

ASIX

AX88141

Fast Ethernet MAC Controller

ASIX AX88141
100BASE-TX/FX PCI Bus
Fast Ethernet MAC Controller
with Power management
Data Sheet (4/11/ 98)

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before starting a design.

DOCUMENT NO. : AX141-01.DOC

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CONTENTS

1.0 INTRODUCTION	6
1.1 GENERAL DESCRIPTION:	6
1.2 FEATURES	7
1.3 BLOCK DIAGRAM:	8
1.4 AX88141 PIN CONNECTION DIAGRAM	9
2.0 SIGNAL DESCRIPTION.....	10
2.1 SIGNAL DESCRIPTIONS	10
2.2 PCI INTERFACE GROUP.....	10
2.3 BOOT ROM , SERIAL ROM , GENERAL-PURPOSE SIGNALS GROUP.....	11
2.4 MII INTERFACE SIGNALS GROUP	12
2.5 POWER PINS GROUP	13
3.0 CONFIGURATION OPERATION	14
3.1 CONFIGURATION SPACE MAPPING	14
3.2 CONFIGURATION SPACE	15
3.2.1 Configuration ID Register (CSID).....	15
3.2.2 Command and Status Configuration Register (CSCS).....	15
3.2.3 Configuration Revision Register (CSRV).....	15
3.2.4 Configuration Latency Timer Register (CSLT)	15
3.2.5 Configuration Base I/O Address Register (CBIO)	16
3.2.6 Configuration Base Memory Address Register (CBMA).....	16
3.2.7 Expansion ROM Base Address Register (CBER).....	16
3.2.8 Configuration Interrupt Register (CSIT).....	16
3.2.9 Special Use Register (SUD).....	16
3.2.10 Subsystem ID and Subsystem Vendor Register (SSID)	16
3.2.11 New Capabilities Pointer (CNCP).....	17
3.2.12 Power Management register block (Offset 44H to 49H).....	17
4.0 REGISTERS OPERATION.....	18
4.1 REGISTERS MAPPING	18
4.2 HOST REGS	19
4.2.1 Bus Mode Register (REG0).....	19
4.2.2 Magic Packet Password Low (REG0B).....	19
4.2.3 Transmit Poll Demand (REG1)	19
4.2.4 Magic Packet Password High (REG1B).....	19
4.2.5 Receive Poll Demand (REG2).....	20
4.2.6 Receive List Base Address (REG3).....	20
4.2.7 Transmit List Base Address (REG4)	20
4.2.8 Status Register (REG5).....	21
4.2.9 Operation Mode Register (REG6).....	22
4.2.10 Interrupt Enable Register (REG7).....	24
4.2.11 Missed Frame and Overflow Counter (REG8).....	24
4.2.12 Serial ROM and MII Management Register (REG9).....	25
4.2.13 General -Purpose Timer (REG11).....	25
4.2.14 General -Purpose Port Register (REG12).....	26
4.2.15 Filtering Index (REG13).....	26
4.2.16 Filtering data (REG14).....	26
5.0 HOST COMMUNICATION.....	28
5.1 DESCRIPTOR LISTS AND DATA BUFFERS	28
5.2 RECEIVE DESCRIPTORS	29
5.2.1 Receive Descriptor 0 (RDES0).....	29



5.2.2 Receive Descriptor 1 (RDES1)..... 30
5.2.3 Receive Descriptor 2 (RDES2)..... 30
5.2.4 Receive Descriptor 3 (RDES3)..... 30
5.3 TRANSMIT DESCRIPTORS..... 31
5.3.1 Transmit Descriptor 0 (TDES0)..... 31
5.3.2 Transmit Descriptor 1 (TDES1)..... 32
5.3.3 Transmit Descriptor 2 (TDES2)..... 32
5.3.4 Transmit Descriptor 3 (TDES3)..... 32

6.0 ELECTRICAL SPECIFICATION AND TIMINGS 33

6.1 ABSOLUTE MAXIMUM RATINGS..... 33
6.2 GENERAL OPERATION CONDITIONS 33
6.3 DC CHARACTERISTICS..... 33
6.4 A.C. TIMING CHARACTERISTICS..... 34
6.4.1 PCI CLOCK..... 34
6.4.2 PCI Timings..... 34
6.4.3 Reset Timing..... 34
6.4.4 MII Timing..... 35
6.4.5 Boot ROM Read Cycles 36

7.0 PACKAGE INFORMATION 37

APPENDIX A H/W NOTE 38

A.1 BOOT ROM READ CYCLE 38
A.2 POWER SUPPLY..... 39
A.3 BOUNDARY SCAN TEST PINS 39

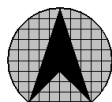
APPENDIX B FUNCTION APPLICATION..... 40

B.1 APPLICATION FOR PCI INTERFACE 40
B.2 APPLICATION FOR BOOT ROM INTERFACE 41
B.3 APPLICATION FOR SERIAL ROM INTERFACE..... 41
B.4 APPLICATIONS 42
B.4.1 Application for NS DP83843 42
B.4.2 Application for LUCENT M-LU6612/M-3X51 42
B.4.3 Application for TI XTNETE2101 43



FIGURES

FIG - 1 AX88141 BLOCK DIAGRAM	.....	8
FIG - 2 AX88141 PIN CONNECTION DIAGRAM	.....	9
FIG - 3 DESCRIPTOR STRUCTURE EXAMPLE	.....	28
FIG - 4 RECEIVE DESCRIPTOR FORMAT	.....	29
FIG - 5 TRANSMIT DESCRIPTOR FORMAT	.....	31
FIG - 6 APPLICATION FOR LXT970	.....	42
FIG - 7 APPLICATION FOR MTD972 +MTD971	.....	43
FIG - 8 APPLICATION FOR DM9101	.....	43



TABLES

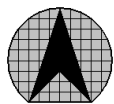
TAB - 1 PCI INTERFACE GROUP.....	11
TAB - 2 BOOT ROM , SERIAL ROM , GENERAL-PURPOSE SIGNALS GROUP	12
TAB - 3 MII INTERFACE SIGNALS GROUP.....	12
TAB - 4 POWER PINS GROUP	13
TAB - 5 CONFIGURATION SPACE MAPPING.....	14
TAB - 6 CSID CONFIGURATION ID REGISTER DESCRIPTION.....	15
TAB - 7 CSCS COMMAND AND STATUS CONFIGURATION REGISTER	15
TAB - 8 CSRV CONFIGURATION REVISION REGISTER DESCRIPTION.....	15
TAB - 9 CSLT CONFIGURATION ID REGISTER DESCRIPTION	15
TAB - 10 CBIO CONFIGURATION BASE I/O ADDRESS REGISTER DESCRIPTION.....	16
TAB - 11 CBMA CONFIGURATION BASE MEMORY ADDRESS REGISTER DESCRIPTION	16
TAB - 12 CBER EXPANSION ROM BASE ADDRESS REGISTER DESCRIPTION	16
TAB - 13 CSIT CONFIGURATION INTERRUPT REGISTER DESCRIPTION.....	16
TAB - 14 CSIT CONFIGURATION INTERRUPT REGISTER DESCRIPTION.....	16
TAB - 15 SSID CONFIGURATION ID REGISTER DESCRIPTION	17
TAB - 16 CNCP CONFIGURATION ID REGISTER DESCRIPTION.....	17
TAB - 17 CSID CONFIGURATION ID REGISTER DESCRIPTION	17
TAB - 18 COMMAND AND STATUS REGISTER MAPPING.....	18
TAB - 19 REG0 BUS MODE REGISTER DESCRIPTION.....	19
TAB - 20 REG1 TRANSMIT POLL DEMAND REGISTER DESCRIPTION	19
TAB - 21 REG1 TRANSMIT POLL DEMAND REGISTER DESCRIPTION	19
TAB - 22 REG1 TRANSMIT POLL DEMAND REGISTER DESCRIPTION	19
TAB - 23 REG2 RECEIVE POLL DEMAND REGISTER DESCRIPTION	19
TAB - 24 REG3 RECEIVE LIST BASE ADDRESS REGISTER DESCRIPTION	20
TAB - 25 REG4 TRANSMIT LIST BASE ADDRESS REGISTER DESCRIPTION	20
TAB - 26 REG5 STATUS REGISTER DESCRIPTION.....	22
TAB - 27 REG6 OPERATION MODE REGISTER DESCRIPTION	23
TAB - 28 PORT AND DATA RATE SELECTION.....	23
TAB - 29 REG7 INTERRUPT ENABLE REGISTER DESCRIPTION	24
TAB - 30 REG8 MISSED FRAME AND OVERFLOW COUNTER DESCRIPTION	24
TAB - 31 REG9 SERIAL ROM, AND MII MANAGEMENT REGISTER DESCRIPTION.....	25
TAB - 32 REG11 GENERAL -PURPOSE TIMER REGISTER DESCRIPTION	26
TAB - 33 REG12 GENERAL -PURPOSE PORT REGISTER DESCRIPTION.....	26
TAB - 34 REG13 FILTERING INDEX REGISTER DESCRIPTION	26
TAB - 35 REG14 FILTERING DATA REGISTER DESCRIPTION.....	26
TAB - 36 DESCRIPTION OF FILTERING BUFFER	26
TAB - 37 LAYOUT OF FILTERING BUFFER.....	27
TAB - 38 RECEIVE DESCRIPTOR 0.....	30
TAB - 39 RECEIVE DESCRIPTOR 1.....	30
TAB - 40 RECEIVE DESCRIPTOR 2.....	30
TAB - 41 RECEIVE DESCRIPTOR 3.....	30
TAB - 42 TRANSMIT DESCRIPTOR 0.....	32
TAB - 43 TRANSMIT DESCRIPTOR 1	32
TAB - 44 TRANSMIT DESCRIPTOR 2	32
TAB - 45 TRANSMIT DESCRIPTOR 3	32



1.0 Introduction

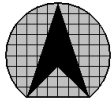
1.1 General Description:

- The AX88141 Fast Ethernet Controller is a high performance and highly integrated PCI Bus Ethernet Controller chip.
- The AX88141 is cost effective, high performance solution for PCI add-in adapters, PC motherboards, or bridge/hub applications.
- It implements both 10Mbps and 100Mbps Ethernet function based on IEEE802.3u LAN standard.
- The AX88141 contains a high speed 32 bit PCI Bus master interface to host CPU. Two large independent transmit and receive FIFO allow the AX88141 to buffer the Ethernet packet efficiently.
- The AX88141 support 10Mbps/100Mbps media-independent interface (MII) to simplify the design.
- The AX88141 is compliant with the Network Device Class Power Management and the Communication Device Class Power Management requirements under the OnNow Architecture for PC 97 and PC 98.
- The AX88141 is compliant with the Advanced Configuration and Power Interface (ACPI) Specification and the PCI Bus Power Management Interface Specification.
- The AX88141 provide both PHY level or MAC level power management function.
- The AX88141 provide magic packet algorithm with password to support ACPI function.



1.2 Features

- Single chip PCI bus Fast Ethernet Controller.
- Direct interface to PCI bus.
- Support both 10Mbps and 100Mbps data rate.
- Full or Half duplex operation supported for both 10Mbps and 100Mbps operation.
- Provides a MII port for both 10/100Mbps operation.
- Support 20MHz to 33MHz no wait state PCI Bus Interface.
- Two large Independent FIFO for transmit and receive. no additional On board buffer memory required.
- Interface to serial ROM for Ethernet ID address and jumper-less board design.
- 64KB boot ROM support.
- Support automatic loading of subvendor ID.
- On chip general purpose, programmable register and I/O pins.
- Unlimited PCI burst.
- External and internal loop-back capability.
- Support early interrupts on transmit.
- Powerful on chip buffer management DMA. And PCI Bus master operation reduce CPU utilization.
- Support network device OnNow requirements for PC 97 and PC 98.
- Compliant with the ACPI specification and the PCI Bus Power Management Interface Specification.
- Support Magic Packet technology.
- Big and little endian byte ordering supported.
- IEEE 802.3u 100BASE-T, TX, and T4 Compatible.
- 128 pin PQFP package.
- 5V CMOS process.



