RTL9310

LED

Application Note

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Realtek Semiconductor Corp.
No. 2, Innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan
Tel.: +886-3-578-0211 Fax: +886-3-577-6047
www.realtek.com

USING THIS DOCUMENT
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Revision	Release Date	Summary
1.0	2018/04/27	Initial

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1 LED

1.1 Overview

RTL9310 provides flexible LED display to show the speed, link status and other information of the port status. RTL9310 supports per port maximum 4 LEDs (per-port optional 3 LEDs, 2 LEDs, 1 LED) in serial LED mode and single color scan LED mode display, per port maximum 3 LEDs (one single color LED + one bi-color LED) in bi-color scan LED mode.

The LED function supports following features:

3 LED modes	Serial mode, single color scan mode and bi-color scan mode.
3 steps power on blinking	Could configure power on blinking for LED[3:0] in step1 and step2, and all LEDs are off in step3. Power on blinking time - disable, 400ms, 800ms or 1.6s.
System LED	LED display mode - off, blinking 64ms, blinking 1024ms or light.
Port status indication	Link, active, RX, TX, half/full duplex, collision, 10G/5G/2.5G/1000M/100M/10M link/active or blinking
Software LED control	Software could control all LEDs status to be off, blinking or light.

1.2 LED Modes

RTL9310 supports three LED modes: serial mode, single color scan mode and bi-color scan mode.

RTL9310 provides 2 LED pins to connect with shift register in serial mode or RTL8231 in scan mode. The description of these two pins is listed in Table 1-1.

Table 1-1 LED interface – Clock and Data

Pin No.	Pin Name	Type	Description
AL18	LED_CLK	O	Apply to serial LED mode: Reference output clock for serial LED interface and Data is latched on the rising of LED_CLK.
	LED_MDC	O	Apply to single color scan LED mode and bi-color scan LED mode: Reference output clock for MDC/MDIO interface.
AK18	LED_DAT	O	Apply to serial LED mode: Serial bit stream of link status information.
	LED_MDIO	I/O	Apply to single color scan LED mode and bi-color scan LED mode: The data written to LED IC.

1.2.1 Serial Mode

The serial LED interface, LED_CLK and LED_DAT provide clock and data to enable/disable the external shift registers to capture the per-port link status and diagnostic information.

In serial LED mode, RTL9310 uses RTL8231 (shift register mode) or 74HC164/74HC595 (8-bits serial-in parallel-out shift register/8-bits serial-in parallel-out shift register with output latches). When using 74HC595, RTL9310 adds LED_SYNC (RTL9310 internal GPIO[31]) to reduce abnormal blinking.

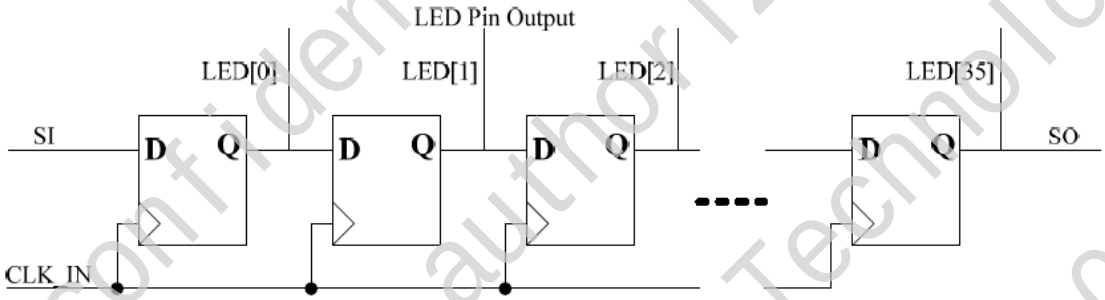
1.2.1.1 RTL8231 Application

The RTL8231 shift register mode could reserve the serial data, and output parallel data in order.

There are 36 shift registers in one RTL8231.

The output data sequence is shown in Figure 1-1.

Figure 1-1 RTL8231 Shift Register Mode logic Diagram



RTL8231 latches the current serial data which received at the SI pin and shift the preceding data to the next stage at the each rising edge of the serial clock.

At the first serial data input, RTL8231 output from pin 15 LED[0]. At the last shift register, the serial data output from LED[35] pin and SO pin at the same time.

Strapping pins configuration of RTL8231 in shift register mode is depicted in Table 1-2.

Table 1-2 RTL8231 Shift Register Mode Strapping Pins Configuration

Pin Name	Pin No.	Description	Configuration for serial LED mode
Dis_SMI (LED[0])	15	Select RTL8231 in the SMI mode or Shift Register mode. 0: SMI mode.(default) **1: Shift register mode.**	Pull high
MOD[1](SO)	16	MOD[1] defines that application circuit is active high or low. 0: Low active 1: High active Note: internal floating. Must be pulled high or low to select the active high or active low application.	Pull low
MOD[0](LED[15])	42	MOD[0] defines the initial value is output high or low. 0: Output low after power on or hardware pin reset. 1: Output high after power on or hardware pin reset. (default)	Pull high

Table 1-3 is an example for some typical application with RTL8231 in serial LED mode.

Table 1-3 Serial LED Application Mode with RTL8231

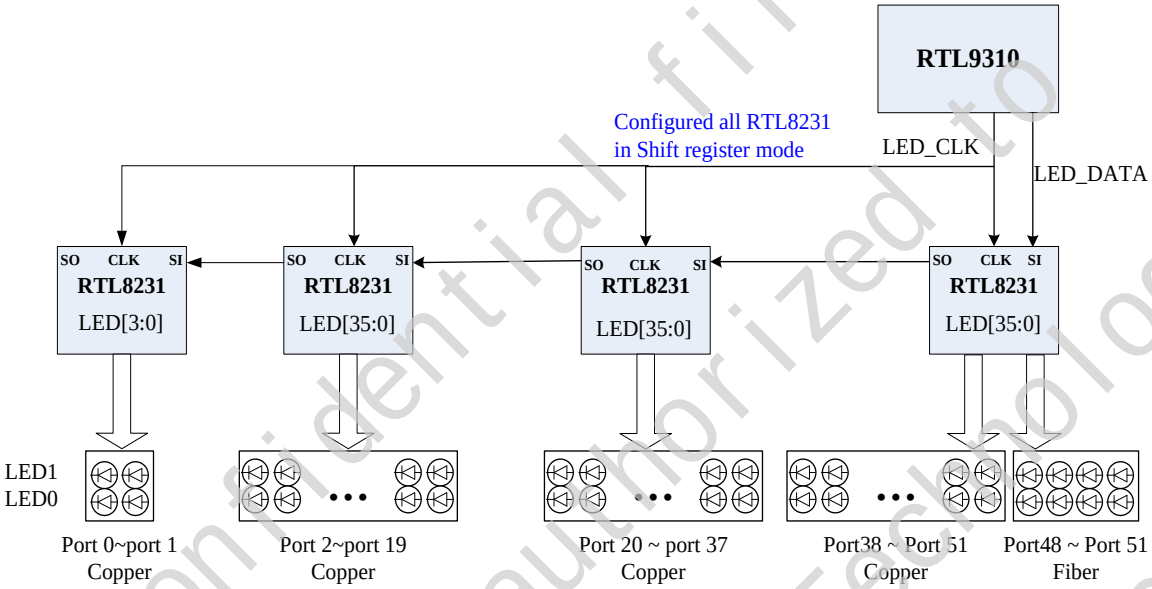
Application Mode	**Per Port LED**	**LED_NUM_SEL** Table 1-11	**Total LED**	**RTL8231 Needed**	**LED Copper Port Mask** Table 1-9	**LED Fiber Port Mask** Table 1-10	**LED Combo Port Mask** Table 1-12	**LED_MOD** Table 1-7
48G+4*1G combo (MAC48-51 display copper and fiber LED)	3 LED	0x2	168	5	P0-P47=1 P48-P51=1 P52-P55=0	P0-P47=0 P48-P51=1 P52-P55=0	P0-P47=0 P48-P51=0 P52-P55=0	Serial Mode
48G+4*1G (MAC48-51 display copper LED and PHY display fiber LED)	3 LED	0x2	156	5	P0-P47=1 P48-P51=1 P52-P55=0	P0-P47=0 P48-P51=0 P52-P55=0	P0-P47=0 P48-P51=0 P52-P55=0	
48G+1*4G (MAC48-51 display copper and fiber status in copper LED)	3 LED	0x2	156	5	P0-P47=1 P48-P51=1 P52-P55=0	P0-P47=0 P48-P51=1 P52-P55=0	P0-P47=0 P48-P51=1 P52-P55=0	
48G+6*10G (fiber)	3 LED	0x2	162	5	0x00-FFFF-FFFF-FFFF	0xF5-0000-0000-0000	0x0	
48G+6*10G (combo port)	3 LED	0x2	180	5	0xF5-FFFF-FFFF-FFFF	0xF5-0000-0000-0000	0x0	
12*10G (fiber)	3 LED	0x2	36	1	0x0	0xF5-0101-0101-0101	0x0	
12*10G (combo port)	3 LED	0x2	72	2	0xF5-0101-0101-0101	0xF5-0101-0101-0101	0x0	

