

### 10/100BASE Local CPU Bus Fast Ethernet MAC Controller

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#### Features

- IEEE 802.3u 100BASE-T, TX, and T4 Compatible
- Single chip local CPU bus 10/100Mbps Fast Ethernet MAC Controller
- NE2000 register level compatible instruction
- Support both 8 bit and 16 bit local CPU interfaces include MCS-51 series, 80186 series and MC68K series CPU
- Support both 10Mbps and 100Mbps data rate
- Support both full-duplex or half-duplex operation
- Provides a MII port for both 10/100Mbps operation
- Support EEPROM interface to store MAC address
- External and internal loop-back capability
- Two external 32K\*8 Asynchronous SRAMs required for packet buffer
- 128-pin LQFP low profile package
- 25MHz Operation, Dual 5V and 3.3V CMOS process with 5V I/O tolerance. Or pure 3.3V operation

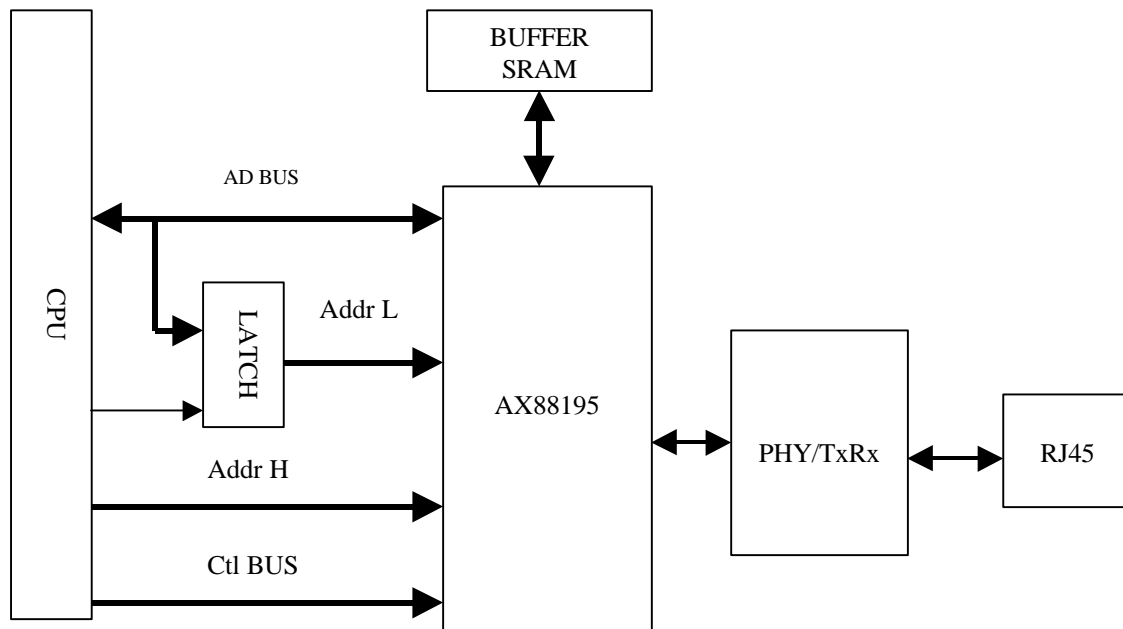
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#### Product description

The AX88195 Fast Ethernet Controller is a high performance and highly integrated local CPU bus Ethernet Controller. The AX88195 supports both 8 bit and 16 bit local CPU interfaces include MCS-51 series, 80x86 series, MC68K series CPU and ISA bus. The AX88195 implements both 10Mbps and 100Mbps Ethernet function based on IEEE802.3 / IEEE802.3u LAN standard and supports both 10Mbps/100Mbps media-independent interface (MII) to simplify the design. Two low cost 32k\*8 SRAM is required for packet buffer.

#### System Block Diagram



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## 1.0 Introduction

### 1.1 General Description:

The AX88195 provides industrial standard NE2000 registers level compatible instruction set. Various drivers are easy acquired, maintenance and usage. No much additional effort to be paid. Software is easily port to various embedded system with no pain and tears

The AX88195 Fast Ethernet Controller is a high performance local CPU bus Ethernet Controller. The AX88195 supports both 8 bit and 16 bit local CPU interfaces include MCS-51 series, 80x86 series, MC68K series CPU and ISA bus. The AX88196 implements both 10Mbps and 100Mbps Ethernet function based on IEEE802.3 / IEEE802.3u LAN standard and supports both 10Mbps/100Mbps media-independent interface (MII) to simplify the design.

AX88195 use 128-pin LQFP low profile package, 25MHz operation, dual 5V and 3.3V CMOS process with 5V I/O tolerance or pure 3.3V operation.

### 1.2 AX88195 Block Diagram:

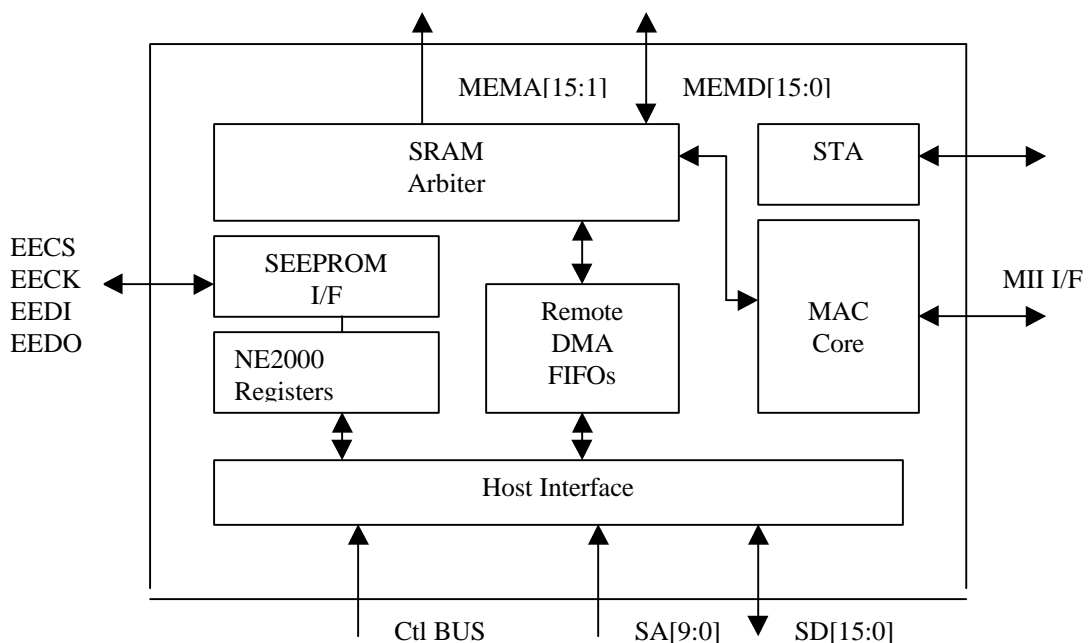


Fig - 1 AX88195 Block Diagram



# AX88195 Local CPU Bus Fast Ethernet MAC Controller

## 1.3 AX88195 Pin Connection Diagram

The AX88195 is housed in the 128-pin plastic light quad flat pack. Fig - 2 shows the AX88195 pin connection diagram.