1.3 Block Diagram:

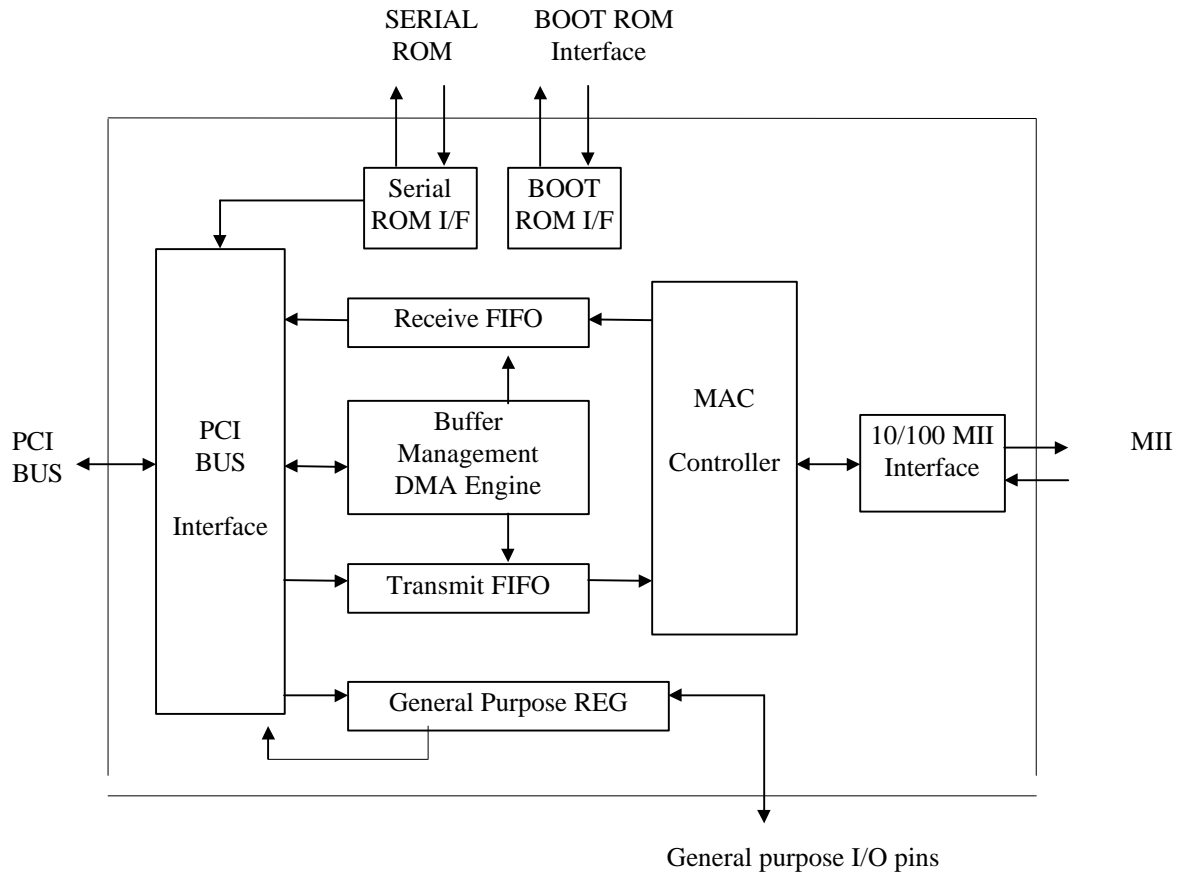


Fig - 1 AX88141 Block Diagram



1.4 AX88141 Pin Connection Diagram

The AX88141 is housed in the 128-pin plastic quad flat pack. Fig - 2 shows the AX88141 pin connection diagram.

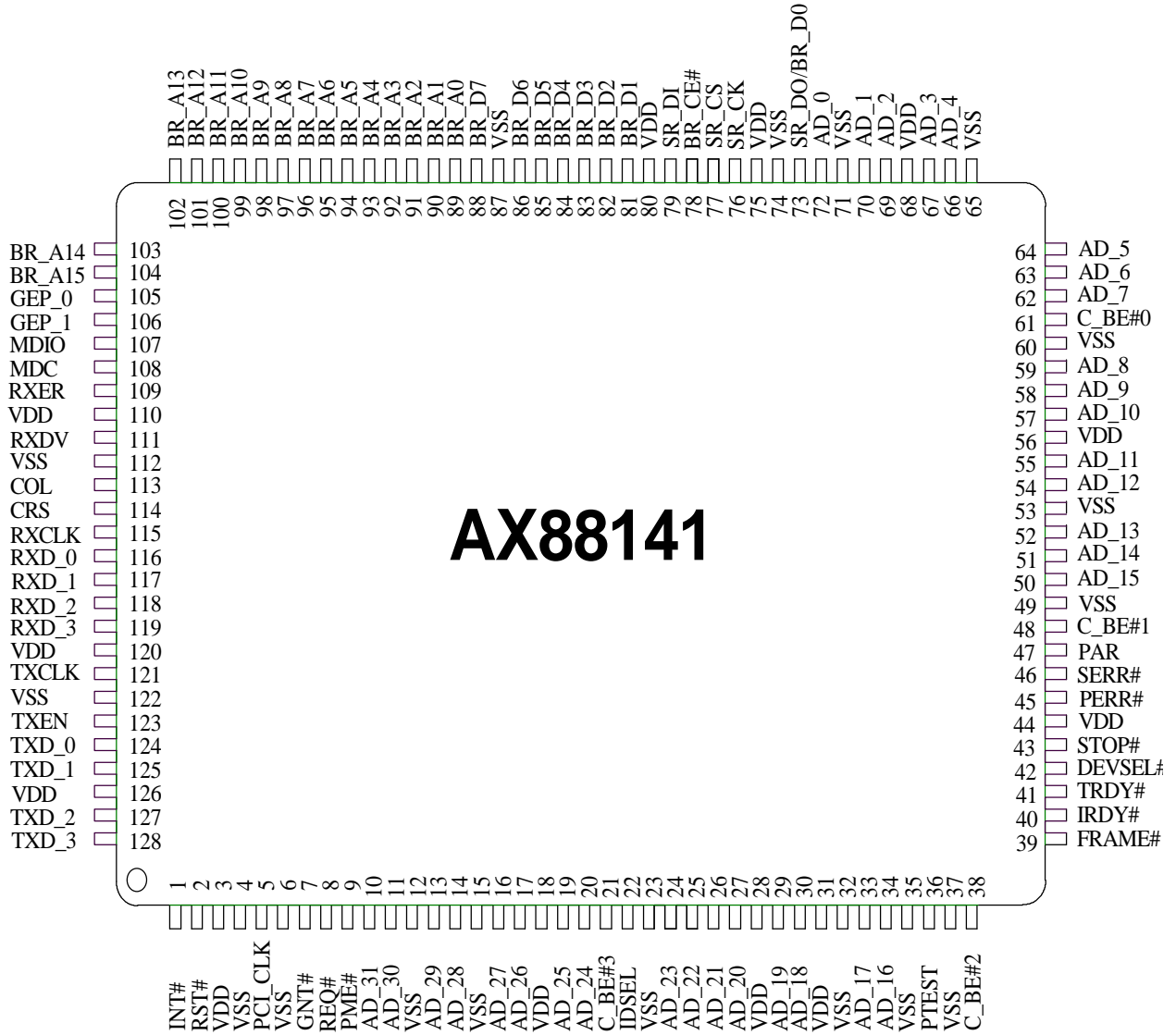
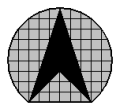


Fig - 2 AX88141 Pin connection diagram



2.0 Signal Description

2.1 Signal Descriptions

The following terms describe the AX88141 pin-out:

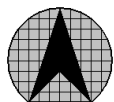
- Address phase
Address and appropriate bus commands are driven during this cycle.
- Data phase
Data and the appropriate byte enable codes are driven during this cycle.
- #
All pin names with the # suffix are asserted low.

The following abbreviations are used in Tab - 1 PCI interface group Tab - 2 Boot ROM , Serial ROM , General-purpose signals group ,Tab - 3 MII interface signals group ,Tab - 4 Power pins group..

I	Input
O	Output
I/O	Input /Output
O/D	Open Drain

2.2 PCI interface group

SIGNAL	TYPE	PIN NUMBER	DESCRIPTION
CBE#<3> CBE#<2> CBE#<1> CBE#<0>	I/O	21, 38, 48, 61	BUS COMMAND and BYTE ENABLE Are multiplexed on the same PCI pins. During the address phase of the transaction, CBE#<3:0> Provide the BUS COMMAND. During the data phase, CBE#<3:0> Provide the BYTE ENABLE. The BYTE ENABLE determines which byte lines carry valid data., CBE#<0> Applies to byte 0, and CBE#<3> Applies to byte 3.
DEVSEL#	I/O	42	Device select Is asserted by the target of the current bus access. When the AX88141 is the master of the current bus access, the target assert DEVSEL# confirming the access. It is driven by AX88141 When AX88141 is selected as a slave.
FRAME#	I/O	39	The FRAME# Signal is driven by the AX88141 To indicate the beginning and duration of an access. FRAME# Asserts to indicate the beginning of a bus transaction. While FRAME# is asserted, data transfers continue. When FRAME# deasserts the next data phase is the final data phase transaction.
GNT#	I	7	BUS GRANT Indicates to the AX88141 That access to the bus is granted.
IDSEL	I	22	Initialization devise select asserts To indicate that the host is issuing a configuration cycle to the AX88141.
INT#	O/D	1	Interrupt request asserts When one of the appropriate bits of reg5 sets and causes an interrupt, provided that the corresponding mask bit in reg7 is not asserted. interrupt request deasserts by writing a 1 into the appropriate reg5 bit. This pin must be pulled up by an external resistor.
IRDY#	I/O	40	Initiator ready Indicates the bus master ability to complete the current data phase of the transaction. A data phase is completed on any rising edge of the clock When both IRDY# and target ready TRDY# are asserted. Wait cycles are inserted until both IRDY# and TRDY# are asserted together. When the AX88141 is the bus master, IRDY# is asserted during write operations to indicate that valid data is present on the AD<31:0>. During read operations, the AX88141 asserts IRDY# to indicate that it is ready to accept data.
PAR	I/O	47	Parity is an even parity bit for the AD<31:0> AD and CBE#<3:0>. During address and data phases, parity is calculated on all the AD<31:0> AND CBE#<3:0>lines whether or not any of these lines carry meaningful information.

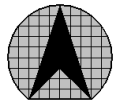


AD<31>	I/O	10,	Address and data bits are multiplexed on the same pins. During the address phase, the AD<31:0> contain a physical address (32 bits). During, data phases, AD<31:0> contain 32 bits of data. The AX88141 supports both read and write bursts (in master operation only). Little and big endian byte ordering can be used.
AD<30>		11,	
AD<29>		13,	
AD<28>		14,	
AD<27>		16,	
AD<26>		17,	
AD<25>		19,	
AD<24>		20,	
AD<23>		24,	
AD<22>		25,	
AD<21>		26,	
AD<20>		27,	
AD<19>		29,	
AD<18>		30,	
AD<17>		33,	
AD<16>		34,	
AD<15>		50,	
AD<14>		51,	
AD<13>		52,	
AD<12>		54,	
AD<11>		55,	
AD<10>		57,	
AD<9>		58,	
AD<8>		59,	
AD<7>		62,	
AD<6>		63,	
AD<5>		64,	
AD<4>		66,	
AD<3>		67,	
AD<2>		69,	
AD<1>		70,	
AD<0>		72	
PCI_CLK	I	5	The clock provides the timing for the AX88141 related PCI bus transactions. All the bus signals are sampled on the rising edge of PCI_CLK. The clock frequency range is between 20MHZ and 33MHZ.
PERR#	I/O	45	Parity error asserts when a data parity error is detected. When the AX88141 is the bus master it monitor PERR# to see if the target report a data parity error., when the AX88141 is the bus target and a parity error is detected, the AX88141 asserts PERR#. This pin must be pulled up by an external resistor.
REQ#	O	8	Bus request is asserted by the AX88141 to indicate to the bus arbiter that it wants to use the bus.
RST#	I	2	Resets the AX88141 to its initial state. This signal must be asserted for at least 10 active PCI clock cycles. When is the reset state, all PCI output pins are put into tri-state and all PCI o/d signals are floated.
SERR#	I/O	46	System Error is used by AX88141 to report address parity Error. This pin must be pulled up by an external resistor.
STOP#	I/O	43	Stop indicator indicates that the current target is requesting the bus master to stop the current transaction. The AX88141 responds to the assertion of STOP# when it is the bus master, and stop the current transaction.
TRDY#	I/O	41	Target ready indicates the target ability to complete the current data phase of the transaction. A data phase is completed on any clock when both TRDY# and IRDY# are asserted. Wait cycles are inserted until both IRDY# and TRDY# are asserted together. When the AX88141 is the bus master, target ready is asserted by the bus slave on the read operation, indicating that valid data is present on the ad lines. During a write cycle, it indicates that the target is prepared to accept data.
PME#	O	9	

Tab - 1 PCI interface group

2.3 Boot ROM , Serial ROM , General-purpose signals group

SIGNAL	TYPE	PIN NUMBER	DESCRIPTION
--------	------	------------	-------------



BR_A<15> BR_A<14> BR_A<13> BR_A<12> BR_A<11> BR_A<10> BR_A<9> BR_A<8> BR_A<7> BR_A<6> BR_A<5> BR_A<4> BR_A<3> BR_A<2> BR_A<1> BR_A<0>	O	104, 103, 102, 101, 100, 99, 98, 97, 96, 95, 94, 93, 92, 91, 90, 89	Boot ROM address lines bit 15 to bit 0.
BR_D<7> BR_D<6> BR_D<5> BR_D<4> BR_D<3> BR_D<2> BR_D<1> BR_D<0>/ SR_DO	I	88, 86, 85, 84, 83, 82, 81, 73	Boot ROM data lines bit 7 to bit 0. Serial ROM data-out signal.
BR_CE#	O	78	Boot ROM chip enable.
SR_CK	O	76	Serial ROM clock signal.
SR_CS	O	77	Serial ROM chip-select signal.
SR_DI	O	79	Serial ROM data-in signal.
GENP<1> GENP<0>	I/O	106, 105	General-purpose pins can be used by software as either status pins or control pins. These pins can be configured by software to perform either input or output functions.