Circuit application:

Figure 1-2 is an example of RTL8231 shift register mode for 48G+ 4*1G Combo with per-port 2-LED:

- One RTL8231 supports 36-bits output in shift register mode.
- Totally system has 56-ports; One port uses 2-LED; Totally need 112-LED
- Need 4* RTL8231 to form 144 bits shift register

Figure 1-2 RTL9310 48G+4*1G Combo Serial LED Connection with RTL8231 Diagram



1.2.1.2 74HC164/74HC595 Application

Table 1-3 is an example for some typical application with RTL8231 in serial LED mode.

Table 1-4 Serial LED Application Mode with 74HC164/74HC595

Application Mode	Per Port LED	LED_NUM_SEL Table 1-11	Total LED	74HC164/74HC595 Needed	LED Copper Port Mask Table 1-9	LED Fiber Port Mask Table 1-10	LED Combo Port Mask Table 1-12	LED_MOD Table 1-7
48G+4*1G combo (MAC48-51 display copper and fiber LED)	3 LED	0x2	168	21	P0-P47=1 P48-P51=1 P52-P55=0	P0-P47=0 P48-P51=1 P52-P55=0	P0-P47=0 P48-P51=0 P52-P55=0	Serial Mode
48G+4*1G (MAC48-51 display copper LED and PHY display fiber LED)	3 LED	0x2	156	20	P0-P47=1 P48-P51=1 P52-P55=0	P0-P47=0 P48-P51=0 P52-P55=0	P0-P47=0 P48-P51=0 P52-P55=0	

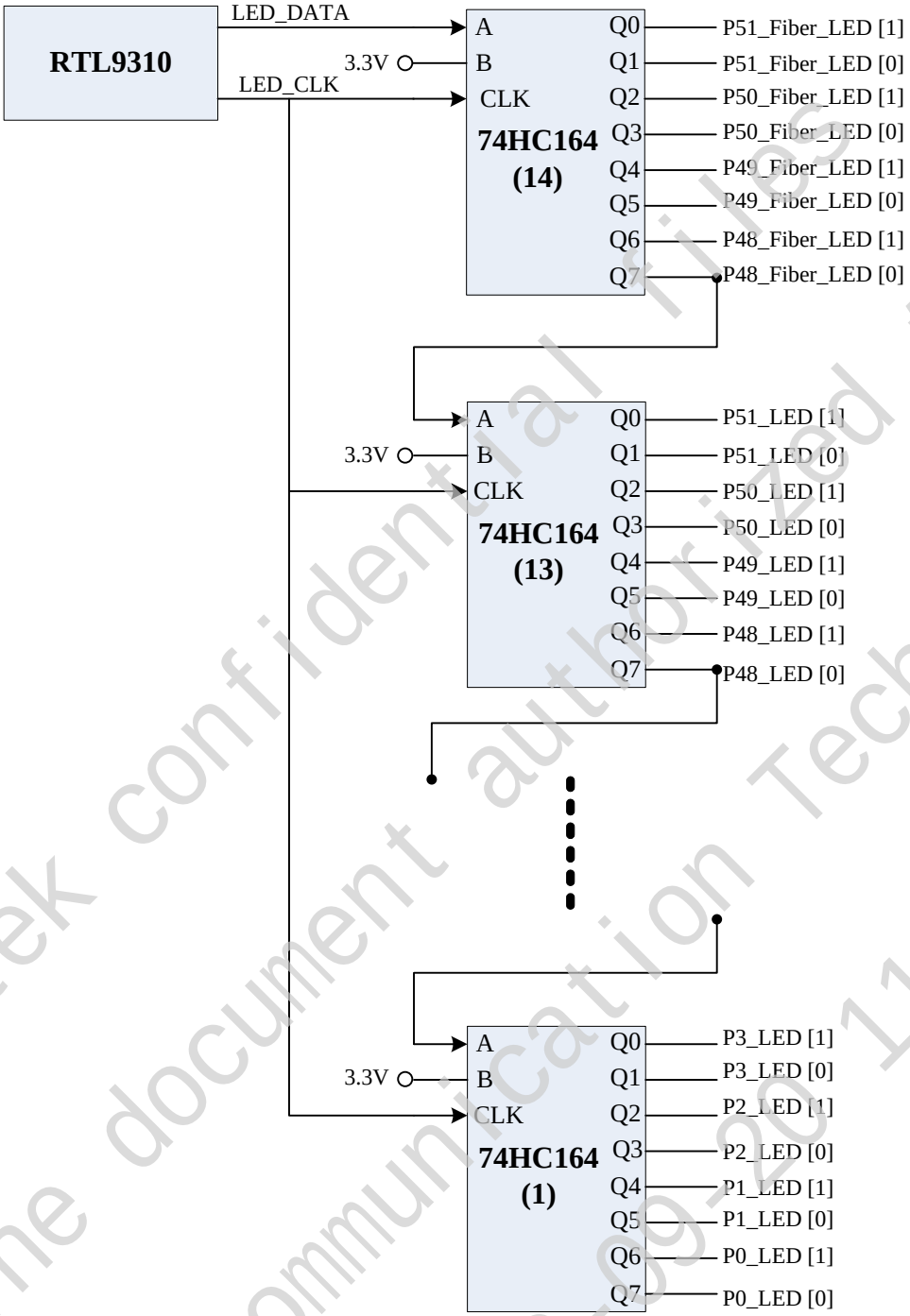
48G+1*4G (MAC48-51 display copper and fiber status in copper LED)	3 LED	0x2	156	20	P0-P47=1 P48-P51=1 P52-P55=0	P0-P47=0 P48-P51=1 P52-P55=0	P0-P47=0 P48-P51=1 P52-P55=0	
48G+6*10G (fiber)	3 LED	0x2	162	21	0x00-FFFF-FFFF-FFFF	0xF5-0000-0000-0000	0x0	
48G+6*10G (combo port)	3 LED	0x2	180	23	0xF5-FFFF-FFFF-FFFF	0xF5-0000-0000-0000	0x0	
12*10G (fiber)	3 LED	0x2	36	5	0x0	0xF5-0101-0101-0101	0x0	
12*10G (combo port)	3 LED	0x2	72	9	0xF5-0101-0101-0101	0xF5-0101-0101-0101	0x0	

