●新特器件应用

光电快速以太网转换器 AL210

国防科技大学航天与材料工程学院 谭文若 刘石明 战威 姚源记

Fast Ethernet Fiber to TP Media Converter AL210

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摘要：AL210是ALLAYER公司设计的用于在100Mbit/s光纤与双绞线之间进行快速以太网转换的芯片，利用它可以实现光纤和双绞线之间信息的相互转换，以提高网络速度。文中介绍了AL210的特点、功能及其引脚，最后给出了它的典型应用电路。

关键词：AL210； 光纤； 双绞线； 转换

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1 概述

AL210主要应用于100Mbit/s光纤和双绞线之间的快速以太网转换设计，利用其设计系统，可以实现光纤和双绞线之间传输信息的相互转换，以提高网络速度。AL210符合IEEE802.3、100BASE-FX和100BASE-TX快速以太网标准。其内部包括光电驱动器、数据量子化转换器、缓存器、扰频器和稳频功能。另外，AL210还提供了一些附加的功能：例如传统的利用离散元件不能实现的故障传播和冗余连接等。该转换器同时提供了一个PECL接口，因此可方便地与1300nm等光纤模块连接器相连接。

2 AL210的特点和引脚功能

AL210转换器具有如下主要特点：

- ●可实现单片100M/s光纤到双绞线之间的转换；
- ●具有低延迟特性；
- ●可进行适时缓存；
- ●支持全双工模式；
- ●可连接故障传播；
- ●有自适应全双工模式；
- ●有光电驱动集成功能；
- ●具有数据量子化转换器集成；
- ●具有远距离故障检测功能；
- ●支持冗余连接
- ●具有80mA的电源驱动能力；
- ●采用48-PIN LQFP封装。

AL210的系统结构框图如图1所示。图2是AL210采用48-PIN LQFP封装的引脚排列图。各引

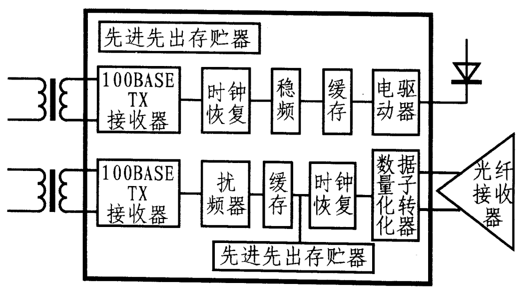

图1 AL210的系统框图

脚的功能说明如下：

1,4脚：双绞线接收电源；

2,3脚：100BASE－TX接收器数据输入；

5,10,32脚：测试脚，常规操作接低；

6,9脚：双绞线发送电源；

7,8脚：100BASE－TX数据发送；

11,12,24脚：空脚；

13脚：复位，低电平有效；

14脚：双绞线接收状态指示；

16脚：双绞线连接状态指示；

18脚：光纤接收指示；

19脚：光纤连接状态指示；

15,17脚：数字电源（+5V）；

20脚：冗余连接输出脚，当设备处于连接错误或检测到远程错误时输出低电平；

21脚：双绞线输出扰频允许，高电频有效；

22脚：双绞线到光纤通路缓存无效，高电平有效；

23脚：光纤到双绞线通路缓存无效，高电平有效；

25脚：暂停功能允许，高电平有效；

26脚：光纤发送电源；

27脚：电压模式光电驱动输出；

28,29脚：光电驱动输出；

30脚：接地；

31脚：该脚选中，光纤接口输出以PECL方式连接，高电平有效；

33,36脚：光纤接收电源；

34,35脚：光纤接收器数据输入；

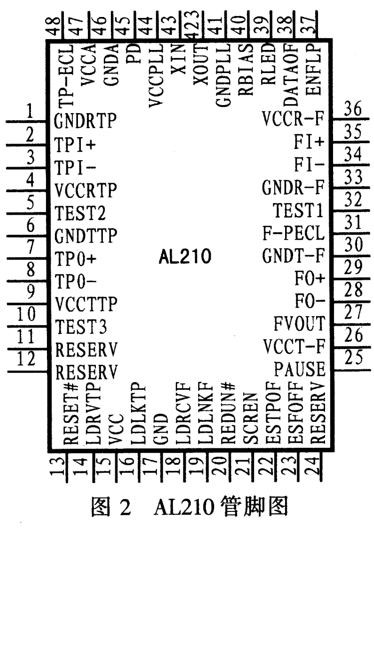

图2 AL210管脚图

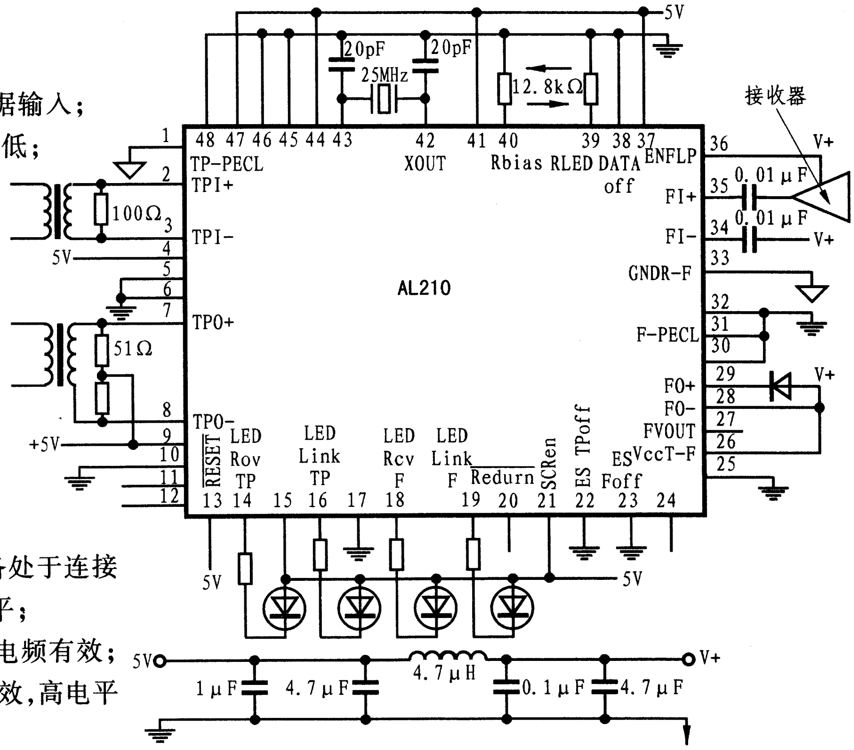

图3 AL210典型应用电路图

37脚：全双工自适应FLP允许，高电平有效；

38脚：该脚选中，双绞线端口输出禁止，低电平有效；

39脚：通过12.8kΩ电阻接地，如果该脚接高，则电流模式输出驱动禁止，电压模式输出驱动允许；

40脚：该脚控制AL210偏置电压，通过12.8kΩ电阻接地；

41,44脚：相位锁定环电源；

42脚：25MHz晶振接点，也可以用于时钟输出；

43脚：25MHz晶振接点；

45脚：高电平有效；

46,47脚：模拟电源（+5V）；

48脚：双绞线端口PECL接口允许。

3 AL210的典型应用电路

图3是AL210的典型应用电路。笔者利用AL210的典型应用电路成功地设计出一个系统电路，并已将其应用于计算机网络中，从而实现了光纤和双绞线间信息的快速转换，该网络可自适应全双工模式传输，而且传输速度快、故障低。同时系统还可实现连接故障传播、远距离故障检测和支持冗余连接等功能。

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Fast Ethernet Fiber to TP Media Converter

- Single chip 100 Mbit/s fiber optic to twisted pair media converter
- Low latency
- Integrated elastic store for retiming
- Full-duplex capable
- Link fault propagation
- Supports auto-negotiation to full duplex
- Integrated LED driver
- Integrated data quantizer
- Remote fault detection capable
- Provides support for redundant link
- 80mA drive capability
- 48-pin LQFP package

Product Description

The AL210 is designed for media converter applications. It is intended for 100 Mbit/s Fast Ethernet fiber optic to twisted pair media converter designs. The device also provides a PECL interface for use with media connectors such as 1300nm fiber optic modules. The AL210 is compatible with IEEE 802.3 100Base-FX and 100Base-TX standards.

