

LP5569 Lighting Pattern Design

ABSTRACT

This application report describes how to design lighting pattern with LP5569 Programmable lighting engine and provides examples of the fashion lighting pattern for the user.

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1 Introduction

This application report describes LP5559 lighting pattern design with examples for the device quick start. Most of the programs are presented with command compiler syntax. The Command compiler is described in The Control View - Source Edit Tab of [Using the BOOST-LP5569EVM Evaluation Module](#). This application report also includes LED ring Demo (click [here](#)) sample code in both command syntax and C language. Command compiler software is available with the evaluation kit.

2 Device Overview

The LP5569 device is a programmable, easy-to-use 9-channel I2C LED driver designed to produce lighting effects for various applications. The LED driver is equipped with an internal SRAM memory for user programmed sequences and three programmable LED engines, which allow operation without processor control. Autonomous operation reduces system power consumption when the processor is put in sleep mode.

3 Lighting Pattern Design with LEDs on LP5569EVM

The following lighting pattern is realized with white LEDs on LP5569EVM.

3.1 Bouncing Effect

This design is best viewed with 9 white LEDs on the LP5569EVM. This design has 4 white LEDs on at all times. Each LED has different PWM settings to create two tracers bouncing back and forth.

```

; bouncing.src

L10:    dw    0000000000000001b
L11:    dw    0000000000000010b
L12:    dw    0000000000000100b
L13:    dw    0000000000001000b
L14:    dw    0000000000010000b
L15:    dw    000000000001000b
L16:    dw    000000000000100b
L17:    dw    000000000000010b
L20:    dw    000000010000000b
L21:    dw    000000001000000b
L22:    dw    000000000100000b
L23:    dw    000000000010000b
L24:    dw    000000000001000b
L25:    dw    000000000001000b
L26:    dw    000000000100000b
L27:    dw    000000001000000b

.segment    program1
    map_start    L10        ;load the start address
    load_end     L17        ;load the end address
loop1:
    trigger      s{2}
    set_pwm      0
    map_next
    set_pwm      30
    map_next
    set_pwm      100
    map_prev
    wait         0.1        ;wait time to create effect
    branch      0, loop1
end

.segment    program2
    map_start    L20        ;load the start address
    load_end     L27        ;load the end address
loop2:
    trigger      w{1}
    set_pwm      0
    map_next
    set_pwm      30
    map_next
    set_pwm      100
    map_prev
    branch      0, loop2
end

.segment    program3
end
  
```

3.2 *Breath_white Effect*

This design is best viewed with 9 white LEDs on the LP5569EVM. This design has 3 group LED breathing.

```

GRP1:      dw      0000000001001001b
GRP2:      dw      0000000010010010b
GRP3:      dw      0000000100100100b
.segment   program1      ;Begin of a segment
    map_addr  GRP1
    set_pwm   00
loop1:
    ramp      1, 100
    ramp      1, -100
    wait      0.3
    branch    0, loop1
end
.segment   program2      ;Begin of a segment
    map_addr  GRP2
    set_pwm   00
loop2:
    ramp      1, 100
    ramp      1, -100
    wait      0.3
    branch    0, loop2
end
.segment   program3      ;Begin of a segment
    map_addr  GRP3
    set_pwm   00
loop3:
    ramp      1, 100
    ramp      1, -100
    wait      0.3
    branch    0, loop3
end

```

3.3 Chaser Effect

This design is best viewed with 9 white LEDs on the LP5569EVM. This design has 3 white LEDs on at all times. Each LED has different PWM settings to create a chaser (or tracer) effect.

```

; chaser.src
;
L00:    dw    0000000000000001b
L01:    dw    0000000000000010b
L02:    dw    0000000000000100b
L03:    dw    0000000000001000b
L04:    dw    0000000000010000b
L05:    dw    0000000001000000b
L06:    dw    0000000010000000b
L07:    dw    0000000010000000b
L08:    dw    0000000100000000b
L09:    dw    0000000100000000b
L10:    dw    0000000001000000b
L11:    dw    0000000001000000b
L12:    dw    0000000000010000b
L13:    dw    00000000000001000b
L14:    dw    0000000000000100b
L15:    dw    000000000000010b
ALL:    dw    0000000111111111b

.segment    program1
    map_addr    ALL
    ramp        0.5, 150
    ramp        0.5, -150
    wait        0.2
    map_start   L00        ;load the start address
    load_end    L15        ;load the end address
loop1:
    set_pwm     0
    map_next
    set_pwm     5
    map_next
    set_pwm     50
    map_next
    set_pwm     150
    map_prev
    map_prev
    wait        0.07        ;wait time to create effect
    branch     0, loop1
end

.segment    program2
end