Circuit application:

Figure 1-3 is an example of 74HC164 for 48G+ 4*1G Combo with per-port 2-LED:

- Totally system has 56-ports; One port uses 2-LED; Totally need 112-LED
- Need 14 * 74HC164

Figure 1-3 RTL9310 48G+4*1G Combo Serial LED Connection with 74HC164 Diagram

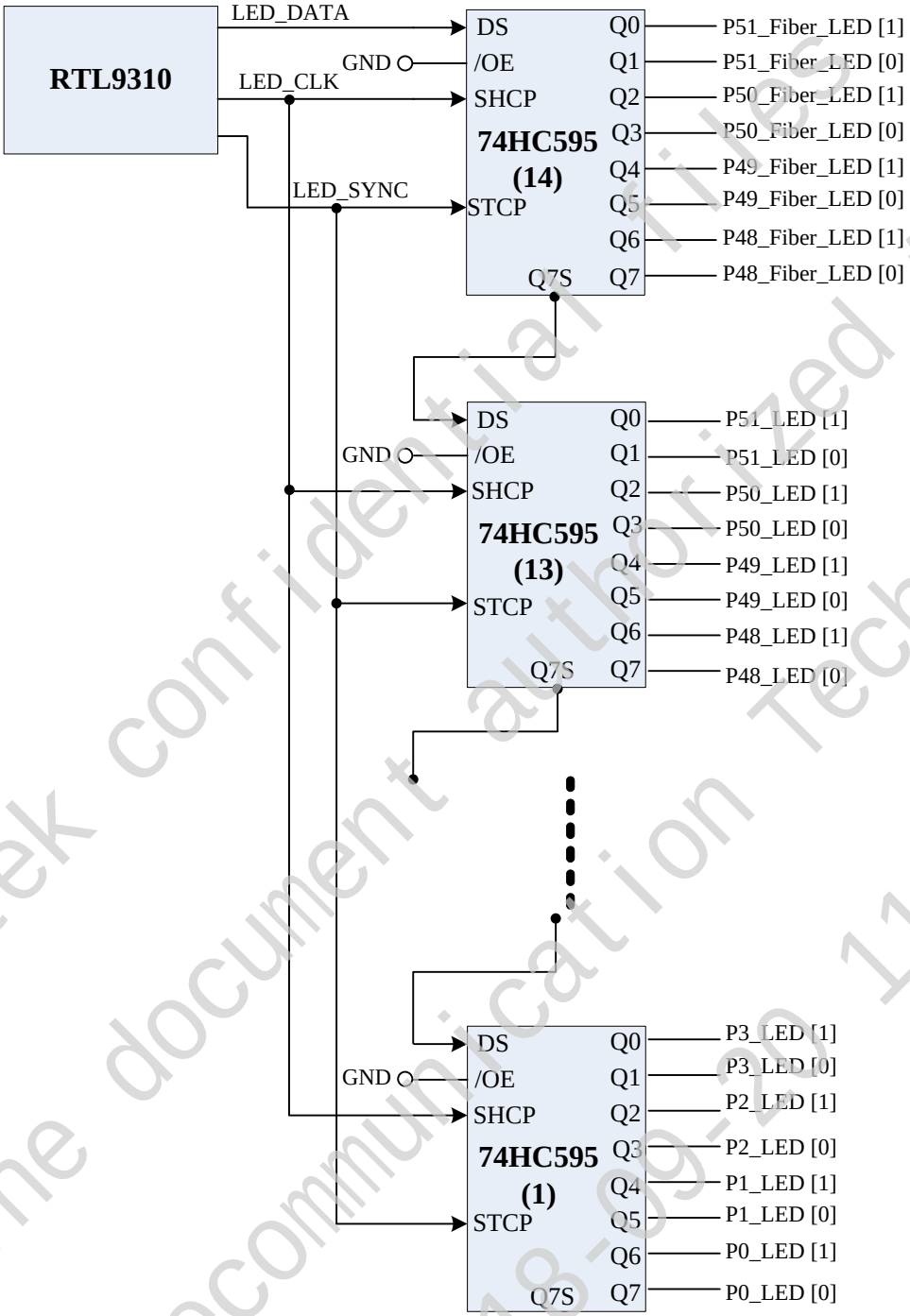


Circuit application:

Figure 1-4 is an example of 74HC595 for 48G+ 4*1G Combo with per-port 2-LED:

- Totally system has 56-ports; One port uses 2-LED; Totally need 112-LED
- Need 14 * 74HC595
- RTL9310 internal GPIO[31] is reused as LED_SYNC to reduce abnormal blinking(Refer to GPIO application note)

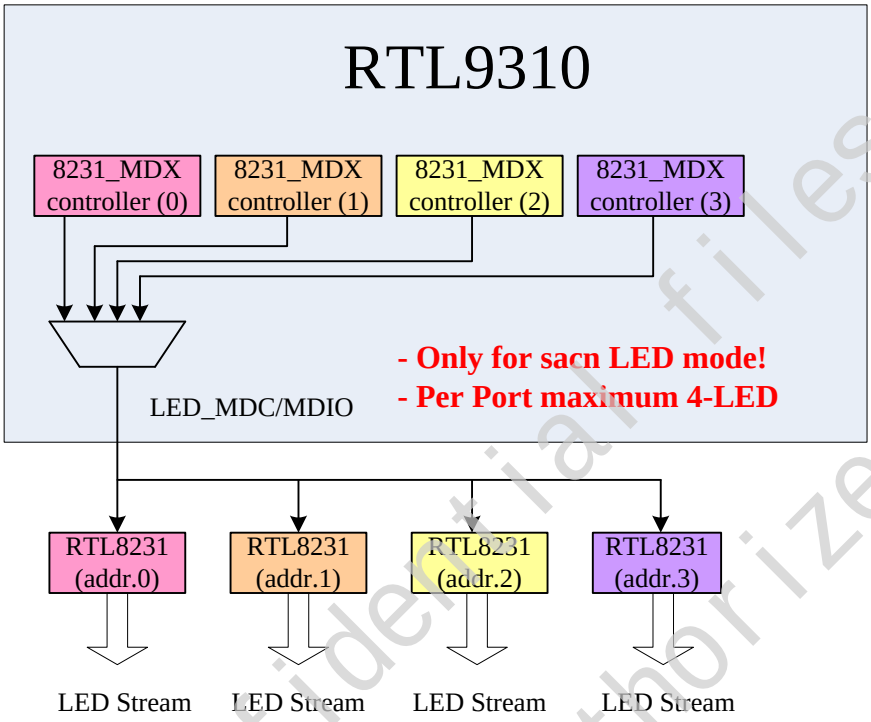
Figure 1-4 RTL9310 48G+4*1G Combo Serial LED Connection with 74HC595 Diagram



1.2.2 Scan Mode

Figure 1-5 shows that RTL9310 supports scan LED by connecting with LED IC of the RTL8231, which provides single color and bi-color scan LED.

