

- All Conneciton are done as per Schematic

## SPLD

### ATMEL F16V8C - SPLD connections -

#### SPLD input

- Pin 2 SPLD – mcu A15
- Pin 6 SPLD – mcu RD
- Pin 8 SPLD – mcu PSEN
- Pin 9 SPLD – mcu WR

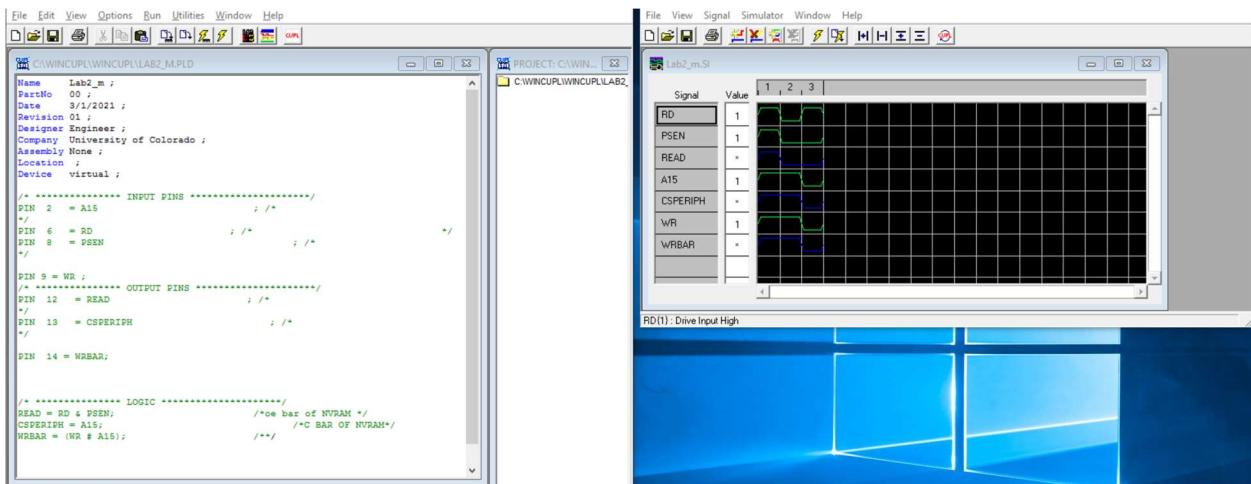
#### SPLD output

- PIN 12 = oe bar of NVRAM
- PIN 13 = CE BAR OF NVRAM
- PIN 14 = we bar of nvram

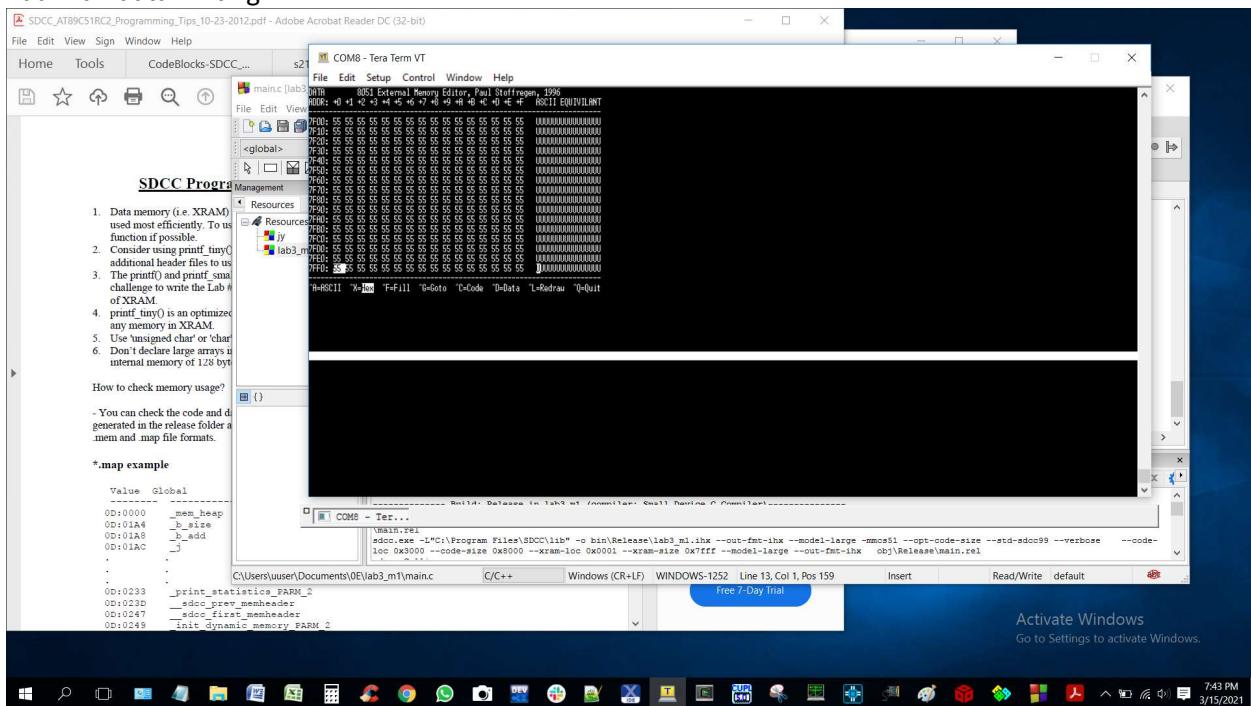
```
/* ***** INPUT PINS *****/
PIN 2 = A15          ; /* Pin 2 SPLD - mcua15          */
PIN 6 = RD           ; /* Pin 6 SPLD - mcua rd           */
PIN 8 = PSEN          ; /* Pin 8 SPLD - mcua PSEN          */
PIN 9 = WR;           ; /* Pin 9 SPLD - mcua WR           */
/* ***** OUTPUT PINS *****/
PIN 12 = READ;        ; /*oe bar of NVRAM */
PIN 13 = CSPERIPH;    ; /*CE BAR OF NVRAM*/
PIN 14 = WRBAR;       ; /*we bar of nvram*/



/* ***** LOGIC *****/
READ = RD & PSEN;           /*oe bar of NVRAM */
CSPERIPH = A15;             /*CE BAR OF NVRAM*/
WRBAR = (WR # A15);         /*we bar of NVRAM*/
```

