

USB to Fast Ethernet/HomePNA Controller

Document No.: AX170-12 / V1.2 / Apr. 11 ' 01

Features

- Single chip USB to 10/100Mbps Fast Ethernet and 1/10Mbps HomePNA Network Controller
- Compliant with USB specification 1.0 and 1.1
- Full Speed USB Device with bus power capability
- USB Communication Class Spec 1.0 Compliant
- Support 4 endpoints on USB
- IEEE 802.3u 100BASE-T, TX, and T4 Compatible
- Embedded 5K*16 bit SRAM
- Support both full-duplex or half-duplex operation on Fast Ethernet
- Provides a MII port for both Ethernet and HomePNA PHY interface
- Supports suspended mode and remote wakeup (link_up or magic packet)
- Optional PHY power down mode for power saving
- Provides optional MII/RMII interface with PHY mode for multiple ports USB-to-USB bridge application.
- Support 256/512 bytes serial EEPROM (used for saving USB Descriptors)
- Support automatic loading of Ethernet ID, USB Descriptors and Adapter Configuration from EEPROM on power-on initialization
- External PHY loop-back diagnostic capability
- Small form factor 64-pin LQFP package
- 48MHz and 25MHz Operation, pure 3.3V operation with I/O 5V tolerance

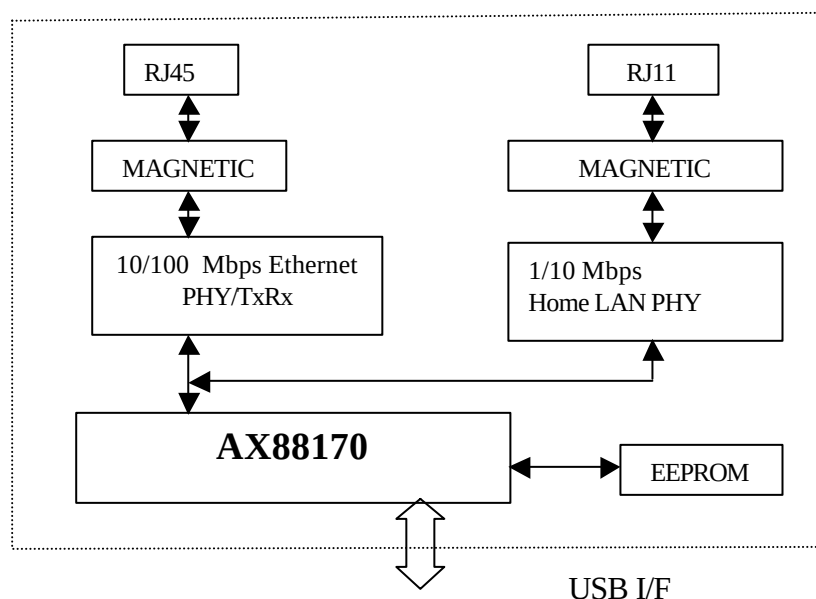
*IEEE is a registered trademark of the Institute of Electrical and Electronic Engineers, Inc.

*All other trademarks and registered trademark are the property of their respective holders.

Product description

The AX88170 USB to Fast Ethernet/HomePNA Controller is a high performance and highly integrated Controller with embedded 5K*16 bit SRAM. The AX88170 contains a USB interface to host CPU and compliant with USB Standard V1.0 and V1.1. The interface between AX88170 and PC Host is compliant with USB Communication Class Specification 1.0. The AX88170 could be used for both 10M/100Mbps Fast Ethernet function based on IEEE802.3 / IEEE802.3u LAN standard and 1M/10M HomePNA standard. The AX88170 supports media-independent interface (MII) or RMII (Reduce MII) interface to simplify the design on implementing Fast Ethernet and HomePNA functions. The chip also provides an optional MII/RMII interface with PHY mode, combine with Ethernet repeater or switch IC can build a multiple ports USB-to-USB bridge application.

System Block Diagram



Always contact ASIX for possible updates before starting a design.

This data sheet contains new products information. ASIX ELECTRONICS reserves the rights to modify product specification without notice. No liability is assumed as a result of the use of this product. No rights under any patent accompany the sale of the product.



CONTENTS

1.0 INTRODUCTION	4
1.1 GENERAL DESCRIPTION:.....	4
1.2 AX88170 BLOCK DIAGRAM:	4
1.3 AX88170 PIN CONNECTION DIAGRAM WITH MII INTERFACE	5
1.4 AX88170 PIN CONNECTION DIAGRAM WITH RMII INTERFACE	6
2.0 SIGNAL DESCRIPTION.....	7
2.1 USB BUS INTERFACE SIGNALS GROUP	7
2.2 EEPROM SIGNALS GROUP	7
2.3A MII INTERFACE SIGNALS GROUP (MAC MODE)	7
2.3B MII INTERFACE SIGNALS GROUP (PHY MODE).....	8
2.4 RMII INTERFACE SIGNAL PINS (PHY MODE)	9
2.5 MISCELLANEOUS PINS GROUP	9
3.0 EEPROM MEMORY MAPPING.....	11
4.0 USB COMMANDS	12
4.1 USB STANDARD COMMANDS.....	12
4.2 USB COMMUNICATION CLASS COMMANDS	13
4.3 USB VENDOR COMMANDS.....	14
5.0 USB CONFIGURATION STRUCTURE.....	16
5.1 USB CONFIGURATION.	16
5.2 USB INTERFACE CLASS.	16
5.3 USB ENDPOINTS.....	16
6.0 ELECTRICAL SPECIFICATION AND TIMINGS	17
6.1 ABSOLUTE MAXIMUM RATINGS.....	17
6.2 GENERAL OPERATION CONDITIONS.....	17
6.3 DC CHARACTERISTICS.....	17
6.4 A.C. TIMING CHARACTERISTICS.....	18
6.4.1 25M_XIN	18
6.4.2 48M_XIN	18
6.4.3 Reset Timing.....	18
6.4.4 MII Timing of MAC mode.....	20
6.4.5 MII Timing of PHY mode	21
6.4.6 RMII Interface Timing of PHY Mode.....	22
6.4.7 STATION MANAGEMENT TIMING.....	23
6.4.8 SERIAL EEPROM TIMING.....	24
7.0 PACKAGE INFORMATION.....	25
APPENDIX A: SYSTEM APPLICATIONS	26
A.1 USB TO FAST ETHERNET CONVERTER.....	26
A.2 USB TO FAST ETHERNET AND/OR HOMELAN COMBO SOLUTION	27
A.3 USB-TO-USB OR USB-TO-ETHERNET BRIDGE THROUGH ETHERNET REPEATER CONTROLLER.....	28
A.4 USB-TO-USB OR USB-TO-ETHERNET BRIDGE THROUGH ETHERNET SWITCH CONTROLLER.....	28
DEMONSTRATION CIRCUIT A: AX88170 + ETHERNET PHY	29
DEMONSTRATION CIRCUIT B: AX88170 + HOMEPNA 1M8 PHY	31
DEMONSTRATION CIRCUIT C: 4 USB PORTS + 1 ETHERNET PORT BRIDGE AP.....	33



FIGURES

FIG - 1 AX88170 BLOCK DIAGRAM	4
FIG - 2 AX88170 PIN CONNECTION DIAGRAM WITH MII INTERFACE	5
FIG - 3 AX88170 PIN CONNECTION DIAGRAM RMII INTERFACE	6

TABLES

TAB - 1 USB BUS INTERFACE SIGNALS GROUP	7
TAB - 2 EEPROM BUS INTERFACE SIGNALS GROUP	7
TAB - 3 MII INTERFACE SIGNALS GROUP (MAC MODE)	8
TAB - 4 MII INTERFACE SIGNALS GROUP (PHY MODE)	8
TAB - 5 RMII INTERFACE SIGNAL PINS (PHY MODE)	9
TAB - 6 MISCELLANEOUS PINS GROUP	10
TAB - 7 EEPROM MEMORY MAPPING	11



1.0 Introduction

1.1 General Description:

The AX88170 USB to Fast Ethernet Controller is a high performance and highly integrated USB bus Ethernet Controller with embedded 5K*16 bit SRAM. The AX88170 contains a full speed USB interface to host CPU and compliant with USB Communication Class Spec. 1.0. The AX88170 implements both 10Mbps and 100Mbps Ethernet function based on IEEE802.3 / IEEE802.3u LAN standard. The AX88170 supports media-independent interface (MII) or RMII (Reduce MII) interface to simplify the design on implementing Fast Ethernet and HomePNA functions. The chip also provides an optional MII/RMII interface with PHY mode, combines with Ethernet repeater or switch IC can build a multiple ports USB-to-USB bridge application.

AX88170 uses 64-pin LQFP low profile package, 48MHz operation for USB and 25MHz operation for Ethernet, CMOS process with pure 3.3V operation and 5 Volt I/O tolerance.

1.2 AX88170 Block Diagram:

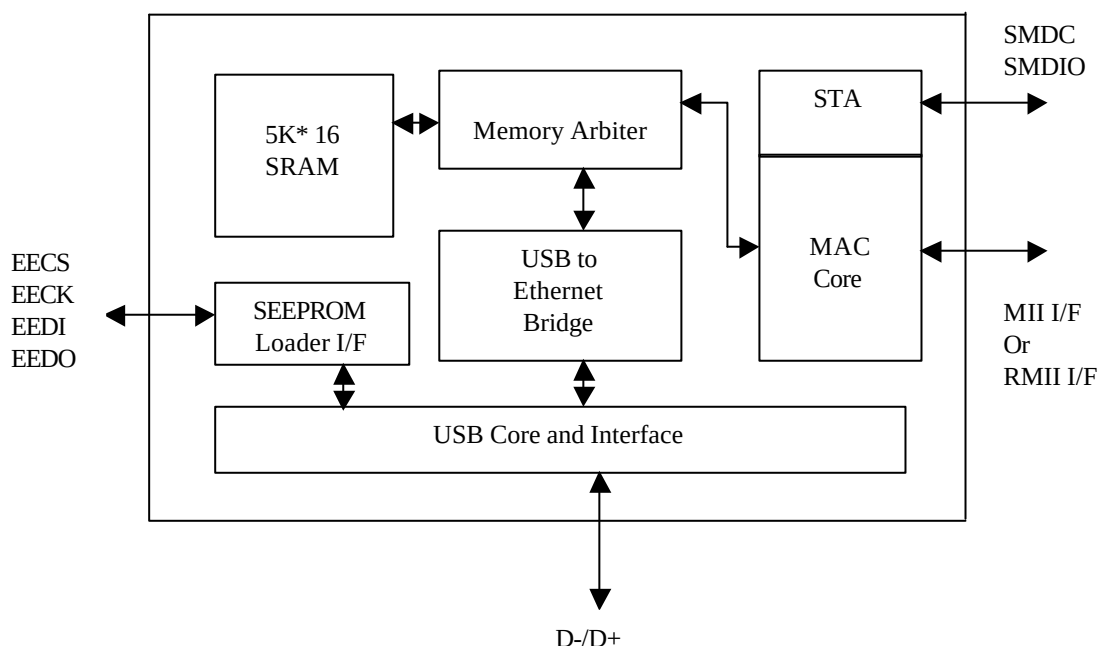


Fig – 1 AX88170 Block Diagram



1.3 AX88170 Pin Connection Diagram with MII Interface

The AX88170 is housed in the 64-pin plastic light quad flat pack. See Fig – 2 AX88170 Pin Connection Diagram.

