Frequently Asked Questions Regarding Xmultiple SFP Gigabit 1000BASE-T

Xmultiple's SFP Gigabit 1000BASE-T products are based on the SFP Multi Source Agreement (MSA). They are compatible with Gigabit Ethernet and 1000BASE-T standards as specified in IEEE Std. 802.3:2002.

This Application Note covers the most commonly asked questions about Xmultiple's SFP Gigabit

1. **Are there special electrical supply considerations when using the SFP GIGABIT 1000BASE-T?**
   Yes. The SFP GIGABIT 1000BASE-T consumes a maximum of 1.20W under worst-case conditions (typical is ~ 1.05 W). The maximum current draw is 375 mA, compared to 300 mA for a standard SFP. The electrical supply of the host should be examined to ensure that it can handle these increased demands.

2. **Will the extra length of the SFP GIGABIT 1000BASE-T cause mechanical interference problems in my system?**
   While there is a chance of interference problems, the probability is small. If you compare the length of an SFP GIGABIT 1000BASE-T to a fiber SFP, with their respective cables inserted, there is little difference in length. This is due to the strain relief features on LC connectors that protrude much farther than the insulation on a Cat 5 cable.

3. **What cable type is recommended for use with the SFP GIGABIT 1000BASE-T?**
   The SFP GIGABIT 1000BASE-T was designed to operate using standard Cat 5 cable that has been configured per IEEE802.3:2002. You can safely use Cat 5e or Cat 6 cables, as these are improved versions of Cat 5. For short cable runs, with intricate routing, stranded cable is recommended, as it is more flexible.

4. **What is the PHY and how can it be accessed?**
   The Xmultiple SFP GIGABIT 1000BASE-T uses the Marvell 88E1111 Rev. B0 Physical Layer IC (PHY) to convert between the serial interface and 1000BASE-T interfaces. This chip has a number of useful features available on internal registers that can be accessed via the 2-wire bi-directional serial interface at address 0xAC. Each register is 2 bytes wide and details for accessing the register can be found at http://www.marvell.com

5. **What is SGMII mode?**
   SGMII is a mode of communication between the MAC and PHY to allow for 10/100/1000BASE-T operation. In 100BASE-TX mode, the MAC still transmits to the PHY at 1.25 Gb/sec, but each byte is repeated 10 times. The PHY then converts this repeated data to 100BASE-TX format. The process is the same in 10BASE-T mode but each byte is repeated 100 times.

6. **How do you configure the module for 10/100/1000BASE-T operation?**
   The SFP GIGABIT 1000BASE-T can be used with a SGMII rev. 1.5 interface (without clocks).This interface supports 10, 100 and 1000 BASE-T modes of operation, as mentioned above. The table below shows how to enable SGMII and advertise all speeds and full/half-duplex using register writes to the PHY over the 2-wire

Xmultiple Technologies, Inc., 1060 E. Los Angeles Avenue, Simi Valley, CA 93065 Tel: 805-579-1100, info@xmultiple.com, www.xmultiple.com

1

serial interface (see Question 4). A simple power cycle will return the module to default operation.

PHY Address: 0xAC		
Register Address	Write Data	Description
0x1B	0x9084	Enable SGMII mode
0x09	0x0F00	Advertise 1000BASE-T Full/Half- Duplex
0x04	0x0DE1	Advertise 100/10BASE-T Full/Half-Duplex
0x00	0x9140	Apply Software Reset

7. **What is auto-negotiation?**

Auto-Negotiation is the communication or handshake between two remote devices to determine if the two devices can transfer data to one another, and, if so, the specifics of data transfer such as data rate, flow control, and duplex traffic.

8. **What does 1000BASE-T or 1000BASE-X mean?**

This designation is defined in IEEE802.3:2002. The "1000" in the designation refers to the transmission speed of 1000Mbps. The "BASE" refers to BASE band signaling, indicating that only Ethernet signals are carried on the medium. The "T" represents twisted-pair copper cable (for example Cat 5), and the "X" represents fiber optic cable.

9. **What is the difference between 1000BASE-T and 1000BASE-X auto-negotiation?**

1000BASE-T auto-negotiation is conducted over the Cat 5 cable between the two 1000BASE-T devices. 1000BASE-X auto-negotiation is typically conducted between two host systems over fiber.

10. **How is SFP GIGABIT 1000BASE-T?**

The SFP GIGABIT 1000BASE-T uses the SFP's RX_LOS pin for link indication, and 1000BASE-X auto-negotiation should be disabled on the host system. In the SFP GIGABIT 1000BASE-T, the RX_LOS pin functions as a link indicator—RX_LOS is asserted when the 1000BASE-T link is lost. Typically, this device is used in systems where the host cannot determine the link status without using RX_LOS as a link indicator.

