RTL839x/RTL835x

LAYER 2 + MANAGED SWITCH CONTROLLER

LED APPLICATION

(CONFIDENTIAL: Development Partners Only)

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1. Introduction

This document provides detailed LED applications to understand how to design RTL839x/RTL835x's LED circuit.

- RTL839x/RTL835x supports three LED modes (serial LED / single color scan LED / bi-color scan LED)
- RTL839x/RTL835x supports 74HC164 and RTL8231 LED display in serial LED mode
- RTL839x/RTL835x supports RTL8231 LED display in single color scan LED mode and bi-color scan LED mode
- RTL839x/RTL835x supports maximum 52-LED port (CPU port does not support LED display)
- RTL839x/RTL835x supports maximum LED signal stream is 56 (copper LED signal stream + fiber LED signal stream)
- RTL839x/RTL835x supports per port maximum 3-LED (optional 2-LED and 1-LED) display with 22 types of configuration for each port
- RTL839x/RTL835x supports external GPIO via RTL8231
- When RTL839x/RTL835x used RTL8231 to display LED in shift register mode, one RTL8231 supports 36-bits output
- When RTL839x/RTL835x used RTL8231 to display LED in single color scan LED mode, one RTL8231 supports 72 single color LEDs
- When RTL839x/RTL835x used RTL8231 to display LED in bi-color scan LED mode, one RTL8231 just only supports 24 ports whether choose how many LED per port
- When RTL839x/RTL835x used RTL8231 to extend GPIO, one RTL8231 supports 37 GPIOs (except for 8 strapping pins)
- RTL839x/RTL835x supports system LED indication by hardware

2. LED Port Number Selection

RTL839x/RTL835x supports to display copper LED and fiber LED in combo port, i.e. when there are combo ports implemented in the system, the combo port's copper LED and fiber LED can be optional displayed by RTL839x/RTL835x or PHY.

RTL839x/RTL835x provides register *COPR_PMASK[51:0]*, *FIB_PMASK[51:0]*, *LED_COMBO[51:0]* to decide copper/fiber status display on copper or fiber LED and enable/disable copper/fiber LED signal stream.

- *COPR_PMASK[51:0]*: select display copper LED port mask
- *FIB_PMASK[51:0]*: select display fiber LED port mask
- *LED_COMBO[51:0]*: 0=>copper status display on copper LED, fiber status display on fiber LED. 1=> copper status and fiber status display on copper LED.

The sequence of RTL839x/RTL835x output LED signal stream=>First output copper LED signal stream and then output fiber LED signal stream.

The maximum LED signal stream is 56 (i.e. copper LED signal stream + fiber LED signal stream ≦ 56 LED signal stream)

2.1. Example for LED Port Number Selection

Example 1:

(1) One 48G+4G-combo device with single color scan LED mode and per port 3-LED

(2) RTL839x/RTL835x display Port0-51 copper LED and Port48-51 fiber LED

(3) Port0-51 Copper status display on Port0-51 copper LED

(4) Port48-51 fiber status display on Port48-51 fiber LED

The register setting as following:

- *COPR_PMASK[51:0]*: copper LED P0-P51=1
- *FIB_PMASK[51:0]*: fiber LED P0-P47=0, P48-P51=1
- *LED_COMBO[51:0]*: combo LED P0-P47=0, P48-P51=0

The RTL839x/RTL835x will output signal stream as following:

P0_copper_LED[0] → P0_copper_LED[1] → P0_copper_LED[2] → P1_copper_LED[0] → P1_copper_LED[1] → P1_copper_LED[2] → P2_copper_LED[0] → P2_copper_LED[1] → P2_copper_LED[2] →….→ P50_copper_LED[0] → P50_copper_LED[1] → P50_copper_LED[2] → P51_copper_LED[0] → P51_copper_LED[1] → P51_copper_LED[2] → P48_fiber_LED[0] → P48_fiber_LED[1] → P48_fiber_LED[2] → P49_fiber_LED[0] → P49_fiber_LED[1] → P49_fiber_LED[2] → P50_fiber_LED[0] → P50_fiber_LED[1] → P50_fiber_LED[2] → P51_fiber_LED[0] → P51_fiber_LED[1] → P51_fiber_LED[2]

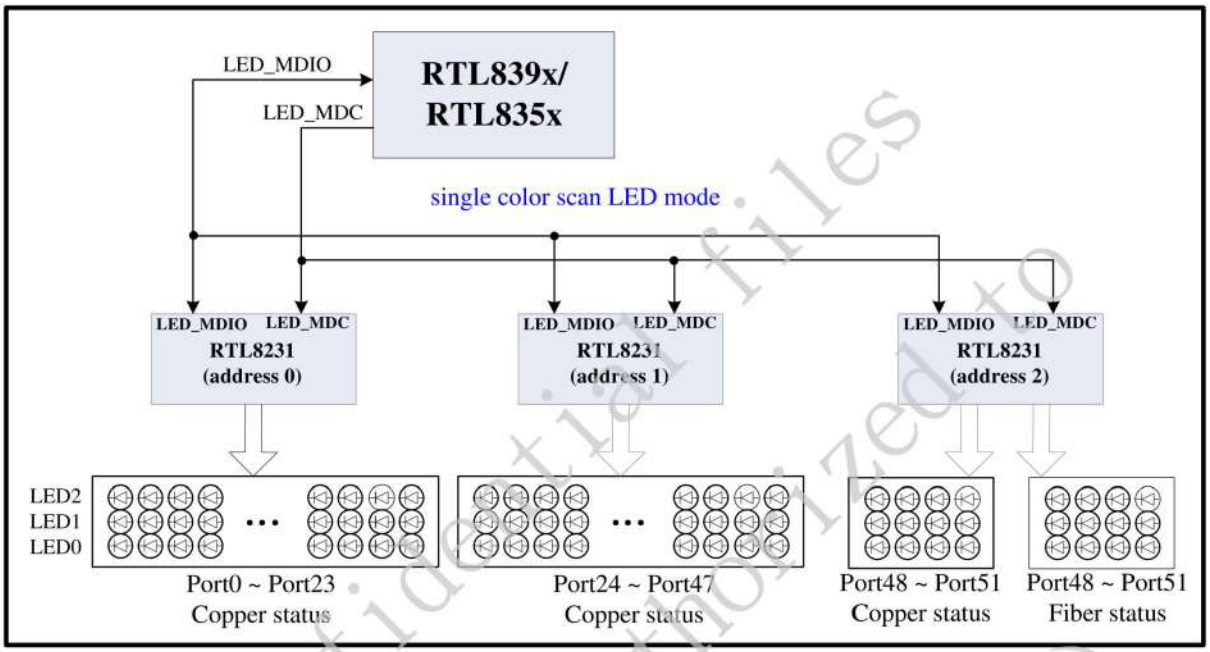

Figure 1. Example 1 illustrate

Example 2:

(1) One 48G+4G-combo device with single color scan LED mode and per port 3-LED

(2) RTL839x/RTL835x display Port0-51 copper LED and Port48-51 fiber LED

(3) Port0-51 Copper status display on Port0-51 copper LED

(4) Port48-51 fiber status display on Port48-51 copper LED

The register setting as following:

- *COPR_PMASK[51:0]*: copper LED P0-P51=1
- *FIB_PMASK[51:0]*: fiber LED P0-P47=0, P48-P51=1
- *LED_COMBO[51:0]*: combo LED P0-P47=0, P48-P51=1

The RTL839x/RTL835x will output signal stream as following:

P0_copper_LED[0] → P0_copper_LED[1] → P0_copper_LED[2] → P1_copper_LED[0] → P1_copper_LED[1] → P1_copper_LED[2] → P2_copper_LED[0] → P2_copper_LED[1] → P2_copper_LED[2] →…→ P48_copper/fiber_LED[0] → P48_copper/fiber_LED[1] → P48_copper/fiber_LED[2] → P49_copper/fiber_LED[0] → P49_copper/fiber_LED[1] → P49_copper/fiber_LED[2] → P50_copper/fiber_LED[0] → P50_copper/fiber_LED[1] → P50_copper/fiber_LED[2] → P51_copper/fiber_LED[0] → P51_copper/fiber_LED[1] → P51_copper/fiber_LED[2]

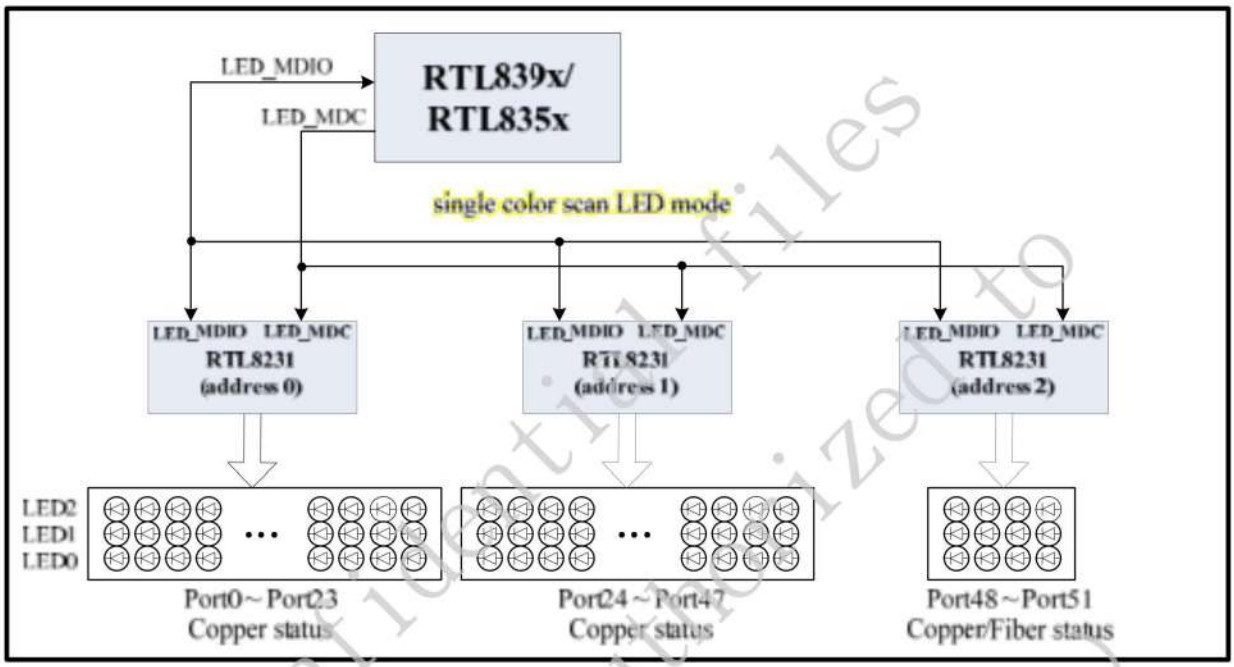

Figure 2. Example 2 illustrate

Example 3:

(1) One 48G+4G-combo device with single color scan LED mode and per port 3-LED

(2) RTL839x/RTL835x display Port0-47 copper LED and PHY display Port48-51 copper/fiber LED

(3) Port0-47 Copper status display on Port0-47 copper LED

The register setting as following:

- *COPR_PMASK[51:0]*: copper LED P0-P47=1, P48-P51=0
- *FIB_PMASK[51:0]*: fiber LED P0-P47=0, P48-P51=0
- *LED_COMBO[51:0]*: combo LED P0-P47=0, P48-P51=0

The RTL839x/RTL835x will output signal stream as following:

P0_copper_LED[0] → P0_copper_LED[1] → P0_copper_LED[2] → P1_copper_LED[0] → P1_copper_LED[1] → P1_copper_LED[2] → P2_copper_LED[0] → P2_copper_LED[1] → P2_copper_LED[2] →….→ P46_copper_LED[0] → P46_copper_LED[1] → P46_copper_LED[2] → P47_copper_LED[0] → P47_copper_LED[1] → P47_copper_LED[2]

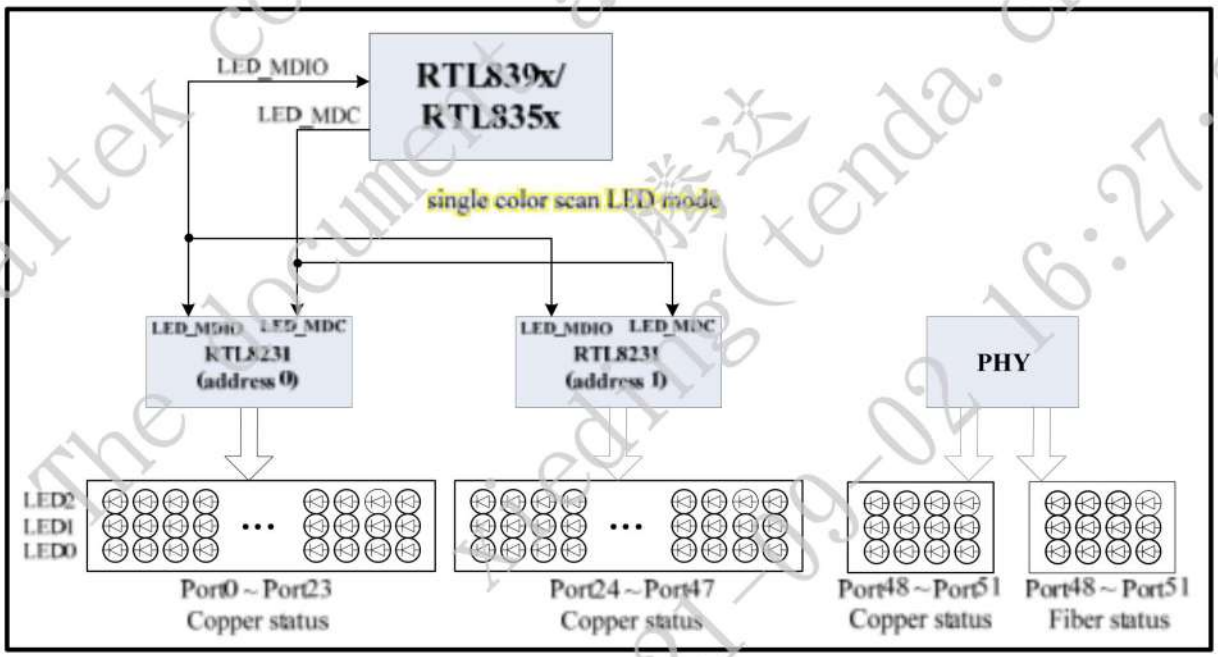

Figure 3. Example 3 illustrate

3. Serial LED

When RTL839x/RTL835x used RTL8231 to display LED in shift register mode, one RTL8231 supports 36-bits output.