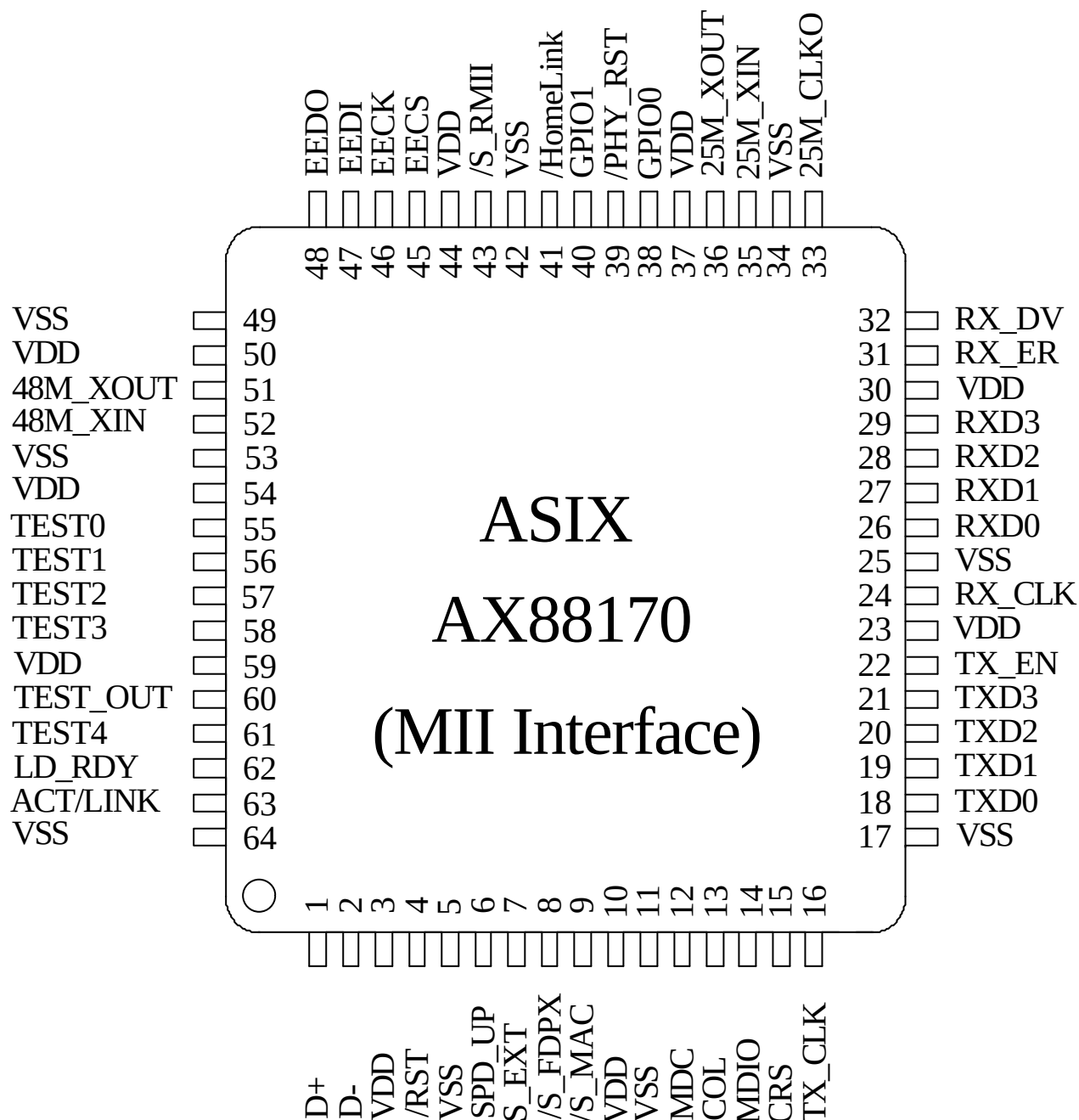


Fig – 2 AX88170 Pin Connection Diagram with MII Interface



1.4 AX88170 Pin Connection Diagram with RMII Interface

The AX88170 is housed in the 64-pin plastic light quad flat pack. See Fig – 3 AX88170 Pin Connection Diagram RMII Interface.

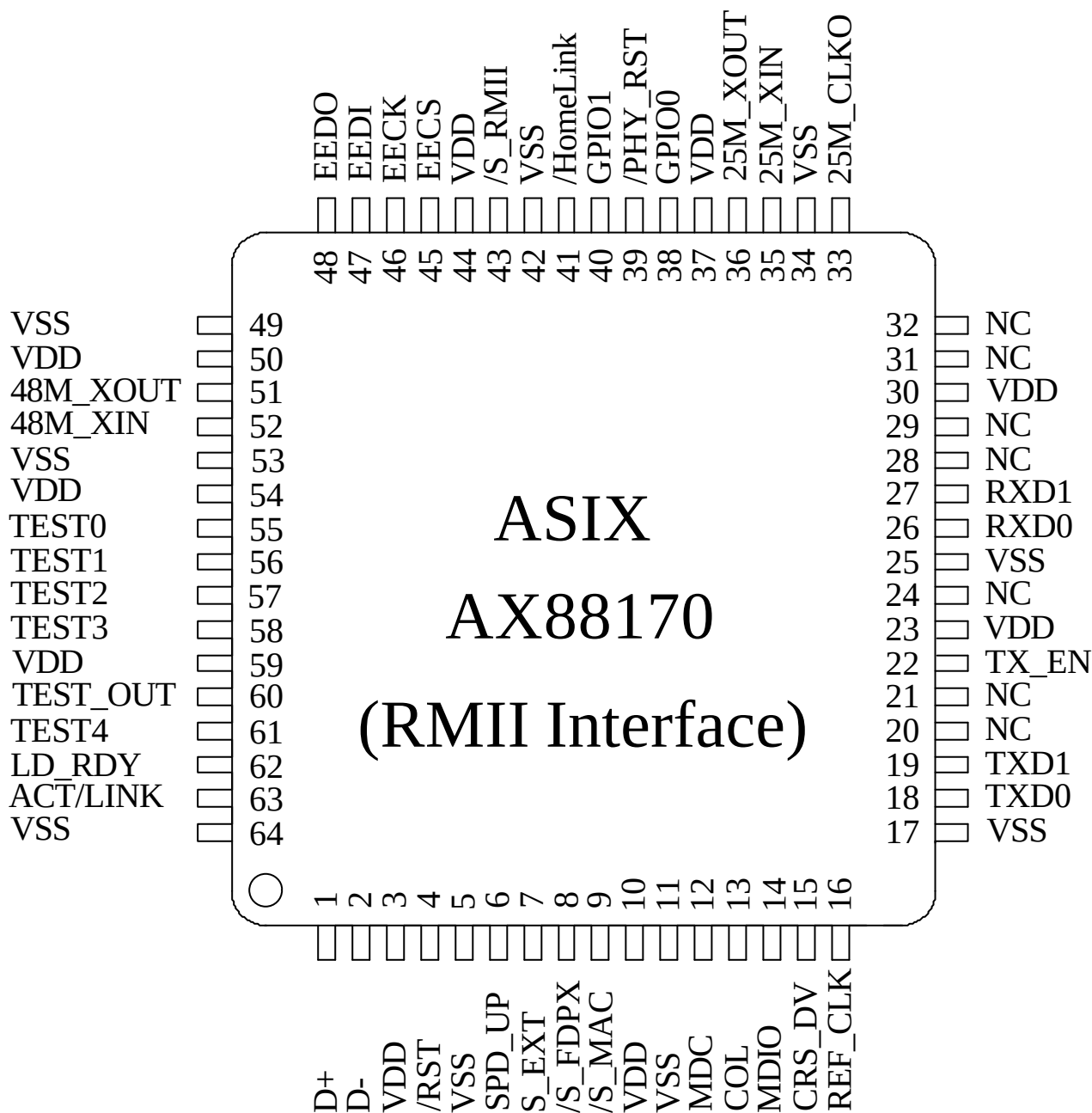


Fig – 3 AX88170 Pin Connection Diagram RMII Interface



2.0 Signal Description

The following terms describe the AX88170 pin-out:

All pin names with the “/” suffix are asserted low.

The following abbreviations are used in following Tables.

I	Input	PU	Pull Up
O	Output	PD	Pull Down
I/O	Input/Output	P	Power Pin
OD	Open Drain		

2.1 USB Bus Interface Signals Group

SIGNAL	TYPE	PIN NO.	DESCRIPTION
D+	I/O	1	USB Data Plus Pin
D-	I/O	2	USB Data Minus Pin

Tab – 1 USB bus interface signals group

2.2 EEPROM Signals Group

SIGNAL	TYPE	PIN NO.	DESCRIPTION
EECS	O	45	EEPROM Chip Select : EEPROM chip select signal.
EECK	O	46	EEPROM Clock : Signal connected to EEPROM clock pin.
EEDI	O	47	EEPROM Data In : Signal connected to EEPROM data input pin.
EEDO	I/PU	48	EEPROM Data Out : Signal connected to EEPROM data output pin.

Tab – 2 EEPROM bus interface signals group

2.3a MII interface signals group (MAC mode)

When /S_RMII=1 and /S_MAC=0

SIGNAL	TYPE	PIN NO.	DESCRIPTION
RXD[3:0]	I/PU	29, 28 27, 26	Receive Data: RXD[3:0] is driven by the PHY synchronously with respect to RX_CLK.
CRS	I/PD	15	Carrier Sense: Asynchronous signal CRS is asserted by the PHY when either the transmit or receive medium is non-idle.
RX_DV	I/PD	32	Receive Data Valid: RX_DV is driven by the PHY synchronously with respect to RX_CLK. Asserted high when valid data is present on RXD [3:0].
RX_ER	I/PD	31	Receive Error: RX_ER is driven by PHY and synchronous to RX_CLK, is asserted for one or more RX_CLK periods to indicate to the port that an error has detected.
RX_CLK	I/PU	24	Receive Clock: RX_CLK is a continuous clock that provides the timing reference for the transfer of the RX_DV, RXD[3:0] and RX_ER signals from the PHY to the MII port of the MAC.
COL	I/PD	13	Collision: this signal is driven by PHY when collision is detected.
TX_EN	O	22	Transmit Enable: TX_EN is transition synchronously with respect to the rising edge of TX_CLK. TX_EN indicates that the port is presenting



SIGNAL	TYPE	PIN NO.	DESCRIPTION
			nibbles on TXD [3:0] for transmission.
TXD[3:0]	O	21, 20 19, 18	Transmit Data: TXD[3:0] is transition synchronously with respect to the rising edge of TX_CLK. For each TX_CLK period in which TX_EN is asserted ,TXD[3:0] are accepted for transmission by the PHY.
TX_CLK	I	16	Transmit Clock: TX_CLK is a continuous clock from PHY. It provides the timing reference for the transfer of the TX_EN and TXD[3:0] signals from the MII port to the PHY.
MDC	O	12	Station Management Data Clock: The timing reference for MDIO. All data transfers on MDIO are synchronized to the rising edge of this clock. MDC is a 2.5MHz frequency clock output.
MDIO	I/O/PU	14	Station Management Data Input/Output: Serial data input/output transfers from/to the PHYs. The transfer protocol conforms to the IEEE 802.3u MII specification.

Tab – 3 MII interface signals group (MAC mode)

2.3b MII interface signals group (PHY mode)

When /S_RMII=1 and /S_MAC=1

SIGNAL	TYPE	PIN NO.	DESCRIPTION
RXD[3:0]	O	29, 28 27, 26	Receive Data: Basically RXD[3:0] is transformed from TXD[3:0] of MAC mode of MII interface.
CRS	O	15	Carrier Sense: Basically CRS is transformed from TX_EN of MAC mode of MII interface.
RX_DV	O	32	Receive Data Valid: Basically RX_DV is transformed from TX_EN of MAC mode of MII interface.
RX_ER	O	31	Receive Error: No used
RX_CLK	O	24	Receive Clock: Basically RX_CLK is sourced from internal 25MHz local clock.
COL	O	13	Collision: this signal is generated by internal logic when collision is detected.
TX_EN	I/PD	22	Transmit Enable: Basically TX_EN is simulation from RX_DV of MAC mode of MII interface.
TXD[3:0]	I/PU	21, 20 19, 18	Transmit Data: Basically TXD[3:0] is simulation from RXD[3:0] of MAC mode of MII interface.
TX_CLK	O	16	Transmit Clock: Basically TX_CLK is sourced from internal 25MHz local clock.

Tab – 4 MII interface signals group (PHY mode)



2.4 RMII interface signal pins (PHY mode)

When /S_RMII=0 and /S_MAC=1

SIGNAL	TYPE	PIN NO.	DESCRIPTION
RXD[1:0]	O	27, 26	Receive Data : Basically RXD[1:0] is transformed from TXD[1:0] of MAC mode of RMII interface.
CRS_DV	O	15	Carrier Sense _ Data Valid : Basically CRS_DV is transformed of TX_EN from MAC mode of RMII interface.
TXD[1:0]	I/PU	19, 18	Transmit Data : Basically TXD[1:0] is transformed from RXD[1:0] of MAC mode of RMII interface.
TX_EN	I/PD	22	Transmit Enable : Basically TX_EN is transformed from RX_DV from MAC mode of RMII interface.
REF_CLK	I	16	Reference clock : The input is a continue clock at 50Mhz for timing reference with RMII interface.