```

4 Lighting Pattern Design with LEDs on LP5569 Ring Demo

The LED ring is the latest HMI in the smart personal electronic device space and improves the user experience. More and more appliance vendors are adopting this concept in next generation products. For the appliance customer, the existing model with the existing MCU already meets system specification, but the fancy lighting pattern will exhaust the system resources and potentially cause the MCU to crash. It requires a triple design circle to design complex lighting patterns without an engine control LED driver.

According to [Figure 1](#) for LED board design, U1,U2,U3, and U5 drive 12 pcs RGB LED modules. The LED mapping and I2C address assignments are shown as the [Table 1](#).

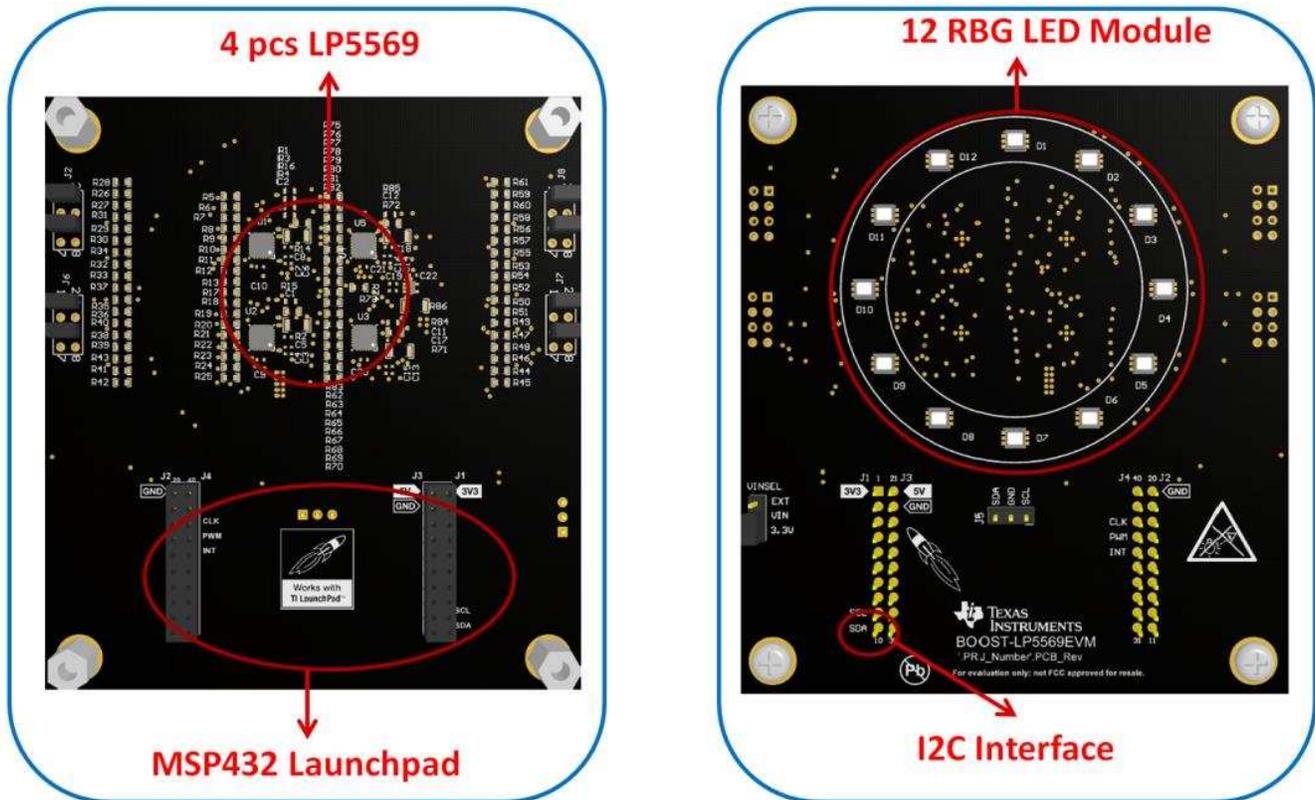


Figure 1. LED Board Design

Table 1. LED and I2C Address Assignment

Device	I2C Address	Broadcasting I2C Address	Channel Number of The LED Driver	LED
U1	0x32H	0x40H	LED0, LED3, LED6	D1-B, D1-G,D1-R
U1	0x32H	0x40H	LED1, LED4, LED7	D2-B, D2-G,D2-R
U1	0x32H	0x40H	LED2,LED5, LED8	D3-B, D3-G,D3-R
U2	0x33H	0x40H	LED0, LED3, LED6	D4-B, D4-G,D4-R
U2	0x33H	0x40H	LED1, LED4, LED7	D5-B, D5-G,D5-R
U2	0x33H	0x40H	LED2,LED5, LED8	D6-B, D6-G,D6-R
U3	0x34H	0x40H	LED0, LED3, LED6	D7-B, D7-G,D7-R
U3	0x34H	0x40H	LED1, LED4, LED7	D8-B, D8-G,D8-R
U3	0x34H	0x40H	LED2,LED5, LED8	D9-B, D9-G,D9-R
U5	0x35H	0x40H	LED0, LED3, LED6	D10-B, D10-G,D10-R
U5	0x35H	0x40H	LED1, LED4, LED7	D11-B, D11-G,D11-R
U5	0x35H	0x40H	LED2,LED5, LED8	D12-B, D12-G,D12-R

Firstly, define the LED Mapping in the beginning of the engine coding as shown below.

```

row1:      dw    0000000001001001b    ;Map B LED = D1, D4, D7 on the eval. board.
           dw    0000000010010010b    ;Map G LED = D2, D5, D8 on the eval. board.
           dw    0000000100100100b    ;Map R LED = D3, D6, D9 on the eval. board.