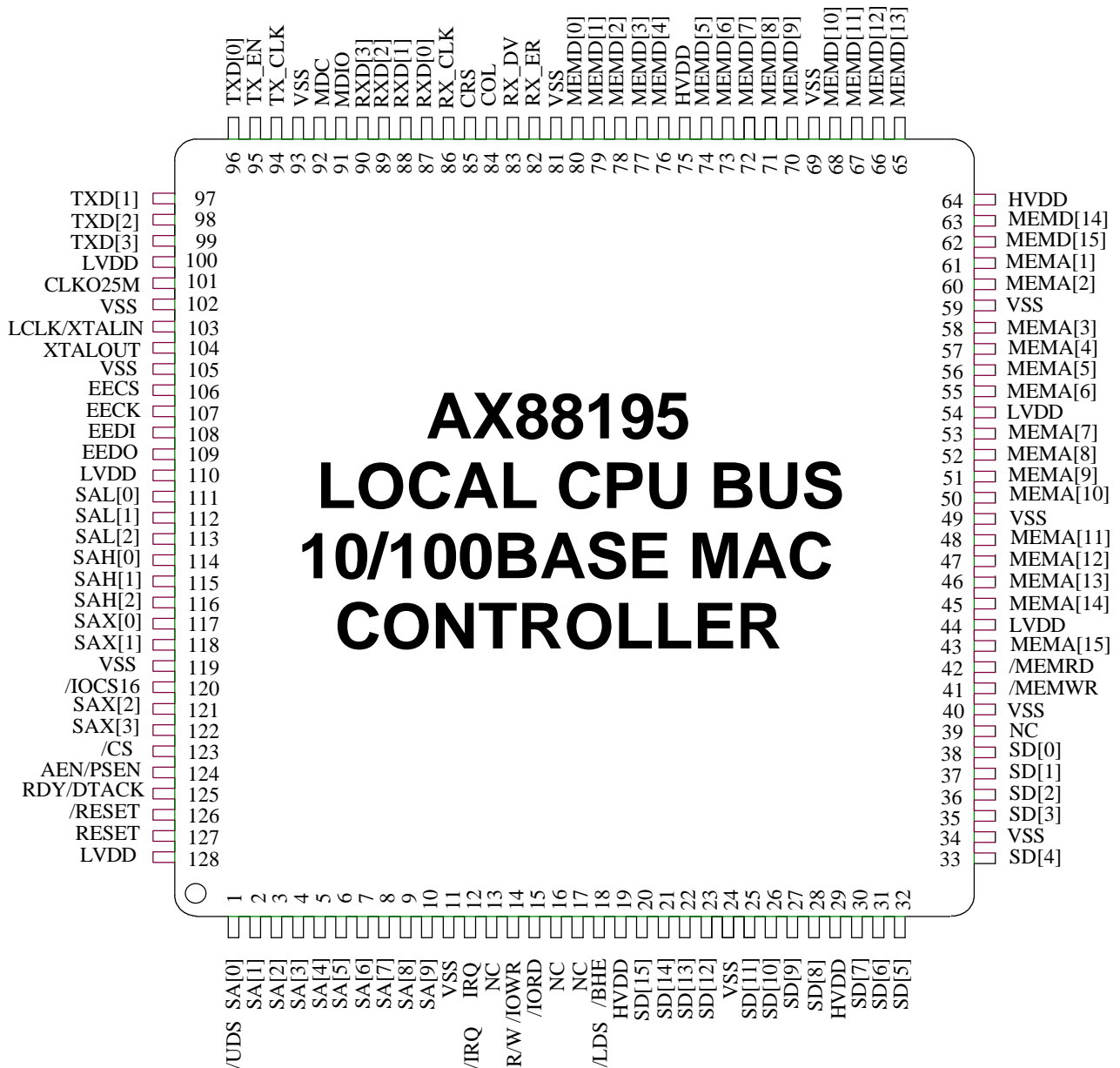


Fig - 2 AX88195 Pin Connection Diagram



# AX88195 Local CPU Bus Fast Ethernet MAC Controller

## 1.3.1 AX88195 Pin Connection Diagram for ISA Bus Mode

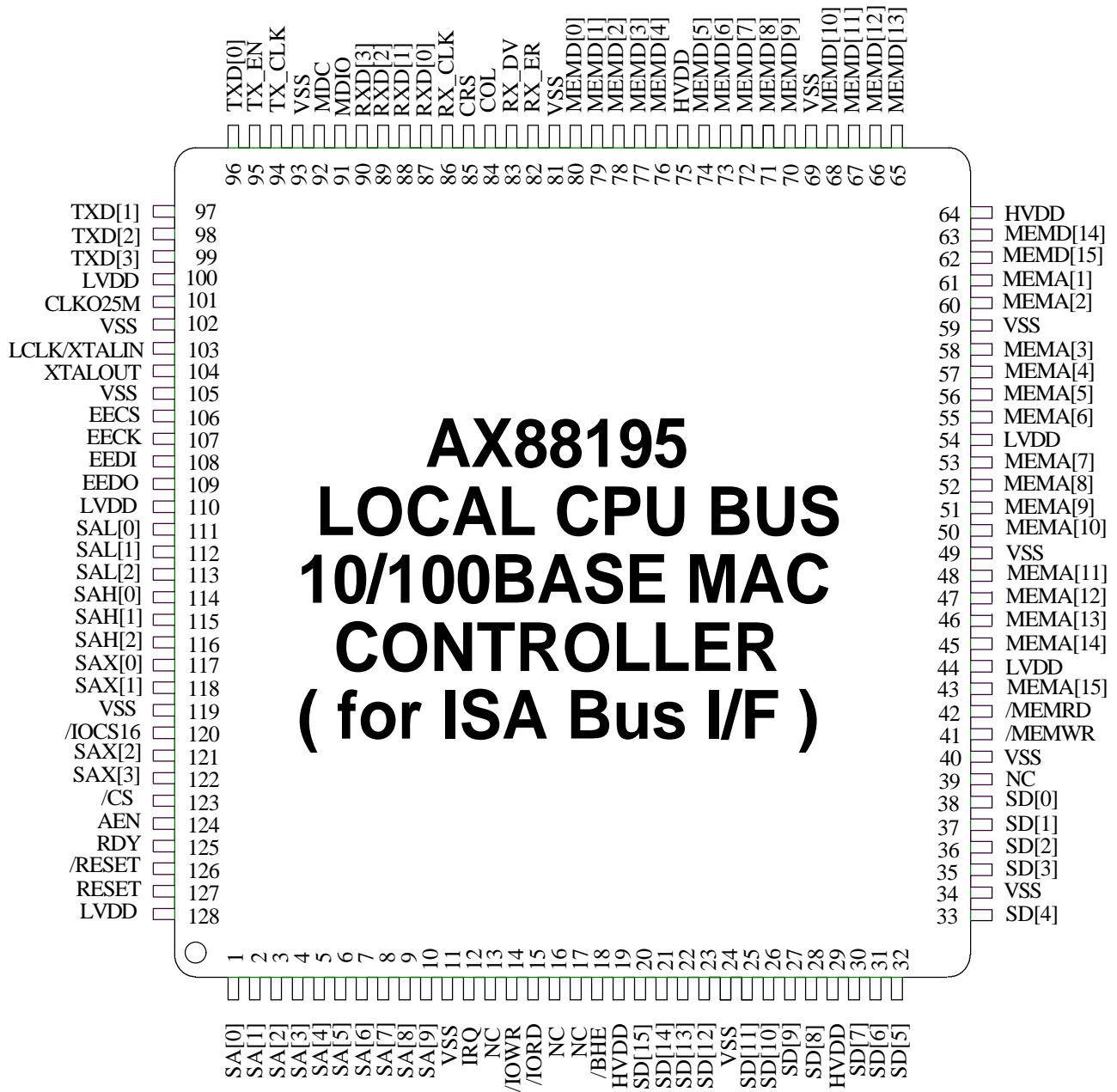


Fig - 3 AX88195 Pin Connection Diagram for ISA Bus Mode



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## 1.3.2 AX88195 Pin Connection Diagram for 80x86 Mode