Tab – 5 RMII interface signal pins (PHY mode)

2.5 Miscellaneous pins group

SIGNAL	TYPE	PIN NO.	DESCRIPTION
25M_XIN	I	35	CMOS Local Clock : Typical a 25Mhz clock, +/- 100 ppm, 40%-60% duty cycle. (See application note also) Crystal Oscillator Input : Typical a 25Mhz crystal, +/- 25 ppm can be connected across 25M_XIN and 25M_XOUT.
25M_XOUT	O	36	Crystal Oscillator Output : Typical a 25Mhz crystal, +/- 25 ppm can be connected across 25M_XIN and 25M_XOUT. If a single-ended external clock is connected to 25M_XIN, the crystal output pin should be left floating.
48M_XIN	I	52	48Mhz CMOS Clock In : Typical a 48Mhz clock, +/- 500 ppm, 40%-60% duty cycle. (See application note also) 48Mhz Crystal Oscillator Input: Typical a 48Mhz crystal, +/- 100 ppm can be connected across 48M_XIN and 48M_XOUT.
48M_XOUT	O	51	48Mhz Crystal Oscillator Output: Typical a 48Mhz crystal, +/- 100 ppm can be connected across 48M_XIN and 48M_XOUT. If a single-ended external clock is connected to 48M_XIN, the crystal output pin should be left floating.
25M_CLKO	O	33	Clock Output : This clock is source from 25M_XIN.
/RST	I/PD	4	Reset: Reset is active low then place AX88170 into reset mode immediately. During Rising edge the AX88170 loads the EEPROM data.
/S_RMII	I/PU	43	Set to RMII mode: 0: RMII mode is selected. 1: MII mode is selected. (default)
/S_MAC	I/PD	9	Set MII/RMII interface to MAC mode: 0: MAC mode is selected. (default) 1: PHY mode is selected.
/S_FDPX	I/PD	8	Set duplex mode when PHY mode is selected or When S_EXT is set and MAC mode is selected: 0: full-duplex mode is selected. (default) 1: half-duplex mode is selected.
S_EXT	I/PD	7	Select where duplex mode is sourced from when MAC mode: 0: duplex mode depends on internal register. (default) 1: duplex mode depends on external signal /S_FDPX
SPD_UP	ID	6	The setting is enable speed up test mode:



			0: Normal operation mode. 1: Speed up test mode enable.
TEST0	I/PD	55	Test Pin: This pin for test purpose only. Pull down the pin or keep no connection for normal operation.
TEST1	I/PD	56	Test Pin: This pin for test purpose only. Pull down the pin or keep no connection for normal operation.
TEST2	I	57	Test Pin: This pin for test purpose only. Pull down the pin for normal operation.
TEST3	I/PD	58	Test Pin: This pin for test purpose only. Pull down the pin or keep no connection for normal operation.
TEST4	I/PD	61	Test Pin: This pin for test purpose only. Pull down the pin or keep no connection for normal operation.
TEST_OUT	O	60	Test Output Pin: This pin for test purpose only.
LDRDY	O	62	Load EEPROM data completed indicator. Active high.
ACT/LINK	O	63	LED indicator: When link fail, drives logic high always. When link OK, the pin drives logic low and will drives high a period when line has activity (data transfer).
/PHY_RST	O	39	PHY Reset: This pin is used to reset PHY and is an active low signal.
GPIO0	B/PD	38	General Purpose I/O 0: Refer to section 4.3 USB Vendor Commands
GPIO1	B/PD	40	General Purpose I/O 1: Refer to section 4.3 USB Vendor Commands
/HOMELINK	I/PU	41	Link Status: For external HomePHY link state input active low
VDD	P	3, 10, 23, 30 37, 44, 50 54, 59	Power Supply: +3.3V DC.
VSS	P	5, 11 17, 25, 34 42, 49, 53 64	Power Supply: +0V DC or Ground Power.

Tab - 6 Miscellaneous pins group

MII/RMII interface Cross Reference Table

MII	RMII
RXD[0]	RXD[0]
RXD[1]	RXD[1]
RXD[2]	
RXD[3]	
CRS	CRS_DV
RX_DV	
RX_CLK	
RX_ER	
TX_EN	TX_EN
TX_CLK	REF_CLK (50MHz)
TXD[0]	TXD[0]
TXD[1]	TXD[1]
TXD[2]	
TXD[3]	
COL	



3.0 EEPROM Memory Mapping

EEPROM OFFSET	HIGH BYTE	LOW BYTE
00H	RESERVED	WORD COUNT FOR PRELOAD
01H	*FLAG	
02H	LENGTH OF DEVICE DESCRIPTOR (BYTE)	EEPROM OFFSET OF DEVICE DESCRIPTOR
03H	LENGTH OF CONFIGURATION DESCRIPTOR (BYTE)	EEPROM OFFSET OF CONFIGURATION DESCRIPTOR
04H	NODE ID 1	NODE ID 0
05H	NODE ID 3	NODE ID 2
06H	NODE ID 5	NODE ID 4
07H	LANGUAGE ID HIGH BYTE	LANGUAGE ID LOW BYTE
08H	LENGTH OF STRING INDEX 1	EEPROM OFFSET OF STRING INDEX 1
09H	LENGTH OF STRING INDEX 2	EEPROM OFFSET OF STRING INDEX 2
0AH	LENGTH OF STRING INDEX 3	EEPROM OFFSET OF STRING INDEX 3
0BH	LENGTH OF STRING INDEX 4	EEPROM OFFSET OF STRING INDEX 4
0CH	LENGTH OF STRING INDEX 5	EEPROM OFFSET OF STRING INDEX 5
0DH	LENGTH OF STRING INDEX 6	EEPROM OFFSET OF STRING INDEX 6
0EH	LENGTH OF STRING INDEX 7	EEPROM OFFSET OF STRING INDEX 7
0FH	LENGTH OF STRING INDEX 8	EEPROM OFFSET OF STRING INDEX 8 (19H)
10H	MAX PACKETSIZE HIGH BYTE	MAX PACKET LOW BYTE
11H	HOME PNA PHY ID	ETHERNET PHY ID
12H	PAUSE PACKET HIGH WATER LEVEL	PAUSE PACKET LOW WATER LEVEL
13H-18H	RESERVED	
19H	03H	0CH
1AH	BYTE 2 OF UNICODE MAC ADDRESS	**BYTE 1 OF UNICODE MAC ADDRESS
1BH	BYTE 4 OF UNICODE MAC ADDRESS	BYTE 3 OF UNICODE MAC ADDRESS
1CH	BYTE 6 OF UNICODE MAC ADDRESS	BYTE 5 OF UNICODE MAC ADDRESS
1DH	BYTE 8 OF UNICODE MAC ADDRESS	BYTE 7 OF UNICODE MAC ADDRESS
1EH	BYTE 10 OF UNICODE MAC ADDRESS	BYTE 9 OF UNICODE MAC ADDRESS
1FH	BYTE 12 OF UNICODE MAC ADDRESS	BYTE 11 OF UNICODE MAC ADDRESS
20H-4FH	DEVICE /CONFIGURATION /INTERFACE /ENDPOINT DESCRIPTOR	
50H-FFH	STRINGS	

Tab - 7 EEPROM Memory Mapping

Note:

*Flag: Bit 0 → Self Powered (for USB GetStatus) Bit 1 → Bus Powered (Reserved)
 Bit 2 → Remote Wakeup (for USB GetStatus) Bit 3 → Interrupt Endpoint Enable (Reserved)
 Bit 4 → ClkNoStop (for Self Power only) Bit 5 → Reserved
 Bit 6 → Reserved Bit 7 → Reserved
 Bit 8 → Capture Effective Mode Bit 9 → Flow Control selector (1: software, 0: read from PHY)
 Bit A – F → Reserved

Bit 4 also effect LED display, if high then LED display USB active only otherwise display USB link and activity.
 (In Self power mode Bit_4 set to high)

**Unicode MAC Address:

If the MAC's NODE ID is 01,23,45,67,89,ABh respect to NODE ID 0, NODE ID 1, ... NODE ID5 Then the unicode will be 30-31,32-33,34-35,36-37,38-39,41-42h respects to BYTE 1 OF UNICODE MAC ADDRESS- BYTE 2 OF UNICODE MAC ADDRESS, ...-BYTE 12 OF UNICODE MAC ADDRESS.



4.0 USB Commands

There are three command groups for Endpoint 0 in AX88170:

- The USB standard commands
- USB Communication Class commands
- USB vendor commands.

4.1 USB standard commands

** The Language ID is 0x0904 for English

** PLL means buffer length

** CC means configuration number

** I I means Interface number

SETUP COMMAND	DATA IN/OUT	DESCRIPTION
80 06 00 01 00 00 LL PP	Data PLL bytes	Get Device Descriptor
80 06 00 02 00 00 LL PP	Data PLL bytes	Get Configuration Descriptor
80 06 00 03 00 00 LL PP	Data 2 bytes	Get Supported Language ID
80 06 01 03 09 04 LL PP	Data PLL bytes	Get Manufacture String
80 06 02 03 09 04 LL PP	Data PLL bytes	Get Product String
80 06 03 03 09 04 LL PP	Data PLL bytes	Get Serial Number String
80 06 04 03 09 04 LL PP	Data PLL bytes	Get Configuration String
80 06 05 03 09 04 LL PP	Data PLL bytes	Get Interface 0 String
80 06 06 03 09 04 LL PP	Data PLL bytes	Get Interface 1/0 String
80 06 07 03 09 04 LL PP	Data PLL bytes	Get Interface 1/1 String
80 06 08 03 09 04 LL PP	Data 12 bytes	Get Ethernet Address String
80 08 00 00 00 00 01 00	Data 1 bytes	Get Configuration
00 09 CC 00 00 00 00 00	No Data	Set Configuration
81 0A 00 00 I I 00 01 00	Data 1 byte	Get Interface
01 0B AS 00 01 00 00 00	No Data	Set Interface



4.2 USB Communication Class Commands

** NN: number of multicast addresses

** BBAA: Ethernet Packet Filter

** TTSS: Number of Ethernet Statics

SETUP COMMAND	DATA IN/OUT	DESCRIPTION
21 40 NN 00 00 00 6*N 00	Data 6*N bytes	Set Ethernet Multicast Filters
21 41 00 00 00 00 10 00	Data 16 bytes	Set Ethernet Power Management Pattern
A1 42 00 00 00 00 02 00	Data 2 bytes	Get Ethernet Power Management Pattern
21 43 AA BB 00 00 00 00	No Data	Set Ethernet Packet Filter (AA BB)

Description of Ethernet Packet Filter (AA BB) Bitmap

BB = [D15:D8]

AA = [D7:D0]

Bit position	DESCRIPTION
D15..D5	RESERVED (Reset to Zero)
D4	PACKET_TYPE_MULTICAST 1: All multicast packets enumerated in the device's multicast address list are forwarded up to the host. 0: Disabled.
D3	PACKET_TYPE_BROADCAST 1: All broadcast packet packets received by the networking device are forwarded up to the host. 0: Disable.
D2	PACKET_TYPE_DIRECTED 1: Directed packets received containing a destination address equal to the MAC address of the networking device are forwarded up to the host. 0: Always not set to Zero.
D1	PACKET_TYPE_ALL_MULTICAST 1: ALL multicast frames received by the networking device are forwarded up to the host, not just the ones enumerated in the device's multicast address list. 0: Disabled.
D0	PACKET_TYPE_PROMISCUOUS 1: ALL frames received by the networking device are forwarded up to the host. 0: Disabled.