3.1. Per Port 3-LED Application

- One 48G+4G-combo device with serial LED mode and per port 3-LED
- RTL839x/RTL835x display Port0-51 copper LED and Port48-51 fiber LED
- Port0-51 Copper status display on Port0-51 copper LED
- Port48-51 fiber status display on Port48-51 fiber LED
- *COPR_PMASK[51:0]*: copper LED P0-P51=1
- *FIB_PMASK[51:0]*: fiber LED P0-P47=0, P48-P51=1
- *LED_COMBO[51:0]*: combo LED P0-P47=0, P48-P51=0

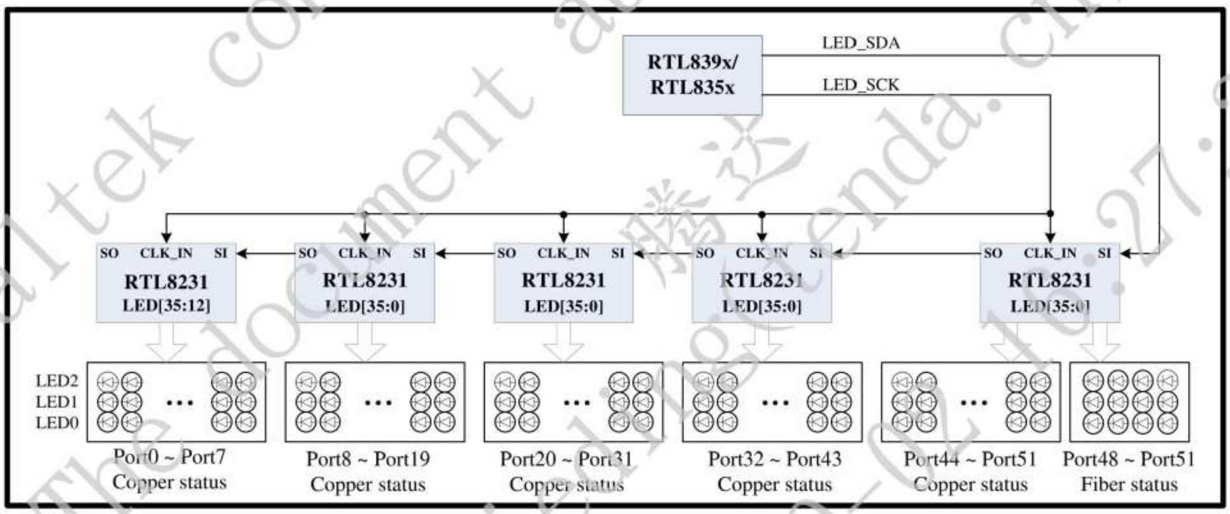

Figure 4. Serial LED Mode & Per Port 3-LED

3.2. Per Port 2-LED Application

- One 48G+4G-combo device with serial LED mode and per port 2-LED
- RTL839x/RTL835x display Port0-51 copper LED and Port48-51 fiber LED
- Port0-51 Copper status display on Port0-51 copper LED
- Port48-51 fiber status display on Port48-51 fiber LED
- *COPR_PMASK[51:0]*: copper LED P0-P51=1
- *FIB_PMASK[51:0]*: fiber LED P0-P47=0, P48-P51=1
- *LED_COMBO[51:0]*: combo LED P0-P47=0, P48-P51=0

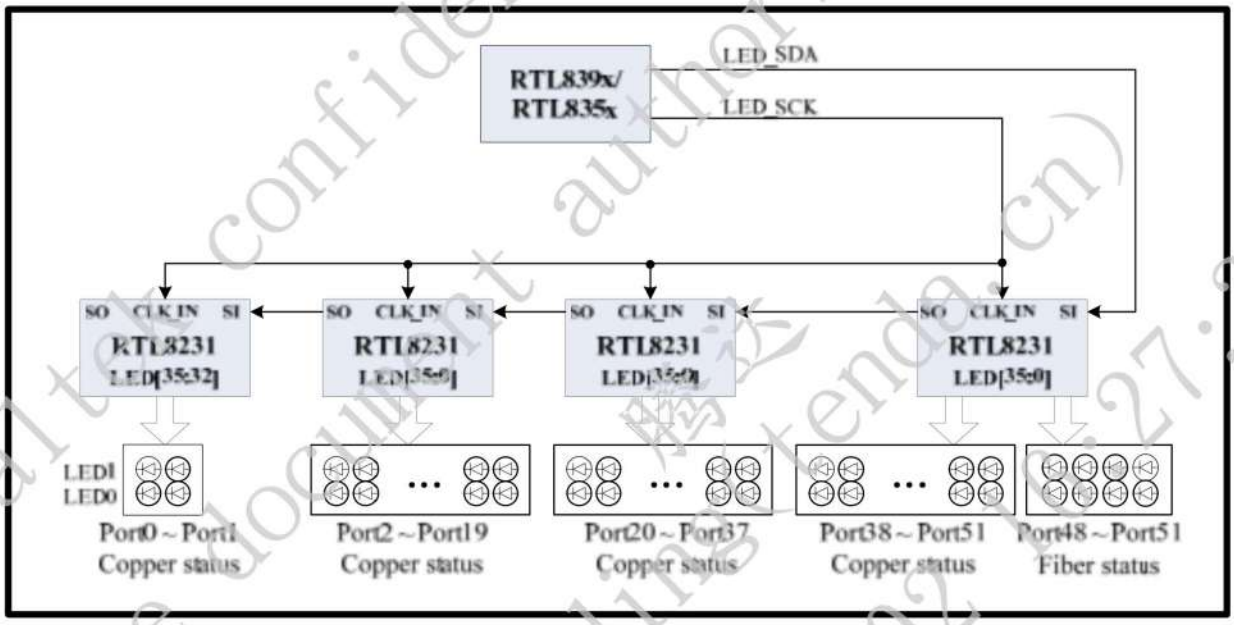

Figure 5. Serial LED Mode & Per Port 2-LED

3.3. Per Port 1-LED Application

- One 48G+4G-combo device with serial LED mode and per port 1-LED
- RTL839x/RTL835x display Port0-51 copper LED and Port48-51 fiber LED
- Port0-51 Copper status display on Port0-51 copper LED
- Port48-51 fiber status display on Port48-51 fiber LED
- *COPR_PMASK[51:0]*: copper LED P0-P51=1
- *FIB_PMASK[51:0]*: fiber LED P0-P47=0, P48-P51=1
- *LED_COMBO[51:0]*: combo LED P0-P47=0, P48-P51=0

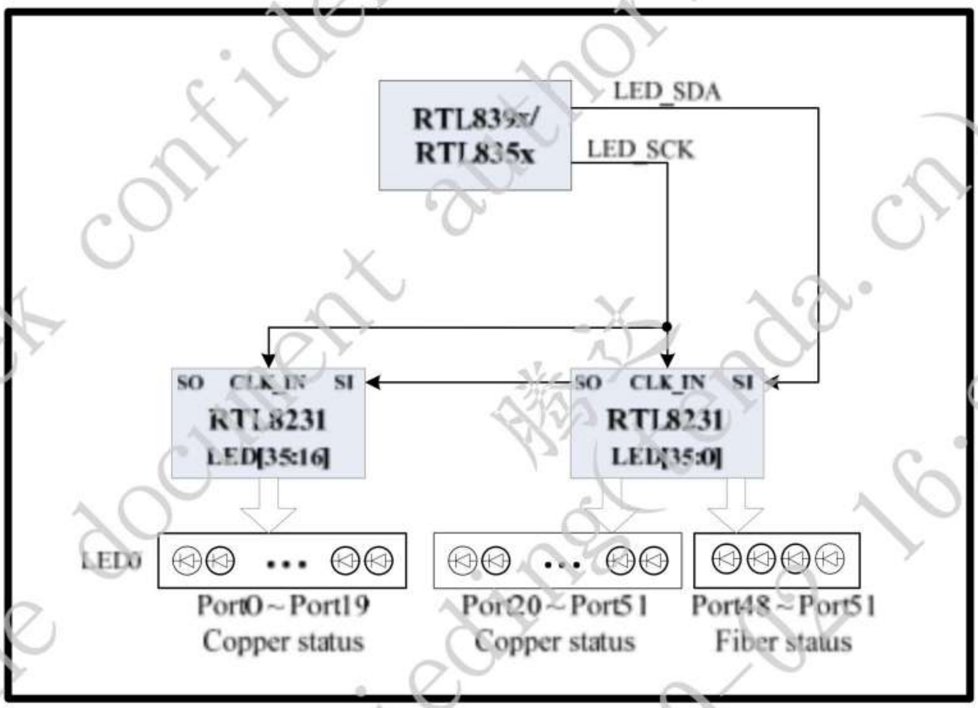

Figure 6. Serial LED Mode & Per Port 1-LED

4. Single Color Scan LED

When RTL839x/RTL835x used RTL8231 to display LED in single color scan LED mode, one RTL8231 supports 72 single color LEDs.

4.1. Per Port 3-LED Application

- One 48G+4G-combo device with single color scan LED mode and per port 3-LED
- RTL839x/RTL835x display Port0-51 copper LED and Port48-51 fiber LED
- Port0-51 Copper status display on Port0-51 copper LED
- Port48-51 fiber status display on Port48-51 fiber LED
- *COPR_PMASK[51:0]*: copper LED P0-P51=1
- *FIB_PMASK[51:0]*: fiber LED P0-P47=0, P48-P51=1
- *LED_COMBO[51:0]*: combo LED P0-P47=0, P48-P51=0

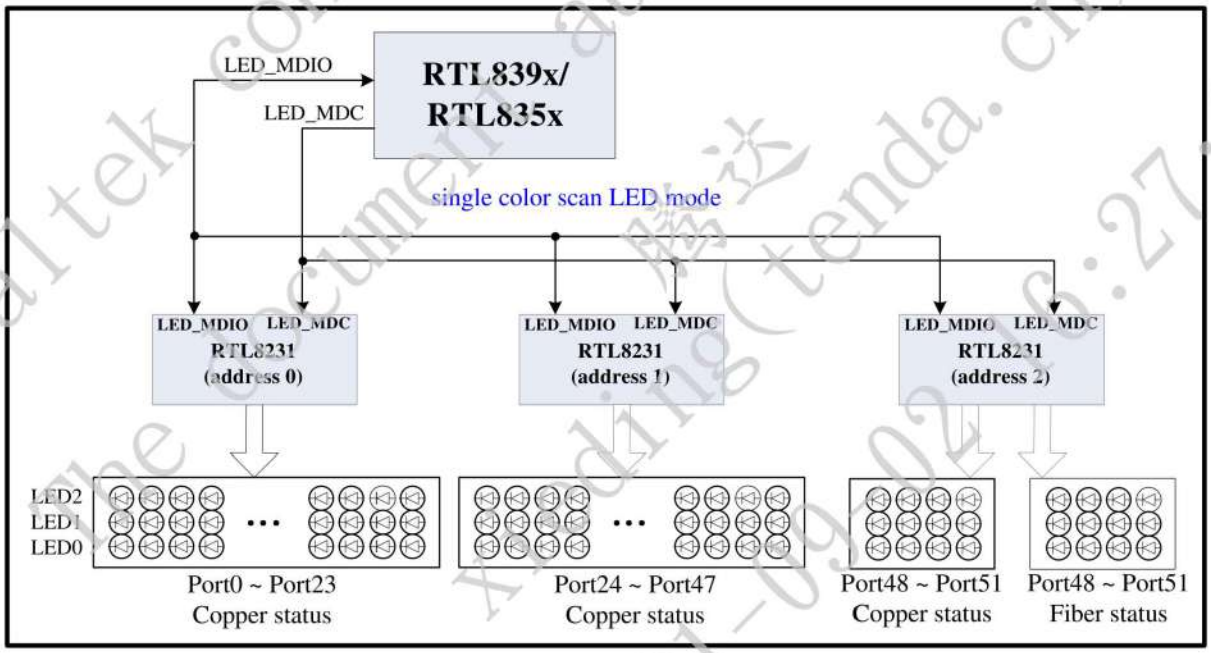

Figure 7. Single Color Scan LED Mode & Per Port 3-LED

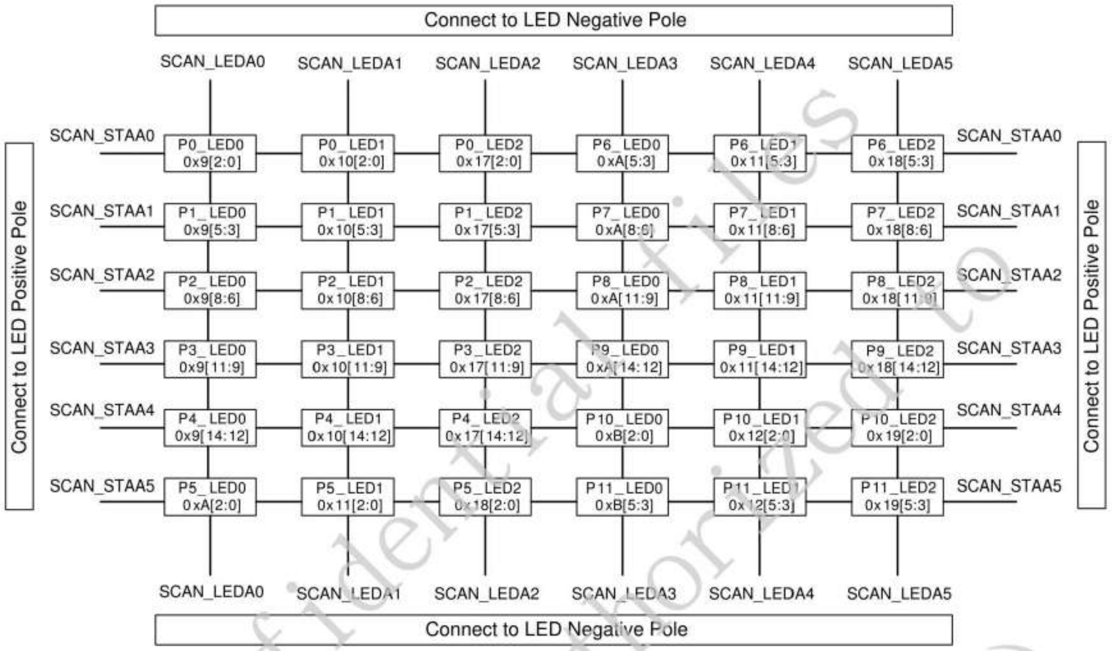

Figure 8. Illustration of RTL8231 (addr=0) in Single Color Scan LED Mode & Per Port 3-LED (1)

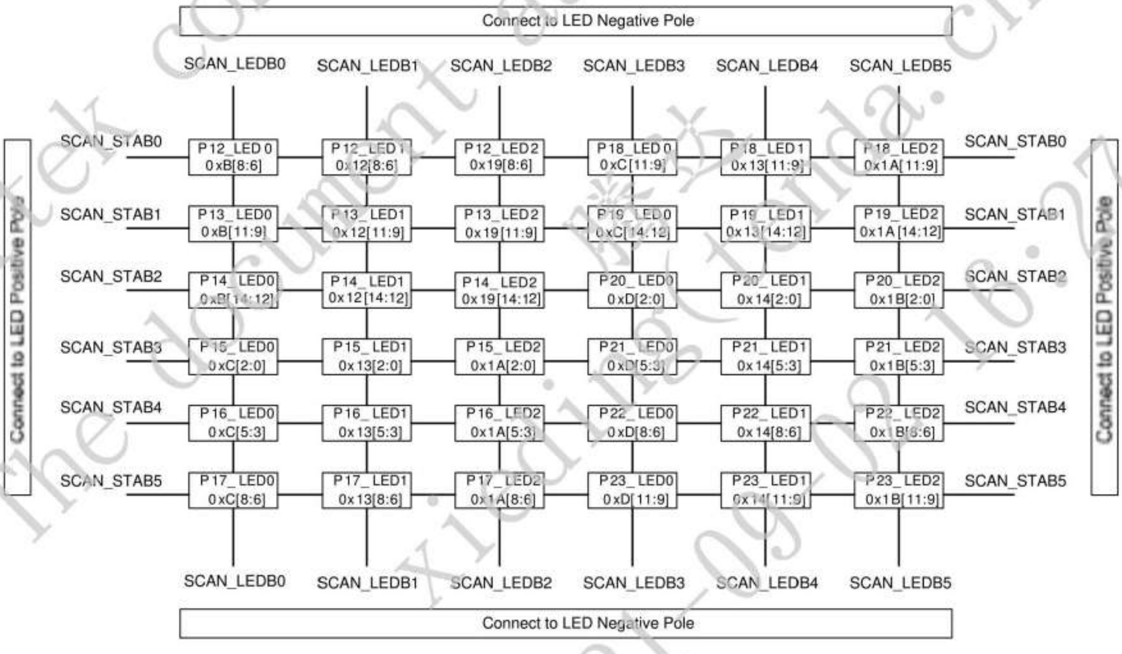

Figure 9. Illustration of RTL8231 (addr=0) in Single Color Scan LED Mode & Per Port 3-LED (2)