Figure 1-5 RTL9310 supports connection with RTL8231 scan LED mode



The LED_CLK/ LED_DAT change to LED_MDC/ LED_MDIO interface mode and transmit MDC/ MDIO data to LED IC (Refer to Table 1-5). After power on or hardware reset, RTL9310 initialize the RTL8231, and then write LED status to it to turn on/ off LED.

RTL8231's single color scan LED mode supports 72 single color LEDs and 8 bi-color LEDs.

RTL8231's bi-color scan LED mode supports 24 single color LEDs and 24 bi-color LEDs.

RTL9310 supports per port maximum 4 LEDs (optional 3 LEDs, 2 LEDs and 1 LED) in serial LED mode and single color scan LED mode.

RTL9310 supports per port maximum 3 LEDs(1 bi-color plus 1 single color LED) in bi-color scan LED mode.

The strapping pins configuration of RTL8231 in SMI Mode is depicted in Table 1-5.

Table 1-5 RTL8231 SMI Mode Strapping Pins Configuration

Pin Name	Pin No.	Description	Configuration for serial LED mode
Dis_SMI	15	Select RTL8231 in the SMI mode or Shift Register mode. **0: SMI mode.(default)** 1: Shift register mode.	Pull low
Addr[0]	37	Addr[4:0] is Device ID. The first LED IC device address should be 0, and others are incrementally addressed;	Strapping address select pull low or high
Addr[1]	38		
Addr[2]	39		
Addr[3]	40		
Addr[4]	41		

MOD[0]	42	When SMI mode is enable, **1: MDC/MDIO interface(default)** 0: I2C interface	Pull high

1.2.2.1 RTL8231 Application – Single Color Scan LED Mode

Table 1-6 is an example for some typical application in single color scan LED mode.

Table 1-6 Single Color Scan LED Application Mode

Application Mode	**Per Port LED**	**LED_NUM_SEL** Table 1-11	**Total LED**	**RTL8231 Needed**	**LED Copper Port Mask** Table 1-9	**LED Fiber Port Mask** Table 1-10	**LED Combo Port Mask** Table 1-12	**LED_MOD** Table 1-7
48G+4*1G combo (MAC48-51 display copper and fiber LED)	4 LED	0x3	224	4 Addr.0 Addr.1 Addr.2 Addr.3	P0-P47=1 P48-P51=1 P52-P55=0	P0-P47=0 P48-P51=1 P52-P55=0	P0-P47=0 P48-P51=0 P52-P55=0	Single Color Scan Mode
48G+4*1G (MAC48-51 display copper LED and PHY display fiber LED)	4 LED	0x3	208	3 Addr.0 Addr.1 Addr.2	P0-P47=1 P48-P51=1 P52-P55=0	P0-P47=0 P48-P51=0 P52-P55=0	P0-P47=0 P48-P51=0 P52-P55=0	
48G+1*4G (MAC48-51 display copper and fiber status in copper LED)	4 LED	0x3	208	3 Addr.0 Addr.1 Addr.2	P0-P47=1 P48-P51=1 P52-P55=0	P0-P47=0 P48-P51=1 P52-P55=0	P0-P47=0 P48-P51=1 P52-P55=0	
48G+6*10G (fiber)	4 LED	0x3	216	3 Addr.0 Addr.1 Addr.2	0x00-FFFF-FFFF-FFFF	0xF5-0000-0000-0000	0x0	
48G+6*10G (combo port)	4 LED	0x3	240	4 Addr.0 Addr.1 Addr.2 Addr.3	0xF5-FFFF-FFFF-FFFF	0xF5-0000-0000-0000	0x0	
12*10G (fiber)	4 LED	0x3	48	1 Addr.0	0x0	0xF5-0101-0101-0101	0x0	

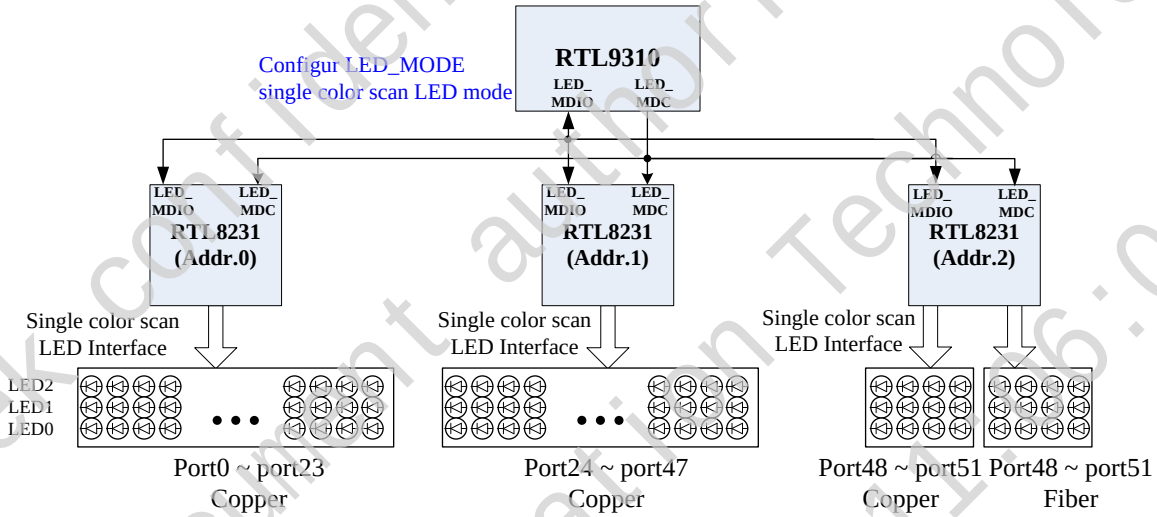
12*10G (combo port)	4 LED	0x3	96	2 Addr.0 Addr.1	0xF5-0101-0101-0101	0xF5-0101-0101-0101	0x0	

Circuit application:

Figure 1-6 is an example for single color scan LED mode 48G+4*1G Combo LED connection diagram with per port 3-LED.

- Totally system has 56-ports; one port uses 3 single color LEDs; Total 168-LEDs.
- One RTL8231 supports 72 single color LEDs.
- Need 3 * RTL8231.

