6×9 LED Matrix with Auto-Breathing Function

General Description

ET6296Y is a constant current LED drive circuit with 128 steps linear current control function and 128 steps PWM modulating control function; Built-in 9 independent low-resistance color LED driver channels, and through 6 channel dynamic scanning, it can realize 6×9 led matrix auto-breathing control independently; each channel output current can be adjusted independently by programming the 128 order liner current registers; Through PWM modulation, it can support the RGB LED lights; each low resistance channel can provide maximum 40mA driver current. ET6296Y also has automatic clock synchronization function, it can facilitate two chip extension design.

The automatic wake-up function from standby state is advantageous for the low power design of electronic products; The breathing effect ends interrupt request output function and built-in 864×16bit SRAM facilitates more frame animation design.

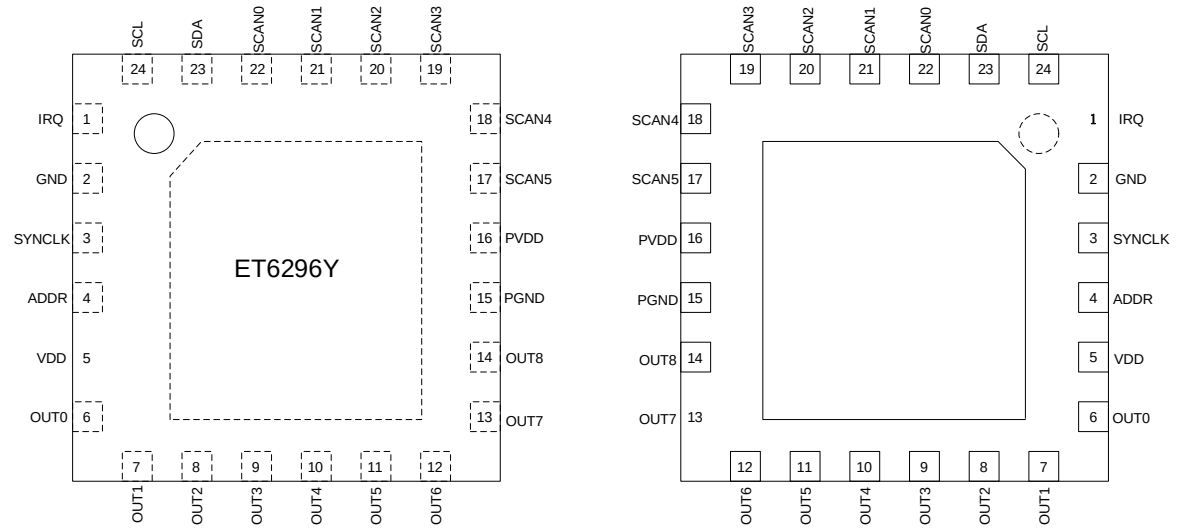
Features

- Operating voltage range：2.4V to 4.5V
- 128 step linear current control each LED (54 dots)
- 128 step PWM current control each RGB (18 groups)
- 4 stage max driver current selection: 25mA/30mA/35mA/40mA
- Each channel current can be adjusted independently
- I^2C bus interface and two I^2C address selection
- Built-in data memory for auto-breathing (864×16 bit)
- Each channel has 16 frame data, which can store up to 16 segment linear function
- Clock synchronization function, easy to realize two chip extension
- Software shut off function
- Automatic wake-up function
- Low voltage reset function
- Respiratory effects end interrupt request output function
- Operating temperature range：T_A=-40 to 85°C
- Package：QFN24 (4mm × 4mm)

Applications

- Mobile Phones
- Smart home
- Toy

Pin Configuration



TOP VIEW BOTTOM VIEW

Figure 1. Pin Configuration

Pin Function

Pin No.	Name	Description
1	IRQ	Interrupt flag open-drain output, low level effective
2, 15	GND, PGND	Ground
3	SYNCLK	Synchronous clock signal IO port (ADDR = 0, output synchronous clock, ADDR = 1, input synchronous clock)
4	ADDR	I^2C address select pin
5	VDD	Supply Power
6~14	OUT0~OUT8	Constant current LED driver port (the cathode of LED)
16	PVDD	Supply Power for LED
17~22	SCAN5~SCAN0	Dynamic Scanning port (the anode of LED)
23	SDA	I^2C bus data port
24	SCL	I^2C bus clock port

Function Diagram

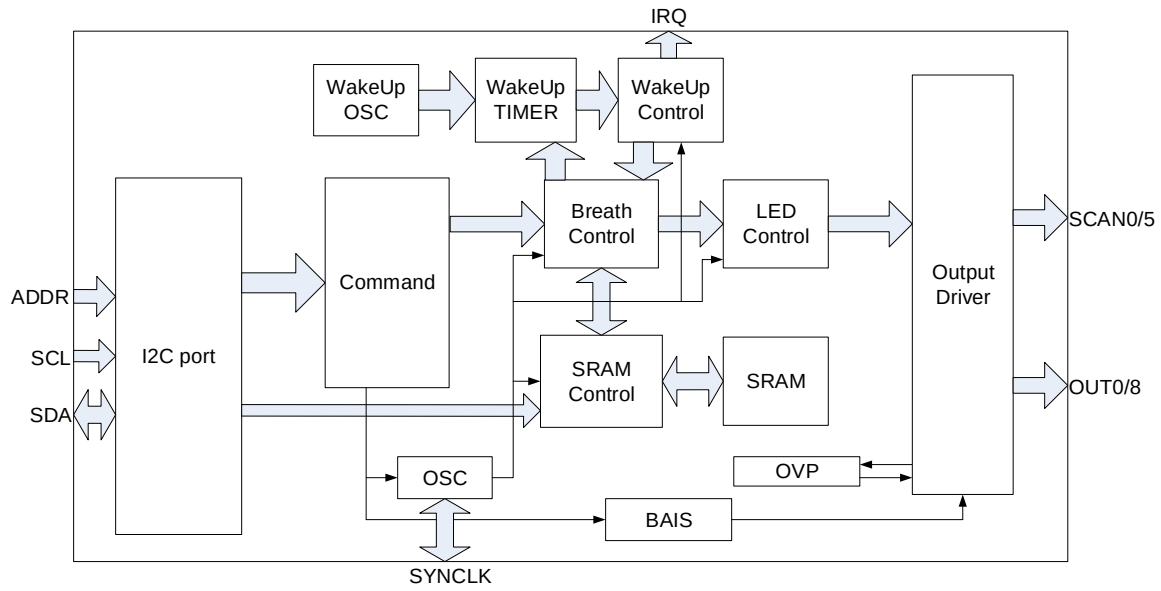


Figure 2. Functional Diagram

Function Description

1. I²C BUS

BUS Interface

MCU and ET6296Y transfer data by the SDA and SCL ports. SDA and SCL bus interface, and each port need a resistor pull-up to VDD.

Data Validity

While SCL signal is high, SDA's data is effective and stable. While SCL signal is low, MCU can change SDA port's voltage to high or low.

Start(Restart) and Stop operate condition

While SCL signal is high, SDA signal change from high to low, the interface start or restart; while SCL signal is high, and SDA signal change from low to high ,the interface will stop operating.

Byte Format

Each byte of data has 8 bits, and each byte include a ACK. Transfer the first bit data is MSB.

ACK

During the ACK clock, the MCU make the SDA port at a high level, and in the write mode, ET6296Y will send ACK signal and make the SDA port at a low level during the response. In the reading mode, ET6296Y will not send the ACK signal and make the SDA port in a high level during the response.

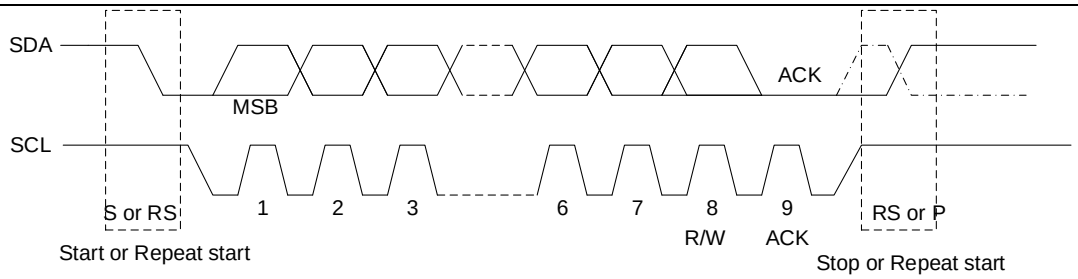


Figure 3. I²C Write mode

Notes:

1. ACK=Acknowledge MSB=Most Significant Bit

2. S=Start Conditions RS=Restart Conditions P=Stop Conditions

3. Fastest Transmission Speed =400KBITS/S

4. Restart：SDA-level turnover as expressed by the dashed line waveform

Chip Address

ET6296Y has two Chip address:

ADDR port pick up the pin	Chip Address
VDD	CEH (only write)
GND	C6H (only write)