The integrated media converter provides additional functionality such as fault propagation and redundant link support that conventional implementations using discrete components typically can not support.

The AL210 includes: fiber LED driver, quantizer, elastic store, scrambler, and descrambler functions to complete the media converter design.

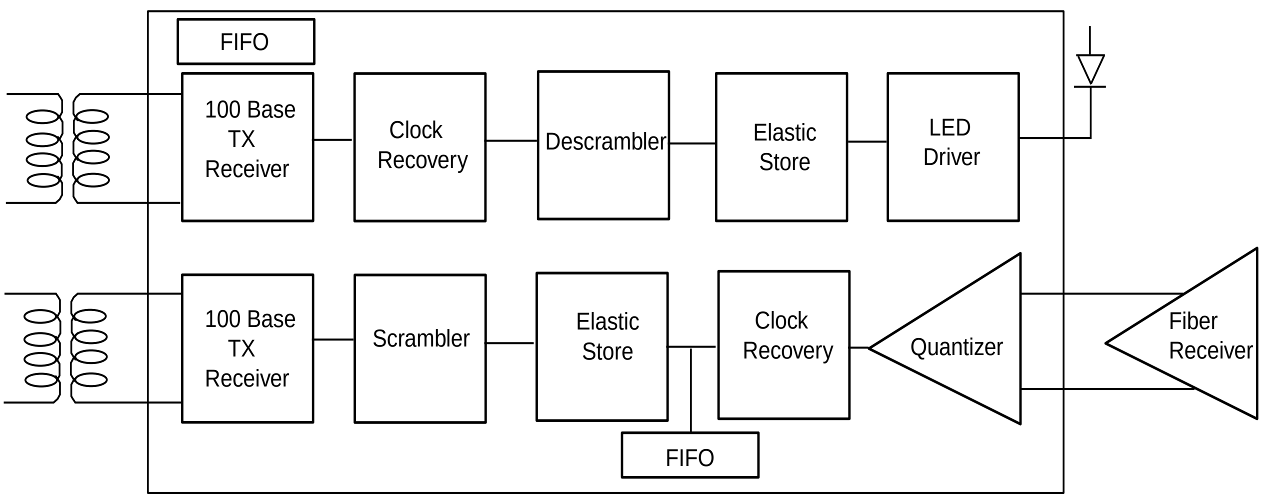

Figure 1 System Block Diagram

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Table of Contents

Pin Diagram

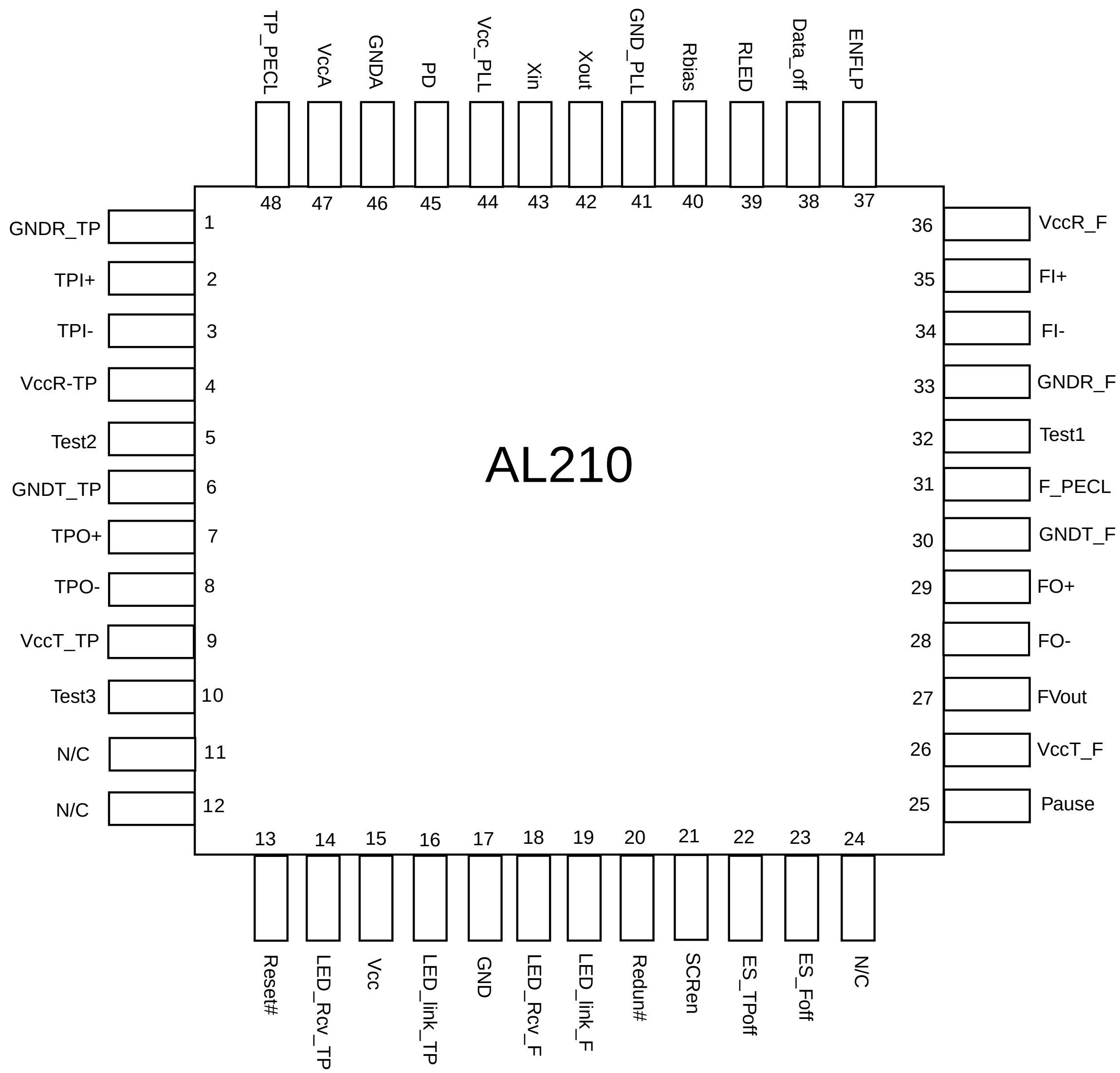


Figure 2 AL210 Pin Out

1. Pin Descriptions

Table 1: AL210 Pin Description

PIN NUMBER	PIN NAME	I/O	DESCRIPTION
1	GNDR_TP	P	TP Receive Ground.
2 3	TPI+ TPI-	I	100Base-TX Receiver Input Data. During normal operation, the pins receive MLT3 signals and are connected to a transformer. When the TPPECL pin is pulled high, these pins become a PECL level interface. It can then be used for interfacing to an external equalizer chip for added distance.
4	VccR_TP	P	TP Receive Power Supply.
5	Test2	I	Test Pin. Tied low for normal operation. Tied high to force TP output enable.
6	GNDT_TP	P	TP Transmit Ground.
7 8	TPO+ TPO-	O	100Base-TX Transmit Data. During normal operation, the pins transmit MLT3 signals and are connected to a transformer. When the TPPECL pin is pulled high, these pins will transmit PECL NRZI signals for interface to an external equalizer chip.
9	VccT_TP	P	TP Transmit Power Supply.
10	Test3	I	Test Pin. Tied low for normal operation. Tied high to force Fx output “idle” when TP link is down.
11	Reserved	-	No Connect or Pull Up to VCC.
12	Reserved	-	No Connect or Pull Up to VCC.
13	Reset#	I	Reset Pin. Active low. Internal pull up.
14	LED_Rcv_TP	O	TP Receiving Activity Output Status Pin. It will be active low when the device is receiving frames on the TP side. It is an open drain driver capable of driving a 10mA LED.
15	Vcc	P	Digital Circuit Power Supply. (+5V)
16	LED_link_TP	O	TP Link Detect Output Status Pin. It will be active low when TP link is detected. It is capable of driving a 10mA LED.
17	GND	P	Digital Circuit Ground.
18	LED_Rcv_F	O	Fiber Receiving Activity Output Status Pin. It will be active low when the device is receiving frames on FB site. It is an output driver capable of driving a 10 mA LED.

