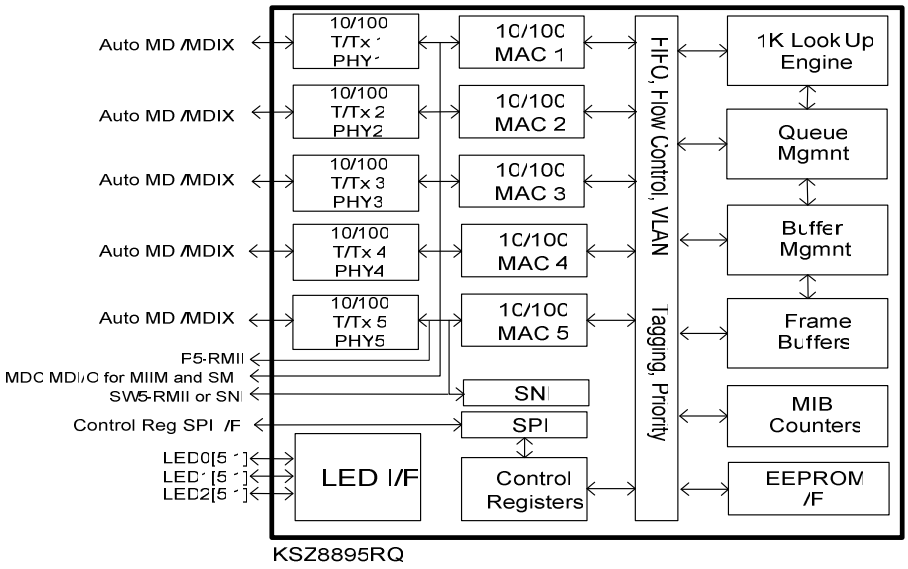
Application Note

RMII Connections for KSZ8895RQ and KSZ8864RMN Rev1.0

Introduction

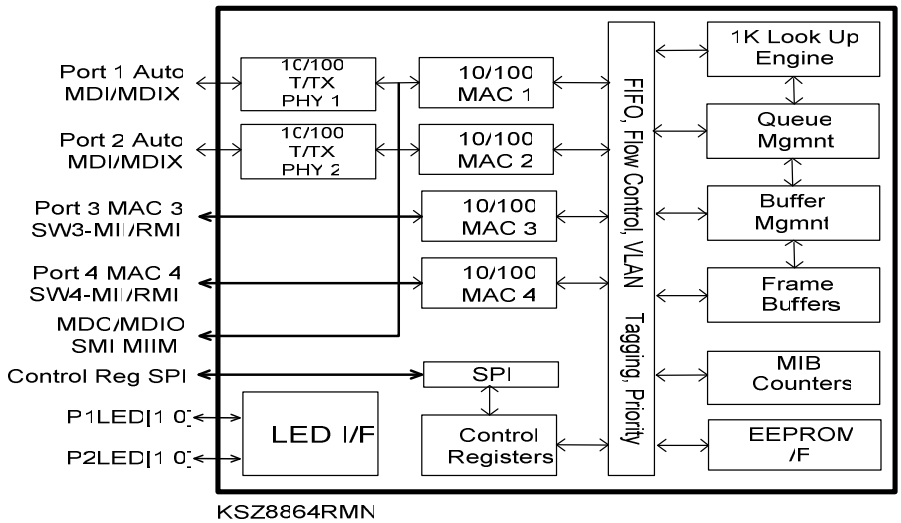
The KSZ8895RQ is a highly integrated Layer 2 managed 5-port standalone switch, Port 5 can be configured as a separate MAC5 with SW5-RMII interface and PHY5 with P5-RMII interface. SW5 means at the switch side, P5 means at port 5 PHY5 side (see diagram below). KSZ8864RMN is a highly integrated Layer 2 managed 4-port switch, the Port 3 and port 4 of the KSZ8864RMN support either MII or RMII interfaces with MAC3 SW3-MII/RMII and MAC4 SW4-MII/RMII (see diagram below). In this app note, we describe RMII interface connections in the different modes and applications for both devices.

Block Diagram of the KSZ8895RQ



KSZ8895RQ

Block Diagram of the KSZ8864RMN



KSZ8864RMN

RMII Connections for KSZ8895RQ

Terminology in KSZ8895RQ RMII used

- Clock mode: In RMII with clock mode, the KSZ8895RQ provide 50MHz RMII reference clock out from SMRXC pin and PMRXC pin, those 50MHz clock signal can be routed back to SMTXC/SMREFCLK pin and PMTXC/PMREFCLK pin, and then go to the reference clock pin of the opposite RMII, the device's clock source comes from X1 pin 25MHz crystal or oscillator (default mode).
- Normal mode: Normally, RMII interface receive 50MHz clock from external. When the KSZ8895RQ RMII interface is used in the normal mode, SMTXC will receive the 50MHz RMII reference clock from an external 50MHz clock, the KSZ8895RQ's clock source comes from SMTXC pin not X1 pin of 25MHz crytsal or oscillator, the X1 pin clock will be ingnored. In the normal mode, the PMRXC can output 50MHz clock to PMTXC/PMREFCLK pin and output to opposite RMII reference clock pin.

