



**Faculty of Engineering
Ain Shams University**

**CSE 211s: Introduction to Embedded
Systems**

REPORT (5)

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Sec.: 1

Program: CSE

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Question 2:

Q2. Write Embedded C application that blinks the three LED lights after delay 1 minute for 3 times where the LEDs blink each time after one second.

Upon starting the program, all the LEDs should be turned on. Assume the SysTick timer operates on 16 MHZ.

Check through the simulated Kit that the behavior of your code is correct and then download your code on the kit.

C code:

```
#include "tm4c123gh6pm.h"

void System_Init (void) {
    SYSTCTL_RCGCGPIO_R |= 0x20;
    while ((SYSTCTL_PRGPIO_R & 0x20)==0);
    GPIO_PORTF_LOCK_R= GPIO_LOCK_KEY;
    GPIO_PORTF_CR_R |= 0x0E;
    GPIO_PORTF_AMSEL_R &= ~0x0E;
    GPIO_PORTF_PCTL_R &= 0x0000FFF0;
    GPIO_PORTF_AFSEL_R &= 0x0E;
    GPIO_PORTF_DIR_R |= 0x0E;
    GPIO_PORTF_DEN_R |= 0x0E;
    GPIO_PORTF_DATA_R |= 0x0E;
}

void SysTick_wait ( unsigned long delay ) {
    NVIC_ST_CTRL_R=0x00;
    NVIC_ST_RELOAD_R= delay-1;
    NVIC_ST_CURRENT_R=0;
    NVIC_ST_CTRL_R=0x05;
    while( (NVIC_ST_CTRL_R&0x00010000)==0);
}

void delay (unsigned long time) {
    int i=0;
    while ( i < time ) {
        SysTick_wait (16000); // 1msec
        i++;
    }
}
```

```
void RGB_Output (unsigned char data) {
    GPIO_PORTF_DATA_R |=data;
}

void RGB_CLR (unsigned char data) {
    GPIO_PORTF_DATA_R &= ~data;
}

int i=0;
int main() {
    System_Init();
    while (1) {
        delay(60000);//wait for a minute
        for (i=0; i<3;i++){
            RGB_CLR(0x0E);
            delay(1000);
            RGB_Output(0x0E);
            delay(1000);
        }
    }
}
```

Snapshots:

Program Started, all LEDs are ON

The screenshot shows the TI-RTOS IDE with the following components:

- Registers:** Core registers R0-R15 and xPSR are visible. R0 is 0x00000045, R1 is 0x20000020, R2 is 0x00000000, R3 is 0x00000045, R4 is 0x00000051, R5 is 0x00000051, R6 is 0x00000000, R7 is 0x00000000, R8 is 0x00000000, R9 is 0x00000000, R10 is 0x00000000, R11 is 0x00000000, R12 is 0x00000000, R13 (SP) is 0x20000020, R14 (LR) is 0x0000004D, R15 (PC) is 0x00000045, and xPSR is 0x61000000.
- Disassembly:** The 'System_Init()' function is shown. It includes a delay of 600000 (wait for a minute) and a loop that sets the RGB CLR (0x0E) and outputs it (0x0E) with a delay of 1000.
- GPIOF:** The GPIOF register table shows the following values:

Property	Value
DATA	0x0000001F
DIR	0x0000000E
IS	0x00000000
IBE	0x00000000
IEV	0x00000000
IM	0
RIS	0
MIS	0
ICR	0
AFSEL	0x00000000
DR2R	0x000000FF
DR4R	0x00000000
DR8R	0x00000000
ODR	0x00000000
PUR	0x00000000
PDR	0x00000000
SLR	0x00000000
- Hardware Diagram:** The TM4C123 microcontroller is shown with LEDs connected to PF0-PF7. The LEDs are labeled 'LED' and 'White'.