11. **How do I enable 1000BASE-X auto-negotiation on the SFP GIGABIT 1000BASE-T?**

If the system using an SFP GIGABIT 1000BASE-T is compatible with 1000BASE-X auto-negotiation, this feature can be enabled as shown in the below table. Please note that depending on how the RX_LOS signal is used by the system, enabling this feature might cause an interface problem with the host system.

PHY Address: 0xAC		
Register Address	Write Data	Description
0x16	0x0001	Select Fiber Register Bank

Xmultiple Technologies, Inc., 1060 E. Los Angeles Avenue, Simi Valley, CA 93065 Tel: 805-579-1100, info@xmultiple.com, www.xmultiple.com

2

0x00	0x9140	Enable Auto-negotiation
0x16	0x0000	Return to Cu Register Bank

12. Is external loopback possible for this module, and do you have any other recommendations to aid in testing and debugging?

Although the PHY does have a test mode for external loopback, the regular operation of the PHY must be severely modified to work with an external loopback cable. By design all 1000BASE-T PHYs cancel the effects of their own transmissions from the received signals, also called Near End Cross Talk (NEXT) canceling. If line A is connected to line B, the crosstalk between the lines becomes 100%, and the PHY will automatically cancel the entire signal. Therefore, to enable external loopback, the NEXT canceling must be disabled, which can then make debugging, and testing ineffective.

Xmultiple recommends using line loopback and internal loopback for testing and debugging purposes in 1000BASE-T mode. This mode still requires that the PHY is reconfigured, but not in a way that could disguise problems in the system.

13. How does Line Loopback mode work?

Line loopback allows a link partner to send frames into the PHY to test transmit and receive data paths. Frames sent from a link partner into the PHY, before reaching the MAC interface pins are looped back and sent out on the line side. The link partner thus receives its own frames.

To enable line loopback, the Xmultiple SFP GIGABIT 1000BASE-T must first establish copper link with another link partner. If auto-negotiation is enabled, both link partners should advertise the same speed and full duplex. If auto-negotiation is disabled, both link partners need to be forced to the same speed and full duplex. Once link is established, enable the line loopback mode by writing to register 0x14 bit 14.

0x14 bit 14 = 1 (Enable line loopback)
0x14 bit 14 = 0 (Disable line loopback)

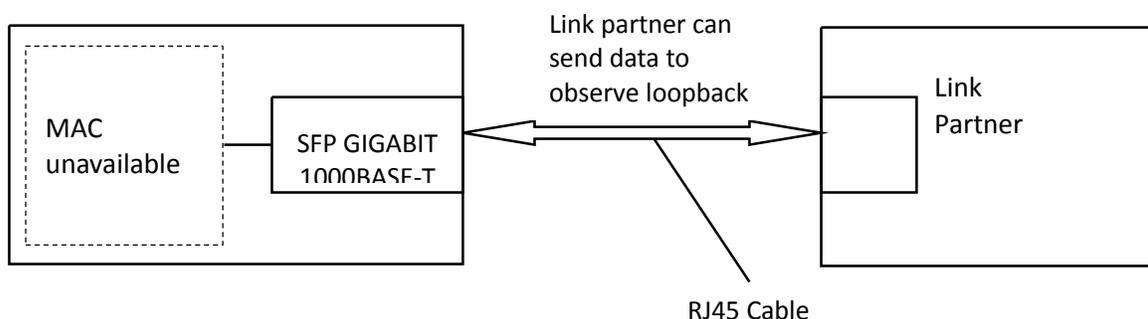Once the line loopback is enabled, the link partner can send data into the PHY.

Figure1. Line Loopback Setup

14. How do you configure the module for internal loopback testing?

Internal loopback testing is a quick way to check the integrity of the MAC to SFP connections. Data sent from the host system to the SFP is looped back internally in the SFP's PHY (data sent in to the TX pin of the SFP are looped out onto the RX pins). This requires register writes to the PHY to put it in loopback mode. For the internal loopback operation, fiber auto-negotiation should be disabled, both on the PHY and on the MAC.   This is because the SFP mode of operation requires a handshake between the fiber auto-negotiation on the MAC side, and the copper auto-negotiation on the RJ45 side. Since the loopback mode automatically disables the receive functionality on the copper side, it will be impossible to carry out this handshake that is required by the SFP mode of operation. Internal loopback can be disabled by setting register 0x00 bit 14 = 0 and 1000BASE-X auto-negotiation can be re-enabled per Question 11.