Strap-in Pin for Clock Mode or Normal Mode in RMII used

- Clock mode: LED2-2 is pull-up (default internal pull-up). The KSZ8895RQ's clock source comes from X1 pin 25MHz crystal or oscillator.
- Normal mode: LED2-2 is pull-down. The KSZ8895RQ's clock source comes from SMTXC pin with external 50MHz reference RMII clock.

Configuration for SW5-RMII and P5-RMII

- SW5-RMII: Port 5 MAC5 RMII is SW5-RMII. Pull up either SCONF1 pin 86 = '1' or SCONF0 pin 87 = '1', the SW5-RMII will be actived.
- P5-RMII: Port 5 PHY5 RMII is P5-RMII. Pull up either SCONF1 pin 86 = '1' or SCONF0 pin 87 = '1' when pin 91 is pull-up (default), the P5-RMII will be actived. At this time, the PHY5 is a single PHY with RMII interface.

Connection Signals for Port 5 MAC 5 SW5-RMII

KSZ8895RQ SW5-RMII MAC to MAC Connection ('PHY mode')				**KSZ8895RQ SW5-RMII MAC to PHY Connection ('MAC mode')**		
Respect to MAC	**SW5-RMII**	**Signal Type**	**Description**	**Respect to PHY**	**SW5-RMII**	**Signal Type**
REF_CLK	SMRXC	Output (clock mode with 50MHz) (Normal mode without connection)	Reference Clock	--------	SMTXC/SMREFCLK	Input (clock comes from SMRXC in clock mode or external clock in normal mode)
CRS_DV	SMRXDV /SMCRSDV	Output	Carier sense/Receive data valid	CRS_DV	SMTXEN	Input
RXD1	SMRXD[1]	Output	Receive data bit 1	RXD1	SMTXD[1]	Input
RXD0	SMRXD[0]	Output	Receive data bit 0	RXD0	SMTXD[0]	Input
TX_EN	SMTXEN	Input	Transmit data enable	TX_EN	SMRXDV /SMCRSDV	Output
TXD1	SMTXD[1]	Input	Transmit data bit 1	TXD1	SMRXD[1]	Output
TXD0	SMTXD[0]	Input	Transmit data bit 0	TXD0	SMRXD[0]	Output
(not used)	(not used)		Receive error	(not used)	(not used)	
---	SMTXC/SMREFCLK	Input (clock comes from SMRXC in clock mode or external clock in normal mode)	Reference Clock	REF_CLK	SMRXC	Output (clock mode with 50MHz) (Normal mode without connection)

Examples of RMII Connection for SW5-RMII, P5-RMII and External MAC/PHY

The KSZ8895RQ supports 50MHz RMII reference clock on its RXC pin at clock mode (default by the strap-in pin LED2_2). The feature will save an external 50MHz oscillator or 50MHz clock source, some connections are shown as followed:

