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ELECTRONIC ENGINEERING

Implementation of Media Converter for Robust Performance

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Abstract— **Media converters play an important role in today's multi-protocol, mixed media Local Area Networks (LANs). Network administrators can deploy media converters to integrate fiber optic cabling and active equipment into existing copper-based, structured cabling systems while achieving significant cost-savings. IP113A can be a 10/100BASE-TX to 100BASE-FX converter. It consists of a 2-port switch controller, a fast Ethernet transceiver and a PHY for 100BASE-FX. The transceivers in IP113A are designed in DSP approach with advance 0.25-µm technology; this results in high noise immunity and robust performance. The study shows that such media converters could be used distances of up to 2 km using half/full duplex multimode fiber and possible distance on the unshielded twisted pair (UTP) side is maximum 100 m length. The media converter for fiber optic/Cat 5 UTP cable systems supports maximum data rate 100 Mbps.**

Keywords— **Media converter, network, optical fiber, twisted pair cable and transmission**

I. Introduction

Media converters are devices that take an incoming data signal from one type of media and convert it for transmission onto another type of media, for example, 100BASE-TX (copper) to 100BASE-FX (fiber). Media converters function at the physical network layer and do not interfere with higher layer functions, making the whole conversion process transparent to switches and routers, and the end user. Converters can be used almost anywhere to converge different media types without affecting network functionality.

Media converters are easily installed, and for many applications represent the most cost-effective choice for adapting new media into an existing network [2]. They also protect investment in current technology by diminishing the need for expensive upgrades or replacement of equipment and infrastructure. In this way, media converters facilitate the transition to fiber, providing greater flexibility in terms of when, where, and how it is deployed.

At the same time, media converters can be used to extend and optimize fiber utilization. For example, while connecting a copper port of a router to a single mode fiber trunk, a media converter so designed can also manipulate the optical signal so that both transmit (TX) and receive (RX) data paths travel together on just one fiber strand instead of the usual two, resulting in a physical doubling of fiber plant capacity.

Other possible applications for a media converter include link extension (signal boosting) and signal repeating (multiple hop links), and the creation of self-healing/redundant links. The benefits of media conversion can even be applied to Wave Division Multiplexing (WDM) applications where media and wavelength conversion can allow for greater deployment flexibility.

II. Analysis on Media Converter

IP113A not only supports store and forward mode, it also supports modified cut through mode and pure converter mode for low latency data forwarding. IP113A can transmit packet(s) up to 1600 bytes to meet requirement of extra long packets.

IP113A supports IEEE802.3x, collision base backpressure, and various LED functions, etc. These functions can be configured to fit the different requirements by feeding operation parameters via EEPROM interface or pull up/down resistors on specified pins.

IP113A supports three types of data forwarding mode, store and forward mode, modified cut-through mode and pure converter mode. It can forward a frame despite of its address and CRC error. IP113A begins to forward the received data only after it receives the frame completely. The latency depends on the packet length.

IP113A begins to forward the received data when it receives the first 64 bytes of the frame. The latency is about 512 bits time width. The maximum packet length can be up to1600 bytes in this mode.

IP113A operates with the minimum latency in this mode. The transmission flow does not wait until entire frame is ready, but instead it forwards the received data immediately after the data being received.

Both transceivers are interconnected via internal media independent interface (MII) signals, therefore the internal switch engine and data buffer are not used. Both twisted pair (TP) port and fiber port of IP113A should work at 100M full duplex in this mode. If TP port is linked at half duplex, the total length of UTP cable and fiber should be less than 60 meters to meet the requirement of CSMA/CD in IEEE802.3.The packet length is not limited at this mode.