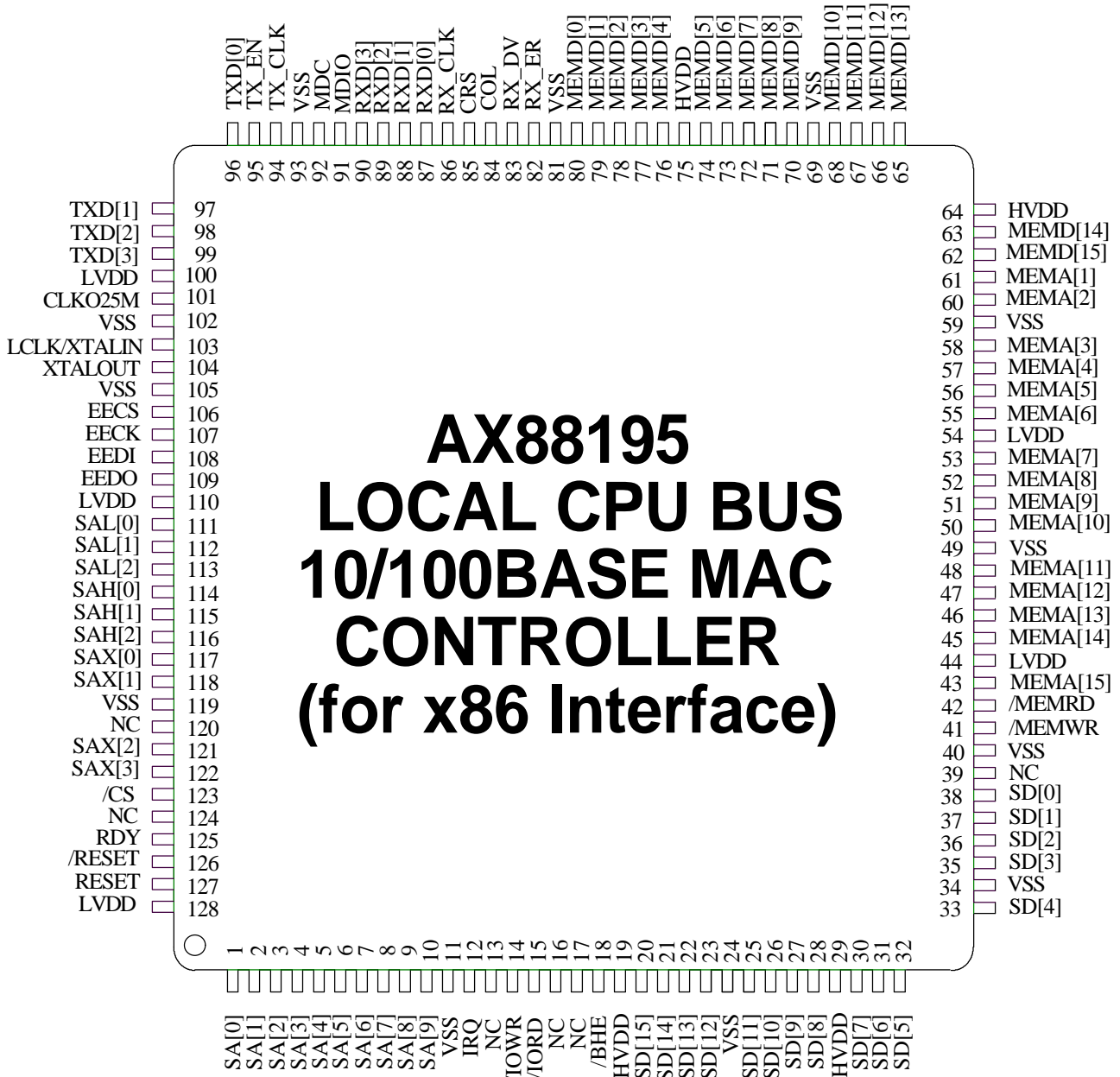


Fig - 4 AX88195 Pin Connection Diagram for 80x86 Mode



## 1.3.3 AX88195 Pin Connection Diagram for MC68K Mode

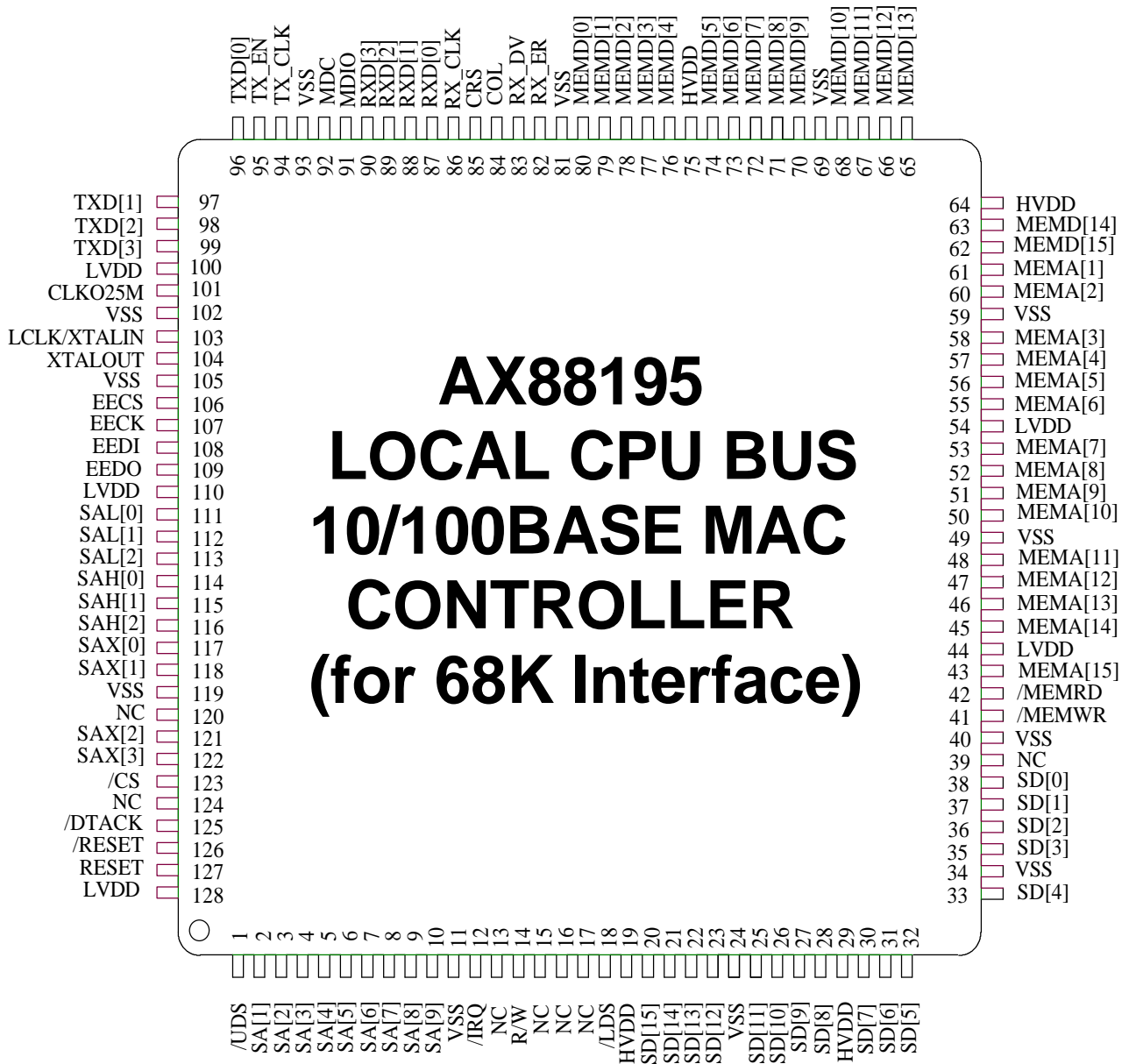


Fig - 5 AX88195 Pin Connection Diagram for MC68K Mode





## 1.3.4 AX88195 Pin Connection Diagram for MCS-51 Mode

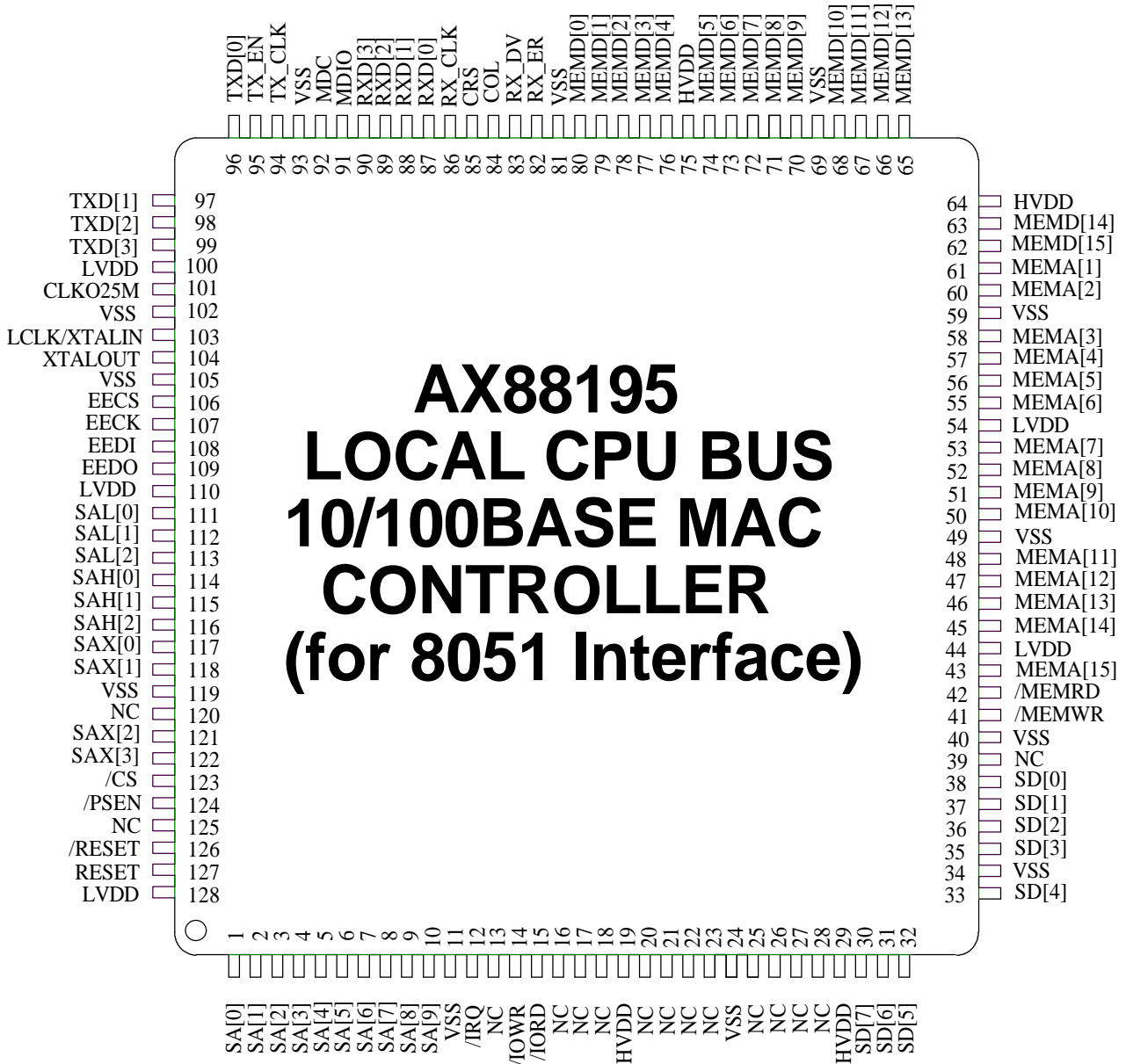


Fig - 6 AX88195 Pin Connection Diagram for MCS-51 Mode



## 2.0 Signal Description

The following terms describe the AX88195 pin-out:

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

The following abbreviations are used in following Tables.

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

## 2.1 Local CPU Bus Interface Signals Group

SIGNAL	TYPE	PIN NO.	DESCRIPTION
SAL[2:0]	I/PD	113 – 111	System Address Select Low : Signals SAL[2:0] are additional address signal input lines which active low enable higher I/O address decoder on chip.
SAH[2:0]	I/PU	116 – 114	System Address Select High : Signals SAH[2:0] are additional address signal input lines which active high enable higher I/O address decoder on chip.
SAX[3:0]	I/PU	122 – 121 118 – 117	System Address Select Low/High : Signals SAX[3:0] are additional address signal input lines which active low/high depend on power on setting to enable higher I/O address decoder on chip.
SA[9:1], SA[0]/UDS	I	10 – 1	System Address : Signals SA[9:0] are address bus input lines which lower I/O spaces on chip. SA[0] also means Upper Data Strobe (/UDS) active low signal in 68K application mode.
/BHE or /LDS	I	18	Bus High Enable or Lower Data Strobe : Bus High Enable is active low signal in some 16 bit application mode which enable high bus (SD[15:8]) active. The signal also name as Lower Data Strobe (/LDS) for 68K application mode.
SD[15:0]	I/O	20 – 23, 25 – 28, 30 – 33, 35 – 38	System Data Bus : Signals SD[15:0] constitute the bi-directional data bus.
IREQ/IREQ	O	12	Interrupt Request : When ISA BUS or 80186 CPU mode is select. IREQ is asserted high to indicate the host system that the chip requires host software service. When MC68K or MCS-51 CPU mode is select. /IREQ is asserted low to indicate the host system that the chip requires host software service.
RDY/DTACK	OD	125	Ready : This signal is set low to insert wait states during Remote DMA transfer. /Dtack : When Motorola CPU type is select, the pin is active low inform CPU that data is accepted.
/CS	I	123	Chip Select When the /CS signal is asserted, the chip is selected.
/IORD	I	15	I/O Read :The host asserts /IORD to read data from AX88195 I/O space. When Motorola CPU type is select , the pin is useless.
/IOWR or R/W	I	14	I/O Write :The host asserts /IOWR to write data into AX88195 I/O space. When Motorola CPU type is select, the pin is active high for read operation at the same time.



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/IOCS16	OD	120	I/O is 16 Bit Port : The /IOIS16 is asserted when the address at the range corresponds to an I/O address to which the chip responds, and the I/O port addressed is capable of 16-bit access.
AEN or /PSEN	I/PD	124	Address Enable : The signal is asserted when the address bus is available for DMA cycle. When negated (low), AX88195 an I/O slave device may respond to addresses and I/O command. PSEN : This signal is active low for 8051 program access. For I/O device, AX88195, this signal is active high to access the chip. This signal is for 8051 bus application only.

Tab - 1 Local CPU bus interface signals group

## 2.2 MII interface signals group

SIGNAL	TYPE	PIN NO.	DESCRIPTION
RXD[3:0]	I	90 – 87	Receive Data : RXD[3:0] is driven by the PHY synchronously with respect to RX_CLK.
CRS	I	85	Carrier Sense : Asynchronous signal CRS is asserted by the PHY when either the transmit or receive medium is non-idle.
RX_DV	I	83	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	82	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	86	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 repeater.
COL	I	84	Collision : this signal is driven by PHY when collision is detected.
TX_EN	O	95	Transmit Enable : TX_EN is transition synchronously with respect to the rising edge of TX_CLK. TX_EN indicates that the port is presenting nibbles on TXD [3:0] for transmission.
TXD[3:0]	O	99 – 96	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	94	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	92	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	91	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 - 2 MII interface signals group



## 2.3 EEPROM Signals Group

SIGNAL	TYPE	PIN NO.	DESCRIPTION
EECS	O	106	EEPROM Chip Select : EEPROM chip select signal.
EECK	O	107	EEPROM Clock : Signal connected to EEPROM clock pin.
EEDI	O	108	EEPROM Data In : Signal connected to EEPROM data input pin.
EEDO	I/PU	109	EEPROM Data Out : Signal connected to EEPROM data output pin.

Tab - 3 EEPROM bus interface signals group

## 2.4 SRAM Interface pins group

SIGNAL	TYPE	PIN NO.	DESCRIPTION
MEMA[15:1]	O	43, 45 – 48, 50 – 53, 55 – 58, 60 – 61	SRAM Address :
MEMD[15:0]	I/O/PU	62 – 63, 65 – 68, 70 – 74, 76 – 80	SRAM Data :
/MEMRD	O	42	SRAM Read
/MEMWR	O	41	SRAM Write

Tab - 4 SRAM Interface pins group

## 2.5 Miscellaneous pins group

SIGNAL	TYPE	PIN NO.	DESCRIPTION
LCLK/XTALIN	I	103	CMOS Local Clock : A 25Mhz clock, +/- 100 ppm, 40%-60% duty cycle. Crystal Oscillator Input : A 25Mhz crystal, +/- 25 ppm can be connected across XTALIN and XTALOUT.
XTALOUT	O	104	Crystal Oscillator Output : A 25Mhz crystal, +/- 25 ppm can be connected across XTALIN and XTALOUT. If a single-ended external clock (LCLK) is connected to XTALIN, the crystal output pin should be left floating.
CLKO25M	O	101	Clock Output 25MHz : This clock is source from LCLK/XTALIN.
RESET	I/PD	127	Reset Reset is active high then place AX88195 into reset mode immediately. During Falling edge the AX88195 loads the power on setting data. User can select either RESET or /RESET for applications.
/RESET	I/PU	126	/Reset Reset is active low then place AX88195 into reset mode immediately. During rising edge the AX88195 loads the power on setting data. User can select either RESET or /RESET for applications.
NC	N/A	13, 16, 17, 39	No Connection : for manufacturing test only.
LVDD	P	44, 54, 100, 110, 128	Power Supply : +3.3V DC.



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HVDD	P	19, 29, 64, 75	Power Supply : +5V DC. Note : for pure 3.3V single power solution, all the HVDD pin can connect to +3.3V. Care should be taken that HVDD input power must be greater or equal ( $\geq$ ) than LVDD.
VSS	P	11, 24, 34, 40, 49,59, 69, 81,93, 102, 105, 119	Power Supply : +0V DC or Ground Power.

Tab - 5 Miscellaneous pins group

### 2.6 Power on configuration setup signals cross reference table

SIGNAL NAME	SHARE WITH	DESCRIPTION			
IO_BASE[2:0]	MEMD[15:13]	IO_BASE[2]	IO_BASE[1]	IO_BASE[0]	IO_BASE
		0	0	0	300h
		0	0	1	320h
		0	1	0	340h
		0	1	1	360h
		1	0	0	380h
		1	0	1	3A0h
		1	1	0	200h
SAX[3:0]	MEMD[12:9]	SAX[3] address decode depends on MEMD[12] power on value			
		SAX[2] address decode depends on MEMD[11] power on value			
		SAX[1] address decode depends on MEMD[10] power on value			
		SAX[0] address decode depends on MEMD[9] power on value			
CPU TYPE	MEMD[8:7]	MEMD[8]	MEMD[7]	CPU TYPE	
		0	0	ISA BUS	
		0	1	80186	
		1	0	MC68K	
		1	1	MCS-51 (805X)	

**All of the above signals are pull-up for default values.**

Tab - 6 Power on Configuration Setup Table



## 3.0 Memory and I/O Mapping

There are four memory or I/O mapping used in AX88195.

1. EEPROM Memory Mapping
2. I/O Mapping
3. Local Memory Mapping

### 3.1 EEPROM Memory Mapping

User can define by themselves and can access via I/O address offset 14H MII/EEPROM registers

### 3.2 I/O Mapping

SYSTEM I/O OFFSET	FUNCTION
0000H 001FH	MAC CORE REGISTER

Tab - 7 I/O Address Mapping

### 3.3 SRAM Memory Mapping

OFFSET	FUNCTION
4000H 7FFF	NE2000 COMPATABLE MODE 8K X 16 SRAM BUFFER
0000H FFFFH	EXTENSION MODE 32K X 16 SRAM BUFFER

Tab - 8 Local Memory Mapping



## 4.0 Registers Operation

All registers of MAC Core are 8-bit wide and mapped into pages which are selected by PS in the Command Register.