Tab - 9 Ethernet Packet Filter Bitmap



4.3 USB Vendor Commands

SETUP COMMAND	DATA IN/OUT	DESCRIPTION
C0 02 XX YY 00 0M 02 00	Data 2 bytes	Read Rx/Tx SRAM M = 0 : Rx, M=1 : Tx
40 03 XX YY PP QQ 00 00	No Data	Write Rx SRAM
40 04 XX YY PP QQ 00 00	No Data	Write Tx SRAM
40 06 00 00 00 00 00 00	No Data	Disable H/W MII Operation
C0 07 PI 00 RG 00 02 00	Data 2 Bytes	Read MII Register
40 08 PI 00 RG 00 02 00	Data 2 Bytes	Write MII Register
C0 09 00 00 00 00 01 00	Data 1 Bytes	Read MII Operation Mode
40 0A 00 00 00 00 00 00	No Data	Enable H/W MII Operation
C0 0B DR 00 00 00 02 00	Data 2 Bytes	Read SROM
40 0C DR 00 MM SS 00 00	No Data	Write SROM
40 0D 00 00 00 00 00 00	No Data	Write SROM Enable
40 0E 00 00 00 00 00 00	No Data	Write SROM Disable
C0 0F 00 00 00 00 02 00	Data 2 Bytes	Read Rx Control Register
40 10 RR 00 00 00 00 00	No Data	Write Rx Control Register
C0 11 00 00 00 00 03 00	Data 3 Bytes	Read IPG/IPG1/IPG2 Register
40 12 II 00 00 00 00 00	No Data	Write IPG Register
40 13 II 00 00 00 00 00	No Data	Write IPG1 Register
40 14 II 00 00 00 00 00	No Data	Write IPG2 Register
C0 15 00 00 00 00 08 00	Data 8 Bytes	Read Multi-Filter Array
40 16 00 00 00 00 08 00	Data 8 Bytes	Write Multi-Filter Array
C0 17 00 00 00 00 06 00	Data 6 Bytes	Read Node ID
C0 19 00 00 00 00 02 00	Data 2 Bytes	Read Ethernet/HomePNA PhyID
C0 1A 00 00 00 00 01 00	Data 1 Byte	Read Medium Status(*)
40 1B MM 00 00 00 00 00	No Data	Write Medium Mode(*)
C0 1C 00 00 00 00 01 00	Data 1 Byte	Get Monitor Mode Status(**)
40 1D MM 00 00 00 00 00	No Data	Set Monitor Mode On/Off(**)

Notes:

* Read / Write Medium status

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Read	GPI1	X	GPI0	X	Home_Link	100MHz	Full_Duplex	Link
Write	GPO1	GPO1EN	GPO0	GPO0EN	FRBI	100MHz	Full_Duplex	Link

** Read / Write Monitor Mode

	Bit7-5	Bit4	Bit3	Bit2	Bit1	Bit0
Read	Reserved (Hardware_Version for ASIX only)	Flow_Contron_En	X	Magic_Packet_En	Link_UP_Wake	Monitor_Mode
Write	X	Flow_Contron_En	X	Magic_Packet_En	Link_UP_Wake	Monitor_Mode



Interrupt Endpoint report link status format

Byte Number		
Byte 0	A1	Fixed value
Byte 1	00	Fixed value
Byte 2	NN	Bit_0 : Ethernet Link state, Bit_1 : Home PHY Link state (active high)
Byte 3	00	Fixed value
Byte 4	NN	Bit_0 : 100MHz speed detect
Byte 5	NN	Reserved (Hardware version for ASIX only)
Byte 6	NN	Bit_0 : Full Duplex
Byte 7	00	Fixed value



5.0 USB Configuration Structure

5.1 USB Configuration.

The AX88170 supports 1 Configuration only.

5.2 USB Interface Class.

The AX88170 supports 2 interfaces, the interface 0 is Data Interface and interface 1 is for Communication Interface.

5.3 USB Endpoints.

The AX88170 supports 4 endpoints.

Endpoint 0 → Control endpoint, it is for configuring device.

Endpoint 1 → (optional) Interrupt endpoint, it is for reporting status change

Endpoint 2 → Bulk Out endpoint, it is for Transmitting Ethernet Packet.

Endpoint 3 → Bulk In endpoint, it is for Receiving Ethernet Packet.



6.0 Electrical Specification and Timings

6.1 Absolute Maximum Ratings

Description	SYM	Min	Max	Units
Operating Temperature	Ta	0	+85	°C
Storage Temperature	Ts	-55	+150	°C
Supply Voltage	Vdd	-0.3	+3.6	V
Input Voltage	Vin	-0.3	Vdd+0.3	V
Output Voltage	Vout	-0.3	Vdd+0.3	V
Lead Temperature (soldering 10 seconds maximum)	Tl	-55	+240	°C

Note: Stress above those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to Absolute Maximum Ratings conditions for extended period, adversely affect device life and reliability.

6.2 General Operation Conditions

Description	SYM	Min	Tpy	Max	Units
Operating Temperature	Ta	0	25	+70	°C
Supply Voltage	Vdd	+3.0	+3.30	+3.6	V

6.3 DC Characteristics

(Vdd=3.0V to 3.6V, Vss=0V, Ta=0°C to 70°C)

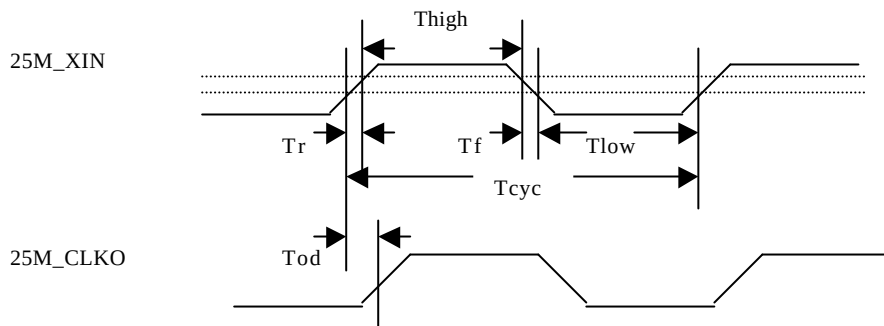
Description	SYM	Min	Tpy	Max	Units
Low Input Voltage	Vil	-		0.3*Vdd	V
High Input Voltage	Vih	0.7*Vdd		-	V
Low Output Voltage	Vol	-		0.4	V
High Output Voltage	Voh	2.4		-	V
Input Leakage Current	Iil	-1		+1	uA
Output Leakage Current	Iol	-10		+10	uA
Input Pull-up / down resistance	Ri		75		K ohm

Description	SYM	Min	Tpy	Max	Units
Power Consumption (3.3V)	SPt3v		40		mA



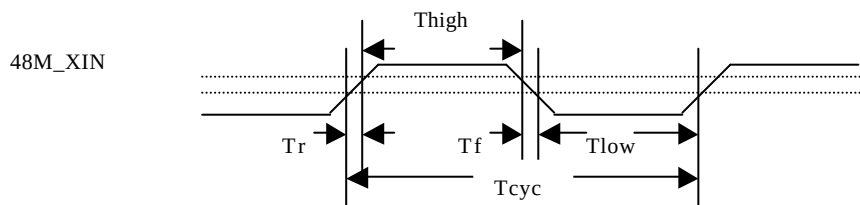
6.4 A.C. Timing Characteristics

6.4.1 25M_XIN



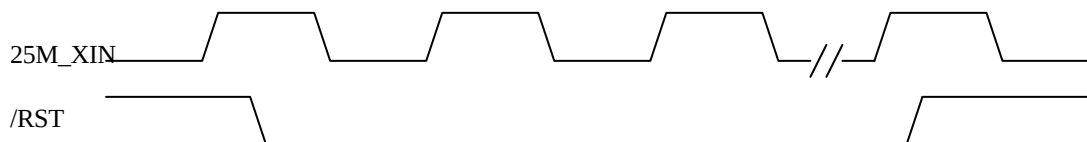
Symbol	Description	Min	Typ.	Max	Units
Tcyc	CYCLE TIME		40		ns
Thigh	CLK HIGH TIME	16	20	24	ns
Tlow	CLK LOW TIME	16	20	24	ns
Tr/Tf	CLK SLEW RATE	1	-	4	ns
Tod	LCLK/XTALIN TO 25M_CLKO OUT DELAY	8		29	ns

6.4.2 48M_XIN



Symbol	Description	Min	Typ.	Max	Units
Tcyc	CYCLE TIME		20.83		ns
Thigh	CLK HIGH TIME	8.3	10.42	12.5	ns
Tlow	CLK LOW TIME	8.3	10.42	12.5	ns
Tr/Tf	CLK SLEW RATE	1	-	4	ns