2. I²C bus protocol

I²C Writing Command Register Interface Protocol (continuous)：

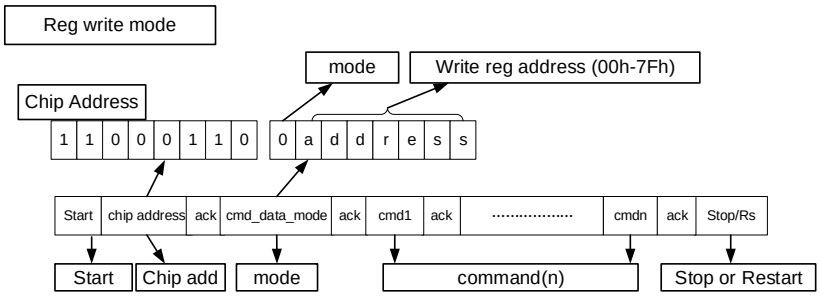


Figure 4. I²C Writing Register Mode(continuous)

- Start Cond=Start Conditions
- Chip Addr=Chip Address=11000110b
- ACK=Acknowledge
- Reg Start Address =(cmd mode 0b + 7bit command reg start address)
- ACK=Acknowledge
- Command reg data 1(cmd1)
- ……
- Command reg data n(cmdn)
- ACK=Acknowledge
- Stop

SDRAM writing Protocol：

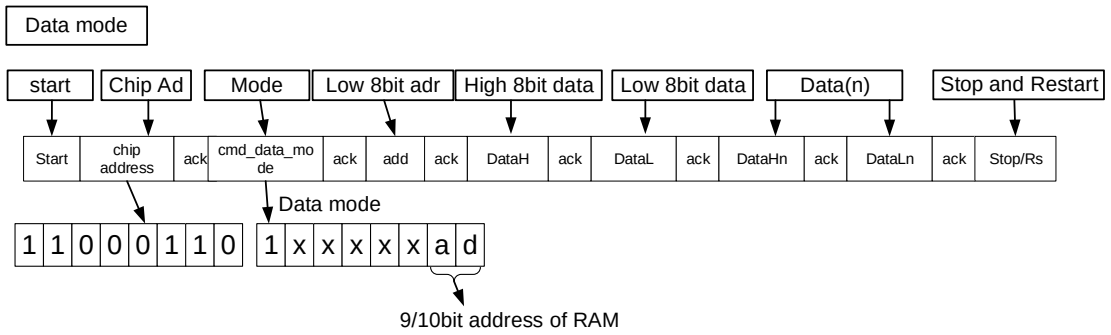


Figure 5. Data Mode

- Start Cond=Start Conditions
- Chip Addr=Chip Address=11000110b
- ACK=Acknowledge
- SRAM data start Address =1xxx_xxad(data mode 1b + don’t care bit xxx_xx + 2bit sram high start address)
- ACK=Acknowledge
- SRAM data start Address(Low 8bit)
- ACK=Acknowledge
- SRAM high 8bit data(DataH)
- ACK=Acknowledge
- SRAM low 8bit data(DataL)
- ACK=Acknowledge
- ……
- SRAM low 8bit data n(DataLn)
- ACK=Acknowledge
- Stop

3. Register Description

Address	Name	Description							
00h	MDCTR	shutdown	x	curtmd[1:0]		x	scan_md[2:0]		
01h	WDTCTR	int_en	wdt_cyc_times[2:0]			wts[2:0]			wdten
02h	INTRCTR	clrint							
03h	MDSEL1	mdsel1[7:0]							
04h	MDSEL2	mdsel2[7:0]							
05h	MDSEL3	mdsel3[7:0]							
06h	MDSEL4	mdsel4[7:0]							
07h	MDSEL5	mdsel5[7:0]							
08h	MDSEL6	mdsel6[7:0]							
09h	MDSEL7	x	x	mdsel7[5:0]					
0Ah	LEN_TIMES0	cyc_len_led0[4:0]					cyc_times_led0[2:0]		
0Bh	LEN_TIMES1	cyc_len_led1[4:0]					cyc_times_led1[2:0]		
0Ch	LEN_TIMES2	cyc_len_led2[4:0]					cyc_times_led2[2:0]		
0Dh	LEN_TIMES3	cyc_len_led3[4:0]					cyc_times_led3[2:0]		
0Eh	LEN_TIMES4	cyc_len_led4[4:0]					cyc_times_led4[2:0]		
0Fh	LEN_TIMES5	cyc_len_led5[4:0]					cyc_times_led5[2:0]		
10h	LEN_TIMES6	cyc_len_led6[4:0]					cyc_times_led6[2:0]		
11h	LEN_TIMES7	cyc_len_led7[4:0]					cyc_times_led7[2:0]		
12h	LEN_TIMES8	cyc_len_led8[4:0]					cyc_times_led8[2:0]		
13h	LEN_TIMES9	cyc_len_led9[4:0]					cyc_times_led9[2:0]		
14h	LEN_TIMES10	cyc_len_led10[4:0]					cyc_times_led10[2:0]		
15h	LEN_TIMES11	cyc_len_led11[4:0]					cyc_times_led11[2:0]		
16h	LEN_TIMES12	cyc_len_led12[4:0]					cyc_times_led12[2:0]		
17h	LEN_TIMES13	cyc_len_led13[4:0]					cyc_times_led13[2:0]		
18h	LEN_TIMES14	cyc_len_led14[4:0]					cyc_times_led14[2:0]		
19h	LEN_TIMES15	cyc_len_led15[4:0]					cyc_times_led15[2:0]		
1Ah	LEN_TIMES16	cyc_len_led16[4:0]					cyc_times_led16[2:0]		
1Bh	LEN_TIMES17	cyc_len_led17[4:0]					cyc_times_led17[2:0]		
1Ch	LEN_TIMES18	cyc_len_led18[4:0]					cyc_times_led18[2:0]		
1Dh	LEN_TIMES19	cyc_len_led19[4:0]					cyc_times_led19[2:0]		
1Eh	LEN_TIMES20	cyc_len_led20[4:0]					cyc_times_led20[2:0]		
1Fh	LEN_TIMES21	cyc_len_led21[4:0]					cyc_times_led21[2:0]		
20h	LEN_TIMES22	cyc_len_led22[4:0]					cyc_times_led22[2:0]		
21h	LEN_TIMES23	cyc_len_led23[4:0]					cyc_times_led23[2:0]		
22h	LEN_TIMES24	cyc_len_led24[4:0]					cyc_times_led24[2:0]		
23h	LEN_TIMES25	cyc_len_led25[4:0]					cyc_times_led25[2:0]		
24h	LEN_TIMES26	cyc_len_led26[4:0]					cyc_times_led26[2:0]		
25h	LEN_TIMES27	cyc_len_led27[4:0]					cyc_times_led27[2:0]		
26h	LEN_TIMES28	cyc_len_led28[4:0]					cyc_times_led28[2:0]		
27h	LEN_TIMES29	cyc_len_led29[4:0]					cyc_times_led29[2:0]		
28h	LEN_TIMES30	cyc_len_led30[4:0]					cyc_times_led30[2:0]		
29h	LEN_TIMES31	cyc_len_led31[4:0]					cyc_times_led31[2:0]		
2Ah	LEN_TIMES32	cyc_len_led32[4:0]					cyc_times_led32[2:0]		
2Bh	LEN_TIMES33	cyc_len_led33[4:0]					cyc_times_led33[2:0]		
2Ch	LEN_TIMES34	cyc_len_led34[4:0]					cyc_times_led34[2:0]		
2Dh	LEN_TIMES35	cyc_len_led35[4:0]					cyc_times_led35[2:0]		
2Eh	LEN_TIMES36	cyc_len_led36[4:0]					cyc_times_led36[2:0]		
2Fh	LEN_TIMES37	cyc_len_led37[4:0]					cyc_times_led37[2:0]		
30h	LEN_TIMES38	cyc_len_led38[4:0]					cyc_times_led38[2:0]		
31h	LEN_TIMES39	cyc_len_led39[4:0]					cyc_times_led39[2:0]		
32h	LEN_TIMES40	cyc_len_led40[4:0]					cyc_times_led40[2:0]		
33h	LEN_TIMES41	cyc_len_led41[4:0]					cyc_times_led41[2:0]		
34h	LEN_TIMES42	cyc_len_led42[4:0]					cyc_times_led42[2:0]		
35h	LEN_TIMES43	cyc_len_led43[4:0]					cyc_times_led43[2:0]		
36h	LEN_TIMES44	cyc_len_led44[4:0]					cyc_times_led44[2:0]		
37h	LEN_TIMES45	cyc_len_led45[4:0]					cyc_times_led45[2:0]		
38h	LEN_TIMES46	cyc_len_led46[4:0]					cyc_times_led46[2:0]		
39h	LEN_TIMES47	cyc_len_led47[4:0]					cyc_times_led47[2:0]		
3Ah	LEN_TIMES48	cyc_len_led48[4:0]					cyc_times_led48[2:0]		
3Bh	LEN_TIMES49	cyc_len_led49[4:0]					cyc_times_led49[2:0]		
3Ch	LEN_TIMES50	cyc_len_led50[4:0]					cyc_times_led50[2:0]		
3Dh	LEN_TIMES51	cyc_len_led51[4:0]					cyc_times_led51[2:0]		
3Eh	LEN_TIMES51	cyc_len_led52[4:0]					cyc_times_led52[2:0]		
3Fh	LEN_TIMES53	cyc_len_led53[4:0]					cyc_times_led53[2:0]		