PAGE 0 (PS1=0,PS0=0)

OFFSET	READ	WRITE
00H	Command Register ( CR )	Command Register ( CR )
01H	Page Start Register ( PSTART )	Page Start Register ( PSTART )
02H	Page Stop Register ( PSTOP )	Page Stop Register ( PSTOP )
03H	Boundary Pointer ( BNR )	Boundary Pointer ( BNR )
04H	Transmit Status Register ( TSR )	Transmit Page Start Address ( TPSR )
05H	Number of Collisions Register ( NCR )	Transmit Byte Count Register 0 ( TBCR0 )
06H	Current Page Register ( CPR )	Transmit Byte Count Register 1 ( TBCR1 )
07H	Interrupt Status Register ( ISR )	Interrupt Status Register ( ISR )
08H	Current Remote DMA Address 0 ( CRDA0 )	Remote Start Address Register 0 ( RSAR0 )
09H	Current Remote DMA Address 1 ( CRDA1 )	Remote Start Address Register 1 ( RSAR1 )
0AH	Reserved	Remote Byte Count 0 ( RBCR0 )
0BH	Reserved	Remote Byte Count 1 ( RBCR1 )
0CH	Receive Status Register ( RSR )	Receive Configuration Register ( RCR )
0DH	Frame Alignment Errors ( CNTR0 )	Transmit Configuration Register ( TCR )
0EH	CRC Errors ( CNTR1 )	Data Configuration Register ( DCR )
0FH	Missed Packet Errors ( CNTR2 )	Interrupt Mask Register ( IMR )
10H 11H	Data Port	Data Port
12H	IFGS1	IFGS1
13H	IFGS2	IFGS2
14H	MII/EEPROM Access	MII/EEPROM Access
15H	-	Test Register
16H	Inter-frame Gap (IFG)	Inter-frame Gap (IFG)
17H to 1EH	Reserved	Reserved
1FH	Reset	Reserved

Tab - 9 Page 0 of MAC Core Registers Mapping



## AX88195 Local CPU Bus Fast Ethernet MAC Controller

PAGE 1 (PS1=0,PS0=1)

OFFSET	READ	WRITE
00H	Command Register ( CR )	Command Register ( CR )
01H	Physical Address Register 0 ( PARA0 )	Physical Address Register 0 ( PAR0 )
02H	Physical Address Register 1 ( PARA1 )	Physical Address Register 1 ( PAR1 )
03H	Physical Address Register 2 ( PARA2 )	Physical Address Register 2 ( PAR2 )
04H	Physical Address Register 3 ( PARA3 )	Physical Address Register 3 ( PAR3 )
05H	Physical Address Register 4 ( PARA4 )	Physical Address Register 4 ( PAR4 )
06H	Physical Address Register 5 ( PARA5 )	Physical Address Register 5 ( PAR5 )
07H	Current Page Register ( CPR )	Current Page Register ( CPR )
08H	Multicast Address Register 0 ( MAR0 )	Multicast Address Register 0 ( MAR0 )
09H	Multicast Address Register 1 ( MAR1 )	Multicast Address Register 1 ( MAR1 )
0AH	Multicast Address Register 2 ( MAR2 )	Multicast Address Register 2 ( MAR2 )
0BH	Multicast Address Register 3 ( MAR3 )	Multicast Address Register 3 ( MAR3 )
0CH	Multicast Address Register 4 ( MAR4 )	Multicast Address Register 4 ( MAR4 )
0DH	Multicast Address Register 5 ( MAR5 )	Multicast Address Register 5 ( MAR5 )
0EH	Multicast Address Register 6 ( MAR6 )	Multicast Address Register 6 ( MAR6 )
0FH	Multicast Address Register 7 ( MAR7 )	Multicast Address Register 7 ( MAR7 )
10H 11H	Data Port	Data Port
12H	Inter-frame Gap Segment 1 IFGS1	Inter-frame Gap Segment 1 IFGS1
13H	Inter-frame Gap Segment 2 IFGS2	Inter-frame Gap Segment 2 IFGS2
14H	MII/EEPROM Access	MII/EEPROM Access
15H	-	Test Register
16H	Inter-frame Gap (IFG)	Inter-frame Gap (IFG)
17H to 1EH	Reserved	Reserved
1FH	Reset	Reserved

Tab - 10 Page 1 of MAC Core Registers Mapping





## 4.1 Command Register (CR) Offset 00H (Read/Write)

FIELD	NAME	DESCRIPTION																								
7:6	PS1,PS0	PS1,PS0 : Page Select The two bit selects which register page is to be accessed. <table style="margin-left: 40px;"> <tr> <td>PS1</td> <td>PS0</td> <td></td> </tr> <tr> <td>0</td> <td>0</td> <td>page 0</td> </tr> <tr> <td>0</td> <td>1</td> <td>page 1</td> </tr> </table>	PS1	PS0		0	0	page 0	0	1	page 1															
PS1	PS0																									
0	0	page 0																								
0	1	page 1																								
5:3	RD2,RD1,RD0	RD2,RD1,RD0 : Remote DMA Command These three encoded bits control operation of the Remote DMA channel. RD2 could be set to abort any Remote DMA command in process. RD2 is reset by AX88195 when a Remote DMA has been completed. The Remote Byte Count should be cleared when a Remote DMA has been aborted. The Remote Start Address are not restored to the starting address if the Remote DMA is aborted. <table style="margin-left: 40px;"> <tr> <td>RD2</td> <td>RD1</td> <td>RD0</td> <td></td> </tr> <tr> <td>0</td> <td>0</td> <td>0</td> <td>Not allowed</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td>Remote Read</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> <td>Remote Write</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>Not allowed</td> </tr> <tr> <td>1</td> <td>X</td> <td>X</td> <td>Abort / Complete Remote DMA</td> </tr> </table>	RD2	RD1	RD0		0	0	0	Not allowed	0	0	1	Remote Read	0	1	0	Remote Write	0	1	1	Not allowed	1	X	X	Abort / Complete Remote DMA
RD2	RD1	RD0																								
0	0	0	Not allowed																							
0	0	1	Remote Read																							
0	1	0	Remote Write																							
0	1	1	Not allowed																							
1	X	X	Abort / Complete Remote DMA																							
2	TXP	TXP : Transmit Packet This bit could be set to initiate transmission of a packet																								
1	START	START : This bit is used to active AX88195 operation.																								
0	STOP	STOP : Stop AX88195 This bit is used to stop the AX88195 operation.																								

## 4.2 Interrupt Status Register (ISR) Offset 07H (Read/Write)

FIELD	NAME	DESCRIPTION
7	RST	Reset Status : Set when AX88195 enters reset state and cleared when a start command is issued to the CR. Writing to this bit is no effect.
6	RDC	Remote DMA Complete Set when remote DMA operation has been completed
5	CNT	Counter Overflow Set when MSB of one or more of the Tally Counters has been set.
4	OVW	OVERWRITE : Set when receive buffer ring storage resources have been exhausted.
3	TXE	Transmit Error Set when packet transmitted with one or more of the following errors <ul style="list-style-type: none"> <li>■ Excessive collisions</li> <li>■ FIFO Underrun</li> </ul>
2	RXE	Receive Error Indicates that a packet was received with one or more of the following errors <ul style="list-style-type: none"> <li>CRC error</li> <li>Frame Alignment Error</li> <li>FIFO Overrun</li> <li>Missed Packet</li> </ul>
1	PTX	Packet Transmitted Indicates packet transmitted with no error
0	PRX	Packet Received Indicates packet received with no error.



### 4.3 Interrupt mask register (IMR) Offset 0FH (Write)

FIELD	NAME	DESCRIPTION
7	-	Reserved
6	RDCE	DMA Complete Interrupt Enable. Default "low" disabled.
5	CNTE	Counter Overflow Interrupt Enable. Default "low" disabled.
4	OVWE	Overwrite Interrupt Enable. Default "low" disabled.
3	TXEE	Transmit Error Interrupt Enable. Default "low" disabled.
2	RXEE	Receive Error Interrupt Enable. Default "low" disabled.
1	PTXE	Packet Transmitted Interrupt Enable. Default "low" disabled.
0	PRXE	Packet Received Interrupt Enable. Default "low" disabled.

### 4.4 Data Configuration Register (DCR) Offset 0EH (Write)

FIELD	NAME	DESCRIPTION
7	RDCR	Remote DMA always completed
6:2	-	Reserved
1	BOS	Byte Order Select 0: MS byte placed on AD15:AD8 and LS byte on AD7-AD0 (80186). 1: MS byte placed on AD7::AD0 and LS byte on AD15:AD0(MC68K)
0	WTS	Word Transfer Select 0 : Selects byte-wide DMA transfers. 1 : Selects word-wide DMA transfers.

### 4.5 Transmit Configuration Register (TCR) Offset 0DH (Write)

FIELD	NAME	DESCRIPTION												
7	FDU	Full Duplex : This bit indicates the current media mode is Full Duplex or not. 0 : Half duplex 1 : Full duplex												
6	PD	Pad Disable 0 : Pad will be added when packet length less than 60. 1 : Pad will not be added when packet length less than 60.												
5	RLO	Retry of late collision 0 : Don't retransmit packet when late collision happens. 1 : Retransmit packet when late collision happens.												
4:3	-	Reserved												
2:1	LB1, LB0	Encoded Loop-back Control These encoded configuration bits set the type of loop-back that is to be performed. <table style="margin-left: 40px;"> <tr> <td>LB1</td> <td>LB0</td> <td></td> </tr> <tr> <td>Mode 0</td> <td>0 0</td> <td>Normal operation</td> </tr> <tr> <td>Mode 1</td> <td>0 1</td> <td>Internal NIC loop-back</td> </tr> <tr> <td>Mode 2</td> <td>1 0</td> <td>PHYceiver loop-back</td> </tr> </table>	LB1	LB0		Mode 0	0 0	Normal operation	Mode 1	0 1	Internal NIC loop-back	Mode 2	1 0	PHYceiver loop-back
LB1	LB0													
Mode 0	0 0	Normal operation												
Mode 1	0 1	Internal NIC loop-back												
Mode 2	1 0	PHYceiver loop-back												
0	CRC	Inhibit CRC 0 : CRC appended by transmitter. 1 : CRC inhibited by transmitter.												



## 4.6 Transmit Status Register (TSR) Offset 04H (Read)

FIELD	NAME	DESCRIPTION
7	OWC	Out of window collision
6:4	-	Reserved
3	ABT	Transmit Aborted Indicates the AX88195 aborted transmission because of excessive collision.
2	COL	Transmit Collided Indicates that the transmission collided at least once with another station on the network.
1	-	Reserved
0	PTX	Packet Transmitted Indicates transmission without error.

## 4.7 Receive Configuration (RCR) Offset 0CH (Write)

FIELD	NAME	DESCRIPTION
7	-	Reserved
6	INTT	Interrupt Trigger Mode for ISA and 80186 modes 0 : Low active 1 : High active (default) Interrupt Trigger Mode for MCS-51 and MC68K modes 0 : High active 1 : Low active (default)
5	MON	Monitor Mode 0 : Normal Operation 1 : Monitor Mode, the input packet will be checked on NODE ADDRESS and CRC but not buffered into memory.
4	PRO	PRO : Promiscuous Mode Enable the receiver to accept all packets with a physical address.
3	AM	AM : Accept Multicast Enable the receiver to accept packets with a multicast address. That multicast address must pass the hashing array.
2	AB	AB : Accept Broadcast Enable the receiver to accept broadcast packet.
1	AR	AR : Accept Runt Enable the receiver to accept runt packet.
0	SEP	SEP : Save Error Packet Enable the receiver to accept and save packets with error.