15. Can the SGMII auto-negotiation be disabled?

Once the module is in SGMII mode, the SGMII auto-negotiation can be disabled using the register writes shown in the table below.

PHY Address: 0xAC		
Register Address	**Write Data**	**Description**
0x16	0x0001	Select Fiber Register Bank
0x00	0x8140	Turn off auto-negotiation and reset
0x16	0x0000	Return to register bank for cable side

16. When two modules are connected across the serial interface, are there any additional register writes required?

In this configuration, the data flows from the RD+/- lines of one module to the TD+/- lines of the other module, and vice versa.
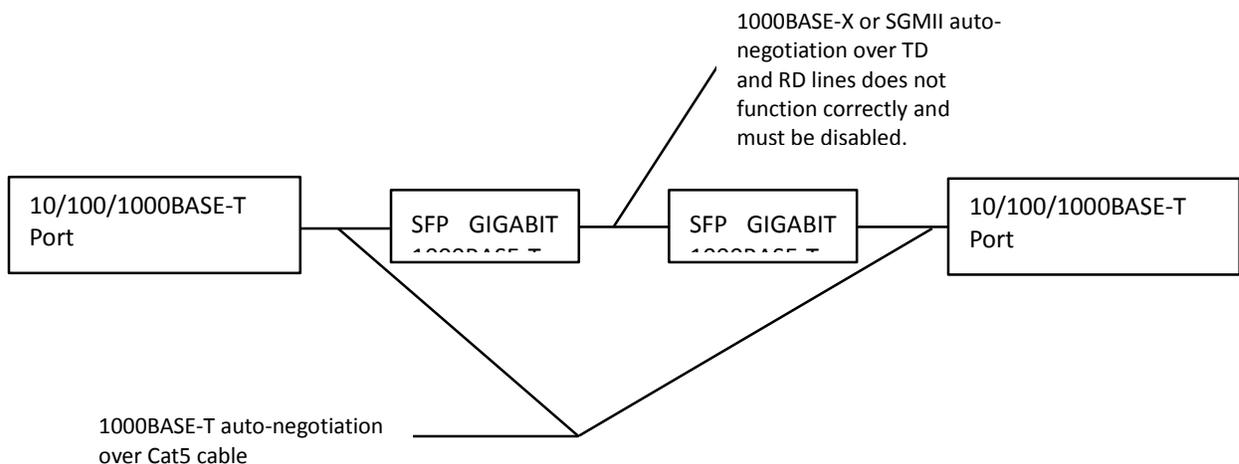
1000BASE-X or SGMII auto-negotiation over TD and RD lines does not function correctly and must be disabled.

10/100/1000BASE-T Port — SFP GIGABIT — SFP GIGABIT — 10/100/1000BASE-T Port

1000BASE-T auto-negotiation over Cat5 cable

Figure2. Connecting two modules across the serial interface

Xmultiple Technologies, Inc., 1060 E. Los Angeles Avenue, Simi Valley, CA 93065 Tel: 805-579-1100, info@xmultiple.com, www.xmultiple.com

4

When using the SFP GIGABIT 1000BASE-T in 1000BASE-T mode in this configuration, each module will link to its partner over the cat 5 cable because the 1000BASE-X auto-negotiation is already disabled. Data will pass between the modules without additional register writes. Again, when the 1000BASE-T link is disconnected from one of the modules, the other link has no way of knowing, and the system must handle this situation by either monitoring the RX_LOS pin or the PHY registers.

When using the SFP GIGABIT 1000BASE-T in SGMII mode, the SGMII auto-negotiation must be disabled (see Question 27). Again, the abilities of each module should be forced to disable flow control and only enable full-duplex. Again, when the link across the cat 5 cable has been disconnected from one of the modules, the other link has no way of knowing. Finally, the speed of the link needs to be known a priori and set in each module.

For more details about monitoring the PHY registers, setting the abilities and speeds of each module, please see the Marvell documentation (see Question 15).

17. Can the PHY registers be accessed when the module TX_DISABLE is asserted?

No. Asserting TX_DISABLE puts the module into its hardware reset state, and the PHY cannot be accessed until the TX_DISABLE has been negated and the reset has completed.

Xmultiple Technologies, Inc., 1060 E. Los Angeles Avenue, Simi Valley, CA 93065 Tel: 805-579-1100, info@xmultiple.com, www.xmultiple.com

5

Xmultiple Technologies Inc.

Xmultiple Technologies Inc. reserves the right to make changes to or discontinue any optical link product or service identified in this document without notice in order to improve design and/or performance. If you have any question regarding this specification sheet, please contact our sales representative or send email to info@xmultiple.com