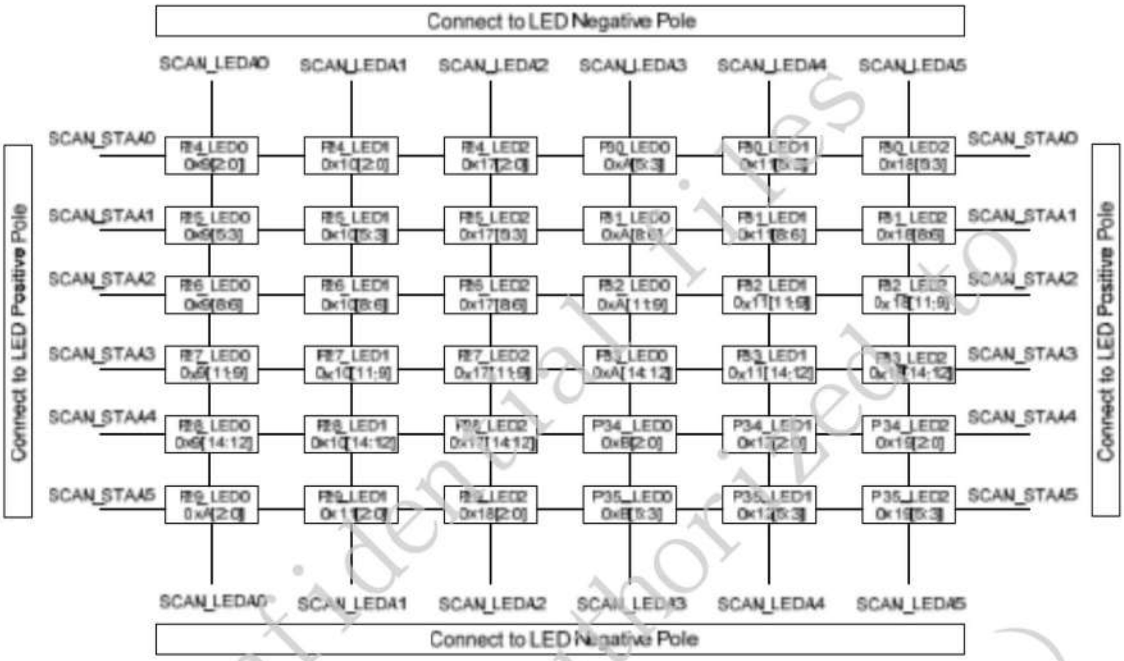

Figure 10. Illustration of RTL8231 (addr=1) in Single Color Scan LED Mode & Per Port 3-LED (1)

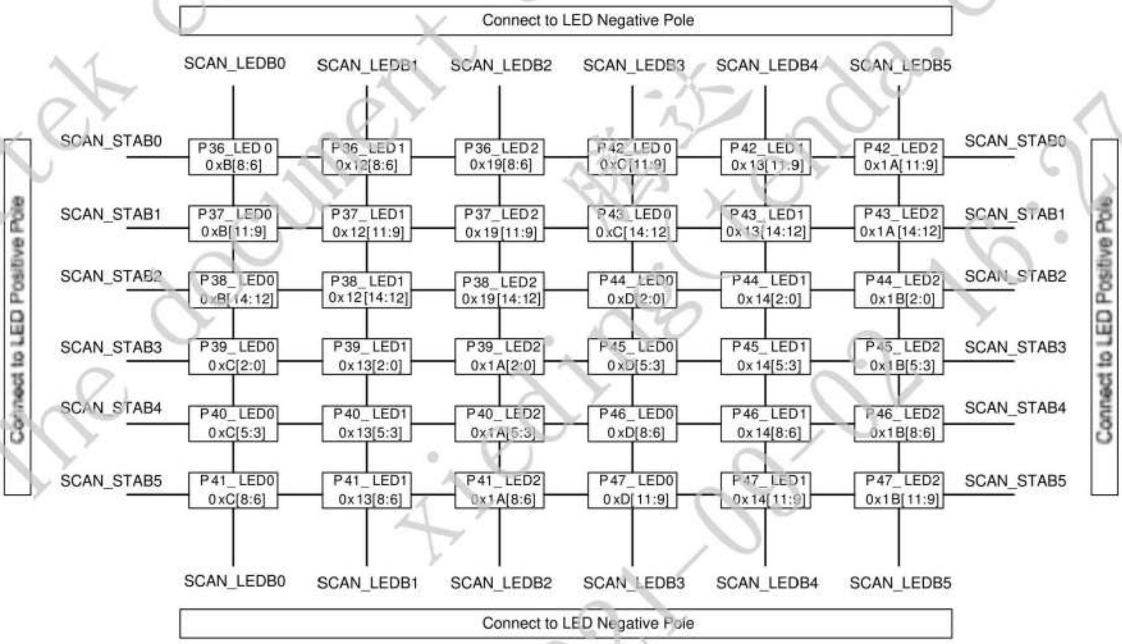

Figure 11. Illustration of RTL8231 (addr=1) in Single Color Scan LED Mode & Per Port 3-LED (2)

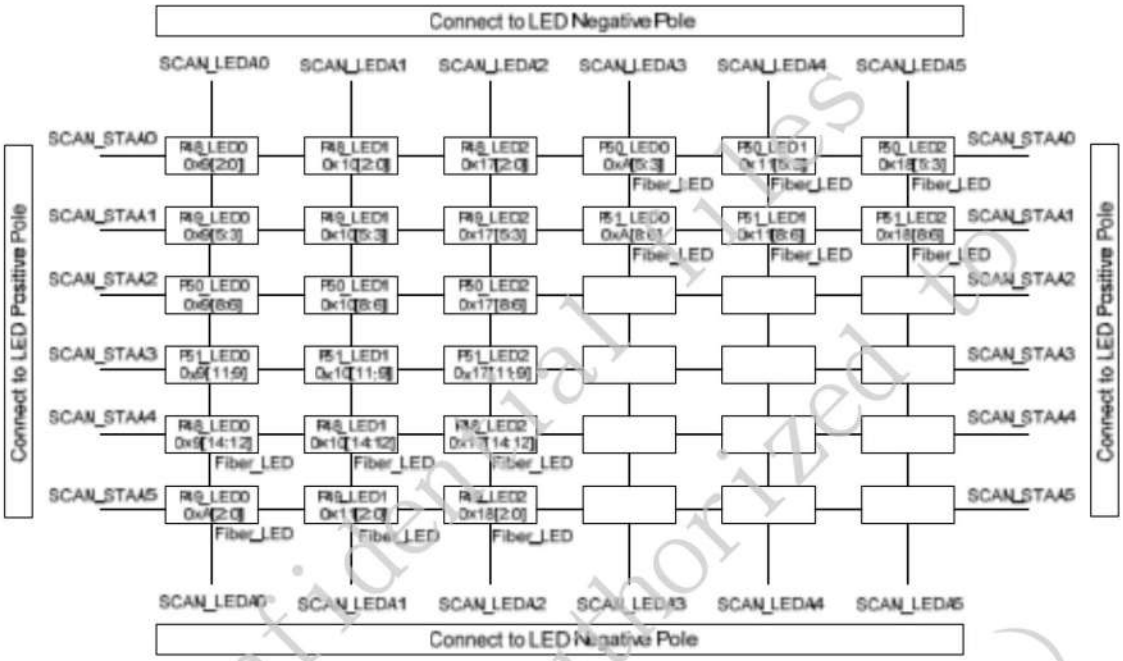

Figure 12. Illustration of RTL8231 (addr=2) in Single Color Scan LED Mode & Per Port 3-LED

4.2. Per Port 2-LED Application

- One 48G+4G-combo device with single color scan LED mode and per port 2-LED
- RTL839x/RTL835x display Port0-51 copper LED and Port48-51 fiber LED
- Port0-51 Copper status display on Port0-51 copper LED
- Port48-51 fiber status display on Port48-51 fiber LED
- *COPR_PMASK[51:0]*: copper LED P0-P51=1
- *FIB_PMASK[51:0]*: fiber LED P0-P47=0, P48-P51=1
- *LED_COMBO[51:0]*: combo LED P0-P47=0, P48-P51=0

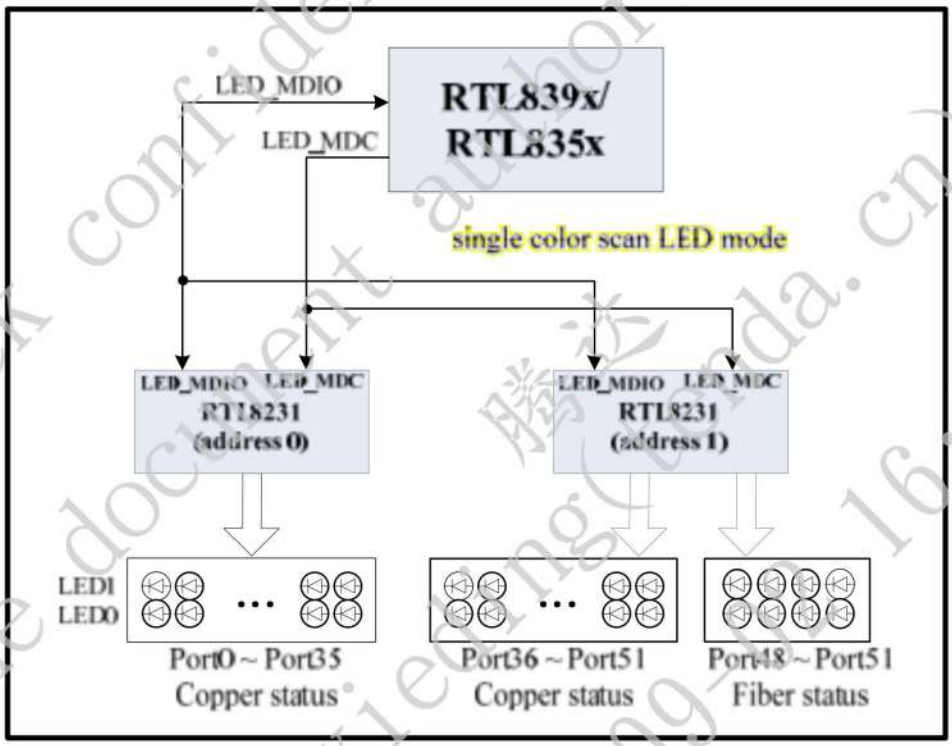

Figure 13. Single Color Scan LED Mode & Per Port 2-LED

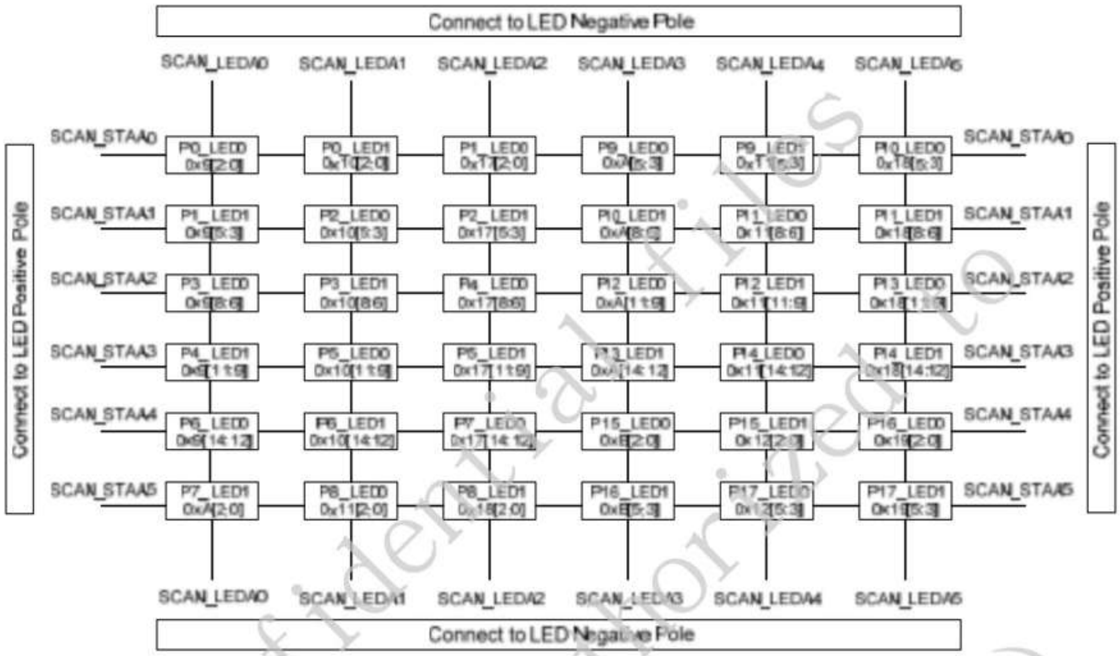

Figure 14. Illustration of RTL8231 (addr=0) in Single Color Scan LED Mode & Per Port 2-LED (1)

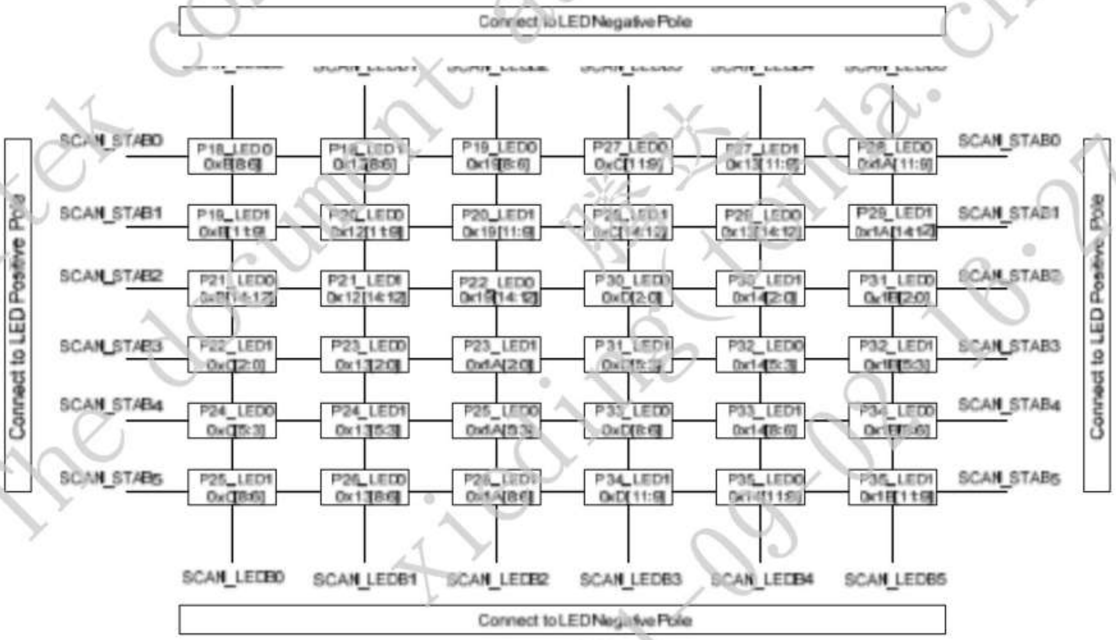

Figure 15. Illustration of RTL8231 (addr=0) in Single Color Scan LED Mode & Per Port 2-LED (2)