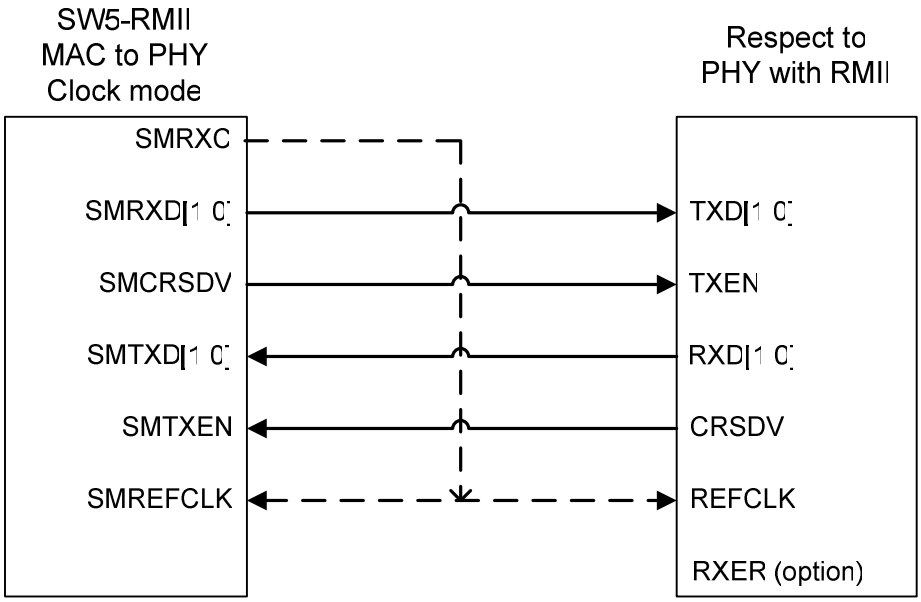


Figure 1. SW5-RMII MAC mode to an external PHY with RMII

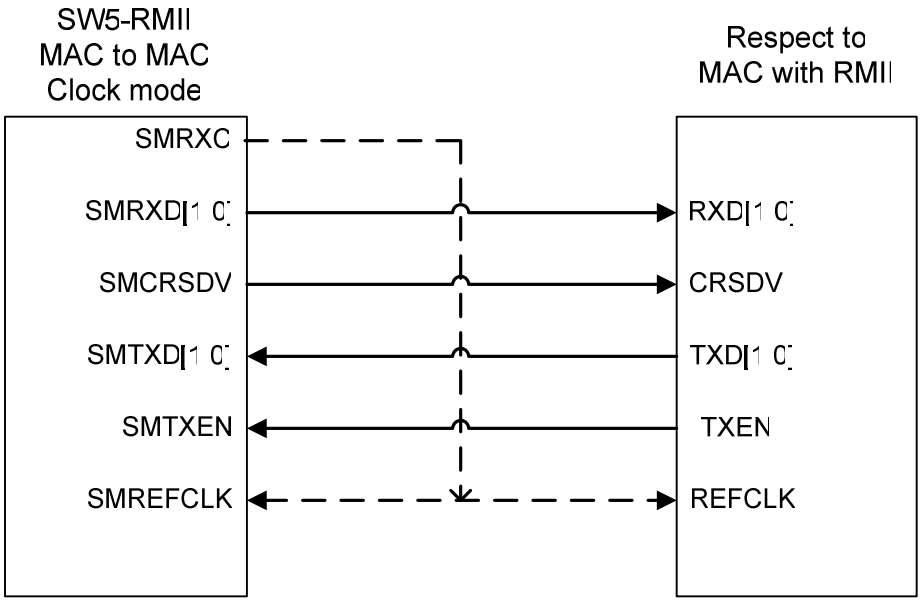


Figure 2. SW5-RMII with clock mode to an external MAC with RMII

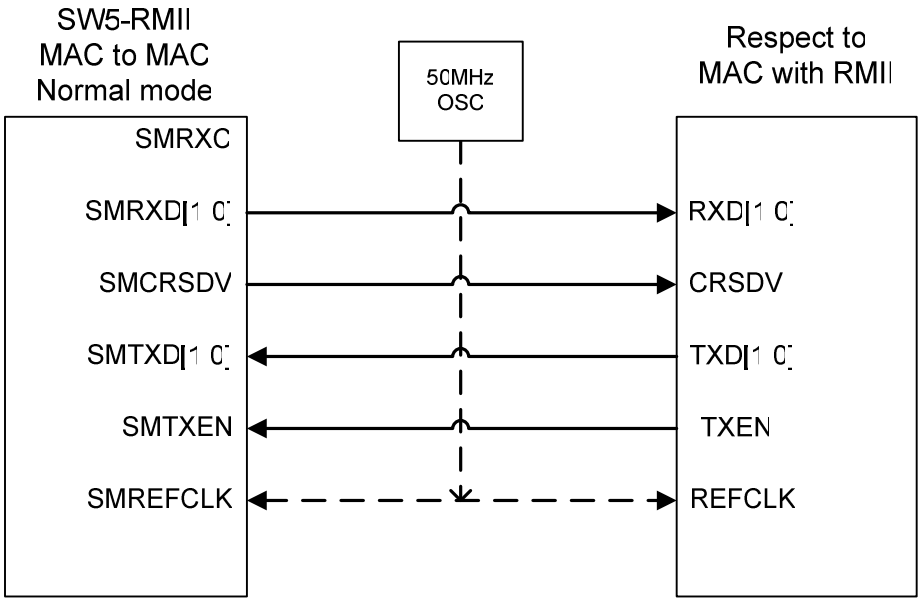


Figure 3. SW5-RMII with normal mode to an external MAC with RMII

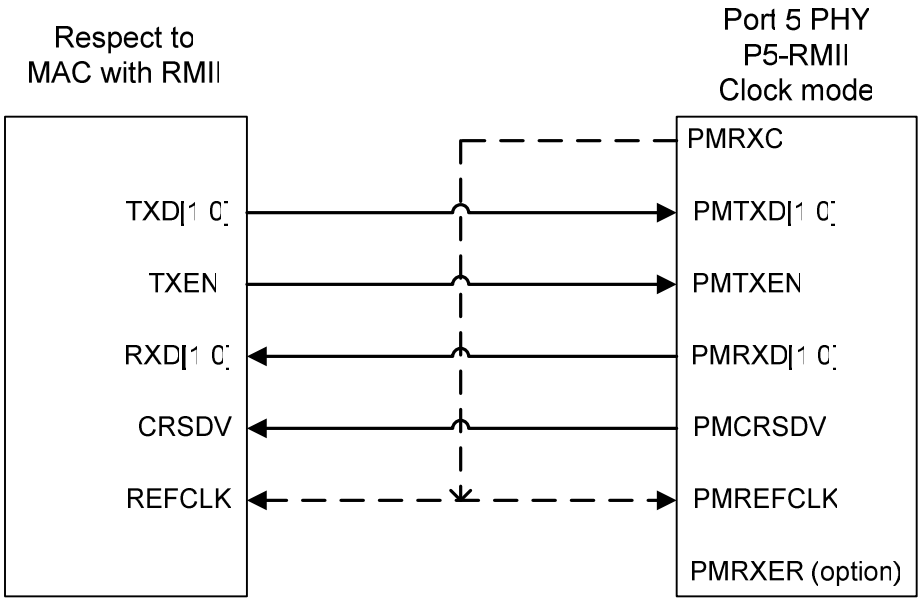


Figure 4. An external MAC with RMII to P5-RMII PHY with clock mode

An external 50MHz oscillator also can be used to provide the 50MHz reference clock to REFCLK pins of both sides. When use an external 50MHz clock source as RMII reference clock, the KSZ8895RQ should be set to normal mode by pull-down LED2_2 strap-in pin first before power up reset or worm reset. The normal mode of KSZ8895RQ device will be start to work when get the 50MHz reference clock on SMTXC/REFCLK pin from an external oscillator or opposite RMII device.