40h	PWM_RGB03	pwm_sel	pwm_rgb0/3[6:0]
41h	PWM_RGB14	pwm_sel	pwm_rgb1/4[6:0]
42h	PWM_RGB25	pwm_sel	pwm_rgb2/5[6:0]
43h	PWM_RGB69	pwm_sel	pwm_rgb6/9[6:0]
44h	PWM_RGB710	pwm_sel	pwm_rgb7/10[6:0]
45h	PWM_RGB811	pwm_sel	pwm_rgb8/11[6:0]
46h	PWM_RGB1215	pwm_sel	pwm_rgb12/15[6:0]
47h	PWM_RGB1316	pwm_sel	pwm_rgb13/16[6:0]
48h	PWM_RGB1417	pwm_sel	pwm_rgb14/17[6:0]
49h	FIXBRIT_LED0	x	fixbrit_led0[6:0]
4Ah	FIXBRIT_LED1	x	fixbrit_led1[6:0]
4Bh	FIXBRIT_LED2	x	fixbrit_led2[6:0]
4Ch	FIXBRIT_LED3	x	fixbrit_led3[6:0]
4Dh	FIXBRIT_LED4	x	fixbrit_led4[6:0]
4Eh	FIXBRIT_LED5	x	fixbrit_led5[6:0]
4Fh	FIXBRIT_LED6	x	fixbrit_led6[6:0]
50h	FIXBRIT_LED7	x	fixbrit_led7[6:0]
51h	FIXBRIT_LED8	x	fixbrit_led8[6:0]
52h	FIXBRIT_LED9	x	fixbrit_led9[6:0]
53h	FIXBRIT_LED10	x	fixbrit_led10[6:0]
54h	FIXBRIT_LED11	x	fixbrit_led11[6:0]
55h	FIXBRIT_LED12	x	fixbrit_led12[6:0]
56h	FIXBRIT_LED13	x	fixbrit_led13[6:0]
57h	FIXBRIT_LED14	x	fixbrit_led14[6:0]
58h	FIXBRIT_LED15	x	fixbrit_led15[6:0]
59h	FIXBRIT_LED16	x	fixbrit_led16[6:0]
5Ah	FIXBRIT_LED17	x	fixbrit_led17[6:0]
5Bh	FIXBRIT_LED18	x	fixbrit_led18[6:0]
5Ch	FIXBRIT_LED19	x	fixbrit_led19[6:0]
5Dh	FIXBRIT_LED20	x	fixbrit_led20[6:0]
5Eh	FIXBRIT_LED21	x	fixbrit_led21[6:0]
5Fh	FIXBRIT_LED22	x	fixbrit_led22[6:0]
60h	FIXBRIT_LED23	x	fixbrit_led23[6:0]
61h	FIXBRIT_LED24	x	fixbrit_led24[6:0]
62h	FIXBRIT_LED25	x	fixbrit_led25[6:0]
63h	FIXBRIT_LED26	x	fixbrit_led26[6:0]
64h	FIXBRIT_LED27	x	fixbrit_led27[6:0]
65h	FIXBRIT_LED28	x	fixbrit_led28[6:0]
66h	FIXBRIT_LED29	x	fixbrit_led29[6:0]
67h	FIXBRIT_LED30	x	fixbrit_led30[6:0]
68h	FIXBRIT_LED31	x	fixbrit_led31[6:0]
69h	FIXBRIT_LED32	x	fixbrit_led32[6:0]
6Ah	FIXBRIT_LED33	x	fixbrit_led33[6:0]
6Bh	FIXBRIT_LED34	x	fixbrit_led34[6:0]
6Ch	FIXBRIT_LED35	x	fixbrit_led35[6:0]
6Dh	FIXBRIT_LED36	x	fixbrit_led36[6:0]
6Eh	FIXBRIT_LED37	x	fixbrit_led37[6:0]
6Fh	FIXBRIT_LED38	x	fixbrit_led38[6:0]
70h	FIXBRIT_LED39	x	fixbrit_led39[6:0]
71h	FIXBRIT_LED40	x	fixbrit_led40[6:0]
72h	FIXBRIT_LED41	x	fixbrit_led41[6:0]
73h	FIXBRIT_LED42	x	fixbrit_led42[6:0]
74h	FIXBRIT_LED43	x	fixbrit_led43[6:0]
75h	FIXBRIT_LED44	x	fixbrit_led44[6:0]
76h	FIXBRIT_LED45	x	fixbrit_led45[6:0]
77h	FIXBRIT_LED46	x	fixbrit_led46[6:0]
78h	FIXBRIT_LED47	x	fixbrit_led47[6:0]
79h	FIXBRIT_LED48	x	fixbrit_led48[6:0]
7Ah	FIXBRIT_LED49	x	fixbrit_led49[6:0]
7Bh	FIXBRIT_LED50	x	fixbrit_led50[6:0]
7Ch	FIXBRIT_LED51	x	fixbrit_led51[6:0]
7Dh	FIXBRIT_LED52	x	fixbrit_led52[6:0]
7Eh	FIXBRIT_LED53	x	fixbrit_led53[6:0]
7Fh	DISCTR	disp_con	xxxxxxx

Table1. Mode Control Register

Addr: 00h		Mode Control Register			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
2:0	scan_md	000b	W	SCAN Mode SET	
				000	SCAN0→ SCAN1 Circular Scanning
				001	SCAN0→ SCAN2 Circular Scanning
				010	SCAN0→ SCAN3 Circular Scanning
				011	SCAN0→ SCAN4 Circular Scanning
				100	SCAN0→ SCAN5 Circular Scanning
				101	Reserved
				110	Reserved
				111	Reserved
3	x	x	x	Don't Care	
5:4	curtmd	10b	W	Max Liner Current Imax	
				00	20mA
				01	25mA
				10	30mA
				11	40mA
6	x	x	x	Don't Care	
7	shutdown	1b	W	0	Start
				1	Shutdown

Table 2. Wake up control and Interrupt enable register

Addr: 01h		Wake Up Control and interrupt enable Register			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
0	wdten	0b	W	Wake Up Enable Bit	
				0	OFF
				1	ON
3:1	wts	000b	W	Wake Up Time Set	
				000	200s
				001	100s
				010	50s
				011	25s
				100	12.5s
				101	6.25s
				110	3.13s
				111	1.56s
6:4	wdt_cyc_times	000b	W	Wake Up Cycles Set	
				000	Unlimited times
				001	1 times
				010	2 times
				011	3 times

				100	4 times
				101	5 times
				110	6 times
				111	7 times
7	int_en	0b	W	Interrupt flag output enable	
				0	Disable
				1	Enable

Note: Interrupt signal output and Wake Up start have occurred in the end all leds spontaneous breathing cycles.

Table 3. Interrupt Clear Register

Addr: 02h		Interrupt Clear Register		
Bit	**Bit Name**	**Default**	**Access**	**Description**
7:0	clrint	xxh	W	Clear interrupt flag
				Write any data that is clear the interrupt signal

Note: When the interrupt signal is generated, writing the register can be used to immediately clear the interrupt signal.

Table 4. Mode Select Register 1

Addr: 03h		Mode Select Register One			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
0	mdsel1	0b	W	LED0 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
1		0b	W	LED1 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
2		0b	W	LED2 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
3		0b	W	LED3 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
4		0b	W	LED4 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
5		0b	W	LED5 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
6		0b	W	LED6 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
7		0b	W	LED7 Work Mode Select	

				0	Auto-breath Mode
				1	Liner Current Mode

Table 5. Mode Select Register 2

Addr: 04h		Mode Select Register Two			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
0	mdsel2	0b	W	LED8 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
1		0b	W	LED9 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
2		0b	W	LED10 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
3		0b	W	LED11 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
4		0b	W	LED12 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
5		0b	W	LED13 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
6		0b	W	LED14 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
7		0b	W	LED15 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode

Table 6. Mode Select Register 3

Addr: 05h		Mode Select Register Three			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
0	mdsel3	0b	W	LED16 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
1		0b	W	LED17 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
2		0b	W	LED18 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode

3		0b	W	LED19 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
4		0b	W	LED20 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
5		0b	W	LED21 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
6		0b	W	LED22 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
7		0b	W	LED23 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode

Table 7. Mode Select Register 4

Addr: 06h		Mode Select Register Four			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
0	mdsel4	0b	W	LED24 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
1		0b	W	LED25 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
2		0b	W	LED26 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
3		0b	W	LED27 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
4		0b	W	LED28 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
5		0b	W	LED29 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
6		0b	W	LED30 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
7		0b	W	LED31 Work Mode Select	
				0	Auto-breath Mode

				1	Liner Current Mode

Table 8. Mode Select Register 5

Addr: 07h		Mode Select Register Five			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
0	mdsel5	0b	W	LED32 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
1		0b	W	LED33 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
2		0b	W	LED34 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
3		0b	W	LED35 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
4		0b	W	LED36 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
5		0b	W	LED37 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
6		0b	W	LED38 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
7		0b	W	LED39 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode

Table 9. Mode Select Register 6

Addr: 08h		Mode Select Register Six			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
0	mdsel6	0b	W	LED40 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
1		0b	W	LED41 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
2		0b	W	LED42 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
3		0b	W	LED43 Work Mode Select	

				0	Auto-breath Mode
				1	Liner Current Mode
4		0b	W	LED44 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
5		0b	W	LED45 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
6		0b	W	LED46 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
7		0b	W	LED47 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode

Table 10. Mode Select Register 7

Addr: 09h		Mode Select Register Seven			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
0	mdsel7	0b	W	LED48 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
1		0b	W	LED49 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
2		0b	W	LED50 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
3		0b	W	LED51 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
4		0b	W	LED52 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
5		0b	W	LED53 Work Mode Select	
				0	Auto-breath Mode
				1	Liner Current Mode
7:6		xx	xx	Don't Care	

Note: The corresponding location of LED0 ~ LED53 can refer to application circuit diagram.

