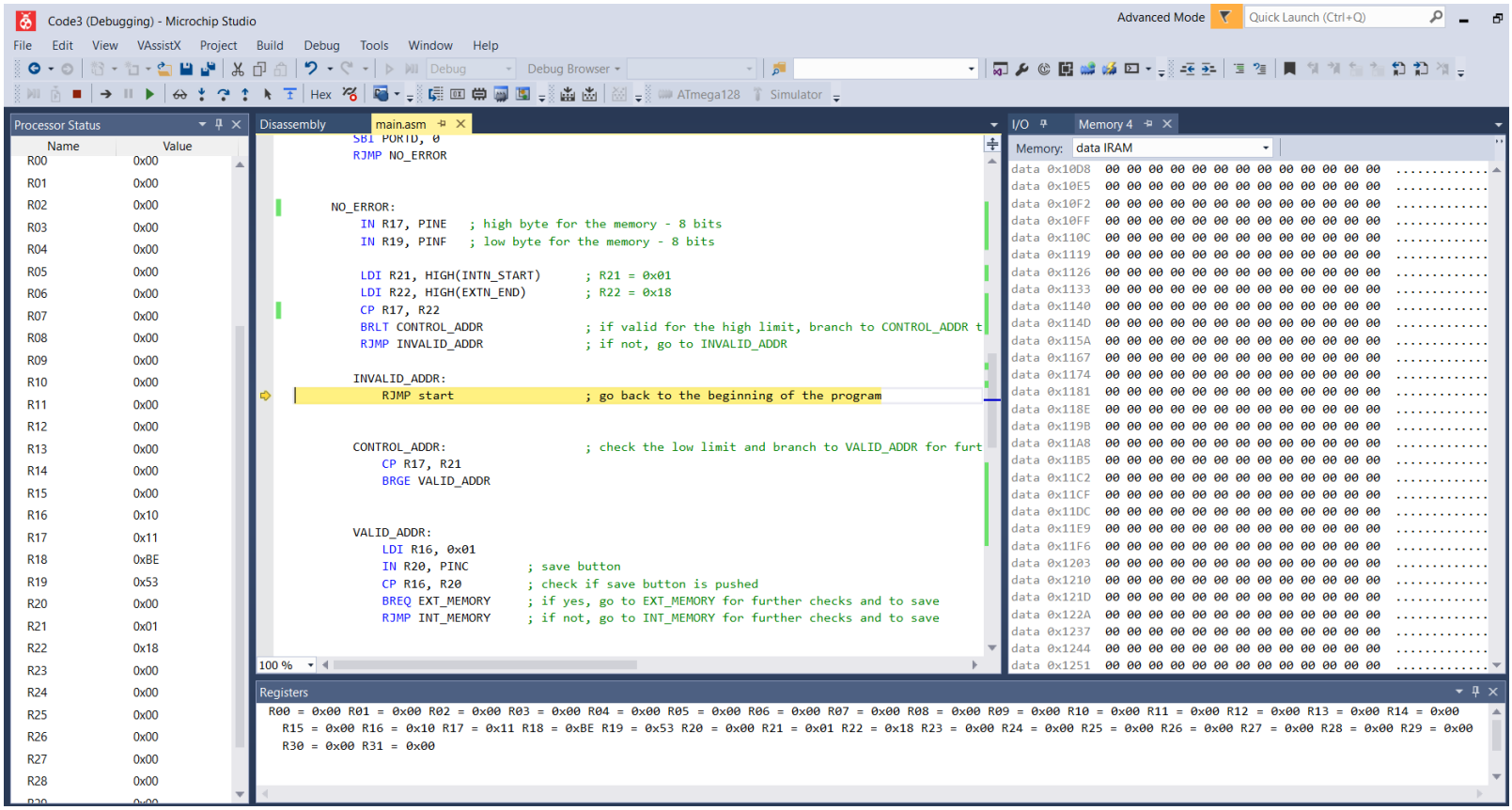
As the address entered is valid and the save button is not pushed, the value of R18 will be saved in the internal memory at address entered which is 0x10E0. It can be seen from the figure, that address is holding 0x8a as expected.