Table 1: AL210 Pin Description (Continued)

PIN NUMBER	PIN NAME	I/O	DESCRIPTION
19	LED_link_F	O	Fiber Link Status Indicator. A steady ON LED indicates a good fiber link. A blinking LED indicates a remote fault detected. A OFF LED indicates no fiber link detected. It is an open drain driver capable of driving a 10mA LED.
20	Redun#	O	Redundant Link Output Pin. The pin will be asserted (LOW) if the device is in either the link-fail state or if it senses a remote fault condition.
21	SCRen	I	Scrambler Enable for TP Port Output. Active high, internal pull up.
22	ES_TPoff	I	Elastic Store of TP to Fiber Path Disable. Active high, internal pull down.
23	ES_Foff	I	Elastic Store of Fiber to TP Path Disable. Active high, internal pull down.
24	Reserved	-	No Connect.
25	Pause	I	Pause Capability Advertisement Enable. Active high, internal pull up.
26	VccT_F	P	Fiber Transmit Power Supply.
27	FVout	O	Voltage Mode Fiber Optic LED Driver Output. This pin is enabled when the RLED (pin 39) is tied to high. If FPECL is selected, this pin will be disabled.
28 29	FO- FO+	O	Fiber LED Driver Output. If FPECL is selected, these pins will be PECL output pins for driving the fiber optic module. In a typical operation, the output is a current mode driver. FO+ should be connected to the fiber LED and FO- should be connected to VccT_F.
30	GNDT_F	P	Fiber Transmit Ground.
31	F_PECL	I	If FPECL is selected, the output of the fiber interface will be PECL for interfacing to a fiber module. Active high.
32	Test1	I	Test Pin. Tied low for normal operation.
33	GNDR_F	P	Fiber Receive Ground.
34 35	FI- FI+	I	Fiber Optic Receiver Input. If FPECL is selected, these pins will be PECL level input pins for interfacing to the receive fiber optic module.
36	VccR_F	P	Fiber Receiver Power Supply.
37	ENFLP	I	Enables Full-Duplex Auto-negotiation FLP. Active high, internal pull up.

Table 1: AL210 Pin Description (Continued)

PIN NUMBER	PIN NAME	I/O	DESCRIPTION
38	Data_off	I	Assertion of this pin turns off the TP port output. De-assertion will enable the AL210 to pass data to the TP port. Internal pull down.
39	RLED	I	Transmit Output LED Driver Control. Tied to ground through a 12.8K 1% resistor. When this pin is tied high, it will disable the current mode output driver and enable the voltage mode driver.
40	Rbias	I	This pin controls the bias of the AL210. Tied to ground through a 12.8K 1% resistor.
41	GND_PLL	P	Phase Locked Loop Ground.
42	Xout	O	25 MHz Crystal Connection. This pin also sources the clock output.
43	Xin	I	25 MHz Crystal Connection. If a clock is used instead of a crystal, this is the input pin of the clock.
44	Vcc_PLL	P	Phase Locked Loop Power Supply.
45	PD	I	Power Down. Active high, internal pull down.
46	GNDA	P	Analog Ground.
47	VccA	P	Analog Power.
48	TP_PECL	I	TP Port PECL Interface Enable. When set to high, the TPI+, TPI-, and TPO+, TPO- pins become PECL level interface. It also disables the MLT3 encoder/decoder. When the PECL level interface is used, the signals expected by the chip are NRZI instead of MLT3. Internal pull down.

Note: In the I/O column, the "I" stands for Input, the "O" stands for Output, and the "P" stands for Power Pins.