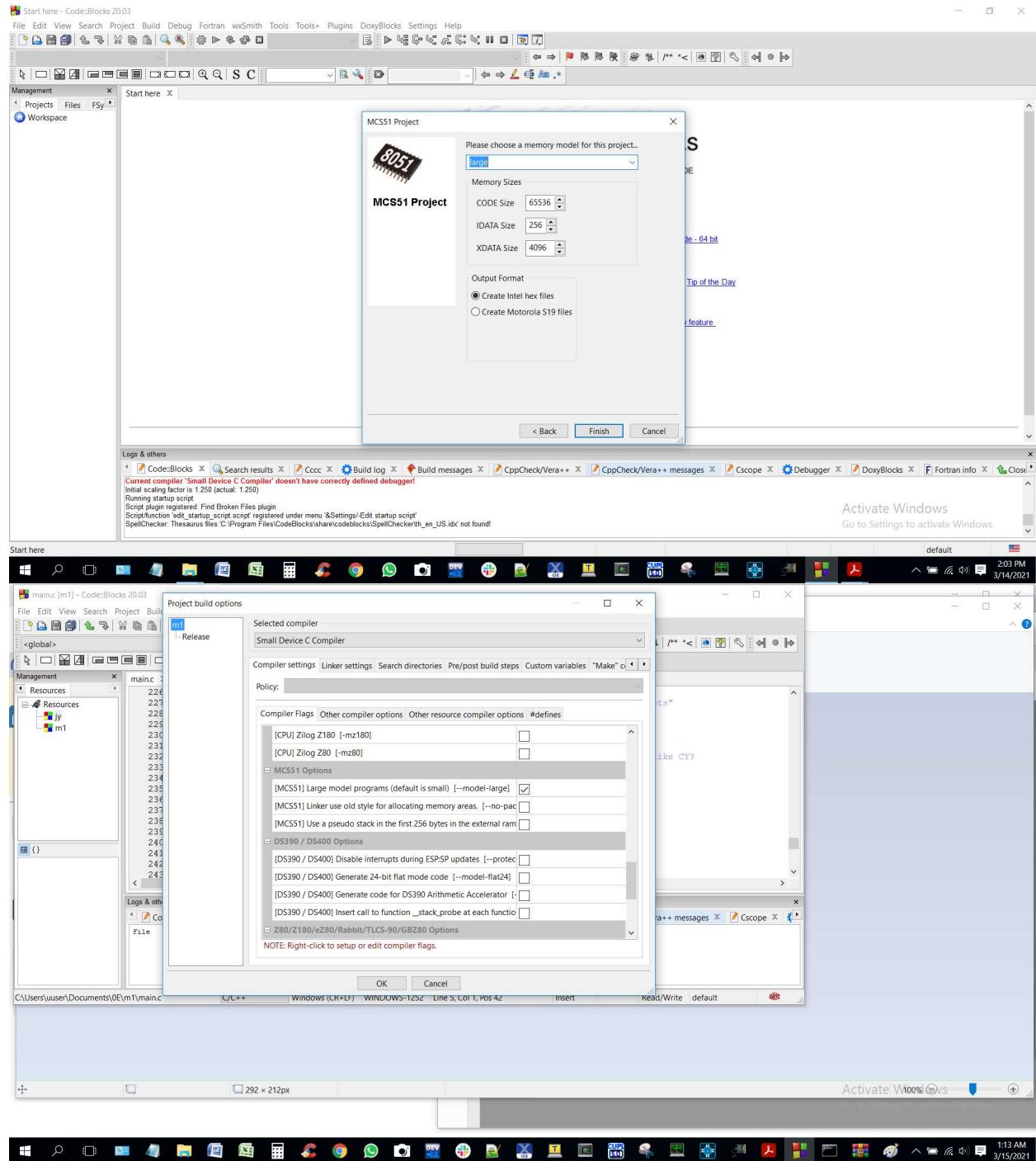


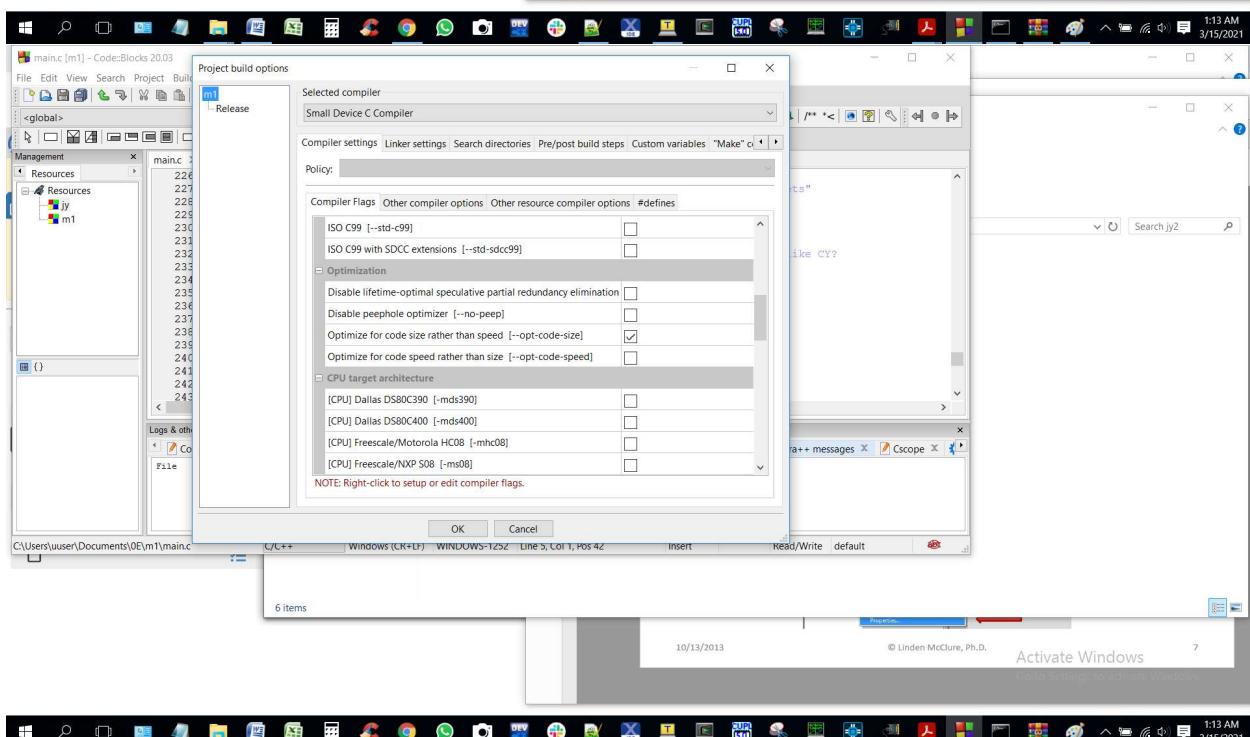
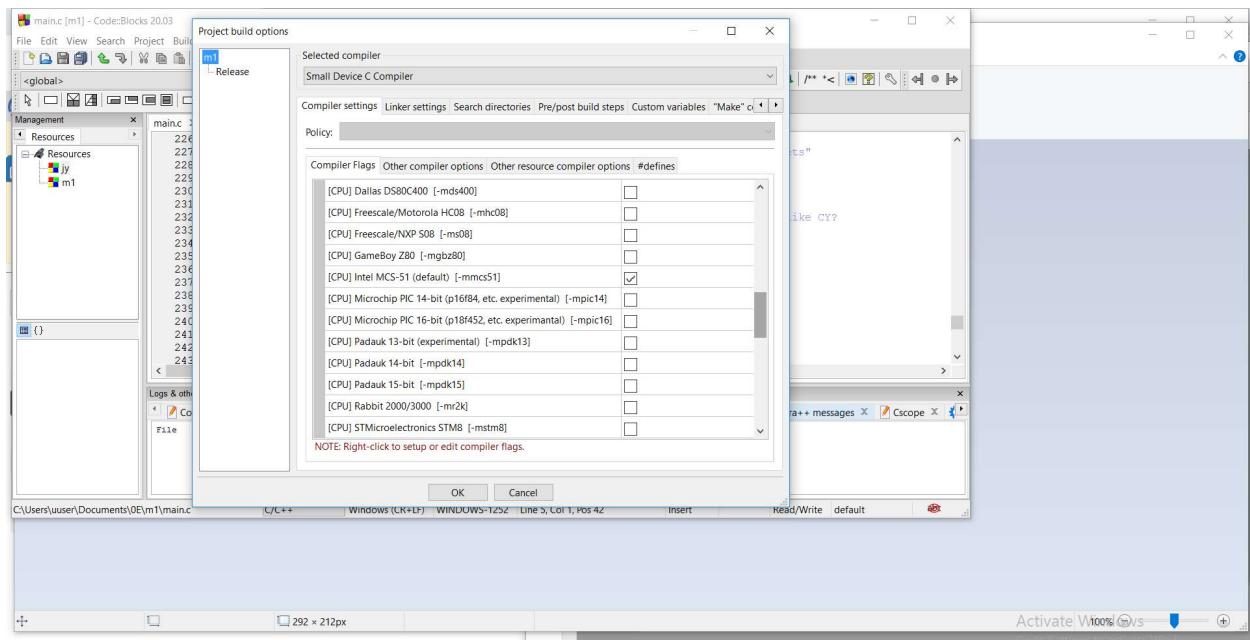
## Paulman data writing