## 4.8 Receive Status Register (RSR) Offset 0CH (Read)

FIELD	NAME	DESCRIPTION
7	-	Reserved
6	DIS	Receiver Disabled
5	PHY	Multicast Address Received.
4	MPA	Missed Packet
3	FO	FIFO Overrun
2	FAE	Frame alignment error.
1	CR	CRC error.
0	PRX	Packet Received Intact



### 4.9 Inter-frame gap (IFG) Offset 16H (Read/Write)

FIELD	NAME	DESCRIPTION
7	-	Reserved
6:0	IFG	Inter-frame Gap. Default value 15H.

### 4.10 Inter-frame gap Segment 1(IFGS1) Offset 12H (Read/Write)

FIELD	NAME	DESCRIPTION
7	-	Reserved
6:0	IFG	Inter-frame Gap Segment 1. Default value 0cH.

### 4.11 Inter-frame gap Segment 2(IFGS2) Offset 13H (Read/Write)

FIELD	NAME	DESCRIPTION
7	-	Reserved
6:0	IFG	Inter-frame Gap Segment 2. Default value 11H.

### 4.12 MII/EEPROM Management Register (MEMR) Offset 14H (Read/Write)

FIELD	NAME	DESCRIPTION
7	EECLK	EECLK: EEPROM Clock
6	EEO	EEO : (Read only) EEPROM Data Out value. That reflects Pin-109 EEDO value.
5	EEI	EEI EEPROM Data In. That output to Pin-108 EEDI as EEPROM data input value.
4	EECS	EECS EEPROM Chip Select
3	MDO	MDO MII Data Out
2	MDI	MDI: (Read only) MII Data In. That reflects Pin-91 MDIO value.
1	MDIR	MII STA MDIO signal Direction MII Read Control Bit, assert this bit let MDIO signal as the input signal. Deassert this bit let MDIO as output signal.
0	MDC	MDC MII Clock

### 4.13 Test Register (TR) Offset 15H (Write)

FIELD	NAME	DESCRIPTION
7:5	-	Reserved
4	TF16T	Test for Collision
3	TPE	Test pin Enable
2:0	IFG	Select Test Pins Output



## 5.0 CPU I/O Read and Write Functions

The AX88195 supports four kinds of CPU/BUS types access function, including ISA, 80186, MC68000 and MCS-51. These Access methods are described as the following sections.

### 5.1 ISA bus type access functions.

ISA bus I/O Read function

Function Mode	/CS	/BHE	A0	/IORD	/IOWR	SD[15:8]	SD[7:0]
Standby Mode	H	X	X	X	X	High-Z	High-Z
Byte Access	L	H	L	L	H	Not Valid	Even-Byte
	L	H	H	L	H	Not Valid	Odd-Byte
Word Access	L	L	L	L	H	Odd-Byte	Even-Byte

ISA bus I/O Write function

Function Mode	/CS	/BHE	A0	/IORD	/IOWR	SD[15:8]	SD[7:0]
Standby Mode	H	X	X	X	X	X	X
Byte Access	L	H	L	H	L	X	Even-Byte
	L	H	H	H	L	X	Odd-Byte
Word Access	L	L	L	H	L	Odd-Byte	Even-Byte

### 5.2 80186 CPU bus type access functions.

80186 CPU bus I/O Read function

Function Mode	/CS	/BHE	A0	/IORD	/IOWR	SD[15:8]	SD[7:0]
Standby Mode	H	X	X	X	X	High-Z	High-Z
Byte Access	L	H	L	L	H	Not Valid	Even-Byte
	L	L	H	L	H	Odd-Byte	Not Valid
Word Access	L	L	L	L	H	Odd-Byte	Even-Byte

80186 CPU bus I/O Write function

Function Mode	/CS	/BHE	A0	/IORD	/IOWR	SD[15:8]	SD[7:0]
Standby Mode	H	X	X	X	X	X	X
Byte Access	L	H	L	H	L	X	Even-Byte
	L	L	H	H	L	Odd-Byte	X
Word Access	L	L	L	H	L	Odd-Byte	Even-Byte



## 5.3 MC68K CPU bus type access functions.

### 68K bus I/O Read function

Function Mode	/CS	/UDS	/LDS	R/W	SD[15:8]	SD[7:0]
Standby Mode	H	X	X	X	High-Z	High-Z
Byte Access	L	H	L	H	Not Valid	Odd-Byte
	L	L	H	H	Even-Byte	Not Valid
Word Access	L	L	L	H	Even-Byte	Odd-Byte

### 68K bus I/O Write function

Function Mode	/CS	/UDS	/LDS	R/W	SD[15:8]	SD[7:0]
Standby Mode	H	X	X	X	X	X
Byte Access	L	H	L	L	X	Odd-Byte
	L	L	H	L	Even-Byte	X
Word Access	L	L	L	L	Even-Byte	Odd-Byte

## 5.3 MCS-51 CPU bus type access functions.

### 8051 bus I/O Read function

Function Mode	/CS	/PSEN	SA0	/IORD	/IOWR	SD[15:8]	SD[7:0]
Standby Mode	H	X	X	X	X	High-Z	High-Z
	X	L	X	X	X	High-Z	High-Z
Byte Access	L	H	L	L	H	Not Valid	Even-Byte
	L	H	H	L	H	Not Valid	Odd-Byte

### 8051 bus I/O Write function

Function Mode	/CS	/PSEN	SA0	/IORD	/IOWR	SD[15:8]	SD[7:0]
Standby Mode	H	X	X	X	X	X	X
	X	L	X	X	X	X	X
Byte Access	L	H	L	H	L	X	Even-Byte
	L	H	H	H	L	X	Odd-Byte



## 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	HVdd	-0.3	+6	V
Supply Voltage	LVdd	-0.3	+4.6	V
Input Voltage	HVin	-0.3	HVdd+0.5	V
	LVin	-0.3	LVdd+0.5	V
Output Voltage	HVout	-0.3	HVdd+0.5	V
	LVin	-0.3	LVdd+0.5	V
Lead Temperature (soldering 10 seconds maximum)	Tl	-55	+220	°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.

Note : The power supply voltages must always fulfill HVdd >= LVdd inequality.

### 6.2 General Operation Conditions

Description	SYM	Min	Tpy	Max	Units
Operating Temperature	Ta	0	25	+75	°C
Supply Voltage	HVdd	+4.75V	+5.00V	+5.25V	V
	LVdd	+2.70	+3.00	+3.30	V
		+3.00	+3.30	+3.60	V

Note : The power supply voltages must always fulfill HVdd >= LVdd inequality.

### 6.3 DC Characteristics

(Vdd=5.0V, Vss=0V, Ta=0°C to 75°C)

Description	SYM	Min	Tpy	Max	Units
Low Input Voltage	Vil	-		0.8	V
High Input Voltage	Vih	2		-	V
Low Output Voltage	Vol	-		0.4	V
High Output Voltage	Voh	Vdd-0.4		-	V
Input Leakage Current	Iil	-1		+1	uA
Output Leakage Current	Iol	-1		+1	uA

(Vdd=3.0V to 3.6V, Vss=0V, Ta=0°C to 75°C)

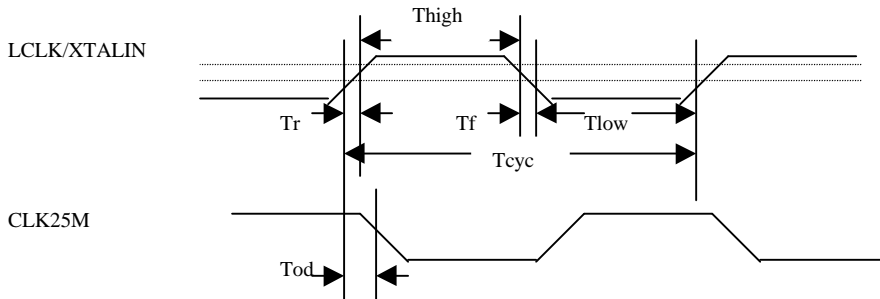
Description	SYM	Min	Tpy	Max	Units
Low Input Voltage	Vil	-		0.8	V
High Input Voltage	Vih	1.9		-	V
Low Output Voltage	Vol	-		0.4	V
High Output Voltage	Voh	Vdd-0.4		-	V
Input Leakage Current	Iil	-1		+1	uA
Output Leakage Current	Iol	-1		+1	uA

Description	SYM	Min	Tpy	Max	Units
Power Consumption (Dual power)	DPT5v		20		mA
	DPT3v		38		mA
Power Consumption (Single power 3.3V)	SPt3v		46		mA



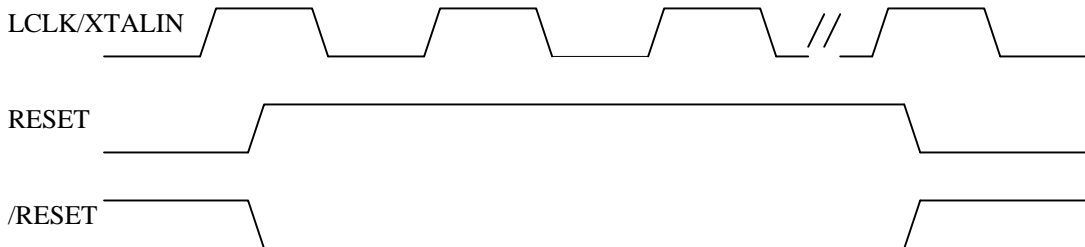
## 6.4 A.C. Timing Characteristics

### 6.4.1 XTAL / CLOCK



Symbol	Description	Min	Typ.	Max	Units
$T_{cyc}$	CYCLE TIME		40		ns
$T_{high}$	CLK HIGH TIME	16	20	24	ns
$T_{low}$	CLK LOW TIME	16	20	24	ns
$T_r/T_f$	CLK SLEW RATE	1	-	4	ns
$T_d$	LCLK/XTALIN TO CLK25M OUT DELAY (INVERTED)	1	3	6	ns