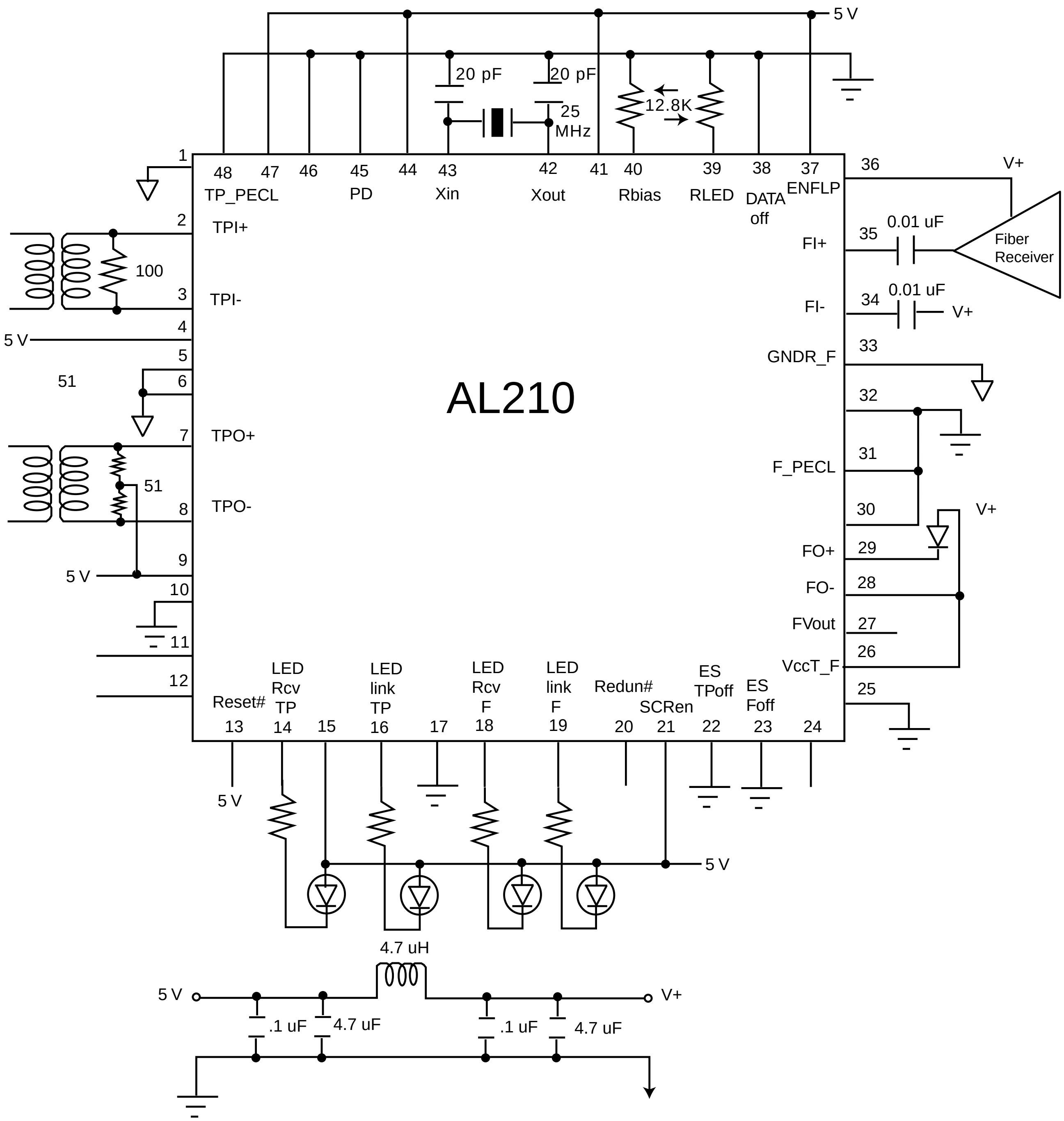


Figure 3 AL210 Typical Application Circuit - LED Driver and FO Receiver

2. Functional Description

The AL210 contains a physical layer interface (PHY) device for IEEE 802.3 100Base-TX and a PHY for 100Base-FX networks. The PHY contains all the necessary functions such as elastic store, quantizer, and driver circuits to complete a media converter design. The device converts the MLT3 scrambled symbols from the twisted pair (TP) input port into 4B5B NRZI encoded data and transmits it over the fiber media. The 4B5B NRZI encoded data from the fiber-input port is converted to a scrambled MLT3 symbol stream for TP transmission.

The AL210 does not encode or decode the 4B5B symbols, therefore all errors and signaling are preserved and propagated. In addition, the benefit of a “straight-through” conversion is that the latency can be as low as 8-bit time (BT). The device also supports Far-End Fault Detection (fiber only) and link status propagation. If any port is in a link-fail state, the device will cease to transmit data and disables the appropriate output port. In essence, the device is transparent in regard to the connecting links.

The AL210 also provides an alternative PECL interface for interfacing either to an equalizer chip or a fiber module.

An elastic store is provided by the media converter to retime the received signal. The elastic store can be disabled to reduce latency of the converter.

The AL210 supports redundant link applications. A redundant link can be formed by either a switch with 100Base-FX transceiver that supports far-end fault signaling or two AL210s. In the event of a link failure, the redundant link will be established automatically.

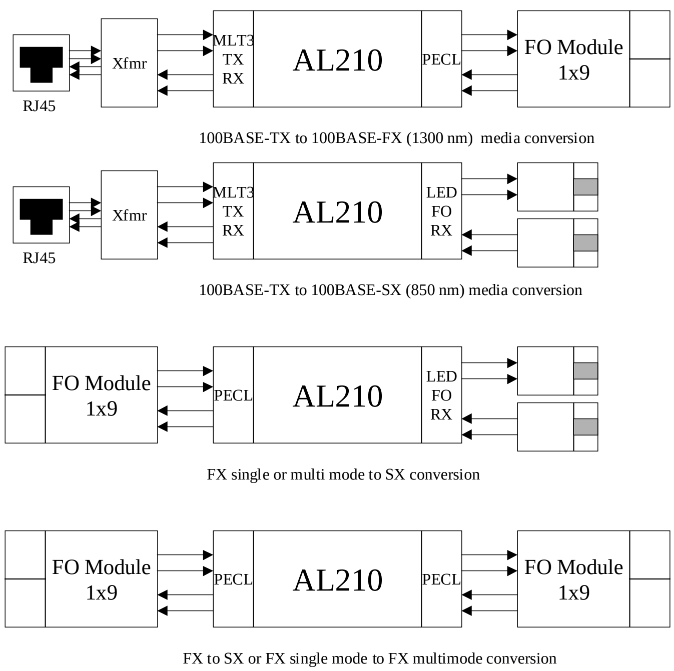


Figure 4 AL210 Applications

2.1 100Base-TX to 100Base-FX Conversion

The AL210's 100Base-TX receiver is designed for data reception of up to a maximum of 10 meters of Category 5 Cable. For applications that require the full IEEE 802.3 distance (100 meters), the AL210 provides alternative PECL interface to interface to an external equalizer chip. However, media converter applications typically are within the wiring closet. A distance of 10 meters is adequate to support these applications.

After the scrambled MLT3 signal from the twisted pair port is received by the AL210, the device descrambles the signal and converts it into a NRZ signal stream. The signal is then passed through an elastic store for retiming. The result signal is then converted into a serial NRZI bit stream and sent to the LED driver. The elastic store can be disabled to reduce the latency of the converter.

During idle, the AL210 will transmit an IDLE signal. If the twisted pair port is in a link-down state, the AL210 will cease to transmit any signal and link fault is thus propagated.

2.2 Fiber LED Driver

The AL210 provides two different modes of fiber LED drivers, current and voltage mode. The edge enhanced current mode driver in general is faster than the voltage mode driver. However, the voltage mode fiber LED driver provides an easier way of shaping the output wave shape. The default driver is an edge enhanced current mode driver. The voltage mode driver can be selected by tying the RLED pin high. The drive current of the LED driver is controlled by an external resistor RLED. The formula is as follows:

RLED = 70 x 12.8 Kohm divided by ILED

Where, RLED = LED current set resistor

ILED = Fiber LED drive current

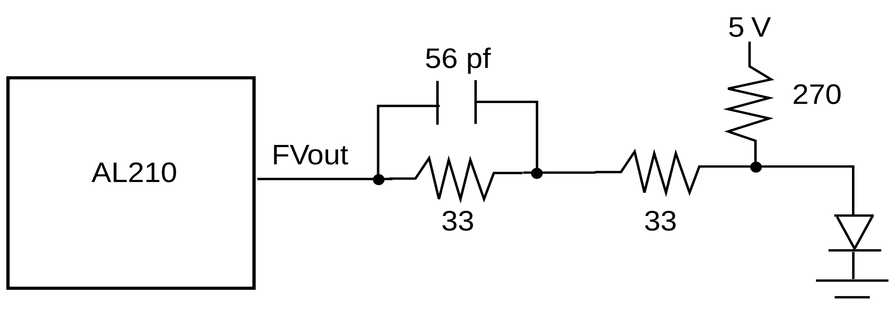


Figure 5 Pulse Shaping with Voltage Mode Output Driver

2.3 100Base-FX to 100Base-TX Conversion

The AL210 100Base-FX receiver is comprised of a scrambler and a quantizer. After receiving the serial bit stream from the PIN amplifier, the device passes the signal through an elastic store for retiming and converts the NRZI coded data into a scrambled MLT3 signal and sends it to the 100Base-TX transmitter.

During idle, the AL210 will transmit the scrambled IDLE signal. If the fiber receiver does not receive any idle signal, the fiber port will go into a link-down state and the AL210 will perform two tasks:

1. Cease to transmit any signal to the TP port and put the transmit TP port in high impedance.
2. Simultaneously start transmitting far-end fault signals.

In the event of remote fault (the receiver receives the far-end fault signal), the receiver will go into a link-down state. The RF LED provides the remote fault signal status indication. The far-end fault signal is indicated by the far-end fault IDLE signal (84 “ones” follow by a “zero”).

When the fiber port is in a link-down state (either remote fault or receive link-fail), the device will put the TP output port into high impedance and assert Redun# signal.

2.4 Full Duplex Application

The ideal function of a media converter chip is to provide a full-duplex transparent media link. However, because the 100Base-FX does not support auto-negotiation, the AL210 can not propagate duplex information to the twisted pair media. Although the AL210 does not support full auto-negotiation, it provides an option to force the link partner into full-duplex mode with auto-negotiated link pulses. When Pin 37, (ENFLP) is pulled high, the AL210 will transmit auto-negotiation FLP with 100 Mbit/s full-duplex capability field forcing the linked unmanaged switch into full-duplex.

2.5 PECL Interface

The AL210 provides an alternative PECL interface to the TP interface and fiber connect interface. The intention of the alternative interfaces are to allow design engineers to be able to choose other media interconnects such as a 1300nm fiber module or external twisted pair equalizer.