6.4.3 Reset Timing



Symbol	Description	Min	Typ.	Max	Units
Trst	Reset pulse width	100	-	-	25M_XIN



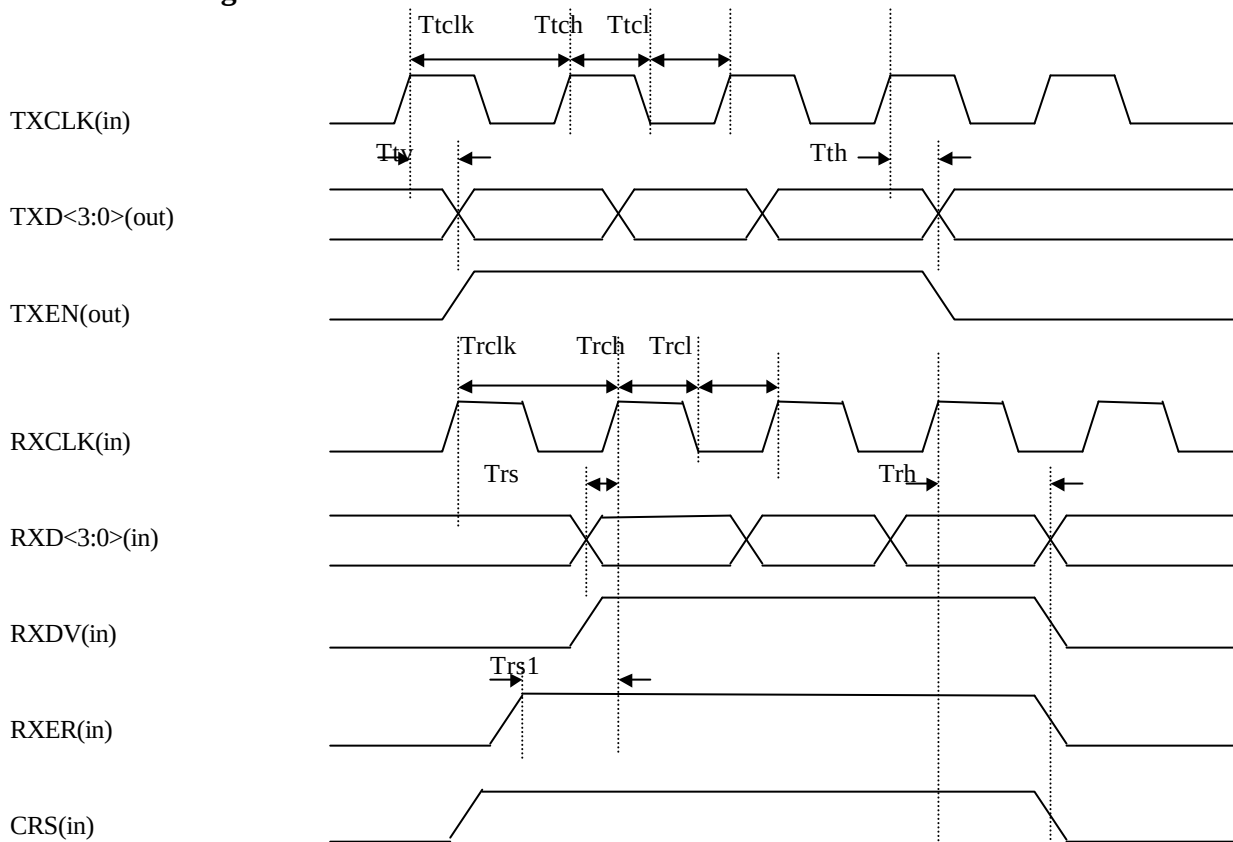
AX88170

CONFIDENTIAL

PRELIMINARY



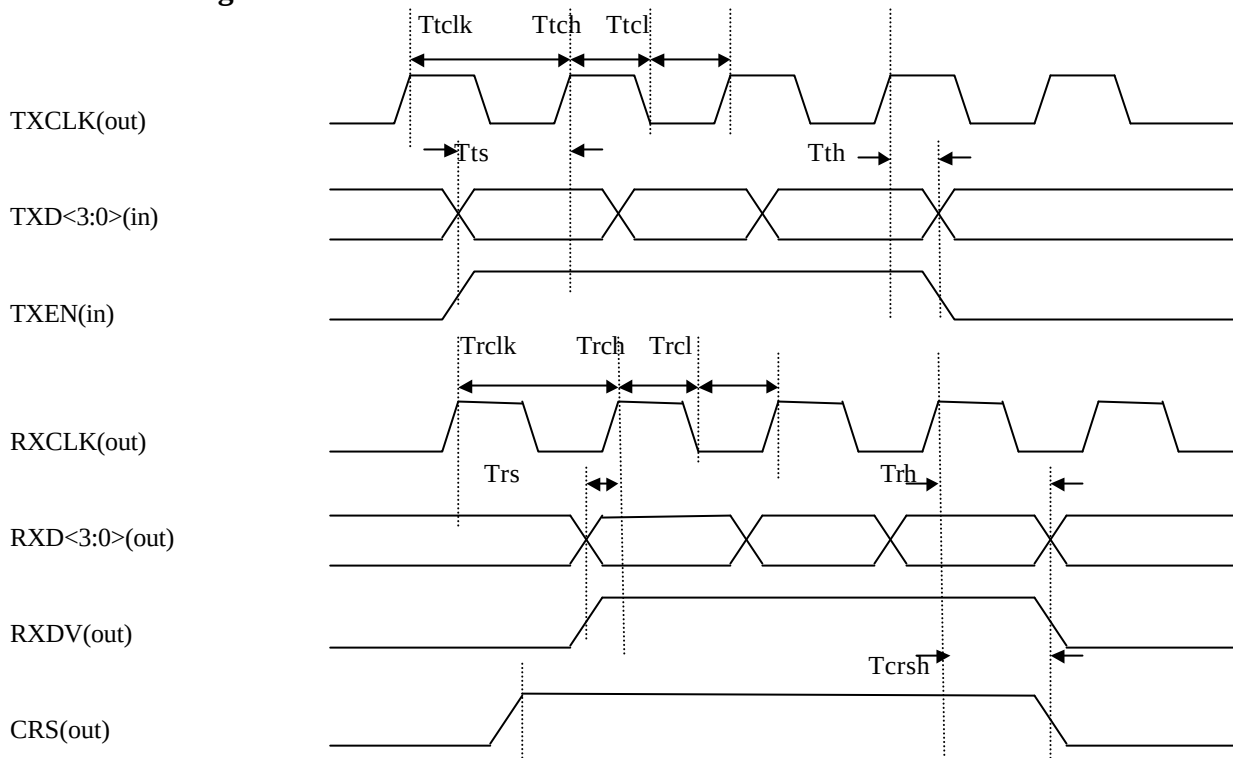
6.4.4 MII Timing of MAC mode



Symbol	Description	Min	Typ.	Max	Units
Ttclk	Cycle time(100Mbps)	-	40	-	ns
Ttclk	Cycle time(10Mbps)	-	400	-	ns
Ttch	high time(100Mbps)	14	-	26	ns
Ttch	high time(10Mbps)	140	-	260	ns
Trch	low time(100Mbps)	14	-	26	ns
Trch	low time(10Mbps)	140	-	260	ns
Ttv	Clock to data valid	-	-	20	ns
Tth	Data output hold time	5	-	-	ns
Trclk	Cycle time(100Mbps)	-	40	-	ns
Trclk	Cycle time(10Mbps)	-	400	-	ns
Trch	high time(100Mbps)	14	-	26	ns
Trch	high time(10Mbps)	140	-	260	ns
Trcl	low time(100Mbps)	14	-	26	ns
Trcl	low time(10Mbps)	140	-	260	ns
Trs	data setup time	6	-	-	ns
Trh	data hold time	10	-	-	ns
Trs1	RXER data setup time	10	-	-	ns



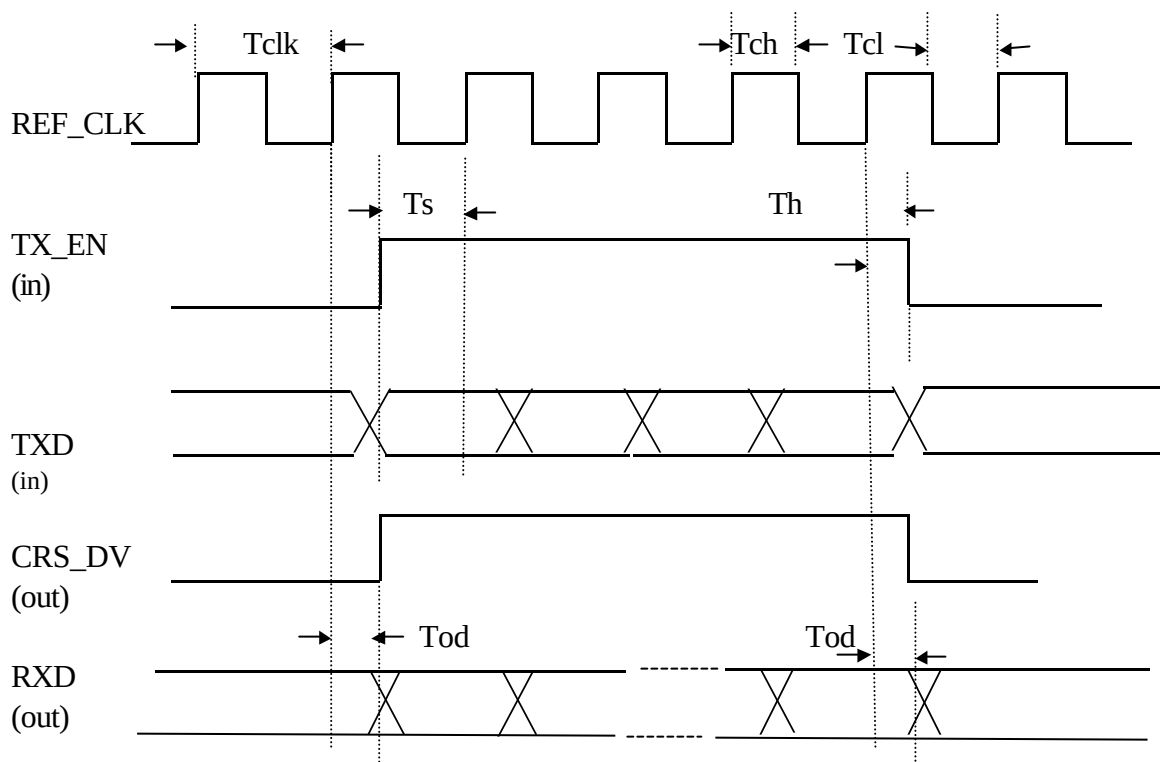
6.4.5 MII Timing of PHY mode



Symbol	Description	Min	Typ.	Max	Units
Ttclk	Cycle time(100Mbps)	-	40	-	ns
Ttclk	Cycle time(10Mbps)	-	400	-	ns
Ttch	high time(100Mbps)	14	-	26	ns
Ttch	high time(10Mbps)	140	-	260	ns
Trch	low time(100Mbps)	14	-	26	ns
Trch	low time(10Mbps)	140	-	260	ns
Tts	TXD, TXEN setup to TXCLK high	15	-	-	ns
Tth	TXD, TXEN hold to TXCLK high	0	-	-	ns
Trclk	Cycle time(100Mbps)	-	40	-	ns
Trclk	Cycle time(10Mbps)	-	400	-	ns
Trch	high time(100Mbps)	14	-	26	ns
Trch	high time(10Mbps)	140	-	260	ns
Trcl	low time(100Mbps)	14	-	26	ns
Trcl	low time(10Mbps)	140	-	260	ns
Trv	RXD, RXDV valid to RXCLK high	10	-	-	ns
Trh	RXCLK high to RXD, RXDV invalid	10	-	-	ns
Tcrsh	RXCLK high to CRS invalid	10	-	-	ns



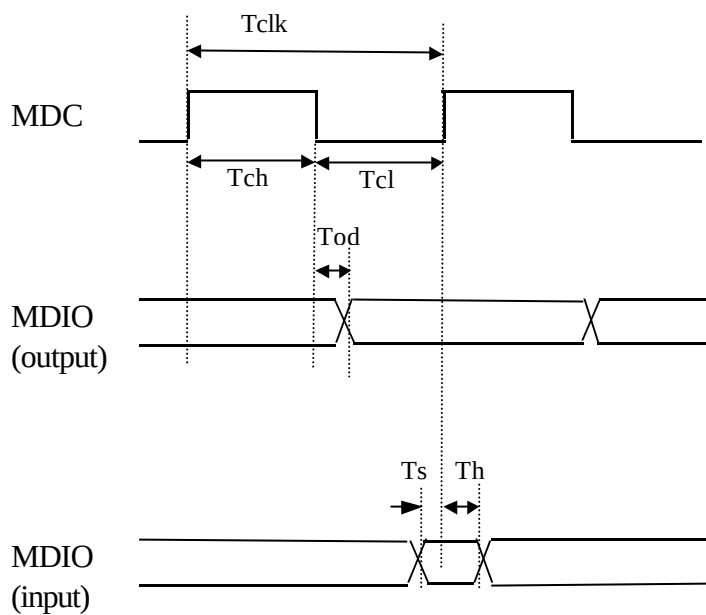
6.4.6 RGMII Interface Timing of PHY Mode



Symbol	Description	Min	Typ.	Max	Units
Tclk	REF_CLK Clock Cycle Time	19.998	20	20.002	ns
Tch	REF_CLK Clock High Time	7	10	13	ns
Tcl	REF_CLK Clock Low Time	7	10	13	ns
Ts	TXEN and TXD data setup to REF_CLK high	4			ns
Th	TXEN and TXD data hold from REF_CLK high	2			ns
Tod	REF_CLK rising edge to CRS_DV, RXD delay	4			ns



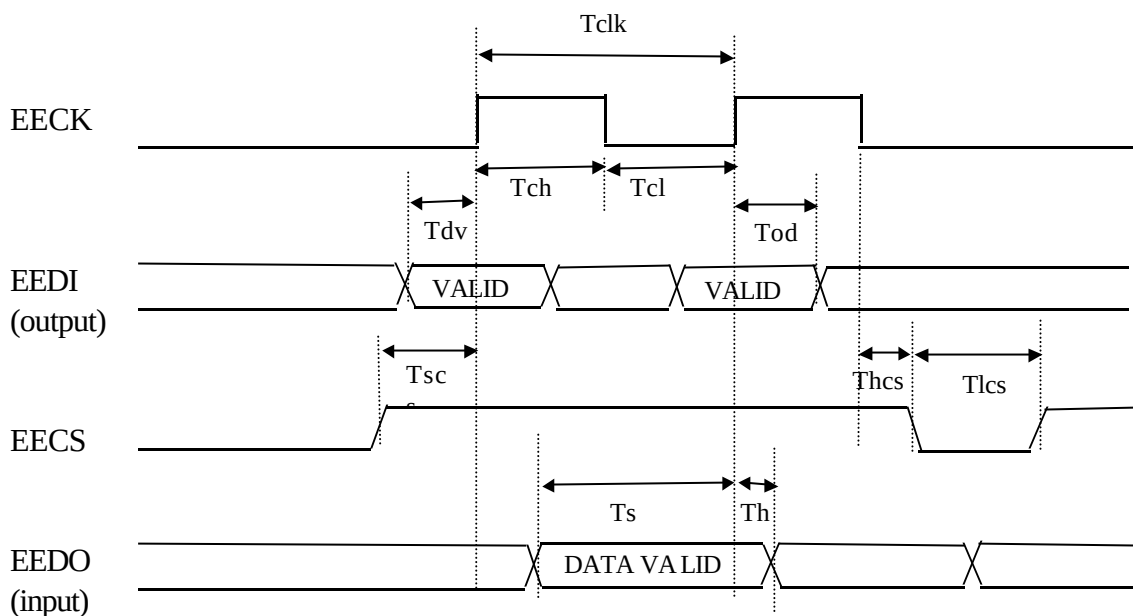
6.4.7 STATION MANAGEMENT TIMING



Symbol	Description	Min	Typ.	Max	Units
T_{clk}	MDC Clock Cycle Time		2560		ns
T_{ch}	MDC Clock High Time		1280		ns
T_{cl}	MDC Clock Low Time		1280		ns
T_{od}	Clock Falling Edge to Output Valid Delay	2		9	ns
T_s	Data In Setup Time	10			ns
T_h	Data In Hold Time	100			ns



