Application Note
Ethernet PHY Fiber Debug Guide

TEXAS INSTRUMENTS

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ABSTRACT

Fiber transmission, otherwise known as 1000BASE-X or 100BASE-FX depending on speed, is a type of communication interface that connects between two Ethernet PHYs. As opposed to traditional copper communication, fiber transmission has advantages such as faster linkup times as well as less signal integrity issues that can otherwise come from a long copper wire.

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1 What is Fiber?

Fiber is a type of communication interface that is supported on DP83822 and DP83869. While DP83869HM has a single variant, DP83822 supports fiber in the -IF and -HF variants.

1.1 Pins Used

For each device, there are fives pins used for fiber communication. However, as best practice, make sure that the PHY is bootstrapped into the respective modes for fiber operation.

Table 1-1. DP83822 Fiber Pins

Pin Name (Number)	Functionality
TD_P (12)	Transmitting Pins. Output of the PHY.
TD_M (11)	
RD_P (10)	Receiving Pins. Input of the PHY.
RD_M (9)	
LED_1/GPIO1 (24)	Signal Detect. Typically connected to SFP module which helps determine if communication has been interrupted and relays to PHY to drop link. Use other LED pins for appropriate functionalities

Table 1-2. DP83822 Fiber Bootstrapping

Pin Name (Number)	Strap Mode	Description
COL (29)	2 or 3	Enables FX_EN
LED_0 (17)	1	Half Duplex
	4 (Default)	Full Duplex
RX_ER (28)	3 or 4 (Default)	Signal Detect Enable

Table 1-3. DP83869 Fiber Pins

Pin Name (Number)	Functionality
SOP (15)	Transmitting Pins. Output of the PHY.
SON (14)	
SIP (16)	Receiving Pins. Input of the PHY.
SIN (17)	
JTAG_TDI/SD (24)	Signal Detect. Typically connected to SFP module which helps determine if communication has been interrupted and relays to PHY to drop link.

Table 1-4. DP83869 Fiber Bootstrapping

Pin Name (Number)	Strap Name	OPMODE[2]	OPMODE[1]	OPMODE[0]	Functional Mode
RX_D2 (35)	OPMODE[2]	0	0	1	RGMII to 1000BASE-X
RX_D3 (36)	OPMODE[1]	0	1	0	RGMII to 100BASE-FX
JTAG_TDO/GPIO_1 (22)	OPMODE[0]	1	0	0	Media Convertor (1000BASE-T to 1000BASE-X): 1000Mbps
		1	0	1	Media Convertor (100BASE-Tx to 100BASE-Fx): 100Mbps

1.2 Hardware Configurations

The following are configurations for connections between the PHY and fiber module. Between fiber modules, there are typically two cables; one for transmitting, and one for receiving. A cable needs to be connected between one module's transmit port and another module's receive port.
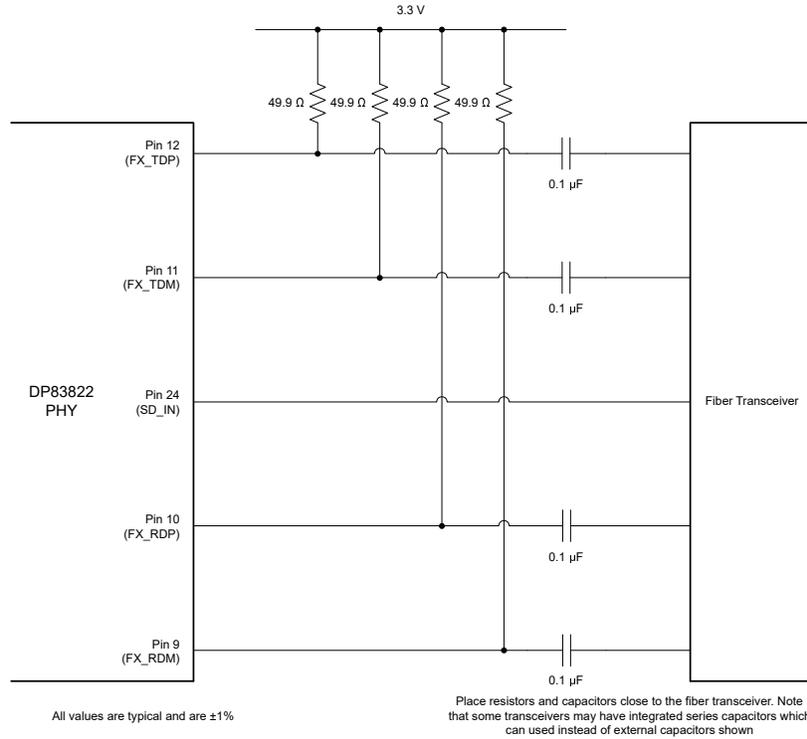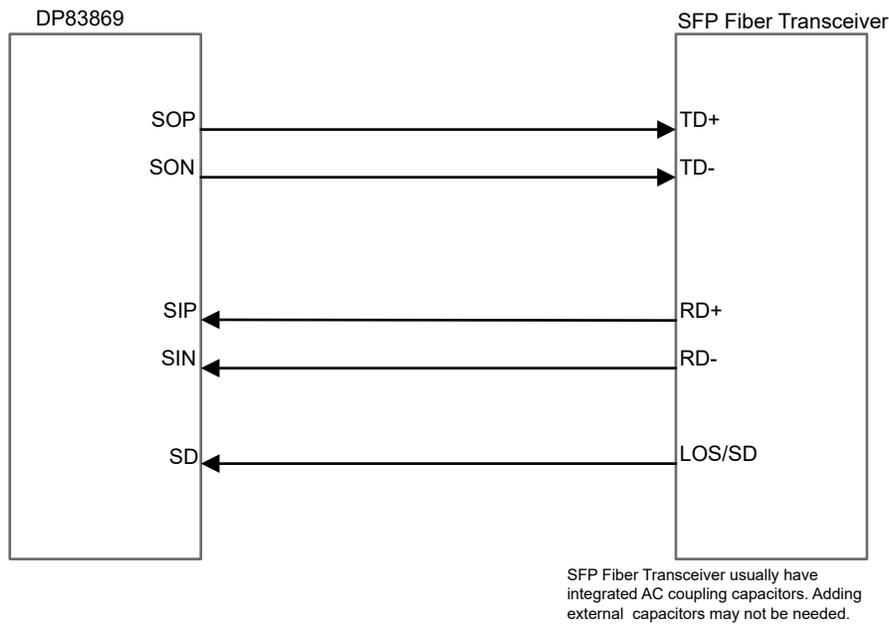