           dw    0000000011011011b    ;Map BG LED on the eval. board.
           dw    0000000110110110b    ;Map GR LED on the eval. board.
           dw    0000000101101101b    ;Map RB LED on the eval. board.
row7:      dw    0000000111111111b    ;Map all LEDs on the eval. board.
row8:      dw    0000000001001001b    ;Map B LED = D1,D4,D7 on the eval. board.
row9:      dw    0000000010010010b    ;Map G LED = D2,D5,D8 on the eval. board.

```

4.1 Breathing

During the breathing pattern, all LEDs fade in and out as the same color at the same rate, therefore all devices should run the same engine code below.

```

.segment      program1      ;Program for engine 1.
loop1_0:
  map_start   row1          ;Map the first LED.
  load_end    row7          ;End address of the mapping data table.
loop1:
  ramp        2, 200        ;Increase PWM 0->78% in 2 second.
  ramp        2, -255       ;Decrease PWM ->0% in 2 seconds.
  wait        0.4           ;Wait for 0.4 seconds.
  ramp        2, 200        ;Increase PWM 0->78% in 2 second.
  ramp        2, -255       ;Decrease PWM ->0% in 2 seconds.
  wait        0.4           ;Wait for 0.4 seconds.
  map_next
  branch      6,loop1       ;Loop 6 time
  map_addr    row8
  ramp        1.5, 200      ;Increase PWM 0->78% in 1.5 second.
  wait        0.4           ;Wait for 0.4 seconds.
  wait        0.4           ;Wait for 0.4 seconds.
  map_addr    row9
  ramp        3, 200        ;Increase PWM 0->78% in 3 second.
  ramp        3, -255       ;Decrease PWM ->0% in 3 seconds.
  ramp        3, 200        ;Increase PWM 0->78% in 3 second.
  ramp        3, -255       ;Decrease PWM ->0% in 3 seconds.
  map_addr    row8
  ramp        1.5, -255     ;Decrease PWM ->0% in 1.5 seconds.

```

4.2 Mono-Color Chasing

The mono-color chasing pattern needs the devices to start execution with a specific sequence delay. Each device has different code, as shown in Figure 2.