Table 11. Frame Length and Repeat times Register

Addr: 0A→3Fh			Frame Length and Repeat times Register		
Addr	**Bit**	**Bit Name**	**Default**	**Access**	**Description**
0AH	2:0	cyc_times_ledn	000b	W	LEDn spontaneous breathing frame cycles

→ 3FH					000	Unlimited times
					001	1 times
					·····	·····. （accumulative in turn）
					111	7 times
	7:3	cyc_len_ledn	00001b	W	LEDn spontaneous breathing frame length	
					000001	1 frame
					000010	2 frame
					·····	·····.（accumulative in turn）
					10000	16 frame
					Other	Reserved

Note: LEDn is the LED0→LED53.

Table 12. RGB0 or RGB3 PWM Parameter Register

Addr: 40h		**RGB0 or RGB3 PWM Parameter Register**			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
6:0	pwm_rbg0/3	7Fh	W	RGB0 or RGB3 PWM Parameter	
				pwm_sel=0	RGB0 PWM Parameter
				pwm_sel=1	RGB3 PWM Parameter
7	pwm_sel	x	W	RGB0 or RGB3 PWM Parameter Select	
				0	RGB0
				1	RGB3

Table 13. RGB1 or RGB4 PWM Parameter Register

Addr: 41h		**RGB1 or RGB4 PWM Parameter Register**			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
6:0	pwm_rbg1/4	7Fh	W	RGB1 or RGB4 PWM Parameter	
				pwm_sel=0	RGB1 PWM Parameter
				pwm_sel=1	RGB4 PWM Parameter
7	pwm_sel	x	W	RGB or RGB4 PWM Parameter Select	
				0	RGB1
				1	RGB4

Table 14. RGB2 or RGB5 PWM Parameter Register

Addr: 42h		**RGB2 or RGB5 PWM Parameter Register**			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
6:0	pwm_rbg2/5	7Fh	W	RGB2 or RGB5 PWM Parameter	
				pwm_sel=0	RGB2 PWM Parameter
				pwm_sel=1	RGB5 PWM Parameter
7	pwm_sel	x	W	RGB2 or RGB5 PWM Parameter Register	
				0	RGB2
				1	RGB5

Table 15. RGB6 or RGB9 PWM Parameter Register

Addr: 43h		RGB6 or RGB9 PWM Parameter Register			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
6:0	pwm_rbg6/9	7Fh	W	RGB6 or RGB9 PWM Parameter	
				pwm_sel=0	RGB6 PWM Parameter
				pwm_sel=1	RGB9 PWM Parameter
7	pwm_sel	X	W	RGB6 or RGB9 PWM Parameter Select	
				0	RGB6
				1	RGB9

Table 16. RGB7 or RGB10 PWM Parameter Register

Addr: 44h		RGB7 or RGB10 PWM Parameter Register			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
6:0	pwm_rbg7/10	7Fh	W	RGB7 or RGB10 PWM Parameter	
				pwm_sel=0	RGB7 PWM Parameter
				pwm_sel=1	RGB10 PWM Parameter
7	pwm_sel	X	W	RGB7 or RGB10 PWM Parameter Select	
				0	RGB7
				1	RGB10

Table 17. RGB8 or RGB11 PWM Parameter Register

Addr: 45h		RGB8 or RGB11 PWM Parameter Register			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
6:0	pwm_rbg8/11	7Fh	W	RGB8 or RGB11 PWM Parameter	
				pwm_sel=0	RGB8 PWM Parameter
				pwm_sel=1	RGB11 PWM Parameter
7	pwm_sel	x	W	RGB8 or RGB11 PWM Parameter Select	
				0	RGB8
				1	RGB11

Table 18. RGB12 or RGB15 PWM Parameter Register

Addr: 46h		RGB12 or RGB15 PWM Parameter Register			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
6:0	pwm_rbg12/15	7Fh	W	RGB12 or RGB15 PWM Parameter	
				pwm_sel=0	RGB12 PWM Parameter
				pwm_sel=1	RGB15 PWM Parameter
7	pwm_sel	x	W	RGB12 or RGB15 PWM Parameter Select	
				0	RGB12
				1	RGB15

Table 19. RGB13 or RGB16 PWM Parameter Register

Addr: 47h		RGB13 or RGB16 PWM Parameter Register		
Bit	**Bit Name**	**Default**	**Access**	**Description**
6:0	pwm_rbg13/16	7Fh	W	RGB13 or RGB16 PWM Parameter

				pwm_sel=0	RGB13 PWM Parameter
				pwm_sel=1	RGB16 PWM Parameter
7	pwm_sel	x	W	RGB13 or RGB16 PWM Parameter Select	
				0	RGB13
				1	RGB16

Table 20. RGB14 or RGB17 PWM Parameter Register

Addr: 48h		RGB14 or RGB17 PWM Parameter Register			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
6:0	pwm_rbg14/17	7Fh	W	RGB14 or RGB17 PWM Parameter	
				pwm_sel=0	RGB14 PWM Parameter
				pwm_sel=1	RGB17 PWM Parameter
7	pwm_sel	x	W	RGB14 or RGB17 PWM PWM Parameter Select	
				0	RGB14
				1	RGB17

Note:

1.The corresponding location of RGB0→RGB17 can refer to application circuit diagram.

2. RGB parameters of PWM is a total of 128 order, min is 0, max is 127 order.

Table 21. Fixed brightness (constant current) register

Addr: 49h→7Eh			Fix Brightness Register			
Addr	**Bit**	**Bit Name**	**Default**	**Access**	**Description**	
49H → 7EH	6:0	fixbrit_ledn	00h	W	Fixed brightness (constant current)	
					00h	0
					01h	1/128Imax
					……	（Brightness increased in turn）
					7FH	127/128Imax
	7	x	x	x	Don’t Care	

Note:

1. n is 0→53.

2. LEDn is the LED0→LED53, the corresponding location refer to application circuit diagram.

Table 22. Display control registers

Addr: 7Fh		Display Control Register			
Bit	**Bit Name**	**Default**	**Access**	**Description**	
6:0	x	x	x	Don’t Care	
7	disp_con	0b	W	Display Control Signal	
				0	Display OFF
				1	Display ON

4. SRAM Date Distribution

SRAM Size：10bit address(35FH)，data length is 16bit，capacity is 864*16bit

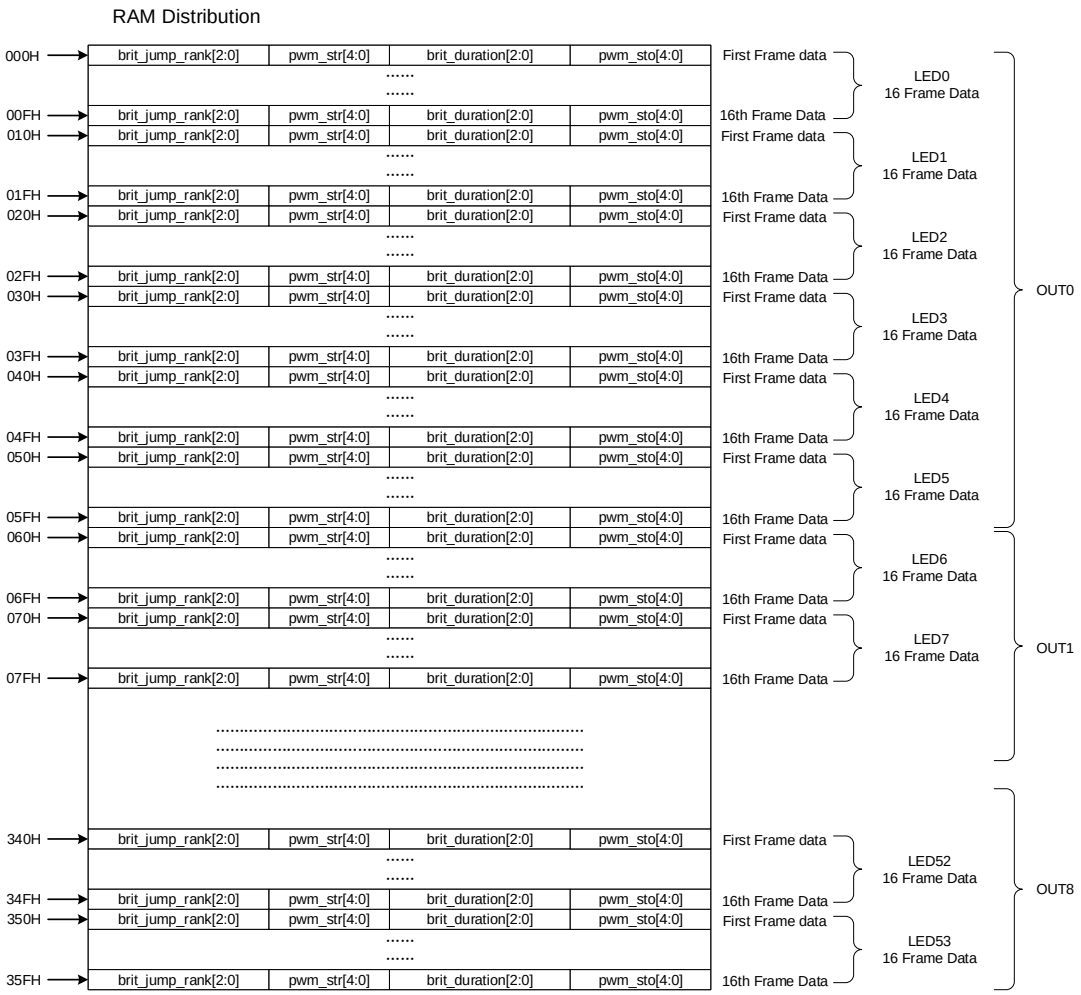


Figure 6. SRAM Date Distribution

Note: SRAM data is divided into nine altogether channel, each channel 6 LED lights, each LED lights have 16 frame data, data 16 per frame, 16 bits is divided into four independent respiratory parameters, respectively：