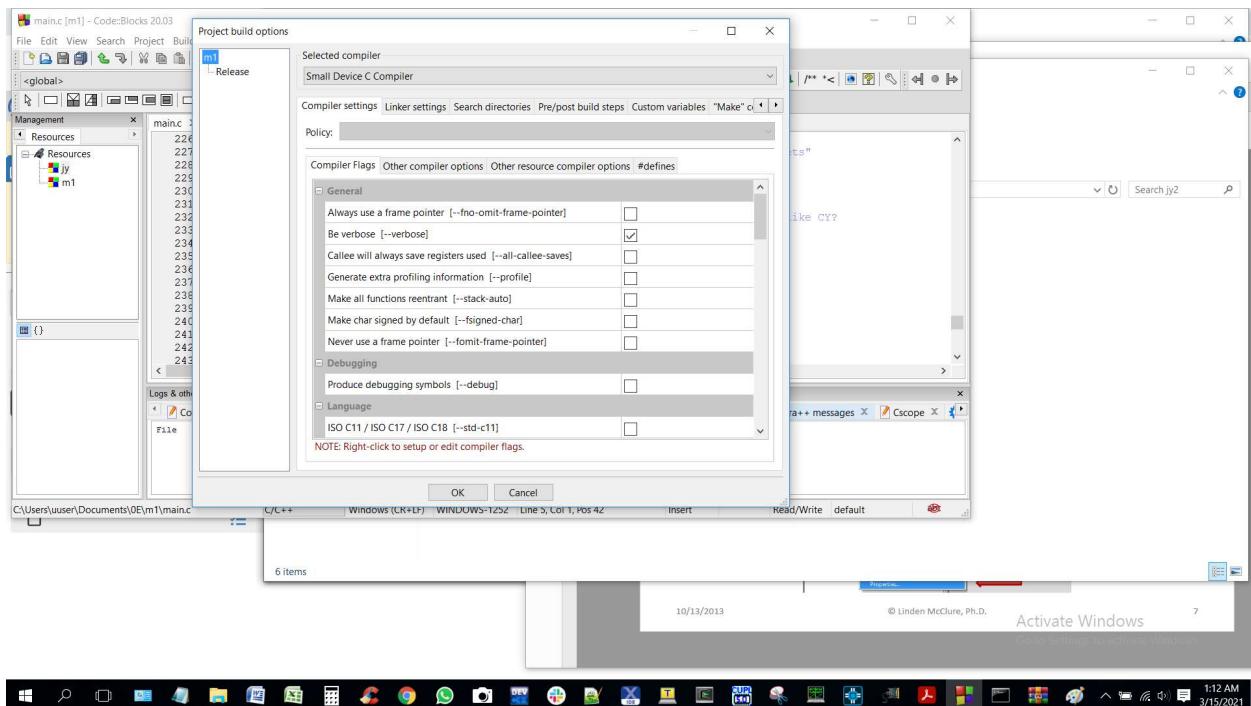


Loading code  
start from 0x3000 loc

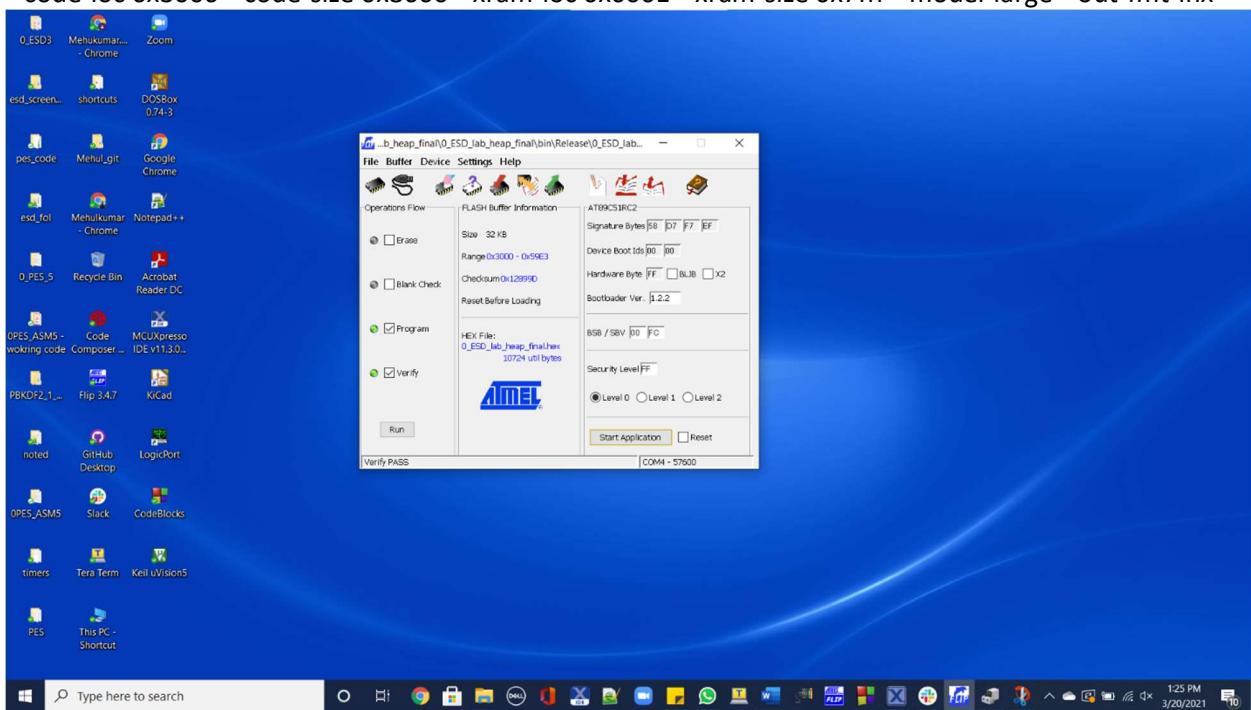
## sdcc settings



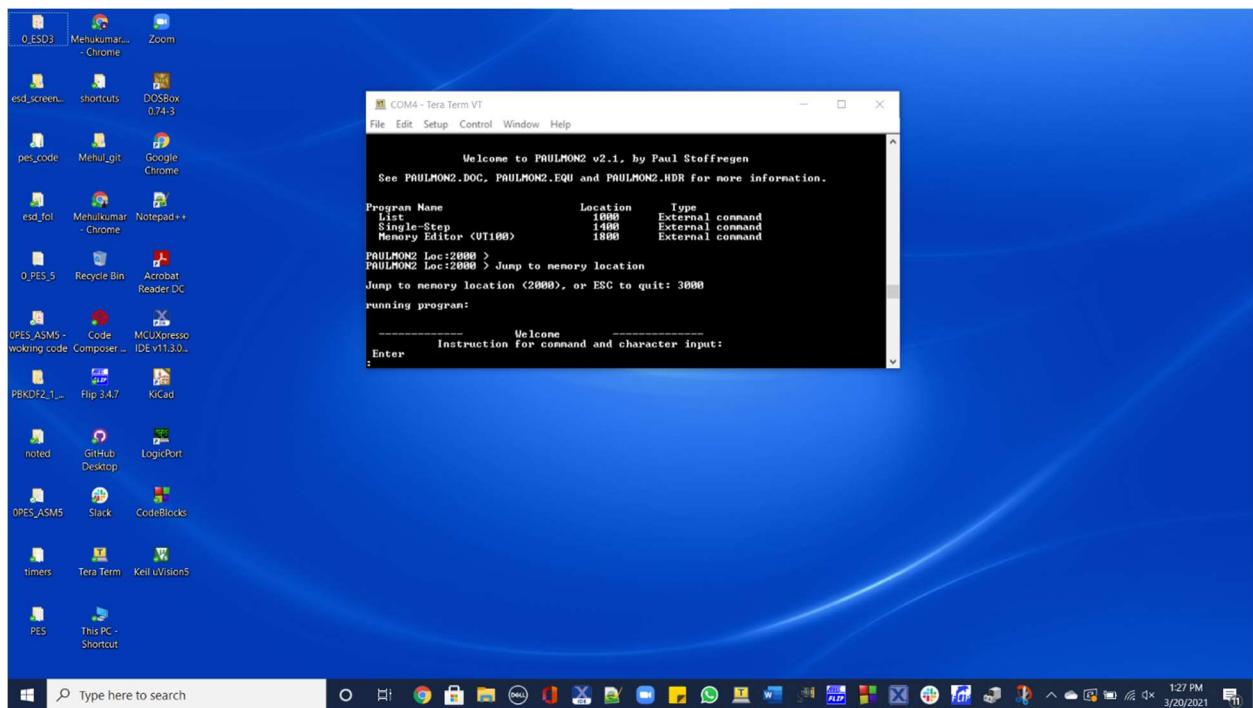




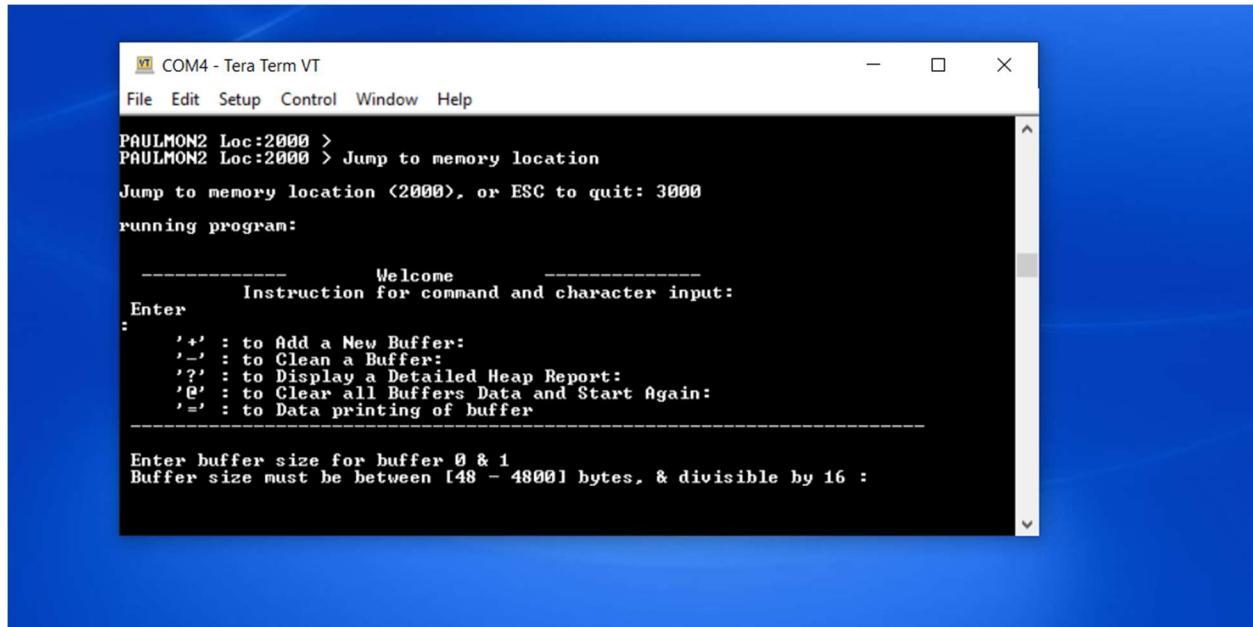
--code-loc 0x3000 --code-size 0x8000 --xram-loc 0x0001 --xram-size 0x7fff --model-large --out-fmt-ihx



Paul man jump location j



## Paulman Welcome msg



---

## Commands

'+' : to Add a New Buffer:  
'-' : to Clean a Buffer:  
'?' : to Display a Detailed Heap Report:  
'@' : to Clear all Buffers Data and Start Again:  
'=' : to Data printing of buffer  
small 'a'-'z' : for char i/p - to Store these Characters in Buffer 0:

if I press '\*' it will provide help

COM4 - Tera Term VT

File Edit Setup Control Window Help

```
Enter buffer size for buffer 0 & 1
Buffer size must be between [48 - 4800] bytes, & divisible by 16 :80
malloc successful, 80 B D M/r for buffer allocated
Buffer 0 created at :0X087
DMA for Buffer 1 - malloc Successful

Buffer 1 created at : :0X0d9

Press '*' - for help - instruction for command and char input
Enter character : *
Total rx bytes = 1
----- Instruction for command and character input:
Enter

'+' : to Add a New Buffer:
'-' : to Clean a Buffer:
'?' : to Display a Detailed Heap Report:
'@' : to Clear all Buffers Data and Start Again:
'=' : to Data printing of buffer
small 'a'-'z' : for char i/p - to Store these Characters in Buffer 0:

Enter character :
```

Entering buffer size

Succful for 64(decimal byte

COM4 - Tera Term VT

File Edit Setup Control Window Help

```
Please Enter valid buffer size according to Instruction

DMA for buffer0 failed
Malloc for Buffer 1 failed, Please re-enter value
Enter buffer size for buffer 0 & 1
Buffer size must be between [48 - 4800] bytes, & divisible by 16 :
Please Enter valid buffer size according to Instruction

DMA for buffer0 failed
Malloc for Buffer 1 failed, Please re-enter value
Enter buffer size for buffer 0 & 1
Buffer size must be between [48 - 4800] bytes, & divisible by 16 :64
malloc successful, 64 B D M/r for buffer allocated
Buffer 0 created at :0X03
DMA for Buffer 1 - malloc Successful

Buffer 1 created at : :0X045

Press '*' - for help - instruction for command and char input
Enter character :
```

Entering buffer size

Succful for 80(decimal) byte

The screenshot shows a terminal window titled "COM4 - Tera Term VT". The window has a menu bar with File, Edit, Setup, Control, Window, and Help. A message "Buffer 1 Cleared" is displayed. Below it, a command prompt "Enter :" is shown, followed by a list of key mappings:

- '+' : to Add a New Buffer:
- '-' : to Clean a Buffer:
- '?' : to Display a Detailed Heap Report:
- '@' : to Clear all Buffers Data and Start Again:
- '=' : to Data printing of buffer

The terminal then prompts for buffer size: "Enter buffer size for buffer 0 & 1". It specifies that the size must be between [48 - 4800] bytes, & divisible by 16 :80. The allocation is successful, with addresses 0x087 and 0xd9 assigned to buffers 0 and 1 respectively. The DMA for Buffer 1 is also successful. The final output is "Buffer 1 created at :0X0d9". The terminal ends with a help message "Press '\*' - for help - instruction for command and char input" and a prompt "Enter character :".

It will try to allocate m/r for buffer only satisfy both condn

- Buffer size must be between [48 - 4800] bytes,
- & divisible by 16 :80

After that if malloc successful then only it will stat next operation

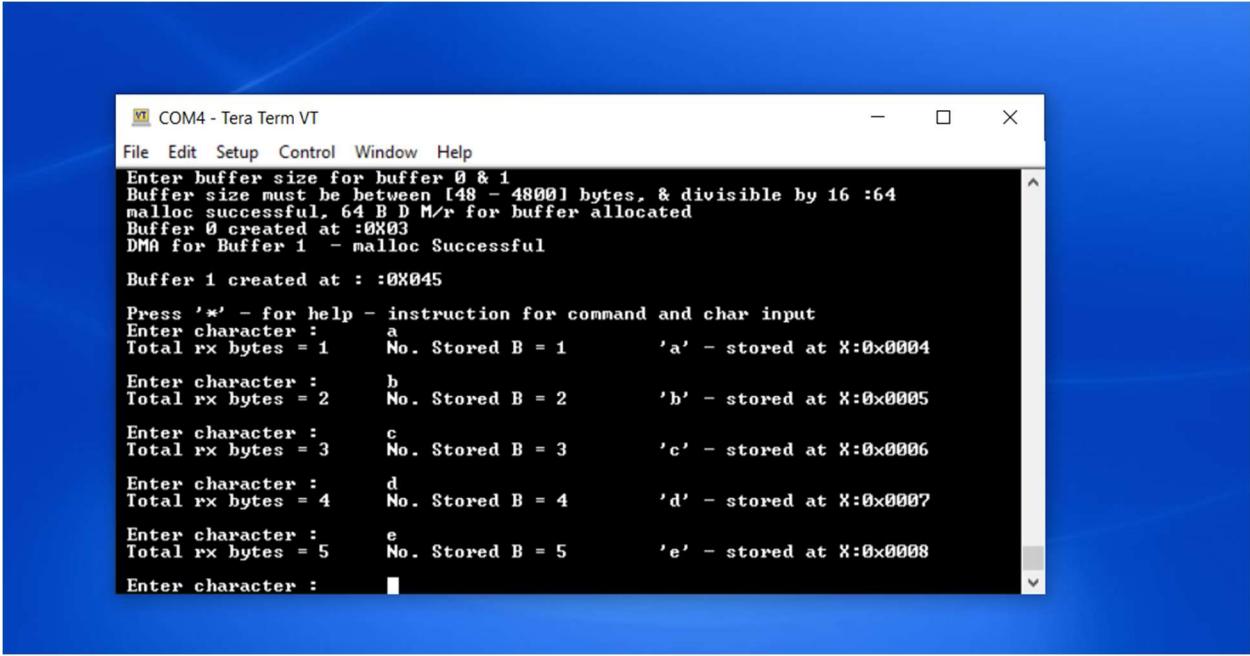
Here it will also allocate m/r for buffer 1 with same size and print