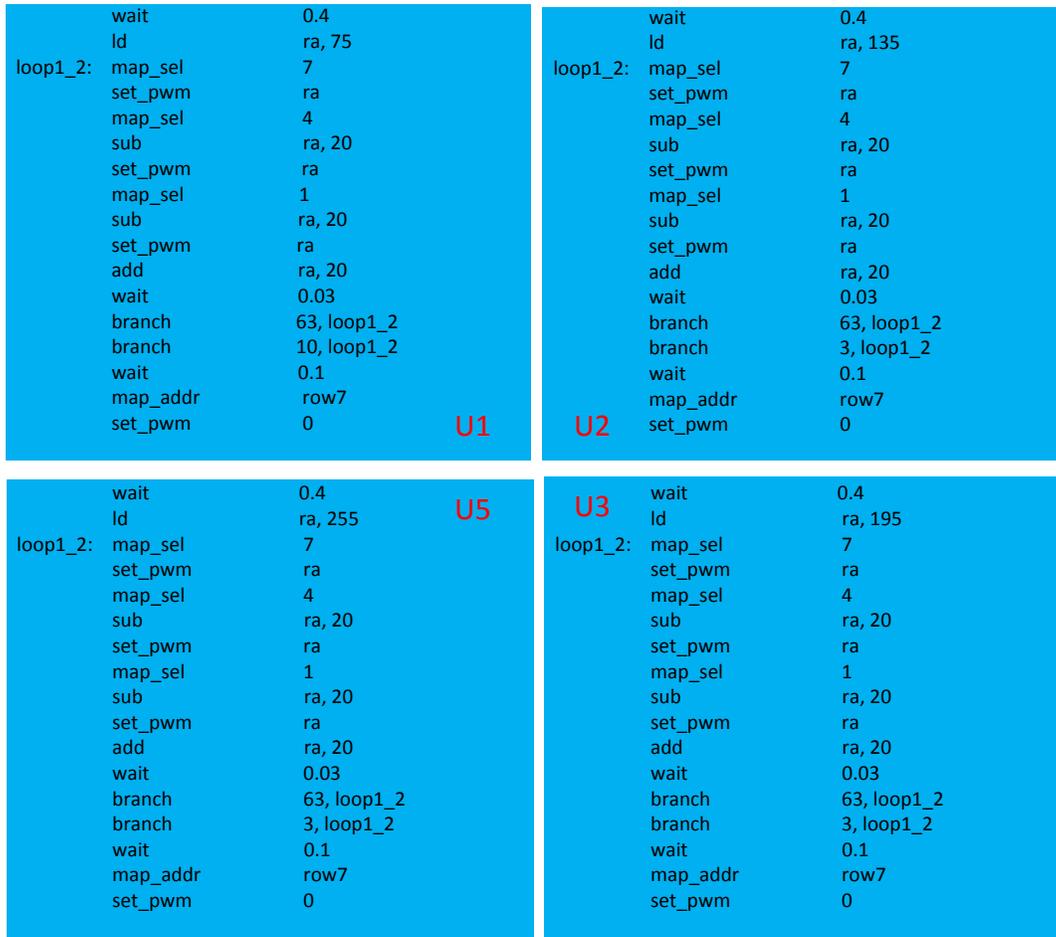


Figure 2. Mono-Color Chasing Engine Code for 4 Devices

4.3 Multi-Color Chasing

The multi-color chasing pattern requires the devices to start execution with a specific sequence delay. Each device has different code, as shown in Figure 3 and Figure 4.

<pre> .segment program2 loop2_3: wait 0.08 branch 2, loop2_3 map_clr trigger s{3} rst trigger w{1} map_addr row8 ramp 1, 200 loop2_1: wait 0.08 loop2_2: map_sel 2 set_pwm 200 wait 0.08 map_sel 5 set_pwm 200 wait 0.08 map_sel 8 set_pwm 200 wait 0.08 map_sel 2 set_pwm 0 wait 0.08 map_sel 5 set_pwm 0 wait 0.08 map_sel 8 set_pwm 0 wait 0.08 map_sel 3 set_pwm 200 wait 0.08 map_sel 6 set_pwm 200 wait 0.08 map_sel 9 set_pwm 200 wait 0.08 map_sel 3 set_pwm 0 wait 0.08 map_sel 6 set_pwm 0 wait 0.08 map_sel 9 set_pwm 0 wait 0.08 branch 63, loop2_2 map_addr row7 set_pwm 0 loop2_3: wait 0.08 branch 2, loop2_3 map_clr trigger s{3} rst </pre>	<p>U1</p>
<pre> .segment program2 trigger w{1} map_addr row8 ramp 1, 200 loop2_1: wait 0.08 branch 3, loop2_1 loop2_2: map_sel 2 set_pwm 200 wait 0.08 map_sel 5 set_pwm 200 wait 0.08 map_sel 8 set_pwm 200 wait 0.08 map_sel 2 set_pwm 0 wait 0.08 map_sel 5 set_pwm 0 wait 0.08 map_sel 8 set_pwm 0 wait 0.08 map_sel 3 set_pwm 200 wait 0.08 map_sel 6 set_pwm 200 wait 0.08 map_sel 9 set_pwm 200 wait 0.08 map_sel 3 set_pwm 0 wait 0.08 map_sel 6 set_pwm 0 wait 0.08 map_sel 9 set_pwm 0 wait 0.08 branch 63, loop2_2 map_addr row7 set_pwm 0 map_clr trigger s{3} rst </pre>	<p>U2</p>