Tab - 2 Boot ROM , Serial ROM , General-purpose signals group

2.4 MII interface signals group

SIGNAL	TYPE	PIN NUMBER FOR 160 PIN	DESCRIPTION
COL	I	113	Collision detected is asserted when detected by an external physical layer protocol(PHY) device.
CRS	I	114	Carrier sense is asserted by the PHY when the media is active.
RXDV	I	111	Data valid is asserted by an external PHY when receive data is present on the RXD lines and is deasserted at the end of the packet. This signal should be synchronized with the RXCLK signal.
RXER	I	109	Receive error asserts when a data decoding error is detected by an external PHY device. This signal is synchronized to RXCLK and can be asserted for a minimum of one receive clock. When asserted during a packet reception, it sets the cyclic redundancy check(CRC) error bit in the receive descriptor (RDES0).
MDC	O	108	MII management data clock is sourced by the AX88141 to the PHY devices as a timing reference for the transfer of information on the MII_MDIO signal.
MDIO	I/O	107	MII management data input/output transfers control information and status between the PHY and the AX88141.
RXCLK	I	115	Supports either the 25-MHZ or 2.5-MHZ receive clock. This clock is recovered by the PHY.
RXD<3> RXD<2> RXD<1> RXD<0>	I	119, 118, 117, 116	Four parallel receive data lines When MII mode is selected. This data is driven by an external PHY that attached the media and should be synchronized with the RXCLK signal.
TXCLK	I	121	Supports the 25-MHZ or 2.5-MHZ transmit clock supplied by the external physical layer medium dependent (PMD) device. This clock should always be active.
TXD<3> TXD<2> TXD<1> TXD<0>	O	128, 127, 125, 124	Four parallel transmit data lines. This data is synchronized to the assertion of the TXCLK signal and is latched by the external PHY on the rising edge of the TXCLK signal.
TXEN	O	123	Transmit enable signals that the transmit is active to an external PHY device.

Tab - 3 MII interface signals group



2.5 Power pins group

SIGNAL	TYPE	PIN NUMBER	DESCRIPTION
VDD	P	3,18,28,31,44,56, 68,75,80,110,120, 126	5-V supply input voltage.
VSS	P	4,6,12,15,23,32, 35,37,49,53,60, 65,71,74,87,112, 122	Ground pins.

Tab - 4 Power pins group



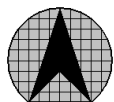
3.0 Configuration Operation

1. Software reset (REG0<0>) has no effect on the configuration registers.
2. Hardware reset puts the configuration registers in default values.
3. The configuration registers could be accessed in byte, word, and long-word.

3.1 Configuration Space Mapping

CONFIGURATION REGISTER	IDENTIFIER	I/O ADDRESS OFFSET
DEVICE/VENDOR ID	CSID	00H
COMMAND AND STATUS	CSCS	04H
REVISION	CSRV	08H
LATENCY TIMER	CSLT	0CH
BASE I/O ADDRESS	CBIO	10H
BASE MEMORY ADDRESS	CBMA	14H
RESERVED	-	18H-28H
SUBSYSTEM/SUBVENDOR ID	SSID	2CH
EXPANSION ROM BASE ADDRESS	CBER	30H
NEW CAPABILITIES POINTER	CNCP	34H
RESERVED	-	38H
INTERRUPT	CSIT	3CH
SPECIAL USE	SUD	40H
POWER MANAGEMENT	CPMR	44H - 49H

Tab - 5 Configuration Space Mapping



3.2 Configuration Space

3.2.1 Configuration ID Register (CSID)

FIELD	R/W	DESCRIPTION
31:16	R	Device ID : Provides the unique AX88141 ID number (1400H)
15:0	R	Vender ID : Provides the manufacturer of the AX88141 (125BH)

Tab - 6 CSID Configuration ID Register Description

3.2.2 Command and Status Configuration Register (CSCS)

FIELD	R/W	TYPE	DESCRIPTION
31	R	STATUS	Detected Parity Error : active high
30	R	STATUS	Signal System Error : active high
29	R	STATUS	Received Master Abort : active high
28	R	STATUS	Received Target Abort : active high
26:25	R	STATUS	Device Select Timing : fixed at 01 which indicates a medium assertion of DEVSEL#
24	R	STATUS	Data Parity Report : active high
23	R	STATUS	Fast Back-to-Back : always set
22:21	-	RESERVED	
20	R	STATUS	Cpability of Power Management : always set.
19-9	-	RESERVED	
8	R/W	COMMAND	System Error Enable : active high
6	R/W	COMMAND	Parity Error Response : active high
2	R/W	COMMAND	Master Operation : active high
1	R/W	COMMAND	Memory Space Access : active high
0	R/W	COMMAND	I/O Space Access : Active high

Tab - 7 CSCS Command and Status Configuration Register

3.2.3 Configuration Revision Register (CSRVR)

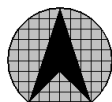
FIELD	R/W	DESCRIPTION
31:24	R	Base Class : Always equal to 2H that indicates the network controller
23:16	R	Subclass : Always equal to 0H that indicates the fast Ethernet controller
7:4	R	Revision Number : Indicates the AX88141 revision number and is equal to 1H
3:0	R	Step Number : Indicates the AX88141 step number and is referred to current silicon step.

Tab - 8 CSRVR Configuration Revision Register Description

3.2.4 Configuration Latency Timer Register (CSLT)

FIELD	R/W	DESCRIPTION
31:16	R/W	Reserved
15:8	R/W	Configuration Latency Timer. The value after hardware reset equal to 0h.
7:0	R/W	Reserved

Tab - 9 CSLT Configuration ID Register Description



3.2.5 Configuration Base I/O Address Register (CBIO)

FIELD	R/W	DESCRIPTION
31:7	R/W	Configuration Base I/O Address : Defines the address assignment mapping of AX88141's regs.
6:1	R	This field value is 0 when read
0	R	I/O Space Indicator : Determines that the register maps into the I/O space. The value in this field is 1.

Tab - 10 CBIO Configuration Base I/O Address Register Description

3.2.6 Configuration Base Memory Address Register (CBMA)

FIELD	R/W	DESCRIPTION
31:7	R/W	Configuration Base Memory Address : Defines the address assignment mapping of AX88141's regs.
6:1	R	This field value is 0 when read
0	R	Memory Space Indicator : Determines that the register maps into the memory space. The value in this field is 0.

Tab - 11 CBMA Configuration Base Memory Address Register Description

3.2.7 Expansion ROM Base Address Register (CBER)

FIELD	R/W	DESCRIPTION
31:10	R/W	Expansion ROM Base Address
9:1	R	This field value is 0 when read
0	R/W	Expansion ROM Enable Bit : Active high

Tab - 12 CBER Expansion ROM Base Address Register Description

3.2.8 Configuration Interrupt Register (CSIT)

FIELD	R/W	DESCRIPTION
31:24	R	MAX_LAT : time unit is equal to 0.25 microsecond.(28H)
23:16	R	MIN_GNT : Time unit is equal to 0.25 microsecond.(14H)
15:8	R	Interrupt Pin : The AX88141 uses INTA# and the read value is (01H).
7:0	R/W	Interrupt Line : The BIOS writes the routing information into this field.

Tab - 13 CSIT Configuration Interrupt Register Description

3.2.9 Special Use Register (SUD)

FIELD	R/W	DESCRIPTION
31:30	R	Reserved
29	R/W	Enable bit, when set to "1", if GEP LINK pin has transition, PME# will active.
28	R/W	This bit will be "1" if GEP LINK pin has transitions.
27	R/W	This bit will be "1" if Magic Packet was detected.
26-25	R	Reserved
24	R/W	Password enable bit, when this bit is set to "1", AX881401 will check the password from Magic Packet With the stored password in REG 0B and REG 1B before asserting the Magic Packet detected bit (<3> of REG 43)
23-16	R	Reserved
15:8	R/W	Driver special Use
7-0	R	Reserved

Tab - 14 CSIT Configuration Interrupt Register Description

3.2.10 Subsystem ID and Subsystem Vendor Register (SSID)

FIELD	R/W	DESCRIPTION
31:16	R	Subsystem ID : Provides the subsystem ID which is loaded from EEPROM at hardware reset
15:0	R	Subsystem Vendor ID : Provides the subsystem vendor ID which is loaded from EEPROM at hardware reset.



Tab - 15 SSID Configuration ID Register Description

3.2.11 New Capabilities Pointer (CNCP)

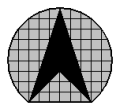
FIELD	R/W	DESCRIPTION
7:0	R	New Capabilities Pointer : Point to Power management registers starting address, value is 44H

Tab - 16 CNCP Configuration ID Register Description

3.2.12 Power Management register block (Offset 44H to 49H)

OFFSET	R/W	DESCRIPTION
44H	R	Capability ID : The value is 01H to indicate power management block.
45H	R	Next item pointer : The value is 00H to indicate this is the last block
46H	R	Power management capabilities, : The value is 21H to indicate version 1.0 of PCI power management specification and need a device specific initialization sequence following transition to the DO uninitialized state
47H	R	Power management capabilities : The value is 48H to indicate PME# support from Do and D3 hot state.
48-49H	R/W	Power management status : <15> : PME# status -- Set when the function would normally assert the PME# signal independent of the state of the PME# pin enable bit. Write a "1" to this bit will clear it and cause the function to stop asserting a PME# (if enabled). Write a "0" no effect. When reset default is "0". <8> : PME# pin enable control bit -- A "1" enable the function to assert PME#. Writing a "0" PME# assertion is disabled. When reset default is "0" <1:0> : Power state -- Only 00 (D0) and 11 (D3) supported

Tab - 17 CSID Configuration ID Register Description



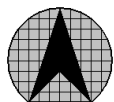
4.0 Registers Operation

1. The REGs are quad-word aligned, 32-bits long, and must be accessed using long-word instruction with quad-word aligned addresses only.
2. Reserved bits should be written with 0.; Reserved bits are UNPREDICTABLE on read access.
3. Retries on second data transactions occur in response to burst accesses.