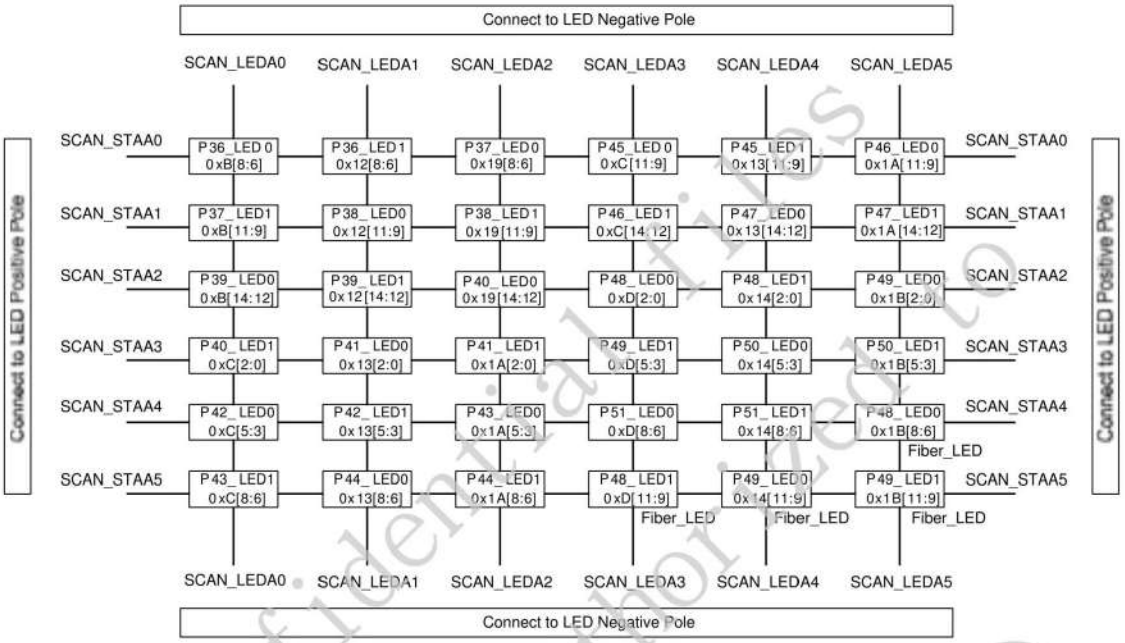

Figure 16. Illustration of RTL8231 (addr=1) in Single Color Scan LED Mode & Per Port 2-LED (1)

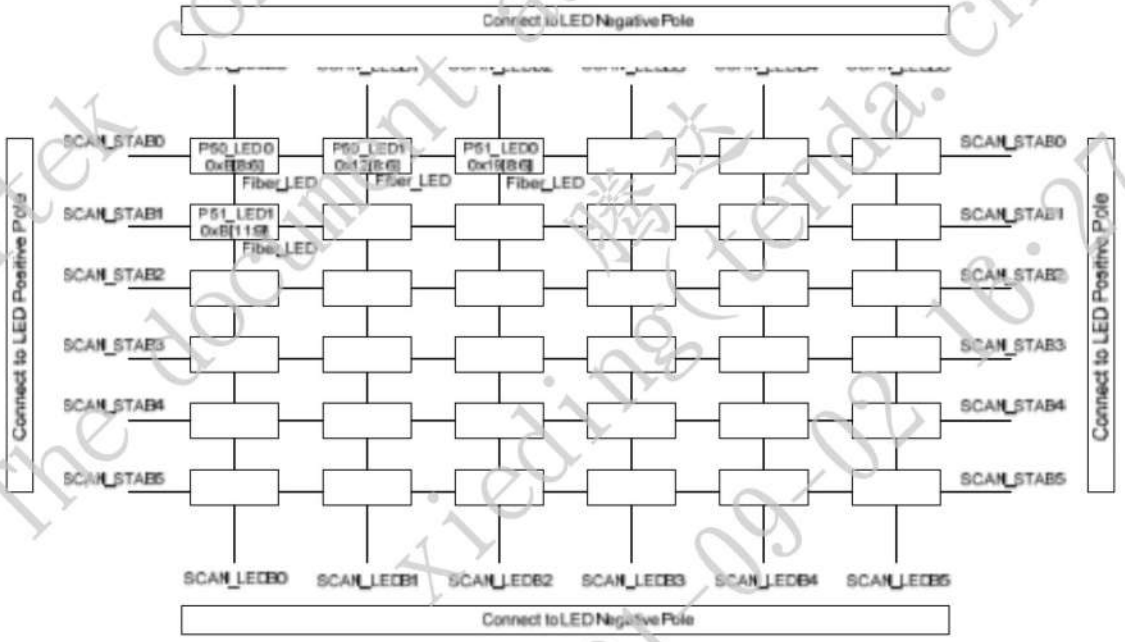

Figure 17. Illustration of RTL8231 (addr=1) in Single Color Scan LED Mode & Per Port 2-LED (2)

4.3. Per Port 1-LED Application

- One 48G+4G-combo device with single color scan LED mode and per port 1-LED
- RTL839x/RTL835x display Port0-51 copper LED and Port48-51 fiber LED
- Port0-51 Copper status display on Port0-51 copper LED
- Port48-51 fiber status display on Port48-51 fiber LED
- *COPR_PMASK[51:0]*: copper LED P0-P51=1
- *FIB_PMASK[51:0]*: fiber LED P0-P47=0, P48-P51=1
- *LED_COMBO[51:0]*: combo LED P0-P47=0, P48-P51=0

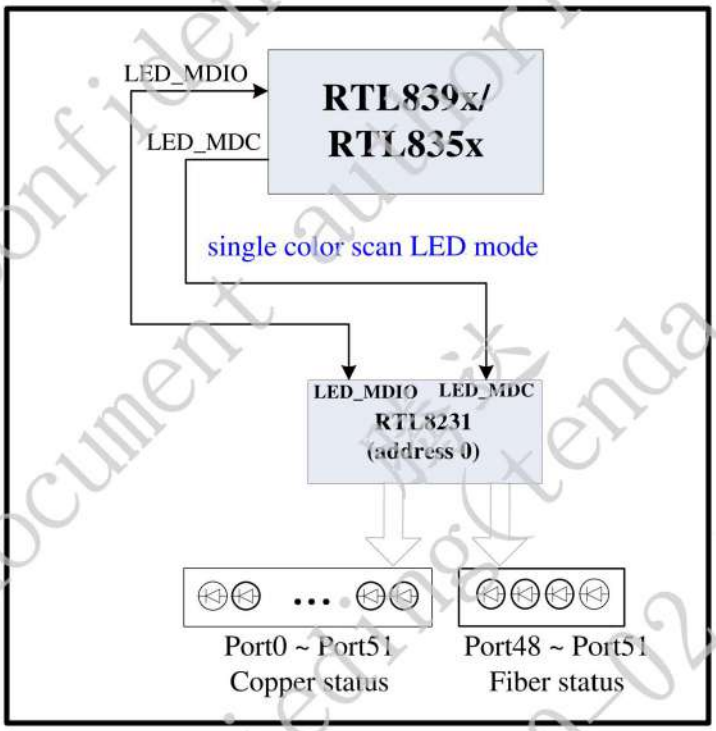

Figure 18. Single Color Scan LED Mode & Per Port 1-LED

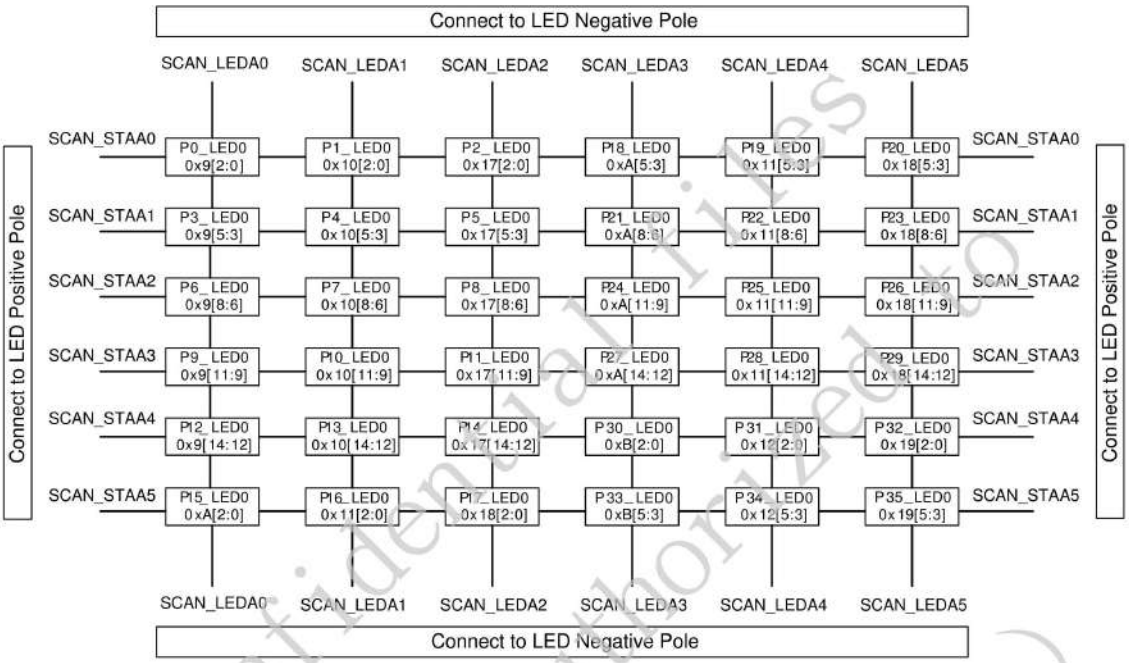

Figure 19. Illustration of RTL8231 (addr=0) in Single Color Scan LED Mode & Per Port 1-LED (1)

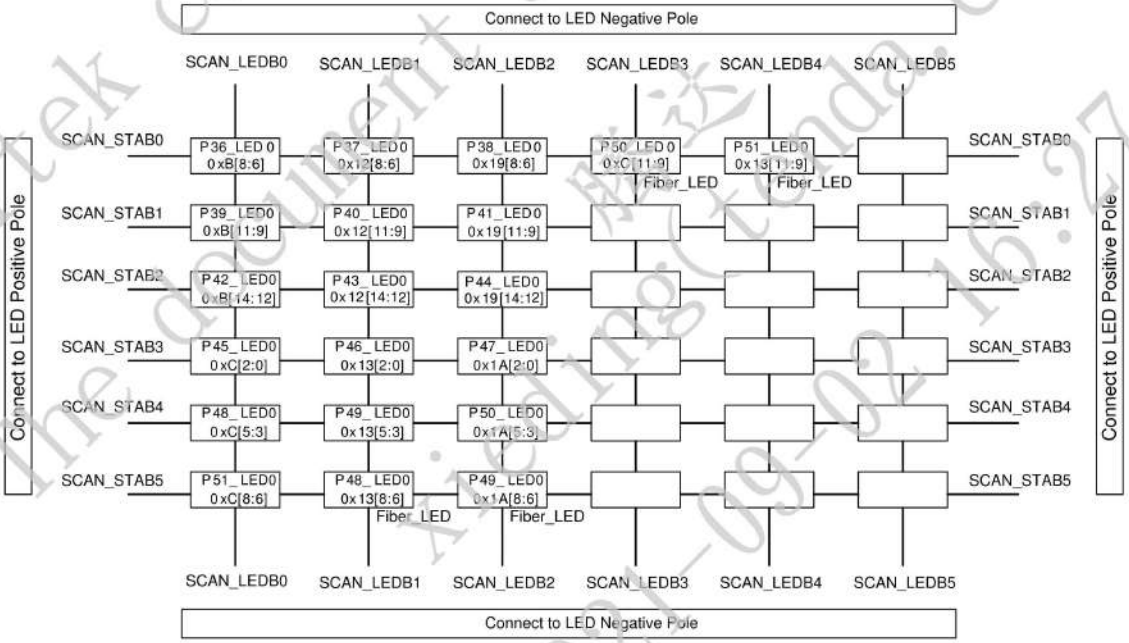

Figure 20. Illustration of RTL8231 (addr=0) in Single Color Scan LED Mode & Per Port 1-LED (2)

5. Bi-Color Scan LED

When RTL839x/RTL835x used RTL8231 to display LED in bi-color scan LED mode, one RTL8231 just only supports 24 ports whether choose how many LED per port.

I.e. whether choose per port 3-LED or 2-LED or 1-LED, the number of RTL8231 is the same.

5.1. Per Port 3-LED Application

- One 48G+4G-combo device with bi-color scan LED mode and per port 3-LED
- RTL839x/RTL835x display Port0-51 copper LED and Port48-51 fiber LED
- Port0-51 Copper status display on Port0-51 copper LED
- Port48-51 fiber status display on Port48-51 fiber LED
- *COPR_PMASK[51:0]*: copper LED P0-P51=1
- *FIB_PMASK[51:0]*: fiber LED P0-P47=0, P48-P51=1
- *LED_COMBO[51:0]*: combo LED P0-P47=0, P48-P51=0

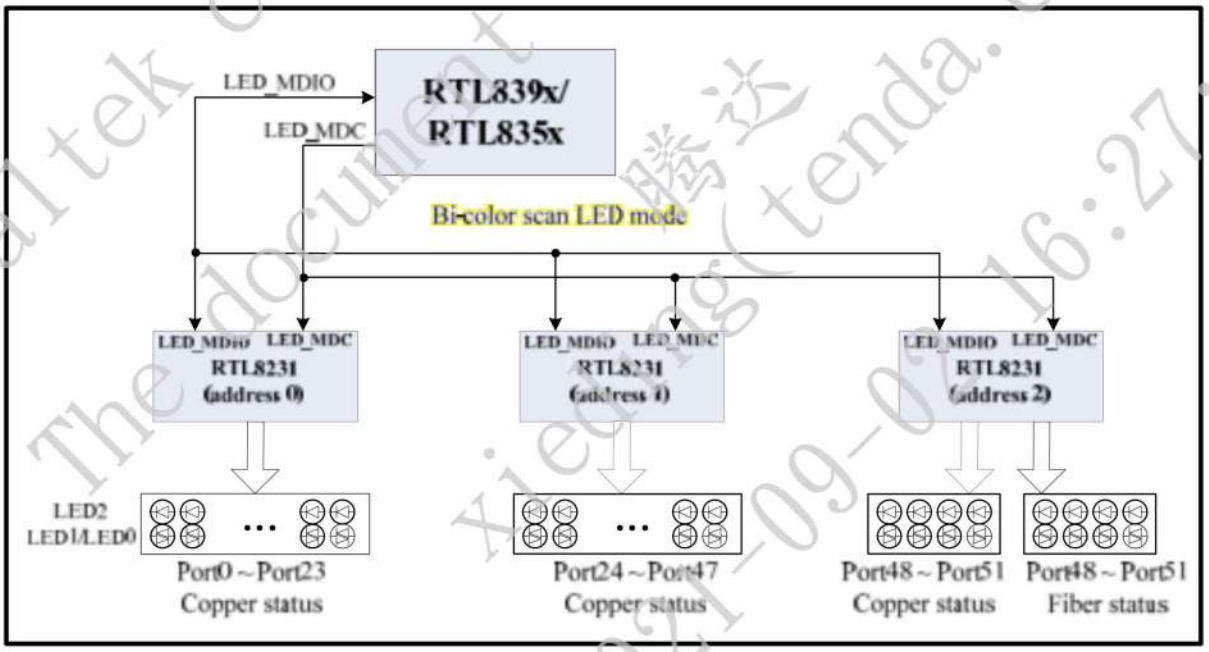

Figure 21. Bi-Color Scan LED Mode & Per Port 3-LED

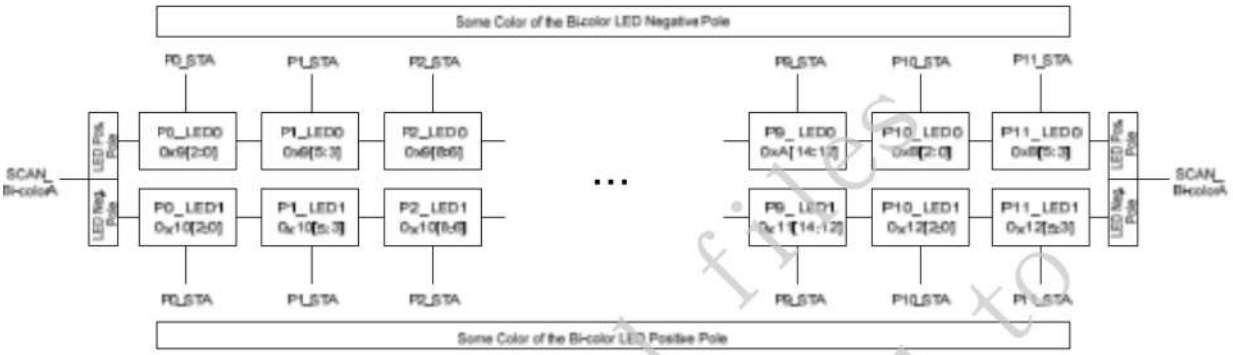

Figure 22. Illustration of RTL8231 (addr=0) in Bi-Color Scan LED Mode & Per Port 3-LED (1)