RMII Connections for KSZ8864RMN

Terminology in KSZ8864RMN RMII used

- Clock mode: In RMII with clock mode, the KSZ8864RMN provide 50MHz RMII reference clock out from SM3RXC pin and SM4RXC pin, those 50MHz clock signal can be routed back to SM3TXC/SM3REFCLK pin and SM4TXC/SM4REFCLK pin individually, and then go to the reference clock pin of the opposite RMII, the device's clock source comes from X1 pin 25MHz crystal or oscillator (default mode).
- Normal mode: Normally, RMII interface receive 50MHz clock from external. When the KSZ8864RMN RMII interface is used in the normal mode, SM4TXC will receive the 50MHz RMII reference clock from an external 50MHz clock source, the KSZ8864RMN's clock source comes from SM4TXC pin not X1 pin of 25MHz crytsal or oscillator, the X1 pin clock will be ingnored. In the normal mode, the SM3RXC can output 50MHz clock to SM3TXC/SM3REFCLK pin by routing-back and output to opposite RMII reference clock pin.

Strap-in Pin for Clock Mode or Normal Mode in RMII used

- Clock mode: P1LED1 is pull-up (default internal pull-up). The KSZ8895RQ's clock source comes from X1 pin 25MHz crystal or oscillator.
- Normal mode: P1LED1 is pull-down. The KSZ8895RQ's clock source comes from SM4TXC pin with external 50MHz reference RMII clock.

Configuration for SW3-RMII and SW4-RMII

- SW3-RMII: Port 3 MAC3 RMII is SW3-RMII. Pull down the strap pin P2LED0, the SW3-RMII will be actived.
- SW4-RMII: Port 4 MAC4 RMII is SW4-RMII. Pull down the strap pin P1LED0, the SW4-RMII will be actived.

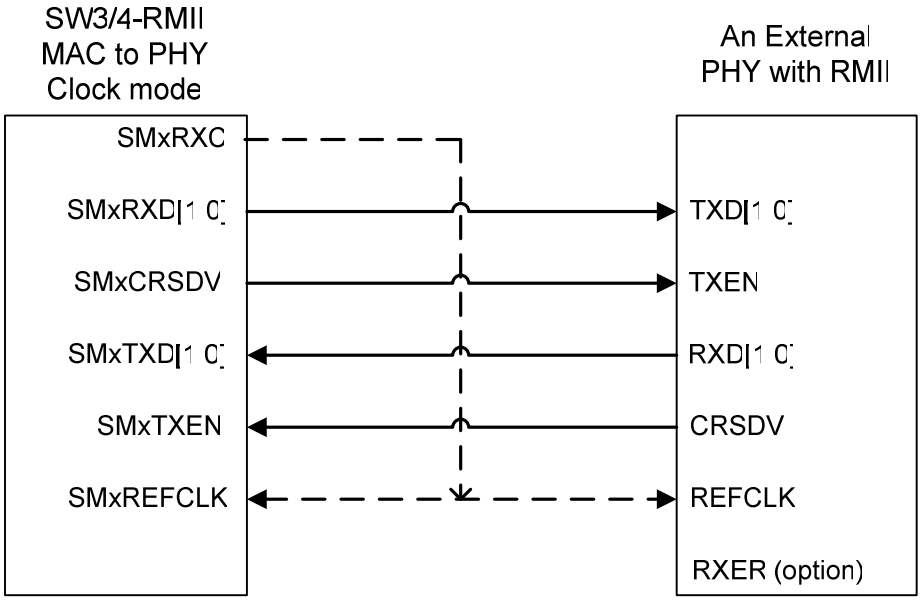
Connection Signals for RMII interface of port 3 and port 4

SW3/4-RMII MAC to MAC Connection ('PHY' mode)				SW3/4-RMII MAC to PHY Connection ('MAC' mode)		
Respect to MAC	**KSZ8864RMN Signal**	**Signal Type**	**Description**	**Respect to PHY**	**KSZ8864RMN Signal**	**Signal Type**
REF_CLK	SMxRXC	Output (clock mode with 50MHz)	Reference Clock	--------	SMxTXC/ SMxREFCLK	Input (clock comes from SMxRXC in clock mode or external 50MHz clock)
CRS_DV	SMxRXDV /SMxCRSDV	Output	Carier sense/Receive data valid	CRS_DV	SMxTXEN	Input
RXD1	SMxRXD[1]	Output	Receive data bit 1	RXD1	SMxTXD[1]	Input
RXD0	SMxRXD[0]	Output	Receive data bit 0	RXD0	SMxTXD[0]	Input
TX_EN	SMxTXEN	Input	Transmit data enable	TX_EN	SMxRXDV /SMxCRSDV	Output
TXD1	SMxTXD[1]	Input	Transmit data bit 1	TXD1	SMxRXD[1]	Output
TXD0	SMxTXD[0]	Input	Transmit data bit 0	TXD0	SMxRXD[0]	Output
(not used)	(not used)		Receive error	(not used)	(not used)	
---	SMxTXC/ SMxREFCLK	Input (clock comes from SMxRXC in clock mode or external 50MHz clock)	Reference Clock	REF_CLK	SMxRXC	Output (clock mode with 50MHz)