The AL210 has the signal detect function built in and does not require any interface to the signal detect input.

2.6 Elastic Store

The AL210 provides an on-chip elastic store. With the elastic store in place, the device retimes the received signal and removes jitter. The elastic store can be turned off to reduce latency of the device by using the appropriate pins.

For typical applications such as media conversion to a 100Base-FX hub, where the twisted pair length is less than 10 meters and fiber length is less than 400 meters (reference to IEEE 802.3 clause 29 for fiber length and system configuration), retiming is not needed.

For full-duplex application of fiber length over 2 km, the elastic store should be used to remove the jitter from the signal.

2.7 Scrambler

The AL210 can also be used as a full-duplex media extender or 850nm to 1300nm media converter by turning the scrambler off. To turn the scrambler off, the pin SCRen should be connected to ground.

2.8 Fault Propagation

The AL210 will propagate the idle signals from media to media. After reception of the idle signal (all “1s”), the device will then transmit an idle signal to the opposite ports, i.e. TP to fiber or fiber to TP. There are two types of link failure, receive or remote fault (also known as far-end fault).

1. TP receive link failure. In the event of a TP receive link failure, the AL210 will cease to transmit an idle signal to the fiber optic driver. A valid TP link signal can be either a 10Base-T link pulse or a 100Base-TX idle signal.
2. Fiber receive link failure. In the event of a fiber receive link failure, the AL210 will cease to transmit an idle signal to the TP driver and put the driver into high impedance. The device will also send a remote fault signal to the fiber optic driver in addition to asserting the Redun# signal.
3. TP transmit link failure. In the event of a TP transmit link failure, the TP far-end transceiver will cease to transmit an idle signal and start transmitting FLP to the AL210. Since the AL210 does not understand FLP, it will continue to transmit an idle signal to the fiber optic driver.
4. Fiber transmit link failure. In the event of a fiber transmit link failure, the far-end transceiver (with remote fault signaling capability) will transmit RF signal to the AL210. As a result, the AL210 will perform two tasks: cease to transmit an idle signal to the TP driver and put the driver into high impedance asserting the Redun# signal.

2.9 Redundant Link

The AL210 supports redundant link through the use of DATAoff and Redun# signals. The redundant link function is only available for the FO port. An implementation of a redundant link is shown in Figure 6. Redundant link can also be configured with two fiber switch ports (far-end fault signaling support required) and two AL210s.

There are two likely scenarios, either the transmit link fault or the receive link fault could trigger the redundant link.

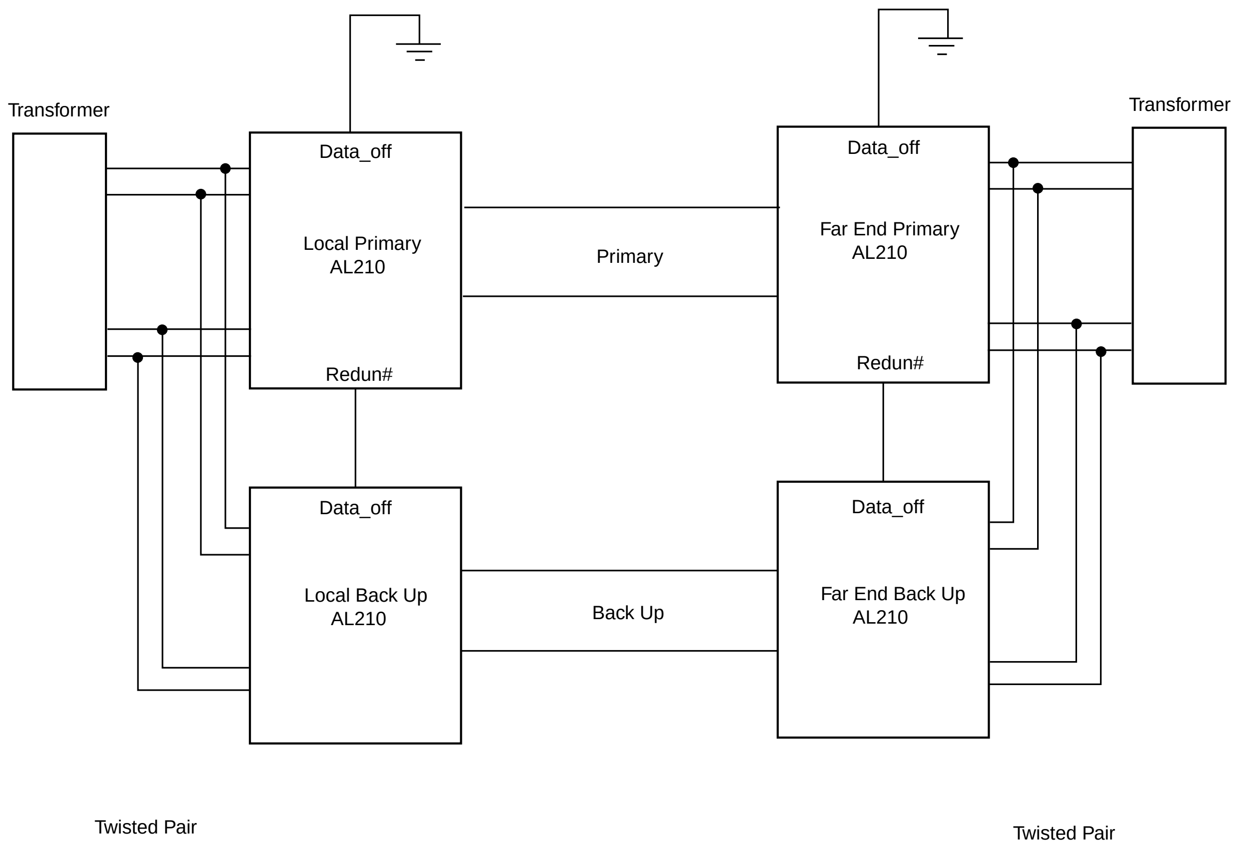


Figure 6 Redundant Link

2.9.1 Receive Link Fault

In the event of a receive link failure, the receiver will go into a link-down mode. The AL210 will take the following actions:

1. Start transmitting remote fault signal; and
2. Put the TPO+ and TPO- pins in high impedance; and
3. Assert Redun# signal.

The far-end primary transceiver is normally in a link-up state and a back-up transceiver in a link-fail state. During receive link failure, the local AL210 will enable data transmission of the backup transceiver by asserting the Redun# signal. The backup AL210 will then start sending copies of the transmit signal.

The primary far-end receiver that receives the RF signal will enter the link-fail state. The back up transceiver will exit the link-fail state upon receiving a signal from the local AL210 re-establishing the link. When the primary link is repaired, Redun# will be de-asserted.

2.9.2 Transmit Link Fault

The 100Base-FX specification provides a way to detect transmit link failure. Whenever a fiber receiver experiences receive link failure, it will transmit a far-end fault signal. The far-end fault signal is indicated by the far-end fault IDLE signal (84 “ones” follow by a “zero”).

When the AL210 receives the far-end fault signal, it is notified by the far-end station that a transmit fault has occurred. The device will go into a link-down state and will take the following actions:

1. Put the TPO+ and TPO- pins in high impedance; and
2. Assert Redun# signal.

The data transmission will be assumed by the backup AL210 and start sending copies of the signal. Upon reestablishment of the primary fiber, Redun# will be de-asserted and the backup data link will be turned off.

2.9.3 Redundant Link with Switches or Repeater

Figure 7 shows a redundant link implemented by a pair of AL210s and a fiber switch/repeater. The key to this configuration is that the transceivers of the fiber switch must support far-end fault signaling (although the IEEE far-end fault signaling is an option).