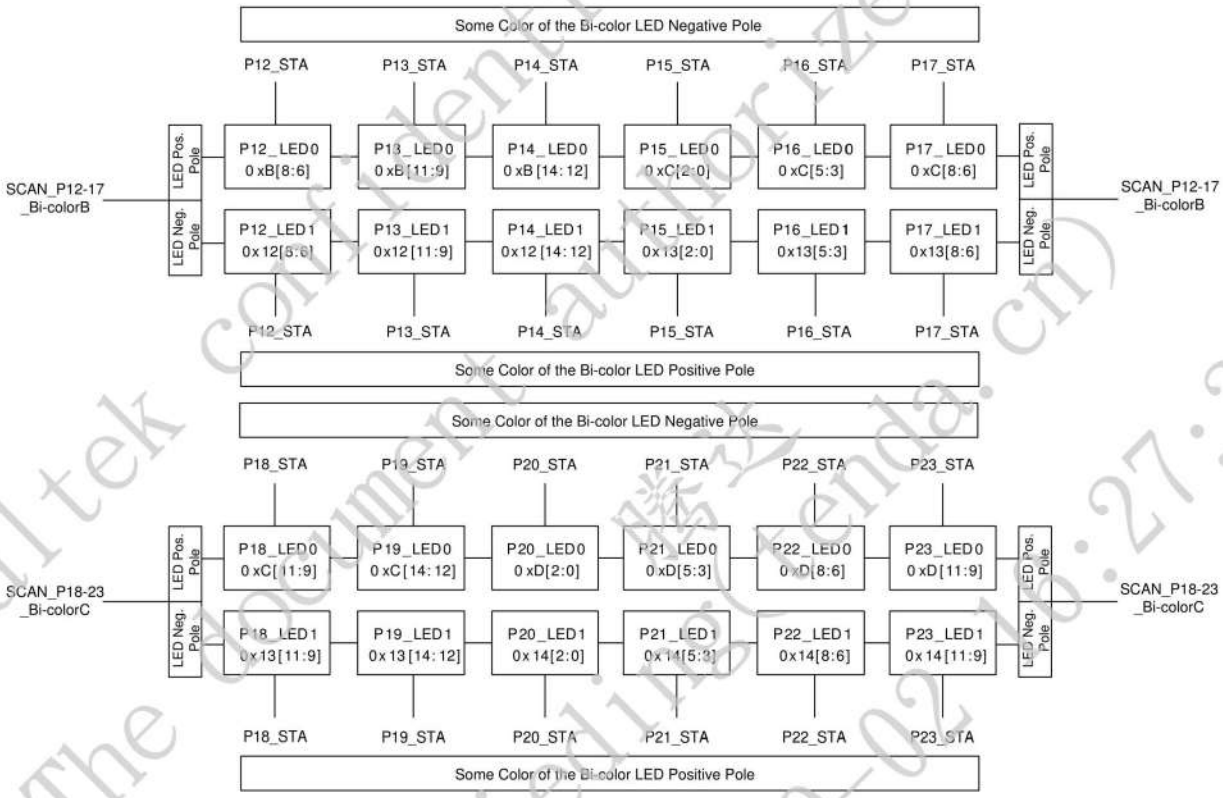

Figure 23. Illustration of RTL8231 (addr=0) in Bi-Color Scan LED Mode & Per Port 3-LED (2)

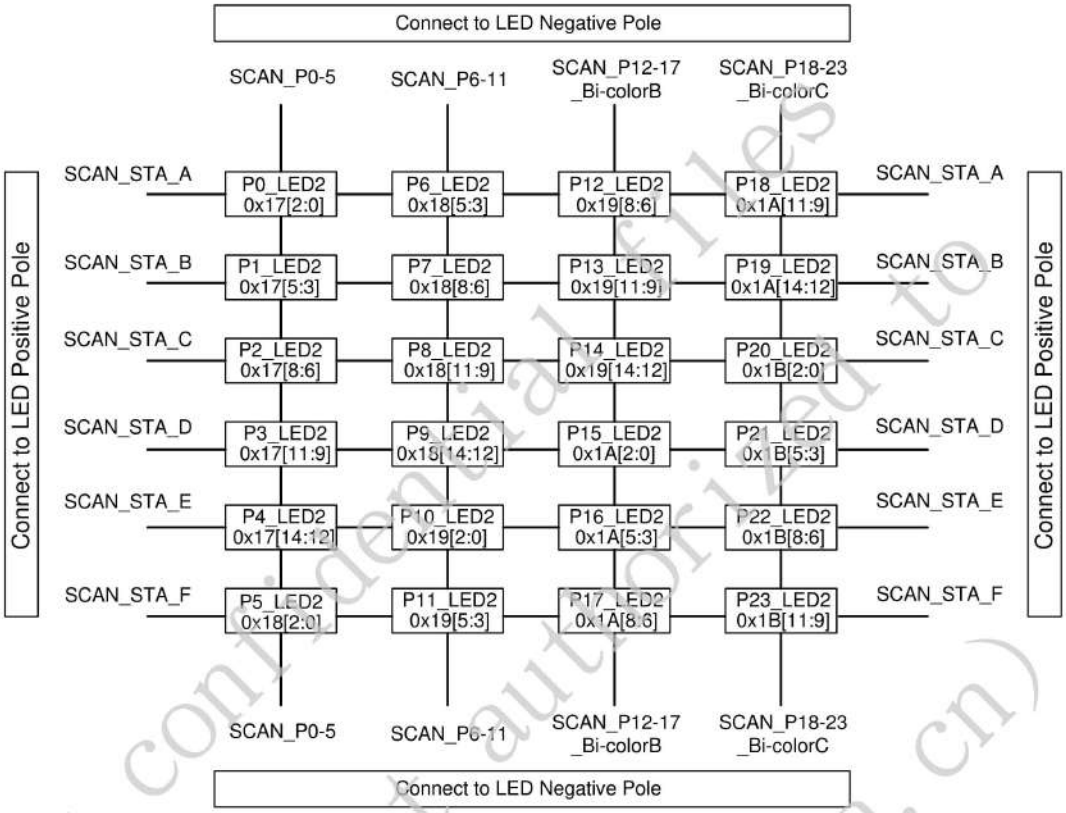

Figure 24. Illustration of RTL8231 (addr=0) in Bi-Color Scan LED Mode & Per Port 3-LED (3)

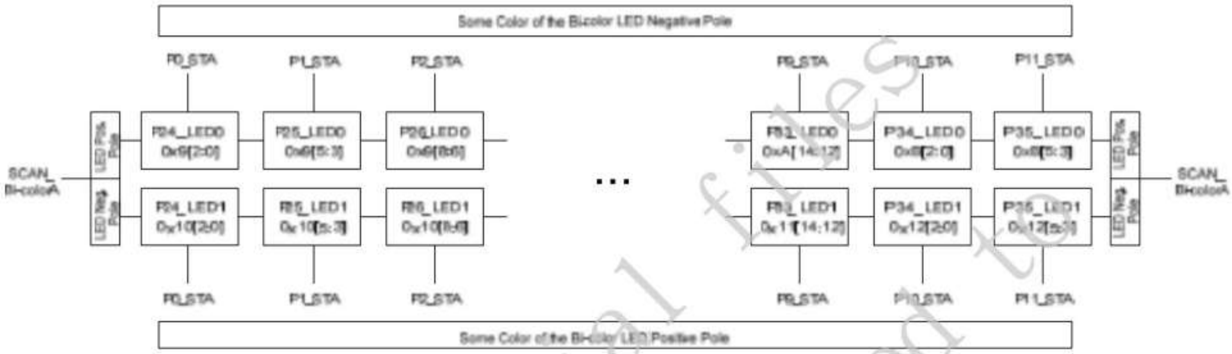

Figure 25. Illustration of RTL8231 (addr=1) in Bi-Color Scan LED Mode & Per Port 3-LED (1)

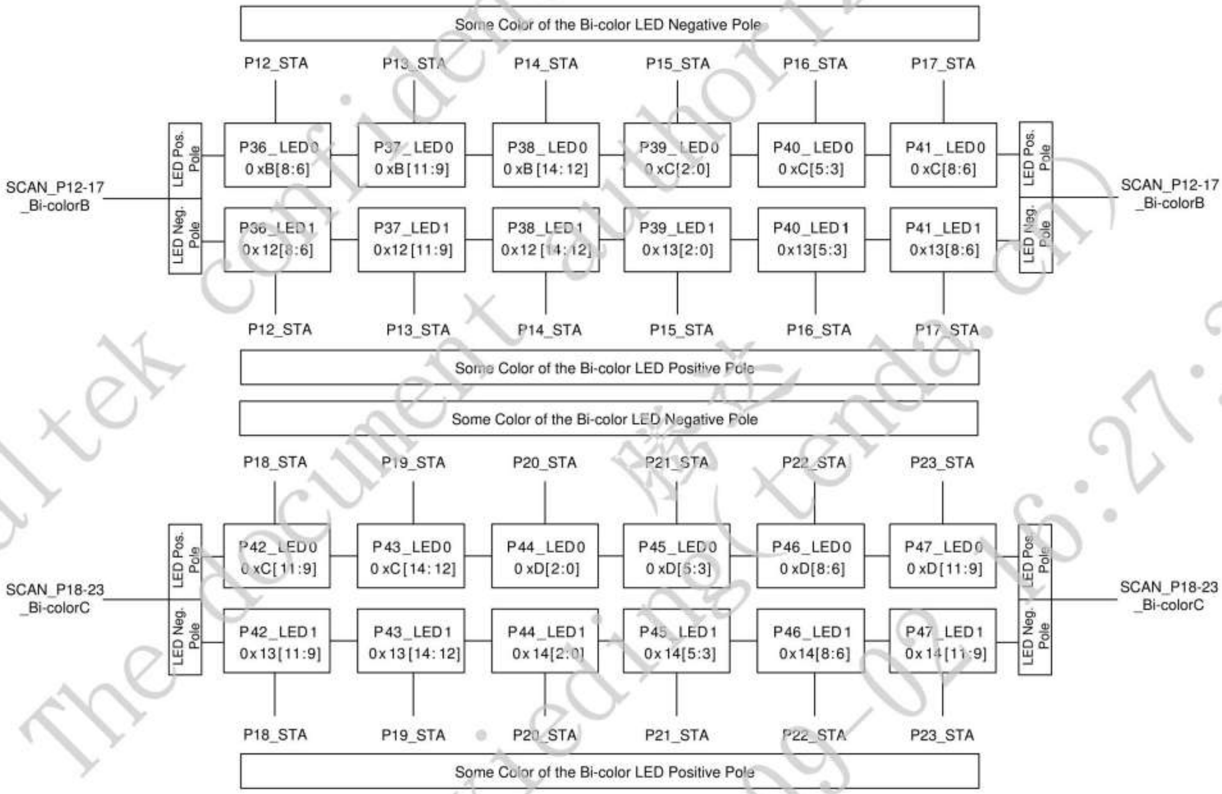

Figure 26. Illustration of RTL8231 (addr=1) in Bi-Color Scan LED Mode & Per Port 3-LED (2)

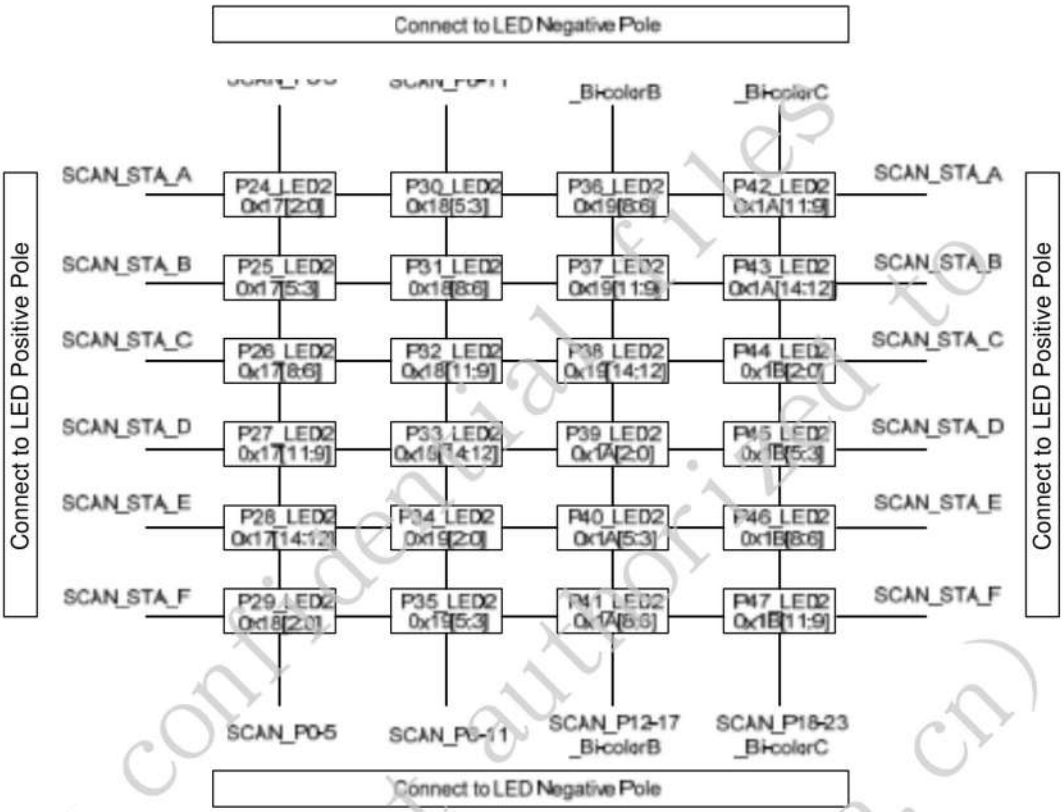

Figure 27. Illustration of RTL8231 (addr=1) in Bi-Color Scan LED Mode & Per Port 3-LED (3)