Buffer 0 created at :0X087  
DMA for Buffer 1 - malloc Successful

---

Entering data – character --- only small chars accepted

'a' to 'z' only



VT COM4 - Tera Term VT

File Edit Setup Control Window Help

```
Enter buffer size for buffer 0 & 1
Buffer size must be between [48 - 4800] bytes, & divisible by 16 :64
malloc successful, 64 B D M/r for buffer allocated
Buffer 0 created at :0x03
DMA for Buffer 1 - malloc Successful

Buffer 1 created at : :0X045

Press '*' - for help - instruction for command and char input
Enter character : a
Total rx bytes = 1 No. Stored B = 1 'a' - stored at X:0x0004

Enter character : b
Total rx bytes = 2 No. Stored B = 2 'b' - stored at X:0x0005

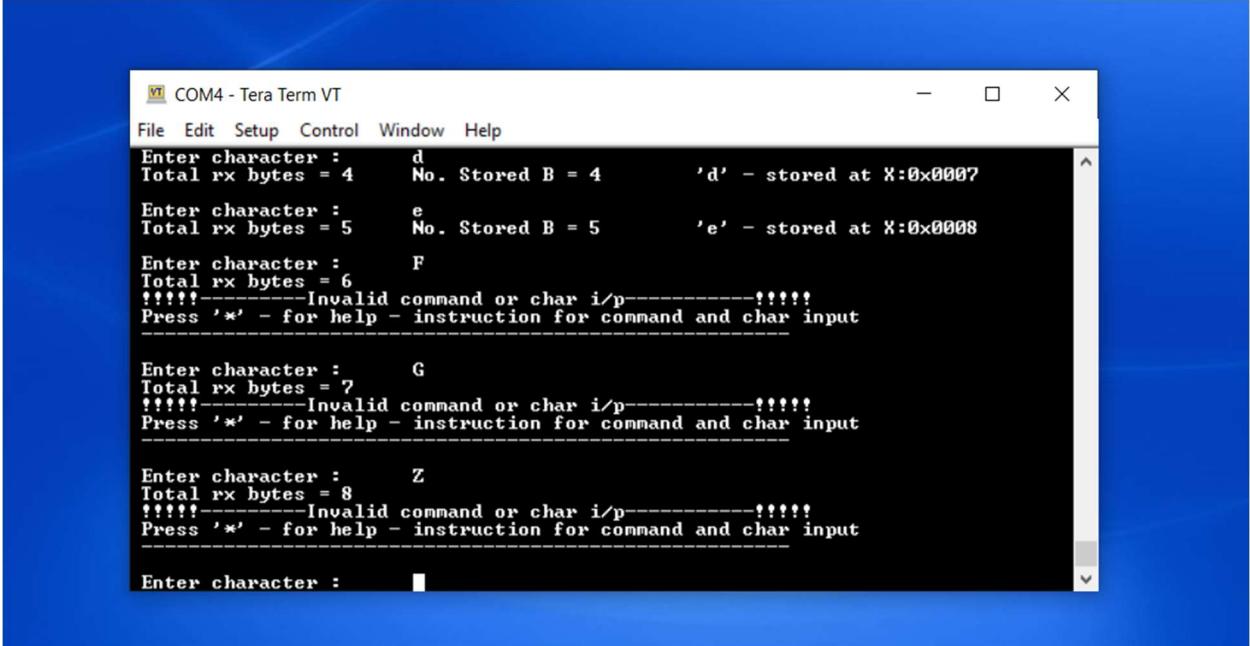
Enter character : c
Total rx bytes = 3 No. Stored B = 3 'c' - stored at X:0x0006

Enter character : d
Total rx bytes = 4 No. Stored B = 4 'd' - stored at X:0x0007

Enter character : e
Total rx bytes = 5 No. Stored B = 5 'e' - stored at X:0x0008

Enter character :
```

For caps – ‘A’ – ‘Z’ it will not allow



VT COM4 - Tera Term VT

File Edit Setup Control Window Help

```
Enter character : d
Total rx bytes = 4 No. Stored B = 4 'd' - stored at X:0x0007

Enter character : e
Total rx bytes = 5 No. Stored B = 5 'e' - stored at X:0x0008

Enter character : F
Total rx bytes = 6
!!!!----- Invalid command or char i/p -----!!!!!
Press '*' - for help - instruction for command and char input

Enter character : G
Total rx bytes = 7
!!!!----- Invalid command or char i/p -----!!!!!
Press '*' - for help - instruction for command and char input

Enter character : Z
Total rx bytes = 8
!!!!----- Invalid command or char i/p -----!!!!!
Press '*' - for help - instruction for command and char input

Enter character :
```

## Heap report

### From lab writeup

The program must keep count of how many total characters and how many storage characters are received. Every time the character '?' is received, the program must provide a report on the heap, including information about each buffer currently in the heap, including: buffer #, buffer start address, buffer end address, total allocated size of the buffer (in bytes), number of storage characters currently in that buffer, and number of free spaces remaining in that buffer. Note that the heap report will change as storage characters are stored in and emptied from buffer\_0. The program must also report the total number of characters received since the last '?'. The C program must clearly report all these numbers on the terminal emulator screen, along with descriptive text. The program then must empty the buffer by transmitting all the characters which were stored in buffer\_0, with a maximum of 64 ASCII characters displayed on each line of the screen. buffer\_0 will then be empty. The quality of your user interface will be a factor in your grade.

If buffer\_0 fills completely before a '?' command is received, any excess character subsequently received for that buffer is echoed out the serial port, but is not added to that buffer (it is discarded). Once the '?' command is received, then buffer\_0 is emptied, as described above.

All in terms of (in bytes)

B\_N : Buffer Number

St\_addr: Buffer Start Address

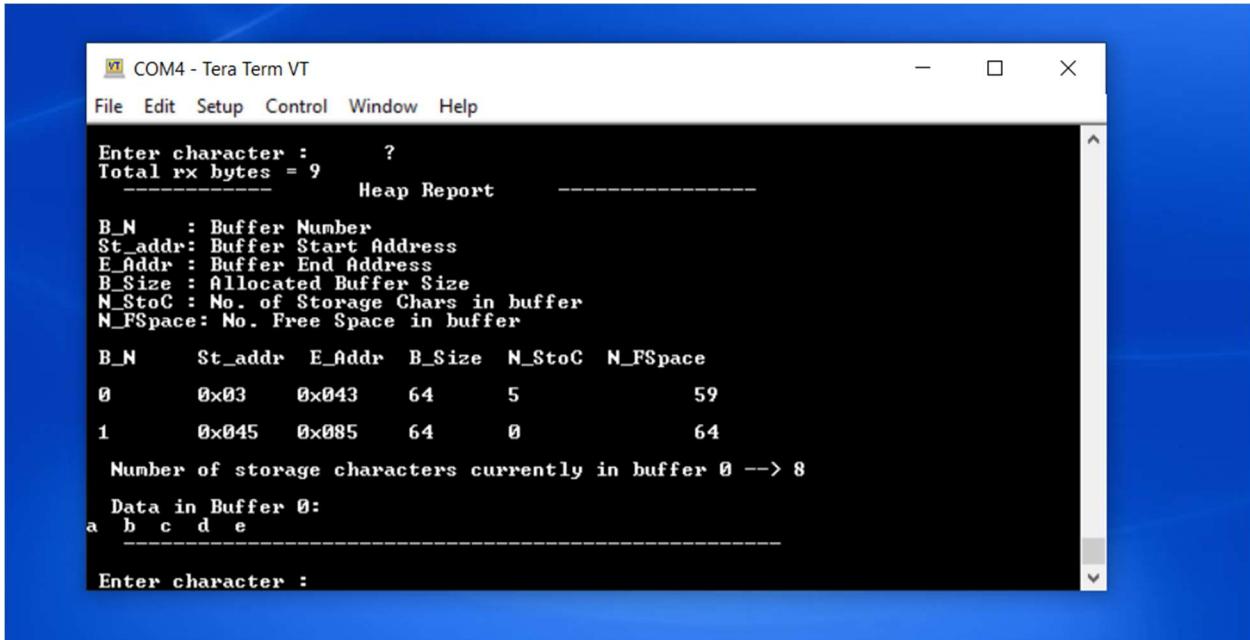
E\_Addr : Buffer End Address

B\_Size : Buffer Size - Total allocated size of the buffer

N\_StoC : Storage Characters - Number of storage characters currently in the buffer

N\_FSpace:Free Space - number of free bytes remaining in the buffer

When I press '?' it will generate heap report like this



COM4 - Tera Term VT

File Edit Setup Control Window Help

```
Enter character :      ?
Total rx bytes = 9
----- Heap Report -----
B_N : Buffer Number
St_addr: Buffer Start Address
E_Addr : Buffer End Address
B_Size : Allocated Buffer Size
N_StoC : No. of Storage Chars in buffer
N_FSpace: No. Free Space in buffer

B_N   St_addr  E_Addr  B_Size  N_StoC  N_FSpace
0     0x03    0x043   64      5        59
1     0x045   0x085   64      0        64
Number of storage characters currently in buffer 0 --> 8
Data in Buffer 0:
a b c d e
-----
Enter character :
```

----- Heap Report -----

B\_N : Buffer Number  
St\_addr: Buffer Start Address  
E\_Addr : Buffer End Address  
B\_Size : Allocated Buffer Size  
N\_StoC : No. of Storage Chars in buffer  
N\_FSpace: No. Free Space in buffer