Figure 3. Multi-Color Chasing Code for U1 and U2

U5			U3		
segment	program2	w(1)	.segment	program2	w(1)
	trigger	row8		trigger	row8
	map_addr	1, 200		map_addr	1, 200
	ramp	1, 200		ramp	1, 200
loop2_1:	wait	0.08	loop2_1:	wait	0.08
	branch	3, loop2_1	loop2_2:	map_sel	2
loop2_2:	map_sel	3		set_pwm	200
	set_pwm	200		wait	0.08
	wait	0.08		map_sel	5
	map_sel	6		set_pwm	200
	set_pwm	200		wait	0.08
	wait	0.08		map_sel	8
	map_sel	9		set_pwm	200
	set_pwm	200		wait	0.08
	wait	0.08		map_sel	2
	map_sel	3		set_pwm	0
	set_pwm	0		wait	0.08
	wait	0.08		map_sel	5
	map_sel	6		set_pwm	0
	set_pwm	0		wait	0.08
	wait	0.08		map_sel	8
	map_sel	9		set_pwm	0
	set_pwm	0		wait	0.08
	wait	0.08		map_sel	3
	map_sel	2		set_pwm	200
	set_pwm	200		wait	0.08
	wait	0.08		map_sel	6
	map_sel	5		set_pwm	200
	set_pwm	200		wait	0.08
	wait	0.08		map_sel	9
	map_sel	8		set_pwm	200
	set_pwm	200		wait	0.08
	wait	0.08		map_sel	3
	map_sel	2		set_pwm	0
	set_pwm	0		wait	0.08
	wait	0.08		map_sel	6
	map_sel	5		set_pwm	0
	set_pwm	0		wait	0.08
	wait	0.08		map_sel	9
	map_sel	8		set_pwm	0
	set_pwm	0		wait	0.08
	wait	0.08		branch	63, loop2_2
	branch	63, loop2_2		map_addr	row7
	map_addr	row7	loop2_3:	set_pwm	0
	set_pwm	0		wait	0.08
	map_clr			branch	2, loop2_3
	trigger	s(3)		map_clr	
	rst			trigger	s(3)
				rst	

Figure 4. Multi-Color Chasing Code for U3 and U5

4.4 Door Open

The door open pattern needs the devices to start execution with a specific sequence delay. Each device has different code as shown in [Figure 5](#).

<pre> loop1_8: wait 0.4 map_sel 1 set_pwm 200 wait 0.05 map_sel 4 set_pwm 200 wait 0.05 map_sel 7 set_pwm 200 loop1_9: wait 0.05 branch 6, loop1_9 wait 0.4 map_sel 7 set_pwm 0 wait 0.05 map_sel 4 set_pwm 0 wait 0.05 map_sel 1 set_pwm 0 wait 0.05 branch 63, loop1_8 map_clr trigger s{2} trigger w{3} rst </pre>	U1	<pre> loop1_8: wait 0.4 loop1_9: wait 0.05 branch 2, loop1_9 map_sel 1 set_pwm 200 wait 0.05 map_sel 4 set_pwm 200 wait 0.05 map_sel 7 set_pwm 200 wait 0.05 map_sel 7 set_pwm 200 wait 0.05 map_sel 7 set_pwm 0 wait 0.05 map_sel 4 set_pwm 0 wait 0.05 map_sel 1 set_pwm 0 wait 0.05 loop1_10: wait 0.05 branch 3, loop1_10 branch 63, loop1_8 map_clr trigger s{2} trigger w{3} rst </pre>	U2
<pre> loop1_8: wait 0.4 loop1_9: wait 0.05 branch 2, loop1_9 map_sel 7 set_pwm 200 wait 0.05 map_sel 4 set_pwm 200 wait 0.05 map_sel 1 set_pwm 200 wait 0.05 map_sel 1 set_pwm 200 wait 0.05 map_sel 1 set_pwm 0 wait 0.05 map_sel 4 set_pwm 0 wait 0.05 map_sel 7 set_pwm 0 wait 0.05 map_sel 7 set_pwm 0 loop1_10: wait 0.05 branch 3, loop1_10 branch 63, loop1_8 map_clr trigger s{2} trigger w{3} </pre>	U5	<pre> loop1_8: wait 0.4 map_sel 7 set_pwm 200 wait 0.05 map_sel 4 set_pwm 200 wait 0.05 map_sel 1 set_pwm 200 wait 0.05 loop1_9: wait 0.05 branch 6, loop1_9 wait 0.4 map_sel 1 set_pwm 0 wait 0.05 map_sel 4 set_pwm 0 wait 0.05 map_sel 7 set_pwm 0 wait 0.05 branch 63, loop1_8 map_clr trigger s{2} trigger w{3} rst </pre>	U3