Figure 1-6 RTL9310 48G+4*1G Combo and Per Port 3 Single Color LED connection diagram



1.2.2.2 RTL8231 Application – Bi-color Scan LED Mode

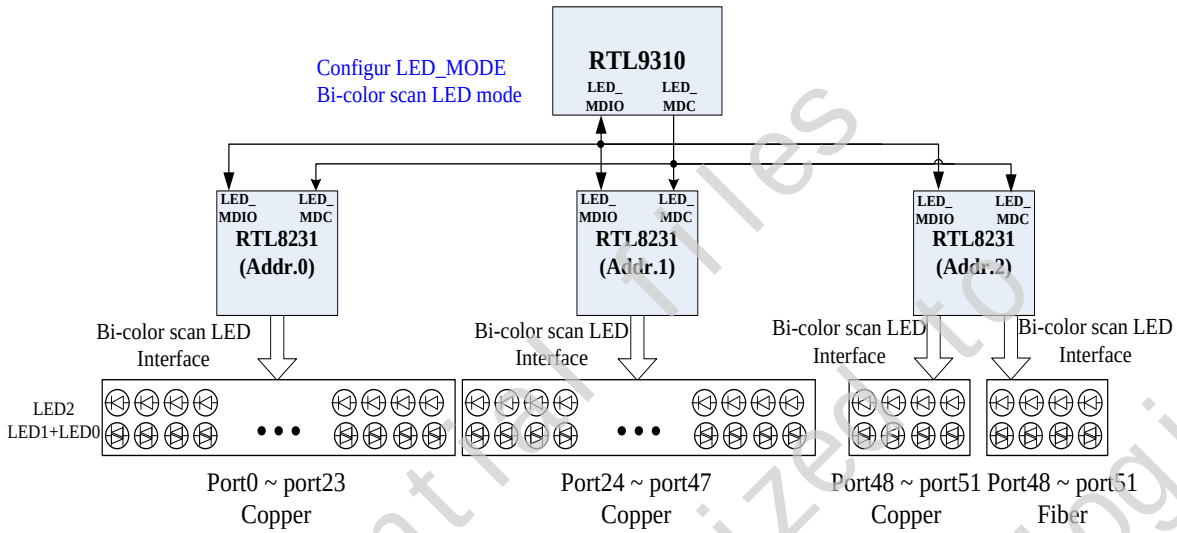
In bi-color LED mode, a little difference from single color LED is that LED_NUM_SEL register must be select 3-LEDs.

Circuit application:

Figure 1-7 is an example for Bi-color scan LED mode 48G+4*1G Combo LED connection diagram with per port one bi-color plus one single color LED.

- Totally system has 56-ports; one port uses one bi-color LED and one single color LED; Total 56 bi-color LEDs and 56 single color LEDs.
- One RTL8231 supports 24 bi-color LEDs and 24 single color LEDs.
- Need 3* RTL8231

Figure 1-7 RTL9310 48G+4*1G Combo and Per Port one bi-color plus one single Color LED connection diagram



1.2.3 Register Setting

LED mode is decided by software.

LED_MOD[1:0] is LED mode selection bits, this bit must not be 0b00 then LED can start to display. LED_MOD[1:0]'s default value is 0b00 until software to rewrite it. That can prevent the LED blinking before software ready.

Table 1-7 LED_GLB_CTRL Register – LED_MODE

Bits	Field	Description	Type	Default
1:0	LED_MODE	LED MODE selection. 0x0: Disable LED. 0x1: Enable LED, and display LED in serial mode; 0x2: Enable LED, and display LED in single color scan mode; 0x3: Enable LED, and display LED in bicolor scan mode;	RW	0x0

LED_CLK period time can be selected by register LED_CLK_SEL[1:0].

Table 1-8 LED_GLB_CTRL Register – LED_CLK_SEL

Bits	Field	Description	Type	Default
16:15	LED_CLK_SEL	Select LED_CLK and LED_MDC period time. 0x0: 800ns 0x1: 400ns 0x2: 200ns 0x3: 100ns Note: these bits are valid both in serial LED mode and scan LED mode	RW	0x1

LED blinking time of 32, 64, 128, 256, 512 and 1024ms can be selected by register BLINK_TIME_SEL[2:0].

Bits	Field	Description	Type	Default
19:17	BLINK_TIME_SEL	Select the LED blinking time. 0x0: Reserved 0x1: 32ms low and 32ms high toggle. 0x2: 64 ms low and 64ms high toggle. 0x3: 128 ms low and 128ms high toggle. 0x4: 256 ms low and 256ms high toggle. 0x5: 512 ms low and 512ms high toggle. 0x6: 1024 ms low and 1024ms high toggle. 0x7: Reserved	RW	0x1

RTL9310 supports register field *LED_COPR_PMASK[55:0]*, *LED_FIB_PMASK[55:0]* to decide enable/disable port LED signal stream, as listed in Table 1-9 and Table 1-10.

Per-Port LED number can be selected by register configured, as listed in Table 1-11.

RTL9310 also supports combo port LED to distinguish from UTP port and Fiber port, when the PHY can work either on UTP mode or fiber mode, and *LED_COMBO_PMASK[55:0]* decide whether copper/fiber status displays on the same LED, as listed in Table 1-12.

Configure port mask for Copper LED.

Table 1-9 LED_PORT_COPR_MASK_CTRL Register

Bits	Field	Description	Type	Default
55:0	LED_COPR_PMASK	Copper LED port mask, default value is decided by chip mode.	RW	0x0

Configure port mask for Fiber LED.

Table 1-10 LED_PORT_FIB_MASK_CTRL Register

Bits	Field	Description	Type	Default
55:0	LED_FIB_PMASK	Fiber LED port mask, default value is decided by chip mode	RW	0x0

Select LED number for specified port.

Table 1-11 LED_PORT_NUM_CTRL Register

PORT INDEX:0-55

Bits	Field	Description	Type	Default
1:0	LED_NUM_SEL	Select LED number for each port. 0x0: 1 LEDs for each port. Pn_LED[0]. 0x1: 2 LEDs for each port. Pn_LED[1:0]. 0x2: 3 LEDs for each port. Pn_LED[2:0]. 0x3: 4 LEDs for each port. Pn_LED[3:0]. Note: This register must be select 3-LEDs in Bi-color scan LED mode.	RW	0x2

Configure port mask for combo port.

Table 1-12 LED_PORT_COMBO_MASK_CTRL Register

Bits	Field	Description	Type	Default
55:0	LED_COMBO_PMASK	LED combo port selection. Mapping to physical port 55 ~ port 0. 0b0: Copper status display on copper LED, fiber status display on fiber LED. 0b1: Copper and fiber status display on same LED. default value is decide by chip mode	RW	0x0

1.2.4 SDK Setting

SDK3

Configure **.led_if_sel** in sdk\system\include\hwp\hw_profiles\rtlxxx_xxx_demo.c

```
.led.descp = {
    .led_if_sel = LED_IF_SEL_SERIAL,
```

.led_if_sel could be configured as:

- LED_IF_SEL_SERIAL
- LED_IF_SEL_SINGLE_COLOR_SCAN
- LED_IF_SEL_BI_COLOR_SCAN

Copper/Fiber/Combo port mask configuration and LED number selecting would be introduced in chapter 1.5.2.

rtk API

None.