A. IP113A IC Design

IP113A can be a 10/100BASE-TX to 100BASE-FX converter. IP113A begins to forward the received data only after it receives the frame completely. The latency depends on the packet length. IP113A begins to forward the received data when it receives the first 64 bytes of the frame. The latency is about 512 bits time width. The maximum packet length can be up to1600 bytes in this mode. IP113A not only supports modified cut through mode and pure converter mode for low latency data forwarding. IP113A can transmit packets up to 1600 bytes to meet requirement of extra long packets. The AFBR-5803Z/5803TZ shown in Fig. 1 is 1300 nm products with optical performance compliant with the FDDI PMD standard. These transceivers for 2 km multimode fiber backbones are supplied in the small 1 x 9 duplex SC or ST package style. The AFBR-5803Z/5803TZ is useful for both ATM 100 Mb/s interfaces and Fast Ethernet 100 Base-FX interfaces.

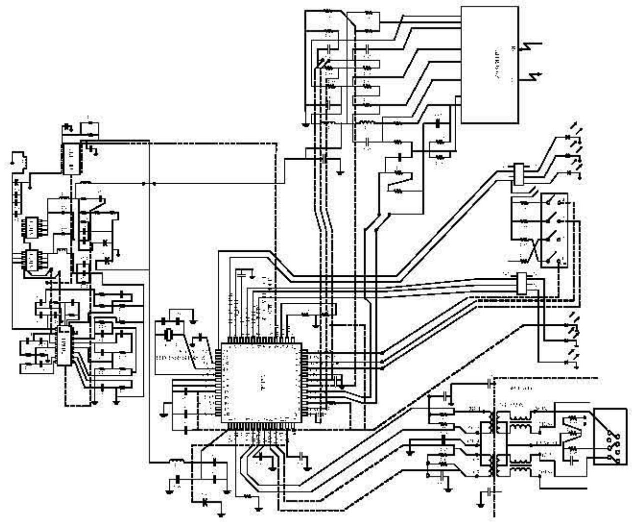

Fig. 1 Circuit Diagram of Media Converter

B. Pin Configuration

Figure 2 shows pin diagram of IP113A. Pin 5 and 6 are twisted pair (TP) receive and pin 8 and 9 are twisted transmit. Pin 2 is band gap resistor. It is connected to the ground through a 6.19k resistor in application circuit. Pin 18 is 100Base-FX signal detect. It is an input signal from fiber MAU. Fiber signal detect is active if the voltage on FXSD is higher than the threshold voltage, which is 1.35v ± 5% when V_{CC} is equal to 2.5v. Pin 13 and 14 are fiber receiver data repair. Pin 16 and 17 are fiber transmit data repair.

Pin 31 is TP port link LED and pin 36 is fiber port link LED. Pin 33 is TP port speed LED. Pin 32 is TP port full duplex LED and pin 37 is fiber port full duplex LED. Pin 38 is fiber port signal detect. Pin 30 is far end fault pattern received. The output of LED pin id logic low when the LED is on.Pin 29 is IEEE 802.3X enable on TP port and fiber port. Pin 24 is local TP port auto negotiation enable. Pin 38 is local TP port speed. Pin 30 id Local TP port duplex. Pin 36 is set the duplex of fiber port.

Pin 21 is link fault pass through. Pin 22 and 23 are direct wire and fast forward. In store and forward switch mode, IP113A will begin to transmit a frame right after the completion of receiving a frame. In modified cut-through switch mode, IP113A will begin to forward a frame after the first 64 bytes data received. TP port should be forced at 100M at this mode.