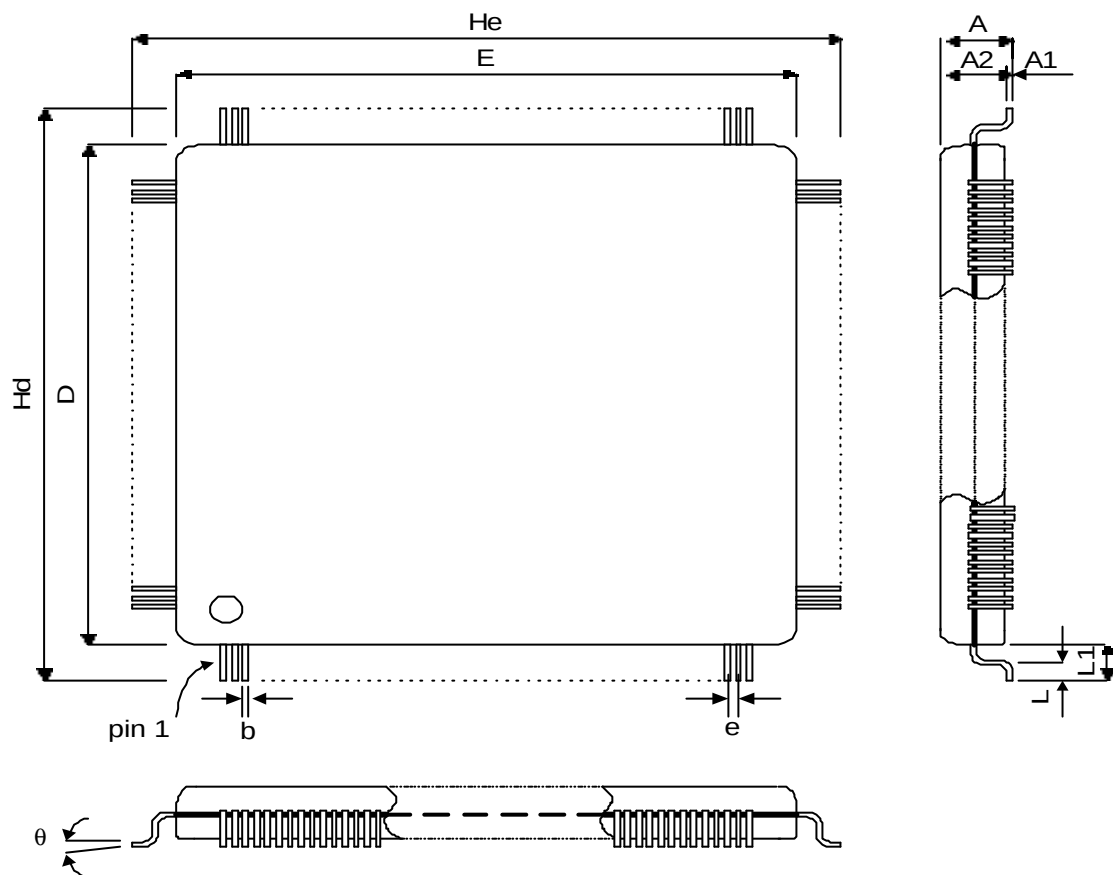
6.4.8 SERIAL EEPROM TIMING



Symbol	Description	Min	Typ.	Max	Units
Tclk	EECK Clock Cycle Time		5120		ns
Tch	EECK Clock High Time	2500		9	ns
Tcl	EECK Clock Low Time	2500		9	ns
Tdv	EEDI Data Valid Output to EECK High Time	500			ns
Tod	EECK High to EEDI Data Output Delay Time	500			ns
Tscs	EECS Valid to EECK High Time	300			ns
Thcs	EECK Low to EECS Invalid Time	0			ns
Tlcs	Minimum EECS Low Time	2500			ns
Ts	Data Input Setup Time	10			ns
Th	Data Input Hold Time	100			ns



7.0 Package Information



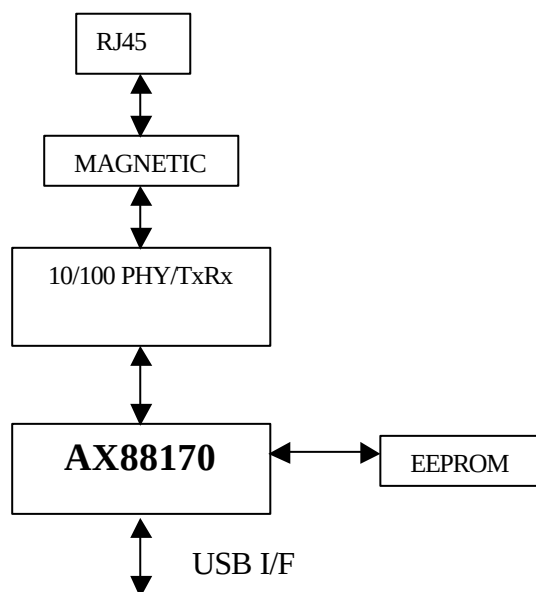


SYMBOL	MILIMETER		
	MIN.	NOM	MAX
A1	0.05	0.1	0.15
A2	1.35	1.40	1.45
A			1.60
b	0.17	0.22	0.27
D		10.00	
E		10.00	
e		0.5	
Hd		12.00	
He		12.00	
L	0.45	0.60	0.75
L1		1.00	
θ	0°	3.5°	7°

Appendix A: System Applications

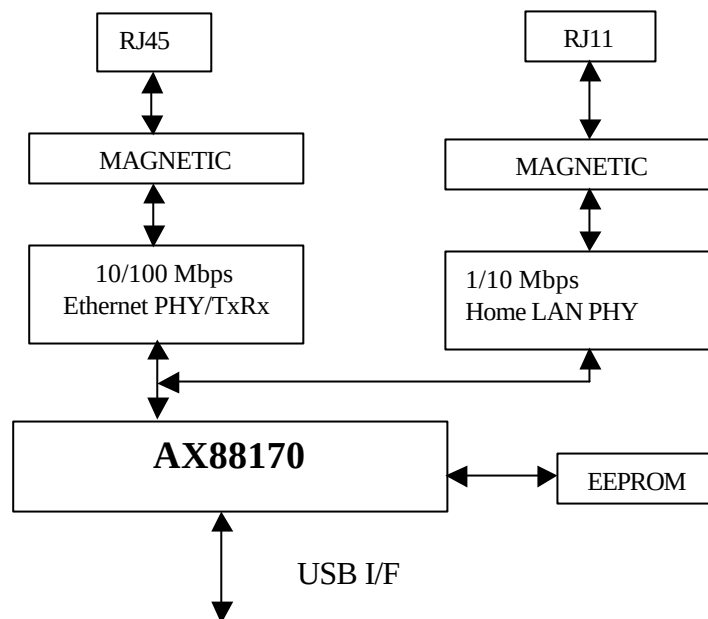
Some typical applications for AX88170 are illustrated bellow.

A.1 USB to Fast Ethernet Converter



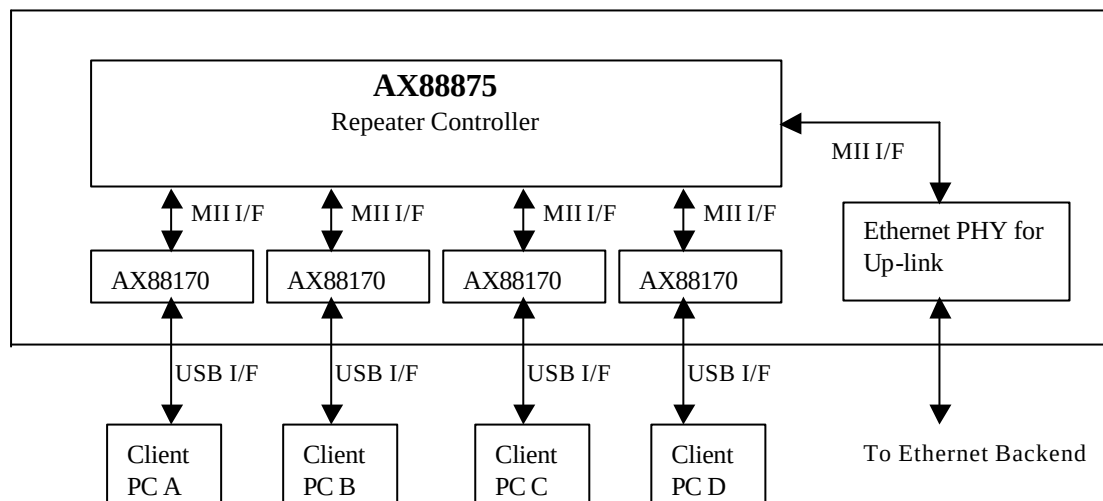


A.2 USB to Fast Ethernet and/or HomeLAN Combo solution



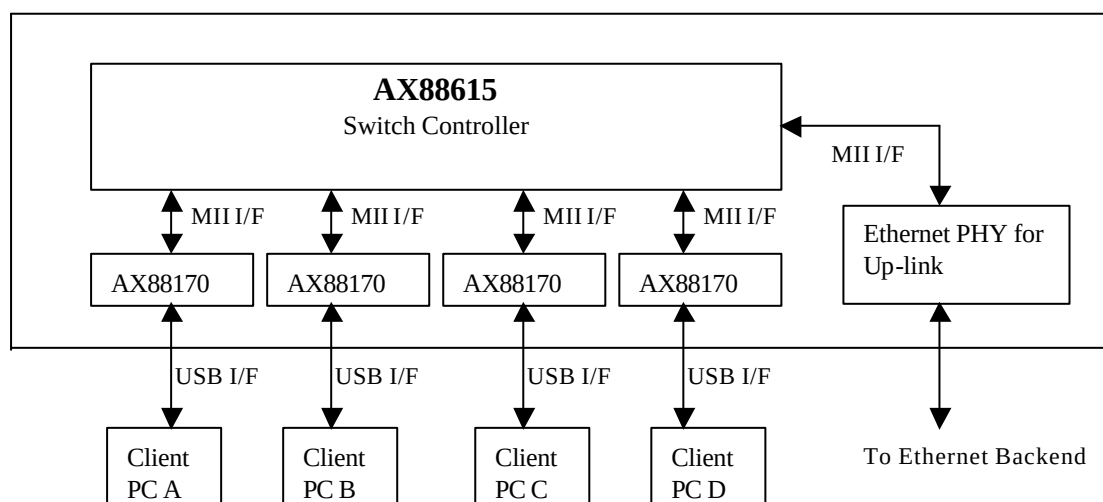


A.3 USB-to-USB or USB-to-Ethernet Bridge through Ethernet Repeater Controller



Note : Using AX88871 for 8-port or less than 8-port solutions.

A.4 USB-to-USB or USB-to-Ethernet Bridge through Ethernet Switch Controller





Demonstration Circuit B: AX88170 + HomePNA 1M8 PHY

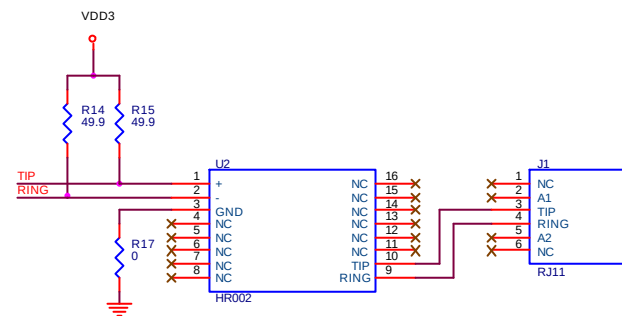
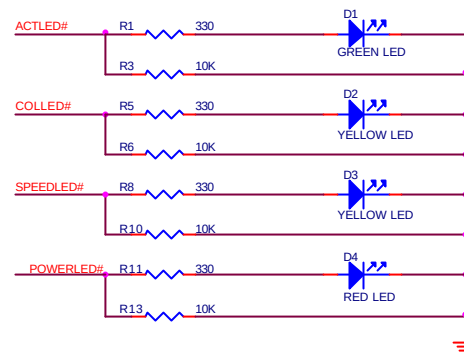
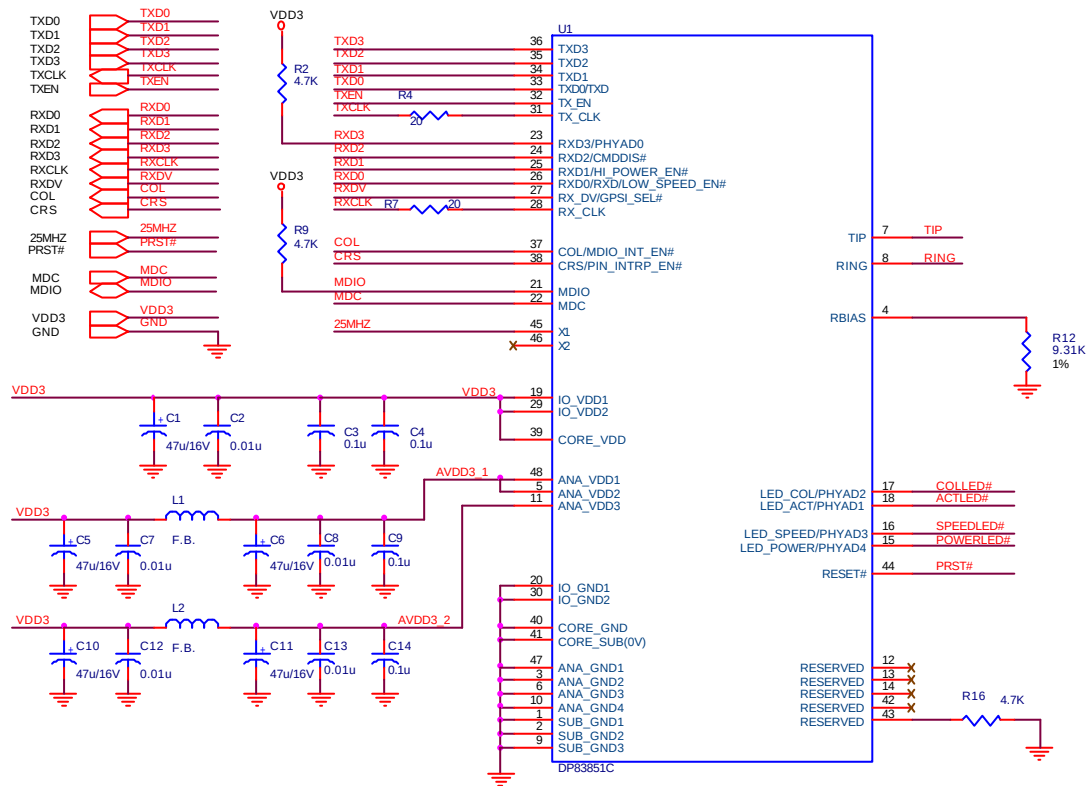
ASIX ELECTRONIC CORPORATION				
Title AX88170				
Size B	Document Number 170AP2A.SCH			Rev. 2.
Date:	Monday, February 26, 2001	Sheet	2	of 2