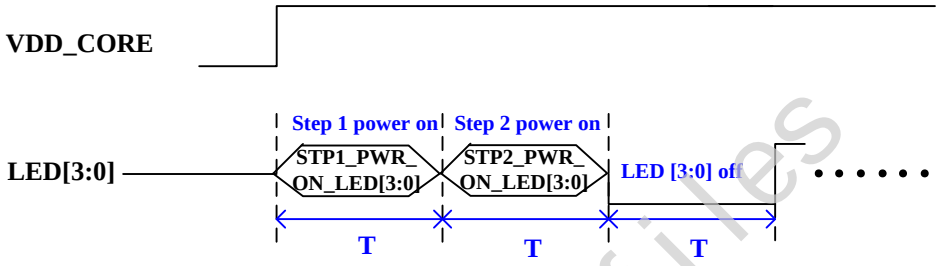
1.3 Power on Blinking

RTL9310 supports power on blinking after every power on or reset. In order to support bi-color LED display, three steps are designed.

Table 1-13 is the list of register that control the LED on/off in step1 and step2, and all LED are off in step3.

LED on/off time in each step can also be set by register, as listed in Table 1-14.

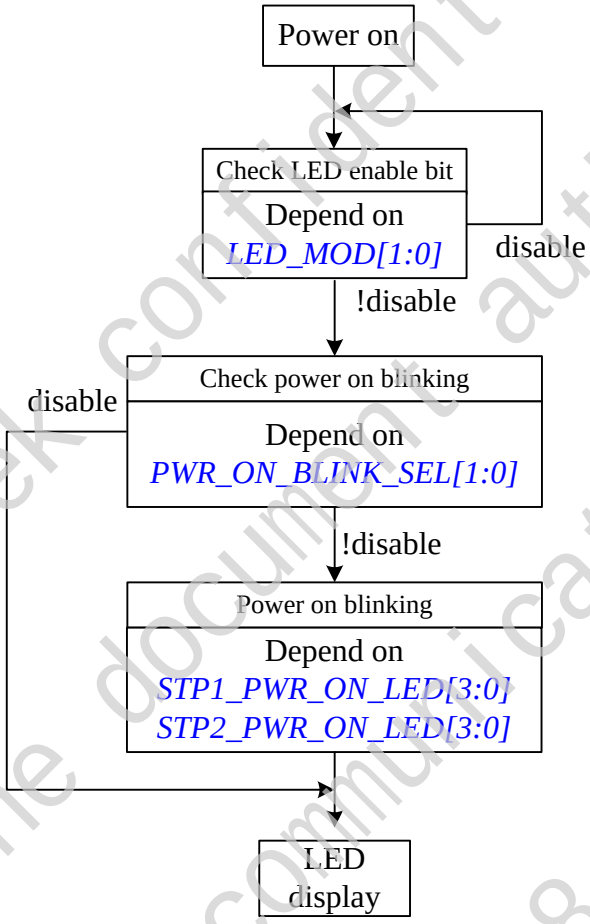
Figure 1-8 Power on LED Timing Diagram



Note: T is dependent on PWR_ON_BLINK_SEL

LED_MODE must not be “disable” then LED can start to display. LED_MODE should be disabled before LED setting is ready that can prevent the LED blinking before software ready.

Figure 1-9 Power on Blinking Flow Chart



1.3.1 Register Setting

Steps of power on blinking are global setting for all ports. A typical setting for bi-color LED mode is that set STEP1_PWR_ON_LED to 3’b101 and set STEP2_PWR_ON_LED to 3’b110 so that LED0(color1) and LED1(color2) can turn on respectively in step1 and step2.

Table 1-13 LED_GLB_CTRL Register – STPx_PWR_ON_LED

Bits	Field	Description	Type	Default
11:8	STP2_PWR_ON_LED	Select power on blinking LED in step 2 power on duration. "0" is LED off, "1" is LED on	RW	0x6
7:4	STP1_PWR_ON_LED	Select power on blinking LED in step 1 power on duration. "0" is LED off, "1" is LED on	RW	0x5

LED power on blinking time can be set by register.

Table 1-14 LED_GLB_CTRL Register – PWR_ON_BLINK_SEL

Bits	Field	Description	Type	Default
3:2	PWR_ON_BLINK_SEL	Select power on blinking time (T), 0x0: disable 0x1: 400ms 0x2: 800ms 0x3: 1.6s	RW	0x1

1.3.2 SDK Setting

SDK3

There is no configuration in SDK. If want to control LED power on blinking, could add setting into rtl9310_led_config() in file sdk/src/hal/mac/led/led_rtl9310.c.

Example:

```
val = 0x1;
reg_field_write(unit, MANGO_LED_GLB_CTRLr, Field_Name, &val);
```

Field_Name could be:

MANGO_STP2_PWR_ON_LEDf For power on blinking LED in step 2

MANGO_STP1_PWR_ON_LEDf For power on blinking LED in step 1

MANGO_PWR_ON_BLINK_SELf For power on blinking time

rtk API

None.

1.4 System LED

RTL9310 uses internal GPIO[0] to do system LED pin(refer to RTL9310 GPIO application note). So internal GPIO[0] can be a GPIO pin or system LED pin depend on SYS_LED_EN setting.

System LED must be high activity to prevent abnormal blinking during system power on period.

1.4.1 Register Setting

Enable/disable system LED.

Table 1-15 System LED Strapping Pin

Pin Name	Pin No.	Default	Description
SYS_LED_EN	B27	0b1	When enable System LED, the GPIO[0] change to system LED pin. 0b0: Disable system LED 0b1: Enable system LED

Table 1-16 LED interface-SYS_LED

Pin Name	Pin No.	Type	Description
SYS_LED(GPIO_0)	AK25	O	System LED.

Table 1-17 MAC_L2_GLOBAL_CTRL2 Register – SYS_LED_EN

Bits	Field	Description	Type	Default
8:8	SYS_LED_EN	When enable System LED, the GPIO[0] change to system LED pin. Strapping pin. 0b0: Disable system LED 0b1: Enable system LED	RW	0x1

Note

The default value of SYS_LED_EN is enabled. If wants to enable GPIO[0], must disable system LED.

System LED mode configuration.

Table 1-18 LED_GLB_CTRL Register – SYS_LED_MODE

Bits	Field	Description	Type	Default
13:12	SYS_LED_MODE	System LED mode configuration When SYS_LED_EN=1, The system LED can be configured as following: 0x0: off 0x1: Blinking 64ms 0x2: Blinking 1024ms 0x3: Light	RW	0x1

1.4.2 SDK Setting

SDK3

There is no configuration in SDK. If want to control system LED, could add setting into rtl9310_led_config() in file sdk/src/hal/mac/led/led_rtl9310.c.

rtk API

int32 rtk_led_sysEnable_get(uint32 unit, rtk_led_type_t type, rtk_enable_t *pEnable);

int32 rtk_led_sysEnable_set(uint32 unit, rtk_led_type_t type, rtk_enable_t enable);

int32 rtk_led_sysMode_get(uint32 unit, rtk_led_swCtrl_mode_t *pMode);

int32 rtk_led_sysMode_set(uint32 unit, rtk_led_swCtrl_mode_t mode);

1.5 Port Status Indication

In serial mode and single color LED mode, RTL9310 supports at most 4 LED per port and each LED status can be defined individually, as listed in Table 1-19.

However, in bi-color LED mode, RTL9310 supports at most 3 LED per port, and LED0 and LED1 can't light simultaneously, so the definition of LED0 and LED1 should avoid this restriction.

RTL9310 supports 4 sets of LED definition setting, as listed in Table 1-20 and Table 1-21. Furthermore, RTL9310 provides 2 registers for LED_SET selecting, one for copper and the other for fiber, as listed in Table 1-28 and Table 1-29.