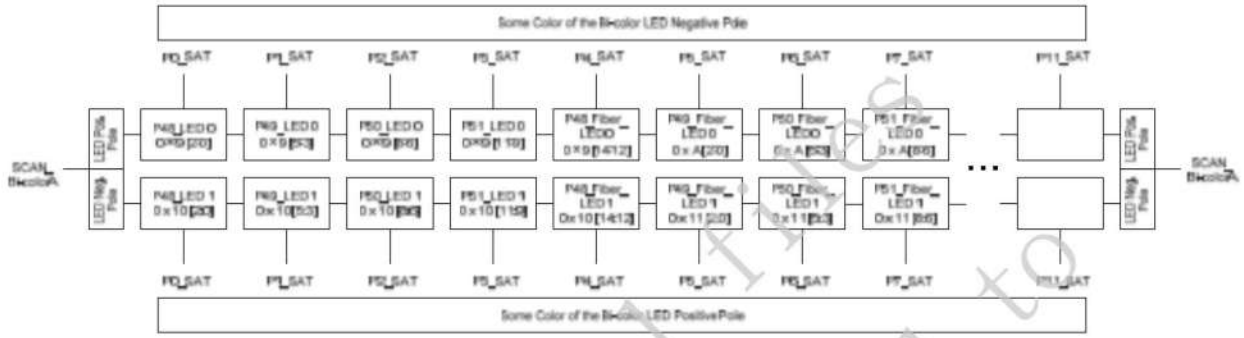

Figure 28 Illustration of RTL8231 (addr=2) in Bi-Color Scan LED Mode & Per Port 3-LED (1)

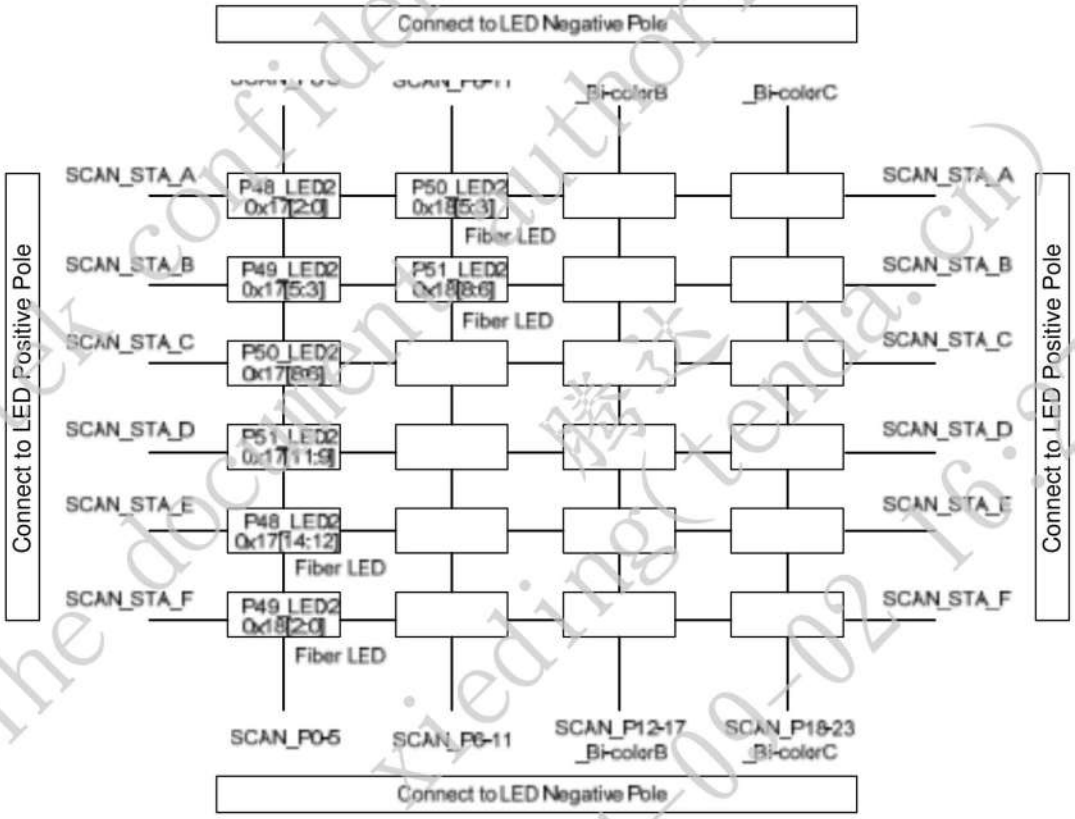

Figure 29. Illustration of RTL8231 (addr=2) in Bi-Color Scan LED Mode & Per Port 3-LED (2)

5.2. Per Port 2-LED Application

- One 48G+4G-combo device with bi-color scan LED mode and per port 2-LED
- RTL839x/RTL835x display Port0-51 copper LED and Port48-51 fiber LED
- Port0-51 Copper status display on Port0-51 copper LED
- Port48-51 fiber status display on Port48-51 fiber LED
- *COPR_PMASK[51:0]*: copper LED P0-P51=1
- *FIB_PMASK[51:0]*: fiber LED P0-P47=0, P48-P51=1
- *LED_COMBO[51:0]*: combo LED P0-P47=0, P48-P51=0

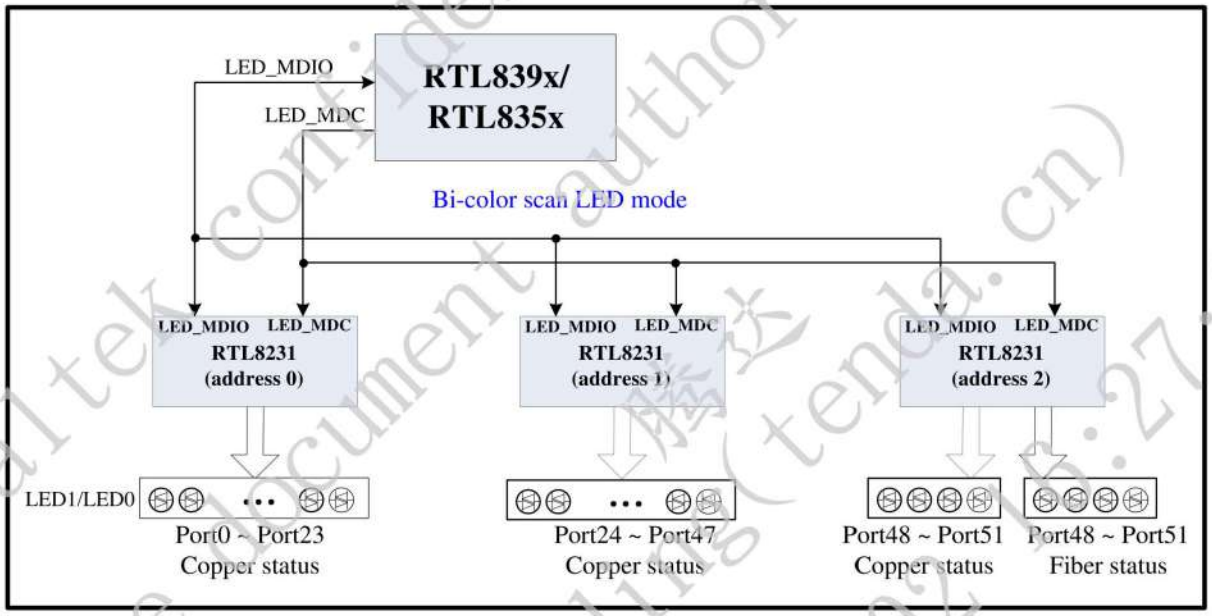

Figure 30. Bi-Color Scan LED Mode & Per Port 2-LED

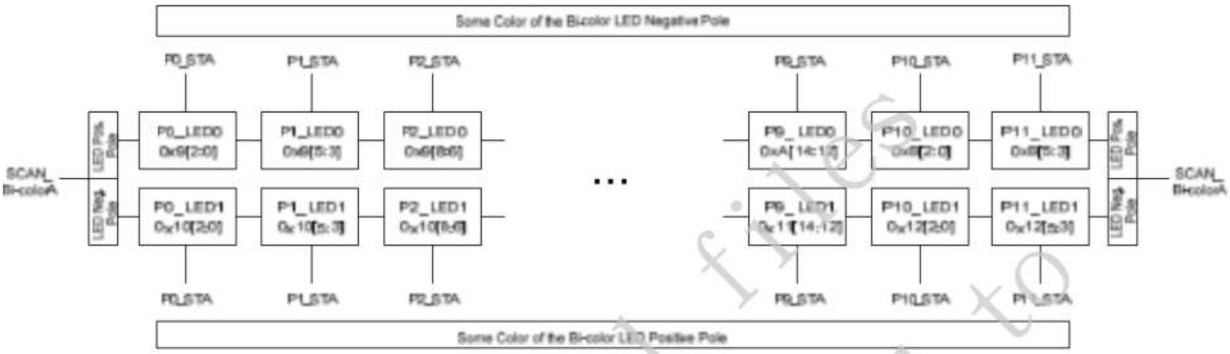

Figure 31. Illustration of RTL8231 (addr=0) in Bi-Color Scan LED Mode & Per Port 2-LED (1)

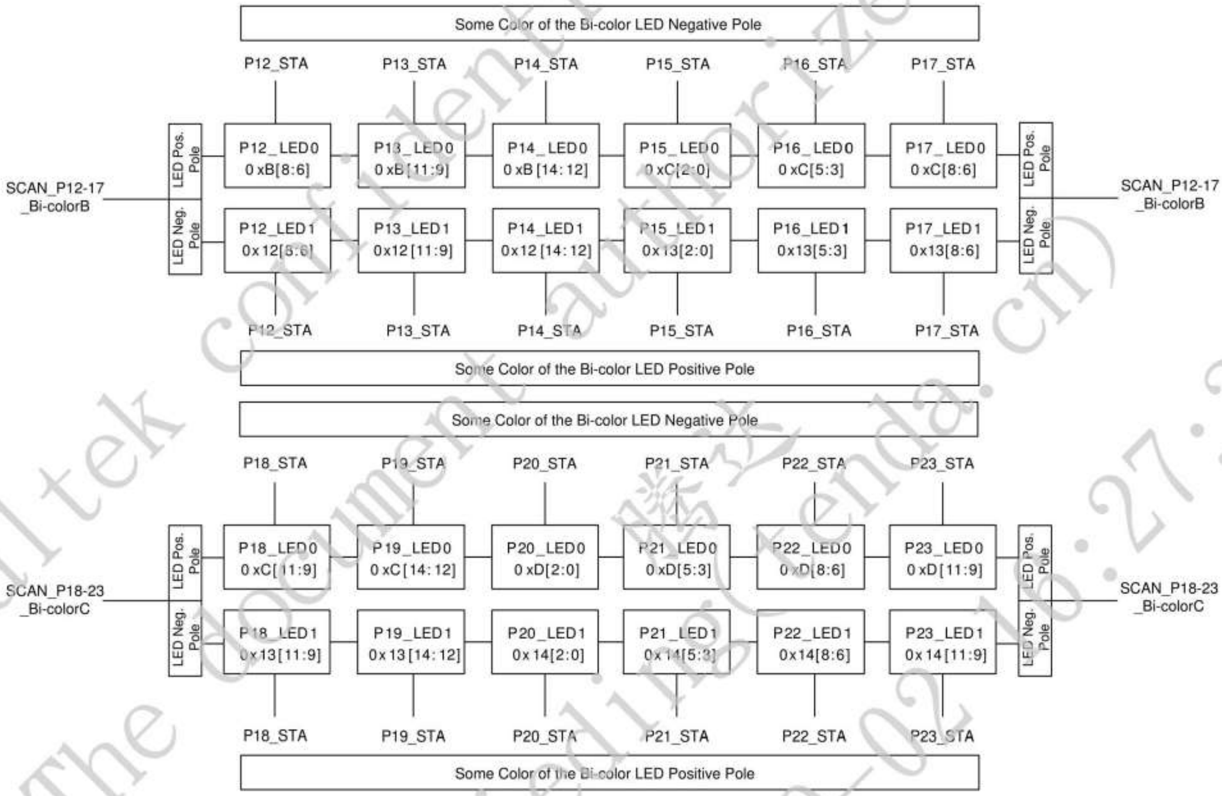

Figure 32. Illustration of RTL8231 (addr=0) in Bi-Color Scan LED Mode & Per Port 2-LED (2)

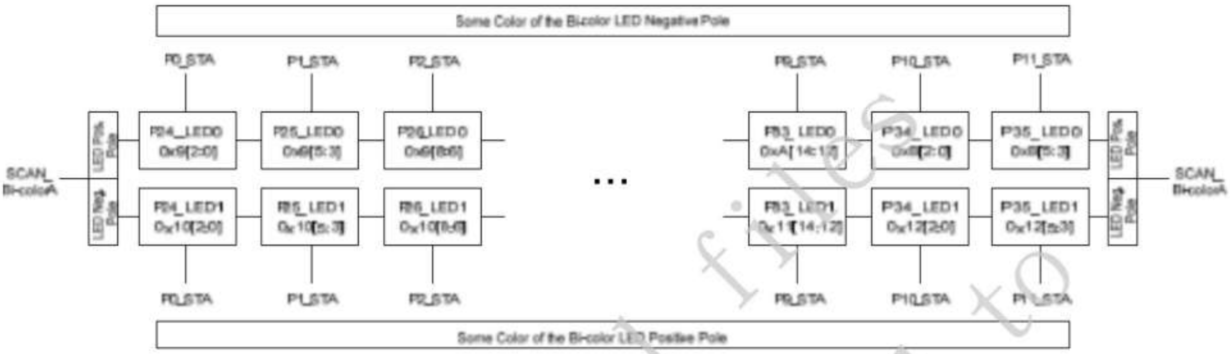

Figure 33. Illustration of RTL8231 (addr=1) in Bi-Color Scan LED Mode & Per Port 2-LED (1)

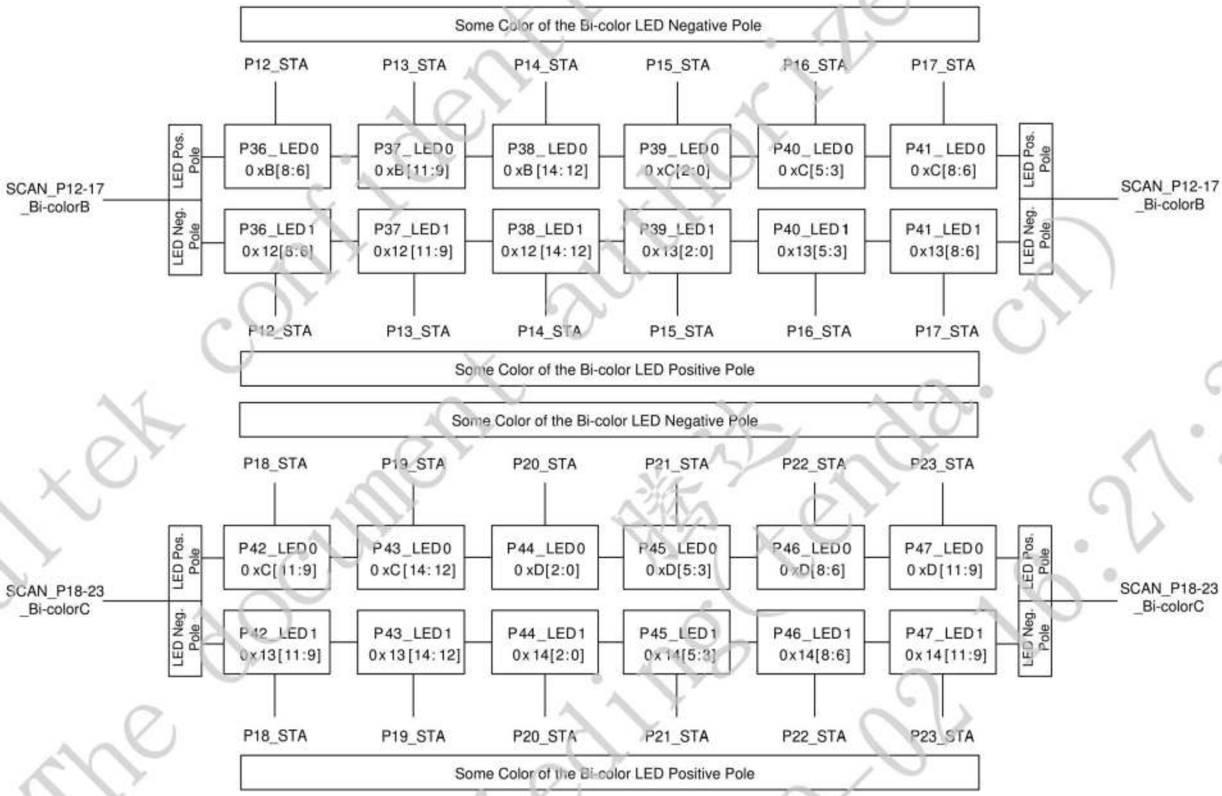

Figure 34. Illustration of RTL8231 (addr=1) in Bi-Color Scan LED Mode & Per Port 2-LED (2)