Case where the values are;

A=101(0xA0), B=10111110(0xBE), C=0 (internal memory save), E=0x11, F=0x53

R16->B, R17->E, R18->transmitted output (equals to B if no error), R19->F, R20->CRC polynomial (G), R21->save button, R22->high bytes of ending address of the stack is tested:

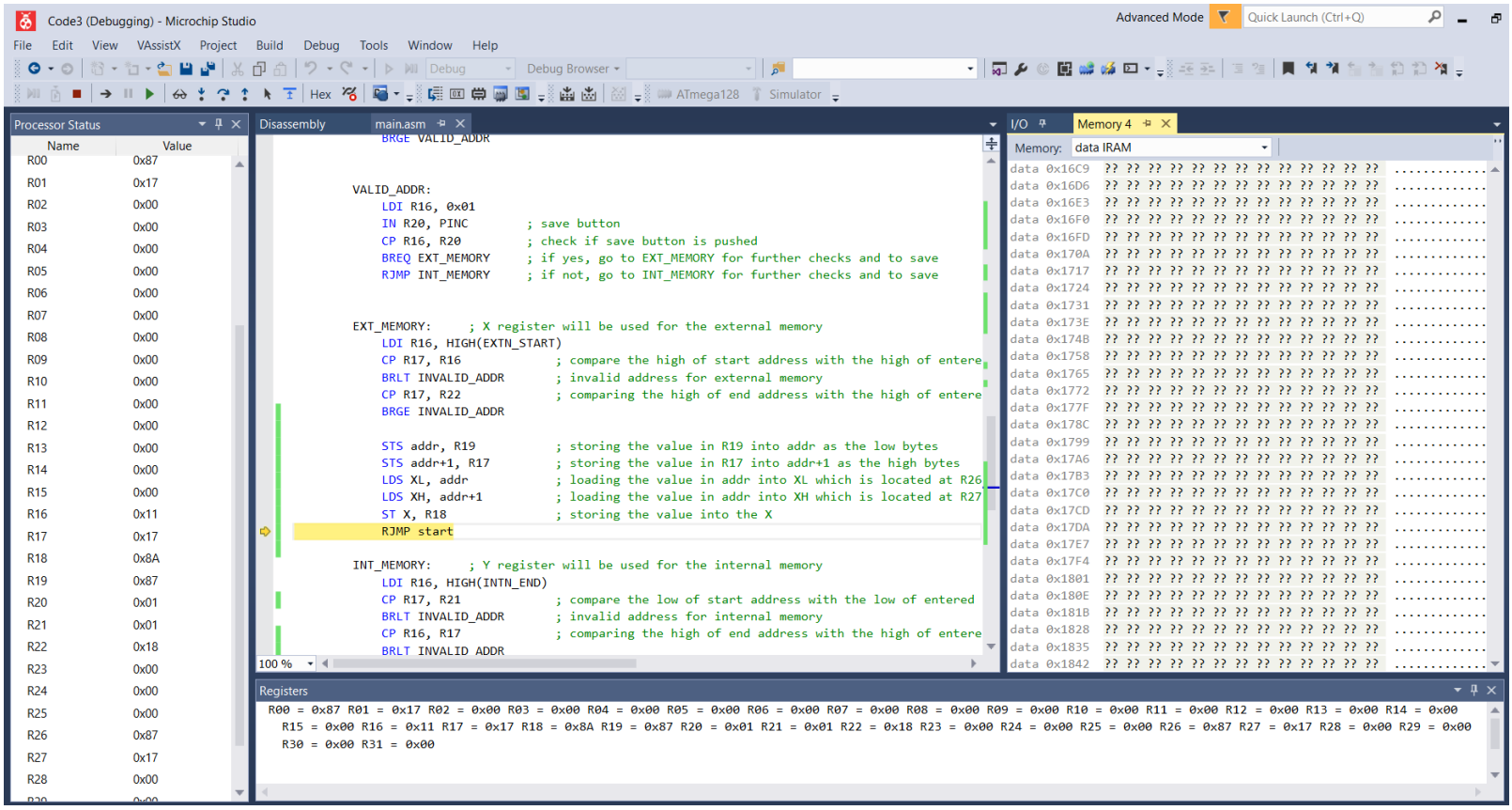
Address = 0x1153 (invalid address for the internal memory save)



The save button is not pushed but the address entered is the address for the external memory, so when the program will treat the address as it is supposed to be in the range for the internal memory but when the checks are done, it will take the address as an invalid address as it is not within the range for the internal memory. So the program will go back to start, and that's why no data will be saved at the address entered, which is 0x1153.

A=100(0x80), B=10001010(0x8A), C=1 (external memory save), E=0x17, F=0x87
R16->B, R17->E, R18->transmitted output (equals to B if no error), R19->F, R20->CRC polynomial (G), R21->save button, R22->high bytes of ending address of the stack

Address = 0x1787 (needs to hold the value 0x8A which is in R18)



The save button is pushed and the address is valid considering the external memory range, so the value in R18 is supposed to be saved in the entered address, which is 0x1787. It assigns the correct values to the X register pairs (in R26 and R27). R26=0x87 and R27=0x17 which represents the high bytes and low bytes of the address, respectively. Both registers get the correct values but the value in R18 is not saved to that address for some reason that I couldn't solve.