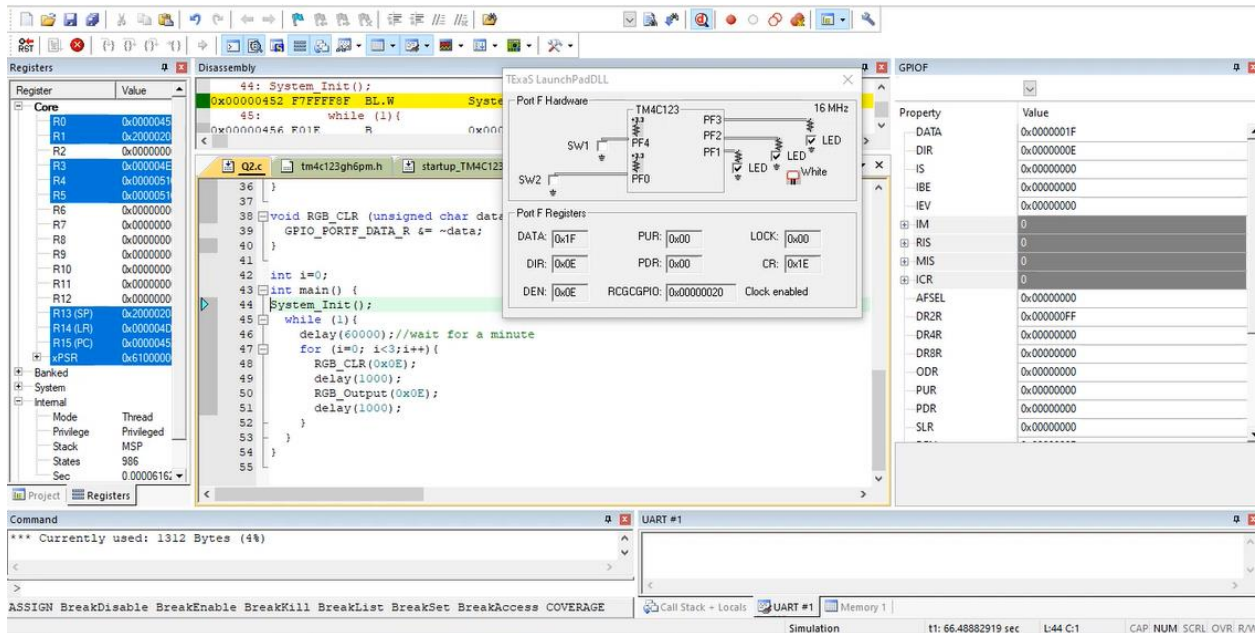
After 1 min delay

The screenshot shows the TI-RTOS IDE with the following components:

- Registers:** Core registers R0-R15 and xPSR are visible. R0 is 0x00000045, R1 is 0x20000020, R2 is 0x00000000, R3 is 0x00000045, R4 is 0x00000051, R5 is 0x00000051, R6 is 0x00000000, R7 is 0x00000000, R8 is 0x00000000, R9 is 0x00000000, R10 is 0x00000000, R11 is 0x00000000, R12 is 0x00000000, R13 (SP) is 0x20000020, R14 (LR) is 0x0000004D, R15 (PC) is 0x00000045, and xPSR is 0x61000000.
- Disassembly:** The 'System_Init()' function is shown. It includes a delay of 600000 (wait for a minute) and a loop that sets the RGB CLR (0x0E) and outputs it (0x0E) with a delay of 1000.
- GPIOF:** The GPIOF register table shows the following values:

Property	Value
DATA	0x00000011
DIR	0x0000000E
IS	0x00000000
IBE	0x00000000
IEV	0x00000000
IM	0
RIS	0
MIS	0
ICR	0
AFSEL	0x00000000
DR2R	0x000000FF
DR4R	0x00000000
DR8R	0x00000000
ODR	0x00000000
PUR	0x00000000
PDR	0x00000000
SLR	0x00000000
- Hardware Diagram:** The TM4C123 microcontroller is shown with LEDs connected to PF0-PF7. The LEDs are labeled 'LED' and 'White'.

Blinking for 1 sec



Video showing the LEDs with timer changing:

[Click here](#)