B\_N St\_addr E\_Addr B\_Size N\_StoC N\_FSpace

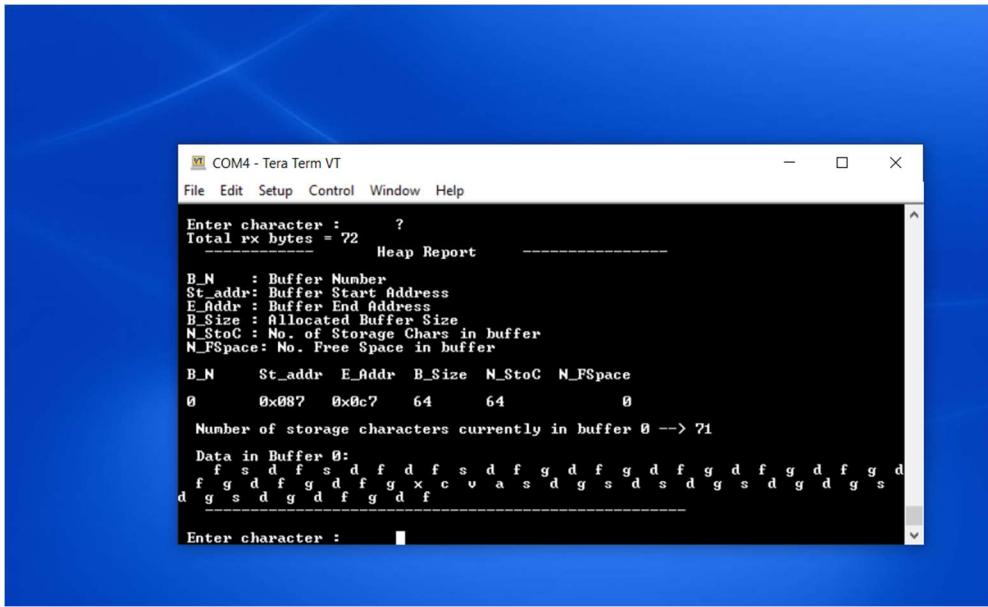
0 0x03 0x043 64 5 59

1 0x045 0x085 64 0 64

Number of storage characters currently in buffer 0 --> 8

Data in Buffer 0:

a b c d e



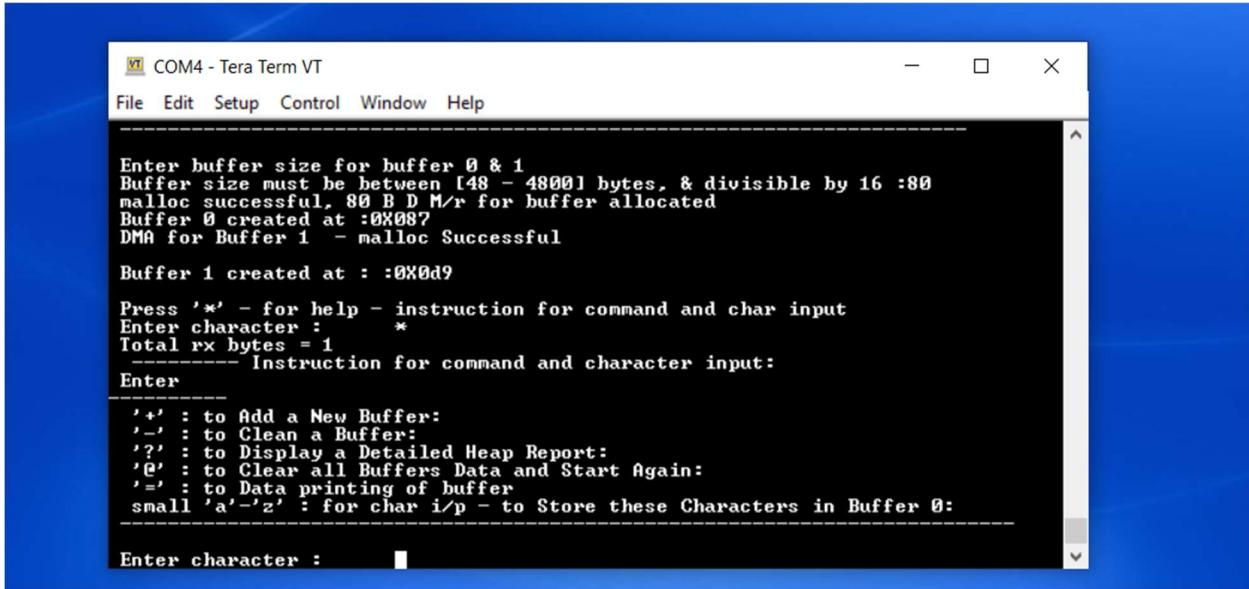
COM4 - Tera Term VT

File Edit Setup Control Window Help

```
Enter character : ?  
Total rx bytes = 72  
-----  
Heap Report  
-----  
B_N : Buffer Number  
St_addr: Buffer Start Address  
E_addr : Buffer End Address  
B_Size : Allocated Buffer Size  
N_StoC : No. of Storage Chars in buffer  
N_FSpace: No. Free Space in buffer  
B_N St_addr E_addr B_Size N_StoC N_FSpace  
0 0x0087 0x0c7 64 64 0  
Number of storage characters currently in buffer 0 --> 71  
Data in Buffer 0:  
f s d f s d f d f s d f g d f s g d f g d f g d f g d  
f g d f g d f g x c v a s d g s d f d g s d g d g d g s  
d g s d g d f g d f -----  
Enter character : █
```

Heap report --- when I have entered chars

We can see data in buffer 0



COM4 - Tera Term VT

File Edit Setup Control Window Help

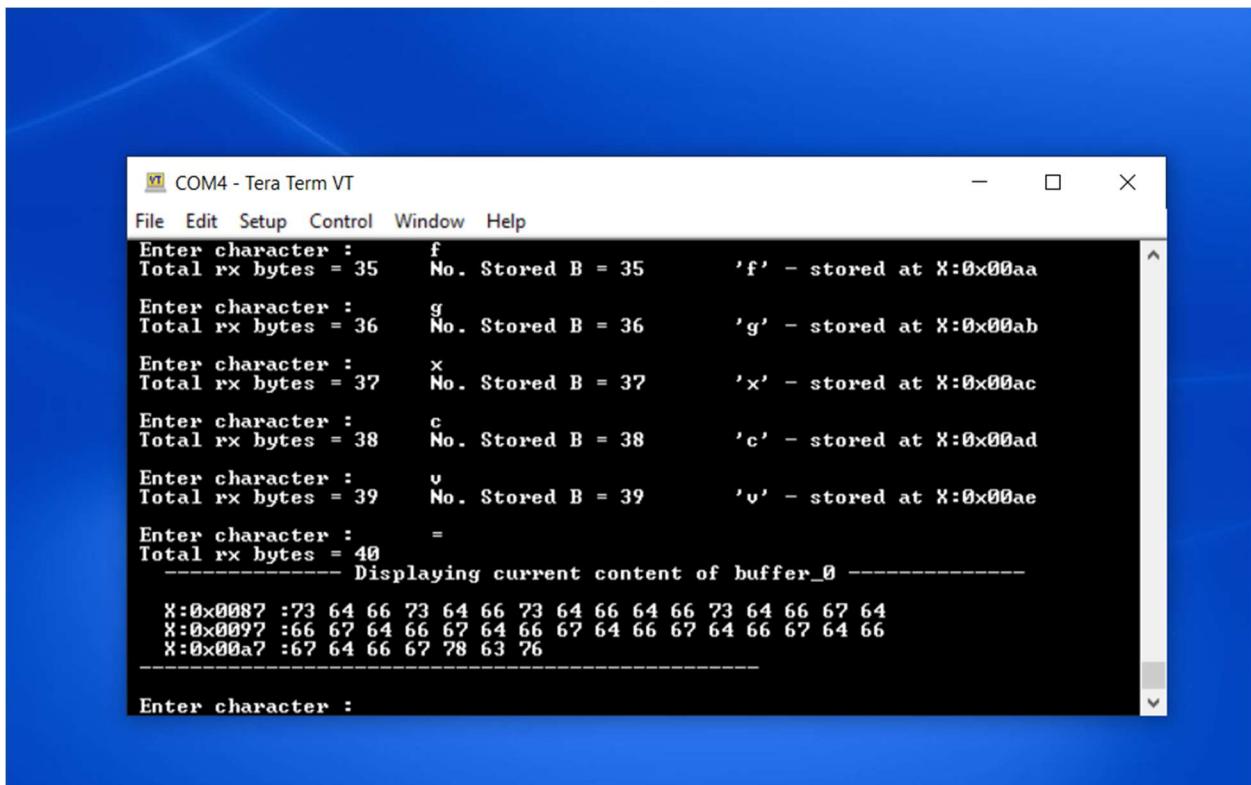
```
Enter buffer size for buffer 0 & 1  
Buffer size must be between [48 - 4800] bytes, & divisible by 16 :80  
malloc successful, 80 B D M/r for buffer allocated  
Buffer 0 created at :0X087  
DMA for Buffer 1 - malloc Successful  
  
Buffer 1 created at : :0X0d9  
  
Press '*' - for help - instruction for command and char input  
Enter character : *  
Total rx bytes = 1  
----- Instruction for command and character input:  
Enter  
-----  
'+' : to Add a New Buffer:  
'-' : to Clean a Buffer:  
'?' : to Display a Detailed Heap Report:  
'Q' : to Clear all Buffers Data and Start Again:  
'=' : to Data printing of buffer  
small 'a'-'z' : for char i/p - to Store these Characters in Buffer 0:  
  
Enter character : █
```

For '=' command

From lab write up

If the '=' character is ever received, the program must display the current contents of buffer\_0 in hex, **but must not empty the buffer** – the data will remain in the buffer until the buffer emptied in response to a '?' command. Display the data on the PC screen in hexadecimal (not ASCII), with 16 bytes of data per line, in the following format (AAAA is address, DD is data):

**AAAA: DD DD**



The screenshot shows a terminal window titled "COM4 - Tera Term VT". The window has a menu bar with File, Edit, Setup, Control, Window, and Help. The main area displays the following text:

```
Enter character : f
Total rx bytes = 35    No. Stored B = 35      'f' - stored at X:0x00aa

Enter character : g
Total rx bytes = 36    No. Stored B = 36      'g' - stored at X:0x00ab

Enter character : x
Total rx bytes = 37    No. Stored B = 37      'x' - stored at X:0x00ac

Enter character : c
Total rx bytes = 38    No. Stored B = 38      'c' - stored at X:0x00ad

Enter character : v
Total rx bytes = 39    No. Stored B = 39      'v' - stored at X:0x00ae

Enter character : =
Total rx bytes = 40
----- Displaying current content of buffer_0 -----
X:0x0087 :73 64 66 73 64 66 73 64 66 64 66 73 64 66 67 64
X:0x0097 :66 67 64 66 67 64 66 67 64 66 67 64 66 67 64 66
X:0x00a7 :67 64 66 67 78 63 76
-----
```

At the bottom of the window, there is an input field labeled "Enter character :".