4.1 Registers Mapping

REGISTER	MEANING	OFFSET FROM REG BASE ADDRESS (CBIO,CBMA)
REG0	BUS MODE	00H
REG0B	MAGIC PACKET PASSWORD LOW <31:0>	04H
REG1	TRANSMIT POLL DEMAND	08H
REG1B	MAGIC PACKET PASSWORD HIGH <47:32>	0CH
REG2	RECEIVE POLL DEMAND	10H
REG3	RECEIVE LIST BASE ADDRESS	18H
REG4	TRANSMIT LIST BASE ADDRESS	20H
REG5	STATUS	28H
REG6	OPERATION MODE	30H
REG7	INTERRUPT ENABLE	38H
REG8	MISSED FRAME AND OVERFLOW COUNTER	40H
REG9	SERIAL ROM, AND MII MANAGEMENT	48H
REG10	-	50H
REG11	GENERAL-PURPOSE TIMER	58H
REG12	GENERAL-PURPOSE PORT	60H
REG13	FILTERING BUFFER INDEX	68H
REG14	FILTERING BUFFER DATA	70H
REG14B	RESERVED	74H
REG15	RESERVED	78H
REG15B	RESERVED	7CH

Tab - 18 Command and Status Register Mapping



4.2 Host REGs

4.2.1 Bus Mode Register (REG0)

FIELD	R/W/C	DESCRIPTION
31:22	-	RESERVED
21	R/W	RML - Read Multiple When set, the AX88141 supports the memory-read-multiple command on the PCI bus. This bus command is used in memory read bursts with more than one longword. When reset, the AX88141 uses memory-read command in all its memory read accesses on the PCI bus.
20	R/W	DBO - Descriptor Byte Ordering Mode When set, the AX88141 operates in big edian ordering mode for descriptors only. When reset, the AX88141 operates in little endian mode.
19:14	-	Reserved.--Written as "0" for future compatibility concern.
13:8	R/W	PBL - Programmable Burst Length Indicates the maximum number of longwords to be transfered in one DMA transaction. If reset, the AX88141 burst is limited only by the amount of data stored in the receive FIFO (at least 16 longword), or by the amount of free space in the transmit FIFO (at least 16 longword) before issuing a bus request. The PBL can be programmed with permissible values 0,1,2,4,8,16, or 32. After reset, the PBL default value is 0.
7	R/W	BLE - Big/Little Endian When set, the AX88141 operates in big endian byte ordering mode. When reset, the AX88141 operates in little endian byte ordering mode. Big endian is applicable only for data buffer
6:2	-	RESERVED
1	R/W	BAR - Bus Arbitration Selects the internal bus arbitration between the receive and transmit processes. When set, a round robin arbitration scheme is applied resulting in equal sharing between processes. When reset, the receive process has priority over the transmit process, unless the AX88141 is currently transmitting.
0	R/W	SWR - Software Reset When set, the AX88141 resets all internal hardware with the exception of the configuration area and also, it does not change the port select setting (REG6<18>). Software reset does not affect the configuration area.

Tab - 19 REG0 Bus Mode Register Description

4.2.2 Magic Packet Password Low (REG0B)

FIELD	R/W	DESCRIPTION
31:0	R/W	MPPL - Magic Packet Password Low This register contains the magic packet password bits 31 to 0.

Tab - 20 REG1 Transmit Poll Demand Register Description

4.2.3 Transmit Poll Demand (REG1)

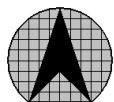
FIELD	R/W	DESCRIPTION
31:0	W	TPD - Transmit Poll Demand When written with any value, the AX88141 checks for frames to be transmitted. If no descriptor is available, the transmit process returns to the suspended states and REG5<2> is asserted. If the descriptor is available the transmit process resumes.

Tab - 21 REG1 Transmit Poll Demand Register Description

4.2.4 Magic Packet Password High (REG1B)

FIELD	R/W	DESCRIPTION
31:16	R	Reserved
15:0	R/W	MPPH - Magic Packet Password High This register contains the magic packet password bits 47 to 32.

Tab - 22 REG1 Transmit Poll Demand Register Description



4.2.5 Receive Poll Demand (REG2)

FIELD	R/W/C	DESCRIPTION
31:0	W	RPD - Receive Poll Demand When written with any value, the AX88141 checks for receive descriptors to be required. If no descriptor is available, the receive process returns to the suspended states and REG5<7> is not asserted. If the descriptor is available the receive process resumes.

Tab - 23 REG2 Receive Poll Demand Register Description

4.2.6 Receive List Base Address (REG3)

1. The register is used to point the AX88141 to the start of receive descriptors list.
2. The descriptor list resides in physical memory space and must be longword aligned. The AX88141 behaves UNPREDICTABLY when the list are not longword aligned.
3. Writing to REG3 is permitted only when receive process is in the stopped state. That is, the REG3 must be written before the receive START command is given .

REG3 Receive List Base Address Register Description

FIELD	R/W/C	DESCRIPTION
31:2	R/W	Start of receive list
1:0	R/W	Must be 00 for longword alignment

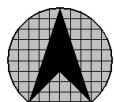
Tab - 24 REG3 Receive List Base Address Register Description

4.2.7 Transmit List Base Address (REG4)

1. The register is used to point the AX88141 to the start of transmit descriptors list.
2. The descriptor list resides in physical memory space and must be long-word aligned. The AX88141 behaves UNPREDICTABLY when the list are not long-word aligned.
3. Writing to REG4 is permitted only when transmit process is in the stopped state. That is, the REG4 must be written before the transmit START command is given .

FIELD	R/W/C	DESCRIPTION
31:2	R/W	Start of transmit list
1:0	R/W	Must be 00 for long-word alignment

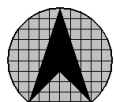
Tab - 25 REG4 Transmit List Base Address Register Description



4.2.8 Status Register (REG5)

1. The status register contains all the status bits that the AX88141 reports to the host.
2. Most of the fields in this register cause the host to be interrupted.
3. REG5 bits are not cleared when read.
4. Writing 1 to these bits clears them; writing 0 has no effect. Each field can be masked.

Field	R/W/C	Description				
31:26	-	Reserved				
25:23	R	EB - Error Bits (Not generate interrupt) Indicates the type of error that caused system error. Valid only when fatal bus error REG5<13> is set.	25	24	23	Description
			0	0	0	Parity error
			0	0	1	Master abort
			0	1	0	Target abort
			0	1	1	Reserved
1	x	x	Reserved			
22:20	-	Reserved.--Written as "0" for future compatibility concern.				
19:17	-	Reserved.--Written as "0" for future compatibility concern.				
16	R	NIS - Normal Interrupt Summary Only the unmasked bits affect normal interrupt summary REG5<16> bit Normal interrupt summary bit. Its value is the logical OR of :	CSR5<0>		transmit interrupt	
			CSR5<2>		transmit buffer unavailable	
			CSR5<6>		receive interrupt	
			CSR5<10>		Early transmit interrupt	
			CSR5<11>		General-purpose timer expired	
15	R	AIS - Abnormal Interrupt Summary Only unmasked bits affect only the abnormal interrupt summary REG5<15> bit. Abnormal interrupt summary bits. Its value is the logical OR of :	CSR5<1>		transmit process stopped	
			CSR5<3>		transmit jabber time out	
			CSR5<5>		transmit under-flow	
			CSR5<7>		receive buffer unavailable	
			CSR5<8>		receive process stopped	
			CSR5<9>		receive watchdog time out	
			CSR5<13>		fatal bus error	
13	R	FBE - Fatal Bus Error Indicates that a system error occurred. If a system error occurs, all bus accesses are disabled				
11	R/W/C	GTE - General Purpose Timer Expired Indicates that the general-purpose timer (REG11) counter has expired. This timer is mainly used by the software driver.				
10	R/W/C	ETI - Early Transmit Interrupt Indicates that the packet to be transmitted was fully transferred into the chip's internal transmit FIFOs. Transmit interrupt (REG5<0>) automatically clears this bit.				
9	R/W/C	RWT - Receive watchdog Time out Indicates that the receive watchdog timer expired and another node is still active on the network. In case of overflow, the long packets may not be received.				
8	R/W/C	RPS - Receive Process Stopped Asserts when the receive process enters stopped state.				
7	R/W/C	RU - Receive Buffer Unavailable Indicates the next descriptor in the receive list is owned by the host and cannot be acquired by the AX88141. The reception process is suspended.				
6	R/W/C	RI - Receive Interrupt Indicates the completion of a frame reception. Specific frame status information has been posted in the descriptor. The reception process remains in the running state.				
5	R/W/C	UNF - Transmit Under-flow Indicates that the transmit FIFO had an under-flow condition during the packet transmission. The transmit process is placed in the suspended state and under-flow error TDES0<1> is set.				
4	-	Reserved.--Written as "0" for future compatibility concern.				



3	R/W/C	TJT - Transmit Jabber Time-out Indicates that the transmit jabber timer expired, meaning that the AX88141 transmitter had been excessively active. The transmission process is aborted and placed in the stopped state. This event causes the transmit jabber time-out TDES0<14> is set.
2	R/W/C	TU - Transmit Buffer Unavailable Indicates that the next descriptor on the transmit list is owned by the host and cannot be acquired by the AX88141. The transmission process is suspended. To resume processing transmit descriptors, the host should change the ownership bit of the descriptor and then issue a transmit poll demand command.
1	R/W/C	TPS - Transmit Process Stopped Asserts when the transmit process enters the stopped state.
0	R/W/C	TI - Transmit Interrupt Indicates that a frame transmission was completed, while TDES1<31> is asserted in the first descriptor of the frame.

Tab - 26 REG5 Status Register Description

4.2.9 Operation Mode Register (REG6)

1. REG6 establishes the receive and transmit operating modes and commands.
2. REG6 should be the last REG to be written as part of initialization.

Field	R/W/C	Description					
31	-	Reserved					
30	R/W	RA - Receive All	1	All incoming packets will be received			
			0	Filtering mode			
29:23	-	Reserved.--Written as "0" for future compatibility concern.					
22	R/W	TTM - Transmit Threshold Mode	1	Threshold is 10Mb/s			
			0	Threshold is 100Mb/s			
21	R/W	SF - Store and Forward	1	Enable Store and Forward			
			0	Disable Store and Forward			
20	-	Reserved.--Written as "0" for future compatibility concern.					
19	R/W	HBD - Heartbeat Disable	1	Heartbeat Disable			
			0	Heartbeat Enable			
18	R/W	PS - Port Select	1	MII port is selected.			
			0	N/A			
17:16	-	Reserved.--Written as "0" for future compatibility concern.					
15:14	R/W	TR - Threshold Control Bits The threshold value has a direct impact on the AX88141 bus arbitration scheme . Transmission starts when the frame size within the transmit FIFO is larger than the threshold. In addition, full frames with a length less than the threshold are also transmitted. The transmit process must be in the stopped state to change these bits. Controls the selected threshold level for the AX88141 transmit FIFO. Four threshold levels are allowed.	REG6<18>=0	REG6<18>=1	REG6<18>=1		
			REG6<21>	REG6<15:14>	REG6<22>=X	REG6<22>=1	REG6<22>=0
			0	00	72	72	128
			0	01	96	96	256
			0	10	128	128	512
			0	11	160	160	1024
13	R/W	ST - Start/Stop Transmission	1	Start Transmission			
			0	Stop Transmission			
12	R/W	FC - Force Collision Mode	1	Enable force collision			
			0	Disable force collision			
11:10	R/W	OM - Operating Mode	00	Normal			
			01	Internal Loop-back			
			10	External Loop-back			
9	R/W	FD - Full-Duplex Mode	1	Full-Duplex			
			0	Half-Duplex			
8	R/W	RB - Receive broadcast packet	1	Accept broadcast packet			
			0	Reject broadcast packet			
7	R/W	PM - Pass All Multicast	1	Enable Pass All Multicast			
			0	Disable Pass All Multicast			
6	R/W	PR - Promiscuous Mode	1	Indicates that any incoming valid frame is received, regardless of its destination address.			
			0	Indicates that no incoming frame is received.			



			0	Disable Promiscuous Mode.
5:4	-	Reserved.--Written as "0" for future compatibility concern.		
3	R/W	PB - Pass Bad Frames	1	All incoming frames that passed the address filtering are received, including runt frames, collided fragments, or truncated frames caused by FIFO over-flow. If any received bad frames are required, promiscuous mode (REG6<6>) should be set to 1.
			0	Disable pass bad frame.
2	-	Reserved.--Written as "0" for future compatibility concern.		
1	R/W	SR - Start/Stop Receive	1	Start Receive
			0	Stop Receive
0	R/W	FIFO Mode	1	AX88141 Mode.
			0	AX88140 Mode.

Tab - 27 REG6 Operation Mode Register Description

Port and Data Rate Selection

REG6 <18>	REG6 <22>	ACTIVE PORT	DATA RATE	FUNCTION
1	1	MII	10MB/S	MII with transmit FIFO thresholds appropriate for 10MB/S
1	0	MII	100MB/S	MII with transmit FIFO thresholds appropriate for 100MB/S

Tab - 28 Port and Data Rate Selection



4.2.10 Interrupt Enable Register (REG7)

1. The interrupt enable register (REG7) enables the interrupts reported by REG5.
2. Setting bit to 1 enables a corresponding interrupt. After a hardware or software reset, all interrupts are disabled.