### 6.4.2 Reset Timing

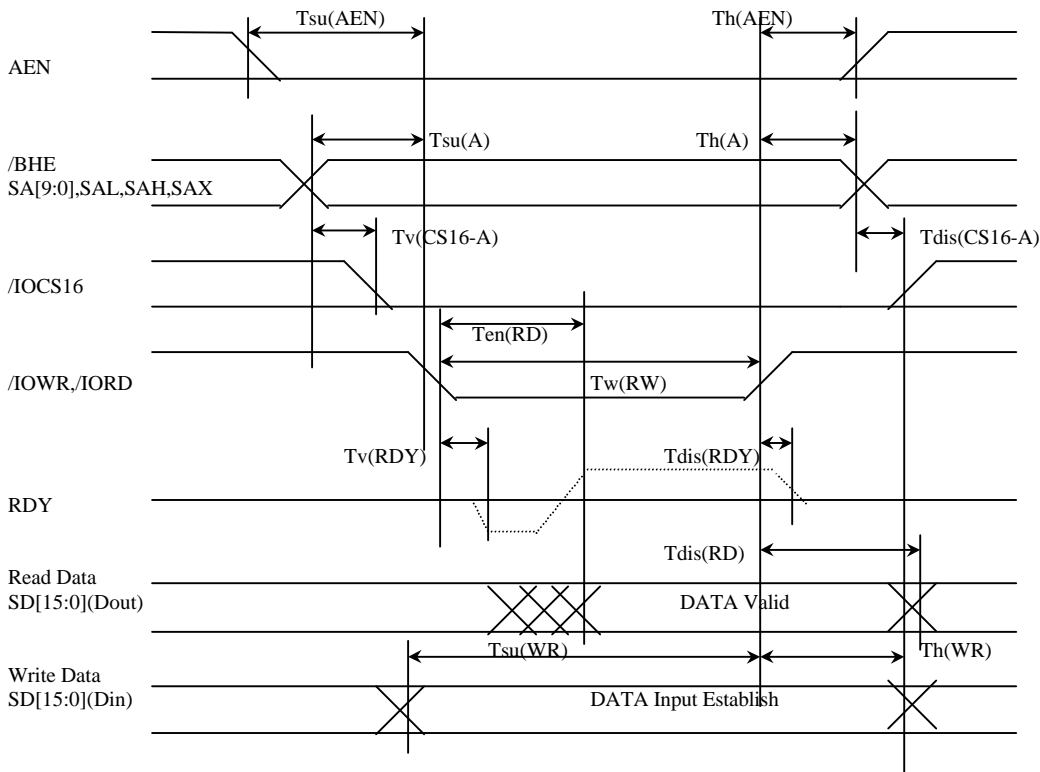


Symbol	Description	Min	Typ.	Max	Units
$T_{rst}$	Reset pulse width	100	-	-	LClk





## 6.4.3 ISA Bus Access Timing

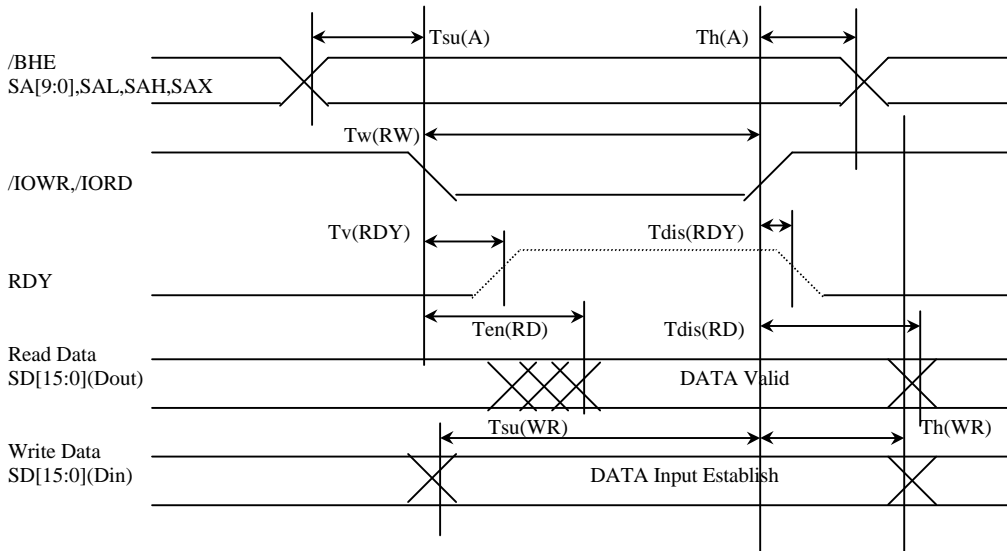


Symbol	Description	Min	Typ.	Max	Units
Tsu(A)	ADDRESS SETUP TIME	0	-	-	ns
Th(A)	ADDRESS HOLD TIME	5	-	-	ns
Tsu(AEN)	AEN SETUP TIME	0	-	-	ns
Th(AEN)	AEN HOLD TIME	5	-	-	ns
Tv(CS16-A)	/IOCS16 VALID FROM ADDRESS CHANGE	-	-	20	ns
Tdis(CS16-A)	/IOCS16 DISABLE FROM ADDRESS CHANGE	-	-	6	ns
Tv(RDY)	RDY VALID FROM /IORD OR /IOWR	-	-	20	ns
Tdis(RDY)	RDY DISABLE FROM /IORD OR /IOWR	0	-	-	ns
Ten(RD)	OUTPUT ENABLE TIME FROM /IORD	-	-	20	ns
Tdis(RD)	OUTPUT DISABLE TIME FROM /IORD	0.5	-	4	ns
Tsu(WR)	DATA SETUP TIME	5	-	-	ns
Th(WR)	DATA HOLD TIME	5	-	-	ns
<b>Tw(RW)</b>	<b>/IORD OR /IOWR WIDTH TIME</b>	<b>*90</b>			<b>ns</b>

\* Note : for byte access minimum is 90ns, for word access minimum is 50 ns.



## 6.4.4 80186 Type I/O Access Timing

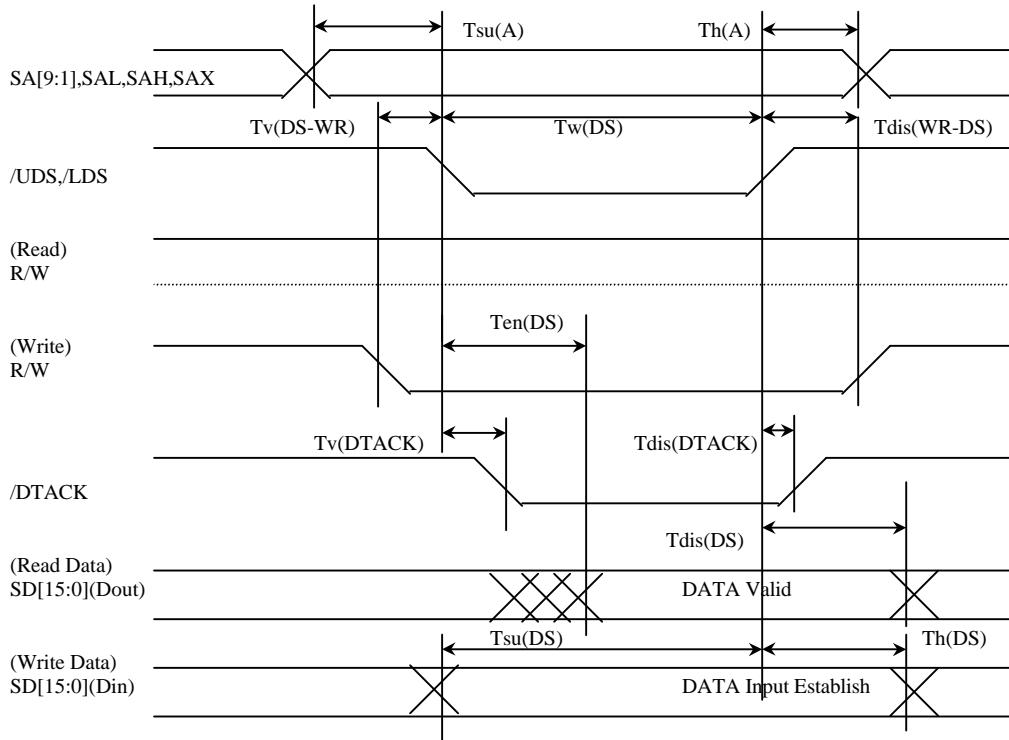


Symbol	Description	Min	Typ.	Max	Units
Tsu(A)	ADDRESS SETUP TIME	0	-	-	ns
Th(A)	ADDRESS HOLD TIME	5	-	-	ns
Tv(RDY)	RDY VALID FROM /IORD OR /IOWR	-	-	20	ns
Tdis(RDY)	RDY DISABLE FROM /IORD OR /IOWR	0	-	-	ns
Ten(RD)	OUTPUT ENABLE TIME FROM /IORD	-	-	20	ns
Tdis(RD)	OUTPUT DISABLE TIME FROM /IORD	0.5	-	4	ns
Tsu(WR)	DATA SETUP TIME	5	-	-	ns
Th(WR)	DATA HOLD TIME	5	-	-	ns
<b>Tw(RW)</b>	<b>/IORD OR /IOWR WIDTH TIME</b>	<b>*90</b>			<b>ns</b>

\* Note : for byte access minimum is 90ns, for word access minimum is 50 ns.



## 6.4.5 68K Type I/O Access Timing

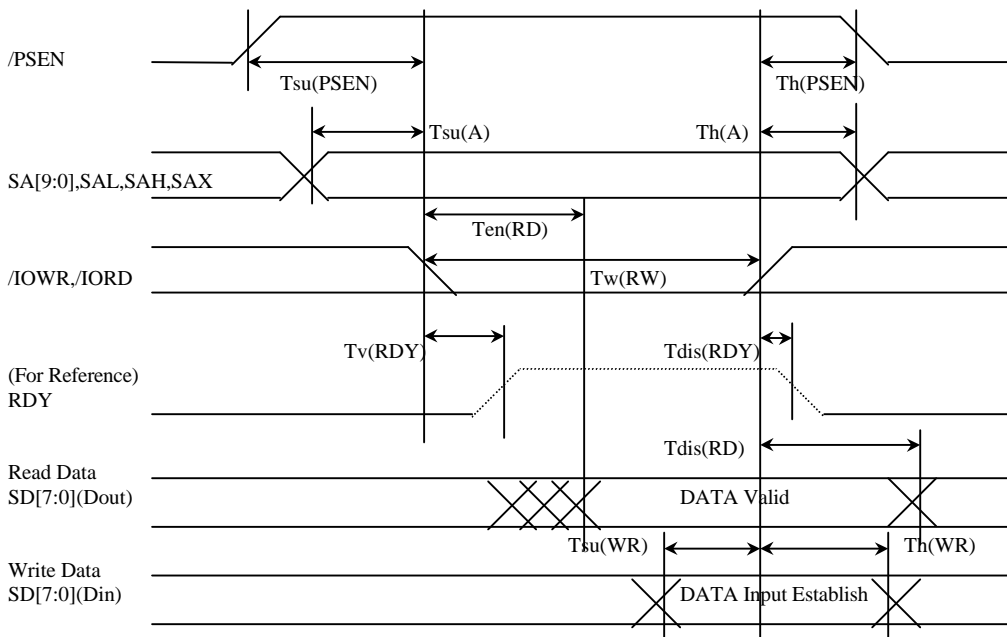


Symbol	Description	Min	Typ.	Max	Units
Tsu(A)	ADDRESS SETUP TIME	0	-	-	ns
Th(A)	ADDRESS HOLD TIME	5	-	-	ns
Tv(DS-WR)	/UDS OR /LDS VALID FROM /W	0	-	-	ns
Tdis(WR-DS)	/W DISABLE FROM /UDS OR /LDS	5	-	-	ns
Tv(DTACK)	DACK VALID FROM /UDS OR /LDS	-	-	20	ns
Tdis(DTACK)	DACK DISABLE FROM /UDS OR /LDS	0	-	-	ns
Ten(DS)	OUTPUT ENABLE TIME FROM /UDS OR /LDS	-	-	20	ns
Tdis(DS)	OUTPUT DISABLE TIME FROM /UDS OR /LDS	0.5	-	4	ns
Tsu(DS)	DATA SETUP TIME	5	-	-	ns
Th(DS)	DATA HOLD TIME	5	-	-	ns
<b>Tw(DS)</b>	<b>/UDS OR /LDS WIDTH TIME</b>	<b>*90</b>			<b>ns</b>

\* Note : for byte access minimum is 90ns, for word access minimum is 50 ns.