AX88170

USB to Fast Ethernet/HomePNA Controller

Set PHY Address TO 00001 and LED DISPLAY C.K.T. :



Title		
HOMENET PHY C.K.T.		
Size	Document Number	Rev
B	170AP2A1.SCH	2.0
Date:	Monday, February 26, 2001	Sheet 1 of 2

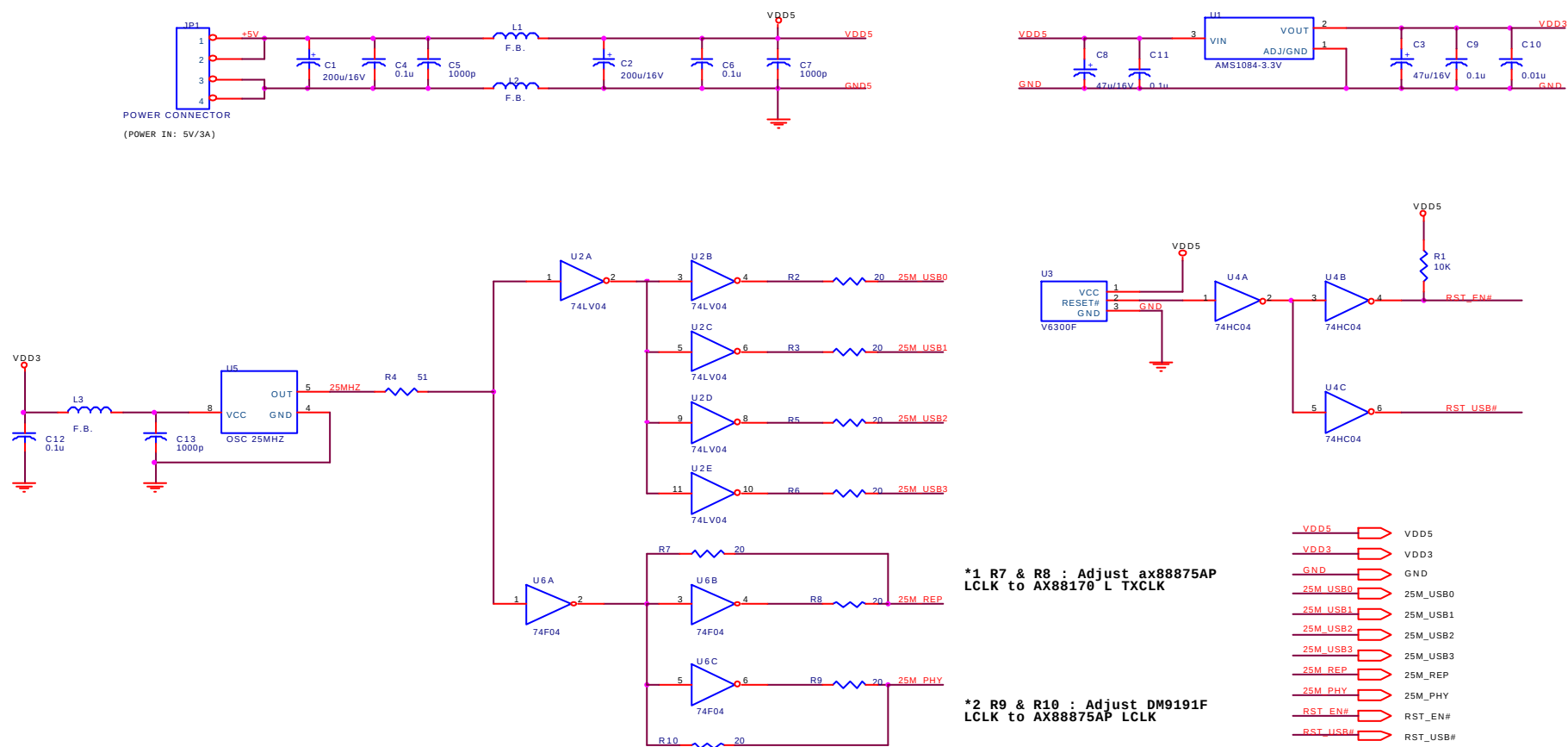


AX88170

USB to Fast Ethernet/HomePNA Controller

Demonstration Circuit C: 4 USB Ports + 1 Ethernet Port Bridge AP

AX88170 L PHY mode application (MII Interface)

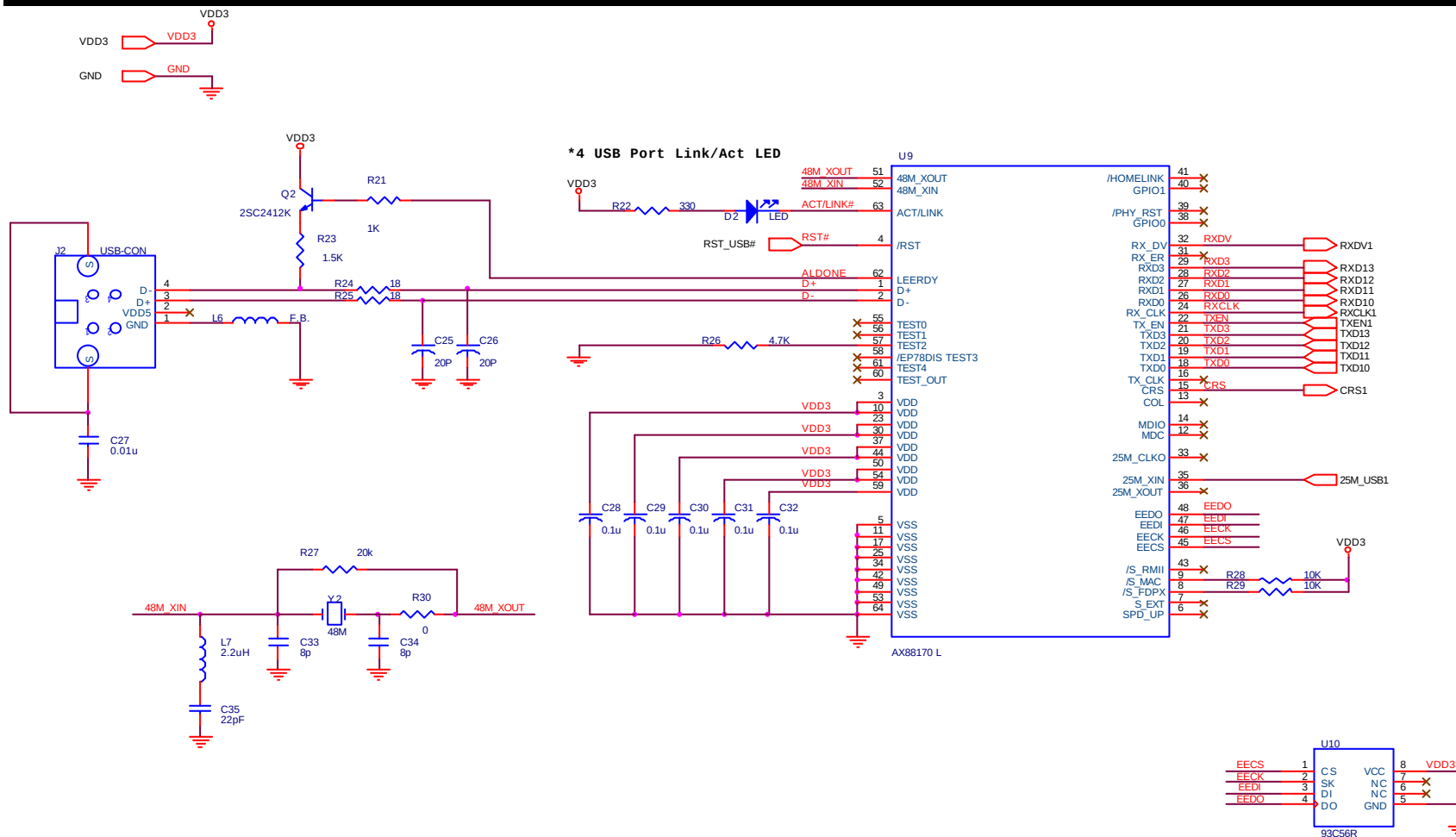


Title		
POWER & RESET C.K.T.		
Size	Document Number	Rev
B	170APSA.SCH	2.0
Date:	Monday, February 26, 2001	Sheet 1 of 7