In heap report we can see  
No of rx and storage chars

COM4 - Tera Term VT

File Edit Setup Control Window Help

```
B_Size : Allocated Buffer Size  
N_StoC : No. of Storage Chars in buffer  
N_FSpace: No. Free Space in buffer
```

B_N	St_addr	E_Addr	B_Size	N_StoC	N_FSpace
0	0x03	0x053	80	80	0
1	0x055	0x0a5	80	0	80
2	0x0a7	0x0e3	60	0	60
3	0x0e5	0x0136	81	0	81

Number of storage characters currently in buffer 0 --> 101

Data in Buffer 0:

```
c b f g n f h g j k h k j h k j h k j h l h k j h k h k  
j h k h j h j k h k j h k j h k j h k j h k j h k j h k  
v c v b c b n b v b c x c v x v
```

Enter character :

if I press '@' then it will clear all buffers  
And start from again – I am calling main from here

From lab writeup

If the '@' character is ever received, the program must immediately use the `free()` function to free the heap space being utilized by all current buffers that have been allocated. The program shall then start over from the beginning and ask the user to specify a new buffer size.

COM4 - Tera Term VT

File Edit Setup Control Window Help

!!!!!----- Invalid command or char i/p -----!!!!!

Press '\*' - for help - instruction for command and char input

Enter character : @  
Total rx bytes = 14  
Buffer @ Cleared

Buffer 1 Cleared

----- All Buffers Cleared -----

Welcome

Instruction for command and character input:

Enter :

'+' : to Add a New Buffer:  
'-' : to Clean a Buffer:  
'?' : to Display a Detailed Heap Report:  
'@' : to Clear all Buffers Data and Start Again:  
'=' : to Data printing of buffer

Enter buffer size for buffer 0 & 1  
Buffer size must be between [48 - 4800] bytes, & divisible by 16 :■

For = command

It will display current data in buffer 0

COM4 - Tera Term VT

File Edit Setup Control Window Help

Enter character : f  
Total rx bytes = 35 No. Stored B = 35 'f' - stored at X:0x00aa

Enter character : g  
Total rx bytes = 36 No. Stored B = 36 'g' - stored at X:0x00ab

Enter character : x  
Total rx bytes = 37 No. Stored B = 37 'x' - stored at X:0x00ac

Enter character : c  
Total rx bytes = 38 No. Stored B = 38 'c' - stored at X:0x00ad

Enter character : v  
Total rx bytes = 39 No. Stored B = 39 'v' - stored at X:0x00ae

Enter character : =  
Total rx bytes = 40

----- Displaying current content of buffer\_0 -----

X:0x0087 :73 64 66 73 64 66 73 64 66 64 66 73 64 66 67 64  
X:0x0097 :66 67 64 66 67 64 66 67 64 66 67 64 66 67 64 66  
X:0x00a7 :67 64 66 67 78 63 76

-----

Enter character :

## Buffer clearing - and @ command

COM4 - Tera Term VT

```
Address of buffer[3]: X:0x00d9
Enter character : b
Total rx bytes = 30    No. Stored B = 28      'b' - stored at X:0x001f

Enter character : n
Total rx bytes = 31    No. Stored B = 29      'n' - stored at X:0x0020

Enter character : m
Total rx bytes = 32    No. Stored B = 30      'm' - stored at X:0x0021

Enter character : b
Total rx bytes = 33    No. Stored B = 31      'b' - stored at X:0x0022

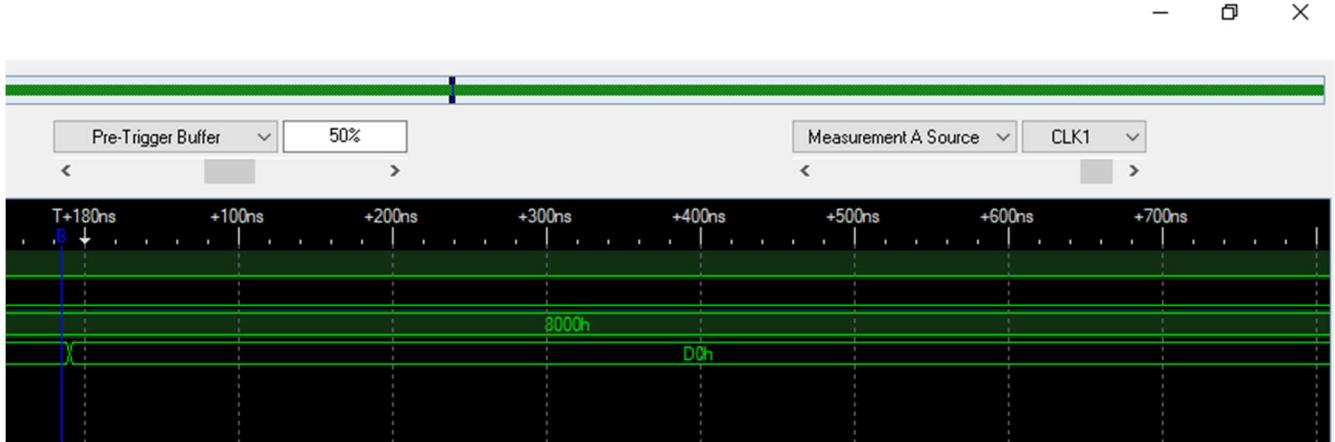
Enter character : -
Total rx bytes = 34
!!!!!!-----Invalid command or char i/p-----!!!!!!
Press '*' - for help - instruction for command and char input
-----
Enter character : -
Total rx bytes = 35
Enter buffer number you want to clear.5
Please enter correct buffer number,You have entered a wrong Buffer number
Enter character : -
Total rx bytes = 36
Enter buffer number you want to clear.2
Buffer 2 Cleared
Enter character : -
Total rx bytes = 37
Enter buffer number you want to clear.1
Buffer 1 Cleared
Enter character : e
Total rx bytes = 38
Buffer 0 Cleared

Buffer 1 Cleared
Buffer 2 Cleared
Buffer 3 Cleared

-----All Buffers Cleared-----
-----      Welcome      -----
Enter      Instruction for command and character input:
:
'+' : to Add a New Buffer:
'-' : to Clean a Buffer:
'?' : to Display a Detailed Heap Report:
'E' : to Clear all Buffers Data and Start Again:
'=' : to Data printing of buffer

Enter buffer size for buffer 0 & 1
Buffer size must be between [48 - 4800] bytes, & divisible by 16 :
```

Virtual Address Debug port  
0x8000h



Code reference : professor lecture/ asmnt writeup

```
#define DEBUG 1
#ifndef DEBUG
#define DEBUGPORT(x) dataout((x));
#else
#define DEBUGPORT(x) // empty statement, nothing passed on from the preprocessor to the compiler
#endif
```

```
void dataout(uint8_t data)
{
    uint8_t * ptr = NULL;
    ptr = 0x8000;      //get address to write at 0x8000 loc
    * ptr = (data);    //write data
}
```

Note: I have used Accessport software – UART terminal software in place of Teraterm –  
- no difference – just like UI

---

1. Echo function is called on receiving input character on uart

- interrupt-driven TX and RX of characters
- :: desinged UART interrupt function

2. PWM signal generation- used pin P2.4

starting duty cycle 55%

starting value of duty\_cycle= 550

if receive 'P'/'p' on uart => print duty cycle

3. ADC temperature calculation using the MSP432 built-in temperature sensor.

if receive 'T'/'t' on uart => print temperature

- here initally set the flag for value to be seen

- for Celsius = = print in temperature value in Celsius

- for Fahrenheit = = print in temperature value in Fahrenheit

---

\* If the switch at P1.4 is pressed - PWM duty cycle increases by 10%

\* If the switch at P1.1 is pressed - PWM duty cycle decreases by 10%

\* for switch is pressed

### User inputs keys/for UART

---

T/t - to print temperature

c/C - to change to see temperature in Celcius

F/f - to change to see temperature in farenheit

p/P - to print PWM duty cycle in percentage

d/D - command to change PWM duty cycle using user input

- next enter value in 0.00-100.00 range for percentage duty cycle %

r/R - to start change PWM duty cycle based on change in temperature

- 10 % change in duty cycle at 0.5 celcius change in temperature

x/X - to stop change PWM duty cycle based on change in temperature

as temperature will not change much change celcius change gap to smaller value  
or print log

if want to see change temp based change change value change from 0.5 to other value  
in read\_temperature() function ----

## Print temperature c or F

Screenshot of Code Composer Studio showing the main.c file and the串行通信窗口 (Serial Communication Window) output.