- brit_jump_rank[2:0] is the each channel brightness jump grades
- pwm_str[4:0]is the start brightness value
- brit_duration[2:0]is the each channel brightness duration time.
- pwm_sto[4:0]is the end brightness value

Spontaneous Breathing Parameters Specific Definition

Parameter Name	Value	Description
brit_jump_rank[2:0]	000	No meaning, disable using
	001	Brightness jump level is 1, the original brightness + 1
	010	Brightness jump level is 2, the original brightness + 2
	011	Brightness jump level is 4, the original brightness + 4

	100	Brightness jump level is 8, the original brightness + 8
	101	Brightness jump level is 16, the original brightness + 16
	110	Brightness jump level is 32, the original brightness + 32
	111	Brightness jump level is 64, the original brightness + 64
pwm_str[4:0]	00000	Brightness is 0, the current is 0/128Iav
	00001	Brightness is 4, the current is 4/128Iav
	00010	Brightness is 8 the current is 8/128Iav
	……..	……..
	11101	Brightness is 116, the current is 116/128Iav
	11110	Brightness is 120, the current is 120/128Iav
	11111	Brightness is 124, the current is 124/128Iav
brit_duration[2:0]	000	2ms
	001	4ms
	010	8ms
	011	16ms
	100	32ms
	101	64ms
	110	512ms
	111	1024ms
pwm_sto[4:0]	00000	Brightness is 0, the current is 0/128Iav
	00001	Brightness is 4, the current is 4/128Iav
	00010	Brightness is 8 the current is 8/128Iav
	……..	……..
	11101	Brightness is 116, the current is 116/128Iav
	11110	Brightness is 120, the current is 120/128Iav
	11111	Brightness is 124, the current is 124/128Iav

Note:

1. Iav=Imax/N Iav is the each channel average current,Imax is the each channel maximum current (20,25,30,40mA), N is the number of dynamic scanning signal, Iav = Imax/N

2. T is the smallest time unit of the whole chip, T=1MHZ/Fclk =1/1 =1us(the clock Fclk frequency is 1MHZ)

3. brit_jump_rank is MSB,pwm_sto is LSB.

Spontaneous Breathing Parameters by illustrations

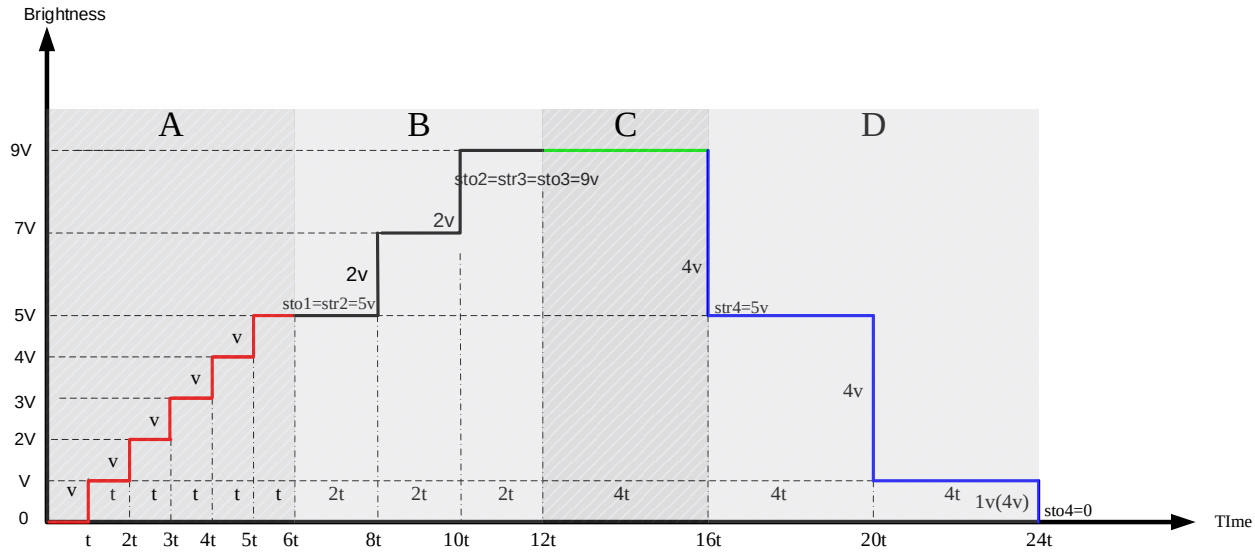


Figure 7. Spontaneous Breathing Parameters by illustrations

In Figure 7：

Abscissa is for time, ordinate is for brightness values

t is the brit_duration [2:0], that is the duration of brightness

v is the brit_jump_rank[2:0]，that is the brightness jump rank

str is the pwm_str[4:0]，that is the brightness initial value

sto is the pwm_sto[4:0]，that is the brightness end value

Diagram is divided into A, B, C, D four areas, namely the four data frames, four frames corresponding respiratory parameters as follows:：

The first frame (A) : the initial brightness (0v), the end of brightness (5v), brightness duration (t), brightness jump level (v)

The second frame (B): the initial brightness (5v), the end of brightness (9v), duration of brightness (2t), brightness jump level (2v)

The third Frame (C): initial brightness (9v), the end of brightness (9v), duration of brightness (4t), brightness jump level (4v)

The fourth Frame (D): initial brightness (9v), the end of brightness (0v), duration of brightness (4t), brightness jump level (4v)

If MDSELx is the default values (spontaneous breathing mode), LEN_TIMESx register is set to 00100000b (20 h), which is the frame length is 4, the above four cycles is set to infinity times, then the frame data, from the first frame to fourth frame(A (0... + v + v to 5v) → B (5v + 2v... to 9v) → C keep (9v) →D (9v - 4v -... to 0 v) → A (0 + v + v to 5v).....). Circular breathing run unlimited times.

Each channel SRAM Distribution

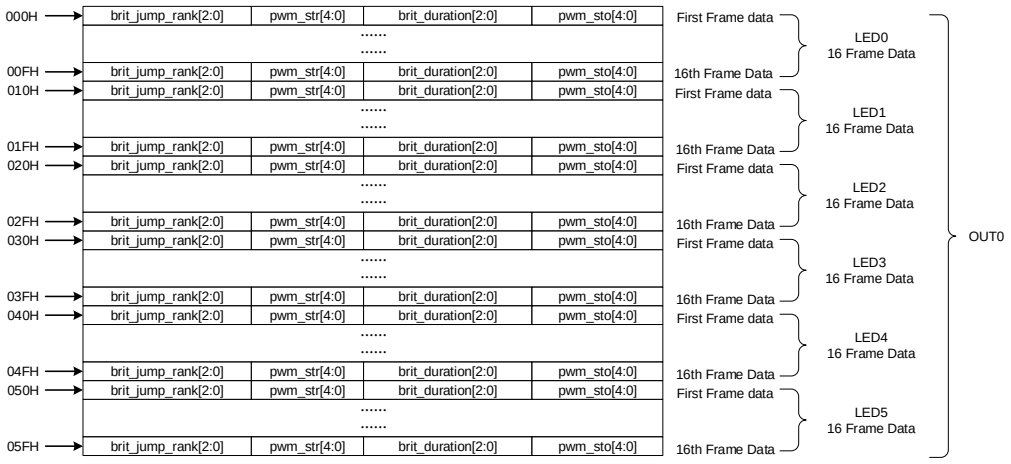


Figure 8. Channel 0 SRAM Distribution

Note:

1. LED0~LED5 is corresponding to OUT0 channel data, respectively by SCAN0~SCAN5 dynamic scanning display output.

2. Each LED lights have 16 frame data, corresponding to the address on the left side of the figure 8, such as LED0 16 frame corresponding to the light address is 000H to 00FH, similar to other lights.