Figure 5. Door Open

4.5 Coding Tips

- Use the branch instruction to synchronize multiple devices, as it guarantees all devices will be at the same time scale and step.
- Remember to clear the LED mapping with map_clr when using the same LED in the difference engine.
- Use the appropriate variable (ra, rb, rc, rd) for the progressive increase or decrease operation.

4.6 Uploading The Program to SRAM

The compile tool (Lasm.exe) can be downloaded from the GUI package on ti.com. The command window or GUI can be used to compile the .scr file.

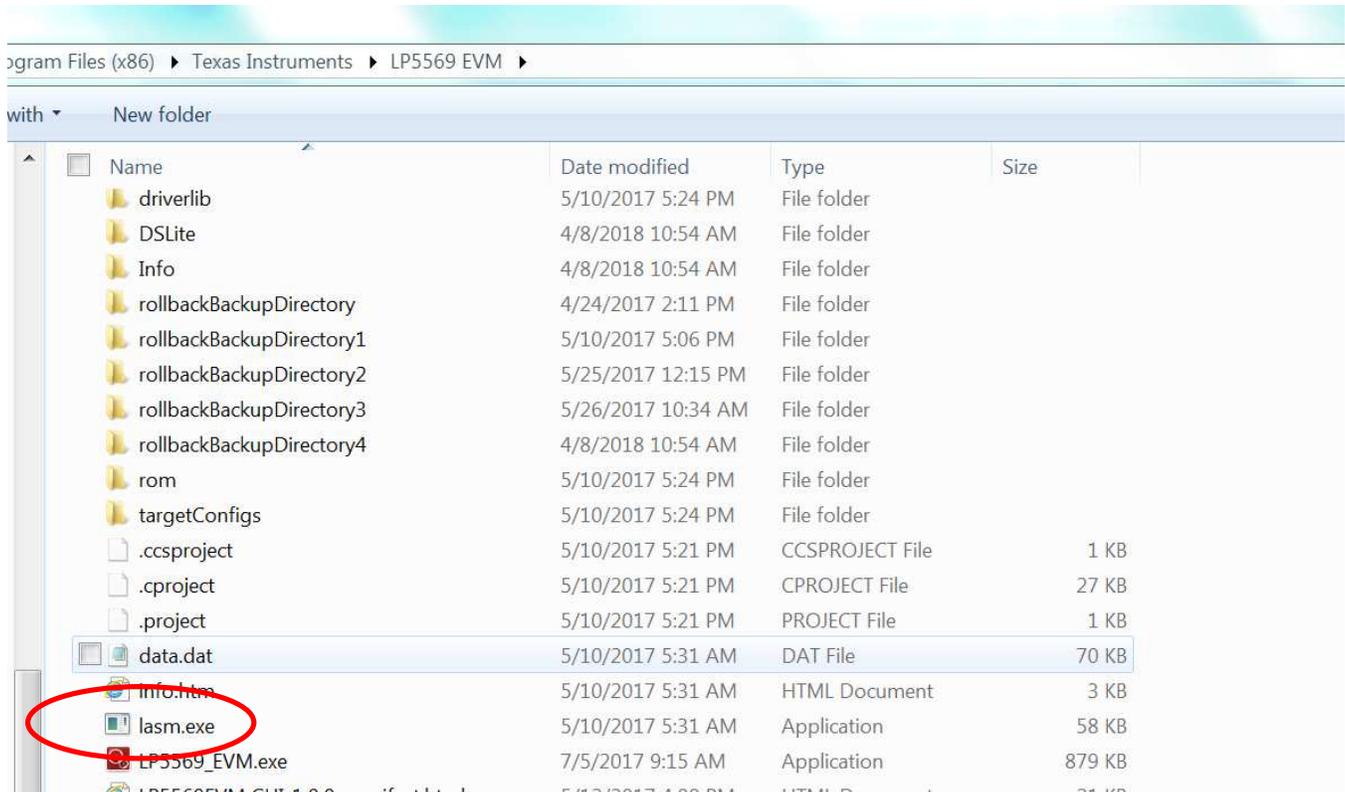


Figure 6. lasm.exe Path

Then, copy the hex file to the array table and upload the data to the SRAM by the below coding.

```

void load_SRAM()
{
    int i,j;
    MAP_I2C_setSlaveAddress(EUSCI_B1_BASE,0x40);           //Device global setting
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x2F); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE,0x48); //send register data
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x02); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE,0x54); //send register data

    MAP_I2C_setSlaveAddress(EUSCI_B1_BASE, 0x32);         //load hex to SRAM in U1
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x4b); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE,0x09); //send register data
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x4c); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE,0x78); //send register data
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x4d); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE,0xa8); //send register data
    for(j=0; j<16; j++)
    {
        MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x4F); //send register address
        MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE, j); //send register data
        MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE,0x50); //send register address
        for(i=0; i<32; i++)
            MAP_I2C_masterSendMultiByteNext(EUSCI_B1_BASE,table_32[i+j*32]); //send register data
    }

    MAP_I2C_setSlaveAddress(EUSCI_B1_BASE, 0x33);         //load hex to SRAM in U2
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x4b); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE,0x09); //send register data
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x4c); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE,0x7b); //send register data
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x4d); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE,0xaa); //send register data
    for(j=0; j<16; j++)
    {
        MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x4F); //send register address
        MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE, j); //send register data
        MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE,0x50); //send register address
        for(i=0; i<32; i++)
            MAP_I2C_masterSendMultiByteNext(EUSCI_B1_BASE,table_33[i+j*32]); //send register data