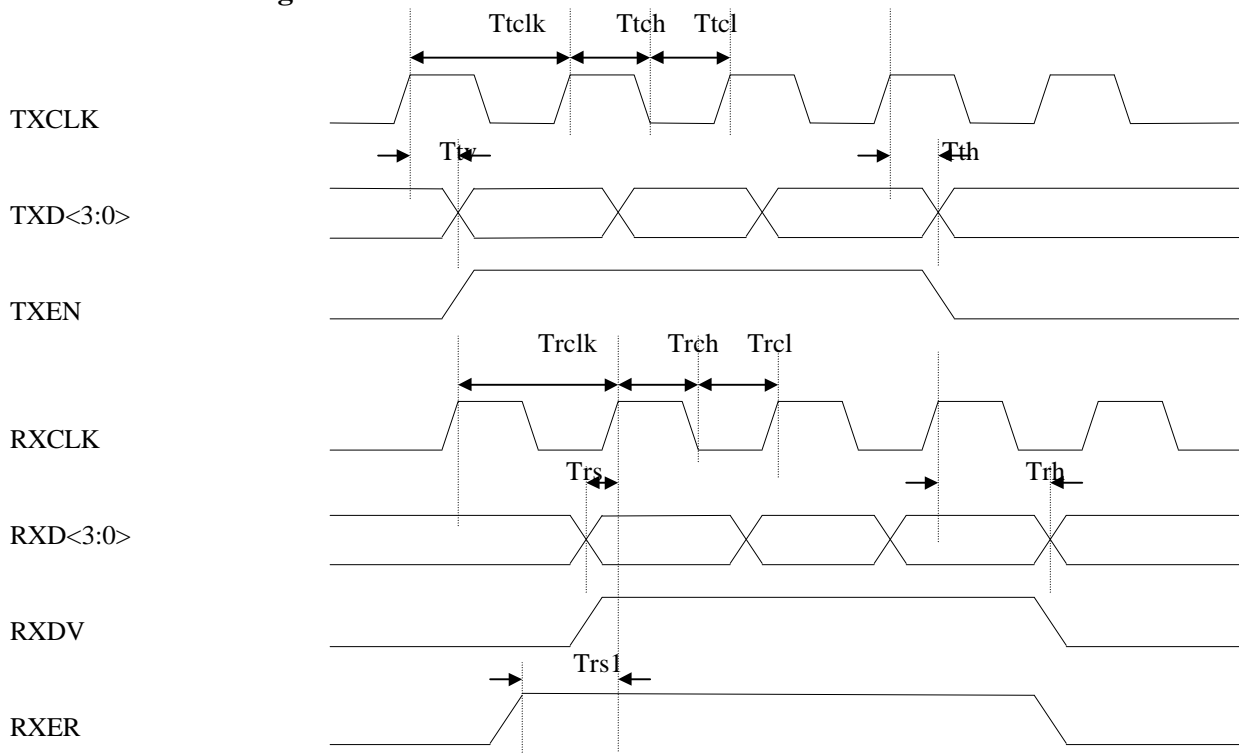
## 6.4.6 8051 Bus Access Timing



Symbol	Description	Min	Typ.	Max	Units
$T_{su}(A)$	ADDRESS SETUP TIME	0	-	-	ns
$T_h(A)$	ADDRESS HOLD TIME	5	-	-	ns
$T_{su}(\overline{\text{PSEN}})$	$\overline{\text{PSEN}}$ SETUP TIME	0	-	-	ns
$T_h(\overline{\text{PSEN}})$	$\overline{\text{PSEN}}$ HOLD TIME	5	-	-	ns
$T_{en}(\text{RD})$	OUTPUT ENABLE TIME FROM $\overline{\text{IORD}}$	-	-	20	ns
$T_{dis}(\text{RD})$	OUTPUT DISABLE TIME FROM $\overline{\text{IORD}}$	0.5	-	4	ns
$T_{su}(\text{WR})$	DATA SETUP TIME	5	-	-	ns
$T_h(\text{WR})$	DATA HOLD TIME	5	-	-	ns
$T_w(\text{RW})$	$\overline{\text{IORD}}$ OR $\overline{\text{IOWR}}$ WIDTH TIME	90			ns



## 6.4.7 MII Timing

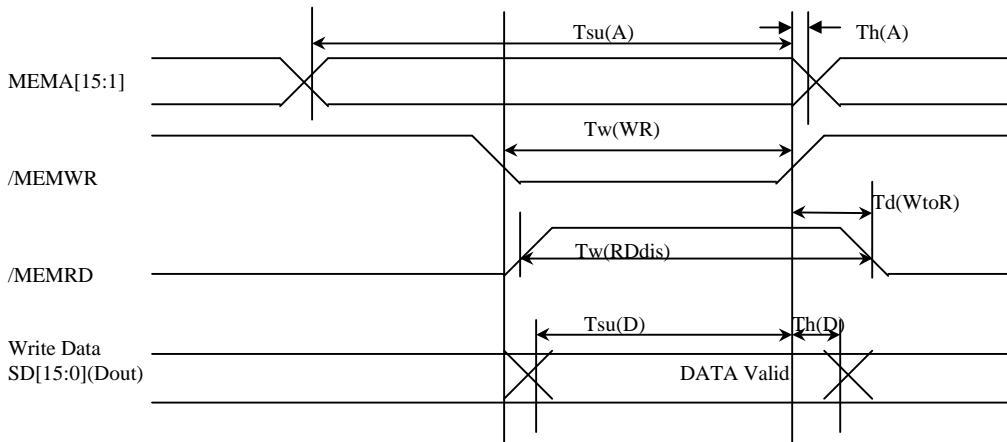


Symbol	Description	Min	Typ.	Max	Units
Ttclk	Cycle time(100Mbps)	-	40	-	ns
Ttclk	Cycle time(10Mbps)	-	400	-	ns
Ttch	high time(100Mbps)	14	-	26	ns
Ttch	high time(10Mbps)	140	-	260	ns
Trch	low time(100Mbps)	14	-	26	ns
Trch	low time(10Mbps)	140	-	260	ns
Ttv	Clock to data valid	-	-	20	ns
Tth	Data output hold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



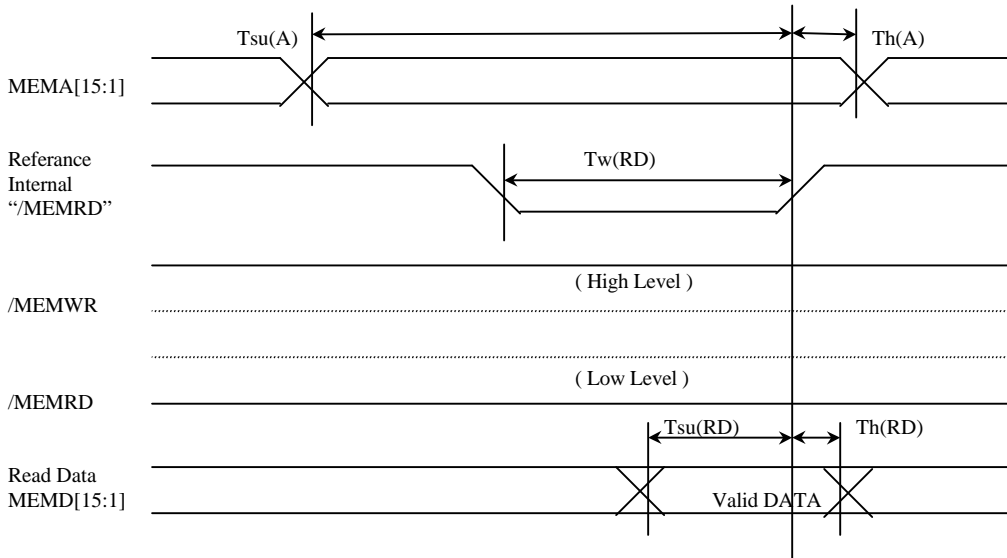
## 6.4.8 Asynchronous Memory I/F Access Timing

### MEMORY WRITE



Symbol	Description	Min	Typ.	Max	Units
Tsu(A)	ADDRESS SETUP TIME	36	-	-	ns
Th(A)	ADDRESS HOLD TIME	0.3	-	1	ns
Tw(WR)	WRITE PULSE WIDTH		*	-	ns
Tw(RDdis)	READ DISABLE PULSE WIDTH		*	-	ns
Td(WtoR)	WRITE TO READ DEALY	1	-	4.5	ns
Tsu(D)	DATA SETUP TIME	16	-	-	ns
Th(D)	DATA HOLD TIME	0.3	-	2	ns

### MEMORY READ

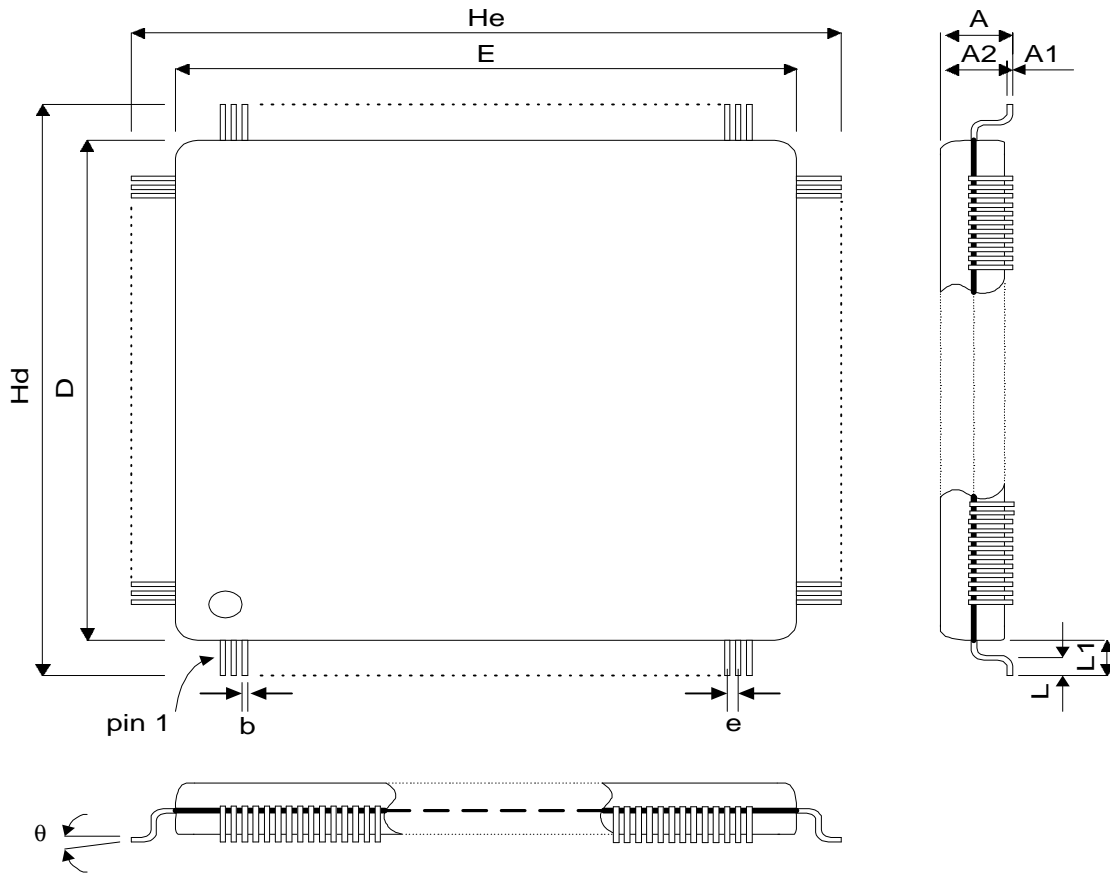


Symbol	Description	Min	Typ.	Max	Units
Tsu(A)	ADDRESS SETUP TIME	30	-	-	ns
Th(A)	ADDRESS HOLD TIME	1.3	-	1	ns
Tw(RD)	READ PULSE WIDTH		*	-	ns
Tsu(D)	DATA SETUP TIME	3	-	-	ns
Th(D)	DATA HOLD TIME	0	-	2	ns

\* NOTE : The pulse width can be seen as LCLK/XTALIN high time. See also 6.4.1 "Thigh" parameter.  
 NOTE : All most any brand asynchronous SRAM access time under 20 ns can fit into the specification.