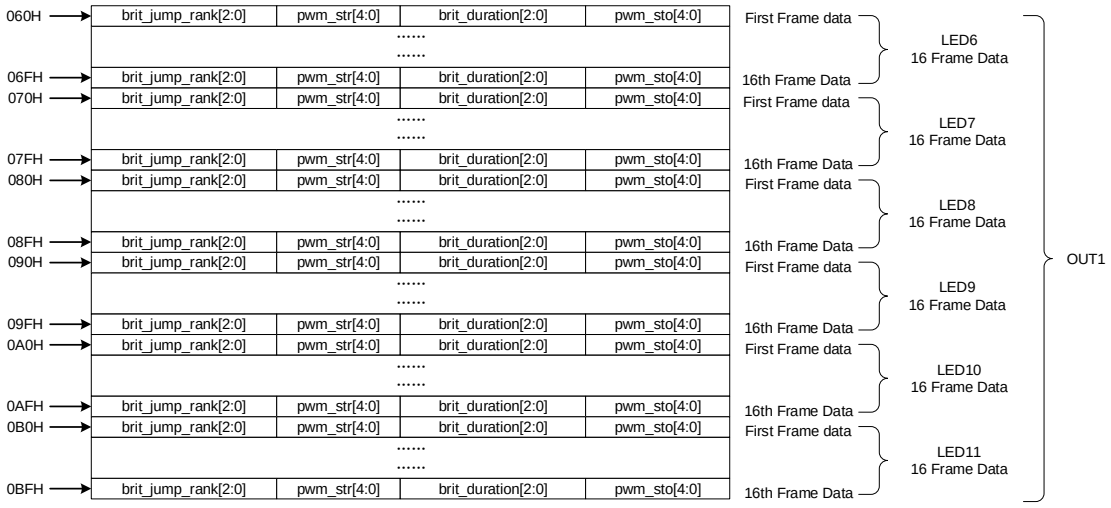


Figure 9. Channel 1 SRAM Distribution

Note:

1. LED6~LED11 is corresponding to OUT1 channel data, respectively by SCAN0~SCAN5 dynamic scanning display output.

2. Each LED lights have 16 frame data, corresponding to the address on the left side of the figure 9, such as LED6 16 frame corresponding to the light address is 060H to 06FH, similar to other lights.

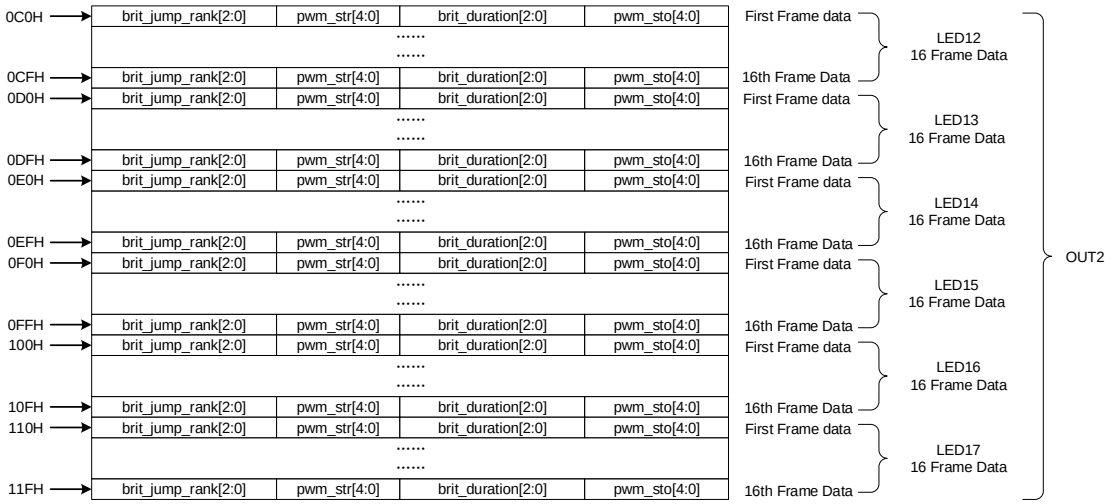


Figure 10. Channel 2 SRAM Distribution

Note:

1. LED12~LED17 is corresponding to OUT2 channel data, respectively by SCAN0~SCAN5 dynamic scanning display output.

2. Each LED lights have 16 frame data, corresponding to the address on the left side of the figure 10, such as LED12 16 frame corresponding to the light address is 0C0H to 0CFH, similar to other lights.

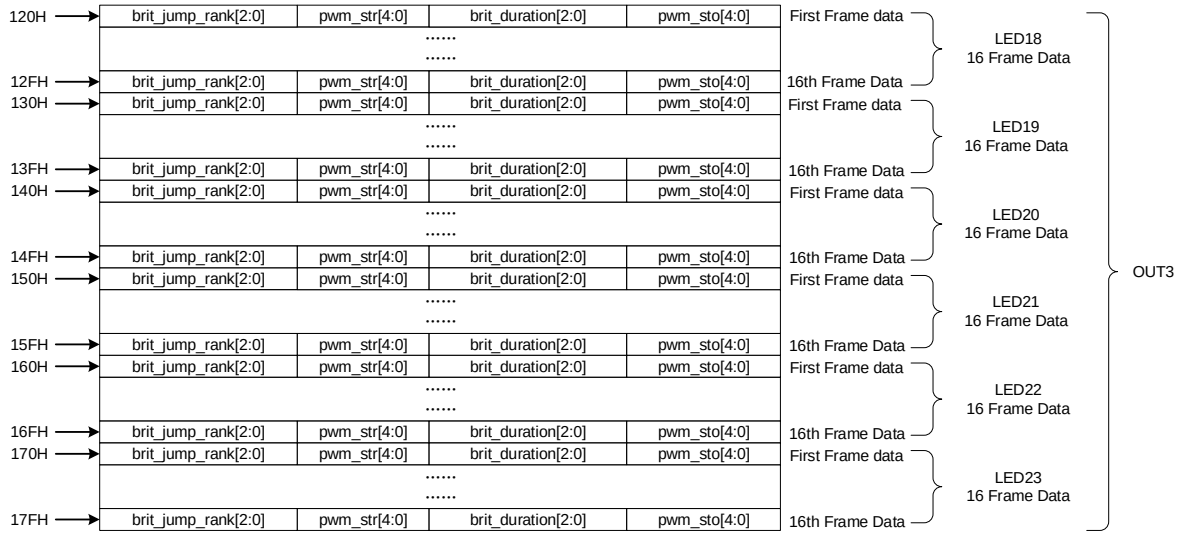


Figure 11. Channel 3 SRAM Distribution

Note:

1. LED18~LED23 is corresponding to OUT3 channel data, respectively by SCAN0~SCAN5 dynamic scanning display output.

2. Each LED lights have 16 frame data, corresponding to the address on the left side of the figure 11, such as LED18 16 frame corresponding to the light address is 120H to 12FH, similar to other lights.

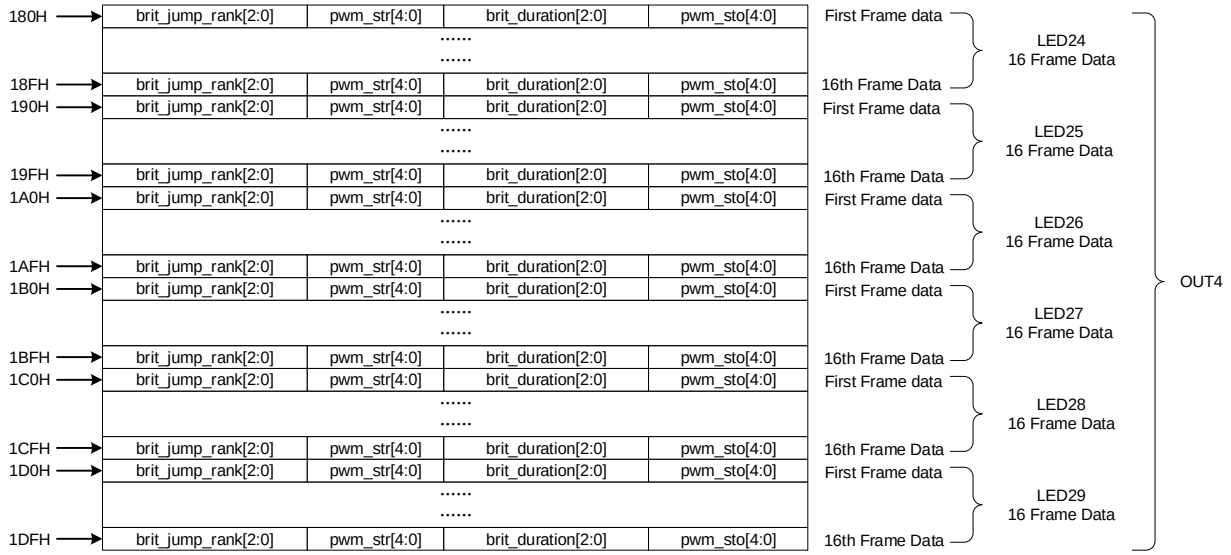


Figure 12. Channel 4 SRAM Distribution

Note:

1. LED24~LED29 is corresponding to OUT4 channel data, respectively by SCAN0~SCAN5 dynamic scanning display output.

2. Each LED lights have 16 frame data, corresponding to the address on the left side of the figure 12, such as LED24 16 frame corresponding to the light address is 180H to 18FH, similar to other lights.