Note:

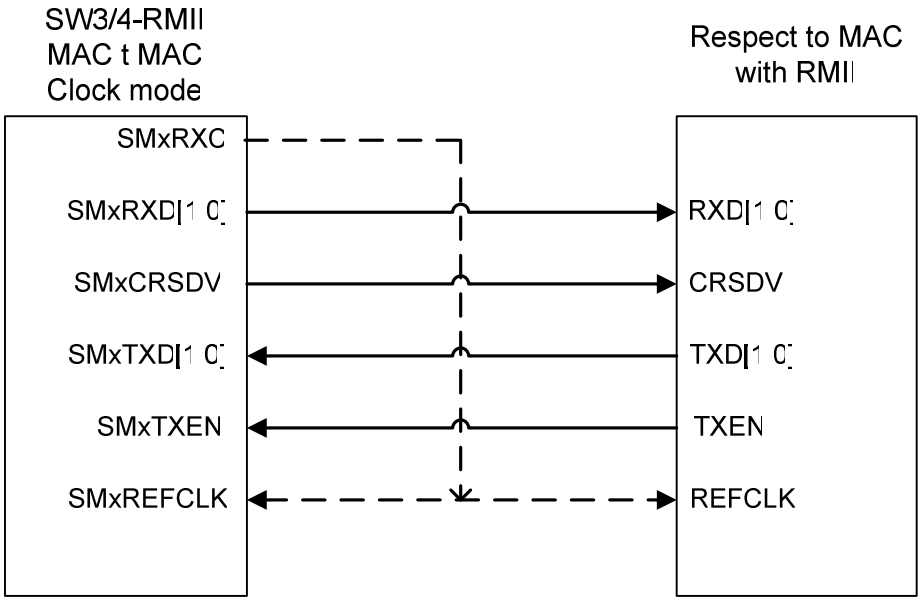
1. 'x' is 3 or 4 for SW3 or SW4 in the table.
2. 'MAC/PHY' mode in RMII is difference with MAC/PHY mode in MII, there is no strap pin and register configuration request in RMII, just follow the signals connection in the table.

Examples of RMII Connection for SW3/4-RMII and External MAC/PHY



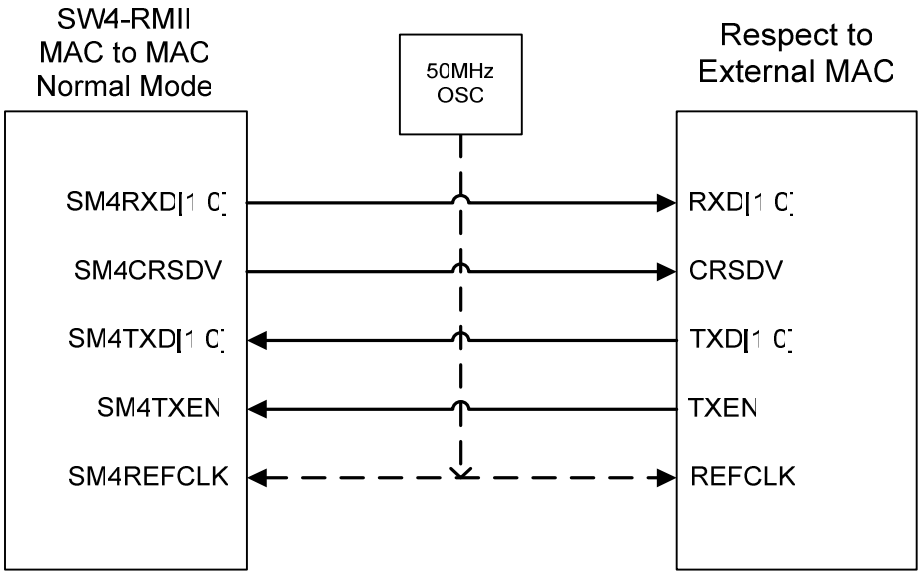
Port 3 SW3-RMII		Port 4 SW4-RMII	
Strap Pins	1=PU(default), 0=PD	Strap Pins	1=PU(default), 0=PD
P2LED0	0	P1LED0	0
P1LED1	1	P1LED1	1