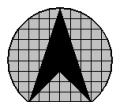
Field	R/W/C	Description
31:17	-	Reserved
16	R/W	NI - Normal Interrupt Summary Enable When set, normal interrupt is enabled. When reset, no normal interrupt is enabled. This bit (REG7<16>) enables the following bits :
		CSR5<0> Transmit interrupt
		CSR5<2> Transmit buffer unavailable
		CSR5<6> Receive interrupt
		CSR5<10> Early transmit interrupt
		CSR5<11> General-purpose timer expired
15	R/W	AI - Abnormal Interrupt Summary Enable When set, abnormal interrupt is enabled. When reset, no abnormal interrupt is enabled. This bit (REG7<15>) enables the following bits :
		CSR5<1> transmit process stopped
		CSR5<3> transmit jabber time-out
		CSR5<5> transmit under-flow
		CSR5<7> receive buffer unavailable
		CSR5<8> receive process stopped
		CSR5<9> receive watchdog time-out
		CSR5<11> fatal bus error
13	R/W	FBE - Fatal Bus Error interrupt enable. Active high.
11	R/W	GPT - General purpose Timer interrupt Enable. Active high.
10	R/W	ETE - Early Transmit Interrupt Enable. Active high.
9	R/W	RW - Receive Watchdog Time out interrupt Enable. Active high
8	R/W	RS - Receive Stopped interrupt Enable. Active high.
7	R/W	RU - Receive Buffer Unavailable interrupt Enable. Active high.
6	R/W	RI - Receive Interrupt Enable. Active high.
5	R/W	UN - under-flow interrupt Enable. Active high.
4	-	Reserved.--Written as "0" for future compatibility concern.
3	R/W	TJ - Transmit Jabber Time out interrupt Enable. Active high.
2	R/W	TU - Transmit Buffer Unavailable interrupt Enable. Active high.
1	R/W	TS - Transmission Stopped interrupt Enable. Active high.
0	R/W	TI - Transmit Interrupt Enable. Active high.

Tab - 29 REG7 Interrupt Enable Register Description

4.2.11 Missed Frame and Overflow Flag (REG8)

Field	R/W	Description
31: 18	-	Reserved
17	R/C	Overflow Flag Indicates the frames discarded because of overflow. The flag clears when read.
16 : 1	-	Reserved
0	R/C	Missed Frame Flag Indicates the frames discarded because no host receive descriptors were available. The flag clears when read.

Tab - 30 REG8 Missed Frame and Overflow Counter Description



4.2.12 Serial ROM and MII Management Register (REG9)

1. The register provides an interface to the Microwire serial ROM and to the physical layer protocol (PHY). It selects the device and contains both the commands and data to be read from and stored in the serial ROM.
2. The MII management selects and operation mode for reading and writing the MII.

FIELD	R/W/C	DESCRIPTION
31:20	-	Reserved.--Written as "0" for future compatibility concern.
19	R	MDI - MII management data_in Used by the AX88141 to read data from the PHY
18	R/W	MII - MII management operation mode Defines the operation mode (read or write) of the PHY.
17	R/W	MDO - MII Management write data Specifies the value of the data that AX88141 writes to the PHY
16	R/W	MDC - MII Management clock MII management data clock (MII_MDC) is an output signal to the PHY. it is used as a timing reference.
14	R/W	RD - Read operation Read control bit. When set together with REG9<12>, The AX88141 performs read cycles from the BOOT ROM, and the serial ROM.
13:12	-	Reserved.--Written as "0" for future compatibility concern.
11	R/W	SR - SERIAL ROM select When set together with either SERIAL ROM read operation (REG9<14>) or SERIAL ROM Write operation (REG9<13>), The AX88141 selects the SERIAL ROM.
10:4	-	Reserved.--Written as "0" for future compatibility concern.
3	R/W	SDO - SERIAL ROM data_out SERIAL ROM data output(SR_DO) From the SERIAL ROM device to the AX88141.
2	R	SDI - SERIAL ROM data_in SERIAL ROM Data input(SR_DI) To the SERIAL ROM device from the AX88141.
1	R/W	SCLK - SERIAL ROM serial clock Serial clock (SR_CK) Output to the SERIAL ROM.
0	R/W	SCS - Serial ROM Chip Select Chip select (sr_cs) output to the serial ROM.

Tab - 31 REG9 Serial ROM, and MII Management Register Description

4.2.13 General -Purpose Timer (REG11)

1. This register contains a 16 bit general-purpose timer. It is used mainly by the software driver for timing functions not supplied by the operating system. After the timer is loaded, it starts counting down . The expiration of the timer causes an interrupt in REG5<11>.
2. If the timer expires with the CON bit on, the counter will load itself automatically with the last value. The timer is not active in snooze mode.

Field	R/W/C	Description
31:17	-	Reserved.--Written as "0" for future compatibility concern.
16	R/W	CON - Continuous Mode
		1 | Continuous operating mode.
		0 | One-shot operating mode.
15:0	R/W	Timer value
		Contains the general-purpose timer value within a N microsecond cycle.
		SRL_10M : 204.8us
		MII_10M : 819.2us
		MII_100M : 81.92us



Tab - 32 REG11 General -Purpose Timer Register Description

4.2.14 General -Purpose Port Register (REG12)

Field	R/W/C	Description		
31:9	-	Reserved.--Written as "0" for future compatibility concern.		
8	R/W	GPC - General Purpose Control . When a hardware reset is initiated, all gep pins become input pins.	1	Indicate next write REG12<7:0> is use for define General purpose port in/out direction.
			0	Indicate next write REG12<7:0> is use for read/write general purpose port data.
7:0	R/W	MD - General Purpose Mode and Data		

Tab - 33 REG12 General -Purpose Port Register Description

4.2.15 Filtering Index (REG13)

FIELD	R/W/C	DESCRIPTION
31:6	-	Reserved.--Written as "0" for future compatibility concern.
5:0	R/W	FI - Filtering Index When writing data to filtering buffer, uses filtering index register REG13 to point the position (buffer number) in filtering buffer. The valid value is between 0 and 3.

Tab - 34 REG13 Filtering Index Register Description

4.2.16 Filtering data (REG14)

FIELD	R/W/C	DESCRIPTION
31:0	R/W	FD - Filtering Data By indexed by filtering index register REG13, write the filtering data register REG14 to put filtering address/hash table into filtering buffer..

Tab - 35 REG14 Filtering Data Register Description

Filtering Buffer

The AX88141 stores one Ethernet address for local physical address and filters the packets with multicast addresses by 64 bits array. For any incoming frame with a multicast destination address, the AX88141 applies the standard Ethernet cyclic redundancy check function to the destination address, then uses the most significant 6 bits of the result as a bit index into the table. If the indexed bit is set, the frame is accepted. If the bit is reset, the frame is rejected.

Description of Filtering Buffer

BUFFER NUMBER	DESCRIPTION
0	BYTE 0 - 3 OF LOCAL PHYSICAL ADDRESS
1	BYTE 4 - 5 OF LOCAL PHYSICAL ADDRESS IN THE LEAST SIGNIFICANT WORD
2	BIT 0 - 31 OF MULTICAST ADDRESS FILTERING TABLE
3	Bit 32 - 63 of multicast address filtering table

Tab - 36 Description of Filtering Buffer

Layout of Filtering Buffer

BUFFER NUMBER	BYTE 3	BYTE 2	BYTE 1	BYTE 0
0	PHYSICAL ADDRESS BYTE 3	PHYSICAL ADDRESS BYTE 2	PHYSICAL ADDRESS BYTE 1	PHYSICAL ADDRESS BYTE 0



AX88141

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PRELIMINARY

1	RESERVED	RESERVED	PHYSICAL ADDRESS BYTE 5	PHYSICAL ADDRESS BYTE 4
2	MULTICAST ADDRESS FILTERING TABLE BIT 24 - 31	MULTICAST ADDRESS FILTERING TABLE BIT 16 - 23	MULTICAST ADDRESS FILTERING TABLE BIT 8 - 15	MULTICAST ADDRESS FILTERING TABLE BIT 0 - 7
3	multicast address filtering table bit 56 - 63	multicast address filtering table bit 48 - 55	multicast address filtering table bit 40 - 47	multicast address filtering table bit 32 - 39

Tab - 37 Layout of Filtering Buffer



5.0 Host Communication

Descriptor lists and data buffers, collectively called the host communication, reside in the host memory and manage the actions and status related to buffer management.

5.1 Descriptor Lists and Data Buffers

The AX88141 transfers data frames to the receive buffers and from the transmit buffers in host memory. Descriptors that reside in the host memory act as pointers to these buffers.

There are two descriptor lists, one for receive and one for transmit. The base address of each list is written into REG3 and REG4, respectively. A descriptor list is forward-linked (explicitly). The last descriptor may point back to the first entry to create a ring structure. Explicit chaining of descriptors is accomplished by setting the address pointer chained in both the receive and transmit descriptors (RDES3 and TDES3). The descriptor lists reside in the host physical memory address space.

A data buffer consists of either an entire frame or part of a frame, but it cannot exceed a single frame. Buffers contain only data; buffer status is maintained in the descriptor. Data chaining refers to frames that span multiple data buffers.

Descriptor Structure Example

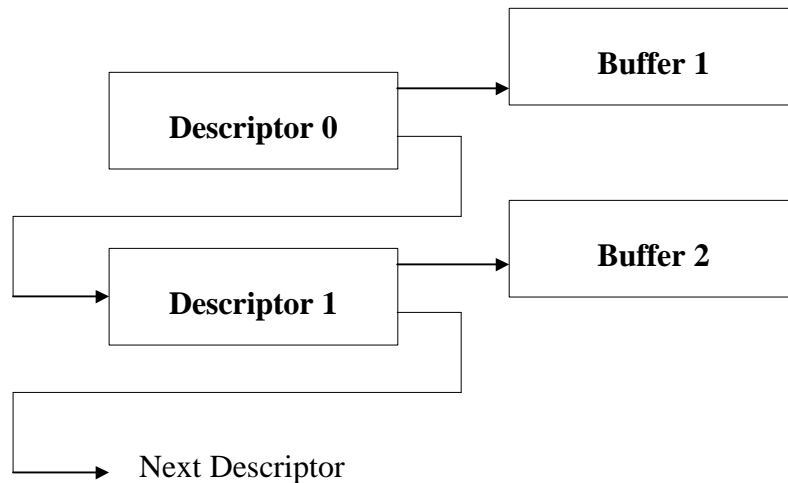
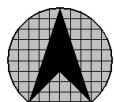


Fig - 3 Descriptor Structure Example



5.2 Receive Descriptors

The receive descriptor provides one buffer, one byte-count buffer, and one address pointer in each descriptor. Descriptors and receive buffers addresses must be long-word aligned.

Receive Descriptor Format

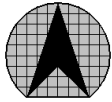
	31				0
RDES0	0 W N	Status			
RDES1	Control bits	Byte Count Buffer 2	Byte Count Buffer 1		
RDES2	Buffer Address 1				
RDES3	Buffer Address 2				

Fig - 4 Receive Descriptor Format

5.2.1 Receive Descriptor 0 (RDES0)

RDES0 contains the received frame status, the frame length, and the descriptor ownership information.

Field	Description		
31	OWN - Own Bit	1	Indicates that the descriptor is owned by the AX88141
	The AX88141 clears this bit either when it completes the frame reception or when the buffers that are associated with this descriptor are full.	0	Indicates that the descriptor is owned by the host
30	FF - Filtering Fail This bit can be set only when receive all (REG6<30>) is set.	1	Indicates that the frame failed the address recognition filtering
		0	Indicates that the frame passed the address recognition filtering
29:16	FL - Frame Length Indicates the length in bytes of the received frame including the cyclic redundancy check (CRC). This field is valid only when last descriptor (RDES0<8>) is set and descriptor error (RDES0<14>) is reset.		
15	ES - Error Summary Indicates the logical OR of the following RDES0 bits : This field is valid only when last descriptor (RDES0<8>) is set.		
	RDES0<1>	CRC error	
	RDES0<6>	collision seen	
	RDES0<7>	frame too long	
	RDES0<11>	runt frame	
RDES0<14>	descriptor error		
14	DE - Descriptor Error. The frame is truncated. Active high. This field is valid only when last descriptor (RDES0<8>) is set.		
13:12	Reserved.--Written as "0" for future compatibility concern.		
11	RF - Runt Frame. Indicates that this frame is a runt frame. Active high. This field is valid only when last descriptor (RDES0<8>) is set .		