The operation of this link configuration is very similar to the AL210 redundant link as described above. Instead of the far-end transceivers being switched, the ports are now switched. Whenever, the far-end transceiver receives the far-end fault signal or no IDLE signal, it will enter the link-fail state. Thus, redundancy is accomplished.

There is no limit on the number of redundant links for the AL210. Also the Redun# and Data_off signals can be cascaded as many times as it needs to offer two or more redundant links.

One minor disadvantage of this scenario with a switch is that the link will not be functional (spanning tree will cut off the port) until the addresses stored in the switch are aged out. However, many of the switches today automatically delete the old address when there is a change of address. With that feature, the link will be immediately established.

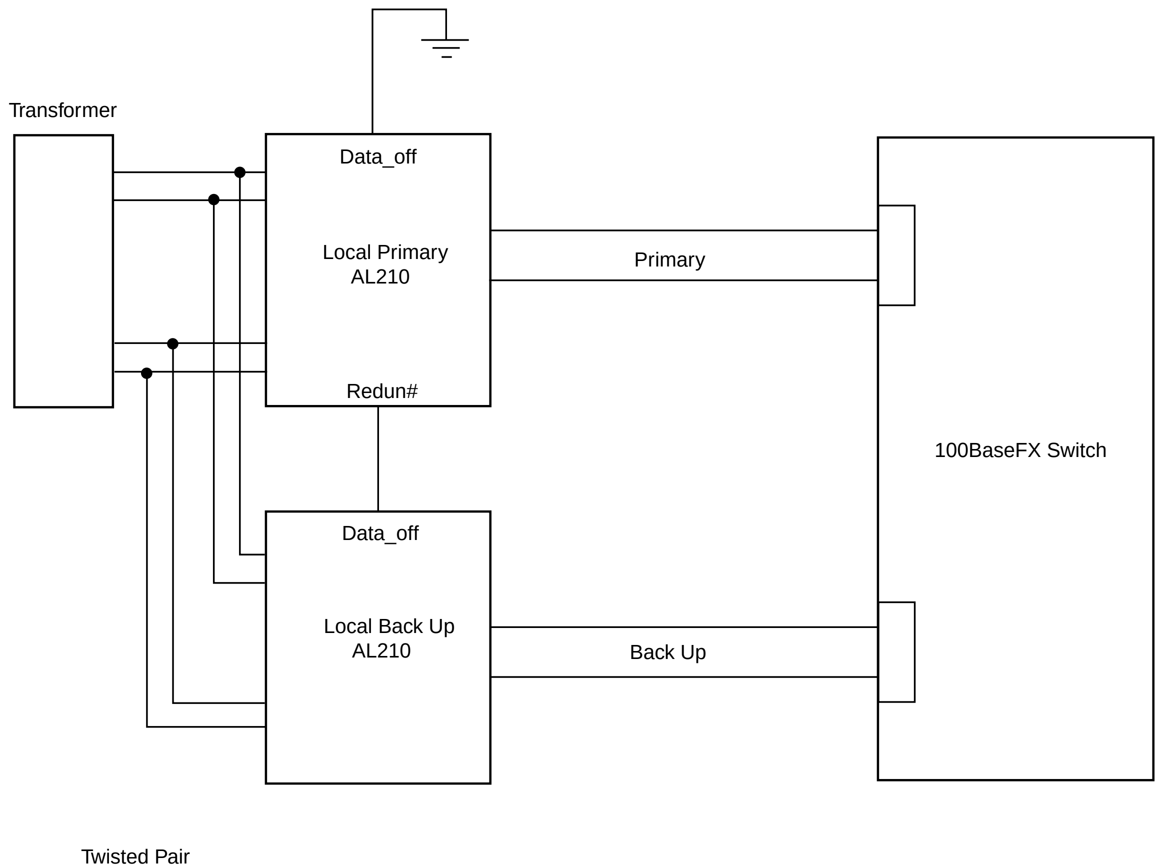


Figure 7 Redundant Link Application with Switch

2.10 LED Indicators

The AL210 provides four LED drivers which consist of activity and link indicators for both TP and fiber. If the AL210 experiences a remote link fault, the link LED (fiber only) will flash in 0.5 second intervals.

3. Electrical Specifications

Note: Operation at absolute maximum ratings outside those listed could cause permanent damage to the device.

Table 2: Maximum Ratings

DC Supply Voltage (Vcc)	-0.5V ~ +6V
DC Input Voltage	-0.3 ~ Vcc + 0.3V
DC Output Voltage	-0.3 ~ Vcc + 0.3V
Storage Temperature	-55 ^{o}C to +150 ^{o}C

Table 3: Recommended Operation Conditions

Supply Voltage	5.0 V ± 5%
Operating Temperature	0 - 70 ^{o}C
Power Dissipation	0.9W (Tx to 850nm LED) 0.65W (Tx to PECL) 0.6W (PECL to PECL)

Table 4: DC Electrical Characteristics

PARAMETER	DESCRIPTION	MIN	TYP	MAX	UNIT
Vcc	Supply voltage.	4.75	5.0	5.25	V
Voh	Output voltage-high.	2.4	-	-	V
Vol	Output voltage-low.	-	-	0.4	V
Iih (1)	Input current-high. (See note 1.)	-10	-	10	uA
Iil (1)	Input current-low. (See note 1.)	-10	-	10	uA
Iih (2)	Input current-high with internal pull down. (See note 2.)	-10	-	100	uA
Iil (2)	Input current-low with internal pull up. (See note 2.)	-200	-	10	uA
Iih (3)	Input current-high with internal pull down. (See note 3.)	-	-	1000	uA
Iil (3)	Input current-low with internal pull up. (See note 3.)	-1000	-	-	uA
Vih	Input high voltage.	0.7*Vcc	-	-	V
Vil	Input low voltage.	-	-	0.3*Vcc	V
Icc	Supply current.	-	TBD	-	mA
Vol	LED driver low (Iol = 10mA).	-	-	0.8	V
It	Transmitter current, RLED=12.8 K +/- 1%. (See note 4.)	63	70	77	mA
Vrx	Fiber receiver input voltage.	5	-	1600	mV
Tr	Fiber transmitter rise time.	-	-	1.3	ns
Tf	Fiber transmitter fall time.	-	-	1.3	ns

Note: Iih (1) refers to pin numbers: 11, 13, 21, 25, 31, and 37.
Iil (1) refers to pin numbers: 12, 22, 23, 32, 38, 45, and 48.
Iih (2) refers to pin numbers: 2, 3, 12, 22, 23, 32, 38, 43, 45, and 48.
Iil (2) refers to pin numbers: 2, 3, 5, 10, 11, 13, 21, 25, 31, 37, and 43.
Iih (3) refers to pin numbers: 5, 10, 34, and 35.
Iil (3) refers to pin numbers: 34 and 35.

Note: (4) Applicable when output operates in LED mode.