## 7.0 Package Information

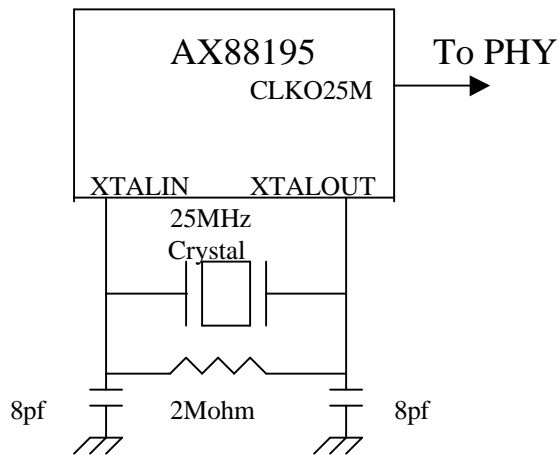


SYMBOL	MILIMETER		
	MIN.	NOM	MAX
A1		0.1	
A2	1.3	1.4	1.5
A			1.7
b	0.155	0.16	0.26
D	13.90	14.00	14.10
E	13.90	14.00	14.10
e		0.40	
Hd	15.60	16.00	16.40
He	15.60	16.00	16.40
L	0.30	0.50	0.70
L1		1.00	
$\theta$	0		10



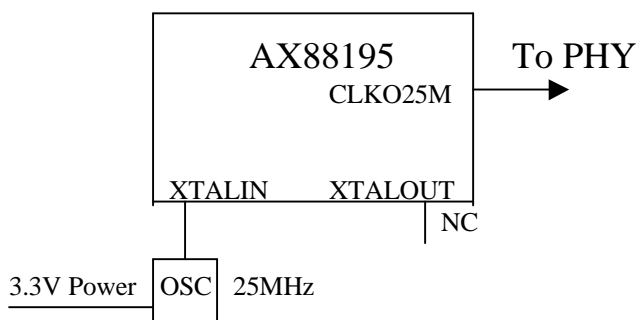
## Appendix A: Application Note 1

### A.1 Using Crystal



Note : The capacitors (8pf) may be various depend on the specification of crystal. While designing, please refer to the suggest circuit provided by crystal supplier.

### A.2 Using Oscillator

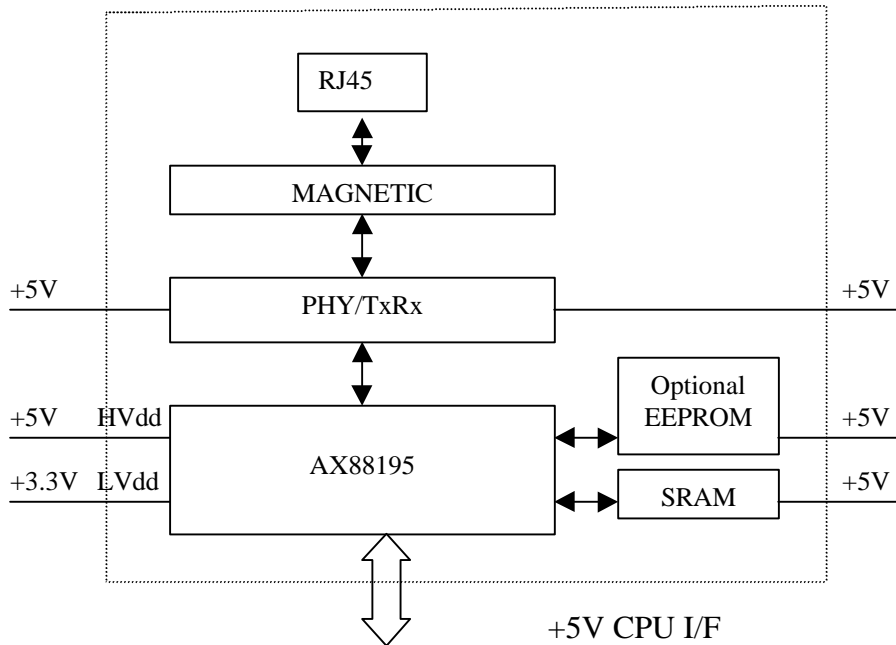




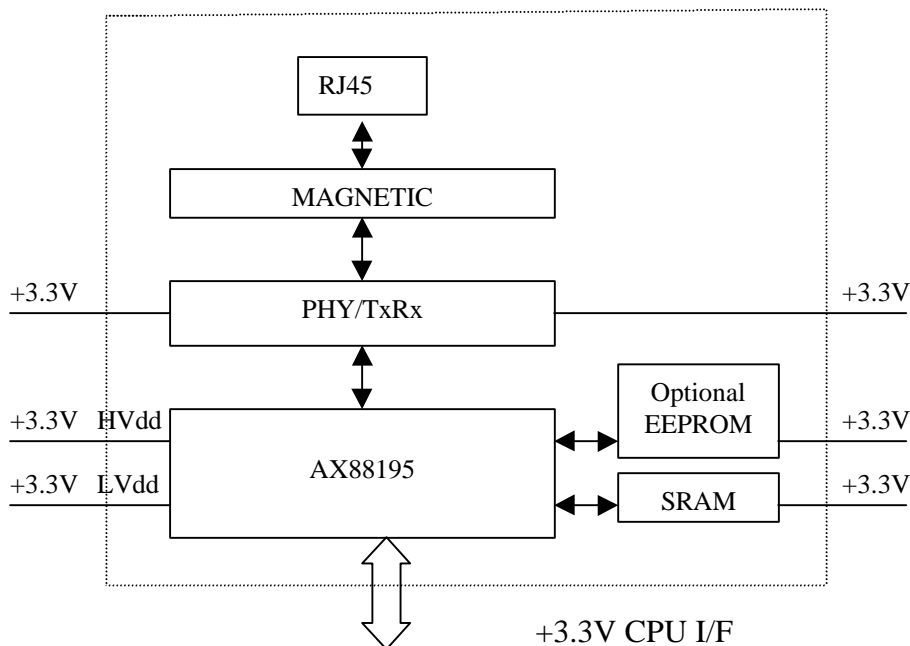


# AX88195 Local CPU Bus Fast Ethernet MAC Controller

## A.3 Dual power (5V and 3.3V/3.0V) application



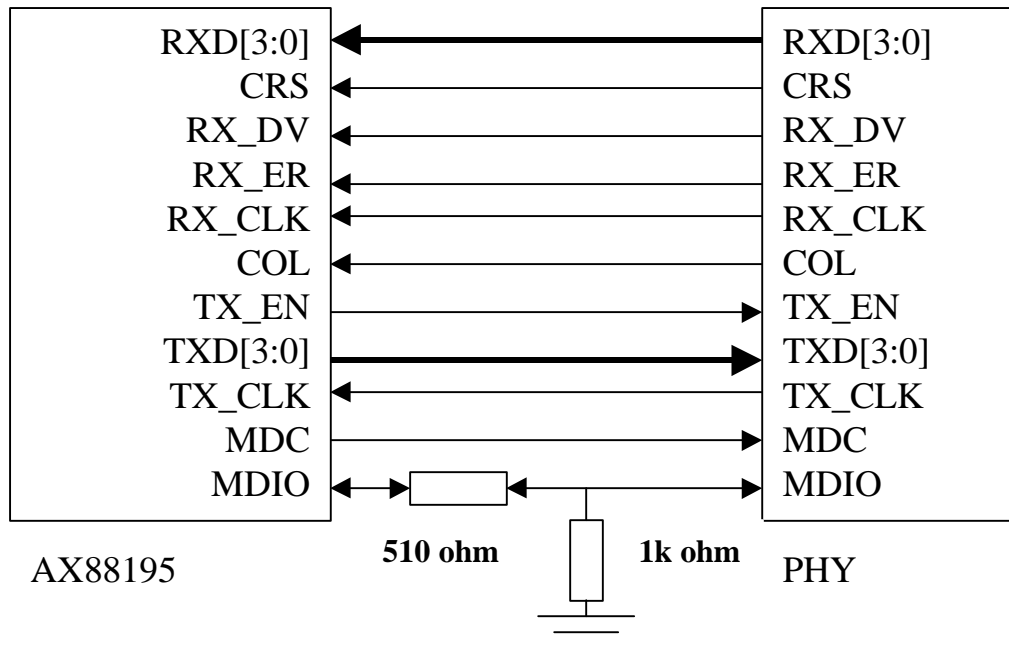
## A.4 Single power (3.3V/3.0V) application





## A.5 Dual power (5V and 3.3V) application with 3.3V PHY

The 510 and 1K Ohm resistors are just for voltage adjustment





## Appendix B: Application Note 2

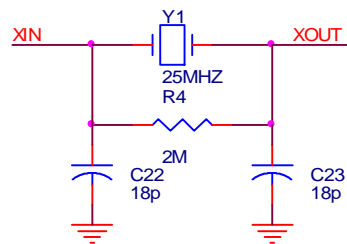
### B.1 Advance Application for Using Crystal

Date: May 21, 1999

Condition: In short cable, AX88195 +AH 101 Phyceiver can't link to BCM 5308 Switch.

Conclusion: 1. After measuring and verifying, we found it's relevant to clock source.  
2. We ascertain the problem is caused by matching issues between crystal and capacitor.

Solution: Change the value of capacitors beside crystal as below:



Note: The capacitors may be various depend on the specification of crystal. While designing, please refer to the circuit provided by crystal supplier.



## Appendix C: Application Note for RDY is not applicable

This application note is for some kind of CPU that doesn't support asynchronous wait state insertion function. For example, 8051 CPU series have only fix access cycle time. For some application that the CPU has the capability of wait state insertion, but the designer do not want to use the handshake signal in order to simply the design. This application note is helpful for those cases.

The following criteria must be meet:

1. The bus access timing must meet the AC timing specification.
2. The "remote DMA" move data from/to data port access time can't faster than 120ns.

Solution:

Because of the access time from FIFO to Packet Buffer RAM or from Packet Buffer RAM to FIFO is 120ns/Word. The "remote DMA read" operation is the only case that RDY signal will be active to request some wait state to pre-fetch data from RAM into FIFO. As soon as the first word of data feed into the FIFO, the RDY will not active again for the lasting cycle. For the critical time, just insert "No Operation" instruction (to insert wait state using software) after write remote DMA read command and before read data port.

**Ex : IOBASE=300 ; Insert wait state by software.**

```
Mov dx,308h      ; Index = 308h
Mov al,0h        ;
Out dx,al        ; Set Remote Start Address low byte = 0
Inc dx           ; Index = 309h
Mov al,4dh       ;
Out dx,al        ; Set Remote Start Address high byte = 4d
Inc dx           ; Index = 30Ah
Mov al,40h       ;
Out dx,al        ; Set Remote DMA Byte Count low byte = 40h
Inc dx           ; Index = 30Bh
Mov al,40h       ;
Out dx,al        ; Set Remote DMA Byte Count high byte = 00h
Mov dx,300h      ; Index = 300h
Mov al,0ah       ;
Out dx,al        ; Set remote DMA read command
Nop             ; Insert wait state here
Nop             ; Insert more wait states again if necessary
Mov dx,310h      ; Index = 310h
Lea di, RxBuffer ; Set Rx Buffer Address
Mov cx, RxLen    ; Set Rx Length
Rep insw         ; Read data port
...
```



## Errata of AX88195 V1

### 1. Interrupt Status can't always clean up

Solution : Using software to do clean and check iteration until clean up.

Ex : IOBASE=300 ; Clear Tx/Rx interrupt.

```

                                Mov dx,307h
ClrISR :
                                Mov al,3      ; clear Tx/Rx interrupt
                                Out dx,al     ; output to clear ISR
                                In  al,dx     ; read ISR
                                Test al,3    ; Check ISR cleared or not
                                Jz  ClrISRDone ; Clear ok
                                Mov al,0     ; if not, clear again
                                Out dx,al
                                Jmp ClrISR
ClrISRDone: ...                  ; clear successful
```

### 2. DTACK can't fit 68K CPU timing in 68K mode

Solution : Using the DTACK automatic insertion function in 68K CPU.