**Code Composer Studio Project Explorer:**

- workspace\_v10 - 0\_ESD\_FinalLab3\_MSP432/source/main.c - Code Composer Studio
- 0\_ESD\_FinalLab3\_MSP432
- Binaries, Includes, Debug, source, header.h, init\_funcs.c, interrupt\_funcs.c, main.c, temperature\_ADC.c, UART0\_funcs.c, targetConfigs, msp432p401r.cmd, startup\_msp432p401r\_ccs, system\_msp432p401r.ccs, 0\_ESD\_Lab3MSP430, E\_Eworking, 0\_lab3, 0\_lab3a, 0\_lab3R, 0\_a, 0\_a\_2, 0\_a\_b, 0\_a\_b2\_w, 0\_aam, 0\_amf, 0\_amf2, 0\_amf2\_suppl, 0\_amf2\_suppl2all, ADC\_temp\_func, lab3, Lab3\_Mehul, LED\_Timer, LED\_Timer2, LED\_Timer3

**Code Composer Studio Editor:**

```

95 volatile int temp_unit_flag=CELCIUS; //by default show in celcius
96
97 double duty_cycle = start_duty*10; // Main variable that calculates duty cycle
98 double duty_percentage = start_duty; // variable that is used to print it
99
100 void main(void)
101 {
102     WDT_A->CTL = WDT_A_CTL_PW | WDT_A_CTL_HOLD; // stop watchdog timer
103
104     // Initialization functions
105     Init_ADC();
106     Init_Port();
107     Init_PWM();
108     Init_UART0();
109     Init_TimerA0();
110
111     // Enable interrupts in NVIC module
112     NVIC->ISER[0] = 1 << ((ADC14_IRQn) & 31); // Enable ADC interrupt in NVIC
113     NVIC->ISER[0] = 1 << ((EUSCI_A0_IRQn) & 31); // Enable USART interrupt in NVIC
114     NVIC->ISER[1] = 1 << ((PORT1_IRQn) & 31); // Enable Port1 interrupt in NVIC
115

```

**Code Composer Studio Variables View:**

Expression	Type	Value
float IntDegC	float	25.0960217
float IntDegF	float	77.2407379
float change_m	unknown	identifier not found
double duty_cycle	double	550.0
float past_DegC	unknown	identifier not found
float IntDegC	float	25.0960217
float duty_out	unknown	identifier not found
float k	unknown	identifier not found
s_pwm_duty	unsigned char[15]	[0 \x00, 0 \x00]

**Serial Communication Window Output:**

```

AccessPort - COM3(9600,N,8,1) Opened
Temperature in Celcius: C 25.36
tt
Temperature in Celcius: C 24.91
tt
Temperature in Celcius: C 25.32
tt
Temperature in Celcius: C 25.13
ff
Showing temp in F:
Press t to see Temp:
tt
Temperature in Farenheit: F 77.17
tt
Temperature in Farenheit: F 76.56
|<
Send> ○ Hex ○ Char PlainText □ Real Time Send Clear Send DTR R
Activate Windows
Go to Settings to activate Windows.
Comm Status CTS DSR RING RLSL (CD) CTS Hold DSR Hold RLSL Hold X
Ready Tx 143 Rx 3268 COM3(9600,N,8,1)
906 PM
3/12/2021

```

Screenshot of Code Composer Studio showing the temperature\_ADC.c file and the串行通信窗口 (Serial Communication Window) output.

**Code Composer Studio Project Explorer:**

- workspace\_v10 - 0\_ESD\_FinalLab3\_MSP432b/source/temperature\_ADC.c - Code Composer Studio
- 0\_ESD\_FinalLab3\_MSP432b [Active - Debug]
- Binaries, Includes, Debug, source, header.h, init\_funcs.c, interrupt\_funcs.c, main.c, temperature\_ADC.c, UART0\_funcs.c, targetConfigs, msp432p401r.cmd, startup\_msp432p401r\_ccs, system\_msp432p401r.ccs, 0\_ESD\_Lab3MSP430, E\_Eworking, 0\_lab3, 0\_lab3a, 0\_lab3R, 0\_a, 0\_a\_2, 0\_a\_b, 0\_a\_b2\_w, 0\_aam, 0\_amf, 0\_amf2, 0\_amf2\_suppl, 0\_amf2\_suppl2all, ADC\_temp\_func, lab3, Lab3\_Mehul, LED\_Timer, LED\_Timer2

**Code Composer Studio Editor:**

```

37 /#if((temp_based_PWM_change_flag)
38 {
39     float change_m = (past_DegC-IntDegC);
40     float change_fraction = (change_m/0.5);
41
42     float k=0;
43
44     //if((change_m <= 10) && (change_m >= -10))
45     if((change_m <= 0.5) && (change_m >= -0.5)//because very fast change ignoring change greater than +/-0.5 that value
46     {
47         k=0.1* duty_cycle*change_fraction;
48         duty_cycle = k*duty_cycle;
49     }
50     duty_percentage = (duty_cycle/10);
51     TIMER_A0->CCR[2] = duty_cycle;
52     print_PWM_dutycycle();

```

**Code Composer Studio Variables View:**

Expression	Type	Value	Address
float IntDegC	float	25.1714668	0x2000...
float IntDegF	float	77.3086395	0x2000...
unsigned char[15] s_pwm_duty	unsigned char[15]	[0 \x00, 0 \x00]	0x2000...
double duty_cycle	double	2.880569913424515	0x2000...
float k	float	0.0	0x2000...
float change_m	float	-0.113166809	0x2000...
float past_DegC	float	25.0583	0x2000...
double duty_percentage	double	0.2880569913424515	0x2000...

**Serial Communication Window Output:**

```

AccessPort - COM3(9600,N,8,1) Opened
Temperature in Celcius: C 25.36
tt
Temperature in Celcius: C 24.91
tt
Temperature in Celcius: C 25.32
tt
Temperature in Celcius: C 25.13
ff
Showing temp in F:
Press t to see Temp:
tt
Temperature in Farenheit: F 77.17
tt
Temperature in Farenheit: F 76.56
|<
Send> ○ Hex ○ Char PlainText □ Real Time Send Clear Send DTR R
Activate Windows
Go to Settings to activate Windows.
Comm Status CTS DSR RING RLSL (CD) CTS Hold DSR Hold RLSL Hold X
Ready Tx 143 Rx 3268 COM3(9600,N,8,1)
553M of 800
10:48 PM
3/12/2021

```

## Changing PWM using temperature value

The screenshot shows the Code Composer Studio interface with a project named "0\_ESD\_FinalLab3\_MSP432b". The code editor displays a C file named "main.c" which includes a function to change PWM duty cycle based on temperature. The terminal window on the right shows the output of the serial port (COM3) with temperature values and PWM duty cycle percentages.

```
30 // Temperature in Fahrenheit
31 // Tf = (9/5)*Tc + 32;
32 IntDegF = ((9 * IntDegC) / 5) + 32;
33
34 ##### Temperature in Celsius #####
35 ##### PWM Duty Cycle based on Temperature #####
36
37 if(temp_based_PWM_change_flag)
38 {
39     float change_m = (past_DegC-IntDegC);
40     float change_fraction = (change_m/0.5);
41
42     float k=0;
43
44     //if((change_m <= 10) && (change_m >= -10))
45     //if((change_m <= 0.5) && (change_m >= -0.5))//because very fast change ignore
46     {
47         k=0.1*duty_cycle*change_fraction;
48         duty_cycle = k+duty_cycle;
49     }
50     duty_percentage = (duty_cycle/10);
51     TIMER_A0->CCR[2] = duty_cycle;
52     print_PWM_dutycycle();
53     sdelay();
54 }
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```

## changing PWM on switch press

The screenshot shows two Code Composer Studio windows and two terminal windows for an MSP432 project.

**Top Window (Code Composer Studio):**

- Project Explorer:** Shows files for `0_ESD_FinalLab3_MSP432`, including `main.c`.
- Code Editor:** Displays `main.c` with code related to PWM and ADC initialization.
- Variables View:** Shows variables like `IntDegC`, `change_m`, `duty_cycle`, etc.
- Terminal:** Shows temperature readings in Celsius and Fahrenheit.

```

95 volatile int temp_unit_flag=CELCIUS; //by default show in celcius
96
97 double duty_cycle = start_duty*10; // Main variable that calculates duty cycle
98 double percentage = start_duty; // variable that is used to print duty cycle
99
100 void main(void)
101 {
102     WDT_A->CTL = WDT_A_CTL_PW | WDT_A_CTL_HOLD; // stop watchdog timer
103
104     // Initialization functions
105     Init_ADC();
106     Init_Port();
107     Init_PWM();
108     Init_UART0();
109     Init_TimerA0();
110
111     // Enable interrupts in NVIC module
112     NVIC->ISER[0] = 1 << ((ADC14_IROn) & 31); // Enable ADC interrupt in NVIC
113     NVIC->ISER[0] = 1 << ((USCI_A0_IROn) & 31); // Enable USART interrupt in NVIC
114     NVIC->ISER[1] = 1 << ((PORT1_IROn) & 31); // Enable Port1 interrupt in NVIC
115

```

**Bottom Window (Code Composer Studio):**

- Project Explorer:** Shows files for `0_ESD_FinalLab3_MSP432`, including `temperature_ADC.c`.
- Code Editor:** Displays `main.c` with code for temperature conversion and PWM control.
- Variables View:** Shows variables like `IntDegC`, `change_m`, `duty_cycle`, etc.
- Terminal:** Shows PWM duty cycle changes in response to switch presses.