Figure 5. SW3/4-RMII MAC mode to an external PHY with RMII



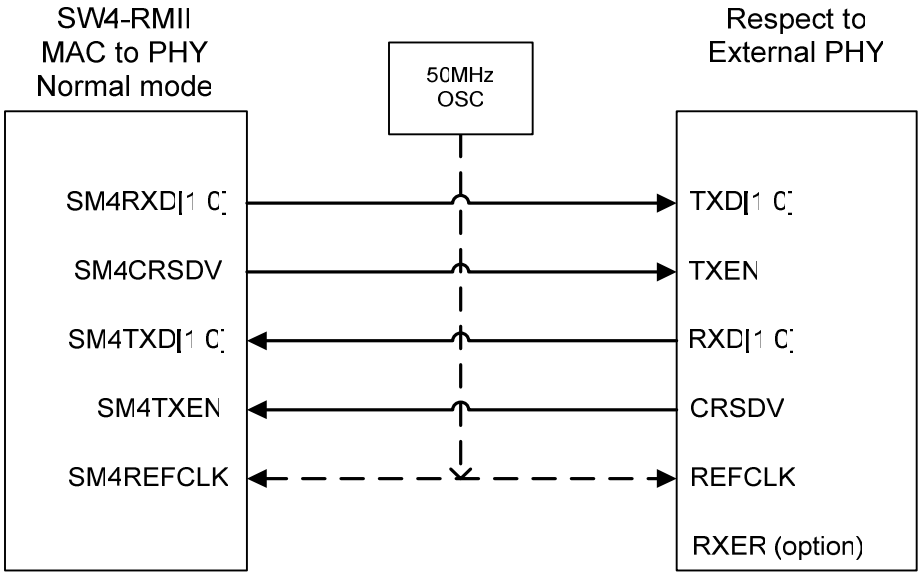
Port 3 SW3-RMII		Port 4 SW4-RMII	
Strap Pins	1=PU(default), 0=PD	Strap Pins	1=PU(default), 0=PD
P2LED0	0	P1LED0	0
P1LED1	1	P1LED1	1

Figure 6. SW3/4-RMII MAC mode to an external PHY with RMII



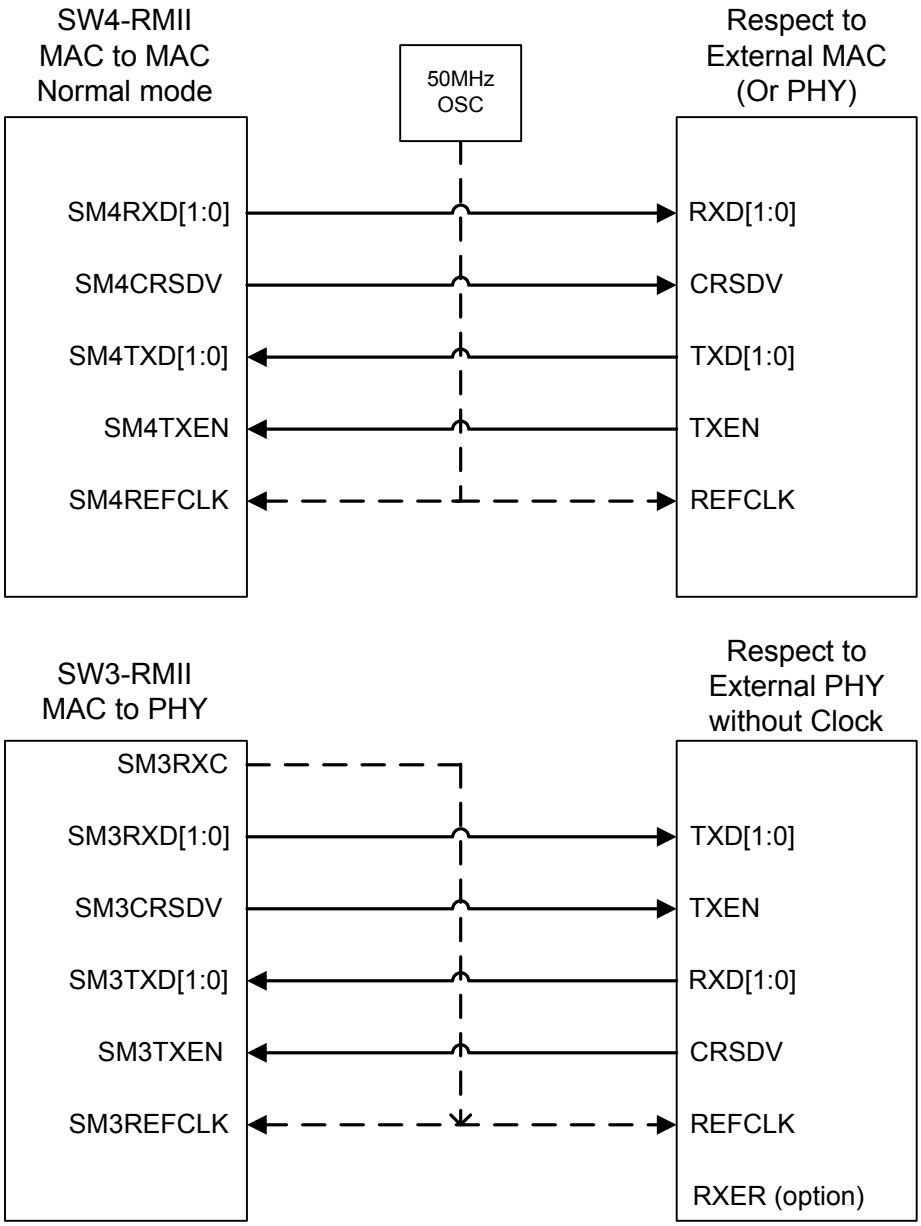
Port 4 SW4-RMII	
Strap Pins	1=PU(default), 0=PD
P1LED0	0
P1LED1	0