10	MF - Multicast Frame Indicates that this frame is a multicast address. This field is valid only when last descriptor (RDES0<8>) is set.		
9	FS - First Descriptor	1	Indicates that this descriptor contains the first buffer of a frame.
		0	Indicates that this descriptor is the middle or last buffer of a frame.
8	LS - Last Descriptor	1	Indicates that the buffers pointed to by this descriptor, are the last buffers
		0	Indicates that this descriptor is the middle or first buffer of a frame.
7	TL - Frame Too Long. Frame length greater than 1518 bytes. Active high. This field is valid only when last descriptor (RDES0<8>) is set.		
6	CS - Collision Seen. This is a late collision. This field is valid only when last descriptor (RDES0<8>) is set.		
5	Reserved.--Written as "0" for future compatibility concern.		
4	RW – Received first packet flag after receiver buffer unavailable state is cleared.		
3	RE - Report on MII Error. Active high.		
2	DB - Dribbling Bit Active high. If set, and CRC error (RDES0<1>) is reset, then the packet is valid.		
1	CE - CRC Error. Active high. This field is valid only when last descriptor (RDES0<8>) is set.		
0	FIFO Overrun. Active high.		

Tab - 38 Receive Descriptor 0

5.2.2 Receive Descriptor 1 (RDES1)

FIELD	DESCRIPTION
31:11	Reserved.--Written as "0" for future compatibility concern.
10:0	RBS - Receive Data Buffer Size Indicates the size in bytes of the data buffer. If this field is 0, the AX88141 ignores this buffer. The buffer size must be a multiple of 4.

Tab - 39 Receive Descriptor 1

5.2.3 Receive Descriptor 2 (RDES2)

FIELD	DESCRIPTION
31:0	Data Buffer Pointer Indicates the physical address of data buffer. The buffer must be long-word-aligned (RDES2<1:0>=00).

Tab - 40 Receive Descriptor 2

5.2.4 Receive Descriptor 3 (RDES3)

FIELD	DESCRIPTION
31:0	Address Pointer Indicates the physical address of next descriptor. The address must be long-word aligned (RDES3<1:0>=00).

Tab - 41 Receive Descriptor 3

5.3 Transmit Descriptors

Providing one buffer, one byte-count buffer, and two address pointers in each descriptor .

Transmit Descriptor Format

	31			0
TDES0	OWN	Status		
TDES1	Control bits	Byte Count Buffer 2	Byte Count Buffer 1	
TDES2	Buffer Address 1			
TDES3	Buffer Address 2			

Fig - 5 Transmit Descriptor Format

5.3.1 Transmit Descriptor 0 (TDES0)

TDES0 contains transmitted frame status and descriptor ownership information.

Field	Description													
31	OWN - Own Bit	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">1</td> <td>Indicates that the descriptor is owned by the AX88141.</td> </tr> <tr> <td style="text-align: center;">0</td> <td>Indicates that the descriptor is owned by the host.</td> </tr> </table>	1	Indicates that the descriptor is owned by the AX88141.	0	Indicates that the descriptor is owned by the host.								
1	Indicates that the descriptor is owned by the AX88141.													
0	Indicates that the descriptor is owned by the host.													
30:16	Reserved.--Written as "0" for future compatibility concern.													
15	ES - Error Summary Indicates the logical OR of the following bits :	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="text-align: center;">TDES0<1></td> <td>under-flow error</td> </tr> <tr> <td style="text-align: center;">TDES0<8></td> <td>successive collisions</td> </tr> <tr> <td style="text-align: center;">TDES0<9></td> <td>late collision</td> </tr> <tr> <td style="text-align: center;">TDES0<10></td> <td>no carrier</td> </tr> <tr> <td style="text-align: center;">TDES0<11></td> <td>loss of carrier</td> </tr> <tr> <td style="text-align: center;">TDES0<14></td> <td>transmit jabber time-out</td> </tr> </table>	TDES0<1>	under-flow error	TDES0<8>	successive collisions	TDES0<9>	late collision	TDES0<10>	no carrier	TDES0<11>	loss of carrier	TDES0<14>	transmit jabber time-out
TDES0<1>	under-flow error													
TDES0<8>	successive collisions													
TDES0<9>	late collision													
TDES0<10>	no carrier													
TDES0<11>	loss of carrier													
TDES0<14>	transmit jabber time-out													
14	TO - Transmit Jabber Time-out : Active high. The transmission process is aborted and placed in the STOPPED state. When TDES0<14> is set any heartbeat fail indication (TDES0<7>) is not valid.													
13:12	Reserved.--Written as "0" for future compatibility concern.													
11	LO - Loss of Carrier during transmission. Active high. (The status is no meaning except 10BASE SRL mode) Not valid in internal loop-back mode (REG6<11:10>=01).													
10	NC - No Carrier. Indicates that the carrier signal from the transceiver was not present during transmission. Active high. Not valid in internal loop-back mode (REG6<11:10>=01).													
9	LC - Late Collision. When set, indicates that the frame transmission was aborted due to collision occurring after the collision window of 64 bytes. Not valid if under-flow error (TDES0<1>) is set.													
8	EC - Excessive Collision When set, indicates that the transmission was aborted after 16 successive collisions while attempting to transmit the current frame.													
7	HF - Heartbeat Fail This bit is effective only in 10Mb/s operation mode. When set, indicates a heartbeat collision check failure This bit is not valid if under-flow error (TDES0<1>) is set. On the second transmission attempt, after the first transmission was aborted due to collision, the AX88141 does not check heartbeat fail and (TDES0<7>) is reset.													
6:3	CC - Collision Count This 4-bit counter indicates the number of collisions that occurred before the frame was transmitted. Not valid when the excessive collisions bit (TDES0<8>) is also set.													
2	Reserved.--Written as "0" for future compatibility concern.													



1	UF - Under-flow Error When set, indicates that the transmitter aborted the message because data arrived late from memory. Under-flow error indicates that the AX88141 encountered an empty transmit FIFO while transmitting a frame. The transmission process enters the suspended state and sets both transmit under-flow (REG5<0>) and transmit interrupt (REG5<0>).
0	DE - Deferred When set, indicates that the AX88141 had to defer while ready to transmit a frame because the carrier was asserted.

Tab - 42 Transmit Descriptor 0

5.3.2 Transmit Descriptor 1 (TDES1)

Field	Description	
31	IC - Interrupt on Completion When set, the AX88141 sets transmit interrupt (REG5<0>) after the present frames has been transmitted. It is valid only when first segment (TDES1<30>) is set.	
30	LS - Last Segment	1 Indicates that the buffer contains the last segment of a frame.
		0 Indicates that the buffer contains the first or middle segment of a frame.
29	FS - First Segment	1 Indicates that the buffer contains the first segment of a frame.
		0 Indicates that the buffer contains the middle or last segment of a frame.
28:27	Reserved.--Written as "0" for future compatibility concern.	
26	AC - Add CRC Disable When set, the AX88141 does not append the CRC to the end of the transmitted frame. This field is valid only when first segment (TDES1<29>) is set.	
25:24	Reserved.--Written as "0" for future compatibility concern.	
23	DPD - Disabled Padding The CRC field is added despite the state of the add CRC disable (TDES1<26>) flag.	1 the AX88141 does not automatically add a padding field, so a packet shorter than 64 bytes.
		0 The AX88141 automatically adds a padding field and also a CRC field to a packet shorter than 64 bytes.
22:11	Reserved.--Written as "0" for future compatibility concern.	
10:0	Data Buffer Size Indicates the size, in bytes, of the data buffer. If this field is 0, the AX88141 ignores this buffer.	

Tab - 43 Transmit Descriptor 1

5.3.3 Transmit Descriptor 2 (TDES2)

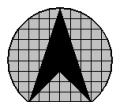
Field	Description
31:0	Data Buffer Pointer Physical address of data buffer. There are no limitations on the buffer address alignment.

Tab - 44 Transmit Descriptor 2

5.3.4 Transmit Descriptor 3 (TDES3)

Field	Description
31:0	Address Pointer Physical address of next descriptor address. There are no limitation on the buffer address alignment.

Tab - 45 Transmit Descriptor 3



6.0 Electrical Specification and Timings

6.1 Absolute Maximum Ratings

Description	SYM	Min	Max	Units
Operating Temperature	Ta	0	+70	°C
Storage Temperature	Ts	-55	+150	°C
Supply Voltage	Vcc	-0.5	+7	V
Input Voltage	Vin	Vss-0.5	Vdd+0.5	V
Output Voltage	Vout	Vss-0.5	Vdd+0.5	V
Lead Temperature (soldering 10 seconds maximum)	Tl	-55	+250	°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	Max	Units
Operating Temperature	Ta	0	+70	°C
Supply Voltage	Vdd	+4.75	+5.25	V

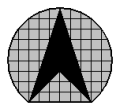
6.3 DC Characteristics

(Vdd=4.75V to 5.25V, Vss=0V, Ta=0°C to 70°C)

Description	SYM	Min	Tpy	Max	Units
Low Input Voltage	Vil	Vss-0.5		0.8	V
High Input Voltage	Vih	2		Vdd+0.5	V
Low Output Voltage	Vol	-		0.4	V
High Output Voltage	Voh	2.4		-	V
Input Leakage Current 1 (Note 1)	Iil1	-		10	uA
Input Leakage Current 2 (Note 2)	Iil1	-		500	uA
Output Leakage Current	Iol	-		10	uA
Power Consumption (Sleep ,Note 3)	Ps		18		mA
Power Consumption (Idle , Driver Loaded)	Pi		72		mA
Power Consumption (Heavy Traffic)	Pt		110		mA

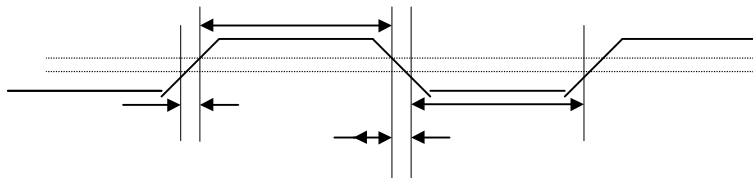
Note :

1. All the input pins without pull low or pull high.
2. Those pins had been pull low or pull high.
3. When sleep mode, PCI clock stop / Link on ; If link off, typical is 2.5mA .