Table 1-19 LED Definition

<table>
<tr><th colspan="2">SETx_LEDx_SEL[15:0]</th><th colspan="2">Definition</th></tr>
<tr><td>Bit[0]</td><td>10G</td><td colspan="2" rowspan="9">Speed selection.
Combine with Link/Link Flash/ACT(Bits[11:9])</td></tr>
<tr><td>Bit[1]</td><td>5G</td></tr>
<tr><td>Bit[2]</td><td>Reserved</td></tr>
<tr><td>Bit[3]</td><td>2.5G</td></tr>
<tr><td>Bit[4]</td><td>Reserved</td></tr>
<tr><td>Bit[5]</td><td>1G</td></tr>
<tr><td>Bit[6]</td><td>Reserved</td></tr>
<tr><td>Bit[7]</td><td>100M</td></tr>
<tr><td>Bit[8]</td><td>10M</td></tr>
<tr><td>Bit[9]</td><td>Link</td><td>LED light when link established.</td><td rowspan="3">Combine with speed selection(Bits[8:0]) .</td></tr>
<tr><td>Bit[10]</td><td>Link Flash</td><td>LED blink when link established.</td></tr>
<tr><td>Bit[11]</td><td>ACT</td><td>LED blink when packet transmitting or receiving.</td></tr>
<tr><td>Bit[12]</td><td>RX</td><td>LED blink when packet receiving.</td><td rowspan="3">There is no relationship with speed selection.</td></tr>
<tr><td>Bit[13]</td><td>TX</td><td>LED blink when packet transmitting.</td></tr>
<tr><td>Bit[14]</td><td>COL</td><td>LED blink when collision occurring.</td></tr>
</table>

Bit[15]	Full Duplex	LED light when link at full duplex.	

The example of LED definitions:

Link/ACT SETx_LEDx_SEL = 0x0bff

1000M Link/ACT SETx_LEDx_SEL = 0x0a20

1000M/100M Link/ACT SETx_LEDx_SEL = 0x0aa0

1.5.1 Register Setting

Configuration for LED indication set0~set3, each set defines LED0~LED3 status.

Table 1-20 LED_SET3_CTRL1 Register

Bits	Field	Description	Type	Default
31:16	SET3_LED3_SEL	Select set3 LED3 mode configuration. Reserved for user configuration.	RW	0x0A40
15:0	SET3_LED2_SEL	Select set3 LED2 mode configuration. Default is 100M Link/Act.	RW	0x0A80

Table 1-21 LED_SET3_CTRL0 Register

Bits	Field	Description	Type	Default
31:16	SET3_LED1_SEL	Select set3 LED1 mode configuration. Default is 1000M Link/Act.	RW	0x0A20
15:0	SET3_LED0_SEL	Select set3 LED0 mode configuration. Default is 10G Link/Act.	RW	0x0A01

Table 1-22 LED_SET2_CTRL1 Register

Bits	Field	Description	Type	Default
31:16	SET2_LED3_SEL	Select set2 LED3 mode configuration. Default is 10G Link.	RW	0x201
15:0	SET2_LED2_SEL	Select set2 LED2 mode configuration. Default is Link/Act.	RW	0xBFF

Table 1-23 LED_SET2_CTRL0 Register

Bits	Field	Description	Type	Default
31:16	SET2_LED1_SEL	Select set2 LED1 mode configuration. Default is 1000M link.	RW	0x220
15:0	SET2_LED0_SEL	Select set2 LED0 mode configuration. Default is 100M link.	RW	0x280

Table 1-24 LED_SET1_CTRL1 Register

Bits	Field	Description	Type	Default
31:16	SET1_LED3_SEL	Select set1 LED3 mode configuration. Default is Col/Full duplex.	RW	0xC000
15:0	SET1_LED2_SEL	Select set1 LED2 mode configuration. Default is Full duplex.	RW	0x8000

Table 1-25 LED_SET1_CTRL0 Register

Bits	Field	Description	Type	Default
31:16	SET1_LED1_SEL	Select set1 LED1 mode configuration. Default is 100M Link/Act.	RW	0xA80
15:0	SET1_LED0_SEL	Select set1 LED0 mode configuration. Default is 10M Link/Act.	RW	0xB00

Table 1-26 LED_SET0_CTRL1 Register

Bits	Field	Description	Type	Default
31:16	SET0_LED3_SEL	Select set0 LED3 mode configuration. Reserved for user configuration.	RW	0xA40
15:0	SET0_LED2_SEL	Select set0 LED2 mode configuration. Default is Full duplex.	RW	0x8000

Table 1-27 LED_SET0_CTRL0 Register

Bits	Field	Description	Type	Default
31:16	SET0_LED1_SEL	Select set0 LED1 mode configuration. Default is 1000M Link/Act.	RW	0xA20
15:0	SET0_LED0_SEL	Select set0 LED0 mode configuration. Default is 10M/100M Link/Act.	RW	0xB80

Configuration for LED indication set of Copper port.

Table 1-28 LED_PORT_COPR_SET_SEL_CTRL Register

PORT INDEX:0-55

Bits	Field	Description	Type	Default
1:0	LED_COPR_SET_PSEL	Select per port copper LED definition is set0 or set1 or set2 or set3. 0x0: set0 0x1: set1 0x2: set2 0x3: set3	RW	0x0

Select LED indication set for Fiber port.

Table 1-29 LED_PORT_FIB_SET_SEL_CTRL Register

PORT INDEX:0-55

Bits	Field	Description	Type	Default
1:0	LED_FIB_SET_PSEL	Select per port fiber LED definition is set0 or set1 or set2 or set3. 0x0: set0 0x1: set1 0x2: set2 0x3: set3	RW	0x0

1.5.2 SDK Setting

SDK3

In sdk\system\include\hwp\hw_profiles\rtlxxx_xxx_demo.c

Refer to Table 1-19 to modify setting .led_definition_set[0].led[x] is for SET0_LEDx_SEL, you can add led_definition_set[1].led[x] for SET1_LEDx_SEL.

```
.led.descp = {
.led_if_sel = LED_IF_SEL_SERIAL,
.led_definition_set[0].led[0] = 0xB80,          /* 10/100Mbps link/act */
.led_definition_set[0].led[1] = 0xA20,          /* 1000Mbps link/act */
.led_definition_set[0].led[2] = 0xA01,          /* duplex mode */
.led_definition_set[0].led[3] = 0x0,            /* Not blink */
.led_definition_set[0].led[4] = HWP_LED_END,          /* None */
```

In sdk\system\include\hwp\hw_profiles\rtlxxx_xxx_demo.c

led_c is for LED_COPR_SET_PSEL. (0 means select SET0_LEDx_SEL)

led_f is for LED_FIB_SET_PSEL

```
.port.descp = {
{ ...                                   .led_c = 0,     .led_f = 0,          ... },
```

In sdk\system\hwp\hw_init.c, hwp_init_led().

SDK calculates LED number via .led_definition_set[x].led[x] defined in hw_profile.