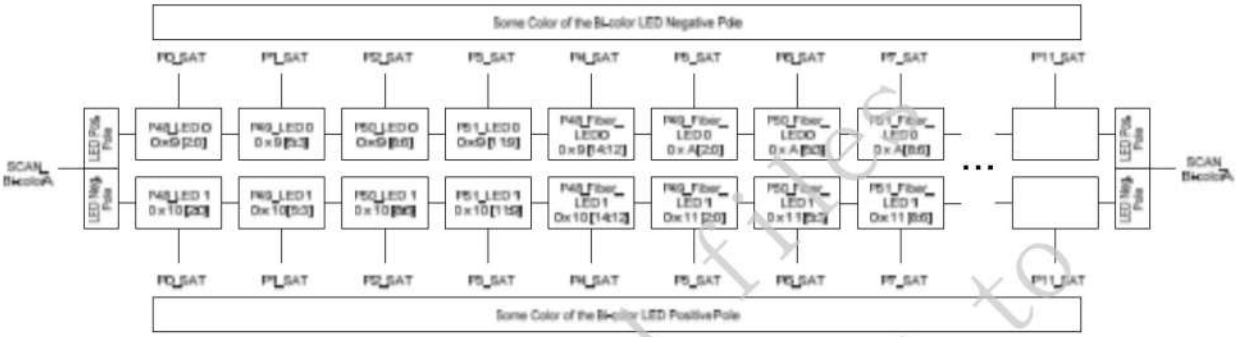

Figure 35. Illustration of RTL8231 (addr=2) in Bi-Color Scan LED Mode & Per Port 2-LED

5.3. Per Port 1-LED Application

- One 48G+4G-combo device with bi-color scan LED mode and per port 1-LED
- RTL839x/RTL835x display Port0-51 copper LED and Port48-51 fiber LED
- Port0-51 Copper status display on Port0-51 copper LED
- Port48-51 fiber status display on Port48-51 fiber LED
- *COPR_PMASK[51:0]*: copper LED P0-P51=1
- *FIB_PMASK[51:0]*: fiber LED P0-P47=0, P48-P51=1
- *LED_COMBO[51:0]*: combo LED P0-P47=0, P48-P51=0

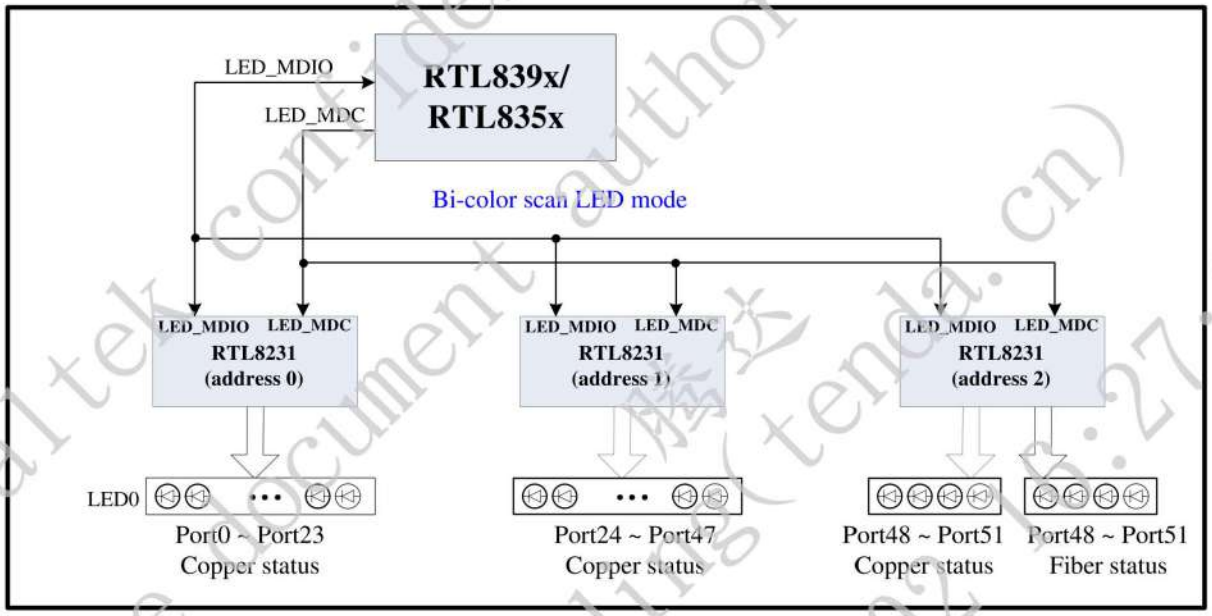

Figure 36. Bi-Color Scan LED Mode & Per Port 1-LED

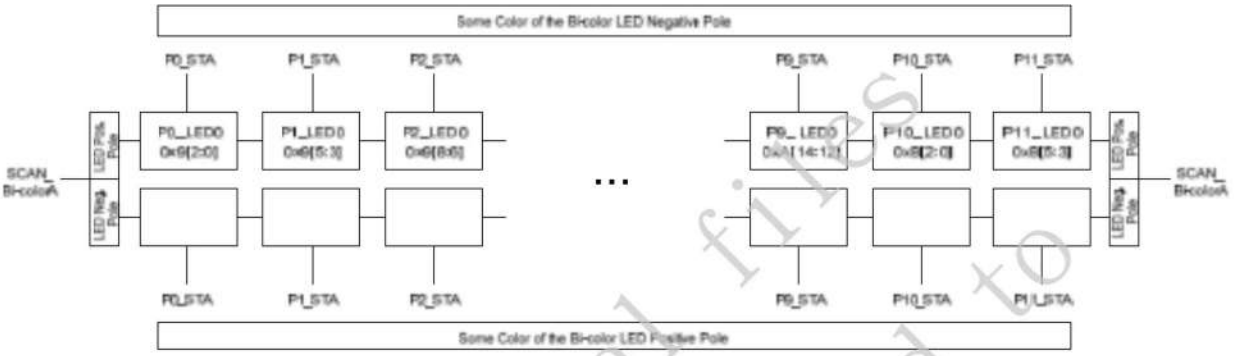

Figure 37. Illustration of RTL8231 (addr=0) in Bi-Color Scan LED Mode & Per Port 1-LED (1)

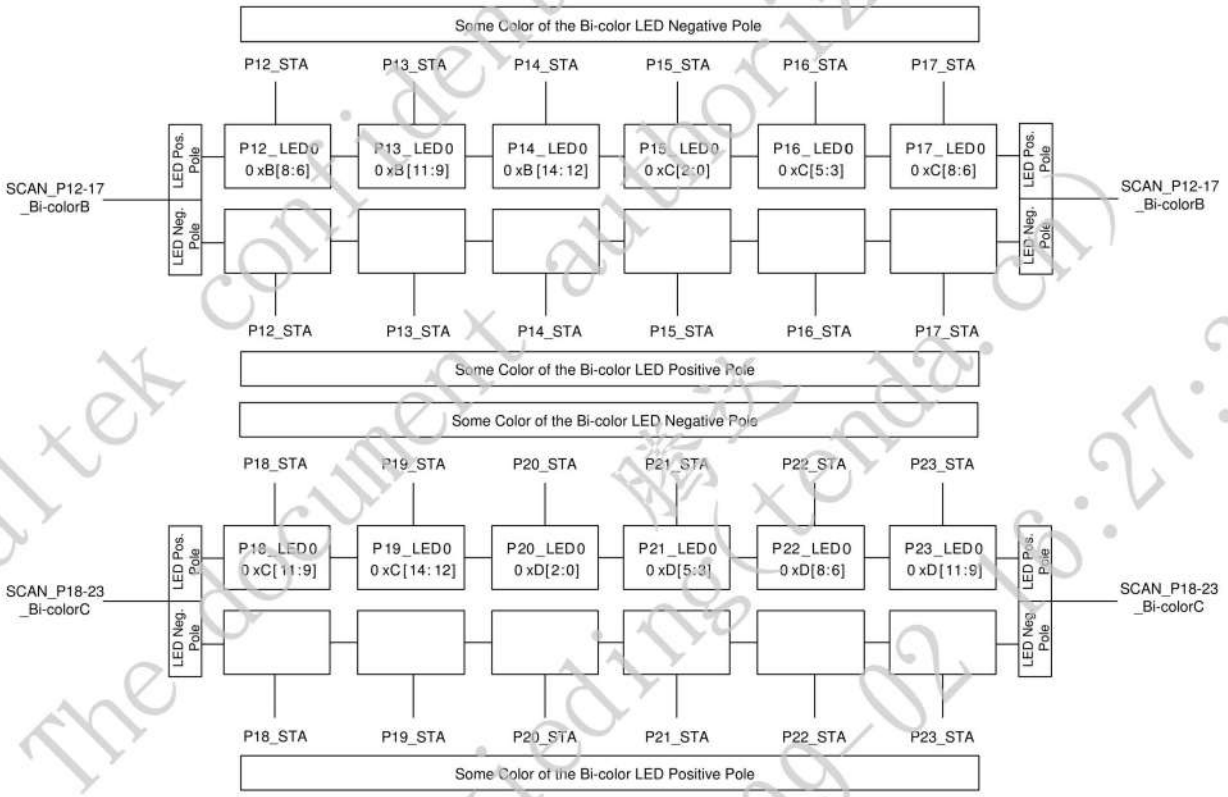

Figure 38. Illustration of RTL8231 (addr=0) in Bi-Color Scan LED Mode & Per Port 1-LED (2)

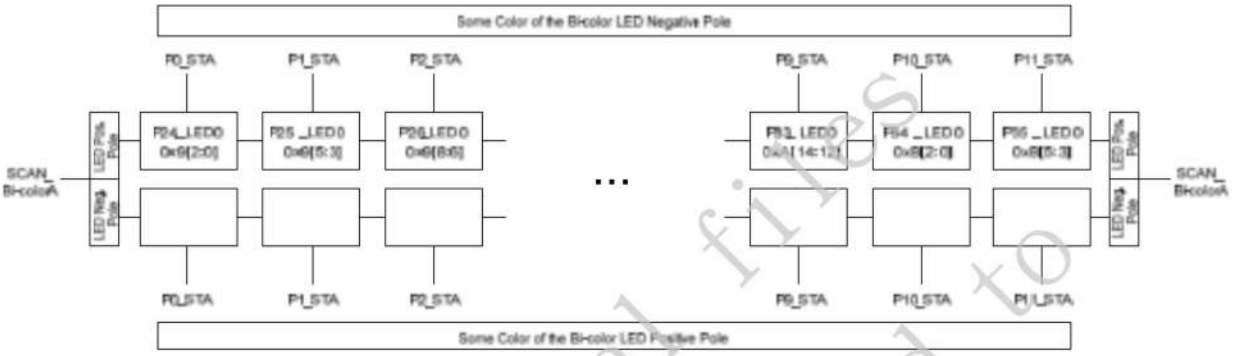

Figure 39. Illustration of RTL8231 (addr=1) in Bi-Color Scan LED Mode & Per Port 1-LED (1)

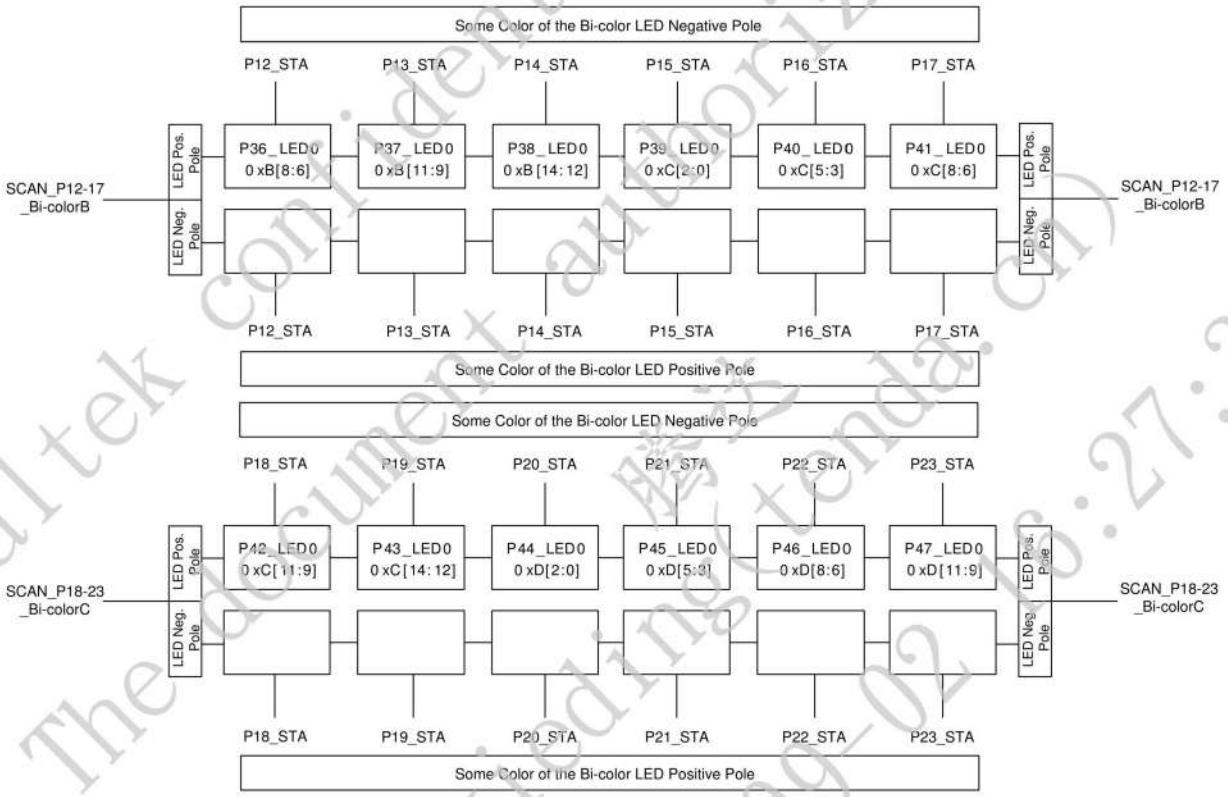

Figure 40. Illustration of RTL8231 (addr=1) in Bi-Color Scan LED Mode & Per Port 1-LED (2)

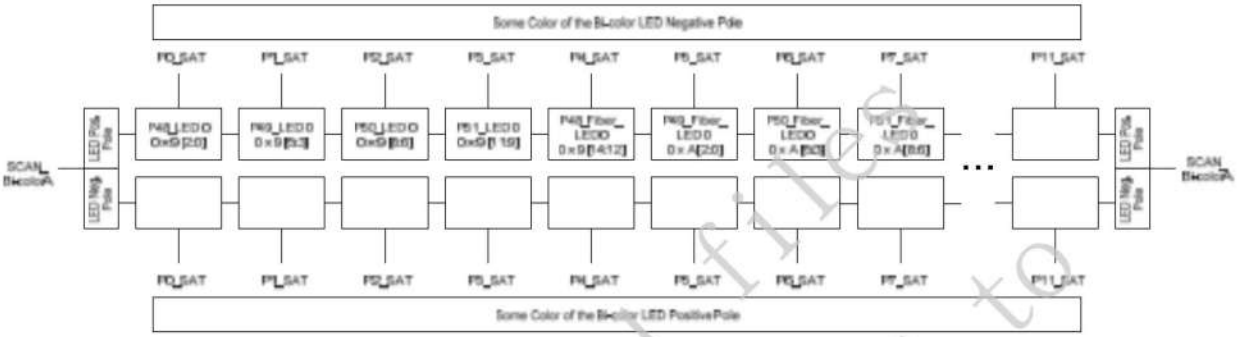

Figure 41. Illustration of RTL8231 (addr=2) in Bi-Color Scan LED Mode & Per Port 1-LED

6. External GPIO

RTL839x/RTL835x supports external GPIO via RTL8231. When RTL839x/RTL835x used RTL8231 to extend GPIO, one RTL8231 supports 37 GPIOs (except for 8 strapping pins). RTL8231's strapping pins only can be GPO function, and these GPO pins must be connected with high impedance device.