    }

    MAP_I2C_setSlaveAddress(EUSCI_B1_BASE, 0x34);         //load hex to SRAM in U3
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x4b); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE,0x09); //send register data
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x4c); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE,0x7b); //send register data
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x4d); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE,0xab); //send register data
    for(j=0; j<16; j++)
    {
        MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x4F); //send register address
        MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE, j); //send register data
        MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE,0x50); //send register address
        for(i=0; i<32; i++)
            MAP_I2C_masterSendMultiByteNext(EUSCI_B1_BASE,table_34[i+j*32]); //send register data
    }

    MAP_I2C_setSlaveAddress(EUSCI_B1_BASE, 0x35);         //load hex to SRAM in U5
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x4b); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE,0x09); //send register data
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x4c); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE,0x77); //send register data
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x4d); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE,0xa6); //send register data

```

```

    for(j=0; j<16; j++)
    {
        MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x4F); //send register address
        MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE, j); //send register data
        MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x50); //send register address
        for(i=0; i<32; i++)
            MAP_I2C_masterSendMultiByteNext(EUSCI_B1_BASE, table_35[i+j*32]); //send register data;
    }

    MAP_I2C_setSlaveAddress(EUSCI_B1_BASE, 0x32); //SET U1 as the clk out
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x2F); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE, 0x49); //send register data
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x3d); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE, 0x08); //send register data

    MAP_I2C_setSlaveAddress(EUSCI_B1_BASE, 0x40); //Run all the engine
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x02); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE, 0x00); //send register data
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x02); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE, 0xa8); //send register data
    MAP_I2C_masterSendMultiByteStart(EUSCI_B1_BASE, 0x01); //send register address
    MAP_I2C_masterSendMultiByteFinish(EUSCI_B1_BASE, 0xa8); //send register data
}

```

5 References

[Using the BOOST-LP5569EVM Evaluation Module](#)

[LP5569 Nine-Channel I2C RGB LED Driver With Engine Control and Charge Pump](#)

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