```

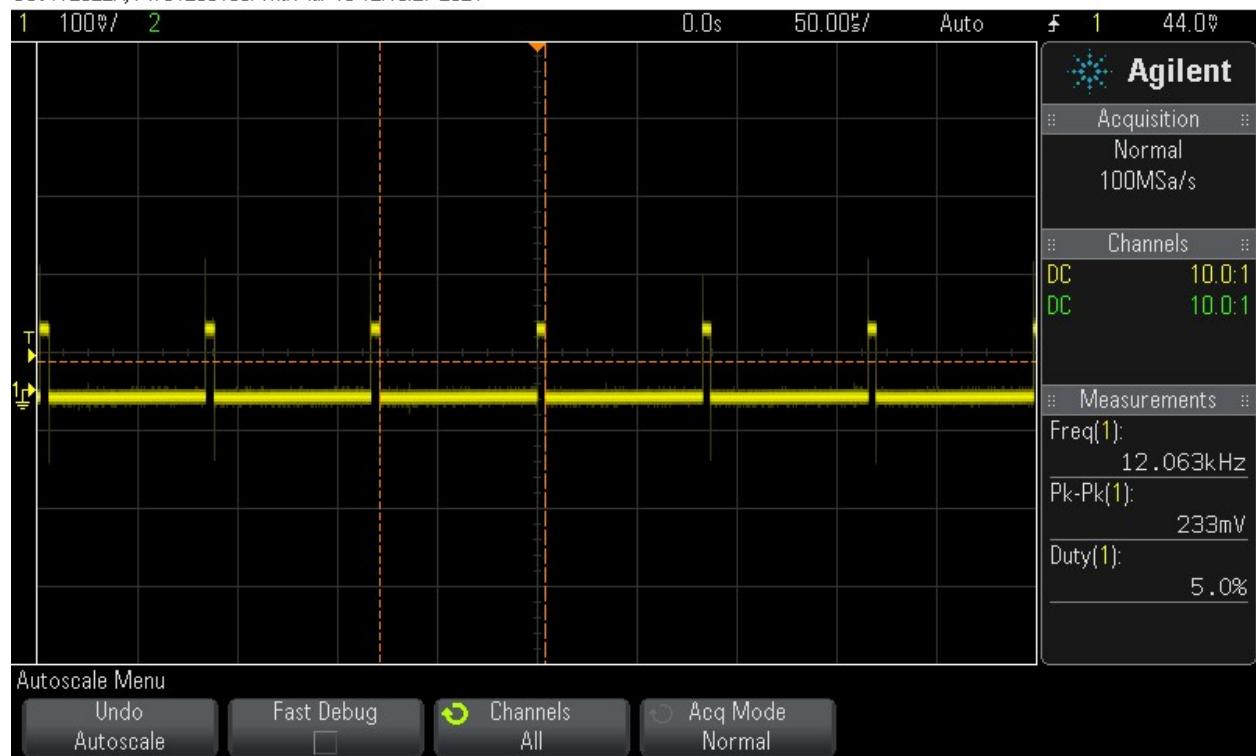
29 //#####
30 //#####
31 //#####
32 /*
33 float change_m = (past_DegC-IntDegC);
34 float change_fraction = (change_m/0.5);
35
36 float K;
37 if((change_m <= 0.5) && (change_m >= -0.5))/initialiatllly drastic change //i
38 {
39     K=0.1* duty_cycle*change_fraction;
40     duty_cycle = k*duty_cycle;
41 }
42 print_PWM_dutycycle();
43 duty_percentage = (duty_cycle/10);
44 TIMER_A0->CCR[2] = duty_cycle;
45 */

```

Duty cycle for PWM

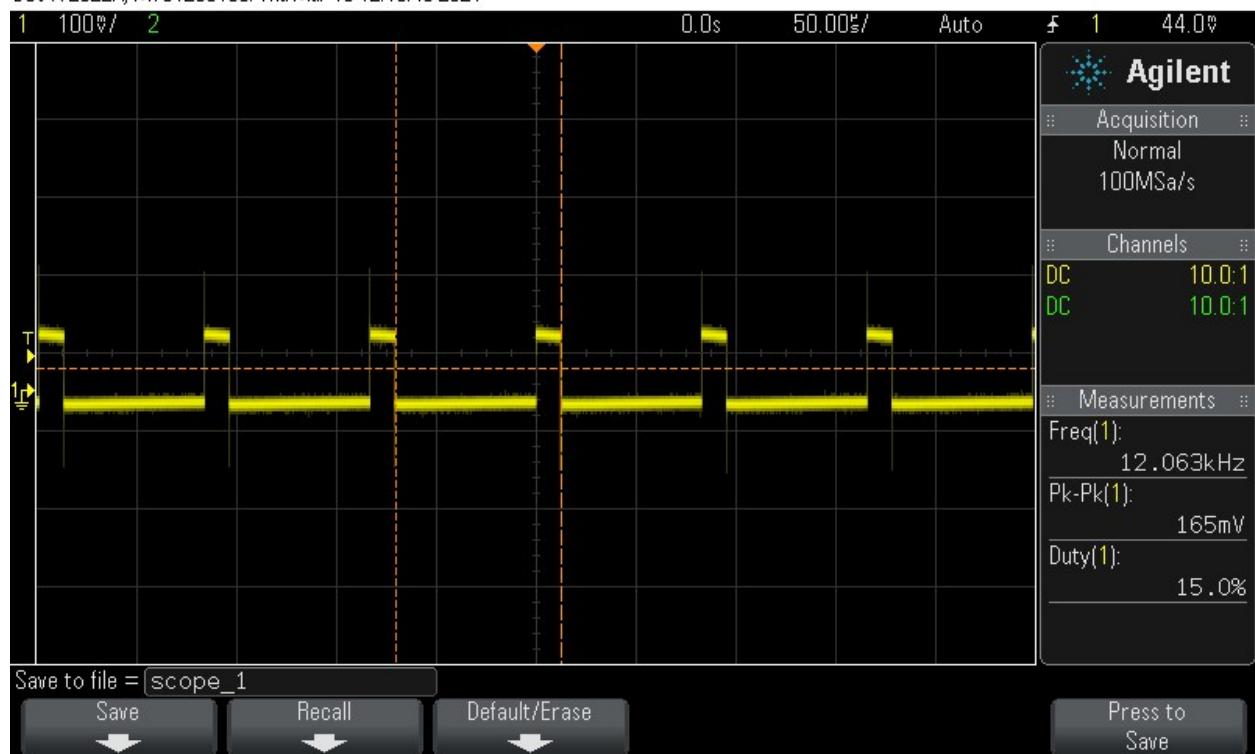
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DSO-X 2022A, MY51290180: Thu Mar 18 12:19:27 2021



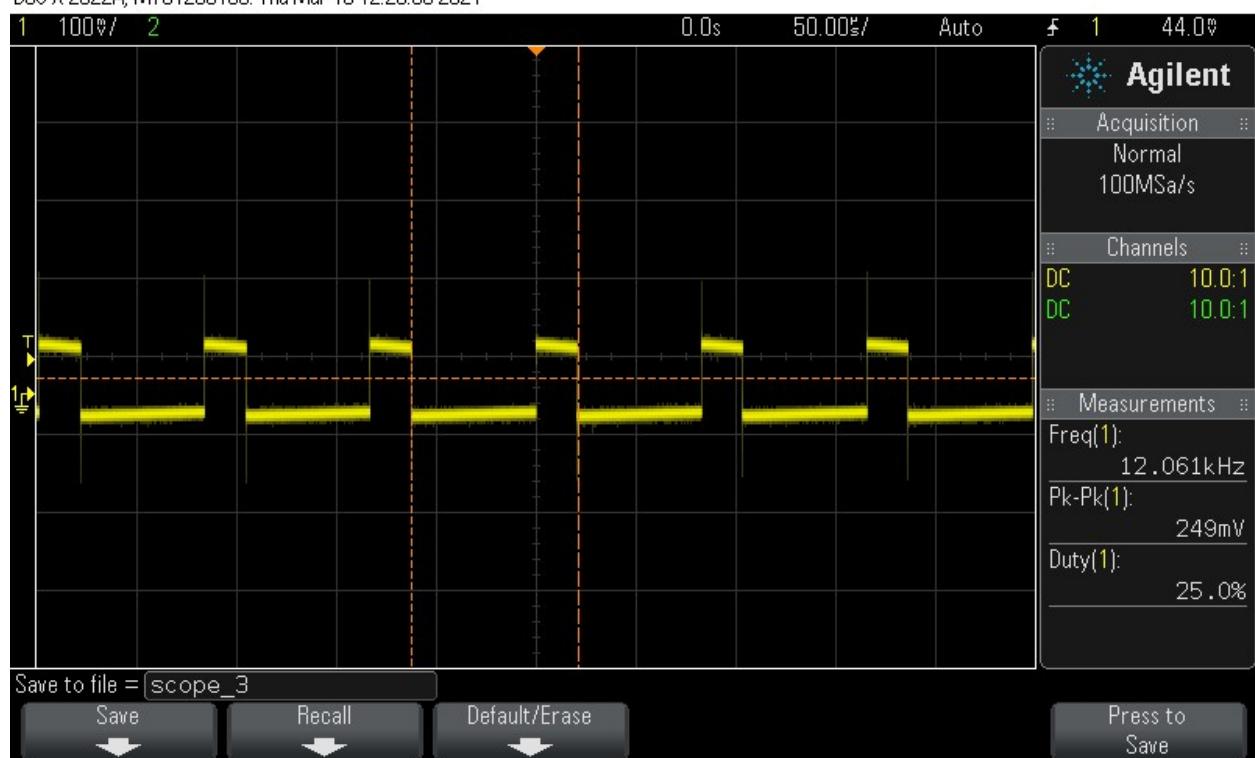
15%

DSO-X 2022A, MY51290180: Thu Mar 18 12:19:45 2021

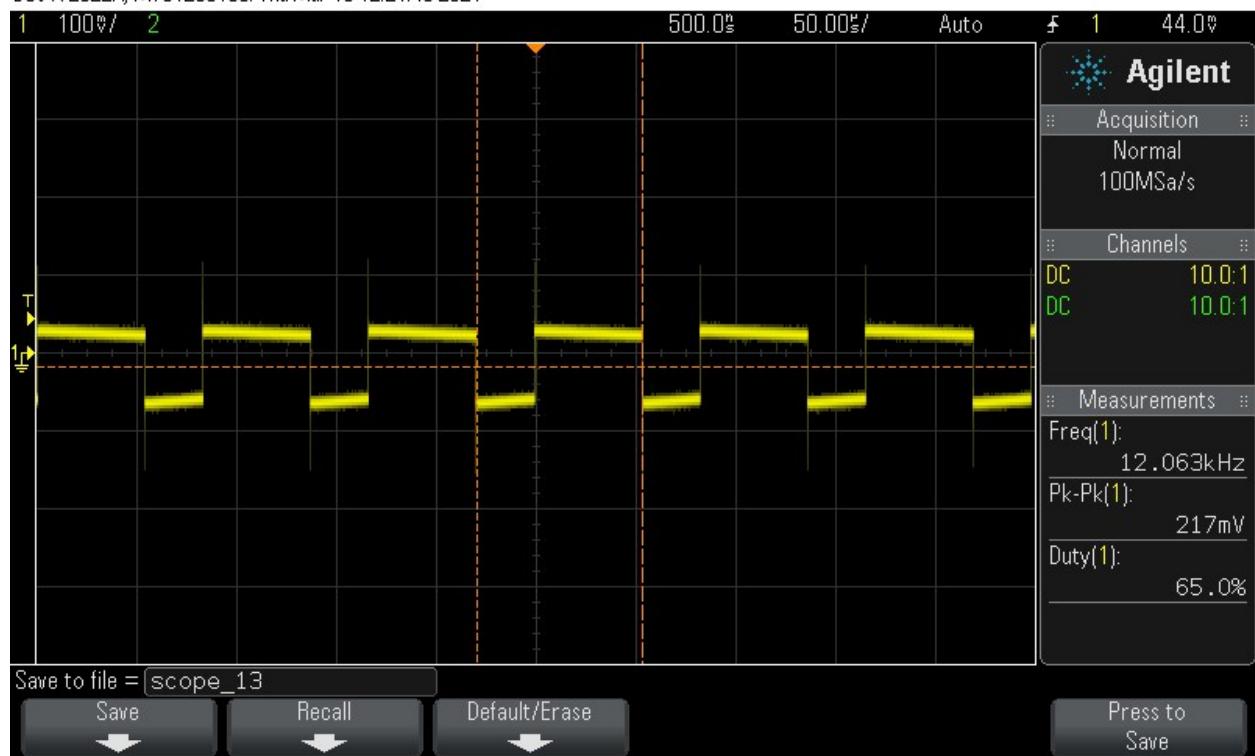


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DSO-X 2022A, MY51290180: Thu Mar 18 12:20:05 2021



DSO-X 2022A, MY51290180: Thu Mar 18 12:21:46 2021



DSO-X 2022A, MY51290180: Thu Mar 18 12:22:08 2021



## Setting pwm using d command

Set to 83