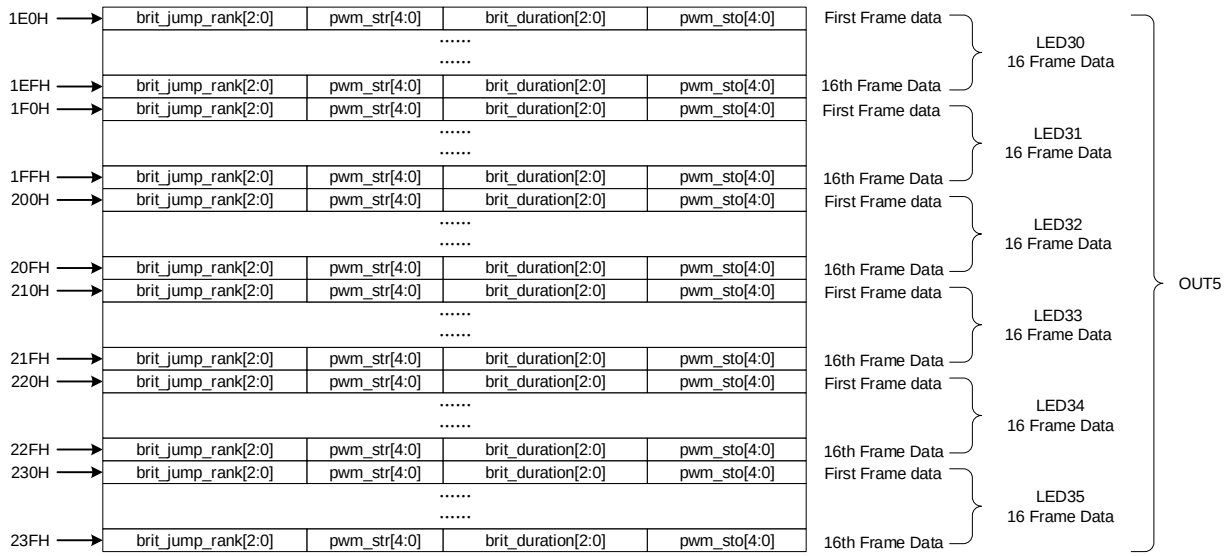


Figure 13. Channel 5 SRAM Distribution

Note:

1. LED30~LED35 is corresponding to OUT5 channel data, respectively by SCAN0~SCAN5 dynamic scanning display output.

2. Each LED lights have 16 frame data, corresponding to the address on the left side of the figure 13, such as LED30 16 frame corresponding to the light address is 1E0H to 1EFH, similar to other lights.

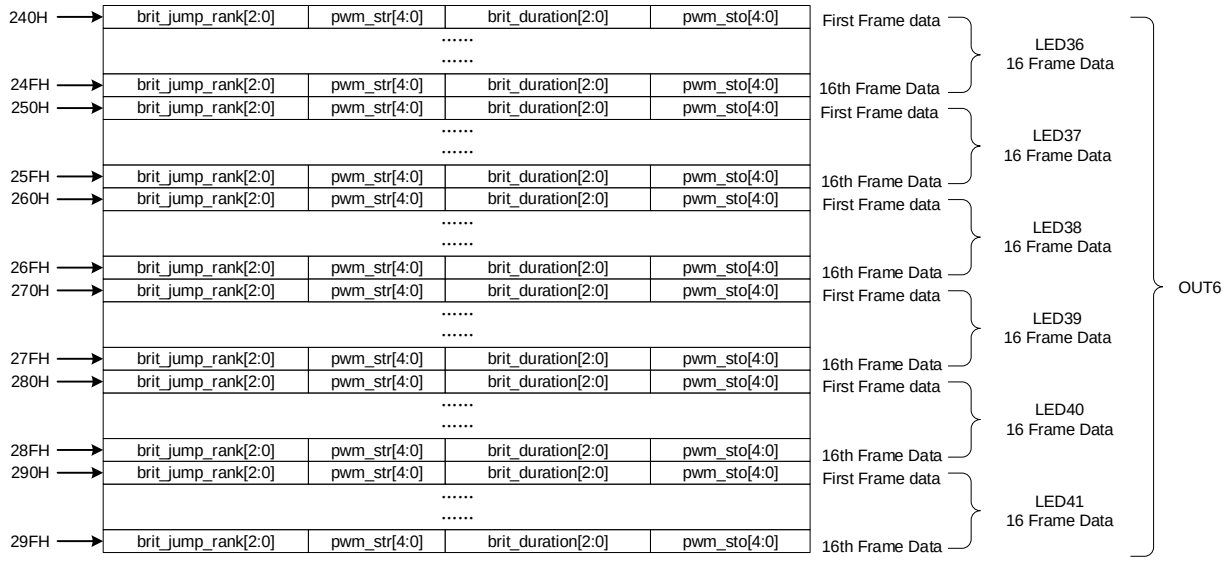


Figure 14. Channel 6 SRAM Distribution

Note:

1. LED36~LED41 is corresponding to OUT6 channel data, respectively by SCAN0~SCAN5 dynamic scanning display output.

2. Each LED lights have 16 frame data, corresponding to the address on the left side of the figure 14, such as LED36 16 frame corresponding to the light address is 240H to 24FH, similar to other lights.

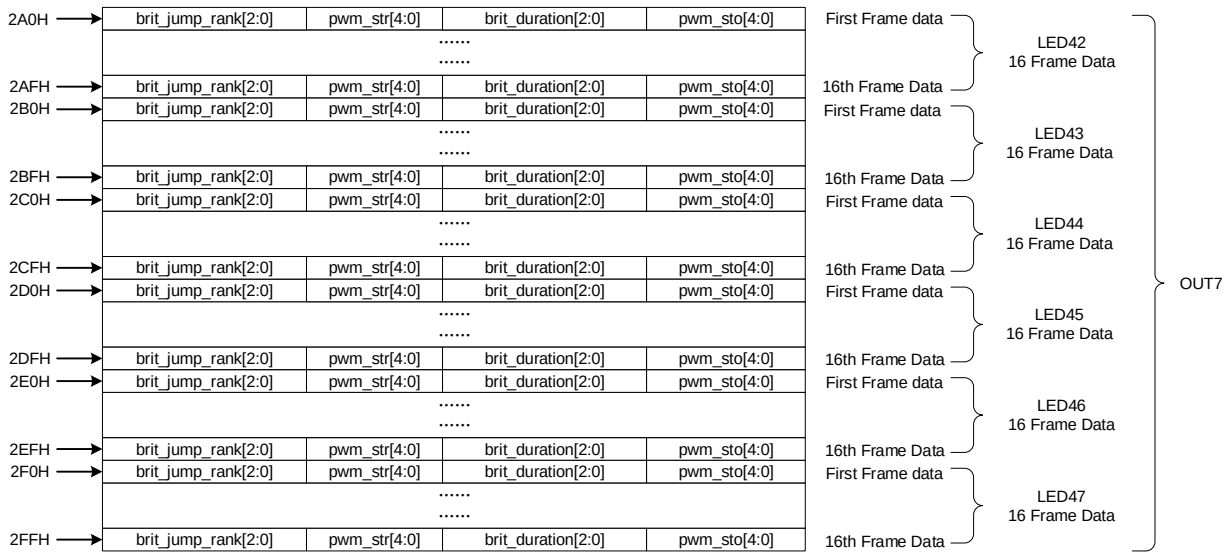


Figure 15. Channel 7 SRAM Distribution

Note:

1. LED42~LED47 is corresponding to OUT7 channel data, respectively by SCAN0~SCAN5 dynamic scanning display output.

2. Each LED lights have 16 frame data, corresponding to the address on the left side of the figure 15, such as LED42 16 frame corresponding to the light address is 2A0H to 2AFH, similar to other lights.

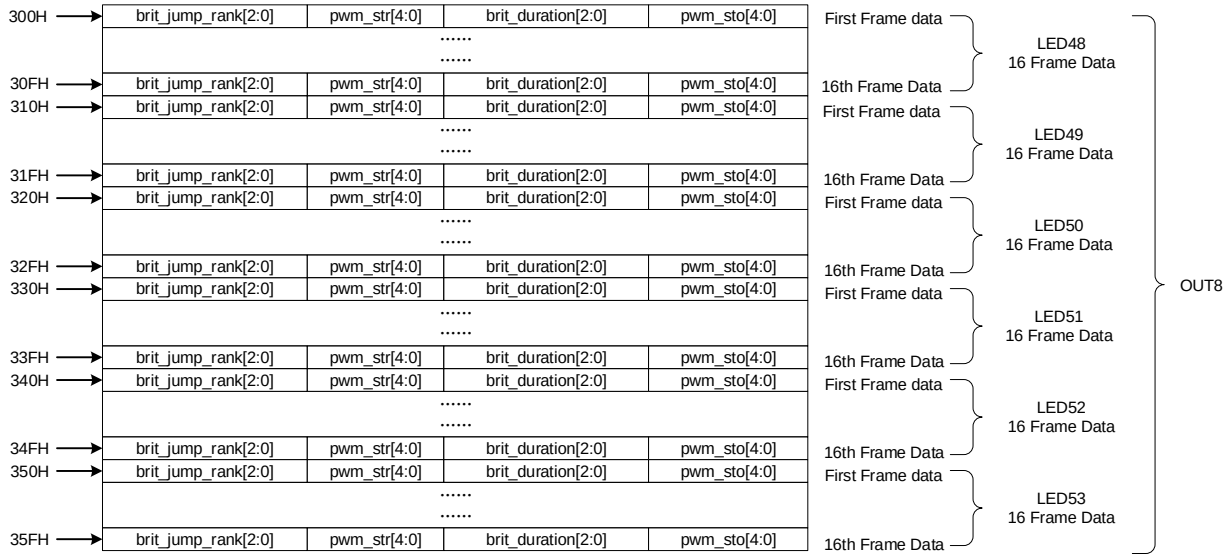


Figure 16. Channel 8 SRAM distribution

Note：

1. LED48~LED53 is corresponding to OUT8 channel data, respectively by SCAN0~SCAN5 dynamic scanning display output.

2. Each LED lights have 16 frame data, corresponding to the address on the left side of the figure 16, such as LED48 16 frame corresponding to the light address is 300H to 30FH, similar to other lights.