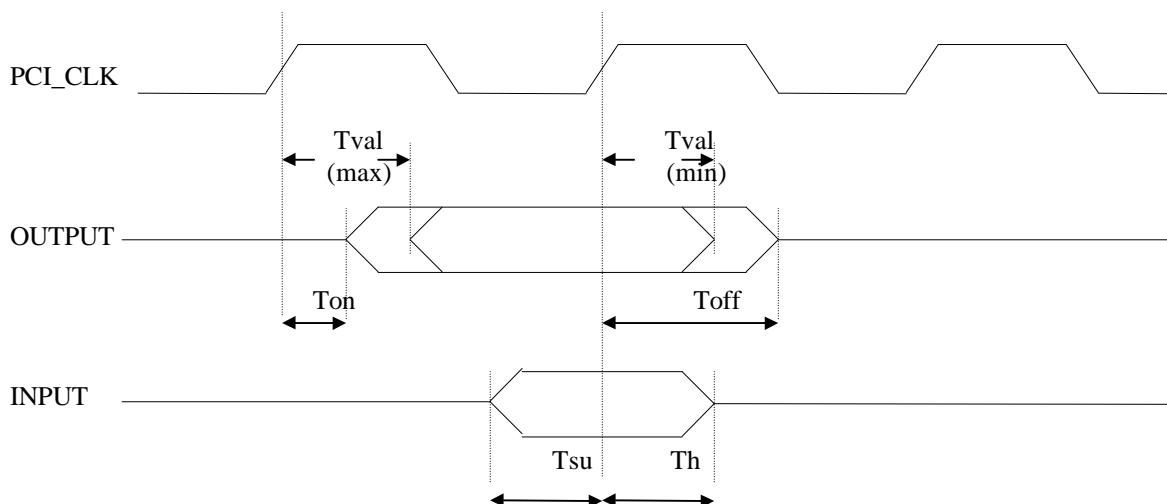
6.4 A.C. Timing Characteristics

6.4.1 PCI CLOCK



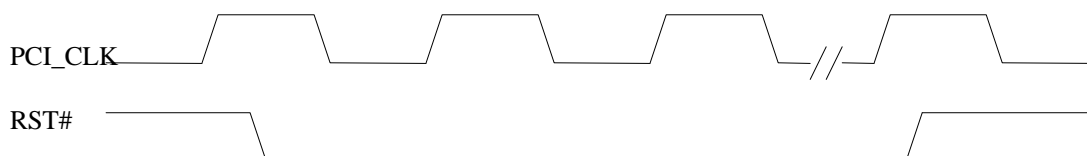
Symbol	Description	Min	Typ.	Max	Units
T _{cy}	CYCLE TIME	30	-	45	ns
T _{high}	PCI_CLK HIGH TIME	11	-	-	ns
T _{low}	PCI_CLK LOW TIME	11	-	-	ns
T _r /T _f	PCI_CLK SLEW RATE	1	-	4	ns

6.4.2 PCI Timings



Symbol	Description	Min	Typ.	Max	Units
T _{val}	CLK TO SIGNAL VALID DELAY	2	-	11	ns
T _{on}	FLOAT TO ACTIVE DELAY	2	-	-	ns
T _{off}	ACTIVE TO FLOAT DELAY	-	-	28	ns
T _{su}	INPUT SETUP TIME TO CLK	7	-	-	ns
T _h	INPUT HOLD TIME FROM CLK	0	-	-	ns

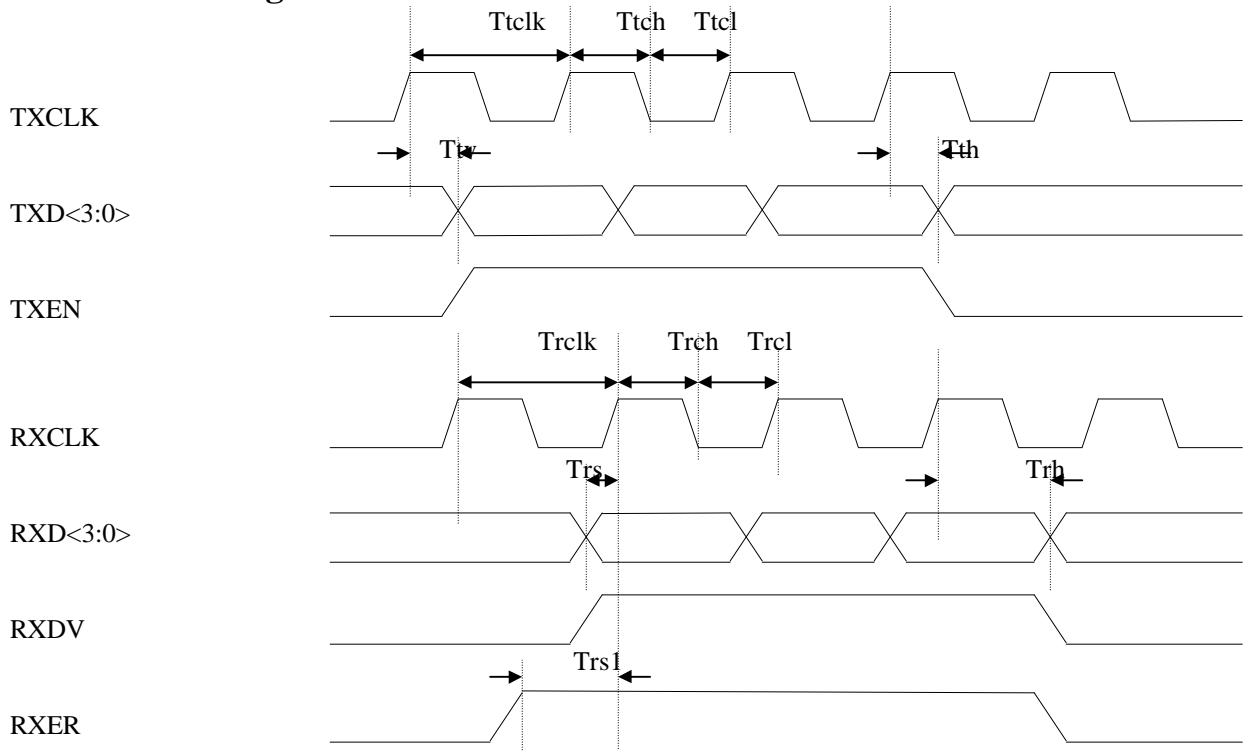
6.4.3 Reset Timing



Symbol	Description	Min	Typ.	Max	Units
T _{rst}	Reset pulse width	10	-	-	PCI CLK



6.4.4 MII Timing

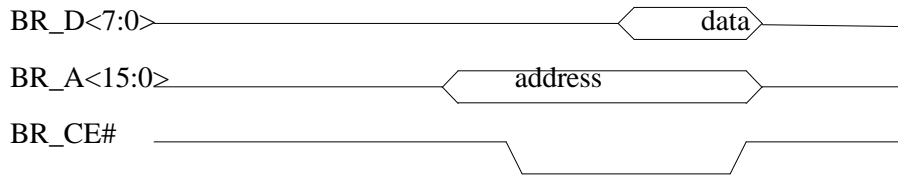


Symbol	Description	Min	Typ.	Max	Units
Ttclk	Cycle time(100Mbps)	-	40	-	ns
Ttclk	Cycle time(10Mbps)	-	400	-	ns
Ttch	high time(100Mbps)	14	-	26	ns
Ttch	high time(10Mbps)	140	-	260	ns
Trch	low time(100Mbps)	14	-	26	ns
Trch	low time(10Mbps)	140	-	260	ns
Ttv	Clock to data valid	-	-	20	ns
Tth	Data output hold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

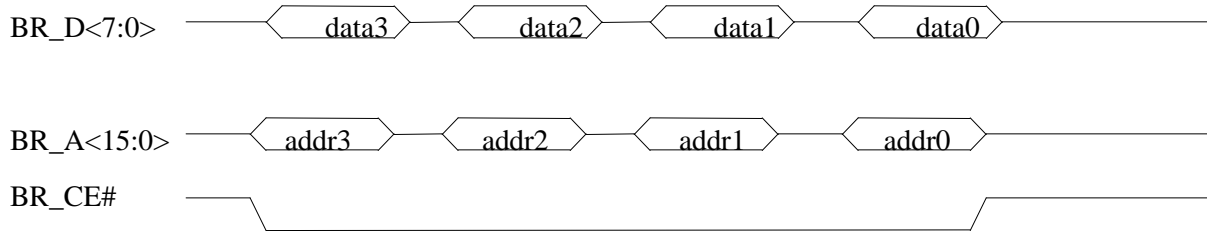


6.4.5 Boot ROM Read Cycles

Boot ROM Byte Read Cycle

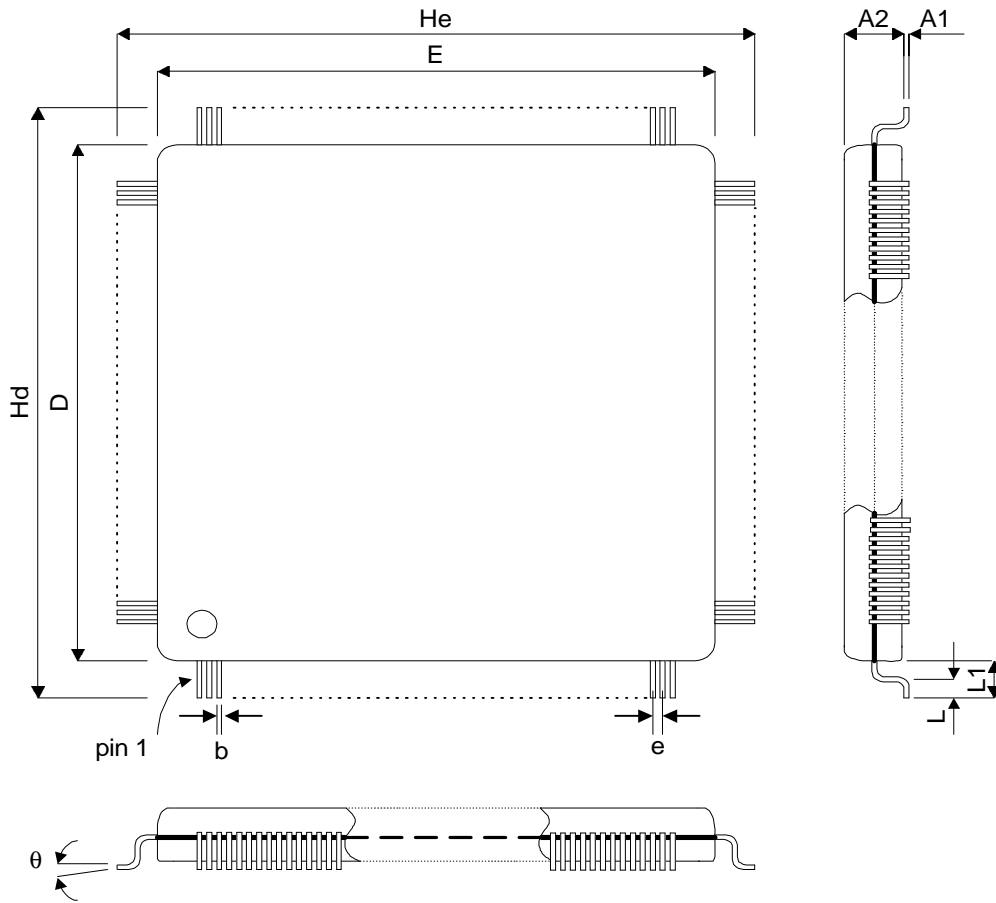


Boot ROM Dword Read Cycle

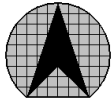




7.0 Package Information



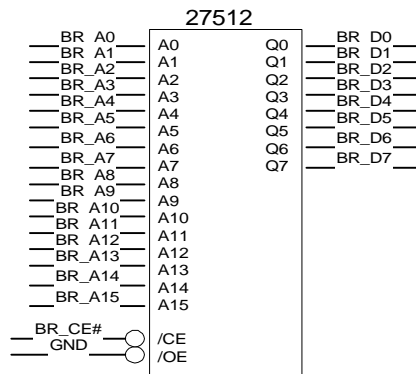
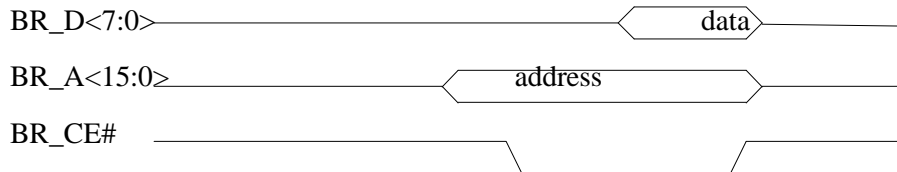
SYMBOL	MILIMETER		
	MIN.	NOM	MAX
A1	0.21	0.31	0.41
A2	2.80	2.85	2.90
b	0.15	0.20	0.30
D	13.80	14.00	14.20
E	19.80	20.00	20.20
e		0.50	
Hd	17.10	17.20	17.30
He	23.10	23.20	23.30
L	0.70	0.80	0.90
L1		1.60	
θ	0		8



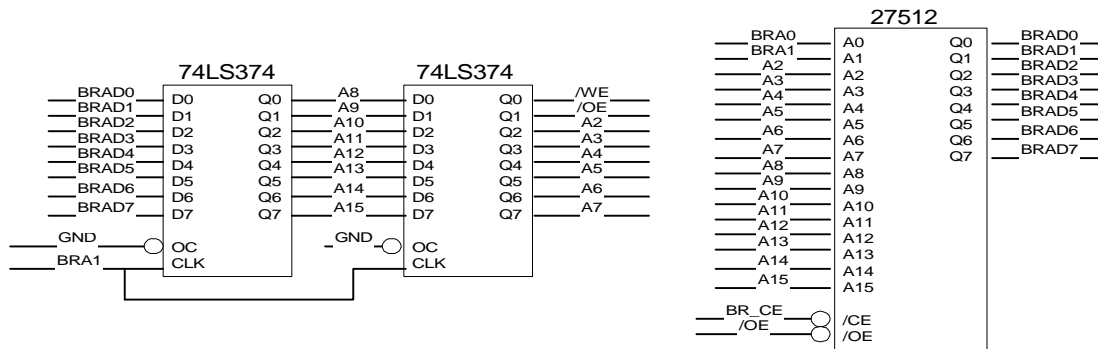
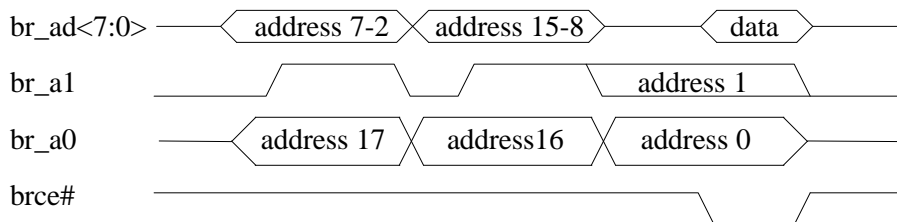
APPENDIX A H/W NOTE