Then check the set that .led_c and led.f defined in per port to configure LED_NUM_SEL(LED number of port).

```
.led.descp = {
.led_if_sel = LED_IF_SEL_SERIAL,
.led_definition_set[0].led[0] = 0xB80,
.led_definition_set[0].led[1] = 0xA20,
.led_definition_set[0].led[2] = 0xA01,
.led_definition_set[0].led[3] = 0x0,
.led_definition_set[0].led[4] = HWP_LED_END,        ➔ LED number of set0 is 4
.led_definition_set[1].led[0] = 0xB80,
.led_definition_set[1].led[1] = 0xA20,
.led_definition_set[1].led[2] = 0xA01,
.led_definition_set[1].led[3] = HWP_LED_END,        ➔ LED number of set1 is 3
```

In sdk\system\include\hwp\hw_profiles\rtlxxx_xxx_demo.c

```
If (led.layout != HWP_NONE)
{
    SDK calculates valid .led_c(0-3) and .led_f(0-3) number,
    Then set related bit of LED_COPR_PMASK and LED_FIB_PMASK as 1.
    If (led.layout = DOUBLE_SET)
    {
        Set related bit of LED_COMBO_PMASK = 0. /* DOUBLE_SET*/
    }
    else
    {
        Set related bit of LED_COMBO_PMASK = 1. /*SINGLE_SET*/
    }
}
```

```
.port.descp = {
    {    …                                                    .led_layout = SINGLE_SET,},
```

rtk API

None.

1.6 Software LED Control

Software can control all of LEDs in all LED modes.

Before software control LED, it must set SW_CTRL_LED_EN=1.

For all LEDs synchronization issue, after software configured all Software Control LED Registers and then set SW_LED_LOAD=1 to notify ASIC to update all of LEDs state.

1.6.1 Register Setting

Enable software LED control for each LED of port. Each bit stands for one LED, bit0 for LED0, bit1 for LED1 …, set 1 to enable.

Table 1-30 LED_PORT_SW_EN_CTRL Register

PORT INDEX:0-55

Bits	Field	Description	Type	Default
3:0	SW_CTRL_LED_EN	Enable software control LED3-LED0 0x0: LED3-LED0 Disable 0x1: LED3-LED1 disable, LED0 Enable 0x2: LED3-LED2 and LED0 disable, LED1 enable … 0xF: LED3-LED0 enable	RW	0x0

After software configured all Software Control LED Registers and then set SW_LED_LOAD=1 to notify ASIC to update all of LEDs state.

Table 1-31 SW_LED_LOAD Register

Bits	Field	Description	Type	Default
0:0	SW_LED_LOAD	In software control LED mode, since software LED control registers distribute in different register sets, they need one bit for all software control registers synchronization. 0b0: normal 0b1: load all software control LED registers. Self-clear to "0".	RWAC	0x0

Define LED mode for Copper/Fiber LED0~LED3.

Table 1-32 LED_PORT_SW_CTRL Register

PORT INDEX:0-55

Bits	Field	Description	Type	Default
31:24	RESERVED			
23:21	SW_FIB_LED3_MODE	Fiber LED3 mode configuration for port. When SW_CTRL_LED_EN=1, The LED3 of port can be configured as following: 0x0: off 0x1: Blinking 32ms 0x2: Blinking 64ms 0x3: Blinking 128ms 0x4: Blinking 256ms 0x5: Blinking 512ms 0x6: Blinking 1024ms 0x7: Light	RW	0x0

20:18	SW_FIB_LED2_MODE	Fiber LED2 mode configuration for port. When SW_CTRL_LED_EN=1, The LED2 of port can be configured as following: 0x0: off 0x1: Blinking 32ms 0x2: Blinking 64ms 0x3: Blinking 128ms 0x4: Blinking 256ms 0x5: Blinking 512ms 0x6: Blinking 1024ms 0x7: Light	RW	0x0
17:15	SW_FIB_LED1_MODE	Fiber LED1 mode configuration for port. When SW_CTRL_LED_EN=1, The LED1 of port can be configured as following: 0x0: off 0x1: Blinking 32ms 0x2: Blinking 64ms 0x3: Blinking 128ms 0x4: Blinking 256ms 0x5: Blinking 512ms 0x6: Blinking 1024ms 0x7: Light	RW	0x0
14:12	SW_FIB_LED0_MODE	Fiber LED0 mode configuration for port. When SW_CTRL_LED_EN=1, The LED0 of port can be configured as following: 0x0: off 0x1: Blinking 32ms 0x2: Blinking 64ms 0x3: Blinking 128ms 0x4: Blinking 256ms 0x5: Blinking 512ms 0x6: Blinking 1024ms 0x7: Light	RW	0x0
11:9	SW_COPR_LED3_MODE	Copper LED3 mode configuration for port. When SW_CTRL_LED_EN=1, The LED3 of port can be configured as following: 0x0: off 0x1: Blinking 32ms 0x2: Blinking 64ms 0x3: Blinking 128ms 0x4: Blinking 256ms 0x5: Blinking 512ms 0x6: Blinking 1024ms 0x7: Light	RW	0x0
8:6	SW_COPR_LED2_MODE	Copper LED2 mode configuration for port. When SW_CTRL_LED_EN=1, The LED2 of port can be configured as following: 0x0: off 0x1: Blinking 32ms 0x2: Blinking 64ms 0x3: Blinking 128ms 0x4: Blinking 256ms 0x5: Blinking 512ms 0x6: Blinking 1024ms 0x7: Light	RW	0x0

5:3	SW_COPR_LED1_MODE	Copper LED1 mode configuration for port. When SW_CTRL_LED_EN=1, The LED1 of port can be configured as following: 0x0: off 0x1: Blinking 32ms 0x2: Blinking 64ms 0x3: Blinking 128ms 0x4: Blinking 256ms 0x5: Blinking 512ms 0x6: Blinking 1024ms 0x7: Light	RW	0x0
2:0	SW_COPR_LED0_MODE	Copper LED0 mode configuration for port. When SW_CTRL_LED_EN=1, The LED0 of port can be configured as following: 0x0: off 0x1: Blinking 32ms 0x2: Blinking 64ms 0x3: Blinking 128ms 0x4: Blinking 256ms 0x5: Blinking 512ms 0x6: Blinking 1024ms 0x7: Light	RW	0x0

1.6.2 SDK Setting

SDK3

There is no configuration in SDK. Call rtk APIs by application to control LED.
Could implement as following steps:

1. Enable software LED control for specified LED
   rtk_led_portLedEntitySwCtrlEnable_set()
2. Set LED mode for specified LED
   rtk_led_portLedEntitySwCtrlMode_set()
3. Load LED setting
   rtk_led_swCtrl_start()

rtk API

int32 rtk_led_portLedEntitySwCtrlEnable_get(uint32 unit, rtk_port_t port, uint32 entity, rtk_enable_t *pEnable);

int32 rtk_led_portLedEntitySwCtrlEnable_set(uint32 unit, rtk_port_t port, uint32 entity, rtk_enable_t enable);

int32 rtk_led_portLedEntitySwCtrlMode_get(uint32 unit, rtk_port_t port, uint32 entity, rtk_port_media_t media, rtk_led_swCtrl_mode_t *pMode);

int32 rtk_led_portLedEntitySwCtrlMode_set(uint32 unit, rtk_port_t port, uint32 entity, rtk_port_media_t media, rtk_led_swCtrl_mode_t mode);

int32 rtk_led_swCtrl_start(uint32 unit);