Figure 7. SW4-RMII MAC4 with normal mode to External MAC RMII



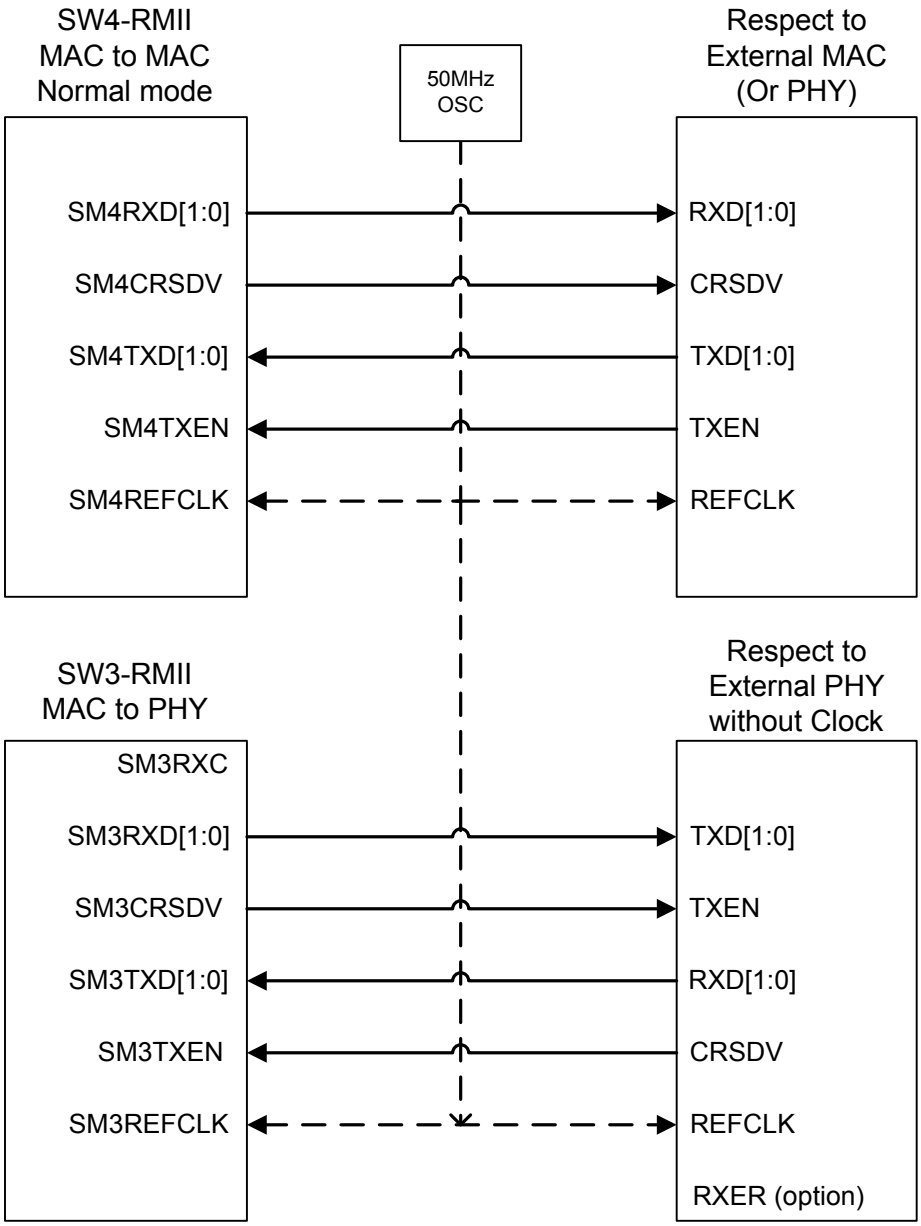
Port 4 SW4-RMII	
Strap Pins	1=PU(default), 0=PD
P1LED0	0
P1LED1	0