A.1 Boot ROM read cycle

ASIX 88141 Boot ROM Byte Read Cycle



DEC 21140 Boot ROM Byte Read Cycle:





A.2 Power Supply

AX88141 power supply is +5V DC

DEC 21140 power supply is +3.3V DC

A.3 Boundary Scan Test Pins

AX88141 do not support boundary scan test pins

DEC 21140 supports boundary scan test pins



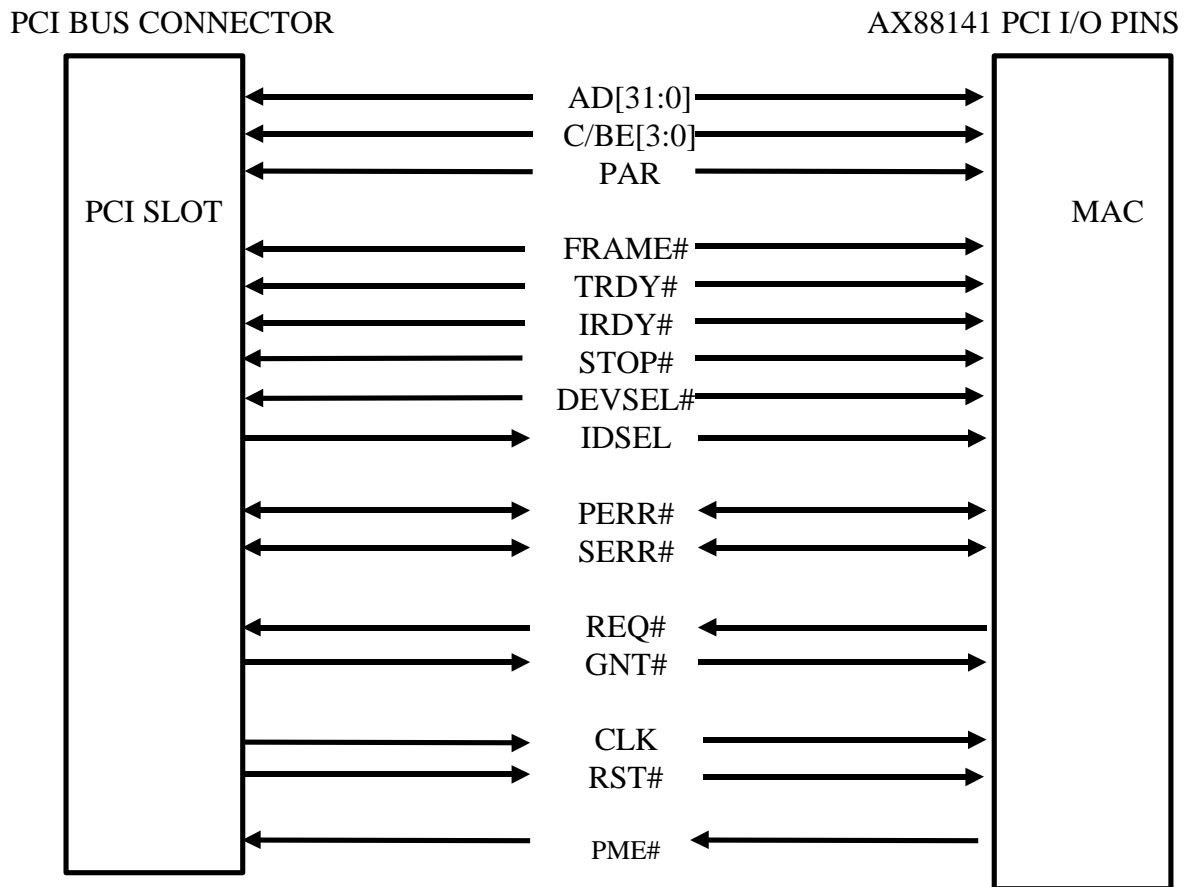
APPENDIX B Function Application

B.1 Application for PCI Interface

Features :

- Direct interface to PCI Bus.
- Support 33 MHz no wait state PCI Bus Interface.
- Powerful on chip buffer management DMA. And PCI Bus master operation reduce CPU utilization.
- 5 Volt CMOS process.

PCI Interface Schematic:



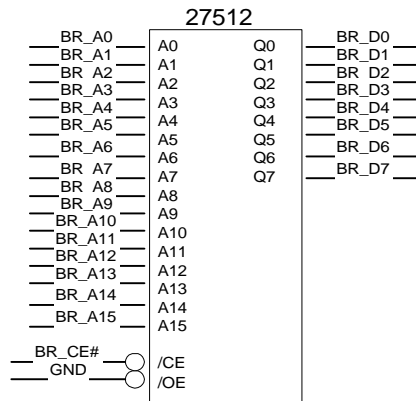
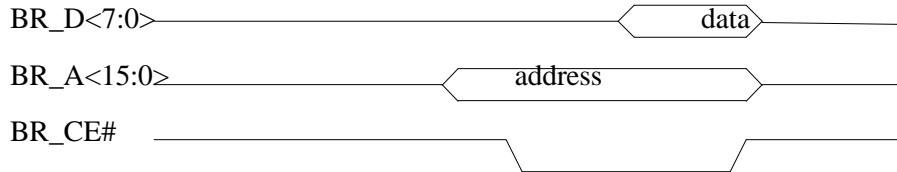
The pull high resistors are required for pin REQ#, GNT#, PERR#, and SERR# on MAC for more detail please to check the schematic.



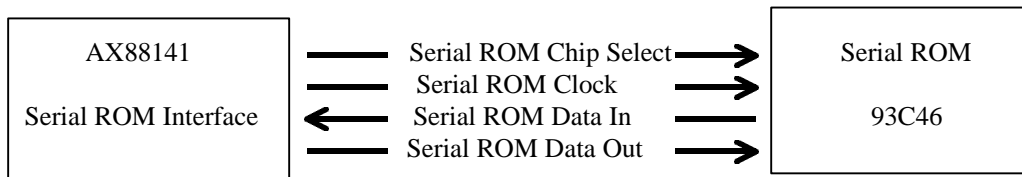
B.2 Application for Boot ROM Interface

AX88141

Boot ROM Byte Read Cycle



B.3 Application for Serial ROM Interface





B.4 Applications

B.4.1 Application for NS DP83843

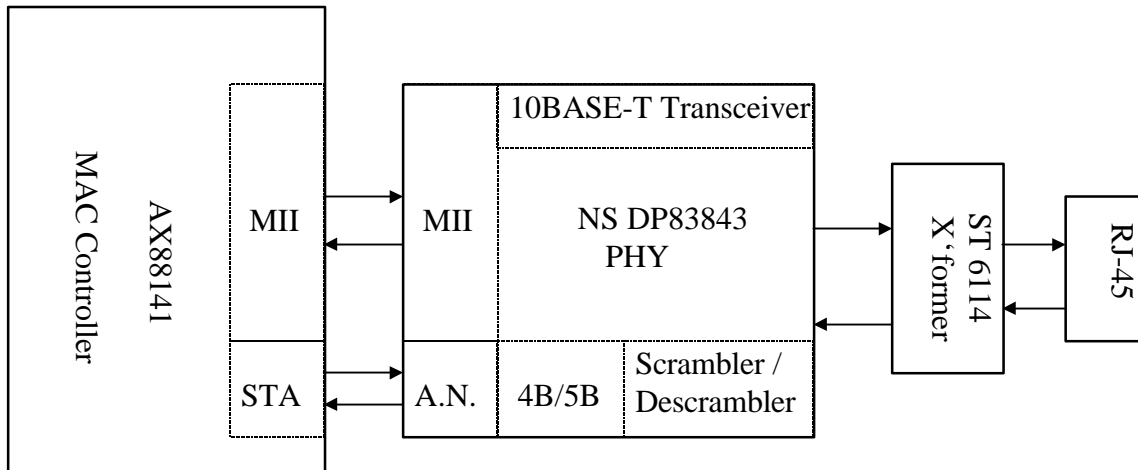


Fig - 6 Application for NS DP83843

B.4.2 Application for LUCENT M-LU6612/M-3X51

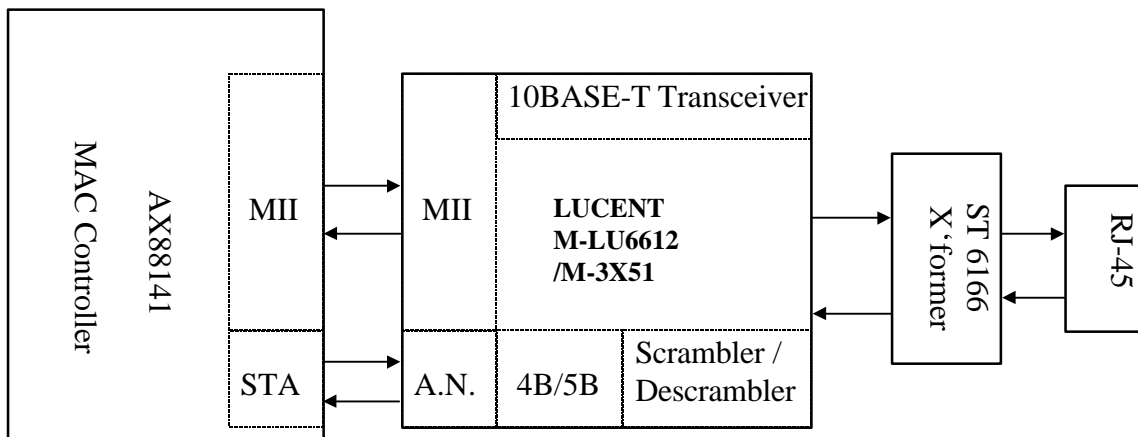


Fig - 7 Application for LUCENT M-LU6612



B.4.3 Application for TI XTNETE2101

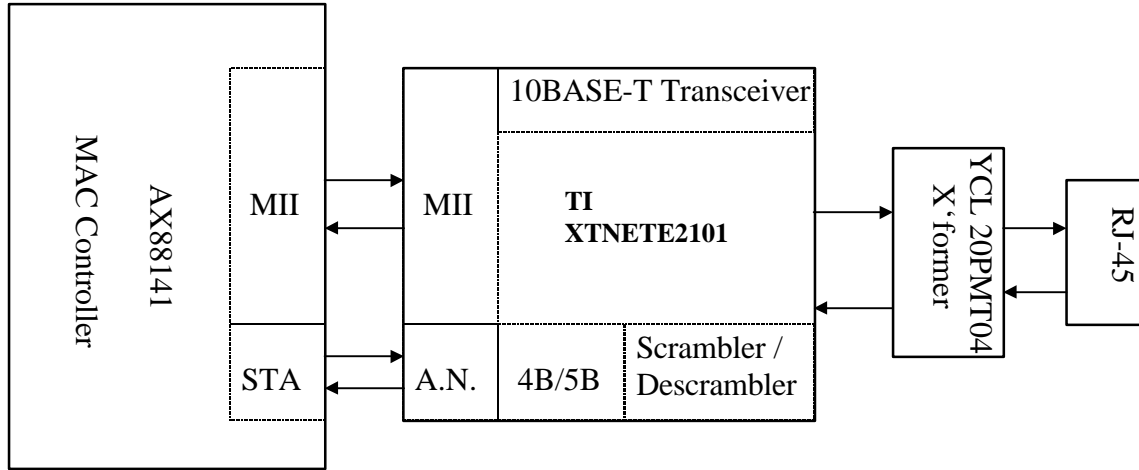


Fig - 8 Application for TI XTNETE2101

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