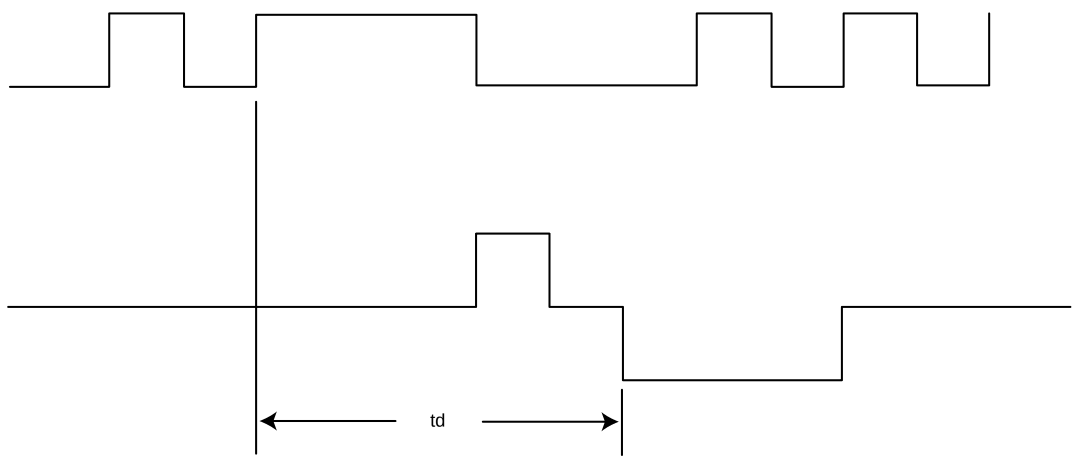


Figure 8 Fiber to TP Latency

Table 5: Fiber to TP Latency Parameters

PARAMETER	DESCRIPTION	MIN	TYP.	MAX.	UNITS
td	Fiber to TP latency without elastic store.	-	90	-	ns
td	Fiber to TP latency with elastic store.	-	120	-	ns

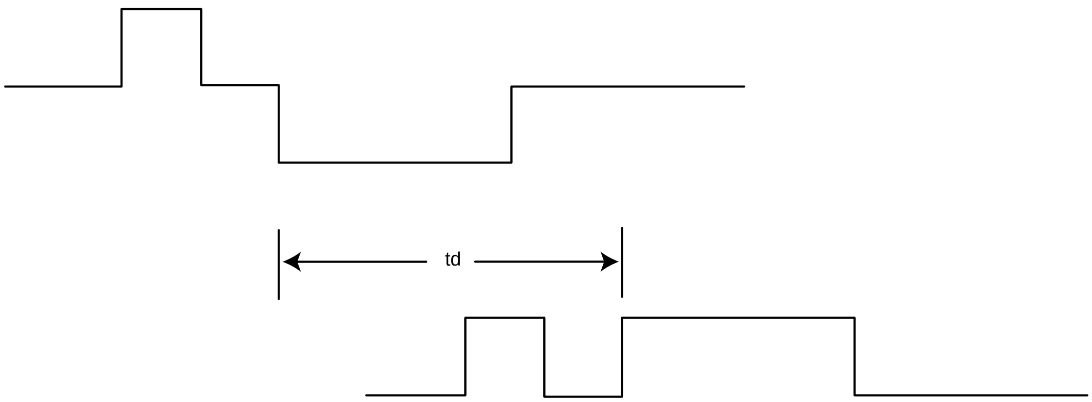


Figure 9 TP to Fiber Latency

Table 6: TP to Fiber Latency Parameters

PARAMETER	DESCRIPTION	MIN	TYP.	MAX.	UNITS
td	TP to Fiber latency without elastic store.	-	90	95	ns
td	TP to Fiber latency with elastic store.	-	120	-	ns

4. AL210 Mechanical Data

48-pin LQFP Package

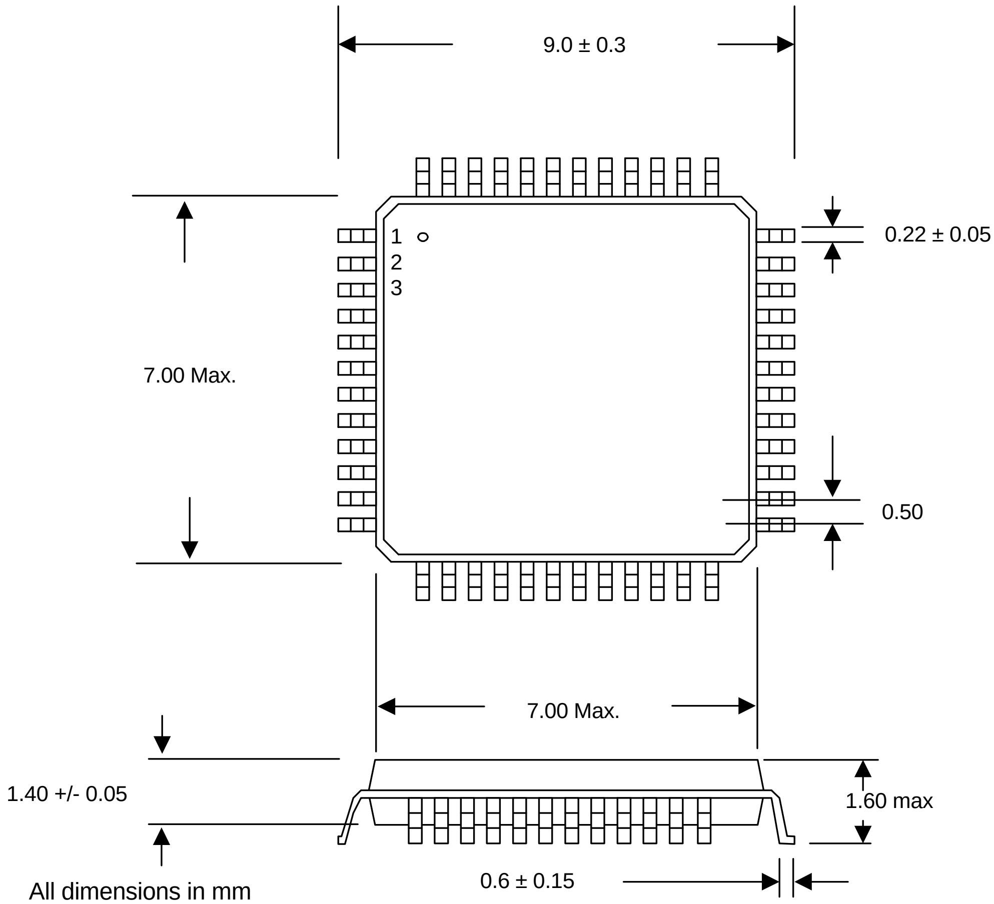


Figure 10 AL210 Mechanical Dimensions

Revision History

Rev. 1.1

1. Pin out and package change.
2. Add secondary channel.
3. Change fiber off to data blocking in redundant mode.

Rev. 1.2

1. Corrected mechanical dimensions.
2. Added AL210 applications diagram.

Rev. 1.2a (6/28/99)

1. Reformatted data sheet.

Rev. 1.3a (7/13/99)

1. Corrected application circuit illustration.

Prelim. 1.4 (8/6/99)

1. Corrected mechanical dimensions to Figure 1-11.

Prelim. 1.5 (9/21/99)

1. Corrected figures 1-7 and 1-8. Changed FOoff to Data_off.

Rev. 1.0 (5/11/00)

1. Fully released document.

Rev. 1.1 (8/30/00)

1. Removed secondary channel information.

Index

APPLICATION BRIEF

MANAGED MEDIA CONVERTERS USING THE AL210

Introduction

This application brief explains different approaches for building managed media converters.

In the past, the media converter was a device that enabled the installer to connect fiber to a copper port. However, because of availability of silicon, the media converter typically did not function as a seamless transparent connecting device. Even though the Ethernet protocol allows for integrity check of the media, the fault condition was isolated from network and the network manager. This made the network diagnostic very difficult.

Today's media converter chip (e.g. AL210), because of higher integration, allows features such as fault propagation and redundant fiber link to be implemented easily and economically. This enables the network to be more resilient and eases the media trouble-shooting task.

The ability to manage the media converter through a management agent, although is not a necessity, will make management easier. Trouble shooting and configuration can now be accomplished from the management console.

Functional Requirement

The media converter is not a switch or a hub; it is a piece of logical wire. There is no real need to know how many packets and what size the packets are that go through it. These statistics are maintained in the network hub. The real need is in configuring and reporting the status of the media converter.