Note: RTL8231's 8 strapping pins are GPIO[15]~GPIO[20], GPIO[35], GPIO[36].

6.1. Serial LED with external GPIO

The serial LED mode and external GPIO coexist in the system as following figure:

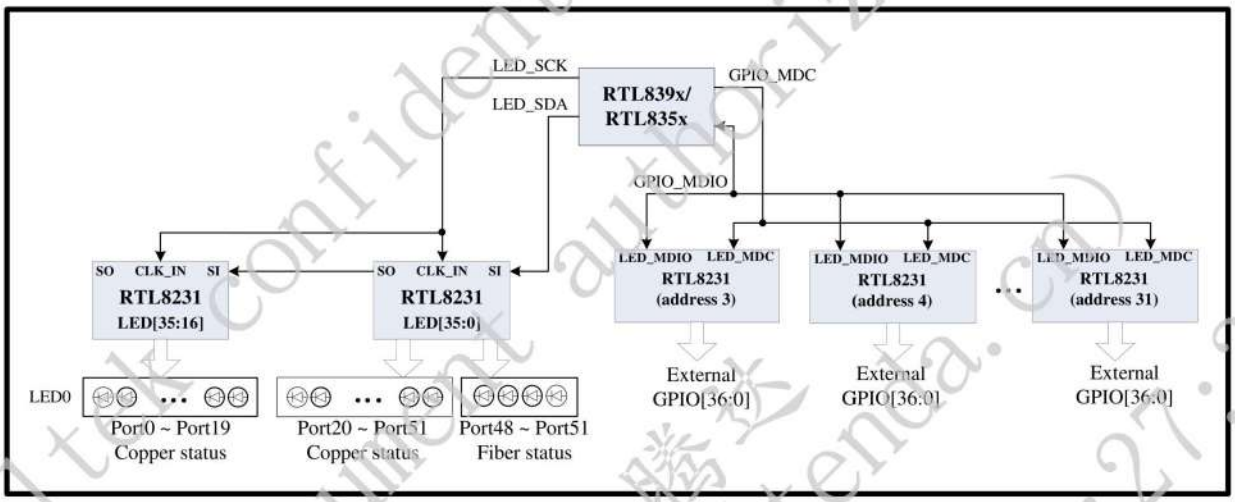

Figure 42. Serial LED Mode and GPIO Coexist in the System

Note:

- *The RTL8231's PHY start address is 3 when* RTL839x/RTL835x *used RTL8231 to extend GPIO*
- *External GPIO[36:0] in RTL8231 with PHY address 3 are mapped to RTL839x/835x's register "EXT_GPIO_DATA[56:20]"*

6.2. Single Color Scan LED with external GPIO

The single color scan LED mode and external GPIO coexist in the system as following figure:

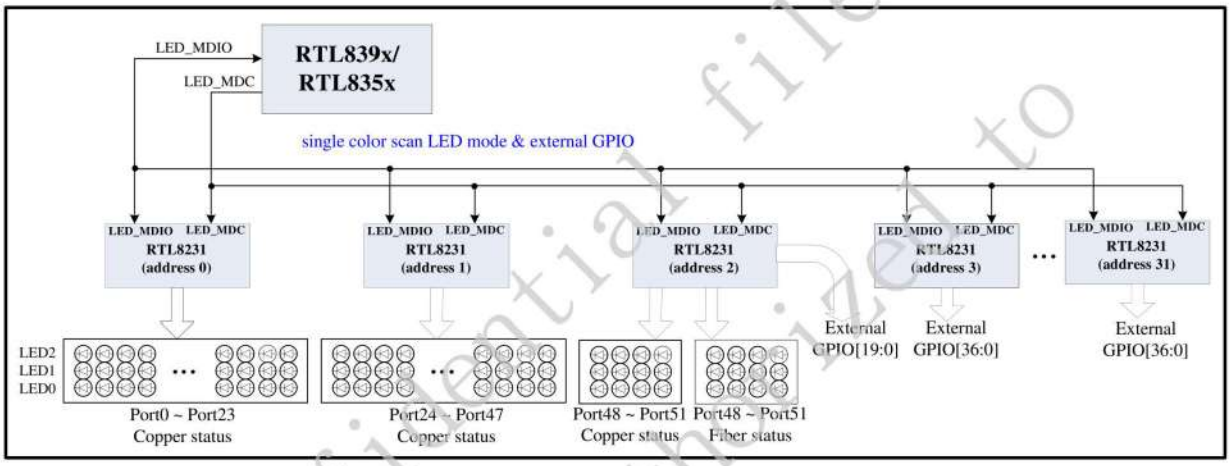

Figure 43. Single Color Scan LED Mode and GPIO Coexist in the System

Note:

- *RTL8231 with PHY address is 0 or 1 can't be external GPIO whether choose per port 3-LED or 2-LED or 1-LED*
- *RTL8231 with PHY address 2 only have 20-GPIOs can be used whether choose per port 3-LED or 2-LED or 1-LED*
- *External GPIO[19:0] are mapped to RTL8231's GPIO[31:12] when RTL8231's PHY address is 2*
- *External GPIO[19:0] in RTL8231 with PHY address 2 are mapped to RTL839x/835x's register "EXT_GPIO_DATA[19:0]"*
- *External GPIO[36:0] in RTL8231 with PHY address 3 are mapped to RTL839x/835x's register "EXT_GPIO_DATA[56:20]"*

6.3. Bi-Color Scan LED with external GPIO

The bi-color scan LED mode and external GPIO coexist in the system as following figure:

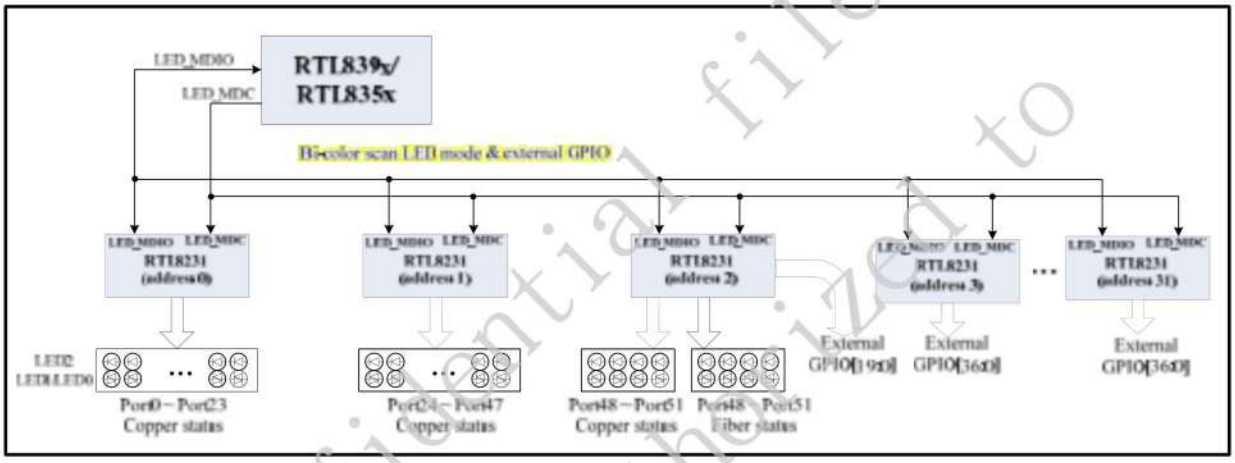

Figure 44. Bi-Color Scan LED Mode and GPIO Coexist in the System

Note:

- *RTL8231 with PHY address is 0 or 1 can't be external GPIO whether choose per port 3-LED or 2-LED or 1-LED*
- *RTL8231 with PHY address 2 only have 20-GPIOs can be used whether choose per port 3-LED or 2-LED or 1-LED*
- *External GPIO[19:0] are mapped to RTL8231's GPIO[36:21] and GPIO[11:8] when RTL8231's PHY address is 2*
- *External GPIO[19:0] in RTL8231 with PHY address 2 are mapped to RTL839x/835x's register "EXT_GPIO_DATA[19:0]"*
- *External GPIO[36:0] in RTL8231 with PHY address 3 are mapped to RTL839x/835x's register "EXT_GPIO_DATA[56:20]"*

7. MISC

7.1. GPIO Combo Pin

GPIO combo pin table as following:

Table 1. GPIO Combo Pin

GPIO #	Option 1	Option 2	GPIO #	Option 1	Option 2
GPIO[0]	System LED		GPIO[12]	1588 output	
GPIO[1]	GPIO_MDC		GPIO[13]	dedicated GPIO	
GPIO[2]	GPIO_MDIO		GPIO[14]	dedicated GPIO	
GPIO[3]	JTAG_TMS	UART1_RTS#	GPIO[15]	dedicated GPIO	
GPIO[4]	JTAG_TCK	UART1_CTS#	GPIO[16]	dedicated GPIO	
GPIO[5]	JTAG_TRST#		GPIO[17]	dedicated GPIO	
GPIO[6]	JTAG_TDI	UART1_RXD	GPIO[18]	dedicated GPIO	
GPIO[7]	JTAG_TDO	UART1_TXD	GPIO[19]	dedicated GPIO	
GPIO[8]	SPI_CS#[2]		GPIO[20]	dedicated GPIO	
GPIO[9]	SPI_CS#[3]		GPIO[21]	dedicated GPIO	
GPIO[10]	SPI_SIO2		GPIO[22]	dedicated GPIO	
GPIO[11]	SPI_SIO3		GPIO[23]	dedicated GPIO	

Note: GPIO[5] can't connect with internal pull high device.

LED Combo Pin table as following:

Table 2. LED Combo Pin

LED Pin	Option
LED_SCK	LED_MDC
LED_SDA	LED_MDIO

7.2. System LED

System LED is implemented to indicate the system booting ready.

When *SYS_LED_EN*=1, after power on, the system LED start to blink until software to write the register SYS_LED_MODE[1:0] to control system LED's behavior.

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

7.3. LED Definition

LED 22-types definition can be set through 4-sets LED control register.

- *SET0_LED0_SEL[4:0]*, *SET0_LED1_SEL[4:0]*, *SET0_LED2_SEL[4:0]*
- *SET1_LED0_SEL[4:0]*, *SET1_LED1_SEL[4:0]*, *SET1_LED2_SEL[4:0]*
- *SET2_LED0_SEL[4:0]*, *SET2_LED1_SEL[4:0]*, *SET2_LED2_SEL[4:0]*
- *SET3_LED0_SEL[4:0]*, *SET3_LED1_SEL[4:0]*, *SET3_LED2_SEL[4:0]*
- *LED_COPR_SET_PSEL[1:0]* to select per port copper LED definition is set0 or set1 or set2 or set3
- *LED_FIB_SET_PSEL[1:0]* to select per port fiber LED definition is set0 or set1 or set2 or set3

Table 3. 22-Types LED Definition

LED[n]_Mode[3:0]	Code	Description
Link/Act	0b00000	Link, Activity Indicator. ON for link established. Blink when the corresponding port is transmitting or receiving.
Link	0b00001	Link Indicator ON for link established.
Act	0b00010	Activity Indicator. Blink for port transmitting or receiving.
RX	0b00011	Receive Status Indicator. Blink for receiving activity.
TX	0b00100	Transmit Status Indicator. Blink for transmission activity
Col/Full Duplex	0b00101	Full duplex and Collision Indicator. ON for full duplex, and OFF for half duplex mode. Blink when the corresponding port is half duplex and collision.
Full Duplex	0b00110	Duplex Status Indicator. ON for indicating full duplex No Blink even in half duplex and collision.
1000M Link	0b00111	1000Mb/s Link Indicator. ON for 1000Mb/s link established.
100M Link	0b01000	100Mb/s Link Indicator. ON for 100Mb/s link established.

10M Link	0b01001	10Mb/s Link Indicator. ON for 10Mb/s link established.
1000M Link /Act	0b01010	1000Mb/s Link, Activity Indicator. ON for 1000Mb/s link established. Blink when the corresponding port is 1000Mb/s transmitting or receiving.
100M Link/Act	0b01011	100Mb/s Link, Activity Indicator. ON for100Mb/s link established. Blink when the corresponding port is 100Mb/s transmitting or receiving.
10M Link/Act	0b01100	10Mb/s Link, Activity Indicator. ON for10Mb/s link established. Blink when the corresponding port is 10Mb/s transmitting or receiving.
1000M/100M Link/Act	0b01101	ON to indicated 1000/100Mb/s Link, Activity. Blink when the corresponding port is 1000/100Mb/s transmitting or receiving. If the port is in 10Mb/s, this signal should keep OFF.
1000M/10M Link/Act	0b01110	ON to indicated 1000/10Mb/s Link, Activity. Blink when the corresponding port is 1000/10Mb/s transmitting or receiving. If the port is in 100Mb/s, this signal should keep OFF.
100M/10M Link/Act	0b01111	ON to indicate 100/10Mb/s Link, Activity. Blink when the corresponding port is 100/10Mb/s transmitting or receiving. If the port is in 1000Mb/s, this signal should keep OFF.
10M Link Flashing	0b10000	10Mb/s link Indicator. Blink for port link in 10Mb/s.
100M Link Flashing	0b10001	100Mb/s link Indicator. Blink for port link in 100Mb/s.
1000M Link Flashing	0b10010	1000Mb/s link Indicator. Blink for port link in 1000Mb/s.
10G Link Flashing	0b10011	10Gb/s link Indicator. Blink for port link in 10Gb/s.
10G Link	0b10100	10Gb/s Link Indicator. ON for 10Gb/s link established.
10G Link/Act	0b10101	10Gb/s Link, Activity Indicator. ON for 10Gb/s link established. Blink when the corresponding port is 10Gb/s transmitting or receiving.

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