Absolute Maximum Ratings

Characteristic	Symbol	Range	Unit
Supply Voltage	V_{DD} / V_{PVDD}	5.0	V
Storage Temperature	T_{STG}	-65~150	°C
Input Voltage	V_{IN}	-0.3~V_{DD}+0.3	V
Operating Temperature	T_A	-40~85	°C

Electrical Characteristic（V_{DD} = V_{PVDD} = 4V,T_A = 25°C ）

Parameter	Symbol	Test Condition	Min	Typ	Max	Unit
Supply Voltage	V_{DD}	-	2.4		4.5	V
Drive Supply Voltage	V_{PVDD}	-		V_{DD}		V
Supply Current	I_{DD}			3		mA
Shutdown Current	I_{SD}	-		4	7	uA
Output Current	I_{OUT}	Curtmd[1:0]=00b Linear constant current regulation bytes = 0xFF		20		mA
SCAN Output Current	I_{SCAN}	V_{SCAN} = V_{PVDD} - 0.4V		360		mA
OUT Output Current	I_{OUT_MAX}	V_{OUT} = 0.5V～V_{PVDD}-0.4V		40		mA
OUT Current Error	△I_{OUT}	V_{OUT} = 0.6V		2		%
Input Low Voltage	$V_{IN(0)}$	-			0.6	V
Input High Voltage	$V_{IN(1)}$	-	1.4			V
Input Low Current	$I_{IN(0)}$	-		5		nA
Input High Current	$I_{IN(1)}$	-		5		nA

I²C mode Timing

Symbol	Parameter	Min	Typ	Max	Unit
F_{SCL}	SCL Clock Frequency	0	-	400	KHz
t_{BUF}	Bus Free Time Between a STOP and START Condition	1.3	-	-	μs
$t_{HD:STA}$	Hold Time(Repeated) START Condition	0.6	-	-	μs
t_{LOW}	Low Period of SCL Clock	1.3	-	-	μs
t_{HIGH}	HIGH Period of SCL Clock	0.6	-	-	μs
$t_{SU:STA}$	Setup Time for a Repeated START Condition	0.6	-	-	μs
$t_{HD:DAT}$	Data Hold Time	-	-	0.9	μs
$t_{SU:DAT}$	Data Setup Time	100	-	-	ns
t_R	Data Hold Time2	20+0.1Cb(1)	-	300	ns
t_F	Data Hold Time2	20+0.1Cb(1)	-	300	ns
$t_{SU:STO}$	Setup Time for STOP Condition	0.6	-	-	μs

Note 1: Cb=total capacitance of one bus line in PF.

I²C mode Timing Diagram

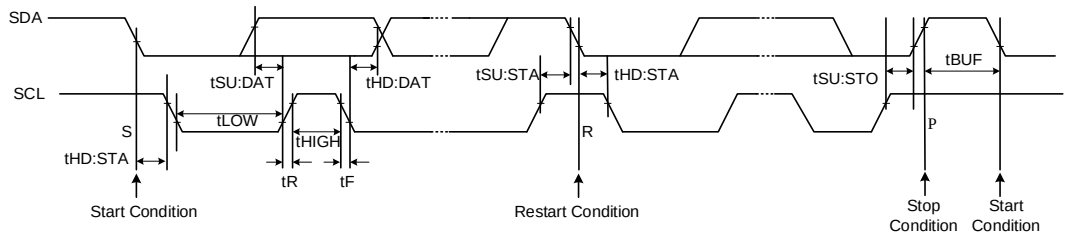


Figure 17.

Typical Application Diagram

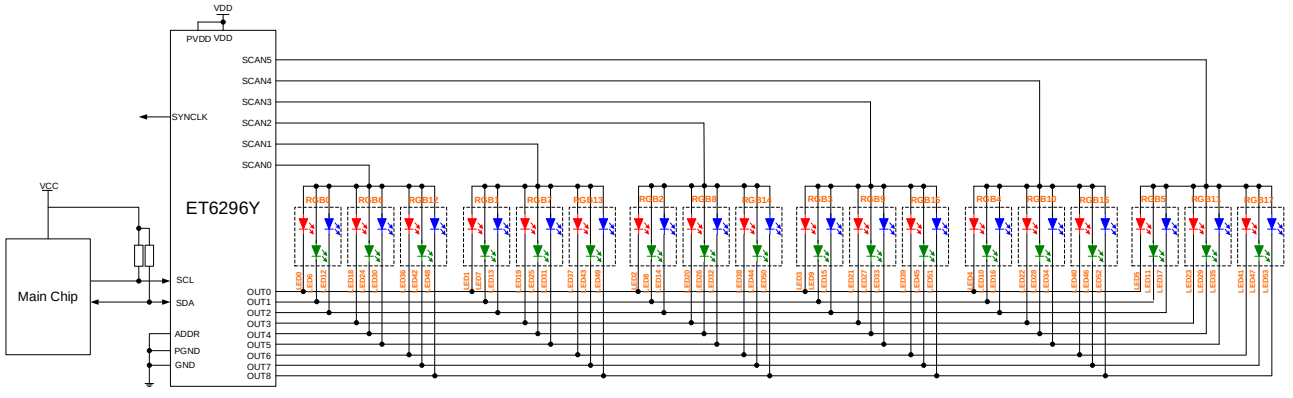


Figure 18.

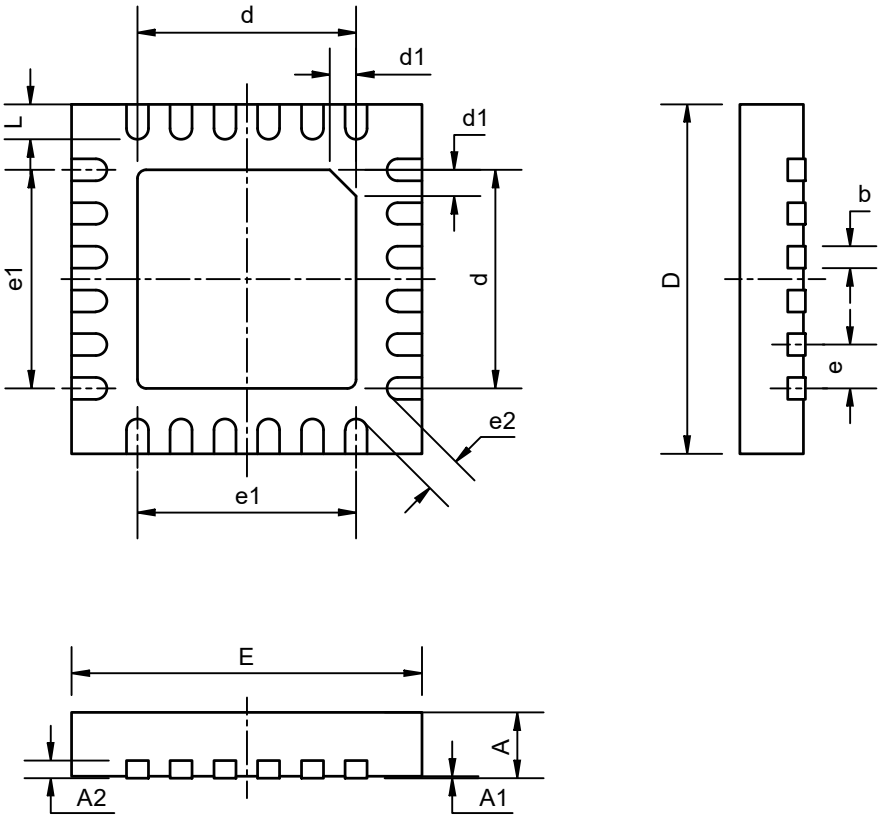
Note:

1. This circuit is only for reference.

2. ADDR = 0, SYNCLK port for synchronous clock output, ADDR = 1, SYNCLK port for synchronous clock input port, if the chips do not use cascade structure, please keep SYNCLK port floating.

Package Dimension

QFN24



Unit: mm

Symbol	Min	Nom	Max
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A2	0.18	0.20	0.25
b	0.18	0.25	0.30
D	3.90	4.00	4.10
d	2.40	2.60	2.80
d1	0.30	0.35	0.40
E	3.90	4.00	4.10
e		0.50	
e1	2.40	2.60	2.80
e2	0.40	0.45	0.50
L	0.35	0.40	0.45

Revision History and Checking Table

Version	Date	Revision Item	Modifier	Function & Spec Checking	Package & Tape Checking
1.0	2011-08-22	Original Version	Shi Liang Jun	Shi Liang Jun	Zhu Jun Li
1.1	2018-05-15	Update Package and Application Circuit	Sun Si Bing	Sun Si Bing	Zhu Jun Li
1.2	2022-12-06	Update form	Tian qi he	Sun Si Bing	Zhu Jun Li