AX88170

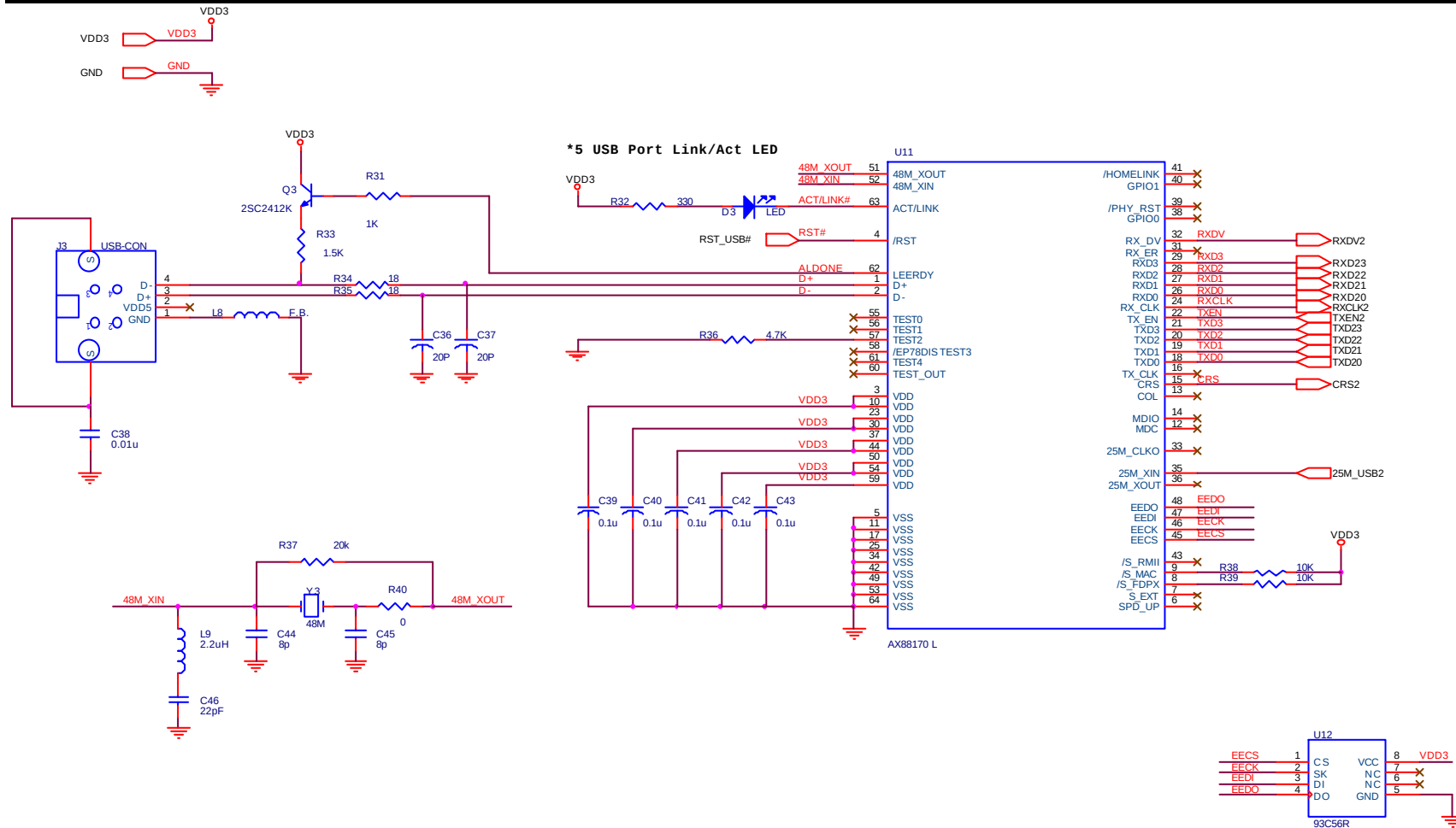
USB to Fast Ethernet/HomePNA Controller





AX88170

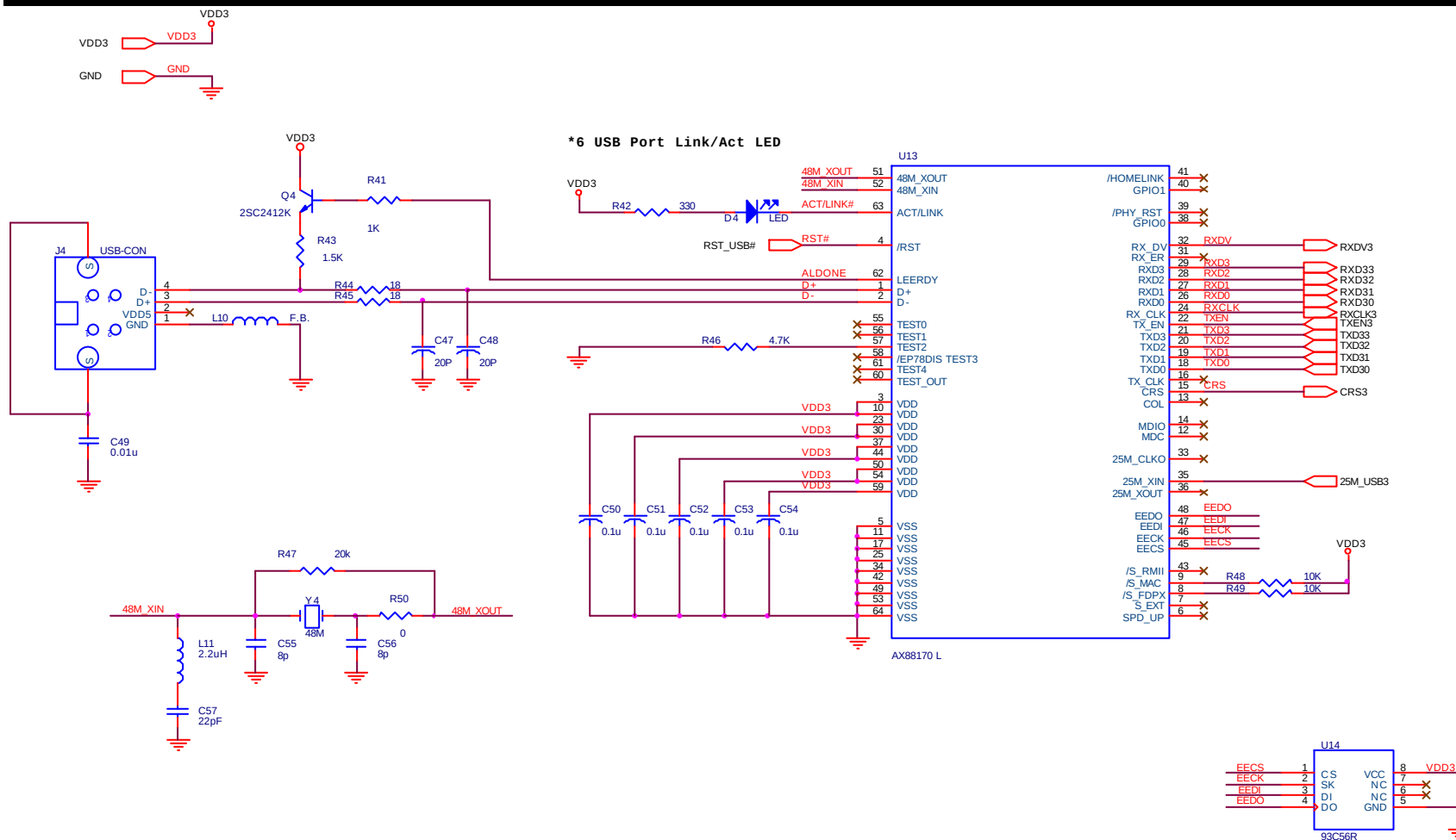
USB to Fast Ethernet/HomePNA Controller





AX88170

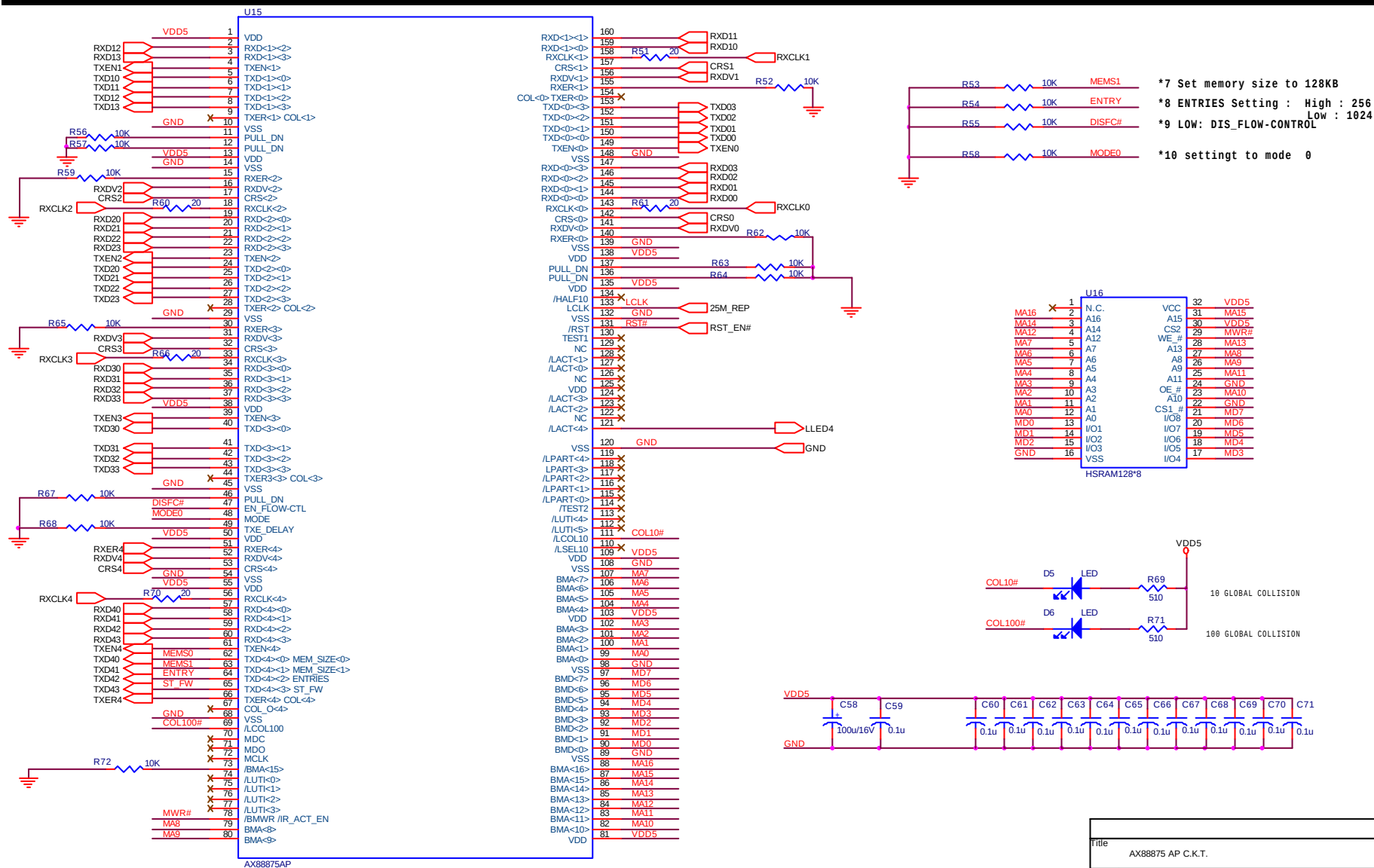
USB to Fast Ethernet/HomePNA Controller





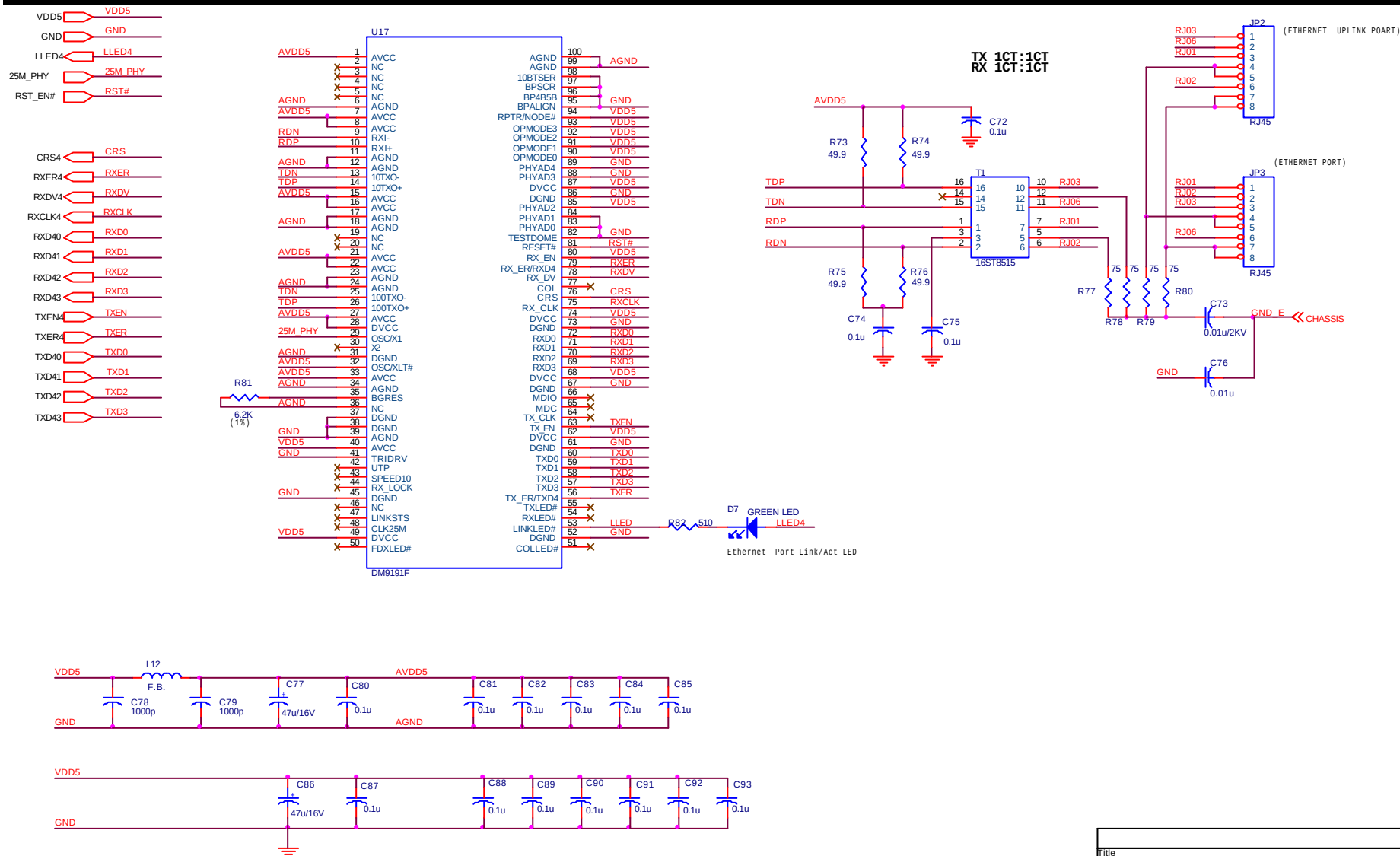
AX88170

USB to Fast Ethernet/HomePNA Controller





USB to Fast Ethernet/HomePNA Controller



Title			
EtherNet PHY C.K.T.			
Size B	Document Number		Rev
	170AP5A6.SCH		2.
Date:	Mondav. Februarv 26. 2001	Sheet	7 of 7