Status Reporting

There are two aspects of the status of a media link, local and far-end. At each end there is a need to know the link status of the connecting ports and its operation mode. Let's assume the interest of the conversion is TP to fiber and not fiber to TP. The fiber has no auto negotiating capability and the only information available will be the link status and the far-end link status. The statuses available at the local converters are:

- Twisted Pair port status; link status
- Fiber port status; link fault and far end fault
- Activity
- Redundancy switch over (if redundancy is implemented)
- Redundant link status
- Duplex mode

The AL210 also has a built-in secondary channel for media converter management purposes. The secondary channel is piggy backed on the regular transmit packets. It is very useful in reporting far-end status. However, if the TP port is not connected, it will cause the secondary channel to be non-functional because of fault propagation.

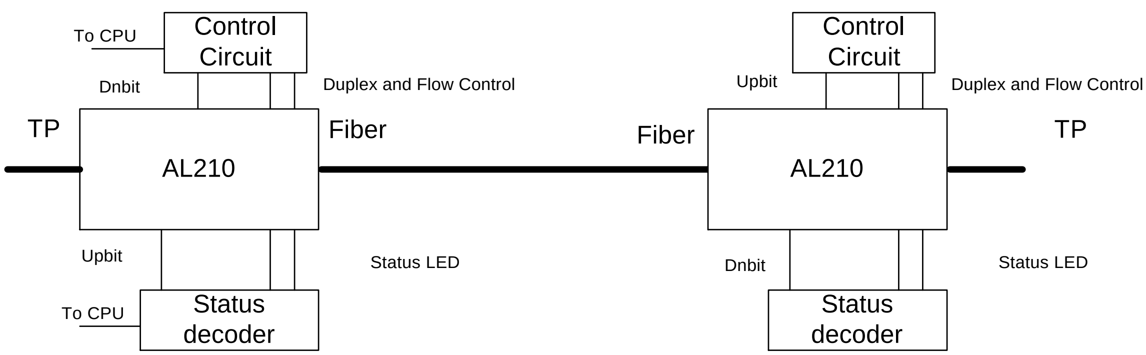
Controlling Function

Ideally, the management should be able to control the entire media link, local and far-end. The local control is very straightforward and easy. Far-end media converters can be controlled via the secondary channel. It is preferable to not turn off any media converter other than for diagnostic purposes. The reason is that once the media converter is turned off, it may not be easily turned on again.

- Port enabling or disabling (data transmission or power down)
- Controlling redundancy
- Duplex control
- Flow control set up

Management Implementation

All the functions are available in the AL210/211. In addition, the AL210/211 has a secondary channel that can support the diagnostic of the remote connecting device.



With the configuration shown, at the local media converter chassis, the status of the converter is latched into the status decoder. The CPU can then read the status from the status decoder. The AL210 includes a secondary channel that allows for communication with the remote media converter to get its status.

Statuses provided by the media converters are:

- TP link status
- Fiber link status
- Redundant link status
- Far End Fault status
- Activity (not very useful)

CONTROL	LOCAL	FAR END
TP link fault	Yes	No
Fiber link fault	Yes	Yes (available locally and via secondary channel)
Redundant channel link status	Yes	Yes (available via secondary channel)

The control circuit takes the command from the CPU and can control the media converter's operating modes. Redundancy can also be controlled using this method.

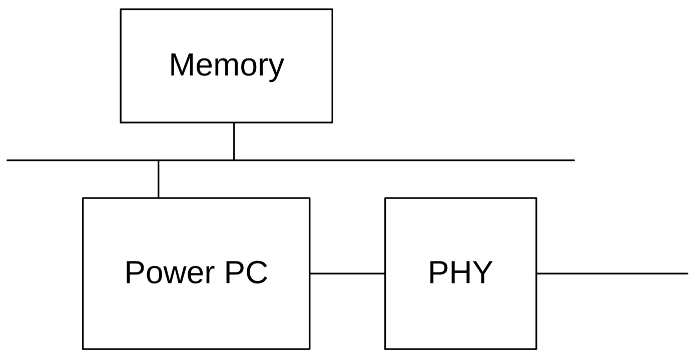
Control function provided by the media converters are:

- Power down
- Link shut down
- Forced full duplex
- Forced 802.3X flow control (it will not be functional if the connected device does not support 802.3X)

CONTROL	LOCAL	FAR END
Power down	Yes	Yes (available via secondary channel), not advised
Link shut down (data transmission only)	Yes	Yes. (Available via secondary channel).
Forcing full duplex	Yes	Yes. (Available via secondary channel).
Forcing 802.3 X flow control	Yes	Yes. (Available via secondary channel).
Turn on redundant channel	Yes	Yes, AL210 supports auto-redundancy and does not require this function. (Available via secondary channel).

Management module

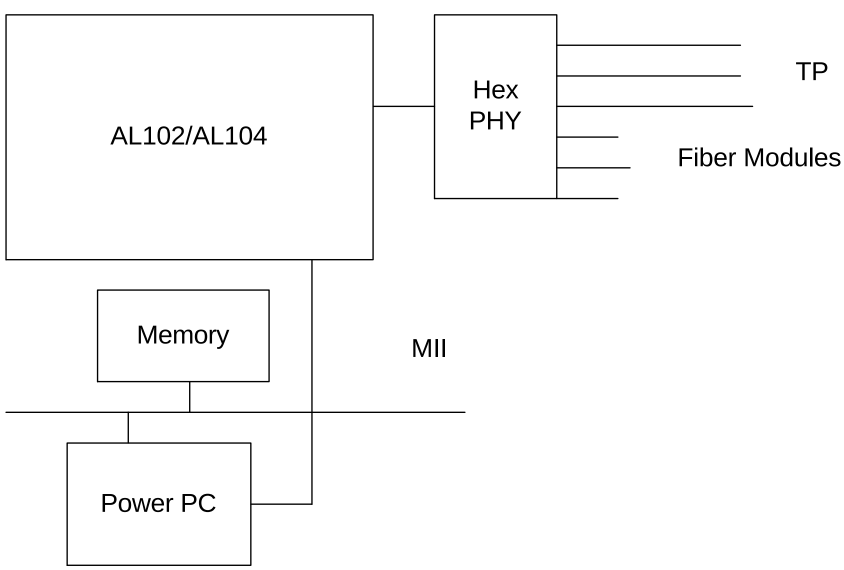
Management modules can be implemented by a single embedded CPU with an Ethernet Port or an Allayer switch.



The above implementation has the advantage of simplicity. A more advanced management module can be implemented with an Allayer switch such as the AL102A, AL104 or the AL216.

Implementing Media Converter with a switch

With the current pricing on switch ICs, it is now economically feasible to implement media converters with a switching chip. At first glance, one might argue that the latency might be too long. However, the latency issue has to do with the collision domain in a repeater environment. The switch segmented the collision domain, so the latency in this case is not relevant. In addition, the latency incurred in a switch is relatively small when compared with the latency of the cable. Even in VOIP and video applications, the requirement for maximum latency is in milliseconds, therefore the latency of a switch will not degrade the performance of the network.



In this system, each media converter is configured by port based VLAN. For an eight-port switch, four media converter ports can be made available. For a N+1 type of redundant link, the CPU can modify the VLAN and set up the redundancy. The management port can use one of the ports. This management module has the capability to map a different TP port to a different fiber port and does not require a dedicated management port. In addition, it will also convert a 10 Mbit stream to 100 Mbit stream. This along with the AL210 will provide the fullest management capability. The design concept can be expanded to a 16-port media converter, using only a single management module. For high port density this is probably the lowest cost design approach.

The shortcomings are:

- This is most cost effective in a multi-port converter module due to added cost of switching hardware. Single port implementations will be expensive.
- There is no fault propagation. Fault propagation must be implemented by hardware.
- It will discard error frames (i.e. frames longer than 1536 bytes).
- No far end management capability, unless the AL210 or AL211 is used as the fiber front end.