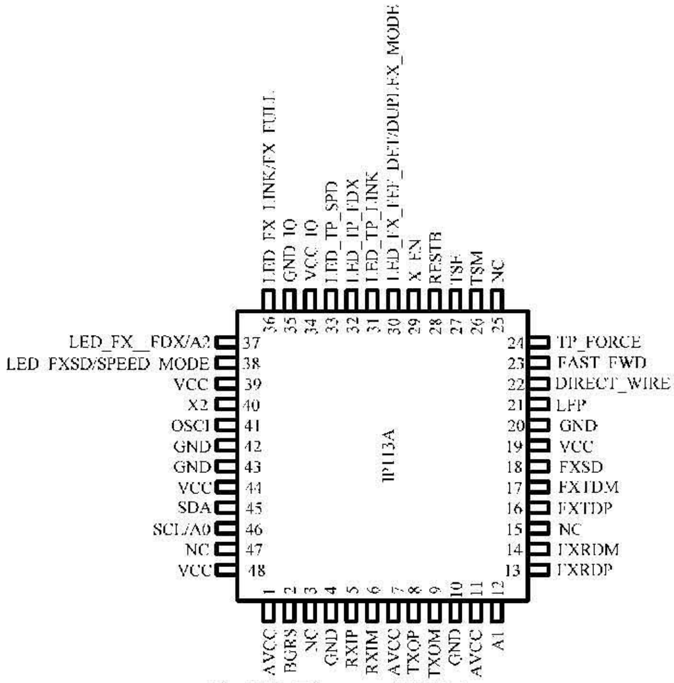

Fig. 2 Pin Diagram of IP113A

In converter mode, incoming frames are not buffered in IP113A to achieve the min latency. Both TP port and fiber port of IP113A should work at 100M full duplex in this mode. If TP port is linked at half duplex, the total length of UTP cable and fiber should be less than 60 meters to meet the requirement of CSMACD in IEEE802.3. Converter mode with auto-change-forward function, IP113A will change to forward mode if it detects the speed is different in TP port and FX port.

III. PERFORMANCE TESTING

IP113A consists of a 2-port switch controller can be a 10/100BASE-TX to 100BASE-FX converter. It also consists of a Fast Ethernet transceiver and a PHY for 100BASE-FX. The transceivers are designed in DSP approach with advance 0.25-μm technology. This can support in high noise immunity and robust performance. Maximum fiber cable length is 500 m.

IP113A begins to forward the received data when it receives the first 64 bytes of the frame. The latency is about 512 bits time width. The maximum packet length can be up to1600 bytes in this mode. This study explores the development of media converter for converging network. The encoder, scrambler and parallel in serial out and NRZI converter for the transmitter and the decoder, descrambler and serial in parallel out and NRZI converter for the receiver. The following experiments are tested at YTU from Internet room to Metallurgy Department.

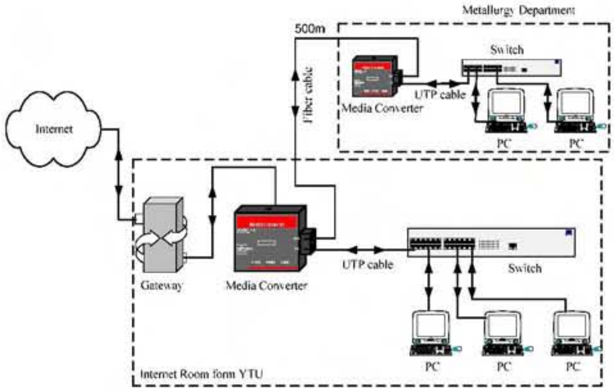

Fig. 3 Proposed System of Media Converter

Figure 4 shows measured result of twisted pair transmit waveform .The magnitude of this waveform is 75 mV, on time is 0.75μs and off time is 0.25 μs.

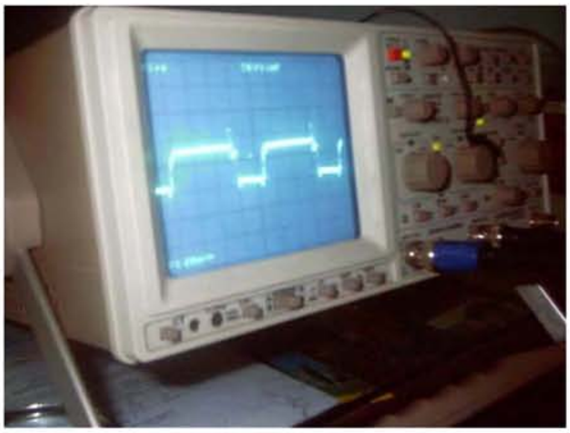

Fig. 4 Measured Result of Twisted Pair Transmit Waveform

Figure 5 shows measured result of twisted pair received waveform. The magnitude of this waveform is 50 mV. Time duration is 1 μs. On time is 0.75μs and off time is 0.25 μs.