Figure 1-1. DP83822 Fiber Configuration

Figure 1-2. DP83869 Fiber Configuration

1.3 Useful Registers

Table 1-5. DP83822 Fiber Registers

Register Address	Bitfield	Description/Usefulness
0x1	2	Link
0xA	14	100BASE-FX Enable
0x16	4	Reverse Loopback Enable
0x40	6:5	[6] = Far End Fault Generator Disable [5] = Far End Fault Detect Disable
0x403	11:8	Adjusts Transmitter Swing
0x465	0	Signal Detect Polarity (Default Active High for good signal)
0x467	15:0	Bootstrapping Status
0x468	15:0	

Table 1-6. DP83869 Fiber Registers

Register Address	Bitfield	Description/Usefulness
0x11	15:11, 9:8	Copper Link Supplimental Status (Useful for Media Converter only)
0x1DF	2:0	Operation Mode: 0x1 for RGMII to 1000BASE-X 0x2 for RGMII to 100BASE-FX 0x4 for 1G Media Converter 0x5 for 100M Media Converter
0xC00	15:12, 10:8, 6	Fiber Control Register [15] = Fiber Reset [14] = MAC Loopback [6,13] = Speed [12] = Enable Auto-Negotiation [10] = Isolate [9] = Restart Auto-Negotiation [8] = Duplex
0xC01	2	Link
0xC10	15:14, 9	[15] = Far End Fault Generator Disable [14] = Far End Fault Detect Disable [1] [9] = Signal Detect Disable
0xC19	9	FEF Interrupt Status
0xC1A	5	Fiber Reverse Loopback Enable
0xC30	2	Signal Detect Polarity Configuration (Default Active Low for good signal)
0x6E	15:0	Bootstrapping Status

(1)   Program Reg 0xC2A[15] = '1' in addition to Reg 0xC10[14] = '1' for FEF detection disable

2 Common Use Cases

The following are common occurrences when using the PHY in Fiber mode and potential descriptions of events which can occur if the occurrence happened.

Table 2-1. Common Occurrences Using PHY in Fiber Mode

Event	Results
Opposing or local SFP modules are disconnected from board	Both PHYs lose link
Both fiber cables disconnected (TX and RX)	
Single fiber cable is disconnected	Both PHYs lose link due to Far-End Fault (FEF), a functionality where if DUT senses that link has been lost, the DUT can send a FEF signal over the transmitting line so the link partner can also drop link. While FEF is enabled by default, the FEF can have the detection and/or generation functionality disabled through register. 1. If FEF generation is disabled on DUT, when DUT RX cable is unplugged, PHY does not send FEF to link partner through DUT TX cable. This can cause a scenario where DUT PHY indicates no link, but link partner PHY does indicate link. 2. If FEF detection is disabled on DUT, when DUT TX cable is unplugged, link partner PHY can send FEF to DUT. However, DUT does not detect FEF and thus not drop link. This can create a scenario where DUT indicates link and link partner indicates no link.
Inverted Signal Detect	This can create false-negative or false-positive linkup status. Please confirm polarity of pin, detect prior to plugging in to avoid damage to device or module. If polarity needs to be switched, a register write needs to be written prior to plugging in module.
Mismatching SFP Modules on optical connection (100BASE-FX with 1000BASE-X)	PHYs do not link up
Mismatching SFP and PHY speed (822)	If given a 1G SFP with a matching 1G SFP from link partner side, DP83822 can link up and think the DUT has a fiber link at 100Mbps. Packet throughput was tested successfully. However, if module speeds mismatch, PHYs do not link per above case.
Mismatching SFP and PHY speed (869)	If given a 100Mbps SFP when in 1G Fiber (1000Base-X or 1000M Media Converter), and connected to another DP83869 in same mode, PHY does not link up. If given a 1000Mbps SFP when in 100M Fiber (100Base-FX or 100M Media Converter) PHYs can link up and have shown valid throughput.

3 Summary

This application note provides consolidated information on the fiber functionality available in DP83822 and DP83869. The document includes characterizations for the interface and exclusive register information for debugging fiber.

4 References

- Texas Instruments, *DP83822 Robust, Low Power 10/100 Mbps Ethernet Physical Layer Transceiver* data sheet.
- Texas Instruments, *DP83869HM High Immunity 10/100/1000 Ethernet Physical Layer Transceiver With Copper and Fiber Interface* data sheet.
- Texas Instruments, *DP83822IF: Fiber Link Status*, E2E™ Design Support Forum.

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