Figure 8. SW4-RMII to External PHY RMII with External 50MHz Clock



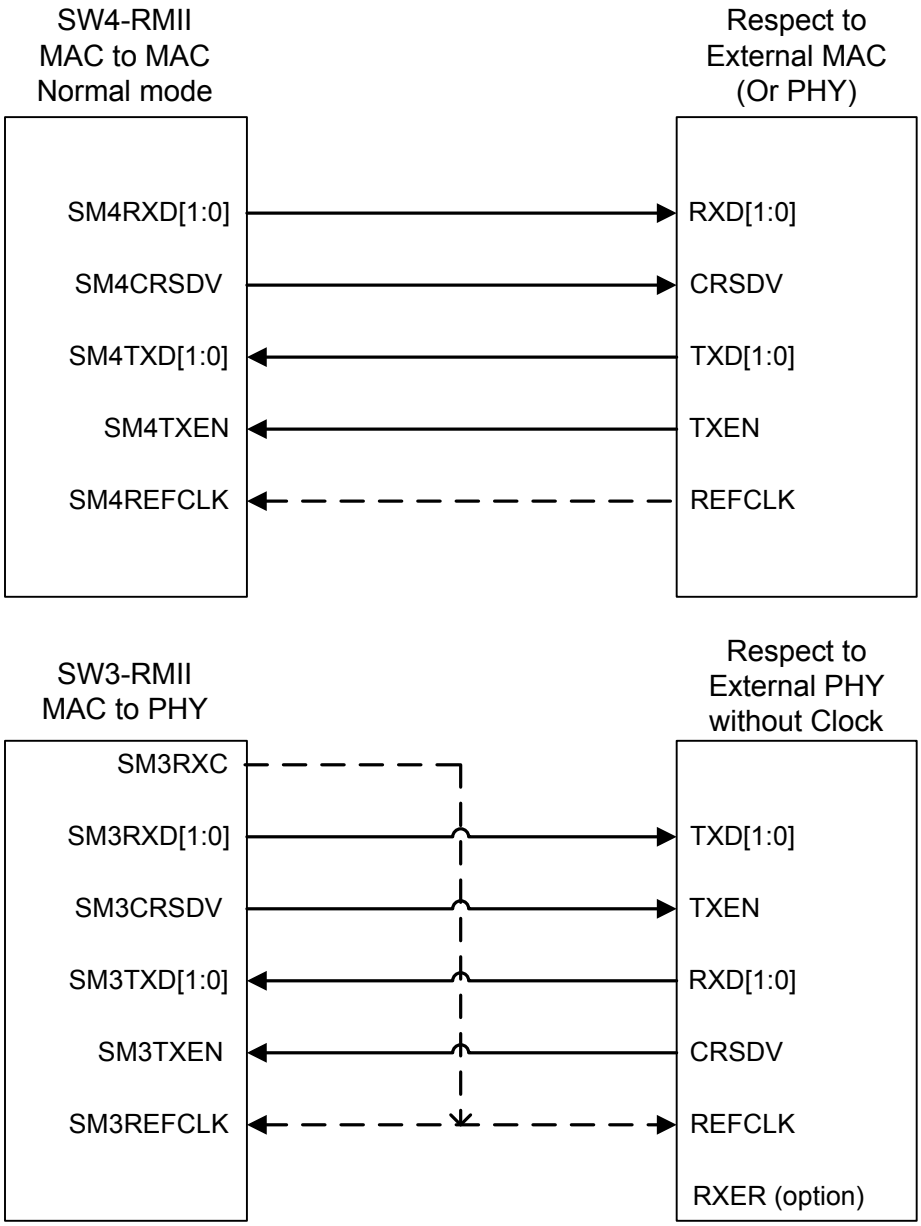
Port 4 SW4-RMII		Port 3 SW3-RMII	
Strap Pins	1=PU(default), 0=PD	Strap Pins	1=PU(default), 0=PD
P1LED0	0	P2LED0	0
P1LED1	0	P1LED1	0

Figure 9. SW4-RMII Receive Clock with Normal Mode and SW3-RMII Provide Clock for dual RMII Used



Port 4 SW4-RMII		Port 3 SW3-RMII	
Strap Pins	1=PU(default), 0=PD	Strap Pins	1=PU(default), 0=PD
P1LED0	0	P2LED0	0
P1LED1	0	P1LED1	0

Figure 10. Use one oscillator provide 50MHz clock to SW4-RMII and SW3-RMII



Port 4 SW4-RMII		Port 3 SW3-RMII	
Strap Pins	1=PU(default), 0=PD	Strap Pins	1=PU(default), 0=PD
P1LED0	0	P2LED0	0
P1LED1	0	P1LED1	0

Figure 11. 50MHz clock source comes from one device with RMII for SW4-RMII and SW3-RMII

SW3-RMII support to provide 50MHz RMII reference clock or reveive 50MHz clock when the clock source is same as SW4-RMII like Figure 10.

SW4-RMII support to provide 50MHz RMII reference clock with clock mode, and also can accept 50MHz RMII clock with normal mode by the strap pin P1LED1 to low.

In Figure 9 and Figure 11, SW4-RMII receive external 50MHz clock with normal mode and can provide 50MHz RMII reference clock to SW3-RMII and opposite RMII. In this kind of application, the register 11 bit [7] and bit 6

can be used to adjust the reference clock sampling adge for best data transfer on dual RMII interfaces.

The bit [6] of the register 12 Global Control 10 can monitor the status for the clock mode or normal mode of the device.

Conclusion

By the above describes for the KSZ8995RQ and the KSZ8864RMN, we have known KSZ8995RQ supports one MAC RMII (SW5-RMII) and on single PHY RMII (P5-MII) data interface, the KSZ8864RMN supports two MAC RMII (SW3-RMII and SW4-RMII). They can be used flexible in RMII connection for data transfer between microprocessors to Ethernet switch MAC layer. The reduced pin count MII interface and dual RMII MAC interfaces can be used widely in current new products and your Ethernet applications. For the detail device information, please see their datasheets in www.micrel.com

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