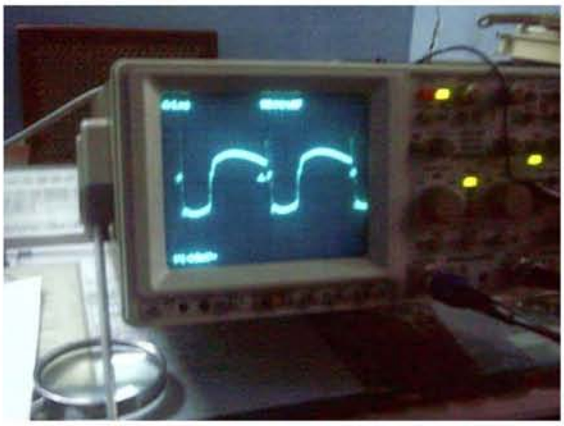

Fig. 5 Measured Result of Twisted Pair Receive Waveform

Figure 6 shows measured result of fiber transmits waveform. The magnitude of this sine wave is 100 mV and time duration is 5 μs.

Fig. 6 Measured Result of Fiber Transmit Waveform

Figure 7 shows measured result of fiber receive waveform. The magnitude of this sine wave is 50 mV and time duration is 5 μs.

Fig. 7 Measured Result of Fiber Receive Waveform

Figure 8 shows measured result of packet when making experiment at YTU from Internet room to Metallurgy Department.

Fig. 8 Measured Result of Packet

IV. DISCUSSION ON MEDIA CONVERTER PERFORMANCE

In data conversion technology, media converters connect dissimilar cable types, making it possible to use mixed media and speed on a network to optimize price and performance. Whether extending legacy networks with the latest technology, or connecting inexpensive, lower bandwidth desktops to a state of the art fiber optic backbone, media converter offer a viable lower cost solution. Media converters are commonly used to connect UTP (unshielded twisted pair) copper cabling and fiber optic cabling in a network cabling plants. Media converter can extend distances between twisted pair devices up to 2 km over multimode fiber or up to 80 km over single mode fiber. However this design can extend multimode fiber length of 500m and twisted pair cable length of 100m.

Media converter provides the network installer the most convenient and economic product. It is used to extend the connection distance between two Fast Ethernet twisted pair devices via fiber cable transparently with no performance degradation. The converter series provide different types of fiber connectors such as ST, SC, and RJ-45 connector for UTP cables. This media converter in LANs which provides the conversion protocols from twisted pair cable to fiber optic cable, the output bit rate of 100 Mbps was designed and implemented. Media conversion is the most cost-effective solution for extending the productive life of legacy wiring plants and equipment while allowing implementation of new technologies. Media conversion's greatest benefits are flexibility and cost savings. Media converter is plug-and-play unit. The media converter is suitable for LANs where copper to fiber, multimode to single mode conversions are required. It supports IEEE 802.3 standard and provides an extensive range of connectivity options across different media.

V. CONCLUSION

Media converters are lighting up the first mile with optical Ethernet services. Media converters make practical sense in both LAN and MAN applications. Media converters are the best solution for the optical demarcation between the LAN and MAN and bridging the bandwidth gap that exists between the Local Area Network. Media converters offer flexibility, cost savings and are easy to install.

In this study, media conversion process of twisted pair LAN to fiber optic LAN was successfully performed. Different types of media conversion, for example, coaxial cable to twisted pair cable and coaxial cable to fiber optic cable LAN over the Internet can be added for further development. Moreover, this media conversion system could be expanded due to its firmware application method and further developed complaint with multi-port 100 Mbps Fast Ethernet which can extend the transmission distance.

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